USTAR: UTAH SCIENCE, TECHNOLOGY AND RESEARCH INITIATIVE

NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING AT THE UNIVERSITY OF UTAH

DFCM Project No. 06291750
University of Utah Project No. 099-12658

PROGRAM

December 17, 2007

USTAR
DFCM
University of Utah
Architectural Nexus
Lord, Aeck & Sargent
m+w zander

USTAR
Utah Science, Technology and Research Initiative

Architectural Facilities Program
December 17, 2007
USTAR
NEUROSCIENCE AND BIOMEDICAL TECHNOLOGY RESEARCH BUILDING
University of Utah
Salt Lake City, Utah
DFCM No. 06291750
U of U No. 0999-12658

University of Utah
Review Signatures

We have reviewed the program and warrant that it adequately represents our request for a facility to fulfill our mission and programmatic needs. All appropriate parties in the agency have reviewed it for completeness and accuracy.

12-17-07

Lorris Betz — Date
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1.1 MISSION STATEMENT

The Neuroscience and Biomedical Technology Building (NBTRB) will house a series of research teams to be recruited by the University of Utah through the Utah Science Technology and Research Initiative (USTAR). This effort builds on existing strengths within the University that includes Pharmaceuticals, Genetic Discovery Techniques, Biomedical Technologies, Nanotechnology, Scientific Visualization and Graphics, Biological Sciences, and Advanced Cancer Research. These core strengths represent the confluence of engineering programs with the medical sciences, creating unique opportunities for scientific innovation and synergies between biomedical and engineering science research efforts.

The USTAR initiative will underwrite recruiting efforts in several key areas, building on existing strengths within the University: Diagnostic Imaging, Personalized Medicine, Circuits of the Brain, Biomedical Device Innovation, IT Networks and Memory, Nanotechnology Biosensor, Fossil Energy and Imaging Technology. The NBTRB may house teams recruited in from each of these areas except Fossil Energy.

The NBTRB is envisioned as consisting of laboratory space, core facilities, faculty office space, symposium and conference space, and public areas designed to encourage maximum interaction of faculty from diverse disciplines. Assignable research and support space will be designed for maximum flexibility and adaptability to accommodate known and yet known occupants. Core facilities will both support faculty within the NBTRB building and serve in some instances as University-wide resources. These core facilities include a Vivarium which will be designed to support multiple species with maximum flexibility of space and species assignment. Also included among the core facilities are an Optical Imaging Core, a Small Animal Imaging Core, and a Nanofabrication Core Facility. All three of the latter are considered to add significant value to the entire University Campus, and should serve as magnets to draw in faculty from other sectors of Campus, promoting interaction with the research community at large throughout the University.

The Optical Imaging Core will house a series of high performance microscopes, including (at a minimum) SEM (environmental, serial block face), TEM (low voltage and tomographic), Confocal microscope (Zeiss 510, two-photon, spinning disc) and fast-acquisition microscope. These new microscopes will extend the capability of the University by providing higher performance imaging in five basic areas: spatial resolution, temporal resolution, cellular activity, deep imaging, and connectivity.

The Small Animal Imaging Core facility will provide a centralized core facility and dedicated staff to support imaging studies of small animals for researchers throughout the University. The facility will likely be organized within the confines of the Vivarium and will house a collection of imaging technologies including, at a minimum: 7-T MRI, Ultrasound, PET-CT, Micro-PET, SPECT-CT and Fluoroscopy. Some of the equipment already exists in several different locations across the University and will be consolidated in the Small Animal Imaging Core.

The Nanofabrication Core will provide the lithographic, deposition and etching capabilities required to fabricate and characterize electronic devices and mechanical structures ranging in feature size down to nanometers. The facility will house an equipment set that supports the fabrication of silicon integrated circuits, microelectromechanical systems, solid-state sensors, and nano-scale devices and materials of many kinds. An important feature of the lab will be a clean area having a separate air handling system, where biological (wet nano) work can be done in close proximity to the semiconductor-based processing without contaminating it.

The NBTRB is presently programmed to be in budget at 193,803 gross square feet.

The following criteria will guide the development of the program, design and construction of the NBTRB:

1. Total project budget cannot exceed $130 million.
2. Balance between security and access: research areas in particular MUST be secure.
3. Should be a "statement" building; should be attractive for faculty recruitment and a magnet for donors.
4. Building cores should serve entire campus.
5. Research space should be designed to be as flexible as possible given unknown needs of future occupants.
6. Every opportunity should be made to create environments that support collaboration and informal interaction.
7. The building should be highly energy efficient; ease of maintenance is also critical.
8. Sustainability of the building is highly valued.
9. The building should have a highly pleasing internal environment for the occupants, and should take advantage of available vistas and site lines to enhance aesthetics.
10. Site selection to consider long term Campus Master Plan and future use of adjacent spaces and buildings around the building.
11. Supportive of infrastructure development by use of central utilities and tunnel / duct bank distribution.
12. Research space sufficient to support the University's vision for USTAR initiative, currently estimated to be approximately 24-30 PI's.

1.2 PROGRAMMING PROCESS

The Organization Chart of the various stakeholder groups including DFCM, USTAR Governing Board, Steering Committee, Core Team, Focus Groups, and Programming Consultant Team having purview for the Neuroscience and Biomedical Technology Research Building is illustrated **Section 1.2 Page 3** and **Section 1.2 Page 4.**

The programming process was conducted under the direction of the State of Utah, Division of Facilities Construction and Management and the USTAR Governing Authority Board. Specific program requirements were documented by the Programming Consultant Team resulting from conversations with the Core Team, Steering Committee, and Focus Groups.

The budget for this project, as funded by the USTAR Initiative, mandates a total project budget of $130 million of which $99 million is allocated to construction hard costs. Therefore, the deliverable of this program is to give definition to all the attributes and costs of a project in compliance with the above funding.

To develop the above, the programming process focused upon three activities conducted simultaneously. One activity was focused on selecting a site for this building. Another activity was directed at documenting specific building program scope requirements. The third activity was to estimate the probable construction costs of various site alternatives and building program scope alternatives with the objective to keep the overall project in budget. A summary discussion of these activities follows.

Site Selection
The site selection activity was conducted in context with the concurrent development of the U of U Campus Master Plan and in consultation with the Core Team. In discussions with the above during a number of meetings, it was determined to initially investigate five possible sites for this project. The Programming Consultant Team assembled information on each of the five sites including existing conditions / constraints, estimated probable infrastructure construction costs, and advantages and disadvantages of each site. This information was passed on to the U of U Campus Master Planning Team for their Master Plan review and direction. The U of U Campus Master Planning Team provided direction to locate this building in context with an Interdisciplinary Quad and Pedestrian Mall Master Plan located in the University Golf Course in the vicinity of Federal Way. This Master Plan provided a site for this building and three possible future research buildings. A more detailed discussion of this process including illustrations is included in **Section 2.1 Site Selection and Location.**

Building Program Scope Requirements
The building program scope requirement documentation activity was conducted in consultation with DFCM, USTAR Governing Board, Steering Committee, Core Team, and with the following Focus Groups:

- Campus Utilities & Infrastructure
- Data Center & IT Infrastructure

- Nanotechnology
- Optical Imaging
- Small Animal Imaging
- Vivarium

The Programming Consultant Team held a number of meetings with each of the above stake holder groups and documented the program requirements as per these discussions. Under the direction of the Steering Committee and in consultation with the Focus Groups the scope of the project including construction estimates were revised several times as required to keep the scope of the program within the construction budget. The final in budget program can be reviewed in this Executive Summary under **1.3.1 Total Facility Summary** and in more detail under **3.0 Total Facility Building Program Analysis** and **4.0 Space Program.**

Estimating Probable Construction Costs

Estimating of probable construction costs for a number of site alternatives and building scope alternatives, including soft costs, was ongoing during the programming process. These separate construction cost estimates were combined and revised several times to provide budget / scope checks along the way. The final in budget cost estimates for the selected site and building scope can be reviewed in the Executive Summary under **1.3.2 Capital Budget Estimate Summary** and in more detail under **5.0 Project Cost Estimate.**

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1.3 PROJECT DESCRIPTION

1.3.1 Total Facility Summary

The Neuroscience and Biomedical Technology Research Building (NBTRB) is a 193,000 +/- GSF facility designed to support Biomedical and Neuroscience research and to promote the growth of new businesses in these fields. In order to accomplish these goals the facility contains laboratory space, analytical processing areas, specialized equipment areas and administrative spaces necessary to house a minimum of 24 Principal Investigators and their support staff.

In addition to this primary function, and viewed as required support areas; the facility contains four core facilities that are designed to support, not only the Principal Investigators housed in the facility, but also the institution as a whole. These core areas include a 23,000 GSF Vivarium that is designed to house rodents and other small animal species and its' required support areas; a 9,000 GSF Microscopy Suite that will house multiple instruments used to support the ongoing research at the University; a 9,000 GSF Imaging Facility that will house a variety of technologies used for in-vivo and molecular explorations; and a 25,000 GSF Nanofabrication Facility. The Nanofabrication Facility will play a key role in the exploration and development of nano-technologies to be used in bioengineered materials and devices. This suite will be a key component in the support of industrial partnerships and the growth of new start-up companies.

The facility will also include public spaces that will be used for information exchanges, scientific presentations and public discuss forums. These include a 150 seat Auditorium, a large Lobby / interaction area, a Café and visitor space for those working with or representing the core areas or Institutes that maybe formed in the facility.

1.3.2 Capital Budget Estimate Summary

The following document summarizes an estimated Total Project Budget for the Neuroscience and Biomedical Research Technology Building (NBRTB). Please refer to **Section 5.0 Project Cost Estimate** for additional information.

Capital Development Projects

Capital Budget Estimate (CBE)

Project Name:	**USTAR - Neuroscience & Biomedical Technology Research Building**
Agency/Institution:	Higher Ed / University of Utah
Project Manager:	BOWEN

Cost Summary		**$ Amount**	**Cost Per SF**	**Notes**
Facility Cost	$	90,175,078	$465.29	
Additional Construction Cost	$	113,342	$0.58	
Site Cost	$	11,333,114	$58.48	
High Performance Building	$	4,083,742	$21.07	
Total Construction Cost	**$**	**105,705,277**	**$545.43**	
Soft Costs:				
Hazardous Materials	$	-		
Pre-Design/Planning	$	1,396,316		
Design	$	8,915,984		
Property Acquisition	$	-		
Furnishings & Equipment	$	4,076,458		
Information Technology:	$	1,469,013		
Utah Art	$	652,833		
Testing & Inspection	$	657,496		
Contingency	$	5,021,001		
Moving/Occupancy	$	350,000		
Builder's Risk Insurance (0.15% of Construction Budget)	$	158,558		
Legal Services (0.2% of Construction Budget)	$	169,128		
DFCM Management	$	-		
User Fees	$	713,473		
Commissioning	$	699,464		
Other Costs	$	15,000		
Total Soft Costs	**$**	**24,294,723**	**$125.36**	
TOTAL PROJECT COST	**$**	**130,000,000**	**$670.79**	
Previous Funding	**$**	**-**		
Other Funding Sources	$	30,000,000		
REQUEST FOR STATE FUNDING	**$**	**100,000,000**		

Project Information

Gross Square Feet	193,803	Base Cost Date	31-Dec-07
Net Square Feet	116,523	Estimated Bid Date	1-May-09
Net/Gross Ratio	60%	Est. Completion Date	30-Dec-11
		Last Modified Date	**9-Nov-07**
		Print Date	18-Dec-07

1.3.3 Space and Area Program Summary

The following table summarizes the square footage requirements for each area included in the Neuroscience and Biomedical Technology Research Building.

USTAR at UNIVERSITY OF UTAH
Neuroscience & Biomedical Research Technology Building
Grossing Factor 59% 121
Projected Space Utilization Summary
Prepared September 20, 2007
Revised November 14, 2007

Program Summary	Total NSF	Total GSF
1.0 PI Assigned Space Total (*Total SF per PI 924 PI's*)	52,647 *2,178*	89,232 *3,753*
2.0 Vivarium	13,582	23,020
3.0 Small Animal Imaging	5,453	9,240
4.0 Microscopy	5,247	8,893
5.0 Nanofabrication	14,999	25,422
6.0 Public / Building Support	22,417	37,995
TOTAL BUILDING AREA	**116,523**	**193,803**

1.3.4 Head Count

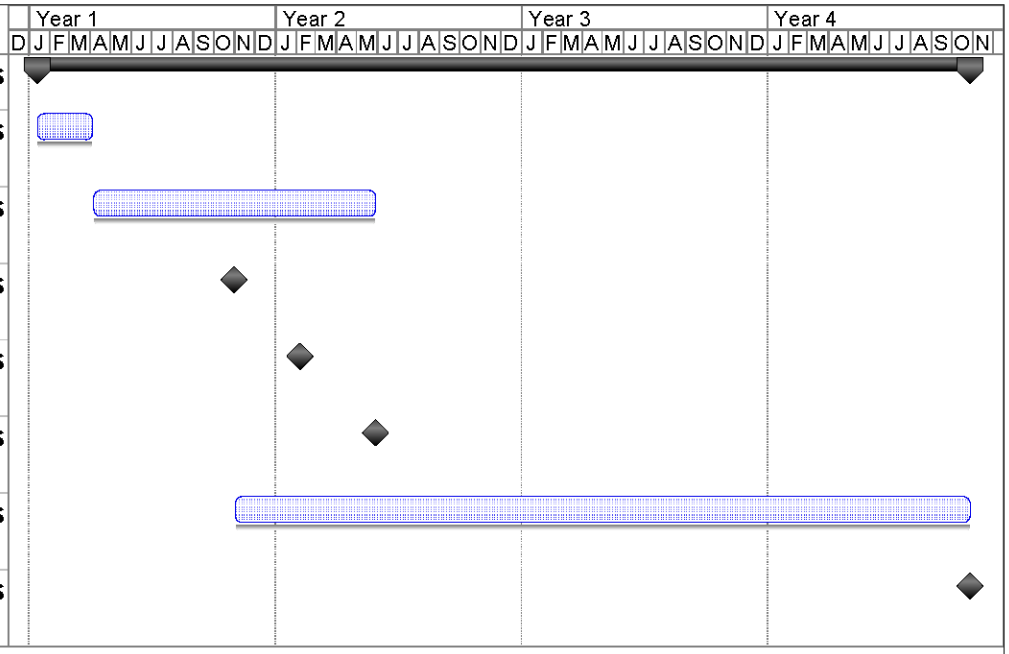
The following describes an estimated head count for the NBTRB Building.

UTAH OCCUPANCY	# OF PEOPLE
Estimated Number of People in Building	
Large Auditorium	150
Cafe Lobby (extra people)	20
PI Team (24PI X 10 people / team)	240
Vivarium Core	4
Imaging Core	7
Miocroscopy Core	8
Nanofabrication Core	20
Nanofabrication Researchers	60
Nanofabrication Students	20
Front Offices / Building Offices	32
ESTIMATED NUMBER OF PEOPLE IN BUILDING	**561**

1.3.5 Project Schedule

The following schedule outlines the project from Design Team and CMGC selection thru construction.

Task Name	Duration
USTAR - UofU	**990 days**
Design Team & CMGC Selection	**60 days**
Engineering & Design	**300 days**
BP#1 - Site Improvements & Infrastructure	**0 days**
BP#2 - Ftgs/Fdn and Core & Shell	**0 days**
BP#3 - Interiors	**0 days**
Construction	**780 days**
Project Complete	**0 days**



USTAR @ the UofU

Task		Milestone		External Tasks	
Split		Summary		External MileTask	
Progress		Project Summary		Split	

2.0 Site Analysis

2.1 Site Selection and Location
2.2 Existing Site Circulation
2.3 Existing Site Conditions and Program Requirements
2.3.1 Climate, Views and Key Open Spaces
2.3.2 Geoseismic Fault Study Summary
2.3.3 Preliminary Soils Report Summary
2.3.4 EMI and RFI Site Assessment Study Summary
2.3.5 Site Vibration Study Report Summary
2.3.6 Modified ALTA/Topographic Survey Summary
2.3.7 Traffic Impact Analysis Summary
2.3.8 Light Rail and Transit Considerations
2.4 Site Utilities
2.4.1 Existing Utilities to be Extended and Utilized
2.4.2 Existing Utilities to be Relocated
2.4.3 New Utilities to be Incorporated
2.4.4 Chilled Water Plant
2.5 Proposed New Site Considerations
2.5.1 Interdisciplinary Site Master Plan Criteria
2.5.2 Pedestrian Access and Circulation
2.5.3 Parking and Vehicle Access
2.5.4 Building Fresh Air Intake and Exhaust Criteria

2.1 SITE SELECTION AND LOCATION

Site selection for this project commenced with the consideration of possible / optimal locations for a group of research buildings. The NBTRB would be the first building constructed with possible future buildings located in close proximity to promote the synergy created by this adjacency. The initial discussions resulted in the identification of five possible site areas to be considered for this group of buildings. The site plan, titled **NBTRB SITE PLAN COMBINED ANAYLSIS, Section 2.1 Page 3**, illustrates the five sites under consideration. This site plan also shows major site attributes including line of sight microwave transmission constraints, setback from roads and light rail to avoid vibration, and possible pedestrian circulation paths connecting Main Campus with the Medical Center Campus. Estimated infrastructure costs to develop each of the five sites were made by the Programming Team and evaluated. Discussions regarding the five site alternatives resulted in the preliminarily selection of Site #3 for further study. The site plan document titled **NBTRB, SITE 3 EVALUATION** is shown in **Section 2.1 Page 4**. See the Site Diagrams in **Appendix Section 6.8** for the five possible sites that were evaluated.

The above information was presented to the Campus Master Planning Committee, CMPC (comprised of University of Utah Administration, Facilities Management and Planning, and a team of consultants led by SOM), for their consideration and direction. The CMPC developed a series of Land Use Options A thru D which illustrated various Campus wide master plan land use options including possible sites for the NBTRB and related research buildings. These options were presented to the Senior Vice Presidents for Health Sciences and for Academic Affairs for consideration. This discussion resulted in the selection of Option A for further study. **Option A** is shown in **Section 2.1 Page 5**. See the Site Diagrams in **Appendix Section 6.8** for the five possible sites that were evaluated.

The CMPC developed Option A into the Interdisciplinary Site Master Plan showing an Interdisciplinary Quadrangle in the Golf Course area to provide a site for a group of four interdisciplinary research buildings containing approximately one million gross square feet. The site area is defined with Wasatch Drive on the east, Central Campus Drive on the west, a new Pedestrian Corridor on the south, and a new Service Corridor / road on the north. This Interdisciplinary Site Master Plan was accompanied with a document titled General Approach and Guidelines giving direction for the development of this area of the overall Campus Master Plan. This **Interdisciplinary Site Master Plan** illustration is in **Section 2.1 Page 6**. The **General Approach and Guidelines** is in **Section 2.1 Pages 7 and 8**.

A number of goals were established based upon the General Approach and Guidelines and during discussions between the CMPC and the Programming Team. These goals are included in **Section 2.5.1 Interdisciplinary Site Master Plan Criteria**.

Utilizing the Interdisciplinary Site Master Plan provided by the CMPC, the Programming Team developed six optional schemes illustrating possible arrangements of four buildings totaling approximately one million gross square feet surrounding an Interdisciplinary Quad. All schemes illustrated the possible locations of the NBTRB which would

be the first building to be constructed and the possible sequence of construction of the remaining three buildings in the Quad. It was emphasized that these site plans schemes do not represent architectural designs, but only general building locations in relation to roads, build to lines, the Pedestrian Mall, and the Service Road. The six schemes were discussed in several meetings culminating in a meeting with the Senior Vice Presidents, where in Scheme 5 was selected and approved. **Scheme 5** is shown in **Section 2.1 Page 9**. Scheme 5 superimposed on the entire Campus site is shown in **Section 2.1 Page 10**. The Programming Team also developed two possible ways the NBTRB and the second building could be developed. These site plans illustrate possible arrangements of Service, Core, Nanofabrication, and Laboratory areas in the program. These alternatives are shown in **Section 2.1 Page 11 and 12**. See the Site Diagrams in **Appendix Section 6.8** for the five possible sites that were evaluated.

Additional discussions on the development of Scheme 5 included:

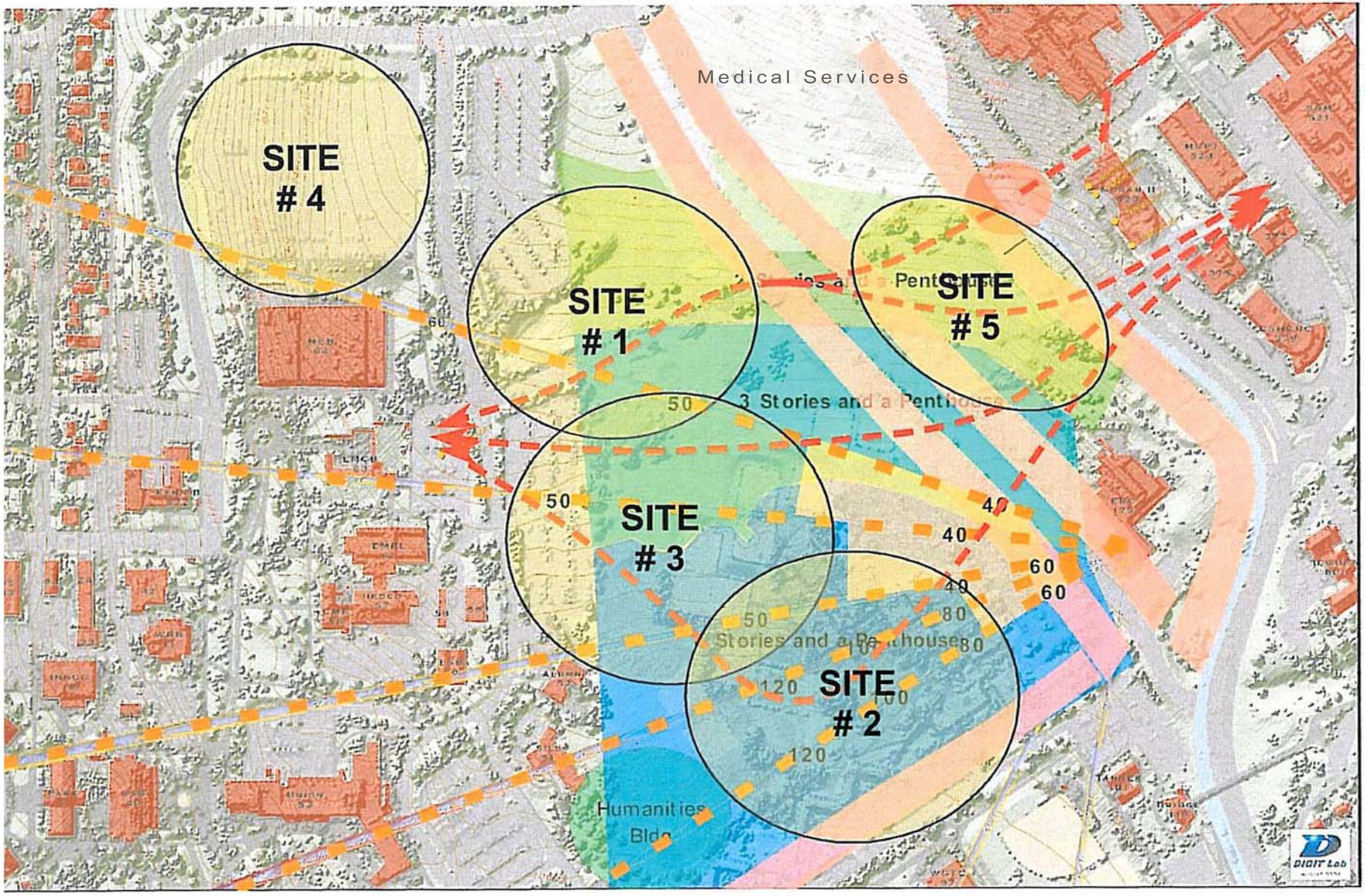
- The Master Plan locations of the Central Chilled Water Plant, existing utilities to remain, existing utilities to be relocated, and new utilities including utility tunnels were discussed. The Master Plan locations of the above are discussed in **Section 2.4 Site Utilities.** The estimated cost of the above is included in **Section 5.0 Project Cost Estimate.** *Note: The master planning of the Interdisciplinary Quadrangle is not presently complete. This work is in the RFP process at the date of this program. The exact location of the Central Chilled Water Plant and the Service Road will be considered as a part of this, yet to be completed, master planning process.*
- Location and condition of existing trees to be considered in the design of the NBTRB. This topic is discussed in **Section 2.3 Existing Site Conditions and Program Requirements.**
- Location of a new natural gas pipe line along the west edge of the Interdisciplinary Quad site. This location of this pipe is discussed in **Section 2.4 Site Utilities.**

Subsequent to the selection and approval of Scheme 5, a number of site attribute assessments and surveys were conducted as follows:

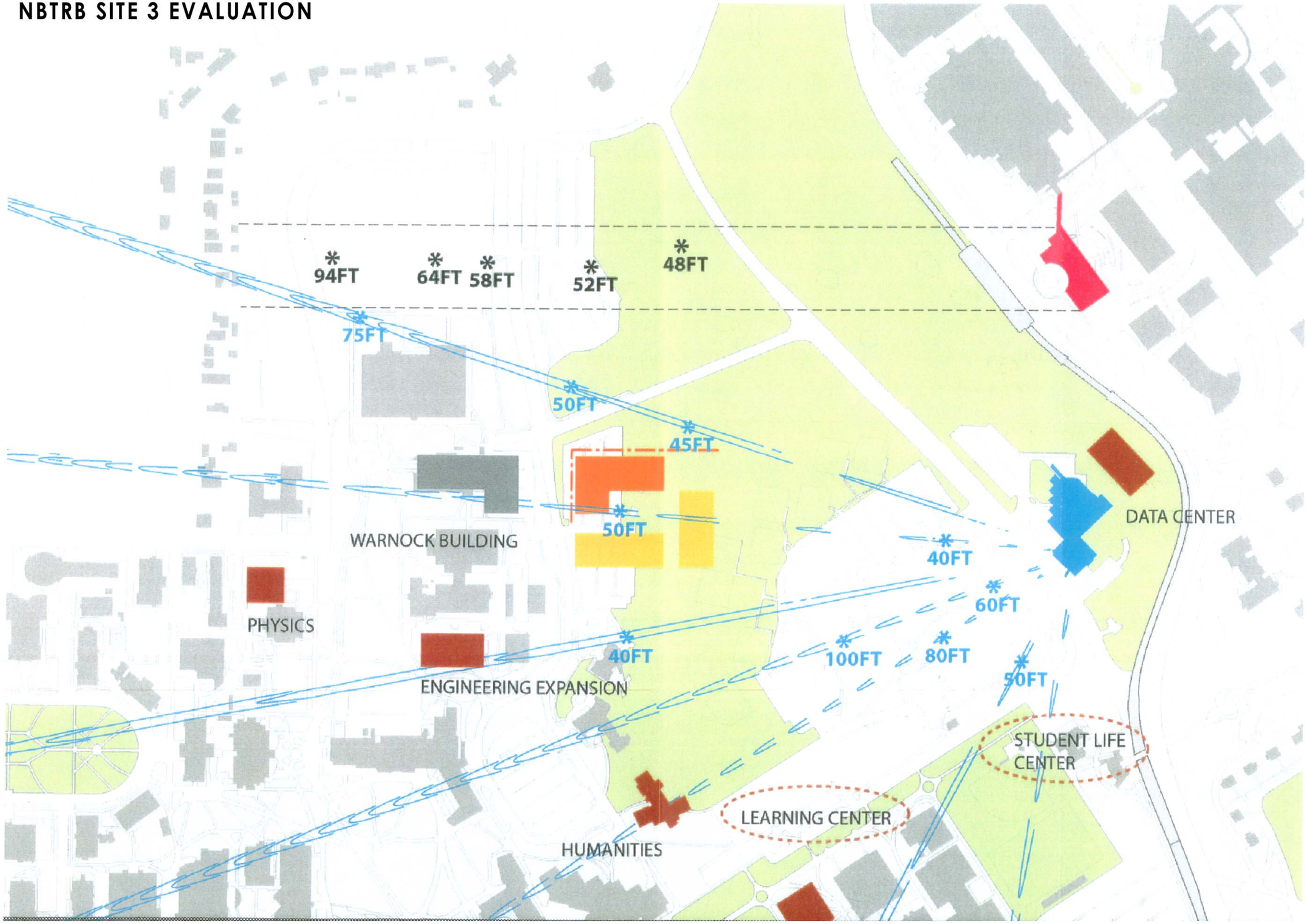
- Geoseismic Fault Trenching Study by GSH Geotechnical
- Preliminary Soils Report by GSH Geotechnical
- Electro Motive Force and Radio Frequency assessment by Vita Tech Engineering
- Vibration assessment by Colin Gordon & Associates
- Modified Alta Survey by Project Engineering Consultants
- Traffic and Parking Report by Project Engineering Consultants

The above reports and surveys are included in **Section 2.3 Existing Site Conditions and Program Requirements,** with the exception of the Traffic and Parking Report which is included in the **Appendix Section 6.6** as a separate compact disk.

NBTRB SITE PLAN COMBINED ANALYSIS

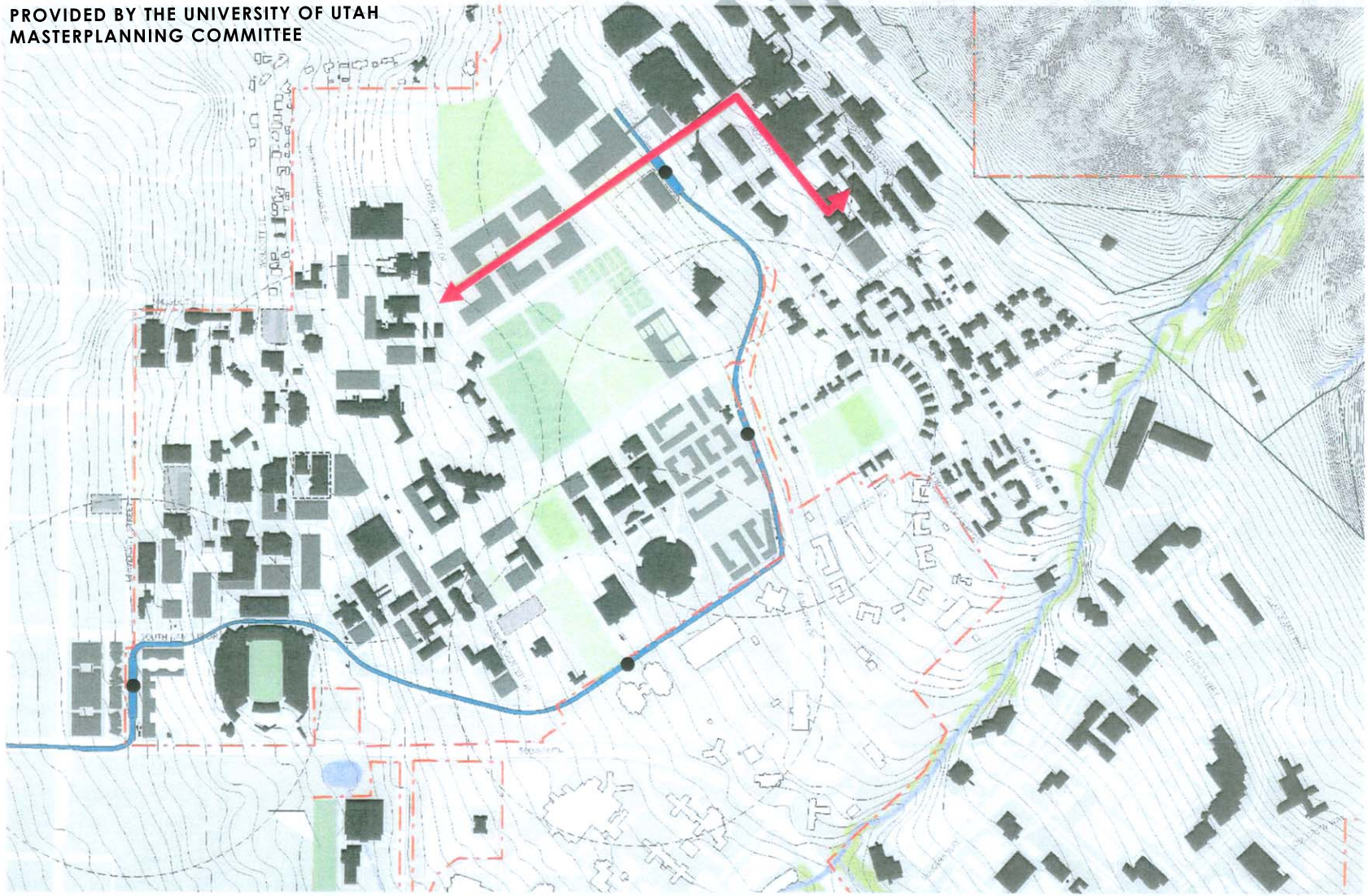


NBTRB SITE 3 EVALUATION



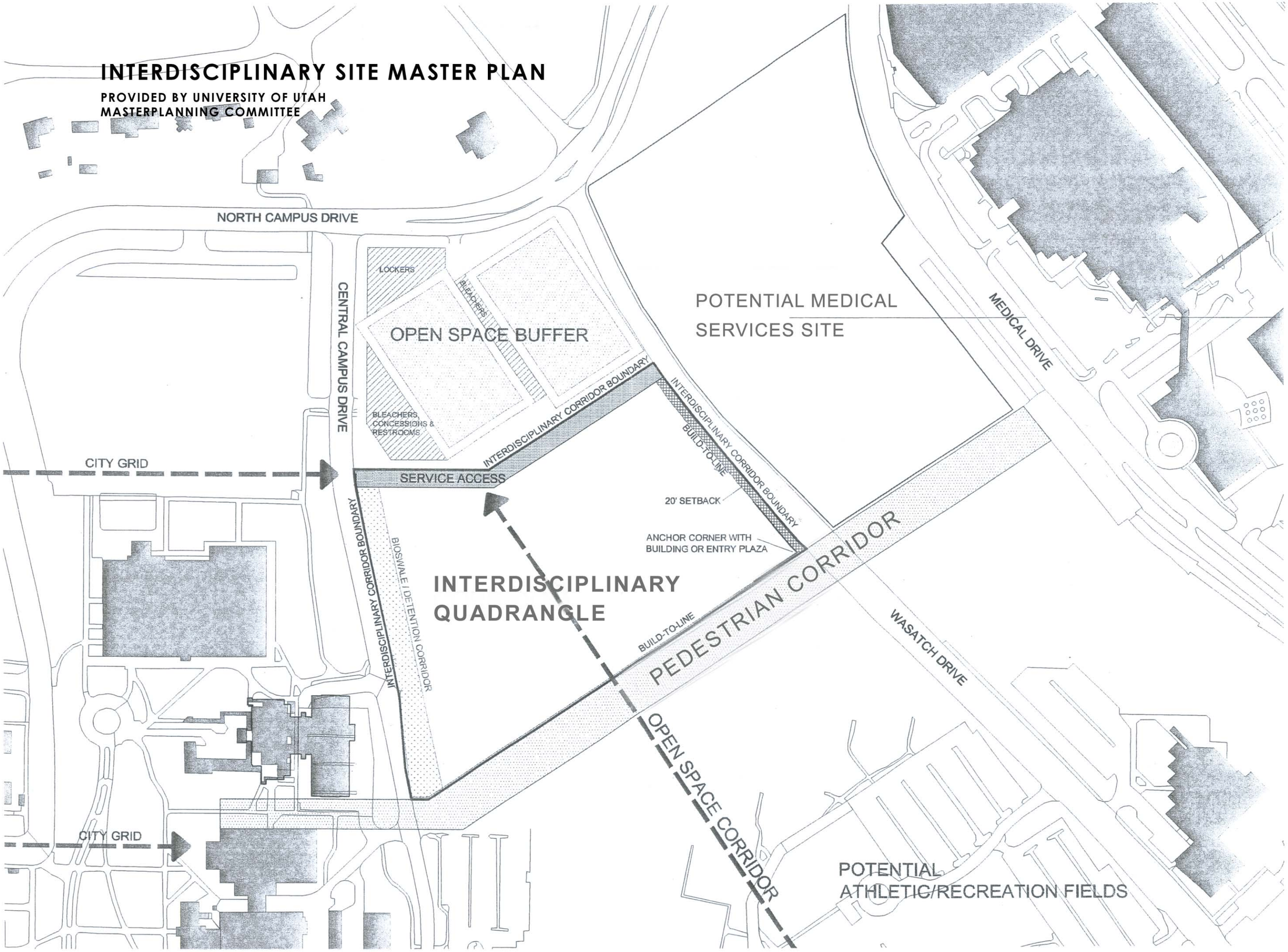
Option A: Interdisciplinary Connection

PROVIDED BY THE UNIVERSITY OF UTAH
MASTERPLANNING COMMITTEE



INTERDISCIPLINARY SITE MASTER PLAN

PROVIDED BY UNIVERSITY OF UTAH MASTERPLANNING COMMITTEE



NOTE: Refer to Facilities Planning for the most current version of the following Campus Master Plan Documents

1.0 General Approach:

1.1 The Interdisciplinary Corridor is envisioned as a new campus zone for interdisciplinary research activity. The corridor will include new laboratory buildings and other collaborative research facilities, including USTAR.

1.2 The Interdisciplinary Mall will provide a movement corridor for pedestrians, bicycles, and potential shuttle services. It will provide an important connection between the College of Engineering and the Health Sciences Campus, and it will be the primary address of buildings located within the Interdisciplinary Corridor.

1.3 An open space buffer will be situated between North Campus Drive and northern boundary the Interdisciplinary Corridor. This open space buffer will include recreation fields and other ancillary facilities such as bleachers, concessions, restrooms, and lockers.

1.4 An open space corridor will be established to provide a visual and pedestrian connection between HPER and the open space buffer located adjacent to North Campus Drive.

1.5 Service access will be provided by a new road situated at northern boundary of the Interdisciplinary Corridor.

1.6 A bioswale/detention zone will be established along Central Campus Drive as part of the new storm water management system. The bioswale/detention zone will capture water runoff and protect mature trees located within the existing boulevard.

2.0 Guidelines:

Setbacks/Build-to-Lines:

2.1 Interdisciplinary Mall: Building setbacks along the Interdisciplinary Mall should be minimized to support the creation of an active and pedestrian-friendly edge. A zero setback to the "build-to-line" should be established along the Interdisciplinary Mall. At least 75% of building facades facing the Interdisciplinary Mall should hold to the "build-to-line"

2.2 Wasatch Drive: The ~~maximum~~ minimum building setback along Wasatch Drive should be 20 feet from the Interdisciplinary Corridor boundary. The setback area should be landscaped and include pedestrian amenities such as sidewalks and landscaping. At least 25% of building facades facing Wasatch Drive should hold to the "build-to-line".

2.3 The intersection of Wasatch Drive and the Interdisciplinary Mall should be anchored by a building with a zero setback from the "build-to-line". This is intended to enhance the quality of pedestrian connections across Wasatch Drive. Alternatively, a plaza with the main building entrance can be established at the intersection of Wasatch Drive and the Interdisciplinary Mall.

Facades:

2.4 General: Blank walls and exposed basement structures should be minimized to the greatest extent possible.

2.5 Interdisciplinary Mall: Ground floor and at-grade facades facing the Interdisciplinary Mall should be highly transparent in order to promote visual connections pedestrians and internal building activity. All ground floor and at-grade facades facing the Interdisciplinary Mall should include windows and other transparent surfaces for least 65% of the total facade area.

Building Entrances:

2.6 General: Buildings should have multiple public entrances to provide access and movement options through the Interdisciplinary Corridor.

2.7 Primary Entrances: The Interdisciplinary Mall should be the primary address of buildings located within the Interdisciplinary Corridor. Primary building entrances must be located along the Interdisciplinary Mall.

2.8 Interdisciplinary Mall Entrances: Building entrances from the Interdisciplinary Mall should be located at-grade.

2.9 Additional Entrances: Additional building entrances may be provided from internal courtyards and quads.

Site Coverage:

2.10 The maximum site coverage should be 50%.

Open Space:

2.11 Existing mature trees situated within the Interdisciplinary Corridor should be mapped, assessed (tree health, age, etc.), and incorporated into the open space design.

2.12 Buildings should be organized around human-scaled courtyards which promote interaction and opportunities for passive recreation. Courtyards width should be no greater than 1 - 2 times the adjacent building height.

2.13 A bioswale should be established along Central Campus Drive to detain, treat, and infiltrate storm water runoff. This bioswale should be at least 50 feet wide (75 feet is preferred).

2.14 An open space corridor should be established within the Interdisciplinary Corridor to provide pedestrian, visual, and open space connections between the open space buffer located adjacent to North Campus Drive and the future athletics/recreation fields located adjacent to HPER Mall.

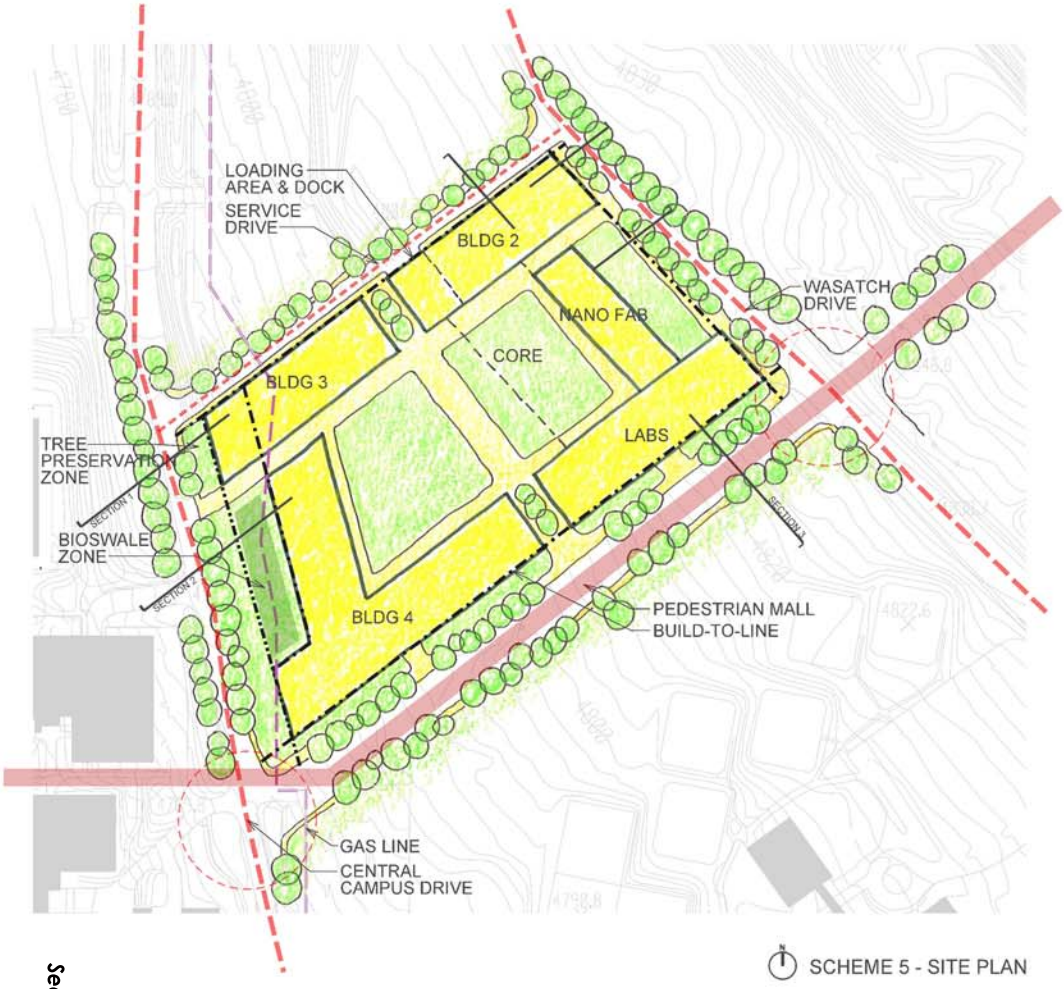
Parking:

2.15 General: Surface parking is highly discouraged within the Interdisciplinary Corridor as it is incompatible with the University's objectives for environmental stewardship and the efficient use of limited land resources. Underground parking should be considered where possible.

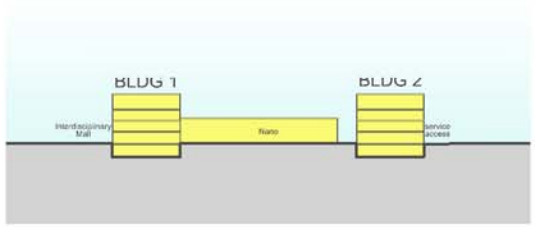
2.16 Phase 1: Parking required for Phase 1 development should utilize existing Parking Lots #30 & #32.

2.17 Future Phases: Parking required for future phases of development should utilize Parking Lot #39.

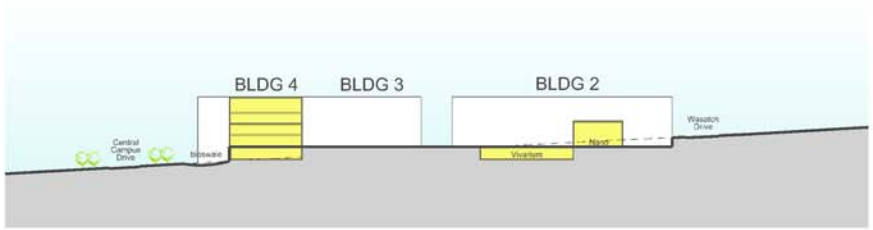
SCHEME 5



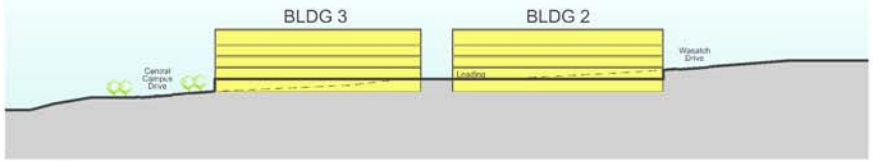
SCHEME 5 - SITE PLAN



SECTION 3



SECTION 2



SECTION 1

SCHEME 5 - SITE SECTIONS

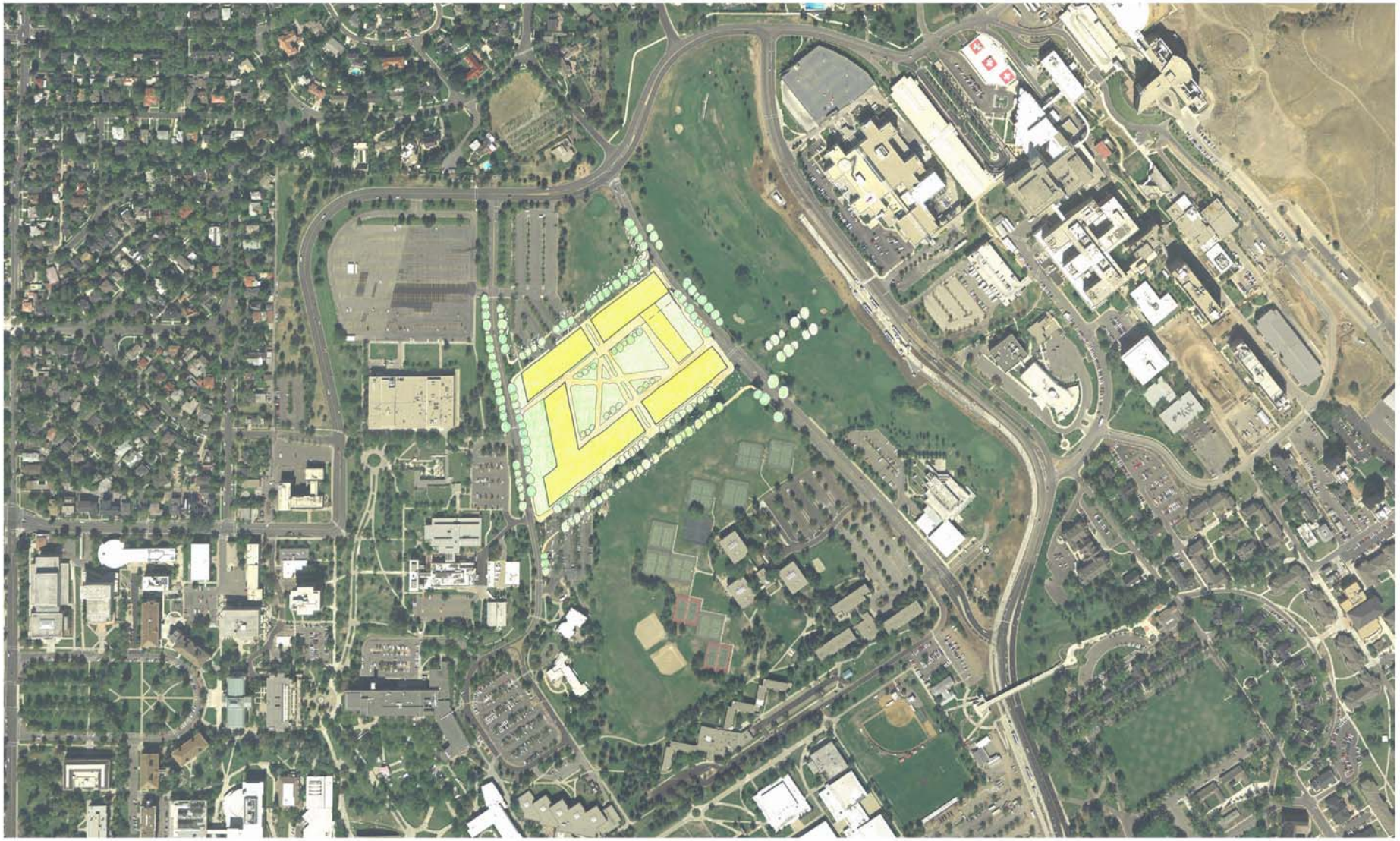
0 50' 100' 200' 400'

July 02, 2007

THE UNIVERSITY OF UTAH
NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL nexus

LORD · AECK · SARGENT
ARCHITECTURE



CAMPUS PLAN

0 100' 200' 400' 800'

July 02, 2007

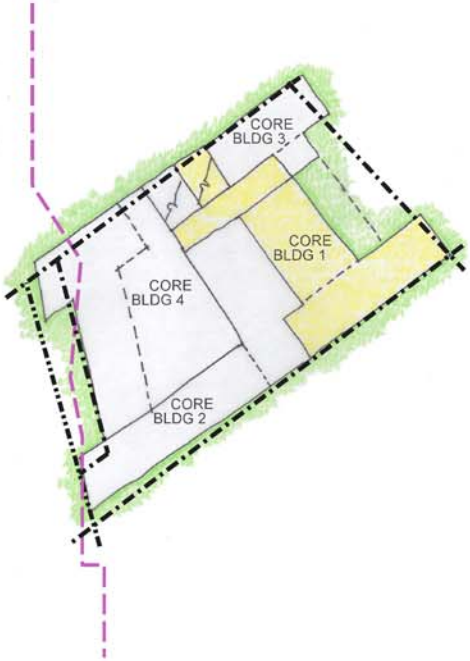
THE UNIVERSITY OF UTAH

NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL nexus

LORD · AECK · SARGENT
ARCHITECTURE

Note: The Moran Eye Center and the Warnock Engineering Building were not constructed at the time this aerial photograpgh was taken.



SCHEME 5 - BELOW GRADE CORE

SCHEME 5 - BUILDING ONE AND LOADING DOCK

SCHEME 5 - BUILDING ONE & BUILDING TWO

SCHEME 5 - ABOVE GRADE SERVICE ENTRY

July 02, 2007

THE UNIVERSITY OF UTAH
NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL nexus

LORD · AECK · SARGENT
ARCHITECTURE

SCHEME 5 - BELOW GRADE LOADING DOCK & CORE

SCHEME 5 - BUILDING ONE

SCHEME 5 - BUILDING ONE & BUILDING TWO

SCHEME 5 - BELOW GRADE SERVICE ENTRY

2.2 EXISTING SITE CIRCULATION

Existing Pedestrian Circulation

The site for the NBTRB, as illustrated by Scheme #5, is located in the University Golf Course green field and therefore existing pedestrian circulation is only associated with that activity. There are no program requirements to maintain this activity within the confines of the Interdisciplinary Site Master Plan. Program requirements for the Interdisciplinary Site Master Plan including the Interdisciplinary Quad and the NBTRB are included in **Section 2.5.2 Pedestrian Access and Circulation.**

Existing Vehicular Circulation

The site for the NBTRB, as shown in Scheme #5, is located on the University Golf Course green field. The site is contained by Wasatch Drive on the east, and Central Campus Drive on the west. These two existing roadways will continue to provide general vehicle and truck access to the Interdisciplinary Site Master Plan area and to the new Service and Access Road on the north side of the Interdisciplinary Quad. The program requirement for this new Service and Access Road is included in **Section 2.5.3 Parking and Vehicle Access.** The Site Master Plan for the Interdisciplinary Quad is imposed over the existing Federal Way connecting road between Wasatch Drive and Central Campus Drive and therefore will require the closing of Federal Way. Specific requirements for closing Federal Way are included in **Section 2.5.3 Parking and Vehicle Access.** Specific requirements for relocating existing utilities in Federal Way are included in **Section 2.4 Site Utilities.**

Existing Service Access

The site for the NBTRB, as shown in Scheme #5, is located in the University Golf Course green field and therefore existing service access has been for golf course maintenance utilizing Wasatch Drive, Central Campus Drive, and Federal Way. Program requirements to implement vehicle service to the new Interdisciplinary Site Master Plan are included in **Section 2.5.3 Parking and Vehicle Access.**

2.3 EXISTING SITE CONDITIONS AND PROGRAM REQUIREMENTS

2.3.1 Climate, Views and Key Open Spaces

Climate

The climate of Salt Lake City and therefore the site approved for this project ranges from winter cold temperatures of 0 to 20 degrees F and summer temperatures of 70 to over 100 degrees F. Typical relative humidity is low, ranging from 15 to 30%. Prevailing winds are from the northwest. Winter storms typically follow the prevailing wind pattern and come from the northwest. These storms are typically preceded by strong winds from the south and then changing to winds from the north as the cold front moves from north to south through the valley. This condition is sometimes reversed with cold fronts moving from south to north. The setting sun in summer months induces a solar heat gain which makes work stations adjacent to west facing windows problematic unless mitigated by architectural and mechanical systems.

The building design must mitigate these climatic conditions. More specific architectural program design criteria are discussed in **3.3.1 Architectural,** and **3.3.3 Mechanical.** In addition, the State of Utah's High Performance Building Standard shall be met.

Views

The site approved for this project has spectacular and panoramic views to the Wasatch Mountains to the south and east, to the valley floor to the southwest, west, and northwest, and to the foot hills to the north. These views improve from floor lines above the ground floor. The views to the north and south shall remain unobstructed due to the adjacent playfield open space. Views to the east shall remain unobstructed until Moran 3 is constructed. Views to the west are only obstructed at lower levels because of the Engineering Building and other adjacent structures. Future buildings constructed in the Interdisciplinary Quad will obstruct the long vistas as evident upon review of the Interdisciplinary Quad Master Plan. Appropriate building window orientation to low west sun angles to reduce solar heat gain will also inhibit possible views.

The building and site design shall promote the quality of the existing view opportunities of the site along with limiting solar heat gain. Program requirements for maintaining and promoting views are discussed in **2.5.1 Interdisciplinary Site Master Plan Criteria** and in **3.1.1 Building Form and Massing.**

Key Open Spaces

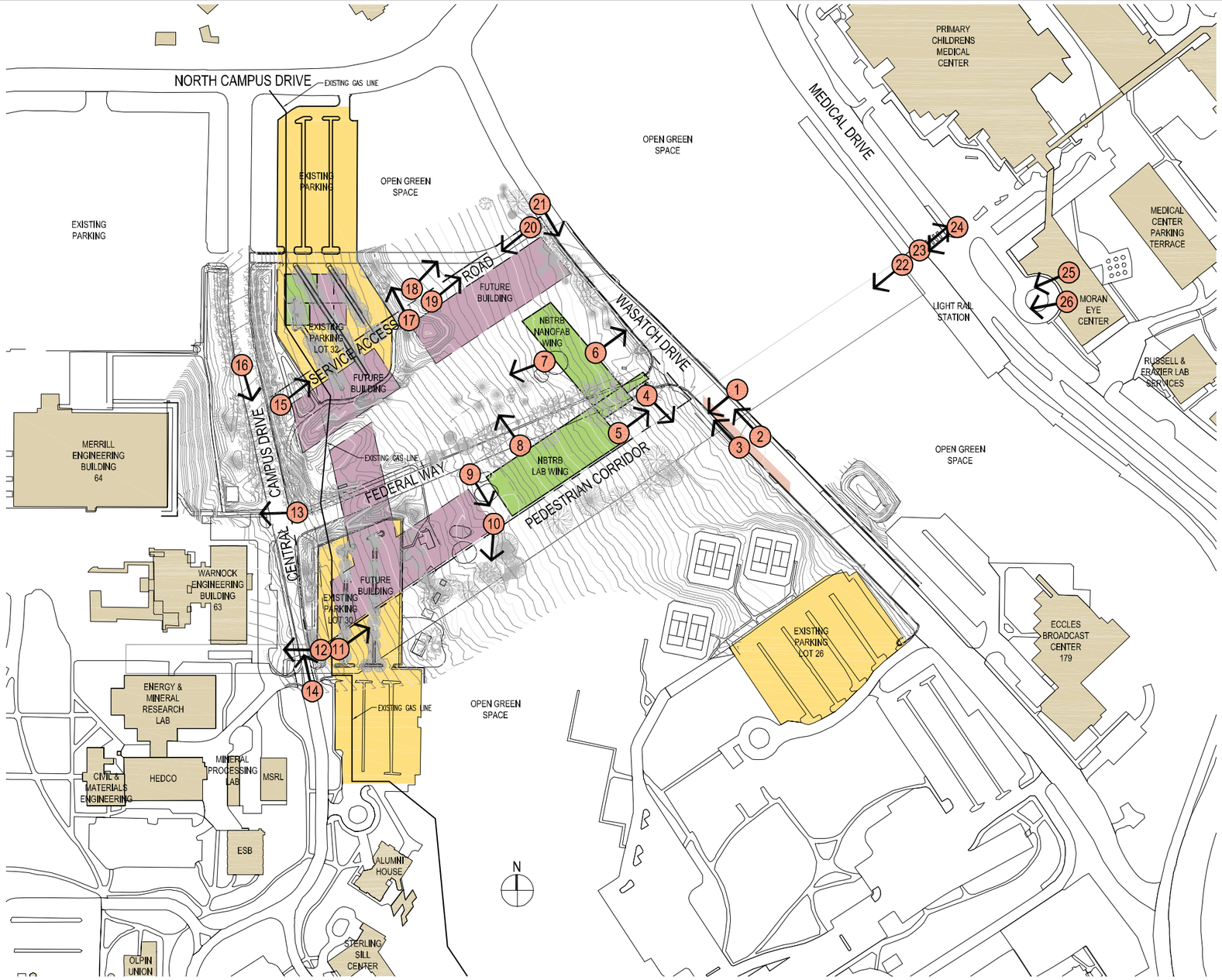
The Master Plan for the University of Utah identifies and illustrates the open spaces associated with and adjacent to the Interdisciplinary Corridor that are key to the success of the Master Plan. These open spaces are defined by the open space between building facades and are reinforced by landscape hardscape and softscape. They consist of the green field play areas to the north and to the south of the Quad, the green field open space to the east reserved for a future Moran Eye Center, the green belt associated with Central Campus Drive to the west, the Interdisciplinary Mall Circulation / View Corridor, and the open space Quad located between the four interdisciplinary buildings all as shown by the approved Scheme #5 Site Master Plan. Together these

elements promote a rich pedestrian experience including interesting near views and far vistas, informal gathering, sitting, eating, people watching, impromptu sports, and many opportunities for the interdisciplinary interaction between those who work in and visit the area. These open areas provide opportunities for walkways, turf areas, tree grouping forms, special paving treatments, seating, sculpture, and fountains and provide focused access to entries into adjacent interdisciplinary buildings. As exterior entry access spaces, the open space design shall be extensions of the interior building organization so that the circulation of people flows naturally through interior and exterior spaces.

The building and site design must promote the quality of the Key Open Spaces associated with this project. Programmatic requirements for Key Open Space are discussed in **2.5.1 Interdisciplinary Site Master Plan Criteria.**

The following diagram titled **View Site Plan** located in **Section 2.3.1 page 3** illustrates the above attributes of the master planned site, and shows the location of the existing view photographs on **Section 2.3.1 pages 4-8**.

VIEW SITE PLAN



See the following pages for corresponding numbered photos

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Photo 18

Photo 19

Photo 20

Photo 21

Photo 22

Photo 23

Photo 24

Photo 25

Photo 26

2.3.2 Geoseismic Fault Study Summary

To protect life safety in the event of an earthquake, the Salt Lake County Geologic Hazards Ordinance - Chapter 19.75 Appendix A, Minimum Standards for Surface Fault Rupture Hazard Studies, articulates the law governing the construction of buildings adjacent to known or inferred* earthquake faults. The accompanying map illustrates locations of the known and / or inferred earthquake faults in Salt Lake County based upon U.S. Geological Surveys. See **Appendix Section 6.1** for a map showing the inferred location of the above faults reprinted here from the University of Utah Long Range Development Plan. The above Salt Lake County Geologic Hazards Ordinance requires a site specific fault location study conducted by a licensed / qualified engineering geologist for a building being planned on or adjacent to known or inferred fault locations. The above referenced map illustrates the zone of land on each side of this inferred fault requiring a specific fault location study. This map indicates that the inferred East Branch of the East Bench Fault passes through the Interdisciplinary Corridor site and that the zone requiring a site specific fault location study extends from the west end of Federal Way to just east of the east end of Federal Way covering the entire Interdisciplinary Quad Site.

The above reference Ordinance stipulates the fault investigation methodology. Some general extrapolations follow: The most direct method of locating existing faults and evaluating the history of fault activity is to excavate exploratory trenches using a backhoe or trackhoe, perpendicular to the fault, generally 8 to 12 feet deep. This trench should run through the building's footprint and extend beyond each side of the footprint a prescribed distance defined by the Ordinance - in this case 50 feet.

Since the NBTRB is being master planned in context with future additional adjacent buildings which occur within the zone requiring site specific fault location studies, it was determined to investigate the entire site illustrated in the approved Scheme #5 Site Plan.

A Geoseismic Fault Study was conducted in compliance with the above Ordinance by Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. A copy of this study is included in the **Appendix Section 6.1 Geoseismic Fault Study.**

The Geoseismic Fault Study did not find a fault.

*The term *inferred* indicates that a fault has not actually been found by specific site specific fault location studies conducted in this area of the geologic hazard map.

2.3.3 Preliminary Soils Report Summary

Based upon the Geoseismic Fault Study's conclusion that a seismic fault was not present, a Preliminary Soils Report investigation was undertaken by Bill Gordon of Gordon, Spilker, Huber Geotechnical Consultants, Inc. This preliminary report is based upon several borings made at the proposed site for the NBTRB and is provided to ascertain, in general, the appropriateness of this site for this intended use.

Since the NBTRB is being master planned in context with future additional adjacent buildings, it was determined to extend the area included in the Preliminary Soils Report to the entire Interdisciplinary Site Master Plan Site.

The Preliminary Soils Report determined that the site is suitable for this use. A copy of the report is included in **Appendix Section 6.2 Preliminary Soils Report.**

A Final Soils Report, including a number of additional borings in more specific locations, must be conducted when the Schematic Design has progressed to a point where the final building configuration and location is established. This Final Soils Report's conclusions and recommendations shall be used by the structural engineer to design the structure of this project.

2.3.4 EMI and RFI Site Assessment Study Summary

An Electromagnetic Interference (EMI) and Radiofrequency Interference (RFI) Site Assessment Study was conducted for the area of the Campus included in the Interdisciplinary Site Master Plan by Louis Vitale of Vita Tech Engineering, LLC. This site specific survey was performed to document the EMI and RFI impact from external sources on the site to assure optimal functionality of sensitive scientific tools including a TEM JEOL 2200F. This report contains specific conclusions regarding the EMI and RFI attributes of the site and recommendations regarding site locations for sensitive equipment. The conclusions and recommendations in the report are too numerous to include in this summary. Some general conclusions follow:

- AC ELF Electromagnetic Interference (EMI) site readings are below acceptable recommended thresholds and therefore the site is acceptable.
- DC Electromagnetic Interference (EMI) site readings mandate that DC EMI sensitive equipment may not be placed closer than 40 meters from Wasatch Drive and all other roads with moving vehicles. With the implementation of this recommendation the site is acceptable.
- Radiofrequency Interference (RFI) site readings are below acceptable recommended thresholds and therefore the site is acceptable.

The Final EMI / RFI Site Report dated August 22, 2007 is included in **Appendix Section 6.3 EMI and RFI Site Assessment Study.** This document shall be included in the program requirements for this project.

2.3.5 Site Vibration Study Report Summary

A Site Vibration Study in the Interdisciplinary Site Master Plan area was conducted by Colin Gordon & Associates. This vibration study was made to determine the suitability of the site to support a facility housing vibration sensitive equipment and instrumentation. Ambient as well as peak hold vibration measurements were taken. As noted in the report, it is typical for the most sensitive floors in state-of-the-art research and biomedical facilities to be designed to meet the VC-D and VC-E criterion.

The following conclusions from the report are quoted below:

Under normal conditions, the ambient vibration in all directions is very low. It essentially meets the VC-E criteria except at very low frequencies below 2 Hz where there appears to be a very low frequency phenomenon (likely seismic) which exceeds the VC-E criteria slightly. This should not be of great concern though since most lab equipment is not sensitive to vibration at these very low frequencies. For the most part, the ambient vibration could be considered as meeting VC-E performance. Near the roads, the impact from bus and truck traffic will momentarily increase the vibration levels. However, these levels are not exceedingly high; and as a matter of fact, they are still below the VC-A requirement. For this reason, we consider the site to be good. General lab equipment should have no problems operating on this site. Highly sensitive equipment requiring VC-D or better should also not have any problems operating on the site if they are kept farthest from the roads.

It can be expected that the mere presence of a building will attenuate the vibrations centered around the 12.5 Hz band. Commonly called the "building effect", an attenuation of 50 percent would be reasonable at frequencies in this range, such that the resulting peak hold building vibration at a distance of 80 feet or more from the road would meet the VC-D during a vehicle passage.

Lastly, a comment regarding the light rail TRAX station east of the site. We did not notice any impact from the trains. In our attempts to measure the vibration from the trains, the vibration from passing vehicle traffic tended to mask it.

During programming discussions, there was a recommendation to take additional vibration measurements within the footprint of the Nanofabrication Cleanroom and at a depth of approximately 20 feet below existing grade. These measurements were taken and included in the Site Vibration Study Report.

The full text of this report is included in the **Appendix Section 6.4 Site Vibration Study Report.**

2.3.6 Modified ALTA/Topographic Survey Summary

A modified ALTA / Topographic Survey site drawing documenting the Interdisciplinary Site Master Plan area of the University Campus has been compiled by Project Engineering Consultants, Ltd. This drawing illustrates the topography, location of all existing adjacent buildings, roads, sidewalks, trees, other miscellaneous site improvements, and underground utilities in this area of the Campus. The locations of underground utilities are illustrated per record drawings furnished by the University. These underground utility locations have not been verified. Therefore exact locations may need to be verified by pot-holing or other means in future design phases when exact utility locations are determined to be critical. This survey shall be used for base information during the Design phases of this project.

The site survey drawing is included in **Appendix Section 6.5 Modified ALTA/Topographic Survey.**

2.3.7 Traffic Impact Analysis Summary

An analysis of the impact of the NBTRB on existing adjacent roads, intersections, and parking lots was conducted by Project Engineering Consultants, Ltd. The conclusions and recommendations of this report follow.

The proposed development is expected to have some impacts on specific intersection in the vicinity of the new NBTRB building. The minor intersection improvements stated below should mitigate the increases to delay and impacts to safety.

In summary, the recommendations within the study area according to this analysis are as follows for Option 1 of the 2012 build condition:

- Future signalization at the intersections of Central Campus Drive and Federal Way and North Campus Drive and Wasatch.
- Signalize Medical Drive and South Medical Drive and add a southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At Medical Drive and Wasatch Drive, increase north / south green time.

The following improvements are recommended for Option 2 of the 2012 build condition:

- Signalize Medical Drive and South Medical Drive and add southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At North Campus Drive and Central Campus Drive, add westbound (WB) left turn leading phase and permit northbound (NB) right turns during the WB leading phase.
- Signalize North Campus Drive and Wasatch Drive and add a westbound (WB) left turn leading phase during the afternoon peak condition.

Additionally, a new 300 stall parking facility should be added with the NBTRB project and should include a minimum 7 stalls that are ADA compliant / accessible.

This report contains a number of recommendations for upgrades for roads and intersection traffic control which fall outside the scope of this project program. These recommendations may be implemented as a part of the overall Campus Master Plan.

This report also recommends the addition of 300 new parking spaces. This recommendation is not consistent with the Campus Master Plan Committee's direction to utilize the existing excess capacity in adjacent parking lots numbers 24, 25, 30, 32, and 39. This direction is intended to encourage the use of modes of transportation other

than private vehicles. These alternate modes of transportation include light rail, city bus lines, and the campus shuttle bus system. The Campus Master Plan will provide a Campus Parking Master Plan which will provide parking for future buildings in the Interdisciplinary Site Master Plan. Therefore, the direction given by the Campus Master Plan Committee to utilize existing excess capacity in parking lots to meet the parking requirement for this building is the program requirement for this project.

The Traffic Impact Analysis report is included in this program in **Appendix Section 6.6 Traffic Impact Analysis.**

2.3.8 Light Rail and Transit Considerations

The University of Utah has an agenda to encourage the use of transportation modes other than private cars. Consistent with this agenda, the Campus Master Planning Committee has directed that parking for this first building in the Interdisciplinary Site Master Plan will be provided by underutilized parking capacity in existing lots in the vicinity of the NBTRB. This directive also included a statement that parking for future buildings around the Interdisciplinary Quadrangle will be addressed as a part of an overall Campus Parking Master Plan which may include underground parking. This direction from the Campus Master Planning Committee increases the importance of the interface of this project with existing mass transit systems such as light rail stations, City Bus Routes, and campus shuttle bus service as well other modes of transportation such has bicycles. The existing mass transit system stops are illustrated on the Site Map in **Section 2.5.2 Page 2.**

Providing convenient pedestrian walk way access from the NBTRB to these stops is a requirement of this program. Providing bicycle storage and locker / shower facilities are also a requirement of this program.

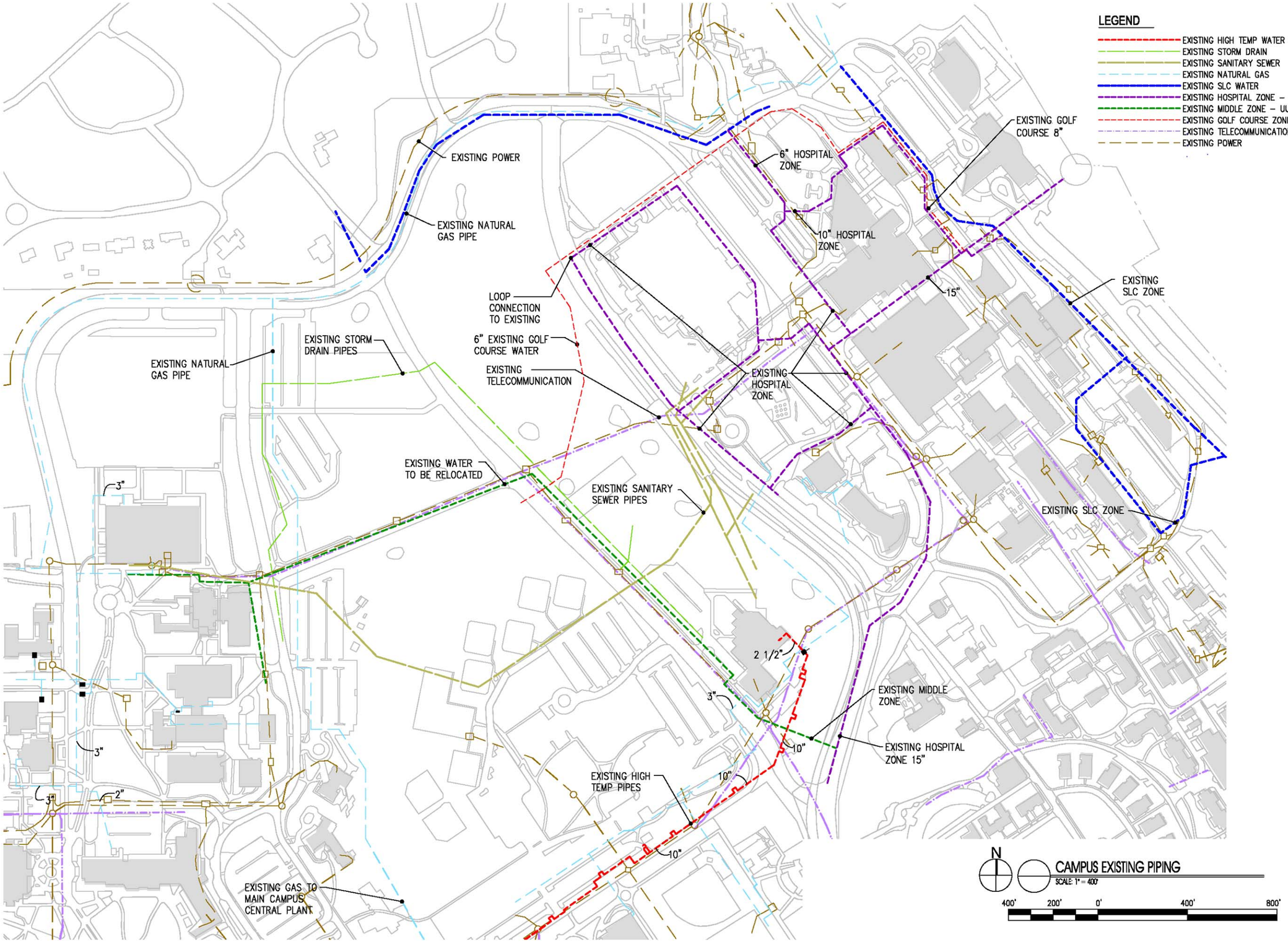
2.4 SITE UTILITIES

The Campus Master Planning Committee, under the direction of University of Utah Administration, has developed a Utilities Master Plan for the area of the Campus known as the Golf Course which includes that part of the Golf Course covered by the Interdisciplinary Site Master Plan. The NBTRB project will be the first project constructed within this area of the Master Plan. All utilities in this area will be constructed in compliance with this Utilities Master Plan. More specifically, all utilities serving the NBTRB will be designed as required to support future connections to accommodate future loads / buildings covered by the Utilities Master Plan. The locations, size, and routing of utilities shall not be altered from this program document unless specific direction is given from the University Facilities Management that a deviation from the Utilities Master Plan is approved.

The following Utility Site Plans are referenced in **Section 2.4.1 Existing Utilities to be Extended and Utilized, Section 2.4.2 Existing Utilities to be Relocated, Section 2.4.3 New Utilities to be Constructed, and Section 2.4.4 Chilled Water Plant.**

The Utilities Master Plan indicates the following Site Plans:

- **Section 2.4 Page 2** Campus Existing Piping - C100
- **Section 2.4 Page 3** New and Existing Piping - C101
- **Section 2.4 Page 4** New and Relocated Power and Communications Key Site Plan
- **Section 2.4 Page 5** New and Relocated Power and Communications
- **Section 2.4 Page 6** New and Relocated Power and Communications
- **Section 2.4 Page 7** New and Relocated Power and Communications
- **Section 2.4 Page 8** New and Relocated Power and Communications
- **Section 2.4 Page 9** New and Relocated Power and Communications
- **Section 2.4 Page 10** New and Relocated Power and Communications
- **Section 2.4 Page 11** New and Relocated Power and Communications



LEGEND

- EXISTING HIGH TEMP WATER
- EXISTING STORM DRAIN
- EXISTING SANITARY SEWER
- EXISTING NATURAL GAS
- EXISTING SLC WATER
- EXISTING HOSPITAL ZONE – UU WATER
- EXISTING MIDDLE ZONE – UU WATER
- EXISTING GOLF COURSE ZONE – UU WATER
- EXISTING TELECOMMUNICATIONS
- EXISTING POWER

UNIVERSITY OF UTAH
Neuroscience and Biomedical Research Tech Building

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SHEET CONTENTS

CAMPUS EXISTING PIPING

C100

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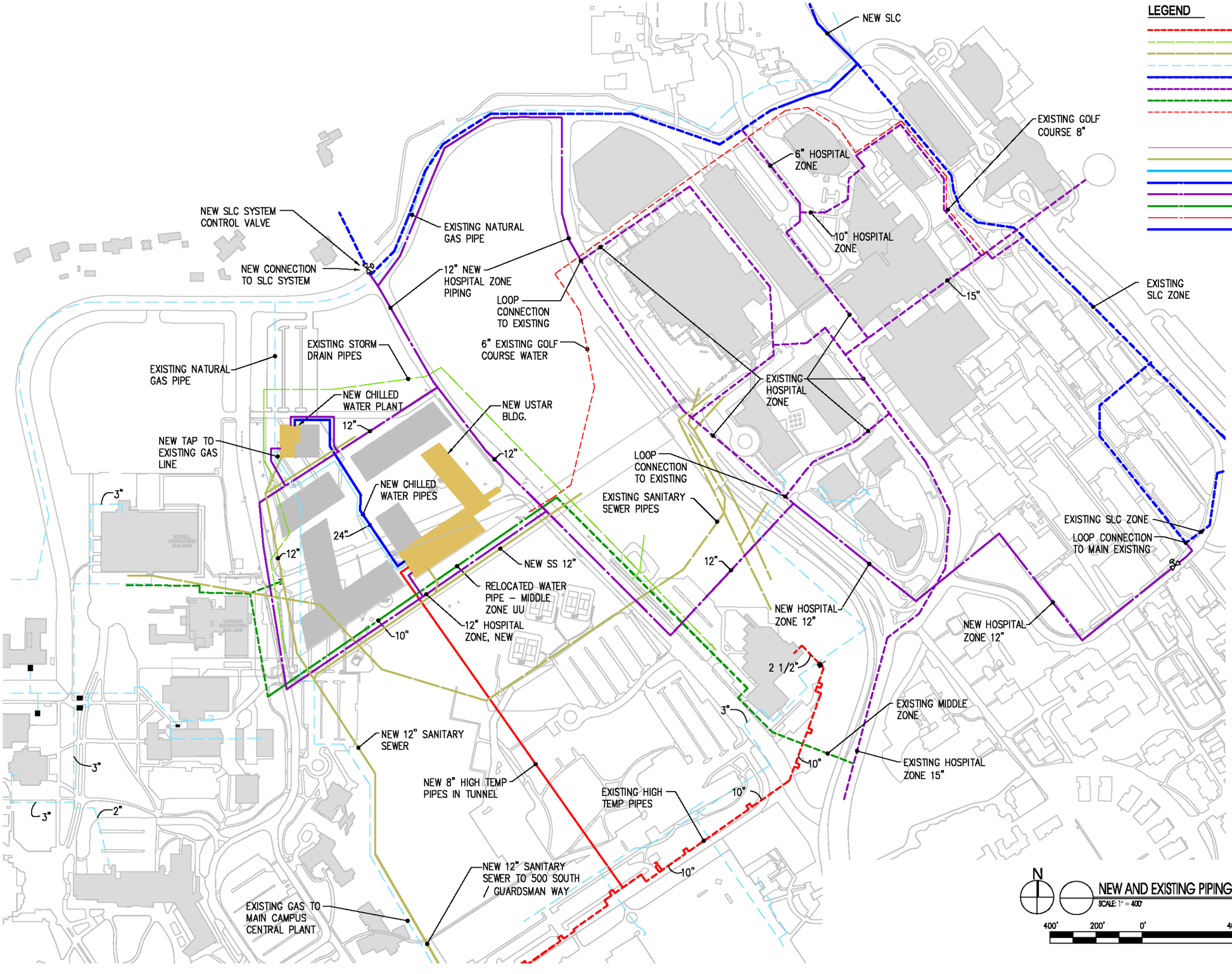

LEGEND

- EXISTING HIGH TEMP WATER
- EXISTING STORM DRAIN
- EXISTING SANITARY SEWER
- EXISTING NATURAL GAS
- EXISTING SLC WATER
- EXISTING HOSPITAL ZONE – UU WATER
- EXISTING MIDDLE ZONE – UU WATER
- EXISTING GOLF COURSE ZONE – UU WATER
- NEW HIGH TEMP WATER
- NEW SANITARY SEWER
- NEW NATURAL GAS
- NEW SLC WATER
- NEW HOSPITAL ZONE – UU WATER
- NEW MIDDLE ZONE – UU WATER
- NEW GOLF COURSE ZONE – UU WATER
- NEW CHILLED WATER

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SHEET CONTENTS

NEW AND EXISTING PIPING

C101

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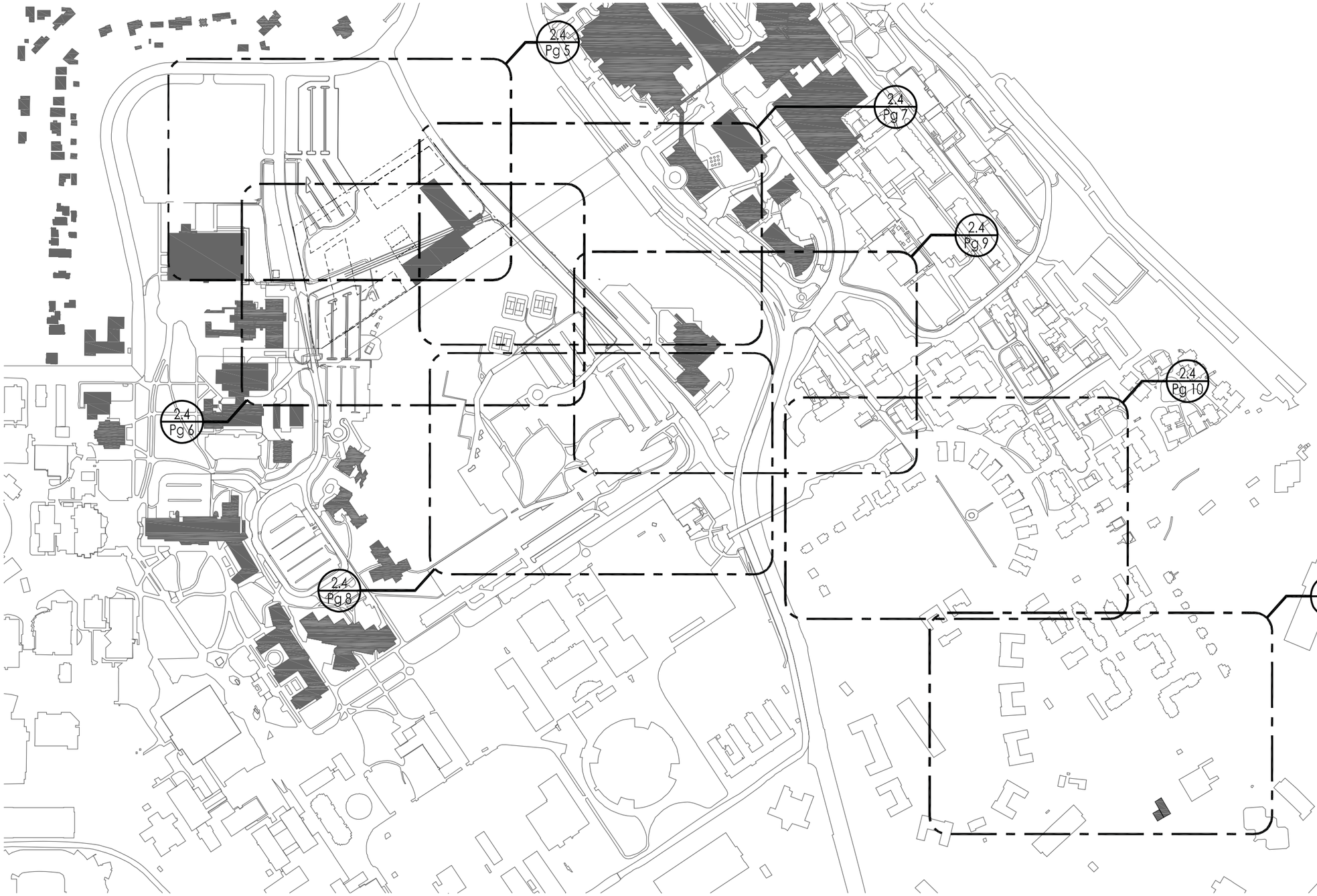
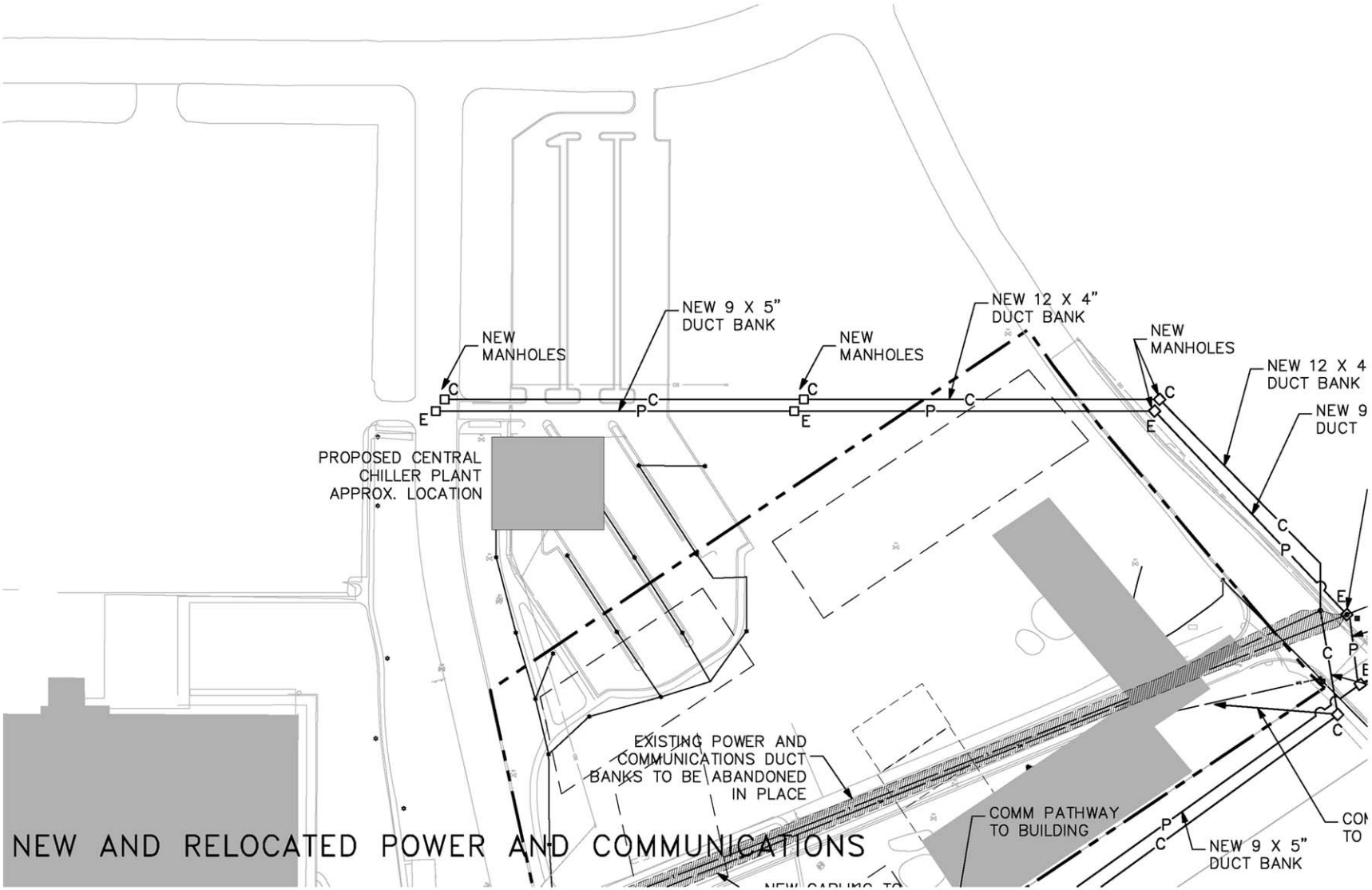
NEW AND RELOCATED POWER AND COMMUNICATIONS KEY SITE PLAN

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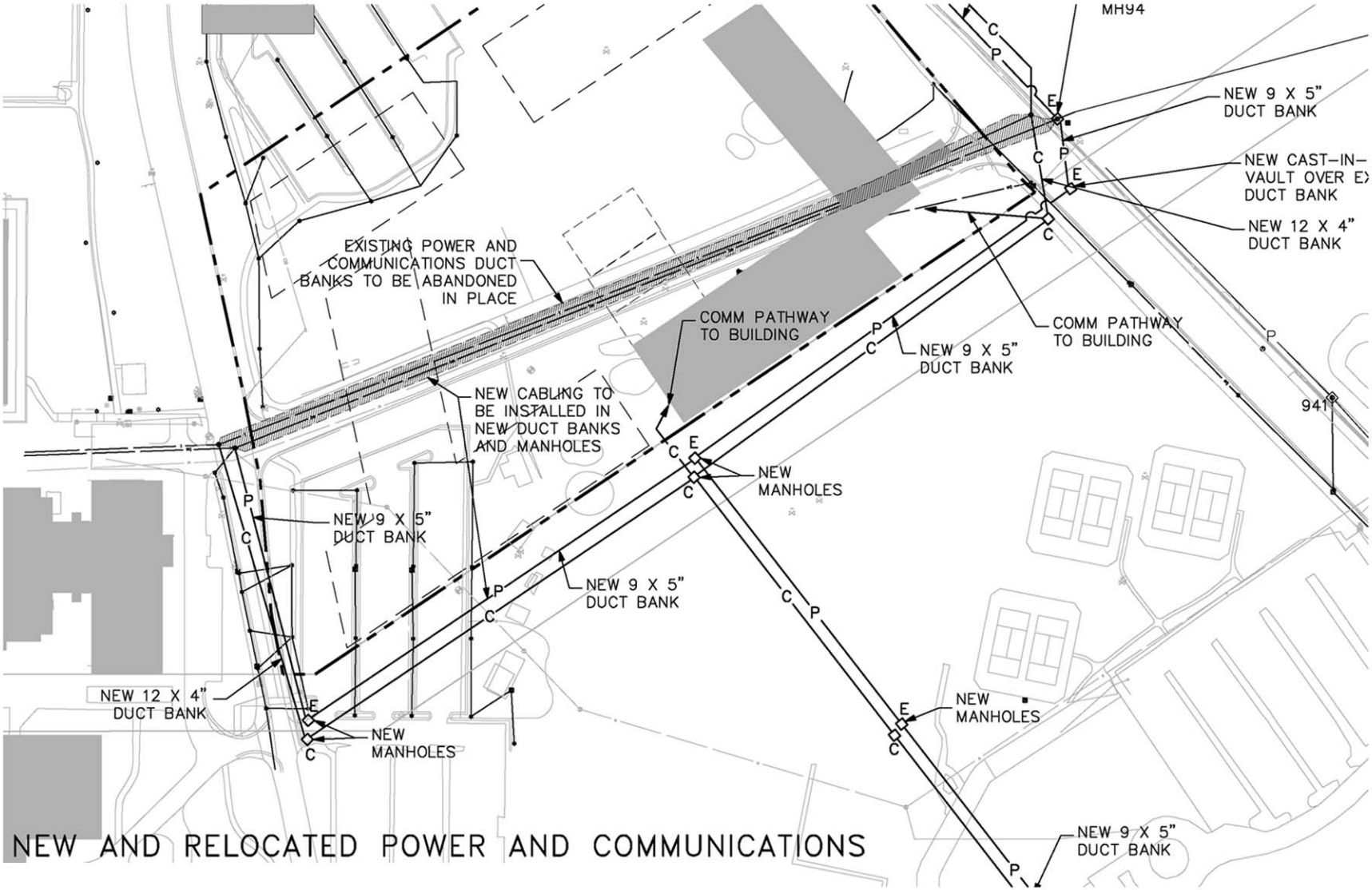
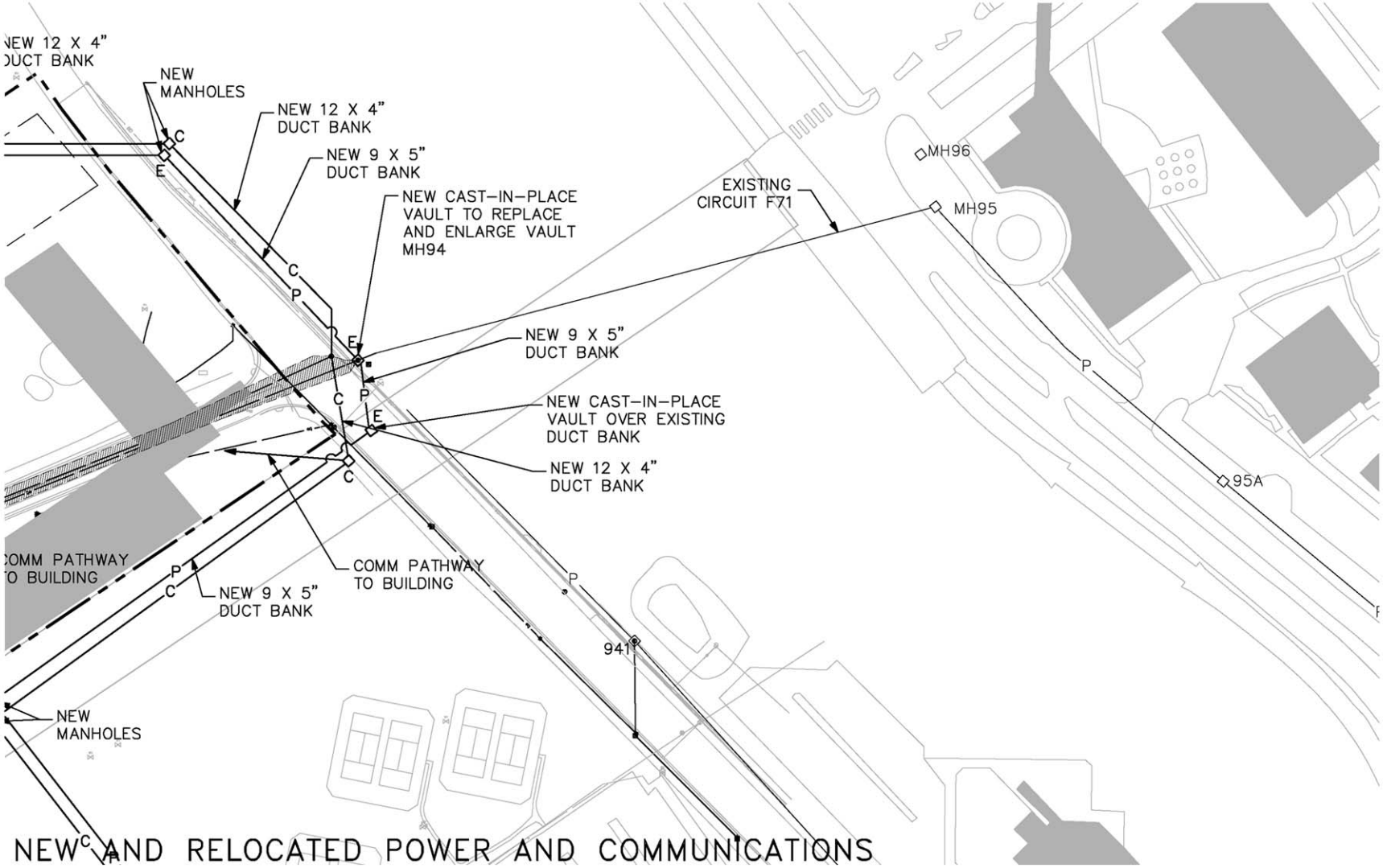
NEW 9 X 5" DUCT BANK
NEW MANHOLES
NEW 12 X 4" DUCT BANK
NEW MANHOLES
NEW 12 X 4 DUCT BANK
NEW 9 DUCT
PROPOSED CENTRAL CHILLER PLANT APPROX. LOCATION
EXISTING POWER AND COMMUNICATIONS DUCT BANKS TO BE ABANDONED IN PLACE
COMM PATHWAY TO BUILDING
NEW 9 X 5" DUCT BANK
NEW AND RELOCATED POWER AND COMMUNICATIONS


MH94
NEW 9 X 5" DUCT BANK
NEW CAST-IN-VAULT OVER EX DUCT BANK
NEW 12 X 4" DUCT BANK
EXISTING POWER AND COMMUNICATIONS DUCT BANKS TO BE ABANDONED IN PLACE
COMM PATHWAY TO BUILDING
COMM PATHWAY TO BUILDING
NEW 9 X 5" DUCT BANK
NEW CABLING TO BE INSTALLED IN NEW DUCT BANKS AND MANHOLES
941
NEW MANHOLES
NEW 9 X 5" DUCT BANK
NEW 9 X 5" DUCT BANK
NEW 12 X 4" DUCT BANK
NEW MANHOLES
NEW MANHOLES
NEW 9 X 5" DUCT BANK
NEW AND RELOCATED POWER AND COMMUNICATIONS



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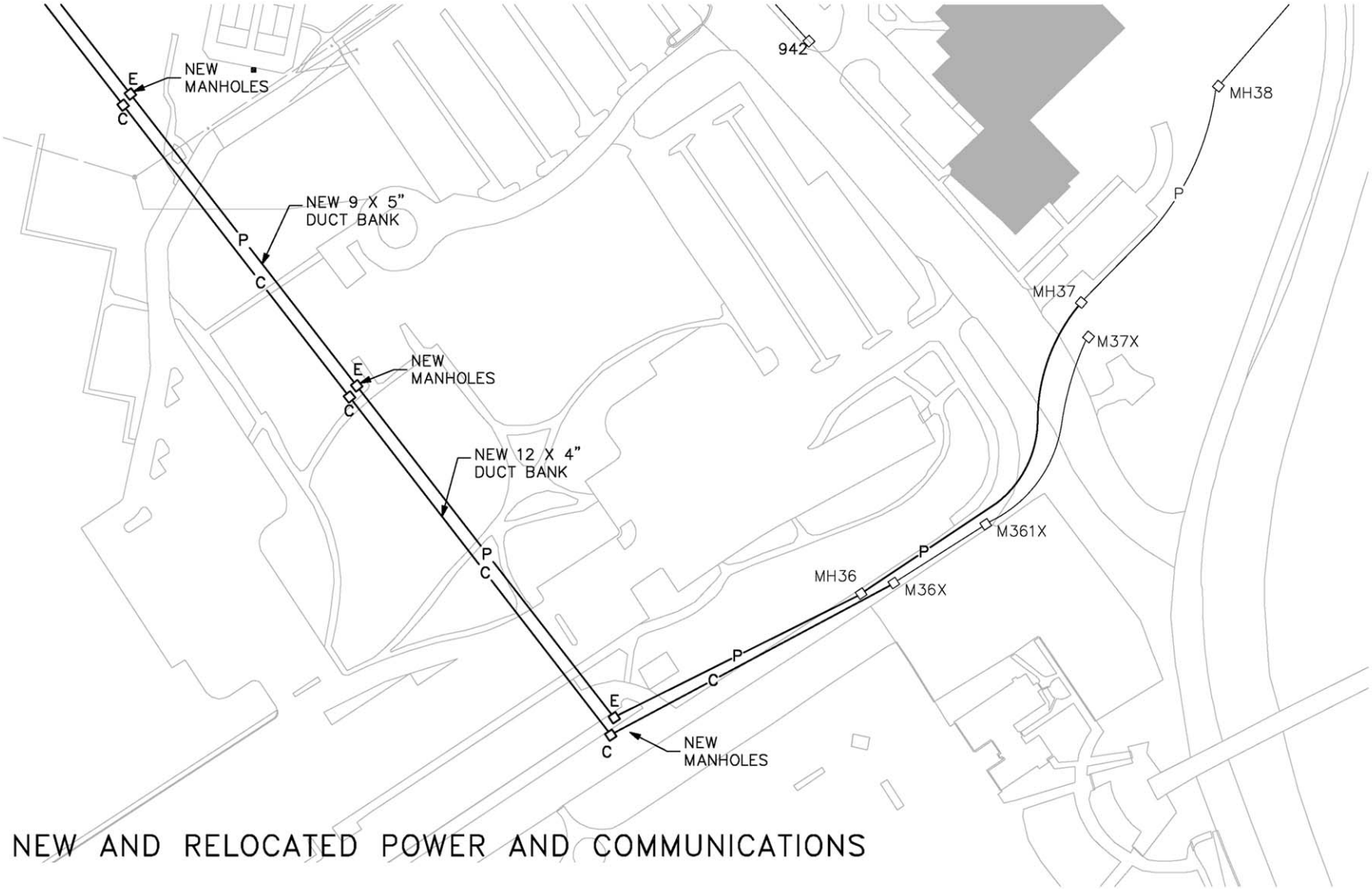

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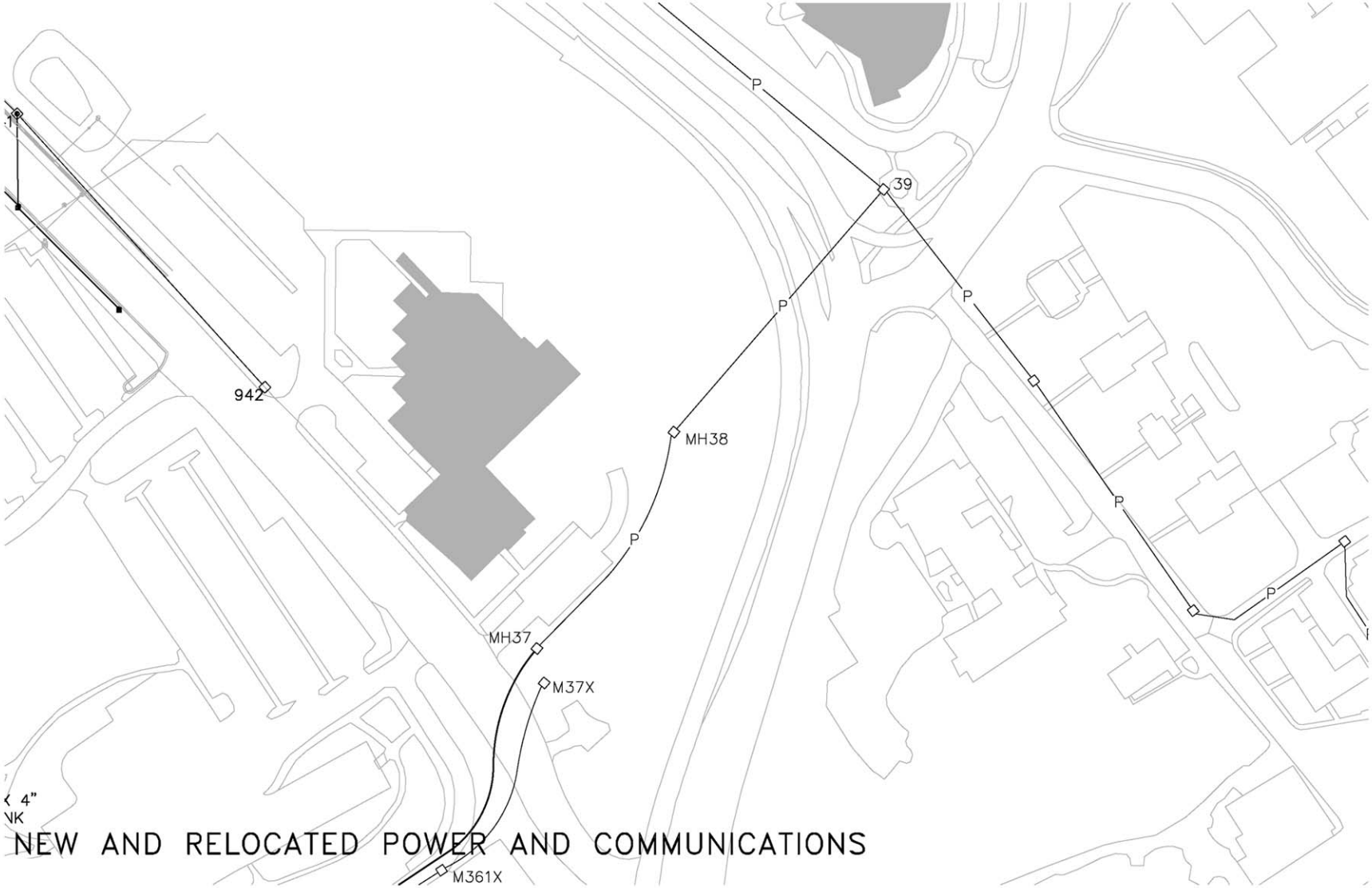
NEW AND RELOCATED POWER AND COMMUNICATIONS
942
39
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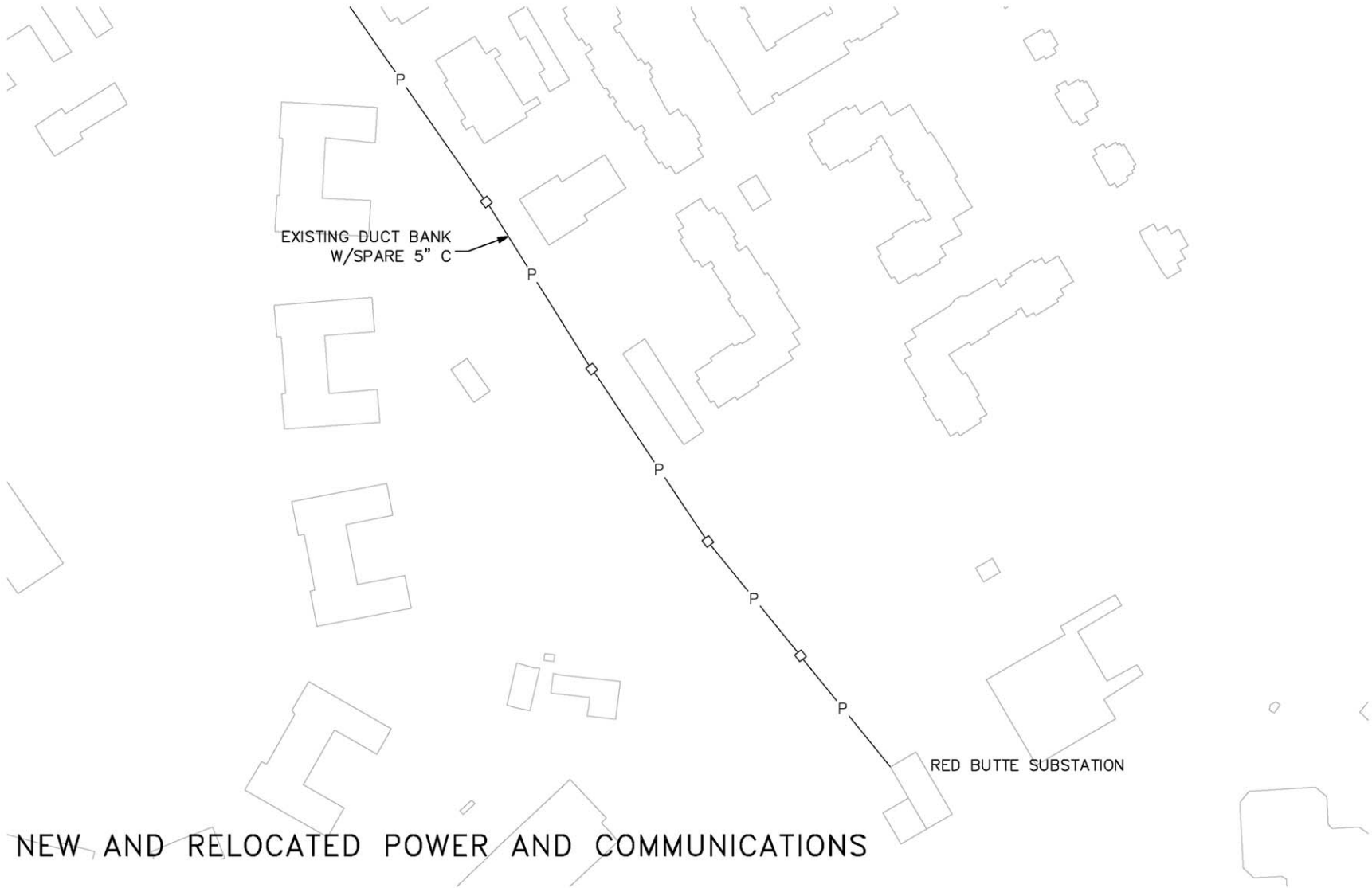
NEW AND RELOCATED POWER AND COMMUNICATIONS



NEW AND RELOCATED POWER AND COMMUNICATIONS

2.4.1 Existing Utilities to be Extended and Utilized

Electrical Utilities
The existing circuit from Medical Substation that is used to supply Warnock Engineering Building will be utilized as a backup circuit for the NBTRB Building. There are no other existing electrical or communications utilities that will be utilized for the NBTRB Building. See **Section 2.4 pages 4-11** for **New and Relocated Power and Communications** site plans.

Existing Utilities to be Extended
See **Section 2.4 Page 2 Drawing C 100** for location of all existing utilities. This information is taken from the Campus Master utility drawings on file with the University.

High Temperature Water
The existing Main Campus High Temperature Water Plant has sufficient excess capacity to support 1,500,000 sq. ft. of buildings to be located on the Golf Course Area of the Campus. The NBRTB project is the first of the buildings to be connected to the extension of the existing High Temperature Water (HTW) piping system.

In accordance with the policies of the University of Utah, the extension of the HTW piping shall be in accordance with the Utilities Master Plan for the Golf Course Area. Furthermore, all new HTW mains intended for the buildings in this area shall be sized for future connections and shall be installed in concrete tunnels. The location and routing of the piping and the tunnel has been set to accommodate the anticipated location of future buildings and is in accordance with the Utilities Master Plan.

The HTW mains shall be connected to HTW Zone 4, 10" supply and return mains at the location shown on **Section 2.4 Page 3 Drawing C 101**. The new mains shall be 8" supply and return and shall extend to the NBRTB Building. There shall be expansion loops installed every 250 feet. The tunnel shall be enlarged horizontally to accommodate the expansion loops. The concrete tunnel shall be a minimum of seven feet high and five feet wide with steel supporting pipe racks. Lighting and drainage shall also be provided with ventilation of tunnel to prevent temperatures from exceeding 90°F.

Culinary Water
Currently there are no water lines of capacity or pressure to service the NBRTB site or other areas to be developed in the Golf Course Area. Extension of the Hospital Zone to the NBRTB is to be achieved by providing loops of water mains that have more than one source of supply. These loops are discussed in detail below and are shown on **Section 2.4 Page 3 Drawing C 101**.

Sanitary Sewer
Currently there is no sewer line of capacity to service the NBRTB site or other areas to be developed in the Golf Course Area. The existing 100 South sewer line serves Eccles Broadcast Center (EBC). No additional services are to be connected as directed by Salt Lake City Public Utilities. A new sewer extension is discussed below in detail and is shown on **Section 2.4 Page 3 Drawing C 101**.

Storm Sewer

The existing storm sewer system is to remain. Detention facilities for the NBRTB are to be provided south of the site in a location that is yet to be determined. The size of the detention is to be in accordance with the Utilities Master Plan.

Natural Gas

Natural gas is to be extended from the new Questar main that was put in service feeding the co-generation facility of the Main Campus Central Plant. A new tap is to be made to the main with a regulator station located west of the new Chilled Water Plant. Distribution lines from this meter are to extend to the various facilities of the NBRTB. Usage of natural gas by the facilities is considered to be negligible unless required by programs within the facilities.

2.4.2 Existing Utilities to be Relocated

Electrical Utilities

The site selection places the new buildings over an existing underground ductbank that is below Federal Way. The ductbank includes a 12,470 volt circuit from Medical Substation that supplies Warnock Engineering and a tie circuit between Stadium Sub 7 and Medical Sub 6. The tie circuit can be interrupted for relocation; however, the feeder to Warnock Engineering is single ended meaning that Warnock is without power if this feeder is interrupted. The following are recommendations for relocation of this ductbank and feeders:

- Establish an alternative feeder for Warnock Engineering. This can be accomplished by installing a new RAM switch at the west side of the site and connecting Stadium Circuit F71 to the RAM switch that is located in the electrical vault that is northeast of Warnock Engineering. A feeder can then be run from the RAM switch to the existing Warnock interrupter switch. Warnock can then be connected to Stadium Circuit F71 while the existing Medical Substation circuit is rerouted around the building site.
- After the Warnock alternative feeder has been established the existing feeders under Federal Way can be de-energized which is a necessary part of relocating the feeders.
- To relocate the feeders new vaults will need to be installed at the east and west sides of the site. These vaults can be cast in place on top of the existing ductbank at the east side. At the west side the ductbank will be installed to the vault that was established for the alternate feeder to Warnock. A ductbank with 9” x 5” conduits should be extended from manhole 94 to the Chiller Plant in a utility corridor that is established on the north side of the site.

See **Section 2.4 pages 4-11** for **New and Relocated Power and Communications** site plans.

Telecommunications Utilities

The Master Plan Study suggests that the existing data node room has capacity to serve some of the initial buildout. The assumption is that the existing node will provide telecommunications for the NBTRB and Chiller Plant buildings. The following will be installed for telecommunications services:

- A manhole will be installed along the east side of the site with a 12” x 4” conduit ductbank then heading west through the utility corridor along the north side to the west side of the site. This manhole will be tied to existing manhole M92 or M92A to provide a means for re-routing cables that are located under Federal Way.
- At the west side this ductbank will be connected to existing manhole M92 to provide a means for re-routing of existing cables that are located under Federal Way.
- Cables located under Federal Way that will require relocation include a 144 strand fiber optic cable.

See **Section 2.4 pages 4-11 for New and Relocated Power and Communications** site plans.

Culinary Water

The NBRTB site location requires the relocation of the 10" Middle Zone water main that is located in Federal Way. This line will be relocated south to the right-of-way of the relocated Federal Way.

Natural Gas

The natural gas line that currently serves the co-generation project in the Main Central Plant is located west of the proposed structures for the NBRTB. No relocation will be required for this building, however this will need to be studied further when footprints of other buildings are studied.

2.4.3 New Utilities to be Constructed

Electrical Utilities

The Master Plan Study recommends supplying electrical power to the NBTRB Building from the Red Butte Substation. To comply with this recommendation the following will be required to supply electrical power to the NBTRB Building from the Red Butte Substation:

- Install a new 22 MVA transformer at Red Butte Substation. Approximately 4.2 MVA will be needed for the NBTRB Building.
- Install new bays at the Red Butte Substation to provide a location for switches that will supply electrical circuits to NBTRB.
- Install new circuit consisting of 500 kcmil copper 15 kv feeder from Red Butte to the area located south of the Eccles Broadcast Center in existing ductbanks. Install new manhole at the terminus of this ductbank and install new 9" x 5" conduit ductbank heading north along Wasatch Drive to the site. Install electrical manholes at approximately 500 feet intervals along this route.
- Install one RAM switch at the east edge of the site. The RAM switch provides a means for sectionalizing or reconnecting the feeder to an alternative circuit. Install two 5" conduits from the RAM switch to a utility yard area for each of the building pads. This will be the location for interrupter switches and transformers for each building.
- Install one interrupter switch to supply medium voltage feeders to the NBTRB Building.

The Master Plan Study recommends supplying electrical power for the Chiller Plant at this location from Medical Substation. However, given that there is added cost for running new ductbanks from Medical Drive to Medical Substation and there is no opportunity for expanding Medical Substation, it is suggested that the feeder for the Chiller plant should come from Red Butte Substation. At some point in the future it would be desirable to supply a second feeder to the Chiller Plant from either Medical or Stadium Substations. The initial buildout of the Chiller Plant will be for two 1500T chillers totaling 3000T which equates to approximately 4.3 MW of electrical power which is just under the 5.4 MW capacity of 500 kcmil circuits installed at the University of Utah. The following will be required to supply electrical power from Red Butte Substation to the Chiller Plant:

- Assuming that the new transformer and bays are installed at Red Butte there will be no additional upgrade requirement. Approximately 4.3 MVA of the 22 MVA transformer capacity will be used for the initial 3000T Chiller Plant. The total Chiller buildout to 9,000T.
- Install new circuit consisting of 500 kcmil copper 15 kv feeder from Red Butte to the north end of Fort Douglas in existing ductbanks and to the NBTRB site in new 9" x 5" conduit ductbanks.
- Continue the circuit from the NBTRB site to the Chiller Plant Site. Install one RAM switch and one interrupter switch near the Chiller Plant.

There are existing ductbanks with spare conduits that run from Red Butte Substation to manhole 39 that is located east of the Eccles Broadcast center across Medical Drive. These ductbanks can be used to install the new feeder from Red Butte to the Golf Course Area.

At approximately 500 foot intervals vault mounted RAM switches will be installed to provide a means for sectionalizing faults and loads. RAM switches will consist of a four 600 amp load break source switches in sealed enclosures with SF-6 gas per University of Utah Standards. Two of the source switches will be used for circuit in and circuit out. One of the switches will be used to supply the padmount interrupter switches for the buildings and the remaining switch will be a spare. In addition to RAM switches at 500 foot intervals a RAM switch shall be installed at each building. If two buildings are in close proximity a single RAM switch may be installed if the two buildings share a single padmounted interrupter switch.

Most of the Campus medium voltage circuits are double-ended. Double-ended means that they are connected to a separate source at each end. Sectionalizing switchgear is used at regular intervals so that sections of the feeder can be taken out of service for repairs without disrupting the entire circuit. It is good practice, but not a code requirement, to use sources that originate at different substations so that an outage at a single substation can be overcome by connecting the circuit to the remaining substation. These are sometimes referred to as preferred and alternate sources. The circuit that was recently installed for the Warnock Engineering building is a good candidate for use as a backup circuit from Medical Substation. The circuit should be extended from the RAM switch that was installed for the Warnock Engineering building. See **Section 2.4 pages 4-11** for **New and Relocated Power and Communications** site plans.

New Communications Utilities

As stated in the recently completed Utilities Study Golf Course Area N.E. Campus Utilities Master Planning Report it is the desire of Campus Netcom to provide a new data center immediately in the vicinity of the Eccles Broadcast Building to provide capacity for all of the Central Campus Area and the Golf Course. To accommodate a future data center multiple conduits should be installed in all ductbanks so that multiple buildings can be served from the data center.

Ductbanks heading north from the Eccles Broadcast Center have capacity for cables that will be needed to supply the new data center. A new 4” x 12” conduit communications ductbank should be installed parallel to the medium voltage ductbank. Communications vaults per University of Utah Standards should be installed at maximum 500 foot intervals and near to each building. At least 4 four inch conduits should be installed from the manhole nearest to each building to the MDF in the building. See **Section 2.4 pages 4-11** for **New and Relocated Power and Communications** site plans.

Chilled Water

Refer to **Section 2.4 Page 3 Drawing C 101** for location of new Chilled Water Plant and new chilled water lines. New chilled water lines will extend from the new Chilled Water

Plant to the NBRTB Buildings. These mains shall be 24" in diameter and are sized to accommodate all new and future buildings in the Interdisciplinary Quad.

Culinary Water

The Golf Course Area is to be served from the Hospital Zone of the culinary water system. This allows for adequate water pressure in the facilities. Development of this site points to the current vulnerability of the Hospital Zone. This zone is served by one connection to Salt Lake City water department and is backed up by only 1,000,000 gallons of storage east of the Huntsman Cancer Institute. Multiple points of connection and the creation of distribution loops are desirable for security of the water system for both the NBRTB site and for the Medical Campus at the University.

As part of this effort, Salt Lake City Public Utilities is designing and will place for bidding and construction the extension of the 16" transmission line that dead ends at the Circle of Hope Drive. This extension will connect to the public utility in 11th Avenue. This will provide the ability to feed water from two directions to the University of Utah Hospital Zone connection.

Salt Lake City Public Utilities will also extend a water main from Circle of Hope Drive west to the end of their utility service at the Children's Center on North Medical Drive.

The connections noted above will also require Salt Lake City Public Utilities to move the section valve for pressure zone separation from Federal Heights Drive to Penrose Drive. At this location a connection to the Hospital Zone will be made to provide another feed of water to the zone.

Three new distribution loops will be created as part of this project. A 12" water main loop is to be constructed that borders the entire Interdisciplinary Quad of which the NBRTB is a part. This loop will connect to a larger 12" loop to the east. The larger loop will be created by connecting to the water main at the northwest corner of Primary Children's Medical Center, continuing north to North Medical Drive, proceeding west to Wasatch Drive, thence south to the NBRTB loop northeast corner. The loop will then continue from the southeast corner of the NBRTB loop proceeding south along Wasatch Drive to Eccles Broadcast Center (EBC) then east, under TRAX to the blind flange at the southeast corner of the Moran II building. The third loop will be completed by extending a 12" water main from the southwest corner of the Moran II building south along Medical Drive, proceeding easterly along South Medical Drive and East South Medical Drive. This loop will connect to the high pressure water main at the southeast corner of Biomedical Polymers Research Facility.

This extension of water utilities will provide infrastructure for future growth and development. It will also provide redundant paths for water distribution from a minimum of three public utility connections. This will also allow for sectionalizing a majority of the buildings in the Medical Campus so that service and or utility interruptions will not deprive these critical facilities of water.

Fire hydrants are to be placed along the new mains as required by IFC. The number and location are to be determined by the current NBRTB facility and for non-developed land for the remainder of the loops.

Sanitary Sewer

Sanitary sewer is to be extended from Guardsman Way / 500 South intersection to the site of the NBRTB at Central Campus Drive and the new Federal Way. The size of the pipe is to be 12" minimum. The extended main will continue east on Federal Way to the intersection of Wasatch Drive. A branch line will be placed along the west side of the new Chilled Water Plant. The routing of these mains is shown on **Section 2.4 Page 3 Drawing C101**.

2.4.4 Chilled Water Plant

Refer to **Section 2.4 Page 3 Drawing C 101** for clarification of this narrative. In accordance with the Utilities Master Plan for the Golf Course Area, a new Chilled Water Plant shall be constructed to provide chilled water for all future buildings in this area. This NBRTB Project is the first of the buildings to be constructed, as such the first phase of the required Chilled Water Plant will be part of this project.

The currently assigned location of the Chilled Water Plant is shown on **Section 2.4 Page 3 Drawing C 101**. The location shall be confirmed by a future master planning study. This plant will be a stand alone building that will accommodate capacity for the NBRTB project and will be designed so that expansion of the plant can take place as future buildings are planned and constructed. It is anticipated that the initial size of the plant will be approximately 3,000 tons, which will be comprised of two chillers sized at 50% each. The plant shall be located on grade and shall include ceramic type cooling towers at grade. The plant shall be designed as a primary / secondary pumping plant and shall be designed for a temperature rise of 14°F, with primary chilled water sent from the plant a 41°F and returned at 55°F. The plant is anticipated to expand to 9,000 tons, planning and design shall anticipate this expansion.

The location and routing of the piping has been set to accommodate the anticipated location of future buildings and is in accordance with the Utilities Master Plan.

The piping shall be buried a minimum of five feet below the surface and shall be embedded in sand. Piping shall be installed in accordance with University Standards and requirements as to proximities to other utilities. Depending upon the exact location of the Chilled Water Plant, the mains extending from the plant to the NBRTB project shall be of such size as to accommodate other buildings which would be connected in the future as shown on the Utilities Master Plan for this area.

2.5 PROPOSED NEW SITE CONSIDERATIONS

2.5.1 Interdisciplinary Site Master Plan Criteria

The master planning process resulting in the selection of the Interdisciplinary Site Master Plan is discussed in **Section 2.1 Site Selection and Location** with accompanying illustrations. As noted in Section 2.1, this process included discussions with the Campus Master Planning Committee which established goals to be attained in the development of the site. These goals were used in the development of the approved **Scheme #5**, shown in **Section 2.1 Page 9**, and are documented as follows:

- **Create an Interdisciplinary Site Master Plan to facilitate an interactive connection between existing research activities on Upper Campus and Main Campus.** This new Interdisciplinary Site Master Plan shall provide a site for a group of interdisciplinary research buildings in an optimal location to form an interactive functional connection between the Engineering Center / Main Campus and the Medical Sciences Center / Upper Campus connecting thru the Medical Center TRAX Station. The facilities constructed on this new site shall promote interdisciplinary interaction between researchers working in this new interdisciplinary area with those working in facilities in Upper Campus and Main Campus. This site shall be large enough to accommodate four buildings, three to four stories in height, totaling approximately one million gross square feet with associated exterior hardscape and softscape open space as required to create a pleasing interactive Campus environment. The first building to be constructed in this Interdisciplinary Site shall be the NBTRB.

- **Create an Interdisciplinary Site Master Plan Quadrangle to facilitate research interaction for the new facilities.** This Interdisciplinary Site Master Plan shall locate four new research buildings with proximities which shall promote synergistic interdisciplinary interaction between research activities conducted in these buildings. The development of the Site Master Plan shall locate these buildings around an open space Quadrangle designed to facilitate formal and informal interaction. The designed proximities between these four buildings shall include shared and efficient utilization of core and service facilities while avoiding unnecessary duplication.

- **Create an Interdisciplinary Site Master Plan which includes a Pedestrian Corridor providing efficient pedestrian circulation and view corridor between Upper and Main Campus.** This new Interdisciplinary Pedestrian Corridor shall provide for efficient pedestrian circulation connecting the Engineering Center / Main Campus with the Medical Sciences Center / Upper Campus thru the Medical Center TRAX Station while providing a pedestrian connection to the existing sidewalk system and adjacent parking lots. This Corridor shall also provide a visual corridor linking these two parts of the Campus.

- **Create an Interdisciplinary Site Master Plan which efficiently organizes service for the Interdisciplinary Quadrangle buildings.** The Site Master Plan shall efficiently organize the service and delivery requirements for the Quad buildings limiting duplication of dock facilities. This goal will maximize views to and from the Inter-

disciplinary Quad buildings unobstructed by duplicated service docks and service facilities.

- **Create an Interdisciplinary Site Master Plan which organizes Campus open green space.** The Site Master Plan shall locate the Interdisciplinary Quadrangle in an area of open green space which will provide for the play field needs of the University and functionally separate and buffer the Quad from the residential neighborhood to the north. The open green space design shall provide for connecting pedestrian circulation paths into and through the Quad open space resulting in an integrated Campus environment.

- **Create an Interdisciplinary Site Master Plan which promotes view corridors.** The Site Master Plan shall provide and maintain the significant view corridors to and from the buildings surrounding the Quad in all directions while not blocking views from the Moran Eye Center. The surrounding green open space setting shall promote this goal.

- **Create an Interdisciplinary Site Master Plan which promotes sustainable design strategies.** These strategies shall include appropriate energy efficient orientation of major building solar exposures. Site organization and facility design shall provide for the efficient conservation and use of storm water. The site design shall preserve existing trees in so far as possible while providing new hardscape and softscape promoting the implementation of these goals.

- **Create an Interdisciplinary Site Master Plan for vehicle parking.** The current Master Plan strategy directs that parking for NBTRB will be provided by the excess capacity in existing adjacent parking lots, and that parking for future buildings will be provided by parking strategies included in a new University Parking Master Plan. This plan may include underground parking.

- **Create an Interdisciplinary Site Master Plan which identifies a site for a new Central Chilled Water Plant.** The Master Plan shall locate a new Central Chilled Water Plant in a location where this function is efficient and that will not detract from the public image of the research quad buildings or block views to and from the research quad buildings.

The above goals shall be included in the program requirements for the implementation of the First Phase of the Interdisciplinary Site Master Plan which is the design and construction of the NBTRB and the Central Chilled Water Plant.

Note: The master planning of the Interdisciplinary Quadrangle is not presently complete. This work is in the RFP process at the date of this program. The exact location of the Central Chilled Water Plant and the Service Road will be considered as a part of this, yet to be completed, master planning process.

2.5.2 Pedestrian Access and Circulation

As previously discussed, the Interdisciplinary Corridor and site for the NBTRB, as schematically illustrated by **Scheme #5 Section 2.1 Page 9**, is located in the University Golf Course green field. The development of the Master Plan in this area shall include the following specific pedestrian circulation goals and program requirements:

- **Interdisciplinary Pedestrian Corridor:** This project shall be designed in context with the Interdisciplinary Site Master Plan to provide only the first phase of the new Interdisciplinary Pedestrian Corridor connecting the Health Sciences Campus/upper campus with the Engineering Center/main campus through the Health Sciences TRAX Station. This circulation corridor/mall will ultimately provide pedestrian access to the NBTRB from upper and main campus as well as connecting pedestrian walks from adjacent parking lots. The pedestrian corridor pavement shall be constructed of concrete and designed in width and thickness to support campus maintenance vehicles and Fire Department equipment to comply with applicable codes. There has been some discussion regarding Campus Shuttle vehicles using this circulation corridor, but direction from the Campus Master Planning Committee on this concept has not been given at this time. Stop signs shall be provided on Wasatch Drive at the intersection with this corridor to insure pedestrian safety and to bring all traffic to a stop to limit ground vibration from otherwise faster moving vehicles.

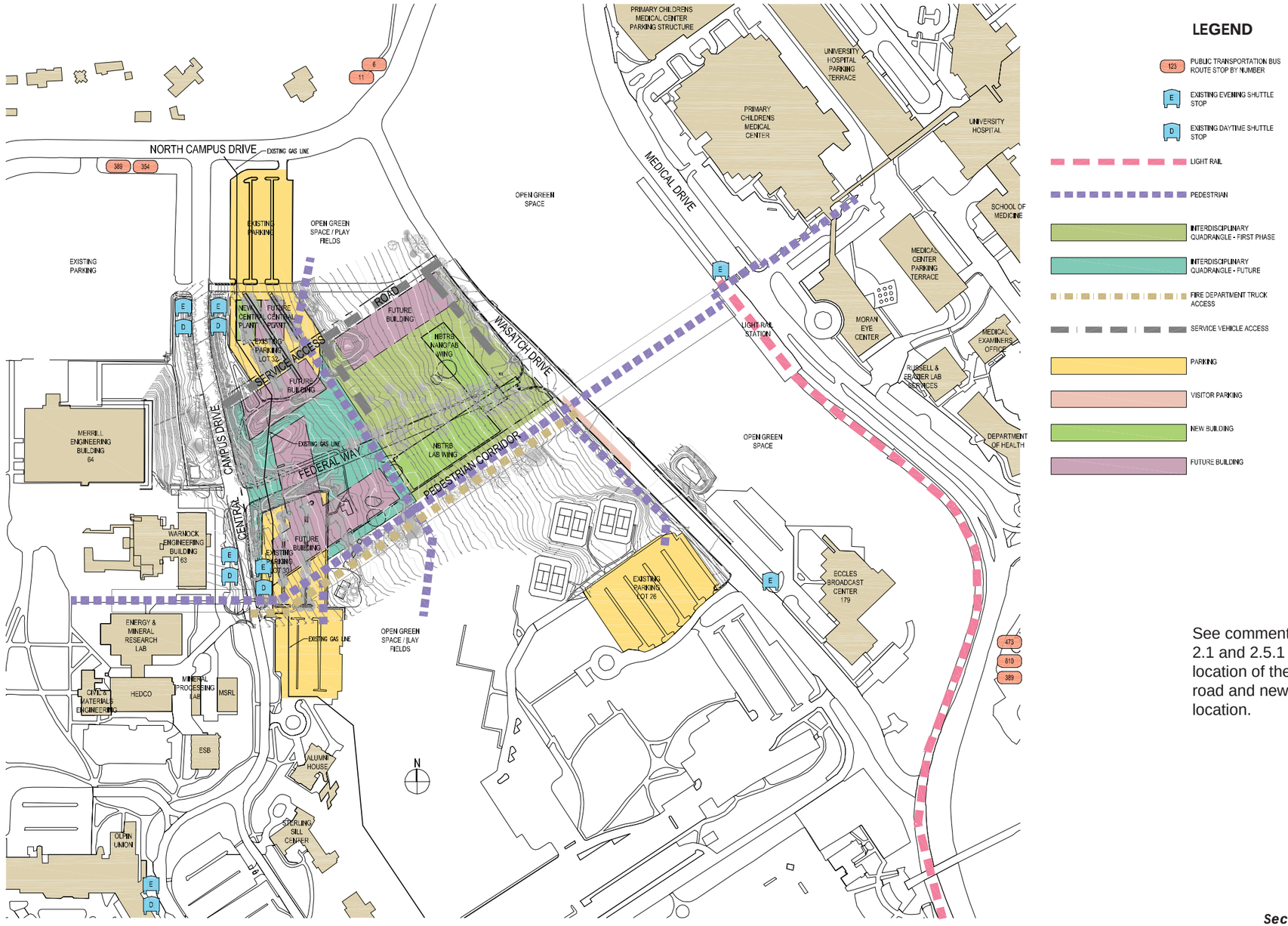
- This project shall provide the first phase of an Interactive Open Space Quad connecting this first building in the Interdisciplinary Quad with three possible future buildings. This open space shall consist of hardscape and softscape spaces designed to promote interaction between the occupants of the adjacent research buildings as well as the first phase of an appropriately designed finish grade transition between the elevation of Wasatch Drive down to Central Campus Drive.

- **Play Field Connectivity:** This project shall provide the first phase of pedestrian connectivity between the Interdisciplinary Quadrangle with the open space play fields to the north and south of the Interdisciplinary Site Master Plan. Ultimately this system of pedestrian circulation walk ways shall interconnect with buildings and open space in ways to make the movement of pedestrians interesting and safe while promoting synergistic interaction between the people working in and visiting this area of the campus.

- This Interdisciplinary Mall shall also provide a view corridor between the Engineering Center Main Campus and the Health Sciences Campus Upper Campus. This view corridor will promote an individual's understanding of location as the pedestrian moves through this area of the Campus. This view corridor will also provide visual connections with pedestrians as they move through the site. This view corridor shall be reinforced by hardscape and softscape designs.

The following **Pedestrian Access and Circulation Site Plan** on **Section 2.5.2 Page 2** shows one way that the pedestrian circulation goals and program requirements outlined above could be implemented.

PEDESTRIAN ACCESSS AND CIRCULATION SITE PLAN



See comments in section 2.1 and 2.5.1 regarding the location of the North service road and new central plant location.

2.5.3 Parking and Vehicle Access

The site for the NBTRB located in the Interdisciplinary Site Master Plan is illustrated in the approved **Scheme 5**, see **Section 2.1, Page 9**. See also **Section 2.5.2 Page 2 Pedestrian Access and Circulation Site Plan** for the existing parking lot locations designated by the Masterplanning Committee to be used for parking for this facility. The first phase of the implementation of this Master Plan is the construction of the NBTRB. The following are program requirements for parking and vehicle access associated with the design and construction of this first phase:

- **Parking:** The Campus Master Planning Committee has directed that parking for this building shall be provided by existing under utilized spaces in adjacent parking lots 24, 25, 30, 32 and 39. This direction is in context with a Campus wide agenda to encourage the use of transportation modes other than private vehicles. The **Appendix Section 6.6 Traffic Impact Analysis** notes that 300 parking stalls will be required to serve this building. This report also notes, in Tables 7 and 8, an average of 857 open parking stalls available for use during peak times of the day during site visits on April 9 and April 12, 2007. Therefore consistent with the direction received from the Campus Master Planning Committee, new vehicle parking stalls will not be provided. Access from the above parking lots shall be accommodated on new and existing pedestrian walks and Campus Shuttle Bus Service. The above referenced analysis also recommends that 7 ADA parking stalls are needed to meet code. These stalls shall be provided in an appropriate location. *Note: Future projects for buildings in the Interdisciplinary Quadrangle should strongly consider underground parking.*

- **Visitor Parking:** Visitor / metered parking shall be provided adjacent to the NBTRB building. A minimum of 30 stalls shall be provided for this use with Visitor Parking passes provided by the Visitor Reception. The approved site **Scheme #5 in Section 2.1 Page 9** suggests that Visitor Parking should be provided along the west side of Wasatch Drive in context with the existing parking at that location.

- **Vehicle Access:** The NBTRB site is bordered by Wasatch Drive on the east and Central Campus Drive on the west. These two existing roadways will continue to provide general vehicle / truck access to the Site Master Plan area and more specifically to a new Service Road on the north side of the Interdisciplinary Quad. The Interdisciplinary Site Master Plan requirement of the Service Road is to provide service access requirements for the play fields on the north side of this road and the four buildings in the Interdisciplinary Quad on the south side. This program requirement will minimize the impact from service roadways and vehicles thus promoting a pedestrian friendly Interdisciplinary Quad site. More specifically the Service Road will be designed for two way vehicle and semi-truck / trailer traffic providing access to a dock serving the NBTRB and possible future dock expansion serving future buildings. Specific requirements for the NBTRB dock are included in

Section 4.0 Individual Space Outline. The Service Road will also provide for Fire Department access on the north side of the Interdisciplinary Quad in compliance with applicable codes. This road will also accommodate local traffic between Central Campus Drive and Wasatch Drive. This road may provide access to the currently assigned location of the Central Chilled Water Plant. The design of the NBTRB will only include the first phase of this Service Road.

- **Federal Way:** The Interdisciplinary Site Master Plan including the Interdisciplinary Quadrangle is imposed over the existing Federal Way road connecting Wasatch Drive and Central Campus Drive. Implementing the Master Plan will require the closing of this existing road. This will require the demolition of the existing hard scape site improvements and relocating existing utilities under the road way. Specific requirements for existing utility relocation are included in **Section 2.4 Site Utilities.**

- **Interdisciplinary Pedestrian Corridor:** The new Interdisciplinary Pedestrian Corridor design must accommodate, in addition to pedestrian circulation, intermittent vehicular use limited to campus maintenance vehicles, Fire Department access, and possible Campus Shuttle vehicles. This program recommends that stop signs be placed on Wasatch Drive at the Interdisciplinary Pedestrian Corridor. This will keep this pedestrian crossing safe and will bring all traffic to a stop which will keep vehicle generated ground vibrations to a minimum. The design of the NBTRB shall only include the first phase of the Pedestrian Corridor.

- **Traffic Control:** The **Appendix Section 6.6 Traffic Impact Analysis** contains assessments of the adjacent roads and intersections and recommendations for traffic control upgrades. The implementation of these traffic control recommendations is not included in the scope of this program and project.

- **Emergency Vehicle Access:** Providing code compliant Fire Department equipment access is a requirement of this program. The design of the Service Road and the Interdisciplinary Pedestrian Corridor will accommodate the code requirements in addition to the access provided by Wasatch Drive and Central Campus Drive.

2.5.4 Building Fresh Air Intake and Exhaust Criteria

Careful attention shall be given in the design of the fresh air intake locations for this building. The design shall keep air borne contaminants from entering the buildings through fresh air intakes to an absolute minimum. These contaminants shall include but are not limited to heavier than air fumes, exhaust fumes from this or other buildings, vehicle exhaust, airborne light snow in cold temperatures, leaves, etc.

The intrinsic nature of this building dictates that there will be highly toxic fumes posing health hazards generated by nanotechnology procedures. These noxious and toxic fumes posing health hazards will be generated by the research procedures conducted in laboratories. The Vivarium will generate offensive but nontoxic odors. Other occupancies such as restrooms, kitchens and lunchrooms will generate air that will need to be exhausted. General building exhaust shall be provided to maintain a healthy building interior environment. Careful attention to the proper treatment of these emissions is a requirement of this program. This program requires a design that provides equipment and ductwork, including scrubbers, as necessary to keep exhaust emissions in compliance with all applicable regulations. This program requires a design that provides exhaust ductwork configurations and exhaust air velocities to minimize exhaust air being drawn into fresh air intake locations.

Wind / wake modeling studies shall be conducted during the Schematic Design phase to provide validation that designs under consideration provide appropriate locations and systems to achieve the above program requirements.

The systems for health hazard exhaust shall remain in operation during normal power outages by the use of the building's emergency power generator. In an outage of normal power the exhaust system shall provide an acceptable level of negative pressure exhaust to protect the occupants of the building.

The systems for health hazard exhaust shall be designed with redundant equipment as required to provide some acceptable level of exhaust during predictable maintenance procedures.

A building fresh air intake should be designed as required to avoid pulling in excessive snow and creating moisture problems when it melts.

3.0 Total Facility Building Program Analysis

3.1 Architectural Planning Issues
- 3.1.1 Building Form and Massing
- 3.1.2 External Relationships/Circulation
- 3.1.3 Internal Relationships
- 3.1.4 Circulation, External and Internal
- 3.1.5 Personnel Interaction
- 3.1.6 Building Security
- 3.1.7 Codes, Regulations, and Safety
- 3.1.8 Testing and Inspections

3.2 Space Planning Issues
- 3.2.1 Expansion Issues
- 3.2.2 Laboratory Planning Units
- 3.2.3 Space Type Narrative

3.3 Building Design Criteria
- 3.3.1 Architectural
- 3.3.2 Structural
- 3.3.3 Mechanical
- 3.3.4 Plumbing
- 3.3.5 Vivarium Core
- 3.3.6 Electrical/Technology Systems
- 3.3.7 Nanofabrication/Cleanroom Facility
- 3.3.8 Small Animal Imaging Core
- 3.3.9 Microscopy
- 3.3.10 Lab Equipment
- 3.3.11 Vertical Transportation
- 3.3.12 Vibration/Acoustical
- 3.3.13 Food Service
- 3.3.14 System Commissioning Controls
- 3.3.15 Value Engineering
- 3.3.16 Sustainability/LEED Certification
- 3.3.17 Wind/Wake Analysis Requirements
- 3.3.18 Building Occupancy Classification/ Hazardous Materials

3.1 ARCHITECTURAL PLANNING ISSUES

3.1.1 Building Form and Massing

The selected site for the NBTRB lies within the Interdisciplinary Quad as defined by the Campus Master Plan which envisions the area as a new zone for interdisciplinary research activity. The Interdisciplinary Quad is defined by Central Campus Drive on the west, Wasatch Drive on the east and includes an area north and south of the present location of Federal Way. Along the southern edge of the Quad site a pedestrian corridor is planned that would ultimately connect the Health Sciences Center / Upper Campus to the east with the Engineering Center / Main Campus to the west. Along the north edge of the Quad a service street is planned. As illustrated in the Scheme 5 drawing shown in **Section 2.1 Page 9,** the NBTRB will be located in the southeastern section of the Interdisciplinary Quad.

Campus Master Plan General Approach and Guidelines

The Campus Master Plan's General Approach and Guidelines delineates several requirements that relate directly to the form of the NBTRB. Central to these guidelines is the notion of minimizing building setbacks in order to promote an active and pedestrian-friendly edge condition around the Quad. To develop this idea, the Master Plan establishes build-to lines at the southern edge of the Interdisciplinary Quad and at 20 feet off of Wasatch Drive. Along this southern border 75% of the building's facade must be on the build-to line and along Wasatch Drive at least 25% of the facades must meet the build-to line. Following these requirements the building will create a continuous edge along the Quad's southern boundary thereby defining a discernable east / west pedestrian path. To define the corner at the intersection of Wasatch Drive and the Interdisciplinary Corridor, a zero setback building is required or a corner plaza shaped by the building's form. If a plaza is provided the building entry must be on the plaza. The intent of this requirement is to complete the formal definition of the pedestrian pathway and, as the Pedestrian Corridor is extended over time, to eventually encourage pedestrian movement to and from the Health Sciences Center / Upper Campus across and beyond Wasatch Drive.

To further promote a pedestrian-friendly building edge, the Campus Master Plan requires that bank walls be minimized and that at-grade facades facing the Pedestrian Corridor should include windows and other transparent surfaces for no less than 65% of the total facade area. Multiple public at-grade entrances should be provided with the primary entrances to be from the Pedestrian Corridor. Additional building entrances from internal courtyards should be provided encouraging pedestrian movement through and around the building. These façade and entry conditions should be considered in articulating the scale and mass of the building.

While buildings arranged around courtyards are encouraged, building coverage of the site is limited to 50%. The width of these courtyards should be no greater than twice the height of adjacent buildings while the arrangement of these building and courtyards must allow pedestrian and visual connections between the recreation areas to the south and to the north.

Interdisciplinary Quad Site Master Plan

Currently the general programming of the Interdisciplinary Quad foresees four buildings with an overall area of approximately 1 million square feet. The NBTRB would be the first building constructed. All of the four buildings are projected to be three stories above ground with a basement below and mechanical penthouses above. The choice of limiting the floors to three above-grade levels is influenced by the desire to have generous sized floor plates accommodating a significant number of researchers who will be able to easily interact with each other. In addition, the three-floor height limitation restricts the amount of vertical distance researchers will need to travel to interact with colleagues on separate floors. Better interaction might be achieved with fewer floors, however the size of each floor plate is restrained by a requirement for a shared courtyard to be located between these four buildings. This exterior space is intended to connect the four buildings and encourage interaction and collaboration between the occupants and thereby foster a sense of community.

Nanofabrication Separation

The Nanofabrication portion of the program has specific requirements that will influence the form of the building. This part of the facility requires its own service and delivery provisions, along with a service court for storage of materials. It also has a viewing corridor which should be located to the outside of the form with opportunities for exterior viewing. In addition, the Nanofabrication has significant mechanical requirements that would best be located in a penthouse over the main Nanofabrication spaces. The Nanofabrication should not be located over other spaces, but should be located on grade. All of these factors suggest a separation of the Nanofabrication from the other programmatic elements dividing the overall massing of the building into at least two separate forms.

Views and Environmental Factors

The site offers favorable views to all directions: to the west are the city and the mountains beyond; to the south and north are green recreation fields and the mountains beyond and to the east are mountain views. A building with a long north / south massing would take advantage of the desirable city views to the west, but would create a long western elevation where the glass required for the view would face the western sun and the heat gain and glare that comes with it. Conversely, a form with a long east / west orientation offers compelling views to the north and south and the opportunity for daylight harvesting.

Service and Delivery

Another influence on the form of the NBTRB's is the requirement for service to the building. Deliveries made by truck to the building should make use of the Service Drive at the north of the Interdisciplinary Quad as defined by the Campus Master Plan. To accommodate service to this building and the future three buildings, a central expandable service court located in the space between the buildings has been proposed, and in order to maintain the open shared courtyard space between the buildings, it is proposed that this service court be located underground. This underground facility reduces the service's impact on the visible above-grade form and maintains the open interactive courtyard.

Summary

The Interdisciplinary Quad Site Master Plan requirements, along with the four building program with an equally shared unifying exterior courtyard, suggests the placement of the four buildings at the perimeter of the site leaving an internal open space. Likewise, the Guidelines for the site require the NBTRB's massing to be set to the site's south and east edge following the Guidelines' build-to lines. Consideration of the environmental issues and daylighting, along with the 75% build-to requirement along the southern site edge, suggests a form oriented in an east / west direction. This form would contain most of the facility's program. To encourage collaboration among researchers, this part of the building's massing is limited in height to three main floors plus a basement and mechanical penthouse. The building's overall massing is broken into two sections because of the desirability of an independent Nanofabrication Building. This form has been placed perpendicular to the Main Building mass and extends along Wasatch Drive. It should be at least 100 feet from Wasatch Drive to avoid EMI emissions associated with moving traffic from effecting instruments inside the building. This location also makes it possible to provide service deliveries to it from the service road at the site's northern edge while the L shape produced from its relationship to the Main Building's mass opens up a space for the shared courtyard. This massing configuration is illustrated in approved Scheme 5 shown in **Section 2.1 Page 9.**

3.1.2 External Relationships/Circulation

The NBTRB Building will be located around a Quad with three other buildings as described in the **Section 3.1.1**. The NBRTB Building will have relationships with the Quad, surrounding buildings, Pedestrian Corridor, and Service Road. These external relationships create the need for a building with no back, which leads to the desire for service to go underground.

People will be coming across the site from all directions. This creates an opportunity to bring people into and through the building from multiple directions. These external relationships will help determine the location of the public spaces in the building. The design could take advantage of the opportunity to create outdoor spaces for events or possibly café seating. It will be important to link these external spaces together in the building design.

The external relationships will change over time. It will be important to look at the relationships in the short term with only building one constructed on the site and the long term with possibly three other buildings and a developed Master Plan.

3.1.3 Internal Relationships

The internal spaces can be broken out into four major categories including public space, PI space, core facilities, and service. Please refer to the adjacency diagrams in **Section 4.3 Adjacencies and Relationships** for diagrams of these relationships.

The main public interior spaces include the Auditorium, Lobby, Café, Front Offices, and possible circulation pieces. The Auditorium serves multiple functions. It serves as a large classroom or lecture space but should also be thought of as a place that could hold symposiums. Symposiums often have the need for smaller groups to break off. The building relationships could allow for spill out small group meetings if the Conference Rooms that are already planned for the building are arranged with easy access from the Auditorium. Some of these spaces could be on the same level but the smaller Conference Rooms on the lab floors could be connected vertically to allow for a relationship between conference spaces for flexibility. Two smaller Conference Rooms could be adjacent to allow for a large room or two small rooms depending on the needs. The Auditorium will bring the public to the building for events and should be located off the Main Lobby. The Café could be an informal way to attract the public to the building. The Café could have a strong relationship to the Main Lobby and be used for events at the Auditorium. The Café is for the daily use of all the users in this building. It can help create interaction among the researchers if it is easily accessible by all. The Front Offices should be close to the public entrance to provide information and an identity. All of these public spaces could be grouped together, but the site and other factors may lead the design to separate them to provide multiple public interfaces with a link between them.

There is a strong relationship between the public spaces and the PI space. The PI space consists of office and lab space. The PI office space should be accessible by the public, the lab space needs to be secured, and their needs to be a strong relationship between the PI office and lab. One concept for this relationship discussed in programming would allow for the PI office to have two faces. One side of the office could be accessible from the main circulation and the other side could open up into the lab space. There is a desire for PI offices to be located with some physical adjacency to the lab. There is also an advantage to grouping the PI offices together to help with the communication and sharing of knowledge among PI's. The design should be challenged to form a creative solution to meet these needs. The sociology within the PI space should be carefully studied. There is a desire to create coziness with in this space. There is a concern that too large of an open lab could create a factory feel that creates a certain mentality. The relationships between the PI spaces will be important in creating the appropriate working environment.

The core facilities are the most secure spaces in the building and have the least need for a physical connection to the public space (with the exception of the Nano Touring Corridor). The core facilities consist of Small Animal Imaging, Vivarium, Microscopy, and Nanofabrication. The Nanofabrication Facility does have the need for the touring corridor to have a relationship with the Lobby or public circulation to allow people to walk into the touring corridor and view into the Nanofabrication Facility. The Nano-

fabrication Facility is likely to be a separate piece to meet the technical requirements, but it must have a strong interior link in order to feel like one building. There should be a relationship between Nanofabrication and Microscopy. This could be a vertical relationship and could be the public circulation. There is not a requirement for a secure circulation path between the two core facilities. The Vivarium and Imaging have a strong physical relationship. These cores should be designed together. The Imaging Facility will use both animals from the Vivarium in this building and animals from other buildings. These animals must be kept separately, and there are holding and procedure rooms for both in the program. There must be some physical connection to take the animals directly from the Vivarium to Imaging. The design may work best with Vivarium holding around the Imaging Facility. Flow studies will be needed to study the design. There will be a link from the Loading Dock to both Imaging and the Vivarium. The distance between specific tools within the cores will need to be studied in design to confirm specific instrument vibration requirements, especially between Microscopy and Imaging.

There will need to be a service elevator to all floors in the building. The core facilities have the strongest need for an adjacency to the main Loading Dock. The Nanofabrication should have a separate service area.

Chemical and Specialty Gas Storage Rooms and the Cleanroom
Since hand carried chemicals and gases must be moved from the chemical storage rooms to the Cleanroom via a dedicated HPM Corridor (see **Section 3.1.4 Circulation, External and Internal**) it is desirable to locate these storage rooms as close as practical to the Cleanroom (adjacent to each other if possible). It is recommended that these rooms be divided into a Hazardous Gas Room and a Solid and Liquid Chemical Storage Room. It is likely that the former will be classified as an H2 occupancy, and the latter an H3 occupancy. These occupancies have restrictions that typically require them to be located on the exterior perimeter of the building. Ideally, these rooms are located directly adjacent to the Loading Dock in order to minimize the degree to which these materials need to be handled, reducing the risk of accidents.

3.1.4 Circulation, External and Internal

There is a desire to have a primary internal circulation piece, possibly an atrium, to provide a vertical connection between lab floors. There will likely be multiple entries at multiple levels on this site. The internal circulation can provide organization and allow clear way finding. Security will play a role in determining the circulation to create security points as required (refer to **Sections 3.1.6 Building Security** and **4.3 Adjacencies and Relationships**).

The public entry will have a security desk in the Lobby to observe and provide information as needed. The public spaces should be located with easy circulation from the Lobby. Please refer to **Section 3.1.3** for additional information on these relationships. The PI offices should be easy to find and off the primary circulation path. There should be a secondary circulation organization within in the secured labs.

The core facilities can be connected to the main vertical circulation but the corridors within the cores should be secured to meet security requirements with the exception of the Nanofabrication Touring Corridor. The circulation from the Loading Dock will be especially important in the core facilities. The circulation path from the Loading Dock to the cores will need to plan for future installation of large equipment such as microscopes or a 3T magnet.

Two types of vertical circulation are planned. Public elevators should have close proximity to the Lobby and primary circulation. There should also be a service elevator to all floors to move equipment and other items throughout the building.

Cleanroom Process Tool Move-In

The characterization and Cleanroom process equipment can be large, heavy and delicate. In addition, many of these tools are likely to be removed and replaced with newer systems on a fairly regular bases. Therefore, a clear tool move in / out path will be maintained from the Loading Dock all the way to the characterization and Cleanroom entry points. This tool move-in path will be 8 feet wide by 9 feet high. These dimensions provide enough space for all of the rigging equipment required and will allow the longer tools to be moved around corners. Ideally, the length of this path should be minimized and its straightness should be maximized.

Chemical and Specialty Gas Move-In

Due to the relatively large amount of chemicals that will be used in the Cleanroom, it will be classified as an H5 (hazardous) occupancy by the International Building Code (IBC). This code classifies any hazardous materials for use in the H5 occupancy as Hazardous Production Materials, or HPMs, if their NFPA Health, Flammability, or Reactivity hazard rating exceeds 2. This code also requires that the transportation path of HPM's from the outside of the building to the chemical storage rooms to the H5 Cleanroom be direct or via a dedicated HPM Service Corridor (also classified as part of the H5 occupancy). These corridors are not allowed to be used as a required means of egress. This requirement will have a significant effect on space organization and circulation near the Cleanroom, storage rooms and Loading Dock.

Liquid Nitrogen Fill Port Circulation

Liquid Nitrogen dewars will regularly need to be filled from the fill port attached to the Liquid Nitrogen tank in the Service Yard. Some of these dewars will be small and hand-carried, such as those for the HR TEM, but others will be larger vessels that need to be pushed on casters. The flooring from the laboratories and characterization suite should therefore be level to the tank. Winter snows should be considered in the Design phase in order to design an accesible path to service the tanks. The level and imact of weather must be studied.

3.1.5 Personnel Interaction

Researchers with different interests will be recruited by USTAR into this building. The core facilities in the building support Animal Research, Microscopy, Imaging, and Nanofabrication. The public spaces within the building should create spaces for interaction between these researchers. This could occur over a cup of coffee in the Café, at an event in the Auditorium, passing by in the stair, in a group of offices, or in the lab next door. There is not a desire to group all of one type of researcher together but instead to allow for a mixing within the building.

The Café is key element to allowing a place for interaction. Many of the spaces in this building will not allow food so people will need a place to go to eat. There is a great potential for the space to possibly spill outdoors to the Quad or Interdisciplinary Corridor to also attract someone passing by. The Auditorium also has this potential. This will allow possible interaction with people who do not work in the building. These people will be allowed to go into the building with the exception of some spaces. There is an opportunity to allow displays in the Lobby to display the science that is not available for everyone to see otherwise (ex. Microscopy). There are also informal meeting areas programmed into the building to create spaces to stop in the hall and have a conversation.

3.1.6 Building Security

The security design for the NBTRB is based on the basic security requirements of the University along with the specialized requirements of this facility. The security systems will include both passive and active measures that provide the least obtrusive methods that deliver the appropriate levels of controlled access. The security will start with the site design and site access, particularly the loading docks and service entries. Site lighting levels surrounding the facility will be design to University standards and will include all service access points, pedestrian paths and all entry points to the facility.

Active systems will include card access devices that comply with the University standards and use a card system that is compatible with other University access control devices; security cameras and digital recording devices. It is anticipated that main public entries will be controlled by a manned visitors station during business hours, and card access controlled otherwise. All other entries will be card access controlled 24 hours a day.

The interior of the facility will have additional security controls at specific locations. The Vivarium, Nanotechnology, Microscopy, and Imaging Core areas will each have card access control devices that restrict access to only those authorized. Security cameras will also be located at the loading docks, access points to the core areas and other secure areas that may be defined during the Design phase of the project. Access control to laboratories will be considered during the Design phase of the project. Individual offices, conference rooms and other areas requiring locked access will be provided with lockset hardware that complies with University standards. A complete hardware schedule will be provided during the Design phase that will document the requirements for each door.

A security office will be provided that will house and maintain the digital recorders and other security systems for the facility. The security equipment specifications and detailed performance criteria will be developed during the Design phase of the project. Security monitors will be placed in the security office and / or will be sent to UPD dispatch. This requirement shall be coordinated with the University Card Office.

3.1.7 Codes, Regulations, and Safety

Design and construction codes and standards are listed below.

The codes and standards listed are minimum requirements. In the case of laboratory related academic buildings, the recommendations of the guidelines below and the standards and requirements suggested by the Design Team, will often address issues not sufficiently covered in the building codes.

Applicable Codes
In all cases the most recent editions of referenced standards apply. Applicable State of Utah amendments to the following referenced standards and guidelines shall apply per Rule R156-56 Utah Uniform Building Standard Act Rules.

Referenced standards and guidelines:

- International Building Code (IBC) 2006
- International Plumbing Code (IPC) 2006
- International Mechanical Code (IMC) 2006
- National Electrical Code (NEC) 2005
- International Fire Code (IFC) 2006
- International Energy Conservation Code 2006
- Life Safety Code (NFPA 30, 40, 45, 68 and 101 as applicable)
- Laws, Rules, and Regulations of the Utah State Fire Marshal
- Planning and Design Criteria to Prevent Architectural Barriers for Aged and Physically Handicapped (Fourth Revision, with lever hardware amendment)
- ADA Accessibility Guidelines 2004
- Division of Facilities Construction and Management (DFCM) Design Requirements
- Division of Facilities Construction and Management (DFCM) Design Requirements Section 5 High Performance Building Rating System
- Division of Facilities Construction and Management (DFCM) Design Criteria for Architects and Engineers
- University of Utah Campus Design Standards
- ICC/ANSI A117.1 2003 American National Standard – Accessible and Usable Buildings and Facilities
- American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE)
- Sheet Metal and Air Conditioning Contractor National Association (SMACNA)
- Underwriters Laboratories (UL)
- American Society of Testing Materials (ASTM)
- University of Utah East Campus Chilled Water and High Temp. Water Plant, Design Manual - Aug. 2000

The above list is presented only to highlight currently applicable code issues and is not a complete list of applicable codes.

In addition the Design Team will be required to coordinate their efforts directly with Campus Design and Construction (CDC).

APPLICABLE CODE COMMENTARY

Occupancy Classification

The laboratory occupancy group will be dependant upon the chemical and hazardous materials inventory for each individual laboratory and fire areas of the building as outlined in the IBC. The State Building Official, University of Utah Building Official, along with the State Fire Marshal, will determine the occupancy classification. Discussions with these jurisdictional entities during the design phases will be corrdinated by the design team.

Fire Separation

Laboratory separation will follow code requirements. One hour fire resistive occupancy separation may need to occur based on the occupancy group of the laboratories.

Exits

Laboratories classified as a Group B occupancy will require 2 exits when the area exceeds 5,000 gross square feet. In this type of laboratory, a maximum travel distance from any point in the laboratory for access to 2 separate exits is 100 feet where the building is fully fire sprinklered.

ADA Accessibility

The building and site will be designed to be in compliance with the Americans with Disabilities Act, Title III, 1991 (ADA) and the 2003 ICC / ANSI A117.1 and the IBC. The Utah State Building Board is adopting the following additional requirements which are a part of this program:

- All public entries to the building will be ADA compliant with automatic door operators including required vestibule doors.
- One set of accessible restroom doors shall be equipped with automatic door operators including vestibule doors if applicable.
- ADA compliant parking shall be addressed.

In accordance with the IBC and ADAAG, employee work areas shall be designed and constructed so that individuals with disabilities can approach, enter and exit the work area. These work areas must also be located on an accessible route and comply with other IBC requirements found in Chapter 11. ADAAG will have other similar requirements.

NFPA 101: Life Safety Code

NFPA 101: Life Safety Code is not applicable to this project.

Corridor Width

The minimum width of any corridor or passageway serving as a required exit, exit access, or exit discharge shall be 44 inches per NFPA 101 Chapter 38 New Business Occupancies paragraph 38.2.3.2 Capacity of Means of Egress.

NFPA 45
NFPA 45 is applicable only at referenced in the IBC, IFC, and ICC.

Access to Exits
A second means of access to an exit shall be provided from a laboratory work area if any of the following situations exist:

- A laboratory work area contains an explosion hazard so located that an incident would block escape from or access to the laboratory work area.
- A fume hood in a laboratory work area is located adjacent to the primary means of exit access.
- A compressed gas cylinder in use which is larger than lecture bottle size, and contains a gas which is flammable or has a hazard rating of 3 or 4 and would prevent safe egress in the event of accidental release of the cylinder contents.
- The required exit doors of all laboratory work areas within Class A or Class B laboratory units shall swing in the direction of exit travel.

Furniture and Equipment
Furniture and equipment in laboratory work areas shall be arranged so that the means of access to an exit may be reached easily from any point.

Hazardous Materials
The quantities of hazardous materials shall not exceed IBC Tables 307.7(1) and 307.7(2). The Building Official is the jurisdictional entitiy who will engage the Fire Marshal for code compliance items.

Explosion Hazard
Explosion hazard is considered to exist if reactivity rating 4 materials are stored or used, or if highly exothermic reactions or procedures without established properties are planned, or if high pressure reactions are planned. The existence of an explosion hazard must be confirmed by the design architects with the University Fire Marshal who will then coordinate discussions with the State Fire Marshal during the Schematic Design phase.

Hazardous Gas Room Chemical Limitations
Hazardous gases will be located in a hazardous Gas Room (IBC 415.2), where they will be piped to equipment located in the cleanroom. These gases should be delivered straight from the loading dock to the Hazardous Gas Room. This room will be classified as an H2 Occupancy by the IBC and has special design requirements. Nanotechnology facilities rarely, and possibly never, exceed the limits of gas allowed in this room, but special barrier construction is required beyond certain limits for certain gas types.

Solid and Liquid Chemical Storage Room Limitations
Solid and liquid hazardous materials will be stored centrally in this room, or locally within individual laboratories. If these materials are also classified as HPM's, they must be delivered straight from the loading dock to this room and straight from this room to the cleanroom through an HPM Service Corridor. This room will be classified as an H2 or

H3 Occupancy (to be determined in future design stages) by the IBC, and has special design requirements. Nanotechnology facilities rarely, and possibly never, exceed the chemical limits allowed in this room.

Cleanroom (Semiconductor Fabrication Facility) Hazardous Materials Limitations
This area will be classified as an H5 Occupancy by the IBC and has special design requirements. Hazardous gases used by equipment in the cleanroom will be piped from cylinders in the Hazardous Gas room or from outside the building (as in the case of Silane). If the chemicals used in this area are also classified as HPM's (meaning that their NFPA Health, Flammability, or Reactivity rating exceeds 2), they must be delivered straight from the loading dock to this occupancy, or straight from the Solid and Liquid Chemical Storage Room to this occupancy. In either case, the materials must be transported through an HPM Service Corridor. The IBC limits STORAGE within this occupancy to the same limits as shown below for a single control area. The IBC limits USE within this occupancy by the values contained in IBC Table 415.8.2.1.1. Chemical amounts beyond these limits must be stored in the Solid and Liquid Chemical Storage Room.

Hazardous Materials Limitations Outside Hazardous Occupancies
Hazardous materials are permitted outside of hazardous occupancies but only up to certain quantity limits. The remainder of the building that is not considered a hazardous occupancy can be divided into Control Areas by fire-rated construction. Each control area is allowed the limits set forth in the following table; however, the number, fire-rating, and quantity limits are discounted based on their elevation within the building, as shown below.

Level	% of Limits	Control Areas	Fire Rating of Perimeter
>9	5%	1	2-hrs
7-9	5%	2	2-hrs
6	12.5%	2	2-hrs
5	12.5%	2	2-hrs
4	12.5%	2	2-hrs
3	50%	2	1-hr
2	75%	3	1-hr
1	100%	4	1-hr
Below Grade Plane 1	75%	3	1-hr
Below Grade Plane 2	50%	2	1-hr
Lower Than 2	Not Allowed	Not Allowed	Not Allowed

The amounts of hazardous materials in the above Control Areas shall be in conformance with IBC 2006 Section 307 requirements including the following IBC 2006 Tables:

Table 3007.1(1), Maximum allowable quantity per control area of hazardous materials posing a physical hazard.

Table 3007.1(2), Maximum allowable quantity per control area of hazardous materials posing a health hazard. *Note: Piped Natural Gas is considered a hazardous material and may be only used by appliances that are UL or FM labeled.*

Safety Equipment / Features

All labs requiring the use of hazardous chemicals shall have chemical fume hoods for the users per the room data sheets. The codes also require emergency eyewashes and safety showers to be located in all rooms having hazardous chemical use. The eyewash and shower should be located together so they can be used simultaneously, and must meet accessibility requirements. Consideration should be given to locate a floor drain adjacent to each eyewash / safety shower. In addition, a separate hand-held eye wash that can be used by someone who may be prostrate should be considered. University of Utah Campus Design Standards also requires emergency eyewashes to have water tempered at 70 degrees. The Design Team shall work with the University Building Official and Fire Marshal concerning the requirements for fire extinguishers and fire blankets.

Each lab using hazardous materials should have chemical spill control stations meeting the University of Utah Campus requirements. The University Environmental Health and Safety Department should also be consulted on requirements for first aid cabinets, protective clothing for chemical spills, and emergency response information.

Vision panels will be included in most doors (enabling dangerous occurrences to be detected from outside the laboratory). Chemical storage rooms are required to keep the storage of hazardous chemicals within the labs to a minimum.

3.1.8 Testing and Inspections

The following information defines the normal construction observation duties which The State of Utah, DFCM requires as a part of an Architect / Engineer Agreement, where they apply; and the normal testing requirements of a Testing Agency which is provided by a separate agreement between DFCM and the Testing Agency. These provisions are not limited to the following, but shall be augmented by possible additional requirements imposed by the Uniform Building Code as referenced below.

Observations and Testing
Inspection and Special Inspection requirements shall be in accordance with the IBC, IFC, IMC, IPC, and NEC. These requirements are clearly defined in these codes and therefore will not be duplicated in this program. More specifically required Inspections are defined in IBC Section 109 and Special Inspections are defined in IBC Section 1704.

A / E Responsibilities
A / E shall make periodic observations in accordance with the Agreement with DFCM and in compliance with the above referenced codes. The A / E shall also provide a Statement of Special Inspections per IBC, Chapter 17, (IBC 1704.1).

Independent testing agencies shall be recommended by the A / E and approved by the Owner. The testing agency shall provide certification to the A / E and Owner for all technicians to cover the type of work to be performed. Where the project requires some special inspection services, the A / E shall recommend the individual and / or testing agency to perform the duties listed in these criteria. Special inspectors and testing laboratories shall be under the direction of the A / E, but approval of the extent and cost for their work shall remain with the Owner.

Contractor Responsibilities
The contractor shall call for Inspections and Special Inspections in as required to be in compliance with the above referenced codes.

Owner Responsibilities
Costs for normal observation duties are a part of the A / E Agreement. Costs for special inspections and tests will be paid for directly by the Owner and are not to be included in the Construction Contract Sum.

Retest Responsibility
Where results of special inspection, tests or similar services do not indicate compliance of related work with the requirement of the contract documents, then retests are the responsibility of the Contractor, regardless of whether the original test was the Contractor's responsibility. All discrepancies shall be brought to the immediate attention of the Contractor. Provide a written report for all work observed.

Coordination
The Contractor and each independent testing agency engaged to perform observations, tests or similar services for the project shall be required to coordinate the

sequence of their activities so as to accommodate required services without delay in the progress of the work. In addition, the Contractor and each independent testing agency shall coordinate their work so as to eliminate the necessity of removing and replacing work to accommodate observations and tests. The Contractor is responsible for scheduling times for observations, tests, taking of samples, and similar activities.

3.2 SPACE PLANNING ISSUES

3.2.1 Expansion Issues

The NBTRB is scheduled to be the first of a series of new research facilities that will support the development of interdisciplinary programs at the University. As such, the "core" areas in this first facility should be expandable to support the additional facilities and their programs. These include the Vivarium, the Nanofabrication Suite, the Small Animal Imaging Core, the Microscopy Core, and their support areas. To make the best use of these cores, the expansions should allow for direct growth of each area while allowing the first phase to continue to operate. The description of each core includes a discussion on their specific expansion criteria. Key support functions, including the loading dock, should be located and sized with future expansions identified. Issues to be considered include adjoining footings and foundations, expansion joints, HVAC systems, site and building utilities, accessibility and building exiting requirements.

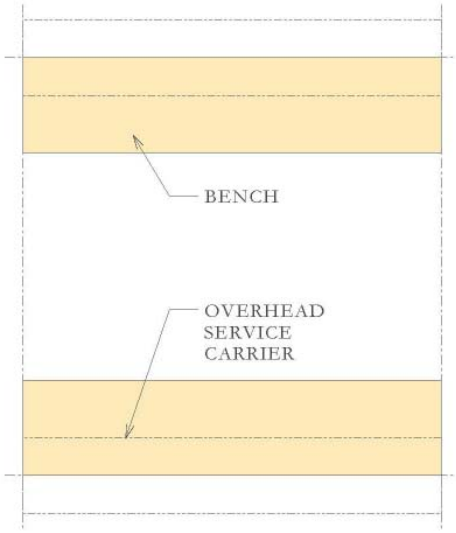
The planning for the expansion of each core must take into account the specific requirements of each in terms of positive and negative adjacencies, technical criteria, particularly vibration and shielding concerns; and the specific support areas for each. The technical requirements are best met with locations that allow for "slab-on-grade" construction to create the stable platform the sophisticated equipment housed in the cores require. The site planning for the NBTRB must take into account the expansion needs of the cores and allow for adequate space. See **Section 2.5.1 Interdisciplinary Site Master Plan Criteria** on site planning for additional criteria on expansion of the NBTRB.

3.2.2 Laboratory Planning Units

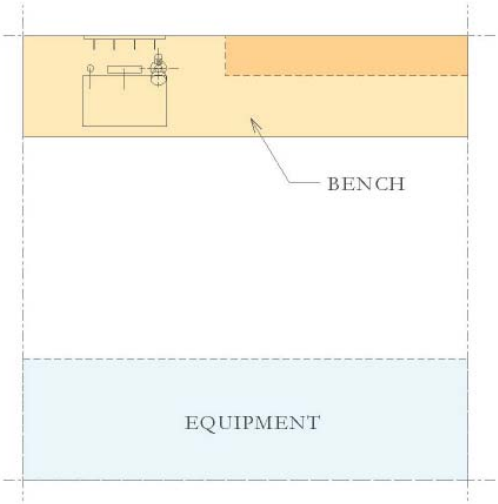
There are two major goals for the design of the "high-performance" work environments for the Neuroscience and Biomedical Technology Research Building (NBTRB). The first is to create work environments that not only support the scientific discovery process, but actually enhance the process. This is to be achieved by providing the appropriate amount of bench space, analytical space, general and specialized equipment space, and administrative space that meets the needs of the individual researchers. The second key driver is to provide work environments that can easily respond to rapidly changing research processes and research personnel. Tools, equipment, processes and people are constantly changing and the laboratories and technical work environments must allow for these changes to occur with minimal disruptions to ongoing activities.

In order to achieve these goals, the program of requirements and the design concepts are based on an 11' x 11' planning units that will be assembled into laboratory modules. These planning grids will allow for the different types of research activities to occur within a lab module based on the needs of the individual researcher. The planning units include a wet bench unit, a laboratory support unit, a dry bench / analytical unit, a special support unit, an equipment unit, and an administrative unit. The programming and planning concepts are based on the ability to assemble a given number of these planning units into laboratory modules which will then be assigned to various researchers based on their research processes and specialty needs.

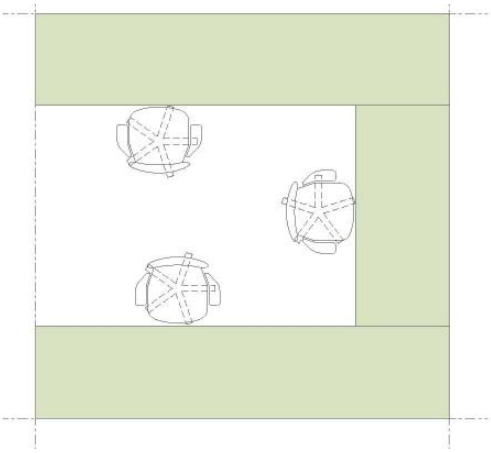
The **"wet bench"** unit, shown below, consists of 22 linear feet of laboratory benches with base and upper cabinets and parallel overhead utility carriers to support the distribution of laboratory utilities. These carriers will be independent of the benches to maximize the flexibility and to create a true "plug & play" environment. The laboratory utilities will include: electrical power, 110V, 208V and E power (8 Watts / SF); data connections; and 2 laboratory gasses. (To be determined). The base cabinets will be modular and movable allowing each researcher the ability to customize their own spaces from a library of available components. The HVAC requirements include: 100% outside air; temperature control between 68°and 78° F; humidity between 40% and 60% RH; the pressurization must be negative to surrounding spaces and each unit should provide for + / - 300 CFM of exhaust air.



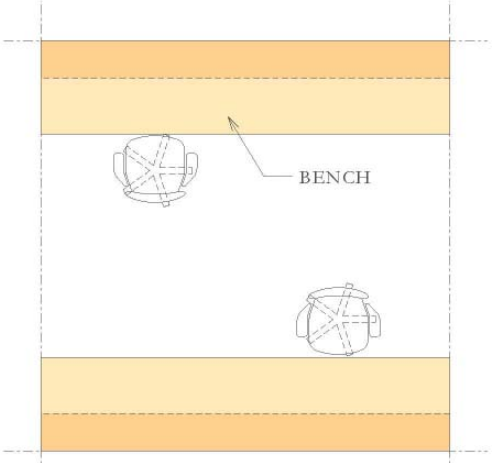
The **"laboratory support"** unit is designed to provide and separate sinks and other hard connected utilities from the other planning units to maximize flexibility and limit the locations of the required "hard-connections." This unit could also contain dishwashers or



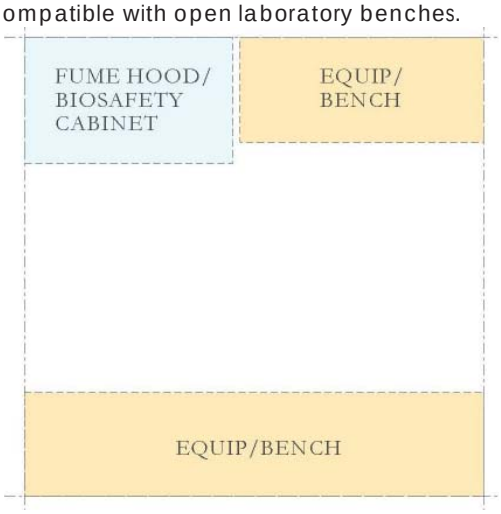
other equipment that needed a plumbing connection. This laboratory support unit would also include the parallel overhead utility carrier for utility distribution. In addition to the overhead utilities, this unit would include hot and cold potable water and laboratory grade water. This planning unit maybe designed to be adjacent to or directly part of other planning units, depending on the overall design of the buildings laboratories. Utilities to be provided include: 110V electrical power (4Watts/SF); hot and cold water; and laboratory grade water. The HVAC requirements include: 100% outside air; temperature control between 68°and 78° F; humidity between 40% and 60% RH; the pressurization must be negative to surrounding spaces and each unit should provide for + / - 300 CFM of exhaust air.



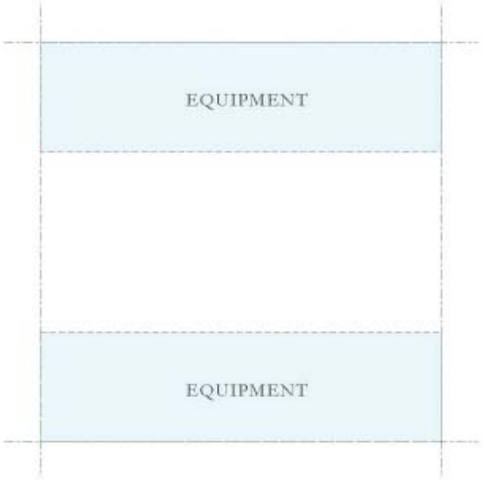
The **"dry bench / analytical"** unit is designed to provide 22 linear feet of dry work space that can be used for a wide variety of research activities that do not require wet services. The working height will be adjustable from 30" to 36" to support both sit down and stand up activities. This unit is planned to support data analysis equipment, primarily computer systems, that will receive data from a wide variety of sources, and will form the heart of the overall laboratory module. This unit is planned to also include the overhead utility carrier to support conversion to a "wet bench" unit depending on the needs of the individual researcher. The overhead utility carrier will include 110V, 208V, and E power (10Watts/SF), data outlets and two laboratory gasses to be determined. The HVAC requirements include: recirculated air; temperature control between 68° and 78° F; humidity between 40% and 60% RH; and the pressurization must be positive to surrounding spaces, but capable of becoming negative. The data requirements include multiple outlets IT systems capable of supporting high speed data transmission.



The **"special support"** unit is designed to provide space for special research functions requiring environments or equipment not compatible with open laboratory benches. This unit can accommodate fume hoods, biological safety cabinets (BSC), incubators, microscopes, and other equipment and is used to support laboratory processes and equipment not used in the wet or dry bench units. This unit may be a completely enclosed space or may be open to other laboratory planning units. They include individual HVAC controls to support the needs of the environment and / or the equipment. The utilities to this unit include: 110V, 208V, 208V, 3PH, and E power (20 Watts/SF). The HVAC requirements include: 100% outside air; temperature control between 68° and 78° F; humidity between 40% and 60% RH; the pressurization must be capable of being either positive or negative to surrounding spaces, depending on the utilization of the space, and each unit should provide for + / - 1500 CFM of exhaust air.

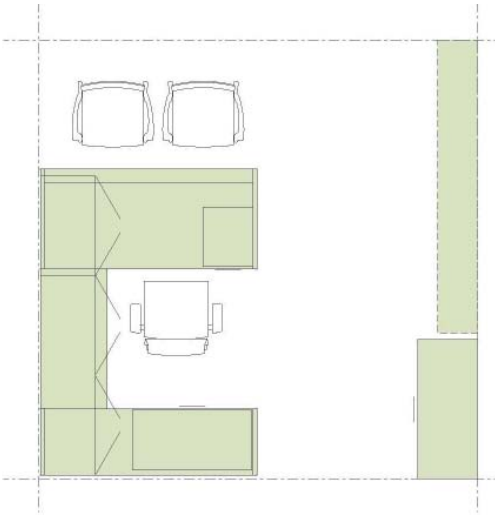


The **"equipment"** unit is space to house larger, typically floor mounted equipment, such as refrigerators, freezers, centrifuges, and other equipment not directly housed in the other laboratory units. The equipment load should be designed for 40 W/SF with its accompanying heat load. Electrical services should include 110 V; 208 V, 208V 3Ph. and E power (50 Watts/SF); along with IT connections for on and off site monitoring of special equipment. The HVAC requirements include: space should be under negative pressure to surrounding areas; temperature below 78°; humidity between 40% and 60% and the space must be acoustically isolated from adjacent occupied spaces.



The architectural finishes for these laboratory planning units should be similar and provide for easy and regular cleaning. Surfaces should be seamless and moisture resistant and be able to withstand regular rolling cart traffic. Example finishes would include: welded seamless flooring; epoxy paint on high-density GWB walls; and vinyl coated lay-in acoustical tile ceilings. GWB ceilings will be required in clean environments, such as for tissue culture processing areas.

The **"administrative"** unit provides an office environment for each Principal Investigator (PI). It will be equipped as a standard office with components selected from a library of options to allow each space to be unique. The location of these administrative units will be determined during the early Design phase of the project and could be grouped in administrative pods or collocated adjacent to the laboratory units. The HVAC requirements include: recirculated air; temperature between 68° and 78°; humidity between 20% and 60%. Typical electrical and data outlets will be provided.



3.2.3 Space Type Narrative

PI Assigned Space
The PI Assigned Space includes office and laboratory space. Office space is included for Principle Investigators, Faculty, and additional workstations. Lab and lab support space is included.

Vivarium
The Vivarium is one of the core facilities. This space includes holding rooms, procedure rooms, surgery suite, cagewash facilities, support areas, and office space.

Small Animal Imaging
Small Animal Imaging is one of the core facilities. This space includes MRI Suites, Imaging Laboratories, Support Laboratories, office space, and shell space.

Microscopy
Microscopy is one of the core facilities. This space includes Instrument Labs, Support Labs, and office space for Biomedical and Engineering Microscopy.

Nanofabrication
Nanofabrication is one of the core facilities. This space includes the Cleanroom, Cleanroom Support, Research / Teaching Labs, office, and support spaces.

Public / Building Support
The Public / Building Support includes the public areas, meeting spaces, administrative offices, and building support areas. Some of these include the Lobby, Auditorium, Café, seminar rooms, offices, Information Technology, Loading Dock, Mechanical Room, and storage.

3.3 BUILDING DESIGN CRITERIA

3.3.1 Architectural

At the beginning of this programming process several meetings were held to discuss the goals and criteria to guide the architectural programming and design of this project. The list has been refined and approved by the Senior Vice Presidents having jurisdiction. The following is a discussion of these goals and criteria presented in an unprioritized order.

Budget

The completed NBTRB building shall provide the programmed facilities to accommodate 24 Principal Investigators. The project program must be completed within the established project budget of $130 million. All hard construction costs are budgeted to be approximately $100 million and all soft non-construction costs are budgeted to be approximately $30 million for a total project budget of $130 million. The program estimates which establish the allocation of these funds can be reviewed in **Section 1.3.2 Capital Budget Estimate Summary** and in more detail in **Section 5.1 Capital Budget Estimate.** It is important to note that the above budget will include only the equipment as specifically noted in the estimate. Additional equipment will be funded by sources outside this budget. It is also important to note that some portion of the site development costs will be funded from sources outside this budget as noted in the Capital Budget Estimate.

Architectural Character

The exterior and interior visual character of this building shall provide a highly attractive architectural statement to provide a great working research environment which will also promote faculty recruitment and donor participation. This high design environment shall reflect the progressive and cutting edge nature of the research being conducted. The design of the facility, building, and site shall provide a highly pleasing environment which shall utilize light, natural and artificial, to enhance the day and night time experience of people with this facility. Transparency of exterior and interior walls shall be considered to maximize appropriate visual connectivity promoting interaction. Views from outside to inside, inside to outside, and between interior spaces shall be provided in so far as consistent with space functions. The building shall be pleasant to look from. Views from the building shall be used to keep the building's occupants in contact with the natural environment. The building shall be pleasant to look at. Views to the building over adjacent green open space shall enhance the public image of this USTAR funded project. Views to and through the site shall fulfill the goals of the Interdisciplinary Site Master Plan. The organization of the building shall be clear to promote the individual's perception of where he is in the time and space and to provide easy way finding. To further this concept, the design should seek to incorporate a central atrium element around which the building is organized which orients the building's circulation ways to the Interdisciplinary Quadrangle and Pedestrian Corridor. Complicated space arrangements which disorient people shall be avoided. A sense of order shall be engendered through well organized plans and details. Interior materials shall be chosen with sufficient color, texture, and human scale to create an attractive, inviting environment while requiring minimum maintenance.

Architectural Character shall be influenced by the Interdisciplinary Master Planning effort that will be completed before design begins.

Sustainability

The building systems design / performance shall be measured against the State of Utah, High Performance Building Rating System with a goal of obtaining a minimum of 20 Sustainability Credits under this system. The building systems design / performance designs shall also be measured utilizing the U. S. Green Building Council, Leadership in Energy & Environmental Design (LEED) criteria with a goal to attain a LEED Gold Certification. Consistent with the above directions, sustainable strategies shall be implemented in the design, construction, and operation of this building. It is important to note that attaining this goal will be assisted by attaining LEED points for the new Campus Cogeneration Plant. See **Section 3.3.16 Sustainability / LEED Certification** for a more detailed discussion of this topic.

Site

The site for this building shall be as illustrated in the Interdisciplinary Site Master Plan and consistent with the approved Scheme #5, all as discussed in **Section 2.5.1 Interdisciplinary Site Master Plan Criteria.** The site and building shall be served by an infrastructure of existing, new, and relocated utilities meeting the requirements of University of Utah Campus Standards all as outlined in **Section 2.4 Site Utilities.**

Security

The building shall provide a hierarchy of security utilizing the Campus Standard Card Access System. After business hours the building shall be card access secure. During business hours the building shall welcome the public but contain them to the public areas of the building. The interface access points between public areas and non-public research areas shall be card access controlled. Access control beyond this interface shall also be card access controlled in response to the security needs of the various research activities conducted. Access to the Vivarium shall be controlled by the University's standard security systems for this type of facility.

FUNCTIONAL GOALS

One of the functional goals of the Neuroscience and Biomedical Technology Research Building is to promote efficient interactive scientific productivity. This goal will be achieved by designs which utilize the following strategies:

The building is a scientific instrument**.** The building will be one of the primary scientific instruments used by the occupants. The building along with its equipment and systems should promote efficient scientific productivity. Therefore, the design of this research building must be approached with the same attention to detail as required for a precise scientific instrument. Each building system must be designed to support the environmental requirements of the functions served. For example, the building must provide a platform sufficiently resistant to vibration to allow research activities to proceed without degradation of the procedure. See **Section 3.3.2 Structural** for a

discussion of this issue.

The building shall be designed for interaction. The facility design shall recognize the intrinsic and multi-disciplinary nature of research and the necessity of varied disciplines to interact effectively. Therefore all aspects of the building and site design shall accommodate and promote interactive, synergistic collaboration in formal and informal settings. The synergy promoted by this interaction is one of the key attributes of a productive research environment. Interaction shall be promoted on every level of organization in the building including intra-research and inter-research activities. This interaction shall also be encouraged on a formal and informal basis. The types and arrangements of spaces shall stimulate intellectual and social interaction between individual and groups of investigators.

The building shall be modular and adaptable**.** The laboratory design shall be modular and adaptable to accommodate the needs of the initial principal investigators, and easily adapted to the changing needs of research for the future. All building systems shall be designed with a modular concept so that the changing research activities will require a minimum of remodeling with a minimum impact of these changes on adjacent ongoing research. All systems shall be adaptable to accommodate change. The fixed elements of the building (columns, stairs, elevators, service shafts, ect.) shall be located so that these elements do not impose unreasonable limitations on adaptability. The building mechanical, plumbing, electrical, and communication systems including service chases shall have some initial excess capacity consistent with budget constraints to accommodate the future needs. The building's intrinsic nature shall not impose unreasonable limitations on the precision of present or future procedures.

The building's life cycle costs shall be minimized. The building's exterior finish and systems shall require a minimum amount of maintenance. The building's interior finishes shall be durable, easily maintained, and designed for the intended level of use and to withstand reasonable abuse. The building's architectural, structural, mechanical, plumbing, electrical, and communication systems shall economically accommodate the level and type of use programmed with consideration given to excess capacity to accommodate future load requirements.

Core Facilities. Core facilities in the NBTRB shall be a resource for the occupants of this building in addition to future adjacent research buildings, and the University campus in general. The design shall provide for future expansion of core facilities integrated with and contiguous to the first phase core programs.

Architectural Character. The Architectural Character of the building shall be influenced by the Interdisciplinary Masterplanning contract that will be completed before design begins.

Miscellaneous Requirements

Ceiling heights will vary with the size and function of the room. Typical ceiling heights in laboratories shall be a minimum of 9 feet high and adjusted as required for special function labs as indicated on the Room Data Sheets in **Section 4.0 Space Program** of

this program.

Access halls and corridors within the building shall be sized to meet code exit requirements and to provide access for the installation of equipment. Special access portals shall be provided to accommodate for mechanical equipment access for installation, maintenance and replacement and for special laboratory equipment.

Passenger and service elevators shall be provided in accordance with **Section 3.3.11 Vertical Transportation** and will serve all floors of the building. They shall comply with University of Utah Design Guide standards. Elevators shall be equipped with the building's card access system to control access to the animal housing stop as well as other possible secure areas.

Way finding shall be aided by the following graphic information systems provided in the project design and in conformance to University of Utah Design Guide standards.

- Exterior signs:
  ADA parking and building accessibility signs
  Building mounted identification signs

- Interior signs:
  Building directories at main entries
  Interior graphics system providing room identification signs
  ADA restroom signs
  Rated Wall identification
  Piped Utility identification

The building design shall provide a dumpster enclosure and recycling enclosure adjacent to the Loading Dock in compliance with University of Utah Design Guide standards.

The building design shall provide modular and typically located telecommunications rooms, custodial rooms, toilet rooms, mechanical service rooms/shafts, electrical rooms, etc., all in compliance with University of Utah Design Guide standards.

Office furnishings shall be modular system furnishings which optimize functionality and adaptability. Finishes including upholstery shall be selected to optimize durability, clean ability, and acoustical properties.

The program for this building shall provide shower and locker facilities for use of the building occupants. This amenity will accommodate bicycle riders, runners, etc., and by doing so will foster effective research by promoting the health of the participants.

Floor Finishes
Vinyl Composition Tile flooring with top set base is recommended for most of the research laboratory and laboratory support spaces. Spaces requiring special floor finishes for specific use applications will be identified during further development of the

building design. Troweled-on epoxy resin flooring with integral base shall be provided in all areas requiring decontamination with cleaning chemicals. Sealed concrete should be used in all areas where traffic, equipment, or cleanup functions would damage an applied surface. Ceramic tile shall be used in staff and public toilets. Carpeting and rubber base are recommended for most other dry non-laboratory spaces, including use in all office and conference areas.

Wall Finishes

In general, the walls will be gypsum drywall mounted on 20 gauge metal studs with semi-gloss, enamel painted finish. Interior, non-rated demising partitions will be provided between conference rooms, laboratories, and offices and extended to the underside of the structure in order to minimize sound transmission between neighboring spaces. Structural wall studs, backing plates, and lateral bracing sufficient to withstand heavy loads will be required to casework, upper cabinets or shelves, and equipment anchorage. Where concrete masonry unit (CMU) block or poured concrete walls occur in occupied spaces due to design requirements or constraints, they shall be furred with gypsum wallboard. Painted unit masonry can be used for corridors, shops and storage areas requiring durable surfaces and / or structural wall integrity, i.e. gas cylinder and chemical storage rooms.

Ceiling Finishes

Finished ceilings in laboratory areas generally will be a suspended acoustical tile ceiling system. Ceiling heights shall be adequate for direct / indirect lighting. Hard ceilings, open ceilings, or other ceiling systems and finishes that may be required in special rooms and laboratory areas will be further identified during the Design Development phase of the project.

Window Coverings

All exterior windows should be furnished with window blinds for solar glare and heat control. Blinds may be either vertical or horizontal type, with metal slats. Rooms requiring blackout capability will be equipped with pre-engineered blackout shades with a fiberglass-coated fabric shadecloth.

Doors and Hardware

Laboratory doors shall be of the width adequate to facilitate easy movement of equipment and carts, generally at least 42” wide and 84” high. At minimum, one door entering from the corridor in to each laboratory and laboratory support space should meet these criteria. Hollow metal doors should be used in all utility / mechanical areas. Solid core veneered doors should be used in all other areas. Fiberglass doors and frames shall be used in the Vivarium. Hollow core veneered doors are not acceptable. Hardware provided should be usable by persons with disabilities and should provide various key levels of access control as necessary, including both combination and key access locks or card reader access. Doors should be operable by a single effort and be provided with vision panels in accordance with all applicable Code requirements. Large vision panels should be sufficiently large to provide as a means of easy, quick safety inspection of the laboratory spaces. Doors at containment barriers shall be in compliance with applicable code requirements.

Occupancy

Hazardous materials quantities used in the Office / Research Building shall be in compliance with the International Building Code for a "B" Occupancy. Hazardous materials quantities used in the Nanotechnology Building shall be in compliance with the International Building Code for a "H3" Occupancy.

The determination of the building classification between "mixed occupancy, separated use" and "mixed occupancy, non-separated use" will be made during the design phase. Hazardous materials to be disposed of shall be treated in compliance with University of Utah Health and Safety Services protocols.

3.3.2 Structural

The structural design for this project should provide a building system which will integrate with the program requirements for space layout, as well as with the architectural and building service needs, while meeting current code standards for vertical and horizontal load carrying capacity. User needs in terms of current flexibility of the spaces and future adaptability of use should be considered. The level of user comfort and the ability to complete motion sensitive tasks as determined by the acoustic and vibration sensitivity of the structure should also be addressed.

Structural / Service Coordination

Layout of the structural grid will need to respect the planning modules established for the various building functions. During the Design phase, a completely integrated approach to building systems is recommended. Distribution of HVAC, plumbing and electrical services must be carefully coordinated with the structural elements, particularly at framing intersections and major crossover points. This close coordination must be achieved in order to avoid conflicts between building systems and limit penetrations of major structural members.

Codes and Standards

The building structure shall be designed in accordance with the 2006 International Building Code (IBC 2006).

Codes and standards that apply to the design of this building are:

- 2006 International Building Code
- American Institute of Steel Construction (AISC) with Commentary
- ACI 318 Building Code Requirements for Reinforced Concrete
- American Iron and Steel Institute (AISI) Specifications for the design of Cold-Formed Steel Structural Members
- American Welding Society (ANSI/AWS) D1.1 Structural Welding Code
- Steel Joist Institute (SJI) for open web Joists and Girders
- Steel Deck Institute (SDI) for Metal floor and Roof Decks

Geotechnical Criteria

Gordon Spilker Huber (GSH) Geotechnical Consultants have completed a preliminary project geotechnical report dated November 19, 2007 (attached - refer to **Appendix Section 6.2 Preliminary Soils Report**). Subsurface conditions disclosed by the test holes drilled by the Geotechnical Consultant consisted of 5.5 to 11.5 feet of silty clay with trace fine to coarse sand and fine gravel. Based upon visual and textural examination, it is the opinion of the geotechnical engineer that these soils will exhibit collapse characteristics. Beneath the surface silty clays and extending to the depths penetrated in Borings B-1 and B-2, and to a depth of approximately 14 feet in Boring B-3, silty fine to coarse sands with fine gravels; silty fine to coarse sand and fine and coarse gravel mixtures; clayey fine and coarse gravels with some sand; clayey fine to coarse sands and fine gravels; were encountered. These soils are medium dense to very dense and in many zones exhibit slight to moderate cementation. These soils will exhibit very high

strength and low compressibility characteristics and are not moisture sensitive. Groundwater was not encountered within the depths explored at the time of drilling.

The site is suitable for the proposed development provided the recommendations of the geotechnical report are properly complied with. Spread footings may be founded upon suitable natural dense granular soils or granular structural fill extending to suitable natural dense granular soils. Under no circumstances should the footings be established over potentially collapsible or highly compressible surface / near surface silty clays. The footings can be proportioned for a net allowable soil bearing pressure of up to 3,000 psf.

Seismicity

Currently no known potentially active mapped faults pass through the site. The nearest known potentially active faults of concern are unnamed segments of the Wasatch Fault Zone located about one-quarter miles to the northwest and east of the site. Evidence of a fault offset was not disclosed in the lithology of the test holes nor in the seismic trenching study.

The proposed building site falls within or near a Salt Lake County Surface Fault Rupture Special Study Area. For this reason, Gordon Spilker Huber Geotechnical (GSH) Geotechnical Consultants were asked to complete a fault investigation study for the parcel to assess the suitability of the site for the proposed development from the standpoint of surface fault rupture.

The findings of the GSH fault investigation study are “No evidence of active faulting was encountered in the exploration trenches.”

Once the final building size, configuration, structural system, number of levels above and below grade, and column loads have been decided, a final project geotechnical report shall be completed to verify that the assumptions in the preliminary geotechnical report conform with the final proposed design of the facility:

- Soil bearing capacity
- Structural fill requirements
- Potential differential settlements
- Potential for expansion / collapse of soils due to moisture changes (Not expected to impact site according to project geotechnical report)
- Liquefaction potential (Very low according to the project geotechnical report)
- Groundwater (Was not encountered according to the project geotechnical report)
- Seismic considerations, coefficients, fault traces, etc.
- Lateral bearing pressures – active and passive
- Alternate foundation systems
- Pavement sections

BASIS OF DESIGN

Loading Criteria

The structural systems in the facility shall be designed to meet the requirements of the 2006 International Building Code (IBC), Minimum Design Loads for Buildings ASCE 7-05 and the Design Requirements Manual adopted by the Utah State Building Board. Copies of the Design Requirements Manual can be obtained from the Division of Facilities Construction Management (DFCM). See **Section 3.1.7 Codes, Regulations, and Safety** for a list of applicable code requirements. The following minimum requirements should be anticipated:

- Wind Velocity: 90 mph, Exposure "B" or "C", for the building structure, as appropriate to the site. Exposure "C" shall be used for elements and components including the exterior window wall system.
- Seismicity: 2006 IBC and ASCE 7-05 Seismic requirements with a "Seismic Importance Factor" of I = 1.0 for a non-essential facility.
- Roof Load: 30 psf minimum plus snow drift where appropriate.
  Snow Load Importance Factor I = 1.0 in accordance with Table 7.4, ASCE 7-05.
- Rain on Snow: An additional 5 psf rain on snow surcharge shall be included in the roof framing structural design (does not need to be included in seismic calculations).
- Floor Design Live Loads: Floor design live loads shall be in accordance with the latest edition of the DFCM Design Criteria Manual and the University of Utah Design Guidelines and as follows:

  1. 80 psf, unreduced, except for column and footing designs
  2. 20 psf movable partition load
  3. Areas of concentrated standard file storage - 125 psf
  4. Floor areas supporting high density rolling files – 225 psf
  5. Paper storage areas – 250 to 350 psf as appropriate
  6. UPS Battery Storage areas – 250 to 450 psf as appropriate
  7. Mechanical Equipment Rooms – 125 psf, minimum, or more as required by the final design

Areas where heavy load concentrations exceed the normal loading requirements shall be designed for the specific load case.

The more stringent requirement between the 2006 IBC, the DFCM Design Criteria Manual, the University of Utah Design Manual, and the loads given above shall govern.

Structural System Selection Cost Comparison

The structural system chosen for the building shall be selected based upon the following criteria:

- A cost comparison of at least two structural systems shall be investigated. The comparison should be broken down in detail with each component of cost significance being listed separately.

- Various structural systems comparing building construction time, material avail ability, coordination of various trades, lead times for ordering materials, appearance, owner preference, maintenance costs, flexibility for future remodeling, and compatibility with surrounding buildings should be considered when choosing the final structural systems for the building.
- The structural system comparison shall include considerations of vibration performance of the finished structural system to provide the stringent vibration environment needed for the proposed research endeavors that are to be undertaken within the facility for the near and distant future.
- Damage to the building structure and its contents due to lateral earthquake and / or wind loads should be evaluated between various structural systems. Damage control to building non-structural systems is a pertinent and important consideration when selecting the building structural system.

A more rigid shear wall and / or braced frame lateral force resisting systems provide greater damage control to a buildings non-structural systems and contents than does a more flexible movement frame type lateral force resisting system. On the other hand, a moment frame lateral force resisting system provides almost unlimited programmatic and planning flexibility initially and during the life of the building.

Cast in place reinforced concrete shear wall lateral systems usually work most economically with a cast in place reinforced concrete structural floor framing system while diagonally braced steel lateral systems are usually most economical in conjunction with composite steel floor framing systems.

All cost comparisons between structural systems should include interface costs between other building components such as architectural finishes, exterior enclosure systems, mechanical systems, and electrical systems. Life cycle costing methods should be used where applicable.

Future Building Expansion

The A / E designers of the building shall not consider potential future vertical expansion because:

- Future vertical expansion is not anticipated because of the significant amount of mechanical equipment located above the rooftop but this topic must be discussed and decided upon by the programming team prior to writing the final program report.
- Future horizontal expansion of the Nano-Fabrication, Cleanroom, and Vivarium is anticipated.

Wind Design

Group B Occupancies are classified as “Standard Occupancy Structures” with a Wind Importance Factor, “Iw” of 1.00 to be used in wind design analysis according to Table 6.1, ASCE 7-05.

Earthquake Design

- The proposed structure shall be designed according to the requirements of the 2006 International Building Code and "Minimum Design Loads for Buildings" ASCE 7-05. According to the preliminary project geotechnical report, the closest distance to a known seismic source for this facility is about one-quarter mile to the northwest and east of the site.
- Group B Occupancies are classified as "Standard Occupancy Structures" with a Seismic Importance Factor I = 1.00 according to ASCE 7-05 Table 11.5.1 requirements.

Electromagnetic Interference

In order to mitigate EMI problems, it is recommended that fiberglass concrete reinforcing be used in concrete areas surrounding the most sensitive characterization spaces such as TEM's and SEM's.

3.3.3 Mechanical

Codes and Standards

The HVAC System shall comply with the following codes and design standards:

- University of Utah Design Standards - Latest edition including Capter 7
- DFCM Design Criteria B March 2006
- University of Utah East Campus Central / Chilled Water Plant, Design Manual B August 2000
- International Building Code - 2006 IBC
- International Mechanical Code - 2006 IMC
- International Plumbing Code - 2006 IPC
- International Fire Code - 2006 IFC
- Utah Energy Code, ASHRAE 90.1-1989

Design Criteria

	Summer	Winter
Design Temperatures, Dry bulb	97F	0F
Design Temperatures, Wet bulb	62F	-
Indoor Design Conditions:	74F	70F

Summer:	72F
Winter:	75F
Humidity:	Animal Areas 40% - 60%
	Lab Areas 40% - 60%
	Non Lab Spaces 20% - 60%
Laboratory:	100% Outside Air
Animal Area:	100% Outside Air
Occupancy:	24 hrs. / day, 7 days / wk.

Note: All design temperatures to be verified by University Campus Design and Construction

Internal Equipment Heat Gains

In addition to people and lighting loads, heat gains in all rooms should be based on anticipated equipment to be used in each room together with appropriate diversities. The following equipment heat gain rates for certain areas should be considered for preliminary load estimates:

Research Labs	30 Btuh / sf
Tissue Culture Labs	60 Btuh / sf
Glasswash / Sterilization	480 Btuh / sf
Equipment Spaces	130 Btuh / sf
Office Areas	10 Btuh / sf

Heating

The building shall be heated with heat from the Main Campus High Temperature Water Plant. High Temperature Water will be supplied at 390F and shall be returned at 250F. High Temperature Water shall be supplied to the primary side of the heat exchangers. The secondary (building side) of the heat exchangers will require building pumps for water distribution to the building mechanical systems. The maximum allowable pressure drop from the HTW mains, into the building and through the heat exchangers is 20 psig. The design of the HTW system shall conform to the University of Utah Design Standards. The piping shall be connected to the existing 10" mains designated as Z-4.

The building shall be designed for a variable flow secondary heating hot water system. Control valves shall be two-way with tight shut-off. Provide a glycol hot water heating system for preheat coils with appropriate heat exchanger and pumps.

Central Chilled Water Plant

A new Central Chilled Water Plant shall be constructed as part of this project. This plant shall be an independent building structure and shall house the equipment for the chilled water system. It is the intent of this plant to serve this project as well as existing and future buildings that do and will occupy land in the central zone of the campus. The plant shall be designed so that phasing will allow future additions to the plant as the need on the campus dictates. The initial size of the plant is estimated to be 3000 tons with the ultimate plant build out to a total of 9000 tons. The currently assigned location of the plant is shown on the site drawings in this program, to be confirmed by a future site master planning study. A separate Chilled Water Plant Study was commissioned by the University and a copy of this study is available from the University for review during the Design phases of the project.

Humidity and Sterilization

Steam for building humidity needs and sterilization will be generated with the main campus high temperature water. High temperature water will be supplied at 390 degrees F and shall be returned at 250 degrees F. A clean steam generator shall provide steam to the Nanotechnology Fabrication Area.

Air Conditioning

The building shall be air conditioned with chilled water from a Central Chilled Water Plant located within close proximity to the building. Water will be supplied at 42 degrees F and shall be returned to the system at 54 degrees F. A primary / secondary pumping system shall be utilized in the building and chilled water valves shall be two-way tight shut-off. See Campus Design Manual for piping instructions.

System Design

The Laboratory HVAC system will consist of supply air, general room exhaust, and fume hood exhaust systems. These systems will be managed and controlled by a sophisticated control system to maintain the following operation:

- Fume hood face velocity will be constant independent of sash height.
- Rooms will be maintained at negative pressure relative to the corridor or adjacent

spaces by varying room supply and exhaust air in conjunction with the fume hood exhaust system.

- Laminar flow type diffusers will be used to keep room supply air turbulence to a minimum around the fume hood.
- A hydronic heating coil will be used to reheat the supply air to maintain a specified room temperature and humidity settings.
- Further consideration should be given to adding motion sensors at the fume hoods to allow for decreased air flow when the hood is not in use or the room is unoccupied. The HVAC system should be designed to have sufficient capacity to facilitate future increases in the number of fume hoods.

Room supply and exhaust air will be controlled through linear or nonlinear air terminal devices utilizing either a volumetric or pressure differential room control device. The recommendation to use such a system will be dependent upon the results of the engineering analysis.

Laboratories - General

The design of the HVAC system for a laboratory should maintain a safe working environment for the users. All laboratory areas shall be served by 100% outside air systems.

- Rooms should be maintained at a negative pressure with respect to adjacent areas. (see ANSI / AIHA Z9.5 - latest edition) Positive pressure rooms will also be required and will be determined during design.
- Rooms should have a minimum of 12 air changes per hour.
- High air discharge velocities should be avoided (not more than 50 feet per minute in the immediate vicinity of the fume hood).
- Fume hood face velocity should be maintained at 100 fpm all sash positions. The system design shall be based on 100 feet per minute hood face velocity when the fume hood sash is opened to a height of 18 inches. Fume hood shall be equipped with a motion sensor which will reduce face velocity to 60 FPM when the hood around the area is occupied. Hoods shall meet ASHRAE 110 criteria and allow for low-flow fume hoods.

The original building design shall be for 30 fume hoods, but eventually there will be 100 fume hoods in the building. The mechanical supply, exhaust and duct systems shall be designed to accommodate the eventual 100 fume hoods.

The HVAC system should have features that enable control of the following:

- Supply and exhaust air volume
- Laboratory pressurization
- Hood face velocity
- Energy consumption
- Room Temperature

Laboratories will be provided with variable volume fume hoods. Room supply and exhaust air will be controlled through linear or nonlinear air terminal devices utilizing either

a volumetric or pressure differential room control device. The recommendation to use such a system will be dependent upon the results of the engineering analysis.

Vivarium

The design of the Vivarium shall incorporate a heating, cooling, ventilation and humidification system that will respond to the type and quantity of animals required for the building. Air change rates shall be a minimum of 15 ACH. The system will require 100% outside air and a complimentary exhaust system. Provide a level of control which will meet the demands of the animals used in the facility. The outside air and exhaust systems shall be fitted with an appropriate heat recovery system as noted under laboratory systems above.

Offices

Design criteria for the office space HVAC system is based on the following:

- Office areas may be served by 100%, fresh-air, central station VAV air handling units which may also service the laboratory and laboratory support areas on that floor if the office area is incidental to the area of building on that floor that is provided by the laboratory system. Otherwise:
- Office / lobby areas shall be served by recirculating VAV air handling units provided with outdoor air economizer controls.

General Exhaust

Each toilet will be exhausted to atmosphere via penthouse exhaust fans. Air will be supplied at a constant volume through the non-laboratory air system.

Electrical and Elevator Machine Rooms

Each room will be exhausted to atmosphere via a designated exhaust fan.

Special Exhaust Considerations

The selection of the fume hood and local exhaust type is critical to the design of the laboratory HVAC system. Vivarium animal housing rooms should provide adequate exhausting for individual self contained cage racks. The most up to date version of the University of Utah Design Standards, Chapter 7, shall be complied with in the design of the code and HVAC requirements for Fume Hood Exhaust Systems for Group B Occupancy Laboratories. This information shall be coordinated with the University Building Offic ial during the design phase.

The chemical exhaust ducting from the laboratories will be type either 304 or 316 stainless steel. The minimum recommended exhaust duct velocity will be 2000 feet per minute.

To achieve acceptable concentration levels and desired concentration rates, the exhaust system will combine and mix exhaust volumes from multiple uses in a commonly ducted (or manifolded) exhaust system. Exhaust concentrations of noxious or hazardous substances would be diluted both within ducts and at roof top plenums prior to exhausting to the atmosphere.

Manifolding of laboratory exhaust ducting will be permitted if ducts do not penetrate rated walls.

Laboratory exhaust fans will be roof-top mounted or housed with in the penthouse and will be resistant to corrosion from the air stream vapors.

The exhaust to atmosphere is an important design consideration. Code requires a minimum discharge height of 10 feet above the highest roof level. The discharge velocity should be a minimum of 4000 feet per minute. At a minimum, the fresh air intake should be 60 feet horizontally and 20 feet vertically from the exhaust stack position. Space should be provided in each exhaust system for the future installation of scrubbers and filters at the point of contamination. Exhaust fan sizes should take into account the added static pressure these added filtration systems would entail.

Consideration should be given to providing additional shaft space for the future accommodation of separate ducting for special fume hood exhausts, such as those from perchloric acid and high-energy radioisotope hoods, that cannot be combined on a commonly manifolded system.

Vivarium animal housing rooms shall accomodate high density rodent housing rack systems.

Controls

Provide individual room temperature controls. Laboratory controls shall include volume and pressure control for each space to assure that a negative pressure relationship will exist between each laboratory and the surrounding non-laboratory spaces.

The control system will be a direct digital control (DDC) system with electric driven actuators and shall be Staefa or Metasys. The direct digital control system shall monitor, control and adjust the building controls from an in building location. The following items of equipment will be monitored and / or controlled:

- All central HVAC equipment including air handling units, heat exchangers , pumps, variable speed drives and exhaust fans.
- All decentralized HVAC equipment such as variable air volume units, reheat coils, thermostats, meters, air and water temperature sensors, system pressure sensors.

The control system shall be connected to the campus Metasys network or to the campus telecommunications Ethernet network.

Energy Conservation

As laboratory buildings necessitate the use of 100% outside air for air conditioning purposes, and the resulting energy requirements are high, in order to conserve energy the following design and control methods will be evaluated for incorporation into the building:

- Window blinds, heat absorbing or reflective glazing, external shading devices and

heavyweight structure.
- Energy efficient motors should be used for all items of equipment.
- Variable air volume systems should be used wherever permitted.
- Variable speed drives will be used in lieu of inlet vane control.
- A heat recovery system of the glycol runaround type, flat plate heat exchangers or molecular sieve heat wheel, should be considered.
- Radiant cooling systems in areas of high internal load concentration.

This new building shall be designed to the current state of Utah High Performance Building Standard.

Air Handling Systems
Air handling systems shall be designed to meet all of the above heating, cooling, ventilation and exhaust requirements of the project. Each supply and exhaust system shall have multiple fans arranged such that if one fan is down the other fan can still supply some air to the space. Air supply systems shall be variable volume type with hot water reheat as needed. Laboratory supply and exhaust systems shall be 100% outside air supply and 100% exhausted and shall be variable volume. Laboratory areas shall be kept at a negative pressure relative to the rest of the building at all times. All portions of the system shall be ducted.

Air Intakes and Exhaust
Air intakes shall be positioned to avoid short-circuiting of exhaust air back into the building. Exhaust from laboratories must be discharged to the atmosphere through stacks at the top of the building with a minimum velocity of 4000 fpm. If variable volume systems are employed for supply and exhaust, then design provisions must be made to assure that the 4000 fpm exhaust velocity is maintained at all times at all volume conditions.

The building fresh air intake will be designed to avoid pulling in excessive snow which could plug filters in creating moisture problems when snow melts.

Supply Air Filtration
In all air conditioned spaces pre-filters and final filters will be provided per latest codes and standards. Pre-filters should have an efficiency of 30% and final filters an efficiency of 90% based on ASHRAE Test Standard 52-76. Final filters will be installed at the point of discharge.

3.3.4 Plumbing

Water Supply
Water meters will be installed where lines enter the building and shall interface with existing Campus distribution system.

A pressure reducing valve assembly will be provided to limit water pressure at the building to an acceptable level. A triplex water pump should be installed if available pressure is not sufficient to maintain at least 40 psi at the furthest outlet.

Domestic Water
A domestic water system shall be provided for all non-laboratory spaces in the building. The system shall be designed to provide a minimum of 40 psig at the farthest building fixture on the highest floor of the building.

Domestic Cold Water: Domestic cold water will be connected to all laboratory and non-laboratory plumbing fittings and fixtures, including emergency eye wash and shower stations. Emergency eyewash units should be installed with a check valve and in-line back flow preventor and provided with independent control valves to regulate water pressure. Emergency shower and eyewash water is to be preheated to 70 degrees F.

Domestic Hot Water: Provide a domestic hot water system with heating being supplied from the Campus High Temperature Water System. Redundant instantaneous heat exchangers shall be provided separate from the building heating heat exchangers. Water shall be generated at 160 degrees F and be mixed down to be supplied to the building at 120 degrees F with no storage tanks. There shall be a recirculation system for both systems.

Laboratory Water
A separate laboratory cold and hot water system shall be provided with appropriate back flow prevention systems in place to prevent laboratory water from entering into the building's domestic water system. Separate instantaneous hot water heaters will be required to supply 140F water to the lab benches. All laboratory fittings will be provided with vacuum breakers.

Purified Water
A laboratory pure water reagent grade system shall be provided to supply 18 megohm water for all lab benches (to be verified during design). The system shall consist of dual softener, carbon filters, primary and secondary cartridge filters and a reverse osmosis system. Polishing shall be accomplished through a separate bed deionizer, and ultraviolet sterilizer, pre and final filters and storage tanks and pumps. This piping system shall have continuous recirculation using unpigmented virgin polypropylene.

For higher purity water requirements than is generated from the central system point of use polishers shall be used and are part of user supplied equipment.

Combination Emergency Showers and Eye Wash
Combination Emergency showers and eye wash will be provided in all laboratories with adjacent floor drains with trap primers.

Sterilization
Glass washing, autoclaves and other steam needs shall be supplied from a central steam generator supplying steam at 90 psig. This steam shall be generated with High Temperature Water from the Campus central system.

Laboratory Vacuum
A central laboratory vacuum system will be provided and designed to deliver vacuum at 18.2" Hg to laboratory fittings. The distribution piping system will deliver vacuum to each laboratory. Piping shall be Sullest Type L medical grade copper with brazed joints. If deeper vacuums are required, they will be generated locally with special vacuum pumps located in the laboratories which will be part of user provided equipment.

Laboratory Air
A central laboratory compressed clean, dry, oil free air system will be provided and designed to deliver compressed air to all laboratory fittings. Piping systems will be Sullest Type L medical grade copper with brazed joints.

Natural Gas
A low pressure natural gas system will deliver gas to fittings in each laboratory as required.

Gas piping will be welded or screwed Schedule 40, black steel pipe. *Note: See 3.1.7 for gas appliances*

Service Distribution Materials
Piped services, except for laboratory waste and vent, will be distributed in a double ended horizontal loop, which can be sectionalized for alterations and repair. Tees, valves, and caps shall be provided on a modular basis to facilitate extension of the services in the future to points of use in each laboratory module without disruption to services in adjacent modules.

Isolation Valves
Each laboratory shall be provided with isolation valves as the laboratory utilities enter the laboratory.

Sanitary Sewer and Waste
A complete sanitary waste and vent system will be provided in accordance with International Plumbing Code (IPC) throughout the building. Extend to exterior mains as shown on site utilities plan. Provide grease, sand and or oil traps as needed.

Laboratory Waste

A separate drainage and vent system constructed of acid resistant materials will be provided for laboratory waste. Laboratory waste may be piped into the sanitary sewer after it exits the building. Vents will be routed up through the roof and will not connect to sanitary vent piping.

Provisions should be made in the design of the wet laboratories for storage of appropriate containers for the collection of waste materials, such as solvents, oils, greases, sediments, and other materials. A central collecting area near the loading area should be provided for collection and for pickups by contracted waste disposal firms or disposed by other methods.

Storm Drainage

A complete roof drainage system that will tie into the existing storm drain systems will be provided. A separate overflow drain system should be provided by means of a piping system or a scupper system.

Fire Protection System

The building will be fully protected by a hydraulically calculated automatic fire protection system designed to be in compliance with the IBC, IFC, and the Utah Administrative Code R710-4, per the occupancy classifications within the building.

Hydraulic calculations shall be based on water pressures available for design as noted in a water flow analysis report. The report shall be prepared by a licensed engineer as required by the Utah State Fire Marshal Department.

A detector check / alarm valve assembly shall be provided at the fire sprinkler system riser to protect the city water supply from contamination. The riser assembly shall meet the requirements of the Utah State Fire Marshal Department.

Each floor shall be supplied with a floor control assembly that includes a flow switch and method of testing. Sprinkler systems shall be supplied from the standpipe system.

Pre-action sprinkler systems shall be included in the sprinkler system design where requested by an owner's representative.

Interstitial mechanical spaces located above lab spaces shall be provided with sprinkler protection.

The building will be protected by a hydraulically calculated automatic wet sprinkler system based upon a ordinary Hazard Group II occupancy.

3.3.5 Vivarium Core

The Vivarium Core is designed to support the needs of the research activities housed in the NBTRB. This core must be accessible to all researchers yet secured for unauthorized access. It should be immediately adjacent to the Small Animal Imaging Core. This core will include Animal Holding Rooms, Procedure Rooms, a Necropsy Lab, a "Survival" Surgery Suite and the process areas needed to support the Vivarium operations. See **Section 4.1 Space and Area Program** for the entire list of spaces and the required area for each space. The core is designed for maximum flexibility to allow for multiple species and procedures for the yet to be determined research. The Animal Holding Rooms are to be designed as universal holding rooms for multiple species and will be of two different sizes. See Individual Room Diagrams for each spaces specific requirements.

The construction of the Vivarium must allow for extreme durability, including; rigorous cleaning procedures; regular sanitation and occasional decontamination. The walls must be masonry with a cement plaster coat and epoxy enamel wall coating leaving an absolutely smooth surface and no pin holes. The floor finish through-out the Vivarium must be monolithic with an integral 6" high base. The ceilings in all critical areas, including Animal Holding Rooms, Procedure Rooms, Necropsy, Cage Processing, and Surgery will be solid with an epoxy enamel coating. See **Section 4.2 Individual Room Data Sheets** for the specific requirements for each space.

The Vivarium will require dedicated mechanical, plumbing and electrical services and will operate 24 / 7 / 365. The supply and exhaust air systems will require emergency electrical supply as will all critical components in the Vivarium. Ventilated rodent housing will be planned for in all Animal Holding Rooms and will require dedicated supply fans for the ventilated racks, while the exhaust requirements can be met with the building systems. Each Animal Holding Room will require 4 air valves; 1 supply and 1 exhaust valve for the room air; and 1 supply and 1 exhaust for all the racks in one room. A dedicated supply air mixing box will be required for the ventilated rodent racks; the number of racks on each box is to be determined. All mechanical, plumbing and electrical equipment and service items are to be located in an interstitial space with access from outside the Vivarium. No access panels are permitted in the Vivarium. The HVAC requirements include: 100% outside air, no recirculated air, 12 to 15 ACH in Animal Holding Rooms; 20 ACH in the Cage Processing Areas (or localized exhaust at all steam locations); 10 to 12 ACH in all other areas; room pressurization is to be adjustable in Animal Holding Rooms to either positive or negative environments; positive pressure in surgery and procedure spaces; and negative elsewhere. Room temperature must be variable to allow for multiple species and range from 65° to 78° with relative humidity between 30% and 70%. Each Small Animal Holding Room will have a continuous trench drain as indicated on the Room Data Sheet while the large rooms will have a trench drain on each side. The trench drains will be served with 6" sanitary lines and connect to the building system. Each Animal Holding Room will require a hose station with 140° water and a hand sink with hot and cold water.

The Vivarium must be designed for expansion, as additional research facilities are

developed. The Cage Processing Areas and equipment should be sized for a 100% expansion of the number of animal holding rooms and cages thus eliminating the need to replicate this area in the next facility. The University is looking into the possibility of using disposable caging to reduce, but not eliminate the cage washing area and costs. The tunnel washer was eliminated and area reduced with this possibility. A large autoclave and rack washer is still planned for this area.

3.3.6 Electrical/Technology Systems

CODES AND STANDARDS

Refer to **Section 3.1.7 Codes, Regulations, and Safety.**

ELECTRICAL POWER

Service and Distribution

The medium voltage power supply from substations to the site is described in **Section 2.4.3 New Utilities to be Constructed** of this report. A 600 amp padmount switch with one source switch and four interrupter switches should be installed close to the main building. The source switch will be supplied from the RAM switch closest to the building site. Two of the interrupter switches will be used to supply 12,470 volt feeders to a main-tie-main secondary unit substation located within the building.

Two secondary unit substations with secondary tie should be installed inside of the new building. Each of the 12,470 volt feeders should terminate at a fusible vacuum break switch that is sized per the primary of the 12,470–480Y / 277 volt transformers. The transformers should be liquid-filled using Envirotemp FR3 fluid. Each of the transformer secondary sides should supply a main circuit breaker that supplies a distribution section. A normally open molded case switch that is rated equal to the secondary mains should be installed to serve as a secondary tie between distribution sections. The main breakers and tie switch in the secondary unit substation should be drawout type. Circuit breakers in the distribution sections should be used to supply major feeders to lighting distribution switchboards, motor control centers, transfer switches, and 480-208Y / 120 volt transformers. Each main switchboard shall be provided with Square D "Powerlogic" type digital metering that is connected to the Campus Central Power Monitoring System via data lines. Separate loads of similar type and function onto separate substation sections so that if one side fails, the other side can maintain some level of operation in the facility. This will be particularly important for the mechanical system loads.

As an additional design consideration, it is preferred on Campus to derive the 120 / 208V power in the building from medium voltage 12,470-208Y / 120 volt transformers, as opposed to 480-208Y / 120 volt dry-type transformers in the facility. Early in design, provide an analysis of these two approaches evaluating initial cost, life-cycle cost, power quality, maintenance and operational issues. Present the evaluation to the Campus for discussion and a decision on which approach to take. If medium voltage 208Y / 120 volt transformers are used, then provide main-tie-main, double-ended service similar to the 480Y / 277 volt service as described above.

It is estimated that the total building connected load will be 20 watts per square foot; however, actual design loads should be used during the design phase to calculate the connected load. At minimum the ampacity of the secondary unit substation transformers and distribution equipment should be based on the following connected loads.

Load	Watts/Square Foot
Lighting	2.5
Receptacles	4.5
HVAC	8.0
Lab Equipment	14.0
Elevators	1.0
Miscellaneous	1.0
Total Design Load	**31.0**

The transformers should be sized, without fan cooling, for a kVA rating equal to the total design load times the total square footage, not including future square footage. The fan cooled rating of the transformers can be used to calculate the total kVA rating including the future square footage.

Feeder Distribution

To the greatest extent possible, separate different types of loads onto different feeders and busses, such as motors, lighting, convenience power and "clean" computer power. In general, large motors and equipment shall be served at 480V, 3 phase; lighting at 277V; outlets and small equipment at 120V. Provide digital metering on feeders serving labs so that accurate load data can be obtained for future remodels and additions that affect the particular feeder(s). Distribution feeders shall be sized to limit voltage drop to 2% at full capacity.

Panelboards shall be provided in vertically stacked electrical rooms. Electrical rooms shall be centrally located as much as possible so that the conductor distance from any panelboard to the most remote outlet is not greater than 150 feet. These rooms shall be dedicated to electrical distribution and shall not be used for storage or any other purposes. Consideration shall be given to the ease and accessibility of running new and future conduits out of each room, for example, do not lock the room between stairs, elevators, restrooms, etc. that would make future work difficult. If inaccessible ceilings surround the room, then stub (5) spare 3 / 4" conduits from each panelboard to accessible ceiling areas. Dedicate an area of each room for current and future riser conduits or busways so that wall-mounted equipment will not impede vertical distribution. Panelboards serving normal lighting and appliance circuits shall be located on the same floor as the circuits they serve. Branch panelboards serving laboratory equipment may be located near each lab, either on the corridor side of the lab or where practical inside the lab, but the panelboard shall be served from distribution panelboards located on the same floor.

Normal power panelboards serving receptacles in Lab Areas should be sized to provide 45 va per square foot and a minimum of six 20 amp, 120 volt circuits and one 30 amp, 120 volt circuit per bench. Refer to other sections of this report for more specific branch circuit requirements. Stepdown transformers that are used to supply circuit for the Lab Areas should be sized at 27 va / square foot. Special 480 / 277 volt circuits for lab tools requiring higher voltages should be supplied from distribution panelboards that are located centrally in the Lab Area. Normal power panelboards and stepdown

transformers in the remainder of the building should be sized to provide 5 va per square foot.

Transformers that are used to supply 208 /120 volt panelboards shall comply with NEMA TP1 for energy efficiency and be designed for non-linear loads. They should be either large transformers located in the main electrical room or smaller transformers located near to the loads. This is a design decision that will be dependent upon the configuration of the building.

Provide motor control centers for areas where 3 or more motors are grouped. The ampacity of motor control centers should be calculated in accordance with the load that is served with an addition 25% spare capacity. All 3-phase motors shall be provided with phase-loss protection. Provide variable frequency drives with harmonic filtering where required for mechanical equipment in compliance with DFCM and Campus requirements.

Branch Circuit Wiring

Branch circuits shall be loaded to no more than 80% of what is allowed by NFPA 70. Where outlets are intended for a specific piece of equipment, the load of the outlet shall be based on the equipment nameplate. Otherwise, allow no more than 4 convenience outlets per circuit in labs and for computer workstations, and 6 convenience outlets per circuit for general purpose use. Outlets with dedicated branch circuits (one outlet per circuit) are required for vending machines, copy machines, break room counters, A / V cabinets and where the equipment nameplate requires. Each branch circuit homerun shall have no more than 3 circuits per raceway. All branch circuits shall be provided with a dedicated neutral, specifically identified for the circuit it serves. Conductors for branch circuits shall be sized to prevent voltage drop exceeding 3% at the farthest load. The total voltage drop on both feeders and branch circuits shall not exceed 5%. When calculating the voltage drop, the load shall be assumed to be 80% of the ampacity of the branch circuit. For labs, a minimum of #10 gauge wire should be used so that circuits can easily be changed between 20A and 30A without having to replace or run new wire. Branch circuit wiring should be installed overhead in accessible or open ceiling spaces to simplify relocation of circuits due to remodeling.

Outlets

Refer to program and space plan sheets for basic requirements. Where requirements cannot be identified, the following shall be used as a general guideline. Each outlet location shall be coordinated with the design team and end user during the design.

Labs: Outlets sufficient for programmed equipment, plus outlets along work benches or tables – no greater than 2' on center (unless otherwise identified in the space plan sheets); at least one emergency circuit per bench, but more if required by the equipment.

Meeting Rooms and Instructional Spaces: Provide outlets for instructor's station, audio / visual equipment. Ensure that there is at least one outlet for each 10' of wall space. Provide floor outlets where stations or equipment cannot be served directly from the

wall without crossing aisle space. Where tables are fixed in place, coordinate power outlets mounted directly into the millwork.

Commons Areas, Lounges and Informal Gathering Areas: Provide power outlets for laptop computers, at least one duplex for each group of 4 seats, but no less than one outlet per each 12' of wall space. Provide floor outlets where stations or equipment cannot be served directly from the wall without crossing aisle space.

Offices: For each workstation, provide one outlet dedicated to computer terminals and one normal outlet, and one additional normal outlet for every 10' of wall space.

Conference and Board Rooms: One outlet for every 10' of wall space, plus one outlet dedicate to computer terminals on two walls. Provide floor outlets underneath conference room tables.

Lounges / Breakrooms / Kitchenettes: GFI Outlets on dedicated circuits every 4' on counter top plus dedicated outlets for refrigerator, microwave, and disposal (switched at counter top), plus one outlet for every 10' of other wall space in room.

Counter tops (in general): One outlet every 4'; GFI where within 8' of a sink.

Telephone / Data Closets: At least 6 quad outlets on emergency power with circuit density to allow for at least 40 VA per square foot.

Electrical Rooms: At least one outlet on emergency power.

Restrooms / Shower Rooms: One GFI outlet near each lavatory counter top.

Corridors, Lobbies: Provide at least one outlet every 25', on alternating sides of the corridor or lobby.

Stairs: One outlet at the landing of each level.

Storage Rooms (small), Janitors Closets: One outlet.

Building Exterior: One WP / GFI outlet near each entrance.

Other Areas: Refer to individual space plan data sheets, and where not defined coordinate requirements with user during design.

Equipment and Furniture

It is the responsibility of the design engineer to obtain equipment catalog sheets and installation diagrams and include power and raceway for all equipment requiring electrical connections. All equipment and furniture identified in the program documents, whether it is furnished in this contract or a separate contract, shall be provided with power and raceway rough-in for complete operation.

Raceways

Design all wiring in raceways, minimum ¾"C. Type MC or AC cable is strictly prohibited. Include pull strings in all empty conduits. Include raceway for all security, audio / visual and technology systems whether furnished as part of the construction contract or furnished by the Owner.

Fault Current and Coordination Study

A fault current and coordination study shall be performed by a licensed electrical engineer to indicate available fault current at all points in the 15 kV and building distribution systems. New equipment shall be adequately rated for the amount of available fault current. System coordination shall be studied, and fuses or breakers selected to ensure minimum system outage due to overloads or fault currents. Breakers with adjustable long time, short time, instantaneous and / or ground fault settings shall be set at levels for optimum system coordination.

Special Grounding

A common ground bus that is bonded to all grounding electrodes should be established in the main electrical room. The grounding system resistance to ground should not exceed 2 ohms. Isolated grounding conductors should be installed with all 208 / 120 volt feeders. Where laboratories require special grounding a separate ground bus should be installed with a dedicated isolated grounding conductor not smaller than #1 / 0 copper bonding it to the main ground bus. Provide a grounding riser throughout all telecommunications rooms with a grounding bar in each of the rooms.

Lightning Protection

Provide a lightning protection system for the new building. The lightning protection system should consist of air terminals, down conductors, ground rods, and a buried grounding conductor to surround and traverse the building. Engage an LPI-certified installer, designer and inspector for the system. Provide a UL Master Label and comply with NFPA 780.

Surge Suppression

To provide protection against damage to sensitive electronic equipment, due to surges, install transient voltage surge suppression (TVSS) devices at the main distribution switchboards and at branch circuit panelboards. TVSS devices should be external to the equipment with the shortest possible conductor length between the equipment and the TVSS device, and should be sized for the level of exposure that is encountered.

Cleanroom

Refer to **Section 3.3.7 Nanofabrication/Cleanroom Facility** of this program for additional requirements in the electrical power for this areas.

EMERGENCY POWER SYSTEMS

Generator

An emergency generator will be required to provide backup for life safety, critical lab

functions, and HVAC serving fume hoods and Vivariums. The emergency generator should be diesel powered with fuel tank sized for not less than 8 hours of operation at full load. Multiple transfer switches should be provided in accordance with the requirements of NEC Article 700. In addition to emergency circuits to serve critical lab equipment, dedicated 20 amp, 120 volt circuits should be provided to each lab bench. For safety purposes at least one light fixture in each lab module should be connected to an emergency circuit so that the module will not be completely dark during power outages. Receptacles in main and intermediate telecommunications closets should be connected to emergency power. Emergency power for lighting, exit signage, and alarm systems should be provided as required by specific codes. Annunciation of the generator status via remote alarm panels should be provided at a constantly attended location.

Uninterruptible Power Supply

A central Uninterruptible Power Supply (UPS) should be installed to provide uninterrup tible circuits for communications closets and critical laboratory equipment. The emergency generator should back up the UPS input and the battery supply should be 15 minutes at full load.

INTERIOR LIGHTING

General Design Criteria

The lighting design should incorporate a strategy that utilizes standard fixtures to meet the illumination requirements while maintaining high efficiency and requiring minimal maintenance. Fixtures should be installed so that special equipment is not required for lamp replacement. In general all light fixtures should be installed no higher than 12 feet above finished floor so that they can be reached from a stepladder. Task lighting fixtures that place higher-than-ambient illumination close to the task should be used to reduce the overall energy consumption. Lighting intensity and uniformity should provide shadow-free and glare-free illumination of work surfaces. Lighting intensity control using dimmers or multi-level switching should be incorporated in specialized laboratories or in spaces where computer or other electronic equipment monitors are used. Pendant indirect or direct / indirect fixtures are ideally suited for the environments that will be encountered and should be used where ceiling heights will allow for suspension of 18 inches or more below the finished ceiling. If pendant fixtures are used in rooms with ceiling projectors, carefully coordinate the pendant fixtures with the projected image to eliminate any conflicts. Animal Holding Areas should use flush, wash-down type fixtures and provide for variable levels of light.

Task Illuminance

Lighting levels should be in accordance with the Recommended Illuminance Categories and Illuminance Values for Lighting Design, IES Lighting Handbook. Total lighting load for the facility should not exceed the calculated lighting power budget, minus 10%, as determined by ASHRAE 90.1-2004. The lighting levels listed below in footcandles should be used for design purposes. The values listed are average maintained illuminance levels using a maintenance factor of 75%. The numbers listed are target values

and should be adjusted to meet the special requirements of individual areas.

Task lights shall be provided by the Construction Contract if part of the lab casework.

Function / Space	Illuminance (Avg. Footcandles)
Laboratories	50 (ambient) – 100 (task)
Offices	30 (ambient) – 50 (task)
Conference / Meeting Spaces	50
Corridors / stairwells	20
Corridors / stairwells, Staff only	10
General Storage	30
Lab Equipment Rooms	30
Vivariums	5 – 50 variable
Mechanical / Electrical Rooms	20

Lamps

The number of different lamps that are used should be kept to a minimum so that replacement stock will be minimal and the opportunity for replacement errors will be reduced. The design should strive to utilize only one type of T8 or T5 fluorescent lamp and one type of compact fluorescent lamp; however, this requirement should not override the goals of maximizing energy efficiency and proper task illumination. T8 lamps characteristics should include rapid-start, low-mercury, minimum color rendering index of 82, 4100 K color temperature, and average rated life of 20,000 hours. T5 lamps characteristics should include programmed-start, low-mercury, minimum color rendering index of 85, 4100 K color temperature, and average rated life of 20,000 hours. Compact fluorescent lamp characteristics should include minimum color rendering index of 80, 4100 K color temperature, 10,000 hours average rated life at 3 hours per start. All fluorescent lamps should comply with the Federal Toxic Characteristics Leaching Process (TCLP) test, and yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

Ballasts for linear fluorescent lamps should be electronic programmed start with not greater than 20% total harmonic distortion. Ballast for compact fluorescent lamps should also be electronic and should operate at minimum 90% power factor.

Incandescent lamps should not be used, except for special cases where a CRI of 100 and / or a dimming range of 0% -100% is critical to the task involved. Incandescent lamps, if used, should be tungsten halogen IR type par lamps.

Interior Lighting Control

Occupancy sensors should be used in normally occupied enclosed areas such as offices, break rooms, conference rooms, and toilet rooms to shutdown lighting when the areas are not occupied. Lighting in common areas such as corridors and lobbies should be controlled by a programmable networked lighting relay control system with the capability of timed control, sensor inputs and building automation system integration. Wall station override switches are required in convenient locations throughout the facility to allow for on / off override to suit the specific needs of the building occupants.

Provide daylighting control in common areas where natural illumination alone provides sufficient lighting levels. Photoelectric sensors should be used to shutdown or dim the artificial lighting when it is not needed. In offices and laboratories where daylighting control is used, utilize continuous dimming to negate the noticeable affects of the on-off cycles of the artificial illumination.

As required by the room use, provide variable lighting levels by multiple level switching or dimming. In rooms with audio / visual (AV) equipment, provide variable and zoned lighting control, from front to back, to allow for flexibility in lighting scenes for the various room functions. Where central AV control systems are used, then provide lighting control / dimming systems with an RS232 AV interface to allow the lights to be controlled from the AV system.

Vivariums should provide a range of lighting level control to allow for normal behaviors of the animals held and for the care giver to perform their duties. Provide a 12-hour light cycle to simulate the natural day-night light cycle.

Provide Cleanroom type fixtures in the Nanofabrication Facility. Refer to the Nanofabrication / Cleanroom section of this program for additional requirements.

EXTERIOR LIGHTING

Design Criteria

The exterior lighting fixtures should be selected to harmonize with the architectural style of the building. In general, all outdoor lighting should have full cut-off optics as defined by the IESNA. Wall mounted decorative fixtures may be used to draw attention to main entry or circulation areas. Wall mounted fixtures at other locations should be non-decorative with cutoff optics that are designed for the intended use. Fixtures for parking surface areas and walkways are to be pole mounted and shall comply with the University of Utah campus standard type. Check with the Campus design standards to ensure that the latest pole standards are used. A common metal halide lamp should be selected for use in all exterior fixtures to minimize the maintenance stock requirements. All exterior light fixtures should be robust and suitable for the harsh exterior environment. Preference should be given to fixtures that have design features such as hinging reflectors and removable ballast trays that reduce the cost of lamp replacement and fixture repairs.

Illuminance

Lighting levels should be in accordance with the Recommended Illuminance Categories and Illuminance Values for Lighting Design, IES Lighting Handbook. Total lighting load for the facility should not exceed the calculated lighting power budget as determined by ASHRAE 90.1. The lighting levels listed below in footcandles should be used for design purposes. The values listed are average maintained illuminance levels using a maintenance factor of 75%.

Function	Iluminance (Avg. Footcandles)
Parking	1
Walkways	1
Building Perimeter - Entrances	5

TELECOMMUNICATION SYSTEMS

Underground Facilities

As indicated in **Section 2.4 Site Utilities** of this report, communications manholes will be installed at each end of the site to provide a redundant path for communication wiring. Each of the manholes should be connected to the main communications room with an underground ductbank of 4 each 4 inch conduits that are installed per the University of Utah Design Standards.

Entrance Facilities and Closets

Communications rooms will consist of a Main Distribution Frame (MDF) and Intermediate Distribution Frames (IDF's). The MDF should be located at the lowest level of the building and will be connected to the campus distribution systems and outside telephone cabling. IDF's should be provided at each level such that the cable distance from any outlet to the IDF will not exceed 90 meters. The dimensions for the MDF and IDF are dependent upon the area served and the criteria can be found in the University of Utah Standards. IDF's should be stacked from floor to floor and, if possible, should be stacked above the MDF. The walls of all MDF and IDF rooms should be lined with ¾" fire treated plywood.

Cabling Pathways

The lowest level IDF in each vertical stack should have four each 4 inch conduits that connect it to the MDF. In addition four each 4 inch conduit sleeves should be provided through the floor of each IDF to the ceiling space above the IDF below. These will be used for backbone cabling. If a floor contains more than one IDF then two each 4 inch conduits should be installed between IDF's. Cable trays should be provided above the corridor ceilings to provide a path for horizontal cabling that is installed from the outlets to the IDF's. Cable trays should be installed in a manner that minimizes the cabling distances. Inside of the IDF's the cable tray should ring the IDF. Communications outlets should consist of a 4 inch square deep box with a single ring and two each ¾" conduits stubbed to the cable tray. In laboratory areas where communication outlets are installed in surface raceways, conduits should be provided from the surface raceways to cable trays in the ratio of one ¾" conduit (or equivalent) per 2 linear feet of work surface. Cable trays should extend into laboratory areas and should be installed above the aisle ways between workbenches so that they can be accessed without climbing over the lab furniture.

Cabling

The University of Utah Net Com will install all voice / data cabling and termination equipment. To ensure proper coordination the installation of raceways and cable trays should be reviewed with Net Com prior to installation.

FIRE ALARM SYSTEM

Comply with Utah State Fire Marshall's "Rules and Regulations" and University of Utah Design Standards. Only FCI as distributed by Nelson Fire Systems is allowed on Campus. Design an addressable system capable of networking with the campus system and reporting back to central campus fire alarm system in building 301 via data network cards. Design strobes visible from all locations except private offices. Evaluate building occupancy type to determine if evacuation speakers are required. Design horns (or speakers) to comply with NFPA including for higher ambient noise requirements. Where smoke control systems are required, coordinate the integration of the fire alarm with the smoke control systems. Provide duct detectors and fan shutdown where required by NFPA and the IMC, including detection of smoke at all return air shafts serving multiple floors. Coordinate location of the building annunciator with the Campus fire marshal. All other detectors and functions shall comply with the referenced codes and standards.

SECURITY SYSTEM

All security systems will comply with established campus standards. Systems will annunciate alarm conditions to, and be completely monitored by, the University of Utah campus police department.

Building Secuirty needs will be established thru collaboration among building users, CD&C and Campus Secuirty staff. All security wiring must be in conduct installed by the building electrical contractor.

The design of the building including the secuirty system will allow easy access to the PI offices by students and visitors while keeping the laboratory access secure.

Card Access

A complete access control system will control entry to all perimeter entry / exit points, and at select sensitive interior spaces. Card readers will be the proximity type, and will comply with established Campus Standards. Card readers will report to central door controllers. Coordinate door hardware to minimize the aesthetic impact to the appearance of the building.

Video Surveillance

A complete video surveillance system will control for visual monitoring at all building entry / exit points, at select main building thoroughfares, elevator lobbies, and at select sensitive interior areas. Cameras will be specified for viewing of Owner designated subject areas, and installed in appropriately rated enclosures. Signals from cameras will be connected to a central switching / multiplexing system with minimum 13" video monitors for viewing. All camera images will be digitally recorded by DVR's that are local area network accessible.

Intrusion Detection

A complete intrusion detection system will be for electronic monitoring and status reporting of all building entry / exit points, select building thoroughfares, and at select sensitive interior areas. Sensing devices will include door position switches, motion sensors, and where / if appropriate, glass break sensors. All sensing devices will report to a zoned monitoring panel for specific location identification of an alarm condition. The intrusion detection system will be integrated with the video surveillance system for priority viewing of security breach areas.

Emergency Phones

Emergency (Blue Light) telephones will be specified. Provide density and alarm annunciation based on established campus standards. At a minimum, locate telephones in outdoor parking and pedestrian areas at highly visible location.

SUSTAINABLE DESIGN - ELECTRICAL

Sustainable design practices should be implemented in this facility, regardless of whether the LEED certification is pursued or not. The following is a list of potential opportunities related to the Electrical Design together with strategies that that should be considered to maximize the energy efficiency and performance of a building:

Light Pollution Reduction: Plan to reduce light pollution, thereby increasing visual access to the night sky, by specifying full cut-off type luminaires for the building exterior. Carefully balance a safe outdoor environment with lighting levels that are not excessive. Exterior lighting that is intended to illuminate the building but does not contribute to safety and security wastes energy and reduces the overall energy efficiency of the building. To maximize energy efficiency the exterior lighting design should include only lighting that is required to provide a safe and secure site.

Optimize Energy: Through careful design of the lighting and control systems, energy usage can be greatly reduced while still providing a pleasing and functional atmosphere to the building occupants. Below are some strategies that are identified:

- Reduce the overall ambient lighting levels and use task lights for specific functions. For example, in labs, the contribution from the permanently installed ceiling lights can be reduced and task lights in the furniture systems be provided.
- Where daylighting is available, provide daylighting control systems. For classrooms and offices, use continual dimming of fluorescent lights to supplement the natural daylight and adjust with less noticeable affect. In corridors and common areas, stepped switching may be used at reduced cost where the expense of dimming is not justified.
- Control all building lighting through a programmable lighting relay system and occupancy sensors. Provide override switches so that the occupants can always turn lights off. If lights are normally off and overridden on, the lights will be timed off after a specified period of time.
- Use premium efficiency lamps and ballasts that last longer, use less energy, and

qualify for maximum dollar credits on the Rocky Mountain Power Finanswer program.

- Use premium efficiency transformers, beyond the NEMA TP1 standard, for the non-regulated 120 / 208V loads.

On-Site Renewable Energy: Investigate the feasibility of a grid-interactive photovoltaic (PV) system to supply 2.5%, 7.5% or 12.5% of the building's total annual energy consumption (corresponding to 1, 2 or 3 LEED points respectively). If the building budget does not allow for the initial installation of PV, then make provisions in the design by allowing roof area for PV panels and stubbing conduit to the roof for future wiring.

Measurement and Verification: Divide the electrical distribution system into separate branches feeding the lighting, outlets and HVAC systems. Provide submetering on these systems to allow the Owner to verify the energy performance of the building during the measurement and verification period. Locate meter displays in a central sustainability exhibit that can show energy consumption of the building and energy being produced by the renewable energy sources.

Indoor Environmental Quality / Controllability of Lighting: Design lighting zones and switching to allow all occupants or groups of occupants to have access to lighting control for the individual tasks, areas or common spaces.

AUDIO AND VIDEO SYSTEMS

General

Audio and video systems will be specified for installation as part of the building construction work, to be completed with all building trades. Audio and video systems will be specified for full compliance with established Campus Standards.

Large Auditorium

The Large Auditorium will be provided with fully integrated audio, video, and control systems. Audio systems will amplify the spoken word from presenters, as well as amplify program audio originating from media source playback devices such as computers and DVD players. The spoken word originating from presenters will be captured using wireless, lapel microphones and lectern-mounted gooseneck microphones. Once captured, the audio signal will be processed and amplified to an appropriate speaker system. Design speaker systems to provide even sound pressure level throughout the entire seating area with + 2 dB at 2 KHz, with a frequency response of at least150 Hz to 15 KHz + 2 dB, and a maximum of 12% articulation loss of consonants. Include all audio system calculations on the construction drawings.

Several media source devices and inputs will be provided. These devices will include, but not be limited to, inputs for portable computing devices, inputs for computer systems resident in lecterns, DVD / VCR players, document cameras, and audio / video / data sources originating from outside the Auditorium. Audio originating from these source devices will be selected, processed, and amplified to a separate, dedicated

speaker system for media playback audio only. The speaker system will be full range, for music playback, including, but not limited to, sub-woofers, and low, mid, and high frequency transducers. The media playback speaker system will be 2-channel only (stereo). A multi-channel (surround sound) speaker system is not required. The media playback speaker system shall faithfully reproduce audio from 50 Hz to 17 KHz, and shall be co-located with the projection screens. Provide a wireless assisted listening system in compliance with the Americans with Disabilities Act for all voice and media reinforced audio.

Provide video systems for the large screen display of presenter subject matter. Size projection screens so that all viewers with average eyesight can read text from any seat. Use AV industry-wide accepted mathematical formulas to determine appropriate image sizes. Locate projection screens in close coordination with seating layouts to assure appropriate viewing sight lines. Provide projectors with a minimum native resolution of 1280 X 1024, or 1920 X 1080 depending upon the desired aspect ratio of the projected image as identified by the Owner during the design process.

Depending upon final room ceiling heights, provide tension cabled, electric roll up or fixed projection screens as directed by the Owner during the design process. As with screen sizing, utilize mathematical formulas to calculate the required light output for each projector to assure that images will not be "washed out" by ambient room lighting. Specify appropriate screen surfaces based on calculations. Include all video system calculations in the construction drawings.

Provide two projectors and screens in the Large Auditorium with the ability to display different images on the screens simultaneously. In addition, provide the ability to write electronically (annotate) over the displayed images independently.

The Large Auditorium will be equipped with an integrated control panel for control of all audio and video system components, and lighting systems. To meet this need, a touch screen control panel will be provided. The touch screen control panel will serve as the control panel, lectern monitor, and the annotation input device. Specify control system manufacturers in compliance with established Campus Standards. The touch screen control panel will be programmed in full compliance with the end user's desired button layout, configuration, and labeling. In addition, the control systems will be programmed with macros so that multiple events will occur when a button on the touch panel is engaged.

Large Seminar Room

The Large Seminar Rooms will be provided with fully integrated audio, video, and control systems. Audio systems will amplify the spoken word from presenters, as well as amplify program audio originating from media source playback devices such as computers and DVD players. The spoken word originating from presenters will be captured using wireless, lapel microphones and lectern-mounted gooseneck microphones. Once captured, the audio signal will be processed and amplified to an appropriate speaker system. Design speaker systems to provide even sound pressure level throughout the entire seating area with + 2 dB at 2 KHz, with a frequency response of

at least150 Hz to 15 KHz + 2 dB, and with a maximum of 12% articulation loss of consonants. Include all audio system calculations on the construction drawings.

Several media source devices and inputs will be provided. These devices will include, but not be limited to, inputs for portable computing devices, inputs for computer systems resident in lecterns, DVD / VCR players, document cameras, and audio / video / data sources originating from outside the Seminar Room. Audio originating from these source devices will be selected, processed, and amplified to the above identified speaker system. Provide a wireless assisted listening system in compliance with the Americans with Disabilities Act.

Provide video systems for the large screen display of presenter subject matter. Size projection screens so that all viewers with average eyesight can read text from any seat. Use AV industry-wide accepted mathematical formulas to determine appropriate image sizes. Locate projection screens in close coordination with seating layouts to assure appropriate viewing sight lines. Provide projectors with a minimum native resolution of 1280 X 1024, or 1920 X 1080 depending upon the desired aspect ratio of the projected image as identified by the Owner during the design process.

Depending upon final room ceiling heights, provide tension cabled, electric roll up or fixed projection screens as directed by the Owner during the design process. As with screen sizing, utilize mathematical formulas to calculate the required light output for each projector to assure that images will not be “washed out” by ambient room lighting. Specify appropriate screen surfaces based on calculations. Include all video system calculations in the construction drawings.

Provide two projectors and screens in the Large Seminar Rooms with the ability to display different images on the screens simultaneously. In addition, provide the ability to write electronically (annotate) over the displayed images independently.

The Large Seminar Rooms will be equipped with an integrated control panel for control of all audio and video system components, and lighting systems. To meet this need, a touch screen control panel will be provided. The touch screen control panel will serve as the control panel, lectern monitor, and the annotation input device. Specify control system manufacturers in compliance with established campus standards. The touch screen control panel will be programmed in full compliance with the end user’s desired button layout, configuration, and labeling. In addition, the control systems will be programmed with macros so that multiple events will occur when a button on the touch panel is engaged.

Small Seminar Rooms

Small Seminar Rooms will be provided with fully integrated audio, video, and control systems. Audio systems will not be provided for the amplification of the spoken word from presenters. However, audio systems will be provided to amplify program audio originating from media source playback devices such as computers and DVD players. Design speaker systems to provide even sound pressure level throughout the entire seating area with + 2 dB at 2 KHz, with a frequency response of at least150 Hz to 15 KHz

+ 2 dB, and with a maximum of 12% articulation loss of consonants. Include all audio system calculations on the construction drawings.

Each Seminar Room will be provided with a building standard technology enabled lectern. Several media source devices and inputs will be provided and housed at each lectern. These devices will include, but not be limited to, inputs for one permanent computer, inputs for one portable computer, a DVD / VCR player, a document camera, and audio / video / data sources originating from outside the Seminar Room. Audio originating from these source devices will be selected, processed, and amplified to the above described speaker system. Provide a wireless assisted listening system in compliance with the Americans with Disabilities Act.

Provide video systems for the large screen display of presenter subject matter. Size projection screens so that all viewers with average eyesight can read text from any seat. Use AV industry-wide accepted mathematical formulas to determine appropriate image sizes. Locate projection screens in close coordination with seating layouts to assure appropriate viewing sight lines. Provide projectors with a minimum native resolution of 1280 X 1024, or 1920 X 1080 depending upon the desired aspect ratio of the projected image as identified by the Owner during the design process.

Depending upon final room ceiling heights, provide tension cabled, electric roll up or fixed projection screens, as directed by the Owner during the design process. As with screen sizing, utilize mathematical formulas to calculate the required light output for each projector to assure that images will not be “washed out” by ambient room lighting. Specify appropriate screen surfaces based on calculations. Include all video system calculations in the construction drawings. Provide one projector and screen with the ability to write electronically over the displayed image (annotation).

Equip Seminar Rooms with an integrated control panel for control of all audio and video system components, and lighting systems. To meet this need, a touch screen control panel will be provided. The touch screen control panel will serve as the control panel, lectern monitor, and the annotation input device. Specify control system manufacturers in compliance with established campus standards. The touch screen control panel will be programmed in full compliance with the end user’s desired button layout, configuration, and labeling. In addition, the control systems will be programmed with macros so that multiple events will occur when a button on the touch panel is engaged.

Informal Meeting Areas
Informal meeting areas will be provided with seating and a marker board to allow for discussions and idea sharing. No audio-video equipment is required for these areas.

Conference Rooms
Conference Rooms will be equipped with audio and video systems for media source device presentations, teleconferencing, and video conference capability. Tables in Conference Rooms will be permanently wired with microphones for the capture of meeting participant audio. All microphones will be mixed through automatic matrix

mixers with individual echo cancellors for each microphone input. Design speaker systems to provide even sound pressure level throughout the entire seating area with + 2 dB at 2 KHz, with a frequency response of at least150 Hz to 15 KHz + 2 dB, and a maximum of 12% articulation loss of consonants. Include all audio system calculations on the construction drawings.

Video systems will be provided for large screen display of meeting subject matter. Provide a minimum of two projectors and screens. Projection screens will be rear screen, fresnel linticular technology. Size projection screens so that all viewers with average eyesight can read text from any seat. Use AV industry-wide accepted mathematical formulas to determine appropriate image sizes. Locate projection screens in close coordination with seating layouts to assure appropriate viewing sight lines.
Provide projectors with a minimum native resolution of 1280 X 1024, or 1920 X 1080 depending upon the desired aspect ratio of the projected image as identified by the Owner during the design process. As with screen sizing, utilize mathematical formulas to calculate the required light output for each projector to assure that images will not be "washed out" by ambient room lighting. Include all video system calculations in the construction drawings.

In lieu of multiple large projection screens, supplementary large screen flat panel displays may be provided for use during video conferencing to supplement a single large projection screen. Provide one CODEC and a minimum of two pan, tilt, zoom cameras for image capture of video conferencing participants in each conference room.

Conference Room tables will be permanently wired with computer video, composite video and S-video inputs, along with their associated audio signals. This connectivity will be provided in a "hidden" connection panel that rises out of the table when needed. Basic source devices including a DVD / VCR player, and document camera will also be provided.

Conference Rooms will be equipped with an integrated wireless control panel for control of all audio and video system components, lighting systems, and motorized window coverings (if applicable). To meet this need, a wireless WiFi touch screen control panel will be provided. The touch screen control panel will be programmed in full compliance with the end user's desired button layout, configuration, and labeling. In addition, macros (multiple events) will occur when a button on the touch panel is engaged.

TV Distribution System
An RF TV distribution system will be provided for distribution of audio and video signals throughout the building on coaxial cable. The TV distribution system will include all cable, amplifiers, splitters, couplers, terminators, outlets, and connectors. The system will be the broadband type, for distribution of low resolution, modulated audio and video signals onto a carrier frequency. A minimum 750 MHz bandwidth will be specified, and all outlets will be provided with between +5 and +10 dBu at each building television outlet.

3.3.7 Nanofabrication/Cleanroom Facility

CLEANROOM SYSTEMS NARRATIVES

Service Yard
Space will need to be made in the service yard for the following equipment supporting the cleanroom.

Liquid Nitrogen
It is assumed that the liquid nitrogen tank will be leased from a local vendor who will provide the tank, mounts, evaporator, outdoor filters, and the line to the Liquid Nitrogen Truck fill point. It is assumed that the project will provide an underground nitrogen gas line to the building. Piped Liquid Nitrogen into the building is assumed not to be required. Liquid Nitrogen dewars could be filled from a port on the side of the tank. The project will provide a concrete pad for the equipment, inside a secure yard area that can be shared with other yard equipment.

Silane Gas
The University does not anticipate the need for toxic mixtures of Silane gas, which is pyrophoric. It is assumed that 100% Silane gas will be provided in cylinders on a regular basis by a vendor. If toxic mixtures are requested at a later date, these cylinders will need to be located in gas cabinets provided by others. The project will provide a concrete pad and either an indoor or outdoor enclosure (small building or covered, secured, fenced area) to secure and protect these cylinders and their cabinets. The project will also provide the necessary air handling (and exhaust systems, if toxic mixtures are requested) to properly ventilate the exposed cylinders (or cabinets in the case of providing for toxic silane mixtures). Space for the piping to the building, gas cabinets, valve manifold boxes, monitors and alarms will be provided, but the items themselves are assumed to be provided by others.

Hydrogen Gas
It is assumed that Hydrogen Gas will be supplied by a hydrogen generator located within the building. If required, Hydrogen Gas cylinders can be accommodated within the hazardous gas room up to the limits as specified in the IFC and as long as they are placed in approved gas cabinets. If multiple H2 cylinders are required, they must be physically separated by at least five feet.

Oxygen, Argon & Other Specialty Gases
It is assumed that other central (house) gas systems will not be required. Other inert specialty gases will be supplied from cylinders located within the cleanroom chases. Other hazardous specialty gases will be supplied from cylinders in the hazardous gas storage room. Space for the specialty gas piping, gas cabinets, valve manifold boxes, monitors and alarms will be provided, but the items themselves are assumed to be provided by others.

Architectural Building Systems General – Criteria
See space data sheets for criteria for individual spaces. Where data sheets do not address particular criteria, see these narratives for additional criteria.

Mock-Ups

Provide mock-ups of the following systems and materials as part of an overall construction quality assurance program. Mock-ups shall be reviewed by the owner and architect, and shall be retained for comparison to installed work once mock-ups are approved.

1. Cleanroom ceiling including fan-filter units (FFU's).
2. Cleanroom partitions.
3. Cleanroom access flooring.

Typical Interior Partition Construction

- Gypsum board layers shall be 5 / 8" thick on metal stud partitions.
- Gypsum board layers shall be 5 / 8" water resistant for wet areas.
- Gypsum board partitions shall be fire-rated to achieve fire resistance for wall assemblies as indicated on code analysis and exiting plans (when provided).
- Finish gypsum drywall by provision of galvanized corner beads at all exterior corners, metal trim on all exposed edges and tape and apply joint compound at all interior corners (unless noted for movement control).
- Provide for movement control with 1 / 4" wide vertical control joint in gypsum drywall as required and + / - horizontal control joints at the floor lines of stairs and shafts.
- Provide for sound control by completely sealing with sealant (PPMC) all heads, sills, joints and penetrations of gypsum drywall and by installation of sound attenuation blankets.
- Two-hour fire rated drywall partitions at typical shaft walls shall be 2 layers of 1/2" fire code "C" gypsum panels one side and 1" gypsum wall liner panel one side on steel "C-H" studs 24" O.C.
- All painting materials and methods shall conform to University of Utah Design Standards.

TYPICAL FINISHES

Characterization Laboratory Finishes

Full-height, non-insulated, gypsum board partitions will form the majority of the laboratory walls. These walls should have a layer of ¾" plywood behind the Gypsum Wallboard to provide backing for cabinetry support. The walls of all of the Characterization Labs will be filled with acoustic batts. The more-sensitive Microscopy labs will be designed with heavy acoustic walls for further acoustic attenuation, but do not require the plywood backing. Laboratory and utility core walls shall be finished with epoxy paint.

The characterization labs should be located on continuous 15" thick (to be reviewed and confirmed by Vibration Consultant) concrete slabs on grade, to meet or exceed their stated VC (vibration criteria) curves. Laboratory and laboratory corridor flooring shall be non-coved, 2'x2' chemical resistant, vinyl tile. The flooring tiles in electrostatically-sensitive labs, see Space Data Sheets, will be conductive and grounded in addition to the properties of the other lab floor tiles.

The Electron Microscopy labs should be enclosed within a continuous, passive, aluminum shield to protect their instruments from Electro-Magnetic Interference (EMI). The rooms can be grouped into a single shielded volume by 1 / 4"-thick, 1100-series, aluminum plating covering all wall, floor and ceiling surfaces. This plating should be screwed to the wall studs beneath the drywall, extending to the floor slab above. It should be laid on top of a recessed floor slab extending to the outside of the wall studs, then covered with a concrete topping slab. It should be attached to the bottom side of the floor slab of the floor above and wrapped around beams and any other obstacles for a continuous shield. The shield needs to meet an EMI-shielded door. This can be a typical door used for MRI rooms.

The more-sensitive Microscopy labs will have a 24" x 24" suspended ceiling grid infilled with anodized aluminum perforated ceiling tiles to screen the structure, ductwork, and other utilities above, without significantly impacting the performance of specialty ambient-diffusion ductwork. The remainder of the characterization labs will have ceilings matching the remainder of the labs in the building, but in any case should be factory-wrapped and sealed with tape where cut) to prevent shedding onto / into sensitive microscopy equipment. Structure above the labs is to be epoxy painted.

There are not anticipated to be any fixed, laboratory furnishings required in the most-sensitive characterization labs. Laboratory furnishings outside these areas are to include chemical fume hoods with flammable and corrosive storage cabinets below. Fume hood work surfaces are to be epoxy resin and dished with integral cupsinks that drain to the standard building sanitary sewer system. The countertops will be 30" deep, modular-width (36" typical), epoxy resin on adjustable-height table frames cantilevered from vertical wall rails. Islands are to be adjustable-height tables with telescoping legs and epoxy resin countertops.

Metal base cabinets will be Fisher-Hamilton Inset Steel or equal, suspended from the cantilevered table frames at the walls and from the island table frames in the middle of the rooms. Sink cabinets will be fixed to match the adjacent adjustable countertops and cabinets with flush sinks and integral splashes. Metal wall cabinets will be adjustable-height, Fisher-Hamilton Inset Steel or equal, with tempered glass, swinging doors, suspended from vertical wall rails.

Access for the disabled is to be provided at every lab with accessible entry and egress doors. All lab fume hoods and sinks will be accessible with 34" high work surfaces approached from the side. Fume hood utility controls and electrical outlets are to be mounted on the face of the hood. All other work surfaces in the labs should be set to 34" above the floor initially, but are adjustable and removable. All base cabinets are removable to provide front access to equipment as required. All combination safety shower / eye wash stations shall not accessability standards with 3' clear width and clear front approach.

Please refer to the Equipment in this report for a schedule of fume hoods, chemical storage cabinets, and other lab furnishings to be provided as part of the construction.

Cleanroom Finishes

All building components and systems must be in comopliance with the IBC for installations in the occupancy groups contained in this building. ICC Evaluation Reports for various systems or Building Official approved alternate systmes will be required.

The main Cleanroom Laboratories are comprised of Class 100, Class 1,000 and Class 10,000 spaces (ISO Class 5,6 and 7) to support all phases of University of Utah research. Although the various clean classifications differ in airflow requirements, the ceiling system and floor air return scheme (low-wall return chases where applicable) are uniform throughout the cleanroom maximizing flexibility. As airflow requirements change, filters may be either removed or added.

The ceiling grid will be 2" wide, aluminum gasketed T-Bar rated for Class 100 and 1,000. The grid will cover the classified spaces only. Re-circulating air will be provided using fan filter units (FFU's) in most clean areas with Recirculation Air Handling Units (RHU) with ducted HEPA filters in the PI/Bio Processing, Photo-Lithography and Nano-Lithography bays. Lighting will be 2' x 4' sealed Troffer fluorescent fixtures typically, with the exception of the class 100 areas. In these areas the use of combination units (consisting of a filter and flow-throw light fixture) will be integrated into the nearly-100% filter coverage at the ceiling. Light fixtures in Nano-Lithography and Photo-Lithography will be amber filtered to minimize potential damage to light sensitive components.

Walls within the Cleanroom envelope are a strut supported aluminum panel system. Typical Cleanroom partitions will be non-progressive, modular, 2" Cleanroom strut system with ¼" aluminum panels and ¼" glazing. Partitions will include 4'- 0" bottom panel of aluminum panel, 4'- 0" glass panel, and a 2'- 0" top panel of aluminum. As with the light fixtures, glass panels will be ambered in photosensitive areas. Where classified space is located directly against a non-Cleanroom surface, such as the Cleanroom perimeter, structural column, or an acoustical wall, the surface will be lined with ¼" aluminum Cleanroom wall panels. All perimeter walls at floor and above structural deck, window frames, doors frames, duct and piping penetrations will be sealed with silicone sealant so that Cleanroom enclosure will meet Cleanroom classification standards. Processing bay and chase flooring will be a depressed concrete slab with a 2-foot-high, perforated, raised metal floor for nearly laminar cleanroom air delivery, and to facilitate flexible tool utility hookup. The raised floor will be 2'x2' aluminum floor panels with a chemical resistant homogeneous conductive vinyl tile top surface. The bottom and sides of the depressed slab will be continuously coated with a trowel-applied, chemical-resistant, eletrostatically dissipative, grounded coating. Where the chase space is not bounded by Cleanroom wall panels, the interior walls, structure and bottom of floor slab above will be coated with epoxy paint.

As a cost savings measure, the Gowning, Wipe-Down, Main Aisle, Clean Conference Room, Class 10K Metrology, and Class 10K Research / Teaching Clean Labs will be slab on grade. In these areas, airflow will occur through continuous, 18"- high, sidewall air-return grills. Slab on grade flooring will be finished with 2'x 2' chemical resistant, conductive and grounded homogeneous vinyl tiles.

To provide the required acoustical segregation, the Nano-Lithography Bay will require unique design efforts. Gasketed, solid core wood doors will be set in acoustical walls (2 layers of gypsum wall board each side of standard metal studs with acoustic batt infill) that extend from the top of the recessed concrete slab to the bottom of the fan deck slab to create an acoustically segregated space. Within this acoustic enclosure, will be ¼" Cleanroom wall liner and opaque Cleanroom chase construction with the clean side finished with a 1 / 4" cleanroom panel on furred channels or clips. Epoxy paint over gypsum board walls over metal studs will be used where the surface is exposed only to the return air stream.

To provide the required mechanical segregation between the Bio-Compatible (Air-stream Segregated) bays and the rest of the Cleanroom, the bays will be entered through sliding doors. Solid flooring will be installed over the raised metal floor and covered with chemical resistant sheet flooring. Return air will duct through dedicated sidewall air returns located on both sides of the bay.

Man doors in the Cleanroom will be either sliding or swing doors as indicated on the plans, and provided with full glazed panels. As with the light fixtures, glass doors to the photo sensitive bays will be ambered filtered.

Entry into the classified portions of the Cleanroom will be via the Gown Room which also provides space for garment storage units, visitor's gown cabinets and benches per the combined Class 100 and 1,000 gowning protocols.

The Class 10K Research / Teaching Labs and their corridor access are to be constructed with a mix of lab and Cleanroom finishes. The walls and ceilings shall follow the same construction as the Characterization Labs (non-shedding, wrapped and sealed tiles), but the flooring shall follow the same as for the non-raised-floor portions of the Cleanroom, such as the Main Aisle, Equipment Wipe Down, and Gowning. Ceiling air return and typical, aluminum doors with full vision glass in welded frames, and interior windows in welded frames will be adequate for these spaces. It is presumed these spaces will be part of the H5 occupancy.

Touring is a significant criteria for this facility, both to enhance recruitment of Principal Investigators and to interest industrial partners. A continuous non-classified corridor should parallel and look into the Cleanroom Main Aisle and down the processing bays. Ideally, the Clean Conference Room would be the culmination of this tour. This touring feature will also provide an enhanced working environment for the staff and researchers inside the Cleanroom, ideally providing transparency to views and daylight outside.

Cleanroom Tools and Layout

A cleanroom equipment layout was generated for the University of Utah based on the following goals / needs:

- The Cleanroom will provide a state-of-the-art research environment promoting an interdisciplinary effort in addressing the major challenges in the emerging areas

of Silicon Microelectronics, Compound Semiconductors, MEMS, Nanomaterials, Microfluidics, and Nanobioscience.

- The Cleanroom is to support key research activities that are based on existing areas of excellence as well as supporting new development areas from outside institutions and companies such as providing quality space and services.
- Processing will be performed on a variety of substrates and substrate sizes. The Cleanroom tool set will enable research on CMOS Microelectronics and MEMS structures and devices. The Cleanroom with therefore provide appropriate environmental conditions (cleanliness, temperature, humidity, vibration and EMI control).
- Cross contamination is not expected to be an issue for the CMOS processing areas (Photolithography, Wet Process, Hot Process, Films Dep and Etch bays). Therefore these bays will not be mechanically (air) isolated from each other.
- However, the two (2) dedicated PI Lab / soft (organic) materials clean bays will be mechanically isolated from each other and all other clean processing aisles to allow the processing of biological and/or exotic materials within the Cleanroom envelope without cross-contaminating other processing areas.
- To optimize their performance, EMI and acoustically sensitive tools are to be isolated from the rest of the Cleanroom by a hard partition (concrete or gypsum walls) and appropriate doors.
- The tools will be grouped functionally. Tools that perform similar processing steps (etch, deposition, lithography) will be located together along with their metrology equipment, if space is available, within the same processing area. Otherwise, the metrology equipment will be located in the main aisle.
- To provide adequate space for future Principal Investigators to bring in additional process tools. However, to meet cost / budget targets, the gross Cleanroom area will be less than or equal to 11,000 square feet.
- To provide a well defined tool move in / out strategy.
- To provide a well defined chemical move in / out strategy.
- To adhere to all required safety / code items.

Cleanroom Configuration

There will be a variety of unique research, design and development activities occurring within the Cleanroom. Research will be conducted in the areas of Silicon Microelectronics, Compound Semiconductors, MEMS, Nanomaterials, Microfluidics, Nanobioscience and other technologies impossible to predict at this time. Therefore, the Cleanroom is designed to support not only the needs of current research programs, but also the future program requirements.

In order to provide the best touring / viewing opportunities, the most efficient utility distribution and the most efficient tool packing density, the fab configuration proposed is a singly loaded bay / chase design.

To optimize equipment performance, EMI, vibration, and acoustically (EVA) sensitive tools (Litho, SEM) are to be located on one side of the Cleanroom, isolated from Cleanroom EVA generators such as the oxidation furnaces, plasma and sputtering equipment.

To support flexible tool installation and relocation, a depressed concrete slab with a 24 inch raised metal floor will be used as the flooring system under the processing bays and chases. This flooring concept will allow for flexible installation of utilities and process support equipment. Airflow will occur through the perforated floor and then up flow through the adjacent interior chases. Tools that are very heavy or require a very low ambient vibration level to operate properly, will sit on 24" high support or vibration isolation pedestals and not on the raised floor.

The placement of this Nanofabrication Cleanroom on the site should be such to allow future Cleanroom expansion along the thin axis of the Cleanroom. In other words, all efforts should be made not to ring the Cleanroom with permanent structures or functions that can not be relocated.

Gowning

The facility will have one central Gowning Area, supporting all Cleanroom-processing areas including the Main Cleanroom, the PI/Bio (isolated) Processing Area and the Class 10k Research / Teaching Labs. There will be 100 regular staff using the Cleanroom during the week with the maximum Cleanroom occupancy defined at 60 persons. The Gowning Room will hold dedicated gowns for 20 operations staff, 100 researchers and 20 shared gowns for the lab classes.

To enter the Cleanroom, everyone will follow the same gowning protocol as defined below:

Typical Gowning Protocol	
STEP	ACTIVITIES
1	Store all personal items not needed inside the cleanroom in your assigned locker located at the outside of the Cleanroom.
2	Upon entering the Cleanroom Gowning Area, clean the soles of your shoes using the shoe scrubber located next to the gowning room entrance.
3	Put on shoe covers located at the entrance. Only flat or low-heeled shoes allowed. No sandals or open-toed shoes.
4	Remove a hair net from a container, and place it over hair. If you have facial hair, use one of the beard covers provided in the first cabinet as well.
5	Step into the Gowning Room. Clean all items that will be hand carried into the Cleanroom at the wipe down station. Wipe down the items with alcohol.
6	Put on shoe covers, hair net, beard cover (if needed) and latex gloves.
7	Remove your hood and bunny suit from the gowning cabinet and inspect. Put on the hood, unzip the suit and climb into it, making sure that the bunny suit does not unnecessarily touch the ground. Zip the smock up all the way to the top.
8	Remove a set of booties from the cabinet. Sit on the bench and place the booties over shoes. Put on one bootie and swing the "clean" foot to the clean side. Put on second Cleanroom bootie, swing fully to the clean side, and stand up.

9	Remove a second pair of Cleanroom latex gloves from the cabinet. Place these gloves on your hands and pull the cuff of the gloves over the sleeve of the bunny suit. Gloves should be worn at all times, no bare hands or fingers. Finally, put on a pair of goggles to protect your eyes.
10	Use the mirror in the Gowning Room to inspect that all your Cleanroom apparel is on correctly and properly fitted before opening the interior Cleanroom door into the Class 1000 Cleanroom Corridor.

When leaving the Cleanroom, the gowns are removed in the reverse order to that listed above.

Maintenance staff who don a full bunny suit can freely move between the Main Cleanroom Aisle and service chases using doors off of the Main Aisle (not from end of bays). The doors at the end of the bay will be alarmed and used for emergency exiting only. Technicians / tool operators working inside the clean bays can also access the chase space by the same method.

Maintenance staff can also enter the service chase directly from the perimeter (dirty) corridor. Once in the chase (by the entrance door, they will don a smock, hairnet, shoe covers, and safety glasses. With this level of gowning, maintenance staff are prohibited to enter the clean bays or main aisle.

Staff entering the Clean Bio Lab will use the main gowning room and are subject to the same gowning protocol. Once entering the bio bay, they will proceed through a level of secondary gowning (to be determined, possibly only changing gloves). If additional gowning is required for entrance into the "bio" material bay, a small gowning station (glove box storage) will occur outside of the bay entrance.

Cleanroom gown laundering will be outsourced therefore associated equipment and facilities are not within the scope of this program.

Circulation

A Cleanroom will be conducive to the movement of a variety of activities. The production flow consists of people, materials, and equipment.

Along one side of the Cleanroom is an 8-foot wide Main Cleanroom Aisle that connects all Cleanroom processing bays. Users will enter the Cleanroom through the Gown Room area, traveling left to right to access the processing bays. Additional (alarmed) doors will be provided to allow emergency exiting as required by the IBC for an H5 occupancy.

Pass-throughs will be provided to support the flow of material both in and out of the Cleanroom. One (1) pass-through will be located from the Gown Room to the Main Cleanroom Corridor. One (1) additional pass-through will be located along a perimeter wall to support the transport of gas cylinders and liquid chemicals (acid, base and solvents), into and out of the Cleanroom chase.

To support process tool transport in and out of the Cleanroom, there will be an 8-foot wide 9-foot high clear aisle from the loading dock to the head of each processing bay. Process Equipment will be unloaded at the dock, location TBD, and move to the tool entry load lock located on one end of the Main Cleanroom Aisle. It is here the final wrapping is removed and the tool receives a final wipe down before entering the Cleanroom. The tool wipe down room will open out to the Main Cleanroom Aisle and from there the tools will move to the respective processing bays.

Segregation

There are three segregation requirements within the Cleanroom; Airborne Molecular Contamination (AMC), Acoustic / Vibration (AV) and photosensitive isolation.
The isolated zones are:

Zone 1 – Bio-Nano / PI Processing Bays

Isolation will occur through a floor to ceiling partition construction. The flooring will be comprised of an aluminum sheet panel covered with a sheet vinyl covering (over the raised floor area). Within these applications, where mixing this air with the overall Cleanroom would present an environmental or safety issue, the air will return through a series of dedicated two foot wide chases along each side of the processing bay. To further address AMC, there will be a sliding door at the entrance of the Bio Processing Bay.

Zone 2 – E-Beam Processing Bay

Unique construction will be provided to isolate the Vibration and Acoustically sensitive SEM and E-Beam writer. The E-Beam Room will require special acoustically treated gypsum wall board partitions and gasketed, solid core doors isolating their environment from noise sources outside their immediate environment. The aluminum wall liner and ceiling tiles will help to attenuate EMI inside the microscope and E-beam Rooms.

Zone 3 – Photolithography Bay

To address the photosensitive environment, there will be amber (yellow) lighting within the bay and amber tinted glazing on this bay's doors and windows. This will reduce exposure of the photosensitive materials to the white lights located off the main aisleway. The remaining bays (films, hot processing, etc) will be open to the main aisle.

Tool Set and Cleanroom Tooling Layout

The University Users developed a detailed equipment list to support the required research. The list is comprised of both existing and new equipment. The equipment list is included in **Appendix Section 6.7 Equipment Schedule for Nanofabrication** of this report.

The **Cleanroom Layout** shown on **Section 3.3.7 Page 28**, groups the equipment by processing function into seven processing labs (bays). The bay arrangement is according to mechanical segregation, EMI, vibration, and acoustic criteria (EVA). To optimize equipment performance, EMI, vibration, and acoustically (EVA) sensitive tools (Litho, SEM) are isolated from Cleanroom EVA generators (elevator, furnaces, plasma, sputtering).

The tools are grouped functionally. Tools that perform similar processing steps (such as wet etch, vacuum, lithography) will be located together. The initial bays along with the required cleanliness class and sensitivities are defined as follows:

Sensitive Environments Criteria (EVA Specifications)						
	EMI		VIBRATION		ACOUSTIC	CLEANLINESS
Description	(mG)	Level	Category	u-in/sec rms)		
Nano-Ligthography	0.5	B	VC-E	125	NC-50	ISO 5 (100)
Photo Lighography	3	E	VC-D	250	NC-55	ISO 5 (100)
Wet/Etch/Films/Hot	N / A	N / A	VC-C	500	NC-55	ISO 6 (1000)
PI Processing Bay	TBD	TBD	TBD	TBD	NC-55	ISO 6 (1000)
Bio Compatible Bay	N / A	N / A	VC-C	500	NC-55	ISO 6 (1000)
Gowning / Tool Entry	N / A	N / A	VC-C	500	NC-55	ISO 6 (1000)

In order to fit the required tool set into the minimum amount of Cleanroom space, the layout shows a "dense pack" arrangement with the minimum spacing around each system that still provides the required maintenance and safety clearances.

Each tool's direct support equipment, such as pumps and power supplies, not needing to be accessible from the Cleanroom, are located in the service chase adjacent to the bay. This reduces the noise level, increases cleanliness, and reduces the size (cost) of the processing bays.

Within each bay, there is a minimum 5-foot clearance between the face of the tools. The width of each clean bay is 14 feet. The service chase widths range between 8 and 10 feet. In order to provide adequate bay depth for functional equipment layout as well as rear chase clearance, bay depth is a constant 46 feet.

CLEANROOM UTILITY REQUIREMENTS AND MEP SYSTEMS

The house facility systems to be provided include; power, process cooling water (PCW), a combined acid / base exhaust, a combined solvent / general exhaust, ultra pure water (UPW), segregated drain, process vacuum (PV), clean dry air (CDA), and general nitrogen (GN2).

The facility system loads were calculated by using top down parametric data for each space type from compilations of previous M+W Zander projects. These parametric values will be validated during the Schematic Design phase through a bottom up calculation. All facility calculations are based upon a typical R&D equipment utilization during day shift of 40% and 15% utilization during nights and weekends.

Cleanroom Chemical and Gas Use

The types of specialty gases and liquid chemicals required are dependent on the substrates and the specific processing operations. A detailed gas and chemical list will be developed during the design phase. However, it is expected that the aggregate quantity of hazardous material in use or in storage in the Cleanroom will require this area to be classified as an H5 Occupancy by the IBC, and therefore has special design requirements. Hazardous gases used by equipment in the Cleanroom will be piped from cylinders in the Hazardous Gas room, or from outside the building (as in the case of Silane). If the chemicals used in this area are also classified as HPM's (meaning that their NFPA Health, Flammability, or Reactivity rating exceeds 2), they must be delivered straight from the loading dock to this occupancy, or straight from the Solid and Liquid Chemical Storage Room to this occupancy. In either case, the materials must be transported through an HPM Service Corridor. The IBC limits STORAGE within this occupancy to the same limits as shown below for a single control area. The IBC limits USE within this occupancy by the values contained in Table 415.8.2.1.1. Chemical amounts beyond these limits must be stored in the Solid and Liquid Chemical Storage Room. See **Section 3.1.7 Codes, Regulations, and Safety.**

Flexibility

The process equipment layout and utility matrix are based upon the expected new and existing (relocated) equipment to be initially installed. The Cleanroom layout will have the capacity to accommodate changes in the tool set as the R&D Program and its associated processing requirements evolve. Within reasonable limits, however, M+W Zander expects that the sizing of the Cleanroom and utility systems will accommodate the flexibility required to address changes in the research mission.

MECHANICAL (HVAC)

Outside Design Conditions

The proposed facility shall be designed utilizing the winter design dry-bulb and summer design dry-bulb and wet-bulb temperatures in accordance with ASHRAE standards for the city of Salt Lake City, Utah.

The following is a summary of outside design conditions proposed for this project:

Winter Design	3˚F db (ASHRAE 99%)
Summer Design	97˚F db / 62˚F wb (ASHRAE 1%)
Site Elevation	4,800 feet above sea level

Inside Design Conditions

Inside design conditions have been established for the various spaces as follows:

	Temp (˚F)	RelativeHumidity (percentage)
Cleanroom (General Bays)	68 ± 3	45 ± 5
Cleanroom (Litho and E-Beam Bays)	68 ± 1	45 ± 2.5
Mech & Elec Spaces (Winter)	60 ± 5	No Control
Mech & Elec Spaces (Summer)	85 ± 10	No Control

*Design load summaries for heating and cooling have been prepared and are included in the Appendix of this report.

Equipment Accessibility

Consideration shall be given to providing easy access to mechanical / process equipment and utility distribution systems. Most of the major mechanical equipment serving the Cleanroom shall be located and accessed from the floor of a fan deck located above the Cleanroom. A Cleanroom exhaust scrubber (if required) shall be located on the fan deck and associated exhaust fans located on the roof of the building at a location to be determined. Elevator / lift access shall be available to all floors that house mechanical equipment spaces.

Fan filter units (FFUs) shall be installed in a Cleanroom filter grid system above the class 1000 clean bays. The FFUs shall be accessed from below for filter replacement and maintenance.

Utilities and branch exhaust ductwork shall be routed 10 to 12 feet above the floor in the core areas of the Cleanroom and shall be accessed by ladder. The distribution ductwork for make up and cooling air injection shall be installed above the Cleanroom class 1000 space fan filter unit systems. Class 100 spaces shall have recirculation air handlers that can be accessed from the fan deck level.

An alternative to cooling air injection would be to install sensible cooling coils in the return air chases that would be accessed from the ground level.

The feasibility of a walkable ceiling system with flexible HVAC equipment locations will be evaluated during the design phase as an alternative to the fan deck and fan filter unit concepts as outlined above.

In all cases care will be taken regarding the layout of the equipment to ensure that adequate clearances are maintained around the equipment for inspection and maintenance access.

Chilled Water System

A peak Cleanroom cooling load of approximately 400 Tons has been estimated based on parametric analysis using load data established for similar projects. A computer load analysis shall be performed during detailed design to establish more precise loads based on the proposed building and equipment layout. It is anticipated that 8-inch chilled water supply and return pipes to / from the main distribution system will supply chilled water to the Cleanroom systems.

The campus chilled water system, providing 42-45 degree F chilled water to the building shall be used to serve the Cleanroom make up air and recirculation air handling units. It shall also serve the process cooling water loads.

Chilled Water Distribution

Based on estimated cooling loads, a chilled water flow rate of 800 GPM shall be re-

quired for the Cleanroom. An 18 degree F temperature rise was allowed for mixed flow coils and a 20 degree F rise for coils with 100% outside air.

The chilled water shall be supplied to meet the following loads:

- Make-up air-cooling for the Cleanroom.
- Re-circulating air for Cleanroom cooling coils.
- Process cooling water loop (Heat Exchanger).
- Sensible cooling water loop (blend loop) for Cleanroom recirculation air handling units.

Sensible Cooling Water
Sensible cooling water supply temperature shall be maintained at 55 degrees. Chilled water at 42-45 degree F shall be blended with sensible cooling return water using a three way mixing valve located on the sensible cooling water return water piping. The higher sensible cooling water supply temperature is intended to prevent condensation occurring on coils in the recirculation air handlers and sensible cooling coils and lessen temperature stratification in the Cleanroom.

Heating Water Distribution
Heating hot water shall be distributed through heating water supply and return mains located in the building. Based on estimated heating loads, a heating hot water flow rate of approximately 200 GPM shall be required for the Cleanroom. A 4-inch heating hot water supply and return piping shall connect to the building heating hot water main. The heating hot water loop shall contain glycol at the same concentration as existing University systems. Heating water shall serve the following loads:

- Air handling unit (AHU) and Make-up air preheat.
- Terminal (zone) heating coils.
- Make-up air re-heat.
- Industrial hot water heating for Cleanroom use.

Process Steam
Steam shall be utilized to supply any process loads and shall serve the make-up air handler steam to steam humidifying system (see humidification section this report). A valve / capped connection shall be provided on the incoming steam will be provided for future use.

Cleanroom Exhaust Concept
Exhaust duct laterals shall be located in the Cleanroom service chases to serve all Cleanroom bays. Duct laterals shall extend toward the ends of the chases and connect to the mains in the rear service aisle. Exhaust risers shall extend from the first level up to the mechanical fan deck above the Cleanroom. One system shall be available for corrosive exhaust, while the second system shall be for general / solvent exhaust. The Corrosive System shall be routed to the roof and connected to a dedicated dual fan set. The general / solvent system shall be connected to an independent dual exhaust fan set located on the roof of the building. Both solvent and corrosive exhaust systems shall contain fully redundant fan units.

EXHAUST SYSTEM EQUIPMENT

The majority of equipment serving the various process exhaust systems shall be located on the roof on the building. The location shall be determined during detailed design. The following equipment is currently anticipated:

Cleanroom Corrosive Exhaust Fans
Two (2) 100% redundancy Cleanroom exhaust fans with approximate capacity of 35,000 CFM each shall be provided to meet the total maximum anticipated load of approximately 33,000 CFM. Both fans shall be mounted in a factory fabricated, pre-assembled intake plenum, with one fan acting as a 100% stand-by. The system shall be with variable air volume control. However, fans shall operate at constant flow, with an outside air by-pass utilized to modulate system pressure. Constant volume is used to maintain a relatively high, constant discharge velocity.

Cleanroom General / Solvent Exhaust Fans
The general / solvent exhaust system shall be served by two (2) 15,000 CFM fans. The anticipated exhaust capacity is 14,000 CFM. Fans will be arranged in a factory fabricated, pre-assembled intake plenum, with one fan in the bank acting as a 100% stand-by. The exhaust fans will operate at constant flow, with an outside air by-pass utilized to modulate system pressure. Constant volume is used to maintain a relatively high, constant discharge velocity.

Cleanroom Exhaust Mains and Branches
All potential hazardous corrosive Cleanroom exhaust ducts shall be Halar or Teflon lined stainless steel in order to protect against potentially corrosive exhaust air flow. General / solvent exhaust systems shall be constructed of galvanized steel.

Acid and VOC Abatement
Due to the minimal amount of solvent usage in the laboratories and Cleanrooms, solvent concentrations in the general / solvent exhaust system are expected to be low, therefore this treatment requirement can be met by dilution alone.

Corrosive use within the Cleanroom is not anticipated to be high. However, provisions shall be made for a future scrubber installation for the Cleanroom corrosive exhaust. The future scrubber shall be located on the mechanical deck above the Cleanroom. It is anticipated that process equipment using hazardous materials, toxic or highly toxic gases shall be provided with point-of-use abatement technologies.

Smoke Exhaust
During the design phase the Cleanroom smoke exhaust requirements shall be determined based on NFPA 318 paragraph 3.5.5, local code officials, and the University.

Clean Room Air Re-Circulation System
Most of the Cleanroom spaces shall be designed for ISO Class 6, as built (Class 1000-FED std. 2098). A cleaner environment of ISO Class 5, as built (Class 100-FED std. 2098) will be required for the E-beam and Photolithography bays.

Cooling of the clean spaces shall be provided by either sensible cooling coils located in the re-circulation air or injection cooling above the fan filter units. Direct air re-circulation shall be provided for the E-Beam Litho, Lithography and Bio Processing Bays shall be cooled by utilizing re-circulating air handlers located on the fan deck. Conditioned air from these units shall be routed to a distribution plenum which shall supply the ducted ULPA filters. The rest of the Cleanroom bays shall utilize Fan Filter Units for both air filtration and air re-circulation. The conditioned air shall be injected and distributed in the plenum above the bays, or alternatively sensible cooling coils shall be located in the return air chases for heat removal. If injection cooling is utilized, three-25,000 cfm injection cooling air handling units (one standby) shall be used to provide an estimated 50,000 CFM of injection cooling. Hot water zone heating coils shall be provided on each injection cooling branch duct serving a bay to provide zone temperature control.

Class 1000 / 100 Cleanliness

As noted above, the airflow circulation to the Class 1000 / 100 spaces shall be provided by either Fan Filter Units (FFUs) or re-circulating air handlers. ULPA filter coverage is expected to be in the range of 33% for Class 1000 and 100% for Class 100. Gross filter air velocity shall be set at approximately 70 FPM. Ducted ULPA filters shall be used in Class 100 spaces. Each ducted ULPA filter module is capable of delivering 560 - 640 CFM of sufficiently cold, filtered air. The estimated number of FFU modules and ducted ULPA filters shall be 128 and 111, respectively. Note that percent filter coverage shall be a function of the desired air change rate. The airflow through a Class 1000 Cleanroom is non-unidirectional due to the reduced filter coverage. Air change rates for Class 1000 Cleanrooms shall be approximately 140 - 150 air changes per hour. The airflow through a Class 100 Cleanroom is approximately unidirectional due to the high filter coverage. Air change rates for Class 100 Cleanrooms shall be approximately 280 - 420 air changes per hour. Return air from the areas is routed from the clean bay, through the raised access floor and back into the adjacent service chases. The return air is then induced to rise through the service chases back to the re-circulating units, or FFUs.

The Cleanroom air conditioning units shall generally be comprised of the following major components in the direction of airflow:

- Sensible cooling coil (55 degrees F blended chilled water).
- Direct drive - plug fan section.
- Supply air sound attenuator.

Cleanroom Make-Up Air

The system is comprised of 50,000 CFM approximate capacity make up air unit (MUA), with dual supply fans. Each sized for 100% make-up airflow capacity. The system shall supply all Cleanroom make up air requirements. The outside air provided by the system shall replace the air exhausted through processes as well as air that is required for pressurization.

The MUA shall be located within the mechanical fan deck above the Cleanroom. Supply air from the MUA shall be distributed directly to the combined Cleanroom plenum

through injection ductwork routed above the fan filer units or supplied directly into the recirculation units dedicated for bays isolated from the main Cleanroom air plenum. Cleanroom pressurization control shall be achieved by MUA capacity control utilizing a variable frequency drive on each fan motor. The unit shall be provided with the ability to re-circulate a portion of the makeup air to allow for continual Cleanroom humidification control. Unique features associated with the supply air arrangement for these make-up air units is discussed in the following paragraphs.

During the design phase, the feasibility of utilizing direct evaporative cooling as an integral part of the MUA for pre-cooling and adding humidification to the outside air will be analyzed.

The Cleanroom make-up air conditioning units shall be comprised of the following major components in the direction of airflow:

1. Intake louver (sized for outside air flow) with ½ inch by ½ inch grid bird / rodent screen.
2. Outside air / return air mixing box with glycol filled preheat coil for ice and snow melting to minimize intrusion of ice and snow to filter bank.
3. Pre-filter bank comprising of a 2-inch matt type media – MERV 5 (30 % efficiency)
4. Pre-filter bank comprising of a 2-inch matt type media – MERV 7 (65% efficiency).
5. Secondary filter, cartridge type media ASHRAE 52-85, - MERV 16 (95% efficiency).
6. Humidification section (steam to clean steam).
7. Primary cooling coil (42-45 degrees F) and drain pan.
8. Future low temperature cooling coil (40 degrees F) and drain pan.
9. Direct drive - dual plug fan section with septum wall.
10. Final HEPA filter – 99.97% efficiency.

The air conditioning units shall be fully sectionalized, double wall construction with pre-insulated panels, 18 gage outer wall, 24 gage 304 stainless steel solid inner wall with 3 lb. density mineral wool insulation, vapor barrier.

The unit will be continuously supported on a galvanized C-channel base. Access doors shall be (54-inch high by 24-inch wide, insulated and gasketed) with hinges and corrosion resistant hardware. They shall be provided between sections for maintenance.

Humidity Control

Humidification shall be achieved through the use of a plant steam to a steam to steam fogger type humidifier located inside the make up air conditioning unit. The water supply to produce the clean steam shall be R.O. water produced for the facility. U / V lights shall be provided with the unit to prevent or minimize the formation of mold growth.

In order to meet the Cleanroom relative humidity specification it shall be necessary to condition the make-up air supply to a 46 degree F dew point, corresponding to the RH specification of approximately 45% at 68 degrees space temperature.

Currently it is not anticipated that dehumidification will be required for the Cleanroom. During the design phase an analysis of the number of days or hours where the Cleanroom may fall out of the humidity specification versus the cost of added a low temperature side stream booster chiller could be provided.

Cleanroom Air Distribution Duct / Pressure Control

The make-up air shall be delivered directly to the Service Chase (Core) area of the Cleanroom. The facility DDC control system, utilizing pressure sensors measuring the differential pressure between the Cleanroom and the adjacent corridor shall adjust the capacity of the make-up air stream damper to ensure that the Cleanroom is under positive pressure with respect to the adjacent corridor. A VFD shall be provided for each Make-up Air Handling Unit Fan in order to account for major make-up air capacity adjustments as the Cleanroom is populated with equipment.

Cleanroom Mechanical and Electrical Rooms

All mechanical and electrical rooms shall be provided with some minimal heating and cooling. Air handling units incorporating chilled water-cooling coils and hot water heating coils shall be provided to supply each space. Mechanical and electrical rooms shall be maintained at a minimum temperature of 60 degrees F and a maximum of 85 degrees F.

Ventilation

Minimum outside air ventilation shall be based on a minimum of 20 CFM / person or 0.15 CFM / sq. ft. per the requirements of ASHRAE 62 standards. It is assumed that the Cleanroom make-up air requirement will greatly surpass ASHRAE 62 standard.

Direct Digital System (DDC)

The facility management and control system shall be arranged as distributed control utilizing DDC technology to provide control and centralized monitoring of all mechanical and process systems. The facility management system shall be coordinated and compatible with, the existing University front-end / building automation and control computer. Equipment and system monitoring points shall permit measurement and optimization of building energy consumption, trending, as well as data logging and alarm sequencing.

Plumbing Fixtures, Water and Sanitary Waste

Potable water shall be provided to all plumbing fixtures, including emergency eyewash fixtures, throughout the building, utilizing type “L” copper tubing. Tepid potable water shall be provided for the Emergency Showers and Eyewashes. A domestic hot water system shall be provided utilizing small tank type, electric water heaters near the major points of use in order to minimize re-circulation requirements. All hot water piping shall be insulated.

Industrial cold water shall be distributed to the Cleanroom in from a connection on the building industrial distribution piping system.

Industrial cold water shall also be the source of make up for all hydronic and service

water applications.

A sanitary waste and vent drainage system shall be provided for all plumbing fixtures, including floor drains in mechanical rooms. Sanitary sewer and vent piping shall be cast iron, hub and spigot below grade, and cast iron, no-hub above grade. Systems shall flow by gravity. Roof drainage shall to be accomplished utilizing a system of interior roof drains and overflow scuppers. Rain water leaders will be cast iron, hub and spigot below grade, and cast iron, no-hub above grade. An under slab foundation drainage system will be provided if required.

Standard low flow plumbing fixtures shall be utilized throughout the facility. Fixtures will include water closets, urinals and lavatories in all toilet areas. The facility shall also include janitor's sinks, coffee sinks, emergency eyewashes, wall hydrants, electric water coolers and floor drains as appropriate. No sanitary drains shall be allowed in the Cleanroom.

A process waste and vent drainage system shall be provided for all plumbing fixtures serving the Cleanroom. Process waste drain and vent piping material shall be schedule 40 polypropylene. Sanitary waste piping from the Laboratory Block shall flow by gravity to the first floor, combine with under floor drainage from the first floor, and connect to the sanitary sewer at a point outside the building.

Fire Protection System

The entire facility shall be protected with a wet pipe automatic sprinkler system. Hazard classifications and sprinkler flow densities will be established based on the occupancy of the protected areas. The system shall be designed, installed and tested in accordance with NFPA 13. Cleanroom fire sprinkler design shall be in accordance with NFPA 318.

The wet sprinkler system shall be zoned by floor, and each floor shall be provided with a floor control station. The water supply for the sprinkler system shall be provided by a connection to the campus water system with a double check valve back flow prevention. All fire protection equipment, devices, and materials shall be Underwriters Laboratories (UL) listed or Factory Mutual (FM) approved.

Waste Water Treatment & Collection Systems

An acid waste gravity drain and collection system will be provided. The system will include a 600 gallon collection and equalization tank, a three stage 20 gpm cascading pH adjustment system, feed pumps, and discharge pumps. N+1 redundancy on pumps will be provided. Sulfuric acid will be used for pH adjustment of the acid waste in the event of a high pH excursion, and sodium hydroxide will be used for pH adjustment in the event of a low pH excursion. Both chemicals will be handled from a drum / pump system.

The acid waste collection tank will be constructed of polypropylene (PP), and collection piping will be run in PP.

The waste neutralization system will be provided with independent controls programmed to maintain system operations. The system will monitor level in the collection tank using transfer pumps to maintain high and low level setpoints. Dual pH monitors in the neutralization tank will provide input to determine the amount of caustic or acid additions required to bring the system pH to setpoint. Waste flows to the monitoring tank where dual pH sensors make final readings prior to discharge to the municipal sewer system. If the pH moves outside acceptance limits, the controller will redirect wastes to the collection tank for further treatment.

The flow rate and the pH value of outgoing neutralized wastewater will be recorded continuously.

ACID WASTE		COMMENTS
Piping Size	3”	Based on 1 / 8” per foot slope, 50% full pipe
Piping Material	Polypropylene	
Cleanroom Flow Rate	18 gpm	Labs will not have centralized system but will have point of use collection and/or drain to sanitary sewer.
System Capacity, Flow Rate	20 gpm	
Treatment	Sulfuric Acid & Sodium Hydroxide	

An alternate approach to forego the acid waste neutralization system can be to direct the acid waste stream to sanitary sewer if the acid concentration is to be within acceptable limits. A pH monitor would detect any deviations, and divert the flow via a control valve and bypass line to a waste collection tank for treatment. When the pH range is back to an acceptable range, flow would be redirected to sanitary. This method is not recommended, however, since the tank retention time would be relatively short based on the anticipated flow rate.

Welded carbon steel drain piping systems will be installed to collect solvent waste. Solvent wastes will be collected in double drum cabinets for offsite disposal. The system will be located in the waste collection pit to eliminate any potential hazards within the process area.

The drum collection systems will contain a redundant storage drum serving an emergency storage drum. Drum level monitoring will be at the Facility Control System.

Ultrapure Water System

The UPW system consists of three treatment trains: the make-up system generating Reverse Osmosis water (RO), the Deionized water (DI) system, and the polishing (UPW) system. The primary components of the RO system include a raw water storage tank, pumps, backwash filters, carbon adsorption, heat exchangers, softeners, prefiltration, RO units, and an RO permeate tank. The DI system includes UV oxidation units, mixed beds, resin traps, and a DI storage tank with nitrogen blanketing. The UPW system

includes heat exchangers, polishing mixed beds with resin traps, ultrafiltration, and analytical monitoring.

The RO water train is sized to produce the required make-up to the DI water train as well as to other facilities and process support systems as required. The DI water train produces high purity water to supply the DI tank, which also holds the returned / unused DI water from the labs, the humidifer loop supplying the makeup air units, and the process cooling water system. The polishing system treats the recirculating UPW distribution loop to the Cleanroom tools. Final sizing of the RO, DI, and UPW equipment will be determined after final consumption figures are computed.

ULTRA PURE WATER		COMMENTS
Piping Size	2”	Based on system recirculation flow rate of approximately 3 times consumption rate
Piping Material	Polypropylene, natural	
Avg. Consumption	15 gpm	
Temperature	70°F ± 1°F	
Quality	SEMI E-1 Grade	Exception: Oxygen 10 ppb and TOC 2 ppb
Pressure	min. 55 psig @ POU	

DEIONIZED WATER		COMMENTS
Piping Size	1-1/4”	
Piping Material	PVC	
Avg. Consumption	24 gpm	5 gpm to laboratories, 4 gpm to humidifiers and PCW make-up and 15 gpm to UPW polish.
Temperature	70°F ± 1°F	
Quality	min. CAP Type II	3-10 Megohm-cm
Pressure	min. 55 psig @ POU	

Process Cooling Water System

The system will consist of VFD controlled pumps, an air separator, a diaphragm expansion tank, plate and frame heat exchangers, and 10 micron cartridge filters. The main header will be constructed of welded 304 stainless steel schedule 10 pipe, and the laterals will be schedule 80 PVC. The system will operate with a resistivity of 1.0 megaohm but may vary depending on the tool requirements. The resistivity will be maintained through blowdown and the addition of DI water.

The system will have N+1 redundancy on the pumps, heat exchanges, and filters. The flow and pressure will be maintained by the use of VFDs on the distribution pumps. The pumps will be controlled to operate in parallel configuration, with automatic pressure controls modulating pump speed to maintain system pressure. In the event of pump failure, the controller will start the backup pump. The controller will modulate the control valve on the chilled water service to the heat exchanger to maintain system supply temperature. The controller will monitor system conductivity and alarm if measured outside acceptable range.

PROCESS COOLING WATER		COMMENTS
Piping Size	3”	Main size; lateral sizing TBD based on flows to different areas of the facility
Piping Material	SS 304L Sch 10 / PVC Sch 80	SS for piping 2-1/2” and larger, PVC for piping 2” and smaller
Cleanroom Flow Rate	155 gpm	
Lab Flow Rate	25 gpm	Initial estimate is 15% of cleanroom flow rate; PCW flows to specified areas of the Lab Building TBD
System Capacity, Flow Rate	180 gpm	
Temperature	55°F/65°F	Supply/Return temperatures
Quality	1 Megohm / 10 micron	Injection of DI water and draining to AW to control resistivity
Pressure	min. 70 psig @ POU	Initial estimate; final pressure TBD

Process Vacuum System

The PVAC system will consist of skid mounted rotary vane vacuum pumps and receiver tank, and distribution piping. The system will be designed to produce 25 inches Hg of vacuum at the vacuum pumps, providing approximately 23 inches Hg at points of use. The system will have N+1 redundancy on the vacuum pumps. The pumps will be controlled in a lead-lag configuration, with automatic switchover based on total run time. The controller will monitor system pressure to start and stop pumps as required to maintain setpoint.

PROCESS VACUUM		COMMENTS
Piping Material	CPVC	
Cleanroom Flow Rate	10 scfm	Lab will not have centralized system, but will have point of use pumps
System Capacity, Flow Rate	205 acfm	
Quality	N/A	
Pressure	23" Hg Vac @ POU	

Clean Dry Air System

The clean dry air system will be designed to provide a continuous supply of oil-free, clean, dry air at an anticipated total system flow rate of 40 scfm, and minimum pressure of 100 psig at points of use. This includes 20 scfm for tool loads and 17 scfm for facility uses, i.e. instrument air, diaphragm pumps, plant air, and steam humidification. The system will include oil free rotary screw compressors, epoxy painted carbon steel receiver tanks, heat reactive dual tower air dryers, and 0.01 micron final filters. The system will have N+1 redundancy on the compressors, heat reactive air dryers, and final filters.

CDA system equipment will be controlled by independent skid controllers provided with the equipment. The air compressors will be controlled in a lead-lag configuration, with automatic switchover based on total run time. The controller will monitor system pressure to start and stop compressors as required to maintain setpoint.

CLEAN DRY AIR		COMMENTS
Cleanroom Piping Material	Copper (CFOS)	
Lab Piping Material	Copper (CFOS)	
Cleanroom Flow Rate	20 scfm	
Lab Flow Rate		Lab will not tie into the centralized system but will have POU CDA cylinders
System Capacity, Flow Rate	40 scfm	Includes dryer purge
Quality	Dewpoint -40°F / 0.01 micron	
Pressure	90 psig @ POU	

Bulk High Purity Nitrogen Gas Systems

The system will consist of cryogenic storage tanks, vaporizers, purifiers, and final filters. Nitrogen gas will be piped into the facility in 316L electropolished stainless steel pipe with orbitally welded joints. All fittings, valves and regulators will also be 316L SS.

A gas vendor will be contracted to provide necessary gas capacities, demands, and qualities. The bulk nitrogen system controls will be provided by the nitrogen vendor with the bulk storage and generation system.

NITROGEN	SIZE/MATERIAL	COMMENTS
Cleanroom Piping Material	Stainless Steel 316L	
Cleanroom Flow Rate	50 scfm	15 scfm of high purity nitrogen
Lab Flow Rate		Lab will not tie into the centralized system but will have POU N2 cylinders
System Capacity, Flow Rate	70 scfm	
Quality	Purity: 99.99%	
Pressure	100 psig @ POU	Pressure required for back-up of CDA system

ELECTRICAL: CODES AND STANDARDS

Codes

National Electrical Code (2005)	NFPA 70
National Electrical Safety Code	NESC
National Fire Alarm Code	NFPA 72

Standards

American National Standards Institute	ANSI
Institute of Electrical and Electronics Engineers	IEEE
National Electrical Manufacturers Association	NEMA
Underwriters' Laboratories	UL
Standard for the Protection of Cleanrooms (1998)	NFPA 318
Installation of Lightning Protection Systems (1997)	NFPA 780

Cleanroom Power Supply

A double ended 480V main switchgear in the main electrical room, will be utilized for power supply to the Cleanroom tools and utility loads. The 480V main switchgear will have two buses, each supplied from a separate utility power stepdown transformer. One bus will serve the technical loads consisting of Cleanroom tools and laboratory equipment. The other bus will be utilized for power to the mechanical and process systems, lighting and general power for the building. There will be a normally open tie breaker between the two switchgear buses. The tie breaker can be manually closed to supply the technical and utility bus from a single transformer in the event one transformer is out of service. 120 / 208V power will be provided from the main switch-gear technical and utility buses via stepdown transformers. Transformers feeding 120 / 208V technical loads will be K– rated. The main 480V switchgear, the associated utility power stepdown substation transformers and the 120 / 208V power system will be provided by others.

Cleanroom Power Loading

The anticipated electrical loading is estimated using parametric values from similar facilities.

Cleanroom Electrical Load Summary (Cleanroom Area= Approx. 12,000 Sq Ft)			
System / Equipment	**Connected Load (KVA)**	**Demand Factor %**	**Demand Load (KVA)**
(Switchgear Bus A Technical) – Cleanroom Tools & Lab Equipment			
Cleanroom Tools (average / diversified)	850	100%	850
Miscellaneous Loads (estimated)	50	100 %	50
Sub Total	1000	-	1000
Future Technical Loads (20%)	200	100 %	200
Total Load on Bus A	**1100**	**-**	**1100**
Switchgear Bus B (Utility) – Mechanical, Process Systems, Lighting & Other Bldg. Loads			
Lighting (4 W / Sq ft)	50	100%	50
Cleanroom HVAC	550	80%	440
Cleanroom Process Systems	500	80%	400
Cleanroom General Use Receptacles (3 W / Sq ft)	35	60%	20
Cleanroom Misc. Utility Loads (estimated)	50	40%	20
Sub Total	1185	-	930
Future Utility Loads (20%)	240	50%	120
Total Load on Bus B	**1425**	**-**	**1050**
Total Cleanroom Load (Bus A & B)	**2525**	**-**	**2150**

Cleanroom Power Distribution

The nominal utilization voltage for the Cleanroom utility loads will be 480 / 277 volt, 3 phase, 4 wire and 208 / 120 volts where needed. Distribution panels and motor control centers fed from the main switchgear utility bus will be provided in the area of the cleanroom HVAC and process equipment. VFD's where required, will be fed from feeder breakers in panel boards or MCC. Motor controllers will have draw-out, combination starters with motor circuit protectors. Control at the starter will be HAND-OFF-AUTO (HOA). Local disconnects will be provided at motors unless the controller is near the motor. Cleanroom lighting will be 277 volts.

The nominal utilization voltage for the technical loads will be 208 / 120 volts, 3 phase, 4 wire. Some tools may require power at 480 V. All panel boards serving the Cleanroom will be located in the chase areas.

In the area of equipment sensitive to EMI, the location of electrical equipment such as transformers, distribution panels shall be avoided or minimized in the defined zone. Appropriate EMI mitigation measures such as providing remote ballasts for the lighting in the area, twisted cables in rigid steel conduit and routing electrical circuits out of the area will be considered.

Chemical and gas storage areas, classified as hazardous per National Electrical Code, shall utilize listed explosion proof devices and hazardous area conduit and wiring methods.

Cleanroom Uninterruptible Power Supply (UPS)
Cleanroom loads requiring continuous power will be supplied from the facility UPS system provided by others. Life safety monitoring and alarm systems will be served from the UPS. Tool user required UPS will not be provided from the facility UPS but will be provided by the users at the tools.

Cleanroom Emergency Power
Cleanroom utility loads including HVAC, process and emergency lighting requiring emergency power will be served from the facility emergency power system provided by others.

Power Quality
The load types for the facility generally produce high harmonic feedback into the power distribution system. The system will be designed to prevent these harmonics from over heating the distribution system components. All step down transformers will have a K-13 rating. All 208 / 120 volt four wire panels will be supplied with double sized neutral bus. All single-phase loads will be served with dedicated neutral conductors. All lighting ballasts and variable frequency drives will be specified with a maximum 10% total harmonic feedback into the power supply system.

Transient Voltage Surge Suppression (TVSS) will be implemented at distribution equipment.

Cleanroom Grounding Systems
The electrical safety ground will be provided in accordance with the NEC. The building grounding system, by others, will be extended into, and connected to the Cleanroom grounding system for sensitive process tools. The Cleanroom grounding system will consist of a 20-foot grid of copper conductors in the raised floor space for extension to tools during the hook-up phase. This grid will be connected to the electrical safety ground system.

Ground fault protection will be provided for receptacles in wet areas and within six feet of all sinks via individual GFCI receptacles.

Conductive flooring in Cleanroom areas will be grounded to the electrical safety ground system.

Cleanroom Lighting and Controls

Lighting will generally be fluorescent fixtures using T-8 lamps at a color of 4,100deg K, and high frequency electronic ballasts will be used. Lighting control of the interior fixtures will be by occupancy sensors or local light switches and will comply with the State Energy Management Plan.

Emergency egress pathway lighting will be supplied power from the building emergency power system. The exit signs will be LED type and fed from the emergency power.

The proposed lighting levels and fixture types are tabulated below:

Area Type		Fixture Type	FC	Remarks
Cleanroom	Class 1000	Cleanroom	70-80	Recessed 2'x4'
Cleanroom	Class 100	Cleanroom	70-80	2'x4' with HEPA filters
Cleanroom Service Cores		Cleanroom	50-60	Enclosed Strip Lights
Utility Spaces		Industrial	30-40	Industrial Strip Lights
Support Areas		Industrial	30-40	Surface / Pendant
Gas Pad / Chem. Storage		Explosion Proof	30-40	Fluorescent / HID

Cleanroom Telecommunications

The telecommunications wiring / pathway system for the facility will be provided by others. The building telecommunications system will consist of two gang outlet faceplates, located as shown below.

Cleanroom: 1 Faceplate / 100 sq. ft.

Conduits will be routed from the jacks to a cable tray system routed in the ceiling spaces by others.

Cleanroom Fire Detection and Alarm (FA)

A complete addressable fire detection and alarm system will be provided for the facility by others. The detection system in the Cleanroom will consist of High Sensitivity Smoke Detection Devices and manual pull stations. Annunciation devices will be horn strobe combination units. Installation will comply with the requirements of the Utah Building Code, and NFPA 72. The Cleanroom fire alarm system will tie into the building fire alarm system.

Toxic Gas Monitoring (TGM)

A monitoring system for the detection and alarming of toxic gas leaks in the Cleanroom and labs will be provided. The detectors will be located in the chemical storage areas, at the gas distribution cabinets and at the point of use. The detectors will provide a local alarm and signal to the remote monitor. The detectors in the labs will be provided by others for tie into the monitoring system. The remote monitor in turn will provide an alarm at a terminal (PC) in the security office that operates 24 hrs / day, 365 days / year, and initiate the gas leak annunciation devices for the personnel evacuation via the fire alarm panel. The gas monitor will also provide signal for gas cabinet shutdown.

Liquid chemical leak detection in secondary containment / sumps will also be pro-

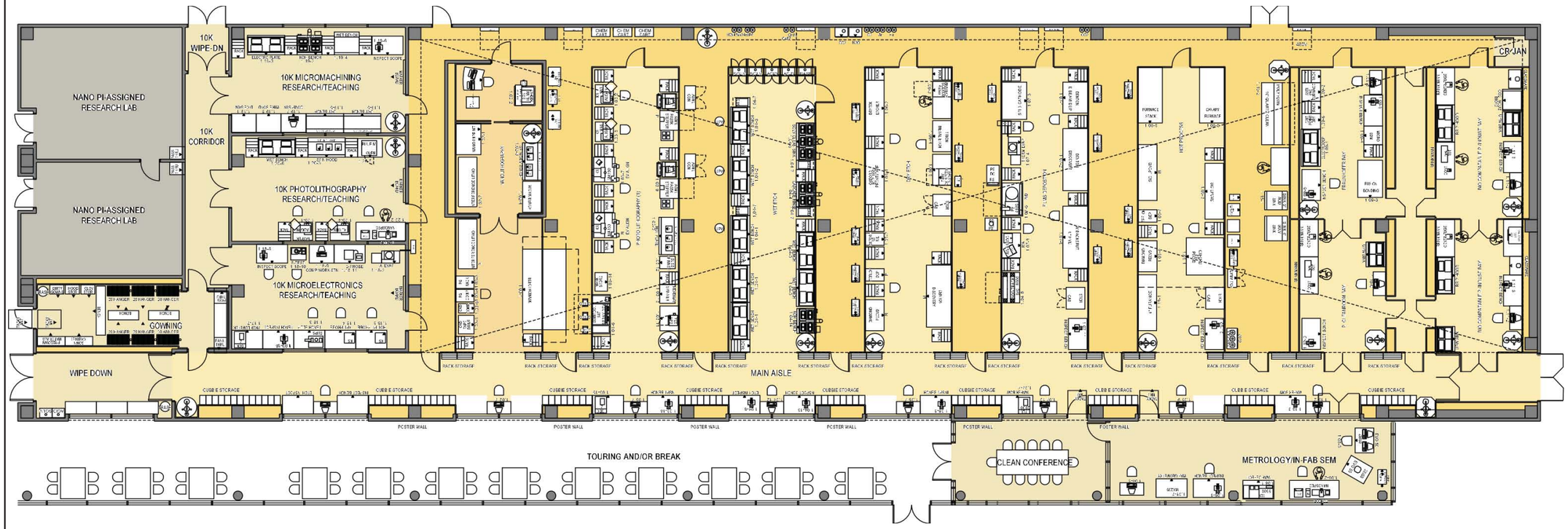
vided as required.

Cleanroom Security

The Cleanroom security system will be comprised of card readers, electric strikes, and door contacts where required to meet Campus requirements. There will be a head-end system, provided by others at the security office. Junction boxes for the installation of security devices at the doors and conduits from the junction boxes into the ceiling spaces will be provided for wiring by others.

Provision shall be made for the installation of a future video surveillance system for monitoring in the Cleanroom, as identified by the University. At each camera location, the provision will include a 120V UPS circuit in a junction for the camera power supply and a second junction box with a conduit stubbed up in the ceiling space for the future video and pan / tilt control wiring to the camera.

CLEAN ROOM LAYOUT



3.3.8 Small Animal Imaging Core

The Small Animal Imaging Core is designed to support the needs of the research activities housed in the NBTRB and will serve to develop new imaging technologies. This core must be accessible to all researchers, yet secured from unauthorized access. Imaging equipment requires specialized environments, particularly in terms of vibration, EM and RF forces, and temperature and humidity controls. This core should be located immediately adjacent too or inside of the Vivarium Core, as there will be continuous traffic between the two cores. Animals may come from the vivarium in this building or from other buildings.

This core will consists of Individual Instrument Rooms with their associated support equipment and Control Rooms; Preparation Rooms; Support Laboratories and other support functions, see **Section 4.0 Space Program** for complete room listing.

The vibration criteria (VC) should be VC-D or 500 MIPS, with temperature range between 68° and 72° in the Instrument Rooms, wider ranges can be tolerated elsewhere; with humidity between 40% and 60%. The shielding requirements will be determined during the design phase, however the shielding may be required to act in both directions, protecting the instruments from outside sources and protecting other equipment from internal sources. Some equipment will be self-shielded, while others will require constructed shielding that can include 6 sided concrete vault surrounds, low-carbon steel and copper sheeting. The use of ferrous metals inside the zone of influence will not be permitted, including reinforcing steel in the concrete, metal stud construction, piping, and conduits. Routing of electrical services must be carefully planned to avoid EM forces negatively affecting the performance of these instruments.

The construction of the Small Animal Imaging Core must allow for extreme durability, including; rigorous cleaning procedures; regular sanitation and occasional decontamination. The walls must be masonry with a cement plaster coat and epoxy enamel wall coating leaving an absolutely smooth surface and no pin holes. The floor finish throughout this core must be monolithic with an integral 6" high base, possibly sloping. The ceilings will be 2 x 2 accessible ceiling systems with vinyl wrapped GWB panels. See **Section 4.2 Individual Room Data Sheets** for the specific requirements for each space.

The utilities required to support each piece of equipment will be finalized during the Design phase but will include; "clean" electrical power; emergency power, (voltage and capacity to be determined); cooling process water; and laboratory grade water; and specialty gasses, (to be determined).

The Small Animal Imaging Core should be designed to allow for direct expansion, particularly in the number of specialized equipment rooms. The Support Laboratories; and Preparation Rooms should be sized to accommodate a 100% growth in the number of specialized equipment modules in this core.

3.3.9 Microscopy

The Microscopy core is designed to support the Research community in the NBTRB and throughout the University. This core consists of a number of specialized equipment rooms to house sophisticated microscopes, including phototonic imaging, and their support equipment along with preparation areas and support laboratories. Critical features required to support this core include: stable platforms that eliminate vibrations; environmental controls that provide tight temperature, humidity and air-flow requirements; and shielding of EM and RF sources that can affect the performance of the equipment; and good particulate control provided through HEPA filtered air supply systems. This core should be located away from the Imaging Core and adjacent to the nanofabrication suite in order to make best use of the shared instruments and support areas. If an adjacency between Imaging and Microscopy is provided to encourage collaboration on image analysis, the sensitive equipment locations shall be carefully studied during design to allow equipment separation required.

The vibration criteria, VC should be VC-E or 125 MIPS with temperature range between 68° and 72°; with humidity between 40% and 60%. Air flows will be critical and the location of supply and exhaust air systems will be crucial and must be coordinated with the equipment requirements during the Design phase.

The utilities required to support each piece of equipment will be finalized during the Design phase but will include; “clean” electrical power; emergency power, (voltage and capacity to be determined); cooling process water; and laboratory grade water; and specialty gasses, (to be determined).

The construction of this will be typical interior construction with GWB partitions; monolithic floor finishes and easily cleaned surfaces, and high-performance acoustical tile ceilings. Shielding maybe required and could include copper lining in some partitions. The Microscopy core should be designed to support a direct expansion of the number of instrument suites and their support requirements. Core laboratories should be sized to accommodate a 50% expansion of the number of instruments to be housed in the core and the expansion must meet the same criteria as described above.

3.3.10 Lab Equipment

The following spreadsheets outline the expected equipment requirements for Core facilities: Vivarium, Small Animal Imaging, Biomedical Microscopy, Nanofabrication, and Microscopy, as well as basic equipment for the P.I. Assignable Lab and Lab Support Spaces.

The cost of the equipment is broken down into three categories:

- Outside Construction
- In Construction
- Outside Project Cost

Items in the "Outside Construction" category would be directly procured by the University of Utah, outside of the construction contract. Examples of these items include furniture, moveable casework, and certain fixed equipment.

Items in the "In Construction" category would be part of the construction contract, as they are in some way essential to the proper operation of the building and / or require contractor coordination to install. Examples of these items include autoclaves, fixed casework, and fume hoods.

Items in the "Outside Project Cost" category would be procured with funds outside of the NBTRB total project budget. The majority of these items are loose equipment, such as microscopes, animal cages, and imaging equipment.

USTAR at University of Utah

Summary Total Project Budget for Lab Equipment Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007 Revised: *14-Nov-07*

							total	in constrution	
Lab Casework	LAB	sf						$0	
			QTY	**unit per P. I. lab**		**extended cost**	**Total**	**Cost in Construction**	**Outside Project Cost**
Lab Bench	A	1	Lab Suppport / Fixed Bench	240	$	2,750	$660,000	$660,000	
			Includes Wall Cabinets						
	B	1	Open Lab / Movable Bench	720	$	2,200	$1,584,000	$1,584,000	
			Includes Reagent Shelving						
			Fume hoods are additional						
	E	0.5	Wall casework-Support	0	$	2,300	$0	$0	
Overhead Service	D		Flexible Open Lab	360	$	2,750	$990,000	$990,000	
			Overhead Service Carrier						
Other	M		Cylinder Straps	90		$96	$8,640	$8,640	
	N		Task Lights	322		$60	$19,320		$19,320
	O		Gas Manifolds	24		$5,000	$120,000	$120,000	
	P		Fume Hoods	30		$8,500	$255,000	$255,000	
			Future Fume Hoods	48		$8,500	$408,000		$408,000
	D		Autoclave	7		$65,000	$455,000	$455,000	
	E		Glasswasher	7		$42,500	$297,500	$297,500	
			RO unit	7		$11,100	$77,700	$77,700	
	G		6' BSC	24		$10,231	$245,544		$245,544
	H		6' Biological Safety Cabinet	6		$17,400	$104,400		$104,400
			4' Biological Safety Cabinet	0		$15,930	$0		$0
	I		Building RO unit	1		$125,000	$125,000	$125,000	
	J		Point of Use Ultra pure - add	0		$7,500	$0		$0
	K		Environmental room	5		$47,491	$237,455	$237,455	
	L		Marker Boards	57		$162	$9,217	$9,217	
	Q		Adjustment response allow.	1		$300,000	$300,000		
							$5,896,776		
			Equipment outside construction				**$300,000**		
			Equipment in construction					**$4,819,512**	
			Equipment outside project						**$777,264**

USTAR at University of Utah

Summary Budget for Animal Equipment Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007

Revised: *14-Nov-07*

Animal Resource Equipment

			QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Racks and Cages	A	Double sided rodent racks w/ 108 cages / rack	32	$30,200	$966,400		$966,400
	B	Medium animal racks	12	$27,500	$330,000		$330,000
	C	Large animal racks	24	$8,000	$192,000		$192,000
	D	Micro isolator racks for quarantine	6	$25,000	$150,000		$150,000
	E	Redundant Racks	3	$21,000	$63,000		$63,000
	F	Redundant Caging	1000	$70	$70,000		$70,000
	G	Material handling accessories; carts, pallet movers, food/bedding scaffolding	1	$52,500	$52,500		$52,500
	H	Cage for large animal temp holding	0	$4,000	$0		$0
	I	Zebrafish tanks racks	44	$1,500	$66,000		$66,000
Safety Cabinets and Hoods	J1	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	11	$12,000	$132,000		$132,000
	J2	Class II Type A2 (A/B3) vertical laminar flow, mobile	0	$10,000	$0	$0	$0
	J3	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0	$0	$0
	K	Fume hood for isotope / carcinigens	0	$9,500	$0		$0
Casework		Average Casework Bench Includes Wall Cabinets	10	$ 2,750	$27,500	$27,500	

Surgery / Procedure Systems / Equipment	L1	Surgery tables	3	$12,500	$37,500		$37,500
	L2	Surgery prep tables	2	$1,000	$2,000		$2,000
	L3	Necropsy downdra	1	$15,000	$15,000	$15,000	
	M	Surgical equipmen	1	$60,000	$60,000		$60,000
	N	Surgical lights	3	$12,000	$36,000	$36,000	
	O	Casework	0	$900	$0	$0	
	P1	Freezer for carcass	1	$7,500	$7,500		$7,500
	P2	Environmental Cha	1	$35,000	$35,000	$35,000	
	P3	Ice Machine	1	$4,000	$4,000		$4,000
	P4	Lab Refrigerator	1	$2,000	$2,000		$2,000
	P5	Lab Freezer -20C	1	$3,000	$3,000		$3,000
	P:6	Lab Freezer -80C	1	$20,000	$20,000		$20,000
Watering System	Q	Point of Use Auto watering control and monitoring system w/ RO purification watering system	0	$7,500	$0	$0	
Monitoring System	R	Monitor system for rooms for temperature, humidity, air flow and light control	14	$14,000	$196,000	$196,000	
	S	Monitor system corridor to room pressure differential	0	$31,000	$0	$0	
		included in R above					
	T	Door latching syste	0	$2,500	$0	$0	
		included in door hardware					
Auto Cage Wash and Bedding System	U	Tunnel Washer	0	$250,000	$0	$0	
	V	Bedding Disp/Waste Removal	0	$350,000	$0	$0	
	W	Cage & Rack Washer	1	$240,000	$240,000	$240,000	
Bulk Autoclave	X1	Autoclave	1	$230,000	$230,000	$230,000	
	X2	Autoclave for BSL	0	$80,000	$0	$0	
	X3	ETO Stirilizer	0	$25,000	$0		
Stations	Y	Waste dumping sta	0	$16,000	$0	$0	
	Z	Bottle filling statio	0	$25,000	$0	$0	

	AA	Hose flushing stati	0	$3,000	$0	$0	
Miscellaneous	AA	Carts at cage wash	0	$40,000	$0	$0	
	BB	Irradiator	0	$120,000	$0		
	CC	Benchtop Clinical	0	$2,000	$0		
	DD	Portable X-ray Equipment & Developing Machine	0	$120,000	$0		
	EE	Washer/Dryer	1	$1,500	$1,500		$1,500
	FF	Misc. Operational Equipment; pressure washer, portable steam generator unit, floor scrubber machine, phone paging system	1	$75,000	$75,000		$75,000
	GG	Diagnostic Lab Equipment	0	$50,000	$0		
	HH	Small Animal Waste reduction unit	0	$25,000	$0 $0		
		Misc Equipment	1	372788	$372,788		
				Total	**$3,386,688**	**$779,500**	
		Equipment outside construction			**$372,788**		
		Equipment in construction				**$779,500**	
		Equipment outside project					**$2,234,400**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: December 10, 2006 Revised: *November 14, 2007*

Imaging Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Current Equipment to be moved	7.0 Tesla MRI	1	n/a	n/a		
Imaging Wish List	Fluorescence Imager	1	$265,000	$265,000		$265,000
	Bioluminescent Imager	1	$350,000	$350,000		$350,000
	Micro PET/CT	1	$810,000	$810,000		$810,000
	Ultrasound/ Color Dopler	1	$320,000	$320,000		$320,000
	QAR	1	$60,000	$60,000		$60,000
	Laser Doppler	1	$22,000	$22,000		$22,000
	Micro SPECT/CT	1	$585,000	$585,000		$585,000
	Cryo-macrotome	1	$235,000	$235,000		$235,000
	Fluoroscopy	1	$130,000	$130,000		$130,000
	Optical Coherence Tomography	1	n/a	n/a		
	PEM-future	1	n/a	n/a		
	Network Analyzer	1	$0	$0		
	Mini PACS	1	$60,000	$60,000		$60,000
Lab Support Wish List	Microscope for surgery	1	$0	$0		$0
	Monitoring Equipment	1	$0	$0		$0
	Anesthesia Equipment	1	$7,500	$7,500		$7,500

	Mini cells for Radioschem. Lab	1	$162,468	$162,468		$162,468
Safety Cabinets and Hoods	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	0	$12,000	$0		$0
	Class II Type A2 (A/B3) vertical laminar flow, mobile	2	$10,000	$20,000		$20,000
	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0		$0
	Fume hood	5	$9,500	$47,500	$47,500	
Casework	Average Casework Bench Includes Wall Cabinets	40	$ 2,750	$110,000	$110,000	
			Total	**$3,184,468**		
	Equipment outside construction			**$0**		
	Equipment in construction				**$157,500**	
	Equipment outside project					**$3,026,968**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: December 10, 2006 Revised: *November 14, 2007*

Biomedical Microscopy Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Biomedical Microscopy Wish List	Confocal	1	$358,000	$358,000		$358,000
	Two-photon confocal	1	$550,000	$550,000		$550,000
	Spinning Disk Confocal	1	$150,300	$150,300		$150,300
	TEM	0	$900,000	$0		$0
	Mid-voltage TEM, tomography	1	$300,000	$300,000		$300,000
	4 Pi	1	$1,200,000	$1,200,000		$1,200,000
	STED	0	$1,300,000	$0		$0
	TIRF	1	$160,000	$160,000		$160,000
	SEM	0	$500,000	$0		$0
	Fast Acquisition Scope	1	$0	$0		$0
Biomedical Lab Support Wish List	Optical Bench	1	$4,000	$4,000		$4,000
	High Pressure Freezer	1	$205,000	$205,000		$205,000
	FC6 - Ultramicrotome	1	$90,000	$90,000		$90,000
	x	1	$0	$0		$0
Safety Cabinets and Hoods	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	0	$12,000	$0		$0
	Class II Type A2 (A/B3) vertical laminar flow, mobile	1	$10,000	$10,000		$10,000
	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0		$0
	Fume hood for isotope / carcinigens	1	$9,500	$9,500		$9,500
Casework	Average Casework Bench Includes Wall Cabinets	9	$2,585	$23,265	$23,265	
			Total	**$3,060,065**		

Equipment outside construction	**$0**		
Equipment in construction		**$23,265**	
Equipment outside project			**$3,036,800**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: March 9, 2007 Revised:

Nanofab Microscopy Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
FE NanoCT	FE nanoCT (300KV)	1	$2,268,000	$2,268,000	$0	$2,268,000
HR SEM	HR SEM (make?)	1	$702,000	$702,000	$0	$702,000
FE ESEM (Analytical)	FE ESEM	0	$702,000	$0	$0	$0
DB FIB and Nabity Nanolithography	DB FIB + Nabity Nanolithography	1	$1,512,000	$1,512,000	$0	$1,512,000
DSIMS	(DSIMS)	0	$0	$0	$0	$0
AUGER	(AUGER)	0	$432,000	$0	$0	$0
XPS	Imaging XPS/Auger/ISS	1	$30,000	$30,000	$0	$30,000
Microscopy Service Corridor	0	1	$0	$0	$0	$0
AFM (Wet + Solid State)	AFM	1	$81,000	$81,000	$0	$81,000
	Wet AFM	1	$270,000	$270,000	$0	$270,000
Optical Microscopy (SNOM)	SNOM	0	$270,000	$0	$0	$0
Optical Microscopy	Profilometer Tencor p-20	1	$54,000	$54,000	$0	$54,000
	Zygo Optical Profilometer	1	$21,600	$21,600	$0	$21,600
	Nano-Indenter	1	$129,600	$129,600	$0	$129,600
	FTIR	1	$108,000	$108,000	$0	$108,000
	Ellipsometer . Woollam . V-Vase	1	$26,000	$26,000	$0	$26,000
	Polyvar Mettalurgical	1	$3,000	$3,000	$0	$3,000
	Image Analyzer	1	$5,400	$5,400	$0	$5,400
	UVVis/NIR	1	$0	$0	$0	$0
Magnetometry	Hall msmt (1T)	0	$162,000	$0	$0	$0
	SQuID	0	$0	$0	$0	$0
	Lakeshore VSM	0	$0	$0	$0	$0
Crystallography	HR XRD	1	$0	$0	$0	$0
Electrical Characterization	Probe stations	1	$270,000	$270,000	$0	$270,000
	Test Apparatus (Keithley 4200)	1	$29,000	$29,000	$0	$29,000
	Test Apparatus (Keithley 2400)	2	$29,000	$58,000	$0	$58,000

	Thermonix Substrate Heating / Cooling	1	$32,400	$32,400	$0	$32,400
	Thermal Cycling Furnace	1	$21,600	$21,600	$0	$21,600
	4-pt probe	1	$32,400	$32,400	$0	$32,400
	C/V measurement with signal generator	1	$21,600	$21,600	$0	$21,600
Sample Prep	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	2.5' Deep Fume Hood	2	$5,940	$11,880	$11,880	$0
	Flammable Storage Cabinet Under Hood	2	$0	$0	$0	$0
	Corrosive Storage Cabinet Under Hood	2	$0	$0	$0	$0
	Epoxy Resin Counter w/ Cabinets Below	1	$0	$0	$0	$0
	Upper Cabinets with Swinging Glass Doors	1	$0	$0	$0	$0
	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	1	$0	$0	$0	$0
	Overhead Service Carrier	1	$0	$0	$0	$0
	Epoxy Resin Adjustable-Height Table w/ Cabinets Below	4	$0	$0	$0	$0
	wet staining / decoration (in hood)	1	$0	$0	$0	$0
	supporting sample prep tools (ion mills, C- Au-coating, dimpler, hoods, cabinets, ultrasonic cutter)	1	$216,000	$216,000	$0	$216,000
	Dimpler . Gatan . 656 Dimple Grinder	1	$0	$0	$0	$0
	Critical Point Dryer . Bal-Tec . CPD-030	1	$0	$0	$0	$0

Ion Mill . Gatan . 681 HR Ion Beam Coater	1	$0	$0	$0	$0
Ultrasonic Cutters . Gatan . 601 Tuned Piezo Cutting Tool	1	$0	$0	$0	$0
UV ozone cleaner . Fischione . 1020 Plasma Cleaner	1	$0	$0	$0	$0
Carbon Coater . NanoMaster . NSC3000	1	$0	$0	$0	$0
Carbon Coater Rough-In Pump (undercabinet)	1	$0	$0	$0	$0
Carbon Coater PC	1	$0	$0	$0	$0
Double-Stacked Curing Ovens . Blue M . STK-04	1	$0	$0	$0	$0
Polishing Wheel . Lapmaster . 15 (TT)	1	$0	$0	$0	$0
Cryoultramicrotome . Leica . Ultracut (EM FC6?)	1	$0	$0	$0	$0
Cryoultramicrotome LN2 Dewar . Leica . Ultracut (EM FC6?)	1	$0	$0	$0	$0
Evaporator . Sharon Vacuum . Custom	1	$0	$0	$0	$0
Wire Saw . South Bay Tech . 850 (TT)	1	$0	$0	$0	$0
Diamond Saw . South Bay Tech . 660 (TT)	1	$0	$0	$0	$0
Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Optical Microscope	1	$0	$0	$0	$0
		Total	**$5,904,680**		

Equipment outside construction **$0**

Equipment in construction	**$13,080**	
Equipment outside project		**$5,891,600**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: March 9, 2007 Revised:

Nanofab Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Nanolithography (Cl 100)	Wafer Handling / Vacuum Wands	2	$1,100	$2,200	$2,200	$0
	Nano Imprint or immersion microstep	1	$540,000	$540,000	$0	$540,000
	Nanolith	1	$1,296,000	$1,296,000	$0	$1,296,000
	Spin/Developer	1	$129,600	$129,600	$0	$129,600
	Interference Lithography	1	$2,000	$2,000	$0	$2,000
Photolithography (Cl 100)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Electromask	1	$85,000	$85,000	$0	$85,000
	Reticle Aligner	1	$15,000	$15,000	$0	$15,000
	PG rack	1	$0	$0	$0	$0
	PG Computer	1	$0	$0	$0	$0
	CAD Computer	2	$0	$0	$0	$0
	CAD Tape Drive	2	$0	$0	$0	$0
	EV Aligner	1	$15,000	$15,000	$0	$15,000
	Suss Aligner	1	$15,000	$15,000	$0	$15,000
	Wafer Stepper	1	$216,000	$216,000	$0	$216,000
	Hot Plate Bake	3	$10,800	$32,400	$0	$32,400
	Vapor Prime Oven	1	$32,400	$32,400	$0	$32,400
	Suss Spinner	1	$3,000	$3,000	$0	$3,000
	Headway Spinner	1	$5,000	$5,000	$0	$5,000
	Mask Storage	1	$1,080	$1,080	$0	$1,080
	Dektak 2	1	$1,000	$1,000	$0	$1,000
	Spray Develop Ultra-Tech	1	$43,200	$43,200	$0	$43,200
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Wet Processing	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Wet Bench (acid)	3	$32,400	$97,200	$0	$97,200
	Wet Bench (base)	1	$32,400	$32,400	$0	$32,400

	Wet Bench (electrochemistry)	1	$32,400	$32,400	$0	$32,400
	Wet Bench (acid) w/ Cascade Rinse	1	$5,000	$5,000	$0	$5,000
	Solvent Bench	2	$32,400	$64,800	$0	$64,800
	Solvent Bench	1	$5,000	$5,000	$0	$5,000
	Spin/Rinse/Dry	3	$32,400	$97,200	$0	$97,200
	Fluoroware	1	$21,600	$21,600	$0	$21,600
	KOH Etch Bench	1	$60,000	$60,000	$0	$60,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Hot Process	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Oxford 80+ PECVD	1	$35,000	$35,000	$0	$35,000
	Oxford 80+ RIE	1	$35,000	$35,000	$0	$35,000
	SiC (LPCVD)	1	$20,000	$20,000	$0	$20,000
	Diamond u-wave hi rate PECVD (ECR for millitorr), also thermal (RF/induction) CVD	1	$594,000	$594,000	$0	$594,000
	Canary Furnace	1	$54,000	$54,000	$0	$54,000
	New Furnace stack 2-ox, LPCVD nitride, LTO, poly, diff (2)	1	$348,000	$348,000	$0	$348,000
	Teflon conformal deposition	1	$216,000	$216,000	$0	$216,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Dry Etch	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Oxford ICP 100+ PECVD/DRIE	1	$50,000	$50,000	$0	$50,000
	Drytek etcher	1	$12,000	$12,000	$0	$12,000
	u-wave Asher	1	$81,000	$81,000	$0	$81,000
	Trion Metal Etch (ion)	1	$232,000	$232,000	$0	$232,000
	XeF2 release etch	1	$86,400	$86,400	$0	$86,400

	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Films Deposition	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Denton e-beam dep	1	$8,000	$8,000	$0	$8,000
	Denton Discovery	1	$36,000	$36,000	$0	$36,000
	SFI 3-cathode	1	$16,000	$16,000	$0	$16,000
	Thermal Evaporator	1	$26,000	$26,000	$0	$26,000
	Perkin Elmer	1	$8,000	$8,000	$0	$8,000
	6" PVD with backsputtering	1	$278,000	$278,000	$0	$278,000
	Flexus wafer bow measurement	1	$0	$0	$0	$0
	RTA with vacuum capability	1	$81,000	$81,000	$0	$81,000
	Spin on Glass - Planarization	1	$129,600	$129,600	$0	$129,600
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
PI Cleanroom Bay 1	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Electrodeposition	2	$270,000	$540,000	$0	$540,000
	SSTI Vacuum Furnace	1	$43,200	$43,200	$0	$43,200
	Fusion Bonding	10	$2,000	$20,000	$0	$20,000
	micro-EDM	4	$140,400	$561,600	$0	$561,600
	Inspection Bench	3	$8,640	$25,920	$0	$25,920
	Critical Point dryer	1	$8,000	$8,000	$0	$8,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
PI Cleanroom Bay 2	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
BioCompatible PI/Industrial Bay	Safety Shower / Face Wash	2	$1,200	$2,400	$2,400	$0

	Wafer Handling / Vacuum Wands	8	$1,100	$8,800	$8,800	$0
	Inspection Bench w/ Digital Imaging Microscope	2	$32,400	$64,800	$0	$64,800
Chemical Pass-Thru	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Chemical Tranfer Rack (Stationary Cart)	5	$6,000	$30,000	$30,000	$0
Cleanroom Main Aisle	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	7	$1,100	$7,700	$7,700	$0
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
	Cube Storage	200	$108	$21,600	$21,600	$0
Clean Janitors (Cl 10K) (in box)	Cleanroom Floor Cleaner	1	$5,000	$5,000	$0	$5,000
Cleanroom Chases	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Quartzware Washer	1	$43,200	$43,200	$0	$43,200
	Diffusion Tube Cleaner	1	$72,000	$72,000	$0	$72,000
Main Gowning (Cl 10K)	Solvent storage Securall A360	2	$500	$1,000	$1,000	$0
	Acid storage Securall A360	1	$500	$500	$500	$0
	Base storage Securall A360	1	$500	$500	$500	$0
Metrology (Cl 10K)	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Wafer defect review tool	1	$29,160	$29,160	$0	$29,160
	Nanospec	1	$32,400	$32,400	$0	$32,400
	In-fab imaging SEM	1	$650,000	$650,000	$0	$650,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
	MX205 Wafer Geometry	1	$108,000	$108,000	$0	$108,000
Clean Microelectronics Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0

	4" furnaces (wet ox, dry ox, B-diff, P-diff, annealing, polySi)	1	$10,000	$10,000	$0	$10,000
	Al evaporator	1	$6,000	$6,000	$0	$6,000
	teaching ellipsometer	1	$0	$0	$0	$0
	4-pt probe	1	$0	$0	$0	$0
	hot pt. probe	1	$0	$0	$0	$0
	teaching inspection microscopes	1	$0	$0	$0	$0
	profilometer	1	$0	$0	$0	$0
	inspection microscopes	1	$0	$0	$0	$0
	computer workstation	1	$0	$0	$0	$0
	electrical test stations	1	$0	$0	$0	$0
	two probe test stations	1	$0	$0	$0	$0
Clean Micromachining Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Dicing saw (MAx2)	2	$0	$0	$0	$0
	KOH Etch Bench	1	$35,000	$35,000	$0	$35,000
	Electroplating	1	$40,000	$40,000	$0	$40,000
	Wet Bench	1	$32,400	$32,400	$0	$32,400
	Dry Bench (exhausted)	2	$20,000	$40,000	$0	$40,000
	Inspection Microscopes	1	$0	$0	$0	$0
	Computer Workstations	1	$0	$0	$0	$0
	Wire Bonding	1	$0	$0	$0	$0
Clean Photolithography Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	OAI Contact Aligner	1	$54,000	$54,000	$0	$54,000
	OAI Contact Aligner	1	$2,500	$2,500	$0	$2,500

	Teaching Tencor p-10	1	$0	$0	$0	$0
	Spinner (exhausted)	1	$5,000	$5,000	$0	$5,000
	Bake Oven (exhausted)	1	$3,000	$3,000	$0	$3,000
	Wet Bench (acid)	1	$5,000	$5,000	$0	$5,000
	Wet Bench (solvent)	1	$5,000	$5,000	$0	$5,000
	Exhausted Dry Bench	1	$20,000	$20,000	$0	$20,000
OMVPE (H2/H3 occupancy)	Safety Shower / Face Wash	0	$1,200	$0	$0	$0
	New OMVPE 1	0	$1,080,000	$0	$0	$0
	Gas Cabinet 2	0	$5,000	$0	$0	$0
	OMVPE Reactor	0	$2,160	$0	$0	$0
	MBE	0	$648,000	$0	$0	$0
	Microscope	0	$0	$0	$0	$0
	Wet Bench	0	$32,400	$0	$0	$0
	POU Arsenic Abatement	0	$32,400	$0	$0	$0
Industrial Partner Lab	acoustic tomography	0	$194,400	$0	$0	$0
	bond pull tester	0	$70,200	$0	$0	$0
	pick and place	0	$97,200	$0	$0	$0
	die attach	0	$43,200	$0	$0	$0
CMP (includes smocking vestibule)	Safety Shower / Face Wash	0	$1,200	$0	$0	$0
	Allied manual polisher	0	$0	$0	$0	$0
	Allied manual polisher	0	$12,960	$0	$0	$0
	Wafer CMP	0	$270,000	$0	$0	$0
	Precision Allied Polisher	0	$0	$0	$0	$0
	2X Low-Magnification Stereo Microscope	0	$8,640	$0	$0	$0
	Hi-Resolution Compound Microscope	0	$17,280	$0	$0	$0
	Staining and Potting (in new hood)	0	$0	$0	$0	$0
	Flexus wafer bow measurement	0	$16,200	$0	$0	$0

Device Assembly / Laser Machining / Dicing	Epoxy Resin Counter w/ Cabinets Below	0	$0	$0	$0	$0
	Upper Cabinets with Swinging Glass Doors	0	$0	$0	$0	$0
	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	0	$0	$0	$0	$0
	Epoxy Resin Adjustable Height Table w/ Cabinets Below	0	$0	$0	$0	$0
	Overhead Service Carrier (Initially Power Only?)	0	$0	$0	$0	$0
	Safety Shower / Face Wash	0	$0	$0	$0	$0
	Laser Machining	0	$35,000	$0	$0	$0
	Wire Bonder (man)	0	$0	$0	$0	$0
	Wire Bonder (KnS)	0	$21,600	$0	$0	$0
	screen printer	0	$0	$0	$0	$0
	Reliability Tester	0	$7,560	$0	$0	$0
	Dicing Saw (Disco)	0	$10,800	$0	$0	$0
	Dicing Saw	0	$86,400	$0	$0	$0
	Wire EDM (hole popper)	0	$0	$0	$0	$0
	Wafer Handling / Vacuum Wands	0	$1,100	$0	$0	$0
	Inspection Bench w/ Digital Imaging Microscope	0	$0	$0	$0	$0
	TMV	0	$70,000	$0	$0	$0
	Nikon Comparator	0	$800	$0	$0	$0
	Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	0	$10,800	$0	$0	$0
	Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	0	$0	$0	$0	$0
	Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	0	$0	$0	$0	$0
	Double-Stacked Ovens . Blue M . STK-04	0	$0	$0	$0	$0
	Plasma Cleaner . Anatech . SP100	0	$0	$0	$0	$0

	Flip Chip Bonder . West Bond . 7476 30E	0	$0	$0	$0	$0
	Hydraulic Press . Hoover? (TT)	0	$8,640	$0	$0	$0
	Electroplating	0	$35,000	$0	$0	$0
	Wet Bench Solvent	0	$32,400	$0	$0	$0
	Laminar Flow Hood for Embossing & Lamination	0	$2,268	$0	$0	$0
	SS Cleanroom Work Bench	0	$594	$0	$0	$0
	Tall Flammable Storage Cabinet	0	$15,000	$0	$0	$0
Clean Conference (10 people) (Cl 10K)	Flat Panel Presentation Display	1	$6,480	$6,480	$6,480	$0
Machine Shop / Vacuum Maintenace & Teaching*	Equipment Space	0	$0	$0	$0	$0
	Storage Racks for Raw Stock	0	$0	$0	$0	$0
	Stick Welder w/ Plasma Cutter	0	$0	$0	$0	$0
	Weld / Brazing Table on Wheels	0	$0	$0	$0	$0
	Torch Set on Wheels	0	$0	$0	$0	$0
	Parts Washer	0	$0	$0	$0	$0
	Bead Blaster	0	$0	$0	$0	$0
	Horizontal Band Saw on Wheels	0	$0	$0	$0	$0
	Machine Tool Work Bench	0	$0	$0	$0	$0
	Assembly Work Bench	0	$0	$0	$0	$0
	Mille / Lathe	0	$0	$0	$0	$0
			Total	**$8,091,240**		
	Equipment outside construction			**$0**		
	Equipment in construction				**$145,180**	
	Equipment outside project					**$7,946,060**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: March 12, 2007 Revised:

Nanofab Gross & Exterior Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Gas Storage	H2 Generator	1	$162,000	$162,000	$0	$0
	3-Bottle Gas Cabinet (2 Hazardous + 1 Purge)	2	$24,840	$49,680	$0	$0
	3-Bottle Gas Cabinet (3 Spares or Empties)	3	$2,160	$6,480	$0	$0
	2-Bottle Gas Cabinet (1 Hazardous + 1 Purge)	10	$20,520	$205,200	$0	$0
	Inert Gas Cylinder Rack - Spares	4	$10,800	$43,200	$0	$0
	Inert Gas Cylinder Rack - Empties	3	$10,800	$32,400	$0	$0
Silane Bunker	Silane Pad/Bunker Equipment	1	$216,000	$216,000	$0	$0
General equipment	General Equipment	1	$366,063	$366,063	$0	$0
			Total	**$1,081,023**		
	Equipment outside construction			**$1,081,023**		
	Equipment in construction				**$0**	
	Equipment outside project					**$0**

3.3.11 Vertical Transportation Summary

EXECUTIVE SUMMARY

General

The program being developed for the Neurological and Biomedical Technology Research Building (NBTRB) includes consideration of both passenger and service elevator functions. This study report is intended to document elevator performance criteria recommended for planning passenger elevators to review possible solutions meeting these criteria based on present program information, and to evaluate needs for service support.

Elevator Performance Standards

Report Section Two gives background on standards previously recommended for evaluating Health Sciences Center passenger elevators at the University of Utah. These standards, which cover the quality and quantity of elevator service, include the following planning criteria recommendations. These criteria are based on 5 minutes of heavy two-way traffic:

	BUILDING PASSENGER ELEVATORS
AVERAGE INTERVAL (SECONDS)	UNDER 40
HANDLING CAPACITY (PERSONS)	AT LEAST 13% OF BUILDING POPULATION IMPACTING ELEVATOR SERVICE

Passenger Elevators

Laboratory functions and teams, as well as support staff and management, are best separated from Vivarium and service support activities. Base passenger elevator requirements on criteria for passenger support only, during five minutes of heavy two-way traffic:

AVERAGE INTERVAL (SECONDS)	UNDER 40
HANDLING CAPACITY (PERSONS)	AT LEAST 13% OF LABORATORY AND ADMINISTRATION STAFF

Preliminary calculations indicate that two elevators are required to meet these criteria. The following were assumed or noted:

1. Vivarium would be at the basement level. Both passenger and service elevators would serve this level.
2. Overhead machine room or machine room-less traction equipment applications are appropriate.
3. Preferred passenger elevator duty is 3500# @ 350 FPM.

Service Support

Dedicated service support using a hospital type elevator configuration (narrow and deep) in order to more easily handle freight, furniture, building material service loads

and Vivarium needs is a possible solution. The elevator should be dimensioned to load the stretcher stipulated by IBC if the building is over four levels. Serving the mechanical level could facilitate service needs for equipment on that level.

An alternative solution for consideration would be a conventional freight elevator of larger size and greater capacity. Such an elevator would have vertically opening doors rather than side opening doors.

Summary
The following applications are recommended:

- Passenger: Traction Equipment, 3500# @ 350 FPM (Platform About 7'-0" Wide x 6'-2" Deep with 3'-6" x 7'-0" Center Opening Doors)
- Service: 5000# Capacity (Platform About 6'-0" Wide x 8'-8" Deep with 4'-6" Wide Side Opening Doors x 8'-0" tall opening doors)
- Alternate Freight: 8,000 to 10,000# Capacity (Platform about 8'-4" Wide by 8' to 10' Deep with 8'-0" Wide Vertical Bi-Parting Doors)

ELEVATOR CRITERIA

General
Passenger elevator performance is generally measured and evaluated using standards which relate to the frequency of available service and the ability of the system to carry passengers as service is required. Elevators intended to handle material and service needs may be subject to similar evaluation, but often the primary consideration is their ability to handle the size and weight of material units that need to be moved vertically. Hereafter, we define and discuss performance standards which should be used to plan elevator requirements for the Neurological and Biomedical Technology Research Building (NBTRB).

Frequency of Service
The availability or quality of elevator serviced, is represented by the length of time prospective passengers wait for an elevator. In existing buildings, event recording meters can be used to measure how long hall calls remain registered before being canceled by an arriving car. This, "System Response Time", averaged over periods of heavy traffic, indicates the average time that the passenger registering the hall call waited for service. Response time is the primary standard we use to evaluate the suitability of elevator service in existing buildings and to specify performance requirements for elevator operating systems for new buildings.

When evaluating requirements for proposed buildings, we use a second measure of elevator service quality, "Average Interval". Average Interval is defined as the average time in seconds between elevator departures from a terminal floor. We generally use periods of five minutes for calculations, 15 minutes for measurements.

If Response Time or Average Interval are too long, space is available for waiting passengers to load on arriving cars, but the duration of the wait is a source of frustration and impatience.

The following tables indicate standards we previously recommended for evaluating the performance potential of passenger elevators at University of Utah Health Sciences' facilities, we suggest these same standards for planning elevators at the Neurological and Biomedical Technology Research Building.

UNIVERSITY OF UTAH HEALTH SCIENCES FACILITIES
PERFORMANCE QUALITY STANDARDS

AVERAGE INTERVAL
5-MINUTE PERIOD OF HEAVY TRAFFIC

RATING	STAFF ELEVATORS (SECONDS)
EXCELLENT	UNDER 30
GOOD TO AVERAGE	30 TO 40
AVERAGE TO FAIR	40 TO 50
POOR	OVER 50

AVERAGE SYSTEM RESPONSE
HEAVY HOUR

RATING	AVERAGE SYSTEM RESPONSE TIME (SECONDS)	DISTRIBUTION OF TIMES		
		% UNDER 30 SECONDS	% UNDER 60 SECONDS	% UNDER 90 SECONDS
EXCELLENT	LESS THAN 25	OVER 75	OVER 95	OVER 98
GOOD	LESS THAN 30	OVER 60	OVER 90	OVER 95
FAIR	LESS THAN 35	OVER 55	OVER 85	OVER 92
POOR	OVER 35	UNDER 55	UNDER 80	UNDER 92

Note: Normally, measured traffic evaluated using these standards will be two-way. (Passengers moving both up and down.) However, they apply equally to traffic which is primarily one direction, either up or down.

Quantity of Service

The quantity measure of passenger elevator service is termed, "Handling Capacity". It is defined as the number of persons that can be transported by the elevators in a designated time period. For service elevators, the volume of goods, number of vehicles, etc., as well as persons, would be included in transport capacity requirements.

If an elevator group has insufficient capacity to carry required loads, cars may arrive with relatively short response times but space is unavailable for waiting passengers or freight to load. Prospective passengers then begin to queue in the lobbies, waiting extended time periods for service.

Handling capacity for passenger elevators is a function of building population and the periodicity of their movement. It can be expressed as the number of persons or percentage of population moved within a designated period for this study, we projected likely requirements using program information.

Recommended Criteria For Planning
The following performance values are recommended for planning a suitable passenger elevator group for this project:

PLANNING CRITERIA – NBTRB PASSENGER ELEVATOR
PLANNING CRITERIA PERFORMANCE TARGETS
5 MINUTES OF HEAVY TWO WAY TRAFFIC

AVERAGE INTERVAL (SECONDS)	UNDER 40
HANDLING CAPACITY (PERSONS)	AT LEAST 13% OF PROJECTED REQUIREMENTS

An estimate of building population was provided by Lord, Aeck & Sargent Architecture:

LARGE AUDITORIUM	150 PERSONS
CAFÉ / LOBBY	20 PERSONS
PI TEAM (24 PI X 10/TEAM)	240 PERSONS
VIVARIUM CORE	4 PERSONS
IMAGING CORE	7 PERSONS
NANOFABRICATION CORE	10 PERSONS
FRONT OFFICES / BUILDING OFFICES	32 PERSONS
TOTAL ESTIMATED BUILDING POPULATION	481 PERSONS

In a preliminary elevator analysis we assumed that about 180 of these persons would be officed on the main floor or entering/leaving the building at the main floor for an Auditorium function. The remaining 300+ persons were assumed to utilize elevators for vertical circulation.

PASSENGER ELEVATOR REVIEW

Background
Program information available for our study suggests that the building will have four primary levels with the following assumed use and / or occupancy:

NBTRB ANALYSIS ASSUMPTIONS

BUILDING USE / OCCUPANCY

LEVEL	USE	OCCUPANCY
MECHANICAL	BUILDING SUPPORT FUNCTIONS (POSSIBLE ADDED LEVEL OF OFFICES AND LABS WITH MECHANICAL ON AN ADDED FLOOR)	NONE
3	OFFICE AND LAB	130
2	OFFICE AND LAB	130
1	PRIMARY ENTRY, PUBLIC SPACE, FOOD COURT, AUDITORIUM, OFFICES	180 (NO ELEVATOR IMPACT)
B	VIVARIUM, CORE FUNCTIONS	40±
TOTAL ESTIMATED OCCUPANCY		**480 PERSONS(1)**

1 OF THIS TOTAL THOSE ON THE FIRST FLOOR (180) ARE ASSUMED TO HAVE NO IMPACT ON ELEVATOR.

The possibility of an additional office / lab level was mentioned. Passenger elevators are required for movement of occupants above and below the 1st floor. A service elevator to support vivarium activity and other building support needs is recommended. This elevator could serve the mechanical level and should be sized to meet the International Building Code stretcher loading requirement if necessary.

Passenger

1. Required Handeling Capacity: The developing Program anticipates as many as 300 persons located on 3 primary levels above and below the main entry level, affecting elevator service. For planning, we have suggested that planned passenger elevators be capable of handling at least 13% of this population in 5 minutes of two way traffic; or 39 persons in five minutes.
2. Calculated Performance Potential of Passenger Elevators: The preferred range for average interval (35 – 40 seconds) applies to elevators transporting staff. Based on outlined projections for handling capacity, and this range for average interval, performance of elevators planned to serve building occupants should approximate the following criteria:

AVERAGE INTERVAL	NO MORE THAN 40 SECONDS
HANDLING CAPACITY	AT LEAST 39 PERSONS IN 5 MINUTES

Based on the number of levels served (4 or 5) and potential elevator travel (52'±), hydraulic equipment is not appropriate. Calculations indicate the following performance potential for one and two traction elevators. Machine room-less or conventional overhead machine room applications should be considered.

PASSENGER ELEVATOR PERFORMANCE
5 MINUTES OF HEAVY TWO-WAY TRAFFIC

ELEVATORS (#, CAPACITY, SPEED)	PERFORMANCE POTENTIAL		MEETS CRITERIA
	AVERAGE INTERVAL (SECONDS)	HANDLING CAPACITY (PERSONS)	
PERFORMANCE CRITERIA	UNDER 40	39	--
1 – 3500# @ 350 FPM	73.1	33	NO
2 – 3500# @ 200 FPM	35.4	42	YES
2 – 3500# @ 350 FPM	27.2	44	YES

Calculations indicate that a single elevator does not have the potential to meet recommended planning criteria. Two elevators at 200 to 350 FPM afford suitable service.

Recommendations
Passenger elevators should be grouped and located on the pathway between building entry and work stations and with visual contact from reception at the 1st floor. Though 3500# cars were indicated in the performance table, car loading will normally be no more than 3 or 4 persons. 2500 pound cars could adequately handle such loads. A range of 2500 to 3500 pounds could be considered.

We prefer and recommend speed of 350 FPM. The difference in cost between 200 and 350 FPM speed approximates 10%, which we feel is justified by the improvement in performance at the faster speed. Faster speed also affords flexibility to accommodate an added stop if such a scheme is considered.

Options
The program outlined assumes traction equipment. Two types are available and either would be an acceptable application in our judgment:

- Overhead machine room for equipment location is a standard arrangement.
- Machine Room-Less arrangements are available from all potential bidders in Salt Lake. This application eliminates the overhead machine room. The hoist machine is located within the hoistway; control and disconnecting means are located within the building, preferably adjacent or near the hoistway.

Service / Freight
If more than four floors in a building are served by elevators, the IBC Code requires that at least one car be sized to load an ambulance stretcher 24” wide x 84” long in a level position. Even recommended 3500# cars will not meet this requirement. A service elevator, configured narrow and deep to handle freight, service and vivarium support could be sized for this secondary purpose.

With a planned Vivarium, we prefer and recommend separate service elevator support so that passenger and service needs can be handled on separate elevators. The

service elevator should be located proximate to a loading dock and to the receiving / waste holding area of the Vivarium. All potential bidders could provide overhead machine room or machine room-less applications for a 5000# capacity elevator sized approximately 6'-0" wide x 8'-8" deep (±) with 4'-6" wide two speed, side opening doors. Speed of 200 FPM is recommended. Also, this car could also serve the mechanical level if desirable for support of equipment located at that level.

An alternative to the noted service elevator, would be a true freight elevator of larger size and higher capacity.

Both options should be considered as design for the building develops. Input from the Owner and User Staff should be considered.

PASSENGER ELEVATOR PERFORMANCE

FROM:
LERCH, BATES & ASSOCIATES INC. - HEADQUARTERS OFFICE

JOB: UNIVERSITH OF UTAH - NBTRB

FOR: ARCHITECTURAL NEXUS, INC

DATE: MAY 1, 2007

FLOORS SERVED: B,1,2,3

********** TWO WAY TRAFFIC (TRACTION) **********

FLOORS ABOVE THE MAIN	LOCAL TRAVEL	EXPRESS TRAVEL	INTERFLOOR HEIGHT	FULL ZONE POPULATION
3	52.00 FT	0.00 FT	14.00 FT	300.0

PASSENGERS PER CAR UP	PASSENGERS PER CAR DOWN	CAR SPEED IN FT/MIN	ROUND TRIP TIME (SEC)	# OF CARS	AVERAGE INTERVAL (SEC)	PASSENGERS IN 5 MIN	5-MIN H.C. (%)
2.0	2.0	350	54.4	1	54.4	22.0	7.3
✓ 2.0	2.0	350	54.4	2	27.2	44.1	14.7
3.0	2.0	350	60.5	1	60.5	24.8	8.3
3.0	2.0	350	60.5	2	30.2	49.6	16.5
4.0	2.0	350	65.4	1	65.4	27.5	9.2
4.0	2.0	350	65.4	2	32.7	55.1	18.4
5.0	2.0	350	69.5	1	69.5	30.2	10.1
5.0	2.0	350	69.5	2	34.7	60.5	20.2
✓ 6.0	2.0	350	73.1	1	73.1	32.9	11.0
6.0	2.0	350	73.1	2	36.5	65.7	21.9

DATA USED

HCR FACILITY DISABLED
SAMPLE LOCAL RUN W/ HCR: 52.00 FT
ADDITIONAL TIME TO RTT: 0.0 SEC
PASSENGER BOARDING TIME: 1.2 SEC
PASSENGER EXITING TIME: 1.1 SEC
INTERLOCK & SWITCH TIME: 0.0 SEC
ACCEL/DECEL RATE: 3.0 FT/SEC2

PERCENT DOWN STOPS: 100 %
OBSTRUCTION FACTOR: 10%
DOOR OPENING TIME: 2.0 SEC
(PREOPEN. TIME:) 0.0 SEC
DOOR CLOSING TIME: 3.0 SEC
INTERPT. RAY TIME: 0.0 SEC
JERK RATE: 6.0 FT/SEC3

Appendix D-1

FROM:
LERCH, BATES & ASSOCIATES INC. - HEADQUARTERS OFFICE

JOB: UNIVERSITH OF UTAH - NBTRB

FOR: ARCHITECTURAL NEXUS, INC

DATE: MAY 1, 2007

FLOORS SERVED: B,1,2,3

********** TWO WAY TRAFFIC (TRACTION) **********

FLOORS ABOVE THE MAIN	LOCAL TRAVEL	EXPRESS TRAVEL	INTERFLOOR HEIGHT	FULL ZONE POPULATION
3	52.00 FT	0.00 FT	14.00 FT	300.0

PASSENGERS PER CAR UP	PASSENGERS PER CAR DOWN	CAR SPEED IN FT/MIN	ROUND TRIP TIME (SEC)	# OF CARS	AVERAGE INTERVAL (SEC)	PASSENGERS IN 5 MIN	5-MIN H.C. (%)
2.0	2.0	200	68.0	1	65.0	18.5	6.2
2.0	2.0	200	65.0	2	32.5	36.9	12.3
3.0	2.0	200	70.7	1	70.7	21.2	7.1
✓ 3.0	2.0	200	70.7	2	35.4	42.4	14.1
4.0	2.0	200	75.4	1	75.4	23.9	8.0
4.0	2.0	200	75.4	2	37.7	47.8	15.9
5.0	2.0	200	79.3	1	79.3	26.5	8.8
5.0	2.0	200	79.3	2	39.6	53.0	17.7
6.0	2.0	200	82.8	1	82.8	29.0	9.7
6.0	2.0	200	82.8	2	41.4	58.0	19.3

DATA USED

HCR FACILITY DISABLED		PERCENT DOWN STOPS:	100 %
SAMPLE LOCAL RUN W/ HCR:	52.00 FT	OBSTRUCTION FACTOR:	10%
ADDITIONAL TIME TO RTT:	0.0 SEC	DOOR OPENING TIME:	2.0 SEC
PASSENGER BOARDING TIME:	1.2 SEC	(- PREOPEN. TIME:)	0.0 SEC
PASSENGER EXITING TIME:	1.1 SEC	DOOR CLOSING TIME:	3.0 SEC
INTERLOCK & SWITCH TIME:	0.0 SEC	INTERPT. RAY TIME:	0.0 SEC
ACCEL/DECEL RATE:	3.0 FT/SEC2	JERK RATE:	6.0 FT/SEC3

Appendix D-2

3.3.12 Vibration/Acoustical

The following recommendations for vibration, noise and acoustical design considerations for Administration Areas and Research Areas are based on accepted and documented criteria for the limitation of vibration and the control of noise.

General
This Section includes the following:

1. Suggests criteria for the limitation of vibration.
2. Identifies major vibration sources and transportation paths.
3. Recommends measures to reduce source levels and impede transmission paths.

Vibration Sensitive People and Equipment
All people and laboratory equipment have a threshold above which they will be disturbed by vibration. The source of these vibrations are (1) impact testing equipment, (2) mechanical equipment, (2) people moving within the building, and (3) external sources such as vehicular traffic. The sensitivity threshold for any person or piece of equipment is determined by its purpose, the mechanisms involved and, to some extent, the person using it.

Control of Suspended Floor and Roof Structure Vibrations
Control of suspended floor and roof structure vibrations due to human and mechanically induced excitation forces shall be considered in the selection of the building's structural floor and roof framing systems. Generally accepted vibration performance guidelines for structural systems are as follows:

1. Floors supporting office and administrative functions shall be designed to provide a maximum floor framing vibration velocity of 16,000 micro-inches per second at 100 paces per minute.

2. Floor framing systems that will exhibit barely perceptible vibrations and be suitable to sleep areas, in most instances, and usually adequate for computer equipment, hospital recover rooms, semiconductor probe test equipment of low sensitivity shall be designed to provide a maximum floor framing vibration velocity of 8,000 micro inches per second at 100 paces per minute.

3. Floor framing systems that will exhibit vibration imperceptible characteristics and be suitable in most instances for surgical suites, microscopes to 100x and for other equipment of low sensitivity shall be designed to provide a maximum floor framing vibration velocity of 4,000 micro inches per second at 100 paces per minute.

4. Floor framing systems suitable for optical microscopes to 400x, microbalances, optical balances, proximity and projection aligners, mass spectrometers other than MALDI and quadruple or high-resolution, conventional spectrometers, etc. shall be designed to provide a maximum floor framing vibration velocity of 2,000 micro inches per second at 100 paces per minute (Class VC-A).

5. Floor framing systems suitable for inspection and lithography equipment (including steppers) to 3 micrometer line widths, microtomes and cryotomes for 5-10 micron slices, most tissue and cell culture except as noted below shall be designed to provide a maximum floor framing vibration velocity of 1,000 micro inches per second at 100 paces per minute (Class VC-B).

6. Floor framing systems suitable for standard optical microscopes to 1000x, lithography and inspection equipment (including moderately sensitive electron microscopes) to 1 micrometer detail size, TFT-LCD stepper/scanner process, digital imaging and/or fluorescence with optical microscope, high-precision balances measuring quantities less than 1 mg, MALDI mass spectrometer, nano-drop spectrophotometers, microtomes and cryotomes for slices less than 5 microns, tissue and cell culture of the following types: hanging drop, unstirred layers, embryonic stem cells, weakly adherent cells, very long-term cultures, chemotaxis, invasion assays except as noted below shall be designed to provide a maximum floor framing vibration velocity of 500 micro inches per second at 100 paces per minute (Class VC-C).

7. Floor framing systems suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E-Beam systems, microinjection, micromanipulation, electrophysiology, confocal microscopy, quadrupole and other high resolution mass spectrometers designed to provide a maximum floor framing vibration velocity of 250 micro inches per second at 100 paces per minute (Class VC-D).

8. Floor framing systems assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability shall be designed to provide a maximum floor framing vibration velocity of 125 micro inches per second at 100 paces per minute (Class VC-E).

Vibrations from a roof structure supporting rooftop mounted mechanical equipment have interfered with the use of inhabited spaces below on many facilities. Careful consideration in the design of roof framing systems shall be given so as to isolate and dampen all mechanical equipment vibrations. Ceiling mounted equipment is very susceptible to vibrations emanating from floor and roof framing systems above.

Isolation Air Tables have been used effectively by current University of Utah researchers to conduct highly sensitive research functions inside existing University of Utah building floor framing systems not suitable for the highly sensitive research otherwise.

For reference, the estimated cost for the following vibration performance levels of a composite structural steel floor framing system for a 30 ft. x 30 ft. bay size is as follows:

1. 16,000 micro-inches per second vibration velocity - Baseline cost of $0.00
2. 2,000 micro-inches per second vibration velocity - Additional cost of approx. $15.00 / sq.ft.

3. 1,000 micro-inches per second vibration velocity - Additional cost of approx. $23.00 / sq.ft.
4. 500 micro-inches per second vibration velocity - Additional cost of approx. $40.00 / sq.ft.

A much different (and much more expensive) framing scheme is required to meet VC-D or VC-E with a suspended floor. These systems involve bay sizes of 20 ft. x 20 ft. or less and waffle slabs or grillages. These criteria are more economically provided through the use of slabs-on-grade, either at surface elevation or in a basement. In general, the vibration environment at basement elevation will be significantly better than on a slab-on-grade at the elevation of the outdoor grade.

The Owner / Programming Team will ultimately need to decide:

1. Whether to design the entire new building to the most stringent vibration performance level so as to provide ultimate use flexibility for the life of the structure.
2. Whether to design different areas or floors within the structure for varying vibration performance levels to match projected types of use. The second option will save initial construction dollars but will limit the types of uses that can accommodated within the new structure because of the varying floor framing system vibration performance levels.

There is a significant cost impact on the structural system framing cost to achieve very high vibration performance levels. Because of the cost impact, the USTAR University of Utah Programming Steering Committee has made the following programming decisions:

Administrative Areas
All suspended levels of Administrative Areas shall be designed to provide a maximum floor framing vibration velocity of 16,000 micro inches per second at 100 paces per minute.

Research Areas
All suspended levels of Research Areas shall be designed to provide a maximum floor framing vibration velocity of 1,000 micro inches per second at 100 paces per minute unless noted otherwise. This is a Class “VC-B” vibration environment. Instrumentation or processes requiring more stringent criteria may need supplemental vibration isolation. If this is not possible (some instruments do not allow for secondary isolation), then it will be necessary to plan for the affected instrumentation or processes to be placed at an on-grade location or near columns.

Vibration Sources
There are four common primary sources of vibration in buildings as follows:

1. Ambient site vibration including those generated by traffic.
2. Building occupant foot traffic.
3. Building services plant and mechanical equipment.

4. Laboratory equipment (vacuum pumps, centrifuges, shakers, etc.) and machinery in the building.

Buildings also experience intermittent vibration from the following sources; door slams, movement of service carts and equipment, and loading / unloading impacts. Of the above, control of intermittent vibration produced by people activities depends almost entirely upon the characteristics of the building structural design. The adequate control of vibration from mechanical equipment and systems is much more straight forward and relatively simple to accomplish through judicious choice of appropriate vibration isolation hardware.

Transmission Paths

Vibration is transmitted through, and is attenuated or amplified by elements of the structure and the internal fittings of the building. Common transmission paths are the structural walls and columns. In addition, vibration is transmitted efficiently via ducted and piped services. The amplification occurs in floor slabs and often in the laboratory furniture.

Recommendations for Schematic Design Phase - Building Planning

Many potential problems associated with vibration sources and their transmission paths can be overcome by considering them at the programming stages of the building design. The general guiding principles are as follows:

1. Identify vibration producing and vibration sensitive activities in the building.
2. Locate vibration producing areas remote from vibration sensitive areas.
3. Establish vibration limits for each area where vibration sensitive tasks or equipment may be in use, grouping together tasks and equipment with similar sensitivities wherever possible.
4. Select a building design that minimizes the response of the structure to vibration.

Sources of Vibration - External Environment

The design of the building must act to control vibration that exists on the site. A survey of the site has been conducted to assess vibration levels of traffic on adjacent roadways and from heavy machinery or loading dock areas.

Sources of vibration located within the building are best dealt with at source. This is done by providing careful vibration isolation measures to all machinery and services, and good laboratory planning. As a general policy, powerful sources of vibration should be located:

1. As far as possible from the more vibration sensitive tasks and laboratory areas.
2. On a ground slab, and / or carried independently to grade.
3. Possibly in a structurally separate part of the building.

Parking Below Vibration Sensitive Buildings

Currently, the building program cost model does not include automobile parking below the proposed building structure. Structured parking is convenient but much more expensive than parking on grade and for that reason is not planned for on this facility.

Research Laboratory Planning

Research Laboratories areas should be planned to minimize the risk of vibration disturbance to sensitive tasks or instruments. This planning can be achieved by the following:

1. Keeping sources and receivers of vibration separate (as described above).
2. Locating both sources and receivers of vibration on the least responsive parts of the structure. The least responsive parts of the structure are likely to be on the grade slab, and within a seven foot radius of column locations on suspended slabs. The most responsive parts of the structure are likely to be in the center of suspended structural bays.
3. Installing a good standard of laboratory benching.
4. Utilizing optical or vibration isolation tables and other passive dampening systems where highly vibration sensitive tasks and experimental techniques are in use.

Massive (marble or concrete) balance tables are very useful in limiting the amplification of vibration between the floor and balances. Small vibration sensitive experimental setups are best mounted on vibration isolation tables to prevent vibration disturbances. The floor loading should take account of these mounting arrangements.

Electromagnetic Interference

In order to mitigate EMI problems, it is recommended that fiberglass concrete reinforcing be used in concrete areas surrounding the most sensitive characterization spaces such as TEM's and SEM's.

Architectural Treatments and Finishes

With attention to general architectural finishes and details, significant benefits can be achieved in reducing sources of impact vibration. This is accomplished by the following:

1. Reducing the impact from slamming doors by appropriate measures, such as minimizing the mass of the door leaf, installing damped closure mechanisms, and fitting door jambs with soft resilient seals.
2. Incorporating resilient flooring surfaces wherever possible.
3. Minimizing floor joints and raised door sills to prevent impacts as wheels pass over them.
4. Incorporating damping modification in concrete slabs-on-grade where there is a high likelihood of impact or unisolated mechanical equipment. This may be achieved with a top coat that is a combination of polymeric damping admixture and fiber reinforcement.

NOISE CONTROL - INTRODUCTION

General

Control of noise in laboratories is achieved by the following:

1. Appropriate building planning.
2. Noise and vibration control in building services design.
3. Appropriate acoustic treatment of laboratory spaces.
4. Incorporating damping modification in concrete slabs-on-grade where there is a high likelihood of impact or unisolated mechanical equipment. This may be achieved with a top coat that is a combination of polymeric damping admixture and fiber reinforcement.

Building Planning

Many noise control problems can be overcome in the initial stages of the building planning by locating noise producing areas remote from noise sensitive areas, or by providing a non-sensitive buffer zone (i.e., a storage area) between them. The alternative is to provide walls with a high standard of sound insulation and upgrade the performance of doors and duct work attenuation, etc.

Likely noise producing areas are as follows: Mechanical rooms and penthouses, equipment rooms, glassware washing areas and receiving / service dock area.

Building Service Noise

Noise from building services are controlled by:

1. Isolating the major mechanical and electrical plant from vibration sensitive areas, as described above.
2. Providing a high standard of vibration isolation for major plant equipment and its associated piping and duct work.
3. Designing the building ventilation system to achieve an acceptable noise level criterion.

Vibration from the mechanical and electrical plant may be re-radiated as noise. Vibration must be controlled at the source, by installing central plant equipment on anti-vibration mounts and ensuring that it is correctly balanced and maintained.

During the Schematic Design phase, appropriate noise criteria should be established for the different spaces. The recommended criteria for various spaces are tabulated below:

Space Category	Criterion
Research Laboratories	NC 40 - 50
Laboratory Instrument Labs	NC 30 - 40
Electron Microscope Suite	NC 25 - 35
Conference Rooms	NC 30 - 35
Private Offices	NC 35 - 40
Reception Areas, Lobbies, Open Offices	NC 40 - 45
Corridors, Stairways (non-sensitive listening)	NC 45 - 50

In general, duct work should be designed as round or flat oval shapes to result in a

smooth flow of air through the whole system, providing minimum pressure drops. Where possible, fan noise is to be controlled at source by allowing sufficient attenuation and acoustic duct lagging at the fan outlet and where the duct work crosses the mechanical room wall.

Nanotechology Facilities
See Section **3.3.7 Page 10 Sensitive Environments Criteria (EVA Specifications)** table for required accurate Noise Control requirements.

Air Regenerated Noise
Turbulence of air in ductwork and duct fittings causes air regenerated noise. This is predominantly at high frequencies, where the noise criteria are more stringent. To control air noise, the following points must be considered:

1. Avoid sharp turns and branches near the terminals.
2. Separate duct fittings from each other by several duct diameters.
3. Avoid large pressure drops through elements.
4. Design self balancing ductwork wherever possible to limit the use of volume control dampers.
5. Limit air velocities.
6. Add acoustic control measures close to air valves such as duct lining.

Breakout and Cross-Talk Noise
Routing main distribution ducts through quiet areas gives rise to noise breakout from the ducts and should be avoided. Similarly, the ductwork should not pass through noisy areas before entering quiet areas that it serves. Cross-talk, which occurs when noise is transmitted via the ductwork, must be avoided in the same way. It must also be avoided where two noise sensitive spaces are served by the same ductwork (i.e., in adjacent meeting rooms) and speech from one room must not be audible in the other. This can be accomplished by installing an attenuator or acoustic duct lining in the ductwork between the two rooms or by rerouting the ductwork to increase the path between the room terminals.

Plumbing and Utility Piping
Vibrations generated by plumbing and utility piping systems may be minimized by several means:

- Judicious equipment selection, limitation of fluid flow velocities, and isolation of key mechanical and piping systems may be employed to reduce vibration caused by these sources.
- Vibration isolation systems should be provided on rotating mechanical equipment greater than ½ hp located within the critical area, greater than 5 hp elsewhere in the building, and greater than 10hp outside the building within 20 feet. Reciprocating equipment (other than emergency equipment) should not be used.
- Concrete inertia bases should be used with rotating mechanical equipment handling liquids (e.g. pumps), reciprocating air compressors, and fans with static pressures above 6.0 inches w.g. Steel frames should be used for other air handling equipment. Flexible pipe connectors (e.g., twin-sphere connectors) should

be used on piping connecting to isolated equipment and where piping exits the mechanical room.

- Passive piping is that piping which is at a great distance from its energy source and which has low flow rates and / or infrequent use, such as sprinkler water, gases, waste water, etc. Conversely, active piping is close to energy source (e.g., a pump), has continuous or frequent use, with high flow rate or velocity of air or liquid. Active piping and ducting can be major source of vibration, and isolation is required in some instances.
- Whenever possible, flow velocities in significant active piping should be sized for maximum flow velocities of 8 feet / second. Systems that require higher velocities for proper function call for more stringent isolation.

In summary, the following guidelines apply for piping that is supported from the structure within the critical areas:

1. Passive piping (waste water, city water, etc.) need not be isolated unless it is racked with piping requiring isolation.
2. Active piping of diameter 2 inches to 6 inches should be supported using spring supports sized to a static deflection of 1 inch.
3. Active piping of diameter exceeding 6 inches should be supported using spring supports sized to a static deflection of greater than 1 inch.

ACOUSTIC TREATMENT - LABORATORIES

General

The surface finishes of laboratories are required to be hard wearing, chemically resistant, and easily cleaned. This usually results in surfaces that are hard and nonporous. These surfaces in turn are highly sound reflecting and result in rooms that may be excessively reverberant. Reverberant rooms often exhibit the following characteristics:

1. High ambient noise levels.
2. Limited decrease in the noise level with distance from the noise source.
3. Poor intelligibility of speech.

Surface Finishes

Sound absorbing surfaces are usually porous, soft or fibrous, making them unsuitable for laboratory walls and floors. It is recommended that acoustical panels suspended in a grid between the mechanical services be utilized for the ceiling of the laboratory. Sound-absorptive panels with a mylar membrane or coating are sometimes used to control reverberant sound in laboratories requiring cleanable surfaces.

Floor Covering

Footfalls on hard floor surfaces in sensitive building areas produce noise and excite the floor framing system, creating vibration. It is recommended that vibration effects be minimized by providing a resilient floor covering. Research Laboratory floor surfaces are commonly vinyl tiles or seamless sheet vinyl.

3.3.13 Food Service

The building's initial isolation from other areas of campus and its anticipated occupancy of close to 300 people necessitate several types of basic food service be included in the building. The following needs should be met with the food service component:

- Full meals (such as breakfast and lunch)
- Snacks and drinks during the day
- Space for a caterer to stage a reception or similar event
- Seating adequate for building occupants and visitors

Full meal service will be needed in the building. The availability of many varied items, such as made to order sandwiches and salads, soups, grill items and fried items will be required. Service will be via order and pick up or by service line. A wash station will be required for processing of used plates and utensils.

Many snacks and drinks should be offered, ideally throughout the day. This availability will serve the building occupants well, but will also help visitors feel welcome when they arrive. Anticipated service options would include baked goods, fruit, hot and cold drinks and bottled drinks.

The kitchen space should have adequate room to cater a function in one of the adjacent spaces, such as the Lobby or the Auditorium. The ability to serve a full meal and cater simultaneously is not anticipated, and but could be established with careful design of adjacent catering space that minimizes overlap with the service kitchen.

Seating should be adequate for a phased meal rush from building occupants, and be able to hold enough people to help enliven the Café and adjacent Lobby and public spaces. The area allotted in the program and project budget have room and funding for 80 people.

The hours of this operation could vary depending on the needs of the building and the pedestrian traffic and could expand to include later meals (dinner) after the building opens.

Future developments of the Interdisciplinary Quadrangle may have an impact on the food services program. Thus, it could be subject to change and/or coordination with forthcoming studies of the Quadrangle.

Similar facilities to this anticipated one exist on the University of Utah campus and could be looked at for similar service options, such as The Point Restaurant at the Huntsman Cancer Institute.

3.3.14 System Commissioning Controls

Project Goals

The nature of this project dictates that a thorough commissioning effort is required to insure that all systems are functioning to the design intention ie. temperatures are being maintained, pressure relationships are demonstrated and all safety and alarm functions are working.

Commissioning work shall be a team effort to ensure that all mechanical and electrical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine tuning of control sequences and operational procedures. A Commissioning Team leader will direct the work of the Commissioning Team. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team.

The Commissioning Authority shall be an integral member of the Design Team and shall have responsibility for coordinating and directing each step of the commissioning process.

The minimum commissioning process shall include:

- Review and provide recommendations on design document prior to issuing the construction document.
- Review the contractor submittals relative to the systems being commissioned.
- Verification of testing and start of all mechanical and electrical equipment.
- Verification of testing, adjusting and balancing of hydronic and air systems.
- Review and approval of operation and maintenance manuals.
- Training of owner personnel.

The minimum system commissioning shall cover the following systems:

- Automatic Temperature Controls
- HVAC Systems
- Laboratory Water and Waste Systems
- Laboratory Gas Systems
- Campus Supplied HTW and Chilled Water Systems
- Variable Frequency Drives
- Fire Suppression Systems
- Electrical Power and Lighting Systems
- Emergency Generator System
- Security Systems
- Fire Alarm System

Commissioning should commence early in the design process, per the LEED point certification requirements, and will require the owner to provide a representative to be part of the Commissioning Team.

3.3.15 Value Engineering

The Owner will conduct Value Engineering Workshops during the review of the Schematic Design Phase and the Design Development Design Phase of this project. These Value Engineering Sessions will consist of project presentation, evaluation, recommendations, and design team response sessions. Participation in these Value Engineering Sessions by the selected Design Team (architects, engineers, etc.) is a requirement of this program. The Owner may contract with an independent firm to provide cold team services or the Owner may request that the Design Team provide a cold team to participate in the Value Engineering Sessions. The Owner will provide compensation for the cold team.

3.3.16 Sustainability/LEED Certification

SUSTAINABLE DESIGN

Definition

Sustainable design has been defined by The American Institute of Architects as "The ability of society to continue functioning in the future without being forced into decline through exhaustion or overloading of the key resources on which that system depends." In simple terms it is the principal of accommodating human needs without diminishing the health and productivity of natural systems.

Green building practices can substantially reduce the negative environmental impacts associated with buildings and reverse the trend of unsustainable construction activities. Currently buildings consume more than 30% of our total energy and 60% of our electricity annually. Buildings are also a major source of the pollutants that cause urban air quality problems and contribute to climate change.

Benefits

Sustainable design can lead to a variety of benefits, many of which are economic. Green design can reduce operating costs, enhance building marketability, potentially increase occupant productivity and help to create a sustainable community. The reduced operating costs can range from 10-50% less than traditional building methods and designs.

There are also numerous studies that link healthy, day lit buildings to decreased absenteeism and increased productivity as much as 2 to 15 percent. Sustainable buildings also provide reduced liability risks by occupant exposure to poor indoor air quality and other known chemical pollutants.

Measuring Sustainability

LEED is a system that has been established by the U.S. Green Building Council to provide opportunity to measure sustainability. The goal for this project is to achieve a LEED gold certification which requires that the project earn a minimum of 39 LEED points. A key component to achieving LEED gold certification will rely on obtaining LEED points for the new University of Utah cogeneration plant that will provide the Biomedical Technology Research Building with high temperature water. Other strategies for obtaining LEED points are outlined and organized under the following five sustainable design categories and the LEED Calculator Table in **Section 3.3.16 Page 4.**

SUSTAINABLE DESIGN CATEGORIES

Restorative Site Development Strategies

1. Reduce pollution and land development impacts from automobile use by providing and accommodating alternatives such as public transportation, pedestrian links to other campus buildings, and bicycle transportation.
2. Encourage opportunities for urban wildlife by developing and restoring landscaped areas with native and compatible adaptive plant species.

3. Maximize landscaped areas to minimize peak storm flows, increase on-site filtration of solids and phosphorous contaminants.
4. Reduce the negative effects of urban heat-islands by providing shade on paved areas with canopy trees and light colored paving materials.
5. Use high reflectance (Energy Star) roof and paving materials to reduce heat-island effects.
6. Provide safe and uniform exterior lighting with no offsite light trespass.

Enhanced Water Efficiency

1. Limit the use of potable water for landscape irrigation by designing high-efficiency irrigation systems and grouping plants with like water requirements to reduce irrigation requirements.
2. Include plumbing fixtures with proven history of reduced water use.

Energy-Saving Design Opportunities

1. Verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended by engaging an independent commissioning authority.
2. Design building systems to reduce energy consumption.
3. Building envelope design to reduce energy use (solar orientation, shading devices at eaves and glazing, high R-value roof and wall assemblies).
4. Design fenestration to provide daylight in occupied spaces to reduce need for artificial illumination.
5. Design electrical switchgear to accommodate future renewable energy producing devices.
6. Design building to include opportunities for future renewable energy devices such as photo-voltaic panels.
7. Reduce ozone depletion and support early compliance with the Montreal Protocol by designing refrigeration systems that do not contain CFC's, HCFC's or Halon.
8. Provide for the ongoing optimization of building energy and water consumption performance over time by including measurement and verification technology.

Materials to Facilitate Healthy Environments

1. Provide multiple recycling areas to accommodate the collection, separation and removal of recyclables to reduce waste that is disposed of in landfills.
2. Divert construction debris from landfill disposal by developing and implementing a waste management plan for construction activities.
3. Prioritize the potential use of building materials with recycled content (tiles, masonry units, steel, carpeting, etc.)
4. Reduce effects of transportation and support local economy by specifying materials manufactured and assembled locally.
5. Encourage environmentally responsible forest management by using wood-based materials certified in accordance with the Forest Stewardship Council Guidelines.

Indoor Environmental Quality

1. Provide for a thermally comfortable environment that supports the productive and healthy performance of the building.

2. Reduce air contaminants coming from building materials by creating a construction Indoor Air Quality Plan.
3. Include capacity for air quality monitoring (CO2) for occupant health and comfort.
4. Provide increased quantities of fresh air to support health, safety and comfort of building occupants.
5. Specify low V.O.C. emitting paints, adhesives, sealants and other products to enhance the health benefits to occupants.
6. Minimize cross-contamination of pollutants in occupied spaces by separating potentially hazardous chemicals.
7. Provide a connection between indoor and outdoor environments through the introduction of sunlight and views into the occupied areas of the building.

Cost Implications

There are cost implications to take into account when dealing with sustainable design. Buildings may incur higher up front costs when designed utilizing sustainable design principles. The bright side of this is that there are usually substantial savings over time that make the higher up front cost easier to bear.

Meeting the LEED Gold Certified Building Goal

LEED utilizes a system where points are awarded for meeting the specified criteria for a variety of sustainable design issues. A preliminary assessment of achieving 39 points and LEED gold certification has been outlined in the LEED calculator on the following page. The actual LEED points attained may vary but the project should meet the end goal of providing a sustainable design that achieves the desired gold certification level.

39	20	9	Total Project Score - U of U Neuroscience & Biomedical Technology Research Bldg	Possible Points 69

Certified 26 to 32 points **Silver** 33 to 38 points **Gold** 39 to 51 points **Platinum** 52 or more points

Sustainable Sites — Possible Points 14

Y	?	N				Costs Construction	Costs Design
Y			Prereq 1	**Erosion & Sedimentation Control**			
1			Credit 1	**Site Selection**	1		
	1		Credit 2	**Development Density/Community Connectivity**	1		
		1	Credit 3	**Brownfield Redevelopment**	1		
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1		
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1		
	1		Credit 4.3	**Alternative Transportation**, Alternative Fuel Refueling Stations	1		
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1		
	1		Credit 5.1	**Site Development**, Protect or Restore Habitat	1		
1			Credit 5.2	**Site Development**, Maximize Open Space	1		
1			Credit 6.1	**Stormwater Design**, Quantity Control	1		
	1		Credit 6.2	**Stormwater Design**, Quality Control	1		
	1		Credit 7.1	**Heat Island Effect**, Non-Roof	1		
1			Credit 7.2	**Heat Island Effect**, Roof	1		
1			Credit 8	**Light Pollution Reduction**	1		

Water Efficiency — Possible Points 5

Y	?	N				Costs Construction	Costs Design
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1		
	1		Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1		
	1		Credit 2	**Innovative Wastewater Technologies**	1		
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1		
	1		Credit 3.2	**Water Use Reduction**, 30% Reduction	1		

Energy & Atmosphere — Possible Points 17

Y	?	N				Costs Construction	Costs Design
Y			Prereq 1	**Fundamental Building Systems Commissioning**			
Y			Prereq 2	**Minimum Energy Performance**			
Y			Prereq 3	**Fundamental Refrigerant Management**			
1			Credit 1.1	**Optimize Energy Performance**, 10.5% New / 3.5% Existing	1		
1			Credit 1.2	**Optimize Energy Performance**, 14% New / 7% Existing	1		
1			Credit 1.3	**Optimize Energy Performance**, 17.5% New / 10.5% Existing	1		
1			Credit 1.4	**Optimize Energy Performance**, 21% New / 14% Existing	1		
	1		Credit 1.5	**Optimize Energy Performance**, 24.5% New / 17.5% Existing	1		
	1		Credit 1.6	**Optimize Energy Performance**, 28% New / 21% Existing	1		
	1		Credit 1.7	**Optimize Energy Performance**, 31.5% New /24.5% Existing	1		
	1		Credit 1.8	**Optimize Energy Performance**, 35% New / 28% Existing	1		
	1		Credit 1.9	**Optimize Energy Performance** 38.5% New / 31.5% Existing	1		
	1		Credit 1.10	**Optimize Energy Performance**, 42% New / 35% Existing	1		
	1		Credit 2.1	**Renewable Energy**, 2.5%	1		
		1	Credit 2.2	**Renewable Energy**, 7.5%	1		
		1	Credit 2.3	**Renewable Energy**, 12.5%	1		
1			Credit 3	**Enhanced Commissioning**	1		
1			Credit 4	**Enhanced Refrigerant Management**	1		
1			Credit 5	**Measurement & Verification**	1		
	1		Credit 6	**Green Power**	1		

SUBTOTAL

Materials & Resources — Possible Points 13

Y	?	N				Costs Construction	Costs Design
Y			Prereq 1	**Storage & Collection of Recyclables**			
		1	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1		
		1	Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1		
		1	Credit 1.3	**Building Reuse**, Maintain 50% Non-Shell	1		
1			Credit 2.1	**Construction Waste Management**, Divert 50%	1		
1			Credit 2.2	**Construction Waste Management**, Divert 75%	1		
		1	Credit 3.1	**Materials Reuse**, Specify 5%	1		
		1	Credit 3.2	**Materials Reuse**, Specify 10%	1		
1			Credit 4.1	**Recycled Content**, 10% (post consumer + 1/2 post-industrial)	1		
1			Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 post-industrial)	1		
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Mftd Regionally	1		
	1		Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Mftd Regionally	1		
	1		Credit 6	**Rapidly Renewable Materials**	1		
		1	Credit 7	**Certified Wood**	1		

Indoor Environmental Quality — Possible Points 15

Y	?	N				Costs Construction	Costs Design
Y			Prereq 1	**Minimum IAQ Performance**			
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**			
1			Credit 1	**Outdoor Air Dlivery Monitoring**	1		
1			Credit 2	**Increased Ventilation**	1		
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1		
	1		Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1		
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1		
1			Credit 4.2	**Low-Emitting Materials**, Paints	1		
1			Credit 4.3	**Low-Emitting Materials**, Carpet	1		
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1		
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1		
1			Credit 6.1	**Controllability of Systems**, Lighting	1		
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1		
1			Credit 7.1	**Thermal Comfort**, Design	1		
1			Credit 7.2	**Thermal Comfort**, Verification	1		
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1		
	1		Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1		

Innovation & Design Process — Possible Points 5

Y	?	N				Costs Construction	Costs Design
1			Credit 1.1	**Non-regulated energy savings**	1		
1			Credit 1.2	**Variable Speed Drive Technology**	1		
1			Credit 1.3	**Innovation in Design**:	1		
1			Credit 1.4	**Innovation in Design**:	1		
1			Credit 2	**LEED™ Accredited Professional**	1		

SUBTOTAL

RESPONSIBILITY COLOR KEY

Primary	(Secondary)	(Synergy)	
			None
			Owner
			Contractor
			Civil
			Landscape
			Architect
			Mechanical
			Electrical
			Commissioning Authority

	Unassigned
	Owner/Developer — Owner
	Contractor — Contractor
	Civlil Engineer — Civil
	Landscape Architect — Landscape
	Architectural Nexus — Architect
	Mechanical Engineer — Mechanical
	Electrical Engineer — Electrical
	Comissioning Agent — Commissioning Authority

Cost Totals		
Construction	Design	TOTAL
		Design column 1
		Design column 2
		Registration
		Certification
Additional Percentage of Original Project Budget		

3.3.17 Wind/Wake Analysis Requirements

The NBTRB project will require the study of the exhaust and intake air components to understand the air-movement in and around the facility. The required study can be performed using one of two recognized and accepted practices. One approach includes the physical modeling of the building and the surrounding macro-environment in a wind tunnel to visually confirm that the exhaust air system is properly designed to insure that the air stream does not impact this or any other facility in the surrounding area. Smoke testing can visually confirm that the air flows are safely removed and not capable of being re-entrained into the supply air intakes. The air flow testing can also confirm where the supply air will come from which can help with the selection of the proper filtration systems.

The other accepted method is "Computational Fluid Dynamics" (CFD) which starts with the development of a computer model of the building and the macro-surroundings. Using this computer model; simulations of the air-flows can be studied for both the supply and exhaust air components of the facility.

These methods will both deliver the information required by the Design Team to engineer the best exhaust system and locate the air intakes to minimize contamination potentials. Both approaches will provide documented visual performance of the supply and exhaust systems and confirm that the proper design has been achieved. The physical model / wind tunnel approach can be less expensive for initial studies but modifications to the physical model can increase the costs. The CFD approach may have a higher initial cost but once the computer model is constructed, modifications are less expensive to study.

The Wind / Wake Analysis will be performed during the Schematic Design phase of the project when there is adequate information to construct the models. The Design Team along with the University will determine the most appropriate approach for this study and then contract with the consultants best suited to perform the work. The results of the Wind / Wake Analysis will then be used to complete the design and engineering of the supply and exhaust air systems.

3.3.18 Building Occupancy Classification/Hazardous Materials

Design and construction codes and standards are listed below.

The codes and standards listed are minimum requirements. In the case of laboratory related academic buildings, the recommendations of the guidelines below and the standards and requirements suggested by the Design Team will often address issues not sufficiently covered in the building codes.

APPLICABLE CODES

In all cases the most recent editions of referenced standards apply.
Referenced Standards and Guidelines:

NFPA 101, 2000 Life Safety Code

- International Mechanical Code, 2000 Edition
- ICC Electric Code, 2000 Edition
- International Fuel Gas Code, 2000 Edition
- Codes published by the Council of American Building Officials
- NFPA 101 — Life Safety Code
- ANSI A117.1 — Providing Accessibility and Usability for Physically Handicapped People
- ADA — Americans with Disabilities Act
- NFPA — 30 Flammable and Combustible Liquids Code
- NFPA 45 — Fire Protection for Laboratories Using Chemicals
- OSHA Standard 29 — Occupational Exposures
- CFR 1910.1450 — Hazardous Chemicals in Laboratories
- ANSI Z358.1 — Emergency Eyewash and Shower Equipment
- ANSI/AIHA — American National Standard Z9.5 for Laboratory Ventilation
- NIH 76-900 — Safety Standards for Research Involving Chemical Carcino gens, Office of Research Safety
- NIH 81-2385 — Guidelines for the Laboratory Use of Chemical Carcinogens

Applicable Code Commentary

Occupancy: The laboratory areas shall be classified as “B” Occupancy.

Fire Separation: Laboratories shall be separated from each other and other portions of the building by not less than one-hour fire resistive occupancy separation.

Hazardous Materials: The quantities of hazardous materials shall not exceed those listed in Tables 307.7(1) and 307.7(2) of the code.

Exits: Occupants in laboratories having an area in excess of 1000 square feet shall have access to at least two exits from the room and all portions of the room shall be within 75 feet of an exit.

NFPA 101: Life Safety Code

Means of Egress: Where exits are not immediately accessible from an open floor area, safe and continuous passageways, aisles, or corridors shall be maintained leading directly to every exit and shall be arranged as to provide convenient access for each occupant to at least two exits by separate ways of travel.

Exit access shall be so arranged that it will not be necessary to pass through any area identified under protection from hazards in Chapter 28.

Corridor Width: The minimum width of any corridor or passageway serving as a required exit, exit access, or exit discharge shall be 44 inches.

NFPA 45: Fire Protection For Laboratories Using Chemicals

Means of Egress: The means of egress for laboratory units and laboratory work areas shall comply with NFPA 101.

Access to Exits: A second means of access to an exit shall be provided from a laboratory work area if any of the following situations exist:

- A laboratory work area contains an explosion hazard so located that an incident would block escape from or access to the laboratory work area.
- A fume hood in a laboratory work area is located adjacent to the primary means of exit access.
- A compressed gas cylinder in use which is larger than lecture bottle size, and contains a gas which is flammable or has a hazard rating of 3 or 4 and would prevent safe egress in event of accidental release of cylinder contents.
- The required exit doors of all laboratory work areas within Class A or Class B laboratory units shall swing in the direction of exit travel.

Furniture and Equipment: Furniture and equipment in laboratory work areas shall be arranged so that means of access to an exit may be reached easily from any point.

Explosion Hazard: Explosion hazard is considered to exist if reactivity rating 4 materials are stored or used, or if highly exothermic reactions or procedures without established properties are planned, or if high pressure reactions are planned. Preliminary program information does not indicate that explosion hazards, as described above, exist in this project.

NFPA 30 - Flammable and Combustible Liquids Code

Liquid Classification: Combustible liquids have a flash point at or above 100° F (37.8°C) and are classified as follows:

- Class II: Liquids with a flash point at or above 100°F (37.8°C) and below 140°F (60°C)
- Class III A: Liquids with a flash point at or above 140°F (60°C) and below 200°F (93°C)
- Class III B: Liquids with a flash point at or above 200°F (93°C)

Flammable liquids have a flash point below 100°F (37.8°C) and a vapor pressure not greater than 40 lbs. per square inch (absolute) (2,068 mm Hg) at 100°F (37.8°C).

Flammable liquids are classified as follows:

- Class I A: Liquids with flash point below 73°F (22.8°C) and a boiling point below 100°F (37.8°C).
- Class I B: Liquids with flash point below 73°F (22.8°C) and a boiling point at or above 100°F (37.8°C).
- Class I C: Liquids with flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

Storage Cabinets: Not more than 120 gallons (454 L) of Class I, Class II, and Class III liquid may be stored in a storage cabinet. Of this total, not more than 60 gallons (227 L) may be of Class I and Class II liquids and not more than three (3) such cabinets may be located in a single fire area, except that, in an industrial occupancy, additional cabinets may be located in the same fire area if the additional cabinets (not more than a group of three (3) are separated from other cabinets or group of cabinets by at least 100 feet (30 M).

In addition to the above standards it will be necessary during the Design phases of the project to work closely with the University's representatives. The Project Team may need to incorporate additional requirements as laboratory and support spaces are more definitively outlined.

4.0 Space Program

4.1 Space and Area Program
4.2 Individual Room Data Sheets
4.3 Adjacencies and Relationships
4.4 Building Organization

4.1 SPACE AND AREA PROGRAM

The following sheets describe the square footage requirements for each area included in the Neuroscience and Biomedical Technology Research Building.

USTAR at University of Utah	Grossing Factor	59%	121
Projected Space Utilization Summary	Neuroscience & Biomedical Research Technology Building		
Prepared: September 20, 2007	Revised:	*14-Nov-07*	

Program Summary		Total NSF	Total GSF
1.0	**PI Assigned Space Total**	**52,647**	**89,232**
	Total SF per PI (24 PI's)	*2,178*	*3,753*
2.0	**Vivarium**	**13,582**	**23,020**
3.0	**Small Animal Imaging**	**5,453**	**9,240**
4.0	**Microscopy**	**5,247**	**8,893**
5.0	**Nanofab**	**14,999**	**25,422**
6.0	**Public/Building Support**	**22,417**	**37,995**
Total Building Area		**116,523**	**193,803**

USTAR at University of Utah		Grossing Factor	59%	121
Projected Space Utilization Summary		Neuroscience & Biomedical Research Technology Building		
Prepared: September 20, 2007		Revised:	*14-Nov-07*	

1.0 P.I. Assigned Space			modules	Total NSF	Total GSF
1.1	**Lab and Lab Support (Finished)**		14.00	1,694	2,871
		Lab and Lab Support Subtotal per P.I.	**14.00**	**1,694**	**2,871**
		Lab and Lab Support Subtotal Overall	**336.00**	**40,656**	**68,908**
1.2	**Office/Admin (Finished)**				
	1.2.1	P.I. Office	1.50	182	308
	1.2.2	Workstations	1.50	182	308
	1.2.3	Faculty Office	1.00	121	205
		Office/Admin Subtotal per P.I.	**4.00**	**484**	**820**
		Office/Admin Subtotal Overall	**96.00**	**11,616**	**19,688**
	Assigned Space per P.I.		**18.00 ***	**2,178**	**3,692**
	Assigned Space SubTotal		**432.00**	**52,272**	**88,597**
	# of P.I.'s			**24**	
1.3	**Design and Simulation Tool Lab**		**3.1**	**375**	**636**
	*** Look into adding space (outside of lab) for central material storage**				
PI Assigned Space Total			**435.10**	**52,647**	**89,232**

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
Vivarium			quantity	Size NSF	Total NSF	Total GSF
2.1	**Animal Holding**					
	2.1.1	Small Holding Room	8	450	3,600	6,102
	2.1.2	Large Holding Room	6	600	3,600	6,102
	Animal Holding Subtotal				**7,200**	**12,203**
2.2	**Animal Holding Support**					
	2.2.1	Small Procedure Room	4	150	600	1,017
	2.2.2	Freezer Room	1	121	121	205
	2.2.3	Necropsy	1	228	228	386
	2.2.4	Survival Surgery	1	1,300	1,300	2,203
	2.2.5	Quarantine	1	450	450	763
	2.2.6	Supply Room (1 prepackage sets)	3	150	450	763
	2.2.7	Restrooms/Lockers/Showers	2	300	600	1,017
	2.2.8	Break Area	1	150	150	254
	Animal Holding Support Subtotal				**3,899**	**6,608**
2.3	**Cagewash**					
	2.3.1	Central Cagewash	1	1,000	1,000	1,695
	2.3.2	Cagewash Support (bedding,feed,detergent)	1	550	550	932
	2.3.3	Cage Storage	1	600	600	1,017
	2.3.4	Janitor Closet	1	20	20	34
	Cagewash Subtotal				**2,170**	**3,678**
2.4	**Office**					
	2.4.1	Office	1	121	121	205
	2.4.2	Workstations	3	64	192	325
	Office Subtotal				**313**	**531**
Vivarium Total					**13,582**	**23,020**

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
Small Animal Imaging (Finished)			quantity	Size NSF	Total NSF	Total GSF
3.1	**7T Small Bore MRI Suite**					
	3.1.1	7TAnimal Magnet	1	194	194	328
	3.1.2	Operator Room	1	125	125	211
	3.1.3	Equipment Room	1	194	194	328
	7T Small Bore Suite Subtotal				**513**	**867**
3.2	**Imaging Laboratories**					
	3.2.1	Small Animal Imaging Lab	1	726	726	1,231
	3.2.2	Ultrasound Lab	1	121	121	205
*	**3.2.3**	PET/CT Lab	1	121	121	205
*	**3.2.4**	SPECT/CT Lab	1	121	121	205
	3.2.5	Fluoroscopy Room	1	121	121	205
	***Note: 3.2.3 and 3.2.4 combined square footage into one room**					
	Imaging Laboratories Subtotal				**1,210**	**2,051**
3.3	**Imaging Support**					
	3.3.1	Radiochemistry Lab	1	484	484	820
	3.3.2	Wet Chemistry Lab	1	484	484	820
	3.3.3	Image Analysis Lab	1	484	484	820
	3.3.4	Instrumentation Development Lab	1	484	484	820
	3.3.5	Gas Cylinder Storage	1	20	20	34
	3.3.6	Computer Room	1	121	121	205
	Imaging Support Subtotal				**2,077**	**3,520**
3.4	**Office**					
	3.4.1	Office	1	121	121	205
	3.4.2	Workstation Area (3 workstations)	2	121	242	410
	Office Subtotal				**363**	**615**
Small Animal Imaging Total- Finished					**4,163**	**7,053**
Small Animal Imaging (Shelled)			quantity	Size NSF	Total NSF	Total GSF
3.5	**3T Large Bore MRI Suite (Shelled)**					
	3.5.1	3T Human Magnet	1	520	520	881
	3.5.2	Operator Room	1	250	250	424
	3.5.3	Equipment Room	1	520	520	881
	3T Large Bore MRI Suite Subtotal				**1,290**	**2,186**
Small Animal Imaging Total- Shelled					**1,290**	**2,186**

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
4.0 Microscopy			quantity	Size NSF	Total NSF	Total GSF
4.1	**Biomedical Instrument Labs**					
	4.1.1	Large Instrument Room	2	240	480	814
	4.1.2	Small Instrument Room	4	144	576	976
	4.1.3	Optics Lab	1	240	240	407
	Biomedical Instrument Labs Subtotal				**1,296**	**2,197**
4.2	**Biomedical Microscopy Support**					
	4.2.1	Equipment Corridor	1	400	400	678
	4.2.2	Wet Lab Prep Area (share space with 4.4.6)	0	384	0	0
	4.2.3	Microtomy Room	1	121	121	205
	4.2.4	High Pressure Freezer Room	1	121	121	205
	Biomedical Microscopy Support Subtotal				**642**	**1,088**
4.3	**Biomedical Office**					
	4.3.1	Office	2	120	240	407
	Biomedical Office Subtotal				**240**	**407**
	Biomedical Microscopy SubTotal				**2,178**	**3,692**
4.4	**Engineering Instrument Labs**					
	4.4.1	HR SEM	1	270	270	458
	4.4.2	DB FIB and Nabity Nanolithography	1	270	270	458
	4.4.3	XPS	1	270	270	458
	4.4.4	Microscopy Service Corridor	1	400	400	678
	4.4.5	AFM(Wet + Solid State)	1	242	242	410
	4.4.6	Shared Sample Prep	1	400	400	678
	4.4.7	Electrical Characterization	1	484	484	820
	4.4.8	Spectrophotometry, Optical Micro Rooms	2	121	242	410
	Engineering Instrument Labs Subtotal				**2,578**	**4,369**
4.5	**Engineering Office**					
	4.5.1	Administrative Manager Office	1	121	121	205
	4.5.2	TEM/XPS Lab Engineer Office	1	121	121	205
	4.4.3	FIB/SEM Engineer Office	1	121	121	205
	4.4.4	Workstation	2	64	128	217
	Engineering Office Subtotal				**491**	**832**
	Engineering Microscopy SubTotal				**3,069**	**5,202**
Microscopy Total					**5,247**	**8,893**

USTAR at University of Utah			Grossing Facto		59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building				
Prepared: September 20, 2007			Revised:	*14-Nov-07*			
5.0 Nanofab			quantity	Size NSF		Total NSF	Total GSF
5.1	**Cleanroom**						
	5.1.1	Cleanroom (Class 1,000/100-spaces below)	1	5,720	0.9	5,720	9,695
	5.1.2	Nanolithography	1				
	5.1.3	Photolithography	1				
	5.1.4	Wet Processing	1				
	5.1.5	Hot Process	1				
	5.1.6	Dry Etch	1				
	5.1.7	Films Deposition	1				
	5.1.8	P.I. Cleanroom Bay 1	1				
	5.1.9	P.I. Cleanroom Bay 2	1				
	5.1.10	BioCompatible P.I./Industrial Bay	1				
	5.1.11	Chemical Pass-thru	1				
	5.1.12	Cleanroom Main Aisle	1				
	5.1.13	Clean Janitors (C1 10K) (in box)	1	50		50	85
	5.1.14	Cleanroom Chases	1	4,620	0.9	4,620	7,831
	Cleanroom Subtotal					**10,390**	**17,610**
5.2	**Cleanroom Support and Research/Teaching**						
	5.2.1	Main Gowning	1	200		200	339
	5.2.2	Equipment Wipe-Down	1	100		100	169
	5.2.3	Metrology	1	475		475	805
	5.2.4	Clean Microelectronics Research/Teaching (CI 10K)	1	475		475	805
	5.2.5	Clean Micromachining Research/Teaching (CI 10K)	1	475		475	805
	5.2.6	Clean Photolitholgraphy Research/Teaching (CI 10K)	1	475		475	805
	Cleanroom Support and Research/Teaching Subtotal					**2,200**	**3,729**
5.3	**Office/ Workstations**						
	5.3.1	Director's Office	1	121		121	205
	5.3.2	Teaching Lab Support Engineer Office	1	121		121	205
	5.3.3	User Training Engineer Office	2	121		242	410
	5.3.4	Applications Development Engineer Office	2	121		242	410
	5.3.5	General Maintenance Engineer Workstation	1	64		64	108
	5.3.6	Chem Tech Workstation	1	64		64	108
	5.3.7	Maintenance Tech Workstation	1	64		64	108
	5.3.8	Work-Study Bullpen	10	30		300	508
	Office/Workstations Subtotal					**1,218**	**2,064**
5.4	**Conference**						
	5.4.1	Clean Conference	1	165		165	280
	Conference Subtotal					**165**	**280**
5.5	**Engineering Nanofab Building Support**						
	5.5.1	Control/ ERT Room	1	242		242	410
	5.5.2	Cleanroom Lockers/ Shoe Clean	1	121		121	205
	5.5.3	Cleanroom Maintenance (outside Cleanroom)	1	300		300	508
	5.5.4	Hazardous Solid and Liquid Storage	1	363		363	615
	Building Support Subtotal					**1,026**	**1,739**
Nanofab Total						**14,999**	**25,422**

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
6.0 Public and Building Support Spaces			quantity	Size NSF	Total NSF	Total GSF
6.1	**Public/Meeting Spaces**					
	6.1.1	Lobby/Multifunction Space	1	2,000	2,000	3,390
	6.1.2	Café	1	3,000	3,000	5,085
	6.1.3	Large Auditorium	1	2,500	2,500	4,237
	6.1.4	Large Seminar Room	2	700	1,400	2,373
	6.1.5	Small Seminar Room	8	350	2,800 **	4,746
	6.1.6	Informal Meeting Areas	8	150	1,200	2,034
	6.1.7	Public Restroom	2	750	1,500	2,542
	6.1.8	Shower/Locker	2	250	500	847
	Public/Meeting Space Total				**14,900**	**25,254**
6.2	**Building Administrative Support**					
	6.2.1	Office (manager, custodial...)	10	121	1,210	2,051
	6.2.2	Workstations	10	64	640	1,085
	6.2.3	Meeting Room	1	300	300	508
	6.2.4	Central Mail/Copy/Supply	1	400	400	678
	6.2.5	Records	1	200	200	339
	Building Administrative Office Subtotal				**2,750**	**4,661**
6.3	**Information Technology**					
	6.3.1	Data Center	1	500	500	847
	6.3.2	Data Closet	4	121	484	820
	6.3.3	Office	1	121	121	205
	6.3.4	Workstations	3	64	192	325
	6.3.5	Main Communications Room	1	150	150	254
	Information Technology Total				**1,447**	**2,453**
6.4	**Building Support**					
	6.4.1	Loading Dock	1	720	720	1,220
	6.4.2	Main Mechanical Room	1	1,200	1,200	2,034
	6.4.3	Main Electrical Room	1	600	600	1,017
	6.4.4	Main Storage Room	1	1,200	800	1,356
	Building Support Total				**3,320**	**5,627**
	**** some seminar rooms will be located around administrative support area**					
Public and Building Support Spaces Total					**22,417**	**37,995**

4.2 INDIVIDUAL ROOM DATA SHEETS

The following Room Data Sheets and Plan Diagrams identify the generic space needs for the Neuroscience and Biomedical Technology Research Building.

USTAR at University of Utah		Grossing Factor	59%	121
Projected Space Utilization Summary		Neuroscience & Biomedical Research Technology Building		
Prepared: September 20, 2007		Revised:	*14-Nov-07*	

1.0 P.I. Assigned Space			modules	Total NSF	Total GSF
1.1	**Lab and Lab Support (Finished)**		14.00	1,694	2,871
		Lab and Lab Support Subtotal per P.I.	**14.00**	**1,694**	**2,871**
		Lab and Lab Support Subtotal Overall	**336.00**	**40,656**	**68,908**
1.2	**Office/Admin (Finished)**				
	1.2.1	P.I. Office	1.50	182	308
	1.2.2	Workstations	1.50	182	308
	1.2.3	Faculty Office	1.00	121	205
		Office/Admin Subtotal per P.I.	**4.00**	**484**	**820**
		Office/Admin Subtotal Overall	**96.00**	**11,616**	**19,688**
	Assigned Space per P.I.		**18.00 ***	**2,178**	**3,692**
	Assigned Space SubTotal		**432.00**	**52,272**	**88,597**
	# of P.I.'s			**24**	
1.3	**Design and Simulation Tool Lab**		**3.1**	**375**	**636**
	*** Look into adding space (outside of lab) for central material storage**				
PI Assigned Space Total			**435.10**	**52,647**	**89,232**

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: 1.1

ROOM NAME: **A. WET BENCH MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP:

CONTACT:

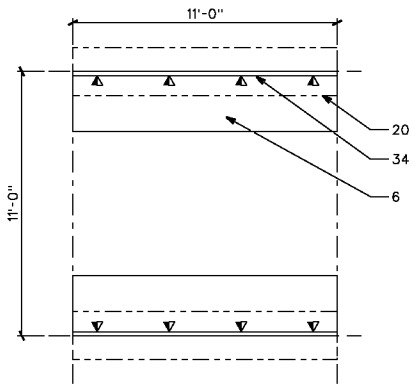
USER:

DIRECTOR:

PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: 1.1

ROOM NAME: **B. DRY BENCH MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP:

CONTACT:

USER:

DIRECTOR:

PHONE:

E-MAIL:

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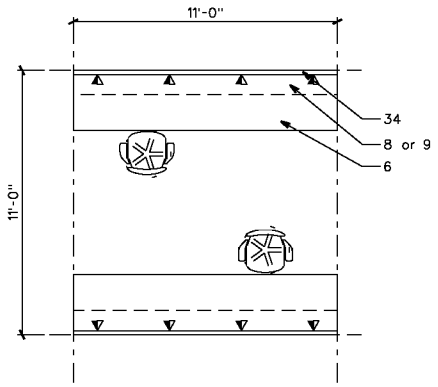

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **1.1**

ROOM NAME: **C. SPECIAL SUPPORT MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP:

CONTACT:

USER:

DIRECTOR:

PHONE:

E-MAIL:

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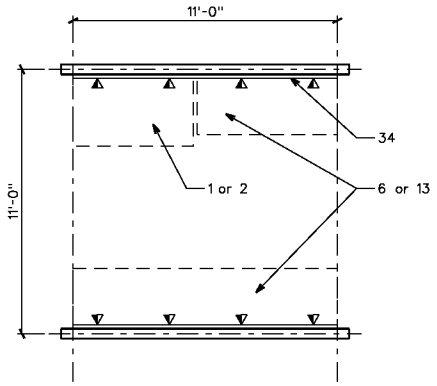

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **1.1**

ROOM NAME: **D. ANALYTICAL MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP:

CONTACT:

USER:

DIRECTOR:

PHONE:

E-MAIL:

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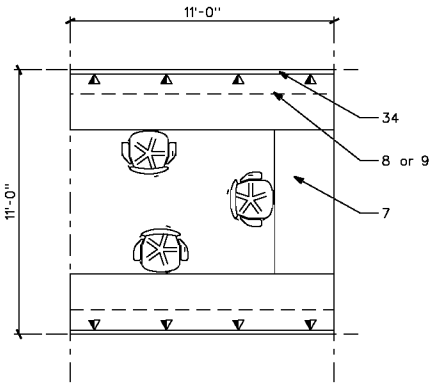


FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **1.1**

ROOM NAME: **E. LAB SUPPORT MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP: _____

CONTACT:

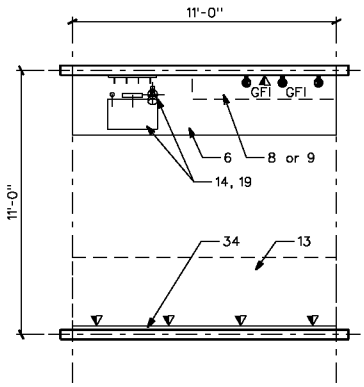
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **1.1**

ROOM NAME: **F. SHARED EQUIPMENT MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP: _____

CONTACT:

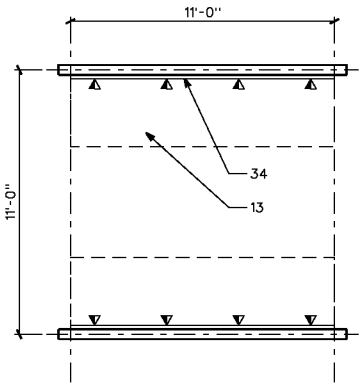
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **1.2**

ROOM NAME: **G. OFFICE/ADMIN MODULE**

DEPARTMENT: **P.I. ASSIGNED SPACE**

GROUP:

CONTACT:

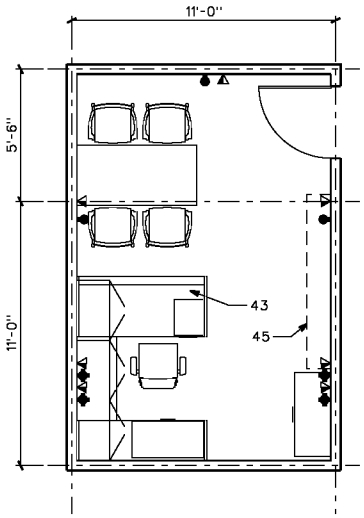
USER:

DIRECTOR:

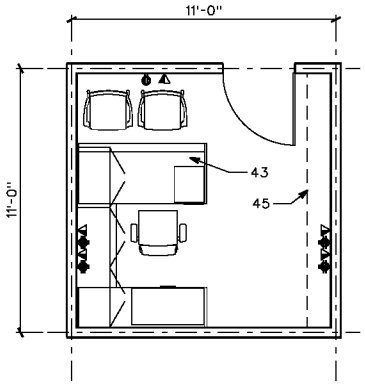
PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



PI OFFICE
182 SF



FACULTY OFFICE
121 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Credenza
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
Vivarium			quantity	Size NSF	Total NSF	Total GSF
2.1	**Animal Holding**					
	2.1.1	Small Holding Room	8	450	3,600	6,102
	2.1.2	Large Holding Room	6	600	3,600	6,102
	Animal Holding Subtotal				**7,200**	**12,203**
2.2	**Animal Holding Support**					
	2.2.1	Small Procedure Room	4	150	600	1,017
	2.2.2	Freezer Room	1	121	121	205
	2.2.3	Necropsy	1	228	228	386
	2.2.4	Survival Surgery	1	1,300	1,300	2,203
	2.2.5	Quarantine	1	450	450	763
	2.2.6	Supply Room (1 prepackage sets)	3	150	450	763
	2.2.7	Restrooms/Lockers/Showers	2	300	600	1,017
	2.2.8	Break Area	1	150	150	254
	Animal Holding Support Subtotal				**3,899**	**6,608**
2.3	**Cagewash**					
	2.3.1	Central Cagewash	1	1,000	1,000	1,695
	2.3.2	Cagewash Support (bedding,feed,detergent)	1	550	550	932
	2.3.3	Cage Storage	1	600	600	1,017
	2.3.4	Janitor Closet	1	20	20	34
	Cagewash Subtotal				**2,170**	**3,678**
2.4	**Office**					
	2.4.1	Office	1	121	121	205
	2.4.2	Workstations	3	64	192	325
	Office Subtotal				**313**	**531**
Vivarium Total					**13,582**	**23,020**

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.1.1	USER:	
ROOM NAME:	SMALL HOLDING ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	
MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	
HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	
LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	●
Safety Shower/Eyewash (SS)	
Hose Bib	●
ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	●
Darkenable	
Zoned Lighting	
Other	
LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	
ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	*
Natural Daylight	
MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Central supply and exhaust. No blowers. Separate reheat for supply, house exhaust.

*Vision panel with red glass

Doors could be 4'-0" wide if determined to be required in design.

All receptacles to be GFI and waterproof, light intensity should be 30 footcandles at 1 meter from floor

Space Diagram - Animal Facilities

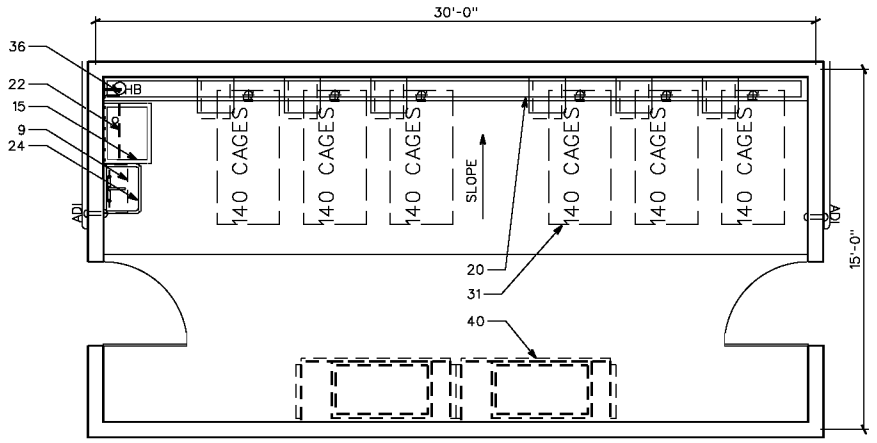
ROOM DATA:

ROOM NUMBER: **2.1.1 (CAGE LAYOUT A)**
ROOM NAME: **SMALL HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER:
DIRECTOR: **JACK TAYLOR**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR MICE
450 SF
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
SOLID SS COVER FOR TRENCH DRAIN IN MICE ROOMS.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W 31" D 67" H____
    Vented X No. Cages 140 No. Shelves___
32. Animal Caging W____ D____ H____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

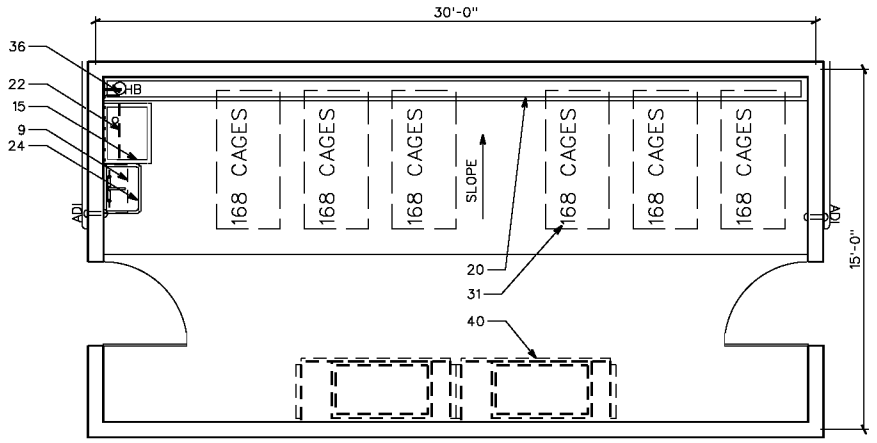
ROOM DATA:

ROOM NUMBER: **2.1.1 (CAGE LAYOUT A-OPTION 2)**
ROOM NAME: **SMALL HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: **JACK TAYLOR**
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR MICE DISPOSABLE CAGE SYSTEM
450 SF
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
SOLID SS COVER FOR TRENCH DRAIN IN MICE ROOMS.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W 31.9" D 69.4" H____
    Vented X No. Cages 168 No. Shelves___
32. Animal Caging W____ D____ H____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

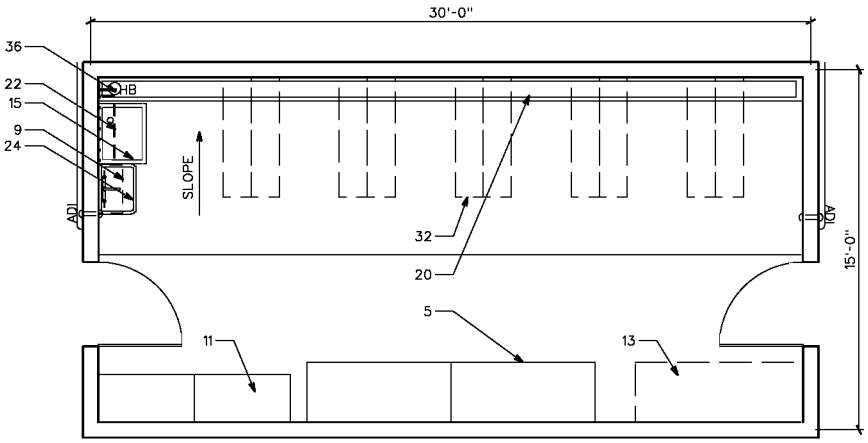
ROOM DATA:

ROOM NUMBER: **2.1.1 (CAGE LAYOUT B)**
ROOM NAME: **SMALL HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR ZEBRAFISH
450 SF
PUMPS ARE LOCATED BELOW SHELVES ON RACKS.
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W 60" D 14" H 84.75"
    Vented ___ No. Cages___ No. Shelves 5
    Type: ZEBRAFISH (NO. CAGES VARIES)
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

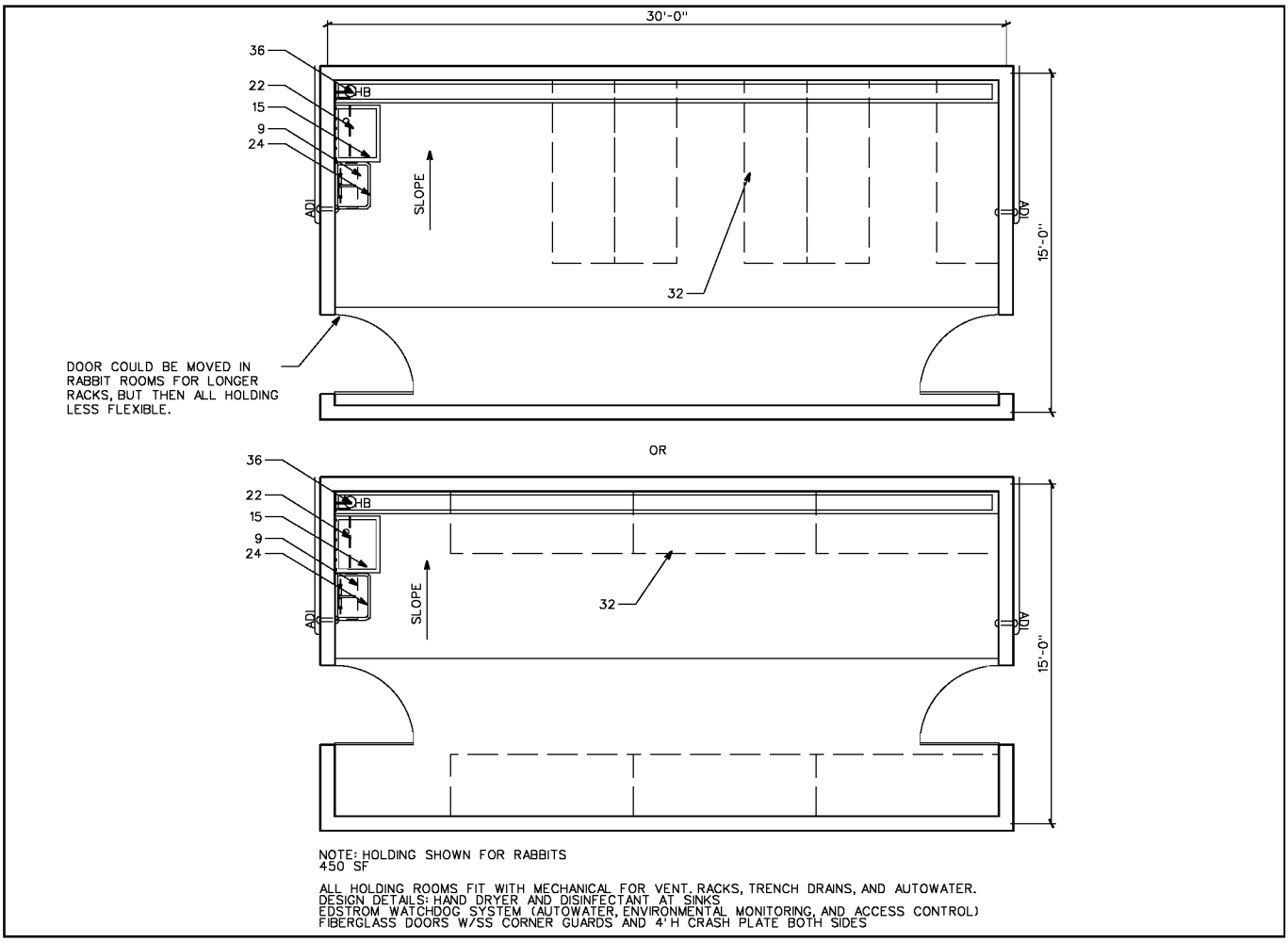
ROOM DATA:

ROOM NUMBER: **2.1.1 (CAGE LAYOUT C)**
ROOM NAME: **SMALL HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W 97" D 33" H_____
    Vented ___ No. Cages 6 No. Shelves 3
    Type: RABBIT (3 OVER 2)
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

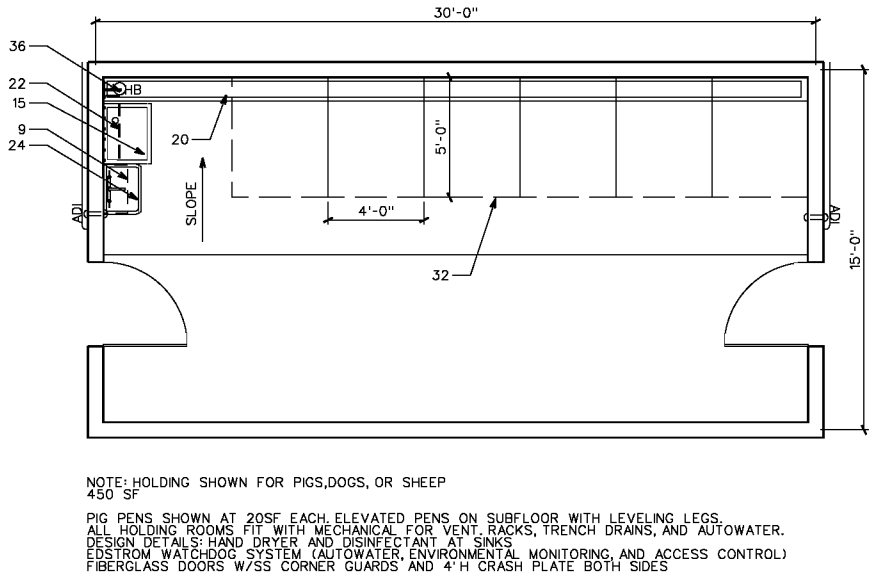
ROOM DATA:

ROOM NUMBER: **2.1.1 (CAGE LAYOUT D)**
ROOM NAME: **SMALL HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR PIGS,DOGS, OR SHEEP
450 SF

PIG PENS SHOWN AT 20SF EACH. ELEVATED PENS ON SUBFLOOR WITH LEVELING LEGS.
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W 5'-0" D 6'-0" H_____
    Vented ___ No. Cages 1 No. Shelves___
    Type: PIGS
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.1.2	USER:	
ROOM NAME:	LARGE HOLDING ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	
MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	
HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	
LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	●
Safety Shower/Eyewash (SS)	
HoseBib	●
ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	●
Darkenable	
Zoned Lighting	
Other	
LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	
ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	*
Natural Daylight	
MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

*Vision panel with red glass

Doors could be 4'-0" wide if determined to be required in design.

Mobile cabinets to be used.

All receptacles to be GFI and waterproof, light intensity should be 30 footcandles at 1 meter from floor

Space Diagram - Animal Facilities

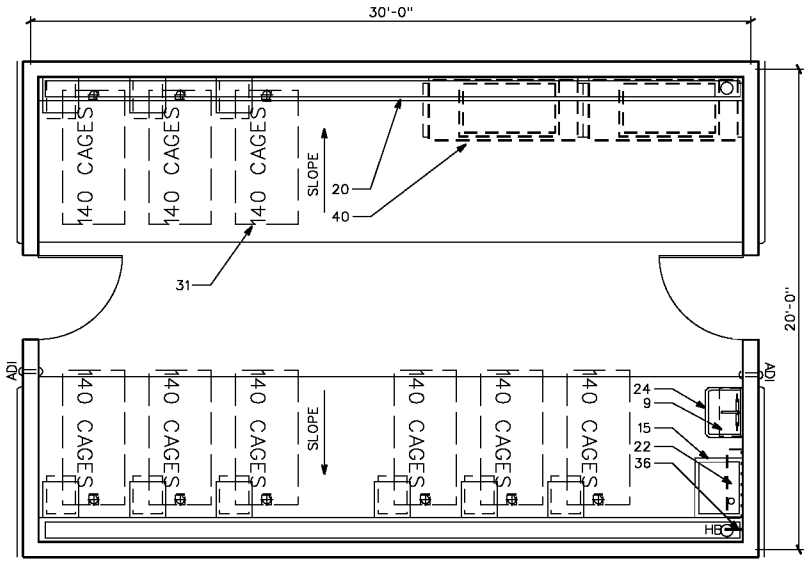
ROOM DATA:

ROOM NUMBER: **2.1.2 (CAGE LAYOUT A)**
ROOM NAME: **LARGE HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR MICE
600 SF
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
SOLID SS COVER FOR TRENCH DRAIN IN MICE ROOMS.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W 31" D 67" H____
    Vented X No. Cages 140 No. Shelves___
32. Animal Caging W____ D____ H____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

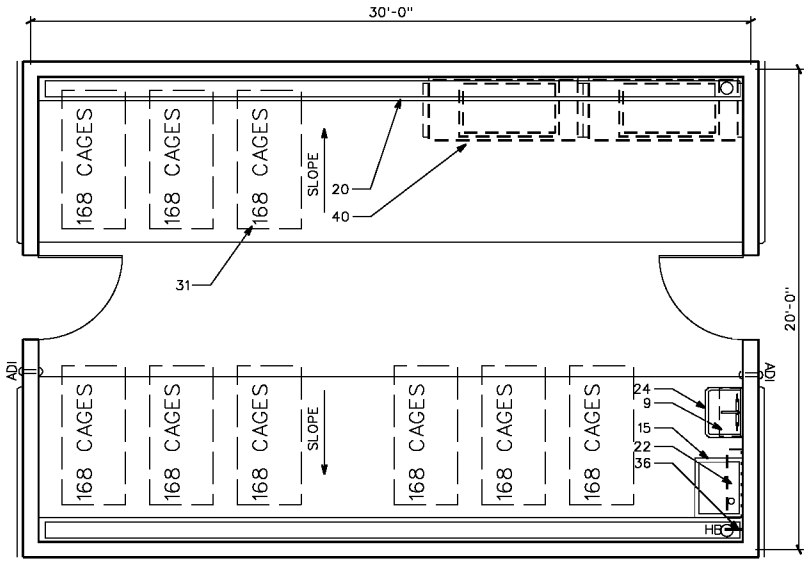
ROOM DATA:

ROOM NUMBER: **2.1.2 (CAGE LAYOUT A-OPTION)**
ROOM NAME: **LARGE HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR MICE DISPOSABLE CAGE SYSTEM
600 SF
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
SOLID SS COVER FOR TRENCH DRAIN IN MICE ROOMS.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W 31.9" D 69.4" H____
    Vented X No. Cages 168 No. Shelves___
32. Animal Caging W____ D____ H____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

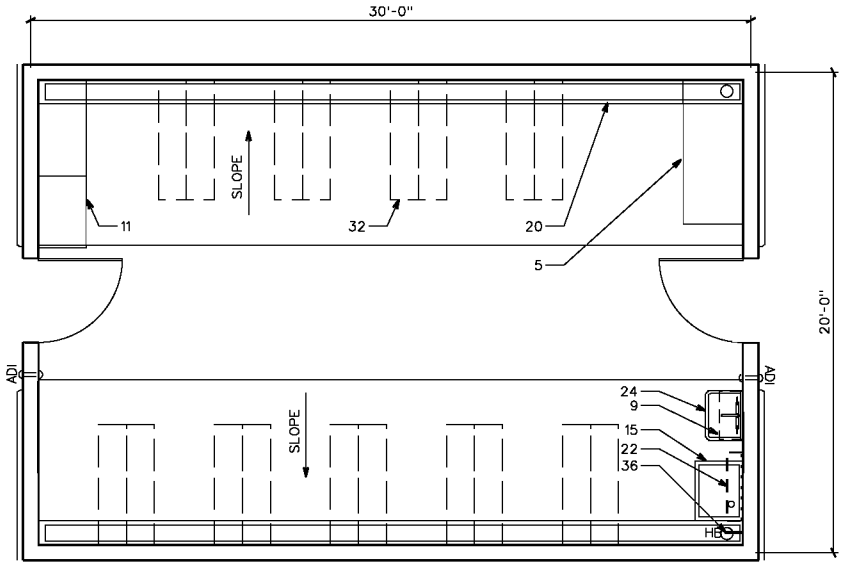
ROOM DATA:

ROOM NUMBER: **2.1.2 (CAGE LAYOUT B)**
ROOM NAME: **LARGE HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W 60" D 14" H 84.75"
    Vented ___ No. Cages___ No. Shelves 5
    Type: ZEBRAFISH (NO. CAGES VARIES)
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

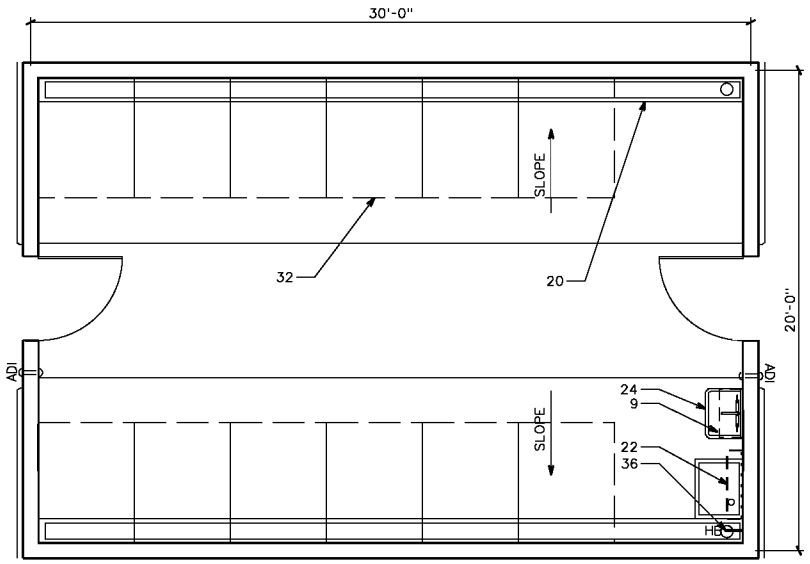
ROOM DATA:

ROOM NUMBER: **2.1.2 (CAGE LAYOUT D)**
ROOM NAME: **LARGE HOLDING ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: HOLDING SHOWN FOR PIGS
600SF

PIG PENS SHOWN AT 20SF EACH. ELEVATED PENS ON SUBFLOOR WITH LEVELING LEGS.
ALL HOLDING ROOMS FIT WITH MECHANICAL FOR VENT. RACKS, TRENCH DRAINS, AND AUTOWATER.
DESIGN DETAILS: HAND DRYER AND DISINFECTANT AT SINKS
EDSTROM WATCHDOG SYSTEM (AUTOWATER, ENVIRONMENTAL MONITORING, AND ACCESS CONTROL)
FIBERGLASS DOORS W/SS CORNER GUARDS AND 4' H CRASH PLATE BOTH SIDES

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W 5'-0" D 6'-0" H_____
    Vented ___ No. Cages 1 No. Shelves___
    Type: PIGS
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.2.1	USER:	
ROOM NAME:	SMALL PROCEDURE ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	
MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	
HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	●
Classification	A2
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	
LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	●
Nitrogen Gas (N_2)	●
Cylinder Gases	O2
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	●
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	
LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	
ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	
MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram - Animal Facilities

ROOM DATA:

ROOM NUMBER: **2.2.1**

ROOM NAME: **SMALL PROCEDURE ROOM**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

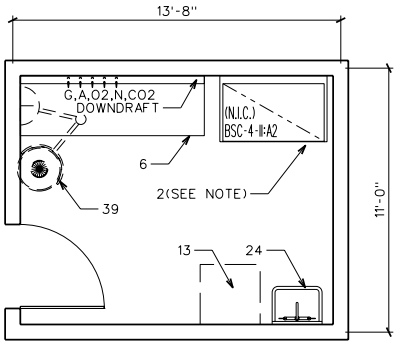
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
150 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W _____ D _____ H _____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W _____ D _____ H _____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal ___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.2.2	USER:	
ROOM NAME:	FREEZER ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	●
14 hours/day	
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	●
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	●
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	●
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other	*
Base	
4" Vinyl	
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	
Height	7' min
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Premanufactured cold room set at -20C

Space Diagram - Animal Facilities

ROOM DATA:

ROOM NUMBER: **2.2.2**

ROOM NAME: **FREEZER ROOM**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

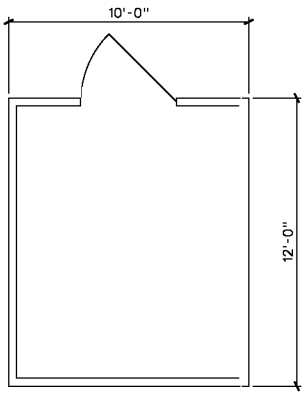
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
CARCASS FREEZER
120 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.2.3	USER:	
ROOM NAME:	NECROPSY	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	●
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other (Necropsy table)	●

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	●
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other(CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram - Animal Facilities

ROOM DATA:

ROOM NUMBER: **2.2.3**

ROOM NAME: **NECROPSY**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

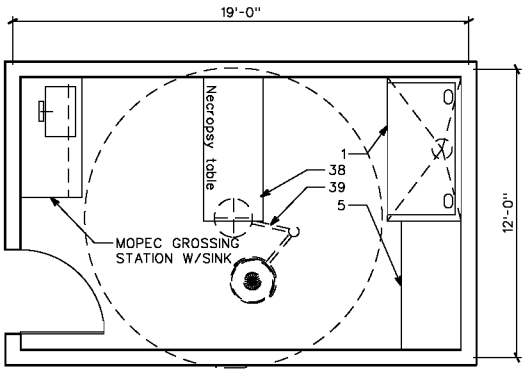
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
228 SF

PLEASE SEE PRODUCT DATA SHEETS TO CONFIRM TYPE OF NECROPSY TABLE AND GROSSING STATION.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.2.4	USER:	
ROOM NAME:	SURVIVAL SURGERY	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	●
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	●
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram

ROOM DATA:

ROOM NUMBER: **2.2.4**

ROOM NAME: **SURVIVAL SURGERY**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

USER: _____

DIRECTOR: _____

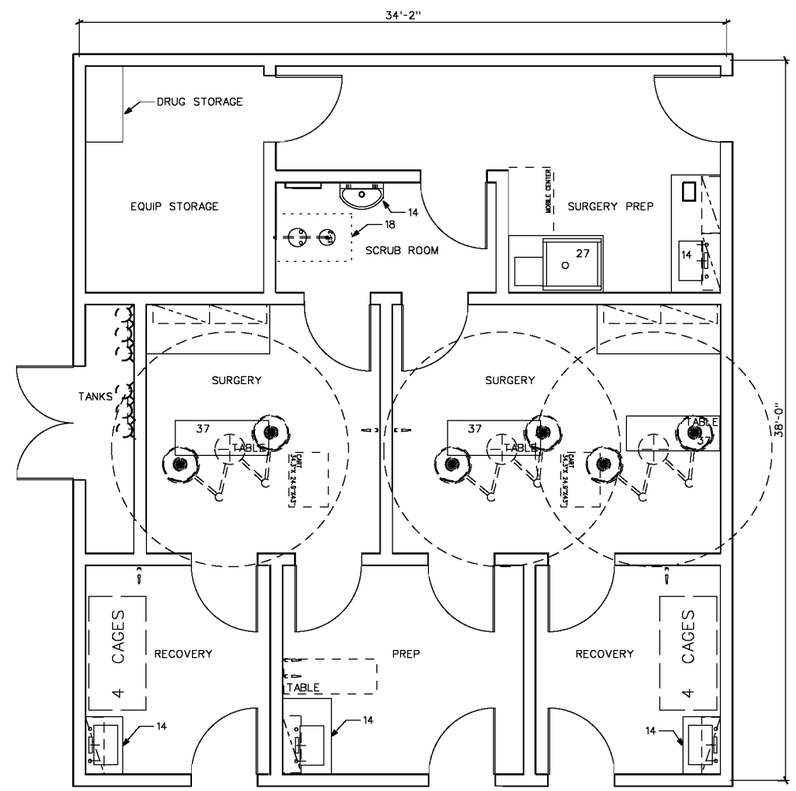
PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Adjustable Shelving
21. White Markerboard
22. Tackboard
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal ___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above



NOTE:
1300 SF OPTION

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.2.5	USER:	
ROOM NAME:	QUARANTINE	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Hose Bib	●

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	●
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram - Animal Facilities

ROOM DATA:

ROOM NUMBER: **2.2.5**

ROOM NAME: **QUARANTINE**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

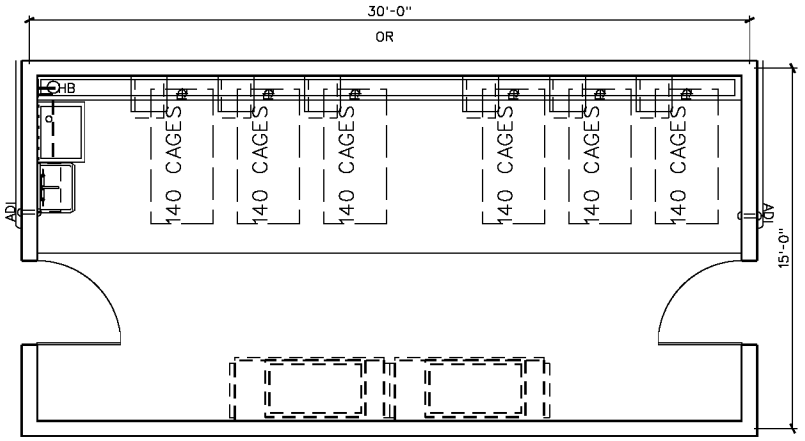
USER: _____

DIRECTOR: _____

PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
450 SF FOR VENT. CAGES
TYPICAL HOLDING ROOM USED AS QUARANTINE. CAGE IS THE BARRIER.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

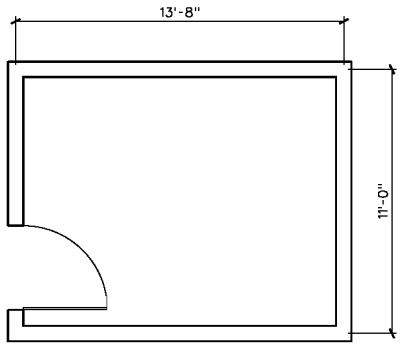
ROOM DATA:

ROOM NUMBER: **2.2.6**
ROOM NAME: **SUPPLY ROOM**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
150 SF
ONE ROOM EACH FOR PREPACKAGE SETS, LARGE ANIMAL, AND SMALL ANIMAL

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:

ROOM NUMBER:	2.2.8
ROOM NAME:	BREAK AREA
DEPARTMENT:	CORE
GROUP:	VIVARIUM

CONTACT:

USER:	
DIRECTOR:	
PHONE:	
E-MAIL:	

UTILIZATION

Hours of Use	
8 hours/day	●
14 hours/day	
24 hours/day	
Other	

MECHANICAL

Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	
Uncontrolled	●
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	●
100% Outside Air	
Recirculated Air	●
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS

Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT

Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING

Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL

110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	●
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK

Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS

Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL

Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	●
GWB, Paint	
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	8'+
Doors	
3'-6" x 8'	
3' x 8'	●
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	●

MOVEABLE EQUIPMENT

Computer	
Printer	
Shredder	
Copier	
Other	

Countertops, cabinets, and sink will be provided.

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.3.1	USER:	
ROOM NAME:	CENTRAL CAGEWASH	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	
MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	●
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	
HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	●
Low Slotted Exhaust	
Other	
LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	●
Heat Producing	●
Noise Producing	●
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	●
Chilled Water (CHW S/R)	●
Steam/Condensate Return	●
Carbon Dioxide ($C0_2$)	●
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	●
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	●
ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	●
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	●
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	
LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	
ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other (CMU)	●
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	10'
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	●
Vision Panel	●
Natural Daylight	
MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram

ROOM DATA:

ROOM NUMBER: **2.3.1**

ROOM NAME: **CENTRAL CAGEWASH**

DEPARTMENT: **CORE**

GROUP: **VIVARIUM**

CONTACT:

USER: _____

DIRECTOR: _____

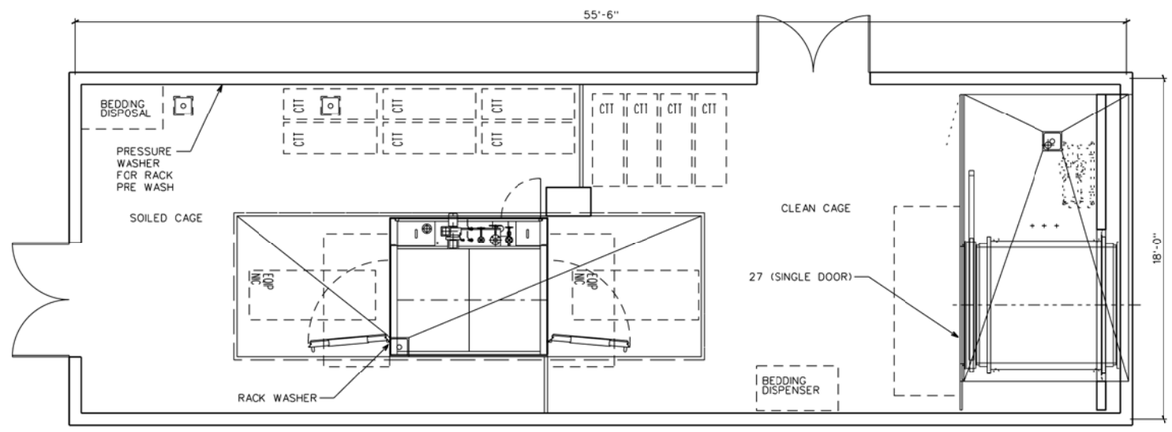
PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Adjustable Shelving
21. White Markerboard
22. Tackboard
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above



NOTE: CO2 NEEDED FOR EUTHANASIA

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.3.2	USER:	
ROOM NAME:	CAGEWASH SUPPORT	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	●
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other	
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Part of this space is a premanufactured 4C cold room for feed storage.

Space Diagram - Animal Facilities

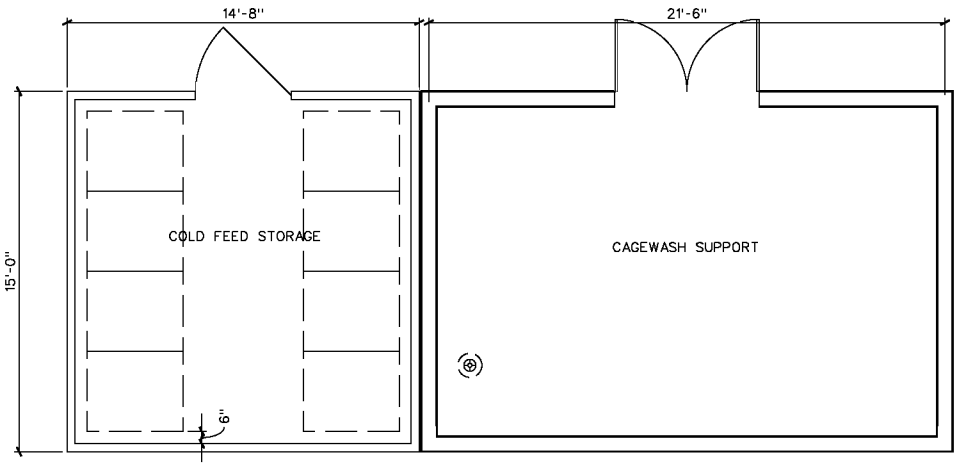
ROOM DATA:

ROOM NUMBER: **2.3.2**
ROOM NAME: **CAGEWASH SUPPORT**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	2.3.3	USER:	
ROOM NAME:	CAGE STORAGE	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	VIVARIUM	E-MAIL:	

UTILIZATION

Hours of Use	
8 hours/day	
14 hours/day	•
24 hours/day	
Other	

MECHANICAL

Temperature	
72°F ± 2°F	
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	
100% Outside Air	
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS

Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT

Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING

Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL

110V, 20A, 1 Phase	
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK

Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS

Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL

Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other	
Base	
4" Vinyl	
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT

Computer	
Printer	
Shredder	
Copier	
Other	

This area will have the environmental and finishes of the surrounding LAS areas.

Detailed Space Requirements

ROOM DATA:

ROOM NUMBER:	2.4
ROOM NAME:	OFFICE
DEPARTMENT:	CORE
GROUP:	VIVARIUM

CONTACT:

USER:	
DIRECTOR:	
PHONE:	
E-MAIL:	

UTILIZATION

Hours of Use	
8 hours/day	●
14 hours/day	
24 hours/day	
Other	

MECHANICAL

Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	●
100% Outside Air	
Recirculated Air	●
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS

Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT

Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING

Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL

110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK

Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS

Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL

Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	
Integral w/floor	●
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	●
Height	
Doors	
3'-6" x 8'	
3' x 8'	●
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	●

MOVEABLE EQUIPMENT

Computer	●
Printer	
Shredder	
Copier	
Other	

Power provided as needed by computer system.

Computer rack for security and Watchdog system located in this room. Extra cooling may be required to accommodate computers.

Space Diagram - Animal Facilities

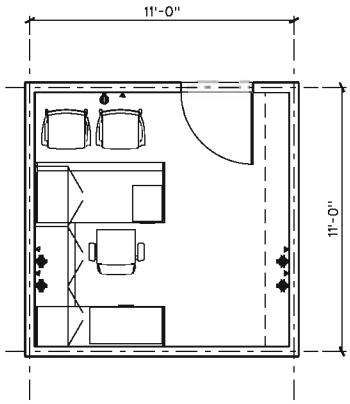
ROOM DATA:

ROOM NUMBER: **2.4.1**
ROOM NAME: **OFFICE**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
121 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

Space Diagram - Animal Facilities

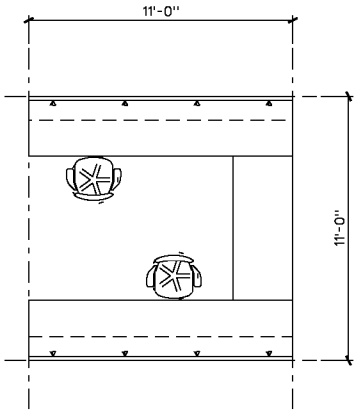
ROOM DATA:

ROOM NUMBER: **2.4.2**
ROOM NAME: **WORKSTATIONS**
DEPARTMENT: **CORE**
GROUP: **VIVARIUM**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet
3. Snorkel Exhaust
4. Vented Workstation
5. Table
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Mop Sink
16. Cylinder Rack
17. Gas Cabinet
18. Safety Shower/ Eyewash
19. Pipe Drop Enclosure
20. Trench Drain
21. White Markerboard
22. Mop Holder
23. Desk
24. Service Sink
25. Glasswasher
26. Glassware Dryer
27. Autoclave
28. Cagewasher
29. Clean Supplies
30. Dirty Supplies
31. Rodent Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
32. Animal Caging W_____ D_____ H_____
    Vented ___ No. Cages___ No. Shelves___
    Type: _____
33. Weaning Caging
    Vented ___ No. Cages___ No. Shelves___
34. Moveable Cage Rack
    Vented ___ No. Cages___ No. Shelves___
35. Circadian Light Control
36. Hose Bib
37. Surgery Table Vented___ Disposal___
38. Necropsy Table Vented___ Disposal___
39. Surgical Light Above
40. Change Station/Class II Biohood

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
Small Animal Imaging (Finished)			quantity	Size NSF	Total NSF	Total GSF
3.1	**7T Small Bore MRI Suite**					
	3.1.1	7TAnimal Magnet	1	194	194	328
	3.1.2	Operator Room	1	125	125	211
	3.1.3	Equipment Room	1	194	194	328
	7T Small Bore Suite Subtotal				**513**	**867**
3.2	**Imaging Laboratories**					
	3.2.1	Small Animal Imaging Lab	1	726	726	1,231
	3.2.2	Ultrasound Lab	1	121	121	205
*	**3.2.3**	PET/CT Lab	1	121	121	205
*	**3.2.4**	SPECT/CT Lab	1	121	121	205
	3.2.5	Fluoroscopy Room	1	121	121	205
	***Note: 3.2.3 and 3.2.4 combined square footage into one room**					
	Imaging Laboratories Subtotal				**1,210**	**2,051**
3.3	**Imaging Support**					
	3.3.1	Radiochemistry Lab	1	484	484	820
	3.3.2	Wet Chemistry Lab	1	484	484	820
	3.3.3	Image Analysis Lab	1	484	484	820
	3.3.4	Instrumentation Development Lab	1	484	484	820
	3.3.5	Gas Cylinder Storage	1	20	20	34
	3.3.6	Computer Room	1	121	121	205
	Imaging Support Subtotal				**2,077**	**3,520**
3.4	**Office**					
	3.4.1	Office	1	121	121	205
	3.4.2	Workstation Area (3 workstations)	2	121	242	410
	Office Subtotal				**363**	**615**
Small Animal Imaging Total- Finished					**4,163**	**7,053**
Small Animal Imaging (Shelled)			quantity	Size NSF	Total NSF	Total GSF
3.5	**3T Large Bore MRI Suite (Shelled)**					
	3.5.1	3T Human Magnet	1	520	520	881
	3.5.2	Operator Room	1	250	250	424
	3.5.3	Equipment Room	1	520	520	881
	3T Large Bore MRI Suite Subtotal				**1,290**	**2,186**
Small Animal Imaging Total- Shelled					**1,290**	**2,186**

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.1.1	USER:	
ROOM NAME:	7T ANIMAL MAGNET	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	●
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other	●
Base	
4" Vinyl	
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	
Height	*
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	●

Shielding Required

* Verify with equipment selected

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.1.2	USER:	
ROOM NAME:	OPERATOR ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	●
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.1.3	USER:	
ROOM NAME:	EQUIPMENT ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	●
Heat Producing	●
Noise Producing	●
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	●
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	
Integral w/floor	
Ceiling	
Open	●
Acoustic Tile	
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	●

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

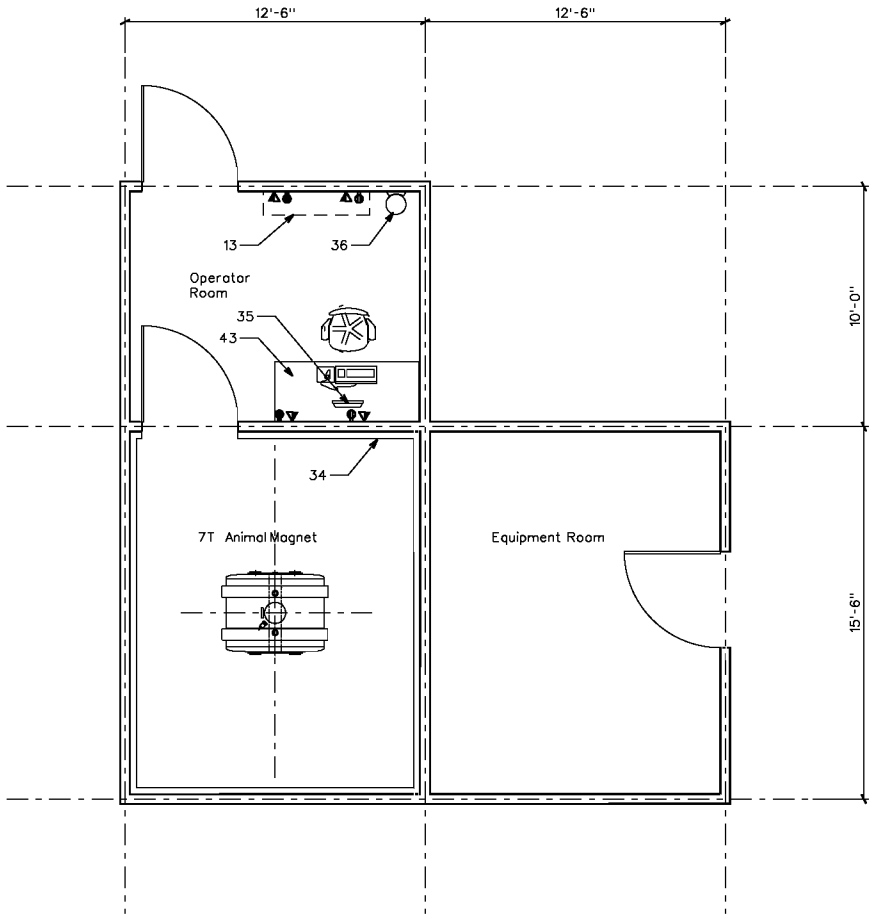
ROOM DATA:

ROOM NUMBER: **3.1**
ROOM NAME: **7T ANIMAL MRI SUITE**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
513 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Shielding
35. Flat Panel Screen
36. Gas Cylinder
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.2.1	USER:	
ROOM NAME:	SMALL ANIMAL IMAGING LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

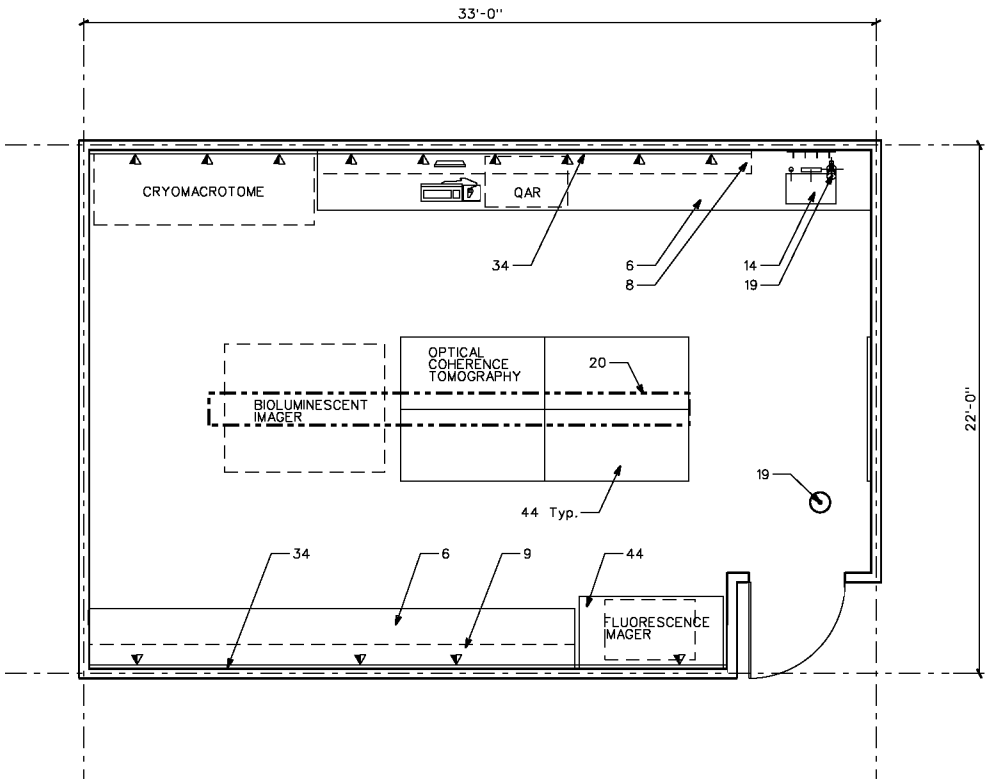
ROOM DATA:

ROOM NUMBER: **3.2.1**
ROOM NAME: **SMALL ANIMAL IMAGING LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
726 NSF
MUST BE ADJACENT TO ANIMAL PREP ROOM

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.2.2	USER:	
ROOM NAME:	ULTRASOUND LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

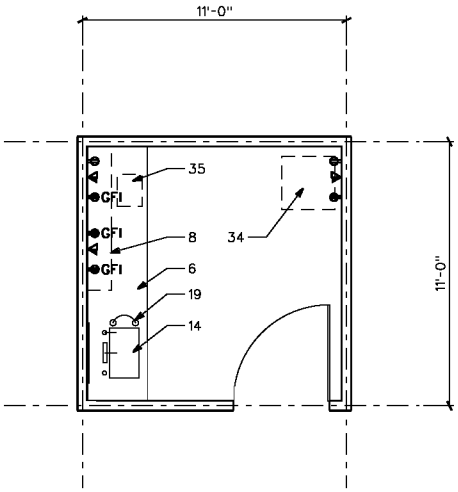
ROOM DATA:

ROOM NUMBER: **3.2.2**
ROOM NAME: **ULTRASOUND LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
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FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Ultrasound
35. Laser Doppler
36.
37.
38.
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.2.3	USER:	
ROOM NAME:	PET/CT LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

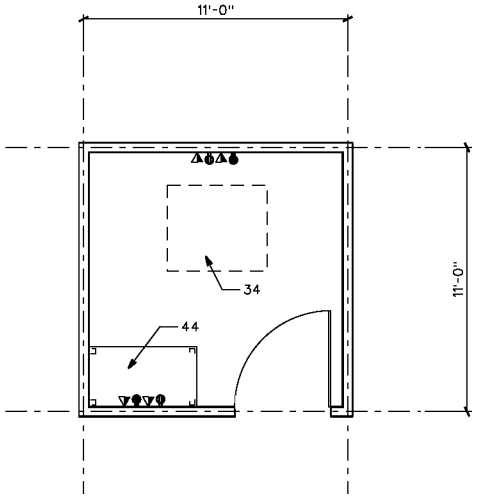
ROOM DATA:

ROOM NUMBER: **3.2.3**
ROOM NAME: **PET/CT LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: 3.2.3-3.2.4 MAY BE COMBINED IN ONE ROOM TO ACCOMODATE ONE LARGER INSTRUMENT INSTEAD OF 2 SMALL INSTRUMENTS.

NOTE
121 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. PET/CT
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.2.4	USER:	
ROOM NAME:	SPECT/CT LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

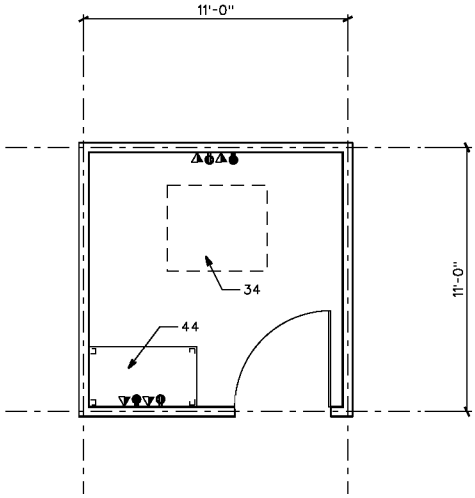
ROOM DATA:

ROOM NUMBER: **3.2.4**
ROOM NAME: **SPECT/CT LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: 3.2.3-3.2.4 MAY BE COMBINED IN ONE ROOM TO ACCOMODATE ONE LARGER INSTRUMENT INSTEAD OF 2 SMALL INSTRUMENTS.

NOTE
121 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. SPECT/CT
35.
36.
37.
38.
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.2.5	USER:	
ROOM NAME:	FLUOROSCOPY ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

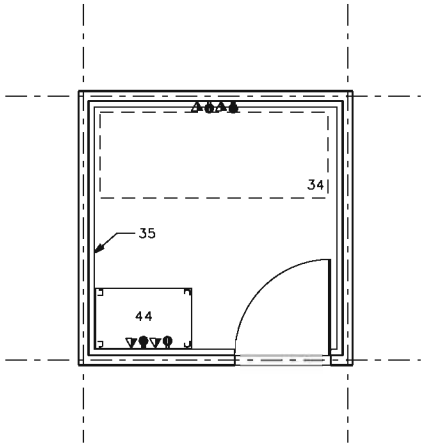
ROOM DATA:

ROOM NUMBER: **3.2.5**
ROOM NAME: **FLUOROSCOPY ROOM**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
121 NSF
VERIFY EQUIPMENT MODEL AND DIMENSIONS-MAY NEED LARGER ROOM

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Fluroroscopy
35. Shielding
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.3.1	USER:	
ROOM NAME:	RADIOCHEMISTRY LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	●
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	●

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	●
Laboratory Vacuum (LV)	●
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	●
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

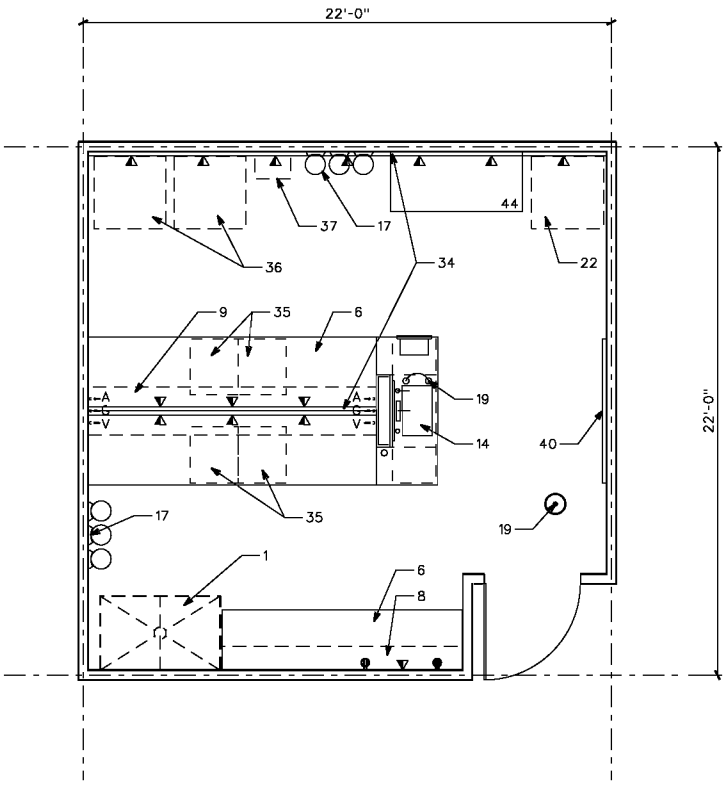
ROOM DATA:

ROOM NUMBER: **3.3.1**
ROOM NAME: **RADIOCHEMISTRY LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
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FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. Mobile Casework
36. Mini Cells
37. Shielded Waste Container
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.3.2	USER:	
ROOM NAME:	WET CHEMISTRY LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	●
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	●
Laboratory Vacuum (LV)	●
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	●

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

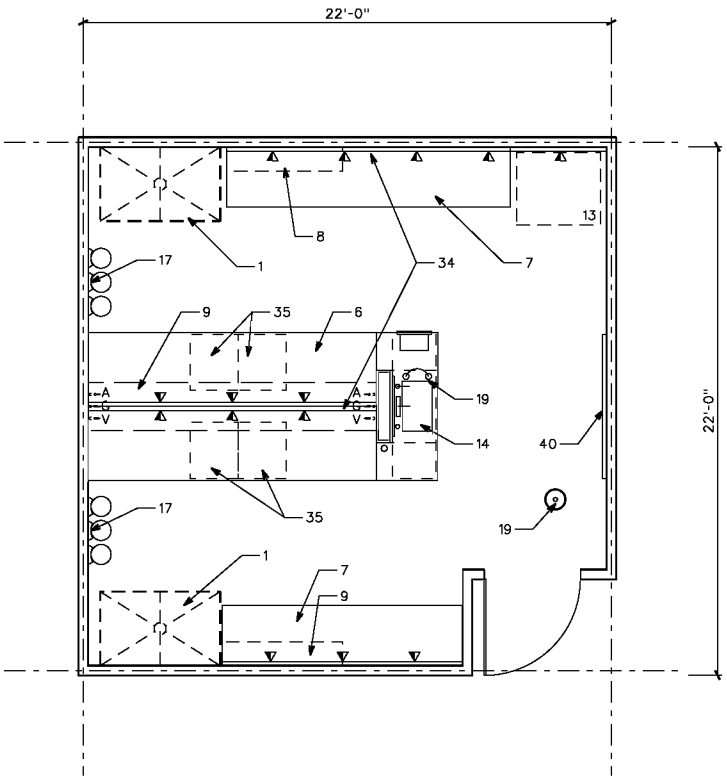
ROOM DATA:

ROOM NUMBER: **3.3.2**
ROOM NAME: **WET CHEMISTRY LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
484 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. Mobile Casework
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.3.3	USER:	
ROOM NAME:	IMAGE ANALYSIS LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	?
100% Outside Air	
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	●
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	●
Printer	●
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

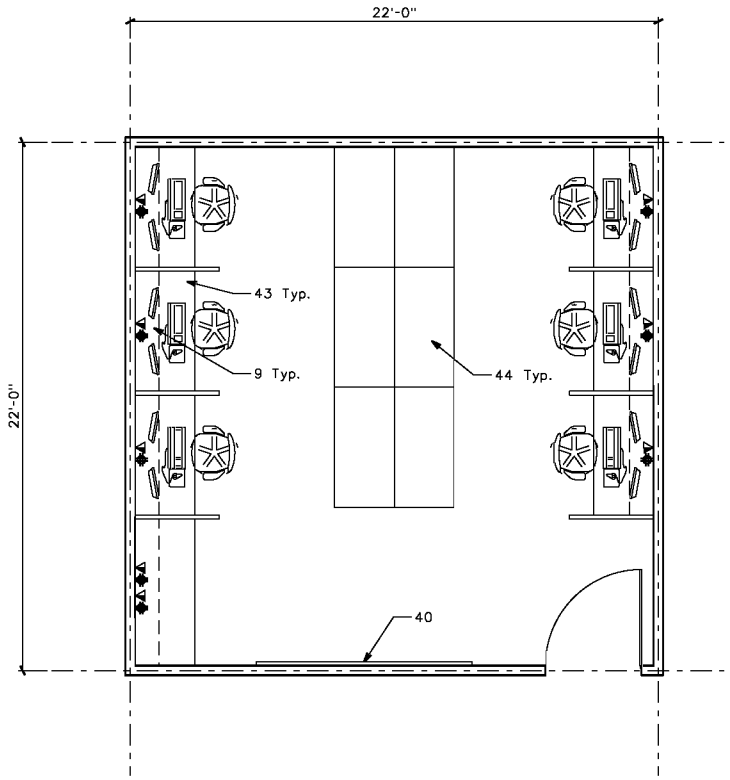
ROOM DATA:

ROOM NUMBER: **3.3.3**
ROOM NAME: **IMAGE ANALYSIS LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
484 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.3.4	USER:	
ROOM NAME:	INSTRUMENTATION DEV. LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	●
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **3.3.4**
ROOM NAME: **INSTRUMENT DEVELOPMENT LAB**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

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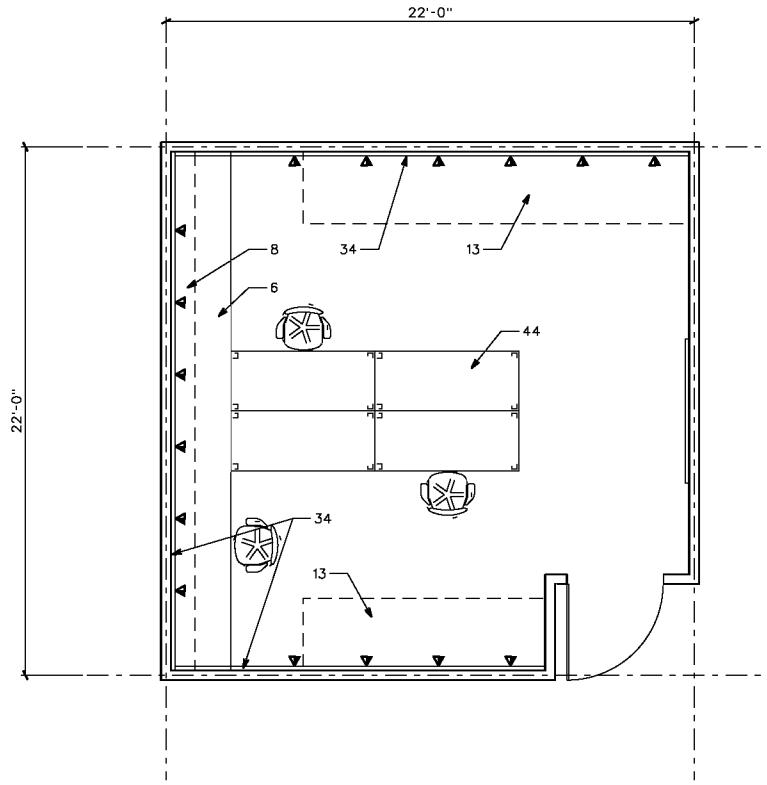

NOTE
484 NSF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram - Lab, Lab Support, and Office Facilities

ROOM DATA:

ROOM NUMBER: **3.3.5**
ROOM NAME: **GAS CYLINDER STORAGE**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

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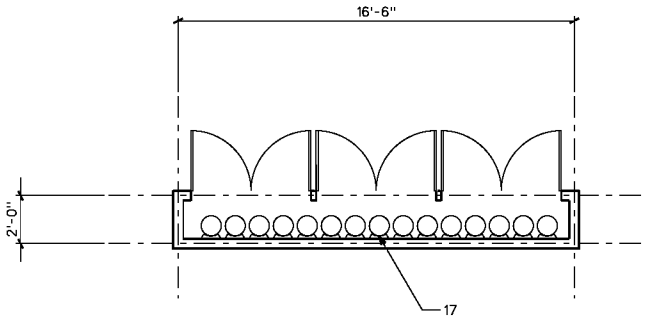

NOTE
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FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. _____
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	3.3.6	USER:	
ROOM NAME:	COMPUTER ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	IMAGING	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	●
14 hours/day	
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	
Uncontrolled	●
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	●
100% Outside Air	
Recirculated Air	●
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	●
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	●
Sheet Vinyl	
Epoxy	
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	●
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

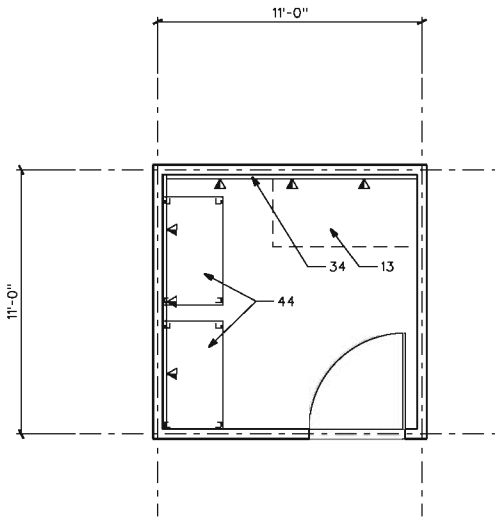
ROOM DATA:

ROOM NUMBER: **3.3.6**
ROOM NAME: **COMPUTER ROOM**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
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SHOULD BE ADJACENT TO BUILDING SUPPORT.
ENSURE PROPER COOLING.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Plugmold w/ outlets at 30" O.C.
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:

ROOM NUMBER:	3.4
ROOM NAME:	OFFICE
DEPARTMENT:	CORE
GROUP:	IMAGING

CONTACT:

USER:	
DIRECTOR:	
PHONE:	
E-MAIL:	

UTILIZATION

Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL

Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	●
100% Outside Air	
Recirculated Air	●
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS

Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT

Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING

Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL

110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK

Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS

Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL

Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	●
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	
3' x 8'	●
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	●

MOVEABLE EQUIPMENT

Computer	●
Printer	
Shredder	
Copier	
Other	

Space Diagram - Lab, Lab Support, and Office Facilities

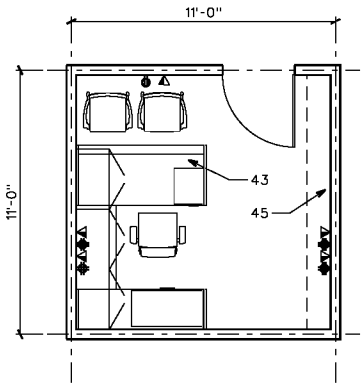
ROOM DATA:

ROOM NUMBER: **3.4.1**
ROOM NAME: **OFFICE**
DEPARTMENT: **CORE**
GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:
DIRECTOR: **JOHN HOFFMAN**
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE
121 NSF
ENSURE ACCESS TO NATURAL LIGHT.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. _____
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Space Diagram

ROOM DATA:

ROOM NUMBER: **3.5**

ROOM NAME: **3T HUMAN MRI SUITE**

DEPARTMENT: **CORE**

GROUP: **SMALL ANIMAL IMAGING**

CONTACT:

USER:

DIRECTOR: **JOHN HOFFMAN**

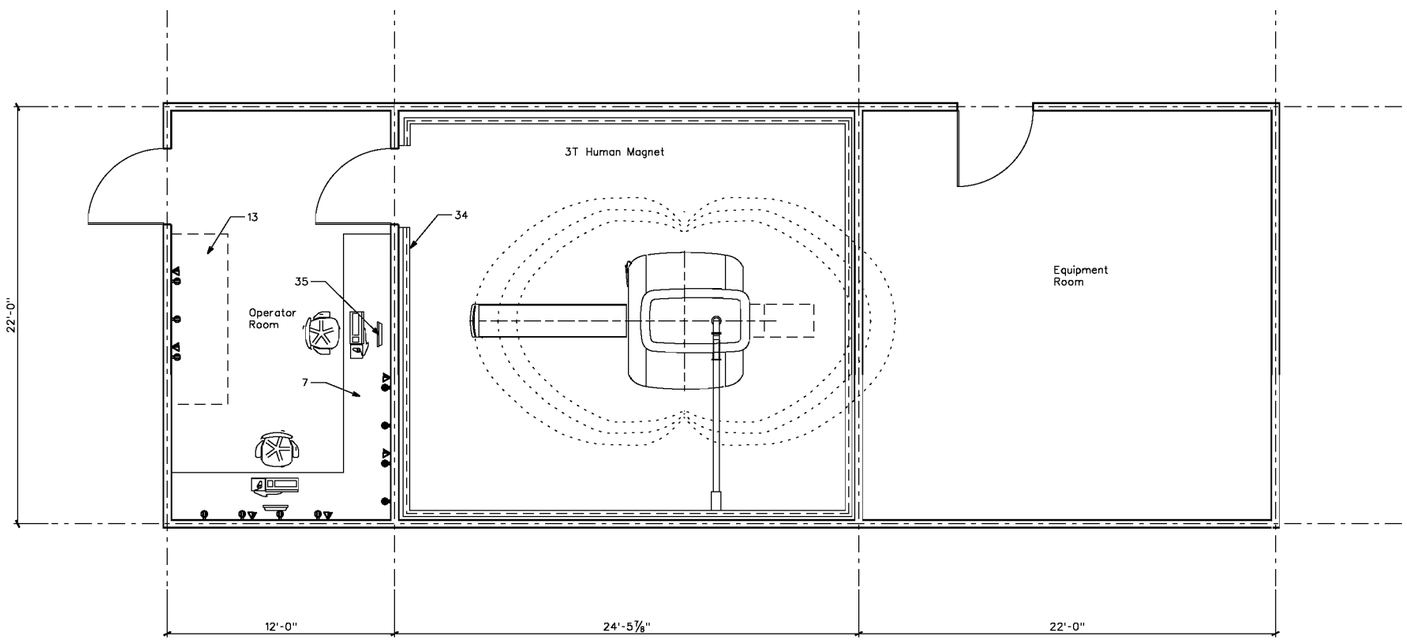
PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Copper and Steel Shielding
35. Flat Panel Screen
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves



NOTE
1,290 NSF
REQUIRES VIBRATION ISOLATION
REQUEST SHELL SPACE FOR FUTURE EQUIPMENT

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
4.0 Microscopy			quantity	Size NSF	Total NSF	Total GSF
4.1	**Biomedical Instrument Labs**					
	4.1.1	Large Instrument Room	2	240	480	814
	4.1.2	Small Instrument Room	4	144	576	976
	4.1.3	Optics Lab	1	240	240	407
	Biomedical Instrument Labs Subtotal				**1,296**	**2,197**
4.2	**Biomedical Microscopy Support**					
	4.2.1	Equipment Corridor	1	400	400	678
	4.2.2	Wet Lab Prep Area (share space with 4.4.6)	0	384	0	0
	4.2.3	Microtomy Room	1	121	121	205
	4.2.4	High Pressure Freezer Room	1	121	121	205
	Biomedical Microscopy Support Subtotal				**642**	**1,088**
4.3	**Biomedical Office**					
	4.3.1	Office	2	120	240	407
	Biomedical Office Subtotal				**240**	**407**
	Biomedical Microscopy SubTotal				**2,178**	**3,692**
4.4	**Engineering Instrument Labs**					
	4.4.1	HR SEM	1	270	270	458
	4.4.2	DB FIB and Nabity Nanolithography	1	270	270	458
	4.4.3	XPS	1	270	270	458
	4.4.4	Microscopy Service Corridor	1	400	400	678
	4.4.5	AFM(Wet + Solid State)	1	242	242	410
	4.4.6	Shared Sample Prep	1	400	400	678
	4.4.7	Electrical Characterization	1	484	484	820
	4.4.8	Spectrophotometry, Optical Micro Rooms	2	121	242	410
	Engineering Instrument Labs Subtotal				**2,578**	**4,369**
4.5	**Engineering Office**					
	4.5.1	Administrative Manager Office	1	121	121	205
	4.5.2	TEM/XPS Lab Engineer Office	1	121	121	205
	4.4.3	FIB/SEM Engineer Office	1	121	121	205
	4.4.4	Workstation	2	64	128	217
	Engineering Office Subtotal				**491**	**832**
	Engineering Microscopy SubTotal				**3,069**	**5,202**
Microscopy Total					**5,247**	**8,893**

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.1.1	USER:	
ROOM NAME:	LARGE INSTRUMENT ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	●
Air Filtration/Exhaust	**

**Exhaust not from above

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	VC-E
Light Sensitive	
Vibration Producing	
Heat Producing	●
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	●
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Liquid Nitrogen (vent)	●
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	●
Emergency Power	●
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other (dimmers)	●

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Linoleum	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	highbay
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	●
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	●
Printer	
Shredder	
Copier	
Other	●

Shieldling Required. No metal materials allowed in area. Concern with wet labs above.

Vibration sensitive. Locate away from elevators and HVAC systems. Locate away from Imaging center.

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

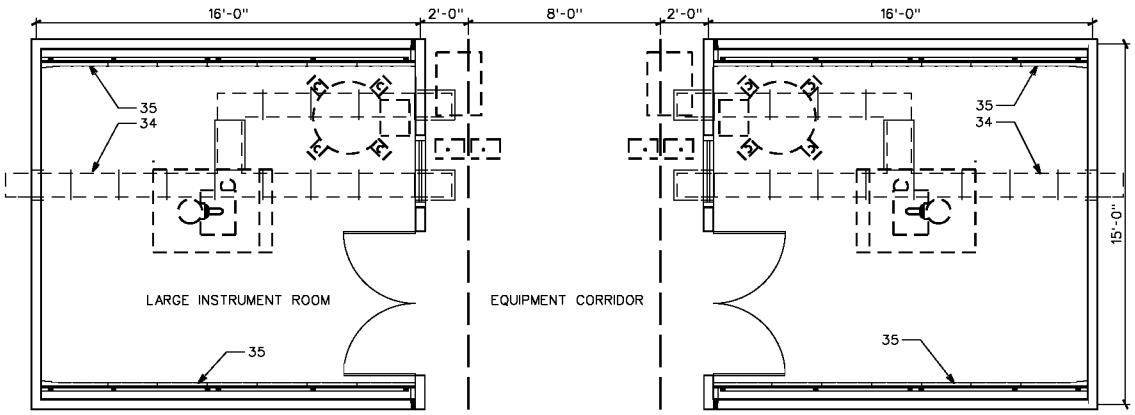
ROOM DATA:

ROOM NUMBER: **4.1.1 AND 4.2.1 (LAYOUT OF 2 ROOMS)**
ROOM NAME: **LARGE INSTR RM AND EQUIP COR**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
LARGE INSTRUMENT ROOM = 240 SF
TARGET VIBRATION "E" CATEGORY TO ALLOW FOR 10' LASER PATH.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Covered Trench (Utilities)
35. Shielding
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.1.2	USER:	
ROOM NAME:	SMALL INSTRUMENT ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	●
Air Filtration/Exhaust	*

*Exhaust not from above

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	VC-E
Light Sensitive	
Vibration Producing	
Heat Producing	●
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	●

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	●
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Liquid Nitrogen (vent)	●
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	●
Emergency Power	●
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other (dimmers)	●

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Linoleum	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	highbay
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	●
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	●
Printer	
Shredder	
Copier	
Other	●

Shieldling Required. No metal materials allowed in area. Concern with wet labs above.

Vibration sensitive. Locate away from elevators and HVAC systems. Locate away from Imaging center.

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

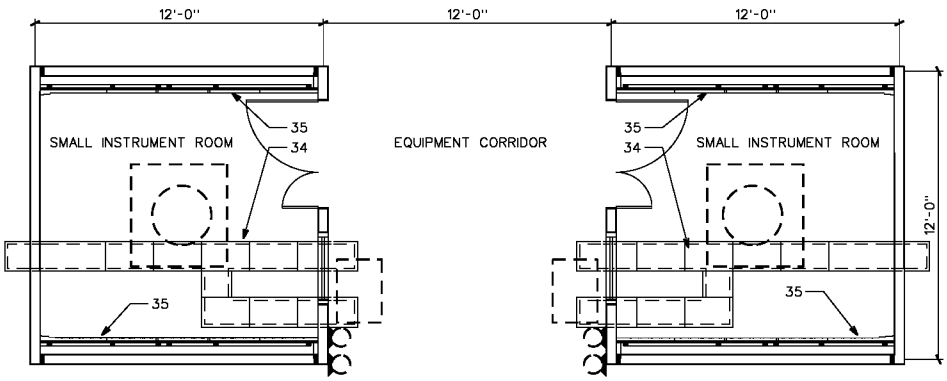
ROOM DATA:

ROOM NUMBER: **4.1.2 AND 4.2.1 (LAYOUT OF 2 ROOMS)**
ROOM NAME: **SMALL INSTR RM AND EQUIP COR**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE:
LARGE INSTRUMENT ROOM - 144 SF
TARGET VIBRATION "E" CATEGORY TO ALLOW FOR 10' LASER PATH.
NEED VACUUM AND AIR

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. _____
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.1.3	USER:	
ROOM NAME:	OPTICS LAB	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	●
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	VC-E
Light Sensitive	
Vibration Producing	
Heat Producing	●
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other (DIMMABLE)	●

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	10'
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	●
Double Door	
Vision Panel	?
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

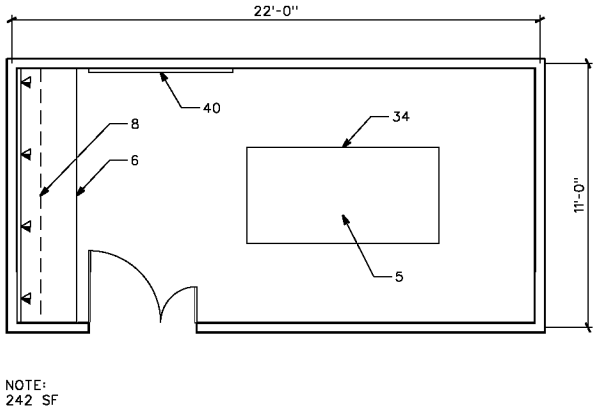
ROOM DATA:

ROOM NUMBER: **4.1.3**
ROOM NAME: **OPTICS LAB**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Optical Bench
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.2.1	USER:	
ROOM NAME:	EQUIPMENT CORRIDOR	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	●
Heat Producing	●
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	*
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	●
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	
Other	
Base	
4" Vinyl	
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.2.2	USER:	
ROOM NAME:	WET LAB PREP AREA	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	●
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	●
Radioisotope Hood	
Biological Safety Cabinet	●
Classification	A2
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	●
Laboratory Vacuum (LV)	●
Laboratory Air (LA)	●
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	●
Potable Cold Water (CW)	●
High Purity Water (DE)	RO
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	●
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	●
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	●
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	
3' x 8'	●
1'-6" x 8'	●
Double Door	
Vision Panel	●
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

Space Diagram

ROOM DATA:

ROOM NUMBER: **4.2.2 and 4.4.6**

ROOM NAME: **PREP, SPECT., AND OPTICAL MICRO**

DEPARTMENT: **CORE**

GROUP: **MICROSCOPY**

CONTACT:

USER: _____

DIRECTOR: _____

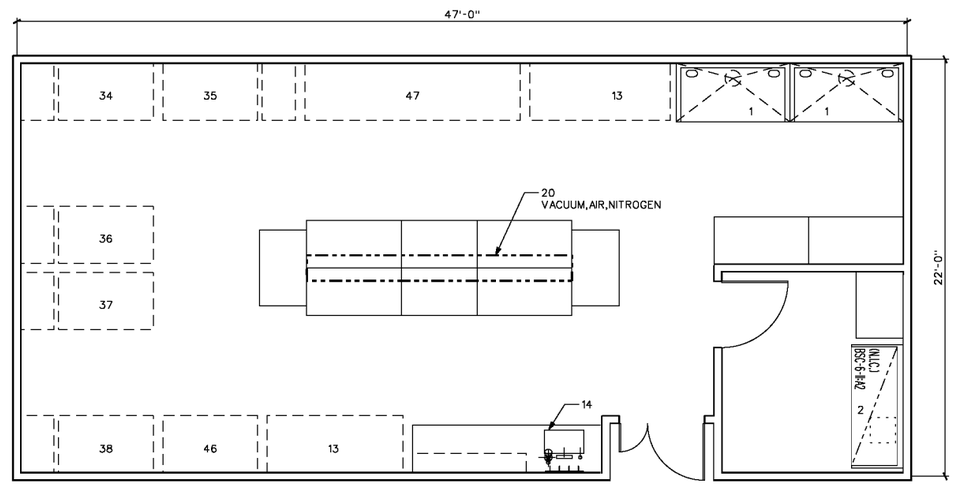
PHONE: _____

E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Ellips.
35. UV VIS
36. TEMCOR
37. Z460
38. FTIR
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves
46. Nano Indent
47. Spec Prep Floor



NOTE:
1047 SF
VACUUM, AIR, AND NITROGEN NEEDED
DESIGN SHOULD LOOK AT ALLOWING VIEWS INTO THIS SPACE FROM CORRIDOR.
IT WOULD BE NICE TO HAVE A MEETING AREA FOR MICROSCOPY ADJACENT TO THIS SPACE.

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.2.3	USER:	
ROOM NAME:	MICROTOMY ROOM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	●
Data	●
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

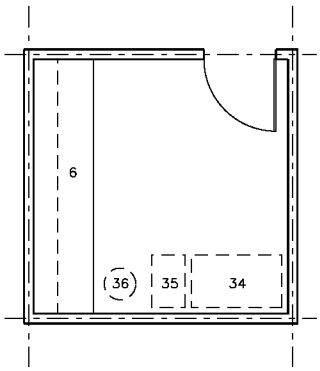
ROOM DATA:

ROOM NUMBER: **4.2.3**
ROOM NAME: **MICROTOMY ROOM**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: 121 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Ultramicrotome (table)
35. Ultramicrotome (drawer)
36. Ultramicrotome (dewar)
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.2.4	USER:	
ROOM NAME:	HIGH PRESSURE FREEZER RM	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	●
68°-75° ± 2°F	
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	●
5 Air Changes/Hour	
100% Outside Air	●
Recirculated Air	
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	
ELECTRICAL	*
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	●
Carpet	
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	●
3' x 8'	
1'-6" x 8'	
Double Door	
Vision Panel	
Natural Daylight	

MOVEABLE EQUIPMENT	
Computer	
Printer	
Shredder	
Copier	
Other	●

* Verify with equipment selected

Space Diagram - Lab, Lab Support, and Office Facilities

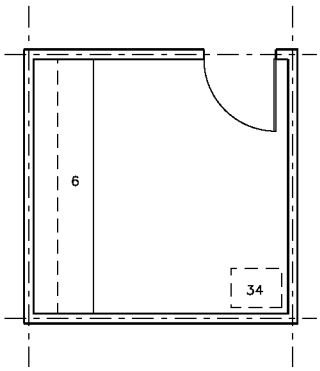
ROOM DATA:

ROOM NUMBER: **4.2.4**
ROOM NAME: **HIGH PRESSURE FREEZER ROOM**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



NOTE: 121 SF

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. High pressure freezer
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves

Detailed Space Requirements

ROOM DATA:		CONTACT:	
ROOM NUMBER:	4.3	USER:	
ROOM NAME:	OFFICE	DIRECTOR:	
DEPARTMENT:	CORE	PHONE:	
GROUP:	MICROSCOPY	E-MAIL:	

UTILIZATION	
Hours of Use	
8 hours/day	
14 hours/day	●
24 hours/day	
Other	

MECHANICAL	
Temperature	
72°F ± 2°F	
68°-75° ± 2°F	●
Other	
Humidity	
55% ± 5%	●
Uncontrolled	
15 Air Changes/Hour	
10 Air Changes/Hour	
5 Air Changes/Hour	●
100% Outside Air	
Recirculated Air	●
Air Pressure Positive	
Air Pressure Negative	
Air Filtration/Supply	
Air Filtration/Exhaust	

HOODS	
Chemical Fume Hood	
Radioisotope Hood	
Biological Safety Cabinet	
Classification	
Laminar Flow Hood	
Snorkel	
Canopy Hood	
Low Slotted Exhaust	
Other	

LABORATORY EQUIPMENT	
Vibration Sensitive	
Light Sensitive	
Vibration Producing	
Heat Producing	
Noise Producing	
Other	
Noise Level Acceptable	
Security Required	

PLUMBING	
Laboratory Gas (LG)	
Laboratory Vacuum (LV)	
Laboratory Air (LA)	
Compressed Air, 100 psi (A)	
Potable Hot Water (HW)	
Potable Cold Water (CW)	
High Purity Water (DE)	
Chilled Water (CHW S/R)	
Steam/Condensate Return	
Carbon Dioxide ($C0_2$)	
Nitrogen Gas (N_2)	
Cylinder Gases	
Inert	
Flammable	
Toxic	
Floor Drain (FD)	
Safety Shower/Eyewash (SS)	
Drench Hose (DH)	

ELECTRICAL	
110V, 20A, 1 Phase	●
208V, 30A, 1 Phase	
208V, 30A, 3 Phase	
480V, 100A, 3 Phase	
Isolated Ground Outlet	
Emergency Power	
UPS (OFOI)	
Phone	
Data	
In Use Light	
Task Lighting	
Lighting Level	
100 fc at bench/desk	●
75 fc at bench/desk	
Safe light	
Special Lighting	
Darkenable	
Zoned Lighting	
Other	

LABORATORY CASEWORK	
Wood	
Metal	
Plastic Laminate	
Adjustable	

CHEMICALS	
Bases	
Acids	
Solvents	
Radioisotopes	
Carcinogens/Regulated	
Chemical Waste Storage	
Biological Storage	
Radioisotope Storage	
Chemical Storage	

ARCHITECTURAL	
Floor	
VCT (SDT)	
VCT	
Sheet Vinyl	
Epoxy	
Carpet	●
Sealed Concrete	
Partitions	
GWB, Epoxy Paint	
GWB, Paint	●
Other	
Base	
4" Vinyl	●
Integral w/floor	
Ceiling	
Open	
Acoustic Tile	●
Gyp Board, Epoxy Paint	
Height	
Doors	
3'-6" x 8'	
3' x 8'	●
1'-6" x 8'	
Double Door	
Vision Panel	●
Natural Daylight	●

MOVEABLE EQUIPMENT	
Computer	●
Printer	
Shredder	
Copier	
Other	

Space Diagram - Lab, Lab Support, and Office Facilities

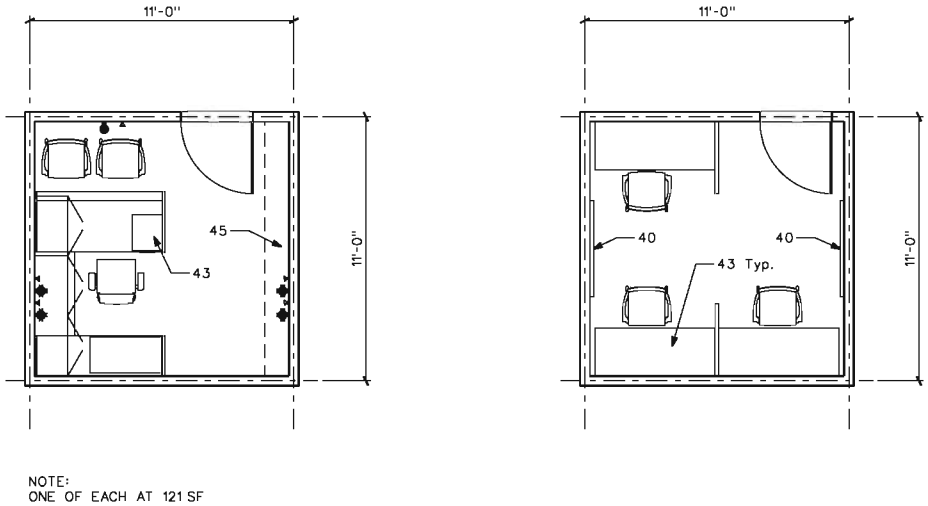
ROOM DATA:

ROOM NUMBER: **4.3.1**
ROOM NAME: **OFFICE**
DEPARTMENT: **CORE**
GROUP: **MICROSCOPY**

CONTACT:

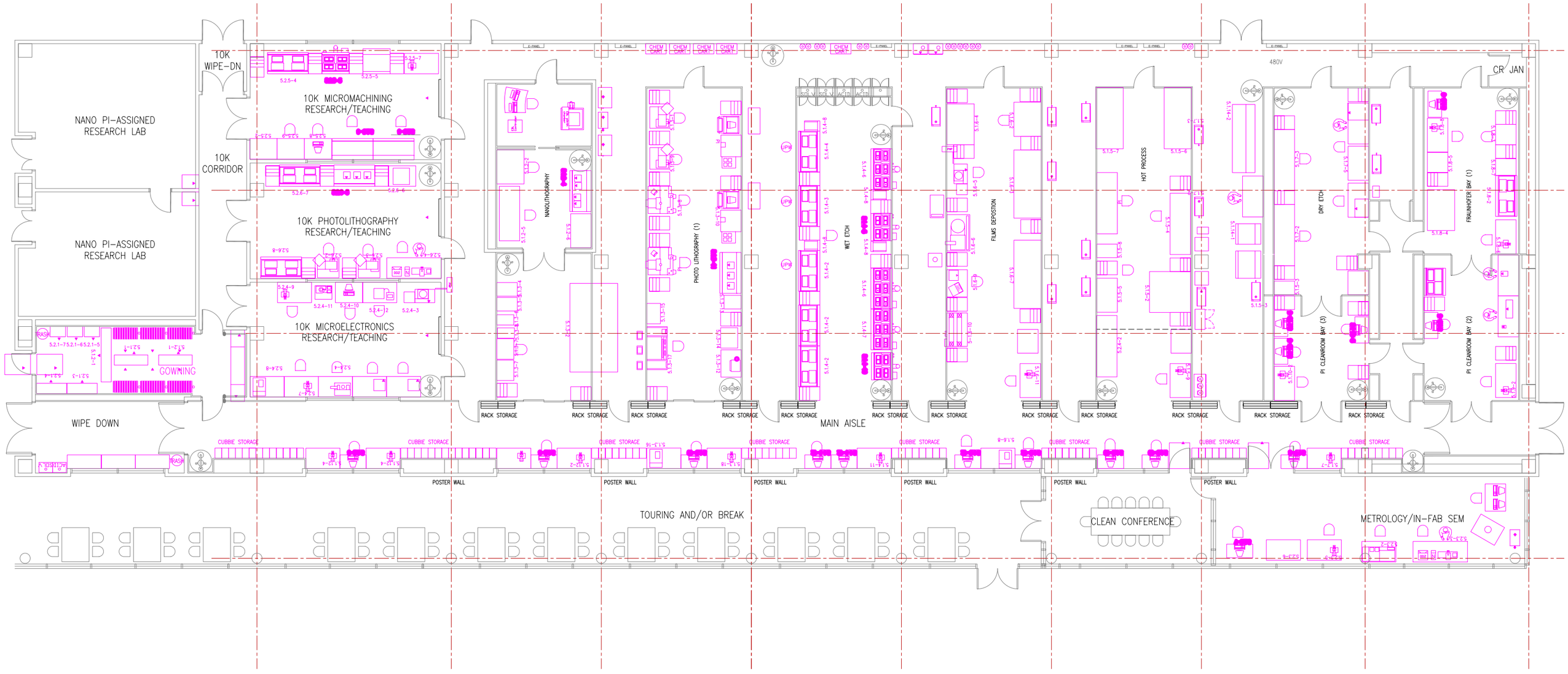
USER: _____
DIRECTOR: _____
PHONE: _____
E-MAIL: _____

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. _____
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves


NANO PI-ASSIGNED RESEARCH LAB
NANO PI-ASSIGNED RESEARCH LAB
10K WIPE-DN
10K CORRIDOR
10K MICROMACHINING RESEARCH/TEACHING
10K PHOTOLITHOGRAPHY RESEARCH/TEACHING
10K MICROELECTRONICS RESEARCH/TEACHING
GOWNING
WIPE DOWN
NANOLITHOGRAPHY
PHOTO LITHOGRAPHY (1)
WET ETCH
FILMS DEPOSITION
HOT PROCESS
DRY ETCH
PI CLEANROOM BAY (3)
PI CLEANROOM BAY (2)
FRAUNHOFER BAY (1)
CR JAN
480V
MAIN AISLE
RACK STORAGE
CUBBIE STORAGE
POSTER WALL
TOURING AND/OR BREAK
CLEAN CONFERENCE
METROLOGY/IN-FAB SEM

Space	***4.4.1 HR SEM***					
Min. W x L	*18'-0" x 15'-0"*	**Area**	*270 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Generically-designed rooms for very sensitive Electron Microscopes or similar tools.*					
Adjacencies	*Near: Specimen Prep, Characterization Offices. Remote: EMI-generators*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*Perforated Clg Tiles*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*Note(1)*	Vibration (VC)	*<E*	Acoustic (NC)	*Note(2)*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*1*	RH (% ±)	*42 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Incandesc. Spots*	Light Control	*Dimmable Remote Ctrl*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Notes: (1) TEM-compatible: Horizontal EMI < 3.5mG p-p; 64mV p-p. TEM Vertical EMI < 6.5mG p-p; 118mV p-p. Non-metallic rebar in slab. (2) TEM-compatible: Low velocity Air < 25mPa/Hz.

Space	***4.4.2 DB FIB and Nabity Nanolithography***					
Min. W x L	*18'-0" x 15'-0"*	**Area**	*270 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Generically-designed rooms for very sensitive Electron Microscopes or similar tools.*					
Adjacencies	*Near: Specimen Prep, Characterization Offices. Remote: EMI-generators*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*Perforated Clg Tiles*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*Note(1)*	Vibration (VC)	*<E*	Acoustic (NC)	*Note(2)*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*1*	RH (% ±)	*42 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Incandesc. Spots*	Light Control	*Dimmable Remote Ctrl*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Notes: (1) TEM-compatible: Horizontal EMI < 3.5mG p-p; 64mV p-p. TEM Vertical EMI < 6.5mG p-p; 118mV p-p. Non-metallic rebar in slab. (2) TEM-compatible: Low velocity Air < 25mPa/Hz.

Space	***4.4.3 XPS***					
Min. W x L	*18'-0" x 15'-0"*	**Area**	*270 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Generically-designed rooms for very sensitive Electron Microscopes or similar tools.*					
Adjacencies	*Near: Specimen Prep, Characterization Offices. Remote: EMI-generators*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*Perforated Clg Tiles*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*Note(1)*	Vibration (VC)	*<E*	Acoustic (NC)	*Note(2)*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*1*	RH (% ±)	*42 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Incandesc. Spots*	Light Control	*Dimmable Remote Ctrl*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Notes: (1) TEM-compatible: Horizontal EMI < 3.5mG p-p; 64mV p-p. TEM Vertical EMI < 6.5mG p-p; 118mV p-p. Non-metallic rebar in slab. (2) TEM-compatible: Low velocity Air < 25mPa/Hz.

Space	***4.4.4 Microscopy Service Corridor***					
Min. W x L	*105'-0" x 6'-0"*	**Area**	*400 Net SF*	**Type**	*Service Chase (LS)*	
Description	*Noisy space to house vacuum pumps, chillers, storage cabinets, electrical panels, etc.*					
Adjacencies	*General Purpose Labs and EM Rooms*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Sealed Concrete*	Walls	*Ptd GWB*	Ceiling	*none*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*8*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*20%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*10*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*No*	Light Control	*On/Off*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***4.4.5 AFM (Wet + Solid State)***					
Min. W x L	*22'-0" x 11'-0"*	**Area**	*242 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Generically-designed rooms for medium sensitive Electron Microscopes or similar tools.*					
Adjacencies	*Near: Specimen Prep, Characterization Offices. Remote: EMI-generators*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*T.B.D.*	Vibration (VC)	*<D*	Acoustic (NC)	*25*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*2*	RH (% ±)	*50 ± 10*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Incandesc. Spots*	Light Control	*Dimmable Remote Ctrl*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Locate on thickened slab for vibration control.

Space	***4.4.6 Shared Sample Prep***					
Min. W x L	*33'-0" x 22'-0"*	**Area**	*400 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Typical wet labortory with fume hoods for preparation of microscopy samples.*					
Adjacencies	*Near: Microscopy Rooms*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4.5*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Ptd GWB*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*45*
	Electrostatic	*No*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*8*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*3 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*15*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***4.4.7 Electrical Characterization***					
Min. W x L	*22'-0" x 22'-0"*	**Area**	*484 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Open room to accommodate a range of Electrical Characterization Equipment.*					
Adjacencies	*Near: Cleanroom, but not critical*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*25*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*No*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*No*
				On/Off		
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***4.4.8 Spectrophotometry, Optical Micro Room***					
Min. W x L	*11'-0" x 11'-0"*	**Area**	*121 Net SF*	**Type**	*Lab Characterization (LC)*	
Description	*Generically-designed rooms for medium sensitive Electron Microscopes or similar tools.*					
Adjacencies	*Near: Specimen Prep, Characterization Offices. Remote: EMI-generators*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Spec. Cond.*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*T.B.D.*	Vibration (VC)	*<D*	Acoustic (NC)	*25*
	Electrostatic	*Yes*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*2*	RH (% ±)	*50 ± 10*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*40%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*40*	Misc (W/sf)	*7*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Incandesc. Spots*	Light Control	*Dimmable Remote Ctrl*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Locate on thickened slab for vibration control.

USTAR at University of Utah			Grossing Facto		59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building				
Prepared: September 20, 2007			Revised:	*14-Nov-07*			
5.0 Nanofab			quantity	Size NSF		Total NSF	Total GSF
5.1	**Cleanroom**						
	5.1.1	Cleanroom (Class 1,000/100-spaces below)	1	5,720	0.9	5,720	9,695
	5.1.2	Nanolithography	1				
	5.1.3	Photolithography	1				
	5.1.4	Wet Processing	1				
	5.1.5	Hot Process	1				
	5.1.6	Dry Etch	1				
	5.1.7	Films Deposition	1				
	5.1.8	P.I. Cleanroom Bay 1	1				
	5.1.9	P.I. Cleanroom Bay 2	1				
	5.1.10	BioCompatible P.I./Industrial Bay	1				
	5.1.11	Chemical Pass-thru	1				
	5.1.12	Cleanroom Main Aisle	1				
	5.1.13	Clean Janitors (C1 10K) (in box)	1	50		50	85
	5.1.14	Cleanroom Chases	1	4,620	0.9	4,620	7,831
	Cleanroom Subtotal					**10,390**	**17,610**
5.2	**Cleanroom Support and Research/Teaching**						
	5.2.1	Main Gowning	1	200		200	339
	5.2.2	Equipment Wipe-Down	1	100		100	169
	5.2.3	Metrology	1	475		475	805
	5.2.4	Clean Microelectronics Research/Teaching (CI 10K)	1	475		475	805
	5.2.5	Clean Micromachining Research/Teaching (CI 10K)	1	475		475	805
	5.2.6	Clean Photolitholgraphy Research/Teaching (CI 10K)	1	475		475	805
	Cleanroom Support and Research/Teaching Subtotal					**2,200**	**3,729**
5.3	**Office/ Workstations**						
	5.3.1	Director's Office	1	121		121	205
	5.3.2	Teaching Lab Support Engineer Office	1	121		121	205
	5.3.3	User Training Engineer Office	2	121		242	410
	5.3.4	Applications Development Engineer Office	2	121		242	410
	5.3.5	General Maintenance Engineer Workstation	1	64		64	108
	5.3.6	Chem Tech Workstation	1	64		64	108
	5.3.7	Maintenance Tech Workstation	1	64		64	108
	5.3.8	Work-Study Bullpen	10	30		300	508
	Office/Workstations Subtotal					**1,218**	**2,064**
5.4	**Conference**						
	5.4.1	Clean Conference	1	165		165	280
	Conference Subtotal					**165**	**280**
5.5	**Engineering Nanofab Building Support**						
	5.5.1	Control/ ERT Room	1	242		242	410
	5.5.2	Cleanroom Lockers/ Shoe Clean	1	121		121	205
	5.5.3	Cleanroom Maintenance (outside Cleanroom)	1	300		300	508
	5.5.4	Hazardous Solid and Liquid Storage	1	363		363	615
	Building Support Subtotal					**1,026**	**1,739**
Nanofab Total						**14,999**	**25,422**

Space	***5.1.2 Nanolithography (Cl 100)***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 100, Temperature and RH-sensitive, Acoustic-, Vibration-, and EMI- (EVA) quiet space for E-Beam Lithography equipment & its prep.*					
Adjacencies	*Remote from EMI sources like Furnaces, Switchgear, Xformers, Elevators, etc.*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Perf ESD VCT*	Walls	*GWB chase behind Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*Note(1)*	Vibration (VC)	*<E*	Acoustic (NC)	*45*
	Electrostatic	*Yes*	Particulate (Class)	*100*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*1*	RH (% ±)	*45 ± 2.5*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens Yellow*	Light Control	*Multi-Level*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*Low O2 at floor*	Leak Detection	*No*
Special Requirments & Outstanding Issues	*Consider evaluating tighter temperature control for future E-Beam tools. UPS by User, Emergency backup of UPS by building. Yellow glass walls only in Litho Prep area, aluminum cleanroom panels inside acoustical enclosure. Vibration <0.5micrometers/sec @ <16Hz; <1.0micrometers/sec @ >16Hz. EMI <1mG (integral spectrum 0 to 625Hz) for initial Raith, design to 0.2mG for future.*					

Space	***5.1.3 Photolithography (Cl 100)***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 100, Temperature and RH-sensitive, Vibration-quiet space for Photolithography equipment & its prep.*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Perf ESD VCT*	Walls	*Alum Panel/ Yellow Glass*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<D*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*100*	Molecular	*Yes*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*1*	RH (% ±)	*45 ± 2.5*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens Yellow*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.4 Wet Processing***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space for wet processing equipment.*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Perf ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.5 Hot Process***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space for hot processing equipment.*					
Adjacencies	*Remote from EMI-sensitive spaces such as Nanolithography and Microscopy*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Perf ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	+ +				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.6 Films Deposition***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space for films deposition equipment.*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Perf ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.7 Dry Etch / BioCompatible Bay***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space with an isolated air stream for Principle Investigators to co-locate equipment for common use. Any equipment and materials that might contaminate the common air stream, such as*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Solid ESD Sheet*	Walls	*GWB chase behind Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*Yes*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.8 BioCompatible PI/Industrial Bay 1***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space with an isolated air stream for Principle Investigators to co-locate equipment for common use. Any equipment and materials that might contaminate the common air stream, such as*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Solid ESD Sheet*	Walls	*GWB chase behind Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*Yes*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.9 BioCompatible PI/Industrial Bay 2***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space with an isolated air stream for Principle Investigators to co-locate equipment for common use. Any equipment and materials that might contaminate the common air stream, such as*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Solid ESD Sheet*	Walls	*GWB chase behind Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*Yes*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.10 BioCompatible PI/Industrial Bay 3***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 1,000 space with an isolated air stream for Principle Investigators to co-locate equipment for common use. Any equipment and materials that might contaminate the common air stream, such as*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Solid ESD Sheet*	Walls	*GWB chase behind Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*Yes*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.11 Chemical Pass-Thru***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Chase (CC)*	
Description	*Chemical Transfer Point between gowned users and ungowned staff delivering materials from the central distribution room.*					
Adjacencies	*Dirty Path from Chem Storage, Clean Path from Cleanroom*					
	Architectural					
Size	Ceiling Ht. (ft)	*19*	Door Width (ft)	*3*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised, Solid ESD Sheet*	Walls	*Epoxy Ptd. Backside*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*Upflow*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*Upflow*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Upflow*
	Pressurization	+				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*3*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*0*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*None*	Light Control	*No*	Natural Light	*n/a*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.12 Cleanroom Main Aisle***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Cleanroom Aisle (CA)*	
Description	*Central Corridor for inspection and log stations, cleanroom storage, and access to the Cleanroom Bays. This is part of the equipment move-in path.*					
Adjacencies	*Cleanroom Bays, Wipe-Down, Gowning, Clean Conference, Class 10K Metrology, Class 10K Res/Teaching*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*7.5*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<B*	Acoustic (NC)	*50*
	Electrostatic	*Yes*	Particulate (Class)	*1,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*10*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*Note (1)*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*2*	Paging	*No*
Lighting	Special Lighting	*Note (2)*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Note (3)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wall phones: 1 at both ends of aisle, 1 outside both ends. Notes: (1) Recessed 4-plex outlet @ 44" each side wall of chases at inspection niches. (2) Card reader is at cleanroom boundary, not between cleanroom and chases. (3) Access aisle lighting is white, but glazing between aisle and "Yellow" bays will be Yellow. See bay descriptions for yellow lighting requirement.

Space	***5.1.13 Clean Janitors (Cl 10K) (in box)***					
Min. W x L	*10'-0" x 5'-0"*	**Area**	*50 Net SF*	**Type**	*Cleanroom Aisle (CA)*	
Description	*Small janitorial room for cleanroom janitorial supplies.*					
Adjacencies	*Accessed directly from the cleanroom chases.*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*3*	Door Ht. (ft)	*7*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*n/a*	Acoustic (NC)	*50*
	Electrostatic	*Yes*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*Yes*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*24' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*n/a*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.1.14 Cleanroom Chases***					
Min. W x L		**Area**	*5250 Net SF*	**Type**	*Cleanroom Chase (CC)*	
Description	*Unfiltered space for accommodating the backside of cleanroom equipment, support equipment, cleanroom utility distribution, and the cleanroom air return path.*					
Adjacencies	*Directly Adjacent: Cleanroom Bays and Main Aisle, Chem Pass-Thru, Chem Storage*					
	Architectural					
Size	Ceiling Ht. (ft)	*19*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Raised Grate Epoxy Coat*	Walls	*Epoxy Ptd. Backside*	Ceiling	*Epoxy Ptd. Above CR Cl*
Other	Full-Height Walls	*No*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*Upflow*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*Upflow*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Upflow*
	Pressurization	+				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*3*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*45*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Underfloor*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*2*	Paging	*No*
Lighting	Special Lighting	*Enclosed*	Light Control	*No*	Natural Light	*n/a*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*note(2)*	Leak Detection	*If Piped Chemicals*

Special Requirments & Outstanding Issues

Wall phones: 1 inside and outside each perimeter entry. Notes: (1) Card reader is at cleanroom boundary, not between cleanroom and chases. (2) Toxic and Flammable gas detection at VMB's, GlB's, and user stations.

Space	***5.2.1 Main Gowning (Cl 10K)***					
Min. W x L	*15'-0" x 18'-0"*	**Area**	*200 Net SF*	**Type**	*Cleanroom Aisle (CA)*	
Description	*Cleanroom Gowning Room for nonclassed to classed users*					
Adjacencies	*Directly Adjacent: Cleanroom Main Aisle, Class 10K Aisle to Res/Teaching Labs*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*3*	Door Ht. (ft)	*7'-9"*
Finishes	Floors	*Slab, Solid VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*n/a*	Acoustic (NC)	*50*
	Electrostatic	*No*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*+*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*2*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*3*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.2.2 Equipment Wipe-Down (Cl 10K)***					
Min. W x L	*8'-0" x 12'-6"*	**Area**	*100 Net SF*	**Type**	*Cleanroom Aisle (CA)*	
Description	*Equipment Move-In Wipe-Down Vesibule*					
Adjacencies	*Interface between Move-In dirty corridor and Main Aisle. Near Loading dock.*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*7.5*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*n/a*	Acoustic (NC)	*50*
	Electrostatic	*No*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*+*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*2*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*3*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wall phones: 1 inside room, 1 outside both ends. Notes: (1) Card reader is at cleanroom boundary, not between cleanroom and chases.

Space	***5.2.3 Metrology (Cl 10K)***					
Min. W x L	*15'-0" x 24'-0"*	**Area**	*475 Net SF*	**Type**	*Cleanroom Aisle (CA)*	
Description	*Metrology equipment directly accessed from cleanroom, including In-Fab SEM.*					
Adjacencies	*Cleanroom Main Aisle, Clean Conference Room*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Ptd. Alum.*
Other	Full-Height Walls	*No*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*1*	Vibration (VC)	*<D*	Acoustic (NC)	*40*
	Electrostatic	*Yes*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 2.5*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*2*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens Yellow*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space: *5.2.4 Clean Microelectronics Res/Teaching (Cl 10K)*

Min. W x L	*33'-0" x 22'-0"*	**Area**	*475 Net SF*	**Type**	*Cleanroom Bay (CB)*
Description	*Class 10K Research and Teaching Cleanroom*				
Adjacencies	*Directly Adjacent to other Clean Res/Teaching Labs and Gowning; Main Cleanroom*				

	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Wrapped ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*40*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wall phones: 1 at both ends of aisle, 1 outside both ends. Notes: (1) Card reader is at cleanroom boundary, not between cleanroom and chases. (2) Access aisle lighting is white, but glazing between aisle and "Yellow" bays will be Yellow. See bay descriptions for yellow lighting requirement.

Space	***5.2.5 Clean Micromachining Res/Teaching (Cl 10K)***					
Min. W x L	*33'-0" x 22'-0"*	**Area**	*475 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 10K Research and Teaching Cleanroom*					
Adjacencies	*Directly Adjacent to other Clean Res/Teaching Labs and Gowning; Main Cleanroom*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Glass/Alum*	Ceiling	*Wrapped ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	*+ +*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*30*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wall phones: 1 at both ends of aisle, 1 outside both ends. Notes: (1) Card reader is at cleanroom boundary, not between cleanroom and chases. (2) Access aisle lighting is white, but glazing between aisle and "Yellow" bays will be Yellow. See bay descriptions for yellow lighting requirement.

Space	***5.2.6 Clean Photolithography Res/Teaching (Cl 10K)***					
Min. W x L	*22'-0" x 22'-0"*	**Area**	*475 Net SF*	**Type**	*Cleanroom Bay (CB)*	
Description	*Class 10K Research and Teaching Cleanroom*					
Adjacencies	*Directly Adjacent to other Clean Res/Teaching Labs and Gowning; Main Cleanroom*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Slab, Solid ESD VCT*	Walls	*Alum Panel/ Yellow Glass*	Ceiling	*Wrapped ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*400*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<C*	Acoustic (NC)	*55*
	Electrostatic	*Yes*	Particulate (Class)	*10,000*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*68w-68s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*45 ± 4*
	Pressurization	+ +				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No (Internal Y)*	Min. A/C (/hr)	*6*	Abatement	*Exhaust+PO*
	Utilities					
Water	Cold	*for Shower*	Hot	*No*	Pure (mΩ)	*18 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*30%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*3*	Tool (W/sf)	*20*	Misc (W/sf)	*5*
	HVAC (W/sf)	*1*	Single-Pt Ground	*Yes*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*12' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*4*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*Prismatic Lens*	Light Control	*No*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Note (1)*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wall phones: 1 at both ends of aisle, 1 outside both ends. Notes: (1) Card reader is at cleanroom boundary, not between cleanroom and chases. (2) Access aisle lighting is white, but glazing between aisle and "Yellow" bays will be Yellow. See bay descriptions for yellow lighting requirement.

Space	***5.5.1 Control / ERT Room***					
Min. W x L	*11'-0" x 22'-0"*	**Area**	*242 Net SF*	**Type**	*Bldg Support (BS)*	
Description	*Emergency Response Team (ERT) room. (Code-prescribed room for H5 occupancies). Space for alarm monitoring equipment and emergency response team gear.*					
Adjacencies	*Nearly-direct exterior access. Cleanroom, but not in H5 occupancy.*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*VCT*	Walls	*Paint*	Ceiling	*None*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-76s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*No*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*4*	Misc (W/sf)	*3*
	HVAC (W/sf)	*3*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*per Code*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*1*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*No*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Room power and lighting, and lighting of route to room from outside, should be fed from separate sub-panel in room fed from Emergency Power. Exhaust is small duct to draw sample air from analysis machine out of room.

Space	***5.5.2 Cleanroom Lockers / Shoe Clean***					
Min. W x L	*11'-0" x 11'-0"*	**Area**	*121 Net SF*	**Type**	*Bldg Support (BS)*	
Description	*Lockers for taking off outer garments and personal belongings before entering cleanroom.*					
Adjacencies	*Before Gowning*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*n/a*	Door Ht. (ft)	*9*
Finishes	Floors	*Granite*	Walls	*Paint*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-76s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*No*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*3*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*per Code*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*1*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*No*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wood Casework Locker Units?

Space	***5.5.3 Cleanroom Maintenance (outside cleanroom portion)***					
Min. W x L	*22'-0" x 22'-0"*	**Area**	*300 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Space for performing maintenance on cleanroom equipment, and some cleaning functions.*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4.5*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Ptd GWB*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*45*
	Electrostatic	*No*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*8*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*3 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*10*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Space	***5.5.4 Hazardous Solid & Liquid Storage***					
Min. W x L	*33'-0" x 11'-0"*	**Area**	*363 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Central room for solid and liquid hazardous chemical storage cabinets and waste transfer station.*					
Adjacencies	*Cleanroom, utility corridor, loading dock*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*3*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. Epoxy Coating*	Walls	*Epoxy Ptd.*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*45*
	Electrostatic	*No*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*3 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*5*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*Yes*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*If Sump*

Special Requirments & Outstanding Issues

USTAR

Space	***5.6.1 Machine Shop / Vacuum Maintenace & Teaching****					
Min. W x L	*33'-0" x 22'-0"*	**Area**	*726 Net SF*	**Type**	*Bldg Support (BS)*	
Description						
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*Sealed Conc*	Walls	*Epoxy Ptd.*	Ceiling	*None*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*250*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-76s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*Yes?*	Hot	*Yes?*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*4*	Misc (W/sf)	*3*
	HVAC (W/sf)	*3*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*TBD*	208V-30A-3Ø (ea)	*TBD*	480V-30A-3Ø (ea)	*TBD*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*1*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*Note (1)*	Light Control	*On/Off*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Card Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Request for a 10' x 10' space for vacuum pump maintenance in room. Notes: (1) High footcandles. More than any other standard type in building.

USTAR

Space	***5.6.2 Control / ERT Room***					
Min. W x L	*11'-0" x 22'-0"*	**Area**	*242 Net SF*	**Type**	*Bldg Support (BS)*	
Description	*Emergency Response Team (ERT) room. (Code-prescribed room for H5 occupancies). Space for alarm monitoring equipment and emergency response team gear.*					
Adjacencies	*Nearly-direct exterior access. Cleanroom, but not in H5 occupancy.*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*6*	Door Ht. (ft)	*9*
Finishes	Floors	*VCT*	Walls	*Paint*	Ceiling	*None*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-76s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*No*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*4*	Misc (W/sf)	*3*
	HVAC (W/sf)	*3*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*per Code*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*1*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*No*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Room power and lighting, and lighting of route to room from outside, should be fed from separate sub-panel in room fed from Emergency Power. Exhaust is small duct to draw sample air from analysis machine out of room.

USTAR

Space	***5.6.3 Cleanroom Lockers / Shoe Clean***					
Min. W x L	*11'-0" x 11'-0"*	**Area**	*121 Net SF*	**Type**	*Bldg Support (BS)*	
Description	*Lockers for taking off outer garments and personal belongings before entering cleanroom.*					
Adjacencies	*Before Gowning*					
	Architectural					
Size	Ceiling Ht. (ft)	*14*	Door Width (ft)	*n/a*	Door Ht. (ft)	*9*
Finishes	Floors	*Granite*	Walls	*Paint*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*No*	Acoustic (NC)	*No*
	Electrostatic	*No*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-76s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*Uncontrolled*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*No*	Snorkels (ea)	*0*
	Recirculated Air	*Yes*	Min. A/C (/hr)	*0*	Abatement	*No*
	Utilities					
Water	Cold	*No*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*0*	Misc (W/sf)	*3*
	HVAC (W/sf)	*3*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*per Code*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*1*	Wall Phones (ea)	*1*	Paging	*No*
Lighting	Special Lighting	*No*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*None*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Wood Casework Locker Units?

USTAR

Space	***5.6.4 Cleanroom Maintenance (outside cleanroom portion)***					
Min. W x L	*22'-0" x 22'-0"*	**Area**	*300 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Space for performing maintenance on cleanroom equipment, and some cleaning functions.*					
Adjacencies						
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*4.5*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. ESD VCT*	Walls	*Ptd GWB*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*45*
	Electrostatic	*No*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*8*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*3 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*10*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*<100' away*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*No*

Special Requirments & Outstanding Issues

USTAR

Space	***5.6.5 Hazardous Solid & Liquid Storage***					
Min. W x L	*33'-0" x 11'-0"*	**Area**	*363 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Central room for solid and liquid hazardous chemical storage cabinets and waste transfer station.*					
Adjacencies	*Cleanroom, utility corridor, loading dock*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*3*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. Epoxy Coating*	Walls	*Epoxy Ptd.*	Ceiling	*ACT*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*<A*	Acoustic (NC)	*45*
	Electrostatic	*No*	Particulate (Class)	*95% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*Yes*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*6*	Abatement	*No*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*3 mΩ*
	Process Cooling	*Yes*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*Yes*	Nitrogen	*Yes*	Process Vacuum	*Yes*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*5*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*No*
	Duplex Outlets (ea)	*4' on center*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Parabolic*	Light Control	*On/Off*	Natural Light	*Preferred*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*Yes*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*No*	Leak Detection	*If Sump*

Special Requirments & Outstanding Issues

USTAR

Space	***G.1.1 Gas Storage***					
Min. W x L	*33'-0" x 11'-0"*	**Area**	*363 Net SF*	**Type**	*Lab Wet (LW)*	
Description	*Central room for hazardous gas cylinder cabinets with gasses directly piped to cleanroom. Also a good place to store Inert Spares and Empties.*					
Adjacencies	*Cleanroom; Loading Dock*					
	Architectural					
Size	Ceiling Ht. (ft)	*10*	Door Width (ft)	*3*	Door Ht. (ft)	*9*
Finishes	Floors	*Chem Res. Epoxy Coating*	Walls	*Epoxy Ptd.*	Ceiling	*None*
Other	Full-Height Walls	*Yes*	Live Load (psf)	*150*		
Sensitivities	EMF (Mg)	*No*	Vibration (VC)	*n/a*	Acoustic (NC)	*n/a*
	Electrostatic	*Yes*	Particulate (Class)	*60% Final*	Molecular	*No*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*72w-72s±2*	ΔT (°Fdb/hr)	*n/a*	RH (% ±)	*50 ± 10*
	Pressurization	*-*				
Exhaust	Σ Hood Length (ft)	*10*	Equipment (ea)	*1/Cabinet*	Snorkels (ea)	*0*
	Recirculated Air	*No*	Min. A/C (/hr)	*6*	Abatement	*Yes*
	Utilities					
Water	Cold	*Yes*	Hot	*No*	Pure (mΩ)	*No*
	Process Cooling	*No*	Heat->PCW (%)	*0%*	Floor Drain	*No*
Gases & Vacuum	Compressed Air	*No*	Nitrogen	*No*	Process Vacuum	*No*
	LN2	*No*	Steam	*No*	Natural Gas	*No*
	Electrical					
Power	Lighting (W/sf)	*2*	Tool (W/sf)	*15*	Misc (W/sf)	*3*
	HVAC (W/sf)	*1*	Single-Pt Ground	*No*	Emergency / UPS	*Yes*
	Duplex Outlets (ea)	*1/Cabinet*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*4*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*6*	Wall Phones (ea)	*0*	Paging	*No*
Lighting	Special Lighting	*Sparkproof*	Light Control	*No*	Natural Light	*No*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*Yes*	Gas Detection	*Toxic+Flam.*	Leak Detection	*No*

Special Requirments & Outstanding Issues

H2/H3 occupancy following sparkproof electrical protocol. Need provisions for explosion control. Need vertical unistrut for pipe routing on wall from 7' to structure above at 4' on center. Need unistrut across ceiling at 4' on center for ductwork and branches down center of room. Emergency power 4-plex outlets, surface-mounted on wall above each cabinet.

USTAR

Space	***G.1.2 Silane Bunker***					
Min. W x L		**Area**	*0 Net SF*	**Type**	*Exterior (EX)*	
Description	*Secured, fenced, covered yard area or bunker for Silane Gas Cabinets and associated Mechanical Equipment*					
Adjacencies	*Near Cleanroom and Truck Access.*					
	Architectural					
Size	Ceiling Ht. (ft)	*0*	Door Width (ft)	*0*	Door Ht. (ft)	*0*
Finishes	Floors	*0*	Walls	*0*	Ceiling	*0*
Other	Full-Height Walls	*0*	Live Load (psf)	*0*		
Sensitivities	EMF (Mg)	*0*	Vibration (VC)	*0*	Acoustic (NC)	*0*
	Electrostatic	*0*	Particulate (Class)	*0*	Molecular	*0*
	Mechanical					
HVAC	T (w-s ±°Fdb)	*0*	ΔT (°Fdb/hr)	*0*	RH (% ±)	*0%*
	Pressurization	*0*				
Exhaust	Σ Hood Length (ft)	*0*	Equipment (ea)	*0*	Snorkels (ea)	*0*
	Recirculated Air	*0*	Min. A/C (/hr)	*0*	Abatement	*0*
	Utilities					
Water	Cold	*0*	Hot	*0*	Pure (mΩ)	*0*
	Process Cooling	*0*	Heat->PCW (%)	*0%*	Floor Drain	*0*
Gases & Vacuum	Compressed Air	*0*	Nitrogen	*0*	Process Vacuum	*0*
	LN2	*0*	Steam	*0*	Natural Gas	*0*
	Electrical					
Power	Lighting (W/sf)	*0*	Tool (W/sf)	*0*	Misc (W/sf)	*0*
	HVAC (W/sf)	*0*	Single-Pt Ground	*0*	Emergency / UPS	*0*
	Duplex Outlets (ea)	*0*	208V-30A-3Ø (ea)	*0*	480V-30A-3Ø (ea)	*0*
Telcom	CAT (ports/box)	*0*	Fiber (ports/box)	*0*	Other (ports/box)	*0*
	T/D Boxes (ea)	*0*	Wall Phones (ea)	*0*	Paging	*0*
Lighting	Special Lighting	*0*	Light Control	*No*	Natural Light	*Yes*
	Safety & Security					
Safety & Security	Security	*Key*	Shwr/Eye Wash	*No*	Laser Control	*No*
	Smoke Detection	*No*	Gas Detection	*Pyrophoric*	Leak Detection	*No*

Special Requirments & Outstanding Issues

Must follow NFPA 318.

USTAR at University of Utah			Grossing Factor	59%	121	
Projected Space Utilization Summary			Neuroscience & Biomedical Research Technology Building			
Prepared: September 20, 2007			Revised:	*14-Nov-07*		
6.0 Public and Building Support Spaces			quantity	Size NSF	Total NSF	Total GSF
6.1	**Public/Meeting Spaces**					
	6.1.1	Lobby/Multifunction Space	1	2,000	2,000	3,390
	6.1.2	Café	1	3,000	3,000	5,085
	6.1.3	Large Auditorium	1	2,500	2,500	4,237
	6.1.4	Large Seminar Room	2	700	1,400	2,373
	6.1.5	Small Seminar Room	8	350	2,800 **	4,746
	6.1.6	Informal Meeting Areas	8	150	1,200	2,034
	6.1.7	Public Restroom	2	750	1,500	2,542
	6.1.8	Shower/Locker	2	250	500	847
	Public/Meeting Space Total				**14,900**	**25,254**
6.2	**Building Administrative Support**					
	6.2.1	Office (manager, custodial...)	10	121	1,210	2,051
	6.2.2	Workstations	10	64	640	1,085
	6.2.3	Meeting Room	1	300	300	508
	6.2.4	Central Mail/Copy/Supply	1	400	400	678
	6.2.5	Records	1	200	200	339
	Building Administrative Office Subtotal				**2,750**	**4,661**
6.3	**Information Technology**					
	6.3.1	Data Center	1	500	500	847
	6.3.2	Data Closet	4	121	484	820
	6.3.3	Office	1	121	121	205
	6.3.4	Workstations	3	64	192	325
	6.3.5	Main Communications Room	1	150	150	254
	Information Technology Total				**1,447**	**2,453**
6.4	**Building Support**					
	6.4.1	Loading Dock	1	720	720	1,220
	6.4.2	Main Mechanical Room	1	1,200	1,200	2,034
	6.4.3	Main Electrical Room	1	600	600	1,017
	6.4.4	Main Storage Room	1	1,200	800	1,356
	Building Support Total				**3,320**	**5,627**
	**** some seminar rooms will be located around administrative support area**					
Public and Building Support Spaces Total					**22,417**	**37,995**

Space Diagram

ROOM DATA:

ROOM NUMBER: **6.1.2**

ROOM NAME: **CAFE**

DEPARTMENT: **PUBLIC AND BLDG SUPPORT SPACES**

GROUP: **PUBLIC/MEETING SPACES**

CONTACT:

USER: **SHARED**

DIRECTOR:

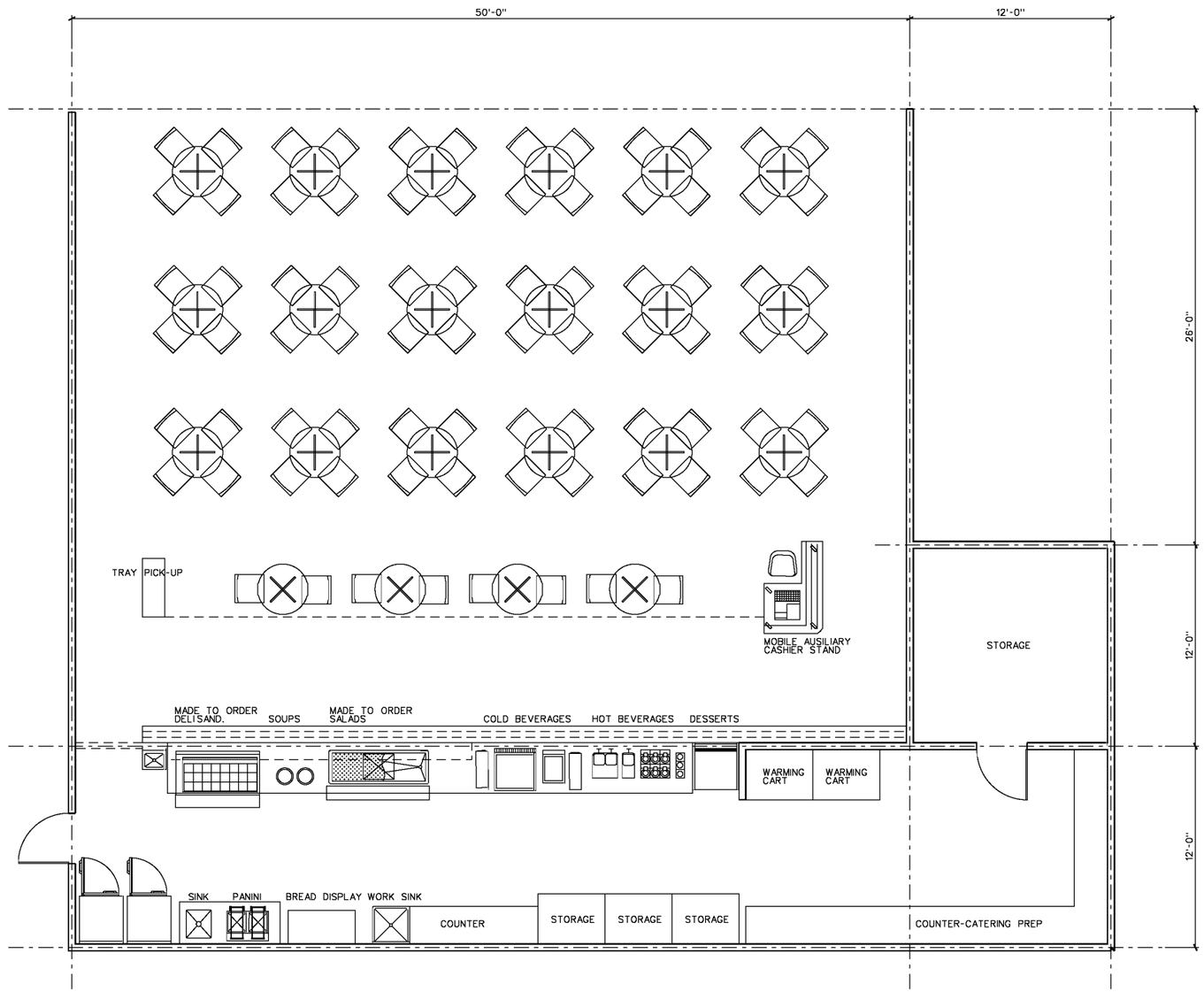
PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. _____
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves



80 SEATS

Space Diagram

ROOM DATA:

ROOM NUMBER: **6.1.3**

ROOM NAME: **LARGE AUDITORIUM**

DEPARTMENT: **PUBLIC AND BLDG SUPPORT SPACES**

GROUP: **PUBLIC/MEETING SPACES**

CONTACT:

USER: **SHARED**

DIRECTOR:

PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
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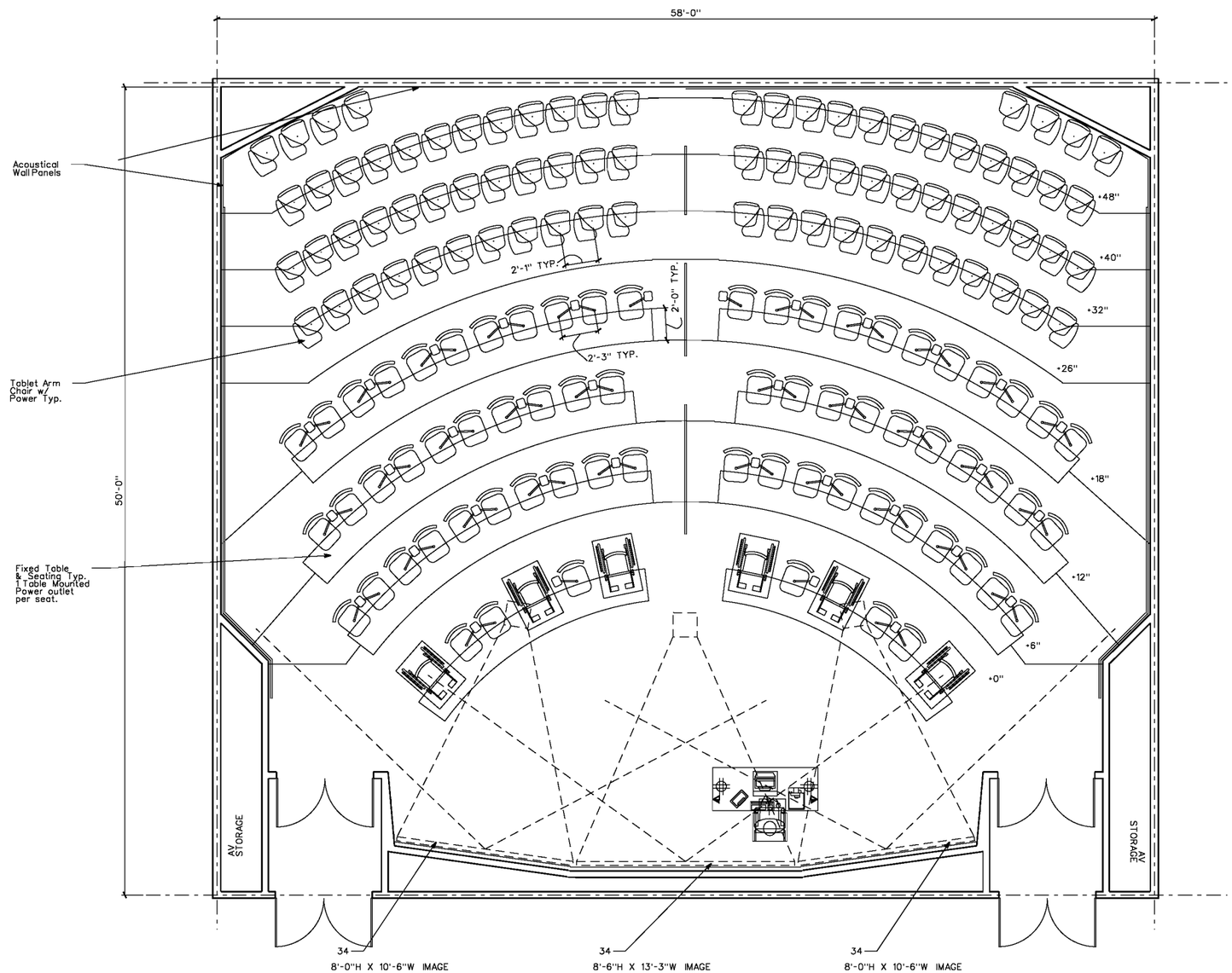
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Projection Screen
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves



152 Seat

FULL ROOM WIRELESS DATA ACCESS

Space Diagram

ROOM DATA:

ROOM NUMBER: **6.1.3 OPTION**

ROOM NAME: **LARGE AUDITORIUM**

DEPARTMENT: **PUBLIC AND BLDG SUPPORT SPACES**

GROUP: **PUBLIC/MEETING SPACES**

CONTACT:

USER: **SHARED**

DIRECTOR:

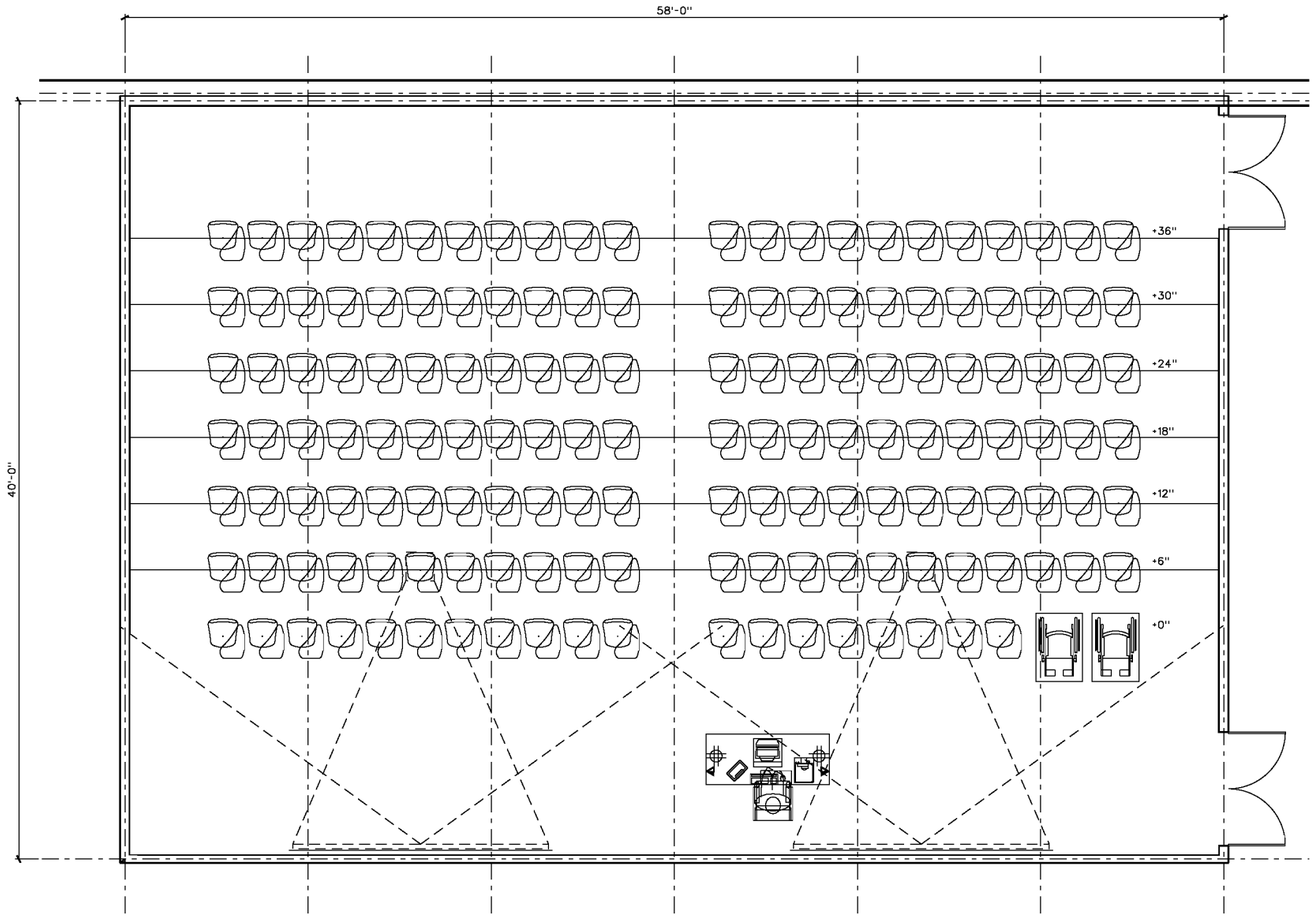
PHONE:

E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.

FURNISHINGS & EQUIPMENT

1. Chemical Fume Hood
2. Biological Safety Cabinet Type: II/A III/B
3. Radioisotope Hood
4. Vented Workstation
5. Snorkel Exhaust
6. Laboratory Bench, Standing Height
7. Laboratory Bench, Sitting Height
8. Wall Cabinet
9. Adjustable Shelves
10. Reagent Shelves
11. Tall Storage Cabinet
12. Vented Flammable Storage Cabinet
13. Equipment Space
14. Laboratory Sink
15. Cup Sink
16. Processing Sink
17. Cylinder Rack
18. Gas Cabinet
19. Safety Shower/ Eyewash
20. Overhead Service Grid
21. Pipe Drop Enclosure
22. Refrigerator/Freezer
23. Glasswasher
24. Glassware Dryer
25. Autoclave
26. Incubator
27. Centrifuge
28. Low Temperature Freezer
29. Explosion Proof Refrigerator/Freezer
30. Icemaker
31. Water Polishing Station
32. Vibration Isolation Table
33. Laminar Flow Cabinet
34. Projection Screen
35. _____
36. _____
37. _____
38. _____
39. Adjustable Shelving
40. White Markerboard
41. Black Chalkboard
42. Tackboard
43. Desk
44. Table
45. Bookshelves



153 Seat
FULL ROOM WIRELESS DATA ACCESS

Space Diagram - Lecture, Seminar and Office

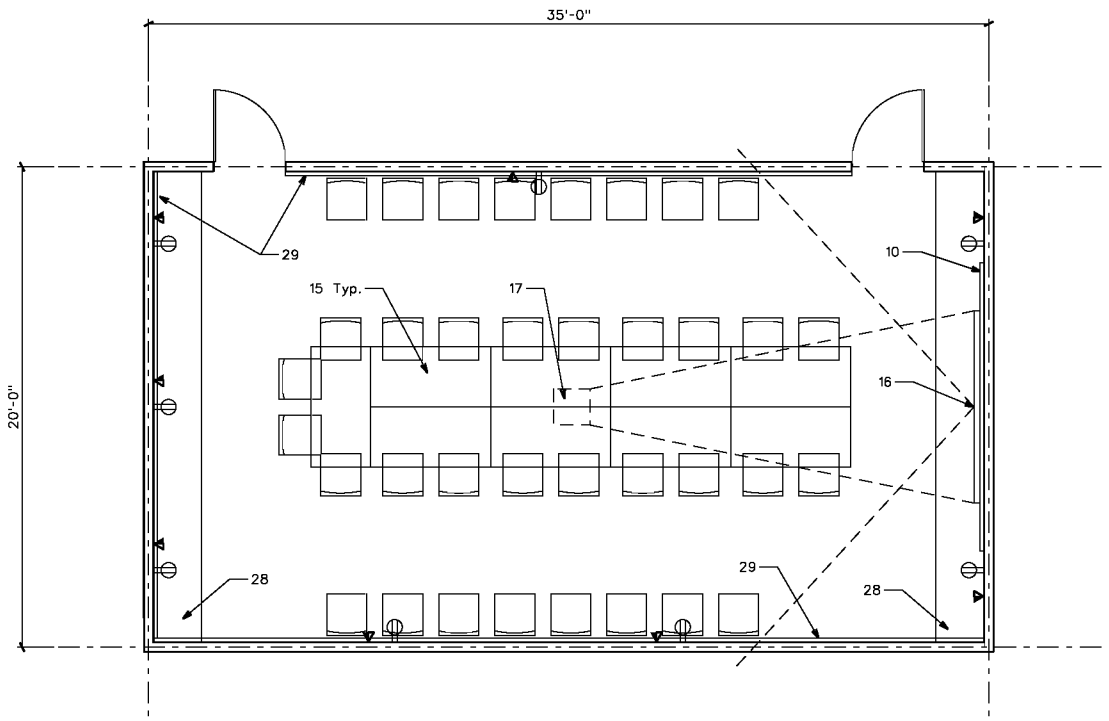
ROOM DATA:

ROOM NUMBER: **6.1.4**
ROOM NAME: **LARGE SEMINAR ROOM**
DEPARTMENT: **PUBLIC AND BLDG SUPPORT SPACES**
GROUP: **PUBLIC/MEETING SPACES**

CONTACT:

USER: **SHARED**
DIRECTOR:
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



700 NSF

FURNISHINGS/EQUIPMENT

1. Desk-Single Ped
2. Desk-Single Ped w/ Return
3. Workstation
4. Credenza
5. Computer Table
6. Bookcase
7. Task Chair
8. Guest Seating
9. Conferencing
10. White Markerboard
11. Blackboard
12. Tackboard
13. Bookshelves
14. Adjustable Shelving
15. Movable Table
16. Projection Screen
17. Projector
18. Computer
19. Printer
20. Scanner
21. Typewriter
22. Power and Data
23. Movable Seating
24. A/V Storage
25. Lockable Tall Storage Cabinet
26. Lounge Seating
27. Stool
28. Counter with Cabinets Below
29. Acoustical Panels
30. Sink
31. Wall Cabinets
32. Mailboxes
33. Copier
34. Refigerator
35. Dishwasher

Space Diagram - Lecture, Seminar and Office

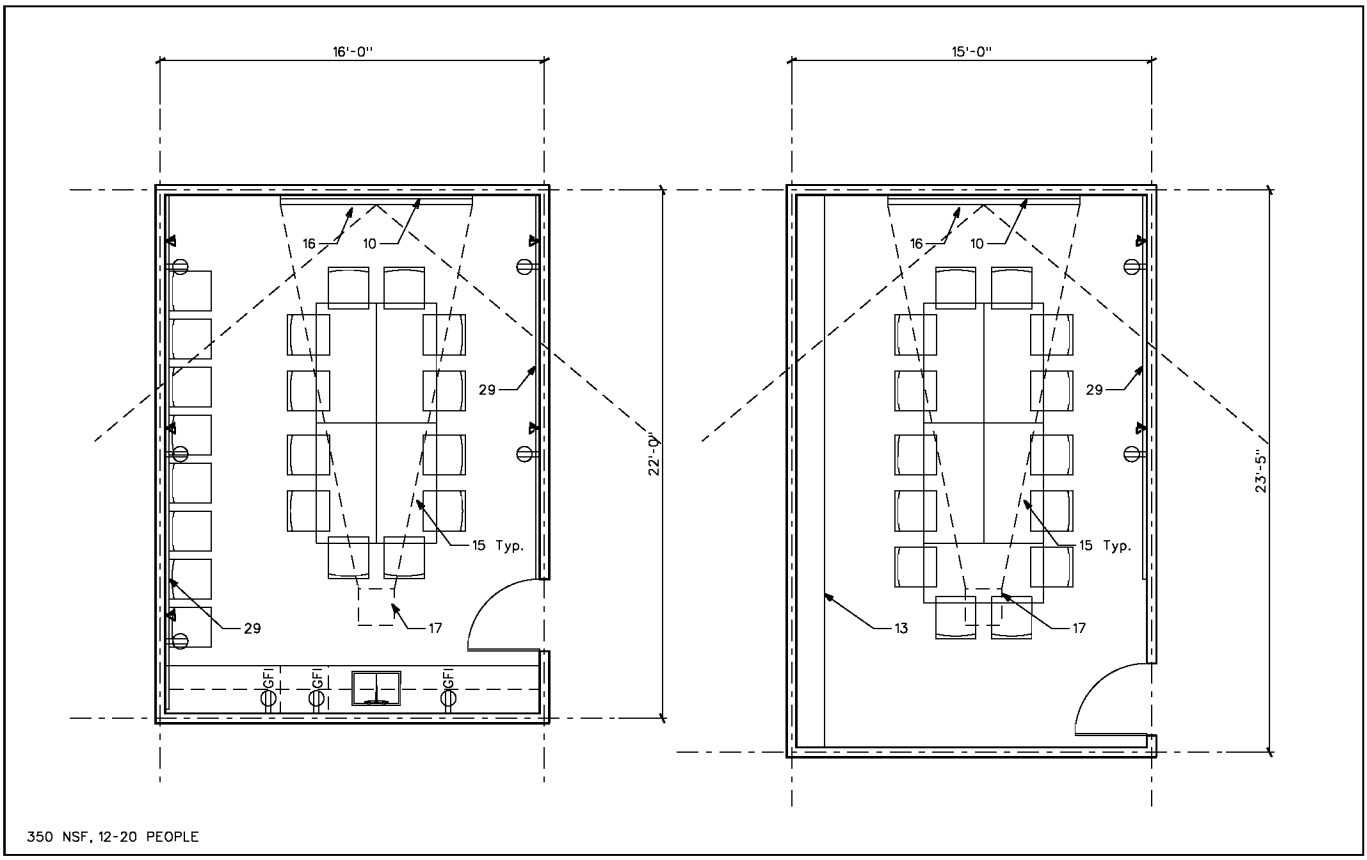
ROOM DATA:

ROOM NUMBER: **6.1.5**
ROOM NAME: **SMALL SEMINAR ROOM**
DEPARTMENT: **PUBLIC AND BLDG SUPPORT SPACES**
GROUP: **PUBLIC/MEETING SPACES**

CONTACT:

USER: **SHARED**
DIRECTOR:
PHONE:
E-MAIL:

This diagram is conceptual and is provided only to indicate required furnishings, equipment, and general room proportions. Actual room design may change.



FURNISHINGS/EQUIPMENT

1. Desk-Single Ped
2. Desk-Single Ped w/ Return
3. Workstation
4. Credenza
5. Computer Table
6. Bookcase
7. Task Chair
8. Guest Seating
9. Conferencing
10. White Markerboard
11. Blackboard
12. Tackboard
13. Bookshelves
14. Adjustable Shelving
15. Movable Table
16. Projection Screen
17. Projector
18. Computer
19. Printer
20. Scanner
21. Typewriter
22. Power and Data
23. Movable Seating
24. A/V Storage
25. Lockable Tall Storage Cabinet
26. Lounge Seating
27. Stool
28. Counter with Cabinets Below
29. Acoustical Panels
30. Sink
31. Wall Cabinets
32. Mailboxes
33. Copier
34. Refigerator
35. Dishwasher

4.3 ADJACENCIES AND RELATIONSHIPS

This section introduces the Adjacency Diagrams that follow. These diagrams have been discussed during programming and agreed on as the required adjacencies. Please refer to the narratives in **Section 3.1** for further explanations of required relationships.

Two types of Adjacency Diagrams are included in this section. The first is a bubble diagram that uses lines and arrows to show adjacencies and relationships between major spaces. Please see the legend at the bottom of each diagram for the type of relationship represented by each line type. These are labeled Adjacency Diagram A.

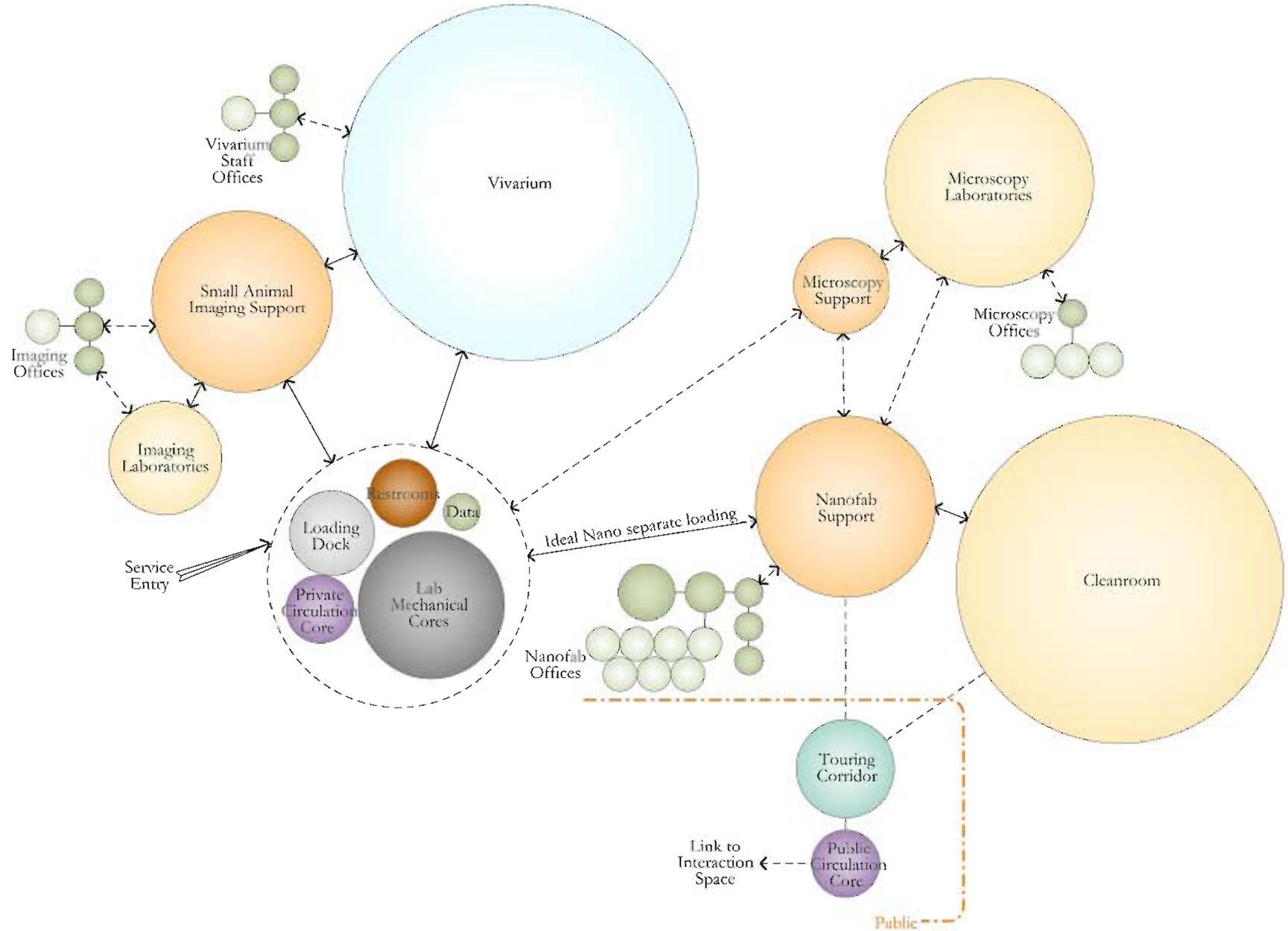
Adjacency Diagram A for the Cores shows Small Animal Imaging, Vivarium, Microscopy, and Nanofabrication / Cleanroom. These cores will support the researchers in this building and on Campus. These cores are all shown within the security zone with the exception of the Touring Corridor for the Nanfabrication Core Facility. This Touring Corridor is thought of as a space that the public can walk into and view into the Nanofabrication Facility.

Adjacency Diagram A for Public / Office / Lab shows the relationships for building spaces not included in the core facilities. These spaces include the public spaces, offices, support, and PI labs. There are two security zones for these spaces. The PI lab space should be secured but all other spaces including the PI offices should allow public access within normal hours. All spaces will be secured after hours.

The second type of Adjacency Diagram begins to look at these relationships in space. Adjacency Diagram B, Core Concept 1.1 shows how the adjacencies shown in the bubble diagrams might work. A direct physical connection between Imaging and the Vivarium is required. These spaces also require a connection from the Loading Dock. There is not a need for a direct physical connection from the Vivarium or Imaging to Microscopy. Adjacency Diagram B, Core Concept 1.2 adds the link to Nanofabrication (also on grade but likely to be one floor above to allow the Touring Corridor to open to the courtyard and keep Nanofabrication above grade for code reasons.) There is an adjacency between Nanofabrication and Microscopy but this could be a vertical connection as shown.

Adjacency Diagram B, Lab Concept 1.1 shows how the lab module zones could work for the adjacencies. The lab support is shown in the center of the lab space. This allows for an organization of infrastructure to support the labs. This also places the solid pieces towards the center to allow light in as many spaces as possible. As seen in Diagram 4, the line between lab and lab support is intended to be extremely flexible. Some researchers will need more lab space and some may need almost all support space. The lab will benefit from this variation as it will break up the large space into smaller areas. Adjacency Diagram B, Lab Concept 1.2 shows two options of how this

space could layout only to give examples. The analytical write up stations could occur in the open lab beside the bench or in the support lab space depending on the needs of the researcher. The lab space must be flexible to meet the needs of each researcher.



USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Analytical Laboratory Space
- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Interaction Space
- Utility Space/Janitor/Storage
- Restrooms
- Mechanical
- Animal Housing
- Direct, Physical Connection
- Functional Connection
- Information/Material Flow
- Security Zone

Adjacency Diagram A Cores

Project : 27001 Date: 11/30/07

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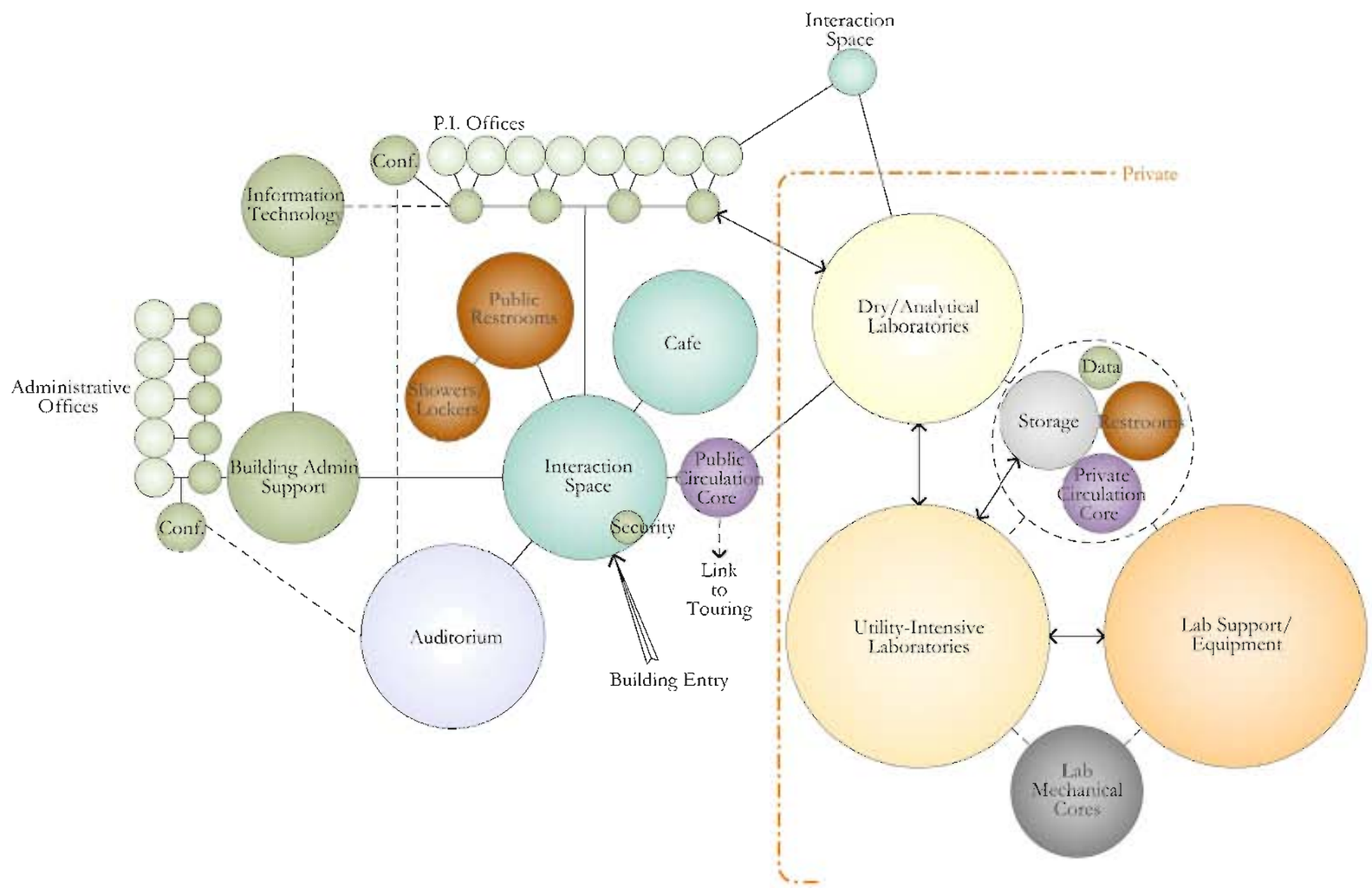

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Analytical Laboratory Space
- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Interaction Space
- Utility Space/Janitor/Storage
- Restrooms
- Mechanical
- Animal Housing
- Direct, Physical Connection
- Functional Connection
- Information/Material Flow
- Security Zone

Adjacency Diagram A Public/Office/Lab

Project : 27001 Date: 11/30/07

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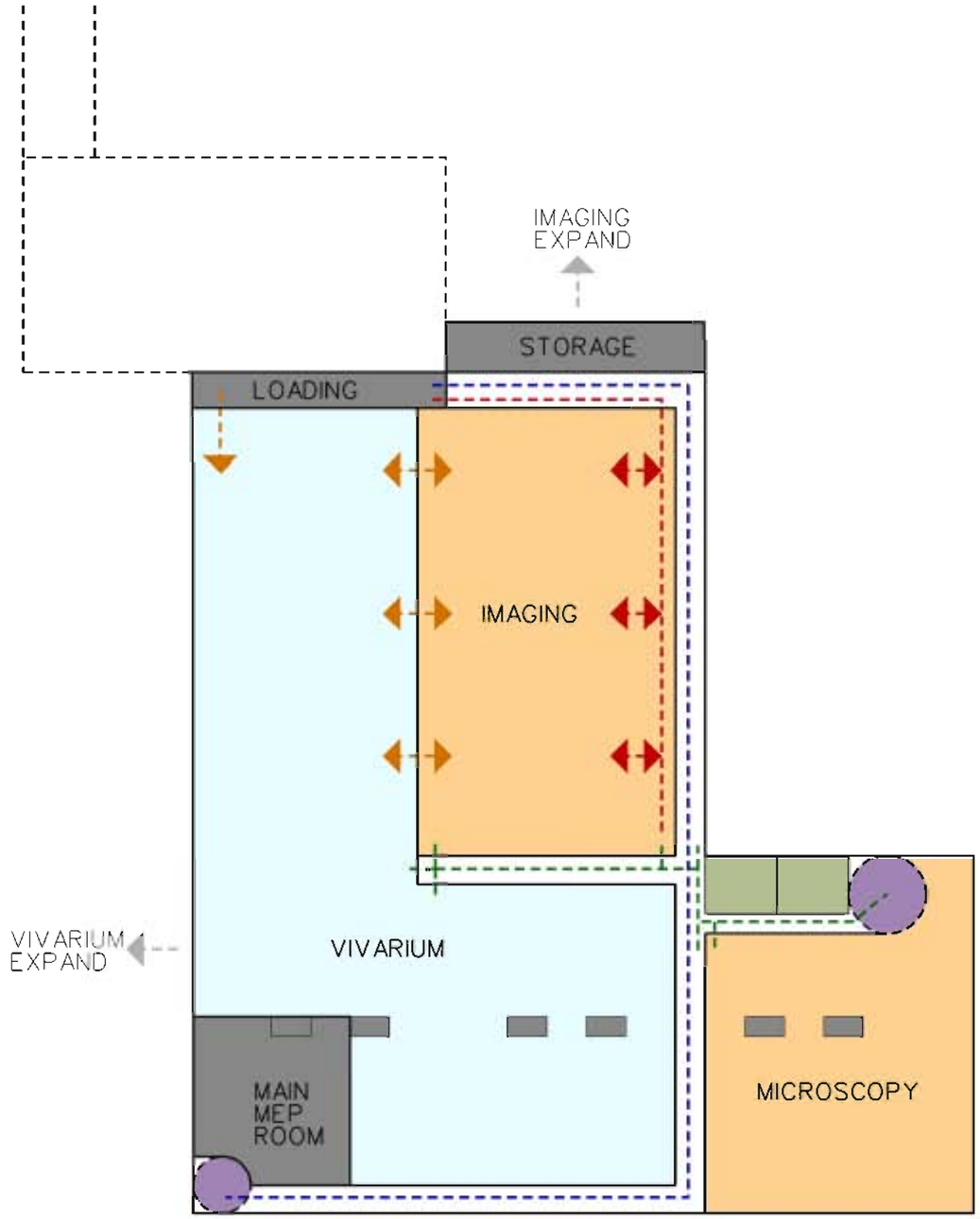

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Utility Space/Janitor/Storage
- Mechanical
- Animal Housing/Vivarium
- Animals other buildings
- Vivarium Animals
- Loading to Building (Up)
- Main Circulation

Adjacency Diagram B
Core Concept 1.1

Project : 27001 Date: 11/30/07

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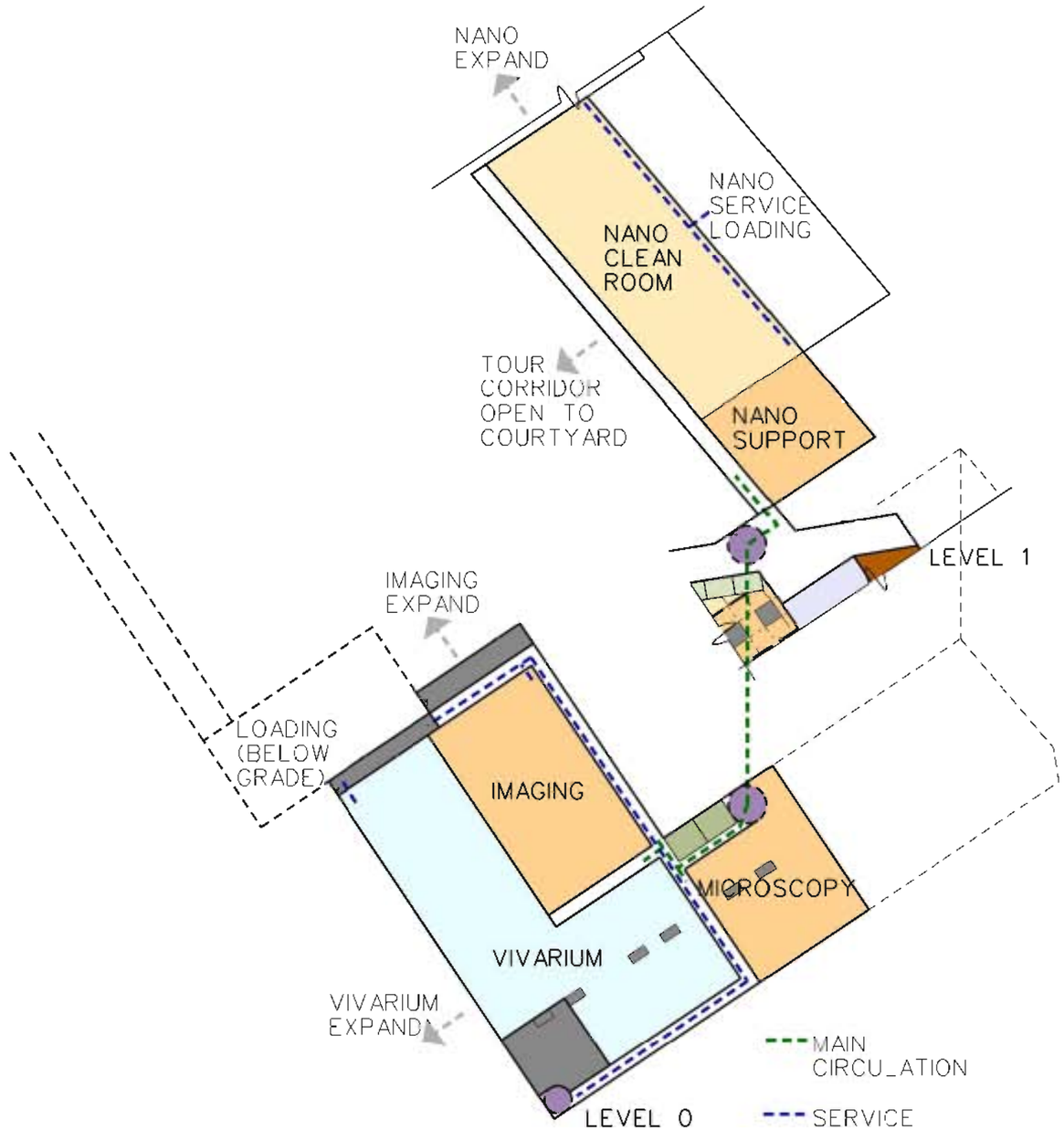

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Utility Space/Janitor/Storage
- Mechanical
- Animal Housing/Vivarium
- Animals other buildings
- Vivarium Animals
- Loading to Building (Up)
- Main Circulation

Adjacency Diagram B
Core Concept 1.2

Project : 27001 Date: 11/30/07

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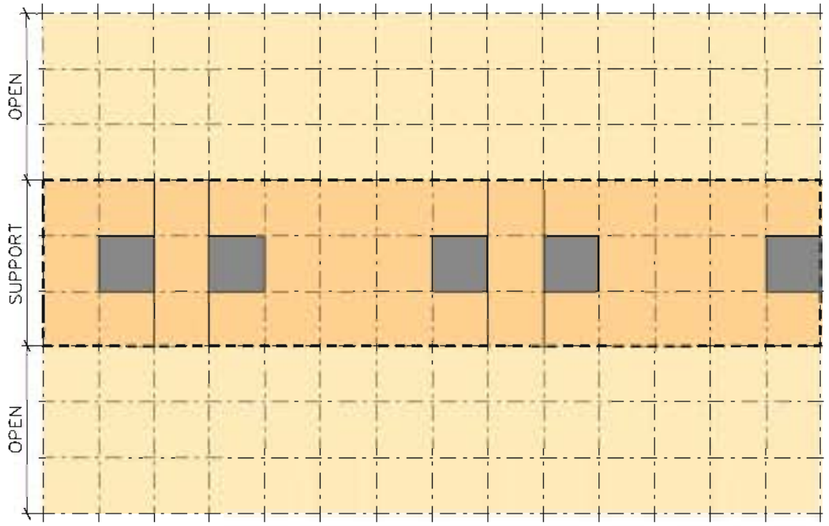

DIAGRAM 2

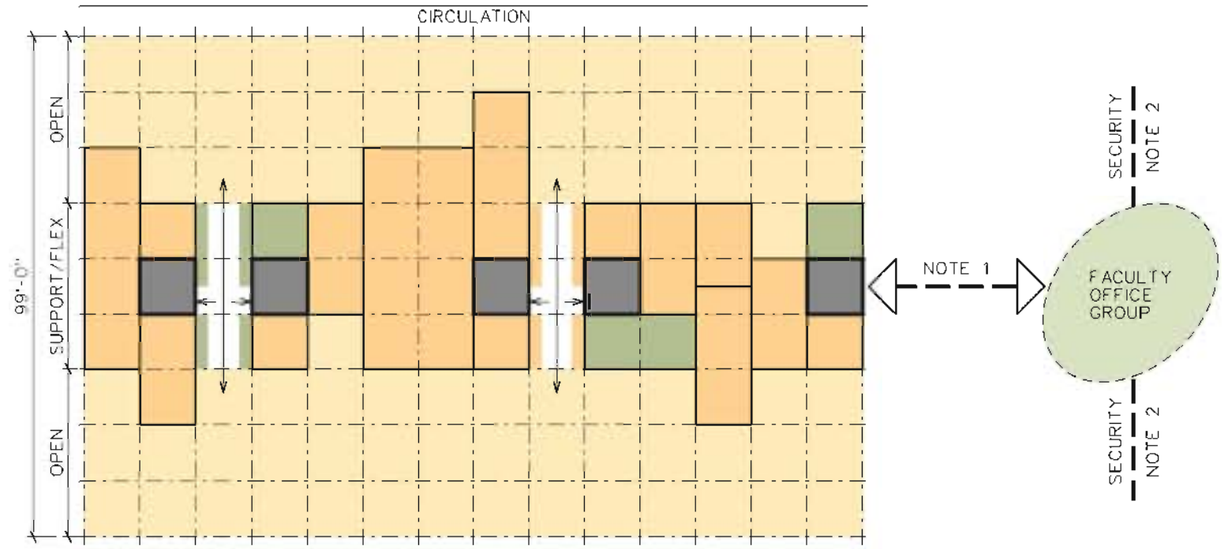

DIAGRAM 4

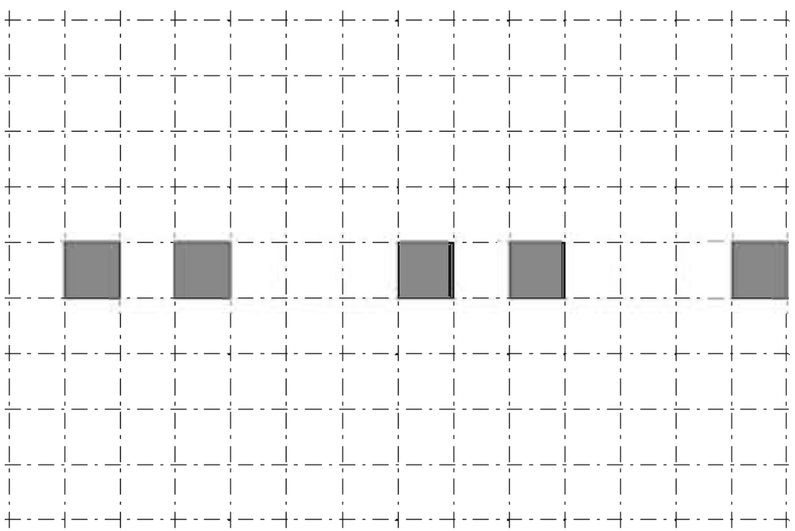

DIAGRAM 1

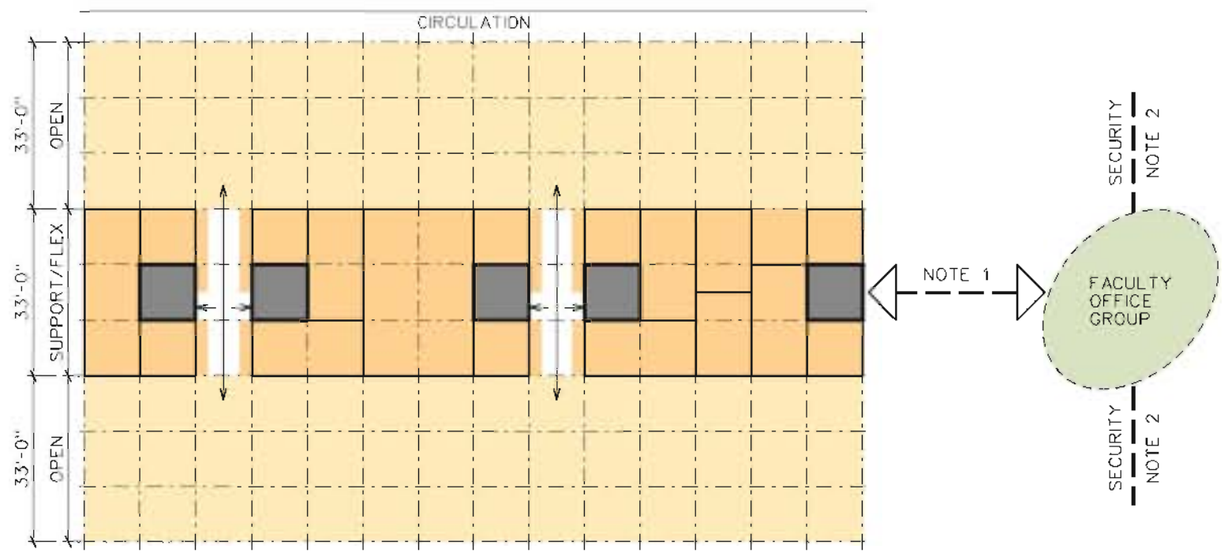

DIAGRAM 3

NOTE 1: PI OFFICES REQUIRE ONE SIDE OF THE GROUP OPEN TO THE PUBLIC CORRIDOR AND ONE SIDE WITH EASY ACCESS TO LABS. OFFICES COULD BE IN ONE LARGE GROUP OR SMALLER GROUPS AS REQUIRED IN BUILDING LAYOUT.
NOTE 2: REFER TO ADJACENCY BUBBLE DIAGRAM AND SECURITY NARRATIVE FOR SECURITY REQUIREMENTS.

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Utility Space/Janitor/Storage
- Mechanical
- Animal Housing/Vivarium

Adjacency Diagram B
Lab Concept 1.1

Project: 27001 Date: 11/30/07

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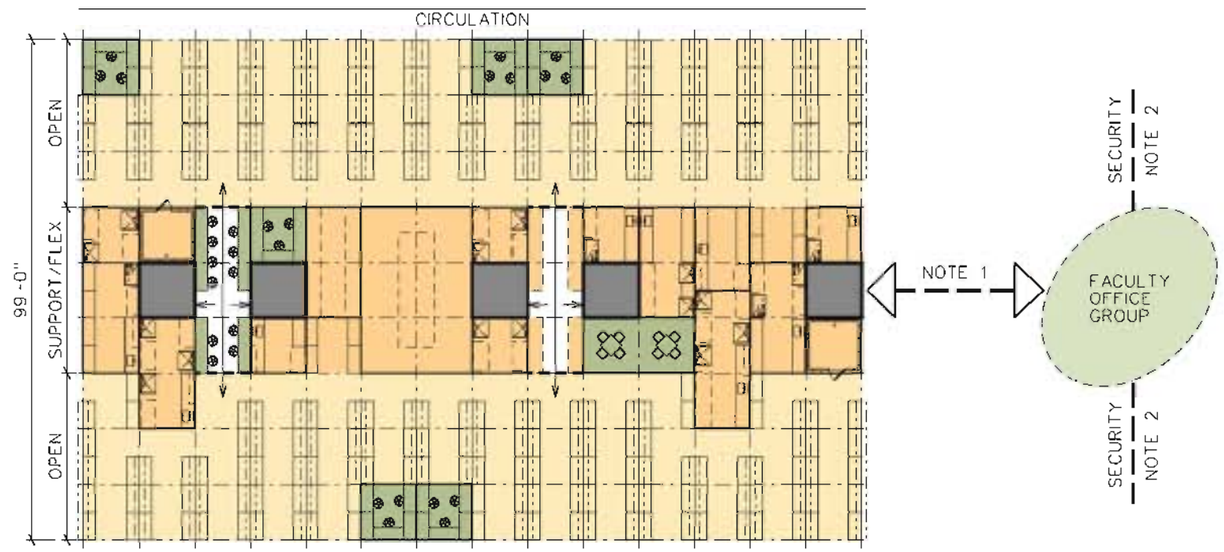
EXAMPLE 1 (EXAMPLE OF HOW CONCEPT COULD BE FITTED OUT)



EXAMPLE 2 (EXAMPLE OF HOW CONCEPT COULD BE FITTED OUT)

NOTE 1: PI OFFICES REQUIRE ONE SIDE OF THE GROUP OPEN TO THE PUBLIC CORRIDOR AND ONE SIDE WITH EASY ACCESS TO LABS. OFFICES COULD BE IN ONE LARGE GROUP OR SMALLER GROUPS AS REQUIRED IN BUILDING LAYOUT.
NOTE 2: REFER TO ADJACENCY BUBBLE DIAGRAM AND SECURITY NARRATIVE FOR SECURITY REQUIREMENTS.

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- Laboratory Space
- Laboratory Support Space
- Office
- Office Support
- Vertical Circulation
- Auditorium
- Utility Space/Janitor/Storage
- Mechanical
- Animal Housing/Vivarium

Adjacency Diagram B
Lab Concept 1.2

Project: 27001 Date: 11/30/07

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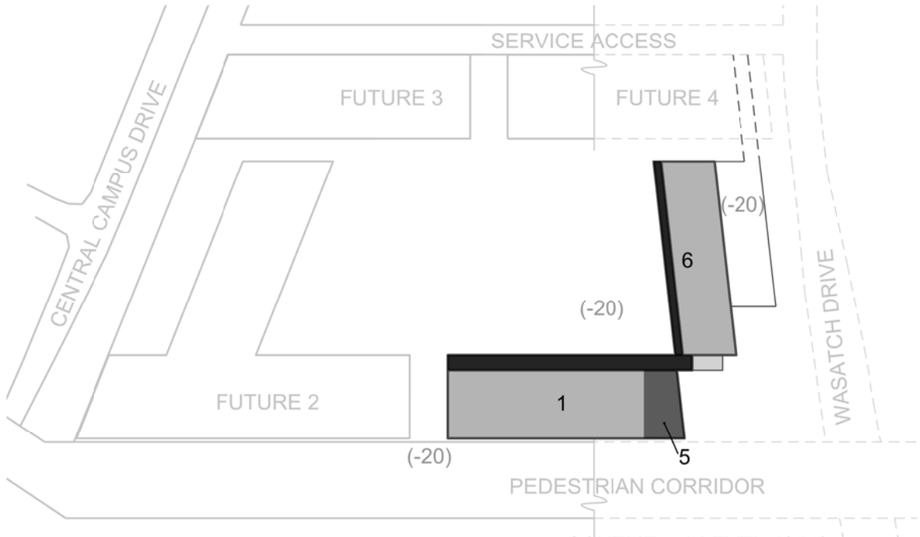
4.4 BUILDING ORGANIZATION

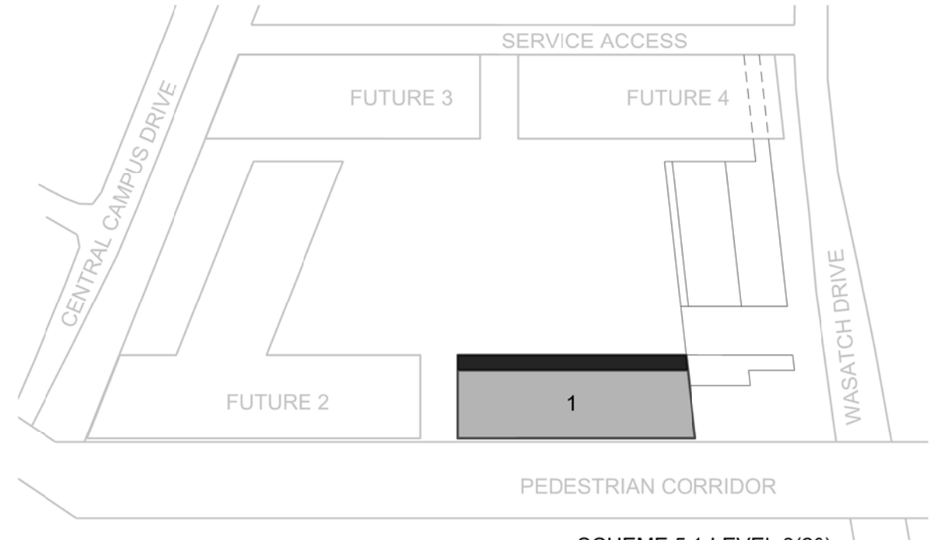
This section introduces the Blocking and Stacking Diagrams that follow. These diagrams are only used to test the program in various blocking arrangements to learn more about the design issues. There are several organizational ideas studied as tests. The location of particular spaces will not be determined in programming but will be decided after the Master Plan of the Quad and design studies are complete. Please refer to the narratives in **Section 3.1** for further explanations of building organization.

There are some major organizational concepts that have been agreed on. The building is likely to be organized in a Main Building of four stories plus Penthouse and a one story plus Penthouse Nanofabrication Facility. The Master Plan concepts for the Quad, discussed in **Section 2.0**, benefit from a shared loading dock under the Quad to serve all 4 buildings. We do know that the core facilities need to be adjacent to the Loading Dock and on grade. This leads to a possibility of one floor being underground. Service and the design of the courtyard will greatly influence the building organization.

Several studies follow that look at different organizational ideas. These studies look at multiple solutions to service, courtyard, and public space. The main groups to be organized in this building include public spaces, core facilities, service, and PI space. The public spaces include the Café, Auditorium, and Front Offices. The core facilities include Small Animal Imaging, Vivarium, Microscopy, and Nanofabrication. The PI space includes office and lab space. Please refer to the **Adjacency Diagrams in Section 4.3** for requirements. Please see the following diagrams for blocking and stacking studies.

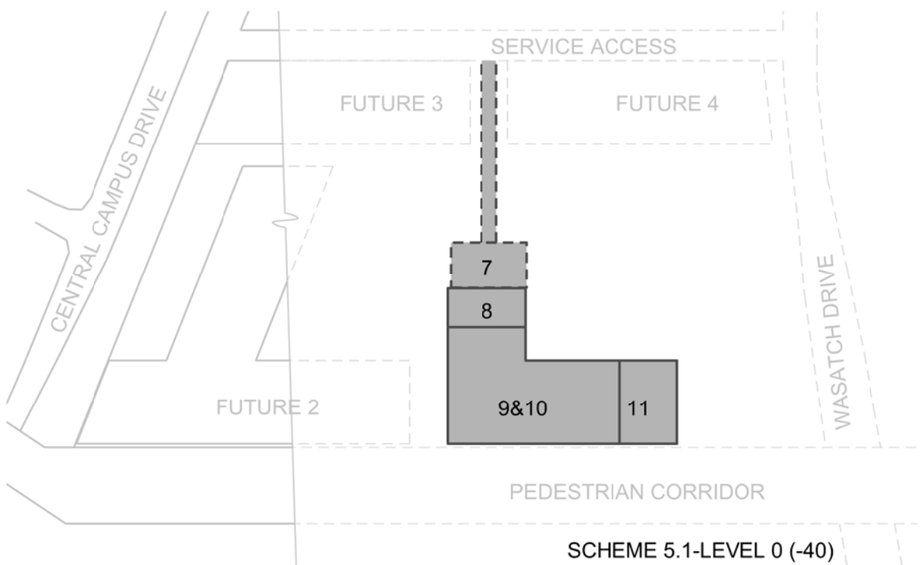


SCHEME 5.1-LEVEL 1(-20)

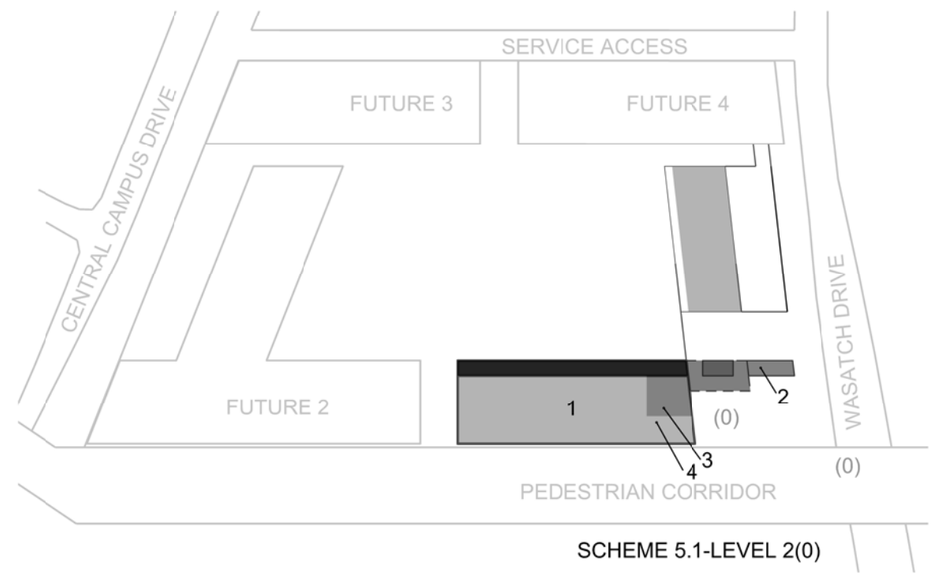


SCHEME 5.1-LEVEL 3(20)

1 - PI LAB/OFFICE 2 - CAFE 3 - AUDITORIUM 4 - IT 5 - FRONT OFFICES 6 - NANO 7 - LOADING 8 - SUPPORT 9 - IMAGING 10 - VIVARIUM 11 - MICROSCOPY



SCHEME 5.1-LEVEL 0 (-40)



SCHEME 5.1-LEVEL 2(0)

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

Blocking Study
Scheme 5.1

0 50' 100' 200' 400'

Project : 27001 Date: 11/30/07

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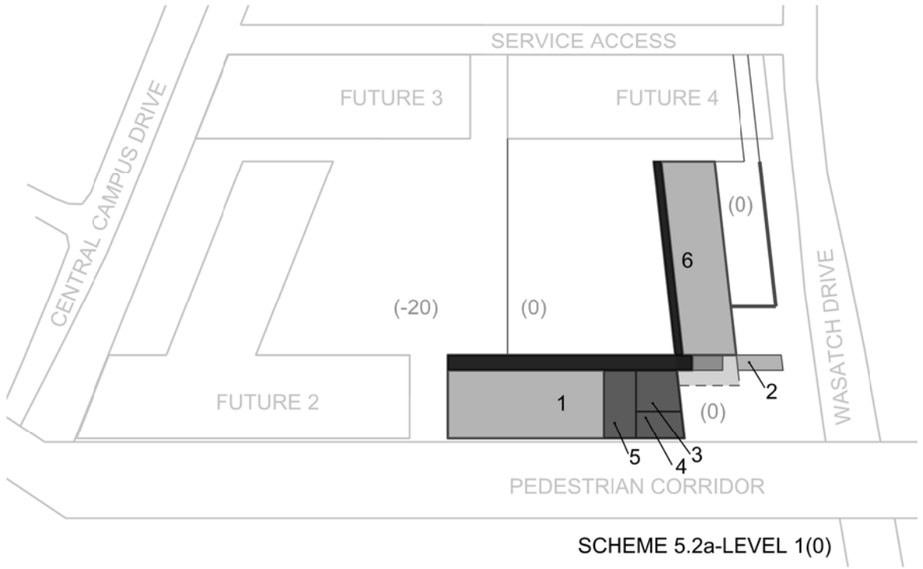
ARCHITECTURE



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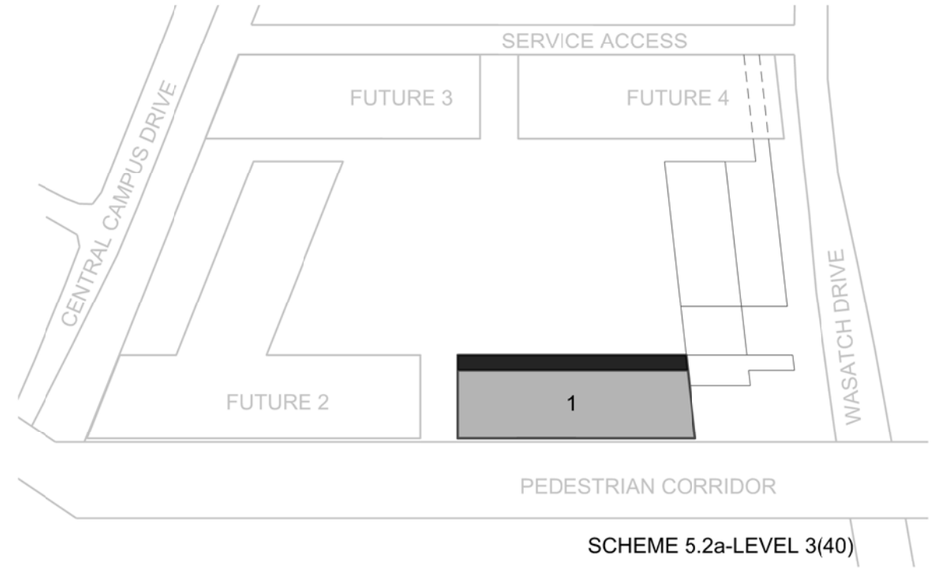
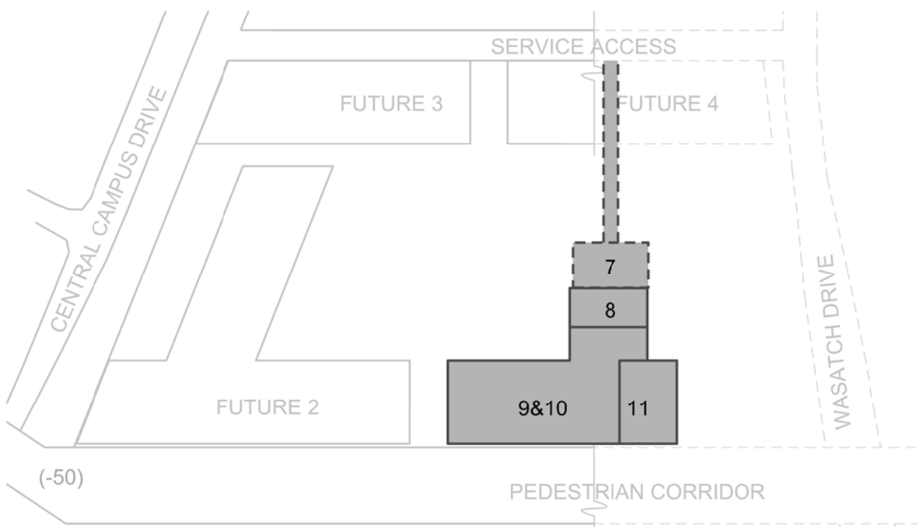
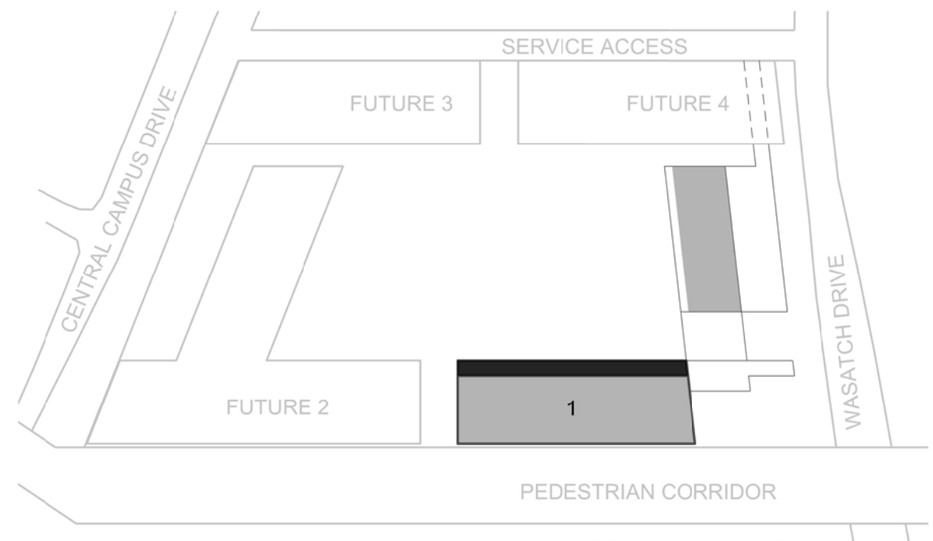


SCHEME 5.2a-LEVEL 3(40)

1 - PI LAB/OFFICE 2 - CAFE 3 - AUDITORIUM 4 - IT 5 - FRONT OFFICES 6 - NANO 7 - LOADING 8 - SUPPORT 9 - IMAGING 10 - VIVARIUM 11 - MICROSCOPY



SCHEME 5.2a-LEVEL 0(-20)



SCHEME 5.2a-LEVEL 2(20)

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

Blocking Study
Scheme 5.2A

0 50' 100' 200' 400'

Project : 27001 Date: 11/30/07

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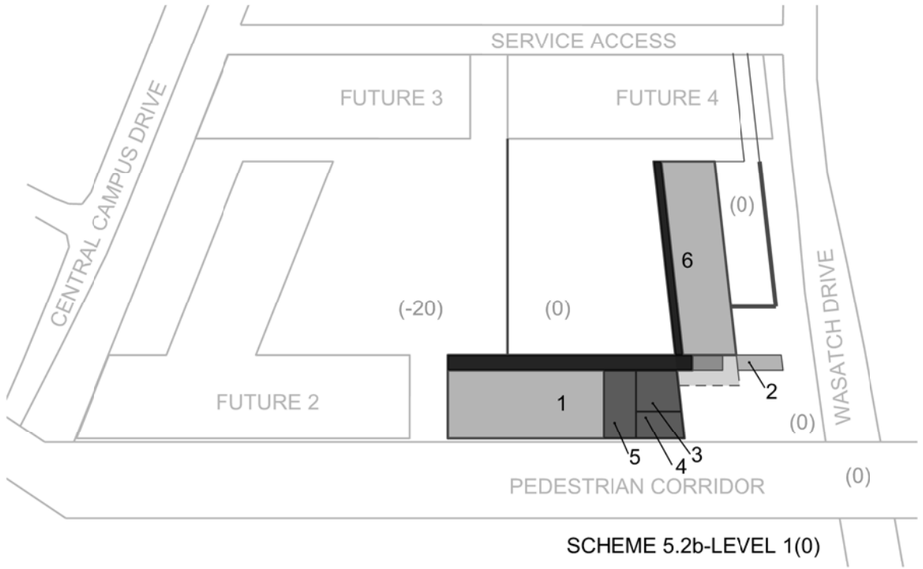
ARCHITECTURE



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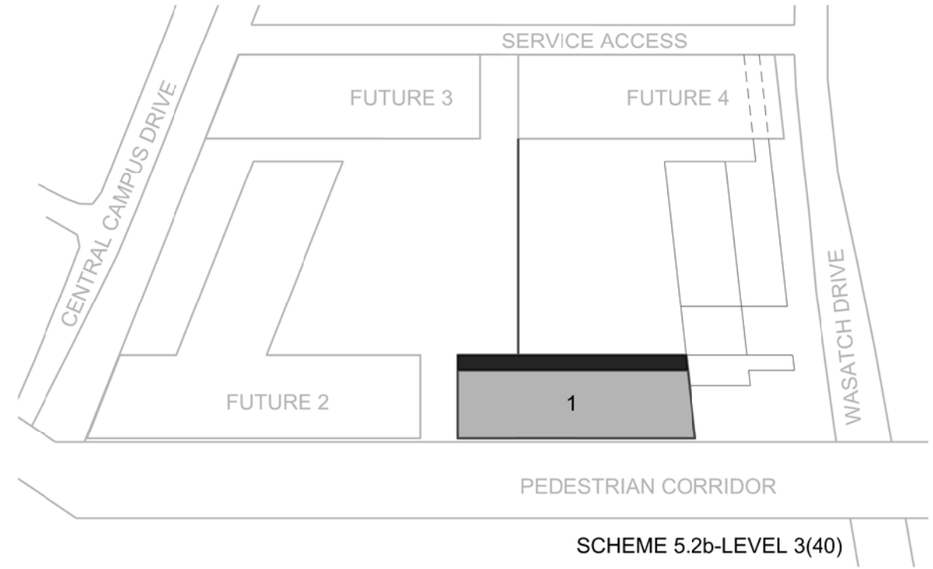
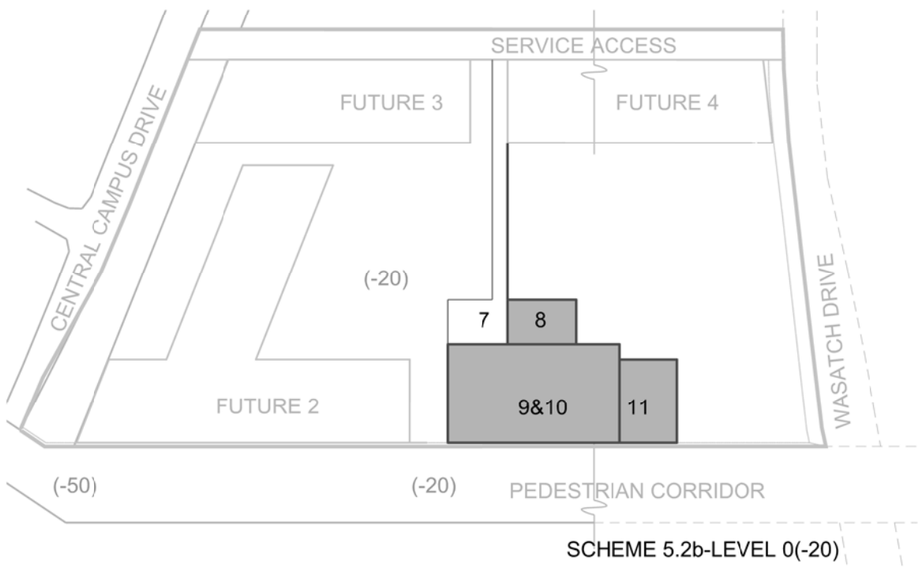


SCHEME 5.2b-LEVEL 3(40)

1 - PI LAB/OFFICE 2 - CAFE 3 - AUDITORIUM 4 - IT 5 - FRONT OFFICES 6 - NANO 7 - LOADING 8 - SUPPORT 9 - IMAGING 10 - VIVARIUM 11 - MICROSCOPY



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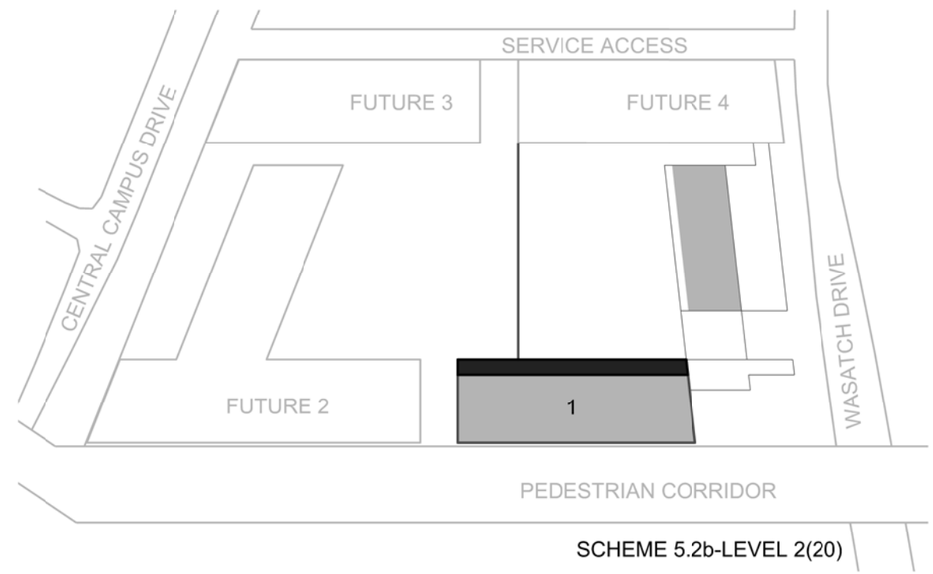

SCHEME 5.2b-LEVEL 2(20)

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

Blocking Study
Scheme 5.2B

0 50' 100' 200' 400'

Project : 27001 Date: 11/30/07

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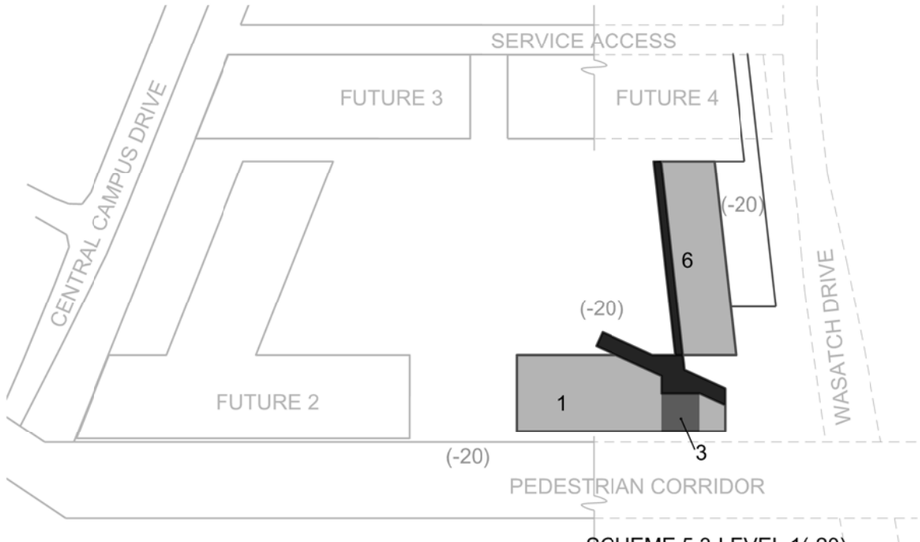

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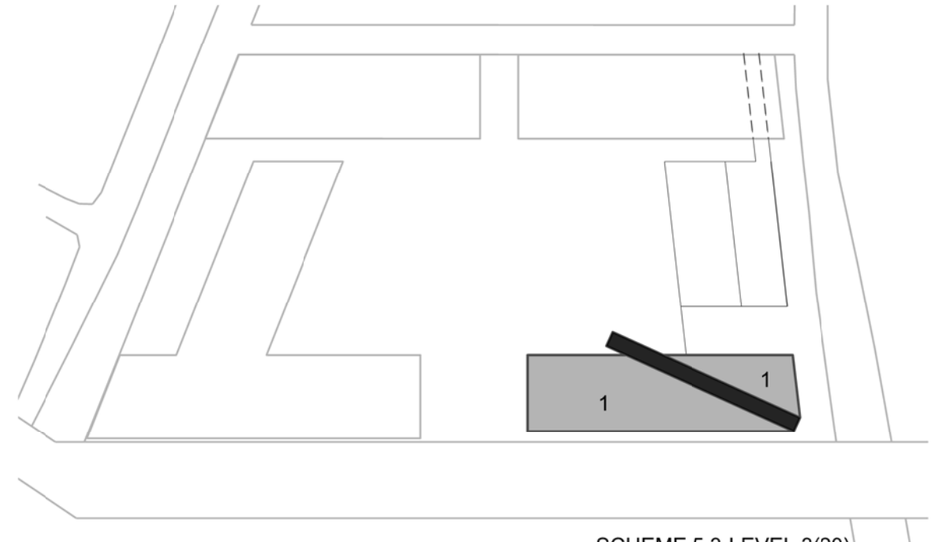
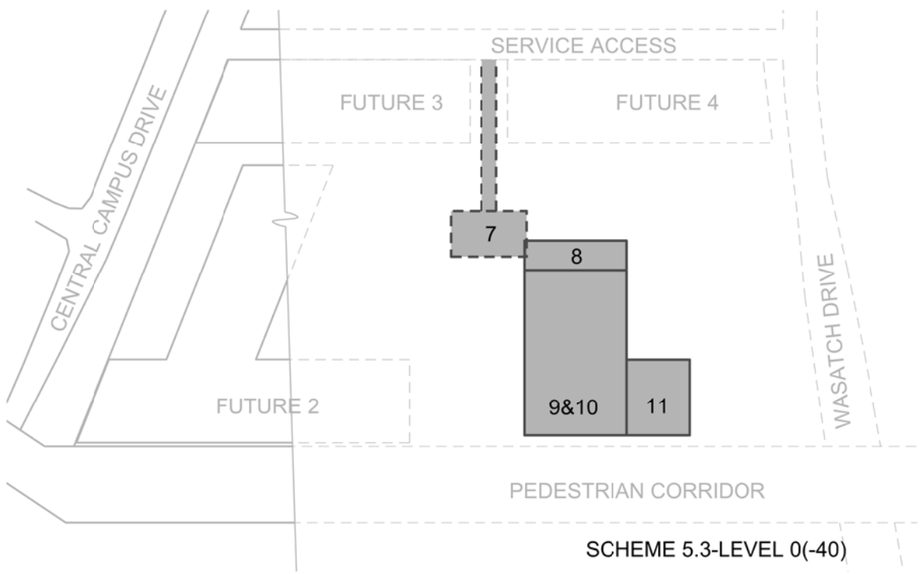


SCHEME 5.3-LEVEL 3(20)

1 - PI LAB/OFFICE 2 - CAFE 3 - AUDITORIUM 4 - IT 5 - FRONT OFFICES 6 - NANO 7 - LOADING 8 - SUPPORT 9 - IMAGING 10 - VIVARIUM 11 - MICROSCOPY



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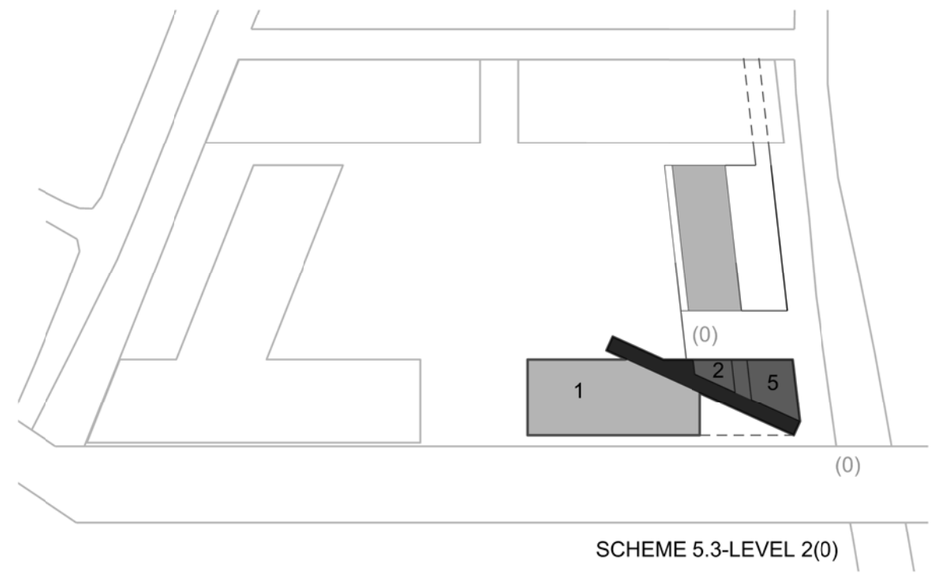

SCHEME 5.3-LEVEL 2(0)

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

Blocking Study
Scheme 5.3

0 50' 100' 200' 400'

Project : 27001 Date: 11/30/07

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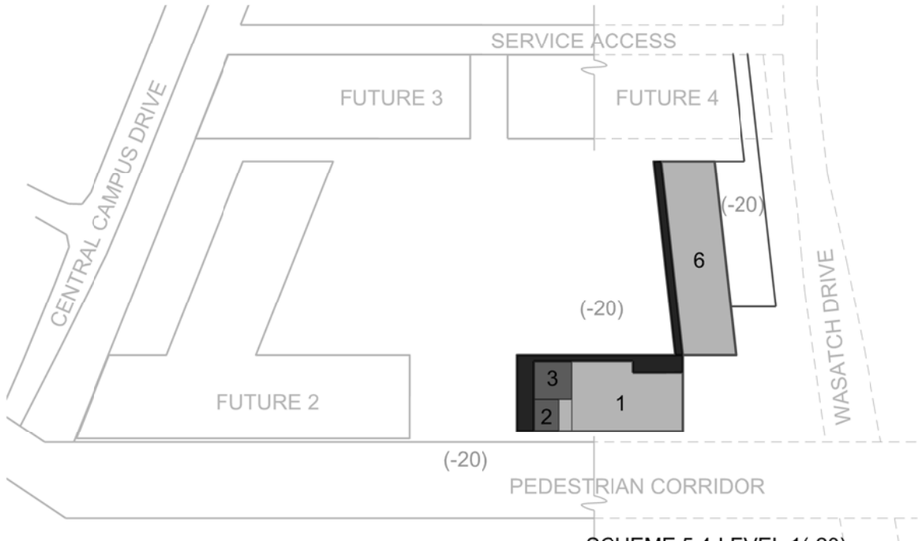
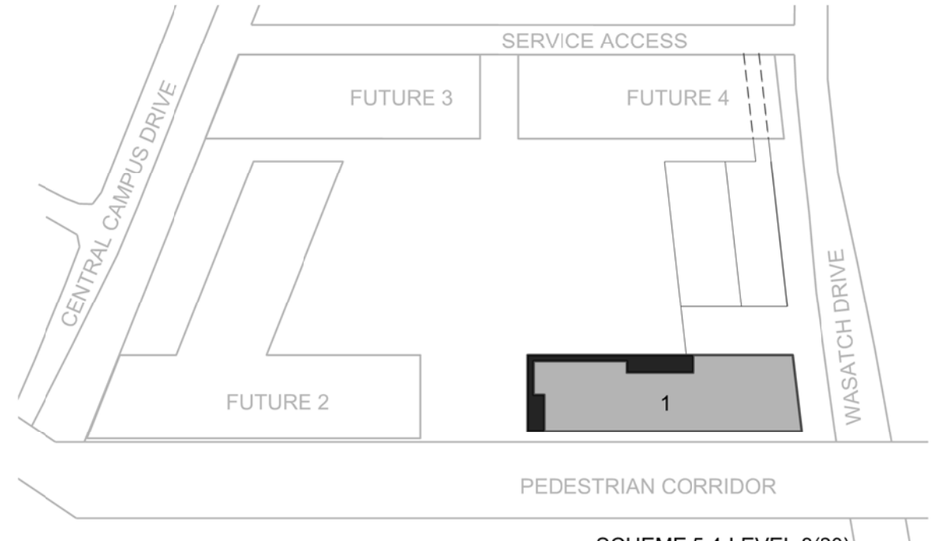
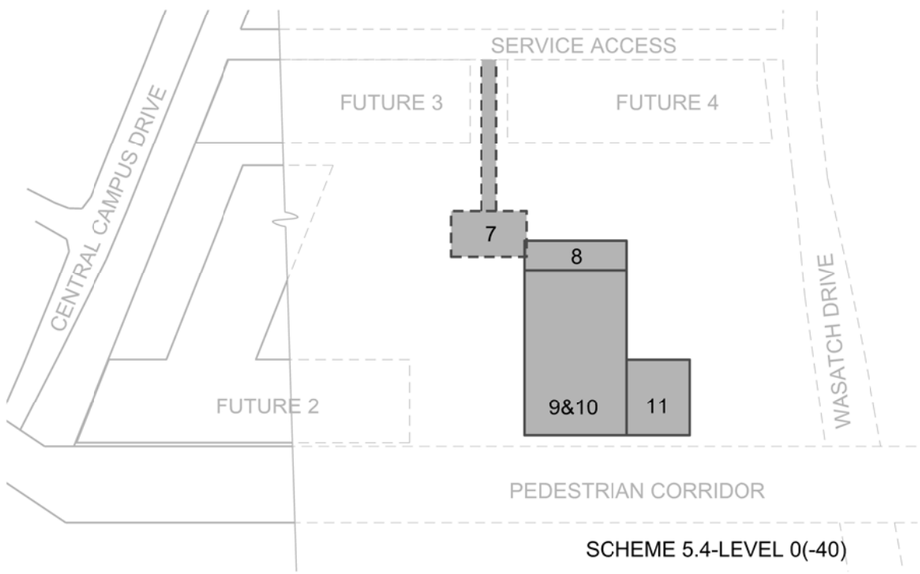


SCHEME 5.4-LEVEL 1(-20)



SCHEME 5.4-LEVEL 3(20)

1 - PI LAB/OFFICE 2 - CAFE 3 - AUDITORIUM 4 - IT 5 - FRONT OFFICES 6 - NANO 7 - LOADING 8 - SUPPORT 9 - IMAGING 10 - VIVARIUM 11 - MICROSCOPY



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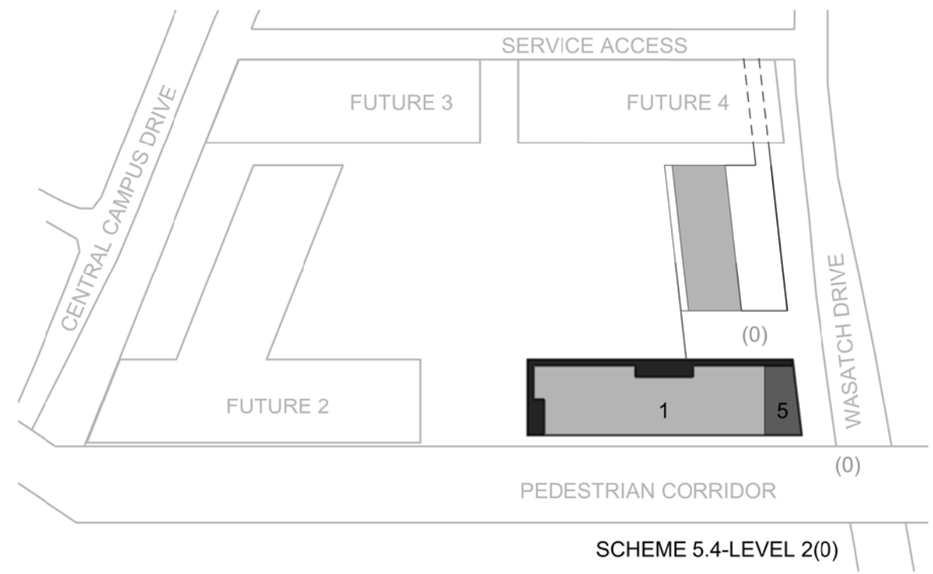

SCHEME 5.4-LEVEL 2(0)

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

Blocking Study
Scheme 5.4

0 50' 100' 200' 400'

Project : 27001 Date: 11/30/07

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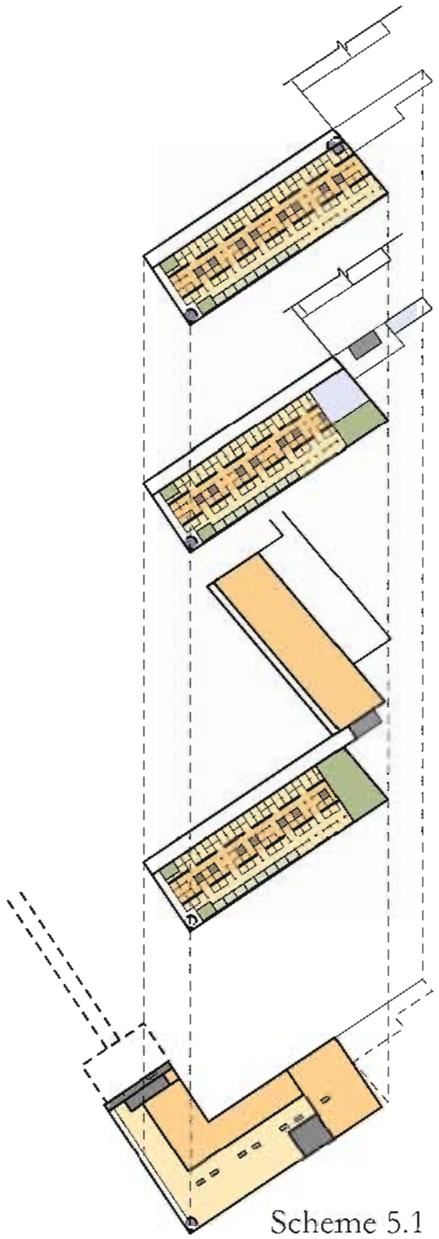
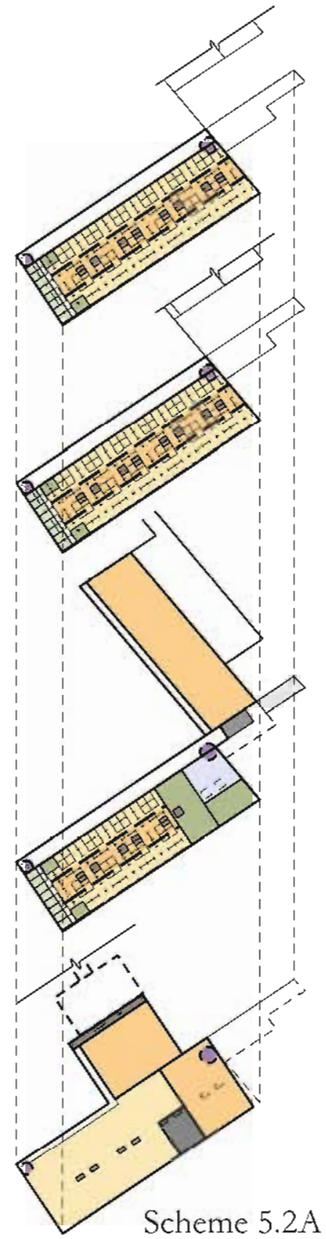
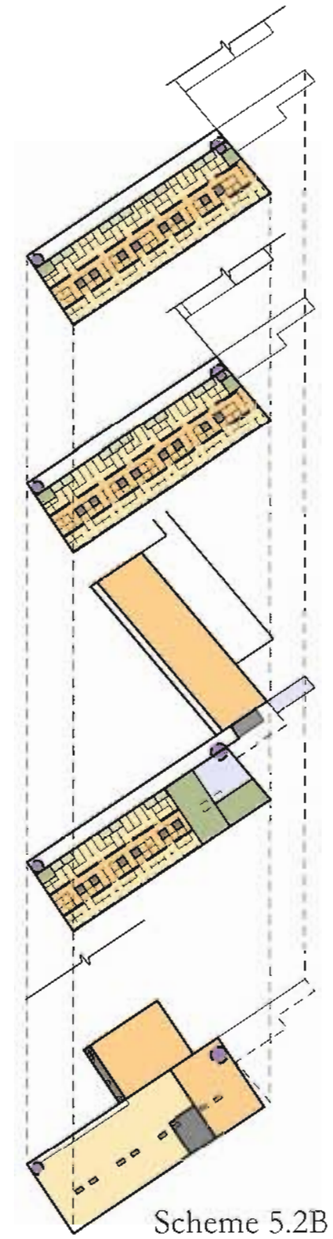
ARCHITECTURE



Scheme 5.1



Scheme 5.2A



Scheme 5.2B

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- OPEN LAB
- LAB SUPPORT
- PI OFFICE
- OFFICE SUPPORT
- WORKSTATIONS
- VERTICAL CIRCULATION & /SUPPORT
- MECHANICAL/ SUPPORT
- CAFE/ AUDITORIUM
- BUILDING SUPPORT

Stacking Study
Scheme 5.1, 5.2A, 5.2B

0 50' 100' 200' 400

Project : 27001 Date: 11/30/07

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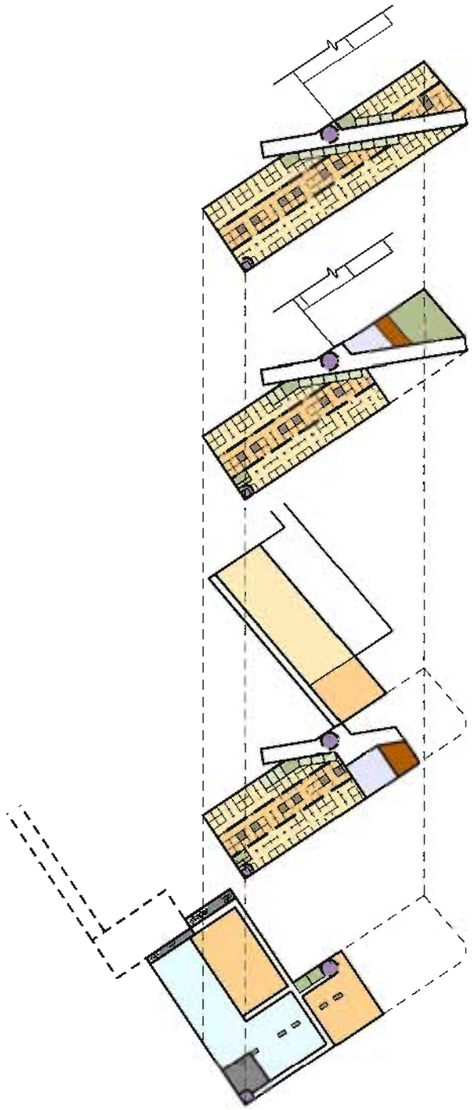
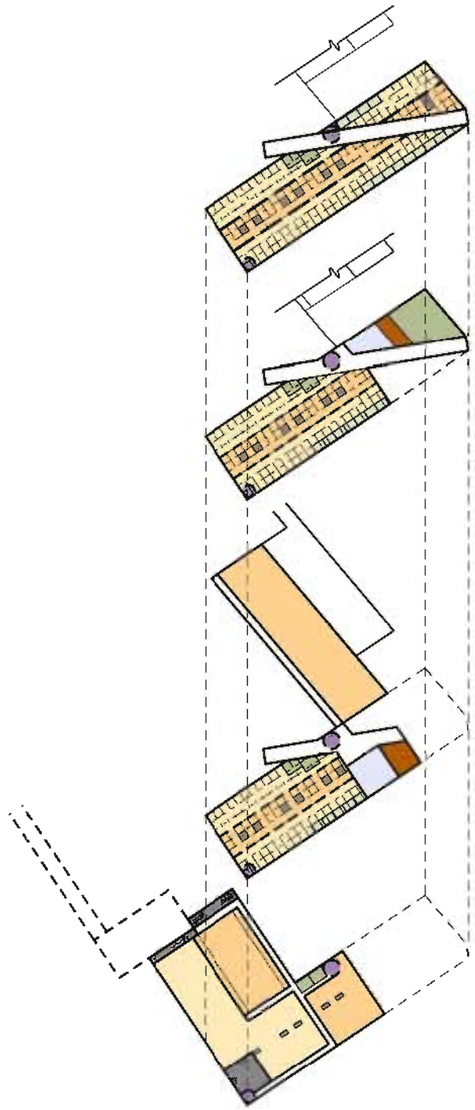
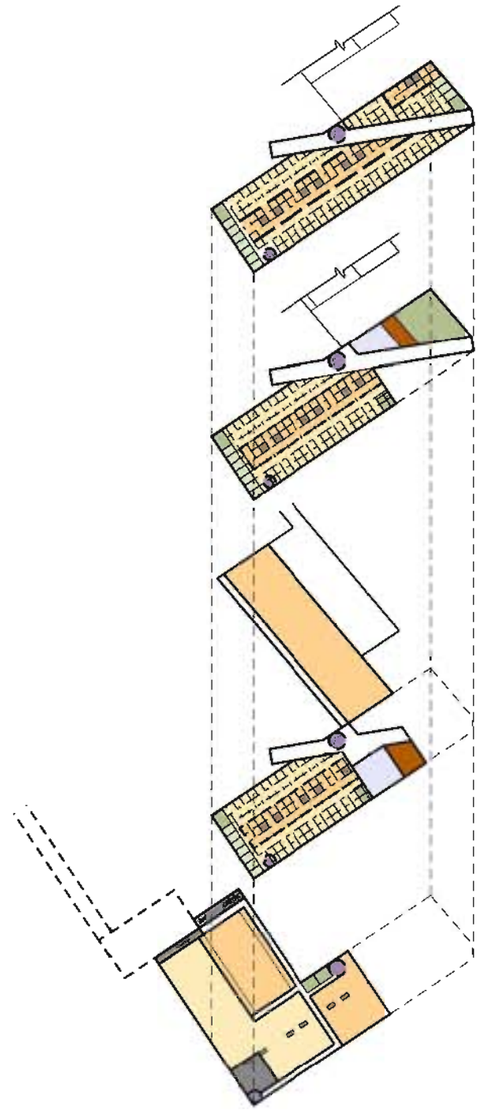
ARCHITECTURE



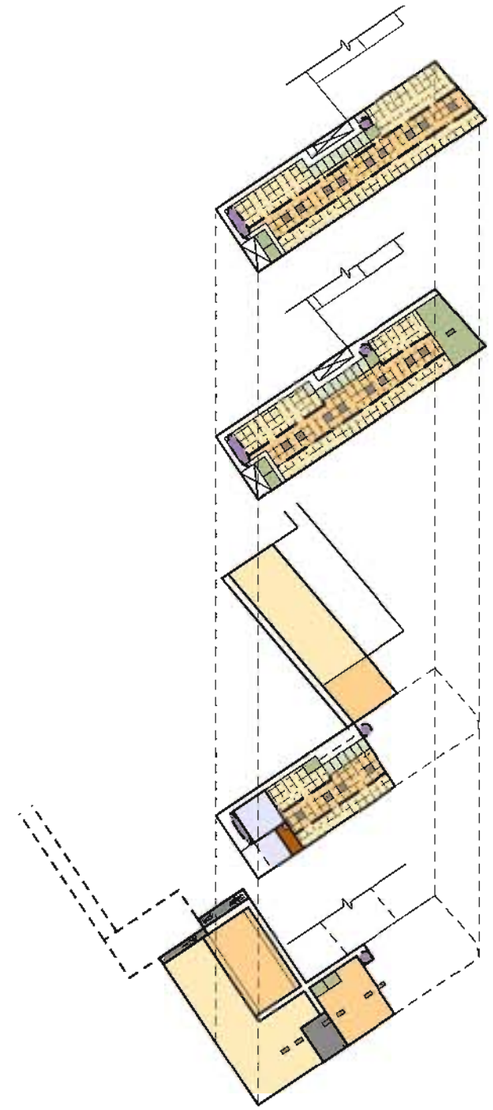
Scheme 5.3A



Scheme 5.3B



Scheme 5.3C



Scheme 5.4

USTAR and The University of Utah

Neuroscience and Biomedical Research Technology Building

Salt Lake City, Utah

- OPEN LAB
- LAB SUPPORT
- PI OFFICE
- OFFICE SUPPORT
- WORKSTATIONS
- VERTICAL CIRCULATION & /SUPPORT
- MECHANICAL/ SUPPORT
- CAFE/ AUDITORIUM
- BUILDING SUPPORT

Stacking Study
Scheme 5.3A-C, 5.4

0 50' 100' 200' 400

Project : 27001 Date: 11/30/07

LORD · AECK · SARGENT
ARCHITECTURE

5.0 Project Cost Estimate

5.1 Capital Budget Estimate

5.2 Comparable Projects

5.1 CAPITAL BUDGET ESTIMATE

The following document summarizes an estimated Total Project Budget for the Neuroscience and Biomedical Research Technology Building (NBRTB).

Factors to note:

- An equipment budget has been included (pages 15-36), with each piece of equipment placed into one of three categories: "In Construction", "Outside Construction", and "Outside Project Cost."
    - Items "In Construction" are there because they are in some way essential to the proper operation of the building and / or require contractor coordination to install.
    - Items "Outside Construction" are necessary to the building's operation and / or use, but may be procured directly by the University.
    - The majority of the equipment is categorized as "Outside Project Cost," and is therefore not reflected in the Total Project Cost.
- Estimates included in "Design, Testing and Related Costs" reflect a budget based on historic averages of similar projects.
- Estimates included in "Other Owner Costs" are based on University of Utah Standards.

Please see page numbers within consultant's document

Capital Development Projects

Capital Budget Estimate (CBE)

Project Name:	**USTAR - Neuroscience & Biomedical Technology Research Building**
Agency/Institution:	Higher Ed / University of Utah
Project Manager:	BOWEN

Cost Summary		**$ Amount**	**Cost Per SF**	**Notes**		
Facility Cost (USTAR Bldg + 3000T Chiller Plant)	$	93,720,570	$483.59			
Additional Construction Cost	$	117,799	$0.61			
Site Cost	$	28,402,505	$146.55			
High Performance Building + LEED Gold Certification	$	4,244,306	$21.90			
Total Construction Cost	**$**	**126,485,179**	**$652.65**			
Soft Costs:						
Hazardous Materials	$	-				
Pre-Design/Planning	$	1,656,065				
Consultant Fees [A/E Design (Basic & Special Services), VE, Cost & Schedule Control]	$	10,273,296				
Property Acquisition	$	-				
Furnishings & Equipment	$	4,076,458				
Information Technology:	$	1,469,013				
Utah Art	$	751,617				
Testing & Inspection	$	756,986				
Contingency	$	6,008,046				
Moving/Occupancy	$	350,000				
Builder's Risk Insurance (0.15% of Construction Budget)	$	189,728				
Legal Services (0.2% of Construction Budget)	$	202,376				
DFCM Management	$	-				
User Fees	$	713,473				
Commissioning	$	805,304				
Other Costs	$	15,000				
Total Soft Costs	**$**	**27,267,361**	**$140.70**			
TOTAL PROJECT COST	**$**	**153,752,540**	**$793.35**			
Previous Funding	**$**	**-**				
Other Funding Sources (Identify in note)	$	53,052,540		GO Bonds	$	70,700,000
REQUEST FOR STATE FUNDING	**$**	**100,700,000**		General Fund	$	30,000,000

Project Information

Gross Square Feet	193,803	Base Cost Date	31-Dec-07
Net Square Feet	116,523	Estimated Bid Date	1-May-09
Net/Gross Ratio	60%	Est. Completion Date	30-Dec-11
		Last Modified Date	**31-Mar-08**
		Print Date	31-Mar-08

	Description of Utility		A USTAR Site Estimate 9/27/07	B Site #3 Est. 5/20/2007	C Variance	D Cost Est. USTAR 1	%	E Cost Est. Future	F Est. Non-Univ Contribution	G Cost Est. Stand Alone
1	Chilled Water Equip (note 2) HVB 9/12/07 3000 Tons		4,183,200	1,834,443	2,348,757	836,640	20	3,346,560		2,221,532
2	Chilled Water Central Plant Bldg (note 2) HVB 9/12/07		1,209,000	651,750	557,250	241,800	20	967,200		
3	Chilled Water - (note 2) HVB 9/12/07 Piping site E		1,133,028	70,000	1,063,028	226,606	20	906,422		
4	HTW (note 3)		855,000	806,000	49,000	684,000	80	171,000		5,953,000
5	Tunnel (note 3)		1,500,000	942,500	557,500	1,200,000	80	300,000		1,200,000
6	Sanitary Sewer - (notes 5 & 6) Previous amt $238,000		1,106,345	1,089,750	16,595	276,586	25	276,586	553,173	276,586
7	Culinary Water - (notes 5 & 7)		296,800	296,890	(90)	74,200	25	74,200	148,400	296,800
8	note 7(a)		163,925	163,925	-	40,981	25	40,981	81,963	40,981
9	note 7(b)		142,885	142,885	-	35,721	25	35,721	71,443	35,721
10	Natural Gas AN/LAS 9/25/07 Jacobsen		46,250	238,000	(191,750)	9,250	20	37,000	-	46,000
11	Storm Sewer - site detainage - (note 5)		169,200	169,200	-	42,300	25	42,300	84,600	42,300
12	Electrical Service - (note 4) AN/LAS 9/25/07		4,685,500	3,787,000	898,500	2,731,000	50	2,731,000		3,175,250
	Data - Communications (notes 5 & 8) AN/LAS 9/25/07 (includes cabling and site restoration)		776,500	401,250	375,250					
13	Sub-Total Est. Site Utility Costs - Site 3		16,267,633	10,593,593	5,674,040	6,399,084		8,928,971	939,578	13,288,171
						39.34%		54.89%	5.78%	
14	**Additional Development Cost**									
a	Relocate Water, High Voltage, Telecomm in Fed Way		1,349,300	-	1,349,300	269,860		1,079,440	-	
b	New Service Road north of site		440,823	-	440,823	88,165		352,658	-	
c	Interdisciplinary Quad		749,266	-	749,266	149,853		599,413	-	
d	Interdisciplinary Mall between Central Campus/Wasatch		920,011	-	920,011	184,002		736,009	-	
e	Loading Dock		2,549,500	-	2,549,500	509,900		2,039,600	-	
						1,201,780				
15	Sub-Total Est Site Utility (13) plus Add'l Development		22,276,533	-	11,682,940	7,600,865		13,736,092	939,578	
16	General Requirements	7.00%	1,559,357	741,552	817,806	532,061		961,526	65,770	930,172
17	Bidding & Contract Req.	1.00%	238,359	113,351	125,007	81,329		146,976	10,053	142,183
18	Precon Fee	0.10%	24,074	855	12,626	8,214		14,845	1,015	930
18	Contractor's Fee	4.00%	962,970	457,940	505,030	328,570		593,784	40,616	574,421
19	Inflation to Dec. 31 ,2007	1.67%	417,287	198,441	218,846	142,380		257,306	17,600	248,916
20	Construction Contingency	3.00%	763,635	363,146	400,489	260,556		470,871	32,209	455,516
21	Estimating Contingency	5.00%	1,310,907	623,401	687,506	447,288		808,328	55,291	781,969
22	Sub-Total Est. Site Utility Soft Costs		27,553,123	13,092,279	14,460,844	9,401,264		16,989,727	1,162,133	16,422,278
					-					
23	Gross Receipts Sales Tax	0.10%	27,553	13,092	14,461	9,401		16,990	1,162	16,422
24	Sub-total Construction Cost		27,580,676	13,105,371	14,475,305	9,410,665		17,006,717	1,163,295	16,438,700
19	Inflation to Bid Date - May 1, 2009	13.34%	3,679,942	1,748,580	1,931,362	1,255,615		2,269,115	155,212	2,195,519
25	Project Cost Factor	15.29%	4,778,394	2,270,525	2,507,868	1,630,412		2,946,439	201,543	2,512,765
					-					
26	Total Utility Development		36,039,011	17,124,476	18,914,536	12,296,691		22,222,272	1,520,050	18,951,465
						34.12%		61.66%	4.22%	
27	Total "State" Cost if PCMC assessment occurs					36,039,013				

Update by VBFA, David Baranowski:

12 - 15' sanitary sewer from 500 South/Guardsman to the north side of Site 3, 5350 LF	901,750	
Extension of sanitary sewer line from the north side of Site 3 to the proposed PCMC site, 1400 LF	188,000	
		1,089,750

$238,000 - original estimate of VBFA that is being distributed as cost

		%
Total Buildout at Golf Course	1,000,000	100.00%
USTAR 1 Square Footage	200,000	20.00%
Balance Square Footage	800,000	80.00%

USTAR at University of Utah **based on:** **193,803 G.S.F** **G. ; 2,057 N.S.F./ P.I.**

Target Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007 Revised: *November 9, 2007*

Item	Reference	Qty	U/M	U/C		Budget	Budget
Construction			GSF	$574.99		**$111,434,136**	**$111,434,136**
Construction Cost of the Building					$64,725,508		
Contractor Cost for the Building					$15,341,416		
Construction Cost of the Central Plant and Infrastructure					$22,276,533		
Contractor Cost of the Central Plant and Infrastructure					$5,280,044		
LEED Certification					$3,603,012		
Connection Fees					$100,000		
Other					$0		
Inflation to Midpoint of Construction					$0		
Utilities Extension					$0		
State Sales Tax Building					$80,067		
State Sales Tax Central Plant and Infrastructure					$27,557		
Equipment						**$1,753,811**	**$1,753,811**
Lab Casework & Equip not in construction					$300,000		
Animal Equipment not in construction					$372,788		
Imaging Equipment not in construction					$0		
BioMicropscopy Equipment not in construction					$0		
NanoMicroscopy Equipment not in construction					$0		
Nanofab Equipment not in construction					$1,081,023		
Furnishings						**$2,203,915**	**$2,203,915**
Signage					$96,901		
Furniture					$2,107,014		
Communications						**$1,469,013**	**$1,469,013**
Alarm & Detection Systems					$0		
Telephone Systems Off-Site					$0		
Telephone Inside					$0		
Equip, Cable, Move-In					$969,013		
Special Phones/Connections					$0		
Special AV Systems					$500,000		
Design, Testing & Related Costs						**$14,042,289**	**$14,042,289**
Design Basic Services					$7,521,804		
Program Services					$1,578,777		
Program Services					$2,228,683		
Precon Services					$0		
Reimbursable Expenses					$557,171		
VE Charette					$25,000		
High Performance Design					$315,755		
Surveys and Tests					$785,611		
Owner Other Design Costs					$0		
Commissioning					$835,756		
Geotechnical Investgation / Reports by Programming Team					$75,000		
FF&E Design Fees					$118,732		
Development Costs						**$20,867,418**	**$20,867,418**
Contingency					$0		
Owner Contingency					$5,999,354		
Inflation Adj to Start - January 1, 2008 through May 1, 2009					$14,868,064		
Other University Costs						**$2,089,888**	**$2,089,888**
Infrastructure Contribution					$0		
Campus Costs					$0		
User Fees - U of U Management Fees					$300,000		
User Fees - CD&C Cost					$413,473		
Temporary Relocation / Move In Costs					$350,000		
Public Art					$652,833		
Advertising / Printing					$0		
Hazardous Materials					$0		
Grounds					$0		
Legal Services					$169,128		
Other					$15,000		
Other PM					$0		
Risk Insurance					$189,453		
Total Project Cost		**193,803**	SF		**$793.90**	**$153,860,470**	**$153,860,470**
Funds Available							**$130,000,000**
Variance - Under (Over)							**($23,860,470)**

USTAR at University of Utah

Target Total Project Budget

Prepared: September 20, 2007

Neuroscience & Biomedical Research Technology Building

Revised: *09-Nov-07*

Item	193802.5932	Qty	U/M	U/C		LAS Budget	Budget	Diff with Budget
Construction				$547.23		$111,434,136	$111,434,136	0
Construction Cost of the Building		193,803	sf	$333.98	$64,725,508			
Contractor Cost for the Building		193,803	sf	$79.16	$15,341,416			
Construction Cost of the Central Plant and Infrastructure		5,200	sf	$4,283.95	$22,276,533			
Contractor Cost of the Central Plant and Infrastructur		102,200	sf	$51.66	$5,280,044			
LEED Certification		4.5%		$80,066,923	$3,603,012			
Connection Fees		1.0	ls	$100,000.00	$100,000			
Other		0.0	ls		$0			
Inflation to Midpoint of Construction		0.0	ea		$0			
Utilities Extension		0.0	ls		$0			
State Sales Tax Building		0.10%			$80,067			
State Sales Tax Central Plant and Infrastructure		0.10%			$27,557			
Equipment						$1,753,811	$1,753,811	0
Lab Casework & Equip not in construction		1.0	ls	300,000	$300,000			
Animal Equipment not in constructio		1.0	ls	372,788	$372,788			
Imaging Equipment not in constructio		1.0	ls	0	$0			
BioMicropscopy Equipment not in constructio		1.0	ls	0	$0			
NanoMicroscopy Equipment not in constructio		1.0	ls	0	$0			
Nanofab Equipment not in constructio		1.0	ls	1,081,023	$1,081,023			
Furnishings						$2,203,915	$2,203,915	0
Signage		193,802.6	ls	0.50	$96,901			
Furniture		193,802.6	ls	10.87	$2,107,014			
Communications						$1,469,013	$1,469,013	0
Alarm & Detection Systems		0.0	ls	0	$0			
Telephone Systems Off-Site		0.0	ls	0	$0			
Telephone Inside		0.0	ls	0	$0			
Equip, Cable, Move-In		193,803		5	$969,013			
Special Phones/Connections		0.0	ls	0	$0			
Special AV Systems		1.0	ls	500,000	$500,000			
Design, Testing & Related Costs						$14,042,289	$14,042,289	0
Design Basic Services		6.75%		111,434,136	$7,521,804			
Program Services		1.25%		126,302,195	$1,578,777			
Special Consultant Services		2.00%		111,434,136	$2,228,683			
Precon Services		0.00%		111,434,136	$0			
Reimbursable Expenses		0.50%		111,434,136	$557,171			
VE Charette		1.0		25,000	$25,000			
High Performance Design		0.25%		126,302,195	$315,755			
Surveys and Tests		0.705%		111,434,136	$785,611			
Owner Other Design Costs		0.00%		111,434,136	$0			
Commissioning		0.75%		111,434,136	$835,756			
Geotechnical Investgation / Reports by Programming Team		1.0		75,000	$75,000			
FF&E Design Fees		3.00%		3,957,726	$118,732			
Contingency						$20,867,418	$20,867,418	0
Contingency		0.00%		111,434,136	$0			
Owner Contingency		5.38%		111,434,136	$ 5,999,354			
Inflation Adj to Start - January 1, 2008 through May 1, 2009		13.34%		111,434,136	$14,868,064			
Other Owner Costs						$2,089,888	$2,089,888	0
Infrastructure Improvement	*in construction / recap*	0.0	ea	0	$0			
Campus Costs		0.0	ls	455,000	$0			
User Fees - U of U Management Fees		1.0	ls	300,000	$300,000			
User Fees - CD&C Cost		1.0	ls	413,473	$413,473			
Temporary Relocation / Move In Costs		1.0	ls	350,000	$350,000			
Public Art		0.70%		93,261,847	$652,833			
Advertising / Printing		0.0	ls	0	$0			
Hazardous Materials	*NIC*	0.0	ls	0	$0			
Grounds		0.0	ls	0	$0			
Legal Services		0.20%		84,564,221	$ 169,128			
Energy Study		1.0	ls	15,000	$15,000			
Owner Facility PM		0.00%		111,434,136	$0			
Risk Insurance		0.15%		126,302,195	$ 189,453			
Total Project Cost		193802.6		$793.90		$153,860,470	$153,860,470	0
Funds Available							$130,000,000	
Variance - Under (Over)							($23,860,470)	

Equipment not in Project Cost Above:

Lab Casework and Equipment	$777,264
Animal Equipment	$2,234,400
Imaging Equipment	$3,026,968
BioMicroscopy Equipment	$3,036,800
NanoMicroscopy Equipment	$5,891,600
Nanofab Equipment	$7,946,060
Total Equipment not in Project Cost *	$22,913,092
Total Project Cost plus Equipment not in Project Cost	$176,773,562

*** Design engineering and procurement not included.**

USTAR at University of Utah						
Summary Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Build				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
Chilled Water Equipment	Two (2) 1500 chillers	3000	ton	245.00	735,000	**4,183,200**
	Cooling Tower	3000	ton	125.00	375,000	
	Condenser Water Pump	2	ea	35000	70,000	
	Primary Chilled Water Pump	2	ea	26000	52,000	
	Secondary Chilled Water Pump	2	ea	38000	76,000	
	Installation of Chiller	2	ea	32000	64,000	
	Installation of Pumps	6	ea	20000	120,000	
	Controls for Pumps and Chiller	1	lot	100000	100,000	
	Piping for Pumps and Chiller	1	lot	725000	725,000	
	Valves	1	lot	180000	180,000	
	Misc. Supports and Pads	1	lot	195000	195,000	
	Electrical for Chiller and Pumps	1	lot	1095000	1,095,000	
	Water Treatment	1	lot	20000	20,000	
	Site Improvements	1	lot	180000	180,000	
	Markup on Equipment	1	lot	196200	196,200	
Chilled Water Plant	Structure	**5200**	sf	41.86	217,685	**1,209,000**
	Exterior envelope	5200	sf	40.16	208,806	
	Interior Construction	5200	sf	31.59	164,255	
	Equip / Spec Construciton	5200	sf	0.00	0	
	Fire Protection	5200	sf	3.00	15,600	
	Plumbing	5200	sf	26.00	135,200	
	Mechanical / Controls	5200	sf	73.56	382,486	
	Electrical	5200	sf	16.34	84,968	
Interdisciplinary Mall Between Wasatch and Central Campus Drive	Clear and Grub Site	55,000	sf	0.18	9,900	**920,011**
	Earthwork - cut/fill 24" avergage	4,074	cy	5.40	22,000	
	Export Surplus Materials	2,037	cy	16.80	34,222	
	Fine Grade under site Concrete	33,000	sf	0.30	9,900	
	Base Course under Site Concrete	509	cy	31	15,873	
	Concrete Sidewalks - 6" thick for Fire Truck Access - 30' wide - 60% of area	33,000	sf	7.80	257,400	
	Concrete Stairs / Ramp - ADA Accessibility	33,450	sf	7.80	260,910	
	Landscape and Irrigation - 70% of area	22,000	sf	3.50	77,000	
	Storm Lines under Interdisciplinary Mall	1,110	lf	52.50	58,275	
	Site Lighting and Security	55,000	sf	1.26	69,081	
	New Fireline in Interdisciplinary Mall w/ Fire Hydrants	1,110	lf	95	105,450	
Interdisciplinary Quad	Clear and Grub Site	78,000	sf	0.18	14,040	**749,266**
	Earthwork - cut/fill 24" avergage	5,778	cy	5.40	31,200	
	Export Surplus Materials	2,889	cy	14.00	40,444	

USTAR at University of Utah						
Summary Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Build				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
	Fine Grade under site Concrete	27,300	sf	0.25	6,825	
	Base Course under Site Concrete	421	cy	31	13,131	
	Hardscape - Site concrete - 35% of Area	**27300**	sf	5.25	171,990	
	Enhanced Hardscape - Pavers - 15% of area	**11700**	sf	18.00	252,720	
	Landscape and Irrigation - 50% of Area	**39000**	sf	4.25	174,038	
	Site Improvements	**78000**	sf	0.08	5,878	
	Site Electrical	**78000**	sf	0.50	39,000	
North Service Road	Clear and Grub Site	35,200	sf	0.25	8,800	**440,823**
	Earthwork - cut/fill 36" avergage	3,911	cy	6.50	25,422	
	Export Surplus Materials	2,607	sf	16.00	41,719	
	Fine Grade under Roadway	35,200	sf	0.25	8,800	
	Strucutral Fill import for Subbase Material	2,607	cy	13.84	36,082	
	Concrete Paving over Base Course	20,000	sf	7.25	145,000	
	Curb and Gutter	1,600	lf	19.00	30,400	
	Concrete Sidewalks including Base Course	4,000	sf	5.75	23,000	
	Storm Lines under North Service Road	800	lf	75.00	60,000	
	Site Lighting and Security	35,200	sf	1.75	61,600	
Central Loading Dock Facility	Structure	12,000	sf	145.16	1,741,926	**2,549,500**
	Exterior envelope	12,000	sf	0.00	0	
	Interior Construction	12,000	sf	8.84	106,074	
	Equip / Spec Construction	12,000	sf	2.50	30,000	
	Fire Protection	12,000	sf	3.50	42,000	
	Plumbing	12,000	sf	10.00	120,000	
	Mechanical / Controls	12,000	sf	15.00	180,000	
	Electrical	12,000	sf	12.00	144,000	
	Access Road / Ramp / Walls	3,500	sf	53.00	185,500	
Infrastructure / Site	Extension of Chilled Watter Piping to site from Plant located at Northwest part of site	**1,681**	lf	674	1,133,028	**12,224,733**
	High Temperature Water	**1500**	lf	570	855,000	
	Precast Tunnel	**1500**	lf	950	1,425,000	
	Surface Restoration at Tunnel	**1500**	lf	50	75,000	
	Sanitary Sewer from 500South/Guardsman to the North side of Site	**5450**	lf	169	918,325	
	Extension of Sanitary Sewer from North side of Site 3 to the Proposaed PCMC Site	**1400**	lf	134	188,020	
	Demolish Hardscape Road Improvements and Rehab Site	**1**	lot	80000	80,000	
	Culinary Water	**2120**	lf	140	296,800	
	Culinary Water - North Loop Extension	**1**	lf	163925	163,925	
	Culinary Water - South Loop Extension	**1**	lf	142885	142,885	
	Natural Gas	**1**	ls	46250	46,250	
	Storm Sewer	**1**	ls	169200	169,200	
	Electrical - Upgrades to Red Butte Station	**1**	ls	2120000	2,120,000	

USTAR at University of Utah						
Summary Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Build				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
	Electrical - Site Feeders	**1**	ls	2565500	2,565,500	
	Electrical - Feeder Relocations	**1**	ls	549300	549,300	
	Electrical - Site Telecommunications Raceways	**1**	ls	573000	573,000	
	Electrical - Site Telecommunications Relocations	**1**	ls	325500	325,500	
	Electrical - Site Telecommunications Cabling	**1**	ls	50000	50,000	
	Relocated Water Piping in Federal Way	**2,400**	lf	164	394,500	
	Surface Restoration for Electrical and Telecommunication Work	**15350**	sf	10	153,500	
		0	ls	0	0	
Cost of the Work	**cost / component**	**5200**	gsf	4283.95	22,276,533	22,276,533
	General Requirements			0.070	22,276,533	1,559,357
	Bidding & Contract Requirements			0.010	23,835,890	238,359
	Precon Services			0.001	24,074,249	24,074
	Contractor's Fee			0.040	24,098,323	963,933
	Inflation to Bid Day	2	MOS	0.017	25,062,256	417,704
	Construction Contingency			0.030	25,479,961	764,399
	Estimating Contingency			0.050	26,244,360	1,312,218
				0.00%	27,556,577	0
Cost of Construction		5200	gsf	**5299.34**		**27,556,577**
Gross Receipts Tax on Unincorporated Materials				**0.10%**		**27,557**
Guaranteed Maximum Price		5200	gsf	**5304.64**		**27,584,134**
Gross Square Feet		**5,200**				

USTAR at University of Utah						
Target Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Bu				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
Lab and Lab Support (Finished)	Structure	**69544**	sf	55.49	3,859,000	**23,999,418**
	Exterior envelope	69544	sf	22.79	1,584,909	
	Interior Construction	69544	sf	23.27	1,618,290	
	Equip / Spec Construction	1	ls	4819512	4,819,512	
	Fire Protection	69544	sf	3.16	219,759	
	Plumbing	69544	sf	22.00	1,529,969	
	Mechanical / Controls	69544	sf	100.07	6,958,927	
	Electrical	69544	sf	49.02	3,409,050	
Office/Admin (Finished)	Structure	**19688**	sf	55.49	1,092,495	**3,885,139**
	Exterior envelope	19688	sf	22.79	448,693	
	Interior Construction	19688	sf	20.94	412,329	
	Equip / Spec Construction	19688	sf	0.00	0	
	Fire Protection	19688	sf	3.16	62,215	
	Plumbing	19688	sf	5.50	108,285	
	Mechanical / Controls	19688	sf	60.04	1,182,056	
	Electrical	19688	sf	29.41	579,067	
Lab and Lab Support (Shelled)	Structure	**0**	sf	55.49	0	**0**
	Exterior envelope	0	sf	22.79	0	
	Interior Construction	0	sf	6.98	0	
	Equip / Spec Construction	0	sf	0.00	0	
	Fire Protection	0	sf	2.37	0	
	Plumbing	0	sf	4.40	0	
	Mechanical / Controls	0	sf	25.02	0	
	Electrical	0	sf	14.71	0	
Office/Admin (Shelled)	Structure	**0**	sf	55.49	0	**0**
	Exterior envelope	0	sf	22.79	0	
	Interior Construction	0	sf	6.98	0	
	Equip / Spec Construction	0	sf	0.00	0	
	Fire Protection	0	sf	2.37	0	
	Plumbing	0	sf	4.40	0	
	Mechanical / Controls	0	sf	25.02	0	
	Electrical	0	sf	14.71	0	
Vivarium	Structure	**23020**	sf	55.49	1,277,399	**7,075,931**
	Exterior envelope	23020	sf	20.51	472,170	
	Interior Construction	23020	sf	23.27	535,683	
	Equip / Spec Construction	1	ls	779500	779,500	
	Fire Protection	23020	sf	3.16	72,744	
	Plumbing	23020	sf	22.00	506,447	
	Mechanical / Controls	23020	sf	100.07	2,303,530	
	Electrical	23020	sf	49.02	1,128,457	
Small Animal Imaging (Finished)	Structure	**7053**	sf	55.49	391,395	**2,086,729**
	Exterior envelope	7053	sf	20.51	144,673	
	Interior Construction	7053	sf	23.27	164,134	
	Equip / Spec Construction	1	ls	157500	157,500	

USTAR at University of Utah						
Target Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Bu				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
	Fire Protection	7053	sf	3.16	22,289	
	Plumbing	7053	sf	22.00	155,176	
	Mechanical / Controls	7053	sf	100.07	705,803	
	Electrical	7053	sf	49.02	345,760	
Small Animal Imaging (Shelled)	Structure	**2186**	sf	55.49	121,326	**280,812**
	Exterior envelope	2186	sf	20.51	44,846	
	Interior Construction	2186	sf	6.98	15,264	
	Equip / Spec Construction	2186	sf	0.00	0	
	Fire Protection	2186	sf	1.58	3,455	
	Plumbing	2186	sf	6.60	14,431	
	Mechanical / Controls	2186	sf	25.02	54,697	
	Electrical	2186	sf	12.26	26,795	
Biomedical Instrument Labs	Structure	**3692**	sf	61.04	225,327	**969,981**
	Exterior envelope	3692	sf	20.51	75,717	
	Interior Construction	3692	sf	23.27	85,902	
	Equip / Spec Construction	1	ls	23265	23,265	
	Fire Protection	3692	sf	3.16	11,665	
	Plumbing	3692	sf	14.30	52,789	
	Mechanical / Controls	3692	sf	90.06	332,453	
	Electrical	3692	sf	44.12	162,863	
Engineering Instrument Labs	Structure	**5202**	sf	61.04	317,506	**1,347,088**
	Exterior envelope	5202	sf	20.51	106,692	
	Interior Construction	5202	sf	23.27	121,043	
	Equip / Spec Construction	1	ls	13080	13,080	
	Fire Protection	5202	sf	3.16	16,437	
	Plumbing	5202	sf	14.30	74,384	
	Mechanical / Controls	5202	sf	90.06	468,457	
	Electrical	5202	sf	44.12	229,488	
Cleanroom	Structure	**17610**	sf	83.24	1,465,782	**12,514,305**
	Exterior envelope	17610	sf	30.31	533,777	
	Interior Construction	17610	sf	34.91	614,683	
	Equip / Spec Construction	17610	sf	100.00	1,761,017	
	Fire Protection	17610	sf	3.95	69,560	
	Plumbing	17610	sf	60.50	1,065,415	
	Mechanical / Controls	17610	sf	275.18	4,845,944	
	Electrical	17610	sf	122.55	2,158,126	
Cleanroom Support and Research/Teaching	Structure	**3729**	sf	61.04	227,603	**1,108,709**
	Exterior envelope	3729	sf	20.51	76,482	
	Interior Construction	3729	sf	23.27	86,769	
	Equip / Spec Construction	3729	sf	25.97	96,840	
	Fire Protection	3729	sf	3.16	11,783	
	Plumbing	3729	sf	14.30	53,322	
	Mechanical / Controls	3729	sf	100.07	373,124	
	Electrical	3729	sf	49.02	182,786	
Office/ Workstations	Structure	**2344**	sf	55.49	130,072	**509,476**
	Exterior envelope	2344	sf	22.79	53,421	
	Interior Construction	2344	sf	20.94	49,092	
	Equip / Spec Construction	2344	sf	0.00	0	

USTAR at University of Utah						
Target Total Project Budget for Construction		Neuroscience & Biomedical Research Technology Bu				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
	Fire Protection	2344	sf	3.16	7,407	
	Plumbing	2344	sf	5.50	12,892	
	Mechanical / Controls	2344	sf	80.05	187,647	
	Electrical	2344	sf	29.41	68,944	
Engineering Nanofab Building Support	Structure	**1739**	sf	55.49	96,496	**374,410**
	Exterior envelope	1739	sf	20.51	35,668	
	Interior Construction	1739	sf	17.45	30,350	
	Equip / Spec Construction	1739	sf	12.99	22,581	
	Fire Protection	1739	sf	3.16	5,495	
	Plumbing	1739	sf	8.80	15,303	
	Mechanical / Controls	1739	sf	65.04	113,107	
	Electrical	1739	sf	31.86	55,409	
Public/Meeting Spaces	Structure	**25254**	sf	55.49	1,401,358	**5,892,855**
	Exterior envelope	25254	sf	22.79	575,544	
	Interior Construction	25254	sf	29.09	734,583	
	Equip / Spec Construction	25254	sf	0.00	0	
	Fire Protection	25254	sf	3.16	79,803	
	Plumbing	25254	sf	11.00	277,797	
	Mechanical / Controls	25254	sf	75.05	1,895,299	
	Electrical	25254	sf	36.77	928,472	
Building Administrative Support	Structure	**4661**	sf	55.49	258,640	**1,013,058**
	Exterior envelope	4661	sf	22.79	106,225	
	Interior Construction	4661	sf	20.94	97,616	
	Equip / Spec Construction	4661	sf	0.00	0	
	Fire Protection	4661	sf	3.16	14,729	
	Plumbing	4661	sf	5.50	25,636	
	Mechanical / Controls	4661	sf	80.05	373,124	
	Electrical	4661	sf	29.41	137,090	
Information Technology	Structure	**2453**	sf	55.49	136,092	**676,399**
	Exterior envelope	2453	sf	22.79	55,893	
	Interior Construction	2453	sf	23.27	57,071	
	Equip / Spec Construction	2453	sf	0.00	0	
	Fire Protection	2453	sf	3.16	7,750	
	Plumbing	2453	sf	22.00	53,956	
	Mechanical / Controls	2453	sf	100.07	245,414	
	Electrical	2453	sf	49.02	120,224	
Building Support	Structure	**5627**	sf	55.49	312,249	**1,070,573**
	Exterior envelope	5627	sf	22.79	128,242	
	Interior Construction	5627	sf	23.27	130,943	
	Equip / Spec Construction	5627	sf	0.00	0	
	Fire Protection	5627	sf	3.16	17,782	
	Plumbing	5627	sf	11.00	61,898	
	Mechanical / Controls	5627	sf	50.03	281,539	
	Electrical	5627	sf	24.51	137,921	
LEED Certification	Certification Upgrade	**193803**	sf	0.00	0	**0**
				14285.71		
Building Site Development	Site Prep / Earthwork	**5.6**	ac	160042	897,096	**1,920,624**
	Site Retaing Walls	**1104**	sf	75.00	82,800	
	Site Utilitiy Infrastructure	**5.6**	ac	15246.00	85,460	
	Hardscape - Site concrete - 20% of Area	**8744**	sf	5.25	45,906	

USTAR at University of Utah						
Target Total Project Budget for Construction		**Neuroscience & Biomedical Research Technology Bu**				
Prepared: September 20, 2007					Revised:	*9-Nov-07*
Item	**Reference**	**Qty**	**U/M**	**U/C**	**Subtotal**	**Construction Estimate**
	Service Yard - Asphalt / Curb and Gutters	**15100**	sf	5.75	86,825	
	Enhanced Hardscape - Pavers - 20% of Area	**8744**	sf	18.00	157,392	
	Conveying Systems	**193803**	ls	2.00	387,605	
	Area	**26232**	sf	4.75	124,602	
	Site Improvements	**58820**	sf	0.15	8,823	
	Site Electrical	**58820**	sf	0.75	44,115	
Cost of the Work	**cost / component**	**193803**	gsf	333.98	64,725,508	64,725,508
Cost of the Work	**cost / component**	**193803**	gsf	333.98	64,725,508	**64,725,508**
	General Requirements			0.070	64,725,508	4,530,786
	Bidding & Contract Requirements			0.010	69,256,293	692,563
	Precon Services			0.001	69,948,856	69,949
	Contractor's Fee			0.040	70,018,805	2,800,752
	Inflation to Bid Day	2	MOS	0.02	72,819,557	1,213,659
	Construction Contingency			0.030	74,033,216	2,220,996
	Estimating Contingency			0.050	76,254,213	3,812,711
				0.00%	80,066,923	0
Cost of Construction		193803	gsf	**413.14**		**80,066,923**
Gross Receipts Tax on Unincorporated Materials				**0.10%**		**80,067**
Guaranteed Maximum Price		193803	gsf	**413.55**		**80,146,990**
Gross Square Feet		**193,803**				*1.24*

USTAR at University of Utah

Cost by Space Type

Target Total Project Budget by Group

Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007

Revised: *09-Nov-07*

Item	Gross Square Feet	Cost of Work	Mark Up	Con Cost	Project Cost Factor	Tot Cost	Cost / GSF	% of Building Area	% of Funds Required
Lab and Lab Support (Finished)	69,544	23,999,418	1.24	29,717,513	1.38	41,031,866	590.01	35.9%	38.2%
Office/Admin (Finished)	19,688	3,885,139	1.24	4,810,811	1.38	6,642,431	337.38	10.2%	6.2%
Lab and Lab Support (Shelled)	0	-	1.24	-	1.38	-	#DIV/0!	0.0%	0.0%
Office/Admin (Shelled)	0	-	1.24	-	1.38	-	#DIV/0!	0.0%	0.0%
Vivarium	23,020	7,075,931	1.24	8,761,841	1.38	12,097,737	525.52	11.9%	11.3%
Small Animal Imaging (Finished)	7,053	2,086,729	1.24	2,583,912	1.38	3,567,686	505.81	3.6%	3.3%
Small Animal Imaging (Shelled)	2,186	280,812	1.24	347,718	1.38	480,104	219.58	1.1%	0.4%
Biomedical Instrument Labs	3,692	969,981	1.24	1,201,088	1.38	1,658,378	449.24	1.9%	1.5%
Engineering Instrument Labs	5,202	1,347,088	1.24	1,668,045	1.38	2,303,121	442.76	2.7%	2.1%
Cleanroom	17,610	12,514,305	1.24	15,495,960	1.38	21,395,739	1214.96	9.1%	19.9%
Cleanroom Support and Research/Teaching	3,729	1,108,709	1.24	1,372,870	1.38	1,895,563	508.36	1.9%	1.8%
Office/ Workstations	2,344	509,476	1.24	630,864	1.38	871,053	371.60	1.2%	0.8%
Engineering Nanofab Building Support	1,739	374,410	1.24	463,617	1.38	640,130	368.11	0.9%	0.6%
Public/Meeting Spaces	25,254	5,892,855	1.24	7,296,885	1.38	10,075,030	398.94	13.0%	9.4%
Building Administrative Support	4,661	1,013,058	1.24	1,254,429	1.38	1,732,028	371.60	2.4%	1.6%
Information Technology	2,453	676,399	1.24	837,558	1.38	1,156,441	471.53	1.3%	1.1%
Building Support	5,627	1,070,573	1.24	1,325,648	1.38	1,830,362	325.28	2.9%	1.7%
LEED Certification	193,803		1.24	3,603,012	1.38	4,974,787	25.67		
Building Site Development	193,803	1,920,624	1.24	2,378,231	1.38	3,283,696	16.94		
Infrastructure / Central Plant	193,803	22,276,533	1.24	27,584,134	1.38	38,086,245	196.52		24.8%
Connection Fees				100,000	1.38	138,073	#DIV/0!		0.1%
	Current Project Cost	87,002,041		111,334,136		$153,860,470	793.90		
	Funds Available					$130,000,000			
	Variance - Under (Over)					($23,860,470)			

USTAR at University of Utah

Summary Total Project Budget for Furniture Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007 Revised: *09-Nov-07*

		QTY	unit cost	extended cost	
Cores/Bldg Support	Vivarium				
	Office 121 sf	1	$5,500	$5,500	
	Workstations 64 sf	3	$3,000	$9,000	
	Small Animal Imaging				
	Office 121 sf	1	$5,500	$5,500	
	Workstations 45 sf	6	$2,500	$15,000	
	Microscopy				
	Office 121 sf	5	$5,500	$27,500	
	Workstations 64 sf	2	$3,000	$6,000	
	Nanofab				
	Office 121 sf	6	$5,500	$33,000	
	Workstations 64 sf	3	$3,000	$9,000	
	Work-Study Bullpen 30 sf	10	$2,250	$22,500	
	Information Technology				
	Office 121 sf	1	$5,500	$5,500	
	Workstations 64 sf	3	$3,000	$9,000	
					$147,500
Public/Admin	Reception Area				
	Reception desk station	1	$40,000	$40,000	
	Lounge Area	1	$25,000	$25,000	
	Coffee table	2	$2,000	$4,000	
	Team table-small	1	$1,500	$1,500	
	Lounge seating-loose	4	$700	$2,800	
	Auditorium	1	n/a: included in construction cost		
	Café (80 People):				
	Seating	80	$250	$20,000	
	Tables	16	$500	$8,000	
	Kitchen Equipment	1	$300,000	$300,000	
					$401,300
	Meeting/Seminar Rooms	2	$36,000	$72,000	
					$72,000
	Administrative Group				
	Private Office 121 sf	10	$5,500	$55,000	
	50sf workstations	10	$4,000	$40,000	
	Lateral filing cabinets(5 high)	12	$800	$9,600	
	Team table-large	1	$2,000	$2,000	
	Accessories	20	$1,000	$20,000	
					$126,600
Typical Floor	Private Office 182 sf	6	$6,500	$39,000	
	Workstations 45 sf	12	$3,500	$42,000	
	Seminar Room (10 People)	2	$8,000	$16,000	
	Post Doc Workstations 64 sf	12	$4,000	$48,000	
	Lateral filing cabinets(5 high)	24	$800	$19,200	
	Accessories	66	$1,000	$66,000	
	Task Chairs	60	$350	$21,000	
	Lab Stools	60	$500	$30,000	
	Team tables	0	$1,100	$0	
	Informal Meeting Areas	2	$2,500	$5,000	
		Typical	1 floor	$286,200	**$314,820**
		Total	4.00	floors	**$1,259,280**
			Subtotal all floors		**$2,006,680**
			Contingency	5%	$100,334
			Sales Tax	0%	$0
			Total other costs		**$100,334**
			Total All Floors		**$2,107,014**

USTAR at University of Utah

Summary Total Project Budget for Lab Equipment Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007 Revised: *09-Nov-07*

							total	in constrution	
Lab Casework	LAB	sf						$0	
			QTY	**unit per P. I. lab**		**extended cost**	**Total**	**Cost in Construction**	**Outside Project Cost**
Lab Bench	A	1	Lab Suppport / Fixed Bench Includes Wall Cabinets	240	$	2,750	$660,000	$660,000	
	B	1	Open Lab / Movable Bench Includes Reagent Shelving Fume hoods are additional	720	$	2,200	$1,584,000	$1,584,000	
	E	0.5	Wall casework-Support	0	$	2,300	$0	$0	
Overhead Service	D		Flexible Open Lab Overhead Service Carrier	360	$	2,750	$990,000	$990,000	
Other	M		Cylinder Straps	90		$96	$8,640	$8,640	
	N		Task Lights	322		$60	$19,320		$19,320
	O		Gas Manifolds	24		$5,000	$120,000	$120,000	
	P		Fume Hoods	30		$8,500	$255,000	$255,000	
			Future Fume Hoods	48		$8,500	$408,000		$408,000
	D		Autoclave	7		$65,000	$455,000	$455,000	
	E		Glasswasher	7		$42,500	$297,500	$297,500	
			RO unit	7		$11,100	$77,700	$77,700	
	G		6' BSC	24		$10,231	$245,544		$245,544
	H		6' Biological Safety Cabinet	6		$17,400	$104,400		$104,400
			4' Biological Safety Cabinet	0		$15,930	$0		$0
	I		Building RO unit	1		$125,000	$125,000	$125,000	
	J		Point of Use Ultra pure - add	0		$7,500	$0		$0
	K		Environmental room	5		$47,491	$237,455	$237,455	
	L		Marker Boards	57		$162	$9,217	$9,217	
	Q		Adjustment response allow.	1		$300,000	$300,000		
							$5,896,776		
			Equipment outside construction				**$300,000**		
			Equipment in construction					**$4,819,512**	
			Equipment outside project						**$777,264**

USTAR at University of Utah

Summary Budget for Animal Equipment Neuroscience & Biomedical Research Technology Building

Prepared: September 20, 2007

Revised: *09-Nov-07*

Animal Resource Equipment

			QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Racks and Cages	A	Double sided rodent racks w/ 108 cages / rack	32	$30,200	$966,400		$966,400
	B	Medium animal racks	12	$27,500	$330,000		$330,000
	C	Large animal racks	24	$8,000	$192,000		$192,000
	D	Micro isolator racks for quarantine	6	$25,000	$150,000		$150,000
	E	Redundant Racks	3	$21,000	$63,000		$63,000
	F	Redundant Caging	1000	$70	$70,000		$70,000
	G	Material handling accessories; carts, pallet movers, food/bedding scaffolding	1	$52,500	$52,500		$52,500
	H	Cage for large animal temp holding	0	$4,000	$0		$0
	I	Zebrafish tanks racks	44	$1,500	$66,000		$66,000
Safety Cabinets and Hoods	J1	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	11	$12,000	$132,000		$132,000
	J2	Class II Type A2 (A/B3) vertical laminar flow, mobile	0	$10,000	$0	$0	$0
	J3	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0	$0	$0
	K	Fume hood for isotope / carcinigens	0	$9,500	$0		$0
Casework		Average Casework Bench Includes Wall Cabinets	10	$ 2,750	$27,500	$27,500	

Surgery / Procedure Systems / Equipment	L1	Surgery tables	3	$12,500	$37,500		$37,500
	L2	Surgery prep tables	2	$1,000	$2,000		$2,000
	L3	Necropsy downdra	1	$15,000	$15,000	$15,000	
	M	Surgical equipmen	1	$60,000	$60,000		$60,000
	N	Surgical lights	3	$12,000	$36,000	$36,000	
	O	Casework	0	$900	$0	$0	
	P1	Freezer for carcass	1	$7,500	$7,500		$7,500
	P2	Environmental Cha	1	$35,000	$35,000	$35,000	
	P3	Ice Machine	1	$4,000	$4,000		$4,000
	P4	Lab Refrigerator	1	$2,000	$2,000		$2,000
	P5	Lab Freezer -20C	1	$3,000	$3,000		$3,000
	P:6	Lab Freezer -80C	1	$20,000	$20,000		$20,000
Watering System	Q	Point of Use Auto watering control and monitoring system w/ RO purification watering system	0	$7,500	$0	$0	
Monitoring System	R	Monitor system for rooms for temperature, humidity, air flow and light control	14	$14,000	$196,000	$196,000	
	S	Monitor system corridor to room pressure differential	0	$31,000	$0	$0	
		included in R above					
	T	Door latching syste	0	$2,500	$0	$0	
		included in door hardware					
Auto Cage Wash and Bedding System	U	Tunnel Washer	0	$250,000	$0	$0	
	V	Bedding Disp/Waste Removal	0	$350,000	$0	$0	
	W	Cage & Rack Washer	1	$240,000	$240,000	$240,000	
Bulk Autoclave	X1	Autoclave	1	$230,000	$230,000	$230,000	
	X2	Autoclave for BSL	0	$80,000	$0	$0	
	X3	ETO Stirilizer	0	$25,000	$0		
Stations	Y	Waste dumping sta	0	$16,000	$0	$0	
	Z	Bottle filling statio	0	$25,000	$0	$0	

	AA	Hose flushing stati	0	$3,000	$0	$0	
Miscellaneous	AA	Carts at cage wash	0	$40,000	$0	$0	
	BB	Irradiator	0	$120,000	$0		
	CC	Benchtop Clinical	0	$2,000	$0		
	DD	Portable X-ray Equipment & Developing Machine	0	$120,000	$0		
	EE	Washer/Dryer	1	$1,500	$1,500		$1,500
	FF	Misc. Operational Equipment; pressure washer, portable steam generator unit, floor scrubber machine, phone paging system	1	$75,000	$75,000		$75,000
	GG	Diagnostic Lab Equipment	0	$50,000	$0		
	HH	Small Animal Waste reduction unit	0	$25,000	$0 $0		
		Misc Equipment	1	372788	$372,788		
				Total	**$3,386,688**	**$779,500**	
		Equipment outside construction			**$372,788**		
		Equipment in construction				**$779,500**	
		Equipment outside project					**$2,234,400**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: December 10, 2006 Revised: *November 9, 2007*

Imaging Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Current Equipment to be moved	7.0 Tesla MRI	1	n/a	n/a		
Imaging Wish List	Fluorescence Imager	1	$265,000	$265,000		$265,000
	Bioluminescent Imager	1	$350,000	$350,000		$350,000
	Micro PET/CT	1	$810,000	$810,000		$810,000
	Ultrasound/ Color Dopler	1	$320,000	$320,000		$320,000
	QAR	1	$60,000	$60,000		$60,000
	Laser Doppler	1	$22,000	$22,000		$22,000
	Micro SPECT/CT	1	$585,000	$585,000		$585,000
	Cryo-macrotome	1	$235,000	$235,000		$235,000
	Fluoroscopy	1	$130,000	$130,000		$130,000
	Optical Coherence Tomography	1	n/a	n/a		
	PEM-future	1	n/a	n/a		
	Network Analyzer	1	$0	$0		
	Mini PACS	1	$60,000	$60,000		$60,000
Lab Support Wish List	Microscope for surgery	1	$0	$0		$0
	Monitoring Equipment	1	$0	$0		$0
	Anesthesia Equipment	1	$7,500	$7,500		$7,500

	Mini cells for Radioschem. Lab	1	$162,468	$162,468		$162,468
Safety Cabinets and Hoods	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	0	$12,000	$0		$0
	Class II Type A2 (A/B3) vertical laminar flow, mobile	2	$10,000	$20,000		$20,000
	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0		$0
	Fume hood	5	$9,500	$47,500	$47,500	
Casework	Average Casework Bench Includes Wall Cabinets	40	$ 2,750	$110,000	$110,000	
			Total	**$3,184,468**		
	Equipment outside construction			**$0**		
	Equipment in construction				**$157,500**	
	Equipment outside project					**$3,026,968**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: December 10, 2006 Revised: *November 9, 2007*

Biomedical Microscopy Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Biomedical Microscopy Wish List	Confocal	1	$358,000	$358,000		$358,000
	Two-photon confocal	1	$550,000	$550,000		$550,000
	Spinning Disk Confocal	1	$150,300	$150,300		$150,300
	TEM	0	$900,000	$0		$0
	Mid-voltage TEM, tomography	1	$300,000	$300,000		$300,000
	4 Pi	1	$1,200,000	$1,200,000		$1,200,000
	STED	0	$1,300,000	$0		$0
	TIRF	1	$160,000	$160,000		$160,000
	SEM	0	$500,000	$0		$0
	Fast Acquisition Scope	1	$0	$0		$0
Biomedical Lab Support Wish List	Optical Bench	1	$4,000	$4,000		$4,000
	High Pressure Freezer	1	$205,000	$205,000		$205,000
	FC6 - Ultramicrotome	1	$90,000	$90,000		$90,000
	x	1	$0	$0		$0
Safety Cabinets and Hoods	Animal transfer hood, Class II Type A2 (A/B3) vertical laminar flow, double sided	0	$12,000	$0		$0
	Class II Type A2 (A/B3) vertical laminar flow, mobile	1	$10,000	$10,000		$10,000
	Class II Type B1 or B2 Bio Safety Cabinet	0	$12,000	$0		$0
	Fume hood for isotope / carcinigens	1	$9,500	$9,500		$9,500
Casework	Average Casework Bench Includes Wall Cabinets	9	$2,585	$23,265	$23,265	
			Total	**$3,060,065**		

Equipment outside construction	**$0**		
Equipment in construction		**$23,265**	
Equipment outside project			**$3,036,800**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: March 9, 2007 Revised: *November 9, 2007*

Nanofab Microscopy Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
FE NanoCT	FE nanoCT (300KV)	1	$2,268,000	$2,268,000	$0	$2,268,000
HR SEM	HR SEM (make?)	1	$702,000	$702,000	$0	$702,000
FE ESEM (Analytical)	FE ESEM	0	$702,000	$0	$0	$0
DB FIB and Nabity Nanolithography	DB FIB + Nabity Nanolithography	1	$1,512,000	$1,512,000	$0	$1,512,000
DSIMS	(DSIMS)	0	$0	$0	$0	$0
AUGER	(AUGER)	0	$432,000	$0	$0	$0
XPS	Imaging XPS/Auger/ISS	1	$30,000	$30,000	$0	$30,000
Microscopy Service Corridor	0	1	$0	$0	$0	$0
AFM (Wet + Solid State)	AFM	1	$81,000	$81,000	$0	$81,000
	Wet AFM	1	$270,000	$270,000	$0	$270,000
Optical Microscopy (SNOM)	SNOM	0	$270,000	$0	$0	$0
Optical Microscopy	Profilometer Tencor p-20	1	$54,000	$54,000	$0	$54,000
	Zygo Optical Profilometer	1	$21,600	$21,600	$0	$21,600
	Nano-Indenter	1	$129,600	$129,600	$0	$129,600
	FTIR	1	$108,000	$108,000	$0	$108,000
	Ellipsometer . Woollam . V-Vase	1	$26,000	$26,000	$0	$26,000
	Polyvar Mettalurgical	1	$3,000	$3,000	$0	$3,000
	Image Analyzer	1	$5,400	$5,400	$0	$5,400
	UVVis/NIR	1	$0	$0	$0	$0
Magnetometry	Hall msmt (1T)	0	$162,000	$0	$0	$0
	SQuID	0	$0	$0	$0	$0
	Lakeshore VSM	0	$0	$0	$0	$0
Crystallography	HR XRD	1	$0	$0	$0	$0
Electrical Characterization	Probe stations	1	$270,000	$270,000	$0	$270,000
	Test Apparatus (Keithley 4200)	1	$29,000	$29,000	$0	$29,000
	Test Apparatus (Keithley 2400)	2	$29,000	$58,000	$0	$58,000

	Thermonix Substrate Heating / Cooling	1	$32,400	$32,400	$0	$32,400
	Thermal Cycling Furnace	1	$21,600	$21,600	$0	$21,600
	4-pt probe	1	$32,400	$32,400	$0	$32,400
	C/V measurement with signal generator	1	$21,600	$21,600	$0	$21,600
Sample Prep	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	2.5' Deep Fume Hood	2	$5,940	$11,880	$11,880	$0
	Flammable Storage Cabinet Under Hood	2	$0	$0	$0	$0
	Corrosive Storage Cabinet Under Hood	2	$0	$0	$0	$0
	Epoxy Resin Counter w/ Cabinets Below	1	$0	$0	$0	$0
	Upper Cabinets with Swinging Glass Doors	1	$0	$0	$0	$0
	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	1	$0	$0	$0	$0
	Overhead Service Carrier	1	$0	$0	$0	$0
	Epoxy Resin Adjustable-Height Table w/ Cabinets Below	4	$0	$0	$0	$0
	wet staining / decoration (in hood)	1	$0	$0	$0	$0
	supporting sample prep tools (ion mills, C- Au-coating, dimpler, hoods, cabinets, ultrasonic cutter)	1	$216,000	$216,000	$0	$216,000
	Dimpler . Gatan . 656 Dimple Grinder	1	$0	$0	$0	$0
	Critical Point Dryer . Bal-Tec . CPD-030	1	$0	$0	$0	$0

Ion Mill . Gatan . 681 HR Ion Beam Coater	1	$0	$0	$0	$0
Ultrasonic Cutters . Gatan . 601 Tuned Piezo Cutting Tool	1	$0	$0	$0	$0
UV ozone cleaner . Fischione . 1020 Plasma Cleaner	1	$0	$0	$0	$0
Carbon Coater . NanoMaster . NSC3000	1	$0	$0	$0	$0
Carbon Coater Rough-In Pump (undercabinet)	1	$0	$0	$0	$0
Carbon Coater PC	1	$0	$0	$0	$0
Double-Stacked Curing Ovens . Blue M . STK-04	1	$0	$0	$0	$0
Polishing Wheel . Lapmaster . 15 (TT)	1	$0	$0	$0	$0
Cryoultramicrotome . Leica . Ultracut (EM FC6?)	1	$0	$0	$0	$0
Cryoultramicrotome LN2 Dewar . Leica . Ultracut (EM FC6?)	1	$0	$0	$0	$0
Evaporator . Sharon Vacuum . Custom	1	$0	$0	$0	$0
Wire Saw . South Bay Tech . 850 (TT)	1	$0	$0	$0	$0
Diamond Saw . South Bay Tech . 660 (TT)	1	$0	$0	$0	$0
Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	1	$0	$0	$0	$0
Optical Microscope	1	$0	$0	$0	$0
		Total	**$5,904,680**		

Equipment outside construction **$0**

Equipment in construction	**$13,080**	
Equipment outside project		**$5,891,600**

Nanofab Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Nanolithography (Cl 100)	Wafer Handling / Vacuum Wands	2	$1,100	$2,200	$2,200	$0
	Nano Imprint or immersion microstep	1	$540,000	$540,000	$0	$540,000
	Nanolith	1	$1,296,000	$1,296,000	$0	$1,296,000
	Spin/Developer	1	$129,600	$129,600	$0	$129,600
	Interference Lithography	1	$2,000	$2,000	$0	$2,000
Photolithography (Cl 100)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Electromask	1	$85,000	$85,000	$0	$85,000
	Reticle Aligner	1	$15,000	$15,000	$0	$15,000
	PG rack	1	$0	$0	$0	$0
	PG Computer	1	$0	$0	$0	$0
	CAD Computer	2	$0	$0	$0	$0
	CAD Tape Drive	2	$0	$0	$0	$0
	EV Aligner	1	$15,000	$15,000	$0	$15,000
	Suss Aligner	1	$15,000	$15,000	$0	$15,000
	Wafer Stepper	1	$216,000	$216,000	$0	$216,000
	Hot Plate Bake	3	$10,800	$32,400	$0	$32,400
	Vapor Prime Oven	1	$32,400	$32,400	$0	$32,400
	Suss Spinner	1	$3,000	$3,000	$0	$3,000
	Headway Spinner	1	$5,000	$5,000	$0	$5,000
	Mask Storage	1	$1,080	$1,080	$0	$1,080
	Dektak 2	1	$1,000	$1,000	$0	$1,000
	Spray Develop Ultra-Tech	1	$43,200	$43,200	$0	$43,200
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Wet Processing	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Wet Bench (acid)	3	$32,400	$97,200	$0	$97,200
	Wet Bench (base)	1	$32,400	$32,400	$0	$32,400

	Wet Bench (electrochemistry)	1	$32,400	$32,400	$0	$32,400
	Wet Bench (acid) w/ Cascade Rinse	1	$5,000	$5,000	$0	$5,000
	Solvent Bench	2	$32,400	$64,800	$0	$64,800
	Solvent Bench	1	$5,000	$5,000	$0	$5,000
	Spin/Rinse/Dry	3	$32,400	$97,200	$0	$97,200
	Fluoroware	1	$21,600	$21,600	$0	$21,600
	KOH Etch Bench	1	$60,000	$60,000	$0	$60,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Hot Process	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Oxford 80+ PECVD	1	$35,000	$35,000	$0	$35,000
	Oxford 80+ RIE	1	$35,000	$35,000	$0	$35,000
	SiC (LPCVD)	1	$20,000	$20,000	$0	$20,000
	Diamond u-wave hi rate PECVD (ECR for millitorr), also thermal (RF/induction) CVD	1	$594,000	$594,000	$0	$594,000
	Canary Furnace	1	$54,000	$54,000	$0	$54,000
	New Furnace stack 2-ox, LPCVD nitride, LTO, poly, diff (2)	1	$348,000	$348,000	$0	$348,000
	Teflon conformal deposition	1	$216,000	$216,000	$0	$216,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Dry Etch	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Oxford ICP 100+ PECVD/DRIE	1	$50,000	$50,000	$0	$50,000
	Drytek etcher	1	$12,000	$12,000	$0	$12,000
	u-wave Asher	1	$81,000	$81,000	$0	$81,000
	Trion Metal Etch (ion)	1	$232,000	$232,000	$0	$232,000
	XeF2 release etch	1	$86,400	$86,400	$0	$86,400

	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
Films Deposition	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Denton e-beam dep	1	$8,000	$8,000	$0	$8,000
	Denton Discovery	1	$36,000	$36,000	$0	$36,000
	SFI 3-cathode	1	$16,000	$16,000	$0	$16,000
	Thermal Evaporator	1	$26,000	$26,000	$0	$26,000
	Perkin Elmer	1	$8,000	$8,000	$0	$8,000
	6" PVD with backsputtering	1	$278,000	$278,000	$0	$278,000
	Flexus wafer bow measurement	1	$0	$0	$0	$0
	RTA with vacuum capability	1	$81,000	$81,000	$0	$81,000
	Spin on Glass - Planarization	1	$129,600	$129,600	$0	$129,600
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
PI Cleanroom Bay 1	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Electrodeposition	2	$270,000	$540,000	$0	$540,000
	SSTI Vacuum Furnace	1	$43,200	$43,200	$0	$43,200
	Fusion Bonding	10	$2,000	$20,000	$0	$20,000
	micro-EDM	4	$140,400	$561,600	$0	$561,600
	Inspection Bench	3	$8,640	$25,920	$0	$25,920
	Critical Point dryer	1	$8,000	$8,000	$0	$8,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
PI Cleanroom Bay 2	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
BioCompatible PI/Industrial Bay	Safety Shower / Face Wash	2	$1,200	$2,400	$2,400	$0

	Wafer Handling / Vacuum Wands	8	$1,100	$8,800	$8,800	$0
	Inspection Bench w/ Digital Imaging Microscope	2	$32,400	$64,800	$0	$64,800
Chemical Pass-Thru	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Chemical Tranfer Rack (Stationary Cart)	5	$6,000	$30,000	$30,000	$0
Cleanroom Main Aisle	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	7	$1,100	$7,700	$7,700	$0
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
	Cube Storage	200	$108	$21,600	$21,600	$0
Clean Janitors (Cl 10K) (in box)	Cleanroom Floor Cleaner	1	$5,000	$5,000	$0	$5,000
Cleanroom Chases	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Quartzware Washer	1	$43,200	$43,200	$0	$43,200
	Diffusion Tube Cleaner	1	$72,000	$72,000	$0	$72,000
Main Gowning (Cl 10K)	Solvent storage Securall A360	2	$500	$1,000	$1,000	$0
	Acid storage Securall A360	1	$500	$500	$500	$0
	Base storage Securall A360	1	$500	$500	$500	$0
Metrology (Cl 10K)	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Wafer defect review tool	1	$29,160	$29,160	$0	$29,160
	Nanospec	1	$32,400	$32,400	$0	$32,400
	In-fab imaging SEM	1	$650,000	$650,000	$0	$650,000
	Inspection Bench w/ Digital Imaging Microscope	1	$32,400	$32,400	$0	$32,400
	MX205 Wafer Geometry	1	$108,000	$108,000	$0	$108,000
Clean Microelectronics Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0

	4" furnaces (wet ox, dry ox, B-diff, P-diff, annealing, polySi)	1	$10,000	$10,000	$0	$10,000
	Al evaporator	1	$6,000	$6,000	$0	$6,000
	teaching ellipsometer	1	$0	$0	$0	$0
	4-pt probe	1	$0	$0	$0	$0
	hot pt. probe	1	$0	$0	$0	$0
	teaching inspection microscopes	1	$0	$0	$0	$0
	profilometer	1	$0	$0	$0	$0
	inspection microscopes	1	$0	$0	$0	$0
	computer workstation	1	$0	$0	$0	$0
	electrical test stations	1	$0	$0	$0	$0
	two probe test stations	1	$0	$0	$0	$0
Clean Micromachining Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	Dicing saw (MAx2)	2	$0	$0	$0	$0
	KOH Etch Bench	1	$35,000	$35,000	$0	$35,000
	Electroplating	1	$40,000	$40,000	$0	$40,000
	Wet Bench	1	$32,400	$32,400	$0	$32,400
	Dry Bench (exhausted)	2	$20,000	$40,000	$0	$40,000
	Inspection Microscopes	1	$0	$0	$0	$0
	Computer Workstations	1	$0	$0	$0	$0
	Wire Bonding	1	$0	$0	$0	$0
Clean Photolithography Res/Teaching (Cl 10K)	Safety Shower / Face Wash	1	$1,200	$1,200	$1,200	$0
	Wafer Handling / Vacuum Wands	4	$1,100	$4,400	$4,400	$0
	OAI Contact Aligner	1	$54,000	$54,000	$0	$54,000
	OAI Contact Aligner	1	$2,500	$2,500	$0	$2,500

	Teaching Tencor p-10	1	$0	$0	$0	$0
	Spinner (exhausted)	1	$5,000	$5,000	$0	$5,000
	Bake Oven (exhausted)	1	$3,000	$3,000	$0	$3,000
	Wet Bench (acid)	1	$5,000	$5,000	$0	$5,000
	Wet Bench (solvent)	1	$5,000	$5,000	$0	$5,000
	Exhausted Dry Bench	1	$20,000	$20,000	$0	$20,000
OMVPE (H2/H3 occupancy)	Safety Shower / Face Wash	0	$1,200	$0	$0	$0
	New OMVPE 1	0	$1,080,000	$0	$0	$0
	Gas Cabinet 2	0	$5,000	$0	$0	$0
	OMVPE Reactor	0	$2,160	$0	$0	$0
	MBE	0	$648,000	$0	$0	$0
	Microscope	0	$0	$0	$0	$0
	Wet Bench	0	$32,400	$0	$0	$0
	POU Arsenic Abatement	0	$32,400	$0	$0	$0
Industrial Partner Lab	acoustic tomography	0	$194,400	$0	$0	$0
	bond pull tester	0	$70,200	$0	$0	$0
	pick and place	0	$97,200	$0	$0	$0
	die attach	0	$43,200	$0	$0	$0
CMP (includes smocking vestibule)	Safety Shower / Face Wash	0	$1,200	$0	$0	$0
	Allied manual polisher	0	$0	$0	$0	$0
	Allied manual polisher	0	$12,960	$0	$0	$0
	Wafer CMP	0	$270,000	$0	$0	$0
	Precision Allied Polisher	0	$0	$0	$0	$0
	2X Low-Magnification Stereo Microscope	0	$8,640	$0	$0	$0
	Hi-Resolution Compound Microscope	0	$17,280	$0	$0	$0
	Staining and Potting (in new hood)	0	$0	$0	$0	$0
	Flexus wafer bow measurement	0	$16,200	$0	$0	$0

Device Assembly / Laser Machining / Dicing	Epoxy Resin Counter w/ Cabinets Below	0	$0	$0	$0	$0
	Upper Cabinets with Swinging Glass Doors	0	$0	$0	$0	$0
	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	0	$0	$0	$0	$0
	Epoxy Resin Adjustable Height Table w/ Cabinets Below	0	$0	$0	$0	$0
	Overhead Service Carrier (Initially Power Only?)	0	$0	$0	$0	$0
	Safety Shower / Face Wash	0	$0	$0	$0	$0
	Laser Machining	0	$35,000	$0	$0	$0
	Wire Bonder (man)	0	$0	$0	$0	$0
	Wire Bonder (KnS)	0	$21,600	$0	$0	$0
	screen printer	0	$0	$0	$0	$0
	Reliability Tester	0	$7,560	$0	$0	$0
	Dicing Saw (Disco)	0	$10,800	$0	$0	$0
	Dicing Saw	0	$86,400	$0	$0	$0
	Wire EDM (hole popper)	0	$0	$0	$0	$0
	Wafer Handling / Vacuum Wands	0	$1,100	$0	$0	$0
	Inspection Bench w/ Digital Imaging Microscope	0	$0	$0	$0	$0
	TMV	0	$70,000	$0	$0	$0
	Nikon Comparator	0	$800	$0	$0	$0
	Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	0	$10,800	$0	$0	$0
	Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	0	$0	$0	$0	$0
	Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	0	$0	$0	$0	$0
	Double-Stacked Ovens . Blue M . STK-04	0	$0	$0	$0	$0
	Plasma Cleaner . Anatech . SP100	0	$0	$0	$0	$0

	Flip Chip Bonder . West Bond . 7476 30E	0	$0	$0	$0	$0
	Hydraulic Press . Hoover? (TT)	0	$8,640	$0	$0	$0
	Electroplating	0	$35,000	$0	$0	$0
	Wet Bench Solvent	0	$32,400	$0	$0	$0
	Laminar Flow Hood for Embossing & Lamination	0	$2,268	$0	$0	$0
	SS Cleanroom Work Bench	0	$594	$0	$0	$0
	Tall Flammable Storage Cabinet	0	$15,000	$0	$0	$0
Clean Conference (10 people) (Cl 10K)	Flat Panel Presentation Display	1	$6,480	$6,480	$6,480	$0
Machine Shop / Vacuum Maintenace & Teaching*	Equipment Space	0	$0	$0	$0	$0
	Storage Racks for Raw Stock	0	$0	$0	$0	$0
	Stick Welder w/ Plasma Cutter	0	$0	$0	$0	$0
	Weld / Brazing Table on Wheels	0	$0	$0	$0	$0
	Torch Set on Wheels	0	$0	$0	$0	$0
	Parts Washer	0	$0	$0	$0	$0
	Bead Blaster	0	$0	$0	$0	$0
	Horizontal Band Saw on Wheels	0	$0	$0	$0	$0
	Machine Tool Work Bench	0	$0	$0	$0	$0
	Assembly Work Bench	0	$0	$0	$0	$0
	Mille / Lathe	0	$0	$0	$0	$0
			Total	**$8,091,240**		
	Equipment outside construction			**$0**		
	Equipment in construction				**$145,180**	
	Equipment outside project					**$7,946,060**

USTAR at University of Utah

Current Total Project Budget based on: Neuroscience & Biomedical Research Technology Building

Prepared: March 12, 2007 Revised: *November 9, 2007*

Nanofab Gross & Exterior Resource Equipment

		QTY	unit cost	extended cost	In Const cost	Outside Project Cost
Gas Storage	H2 Generator	1	$162,000	$162,000	$0	$0
	3-Bottle Gas Cabinet (2 Hazardous + 1 Purge)	2	$24,840	$49,680	$0	$0
	3-Bottle Gas Cabinet (3 Spares or Empties)	3	$2,160	$6,480	$0	$0
	2-Bottle Gas Cabinet (1 Hazardous + 1 Purge)	10	$20,520	$205,200	$0	$0
	Inert Gas Cylinder Rack - Spares	4	$10,800	$43,200	$0	$0
	Inert Gas Cylinder Rack - Empties	3	$10,800	$32,400	$0	$0
Silane Bunker	Silane Pad/Bunker Equipment	1	$216,000	$216,000	$0	$0
General equipment	General Equipment	1	$366,063	$366,063	$0	$0
			Total	**$1,081,023**		
	Equipment outside construction			**$1,081,023**		
	Equipment in construction				**$0**	
	Equipment outside project					**$0**

1.0 P.I. Assigned Space			modules	Total NSF	Total GSF
1.1	**Lab and Lab Support (Finished)**		14.00	1,694	2,871
		Lab and Lab Support Subtotal per P.I.	**14.00**	**1,694**	**2,871**
		Lab and Lab Support Subtotal Overall	**336.00**	**40,656**	**68,908**
1.2	**Office/Admin (Finished)**				
	1.2.1	P.I. Office	1.50	182	308
	1.2.2	Workstations	1.50	182	308
	1.2.3	Faculty Office	1.00	121	205
		Office/Admin Subtotal per P.I.	**4.00**	**484**	**820**
		Office/Admin Subtotal Overall	**96.00**	**11,616**	**19,688**
	Assigned Space per P.I.		**18.00 ***	**2,178**	**3,692**
	Assigned Space SubTotal		**432.00**	**52,272**	**88,597**
	# of P.I.'s			**24**	
1.3	**Design and Simulation Tool Lab**		**3.1**	**375**	**636**
1.4	**Lab and Lab Support (Shelled)**		17.00	2,057	3,486
		Lab and Lab Support Subtotal per P.I.	**17.00**	**2,057**	**3,486**
		Lab and Lab Support Subtotal Overall	**0.00**	**0**	**0**
1.5	**Office/Admin (Shelled)**				
	1.5.1	P.I. Office	1.00	121	205
	1.5.2	Workstations	0.30	36	62
		Office/Admin Subtotal per P.I.	**1.30**	**157**	**267**
		Office/Admin Subtotal Overall	**0.00**	**0**	**0**
	Assigned Space per P.I.		**18.3**	**2,214**	**3,753**
	Assigned Space SubTotal		**0.00**	**0**	**0**
	# of P.I.'s			**0**	

*** Look into adding space (outside of lab) for central material storage**

PI Assigned Space Total	**435.10**	**52,647**	**89,232**

Vivarium			quantity	Size NSF	Total NSF	Total GSF
2.1	**Animal Holding**					
	2.1.1	Small Holding Room	8	450	3,600	6,102
	2.1.2	Large Holding Room	6	600	3,600	6,102
	Animal Holding Subtotal				**7,200**	**12,203**
2.2	**Animal Holding Support**					
	2.2.1	Small Procedure Room	4	150	600	1,017
	2.2.2	Freezer Room	1	121	121	205
	2.2.3	Necropsy	1	228	228	386
	2.2.4	Survival Surgery	1	1,300	1,300	2,203
	2.2.5	Quarantine	1	450	450	763
	2.2.6	Supply Room (1 prepackage sets)	3	150	450	763
	2.2.7	Restrooms/Lockers/Showers	2	300	600	1,017
	2.2.8	Break Area	1	150	150	254
	Animal Holding Support Subtotal				**3,899**	**6,608**
2.3	**Cagewash**					
	2.3.1	Central Cagewash	1	1,000	1,000	1,695
	2.3.2	Cagewash Support (bedding,feed,detergent)	1	550	550	932
	2.3.3	Cage Storage	1	600	600	1,017
	2.3.4	Janitor Closet	1	20	20	34
	Cagewash Subtotal				**2,170**	**3,678**
2.4	**Office**					
	2.4.1	Office	1	121	121	205
	2.4.2	Workstations	3	64	192	325
	Office Subtotal				**313**	**531**
Vivarium Total					**13,582**	**23,020**

Small Animal Imaging (Finished)			quantity	Size NSF	Total NSF	Total GSF
3.1	**7T Small Bore MRI Suite**					
	3.1.1	7TAnimal Magnet	1	194	194	328
	3.1.2	Operator Room	1	125	125	211
	3.1.3	Equipment Room	1	194	194	328
	7T Small Bore Suite Subtotal				**513**	**867**
3.2	**Imaging Laboratories**					
	3.2.1	Small Animal Imaging Lab	1	726	726	1,231
	3.2.2	Ultrasound Lab	1	121	121	205
*	**3.2.3**	PET/CT Lab	1	121	121	205
*	**3.2.4**	SPECT/CT Lab	1	121	121	205
	3.2.5	Fluoroscopy Room	1	121	121	205
	***Note: 3.2.3 and 3.2.4 combined square footage into one room**					
	Imaging Laboratories Subtotal				**1,210**	**2,051**
3.3	**Imaging Support**					
	3.3.1	Radiochemistry Lab	1	484	484	820
	3.3.2	Wet Chemistry Lab	1	484	484	820
	3.3.3	Image Analysis Lab	1	484	484	820
	3.3.4	Instrumentation Development Lab	1	484	484	820
	3.3.5	Gas Cylinder Storage	1	20	20	34
	3.3.6	Computer Room	1	121	121	205
	Imaging Support Subtotal				**2,077**	**3,520**
3.4	**Office**					
	3.4.1	Office	1	121	121	205
	3.4.2	Workstation Area (3 workstations)	2	121	242	410
	Office Subtotal				**363**	**615**
Small Animal Imaging Total- Finished					**4,163**	**7,053**

Small Animal Imaging (Shelled)			quantity	Size NSF	Total NSF	Total GSF
3.5	**3T Large Bore MRI Suite (Shelled)**					
	3.5.1	3T Human Magnet	1	520	520	881
	3.5.2	Operator Room	1	250	250	424
	3.5.3	Equipment Room	1	520	520	881
	3T Large Bore MRI Suite Subtotal				**1,290**	**2,186**
Small Animal Imaging Total- Shelled					**1,290**	**2,186**

4.0 Microscopy			quantity		Size NSF	Total NSF	Total GSF
4.1	**Biomedical Instrument Labs**						
	4.1.1	Large Instrument Room	2	(verify)	240	480	814
	4.1.2	Small Instrument Room	4		144	576	976
	4.1.3	Optics Lab	1		240	240	407
	Biomedical Instrument Labs Subtotal					**1,296**	**2,197**
4.2	**Biomedical Microscopy Support**						
	4.2.1	Equipment Corridor	1		400	400	678
	4.2.2	Wet Lab Prep Area (share space with 4.4.6)	0		384	0	0
	4.2.3	Microtomy Room	1		121	121	205
	4.2.4	High Pressure Freezer Room	1		121	121	205
	Biomedical Microscopy Support Subtotal					**642**	**1,088**
4.3	**Biomedical Office**						
	4.3.1	Office	2		120	240	407
	Biomedical Office Subtotal					**240**	**407**
	Biomedical Microscopy SubTotal					**2,178**	**3,692**
4.4	**Engineering Instrument Labs**						
	4.4.1	HR SEM	1	(verify)	270	270	458
	4.4.2	DB FIB and Nabity Nanolithography	1		270	270	458
	4.4.3	XPS	1		270	270	458
	4.4.4	Microscopy Service Corridor	1		400	400	678
	4.4.5	AFM(Wet + Solid State)	1		242	242	410
	4.4.6	Shared Sample Prep	1		400	400	678
	4.4.7	Electrical Characterization	1		484	484	820
	4.4.8	Spectrophotometry, Optical Micro Rooms	2		121	242	410
	Engineering Instrument Labs Subtotal					**2,578**	**4,369**
4.5	**Engineering Office**						
	4.5.1	Administrative Manager Office	1		121	121	205
	4.5.2	TEM/XPS Lab Engineer Office	1		121	121	205
	4.4.3	FIB/SEM Engineer Office	1		121	121	205
	4.4.4	Workstation	2		64	128	217
	Engineering Office Subtotal					**491**	**832**
	Engineering Microscopy SubTotal					**3,069**	**5,202**
Microscopy Total						**5,247**	**8,893**

5.0 Nanofab			quantity	Size NSF		Total NSF	Total GSF
5.1	**Cleanroom**						
	5.1.1	Cleanroom (Class 1,000/100-spaces below)	1	5,720	0.88	5,720	9,695
	5.1.2	Nanolithography	1				
	5.1.3	Photolithography	1				
	5.1.4	Wet Processing	1				
	5.1.5	Hot Process	1				
	5.1.6	Dry Etch	1				
	5.1.7	Films Deposition	1				
	5.1.8	P.I. Cleanroom Bay 1	1				
	5.1.9	P.I. Cleanroom Bay 2	1				
	5.1.10	BioCompatible P.I./Industrial Bay	1				
	5.1.11	Chemical Pass-thru	1				
	5.1.12	Cleanroom Main Aisle	1				
	5.1.13	Clean Janitors (C1 10K) (in box)	1	50		50	85
	5.1.14	Cleanroom Chases	1	4,620	0.88	4,620	7,831
	Cleanroom Subtotal					**10,390**	**17,610**
5.2	**Cleanroom Support and Research/Teaching**						
	5.2.1	Main Gowning	1	200		200	339
	5.2.2	Equipment Wipe-Down	1	100		100	169
	5.2.3	Metrology	1	475		475	805
	5.2.4	Clean Microelectronics Research/Teaching (CI 10K)	1	475		475	805
	5.2.5	Clean Micromachining Research/Teaching (CI 10K)	1	475		475	805
	5.2.6	Clean Photolitholgraphy Research/Teaching (CI 10K)	1	475		475	805
	Cleanroom Support and Research/Teaching Subtotal					**2,200**	**3,729**
5.3	**Office/ Workstations**						
	5.3.1	Director's Office	1	121		121	205
	5.3.2	Teaching Lab Support Engineer Office	1	121		121	205
	5.3.3	User Training Engineer Office	2	121		242	410
	5.3.4	Applications Development Engineer Office	2	121		242	410
	5.3.5	General Maintenance Engineer Workstation	1	64		64	108
	5.3.6	Chem Tech Workstation	1	64		64	108
	5.3.7	Maintenance Tech Workstation	1	64		64	108
	5.3.8	Work-Study Bullpen	10	30		300	508
	Office/Workstations Subtotal					**1,218**	**2,064**
5.4	**Conference**						
	5.4.1	Clean Conference	1	165		165	280
	Conference Subtotal					**165**	**280**
5.5	**Engineering Nanofab Building Support**						
	5.5.1	Control/ ERT Room	1	242		242	410
	5.5.2	Cleanroom Lockers/ Shoe Clean	1	121		121	205
	5.5.3	Cleanroom Maintenance (outside Cleanroom)	1	300		300	508
	5.5.4	Hazardous Solid and Liquid Storage	1	363		363	615
	Building Support Subtotal					**1,026**	**1,739**
Nanofab Total						**14,999**	**25,422**

6.0 Public and Building Support Spaces		quantity	Size NSF	Total NSF	Total GSF
6.1	**Public/Meeting Spaces**				
6.1.1	Lobby/Multifunction Space	1	2,000	2,000	3,390
6.1.2	Café	1	3,000	3,000	5,085
6.1.3	Large Auditorium	1	2,500	2,500	4,237
6.1.4	Large Seminar Room	2	700	1,400	2,373
6.1.5	Small Seminar Room	8	350	2,800 **	4,746
6.1.6	Informal Meeting Areas	8	150	1,200	2,034
6.1.7	Public Restroom	2	750	1,500	2,542
6.1.8	Shower/Locker	2	250	500	847
	Public/Meeting Space Total			**14,900**	**25,254**
6.2	**Building Administrative Support**				
6.2.1	Office (manager, custodial...)	10	121	1,210	2,051
6.2.2	Workstations	10	64	640	1,085
6.2.3	Meeting Room	1	300	300	508
6.2.4	Central Mail/Copy/Supply	1	400	400	678
6.2.5	Records	1	200	200	339
	Building Administrative Office Subtotal			**2,750 ***	**4,661**
6.3	**Information Technology**				
6.3.1	Data Center	1	500	500	847
6.3.2	Data Closet	4	121	484	820
6.3.3	Office	1	121	121	205
6.3.4	Workstations	3	64	192	325
6.3.5	Main Communications Room	1	150	150	254
	Information Technology Total			**1,447**	**2,453**
6.4	**Building Support**				
6.4.1	Loading Dock	1	720	720	1,220
6.4.2	Main Mechanical Room	1	1,200	1,200	2,034
6.4.3	Main Electrical Room	1	600	600	1,017
6.4.4	Main Storage Room	1	1,200	800	1,356
	Building Support Total			**3,320**	**5,627**

*** checking on security office**
**** some seminar rooms will be located around administrative support area**

Public and Building Support Spaces Total	**22,417**	**37,995**

Program Summary		Total NSF	Total GSF
1.0	**PI Assigned Space Total**	**52,647**	**89,232**
	Total SF per PI (24 PI's)	*2,178*	*3,753*
2.0	**Vivarium**	**13,582**	**23,020**
3.0	**Small Animal Imaging**	**5,453**	**9,240**
4.0	**Microscopy**	**5,247**	**8,893**
5.0	**Nanofab**	**14,999**	**25,422**
6.0	**Public/Building Support**	**22,417**	**37,995**
Total Building Area		**116,523**	**193,803**

5.2 COMPARABLE PROJECTS

The following documents introduce three projects comparable to the University of Utah Neuroscience and Biomedical Research Technology Building (NBTRB). These comparable projects are similar in size and contain similar functions with the exception that they do not have the Cleanroom component that the NBTRB has. A project description is provided that includes construction cost, project size, and project images. A square foot cost comparison is also included which provides a side by side comparison of the three projects compared to the proposed NBTRB project. The square foot cost comparison outlines the construction cost / s.f. for each project and also breaks the construction cost / s.f. into construction divisions for a thorough comparison.

The Biodesign Institute at Arizona State University

Arizona State University, Tempe, Arizona

Lord, Aeck & Sargent, in collaboration with Gould Evans Associate Architects, designed this multiphase interdisciplinary research facility project, which brings together life science and engineering to pursue biotechnology, bioengineering and nanotechnology for Arizona State University.

Building A of the Institute houses interdisciplinary laboratory space for microbiology including infectious disease and vaccinology research as well as bio-informatics. The basement level is designed to house vibration-sensitive nanotechnology while the first, second and third floors are designed to house flexible laboratory and research space.

Building B of the Institute continues and expands upon Arizona State University's aspirations to create a world-class institute that facilitates cutting-edge research. The facility is connected to Building A through the use of light and landscape.

The Institute is designed to promote dynamic interaction and collaboration between disparate scientific fields, and is designed using flexible modules in the research and office areas to allow utility and architectural systems to be easily modified over time and across various scientific disciplines.

Building A	LEED Gold
Size:	176,018 sf
Construction Cost:	$51.4 million
Building B	LEED Platinum
Size:	174,373 sf
Construction Cost:	$55.9 million
Awards	*R&D Magazine* 2006 Laboratory of the Year

Margaret M. Alkek Building for Biomedical Research

Baylor College of Medicine, Houston, Texas

This eight story tower, with five stories of research laboratories and a two-story vivarium, houses research for major interdisciplinary programs in cardiovascular sciences, cancer, pharmacogenomics, genomics and proteomics. Design features such as open lab plans and extensive use of interior glass will greatly enhance flexibility and collaboration.

The vivarium includes a fully automated cage washing and a fully automated bottle washing system (the first of its kind in the U.S.), the vivarium will be one of the most space efficient and operationally efficient rodent barrier vivariums in the world.

The exterior façade utilizes a faceted curtainwall system to provide shading – solving common problems related to exterior maintenance that often arise with external shading devices.

Building opened in September, 2007.

Size:	203,000 sf
Construction Cost:	$83,500,000

LORD AECK SARGENT

Neuroscience & Biomedical Technology Research Building

Square Foot Cost Comparison by MasterFormat Construction Divisions - New Construction

28-Nov-07

Item	BIODESIGN Bldg. A 176018 gsf 12/17/3	BIODESIGN Bldg. B Sundt /DPR 174373 gsf 9/14/04	Baylor Alkek Research Tower TMFT 203000 gsf 9/1/5	Neuroscience & Biomedical technology Research Building 193,803 gsf 11/30/07
Sitework	$13.43	$4.54	$9.88	$8.80
Demolition	$0.20	$1.06	$2.21	$0.00
Earthwork	$8.13	$5.13	$2.71	$0.00
Foundations	$0.00	$0.00	$0.00	$0.00
Reinforced Concrete	$44.21	$49.35	$14.15	$64.91
Cement Finish	$0.00	$0.00	$0.00	$0.00
Precast Concrete	$0.26	$0.20	$0.00	$0.00
Masonry	$7.27	$11.04	$1.49	$0.00
Natural Stone	$0.00	$0.00	$7.49	$0.00
Structural Steel & Misc. Metal	$15.66	$17.56	$39.76	$0.00
Rough Carpentry	$0.00	$0.00	$0.66	$0.00
Millwork	$1.77	$2.32	$1.20	$0.00
Waterproofing & Caulking	$2.39	$1.75	$3.71	$0.00
Roofing & Sheet Metal	$2.39	$2.51	$3.58	$0.00
Hollow Metal	$4.09	$4.81	$0.63	$0.00
Wood Doors	$0.00	$0.00	$0.86	$0.00
Special Acting Doors	$0.00	$0.00	$0.19	$0.00
Finish Hardware	$0.00	$0.00	$2.56	$0.00
Glass, Glazing & Storefront	$24.71	$25.18	$33.29	$25.50
Lath, Plaster & Stucco	$0.00	$0.00	$0.36	$0.00
Drywall	$16.76	$16.40	$17.16	$27.28
Ceramic Tile	$2.50	$2.94	$1.35	$0.00
Acoustical	$5.33	$5.46	$1.96	$0.00
Resilient Floors	$1.88	$3.89	$1.50	$0.00
Painting & Wallcovering	$1.80	$3.79	$3.41	$0.00
Special Flooring	$0.00	$0.00	$2.33	$0.00
Miscellaneous Specialties	$0.62	$0.69	$6.81	$0.00
Toilet Partitions & Accessories	$0.00	$0.00	$0.35	$0.00
Equipment	$28.55	$36.18	$12.81	$44.02
Casework	$0.00	$0.00	$0.20	$0.00
Furnishings	$1.91	$4.16	$0.47	$0.00
Special Construction	$5.08	$0.00	$0.10	$0.00
Conveying Systems	$2.48	$3.22	$6.21	$2.22
Fire Protection Systems	$3.90	$4.16	$5.44	$3.57
Plumbing Systems	$0.00	$0.00	$21.56	$23.00
HVAC Systems	$91.56	$97.65	$96.07	$116.59
Electrical Systems	$49.14	$53.13	$49.22	$55.49
Construction Total	$336.04	$357.09	$351.69	$371.36
General Requirements	$35.31	$37.80	$28.02	$23.38
Bidding & Contract Requirements	$18.78	$21.20	$0.00	$3.57
General Contractor's O.H. & Fee	$11.71	$16.70	$13.18	$14.83
Inflation	$0.00	$0.00	$0.00	$0.00
Contingencies	$0.00	$0.00	$0.00	$0.00
Construction Budget	**$401.84**	**$432.79**	**$392.89**	**$413.14**

Sitework	*$21.76*	*$10.72*	*$14.80*	$8.80
Superstructure	*$59.87*	*$66.91*	*$53.91*	$64.91
Shell	*$37.04*	*$40.67*	*$49.93*	$25.50
Interior Fit-up	*$34.75*	*$40.28*	*$40.98*	$27.28
Equipment & Furnishings	*$38.01*	*$43.56*	*$19.78*	$46.25
Mechanical Systems	*$95.45*	*$101.81*	*$123.07*	$143.16
Electrical Systems	*$49.14*	*$53.13*	*$49.22*	$55.49
Mark-Up	*$65.81*	*$75.70*	*$41.20*	$41.78

Notes:

1. *All costs adjusted to ……* ***Salt Lake City, UT***
2. *All costs escalated to ……..* ***2007***

6.0 Appendix

6.1 Geoseismic Fault Study
6.2 Preliminary Soils Report
6.3 EMI and RFI Site Assessment Study
6.4 Site Vibration Study Report
6.5 Modified ALTA/Topographic Survey
6.6 Traffic Impact Analysis
6.7 Equipment Schedule for Nanofabrication
6.8 Site Plan Option Studies

6.1 GEOSEISMIC FAULT STUDY

Please see page numbers with in the consultant's document.

Gordon Spilker Huber
Geotechnical Consultants, Inc.

REPORT
GEOSEISMIC/FAULT STUDY
NEW NEUROSCIENCE AND BIOMEDICAL TECHNOLOGY RESEARCH BUILDING
WEST SIDE OF WASATCH DRIVE AT FEDERAL WAY
UNIVERSITY OF UTAH CAMPUS
SALT LAKE CITY, UTAH

Submitted To:

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106-4333

Submitted By:

Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

November 19, 2007

Job No. 0283-002-07

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

November 19, 2007
Job No. 0283-002-07

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106-4333

Attention: Mr. Tim Thomas, AIA

Gentlemen:

Re: Report
Geoseismic/Fault Study
New Neuroscience and Biomedical Technology
Research Building
West Side of Wasatch Drive at Federal Way
University of Utah Campus
Salt Lake City, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geoseismic/fault study performed for the proposed new Neuroscience and Biomedical Technology Research building and possible future adjacent buildings, which will be constructed on the west side of Wasatch Drive at Federal Way on the University of Utah campus in Salt Lake City, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A more detailed layout of the site on an air photo base is shown on Figure 2, Area Map. A detailed layout of the site showing existing and proposed facilities and site-specific topography is presented on Figure 3, Site Plan. The locations of the borings drilled in conjunction with our preliminary geotechnical study and the approximate locations of trenches excavated in conjunction with our geoseismic/fault study of the site are also presented on Figure 3.

During the course of this study, many of the conclusions and recommendations were presented to the design team and owner.

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1.2 OBJECTIVES AND SCOPE

The objectives of this study were planned in discussions between Mr. Tim Thomas of Architectural Nexus, Inc., and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objective of this study was to:

1. Determine whether or not any evidence of active faulting or other earth deformation is present on the site of the presently proposed Neuroscience and Biomedical Technology Research building and future adjacent buildings to the immediate north and west.

During initial planning for the field portion of this study, we were requested to also extend an additional fault exploration trench from the east side of Wasatch Drive, just south of the intersection between Wasatch Drive and Federal Way to the Trax station to the east.

In accomplishing this objective, our scope has included the following:

1. An initial office program consisting of the review of available literature, previous geoseismic faulting studies in the area, and appropriate aerial photographs.

2. A detailed field program consisting of the excavation and logging of three exploration trenches in a general direction perpendicular to the projected north-south alignment of an inferred fault in the area.

3. An office program consisting of the correlation of available data and the preparation of a summary report.

1.3 AUTHORIZATION

Authorization was provided by Mr. Tim Thomas of Architectural Nexus, Inc.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the fault study trenches, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

At the present time, a Neuroscience and Biomedical Technology Research building is proposed to be constructed just west of Wasatch Drive at the intersection of Wasatch Drive and Federal Way. The details pertaining to the structure are not available at this time. The structure could have its first level established at-grade or one to two levels below grade. Above grade, the structure could be one to three levels in height. The future adjacent buildings to the immediate north and west would be of similar configuration.

It is anticipated that some time in the future, similar types of structures could be constructed east of Wasatch Drive to Medical Drive, immediately east of the presently proposed Neuroscience and Biomedical Technology Research building.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to determine if active faulting passes through or immediately adjacent to the site, three continuous trenches were excavated. The approximate locations of the trenches are shown on Figure 3, Site Plan. Logging of the trenches was performed by Mr. Bill Black of Western GeoLogic, LLC. Trenching was initiated on November 5, 2007 and continued near continuously through Friday, November 16, 2007. Because the last of the fault trenches was completed on this date, November 16, 2007, detailed logs and discussions pertaining to the specific geology of the site and surface have not been completed.

<u>No evidence of active faulting was encountered in the exploration trenches.</u>

The final report, including the detailed logs, should be completed on or about November 26, 2007.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

Gordon Spilker Huber Geotechnical Consultants, Inc.

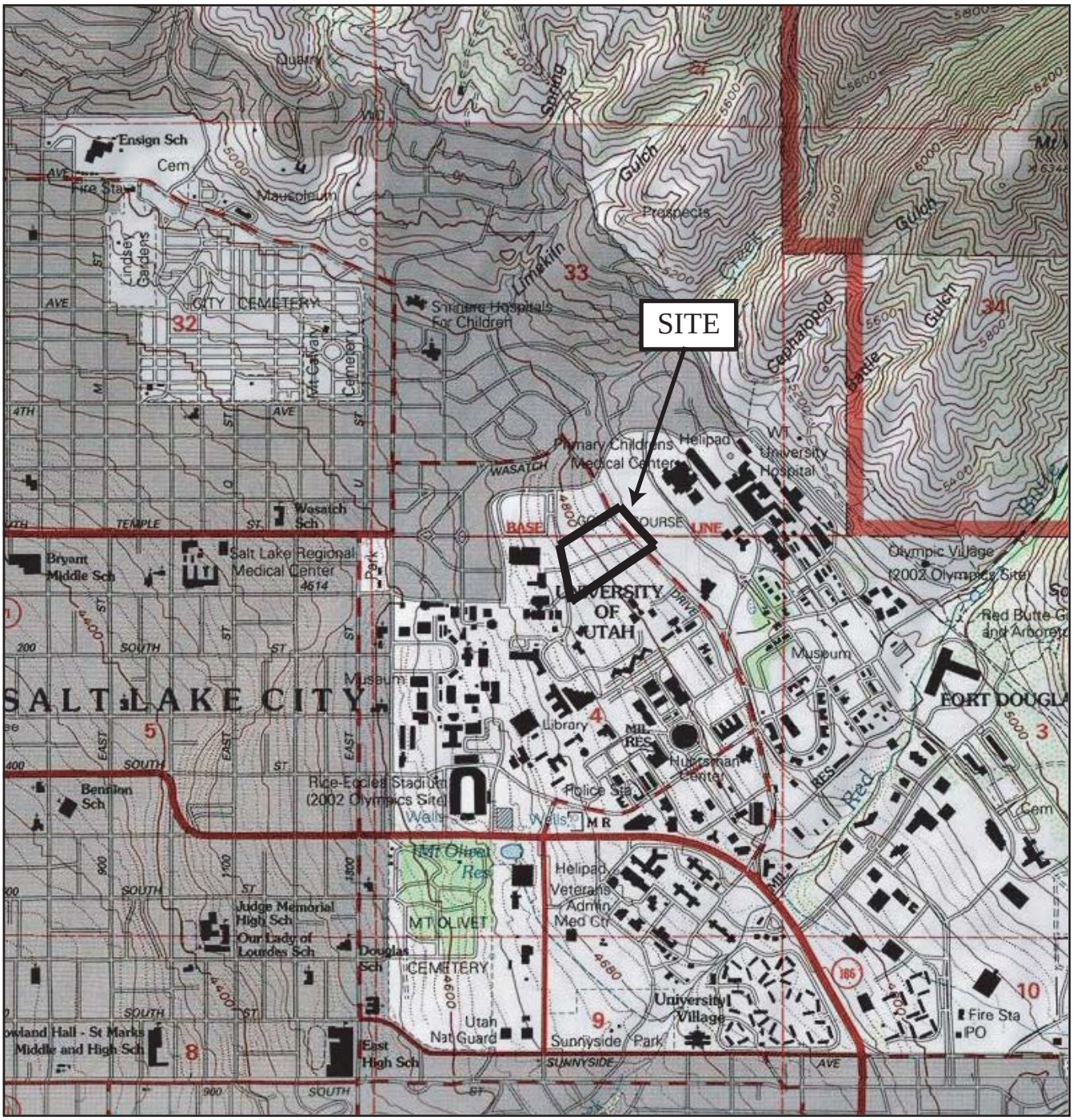
William J. Gordon, State of Utah No. 146417
Professional Engineer

WJG:jlh/sn

Encl. Figure 1, Vicinity Map
Figure 2, Area Map
Figure 3, Site Plan

Addressee (3 + email)
c: Mr. Ron Reaveley (1 + email)
Reaveley Engineers + Associates, Inc.
675 East 500 South, Suite 400
Salt Lake City, Utah 84102

ARCHITECTURAL NEXUS, INC.
JOB NO. 0283-002-07



SCALE IN FEET

1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS
TITLED "FORT DOUGLAS, UTAH" AND "SUGARH HOUSE, UTAH"
BOTH DATED 1998

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NOT TO SCALE

FIGURE 2
AREA MAP

REFERENCE:
ADAPTED AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
DATED 2007

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ARCHITECTURAL NEXUS, INC
JOB NO. 0283-002-07

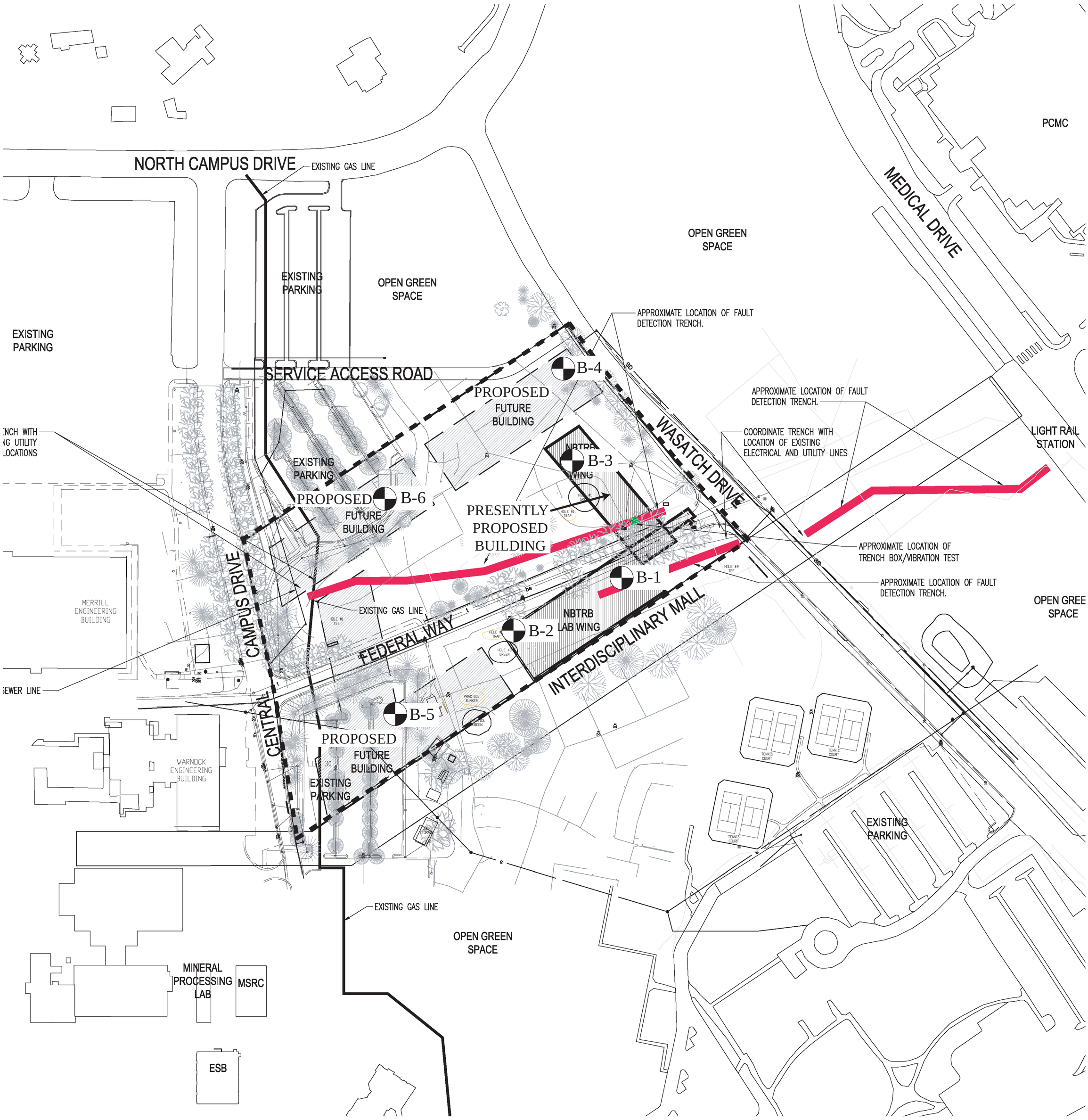

FIGURE 3
SITE PLAN

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"ARCHITECTURAL SITE PLAN, AS101"
BY ARCHITECTURAL NEXUS, DATED OCTOBER 30, 2007

SCALE IN FEET
100 0 100 200

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REPORT
SURFACE FAULT RUPTURE HAZARD STUDY
USTAR – UNIVERSITY OF UTAH
SITE OF PROPOSED NEUROSCIENCES AND BIOMEDICAL TECHNOLOGY RESEARCH BUILDING AND ADJOINING FUTURE DEVELOPMENT AREAS TO THE IMMEDIATE WEST AND EAST GENERAL AREA OF WASATCH DRIVE AND FEDERAL WAY
UNIVERSITY OF UTAH CAMPUS
SALT LAKE CITY, UTAH

Submitted To:

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
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Submitted By:

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4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

December 31, 2007

Job No. 0283-002-07

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

December 31, 2007
Job No. 0283-002-07

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106-4333

Attention: Mr. Tim Thomas, AIA

Gentlemen:

Re: Report
Surface Fault Rupture Hazard Study
USTAR – University of Utah
Site of Proposed Neurosciences and Biomedical Technology
Research Building and Adjoining Future Development Areas
to the Immediate West and East
General Area of Wasatch Drive and Federal Way
University of Utah Campus
Salt Lake City, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our surface fault rupture hazard study performed at the site of the proposed Neurosciences and Biomedical Technology Research building and adjoining future development areas to the immediate east and west. The general location of the site of the proposed primary building and future development to the west with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A more detailed layout of this site showing adjoining roadways and facilities on an air-photo base is presented on Figure 2, Area Map. The approximate locations of the exploration trenches extended in conjunction with this study are also presented on Figure 2. Trench No. 3 was extended in the southern portion of the proposed future development area on the east side of Wasatch Drive.

Immediately following the completion of Trenches No. 1 and 2, the fact that there was no evidence of active faulting at the presently proposed site of the Neurosciences and Biomedical

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Technology Research building was transmitted to Mr. Tim Thomas of Architectural Nexus, Inc. and representatives of the University of Utah in our initial report dated November 19, 2007[1].

1.2 OBJECTIVES AND SCOPE

The objectives and scope of this study were planned in discussions between Mr. Tim Thomas of Architectural Nexus, Inc., other members of the USTAR site-selection team, and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

The objective of this study was to:

1. Determine whether or not any evidence of active faulting or earth deformation is present at the presently proposed site for the Neurosciences and Biomedical Technology Research building. Subsequently, the same objective was extended for the parcel of land extending west almost to Central Campus Drive and then the parcel east of Wasatch Drive to the Trax station.

In accomplishing this objective, our scope included the following:

1. An initial office program consisting of the review of available literature, previous geoseismic/faulting studies in the area, and appropriate aerial photographs.

2. A field program consisting of the excavation, logging and backfilling of three continuous trenches and a test pit for in-situ vibration monitoring.

3. An office program consisting of the correlation of available data and the preparation of this final summary report.

1.3 AUTHORIZATION

Authorization was provided by Mr. Tim Thomas of Architectural Nexus, Inc., through an AIA Standard Form Agreement between Architect and Consultant.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections and attachments to this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration trenches.

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1 "Report, Geoseismic/Fault Study, New Neuroscience and Biomedical Technology Research Building, West Side of Wasatch Drive at Federal Way, University of Utah Campus, Salt Lake City, Utah" GSH Job No. 0283-002-07.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted geological principles and practices in this area at this time.

2. BACKGROUND - PROPOSED CONSTRUCTION

Approximately a year ago, a team was assembled to determine the most favorable site(s) for the proposed Neurosciences and Biomedical Technology Research building. As the result of this overall evaluation, the site which is the subject of this study was selected as the primary site.

During the evaluation, the fact that this site and others were within the Surface Fault Rupture Special Study Area on Salt Lake County hazard maps was discussed with representatives of the site-selection team. However, based upon numerous previous fault rupture hazard studies performed in this area and along a projected trace of the East Bench fault, it was projected that the probability of faulting at this site would be minimal. Evidence of faulting or other related deformation, if encountered at the site, would be a "fatal site flaw".

Although details pertaining to the proposed Neurosciences and Biomedical Technology Research building are not available at this time, it is projected that the structure will generally extend two to three levels above grade and, most likely, include one below-grade level. In vibration-sensitive areas, the buildings will be of reinforced concrete construction. Other areas could be of steel-frame construction, all with masonry perimeter walls. In the future and associated with the Neurosciences and Biomedical Technology Research building, buildings of similar layout and construction could be constructed to the immediate north and west, that is, in the area between Wasatch Drive and Central Campus Drive and extending on both sides of Federal Way.

In the future, similar or even more substantial structures may be constructed in the area of Wasatch Drive and extending to the Trax station associated with the University of Utah Medical Center.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

Prior to the initiation of field trenching the proposed alignments of the trenches were "walked" with Messrs. Tim Thomas and Jeff Gardner of Architectural Nexus; Messrs. Tom Christensen and Leonard Barney of the University of Utah; the golf course pro; members of the Campus Grounds Group; and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH). The purpose of the walk-over was to select the locations of the trench alignments based upon providing data needed for this study and inflecting the least amount of interference with the on-going golf course operations, utilities, and access. The site meeting was completed and an excavation permit issued. Excavation of the trenches was initiated on November 5, 2007 and continued to November 15, 2007. Approximate alignment of the trenches is presented on Figure 2. Detailed locations and alignment of the trenches are shown on Figure 3 of the detailed

summary report by Western GeoLogic, LLC, which is attached. The Trenches No. 1, 2, and 3 were 696.5, 188.6, and 500.0 feet long, respectively, and extended to depths generally ranging from 5.5 to 6.5 feet. At a point 75 feet west of the east beginning point of Trench No. 1, a test pit was excavated and braced to a depth of 17.5 feet to facilitate performance in-situ vibration tests, by others.

All trenches were logged by Mr. Bill Black, registered geologist of Western GeoLogic, LLC. Mr. Black's detailed report summarizing and discussing the geologic and geotectonic setting of the site and findings and conclusions pertaining to active faulting are present in the attached report dated December 14, 2007.

Following logging, the trenches were backfilled with the excavated soils. Soils were placed in lifts and compacted by dropping the backhoe bucket uniformly over the backfill soils. The backfill sequence was additionally compacted by running the large pneumatic backhoe tires over the upper portion of the backfill sequence. Subsequently, remaining loose soils on either side of Trenches No. 1 and 2 were hand-shoveled and placed over the trench alignments. Topsoil that had been stripped during initial excavation was placed over the mounded backfill. It is anticipated that significant amount of settlement of the fills will occur during the winter and early spring months. Subsequently, sod will be brought to the site and filled over the exposed backfill soils. Backfilling operations, as discussed above, could not be completed for Trench No. 3 on the east side of Wasatch Drive because of weather conditions. This area will be similarly "cleaned up" this coming spring.

4. SUMMARY

Based upon the results of this study, primary conclusions are:

1. No evidence of active faulting was observed in Trenches No. 1 and 2.

2. Hypothetically projecting that active faults are present just beyond the eastern limits of Trenches No. 1 and 2 and the western limit of Trench No. 1, the area between points approximately 30 feet west of the eastern limits of Trenches No. 1 and 2, and 30 feet east of the western limit of Trench No. 1, are buildable from a geoseismic/fault rupture standpoint.

3. Trench No. 1 could not be extended further to the west because of a new buried gas line, landscaping fills in excess of 15 feet, and Central Campus Drive. The probability of active faulting in the far western portion of the primary development area; that is, approximately 30 feet east of the western limit of Trench No. 1 to Central Campus Drive, is extremely low.

4. Although no evidence of active faulting, such as displacements in the exposed soils, were observed in Trench No. 3, stratigraphy correlation between Trenches No. 1 and 3 suggest a buried fault that displacing Pleistocene Lake Bonneville

sediments may be located slightly east of Wasatch Drive. This projected fault is overlain by post-lake alluvium sediment that conceals it and shows no evidence of deformation. These overlying deposits are greater than 10,000 to 16,000 years old. By definition, this fault would not be classified as active.

5. The alignment of this older fault may, in fact, be the actual alignment of the eastern splay of the East Bench fault, which has been previously projected to be located approximately 500 feet to the west. As discussed above, however, deformation of sediments projected to be greater than 10,000 to 16,000 years old over the projected fault alignment shown no signs of deformation; therefore, the fault under present guidelines would not be defined as active.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

Gordon Spilker Huber Geotechnical Consultants, Inc.

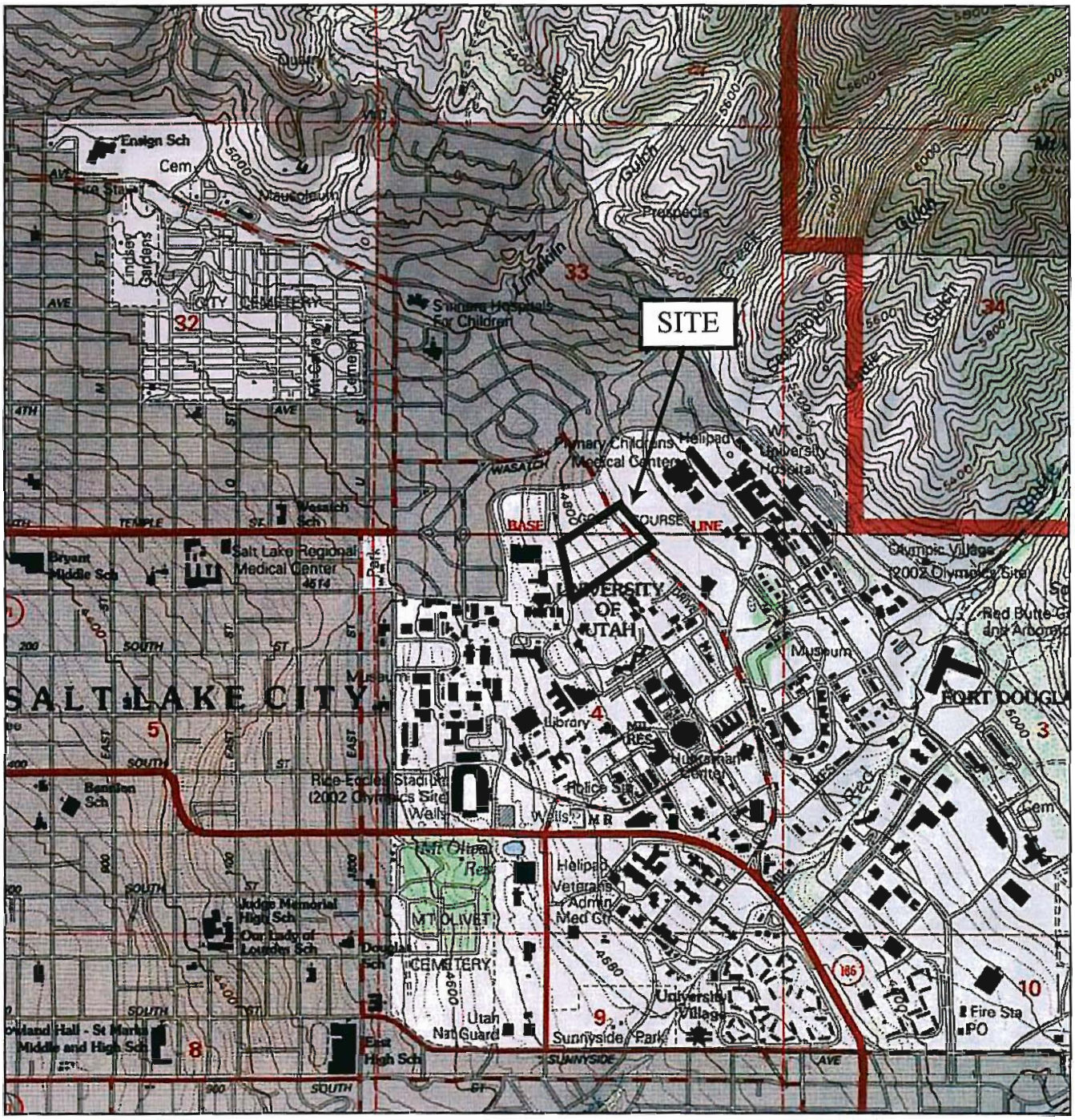
William J. Gordon, State of Utah No. 146417
Professional Engineer

WJG:jlh/sn

Encl. Figure 1, Vicinity Map
Figure 2, Area Map
Western GeoLogic, LLC's December 14, 2007 Report

Addressee (4 + email)

ARCHITECTURAL NEXUS, INC.
JOB NO. 0283-002-07



SCALE IN FEET
1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS
TITLED "FORT DOUGLAS, UTAH" AND "SUGAR HOUSE, UTAH"
BOTH DATED 1998

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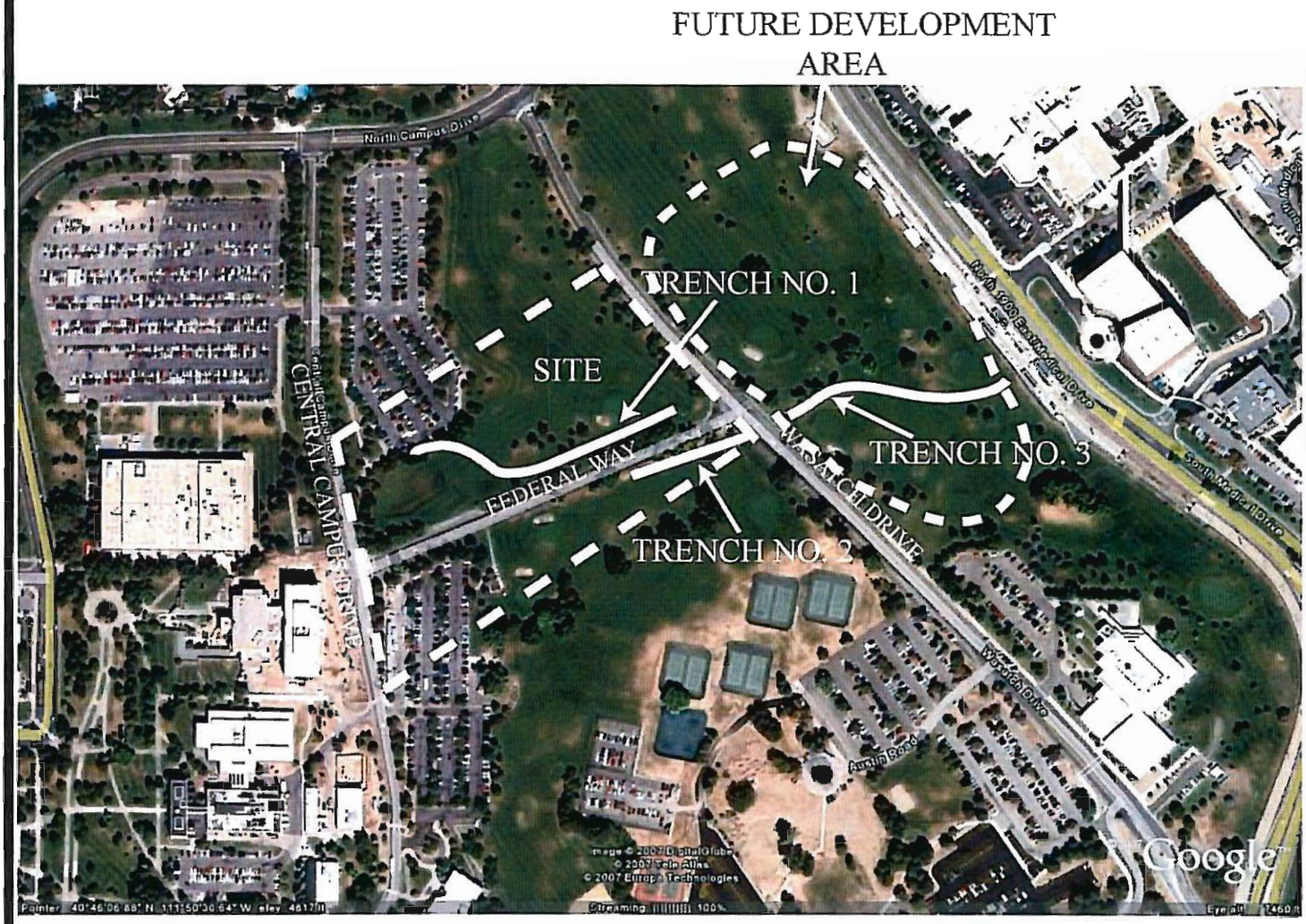
Geotechnical Consultants, Inc.

ARCHITECTURAL NEXUS, INC.
JOB NO. 0283-002-07



NOT TO SCALE

FIGURE 2
AREA MAP

REFERENCE:
ADAPTED AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
DATED 2007

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Gordon Spilker Huber
Geotechnical Consultants, Inc.

WESTERN GEOLOGIC, LLC'S

DECEMBER 14, 2007 REPORT

REPORT

SURFACE FAULT RUPTURE HAZARD EVALUATION

PROPOSED NANOTECHNOLOGY RESEARCH CENTER
UNIVERSITY OF UTAH GOLF COURSE
SALT LAKE CITY, UTAH

Prepared for

GSH Geotechnical
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

December 14, 2007

Prepared by

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December 14, 2007

Mr. Bill Gordon, P.E.
GSH Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

SUBJECT: Surface Fault Rupture Hazard Evaluation
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

Dear Mr. Gordon:

This report presents results of a surface fault rupture hazard evaluation conducted by Western GeoLogic, LLC (Western GeoLogic) for the proposed Nanotechnology Research Center site at the University of Utah Golf Course near Wasatch Drive and Federal Way in Salt Lake City, Utah (Figure 1 – Project Location). The site is in the N½ Section 4, Township 1 South, Range 1 East; and S½ Section 33, Township 1 North, Range 1 East (Salt Lake Base Line and Meridian). Elevation of the site is between about 4,760 and 4,880 feet above sea level.

PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the hazard from surface faulting at the site. Other geologic hazards possibly present at the site were not evaluated and are beyond the scope of this study. The following scope of services was performed in accordance with the above purpose:

- Excavation and logging of three exploratory trenches at the site in the Surface Fault Rupture Special Study Area on Salt Lake County hazard maps and to the east to identify the presence and location of any active faults, assess the zone of fault-related deformation, and recommend appropriate fault set-back distances and safe "buildable" areas should active faults be discovered;

- Review of available geologic maps and reports; and

- Evaluation of available data and preparation of this report, which presents the results of our study.

This report has been prepared in general accordance with the Guidelines for Evaluating Surface Fault Rupture Hazards in Utah (Christenson and others, 2003).

Geologists from the Utah Geological Survey Applied Geology Section and University of Utah Department of Geology were contacted to request a formal field review of the trenches and logs, but both groups declined.

GEOLOGY

Seismotectonic Setting

The property is located in northeastern Salt Lake Valley about 0.3 miles southwest of the western base of the Wasatch Range. Salt Lake Valley is a deep, sediment-filled structural basin of Cenozoic age that is bounded by two uplifted range blocks, the Oquirrh Mountains and the Wasatch Range (to the west and east, respectively). The valley lies at the eastern edge of the Basin and Range physiographic province (Stokes, 1977, 1986). The Basin and Range province is characterized by a series of generally north-trending elongate mountain ranges, separated by predominately alluvial and lacustrine sediment-filled valleys and typically bounded on one or both sides by major normal faults (Stewart, 1978). The boundary between the Basin and Range and Middle Rocky Mountains provinces is the prominent, west-facing escarpment along the Wasatch fault zone at the western base of the Wasatch Range. Late Cenozoic normal faulting, a characteristic of the Basin and Range, began between about 17 and 10 Ma (million years ago) in the Nevada (Stewart, 1980) and Utah (Anderson, 1989) portions of the province. The faulting is a result of a roughly east-west directed, regional extensional stress regime that has continued to the present (Zoback and Zoback, 1989; Zoback, 1989).

The Wasatch fault zone is one of the longest and most active normal-slip faults in the world, and extends for 213 miles along the western base of the Wasatch Range from southeastern Idaho to north-central Utah (Machette and others, 1992). The fault zone generally trends north-south and, at the surface, can form a zone of deformation up to several hundred feet wide containing many subparallel west-dipping main faults and east-dipping antithetic faults. Previous studies divided the fault zone into 10 sections, each of which rupture independently and are capable of generating large-magnitude surface-faulting earthquakes (Machette and others, 1992). The central five sections of the fault (Brigham City, Weber, Salt Lake, Provo, and Nephi) have each produced two or more surface-faulting earthquakes in the past 6,000 years (Black and others, 2003).

The site is located partly within Salt Lake County's Surface Fault Rupture Special Study Area at the northern end of the East Bench fault subsection of the active Salt Lake City segment of the Wasatch fault zone. The Salt Lake City segment consists of three subsections, from north to south: Warm Springs, East Bench, and Cottonwood, that trend across the heavily populated east side of Salt Lake Valley. The East Bench fault comprises the central portion of the Salt Lake City segment, and forms prominent northwest- to southwest-facing intrabasin fault scarps.

Personius and Scott (1992) and Salt Lake County Planning Division maps show the easternmost splay of two down-to-the-west traces of the East Bench fault crosses the site, but show the fault as approximately located (dashed). These traces diverge from a single splay about 2 miles to the southwest, and then converge again north of the site. The western splay is about 1,300 feet northwest of the site. The main East Bench fault trace

is mapped continuing southward to Holladay near 4500 South Street, where it dies out. The fault zone then steps over about 1.4 miles to the east and continues southward along the Wasatch Range front in the Cottonwood subsection. Lund (2005) indicates preferred earthquake timing for the last four surface-faulting earthquakes on the Salt Lake City segment, mainly based on trenching data from sites on the Cottonwood section, is: (1) about 1,300 years ago, (2) about 2,450 years ago, (3) about 3,950 years ago, and (4) about 5,300 years ago. The consensus preferred recurrence interval for the Salt Lake City segment, as determined by the Utah Quaternary Fault Working Group, is 1,300 years for the past four surface-faulting earthquakes (Lund, 2005).

Machette and others (1992) indicate the East Bench fault shows evidence for at least two surface-faulting earthquakes, based on trenching data from the Dresden Place site near 550 South and 900 East in Salt Lake City (about 1.3 miles southwest of the property). The earliest documented event likely occurred subaqueously in Lake Bonneville between 12,500 and 25,000 years ago, and appears as monoclinally warped, deep-water sediments with about 10 feet (3 m) of down-to-the-west displacement (Machette and others, 1992). One or more subsequent events after 12,500 years ago produced a minimum of 13 feet (4 m) of brittle deformation expressed as planar fault ruptures that extended to the top of native sediments under man-made fill (Machette and others, 1992). We note that the Dresden Place site investigated only the western trace of the East Bench fault discussed above. To the best of our knowledge, no previous studies at the University of Utah have documented Holocene faulting on the eastern splay, and no supporting subsurface evidence for this inferred fault has been documented.

The site is also in the central portion of the Intermountain Seismic Belt (ISB), a generally north-south trending zone of historical seismicity along the eastern margin of the Basin and Range province extending from northern Arizona to northwestern Montana (Sbar and others, 1972; Smith and Sbar, 1974). At least 16 earthquakes of magnitude 6.0 or greater have occurred within the ISB since 1850; the largest of these earthquakes was a M_S 7.5 event in 1959 near Hebgen Lake, Montana. However, none of these earthquakes occurred along the Wasatch fault or other known late Quaternary faults (Arabasz and others, 1992; Smith and Arabasz, 1991). The closest of these events was the 1934 Hansel Valley (M_S 6.6) event north of the Great Salt Lake.

Unconsolidated Deposits

Personius and Scott (1992) map the site in Pleistocene lacustrine deposits related to Lake Bonneville, and Holocene to uppermost Pleistocene alluvium (units lbm, afb, and af2; Figure 2). Given the relatively simple geology of the site and surrounding area, Figure 2 was enlarged to a scale of 1:24,000 from the original map scale of 1:50,000. The eastern splay of the East Bench fault crosses the site, but the western splay is about 1,300 feet to the northwest (Figure 2). Personius and Scott (1992) describe surficial geologic units in the site vicinity, from youngest to oldest in age, as follows:

f - Manmade fill (historic). Most consist of locally derived surficial deposits of variable grain size; used as engineered fills for highways, railways, and buildings; also includes assorted materials in landfills and tailing piles and ponds. Thickness >1 m.

chs - *Hillslope colluvium (Holocene to upper Pleistocene).* Pebble, cobble, and boulder gravel, usually clast supported, in a matrix of sand and silt; clasts usually angular to subangular, but unit contains some recycled lacustrine gravel of the Bonneville lake cycle. Very poorly sorted; massive to crude parallel bedding. Forms small fans, cones, and debris aprons at the mouths of small canyons and at the bases of bedrock slopes. Deposited by mass-wasting processes, sheetwash, and small debris flows. Thickness 1 to >10 m.

al1 - *Stream alluvium 1 (upper Holocene).* Sand, silt, and minor clay and gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Forms modern flood plain and terraces less than 5 m above modern stream level. Subject to flooding and high water table. Exposed thickness 1-3 m.

al2 - *Stream alluvium 2 (middle Holocene to uppermost Pleistocene).* Sand, silt, clay, and local gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Deposited by streams graded to recessional stands of Lake Bonneville and to lakes of early Holocene age; forms terraces more than 5 m above modern stream level, usually inset into deposits of the Bonneville lake cycle. Exposed thickness 1-5 m.

af2 - *Fan alluvium 2 (middle Holocene to uppermost Pleistocene).* Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silty sand; poorly sorted; casts subangular to round. Thin to thick, parallel bedding and crossbedding; locally massive. Deposited by perennial and intermittent streams, debris flows, and debris floods (hyperconcentrated floods) graded approximately to modern stream level. May contain small deposits of units af1 and cd1, especially near fan heads and along active stream channels. No shorelines present on surfaces. Typical soil profiles range from A-Bw-Cox-Cn to A-Bt(weak)-Cox-Cn. Thickness 1 to >10 m.

afb - *Fan alluvium related to transgressive phase (upper Pleistocene).* Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silty sand; poorly sorted; clasts subangular to round. Thin to thick, parallel bedding and crossbedding; locally massive. Deposited by streams graded to shorelines of the transgressive phase of the Bonneville lake cycle, and forms fans graded to these shorelines. May be covered by thin deposits of post-transgressive phase alluvium and colluvium. Typical soil profile, A-Bt-Cox-Cn. Thickness 1 to >10 m.

lpm - *Lacustrine clay and silt related to regressive phase (uppermost Pleistocene).* Clay, silt, and minor sand deposited in quiet water areas along the Provo shoreline. Thickness >1 m.

lbpm - *Lacustrine clay and silt, undivided (upper Pleistocene).* Clay, silt, and minor fine sand and pebble gravel; bedding locally disrupted by soft-sediment deformation or liquefaction. Deposited in deep and (or) quiet water in lower part of basin. Usually grades laterally into other deposits of the Bonneville lake cycle. Unit probably contains small deposits of unit clsp in urbanized areas. Thickness 1 to >10 m.

lbm - *Lacustrine clay and silt related to transgressive phase (upper Pleistocene).* Clay, silt, and minor fine sand; locally contains medium to coarse sand and pebble gravel. Good sorting within beds; deposited in very thin to thick, parallel and crossbedded, horizontal to gently dipping beds; bedding locally disrupted by soft-sediment deformation or liquefaction. Deposited in quiet-water environments, in sheltered bays between headlands, in lagoons behind barrier bars, or on lake floor in deeper water. Usually overlie coarse-grained transgressive shoreline deposits, implying deposition in increasingly deeper, quieter water. Thickness 1-25 m.

lbg - *Lacustrine sand and gravel related to transgressive phase of Lake Bonneville (upper Pleistocene).* Clast-supported pebble, cobble, and rarely boulder gravel, in a matrix of sand and pebbly sand; locally includes interbedded silt and clay ranging from thin beds and lenses to lagoonal deposits as much as 10 m thick. Good sorting within beds; clasts subround to round. Deposited in parallel and crossbedded, thin to thick beds, dipping from horizontal to as much as 15°. Base is bouldery in some places. Deposited in beaches, bars, spits, and small deltas and lagoons. Mapped between the Provo and Bonneville shorelines (1,463-1,585 m; 4,800-5,200 ft). Commonly covered by deposits of hillslope colluvium (chs), but typically forms wave-built bench at the Bonneville shoreline and at several less well developed beach berms between the Provo and Bonneville shorelines. Thickness 1-25 m.

Lake Bonneville History

Lakes occupied nearly 100 basins in the western United States during late-Quaternary time, the largest of which was Lake Bonneville in northwestern Utah. The Bonneville basin consists of several topographically closed basins created by regional extension in the Basin and Range (Gwynn, 1980; Miller, 1990), and has been an area of internal drainage for much of the past 15 million years. Lake Bonneville consisted of numerous topographically closed basins, including the Salt Lake and Cache Valleys (Oviatt and others, 1992). Sediments from Lake Bonneville comprise much of the unconsolidated deposits in the site vicinity.

Timing of events related to the transgression and regression of Lake Bonneville is indicated by calendar age estimates of significant radiocarbon dates in the Bonneville Basin (Donald Currey, University of Utah; written communication to the Utah Geological Survey, 1996; and verbal communication to the Utah Quaternary Fault Parameters Working Group, 2004). Approximately 32,500 years ago, Lake Bonneville

began a slow transgression (rise) to its highest level of 5,160 to 5,200 feet above mean sea level. The lake rise eventually slowed as water levels approached an external basin threshold in northern Cache Valley at Red Rock Pass near Zenda, Idaho. Lake Bonneville reached the Red Rock Pass threshold and occupied its highest shoreline, termed the Bonneville beach, after about 18,000 years ago. The lake remained at this level until 16,500 years ago, when headward erosion of the Snake River-Bonneville basin drainage divide caused a catastrophic incision of the threshold and the lake level lowered by roughly 360 feet in fewer than two months (Jarrett and Malde, 1987; O'Conner, 1993). Following the Bonneville flood, the lake stabilized and formed a lower shoreline referred to as the Provo shoreline. Climatic factors then caused the lake to regress rapidly from the Provo shoreline, and by about 13,000 years ago the lake had eventually dropped below historic levels of Great Salt Lake. Oviatt and others (1992) deem this low stage the end of the Bonneville lake cycle. Great Salt Lake then experienced a brief transgression between 12,800 and 11,600 years ago to the Gilbert level at about 4,250 feet before receding to and remaining within about 20 feet of its historic average level (Lund, 1990). The site is located below the Bonneville shoreline, at slightly above and below the elevation of the Provo shoreline.

SUBSURFACE INVESTIGATION

To evaluate subsurface geologic conditions at the site and assess the surface fault rupture hazard, a field exploration plan was developed to excavate three generally southwest-trending trenches across the site using a large backhoe. Two trenches were west of Wasatch Drive and one trench was to the east. Because Wasatch Drive could not be closed, a gap of about 113 feet was created in subsurface data between two trenches. Stratigraphic correlations across this gap are discussed below.

Figure 3 shows locations of the trenches in relation to the proposed site plan at a scale of 1 inch equals 200 feet (1:2,400). Trench locations were measured by a hand-held GPS accurate to within 10 feet (3m), and corrected by tape distances and trends from known air photo locations. Based on the above methodology, we deem the trench locations accurate to within 1 foot. Trench 1 (T-1) extended sinuously an overall S75°W along the north side of Federal Way for a total distance of 696.5 feet. Trench 2 (T-2) was south of Federal Way and extended S73°W for a total distance of 188.6 feet, from about 122 feet southwest of the east end of T-1 to 21 feet west of Wasatch Drive. Trench 3 (T-3) was east of Wasatch Drive about 113 feet east of the east end of T-2, and extended sinuously an overall S80°W for a total distance of 500 feet.

Although the area explored by trenching extends beyond the special study zone to the east, because of the presence of a waterline utility easement that passes through the west side of the golf course (no excavation was permitted within 20 feet of either side of the pipeline), trench T-1 could not be extended to the western edge of the project boundary. Thus our subsurface exploration extends to within about 80 feet of the western boundary of the Surface Fault Rupture Special Study Area. The 500-foot-wide special study area boundary for the downthrown side of mapped faults was based on the maximum width of fault deformation observed on the southern part of the Salt Lake Segment (near Bells Canyon, for example). It is our experience, based on

field evidence from numerous other subsurface investigations conducted along the western (downthrown) side of the East Bench Fault, that no evidence of active fault rupture-related deformation has been documented in the area beyond 400 feet from the active fault trace. Based on this, and the correlation evidence that suggests that the fault is actually located over 500 feet further east than shown on U.S.G. S. mapping, we believe the trenches provide sufficient subsurface information age to adequately characterize the surface fault rupture hazard for the proposed site development.

Figures 4 through 6 are detailed logs of the trenches at a scale of 1 inch equals 5 feet (1:60). Due to the scale of the trenches, each figure covers several sheets. Excavation was complicated in places by areas of fill associated with golf course irrigation lines, historical site development, and hard cemented deposits. Although lacustrine sediments associated with Lake Bonneville could not be completely exposed across the site due to their depth, the trenches extended completely through all fill materials and into sediments of sufficient age to indicate active faulting (less than 10,000 years old) if any was present. Trench logging followed methodology in McCalpin (1996).

All three trenches at the site exposed a similar stratigraphic sequence of latest Pleistocene to Holocene lacustrine and alluvial sediments, except for T-2 which did not expose the lake sediments. This stratigraphic sequence (numbered from oldest to youngest in age on Figures 4-6) consists of:

Unit 1. *Lacustrine sand and gravel related to the transgressive stage of Pleistocene Lake Bonneville* – pale-brown, pale-grayish-brown, and reddish-brown sequence of sand with gravel and lesser silt and cobbles (SW); low to high density; poorly bedded, with discontinuous silt and cemented gravel lenses in places (stage III-IV carbonate); clasts round to subround, mainly quartzite; likely correlates to Personius and Scott's (1992) unit lbg described above, although mapped as unit lbm at the site on Figure 2.

Unit 2. *Latest Pleistocene to early Holocene alluvium deposited during the transgressive stage of Lake Bonneville and after lake regression* – brown to pale-brown, moderate to high density, poorly bedded to massive, sandy gravel to gravelly sand (GW/SW) with cobbles and boulders; clasts subangular to subround, with cemented zones (stage III-IV carbonate) in places, some of which caused backhoe refusal; clasts include degraded red sandstone; contains discontinuous and gravel channels in places; likely correlates to Personius and Scott's (1992) units afb and af2.

- **2A.** Partly disturbed modern A-horizon soil formed in unit 2 at surface.
- **2B.** B_K-horizon formed in unit 2.

Unit 3. *Early to mid-Holocene post-Lake Bonneville alluvium* – brown to pale-brown, moderate to high density, massive to poorly bedded, silty sand to sandy silt (SM/ML) with trace gravel and cobbles; clasts subangular to subround with strong stage II carbonate; coarsens slightly westward in T-1 where it includes several discontinuous, topset gravelly lenses; likely correlates to Personius and Scott's (1992) unit af2.

- **3A.** Partly disturbed modern A-horizon soil formed in unit 3 at surface.
- **3B.** B_K-horizon formed in unit 3.

Unit 4. *Holocene alluvium and slope wash* – Brown, reddish-brown, and dark-brown, generally massive, low density, sandy silt to silty sand (ML/SM) with gravel; slightly root penetrated and bioturbated (burrowed) in places.

4A. Partly disturbed modern A-horizon soil formed in unit 4 at surface.

4B. B_{WK}-horizon formed in unit 4.

No direct evidence of faulting, such as displaced stratigraphic horizons, vertical clast alignments or terminations, or fault-zone colluvium was observed in the trench excavations. No evidence of the inferred East Bench fault trace mapped across the site (Figures 2 and 3) was observed in T-1 at its mapped location. However, unit 2 appears to be possibly texturally backtilted to the east in T-1 (Figure 4F), perhaps from prograding alluvial deposition into a depression. Correlations of the upper contacts of units 1 and 2 between Figures 4B and 4F show no evidence of fault displacement, but demonstrate the post-Lake Bonneville alluvial sequence (units 2 through 4) is thickening eastward. The upper contact of unit 1 best demonstrates evidence for prior faulting at the site, consisting of about 2.5 degrees of backtilting east of the hinge point on Figure 4F. Figure 7 shows the correlation of the upper contact of unit 1 across Wasatch Drive between T-3 and T-1. This correlation suggests that a fault may be located slightly east of Wasatch Drive, with a vertical offset of about 15 feet and a net displacement (subtracting backtilting) of 4 to 9 feet (Figure 7). The crest of the fault scarp is near station 360 feet horizontal in T-3 (Figure 6E). West of this location on Figures 6E-F, the upper contact of unit 1 shows a steepening westward dip into the T-3 floor, and then unit 1 appears again in T-1 in the background vibration test pit (Figures 4A-B) at a roughly 15-foot depth. We note that unit 2 displayed several sandy channels west of station 360 feet horizontal (Figure 6F), possibly from erosion of the fault scarp crest. West of the background vibration test pit (Figures 4A-B), the upper contact of unit 1 trends closer to the surface to a hinge point on Figure 4F, and then resumes native dip.

Based on correlations of subsurface deposits (Figure 7) and the trenching evidence as described above, we infer that the East Bench fault eastern splay is actually located slightly east of Wasatch Drive, over 500 feet east of its mapped inferred location as shown in Figure 3. The inferred fault location appears to correspond well with the eastern contact between units afb and lbm on Figure 2. The fault appears to have displaced unit 1 and then was mantled by subsequent post-Lake Bonneville alluvium that concealed its location. We believe this faulting corresponds to Machette and others' (1992) subaqueous Lake Bonneville event at the Dresden Place site (described in the Seismotectonic Setting Section above) between 12,500 and 25,000 years ago, which displayed monoclinal displacement of a similar amount. Such faulting would not be considered active because of its age (more than 10,000 years). Younger (active) faulting at the Dresden Place site was evident extending upward through native sediments to the base of the fill (Machette and others, 1992), but we did not observe evidence for the younger faulting in our trenches although the exposed sediments were of sufficient age to display such evidence.

CONCLUSIONS AND RECOMMENDATIONS

The site is crossed by the easternmost splay of two west-dipping traces of the East Bench fault, which comprise the central part of the active Salt Lake City segment of the Wasatch fault zone. Surficial geology of the site is mapped as Lake Bonneville sediments and post-lake alluvium. The western part of the site is in the Surface Fault Rupture Special Study Area on Salt Lake County Planning Division maps. Three trenches were excavated at the site to evaluate the hazard from surface fault rupture. The trenches exposed no evidence of active faults, but stratigraphic correlations between trenches 1 and 3 suggest that a buried fault may be located slightly east of Wasatch Drive that displaces Pleistocene Lake Bonneville sediments. This fault is overlain by post-lake alluvium that conceals it and shows no evidence for deformation. The faulting appears to correspond to subaqueous faulting observed in Lake Bonneville sediments at the Dresden Place site on the East Bench fault, which would not be considered active because of its age. No evidence for active faulting was observed in our trenches. Even if active faulting is present in the gap between our trenches along Wasatch Drive, such faulting would pose a low risk since it is sufficiently distant from the proposed structures at the site (more than 100 feet).

Based on the information observed at the site and the geologic characterizations in this report, the hazard from surface fault rupture is expected to be low. No evidence for active faulting was observed at the site, although older faulting is believed present east of the proposed structures at the site. A geotechnical investigation is recommended to provide design-level recommendations for cut and fill, site grading, footing and foundation design, and drainage during the construction phase of the project.

Availability of Report

The report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. This report should be referenced for information on technical data only as interpreted from observations and not as a warranty of conditions throughout the site. The report should also be submitted in its entirety, or referenced appropriately, as part of any document submittal to a local or state government entity responsible for planning decisions or geologic review. We consider partial submittals to be unauthorized alterations, thereby voiding the professional certifications and signatures we provide herein.

Excavation Backfill Considerations

The trenches may be in areas where structures could subsequently be placed. However, backfill may not have been replaced in the trenches in compacted layers. The fill could settle with time and upon saturation. Should structures be located in a trenched area, no footings or structure should be founded over the trench excavations unless the backfill has been removed and replaced with structural fill, if the fill is to support a structure.

LIMITATIONS

This investigation was performed at the request of the Client using the methods and procedures consistent with good commercial and customary practice designed to conform to acceptable industry standards. The analysis and recommendations submitted in this report are based upon the data obtained from site-specific observations and compilation of known geologic information. This information and the conclusions of this report should not be interpolated to adjacent properties without additional site-specific information. In the event that any changes are later made in the location of the proposed site, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or approved in writing by the engineering geologist.

This report has been prepared by the staff of Western GeoLogic for the Client under the professional supervision of the principal and/or senior staff whose seal(s) and signatures appear hereon. Neither Western GeoLogic, nor any staff member assigned to this investigation has any interest or contemplated interest, financial or otherwise, in the subject or surrounding properties, or in any entity which owns, leases, or occupies the subject or surrounding properties or which may be responsible for environmental issues identified during the course of this investigation, and has no personal bias with respect to the parties involved.

The information contained in this report has received appropriate technical review and approval. The conclusions represent professional judgment and are founded upon the findings of the investigations identified in the report and the interpretation of such data based on our experience and expertise according to the existing standard of care. No other warranty or limitation exists, either expressed or implied.

The investigation was prepared in accordance with the approved scope of work outlined in our proposal for the use and benefit of the Client; its successors, and assignees. It is based, in part, upon documents, writings, and information owned, possessed, or secured by the Client. Neither this report, nor any information contained herein shall be used or relied upon for any purpose by any other person or entity without the express written permission of the Client. This report is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of Western GeoLogic.

In expressing the opinions stated in this report, Western GeoLogic has exercised the degree of skill and care ordinarily exercised by a reasonable prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. Documentation and data provided by the Client, designated representatives of the Client or other interested third parties, or from the public domain, and referred to in the preparation of this assessment, have been used and referenced with the understanding that Western GeoLogic assumes no responsibility or liability for their accuracy.

The independent conclusions represent our professional judgment based on information and data available to us during the course of this assignment. Factual information regarding operations, conditions, and test data provided by the Client or their representative has been assumed to be correct and complete. The conclusions presented are based on the data provided, observations, and conditions that existed at the time of the field exploration.

It has been a pleasure working with you on this project. Should you have any questions, please call.

Sincerely,
Western GeoLogic, LLC

Bill. D. Black, P.G.
Associate Engineering Geologist

Reviewed by:

Craig V Nelson, P.G., R.G., C.E.G.
Principal Engineering Geologist

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ATTACHMENTS

Figure 1. Location Map
Figure 2. Geologic Map
Figure 3. Site Plan and Air Photo
Figure 4A-J. Trench 1 Log
Figure 5A-C. Trench 2 Log
Figure 6A-G. Trench 3 Log
Figure 7. Stratigraphic Correlation

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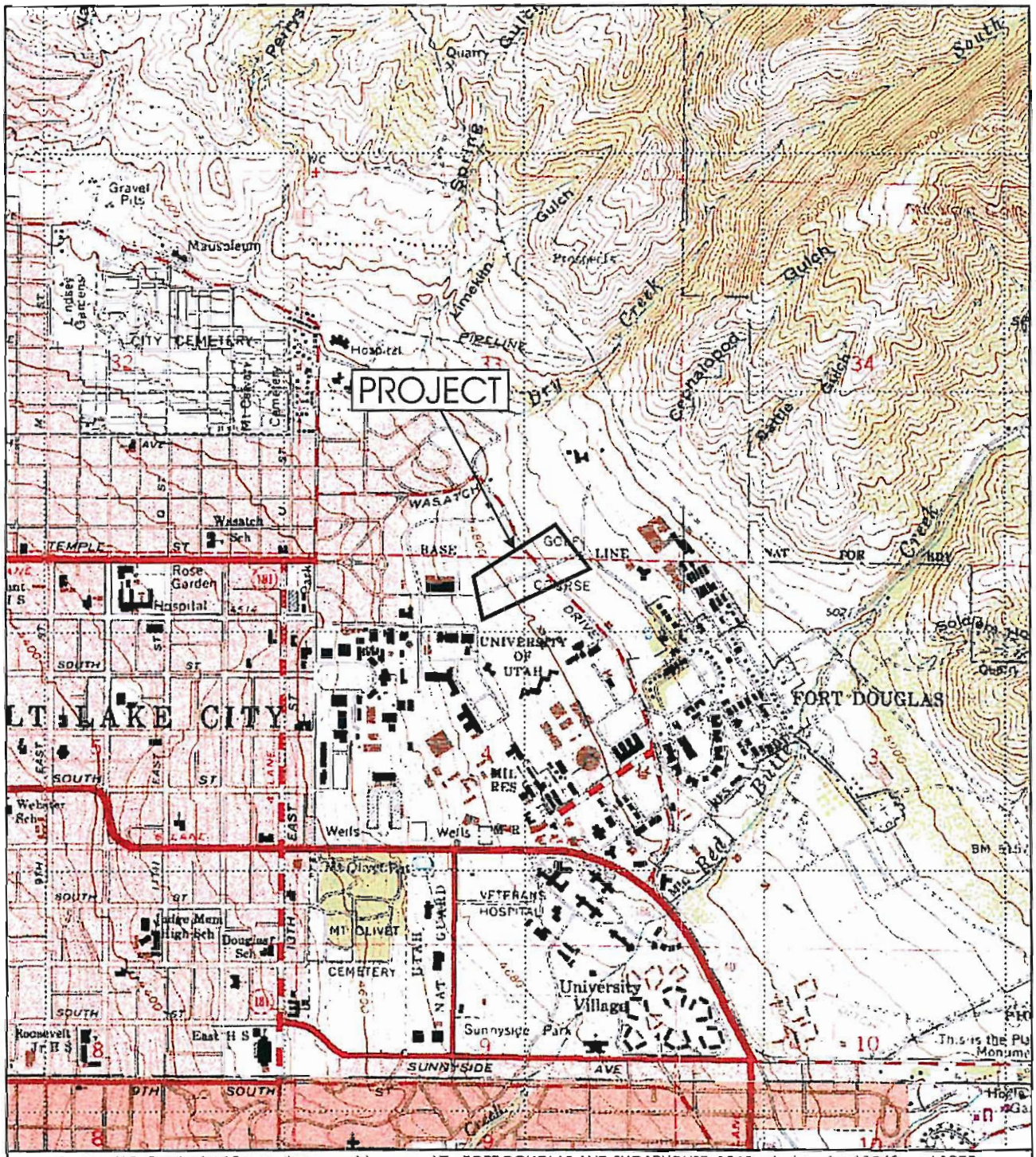

Source: U.S. Geological Survey topographic maps, UT - FORT DOUGLAS AND SUGARHOUSE, 1963, photorevised 1969 and 1975.

WESTERN GEOLOGIC

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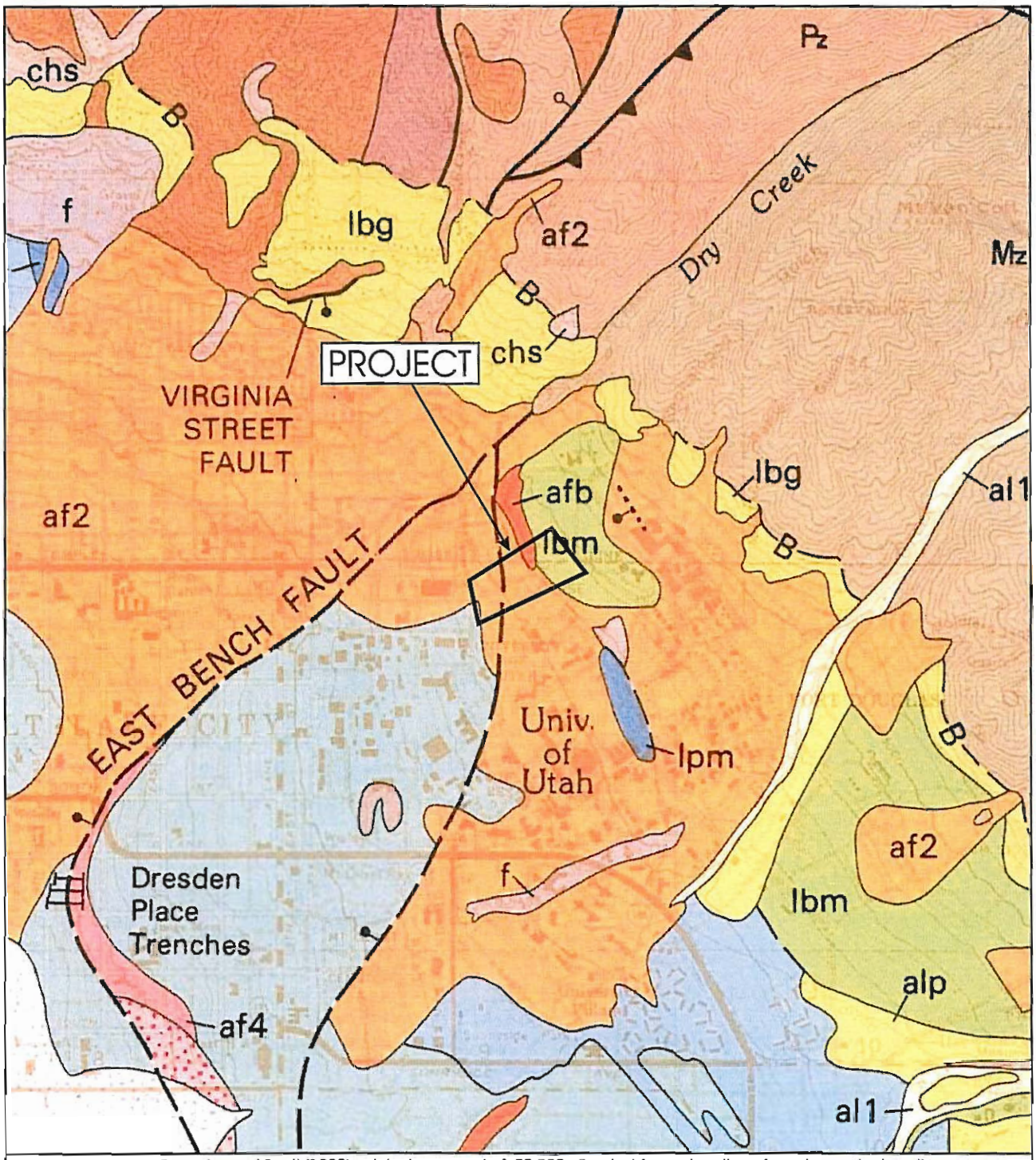
0 1000 2000 feet
Scale 1:24,000
(1 inch = 2000 feet)

LOCATION MAP

SURFACE FAULT RUPTURE HAZARD EVALUATION

Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 1



Source: Personius and Scott (1992), original map scale 1:50,000. See text for explanation of nearby geologic units.

WESTERN GEOLOGIC

N
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0 1000 2000 feet
Scale 1:24,000
(1 inch = 2000 feet)

GEOLOGIC MAP

SURFACE FAULT RUPTURE HAZARD EVALUATION

Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 2

Source: U.S. Geological Survey high resolution urban area photography, Salt Lake City, 2003, 0.3 meter resolution; fault mapping from Salt Lake County Planning and Development Services interactive map at http://maps.slco.org/website/devserv/viewer.htm.

N
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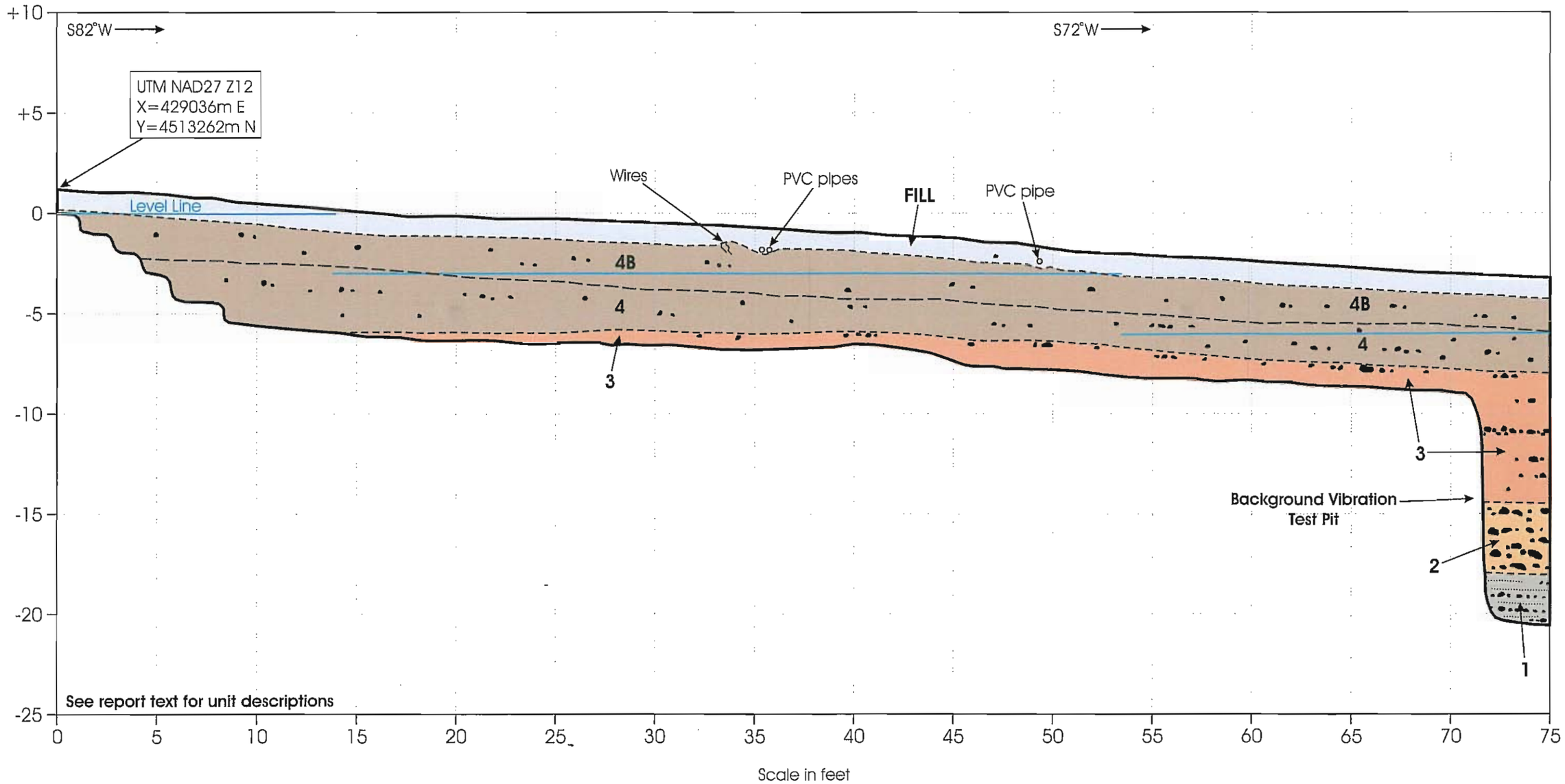
0 100 200 feet
Scale 1:2,400
(1 inch = 200 feet)

WESTERN GEOLOGIC

AIR PHOTO AND SITE PLAN

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 3



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STATE OF UTAH

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(no vertical exaggeration)
South Trench Wall Logged

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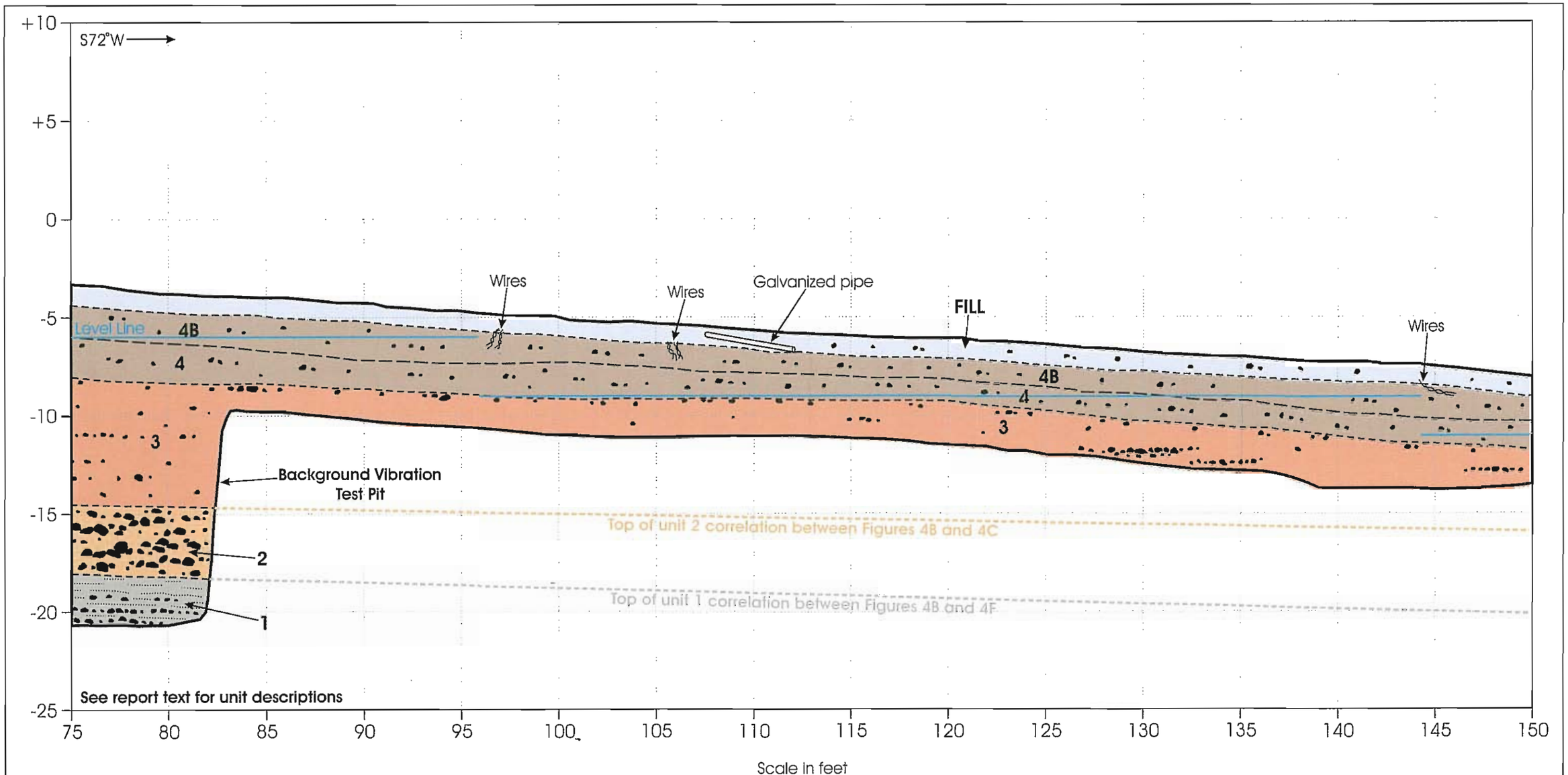
November 5-9, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 1 LOG, SHEET 1

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4A



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SURFACE FAULT RUPTURE HAZARD EVALUATION
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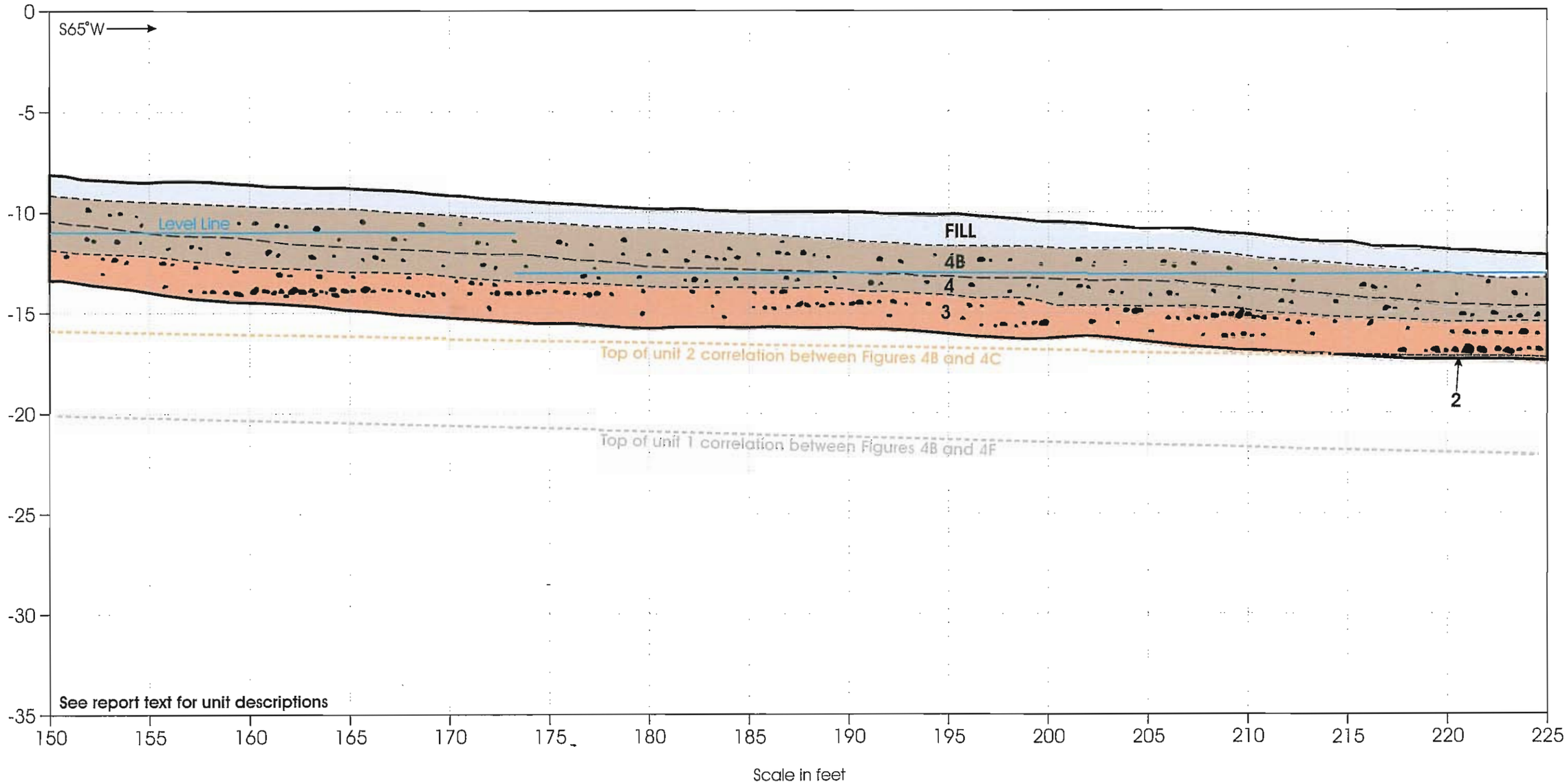
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4B



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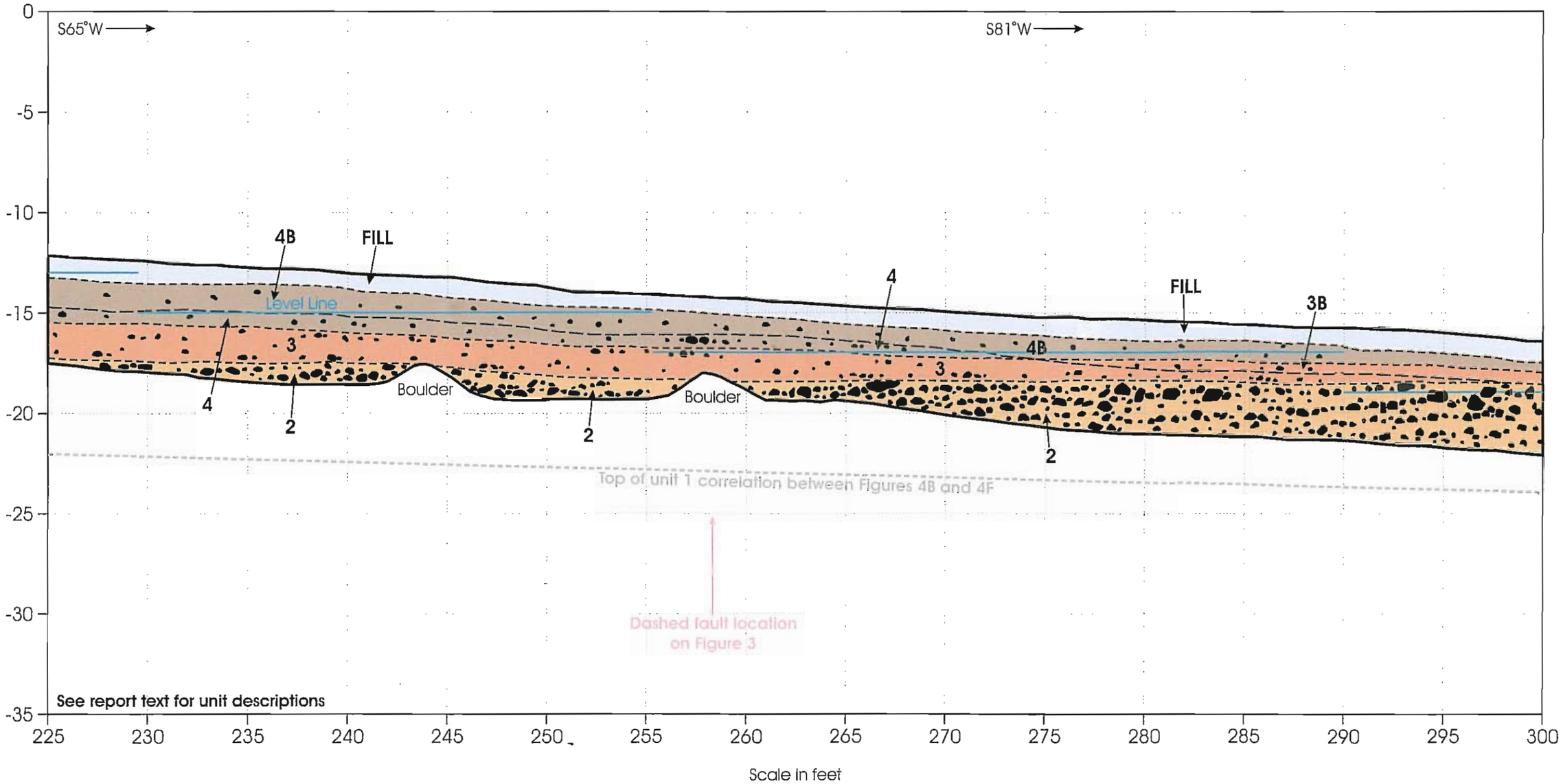
SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4C



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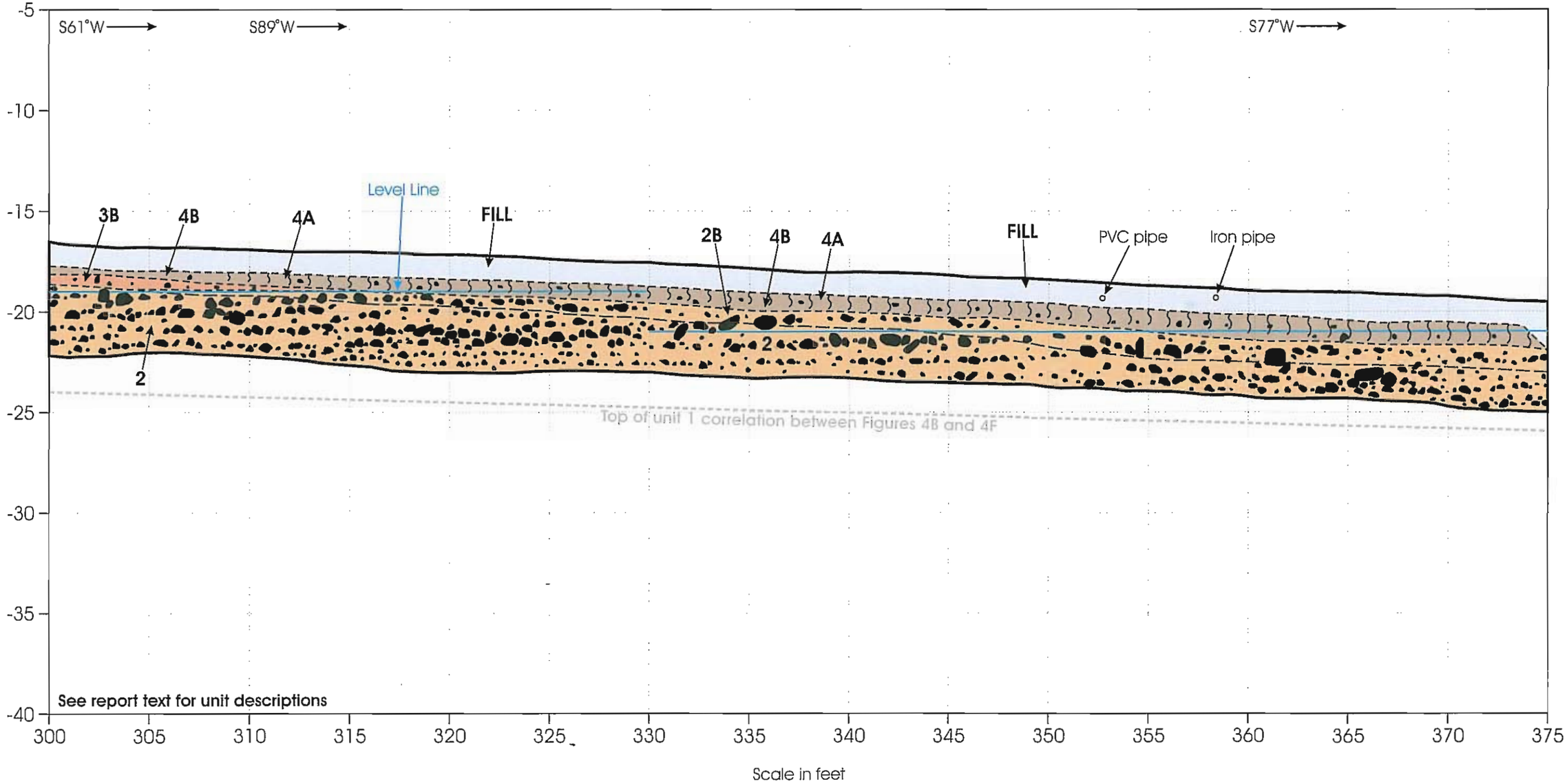
TRENCH 1 LOG, SHEET 4

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4D



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TRENCH 1 LOG, SHEET 5

SURFACE FAULT RUPTURE HAZARD EVALUATION
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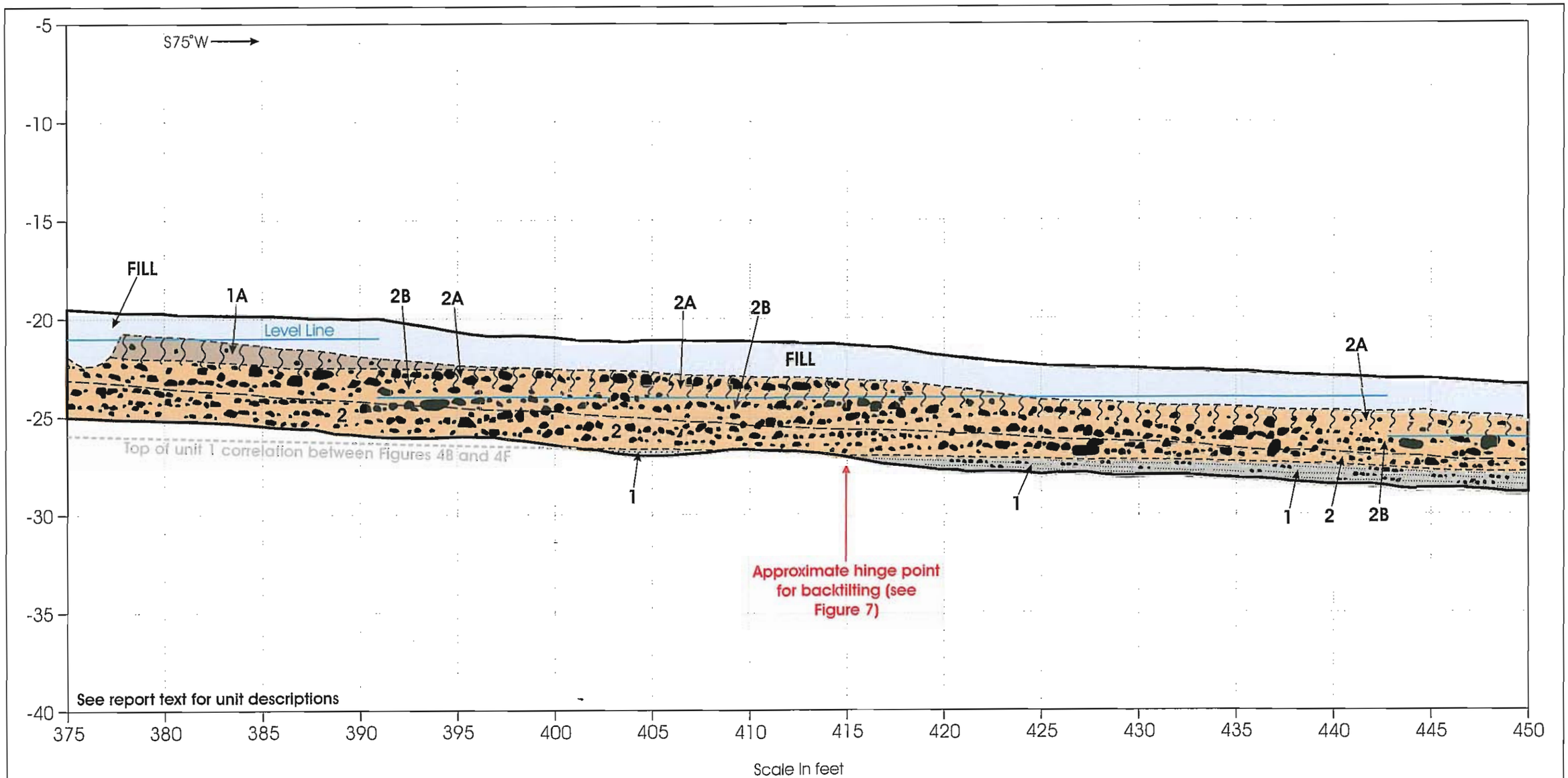
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4E



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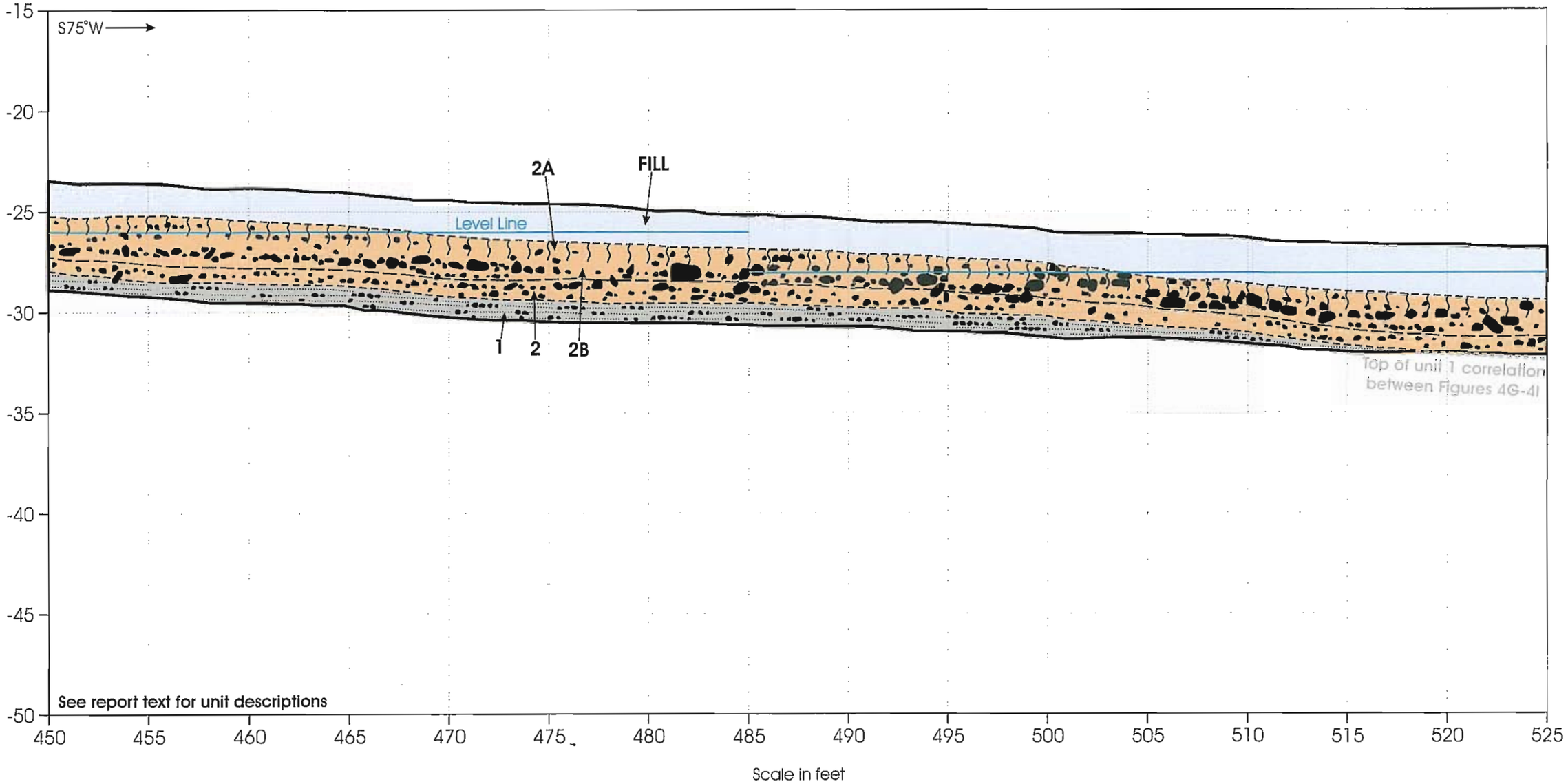
TRENCH 1 LOG, SHEET 6

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City City, Utah

FIGURE 4F



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TRENCH 1 LOG, SHEET 7

SURFACE FAULT RUPTURE HAZARD EVALUATION
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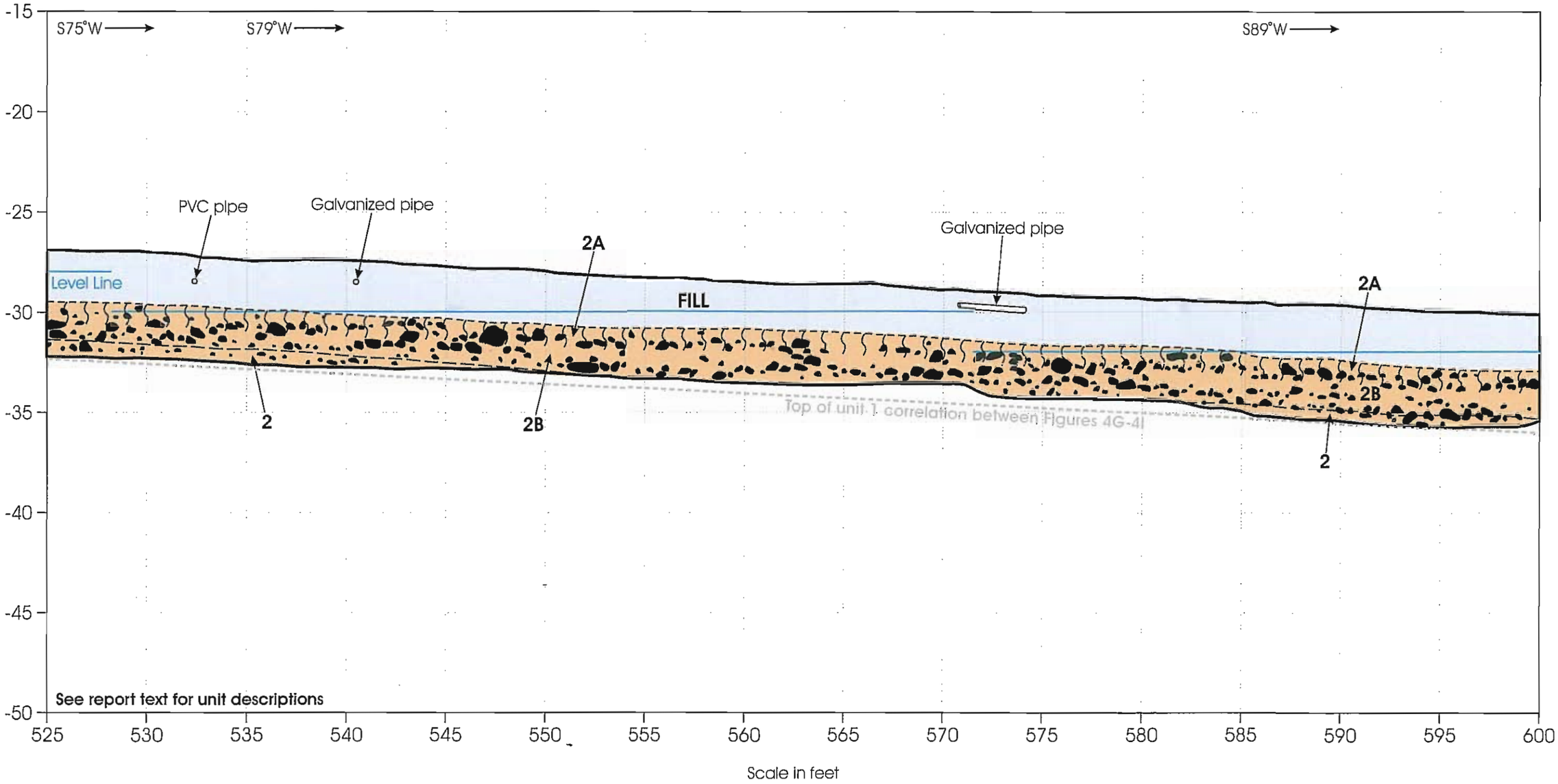
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4G



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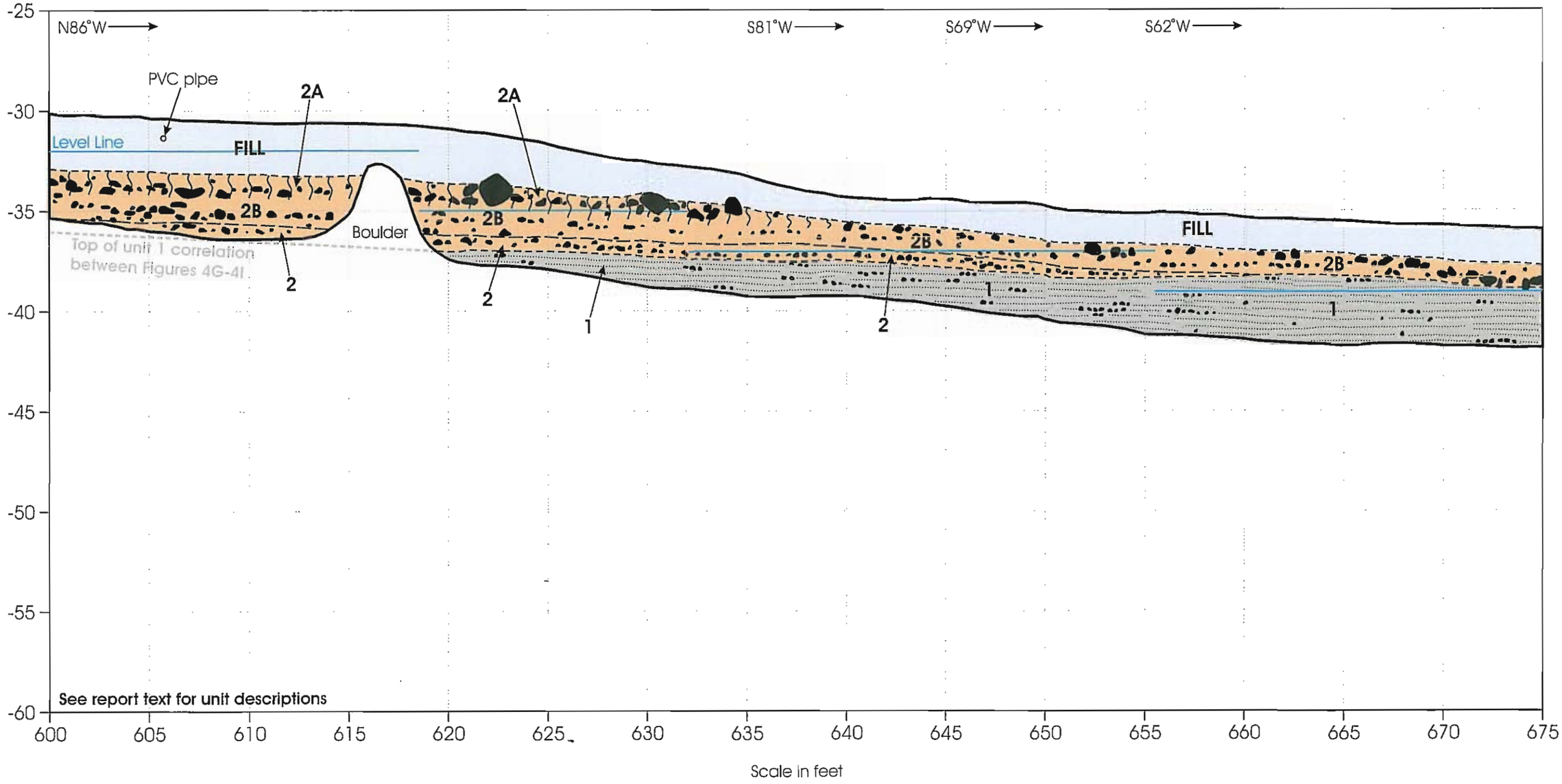
TRENCH 1 LOG, SHEET 8

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4H



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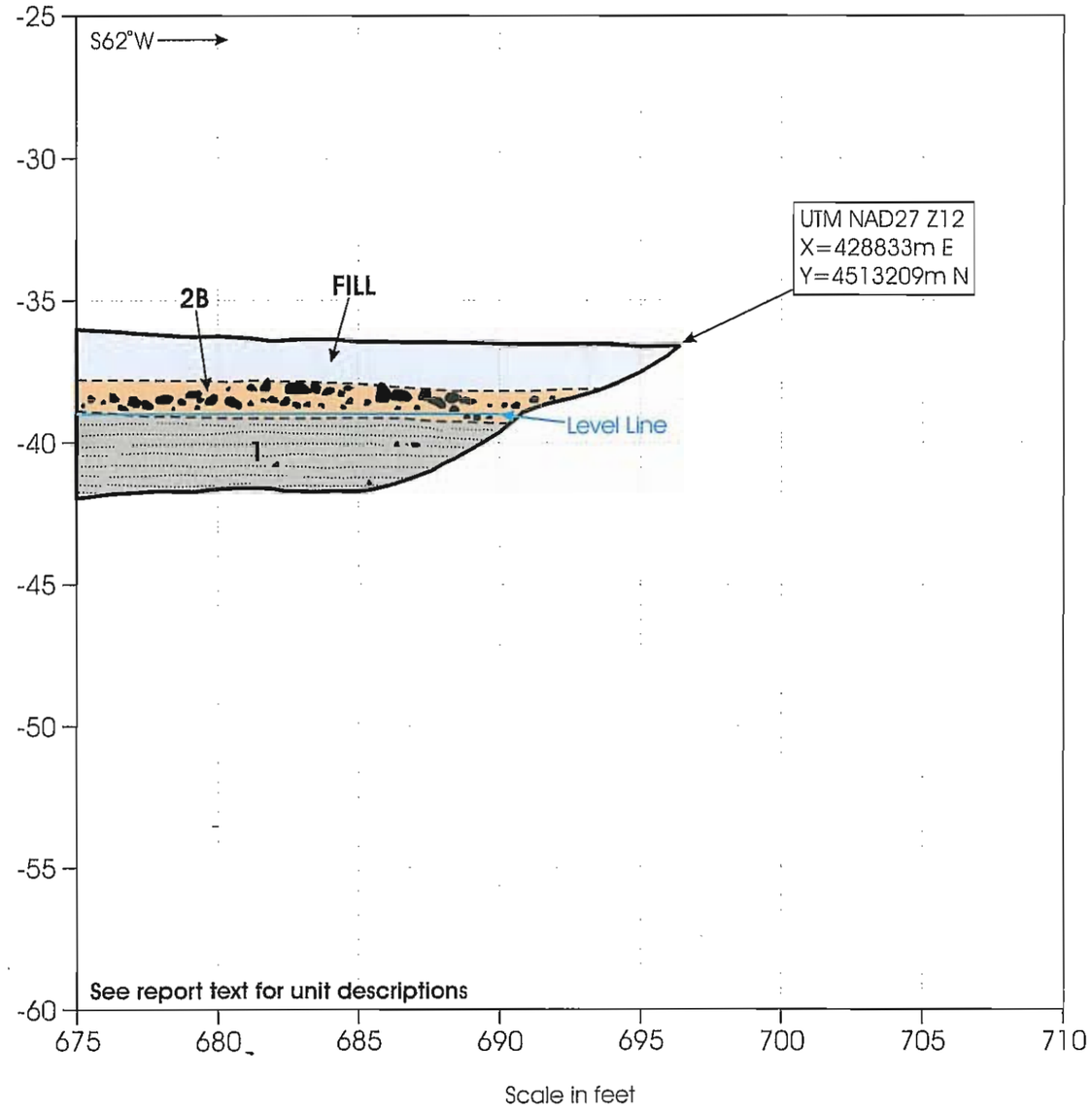
TRENCH 1 LOG, SHEET 9

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4I



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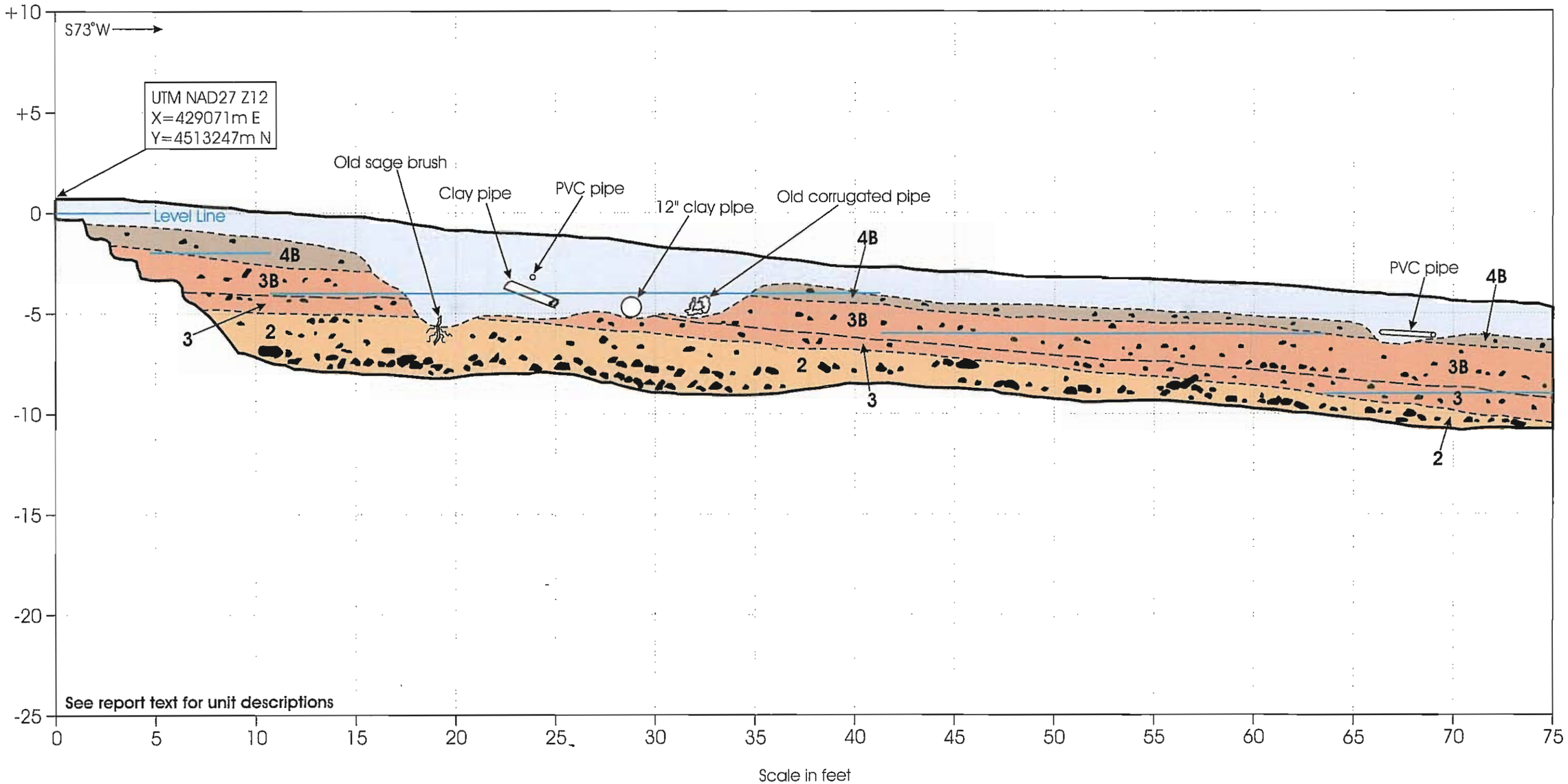
TRENCH 1 LOG, SHEET 10

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 4J



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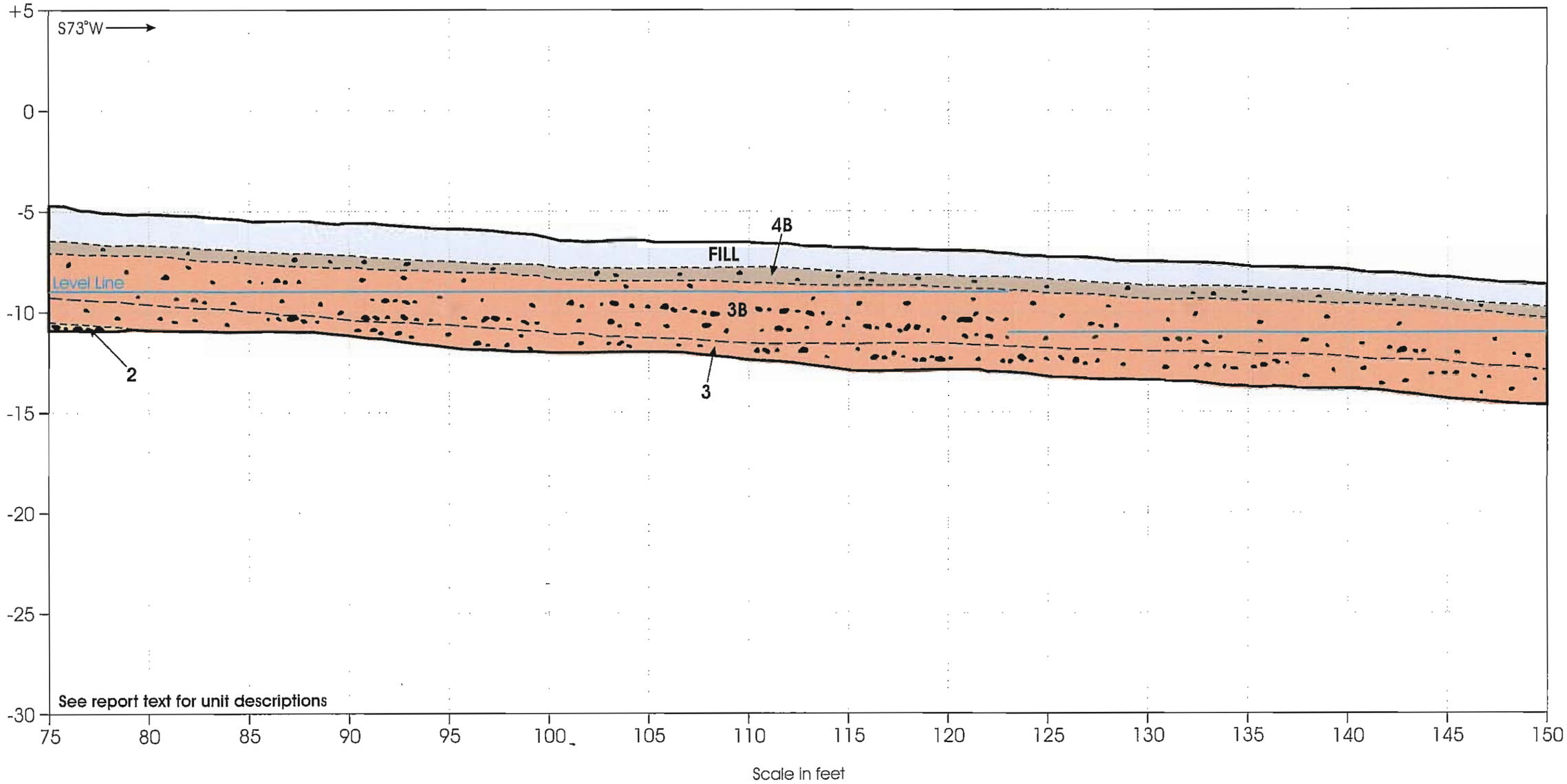
TRENCH 2 LOG, SHEET 1

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 5A



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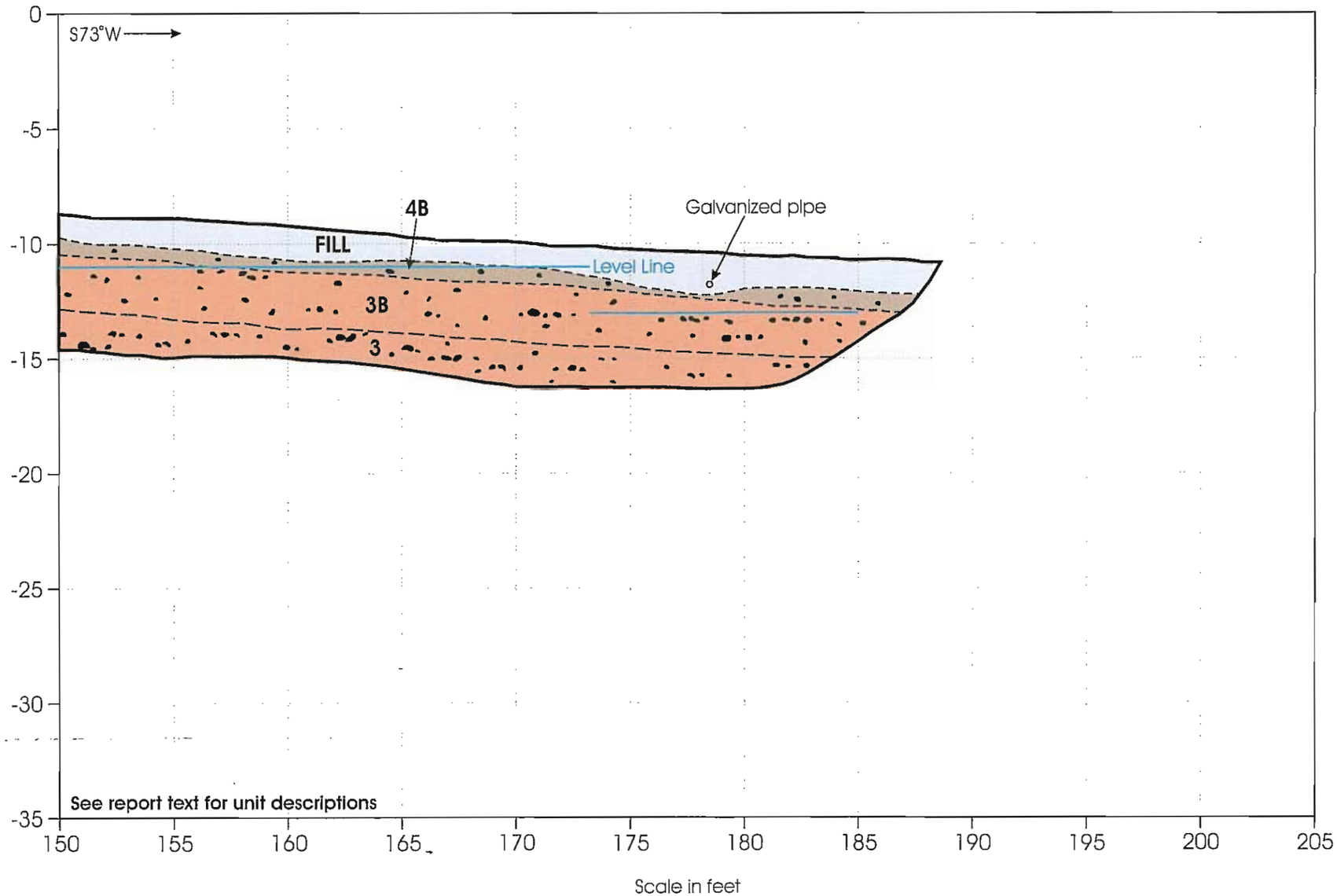
TRENCH 2 LOG, SHEET 2

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 5B



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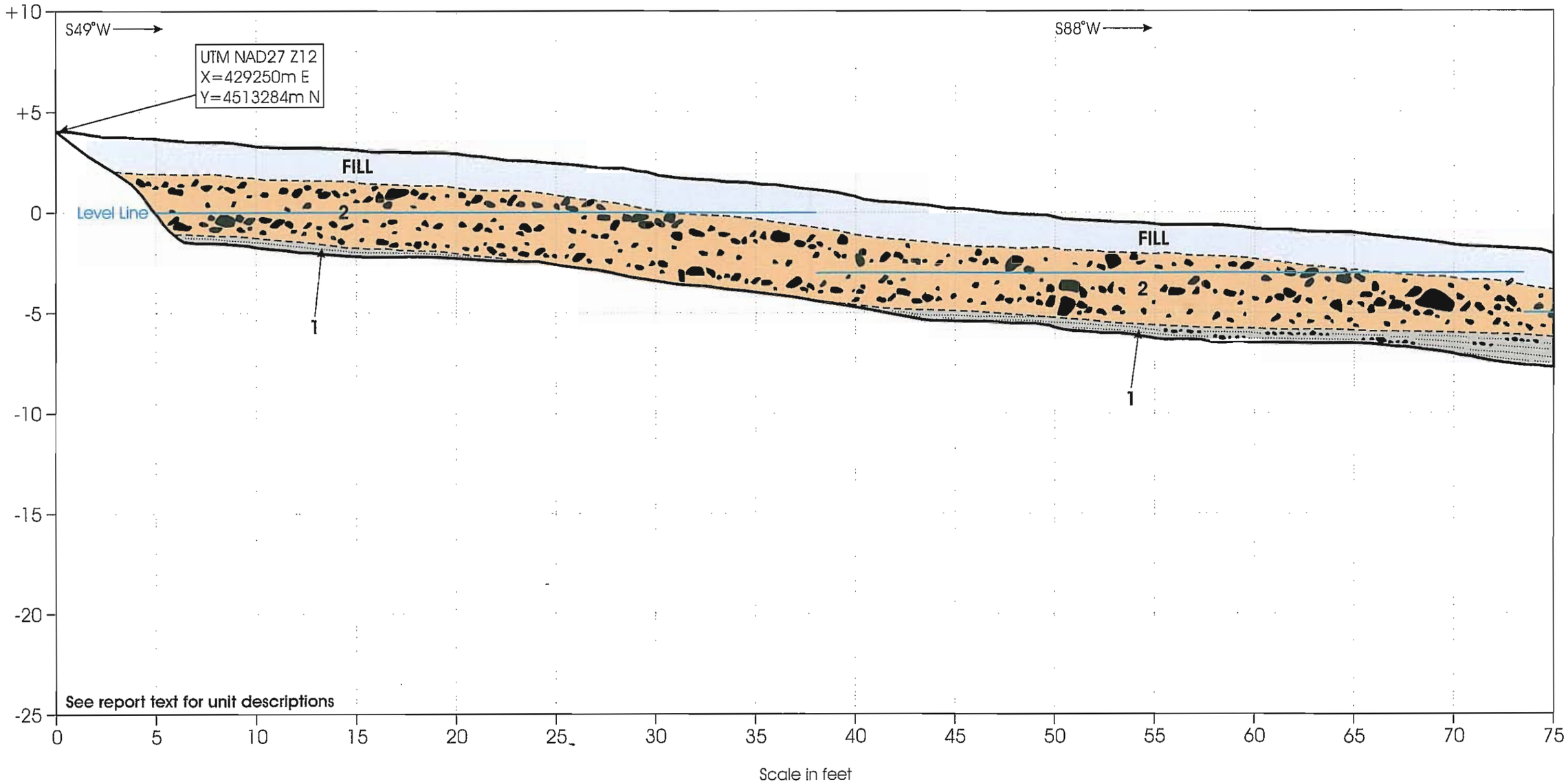
Trench logged by Bill Black, P.G. on
November 9 and 11, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 2 LOG, SHEET 3

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 5C



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

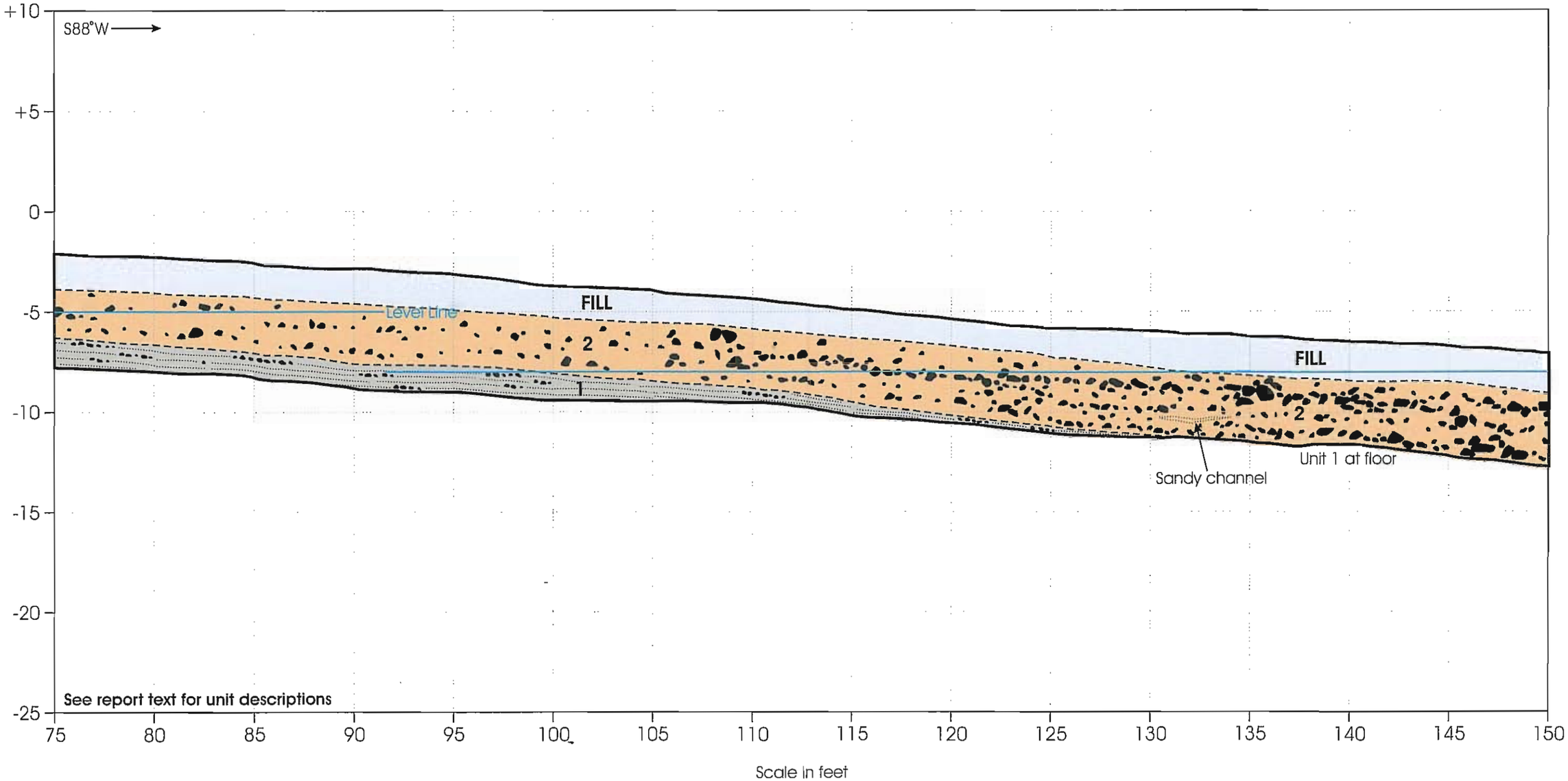
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 1

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6A



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

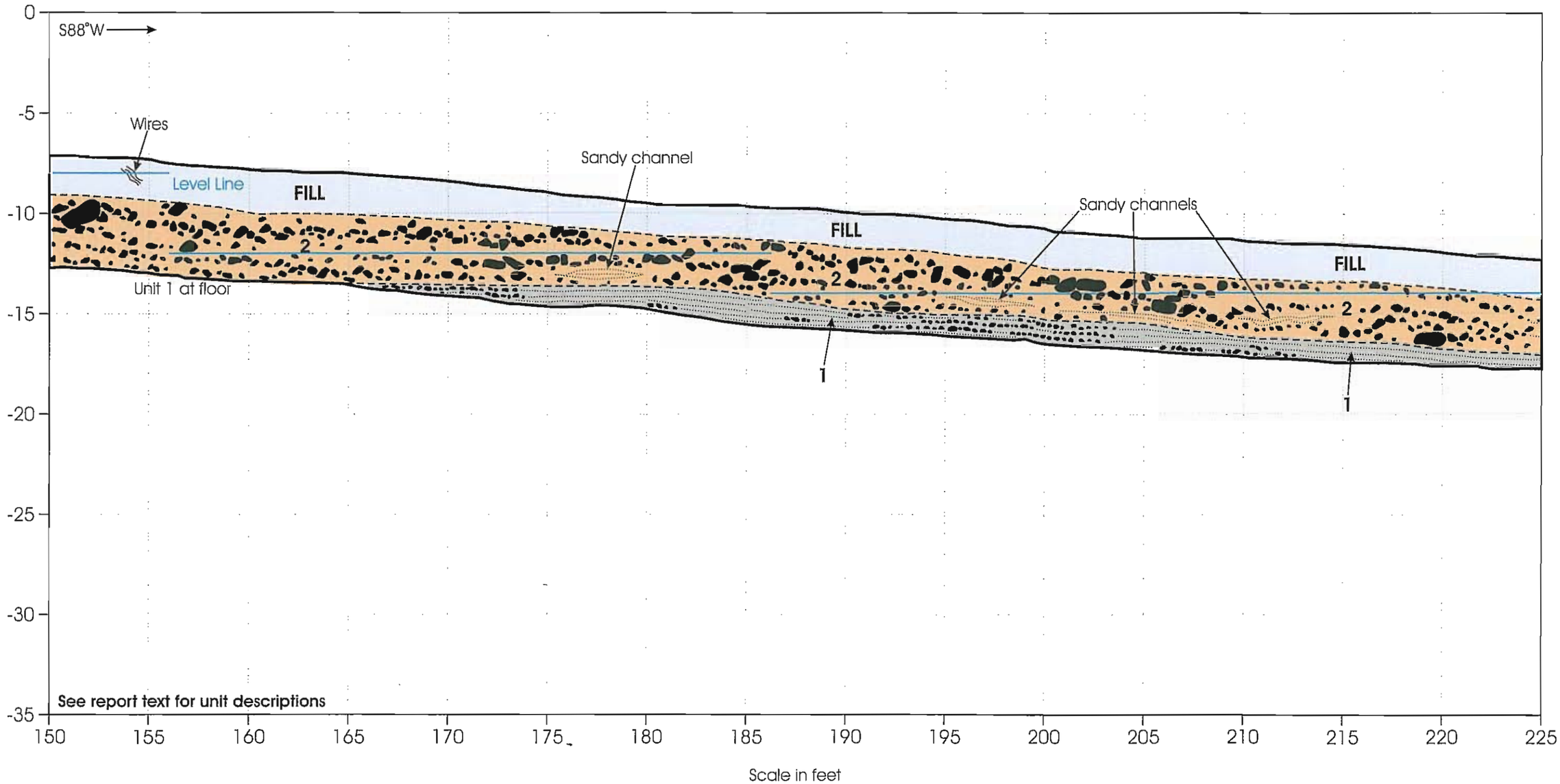
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 2

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6B



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

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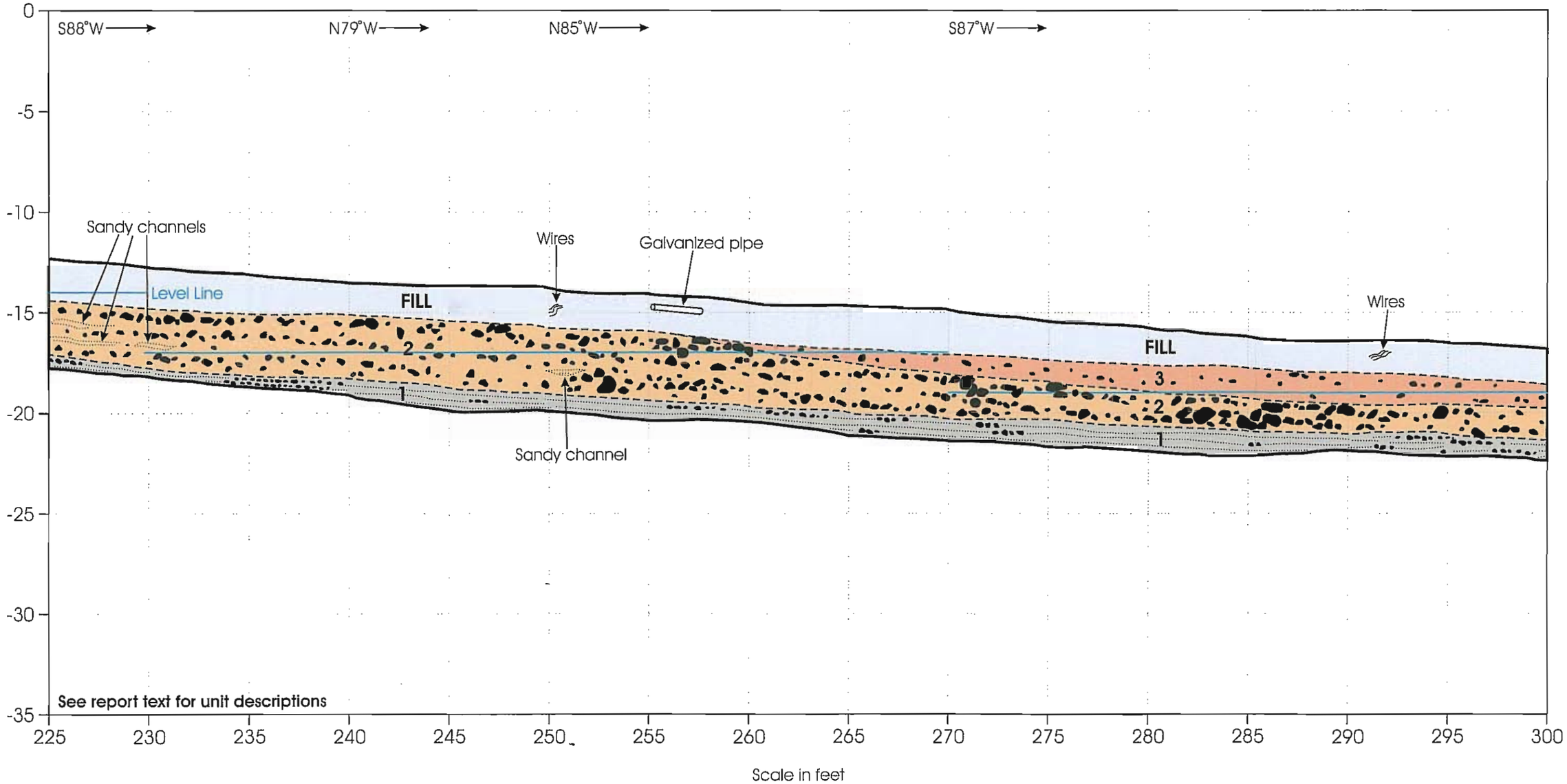
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 3

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6C



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

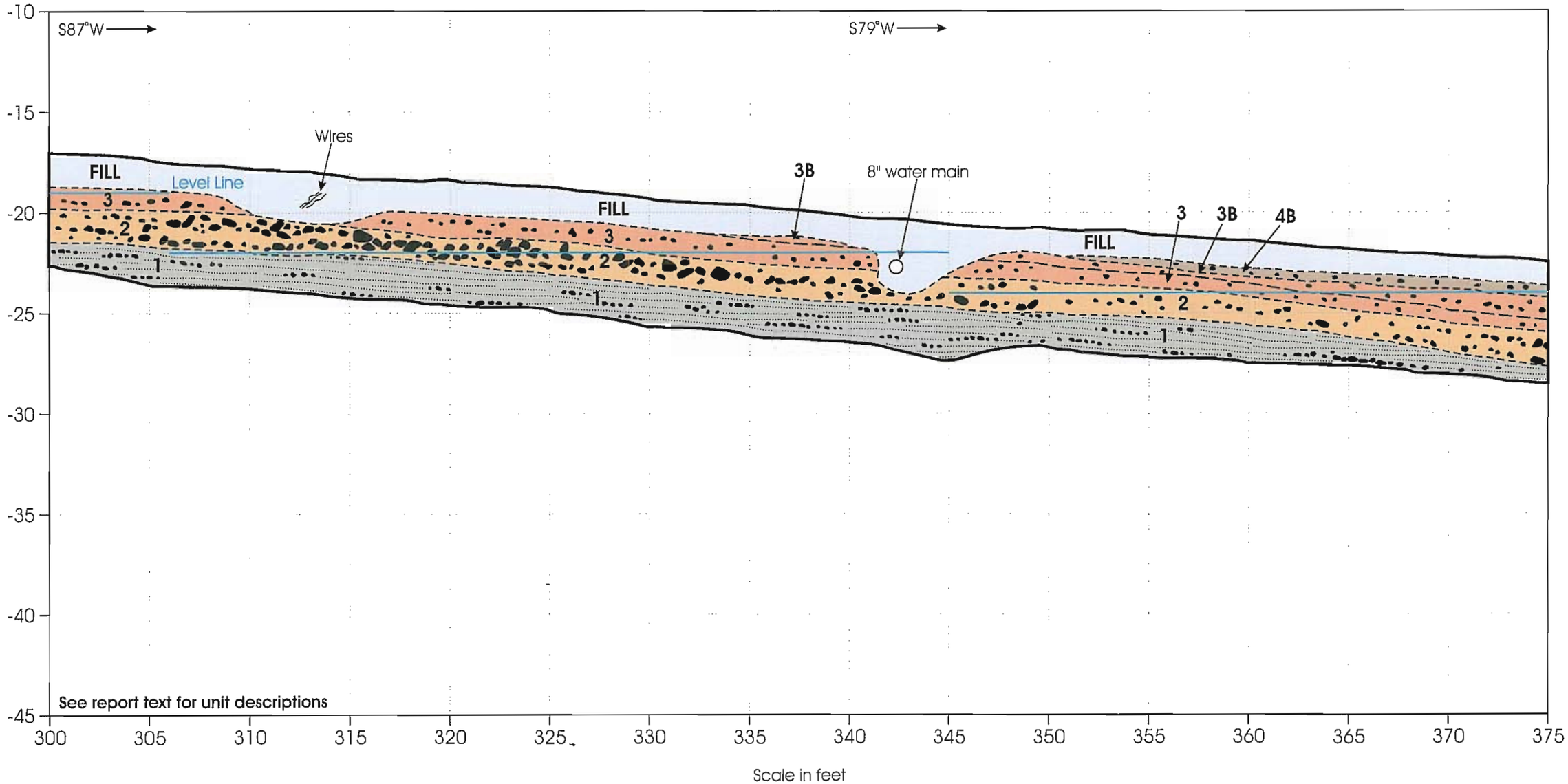
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 4

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6D



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

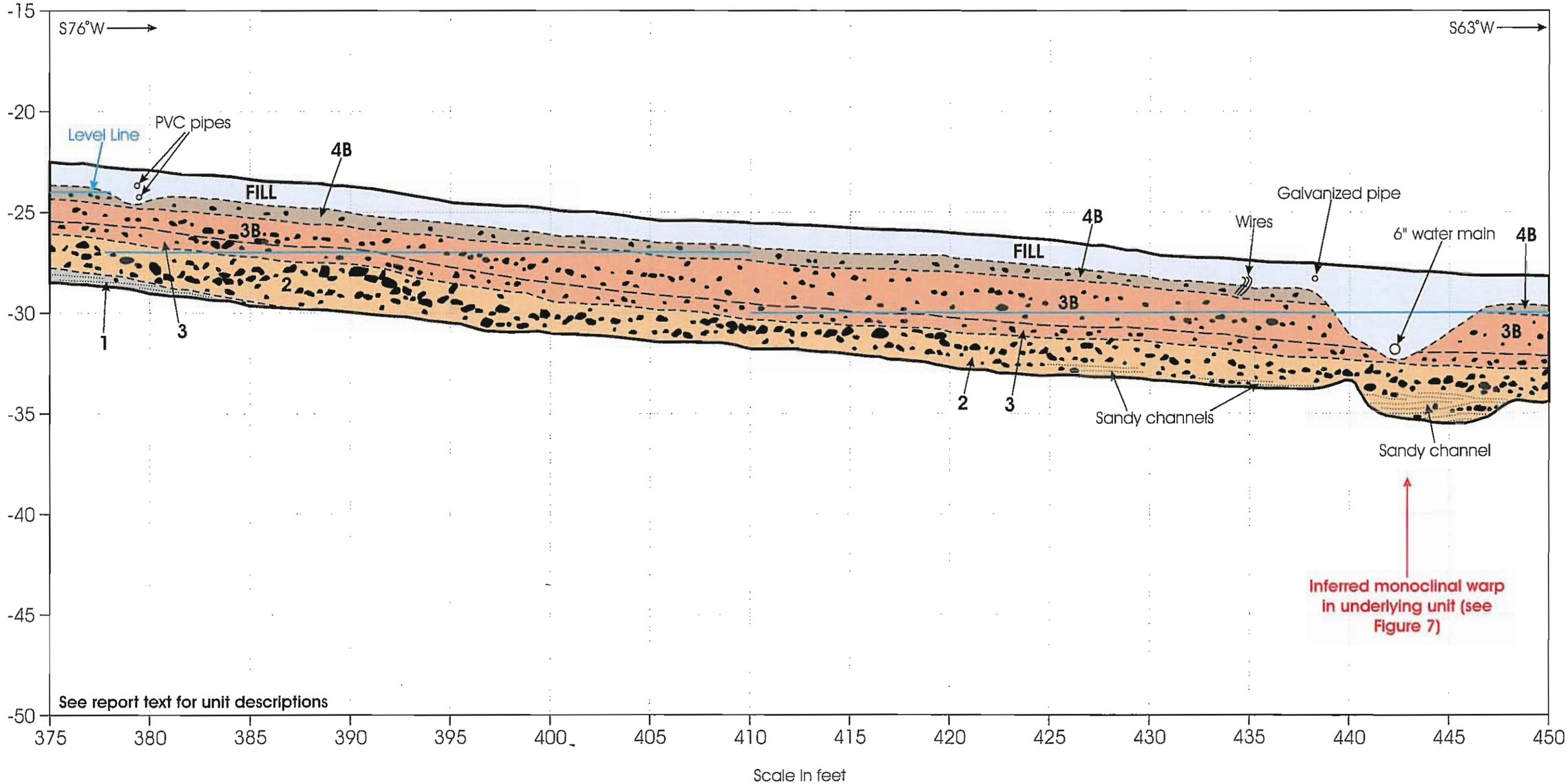
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 5

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6E



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

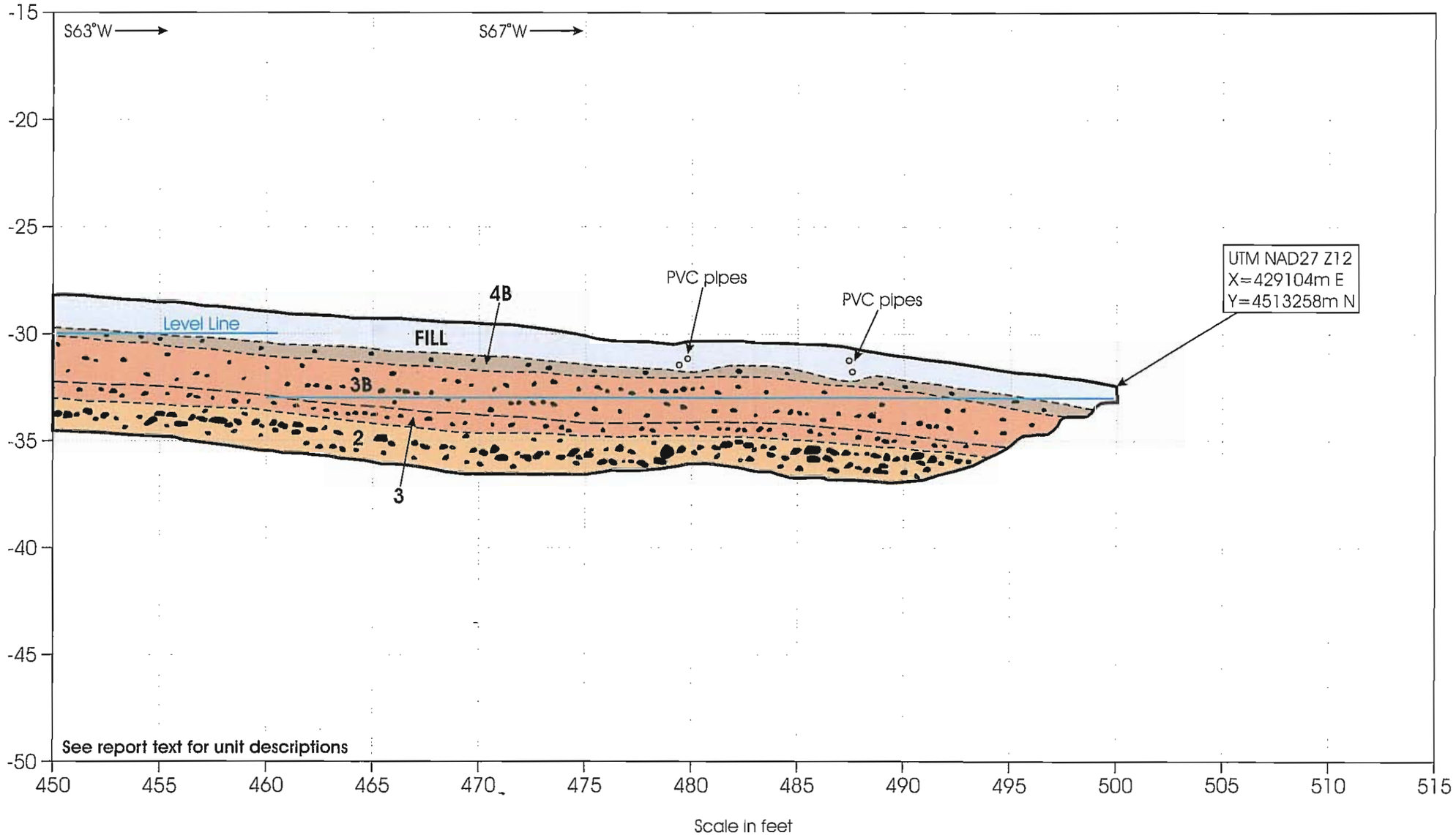
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 6

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6F



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

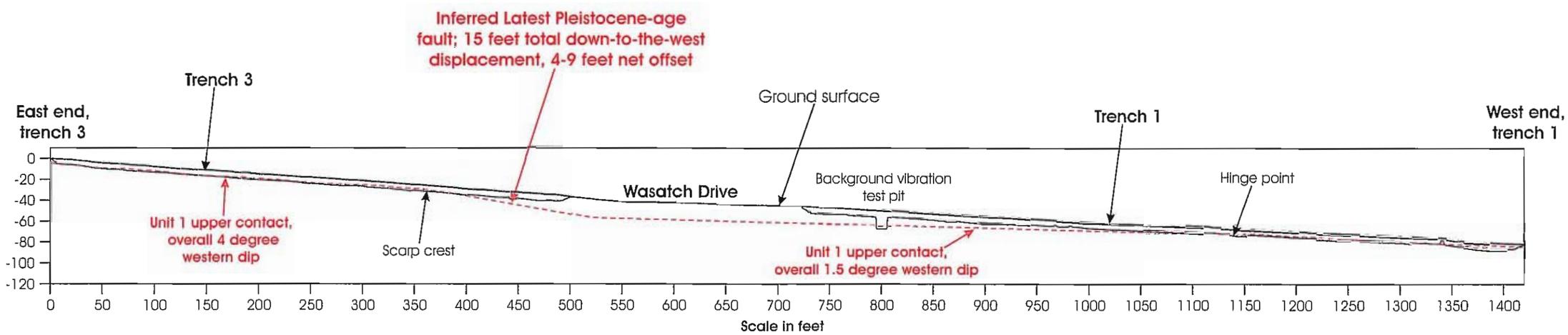
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
November 12 and 15, 2007
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 3 LOG, SHEET 7

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 6G



SCALE: 1 inch = 100 feet
(no vertical exaggeration)

STRATIGRAPHIC CORRELATION

SURFACE FAULT RUPTURE HAZARD EVALUATION
Proposed Nanotechnology Research Center
University of Utah Golf Course
Salt Lake City, Utah

FIGURE 7

6.2 PRELIMINARY SOILS REPORT

Please see page numbers with in the consultant's document.

Gordon Spilker Huber
Geotechnical Consultants, Inc.

UPDATED REPORT
PRELIMINARY GEOTECHNICAL STUDY
NEW NEUROSCIENCE AND BIOMEDICAL TECHNOLOGY RESEARCH BUILDING
WEST SIDE OF WASATCH DRIVE AT FEDERAL WAY
UNIVERSITY OF UTAH CAMPUS
SALT LAKE CITY, UTAH

Submitted To:

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106-4333

Submitted By:

Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

November 19, 2007

Job No. 0283-003-07

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

November 19, 2007
Job No. 0283-003-07

Architectural Nexus, Inc.
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106-4333

Attention: Mr. Tim Thomas, AIA

Gentlemen:

Re: Updated Report
Preliminary Geotechnical Study
New Neuroscience and Biomedical Technology
Research Building
West Side of Wasatch Drive at Federal Way
University of Utah Campus
Salt Lake City, Utah

1. INTRODUCTION

1.1 GENERAL

This updated report presents the results of our preliminary geotechnical study performed for the proposed new Neuroscience and Biomedical Technology Research building and possible future adjacent buildings, which will be constructed on the west side of Wasatch Drive at Federal Way on the University of Utah campus in Salt Lake City, Utah. The updated report includes correction to a few typos and the results of laboratory test results not completed at the time of our initial report dated November 19, 2007 was submitted. Discussions and recommendations have not been altered. The general location of the site with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A more detailed layout of the site on an air photo base is shown on Figure 2, Area Map. A detailed layout of the site showing existing and proposed facilities and site-specific topography is presented on Figure 3, Site Plan. The locations of the borings drilled in conjunction with this study are also presented on Figure 3.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of this study were planned in discussions between Mr. Tim Thomas of Architectural Nexus, Inc.; Mr. Ron Reaveley of Reaveley Engineers + Associates, Inc.; and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this preliminary study were to:

1. Define, on an initial basis, the subsurface soil and groundwater conditions at the site of the presently proposed buildings and future adjacent buildings in the area.

2. Discuss the geotechnical suitability of the site for the proposed construction with preliminary emphasis on whether adverse soils, such as collapsible soils, may be present.

3. Provide initial foundation recommendations to be utilized in the site selection and planning.

In accomplishing these objectives, our scope was:

1. A field program originally proposed to include 3 exploration borings to the depths of 20 to 50 feet. However, during initial planning, it was decided to add three additional borings in the general area of future adjacent buildings to the immediate north and west.

2. A preliminary laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided through Architectural Nexus, Inc.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

The proposed layout of the initial building and the approximate location of potential future adjacent buildings are shown on Figure 3. Details regarding the buildings are not available at this time. The initial buildings and future buildings could be established with the first floor at approximate existing grade or could extend under a portion or under the entire footprint of the structure one to two levels below grade. Above grade, structures will generally be two to three levels in total height. It is anticipated that in vibration-sensitive areas, the buildings will be of reinforced concrete construction. Other areas could be steel-frame construction, all with masonry perimeter walls.

Structural loads will be transmitted down through bearing walls and columns to supporting foundations. In preliminary discussions with the project structural engineer, we are anticipating that maximum column loads could be in the range of 450 to 500 kips with wall loads being in the range of 10 to 12 kips per lineal foot. These are preliminary. At-grade floor slab loads will be relatively light and should not exceed an average uniform loading of approximately 150 to 200 pounds per square foot.

Because of the slope of the site, a moderate amount of earthwork will be required to obtain desired building pad grades and the grades for adjoining roadways and parking areas. At this time, we would project that the maximum cuts and fills associated with any particular building could be as much as 5 to 10 feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

As stated earlier, the original field program was to consist of 3 exploration borings to depths of approximately 20 to 50 feet in the area of the presently proposed building. However, during initial planning, our scope was increased to include three additional borings in the general area of the proposed future adjacent structures. Exploration borings were drilled with a truck-mounted rig equipped with hollow-stem augers and extended to depths of 9.5 to 27.5 feet. It must be noted that because of very dense and slightly to moderately cemented granular soils, practical drilling refusal was met at depths ranging from 9.5 to 27.5 feet at the boring locations. The locations of the borings are shown on Figure 3. The field portion of this study was initiated only after the initial geoseismic/fault trenches indicated that active faulting did not pass through or immediately adjacent to the site.

The field portion of this study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, relatively undisturbed and some small disturbed samples of the typical soils encountered were obtained.

The soils were classified in the field based upon visual and textural examination. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 4A through 4F, Log of Borings. The nomenclature utilized to describe the soil types is presented on Figure 5, Unified Soil Classification System.

A 3.25-inch outside diameter, 2.42-inch inside diameter drive (Dames & Moore) sampler was utilized in the subsurface sampling at the site. The blow-counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of drilling operations, one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-1 and B-3 through B-6 to provide a means of monitoring groundwater fluctuations.

3.2 LABORATORY TESTING

3.2.1 General

To provide preliminary data for our analyses, a laboratory testing program has been initiated. The program includes moisture, density, partial gradation, and collapse-consolidation tests. Descriptions of the tests are presented in the following sections. Results of the test data will be presented shortly as a supplement to this report.

3.2.2 Moisture and Density Tests

To aid in classifying the soils and to correlate collapse-consolidation tests, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 4A through 4F.

3.2.3 Partial Gradation Tests

To further aid in classifying the granular soils, gradation tests were performed on representative samples. The results of the tests are tabulated below:

	Percent Passing		
Sieve Size	**B-1 @ 15.0’**	**B-3 @ 10.0’**	**B-5 @ 10.0’**
No. 4	48.0	75.2	65.4
No. 10	33.3	53.8	45.8
No. 40	21.2	35.7	30.9
No. 200	12.2	20.1	19.6
Soils Classification	SM/GM	SC/GC	SC/GM

3.2.4 Collapse-Consolidation Tests

To provide data necessary for our settlement analyses, a collapse-consolidation test was performed on each of five representative samples. The collapse portion of the tests was performed in accordance with the following procedures:

1. Load sample at in-situ moisture content to specific axial pressure.
2. Measure and record axial deflection.
3. Saturate sample.
4. Measure and record resulting collapse.

The test results are tabulated below:

Boring No.	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture Content (percent)	Axial Load When Saturated (psf)	Collapse (-) or Swell (+) (percent)
B-1	3.0	CL	87	8.3	800	7.8 (-)
B-1	10.0	CL	101	18.9	1,600	1.0 (-)
B-3	6.5	CL	98	22.6	1,600	1.4 (-)
B-3	15.0	CL	112	17.1	100	slight swell
B-5	2.5	CL	106	17.5	100	slight swell

The results of the tests indicate that some of the upper silty clay soils, especially encountered in the area of the presently proposed building, are collapsible.

Following completion of the collapse test, normal consolidation loading was applied. The results of these tests indicate that the collapsible soils, after saturation, become highly compressible where the non-collapsible clays exhibit moderate over-consolidation characteristics. Detailed results of the tests are maintained in our files but can be provided, upon your request.

4. SITE CONDITIONS

4.1 SURFACE

The site of the presently proposed Neuroscience and Biomedical Technology Research building is located within the University of Utah golf course. The site is bounded on the immediate east by Wasatch Drive and is intersected by Federal Way. The site is bounded to the south, west, and north by golf course fairways.

The initial building site slopes moderately downward to the west with relief across the building footprint being on the order of 20 to 22 feet.

The locations of the future adjacent buildings are also predominantly located on the existing golf course fairways. Exceptions are the western portions of the proposed buildings at the northwest and southwest corners of the overall site. In these areas, there are existing at-grade parking lots. Existing structures consist of a golf shop and some maintenance sheds, all lightly loaded and one-level in height.

Relief across the overall site is on the order of 45 to 50 feet.

4.2 SUBSURFACE SOIL AND GROUNDWATER

Subsurface conditions encountered in the exploration borings were found to be moderately consistent. Borings B-1, B-2, and B-3 were drilled within the footprint of the presently proposed Neuroscience and Biomedical Technology Research building. At these locations, the site was found to be blanketed by 5.5 to 12.5 feet of silty clay with trace fine to coarse sand and fine gravel. The upper five to six inches are generally loose with the upper three inches of this loose zone contain major roots (topsoil). Soils are dark brown at the surface, grading brown with depth. In Boring B-1, the soils to a depth of approximately five to six feet were very dry and then graded moist. In Borings B-2 and B-3, the soils were very moist from the surface and then graded moist with depth. These varying moisture contents are a reflection of the irrigation of the golf course fairways. Based upon visual and textural examination, it is our opinion that these soils will exhibit collapse characteristics. Collapsible soils are defined as soils which will exhibit moderate strength and compressibility characteristics when dry but will loose strength, become highly compressible, and collapse with significant increase in moisture content.

Beneath the surface silty clays and extending to the depths penetrated in Borings B-1 and B-2, and to a depth of approximately 14 feet in Boring B-3, silty fine to coarse sands with fine gravels; silty fine to coarse sand and fine and coarse gravel mixtures; clayey fine and coarse gravels with some sand; and clayey fine to coarse sands and fine gravels were encountered. These soils are medium dense to very dense and, in many zones, exhibit a slight to moderate cementation. The slightly to moderately cemented samples, when undisturbed, can be broken down with some effort by hand. These soils will exhibit very high strength and low compressibility characteristics and are not moisture sensitive. In Boring B-3, the layer of medium dense granular soils terminated at approximately 14 feet and is underlain by stiff to very stiff silty clays, which extended to depths of approximately 23.5 feet. Based upon visual and textural examination, it does not appear that these soils are collapsible but might not exhibit high over-consolidation pressures. From 23.5 feet to the depths penetrated in Boring B-3, which is 31.0 feet, the very dense clay, fine and coarse gravels, and fine to coarse sands, were encountered.

Groundwater was not encountered to the depths penetrated.

In Borings B-4, B-5, and B-6, which are in the areas of the future adjacent buildings, a similar subsurface sequence was encountered. At the locations of Borings B-5 and B-6, asphalt pavement, consisting of 2 to 3 inches of asphalt concrete over 12 to 18 inches of aggregate base fill, was penetrated. Beneath the pavements in Borings B-5 and B-6 and at the ground surface in Boring B-4, silty clays with trace fine sand were encountered. The upper portion is dark brown; with depth the silty clay grades brown. In Boring B-4, the upper eight inches are loose with the upper three inches of the loose zone containing major roots (topsoil). Soils are moist, stiff to very stiff, and are projected to exhibit some collapse characteristics and/or be moderately highly compressible under low loading pressures.

Below the surface clays in all of the borings and extending to the depths penetrated, medium dense to very dense silty fine to coarse sands with fine gravels; silty/clayey fine to coarse sands and fine gravels; clayey fine to coarse sands with some gravels; clayey fine and coarse gravels with some fine sand; were encountered. All of these soils will exhibit high strength, low compressibility characteristics and are not moisture sensitive.

Groundwater was not encountered to the depths penetrated.

As stated previously, practical drilling refusal was encountered at the base of all of the borings due to the slightly to moderately cemented, very dense coarse granular soils.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

By far, the most significant geotechnical aspect of the site are the projected collapsible characteristics of the silty clays encountered to depths ranging from approximately 5.5 to 12.5 feet in Borings B-1, B-2, and B-3, which were drilled in the area of the presently proposed Neuroscience and Biomedical Technology Research building. These soils are unsuitable to support foundations and floor slabs. Underlying these soils are very dense granular soils exhibiting high strength and low compressibility characteristics. In Boring B-3, beneath a 6.5-foot layer of very dense granular soils, stiff to very stiff clays were encountered to a depth of approximately 23.5 feet. Based on visual and textural examination, these clays appear to be non-collapsible and may exhibit reasonable engineering characteristics.

In Borings B-4, B-5, and B-6, the surficial clays extend to depths of approximately four to four and one-half feet and, again, are underlain by very dense granular soils exhibiting high strength and low compressibility characteristics. Groundwater was not encountered to the depths penetrated.

Potentially collapsible and compressible silty clays are not suitable to support foundations or floor slabs. In the footprint of the presently proposed building, it appears that one below-grade level would essentially penetrate these unsuitable soils. In this case, the structure can be supported upon conventional spread and continuous wall foundations established upon the dense

granular soils. All indications are that if two below-grade levels are desired, the footings again would terminate on the very dense, partially cemented granular soils. Subsequent studies would have to verify the lateral and vertical continuity of these dense granular soils below approximately 20 feet. If the lowest level of the structure is established at approximate existing grade, over-excavation of the soils or near-surface collapsible soils will be required.

In the remaining borings in future adjacent building sites, the unsuitable silty clays extend to depths of approximately four to four and one-half feet. In these areas, the structures can be supported at-grade or with one or two levels below grade. The upper clays, however, would have to be removed from beneath footings and possibly from beneath at-grade slabs. If established with one to two levels below grade, all indications are that conventional footings established upon the high-strength gravels can be used. Again, verification of the continuity of the very dense granular soils with greater depth will be required. As part of the detailed study, the extension of these borings will require a percussion rig, which can penetrate through dense granular soil.

Groundwater was not encountered to depths penetrated; however, the area is notorious for laterally and vertically variable "perched" groundwater conditions.

In the following sections, initial discussions pertaining to earthwork, foundations, at-grade slabs, lateral resistance and pressure, and initial geoseismic parameters are provided.

5.2 EARTHWORK

5.2.1 Site Preparation

Prior to initiation of any major construction activity, all utilities passing through or immediately adjacent to the construction site must be identified, then either abandoned or relocated if required. Subsequently, earthwork may be initiated. Earthwork will initially consist of the removal of all surface vegetation, topsoil, and other deleterious materials from an area extending out at least three feet from the perimeter of the proposed structure, which would include at-grade pavements. Subsequent to these operations, mass excavations for the removal of collapsible soils and/or to obtain below-grade levels can be initiated. Excavation through the clayey soils will be relatively straight-forward. Excavation through the dense and, sometimes slightly to moderately cemented, granular soils will be more difficult. However, our experience indicates that these excavations can be accomplished with standard heavy duty construction equipment.

5.2.2 Excavations

Temporary excavations not exceeding four feet in depth through the granular or cohesive soils may be constructed with near-vertical sideslopes.

Deeper excavations up to approximately eight feet in both the granular and cohesive soils can be constructed with sideslopes no steeper than one-half horizontal to one vertical. Deeper

excavations, up to approximately 20 feet, should be constructed with sideslopes no steeper than three-quarters horizontal to one vertical. If zones of loose granular soils or "perched" groundwater are encountered, the slopes must be flattened.

All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill will be required as site grading fill, as backfill over foundations and utilities, and possibly as replacement fill below footings. All structural fill must be free of sod, rubbish, construction debris, frozen soil, and other deleterious materials. Maximum particle size within structural site grading fills should generally not exceed four inches; although, occasional particles up to six to eight inches may be incorporated provided that they do not result in "honeycombing" or preclude the obtainment of the desired degree of compaction. Structural fill is defined as fill placed over fairly large open areas to raise overall site grade. In confined areas, the maximum particle size should generally be restricted to two and one-half inches.

The on-site silty clay soils may be utilized as structural site grading fill beneath pavements and outside flatwork. These materials, however, are not recommended beneath the proposed structures. The on-site granular soils can be utilized beneath pavements, outside flatwork, and buildings if they meet the requirements as stated above for structural fill.

5.2.4 Fill Placement and Compaction

All structural fill should be placed in lifts not exceeding eight inches in loose thickness. Structural fills placed within an area extending out at least 3 feet from the perimeter of the buildings and not exceeding 7 feet in thickness must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria. Structural fill outside the footprint of the buildings, such as underneath pavements, at-grade slabs not exceeding 5 feet in thickness, can be compacted to at least 90 percent of the above-defined criteria. If the fill thickness is greater than 5 feet but not exceeding 10 feet, the degree of compaction of the entire sequence must be increased to 92 percent.

Prior to placement of structural fills, subgrade must be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, preparation must consist of the removal of all loose and disturbed soils.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

---

1 American Association of State Highway and Transportation Officials
2 American Society for Testing and Materials

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

All indications are that the proposed structures can be supported upon conventional spread and continuous wall foundations established upon suitable natural dense granular soils or granular structural fill extending to suitable natural dense granular soils. Under no circumstances should the footings be established over potentially collapsible or highly compressible surface/near-surface silty clays. For preliminary design, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	- 3,000 pounds per square foot*
Bearing Pressure Increase for Seismic Loading	- 50 percent

* If it can be shown that the thickness of the dense granular soils is at least 7 to 10 feet thick below the base of the footings, the bearing pressures for larger size footings can be increased to approximately 5,000 pounds per square foot.

The term “net bearing pressure” refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.3.2 Installation

Under no circumstances should the footings be installed on loose or disturbed soil, sod, rubbish, construction debris, frozen soil, or other deleterious materials. If unsuitable soils are encountered, they must be removed and replaced with compacted granular fill. The width of the

replacement fill should be equal to the width of the footing plus one foot for each foot of fill thickness.

5.3.3 Settlements

Settlements of foundations designed and installed in accordance with the above recommendations and supporting the maximum loads as discussed in Section 2., Proposed Construction, can generally be controlled to not exceed approximately one-half to five-eighths of an inch. Settlements will occur fairly rapidly with 50 to 60 percent of the quoted settlements occurring during construction.

5.4 AT-GRADE SLABS

We strongly recommend that the at-grade slabs also be established upon the dense granular soils or structural fill extending into dense soils. Based upon available data, we do not recommend that the at-grade slabs be established upon the surface or near-surface potentially collapsible and highly compressible silty clays. Floor slabs can, however, be established over the deeper silty clays. In all cases, the at-grade slabs should be underlain by a minimum of four inches of "free-draining" granular material, such as three-quarters to one-inch minus clean gap-graded crushed gravel. Settlement of the at-grade lightly to moderately loaded floor slabs should be minimal.

5.5 SUBDRAINS

Although groundwater was not encountered to the depths penetrated, the area is notorious for laterally and vertically variable "perched" groundwater conditions. We, therefore, strongly recommend that around the outside perimeter of all portions of the structures, which will extend below grade, that a perimeter foundation/chimney subdrain be included into the design. The foundation subdrain would consist of a four-inch diameter slotted or perforated pipe with its invert at least 12 inches below the top of the lowest adjacent slab. Extending up from the perimeter drain to within two feet of final grade should be a chimney drain. In this case, we recommend the chimney drain consist of a minimum three-foot width, perpendicular to the face of the wall, of "free-draining" granular materials. These gravels will act as a chimney drain and will also reduce lateral pressures imposed upon the subgrade walls. Details pertaining to the subdrain system will be provided in the final report.

5.6 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.45 should be utilized. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.7 LATERAL PRESSURES

The lateral pressure parameters, as presented within this section, project that the backfill will consist of a three-foot zone of crushed gravel adjacent to the subgrade wall and "free-draining" soils beyond. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For the subgrade walls as proposed, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot in computing lateral pressures.

For seismic loading, an average uniform pressure of 90, 180, 270, and 365 pounds per square foot should be used for 5, 10, 15, and 20-foot high subgrade walls, respectively. Detail distribution pattern will be provided in the final report.

5.8 GEOSEISMIC SETTING

5.8.1 General

Utah municipalities adopted the International Building Code (IBC) 2006 on January 1, 2007. The IBC 2006 code determines the seismic hazard for a site based upon 2002 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structures must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2006 edition.

5.8.2 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Table 1613.5.2, Site Class Definitions, of the IBC 2006 can be utilized.

5.8.3 Liquefaction

Data available to date indicates that the water table is in excess of 30 to 35 feet below grade. The soils above the water table are not susceptible to liquefaction, even during major seismic event. All indications are that the potential for liquefaction at the site will be minimal.

5.8.4 Faulting

Our geoseismic study of the site uncovered no evidence of active faulting.

Active faulting has been identified more than one-quarter mile to the northwest and east of the site.

5.8.5 Ground Motions

The IBC 2006 code is based on 2002 USGS (United States Geologic Survey) mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (40.7688 degrees north and 111.8423 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T Seconds	**Site Class B-C Boundary [mapped values] (% g)**	**Site Class D [adjusted for site class effects] (% g)**
Peak Ground Acceleration	0.630	0.630
0.2 Seconds, (Short Period Acceleration)	$S_S = 1.575$	$S_{MS} = 1.575$
1.0 Seconds (Long Period Acceleration)	$S_1 = 0.622$	$S_{M1} = 0.933$

The IBC 2006 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds (⅔).

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

Gordon Spilker Huber Geotechnical Consultants, Inc.

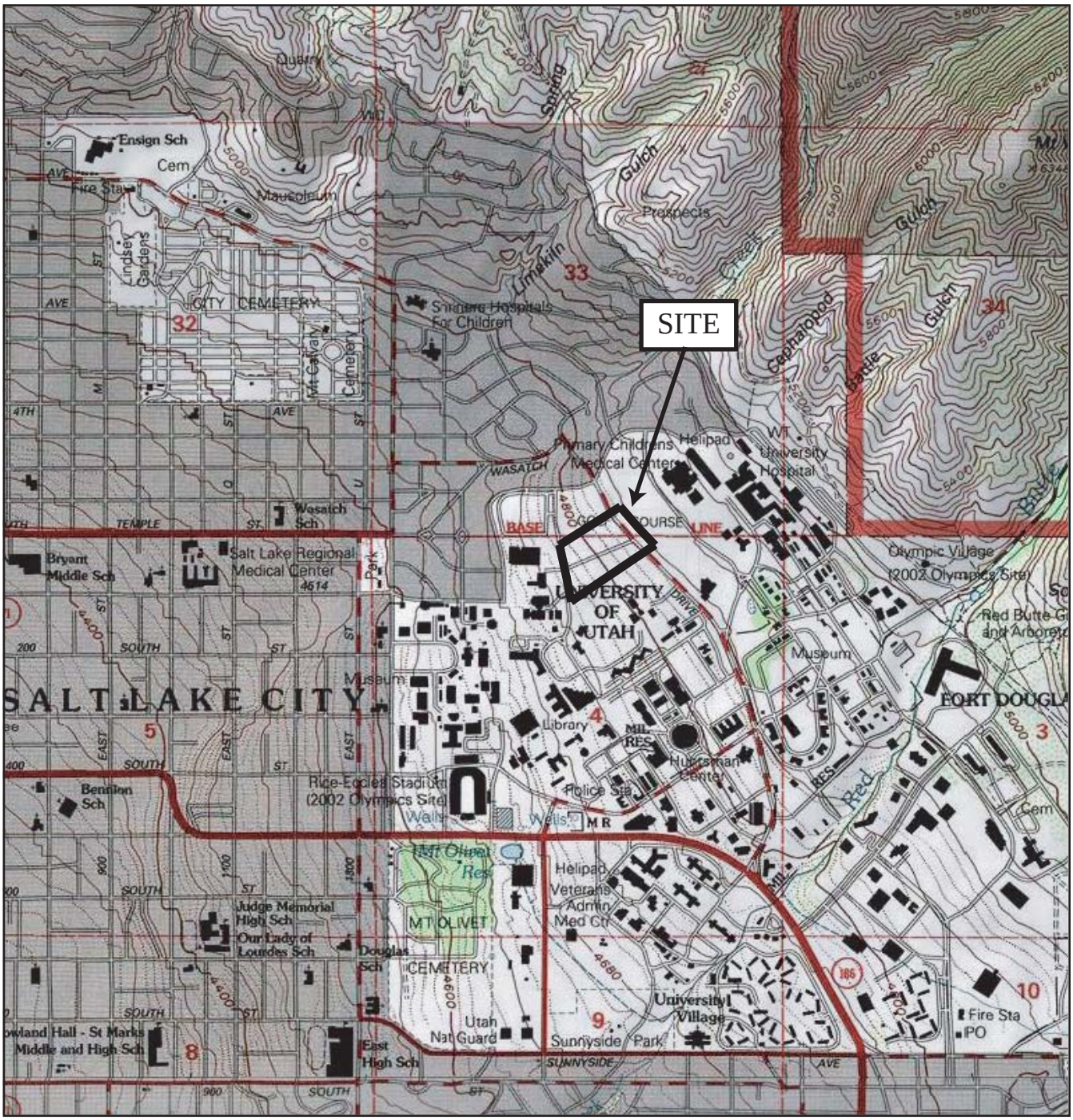
William J. Gordon, State of Utah No. 146417
Professional Engineer

WJG:jlh/sn

Encl.	Figure	1,	Vicinity Map
	Figure	2,	Area Map
	Figure	3,	Site Plan
	Figures	4A	through 4F, Log of Borings
	Figure	5,	Unified Soil Classification System

Addressee (3 + email)
c: Mr. Ron Reaveley (1 + email)
Reaveley Engineers + Associates, Inc.
675 East 500 South, Suite 400
Salt Lake City, Utah 84102

ARCHITECTURAL NEXUS, INC.
JOB NO. 0283-003-07



SCALE IN FEET

1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS
TITLED "FORT DOUGLAS, UTAH" AND "SUGARH HOUSE, UTAH"
BOTH DATED 1998

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NOT TO SCALE

FIGURE 2
AREA MAP

REFERENCE:
ADAPTED AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
DATED 2007

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JOB NO. 0283-003-07

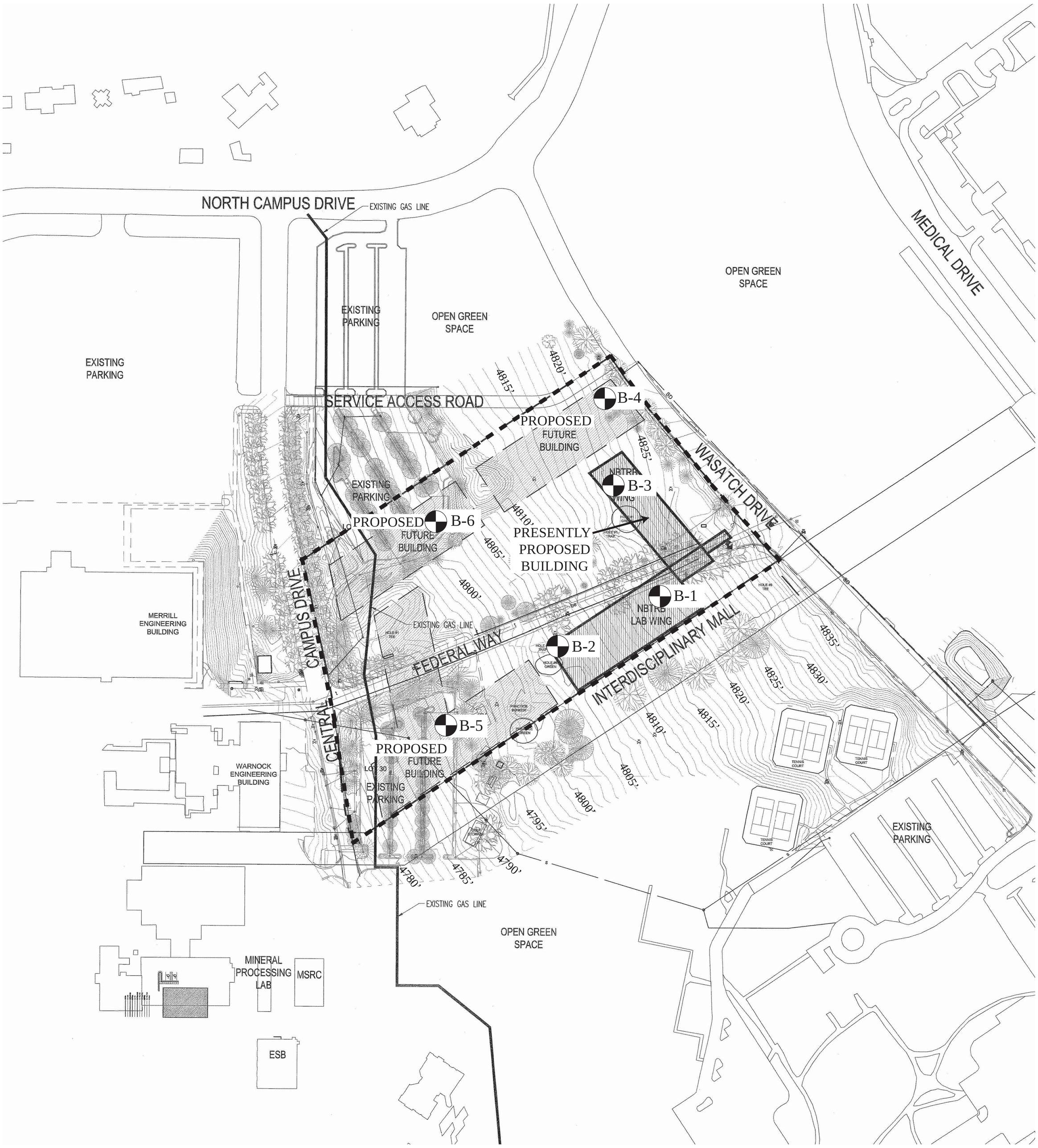

FIGURE 3
SITE PLAN

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"ARCHITECTURAL SITE PLAN, AS101"
BY ARCHITECTURAL NEXUS, DATED SEPTEMBER 13, 2007

SCALE IN FEET
100 0 100 200

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Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4819.5' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY with trace fine to coarse sand and fine gravel; major roots (topsoil) to 3"; brown (CL)	0								loose to 6" dry very stiff
				35		8.3		87			
			5	16		11.0		86			stiff
		gravel grades out									
			10	2		18.9		101			moist
		SILTY SAND AND GRAVEL fine and coarse gravel; fine to coarse sand; moderately cemented; brown (SM/GM)									moist very dense
			15	100 5"		4.0	12.3	114			
		grades slightly cemented									moist very dense
			20	100 4"		3.9		103			
		grades with zones of fine to coarse sand and fine and coarse gravel with trace silt									
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4A

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4819.5' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
				89							
		Drilling refusal at 27.5'.									
		Stopped sampling at 26.0'.	30								
		Installed 1-1/4" diameter slotted PVC pipe to 26.0'.									
		No groundwater encountered at time of drilling.									
			35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4A
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4806.0' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with trace fine to medium sand and fine gravel; major roots (topsoil) to 3"; dark brown (CL)									loose to 6" very moist stiff
				12		19.6		94			
											moist
			5	110		10.5					very stiff moist
		CLAYEY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GC)									very dense
		grades to brown									
			10	100 5"							
				50 1"							
		Drilling refusal at 13.5'.	15								
		Stopped sampling at 14.0'.									
		No groundwater encountered at time of drilling.	20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4B

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4820.5' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY with trace fine sand; major roots (topsoil) to 3"; dark brown (CL)	0								loose to 6" very moist medium stiff
		grades brown		9							
			5								
				6		22.6		98			
		CLAYEY SAND AND GRAVEL fine to coarse sand; fine and coarse gravel; brown (SC/GC)									very moist medium dense
			10	32		9.5	20.2	119			
		SILTY CLAY with some fine to medium sand and fine gravel; brown (CL)									very moist stiff
			15	19		17.1		112			
		grades with trace fine to medium sand and fine gravel									
			20	22							very stiff
		CLAYEY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GC)									moist very dense
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4C

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4820.5' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
				50 1"							
			30	108							
		Drilling refusal at 31.0'.									
		Stopped sampling at 31.0'.									
		Installed 1-1/4" diameter slotted PVC pipe to 31.0'.									
		No groundwater encountered at time of drilling.	35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4C
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4823.5' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with trace fine sand; major roots (topsoil) to 3"; dark brown (CL)									loose to 4" moist very stiff
				28		13.9		104			
		grades brown									
		CLAYEY SAND AND GRAVEL fine to coarse sand; fine gravel; slightly cemented; brown (SC/GC)	5	100 4"							moist very dense
				100 3"							
			10								
		Drilling refusal at 9.5'.									
		Stopped sampling at 10.0'.									
		Installed 1-1/4" diameter slotted PVC pipe to 9.5'.									
		No groundwater encountered at time of drilling.									
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4D

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4791.0' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		2" ASPHALT CONCRETE									
		18" AGGREGATE BASE brown									
		SILTY CLAY with trace fine sand; brown (CL)		27		17.5		106			moist very stiff
		SILTY SAND with trace fine gravel; fine to coarse sand; brown (SM)	5	26							moist medium dense
		grades with seams of fine to medium sand with some silt									
		SILTY/CLAYEY SAND AND GRAVEL fine to coarse sand; fine gravel; brown (SC/GM)	10	45		6.9	19.5	116			moist medium dense
		CLAYEY SAND with some fine gravel; fine to coarse sand; brown (SC)	15	94							moist dense
		Drilling refusal at 17.0'. Stopped sampling at 16.0'. Installed 1-1/4" diameter slotted PVC pipe to 16.0'. No groundwater encountered at time of drilling.	20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4E

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Neuroscience & Biomedical Tech Research Bldg
Project No.: 0283-003-07
Location: Wasatch Dr at Federal Way, U of U Campus, SLC, UT
Client: Architectural Nexus, Inc.
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-09-07
Elevation: 4804.0' +/-
Water Level: No groundwater encountered.
Remarks: Datum: See Figure 3, Site Plan

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		3" ASPHALT CONCRETE									
		12" AGGREGATE BASE brown									
		SILTY CLAY with trace fine sand; dark brown (CL)									moist stiff
				13		21.5		100			
		CLAYEY GRAVEL with some fine sand; fine and coarse gravel; brown (GC)									moist dense
			5	73							
		grades to brown									
		slightly cemented to 12'	10	100 6"		7.6		124			very dense
				55							
		Drilling refusal at 12.5'.	15								
		Stopped sampling at 14.0'.									
		Installed 1-1/4" diameter slotted PVC pipe to 14.0'									
		No groundwater encountered at time of drilling.									
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 4F

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES				GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	Silty sands, poorly graded sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		SC	Clayey sands, poorly graded sand-clay mixtures.

IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)			
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity.
		Medium to high	None to very slow	Medium		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight		OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		High to very high	None	High		CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.				Pt	Peat and other highly organic soils.

[1] Boundary classifications: –Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW–GC, well graded gravel–sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

GENERAL NOTES

1. In general, Unified Soil Classification Designations presented on the logs were evaluated by visual methods only. There rore, actual designations (based on laboratory testing) may differ.

2. Lines seperating strata on the logs represent approximate boundaries only Actual transitions may be gradual.

3. Logs represent general soil conditions observed at teh point of exploration onthe date indicated.

4. No warranty is provided as to the continuity of soil conditions between individual sample locations.

FINE - GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches by Thumb. Squeezes through fingers.
Soft	2 - 4	0.125 - 0.25	0.25 - 0.5	Easily penetrated 1 " by Thumb . Molded by light finger pressure.
Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0	Penetrated over 1/2 " by Thumb with moerate effort. Molded by strong finger pressure.
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0	Indented about 1/2 " by Thumb but penetrated only with great effort
Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0	Readily indented by Thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty by Thumbnail

LOG KEY SYMBOLS

- Bulk / Bag Sample
- Thin Wall
- Standard Penetration Split Spoon Sampler
- No Recovery
- Rock Core
- 3-3/4" ID D&M Sampler
- 3" ID D&M Sampler
- Water Level
- California Sampler

COARSE -GRAINDE SOIL

APPERENT DENSITY	SPT (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
Very Loose	<4	0 - 15	Easily penetrated with 1/2 " reinforcing rod pushed by hand
Loose	4 - 10	15 - 35	Difficult to penetrated with 1/2 " reinforcing rod pushed by hand
Medium Dense	10 - 30	35 - 65	Easily penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Dense	30 - 50	65 - 85	Difficult to penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Very Dense	>50	85 - 100	Penetrated only a few inches with 1/2 " reinforcing rod driven with 5-lb hammer

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2 "
LAYER	1/2 - 12 "

DESCRIPTION	THICKNESS
Occasional	One or less per foot of thickness
Frequent	More than on per foot of thichness

CEMENTATION

DESCRIPTION	DESCRIPTION
Weakely	Crumbles or breaks with handling of slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumbles or breaks with finger pressure

MODIFIERS

DESCRIPTION	%
Trace	<5
Some	5 - 12
With	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil below Water Table

FIGURE 5

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

6.3 EMI AND RFI SITE ASSESSMENT STUDY

Please see page numbers with in the consultant's document.

VitaTech Engineering, LLC

EMF Measurements, Surveys & Risk Assessment
EMF Mitigation - Shielding & Cancellation
Homepage: www.vitatech.net
Email: lvitale@vitatech.net

115 Juliad Court, Suite 105
Fredericksburg, VA 22406
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August 22, 2007

Tim Thomas
Principal
Architectural Nexus
2150 South 1300 East, Suite 200
Salt Lake City, Utah 84106

Phone: (801) 924-5000
Cell: (801) 633-9720
Fax: (801) 924-5001

Subject: Final EMI/RFI Site Report: USTAR Neuroscience and Biomedical Technology Research Building – University of Utah

Dear Mr. Thomas:

VitaTech Engineering was engaged by Architectural Nexus to perform an EMI/RFI Site Assessment for the USTAR Neuroscience and Biomedical Technology Research Building at the University of Utah. The EMI/RFI data contained in this report was recorded on 2 April 2007 by Mr. Louis Vitale, President & Chief Engineer, and Debra Vitale, Chief Financial Officer of VitaTech Engineering. This site survey was performed to assure optimal functionality of a TEM JEOL 2200F and other sensitive scientific tools in addition to assessing the EMI/RFI impact from external sources on the site.

AC ELF Electromagnetic Interference (EMI)

Electromagnetic induction occurs when time-varying AC magnetic fields couple with any conductive object including wires, electronic equipment and people, thereby inducing circulating currents and voltages. In unshielded (susceptible) electronic equipment (computers monitors, video projectors, computers, televisions, LANs, diagnostic instruments, magnetic media, etc.) and signal cables (audio, video, telephone & data), electromagnetic induction generates electromagnetic interference (EMI), which is manifested as visible screen jitter in displays, hum in analog telephone/audio equipment, lost sync in video equipment and data errors in magnetic media or digital signal cables. Placement of each scientific tool and instrument depends on the actual EMI susceptibility under defined thresholds, which are often not easy to ascertain from the manufacturer's performance criteria. Magnetic flux density susceptibility can be specified in magnetic field strength (A/m) or one of three magnetic flux density terms: Brms, Bpeak-to-peak(Bp-p) and Bpeak (Bp) according to the following conversion formula below.

$$B_{rms} = \frac{Bp-p}{2\sqrt{2}} = \frac{Bp}{\sqrt{2}}$$

To convert magnetic field strength to units of milligauss (mG), simply multiple the magnetic field strength by 4π. For example, 3 A/m is equal to 37.7 mG (3 x 12.57 = 37.7 mG).

High resolution imaging tools such as the JOEL 2200F require 0.3 mG horizontal and 0.7 mG vertical Bp-p (less than 0.25 B rms) levels, so VitaTech recommends 0.1 mG and less in EMI Quiet Labs. New Super STEM tools can demand levels as low as 0.01 mG. Using the simulated emission profiles within this report and the correct conversion formula, it is possible to identify the appropriate levels acceptable for each tool *if the correct EMI susceptibility figure can be ascertained from the manufacturer's specifications. Therein, lies the real EMI challenge.*

Generally, for AC ELF sources the minimum EMI threshold is 10 mG in unshielded electronic equipment, especially 14" to 17" CRT color computer monitors and analog signal cables; however, the AC ELF EMI threshold for high-resolution 17" to 21" CRT color monitors is only 5 mG. Scientific instruments are typically susceptible to 1 mG while field emission TEMs and SEMs are susceptible down to 0.1 mG Br RMS with super high resolution STEMs demanding levels as low as 0.01 mG Br RMS and less for optimal performance.

Based upon VitaTech's EMI experience working on similar Nanotechnology projects around the United States, the following EMI AC & DC Magnetic Field Performance Specifications in Chart #1 are recommended for the NMR areas, Instrument & Quiet Labs and Cleanrooms:

Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirements:
1 mG Br RMS (2.83 mG p-p)

Quiet & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

Cleanroom Maximum Requirements:
0.3 mG Br Rms (0.85 mG p-p)

Chart #1, AC ELF & DC EMI Magnetic Field Performance Specs

VitaTech recommends 0.1 mG Br RMS for the Quiet and EM Laboratories to accommodate the tool AC ELF and DC EMI performance requirements of current and next generation nano/pico resolution research tools. Achieving 0.1 mG Br RMS levels without the use of AC ELF and DC magnetic shielding can be very challenging in most Nanotech buildings because of external EMI sources (i.e., moving vehicles, loading dock activities, underground electrical feeders, etc.) and internal EMI sources (i.e., elevators, electrical switchgear room, conduit runs, motors, electric rooms and panels, etc.). Since clean rooms are normally filled with

significantly more environmental support equipment generating higher EMI emissions within electromechanical equipment proximity, VitaTech recommends a slightly higher performance requirement of 0.3 mG Brms, which is more practical considering the complex EMI environments. There will be selected locations within the cleanroom where tool environments will meet the 0.1 mG Br RMS criteria.

Accurately predicting the differences between 0.1 mG and 0.3 mG isolines from AC ELF and DC magnetic emission sources, considering the number of variables, is very challenging when compared to measuring the actual EMI environment after the building is constructed and fitted with equipment and research tools. Finally, it is very difficult to measure the difference between 0.1 mG and 0.2 mG AC ELF and DC EMI levels after the building is operational due to the typical variations in electric power loads (i.e., HVAC systems turning on/off, normal diurnal variations in power demand, etc.) and nearby moving ferromagnetic masses (i.e., truck sizes are all different with variable loads, actual elevator sizes and masses are all different, etc.). *Eventually, based upon hands-on experience and tool use, the researchers will determine to optimal time of the day when to perform complex and high resolution experimentation with minimal EMI interference.*

<u>AC ELF EMI Recorded Data & Assessment</u>
VitaTech recorded mapped AC extremely low frequency (ELF) magnetic flux density levels at 1-meter above grade with a survey wheel and the FieldStar 1000 gaussmeter (see Test Instruments for details). A succinct overview of the recorded data is presented below by figure:

> Figure #1 presents the perimeter Hatch, Profile and 3D Plots recorded around the USTAR building site, located in the southeast corner of the interdisciplinary corridor, straddling Federal Way. The perimeter data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant Br (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance as well as a three-dimensional plot representing eight threshold levels. Data in Figure #1 was low, ranging from 0.04 mG to 0.30 mG with peak emissions reaching 1.04 mG at the labeled location and emissions reaching 0.8 mG near label A.
>
> Figure #2, lateral plot L1, presents the Hatch and Profile plots recorded at the USTAR building site, from Federal Way to the north edge of the site. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant Br (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown by Diagram #1, Profile Plot, emissions peak at 0.9 mG above Federal Way,

but rescind to very low levels (0.00 mG to 0.20 mG) over the rest of the lateral L1. Diagram #2, Hatch Plot, presents the lateral path laid atop the site plan.

Figure #3, lateral plot L2, presents the Hatch and Profile plots recorded at the USTAR building site, from Federal Way to the north edge of the site. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant Br (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown by Diagram #1, Profile Plot, emissions peak at 0.8 mG above Federal Way, but rescind to extremely low levels (0.00 mG to 0.04 mG) over the rest of the lateral L2. Diagram #2, Hatch Plot, presents the lateral path laid atop the site plan.

Figure #4, lateral plot L3, presents the Hatch and Profile plots recorded at the USTAR building site, from Federal Way to the north edge of the site. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant Br (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown by Diagram #1, Profile Plot, emissions peak at 0.8 mG above Federal Way, but rescind to extremely low levels (0.00 mG to 0.04 mG) over the rest of the lateral L3. Diagram #2, Hatch Plot, presents the lateral path laid atop the site plan.

Figure #5, lateral plot L4, presents the Hatch and Profile plots recorded at the USTAR building site, from the south edge of the site to Federal Way. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant Br (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown by Diagram #1, Profile Plot, emissions peak at 0.28 mG above the site from a transient Bx component. This lateral recorded an extremely low mean emission of 0.04 mG.

Figure #6, lateral plot L5, presents the Hatch and Profile plots recorded at the USTAR building site, from the south edge of the site to Federal Way. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant B4 (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown

by Diagram #1, Profile Plot, emissions peak at 0.12 mG above the site from a transient horizontal and vertical component. This lateral recorded an extremely low mean emission of 0.04 mG.

Figure #7, lateral plot L6, presents the Hatch and Profile plots recorded at the USTAR building site, from the south edge of the site to Federal Way. The lateral data path has four color hatch marks (0.05 mG, 0.1 mG, 0.5 mG and 1.0 mG) representing the threshold level recorded at each one-foot interval (no hatch marks indicate levels less than 0.05 mG). Included is the associated Profile Plot with resultant B4 (black) level and three Bx (red), By (green), and Bz (blue) components shown as a function of distance. As shown by Diagram #1, Profile Plot, emissions peak at 0.2 mG above the site from transient horizontal components. This lateral recorded an extremely low mean emission of 0.045 mG.

Conclusions: The recorded AC ELF magnetic flux density emissions around the future USTAR Neuroscience and Biomedical Technology Research Building are low, ranging from 0.04 mG average (mean) to sporadic 0.2/0.3 mG transients due to ground/net currents on nearby feeders. During peak summer demand, the current loads can double (2X) to triple (3X) on electrical feeders proportionally increasing the ambient magnetic field levels around the site. This infers that the recorded 0.04 mG average emission could increase from 0.04 mG to 0.08 mG (2X) or 0.12 mG (3X) during peak summer loads, which would exceed the recommended 0.1 mG Brms threshold for EMI sensitive research tools in Quiet Rooms.

The USTAR Neuroscience and Biomedical Technology Research Building at the University of Utah complies with the following AC ELF EMI magnetic flux density performance requirements:

- ***0.1 mG Br RMS (0.28 mG p-p) for the Quiet and EM Laboratories (emissions at certain location approach this threshold and magnetic shielding may be required for optimal functionality of sensitive scientific tools),***
- ***0.3 mG Br RMS (0.85 mG p-p) for Cleanrooms,***
- ***1 mG Br RMS (2.8 mG p-p) for NMRs and MRIs; and,***
- ***10 mG long-term human exposures threshold recommended by the Swiss Bunderstat and NCRP Draft Report (see AC ELF Magnetic Field Health Issues, Standards & Guidelines)***
- ***In addition, and in response to the compliant of a JEOL 2200F with a Cs corrector, this site complies with manufacturer given thresholds for the tool. Vertical component emissions are less than 0.1 mG RMS (0.3 mG p-p) and horizontal component emissions are less than 0.3 mG RMS (0.7 mG p-p). VitaTech acknowledges the inclusion of the Cs corrector, a tool capable of producing sub-angstrom resolution for SEMs and TEMs, and believes the addition***

of the corrector will not compromise the equipment within these ambient magnetic field levels.

DC Electromagnetic Interference (EMI)

Large and small ferromagnetic masses in motion such as elevators, cars, trucks, and metal doors produce geomagnetic field perturbations in the sub-extremely low frequency (SELF) 0 - 3 Hz band that radiate (similar to throwing a pebble in a pond) from the source generating DC electromagnetic interference (EMI) in sensitive scientific tools and instruments. The magnitude of the geomagnetic field perturbation and radiated distance from the source depends on the size, mass and speed of the moving ferromagnetic object. Theoretically, DC magnetic emission sources (i.e., ferromagnetic objects, magnets, etc.) decay according to the inverse cube law, in practice the decay rates are not ideal. Other problematic DC EMI sources include electromagnetic pulse (EMP) devices, which are usually high-voltage discharge instruments, subways, trolleys, NMRs, and MRIs. Electron microscopes (SEMs, TEMs, STEMs), Focus Ion Beam (FIB) writers and E-Beam Writers are also very susceptible to DC EMI emissions and require clean DC environments with dB/dt 1 mG and less differentials.

Placement of scientific tools depends on the actual DC EMI susceptibility under defined thresholds, which are often not easy to ascertain from the manufacturer's performance criteria. Electron microscopes are sensitive at 1 mG Brms from DC disturbances while SEMs and TEMs such as the TEM JOEL 2200F have 0.25 mG horizontal and 0.1 mG vertical performance requirements while next generation EM tools are less than 0.1 mG Brms and Super STEMs (also known as ultra-high resolution STEMs) have a 0.01 mG DC EMI threshold. DC susceptibility in typical 1.5 to 4 Tesla MRIs can range from 1 mG to over 0.5 Gauss depending on the magnetic field strength, resolution and type (open vs. closed, active shielding, etc.). Furthermore, to ensure a safe working environment around MRIs and NMRs, adequate signage must be posted at 5 and 10 Gauss lines to warn staff and visitors with implantable devices and to minimize inadvertent data corruption (coercivity) of credit cards and other valuable magnetic media. Below is a list of DC EMI Thresholds in Gauss that will impact CRT displays, electronic instruments and magnetic media:

Table #1 – DC EMI Threshold Chart

DC EMI Thresholds - CRT screen shift, noise & coercivity (data errors)
0.001 Gauss & Less SEMs, TEMs E-Beam/FIB Writers
0.75 Gauss CRT Monitors & Electronic Instruments
5 Gauss Cardiac Pacemakers & Implantable Devices Warning Sign
10 Gauss Credit Cards & Magnetic Media Warning Sign
300 Gauss Low Coercivity Mag-Stripe Cards
700 Gauss High Coercivity Mag-Sripe Cards & Video Tapes
1000 milligauss (mG) = 1 Gauss (G) & 1 mG = 0.001 G = 0.1 uT (microtesla)

Based upon VitaTech's EMI experience working on similar Nanotechnology projects around the United States, the following EMI AC & DC Magnetic Field Performance Specifications in Chart #1 are recommended below:

Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirements:
1 mG Br RMS (2.83 mG p-p)

Quiet & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

Cleanroom Maximum Requirements:
0.3 mG Br Rms (0.85 mG p-p)

Moving Vehicles & Train DC EMI Emission Profiles & Impact

Figures #8 and #9 present the DC EMI data recorded at the University of Utah along Wasatch Drive. VitaTech also presents normal decay for DC EMI in the below chart, based off of a study at the University of Florida and overlayed on the USTAR site survey diagram in Figure #8A. Assuming the average mass of a car is 3000 lbs and of a large bus is 30,000 lbs (DOT information) I used curve tracing software to generate formulas for the decay rates. Although the ideal decay for DC sources is the inverse cube, the actual decay formulas for a bus based upon the recorded data was: $mG = 30(x^{-1.36})$. Comparing the car and bus EMI emission data, the below chart presents the EMI decay rates based upon the predicted formulas:

Calculated Vehicle Profiles

Distance	Car	Bus
1 m	3.50 mG	30.0 mG
6 m	0.48 mG	2.6 mG
12 m	0.22 mG	1.0 mG
18 m	0.15 mG	0.59 mG
24 m	0.11 mG	0.40 mG
30 m	0.08 mG	0.30 mG
36 m	0.07 mG	0.23 mG
40 m	0.06 mG	0.20 mG

Special Note: magnetic fields decay more rapidly after 30 meters than the calculated levels indicate.

Figure #8 presents the DC EMI Vehicle Emission Profile for the USTAR Neuroscience and Biomedical Technology Research Building. Data was recorded along Wasatch Drive, north of Federal Way, for 10 minutes at 0.2-second sampling. VitaTech calculated the component and resultant values from the vehicles traveling in motion along Wasatch Drive and has presented them along with the JEOL 2200F's DC EMI thresholds for comparison:

USTAR DC EMI Comparison – Location 1				
Emission Component	Vehicles 1	Vehicle 2	Vehicle 3	Thresholds
Bx Horizontal	0.12 mG	0.20 mG	0.20 mG	0.25 mG
By Horizontal	0.13 mG	0.05 mG	0.05 mG	0.25 mG
Bz Vertical	0.10 mG	0.15 mG	0.05 mG	0.1 mG
Br Resultant	0.11 mG	0.16 mG	0.07 mG	0.29 mG

Note that this data was recorded adjacent to Wasatch Road and represents a worst-case vehicle emission profile.

Figure #9 presents the DC EMI Vehicle Emission Profile for the USTAR Neuroscience and Biomedical Technology Research Building. Data was recorded along Wasatch Drive, south of Federal Way, for 10 minutes at 0.2-second sampling. VitaTech calculated the component and resultant values from the vehicles traveling in motion along Wasatch Drive and has presented them along with the JEOL 2200F's DC EMI thresholds for comparison:

USTAR DC EMI Comparison – Location 2					
Emission Component	Vehicles 1	Vehicle 2	Vehicle 3	Vehicle 4	Thresholds
Bx Horizontal	0.22 mG	0.50 mG	0.15 mG	0.10 mG	0.25 mG
By Horizontal	0.10 mG	0.30 mG	0.15 mG	0.20 mG	0.25 mG
Bz Vertical	0.05 mG	0.16 mG	0.05 mG	0.10 mG	0.1 mG
Br Resultant	0.14 mG	0.23 mG	0.03 mG	0.09 mG	0.29 mG

Note that this data was recorded adjacent to Wasatch Road and represents a worst-case vehicle emission profile.

Conclusion: The DC EMI impact will be relative to distance at the USTAR Neuroscience and Biomedical Technology Research Building. Although it is not a serious issue, DC EMI sensitive equipment may not be placed closer than 40 meters from Wasatch Road in order to achieve optimal functionality of any and all scientific instruments designated for use at USTAR. The differential emissions generated by vehicles traveling along Wasatch Road will not affect instruments located away from the road, and this should be kept in mind when finalizing building planning. VitaTech did not notice a significant, if any, DC EMI impact from the trains.

The USTAR Neuroscience and Biomedical Technology Research Building at the University of Utah complies with the following DC EMI magnetic flux density performance requirements:

- ***0.1 mG Br RMS (0.28 mG p-p) for the Quiet and EM Laboratories (provided EMI sensitive instruments have appropriate separation distance);***
- ***0.3 mG Br RMS (0.85 mG p-p) for Cleanrooms, and;***
- ***1 mG Br RMS (2.8 mG p-p) for NMRs and MRIs.***

Radiofrequency Interference (RFI)

The Federal Communications Commission (FCC), not the local municipal zoning authorities or law enforcement, has legal jurisdiction over radiofrequency interference (RFI). Simply stated RF devices (intentional and unintentional emitters) are not permitted to cause RFI with other radio services, electronic

equipment and systems. At present, there are no mandated radiofrequency interference (RFI) susceptibility government standards in the United States. The only equipment susceptibility standards that exist are unique to equipment (quality control) internal standards written by equipment manufacturers based on radiated emission standards for intentional radiators set forth by the FCC. In other words, an equipment manufacturer in United States must design the equipment to function properly within a radiated emission field level from intentional radiators set forth by the FCC, Part 15. Like any other communications facility, wireless broadband facilities must comply with these FCC limits. The following FCC parts apply to electromagnetic interference (EMI) and radio frequency interference (RFI) conducted and radiated emissions (see below):

Radio Frequency Devices - Part 15
Multipoint Distribution Service - Part 21, subpart K
Paging and Radiotelephone Service - Part 22, subpart E
Cellular Radiotelephone Service - Part 22, subpart H
Personal Communications Services - Part 24
Satellite Communications - Part 25
General Wireless Communications Service - Part 26
Wireless Communications Service - Part 27
Radio Broadcast Services - Part 73
Experimental, auxiliary, and special broadcast and other program distributional services - Part 74
Experimental Radio Service - Part 5
Stations in the Maritime Service - Part 80
Private Land Mobile, Paging Operations - Part 90
Private Land Mobile, "Covered" Specialized Mobile Radio - Part 90
Amateur Radio Service - Part 97
Local Multipoint Distribution Service - Part 101, subpart L
Mobile and portable devices used as follows:
- Cellular Radio Service
- Personal Communications Service
- Satellite Communications Branch
- General Wireless Communications Service
- Wireless Communications Service
- Maritime Service
- "Covered" Specialized Mobile Radio Service

In Europe, there are susceptibility (radiated immunity) standards, such as the EN 61000-6-1, that states 3 V/m level for residential electronic equipment, while 10 V/m is standard for industrial electronic equipment in the EN 61000-6-2. Engineers in the United States utilize the European susceptibility standards as a guideline. VitaTech recommend 3 V/m as the industrial RFI threshold and 1 V/m for the medical/scientific instrument RFI threshold for maximum performance.

RFI Electric Field Strength Site Assessments & Conclusions
Timed RF electric field strength data in volts-per-meter (V/m) was recorded at two locations of the proposed USTAR site at the University of Utah from 100 kHz to 3 GHz and 3 MHz to 18 GHz at 0.4 second intervals for two 10 minute periods as shown in Figures #10 and #11 and in summary Tables #1 and #2 below:

Table #1: 100KHz - 3GHz RF Data

Loc.	Max (V/m)	Min (V/m)	Average (V/m)
1	0.63	0.00	0.47
2	0.71	0.40	0.58

Table #2: 3MHz - 18GHz RF Data

Loc.	Max (V/m)	Min (V/m)	Average (V/m)
1	0.98	0.00	0.11
2	0.25	0.00	0.01

Tables #1 and #2 present the recorded RF electric field strength data at two locations aside Federal Way. The 100 KHz – 3 GHz electric field strength levels were low at both locations with a peak of 0.71 V/m at Location 2. Locations 1 and 2 averaged 0.47 V/m and 0.58 V/m, respectively. Even lower electric field strengths were recorded in the 3 MHz – 18 GHz band at both locations. Elevated peaks above 0.4 V/m in this range was due to cell phone testing by the technician. Locations 1 and 2 achieved optimal averages of 0.11 V/m and 0.01 V/m, respectively.

Conclusions: The ambient timed recorded 100 kHz to 18 GHz electric field strength level were low at the USTAR Neuroscience and Biomedical Technology Research Building's proposed site. Therefore, the recorded timed RF electric field strength levels at the three buildings were less than the following RFI thresholds:

- ***1 V/m RFI threshold for medical/scientific equipment (author generated higher levels during cell phone testing and usage);***
- ***3 V/m RFI industrial/commercial/residential thresholds and SEMI E33-94 signal and DC/AC power port thresholds; and,***
- ***10 V/m RFI industrial/commercial/residential thresholds and Semi E33-94 enclosure port thresholds.***

If RFI problems are detected from any RF sources in the future, the FCC may impose "quite hours" until the RFI investigation is completed. It is incumbent on the RFI source to correct, at their expense, any unintentional, willful or malicious RFI emissions detected from their transmitters and antennas.

AC ELF/DC & RF Test Instruments
FieldStar 1000 Gaussmeter - AC ELF Magnetic Flux Density
VitaTech recorded the AC ELF magnetic flux density data using a FieldStar 1000 gaussmeter with a NIST traceable calibration certificate manufactured by Dexsil Corporation. The FieldStar 1000 has a resolution of 0.04 mG in the 0 - 10 mG range, 1% full-scale accuracy to 1000 mG and a frequency response of 60 Hz (55 - 65

Hz @ 3dB). Three orthogonal powdered-iron core coils are oriented to reduce interference to less than 0.25% over the full dynamic range. The three coils are arranged inside the unit holding horizontal with the display forward: Bx horizontal coil points forward, By horizontal coil points to the right side, and Bz vertical coil points upward. The microprocessor instantly converts the magnetic field to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and simultaneously calculates the resultant R_{rms} (root-means-square) vector according to the following formula:

$$R_{rms} = \sqrt{Bx^2 + By^2 + Bz^2}$$

When collecting contour path data, a nonmetallic survey wheel is attached to the FieldStar 1000 gaussmeter and the unit is programmed to record mapped magnetic flux density data at selected (1-ft., 5-ft., 10-ft. etc.) intervals. The FieldStar 1000 is exactly 39.37 inches (1 meter) above the ground with the survey wheel attached. Along each path the distance is logged by the survey wheel and the relative direction (turns) entered on the keyboard. Up to 22,000 spot, mapped and timed data points can be stored, each containing three components (Bx, By & Bz), event markers and turn information. After completing the path surveys, magnetic flux density data is uploaded and processed. All plots display a title, time/date stamp, ID path number, and the following statistical data (in milligauss) defined below:

Peak - maximum magnetic field (flux) value measured in group.
Mean - arithmetic average of all magnetic field (flux) values collected.

The following is a quick description of the Hatch, Profile and 3-D Contour plots presented in the figures of this report on the next page:

Hatch Plot - data is represented by four difference hatch marks (1 mG, 2.5 mG, 5.0 mG and 10.0 mG thresholds) based on width and color as a function of distance along the survey path that shows 90 and 45 degree turns. Note: the site drawing and all Hatch Plots were scaled in feet to verify actual recorded distances and correct survey locations.

Profile Plot - data shows each recorded component (Bx, By, Bz) axis and the resultant (Br) levels as a function of distance: Bx (red) is the horizontal component parallel to the survey path, By (green) is the horizontal component normal (perpendicular) to the survey path, and Bz (blue) is the vertical component with the computed Br resultant RMS (root-means-square) summation of the three components.

3-D Plot - data is presented along survey with Br resultant level in the vertical direction using eight (8) color thresholds on an horizontal plane.

MEDA FVM-400 DC Three-Axis MagnetometerTimed three-axis DC magnetic flux density levels were recorded from the elevators and moving vehicles with a three-axis fluxgate magnetometer at 1 second intervalsover a 10-minute periods. The MEDA FVM-400 three-axis fluxgate magnetometer has 1 nT (0.01 mG) resolution and 1.2 Gauss (1,200 mG) maximum range with 1% full scale accuracy from 0-10 Hz. Data is downloaded directly to a computer during data collection and than processed for graphical presentations.

EMR-300 RF Meter - Electric Field Strength Data 100 kHz - 18 GHz
The EMR-300 is an radiofrequency (RF) electric field strength meter for broadband measuring and monitoring from 100 kHz to 18 GHz. The isotropic non-directional field probe with high sensitivity records average, maximum, peak and timed data in electric fields strength volts-per-meter (V/m), magnetic field strength amps-per-meter (A/m) and power levels. Ten minute timed data was sampled at 0.4 seconds intervals from 100 kHz – 3 GHz with a Probe 18 (range 0.2 V/m to 320 V/m) at each location.

AC ELF Magnetic Field Health Issues, Standards & Guidelines
Regarding human exposure to AC ELF magnetic fields, VitaTech recommends 10 mG and less for long-term (4 - 8 hours per day) AC ELF magnetic field exposure in all laboratories, offices, and work areas in the future Physical Sciences Facility buildings (Ultra Trace, RAD Detection & MS&T buildings) at Pacific Northwest National Laboratory (PNNL) in Richland, WA.

Currently, there are no Federal standards for AC ELF electric and magnetic field levels. The National Energy Policy Act of 1992 authorized the Secretary of the Department of Energy (DOE) to establish a five-year, $65 million EMF Research and Public Information Dissemination (RAPID) Program to ascertain the affects of ELF EMF on human health, develop magnetic field mitigation technologies, and provide information to the public. In May 1999, the NIEHS Director Kenneth Olden, Ph.D. delivered his final report, *Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, to Congress that stated the following in the Cover Letter and Executive Summary below:

> *The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and* ***chronic lymphocytic leukemia in occupationally exposed adults... The NIEHS concludes that ELF-EMI exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard.***

U.S. & International Organizational AC ELF EMF Standards
The International Commission on Non-Ionizing Radiation Protection (IRPA/INIRC) have established 833 mG maximum human exposure limit over 24 hours for the

general public and 4,167 mG for occupational workers. Whereas The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 10,000 mG (10 Gauss) exposure limit over 24 hours for occupational workers, but specifies only 1,000 mG (1 Gauss) as a maximum exposure for workers with cardiac pacemakers.

New York State Public Service Commission AC ELF EMF Standards

Effective September 1990, the State of New York Public Service Commission (PSC) "began a process looking toward the adoption of an interim magnetic field standard for future major electric transmission facilities". The Commission concludes that a prudent approach should be taken that will avoid unnecessary increases in existing levels of magnetic field exposure. Therefore, future transmission circuits shall be designed, constructed and operated such that magnetic fields at the edges of their rights-of-way will not exceed 200 mG when the circuit phase currents are equal to the winter-normal conductor rating. They also established an electric field strength interim standard of 1.6 kV/m electric transmission facilities.

IARC June 2002 Report

In June 2002, the International Agency for Research on Cancer (IARC) issued a 400+ page report formally classifying extremely low frequency magnetic fields as ***possibly carcinogenic to humans*** based on studies of EMF and childhood leukemia. **This is the first time that a recognized public health organization has formally classified EMF as a possible cause of human cancer**. IARC found that, while selection bias in the childhood leukemia studies could not be ruled out, pooled analyses of data from a number of well-conducted studies show a fairly consistent statistical association between childhood leukemia and power-frequency residential magnetic fields above 4 milliGauss (mG), with an approximately two-fold increase in risk that is unlikely to be due to chance.

IARC is a branch of the World Health Organization. The IARC classification of EMF was made by a panel of scientists from the U.S. National Institute of Environmental Health Sciences, the U.S. Environmental Protection Agency, the U.K. National Radiological Protection Board, the California Department of Health Services, EPRI, and other institutions around the world.

Switzerland's February 2000 AC ELF Standard

The Swiss Bundersrat in February 2000 set by law an emission control limit of 10 mG from overhead and underground transmission lines, substations, transformer vaults and all electrical power sources.

VitaTech's & NCRP Draft Recommended 10 mG Standard

Section 8.4.1.3 option 3 in the National Council of Radiation Protection and Measurements (NCRP) draft report published in the July/August 1995 issue of *Microwave News* (visit the Microwave News Homepage <www.microwavenews.com> for the entire draft report) recommended the following on the next page:

8.4.1.3 Option 3: *An exposure guideline of 1 μT (10 mG) and 100 V/m: A considerable body of observations has documented bioeffects of fields at these strengths across the gamut from isolated cells to animals, and in man. Although the majority of these reported effects do not fall directly in the category of hazards, many may be regarded as potentially hazardous. Since epidemiological studies point to increased cancer risks at even lower levels, a case can be made for recommending 1 μT (10 mG) and 100 V/m as levels not to be exceeded in prolonged human exposures. Most homes and occupational environments are within these values, but it would be prudent to assume that higher levels may constitute a health risk. In the short term, a safety guideline set at this level would have significant consequences, particularly in occupational settings and close to high voltage transmission and distribution systems, but it is unlikely to disrupt the present pattern of electricity usage. These levels may be exceeded in homes close to transmission lines, distribution lines and transformer substations, in some occupational environments, and for users of devices that operate close to the body, such as hair dryers and electric blankets. From a different perspective, adoption of such a guideline would serve a dual purpose: first, as a vehicle for public instruction on potential health hazards of existing systems that generate fields above these levels, as a basis for "prudent avoidance"; and second, as a point of departure in planning for acceptable field levels in future developments in housing, schooling, and the workplace, and in transportation systems, both public and private, that will be increasingly dependent on electric propulsion.*

RF Human Exposure Standards

Presently, four major RF standards are used in the United States: IEEE, ACGIH (American Conference of Governmental Industrial Hygienists), NCRP (National Council on Radiation Protection and Measurements) and the ICNIRP (International Commissions of Non-Ionizing Radiation Protection). In 1991, the IEEE released a revised RF human exposure standard IEEE C95.1-1991, *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHZ*. However, in August 1997 the Federal Communications Commission (FCC) Office of Engineering & Technology (OTE) released Bulletin 65 *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, which became the defacto RF exposure standard in the United States. Both standards are very similar for Occupational/Controlled and General Population/Uncontrolled maximum permissible exposure (MPE), except for some minor differences -- the FCC standard is more restrictive and used in RF Safety & Exposure Testing.

The FCC's Bulletin 65 specifies separate maximum permissible exposure (MPE) limits for Occupational/Controlled and General Population/Uncontrolled exposure over a 0.3 MHz to 100 GHz bandwidth as shown below.

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

See Note 1 below.

NOTE 1: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

(B) Limits for General Population/Uncontrolled Exposure

Frequency RangeStrength (E) (MHz)	Electric Field (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

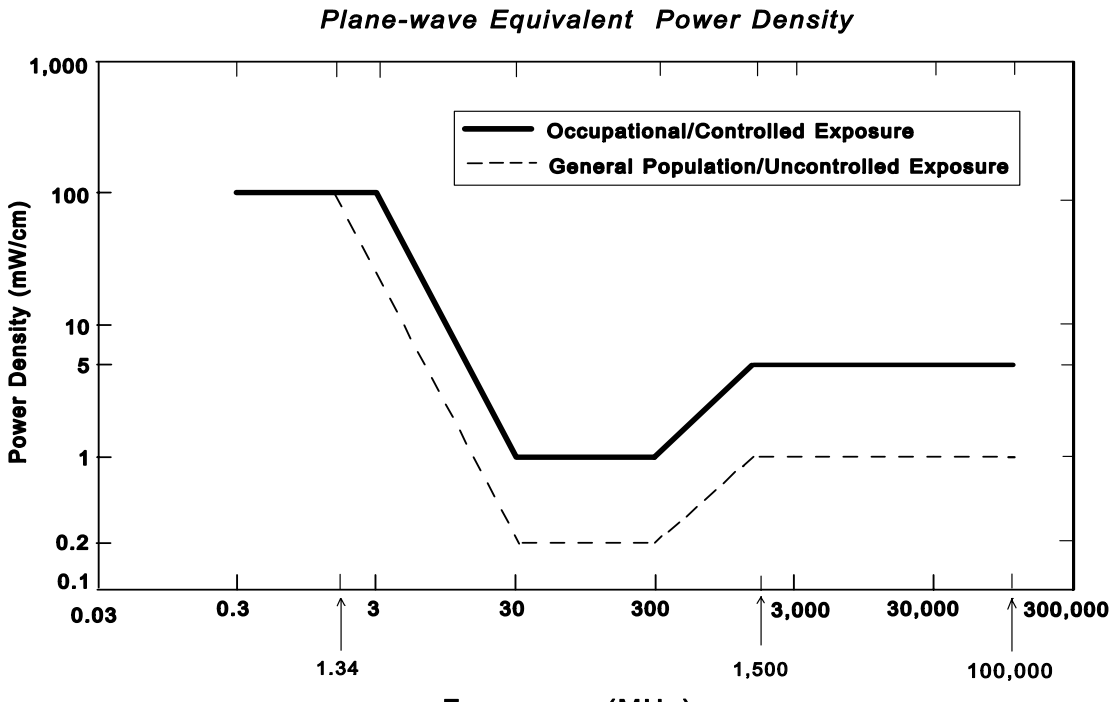
NOTE 2: ***General population/uncontrolled*** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Specific Absorption Rate (SAR) is the basis of most safety standards, when applied in the far-field, plane-wave conditions. It is the rate of energy absorption per unit of body mass. When the human body is exposed to the RF field, the SAR experienced is proportional to the squared value of the electric field strength induced in the body. At an absorption level of 4 W/kg, reversible behavioral disruption is noted. Levels above 5 W/kg can result in permanent adverse affects. Therefore, most standards have been based on SAR's of 0.4 W/kg to conservatively limit exposures to 1/10th of the levels to account for biological uncertainty and to add an additional safety factor.

Unfortunately, the Occupational Safety & Health Administration (OSHA) has not revised the standard since 1978 (see OSHA Regulations Standards - 29 CFR, Non-ionizing Radiation - 1910.97), but has already cited and fined organizations for exceeding the new standards. OSHA has the right to enforce based on consensus of scientifically-based standards under its general duty clause. **Nevertheless, OSHA uses 10 mW/cm² as the maximum SAR exposure over an averaged period of 6 minutes from continuous or intermittent RF sources between 10 MHz and 100 GHz.**

Figure 1, below, presents the FCC Limits for Maximum Permissible Exposure (MPE) in units of Power Density (mW/cm²):

Figure 1. **FCC Limits for Maximum Permissible Exposure (MPE)**



This completes the ***Final EMI/RFI Site Report: USTAR Neuroscience and Biomedical Technology Research Building, University of Utah***

The contents of this report are intended for the exclusive use of Architectural Nexus and the University of Utah. VitaTech Engineering, LLC shall not be responsible for any magnetic shield designs based upon the information contain within this report, except those designs and bids exclusively submitted by VitaTech Engineering, LLC.

Please call if you have any further questions

Best regards,

Louis S. Vitale, Jr.
President & Chief Engineer

Attachments: Figures #1 to #11

Figure #1, Perimeter Plots
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

AC ELF EMI Threshold (screen jitter & noise)

10 mG for 12-15 in. computer monitors & audio/video equipment
5 mG for 17-21 in. CRT monitors & medical (i.e., EEGs, ECGs, EMGs)
1.0 mG minimum for scientific tools (STEMs, TEMs, FIB, I-Beams)
0.1 - 0.3 mG optimum for next generation Nano/Pico Tech scientific tools

Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirement:
1 mG Br RMS (2.83 mG p-p)

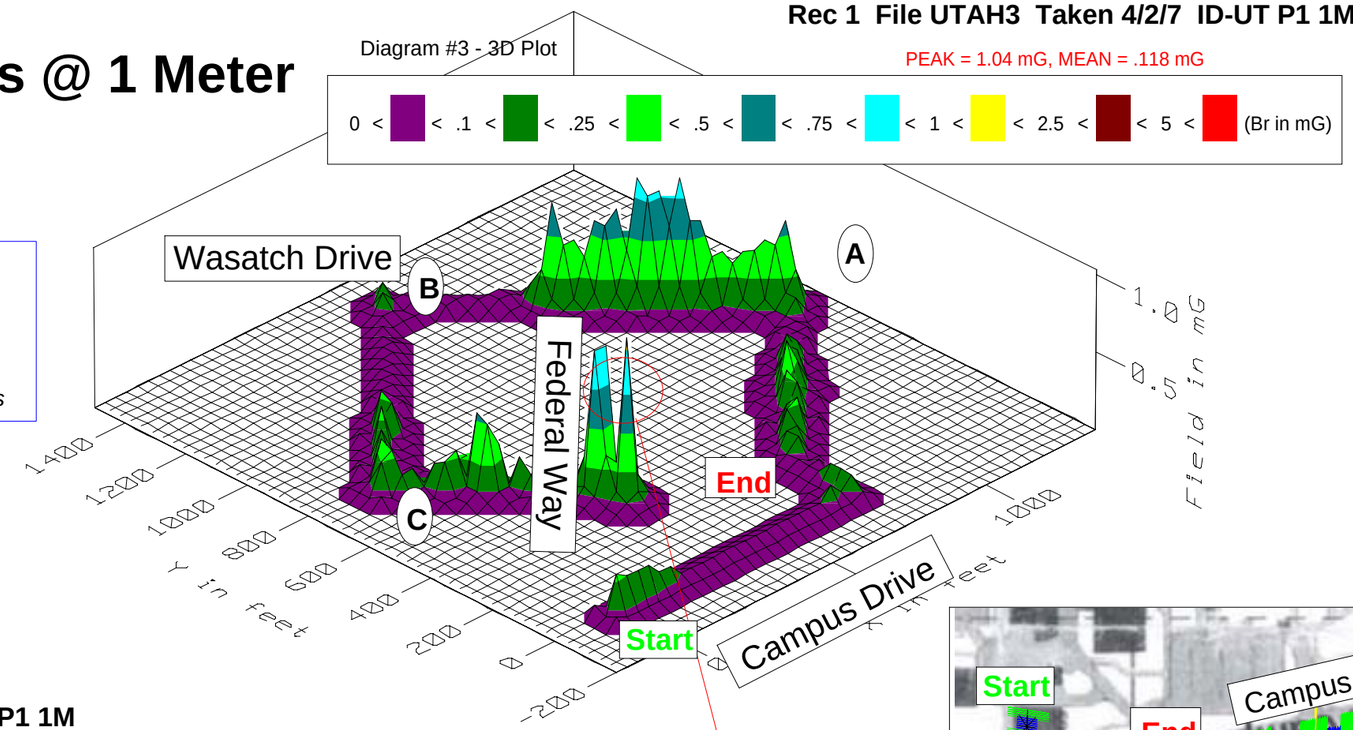
Quiet & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

Cleanroom Maximum Requirements:
0.3 mG BR RMS (0.85 mG p-p)

Rec 1 File UTAH3 Taken 4/2/7 ID-UT P1 1M

PEAK = 1.04 mG, MEAN = .118 mG

Diagram #3 - 3D Plot



AC ELF Magnetic Field Human Exposure Standards

NYS Public Service Commission
200 mG @ 1-meter on Edge -ROW
or 50 ft. from 69 kV poles

IRPA/INIRC
833 mG over 24 hours
General Public Exposure

ACGIH
1000 mG general public
& workers with cardia pacemakers

Swiss Bunderstat
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

Peak Location (1.04 mG)

Diagram 2 - Hatch Plot

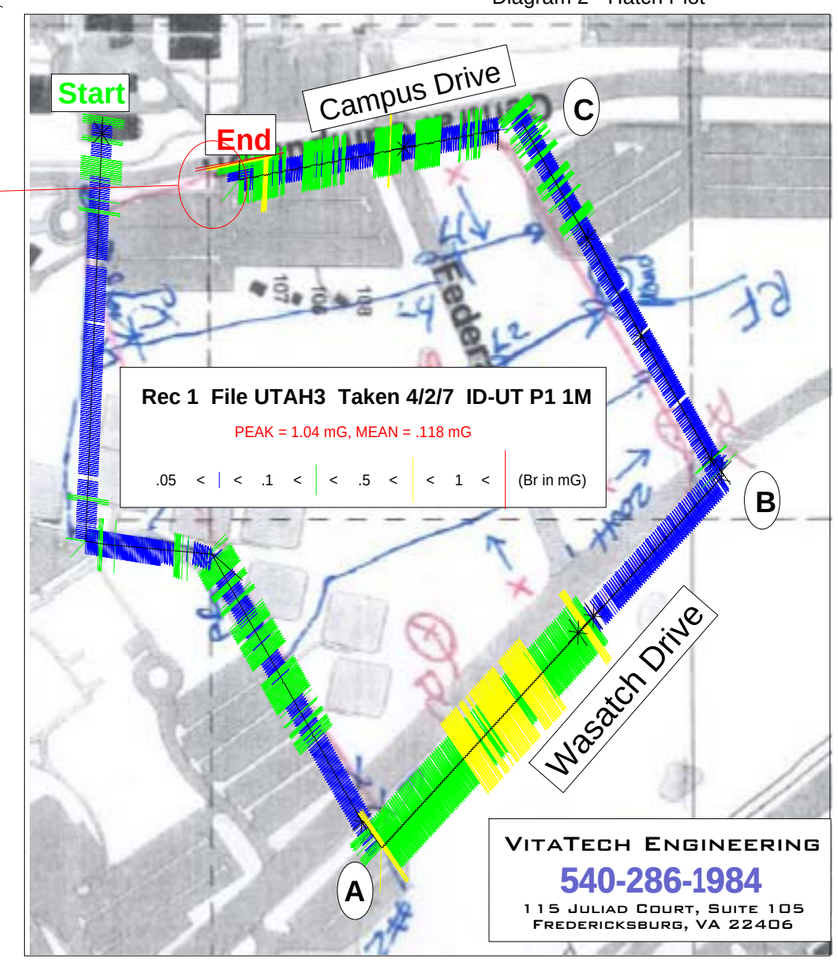
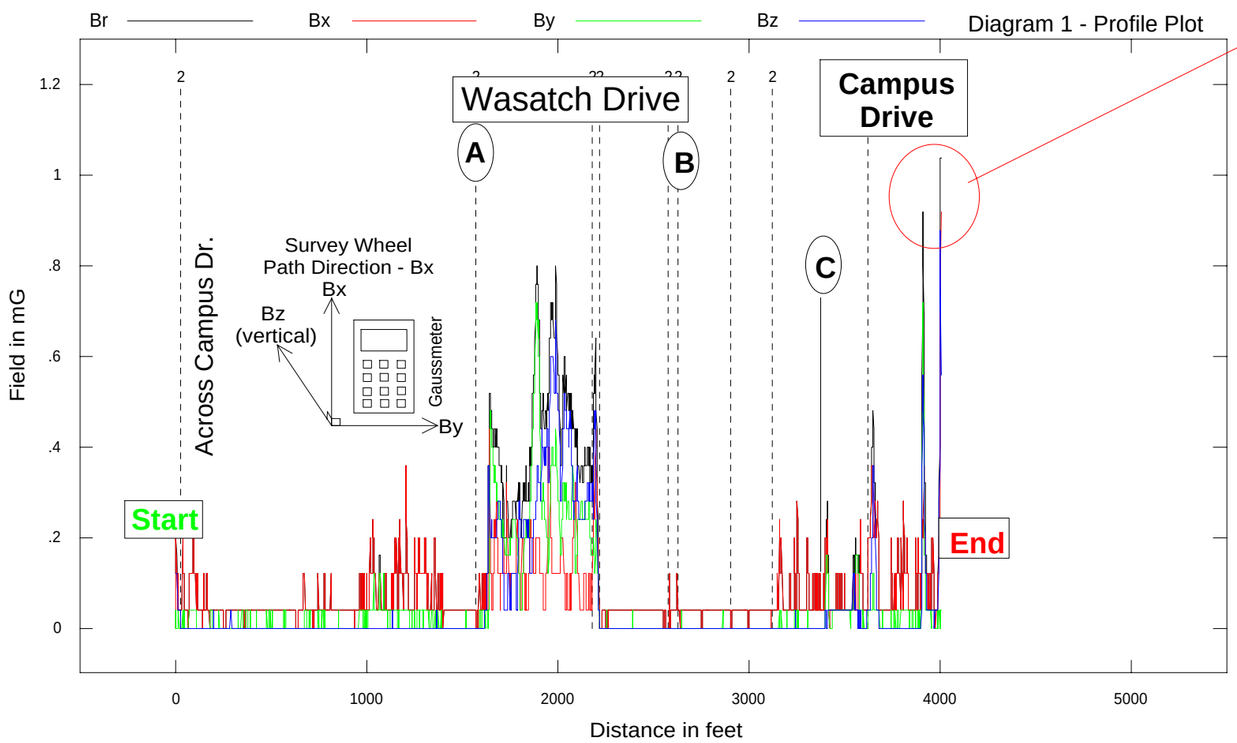


Diagram 1 - Profile Plot



The FieldStar 1000 gaussmeter converts the magnetic field to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and simultaneously calculates the resultant Rrms (root-means-square) vector according to the following formula:

$$R_{rms} = \sqrt{Bx^2 + By^2 + Bz^2}$$

Magnetic flux density susceptibility can be specified in magnetic field strength (A/m) or one of three magnetic flux density terms: Brms, Bpeak-to-peak(Bp-p) and Bpeak (Bp) according to the following conversion formula:

$$B_{rms} = \frac{Bp-p}{2\sqrt{2}} = \frac{Bp}{\sqrt{2}}$$

All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

Figure #2, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

The FieldStar 1000 gaussmeter converts the magnetic field to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and simultaneously calculates the resultant Rrms (root-means-square) vector according to the following formula:

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Swiss Bunderstat
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

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540-286-1984
115 JULIAD COURT, SUITE 105
FREDERICKSBURG, VA 22406

All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

AC ELF EMI Threshold (screen jitter & noise)

10 mG for 12-15 in. computer monitors & audio/video equipment
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0.1 - 0.3 mG optimum for next generation Nano/Pico Tech scientific tools

Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirement:
1 mG Br RMS (2.83 mG p-p)

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Cleanroom Maximum Requirements:
0.3 mG BR RMS (0.85 mG p-p)

Diagram 1 - Profile Plot

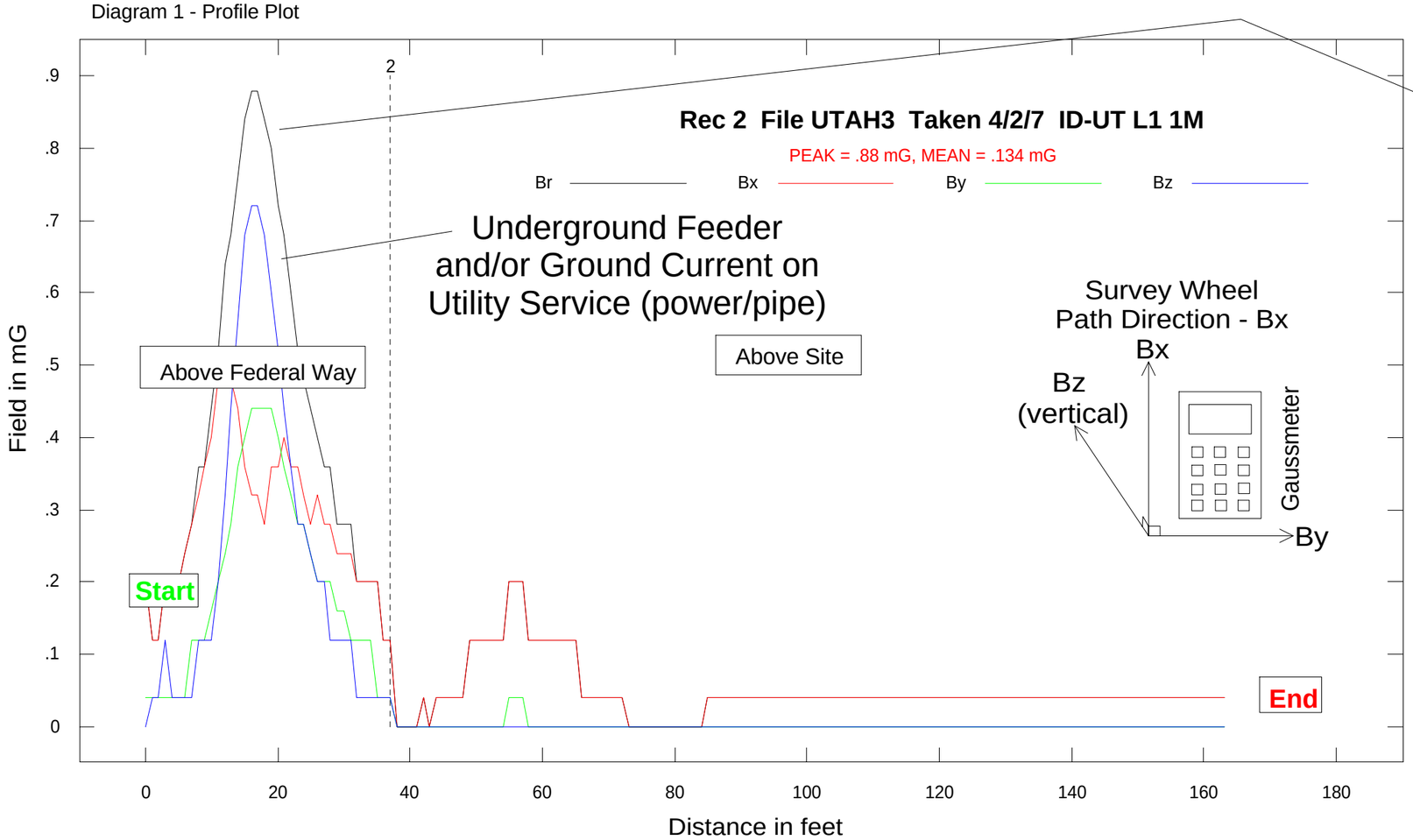

Diagram 2 - Hatch Plot

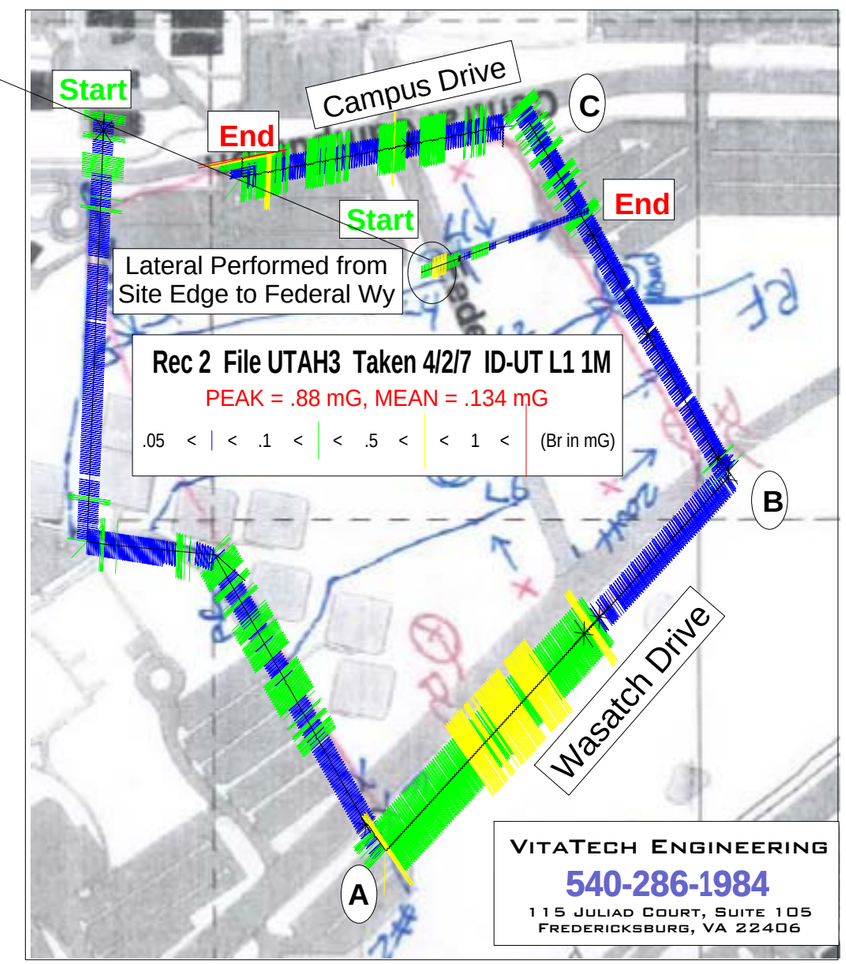

Figure #3, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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Swiss Bunderstat
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

Diagram 1 - Profile Plot

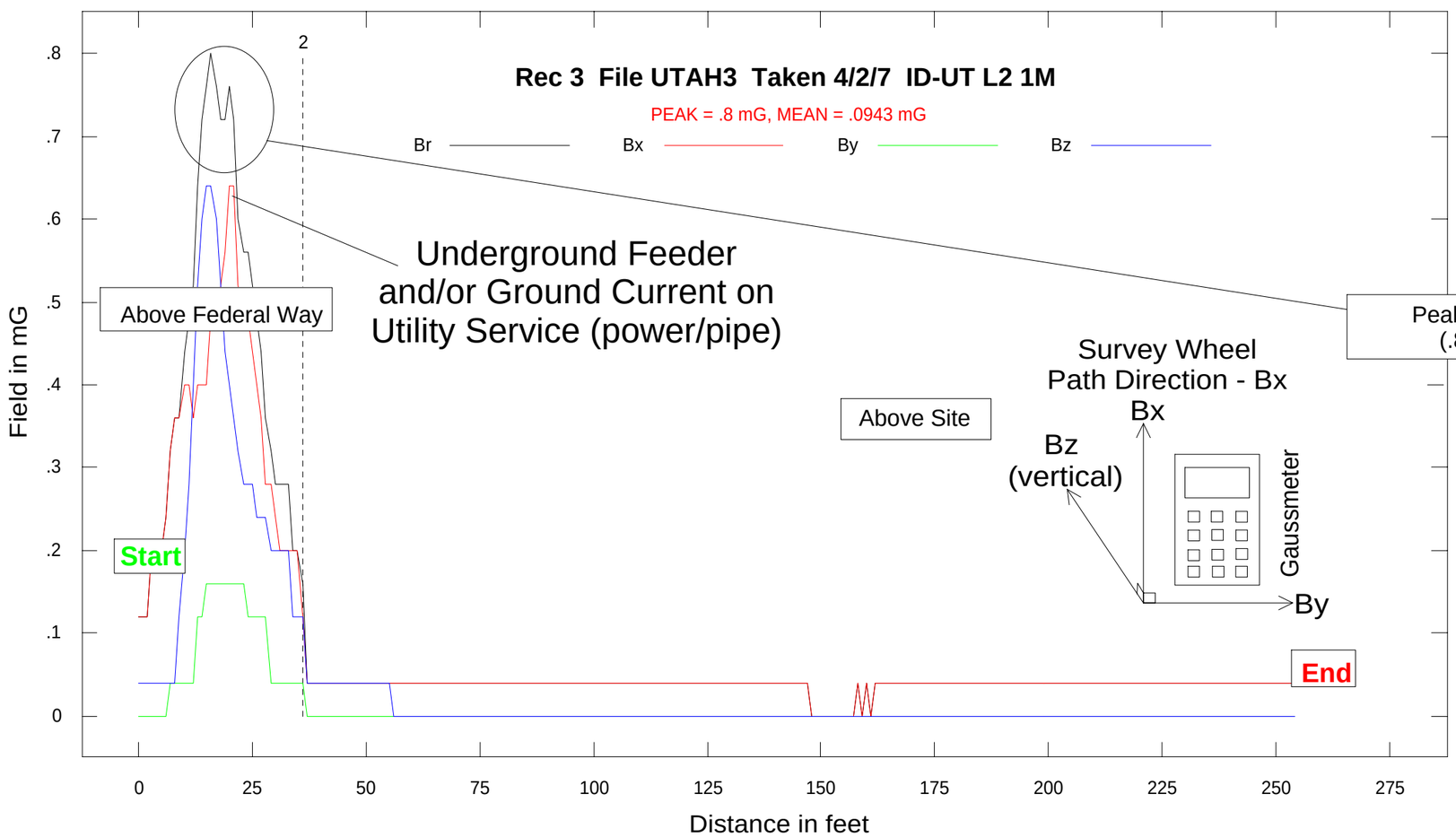

Diagram 2 - Hatch Plot

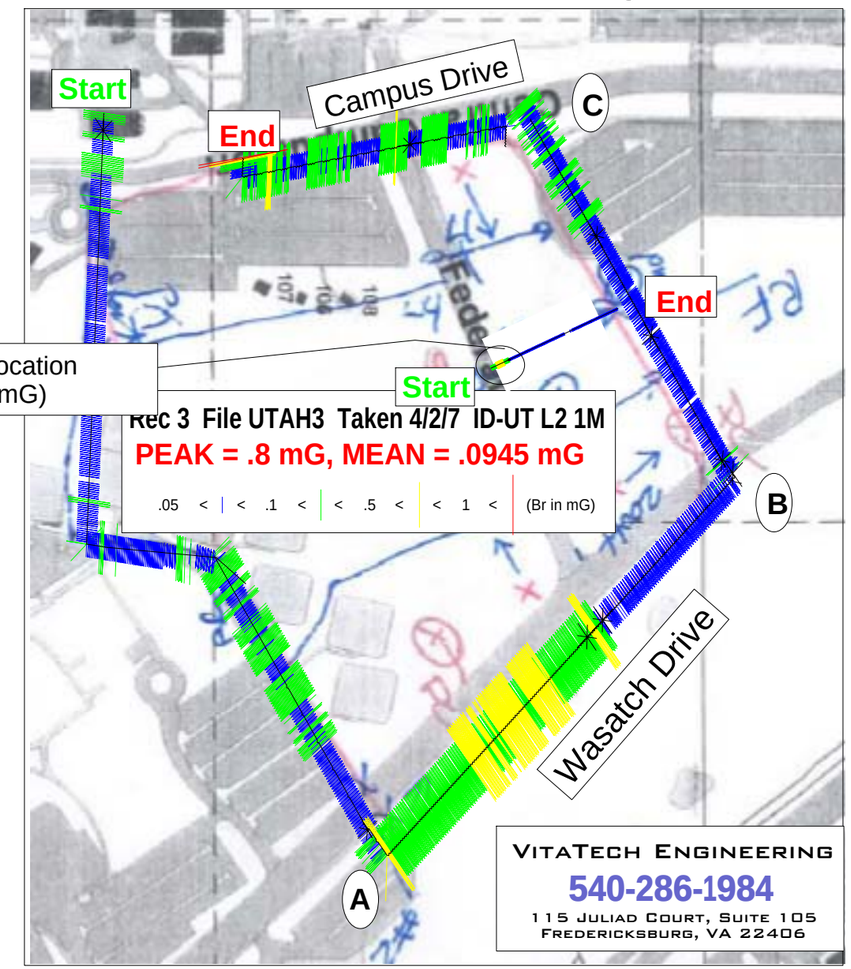

Figure #4, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

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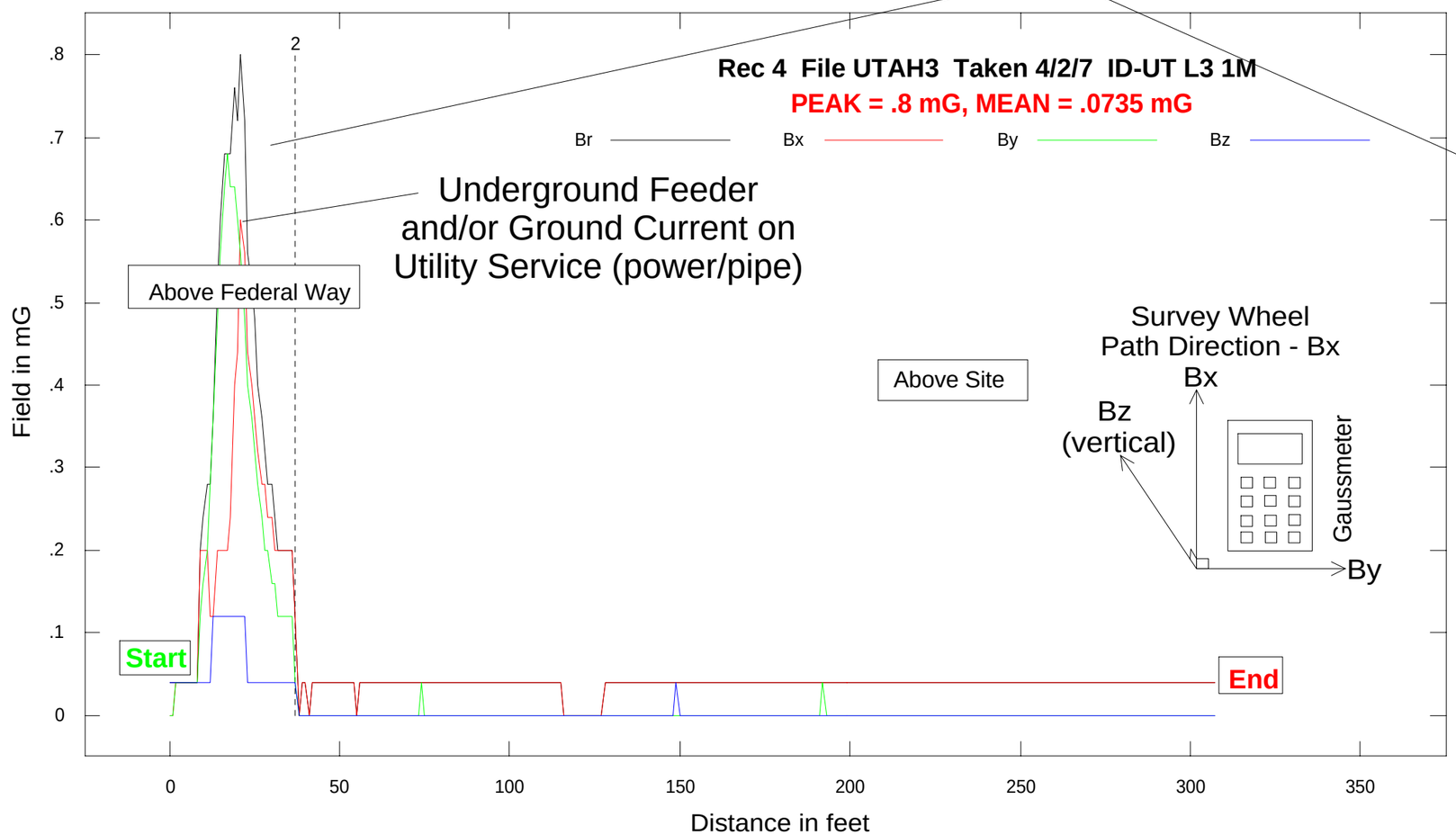

Diagram 2 - Hatch Plot

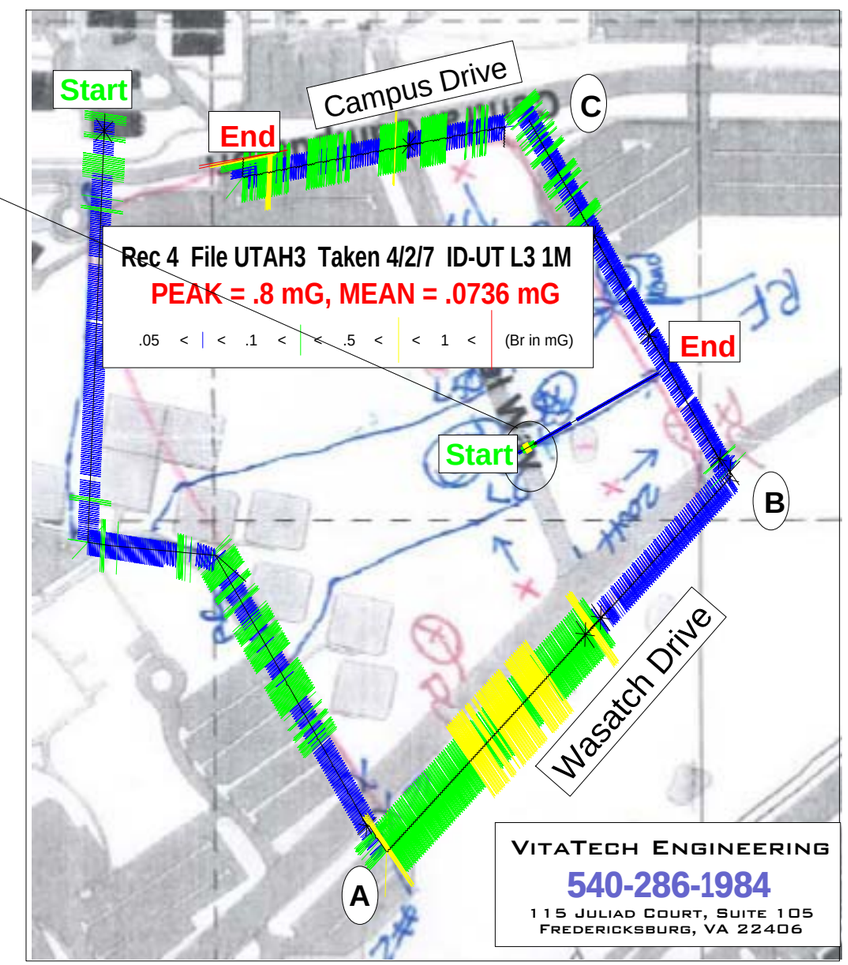

Figure #5, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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Swiss Bunderstat
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

Diagram 1 - Profile Plot

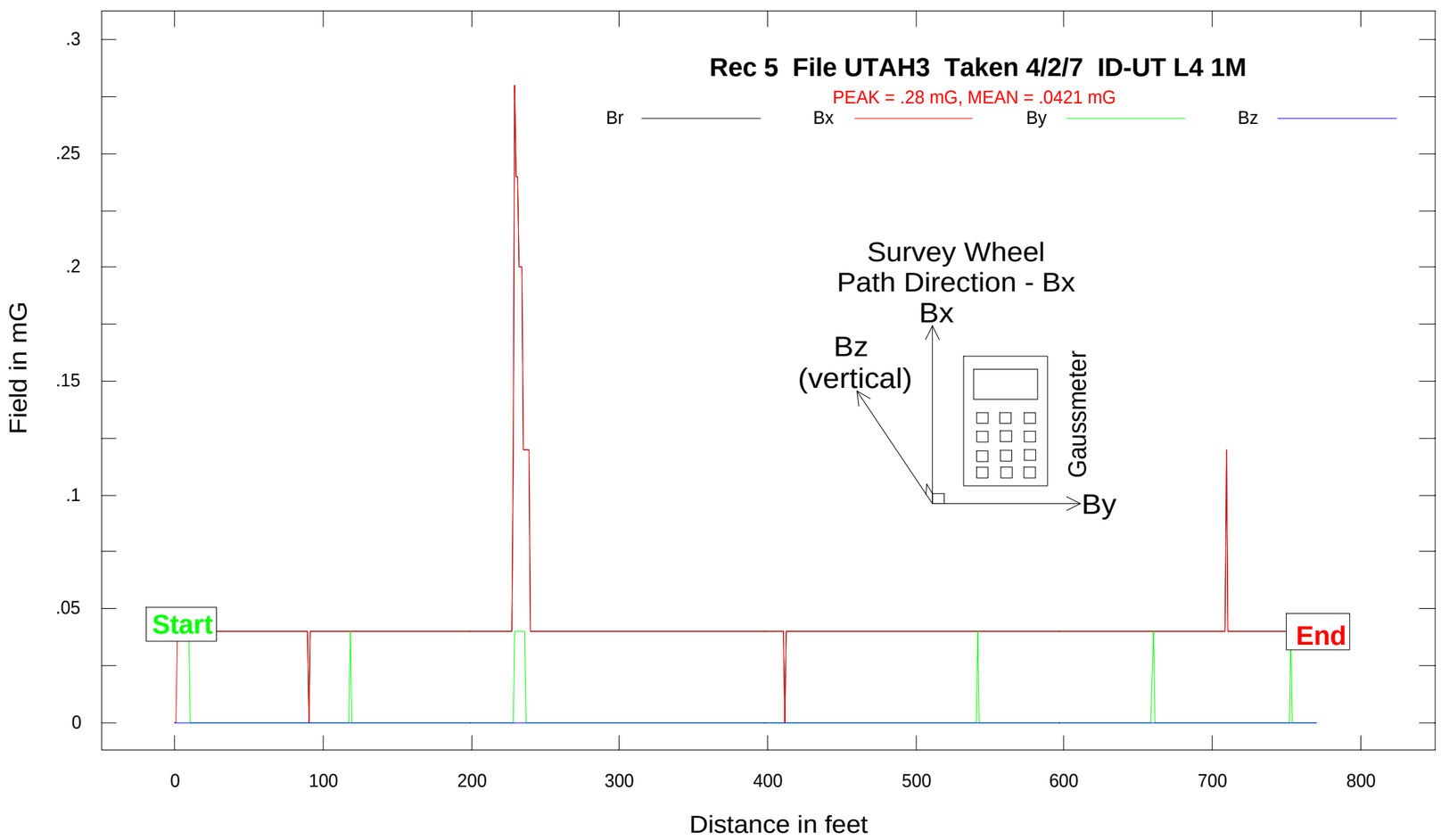
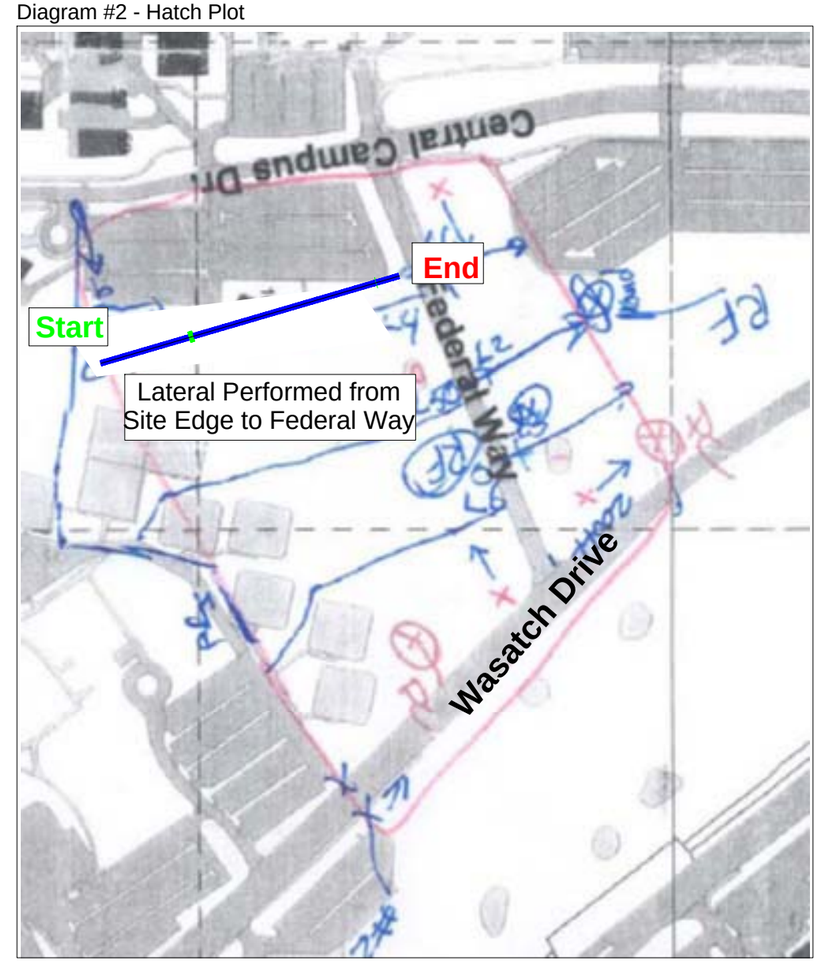


Diagram #2 - Hatch Plot



Rec 5 File UTAH3 Taken 4/2/7 ID-UT L4 1M
PEAK = .28 mG, MEAN = .0421 mG

.05 < | < .1 < | < .5 < | < 1 < | (Br in mG)

Figure #6, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

The FieldStar 1000 gaussmeter converts the magnetic field to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and simultaneously calculates the resultant Rrms (root-means-square) vector according to the following formula:

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$$B_{rms} = \frac{Bp-p}{2\sqrt{2}} = \frac{Bp}{\sqrt{2}}$$

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AC ELF EMI Threshold (screen jitter & noise)

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1000 mG general public
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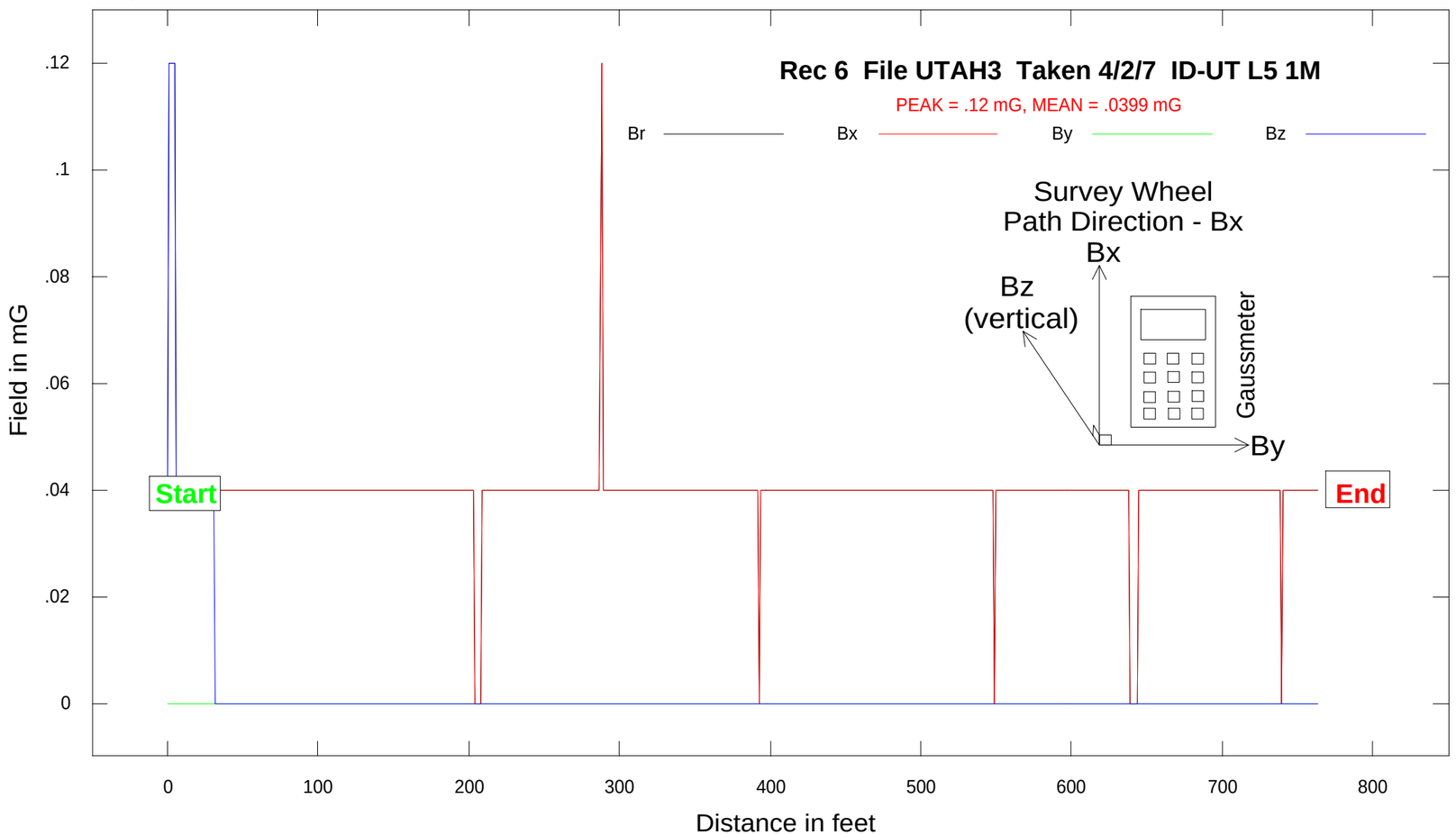
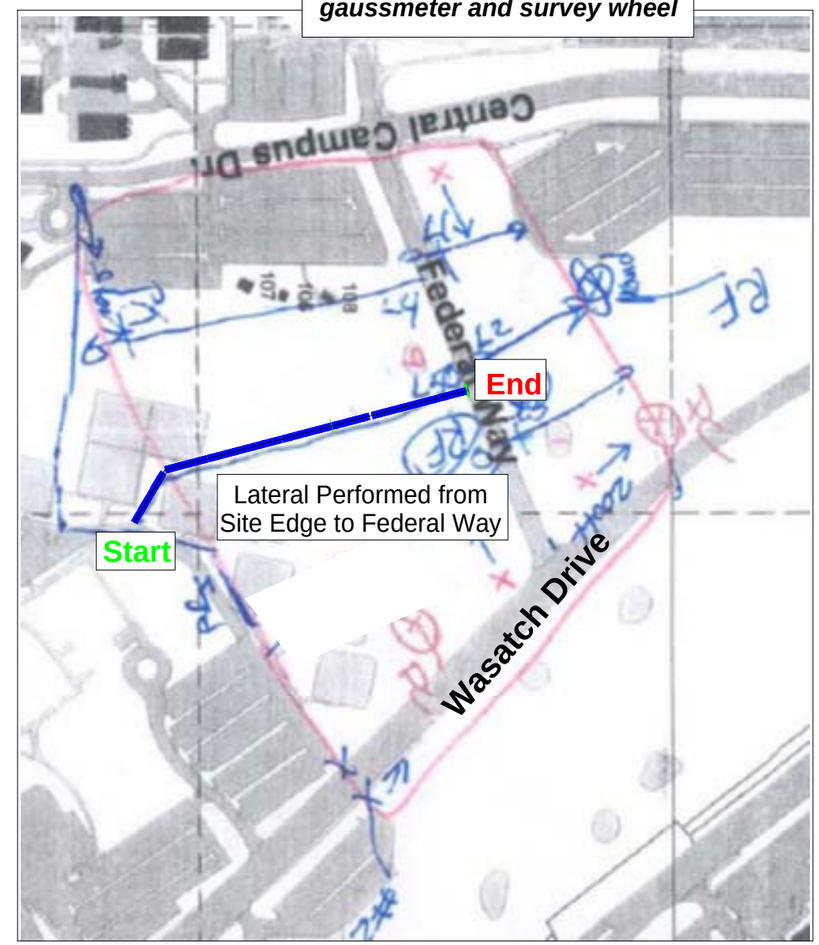
Swiss Bunderstat
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

Diagram 1 - Profile Plot



All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

Diagram #2 - Hatch Plot



Rec 6 File UTAH3 Taken 4/2/7 ID-UT L5 1M
PEAK = .12 mG, MEAN = .0399 mG

.05 < | < .1 < | < .5 < | < 1 < | (Br in mG)

Figure #7, Lateral Plot
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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$$B_{rms} = \frac{Bp-p}{2\sqrt{2}} = \frac{Bp}{\sqrt{2}}$$

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Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

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ACGIH
1000 mG general public
& workers with cardia pacemakers

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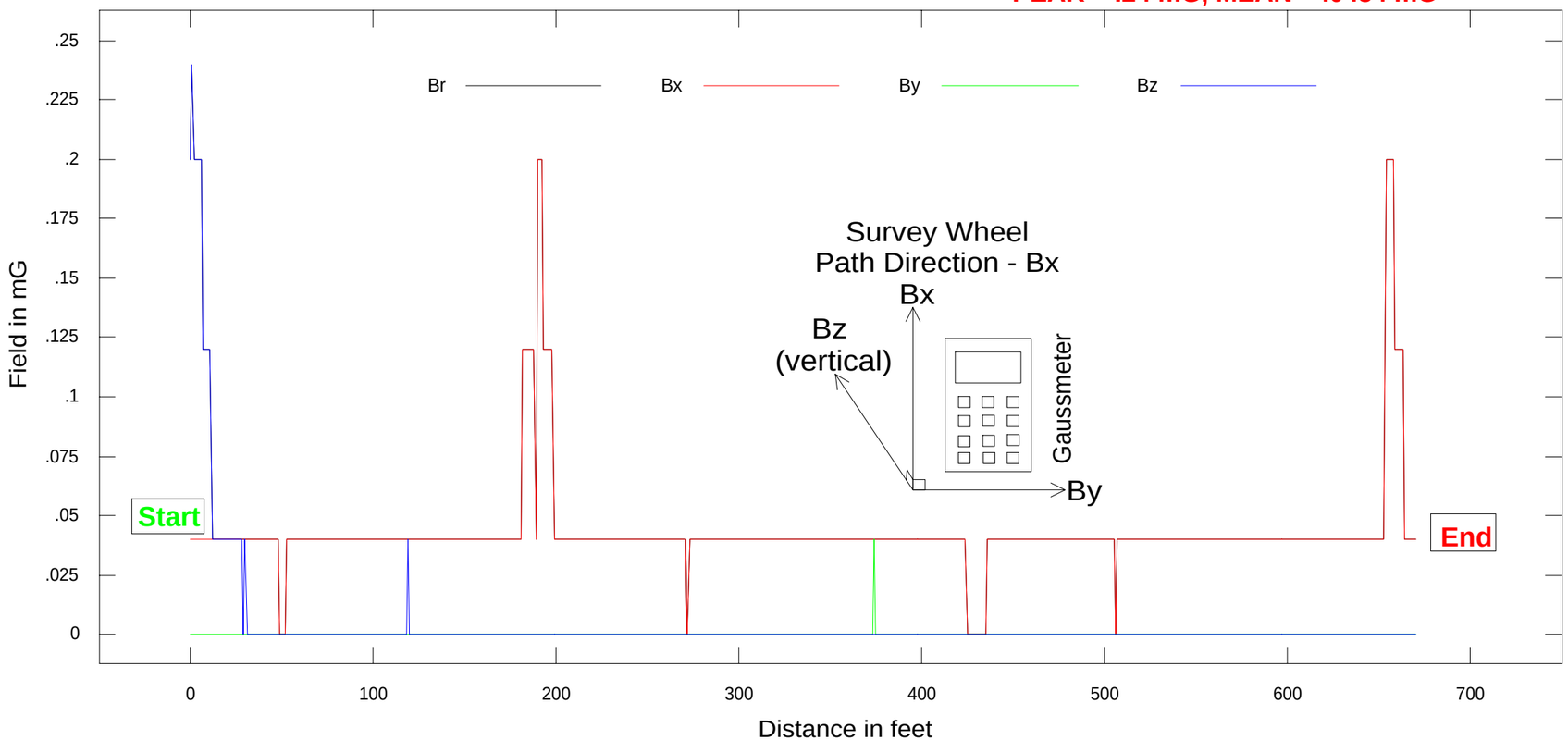
NCRP Draft Report
10 mG from overhead/underground transmission/distribution lines, substations, etc.

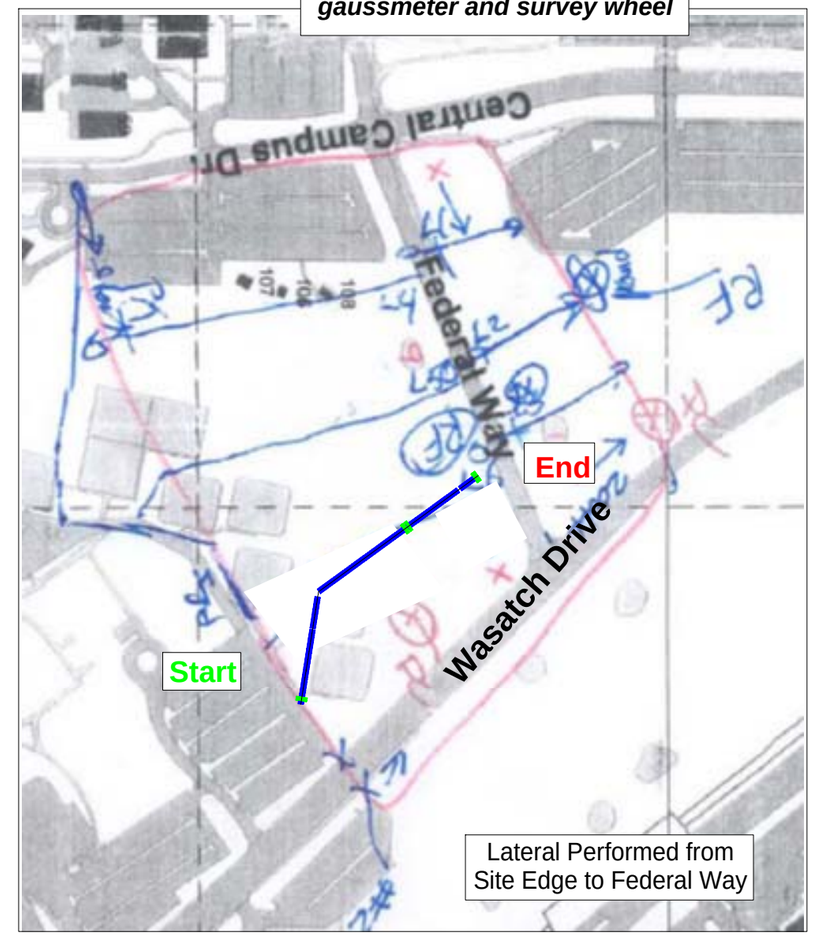
Diagram 1 - Profile Plot

Rec 7 File 1UT_SITE Taken 4/2/7 ID-UT L6 1M
PEAK = .24 mG, MEAN = .0454 mG



All magnetic flux density data recorded with a FieldStar 1000 gaussmeter and survey wheel

Diagram #2 - Hatch Plot



Rec 7 File 1UT_SITE Taken 4/2/7 ID-UT L6 1M
PEAK = .24 mG, MEAN = .0454 mG

.05 < | < .1 < | < .5 < | < 1 < | (Br in mG)

Figure #8, DC Data
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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540-286-1984
115 JULIAD COURT, SUITE 105
FREDERICKSBURG, VA 22406

DC EMI Thresholds - CRT screen shift, noise & coercivity (data errors)
0.001 Gauss & Less SEMs, TEMs E-Beam/FIB Writers
0.75 Gauss CRT Monitors & Electronic Instruments
5 Gauss Cardiac Pacemakers & Implantable Devices Warning Sign
10 Gauss Credit Cards & Magnetic Media Warning Sign
300 Gauss Low Coercivity Mag-Stripe Cards
700 Gauss High Coercivity Mag-Stripe Cards & Video Tapes
1000 milligauss (mG) = 1 Gauss (G) & 1 mG = 0.001 G = 0.1 uT (microtesla)

Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirement:
1 mG Br RMS (2.83 mG p-p)

Quiet & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

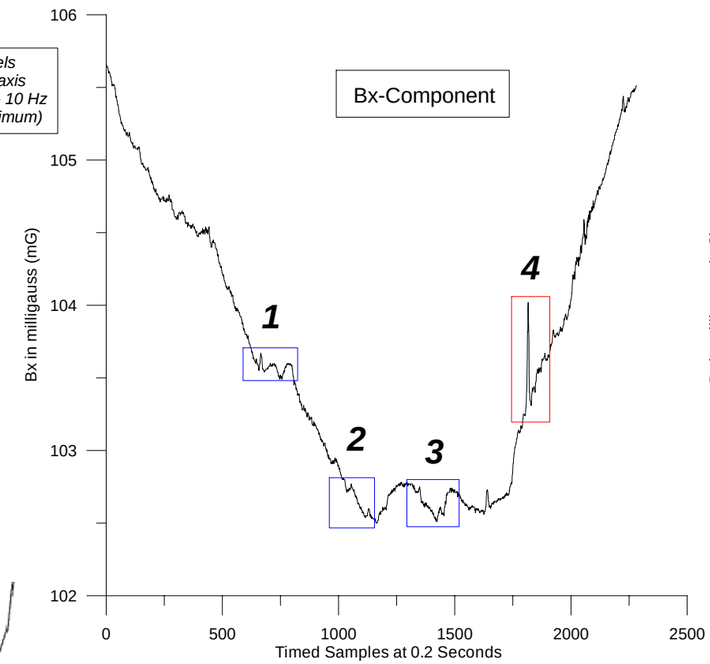
Cleanroom Maximum Requirements:
0.3 mG BR RMS (0.85 mG p-p)

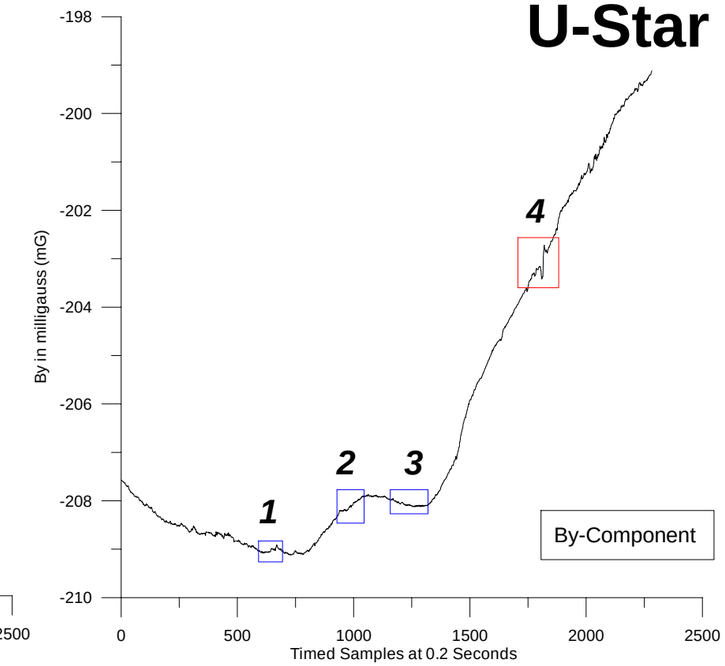
Timed DC magnetic flux density levels recorded with MEDA FVM-400 three-axis fluxgate magnetometer (bandwidth DC - 10 Hz and 0.01 mG resolution, 1200 mG maximum)

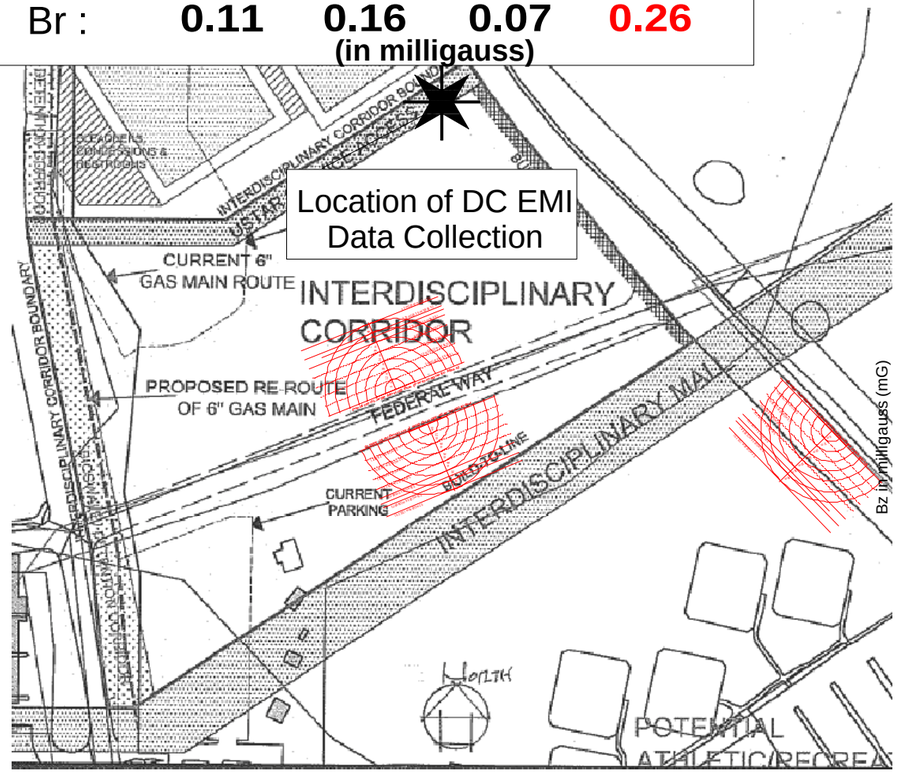
Differential dB/dt DC EMI (per vehicle):

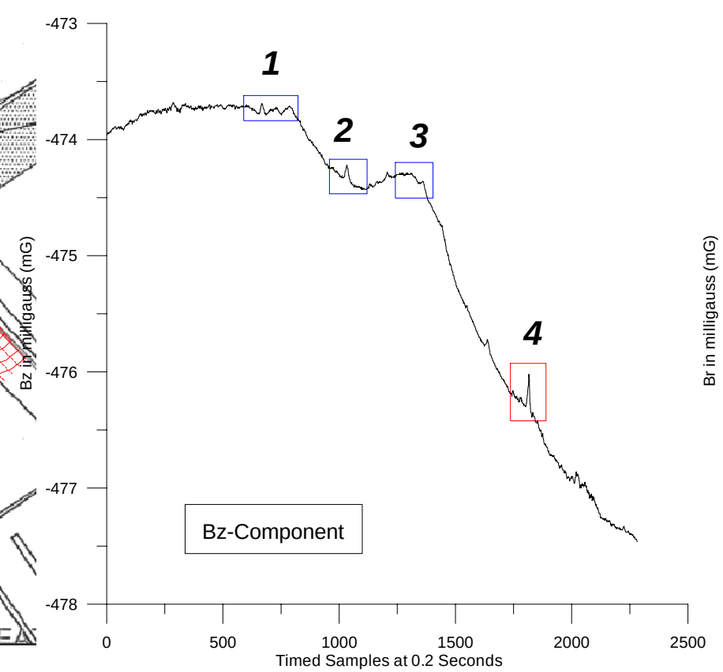
(dB/dt)	1	2	3	4★
Bx :	0.12	0.20	0.20	0.70
By :	0.13	0.05	0.05	0.65
Bz :	0.10	0.15	0.05	0.37
Br :	0.11	0.16	0.07	0.26

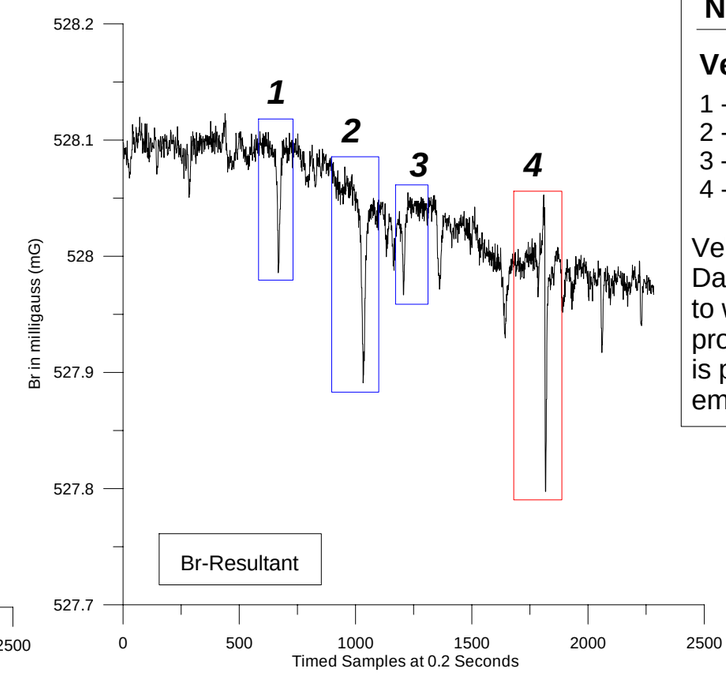
(in milligauss)











Notes :

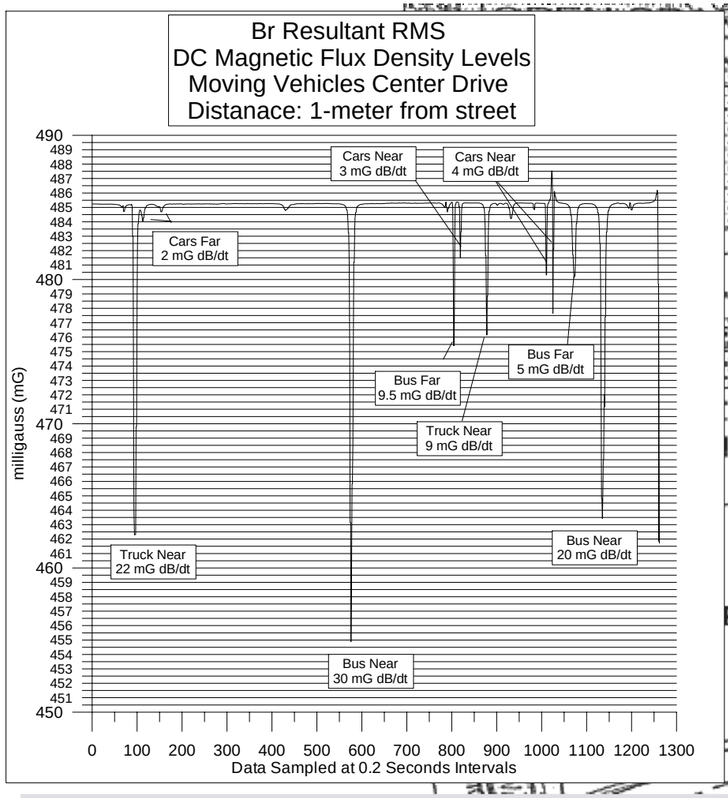
Vehicles:
1 - Car & Van
2 - Campus Bus
3 - Small Truck
4 - Clubs Near Probe

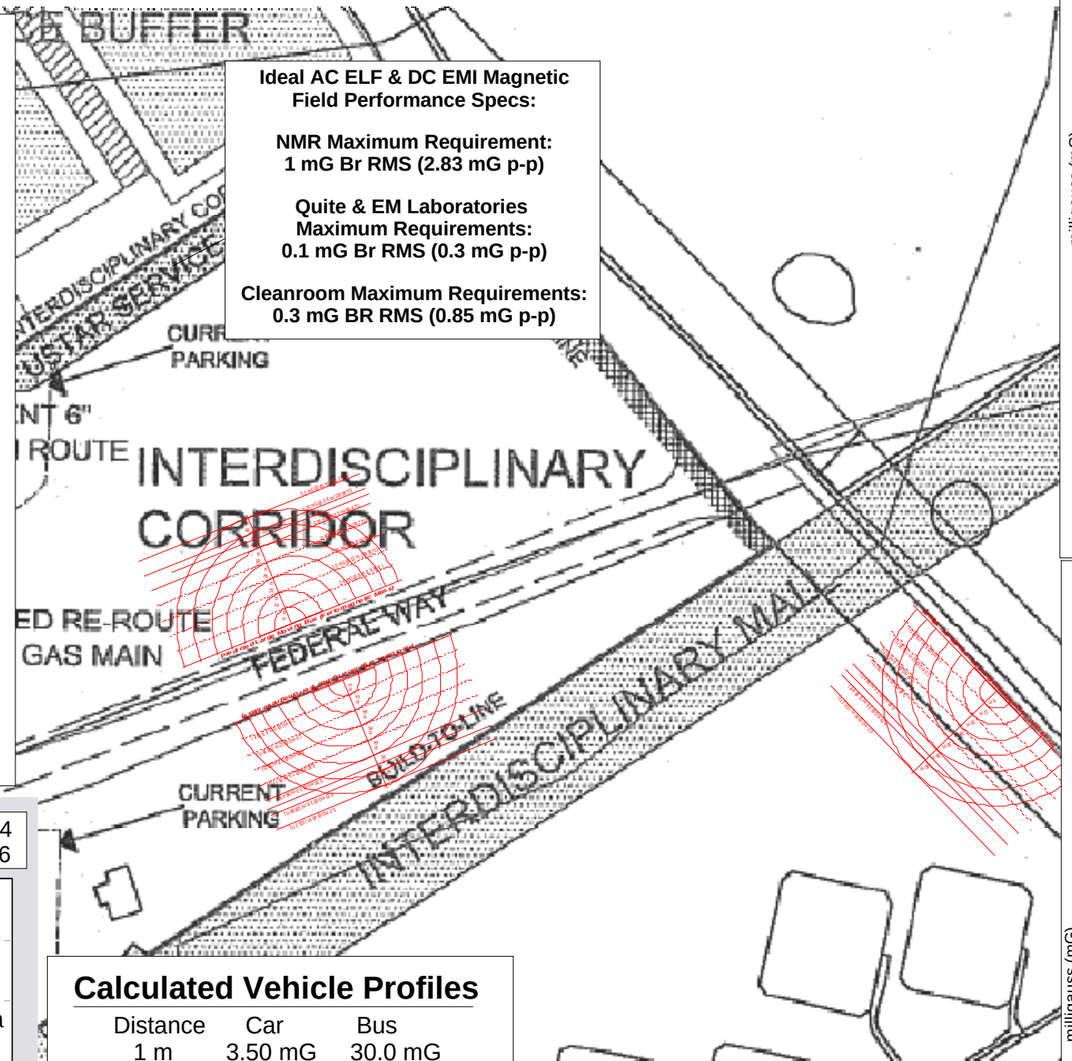
Vehicle 4 DC EMI★ Data invalid due to walking near probe. 0.16 mG is peak differential emission on this set.

Figure #8A, Comparison Recorded & Predicted Moving Vehicle DC Magnetic Emissions

DC magnetic flux density data recorded at 0.2 second intervals
University of Florida DC EMI Data
Nanoscience Institute for Medical & Engineering Technology (NIMET)
Nanoscale Research Facility (NRF), University of Florida
Overlayed on USTAR Site

Timed DC magnetic flux density levels recorded with MEDA FVM-400 three-axis fluxgate magnetometer (bandwidth DC - 5 Hz and 0.01 mG resolution, 1200 mG maximum)
Data recorded on October 6, 2004



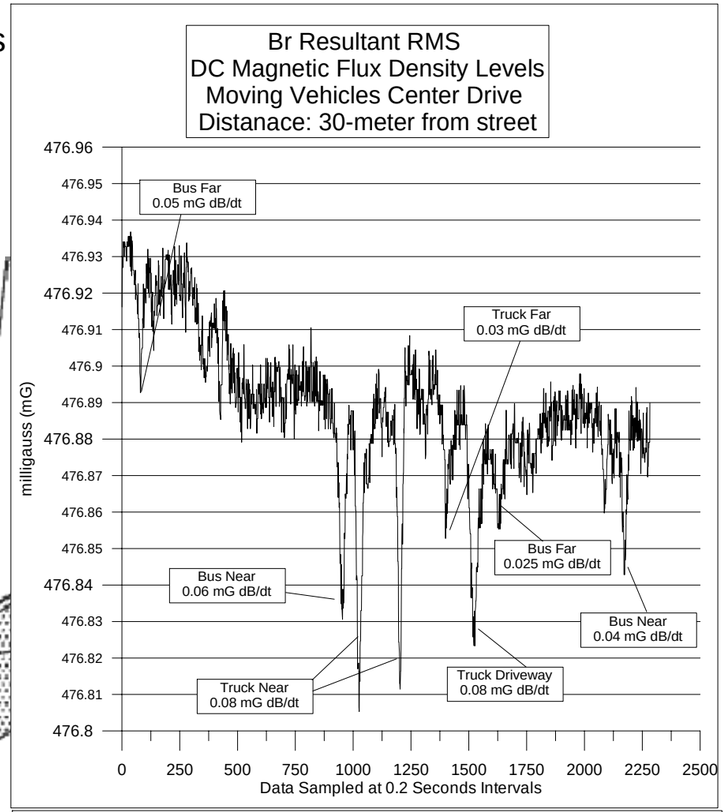


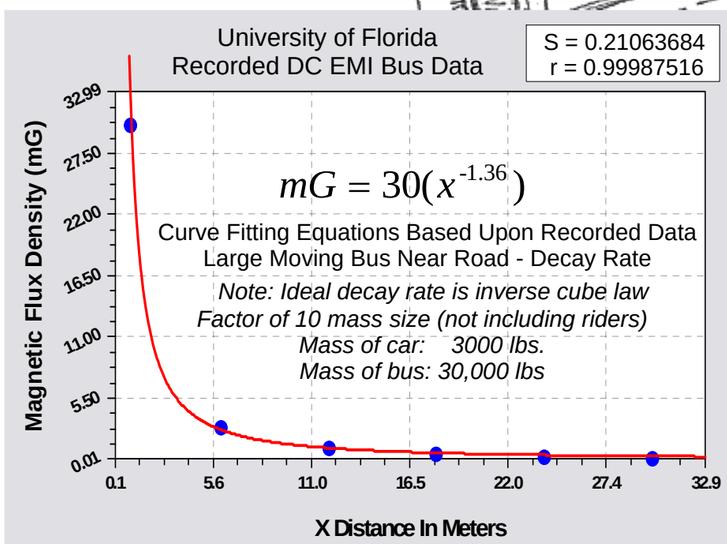
Ideal AC ELF & DC EMI Magnetic Field Performance Specs:

NMR Maximum Requirement:
1 mG Br RMS (2.83 mG p-p)

Quite & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

Cleanroom Maximum Requirements:
0.3 mG BR RMS (0.85 mG p-p)



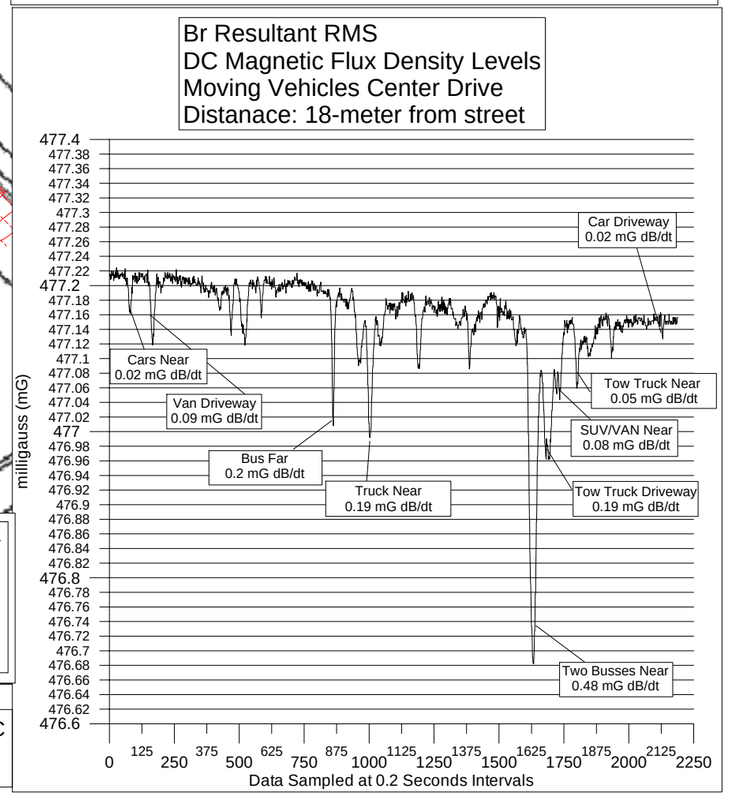


Calculated Vehicle Profiles

Distance	Car	Bus
1 m	3.50 mG	30.0 mG
6 m	0.48 mG	2.6 mG
12 m	0.22 mG	1.0 mG
18 m	0.15 mG	0.59 mG
24 m	0.11 mG	0.40 mG
30 m	0.08 mG	0.30 mG
36 m	0.07 mG	0.23 mG
40 m	0.06 mG	0.20 mG

Special Note: magnetic fields decay more rapidly after 30 meters than the calculated levels indicate.

DC EMI Thresholds - CRT screen shift, noise & coercivity (data errors)
0.001 Gauss & Less SEMs, TEMs E-Beam/FIB Writers
0.75 Gauss CRT Monitors & Electronic Instruments
5 Gauss Cardiac Pacemakers & Implantable Devices Warning Sign
10 Gauss Credit Cards & Magnetic Media Warning Sign
300 Gauss Low Coercivity Mag-Stripe Cards
700 Gauss High Coercivity Mag-Stripe Cards & Video Tapes
1000 milligauss (mG) = 1 Gauss (G) & 1 mG = 0.001 G = 0.1 uT (microtesla)



VitaTech Engineering, LLC
Fredericksburg, VA
August 20, 2007

Figure #9, DC Data
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

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DC EMI Thresholds - CRT screen shift, noise & coercivity (data errors)
0.001 Gauss & Less SEMs, TEMs E-Beam/FIB Writers
0.75 Gauss CRT Monitors & Electronic Instruments
5 Gauss Cardiac Pacemakers & Implantable Devices Warning Sign
10 Gauss Credit Cards & Magnetic Media Warning Sign
300 Gauss Low Coercivity Mag-Stripe Cards
700 Gauss High Coercivity Mag-Stripe Cards & Video Tapes
1000 milligauss (mG) = 1 Gauss (G) & 1 mG = 0.001 G = 0.1 uT (microtesla)

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Quiet & EM Laboratories Maximum Requirements:
0.1 mG Br RMS (0.3 mG p-p)

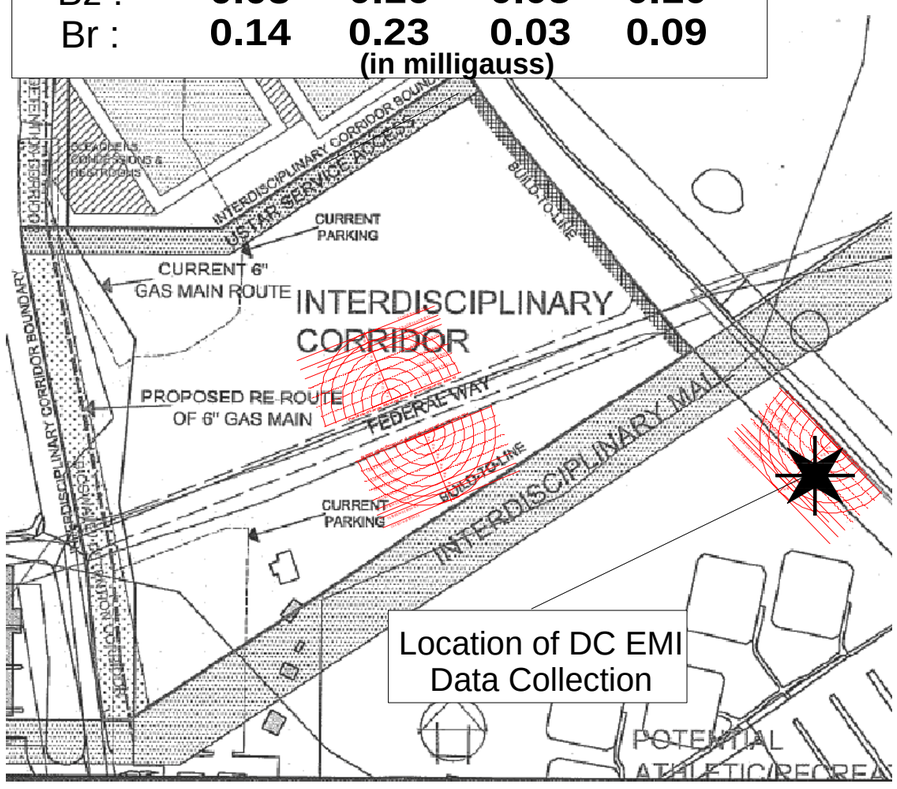
Cleanroom Maximum Requirements:
0.3 mG BR RMS (0.85 mG p-p)

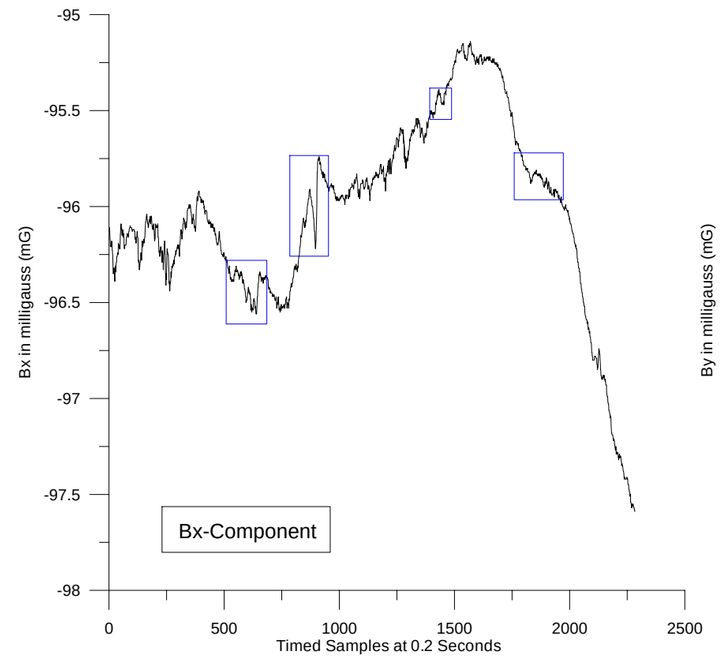
Timed DC magnetic flux density levels recorded with MEDA FVM-400 three-axis fluxgate magnetometer (bandwidth DC - 10 Hz and 0.01 mG resolution, 1200 mG maximum)

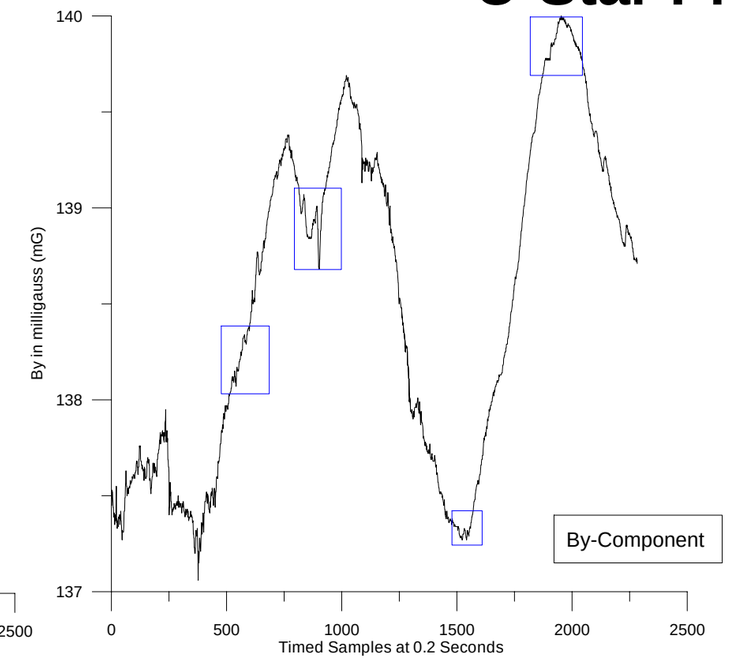
Differential dB/dt DC EMI (per vehicle):

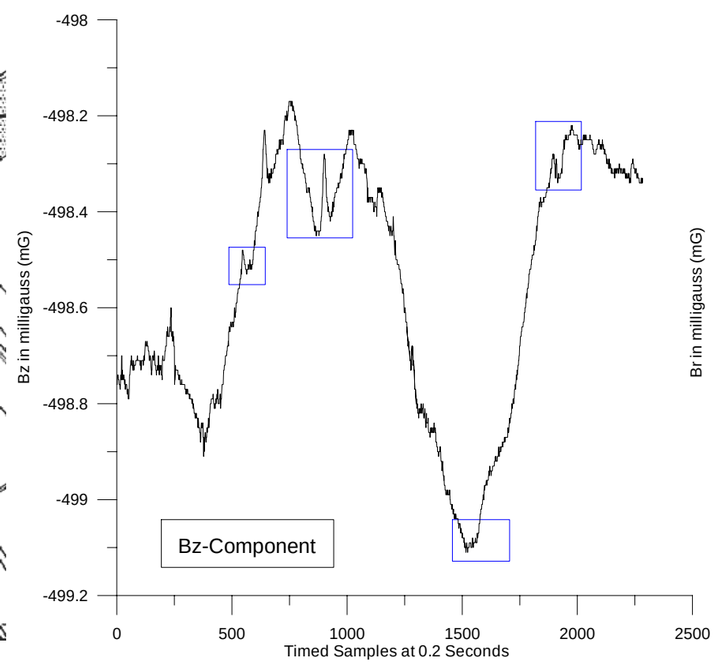
(dB/dt)	*1*	*2*	*3*	*4*
Bx :	**0.22**	**0.50**	**0.15**	**0.10**
By :	**0.10**	**0.30**	**0.15**	**0.20**
Bz :	**0.05**	**0.16**	**0.05**	**0.10**
Br :	**0.14**	**0.23**	**0.03**	**0.09**

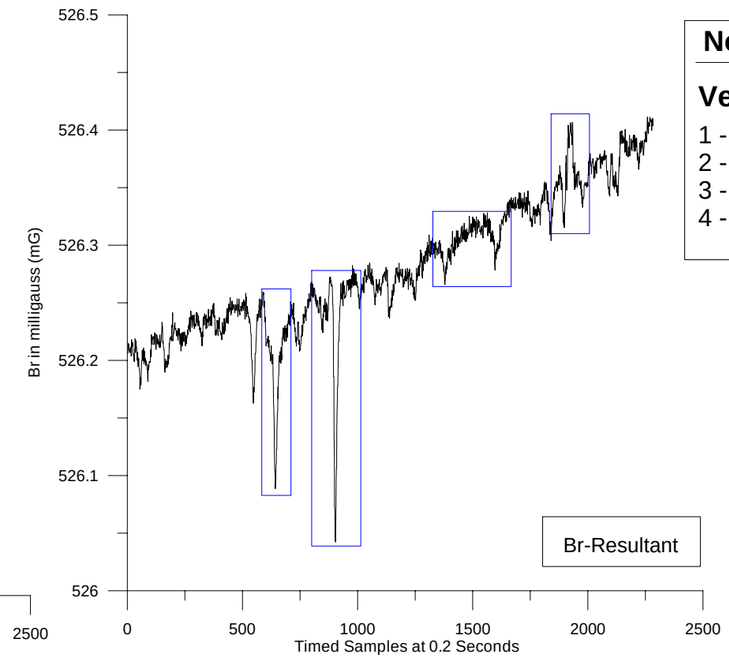
(in milligauss)











Notes :

Vehicles:
1 - Pickup Truck
2 - Small Truck
3 - Train Activity
4 - Shuttle Bus

Figure #10, RF Data
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

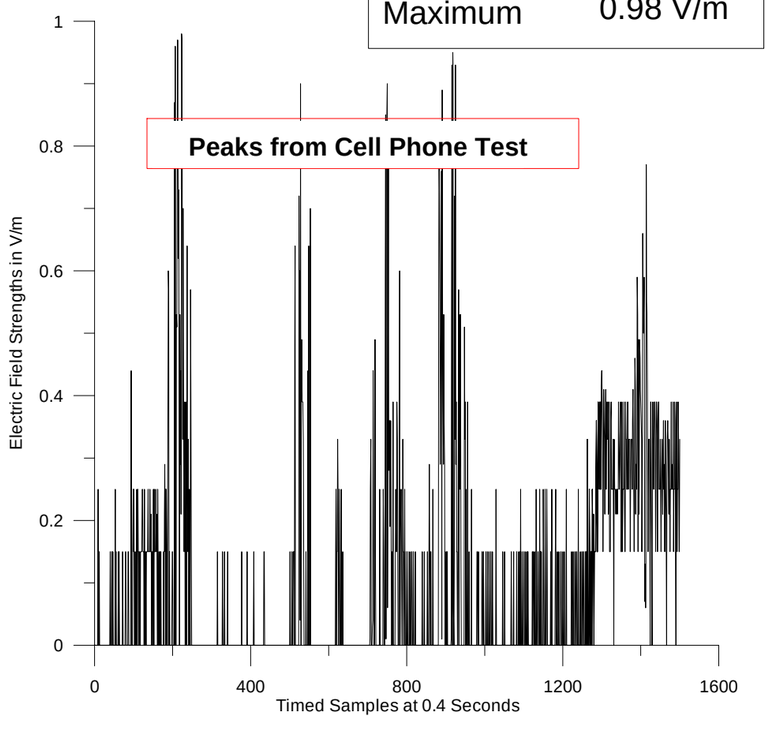
RF Assessment

Instrument:	Narda ERM-300 electric field meter
Sampling Method:	Electric field strength RF levels were recorded in volts-per-meter (V/m) for 10 minutes sampled at 0.4-second intervals.
Objective:	To investigate sources of RFI (Radio-Frequency Interference) over a 100 MHz to 18 GHz bandwidth.

Probe 9 - Electric Field Strength
3 MHz to 18 GHz
(range of 0.5 to 1000 V/m)
Actual Sampled Data Points

Statistics

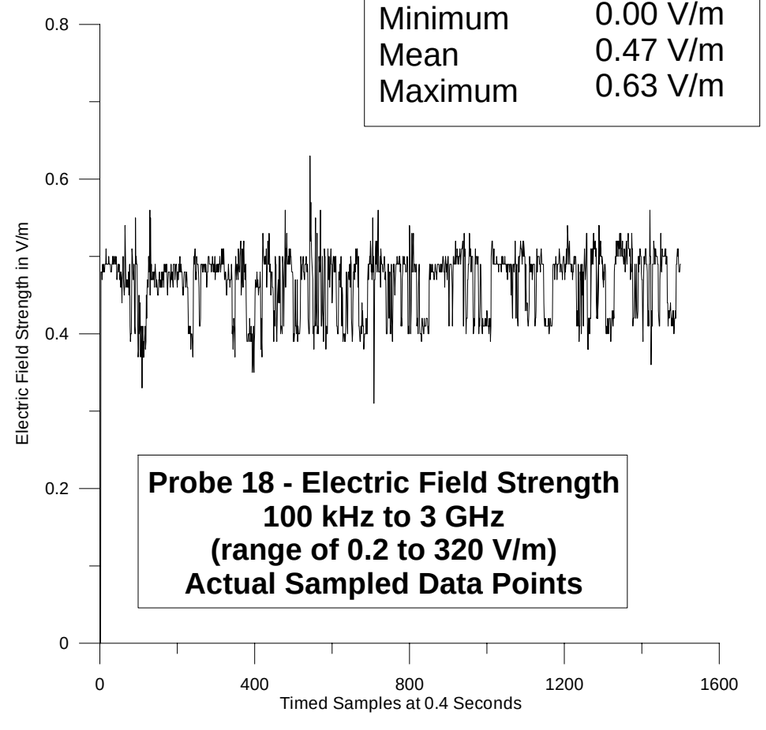
Minimum	0.00 V/m
Mean	0.11 V/m
Maximum	0.98 V/m



U-Star Project 1 MHz to 18 GHz Electric Field Strength Data

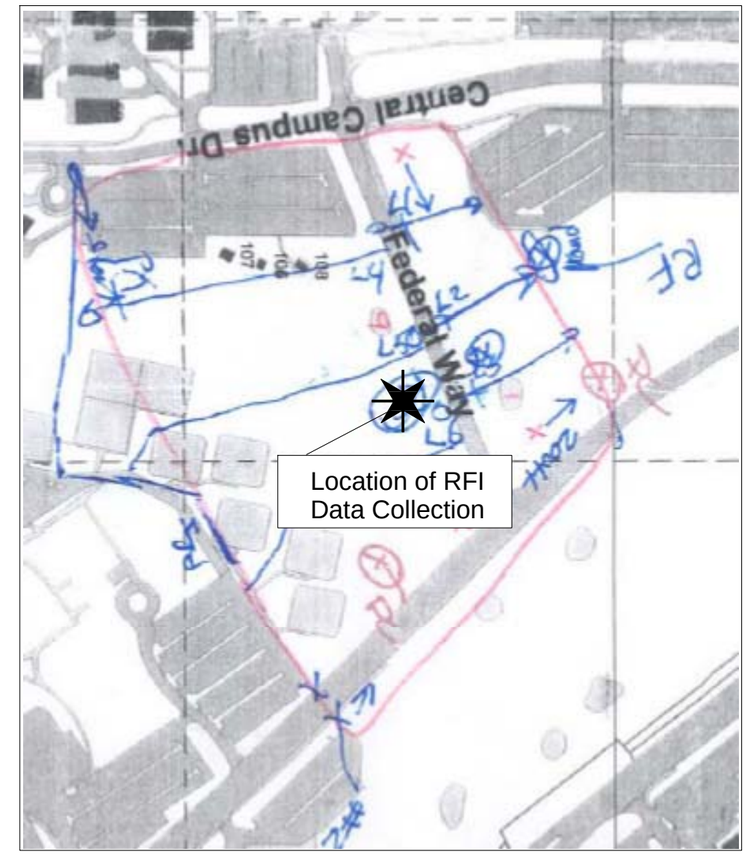
Statistics

Minimum	0.00 V/m
Mean	0.47 V/m
Maximum	0.63 V/m



Probe 18 - Electric Field Strength
100 kHz to 3 GHz
(range of 0.2 to 320 V/m)
Actual Sampled Data Points

U-Star Project 100 KHz to 3 GHz Electric Field Strength Data



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FREDERICKSBURG, VA 22406

Figure #11, RF Data
Magnetic Flux Density Levels @ 1 Meter
University of Utah
U-Star Project

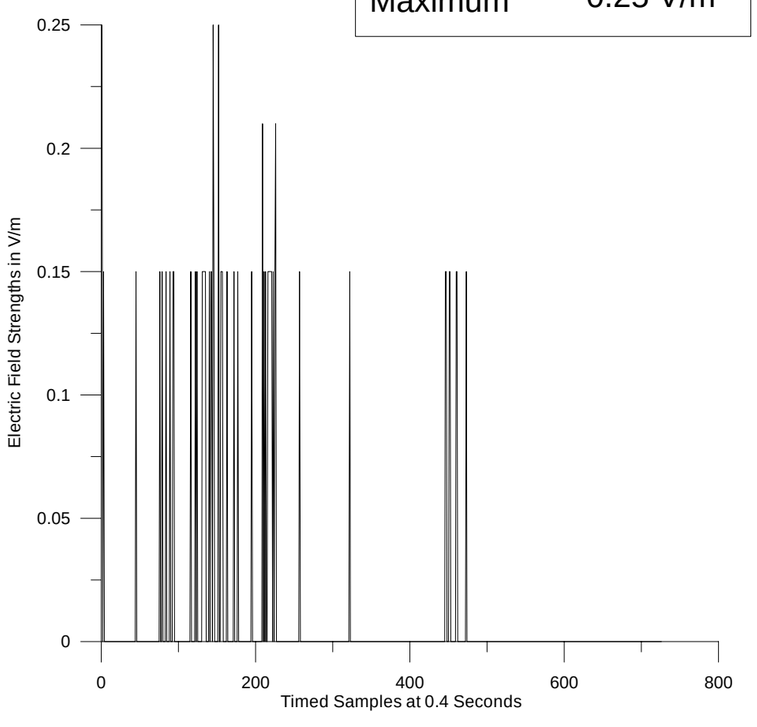
RF Assessment

Instrument:	Narda ERM-300 electric field meter
Sampling Method:	Electric field strength RF levels were recorded in volts-per-meter (V/m) for 10 minutes sampled at 0.4-second intervals.
Objective:	To investigate sources of RFI (Radio-Frequency Interference) over a 100 MHz to 18 GHz bandwidth.

Probe 9 - Electric Field Strength
3 MHz to 18 GHz
(range of 0.5 to 1000 V/m)
Actual Sampled Data Points

Statistics

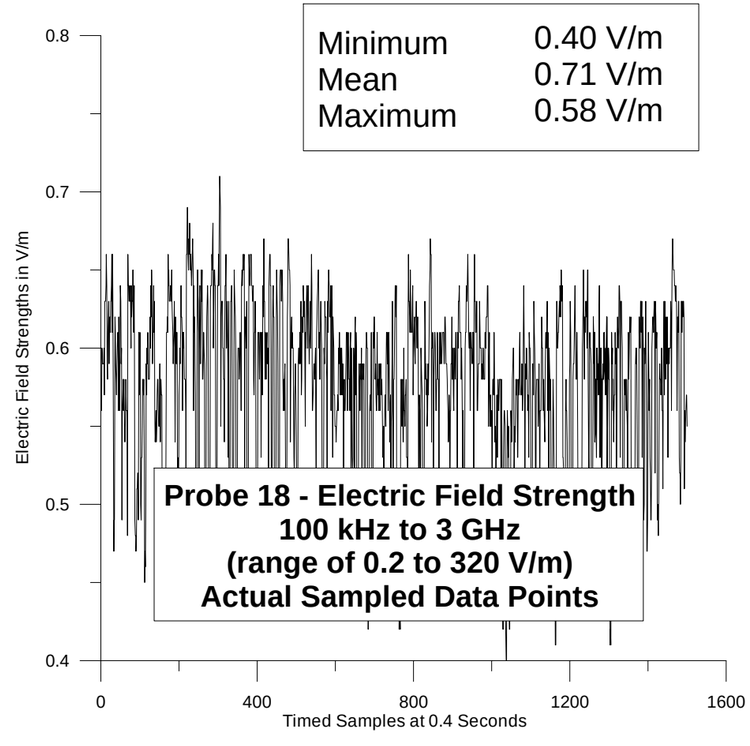
Minimum	0.00 V/m
Mean	0.01 V/m
Maximum	0.25 V/m



U-Star Project 1 MHz to 18 GHz Electric Field Strength Data

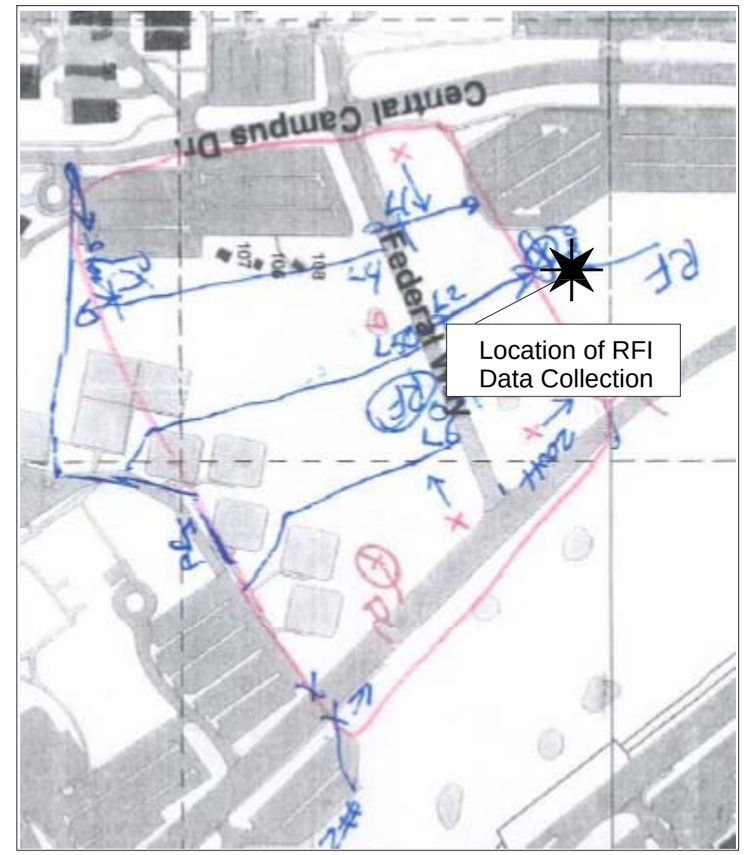
Statistics

Minimum	0.40 V/m
Mean	0.71 V/m
Maximum	0.58 V/m



Probe 18 - Electric Field Strength
100 kHz to 3 GHz
(range of 0.2 to 320 V/m)
Actual Sampled Data Points

U-Star Project 100 KHz to 3 GHz Electric Field Strength Data



VitaTech Engineering
540-286-1984
115 Juliad Court, Suite 105
Fredericksburg, VA 22406

6.4 SITE VIBRATION STUDY REPORT

Please see page numbers with in the consultant's document.

University of Utah
Neuroscience and Biomedical Technology Research Building

Site Vibration Study Report

Architectural Nexus

Prepared by: **Chris Wu**
Colin Gordon & Associates
883 Sneath Lane, Suite 150
San Bruno CA 94066 USA
+1 (650) 358-9577
www.colingordon.com

CG&A Project Nr. 07012.01
November 16, 2007

1. Introduction

Vibration site surveys were carried out at the proposed site of the University of Utah Neuroscience and Biomedical Technology Research Building in Salt Lake City, UT. The first survey was carries out on August 8, 2007. Ambient as well as peak hold vibration measurements were taken at several locations to assess the vibration impact from the surrounding environment. The results will show that the vibration levels at the site under ambient conditions are very low and would satisfy the VC-E criterion for all frequencies above 2 Hz. At locations closest to the road, the impact from traffic will cause momentary increases in vibration, however for the most part these levels do not exceed VC-A.

The second survey was carries out on November 6, 2007. Peak hold vibration measurements were taken at various time to assess the attenuation factor due to the trench. The results will show that the vibration level at the subsurface are very low and would satisfy the VC-E criterion for all frequencies above 2 Hz. On surface, the impact from traffic will cause momentary increases in vibration, however for the most part these levels do not exceed VC-B. The attenuation factor for the dominant frequencies are about 0.2.

2. Site Criteria

For the purpose of this study, we will use the generic VC curves to characterize the vibration performance of the site. A description of these curves and their applications can be found in **Appendix A**. It is typical for the most sensitive floors in state-of-the-art research and biomedical facilities to be designed to meet the VC-D or VC-E criterion.

3. Measurement Methodology

Vibration data were measured in terms of vibration velocity using a measurement bandwidth of 0.5 Hz and a Hanning windowing function for an effective bandwidth of 0.75 Hz. The measurement frequency range was 0 to 100 Hz. When comparing to the generic VC criteria, the data are converted into one-third octave bands. Vibration velocity at a single location is quantified on the basis of RMS linear average (energy average) of multiple sequential samples acquired over the period of about 20 seconds. This is an adequate statistic for environments that are statistically 'stationary', or dominated by steady-state random sources. In the case where there are short-term transient events such as passing vehicles, we may measure the 'maximum RMS' (often referred to as 'peak hold') amplitude.

When we evaluate a site, we typically do so at multiple locations. When considering the set of measurements in total and when the data are relatively uniform in magnitude, we generally summarize the linear average data in terms of the "mean-plus-sigma[1]" ($\Delta+\sigma$) value of the data set at each frequency. This statistic is a useful measure of the site. For a statistically "normal" distribution, it defines the condition at or below which 84 percent of the data lie.

The vibration measurements were carried out with the following instruments:

Site Survey 1

Signal Analyzer	– Rion Model SA-77
Accelerometer	– Brüel & Kjær Model 8318
Charge Amplifier	– Brüel & Kjær Model 2635

Site Survey 2

Signal Analyzers	– SignalCalc ACE Dynamic Signal Analyzer
Accelerometers	– Wilcoxon Model 731A
Charge Amplifier	– Wilcoxon Model P31

together with the associated calibration system, cables, connectors, etc. The calibration of the measurement instruments, which uses reference standards traceable to the US National Institute of Standards and Technology (NIST), is carried out on a regular basis and was verified in the field during the tests.

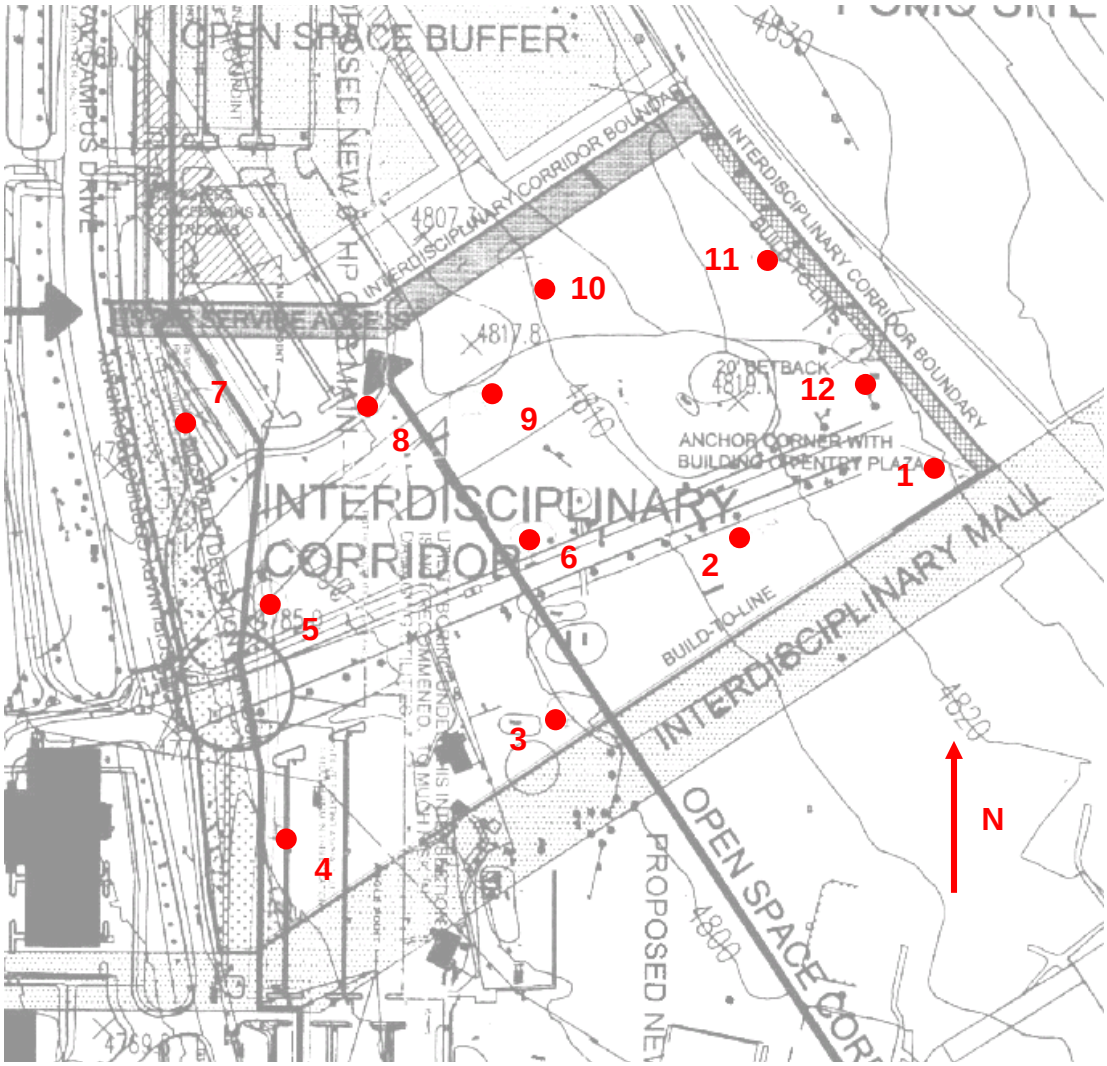
[1] Sigma is the logarithmic standard deviation of the measured amplitudes.

4. Site Conditions & Measurement Locations

Site Survey 1

The first site study was conducted on August 9, 2007 from 9:30 am until about 1:30 pm. The site is currently a golf course which is bounded by roads along the east and west perimeters as shown in **Figure 1**. There is also a road (Federal Way) that runs through the site in the east-west direction, though this road will be eliminated for the new buildings. The traffic flow along these roads were fairly light though it did include a fair number of buses and trucks. There is a TRAX line to the east of the site which did not appear to have any impact on the vibration at the site.

Figure 1: Site Survey Measurement Locations



For the most part, measurements were carried out with the accelerometer mounted onto a metal spike which was driven into the ground. In the measurement locations such as the parking lots, the accelerometer was placed directly onto the asphalt. At the

locations nearest the roads, peak hold measurements were taken to evaluate the impact from traffic.

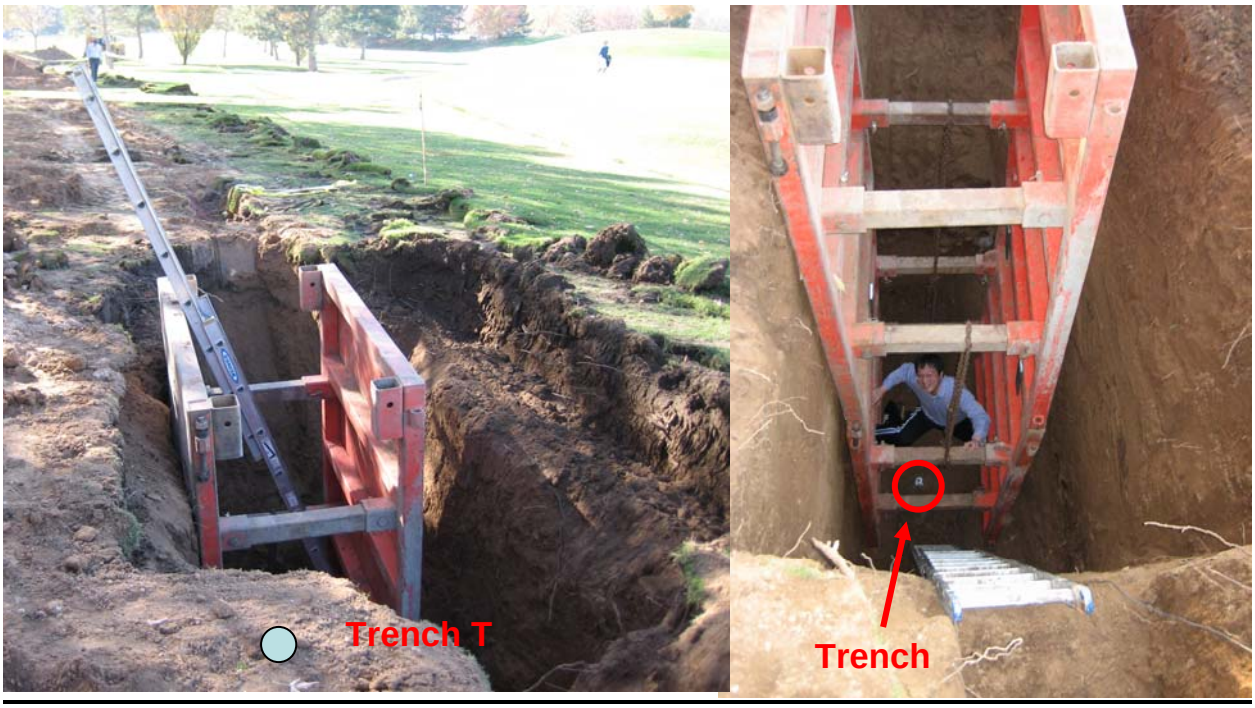
Site Survey 2

The second site study was conducted on November 6, 2007 from 2:30 pm until about 4:30 pm.

There was a lot of traffic on the Federal Way between 3:00 pm and 3:30pm.
A 20' trench was dig and accelerometers were placed on the top and bottom surfaces of the trench, respectively. The traffic flow along these roads were fairly heavy between 3:00PM and 3:30PM. Lots of cars, pickup trucks and mini van passed by. Periodically, there were buses passed by the Wasatch Drive. During the measured period, only one truck was observed, which passed the Federal Way. There is a TRAX line to the east of the site which did not appear to have any impact on the vibration at the site.

For the most part, measurements were carried out with the accelerometer mounted onto a metal spike which was driven into the ground, as shown in **Figure 2**. Since the location is close to the roads (less than 10 meters from Federal Way, and less than 36 meters from Wasatch Drive), peak hold measurements were taken to evaluate the impact from traffic.

Figure 2: Trench Study Measurement Locations



Another study was conducted on November 7, 2007 from 8:30 am until about 10:30 am. Several surface level measurements at various distances from Central Campus Drive were taken. For the most part, measurements were carried out with the accelerometer mounted onto a metal spike which was driven into the ground. Since the location is close to the roads (less than 10 meters from Central Campus Drive), peak hold measurements were taken to evaluate the impact from traffic.

5. Results & Analysis

Site Survey 1

The figures discussed in this section can be found in **Appendix B**.

The linear averaged ambient vibration for the site are presented as a statistical summary for each direction. **Figure B.1** shows the results for the vertical direction which comprised of 12 total measurement locations. As one can see, the 'mean-plus-sigma' or 'Avg + 1 Std Dev' level is well below VC-E except below 2 Hz where it approaches very close to the limit. The results for the two horizontal directions are shown in **Figure B.2** and **B.3**. These also consist of 12 measurements each and the 'Avg + 1 Std Dev' levels for those directions also fall below the VC-E criterion except below 2 Hz. At the very low frequencies, the vibration slightly exceeds VC-E.

Figure B.4 compares the peak vertical vibration under ambient conditions against the peak vibration with a passing bus at Location 1. It can be seen that with the bus, the maximum vibration levels are still below VC-B which is very good considering that Location 1 was at a distance of about 30' from the road.

Figure B.5 shows the vertical peak hold measurements at Location 4, which is about 80' from the road. Here we present vertical peak hold results for several heavy vehicle passages. As can be seen, the maximum vibration observed is well below VC-B. **Figures B.6** and **B.7** show the peak hold results in the horizontal directions at Location 4. These levels fall within the VC-D range.

Figures B.8 and **B.9** show the vertical peak hold result at Location 5 and 7 respectively. As with the other results seen thus far, the increase in vibration with passing vehicles is not significantly adverse. Here the maximum vibration is well below VC-C at Location 5 and below VC-D at Location 7.

Figures B.10 through **B.12** show the peak hold results for the vertical as well as horizontal directions at Location 12 which is about 20' to 30' from the road. Here the maximum vibration levels are slightly higher since the measurement location is closer to the road. In any case, the vibration levels here did not exceed VC-A under any of the conditions observed.

Site Survey 2

The figures discussed in this section can be found in **Appendix C**.

Twenty one data sets were measured for the top (surface) and bottom (subsurface) of trench. For all valid data sets, the vibration levels of the subsurface were all below VC-E. The vibration levels on the surface usually exceed VC-E, and sometimes reached VC-B . Some typical vibration responses are shown in **Figures C.1** to **C.3**.

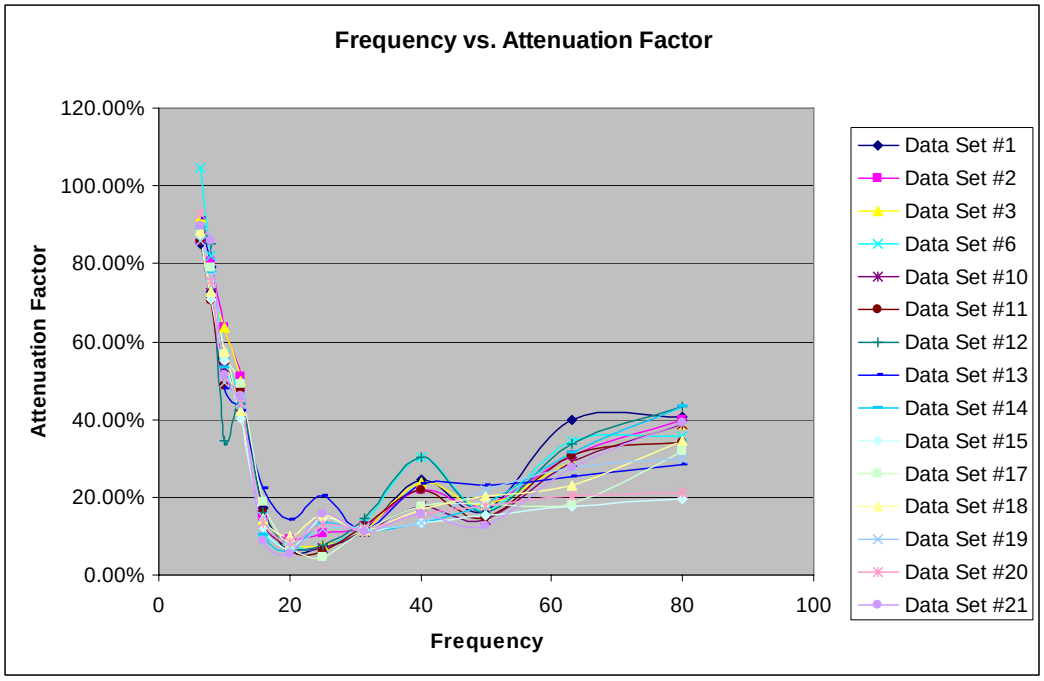
Figure C.1 shows the vertical peak hold measurements for data sets 11 and 12. In addition to cars passed by, a truck passed the Federal Way for data set 11, and a bus passed the Wasatch Drive for data set 12. Vibration level of these data sets on the surface exceed VC-C.

Figure C.2 shows the vertical peak hold measurements for data sets 17 and 18. The main vehicles passed by the Federal Way are cars, and a few minivans and pickup trucks passed by the Wasatch Drive. Vibration level of these data sets on the surface fall between VC-B and VC-D.

Figure C.3 shows the vertical peak hold measurements for data sets 17 and 18. The main vehicles passed by both the Federal Way and the Wasatch Drive were cars. Vibration level of these data sets on the surface fall below VC-C.

Attenuation due to the trench was studied, and the results are shown in **Figure 3**.

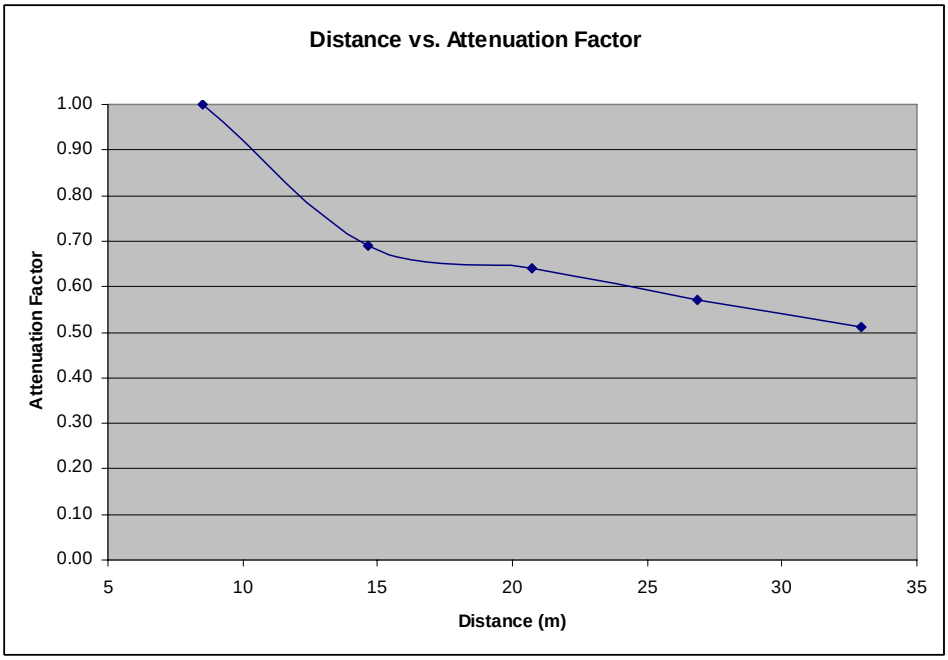
Figure 3: Frequency vs. Attenuation Factor



From Figures C.1 to C.3 we understand that the dominant frequencies due to vehicles passing by are between 16 Hz and 31.5 Hz. From Figure 2 we can conclude that, when a 20' trench is in place, we can reduce the vibration to about 80% (Attenuation factor ≈ 0.2 or 20%).

Five locations were measured along the line that's approximately perpendicular to the Central Campus Drive. For all valid data sets, attenuation due to the distance from road was studied, and the results are shown in **Figure 4**.

Figure 4: Distance vs. Attenuation Factor @ 25 Hz



It can be seen that, on the date of measurement, the vibration velocity will reduce about 50% when the distance increase 25 meters. Notice that this value was subject to the traffic of the day of measurement..

6. Conclusions

Under normal conditions, the ambient vibration in all directions is very low. It essentially meets the VC-E criteria except at very low frequencies below 2 Hz where there appears to be a very low frequency phenomenon (likely seismic) which exceeds the VC-E criteria slightly. This should not be of great concern though since most lab equipment are not sensitive to vibration at these very low frequencies. For the most part, the ambient vibration could be considered as meeting VC-E performance. Near the roads, the impact from bus and truck traffic will momentarily increase the vibration levels. However, these levels are not exceedingly high; and as a matter of fact, they are still below the VC-A requirement. For this reason, we consider the site to be very good. General lab equipment should have no problems operating on this site. Highly sensitive equipment requiring VC-D or better should also not have any problems operating on the site if they are kept farthest from the roads.

From the trench study, the vibration velocity reduced about 80% (Attenuation factor ≈ 0.2 or 20%) when accelerometer is placed 20' below surface. Hence, very sensitive equipments are recommended to put in the basement.

From the distance study, the vibration velocity reduced about 50% (Attenuation factor ≈ 0.5 or 50%) when accelerometer is placed 25 meters away. For the most sensitive equipments, they should be place in the basement and at least 25 meters away from the road.

Lastly, a comment regarding the light rail TRAX station east of the site. We did not notice any impact from the trains. In our attempts to measure the vibration from the trains, the vibration from passing vehicle traffic tended to mask it.

APPENDIX A

GENERIC DESIGN CRITERIA FOR VIBRATION-SENSITIVE EQUIPMENT AND PROCESSES

Colin Gordon & Associates

This appendix presents vibration criteria that have been used quite extensively for several years, particularly by the microelectronics and optoelectronics industries and research communities.

Two families of generic criteria are discussed here: (1) the VC criteria developed in the early 1980s by Eric Ungar and Colin Gordon[*]; and (2) the NIST-A criterion developed in the early 1990s for the Advanced Measurement Laboratory at the U.S. National Institute of Standards and Technology (NIST). The VC criteria were originally developed for use in the semiconductor industry, but have found application in a wide variety of technological applications. The NIST-A criterion was developed for metrology, but has gained popularity within the nanotechnology community.[†]

The VC criteria take the form of a set of one-third octave band velocity spectra labeled vibration criterion curves VC-A through VC-G, as developed by Gordon and Ungar, modified several times during the intervening years, and currently published in an IEST Recommended Practice.[‡] These are shown in Figure A.1, together with the International Standards Organization (ISO) guidelines for the effects of vibration on people in buildings.[§] The criteria apply to vibration as measured in the vertical and two orthogonal horizontal directions, and are applied to each direction separately.

For environments that are continuous and steady-state in time, the criteria apply to the "linear average" of data samples acquired over an adequate time period. In instances where the environment is impacted by occasional disturbances such as vehicular movements, "stage" movements (in tools), passing trains, etc., these may be evaluated in the "peak hold" or "maximum RMS" mode of the measuring system. If the disturbing event is long enough (i.e., "Quasi-static", or steady-state during the averaging time) the linear average mode should be used. The importance attributed to these occasional events will depend upon the frequency of occurrence and other parameters relating to the vibration-sensitive process.

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[*] Eric E. Ungar and Colin G. Gordon, "Vibration Challenges in Microelectronics Manufacturing," *Shock and Vibration Bulletin*, 53(I):51-58 (May 1983), or Gordon, C. G., and Ungar, E. E., "Vibration Criteria for Microelectronics Manufacturing Equipment," *Proceedings of Inter-Noise 83*, pp. 487-490 (July 1983).

[†] H. Amick, M. Gendreau, and C. G. Gordon, "Facility Vibration Issues for Nanotechnology Research," *Proc. Symp. on Nano Device Technology 2002*, May 2-3, 2002, National Chiao-Tung University, Hsinchu, Taiwan.

[‡] Institute of Environmental Sciences and Technology, "Considerations in Cleanroom Design," RP-CC012.2, 2005.

[§] International Standards Organization, ISO 2631 "Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration, Parts 1 and 2." Part 1 was updated 15 July 1997 and Part 2 was updated 1 April 2003.

For environments involving large areas, such as an entire cleanroom, a single location is probably not representative of the whole. The ambient vibrations of a large area may be characterized by a spectrum representing the mean plus one standard deviation spectrum, $A_{mean+sig,}$ of a collection of spectra obtained at a statistically significant number of locations randomly distributed throughout the cleanroom or other area of interest. The A_{mean} and A_{sig} spectra are defined for a collection of linear spectra X_i as

$$\log(A_{mean}) = Average(\log(X_i)) \tag{A.1}$$

$$\log(A_{sig}) = StdDev(\log(X_i)) \tag{A.2}$$

The statistics are calculated for each frequency. The two spectra are combined in *log space* to obtain $A_{mean+sig}$, defined as**

$$\log(A_{mean+sig}) = \log(A_{mean}) + \log(A_{sig}) \tag{A.3}$$

When presenting data in a report, the data for a single direction (*e.g.*, vertical) may be summarized in a plot that shows four spectra: A_{min}, A_{mean}, $A_{mean+sig}$, and A_{max}. The reader can then easily see the range of the data, the statistically meaningful representations, and the spectrum used to characterize the space as a whole, $A_{mean+sig.}$ In order to compare the performance of the entire space at two different times, the $A_{mean+sig}$ spectra from each set of measurements may be used.

The use of $A_{mean+sig}$ as a means for characterizing a large area infers that the data approximate a Gaussian distribution at each frequency. This is not always the case, because the mechanical "load" (i.e., the dynamic forces traveling into the floor from mechanical equipment, piping, and ducting) may not always be distributed uniformly about the space being evaluated. If it were truly Gaussian, then one could assume that at any location within the area being evaluated, there was an 84% probability that the vibrations at that location would be equal to or less than $A_{mean+sig}$. Even if the data are not truly Gaussian, it may be argued that $A_{mean+sig}$ provides a more reliable estimate of the majority of the data than either A_{max} or A_{mean}.

The application of these criteria to people and vibration-sensitive equipment is described in Table A.1. The criteria do not necessarily apply to experimental systems used in laboratory research. Such systems often have not received the benefits of dynamic modeling and vibration isolation available to the equipment manufacturer, or may be one-of-a-kind.

The main elements of the criteria are as follows:

** Carrying out statistical operations on levels expressed in decibels produces the same results as operations in log space. The latter is simply a more general format for definition.

1) The vibration is expressed in terms of its root-mean-square (rms) velocity (as opposed to displacement or acceleration). It has been found in various studies that while different items of equipment (and people) may exhibit maximum sensitivity at different frequencies (corresponding to internal resonances), often these points of maximum sensitivity lie on a curve of constant velocity. [††]

2) The use of a proportional bandwidth (the bandwidth of the one-third octave is twenty-three percent of the band center frequency) as opposed to a fixed bandwidth is justified on the basis of a conservative view of the internal damping of typical equipment components. Experience shows that in most environments where adequate layout and isolation of electrical and mechanical equipment has been provided, the vibration is dominated by broadband (random) energy rather than tonal (periodic) energy.

3) The fact that some of the criterion curves allow for greater vibration velocity for frequencies below 8 Hz reflects experience that this frequency range, in most instances, lies below the lowest resonance frequency of the equipment components to which these curves apply. Relative motions between the components are, therefore, harder to excite and the sensitivity to vibration is reduced. The curves more stringent than VC-C do not relax the requirements at frequencies below 8 Hz, and the curves extend down to 1 Hz. This change was based upon the requirements of equipment with internal pneumatic vibration isolation, which in many cases shifted the frequency of greatest vibration sensitivity from greater than 8 Hz down to the range of 1 to 4 Hz. [‡‡]

4) For a floor or site to comply with a particular equipment category, the measured one-third octave band velocity spectrum must lie below the appropriate criterion curve of Figure A.1. It is generally accepted that vibration measurements are accurate and repeatable only within about 1 or 2 decibels (12% or 26%), so an overly strict interpretation of a comparison with the criteria is not encouraged. (For instance, a measured value of 51 μm/s versus one of 49 μm/s, when being compared to a criterion of 50 μm/s, lies within the range of inaccuracy—less than 1 decibel—with respect to the criterion, and it may be argued that both of them meet the criterion, from a measurement accuracy perspective.)

The equipment criterion curves have been developed on the basis of data on individual items of equipment and from data obtained from measurements made in facilities before and after vibration-related problems were solved. The curves are generic in the sense that they are intended to apply to broadly defined classes of equipment and processes. They are intended to apply to the more sensitive equipment within each category that is defined.

[††] Amick, H., “On Generic Vibration Criteria for Advanced Technology Facilities: with a Tutorial on Vibration Data Representation,” *J. Institute of Environmental Sciences*, pp. 35-44, (Sept/Oct, 1997).
[‡‡] E. E. Ungar, D. H. Sturz, and H. Amick, "Vibration Control Design of High Technology Facilities," *Sound and Vibration* (Jul. 1990).

The criteria assume that equipment will be supported on benches or pedestals that are rigidly constructed and damped so that amplifications due to resonances are limited to a small value or located at non-critical frequencies. The criteria take into account the fact that certain types of equipment (such as stepper scanners) are supplied by the manufacturer with built-in vibration isolation.

The NIST-A criterion is identical to VC-E at frequencies above 20 Hz, but maintains a constant rms *displacement* amplitude at lesser frequencies. This is to accommodate some of the ultra-high-precision metrology, probe, and lithography equipment being used in nanotechnology. This is a very difficult criterion to meet at some sites with significant low-frequency vibration content.

It is important to note that these criteria are for guidance only. The "detail sizes" given in Table A.1 appear to represent experience at the time of writing. They reflect the fact that the quality of design and of built-in isolation in most equipment tends to improve as dimensional requirements become more stringent. In some instances the criteria may be overly conservative because of the high quality of built-in isolation.

Facility vibrations do not necessarily remain constant over extended periods of time. Vibrations measured during construction may not reflect the contribution of the mechanical systems in their operational state at building completion. Likewise, vibrations at a few months beyond completion may include contributions from user-installed equipment, and this contribution could change over time as layout is varied. (This variation has been called "maturation," and must be considered a normal part of the aging process.[§§]) It is important that a facility survey be carried out at a time appropriate for characterization of the operational state of interest. For example, one would not want to characterize the "as built" state using measurements made either during construction or at one year after startup.[***]

In most instances it is recommended that the advice of a vibration consultant be sought in selecting a design standard.

[§§] M. Gendreau and H. Amick, "'Maturation' of the Vibration and Noise Environments in Semiconductor Production Facilities," *Proc. ESTECH 2004*, 50th Annual Technical Meeting, Institute of Environmental Sciences and Technology (IEST), Las Vegas, Nevada, April 28, 2004

[***] H. Amick, M. Gendreau, and T. Xu, "On the Appropriate Timing for Facility Vibration Surveys," *Semiconductor Fabtech*, No. 25, March 2005, Cleanroom Section.

Table A.1: Application and interpretation of the generic vibration criterion (VC) curves (as shown in Figure A.1)

Criterion Curve	Amplitude[1] µm/s (µin/s)	Detail size[2] µm	Description of use
Workshop (ISO)	800 (32 000)	N/A	Distinctly perceptible vibration. Appropriate to workshops and nonsensitive areas.
Office (ISO)	400 (16 000)	N/A	Perceptible vibration. Appropriate to offices and nonsensitive areas.
Residential day (ISO)	200 (8 000)	75	Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment, hospital recovery rooms, semiconductor probe test equipment, and microscopes less than 40x.
Operating theatre (ISO)	100 (4 000)	25	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100x and for other equipment of low sensitivity.
VC-A	50 (2 000)	8	Adequate in most instances for optical microscopes to 400x, microbalances, optical balances, proximity and projection aligners, mass spectrometers other than MALDI and quadrupole or high-resolution, conventional spectrophotometers, etc.
VC-B	25 (1 000)	3	Appropriate for inspection and lithography equipment (including steppers) to 3 µm line widths, microtomes and cryotomes for 5-10 micron slices, most tissue and cell culture, except as noted below.
VC-C	12.5 (500)	1 – 3	Appropriate standard for optical microscopes to 1000x, lithography and inspection equipment (including moderately sensitive electron microscopes) to 1 µm detail size, TFT-LCD stepper/scanner processes, digital imaging and/or fluorescence with optical microscope, high-precision balances measuring quantities less than 1 mg, MALDI mass spectrometer, nano-drop spectrophotometers, microtomes and cryotomes for slices < 5 microns, tissue and cell culture of the following types: hanging drop, unstirred layers, embryonic stem cells, weakly adherent cells, very long-term cultures, chemotaxis, invasion assays.
VC-D	6.25 (250)	0.1 – 0.3	Suitable in most instances for demanding equipment, including many electron microscopes (SEMs and TEMs) and E-Beam systems, microinjection, micromanipulation, electrophysiology, confocal microscopy, quadrupole and other high-resolution mass spectrometers.
VC-E	3.12 (125)	< 0.1	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.
VC-F	1.56 (62.5)	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.
VC-G	0.78 (31.3)	N/A	Appropriate for extremely quiet research spaces; generally difficult to achieve in most instances, especially cleanrooms. Not recommended for use as a design criterion, only for evaluation.

[1]As measured in one-third octave bands of frequency over the frequency range 8 to 80 Hz (VC-A and VC-B) or 1 to 80 Hz (VC-C through VC-G).

[2]The detail size refers to line width in the case of microelectronics fabrication, the particle (cell) size in the case of medical and pharmaceutical research, etc. It is not relevant to imaging associated with probe technologies, AFMs, and nanotechnology.

The information given in this table is for guidance only. In most instances, it is recommended that the advice of someone knowledgeable about applications and vibration requirements of the equipment and processes be sought.

Figure A.1. Generic Vibration Criterion (VC) Curves for vibration-sensitive equipment - Showing also the ISO Guidelines for People in Buildings (see Table A.1 for description of equipment and uses.) [From IEST RP-012.2 (2005)]

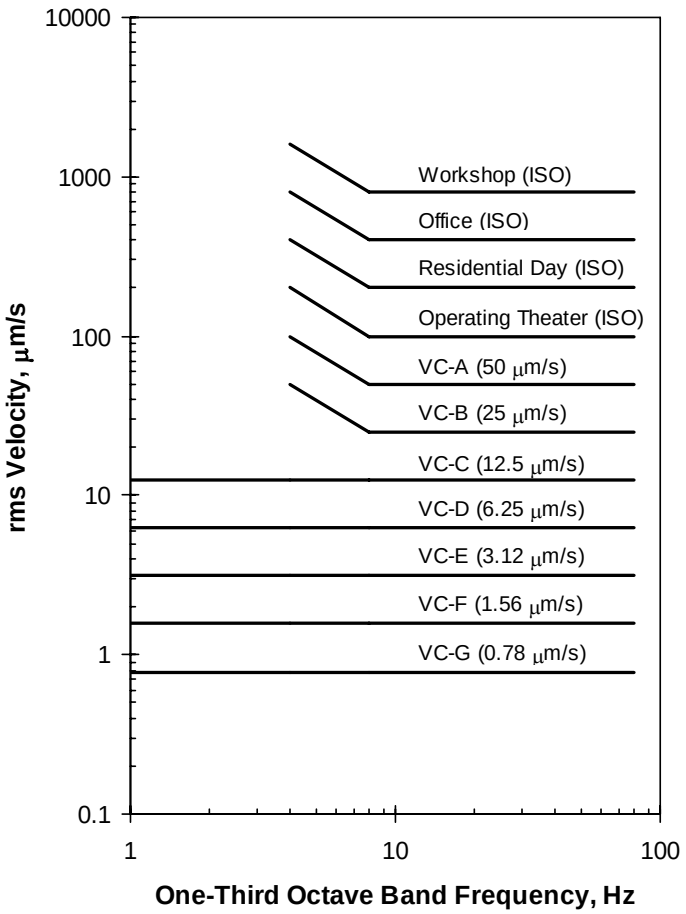


Table A.2: Numerical definition of criterion curves shown in Figure A.1

Criterion	Definition
VC-A	260 μg between 4 Hz and 8 Hz; 50 μm/s (2000 μin/s) between 8 Hz and 80 Hz
VC-B	130 μg between 4 Hz and 8 Hz; 25 μm/s (1000 μin/s) between 8 and 80 Hz
VC-C	12.5 μm/s (500 μin/s) between 1 and 80 Hz
VC-D	6.25 μm/s (250 μin/s) between 1 and 80 Hz
VC-E	3.1 μm/s (125 μin/s) between 1 and 80 Hz
VC-F	1.6 μm/s (62.5 μin/s) between 1 and 80 Hz
VC-G	0.78 μm/s (31.3 μin/s) between 1 and 80 Hz

Figure A.2. Generic Vibration Criterion (NIST-A) Curve for critical areas In nanotechnology facilities - Showing also several of the VC criteria for reference

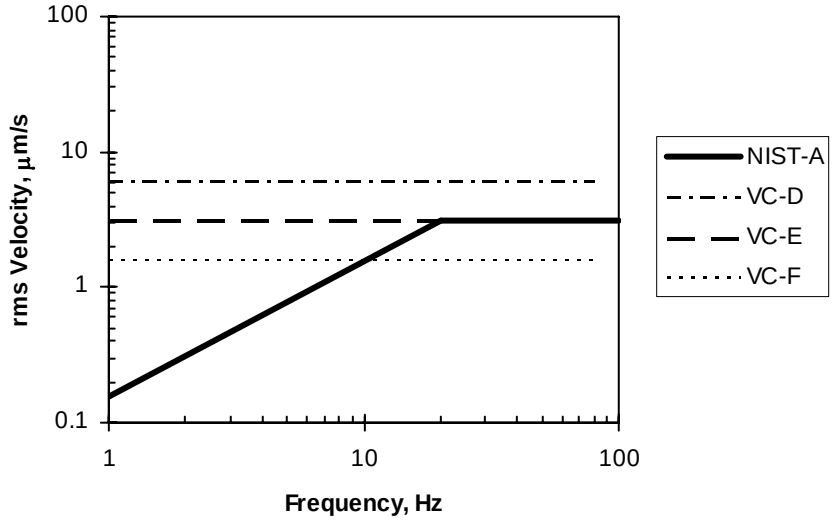


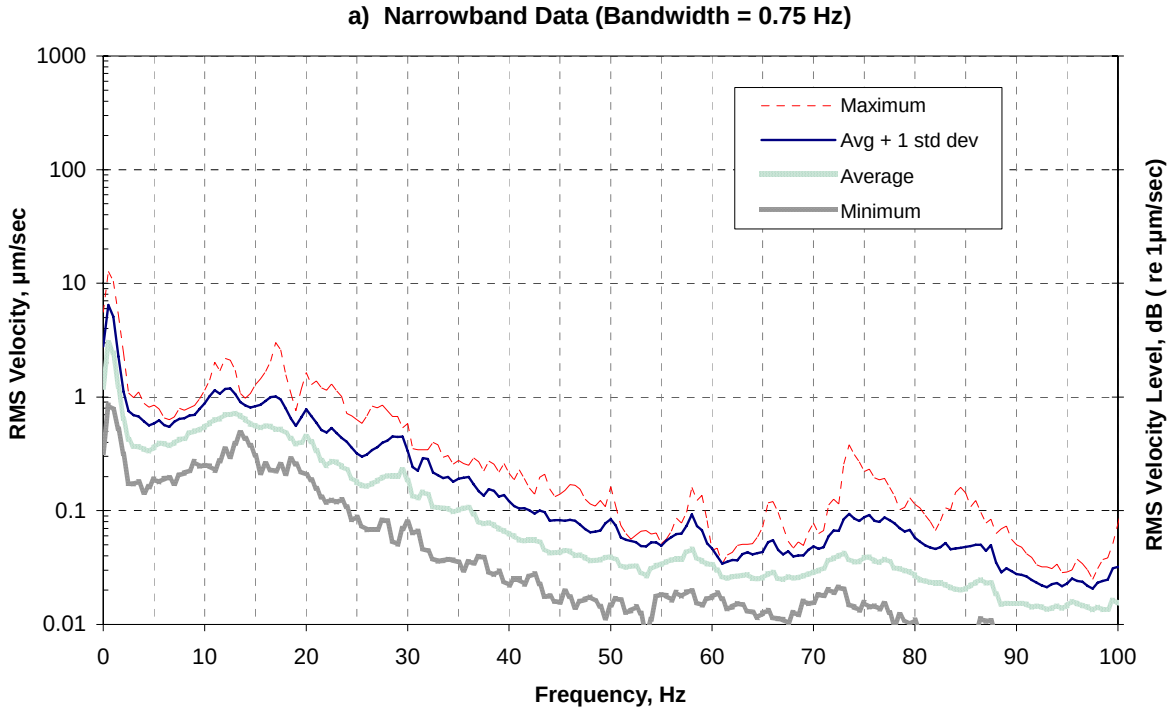
Table A.3: Numerical definition of criterion curves shown in Figure A.2

Criterion	Definition
NIST-A	0.025 μm or 25 nm (1 μin) between 1 and 20 Hz; 3.1 μm/s (125 μin/s) between 20 and 100 Hz
VC-D	6.25 μm/s (250 μin/s) between 1 and 80 Hz
VC-E	3.1 μm/s (125 μin/s) between 1 and 80 Hz
VC-F	1.6 μm/s (62.5 μin/s) between 1 and 80 Hz

APPENDIX B: Result Figures

Figure B.1: Statistical Summary of Vertical Vibration
Figure B.2: Statistical Summary of Horizontal N-S Vibration
Figure B.3: Statistical Summary of Horizontal E-W Vibration
Figure B.4: Peak Hold Vibration Location 1 - Vertical
Figure B.5: Peak Hold Vibration Location 4 - Vertical
Figure B.6: Peak Hold Vibration Location 4 - Horizontal NS
Figure B.7: Peak Hold Vibration Location 4 - Horizontal EW
Figure B.8: Peak Hold Vibration Location 5 - Vertical
Figure B.9: Peak Hold Vibration Location 7 - Vertical
Figure B.10: Peak Hold Vibration Location 12 - Vertical
Figure B.11: Peak Hold Vibration Location 12 - Horizontal NS
Figure B.12: Peak Hold Vibration Location 12 - Horizontal EW

Figure B.1: Statistical Summary of Vertical Vibration



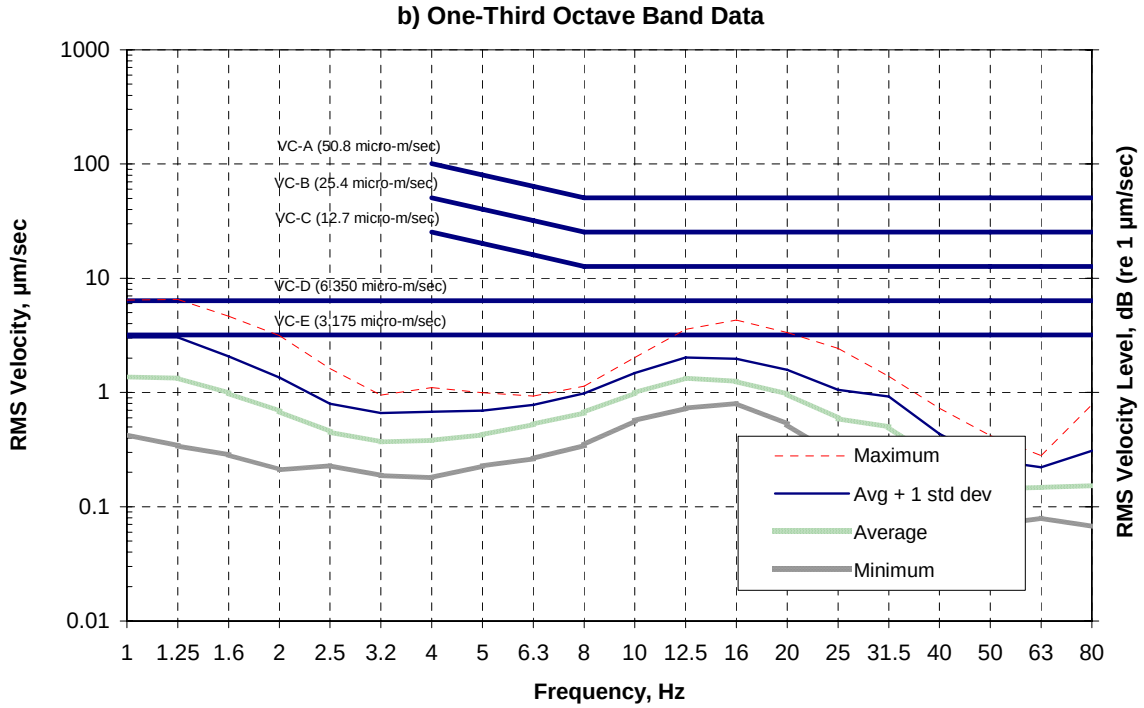
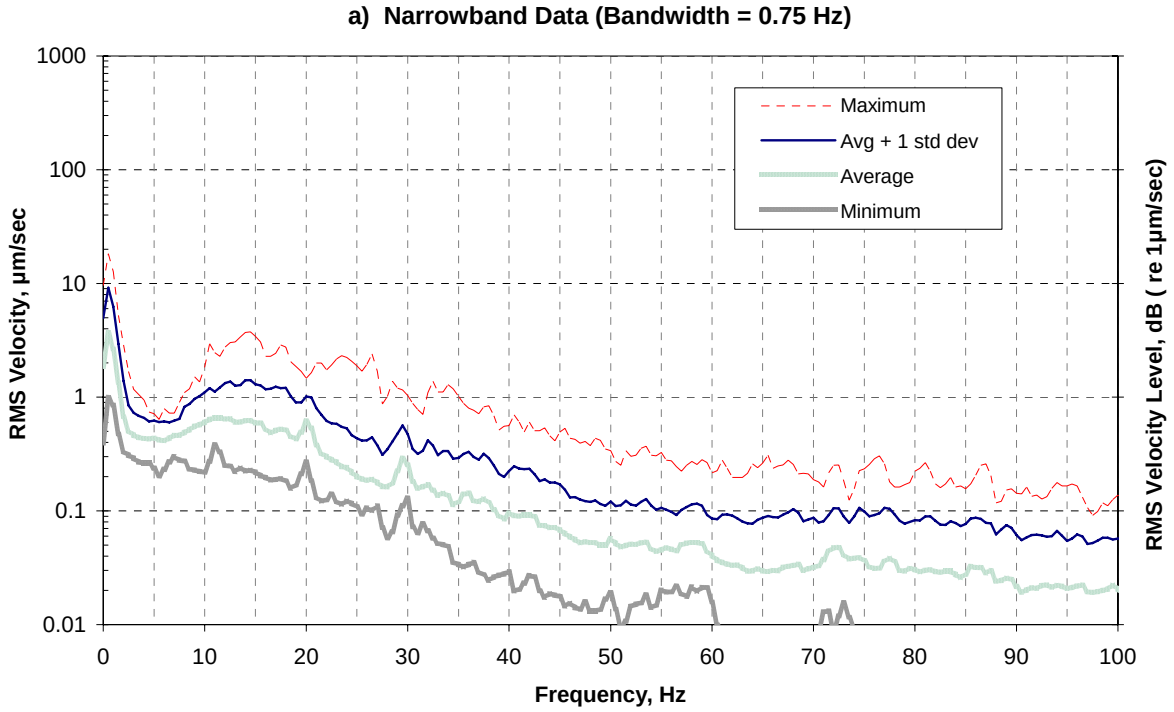


Figure B.2: Statistical Summary of Horizontal N-S Vibration



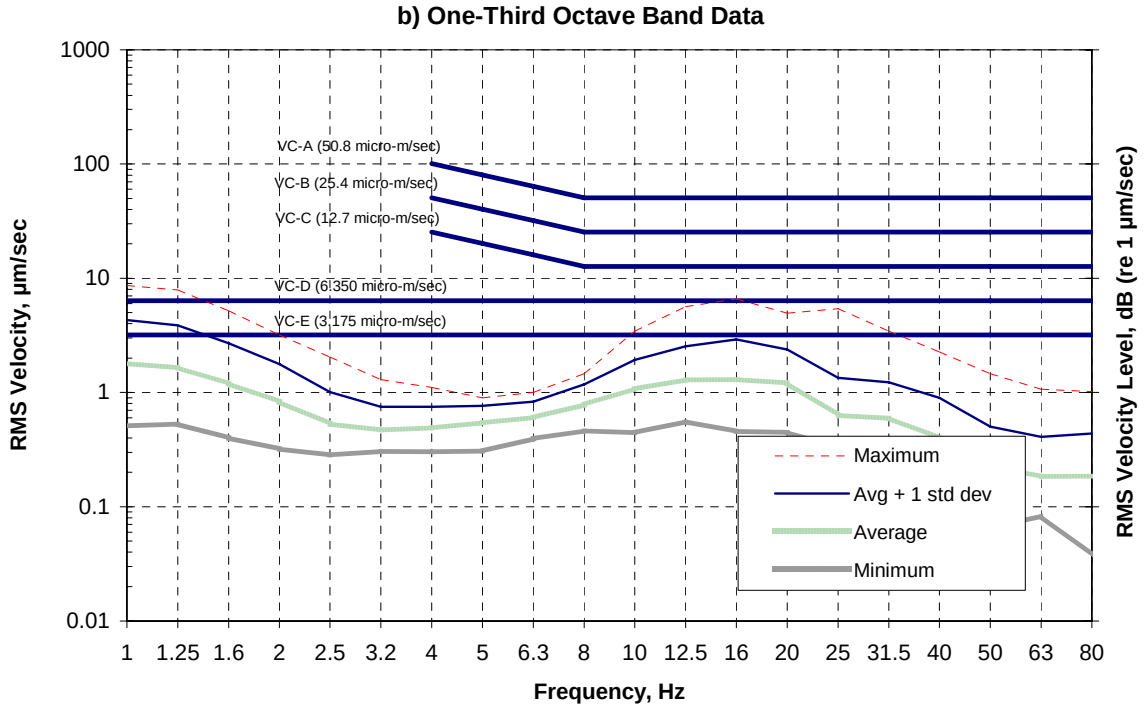
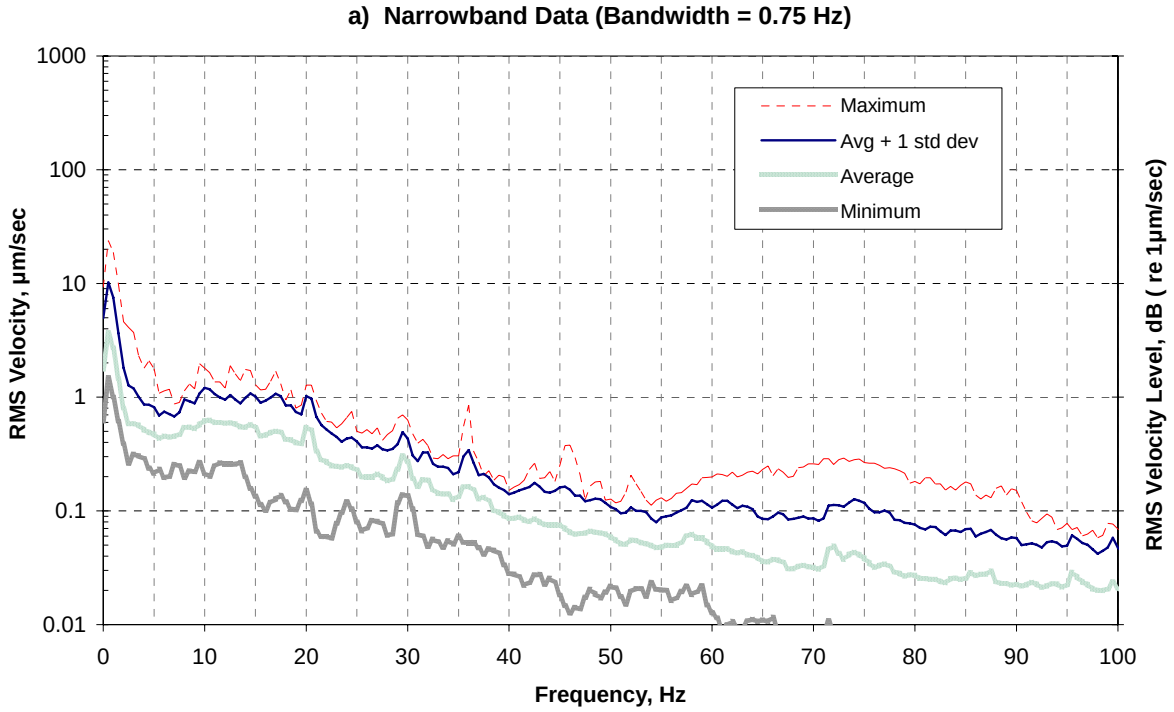


Figure B.3: Statistical Summary of Horizontal E-W Vibration



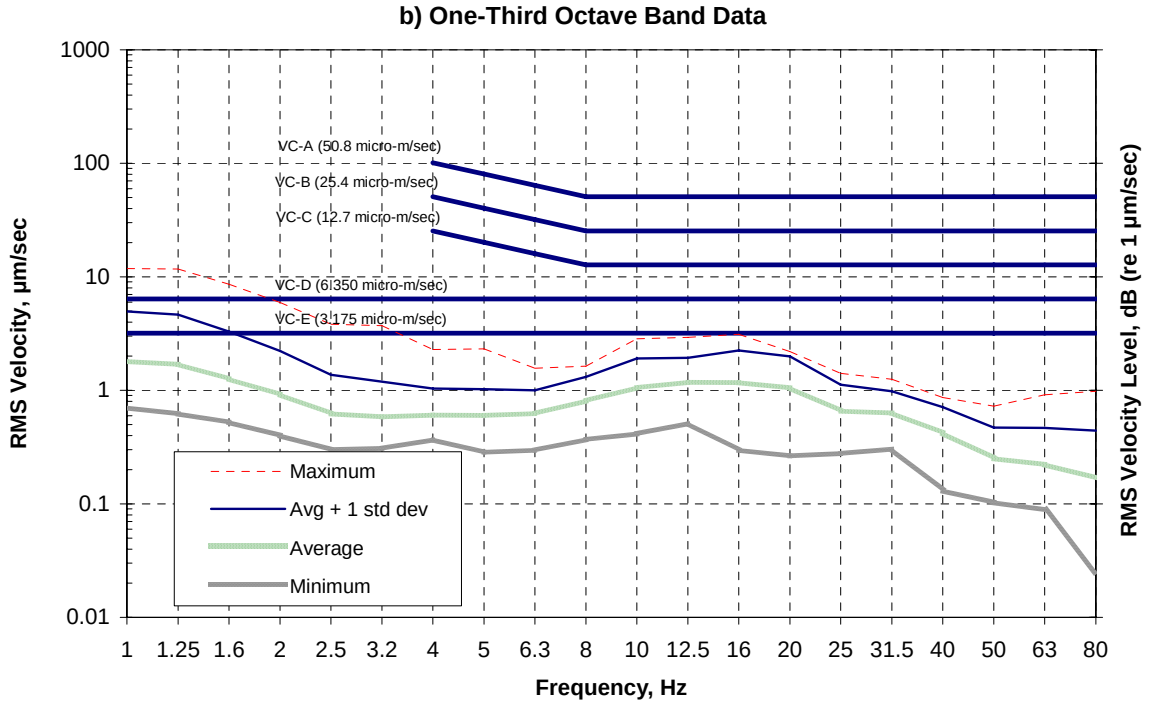
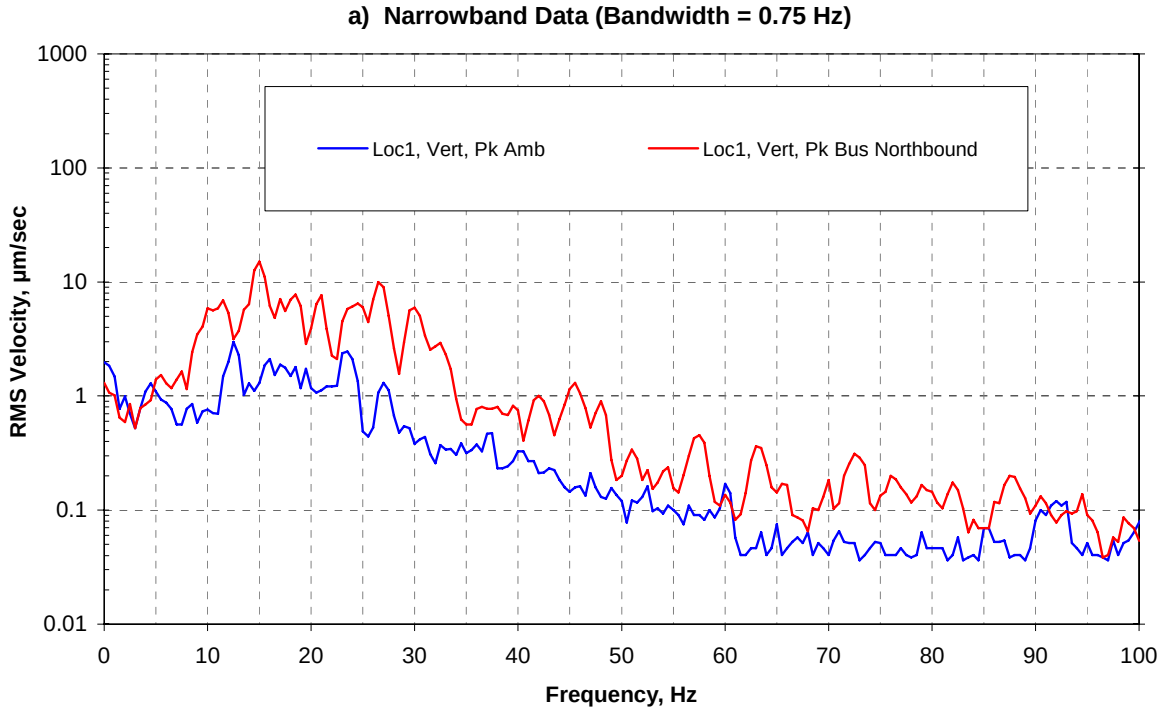


Figure B.4: Peak Hold Vibration Location 1 - Vertical



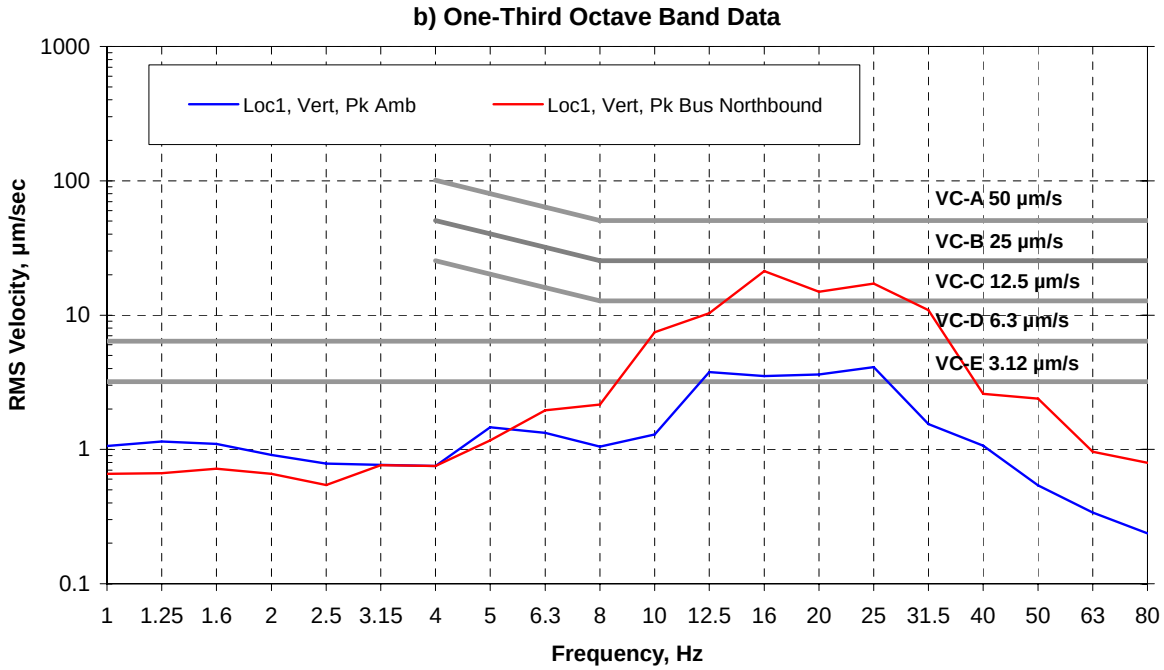
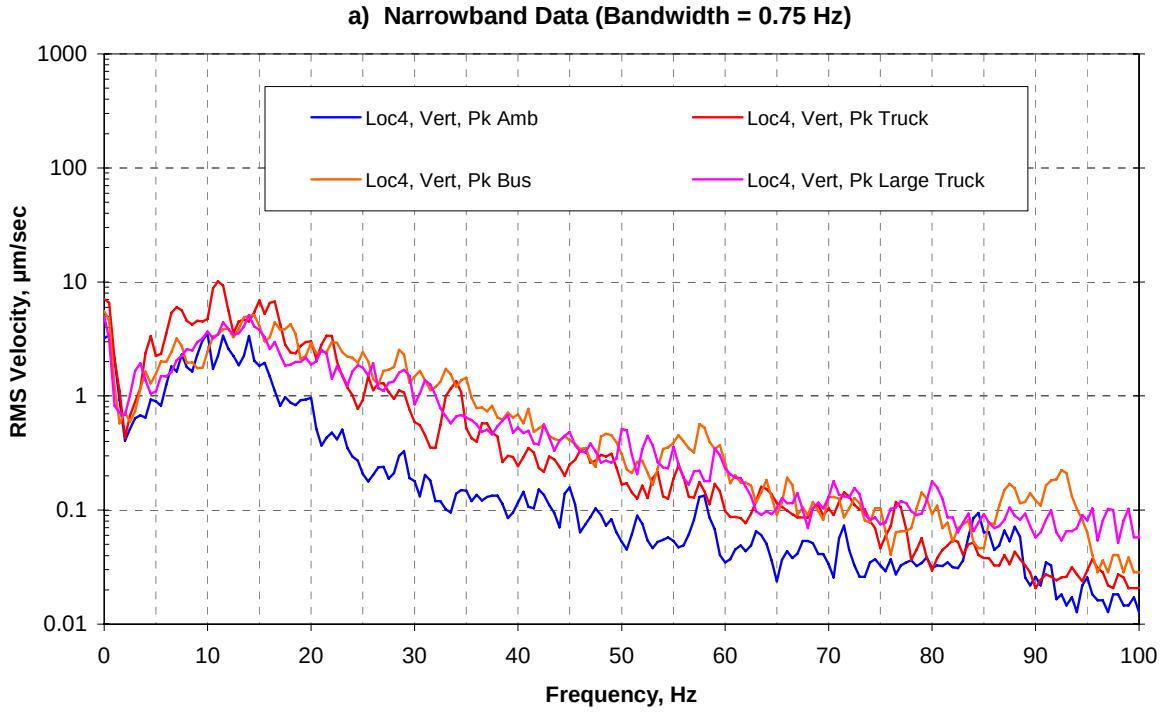


Figure B.5: Peak Hold Vibration Location 4 - Vertical



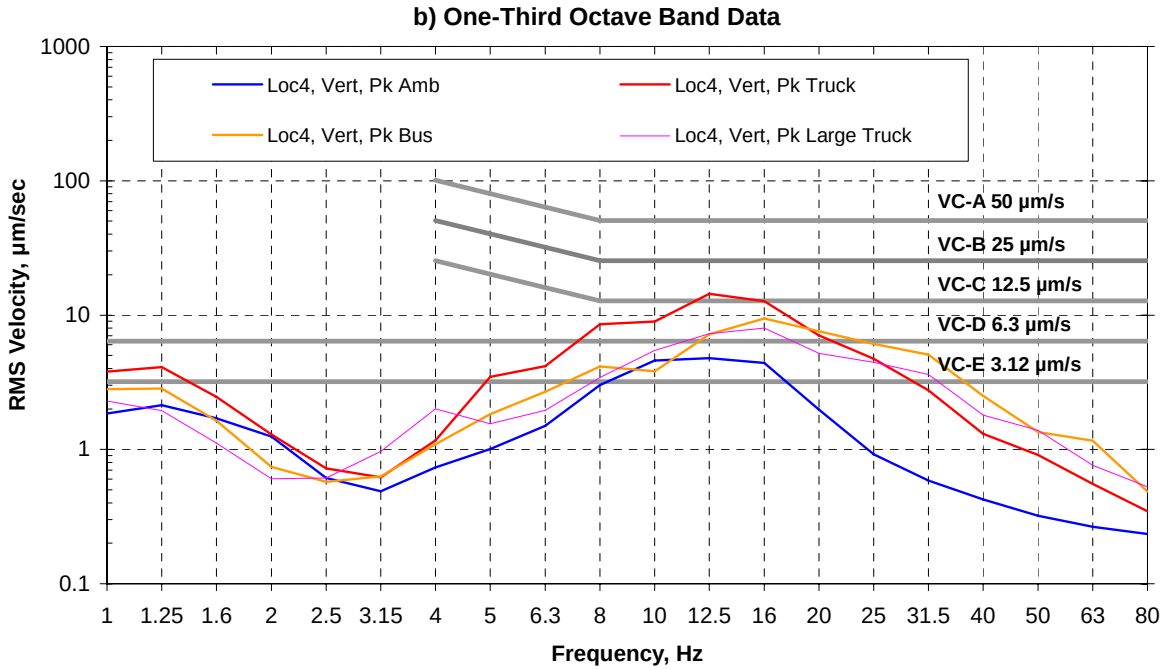
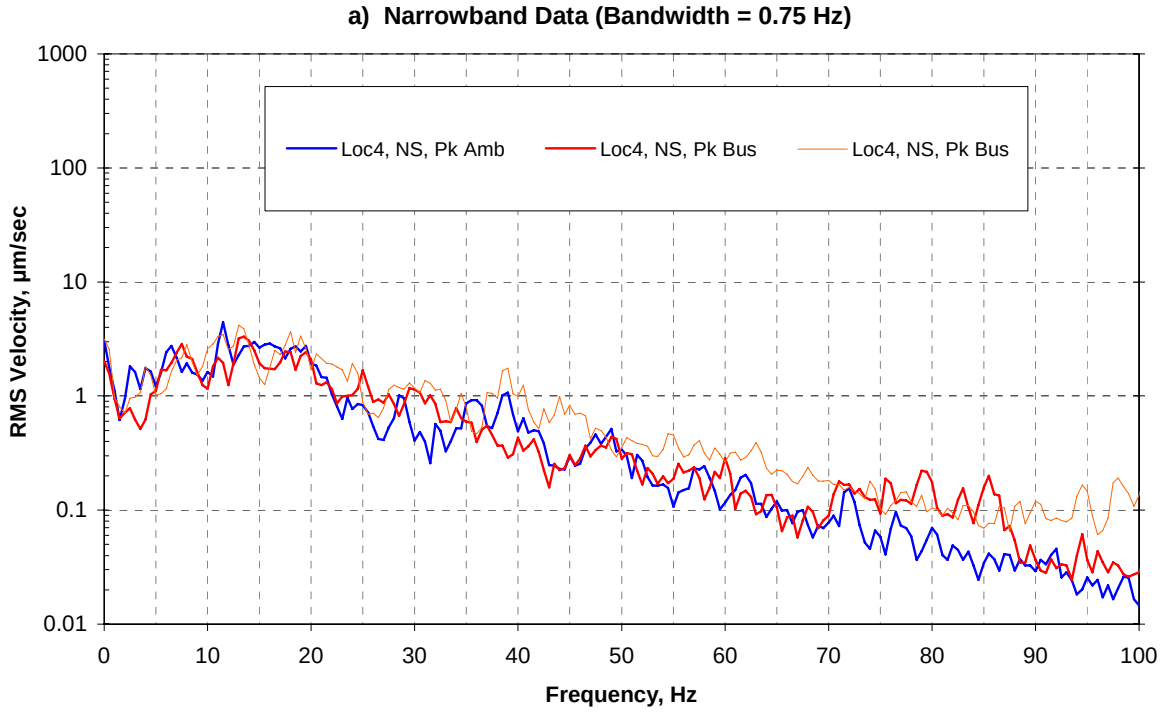


Figure B.6: Peak Hold Vibration Location 4 – Horizontal NS



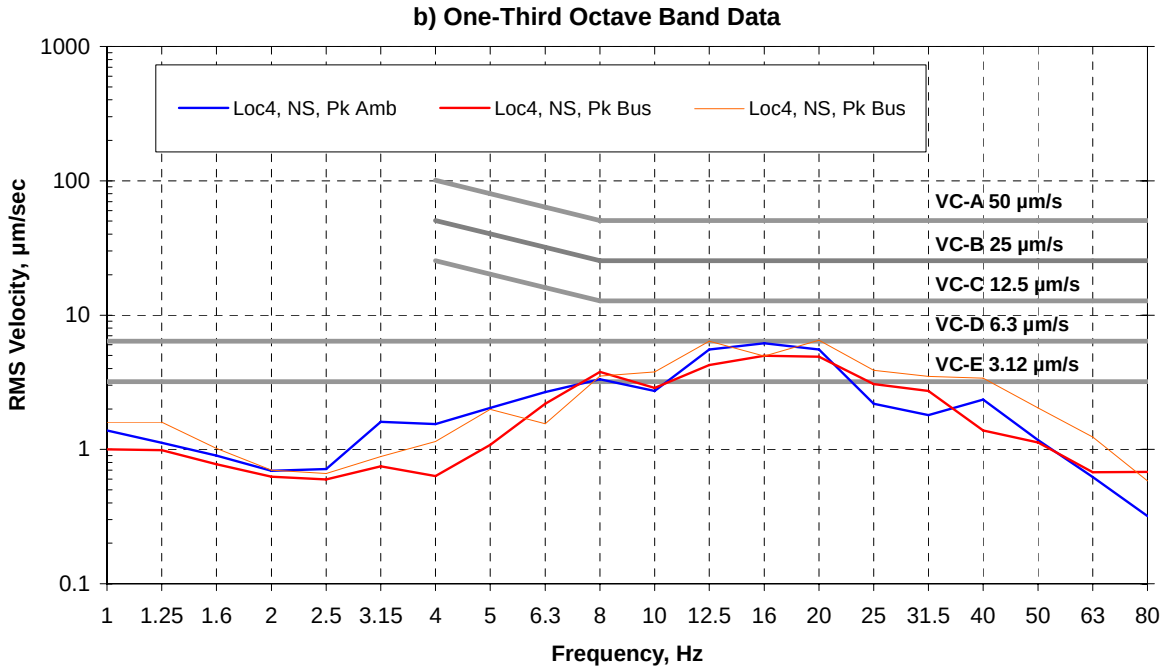
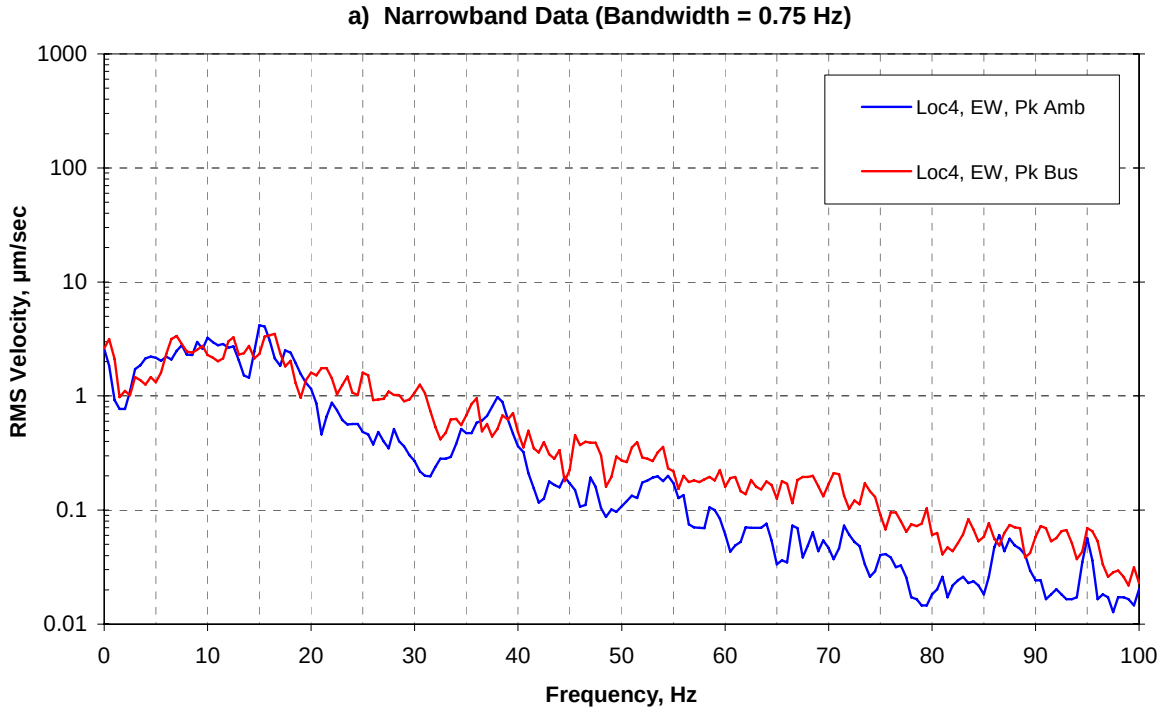


Figure B.7: Peak Hold Vibration Location 4 - Horizontal EW



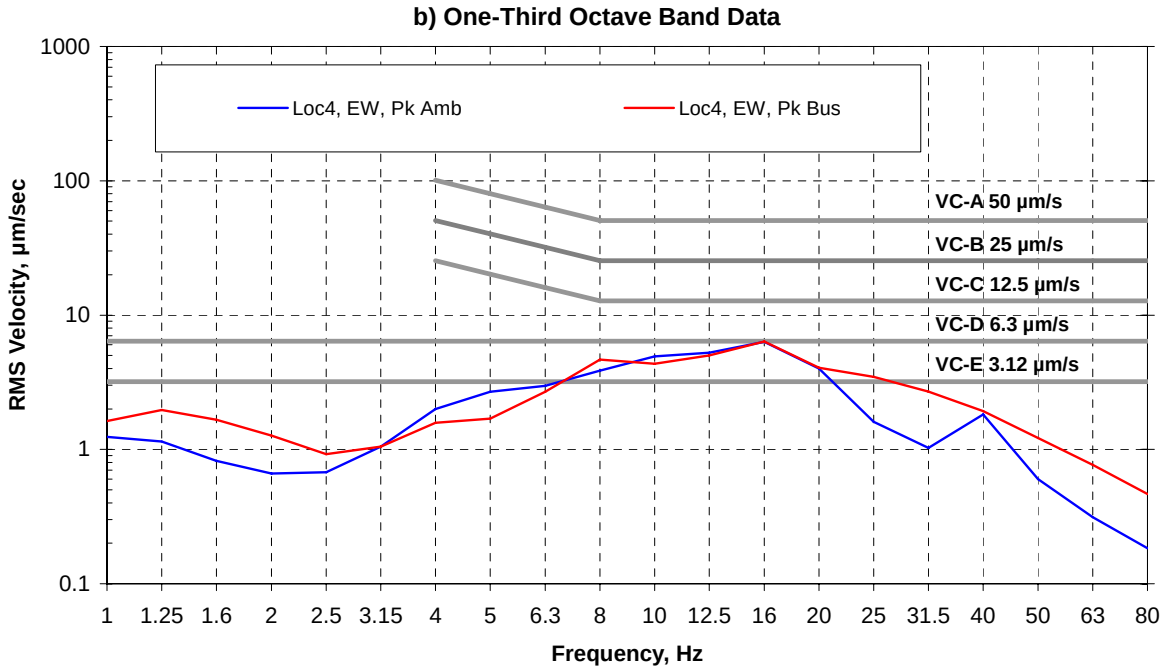


Figure B.8: Peak Hold Vibration Location 5 - Vertical

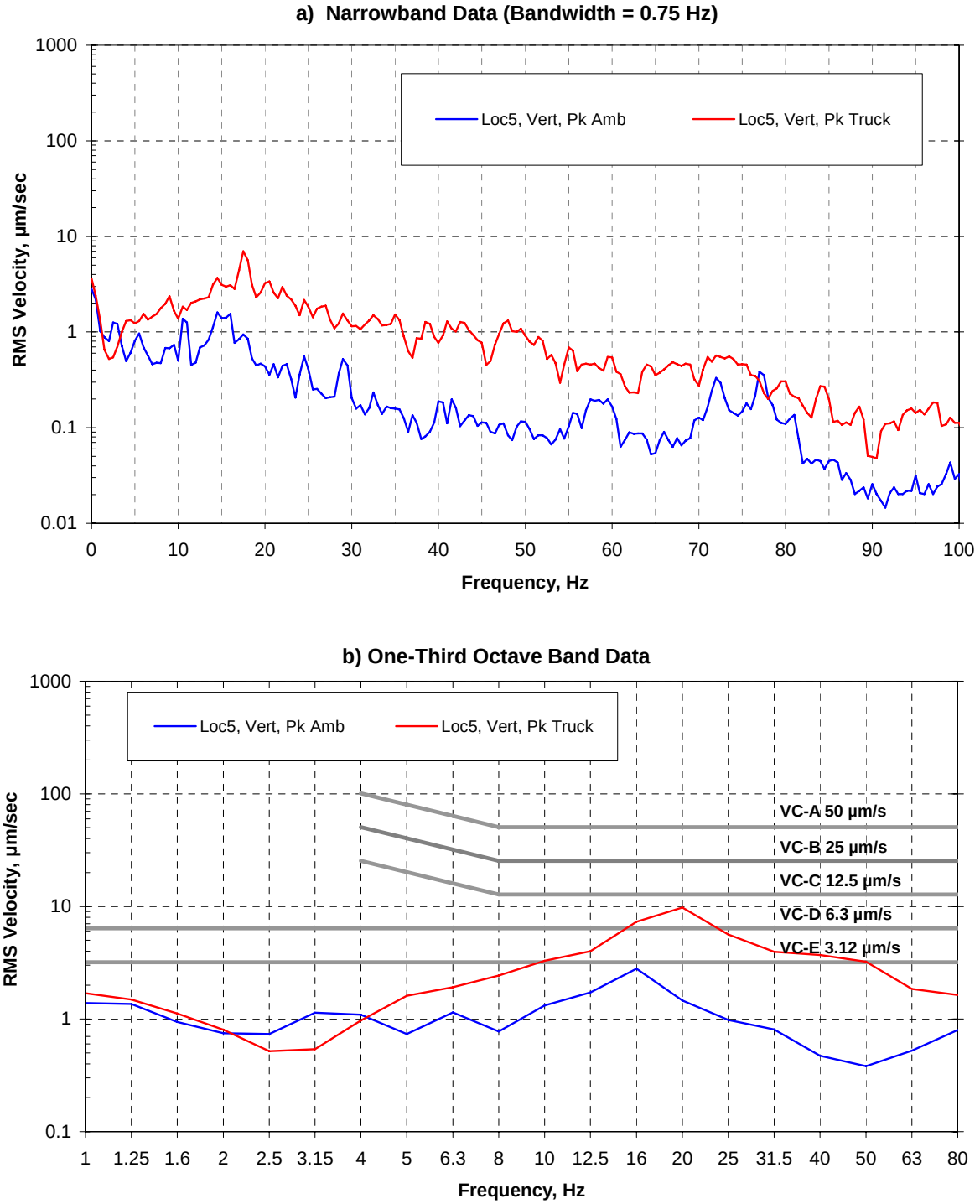
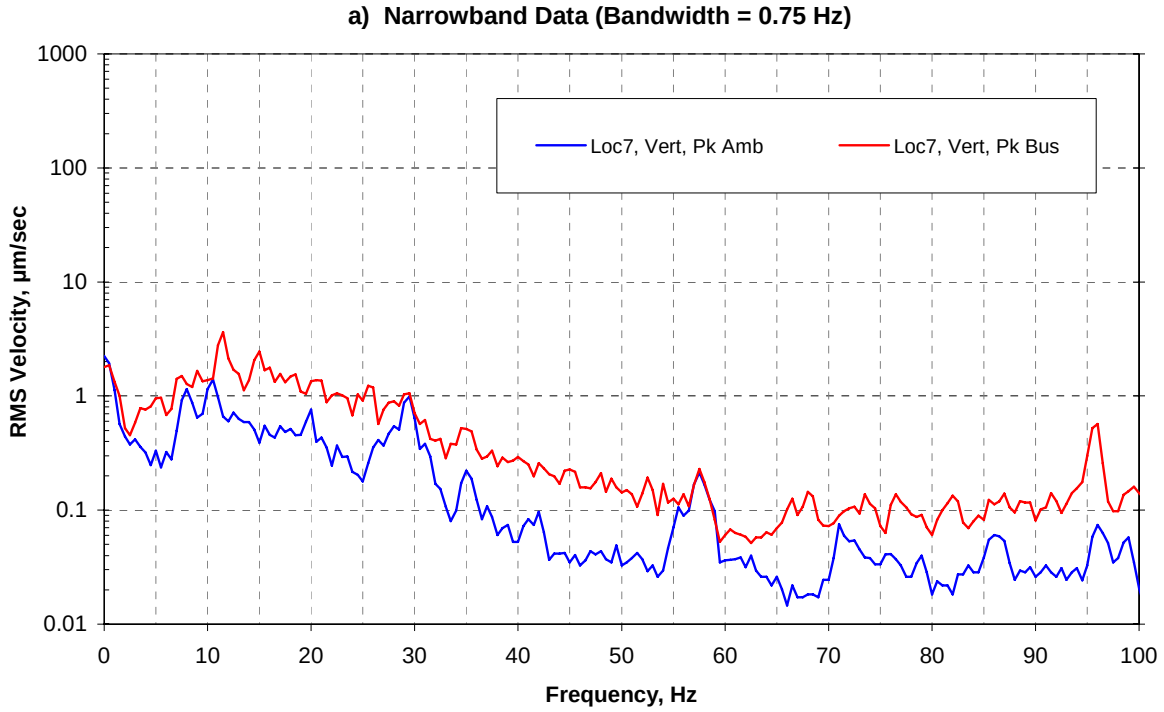


Figure B.9: Peak Hold Vibration Location 7 - Vertical



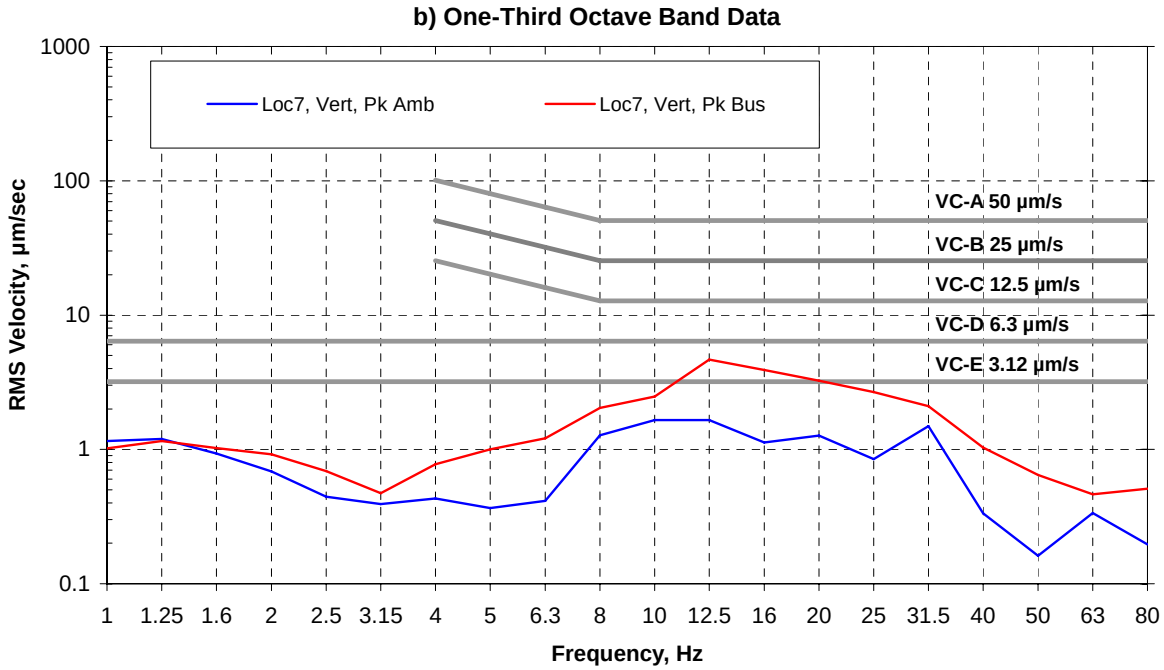
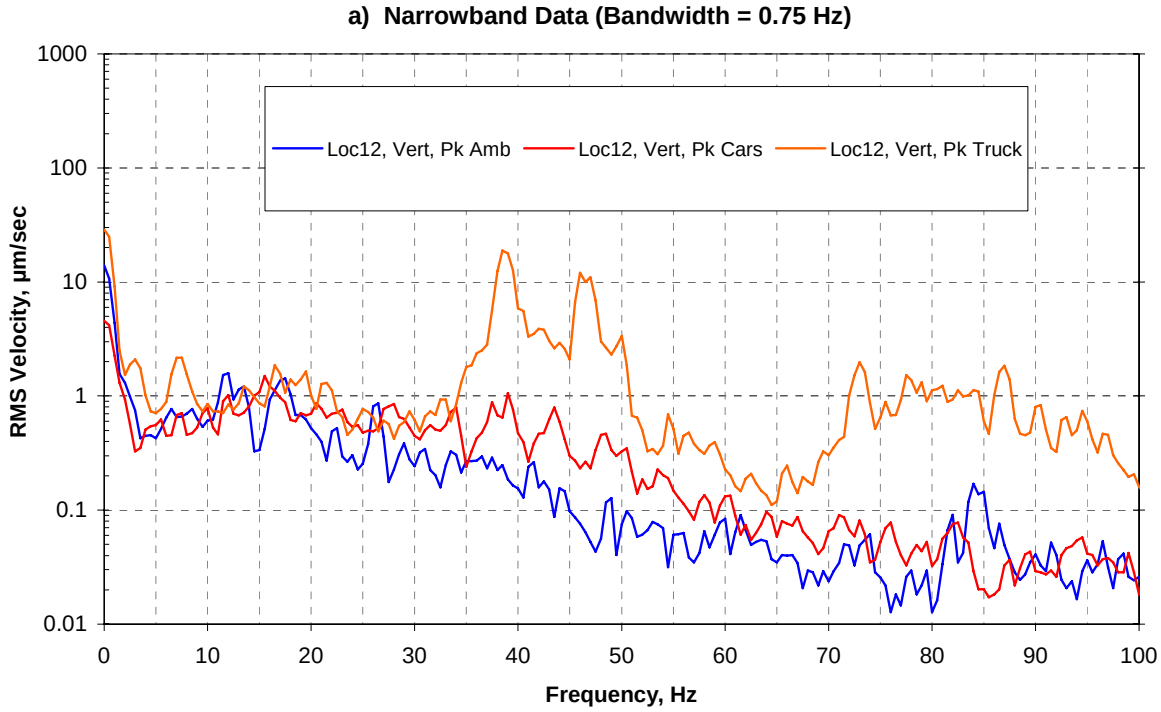


Figure B.10: Peak Hold Vibration Location 12 - Vertical



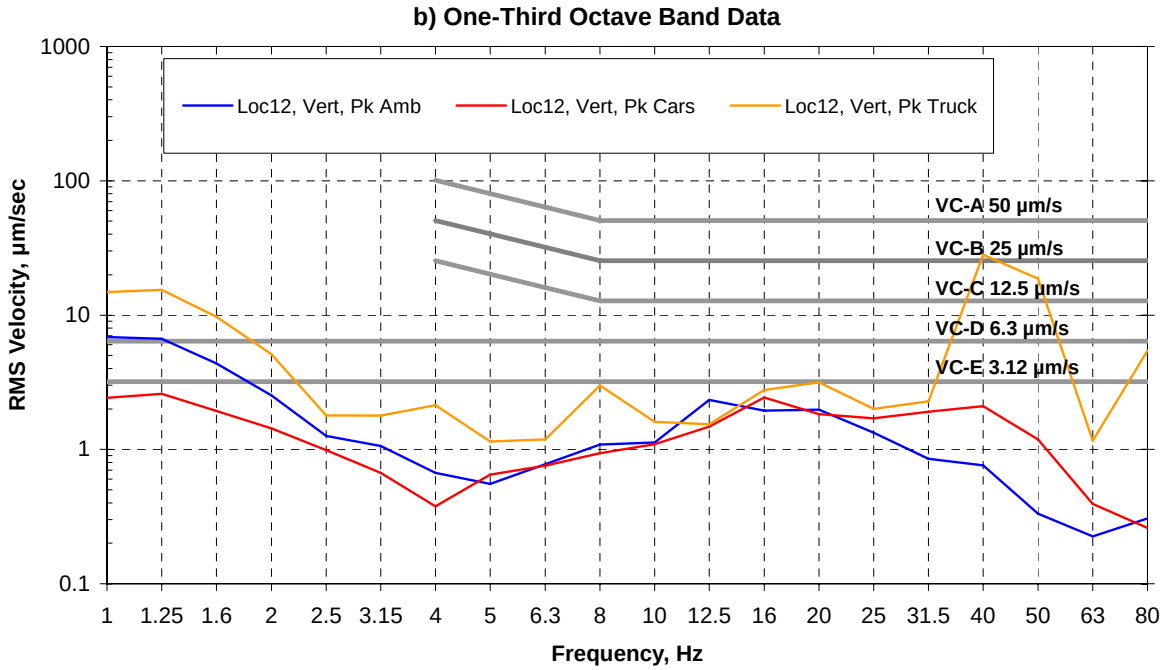
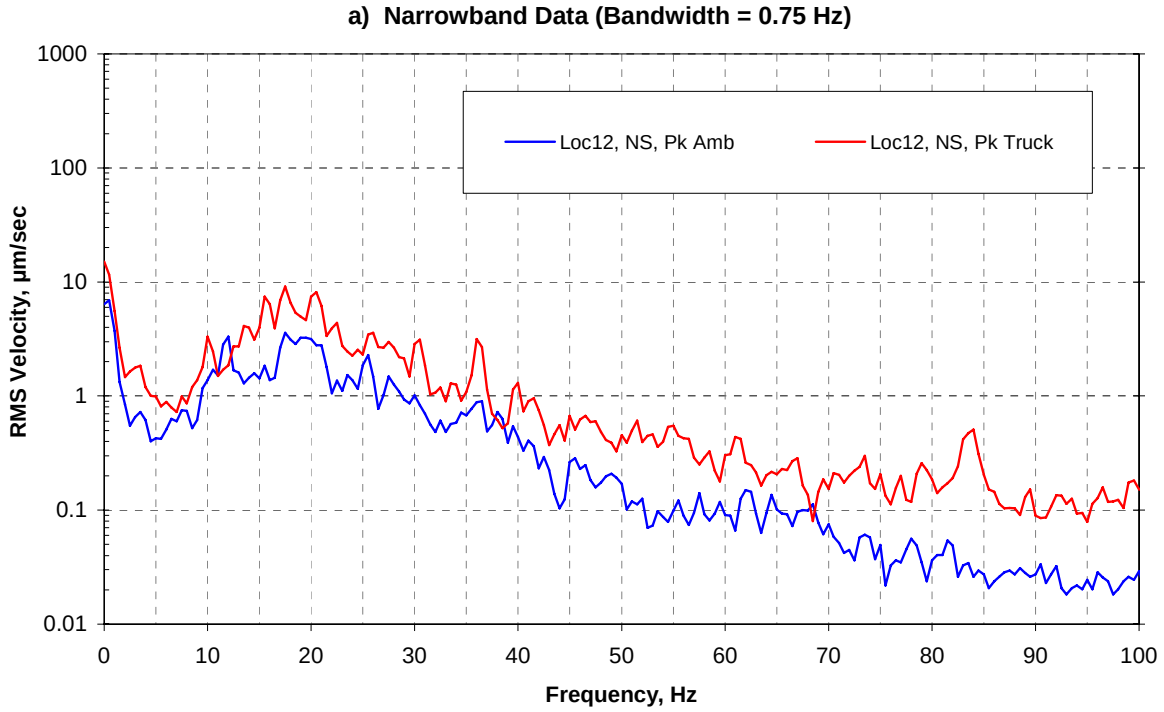


Figure B.11: Peak Hold Vibration Location 12 - Horizontal NS



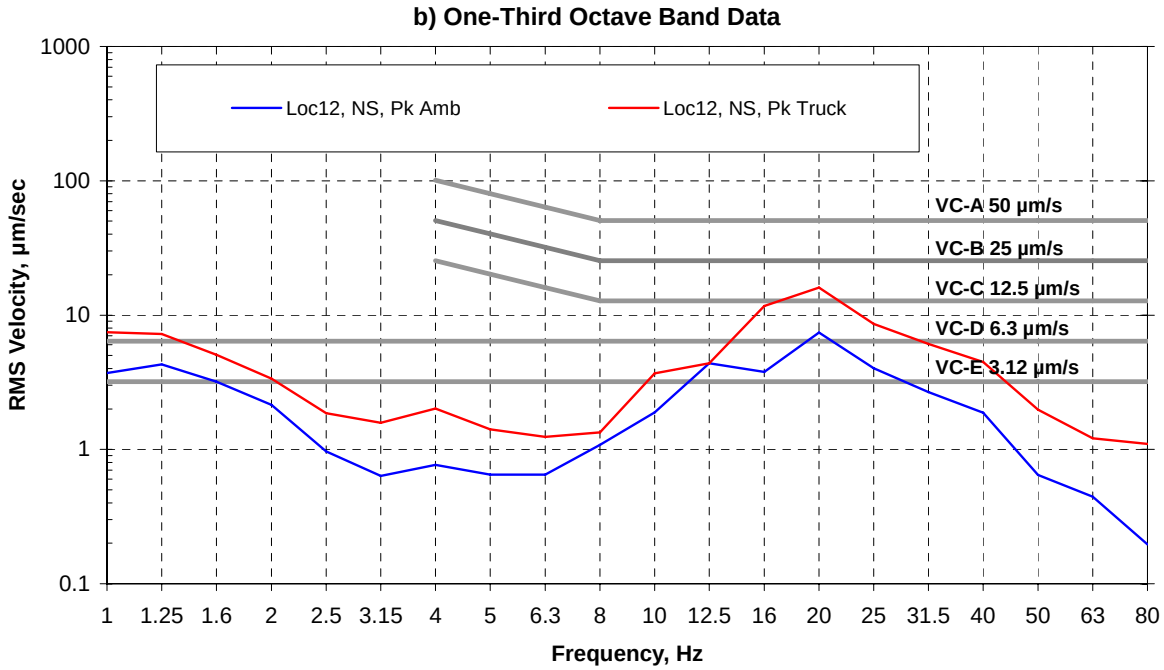
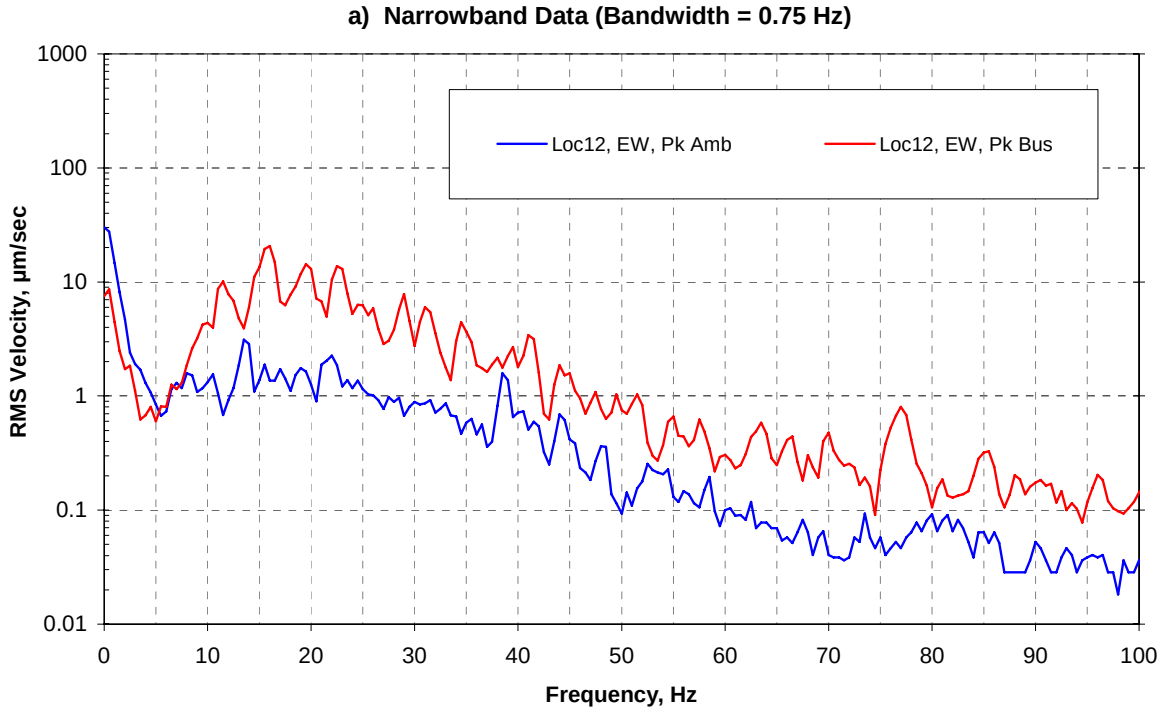
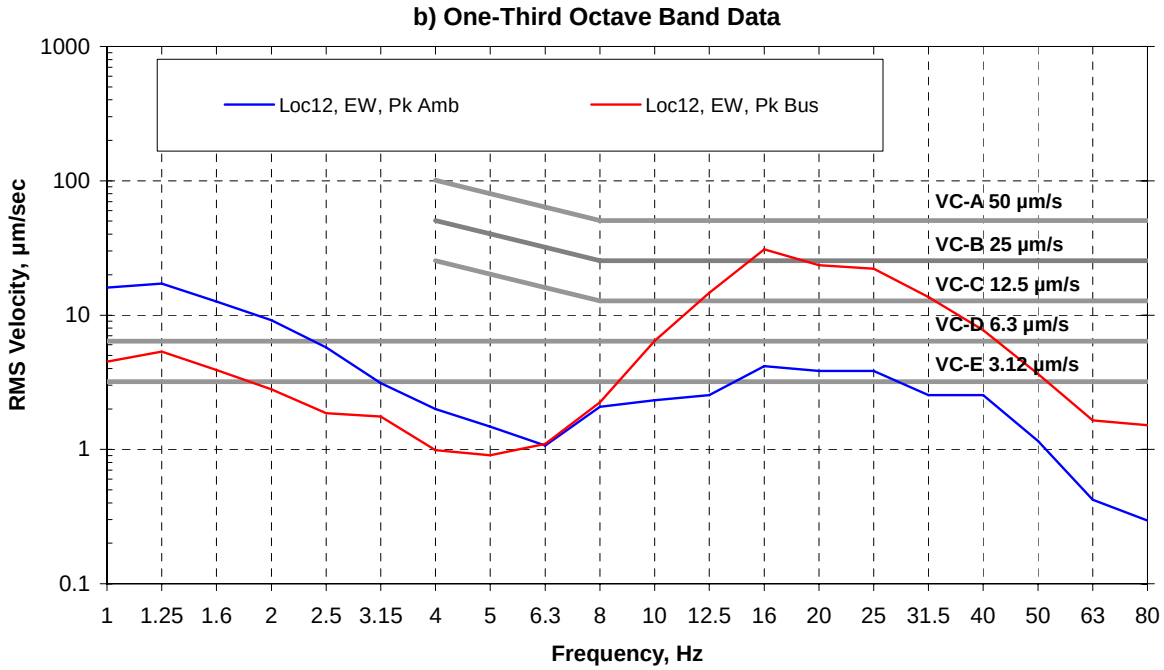


Figure B.12: Peak Hold Vibration Location 12 - Horizontal EW

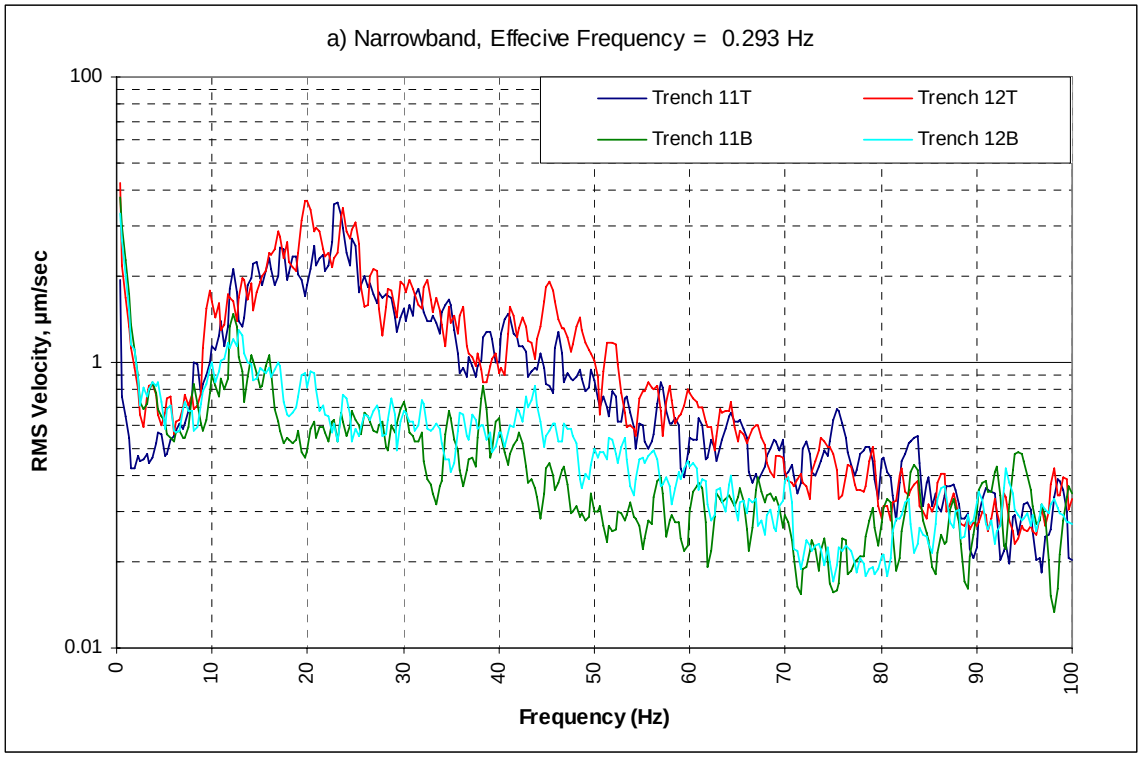




APPENDIX C: Result Figures of Site Survey 2

Figure C.1: Peak Hold Vibration – Data Sets 11 and 12 for Trench Study
Figure C.2: Peak Hold Vibration – Data Sets 17 and 18 for Trench Study
Figure C.3: Peak Hold Vibration – Data Sets 20 and 21 for Trench Study

Figure C.1: Peak Hold Vibration – Data Sets 11 and 12 for Trench Study



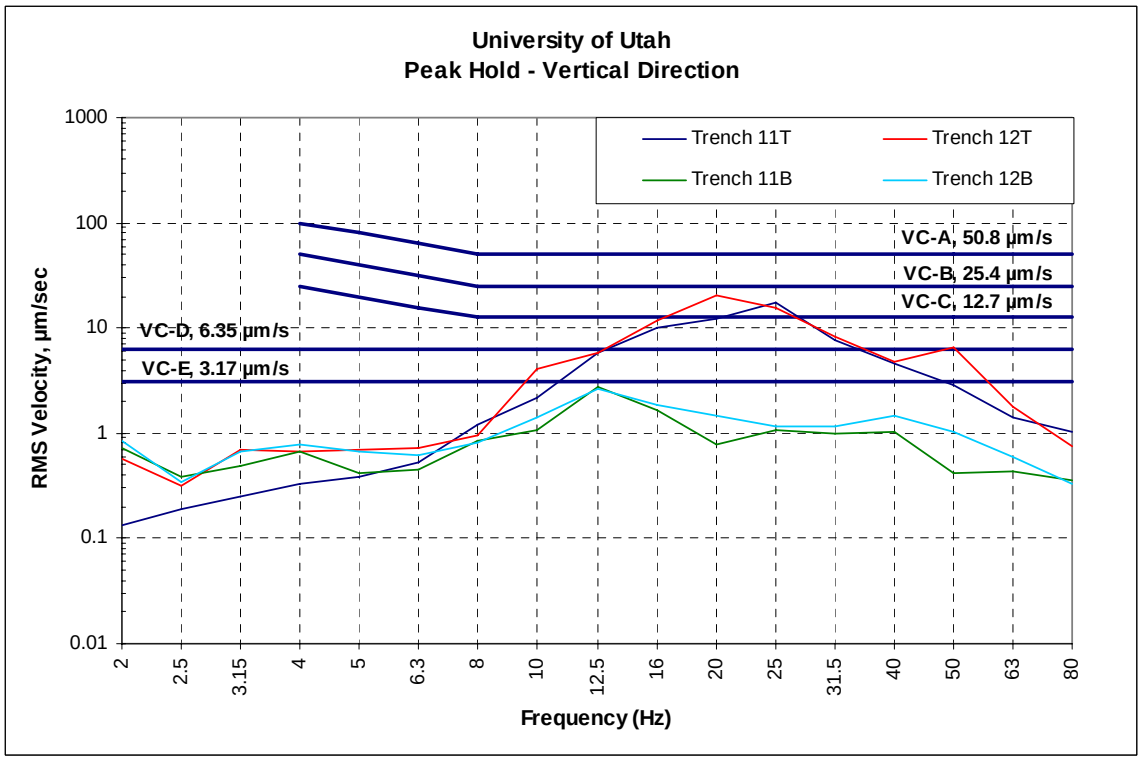
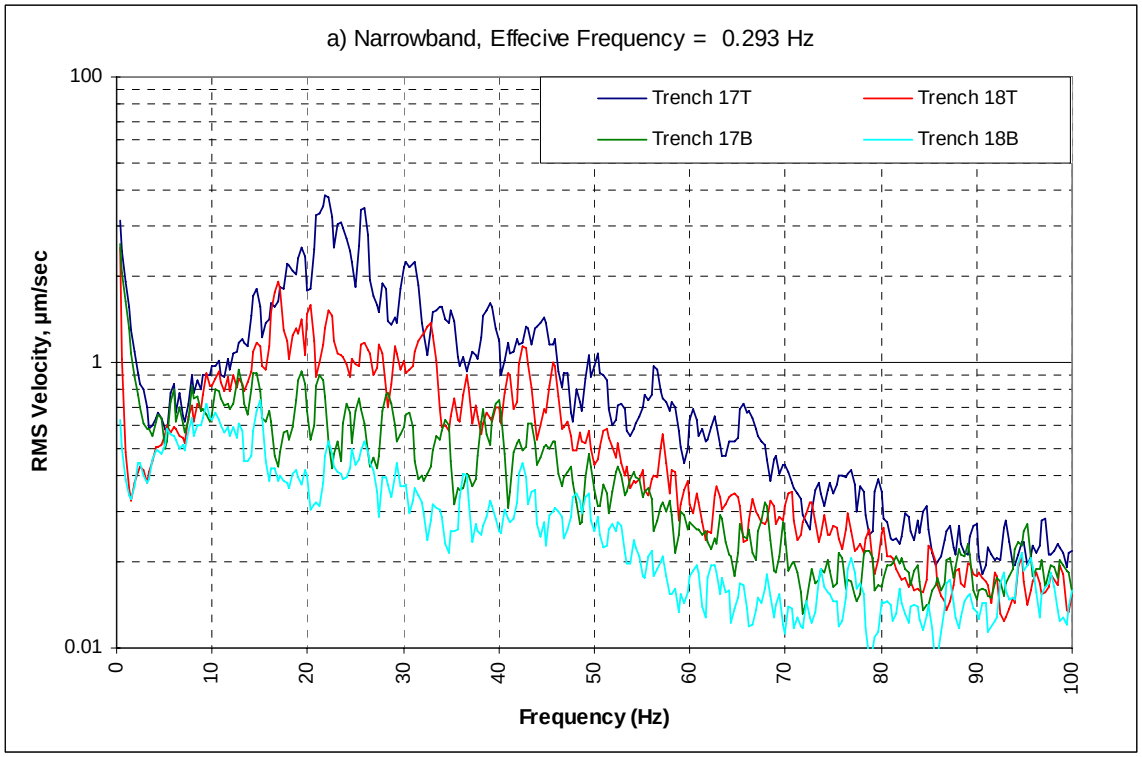


Figure C.2: Peak Hold Vibration – Data Sets 17 and 18 for Trench Study



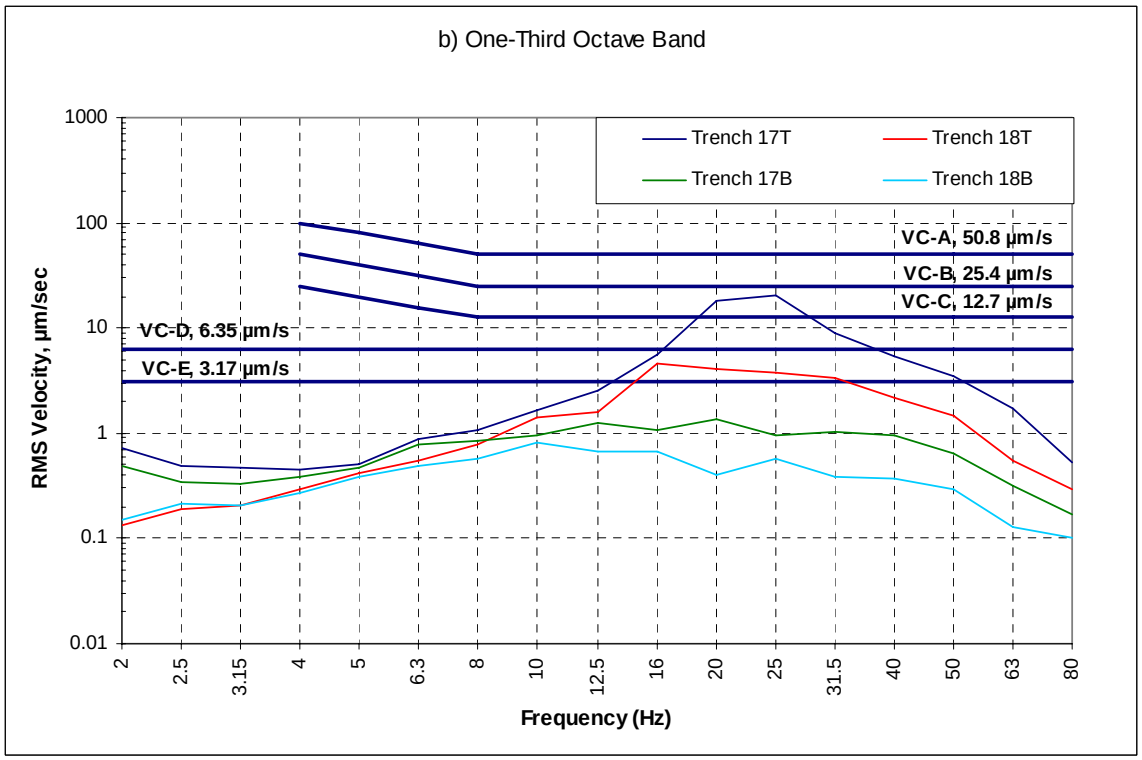
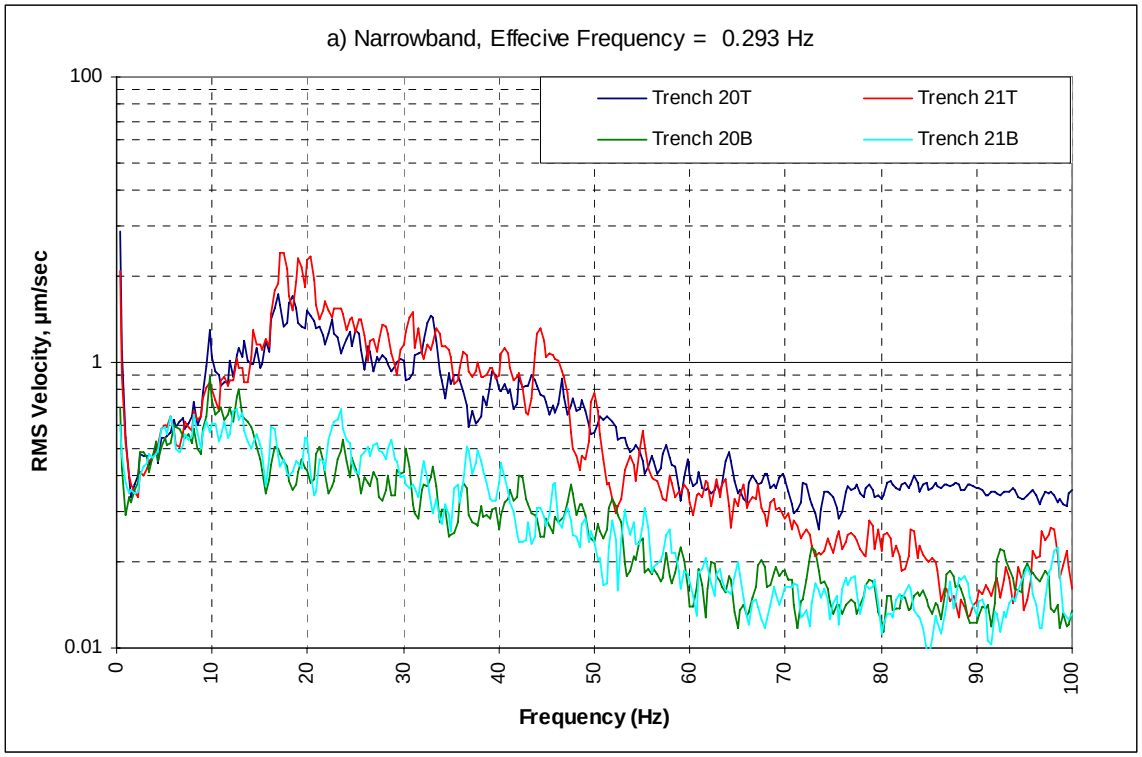
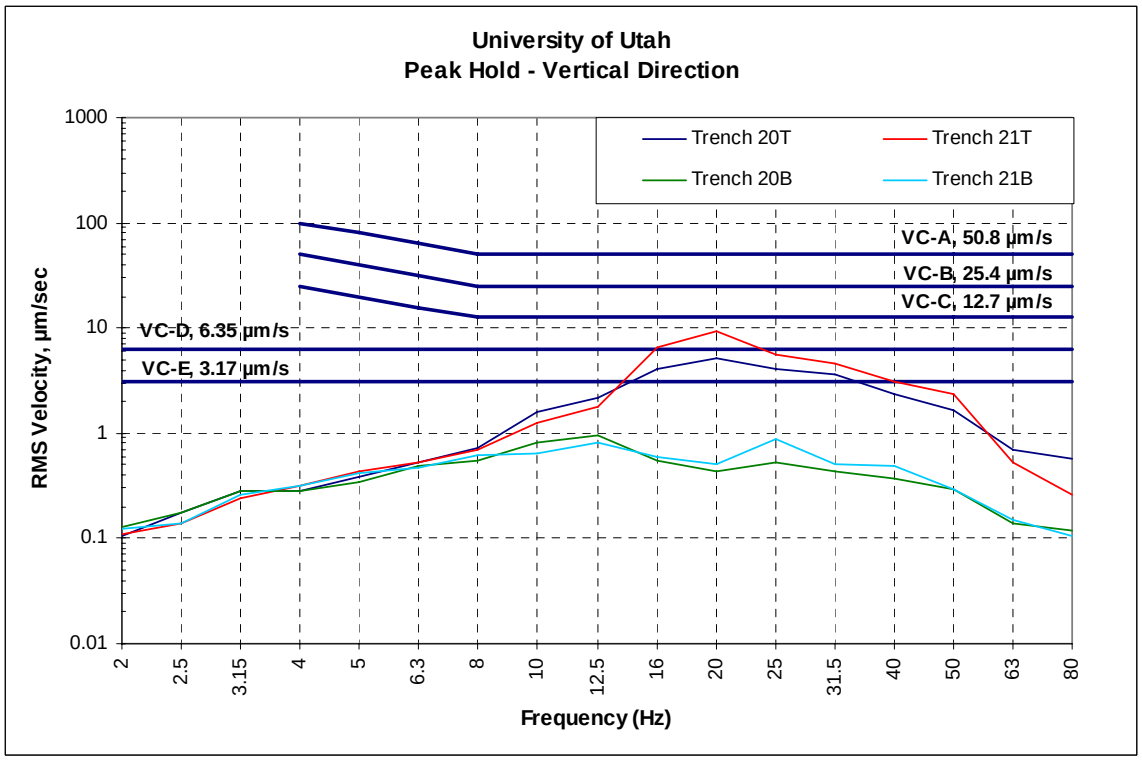


Figure 7: Peak Hold Vibration – Data Sets 20 and 21 for Trench Study





6.5 MODIFIED ALTA/TOPOGRAPHIC SURVEY

Please see the following page (**Section 6.5 page 2**) for Modified Alta Topographic Survey.

MODIFIED ALTA/TOPOGRAPHIC SURVEY

6.6 TRAFFIC IMPACT ANALYSIS

TRAFFIC IMPACT ANALYSIS

FOR

UNIVERSITY OF UTAH NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

USTAR: UTAH SCIENCE, TECHNOLOGY AND RESEARCH INITIATIVE

SUBMITTED TO:

ARCHITECTURAL NEXUS
2150 SOUTH 1300 EAST, SUITE 200
SALT LAKE CITY, UT 84106

SUBMITTED BY:

PROJECT ENGINEERING CONSULTANTS, LTD.
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April 2007

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I. Introduction and Executive Summary

Project Engineering Consultants (PEC) was retained by the Architectural Nexus to perform a traffic and parking analysis for the programming of the proposed Neuroscience and Biomedical Technology Research Building (NBTRB) located within the University of Utah campus. The proposed NBTRB is currently estimated between 200,000 and 250,000 gross square feet and is envisioned as consisting of laboratory space, core facilities, faculty office space, symposium and conference space, and public areas designed to encourage maximum interaction of faculty from diverse disciplines. The objective of this study is to determine the effects of the new building on the adjacent transportation system and to determine what future improvements could be necessary. The affected intersections of the street network were analyzed with existing geometry, closure of Federal Way, and provided consideration for intersection improvements.

The proposed development is expected to have some impacts on specific intersections in the vicinity of the new NBTRB building. The minor intersection improvements stated below should mitigate the increases to delay and impacts to safety. In summary the recommendations within the study area according to this analysis are as follows for Option 1 of the 2012 build condition:

- Future signalization at the intersections of Central Campus Drive and Federal Way and North Campus Drive and Wasatch.
- Signalize Medical Drive and South Medical Drive and add a southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At Medical Drive and Wasatch Drive, Increase north/south green time.

The following improvements are recommended for Option 2 of the 2012 build condition:

- Signalize Medical Drive and South Medical Drive and add a southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At North Campus Drive and Central Campus Drive, add a westbound (WB) left turn leading phase and permit northbound (NB) right turns during the WB leading phase.
- Signalize North Campus Drive and Wasatch Drive and add a westbound (WB) left turn leading phase during the afternoon peak condition.

Additionally, a new 300 stall parking facility should be added with the NBTRB project and should include 7 stalls that are ADA compliant/accessible.

II. Existing Conditions

According to the programming efforts currently underway and the draft site assessment, the preferred site for the NBTRB building is situated north of Federal Way bound by Wasatch Drive on the East and Central Campus Drive on the West. In order to establish logical termini for the purposes of this analysis, study limits were selected as north campus drive on the north, Medical Drive on the east, Medical Drive and Wasatch on the south, and Central Campus Drive on the west. Based upon the established study area the existing conditions of the proposed site were investigated. PEC collected traffic counts of the individual movements at five intersections within the specified study area. The traffic counts were performed on Wednesday, March 28 and Thursday, March 29 of 2007 between the hours of 7:00 AM and 9:00 AM as well as 4:00 PM and 6:00 PM. These days and times were considered to be representative of the typical peak traffic flow, and weather conditions were fair so no unusual impacts existed. The intersections selected and analyzed include:

- Central Campus Drive and Federal Way
- Medical Drive and North Medical Drive
- Medical Drive and South Medical Drive
- Medical Drive and Wasatch Drive
- North Campus Drive and Central Campus Drive
- North Campus Drive and Wasatch Drive
- Wasatch Drive and Federal Way

A general vicinity map of the study area illustrating intersections and pneumatic count locations is included as Figure 1. Existing geometric conditions and current control device for each intersection were also collected. This information is summarized in Figure 2. Figure 3 illustrates the 2007 Existing Peak Hour Traffic volumes and the corresponding peak hour Level of Service (LOS) at each intersection. Section 3 of this report describes level of service and how it is measured.

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FIGURE 1
STUDY AREA & VICINITY MAP

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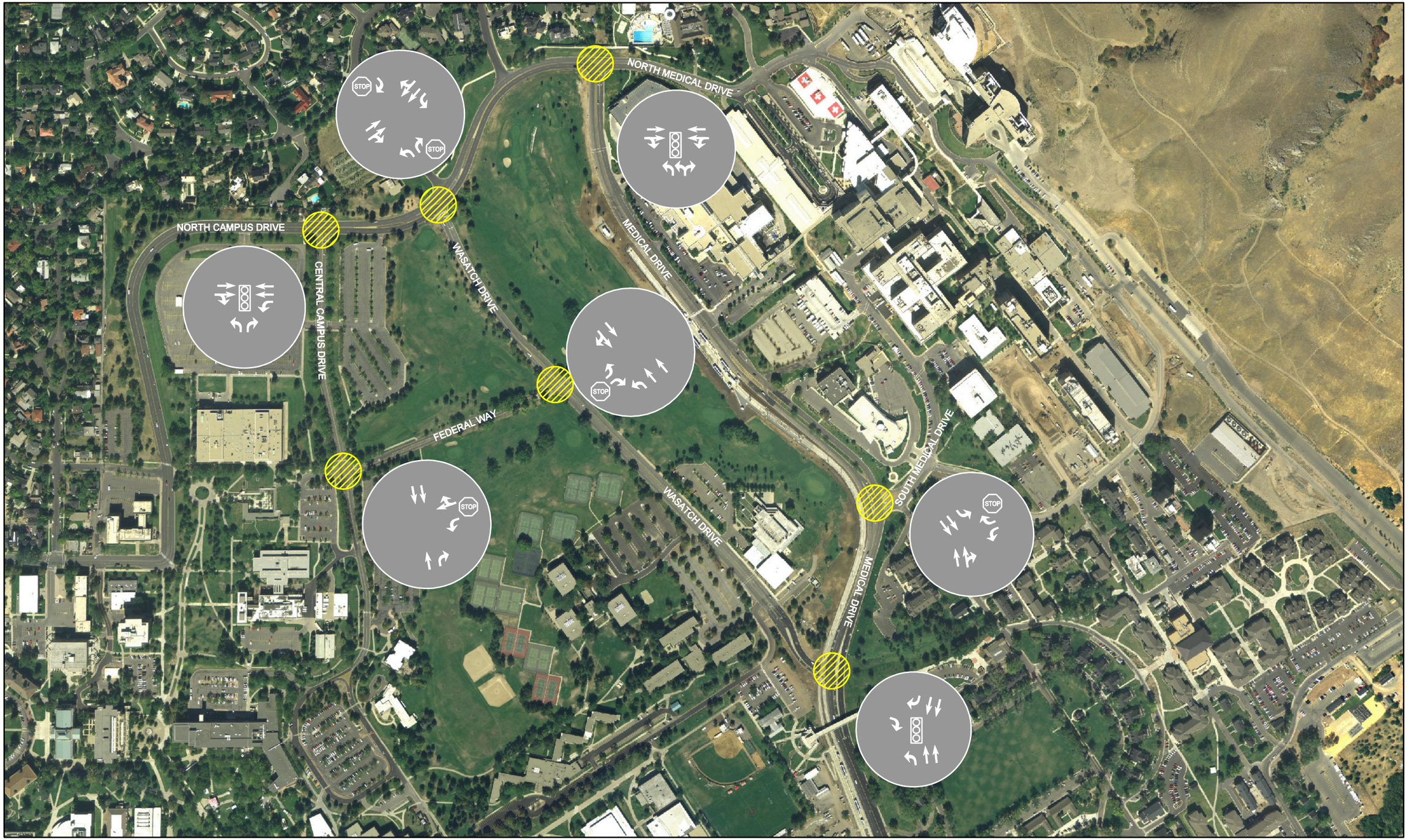

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FIGURE 2
EXISTING LANE CONFIGURATIONS AND TRAFFIC CONTROL DEVICES

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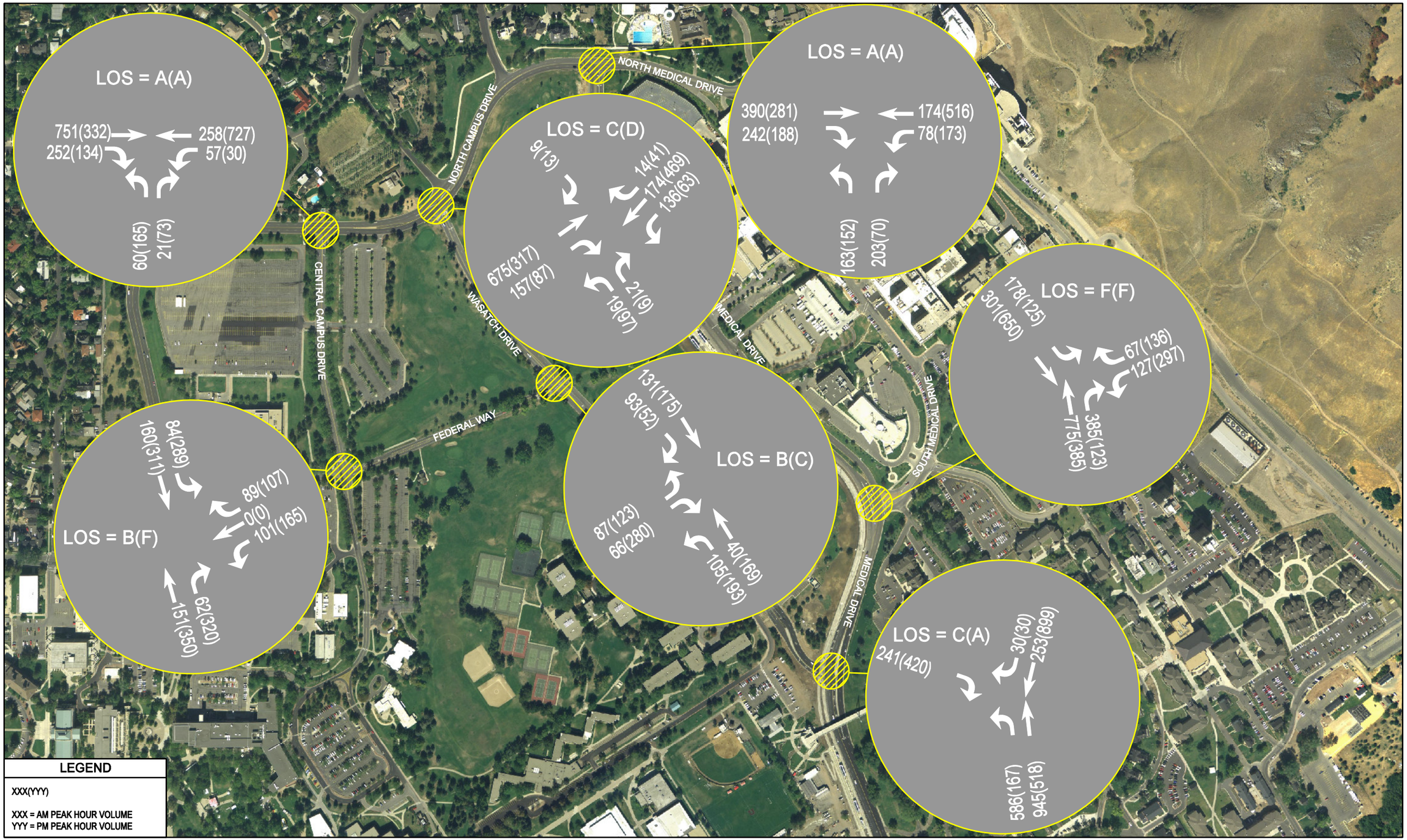

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FIGURE 3
2007 EXISTING PEAK HOUR TRAFFIC

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III. Traffic Analysis

In order to quantify the impact that the forecasted traffic could have on the adjacent roadways and intersections, an assessment and intersection analysis was performed for the existing conditions at each intersection. Intersection analyses were conducted in accordance with the 2000 Highway Capacity Manual guidelines using HCS+ capacity analysis software. Utilizing this method the intersections are given a level of service. Level of Service (LOS) is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or pedestrians. A Level of Service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. There are six levels of service describing these conditions, ranging from A to F, which have been standardized by the Transportation Research Board. LOS A represents a free-flowing traffic condition where motorists are affected very little by other motorists, there is a high degree of freedom to select desired speeds and the level of comfort and convenience to the motorist is excellent. LOS F is characterized by congested flow conditions with stoppages as the amount of traffic approaching a point exceeds the amount that can pass that point. Motorists have little if any freedom to choose speeds or lanes of travel, and experience discomfort, inconvenience, and delay. The various levels of service and associated delay relationships are summarized in Table 1.

TABLE 1 – INTERSECTION LOS-DELAY RELATIONSHIP

Level of Service	Unsignalized	Signalized
	Total Delay per Vehicle (sec)	Total Delay per Vehicle (sec)
A	< 10.0	< 10.0
B	> 10.0 < 15.0	> 10.0 < 20.0
C	> 15.0 < 25.0	> 20.0 < 35.0
D	> 25.0 < 35.0	> 35.0 < 55.0
E	> 35.0 < 50.0	> 55.0 < 80.0
F	> 50.0	> 80.0

The intersections included within the study area were analyzed for the existing conditions and were input into the HCS+ software for signal controlled intersections. The lane widths at each of the intersections were approximated at 12-feet. The results at each intersection for the existing conditions can be found in the appendix of this report and are also summarized and described in Table 2 as follows:

TABLE 2 - LOS AND DELAY, 2007 EXISTING CONDITION				
Intersection	**Traffic Control Device**	**Time of Day**	**Existing LOS**	**Delay**
Central Campus Dr & Federal Way	Stop Controlled	AM	B	12.1
		PM	F [1]	245.8
Medical Dr & North Medical Dr	Signal	AM	A	7.5
		PM	A	7.2
Medical Dr & South Medical Dr	Stop Controlled	AM	F [1]	532.1
		PM	F [1]	339.5
Medical Dr & Wasatch Dr	Signal	AM	C	22.4
		PM	A	10
North Campus Dr & Central Campus	Signal	AM	A	5.9
		PM	A	7
North Campus Dr & Wasatch Dr	Stop Controlled	AM	C	17
		PM	D	26.9
Wasatch Dr & Federal Way	Stop Controlled	AM	B	12
		PM	C	16

[1] WB left movement fails

This analysis shows that two intersections are currently operating in failing conditions. Excessive delays are expected at the intersections of Central Campus Drive and Federal Way and at Medical Drive and South Medical Drive. The analysis results at each intersection can also be found in the appendix of this report.

Background Traffic Conditions

In addition to the existing conditions, the projected traffic volumes within the study area were also considered for the year 2012 and 2030 assuming that the NBTRB is not built. These volumes represent the background traffic conditions of when the NBTRB might be completed and occupied (roughly five years) and a build-out condition of the study area assumed for twenty-two years from the opening day. The background traffic volumes serve as a baseline to compare the project generated traffic and horizon/build conditions against. A four percent annual growth rate, consistent with typical Wasatch Front Regional Council (WFRC) forecasts for the area, was applied to the existing traffic volumes within the study area in order to generate the 2012 and 2030 background traffic volumes. The projected background traffic volumes and LOS for the years 2012 and 2030 are shown in Figures 4 and 5, respectively.

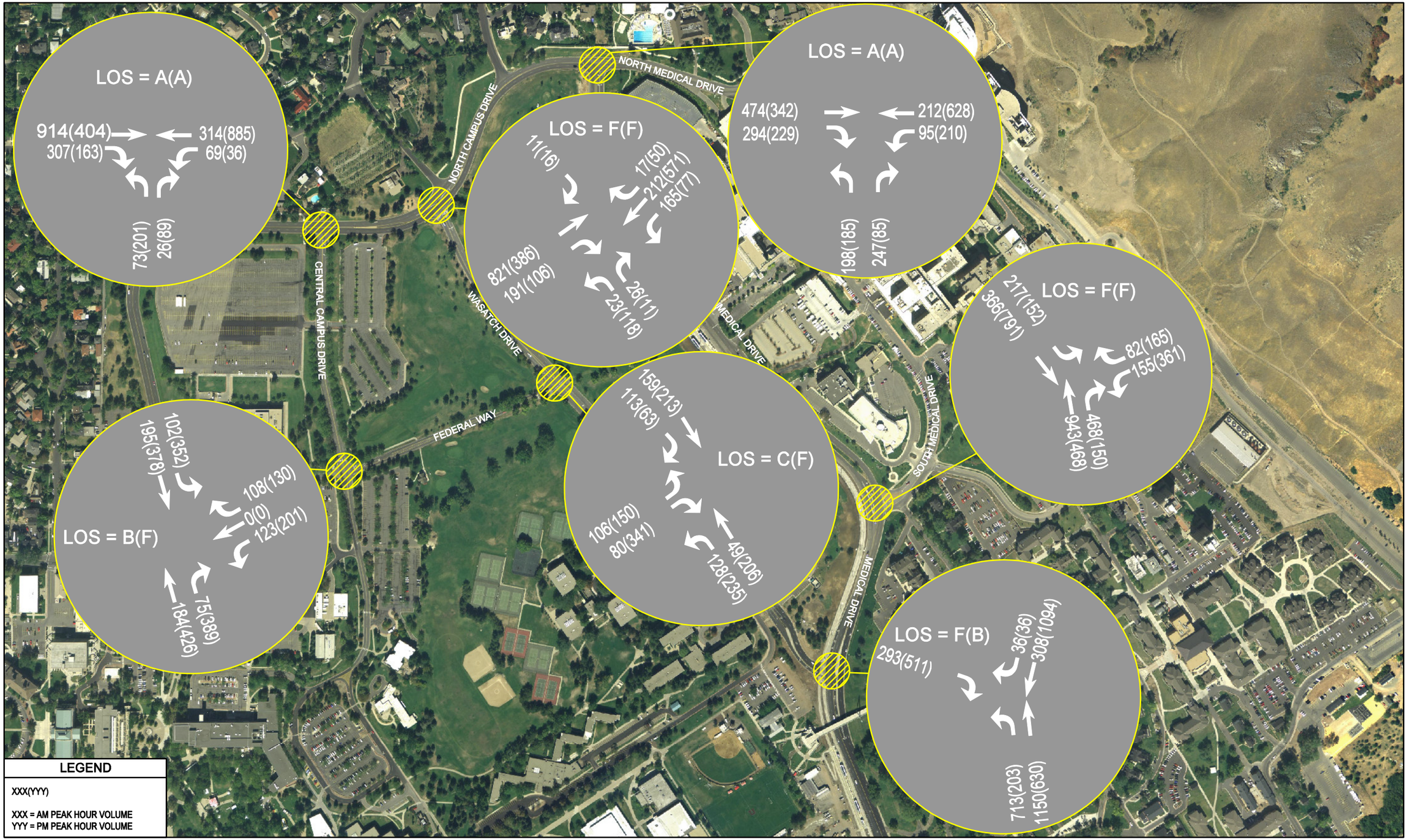

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FIGURE 4
2012 BACKGROUND PEAK HOUR TRAFFIC

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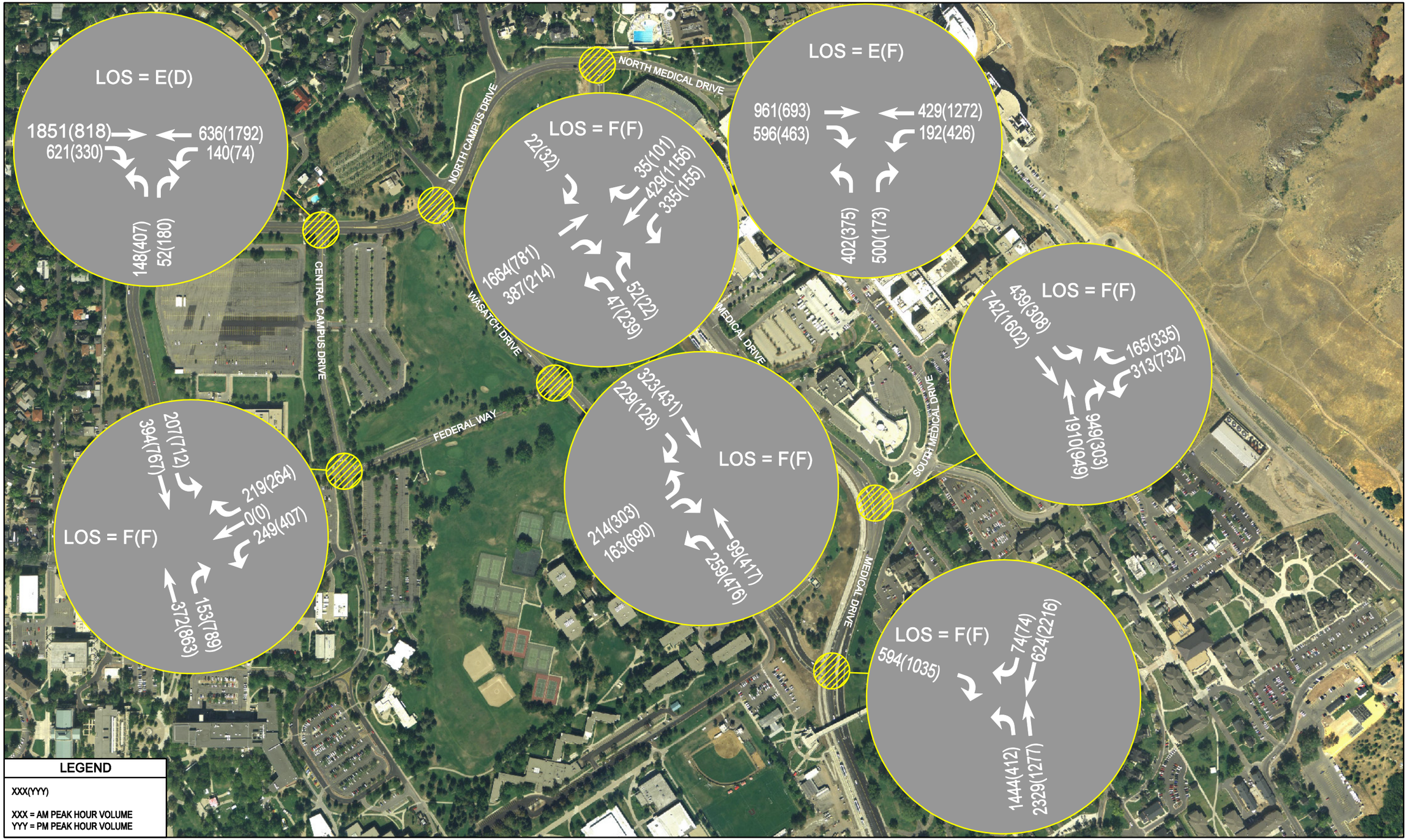

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FIGURE 5
2030 BACKGROUND PEAK HOUR TRAFFIC

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Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual, 7th Edition, *2003,* along with building utilization numbers and square footage as provided by the programming team, were utilized to project the trip generation that might be expected from the new NBTRB. The *ITE Trip Generation Manual* is a standard compilation of trip generation rates for different types of facilities during various time periods. In this report the following ITE land uses (L.U.) were used and cited: L.U. 760 for Research and Development, L.U. 610 for Hospital, and L.U. 550 for University/College. The trip generation rate for the various land uses can be determined either by gross square footage of the facilities or by the number of employees/students. In order to provide the most conservative forecast for the project generated traffic, trip generations were calculated for each of the land uses considering both square footage and user data as follows:

- **Estimated Gross Square Footage 250,000**
- User Estimate

Large Auditorium	150
Café/Lobby (extra people)	20
PI team (24PIx10 people/team)	240
Vivarium Core	4
Imaging Core	7
Microscopy Core	8
Nanofab Core	20
Front Offices/Building Offices	32
Total Estimated Number of Users	**481**

Copies of the land uses as seen in the ITE manual can be found in the appendix of this report. Appendix Table One summarizes the ITE trip projections based upon gross square footage. Appendix Table Two summarizes the ITE trip projections based upon number of employees/student. According to the trip generation calculations, the most conservative scenario is based upon L.U. 550 for University/College considering number of employees/students. Under these conditions it was determined that during the AM peak hour there would be approximately 344 vehicles entering the study area and 115 vehicles exiting. During the PM Peak Hour it was determined that there would be approximately 163 vehicles entering the study area and 380 vehicles exiting.

Trip Distribution

In order to allocate the project generated traffic to the study area, the major traffic corridors, availability of parking, and existing traffic patterns in the vicinity of the proposed NBTRB building were taken into consideration. Two options were considered for the 2012 and 2030 horizon years. Option 1 assumes that the existing road network remains intact. Option 2 examines the potential closure of Federal Way. By converting Federal Way to a non-motorized pedestrian friendly pathway, the travel patterns through this area of campus will be modified. Under these conditions and considering the general arrival and departure within the study area, it was determined that 65% of the trips would utilize Medical/Wasatch Drive, with the remaining 35% utilizing North Campus Drive. Figures 6 and 7 show the anticipated 2012 and 2030 horizon/build traffic volumes for Option 1. Figures 8 and 9 show expected traffic conditions within the study area for Option 2.

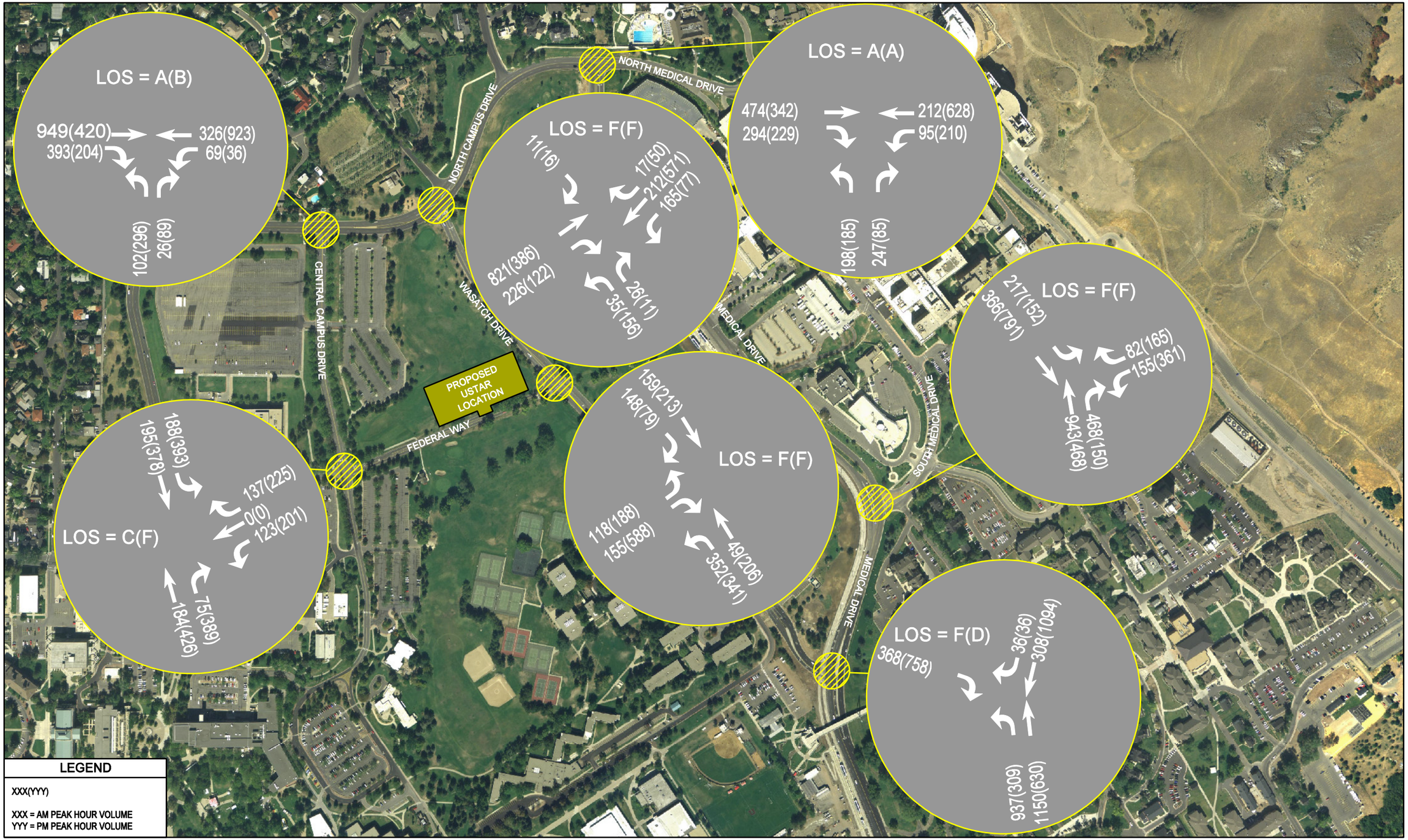

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FIGURE 6
2012 BUILD/HORIZON (OPTION 1) PEAK HOUR TRAFFIC

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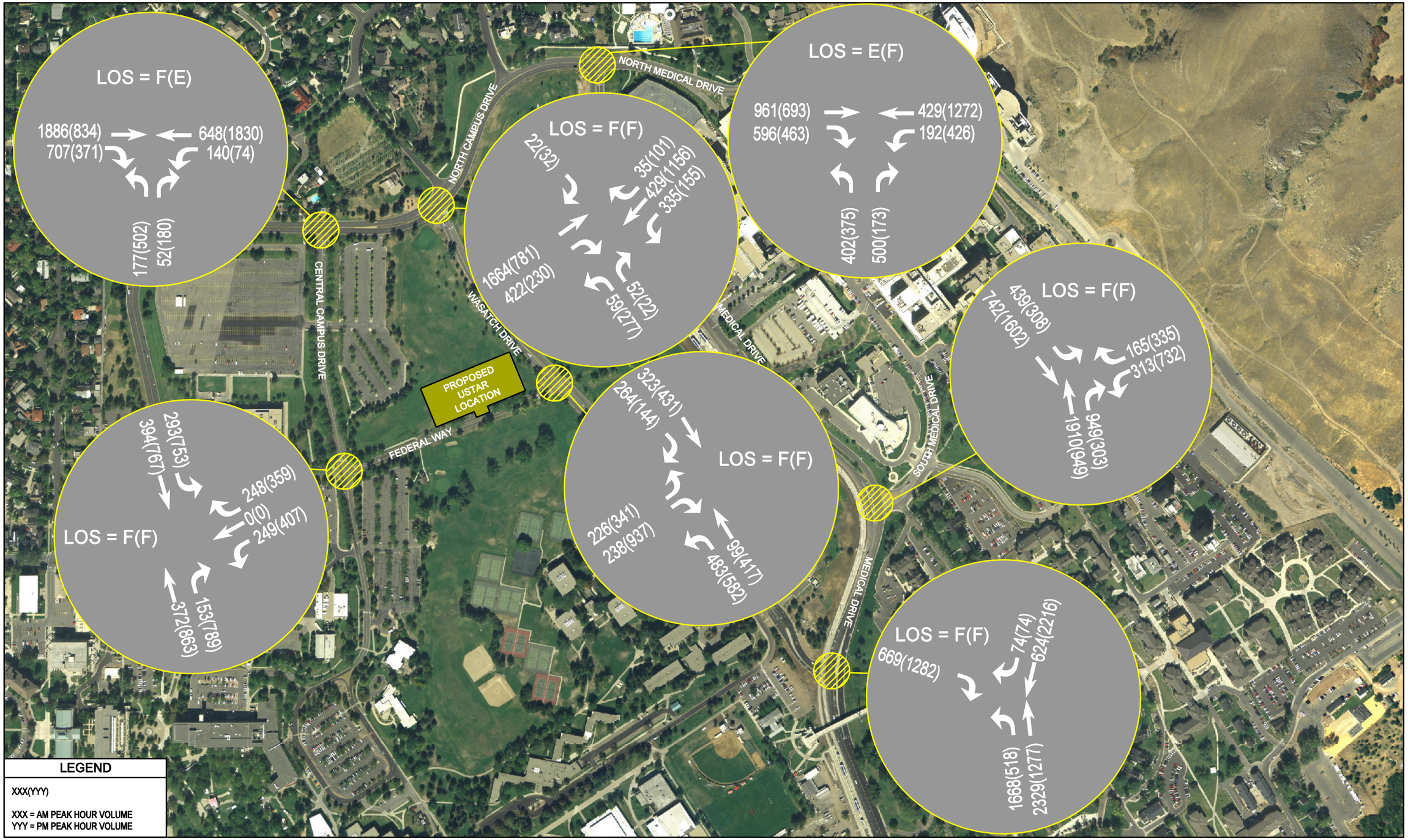

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FIGURE 7
2030 BUILD/HORIZON (OPTION 1) PEAK HOUR TRAFFIC

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SCALE IN FEET

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LEGEND

XXX(YYY)

XXX = AM PEAK HOUR VOLUME
YYY = PM PEAK HOUR VOLUME

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FIGURE 8
2012 BUILD/HORIZON (OPTION 2) PEAK HOUR TRAFFIC

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SCALE IN FEET

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FIGURE 9
2030 BUILD/HORIZON (OPTION 2) PEAK HOUR TRAFFIC

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IV. 2012 and 2030 Level of Service Traffic Summary

Following distribution of the forecasted traffic volumes and establishment of the 2012 and 2030 background and horizon/build conditions, the intersections were analyzed once again utilizing the 2000 Highway Capacity Manual guidelines and HCS+ software for both AM and PM peak hours. Tables 3 and 4 summarize the LOS and delay for the background conditions, and Tables 5 and 6 summarize the LOS and delay for the horizon/build conditions for Options 1 and 2. The analysis results at each intersection for the various conditions can also be found in the appendix of this report.

TABLE 3 - LOS AND DELAY, 2012 BACKGROUND CONDITION

Intersection	Traffic Control Device	Time of Day	LOS	Delay
Central Campus Dr & Federal Way	Stop Controlled	AM	B	13.9
		PM	F [1]	>600
Medical Dr & North Medical Dr	Signal	AM	A	8.7
		PM	A	8.9
Medical Dr & South Medical Dr	Stop Controlled	AM	F [1]	>600
		PM	F [1]	>600
Medical Dr & Wasatch Dr	Signal	AM	F [2]	118.8
		PM	B	19.1
North Campus Dr & Central Campus	Signal	AM	A	6.0
		PM	A	7.9
North Campus Dr & Wasatch Dr	Stop Controlled	AM	F [1]	51.1
		PM	F [1]	54.4
Wasatch Dr & Federal Way	Stop Controlled	AM	C	18.5
		PM	F [1]	170.8

[1] WB left movement fails

[2] NB thru movement fails

TABLE 4 - LOS AND DELAY, 2030 BACKGROUND CONDITION				
Intersection	**Traffic Control Device**	**Time of Day**	**LOS**	**Delay**
Central Campus Dr & Federal Way	Stop Controlled	AM	F [1]	220.1
		PM	F [2]	>600
Medical Dr & North Medical Dr	Signal	AM	E [1]	68.8
		PM	F [3]	212.9
Medical Dr & South Medical Dr	Stop Controlled	AM	F [2]	>600
		PM	F [3]	>600
Medical Dr & Wasatch Dr	Signal	AM	F [4]	562.2
		PM	F [5]	163.7
North Campus Dr & Central Campus	Signal	AM	E [6]	75.7
		PM	D	36.3
North Campus Dr & Wasatch Dr	Stop Controlled	AM	F [7]	>600
		PM	F [8]	>600
Wasatch Dr & Federal Way	Stop Controlled	AM	F [9]	223.5
		PM	F [6]	>600

[1] WB left movement fails

[2] All movements fail

[3] WB movements fail

[4] NB movements fail

[5] EB right and SB thru movements fail

[6] EB movements fail

[7] WB and NB left movements fail

[8] NB left movement fails

[9] EB left movement fails

The analysis of the 2012 and 2030 background conditions show a decline in the functionality of the study intersections. By 2030 all seven of the study intersections will have a LOS of F with the added traffic volume caused by growth.

TABLE 5 - LOS AND DELAY, 2012 BUILD CONDITIONS						
Intersection	**Traffic Control Device**	**Time of Day**	**Option 1**		**Option 2**	
			LOS	**Delay**	**LOS**	**Delay**
Central Campus Dr & Federal Way	Stop Controlled	AM	C	18.1	-	-
		PM	F [1]	>600	-	-
Medical Dr & North Medical Dr	Signal	AM	A	8.7	A	8.7
		PM	A	8.9	A	8.9
Medical Dr & South Medical Dr	Stop Controlled	AM	F [1]	>600	F [1]	>600
		PM	F [1]	>600	F [1]	>600
Medical Dr & Wasatch Dr	Signal	AM	F [2]	253.8	F [2]	247.2
		PM	D	38.4	F [5]	125.3
North Campus Dr & Central Campus	Signal	AM	A	6.6	E	74.3
		PM	B	10.1	F [6]	93.9
North Campus Dr & Wasatch Dr	Stop Controlled	AM	F [3]	82.4	F [3]	>600
		PM	F [3]	95.6	F [3]	>600
Wasatch Dr & Federal Way	Stop Controlled	AM	F [4]	52.1	-	-
		PM	F [4]	99.6	-	-

[1] WB left movement fails
[2] NB thru movement fails
[3] NB left movement fails
[4] EB left movement fails
[5] EB right movement fails
[6] WB left and NB right movements fails

In Option 1, analysis demonstrates that excessive delays (LOS of E or worse) will be experienced at all study intersections with the exception of Medical Drive and North Medical Drive, and North Campus Drive and Wasatch Drive. Option 2 eliminates the delays at Federal Way and improves the LOS of the Central Campus Drive and Wasatch Drive segments, but compounds the delay at other intersections.

TABLE 6 - LOS AND DELAY, 2030 BUILD CONDITIONS						
Intersection	Traffic Control Device	Time of Day	Option 1		Option 2	
			LOS	Delay	LOS	Delay
Central Campus Dr & Federal Way	Stop Controlled	AM	F [1]	420.8	-	-
		PM	F [2]	>600	-	-
Medical Dr & North Medical Dr	Signal	AM	E [1]	68.8	E [1]	68.8
		PM	F [3]	212.9	F [3]	212.9
Medical Dr & South Medical Dr	Stop Controlled	AM	F [2]	>600	F [2]	>600
		PM	F [3]	>600	F [3]	>600
Medical Dr & Wasatch Dr	Signal	AM	F [4]	566.1	F [4]	551.4
		PM	F [5]	213.5	F [5]	416.3
North Campus Dr & Central Campus	Signal	AM	F [6]	105.8	F [6]	406.5
		PM	E [3]	67.1	F [11]	195.6
North Campus Dr & Wasatch Dr	Stop Controlled	AM	F [7]	>600	F [12]	>600
		PM	F [8]	>600	F [8]	>600
Wasatch Dr & Federal Way	Stop Controlled	AM	F [9]	>600	-	-
		PM	F [10]	>600	-	-

[1] WB left movement fails
[2] All movements fail
[3] WB movements fail
[4] NB movements fail
[5] EB right and SB thru movements fail
[6] EB thru and WB left movements fail
[7] WB and NB left movements fail
[8] NB left movement fails
[9] EB left movement fails
[10] EB movements fail
[11] NB right and all WB movements fail
[12] WB and all NB movements fail

With current intersection geometry, all of the study intersections will experience a LOS of F in the 2030 build condition. Typically, modifications are recommended at intersections for a LOS of D or worse and along roadway segments for intersections at LOS E or worse. Tables 3 through 6 show the LOS for the intersections if their current geometry is maintained. Improvements to the intersections will increase capacity and improve LOS. Analysis of the roadway segments should also be conducted to determine the capacity of the connecting street segments.

V. 2012 Level of Service Traffic Summary with Improvements

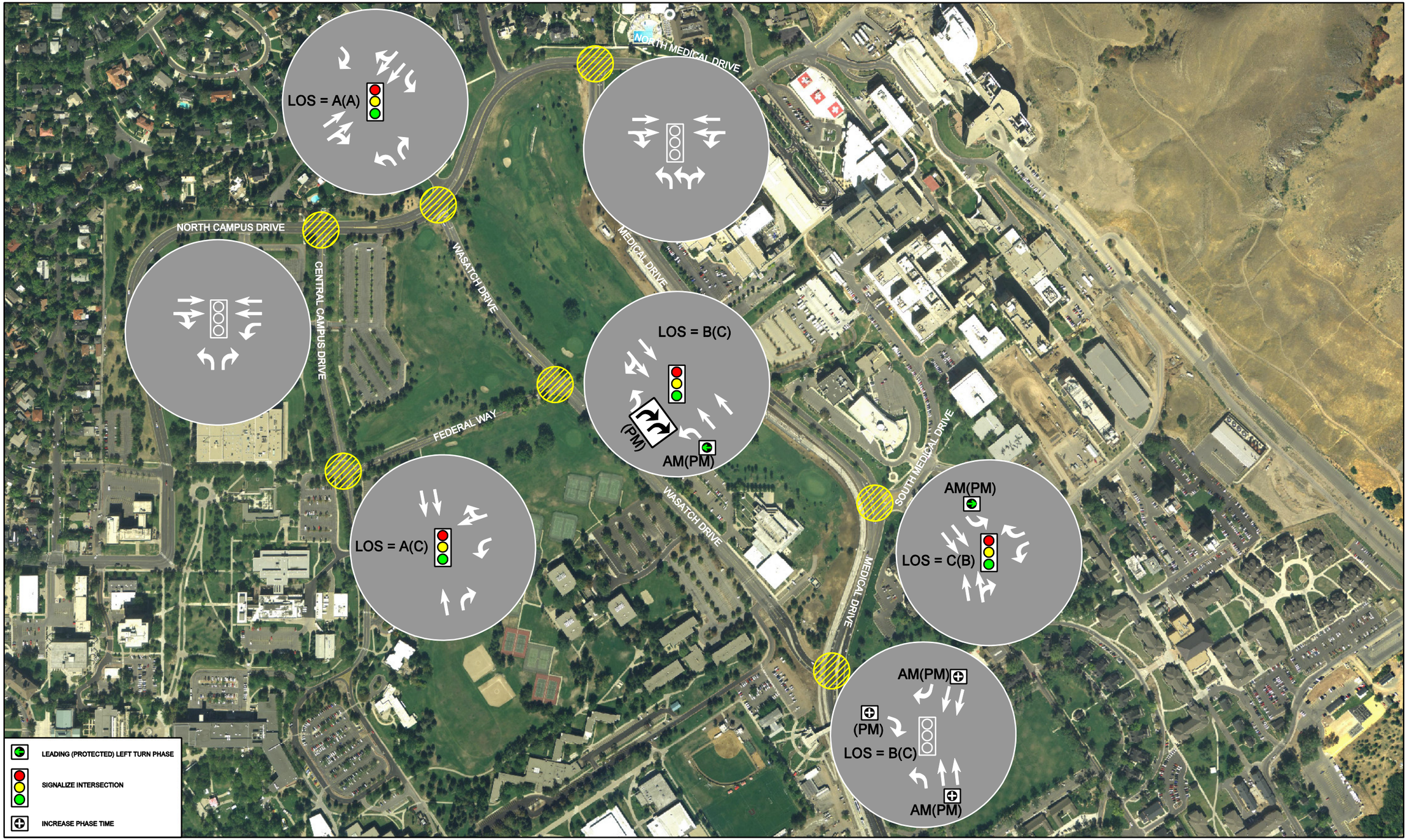
Considering the poor or failing LOS values in 2012 for the build conditions, PEC evaluated several spot improvement alternatives that might increase intersection performance, capacity, and safety. Table 7 is a summary of the Level of Service with the recommended improvements at five intersections for the 2012 Option 1 build condition. Table 8 is a summary of the Level of Service with the recommended improvements at four intersections for the 2012 Option 2 build condition. Due to constraints generated by light rail and existing structures, and to maintain and encourage alternative modes of transportation, no roadway widening is recommended at this time. The only minor roadway improvement that might be considered would be to realign Medical Drive with the T-intersection immediately to the west. Figures 10 and 11 illustrate the recommend geometric improvements and control upgrades at each intersection, along with the corresponding LOS under 2012 build conditions. Further traffic control changes will also improve the 2030 build conditions.

TABLE 7 - 2012 INTERSECTION LOS WITH IMPROVEMENTS (OPTION 1)

Intersection	AM with Improvements	PM with Improvements
Central Campus Dr & Federal Way	A - Signalize	C - Signalize
Medical Dr & South Medical Dr	C - Signalize. SB leading left.	B - Signalize. SB leading left.
Medical Dr & Wasatch Dr	B - Increase N/S green time.	C - Increase N/S and EB green time.
North Campus Dr and Wasatch Dr	A - Signalize	A - Signalize
Wasatch Dr & Federal Way	B - Signalize. NB leading left.	C - Signalize, NB leading left. Dual EB right turn lanes.

TABLE 8 - 2012 INTERSECTION LOS WITH IMPROVEMENTS (OPTION 2)		
Intersection	**AM with Improvements**	**PM with Improvements**
Medical Dr & South Medical Dr	C - Signalize. SB leading left.	B - Signalize. SB leading left.
Medical Dr & Wasatch Dr	B - Increase N/S green time.	C - Increase N/S and EB green time. Dual EB right turn lanes.
North Campus Dr & Central Campus Dr	B - WB leading left. NB right turn permitted on WB leading left phase.	C - WB leading left. Dual WB left turn lanes. NB right turn permitted on WB leading left phase.
North Campus Dr & Wasatch Dr	A - Signalize	D - Signalize. WB leading left.

The improvements proposed in Tables 7 and 8 were analyzed as isolated intersections only. Because the intersections are a part of a road network within the study area, the methods used to control traffic also need to be analyzed on a network basis. In some cases the improvements suggested may decrease the capacity of the larger network. Care should be taken to coordinate signal timing and consistency between intersections and any improvements should be coordinated with the campus wide master plan study currently being conducted.



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Salt Lake City, Utah 84112
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www.utah.edu

FIGURE 10
2012 INTERSECTION LOS WITH IMPROVEMENTS (OPTION 1)

400 0 400
SCALE IN FEET

N

U:\2007\UT 7003 USTAR Programming\D-swing\Figures\UT7003 Figure 10 2012 Intersection LOS with Improvements (Option 1).dgn
4/23/2007 5:53:53 PM

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www.utah.edu

FIGURE 11
2012 INTERSECTION LOS WITH IMPROVEMENTS (OPTION 2)

400 0 400
SCALE IN FEET

N

U:\2007\UT 7003 USTAR Programming\Drawings\Figures\UT7003 Figure 11 2012 Intersection LOS with Improvements (Option 2).dgn
5:51:34 PM
4/23/2007

VI. Parking

As described in the site analysis section of the programming document dated February 28, 2007, the area of site numbers 1 and 3 would encompass the study area for parking and traffic analysis. This study area would encompass, or would be adjacent to, five existing parking lot facilities that could be available for shared parking usage including lots 30, 32, 39, 24, and 25. In order to understand the current parking capacity within the adjacent facilities site visits and lot inventories were conducted on Monday April 9, 2007 at 10:30 AM and again on Thursday April 12, 2007. Figure 11 bellow illustrates the parking facilities available within and adjacent to the study area. Tables 7 and 8 summarize the parking conditions and usage observed and during the site visits.

FIGURE 12 – PARKING VICINITY MAP

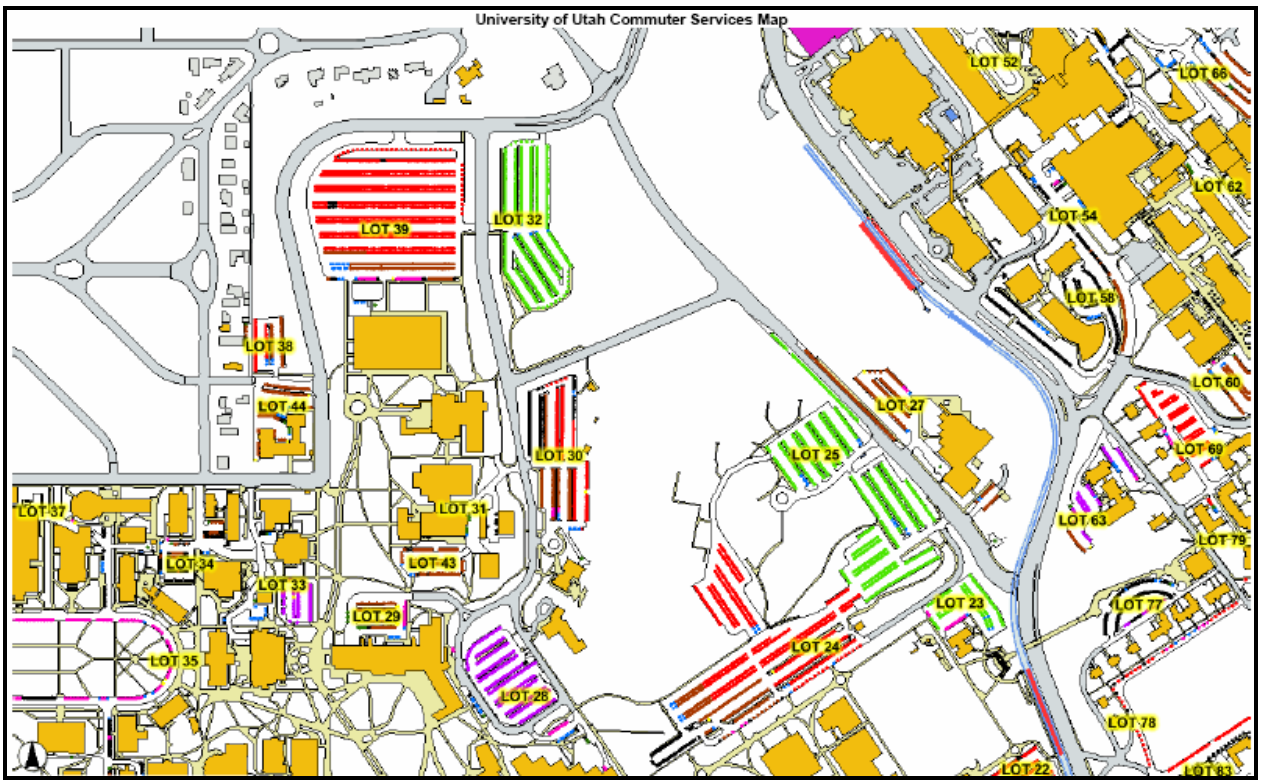


TABLE 9 – APRIL 9TH PARKING SUMMARY				
Lot Number	***Total Stalls Available***	***Vacant Stalls***	***Utilized Stalls***	***Lot Utilization***
Lot 30	371	47	324	87%
Lot 32	489	74	415	85%
Lot 39	1105	330	775	70%
Lot 24	1021	224	797	78%
Lot 25	425	150	275	65%

TABLE 10 – APRIL 12TH PARKING SUMMARY				
Lot Number	***Total Stalls Available***	***Vacant Stalls***	***Utilized Stalls***	***Lot Utilization***
Lot 30	371	43	328	88%
Lot 32	489	61	428	88%
Lot 39	1105	341	764	69%
Lot 24	1021	244	777	76%
Lot 25	425	201	224	53%

Typically parking facilities are design to accommodate the 85th percentile of the peak period demand. According to the collected data lot numbers 30 and 32 are heavily utilized and could not offer much, if any capacity, for shared parking usage with the proposed Neuroscience & Biomedical Technology Research Building. Additionally, the proximity of lots 24, 25, and 39 to the proposed building sites is not optimal and may not be desirable for shared parking as the stalls that are available are on the outside edges of the facilities to the northern and southern extremes.

In order to quantify the number of stalls that would be necessary for the new 250,000 square foot building, the *Institute of Transportation Engineers, Parking Generation Manual, 3rd Edition, 2004 was reviewed.* For the purposes of this report the ITE land uses (L.U.) applied and cited include University/College (550), Hospital (610), and Office Building (701). Copies of the land uses as seen in the ITE parking manual can be found in the appendix of this report. Due to the fact that no information was available for research facilities, and upon review of the selected land uses, L.U. 550 for University/College was selected as the most representative data point. This design criteria indicates an 85th percentile of 0.34 vehicles/stalls per population. Furthermore, the average parking supply ratio for building square footage is 1.2 spaces per 1,000 square feet. These conditions would recommend a minimum of 300 Stalls for the proposed Neuroscience & Biomedical Technology Research Building. It should also be noted

that according to ADA requirements, a 300 stall parking facility should have 7 stalls designated as accessible spaces.

TABLE 11 – ADA PARKING REQUIREMENTS	
Total Parking in Lot	**Required Minimum Number of Accessible Spaces**
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	2 percent of total
1001 and over	20, plus 1 for each 100 over 1000

VII. Conclusions and Recommendations

The proposed development is expected to have some impacts on specific intersections in the vicinity of the new NBTRB building. The minor intersection improvements stated below should mitigate the increases to delay and impacts to safety.

In summary the recommendations within the study area according to this analysis are as follows for Option 1 of the 2012 build condition:

- Future signalization at the intersections of Central Campus Drive and Federal Way and North Campus Drive and Wasatch.
- Signalize Medical Drive and South Medical Drive and add a southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At Medical Drive and Wasatch Drive, Increase north/south green time.

The following improvements are recommended for Option 2 of the 2012 build condition:

- Signalize Medical Drive and South Medical Drive and add a southbound (SB) leading left turn phase.
- Signalize Wasatch Drive and Federal Way and add a northbound (NB) leading left phase. For the afternoon peak hour condition, add dual eastbound (EB) right turn lanes.
- At North Campus Drive and Central Campus Drive, add a westbound (WB) left turn leading phase and permit northbound (NB) right turns during the WB leading phase.
- Signalize North Campus Drive and Wasatch Drive and add a westbound (WB) left turn leading phase during the afternoon peak condition.

Additionally, a new 300 stall parking facility should be added with the NBTRB project and should include at a minimum 7 stalls that are ADA compliant/accessible.

APPENDIX

APPENDIX TABLE ONE - TRIP GENERATION ESTIMATES

Type of Facility	Gross Square Footage	AM Peak Hour Trip Generation	PM Peak Hour Trip Generation	AM % Entering	AM % Exiting	PM % Entering	PM % Exiting	AM Peak Hour		PM Peak Hour	
								# Entering	# Exiting	# Entering	# Exiting
Research and Development Center (LU 760)	250,000	311	282	83%	17%	15%	85%	258	53	42	240
Hospital (LU 610)	250,000	411	442	63%	37%	38%	62%	259	152	168	274
University/College (LU 550)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX TABLE TWO - TRIP GENERATION ESTIMATES

Type of Facility	Employees	AM Peak Hour Trip Generation	PM Peak Hour Trip Generation	AM % Entering	AM % Exiting	PM % Entering	PM % Exiting	AM Peak Hour		PM Peak Hour	
								# Entering	# Exiting	# Entering	# Exiting
Research and Development Center (LU 760)	481	220	222	86%	14%	10%	90%	189	31	22	200
Hospital (LU 610)	481	225	271	65%	35%	37%	63%	146	79	100	170
University/College (LU 550)	481	459	543	75%	25%	30%	70%	344	115	163	380

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Central Campus Dr.*
E-W STREET: *Federal Way*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES: .

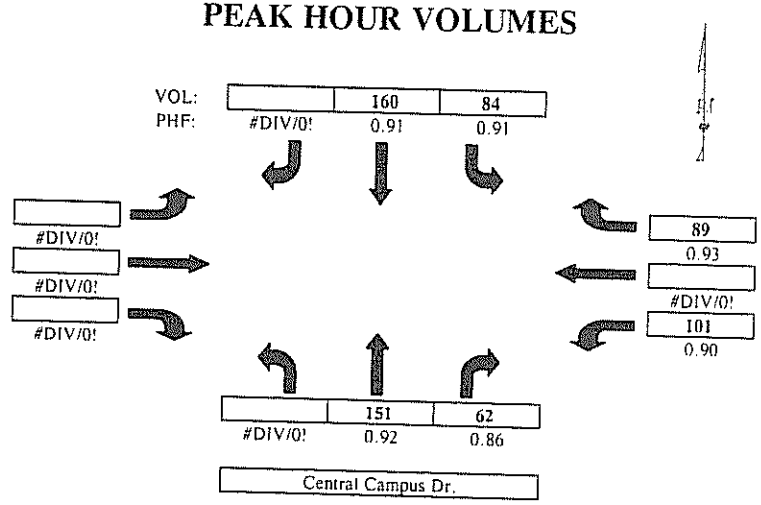
COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	647
PHF:	0.98
PEAK HOUR:	
FROM:	TO:
7:45 AM	8:45 AM

Federal Way

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM		20	7				9	27		12		18	93
7:15 AM	7:30 AM		26	14				7	31		13		22	113
7:30 AM	7:45 AM		32	19				18	30		17		15	131
7:45 AM	8:00 AM		35	14				23	39		28		24	163
8:00 AM	8:15 AM		38	15				19	39		25		22	158
8:15 AM	8:30 AM		37	15				20	44		26		23	165
8:30 AM	8:45 AM		41	18				22	38		22		20	161
8:45 AM	9:00 AM		39	15				19	37		19		19	148
Included HV (trucks + buses):		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!		#DIV/0!		

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM		113	54				57	127		70		79	500
7:15 AM	8:15 AM		131	62				67	139		83		83	565
7:30 AM	8:30 AM		142	63				80	152		96		84	617
7:45 AM	8:45 AM		151	62				84	160		101		89	647
8:00 AM	9:00 AM		155	63				80	158		92		84	632

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

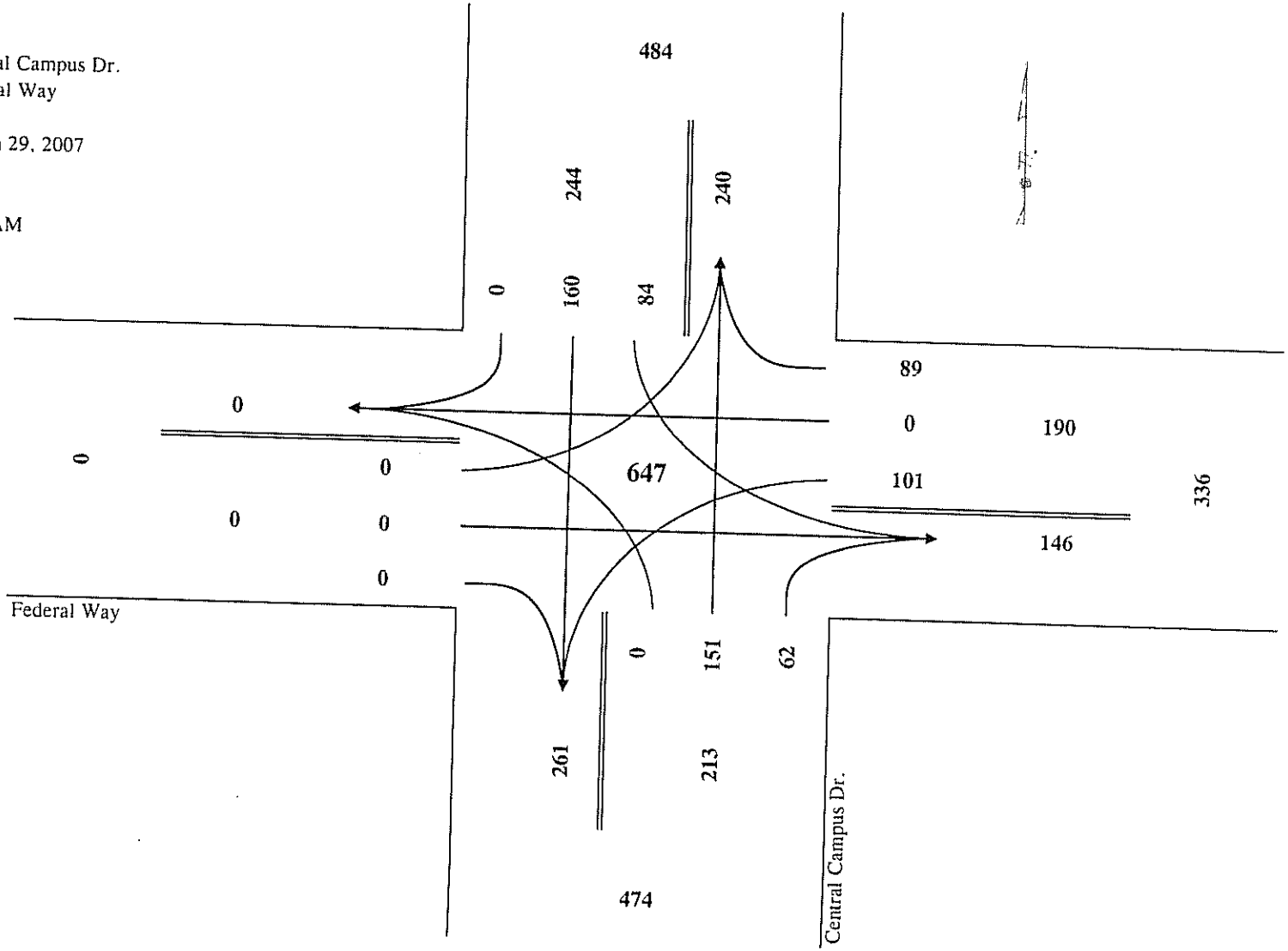
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Central Campus Dr.
E-W STREET: Federal Way

COUNT DATE: March 29, 2007

PEAK HOUR:
7:45 AM TO 8:45 AM

NOTES:



Central Campus and Federal Way.xls AM Diagram

4/12/2007 2:05 PM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Central Campus Dr.*
E-W STREET: *Federal Way*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

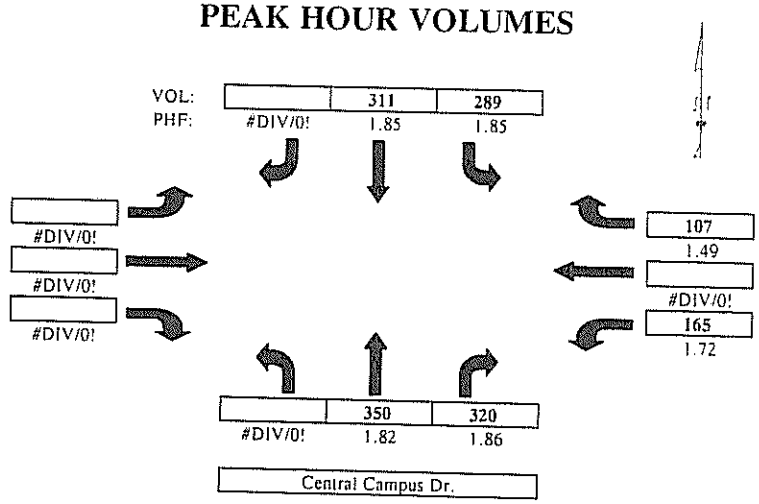
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME: 771
PHF: 0.97
PEAK HOUR:
FROM: TO:

Federal Way

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
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4:15 PM	4:30 PM		32	28				21	27		14		11	133
4:30 PM	4:45 PM		38	35				30	25		22		9	159
4:45 PM	5:00 PM		41	39				36	35		24		18	193
5:00 PM	5:15 PM		42	40				37	36		20		15	190
5:15 PM	5:30 PM		48	38				33	41		18		11	189
5:30 PM	5:45 PM		45	43				37	40		22		12	199
5:45 PM	6:00 PM		39	39				39	42		21		13	193
Included HV (trucks + buses):		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!		#DIV/0!		

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM		146	127				106	116		71		43	609
4:15 PM	5:15 PM		153	142				124	123		80		53	675
4:30 PM	5:30 PM		169	152				136	137		84		53	731
4:45 PM	5:45 PM		176	160				143	152		84		56	771
5:00 PM	6:00 PM		174	160				146	159		81		51	771

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

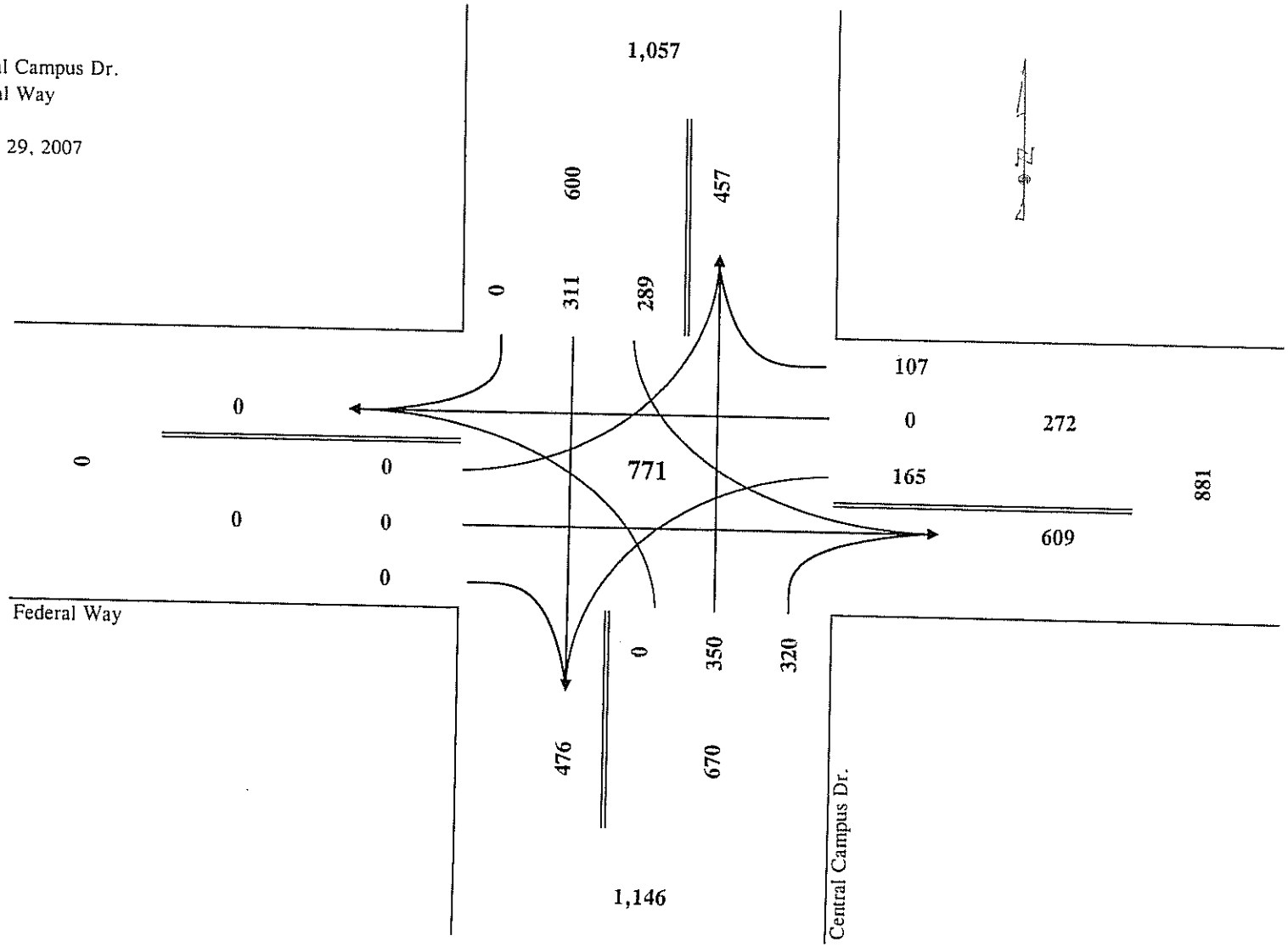
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Central Campus Dr.
E-W STREET: Federal Way

COUNT DATE: March 29, 2007

PEAK HOUR:

NOTES:



TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Wasatch Dr.*
E-W STREET: *Federal Way*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

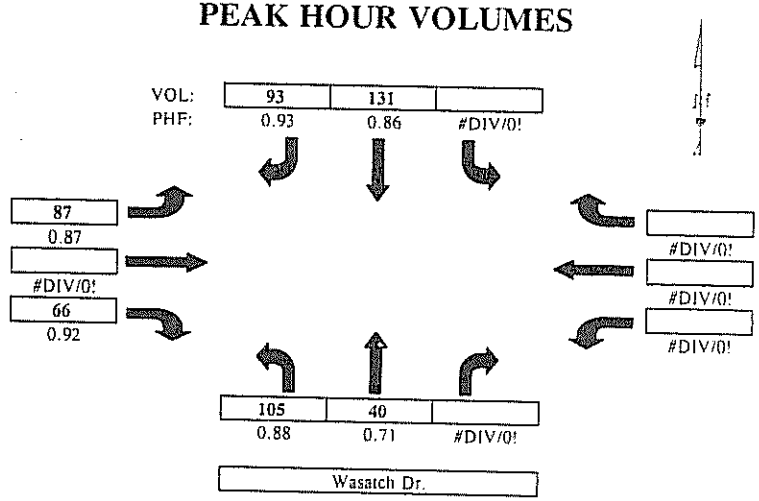
COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME: 522
PHF: 0.91
PEAK HOUR:
FROM: TO:
7:45 AM 8:45 AM

Federal Way

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM	11	1		10		7		16	18				63
7:15 AM	7:30 AM	14	8		13		14		20	22				91
7:30 AM	7:45 AM	18	8		19		20		21	15				101
7:45 AM	8:00 AM	30	14		25		16		35	24				144
8:00 AM	8:15 AM	27	7		20		17		38	24				133
8:15 AM	8:30 AM	26	10		18		15		31	25				125
8:30 AM	8:45 AM	22	9		24		18		27	20				120
8:45 AM	9:00 AM	19	12		20		15		28	19				113
Included HV (trucks + buses):				#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM	73	31		67		57		92	79				399
7:15 AM	8:15 AM	89	37		77		67		114	85				469
7:30 AM	8:30 AM	101	39		82		68		125	88				503
7:45 AM	8:45 AM	105	40		87		66		131	93				522
8:00 AM	9:00 AM	94	38		82		65		124	88				491

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

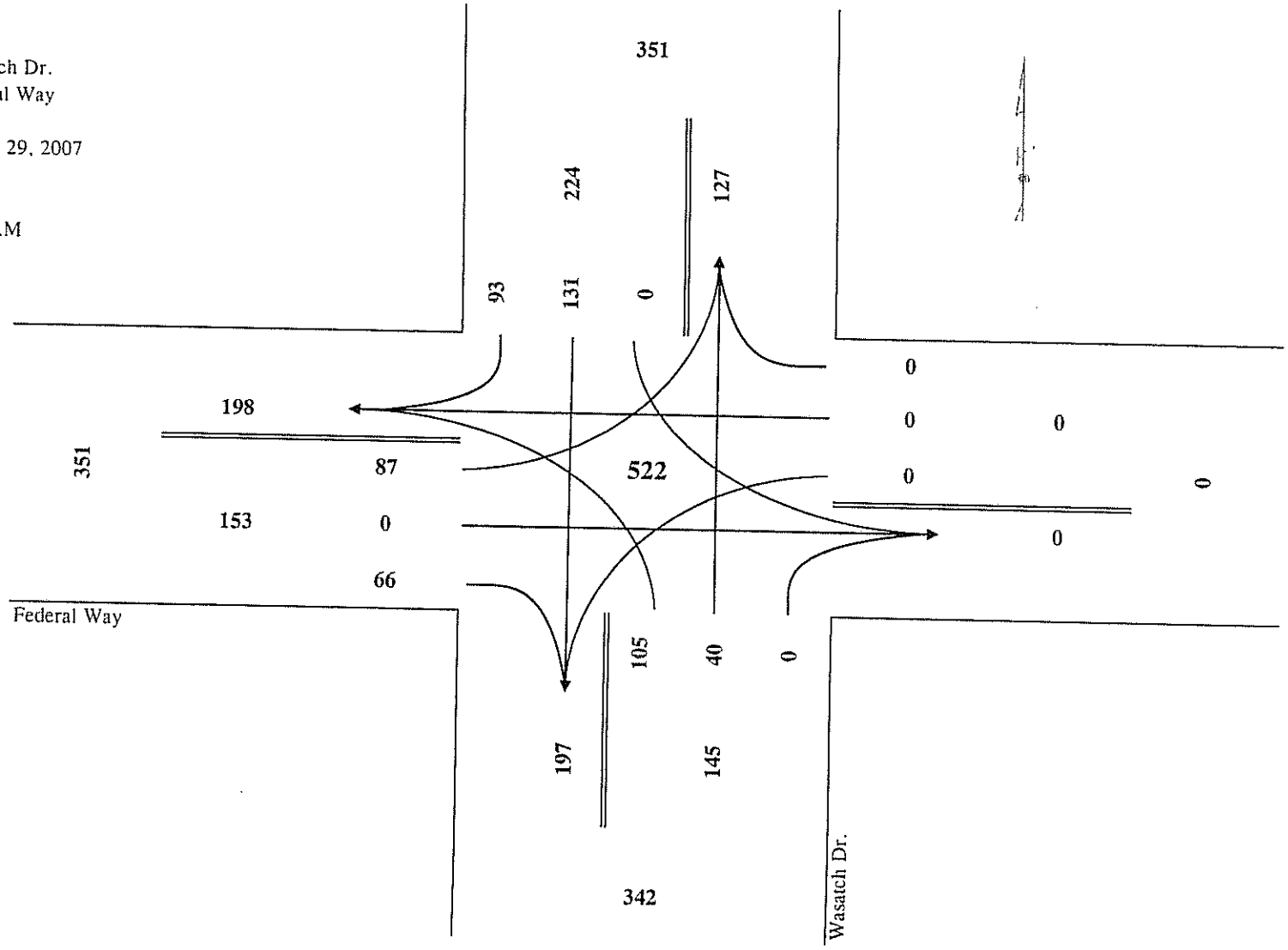
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Wasatch Dr.
E-W STREET: Federal Way

COUNT DATE: March 29, 2007

PEAK HOUR:
7:45 AM TO 8:45 AM

NOTES:



Wasatch and Federal Way.xls AM Diagram

4/12/2007 3:34 PM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Wasatch Dr.*
E-W STREET: *Federal Way*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

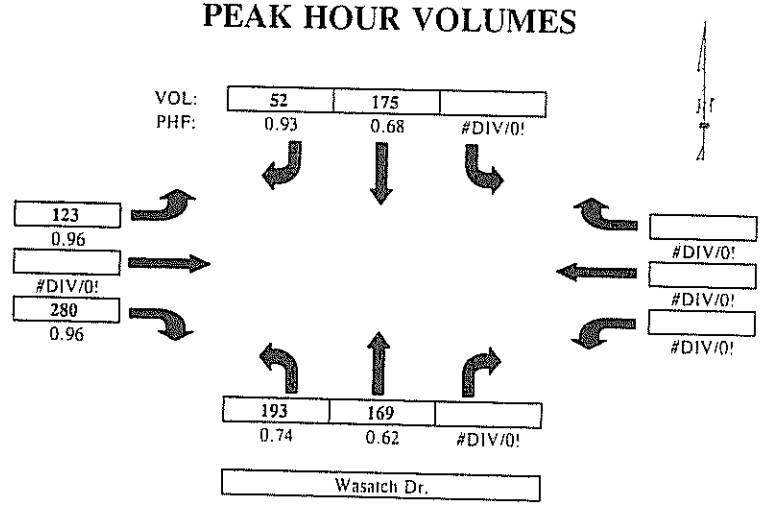
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	992
PHF:	0.86
PEAK HOUR:	
FROM:	TO:
4:45 PM	5:45 PM

Federal Way

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM	37	21		22		55		24	12				171
4:15 PM	4:30 PM	50	34		26		58		32	12				212
4:30 PM	4:45 PM	44	27		29		65		27	11				203
4:45 PM	5:00 PM	45	38		30		69		42	13				237
5:00 PM	5:15 PM	43	68		31		70		64	14				290
5:15 PM	5:30 PM	40	36		30		68		32	13				219
5:30 PM	5:45 PM	65	27		32		73		37	12				246
5:45 PM	6:00 PM	50	23		29		69		31	3				205
Included HV (trucks + buses):				#DIV/0!		#DIV/0!		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM	176	120		107		247		125	48				823
4:15 PM	5:15 PM	182	167		116		262		165	50				942
4:30 PM	5:30 PM	172	169		120		272		165	51				949
4:45 PM	5:45 PM	193	169		123		280		175	52				992
5:00 PM	6:00 PM	198	154		122		280		164	42				960

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

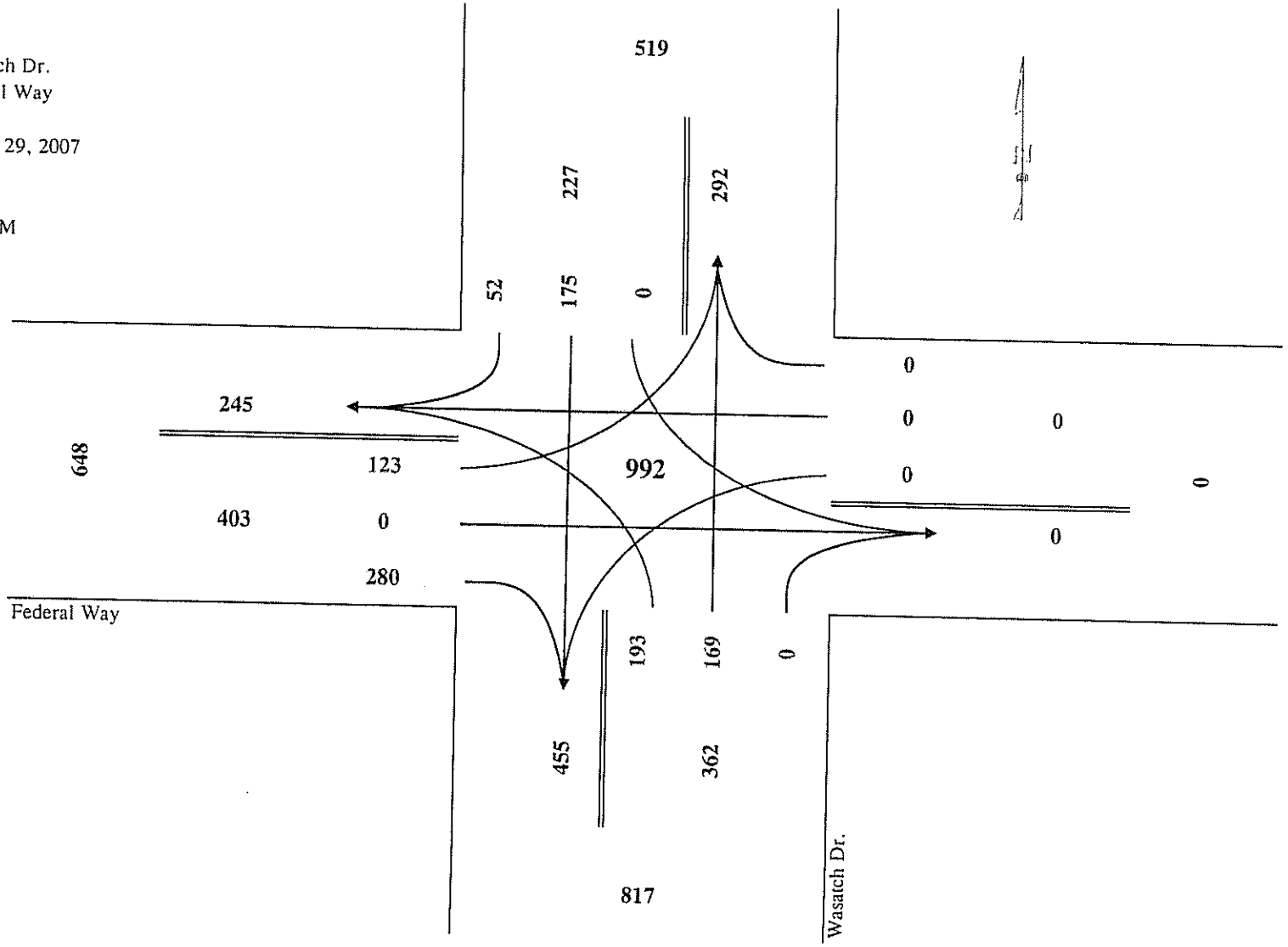
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Wasatch Dr.
E-W STREET: Federal Way

COUNT DATE: March 29, 2007

PEAK HOUR:
4:45 PM TO 5:45 PM

NOTES:



Wasatch and Federal Way.xls PM Diagram

4/12/2007 3:34 PM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Medical Dr.*
E-W STREET: *North Campus Dr.*

PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES:

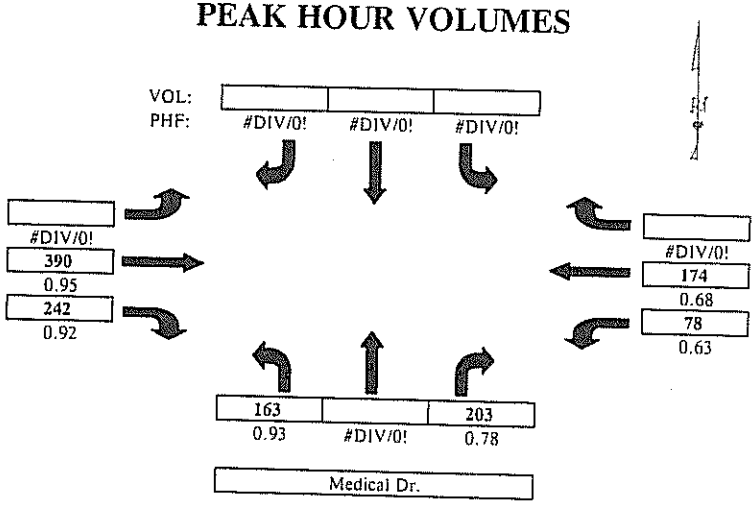
COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,250
PHF:	0.94
PEAK HOUR:	
FROM:	TO:
8:00 AM	9:00 AM

North Campus Dr.

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM	11		10		105	60				26	89		301
7:15 AM	7:30 AM	16		19		112	45				13	77		282
7:30 AM	7:45 AM	14		29		103	44				9	61		260
7:45 AM	8:00 AM	32		23		95	54				26	71		301
8:00 AM	8:15 AM	38		35		103	51				12	64		303
8:15 AM	8:30 AM	40		45		102	65				15	30		297
8:30 AM	8:45 AM	44		58		95	66				20	35		318
8:45 AM	9:00 AM	41		65		90	60				31	45		332
Included HV (trucks + buses):		#DIV/0!			#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM	73		81		415	203				74	298		1,144
7:15 AM	8:15 AM	100		106		413	194				60	273		1,146
7:30 AM	8:30 AM	124		132		403	214				62	226		1,161
7:45 AM	8:45 AM	154		161		395	236				73	200		1,219
8:00 AM	9:00 AM	163		203		390	242				78	174		1,250

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

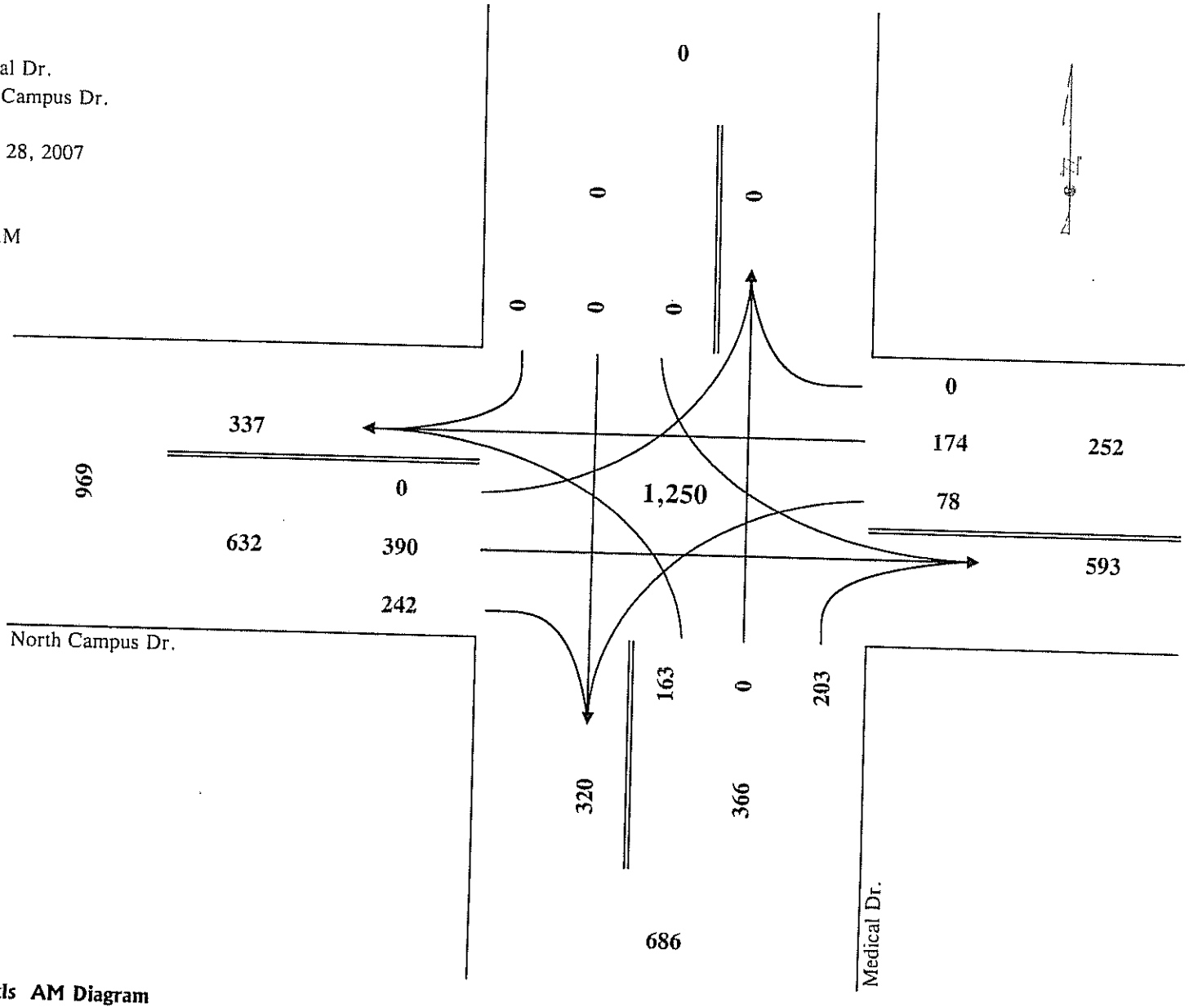
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Medical Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 28, 2007

PEAK HOUR:
8:00 AM TO 9:00 AM

NOTES:



Medical and North Campus Dr.xls AM Diagram

4/12/2007 1:27 PM

845

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Medical Dr.*
E-W STREET: *North Campus Dr.*

PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES: .

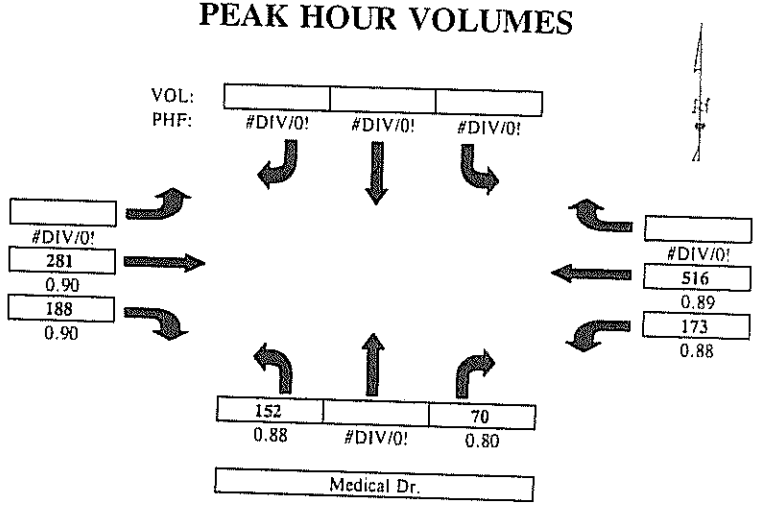
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,380
PHF:	0.94
PEAK HOUR:	
FROM:	TO:
4:00 PM	5:00 PM

North Campus Dr.

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM	39		18		74	52				47	130		360
4:15 PM	4:30 PM	28		22		78	49				45	116		338
4:30 PM	12:00 AM	42		18		60	37				32	125		314
4:45 PM	5:00 PM	43		12		69	50				49	145		368
5:00 PM	5:15 PM	27		19		66	32				35	133		312
5:15 PM	5:30 PM	20		23		54	46				47	118		308
5:30 PM	5:45 PM	22		8		70	42				36	131		309
5:45 PM	6:00 PM	20		15		52	38				32	109		266
Included HV (trucks + buses):			#DIV/0!		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM	152		70		281	188				173	516		1,380
4:15 PM	5:15 PM	140		71		273	168				161	519		1,332
4:30 PM	5:30 PM	132		72		249	165				163	521		1,302
4:45 PM	5:45 PM	112		62		259	170				167	527		1,297
5:00 PM	6:00 PM	89		65		242	158				150	491		1,195

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

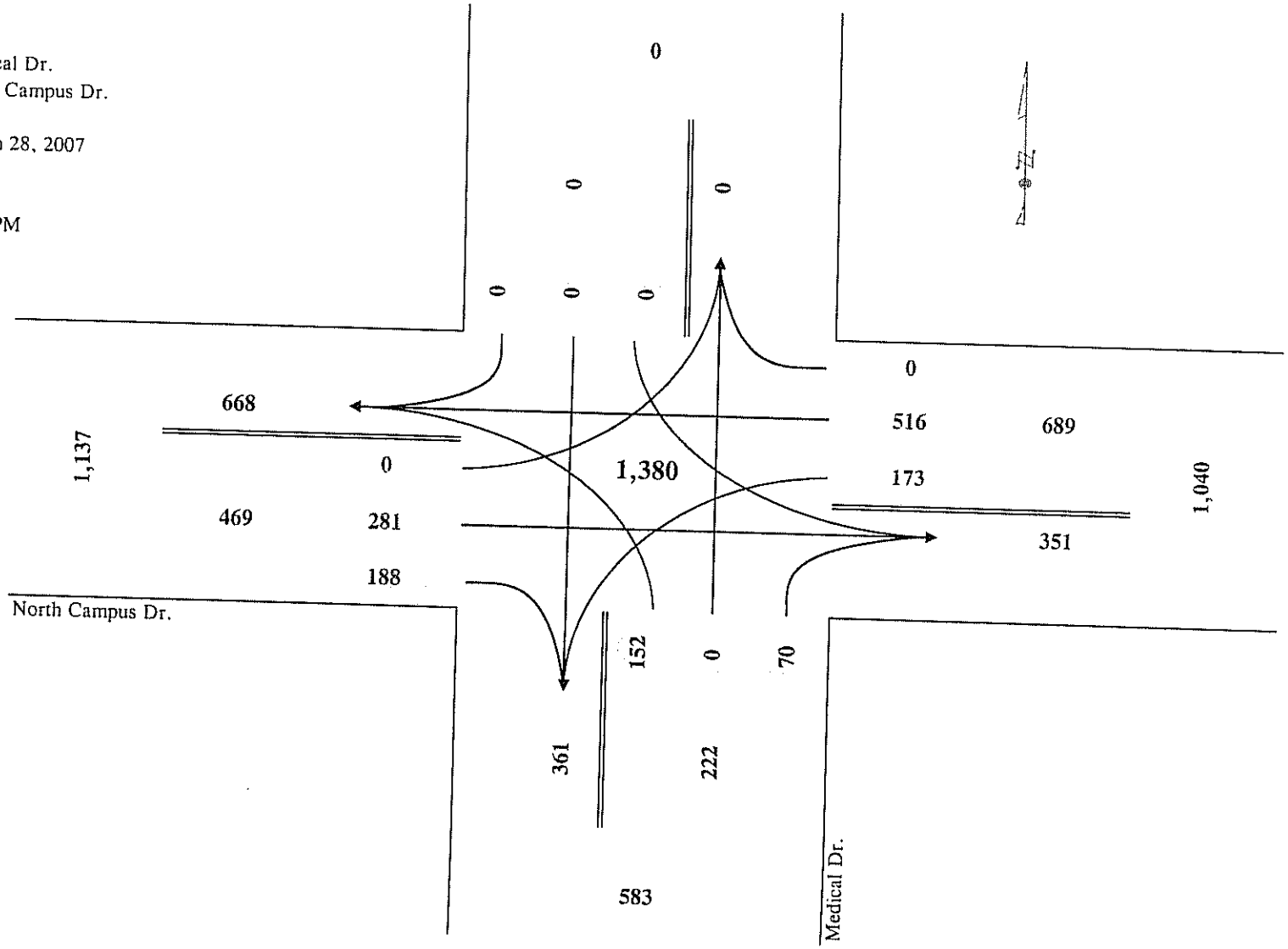
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Medical Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 28, 2007

PEAK HOUR:
4:00 PM TO 5:00 PM

NOTES:



Medical and North Campus Dr.xls PM Diagram

4/12/2007 1:27 PM

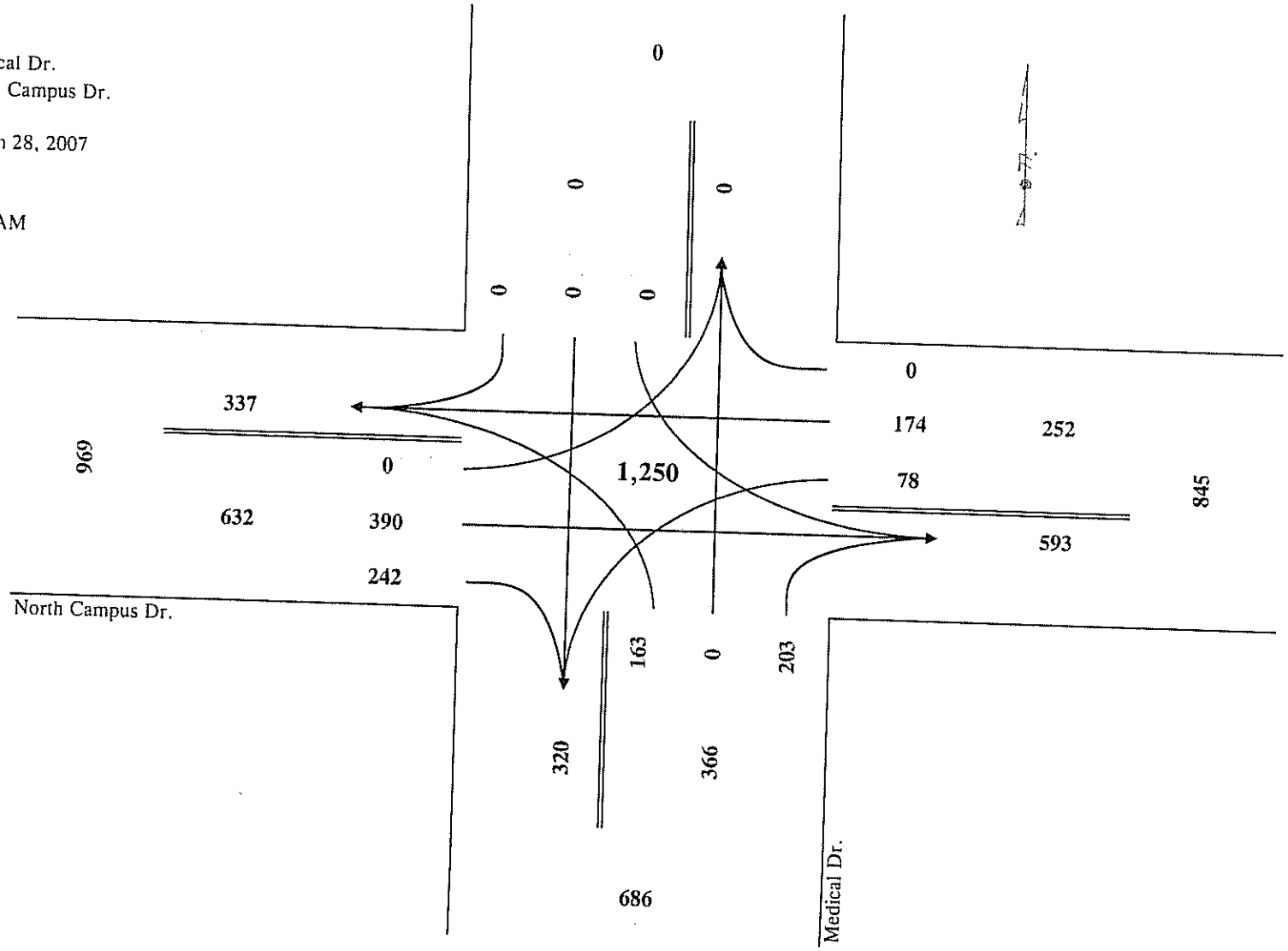
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Medical Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 28, 2007

PEAK HOUR:
8:00 AM TO 9:00 AM

NOTES:



Medical and North Campus Dr.xls AM Diagram

4/12/2007 1:27 PM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Medical Drive*
E-W STREET: *South Medical Drive*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES: .

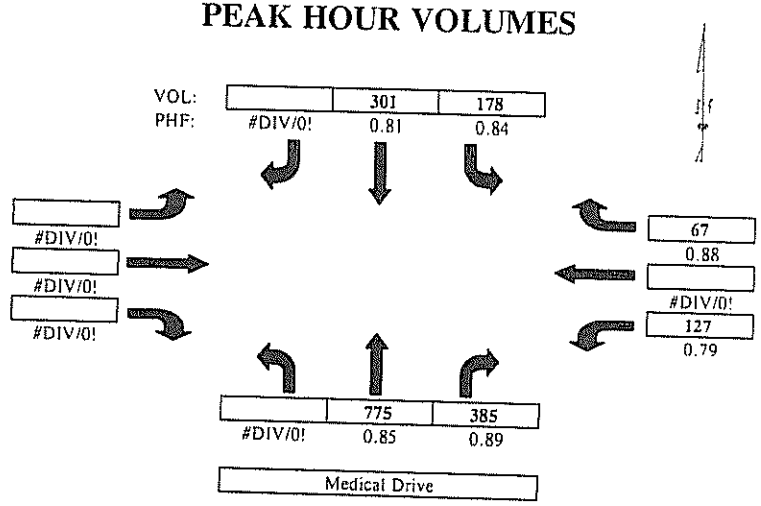
COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,833
PHF:	0.94
PEAK HOUR:	
FROM:	TO:
7:30 AM	8:30 AM

South Medical Drive

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM		110	76				39	50		39		15	329
7:15 AM	7:30 AM		140	85				28	75		25		12	365
7:30 AM	7:45 AM		151	91				36	90		31		13	412
7:45 AM	8:00 AM		182	101				49	93		28		19	472
8:00 AM	8:15 AM		214	108				53	66		28		17	486
8:15 AM	8:30 AM		228	85				40	52		40		18	463
8:30 AM	8:45 AM		194	62				41	48		45		20	410
8:45 AM	9:00 AM		180	72				42	64		40		31	429
Included HV (trucks + buses):		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!			#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM		583	353				152	308		123		59	1,578
7:15 AM	8:15 AM		687	385				166	324		112		61	1,735
7:30 AM	8:30 AM		775	385				178	301		127		67	1,833
7:45 AM	8:45 AM		818	356				183	259		141		74	1,831
8:00 AM	9:00 AM		816	327				176	230		153		86	1,788

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

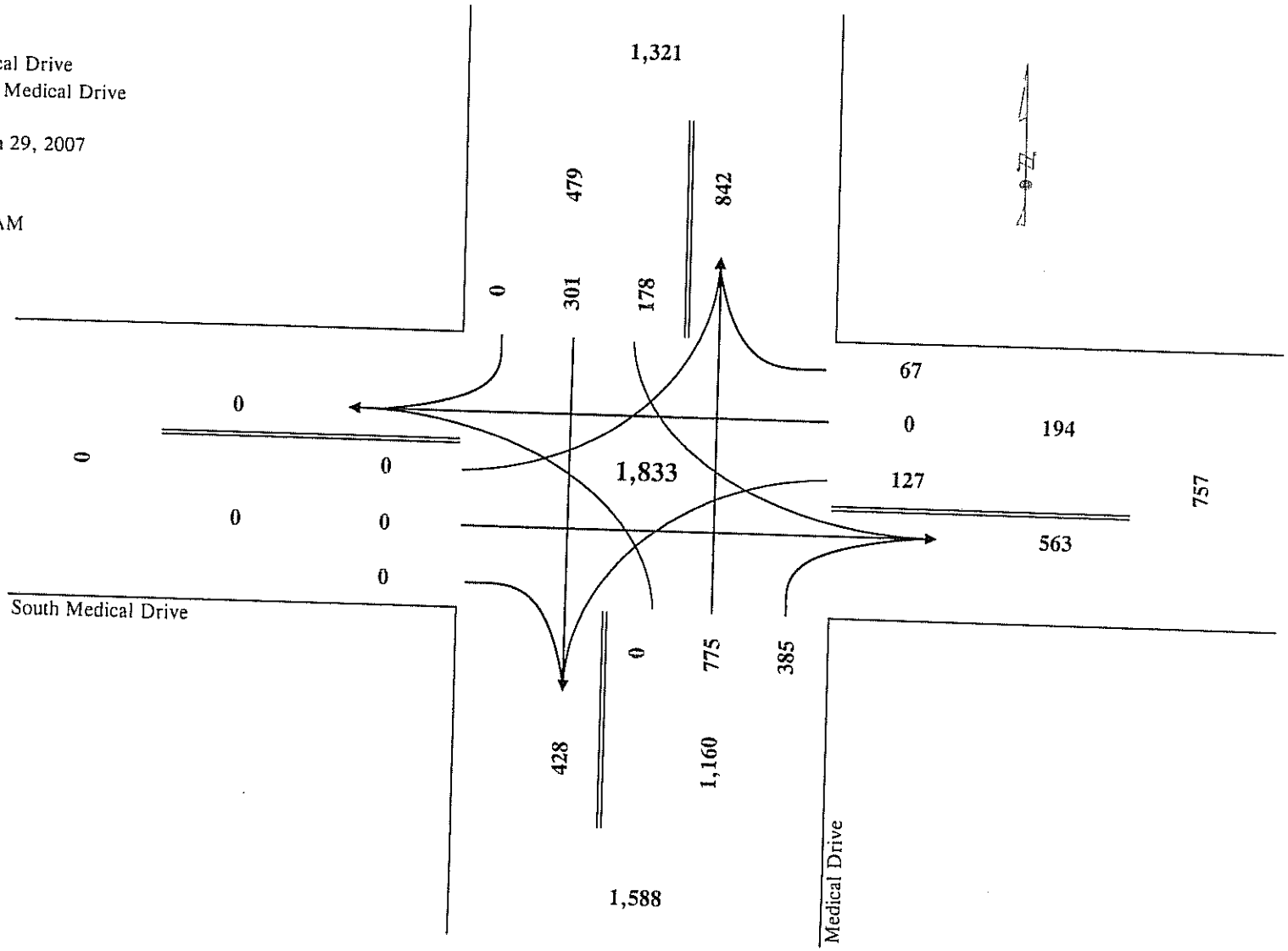
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Medical Drive
E-W STREET: South Medical Drive

COUNT DATE: March 29, 2007

PEAK HOUR:
7:30 AM TO 8:30 AM

NOTES:



Medical Drive and South Medical Drive.xls AM Diagram

4/12/2007 11:27 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Medical Drive*
E-W STREET: *South Medical Drive*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

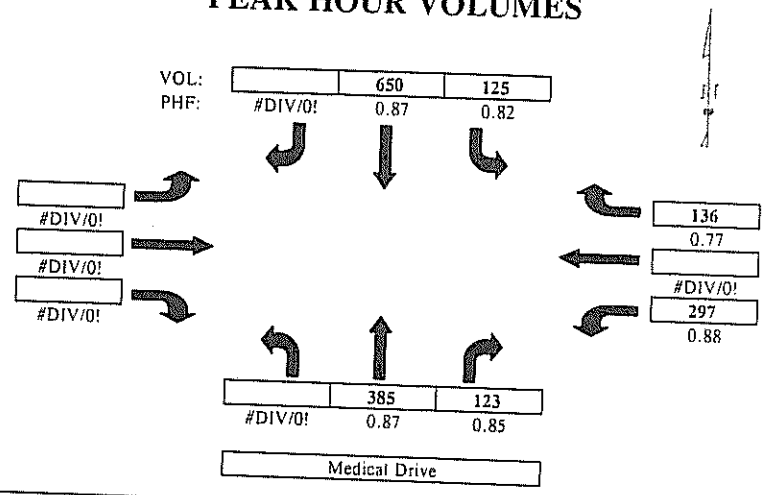
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,716
PHF:	0.92
PEAK HOUR:	
FROM:	TO:
4:30 PM	5:30 PM

South Medical Drive

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM		85	31				32	126		93		35	402
4:15 PM	4:30 PM		86	29				18	166		79		30	
4:30 PM	4:45 PM		92	29				22	158		84		33	418
4:45 PM	5:00 PM		111	30				34	150		63		29	417
5:00 PM	5:15 PM		85	36				38	155		70		30	414
5:15 PM	5:30 PM		97	28				31	187		80		44	467
5:30 PM	5:45 PM		87	40				41	148		60		36	412
5:45 PM	6:00 PM		93	42				37	123		66		35	396
Included HV (trucks + buses):		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!			#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM		374	119				106	600		319		127	1,645
4:15 PM	5:15 PM		374	124				112	629		296		122	1,657
4:30 PM	5:30 PM		385	123				125	650		297		136	1,716
4:45 PM	5:45 PM		380	134				144	640		273		139	1,710
5:00 PM	6:00 PM		362	146				147	613		276		145	1,689

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

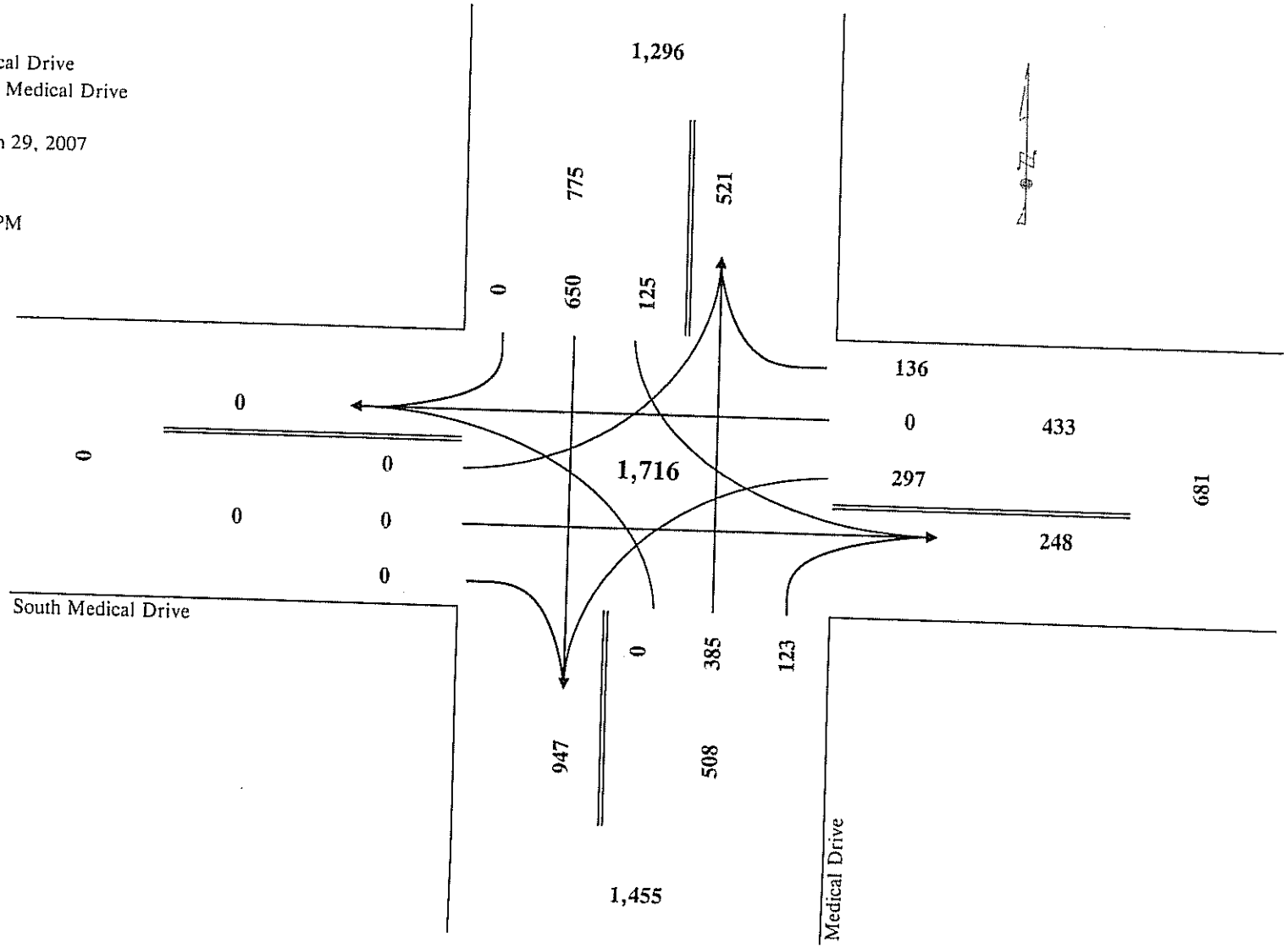
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Medical Drive
E-W STREET: South Medical Drive

COUNT DATE: March 29, 2007

PEAK HOUR:
4:30 PM TO 5:30 PM

NOTES:



Medical Drive and South Medical Drive.xls PM Diagram

4/12/2007 11:27 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Central Campus Dr.*
E-W STREET: *North Campus Dr.*

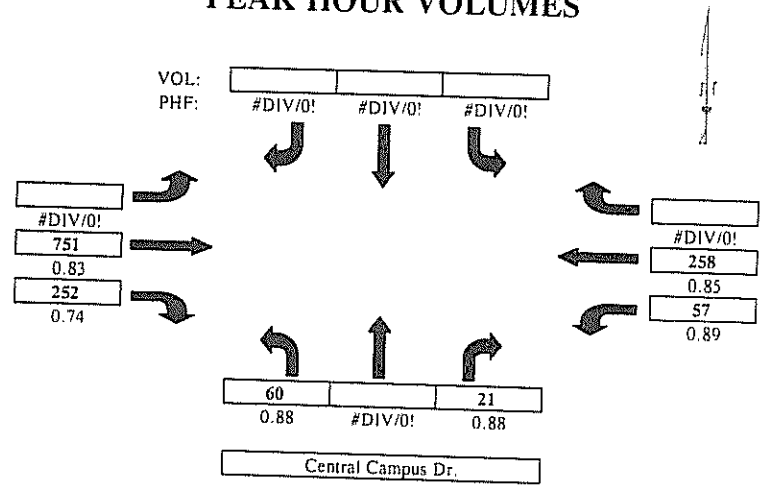
PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES: .

COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME: 1,399
PHF: 0.84
PEAK HOUR:
FROM: 7:45 AM TO: 8:45 AM

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM	4		5		148	33				4	61		255
7:15 AM	7:30 AM	6		3		151	21				6	50		237
7:30 AM	7:45 AM	8		4		160	43				6	65		286
7:45 AM	8:00 AM	12		6		225	85				11	76		415
8:00 AM	8:15 AM	15		5		212	74				15	68		389
8:15 AM	8:30 AM	16		6		148	52				16	65		303
8:30 AM	8:45 AM	17		4		166	41				15	49		292
8:45 AM	9:00 AM	11		9		151	36				5	50		262
Included HV (trucks + buses):			#DIV/0!			#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM	30		18		684	182				27	252		1,193
7:15 AM	8:15 AM	41		18		748	223				38	259		1,327
7:30 AM	8:30 AM	51		21		745	254				48	274		1,393
7:45 AM	8:45 AM	60		21		751	252				57	258		1,399
8:00 AM	9:00 AM	59		24		677	203				51	232		1,246

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

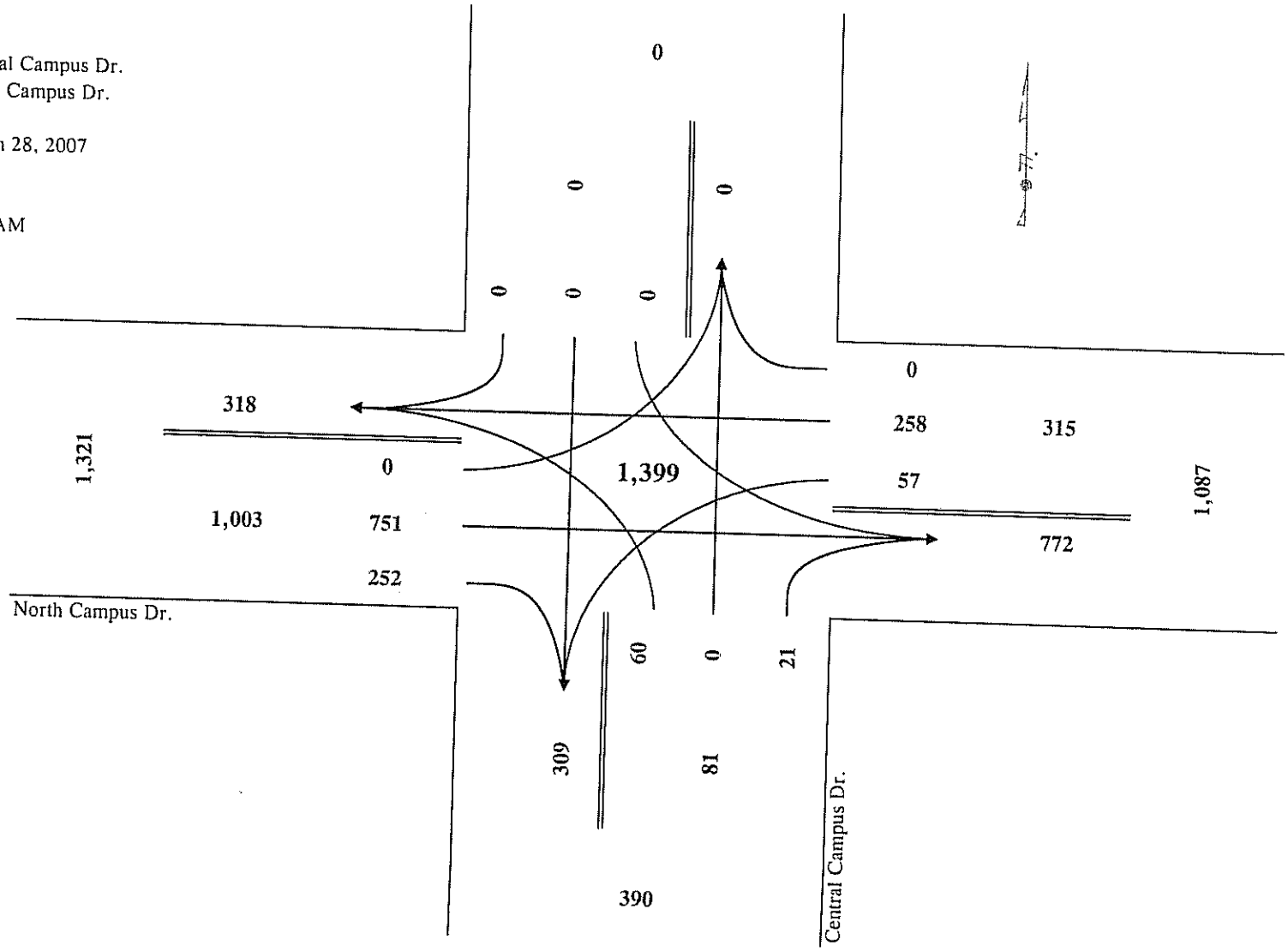
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Central Campus Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 28, 2007

PEAK HOUR:
7:45 AM TO 8:45 AM

NOTES:



Central and North Campus Dr.xls AM Diagram

4/12/2007 10:44 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Central Campus Dr.*
E-W STREET: *North Campus Dr.*

PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES: .

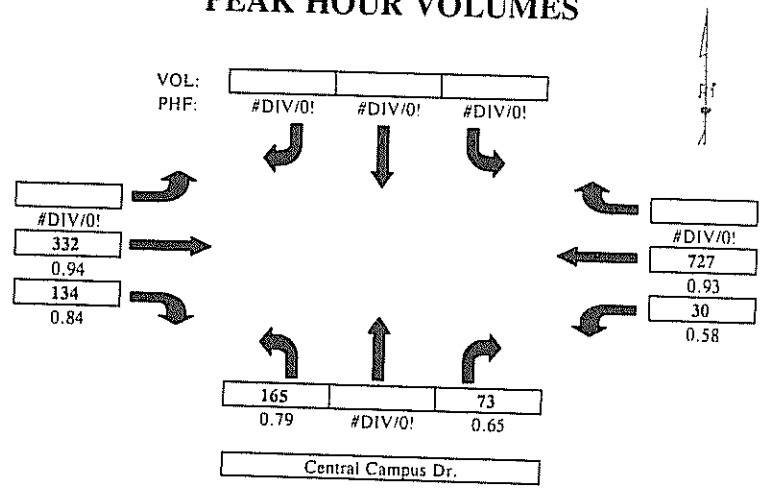
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,461
PHF:	0.94
PEAK HOUR:	
FROM:	TO:
4:45 PM	5:45 PM

North Campus Dr.

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM	36		21		59	25				8	138		287
4:15 PM	4:30 PM	38		35		75	29				9	150		336
4:30 PM	4:45 PM	45		31		81	27				11	152		347
4:45 PM	5:00 PM	35		28		80	30				6	165		344
5:00 PM	5:15 PM	36		15		80	32				4	175		342
5:15 PM	5:30 PM	42		19		88	40				7	192		388
5:30 PM	5:45 PM	52		11		84	32				13	195		387
5:45 PM	6:00 PM	28		9		67	31				7	168		310
Included HV (trucks + buses):		#DIV/0!			#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM	154		115		295	111				34	605		1,314
4:15 PM	5:15 PM	154		109		316	118				30	642		1,369
4:30 PM	5:30 PM	158		93		329	129				28	684		1,421
4:45 PM	5:45 PM	165		73		332	134				30	727		1,461
5:00 PM	6:00 PM	158		54		319	135				31	730		1,427

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

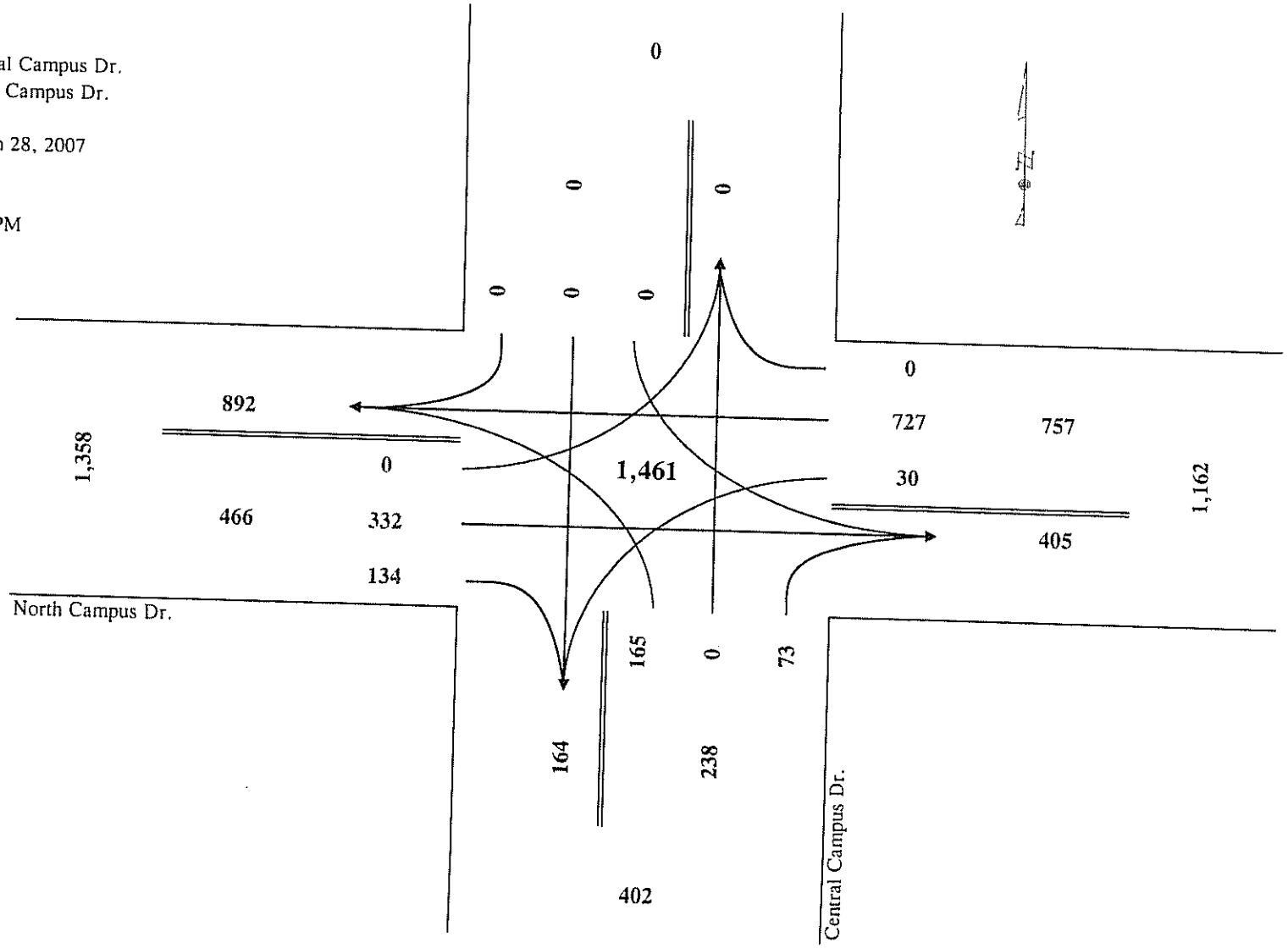
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Central Campus Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 28, 2007

PEAK HOUR:
4:45 PM TO 5:45 PM

NOTES:



Central and North Campus Dr.xls PM Diagram

4/12/2007 10:42 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Medical Drive*
E-W STREET: *Wasatch Drive*

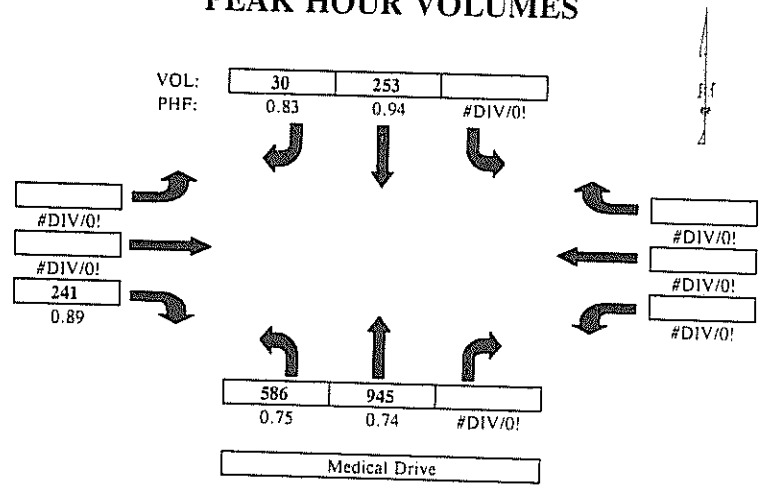
PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES:

COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	2,055
PHF:	0.94
PEAK HOUR:	
FROM:	TO:
8:00 AM	9:00 AM

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	NORTHBOUND T	NORTHBOUND R	EASTBOUND L	EASTBOUND T	EASTBOUND R	SOUTHBOUND L	SOUTHBOUND T	SOUTHBOUND R	WESTBOUND L	WESTBOUND T	WESTBOUND R	TOTAL VOLUMES
7:00 AM	7:15 AM	92	180				18		80	1				371
7:15 AM	7:30 AM	108	201				25		88	3				425
7:30 AM	7:45 AM	113	141				28		112	6				400
7:45 AM	8:00 AM	83	262				45		88	4				482
8:00 AM	8:15 AM	100	320				53		64	9				546
8:15 AM	8:30 AM	166	260				55		58	4				543
8:30 AM	8:45 AM	125	210				65		64	8				472
8:45 AM	9:00 AM	195	155				68		67	9				494
Included HV (trucks + buses):		#DIV/0!	#DIV/0!	#DIV/0!			#DIV/0!				#DIV/0!	#DIV/0!	#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	NORTHBOUND T	NORTHBOUND R	EASTBOUND L	EASTBOUND T	EASTBOUND R	SOUTHBOUND L	SOUTHBOUND T	SOUTHBOUND R	WESTBOUND L	WESTBOUND T	WESTBOUND R	TOTAL VOLUMES
7:00 AM	8:00 AM	396	784				116		368	14				1,678
7:15 AM	8:15 AM	404	924				151		352	22				1,853
7:30 AM	8:30 AM	462	983				181		322	23				1,971
7:45 AM	8:45 AM	474	1,052				218		274	25				2,043
8:00 AM	9:00 AM	586	945				241		253	30				2,055

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

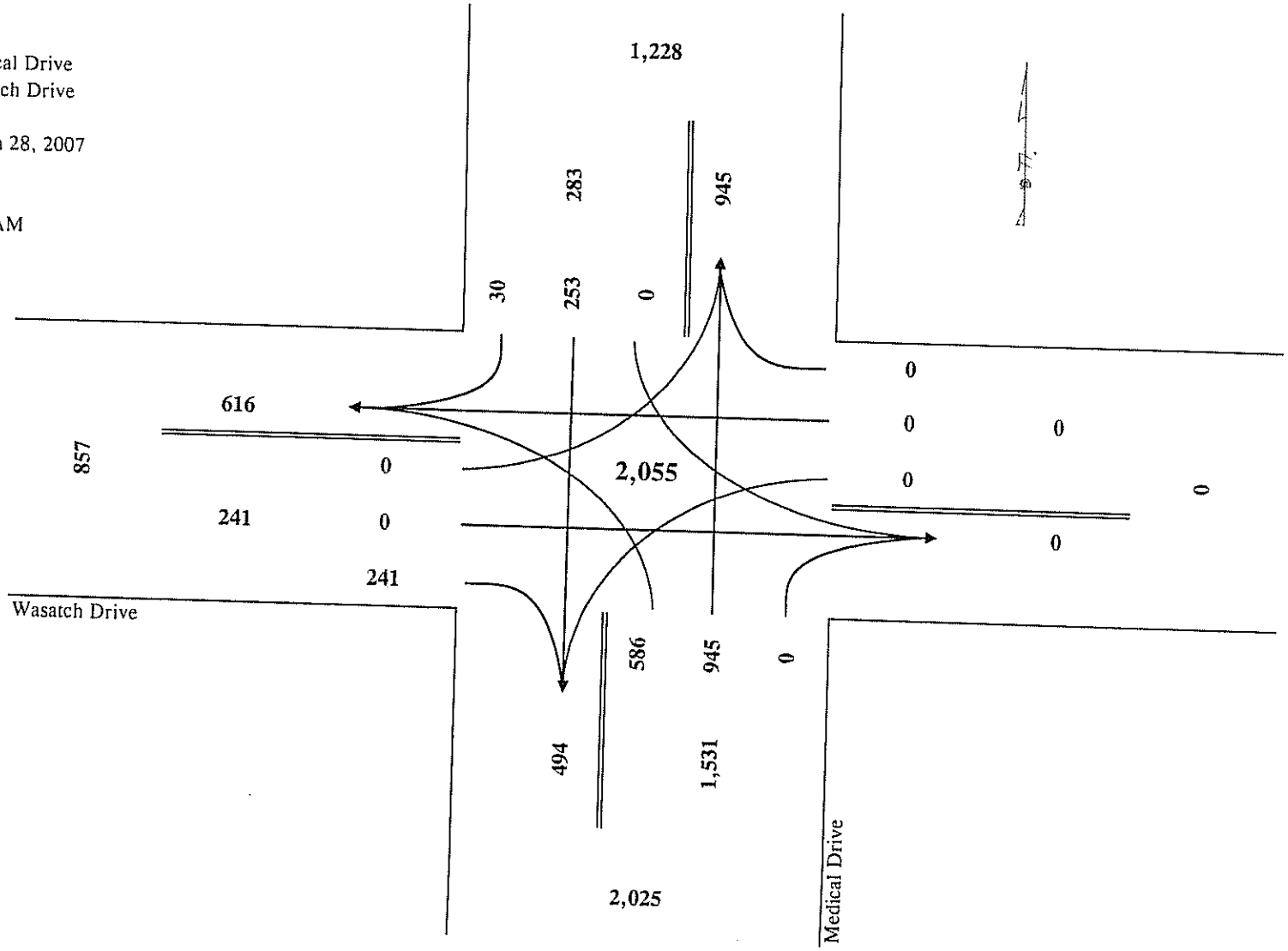
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Medical Drive
E-W STREET: Wasatch Drive

COUNT DATE: March 28, 2007

PEAK HOUR:
8:00 AM TO 9:00 AM

NOTES:



Wasatch Drive UofU.xls AM Diagram

4/12/2007 11:34 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Medical Drive*
E-W STREET: *Wasatch Drive*

PROJECT NO.: *UT7003*
COUNT DATE: *March 28, 2007*
NOTES: .

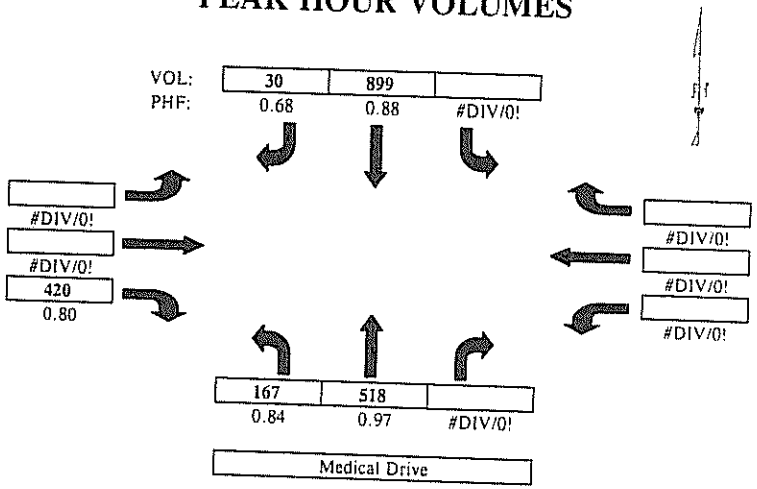
COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	2,034
PHF:	0.90
PEAK HOUR:	
FROM:	TO:
4:15 PM	5:15 PM

Wasatch Drive

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM	51	128				100		221	6				506
4:15 PM	4:30 PM	50	134				103		196	6				
4:30 PM	4:45 PM	35	125				97		234	6				497
4:45 PM	5:00 PM	46	126				88		214	11				485
5:00 PM	5:15 PM	36	133				132		255	7				563
5:15 PM	5:30 PM	53	122				104		134	8				421
5:30 PM	5:45 PM	69	112				122		213	4				520
5:45 PM	6:00 PM	78	123				124		154	6				485
Included HV (trucks + buses):				#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!			#DIV/0!	#DIV/0!	#DIV/0!	

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM	182	513				388		865	29				1,977
4:15 PM	5:15 PM	167	518				420		899	30				2,034
4:30 PM	5:30 PM	170	506				421		837	32				1,966
4:45 PM	5:45 PM	204	493				446		816	30				1,989
5:00 PM	6:00 PM	236	490				482		756	25				1,989

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

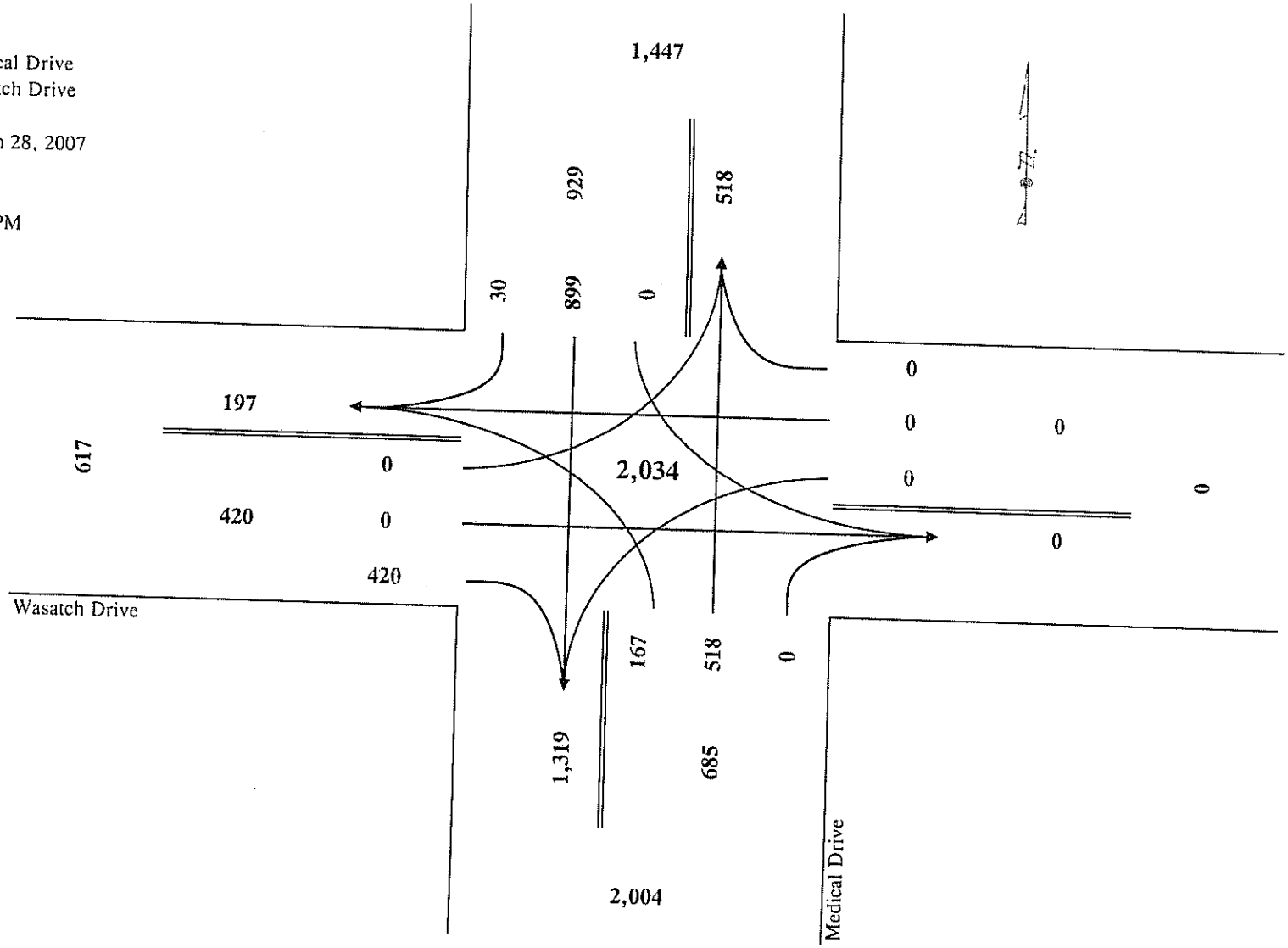
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Medical Drive
E-W STREET: Wasatch Drive

COUNT DATE: March 28, 2007

PEAK HOUR:
4:15 PM TO 5:15 PM

NOTES:



Wasatch Drive UofU.xls PM Diagram

4/12/2007 11:34 AM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION
N-S STREET: *Wasatch Dr.*
E-W STREET: *North Campus Dr.*

PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

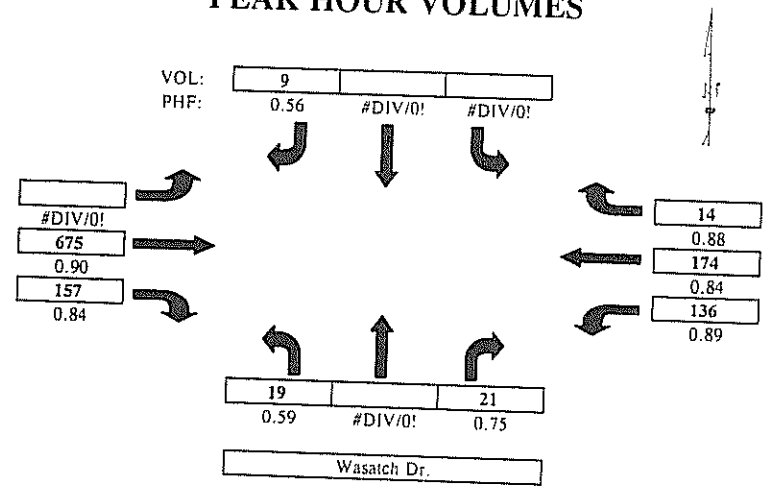
COUNT TIME
FROM: *7:00 AM*
TO: *9:00 AM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,205
PHF:	0.93
PEAK HOUR:	
FROM:	TO:
7:45 AM	8:45 AM

North Campus Dr.

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	7:15 AM	1				92	15				11	28	1	148
7:15 AM	7:30 AM	2		6		112	29			2	24	30	1	206
7:30 AM	7:45 AM	4		4		120	18			2	33	31	1	213
7:45 AM	8:00 AM	8		6		169	47				38	52	3	323
8:00 AM	8:15 AM	3		4		188	36			3	38	38	3	313
8:15 AM	8:30 AM	3		7		173	36			4	25	40	4	292
8:30 AM	8:45 AM	5		4		145	38			2	35	44	4	277
8:45 AM	9:00 AM	6		6		146	29				22	28	1	238
Included HV (trucks + buses):		#DIV/0!			#DIV/0!			#DIV/0!		#DIV/0!				

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
7:00 AM	8:00 AM	15		16		493	109			4	106	141	6	890
7:15 AM	8:15 AM	17		20		589	130			7	133	151	8	1,055
7:30 AM	8:30 AM	18		21		650	137			9	134	161	11	1,141
7:45 AM	8:45 AM	19		21		675	157			9	136	174	14	1,205
8:00 AM	9:00 AM	17		21		652	139			9	120	150	12	1,120

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

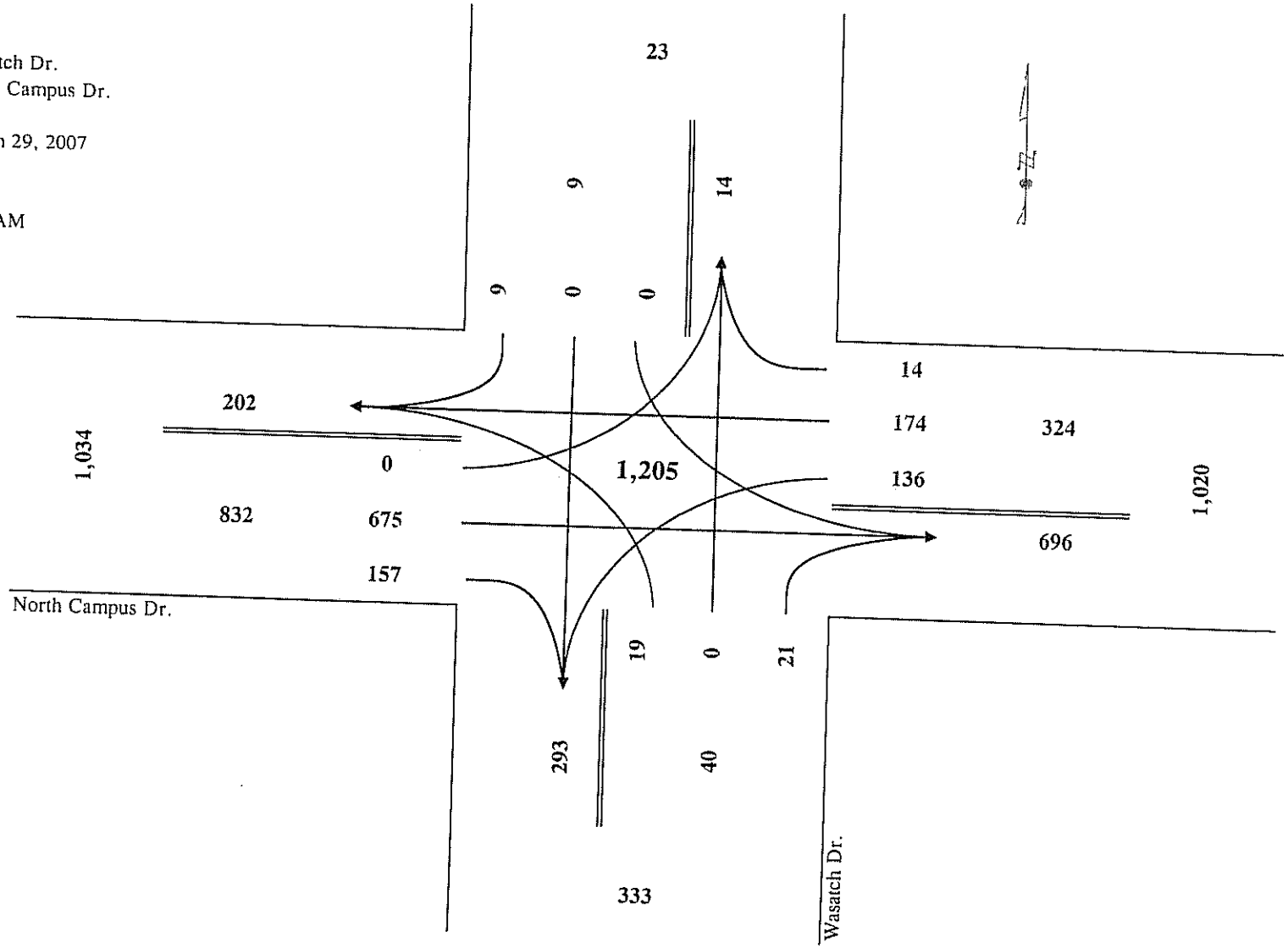
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION
N-S STREET: Wasatch Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 29, 2007

PEAK HOUR:
7:45 AM TO 8:45 AM

NOTES:



Wasatch and North Campus Dr.xls AM Diagram

4/12/2007 12:16 PM

TURNING MOVEMENT COUNT SUMMARY

INTERSECTION:
N-S STREET: *Wasatch Dr.*
E-W STREET: *North Campus Dr.*

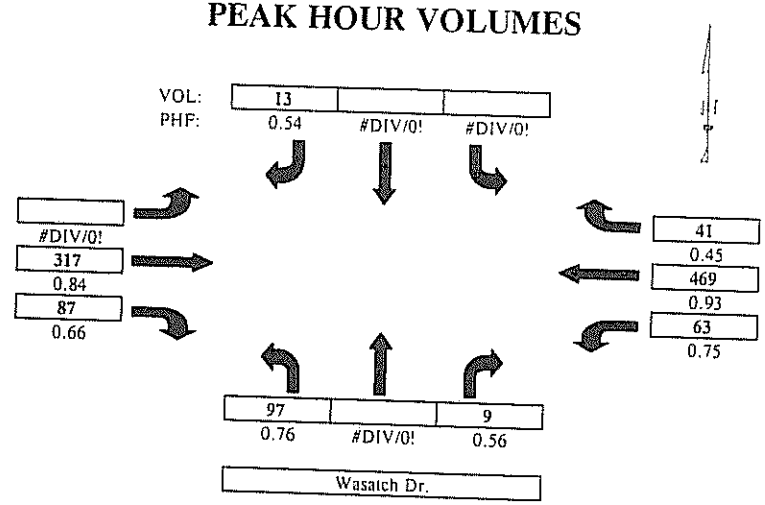
PROJECT NO.: *UT7003*
COUNT DATE: *March 29, 2007*
NOTES:

COUNT TIME:
FROM: *4:00 PM*
TO: *6:00 PM*

GROWTH FACTOR: *1.00*

PEAK HOUR VOLUME:	1,096
PHF:	0.91
PEAK HOUR:	
FROM:	TO:
4:15 PM	5:15 PM

PEAK HOUR VOLUMES



COUNT DATA INPUT:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	4:15 PM	24		3		80	25			4	16	107	17	276
4:15 PM	4:30 PM	23		1		62	17			6	21	122	23	275
4:30 PM	12:00 AM	28		1		77	19			3	10	101	13	252
4:45 PM	5:00 PM	14		3		94	18			1	17	120		267
5:00 PM	5:15 PM	32		4		84	33			3	15	126	5	302
5:15 PM	5:30 PM	26		2		79	20			4	11	115		257
5:30 PM	5:45 PM	22		5		80	26			2	13	110		258
5:45 PM	6:00 PM	28		4		62	11			5	14	101	8	233
Included HV (trucks + buses):			#DIV/0!		#DIV/0!			#DIV/0!	#DIV/0!					

HOURLY TOTALS:

TIME PERIOD FROM:	TO:	NORTHBOUND L	T	R	EASTBOUND L	T	R	SOUTHBOUND L	T	R	WESTBOUND L	T	R	TOTAL VOLUMES
4:00 PM	5:00 PM	89		8		313	79			14	64	450	53	1,070
4:15 PM	5:15 PM	97		9		317	87			13	63	469	41	1,096
4:30 PM	5:30 PM	100		10		334	90			11	53	462	18	1,078
4:45 PM	5:45 PM	94		14		337	97			10	56	471	5	1,084
5:00 PM	6:00 PM	108		15		305	90			14	53	452	13	1,050

NOTE PHF IS BASED ON 15 MIN. PEAK WITHIN THE PEAK HOUR.

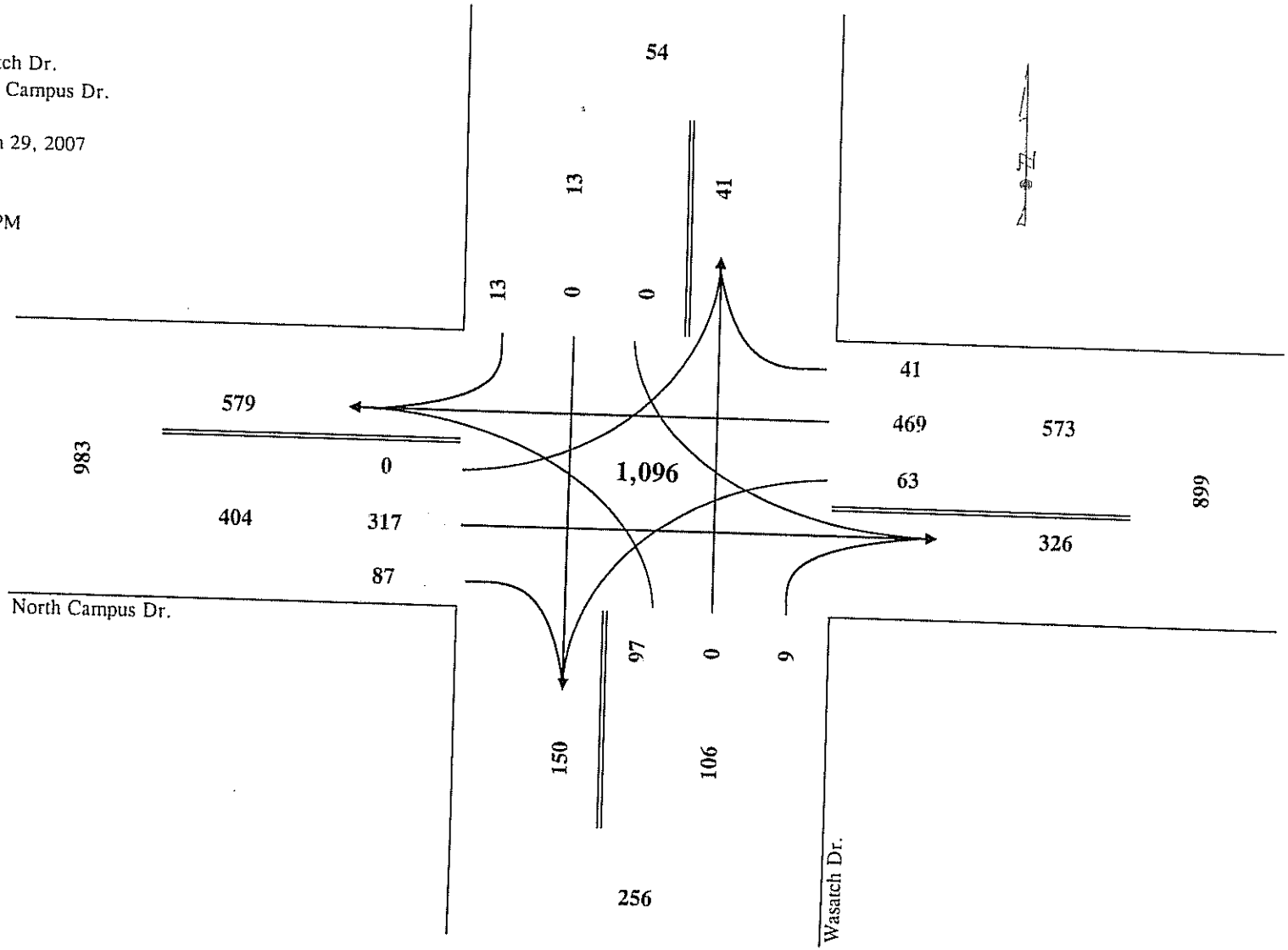
PEAK HOUR TURNING MOVEMENT DIAGRAM

INTERSECTION:
N-S STREET: Wasatch Dr.
E-W STREET: North Campus Dr.

COUNT DATE: March 29, 2007

PEAK HOUR:
4:15 PM TO 5:15 PM

NOTES:



Wasatch and North Campus Dr.xls PM Diagram

4/12/2007 12:16 PM

Land Use: 610
Hospital

Description

A hospital is any institution where medical or surgical care and overnight accommodations are provided to non-ambulatory and ambulatory patients. However, the term "hospital" does not refer to medical clinics (facilities that provide diagnoses and outpatient care only) or nursing homes (facilities devoted to the care of persons unable to care for themselves), which are covered elsewhere in this report. Clinic (Land Use 630) is a related use.

Additional Data

Peak hours of the generator—

The weekday a.m. peak hour varied between 8:00 a.m. and 10:00 a.m. The weekday p.m. peak hour varied between 1:00 p.m. and 5:00 p.m.

The sites were surveyed from the 1960s to the 1990s throughout the United States.

Source Numbers

2, 6, 14, 28, 88, 98, 110, 112, 186, 241, 253, 262, 423, 429, 533, 573

Hospital
(610)

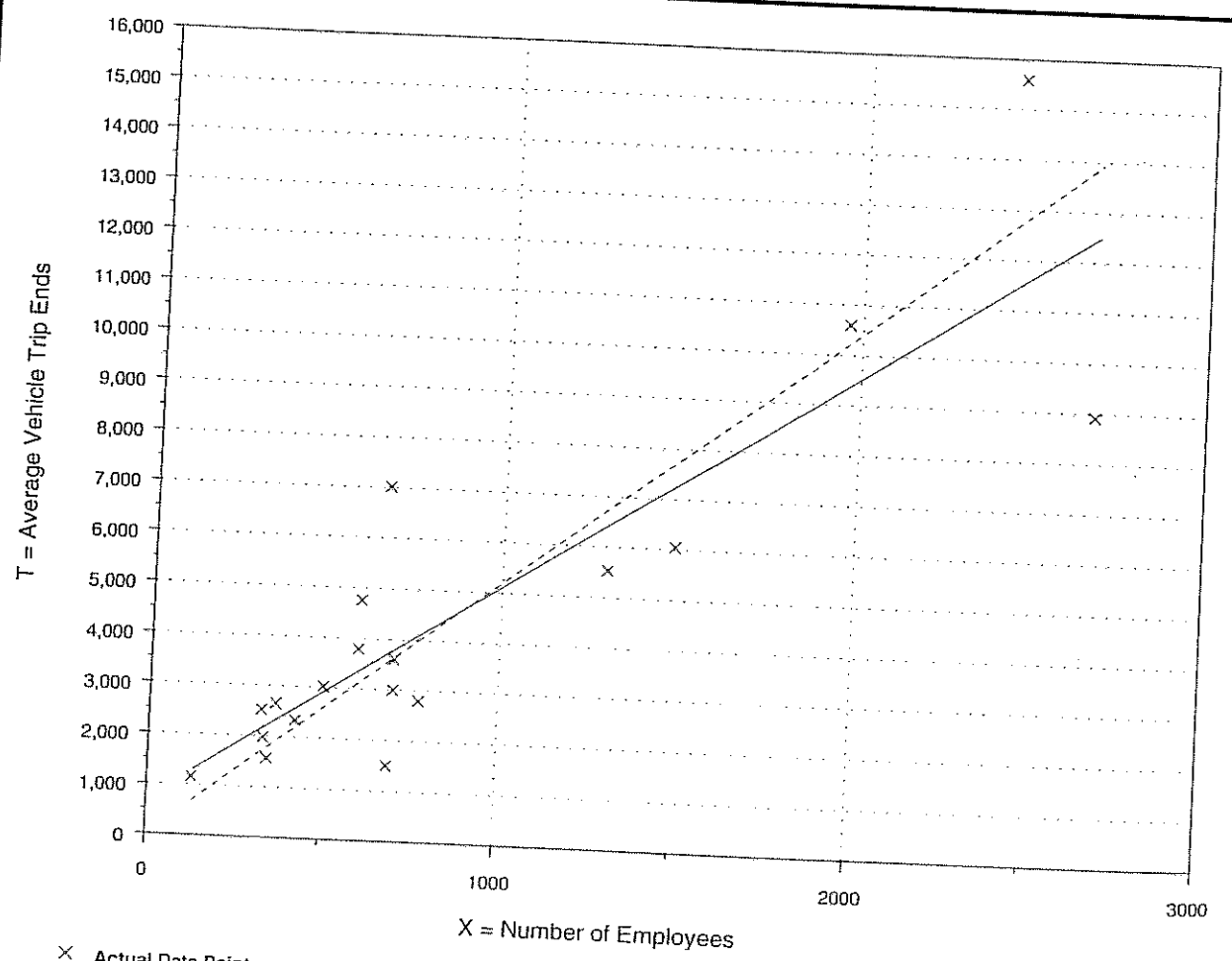
Average Vehicle Trip Ends vs: Employees
On a: Weekday

Number of Studies: 19
Avg. Number of Employees: 896
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
5.20	2.17 - 10.48	2.90

Data Plot and Equation



Fitted Curve Equation: T = 4.40(X) + 711.46

$R^2 = 0.77$

Hospital
(610)

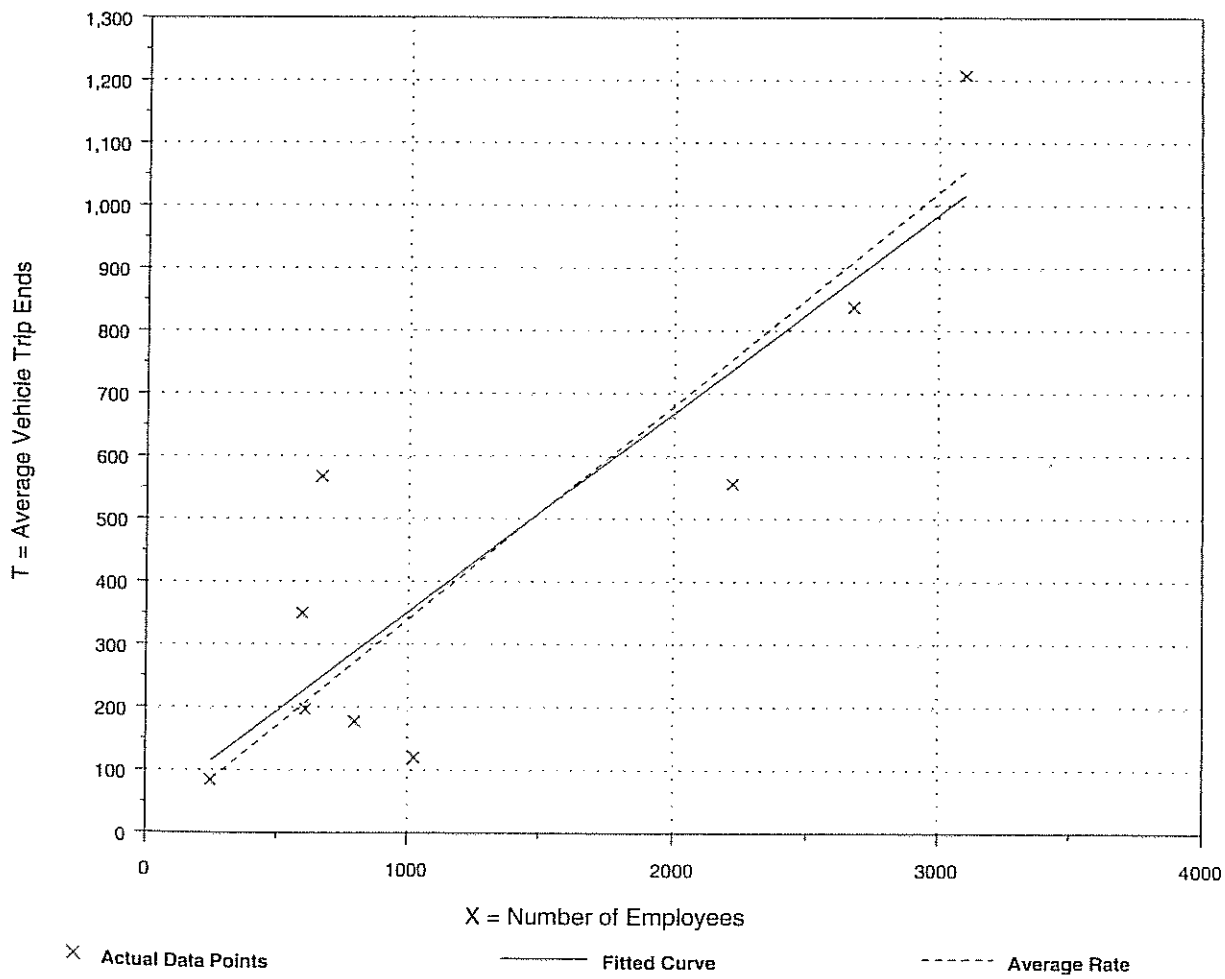
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 9
Avg. Number of Employees: 1,328
Directional Distribution: 71% entering, 29% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.34	0.12 - 0.85	0.61

Data Plot and Equation



Fitted Curve Equation: T = 0.32(X) + 35.15

R^2 = 0.77

Hospital
(610)

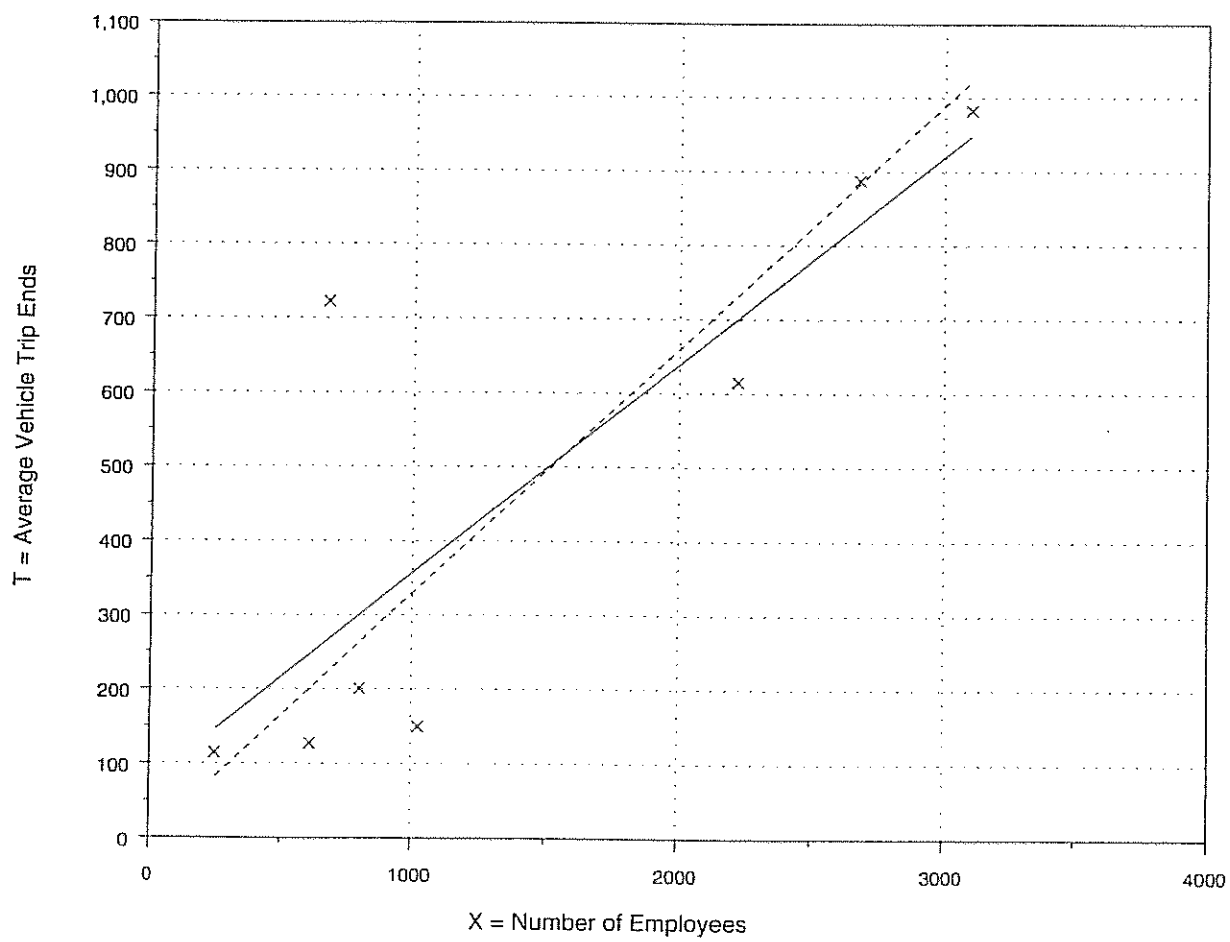
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 8
Avg. Number of Employees: 1,419
Directional Distribution: 31% entering, 69% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.33	0.15 - 1.08	0.61

Data Plot and Equation



Fitted Curve Equation: T = 0.28(X) + 75.75

$R^2 = 0.69$

Hospital
(610)

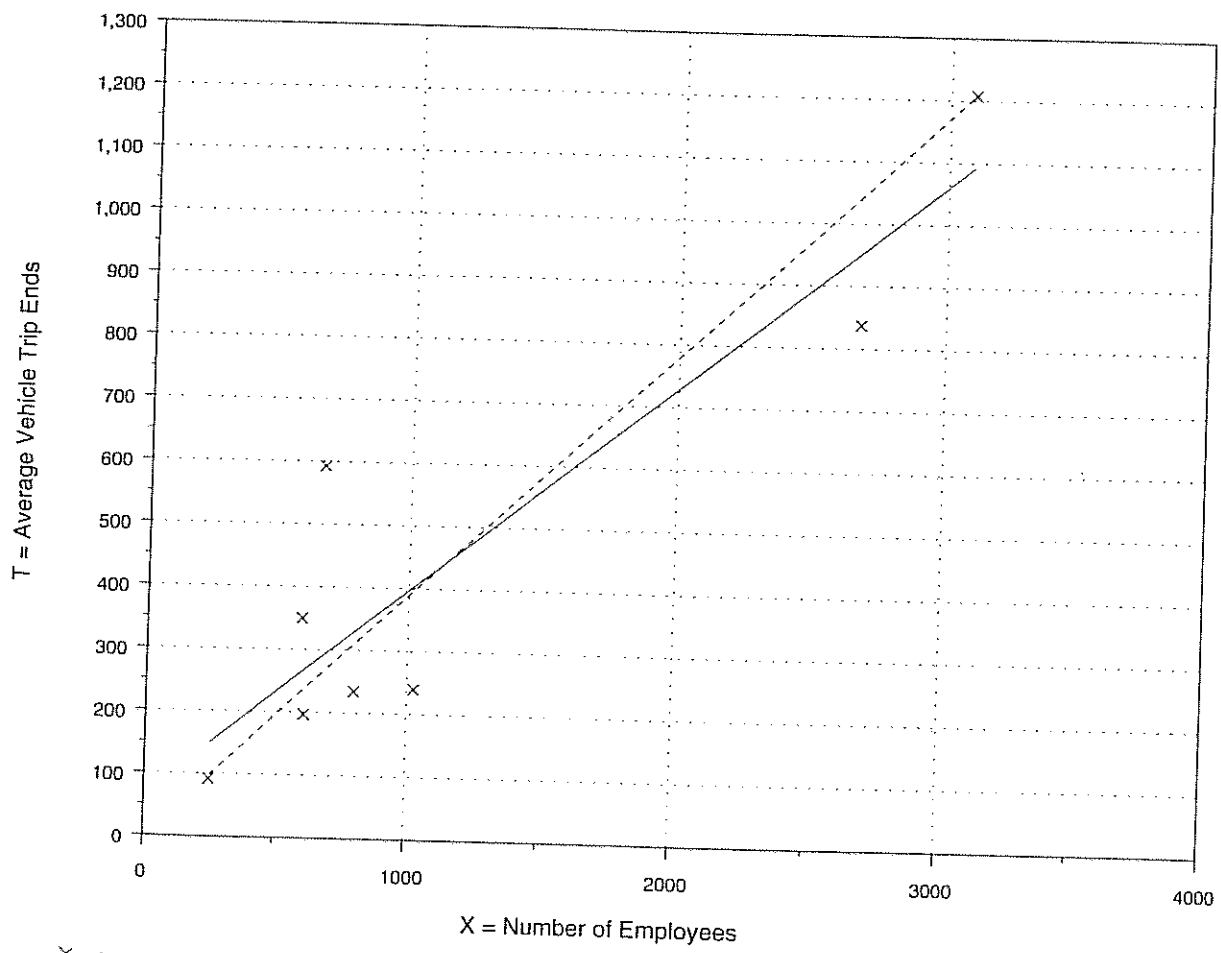
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
A.M. Peak Hour of Generator

Number of Studies: 8
Avg. Number of Employees: 1,216
Directional Distribution: 65% entering, 35% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.39	0.23 - 0.89	0.64

Data Plot and Equation



Fitted Curve Equation: T = 0.33(X) + 66.57

$R^2 = 0.83$

Hospital
(610)

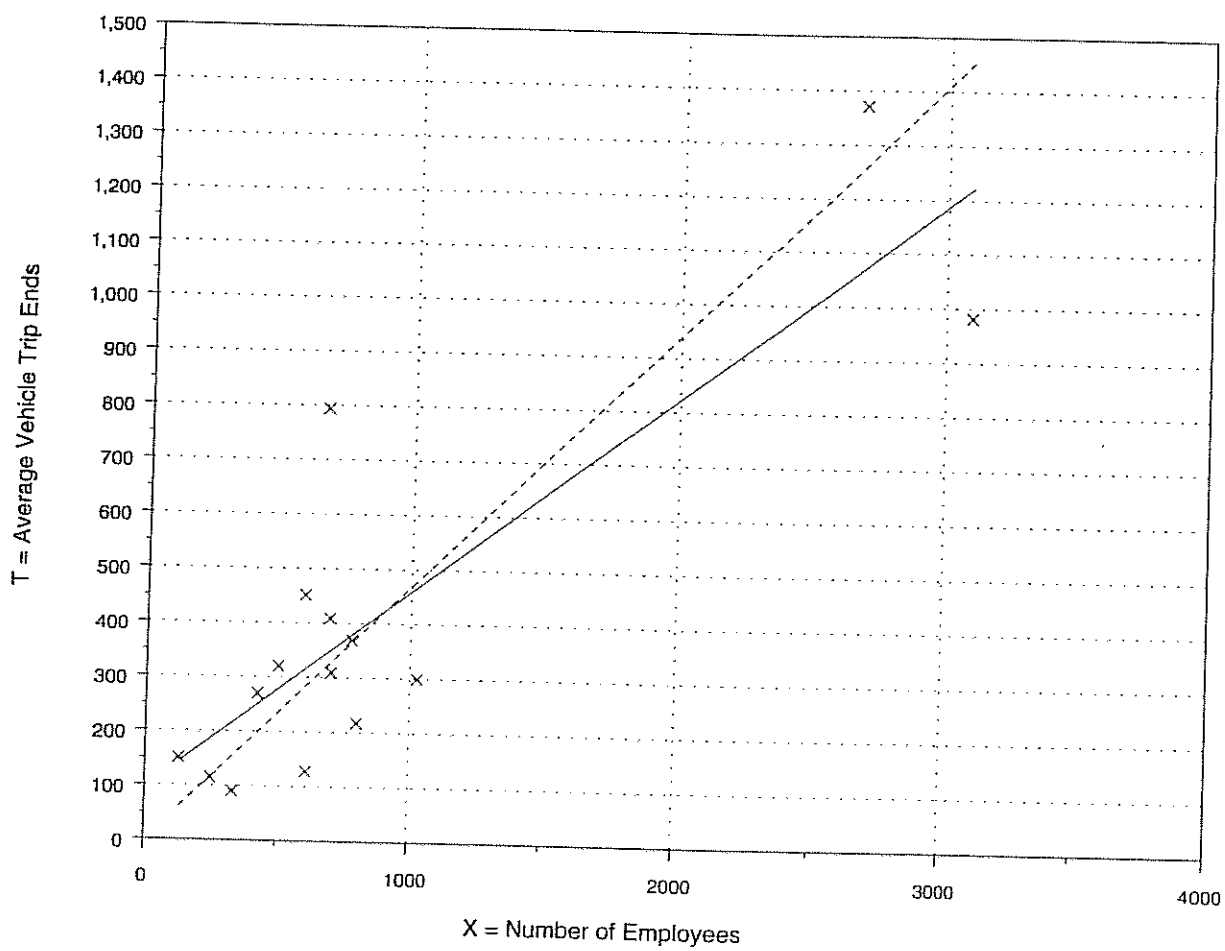
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
P.M. Peak Hour of Generator

Number of Studies: 15
Avg. Number of Employees: 885
Directional Distribution: 37% entering, 63% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.47	0.21 - 1.19	0.72

Data Plot and Equation



× Actual Data Points ——— Fitted Curve - - - - - Average Rate

Fitted Curve Equation: T = 0.36(X) + 97.41

R^2 = 0.73

Hospital
(610)

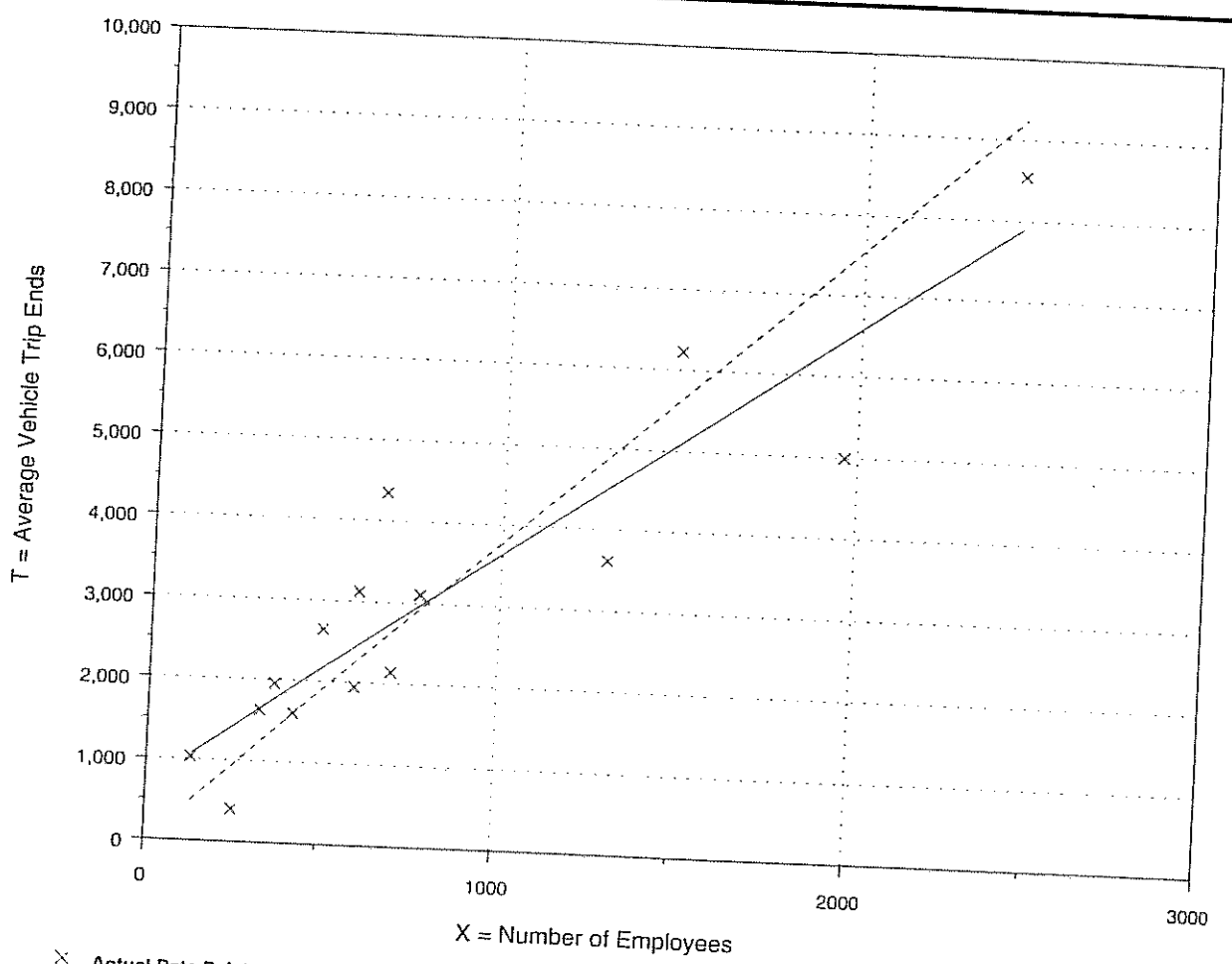
Average Vehicle Trip Ends vs: Employees
On a: Saturday

Number of Studies: 15
Avg. Number of Employees: 835
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
3.78	1.60 - 7.98	2.27

Data Plot and Equation



Fitted Curve Equation: T = 2.95(X) + 691.43

$R^2 = 0.84$

Hospital
(610)

Average Vehicle Trip Ends vs: Employees
On a: Saturday,
Peak Hour of Generator

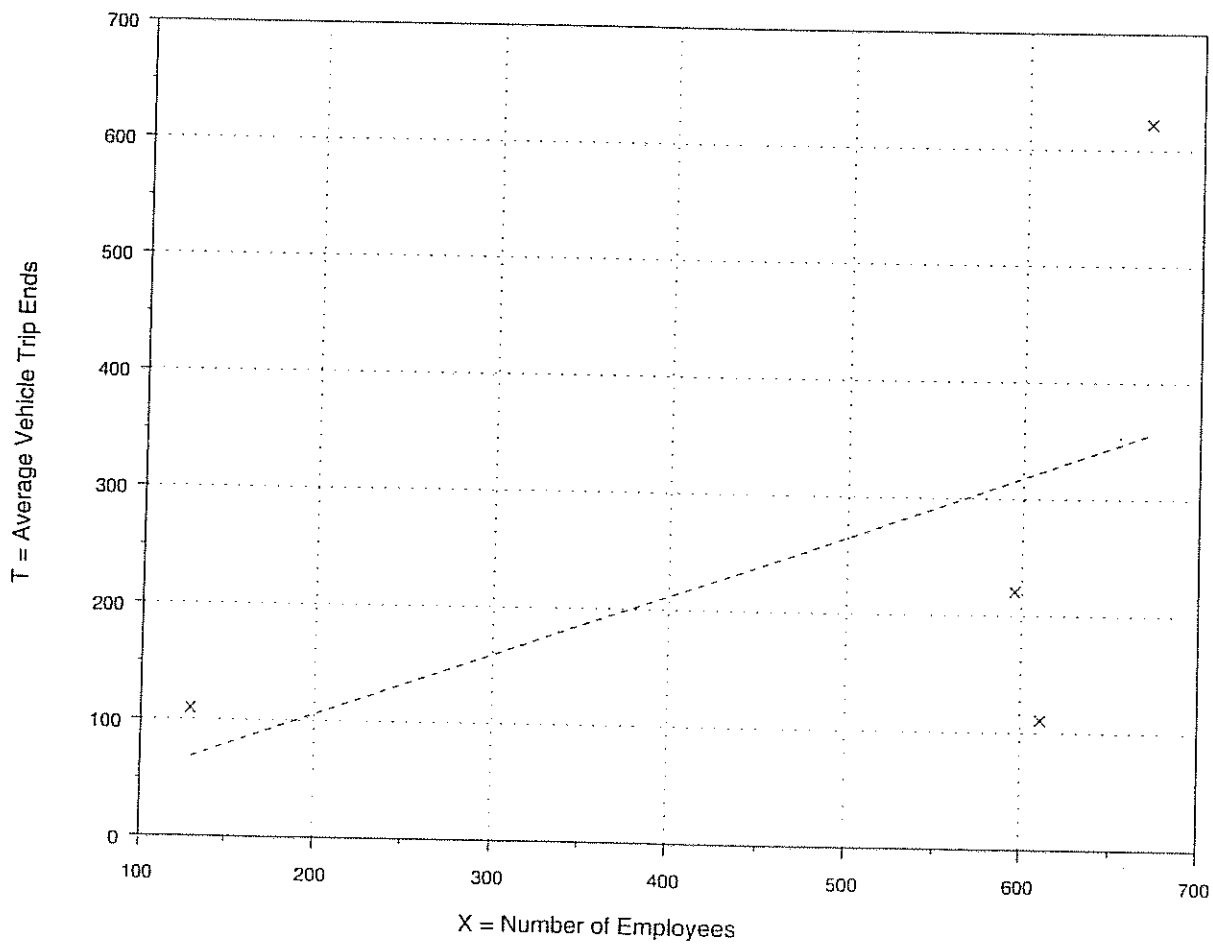
Number of Studies: 4
Avg. Number of Employees: 502
Directional Distribution: 49% entering, 51% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.53	0.18 - 0.93	0.80

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Hospital
(610)

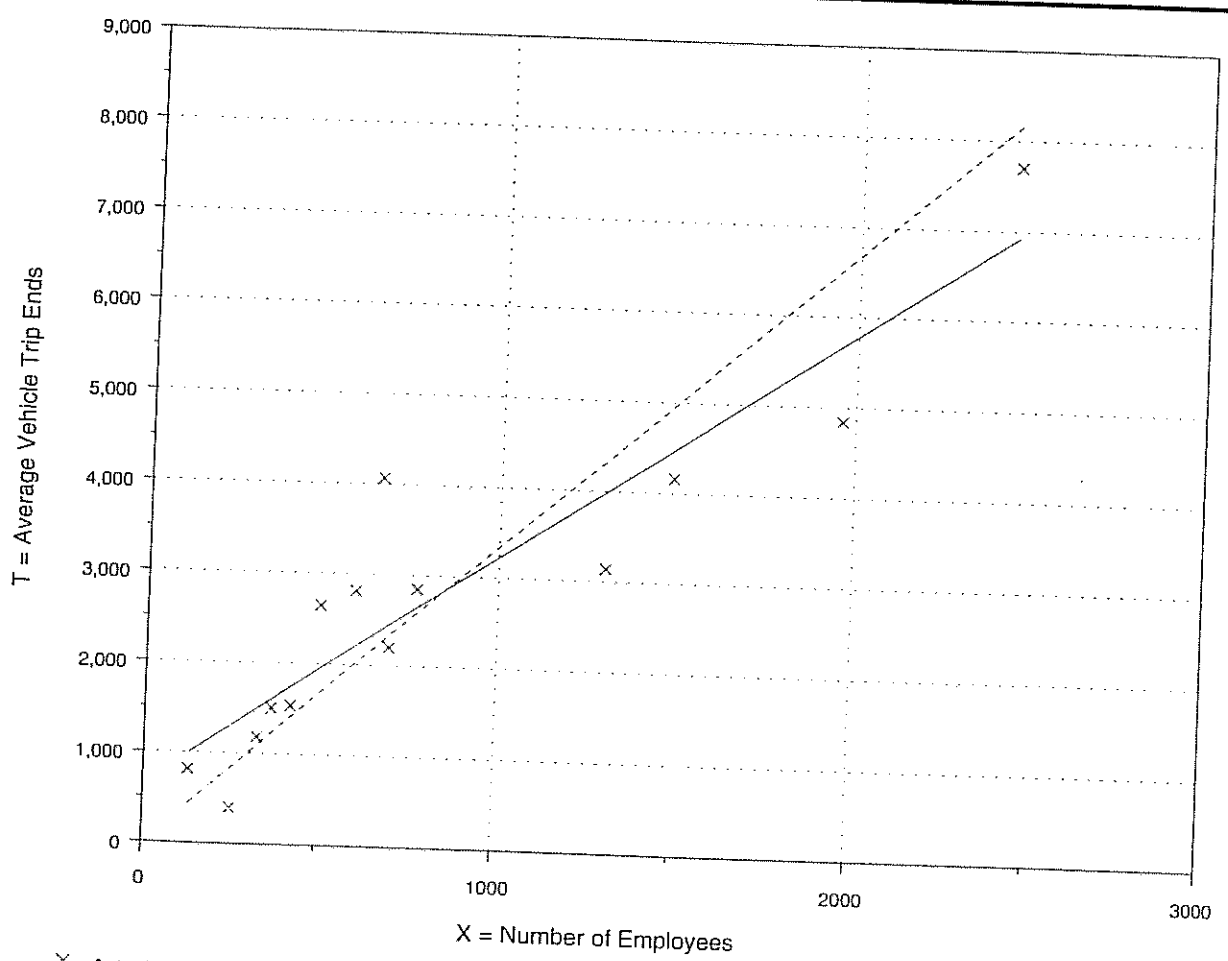
Average Vehicle Trip Ends vs: Employees
On a: Sunday

Number of Studies: 14
Avg. Number of Employees: 852
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
3.34	1.59 - 6.28	2.11

Data Plot and Equation



Fitted Curve Equation: T = 2.56(X) + 663.23

R^2 = 0.85

Hospital
(610)

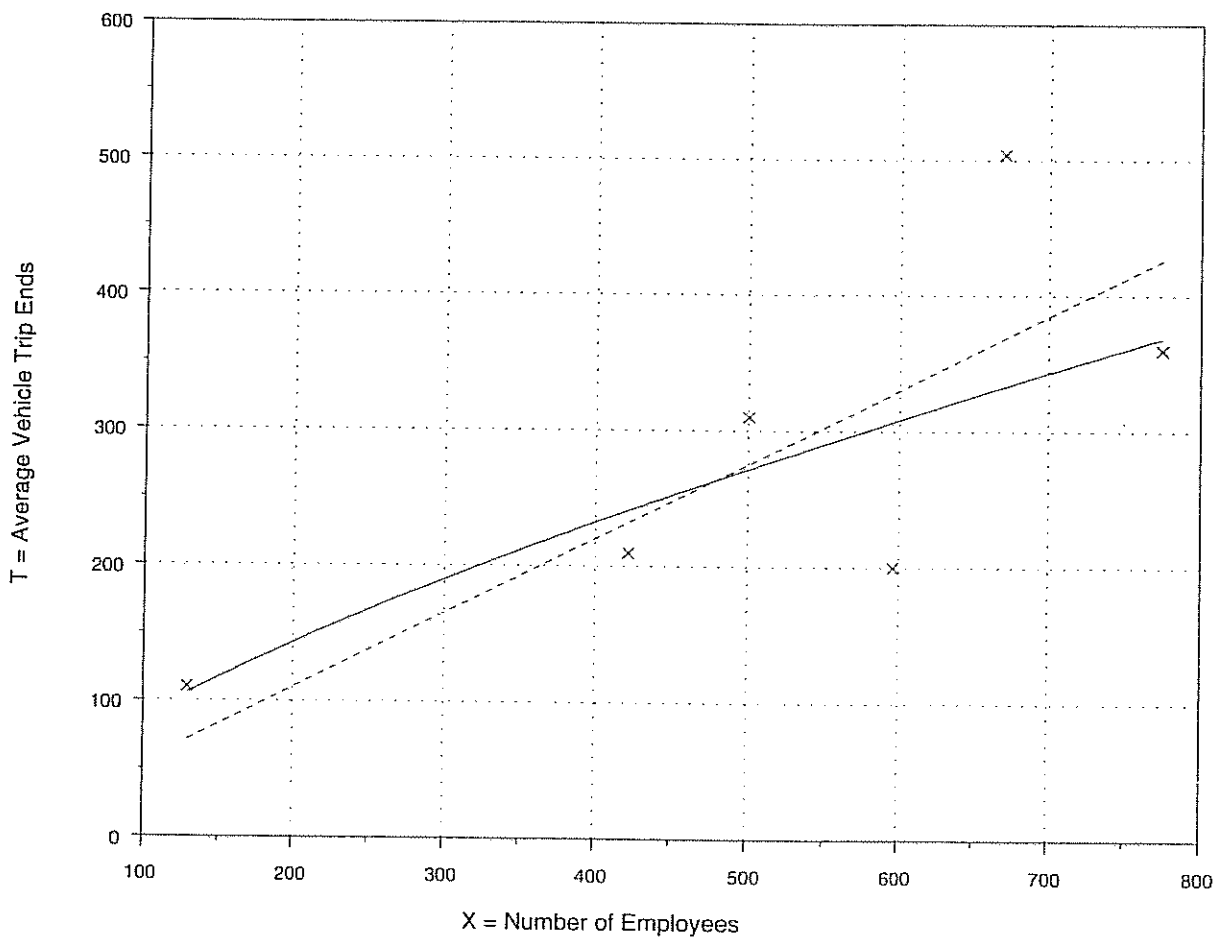
Average Vehicle Trip Ends vs: Employees
On a: Sunday,
Peak Hour of Generator

Number of Studies: 6
Avg. Number of Employees: 515
Directional Distribution: 44% entering, 56% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.55	0.34 - 0.85	0.76

Data Plot and Equation



× Actual Data Points ——— Fitted Curve - - - - - Average Rate

Fitted Curve Equation: Ln(T) = 0.70 Ln(X) + 1.26 $R^2 = 0.72$

Hospital
(610)

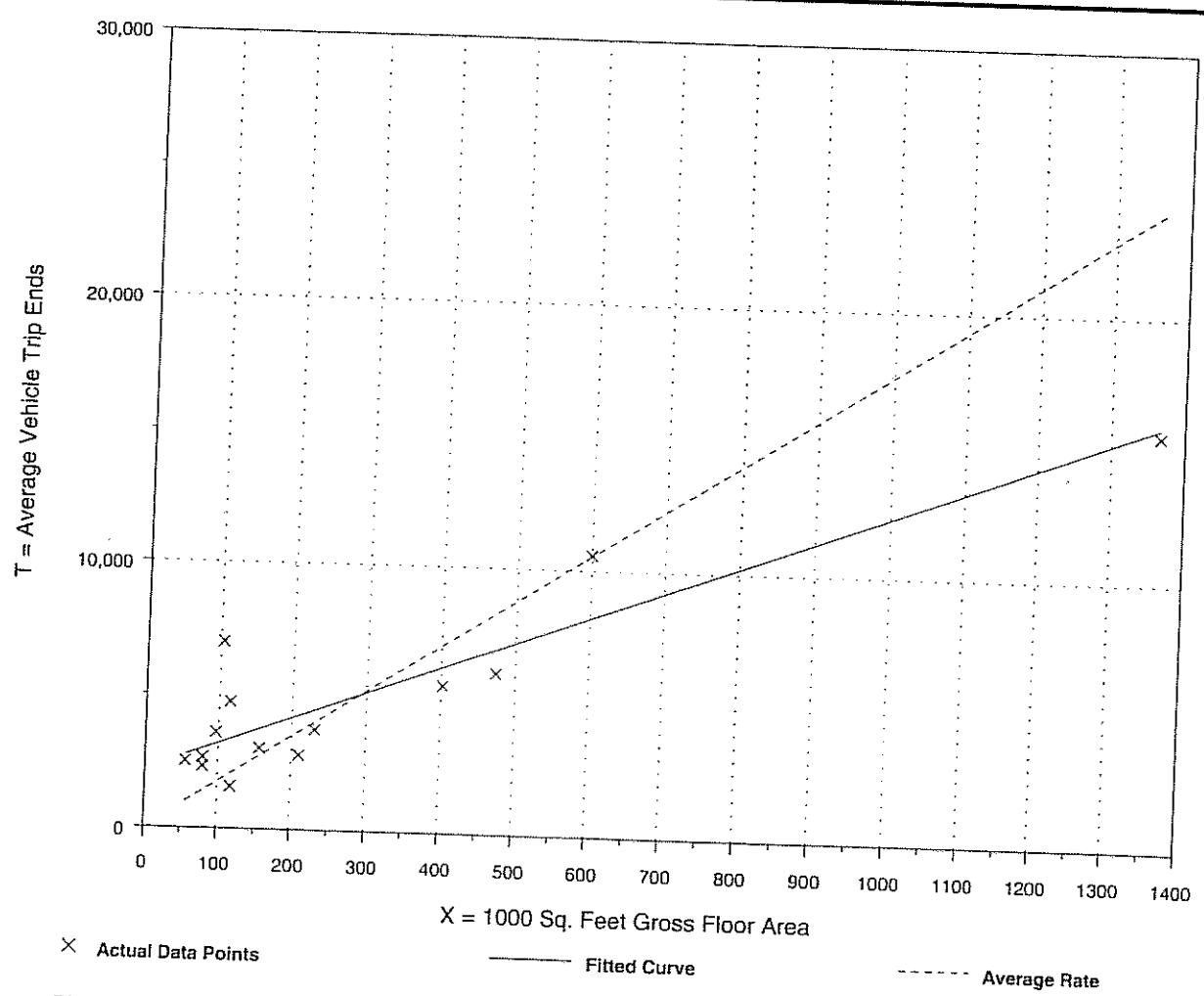
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 14
Average 1000 Sq. Feet GFA: 292
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
17.57	11.40 - 67.52	11.93

Data Plot and Equation



Fitted Curve Equation: T = 10.01(X) + 2209.31

R^2 = 0.84

Hospital
(610)

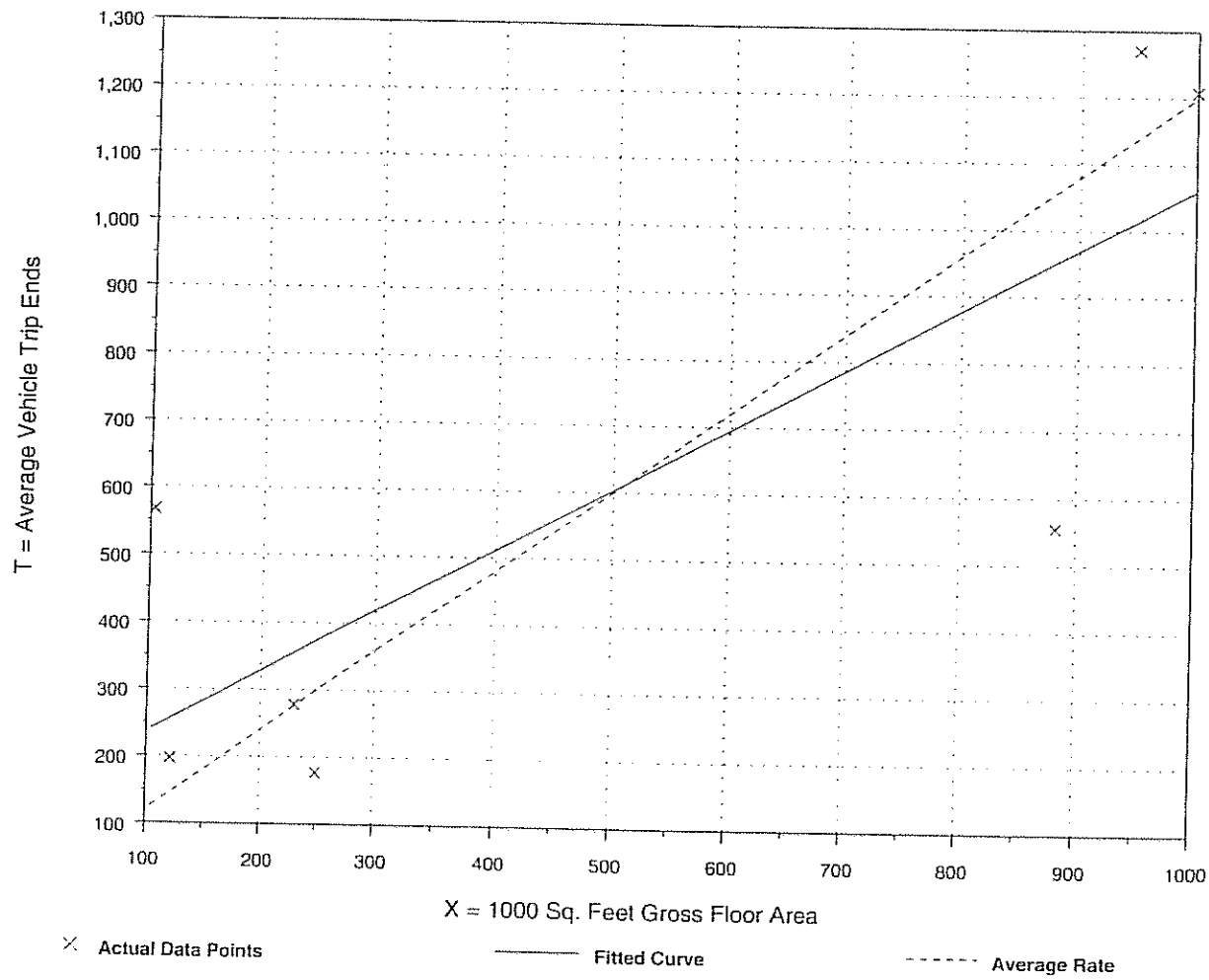
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 7
Average 1000 Sq. Feet GFA: 505
Directional Distribution: 67% entering, 33% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.20	0.63 - 5.45	1.36

Data Plot and Equation



Fitted Curve Equation: $T = 0.91(X) + 145.24$

$R^2 = 0.68$

Hospital
(610)

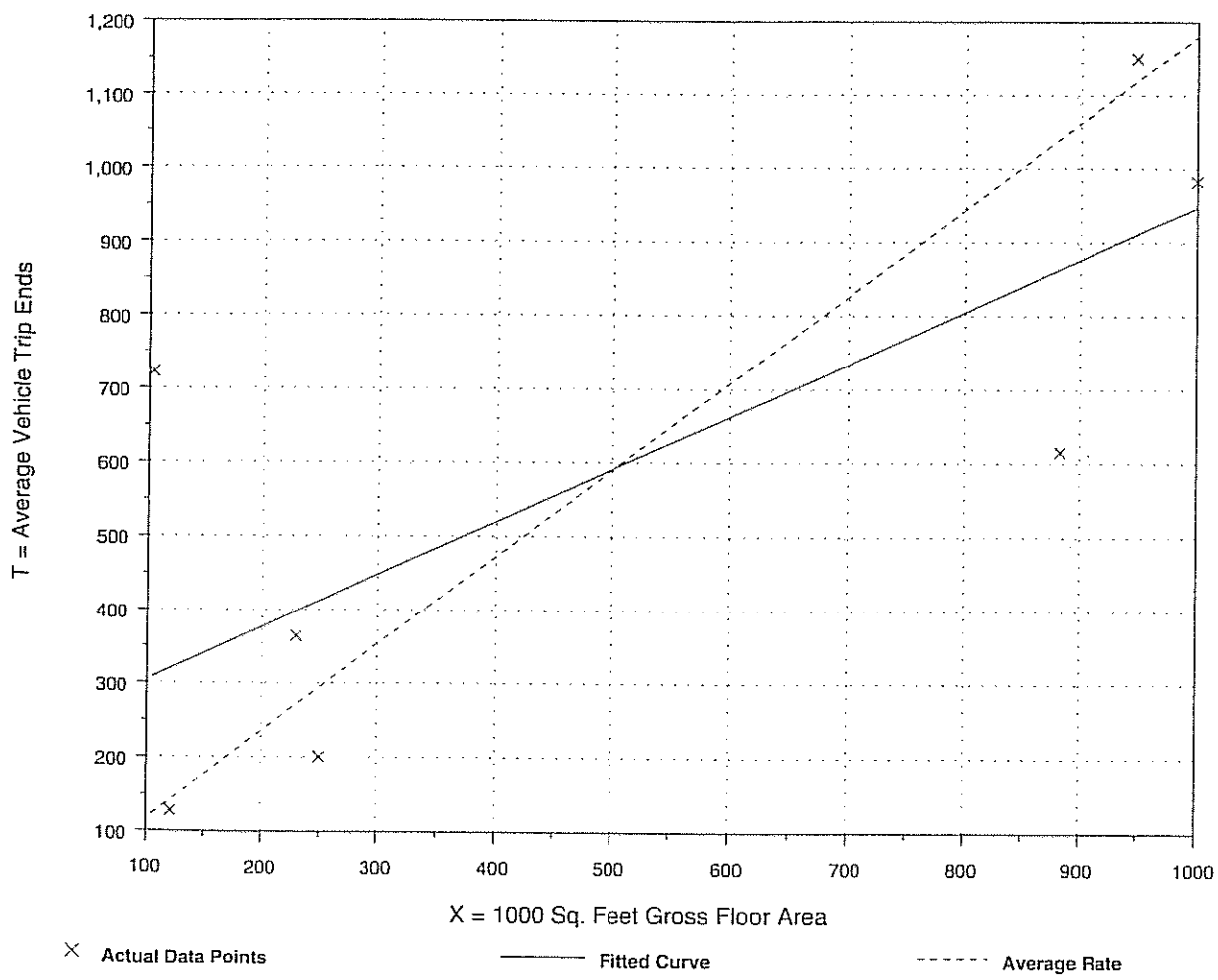
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 7
Average 1000 Sq. Feet GFA: 505
Directional Distribution: 33% entering, 67% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.18	0.70 - 6.94	1.50

Data Plot and Equation



Fitted Curve Equation: T = 0.71(X) + 233.89

$R^2 = 0.58$

Hospital
(610)

Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday,
A.M. Peak Hour of Generator

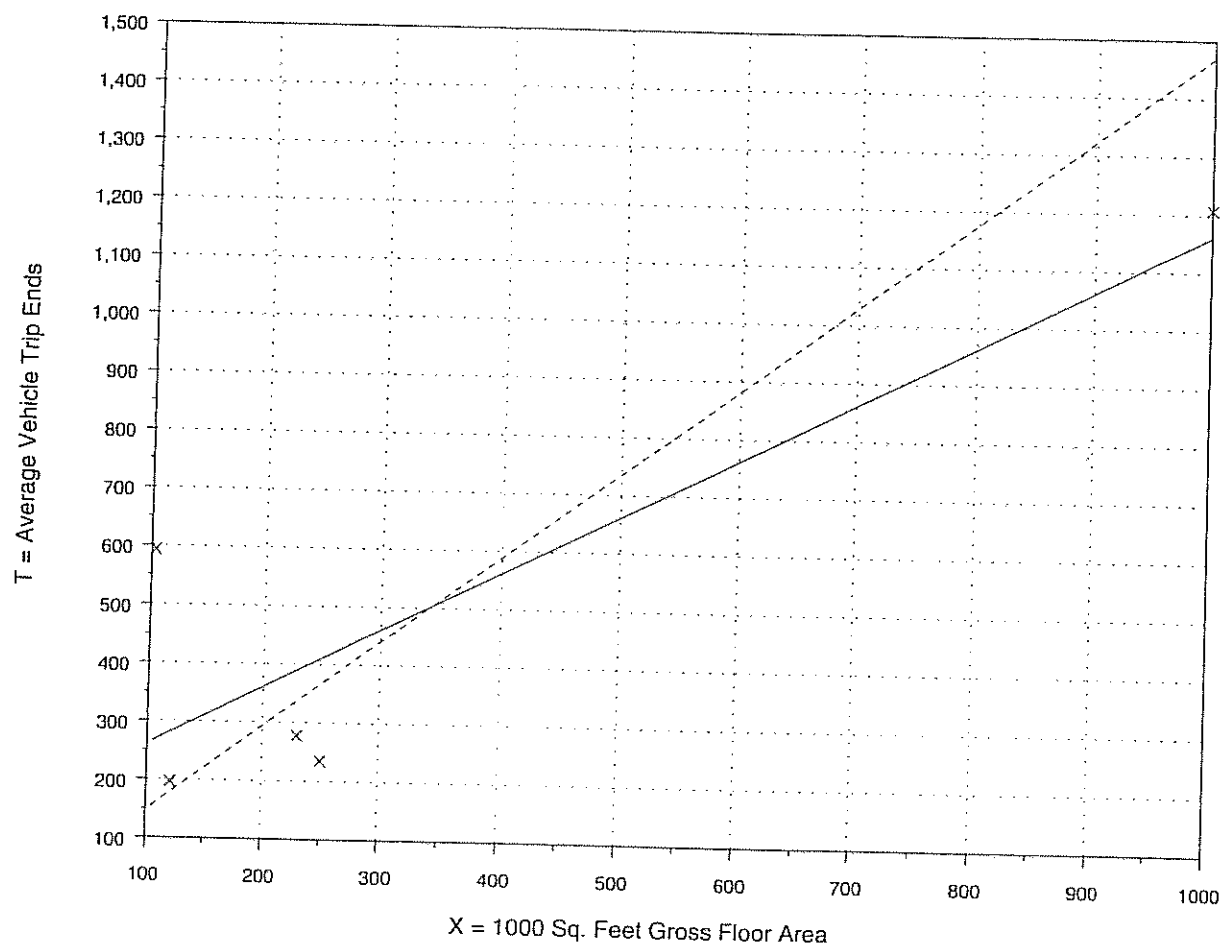
Number of Studies: 5
Average 1000 Sq. Feet GFA: 341
Directional Distribution: 63% entering, 37% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.47	0.94 - 5.70	1.63

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points ——— Fitted Curve - - - - - Average Rate

Fitted Curve Equation: T = 1.00(X) + 160.90

R^2 = 0.78

Hospital
(610)

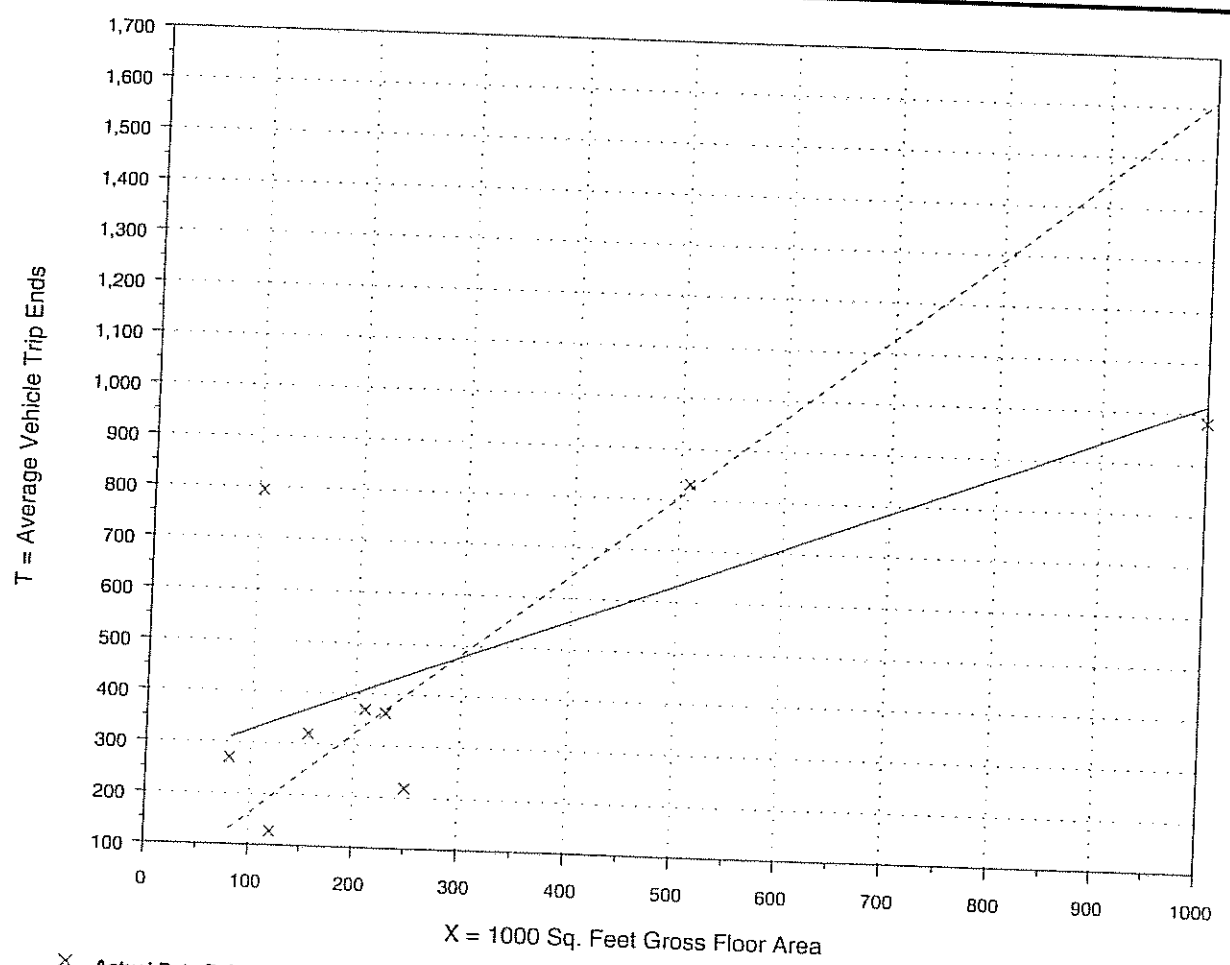
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
P.M. Peak Hour of Generator

Number of Studies: 9
Average 1000 Sq. Feet GFA: 295
Directional Distribution: 38% entering, 62% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.61	0.87 - 7.63	1.83

Data Plot and Equation



Fitted Curve Equation: T = 0.77(X) + 249.13

$R^2 = 0.53$

Hospital
(610)

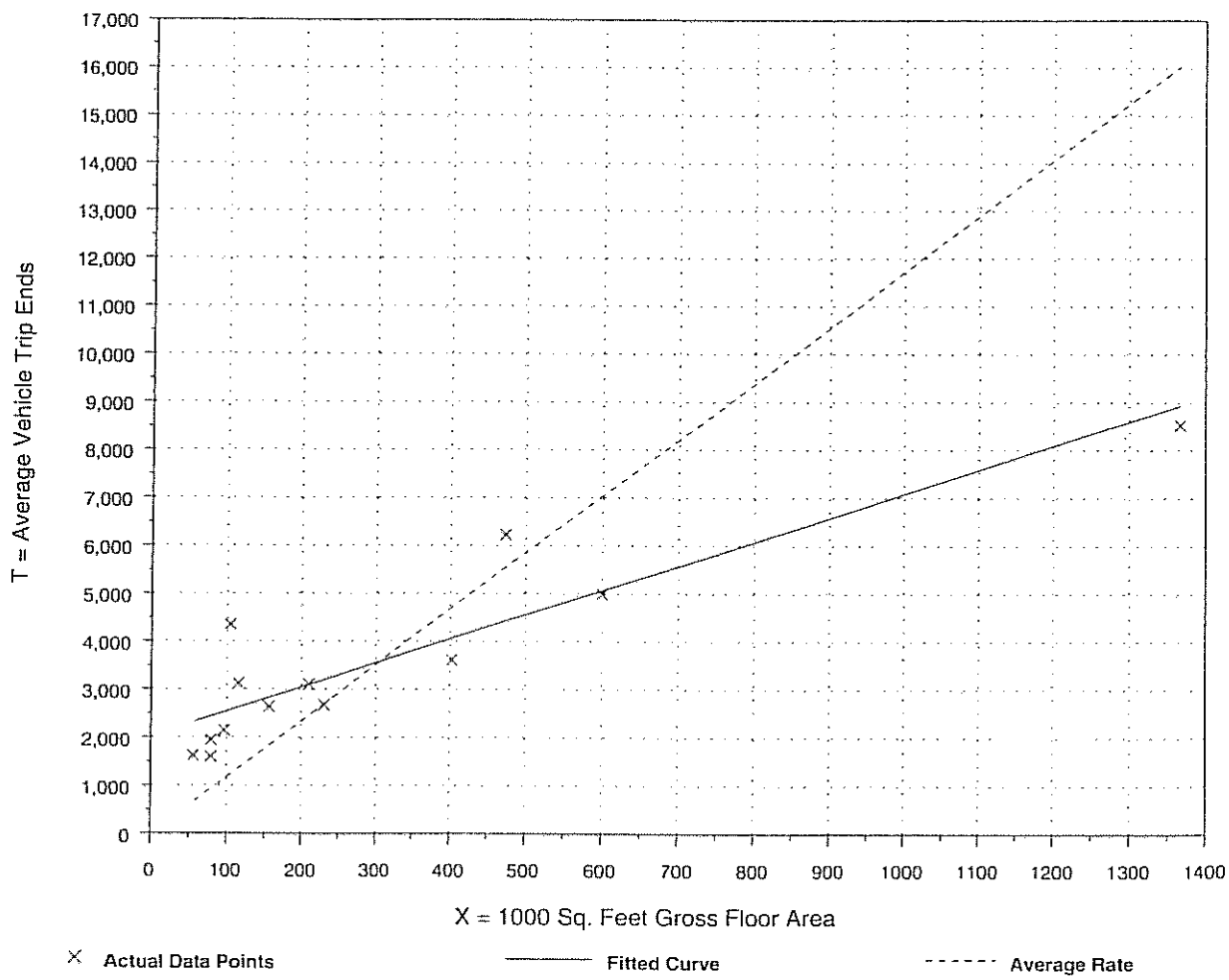
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Saturday

Number of Studies: 13
Average 1000 Sq. Feet GFA: 305
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
11.73	6.25 - 41.80	8.26

Data Plot and Equation



Fitted Curve Equation: T = 5.04(X) + 2045.63 $R^2 = 0.82$

Hospital
(610)

Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Saturday,
Peak Hour of Generator

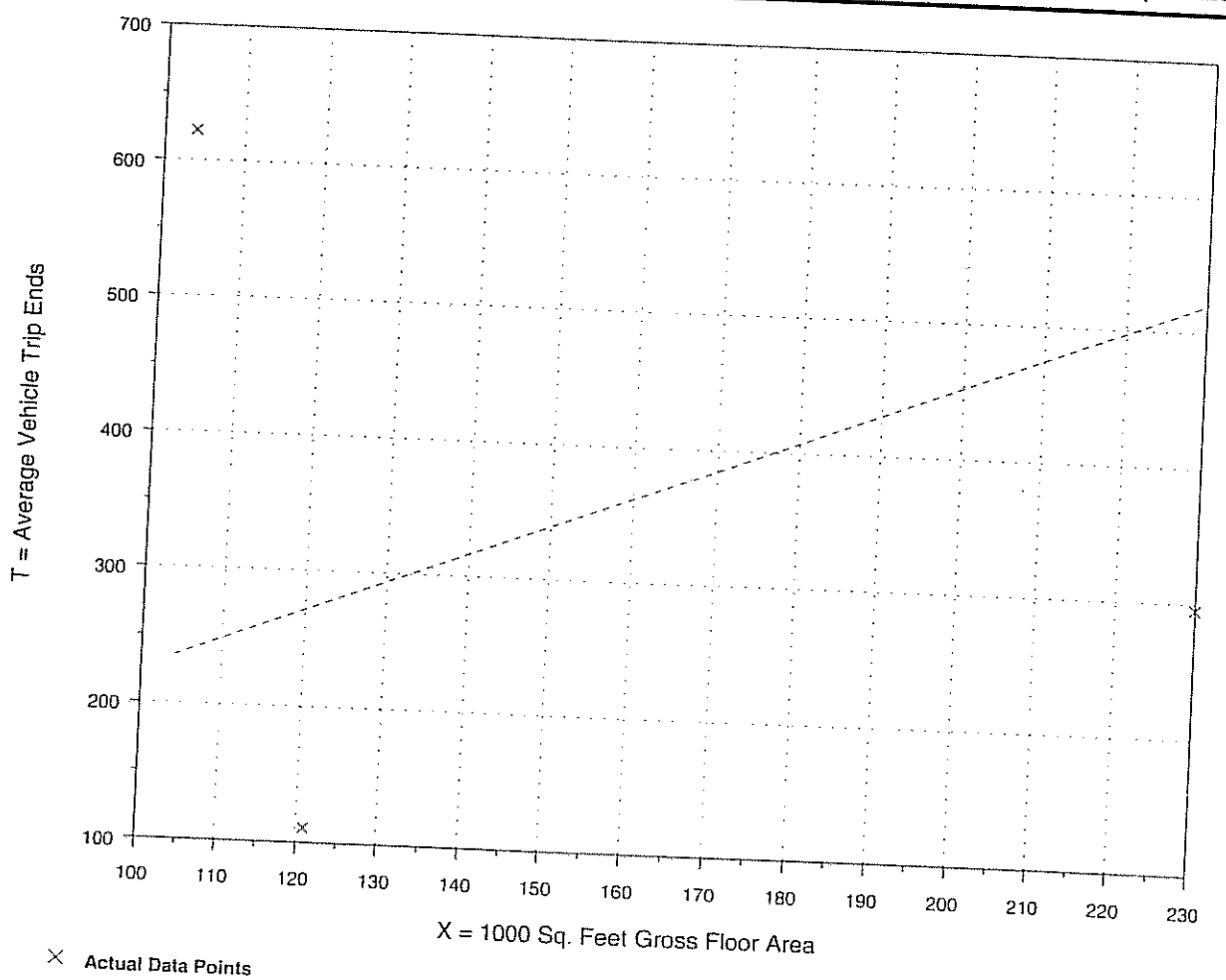
Number of Studies: 3
Average 1000 Sq. Feet GFA: 152
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
2.26	0.92 - 5.98	2.53

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points

Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Hospital
(610)

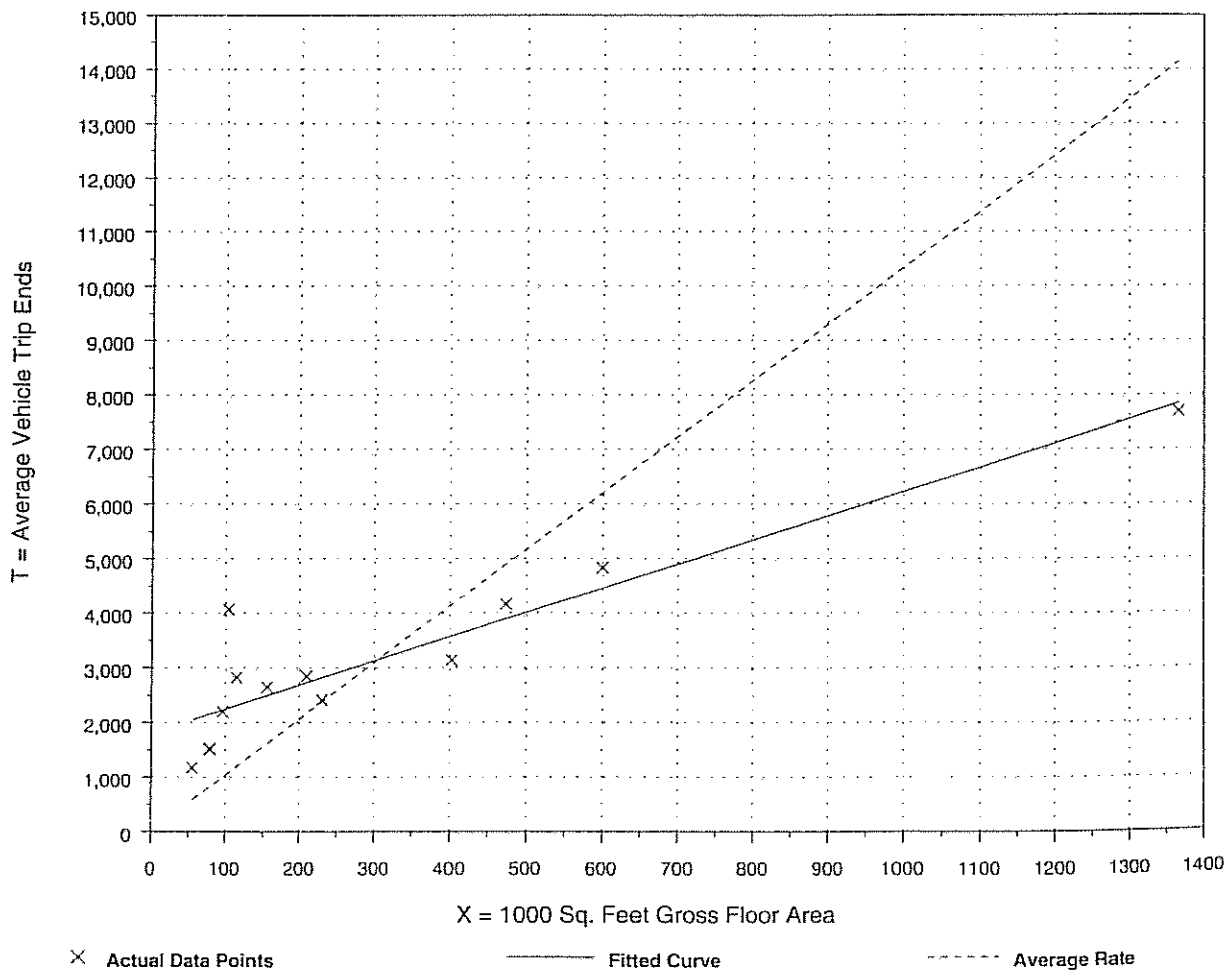
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Sunday

Number of Studies: 13
Average 1000 Sq. Feet GFA: 305
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
10.34	5.63 - 39.13	7.60

Data Plot and Equation



Fitted Curve Equation: T = 4.43(X) + 1806.05 $R^2 = 0.84$

Hospital
(610)

Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Sunday,
Peak Hour of Generator

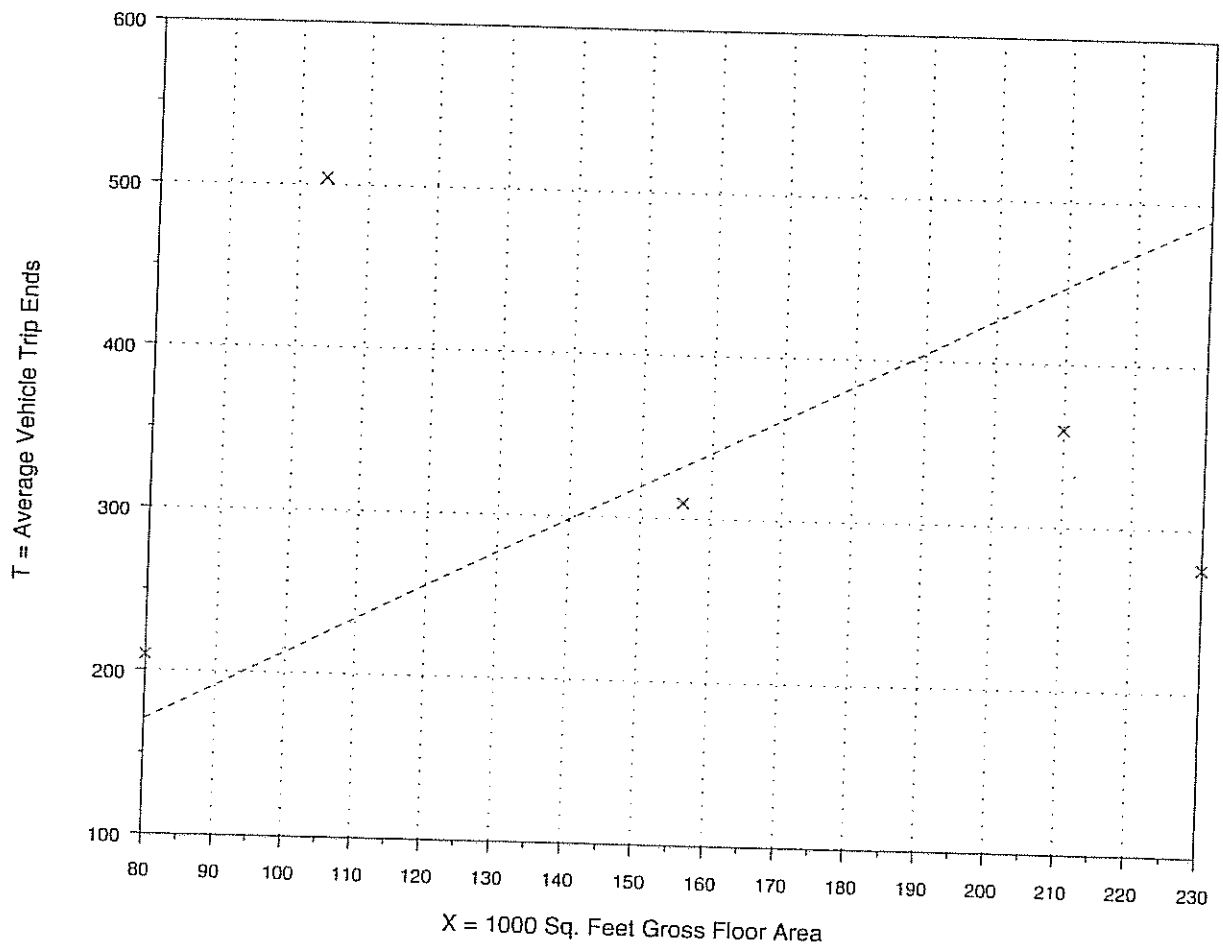
Number of Studies: 5
Average 1000 Sq. Feet GFA: 156
Directional Distribution: 45% entering, 55% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
2.13	1.20 - 4.85	1.85

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× **Actual Data Points**

------ **Average Rate**

Fitted Curve Equation: Not given

R^2 = ****

Hospital
(610)

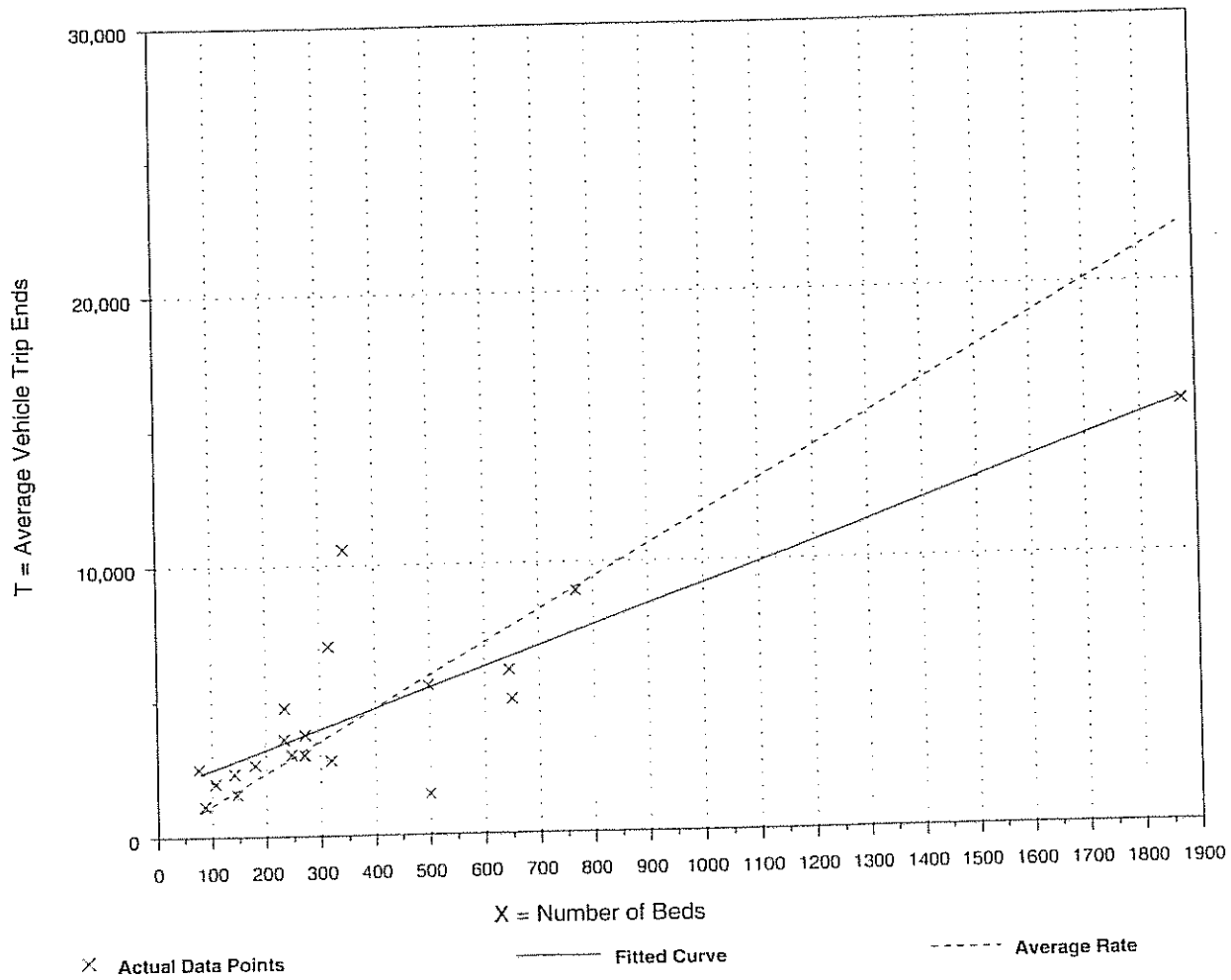
Average Vehicle Trip Ends vs: Beds
On a: Weekday

Number of Studies: 20
Average Number of Beds: 396
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
11.81	3.00 - 32.83	7.08

Data Plot and Equation



Fitted Curve Equation: T = 7.42(X) + 1733.31

R^2 = 0.69

Hospital
(610)

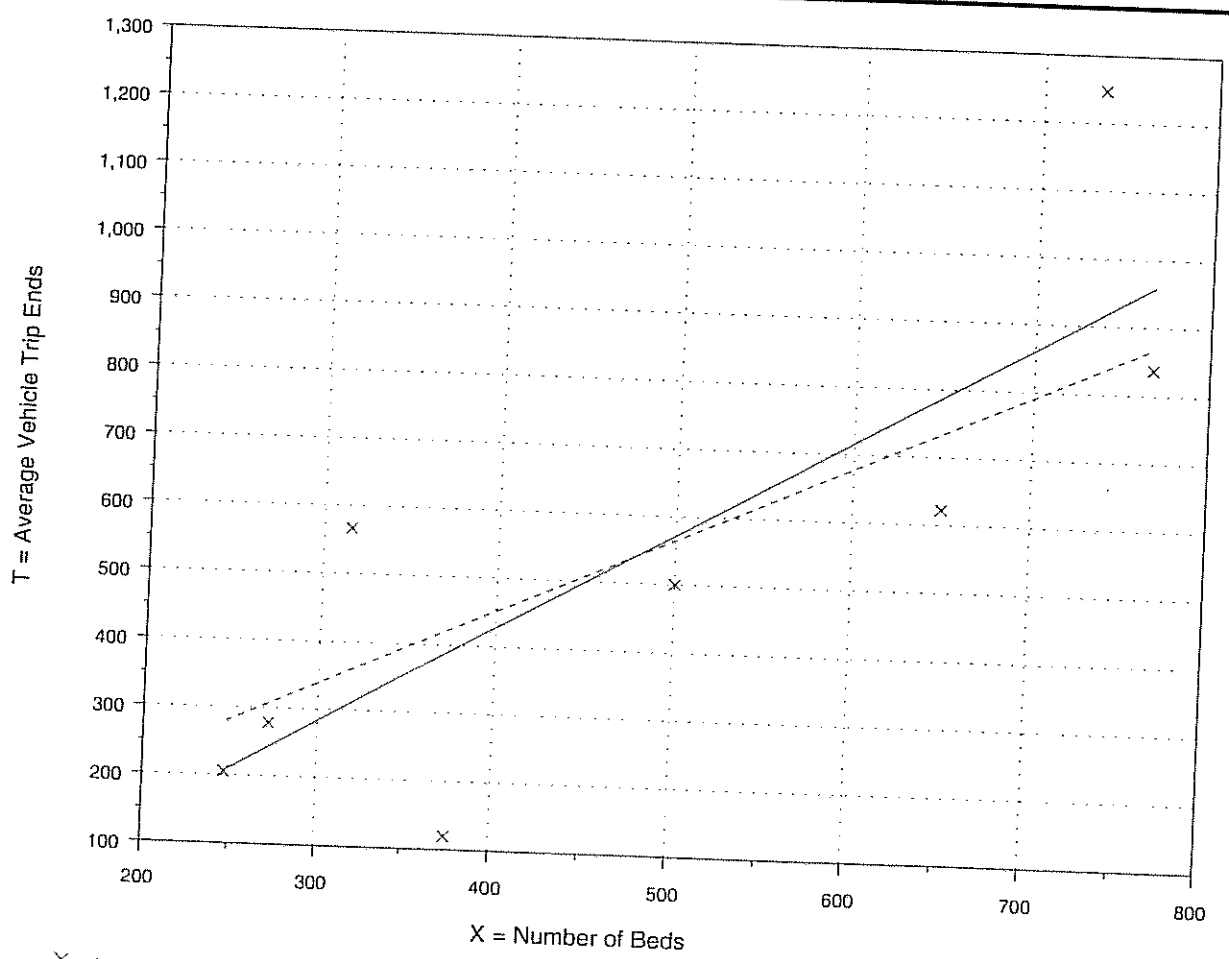
Average Vehicle Trip Ends vs: Beds
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 8
Average Number of Beds: 483
Directional Distribution: 70% entering, 30% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.13	0.32 - 1.79	1.14

Data Plot and Equation



Fitted Curve Equation: T = 1.44(X) - 149.79

$R^2 = 0.68$

Hospital
(610)

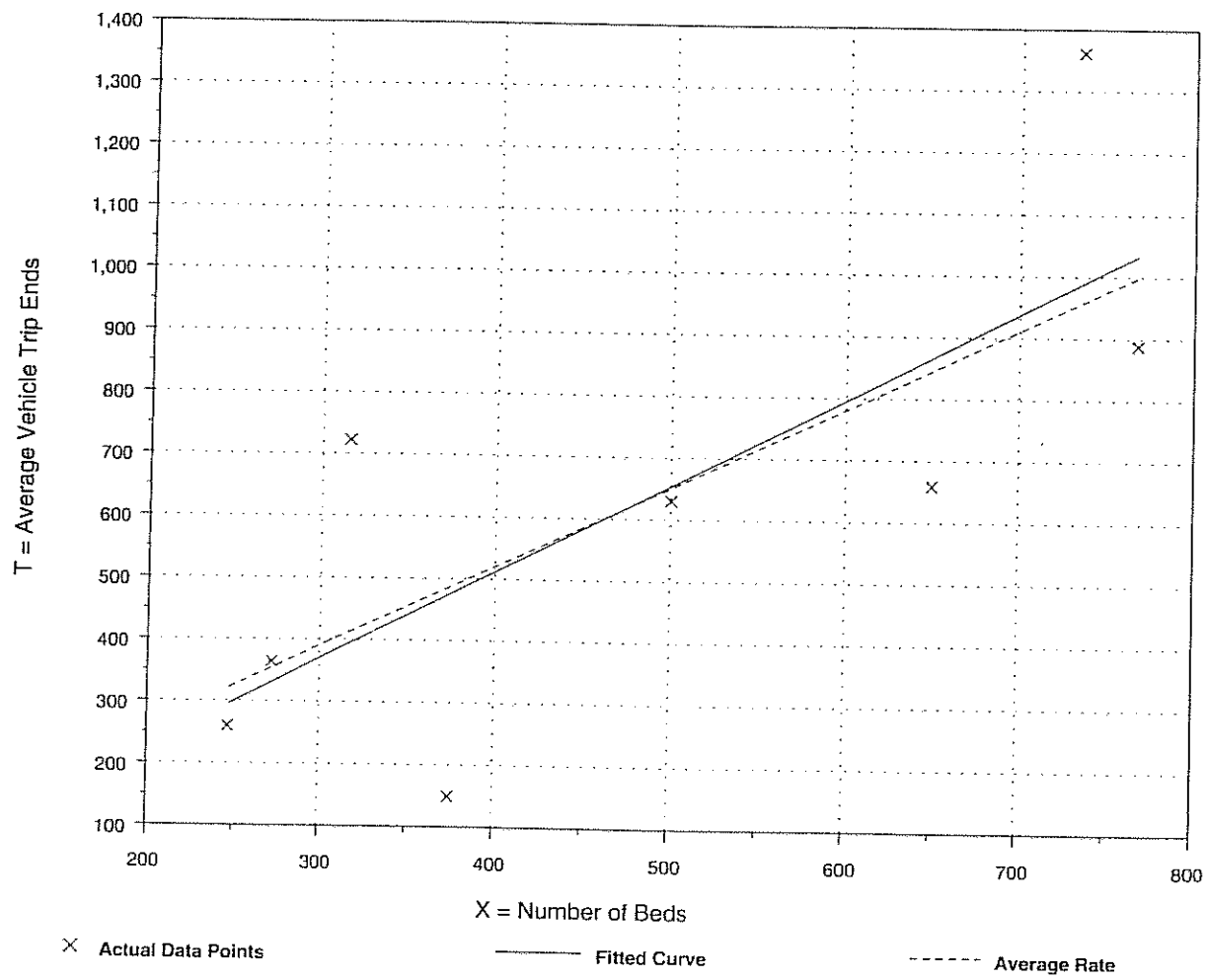
Average Vehicle Trip Ends vs: Beds
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 8
Average Number of Beds: 483
Directional Distribution: 36% entering, 64% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.30	0.40 - 2.28	1.24

Data Plot and Equation



Fitted Curve Equation: T = 1.42(X) - 54.39

R^2 = 0.60

Hospital
(610)

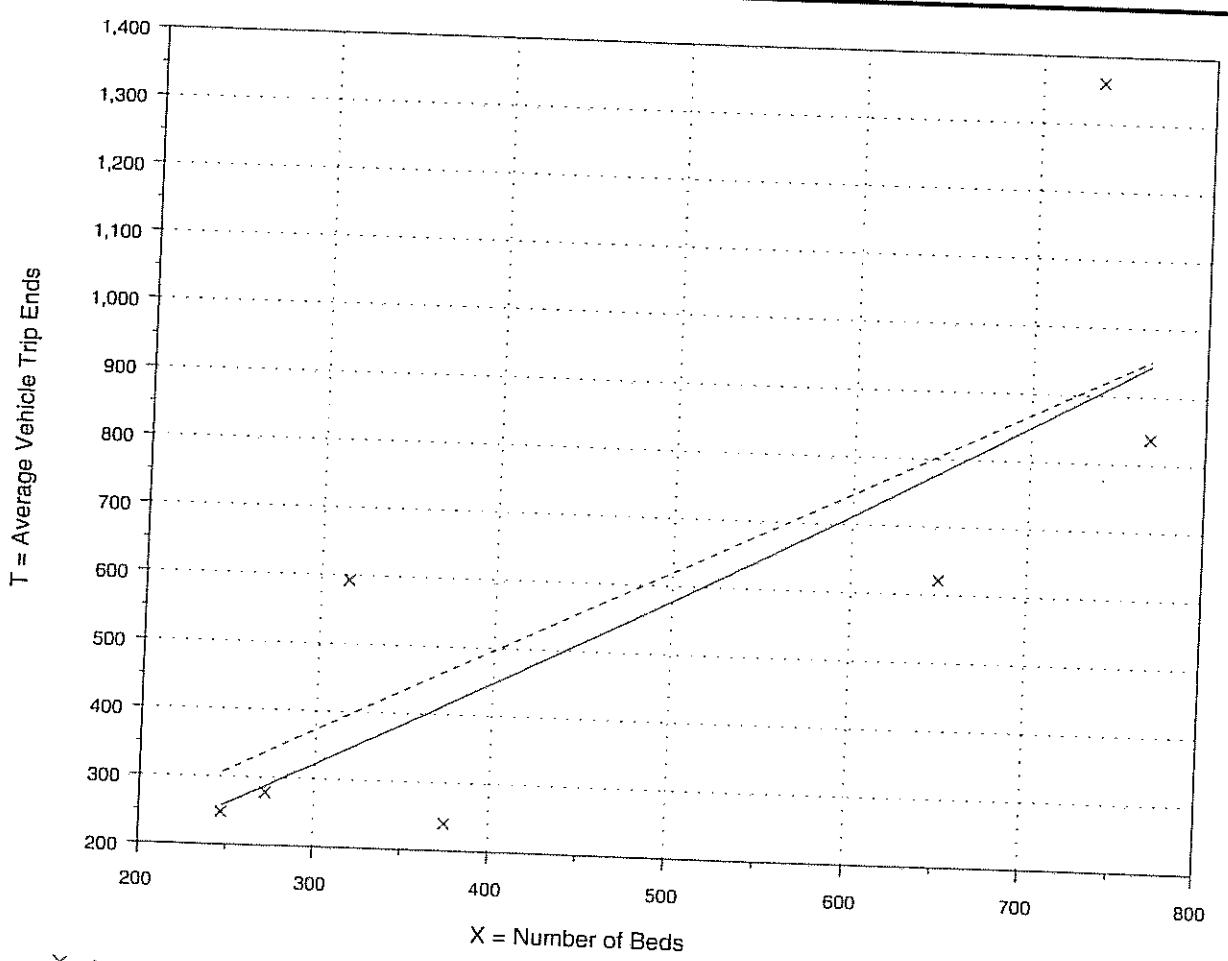
Average Vehicle Trip Ends vs: Beds
On a: Weekday,
A.M. Peak Hour of Generator

Number of Studies: 7
Average Number of Beds: 480
Directional Distribution: 65% entering, 35% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.24	0.64 - 1.88	1.20

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 1.15 Ln(X) - 0.76

$R^2 = 0.69$

Hospital
(610)

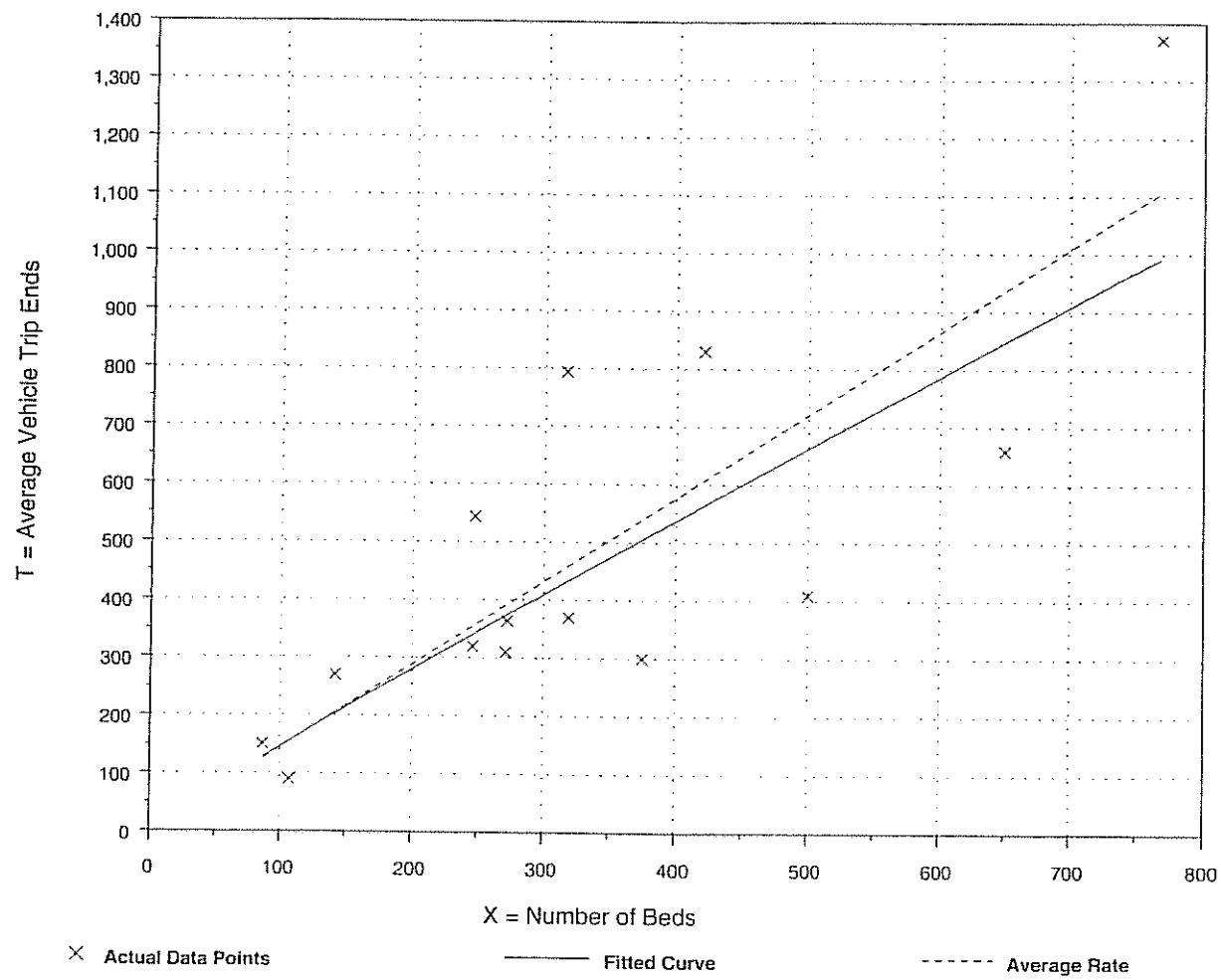
Average Vehicle Trip Ends vs: Beds
On a: Weekday,
P.M. Peak Hour of Generator

Number of Studies: 14
Average Number of Beds: 337
Directional Distribution: 39% entering, 61% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.44	0.80 - 2.51	1.31

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.94 Ln(X) + 0.66 $R^2 = 0.71$

Hospital
(610)

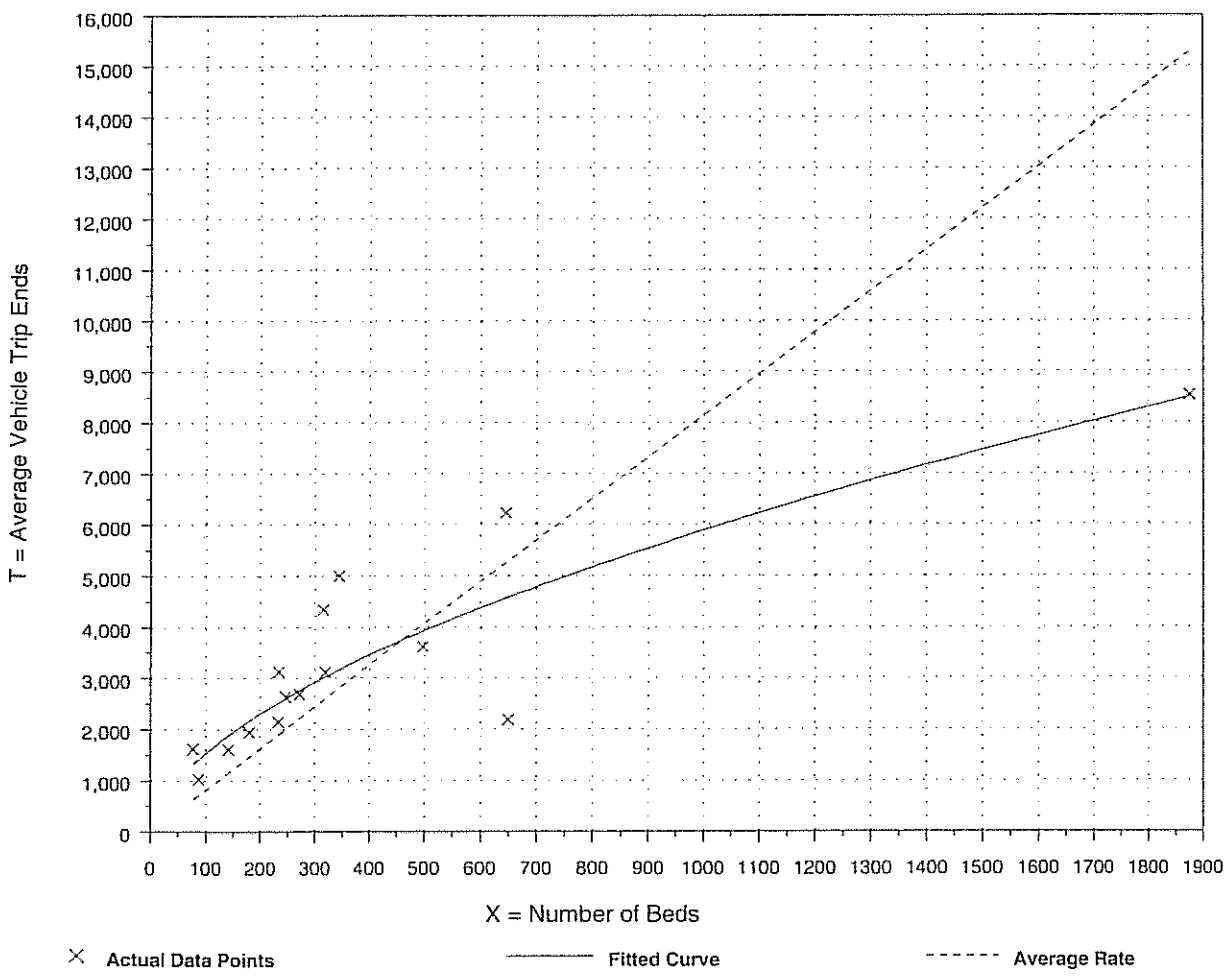
Average Vehicle Trip Ends vs: Beds
On a: Saturday

Number of Studies: 15
Average Number of Beds: 408
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
8.14	3.35 - 21.04	4.80

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.58 Ln(X) + 4.65 $R^2 = 0.71$

Hospital
(610)

Average Vehicle Trip Ends vs: Beds
On a: Saturday,
Peak Hour of Generator

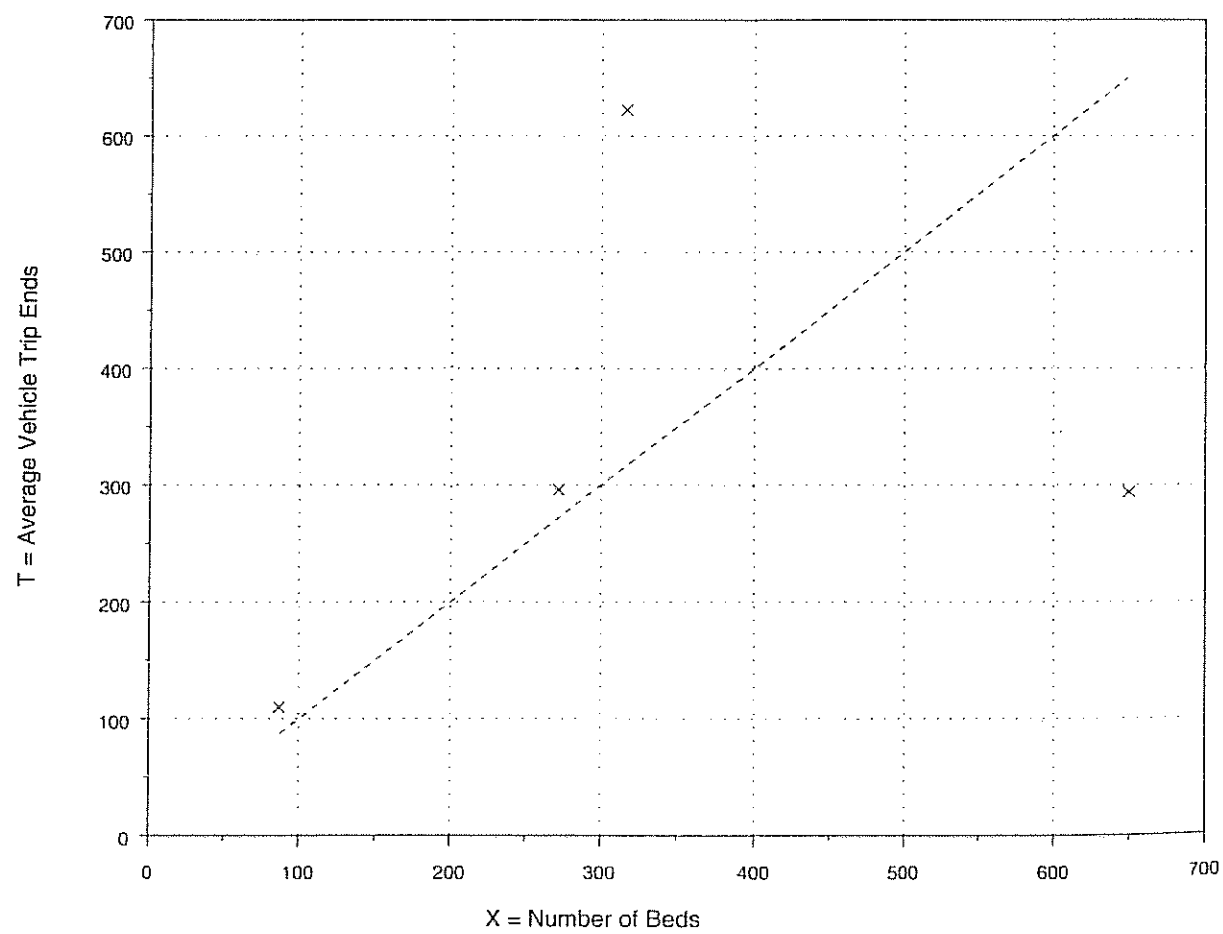
Number of Studies: 4
Average Number of Beds: 331
Directional Distribution: 47% entering, 53% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.00	0.45 - 1.97	1.17

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Hospital
(610)

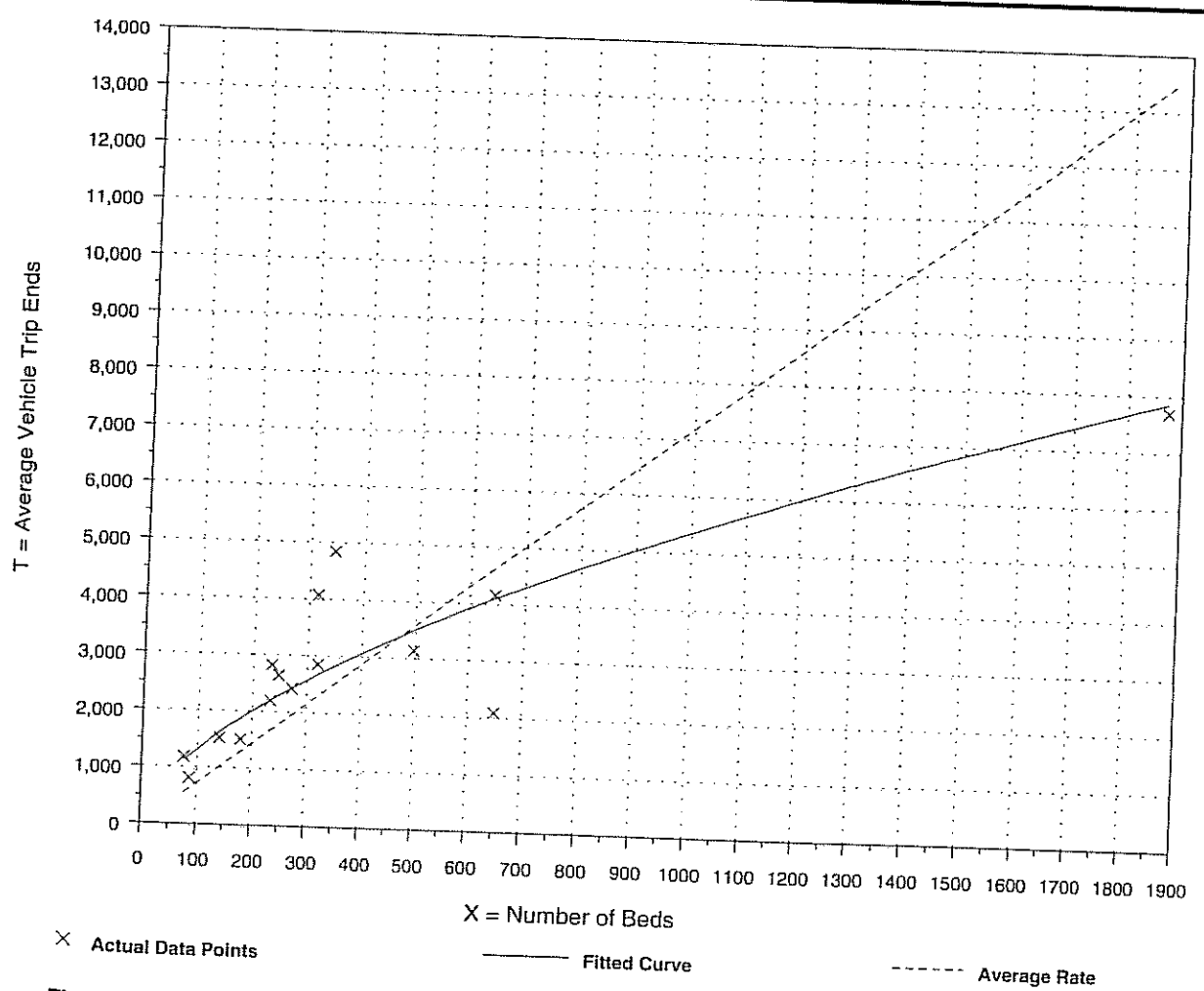
Average Vehicle Trip Ends vs: Beds
On a: Sunday

Number of Studies: 15
Average Number of Beds: 408
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
7.19	3.22 - 15.32	4.40

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.61 Ln(X) + 4.38

R^2 = 0.73

Hospital
(610)

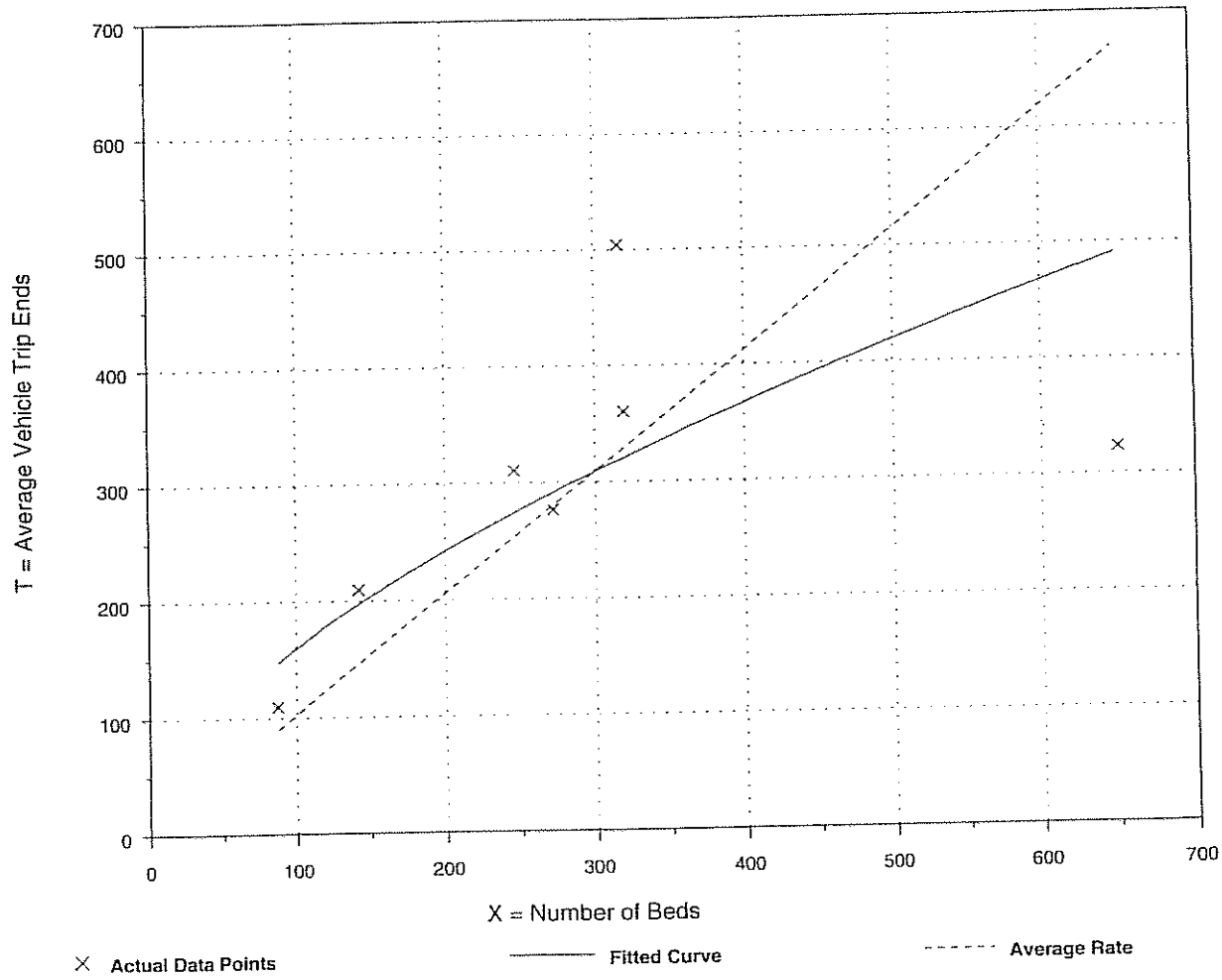
Average Vehicle Trip Ends vs: Beds
On a: Sunday,
Peak Hour of Generator

Number of Studies: 7
Average Number of Beds: 290
Directional Distribution: 45% entering, 55% exiting

Trip Generation per Bed

Average Rate	Range of Rates	Standard Deviation
1.03	0.50 - 1.59	1.09

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.60 Ln(X) + 2.31

R^2 = 0.64

Land Use: 760
Research and Development Center

Description

Research and development centers are facilities or groups of facilities devoted almost exclusively to research and development activities. The range of specific types of businesses contained in this land use varies significantly. Research and development centers may contain offices and light fabrication areas. General office building (Land Use 710), corporate headquarters building (Land Use 714), single tenant office building (Land Use 715), office park (Land Use 750) and business park (Land Use 770) are related uses.

Additional Data

Truck trips accounted for 1.84 percent of the weekday traffic at the research and development centers surveyed (range of 0.4 percent to 4.0 percent).

The average vehicle occupancy for the 13 studies where information was submitted was approximately 1.19 persons per automobile. The vehicle occupancy rates ranged from 1.10 to 1.33 persons per automobile.

The sites were surveyed from the 1960s to the 1990s throughout the United States.

Trip Characteristics

The trip generation for the a.m. and p.m. peak hours of the generator typically coincided with the peak hours of the adjacent street traffic; therefore, only one a.m. peak hour and one p.m. peak hour, which represent both the peak hour of the generator and the peak hour of the adjacent street traffic, are shown for research and development centers.

Source Numbers

9, 105, 213, 218, 253, 332, 384, 423

Research and Development Center
(760)

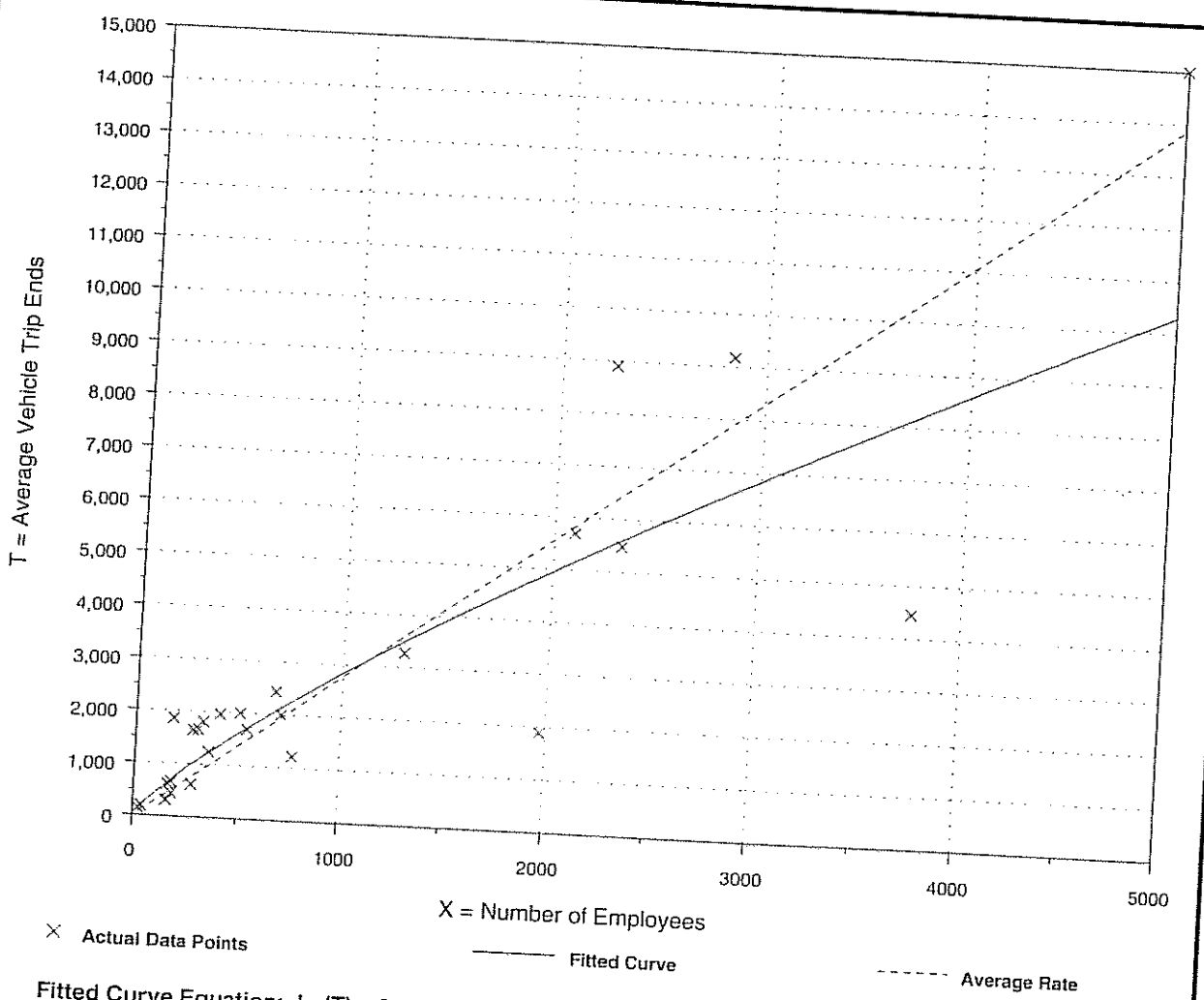
Average Vehicle Trip Ends vs: Employees
On a: Weekday

Number of Studies: 27
Avg. Number of Employees: 1,022
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
2.77	0.96 - 10.63	2.09

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.80 Ln(X) + 2.42

$R^2 = 0.87$

Research and Development Center
(760)

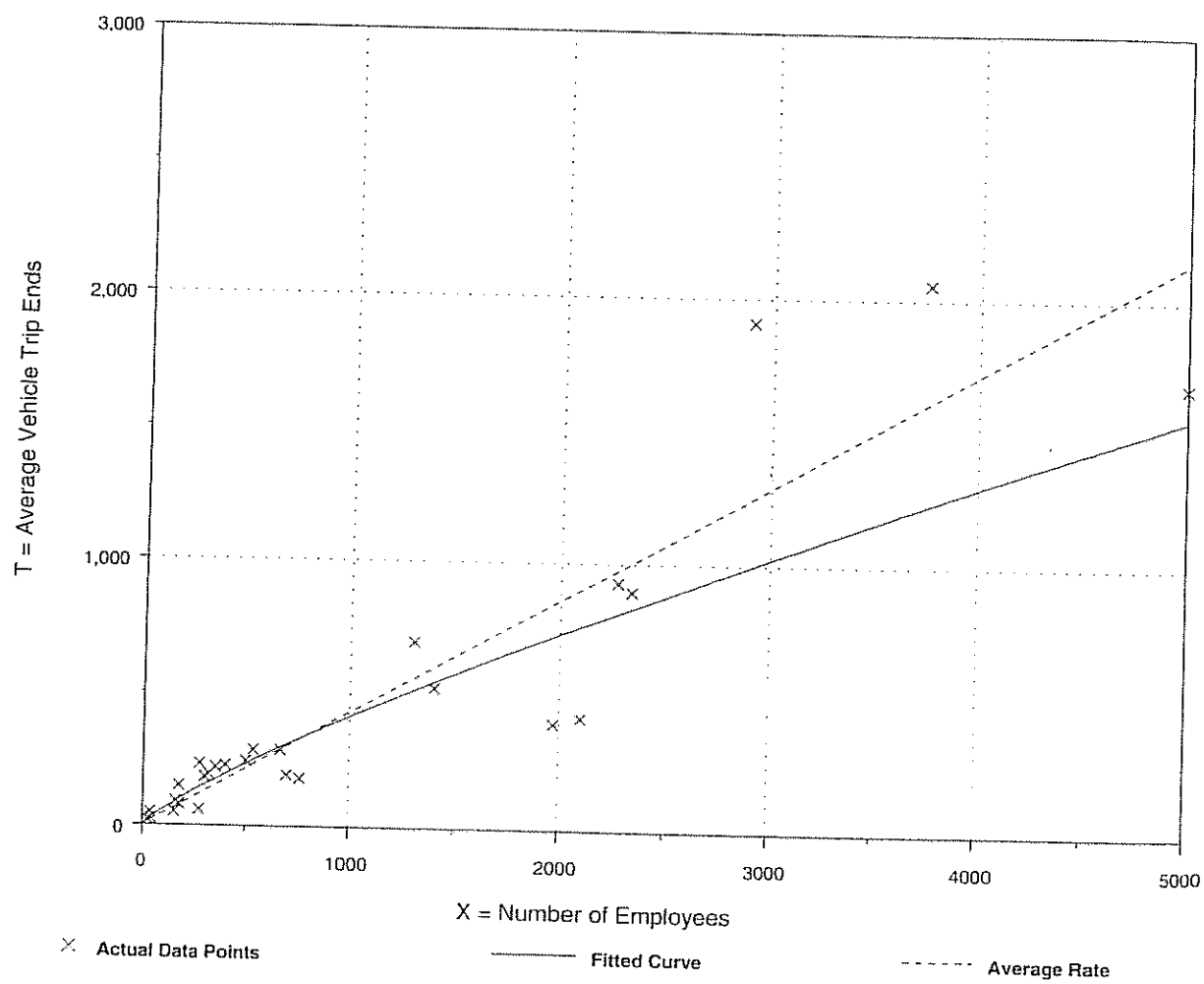
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
A.M. Peak Hour

Number of Studies: 28
Avg. Number of Employees: 1,038
Directional Distribution: 86% entering, 14% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.43	0.20 - 1.39	0.67

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.82 Ln(X) + 0.33

R^2 = 0.90

Research and Development Center
(760)

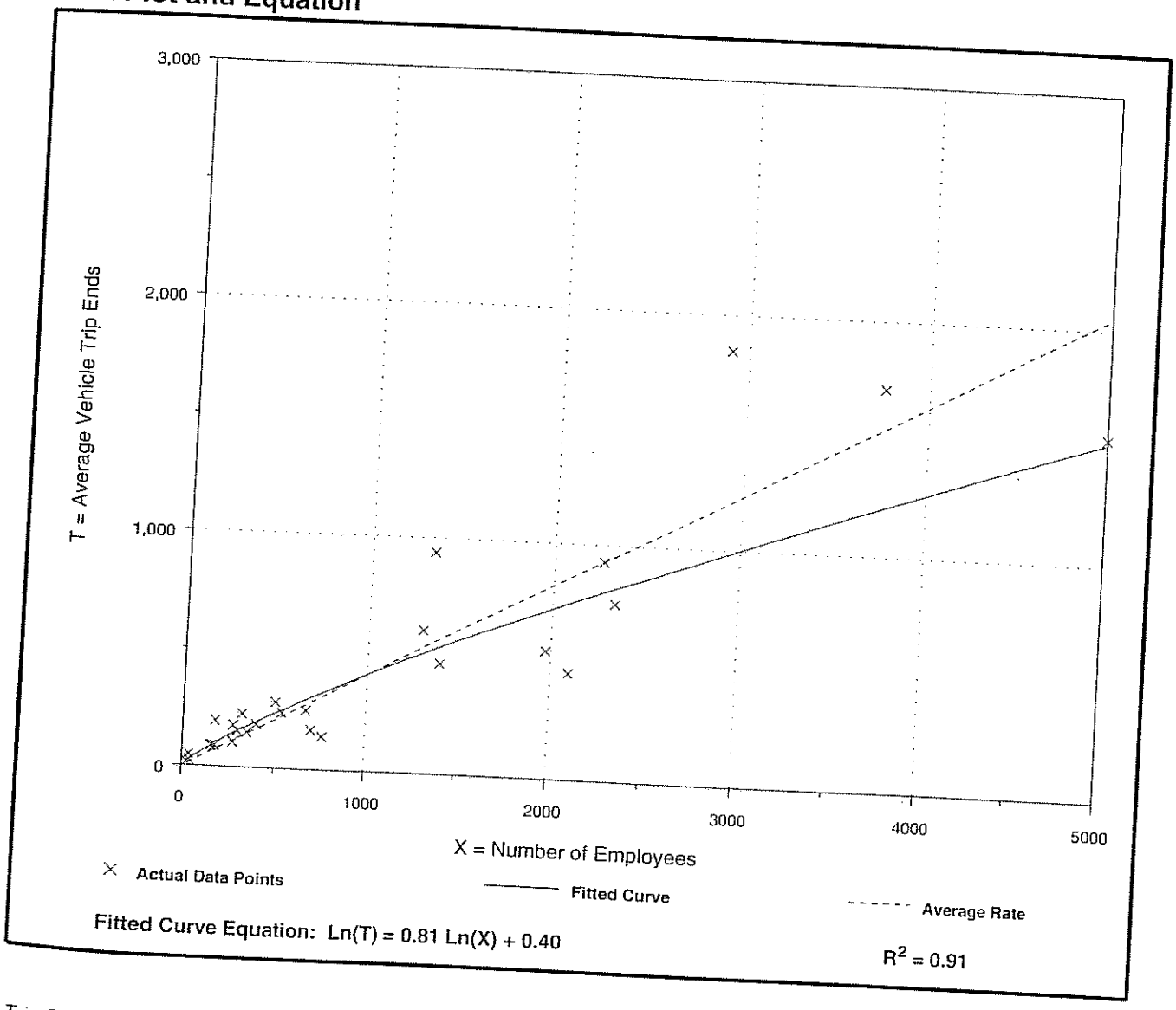
Average Vehicle Trip Ends vs: Employees
On a: Weekday,
P.M. Peak Hour

Number of Studies: 29
Avg. Number of Employees: 1,049
Directional Distribution: 10% entering, 90% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.41	0.18 - 1.39	0.66

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.81\ Ln(X) + 0.40$

$R^2 = 0.91$

Research and Development Center
(760)

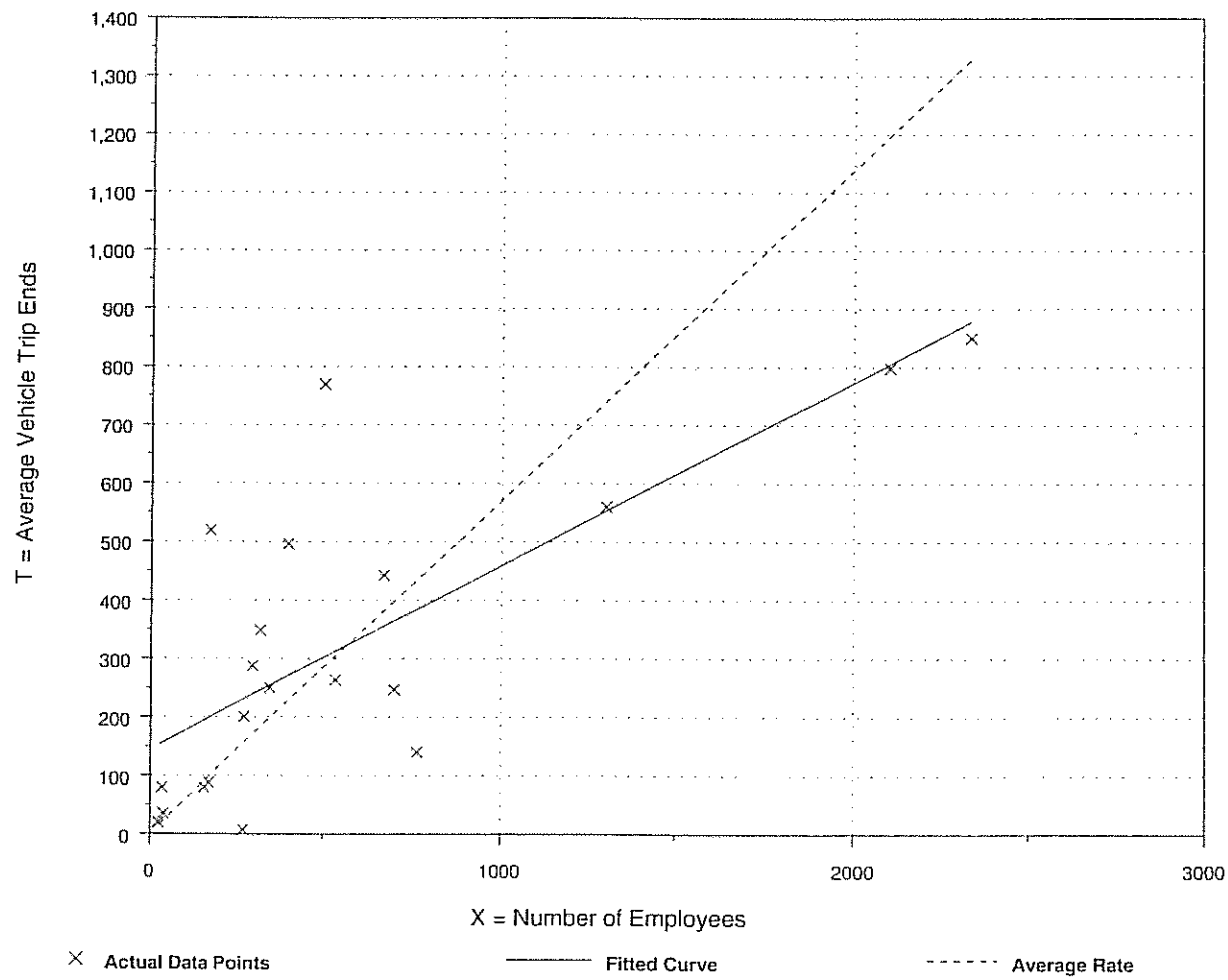
Average Vehicle Trip Ends vs: Employees
On a: Saturday

Number of Studies: 20
Avg. Number of Employees: 572
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.57	0.03 - 2.97	0.88

Data Plot and Equation



Fitted Curve Equation: T = 0.31(X) + 144.44

R^2 = 0.57

Research and Development Center
(760)

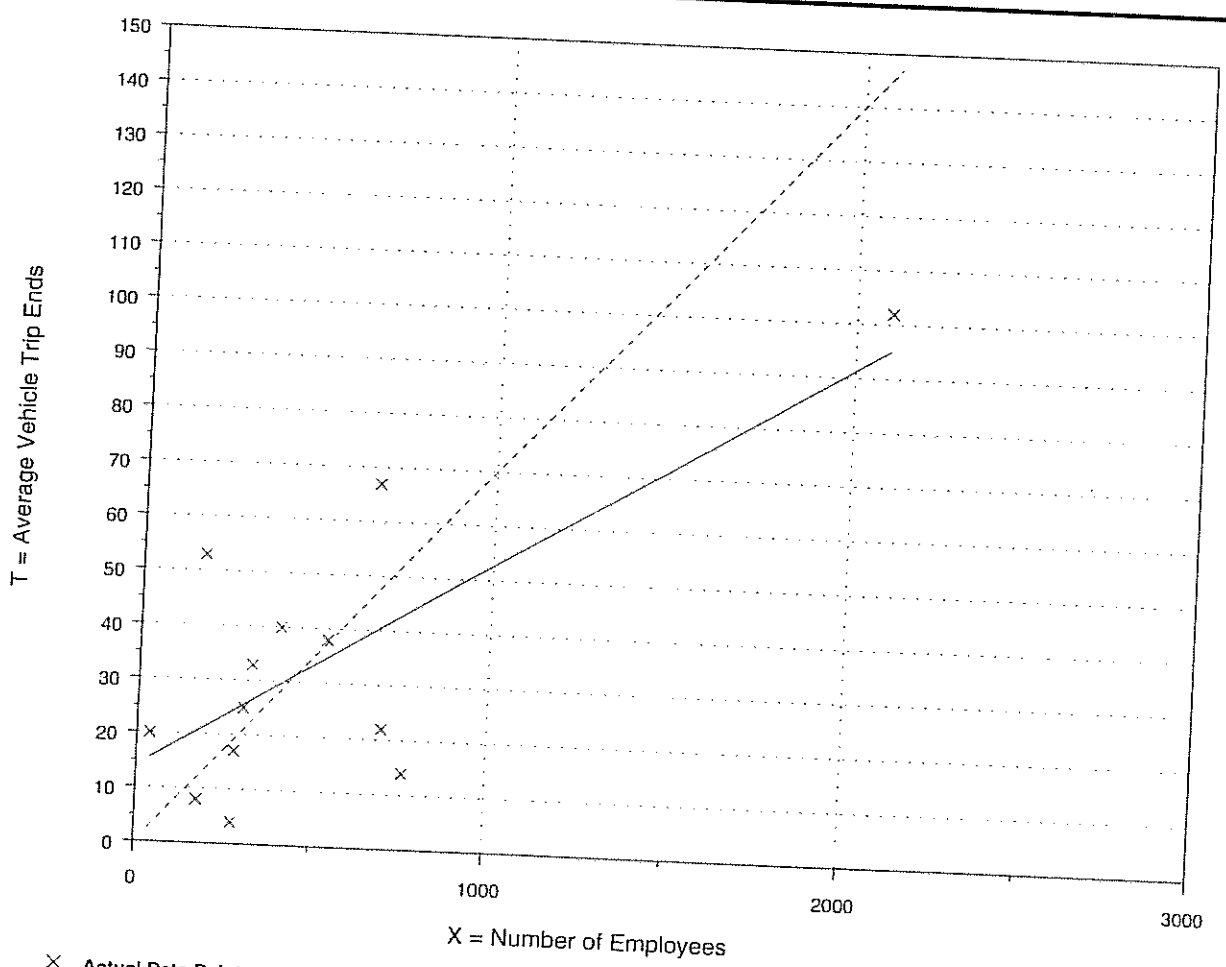
Average Vehicle Trip Ends vs: Employees
On a: Saturday,
Peak Hour of Generator

Number of Studies: 13
Avg. Number of Employees: 518
Directional Distribution: Not available

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.07	0.01 - 0.56	0.26

Data Plot and Equation



Fitted Curve Equation: T = 0.04(X) + 14.10

$R^2 = 0.56$

Research and Development Center
(760)

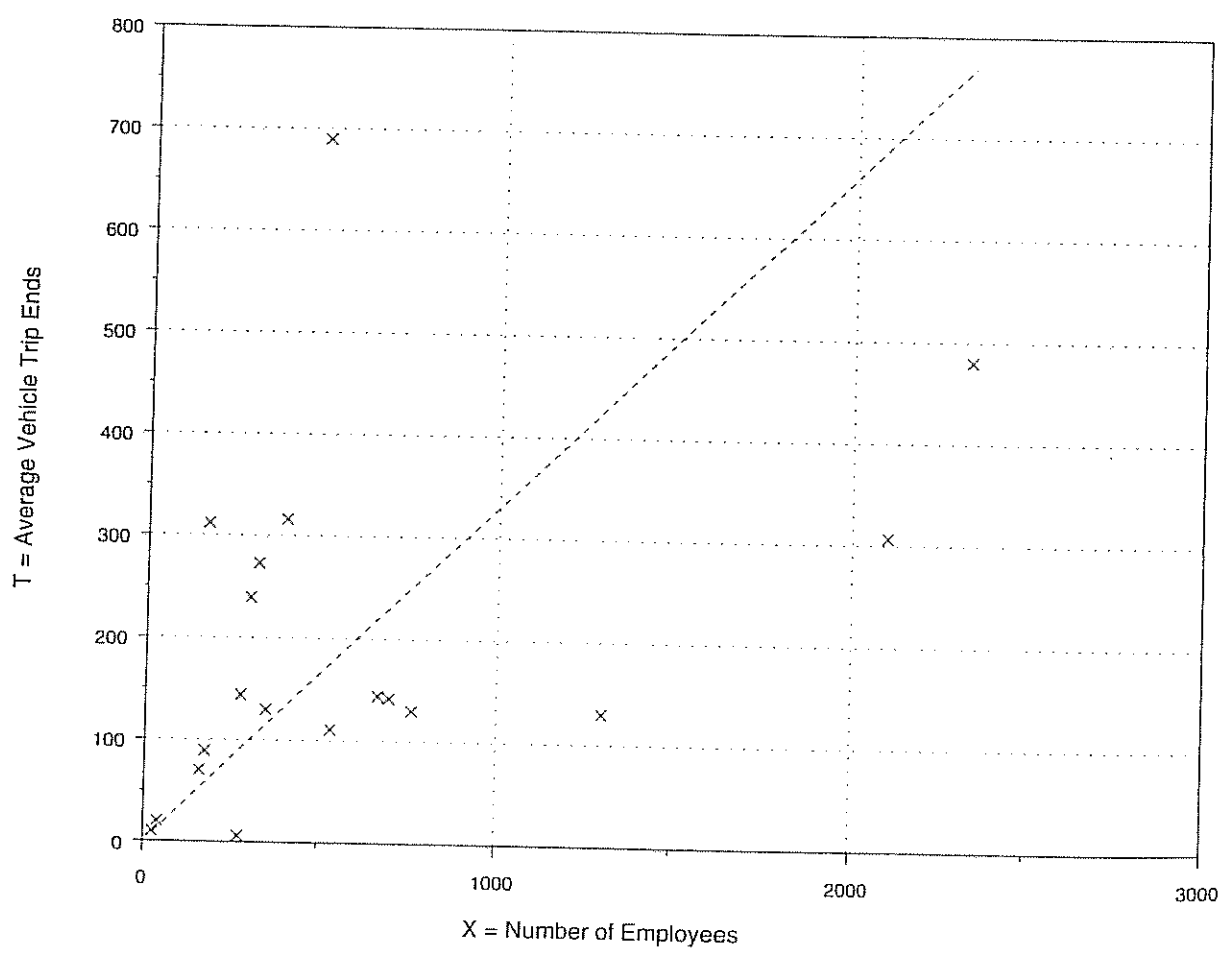
Average Vehicle Trip Ends vs: Employees
On a: Sunday

Number of Studies: 19
Avg. Number of Employees: 600
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.33	0.02 - 1.78	0.67

Data Plot and Equation



× Actual Data Points

- - - - - Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

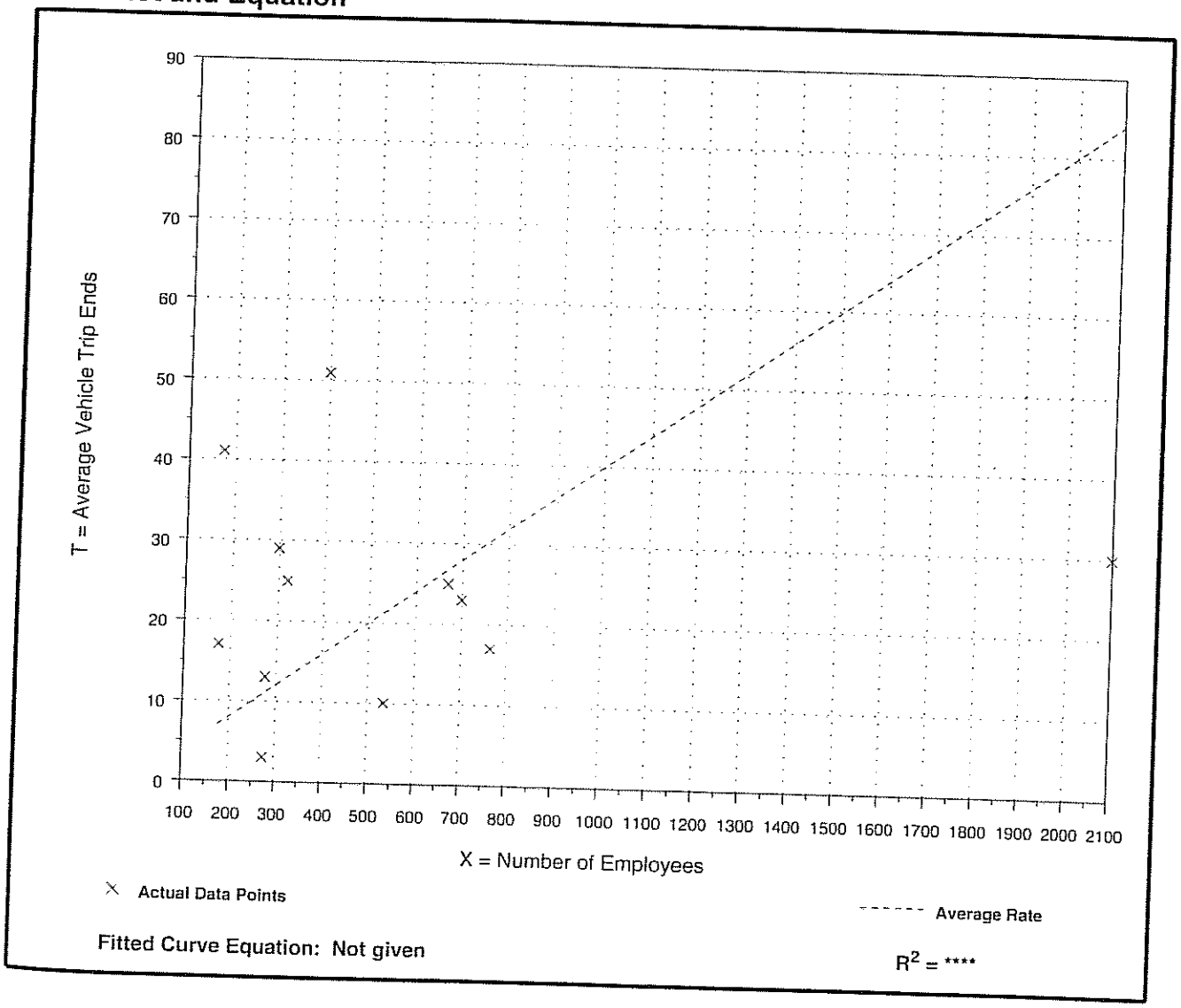
Average Vehicle Trip Ends vs: Employees
On a: Sunday,
Peak Hour of Generator

Number of Studies: 12
Avg. Number of Employees: 558
Directional Distribution: Not available

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.04	0.01 - 0.23	0.21

Data Plot and Equation



Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

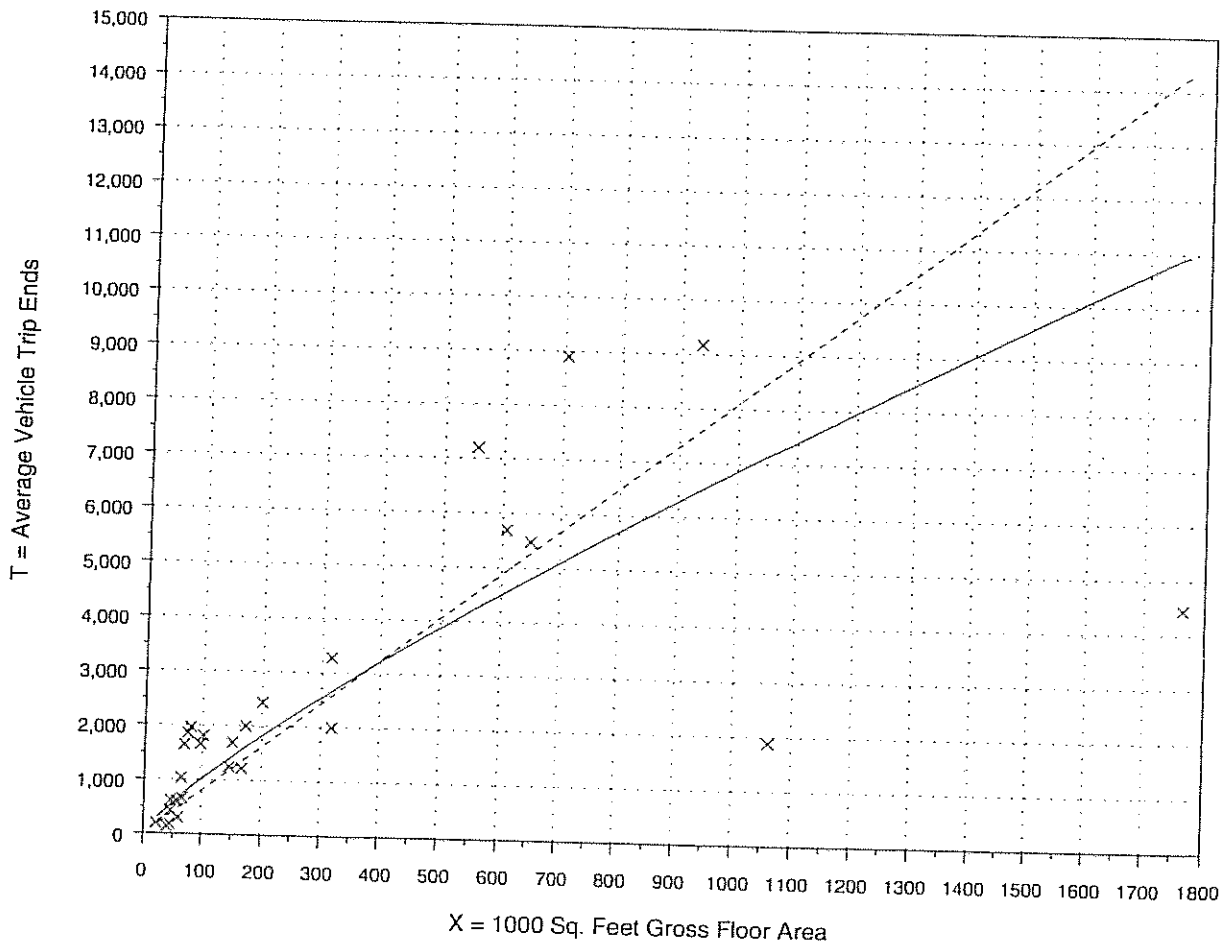
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 28
Average 1000 Sq. Feet GFA: 308
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
8.11	1.78 - 24.95	5.85

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.82 Ln(X) + 3.14

R^2 = 0.72

Research and Development Center
(760)

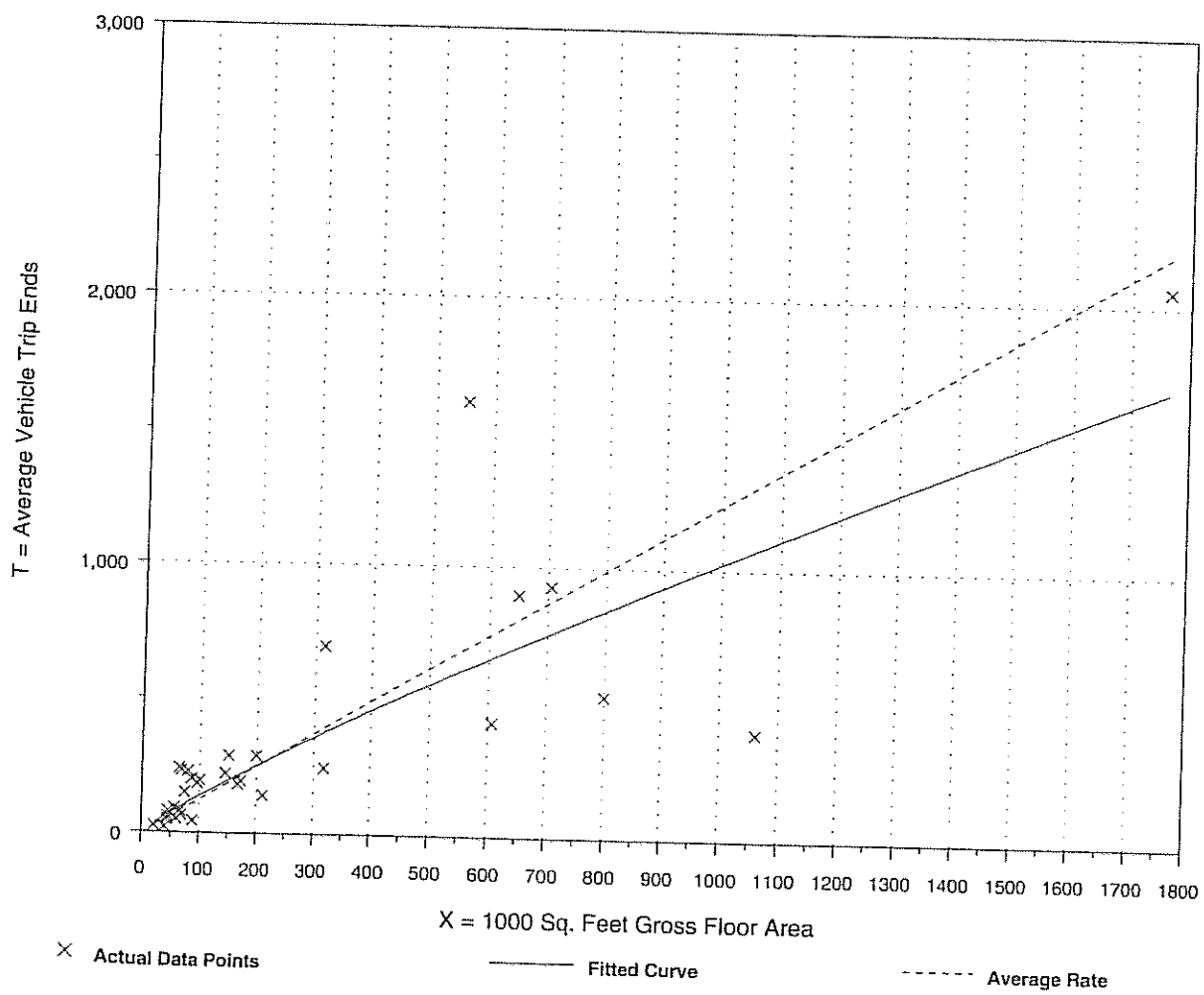
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday,
A.M. Peak Hour

Number of Studies: 32
Average 1000 Sq. Feet GFA: 279
Directional Distribution: 83% entering, 17% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.24	0.37 - 3.73	1.32

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.88 Ln(X) + 0.88

$R^2 = 0.75$

Research and Development Center
(760)

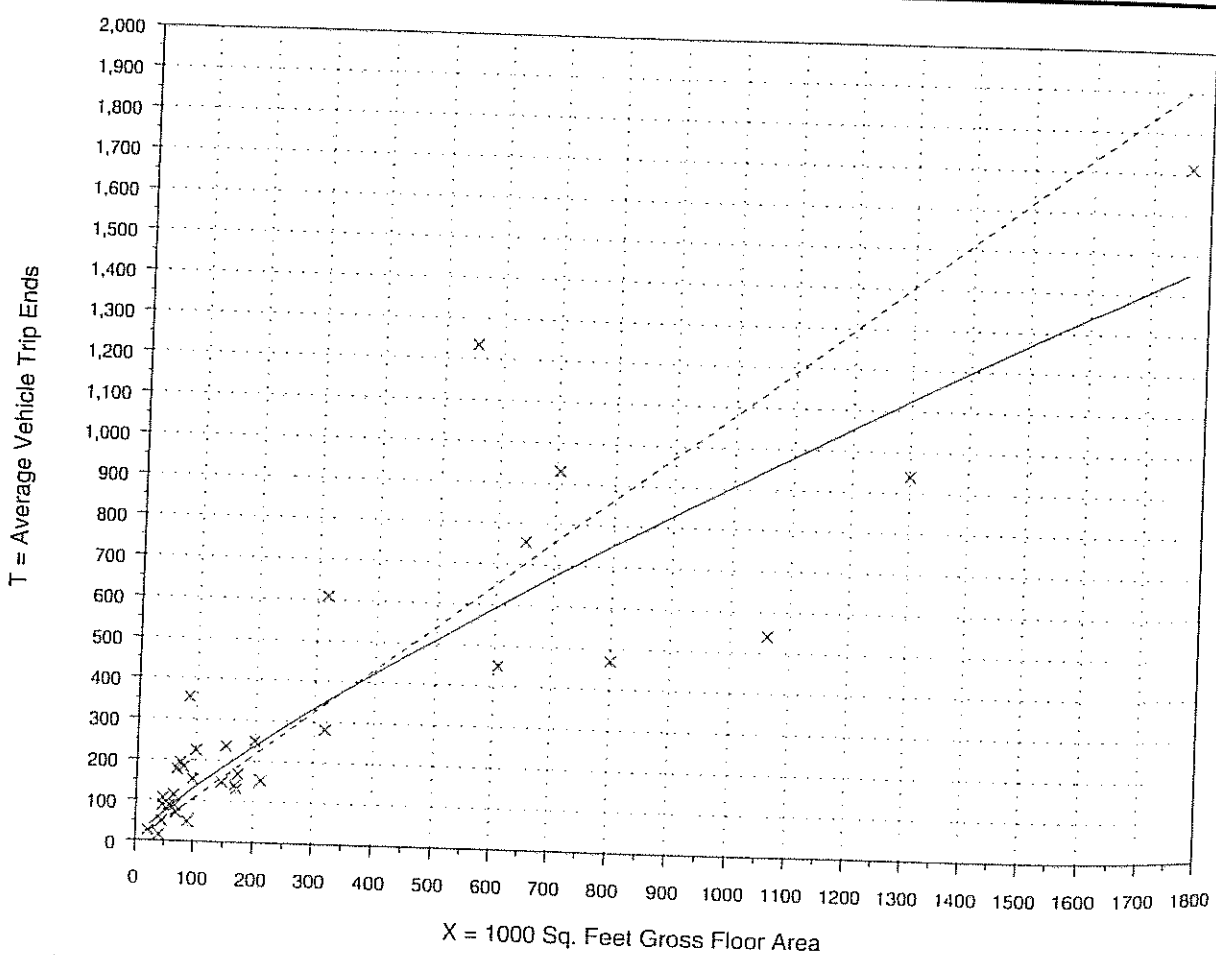
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday,
P.M. Peak Hour

Number of Studies: 34
Average 1000 Sq. Feet GFA: 306
Directional Distribution: 15% entering, 85% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.08	0.40 - 4.13	1.19

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.83\ Ln(X) + 1.06$

$R^2 = 0.78$

Research and Development Center
(760)

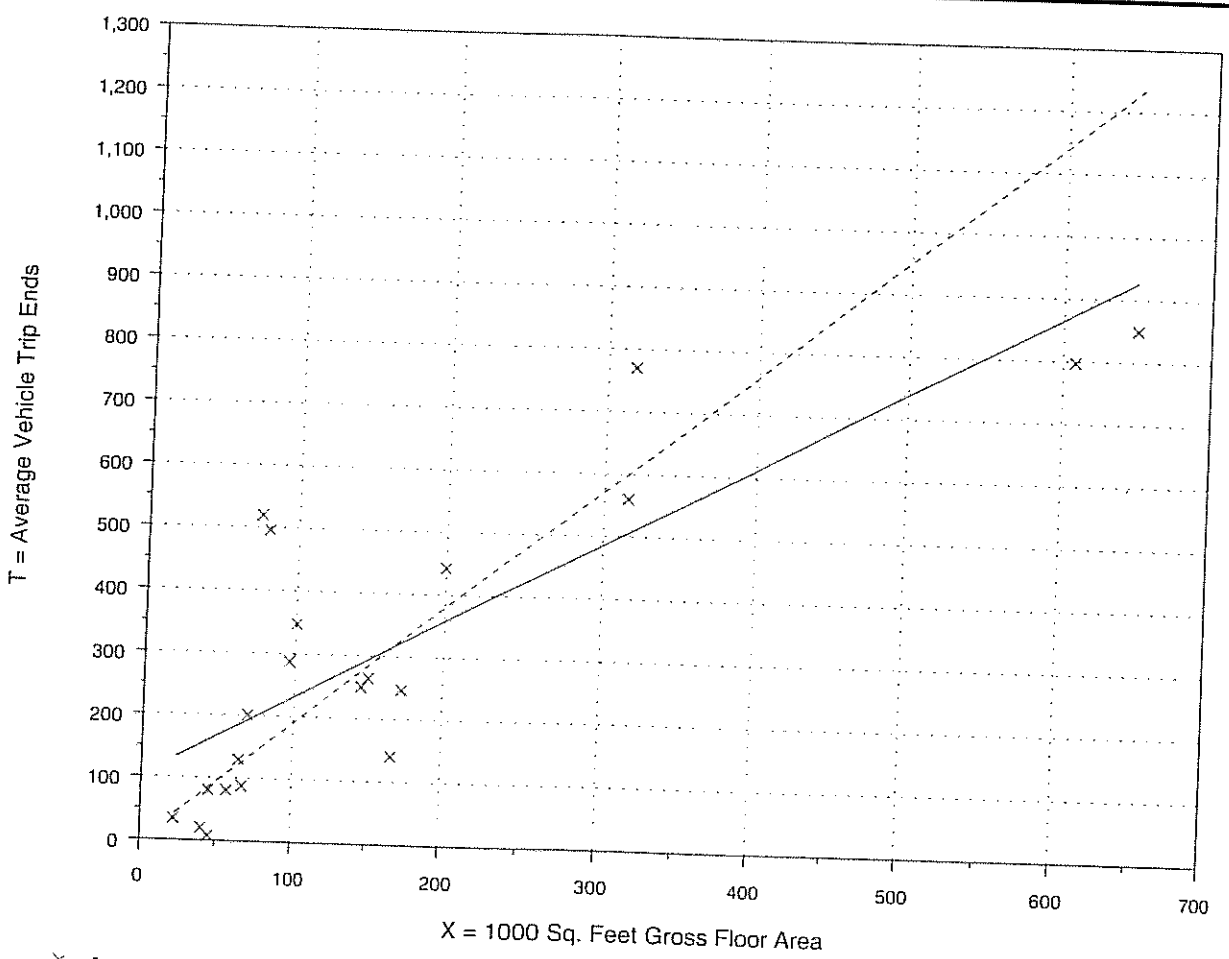
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Saturday

Number of Studies: 21
Average 1000 Sq. Feet GFA: 166
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.90	0.18 - 6.96	1.81

Data Plot and Equation



Fitted Curve Equation: $T = 1.27(X) + 104.92$

$R^2 = 0.70$

Research and Development Center
(760)

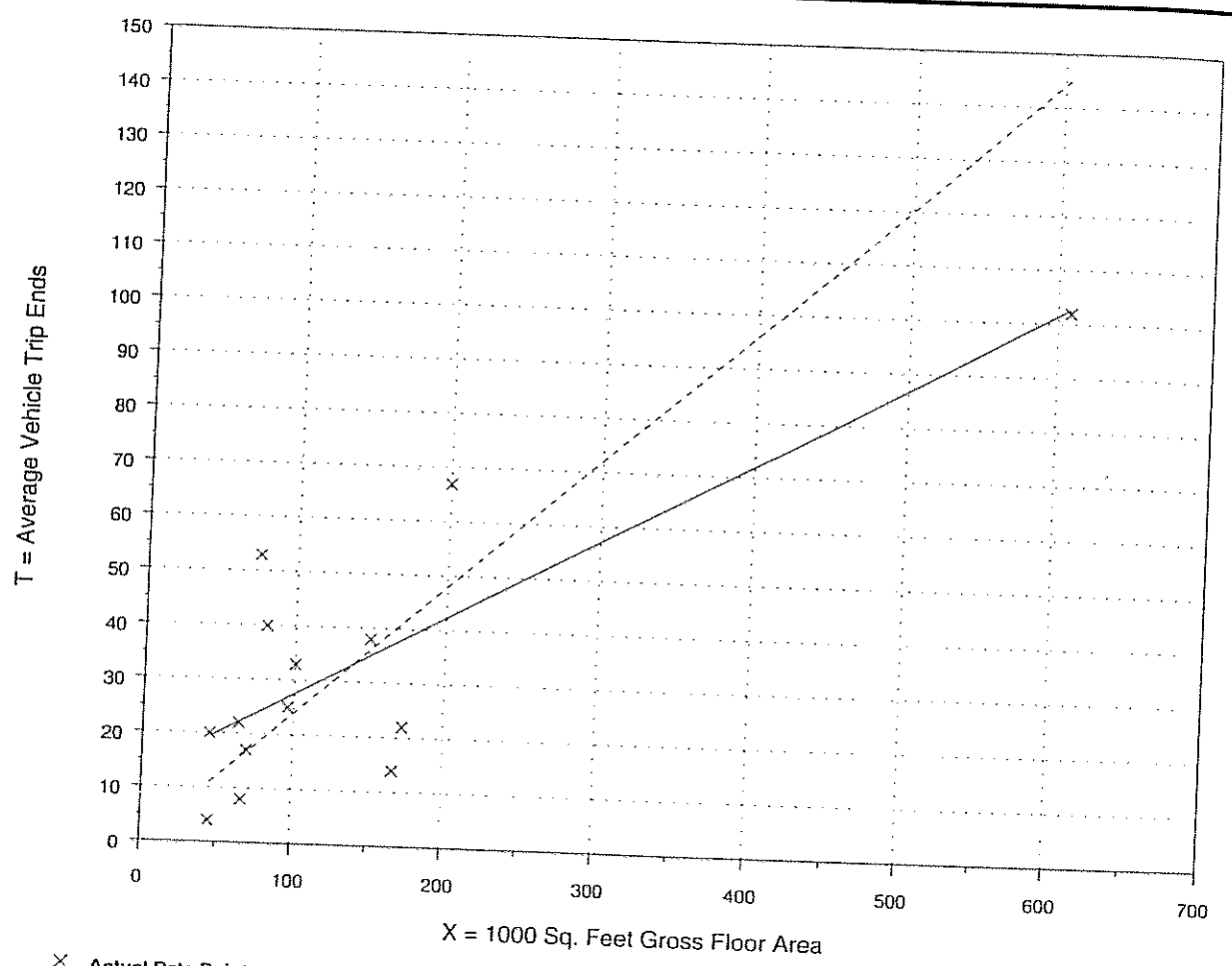
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Saturday,**
Peak Hour of Generator

Number of Studies: 14
Average 1000 Sq. Feet GFA: 138
Directional Distribution: Not available

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.24	0.08 - 0.71	0.51

Data Plot and Equation



× Actual Data Points — Fitted Curve - - - - Average Rate

Fitted Curve Equation: $T = 0.15(X) + 12.75$

$R^2 = 0.66$

Research and Development Center
(760)

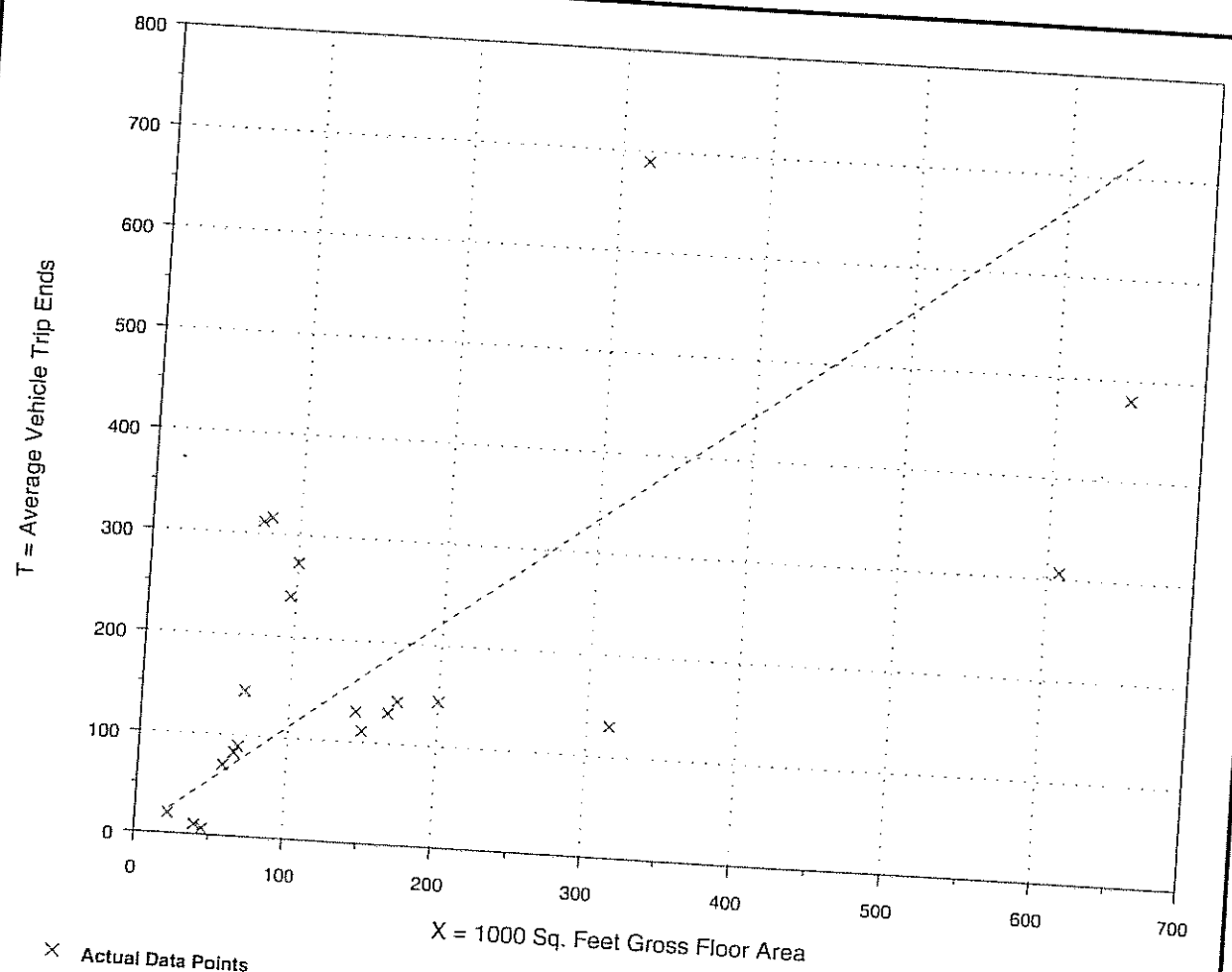
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Sunday

Number of Studies: 20
Average 1000 Sq. Feet GFA: 172
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.11	0.13 - 4.18	1.39

Data Plot and Equation



× Actual Data Points

Fitted Curve Equation: Not given

------ Average Rate

R^2 = ****

Research and Development Center
(760)

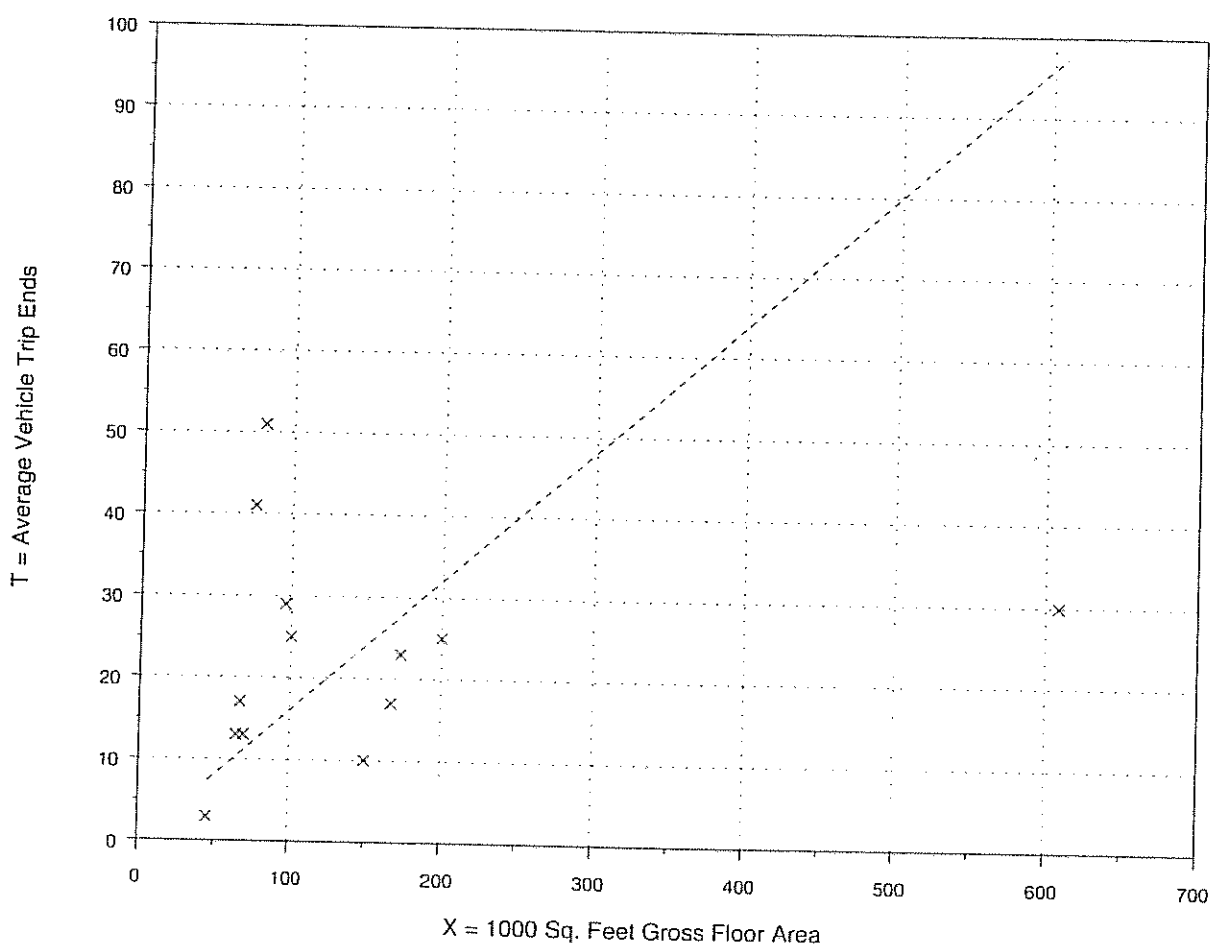
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Sunday,
Peak Hour of Generator

Number of Studies: 13
Average 1000 Sq. Feet GFA: 146
Directional Distribution: Not available

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.16	0.05 - 0.64	0.42

Data Plot and Equation



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

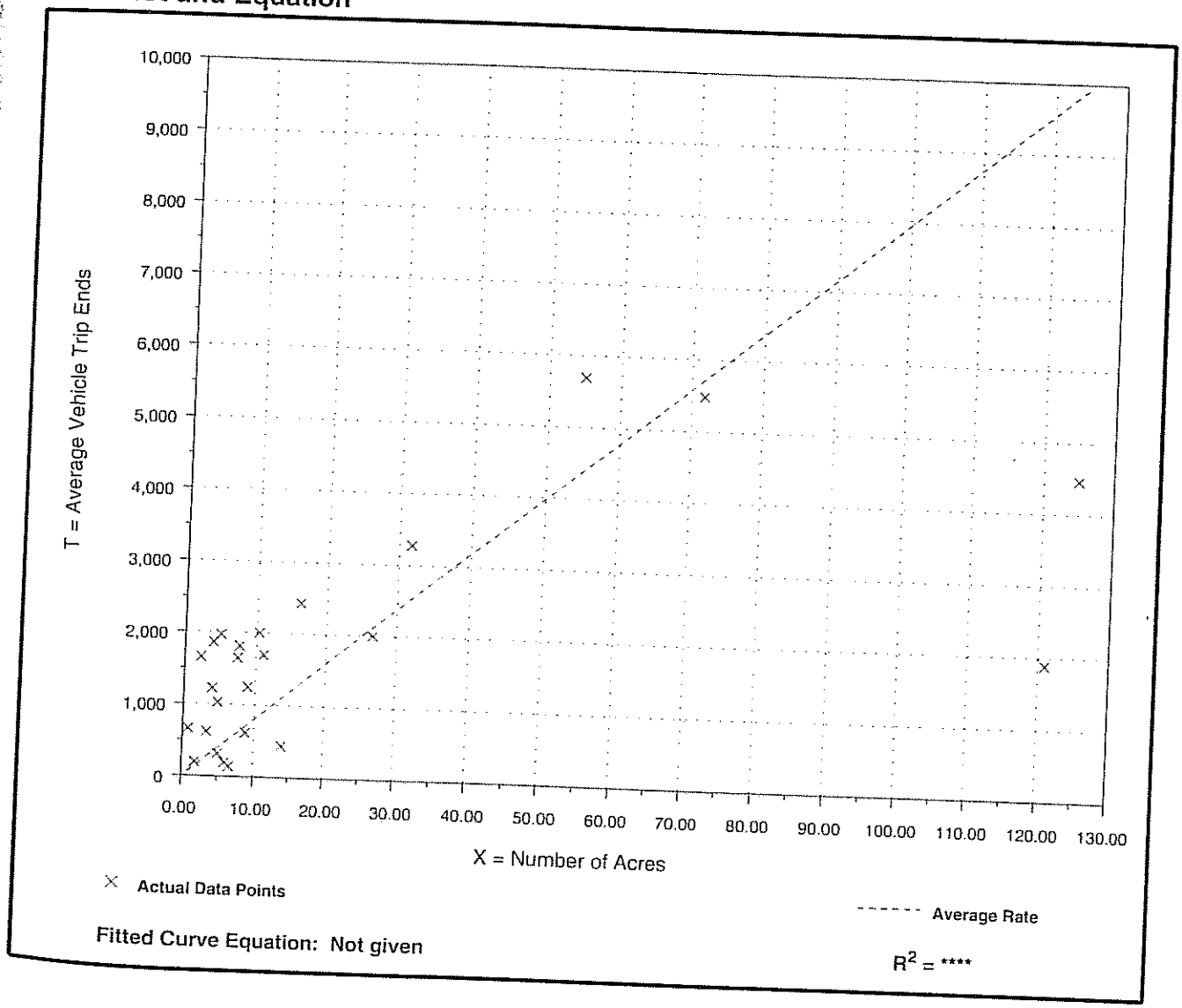
Average Vehicle Trip Ends vs: Acres
On a: Weekday

Number of Studies: 25
Average Number of Acres: 22
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
79.61	15.61 - 876.00	88.46

Data Plot and Equation



Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

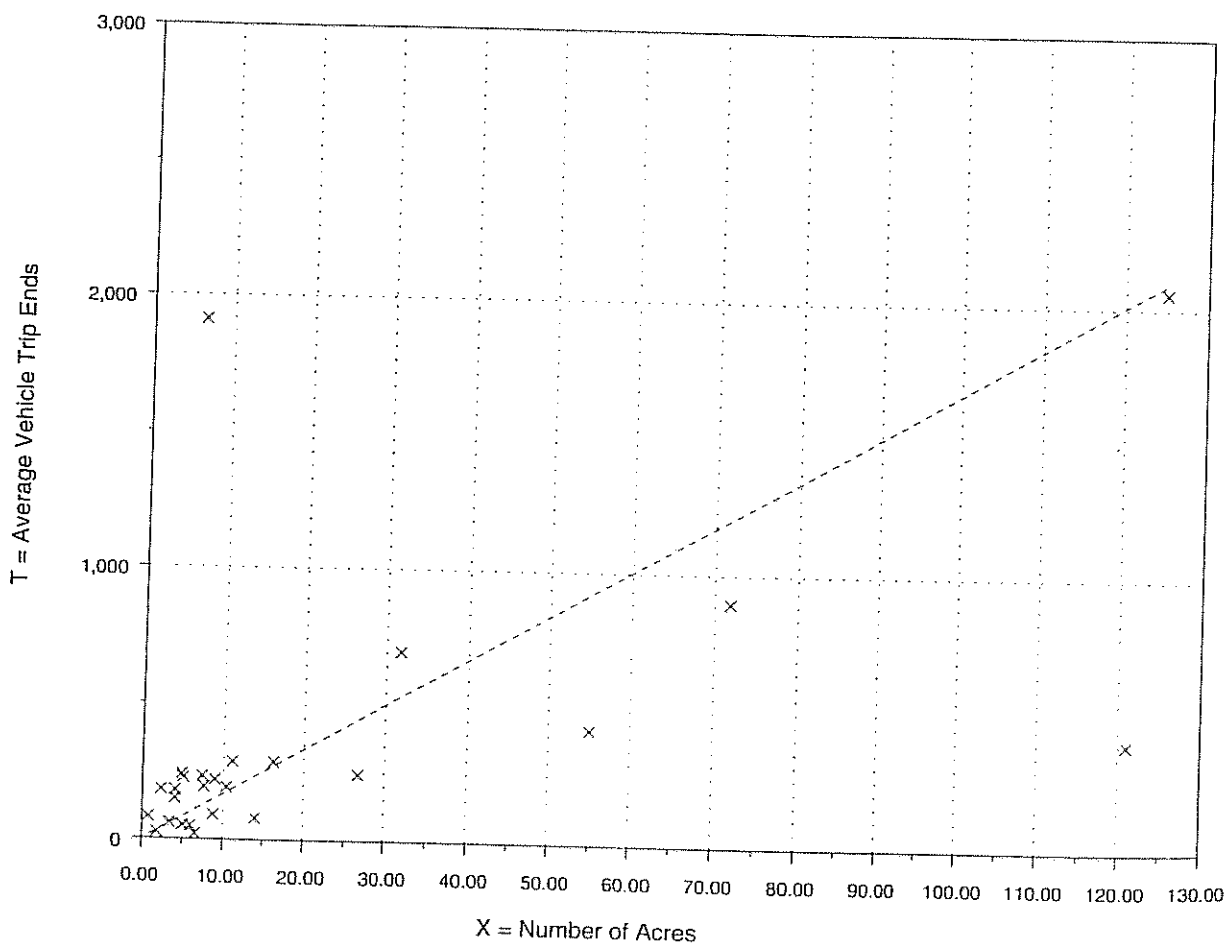
Average Vehicle Trip Ends vs: Acres
On a: Weekday,
A.M. Peak Hour

Number of Studies: 26
Average Number of Acres: 22
Directional Distribution: 84% entering, 16% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
16.77	3.03 - 293.85	31.93

Data Plot and Equation



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

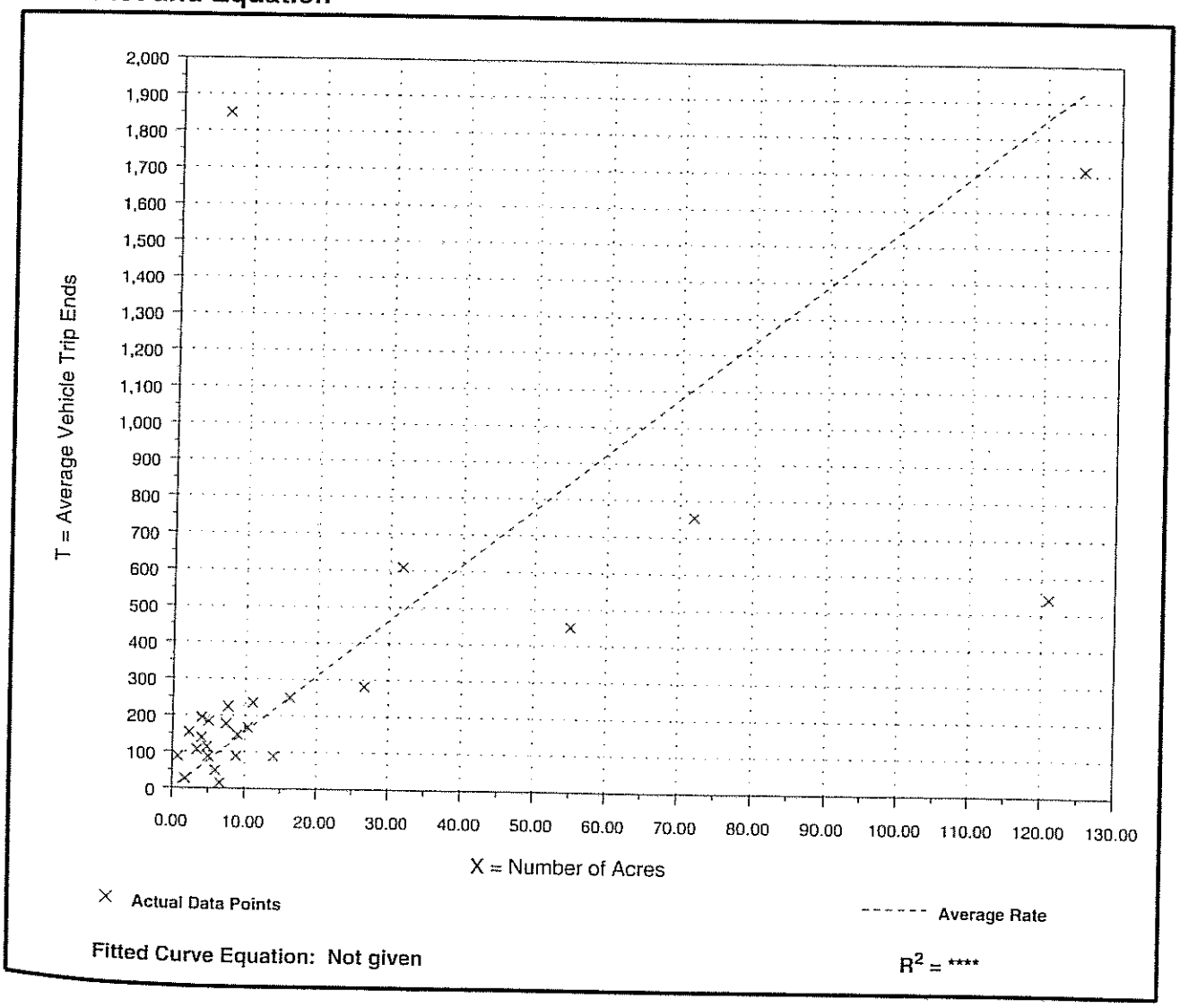
Average Vehicle Trip Ends vs: Acres
On a: Weekday,
P.M. Peak Hour

Number of Studies: 26
Average Number of Acres: 22
Directional Distribution: 12% entering, 88% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
15.44	2.42 - 284.62	30.56

Data Plot and Equation



Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

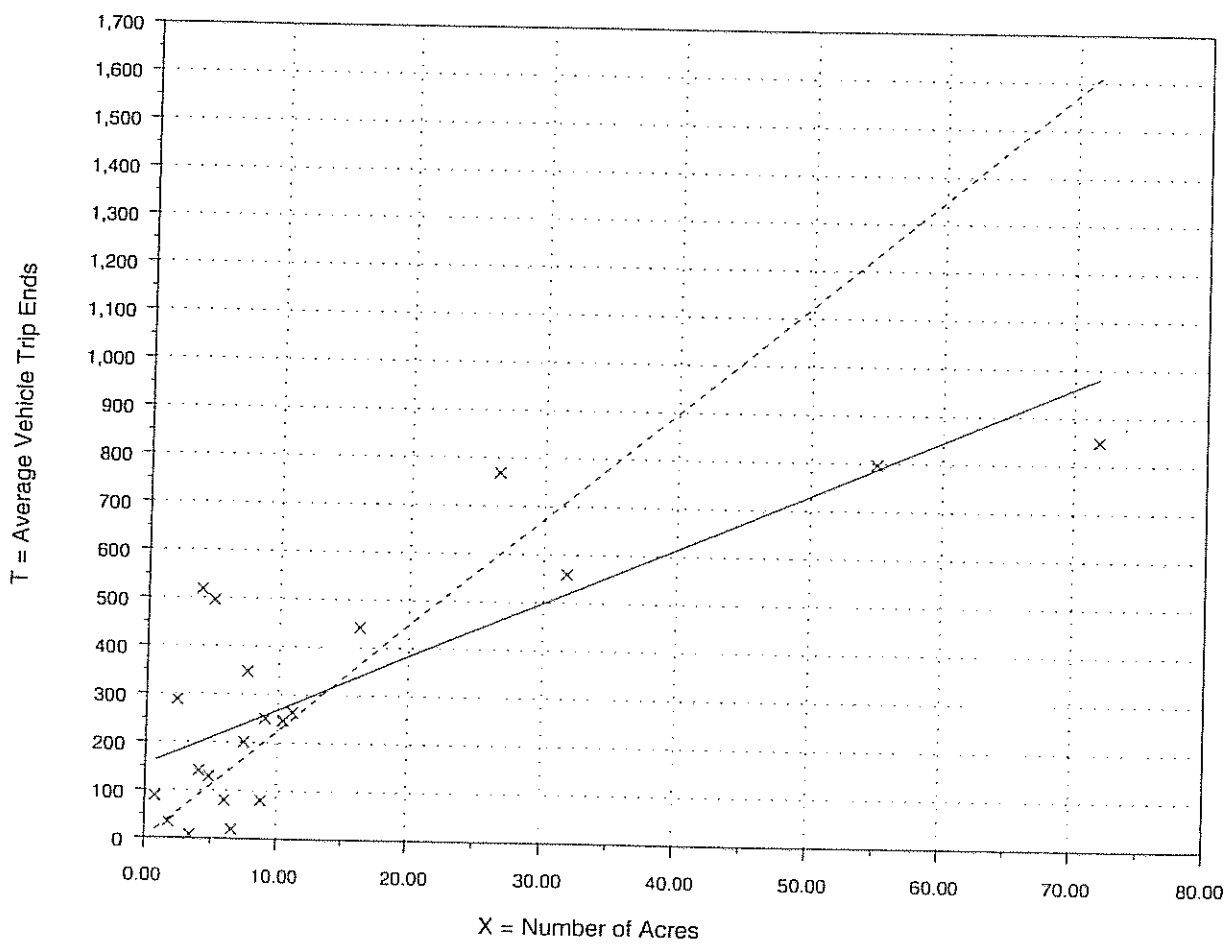
Average Vehicle Trip Ends vs: Acres
On a: Saturday

Number of Studies: 21
Average Number of Acres: 14
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
22.47	2.35 - 128.78	21.60

Data Plot and Equation



Fitted Curve Equation: T = 11.52(X) + 153.52

$R^2 = 0.64$

Research and Development Center
(760)

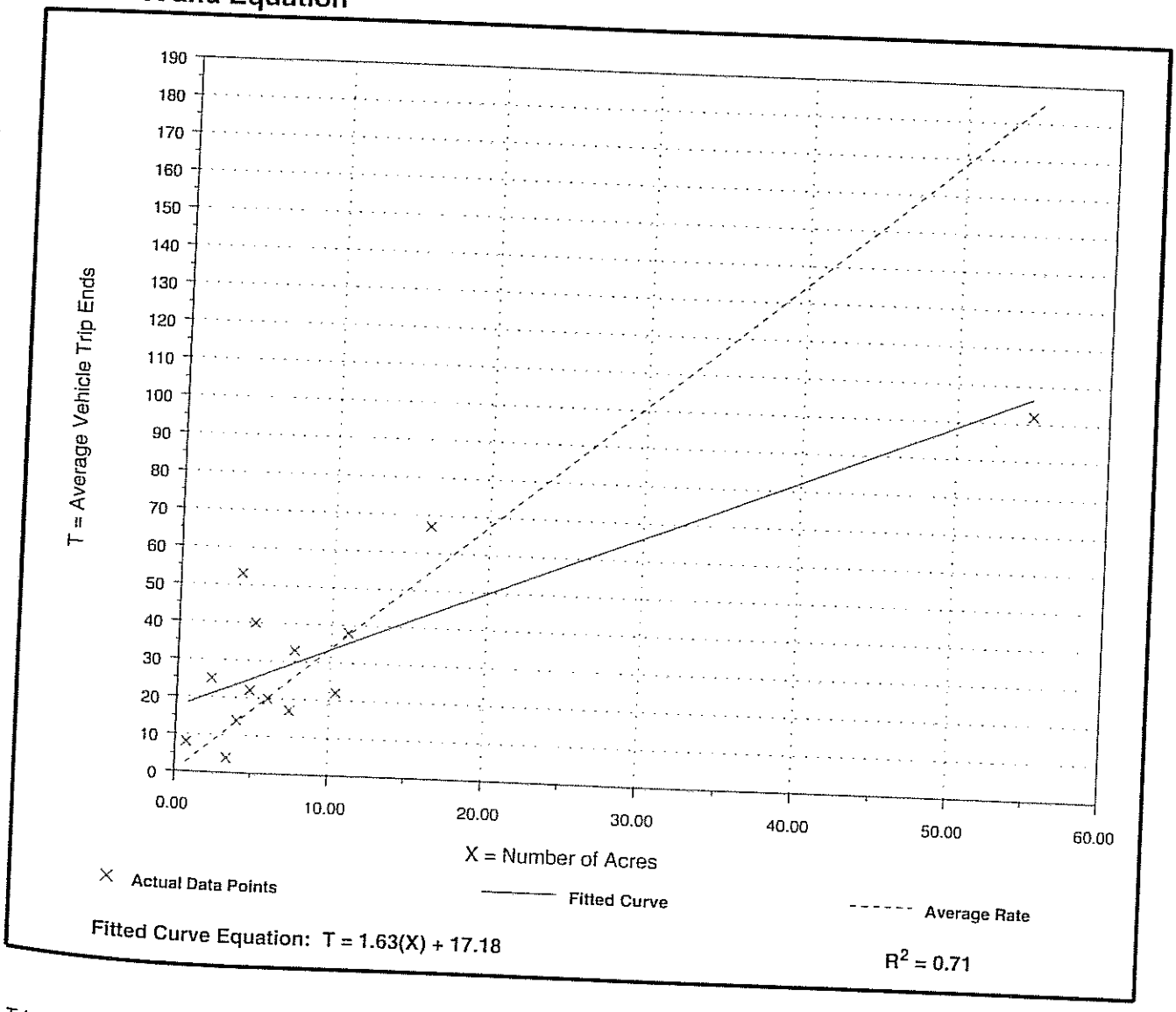
Average Vehicle Trip Ends vs: Acres
On a: Saturday,
Peak Hour of Generator

Number of Studies: 14
Average Number of Acres: 10
Directional Distribution: Not available

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
3.37	1.18 - 13.15	3.01

Data Plot and Equation



Fitted Curve Equation: T = 1.63(X) + 17.18

$R^2 = 0.71$

Research and Development Center
(760)

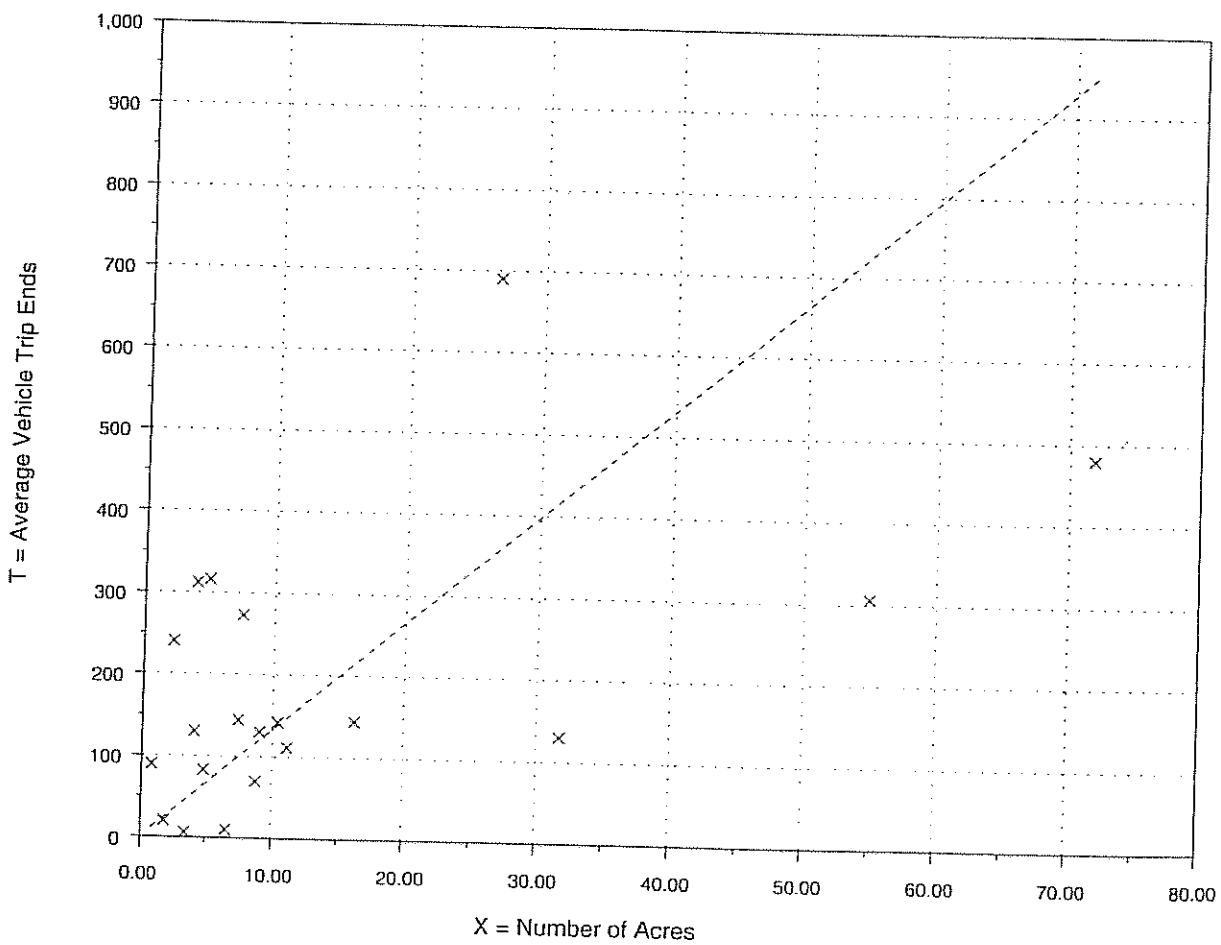
Average Vehicle Trip Ends vs: Acres
On a: Sunday

Number of Studies: 20
Average Number of Acres: 14
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
13.27	1.52 - 118.67	16.76

Data Plot and Equation



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Research and Development Center
(760)

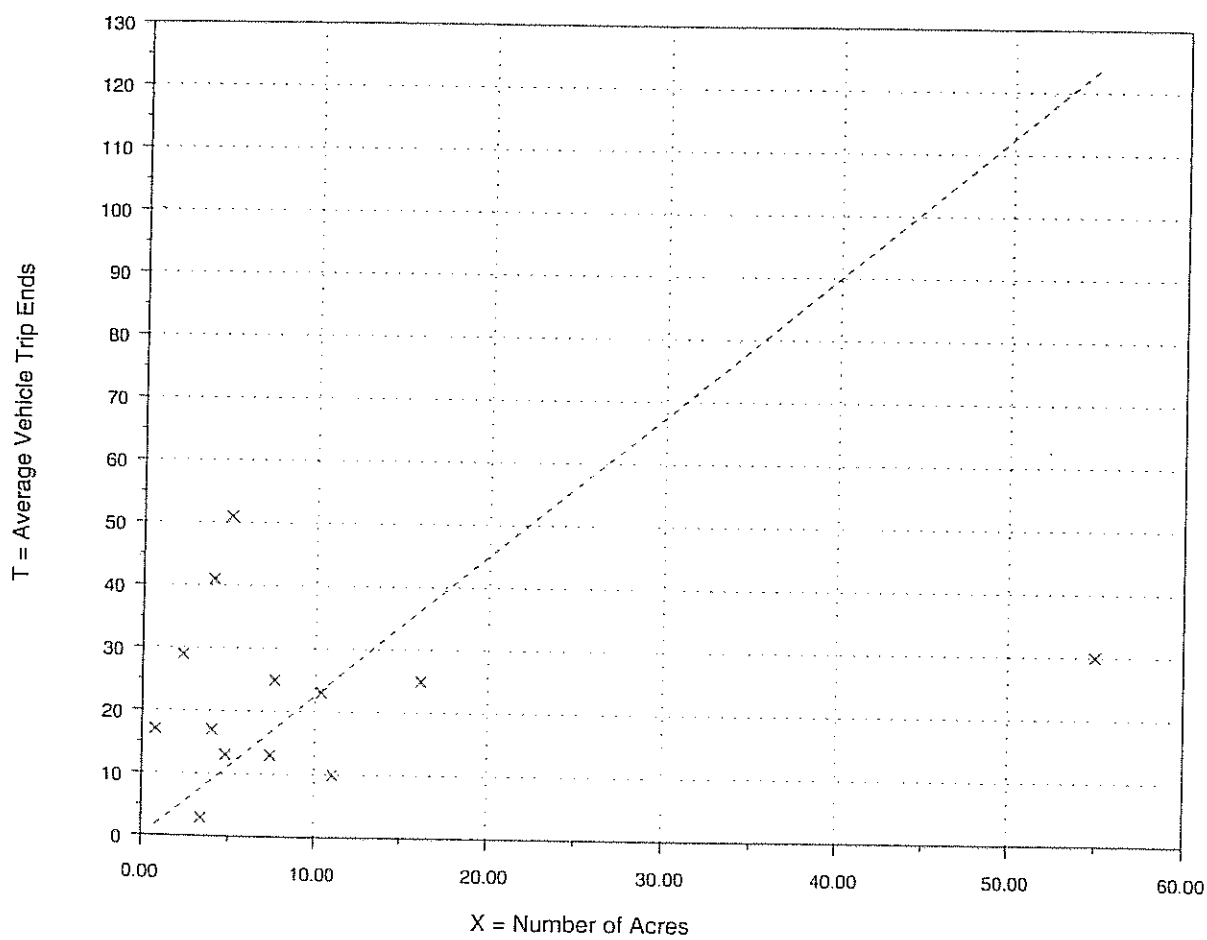
Average Vehicle Trip Ends vs: Acres
On a: Sunday,
Peak Hour of Generator

Number of Studies: 13
Average Number of Acres: 10
Directional Distribution: Not available

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
2.25	0.55 - 22.67	3.46

Data Plot and Equation



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

Land Use: 550
University/College

Description

This land use includes four-year universities or colleges that may or may not offer graduate programs. Two-year junior, community, or technical colleges are described in junior/community college (Land Use 540).

Additional Data

The trip generation for weekend time periods varied considerably; therefore, caution should be used when applying weekend statistics. Information describing the weekend activities conducted at universities/colleges was not available.

Acreage, floor space, staff and parking accommodations varied widely with the populations served and the social and economic characteristics of the area; thus, the number of students may be a more reliable independent variable on which to establish trip generation rates.

The sites were surveyed from the late 1970s to the 1990s throughout the United States.

Source Numbers

86, 365, 423, 440

University/College
(550)

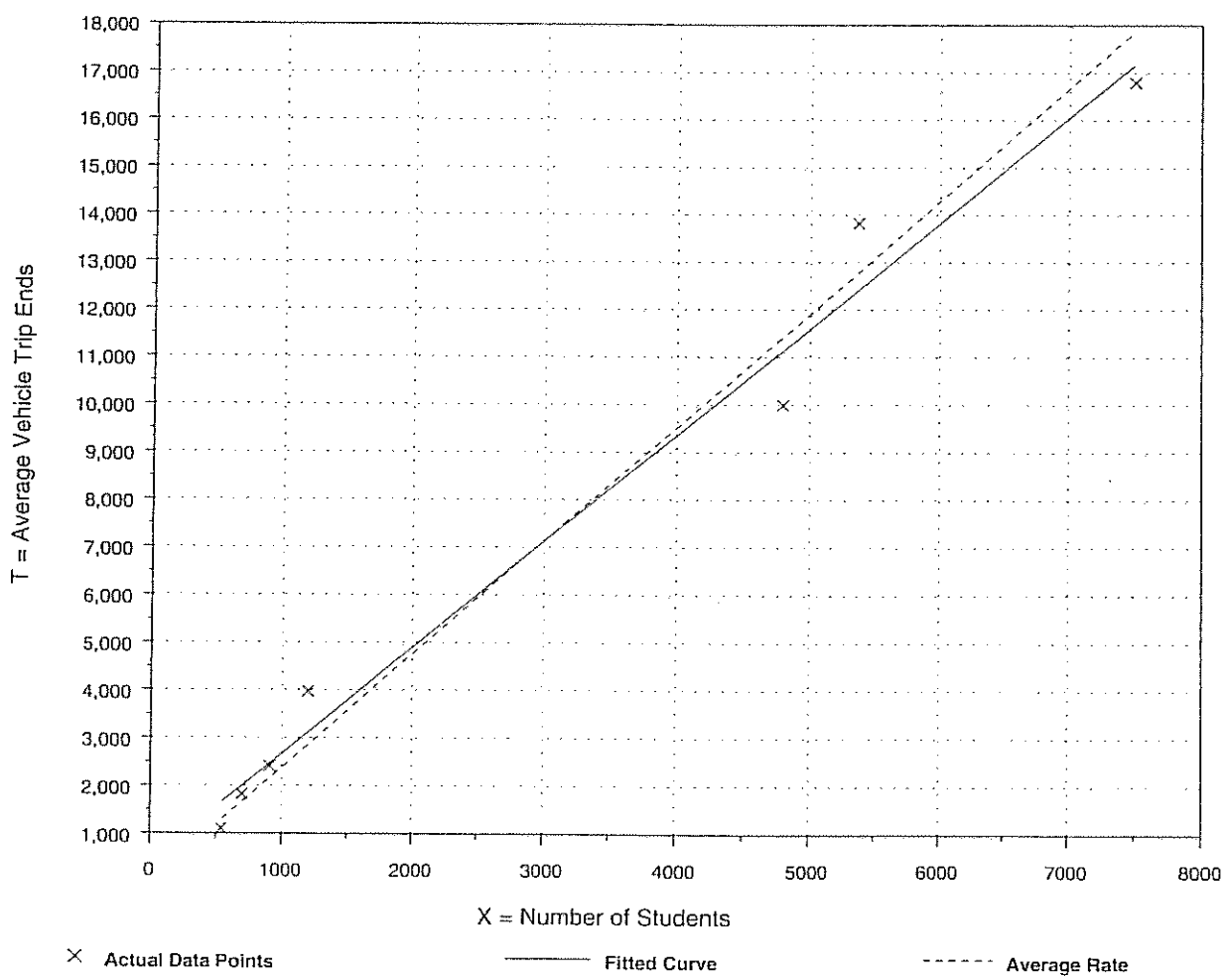
Average Vehicle Trip Ends vs: Students
On a: Weekday

Number of Studies: 7
Average Number of Students: 3,002
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
2.38	2.03 - 3.31	1.57

Data Plot and Equation



Fitted Curve Equation: T = 2.23(X) + 440.00 $R^2 = 0.98$

University/College
(550)

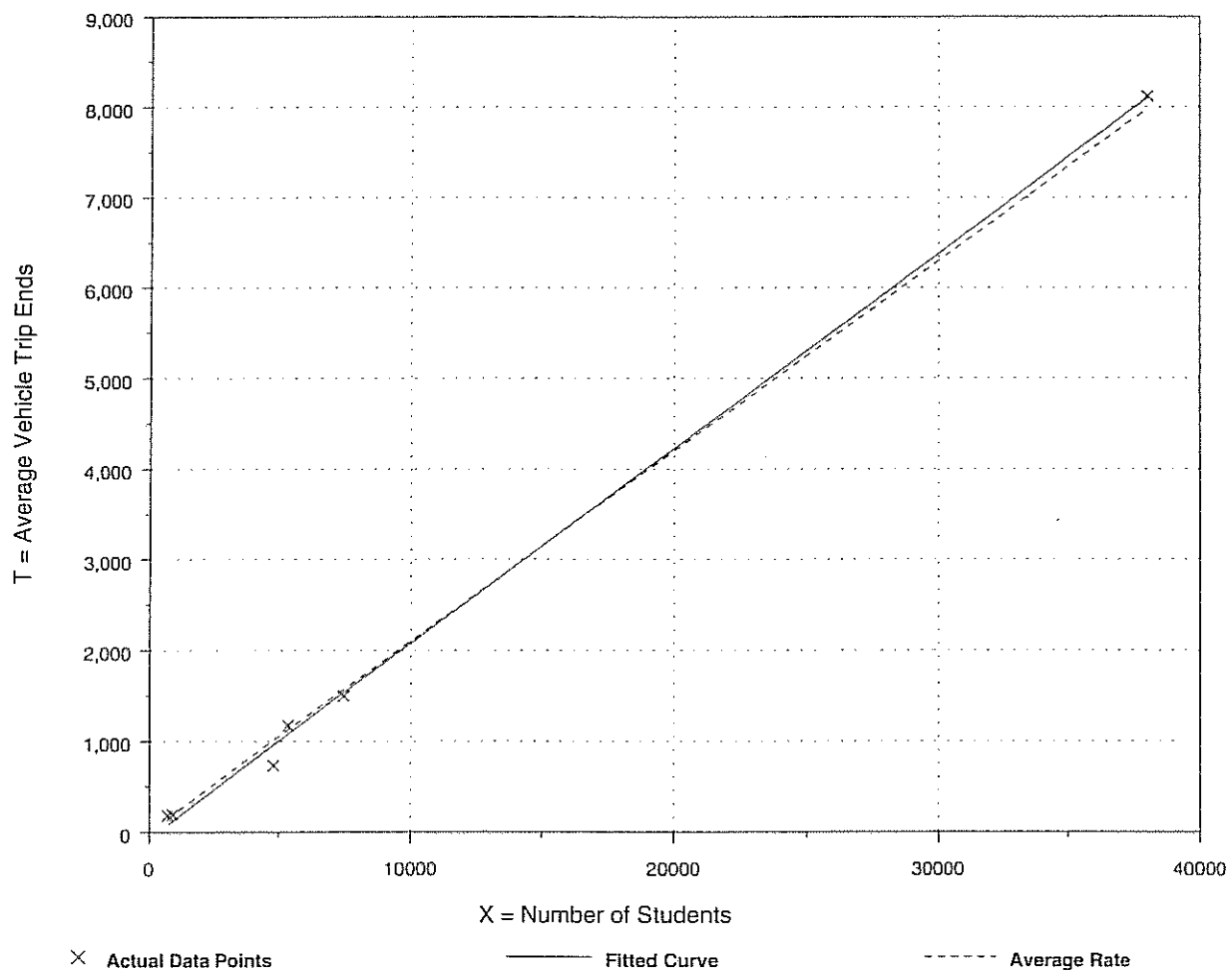
Average Vehicle Trip Ends vs: Students
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 6
Average Number of Students: 9,545
Directional Distribution: 80% entering, 20% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
0.21	0.15 - 0.26	0.46

Data Plot and Equation



Fitted Curve Equation: T = 0.21(X) - 69.14 R^2 **= 1.00**

University/College
(550)

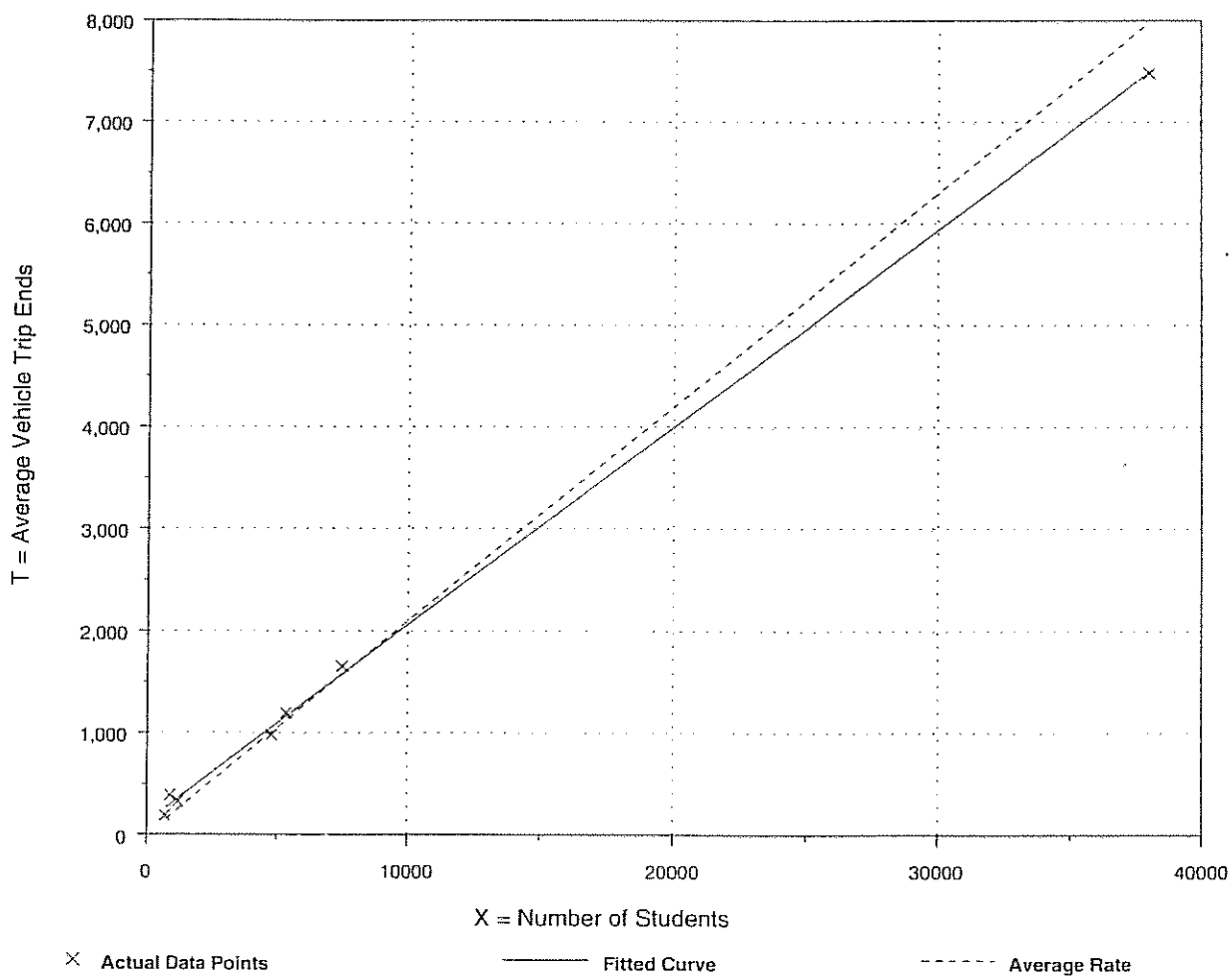
Average Vehicle Trip Ends vs: Students
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 7
Average Number of Students: 8,353
Directional Distribution: 30% entering, 70% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
0.21	0.20 - 0.43	0.46

Data Plot and Equation



Fitted Curve Equation: T = 0.19(X) + 125.35 $R^2 = 1.00$

University/College
(550)

Average Vehicle Trip Ends vs: Students
On a: Weekday,
A.M. Peak Hour of Generator

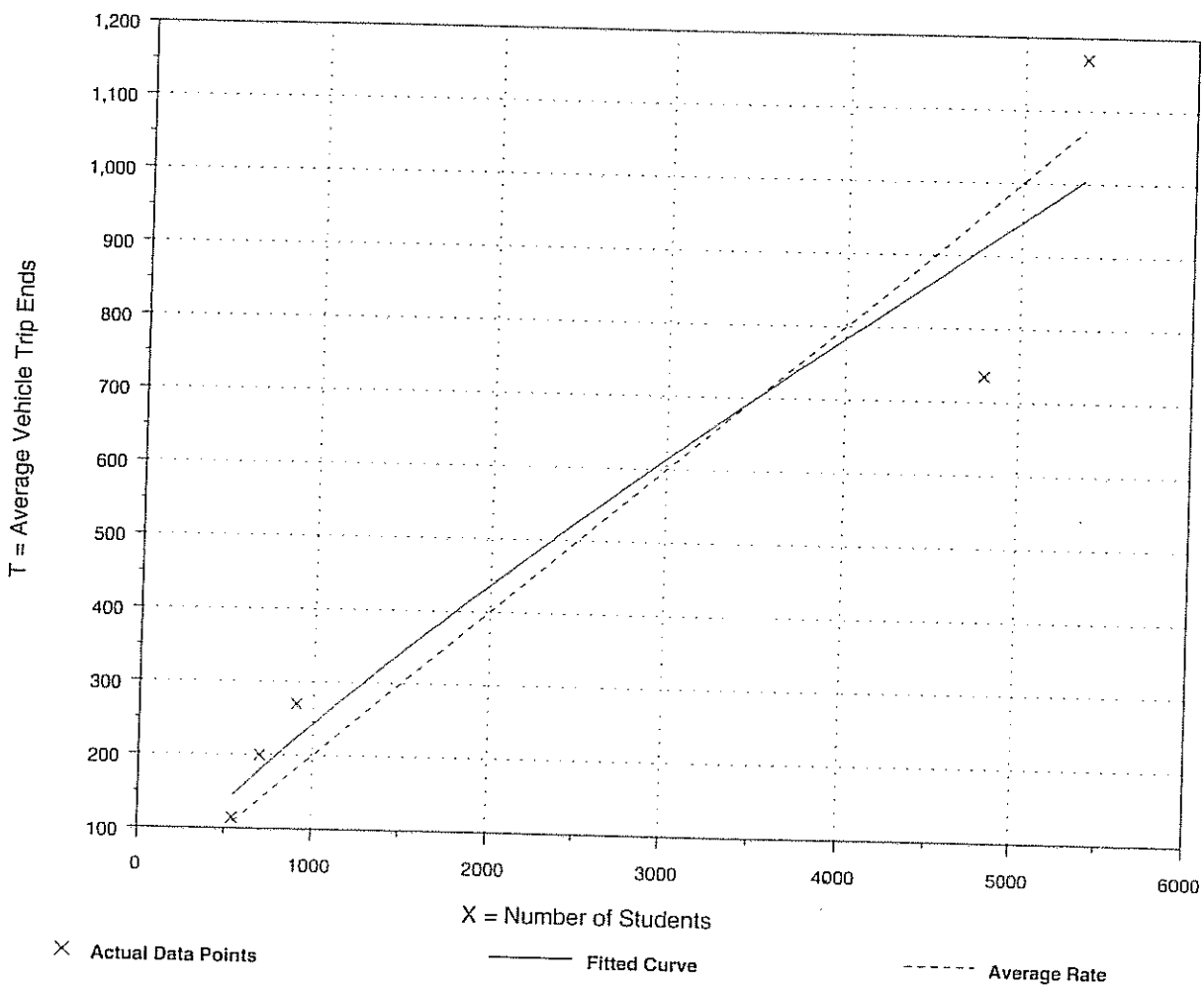
Number of Studies: 5
Average Number of Students: 2,463
Directional Distribution: 75% entering, 25% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
0.20	0.15 - 0.30	0.45

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.85 Ln(X) - 0.35

$R^2 = 0.95$

University/College
(550)

Average Vehicle Trip Ends vs: Students
On a: Weekday,
P.M. Peak Hour of Generator

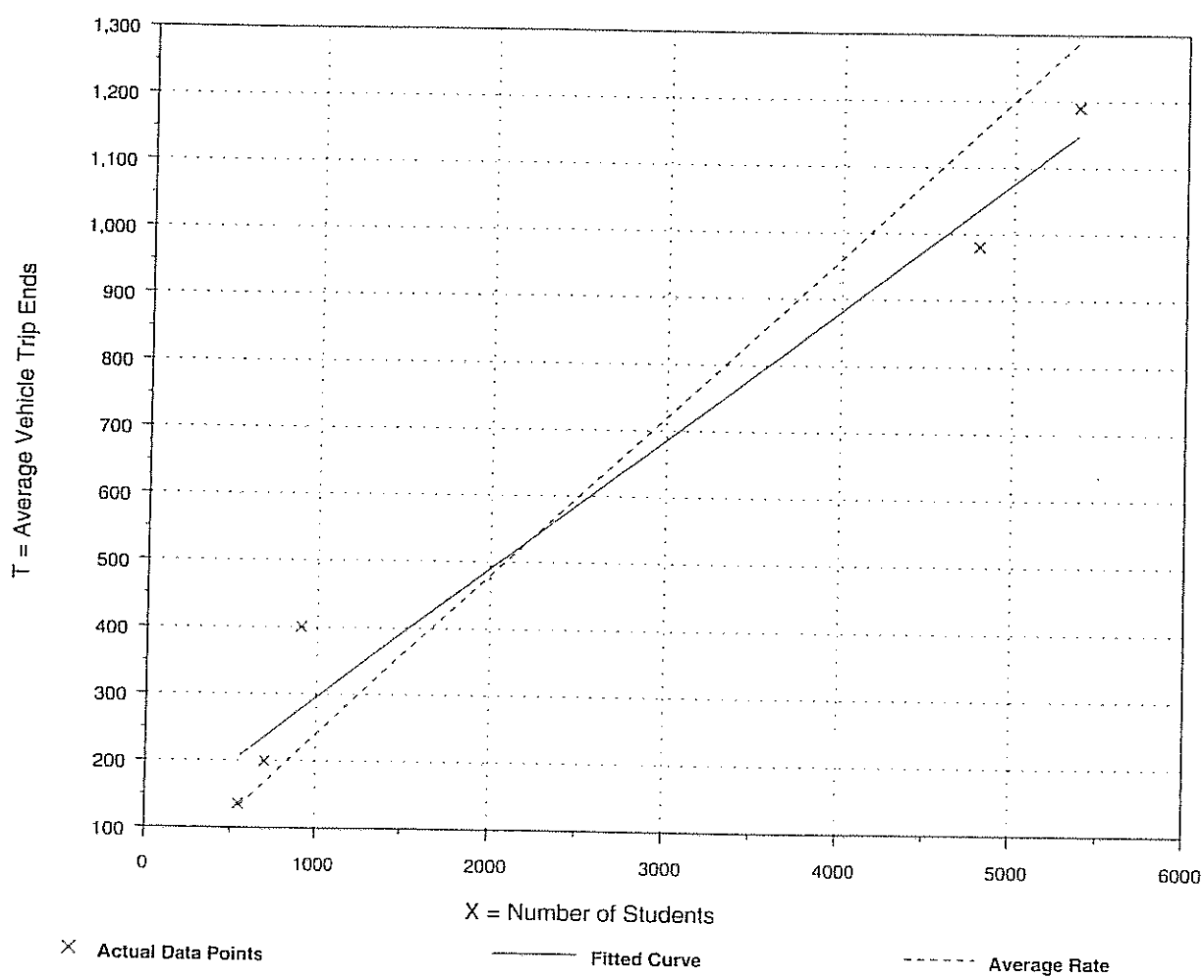
Number of Studies: 5
Average Number of Students: 2,463
Directional Distribution: 30% entering, 70% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
0.24	0.20 - 0.44	0.49

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: T = 0.20(X) + 100.48

R^2 = 0.97

University/College
(550)

Average Vehicle Trip Ends vs: Students
On a: Saturday

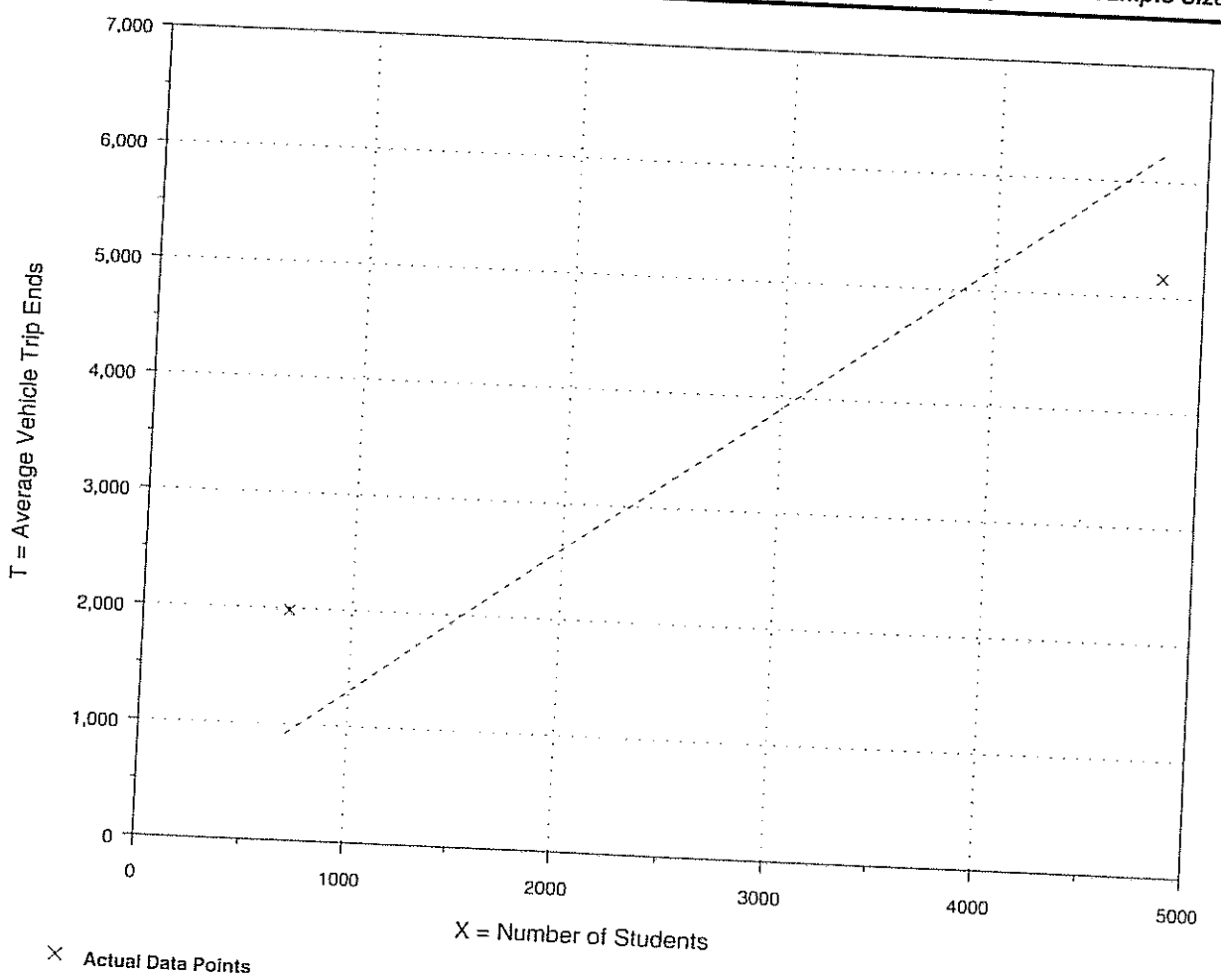
Number of Studies: 2
Average Number of Students: 2,749
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Student

Average Rate	Range of Rates	Standard Deviation
1.30	1.08 - 2.83	*

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points

------ Average Rate

Fitted Curve Equation: Not given

R^2 = ****

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Weekday

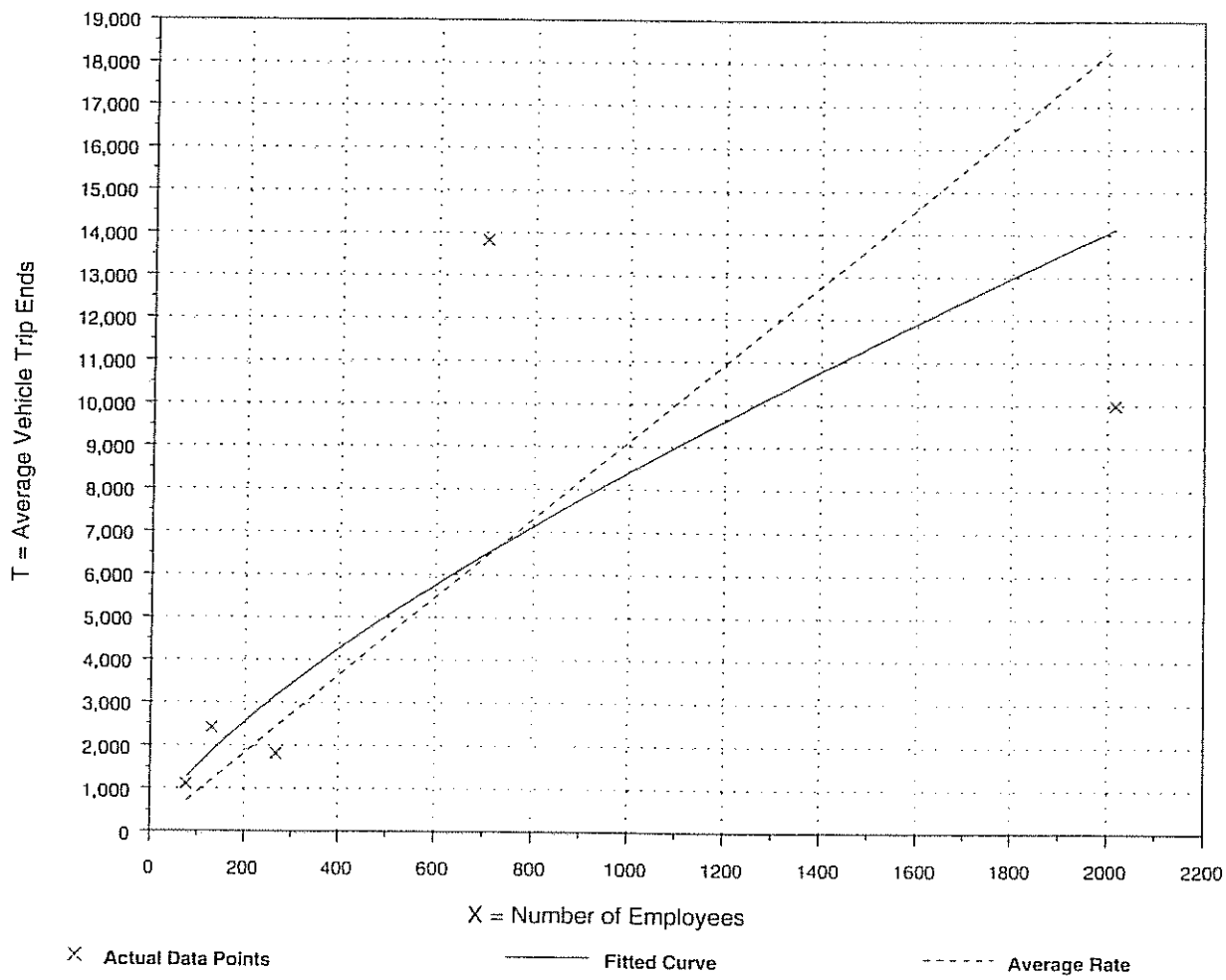
Number of Studies: 5
Avg. Number of Employees: 639
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
9.13	4.96 - 19.70	7.03

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.74 Ln(X) + 3.92 $R^2 = 0.78$

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

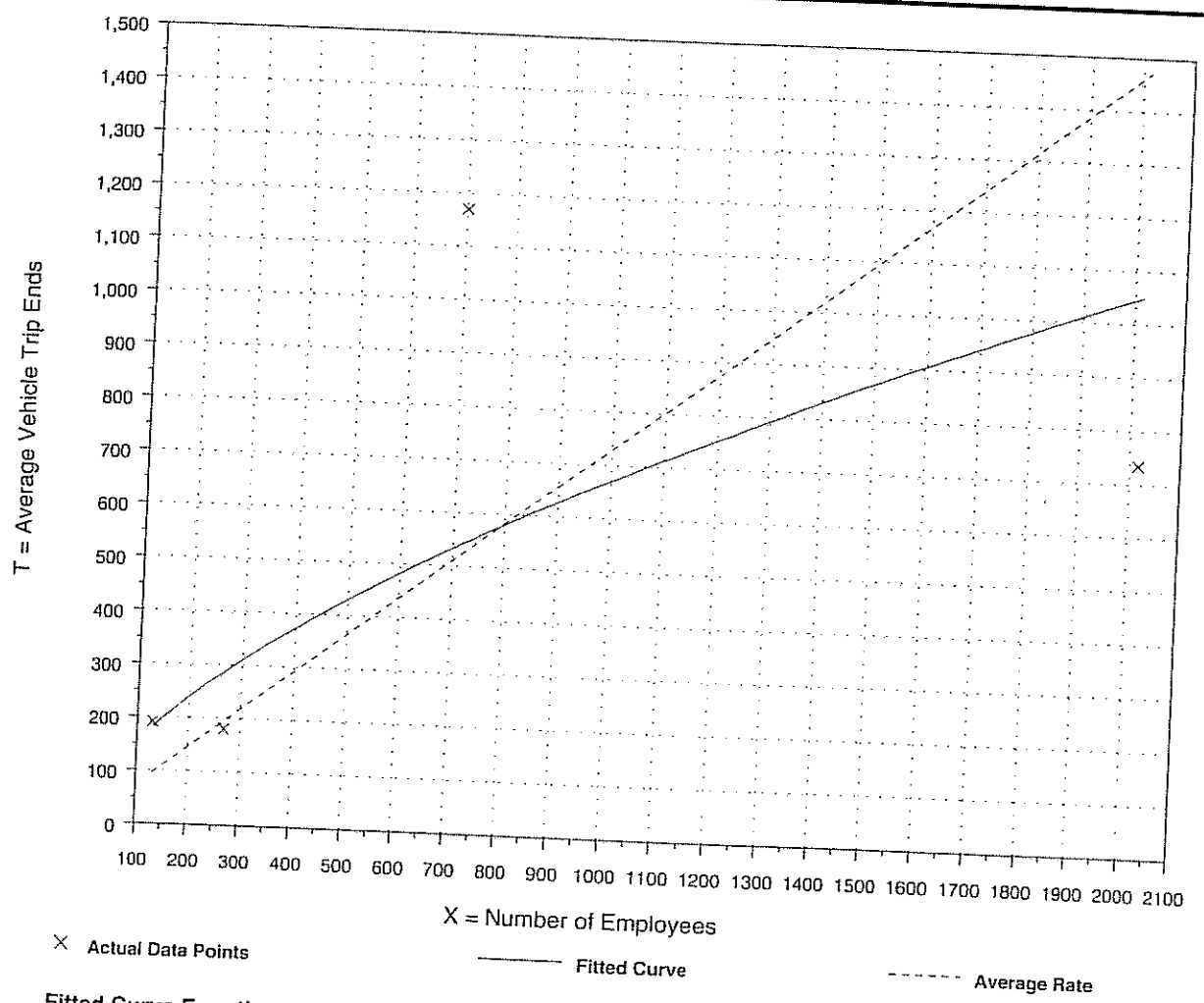
Number of Studies: 4
Avg. Number of Employees: 779
Directional Distribution: 82% entering, 18% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.73	0.36 - 1.67	1.02

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.64 Ln(X) + 2.08

$R^2 = 0.64$

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

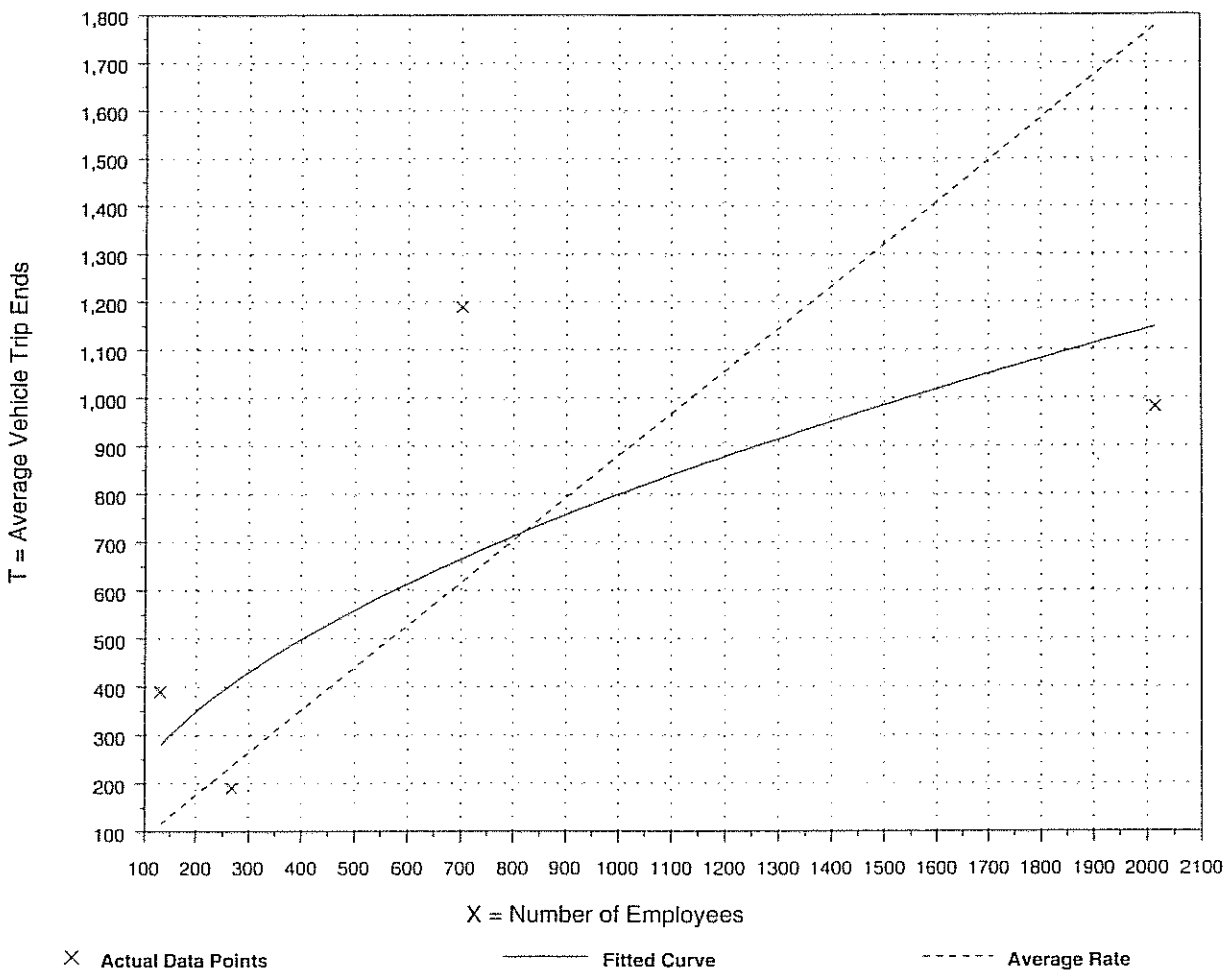
Number of Studies: 4
Avg. Number of Employees: 779
Directional Distribution: 29% entering, 71% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.88	0.49 - 3.00	1.15

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.52 Ln(X) + 3.12 $R^2 = 0.52$

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Weekday,
A.M. Peak Hour of Generator

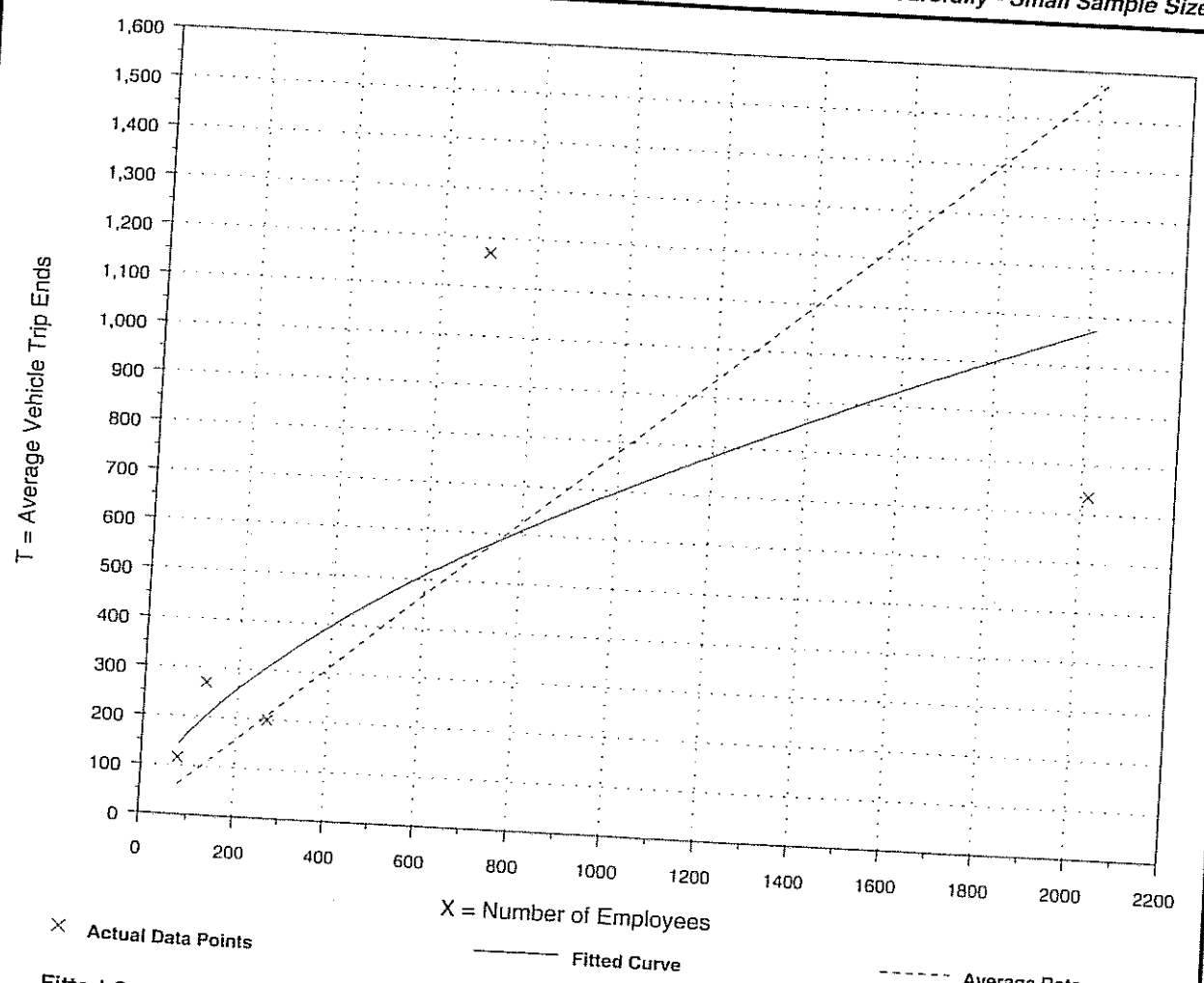
Number of Studies: 5
Avg. Number of Employees: 639
Directional Distribution: 75% entering, 25% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.78	0.36 - 2.08	1.07

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.62 Ln(X) + 2.30

$R^2 = 0.72$

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Weekday,
P.M. Peak Hour of Generator

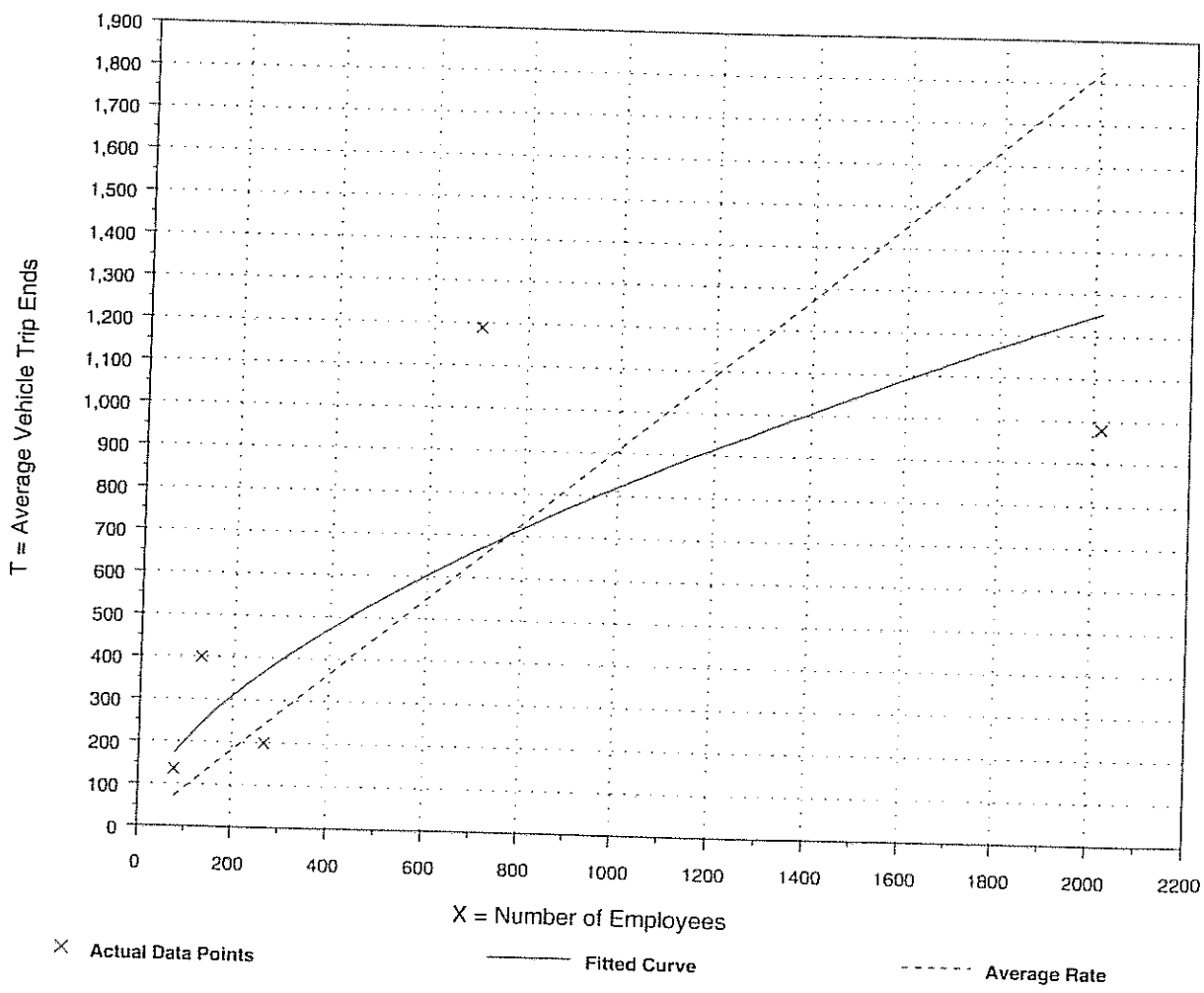
Number of Studies: 5
Avg. Number of Employees: 639
Directional Distribution: 30% entering, 70% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
0.91	0.49 - 3.08	1.17

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



Fitted Curve Equation: Ln(T) = 0.61 Ln(X) + 2.53

$R^2 = 0.69$

University/College
(550)

Average Vehicle Trip Ends vs: Employees
On a: Saturday

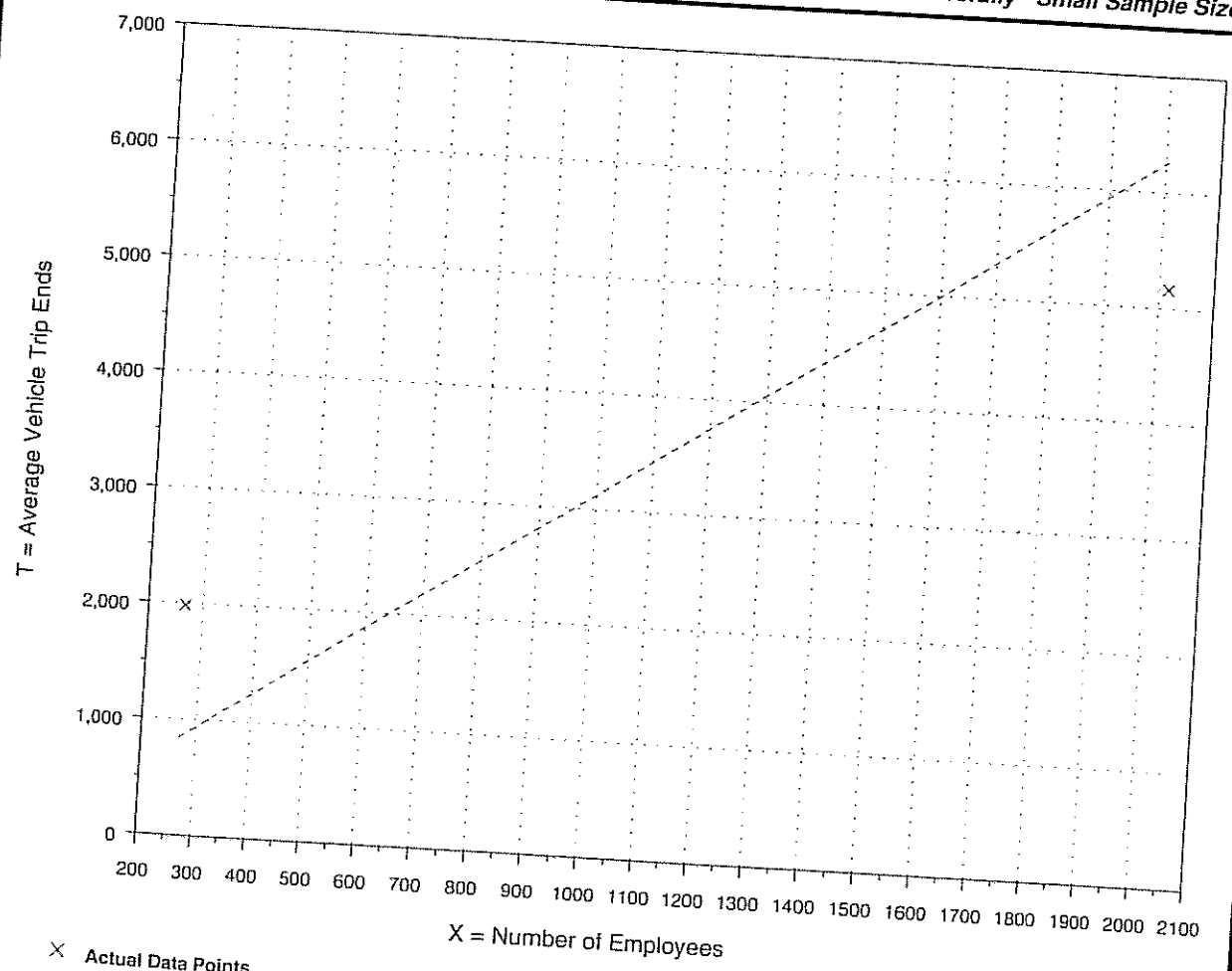
Number of Studies: 2
Avg. Number of Employees: 1,143
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Employee

Average Rate	Range of Rates	Standard Deviation
3.12	2.56 - 7.39	*

Data Plot and Equation

Caution - Use Carefully - Small Sample Size



× Actual Data Points

Fitted Curve Equation: Not given

Average Rate

R^2 = ****

Land Use: 210
Single-Family Detached Housing

Land Use Description

Single-family detached housing includes all single-family detached homes on individual lots.

Database Description

- Number of bedrooms: ranged between one and four, with a mean value of 2.7 and mode and median values of two and three bedrooms, respectively.
- Average parking supply ratio: 2.0 spaces per dwelling unit.

Additional Data

Vehicle ownership, a primary component of single-family housing parking demand, is estimated in the United States by utilizing Census data regarding auto ownership patterns. While these Census data do not provide information regarding visitor parking, the data provide a starting point for the understanding of single-family housing parking demand. The data can be reviewed for each unique neighborhood or community.

During the past 40 years, auto ownership per household has increased. The following table provides a summary of U.S. Census vehicle ownership data. These data combine single and multi-family households and indicate a year 2000 estimate of approximately 1.75 vehicles per household.

Household Vehicle Ownership: 1960–2000 United States Census Data

Year	No Vehicle (%)	One Vehicle (%)	Two Vehicles (%)	Three or More Vehicles (%)
1960	21	57	19	3
1970	17	48	29	6
1980	13	36	34	17
1990	12	34	37	17
2000	9	34	39	18

SOURCES:
2000 data: U.S. Bureau of the Census, American Fact Finder, Table QT-04, August 2001.
1960–1990 data: U.S. Department of Transportation, Volpe National Transportation Systems Center, *Journey-to-Work Trends in the United States and its Major Metropolitan Areas*, 1960–1990, Cambridge, MA, 1994, p. 2-2.

Census data relating household ownership (single family and condominium, not including rental households) and ownership of vehicles from the Portland, OR region[1] have been reviewed to evaluate trends in the ratio of vehicles per household. The following table summarizes the number of vehicles owned per household, based on year 2000 Census data. Note that these data do not include parking demand for visitors.

[1] Census 2000, U.S. Census Bureau, 2002, Table H44.

Land Use: 210
Single-Family Detached Housing

Area Type	Vehicles Owned per Household
Suburban (within urban growth boundary)	2.0
Central City, Not Downtown	1.8
Central Business District	1.6
Areas within 1/3 mile of a light rail station and more than 10 miles from CBD	1.9–2.0
Areas within 1/3 mile of a light rail station and less than 10 miles from CBD	1.6–1.8

SOURCE: DKS Associates. Portland, OR, 2002 (based upon 2000 Census block data).

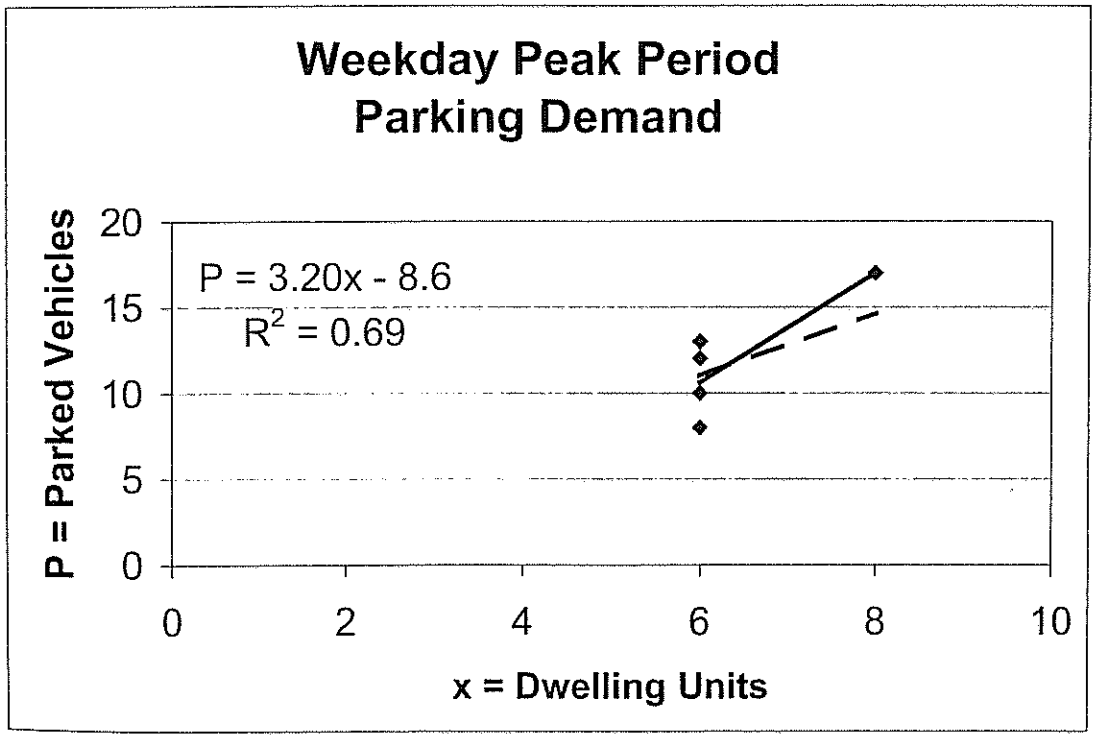
Study Site/Year

Glendale, CA (1978)

Land Use: 210
Single-Family Detached Housing

Average Peak Period Parking Demand vs: Dwelling Units
On a: Weekday

Statistic	Peak Period Demand
Peak Period	10:00–11:00 p.m. (only time period with data)
Number of Study Sites	6
Average Size of Study Sites	6.3 dwelling units
Average Peak Period Parking Demand	1.83 vehicles per dwelling unit
Standard Deviation	0.33
Coefficient of Variation	18%
Range	1.33–2.17 vehicles per dwelling unit
85th Percentile	2.14 vehicles per dwelling unit
33rd Percentile	1.67 vehicles per dwelling unit



◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 550
University/College

Land Use Description

This land use includes 4-year universities or colleges that may or may not offer graduate programs. Two-year junior, community, or technical colleges are described in junior/community college (Land Use 540).

Database Description

The database consisted of a mix of suburban and urban sites. Parking demand rates at the suburban sites differed from those at urban sites and therefore the data were analyzed separately.

- Average parking supply ratio: 0.33 spaces per total number of students, faculty and staff (school population) at the suburban sites and 0.22 spaces per school population at the urban sites.
- Average parking supply ratio for building square footage: 1.2 spaces per 1,000 sq. ft. GFA (three study sites).

The measured peak demand at four of the eight suburban sites was within 10 percent of the total parking supply, suggesting that the supply could potentially be constraining demand in sectors of the campuses.

The presence of paid parking was noted for only one study site. The peak parking demand at this site was similar to the average peak parking demand.

For the six suburban study sites, parking demand data counts were submitted for at least five consecutive hours. The following table presents the time-of-day distribution of parking demand for the sites.

Based on Vehicles per School Population (Suburban Sites)	*Weekday Data*	
Hour Beginning	Percent of Peak Period	Number of Data Points*
12:00–4:00 a.m.	–	0
5:00 a.m.	–	0
6:00 a.m.	–	0
7:00 a.m.	–	0
8:00 a.m.	79	3
9:00 a.m.	88	5
10:00 a.m.	98	6
11:00 a.m.	100	6
12:00 p.m.	93	6
1:00 p.m.	88	5
2:00 p.m.	81	5
3:00 p.m.	74	3
4:00 p.m.	33	1
5:00 p.m.	23	1
6:00 p.m.	–	0
7:00 p.m.	–	0
8:00 p.m.	–	0
9:00 p.m.	–	0
10:00 p.m.	–	0
11:00 p.m.	–	0

*Subset of database

Land Use: 550
University/College

A 12-day study of weekday parking demand at San Diego State University[1] provided the following day-of-week distribution of peak parking demand.

Day of the Week	Peak Parking Demand as a Percent of Parking Demand on Peak Weekday (%)
Monday	89
Tuesday	99
Wednesday	89
Thursday	100

For all school uses, it is important to collect data on the size of the building and total number of students, faculty and employees in order to accurately measure parking demand for the site. Additional parking demand observations should also include evening hours and when special events occur at the site.

Additional Data

Quality of transit access may play a role in reducing the parking demand at universities/colleges.

Study Sites/Years

Canada:
Ottawa, ON (1985)

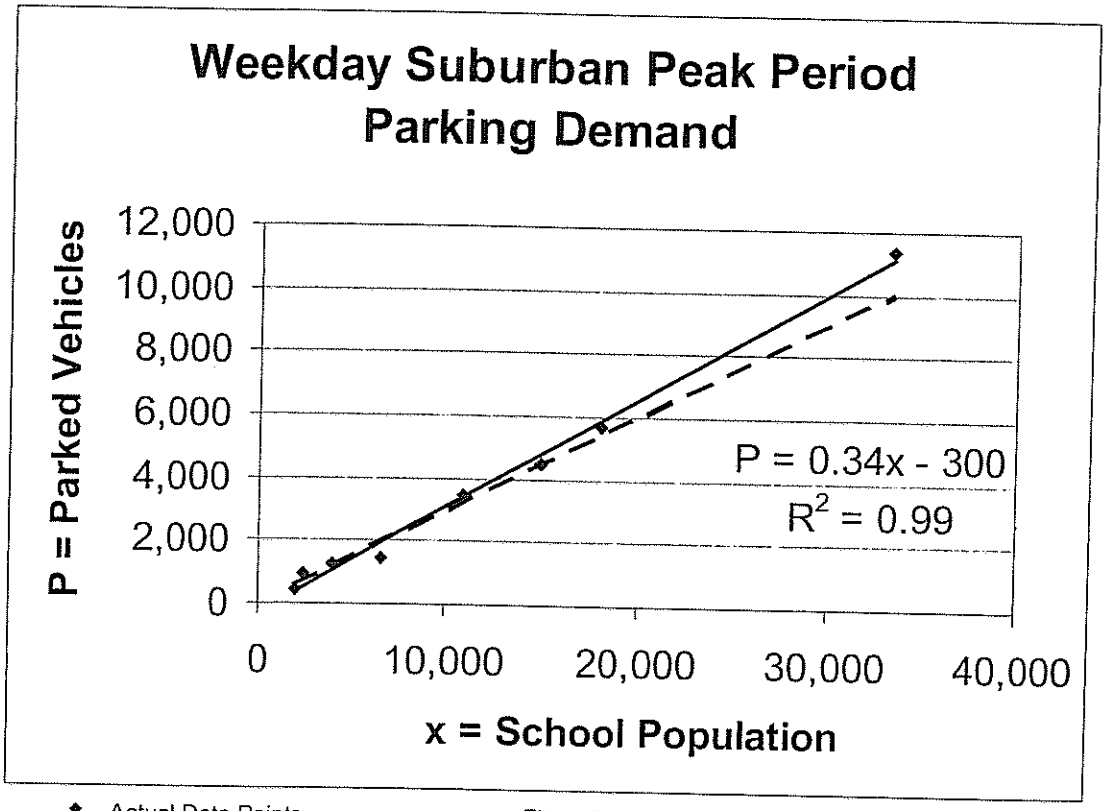
United States:
St. Louis, MO (1987); Dayton, OH (1992); Fairmont, WV (1992); Pittsburgh, PA (1992); Denver, CO (1993); West Palm Beach, FL (1993); Portland, OR (1995); Greensboro, NC (1998); San Luis Obispo, CA (2000); San Diego, CA (2004)

[1] SOURCE: San Diego State University ITE Student Chapter, 2004 District 6 Data Collection Fund study

Land Use: 550
University/College

Average Peak Period Parking Demand vs: School Population
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–3:00 p.m.
Number of Study Sites	8
Average Size of Study Sites	school population of 11,500
Average Peak Period Parking Demand	0.30 vehicles per school population
Standard Deviation	0.05
Coefficient of Variation	18%
Range	0.22–0.38 vehicles per school population
85th Percentile	0.34 vehicles per school population
33rd Percentile	0.30 vehicles per school population

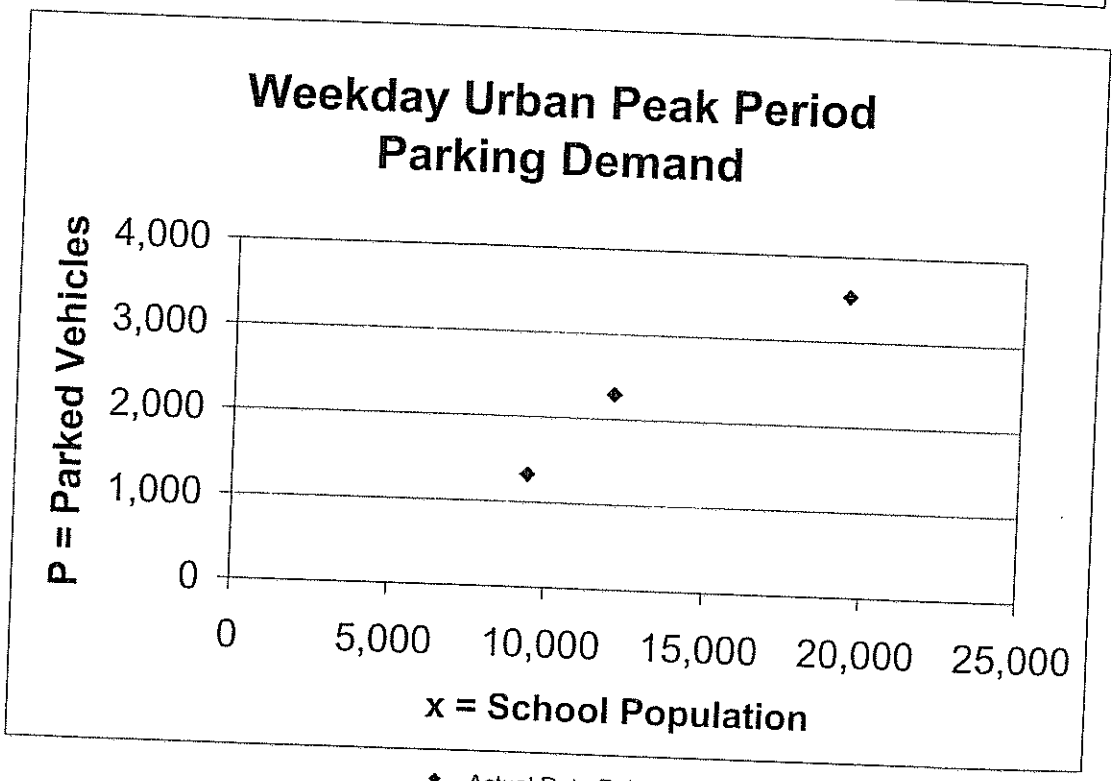


◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 550
University/College

Average Peak Period Parking Demand vs: School Population
On a: Weekday
Location: Urban

Statistic	Peak Period Demand
Peak Period	10:00–11:00 a.m.
Number of Study Sites	3
Average Size of Study Sites	school population of 13,600
Average Peak Period Parking Demand	0.17 vehicles per school population
Standard Deviation	0.03
Coefficient of Variation	15%
Range	0.14–0.19 vehicles per school population
85th Percentile	0.19 vehicles per school population
33rd Percentile	0.17 vehicles per school population



◆ Actual Data Points

Land Use: 610
Hospital

Land Use Description

A hospital is any institution where medical or surgical care and overnight accommodations are provided to non-ambulatory and ambulatory patients. However, the term "hospital" does not refer to medical clinics (facilities that provide diagnoses and outpatient care only) or nursing homes (facilities devoted to the care of persons unable to care for themselves), which are covered elsewhere in this report. Surgery center (Land Use 612) and clinic (Land Use 630) are related uses.

Database Description

The database consisted of a mix of rural, suburban and urban locations. Parking demand differed between these area types and therefore the data were analyzed separately.

- Average hospital size: 640,000 sq. ft. GFA (eight study sites). Average number of daily patients: 460 (12 study sites). Average number of daily patients per bed: 1.02 (ten study sites). Average number of staff per daily patient: 8.15 (seven study sites). These statistics apply to sites from all area types.
- Average parking supply ratios: 4.7 spaces per bed (49 study sites) and 0.82 spaces per employee (34 study sites). The table below presents comparative statistics for study sites, separated by area types.

Site Data	Rural	Suburban	Urban
Parking supply per bed	4.9 (7 sites)	5.5 (20 sites)	4.0 (22 sites)
Parking supply per employee	0.95 (4 sites)	0.90 (14 sites)	0.72 (16 sites)

Four hospitals located on university campuses were included in the data analyzed for this land use. These sites may exhibit parking generation characteristics different from other hospitals. However, based on the limited number of university medical hospitals in the database, conclusive quantitative comparisons could not be drawn. In general, average parking demand per bed for the surveyed university medical sites was greater than that for the other hospital sites. This could be attributed to the higher number of employees and larger floor area devoted to researchers and faculty at university medical centers compared to the other hospitals. For the university medical center study sites, average parking demand per employee was comparable to that found at other hospitals.

Seven of the study sites charged fees for parking. Daily parking fees ranged between $2.00 and $5.20. The average peak period parking demand at these study sites was substantially less than that observed for the overall hospital database. However, based on the small number of observations and the possibility that additional hospitals in the database charged for parking (most do not clearly indicate whether they charge for parking) conclusive development of a parking demand rate reduction attributable to paid parking could not be derived.

Land Use: 610
Hospital

The following table presents the time-of-day distribution of parking demand for all hospitals in the database, calculated on a per bed basis.

Based on Vehicles per Bed	*Weekday Data*	
Hour Beginning	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0
5:00 a.m.	8	1
6:00 a.m.	15	6
7:00 a.m.	41	15
8:00 a.m.	75	29
9:00 a.m.	95	43
10:00 a.m.	93	41
11:00 a.m.	98	46
12:00 p.m.	91	37
1:00 p.m.	100	48
2:00 p.m.	91	38
3:00 p.m.	97	47
4:00 p.m.	72	36
5:00 p.m.	44	17
6:00 p.m.	36	9
7:00 p.m.	33	6
8:00 p.m.	23	3
9:00 p.m.	14	1
10:00 p.m.	12	1
11:00 p.m.	14	1

Future parking demand data collection should include additional potential variables (such as 1,000 sq. ft. GFA, doctors, occupied beds and daily patient visits) as well as those currently plotted.

Study Sites/Years

Canada:
Saskatoon, SK (1982);Ottawa, ON (1985); Richmond, BC (1989)

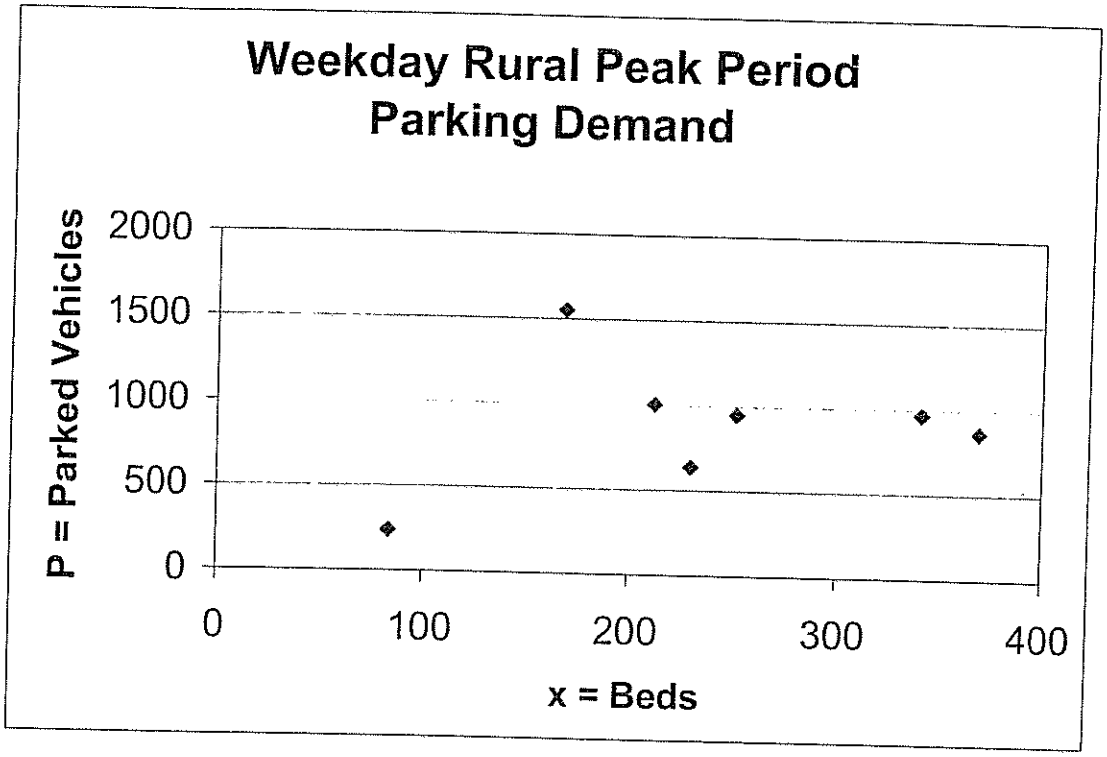
Puerto Rico:
Ponce, PR (1993); Caguas, PR (2000)

United States:
Daytona Beach, FL (1985); Lynn, MA (1985); Jacksonville, FL (1986); Columbus, OH (1990); Cumberland, MD (1990); Elgin, IL (1990); Greensburg, PA (1990); Madison, WI (1990); Milwaukee, WI (1990); New Albany, IN (1990); Pittsburgh, PA (1990); Royal Oak, MI (1990); Stuart, FL (1990); Baltimore, MD (1991); Castle, PA (1991); Charleston, WV (1991); Chicago, IL (1991); Huntsville, AL (1991); LaGrange, IL (1991); Nashville, TN (1991); New Fairmont, WV (1991); Pittsburgh, PA (1991); Vineland, NJ (1991); Durham, NC (1992); Gainesville, FL (1992); Pittsburgh, PA (1992); Springfield, OH (1992); West Palm Beach, FL (1992); Arlington Heights, IL (1993); Atlanta, GA (1993); Baltimore, MD (1993); Easton, PA (1993); Wichita, KS (1993); Sarasota, FL (1994); Jacksonville, FL (1995); Maywood, IL (1995); Evansville, IN (1996); Orlando, FL (1996); Edgewood, KY (1997); Downers Grove, IL (1998); Raleigh, NC (1998); Portsmouth, OH (1998); Templeton, CA (1998); Kankakee, IL (1999); Terre Haute, IN (1999); Walnut Creek, CA (1999); Winston-Salem, NC (1999); Atlanta, GA (2000); Columbus, GA (2000); Flagstaff, AZ (2000); Lincoln, NE (2000); Oklahoma City, OK (2000); Santa Barbara, CA (2000)

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Beds
On a: Weekday
Location: Rural

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 1:00–4:00 p.m.
Number of Study Sites	7
Average Size of Study Sites	240 beds
Average Peak Period Parking Demand	4.08 vehicles per bed
Standard Deviation	2.41
Coefficient of Variation	59%
Range	2.34–9.23 vehicles per bed
85th Percentile	5.19 vehicles per bed
33rd Percentile	2.83 vehicles per bed

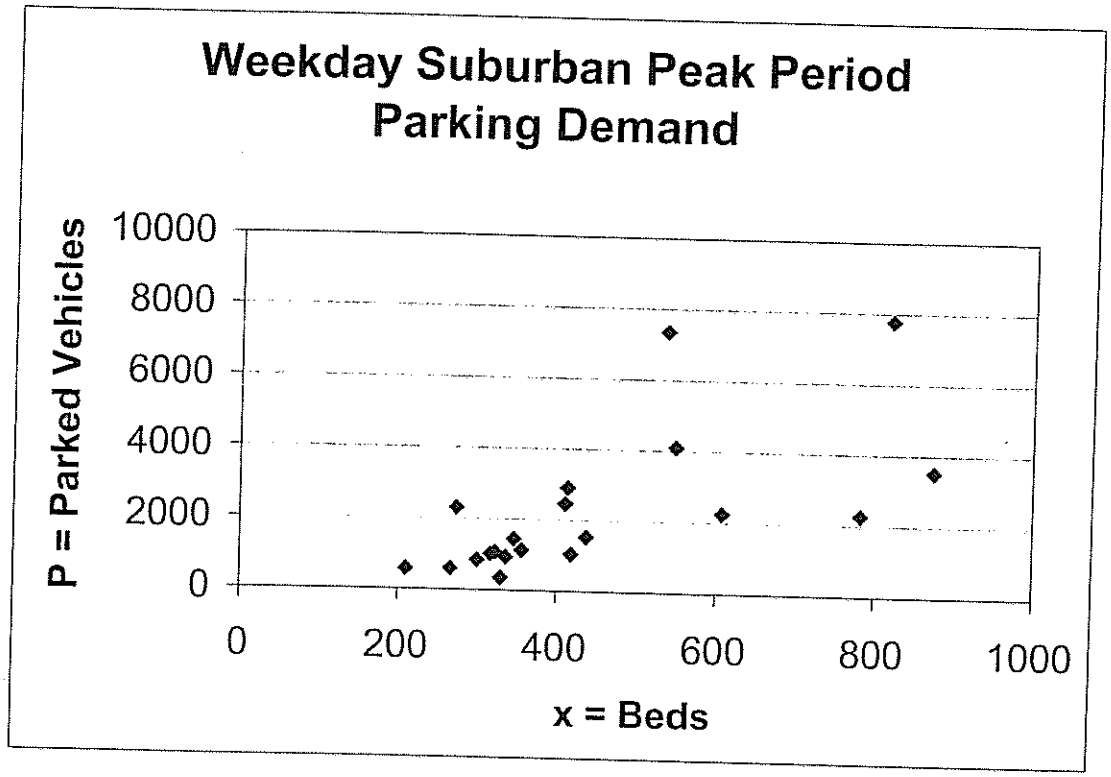


◆ Actual Data Points

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Beds
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–4:00 p.m.
Number of Study Sites	20
Average Size of Study Sites	440 beds
Average Peak Period Parking Demand	4.72 vehicles per bed
Standard Deviation	3.08
Coefficient of Variation	65%
95% Confidence Interval	3.37–6.07 vehicles per bed
Range	1.06–13.71 vehicles per bed
85th Percentile	7.63 vehicles per bed
33rd Percentile	2.98 vehicles per bed

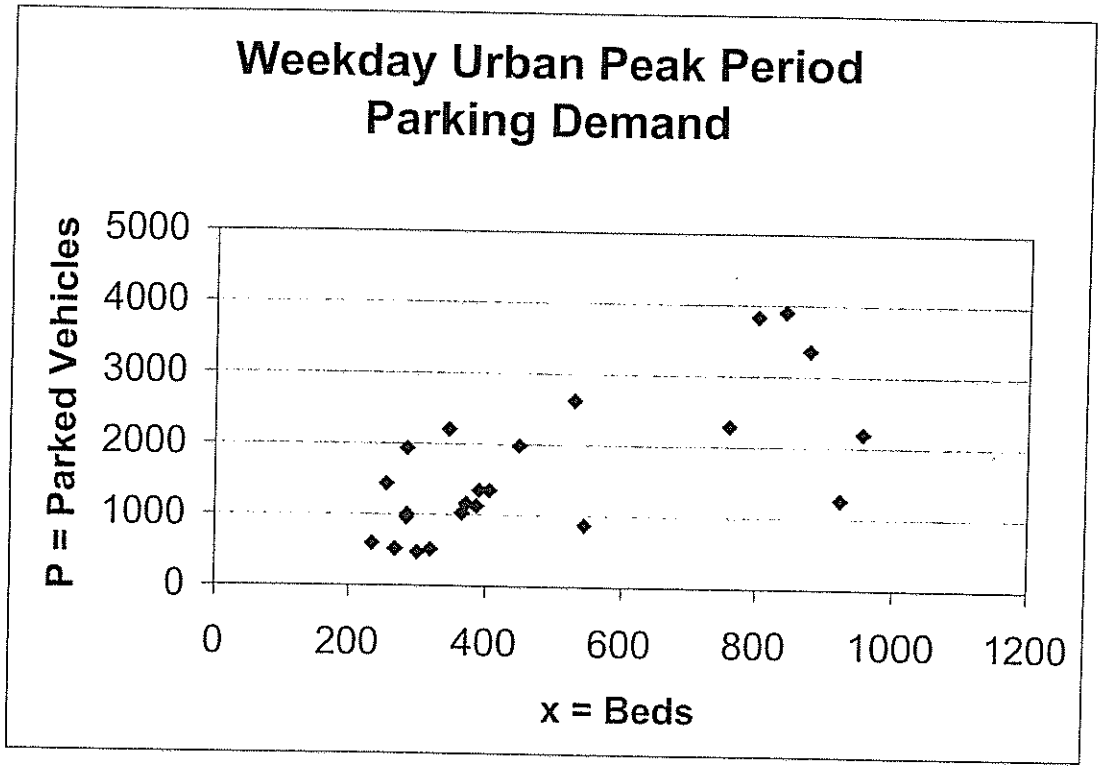


◆ Actual Data Points

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Beds
On a: Weekday
Location: Urban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–4:00 p.m.
Number of Study Sites	23
Average Size of Study Sites	490 beds
Average Peak Period Parking Demand	3.47 vehicles per bed
Standard Deviation	1.53
Coefficient of Variation	44%
95% Confidence Interval	2.84–4.10 vehicles per bed
Range	1.36–6.81 vehicles per bed
85th Percentile	4.92 vehicles per bed
33rd Percentile	2.84 vehicles per bed

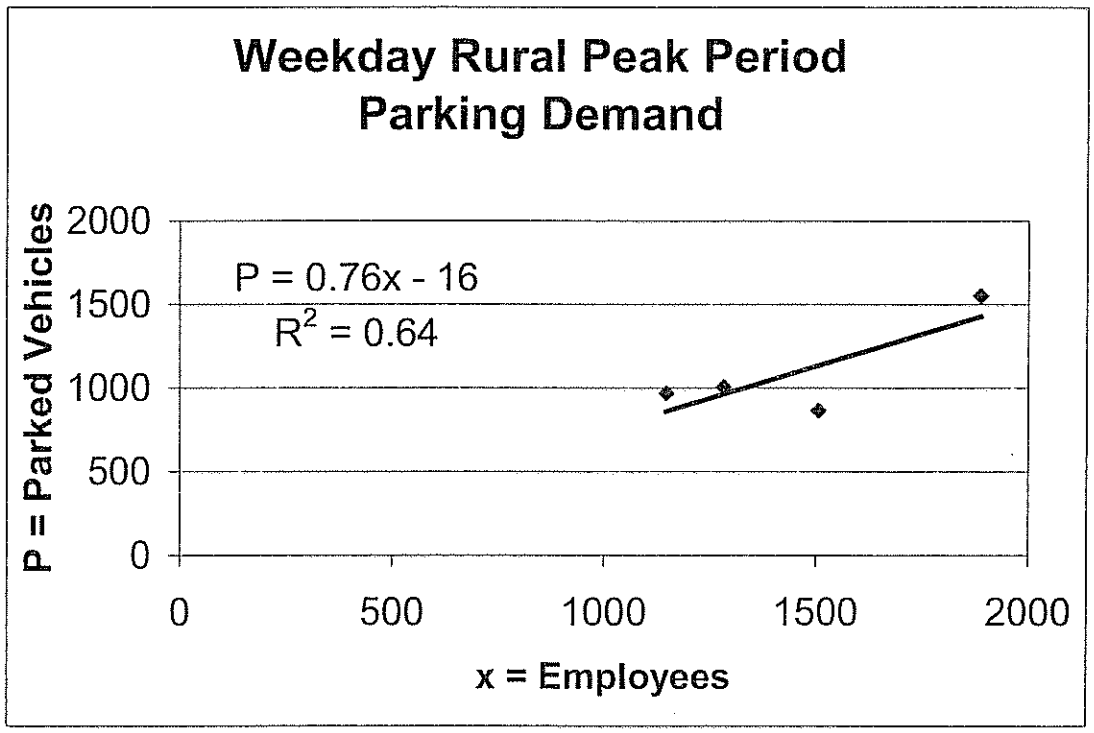


◆ Actual Data Points

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Employees
On a: Weekday
Location: Rural

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 1:00–4:00 p.m.
Number of Study Sites	4
Average Size of Study Sites	1,400 employees
Average Peak Period Parking Demand	0.76 vehicles per employee
Standard Deviation	0.12
Coefficient of Variation	16%
Range	0.57–0.84 vehicles per employee
85th Percentile	0.83 vehicles per employee
33rd Percentile	0.78 vehicles per employee

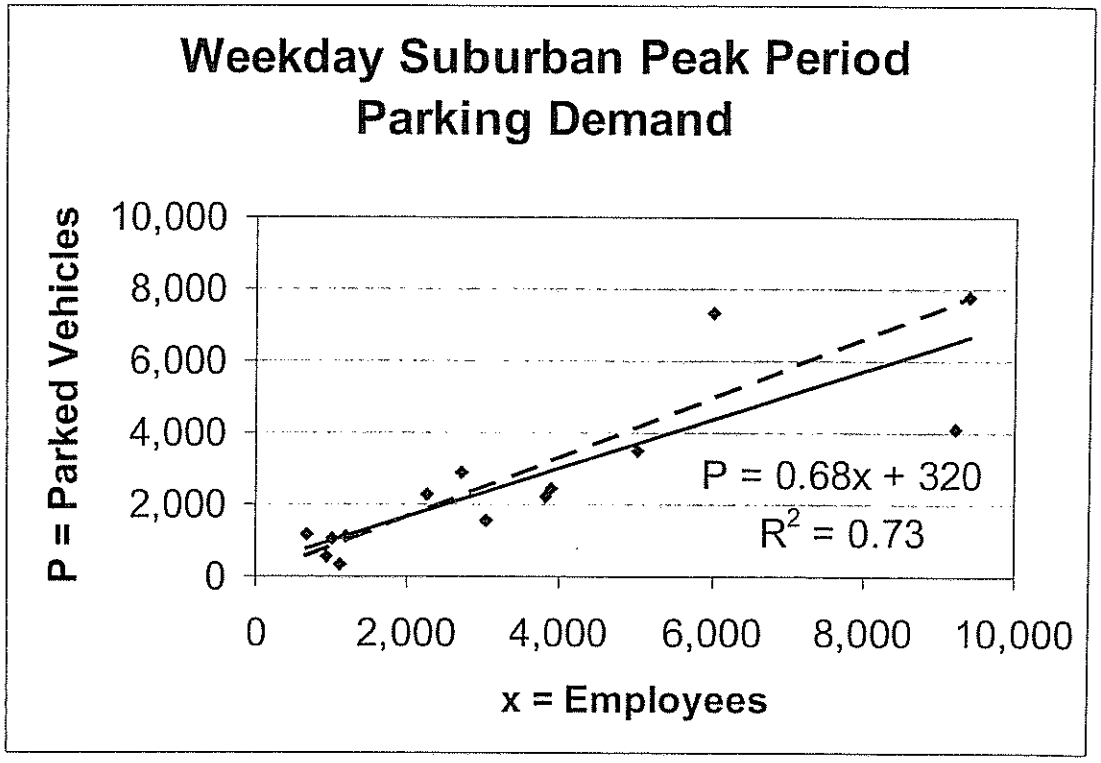


◆ Actual Data Points ——— Fitted Curve/Average Rate

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Employees
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–4:00 p.m.
Number of Study Sites	14
Average Size of Study Sites	3,600 employees
Average Peak Period Parking Demand	0.83 vehicles per employee
Standard Deviation	0.37
Coefficient of Variation	44%
Range	0.31–1.71 vehicles per employee
85th Percentile	1.09 vehicles per employee
33rd Percentile	0.62 vehicles per employee

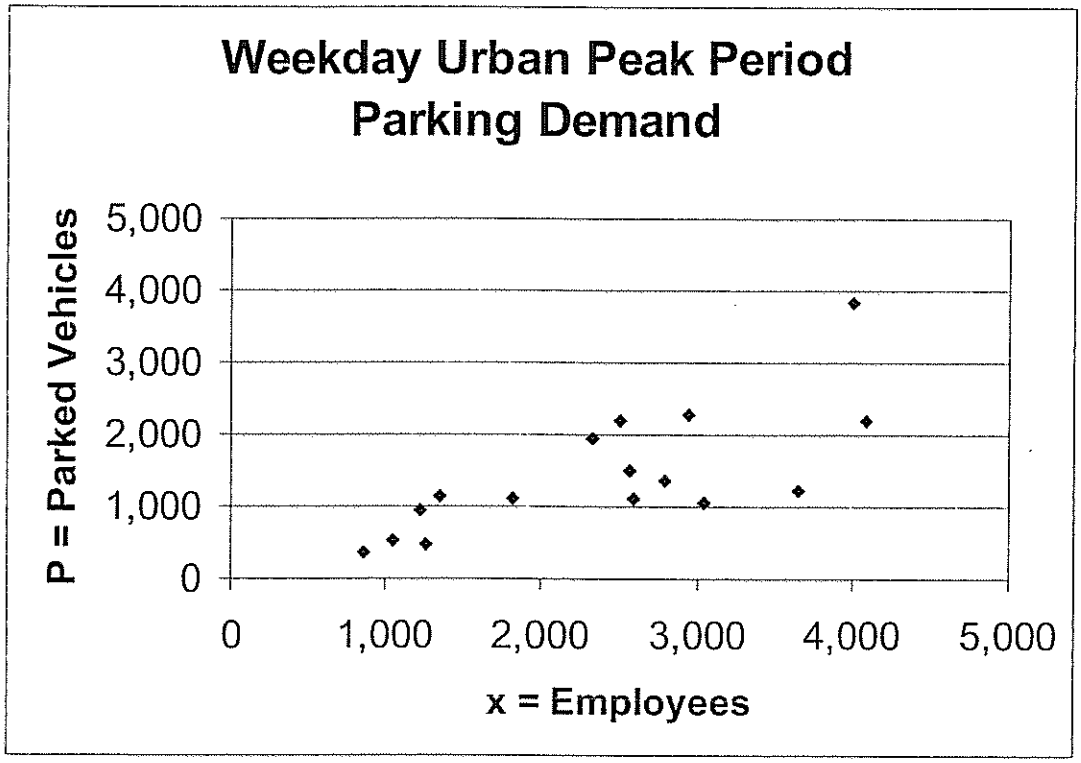


◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 610
Hospital

Average Peak Period Parking Demand vs: Employees
On a: Weekday
Location: Urban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–4:00 p.m.
Number of Study Sites	16
Average Size of Study Sites	2,400 employees
Average Peak Period Parking Demand	0.60 vehicles per employee
Standard Deviation	0.21
Coefficient of Variation	34%
Range	0.34–0.96 vehicles per employee
85th Percentile	0.83 vehicles per employee
33rd Percentile	0.48 vehicles per employee



◆ Actual Data Points

Land Use: 701
Office Building

Land Use Description

ITE defines office uses in several categories. In reviewing the statistics for office parking demand, it was found that five of the basic office land uses had virtually no difference in parking demand characteristics. The following section merges these uses together for analysis purposes. ***Analysts should continue to record the specific ITE land use category for data that they submit.***

710: General Office Building—A general office building houses multiple tenants; it is a location where affairs of businesses, commercial or industrial organizations, or professional persons or firms are conducted. An office building or buildings may contain a mixture of tenants including professional services; insurance companies; investment brokers; and tenant services, such as a bank or savings and loan institution, a restaurant or cafeteria and service retail facilities. Corporate headquarters (Land Use 714), single tenant office building (Land Use 715), office park (Land Use 750) and research and development center (Land Use 760) are related uses.

714: Corporate Headquarters Building—A corporate headquarters building is a single tenant office building that houses the corporate headquarters of a company or organization, which generally consists of offices, meeting rooms, space for file storage and data processing, a restaurant or cafeteria and other service functions. General office building (Land Use 710), single tenant office building (Land Use 715), office park (Land Use 750) and research and development center (Land Use 760) are related uses.

715: Single Tenant Office Building—A single tenant office building generally contains offices, meeting rooms and space for file storage and data processing for a single business or company, and possibly other service functions, including a restaurant or cafeteria. General office building (Land Use 710), corporate headquarters building (Land Use 714), office park (Land Use 750) and research and development center (Land Use 760) are related uses.

750: Office Park—Office parks are usually suburban subdivisions or planned unit developments containing general office buildings and support services, such as banks, restaurants and service stations, arranged in a park- or campus-like atmosphere. General office building (Land Use 710), corporate headquarters building (Land Use 714), single tenant office building (Land Use 715) and research and development center (Land Use 760) are related uses.

760: Research and Development Center—Research and development centers are facilities or groups of facilities devoted almost exclusively to research and development activities. The range of specific types of businesses contained in this land use varies significantly. Research and development centers may contain offices and light fabrication areas. General office building (Land Use 710), corporate headquarters building (Land Use 714), single tenant office building (Land Use 715) and office park (Land Use 750) are related uses.

Database Description

The database consisted of a mix of suburban and urban sites. Parking demand differed between the area types for one independent variable (1,000 sq. ft. GFA) but not for another (employees). Therefore, parking demand was analyzed separately for 1,000 sq. ft. and was combined for employees.

- Average parking supply ratios: 4.0 spaces per 1,000 sq. ft. GFA (84 study sites) and 1.1 spaces per employee (48 study sites).
- Average employee density: 3.3 employees per 1,000 sq. ft. GFA (54 study sites). Employee densities for corporate headquarter buildings and research and development centers tended to be slightly lower than the average.

Land Use: 701
Office Building

As noted, peak parking demand rates were different between sites located in suburban settings and those located in urban settings for the independent variable 1,000 sq. ft. GFA. The individual site surveys did not enable a quantitative explanation of the factors that caused the difference. One potential explanation may relate to differences in the availability of alternative modes (for example, transit, bike and pedestrian) available at the urban sites. Of the studies with data on transit availability and presence of a TDM program, the suburban sites reported about 55 percent with available transit services and 20 percent with TDM programs. The urban sites reported 100 percent with available transit and 83 percent with TDM programs of some form.

Weekend parking demand data were available at two study sites. At one site, the Saturday peak demand was less than 10 percent of peak weekday demand at the same site. At the other site, the Saturday and Sunday demand approached 90 percent of the weekday peak demand for the same site. It was not possible to derive reliable weekend parking demand rates due to lack of information on the nature of work conducted during the weekend at the two sites.

The size of one site (1.9 million sq. ft. GFA) resulted in a data plot with a scale that did not allow the 12 data points for sites less than 500,000 sq. ft. GFA to be reasonably distinguished for user analysis. Therefore, the large site was not included in the data plot for urban sites. The peak parking demand rate for the 1.9 million sq. ft. GFA site was 2.58 vehicles per 1,000 sq. ft. GFA, which was approximately the same as the average for the other 12 study sites.

The following table presents the time-of-day distributions of parking demand variation for suburban and urban sites. The only sites included in the table data were those that submitted at least four consecutive hours of parking demand observations (note: the majority of the parking demand data in the overall database consisted of one or two hourly observations).

Based on Vehicles per 1,000 sq. ft. GFA	Weekday Suburban Data		Weekday Urban Data	
Hour Beginning	Percent of Peak Period	Number of Data Points*	Percent of Peak Period	Number of Data Points*
12:00–4:00 a.m.	–	0	–	0
5:00 a.m.	–	0	–	0
6:00 a.m.	6	1	–	0
7:00 a.m.	56	2	20	2
8:00 a.m.	86	11	68	4
9:00 a.m.	97	13	90	4
10:00 a.m.	100	12	96	4
11:00 a.m.	98	12	95	4
12:00 p.m.	87	11	94	4
1:00 p.m.	75	6	96	4
2:00 p.m.	84	6	100	4
3:00 p.m.	87	6	99	4
4:00 p.m.	75	6	92	4
5:00 p.m.	43	7	62	3
6:00 p.m.	18	2	–	0
7:00 p.m.	–	0	–	0
8:00 p.m.	–	0	–	0
9:00 p.m.	–	0	–	0
10:00 p.m.	–	0	–	0
11:00 p.m.	–	0	–	0

* Subset of database

Land Use: 701
Office Building

The parking demand studies in the database for this land use were conducted from 1970 through 2001. The following table summarizes the age of the data set and presents the average weekday peak period parking demand ratio for each chronological time period. Suburban and urban sites are mixed in the table data set. It is evident from the table that parking demand for this land use has not changed substantially over time (in terms of vehicles per building square footage).

Time Period of Parking Demand Study	*Average Weekday Peak Period Parking Demand Ratio*	*Parking Demand Studies Within Time Period*	
Years	Parked Vehicles per 1,000 sq. ft. GFA	Number of Study Sites	Percentage of Entire Data Set (%)
1970–1976	2.8	7	4
1978–1979	3.2	14	8
1981	2.8	18	10
1982	2.8	27	15
1983	2.7	21	11
1984	2.6	32	17
1985–1986	2.9	20	11
1987–1990	3.0	16	9
1991	2.7	17	9
1994–1996	2.8	7	4
1998–2001	2.8	6	3
Total	2.8	185	100

An examination of the day-of-week trends of parking demand for all study sites in this land use indicated that weekday peak period parking demand tended to be at its highest for a site on a Friday. The next highest weekday for parking demand was observed to be on a Tuesday.

Data were provided for a television station and office in a suburban location. Its peak period demand appeared to differ from other offices in this land use and was therefore excluded from the database. The site was 8,240 sq. ft. GFA and had 86 employees, with parking supply ratios of 6.8 spaces per 1,000 sq. ft. GFA and 0.65 spaces per employee. Peak parking demand was counted for 12 consecutive hours during two weekdays and the site's peak parking period was between 4:00 and 5:00 p.m. The peak parking demand ratios were 8.25 vehicles per 1,000 sq. ft. GFA and 0.79 vehicles per employee.

Data were provided for a credit card processing office in a suburban location. Its peak period demand appeared to differ from other offices in this land use and was therefore excluded from the database. The site was 73,300 sq. ft. GFA, with a parking supply ratio of 3.7 spaces per 1,000 sq. ft. GFA. Peak parking demand was counted for 11 consecutive hours during two weekdays and the site's peak parking period was between 9:00 and 10:00 a.m. The peak parking demand ratio was 5.57 vehicles per 1,000 sq. ft. GFA.

Land Use: 701
Office Building

Additional Data

- Specific studies conducted in downtown areas documented parking ratios between 1.0 and 2.0 vehicles per 1,000 sq. ft. GFA in settings with priced parking and where high quality transit options exist.[1]
- A study[2] conducted by King County Metro in Seattle, WA indicated that approximately 6.5 percent of the peak parking demand was generated by visitor parking. This study included visitor-parking observations from 23 office buildings in both the morning and afternoon peak demand periods.

Study Sites/Years

Canada:
Calgary, AL (1978)

United States:
Newport Beach, CA (1970); Hinsdale, IL (1974); Schiller Park, IL (1974); Dallas, TX (1976); Overland Park, KS (1978); Indianapolis, IN (1979); Concord, CA (1981); Danville, CA (1981); Dublin, CA (1981); Houston, TX (1981); La Plama, CA (1981); Lafayette, CA (1981); Naperville, IL (1981); Orinda, CA (1981); Palm Beach, FL (1981); Rolling Meadows, IL (1981); San Ramon, CA (1981); Schaumburg, IL (1981); Skokie, IL (1981); Walnut Creek, CA (1981); Aurora, CO (1982); Bellevue, WA (1982); Burlingame, CA (1982); Greenwood, CO (1982); Goleta, CA (1982); Houston, TX (1982); Newport Beach, CA (1982); Phoenix, AZ (1982); San Antonio, TX (1982); San Mateo, CA (1982); Santa Ana, CA (1982); Schaumburg, IL (1982); Seattle, WA (1982); Walnut Creek, CA (1982); Addison, TX (1983); Century City, CA (1983); Dallas, TX (1983); Denver, CO (1983); Foster City, CA (1983); Houston, TX (1983); Newport Beach, CA (1983); Phoenix, AZ (1983); San Ramon, CA (1983); Aurora, CO (1984); Bridgeport, CT (1984); Brook, NY (1984); Clark, NJ (1984); Dallas, TX (1984); Foster City, CA (1984); Harrisburg, PA (1984); Livermore, CA (1984); Milford, CT (1984); Norwalk, CT (1984); Pleasanton, CA (1984); Provo, UT (1984); Rye Wilton, CT (1984); San Ramon, CA (1984); Schaumburg, IL (1984); Stamford, CT (1984); Syracuse, NY (1984); Cobb County, GA (1985); Dublin, CA (1985); Milpitas, CA (1985); San Bruno, CA (1985); IL (1985); Armonk, NY (1986); Deerfield, IL (1986); Bellevue, WA (1987); Dallas, TX (1987); Irving, TX (1987); Kirkland, WA (1987); North Syracuse, NY (1987); Oklahoma City, OK (1987); Dallas, TX (1989); Glenview, IL (1990); Walnut Creek, CA (1988); Anaheim, CA (1991); Bellevue, WA (1991); Bothell, WA (1991); Federal Way, WA (1991); Montlake Terrace, WA (1991); Redmond, WA (1991); Renton, WA (1991); Seattle, WA (1991); Snohomish Co., WA (1991); Tukwila, WA (1991); Lake Oswego, OR (1994); Goleta, CA (1995); Walnut Creek, CA (1996); Cleveland, OH (1998); Goleta, CA (1998); Goleta, CA (1999); Saratoga, CA (2000); Santa Barbara, CA (2001)

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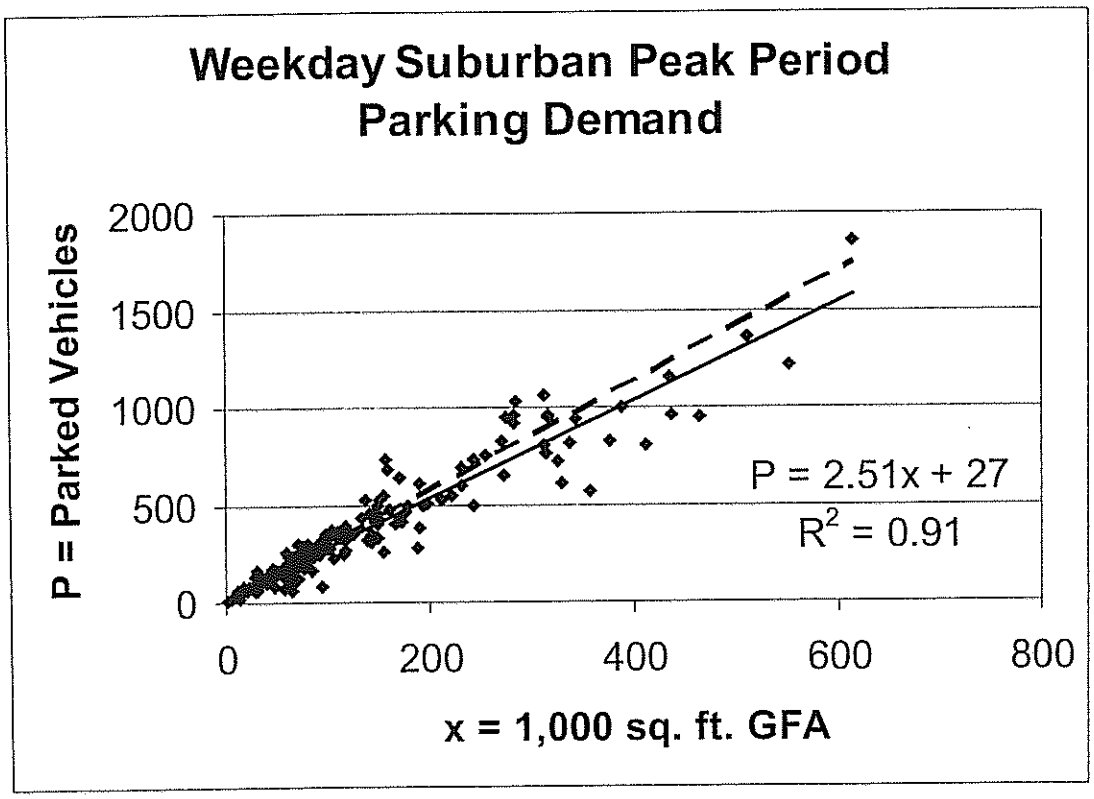
[1] *Downtown Portland Older and Historic Building Parking Demand Study.* Portland Development Commission, by DKS Associates. June 1992, page 4–13 (notes parking ratio of 1.3 spaces per 1000 sq. ft. GFA); *Oakland Central District Development Program—Tech Memo #2: Parking Analysis and Recommended Parking Plan.* City of Oakland, by DKS Associates. October 1985, page 9 (office parking ratio range of 1.11 to 1.49 vehicles/KSF); Levinson, Herbert & Robert Weant. *Parking.* Eno Foundation, 1990, Table 6-8, page 104 (estimates ranges in CBD parking ratios with varying transit usage: 2.2–2.6 spaces per 1000 GLA for 20 percent transit, 1.6–2.0 spaces per 1000 GLA for 40 percent transit and 1.0–1.4 spaces per 1000 GLA for 60 percent transit); Holdsworth, Glen. *CBD Parking Policy: Development Policy or Parking Policy.* 2001 ITE Annual Meeting, August 2001, page 11 (notes range of Australian CBDs of 1.0 to 2.0 spaces per 100 sq. m. or 0.93 to 1.86 spaces per 1000 sq. ft. GFA).

[2] *1991 Parking Utilization Study in Seattle.* King County Metro, June 1992, Appendix B.

Land Use: 701
Office Building

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday
Location: Suburban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 2:00–4:00 p.m.
Number of Study Sites	173
Average Size of Study Sites	136,000 sq. ft. GFA
Average Peak Period Parking Demand	2.84 vehicles per 1,000 sq. ft. GFA
Standard Deviation	0.72
Coefficient of Variation	25%
95% Confidence Interval	2.73–2.95 vehicles per 1,000 sq. ft. GFA
Range	0.86–5.58 vehicles per 1,000 sq. ft. GFA
85th Percentile	3.44 vehicles per 1,000 sq. ft. GFA
33rd Percentile	2.57 vehicles per 1,000 sq. ft. GFA

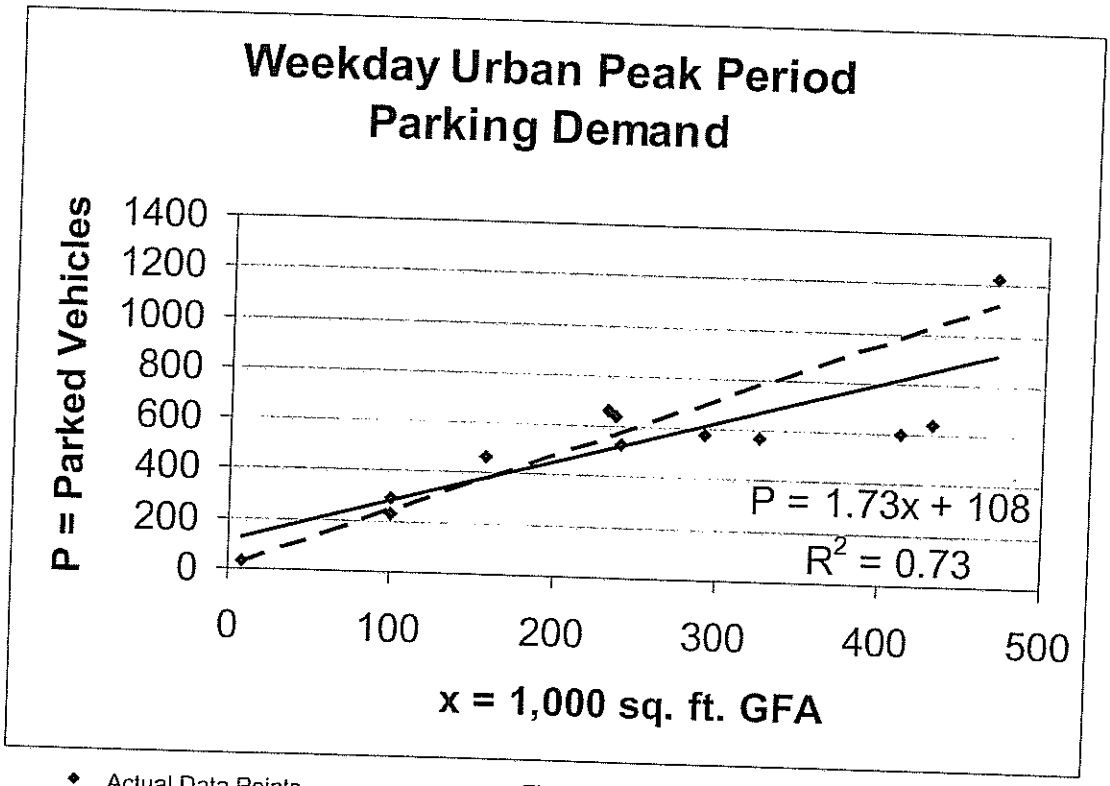


◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 701
Office Building

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday
Location: Urban

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–4:00 p.m.
Number of Study Sites	12
Average Size of Study Sites	250,000 sq. ft. GFA
Average Peak Period Parking Demand	2.40 vehicles per 1,000 sq. ft. GFA
Standard Deviation	0.63
Coefficient of Variation	26%
Range	1.46–3.43 vehicles per 1,000 sq. ft. GFA
85th Percentile	2.97 vehicles per 1,000 sq. ft. GFA
33rd Percentile	2.12 vehicles per 1,000 sq. ft. GFA

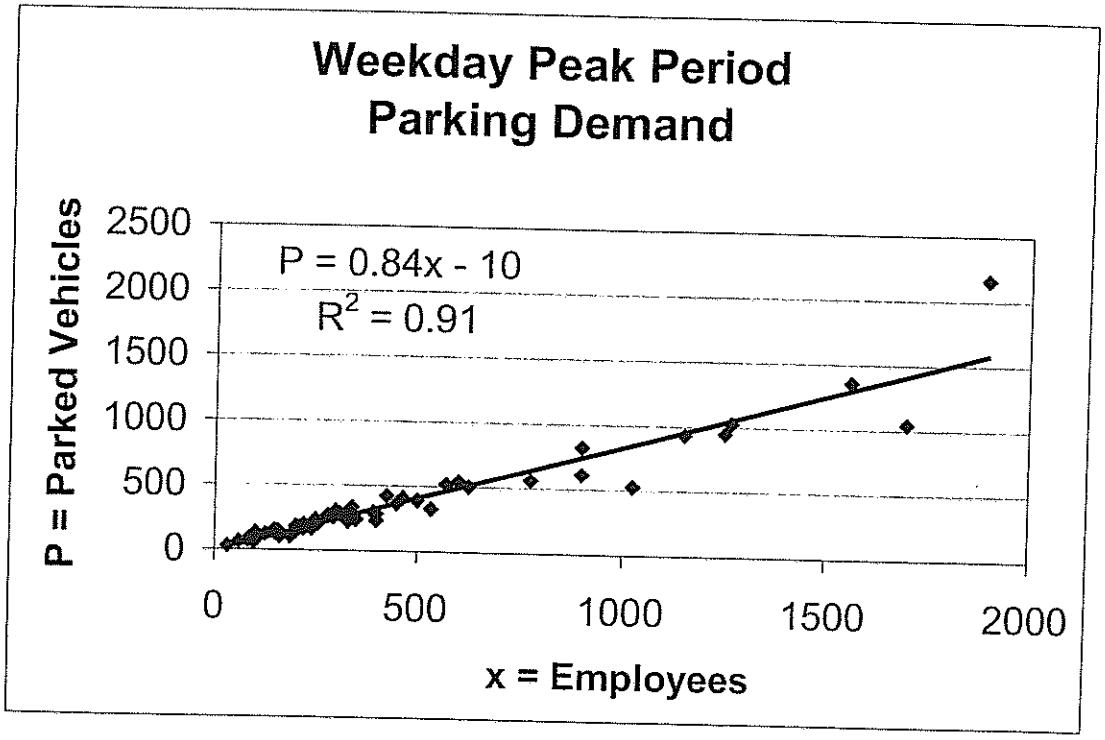


◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 701
Office Building

Average Peak Period Parking Demand vs: Employees
On a: Weekday

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.; 2:00–4:00 p.m.
Number of Study Sites	58
Average Size of Study Sites	440 employees
Average Peak Period Parking Demand	0.83 vehicles per employee
Standard Deviation	0.16
Coefficient of Variation	19%
95% Confidence Interval	0.79–0.87 vehicles per employee
Range	0.52–1.35 vehicles per employee
85th Percentile	0.98 vehicles per employee
33rd Percentile	0.76 vehicles per employee



◆ Actual Data Points ——— Fitted Curve/Average Rate

Land Use: 720
Medical-Dental Office Building

Land Use Description

A medical-dental office building is a facility that provides diagnoses and outpatient care on a routine basis, but is unable to provide prolonged in-house medical and surgical care. One or more private physicians or dentists generally operate this type of facility. Clinic (Land Use 630) is a related use.

Database Description

The database consisted of a mix of urban and suburban sites. Parking demand rates at the suburban sites were similar to those at urban sites and therefore the data were combined and analyzed together.

- Average parking supply ratio: 3.9 spaces per 1,000 sq. ft. GFA (11 study sites).

The two study sites with weekend parking demand observations had Saturday peak demand rates 18 and 25 percent less than the weekday peak demand rates for the same study sites.

The following table presents the time-of-day distribution of parking demand, based on data from sites with at least five hours of continuous count data.

Based on Vehicles per 1,000 sq. ft. GFA	*Weekday Data*	
Hour Beginning	Percent of Peak Period	Number of Data Points*
12:00–4:00 a.m.	–	0
5:00 a.m.	–	0
6:00 a.m.	–	0
7:00 a.m.	15	2
8:00 a.m.	49	2
9:00 a.m.	84	7
10:00 a.m.	100	8
11:00 a.m.	100	8
12:00 p.m.	88	8
1:00 p.m.	79	8
2:00 p.m.	86	7
3:00 p.m.	96	7
4:00 p.m.	91	6
5:00 p.m.	72	1
6:00 p.m.	–	0
7:00 p.m.	–	0
8:00 p.m.	–	0
9:00 p.m.	–	0
10:00 p.m.	–	0
11:00 p.m.	–	0

* Subset of database

Future studies should include data on the number of doctors working at a study site.

Study Sites/Years

Canada:
Coquitlam, BC (1992)

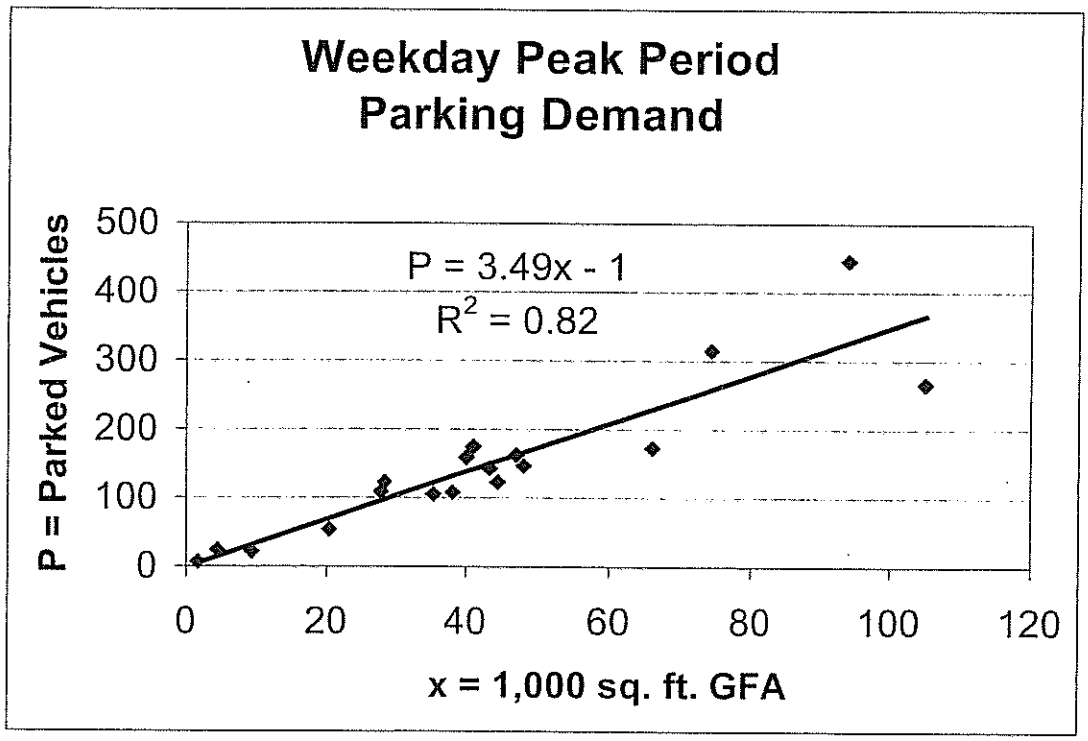
Land Use: 720
Medical-Dental Office Building

United States:
Skokie, IL (1963); Evanston, IL (1972); Munster, IN (1978); Overland Park, KS (1978); San Antonio, TX (1982); Cincinnati, OH (1986); Anaheim, CA (1988); Laguna Niguel, CA (1989); Fullerton, CA (1990); Garden Grove, CA (1990); Towson, MD (1991); Towson, MD (1992)

Land Use: 720
Medical-Dental Office Building

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday

Statistic	Peak Period Demand
Peak Period	10:00 a.m.–12:00 p.m.; 2:00–5:00 p.m.
Number of Study Sites	18
Average Size of Study Sites	43,000 sq. ft. GFA
Average Peak Period Parking Demand	3.53 vehicles per 1,000 sq. ft. GFA
Standard Deviation	0.87
Coefficient of Variation	25%
Range	2.34 – 5.35 vehicles per 1,000 sq. ft. GFA
85th Percentile	4.30 vehicles per 1,000 sq. ft. GFA
33rd Percentile	2.92 vehicles per 1,000 sq. ft. GFA



◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 730
Government Office Building

Land Use Description

A government office building is an individual building containing either the entire function or simply one agency of a city, county, state, federal, or other governmental unit.

Database Description

The database consisted of three suburban sites and one urban site. Parking demand rates at the suburban sites were similar to those at urban sites and therefore the data were combined and analyzed together.

- Average parking supply ratios: 3.3 spaces per 1,000 sq. ft. GFA and 0.85 spaces per employee (both based on three study sites).
- Average employee density: 4 employees per 1,000 sq. ft. GFA.

The study sites for this land use served a wide range of functions, from a city hall to a federal agency's office building. Most of the study sites typically had a high rate of visitors who conducted business with the governmental unit.

The following table presents the time-of-day distribution of parking demand at the single site with continuous count data.

Based on Vehicles per 1,000 sq. ft. GFA	*Weekday Data*	
Hour Beginning	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0
5:00 a.m.	–	0
6:00 a.m.	–	0
7:00 a.m.	–	0
8:00 a.m.	–	0
9:00 a.m.	83	1
10:00 a.m.	100	1
11:00 a.m.	92	1
12:00 p.m.	77	1
1:00 p.m.	59	1
2:00 p.m.	71	1
3:00 p.m.	78	1
4:00 p.m.	–	0
5:00 p.m.	–	0
6:00 p.m.	–	0
7:00 p.m.	–	0
8:00 p.m.	–	0
9:00 p.m.	–	0
10:00 p.m.	–	0
11:00 p.m.	–	0

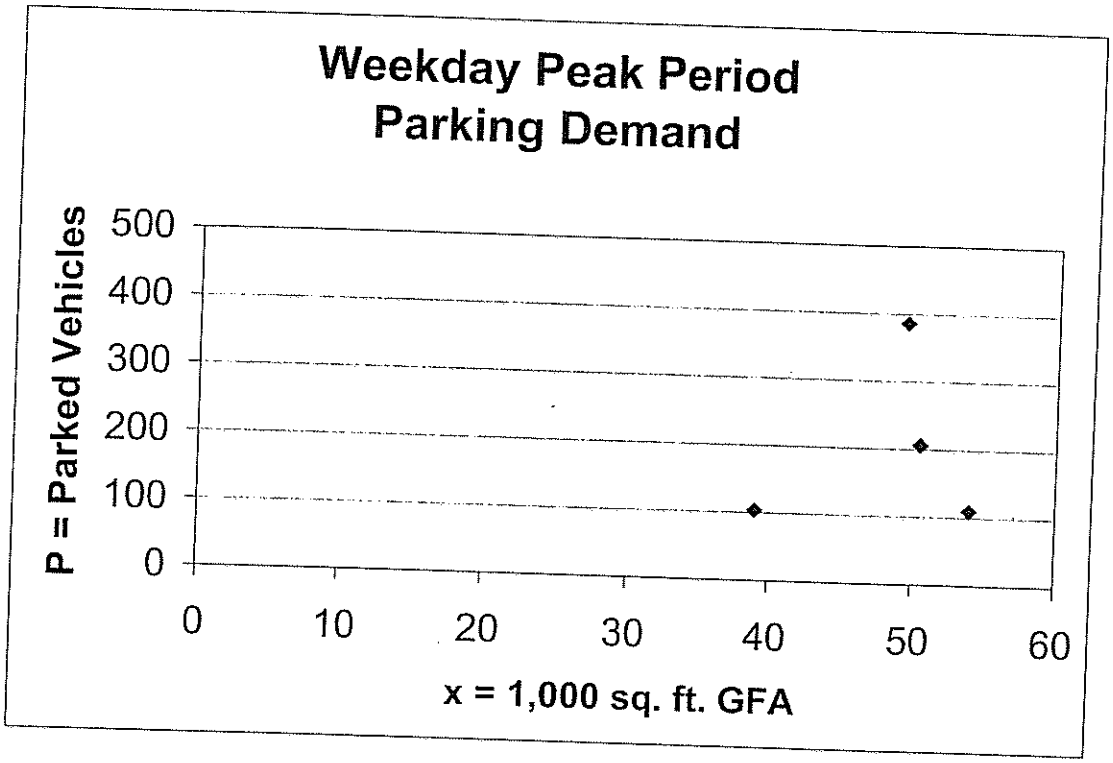
Study Sites/Years

Newport News, VA (1984); Metairie, LA (1986); Kirkland, WA (1991); Bothell, WA (1991)

Land Use: 730
Government Office Building

Average Peak Period Parking Demand vs: 1,000 sq. ft. GFA
On a: Weekday

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.
Number of Study Sites	4
Average Size of Study Sites	50,000 sq. ft. GFA
Average Peak Period Parking Demand	4.15 vehicles per 1,000 sq. ft. GFA
Standard Deviation	2.59
Coefficient of Variation	62%
Range	2.04–7.81 vehicles per 1,000 sq. ft. GFA
85th Percentile	6.13 vehicles per 1,000 sq. ft. GFA
33rd Percentile	2.66 vehicles per 1,000 sq. ft. GFA

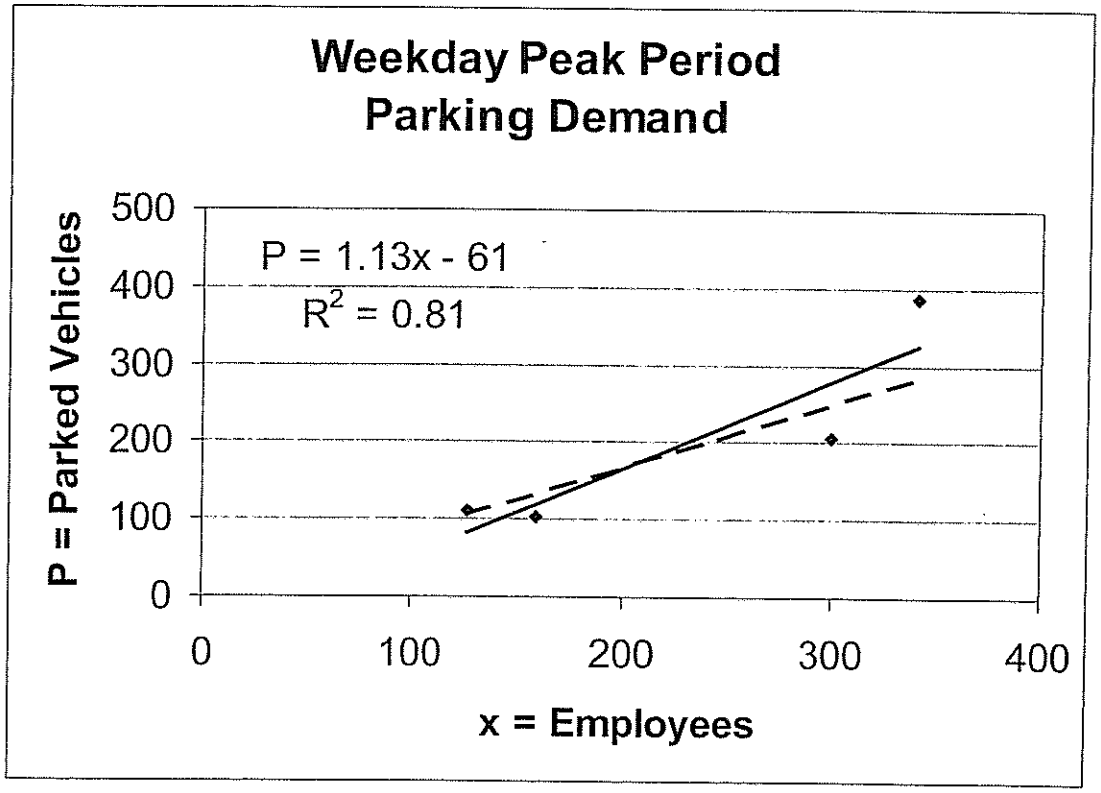


◆ Actual Data Points

Land Use: 730
Government Office Building

Average Peak Period Parking Demand vs: Employees
On a: Weekday

Statistic	Peak Period Demand
Peak Period	9:00 a.m.–12:00 p.m.
Number of Study Sites	4
Average Size of Study Sites	230 employees
Average Peak Period Parking Demand	0.83 vehicles per employee
Standard Deviation	0.22
Coefficient of Variation	26%
Range	0.65–1.13 vehicles per employee
85th Percentile	1.01 vehicles per employee
33rd Percentile	0.69 vehicles per employee



◆ Actual Data Points ——— Fitted Curve - - - - Average Rate

Land Use: 732
United States Post Office

Land Use Description

A U.S. Post Office is a federal building that contains service windows for mailing packages and letters, post office boxes, offices, sorting and distributing facilities for mail and vehicle storage areas.

Database Description

The database consisted of one study site.

- Size: 4,800 sq. ft. GFA with 80 employees.
- Parking supply ratios: 33 spaces per 1,000 sq. ft. GFA and 2.0 spaces per employee.
- Average weekday peak period parking demand ratios: 33.2 vehicles per 1,000 sq. ft. GFA and 2.0 vehicles per employee between 9:00 and 10:00 a.m.

The following table presents time-of-day distribution of parking demand at the single site.

Based on: Vehicles per 1,000 sq. ft. GFA	*Weekday Data*	
Hour Beginning	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0
5:00 a.m.	–	0
6:00 a.m.	–	0
7:00 a.m.	39	1
8:00 a.m.	81	1
9:00 a.m.	100	1
10:00 a.m.	76	1
11:00 a.m.	60	1
12:00 p.m.	60	1
1:00 p.m.	54	1
2:00 p.m.	63	1
3:00 p.m.	68	1
4:00 p.m.	53	1
5:00 p.m.	43	1
6:00 p.m.	37	1
7:00 p.m.	–	0
8:00 p.m.	–	0
9:00 p.m.	–	0
10:00 p.m.	–	0
11:00 p.m.	–	0

Study Site/Year

Syracuse, NY (1988)

Land Use: 735
Judicial Complex

Land Use Description

A judicial complex is a group of government office buildings interconnected by pedestrian walkways, with uses limited to public safety (police station, sheriffs office) and court activity. These facilities can include courtrooms, jails, public safety offices and community corrections uses.

Database Description

The database consisted of two study sites, one suburban and one urban.

- Building size: 53,000 sq. ft. GFA (suburban) and 88,000 sq. ft. GFA (urban).
- Parking supply ratios: 4.1 spaces per 1,000 sq. ft. GFA and 0.8 spaces per employee (suburban site only).
- Number of employees: 260 (suburban) and 350 (urban).

The suburban site weekday peak parking demand rates were 3.02 vehicles per 1,000 sq. ft. GFA and 0.61 vehicles per employee. The peak hour of the suburban site was between 3:00 and 4:00 p.m. based on hourly counts taken between 8:00 a.m. and 6:00 p.m.

The urban site weekday parking demand rates were 1.64 vehicles per 1,000 sq. ft. GFA and 0.41 vehicles per employee. The urban site had only a single hourly observation, which was made between 11:00 a.m. and 12:00 p.m.

Study Sites/Years

Bridgeport, CT (1984); Grand Prairie, TX (1992)

Land Use: 812
Building Materials and Lumber Store

Land Use Description

A building materials and lumber store is a free-standing building that sells hardware, building materials and lumber. The lumber may be stored in the main building, yard, or storage shed. The buildings contained in this land use are less than 30,000 sq. ft. GFA. Hardware/paint store (Land Use 816) and home improvement superstore (Land Use 862) are related uses.

Database Description

The database consisted of two study sites, one in a suburban setting and one in an urban setting.

- Size: 26,000 sq. ft. GFA and 11,300 sq. ft. GFA at the suburban and urban sites, respectively.
- Parking supply ratios: 3.8 and 2.4 spaces per 1,000 sq. ft. GFA at the suburban and urban sites, respectively.
- Suburban weekday peak parking demand ratio: 1.7 vehicles per 1,000 sq. ft. GFA between 6:00 and 7:00 p.m. (based on a continuous count between 4:00 and 8:00 p.m.).
- Urban weekday peak parking demand ratio: 1.1 vehicles per 1,000 sq. ft. between 1:00 and 3:00 p.m. (based on a continuous count between 8:00 a.m. and 6:00 p.m.).

Outside storage areas are not included in the overall gross floor area measurements. However, if storage areas are located within the principal outside faces of the exterior walls, they are included in the building's overall gross floor area.

Study Sites/Years

Dewitt, NY (1984); Santa Barbara, CA (1998)

Land Use: 815
Free-Standing Discount Store

Land Use Description

The discount stores in this category are free-standing stores. These stores offer a variety of customer services, centralized cashiering and a wide range of products. They typically maintain long store hours 7 days a week. The stores included in this land use are often the only ones on the site, but they can also be found in mutual operation with a related or unrelated garden center and/or service station. Free-standing discount stores are also sometimes found as separate parcels within a retail complex with their own dedicated parking.

Database Description

- Average parking supply ratio: 5.0 spaces per 1,000 sq. ft. GFA (seven study sites).
- Average employee density: 1 employee per 1,000 sq. ft. GFA (three study sites).

Parking demand data were available for several combinations of weekdays, Saturdays and Sundays during December and non-December months. Data sets with at least three study sites were presented in the data plots. Other time periods are summarized below.

- Average peak parking demand rates during Sundays in December: 3.15 and 5.86 vehicles per 1,000 sq. ft. GFA (two study sites).
- Average peak parking demand rates during weekdays in non-December months: 0.88 and 0.78 vehicles per 1,000 sq. ft. GFA (two study sites).

The following table presents the time-of-day distributions of parking demand for all sites that included at least five hours of continuous count data.

	December Weekday		*December Saturday*		*December Sunday*		*Non-December Weekday*		*Non-December Saturday*	
Hour Beginning	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points	Percent of Peak Period	Number of Data Points
12:00–4:00 a.m.	–	0	–	0	–	0	–	0	–	0
5:00 a.m.	–	0	–	0	–	0	–	0	–	0
6:00a.m.	–	0	–	0	–	0	–	0	–	0
7:00 a.m.	–	0	–	0	–	0	–	0	–	0
8:00 a.m.	–	0	–	0	–	0	–	0	–	0
9:00 a.m.	–	0	–	0	–	0	–	0	–	0
10:00 a.m.	97	1	73	1	–	0	97	1	91	1
11:00 a.m.	100	1	84	1	81	2	96	1	100	1
12:00 p.m.	91	1	95	1	92	2	96	1	82	1
1:00 p.m.	87	1	100	1	96	2	100	1	80	1
2:00 p.m.	94	1	95	2	100	2	96	1	74	1
3:00 p.m.	87	1	97	2	96	2	100	1	76	1
4:00 p.m.	84	1	100	2	89	2	94	1	73	1
5:00 p.m.	68	1	98	2	–	0	90	1	59	1
6:00 p.m.	52	1	93	2	–	0	69	1	–	0
7:00 p.m.	64	1	–	0	–	0	71	1	–	0
8:00 p.m.	61	1	–	0	–	0	67	1	–	0
9:00 p.m.	–	0	–	0	–	0	66	1	–	0
10:00 p.m.	–	0	–	0	–	0	–	0	–	0
11:00 p.m.	–	0	–	0	–	0	–	0	–	0

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/17/2007	Analysis Year	2007
Analysis Time Period	2007 AM		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Central Campus Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		151	62	84	160	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	112	0	98
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				101	0	89
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	93	177	0	0	167	68
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		93	112		98			
C (m) (veh/h)		1329	507		848			
v/c		0.07	0.22		0.12			
95% queue length		0.23	0.84		0.39			
Control Delay (s/veh)		7.9	14.1		9.8			
LOS		A	B		A			
Approach Delay (s/veh)	--	--	12.1					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/17/2007	Analysis Year	2007
Analysis Time Period	2007 PM		

Project Description	7003 USTAR Programming
East/West Street: Federal Way	North/South Street: Central Campus Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		350	320	289	311	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	183	0	118
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				165	0	107
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	321	345	0	0	388	355
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		321	183		118			
C (m) (veh/h)		860	111		611			
v/c		0.37	1.65		0.19			
95% queue length		1.74	13.93		0.71			
Control Delay (s/veh)		11.7	396.4		12.3			
LOS		B	F		B			
Approach Delay (s/veh)	--	--	245.8					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		390	242	78	174		163		203			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 16.8	G = 0.0	G = 0.0	G = 0.0	G = 11.2	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 36.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		702			280		181	226				
Lane Group Capacity		1591			1225		562	502				
v/c Ratio		0.44			0.23		0.32	0.45				
Green Ratio		0.47			0.47		0.31	0.31				
Uniform Delay d_1		6.4			5.7		9.5	9.9				
Delay Factor k		0.11			0.11		0.11	0.11				
Incremental Delay d_2		0.2			0.1		0.3	0.6				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		6.6			5.8		9.8	10.6				
Lane Group LOS		A			A		A	B				
Approach Delay	6.6			5.8			10.2					
Approach LOS	A			A			B					
Intersection Delay	7.5			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		281	188	173	516		152		70			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 23.4	G = 0.0	G = 0.0	G = 0.0	G = 11.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 43.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		521			765		169	78				
Lane Group Capacity		1850			1421		487	436				
v/c Ratio		0.28			0.54		0.35	0.18				
Green Ratio		0.54			0.54		0.27	0.27				
Uniform Delay d_1		5.3			6.3		12.6	12.0				
Delay Factor k		0.11			0.14		0.11	0.11				
Incremental Delay d_2		0.1			0.4		0.4	0.2				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		5.4			6.7		13.1	12.2				
Lane Group LOS		A			A		B	B				
Approach Delay	5.4			6.7			12.8					
Approach LOS	A			A			B					
Intersection Delay	7.2			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical Dr & South Medical Dr
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/17/2007	Analysis Year	2007
Analysis Time Period	2007 AM		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		775	385	178	301	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	141	0	74
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				127		67
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	197	334	0	0	861	427
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		197	141		74			
C (m) (veh/h)		534	58		416			
v/c		0.37	2.43		0.18			
95% queue length		1.69	14.12		0.64			
Control Delay (s/veh)		15.6	803.3		15.5			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	532.1					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical Dr & South Medical Dr
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/17/2007	Analysis Year	2007
Analysis Time Period	2007 PM		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		385	123	125	650	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	330	0	151
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				297		136
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	138	722	0	0	427	136
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		138	330		151			
C (m) (veh/h)		1005	170		715			
v/c		0.14	1.94		0.21			
95% queue length		0.48	24.96		0.79			
Control Delay (s/veh)		9.2	489.6		11.4			
LOS		A	F		B			
Approach Delay (s/veh)	--	--	339.5					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical Dr & Wasatch Dr
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			241				586	945			253	30
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G = 0.0	G = 0.0	G = 0.0	G =	G = 10.0	G = 16.9	G = 0.0	G = 0.0
	Y = 0	Y = 0	Y = 0	Y =	Y = 4	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 34.9		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			268				651	1050			281	33
Lane Group Capacity			796				1396	1036			1036	463
v/c Ratio			0.34				0.47	1.01			0.27	0.07
Green Ratio			0.48				0.89	0.29			0.29	0.29
Uniform Delay d_1			5.5				0.6	12.5			9.6	9.1
Delay Factor k			0.11				0.11	0.50			0.11	0.11
Incremental Delay d_2			0.3				0.2	31.4			0.1	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			5.8				0.8	43.8			9.8	9.1
Lane Group LOS			A				A	D			A	A
Approach Delay	5.8						27.4			9.7		
Approach LOS	A						C			A		
Intersection Delay	22.4			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical Dr & Wasatch Dr
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			420				167	518			899	30
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G =	G =	G =	G =	G = 10.8	G = 10.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =

Duration of Analysis (hrs) = 0.25

Cycle Length C = 28.8

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			467				186	576			999	33
Lane Group Capacity			570				1141	1358			1358	606
v/c Ratio			0.82				0.16	0.42			0.74	0.05
Green Ratio			0.35				0.86	0.38			0.38	0.38
Uniform Delay d_1			8.6				1.2	6.7			7.8	5.7
Delay Factor k			0.36				0.11	0.11			0.29	0.11
Incremental Delay d_2			9.2				0.1	0.2			2.1	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			17.8				1.2	6.9			9.9	5.8
Lane Group LOS			B				A	A			A	A
Approach Delay	17.8						5.5			9.8		
Approach LOS	B						A			A		
Intersection Delay	10.0			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		751	252	57	258		60		21			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 25.2	G = 0.0	G = 0.0	G = 0.0	G = 10.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 Cycle Length C = 43.2

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1114		63	287		67		23			
Lane Group Capacity		2031		232	2110		418		374			
v/c Ratio		0.55		0.27	0.14		0.16		0.06			
Green Ratio		0.58		0.58	0.58		0.23		0.23			
Uniform Delay d_1		5.5		4.5	4.1		13.2		12.9			
Delay Factor k		0.15		0.11	0.11		0.11		0.50			
Incremental Delay d_2		0.3		0.6	0.0		0.2		0.3			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		5.8		5.1	4.1		13.4		13.3			
Lane Group LOS		A		A	A		B		B			
Approach Delay	5.8			4.3			13.4					
Approach LOS	A			A			B					
Intersection Delay	5.9			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/17/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		332	134	30	727		165		73			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 18.3	G = 0.0	G = 0.0	G = 0.0	G = 11.4	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 37.7		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		518		33	808		183		81			
Lane Group Capacity		1680		425	1756		546		488			
v/c Ratio		0.31		0.08	0.46		0.34		0.17			
Green Ratio		0.49		0.49	0.49		0.30		0.30			
Uniform Delay d_1		5.9		5.2	6.4		10.2		9.7			
Delay Factor k		0.11		0.11	0.11		0.11		0.50			
Incremental Delay d_2		0.1		0.1	0.2		0.4		0.7			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		6.0		5.3	6.6		10.6		10.4			
Lane Group LOS		A		A	A		B		B			
Approach Delay	6.0			6.6			10.5					
Approach LOS	A			A			B					
Intersection Delay	7.0			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/17/2007
Analysis Time Period	2007 AM

Site Information

Intersection	Wasatch Dr & North Campus
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: North Campus/Medical Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		675	157	136	174	14
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	750	174	151	193	15
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Raised curb					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	19		21			9
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	21	0	23	0	0	10
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		151	21		23			10
C (m) (veh/h)		735	225		547			931
v/c		0.21	0.09		0.04			0.01
95% queue length		0.77	0.31		0.13			0.03
Control Delay (s/veh)		11.2	22.6		11.9			8.9
LOS		B	C		B			A
Approach Delay (s/veh)	--	--	17.0			8.9		
Approach LOS	--	--	C			A		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/18/2007
Analysis Time Period	2012 PM

Site Information

Intersection	North Campus & Wasatch
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		386	106	77	571	50
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	428	117	85	634	55
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	118		11			16
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	131	0	12	0	0	17
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		85	131		12			17
C (m) (veh/h)		1020	189		726			652
v/c		0.08	0.69		0.02			0.03
95% queue length		0.27	4.27		0.05			0.08
Control Delay (s/veh)		8.9	58.5		10.0			10.7
LOS		A	F		B			B
Approach Delay (s/veh)	--	--	54.4			10.7		
Approach LOS	--	--	F			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/17/2007
Analysis Time Period	2007 AM

Site Information

Intersection	Wasatch Dr & Federal Way
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	105	40			131	93
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	96	0	73	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	87		66			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	145	103	116	44	0
Percent Heavy Vehicles	2	0	2	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	116					96		73
C (m) (veh/h)	1315					491		904
v/c	0.09					0.20		0.08
95% queue length	0.29					0.72		0.26
Control Delay (s/veh)	8.0					14.1		9.3
LOS	A					B		A
Approach Delay (s/veh)	--	--				12.0		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/17/2007
Analysis Time Period	2007 PM

Site Information

Intersection	Wasatch Dr & Federal Way
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: Federal Way

North/South Street: Wasatch Drive

Intersection Orientation: North-South

Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	193	169			175	52
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	136	0	311	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	123		280			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	194	57	214	187	0
Percent Heavy Vehicles	2	0	2	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	214					136		311
C (m) (veh/h)	1311					294		901
v/c	0.16					0.46		0.35
95% queue length	0.58					2.31		1.55
Control Delay (s/veh)	8.3					27.4		11.1
LOS	A					D		B
Approach Delay (s/veh)	--	--				16.0		
Approach LOS	--	--				C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 AM		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Central Campus Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		184	75	102	195	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	136	0	120
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				123	0	108
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	113	216	0	0	204	83
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		113	136		120			
C (m) (veh/h)		1272	431		803			
v/c		0.09	0.32		0.15			
95% queue length		0.29	1.33		0.52			
Control Delay (s/veh)		8.1	17.2		10.3			
LOS		A	C		B			
Approach Delay (s/veh)	--	--	13.9					
Approach LOS	--	--	B					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 PM		

Project Description 7003 USTAR Programming

East/West Street: Federal Way	North/South Street: Central Campus Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		426	389	352	378	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	223	0	144
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				201	0	130
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	391	420	0	0	473	432
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0.	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		391	223		144			
C (m) (veh/h)		747	57		538			
v/c		0.52	3.91		0.27			
95% queue length		3.08	24.20		1.07			
Control Delay (s/veh)		15.0	1459		14.1			
LOS		B	F		B			
Approach Delay (s/veh)	--	--	891.9					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		474	294	95	212		198		247			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 21.2	G = 0.0	G = 0.0	G = 0.0	G = 13.1	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 42.3

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		854			342		220	274				
Lane Group Capacity		1709			1233		559	500				
v/c Ratio		0.50			0.28		0.39	0.55				
Green Ratio		0.50			0.50		0.31	0.31				
Uniform Delay d_1		7.0			6.1		11.5	12.1				
Delay Factor k		0.11			0.11		0.11	0.15				
Incremental Delay d_2		0.2			0.1		0.5	1.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		7.3			6.2		11.9	13.4				
Lane Group LOS		A			A		B	B				
Approach Delay	7.3			6.2			12.8					
Approach LOS	A			A			B					
Intersection Delay	8.7			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		342	229	210	628		185		85			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 36.6	G = 0.0	G = 0.0	G = 0.0	G = 14.8	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 59.4

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		634			931		206	94				
Lane Group Capacity		2095			1478		450	402				
v/c Ratio		0.30			0.63		0.46	0.23				
Green Ratio		0.62			0.62		0.25	0.25				
Uniform Delay d_1		5.4			7.2		18.9	17.8				
Delay Factor k		0.11			0.21		0.11	0.11				
Incremental Delay d_2		0.1			0.9		0.7	0.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		5.5			8.0		19.6	18.1				
Lane Group LOS		A			A		B	B				
Approach Delay	5.5			8.0			19.2					
Approach LOS	A			A			B					
Intersection Delay	8.9			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 AM		

Project Description	7003 USTAR Programming
East/West Street: South Medical Drive	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		943	468	217	366	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	172	0	91
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				155		82
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	241	406	0	0	1047	520
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		241	172		91			
C (m) (veh/h)		417	22		340			
v/c		0.58	7.82		0.27			
95% queue length		3.54	21.72		1.06			
Control Delay (s/veh)		24.8	3414		19.4			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	2240					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 PM		

Project Description	7003 USTAR Programming
East/West Street: South Medical Drive	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		468	150	152	791	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	401	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				361		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	168	878	0	0	520	166
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		168	401		183			
C (m) (veh/h)		904	111		659			
v/c		0.19	3.61		0.28			
95% queue length		0.68	40.01		1.13			
Control Delay (s/veh)		9.9	1256		12.5			
LOS		A	F		B			
Approach Delay (s/veh)	--	--	866.6					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			293				713	1150			308	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 10.0	G = 24.4	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 42.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			326				792	1278			342	40
Lane Group Capacity			946				1039	853			853	381
v/c Ratio			0.34				0.76	1.50			0.40	0.10
Green Ratio			0.58				0.58	0.24			0.24	0.24
Uniform Delay d_1			4.8				6.8	16.2			13.7	12.7
Delay Factor k			0.11				0.31	0.50			0.11	0.11
Incremental Delay d_2			0.2				3.4	230.4			0.3	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			5.0				10.2	246.6			14.0	12.8
Lane Group LOS			A				B	F			B	B
Approach Delay	5.0						156.1			13.9		
Approach LOS	A						F			B		
Intersection Delay	118.8			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			511				203	630			1094	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 12.7	G = 10.6	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 31.3		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			568				226	700			1216	40
Lane Group Capacity			557				611	1468			1468	655
v/c Ratio			1.02				0.37	0.48			0.83	0.06
Green Ratio			0.34				0.34	0.41			0.41	0.41
Uniform Delay d_1			10.4				7.8	6.9			8.3	5.7
Delay Factor k			0.50				0.11	0.11			0.37	0.11
Incremental Delay d_2			43.2				0.4	0.2			4.1	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			53.6				8.2	7.1			12.4	5.7
Lane Group LOS			D				A	A			B	A
Approach Delay	53.6						7.4			12.2		
Approach LOS	D						A			B		
Intersection Delay	19.1			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		914	307	69	314		73		26			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 32.1	G = 0.0	G = 0.0	G = 0.0	G = 10.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 50.1

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1357		77	349		81		29			
Lane Group Capacity		2230		185	2318		360		322			
v/c Ratio		0.61		0.42	0.15		0.22		0.09			
Green Ratio		0.64		0.64	0.64		0.20		0.20			
Uniform Delay d_1		5.3		4.4	3.6		16.8		16.3			
Delay Factor k		0.19		0.11	0.11		0.11		0.50			
Incremental Delay d_2		0.5		1.5	0.0		0.3		0.6			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		5.8		5.9	3.6		17.1		16.9			
Lane Group LOS		A		A	A		B		B			
Approach Delay	5.8			4.0			17.1					
Approach LOS	A			A			B					
Intersection Delay	6.0			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		404	163	36	885		201		89			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 22.7	G = 0.0	G = 0.0	G = 0.0	G = 13.4	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 44.1		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		630		40	983		223		99			
Lane Group Capacity		1782		390	1862		548		491			
v/c Ratio		0.35		0.10	0.53		0.41		0.20			
Green Ratio		0.51		0.51	0.51		0.30		0.30			
Uniform Delay d_1		6.3		5.5	7.1		12.2		11.4			
Delay Factor k		0.11		0.11	0.13		0.11		0.50			
Incremental Delay d_2		0.1		0.1	0.3		0.5		0.9			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		6.5		5.6	7.4		12.7		12.3			
Lane Group LOS		A		A	A		B		B			
Approach Delay	6.5			7.3			12.6					
Approach LOS	A			A			B					
Intersection Delay	7.9			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 AM		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		821	191	165	212	17
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	912	212	183	235	18
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	23		26			11
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	25	0	28	0	0	12
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		183	25		28			12
C (m) (veh/h)		617	64		470			901
v/c		0.30	0.39		0.06			0.01
95% queue length		1.24	1.48		0.19			0.04
Control Delay (s/veh)		13.3	93.5		13.1			9.0
LOS		B	F		B			A
Approach Delay (s/veh)	--	--	51.1			9.0		
Approach LOS	--	--	F			A		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/18/2007
Analysis Time Period	2012 AM

Site Information

Intersection	North Campus & Wasatch
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		821	191	165	212	17
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	912	212	183	235	18
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	23		26			11
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	25	0	28	0	0	12
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		183	25		28			12
C (m) (veh/h)		617	64		470			901
v/c		0.30	0.39		0.06			0.01
95% queue length		1.24	1.48		0.19			0.04
Control Delay (s/veh)		13.3	93.5		13.1			9.0
LOS		B	F		B			A
Approach Delay (s/veh)	--	--	51.1			9.0		
Approach LOS	--	--	F			A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 PM		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		386	106	77	571	50
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	428	117	85	634	55
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	118		11			16
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	131	0	12	0	0	17
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		85	131		12			17
C (m) (veh/h)		1020	189		726			652
v/c		0.08	0.69		0.02			0.03
95% queue length		0.27	4.27		0.05			0.08
Control Delay (s/veh)		8.9	58.5		10.0			10.7
LOS		A	F		B			B
Approach Delay (s/veh)	--	--	54.4			10.7		
Approach LOS	--	--	F			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch Dr & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 AM		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	106		80			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	117	0	88	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	128	49			159	113
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	142	54	0	0	176	125
Percent Heavy Vehicles	2	2	0	0	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L	T			T	TR
v (veh/h)	117		142	54			88	213
C (m) (veh/h)	1623		363	618			552	776
v/c	0.07		0.39	0.09			0.16	0.27
95% queue length	0.23		1.81	0.29			0.56	1.12
Control Delay (s/veh)	7.4		21.1	11.4			12.8	11.4
LOS	A		C	B			B	B
Approach Delay (s/veh)	--	--	18.5			11.8		
Approach LOS	--	--	C			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch Dr & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2012 PM		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	150		341			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	166	0	378	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	235	206			213	63
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	261	228	0	0	236	70
Percent Heavy Vehicles	2	2	0	0	2	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L		L	T			T	TR
v (veh/h)	166		261	228			118	188
C (m) (veh/h)	1623		173	528			322	436
v/c	0.10		1.51	0.43			0.37	0.43
95% queue length	0.34		16.82	2.16			1.63	2.13
Control Delay (s/veh)	7.5		305.3	16.9			22.5	19.4
LOS	A		F	C			C	C
Approach Delay (s/veh)	--	--	170.8			20.6		
Approach LOS	--	--	F			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Central Campus Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		184	75	188	195	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	136	0	152
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				123	0	137
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	208	216	0	0	204	83
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		208	136		152			
C (m) (veh/h)		1272	299		809			
v/c		0.16	0.45		0.19			
95% queue length		0.58	2.25		0.69			
Control Delay (s/veh)		8.4	26.7		10.5			
LOS		A	D		B			
Approach Delay (s/veh)	--	--	18.1					
Approach LOS	--	--	C					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Central Campus Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		426	389	393	378	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	223	0	250
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				201	0	225
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	436	420	0	0	473	432
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		436	223		250			
C (m) (veh/h)		747	43		543			
v/c		0.58	5.19		0.46			
95% queue length		3.83	25.75		2.40			
Control Delay (s/veh)		16.3	2071		17.2			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	985.5					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		474	294	95	212		198		247			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 21.2	G = 0.0	G = 0.0	G = 0.0	G = 13.1	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 42.3		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		854			342		220	274				
Lane Group Capacity		1708			1233		559	500				
v/c Ratio		0.50			0.28		0.39	0.55				
Green Ratio		0.50			0.50		0.31	0.31				
Uniform Delay d_1		7.0			6.1		11.5	12.1				
Delay Factor k		0.11			0.11		0.11	0.15				
Incremental Delay d_2		0.2			0.1		0.5	1.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		7.3			6.2		11.9	13.4				
Lane Group LOS		A			A		B	B				
Approach Delay	7.3			6.2			12.7					
Approach LOS	A			A			B					
Intersection Delay	8.7			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		342	229	210	628		185		85			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 36.6	G = 0.0	G = 0.0	G = 0.0	G = 14.8	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 | Cycle Length C = 59.4

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		634			931		206	94				
Lane Group Capacity		2095			1478		450	402				
v/c Ratio		0.30			0.63		0.46	0.23				
Green Ratio		0.62			0.62		0.25	0.25				
Uniform Delay d_1		5.4			7.2		18.9	17.8				
Delay Factor k		0.11			0.21		0.11	0.11				
Incremental Delay d_2		0.1			0.9		0.7	0.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		5.5			8.0		19.6	18.1				
Lane Group LOS		A			A		B	B				
Approach Delay	5.5			8.0			19.2					
Approach LOS	A			A			B					
Intersection Delay	8.9			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: South Medical	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		943	468	217	366	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	172	0	91
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				155		82
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	241	406	0	0	1047	520
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		241	172		91			
C (m) (veh/h)		417	22		340			
v/c		0.58	7.82		0.27			
95% queue length		3.54	21.72		1.06			
Control Delay (s/veh)		24.8	3414		19.4			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	2240					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 1)		

Project Description	7003 USTAR Programming
East/West Street: South Medical	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		468	150	152	791	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	401	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				361		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	168	878	0	0	520	166
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		168	401		183			
C (m) (veh/h)		904	111		659			
v/c		0.19	3.61		0.28			
95% queue length		0.68	40.01		1.13			
Control Delay (s/veh)		9.9	1256		12.5			
LOS		A	F		B			
Approach Delay (s/veh)	--	--	866.6					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			368				937	1150			308	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 10.0	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 64.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			409				1041	1278			342	40
Lane Group Capacity			1182				1297	565			565	252
v/c Ratio			0.35				0.80	2.26			0.61	0.16
Green Ratio			0.72				0.72	0.16			0.16	0.16
Uniform Delay d_1			3.4				6.0	27.0			25.2	23.4
Delay Factor k			0.11				0.35	0.50			0.19	0.11
Incremental Delay d_2			0.2				3.7	573.5			1.9	0.3
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			3.5				9.7	600.5			27.0	23.7
Lane Group LOS			A				A	F			C	C
Approach Delay	3.5						335.3			26.7		
Approach LOS	A						F			C		
Intersection Delay	253.8			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			758				309	630			1094	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 13.6	G = 19.5	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 41.2		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			842				343	700			1216	40
Lane Group Capacity			781				858	1196			1196	534
v/c Ratio			1.08				0.40	0.59			1.02	0.07
Green Ratio			0.48				0.48	0.33			0.33	0.33
Uniform Delay d_1			10.8				7.0	11.4			13.8	9.5
Delay Factor k			0.50				0.11	0.18			0.50	0.11
Incremental Delay d_2			55.3				0.3	0.7			30.3	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			66.1				7.3	12.2			44.0	9.5
Lane Group LOS			E				A	B			D	A
Approach Delay	66.1						10.6			42.9		
Approach LOS	E						B			D		
Intersection Delay	38.4			Intersection LOS						D		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		949	393	69	326		102		26			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 37.2	G = 0.0	G = 0.0	G = 0.0	G = 10.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 55.8		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1491		77	362		113		29			
Lane Group Capacity		2304		161	2410		344		308			
v/c Ratio		0.65		0.48	0.15		0.33		0.09			
Green Ratio		0.67		0.67	0.67		0.19		0.19			
Uniform Delay d_1		5.5		4.6	3.5		19.5		18.6			
Delay Factor k		0.22		0.11	0.11		0.11		0.50			
Incremental Delay d_2		0.6		2.2	0.0		0.6		0.6			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		6.1		6.8	3.5		20.1		19.2			
Lane Group LOS		A		A	A		C		B			
Approach Delay	6.1			4.1			19.9					
Approach LOS	A			A			B					
Intersection Delay	6.6			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		420	204	36	923		296		89			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 25.5	G = 0.0	G = 0.0	G = 0.0	G = 18.3	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 51.8

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		694		40	1026		329		99			
Lane Group Capacity		1693		325	1780		638		571			
v/c Ratio		0.41		0.12	0.58		0.52		0.17			
Green Ratio		0.49		0.49	0.49		0.35		0.35			
Uniform Delay d_1		8.4		7.1	9.3		13.2		11.5			
Delay Factor k		0.11		0.11	0.17		0.12		0.50			
Incremental Delay d_2		0.2		0.2	0.5		0.7		0.7			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		8.5		7.3	9.8		14.0		12.2			
Lane Group LOS		A		A	A		B		B			
Approach Delay	8.5			9.7			13.6					
Approach LOS	A			A			B					
Intersection Delay	10.1			Intersection LOS						B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		821	226	165	212	17
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	912	251	183	235	18
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	35		26			11
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	38	0	28	0	0	12
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		183	38		28			12
C (m) (veh/h)		596	61		456			901
v/c		0.31	0.62		0.06			0.01
95% queue length		1.30	2.60		0.20			0.04
Control Delay (s/veh)		13.7	133.3		13.4			9.0
LOS		B	F		B			A
Approach Delay (s/veh)	--	--	82.4			9.0		
Approach LOS	--	--	F			A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		386	122	77	571	50
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	428	135	85	634	55
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	156		11			16
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	173	0	12	0	0	17
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		85	173		12			17
C (m) (veh/h)		1005	185		715			652
v/c		0.08	0.94		0.02			0.03
95% queue length		0.28	7.34		0.05			0.08
Control Delay (s/veh)		8.9	101.5		10.1			10.7
LOS		A	F		B			B
Approach Delay (s/veh)	--	--	95.6			10.7		
Approach LOS	--	--	F			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way	North/South Street: Wasatch Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	352	49			159	148
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	131	0	172	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	118		155			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	176	164	391	54	0
Percent Heavy Vehicles	2	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	391					131		172
C (m) (veh/h)	1216					147		851
v/c	0.32					0.89		0.20
95% queue length	1.40					6.08		0.75
Control Delay (s/veh)	9.4					107.1		10.3
LOS	A					F		B
Approach Delay (s/veh)	--	--				52.1		
Approach LOS	--	--				F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	341	206			213	79
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	208	0	653	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	188		588			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	236	87	378	228	0
Percent Heavy Vehicles	2	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	378					208		653
C (m) (veh/h)	1234					133		861
v/c	0.31					1.56		0.76
95% queue length	1.31					14.69		7.34
Control Delay (s/veh)	9.2					346.4		21.0
LOS	A					F		C
Approach Delay (s/veh)	--	--				99.6		
Approach LOS	--	--				F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & North Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		474	294	95	212		198		247			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 21.2	G = 0.0	G = 0.0	G = 0.0	G = 13.1	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 42.3		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		854			342		220	274				
Lane Group Capacity		1708			1233		559	500				
v/c Ratio		0.50			0.28		0.39	0.55				
Green Ratio		0.50			0.50		0.31	0.31				
Uniform Delay d_1		7.0			6.1		11.5	12.1				
Delay Factor k		0.11			0.11		0.11	0.15				
Incremental Delay d_2		0.2			0.1		0.5	1.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		7.3			6.2		11.9	13.4				
Lane Group LOS		A			A		B	B				
Approach Delay	7.3			6.2			12.7					
Approach LOS	A			A			B					
Intersection Delay	8.7			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & North Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR			LT		L	LR				
Volume (vph)		342	229	210	628		185		85			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0			2.0		2.0	2.0				
Extension of Effective Green		2.0			2.0		2.0	2.0				
Arrival Type		3			3		3	3				
Unit Extension		3.0			3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0			12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0			0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 36.6	G = 0.0	G = 0.0	G = 0.0	G = 14.8	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 59.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		634			931		206	94				
Lane Group Capacity		2096			1479		449	402				
v/c Ratio		0.30			0.63		0.46	0.23				
Green Ratio		0.62			0.62		0.25	0.25				
Uniform Delay d_1		5.4			7.1		18.9	17.8				
Delay Factor k		0.11			0.21		0.11	0.11				
Incremental Delay d_2		0.1			0.9		0.7	0.3				
PF Factor		1.000			1.000		1.000	1.000				
Control Delay		5.5			8.0		19.7	18.1				
Lane Group LOS		A			A		B	B				
Approach Delay	5.5			8.0			19.2					
Approach LOS	A			A			B					
Intersection Delay	8.9			Intersection LOS						A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		943	468	217	366	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	172	0	91
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				155		82
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	241	406	0	0	1047	520
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		241	172		91			
C (m) (veh/h)		417	22		340			
v/c		0.58	7.82		0.27			
95% queue length		3.54	21.72		1.06			
Control Delay (s/veh)		24.8	3414		19.4			
LOS		C	F		C			
Approach Delay (s/veh)	--	--	2240					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		468	150	152	791	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	401	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				361		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	168	878	0	0	520	166
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		168	401		183			
C (m) (veh/h)		904	111		659			
v/c		0.19	3.61		0.28			
95% queue length		0.68	40.01		1.13			
Control Delay (s/veh)		9.9	1256		12.5			
LOS		A	F		B			
Approach Delay (s/veh)	--	--	866.6					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			444				937	1150			308	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 10.0	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 64.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			493				1041	1278			342	40
Lane Group Capacity			1182				1297	565			565	252
v/c Ratio			0.42				0.80	2.26			0.61	0.16
Green Ratio			0.72				0.72	0.16			0.16	0.16
Uniform Delay d_1			3.6				6.0	27.0			25.2	23.4
Delay Factor k			0.11				0.35	0.50			0.19	0.11
Incremental Delay d_2			0.2				3.7	573.5			1.9	0.3
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			3.9				9.7	600.5			27.0	23.7
Lane Group LOS			A				A	F			C	C
Approach Delay	3.9						335.3			26.7		
Approach LOS	A						F			C		
Intersection Delay	247.2			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			1147				309	630			1094	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 13.6	G = 19.5	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 41.2		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			1274				343	700			1216	40
Lane Group Capacity			781				857	1197			1197	534
v/c Ratio			1.63				0.40	0.58			1.02	0.07
Green Ratio			0.47				0.47	0.33			0.33	0.33
Uniform Delay d_1			10.8				7.0	11.4			13.8	9.4
Delay Factor k			0.50				0.11	0.18			0.50	0.11
Incremental Delay d_2			289.9				0.3	0.7			30.0	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			300.7				7.3	12.2			43.8	9.5
Lane Group LOS			F				A	B			D	A
Approach Delay	300.7						10.6			42.7		
Approach LOS	F						B			D		
Intersection Delay	125.3			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		1034	307	299	354		73		101			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 36.4	G = 0.0	G = 0.0	G = 0.0	G = 10.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 54.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1490		332	393		81		112			
Lane Group Capacity		2337		163	2421		332		297			
v/c Ratio		0.64		2.04	0.16		0.24		0.38			
Green Ratio		0.67		0.67	0.67		0.18		0.18			
Uniform Delay d_1		5.2		9.0	3.3		19.0		19.5			
Delay Factor k		0.22		0.50	0.11		0.11		0.50			
Incremental Delay d_2		0.6		487.3	0.0		0.4		3.6			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		5.8		496.3	3.4		19.4		23.1			
Lane Group LOS		A		F	A		B		C			
Approach Delay	5.8			229.1			21.5					
Approach LOS	A			F			C					
Intersection Delay	74.3			Intersection LOS						E		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		461	163	623	1018		201		478			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 21.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 75.6		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		693		692	1131		223		531			
Lane Group Capacity		2115		415	2201		516		462			
v/c Ratio		0.33		1.67	0.51		0.43		1.15			
Green Ratio		0.61		0.61	0.61		0.29		0.29			
Uniform Delay d_1		7.2		14.8	8.4		22.0		27.0			
Delay Factor k		0.11		0.50	0.12		0.11		0.50			
Incremental Delay d_2		0.1		310.8	0.2		0.6		89.7			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		7.3		325.6	8.6		22.6		116.7			
Lane Group LOS		A		F	A		C		F			
Approach Delay	7.3			129.0			88.8					
Approach LOS	A			F			F					
Intersection Delay	93.9			Intersection LOS						F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon AM (Option 2)		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		879	430	52	325	17
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	976	477	57	361	18
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	191		26			11
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	212	0	28	0	0	12
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		57	212		28			12
C (m) (veh/h)		462	74		367			820
v/c		0.12	2.86		0.08			0.01
95% queue length		0.42	21.03		0.25			0.04
Control Delay (s/veh)		13.9	961.9		15.6			9.5
LOS		B	F		C			A
Approach Delay (s/veh)	--	--	851.5			9.5		
Approach LOS	--	--	F			A		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2012 Horizon PM (Option 2)		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		495	795	113	634	50
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	550	883	125	704	55
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	486		11			16
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	540	0	12	0	0	17
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		125	540		12			17
C (m) (veh/h)		470	56		373			618
v/c		0.27	9.64		0.03			0.03
95% queue length		1.06	63.68		0.10			0.08
Control Delay (s/veh)		15.4	4029		15.0			11.0
LOS		C	F		B			B
Approach Delay (s/veh)	--	--	3942			11.0		
Approach LOS	--	--	F			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2030 AM		

Project Description	7003 USTAR Programming
East/West Street: Federal Way	North/South Street: Central Campus Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		372	153	207	394	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	276	0	243
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				249	0	219
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	230	437	0	0	413	170
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		230	276		243			
C (m) (veh/h)		987	160		594			
v/c		0.23	1.73		0.41			
95% queue length		0.90	19.74		1.99			
Control Delay (s/veh)		9.8	400.6		15.2			
LOS		A	F		C			
Approach Delay (s/veh)	--	--	220.1					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2030 PM		

Project Description	7003 USTAR Programming
East/West Street: Federal Way	North/South Street: Central Campus Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		863	789	712	767	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	452	0	293
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				407	0	264
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	791	852	0	0	958	876
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		791	452		293			
C (m) (veh/h)		329	0		0			
v/c		2.40						
95% queue length		62.50						
Control Delay (s/veh)		666.1						
LOS		F	F		F			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		961	596	192	429		402		500			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 30.7	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 84.7		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1730		213	477		447	556				
Lane Group Capacity		1853		90	1032		654	585				
v/c Ratio		0.93		2.37	0.46		0.68	0.95				
Green Ratio		0.54		0.54	0.54		0.36	0.36				
Uniform Delay d_1		17.9		19.3	11.8		22.9	26.3				
Delay Factor k		0.45		0.50	0.11		0.25	0.46				
Incremental Delay d_2		9.3		647.9	0.3		2.9	25.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		27.3		667.2	12.1		25.8	51.7				
Lane Group LOS		C		F	B		C	D				
Approach Delay	27.3			214.3			40.2					
Approach LOS	C			F			D					
Intersection Delay	68.8			Intersection LOS						E		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		693	463	426	1272		375		173			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 28.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 82.6		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1284		473	1413		417	192				
Lane Group Capacity		1893		140	1058		625	559				
v/c Ratio		0.68		3.38	1.34		0.67	0.34				
Green Ratio		0.56		0.56	0.56		0.35	0.35				
Uniform Delay d_1		13.0		18.3	18.3		23.0	20.0				
Delay Factor k		0.25		0.50	0.50		0.24	0.11				
Incremental Delay d_2		1.0		1088	157.5		2.7	0.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		14.0		1107	175.8		25.7	20.4				
Lane Group LOS		B		F	F		C	C				
Approach Delay	14.0			409.2			24.0					
Approach LOS	B			F			C					
Intersection Delay	212.9			Intersection LOS						F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2030 AM		

Project Description 7003 USTAR Programming

East/West Street: South Medical Drive	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1910	949	439	742	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	347	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				313		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	487	824	0	0	2122	1054
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		487	347		183			
C (m) (veh/h)		96	0		99			
v/c		5.07			1.85			
95% queue length		52.36			15.06			
Control Delay (s/veh)		1921			490.5			
LOS		F	F		F			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/18/2007
Analysis Time Period	2030 PM

Site Information

Intersection	Medical & South Medical
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: South Medical Drive | North/South Street: Medical Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		949	303	308	1602	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	813	0	372
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				732		335
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	342	1780	0	0	1054	336
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		342	813		372			
C (m) (veh/h)		488	4		389			
v/c		0.70	203.25		0.96			
95% queue length		5.42	104.05		10.80			
Control Delay (s/veh)		27.9	92813		68.3			
LOS		D	F		F			
Approach Delay (s/veh)	--	--	63698					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			594				1444	2329			624	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 14.4	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 68.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			660				1604	2588			693	82
Lane Group Capacity			1106				1214	762			762	340
v/c Ratio			0.60				1.32	3.40			0.91	0.24
Green Ratio			0.67				0.67	0.21			0.21	0.21
Uniform Delay d_1			6.1				11.2	27.0			26.4	22.5
Delay Factor k			0.19				0.50	0.50			0.43	0.11
Incremental Delay d_2			0.9				150.4	1082			14.9	0.4
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			7.0				161.6	1109			41.3	22.8
Lane Group LOS			A				F	F			D	C
Approach Delay	7.0						746.3			39.3		
Approach LOS	A						F			D		
Intersection Delay	562.2			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			1035				412	1277			2216	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 46.0	G = 39.5	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 93.5		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			1150				458	1419			2462	82
Lane Group Capacity			695				763	1780			1780	795
v/c Ratio			1.65				0.60	0.80			1.38	0.10
Green Ratio			0.42				0.42	0.49			0.49	0.49
Uniform Delay d_1			27.0				20.9	19.9			23.8	12.7
Delay Factor k			0.50				0.19	0.34			0.50	0.11
Incremental Delay d_2			301.0				1.3	2.6			176.0	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			328.0				22.2	22.5			199.7	12.8
Lane Group LOS			F				C	C			F	B
Approach Delay	328.0						22.4			193.7		
Approach LOS	F						C			F		
Intersection Delay	163.7			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		1851	621	140	636		148		52			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 13.8	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 67.8

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		2747		156	707		164		58			
Lane Group Capacity		2362		112	2455		367		329			
v/c Ratio		1.16		1.39	0.29		0.45		0.18			
Green Ratio		0.68		0.68	0.68		0.20		0.20			
Uniform Delay d_1		10.9		10.9	4.4		23.7		22.3			
Delay Factor k		0.50		0.50	0.11		0.11		0.50			
Incremental Delay d_2		78.4		222.1	0.1		0.9		1.2			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		89.3		233.0	4.4		24.5		23.5			
Lane Group LOS		F		F	A		C		C			
Approach Delay	89.3			45.7			24.2					
Approach LOS	F			D			C					
Intersection Delay	75.7			Intersection LOS						E		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		818	330	74	1792		407		180			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 33.2	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 87.2		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1276		82	1991		452		200			
Lane Group Capacity		1826		121	1909		687		615			
v/c Ratio		0.70		0.68	1.04		0.66		0.33			
Green Ratio		0.53		0.53	0.53		0.38		0.38			
Uniform Delay d_1		15.4		15.1	20.6		22.3		19.1			
Delay Factor k		0.27		0.25	0.50		0.23		0.50			
Incremental Delay d_2		1.2		14.2	32.8		2.3		1.4			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		16.6		29.3	53.4		24.6		20.5			
Lane Group LOS		B		C	D		C		C			
Approach Delay	16.6			52.5			23.4					
Approach LOS	B			D			C					
Intersection Delay	36.3			Intersection LOS						D		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/18/2007
Analysis Time Period	2030 AM

Site Information

Intersection	North Campus & Wasatch
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive | North/South Street: Wasatch Drive

Intersection Orientation: East-West | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1664	387	335	429	35
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	1848	430	372	476	38
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	47		52			22
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	52	0	57	0	0	24
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		372	52		57			24
C (m) (veh/h)		220	0		195			742
v/c		1.69			0.29			0.03
95% queue length		24.66			1.16			0.10
Control Delay (s/veh)		368.2			30.9			10.0
LOS		F	F		D			B
Approach Delay (s/veh)	--	--				10.0		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2030 PM		

Project Description: 7003 USTAR Programming

East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		781	214	155	1156	101
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	867	237	172	1284	112
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	239		22			32
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	265	0	24	0	0	35
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		172	265		24			35
C (m) (veh/h)		628	27		477			383
v/c		0.27	9.81		0.05			0.09
95% queue length		1.11	32.78		0.16			0.30
Control Delay (s/veh)		12.9	4248		12.9			15.3
LOS		B	F		B			C
Approach Delay (s/veh)	--	--	3897			15.3		
Approach LOS	--	--	F			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RDL
Agency/Co.	PEC
Date Performed	4/18/2007
Analysis Time Period	2030 AM

Site Information

Intersection	Wasatch & Federal
Jurisdiction	University of Utah
Analysis Year	2007

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	259	99			323	229
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	237	0	181	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	214		163			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	358	254	287	110	0
Percent Heavy Vehicles	2	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	287					237		181
C (m) (veh/h)	963					142		696
v/c	0.30					1.67		0.26
95% queue length	1.26					17.08		1.04
Control Delay (s/veh)	10.3					385.1		12.0
LOS	B					F		B
Approach Delay (s/veh)	--	--				223.5		
Approach LOS	--	--				F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/18/2007	Analysis Year	2007
Analysis Time Period	2030 PM		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way	North/South Street: Wasatch Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	476	417			431	128
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	336	0	766	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	303		690			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	478	142	528	463	0
Percent Heavy Vehicles	2	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	528					336		766
C (m) (veh/h)	956					30		692
v/c	0.55					11.20		1.11
95% queue length	3.48					41.30		22.19
Control Delay (s/veh)	13.3					4843		90.6
LOS	B					F		F
Approach Delay (s/veh)	--	--	1540					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way	North/South Street: Central Campus Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		372	153	293	394	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	276	0	275
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				249	0	248
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	325	437	0	0	413	170
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		325	276		275			
C (m) (veh/h)		987	105		588			
v/c		0.33	2.63		0.47			
95% queue length		1.45	25.44		2.48			
Control Delay (s/veh)		10.4	823.8		16.4			
LOS		B	F		C			
Approach Delay (s/veh)	--	--	420.8					
Approach LOS	--	--	F					

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon PM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Central Campus Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		863	789	753	767	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	452	0	398
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	1	0	2	0
Configuration		T	R	LT	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				407	0	359
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	836	852	0	0	958	876
Percent Heavy Vehicles	0	0	0	2	2	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		TR			
v (veh/h)		836	452		398			
C (m) (veh/h)		329	0		0			
v/c		2.54						
95% queue length		67.99						
Control Delay (s/veh)		727.0						
LOS		F	F		F			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		961	596	192	429		402		500			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 30.7	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 84.7		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1730		213	477		447	556				
Lane Group Capacity		1852		90	1032		654	585				
v/c Ratio		0.93		2.37	0.46		0.68	0.95				
Green Ratio		0.54		0.54	0.54		0.36	0.36				
Uniform Delay d_1		17.9		19.4	11.8		22.9	26.3				
Delay Factor k		0.45		0.50	0.11		0.25	0.46				
Incremental Delay d_2		9.4		647.9	0.3		2.9	25.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		27.3		667.2	12.1		25.8	51.7				
Lane Group LOS		C		F	B		C	D				
Approach Delay	27.3			214.4			40.2					
Approach LOS	C			F			D					
Intersection Delay	68.8			Intersection LOS						E		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		693	463	426	1272		375		173			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 28.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 82.6		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1284		473	1413		417	192				
Lane Group Capacity		1893		140	1058		625	559				
v/c Ratio		0.68		3.38	1.34		0.67	0.34				
Green Ratio		0.56		0.56	0.56		0.35	0.35				
Uniform Delay d_1		13.0		18.3	18.3		23.0	20.0				
Delay Factor k		0.25		0.50	0.50		0.24	0.11				
Incremental Delay d_2		1.0		1088	157.5		2.7	0.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		14.0		1107	175.8		25.7	20.4				
Lane Group LOS		B		F	F		C	C				
Approach Delay	14.0			409.2			24.0					
Approach LOS	B			F			C					
Intersection Delay	212.9			Intersection LOS						F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 1)		

Project Description	7003 USTAR Programming
East/West Street: South Medical Drive	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1910	949	439	742	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	347	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				313		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	487	824	0	0	2122	1054
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		487	347		183			
C (m) (veh/h)		96	0		97			
v/c		5.07			1.89			
95% queue length		52.36			15.25			
Control Delay (s/veh)		1921			508.6			
LOS		F	F		F			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon PM (Option 1)		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		949	303	308	1602	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	813	0	372
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				732		335
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	342	1780	0	0	1054	336
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		342	813		372			
C (m) (veh/h)		488	4		385			
v/c		0.70	203.25		0.97			
95% queue length		5.42	104.05		11.03			
Control Delay (s/veh)		27.9	92813		71.0			
LOS		D	F		F			
Approach Delay (s/veh)	--	--	63699					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			669				1668	2329			624	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 14.4	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 68.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			743				1853	2588			693	82
Lane Group Capacity			1105				1214	762			762	340
v/c Ratio			0.67				1.53	3.40			0.91	0.24
Green Ratio			0.67				0.67	0.21			0.21	0.21
Uniform Delay d_1			6.7				11.2	27.0			26.4	22.5
Delay Factor k			0.24				0.50	0.50			0.43	0.11
Incremental Delay d_2			1.6				241.1	1082			14.9	0.4
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			8.3				252.3	1109			41.3	22.8
Lane Group LOS			A				F	F			D	C
Approach Delay	8.3						751.4			39.3		
Approach LOS	A						F			D		
Intersection Delay	566.1			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			1282				518	1277			2216	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 46.0	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 100.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			1424				576	1419			2462	82
Lane Group Capacity			756				830	1664			1664	743
v/c Ratio			1.88				0.69	0.85			1.48	0.11
Green Ratio			0.46				0.46	0.46			0.46	0.46
Uniform Delay d_1			27.0				21.4	24.0			27.0	15.4
Delay Factor k			0.50				0.26	0.39			0.50	0.11
Incremental Delay d_2			402.6				2.5	4.5			219.1	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			429.6				23.9	28.5			246.1	15.4
Lane Group LOS			F				C	C			F	B
Approach Delay	429.6						27.2			238.7		
Approach LOS	F						C			F		
Intersection Delay	213.5			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		1886	707	140	648		177		52			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 15.5	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 69.5		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		2882		156	720		197		58			
Lane Group Capacity		2296		109	2394		403		360			
v/c Ratio		1.26		1.43	0.30		0.49		0.16			
Green Ratio		0.66		0.66	0.66		0.22		0.22			
Uniform Delay d_1		11.8		11.8	5.0		23.5		21.8			
Delay Factor k		0.50		0.50	0.11		0.11		0.50			
Incremental Delay d_2		118.6		238.6	0.1		0.9		1.0			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		130.3		250.4	5.0		24.5		22.7			
Lane Group LOS		F		F	A		C		C			
Approach Delay	130.3			48.7			24.1					
Approach LOS	F			D			C					
Intersection Delay	105.8			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		834	371	74	1830		502		180			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 41.9	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 | Cycle Length C = 95.9

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1339		82	2033		558		200			
Lane Group Capacity		1655		79	1735		789		706			
v/c Ratio		0.81		1.04	1.17		0.71		0.28			
Green Ratio		0.48		0.48	0.48		0.44		0.44			
Uniform Delay d_1		21.2		25.0	25.0		22.0		17.4			
Delay Factor k		0.35		0.50	0.50		0.27		0.50			
Incremental Delay d_2		3.1		112.1	83.8		2.9		1.0			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		24.3		137.0	108.8		24.9		18.4			
Lane Group LOS		C		F	F		C		B			
Approach Delay	24.3			109.9			23.2					
Approach LOS	C			F			C					
Intersection Delay	67.1			Intersection LOS						E		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 1)		

Project Description	7003 USTAR Programming		
East/West Street:	North Medical Drive	North/South Street:	Wasatch Drive
Intersection Orientation:	East-West	Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1664	422	335	429	35
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	1848	468	372	476	38
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	59		52			22
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	65	0	57	0	0	24
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		372	65		57			24
C (m) (veh/h)		212	0		189			742
v/c		1.75			0.30			0.03
95% queue length		25.48			1.21			0.10
Control Delay (s/veh)		397.3			32.1			10.0
LOS		F	F		D			B
Approach Delay (s/veh)	--	--				10.0		
Approach LOS	--	--				B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Medical & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon PM (Option 1)		

Project Description	7003 USTAR Programming
East/West Street: North Medical Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		781	230	155	1156	101
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	867	255	172	1284	112
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	277		22			32
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	307	0	24	0	0	35
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		172	307		24			35
C (m) (veh/h)		618	26		471			383
v/c		0.28	11.81		0.05			0.09
95% queue length		1.13	38.14		0.16			0.30
Control Delay (s/veh)		13.1	5154		13.1			15.3
LOS		B	F		B			C
Approach Delay (s/veh)	--	--	4781			15.3		
Approach LOS	--	--	F			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 1)		

Project Description	7003 USTAR Programming
East/West Street: Federal Way	North/South Street: Wasatch Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	483	99			323	264
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	251	0	264	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	226		238			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	358	293	536	110	0
Percent Heavy Vehicles	2	0	2	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	536					251		264
C (m) (veh/h)	931					39		670
v/c	0.58					6.44		0.39
95% queue length	3.78					29.67		1.88
Control Delay (s/veh)	14.0					2648		13.8
LOS	B					F		B
Approach Delay (s/veh)	--	--				1298		
Approach LOS	--	--				F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/19/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon PM (Option 1)		

Project Description: 7003 USTAR Programming

East/West Street: Federal Way | North/South Street: Wasatch Drive

Intersection Orientation: North-South | Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	582	417			431	144
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	378	0	1041	0	0	0
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	1	2	0	0	2	0
Configuration	L	T			T	TR
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	341		937			
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	478	160	646	463	0
Percent Heavy Vehicles	2	0	2	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	L					L		R
v (veh/h)	646					378		1041
C (m) (veh/h)	942					14		677
v/c	0.69					27.00		1.54
95% queue length	5.68					48.43		52.88
Control Delay (s/veh)	16.7					12223		266.6
LOS	C					F		F
Approach Delay (s/veh)	--	--				3452		
Approach LOS	--	--				F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & North Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		961	596	192	429		402		500			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 30.7	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 84.7		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1730		213	477		447	556				
Lane Group Capacity		1853		90	1032		654	585				
v/c Ratio		0.93		2.37	0.46		0.68	0.95				
Green Ratio		0.54		0.54	0.54		0.36	0.36				
Uniform Delay d_1		17.9		19.3	11.8		22.9	26.3				
Delay Factor k		0.45		0.50	0.11		0.25	0.46				
Incremental Delay d_2		9.3		647.9	0.3		2.9	25.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		27.3		667.2	12.1		25.8	51.7				
Lane Group LOS		C		F	B		C	D				
Approach Delay	27.3			214.3			40.2					
Approach LOS	C			F			D					
Intersection Delay	68.8			Intersection LOS						E		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & North Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	0	2		1		0			
Lane Group		TR		DefL	T		L	LR				
Volume (vph)		693	463	426	1272		375		173			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0	2.0				
Extension of Effective Green		2.0		2.0	2.0		2.0	2.0				
Arrival Type		3		3	3		3	3				
Unit Extension		3.0		3.0	3.0		3.0	3.0				
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0	12.0				
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0	0				
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 28.6	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 82.6		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1284		473	1413		417	192				
Lane Group Capacity		1893		140	1058		626	560				
v/c Ratio		0.68		3.38	1.34		0.67	0.34				
Green Ratio		0.56		0.56	0.56		0.35	0.35				
Uniform Delay d_1		13.0		18.3	18.3		22.9	20.0				
Delay Factor k		0.25		0.50	0.50		0.24	0.11				
Incremental Delay d_2		1.0		1088	157.5		2.7	0.4				
PF Factor		1.000		1.000	1.000		1.000	1.000				
Control Delay		14.0		1107	175.8		25.6	20.4				
Lane Group LOS		B		F	F		C	C				
Approach Delay	14.0			409.3			24.0					
Approach LOS	B			F			C					
Intersection Delay	212.9			Intersection LOS						F		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street: South Medical Drive	North/South Street: Medical Drive
Intersection Orientation: North-South	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1910	949	439	742	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	347	0	183
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				313		165
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	487	824	0	0	2122	1054
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		487	347		183			
C (m) (veh/h)		96	0		99			
v/c		5.07			1.85			
95% queue length		52.36			15.06			
Control Delay (s/veh)		1921			490.5			
LOS		F	F		F			
Approach Delay (s/veh)	--	--						
Approach LOS	--	--						

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street:	South Medical Drive
North/South Street:	Medical Drive
Intersection Orientation:	North-South
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		949	303	308	1602	
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	0	0	813	0	372
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				732		335
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	342	1780	0	0	1054	336
Percent Heavy Vehicles	0	0	0	2	0	0
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		342	813		372			
C (m) (veh/h)		488	4		389			
v/c		0.70	203.25		0.96			
95% queue length		5.42	104.05		10.80			
Control Delay (s/veh)		27.9	92813		68.3			
LOS		D	F		F			
Approach Delay (s/veh)	--	--	63698					
Approach LOS	--	--	F					

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			822				1668	2329			624	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 14.4	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 68.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			913				1853	2588			693	82
Lane Group Capacity			1105				1214	762			762	340
v/c Ratio			0.83				1.53	3.40			0.91	0.24
Green Ratio			0.67				0.67	0.21			0.21	0.21
Uniform Delay d_1			8.3				11.2	27.0			26.4	22.5
Delay Factor k			0.36				0.50	0.50			0.43	0.11
Incremental Delay d_2			5.3				241.1	1082			14.9	0.4
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			13.5				252.3	1109			41.3	22.8
Lane Group LOS			B				F	F			D	C
Approach Delay	13.5						751.4			39.3		
Approach LOS	B						F			D		
Intersection Delay	551.4			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			2071				518	1277			2216	74
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	Thru & RT	NB Only	07	08
Timing	G =	G =	G =	G =	G = 46.0	G = 46.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 100.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			2301				576	1419			2462	82
Lane Group Capacity			756				830	1664			1664	743
v/c Ratio			3.04				0.69	0.85			1.48	0.11
Green Ratio			0.46				0.46	0.46			0.46	0.46
Uniform Delay d_1			27.0				21.4	24.0			27.0	15.4
Delay Factor k			0.50				0.26	0.39			0.50	0.11
Incremental Delay d_2			923.2				2.5	4.5			219.1	0.1
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			950.2				23.9	28.5			246.1	15.4
Lane Group LOS			F				C	C			F	B
Approach Delay	950.2						27.2			238.7		
Approach LOS	F						C			F		
Intersection Delay	416.3			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		1971	621	606	676		148		205			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 14.4	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 Cycle Length C = 68.4

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		2880		673	751		164		228			
Lane Group Capacity		2345		111	2432		380		340			
v/c Ratio		1.23		6.06	0.31		0.43		0.67			
Green Ratio		0.67		0.67	0.67		0.21		0.21			
Uniform Delay d_1		11.2		11.2	4.6		23.4		24.8			
Delay Factor k		0.50		0.50	0.11		0.11		0.50			
Incremental Delay d_2		106.6		2298	0.1		0.8		10.1			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		117.9		2309	4.7		24.2		34.9			
Lane Group LOS		F		F	A		C		C			
Approach Delay	117.9			1094			30.4					
Approach LOS	F			F			C					
Intersection Delay	406.5			Intersection LOS						F		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		875	330	1262	1925		407		969			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	EW Perm	02	03	04	NB Only	06	07	08
Timing	G = 46.0	G = 0.0	G = 0.0	G = 0.0	G = 42.1	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 96.1		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1339		1402	2139		452		1077			
Lane Group Capacity		1660		79	1732		791		708			
v/c Ratio		0.81			1.23		0.57		1.52			
Green Ratio		0.48		0.48	0.48		0.44		0.44			
Uniform Delay d_1		21.3			25.1		20.2		27.0			
Delay Factor k		0.35			0.50		0.17		0.50			
Incremental Delay d_2		3.1			111.0		1.0		241.7			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		24.3			136.0		21.2		268.7			
Lane Group LOS		C			F		C		F			
Approach Delay	24.3						195.6					
Approach LOS	C						F					
Intersection Delay				Intersection LOS								

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon AM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street: North Campus Drive	North/South Street: Wasatch Drive
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1782	749	106	658	35
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	1980	832	117	731	38
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	346		52			22
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	384	0	57	0	0	24
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		117	384		57			24
C (m) (veh/h)		135	2		129			614
v/c		0.87	192.00		0.44			0.04
95% queue length		5.59	50.60		1.95			0.12
Control Delay (s/veh)		108.0	89528		53.3			11.1
LOS		F	F		F			B
Approach Delay (s/veh)	--	--	77963			11.1		
Approach LOS	--	--	F			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency/Co.	PEC	Jurisdiction	University of Utah
Date Performed	4/20/2007	Analysis Year	2007
Analysis Time Period	2030 Horizon PM (Option 2)		

Project Description	7003 USTAR Programming
East/West Street:	North Campus Drive
North/South Street:	Wasatch Drive
Intersection Orientation:	East-West
Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		1002	1552	27	1284	101
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	1113	1724	30	1426	112
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	1	2	0
Configuration		T	TR	L	T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	848		22			32
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	942	0	24	0	0	35
Percent Heavy Vehicles	2	0	2	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	1
Configuration	L		R			R

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			R
v (veh/h)		30	942		24			35
C (m) (veh/h)		131	7		126			344
v/c		0.23	134.57		0.19			0.10
95% queue length		0.84	119.82		0.67			0.34
Control Delay (s/veh)		40.5	61140		40.2			16.6
LOS		E	F		E			C
Approach Delay (s/veh)	--	--	59622			16.6		
Approach LOS	--	--	F			C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		2				1	2			2	0
Lane Group	L		R				L	T			TR	
Volume (vph)	188		588				341	206			79	213
% Heavy Vehicles	0		0				0	0			0	0
PHF	0.90		0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)	A		P				A	A			A	A
Startup Lost Time	2.0		2.0				2.0	2.0			2.0	
Extension of Effective Green	2.0		2.0				2.0	2.0			2.0	
Arrival Type	3		3				3	3			3	
Unit Extension	3.0		3.0				3.0	3.0			3.0	
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width	12.0		12.0				12.0	12.0			12.0	
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0				0	0			0	
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	EB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = 16.6	G = 0.0	G = 0.0	G = 0.0	G = 21.2	G = 14.9	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 62.7		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	209		653				379	229			325	
Lane Group Capacity	478		757				610	2198			766	
v/c Ratio	0.44		0.86				0.62	0.10			0.42	
Green Ratio	0.26		0.26				0.34	0.61			0.24	
Uniform Delay d_1	19.2		22.0				17.4	5.2			20.3	
Delay Factor k	0.11		0.50				0.20	0.11			0.11	
Incremental Delay d_2	0.6		12.4				2.0	0.0			0.4	
PF Factor	1.000		1.000				1.000	1.000			1.000	
Control Delay	19.8		34.4				19.3	5.2			20.6	
Lane Group LOS	B		C				B	A			C	
Approach Delay	30.9						14.0			20.6		
Approach LOS	C						B			C		
Intersection Delay	23.3			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wasatch & Federal
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes	1		1				1	2			2	0
Lane Group	L		R				L	T			TR	
Volume (vph)	118		155				352	49			159	148
% Heavy Vehicles	0		0				0	0			0	0
PHF	0.90		0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)	A		P				A	A			A	A
Startup Lost Time	2.0		2.0				2.0	2.0			2.0	
Extension of Effective Green	2.0		2.0				2.0	2.0			2.0	
Arrival Type	3		3				3	3			3	
Unit Extension	3.0		3.0				3.0	3.0			3.0	
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width	12.0		12.0				12.0	12.0			12.0	
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour	0		0				0	0			0	
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	EB Only	02	03	04	NB Only	Thru & RT	07	08
Timing	G = 10.9	G = 0.0	G = 0.0	G = 0.0	G = 16.8	G = 12.7	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 50.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate	131		172				391	54			341	
Lane Group Capacity	390		349				603	2263			845	
v/c Ratio	0.34		0.49				0.65	0.02			0.40	
Green Ratio	0.22		0.22				0.33	0.63			0.25	
Uniform Delay d_1	16.7		17.3				14.3	3.6			15.7	
Delay Factor k	0.11		0.50				0.23	0.11			0.11	
Incremental Delay d_2	0.5		4.9				2.4	0.0			0.3	
PF Factor	1.000		1.000				1.000	1.000			1.000	
Control Delay	17.2		22.2				16.7	3.6			16.0	
Lane Group LOS	B		C				B	A			B	
Approach Delay	20.1						15.1			16.0		
Approach LOS	C						B			B		
Intersection Delay	16.8			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2	0	1		1			1
Lane Group		TR		L	TR		L		R			R
Volume (vph)		386	122	77	571	50	156		11			16
% Heavy Vehicles		0	0	0	0	0	0		0			0
PHF		0.90	0.90	0.90	0.90	0.90	0.90		0.90			0.90
Pretimed/Actuated (P/A)		A	A	A	A	A	A		P			P
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			2.0
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			2.0
Arrival Type		3		3	3		3		3			3
Unit Extension		3.0		3.0	3.0		3.0		3.0			3.0
Ped/Bike/RTOR Volume	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width		12.0		12.0	12.0		12.0		12.0			12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 16.3	G = 0.0	G = 0.0	G = 0.0	G = 10.9	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 35.2		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		565		86	690		173		12			18
Lane Group Capacity		1616		388	1656		559		500			509
v/c Ratio		0.35		0.22	0.42		0.31		0.02			0.04
Green Ratio		0.46		0.46	0.46		0.31		0.31			0.31
Uniform Delay d_1		6.1		5.7	6.3		9.3		8.5			8.5
Delay Factor k		0.11		0.11	0.11		0.11		0.50			0.50
Incremental Delay d_2		0.1		0.3	0.2		0.3		0.1			0.1
PF Factor		1.000		1.000	1.000		1.000		1.000			1.000
Control Delay		6.2		5.9	6.5		9.6		8.6			8.6
Lane Group LOS		A		A	A		A		A			A
Approach Delay	6.2			6.4			9.5			8.6		
Approach LOS	A			A			A			A		
Intersection Delay	6.7			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2	0	1		1			1
Lane Group		TR		L	TR		L		R			R
Volume (vph)		821	226	165	212	17	35		26			11
% Heavy Vehicles		0	0	0	0	0	0		0			0
PHF		0.90	0.90	0.90	0.90	0.90	0.90		0.90			0.90
Pretimed/Actuated (P/A)		A	A	A	A	A	A		P			P
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			2.0
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			2.0
Arrival Type		3		3	3		3		3			3
Unit Extension		3.0		3.0	3.0		3.0		3.0			3.0
Ped/Bike/RTOR Volume	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width		12.0		12.0	12.0		12.0		12.0			12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	EW Perm	02	03	04	NS Perm	06	07	08
Timing	G = 26.4	G = 0.0	G = 0.0	G = 0.0	G = 10.0	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 44.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1163		183	255		39		29			12
Lane Group Capacity		2080		221	2126		407		364			371
v/c Ratio		0.56		0.83	0.12		0.10		0.08			0.03
Green Ratio		0.59		0.59	0.59		0.23		0.23			0.23
Uniform Delay d_1		5.5		7.2	3.9		13.6		13.6			13.4
Delay Factor k		0.16		0.37	0.11		0.11		0.50			0.50
Incremental Delay d_2		0.3		22.3	0.0		0.1		0.4			0.2
PF Factor		1.000		1.000	1.000		1.000		1.000			1.000
Control Delay		5.8		29.5	4.0		13.7		14.0			13.6
Lane Group LOS		A		C	A		B		B			B
Approach Delay	5.8			14.6			13.8			13.6		
Approach LOS	A			B			B			B		
Intersection Delay	8.5			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			758				309	630			1094	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G =	G =	G =	G =	G = 26.0	G = 35.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 69.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			842				343	700			1216	40
Lane Group Capacity			834				1130	1363			1363	609
v/c Ratio			1.01				0.30	0.51			0.89	0.07
Green Ratio			0.51				0.94	0.38			0.38	0.38
Uniform Delay d_1			17.0				5.6	16.6			20.2	13.7
Delay Factor k			0.50				0.11	0.12			0.42	0.11
Incremental Delay d_2			33.5				0.2	0.3			7.8	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			50.5				5.8	16.9			28.0	13.8
Lane Group LOS			D				A	B			C	B
Approach Delay	50.5						13.3			27.6		
Approach LOS	D						B			C		
Intersection Delay	29.0			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			368				937	1150			308	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G = 0.0	G = 0.0	G = 0.0	G =	G = 26.0	G = 26.0	G = 0.0	G = 0.0
	Y = 0	Y = 0	Y = 0	Y =	Y = 4	Y = 4	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 Cycle Length C = 60.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			409				1041	1278			342	40
Lane Group Capacity			712				1353	1568			1568	700
v/c Ratio			0.57				0.77	0.82			0.22	0.06
Green Ratio			0.43				0.93	0.43			0.43	0.43
Uniform Delay d_1			12.8				2.1	14.9			10.6	9.9
Delay Factor k			0.17				0.32	0.36			0.11	0.11
Incremental Delay d_2			1.1				2.8	3.5			0.1	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			14.0				4.8	18.3			10.7	9.9
Lane Group LOS			B				A	B			B	A
Approach Delay	14.0						12.3			10.6		
Approach LOS	B						B			B		
Intersection Delay	12.3			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1		2	0	1	2	
Lane Group				L		R		TR		L	T	
Volume (vph)				361		165		468	150	152	791	
% Heavy Vehicles				0		0		0	0	0	0	
PHF				0.90		0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A		P		A	A	A	A	
Startup Lost Time				2.0		2.0		2.0		2.0	2.0	
Extension of Effective Green				2.0		2.0		2.0		2.0	2.0	
Arrival Type				3		3		3		3	3	
Unit Extension				3.0		3.0		3.0		3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0		12.0		12.0		12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0		0		0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 26.1	G = 0.0	G = 0.0	G = 0.0	G = 12.2	G = 23.7	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 72.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				401		183		687		169	879	
Lane Group Capacity				654		585		1147		306	1904	
v/c Ratio				0.61		0.31		0.60		0.55	0.46	
Green Ratio				0.36		0.36		0.33		0.17	0.53	
Uniform Delay d_1				18.8		16.5		20.2		27.4	10.7	
Delay Factor k				0.20		0.50		0.19		0.15	0.11	
Incremental Delay d_2				1.7		1.4		0.9		2.2	0.2	
PF Factor				1.000		1.000		1.000		1.000	1.000	
Control Delay				20.5		17.9		21.1		29.6	10.8	
Lane Group LOS				C		B		C		C	B	
Approach Delay				19.7			21.1			13.9		
Approach LOS				B			C			B		
Intersection Delay	17.5			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1		2	0	1	2	
Lane Group				L		R		TR		L	T	
Volume (vph)				155		82		943	468	217	366	
% Heavy Vehicles				0		0		0	0	0	0	
PHF				0.90		0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A		P		A	A	A	A	
Startup Lost Time				2.0		2.0		2.0		2.0	2.0	
Extension of Effective Green				2.0		2.0		2.0		2.0	2.0	
Arrival Type				3		3		3		3	3	
Unit Extension				3.0		3.0		3.0		3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0		12.0		12.0		12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0		0		0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 16.1	G = 0.0	G = 0.0	G = 0.0	G = 15.9	G = 46.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 88.1		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				172		91		1568		241	407	
Lane Group Capacity				331		296		1796		326	2626	
v/c Ratio				0.52		0.31		0.87		0.74	0.15	
Green Ratio				0.18		0.18		0.52		0.18	0.73	
Uniform Delay d_1				32.4		31.1		18.5		34.1	3.7	
Delay Factor k				0.13		0.50		0.40		0.30	0.11	
Incremental Delay d_2				1.5		2.7		5.1		8.6	0.0	
PF Factor				1.000		1.000		1.000		1.000	1.000	
Control Delay				33.9		33.8		23.5		42.8	3.8	
Lane Group LOS				C		C		C		D	A	
Approach Delay				33.9			23.5			18.3		
Approach LOS				C			C			B		
Intersection Delay	23.3			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1	1	0		1	1	0	2	
Lane Group				L	TR			T	R	DefL	T	
Volume (vph)				201	0	225		426	389	393	378	
% Heavy Vehicles				0	0	0		0	0	0	0	
PHF				0.90	0.90	0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A	P	P		A	A	A	A	
Startup Lost Time				2.0	2.0			2.0	2.0	2.0	2.0	
Extension of Effective Green				2.0	2.0			2.0	2.0	2.0	2.0	
Arrival Type				3	3			3	3	3	3	
Unit Extension				3.0	3.0			3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0	12.0			12.0	12.0	12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0	0			0	0	0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NS Perm	06	07	08
Timing	G = 16.7	G = 0.0	G = 0.0	G = 0.0	G = 29.9	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 54.6		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				223	250			473	432	437	420	
Lane Group Capacity				552	494			1040	884	430	1040	
v/c Ratio				0.40	0.51			0.45	0.49	1.02	0.40	
Green Ratio				0.31	0.31			0.55	0.55	0.55	0.55	
Uniform Delay d_1				15.0	15.6			7.4	7.6	12.3	7.2	
Delay Factor k				0.11	0.50			0.11	0.11	0.50	0.11	
Incremental Delay d_2				0.5	3.7			0.3	0.4	47.6	0.3	
PF Factor				1.000	1.000			1.000	1.000	1.000	1.000	
Control Delay				15.5	19.2			7.8	8.1	59.9	7.4	
Lane Group LOS				B	B			A	A	E	A	
Approach Delay				17.5			7.9			34.2		
Approach LOS				B			A			C		
Intersection Delay	20.0			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Central Campus & Federal Way
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1	1	0		1	1	0	2	
Lane Group				L	TR			T	R	DefL	T	
Volume (vph)				123	0	137		184	75	188	195	
% Heavy Vehicles				0	0	0		0	0	0	0	
PHF				0.90	0.90	0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A	P	P		A	A	A	A	
Startup Lost Time				2.0	2.0			2.0	2.0	2.0	2.0	
Extension of Effective Green				2.0	2.0			2.0	2.0	2.0	2.0	
Arrival Type				3	3			3	3	3	3	
Unit Extension				3.0	3.0			3.0	3.0	3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0	12.0			12.0	12.0	12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0	0			0	0	0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	NS Perm	06	07	08
Timing	G = 11.4	G = 0.0	G = 0.0	G = 0.0	G = 13.8	G = 0.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 33.2		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				137	152			204	83	209	217	
Lane Group Capacity				621	555			789	671	497	789	
v/c Ratio				0.22	0.27			0.26	0.12	0.42	0.28	
Green Ratio				0.34	0.34			0.42	0.42	0.42	0.42	
Uniform Delay d_1				7.7	7.9			6.4	6.0	6.9	6.4	
Delay Factor k				0.11	0.50			0.11	0.11	0.11	0.11	
Incremental Delay d_2				0.2	1.2			0.2	0.1	0.6	0.2	
PF Factor				1.000	1.000			1.000	1.000	1.000	1.000	
Control Delay				7.9	9.1			6.5	6.1	7.5	6.6	
Lane Group LOS				A	A			A	A	A	A	
Approach Delay				8.6			6.4			7.0		
Approach LOS				A			A			A		
Intersection Delay	7.3			Intersection LOS						A		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	2	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		461	163	623	1018		201		478			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	WB Only	Thru & RT	03	04	NB Only	06	07	08
Timing	G = 35.5	G = 36.3	G = 0.0	G = 0.0	G = 26.1	G = 0.0	G = 0.0	G = 0.0
	Y = 2	Y = 4	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 107.9		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		693		692	1131		223		531			
Lane Group Capacity		1170		1153	2475		436		982			
v/c Ratio		0.59		0.60	0.46		0.51		0.54			
Green Ratio		0.34		0.33	0.68		0.24		0.61			
Uniform Delay d_1		29.7		30.3	7.8		35.4		12.4			
Delay Factor k		0.18		0.19	0.11		0.12		0.14			
Incremental Delay d_2		0.8		0.9	0.1		1.0		0.6			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		30.5		31.1	8.0		36.4		13.0			
Lane Group LOS		C		C	A		D		B			
Approach Delay	30.5			16.8			19.9					
Approach LOS	C			B			B					
Intersection Delay	20.4			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Central Campus
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/20/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2		1		1			
Lane Group		TR		L	T		L		R			
Volume (vph)		1034	163	299	354		73		101			
% Heavy Vehicles		0	0	0	0		0		0			
PHF		0.90	0.90	0.90	0.90		0.90		0.90			
Pretimed/Actuated (P/A)		A	A	A	A		A		P			
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			
Arrival Type		3		3	3		3		3			
Unit Extension		3.0		3.0	3.0		3.0		3.0			
Ped/Bike/RTOR Volume	0	0	0	0	0		0	0	0			
Lane Width		12.0		12.0	12.0		12.0		12.0			
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N			
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			
Minimum Pedestrian Time		3.2			3.2			3.2				

Phasing	WB Only	Thru & RT	03	04	NB Only	06	07	08
Timing	G = 18.5	G = 41.4	G = 0.0	G = 0.0	G = 10.5	G = 0.0	G = 0.0	G = 0.0
	Y = 2	Y = 4	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 80.4		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1330		332	393		81		112			
Lane Group Capacity		1823		416	2786		236		664			
v/c Ratio		0.73		0.80	0.14		0.34		0.17			
Green Ratio		0.51		0.23	0.77		0.13		0.41			
Uniform Delay d_1		15.2		29.2	2.4		31.8		15.0			
Delay Factor k		0.29		0.34	0.11		0.11		0.11			
Incremental Delay d_2		1.5		10.5	0.0		0.9		0.1			
PF Factor		1.000		1.000	1.000		1.000		1.000			
Control Delay		16.7		39.7	2.4		32.7		15.1			
Lane Group LOS		B		D	A		C		B			
Approach Delay	16.7			19.5			22.5					
Approach LOS	B			B			C					
Intersection Delay	18.1			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			2				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			1147				309	630			1094	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G =	G =	G =	G =	G = 26.0	G = 35.0	G =	G =
	Y =	Y =	Y =	Y =	Y = 4	Y = 4	Y =	Y =
Duration of Analysis (hrs) = 0.25						Cycle Length C = 69.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			1274				343	700			1216	40
Lane Group Capacity			1450				1130	1363			1363	609
v/c Ratio			0.88				0.30	0.51			0.89	0.07
Green Ratio			0.51				0.94	0.38			0.38	0.38
Uniform Delay d_1			15.1				5.6	16.6			20.2	13.7
Delay Factor k			0.41				0.11	0.12			0.42	0.11
Incremental Delay d_2			6.5				0.2	0.3			7.8	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			21.6				5.8	16.9			28.0	13.8
Lane Group LOS			C				A	B			C	B
Approach Delay	21.6						13.3			27.6		
Approach LOS	C						B			C		
Intersection Delay	21.3			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Wastatch & Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/18/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes			1				1	2			2	1
Lane Group			R				L	T			T	R
Volume (vph)			444				937	1150			308	36
% Heavy Vehicles			0				0	0			0	0
PHF			0.90				0.90	0.90			0.90	0.90
Pretimed/Actuated (P/A)							A	A			A	A
Startup Lost Time			2.0				2.0	2.0			2.0	2.0
Extension of Effective Green			2.0				2.0	2.0			2.0	2.0
Arrival Type			3				3	3			3	3
Unit Extension			3.0				3.0	3.0			3.0	3.0
Ped/Bike/RTOR Volume	0	0	0				0	0		0	0	0
Lane Width			12.0				12.0	12.0			12.0	12.0
Parking/Grade/Parking	N	0	N				N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour			0				0	0			0	0
Minimum Pedestrian Time		3.2						3.2			3.2	

Phasing	01	02	03	04	NS Perm	NB Only	07	08
Timing	G = 0.0	G = 0.0	G = 0.0	G =	G = 26.0	G = 26.0	G = 0.0	G = 0.0
	Y = 0	Y = 0	Y = 0	Y =	Y = 4	Y = 4	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25 Cycle Length C = 60.0

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate			493				1041	1278			342	40
Lane Group Capacity			712				1353	1568			1568	700
v/c Ratio			0.69				0.77	0.82			0.22	0.06
Green Ratio			0.43				0.93	0.43			0.43	0.43
Uniform Delay d_1			13.8				2.1	14.9			10.6	9.9
Delay Factor k			0.26				0.32	0.36			0.11	0.11
Incremental Delay d_2			2.9				2.8	3.5			0.1	0.0
PF Factor			1.000				1.000	1.000			1.000	1.000
Control Delay			16.7				4.8	18.3			10.7	9.9
Lane Group LOS			B				A	B			B	A
Approach Delay	16.7						12.3			10.6		
Approach LOS	B						B			B		
Intersection Delay	12.8			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1		2	0	1	2	
Lane Group				L		R		TR		L	T	
Volume (vph)				361		165		468	150	152	791	
% Heavy Vehicles				0		0		0	0	0	0	
PHF				0.90		0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A		P		A	A	A	A	
Startup Lost Time				2.0		2.0		2.0		2.0	2.0	
Extension of Effective Green				2.0		2.0		2.0		2.0	2.0	
Arrival Type				3		3		3		3	3	
Unit Extension				3.0		3.0		3.0		3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0		12.0		12.0		12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0		0		0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 26.1	G = 0.0	G = 0.0	G = 0.0	G = 12.2	G = 23.7	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 72.0		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				401		183		687		169	879	
Lane Group Capacity				654		585		1147		306	1904	
v/c Ratio				0.61		0.31		0.60		0.55	0.46	
Green Ratio				0.36		0.36		0.33		0.17	0.53	
Uniform Delay d_1				18.8		16.5		20.2		27.4	10.7	
Delay Factor k				0.20		0.50		0.19		0.15	0.11	
Incremental Delay d_2				1.7		1.4		0.9		2.2	0.2	
PF Factor				1.000		1.000		1.000		1.000	1.000	
Control Delay				20.5		17.9		21.1		29.6	10.8	
Lane Group LOS				C		B		C		C	B	
Approach Delay				19.7			21.1			13.9		
Approach LOS				B			C			B		
Intersection Delay	17.5			Intersection LOS						B		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	Medical & South Medical
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes				1		1		2	0	1	2	
Lane Group				L		R		TR		L	T	
Volume (vph)				155		82		943	468	217	366	
% Heavy Vehicles				0		0		0	0	0	0	
PHF				0.90		0.90		0.90	0.90	0.90	0.90	
Pretimed/Actuated (P/A)				A		P		A	A	A	A	
Startup Lost Time				2.0		2.0		2.0		2.0	2.0	
Extension of Effective Green				2.0		2.0		2.0		2.0	2.0	
Arrival Type				3		3		3		3	3	
Unit Extension				3.0		3.0		3.0		3.0	3.0	
Ped/Bike/RTOR Volume				0	0	0	0	0	0	0	0	
Lane Width				12.0		12.0		12.0		12.0	12.0	
Parking/Grade/Parking				N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour				0		0		0		0	0	
Minimum Pedestrian Time					3.2			3.2			3.2	

Phasing	WB Only	02	03	04	SB Only	Thru & RT	07	08
Timing	G = 16.1	G = 0.0	G = 0.0	G = 0.0	G = 15.9	G = 46.0	G = 0.0	G = 0.0
	Y = 4	Y = 0	Y = 0	Y = 0	Y = 2	Y = 4	Y = 0	Y = 0
Duration of Analysis (hrs) = 0.25						Cycle Length C = 88.1		

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate				172		91		1568		241	407	
Lane Group Capacity				331		296		1796		326	2626	
v/c Ratio				0.52		0.31		0.87		0.74	0.15	
Green Ratio				0.18		0.18		0.52		0.18	0.73	
Uniform Delay d_1				32.4		31.1		18.5		34.1	3.7	
Delay Factor k				0.13		0.50		0.40		0.30	0.11	
Incremental Delay d_2				1.5		2.7		5.1		8.6	0.0	
PF Factor				1.000		1.000		1.000		1.000	1.000	
Control Delay				33.9		33.8		23.5		42.8	3.8	
Lane Group LOS				C		C		C		D	A	
Approach Delay				33.9			23.5			18.3		
Approach LOS				C			C			B		
Intersection Delay	23.3			Intersection LOS						C		

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SHORT REPORT

General Information		Site Information	
Analyst	RDL	Intersection	North Campus & Wasatch
Agency or Co.	PEC	Area Type	All other areas
Date Performed	4/23/2007	Jurisdiction	University of Utah
Time Period		Analysis Year	

Volume and Timing Input

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes		2	0	1	2	0	1		1			1
Lane Group		TR		L	TR		L		R			R
Volume (vph)		495	795	113	634	50	483		26			11
% Heavy Vehicles		0	0	0	0	0	0		0			0
PHF		0.90	0.90	0.90	0.90	0.90	0.90		0.90			0.90
Pretimed/Actuated (P/A)		A	A	A	A	A	A		P			P
Startup Lost Time		2.0		2.0	2.0		2.0		2.0			2.0
Extension of Effective Green		2.0		2.0	2.0		2.0		2.0			2.0
Arrival Type		3		3	3		3		3			3
Unit Extension		3.0		3.0	3.0		3.0		3.0			3.0
Ped/Bike/RTOR Volume	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width		12.0		12.0	12.0		12.0		12.0			12.0
Parking/Grade/Parking	N	0	N	N	0	N	N	0	N	N	0	N
Parking/Hour												
Bus Stops/Hour		0		0	0		0		0			0
Minimum Pedestrian Time		3.2			3.2			3.2			3.2	

Phasing	WB Only	Thru & RT	03	04	NS Perm	06	07	08
Timing	G = 12.6	G = 46.0	G = 0.0	G = 0.0	G = 41.5	G = 0.0	G = 0.0	G = 0.0
	Y = 2	Y = 2	Y = 0	Y = 0	Y = 4	Y = 0	Y = 0	Y = 0

Duration of Analysis (hrs) = 0.25

Cycle Length C = 108.1

Lane Group Capacity, Control Delay, and LOS Determination

	EB			WB			NB			SB		
Adjusted Flow Rate		1433		126	760		537		29			12
Lane Group Capacity		1397		211	2006		693		620			631
v/c Ratio		1.03		0.60	0.38		0.77		0.05			0.02
Green Ratio		0.43		0.12	0.56		0.38		0.38			0.38
Uniform Delay d_1		31.1		45.3	13.3		29.2		20.9			20.7
Delay Factor k		0.50		0.19	0.11		0.32		0.50			0.50
Incremental Delay d_2		30.9		4.6	0.1		5.5		0.1			0.1
PF Factor		1.000		1.000	1.000		1.000		1.000			1.000
Control Delay		61.9		49.9	13.4		34.7		21.0			20.7
Lane Group LOS		E		D	B		C		C			C
Approach Delay	61.9			18.6			34.0			20.7		
Approach LOS	E			B			C			C		
Intersection Delay	43.0			Intersection LOS						D		

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6.7 EQUIPMENT SCHEDULE FOR NANOFABRICATION

Please see page numbers with in the consultant's document.

Section 6.7 Nanofabrication Cleanroom Equipment

University of Utah Neuroscience & Biomedical Technology Research Building

N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or Install	Assignment:	Comments: uUtah Comments
	4.1.1 (x)	**FE NanoCT**					
(F)	4.1.1-1	FE nanoCT (300KV)	1	P		Future	
(N)	4.1.1-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.1-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.1-4	Chair or Stool	2	P	I	Furniture	
	4.1.2 (1x)	**HR SEM**					
(F)	4.1.2-1	HR SEM (make?)	1	P		Future	
(N)	4.1.2-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.2-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.2-4	Chair or Stool	2	P	I	Furniture	
	4.1.3 (x)	**FE ESEM (Analytical)**					
(F)	4.1.3-1	FE ESEM	1	P		Future	
(N)	4.1.3-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.3-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.3-4	Chair or Stool	2	P	I	Furniture	
	4.1.4 (1x)	**DB FIB and Nabity Nanolithography**					
(N)	4.1.4-1	DB FIB + Nabity Nanolithography	1	P	I	Future	
(N)	4.1.4-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.4-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.4-4	Chair or Stool	2	P	I	Furniture	
	4.1.5 (x)	**DSIMS**					
(F)	4.1.5-1	(DSIMS)	1	P		Future	
(N)	4.1.5-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.5-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.5-4	Chair or Stool	2	P	I	Furniture	
	4.1.6 (x)	**AUGER**					
(F)	4.1.6-1	(AUGER)	1	P		Future	
(N)	4.1.6-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.6-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.6-4	Chair or Stool	2	P	I	Furniture	
	4.1.7 (1x)	**XPS**					
(E)	4.1.7-1	Imaging XPS/Auger/ISS	1	U	M/I	Future	Complex Move
(N)	4.1.7-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.7-3	Tall Storage Cabinet	2	P	I	Furniture	
(N)	4.1.7-4	Chair or Stool	2	P	I	Furniture	
	4.1.8 (1x)	**Microscopy Service Corridor**					
(N)	4.1.8-1		1	P	I		
	4.1.9 (1x)	**AFM (Wet + Solid State)**					
(E)	4.1.9-1	AFM	1	U	M/I	Future	
(F)	4.1.9-2	Wet AFM	1	P		Future	
(N)	4.1.9-3	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.9-4	Chair or Stool	2	P	I	Furniture	
	4.1.14 (x)	**Optical Microscopy (SNOM)**					
(F)	4.1.14-1	SNOM	1	P		Future	
(N)	4.1.14-2	SS Cleanroom Work Bench	1	P	I	Furniture	
(N)	4.1.14-3	Chair or Stool	2	P	I	Furniture	
	4.1.13 (1x)	**Optical Microscopy**					
(N)	4.1.13-1	Profilometer Tencor p-20	1	P	I	Future	Refurbished
(E)	4.1.13-2	Zygo Optical Profilometer	1	U	M/I	Future	Upgrade
(F)	4.1.13-3	Nano-Indenter	1	P		Future	
(F)	4.1.13-4	FTIR	1	P		Future	
(E)	4.1.13-5	Ellipsometer . Woollam . V-Vase	1	U	M/I	Future	
(E)	4.1.13-6	Polyvar Mettalurgical	1	U	M/I	Future	
(N)	4.1.13-7	Image Analyzer	1	P	I	Future	
(F)	4.1.13-8	UVVis/NIR	1	P		Future	
(N)	4.1.13-9	SS Cleanroom Work Bench	4	P	I	Furniture	

Section 6.7 Nanofabrication Cleanroom Equipment

University of Utah Neuroscience & Biomedical Technology Research Building

N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(N)	4.1.13-10	Chair or Stool	6	P	I	Furniture	
	4.1.15 (x)	**Magnetometry**					
(F)	4.1.15-1	Hall msmt (1T)	1	P		Future	
(F)	4.1.15-2	SQuID	1	P		Future	
(F)	4.1.15-3	Lakeshore VSM	1	P		Future	
(N)	4.1.15-4	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	4.1.15-5	Chair or Stool	3	P	I	Furniture	
	4.1.16 (1x)	**Crystallography**					
(F)	4.1.16-1	HR XRD	1	P		Future	
(N)	4.1.16-2	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	4.1.16-3	Chair or Stool	2	P	I	Furniture	
	4.1.17 (1x)	**Electrical Characterization**					
(N)	4.1.17-1	Probe stations	1	P	I	Future	
(N)	4.1.17-2	Test Apparatus (Keithley 4200)	1	P	I	Future	
(N)	4.1.17-3	Test Apparatus (Keithley 2400)	2	P	I	Future	
(N)	4.1.17-4	Thermonix Substrate Heating / Cooling	1	P	I	Future	
(F)	4.1.17-5	Thermal Cycling Furnace	1	P		Future	
(N)	4.1.17-6	4-pt probe	1	P	I	Future	
(N)	4.1.17-7	C/V measurement with signal generator	1	P	I	Future	
(N)	4.1.17-8	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	4.1.17-9	Chair or Stool	4	P	I	Furniture	
	4.1.18 (1x)	**Sample Prep**					
(N)	4.1.18-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	4.1.18-B	2.5' Deep Fume Hood	2	P	I	USTAR	
(N)	4.1.18-C	Flammable Storage Cabinet Under Hood	2	P	I	USTAR	
(N)	4.1.18-D	Corrosive Storage Cabinet Under Hood	2	P	I	USTAR	
(N)	4.1.18-E	Epoxy Resin Counter w/ Cabinets Below	1	P	I	USTAR	
(N)	4.1.18-F	Upper Cabinets with Swinging Glass Doors	1	P	I	USTAR	
(N)	4.1.18-G	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	1	P	I	USTAR	
(N)	4.1.18-H	Overhead Service Carrier	1	P	I	USTAR	
(N)	4.1.18-I	Epoxy Resin Adjustable-Height Table w/ Cabinets Below	4	P	I	USTAR	
(F)	4.1.18-1	wet staining / decoration (in hood)	1	P		Future	
(F)	4.1.18-2	supporting sample prep tools (ion mills, C- Au- coating, dimpler, hoods	1	P		Future	Costs capture items below
(F)	4.1.18-3	Dimpler . Gatan . 656 Dimple Grinder	1	P		Future	
(F)	4.1.18-4	Critical Point Dryer . Bal-Tec . CPD-030	1	P		Future	Assumed purchased by Bio side
(F)	4.1.18-5	Ion Mill . Gatan . 681 HR Ion Beam Coater	1	P		Future	
(F)	4.1.18-6	Ultrasonic Cutters . Gatan . 601 Tuned Piezo Cutting Tool	1	P		Future	
(F)	4.1.18-7	UV ozone cleaner . Fischione . 1020 Plasma Cleaner	1	P		Future	
(F)	4.1.18-8	Carbon Coater . NanoMaster . NSC3000	1	P		Future	
(F)	4.1.18-9	Carbon Coater Rough-In Pump (undercabinet)	1	P		Future	
(F)	4.1.18-10	Carbon Coater PC	1	P		Future	
(F)	4.1.18-11	Double-Stacked Curing Ovens . Blue M . STK-04	1	P		Future	
(F)	4.1.18-12	Polishing Wheel . Lapmaster . 15 (TT)	1	P		Future	
(F)	4.1.18-13	Cryoultramicrotome . Leica . Ultracut (EM FC6?)	1	P		Future	Assumed purchased by Bio side
(F)	4.1.18-14	Cryoultramicrotome LN2 Dewar . Leica . Ultracut (EM FC6?)	1	P		Future	Assumed purchased by Bio side
(F)	4.1.18-15	Evaporator . Sharon Vacuum . Custom	1	P		Future	
(F)	4.1.18-16	Wire Saw . South Bay Tech . 850 (TT)	1	P		Future	
(F)	4.1.18-17	Diamond Saw . South Bay Tech . 660 (TT)	1	P		Future	
(F)	4.1.18-18	Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	1	P		Future	
(F)	4.1.18-19	Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	1	P		Future	
(F)	4.1.18-20	Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	1	P		Future	
(F)	4.1.18-21	Optical Microscope	1	P		Future	
(N)	4.1.18-22	Tall Storage Cabinet	1	P	I	Furniture	
(N)	4.1.18-23	Chair or Stool	4	P	I	Furniture	
	5.1.2 (1x)	**Nanolithography (Cl 100)**					
(N)	5.1.2-1	Wafer Handling / Vacuum Wands	2	P	I	USTAR	
(F)	5.1.2-2	Nano Imprint or immersion microstep	1	P		Future	
(F)	5.1.2-3	Nanolith	1	P		Future	
(N)	5.1.2-4	Spin/Developer	1	P	I	Future	

Section 6.7 Nanofabrication Cleanroom Equipment

University of Utah Neuroscience & Biomedical Technology Research Building

N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(E)	5.1.2-5	Interference Lithography	1	U	M/I	Future	
(N)	5.1.2-6	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	5.1.2-7	Cleanroom Chair or Stool	2	P	I	Furniture	
	5.1.3 (1x)	**Photolithography (Cl 100)**					
(N)	5.1.3-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.3-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(E)	5.1.3-2	Electromask	1	U	M/I	Future	Improve, Complex Move
(E)	5.1.3-3	Reticle Aligner	1	U	M/I	Future	
(E)	5.1.3-4	PG rack	1	U	M/I	Future	
(E)	5.1.3-5	PG Computer	1	U	M/I	Future	
(E)	5.1.3-6	CAD Computer	2	U	M/I	Future	
(E)	5.1.3-7	CAD Tape Drive	2	U	M/I	Future	
(E)	5.1.3-8	EV Aligner	1	U	M/I	Future	
(E)	5.1.3-9	Suss Aligner	1	U	M/I	Future	
(F)	5.1.3-10	Wafer Stepper	1	P		Future	
(E)	5.1.3-11	Hot Plate Bake	3	U	M/I	Future	Improve
(N)	5.1.3-12	Vapor Prime Oven	1	P	I	Future	
(E)	5.1.3-13	Suss Spinner	1	U	M/I	Future	
(E)	5.1.3-14	Headway Spinner	1	U	M/I	Future	6' - Long Bench
(F)	5.1.3-15	Mask Storage	1	P		Future	
(E)	5.1.3-16	Dektak 2	1	U	M/I	Future	
(N)	5.1.3-17	Spray Develop Ultra-Tech	1	P	I	Future	
(N)	5.1.3-18	Inspection Bench w/ Digital Imaging Microscope	1	P	I	Future	
(N)	5.1.3-19	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.3-20	Cleanroom Chair or Stool	2	P	I	Furniture	
	5.1.4 (1x)	**Wet Processing**					
(N)	5.1.4-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.4-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(N)	5.1.4-2	Wet Bench (acid)	3	P	I	Future	
(N)	5.1.4-3	Wet Bench (base)	1	P	I	Future	
(N)	5.1.4-4	Wet Bench (electrochemistry)	1	P	I	Future	
(E)	5.1.4-5	Wet Bench (acid) w/ Cascade Rinse	1	U	M/I	Future	
(N)	5.1.4-6	Solvent Bench	2	P	I	Future	
(E)	5.1.4-7	Solvent Bench	1	U	M/I	Future	
(N)	5.1.4-8	Spin/Rinse/Dry	3	P	I	Future	
(N)	5.1.4-9	Fluoroware	1	P	I	Future	
(N)	5.1.4-10	KOH Etch Bench	1	P	I	Future	
(N)	5.1.4-11	Inspection Bench w/ Digital Imaging Microscope	1	P	I	Future	
(N)	5.1.4-12	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.4-13	Cleanroom Chair or Stool	1	P	I	Furniture	
	5.1.5 (1x)	**Hot Process**					
(N)	5.1.5-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.5-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(N)	5.1.5-2	Oxford 80+ PECVD	1	P	I	Future	
(N)	5.1.5-3	Oxford 80+ RIE	1	P	I	Future	
(E)	5.1.5-4	SiC (LPCVD)	1	U	M/I	Future	FS?
(F)	5.1.5-5	Diamond u-wave hi rate PECVD (ECR for millitorr), also thermal (RF/ı	1	P		Future	
(E)	5.1.5-6	Canary Furnace	1	U	M/I	Future	Complex Move
(N)	5.1.5-7	New Furnace stack 2-ox, LPCVD nitride, LTO, poly, diff (2)	1	P	I	Future	
(F)	5.1.5-8	Teflon conformal deposition	1	P		Future	
(F)	5.1.5-9	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.5-10	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.5-11	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.6 (1x)	**Films Deposition**					
(N)	5.1.6-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.6-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(E)	5.1.6-2	Denton e-beam dep	1	U	M/I	Future	Complex Move
(N)	5.1.6-3	Denton Discovery	1	P	I	Future	Improve
(E)	5.1.6-4	SFI 3-cathode	1	U	M/I	Future	Donated, Modify
(E)	5.1.6-5	Thermal Evaporator	1	U	M/I	Future	Complex Move

Section 6.7 Nanofabrication Cleanroom Equipment

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N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(E)	5.1.6-6	Perkin Elmer	1	U	M/I	Future	Used
(N)	5.1.6-7	6" PVD with backsputtering	1	P	I	Future	Refurbished
(F)	5.1.6-8	Flexus wafer bow measurement	1	P		Future	
(N)	5.1.6-9	RTA with vacuum capability	1	P	I	Future	
(N)	5.1.6-10	Spin on Glass - Planarization	1	P	I	Future	
(F)	5.1.6-11	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.6-12	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.6-13	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.7 (2x)	**Dry Etch / BioCompatible Bay**					
(N)	5.1.7-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.7-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(E)	5.1.7-2	Oxford ICP 100+ PECVD/DRIE	1	U	M/I	Future	
(E)	5.1.7-3	Drytek etcher	1	U	M/I	Future	
(N)	5.1.7-4	u-wave Asher	1	P	I	Future	
(N)	5.1.7-5	Trion Metal Etch (ion)	1	P	I	Future	
(N)	5.1.7-6	XeF2 release etch	1	P	I	Future	
(F)	5.1.7-7	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.7-8	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.7-9	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.8 (2x)	**BioCompatible PI/Industrial Bay 1**					
(N)	5.1.8-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.8-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(F)	5.1.8-2	Electrodeposition	2	P		Future	Planned Semitool
(F)	5.1.8-3	SSTI Vacuum Furnace	1	P		Future	
(F)	5.1.8-4	Fusion Bonding	10	P		Future	FS
(F)	5.1.8-5	micro-EDM	4	P		Future	
(F)	5.1.8-6	Inspection Bench	3	P		Future	
(F)	5.1.8-7	Critical Point dryer	1	P		Future	
(F)	5.1.8-8	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.8-9	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.8-10	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.9 (2x)	**BioCompatible PI/Industrial Bay 2**					
(N)	5.1.9-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.9-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(F)	5.1.9-2	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.9-3	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.9-4	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.10 (2x)	**BioCompatible PI/Industrial Bay 3**					
(N)	5.1.10-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.10-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(F)	5.1.10-2	Inspection Bench w/ Digital Imaging Microscope	1	P		Future	
(N)	5.1.10-3	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.1.10-4	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.1.11 (1x)	**Chemical Pass-Thru**					
(N)	5.1.11-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.11-1	Chemical Tranfer Rack (Stationary Cart)	5	P	I	USTAR	Use Stanford Model, except stationary
	5.1.12 (1x)	**Cleanroom Main Aisle**					
(N)	5.1.12-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.12-1	Wafer Handling / Vacuum Wands	7	P	I	USTAR	
(N)	5.1.12-2	Inspection Bench w/ Digital Imaging Microscope	1	P	I	Future	
(N)	5.1.12-3	Cube Storage	200	P	I	USTAR	12"w. x 18"d. x 12" h.
(N)	5.1.12-4	SS Cleanroom Work Bench	21	P	I	Furniture	
(N)	5.1.12-5	Cleanroom Chair or Stool	7	P	I	Furniture	
	5.1.13 (1x)	**Clean Janitors (Cl 10K) (in box)**					
(N)	5.1.13-1	Cleanroom Floor Cleaner	1	P	I	Future	
	5.1.14 (1x)	**Cleanroom Chases**					
(N)	5.1.14-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.1.14-1	Quartzware Washer	1	P	I	Future	

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N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(N)	5.1.14-2	Diffusion Tube Cleaner	1	P	I	Future	
	5.2.1 (1x)	**Main Gowning (Cl 10K)**					
(N)	5.2.1-1	Bench	3	P	I	Furniture	
(N)	5.2.1-2	20 Gown Hanger Rack	6	P	I	Furniture	
(N)	5.2.1-3	Gown Cabinet	1	P	I	Furniture	
(N)	5.2.1-4	Pre gown storage	1	P	I	Furniture	
(N)	5.2.1-5	Glove / goggle storage	1	P	I	Furniture	
(N)	5.2.1-6	Hood / Bootie Storage	1	P	I	Furniture	
(N)	5.2.1-7	Dirty Bin (gowns)	1	P	I	Furniture	
(N)	5.2.1-8	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.2.1-9	Cleanroom Chair or Stool	1	P	I	Furniture	
(N)	5.2.1-10	Trash Bin	1	P	I	Furniture	
	5.2.2 (1x)	**Equipment Wipe-Down (Cl 10K)**					
(N)	5.2.2-1	Solvent storage Securall A360	2	P	I	USTAR	
(N)	5.2.2-2	Acid storage Securall A360	1	P	I	USTAR	
(N)	5.2.2-3	Base storage Securall A360	1	P	I	USTAR	
(N)	5.2.2-4	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.2.2-5	Cleanroom Chair or Stool	1	P	I	Furniture	
(N)	5.2.2-6	Trash Bin	2	P	I	Furniture	
	5.2.3 (1x)	**Metrology (Cl 10K)**					
(N)	5.2.3-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(N)	5.2.3-2	Wafer defect review tool	1	P	I	Future	
(N)	5.2.3-3	Nanospec	1	P	I	Future	
(N)	5.2.3-4	In-fab imaging SEM	1	P	I	Future	
(N)	5.2.3-5	Inspection Bench w/ Digital Imaging Microscope	1	P	I	Future	
(N)	5.2.3-6	MX205 Wafer Geometry	1	P	I	Future	
(N)	5.2.3-7	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	5.2.3-8	Cleanroom Chair or Stool	2	P	I	Furniture	
	5.2.4 (1x)	**Clean Microelectronics Res/Teaching (Cl 10K)**					
(N)	5.2.4-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.2.4-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(E)	5.2.4-2	4" furnaces (wet ox, dry ox, B-diff, P-diff, annealing, polySi)	1	U	M/I	Future	
(E)	5.2.4-3	Al evaporator	1	U	M/I	Future	
(E)	5.2.4-4	teaching ellipsometer	1	U	M/I	Future	
(E)	5.2.4-5	4-pt probe	1	U	M/I	Future	
(E)	5.2.4-6	hot pt. probe	1	U	M/I	Future	
(E)	5.2.4-7	teaching inspection microscopes	1	U	M/I	Future	
(E)	5.2.4-8	profilometer	1	U	M/I	Future	
(E)	5.2.4-9	inspection microscopes	1	U	M/I	Future	
(E)	5.2.4-10	computer workstation	1	U	M/I	Future	
(E)	5.2.4-11	electrical test stations	1	U	M/I	Future	
(E)	5.2.4-12	two probe test stations	1	U	M/I	Future	Upgrade to 4"
(N)	5.2.4-1	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.2.4-2	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.2.5 (1x)	**Clean Micromachining Res/Teaching (Cl 10K)**					
(N)	5.2.5-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.2.5-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(E)	5.2.5-2	Dicing saw (MAx2)	2	U	M/I	Future	
(E)	5.2.5-3	KOH Etch Bench	1	U	M/I	Future	
(E)	5.2.5-4	Electroplating	1	U	M/I	Future	
(N)	5.2.5-5	Wet Bench	1	P	I	Future	
(E)	5.2.5-6	Dry Bench (exhausted)	2	U	M/I	Future	
(E)	5.2.5-7	Inspection Microscopes	1	U	M/I	Future	
(E)	5.2.5-8	Computer Workstations	1	U	M/I	Future	
(E)	5.2.5-9	Wire Bonding	1	U	M/I	Future	
(N)	5.2.5-10	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.2.5-11	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.2.6 (1x)	**Clean Photolithography Res/Teaching (Cl 10K)**					
(N)	5.2.6-A	Safety Shower / Face Wash	1	P	I	USTAR	

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N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(N)	5.2.6-1	Wafer Handling / Vacuum Wands	4	P	I	USTAR	
(N)	5.2.6-2	OAI Contact Aligner	1	P	I	Future	
(E)	5.2.6-3	OAI Contact Aligner	1	U	M/I	Future	
(E)	5.2.6-4	Teaching Tencor p-10	1	U	M/I	Future	
(E)	5.2.6-5	Spinner (exhausted)	1	U	M/I	Future	
(E)	5.2.6-6	Bake Oven (exhausted)	1	U	M/I	Future	
(E)	5.2.6-7	Wet Bench (acid)	1	U	M/I	Future	
(E)	5.2.6-8	Wet Bench (solvent)	1	U	M/I	Future	
(E)	5.2.6-9	Exhausted Dry Bench	1	U	M/I	Future	
(N)	5.2.6-10	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.2.6-11	Cleanroom Chair or Stool	4	P	I	Furniture	
	5.3.1 (x)	**OMVPE (H2/H3 occupancy)**					
(N)	5.3.1-A	Safety Shower / Face Wash	1	P	I	USTAR	
(F)	5.3.1-1	New OMVPE 1	1	P		Future	
(E)	5.3.1-2	Gas Cabinet 2	2	U	M/I	Future	Pending = "Existing" (Donation)
(E)	5.3.1-3	OMVPE Reactor	1	U	M/I	Future	Complex Move
(F)	5.3.1-4	MBE	1	P		Future	
(E)	5.3.1-5	Microscope	1	U	M/I	Future	
(N)	5.3.1-6	Wet Bench	1	P	I	Future	EHS Upgrade
(F)	5.3.1-7	POU Arsenic Abatement	1	P		Future	
(N)	5.3.1-8	Tall Storage Cabinet	1	P	I	Furniture	
(F)	5.3.1-9	SS Cleanroom Work Bench	3	P		Furniture	
(N)	5.3.1-10	Chair or Stool	4	P	I	Furniture	
	5.3.2 (x)	**Industrial Partner Lab**					
(F)	5.3.2-1	acoustic tomography	1	P		Future	Fraunhofer
(F)	5.3.2-2	bond pull tester	1	P		Future	Fraunhofer
(F)	5.3.2-3	pick and place	1	P		Future	Fraunhofer
(F)	5.3.2-4	die attach	1	P		Future	Fraunhofer
(N)	5.3.2-5	Tall Storage Cabinet	1	P	I	Furniture	
(N)	5.3.2-6	SS Cleanroom Work Bench	2	P	I	Furniture	
(N)	5.3.2-7	Chair or Stool	4	P	I	Furniture	
	5.3.3 (x)	**CMP (includes smocking vestibule)**					
(N)	5.3.3-A	Safety Shower / Face Wash	1	P	I	USTAR	
(E)	5.3.3-1	Allied manual polisher	2	U	M/I	Future	Move MetE
(N)	5.3.3-2	Allied manual polisher	2	P	I	Future	Needed 2 more of these
(N)	5.3.3-3	Wafer CMP	1	P	I	Future	
(E)	5.3.3-4	Precision Allied Polisher	1	U	M/I	Future	
(N)	5.3.3-5	2X Low-Magnification Stereo Microscope	2	P	I	Future	
(N)	5.3.3-6	Hi-Resolution Compound Microscope	1	P	I	Future	
(E)	5.3.3-7	Staining and Potting (in new hood)	1	U	M/I	Future	
(N)	5.3.3-8	Flexus wafer bow measurement	1	P	I	Future	
(N)	5.3.3-9	Pre gown storage	1	P	I	Furniture	
(N)	5.3.3-10	Glove / goggle storage	1	P	I	Furniture	
(N)	5.3.3-11	Hood / Bootie Storage	1	P	I	Furniture	
(N)	5.3.3-12	Dirty Bin (gowns)	1	P	I	Furniture	
(N)	5.3.3-13	Bench	1	P	I	Furniture	
(E)	5.3.3-14	SS Cleanroom Work Bench	3	U	M/I	Furniture	
(N)	5.3.3-15	Tall Storage Cabinet	3	P	I	Furniture	
(N)	5.3.3-16	Chair or Stool	4	P	I	Furniture	
(N)	5.3.3-17	Trash Bin	1	P	I	Furniture	
	5.3.4 (x)	**Device Assembly / Laser Machining / Dicing**					
(N)	5.3.4-A	Epoxy Resin Counter w/ Cabinets Below	1	P	I	USTAR	
(N)	5.3.4-B	Upper Cabinets with Swinging Glass Doors	1	P	I	USTAR	
(N)	5.3.4-C	Epoxy Resin Sink w/ Drying Rack & Cabinet Below	1	P	I	USTAR	
(N)	5.3.4-D	Epoxy Resin Adjustable-Height Table w/ Cabinets Below	4	P	I	USTAR	
(N)	5.3.4-E	Overhead Service Carrier (Initially Power Only?)	1	P	I	USTAR	
(N)	5.3.4-F	Safety Shower / Face Wash	1	P	I	USTAR	
(E)	5.3.4-1	Laser Machining	2	U	M/I	Future	Upgrade
(E)	5.3.4-2	Wire Bonder (man)	1	U	M/I	Future	Existing/Planned? 2 of these?
(E)	5.3.4-3	Wire Bonder (KnS)	1	U	M/I	Future	Modify

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N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(E)	5.3.4-4	screen printer	1	U	M/I	Future	Pending = "Existing" (Donation)
(E)	5.3.4-5	Reliability Tester	1	U	M/I	Future	Upgrade
(E)	5.3.4-6	Dicing Saw (Disco)	1	U	M/I	Future	Upgrade
(N)	5.3.4-7	Dicing Saw	1	P	I	Future	
(F)	5.3.4-8	Wire EDM (hole popper)	1	P		Future	Fraunhofer
(N)	5.3.4-9	Wafer Handling / Vacuum Wands	3	P	I	Future	
(E)	5.3.4-10	Inspection Bench w/ Digital Imaging Microscope	1	U	M/I	Future	
(E)	5.3.4-11	TMV	1	U	M/I	Future	Complex Move
(E)	5.3.4-12	Nikon Comparator	1	U	M/I	Future	Improve
(N)	5.3.4-13	Ultrasonic Cleaner Main Unit- Nano Master . SWC 2000-S	1	P	I	Future	Includes 2 components below
(N)	5.3.4-14	Ultrasonic Cleaner RF Supply - Nano Master . SWC 2000-S	1	P	I	Future	
(N)	5.3.4-15	Ultrasonic Cleaner N2/IPA Box - Nano Master . SWC 2000-S	1	P	I	Future	
(F)	5.3.4-16	Double-Stacked Ovens . Blue M . STK-04	1	P		Future	
(F)	5.3.4-17	Plasma Cleaner . Anatech . SP100	1	P		Future	
(F)	5.3.4-18	Flip Chip Bonder . West Bond . 7476 30E	1	P		Future	
(N)	5.3.4-19	Hydraulic Press . Hoover? (TT)	1	P	I	Future	
(N)	5.3.4-20	Electroplating	1	P	I	Future	
(N)	5.3.4-21	Wet Bench Solvent	1	P	I	Future	
(N)	5.3.4-22	Laminar Flow Hood for Embossing & Lamination	1	P	I	Future	
(N)	5.3.4-23	SS Cleanroom Work Bench	4	P	I	Future	
(N)	5.3.4-24	Tall Flammable Storage Cabinet	1	P	I	Future	
(N)	5.3.4-25	Chair or Stool	7	P	I	Furniture	
	5.5.1 (1x)	**Clean Conference (10 people) (Cl 10K)**					
(N)	5.5.1-A	Flat Panel Presentation Display	1	P	I	USTAR	
(N)	5.5.1-1	SS Conference Table	1	P	I	Furniture	
(N)	5.5.1-2	Cleanroom Chair or Stool	10	P	I	Furniture	
	5.6.1 (x)	**Machine Shop / Vacuum Maintenace & Teaching***					
(N)	5.6.1-1	Shop Work Bench	4	P	I	Furniture	Assumed building-wide resource
(N)	5.6.1-2	Equipment Space	1	P	I		Assumed building-wide resource
(N)	5.6.1-3	Storage Racks for Raw Stock	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-4	Stick Welder w/ Plasma Cutter	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-5	Weld / Brazing Table on Wheels	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-6	Torch Set on Wheels	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-7	Parts Washer	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-8	Bead Blaster	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-9	Horizontal Band Saw on Wheels	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-10	Machine Tool Work Bench	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-11	Assembly Work Bench	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-12	Mille / Lathe	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-13	Band Saw	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-14	Drill Press	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-15	Grinder on Stand	1	P	I	Shared	Assumed building-wide resource
(N)	5.6.1-16	Job Box - Field Projects	1	P	I	Furniture	Assumed building-wide resource
(N)	5.6.1-17	Rolling Tool Box	1	P	I	Furniture	Assumed building-wide resource
(N)	5.6.1-18	Storage Cabinet	3	P	I	Furniture	Assumed building-wide resource
(N)	5.6.1-19	Cart - Field Projects and Delivery	1	P	I	Furniture	Assumed building-wide resource
(N)	5.6.1-20	Chair or Stool	4	P	I	Furniture	Assumed building-wide resource
	5.6.2 (1x)	**Control / ERT Room**					
(N)	5.6.2-A	Gas Detection	1	P	I	USTAR	
(N)	5.6.2-B	Desk	2	P	I	Furniture	
(N)	5.6.2-C	Chair or Stool	2	P	I	Furniture	
	5.6.3 (1x)	**Cleanroom Lockers / Shoe Clean**					
(N)	5.6.3-1	Half-Height Lockers	20	P	I	USTAR	
(N)	5.6.3-2	Cubbie Lockers	120	P	I	USTAR	12" x 12" x 12"
(N)	5.6.3-3	Shoe Cleaner	1	P	I	Future	
(N)	5.6.3-4	Bench	1	P	I	Furniture	
(N)	5.6.3-5	Trash Bin	1	P	I	Furniture	
	5.6.4 (1x)	**Cleanroom Maintenance (outside cleanroom portion)**					
(N)	5.6.4-A	Safety Shower / Face Wash	1	P	I	USTAR	

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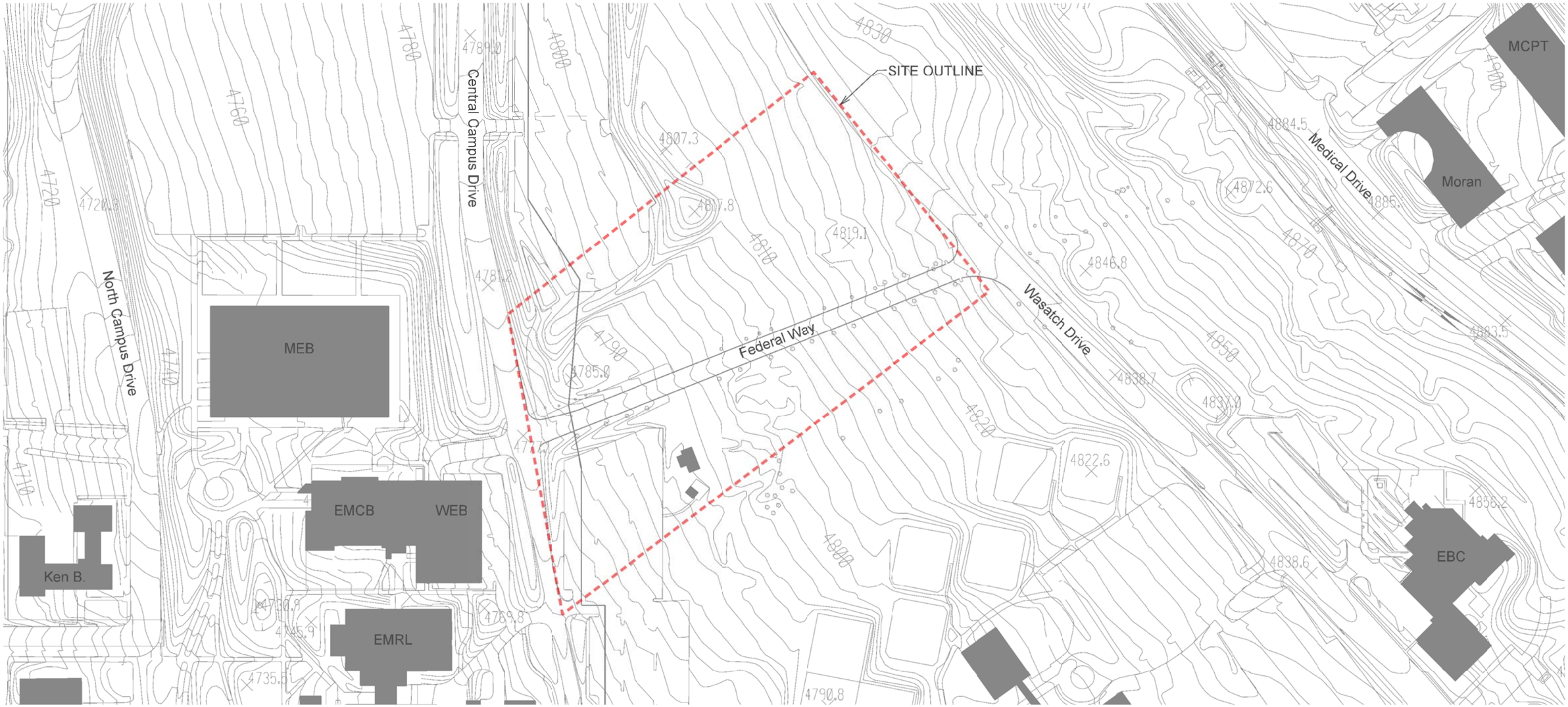
N/E/F	ID: MWZ	Description . Make . Model	Qty	Purchase Or Upgrade	Move and/or	Assignment:	Comments: uUtah Comments
(N)	5.6.4-1	Air Particle Counter	1	P	I	Future	
(N)	5.6.4-2	Leak Checker	1	P	I	Future	
(N)	5.6.4-3	Welding Table	1	P	I	Future	
(N)	5.6.4-4	TIG Welder	1	P	I	Future	
(N)	5.6.4-5	Orbital Welder on Cart	1	P	I	Future	Includes cost of Ar Cart below
(N)	5.6.4-6	Argon Cylinder Cart for Orbital Welder	1	P	I	Future	
(N)	5.6.4-7	Bake-Out Oven	1	P	I	Future	
(N)	5.6.4-8	Ultrasonic Cleaner	1	P	I	Future	
(N)	5.6.4-9	Clean Fittings / Supplies Cabinet	2	P	I	Furniture	
(N)	5.6.4-10	SS Cleanroom Work Bench	3	P	I	Furniture	
(N)	5.6.4-11	Tall Storage Cabinet	1	P	I	Furniture	
(N)	5.6.4-12	Rolling Tool Box	1	P	I	Furniture	For Clean Tools
(N)	5.6.4-13	Chair or Stool	2	P	I	Furniture	
	5.6.5 (1x)	**Hazardous Solid & Liquid Storage**					
(N)	5.6.5-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	5.6.5-B	Waste Transfer Station w/ 4" Snorkel Exhaust	1	P	I	USTAR	
(N)	5.6.5-1	Class 1A and 1C Solvent Storage Cabinet - 60 Gal	3	P	I	USTAR	
(N)	5.6.5-2	Class 1A and 1C Solvent Waste Cabinet - 60 Gal	1	P	I	USTAR	
(N)	5.6.5-3	Acid Storage Cabinet 45 Gal . LYON 5444N	4	P	I	USTAR	
(N)	5.6.5-4	Acid Waste Cabinet 45 Gal . LYON 5444N	1	P	I	USTAR	
(N)	5.6.5-5	Base Storage Cabinet 45 Gal . LYON 5444N	3	P	I	USTAR	
(N)	5.6.5-6	Base Waste Cabinet 45 Gal . LYON 5444N	1	P	I	USTAR	
(N)	5.6.5-7	Certified Flammable Storage Fridge/Freezer . F/S 13-986-106A	1	P	I	USTAR	
(N)	5.6.5-8	Chemical Log-In Personal Computer	1	P	I	USTAR	
(N)	5.6.5-9	Desk	1	P	I	Furniture	
(N)	5.6.5-10	Chair or Stool	2	P	I	Furniture	
(N)	5.6.5-11	Chemical Cart	2	P	I	Furniture	
	G.1.1 (1x)	**Gas Storage**					
(N)	G.1.1-1	H2 Generator	1	P	I	USTAR	
(N)	G.1.1-2	3-Bottle Gas Cabinet (2 Hazardous + 1 Purge)	2	P	I	USTAR	
(N)	G.1.1-3	3-Bottle Gas Cabinet (3 Spares or Empties)	3	P	I	USTAR	
(N)	G.1.1-4	2-Bottle Gas Cabinet (1 Hazardous + 1 Purge)	10	P	I	USTAR	
(N)	G.1.1-5	Inert Gas Cylinder Rack - Spares	4	P	I	USTAR	
(N)	G.1.1-6	Inert Gas Cylinder Rack - Empties	3	P	I	USTAR	
(N)	G.1.1-7	Cylinder Dolly	1	P	I	Furniture	
	G.1.2 (1x)	**Silane Bunker**					
(N)	G.1.2-1	Silane Pad/Bunker Equipment	1	P	I	USTAR	
		Global (Insert Copied Rows; Change Global Costs Here)					
(N)	0.00-A	Safety Shower / Face Wash	1	P	I	USTAR	
(N)	0.00-B	Chair or Stool	1	P	I	Furniture	
(N)	0.00-C	Cleanroom Chair or Stool	1	P	I	Furniture	
(N)	0.00-D	Trash Bin	1	P	I	Furniture	
(N)	0.00-E	Desk	1	P	I	Furniture	
(N)	0.00-F	Chemical Cart	1	P	I	Furniture	
(N)	0.00-G	Cylinder Dolly	1	P	I	Furniture	
(E)	0.00-H	SS Cleanroom Work Bench	1	U	M/I	Furniture	
(N)	0.00-I	Tall Storage Cabinet	1	P	I	Furniture	
(N)	0.00-J	Tall Flammable Storage Cabinet	1	P	I	Furniture	
(N)	0.00-K	Rolling Tool Box	1	P	I	Furniture	Assumed building-wide resource
(N)	0.00-L	Bench	1	P	I	Furniture	

6.8 SITE PLAN OPTION STUDIES

Please see the following Site Diagram Option Studies conducted to assist in site selection.



EXISTING SITE PLAN

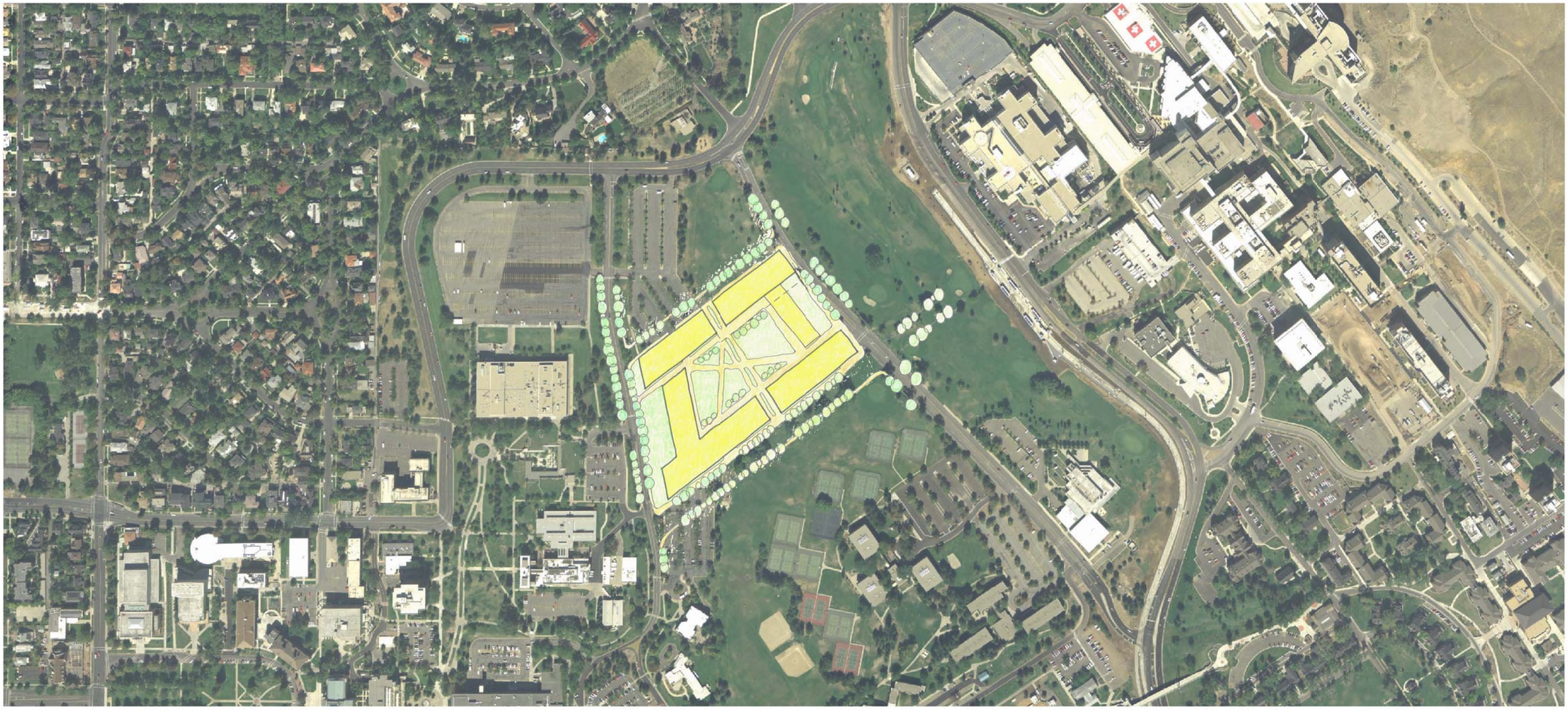
0 50' 100' 200' 400'

July 02, 2007

THE UNIVERSITY OF UTAH
NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL nexus

LORD · AECK · SARGENT
ARCHITECTURE



SCHEME 2 - VICINITY PLAN

0 100' 200' 400' 800'

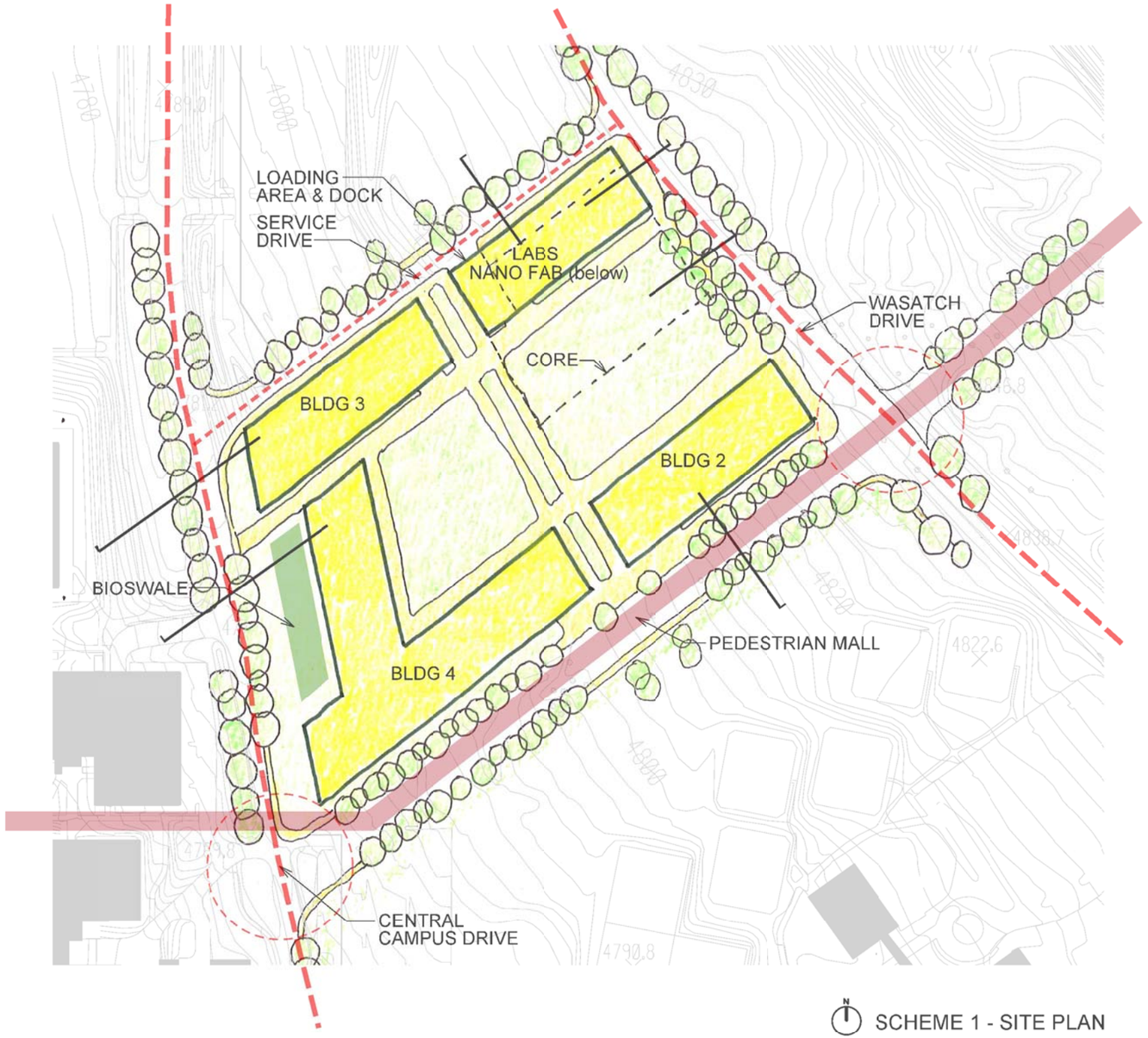
July 02, 2007

THE UNIVERSITY OF UTAH

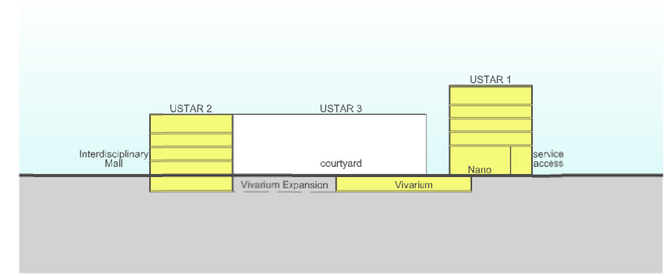
NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL nexus

LORD · AECK · SARGENT ARCHITECTURE



SCHEME 1 - SITE PLAN



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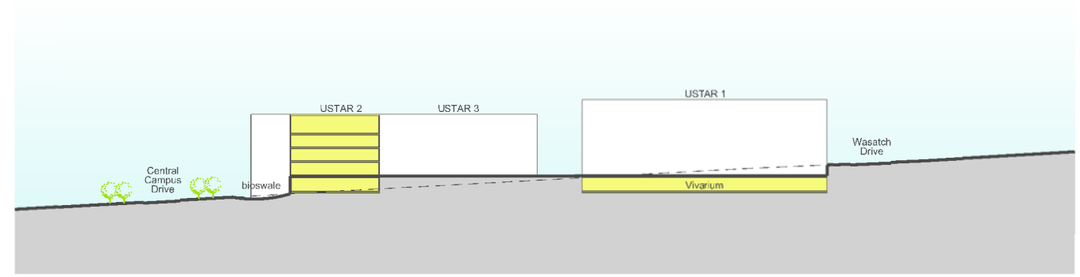

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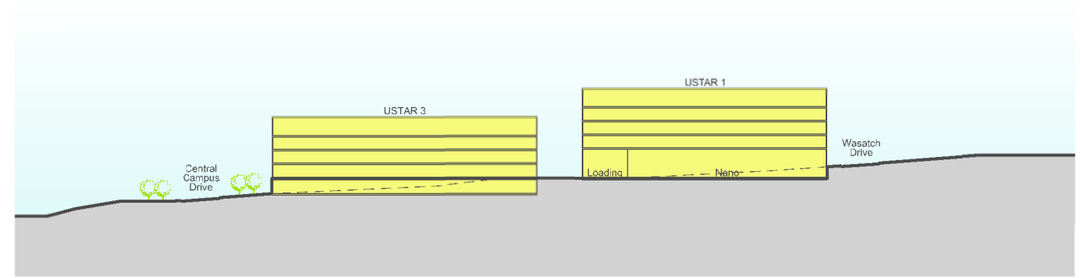
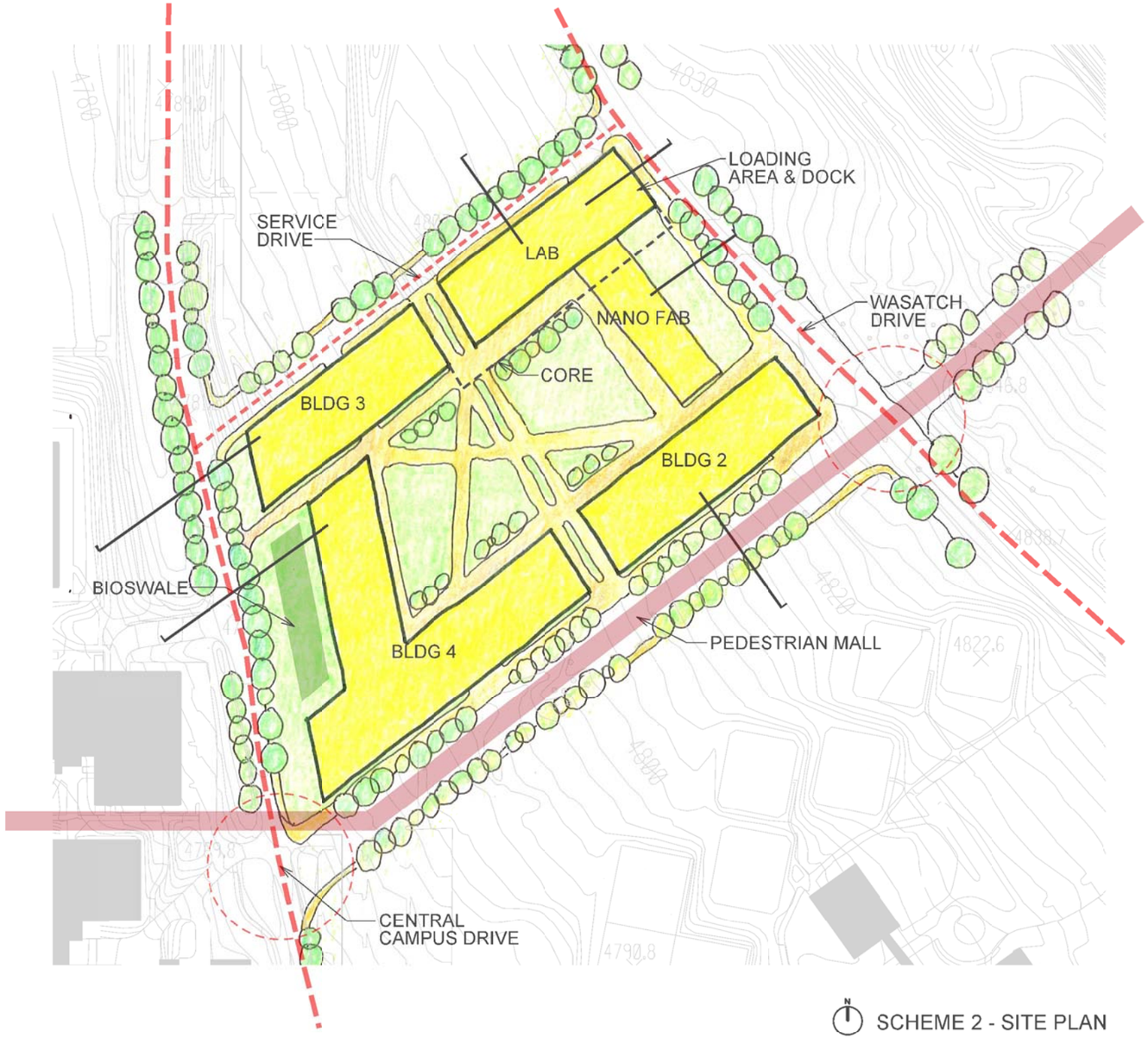


SECTION 1

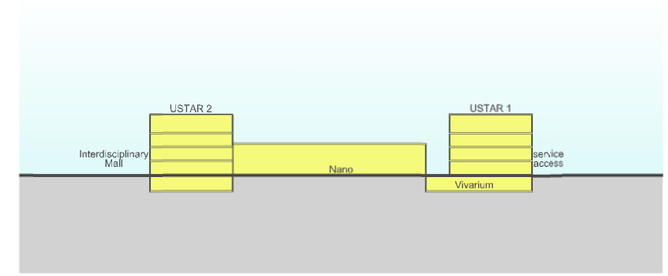
SCHEME 1 - SITE SECTIONS

0 50' 100' 200' 400'

July 02, 2007



SCHEME 2 - SITE PLAN



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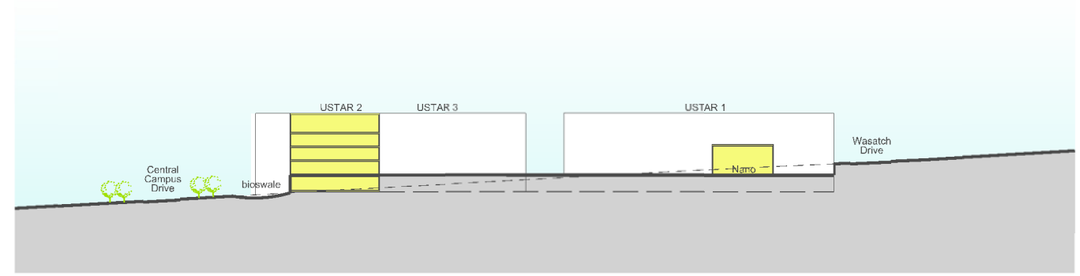

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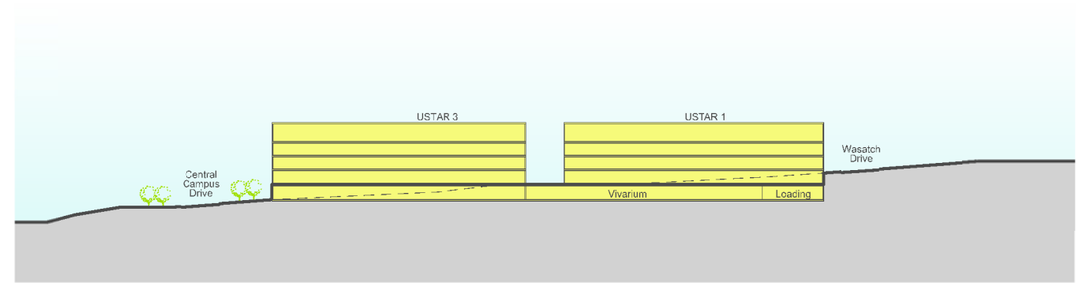


SECTION 1

SCHEME 2 - SITE SECTIONS

0 50' 100' 200' 400'

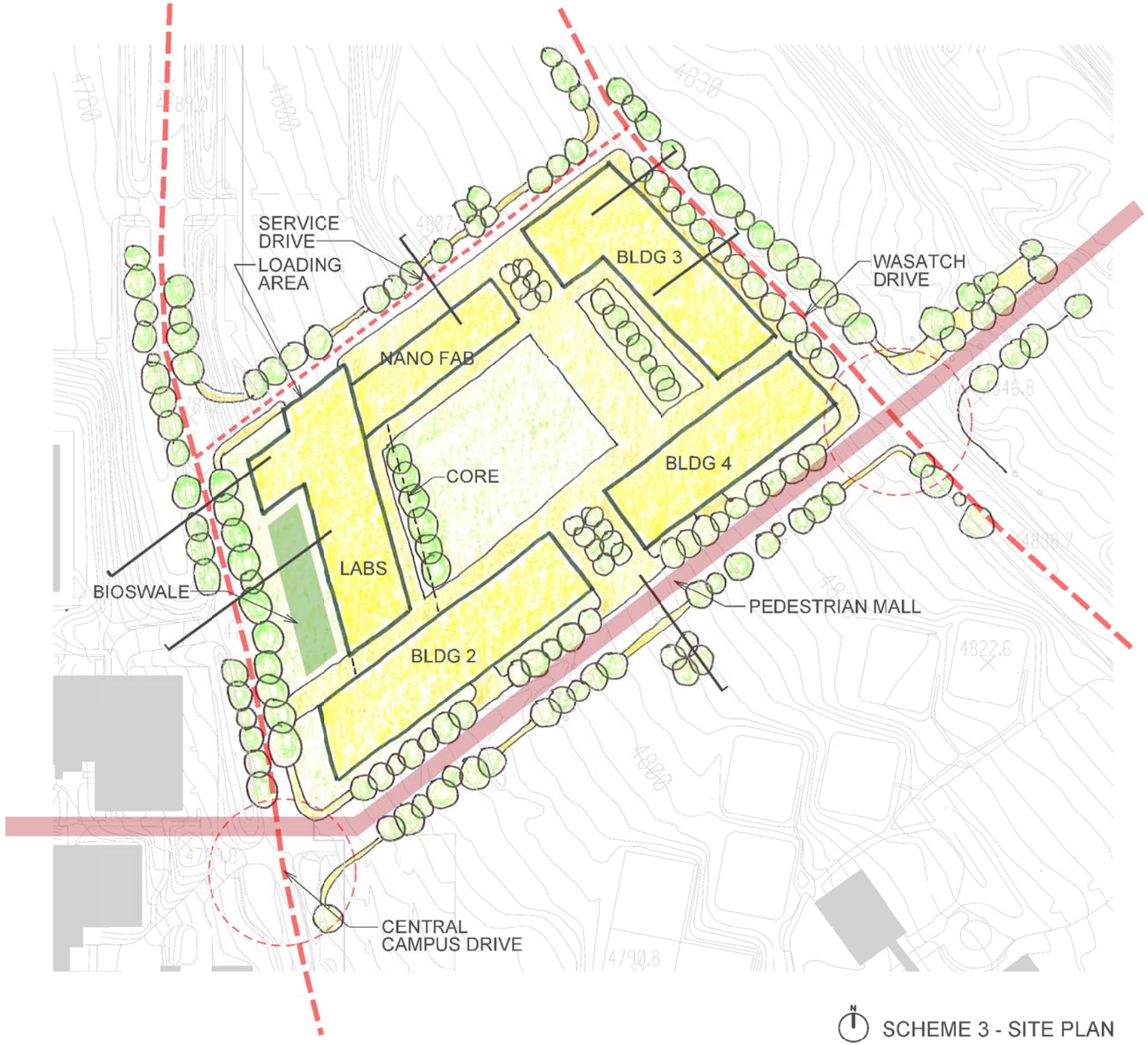
July 02, 2007

THE UNIVERSITY OF UTAH

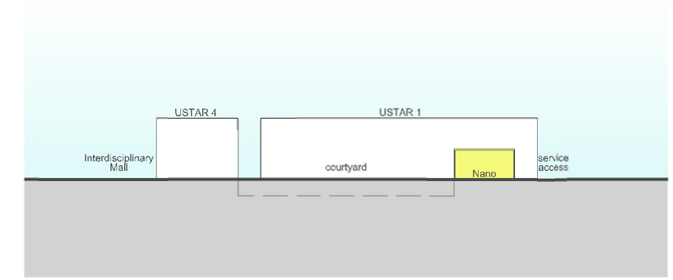
NEUROSCIENCE & BIOMEDICAL TECHNOLOGY RESEARCH BUILDING

ARCHITECTURAL NEXUS

LORD · AECK · SARGENT ARCHITECTURE



SCHEME 3 - SITE PLAN



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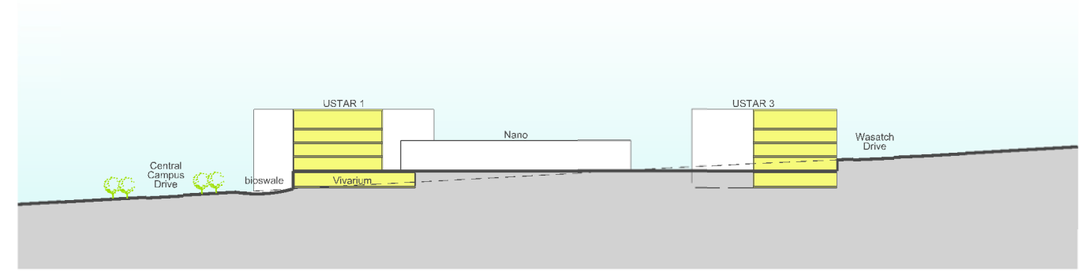

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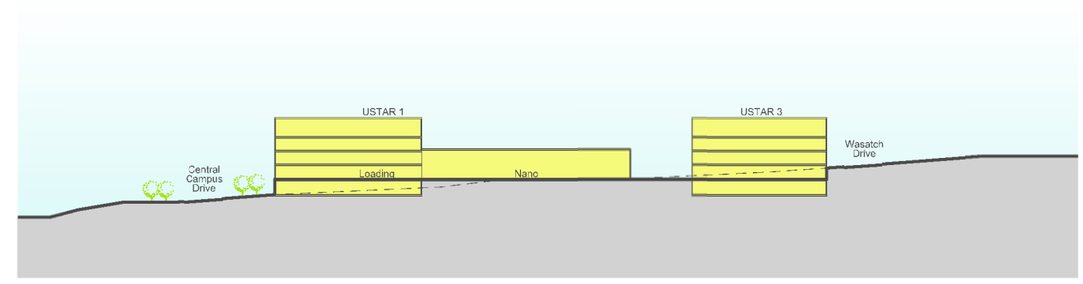
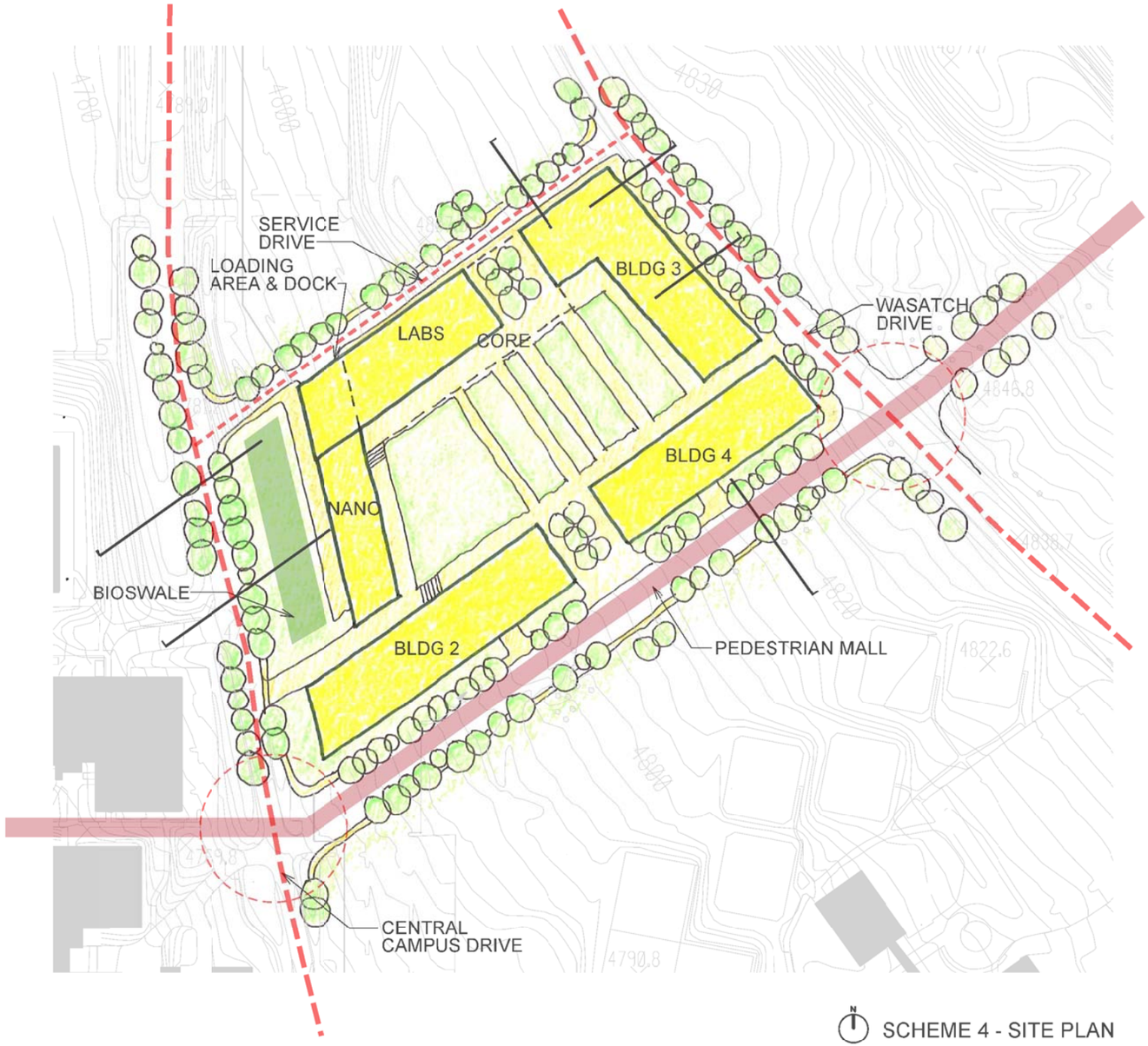


SECTION 1

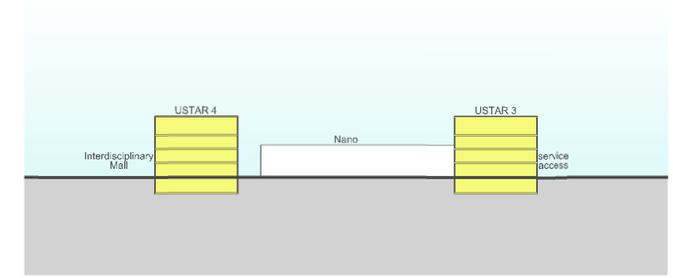
SCHEME 3 - SITE SECTIONS

0 50' 100' 200' 400'

July 02, 2007



SCHEME 4 - SITE PLAN



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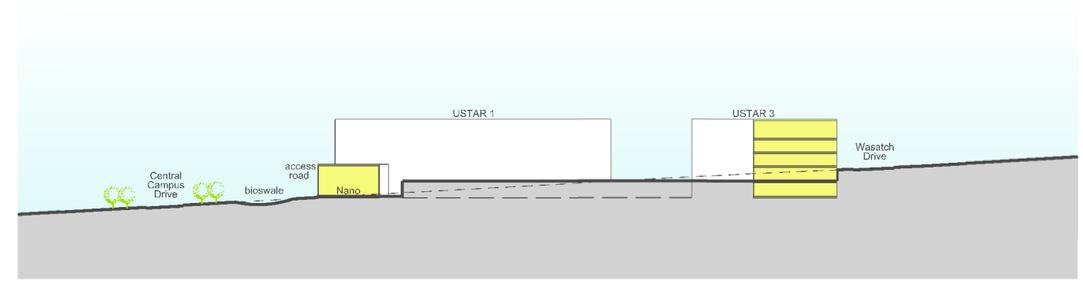

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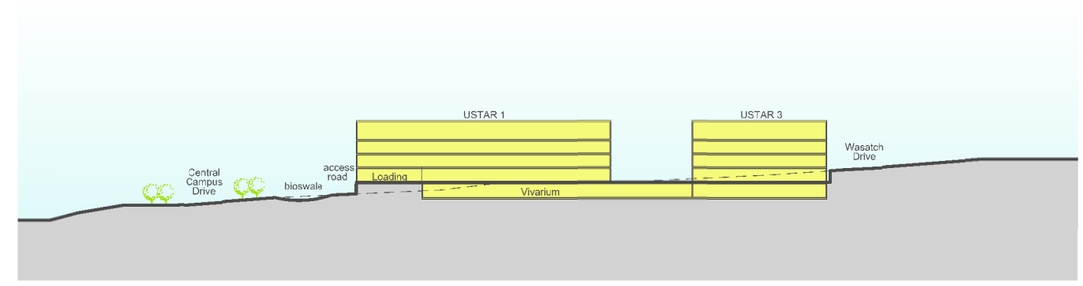
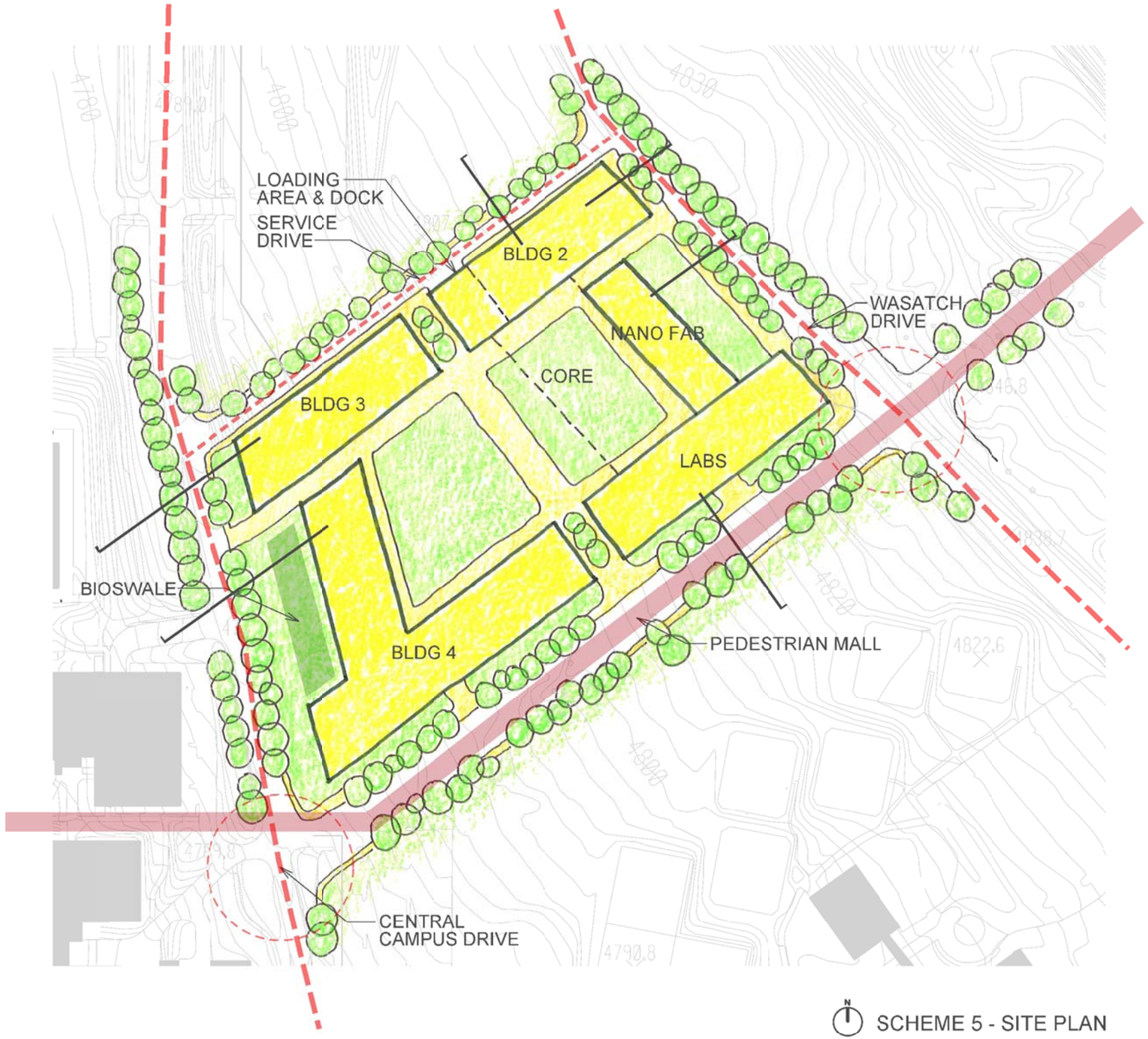


SECTION 1

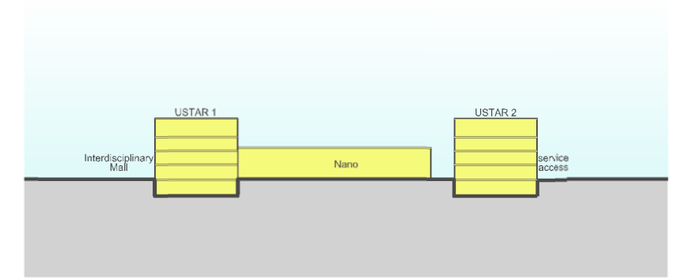
SCHEME 4 - SITE SECTIONS

0 50' 100' 200' 400'

July 02, 2007



SCHEME 5 - SITE PLAN



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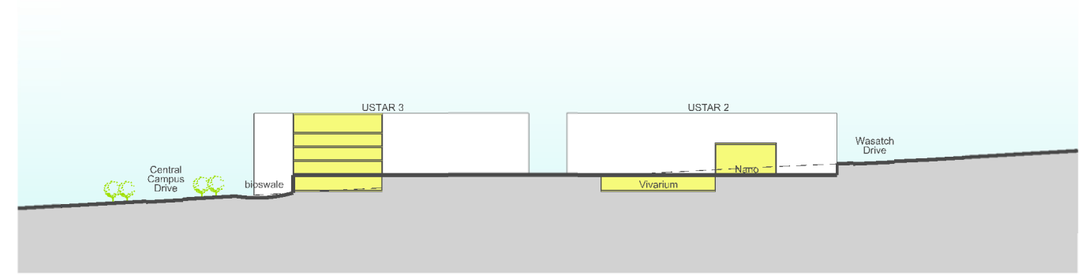

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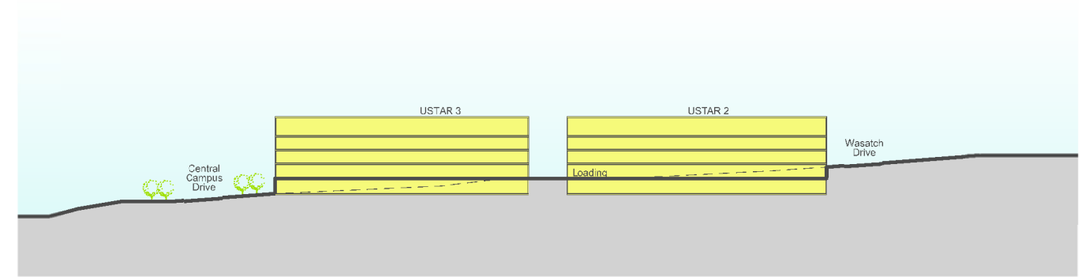


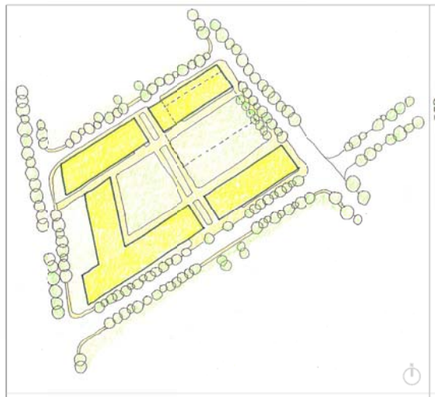
SECTION 1

SCHEME 5 - SITE SECTIONS

0 50' 100' 200' 400'

July 02, 2007

PROS AND CONS



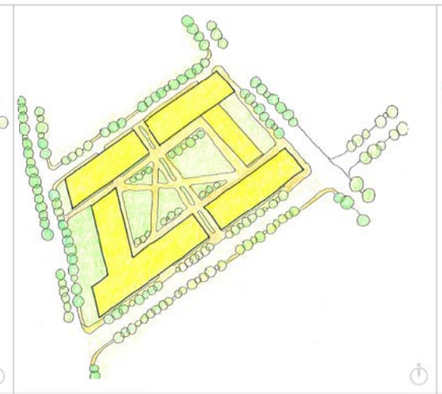
SCHEME 1

Pros

Easy service to Building 1
Good North/South exposures
Expandable design opportunities

Cons

Further from Academic Medical Center
Further from Pedestrian Path
Nano separated from Engineering



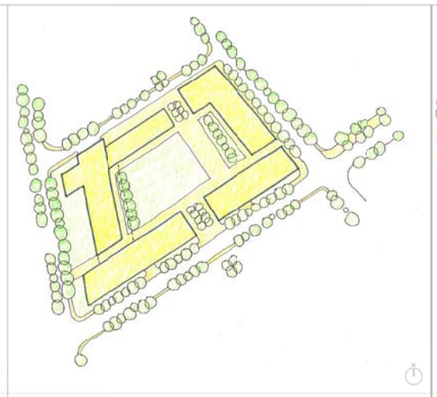
SCHEME 2

Pros

Separate Nano Suite
Concealed loading/service areas
Courtyard defined on all sides
Easy service to Building 1
Good North/South exposures
Expandable design opportunities

Cons

Larger footprint and more exterior skin
Further from Academic Medical Center
Further from Pedestrian Path
Nano separated from Engineering



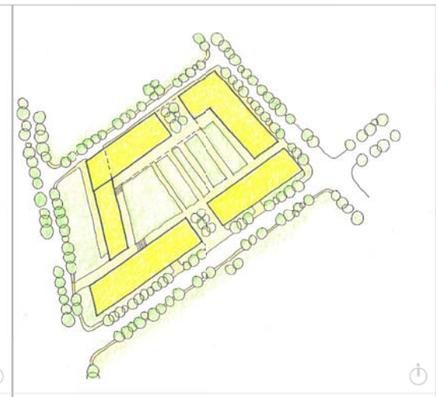
SCHEME 3

Pros

Easy service to Building 1
Expandable design opportunities
Separate Nano Suite

Cons

Poor east/west orientation
Larger footprint and more exterior skin
Further from Academic Medical Center
Further from Pedestrian Path
Nano separated from Engineering



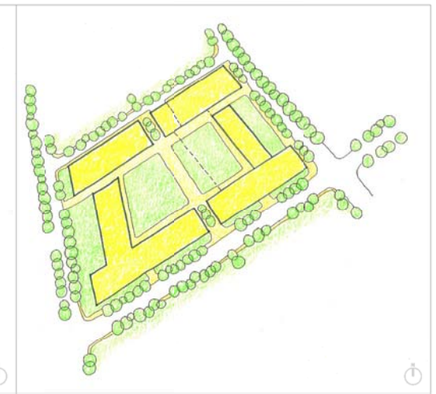
SCHEME 4

Pros

Good North/South exposures
Nano suite close to Engineering
Easy service to Building 1
Expandable design opportunities
Separate Nano Suite

Cons

Larger footprint and more exterior skin
Furthest from Academic Medical Center
Further from Pedestrian Path
Loading dock remote from other buildings



SCHEME 5

Pros

Good North/South exposures
Nano suite encloses the courtyard
Closest to Acedemic Medical Center
Closest to Pedestrian Path
Establishes a critical intersection

Cons

Nano suite further from Engineering
Service access separate from service drive

OPTIONS - EVALUATIONS

July 02, 2007