Capitol Square

Rehabilitation and Restoration

State of Wyoming A&I Construction Management

HDR in association with PDP Preservation Design Partnership, LLC and PLAN ARCHITECTS

State of Wyoming- Office of Construction Management

CHEYENNE, WYOMING

Capitol Square - Series 3 - Herschler

Schematic Design Narrative

Owner Review Set

VOLUME 1
Version 1.1

October 30, 2014

HDR Project No. 203619

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SECTION 1.1
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PART 1 - GENERAL

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END OF SECTION

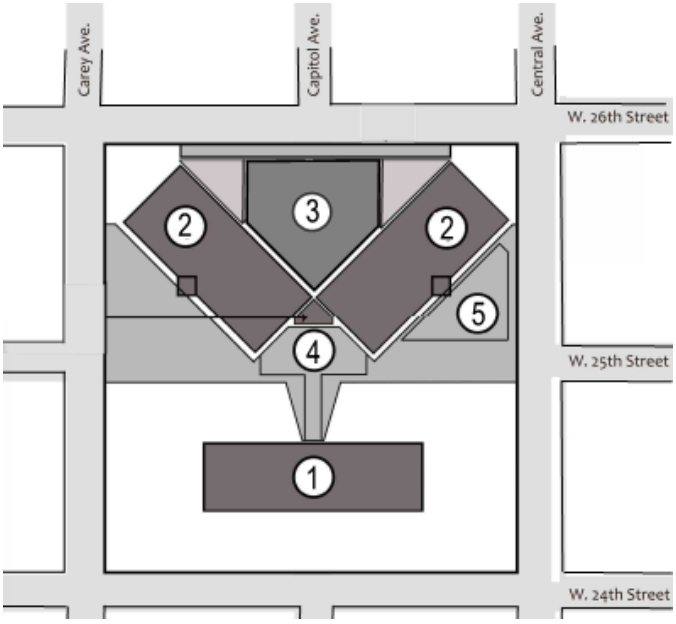
SECTION 1.2
EXECUTIVE SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Schematic Design Narrative is for the **Capitol Square - Series 3 - Herschler** project. This package includes work on the following elements: existing Herschler Building, an addition to the Herschler, a new North Drive access and loading dock, a new connecting link between the Herschler and the Capitol, and a new central plant.

1.2 DESCRIPTION



A. Historic Capitol Building [# 1]
   1. The Capitol project is included in Capitol Square - Series One. It is shown here for reference.

B. Herschler State Office Building [#2]
   1. The Herschler was constructed between 1981 and 1983. The Herschler contains 249,000 square feet of office space, housing several state agencies and meeting rooms that are used by the State of Wyoming. It also contains a 220 underground parking garage.
   2. The State has a need for additional office space for key state agencies. The current building floor plan is inefficient, and the building has a large atrium that could be infilled. The exterior has water infiltration issues that are identified in a August 20, 2014 report by Terracon titled Limited Scope Evaluation of Building Exterior- Final. The report identifies possible sources of water infiltration in the building.
   3. The scope of work for this project includes:
      a. Replace the building envelope, inclusive of exteriors walls, windows and roof.
      b. Renovate the building core to provide new restrooms, stairs and elevators.
      c. Infill the atrium to add additional usable square footage.

d. Construct a new central plant related electrical switchgear room on the first floor of the east wing. Remove part of the roof of the east wing to provide a well for central plant related Cooling towers, emergency generators and an air handler.

C. Herschler Office Building Addition and North Drive[#3]
1. The original design of the Herschler made provisions for an addition of a four story library.
2. The State has a need for office space for elected officials that who are being relocated from the Capitol due to the renovation.
3. The existing west drive and loading dock are being removed and need to be relocated. Exiting from the parking garage needs to be relocated.
4. The scope of work for the addition includes:
   a. Construction of an 84,000 square foot, four story addition of Class A office space.
      1) The first floor will house a large conference center, the upper floors will contain offices and open work areas. This work will be included in a future Tenant Improvement package.
   b. Construction of a North Drive and Loading dock. This will require extensive modifications to 26th Street including utility relocations. The new drive will provide secure access by delivery vehicles.

D. Below Grade Connector [#4]
1. A below grade Connector provides a pedestrian connection between the Capitol and the Herschler, and provides meeting rooms. The existing infrastructure is over 30 years old and has significant water infiltration issues. There is an existing loading dock that creates a security concern due to its proximity to the Capitol.
2. The scope of work for the connector includes:
   a. Demolition of the existing connector, loading dock and west drive.
   b. Replacement of the existing Connector with a larger footprint. The larger footprint will contain a grand corridor between the Capitol and the Herschler, conference rooms, a catering kitchen, and storage space.

E. Central Utility Plant (CUP) [#5]
1. The existing CUP is poorly located, has water infiltration issues, contains equipment that is past its useful life, and is undersized to handle the additional square footage in the Herschler. The cooling tower condensate plume obstructs the view of the Capitol and contributes to icy sidewalks in the winter.
2. The scope of work for the central plant includes:
   a. A below grade room for boilers and chillers.
   b. Connections to new shafts in the Herschler to the new electrical switchgear room and cooling towers and emergenc generators on the roof of the Herschler.
   c. New tunnels to deliver chilled water supply and returns, domestic water, fire sprinkler water and condensate returns, and electrical conduits.

SECTION 1.3
SPACE PROGRAM COMPARISON

PART 1 -

1.1 SUMMARY TABLE

Location	Existing		Level I/II proposed		Schematic Design	
	Net Assignable s.f.	Gross s.f	Net Assignable s.f.	Gross s.f	Net Assignable s.f.	Gross s.f
Herschler Bsmt	10,393	146,995	12,646	171,480	838	102,856
Herschler First	42,941	63,914	59,867	81,474	59,158	85,592
Herschler Second	44,111	63,079	55,243	73,383	66,080	85,592
Herschler Third	43,263	62,156	61,615	78,260	66,088	85,592
Herschler Fourth	42,932	60,743	58,704	74,767	58,596	85,592
Subtotal	**183,640**	**396,887**	**248,075**	**479,365**	**250,760**	**445,224**
CUP					0	15,919
Connector					18,405	46,527
Total					**269,165**	**507,670**

SECTION 2.1
CIVIL DESIGN & UTILITIES

PART 1 - GENERAL

1.1 APPLICABLE JURISDICTIONS, CODES, AND STANDARDS

A. Local Jurisdictions:
1. Carey Avenue Right-of-Way (City of Cheyenne)
   a. Design Standards
      1) 2014 City of Cheyenne Construction Specifications and Standard Details
      2) Review and approval of construction documents for right-of-way improvements
2. 26th Street (City of Cheyenne – (see item 'a' above for design codes)
3. Central Avenue (Wyoming Department of Transportation (WyDOT)
   a. Design Standards
      1) 2010 Edition Standard Specifications for Road and Bridge Construction
      2) WyDOT Standard Details (as currently amended)
      3) Review and approval of plans and alterations through license applications through WyDOT District 1 office (Laramie, WY).

B. Other Applicable Codes:
1. Fire Access, Fire Flow, Fire Hydrant Spacing
   a. Current Edition International Fire Code

2. Potable Water and Sanitary Sewer
   a. Water Quality Rules and Regulations – Wyoming Department of Environmental Quality (WyDEQ)
      1) Chapter 11 Design and Construction Standards for Sewage Systems
      2) Chapter 12 Design and Construction Standards Public Water Supply
      3) Rules and Regulations for Establishing Policies & Design Criteria by the Cheyenne Board of Public Utilities (BOPU) (as currently amended)
   b. Current Edition of the International Plumbing Code
   c. Review and approvals required through BOPU and WyDEQ prior to construction

1.2 SITE SPECIFIC PROJECT INFORMATION

A. Site Assessment Reports
1. Topography, Utilities, and Boundary
   a. Site topographic and boundary survey by BenchMark Engineers, PC and Steil Surveying Services, LLC.

2. Soils
   a. Geotechnical Engineering Report, Capitol and Herschler Buildings Improvements, Cheyenne, WY dated August 22, 2014 by Terracon (included in Appendix).

B. Site Drainage

1. Drainage
   a. The project is not located in an official FEMA Special Flood Hazard Area but is in an area with known flooding issues. Existing storm sewers are known to surcharge during moderate to large storm events. Ponded stormwater is a frequent observation at the intersection of Capitol Avenue and 26th Street. A site specific flood hazard assessment has been prepared by BenchMark Engineers, PC to assist with the design on this project.

C. Traffic:
1. A Traffic Study was completed by HDR in October of 2014 to provide recommendations for this project. This report is included in the appendix.

D. Fire Department Access, Fire Hydrant Spacing, & Fire Flow Rates:
1. Current edition International Fire Code

1.3 DESIGN CONCEPT SUMMARY

A. Herschler Existing
1. Civil aspects include demolition of existing surfacing in conflict with new work and reconnection of utilities displaced by the Herschler Addition.

B. Herschler Addition
1. Civil aspects include demolition of all existing surfacing (i.e. sidewalks, driveways, landscaping, etc.) in conflict with the new addition and on the north side of the building up to the street right of way of 26th Street.

2. New civil work will include new sidewalk connections to the existing and new building pedestrian access points.

3. Utility reconnections required for the following displaced services:
   a. Sanitary sewer service line in eastern portion of building to 26th Street
   b. Storm sewer roof drain connections

C. Connector
1. Civil aspects includes demolition of existing surfacing in conflict with new work. The east underground parking entry shall be demolished are re-graded to reflect new access entries to the underground parking areas.
2. A new fire sprinkler line connection to an existing 6-inch water main in Carey Avenue

D. Central Plant
1. Civil aspects include extension of a new fire sprinkler lines, a domestic water service line, a new gas service, and new electrical services. New gas and electrical services are provided by Cheyenne Light Fuel and Power (CLF&P) to the building meters and transformers.

E. Central Avenue Right-of-Way
1. Civil aspects include a new auxiliary drive lane on the west side of Central Avenue to facilitate entry to a reconstructed access to the underground parking at 25th Street. The auxiliary lane will include an elevated median island with an exit lane at 25th Street.
2. The new auxiliary lane will require relocation of existing street lights and traffic signal posts at the NW quadrant of the intersection.
3. New utility connections are required for the following:
   a. New fire sprinkler line connection to an existing 12-inch water main
   b. New domestic water service line connection to an existing 12-inch main in Central Avenue.
   c. New gas service (provided by Cheyenne Light Fuel and Power (CLF&P) from existing gas mains in Central Avenue

F. North Drive and 26th Street Right-of-Way
1. Civil aspects include a full reconstruction of the existing roadway between Carey Avenue and Central Avenue. The street reconstruction will include the following:
   a. A 22' wide (minimum) two-way (no parking) street section on the north side of the existing 80' right-of-way.

b. A new concrete service drive ramp to the existing below grade parking level elevation. This service drive will enter on Carey Avenue and exit at Central Avenue. The concrete service drive ramp will have retaining wall sides and be elevated as much as possible to reduce the potential for street flooding to flow down the ramp section. A floodwall system is recommended at the access drive ramp high point to reduce the flooding potential for the underground facilities. The recommended design storm is the 0.2% annual chance event (500-Year). The proposed floodwall is a Floodbreak™ passive-automatic flood panel system activated only by floodwater flow over the system.
c. Two ADA accessible parking spaces are proposed on the north side of 26th Street to replace one existing ADA parking space currently utilized by a residential property on this street.
d. It is proposed to expand an existing park island at the intersection of Randall Avenue and 26th Street to mitigate potential traffic issues at this intersection.
e. Parking is proposed to be removed with new directional curb radii added on the east side of Central Avenue at 26th Street. This facilitates the lane changes made west of Central Avenue.
f. New utility relocations will be required for the following:
   1) An existing 12-inch water line with two new fire hydrants will be required for this reconstruction. The proposed design removes an existing 4-inch water main and replaces with the new 12-inch main. This will require replacement of existing water services lines to the property line.
   2) The proposed access drive construction will undercut existing sanitary sewer and storm mains. It is proposed to replace the sanitary sewer system with a new 8-inch PVC main which will be extended to connect to a relocated service line from the Herschler building. Camera inspection of the existing sanitary sewer main in 26th Street found the clay line was in very poor condition and partially blocked by tree roots. Existing service lines will be reconnected with the replacement sewer line.
   3) The proposed design includes a replacement storm sewer with a 42-inch main line from Carey Avenue and a 36-inch storm sewer extension to Central Avenue. A large capacity storm sewer inlet is proposed at the intersection of Capitol Avenue and 26th Street. The new storm sewer system is to be connected by a future City of Cheyenne storm sewer improvement project currently known as the 26th Street Interceptor Project. This city project would be an extension from a higher capacity storm sewer currently stubbed out near the intersection of 23rd Street and Snyder Avenue. Once connected, this storm sewer network will significantly reduce the flooding potential of the Capitol Square complex. The tentative schedule for the 26th Street interceptor is an RFP for design services in late fall 2014 with the possibility of construction in late 2015 depending on finalization of all the required funding.
   4) An existing gas main will be displaced (under the ownership of Cheyenne Light Fuel and Power (CLF&P)). The proposed project will require a replacement gas main from Carey Avenue to Central Avenue and replacement service feeds to residences on the north side of 26th Street. The project will be required to pay for the relocation.

G. Carey Avenue Right-of-way
1. Civil aspects include a new drop off lane with curb and gutter replacement from approximately the south connection with Randall Avenue north to 25th Street.
2. New utility connections are required for the following:
   a. A new fire sprinkler line connection to an existing 6-inch water main
   b. A new domestic water service line connection to an existing 6-inch water main
   c. A potential replacement sanitary sewer service from the NW corner of the Capitol Building to a main in Carey Avenue. The existing service line has been reported to have plugging issues and is recommended to be replaced with a modern PVC service line.

H. Grading - General

1. In general, site grading will not significantly alter the capitol complex with the exception of the 26th Street access ramp to the lower level of the existing parking garage. The drop in elevation will require the ramp to have pedestrian barriers constructed around the perimeter. Minor regarding of the existing underground parking access at 25th Street and Central Avenue will be required to meet the new VIP access door location.

SECTION 2.2
LANDSCAPE ARCHITECTURE

PART 1-INTRODUCTION

The Capitol Square site renovation will support the work going on in both the Capitol and Herschler buildings. Overarching design principles that have been established are:

- Allow for the historic landscape
- Pedestrian spine
- Maintain trees where possible
- Maintain focus on the Capitol
- Create some breathing space
- Reflect the Connector

These principles have helped to guide the refinement of designs as they have moved from simple programming and conceptual development through to Schematic Design. Each area of the site is designed to relate to the context, historical uses or reflect new additions to the landscape of the Square. To help break down the components of the Square design and provide the information succinctly, the site has been categorized into the following geographic areas:

- North Drive Cap (area directly north of the Herschler addition to 26th Street over the ramp)
- North Herschler Area (area from the east and west Herschler doors north to 26th Street)
- Connector (area directly over the below-grade Connector)
- West Plaza (area at the terminus of 25th Street on the west side of the site)

PART 2- NORTH DRIVE CAP

2.1 INTRODUCTION

The North Drive Cap is located just north of the Herschler addition and is a part of the overall ramping, parking and servicing plan for the Capitol Square. The ramp caused inherent challenges with pedestrian movements and the cap allowed those to be resolved in a way that is stylish, functional and provides a focal point for visitors traveling on Capitol Avenue.

2.2 DESIGN INTENT

A. The North Drive Cap will provide a pedestrian connection between the new Herschler addition, the sidewalk and 26th Street as well as an entry area for pedestrians coming from the north.

B. The landscape and hardscape on the cap will be placed on top of a membrane structure protecting the servicing area underneath.

C. Stairs will take pedestrians from the finished walking surface on top of the cap down to 26th Street

D. The south ramp wall will be solid up to grade and then will transition to a railing so that the sidewalk does not feel as closed in as it might if a wall was in place.

E. The north ramp wall will be solid up to grade but continue to 42” above grade to provide fall zone protection.

2.3 MATERIALS

A. Planters will be precast concrete, acid-etch finish 12" wide with 2' exposed above finished paving.

B. Paving will be precast concrete paving materials over pedestals. Final size of pavers to be determined. Standard thickness is 2".

C. Turf and landscape areas will include +/- 2' of Intensive green roof growing media.

D. Landscape material will be a blend of shrubs and perennials as well as mulch.

E. Stone veneer, matching the Herschler addition façade, will be used on the north, west and east faces of the walls. See architectural narrative for specific façade materials.

F. Bronze medallions of the State seal will be located on the veneer wall at the terminus of the Capitol Avenue crosswalks

G. Engraved text will be utilized on the stone veneer on the stair wall facing north

H. The railing on the south ramp wall may be material reused from the existing ramps in the center of the site as those are removed. If those railings are not reusable, the railing will be a metal picket system with semi-custom elements. See architectural narrative for wall finishes below grade on the ramp side.

I. The street side of the wall on the north ramp wall will have a concrete form liner finish.

J. Handrails and fall protection guardrail on the stairs down to street level will be decorative metal.

PART 3- NORTH HERSCHLER AREA

3.1 INTRODUCTION

This portion of the Square is primarily used as a pedestrian connection between the 26th and Carey/Central intersections. Simple walkways and consistent landscape plantings characterize the area and reinforce the importance of the Connector portion of the site. The north doors of the building are not intended to be public doors and the design reflects the lesser importance by not creating large gathering areas or unique elements that might otherwise attract the attention of passers-by. This area also includes the east and west entry areas of the Herschler. Seating and the opportunity for monumentation are the primary focus of these small spaces.

3.2 DESIGN INTENT

A. Walkways from the Herschler building addition on the north side will provide access between the exit/staff doors and the 26th Street sidewalk that runs the length of the North Drive ramp. A small seating area directly outside of the doors will provide a place of respite for breaks.

B. Landscape will be used to provide a visual separation between the public sidewalk and these small courtyard spaces as well as buffer between the sidewalk and the North Drive ramp walls.

C. The public sidewalk will run from the Carey/26th intersection east to the Central/26th Street intersection to provide connections to the corners.

D. The intersections at Carey and Central will have a generous amount of paving to accommodate larger groups congregating at the entrances. The perimeter curbing that stretches north from the Capitol will continue around the building to provide a stable edge for the pedestal pavers.

E. The entries into Herschler to the east and west will have a concrete seating area outside as well as a planned location for a monument.

F. The walkway leading from the monument to the feature stair on the south facades are for egress only, connecting the exit door of the building to the perimeter sidewalks.

3.3 MATERIALS

A. Walkways that are over structure will be a pedestal paver system with 2" precast concrete pavers.

B. Walkways outside of the structure will be poured-in-place concrete.

C. Seating areas outside of the staff exits to the north, east and west will include benches and a trash receptacle.

D. Perimeter curbing is precast curbing with an acid-etch finish.

E. Landscape materials will consist of sod, shrubs and perennials as well as mulch.

F. The area directly around the monuments will be a specialty paving, most likely concrete with unique scoring and sandblasting to differentiate it from the standard concrete walk areas.

G. Egress walkways will be poured-in-place concrete on aggregate when not over structure.

PART 4- CONNECTOR

4.1 INTRODUCTION

The Connector is the heart of the Square and provides the primary circulation path for all patrons entering both the Capitol and Herschler along a main east/west walkway between the buildings and a north/south walkway to each building. Situated above the underground Connector space, this portion of the Square reflects the changes required because of the Connector ceiling heights while still being respectful of the historic simplicity of the Square design. This area also reinforces many of the principles and seeks to recognize the importance of the Capitol while providing consistent, yet unique, improvements north of the main east/west walkway.

4.2 DESIGN INTENT

A. Be the singular access route into the center of the Square and the singular connection between the Capitol north entrance and main south Herschler building entrance.

B. Accommodate the grade changes that will occur because of the underground Connector with terracing walls that allow for daily use.

C. Focus users on the Capitol building by strengthening the east/west walk with seatwalls that direct views towards the Capitol

D. Strengthen the connection of the skylight structures and the site.

E. Provide ample, but not too much, space directly outside of the Herschler building entrance for small group gathering and a modest amount of integrated seating.

4.3 MATERIALS

A. Seatwalls along the east/west and north/south walks will be precast concrete, acid-wash finish. The east/west seatwall will be 2' wide with a cross section that uses the top of wall as a seat and also includes a short back. A light strip is integrated into the nosing of the wall. Walls that run north/south do not have the back.

B. Terrace walls will be poured-in-place concrete with a precast cap to match the other precast on site. If possible, these caps should be precast reused from the existing site.

C. The low curb around the skylight will be poured-in-place concrete or precast depending on structural support.

D. Soil will be Lite-Top or equal when over structure, amended topsoil when not over structure. Average depth is 18" over the underground Connector, 2' over the Central Utility Plant, 12" from the east/west walk south to the Capitol.

E. Landscape materials will include turf, shrubs, groundcovers and perennials.

F. Along the façade of the Herschler, metal edging will be used between the landscape beds and turf until the landscape is located behind the egress walk from the feature stairs.

G. Trees located on structure will include dead-men anchors to hold them in place during periods of high wind. Amount of material to be determined during Design Development.

PART 5- WEST PLAZA

5.1 INTRODUCTION

The West Plaza will serve as a staging area for groups, the terminus of 25th Street from the west, an informal space for small groups and an interpretive space. It is designed to continue the historic connection of 25th Street through the site while satisfying the other needs of this location.

5.2 DESIGN INTENT

A. Provide interpretive elements that are integrated into the design but allow for the intended staging for groups.

B. Provide seating and places of respite for staff and visitors.

C. Utilize the plaza's prominent location on the site to provide a location for a monument (relocated or new) that will provide a node and destination at the end of West 25th Street.

D. Provide access to the Terrace walls.

E. Continue the interpretation of the 25th Street parkway and right-of-way geometry through the west portion of the site.

5.3 MATERIALS

A. Seatwalls will be acid-wash precast concrete or reuse existing precast where possible. Some will have aesthetic lighting underneath.

B. Interpretive ground plane elements will be carved, etched and cut granite with custom graphics as well as metal banding where appropriate

C. Paving materials will be precast concrete unit pavers on a concrete underlayment.

D. Benches will be a standard site furnishing.

E. Seatwall parallel to Carey Avenue will be a semi-custom wood and metal furnishing.

F. Curbing will be acid-wash precast, height to be dictated by final Capitol perimeter curbing cross section.

G. Landscape material will consist of trees, shrubs, perennials and groundcovers.

H. Soil will be amended topsoil, depth noted on the landscape plans.

I. Monument base to be designed upon selection of a monument to relocate or design of new monument is created.

SECTION 2.3

CODES, LIFE SAFETY, FIRE PROTECTION SYSTEM

PART 1 - GENERAL

A. This information has been placed on the drawings.

SECTION 2.4
STRUCTURAL DESIGN

PART 1 - GENERAL

1.1 INTRODUCTION

A. The Herschler Building Renovation and Addition project involves a new four story steel frame addition adjacent to the existing 1980s steel framing Herschler building and above an existing garage space, selective structural modifications to the existing Herschler building including the addition of a North Drive access to the existing garage, the addition of a below grade Central Utility Plant (CUP) to the southeast of the existing Herschler Building, and a one story Connector structure below grade between the Herschler and Capitol building. The West access drive to the garage will be closed as part of this project. The purpose of the addition and renovation is to provide additional office space for the State of Wyoming as well as to accommodate new mechanical systems for the Capitol.

PART 2 -

PART 3 -

3.8 SUMMARY

A. BASIS OF DESIGN
   1. CODES
      a. International Building Code, 2012 Edition
      b. International Existing Building Code, 2012 Edition
      c. City of Cheyenne Building Safety Department Plan Review Document

   2. CODE PRESCRIBED STANDARDS
      a. ASCE 7-10, Minimum Design Loads for Buildings and other Structures
      b. AISC 360-10, AISC Steel Construction Manual, LRFD
      c. ACI 318-11, Building Code and Commentary for Concrete Design

   3. PERTINENT DOCUMENTS
      a. HDR Design Documents
         1) CUP/CON Drawings dated October 23, 2014
         2) Herschler Addition Drawings dated October 23, 2014
      b. Existing Building Drawings
         1) State Office Building North Architectural Drawings by Kemper & Pappas P.C., 1980
         2) State Office Building North Structural Drawings, 1980
      c. Historic photography
      d. Geotechnical Engineering Report - Capitol and Herschler Buildings Improvements Cheyenne, Wyoming by Terracon dated August 22, 2014
      e. Wyoming State Capitol Complex, Herschler Feasibility Study dated November 18, 2013 by Robert Silman Associates
      f. Wyoming State Capitol Level 1 Reconnaissance/Level II Feasibility Study dated February 24, 2014

B. DESIGN CRITERIA
   1. OCCUPANCY CATEGORY II
   2. FIRE RATING FOR NEW CONSTRUCTION
      a. Concrete slab on metal deck (2 Hour Rating)
         1) 3¼" Light Weight Concrete on 2" Composite Metal Deck
         2) 4½" Normal Weight concrete on 3" Composite Metal Deck

b. Steel beams (spray fireproofing)
c. Precast panels
d. Columns
   1) Concrete
   2) Steel: spray fireproofing or rated encasement required

3. GEOTECHNICAL CONDITIONS
   a. GEOTECHNICAL INVESTIGATION
      1) A preliminary geotechnical investigation was done by Terracon and a report dated August 22, 2014 was provided to the design team. The report discusses recommendations pertaining to the foundations of each building. Underpinning of existing foundation and dewatering are important items also discussed in the report. Below are preliminary values that will be used for the structural foundation design.
   b. RECOMMENDED FOUNDATION SYSTEM
      1) CUP: Mat Foundation
      2) Connector and Herschler:
   c. NET BEARING CAPACITIES
      1) CUP: 6500 psf
      2) Connector: 2500 psf
      3) Herschler North Drive: 4500 psf
   d. PREDICTED FOUNDATION SETTLEMENT = 1”
   e. DIFFERENTIAL SETTLEMENT = 1.5”
   f. DRY SOIL UNIT WEIGHT = 105 PCF
   g. FROST DEPTH = 36”
   h. HYDROSTATIC
      1) At present, it is currently assumed that there will be permanent dewatering systems under the new structures. Therefore, no hydrostatic pressure is being accounted for in the foundation design.
      2) Based on the future loads in the existing column schedule of the Herschler Drawings, it appears that the thickness of the existing Herschler mat slab was designed based on the anticipated future loading of a 5-story library. The bearing capacity of the soil used for the design of the original mat foundation was 3000psf per the existing building drawings. Based on this initial assessment of the existing foundation, a permanent dewatering system will be required, and foundations are not designed for hydrostatic pressure. This assumption agrees with the geotechnical engineer’s recommendations regarding dewatering and foundation bearing pressures. A good waterproofing system will still be required below the mat slab and on the new exterior walls. The existing dewatering system is still needed below the existing structures to remain and will be needed below the new CUP and North Drive.
   i. DEWATERING
      1) Dewatering is currently being used under the existing mat slabs at the Herschler garage and the connector structure between the Capitol and Herschler. A permanent dewatering system is proposed in the geotechnical report for the north access drive and the CUP. Dewatering will also be required during construction. As part of the next phase of work, the new loads at the existing mat slab and at the new structures as well as the quantity of water to be displaced will be reviewed by the geotechnical engineering team to determine if there will be any issues to the overall existing structure including the Capital. Potential issues include additional differential settlement. Additional limitations on means and methods of construction with regards to dewatering will be developed further in the next phase of work.

C. DESIGN LOADS
   1. DEAD LOADS
      a. Existing Herschler Building
         1) First Floor — TOTAL = 181 psf
            Waffle Slab Structure — 161 psf

Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf

2) Second Floor TOTAL = 45 psf

2½" Light Weight Concrete on 3" Composite Metal Deck	25 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf

3) Third Floor TOTAL = 45 psf

2½" Light Weight Concrete on 3" Composite Metal Deck	25 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf

4) Fourth Floor TOTAL = 70 psf

2½" Light Weight Concrete on 3" Composite Metal Deck	25 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf
Pavers on Existing Fourth Floor Roof and Existing Roof	25 psf

b. Herschler Building Addition

1) First Floor TOTAL = 61 psf

3¼" Light Weight Concrete on 2" Composite Metal Deck	41 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf

2) Second Floor TOTAL = 76 psf

3¼" Light Weight Concrete on 2" Composite Metal Deck	41 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf
Partitions	15 psf

3) Third Floor TOTAL = 76 psf

3¼" Light Weight Concrete on 2" Composite Metal Deck	41 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf
Partitions	15 psf

4) Fourth Floor TOTAL = 76 psf

3¼" Light Weight Concrete on 2" Composite Metal Deck	41 psf
Typical MEP and Ceiling	10 psf
Typical Floor Finish	10 psf
Partitions	15 psf

5) Roof TOTAL = 76 psf

3¼" Light Weight Concrete on 2" Composite Metal Deck	41 psf
Typical MEP and Ceiling	10 psf
Pavers at New Roof	25 psf

c. North Drive

24" Intensive Soil at Roof (@ 93pcf per Hydrotech)	186 psf
Normal Weight Concrete on Metal Deck	73 psf

d. Central Utility Plant (CUP) TOTAL = 344 psf

4½" Normal Weight concrete on 3" Composite Metal Deck	73 psf
Hanging MEP	50 psf
Typical Ceiling, Miscellaneous	5 psf
24" Intensive Soil at Roof (@ 93pcf per Hydrotech)	186 psf

6” flood water at Roof	30 psf

e. Connector (CON)

1) Typical TOTAL = 311 psf

12” Hollowcore Precast Plank + 2” topping	105 psf
Typical MEP and Ceiling	20 psf
24” Intensive Soil at Roof (@ 93 pcf per Hydrotech)	186 psf

2) Security/Storage TOTAL = 235 psf

12” Hollowcore Precast Plank + 2” topping	105 psf
Typical MEP and Ceiling	20 psf
14” Extensive Soil at Roof (@ 92 pcf per Hydrotech)	110 psf

3) Large Session Staff TOTAL = 326 psf

16” Hollowcore Precast Plank + 2” topping	120 pcf
Typical MEP and Ceiling	20 psf
24” Intensive Soil at Roof (@ 93 pcf per Hydrotech)	186 psf

4) Walkway TOTAL = 115 psf

8” Hollowcore Precast Plank + 2” topping	70 psf
Typical MEP and Ceiling	20 psf
Pavers	25 psf

2. LIVE LOADS

a. Existing Herschler Building

Roof	see: Snow Load
Typical Floor	150 psf
Stairs and Plazas and First Floor	100 psf
Mechanical Equipment Rooms	125 psf
Corridors above First Floor	80 psf
Garage	40 psf
North Drive Loading Dock	250 psf

b. Herschler Building Addition

Roof	see: Snow Load
Office	50 psf
Public Space and Conference Rooms	100 psf

c. Central Utility Plant (CUP)

Roof with vehicular access (firetruck)	250 psf
Mechanical Room	per equipment weights (150 psf min)

d. Connector (CON)

Roof	100 psf
Conference Rooms/Corridor	100 psf
Office	50 psf
Parking Garage	40 psf
Foundation	100 psf

3. SNOW LOADS

a. Herschler Building Addition

Ground Snow Load	30 psf
Flat Roof Snow Load	20.79 psf
Snow Exposure Factor	0.9
Snow Load Importance Factor	1.1
Thermal Factor	1.0

b. Central Utility Plant (CUP) see: Live Load

c. Connector (CON) see: Live Load

4. FLOOD LOADS

a. Flood Hazard Assessment Map by BenchMark Engineers PC, dated 4/23/2014 outlines the limit of the 100 year storm. The flood water reaches up to the first floor finish floor elevation of Existing Herschler. This brings flood water on top of the CUP and on top of the waffle slab at the North side of Herschler.

5. BLAST LOADS

At present, no blast loads are being considered

6. WIND LOADS

Basic Wind Speed	115 mph
Wind Importance Factor/Risk Category	II
Wind Exposure	C
Internal Pressure Coefficient	0.18

7. EARTHQUAKE (SEISMIC) LOADS

a. Existing Herschler Building

1) The existing Herschler Building was constructed in the 1980s and falls under the Uniform Building Code Seismic Load requirements.

b. Herschler Building Addition

Seismic Importance Factor	1.25
Occupancy Category	III
Site Class	C
Short Period Spectral Response Coefficient S_{DS}	0.127% g
One Second Spectral Response Coefficient S_{D1}	0.061% g
Seismic Design Category	B
Seismic Response Coefficient	.042
Response Modification Factor	3
Analysis Procedure	Equivalent Lateral Force

c. Central Utility Plant (CUP) N/A

d. Connector (CON) N/A

8. SOIL

a. North Drive

24" Intensive Soil at Roof (@93pcf per Hydrotech email 10/17/14) 186 psf

b. Central Utility Plant (CUP)

24" Intensive Soil at Roof (@93pcf per Hydrotech email 10/17/14) 186 psf

c. Connector (CON)

14" Extensive Soil at Roof (@92pcf per Hydrotech email 10/17/14) 107 psf
24" Intensive Soil at Roof (@93pcf per Hydrotech email 10/17/14) 186 psf

9. EQUIPMENT AND SPECIAL LOADS

a. MECHANICAL EQUIPMENT

1) New Unit at 4th Floor Herschler East Wing TBD

b. VIBRATION FACTORS

1) Special consideration will be made as required for mechanical units

10. TEMPORARY LOADS

a. The existing Herschler building has a buried waffle slab to the north of the existing wings. The proposed CUP structure will also be buried. The proposed construction sequence is to build the CUP prior the addition at Herschler. These structures have the potential of seeing temporary construction loads. During the design process the sequence of construction will be discussed to ensure that potential construction loads are acceptable for the permanent structure.

D. DIMENSIONAL AND SERVICEABILITY CONSIDERATIONS
1. MAXIMUM VERTICAL DEFLECTION
   a. ROOFS AND FLOORS
      Live Load Deflection: L/360
      Total Load Deflection: L/240
   b. SPANDREL BEAMS
      Live Load Deflection: L/600
      Total Load Deflection: L/480
2. DRIFT DEFLECTION
   a. SEISMIC: H/150
   b. WIND: H/375

E. VIBRATION DESIGN REQUIREMENTS
No special guidelines have been provided yet.

F. CONSTRUCTION MATERIALS
1. STRUCTURAL STEEL
   a. Wide Flange Beams, Columns, and Structural Tees: A992
   b. Hollow Structural Sections: ASTM A500, Grade B
   c. Structural Pipe Sections: ASTM A500, Grade B
   d. Channels, Angles, and Plates: ASTM A36 (unless noted otherwise on drawings)
   e. Anchor Bolts: ASTM F1554, Grade B
   f. Stainless Steel: ASTM A276, Grade 304
2. METAL DECK
   a. ASTM A653, Grade 90
   b. Gage/thickness varies, see drawings
3. CONCRETE STRENGTH AND REINFORCING
   a. Light weight concrete on metal deck with minimum compressive strength of 4000 psi at 28 days
   b. Normal weight concrete on metal deck with minimum compressive strength of 4000 psi at 28 days
   c. All other concrete: Normal weight with minimum compressive strength of 4000 psi at 28 days
4. PRECAST CONCRETE HOLLOWCORE PLANKS
   a. Plank concrete: strength of 5000 psi (per Oldcastle Precast load tables)
   b. Topping: strength of 3500 psi and minimum thickness of 2” (per Oldcastle Precast load tables)
5. NON-SHRINK GROUT AND NON-METALLIC GROUT
   a. Minimum compressive strength of 5000 psi

G. SYSTEM DESCRIPTIONS
1. RENOVATION AND ADDITION AT HERSCHLER BUILDING

Existing Herschler and Herschler Addition are supported on an existing mat slab foundation varying in thickness from 31” to 57”. The proposed addition to the existing Herschler Building is to be located at the existing atrium to the north of the existing building and is to extend north to the curb line at the north wall of the parking garage. There are existing steel cantilever beams along the north edge of the two wings of the existing building that will be trimmed to accommodate the geometry of the new building (see Figure A). The addition will live on top of the existing waffle slab at the first floor above the garage and will ultimately be supported on the existing 45" and 57” mat slab at the foundation level. The new construction will be steel frame with composite concrete slab on metal deck floors. There will be (4) stories above the existing first floor including the roof. A preliminary floor plan layout of a typical floor (Figure B) and the 2nd floor framing (Figure C) over the proposed conference rooms is included at the end of this section.

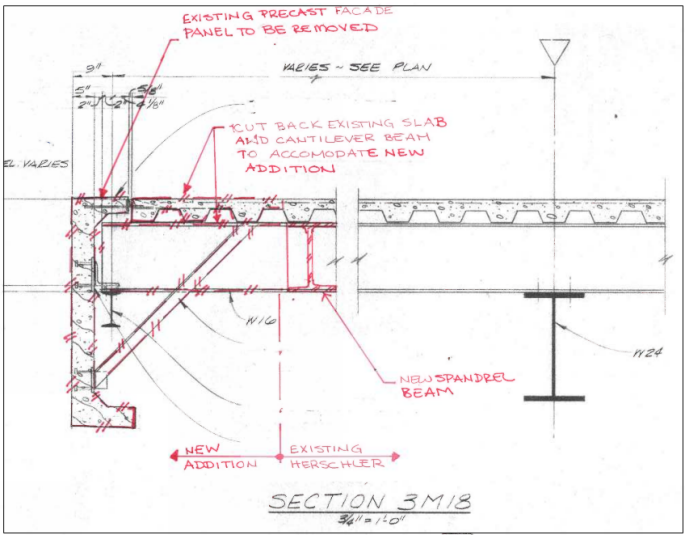


Figure A. Section at Existing Spandrel Condition

The grid of new construction provides approximately 30 foot by 34 foot bays that do not align with the existing grid in the garage. A new layer of steel structure is required over the waffle slab to transfer the heavy loads from the new columns at the addition to the existing columns since the waffle slab will not be capable of supporting these loads. The waffle slab steps down two feet from the existing interior Herschler to the current atrium location. The proposed floor level in the addition at the waffle slab level is to be the same as the existing interior Herschler. This means that there will be space for some depth of structure above the waffle slab. The transfer level of steel would also help provide a build up to get the new addition space elevation up to match the existing interior space. A concrete slab on metal deck construction would be provided over the transfer level.

Currently, it is unclear if the transfer level can fit within the 24” space. As the design develops, an option will be studied that considers the removal of the existing low waffle slab if the required structure is deeper than 24”. The transfer level described above would then be an infill at the demolished slab. Due to the geometry of the grid layouts and the quantity of load being transferred, the steel framing at this transfer level is anticipated to weigh about 35 psf. If the waffle slab is removed in areas, additional analysis will be required to determine the effects on the remaining slab.

In general, the existing Herschler space has been designed for either 100 psf or 150 psf live load. As part of the renovation and addition to the Herschler building, the architectural layout within the existing Herschler building is being reconfigured. The proposed first floor architectural layout includes large open conference rooms. The existing live load capacity of the floors is 100 psf as indicated in the 1980 structural drawings on drawing S-11. Therefore, the existing structure is capable of supporting the proposed occupancy at this level. A new electrical room is being located within the existing east wing. The new units will sit on curbs that are supported on the concrete waffle slab. Penetrations from the electrical equipment down to the garage will be required. Penetrations are to be located within the pans of the waffles and not within the beams or column capitals.

New mechanical units are being installed within the existing Herschler building at the fourth floor of the east wing as part of the revised layout. A portion of the roof at the existing east wing will be removed to accommodate the large equipment and allow for ventilation. Reinforcing will be required to accommodate the distribution of the load from the equipment. The existing floor structure is designed for 150 psf, so the columns will be able to support the weight of the equipment. Additionally, the spandrel beams at the roof level will require replacement as the slab structure and filler beams that currently provide bracing will be removed.

The existing Herschler structural lateral system is comprised of steel braced frames and concrete shear walls. At the addition, steel moment frames and concrete shear walls are being proposed to resist code required lateral loads. The moment frames are being used to accommodate flexibility in layout for both the currently proposed layout and the possibility of future renovations. At the proposed vertical circulation, the walls can be used as shear walls to gain additional stiffness in the system. At present, these is an expansion joint in the waffle slab between existing gridlines G and GG and existing gridlines 8 and 8.1. So, the waffle slab under the addition is laterally separated from the waffle slab below the existing Herschler building. Since the existing structure in this area was designed for an addition, the waffle slab under the addition has capacity for added lateral loading. But, the currently proposed addition will not distribute loads to the existing waffle slab in the same way as initially proposed during the building's original construction. Therefore, the slab will be evaluated and local modifications may be made to ensure adequate load path to the soil around the building.

The new addition layout does not align with the existing expansion joint described above. An expansion joint or seismic gap will be created between the new and existing construction so the systems can be laterally separated. The floor framing layout of the addition may require some additional cantilevering to ensure the lateral loads from the addition are being transferred to the north of the existing joints. In providing a joint, the existing lateral resisting system will not need to be designed for additional loads from the addition.

As part of the addition and renovation, the circulation for each floor is being improved. This includes 4 new elevators at the center of the new addition, a new stair at the new atrium that extends from the Garage/Connector level up to the 4th floor, and new stairs from the first to forth floors at the reentrant corners at the east and west facades of existing Herschler.

The new elevators require a six foot elevator pit, plus a two foot sump. The slab elevation at the garage level is being built up to minimize the cutting of the existing Herschler mat slab. However, the mat slab will need to be cut into one foot for the elevator pit and an additional two feet for the sump pit. The existing mat slab will be over cut for the outside perimeter of the elevator pit to allow for a new 8" reinforced concrete walls to be cast up against the cut mat slab. The concrete walls will extend up through the building and act as shear walls. The existing mat slab has #10 at 6" on center both ways as the existing top reinforcing. This is the reinforcing that will need to be cut through.

The new stairs at the atrium and wings of Herschler will be steel framed stairs with concrete filled metal pans. The atrium stairs will be architecturally exposed concrete and steel. At the new stairs at the wings of Herschler, the reentrant corners will be extended out to allow for the new stairs. New steel framing for the landings and support of the curtain-wall at the façade will be similar to the framing at the new Herschler Addition.

The local removal of the roof structure for mechanical equipment as described earlier will locally remove the continuous diaphragm that currently exists to distribute lateral forces to the steel braced frames and concrete shear walls that are part of the lateral resisting system in the Herschler Building. Reinforcement and replacement of existing beams will be required as well as the addition of new steel elements to reestablish a load path to the lateral force resisting elements. Girders will be removed along gridline 3 and shall be replaced between gridlines 3 and 4. Additionally, the mechanical unit provided has significant weight. This will affect the torsion exerted on the existing structure in a seismic event. The consequence of this is that localized reinforcement of the lateral system is required at the existing east wing.

A proposal has been made to change the occupancy of the existing Herschler Building to Occupancy Category III. The reason for this is because the Herschler building will house the mechanical connection between the CUP and the Capitol, and the Capitol is to be an emergency facility. Per Chapter 9 of the IEBC, the existing lateral system will need to be designed for current IBC lateral load provisions because of this occupancy change. The original Herschler design was performed under the Uniform Building Code (UBC). An analysis of the wind and seismic loads under both the UBC and the current IBC was done to compare the historic force values at the original assumed occupancy. It is currently assumed that the occupancy of the existing structure falls into a current code occupancy of II. This correlates to a structure in the UBC that is not an essential facility or a facility with intended assembly of more than 300 persons.

The required design wind pressure based on the UBC varies from 25psf to 40psf from the base of the building to the roof. While the existing code does not consider occupancy when determining wind pressures, the change in occupancy requires the evaluation of the structure for current code provisions. The current code provision considers occupancy in load determination. The wind loads based on the new code based on an occupancy category of III range from about 25psf to 33 psf. Therefore, the change in occupancy will not require any supplementary work due to wind loading.

The existing UBC code required seismic load is approximately 2.6% percent of the weight of the building. Based on the current IBC provisions, the required seismic loads based on occupancy category III are 4.2% of the building's weight. This difference requires the existing structure to be evaluated for an additional 1.6% of the building's weight. It is presumed that the existing building was designed using elastic design and working stresses. While Load Resistance Factor Design (LRFD) was in existence in 1980, the UBC makes reference to working stresses in the steel provisions. Additionally, loads on the existing column schedule are indicated as working loads. Current steel provisions utilize LRFD which is generally less conservative than Allowable Stress Design (ASD) and working stress methods. This can potentially allow for more capacity than was initially assumed in the original design. However, a change in occupancy will require a more comprehensive analysis of the existing lateral system. An upgrade may trigger reinforcing of elements and connections in the lateral system.

To allow access to the garage from the north of the Herschler Building, a North Drive will be excavated to form a ramp and truck loading dock directly adjacent to Herschler's north foundation wall. A new retaining wall with be built on the north side of the ramps. A steel and concrete pedestrian bridge will span 39 feet from Herschler to the new north foundation wall. The existing foundation wall will require a large opening for access to the North Drive from the garage and will require reinforcing for the wall to span over this opening. The existing foundation wall had previously been retaining soil, which will now be retained by the new north foundation wall.

The removal of earth from the existing concrete wall at the new north drive will result in the loss of lateral load transfer from the building's diaphragm to the soil. This also theoretically lowers the grade elevation considered in a seismic analysis and therefore will increase the seismic load. To prevent altering the lateral load path of the building and increasing the seismic forces on the building, structure will need to be designed to redistribute the lateral loads back into the soil at the existing street level. A large beam at the top of the existing concrete foundation wall will need to be designed to span between points of contact with soil. The pedestrian bridge can be used to transfer lateral loads to the soil. This bridge will be comprised of a concrete slab on metal deck with steel framing.

The existing Herschler Building has a concrete and precast panel façade. The façade is proposed to be removed in its entirety and replaced. Glass curtain wall is proposed for the southeast and southwest faces of the existing wings. The remaining faces of the building are a combination of limestone, precast panels, and curtain wall. Presumably, the glass curtain wall will weigh less than the existing stone. At areas where there is stone and concrete, the weight is likely similar. Once the approximate weight of the systems is known, an analysis of the existing spandrel beams will be required. Some beams will require reinforcing based on the change in load. New connections will be required for the new façade. This will impact the way load is transferred back to the steel framing. Local reinforcing may be required based on these details.

2. CENTRAL UTILITY PLANT

The new Central Utility Plant will be a one story building located below grade in its entirety, adjacent to the existing Herschler building to the southeast. The roof construction will be concrete slab on composite metal with steel beams and concrete columns. The columns are located on a typical 30 foot by 30 foot grid; the grid was carefully coordinated with the large mechanical units, allowing for sufficient access space and maintaining a relatively shallow structure.

The roof structure of the CUP will have landscaping above and therefore will see heavy soil loads. There is the potential for vehicular access, namely by fire trucks, over the CUP structure. This is to be confirmed with the State and Fire Department of Cheyenne. Flood loads will also be located above a portion of the CUP bases on the Flood Hazard Assessment Map by BenchMark Engineers for the 100 year flood.

There will be a large quantity of hung MEP piping and ductwork from the roof structure. Rather than install a secondary level of steel to support this hanging load, which could impact clearance heights and result in higher total steel weight, the main roof steel was designed for the hanging MEP load. Strut channels spanning 10 feet between roof beams will be used to carry the piping and distribute the loads to steel above.

Steel was chosen as the structural framing option at the CUP to more easily coordinate and accommodate heavy loads from hung MEP piping and ductwork. A concrete flat slab or precast plank system would have to be designed specifically for these loads and the exact anchor points with little room for adjustment in the field. Concrete columns were selected for their durability in this type of environment. Another option is to use steel columns and encase them in concrete.

The roof slab is sloped for drainage, at 1/8" per foot away from the existing Herschler building. The steel infill beams at the roof are orientated parallel to the roof pitch and slope with the slab. The girders perpendicular to the slope are flat, so bent steel plates welded to the top flange of the beams will be required to build up the top of steel to the underside of the sloped deck.

The CUP foundation will be a 30” mat slab (see Figure 1), designed for gravity loading against the soil bearing pressure provided by the geotechnical report. Per the geotechnical engineer’s recommendations, there will be permanent dewatering system below the CUP structure, therefore the mat slab is not designed to resist any hydrostatic pressure. Within the CUP will be the pumps for the dewatering system. Redundancy of this system is critical to keeping the CUP dry. Refer to mechanical drawings and narrative for additional information.

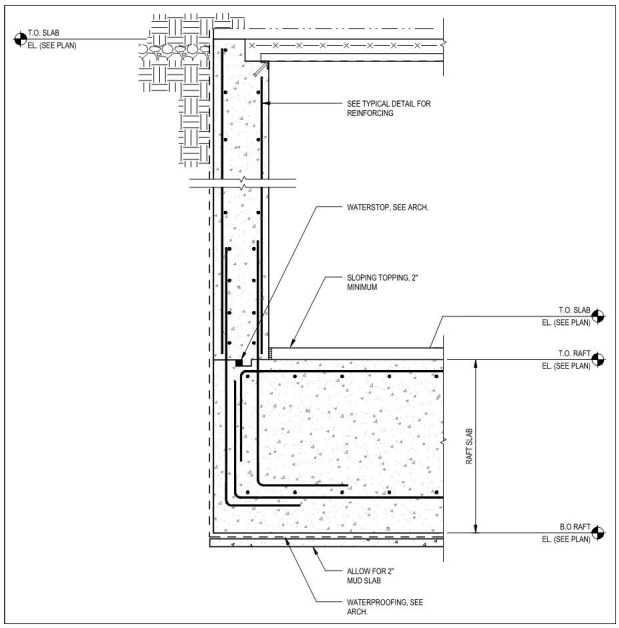


Figure 1. Section through CUP exterior wall and mat slab

The CUP foundation is at two levels, to accommodate the ceiling heights required for MEP equipment and access, but to avoid the need for underpinning at existing Herschler. The bottom of the high mat slab (Mezzanine level) will match the bottom of Herschler foundation. The low mat slab elevation is located at a 2H:1V down and out from the bottom of the Herschler foundation wall, to maintain safe working conditions during excavation. The allowable cut slope is to be confirmed by the geotechnical engineer, and the CUP mat slab elevations and extents will be adjusted accordingly. The bottom of mat slab will be flat to allow for even bearing on the soil below. The top of the mat slab will be sloped toward three interior trench drains. Per the architect and MEP engineers, the trenches will be 6” wide and depressed 6” into the mat slab. A 4" topping slab will be located on top of the mat slab for protection. The topping slab will be reinforced with galvanized welded wire fabric.

Since this is a Central Utility Plant, there will be high levels of moisture within the space. Steel framing and the underside of the metal deck will be painted with a zinc rich paint to minimize rusting of steel and metal deck.

Wind and Seismic loading were not considered in the CUP design as the entire structure is below grade. The exterior foundation walls of the CUP are designed for active soil pressure and surcharge from the live loading above.

3. CONNECTOR

The new Connector will provide a link between the Capitol building and existing Herschler, as well as meeting space, committee, rooms, offices, storage, mechanical, and VIP parking. The existing connector structure is being demolished down to the existing mat slab and rebuilt above. The connector will be one story, below grade with three “pop-up” skylights aligning with the historic 25th street.

The Connector roof will be used as a plaza space, with landscaping features and pedestrian walkways. The Connector will be paved above the historic 25th street line and 'link' corridor; all other areas of the Connector will have green roof above. It is assumed there will be no vehicular access above the Connector, which is to be confirmed by the State and the Fire Department of the City of Cheyenne.

Several framing options were discussed for the connector structure, including: steel framing with slab on composite deck, concrete flat slab with concrete beams and columns, concrete flat slab on concrete walls, precast plank on steel beams and columns, and precast plank on concrete walls. To allow for flexibility of usage in the space, the direction was taken early on to use both columns and walls as vertical support. While steel framing is also being used at the CUP and Herschler Addition, the architectural direction for the Connector was to limit the number of low points in the structure and keep the depth as shallow as possible. Concrete flat slab demanded the use of drop caps at columns, which impacted architectural layout. Precast plank was chosen as the direction for the Connector structure, to allow for longer spans between beams and walls, and shallower structure.

The new structure at the connector was designed as hollow core precast plank spanning to structural concrete walls and steel beams supported on steel columns. Plank design was based on published load tables from Oldcastle Precast. The steel beams are to be upset into the precast plank to reduce overall structural depth and maximize clearance heights in the Connector (see Figure 2)

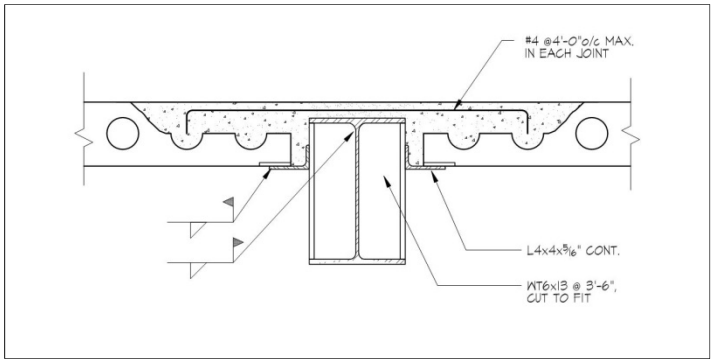


Figure 2. Typical Detail Steel Beam Upset Into Plank Slab

The columns will bear on the existing mat slab. The existing mat slab varies in thickness from 31" to 45" and steps in elevation. The finish floor will be built up to a typical elevation at the Connector. As the existing mat slab elevations vary, so too will the build-up thicknesses and thus systems: for elevation differentials of 12" or less, a typical concrete fill will be used on top of the existing mat slab; to build up more than 12", the raised slab will be constructed with high-density polystyrene fill with a concrete topping slab on vertical concrete ribs down to the existing mat (see Figure 3). A similar detail will be used at any sloped or ramped raised slab area.

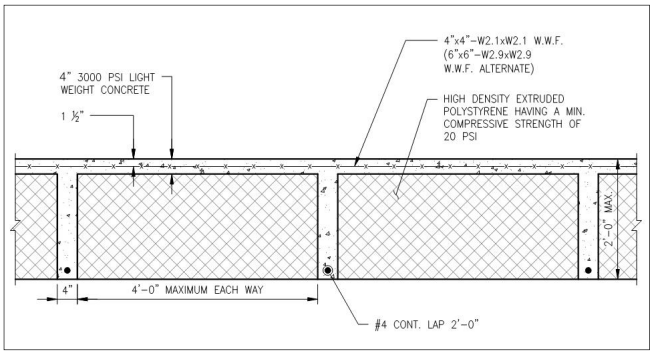


Figure 3a. Typical Raised Slab Detail

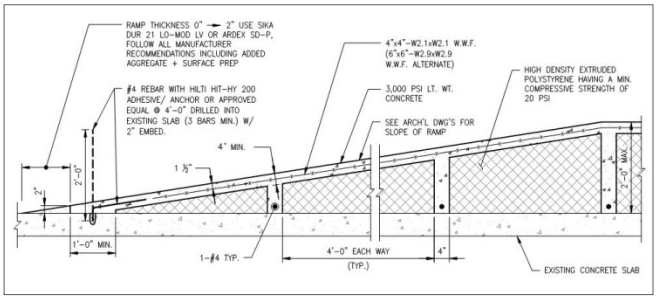


Figure 3b. Typical Raised Slab with Ramp Detail

The exterior foundation walls of the Connector are designed for active soil pressure and surcharge from the live loading above.

East of the Connector, the existing foundation transitions from a mat slab to a 6" slab on grade per the existing Herschler drawings. The existing slab on grade and walls will be demolished to install the CUP structure. The new East Access ramp will be new slab on grade with wearing slab. The slab reinforcing will need to be epoxy coated or galvanized as the slab is exposed directly to the earth. The new cantilever retaining walls at the Drive will be designed for lateral soil pressure.

There is an existing dewatering system below the existing Connector mat slab, which is to remain. The load is not being increased on the existing mat, therefore the slab does not need to be reinforced or redesigned.

A portion of the new parking garage will extend past the existing mat slab. A new mat slab foundation will be provided at that area of the parking garage. Permanent dewatering will be required below this portion of the slab to eliminate hydrostatic uplift on this slab. Piles will be required here to prevent differential settlement between the new and existing mat slab.

4. INTERACTION BETWEEN EXISTING HERSCHLER BUILDING AND CUP/CON
The grade elevation and amount of backfill around the existing Herschler mat are being lowered due to the North Drive and the CUP installation below grade. This has potential impacts on the wind and seismic design forces on the building. At the North Drive, a story is being removed from the face of the existing building. In order to avoid a seismic upgrade of the building at this location, structural elements will need to be designed to transfer the seismic and wind base shear from the current grade (first floor elevation) into the earth north of the access driveway.

At the east side of the existing building the construction of the CUP changes the perceived grade elevation of the Herschler Building. When evaluating seismic loads, the weight of the structure above grade is included in determining the lateral forces. Lowering the grade at the area of the CUP leads to the waffle slab level being considered above grade. This would add a substantial amount of weight above grade. Per the IEBC, any structural renovation that increases the seismic base shear by more than 10% requires the structure to be revaluated for the new loads based on the current IBC provisions. In order to avoid this trigger and upgrade the existing lateral system, the CUP structure will be designed to receive the horizontal shear at this level and transfer it through diaphragm action in the roof slab to the surrounding grade.

If the CUP is designed to transfer lateral loads from the Herschler building, the structures will need to be tied together. There is potential for differential settlement between the new and existing structures described above. The geotechnical engineer will provide recommendations for the exact values as the project develops. The foundation of the CUP will be designed to minimize differential movement. This may be done by increasing the mat foundation structure to distribute loads over a larger area. Alternatively, piles could be utilized to prevent the differential settlement.

5. INTERACTION BETWEEN CUP/CON AND THE CAPITOL

There will be a new tunnel structure from the CUP to the historic Capitol for routing of MEP piping and ductwork. Assuming only soil loading above and moderate mechanical loading within will have an 8" thick cast in place roof slab, 8" thick concrete walls, and an 18" mat slab. Elevation and slope of tunnel to be confirmed by MEP engineer. This tunnel will tie into the existing tunnel located at the north east corner of the Capital. Underpinning may be required at the Capitol if the tunnel is to be excavated below the existing Capitol foundation. Refer to MEP narrative and drawings for tunnel information.

Refer to the Capitol drawings and narrative for reinstituted north steps, which tie the Capitol building to Herschler, via the new Connector. There will be an expansion joint between The Connector and Capitol, to prevent interaction between the two buildings. At this location, a MEP tunnel will step down below the Connector slab elevation just to the south of the existing mat slab. On both the east and west side of the north steps will be mechanical tunnels that connect the Connector to the new mechanical rooms within the Capital. Underpinning of the Capital in this area will be required. Please refer to the Capital structural and mechanical drawings for extent.

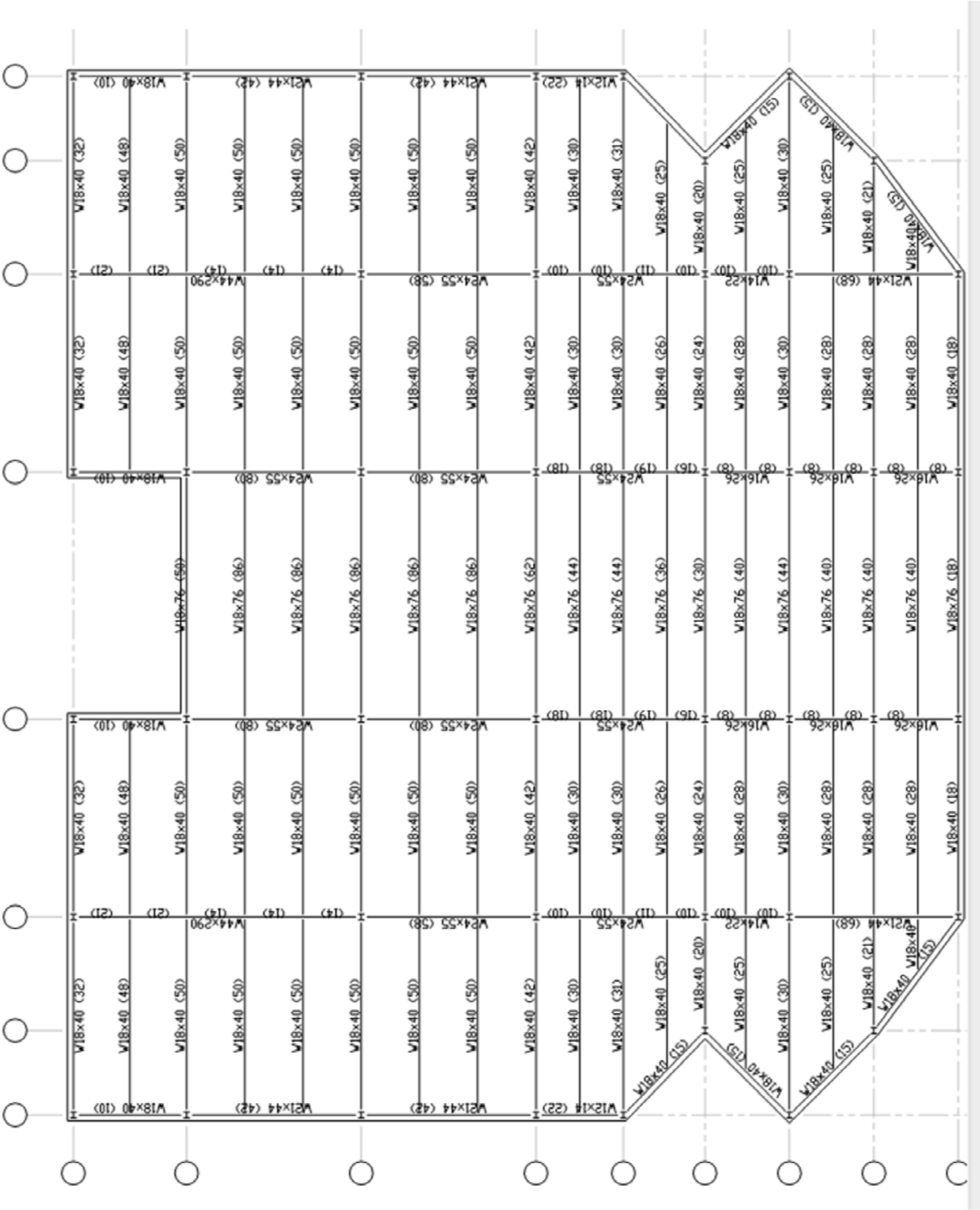


Figure B. Typical Floor and Roof Framing Plan

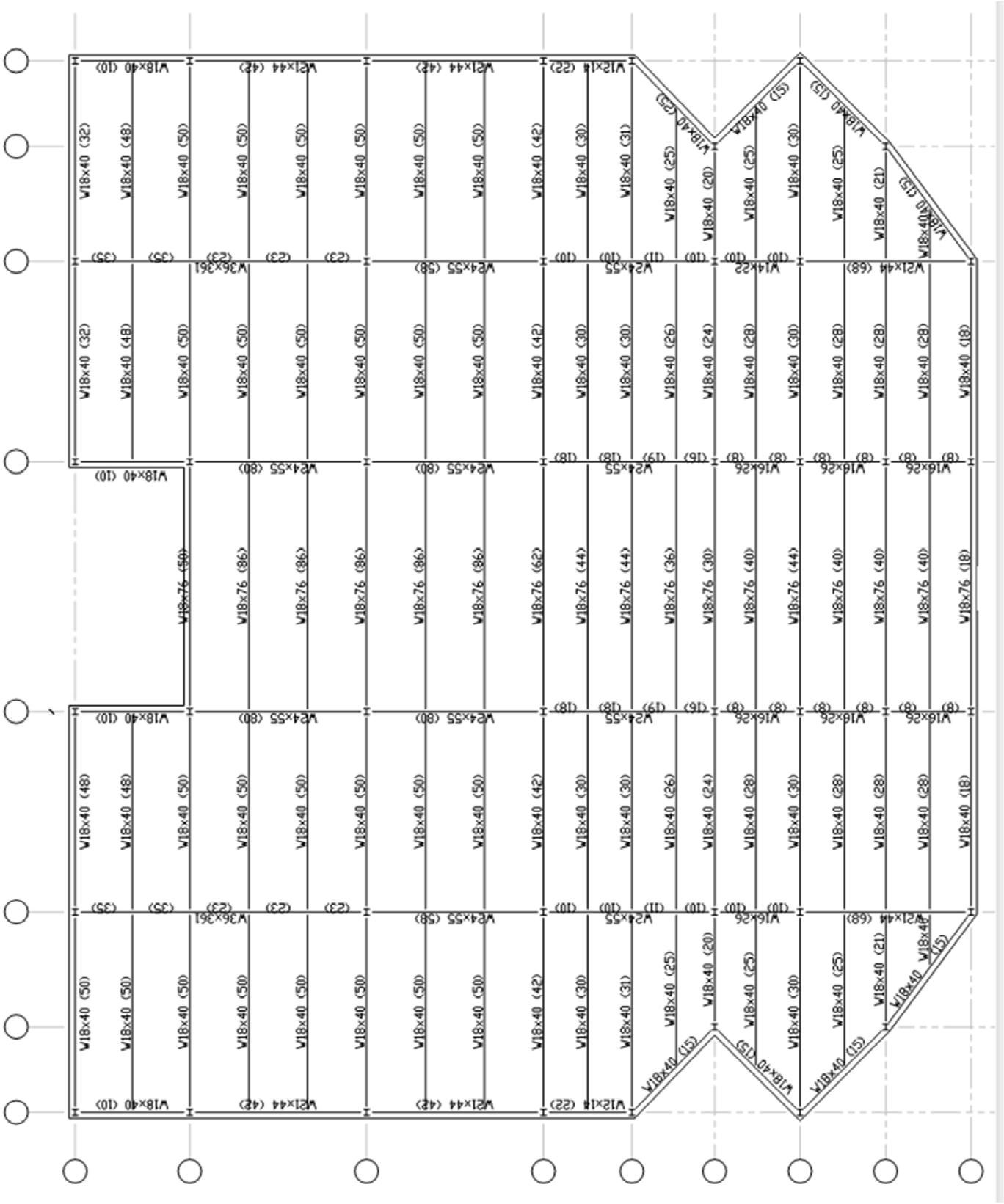


Figure C. Second Floor Framing Plan (Above Conference Room)

SECTION 2.5
ARCHITECTURE

PART 1 - GENERAL DESIGN CONCEPT SUMMARY

1.1 OVERALL SUMMARY

The existing Herschler building and Connector consists of a variety of architectural systems that will be revised, enhanced, or replaced in their entirety as part of the scope of this contract. The Herschler addition and Central Utility Plant will include a series of new systems as part of the design.

1.2 DESIGN CONCEPT SUMMARY

A. Vision

1. The Herschler Building component of the Wyoming Capitol Square project will create a new vision for the building and surrounding grounds. The overarching vision for the project is to achieve success across three broad themes: to meet the needs of the State; to fit the Cheyenne and Wyoming community; and to embrace value. These goals were defined during a visioning session workshop facilitated by HDR Architecture and Plan One Architects with the Steering Committee on September 7, 2011, and expanded upon in more detail in the Level I Reconnaissance & Level II Feasibility Report for the New State Office Building project on February 24, 2014.

B. Site

1. The Herschler and Connector portions of the Capitol Square site design are intended to reflect the importance of the Capitol structure while retaining design elements that are related with the new renovations and addition to the Herschler building. The unique situation of having both a historic and present day building on the same block presents some interesting opportunities. The intrusion of the Connector into the historic landscape of the original Capitol Square also presents challenges involving topography, accessibility, wayfinding and circulation.

   The plaza portion located between the Herschler building and Capitol reintroduces the historic 25th Street demarcation with an east/west walkway extending from Central Avenue to Carey Avenue as a boundary that reinforces the original Capitol grounds.

   This relationship sets the stage for the centralized circulation system that simplifies access into and around the Square. The site design utilizes a centralized pedestrian walkway system to focus circulation onto intentional pathways through the site in an east/west and north/south orientation. These pathways become the focal point for all activity at all times of day as business, tourism, governance and personal activities occur and set the geometry by which other portions of the site are developed.

   On both ends of the east/west pedestrian spine, the site symmetry is expressed to acknowledge the prevailing geometries of the Capitol and Herschler buildings. To the west, a gathering plaza is envisioned to assist with staging the large numbers of tourists and students who visit the Capitol. When not being used for staging, the plaza allows a place for intimate conversation shaded by trees reflecting the historic parkway of 25th Street. Bus drop-off service is provided along Carey Avenue in a dedicated pull-off lane, allowing visitors to disembark and gather in one location. This plaza offers a primary opportunity for education and the experience of the Capitol Square to begin. The plaza extents are defined to reflect the historical 25th Street right-of-way. To the east, the existing vehicular ramp will remain substantially unchanged, allowing for vehicular entrance into both the staff garage as well as the VIP garage to the south. A dedicated queuing lane is provided to help facilitate access into the garage and limit the disturbance on Central Avenue.

Similar to the development of the west portion of the site, walls and landscape are utilized to reflect the continuation of the 25th Street connection through the block. Flowing down to both locations are a series of terracing walls that will allow for the grade change between the Connector structure and the plaza and Central Avenue sidewalk. The walls serve multiple purposes by assisting with the grade change that allow increased floor to ceiling heights as part of the Connector below and simultaneously provide places for people to sit. The walls are designed to be simple, unobtrusive elements in the landscape that will not detract from the focus on the Capitol building.

The desire to remove the existing west parking garage/service ramp and the area directly north of the Capitol to facilitate deliveries and parking requires a creative approach to provide a new servicing plan. The north edge of the Capitol Square along 26th Street has been redesigned to accommodate a new ramp system allowing trucks access to a lower level delivery area that functions as the main distribution point of goods for both the Capitol and Herschler building. The ramp is also the primary exit point from the underground parking garage, allowing vehicles to exit onto the 26th/Central intersection. North of this ramp, a reconfigured 26th Street will allow for two-way traffic as well as provide a landscaped buffer between the south edge of 26th Street and the ramp, screening the physical impact of the ramp structure from the historic neighborhood to the north.

A design option to the above scenario for servicing the Capitol Square has also been developed as a cost savings alternate. This option proposes to maintain the existing west parking garage ramp only and eliminate the adjacent existing service ramp to the south. To accommodate deliveries, a new dock area would be located in the northeast courtyard between the addition and existing Herschler building. Access would occur along 26th Street that would allow trucks in the east bound lane to back into a dock located adjacent to the Herschler addition. This location would be in close proximity to the new Herschler elevator core that contains the service elevator minimizing travel distances for distribution of supplies and trash removal. The cost savings benefit of this alternate need to be evaluated against the visual impact of a service dock at grade against the new addition along the 26th street corridor and historic neighborhood to the north. It would also have an impact on the net space availability in a premium first floor location along with increased service movement of materials in a more conspicuous location.

C. Existing Herschler Building Exterior Design

1. The design for the exterior of the Herschler will provide a new aesthetic that will allow more daylight into the building interior and improve the performance of the building envelope.
   Probes were performed on the exterior envelope and summarized in the Limited Scope Evaluation of Building Exterior performed by Terracon and dated August 20, 2014. The new envelope will remediate the deficiencies of water infiltration and the poor performance of existing windows.

The image of the building will be redefined by the removal of the existing vertical precast sunshades and horizontal C shaped bands and replaced with a pressure plate curtain wall system that will extend from levels 2 through 4. The curtain wall horizontal mullions are located on increments of the current Herschler module of 2'-3" in keeping with the original window proportions. Vertical mullion locations will be on a 5' module which is based on dividing the 30' structural grid into 6 even modules. This will also allow for an interior planning base module of 5' for partitions to align with mullions when required. While the curtain wall will provide more daylight, glare and heat gain will be mitigated by the use of aluminum extruded vertical sunshades at each vertical mullion on the South and West elevations. Ceramic frit on the insulated glazing units will also mitigate glare and heat gain. The desired visibility outward towards the Capitol will be maintained through the use of a graduated line pattern decreasing in density from the floor moving up to eye level. A new base to the building will be expressed out of architectural precast that gives a stronger sense of grounding and gravity befitting the State of Wyoming. The base is characterized by repetitive punched openings on a 10' module.

New public circulation stairs will occupy the current triangular notches of the Herschler building and will be enclosed with a butt joint curtain wall. The resulting triangular projection is a vertical feature that serves as a focal point in the long expanse of the curtain wall. To help mitigate the glare and heat gain in the stair volume, 10" deep horizontal sunshade devices are located at a 2'-3" vertical spacing.

The main entrance between the existing Herschler wings will be comprised of a new structural glass wall system with low iron glass to accentuate the visibility into the atrium as a metaphor of reinforcing the transparency of the Wyoming government at work and reinforce the view back to the Capitol dome.

D. Herschler addition design
   1. The addition to the North of the existing Herschler Building is informed by the exterior character of both the Capitol Building and Herschler Building with the intent of weaving characteristics of each of these buildings into a new vision that is rooted and complimentary to their context. The exterior treatment takes cues from the Herschler in the use of the same limestone cladding and base treatment of architectural precast in a series of punched window openings. The window mullion patterns and opening proportions are derived from the prevalent window proportions and rhythms evident in the Capitol. At the juncture between the addition volume and the existing Herschler a vertical slot of butt joint curtain wall is introduced as a transition between each of these primary building forms. This curtain wall will be treated in the same low iron glass type as the main entry atrium to reinforce the transparency into the building. An egress stair is located behind a butt joint curtain wall system centered along the north wall of the addition, reinforcing the symmetry of the composition and terminating the Capitol St. axis.

E. Connector Plan

1. Beneath the plaza space between the Herschler and the Capitol, the lower level will serve as a connector between both buildings to allow a protected circulation link and serve the programmatic needs of the complex. This level also includes the parking garage that serves both buildings. The existing connector space will be demolished down to the mat slab in order to accommodate the various new programmatic needs. At the north edge of the parking garage a loading dock will receive supplies as well as be utilized for trash removal. A staging area is located to the south of the loading dock adjacent to the dock with a lift up to a platform that connects to the new Herschler central elevator core containg one service/passenger swing elevator and three additional passenger elevators. The elevated platform for the elevator core is required in order to accommodate the elevator pits and avoid penetrating through the existing mat slab. From the elevated elevator lobby, a stair and ramp are located to transition back down to the lower level. At the lower level, access to the Capitol Club, media room, restrooms and sitting areas occur and surround an ornamental stair that descends from the atrium above. A catering kitchen is located adjacent to the sitting area with direct access to the garage for deliveries and trash removal. A ramp is located down the center connector to transition down to the existing connector slab which leads to an intersection where two break-out areas are located adjacent to four committee rooms. Daylighting filters down to the subterranean lower level through a series of three skylights in order to provide an uplifting and quality space befitting the Wyoming state government. Two skylights are located over the pair of break-out areas and another skylight occurs over the ramp that along with daylight also provides direct views of the Captiol dome. These skylights will also create sculptural forms on the plaza above and glow with light in the evenings. Moving further south toward the Capitol, session staff areas and offices are located on both sides off the connector spine. At the terminus of the connector circulation spine a glass wall with doors on hold opens will demarcate the threshold into the Capitol building. The lower level connector will also accommodate various mechanical spaces and extensive storage areas that capitalize on the extents of the existing mat slab. A VIP parking area with eight spaces is located on the east side of the connector and provides off stage access to the connector via a corridor link which also houses the security offices in a discreet location.

F. Herschler Plans

1. An unobstructed four story atrium space will greet staff and visitors upon entry through the vestibule of the Herschler building to the south. An ornamental stair in the center of this atrium provides access to the connector below and allows daylight to filter down through the floor opening. A central hall space drives through to the north that provides clear way finding and an opportunity to celebrate the history of Wyoming with displays. The hall is flanked by a new central core that will contain elevators, restrooms, mechanical, electrical and data rooms. An ornamental stair is located beyond the elevator core to the north and ascends within a smaller four story atrium space in the new addition.
   This atrium will provide clerestory daylighting at the roof that will allow daylight to filter into the inner most area of the floor plate allowing for an uplifting environment for staff. At the far northern end of the hall, an egress stair is located which will also serve as an intercommunicating stair for the addition. A transverse corridor to the hall in the east and west direction occurs at the ornamental stair atrium that leads to vestibules that are envisioned to be predominantly exits from the building. At the vestibules, corridors connect to the existing elevator cores of the Herschler wings. The net result of the circulation system creates five departmental zones, two in each existing Herschler wing and one in the addition. The first floor addition zone contains a conference center, whereas the remaining zones are for departments. The overall arrangement of the public spaces and circulation creates an efficient building with large contiguous departmental areas that will provide flexibility over the long term to accommodate the State of Wyoming needs as they evolve.

Upon exiting the elevator lobby at Level 2, a balcony overlooks the atrium and Capitol building beyond and wraps around as circulation to the two existing egress stairs. Off of the circulation two recesses occur that provide the framework for departmental entrances off of the atrium. As one exits the elevator bank going north, an ornamental stair is on center of the addition atrium. This area will provide opportunities for staff to have impromptu encounters and encourage interaction. At the far northern end of this atrium and alcove space occurs that will serve as a vestibule area for entrances to the departments or legislative offices beyond. The remainder of the floors circulation is structured similarly to Level 1 and terminates at new ornamental egress stairs that infill the existing Herschler wing notches along the south and are arranged to emphasize views back toward the Capitol. The stair landings reach out into the stair volume and are oriented directly perpendicular to the Capitol for views. The stairs also descend in a rotation that is oriented toward the Capitol. Levels 2 and 3 are similar in layout to each other.

Level 4 is similar to Level 3 with the exception that on the east wing of the existing Herschler, a mechanical well will be created to house four cooling towers, four emergency generators and an electrical room. The existing roof will be removed in this area, however, the primary steel structural frame will remain.

1.3 SYSTEMS SUMMARIES

A. General Building enclosure

Exterior Enclosure Systems

The exterior closure of the building will be selected from systems and materials that will provide for low maintenance, durability, economy, and appropriate appearance. It is also important that these components are resistant to the extremes of climate that this site is subject to at times.

Fenestration Systems

Exterior wall surfaces will be composed of materials with windows and larger glazed applications, such as curtain wall.

Glazing systems are comprised of curtainwall systems and 'Punched Window' systems utilizing curtainwall mullion profiles.

- Curtainwall System - The curtainwall systems are larger expanses of aluminum framed systems, constructed of aluminum extrusions, and provided with an insulated window glass. Where possible this system is to be 'unitized' to facilitate larger shop-assembled sections to allow for a methodology of better quality control, quicker installation and relying on less manual labor in the field.
- Punched Window System – The punched window system is comprised of small openings with aluminum framed systems constructed of aluminum extrusions with the same profile as the larger curtainwall system, and provided with an insulated window glass.
- Skylight System – The skylight system is constructed of industry standard framing with internal drainage and insulated window glass components. The design intent is to utilize an insulated, laminate glazing system to limit the effects of hail.

Exterior Wall Systems

Exterior wall systems will utilize two main systems including an above grade rainscreen cladding system and below grade waterproofed structural walls.

- Rainscreen Systems - The construction of the Rainscreen system is comprised of an exterior cladding material (Indiana limestone, architectural precast/caststone, dry-joint metal panel system), supported by an aluminum sub-girt support system. The support system transfers the loads to a conventional stud wall system.

The exterior stud wall system is a light gauge stud framing system, covered with fiber glass reinforced gypsum sheathing. The sheathing receives a fluid-applied waterproof 'air barrier' system to seal-up the building weather tight.

The support system is comprised of vertical and horizontal components that when assembled create a void space of approximately 4 inches. Within the void, insulation is applied to the stud wall and sheathing. The insulation is classified as a continuous rigid fiber insulation system throughout the Rainscreen envelope. Additionally, there is an air space which allows the Rainscreen to drain water if any infiltrates the void area and provides the system an ability to breathe.

The 'rainscreen' system is provided for the Herschler building project for several reasons:

- Provide a high degree of continuous thermal resistivity
- The air space void area allows for a breathable system, allow the heat gain to be exhaust through the top of the system, minimizing heat gain through the exterior stud wall system
- Provides for highly durable, long-lasting, and easily maintainable exterior cladding system

Roofing System

The Herschler building project anticipates utilizing three specific roof systems which includes green roof, open joint paver roof system, inverted roof system (IRMA). The roofing has been selected for both its integrity and control of rainwater as well as energy efficiency.

- The design for the roof of the addition and the Herschler is a 'protected membrane roofing system'. Sometimes referred to as an 'inverted roof system (IRMA)'. It provides for a hot-applied liquid waterproof membrane system to be directly applied to the concrete roof deck which is sloped to drains. A rigid roof insulation is installed over the membrane. Finally the system is ballasted and protected by three separate ballast/topping materials which includes soil, open jointed pedestal pavers, and sloped pavers.
- The roof design for the CUP and Connector is either a green roof, or in select an open jointed pedestal paver system with select areas where a modular heat exchanger snowmelt system will be employed.

Shading Devices

The current design provides for either horizontal or vertical integrated shading devices. They are located predominantly on the larger expanses of glass. These shading devices will reduce solar heat gain resulting in lower energy consumption and minimize glare. Window washing methodologies will be provided and coordinated with each specific shading device type.

For more detailed exterior enclosure system information, refer to the AE 600 series drawings.

B. Existing Herschler Building

1. Concrete

Precast panels will be installed as part of the rainscreen system and used at the base of the existing Herschler building from the 1st floor to grade condition. Precast will also be used as the 1st floor to 2nd floor base expressions along with horizontal banding where "punched" openings occur at the new curtainwall locations in the main part of the existing Herschler building. A precast horizontal band will also be below the limestone at the parapet location and above the new curtainwall.

2. Masonry

The majority of the existing Herschler exterior wall system contains an Indiana limestone cladding panel system as part of a veneer material over a secondary steel structural system. Generally, the existing Limestone veneer panel material appears to be in good shape, but lacks a maintained joint/sealant material. As such, the wall system's substrate has been compromised and requires attention and repair. Note: The existing limestone panels from the grade to the 1st floor level are currently spalling.

The State requested a series of probes to be implemented by a third party consultant to review and better understand the condition of the exterior limestone veneer, supporting structural system, and the substrate assembly condition. The resulting report is included in the Appendices in it's entirety as part of this document – See Appendix 6-2, Exterior Probe Report.

HDR anticipates the removal of the exterior limestone cladding wall system assembly including the cladding, masonry support system, insulation, metal stud framing members, and interior gypsum board leaving the primary structural system and fire spray in place. The design intent is to replace the existing limestone veneer with new 2" to 3" Indiana Limestone cladding panels as part of a rainscreen system. Note: Consideration should be given to store and clean the existing limestone panels for installation as part of a new exterior rain screen wall assembly as an alternate option.

Cast stone is anticipated at the openings of the exterior façade including sill components and wall caps.

New support spaces are planned within the existing parking garage and are anticipated to use concrete masonry (CMU) wall partition assemblies.

3. Metals

As part of the exterior wall assembly, the design will utilize cold formed metal framing to support the new exterior rainscreen assembly. A 6" metal stud is anticipated at the majority of the exterior perimeter locations.

A dry joint metal panel system will be utilized as a rainscreen wall/soffit system at the new south exterior stair roof locations and entry vestibules.

At the location of the new rooftop mechanical well, the exposed existing structure will require new metal cladding.

3. Wood, Plastics, Composites

As part of the rainscreen wall system, gypsum sheathing will be placed onto the metal stud framing member. The fiber glass reinforced gypsum sheathing will be the substrate for the fluid applied air/vapor barrier.

4. Thermal and Moisture protection

The various rainscreen systems will contain a 4" rigid fiber insulation over a fluid applied air/vapor barrier (vapor permeable). The air/vapor barrier will be tied into the new curtainwall system and the new roofing system at the parapet. Additionally, the proposed new air/vapor barrier will tie into the new green roof /plaza deck system.

The new air/vapor barrier will be required to overlap/tie into the existing foundation waterproofing. Overlap/Tie-ins are anticipated to use a peel and stick type product fully compatible with each other as well as the air/vapor barrier. Note: The same peel and stick product will be utilized at corner conditions in order to provide a fully compatible and functioning system.

Due to the removal of the existing exterior wall systems and parapets in their entirety, the remaining roof system of the Herschler building will be removed to the concrete slab of the roof and replaced with a new IRMA roof system over the existing composite metal deck and concrete slab. Note: The new stair additions at the existing wings of the Herschler will contain the same new roof system as the existing building.

The eastern portion of the existing roof of the Herschler building will be removed and a new roof will be installed in this location at the top of the 3rd floor structure. The design will incorporate an IRMA roof system providing a weatherproofed assembly and heightened STC ratings to mitigate noise and vibration from the new mechanical equipment. This system will be designed to incorporate multiple locations for equipment support.

6. Openings

Exterior opening assemblies include an existing extruded aluminum storefront window system, currently located as ribbon window bands along the main body and small areas on the building ends of the east and west wings. These windows will be completely removed from the project and replaced with a new outside glazed curtainwall system. Existing extruded aluminum curtainwall systems located at the north will be completely removed. The south curtainwall at the main entrance of the building will be removed and replaced with a new structural glass wall system.

The main body of the building's south side of the east and west wings will utilize a new powder coated/fluorocarbon sunshade devices, in the vertical direction, tied directly to the curtainwall mullion with an engineered connection. Depths are as indicated as part of the drawings. The vertical curtainwall joints utilize a butt glazed joint system.

New stairs from the 1st to 4th floors will be added to the exterior of each east and west wing and will be enclosed with a new vertically butt glazed curtainwall system. Horizontal aluminum sunshades will be applied to the exterior curtainwall system in select areas consisting of an extruded profile tied back to the vertical mullion through an engineered connection.

Glazing systems in the curtainwall assembly of the main body of the Herschler building will include high performance coated glazing, fritted glazing and vision glazing. High performance coated glazing with prefinished metal backpans will be utilized at each floor level to provide a "shadowbox" effect in the large expanses of the curtainwall system and provide a rated floor-to-floor edge assembly. Low iron glazing will be used at the south elevation of the main entry and in the new stair enclosures at the exterior of the building.

The entry portal at the parking garage and VIP vehicular opening at the east ramp as well as the entry portal along the existing north wall of the parking garage will use a high-speed, insulated overhead coiling door at the vehicular entry point.

Standard insulated overhead coiling doors will be utilized at new service support areas located in the parking garage including the new dock area and dock storage.

The design of the multi-story vertical open space of the interior at the main south entry of the Herschler building will utilize a horizontal, 2 hour fire shutter assembly at a single floor to remove the need of a smoke evacuation system as typically required for an atrium thus creating a vertical compartment separation.

The existing air intake shafts currently open to the exterior environment will be enclosed with a raised roof structure and new architectural louvers to be utilized as cladding. This will occur on both east and west wings.

The north elevation, east wing of the Herschler building, above the 4th floor, will receive new architectural louvers to accommodate the new mechanical well equipment.

New exterior wall partitions will be constructed between the mechanical well and tenant space providing a weatherproofed assembly and heightened STC ratings to mitigate noise and vibration from the new mechanical equipment.

7. Vertical Transportation

The existing vertical circulation for the Herschler building is provided by 4 traction elevators dating back to the original construction. The configuration contains two elevators positioned into a dual shaft with one pair servicing the east and the other servicing the west wing.

The design intent is to remove the existing cabs in these shafts and replace them with new cabs, motors, and controllers as part of a fully operating system. HDR anticipates the reconfiguration of the elevator machine room in the parking garage. Additional design information is included in the design narrative as provided by the elevator consultant and included in the Appendices of this Narrative – See section 2-14.

Additionally, the design intent is to remove the service elevator and all related equipment that currently occupies the west wing near the south stair of the existing Herschler building servicing the parking garage level to the 4th floor.

Vertical transportation at the new dock storage area in the Lower Level will include a Mechanical vertical lift to move building supplies from the parking garage level to the raised elevator lobby – See drawing 3AE461.

C. Herschler Building Addition

1. Concrete

Precast panels will be installed as part of the rainscreen system and used at the base of the Herschler building addition from grade to the 2nd floor.

2. Masonry

The design of the exterior wall assembly for the north addition of the Herschler building will contain new 2” to 3” Indiana Limestone cladding panels, as part of a rainscreen system.

Cast stone is anticipated at the openings of the exterior façade including sill components and wall caps.

3. Metals

As part of the exterior wall assembly, the design will utilize cold formed metal framing to support the new exterior rainscreen assembly. A 6" metal stud is anticipated at the majority of the exterior perimeter locations.

A dry joint metal panel system will be utilized as a rainscreen wall/soffit system above the new north curtainwall assembly and curtainwall locations between the existing Herschler building and north addition locations.

4. Woods, Plastics, Composites

As part of the rainscreen wall system, gypsum sheathing will be placed onto the metal stud framing member. The gypsum sheathing will be the substrate for the fluid applied air/vapor barrier.

5. Thermal and Moisture protection

The various rainscreen systems will contain a 4" rigid fiber insulation over a fluid applied air/vapor barrier (vapor permeable). The air/vapor barrier will be tied into the new curtainwall system and the new roofing system at the parapet. Additionally, the proposed new air/vapor barrier will tie into the new green roof /plaza deck system at the existing Herschler parking garage structure.

Overlap/Tie-ins are anticipated to use a peel and stick type product fully compatible with each other as well as the air/vapor barrier. Note: The same peel and stick product will be utilized at corner conditions in order to provide a fully compatible and functioning system.

A new IRMA roof system over a new sloped composite metal deck and concrete slab will be installed at the north addition. The design anticipates to separate the new roof of the north addition from the new roof of the existing Herschler building with new curbs separated by an expansion joint.

In addition, the remaining infill areas between the north addition and the existing Herschler building will utilize a green roof and an open joint paver roof system over the protected hot-applied liquid waterproofing membrane over the existing parking garage structure.

6. Openings

The dominant exterior "punched" opening assemblies include a new outside glazed curtainwall system of aluminum.

The openings that are located between the existing Herschler building and the addition to the north as well as the expansive north curtainwall opening will utilize the same new outside vertical butt glazed system of aluminum as used at the new exterior south stairs.

The clerestory "pop-up" above the new north, interior communicating stair will utilize a new outside glazed curtainwall system of aluminum.

Glazing systems in the curtainwall assembly of the main body of the Herschler building will include high performance coated glazing and vision glass. High performance coated glazing with prefinished, metal "backpans" will be utilized at select areas of the punched openings to provide a "shadowbox" effect and relate to the interior wall layouts anticipated as part of the T.I. package of the project to be distributed at a later date.

Low iron glazing will be used at the expansive opening of the north elevation and the opening enclosures located between the existing Herschler building and the addition to the north at the exterior of the building.

The design of the new elevator core will contain drop down smoke curtains at each elevator as part of a fully operating system tied to the fire suppression system. Vertical draft curtains will be designed as surrounding elements to the communication stairs at the Connector to 1st floor and the communication stairs in the north addition of the Herschler building located at each floor from the 1st to 4th.

The design of the multi-story vertical open space of the interior at the new secondary entry points between the north addition and existing Herschler building will utilize a horizontal, 2 hour fire shutter assembly at a single floor to remove the need of a smoke evacuation system as typically required for an atrium thus creating a vertical compartment separation.

7. Vertical Transportation

The new vertical circulation for the Herschler building addition is provided by 4 traction elevators configured in a new central elevator core located in the existing area of the atrium on top of the existing raft slab at the lower level. The existing raft slab will provide the bottom of the elevator pits in this location. The configuration contains two dual elevator shafts positioned facing each other in the central core.

Additional design information is included in the design narrative as provided by the elevator consultant and included in the Appendices of this Narrative – See Section 2-13.

D. Connector

1. Concrete

The perimeter walls of the Connector will be constructed with CIP concrete and tied into the existing mat slab. Throughout the Connector, multiple walls will be constructed as load bearing structural walls. The roof structure will be constructed with sloped hollow core precast planks with topping slab.

Multiple locations of the existing mat slab will receive new elevated concrete slabs.

Additional information pertaining to these components will be provided in this Project Manual as part of the structural narrative – See Section 2-4.

2. Masonry

Where exterior walls are exposed above the pedestal paver system and green roof, such as skylights, a cast stone material will be used as an integrated rainscreen wall assembly.

The Connector will use a CMU wall assembly at various MEP support rooms and the perimeter wall separating the existing parking garage from the main Connector spaces.

3. Thermal and Moisture protection

Exterior concrete perimeter walls will utilize a direct applied below grade waterproofing system that will be tied into the existing mat slab waterproofing system and the new roofing waterproofing system to create a monolithic waterproof system. Additionally, the waterproofing system will be tied into the new perimeter drain system per the Geotechnical Report Recommendations. See Section 6-3.

A rigid insulation board will be placed over the waterproofing system. The intent is to maintain continuity of the insulation layer from the wall to roof assemblies.

A drainage board layer will be placed over the insulation board. Similarly, we will match the continuity of the insulation layer with the drainage board with the walls and roof. The drainage board will be tied directly to the perimeter drain per the Geotechnical Report Recommendations. See Section 6-3.

Note: For additional perimeter dewatering system requirements see the Geotech Report in section 6-3.

In addition, the areas above the Connector will utilize a green roof and an open joint paver roof system over the protected hot-applied liquid waterproofing membrane. Refer to drawings for recommended products.

4. Openings

The Connector contains 3 large anodized aluminum skylights with sloped glazing to provide daylight into the interior space of the lower level building. The design will only employ these 3 opening s in the exterior wall and roof assembly in order to remove the infiltration of water into the finished space.

A watertight expansion joint system will be implemented as part of the Connector to provide movement control between the Capitol and Connector and the Herschler building and the Connector portions of the project.

E. Central Utility Plant (CUP)

1. Concrete

The perimeter walls of the CUP will be constructed with CIP concrete and tied into a new mat slab. The roof will be constructed with a sloped composite roof structure and topping slab supported by concrete columns. See the Structural Narrative for additional information.

The new mat slab of the CUP mezzanine will align with the floor of the parking garage and tie into the existing mat slab of the Herschler building. The floor of the CUP, lower level 2, will contain an independent mat slab with an integrated sloping top that is significantly lower than the new mezzanine floor. Note: A new dewatering system will be placed below the new mat slabs within the CUP. See the Geotech Report for additional information - See Section 6-3.

Additional information pertaining to the structural components will be provided in this Project Manual as part of the structural narrative – See Section 2-4.

Building services will be routed through a new underground tunnel that will terminate at the existing underground tunnel to the east of the Capitol building. Additionally, a new tunnel link will pick-up to the west of the existing tunnel and terminate at the new proposed security area.

2. Masonry

All interior walls as part of the CUP will be constructed as Calcium Silicate Masonry Units - CSMU.

Where the exterior walls of the CUP are exposed at the east ramp an Indiana limestone cladding system will be employed as part of a rainscreen system.

3. Thermal and Moisture protection

Exterior concrete perimeter walls will utilize a direct applied below grade waterproofing system that will be tied into a new mat slab waterproofing system and the new roofing waterproofing system to create a monolithic system. Additionally, the waterproofing system will be tied into the new perimeter drain system per the Geotechnical Report Recommendations. See Section 6-3.

A rigid insulation board will be placed over the waterproofing system. The intent is to maintain continuity of the insulation layer from the wall to roof assemblies.

A drainage board layer will be placed over the insulation board. Similarly, we will match the continuity of the insulation layer with the drainage board with the walls and roof. The drainage board will be tied directly to the perimeter drain.

Note: For additional perimeter dewatering system requirements see the Geotech Report in section 6-3.

On top of the new sloped CUP roof structure, a green roof system will be placed over the protected hot-applied liquid waterproofing membrane.

4. Openings

The south elevation of the new CUP will receive new architectural louvers integrated into the new rainscreen system.

A secure, overhead coiling door will be utilized at the west side of the CUP for future equipment replacement along with a hoistway beam.

A Standard overhead coiling door will be placed between the chiller and boiler areas of the CUP for supply and equipment movement.

5. Vertical Transportation

The Central Utility Plant will use a mechanical vertical lift to move equipment and supplies from the mezzanine, aligned with lower level 1, down to the Lower Level 2 – See drawing 3AE461.

F. North Drive

1. Concrete

The perimeter walls of the new north drive will be constructed with Architectural Cast-in Place Concrete - ACIP concrete and tied into a new mat slab. The roof at the "pop-up" area in the center of the drive will be constructed with a sloped composite roof structure and topping slab supported by the surrounding concrete walls. See the Structural Narrative for additional information.

The new mat slab for the north drive will align with the floor of the parking garage and tie into the existing mat slab of the Herschler building.
Note: A new dewatering system will be placed below the new mat slab of the north drive. See the Geotech Report for additional information - See Section 6-3.

Cast stone is anticipated for use of wall caps.

2. Thermal and Moisture protection

Exterior concrete perimeter walls will utilize a direct applied below grade waterproofing system that will be tied into a new mat slab waterproofing system and the new roofing waterproofing system to create a monolithic system. Additionally, the waterproofing system will be tied into the new perimeter drain system per the Geotechnical Report Recommendations. See Section 6-3.

A drainage board layer will be placed over the waterproofing system. Similarly, we will match the continuity of the drainage board with the walls and roof. The drainage board will be tied directly to the perimeter drain.

Note: For additional perimeter dewatering system requirements see the Geotech Report in section 6-3.

3. Vertical Transportation

The North Drive, and specifically the dock portion, will use 2 vertical dock lifts to move equipment and supplies from delivery trucks to the level of the new dock for distribution throughout the site.

SECTION 2.6
INTERIOR DESIGN

PART 1 - GENERAL

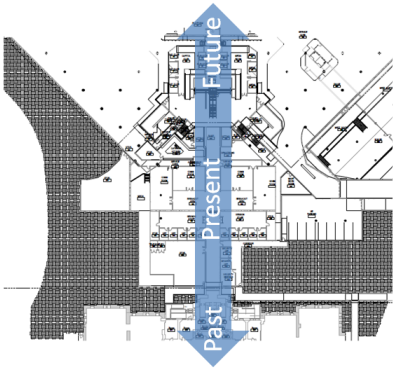
OVERALL SUMMARY

1.1. The design should incorporate the unique natural splendor of Wyoming, the unspoiled wilderness, the American West history, character and traditions. Because the Herschler building it is part of the State of Wyoming, the building really belongs to its people. So it should be a reflection of its culture, history and future. In designing for the renovation, we must take into consideration the needs of the government employees, of the agencies they represent and of the state government as a whole. They are a diverse group that includes people of varied age, ethnicity, gender and physical disabilities. The goal is to produce an environment that values all core identities equally and creates a true level playing field to compete and succeed.

One of the many design challenges is to gracefully marry the historic interior ornamental components of the Capital with the Herschler interiors in a way that is graceful, respectful and forward thinking. The multi-agency and campus like design must feel cohesive and holistic, yet support and maintain group identities. This could be accomplished through traditional finishes applied in a contemporary manner with color and graphics.

The connector link is a key transition element connecting the buildings that should convey a sense of the past when leaving the capital and conversely - looking into the future upon entering the Herschler building. Key art pieces should be selected in this area and throughout the public and meeting spaces. The art should be of the highest quality and reflect significant subjects of the state.

HESCHLER BUILDING



STATE CAPITOL

1.2. CONCEPT & APPROACH

A. Overall Interior Environment and Office Program Goals

- Optimize state consolidated space in a “totally new” facility.
- Develop a safe and healthy working environment for the delivery of government services.

- Explore emerging workplace ideas and trends for quality operations.
- Assess agency services and elected officials office needs to validate initial build out.
- Evaluate and differentiate future agency departmental growth needs.
- Develop strategies to improve internal and external government operations.
- Develop appropriate space for the diverse Wyoming population and programs.

B. Key design concepts have yet to be developed, further meetings with State of Wyoming decision makers will be required to determine a overall design concepts that express the state's history, culture, natural beauty, unique businesses and industries.

1.3 INTERIOR COMPONENTS & QUALITY FINISH LEVELS

A. Construction General Notes:

1. Contractor to provide level 4 finished surface on all existing drywall perimeter and core walls.
2. Contractor to provide level 5 finish at all drywall ceilings.
3. All new partitions adjoining perimeter walls to have vertical slip joint connection, if applicable.
4. All new partitions adjoining existing core walls to have vertical slip joint connection, if applicable.
5. All holes in slabs are to be filled with code compliant filler. maintain the existing floor slab rating at all floor slab penetrations as required by UL design guidelines.
6. Frame around ductwork as required at walls to deck and grid break partitions.
7. All partitions within wet areas shall be water resistant gypsum wallboard (i.e. pantry sink areas, restrooms, etc.)
8. Provide fire treated wood blocking or metal blocking in walls as required for secure installation of all millwork, doors, windows and accessories.
9. Contractor to level floor as required to install new finishes.
10. All carpeted areas to receive 4” straight base. all resilient flooring areas to receive 4” coved base, unless noted otherwise..
11. Provide and install schluter scheine or equal at all transitions between carpet and hard surface flooring, stainless steel 304 finish.
12. Provide and install matching resilient transition strip at all transitions between carpet and resilient flooring, unless noted otherwise.
13. All painted wall surfaces are to be painted with two coats of paint and one coat of primer on all new walls. all areas in which any alteration or construction is required as shown on plan will receive one coat tinted primer and one or two finish coats of paint to achieve uniform finish.
14. Contractor to provide mock-ups of all paint, fabric wall panels, and wall coverings for architect's approval.
15. Contractor to submit carpet seaming diagram for architect's approval. seams along the length of hallways and other conspicuous areas are to be avoided.
16. All stone surfaces to be sealed with clear penetrating sealer per manufacturer's instructions.
17. For all glass, metallic or other specialty wall or floor tiles, contractor to submit (2) 9" x 9" minimum mock-ups for each specified tile.
18. Flame spread: All finish materials and assemblies attached to interior walls of exit enclosures to be class b or better. finish materials at all other interior walls to be class c or better.
19. Provide and install as required, mecho shade type window covering throughout building.
20. All wood millwork to be AWI premium grade. all plastic laminate millwork to be AWI custom grade.
21. All wood paneling and molding to be AWI grade a cherry with transparent stain to match architect's sample.

1.4 FINISH QUALITY LEVEL PER AREA

A. Area Type 1: Great Hall, Committee Rooms, Breakout Areas, Main Public Spaces
   1. Provide and install natural stone tile or poured-in-place terrazzo floor with decorative metal insets
   2. Provide and install 2'-0" h stone base to match flooring with cut reveals
   3. Provide and install acoustical fabric panels with wood decorative molding at all walls in this area
   4. Provide and install continuous, recessed metal art rail along entire corridor length, both sides.
   5. Provide and install rated firelite type glass doors or equal and as required to meet building code
   6. Provide and install custom wood doors with transparent finish with grade a faces, raised molding and custom wood frames throughout
   7. Provide and install semi-custom - solid metal finish door hardware throughout, no spray on metal finishes will be acceptable
   8. All doors requiring closures to have concealed hardware at header or recessed in floor

B. Area type 2: Capitol Club, Media Rooms
   1. Provide and install carpet, $55 per sq yd installed, with 12” high wood base with reveals, throughout.
   2. All walls to have an STC rating of 45 or greater.
   3. Provide and install vinyl wallcovering throughout.
   4. Provide and install 4” wood chair rail throughout.
   5. Provide and install custom wood doors with transparent finish with grade a faces, raised molding and custom wood frames throughout.
   6. Provide and install semi-custom - solid metal finish door hardware throughout, no spray on metal finishes will be acceptable.
   7. All doors requiring closures to have concealed hardware at header or recessed in floor.

C. Area type 3: Office Corridors
   1. Provide and install carpet, $55 per sq yd installed, with 8” high wood base with reveals, throughout
   2. All walls to have an STC rating of 45 or greater
   3. Provide and install vinyl wallcovering throughout
   4. Provide and install rated firelite sidelights as required to meet building code.
   5. Provide and install solid core premium quality wood doors with hollow metal frames.
   6. Provide and install lever handle, solid metal lockset for all offices and latch set for all meeting/ conference rooms.
   7. All doors requiring closures to have concealed hardware at header or recessed in floor.

D. Area type 4: Session Offices, Open Office Areas
   1. Provide and install carpet, $45 per sq yd installed, with 4” high rubber base, throughout.
   2. Provide and install vinyl wallcovering in 25% of all office spaces.
   3. Provide and install accent paint color on 1 wall in all private offices.
   4. All wood doors to be solid core premium quality wood with hollow metal frames.
   5. Provide and install lever handle, solid metal lockset for all offices and latch set for all meeting/ conference rooms.
   6. All doors requiring closures to have concealed hardware at header or recessed in floor.

E. Area type 5: Storage and Utility rooms
   1. Provide and install sealed concrete with high traffic coating throughout.
   2. Provide and install paint throughout.
   3. Provide and install painted hollow metal doors with hollow metal frames.
   4. Provide and install lever handle, solid metal lockset for all offices, storage and utility rooms.

F. Area type 6: Conference Facilities, Legislator Offices
   1. Provide and install carpet, $55 per sq yd installed, with 12” high wood base with reveals, throughout.
   2. All walls to have an STC rating of 45 or greater.
   3. Provide and install vinyl wallcovering throughout.
   4. Provide and install custom wood doors with transparent finish with grade a faces, raised molding and custom wood frames throughout.
   5. Provide and install semi-custom - solid metal finish door hardware throughout, no spray on metal finishes will be acceptable.
   6. All doors requiring closures to have concealed hardware at header or recessed in floor.

G. Elevator Cabs - Public

   1. Provide and install natural stone tile or poured-in-place terrazzo floor with decorative metal insets.
   2. Provide and install custom metal, ADA compliant hand railing. 1 per cab.
   3. Provide and install 1'-0" h natural stone base to match flooring with cut reveals throughout.
   4. Provide and install custom wood paneling throughout.

H. Elevator Cabs - Office
   1. Provide and install porcelain tile floor throughout
   2. Provide and install custom wood paneling throughout
   3. Provide and install stainless steel, ADA compliant hand railing. 1 per cab
   4. Provide and install 6" high porcelain tile base to match flooring

I. Stairs - Ornamental
   1. Provide and install natural stone slab stair treads with decorative metal riser insets and custom metal, ADA compliant handrail.
   2. Provide and install natural stone tile or poured-in-place terrazzo floor and custom metal, ADA complaint handrail
   3. Provide and install 2'-0" h stone base to match flooring with cut reveals

J. Stairs - Office (5 story)
   1. Provide and install resilient flooring at all treads, risers and landings on "existing" stairs.
   2. Provide and install ADA compliant metal handrail on "existing" stairs.
   3. Provide and install rubber base to match flooring throughout.
   4. Provide and install Scuffmaster paint or approved equal on all "existing" walls throughout.

K. Catering Kitchen
   1. Provide and install porcelain tile floor throughout.
   2. Provide and install ceramic tile on all walls throughout.
   3. Provide and install custom plastic laminate millwork with solid surface countertops in 25% of space.

L. Restrooms
   1. Provide and install natural stone tile floor throughout.
   2. Provide and install porcelain tile to 4'-0” AFF throughout.
   3. Provide and install vinyl wallcovering from 4'-0” AFF to ceiling throughout.
   4. Provide and install stainless steel toilet partitions - support off walls.
   5. Provide and install granite countertops at all vanities, with tube steel supports in wall to support countertop. provide stainless steel, under mount sinks with touch less faucets and soap dispensers.
   6. Provide and install all ADA compliant grab bars, accessories, paper towel dispensers, diaper changing stations (stainless steel), and trash receptacles
   7. Provide and install 1 full height mirror at each restroom

1.5 REFLECTED CEILING - QUALITY LEVEL PER AREA

A. Area type 1: Great Hall, Committee Rooms, Breakout Areas, Main Public Spaces
   1. Provide and install drywall ceilings throughout.
   2. Provide and install decorative wood crown molding throughout.
   3. Provide and install coffered detail on 50% of all ceilings.
   4. Provide and install cove lighting along entire corridor.
   5. Provide and install custom, ceiling mount pendant light fixtures.
   6. Provide and install decorative wall mount sconces interspersed throughout corridor .
   7. Provide and install recessed 4" wall wash fixtures - art work lighting.

B. Area type 2: Capitol Club, Media Rooms, Conference Facilities, Legislator Offices
   1. Provide and install 2x2 ceiling grid and fine fissured tegular acoustical ceiling tile throughout, unless noted otherwise.
   2. Provide and install 20% drywall ceilings/soffits.
   3. Provide and install decorative wood crown molding throughout.
   4. Provide and install 2x2 led direct/indirect light fixtures on fully dimmable control system throughout, unless noted otherwise.
   5. Provide and install 4” wall wash fixtures for 25% of ceiling.

C. Area type 3: Office Corridors
   1. Provide and install 2x2 ceiling grid and fine fissured tegular acoustical ceiling tile throughout
   2. Provide and install 2x2 led direct/indirect light fixtures throughout, unless noted otherwise
   3. Provide and install 4” wall wash fixtures for 10% of ceiling

D. Area type 4: Session Offices, Open Office Areas
   1. Provide and install 2x2 ceiling grid and fine fissured tegular acoustical ceiling tile throughout.
   2. Provide and install 2x2 led direct/indirect light fixtures throughout, unless noted otherwise.
   3. Provide 4” wall wash fixtures for 15% of ceiling.

E. Area type 5: Storage and Utility Rooms
   1. No ceiling in this area - will be open to deck.
   2. Provide and install 8' long pendant mounted fluorescent fixtures throughout.

F. Area type 6: Legislator Offices
   1. Provide and install 2x2 ceiling grid and fine fissured tegular acoustical ceiling tile throughout, unless noted otherwise.
   2. Provide and install 20% drywall ceilings/soffits
   3. Provide and install decorative wood crown molding throughout
   4. Provide and install 2x2 led direct/indirect light fixtures on fully dimmable control system throughout, unless noted otherwise.
   5. Provide and install 4” wall wash fixtures for 25% of ceiling

G. Elevator Cabs - Public
   1. Provide and install ornamental metal ceiling
   2. Provide and install 8, recessed led down light fixtures per cab

H. Elevator Cabs - Office
   1. Provide and install ornamental metal
   2. Provide and install 8, recessed led down light fixtures per cab

I. Stairs - Ornamental
   1. Provide and install custom multi- story pendant and ADA compliant wall sconces at each story.

J. Stairs - Office (5 story)
   1. Provide and install mid-range price point, surface mounted fluorescent fixtures and ADA compliant wall sconces.

K. Catering Kitchen
   1. Provide and install gypsum board ceiling throughout.
   2. Provide and install led recessed down lights throughout.

L. Restrooms
   1. Provide and install gyp board ceiling throughout.
   2. Provide and install cove lighting at perimeter of room.
   3. Provide and install led recessed down lights throughout.
   4. Provide and install ADA compliant wall sconce fixtures integrated into all vanity mirrors.

SECTION 2.7
HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The selected mechanical systems and equipment will support the new facility and meet and/or exceed the new program and conventional requirements for the indoor air quality, comfort, maintenance, and energy efficiency.

B. All systems will be designed to conform to the 2012 International Building Codes (IBC), 2012 International Mechanical Code (IMC), 2012 International Energy Conservation Code, OSHA safety codes, NFPA Codes, applicable local codes and regulations of the authorities having jurisdiction.

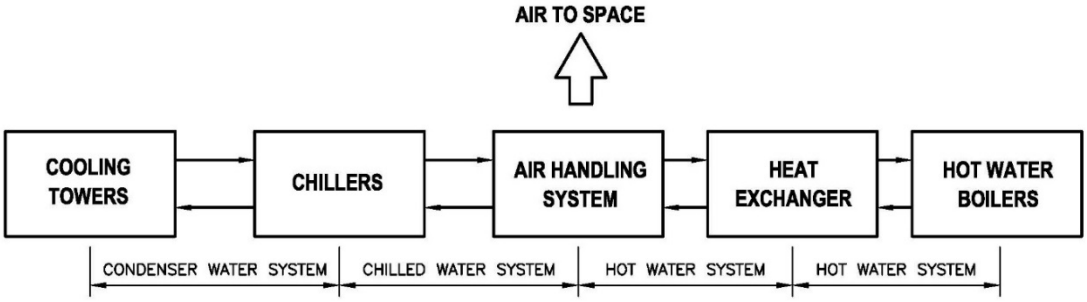
1.2 EXISTING CONDITIONS

A. The existing HVAC systems at the Herschler Building are beyond their expected useful service lives and will be replaced in their entirety. The existing chillers and steam boilers located within the Herschler Basement and Connector Mechanical Rooms will be removed and new systems put in their place with a new Central Utility Plant or CUP. Existing cooling towers, located at grade, and the existing snow melt system will all be removed to make room for new program space and completely new mechanical systems. All of the ductwork and piping risers are to be replaced within the Herschler Building. The existing floor by floor, built up AHUs will have the coils and fans removed but the actual AHU casing / room wall will remain and be reused.

PART 2 - SYSTEMS DESCRIPTION

2.1 PROPOSED MECHANICAL SYSTEMS

A. Central Utility Plant (CUP)
   1. Air and water system



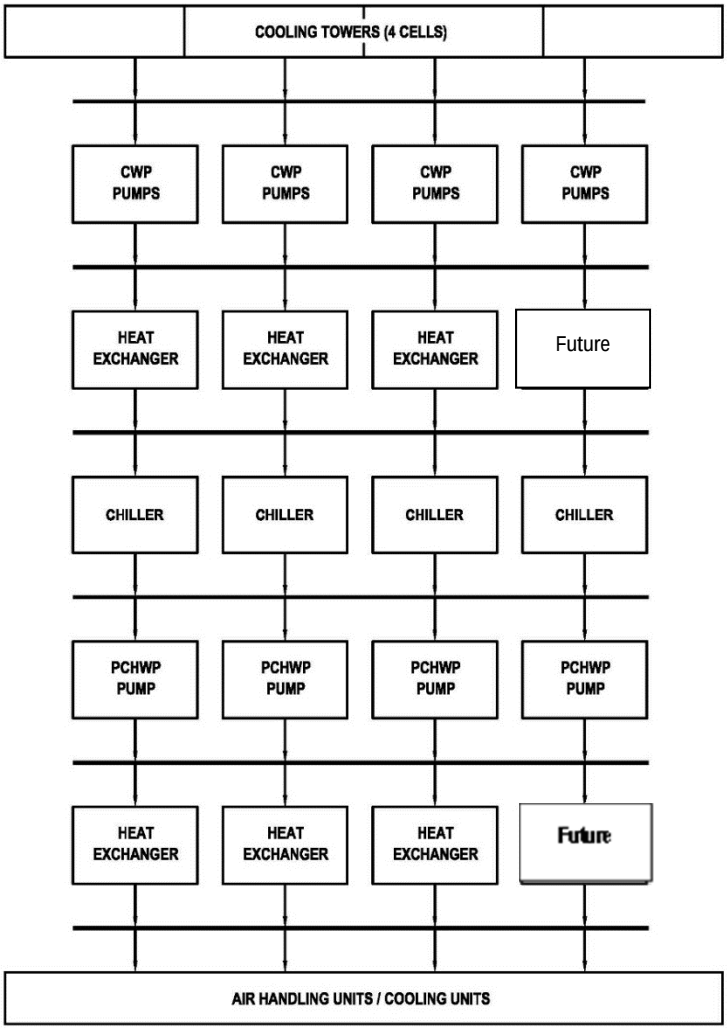
   a. Cooling systems: chilled water will be used. Four electric centrifugal chillers of 550 tons each (units to be oil less units with magnetic levitation bearings with variable speed drive compressors) will be designed for. Each chiller will be capable of 33% of the total design load for an n + 1 redundant chiller capacity. The total cooling load is approximately 1650 tons.
   b. Refer to the Schematic Design drawings for additional equipment information and diagrams.

c. The cooling summary schematic block loads for all buildings are included in Section 4.1 herein.

2. Heating systems: hot water heating with condensing hot water boilers
   a. Hot water boilers will be provided in the new central plant (CUP) for comfort heating purposes, snow melt, and domestic hot water heating. The boilers will be natural gas fired high efficiency, condensing type that have an efficiency greater than 90% when hot water return temperatures approach 120°F temperatures. The temperatures for this system will be 160°F supply temperature and 130°F return temperature with the water reset upon outdoor air temperature to get the temperatures closer to 120°F to promote condensing as much as practical. By resetting the temperatures as much as possible, the boilers will be in the temperature range of maximum efficiency which means that the boiler flue temperatures will reach a "condensing" point which is the point of optimal efficiency. The boiler systems will however have the capability to provide 180°F water if the space temperatures are not being met. The new systems in the Herschler Building and the Capitol Building will all use hot water for their heating needs. Hot water will be produced with seven boilers which will give the system n + 1 redundancy. Three heat exchanger (HX) units for the pre-heat systems and three HX units will be used for the snow melting. These systems will use heat exchangers since this system will use 40% propylene glycol for freeze protection. Each HX unit will be sized for 50% of the required capacity for n + 1 system redundancy. The hot water distribution systems will be configured as a variable flow system with two way valves in the system and variable speed pumps feeding into this system. This will allow for horsepower savings at the hot water pumps.
   b. Refer to the Schematic Design drawings for additional equipment information and diagrams.
   c. The heating summary schematic block loads for all buildings are included in Section 4.1 herein.
3. Snow melt system
   a. The garage ramps, sidewalks and areas of the plaza above the connector space will be provided with a snow melt system (refer to Schematic Snow Melt drawings for proposed extent of system). This snow melt system will obtain its heat from the new hot water boilers via plate and frame heat exchangers as previously mentioned. The water distributed to the snow melt system will be 40% propylene glycol and have a supply temperature of 100 degrees F. Separate pumps will be provided for this system.
   b. This system will require manifold rooms or mechanical rooms nearby to each space that is to receive the snow melt system. Coordination of these spaces has not yet taken place. The supply and return piping manifolds for the snow melt system are to be located in these rooms.
4. Humidification:
   a. No humidification will be used in these facilities.
5. Domestic hot water heating:
   a. The new domestic hot water system will use the heating hot water through a plate and frame heat exchanger to produce hot water. This hot water system will be a back up to the new solar thermal hot water heating system being proposed to replace the existing solar thermal system. There will be one duty and one stand-by HX as well as associated pumps for this system. Refer to the Plumbing narrative for additional requirements.

6. Air handling units: (note: all AHUs are indoor units)
   a. Central plant area: recirculating heating & ventilating (H & V) unit for the mechanical room spaces and chiller room - H & V - C - 101, and boiler room H & V – C- 102. Heating coils in these units will maintain 60 degrees f in the winter except office unit (FCU-C-1) will maintain 75 degrees f in summer and 72 degrees f in winter. H & V units are to be configured as follows: filter / mixing box for outside air and return air, MERV 8 pre-filters and MERV 13 final filters, multiple row hot water (40% propylene glycol) heating coil, plenum style supply fans.
   b. Chiller room purge: upon the activation of the refrigerant monitoring system, the room exhaust fan will be activated and it will purge the room. The cup H & V unit will be configured for 100% outside air during this event.
   c. Natural gas room exhaust: this space will be constantly exhausted at the rate of 6 air changes per hour.
   d. Telecom / AV rooms - rooms will be served by fan coil units.
7. Chilled water system
   a. System description: The chillers will utilize an open cooling tower system with one cooling tower per chiller for a similar N + 1 redundancy. The cooling towers will be located at a new exterior roof area at the 4th Floor of the existing East Wing of the Herschler Building. A single variable speed condenser water pump will be provided for each chiller and cooling tower cell. They will be interconnected for redundancy. The chillers will be primary variable speed / variable flow through the chiller barrel. There will be one chilled water pump for each chiller arranging common header configuration. All new chilled water pumps will be fitted with variable speed drives for optimal efficiency. The new chilled water system will tie into the existing tunnel piping network serving the Supreme Court, Barrett and Hathaway buildings.
   b. The condenser water system will be a flow control system and will include a side stream filtration system with its own separate pump. Due to the equipment (heat exchangers and chillers) having similar pressure drops, the system will generally be self-balancing within the central plant.
   c. A winter time plate and frame heat exchanger (HX) will be provided for winter time cooling loads. The HX unit will use the same chilled water and condenser water pumps that are being used for the chillers. The plate and frame exchangers are required for winter, waterside economizer, for the Capitol Building AHUs and fan coil loads located throughout the system. This system is designed as an "integrated economizer" so that the HX units are capable of doing, for example, the first seven degrees of cooling, and then the chillers would do the last seven degrees of cooling.
   d. Only three plate and frame heat exchangers will be provided (not four) since cooling requirements will be reduced significantly in the winter time.
   e. The cooling towers will be arranged so that there is one tower per chiller.
   f. A condenser water filtration system (sidestream) is being provided to maintain the cleanliness of the condenser water system. These systems have been shown to be highly worthwhile as they maintain high levels of efficiency and also reduce blow down requirements of the system thereby saving significant make up water.

g. The block diagram below provides chilled / condenser system configuration:



B. Connector Link (Conn)

1. The connector building spaces will be served by two new heat recovery air handling units (HRUs) which will feed conditioned ventilation air (neutral air) into fan coil units (FCUs) for zone control. Each HRU will be located within new mechanical rooms (MERs) located at the connector level – one to the East and one to the West. Multiple, four pipe FCUs will then serve the individual zones. Each of the FCUs will be single zone variable speed units using either ECM motors or VFDs for speed control.
2. A demand controlled ventilation (CO2) system will be provided to adjust the amount of ventilation air being provided by the ventilation air unit and to track ventilation rates.
3. The spaces will use either linear slot diffusers or square “Plaque” type of diffusers or combinations thereof. The diffusers serving the central corridor will be double deflection sidewall registers. All spaces will have a return plenum for return air. The West side will use a mechanical corridor as a return plenum and the FCUs on the East side will be located above the occupied spaces.

C. Parking Area

1. The existing relief air being supplied to the space and the existing exhaust air systems will be conceptually be the same for the changes and additions. The new energy recovery units will provide ventilation air to the parking level. The parking level will also have Carbon Monoxide (CO) detectors and the exhaust and located to the Northeast and the Northwest will be replaced. These fans are to be engaged upon a rise in CO levels within the garage. The VIP parking will be provided with a separate CO detection system and a separate exhaust system for ventilation.
2. Hot water unit heaters will be placed in strategic locations throughout the garage to maintain temperatures above freezing at all times in the garage.
3. Revisions associated with new ramps, dock and VIP Parking Area; dedicated heating and cooling for VIP Parking Area.
4. The existing snow melt boiler system will be removed and relocated and piping replaced.

D. Herschler Renovation

1. Existing HVAC systems serving the renovated tenant areas, floor by floor Air Handling Units, will be completely renovated and provided with new direct digital control (DDC) pressure independent terminal boxes, new medium pressure and low pressure ductwork based on the new space configurations. Where applicable, each space will be zoned separately via the use of pressure independent terminal boxes. Each existing AHU fan room, eight (8) in total, two (2) per floor, will be retrofitted as follows: The existing pneumatic controls, fans, cooling coils and heating coils will be removed. New fans, hot water coils, chilled water coils, DDC-based controls, and new variable frequency drives (VFDS) will be provided. The existing hot water and chilled water risers will be tested for reuse. The fresh air intakes will have installed at the roof intake a filter rack and a preheat coil to temper the incoming air.
2. Each floor by floor unit will be capable of just below 45,000 CFM of supply air and they will have a maximum of 35% outside air from the new energy recovery unit. Each unit will also have the capability of winter time cooling with a waterside economizer. These new units are approximately equal in size and capacity to the existing floor by floor units.
3. The floor by floor AHUs will be fed tempered air from a single energy recovery wheel AHU. This unit will have MERV 8 and MERV 13 filters on the supply air and it will also have hot water (40% glycol) heating coils to further temper the air if needed. The units will not have a cooling coil. These units will be located indoors above the toilet / central core in a new penthouse type of structure. This unit will provide ventilation air to the parking garage via a new duct extending from the roof down to the parking level. The units will be supplied air that is to be measured at each floor by floor AHU location. A demand controlled ventilation (CO2) system will be provided to adjust the amount of ventilation air being provided by the ventilation air unit and to track ventilation rates.
4. The existing solar atrium exhaust fan rooms will be removed due to the new tenant infill and vertical circulation program space in the Basement / Parking level. A new exhaust fan room will be provided based on the configuration of the new tenant infill and vertical circulation program spaces on 1st- 4th floors.
5. The existing atrium smoke control exhaust system will be removed in its entirety.
6. New vertical circulation (elevators and stairs) will be provided with new HVAC provisions. Mechanical room locations and space requirements will be determined as part of the future Level III scope of work.
7. Floor mounted fin tube radiation will be provided at all exterior locations where there are windows. It is envisioned that these units will be low-profile, floor or pedestal mounted.

E. Herschler Addition:
   1. The new addition will be provided with floor by floor air handling units similar to what is existing, and proposed for renovation, within the existing Herschler Building.
   2. Single wheel energy recovery units will provide ventilation air to the floor by floor units.
   3. A demand controlled ventilation (CO2) system will be provided to adjust the amount of ventilation air being provided by the ventilation air unit and to track ventilation rates.
   4. Floor mounted fin tube radiation will be provided at all exterior locations where there are windows. It is envisioned that these units will be low-profile, floor or pedestal mounted.
   5. A toilet exhaust fan will be provided for the West Core toilets and a second fan will be provided for the East core toilets. This fan will be a mushroom type of fan located on the roof.

F. New Infill Space between existing East and West Wings of Herschler
   1. This space will be heated and cooled by multiple fan coil units. Along the southern glass, fin tube radiation will be placed at 20 foot intervals to offset the cold air that will spill down from this window. This fin tube radiation, with decorative cover, will also be used at the northern most glass in the addition. Ventilation air for the space will be taken from the floor by floor units located in the core f the East and West wings.

G. New Stair Towers on Existing East and West Wings
   1. The new stair towers will be heated and cooled by fan coil units. At least one fan coil unit will be placed in the top floor and one in the lowest floor of each stair tower.

H. Herschler Atrium
   1. The newly renovated Herschler Building is currently being designed to not need atrium smoke exhaust fans.

I. Emergency Generator Fuel Oil System
   1. The emergency generators will be fed fuel oil from a new fuel oil tank of approximately 15,000 gallons which gives approximately four days of run time. The tank will be located near the new North Drive area; access to the vault via a man-door and removable roof or wall panels will be provided for maintenance and future replacement of the tank. A duplex, skid mounted fuel oil pump system will be provided to take fuel oil from the tank up to the emergency generators located on the new Herschler Addition Roof. Fuel oil fill to the oil tank will be from nearby to the new loading dock area. Double wall piping with 2 inch inside piping and 4 inch outside piping will be provided within the Herschler building up to the emergency generators. A fuel oil filter system will also be provided for this system to keep the fuel oil ready for use.
   2. The fuel will be either low sulfur No. 2 fuel oil or low sulfur diesel fuel oil depending on the preferences of the maintenance personnel, the purchase agreements, and availability of fuel nearby.

2.2 BACKGROUND ON CERTAIN DECISIONS

A. Steam boilers Versus Condensing Boilers
   1. Steam boilers were not chosen for the heating system because of the client's desire to go with a more efficient heating plant. This new system will not allow for tie into the existing steam systems in the Barrett building, Supreme Court and the Hathaway buildings. With three 250 BHP, high pressure steam boilers in the Barrett building that typically serve the Barrett, Supreme Court and the Hathaway buildings, the client wanted to have the capability to back feed these systems from the new CUP boiler system but the efficiency of a new

condensing hot water system won out over the desire to back feed these older buildings. The current design of the CUP systems has the system capable of providing heat for the Capitol Building, Herschler Building and Herschler Addition, as well as the snow melt system, and domestic hot water systems at the Capitol Complex.

B. CUP Location / Water Infiltration Considerations
   1. With the water table being located about seven feet below the ground level, the entire CUP will be designed with a matt slab and waterproofing at the perimeter wall. The objective is to prevent the infiltration of outside water to the CUP. The equipment access will be through a coiling overhead door for large equipment access. A structural rail will be provided within the CUP to lift equipment from the CUP level up to the ramp level when equipment movement is needed.

C. Emergency and Stand-By Equipment
   1. It is the desire of the client to have the capability to keep the Capitol building running in both summer and winter if there is a power failure. Specific requirements and duration are to be confirmed. As a result, all of the heating equipment will be on stand-by power including boilers, pumps, and heating units (AHUs, etc.) The electrical system will allow the operation of any one of the four chillers on standby power as selected by the BAS. In the event of a power interruption in the summer, one chiller will be capable of running during this time period. All of the associated chilled water, condenser water and cooling tower systems for the one chiller will also be capable of running.

D. Atrium Smoke Exhaust System
   1. Current design does not have an Atrium smoke exhaust system within the Herschler building. This will be confirmed with the project team after the schematic design deliverable.

E. Equipment located On Existing Herschler Building East Wing Roof
   1. In order to keep the roof above the CUP “clean”, with minimal equipment located thereon, and to push the cooling tower plume away from the ground, the decision was made to put the cooling towers on the 4th Floor Herschler east wing which is now to be a new depressed “roof area” for this equipment. The cooling towers are to be located next to the backup generators that are also to be placed close to this same depressed roof area.

F. New Technology Chillers
   1. The chillers are to be magnetic bearing chillers that are very high efficiency and low maintenance as compared to more conventional electrical centrifugal chillers. This technology has proven itself in the marketplace for the past five to ten years and it offers great value to the project in terms of low maintenance and high efficiency.

2.3 SPECIAL EMPHASIS, CONCERNS, AND LIMITATIONS

A. CUP Roof (Ground Level)
   1. A green roof and landscaping have been proposed for the roof of the CUP. To maintain the aesthetic of this system, no pipes or ducts will be routed directly up to grade. The CUP roof area will maintain the open, clean look of the surrounding landscaping and to provide additional security for the CUP and associated equipment.

B. Tunnel System / Feeding Into Existing Buildings

1. The Supreme Court, Hathaway, and Barrett Buildings will receive chilled water and compressed air from the new CUP. New CHWS and CHWR piping will connect to the existing 6 inch piping within the existing tunnels located to the east of the Capitol Building. These pipes were installed new within the tunnel as part of a 1997 renovation project. Their current condition appears to be good. A new compressed air line, for building controls, will connect to the 2 inch existing pipe within the tunnels at about the same spot.

C. CUP Piping Supports

1. The piping supports for the large piping at the ceiling of the CUP are envisioned to be designed by the structural engineer with close coordination with the HVAC design. We believe that this will lead to better overall construction coordination, less miscellaneous steel and should then lead to lower construction costs.

D. Commissioning

1. The fundamental objective of the commissioning (Cx) process is to ensure that building systems are properly designed, installed and operational upon project completion and are in accordance with the state of Wyoming's project requirements. The commissioning process also ensures that the operations staff receives proper training and documentation for all systems. This process starts in the design phase and continues throughout the physical construction process and continues after occupancy of the finished building. The end result is reduced life cycle operating costs, from a thermal comfort, energy and maintenance perspective, for the building. The RFP for Cx services was issues on September 17th, 2014.
2. The commissioning procedure will be performed in accordance with ASHRAE guideline 0-2005 – the commissioning process. A team of certified commissioning professionals will be required to complete this effort in conjunction with the operations staff, the design team and the installing contractors.
3. The systems that can be part of the formal commissioning process include:
   a) HVAC systems
   b) Life safety systems
   c) Fire alarm systems
   d) Lighting systems and controls
   e) Select plumbing systems

E. Major commissioning tasks per phase are outlined below (The specific Cx scope is being addressed separately in other parts of the schematic report.):

1. Design Phase:
   a) Review the project design and develop with the state of Wyoming, an Owners Project Requirement (OPR) document which will be the guideline for commissioning agent and the project team in implementing the commissioning process.
   b) Develop a commissioning plan for the systems
   c) Develop commissioning specifications along with preliminary installation checklists and functional testing requirements.
   d) Requirement for performance testing requirements, operations and maintenance (O&M) training and O&M documentation will be included in the construction documents.
   e) Conduct commissioning design review and back-check at each the end of each design phase milestone.

2. Bid Phase:
   a) Attend construction pre-bid meeting to respond to commissioning related questions.
   b) Coordinate responses to commissioning related questions submitted by bidders.
   c) Review the bid proposals in order to assure that the contractor fully understands the project scope of work and that he/she has included in their bid all materials and labor necessary to satisfactorily complete the commissioning aspects of the project.
3. Construction Phase:
   a) Coordinate and direct the commissioning activities in a logical, sequential and efficient manner consistent with the OPR.
   b) Review contractors schedule and verify commissioning activities are planned and appropriated adequate time.
   c) Review contractor submittals including, shop drawings and catalog cuts for equipment being commissioned.
   d) Review O&M manuals, equipment warranties for compliance with the OPR.
   e) Plan and conduct commissioning meetings as required, coinciding with regularly scheduled bi-weekly construction progress meetings.
   f) Perform site visits as necessary to observe component, equipment and systems installation.
   g) Complete installation checklists.
   h) Witness all functional and operational equipment and systems tests.
   i) Review air balancing (TAB) reports for compliance with the OPR.
   j) Oversee the training of the operations and maintenance personnel.
   k) Provide bi-weekly progress reports of commissioning activities to include the status of:
      (1) Installation checklists
      (2) Functional testing
      (3) Performance testing
      (4) O&M training & documentation
      (5) Issues log
4. Close out phase
      (1) Provide a final commissioning report.
      (2) The systems that can be part of the formal commissioning process include:
      (3) HVAC systems
      (4) Life safety systems
      (5) Fire alarm systems
      (6) Lighting systems and controls
      (7) Select plumbing systems

PART 3 - SUMMARY SPECIFICATIONS

3.1 DESIGN CRITERIA:

Outside design conditions:

Location:	Cheyenne, Wyoming
Latitude:	41°
Elevation:	6,100 ft.
Winter:	DBT -10°F
Summer:	DBT 87°F
	WBT 62°F

Inside design conditions:

Dry bulb temperature (summer):	75°f (±2.0°F)
Dry bulb temperature (winter):	72°f (±2.0°F)
IDF / MDF / Electrical Rooms	65°F - 85°F

CUP:

Winter:	60°F
Summer:	Cooling not provided
Relative humidity (summer):	50% (±10%)
Relative humidity (winter):	Not Controlled
Mass wall construction :u value =	0.104 btu/h°f-sf (entire assembly)
r value =	9.5 h°f-sf/ btu (continuous insulation)
Roof construction (insulation entirely above deck): u value =	0.063 btu/h°f-sf

Window (subject to % glazed):

0-10%	u value =	0.57 btu/h°F-sf (fixed window)
	sc =	0.49 (north & all)
10.1-20%	u value =	0.57 btu/h°F-sf (fixed window)
	sc =	0.39 (all)
20.1-30%	u value =	0.57 btu/h°F-sf (fixed window)
	sc =	0.39 (all)
30.1-40%	u value =	0.57 btu/h°F-sf (fixed window)
	sc =	0.39 (all)
40.1-50%	u value =	0.57 btu/h°F-sf (fixed window)
	sc =	0.26 (all)

The building construction u-values have not been confirmed to date.

Occupancy	
Work room	1 person / 20 sf
Control room	1 person / 100 sf
Miscellaneous sensible gains:	
Office equipment:	1.5 watts/sf
Area lighting:	1.5 watts/sf
Noise criteria:	
Control rooms:	NC-45
Work room:	not defined
Open cup areas:	NC-55
Filtration:	

Air filtration to control contaminants will be provided in the air handlers by means of MERV 8 (30% atmospheric dust spot efficiency) pre-filters and MERV 13 (85%) final filters.

3.2 PRODUCT AND MATERIALS

A. Ductwork:
   1. All ductwork, fittings, dampers, hangers, stiffeners, joints, etc. Will conform to the requirements of the SMACNA HVAC duct construction standards and ASHRAE guide.
   2. Ductwork will generally be fabricated of galvanized sheet steel.
   3. Duct transitions will be fabricated with fittings with slopes not exceeding one in seven (maximum of 15°).
   4. All elbows and branch duct take-off fittings will conform to SMACNA details.
   5. All joints and seams will be sealed to SMACNA class 'a' for air tightness using UL approved duct sealants.
   6. Ductwork for constant air volume systems will be tested in accordance with SMACNA test methods for 2" W.G. design.
   7. Volume control dampers will be provided at all branch take-offs and where required for balancing the system. Volume dampers will be of the opposed blade, multi-louver type.
   8. Fire, smoke, and combination fire/smoke dampers will be provided where required by the building code and will be UL tested and certified. Duct access doors will be provided for access to the damper's motor and fusible link.
   9. Air handling units will have duct smoke detectors monitored by the fire alarm system.

B. Motors for mechanical equipment:
   1. All motors sized at ½ horsepower and larger will be 480v, three phase. All motors will be rated and tagged to operate at 460v with a service factor of 1.15. All motors will be premium efficiency. All motors for variable speed drives will be invertor duty rated and will come with a shaft grounding ring.

C. Piping:
   1. Chilled water and heating hot water
      a. Pipes: Standard weight steel pipe, schedule 40, ASTM, a-53, or soldered copper type l up to 3".
      b. Fittings: welded fittings for 2-1/2" and larger, schedule 40 steel, screwed fittings for 2" and smaller.
      c. Valves: shut-off 2-1/2" and smaller two piece ball valve with bronze body, screwed, 125# SWP.
         (1) Shut-off 3" and larger: High performance butterfly valve with flame cut carbon steel body, 150# flanges, forged carbon steel disk.
         (2) By-pass & control 3" and smaller: lubricated plug valve
      d. By-pass & control 3" and larger: High performance butterfly valve with carbon steel body, 300# flanges,
      e. All valves will have 150 psig shut-off capabilities.

D. HVAC insulation:
   1. Supply air ductwork and return air ductwork will be insulated in accordance with the requirements of the energy code. Insulation will meet the requirements of UL for flame spread and smoke developed (less than 25 and 50, respectively). Outdoor air intake ductwork in mechanical rooms will be 1" thick, 4# density, rigid insulation applied with metal pins and shields. Most all ductwork will be externally wrapped with foil faced insulation. Acoustical lining of ductwork will be limited to transfer ducts and small sections of ductwork as recommended by the acoustical consultant.

2. Pipe will be insulated as follows: Chilled water, condenser water & hot water: glass fiber insulation with vapor barrier and an average thermal conductivity of 0.22 btu/in/ft2-°f.

E. Building Automation System

1. The Building Automation System (BAS) contractor will provide and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified. The basis of design will be either Honeywell or Johnson Controls Inc. so as to be compatible with other Capitol Buildings and the existing "Front End" of the computer system.
   a. Open communications system will be provided. System will be capable of utilizing standard protocols as follows as well as be able to integrate third-party systems via equipment vendor protocols. System will be capable of BACNET communication according to ASHRAE standard spc-135a/95.
   b. The BAS system will have provisions, including all software and hardware, for a remote monitoring and control station.
   c. The BAS system will also incorporate maintenance scheduling software to enhance the continued maintenance of the system
   d. The design of the BAS will network operator workstations and standalone DDC controllers (sac). The network architecture will consist of three levels, a campus-wide (management level network) Ethernet network based on TCP/IP protocol, high performance peer to peer building level network(s) and DDC controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs. All controllers will be standalone DDC (sac) controllers. Loss of network communications will not stop/limit the control sequences. System architecture will have multiple password protected levels of access.
   e. Communication capability: Automatic communications will be provided to allow DDC controllers to communicate with the remote operator workstation. The locations of the remote operator workstations will be reviewed with the operations staff. Standard internet protocols will be used for communications.
   f. Building automation:
      1) The building control systems will comprise the following sub-systems and functions at the minimum:
      2) DDC based control systems with electronic actuation for control valves and dampers.
      3) DDC based central building automation system (BAS) connected to local standalone DDC field panels.
      4) Interface with the central fire alarm system as required for implementing system shutdown and smoke control system.
      5) Interface with security system.
      6) Emergency generator monitoring.
2. The energy management software of the BAS will contain the following energy conservation features:
   a. Start-stop programs.
   b. Space temperature monitoring.
   c. Economizer cycle control.
   d. Electrical demand monitoring.
   e. Fire alarm system control interface.

f. Smoke exhaust.

3. The variable air volume systems will be provided with air flow monitoring stations installed in the supply, return, exhaust and fresh air intake ductwork.
4. The DDC system will control the variable frequency drive of the supply fan based on the supply ductwork static pressure. The variable frequency drive of the return/exhaust air fan will be controlled to track the supply fan.
5. In addition, the DDC system will modulate the fresh air damper, spill air (relief) damper and the return air damper to maintain the minimum setting for the outside air intake.
6. The BAS will monitor electrical and telecommunications systems for alarm conditions and high temperature alarms in the telecommunications room.
7. All valves, dampers, etc. Will use electronic modulating devices. All chilled water and hot water control valves will be pressure independent characterized control valves (PICCV) type for easy testing adjusting and balancing and for ease of system change or modification.
8. All low voltage signal and power wiring within MER's, outdoors, within walls and above inaccessible ceilings will be in EMT. All low voltage signal wiring above accessible ceilings will be plenum rated cable.
9. A pneumatic system will be available for any control valves over approximately 8 inches. Duplex ATC compressors will be located in the CUP. Compressed air will be run to the new cooling tower location on the third floor of the existing Herschler East wing. The CUP system will be large enough to also provide compressed air to the Supreme Court, Hathaway and Barrett Buildings via an existing 2 inch, copper compressed air line within the tunnel system.

PART 4 - HVAC APPENDICES

4.1 HVAC SUMMARY BLOCK LOAD CALCULATIONS:

Summary Block Loads for Wyoming Capitol Project
October, 2014 UPDATE

Building Name	Square footage	Use	Cooling (New & Renovations) SF/ton	Cooling (New & Renovations) tons	Cooling (Existing Buildings) SF/ton	Cooling (Existing Buildings) tons	Heating (New & Renovation) btu/sf	Heating (New & Renovation) btuh	Heating (New & Renovation) BHP	Heating Preheat GPM	Heating Reheat & FTR GPM	Heating Snow Melt GPM	Heating Domestic HW GPM
Capitol (Note 1)	86,625	Office/Assembly	350	248			53	4,600,000	**137**	101	205	(See Below)	(See Below)
Herschler	220,400	Office	450	490			60	13,224,000	**395**	291	591	(See Below)	(See Below)
Herschler Addition	75,000	Assembly	475	158			75	5,625,000	168	124	251	(See Below)	(See Below)
Herschler Basement	9,500	Office	550	17			50	475,000	14	10	21	(See Below)	(See Below)
Connector	45,000	Assembly	400	113			75	3,375,000	101	74	151	(See Below)	(See Below)
Central Utility Plant	25,000	Mechanical	1000	25			15	375,000	11	8	17	(See Below)	(See Below)
Supreme Court	55,250	Office/ Assembly			500	110.5				-	-	-	-
Barrett	73,700	Office			500	147.4				-	-	-	-
Hathaway	135,000	Office/lab			300	450				-	-	-	-
Domestic Water (Note 2)													
Domestic Herschler Existing/ Addition/ Con	-	-						919,400	27	-	-	-	111
New Domestic Load	?							883,000	26	-	-	-	70
Snow Melt System (Note 3)	-	-											
Connector Snow Melt	9,500						175	1,662,500	50	-	-	111	-
East Driveway Snow Melt	6,000						175	1,050,000	31	-	-	70	-
North Drive Snow Melt	15,500						175	2,712,500	81	-	-	181	-
Totals	**725,475**		**New & Reno**	**1050**	**Exist.**	**708**		**34,901,400**	**1043**	**609**	**1,236**	**362**	**181**
		Diversity	0.9					1					
			Diversified TOTAL	**945**			Diversified TOTAL	**34,901,400**	**1043**		TOTAL GPM:	2,387	

Cooling Summary

New & Reno	945 tons
Existing	**708 tons**
Total Capacity	1653 tons

Heating Assumptions:
Temperatures - 160 F EWT, 130 F LWT = 30 Degree ΔT
Assume 33% for Preheat and 67% for Reheat /FTR

CHILLER DESIGN:
Total Tons Divided By (3) chillers = 551 Tons per chiller
For N+1 Redundancy have (4) Chillers at 550 Tons EACH.

BOILER DESIGN:
Total BTUH Divided 6000 MBH (largest condensing boiler made) = 6 Boilers
For N+1 Redundancy have (7) Boilers at 6000 MBH EACH.

NOTES:
1. Capitol Building Block Loads Confirmed by Room by Room Calculations
2. Domestic Hot Water Loads Estimated from previous Herschler Load and other estimates for new spaces.
3. 30 Degree ΔT

4.2 BAS CONTROLS POINT LIST:

HW Boilers CUP																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integration or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
1	BI	BLR1-A	Boiler 1 Alarm		Dry Contact Maintained				H								
2	BO	BLR1-EN	Boiler 1 Enable	?	24VAC Maintained			H									
3	AI	BLR1EW-T	Boiler 1 Entering Water Temperature		Nickel 1K RTD												
4	AI	BLR1-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
5	AI	BLR1LW-T	Boiler 1 Leaving Water Temperature		Nickel 1K RTD												
6	BI	BLR1-S	Boiler 1 Status		Dry Contact Maintained				H								
7	BI	BLR2-A	Boiler 2 Alarm		Dry Contact Maintained				H								
8	BO	BLR2-EN	Boiler 2 Enable	?	24VAC Maintained			H									
9	AI	BLR2EW-T	Boiler 2 Entering Water Temperature		Nickel 1K RTD												
10	AI	BLR2-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
11	AI	BLR2LW-T	Boiler 2 Leaving Water Temperature		Nickel 1K RTD												
12	BI	BLR2-S	Boiler 2 Status		Dry Contact Maintained				H								
13	BI	BLR3-A	Boiler 3 Alarm		Dry Contact Maintained				H								
14	BO	BLR3-EN	Boiler 3 Enable	?	24VAC Maintained			H									
15	AI	BLR3EW-T	Boiler 3 Entering Water Temperature		Nickel 1K RTD												
16	AI	BLR3-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
17	AI	BLR3LW-T	Boiler 3 Leaving Water Temperature		Nickel 1K RTD												
18	BI	BLR3-S	Boiler 3 Status		Dry Contact Maintained				H								
19	BI	BLR4-A	Boiler 4 Alarm		Dry Contact Maintained				H								
20	BO	BLR4-EN	Boiler 4 Enable	?	24VAC Maintained			H									
21	AI	BLR4EW-T	Boiler 4 Entering Water Temperature		Nickel 1K RTD												
22	AI	BLR4-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
23	AI	BLR4LW-T	Boiler 4 Leaving Water Temperature		Nickel 1K RTD												
24	BI	BLR4-S	Boiler 4 Status		Dry Contact Maintained				H								
25	BI	BLR5-A	Boiler 5 Alarm		Dry Contact Maintained				H								
26	BO	BLR5-EN	Boiler 5 Enable	?	24VAC Maintained			H									
27	AI	BLR5EW-T	Boiler 5 Entering Water Temperature		Nickel 1K RTD												
28	AI	BLR5-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
29	AI	BLR5LW-T	Boiler 5 Leaving Water Temperature		Nickel 1K RTD												
30	BI	BLR5-S	Boiler 5 Status		Dry Contact Maintained				H								
31	BI	BLR6-A	Boiler 6 Alarm		Dry Contact Maintained				H								
32	BO	BLR6-EN	Boiler 6 Enable	?	24VAC Maintained			H									
33	AI	BLR6EW-T	Boiler 6 Entering Water Temperature		Nickel 1K RTD												
34	AI	BLR6-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt												
35	AI	BLR6LW-T	Boiler 6 Leaving Water Temperature		Nickel 1K RTD												
36	BI	BLR6-S	Boiler 6 Status		Dry Contact Maintained				H								
37	BI	BLR7-A	Boiler 7 Alarm		Dry Contact Maintained				H								
38	BO	BLR7-EN	Boiler 7 Enable	?	24VAC Maintained			H									
39	AI	BLR7EW-T	Boiler 7 Entering Water Temperature		Nickel 1K RTD												
40	AI	BLR7-DPT	Boiler 1 Flow Differential Pressure		0-10 Volt		H										
41	AI	BLR7LW-T	Boiler 7 Leaving Water Temperature		Nickel 1K RTD		H										
42	BI	BLR7-S	Boiler 7 Status		Dry Contact Maintained				H								
43	BO	BP1-C	Boiler Pump 1 Command	?	24VAC Maintained			H									
44	BI	BP1-S	Boiler Pump 1 Status		Dry Contact Maintained				H								
45	BO	BP2-C	Boiler Pump 2 Command	?	24VAC Maintained			H									
46	BI	BP2-S	Boiler Pump 2 Status		Dry Contact Maintained				H								
47	BO	BP3-C	Boiler Pump 3 Command	?	24VAC Maintained			H									
48	BI	BP3-S	Boiler Pump 3 Status		Dry Contact Maintained				H								
49	BO	BP4-C	Boiler Pump 4 Command	?	24VAC Maintained			H									
50	BI	BP4-S	Boiler Pump 4 Status		Dry Contact Maintained				H								
51	BO	BP5-C	Boiler Pump 5 Command	?	24VAC Maintained			H									

HW Boilers CUP																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integration or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
52	BI	BP5-S	Boiler Pump 5 Status		Dry Contact Maintained				H								
53	BO	BP6-C	Boiler Pump 6 Command	?	24VAC Maintained			H									
54	BI	BP6-S	Boiler Pump 6 Status		Dry Contact Maintained				H								
55	BO	BP7-C	Boiler Pump 7 Command	?	24VAC Maintained			H									
56	BI	BP7-S	Boiler Pump 7 Status		Dry Contact Maintained				H								
57	BI	EMER-STOP	Emergency Shutdown		Dry Contact Maintained				H								
58	AI	HW-DP	Hot Water Differential Pressure		0-10VDC		H										
59	AI	PHWR-T	Primary HW Return Temperature		Nickel 1K RTD		H										
60	AI	PHWS-T	Primary HW Supply Temperature		Nickel 1K RTD		H										
61	BO	SHWP1-C	Secondary HW Pump 1 Command	?	24VAC Maintained			H									Serves Preheat coils
62	BI	SHWP1-FAULT	Secondary HW Pump 1 VFD Fault		Dry Contact Maintained				H								Serves Preheat coils
63	AO	SHWP1-O	Secondary HW Pump 1 Output		0-10VDC	H											Serves Preheat coils
64	BI	SHWP1-S	Secondary HW Pump 1 Status		Dry Contact Maintained				H								Serves Preheat coils
65	BO	SHWP2-C	Secondary HW Pump 2 Command	?	24VAC Maintained			H									Serves Preheat coils
66	BI	SHWP2-FAULT	Secondary HW Pump 2 VFD Fault		Dry Contact Maintained				H								Serves Preheat coils
67	AO	SHWP2-O	Secondary HW Pump 2 Output		0-10VDC	H											Serves Preheat coils
68	BI	SHWP2-S	Secondary HW Pump 2 Status		Dry Contact Maintained				H								Serves Preheat coils
69	BO	SHWP3-C	Secondary HW Pump 3 Command	?	24VAC Maintained			H									Serves Preheat coils
70	BI	SHWP3-FAULT	Secondary HW Pump 3 VFD Fault		Dry Contact Maintained				H								Serves Preheat coils
71	AO	SHWP3-O	Secondary HW Pump 3 Output		0-10VDC	H											Serves Preheat coils
72	BI	SHWP3-S	Secondary HW Pump 3 Status		Dry Contact Maintained				H								Serves Preheat coils
73	BO	SRHWP1-C	Secondary HW Pump 1 Command	?	24VAC Maintained			H									Serves Reheat coils
74	BI	SRHWP1-FAULT	Secondary HW Pump 1 VFD Fault		Dry Contact Maintained				H								Serves Reheat coils
75	AO	SRHWP1-O	Secondary HW Pump 1 Output		0-10VDC	H											Serves Reheat coils
76	BI	SRHWP1-S	Secondary HW Pump 1 Status		Dry Contact Maintained				H								Serves Reheat coils
77	BO	SRHWP2-C	Secondary HW Pump 2 Command	?	24VAC Maintained			H									Serves Reheat coils
78	BI	SRHWP2-FAULT	Secondary HW Pump 2 VFD Fault		Dry Contact Maintained				H								Serves Reheat coils
79	AO	SRHWP2-O	Secondary HW Pump 2 Output		0-10VDC	H											Serves Reheat coils
80	BI	SRHWP2-S	Secondary HW Pump 2 Status		Dry Contact Maintained				H								Serves Reheat coils
81	BO	SRHWP3-C	Secondary HW Pump 3 Command	?	24VAC Maintained			H									Serves Reheat coils
82	BI	SRHWP3-FAULT	Secondary HW Pump 3 VFD Fault		Dry Contact Maintained				H								Serves Reheat coils
83	AO	SRHWP3-O	Secondary HW Pump 3 Output		0-10VDC	H											Serves Reheat coils
84	BI	SRHWP3-S	Secondary HW Pump 3 Status		Dry Contact Maintained				H								Serves Reheat coils
85	AI	SHWR-T	Secondary HW Return Temperature		Nickel 1K RTD		H										
86	AI	SHWS-T	Secondary HW Supply Temperature		Nickel 1K RTD		H										
87	AI	SHWSFM-F	Secondary HWS Flow meter		0-10VDC		H										See Note 15
88																	

Provide BACnet MS\TP integration to boiler 1 to 7.

Condenser Water System																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integration or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
1	BO	CWP1-C	Condenser Water Pump 1 Command	?	24VAC Maintained			H									
2	BI	CWP1-OL	Condenser Water Pump 1 Overload		Dry Contact Maintained				H								
3	BI	CWP1-S	Condenser Water Pump 1 Status		Dry Contact Maintained				H								
4	BO	CWP2-C	Condenser Water Pump 2 Command	?	24VAC Maintained			H									
5	BI	CWP2-OL	Condenser Water Pump 2 Overload		Dry Contact Maintained				H								
6	BI	CWP2-S	Condenser Water Pump 2 Status		Dry Contact Maintained				H								
7	BO	CWP3-C	Condenser Water Pump 3 Command	?	24VAC Maintained			H									
8	BI	CWP3-OL	Condenser Water Pump 3 Overload		Dry Contact Maintained				H								
9	BI	CWP3-S	Condenser Water Pump 3 Status		Dry Contact Maintained				H								
10	BO	CWP4-C	Condenser Water Pump 4 Command	?	24VAC Maintained			H									
11	BI	CWP4-OL	Condenser Water Pump 4 Overload		Dry Contact Maintained				H								
12	BI	CWP4-S	Condenser Water Pump 4 Status		Dry Contact Maintained				H								
13	AI	CWS-T	Condenser Water Supply Temperature		Nickel 1K RTD		H										
14	AI	PCHWR-T	Primary CHW Supply HX Temperature - Bypassing chillers		Nickel 1K RTD		H										
15	BO	CH1-5CHWISOV-C	Chiller 1 to 5 Condenser W Bypass Valve Command	?	24VAC Maintained			H									5 DDC points
16	BI	CH1-5CHWISOV-S	Chiller 1 to 5 Condenser W Bypass Valve Status		Dry Contact Maintained				H								5 DDC points
17	BO	CH1-5CHWISOV-C	Chiller 1-5 Condenser W Isolation Valve Command	?	24VAC Maintained			H									5 DDC points
18	BI	CH1-5CHWISOV-S	Chiller 1-5 Condenser W Isolation Valve Status		Dry Contact Maintained				H								5 DDC points

Towers																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integation or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
1	BO	BO1-SPARE	Top of sump valve 1	?	24VAC Maintained			H									
2	BO	BO2-SPARE	Top of sump valve 2	?	24VAC Maintained			H									
3	BO	BO3-SPARE	Top of sump valve 3	?	24VAC Maintained			H									
4	BO	BO4-SPARE	Top of sump valve 4	?	24VAC Maintained			H									
5	BO	BO5-SPARE	Bottom of sump valve 1	?	24VAC Maintained			H									
6	BO	BO6-SPARE	Bottom of sump valve 2	?	24VAC Maintained			H									
7	BO	BO7-SPARE	Bottom of sump valve 3	?	24VAC Maintained			H									
8	BO	BO8-SPARE	Bottom of sump valve 4	?	24VAC Maintained			H									
9	BO	CT1-C	Tower 1 Command	?	24VAC Maintained			H									
10	BI	CT1-FAULT	Tower 1 VFD Fault		Dry Contact Maintained				H								
11	BO	CT1ISOV-C	Tower 1 Isolation Valve Command	?	24VAC Maintained			H									
12	BI	CT1ISOV-S	Tower 1 Isolation Valve Status		Dry Contact Maintained				H								
13	AO	CT1-O	Tower 1 Output		0-10VDC	H											
14	BI	CT1-S	Tower 1 Status		Dry Contact Maintained				H								
15	BI	CT1VIB-A	Tower 1 Vibration Alarm		Dry Contact Maintained				H								
16	BO	CT2-C	Tower 2 Command	?	24VAC Maintained			H									
17	BI	CT2-FAULT	Tower 2 VFD Fault		Dry Contact Maintained				H								
18	BO	CT2ISOV-C	Tower 2 Isolation Valve Command	?	24VAC Maintained			H									
19	BI	CT2ISOV-S	Tower 2 Isolation Valve Status		Dry Contact Maintained				H								
20	AO	CT2-O	Tower 2 Output		0-10VDC	H											
21	BI	CT2-S	Tower 2 Status		Dry Contact Maintained				H								
22	BI	CT2VIB-A	Tower 2 Vibration Alarm		Dry Contact Maintained				H								
23	BO	CT3-C	Tower 3 Command	?	24VAC Maintained			H									
24	BI	CT3-FAULT	Tower 3 VFD Fault		Dry Contact Maintained				H								
25	BO	CT3ISOV-C	Tower 3 Isolation Valve Command	?	24VAC Maintained			H									
26	BI	CT3ISOV-S	Tower 3 Isolation Valve Status		Dry Contact Maintained				H								
27	AO	CT3-O	Tower 3 Output		0-10VDC	H											
28	BI	CT3-S	Tower 3 Status		Dry Contact Maintained				H								
29	BI	CT3VIB-A	Tower 3 Vibration Alarm		Dry Contact Maintained				H								
30	BO	CT4-C	Tower 4 Command	?	24VAC Maintained			H									
31	BI	CT4-FAULT	Tower 4 VFD Fault		Dry Contact Maintained				H								
32	BO	CT4ISOV-C	Tower 4 Isolation Valve Command	?	24VAC Maintained			H									
33	BI	CT4ISOV-S	Tower 4 Isolation Valve Status		Dry Contact Maintained				H								
34	AO	CT4-O	Tower 4 Output		0-10VDC	H			H								
35	BI	CT4-S	Tower 4 Status		Dry Contact Maintained				H								
36	BI	CT4VIB-A	Tower 4 Vibration Alarm		Dry Contact Maintained				H								
37	AI	CW-F	Condenser Water Flow		0-10VDC		H										
38	AI	CWR-T	Condenser Water Return Temperature		Nickel 1K RTD		H										
39	AI	CWS-T	Condenser Water Supply Temperature		Nickel 1K RTD		H										

HW HX Domestic CUP																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integration or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
1	AI	HW-DP	Hot Water Differential Pressure		0-10VDC		H										
2	AO	HX1V1-O	Heat Exchanger 1 Valve 1 Output		0-10VDC	H											
3	AO	HX1V2-O	Heat Exchanger 1 Valve 2 Output		0-10VDC	H											
4	AO	HX2V1-O	Heat Exchanger 2 Valve 1 Output		0-10VDC	H											
5	AO	HX2V2-O	Heat Exchanger 2 Valve 2 Output		0-10VDC	H											
6	BO	PHWP1-C	Domestic HW Pump 1 Command	?	24VAC Maintained			H									Note 1
7	BI	PHWP1-FAULT	Primary HW Pump 1 VFD Fault		Dry Contact Maintained				H								
8	AO	PHWP1-O	Primary HW Pump 1 Output		0-10VDC	H											
9	BI	PHWP1-S	Primary HW Pump 1 Status		Dry Contact Maintained				H								
10	BO	PHWP2-C	Domestic HW Pump 2 Command	?	24VAC Maintained			H									Note 1
11	BI	PHWP2-FAULT	Primary HW Pump 2 VFD Fault		Dry Contact Maintained				H								
12	AO	PHWP2-O	Primary HW Pump 2 Output		0-10VDC	H											
13	BI	PHWP2-S	Primary HW Pump 2 Status		Dry Contact Maintained				H								
14	AI	PHWS-T	Primary DHW Supply Temperature		Nickel 1K RTD		H										Note 2

HW HX Snow Melt CUP																	
Point Number	Type	Name	Description	Motor enabled "E" or disabled "D" in Emergency power mode	Signal	Hardware Point "H" Integration or Software "IS"				Alarm		Trend (min)				Graphic	Comments
						AO	AI	BO	BI	Local	Remote	0.5	1	5	COS		
1	AI	HW-DP	Hot Water Differential Pressure		0-10VDC		H										
2	AO	HX1V1-O	Heat Exchanger 1 Valve 1 Output		0-10VDC	H											
3	AO	HX1V2-O	Heat Exchanger 1 Valve 2 Output		0-10VDC	H											
4	AO	HX2V1-O	Heat Exchanger 2 Valve 1 Output		0-10VDC	H											
5	AO	HX2V2-O	Heat Exchanger 2 Valve 2 Output		0-10VDC	H											
6	AO	HX2V1-O	Heat Exchanger 3 Valve 1 Output		0-10VDC	H											
7	AO	HX2V2-O	Heat Exchanger 3 Valve 2 Output		0-10VDC	H											
8	BO	PHWP1-C	Primary HW Pump 1 Command	?	24VAC Maintained			H									
9	BI	PHWP1-FAULT	Primary HW Pump 1 VFD Fault		Dry Contact Maintained				H								
10	AO	PHWP1-O	Primary HW Pump 1 Output		0-10VDC	H											
11	BI	PHWP1-S	Primary HW Pump 1 Status		Dry Contact Maintained				H								
12	BO	PHWP2-C	Primary HW Pump 2 Command	?	24VAC Maintained			H									
13	BI	PHWP2-FAULT	Primary HW Pump 2 VFD Fault		Dry Contact Maintained				H								
14	AO	PHWP2-O	Primary HW Pump 2 Output		0-10VDC	H											
15	BI	PHWP2-S	Primary HW Pump 2 Status		Dry Contact Maintained				H								
16	BO	PHWP3-C	Primary HW Pump 3 Command	?	24VAC Maintained			H									
17	BI	PHWP3-FAULT	Primary HW Pump 3 VFD Fault		Dry Contact Maintained				H								
18	AO	PHWP3-O	Primary HW Pump 3 Output		0-10VDC	H											
19	BI	PHWP3-S	Primary HW Pump 3 Status		Dry Contact Maintained				H								
20	AI	PHWR-T	Primary HW Return Temperature		Nickel 1K RTD		H										
21	AI	PHWS-T	Primary HW Supply Temperature		Nickel 1K RTD		H										
22	AI	CH4CHW-F	Glycol Snow Melt HWS Flow meter\BTU Meter		BACnet flow and BTU		IS										
23	AI	OA-T	Outdoor Air Temperature		Nickel 1K RTD		IS										Shared Global Point

SECTION 2.8
PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The selected plumbing systems and equipment will support the new facility and meet and/or exceed the new program and conventional requirements of the domestic water, sanitary and storm drainage, natural gas and fire protection systems serving the complex.

B. All systems will be designed to conform to the 2012 International Building Codes (IBC), 2012 International Plumbing Code (IPC), OSHA safety codes, NFPA Codes, applicable local codes and regulations of the authorities having jurisdiction.

1.2 EXISTING CONDITIONS

A. The existing Plumbing systems in the Herschler Basement and Connector Mechanical Rooms are beyond their expected useful service lives. The existing solar thermal system, hot water boilers, duplex sump pump motors and valves, and partial storm and sanitary drainage systems located within the Herschler Building and Connector will be removed and new systems put in their place.

PART 2 - SYSTEMS DESCRIPTION

2.1 PROPOSED PLUMBING SYSTEMS

A. Central Utility Plant (CUP)

1. CUP Location / Water Infiltration Considerations

   a) The water table at the Central Utility Plant location is approximately seven feet below the existing Herschler parking garage level. The CUP will be designed with a matt slab with waterproofing at the perimeter walls. The objective is to prevent the infiltration of outside water to the CUP. The equipment access will be through a coiling overhead door for large equipment access.

   b) Due to the high water table, a duplex sump pump dewatering station will be installed to handle below slab and foundation drainage systems. The dewatering sump will be installed in an attached vault room located outside, and immediately adjacent to, the CUP building perimeter walls. The sump pit will be 60” diameter and 13 feet deep. The pumps will be vertical, cover-mount type. Per the Geotechnical Engineering Report, dated August 22, 2014, Terracon has recommended a dewatering rate of 40 gpm to lower the water table. The dewatering pumps for the CUP will discharge to the Central Avenue sewer.

   c) Refer to the Schematic Design drawings for additional equipment information and diagrams.

2. Plumbing Drainage System

   a) The principal plumbing fixtures located in the CUP building will be floor drains to handle mechanical condensate drainage, HVAC blowdown, and general area emergency drainage. The Mechanical Room should also have a janitors sink. Discharge from the floor drains will run by gravity to a sump pit. The

associated duplex sump pumps will be vertical, cover-mount type. As an alternate to floor drains, a system of trench drains distributed at the perimeter of the Mechanical Room is being considered. The sump will discharge into the existing, adjacent Herschler building gravity sanitary system. The final pit quantities and dimensions will be determined based on the final system layout drainage load.

3. Emergency and Stand By Equipment
   a) It is the desire of the client to keep the CUP and Connector buildings running if there is a power failure. As a result, all dewatering and floor drain sump pumps will be on stand-by power.
4. CUP Roof
   a) A green roof and landscaping have been proposed for the roof of the CUP. To maintain the aesthetic of this system and to provide additional security for the CUP and associated equipment, plumbing pipes will not be routed directly up to grade. All plumbing vents will be routed through the adjacent parking area below the Herschler Building and up through an existing chase to the roof of the Herschler Building. The Green Roof system will be drained by a series of Green Roof filtration type planter and scupper drains located throughout the roof to accommodate drainage of the extensive green roof system.
5. Domestic Cold Water:
   a) Due to architectural modifications to the existing CUP and Connector buildings, the existing combined 6” domestic / fire water service, including backflow preventers and meters will be demolished. It is the desire of the client to have redundant water services throughout the Wyoming State Capitol building complex. Main branch piping to the Herschler building, Capitol building, irrigation and cooling tower make-up will also be removed. Therefore, a total of (4) new water services are to be installed. A 6” fire water service with backflow prevention and a 6” domestic water service with backflow prevention and pressure reduction will feed from Carey Ave. Similarly a second set of identically sized fire water and domestic water pipes will be fed from Central Ave. New domestic water piping will be routed from the CUP bldg., distributed throughout Herschler, Cup Connector and Capitol buildings to the existing utility service piping system in the main tunnel.
6. Solar Thermal System:
   a) A solar thermal system located on the existing Herschler roof will be the primary generator for the domestic hot water system. All existing solar panels and equipment will be removed excluding the existing panel support system on the roof that will be used to support new solar panels that will be installed at the same location on the roof. Associated pumps, tanks, heat exchangers, controls etc., will be located in the CUP Bldg. Solar glycol supply and return mains will be routed from the CUP, up through the Herschler building to the roof.
7. Domestic Hot Water:
   a) A new plate and frame heat exchanger located adjacent to the mechanical heating boilers will produce domestic hot water from the new hot water heating system as described in the HVAC narrative. This domestic hot water system will serve as a back-up system to the new solar thermal system. There will be one duty and one stand-by heat exchanger with associated pumps for this domestic hot water system. These combined systems will feed the Herschler,

Cup Connector, State Capitol, Barrett, Supreme Court and Hathaway buildings. The existing hot water recirculating piping system in the existing tunnel serving Barrett, Supreme Court and Hathaway buildings utility service system will be re-connected to the new domestic water heating system with the new pumps which are being located within the CUP.

8. Natural Gas System

a) Due to architectural modifications to the existing CUP and Connector building, the existing natural gas system will be entirely demolished, including meters and regulators. A new, 2" high pressure, natural gas service provided by the utility company will enter the CUP building at the new dedicated Natural Gas Meter Room, within the CUP, from Central Ave. Gas meters and pressure regulators will be located in this room. Vents associated with the pressure regulators will run through the adjacent Herschler parking area and rise in an existing chase to a location above the Herschler roof. Gas piping will feed new boilers located within the CUP Building.

B. Connector Link

1. Plumbing Drainage System

a) All existing plaza drains will be removed. Storm piping and drains above grade will be modified as necessary for new plaza configurations. Abandoned piping under the mat slab will be cut and capped flush at the floor level. New storm water plaza drainage piping will be installed and routed to new civil site storm piping.

b) Existing sanitary piping below the slab will remain. This piping is routed to a sewage ejector pit at the existing Herschler building loading dock.

c) The Connector Link Roof consists of extensive green space systems with walkway pavers which will be kept free from pipe penetrations so as to maintain the open, clean look of the surrounding landscaping. The new Green Roof system will be drained by a drainage board tied to the perimeter drain located throughout the roof and walls. All storm drainage in this area will discharge into (2) existing storm water manholes located between the Herschler and Capitol buildings.

2. Dewatering System

a) The existing dewatering piping below the slab shall remain. This piping is routed to a dewatering sump pit in the existing Herschler Boiler Room.

C. Herschler Building

1. Plumbing Drainage System

a) Existing sanitary stacks, vents and plumbing fixtures from toilet cores on the 4th, 3rd 2nd and 1st floors will be demolished to accommodate new architectural configurations. A total of four (4) new stacks will be provided to serve new center core toilet rooms with plumbing fixtures as located by the architect. Additionally, new secondary waste stacks will be installed in the East side 3rd floor roof and central fan rooms to serve the floor drains. All stacks will be sized 4". This piping will re-connect to existing main building drainage in garage ceiling areas.

b) Additional sanitary stacks can be run at selected column locations within the existing Herschler Building and within the new addition in order to provide "wet columns" for future fit out of water fountains and kitchenette units.

c) Existing sub-slab sanitary piping serving garage-level core toilet rooms shall remain. This piping is routed to an existing ejector pit at the Herschler loading

dock. The pit shall remain. The duplex sewage ejector pumps will be replaced with new pumps sized for the reconfigured toilet load.

d) A total of (2) sump pumps will be added at the new elevator pits, one pump at each set of elevators.

e) All storm drains located on the roof will be removed and replaced with new. A portion of the existing storm water system at the rear of the East wing will be demolished. New piping and drains will serve this portion, and re-connect to existing storm leaders. At the garage level existing drainage at the East wing will be re-routed around the new CUP Bldg. and terminate at a new manhole located on Central Ave.

f) A total of (2) new storm stacks will be installed in the new addition area located between the existing east and west wings to accommodate a new roof drain system. This system will discharge to sewers located on 26th Street as per the 2012 International Plumbing Code as supplemental overflow drainage system will be added throughout the entire Herschler building and discharge in a visible manner above grade.

g) Refer to the Schematic Design drawings for additional equipment information and diagrams.

2. Domestic Water

a) Two sets of domestic water risers consisting of cold, hot and hot water return piping will be installed within the central core of the Herschler Building addition to feed new toilet room cores. This piping will be fed from mains in the Herschler garage area. All isolation valves will be located in an accessible fashion. At certain column locations within the existing Herschler Building and within the new addition, new domestic water will run up within “wet columns” for future fit out of water fountains and kitchenette units.

3. Dewatering System

a) The existing dewatering system is divided into a North and South zone below the slab, each routed to a separate dewatering sump pit. The system of pipes and pits shall remain. Pumps will be replaced if necessary.

PART 3 - SUMMARY SPECIFICATIONS

3.1 PRODUCTS AND MATERIALS

A. Sanitary Sewer Piping, Buried Within 5 Feet of Building and Sanitary Sewer Piping, above Grade:

1. Cast Iron Pipe: ASTM A74, service weight, with neoprene gaskets or lead and oakum joints.
2. Cast Iron Pipe: CISPI 301, hubless, service weight, with neoprene gaskets and stainless steel clamps.
3. Copper Tube: ASTM B306, type DWV with cast bronze or wrought copper fittings and Grade 50B solder joints.
4. ABS Pipe: ASTM D2661 or ASTM D2751 with ABS fittings and solvent weld joints.
5. PVC Pipe: ASTM D2665 or ASTM D3034 SDR 26, polyvinyl chloride (PVC) material.
   a) Fittings: PVC, ASTM D2665 or ASTM D3034.
   b) Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

6. PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679 with PVC fittings and elastomeric gasket joints.

B. Water Piping, Buried Within 5 Feet of Building:
1. Copper Tubing: ASTM B42, Tempered O61 annealed without fittings.
2. Ductile Iron Pipe: AWWA C151 with ductile iron fittings rubber gasket joints and 3/4 inch diameter rods.

C. Water Piping, above Grade:
1. Copper Tubing: ASTM B88, Type L drawn, with cast brass or wrought copper fittings and Grade 95TA solder joints.
2. Galvanized Steel Pipe (Cold Water Only Sizes 4 inch and Larger): ASTM A53/A53M, Grade B, Schedule 40 with cast iron fittings and grooved mechanical couplings.

D. Storm Water Piping, Buried Within 5 Feet of Building and Storm Water Piping, above Grade:
1. Cast Iron Pipe: ASTM A74 service weight with neoprene gaskets or lead and oakum.
2. Cast Iron Pipe: CISPI 301, hubless, service weight with neoprene gaskets and stainless steel clamps.
3. Copper Pipe: ASTM B306, type DWV with cast bronze or wrought copper fittings and Grade 50B solder joints.
4. Aluminum DWV Pipe: CAN 3-B281 with cast iron fittings joints of thermoplastic rubber coupling and stainless steel clamps.
5. ABS Pipe: ASTM D2680 or ASTM D2751 with solvent weld joints.
6. PVC Pipe: ASTM D2665 or ASTM D3034 SDR 26, polyvinyl chloride (PVC) schedule 40 and 80 material.
   a) Fittings: PVC, ASTM D2665 or ASTM D3034.
   b) Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

E. Natural gas piping, Buried Within 5 Feet of Building, below grade:
1. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   a) Fittings: ASTM A234/A234M forged steel welding type.
   b) Joints: ASME B31.9, welded.
   c) AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

F. Natural gas piping, above grade:
1. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   a) Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
   b) Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

G. Equipment Drains and Overflows:
1. J.R. Smith, Josam or approved equal
2. Body: Galvanized cast iron with sump
3. Strainer Removable cast iron dome with vandal proof screws.
4. Accessories: Coordinate with roofing type:
   a) Membrane flange and membrane clamp with integral gravel stop.
   b) Adjustable under deck clamp.
   c) Roof sump receiver.
   d) Waterproofing flange.
   e) Adjustable extension sleeve for insulation.

f) Perforated standpipe

H. Sump Pumps – Sewage Ejectors
1. Impeller: Cast iron, semi-open, non-clog.
2. Casing: Cast iron.
3. Mechanical Seal: Silicon carbide.
4. Shaft: Stainless steel.
5. Designed for continuous operation.
6. Bearings: Upper and lower heavy duty ball bearings.

I. Pump Motors
1. Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.
2. Power Cable: Severe duty rated, oil and water resistant, epoxy seal on motor end.
3. Built-in overload with automatic reset.
4. Class B insulation.

J. Controls (Duplex):
1. Float operated mechanical alternator to alternate operation of pumps. Cut-in second pump on rising level or lead pump failure. Furnish separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and extra set of wired terminals for remote alarm circuit and emergency float switch with float rod, stops, and float to operate both pumps on failure of alternator.
2. All pumps will be tied into the Building Automation System (BAS) so as to monitor the system status.

SECTION 2.9
ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The selected electrical systems and equipment will support the new facility and meet and/or exceed the new program and conventional requirements for power, lighting, comfort, maintenance, and energy efficiency.

B. All systems will be designed to conform to the 2012 International Building Codes (IBC), 2011 National Electrical Code (NEC), OSHA safety codes, NFPA Codes, applicable local codes and regulations of the authorities having jurisdiction.

1.2 EXISTING CONDITIONS

A. There are three (3) existing outdoor service transformers on the Capitol Complex site. Two (2) serve the Herschler Building and (1) serves the Capitol Building (Capitol Building work is addressed in the separate Capitol Building design package). All existing utility service equipment will be removed. All electrical distribution equipment will be removed as well. There is an existing 750kW emergency generator in the Herschler Basement Mechanical Room that will be removed. There is also an existing exterior pad-mounted standby generator that serves the data center, which will be removed by others. Two (2) vertical plug-in busway risers in the Herschler Building are to remain and be backfed from the new service equipment. Replacing the busduct risers should be considered as alternate scope. Refer to the Schematic Electrical Demolition drawings for additional information.

PART 2 - SYSTEMS DESCRIPTION

2.1 PROPOSED ELECTRICAL SYSTEMS

A. The site will be served from two (2) 13.2kV utility feeders that originate from the same utility company substation but follow separate paths for reliability. The two (2) utility feeders will terminate at an outdoor utility company selector switch and will be routed through an adjacent outdoor utility company metering switchgear. From there a single 13.2kV feeder will be routed to the “High Voltage Electric Room” at the first floor of the Herschler Building. As an alternate, a second redundant 13.2kV feeder can be routed into the building from the outdoor utility equipment (a single 13.3kV feeder routed from the outdoor utility equipment into the building is preferred per facilities personnel). Refer to the Schematic Electrical One-Line diagram drawing for additional information.

B. 15 kV switchgear “MSG-1” will distribute power to (4) 2500/3333kVA AA/FA, 13.2kV-480/277V Vacuum Pressure Impregnated (VPI), wye-wye type transformers. Each transformer secondary will feed the low voltage side of four (4) Substations A, B, C & D. All low voltage equipment (600V nominal and less) will be separated from high voltage equipment to limit access to high-voltage equipment to qualified personnel only and will be located in the “Low Voltage Main Electrical Room” on the First Floor of the Herschler Building.

C. DC controls with redundant station battery system, chargers, panels, DC & AC ATS's will be provided for reliable circuit breaker, relay and trip operations for the 15kV Switchgear "MSG-1".

D. Substations A & B and C & D will be configured in main-tie-main configurations with 4000A mains and fully rated 4000A bus ties with mechanical interlocks, such that either transformer A or B could feed both 480V buses A & B. Similarly, either transformer C or D could feed both 480V buses C & D.

E. Four (4) 550kW emergency generators and a 4000A, 480/277V, 3-Phase, 4-Wire paralleling switchboard, MSB-GEN will be located at the Herschler Building's 4th Floor open well area and at the adjacent 4th Floor Emergency Electrical Room, respectively. The generator ratings include capacity for serving Atrium smoke exhaust equipment at the Herschler Building; if atrium smoke exhaust is not required, the generator ratings will be reduced accordingly. The generators will be in self-contained walk-in type, sound-attenuated, weatherproof enclosures, each with a 24-hour base-mounted day tank. A fuel system will be provided to pump fuel up from main tank in the garage (running time duration to be determined); refer to the Mechanical Section for additional information.

F. The Herschler Building / Connector existing distribution equipment will be replaced. This includes 1200A MSB-H and 800A EDP-H. As noted above, the Herschler east and west bus duct risers are to remain and be re-fed from the new service equipment. Existing panels may remain for reuse, depending on condition, which varies.

G. The Central Utility Plant (CUP) will be entirely fed via generator standby power, with the exception of the Chillers. Each of four (4) chillers will have a dedicated Automatic Transfer Switch (ATS) that shares a single emergency feeder such that any one of the four (4) chillers can operate on generator power, while the Building Management System (BMS) inhibits transfer of the other three (3) chillers. Operating one (1) chiller on standby power will allow for full operation of the Capitol Building upon loss of normal utility power. Life safety loads are fed via 225A panel EDP-CP. Two (2) standby panels, SDP-CP-A and SDP-CP-B will serve the remaining CUP loads.

H. The Herschler Addition will be served from a single 800A, 480/277V, 3-P, 4W vertical busduct fed from Substation 'C' that will feed over to panelboards and step-down transformers at remote closets at each level.

I. The Connector will be served from a 600A, 480/277V, 3-phase, 4-wire distribution panels fed from Substation 'A'. All distribution will be new.

J. The Capitol Building will be served by an 800A, 480/277V, 2-phase, 4-wire normal / standby feeder and a 400A, 480/277V, 2-phase, 4-wire emergency feeder; both feeders will be served via the generator system via automatic transfer switches located in the Herschler Building to allow for full operation of the Capitol Building upon loss of normal utility power.

K. ANSI C12.20 revenue grade metering will be provided with a site-wide Power Monitoring and Control System (PMCS) for monitoring of power consumption.

L. The entire electrical system will be fully rated for all available short circuit currents and will be fully coordinated.

M. If desired by the Owner, an EMF consultant can be retained to review the proposed design to identify and analyze potential EMF issues and impacts on the Building's occupants and systems resulting from electrical equipment and feeders located and routed within the Herschler Building and to propose mitigation methods, if required.

PART 3 - SUMMARY SPECIFICATIONS

3.1 PRODUCTS AND MATERIALS

A. Electrical Distribution and Equipment:

1. Refer to Section 2.1 for description of 15kV Main Switchgear "MSG.1", Substation, Transformers and Generators.
2. Main Switchgear (located in Herschler Building First Floor East):
   a) There will be four (4) main 480/277V low voltage switchgear lineups. They will consist of drawout type power circuit breakers, each with customer metering and solid-state trip units.
   b) Surge Protection Devices (SPD) will be provided at each main switchgear.
   c) All distribution equipment will have copper buses, and the entire electrical system will be fully rated for available short circuit currents.
3. Distribution Panelboards:
   a) Distribution panelboards of the molded case circuit breaker type, rated 480/277 volts and 208/120 volts will be utilized to serve branch circuit panelboards and three phase equipment loads.
   b) Equipment ground buses bonded to enclo-sures will be provided for all distribution panelboards.
4. Branch Circuit Panelboards:
   c) Branch circuit panelboards of the molded case circuit breaker type, rated 480/277 volts and 208/120 volts will be utilized to serve all lighting, receptacle and general power loads.
   d) Equipment ground buses bonded to enclo-sures will be provided for all branch circuit panelboards.
   e) Lighting panelboards will be provided with 20% spare circuit breakers (min. 6, 1P-20A).
   f) Receptacle panelboards will be provided with 20% spare circuit breakers (min. 12, 1P-20A).
   g) Door-in-door type trim will be provided for panelboards.

B. Wiring Methods:

1. Feeder and branch circuit wiring will be run in RGS (Rigid Galvanized Steel) or EMT (Electric Metallic Tubing) as follows:

Power Feeders:	RGS or IMC for all exterior exposed. EMT for interior.
Branch Circuits:	RGS or IMC for all exterior exposed. EMT for interior.
Telecom:	EMT

Branch circuits routed concealed above accessible ceilings will be Metal-Clad (MC) cable with steel armor.

EMT fittings will be insulated throat, steel set-screw type.

Conduits routed underground, in slabs or under slabs will be PVC, with RGS elbows and turn-ups and with RGS sleeves at foundation penetrations as required.

Emergency risers and emergency feeders routed in non-sprinklered locations above ceilings, in shafts, etc., will be minimum 2-hour rated Mineral-Insulated (MI) cable.

a) Minimum conduit size will be 3/4", 1/2" for switch drops. Conduit fill will comply with NEC Art. 310.
b) Lighting and receptacle branch circuit wiring will be installed concealed in suspended ceilings and walls in finished areas and exposed in mechanical spaces and other areas without suspended ceilings.
c) Wiring will be copper with type "THHN" or type "THWN" insulation rated at 600 volts, except insulation will be "SF" when terminating in incandescent fixtures. Wire sizes #10AWG and smaller will be solid, wire sizes #8AWG and larger will be stranded.

C. Utilization Voltages and Branch Circuiting Criteria:

120V Lighting:	On a 1 pole, 20 ampere, 120V branch circuit, average 1200 watts
Convenience Receptacles:	On a 1 pole, 20 ampere, 120V branch circuit, typically receptacles, maximum 8 receptacles
Special Purpose Receptacles:	On a 120 or 208 volt appliance branch circuit, ampere rating as required
Motors 1/2 HP and larger	On a three-phase 480V circuit, ampere rating as required
Motors less than 1/2 HP	On a 1 pole, 20 ampere 120V branch circuit

D. Grounding:
1. Power system grounding will meet or exceed requirements of Article 250 of the NEC.
2. Insulated ground conductors will be routed with all feeders and branch circuits.
3. All panelboards and equipment will be provided with ground buses or lugs connected to equipment enclosures.
4. Wall mounted copper ground buses will be provided in the main electric and telecommunication rooms. Main switchboard equipment ground buses, water service ground conductor, building steel ground conductor, and transformer grounds will be connected to the wall mounted ground bus.

E. Wiring Devices:
1. General wiring devices will be specification grade. Standard switches will be 120/277 volt toggle switches; standard duplex receptacles will be NEMA 5-20R. Device plates will be plastic, colored to match receptacles in coordination with architectural color scheme or galvanized steel in unfinished areas.
2. Receptacles on emergency service will be red, NEMA 5-20R.
3. Special purpose receptacles will be brown, NEMA configuration as required.

F. Lighting:

1. Lighting will be primarily LED type. Refer to Lighting Section for additional information.

G. Miscellaneous Electrical Provisions:

1. Power:
   a. Lightning arrestors will be provided at 15kV switchgear and the high voltage side of each service transformer.
   b. Surge protection devices (SPD) will be provided at low voltage bus of each substation.
   c. One (1) duplex receptacle will be provided in public corridors and lobbies with a maximum spacing of 50 ft on centers and 25 ft. from corridor ends, maximum of two (2) receptacles per circuit.
   d. Minimum of one (1) duplex receptacle on emergency service will be provided in each electric and mechanical room.
   e. One (1) duplex GFI receptacle will be provided in each toilet room at the counter.
   f. Heavy-duty, lockable safety disconnect switches or EPO buttons will be provided at all three-phase motors.
   g. Single-phase motors will be served via lockable manual motor starter toggle type switches with thermal overloads.
   h. Variable speed drives will be provided for all motors requiring variable speed control.
   i. Motor-circuit-protector type combination motor starters will be provided for all 3-phase motors requiring on/off operation.
   j. Elevators will be served via a fused dis-connect switches and contactor located in elevator machine rooms for power shutdown per ANSI 17.1 requirements.
   k. GFI receptacles, switched lighting fixtures and power provisions for sump pumps will be provided in elevator pit.
   l. Special power requirements for specific equipment and systems will be provided per owner specifications.
2. Lighting Control:
   a. Multiple light switches will be provided at all locations to permit selective operation of partial lighting per Building Code requirements.
   b. Local vacancy sensor switches or timer switches will be provided in individual offices and rooms.
   c. Lighting control system utilizing low volt¬age relay cabinets will be provided for central automatic control of all common area lighting circuits. Combination photocell and time clock control will be provided for all exterior lighting circuits via the low voltage relay cabinets.
   d. Emergency lighting will be provided in all mechanical, electrical and telecommunication rooms.
   e. Two-lamp emergency lighting on photoelectric control will be provided at all building exterior exits.
   f. The lighting control panels will be tied into the Building Management System (BMS).

3. General:
    a. Floor mounted electric equipment will be mounted on 4 in. high concrete house-keeping pads sized min. 3 in. larger than equipment footprint.
    b. Raceway penetrations through fire rated walls and floors will be sealed with approved fire stopping material. Interiors of communication wiring sleeves will be sealed in the same manner after installation of wiring.
4. Fire Alarm System:
    a. An addressable field programmable fire alarm system combining manual and automatic devices will be provided in accordance with code, NFPA and local requirements, including requirements of the Local Fire Marshall.
    b. The fire alarm system will be interfaced to the existing Central Station for 24/7 monitoring.
    c. Smoke detectors will be provided in elevator lobbies, electric rooms and closets, telecommunication rooms and closets, storage rooms, and elevator equipment rooms and shafts.
    d. Heat detectors will be provided in elevator shafts, mechanical rooms, and elevator machine rooms.
    e. Duct mounted smoke detectors will be installed at the supply fans and at each return air inlet to initiate fan shutdown per NFPA requirements.
    f. Manual pull stations will be provided at all egress doors.
    g. Sprinkler system water-flow switches and tamper switches will be connected to the fire alarm system via addressable monitoring modules for alarm and trouble indication.
    h. Activation of any manual or automatic fire alarm initiating device will sound an alarm throughout the entire affected building via speakers and strobe devices; voice-evacuation will be cable via the fire alarm speakers.
    i. Activation of a smoke detector in an elevator lobby or elevator machine room will recall elevator car to the ground floor via addressable control module interfaces with elevator controller.
    j. Activation of elevator shaft or elevator machine room heat detectors will shut down elevator power via addressable control module interface with elevator contactor per ANSI 17.1 requirements.
5. Electrical Provisions for Telecommunication Systems:
    a. A pathway system of conduits and sleeves will be provided for the building's cabling infrastructure. Typical horizontal cable pathways will consist of j-hooks above accessible ceilings for support of cabling; conduit pathways will be provided at inaccessible ceilings. Each typical outlet will be a 2-gang box with a minimum 1" conduit routed to the pathway system. Large radius sweeps will be utilized at all conduit bends.
    b. MDF/IDF equipment rooms will be provided with plywood backboards, four (4) dedicated 20A, 120V circuits each with a double duplex receptacle, and ground bus and ground riser.
6. Auxiliary Systems:
    a. Power connections and conduit and wiring will be provided for all auxiliary systems, including security and audio/visual systems - scope to be defined.
    b. Power and conduit provisions for security systems (door access, intrusion detection and CCTV cameras) will be provided in accordance with the Owner's guidelines – scope to be defined.

7. Lightning Protection:
   a. The existing Herschler Building has no lightning protection system.
   b. As a new lightning protection system will be provided for the Capitol Building and the Capitol Building is connected to and fed electrically from the Herschler Building, a new UL Master-Labeled Faraday Cage Type (Franklin rod) lightning protection system will be provided for the Herschler Building. The system will include perimeter air terminals down conductors and ground rods (in lieu of down conductors, the building steel may be used for connecting to ground rods where feasible).

PART 4 – ELECTRICAL

4.1 DESIGN CRITERIA

A. The following criteria are the basis for sizing the electric distribution systems.

Lighting Loads:

General Office Areas	2 W/sf
Corridors, Stairs	1 W/sf
Mechanical and Storage Rooms, Toilets	1 W/sf
Emergency Lighting (per building gsf)	0.25 W/sf

Receptacle Loads:

General Office Areas	4 W/sf
Lobbies, Corridors, Stairs	1 W/sf
Mechanical and Storage Rooms, Toilet Rooms	1 W/sf

Demand Factors:

Lighting		100%
Receptacles	1st 10 kVA	100%
	Over 10 kVA	50%
Fans		100%
Pumps (0% DF for standby pumps)		100%
Elevators (2)		95%
Elevators (8)		75%
Misc. Mech. Equipment		80%
Misc. System Equipment		80%
Exterior Lighting		100%

Equipment and Feeder Capacities:

Equipment and feeder capacities (ampacities) will be sized at 125% of calculated coincident demand plus spare capacity as follows:

Branch Circuit Panelboards	+ 50% spare
Distribution Panelboards	+ 35% spare
Main Switchboards	+ 25% spare

All kW loads will be converted to kVA using the following power factors:

General Receptacle and Lighting Loads	0.90 PF
Mechanical Equipment Loads	0.90 PF

Lighting Levels for Sizing Systems:

Nominal maintained illuminance levels will be as follows (to be confirmed by lighting designer):

General Office Areas	35-50 fc
Lobbies	30-35 fc
Corridors, Stairs	15-20 fc
Mechanical and Storage Rooms, Toilets	25 fc

Available Fault Current (kA) to be determined.

4.2 ESTIMATED ELECTRICAL LOADS

A. Herschler Building (includes Herschler Addition and Connector):

Normal:

Lighting (general)	913 kVA
Receptacles/Gen'l Pwr. (demand)	894 kVA
Mechanical	550 kVA
Elevators	(4) 30 HP
Misc. Equipment	45 kVA

Emergency (includes Standby loads):

Lighting (emergency)	114 kVA
Mechanical	100 kVA
Elevators	(4) 30 HP
Misc. Equipment	5 kVA

B. CUP:

Normal:

Lighting (general)	50 kVA
Receptacles/Gen'l Pwr. (demand)	20 kVA
Mechanical	1,320 kVA
Misc. Equipment	60 kVA

Emergency:

Lighting (emergency)	4 kVA
Fire Alarm	5 kVA

Standby A:

Lighting (general)	15 kVA
Receptacles/Gen'l Pwr. (demand)	10 kVA
Mechanical	300 kVA
Misc. Equipment	30 kVA
Elevator (Lift)	(1) 30HP

Standby B:

Lighting (general)	15 kVA
Receptacles/Gen'l Pwr. (demand)	10 kVA
Mechanical	300 kVA
Misc. Equipment	30 kVA

C. Capitol:

Normal / Standby

Lighting	160kVA
Power	135 kVA
Miscellaneous Equipment	35 kVA
Mechanical Equipment	180 kVA

Emergency

Lighting	30 kVA
Elevators	3 @ 30 HP
Smoke Exhaust Fans	4 @ 15HP, 2 @ 5HP = 70 HP
Garden-Level Supply Fans – East	12 @ 5 HP
Garden-Level Supply Fans – West	12 @ 5 HP
Miscellaneous Equipment	10 HP

D. Incoming Service - Summary

Normal

Building	Demand Load kVA
Capitol	
Normal/Standby	500
Emergency	200
Herschler	
Normal	2,300
Emergency	350
Central Utility Plant	
Normal / Standby	1,450
Emergency	10
Chillers	900

	DEMAND LOAD	5647.1	kVA
25%	SPARE	1411.8	kVA
	DEMAND W/SPARE	**7,058.8**	**kVA**

NOTE: Loads are divided equally among four (4) 2,500 kVA substations A, B, C and D under normal operation. Three (3) of the (4) 2,500 kVA substations can serve the entire facility's load if one (1) substation fails.

SECTION 2.10
TELECOM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The Telecommunication Systems will be designed to conform to the International Organization for Standardization (ISO), Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA), Building Industry Consulting Service International (BICSI) and Institute of Electrical & Electronics Engineers (IEEE).

1.2 EXISTING CONDITIONS

A. The existing telecom service for the Complex is fed via a Telephone Service Entrance Room (TSER) located in the Herschler Building's Basement and an existing Datacenter on the the Herschler Building's 1st Floor; the Datacenter will be relocated from the by others. From these locations cabling serves stacked Intermediate Distribution Frames (IDFs) for Herschler West and East. Separate cable in conduit will be run to the Connector and the Capitol Building.

PART 2 – SYSTEMS DESCRIPTION

2.1 PROPOSED TELECOM SYSTEM

A. The telecom service for the Complex will be fed via a Telephone Service Entrance Room (TSER) located in the Central Utility Plant (CUP). From there, it will feed the Main Distribution Frame (MDF) at the 1st Floor of Herschler; from there it will serve stacked Intermediate Distribution Frames (IDFs) for Herschler West, East and the Addition. Separate cabling in conduits will be run to the Connector and the Capitol Building West and East Cores and to the existing tunnel system to nearby adjacent State buildings.

B. The primary goal of the telecommunication system design will be to employ the latest available technology to enable highest quality media delivery of scientific information. Through properly designed infrastructure, the two major principles established by the WSC may be reached:
   1. Open-systems standards, enabling delivery of a wide variety of media to varying levels of technological sophistication
   2. Local and Wide-area networking, facilitating an outreach program of technology to end-users internal and external to the WSC itself.

C. The telecommunications infrastructure will be sensitive to the principles above to provide the capacity and flexibility necessary to support changing telecommunications technology throughout the life cycle of the Complex. Recognizing the dynamic nature of data networking requirements, telecommunications and video communications, careful attention to how the telecommunications infrastructure relates and interacts with the building structure and systems will allow for changes which will best serve the administrators, managers, occupants, visitors and the systems themselves.

D. Our recommendation is to install data cable meeting advanced standards at the time of specification to forestall obsolescence. Category 6A cable to the workstation meets that definition today, and likely still will when this building is constructed. It is an industry-standardized classification of cable that can support 10Gbps.

2.2 TECHNOLOGY SPACES

A. Telecommunications Service Entrance Room (TSER): This room will function as the primary entrance for telecommunications services. It will be the point of demarcation for incoming telecommunications services, and is the interface point between the outside cable plant and the inside cable plant. This room will be located in the Central Utility Plant (CUP) at the east side of the site.

B. Network Communications Center / MDF Room: The Network Communications Center or MDF Room will be the central location to facilitate the routing of telecommunications cabling from the TSER room to telecommunications / IDF rooms and user outlet positions.

C. The MDF Room will be centrally located in the Herschler Building on Level 1 at the core of the new addition and will accommodate the following systems:

1. Voice communications hardware,
2. Building operator-owned transmission equipment used to connect the building to the public switched network;
3. Data system MDF for the intra-building data copper and optical fiber backbone cables;
4. Local Area Networking equipment;
5. Wide Area Networking equipment;
6. Front-end processors, computers and data storage devices;
7. Audiovisual, MATV/CATV and satellite receiver head-end equipment;
8. Printers, modems and associated peripheral equipment.

D. Telecommunications / IDF Rooms: The IDF Rooms will house copper and optical fiber cable terminations and network electronics for delivery of information to the workstations. Backbone connectivity will extend from the MDF Room to IDF Rooms strategically located throughout the Complex. Horizontal Station Cabling will run from the IDF Rooms to each workstation, telephone, and printer or fax location, etc. Horizontal cables will also be run to each photocopier location as they serve as network printers. As described below, the standards for modern high-speed cable specify a maximum of 295 cable-feet for horizontal runs between the termination point in the IDF Room and the workstation outlet device or other termination point. This is to ensure that the cable will actually deliver the performance for which it was designed and certified for the duration of its warranty.

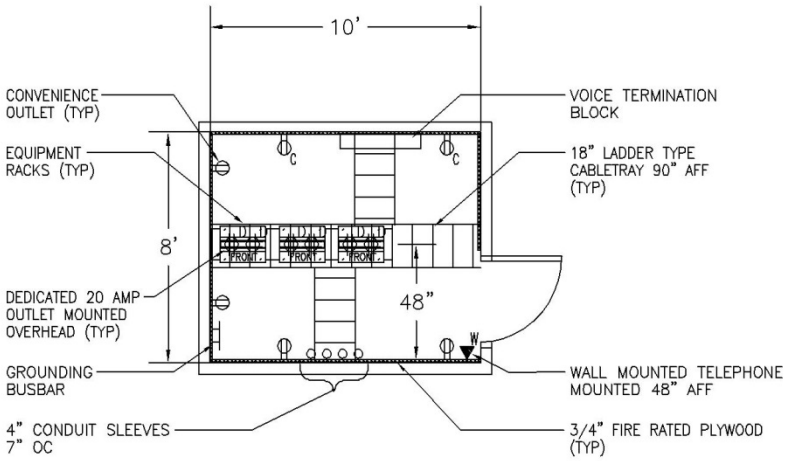


Figure 1 - Typical Telecom IDF Room Detail

This illustration does not represent any specific design and should be considered generic. Refer to Schematic Electrical Communication Drawings for project-specific rooms.

2.3 BACKBONE CABLING

A. Intra- and inter-building pathway systems: the current standards for structured cabling define a system of copper and fiber cable runs in a star topology. The cable system will be supported by:
   1. The Telecommunications Service Entrance Room (TSER) for incoming service providers;
   2. Telecom IDF Rooms strategically located and distributed throughout the Complex.

B. Backbone cables will be a combination of copper and fiber run from the MDF Room to each IDF Room in a "home-run" configuration. Connections to voice and data network devices at user workstations will be unshielded twisted pair (UTP) copper cables from the closest serving IDF Rooms. These horizontal cable runs will be point-to-point, so that each workstation connection is served with a dedicated cable that, under EIA/TIA Standards, may not exceed 295' in length. A simplified design illustration is shown in Figure 2.

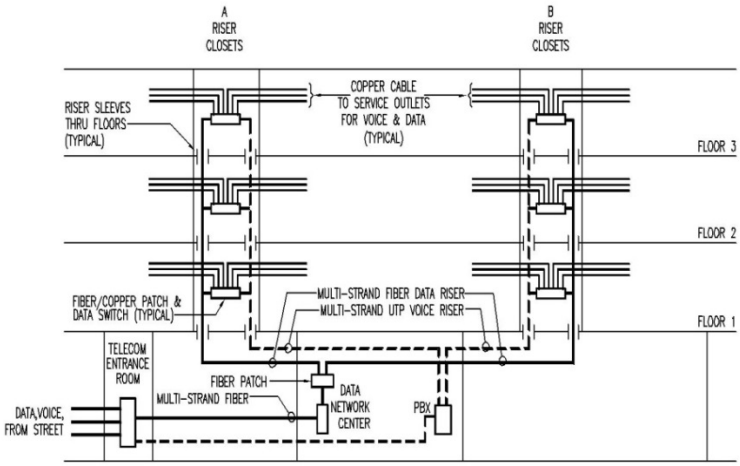


Figure 2 – Typical Structured Cable Plant Distribution

This illustration does not represent any specific design and should be considered generic; refer to the Schematic Electrical Communication Riser Diagram for specific information.

C. Pathways and cable types supporting the structured cable plant will be as follows:
   1. Backbone cables will be run in EMT conduit and/or through conduit sleeves from the Data Network Center MDF Room to each Telecom IDF Room and TSER. The conduit will provide an easy means of initial cable installation. It will also physically protect the cables from damage, and will simplify future cable installations.
   2. Backbone cables will consist of both optical fiber and UTP cable types. Both 50µ multi-mode fibers, and single-mode fiber, will be used for the data backbone. Multi-pair Category-3 UTP cables will be used for the voice circuits to support emergency lines, POTS lines, security etc. As the voice system for the complex will be transported over the data network using the VoIP protocol, a large UTP backbone will not be required; and spare optical fiber and UTP will be provided in the base design.

2.4 WORKSTATION CABLING

A. For some years, commercial office buildings have generally been provided with groups of four cables to each communications outlet location. This has been reduced to sets of three cables each in a number of new buildings due to the integration of some data services, and the anticipation of more converged voice and data networks.

B. At the present time, we are recommending that Administrative areas in the new WSC be provided with sets of two (2) Category 6a cables to each location.

C. Since all cables are of the same type (data and voice), and all are terminated on patch panels, they are completely applications independent. This means that changes can easily be made by moving patch cords in the Telecom Rooms to re-assign usage,.

D. In larger private offices, we recommend at least (2) typical cable-sets consisting of (2) UTP cables each, for a total of four (4) cables per office. The outlet locations should be placed to allow for flexible furniture and equipment arrangements and, of course, associated with power receptacles as well (although physically separated in a different box).

E. Printer, copier and fax locations should all be provided with voice and data connectivity. These can be considered the same as staff areas, and provided with two (2) cable terminations each. Depending on the number of devices in each location, single or multiple voice/data plates and cable sets may be required.

F. 4 x 4-inch junction boxes with 1" conduit stubs to the accessible ceiling areas will be provided for all wall mounted workstation outlets. Wall mounted telephone outlets wills be provided with 2-inch by 4-inch junction boxes and 1-inch conduit stub ups. Organized cable management and protected cable are strongly recommended. Therefore, where there is available space, cable trays will be provided in the corridors of the ceiling areas to route workstation cables back to the Telecom Rooms. J-hooks, placed every 4-feet, will be used to transition cables from the cable trays to the conduit stubs.

2.5 WIRELESS DATA/VOICE COVERAGE

A. Provisions will be included in the design to locate wireless access point data/voice location throughout the facility, focused mostly in open areas where network mobility and ad-hoc network access is desired for staff. Wireless access points will be placed close enough to provide seamless coverage throughout the building. The implementation of wireless technology in the building should be seen as a supplement to the wired infrastructure.

2.6 ADDITIONAL M.E.P AND ARCHITECTURAL REQUIREMENTS

A. Telecommunications Rooms:
   1. Cabling associated with radio frequency (RF) distribution, i.e. slotted radial coaxial cable, if required, will not be installed within the Telecommunications Room.
   2. Telecommunication Rooms will be of slab-to-slab construction, to facilitate the outfitting of the rooms for environmental conditioning and fire protection / isolation. A suspended ceiling is not required.
   3. Telecommunication Room walls will be a minimum 1-hour fire rated construction. All penetrations will be sealed to prevent the passage of fire, smoke and gases.
   4. Telecommunication Rooms will be fully sprinklered with re-settable sidewall sprinkler heads. Wet pipes, either run overhead or along the walls will not traverse the rooms.

5. Telecommunication Rooms will be furnished with 3/4-inch fire-rated plywood on all designated walls installed 6-inches AFF. Finishes in the room will be light in color to enhance lighting. Finishes will be applied before room fit-out. Concrete floors and walls will be sealed and cured to eliminate dust.
6. Telecommunications Rooms will be furnished with a single lockable door of at least 36-inches wide by 80-inches high. An outward opening door is preferable.
7. The environmental limits for the Telecommunications Room will be 65-75 degrees Fahrenheit and 30-55 percent relative humidity, non-condensing. Telecommunications Rooms will be equipped with high-temperature alarms that report to the Security and/or BMS systems.
8. HVAC systems serving the Telecommunications Room will be capable of 24-hours-a-day, 7-days-a-week operation. HVAC units that are installed in the room will be located away from telecommunications equipment, either on the wall or in racks, and will be supplied with drip pans to preclude condensed water from damaging system components. Flow valves, bleeder valves and any other pipe filling associated with chilled water and return lines will not be mounted overhead of the equipment cabinets. Water pipes associated with any other building systems will not pass through the rooms.
9. Lighting levels within the Telecommunications Room will be a minimum of 50 foot-candles maintained at 36-inches AFF.
10. Dedicate power circuits will be provided for all telecommunications equipment located within the telecommunications rooms. Rack mounted uninterruptible power supply (UPSs) units will be provided in coordination with system requirements.
11. In addition to outlets dedicated to telecommunications equipment, electrical convenience outlets (120V, 20A, duplex, U-ground) will be provided at 8-foot intervals within all Telecommunications Rooms. A maximum of four duplex outlets will be fed from a single circuit. All branch circuiting will include a ground wire from the distribution panel's ground busbar to all electrical outlets in the room. The outlets will be used for testing equipment and power tools only, and not for transport electronics.
12. A solid copper ground bar will be provided in all Telecommunications Rooms, for signal ground connections. The ground busbar will be bonded to all permanent metallic objects in the room.

B. Conduit And Boxes
1. Conduits, boxes and sleeves will be provided as described herein per National Electrical Code and other relevant specifications.
2. For all conduit runs pull boxes will be provided for:
   - Every 100 feet in straight conduit runs
   - After every 180 degree of bends or equivalent
3. No conduits bends will be more than 4 times the inside diameter of the conduit that is less than 2” and 10 times the inside diameter of the conduit that is more than 2”.
4. Conduit stub-ups will be installed 6” above the finished ceiling into corridor or cable tray towards Telecom Room.
5. Non-metallic draglines, with a minimum tensile strength of 600 pounds in each conduit and sleeve less than 2” inside diameter and of 1200 pounds in each conduit and sleeve equal to or greater than 2” inside diameter will be provided.
6. Permanent, non-removable plastic or metal hanging tags on the ends off all conduits providing the conduit length, service and the originating and terminating destination of each respective conduit will be provided.
7. Bushings for all conduit and sleeve ends will be provided.

C. Telecommunications Grounding And Bonding System

1. A unified Telecommunications Grounding and Bonding System will be provided and integrated with the Building's electrical / life safety grounding system. The grounding system will be designed in accordance with EIA/TIA 607 "Commercial Building Grounding and Bonding Requirements for Telecommunications".
2. The Telecommunications Grounding and Bonding System will include a pre-drilled 4" x 20" x ¼" solid copper ground bar with Plexiglas cover, wall mounted on insulated standoffs in all Telecommunication Rooms that will be bonded to the Building's grounding system with a minimum No. 2/0 AWG copper grounding conductor.
3. All the equipment racks and cable trays in the IDF and MDF Rooms will be bonded to the local ground bar with a stranded, insulated (green) minimum No. 6 AWG grounding conductor.

SECTION 2-11
LIGHTING DESIGN

PART 1 - GENERAL LIGHTING CONCEPT SUMMARY

1.1 INTRODUCTION

Lighting – electric and daylight – is about people – the users. Lighting affects visual performance, subjective impressions, senses of comfort, safety, and security, energy use, and sustainability. The lighting design for the Herschler Building, the addition, the connector, central utility plant, and the site should address these attributes in the context of the architectural and site designs and in a manner that is cognizant of, but not subservient to budget. (file SECTION 2-11_LIGHTING-grs-20141029-grsedits.docx)

1.2 DESIGN CONCEPT SUMMARY

A. Concept and Approach
Lighting is proposed to consist of a number of strategies that are combined into a unified lighting scheme appropriate to the interior design and architectural schemes. This unified scheme will address occupants' visual needs and create a pleasant and comfortable setting for work and discourse. For purposes of this concept summary, the lighting strategies are cited as planar lighting, functional lighting, contrast, and sustainability.

B. Overview
1. Planar Lighting: Lighting wants – needs – to permeate the project, but be so well-integrated with its surroundings that it is not identified as a unique or separate subsystem. It is organized and integrated with the interior and exterior architecture. Lighting should visually lead users through the architectural and site hierarchies, define architecture, and define place. To these ends, straightforward lighting of planar surfaces and their intersections – walls, ceilings, and features – is proposed thematically throughout the project.
2. Functional Lighting: Lighting will address the visual function needs of users – whether it be navigating exterior walkways at night or interior corridors day or night or parking underground or viewing computer screens or paperwork.
3. Contrast: Degrees of contrast help define visual hierarchies and introduce visual interest or simply enable work. A consistent fog of light without contrast throughout the interior or exterior of a project does not enhance visual tasks, architectural details, spatial volumes, or special focals.
4. Sustainability: Sustainable lighting results from the judicious use of efficient, long-life lamps, efficient luminaires, daylight harvesting, and controls in solutions that encourage people to visit or work. Industry-recognized qualitative and quantitative criteria will guide specific selections and layouts.
5. Unified Lighting: Unifying the above four lighting strategies in a way that relates to the interior design and architectural schemes is the ultimate charge in lighting design and will establish the lighting design concept. Although each of the above strategies are discussed separately, they will be unified with interiors and architecture for a cohesive visual appearance that leverages their effects into an effective and efficient lighting system.

C. Planar Lighting – Lighting Walls, Ceilings, and Features
1. The lighting of these surfaces and their junctures is responsible for brightness and dimensional perceptions and contributes to well-being, improved visual comfort, and functional performance. Such lighting is recommended throughout much of the "front-of-house" work area.
   a. Example applications
      1) Cove lighting where ceiling pop-ups or coves are part of the architectural program
      2) Wallslot lighting at junctures of select walls and ceilings

3) Indirect or direct/indirect lighting in offices, conference and committee rooms where ceiling heights allow

2. Wall and ceiling lighting should also be used to balance daylight brightnesses and avoid harsh contrasts in work areas that can result from too much daylight brightness in the zone of fenestration and too little brightness in interior zones distant from fenestration. Techniques to balance daylight are recommended throughout much of the "front-of-house" daylighted work area.
   a. Example applications
      1) Wallslot lighting opposite window walls at junctures of walls and ceilings
      2) Wallwash lighting opposite window walls
      3) Backlighting of translucent glass or art or textured glass opposite window walls

D. Functional Lighting
   1. Visual function needs are addressed with specific lighting quality and quantity criteria. Industry-recognized qualitative and quantitative criteria will guide specific lighting equipment selections and counts throughout the project.
   2. Glare can degrade the quality of functional lighting. Techniques are available and should be used throughout the work areas to minimize glare.
      a. Planar lighting softens effects of glare.
      b. Well-shielded optically-controlled luminaires minimize the effects of glare.
      c. Active or passive control of fenestration in work areas reduces the effects of glare.

E. Contrast
   1. Contrast is achieved by juxtaposing light and dark for better visibility. Feature lighting, such as strong accents on a civic leader's portrait, establishes contrast between a feature and the background for better visibility and conscious focus. Silhouetting people against even a softly lighted façade backdrop is a security measure that is the result of contrast between the unlit people (foreground) and the softly lit façade feature (background). Viewing the capitol day or night through windows or skylights is best achieved against the contrast of a relatively dark interior. Office task lights establish a contrasting zone of focused work on task areas. Lighting techniques that establish appropriate contrast effects are proposed throughout much of the project.
   2. Feature lighting is used to acknowledge objects important to the mission, culture, or history, acknowledge special surfaces, to establish wayfinding, or offer areas of respite, such as lobbies, breakouts, or waiting areas. Feature lighting in office areas has been shown to provide periodic relief, or "vision breaks," from close-up reading work. Such lighting is recommended throughout much of the "front-of-house" public area and in those work areas where intensive reading of paper and computer screens comprises much of the work effort.
      a. Example applications
         1) Memorial plaques
         2) Portraits
         3) Murals
         4) Artworks
         5) Sculptures
         6) Architectural niches
         7) Unique materials or bold color appliques
         8) Open offices

F. Sustainable Lighting
   1. Lighting making the most of the earth resources expended in its production, transportation, installation, and operation while achieving the attributes identified above exemplifies sustainability.
   2. Lighting power densities will be at or below ASHRAE 90.1-defined limits.
   3. Automated and manual controls are proposed throughout the project to minimize energy consumption and offer flexibility.
   4. Lamps and luminaires will be "most efficient in class" varieties.

5. Lamps will be long-life to reduce the number of replacement cycles and limit disposal and recycling.

1.3 LIGHTING SYSTEMS SUMMARY

At this phase, a round-up of proposed baseline parameters for various lighting system hardware components is possible. Lamps, Drivers, Luminaires, Daylight Harvesting, and Glazing are reviewed.

A. Lamps
   1. Recommended lamps are light emitting diodes (LEDs) for the following reasons:
      a. Best efficiency
      b. Best life
      c. Best color
         1) Interior recommendation to better address visual comfort, less-industrial appearance
            a) 3000K (crisp warm white)
            b) CRI >80
            c) R9 >20
            d) Other lamp color(s) may be introduced for special contrast of select features
         2) Exterior recommendation to better address visual comfort, less-industrial appearance, circadian rhythms
            a) 2700K (very warm white)
            b) CRI >80
            c) R9 >20
            d) Other lamp color(s) may be introduced for special contrast of select features
      d. Dimmable
      e. Instant on/off (suitable for emergency/egress lighting)
      f. Least toxic waste
      g. Available in nearly all off-the-shelf interior and exterior luminaire styles and types

B. Drivers
   1. Drivers regulate and monitor current and voltage to LEDs. These are available in varying degrees of performance and affect quality of light. The following operational characteristics are recommended:
      a. Flicker-free
         1) Constant-current regulation (CCR) types recommended
         2) Hybrid CCR/PWM (pulse-width-modulation) recommended for deep dimming in theater/auditorium settings
      b. Dimmable
         1) Ranging from 15% to 100% – CCR standard typical (no cost premium)
         2) Ranging from less than 1% to 100% for hybrid drivers
         3) Relatively simple control protocol, but requires control data wiring to each dimmable luminaire in addition to power wiring

C. Luminaires
   1. Dedicated or purpose-built LED luminaires are recommended for best optics, efficiencies, operation, and, typically, longest system life.
   2. Only luminaires that are UL/NRTL-listed labeled for specific lamping are recommended. Purchasing/installing new luminaires and using retrofit lamps is not recommended as these luminaires are typically not UL/NRTL listed and labeled for retrofit lamps nor intended for new-construction work with retrofit lamping.
   3. Luminaire selections will be based on interior design and architectural schemes and will be functionally-specific and aesthetically appropriate. Glary and/or over-sized equipment contributes to an intimidating and uncomfortable setting. Controlled optics will help address glare. Luminaires scaled proportionally to the architecture and occupants will contribute to a more hospitable work setting.

D. Controls
   1. A centralized control system is recommended with astronomical timeclock, photocell, and occupancy sensor inputs. Automated and manual controls are proposed throughout the project to minimize energy consumption, balance electric lighting use with daylight availability, and to provide flexibility with a minimum of two settings in most spaces.
   2. Benefits of automated controls are:
      a. Availability of multiple preset scenes
         1) Conference rooms
         2) Committee rooms
         3) Auditorium
         4) Meeting rooms
         5) Executive offices
      b. Daylight harvesting
         1) Open plan offices
         2) Daylit stairs
         3) Atria
      c. Site lighting scheduling
         1) Pedestrian lighting
            a) Dusk – on
            b) Curfew – setback to 30%
            c) Occupancy-sense to 100%
            d) Dawn – off
            e) Security override
         2) Façade lighting
            a) Dusk – on
            b) Curfew – setback to 30%
            c) Dawn – off
            d) Security override
         3) Landscape lighting
            a) Dusk – on
            b) Curfew – off
            c) Security override
      d. Parking garage lighting scheduling
         1) Entry/exit daylight adaptation transitions
         2) Time-of-day setbacks
            a) Engage occupancy sensors
            b) Security override

E. Daylight Harvesting
   1. Daylight harvesting should be explored as a means to energy savings, extended service-life of lamps, and enhancing the user experience with a more dynamic daytime experience. Depending on glazing transmittances (see Fenestration Glazing below), ceiling heights, finishes, and space layout configurations, daylight harvesting may result in lighting energy use reductions of between 30 and 60 percent. Daylighting controls, automated window shading systems, and dimmable electric lighting are recommended for daylight harvesting.

F. Fenestration Glazing

1. At this phase, the intent is to provide sufficient lighting-relevant information to assist in the development and selection of shading and glazing approaches for skylights and curtain walls. Other parameters such as solar heat gain coefficient, U-Value as established by the Mechanical Engineer and Architect will also influence fenestration glazing. Architectural shading devices, such as fins, light shelves, or brise soleils or reflecting devices such as light shelves or passive optical systems can mitigate glare and will influence the glazing approach. Some of these may be relatively simple, such as those at the connector and breakout skylights where glare may be more readily tolerated given the transient nature of the space activity than in an office or work setting. Frit of the right pattern and area and location of coverage may suffice, for example. Advancement during the Design Development Phase should include:
   a. Study of the various curtain wall and skylight fenestration and shading options.
   b. Undertaking detailed lighting and energy modeling on the shading and glazing approach(es) of choice.
   c. Undertaking full- and relatively-large-scale mockups of glazing selections to confirm color, clarity or visibility, and transmission properties.
2. A number of traditional techniques are available to temper daylight. Visible Light Transmittance (VLT) is an important criterion and depends on the application – lower VLTs typically in work settings and higher VLTs typically in public circulation settings
   a. The following glazing options, cited in order of simplicity and cost (low to high) are typically used individually or in some combination, which may be different on different curtain wall elevations and skylights, to meet overall VLTs for a comfortable, productive, and efficient setting:
      1) Tint of glass
         a) Depends on the use and degree of frit, shades, and/or electrochromic glazing outlined below.
         b) Coupled with dimmable lighting to reduce lighting-energy use.
         c) Depends on the clarity/color of view desired.
         d) Clear glass typically exhibits too much glare and/or heat gain.
      2) Frit coatings
         a) Allow for somewhat higher base glass transmittances which can result in clearer or “less smoggy” view.
         b) Are recommended to be opaque to prevent translucent glare and preserve some view to exterior.
         c) Coupled with dimmable lighting to reduce lighting-energy use.
      3) Shades
         a) If shades are used, automated shades are recommended. A number of studies have shown manual shades to be pointless – with the majority of these set to a position to eliminate the worst glare condition which also eliminates most daylight for most of the day, regardless of glare and sky conditions.
         b) Coupled with dimmable lighting to offer greater lighting-energy savings than tinted and/or fritted glazing alone.
         c) Density of weave depends on VLT of glazing.
      4) Electrochromic glazing
         a) Variable VLTs are available that correspond to various sky conditions.
            (1) Variable VLTs typically range from as much as 40% to as low as 5%, depending on base glass transmittance, to accommodate changing daylight throughout the day and seasons.
            (2) Requires wiring to glass panels.
         b) Automated via photocell and timeclock inputs.
            (1) Coupled with dimmable lighting to offer greatest lighting-energy savings.
            (2) Windows and skylights can be set to lowest VLT (typically 5%) at night to limit spill light to exterior.

PART 2 - LIGHTING CRITERIA

2.1 INTRODUCTION

Industry-standard quantitative lighting criteria are primarily sourced from the Illuminating Engineering Society (IES). A lighting criteria.summary spreadsheet is inserted at the end of this Lighting Design Section. Some qualitative criteria are also presented, much of which is based on a combination of IES documentation and experience. Interior and Exterior Lighting Criteria are presented.

PART 3 - INITIAL LIGHTING DESIGN DISCUSSION

3.1 INTRODUCTION

Lighting design ideas and techniques for specific areas or spaces are posed here for initial discussion, but are subject to the landscape architectural schemes and the interior design and architectural schemes and the Owner's approval.

3.2 EXTERIOR LIGHTING

Exterior lighting should be relatively subdued to avoid issues of glare, night-sky, and light-trespass. Discussion here is pending coordination with security and landscape architecture.

A. Pedestrian lighting is proposed from contemporary pedestrian postlights. Experience suggests that postlights of 12- to 15-feet in height on 40- to 60-foot spacings will meet path lighting criteria.

B. At the feature bench wall along the East/West walkway between the Capitol and Herschler buildings, pedestrian path lighting is proposed from a bench-integrated seat-edge detail. Continue this lighting approach, pending continuation of the detail into the south plaza.

C. Landscape lighting is proposed for the ornamental trees at the southeast and southwest corners of the site – two in- or above-grade uplights are proposed per tree to provide a soft transition between building and street.

D. Street lighting in the State right-of-way along Central Avenue will be replaced to accommodate the new turn lanes into the garage.

E. Façade lighting is proposed from a number of techniques.
   1. Dimmed interior lighting of the crystalline architectural features, such as the new stairs.
   2. Dimmed amber lighting of the south-facing facades oriented to the south plaza and capitol.

3.3 INTERIOR LIGHTING

A. Offices
   1. Open office ceiling planar lighting is proposed from linear direct/indirect pendants of small, simple rectilinear cross-section, on roughly 12-foot spacings, pending ceiling heights.
   2. Closed office ceiling planar lighting is proposed from linear direct/indirect pendants of small, simple rectilinear cross-section, on roughly 6- to 8-foot spacings, pending ceiling heights and geometry of space.
   3. Wallwash lighting is proposed from 4- to 6-inch square luminaires spaced roughly 2- to 3-feet from walls and on roughly 2- to 4-foot spacings, pending ceiling heights and wall layouts. Alternatively, 2- to 4-inch wide rectilinear luminaires spaced roughly 2- to 4-feet from walls of lengths and spacings corresponding to the modular ceiling layout.
   4. Accent lighting is proposed from wall-mounted picture lights, roughly 3-feet in length and one per 30-feet of linear interior wall (opposite curtain wall).

B. Atria
   1. Bulkhead fascia accenting is proposed at each floor level, pending detailing and finish of these surfaces to provide planar lighting and generally illuminate space.
   2. Introduce some lighting or lighting effects for visual interest, such as one or several of these options:
      a. In-floor indicator lighting or in-floor sculpture lighting for visual interest and focal.
      b. In-floor or millwork-integrated detail lighting to illuminate permanent reception or information desk(s) or kiosk(s), pending detailing of these elements, if any.
      c. Introduce a “light” sculpture consisting of an array of off-the-shelf luminaires in a massing or massings reminiscent of a chandelier(s) or light-art of sufficient scale for the space (without incurring cost of custom chandelier[s]).
      d. Introduce projector(s) and gobo(s) to project imagery on floor or bulkheads, such as the State Seal.

C. Stairs
   1. Stair-integrated lighting, pending detailing of stair treads, risers, nosing, and railing to provide functional lighting while minimizing or eliminating difficult-to-reach ceiling-based lighting over stairs.
   2. More monumental or visually-significant stairs are features in their own right. Selection of more finished or refined lighting equipment should be considered as should the lighting of the surrounding architecture:
      a. Small-scale steplights in side walls or risers, or lighting routed into undersides of floating treads.
      b. Dimmable planar lighting at angular wall-to-wall junctures or ceiling-to-wall junctures.

D. Connector
   1. As a space of potentially significant spontaneous meetings and discourse, lighting should allow for quiet sidebars. Consider:
      a. Strong accenting of focal features, such as at the skylight, or of ceiling/wall planes in zones at the ends of the connector to avoid the “black hole” effect.
      b. Provide for softer/dimmer intermediate areas for conversations with lighting of cleaved ceiling/wall planes or architectural detailing, such as door setbacks or transoms.
      c. Emphasize the skylight with dimmable and/or colored light for best viewing of the capitol.

E. Committee Rooms
   1. Clean, simple lighting aesthetic is proposed. Pending interior design and architectural schemes, consider:
      a. Cove lighting, pending ceiling configuration and finish) combined with small (4” square or pinhole) downlights or where ceiling height is greater than 10 feet, small-cross-section linear direct/indirect pendants. Cove lighting offers improved perceptions of spaciousness.
      b. Art accenting with simple-profile picture lights.
      c. Wallslot or wallwash lighting for improved perceptions of spaciousness and to provide backdrop appropriate for filming.
      d. Feature “daylight-like” slot along one key wall for visual interest. Dimmable and tunable-white light would respond to time-of-day.

F. Public Circulation
   1. Typical circulation areas should be addressed with a straightforward downlighting approach with some accent or feature lighting placed intermittently for visual interest and improved brightness perceptions. Destination elements should be accented for similar reasons and for wayfinding. Consider:
      a. Small-scale (4” round or square), 12-inch square architecturally-dimensional luminaire, or pinhole general lighting on roughly 8- to 10-foot spacings, pending ceiling heights.
      b. Introduce some lighting or lighting effects for visual interest and to break-up lengths of corridors, such as one or several of these options:

1) Periodic cove or ceiling/wall juncture detail lighting corresponding to architectural nodes, details, wall-and-door layout patterns or transoms.
2) Accent lighting is proposed for features or wall artworks at key nodes or destinations.
3) Cove or floor accent lighting at corridor intersections or nodes.
4) Accent lighting at cleaved planar intersections at corridor intersection or nodes or to announce destinations.
5) Accent lighting of elevator core walls.

G. Parking Garage

1. Direct/indirect, low-glare LED lighting is recommended for safety and security, with occupancy sensors to reduce lighting to 30% output when unoccupied. Accent lighting is recommended at important nodes/elevator core. Paint ceilings and walls white for improved security surveillance, efficiency, and spaciousness.

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

Interior Lighting Criteria

VISITOR ZONES

Vestibules

Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Day - High Activity		E_h @ Floor = 10 lux Min.	3000K	80+	0.72 W/sf	BMS
E_h @ floor = 150 lux					with programmable controls	Presets
E_v @ 5' AFF = 75 lux	2:1 Avg:Min				0.79 W/sf	Local keypads, handhelds (secure)
Night - High Activity						Occupancy Sensors
E_h @ floor = 100 lux						Photocell
E_v @ 5' AFF = 50 lux	2:1 Avg:Min					
Night - Low Activity						
E_h @ floor = 40 lux						
E_v @ 5' AFF = 15 lux	2:1 Avg:Min					

Lobbies and Atria

Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
General Circulation		E_h @ Floor = 10 lux Min.	3000K	80+	0.72 W/sf	BMS
at Entries - Day					with programmable controls	Presets
E_h @ floor = 100 lux					0.79 W/sf	Local keypads, handhelds (secure)
E_v @ 5' AFF = 30 lux	4:1 Avg:Min					Photocell
at Entries - Night						
E_h @ floor = 50 lux						
E_v @ 5' AFF = 20 lux	4:1 Avg:Min					
Distant from Entries						
E_h @ floor = 100 lux						
E_v @ 5' AFF = 30 lux	4:1 Avg:Min					
Security Screening						
E_h @ 3' AFF = 200 lux						
E_v @ 5' AFF = 100 lux	2:1 Avg:Min					

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
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Circulation Corridors						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Adjancency Passageways		E_h @ Floor = 10 lux Min.	3000K	80+	≥ 8 ft Wide	BMS
E_h @ floor ≥ 0.3 task E_h					0.53 W/sf	Presets
adjacent space					with programmable controls	Local keypads, handhelds (secure)
min ≥ 10 lux	3:1 Avg:Min				0.58 W/sf	Photocell
E_v @ 5' AFF ≥ 0.2 task E_h						Occupancy Sensors
adjacent space					< 8ft Wide	
min ≥ 10 lux					0.63 W/sf	
Independent Passageways					with programmable controls	
E_h @ floor = 50 lux					0.70 W/sf	
E_v @ 3.5' AFF = 30 lux	2:1 Avg:Min					
Passenger Elevators[4]						
Cab Interior						
E_h @ floor = 50 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Threshold Inside						
E_h @ floor = 50 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Threshold Outside						
E_h @ floor = 100 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Escalators[4]						
E_h @ floor = 50 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Reading Work Areas						
E_h @ floor = 150 lux						
E_v @ 5' AFF = 50 lux	4:1 Avg:Min					

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

Stairs						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
High Activity E_h @ floor = 100 lux E_v @ 5' AFF = 50 lux	2:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.55 W/sf with programmable controls 0.60 W/sf	BMS Occupancy Sensors
Live Surveillance E_h @ floor = 100 lux E_v @ 5' AFF = 50 lux	2:1 Avg:Min					Notes: Bi-level control for stairs with infrequent access with occupancy sensors to bring lights to full output
Typical E_h @ floor = 50 lux E_v @ 5' AFF = 30 lux	2:1 Avg:Min					

Toilets						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Fixtures E_h @ top surf = 150 lux E_v @ 3.5' AFF = 50 lux	2:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.78 W/sf	BMS Occupancy Sensors
General E_h @ floor = 50 lux E_v @ 3.5' AFF = 30 lux	2:1 Avg:Min					
Vanities E_h @ counter = 150 lux E_v @ 3.5' AFF = 200 lux	2:1 Avg:Min					

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

ADMINISTRATION ZONES						
Circulation						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Corridors		E_h @ Floor = 10 lux Min.	3000K	80+	≥ 8 ft Wide	BMS
E_h @ floor = 50 lux					0.53 W/sf	Presets
E_v @ 3.5' AFF = 30 lux	2:1 Avg:Min				with programmable controls	Local keypads, handhelds (secure)
Passenger Elevators[4]					0.58 W/sf	Photocell
Cab Interior						Occupancy Sensors
E_h @ floor = 50 lux					< 8ft Wide	
E_v @ 5' AFF = 30 lux	2:1 Avg:Min				0.63 W/sf	
Threshold Inside					with programmable controls	
E_h @ floor = 50 lux					0.70 W/sf	
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Threshold Outside						
E_h @ floor = 100 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

Conference Rooms						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Discourse E_h @ 2'-6" = 300 lux E_v @ 4' AFF = 75 lux White Boards E_v @ 5' AFF = 150 lux Video Conferencing E_h @ 2.5' = 300 lux E_v @ 4' AFF = 400 lux Walls E_v @ 3' -6' AFF = 200-400 lux depending on wall color	3:1 Avg:Min 3:1 Avg:Min 1.5:1 Avg:Min 3:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.98 W/sf with programmable controls 1.08 W/sf	BMS Presets Local keypads Photocell Occupancy Sensors
Copy Rooms						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
General E_h @ floor = 100 lux E_v @ 5' AFF = 30 lux Machines E_h @ 3.5' = 300 lux E_v @ 3.5' AFF = 100 lux	3:1 Avg:Min 3:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	1.11 W/sf	BMS Occupancy Sensors
Filing						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
General E_h @ 2.5' AFF = 100-300 lux E_v @ face = 75-200 lux dependent on frequency and duration of task	3:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.89 W/sf	BMS Occupancy Sensors

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
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Lobby/Reception						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Reception Desk E_h @ 2.5' AFF = 300 lux E_v @ 5' AFF = 100 lux	3:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.89 W/sf with programmable controls 0.98 W/sf	BMS Occupancy Sensors

Offices						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Reading High Quality Tasks E_h @ 2.5' AFF = 300 lux E_v @ 4' AFF = 50 lux Reading Poor Quality Tasks E_h @ 2.5' AFF = 500 lux E_v @ 4' AFF = 100 lux Electronic Offices E_h @ 2.5' AFF = 300 lux E_v @ 4' AFF = 150 lux	1.5-2:1 Avg:Min 5:1 Max:Min 1.5-2:1 Avg:Min 5:1 Max:Min 1.5-2:1 Avg:Min 5:1 Max:Min	E_h @ Floor = 10 lux Min.	3000K	80+	Private Offices 0.89 W/sf with programmable controls 0.93 W/sf Open Offices 0.78 W/sf with programmable controls 0.82 W/sf Task lights exempt if controlled per requirements	BMS Photocell Occupancy Sensors Notes: As needed, localized task lighting to be used in conjunction with ambient lighting system to achieve light levels cited. Typical ratio of task levels to ambient ~1.5:1.

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
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Support Spaces						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Break Rooms		E_h @ Floor = 10 lux Min.	3000K	80+	0.58 W/sf	BMS
E_h @ 2.5' AFF = 100 lux						Presets
E_v @ 4' AFF = 30 lux	3:1 Avg:Min					Local keypads
Mail Room					0.78 W/sf	Photocell
Sorting						Occupancy Sensors
E_h @ 2.5' AFF = 300 lux						
E_v @ 4' AFF = 75 lux	3:1 Avg:Min					
Security Inspection						
E_h @ 2.5' AFF = 1000 lux						
E_v @ 4' AFF = 300 lux						
Storage					0.50 W/sf	
Frequent Use						
E_h @ 2.5' AFF = 100 lux						
E_v @ 4' AFF = 30 lux	3:1 Avg:Min					
Infrequent Use						
E_h @ 2.5' AFF = 50 lux						
E_v @ 4' AFF = 20 lux						

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
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BACK OF HOUSE ZONES						
Support Spaces						
Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Freight Elevators[4]		E_h @ Floor = 10 lux Min.	3000K	80+		BMS
Cab Interior						Photocell
E_h @ floor = 50 lux						Occupancy Sensors
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Threshold Inside						
E_h @ floor = 25 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Threshold Outside						
E_h @ floor = 100 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Information Technology						
E_h @ 3' AFF = 100 lux (500 lux min during service)						
E_v @ 4' AFF = 100 lux (200 lux min during service)						
Workshops/Assembly						
E_h @ floor = 300-1000 lux					0.93 W/sf	
E_v @ 5' AFF = 300-1000 lux	3:1 Max:Min					
depending on difficulty						
Receiving/Shipping						
Dock					0.61 W/sf	
E_h @ floor = 100 lux						
E_v @ 5' AFF = 30 lux	2:1 Avg:Min					
Receiving Staging					0.61 W/sf	
E_h @ floor = 300 lux						
E_v @ 5' AFF = 100 lux	2:1 Avg:Min					

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

Exterior Lighting Criteria

Façade

Illuminance Criteria[1]			Color Criteria		Allowed Power	Controls Considerations
Max Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Medium Activity LZ2 Façade Accent E_v @ Surface = 50 lux Façade Fields E_v @ Surface = 20 lux	3:1 Avg:Min		2700K	80+	0.15 W/sf of illuminated wall -or- 3.00 W/linear-foot of illuminated wall or surface length	BMS Photocell Astronomical Timeclock

Parking Garage

Illuminance Criteria[5]			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
General Parking E_h @ floor = 54 lux E_v @ 5' AFF = 27 lux Ramps & Corners E_h @ floor = 110 lux E_v @ 5' AFF = 54 lux Entrance Areas Day E_h @ floor = 540 lux E_v @ 5' AFF = 270 lux Night E_h @ floor = 54 lux E_v @ 5' AFF = 27 lux	4:1 Avg:Min 4:1 Avg:Min 4:1 Avg:Min 4:1 Avg:Min	E_h @ Floor = 10 lux Min.	3000K	80+	0.12 W/sf Daytime transition lighting at entrance is exempt from LPD calculation	BMS Photocell Occupancy Sensors Astronomical Timeclock

Wyoming Capitol - Herschler
Normal Power Architectural Lighting
Criteria Summary - Illuminance, Color, Power, Controls
Gary Steffy Lighting Design Inc.
10/30/2014 File GSLD10114_WYHerschler_CriteriaSummary_20141029_01_R0_GRS.xlsx

Pedestrian Areas						
Illuminance Criteria[1] (as applicable, values based on IES Medium Activity/LZ2)			Color Criteria		Allowed Power	Controls Considerations
Avg, Maint'd (except as noted)	Uniformity	NPAL Code Minimum[2]	CCT	CRI	LPD[3]	Interface
Art & Feature Accenting			2700K	80+	art lighting exempt	BMS
5-10 times ambient E_h						Presets
Exit Discharge (area = width of threshold by 3 feet)					24 W/linear-foot	Photocell
E_h @ grade = 10 lux min		E_h @ grade = 10 lux min			of door width	Occupancy Sensors
E_v @ 5' AFF[6] = 6 lux	2:1 Avg:Min				0.32 W/sf	
Building Entries					of canopy	Notes:
E_h @ grade = 10 lux					24 W/linear-foot	At curfew (e.g., 11 p.m.) set-back light
Ev @ 5' AFF6 = 6 lux	2:1 Avg:Min				of door width	levels to 30%, but brighten to 100%
Landscape Accenting					0.04 W/sf	when motion is sensed. Provide for
2.5-5 times ambient E_h						security overrride.
Select Paths to Curb					0.13 W/sf	Select primary or most-used paths.
E_h @ grade = 4 lux						
E_v @ 5' AFF = 1 lux	3:1 Avg:Min					
Select Pedestrian Sidewalks						Select primary or most-used sidewalks.
E_h @ grade = 5 lux					<10 ft wide = 0.64 w/LF	
E_v @ 5' AFF = 2 lux	4:1 Avg:Min				≥10 ft wide = 0.13 W/sf	
Plaza Areas					0.13 W/sf	
E_h @ grade = 2 lux						
E_v @ 5' AFF = 1 lux	5:1 Avg:Min					
Ramps, Stairs and Steps					0.80 W/sf	
E_h @ grade = 4 lux						
E_v @ 5' AFF = 2 lux	5:1 Avg:Min					

References
1. IES Handbook 10e - Lighting for Art, Common Applications, Exteriors, Manufacturing, Offices, Retail
2. IBC
3. ASHRAE 90.1-2013, Section 9 - Reduced by 20% (x0.80)
4. ASME 17.1-2013
5. IES Handbook 8e - Lighting for covered parking
6. E_v facing discharge

SECTION 2.12
SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. INSERT DVS SUMMARY

SECTION 2.13
VERTICAL TRANSPORTATION

PART 1 GENERAL

1.1 SUMMARY

A. The Herschler Building is to be renovated and expanded in a manner to better meet the needs of the current and future tenants. The renovation will include modernization of the existing four passenger elevators. The expansion will include an additional four new passenger elevators.

B. Vertical transportation design must consider the various types of patrons, including visitors and staff, as well as facility services support. Design should provide for proper separations of the population based on destination and type. Finally, a good vertical transportation design should consider the functionality of the building including the vertical transport of goods and equipment. Lerch Bates will work closely with the Design Team to determine the best VT program for the building program and design as it develops. The following is our initial VT program based on the Schematic Design information provided by HDR Architecture.

1.2 EXISTING VERTICAL TRANSPORTATION EQUIPMENT

A. A preliminary survey of the existing vertical transportation equipment was conducted to determine the type, age, and overall condition of the equipment for possible modernization.

1. The four existing passenger elevators are located in two duplex banks. One two-car bank in the West wing and one two-car bank in the East wing. These elevators are currently the primary transport for visitors and staff. In the proposed new building design, these four elevators will primarily service visitors and staff entering from the parking level below and interfloor activity in each wing. The four existing passenger elevators are 3000 lb. capacity with 42” wide by 84” tall, single speed, center opening doors. The geared machines are mounted at the bottom floor in the machine room located to the rear of the hoistway. These elevators were modernized by Kone in 2005-2006. A comprehensive survey of the four existing passenger elevators will be conducted to specifically identify and specify the equipment to be retained and refurbished or replaced. The main concern with these four existing elevators is the presence of a significant amount of water in the pit and corrosion evident on the elevator pit equipment. Any water damaged equipment will need to be replaced and the pits need to be refurbished to provide a permanently dry environment. Our best estimate of probable cost for full modernization (including new machines) for these four elevators is $215,000.00. This includes the elevator equipment and labor only. This estimate does not include any general construction, electrical, or mechanical modifications required to the hoistways, machine rooms, or building systems required.
2. The existing service elevator located to the Southwest was also modernized by Kone in 2005-2006. This elevator is currently used for staff and materials transport. The Schematic Design plans schedule this elevator for complete removal. A comprehensive study of the equipment condition will not be required.

1.3 NEW VERTICAL TRANSPORTATION EQUIPMENT

3. The current Schematic Design includes four new passenger elevators located in the center of the building. These elevators will primarily service visitors and staff entering from the main lobby or at first floor or the Capitol connector tunnel. One of the four elevators will be rated for heavier loading to transport goods and materials delivered to the new dock on the lower level. Our best estimate of probable cost to furnish and install these four new passenger elevators is $580,000.00. This estimate includes elevator equipment and installation only. This cost does not include any demolition, general construction, electrical, or mechanical work required to prepare the building for the new elevators.

PART 2 - PRODUCTS

1.1 QUALITY ASSURANCE

A. All work shall be performed in accordance with the latest edition of the "American Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks" (ASME A17.1), including published supplements; "National Electrical Code," "OSHA," "NFPA," "UBC," A.D.A. Handicapped Code, and such state and local codes as may be applicable.

1.2 SUMMARY – NEW TRACTION ELEVATOR EQUIPMENT

A. Passenger Elevators:

Number:	Cars P1, P2, P3, P4
Capacity:	4000 #
Class Loading:	Cars P1, P2, P3: Passenger Class A Car P4: Freight Class C3
Contract Speed:	350 F.P.M
Roping:	2:1 Underslung
Machine:	Gearless
Machine Location:	Overhead in the Hoistway
Supervisory Control:	Group Automatic Microprocessor- Based System
Operational Control:	Selective Collective Microprocessor-Based System
Motor Control:	AC Variable Voltage Variable Frequency Microprocessor-Based With Digital Closed-Loop Feedback
Power Characteristics:	480 Volts, 3 Phase, 60 Hertz
Stops:	5
Openings:	5 Front

Floors Served:	Lower Level, 1st Floor, 2nd Floor, 3rd Floor, and 4th Floor
Travel:	51’-0” ±
Platform Size:	8’-0” Wide X 6’-2” Deep
Minimum Clear Inside Car:	7’-8” Wide X 5’-5” Deep
Entrance Size:	4’-0” Wide X 7’-0” High
Entrance Type:	Single Speed, Center Opening
Door Operation:	Medium Speed, Heavy-Duty, Door Operator, Minimum Opening Speed 2.0 F.P.S.
Door Protection:	Infrared, Full Screen Device with Differential Timing, Nudging and Interrupted Beam Time
Safety:	Flexible Guide Clamp-Type B, Car
Guide Rails:	Planed Steel Tees
Buffers:	Oil
Compensation:	Contractor’s Standard Application
Car Enclosure:	As Detailed on Architectural Drawings
	Steel Shell as Specified Plus $20,000 Allowance and 1,200# Weight Allowance for Interior Finishes
	Car Interior Finishes Provided Under This Section
	8’-0” Clear Height Under Canopy
	Extend Rear Portion of Car P4 to Maximum Height, Width, and Depth Behind Car Frame Crosshead
	Car Dropped Ceiling Designed for Easy Removal with Auxiliary Car Lighting Flush Mounted in Car Canopy, Under Car Crosshead. Include Separate Light Switch in Car Service Compartment.
	Pad Buttons or Hooks and Vinyl-Covered Pads, All Cars
	Battery Powered Emergency Car Lighting. Provide Separate Constant Pressure Test Button in Car Service Compartment. Illuminate Portion Of Normal Car Lighting

Signal Fixtures:	LED Illumination Contractor's Standard, Vandal Resistant Assembly
Hall and Car Pushbutton Stations:	Dual Hall Pushbutton Riser Service Operation Riser, Car P4 Dual Car Operating Panel(s)
	Vandal Resistant Car and Hall Pushbuttons
Car Position Indicators:	Dual Digital with Car Direction Arrows
	Security Control Panel
	Firefighters' Control Panel
In Car Lanterns:	All Car Entrance Columns with Volume Adjustable Electronic Chime or Tone. Sound Twice for Down Direction
Hall Car Position Indicator:	Digital Type with Car Direction Arrows at All Floors
Communication System:	Intercom with Distress Signal
	Self-Dialing, Vandal Resistant, Push to Call, Two-Way Communication System with Recall, Tracking and Voiceless Communication
Fixture Submittal:	Submit Brochure Depicting Contractor's Proposed Designs with Bid
Additional Features, All Cars:	Car and Counterweight Roller Guides
	Car Top Inspection Station
	Firefighters' Service, Phase I And II, including Alternate Floor Return
	Standby Power Transfer (Automatic to Main Floor) with Manual Override in Firefighters' Control Panel
	Accessibility Signage
	Swing Car Return Panel(s) Arranged for Integral Car Operating Panel(s)
	Hoistway Access Switches Top and Bottom Floors
	Hoistway Door Unlocking Device at All Floors
	Platform Isolation
	Load-Weighing Device

Anti-Nuisance Feature

Independent Service Feature

Priority Service, Car P4

Card Reader Provisions, All Cars

CCTV Provisions, All Cars

Digital Video Display Provisions, All Cars

Security Control Panel and Remote Wiring

Firefighters' Control Panel and Remote Wiring

Machine, Power Conversion Unit, and Controller Sound Isolation

Tamper Resistant Fasteners for All Fastenings Exposed To The Public

One Year Warranty Maintenance with 24-Hour Call-Back Service

Sill Support Angles

Firefighters' Telephone Jack

Emergency Paging Speaker Installation

Signage Engraving Filled with Black Paint or Approved Etching Process

No Visible Company Name or Logo

Wiring Diagrams, Operating Instructions, and Parts Ordering Information

Monitoring System

System Diagnostic Means and Instructions

Non-Proprietary Control System and Diagnostics Provisions

1.3 CAR AND GROUP PERFORMANCE

A. Car Speed: ± 3% of contract speed under any loading condition.

B. Car Capacity: Safely lower, stop and hold 125% of rated load.

C. Car Stopping Zone: ±1/4" under any loading condition.

D. Door Opening Time: Seconds from start of opening to fully open: 1.8 seconds.

E. Door Closing Time: Seconds from start of closing to fully closed: 2.7 seconds.

F. Car Floor-to-Floor Performance Time: Seconds from start of doors closing until doors are 3/4 open (1/2 open for side opening doors) and car stopped at next successive floor under any loading condition or travel direction (13'-6" typical floor height): 9.9 seconds.

G. Car Ride Quality
   1. Horizontal and vertical acceleration within car during all riding and door operating conditions. Not more than 15 mg peak to peak (adjacent peaks) in the 1 - 10 Hz range.
   2. Acceleration and Deceleration: Smooth constant and not less than 2.5 feet/second^2 with an initial ramp between 0.5 and 0.75 second. Sustained Jerk: Not more than 6 feet/second^3.
   3. Measurement Standards: Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.

H. Noise and Vibration Control
   1. Airborne Noise: Measured noise level of elevator equipment and its operation shall not exceed 55 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed. Limit noise level in the machine room relating to elevator equipment and its operation to no more than 80 dBA. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.
   2. Vibration Control: All elevator equipment provided under this contract, including power unit, controller, oil supply lines, and their support shall be mechanically isolated from the building structure and electrically isolated from the building power supply and to each other to minimize the possibility of objectionable noise and vibrations being transmitted to occupied areas of the building.

I. System-Response Time: Meet the following criteria during any 60-minute peak period as measured by duration of all hall call registration times:
   1. System-Response Time: Not more than 20 seconds.
   2. Hall Calls Answered within 30 Seconds: Not less than 75%.
   3. Hall Calls Answered within 60 Seconds: Not less than 98%.
   4. Hall Calls Answered within 90 Seconds: Not less than 100%.

PART 3 - EXECUTION

1.1 INSTALLATION

A. Comply with applicable codes, manufacturer's instructions, shop drawings, and recommendations. Comply with National Electrical Code (ASME C1 by NFPA) for electrical work required during construction.

1.2 FINAL INSPECTION AND TEST

A. Comply with ASME A17.2-latest edition Inspectors' Manual.

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SECTION 2.14
SIGNAGE AND WAYFINDING

PART 1 - GENERAL

1.1 SUMMARY
We will be developing a complete Site Wayfinding and Signage design intent package for the entire Capitol Site - approximately 14 acres of site area. We will also be developing a complete Interior Wayfinding and Signage design intent package for the Herschler Building and Connector - approximately 350,000 sf of interior space.

A. DESIGN CONCEPT SUMMARY
1. Vision
    a. Exterior. Our designs for the exterior and campus wayfinding signage will be influenced by the exterior building designs as well as important current and historical architectural and cultural references specific to Wyoming.
    b. Interior. Our designs for the interior signage will be based on materials, shapes, colors, and motifs from the exterior and interior building designs. We will work closely with architects, interior designers, and lighting designers to maximize the impact of the wayfinding system.
2. Goals
    a. Exterior. Exterior signage will be consistent and easily recognizable as “site-specific”. They will help to identify the boundaries of the site and differentiate it from adjacent areas. Campus wayfinding will guide pedestrians and vehicles to destinations and also include opportunities for educational elements about Wyoming.
    b. Interior. Wayfinding in the Connector and Herschler building will be designed to efficiently move visitors from entrances to their destinations. While there will always be visitors who prefer to ask for directions, our goal is that 85% of first-time users will be able to find their way to their destination by using only the wayfinding system.

B. Wayfinding Components
Refer to Section C – Cost Estimating Guidelines for additional details
1. Exterior signage will consist of:
    a. Exterior Building Identification
    b. Exterior Vehicular Wayfinding
    c. Exterior Pedestrian Wayfinding
2. Interior signage will consist of:
    a. Large Area Identification
    b. Wayfinding signage and directories
    c. Room identification signage

C. Cost Estimating Guideline
Based on the caliber of this project, we will be developing the exterior and interior package to a Moderate Design Standard as outlined below and at a cost range of $.80 - .95 per sq ft.
- Medium level of complexity in design
- Frequent directional and way finding needs
- Medium level of finishes (painted acrylics, aluminum, etc.)
- Minimal experiential graphics.
- Design details themed to the site.

SECTION 2.15
COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. The State of Wyoming, Administration and Information Department, Construction Management Division has issued an RFQ for a Commissioning Agent on September 19, 2014.

SECTION 2.16
ACOUSTICS

PART 1 - INTRODUCTION

The following provides guidelines and criteria for control of noise and vibration from building services, important for the comfort of staff and visitors to the Capitol building complex.

PART 2 - NOISE AND VIBRATION CONTROL FROM BUILDING SERVICES

BACKGROUND NOISE

Maximum acceptable background noise levels attributable to mechanical and air distribution systems are defined in terms of octave band sound pressure levels in dB from 63 Hz to 4000 Hz., and expressed in terms of Noise Criteria (NC) ratings.

The following are the maximum Sound Pressure Levels in decibels by Octave Band for the Ambient (Background) Noise Level Criteria.

Frequency (Hz.)	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dBA**
NC-30	57	48	41	35	31	29	28	40
NC-35	60	52	45	40	36	34	33	44
NC-40	64	56	50	45	41	39	38	49

The table below assigns the range of acceptable NC ratings for specific spaces. The ambient noise level in publicly occupied spaces not listed here should not exceed NC-40.

Ambient Noise Level Criteria (NC)

House and Senate Chamber	NC-30
Committee & Hearing Rooms	NC-30
Private Offices (Governor, Sec. of State, Legislative Leadership)	NC-30
Reception Rooms	NC-30
Staff Offices	NC-30 to NC-35
Conference Rooms	NC-30 to NC-35
Open Offices	NC-35
Chamber Lobbies	NC-35
Circulation and Public Areas	NC-40 max.

PART 3 - MECHANICAL EQUIPMENT VIBRATION ISOLATION

Interior Mounted Air Handling Units and Fan Coil Units

All interior mounted air handling equipment should be mounted on a concrete housekeeping pad of minimum 4" thickness. Each unit cabinet should be vibration isolated from the housekeeping pad by means of spring and neoprene vibration isolators with static deflection of 1" for units located on Garden Level, and 2" for units located on the Attic Level.

Fan bases within the air handling units are to be isolated from the unit cabinet by means of rubber or neoprene isolators with a minimum static deflection of 0.15" under load conditions. These isolators may be provided by the air handling unit manufacturer, or purchased through a third party vibration isolation vendor and installed by the mechanical contractor.

Neoprene pads are to be used for air handling units sitting on top of another unit – as may be the case with Garden Level air handlers. In this instance, the air handler manufacturer must be consulted to advise on center of gravity issues associated with spring isolation of both units from the housekeeping pad.

Fan coil units shall be isolated by means of spring and neoprene type mountings or hangers as applicable. Fan/blower sections shall be isolated from the unit cabinet by neoprene or rubber type mountings, supplied by the unit manufacturer.

All piping connections to each isolated unit (2" diameter and above) should be made with a twin sphere flexible piping connector, constructed from neoprene, EPDM, or rubber as required for compatibility with the fluid, temperature, and external conditions. Control cables may be required to prevent axial elongation in the piping. Condensate piping may be connected directly to the isolated unit, but should not be hard connected to the non-isolated structure.

Ductwork connections to all air handling units and fan coil units should be made with standard flexible duct connectors. Electrical connections to each unit are to be made with flexible conduit, installed with sufficient slack so it will not become taut during normal equipment start-up.

Pumps

Inline pumps are to be vibration isolated by means of spring and neoprene type hangers or mountings, with a minimum static deflection of 1" for pumps up to 30 HP, and 1.5" for pumps 30 HP and greater. Floor bases, if applicable, must be designed to be isolated in this manner, or mounted to steel rails to allow for isolator mounting. Large pumps may require snubber bushings or equivalent to resist torque on start-up, and will be considered in subsequent design phases.

Piping connections to each isolated unit should be made with a twin sphere flexible piping connector, constructed from neoprene, EPDM, or rubber as required for compatibility with the fluid, temperature, and external conditions. Control cables may be required to prevent axial elongation in the piping. Electrical connections shall be made using flexible conduit in a slack U-shape.

Piping

Chilled water and HVAC piping above 2" diameter within attic areas are to be supported from building structure by spring type hangers or mountings as applicable. Neoprene or spring type pipe risers shall be used to isolate all large piping in piping chases.

AIR DISTRIBUTION SYSTEMS

Fresh Air Inlet and Exhaust Discharge Locations

Fresh air inlets and exhaust air discharges, where provided, should not lead to public outdoor areas or to locations where noise can re-enter the building through walls, windows, doors or vents into any publically occupied areas. Care must be taken to avoid discharge and intake outlets close to the building property line to avoid environmental noise issues.

Acoustical Lining

Acoustical duct lining should be 1" thick, 1.5 pcf density fiberglass core with integral coated facing. This lining should be installed in the following minimum ductwork and systems:

- All supply and return ductwork serving House and Senate Chambers, Committee and Hearing Rooms.
- All supply and Return ductwork for minimum 25' from all air handling units and fan coil units.
- All supply ductwork for minimum length of 15' downstream of VAV terminal units.
- All return air transfer ducts.

If internal lining is not used, additional care must be given to location of units, sizing of ductwork, locations of balancing dampers, ductwork configurations serving terminal devices, and specification of terminal devices. In short, care must be given to reduce all sources of turbulence in the airstream, particularly closer to the terminal device. This may result in increased mechanical system cost to achieve an equivalent noise level.

Duct Silencers

For certain systems, particularly where there is a short run of ductwork back to the fan, a duct silencer may be required to meet the noise criteria. Final determination and selection of silencers will be made when the design is further developed.

Duct Distribution

Costs of noise control devices such as silencers can be greatly reduced through careful attention to duct distribution and locations of duct penetrations. The following guidelines should be considered as the mechanical systems design is developed:

- Maximize duct run between fan and first terminal outlet. A distance of 30' – 50' should be taken as a minimum guideline.
- Extend return air duct runs back to the fan unit, especially in noise-critical systems serving committee rooms and conference rooms. Provide a minimum of 25' of duct between outlet and fan. Also consider creating branch ducts off of a main return duct to extend the overall length.
- Provide lined transfer ducts in offices where privacy is a concern, extending into corridors. Do not locate transfer ducts between adjacent offices or meeting rooms to prevent crosstalk through the duct system.
- Develop each duct distribution system to be as self balancing as possible in a "dampers wide open" scenario, meaning symmetrical distribution with branch ducts feeding each supply outlet. Where multiple diffusers feed off a single branch or header duct, utilize static regain methods to equalize downstream air pressure in the duct.
- Avoid running ductwork serving a noise sensitive space directly through an adjacent, noisy space, adjacent office, etc. Main headers should be run within corridors, with separate branch ducts serving each individual space. This is especially important in spaces where privacy is important, including private offices, committee rooms, and conference rooms.

- Pay close attention to providing gradual velocity transitions to reduce turbulence generated noise.
- Utilize full radiused elbows where possible to reduce turbulence generated noise.
- Locate primary air balancing devices at major branch takeoffs far from terminal outlets – a minimum of 5-7 duct diameters from the nearest terminal device.

Diffusers, Grilles, VAV Terminal Units, and Duct Velocities

Diffusers and Grilles

All diffusers and grilles should be selected to meet the background noise criteria for the space in which they will be installed. In order for this to be achieved, in smaller spaces, the terminal device should be selected taking into account the total number of diffusers and grilles in the space, and using the following formula:

NC (selection criteria for diffuser) = NC Level (of space) – 10 x log (total no. diffusers and grilles)

This number will provide an NC level required of the diffuser that can be matched to manufacturer's performance ratings under design conditions.

For larger spaces, such as Committee Rooms and large conference rooms, the diffuser should be selected to meet an NC rating of 6 dB less than the rated NC criteria.

Integral dampers cause turbulence-induced noise that can not be attenuated from the system. Remember to take into account the effects of integral dampers when selecting the diffuser. These can add 5 to 9 NC over the published performance ratings. These effects are published or can be obtained from the larger manufacturers.

VAV Terminal Units

All terminal units should be selected to meet the rated NC level of the space it serves, under maximum operating capacity and pressure drop. This should be done using the octave band criteria published in manufacturer's catalogs for both radiated and discharge conditions. In general, the radiated levels will be higher.

VAV units serving spaces like private offices, Committee, conference, and meeting rooms should be located outside these spaces, particularly where Video conferencing capabilities are being considered. Locate them in corridors or less critical areas where possible.

Fan powered terminal units should not be used in areas with noise criteria of NC-35 or less unless they are located remote (minimum 20') from the space they serve, concealed above a ceiling, and ductwork downstream can be internally lined with 1" thick duct liner insulation.

Air Velocities

Air velocities in ducted systems should not exceed the following:

Location:	**NC30**	**NC35**	**NC40**
Supply and return main ducts outside of space (as long as duct does not terminate with a terminal device)	1800 fpm	2000 fpm	2200 fpm
Main supply and return distribution within space (including above ceilings)	1100	1300	1400
Branch supply and return ducts	800	900	1000

Location:	NC30	NC35	NC40
Terminal supply ducts	550	600	650
Return grilles up to 10 diameters from inlet	500	550	600

Air velocity transitions in ductwork should be made as gradual as possible, especially closer to the terminal duct and outlet. Transitions should be limited to 1.5:1 within the noise sensitive space, but can be up to 2:1 closer to the fan unit. After an air velocity transition, a duct of length equal to 3-5 equivalent diameters should be used so that the airflow velocity profile can be laminar at the entry to the terminal device.

PART 4 - ELECTRICAL SYSTEMS NOISE CONTROL

Noise generated by electrical equipment is of particular concern because of its pure-tone frequency character. Small and large transformers, relays and ballasts can generate noise that is annoying and may interfere with speech intelligibility and overall comfort.

Vibration Isolation and Location of Transformers

Transformers should only be located in designated electrical rooms. In general, large transformers (above 50 kVA) should be located on grade where possible, and in locations not directly adjacent to publicly occupied spaces. Doors to these electrical rooms should open onto service corridors, not public corridors.

All floor mounted transformers should be installed on 4" high concrete housekeeping pads, and will be vibration isolated according to the following table:

Size	Mounting method	Isolator	Static Deflection
< 500 VA	All	Neoprene & steel pad	
500 VA – 50 kVA	Floor	Neoprene mounts	
	Suspended	Neoprene hanger	
	Wall	NOT RECOMMENDED	
> 50 kVA	Floor on grade	Spring & neoprene mountings	1"
	Floor above grade		2"
	Suspended above grade		2"

Electrical connections to transformers should be made with flexible conduit installed in a slack "U-shape" in sufficient length to not become taut during normal start up or operation.

SECTION 3.1
SPECIFICATIONS

PART 1 - GENERAL

The following is a list of specifications that the Design Team anticipates using for this project. This is only a table of contents for the Schematic Design Narrative. Sections may be added or deleted as the design progresses. Actual specifications will be included in the Design Development and Construction Document packages.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 07	SEALS AND SIGNATURES
00 01 09	PROJECT MANUAL – PREFACE
00 11 13	ADVERTISEMENT TO BID
00 26 00	SUBSTITUTIONS PRIOR TO BIDDING
00 31 33	SUBSURFACE DRILLING AND SAMPLING INFORMATION
00 72 07	GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION – 2007

DIVISION 01 – GENERAL REQUIREMENTS

01 11 16	WORK BY OWNER
01 14 16	COORDINATION WITH OCCUPANTS AND WORK RESTRICTIONS
01 21 16	CONTINGENCY ALLOWANCES
01 22 00	UNIT PRICES
01 23 04	CHANGES IN WORK
01 25 13	SUBSTITUTION PROCEDURES AFTER EXECUTION OF CONTRACT
01 26 13	REQUESTS FOR INFORMATION (RFI)
01 29 01	APPLICATIONS FOR PAYMENT AND SCHEDULE OF VALUES (CM)
01 31 12	MECHANICAL AND ELECTRICAL COORDINATOR
01 31 19	PROJECT MEETINGS
01 31 26	PROJECT COLLABORATION SYSTEM REQUIREMENTS
01 31 33	MECHANICAL AND ELECTRICAL SUBMITTAL COORDINATION
01 32 26	PROGRESS REPORTS AND PHOTOS
01 33 00	SUBMITTAL PROCEDURES
01 41 00	CODES, REGULATIONS, AND GUIDELINES
01 41 10	REGULATORY REQUIREMENTS AND DEFERRED APPROVALS
01 42 13	ABBREVIATIONS FOR UNITS OF MEASURE - ENGLISH SYSTEM OF UNITS (IP)
01 42 16	DEFINITIONS
01 43 39	MOCK-UPS
01 43 44	COORDINATION DRAWINGS (CM)
01 45 23	TESTS AND INSPECTIONS
01 50 00	CONSTRUCTION FACILITIES, TEMPORARY CONTROLS AND UTILITIES
01 50 13	GENERAL CLEAN ZONE CONSTRUCTION PROCEDURES
01 61 00	ACCEPTABLE MANUFACTURERS AND PRODUCTS
01 61 10	CERTIFIED PRODUCTS
01 62 35	RECYCLED RECOVERED MATERIALS
01 65 00	DELIVERY, HANDLING AND STORAGE MATERIALS AND EQUIPMENT
01 71 23	FIELD ENGINEERING
01 73 29	CUTTING AND PATCHING
01 74 19	CONSTRUCTION WASTE MANAGEMENT
01 74 23	CLEANING
01 77 01	CONTRACT CLOSEOUT (CM)
01 78 26	INTERIOR FINISH FIRE PERFORMANCE DATA
01 78 36	WARRANTIES AND GUARANTEES
01 78 39	PROJECT RECORD DOCUMENTS
01 78 43	SPARE PARTS AND MAINTENANCE MATERIALS
01 79 00	SYSTEM DEMONSTRATIONS

01 81 14 VOLATILE ORGANIC COMPOUND LIMITS
01 81 21 INDOOR AIR QUALITY MANAGEMENT (IAQ) DURING CONSTRUCTION
requirements to maintain quality of indoor air during construction and protect HVAC equipment
01 81 22 INDOOR AIR QUALITY PROTECTION BEFORE OCCUPANCY
01 89 30 CONSTRUCTION ACTIVITY ACOUSTICS REQUIREMENTS

DIVISON 02 – EXISTING CONDITIONS
02 41 00 DEMOLITION
partial or complete building demolition and general cutting and patching

DIVISION 03 – CONCRETE
03 01 04 MAINTENANCE OF PRECAST CONCRETE
cleaning and sealing of existing precast concrete wall panels
03 08 13 CONCRETE TESTING AND EVALUATION – OWNER
concrete testing by owner
03 11 00 CONCRETE FORMWORK
03 15 23 EXPANSION OF JOINT SEALS IN CONCRETE
expansion joint for exterior use where water-tightness is required
03 20 00 CONCRETE REINFORCING
03 31 10 CONCRETE MIXING, PLACING, JOINTING, CURING
03 33 00 ARCHITECTURAL CAST-IN PLACE CONCRETE (ACIP)
architectural cast-in place concrete walls
03 35 00 CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS
03 38 16 POST-TENSIONED CONCRETE
03 45 00 ARCHITECTURAL PRECAST CONCRETE (APC)
non-structural precast concrete panels
03 54 16 SELF-LEVELING UNDERLAYMENT
Self-leveling underlayment, NOT intended to be used as a permanent wearing surface, even if coated or sealed

DIVISION 04 – MASONRY
04 05 05 COLD AND HOT WEATHER MASONRY
services for cold and hot weather masonry procedures
04 05 10 MASONRY CLEANING
normal cleaning of new masonry products
04 05 13 PORTLAND CEMENT-LIME (PCL) MORTAR AND GROUT
portland cement-lime mortar used in most all applications
04 05 23 MASONRY ACCESSORIES
masonry anchors, reinforcing, through-wall flashing, weeps, control and expansion joint strips
04 22 00 CONCRETE MASONRY (CMU)
normal weight concrete block
04 42 00 DIMENSION STONE CLADDING
stone cladding panels having face dimensions greater than thickness, and supported from the building frame by metal anchors mechanically secured to holes or kerfs in stone units
04 72 00 CAST STONE
architectural precast concrete building units intended to simulate natural cut stone
04 73 13 CALCIUM SILICATE MASONRY UNITS (CSMU)
calcium silicate masonry units made from limestone aggregate and high-calcium lime as a binder. no portland cement is used. This may be used in the CUP.

DIVISION 05 – METALS
05 12 10 STRUCTURAL STEEL
steel floor and roof decks, including accessories
05 31 23 METAL ROOF DECKING
steel floor and roof decks, including accessories

05 40 00 COLD-FORMED METAL FRAMING
cold-formed metal framing for perimeters of building only
05 45 23 EQUIPMENT SUPPORT SYSTEM
equipment support system
05 45 26 EXTERIOR WALL RAINSCREEN METAL SUPPORT ASSEMBLIES
05 50 10 MISCELLANEOUS METAL FABRICATIONS
miscellaneous metalwork
05 50 13 STEEL STAIRS AND RAILINGS
steel stair systems which are not a part of any other metals system of the specifications; metal railing systems whish are not a part of any other metals system of the specifications
05 73 00 CUSTOM METAL RAILINGS
aluminum, stainless steel and bronze railings and other custom railings
05 73 13 GLASS-SUPPORTED RAILINGS
pre-engineered, component based, ornamental railing system

DIVISION 06 – WOOD, PLASTICS, COMPOSITES
06 10 53 ROUGH CARPENTRY
framing, grounds, nailers, blocking, and sheathing of light wooden structures and includes the use of preassembled components and plastic lumber
06 16 43 GYPSUM SHEATHING
gypsum sheathing on metal studs as part of an exterior wall system
06 20 00 FINISH CARPENTRY
covers general exterior and interior finish carpentry
06 42 00 WOOD PANELING
wood wall panels, wood wainscot and base

DIVISION 07 – THERMAL AND MOISTURE PROTECTION
07 13 53 ELASTOMERIC SHEET WATERPROOFING
Drainage Board Hydroduct 220
vertical drainage layer
Waterproofing Prepruf
vertical blindside and horizontal underslab waterproofing conditions
07 14 13 RUBBERIZED ASPHALT MEMBRANE WATERPROOFING (RAM)
high performance membrane for horizontal waterproofing applications
07 14 16 COLD FLUID-APPLIED WATERPROOFING
Waterproofing Procor 75
waterproofing for general duty below grade and concealed applications
07 16 04 CONCRETE FLOOR MOISTURE TESTING
identify potential moisture issues in concrete slabs, whether on grade or suspended
07 16 05 WATER VAPOR EMISSION CONTROL SYSTEM
control moisture and alkalinity in concrete slabs on grade and elevated concrete slabs
07 18 00 TRAFFIC COATINGS
surfaces exposed to pedestrian or vehicular traffic above spaces that must be waterproofed or require a additional protection for concrete surfaces
07 19 16 SILANE WATER REPELLENT
clear, water-repellent. does not change appearance of substrate
07 21 00 BUILDING INSULATION
Rigid Board Insulation Extruded Polystyrene
rigid board insulation extruded polystyrene
Rigid Fiber Insulation
rigid fiber insulation
07 27 29 FLUID APPLIED AIR BARRIER – VAPOR PERMEABLE
fluid applied air barrier - vapor permeable
07 42 43 ALUMINUM COMPOSITE MATERIAL (ACM) SYSTEM
aluminum composite material (ACM) system is comprised of two sheets of 0.20 IN aluminum sheet with low density polyethylene core

07 46 18 DRY JOINT METAL WALL PANEL SYSTEM
metal panel pressure equalized rainscreen system

07 72 13 PREFABRICATED ROOF CURBING
standard and custom prefab metal roof curbs used to support things like skylights, mechanical equipment, electrical items, pipe and ductwork runs over roof

07 72 35 ROOF HATCH – THERMALLY ENHANCED
thermally enhanced roof hatch line with bonded EPDM gasketing and 2 IN polyisocyanurate insulation

07 76 16 PRECAST CONCRETE PAVER SYSTEM
precast concrete pavers elevated on pedestals, used over a roof membrane

07 81 16 FIREPROOFING – PERFORMANCE BASED
fireproofing - performance based. Contractor is responsible to select applicable UL designs whish meet criteria listed.

07 84 00 FIRESTOPPING
firestopping of openings through fire rated walls, floors, and assemblies

07 84 53 PERIMETER FIRE CONTAINMENT SYSTEMS
Curtain Wall
perimeter fire containment systems consist of rated fill and forming materials which provide a seal between a rated floor and a non-rated exterior wall assembly
Floor
perimeter fire containment systems consist of rated fill and forming materials which provide a seal between a rated floor and a non-rated exterior wall assembly

07 92 13 EXTERIOR JOINT SEALANTS
wet sealant and premolded, compressible sealants

07 92 16 INTERIOR JOINT SEALANTS
interior joint sealants

07 95 13 INTERIOR EXPANSION JOINT COVERS
interior expansion joint covers, including fire rated and seismic conditions

07 95 14 EXTERIOR EXPANSION JOINT SEALANTS
exterior expansion joint covers, including fire rated and seismic conditions

DIVISION 08 – OPENINGS

08 06 00 DOOR, FRAME AND HARDWARE SCHEDULE
schedule is intended to cover swing doors, and sliders

08 06 13 OVERHEAD DOOR SCHEDULE
schedule is intended to cover overhead doors

08 11 13 HOLLOW METAL (HM) DOORS AND FRAMES
hollow metal doors, door frames, metal window frames

08 12 16 INTERIOR ALUMINUM DOOR AND WINDOW FRAMES
Pre-finished, site assembled interior aluminum doors, door frames and window frames

08 14 16 FLUSH WOOD DOORS
solid core wood flush doors: non-rated and fire-rated, both neutral and positive pressure rated flush or glazed design

08 14 33 STILE AND RAIL WOOD DOORS
stile and rail wood doors with raised or flat panels, glass panels or louvered panels

08 31 16 ACCESS PANELS AND DOORS
access panels and doors

08 31 23 FLOOR HATCH – STEEL
floor hatch – steel

08 33 23 OVERHEAD COILING DOORS (CD)
overhead coiling doors with narrow slats, which interlock to form a solid curtain coiling around an overhead tube when opened

08 33 24 OVERHEAD COILING DOOR – SECURITY (CD-S)
large vehicular intake doors that includes a remote controlled electric lock

08 33 46 HIGH SPEED ROLLING DOOR
high speed rolling door with rigid, aluminum slat construction with rubber weather seal

08 35 06	OPERABLE WALLS – PAIRED PANELS
	Manually operated Paired Panels
08 39 23	SMOKE CONTAINMENT SYSTEMS
	overhead coil of fire and heat-resistive film, activated by a local smoke detector
08 43 29	MANUAL SLIDING DOORS – EXTERIOR
	high performance sliding doors. aluminum frames with glass lights up to 1 IN thick
08 44 13	CURTAIN WALL SYSTEMS (CWS)
	outside glazed curtain wall systems
08 44 15	RIBBONWALL CURTAINWALL SYSTEM (RCW)
	outside glazed ribbon curtain wall systems
08 63 00	ALUMINUM FRAMED SKYLIGHTS
	larger monumental type skylights glazed with laminated insulating glass
08 71 00	DOOR HARDWARE
	door hardware
08 71 13	AUTOMATIC SWINGING DOOR OPERATORS
08 81 02	EXTERIOR GLASS AND GLAZING
08 81 04	INTERIOR GLASS AND GLAZING
08 91 00	ARCHITECTURAL LOUVERS

DIVISION 09 – FINISHES

09 22 16	NON-STRUCTURAL METAL FRAMING
09 27 19	SCULPTURED GYPSUM PANEL
09 29 00	GYPSUM WALLBOARD
09 30 00	TILE
09 30 33	NATURAL STONE TILE (NST) FLOORING
09 30 39	CAST MARBLE TILE
09 30 41	STONE MATRIX TILE AND STAIR TREADS
09 51 00	ACOUSTICAL & CEILING TILE MATERIALS (AM)
09 51 16	CUSTOM ACOUSTICAL CEILING SYSTEM (CAC)
09 54 16	SPECIALTY CEILING SYSTEM
09 54 27	WOOD CEILING SYSTEM
09 63 40	GRANITE FLOORING (GF)
09 63 41	MARBLE FLOORING (MF)
09 63 42	LIMESTONE FLOORING (LF)
09 65 13	RESILIENT BASE (RB)
09 65 15	SHEET VINYL FLOORING (SV)
09 66 23	THIN-SET EPOXY TERRAZZO (TERR)
09 67 13	WATERPROOF FLOORING (WPF)
09 67 26	SEAMLESS EPOXY FLOORING (SEF)
09 67 81	CONCRETE FLOOR SEALER (CFS-ND)
09 68 13	CARPET TILE
09 77 61	FIBERGLASS REINFORCED PLASTIC (FRP) PANELS
09 77 73	METAL COLUMN COVERS (INTERIOR)
09 91 13	EXTERIOR PAINTING
09 91 23	INTERIOR PAINTING

DIVISION 10 – SPECIALTIES

10 11 00	MARKERBOARDS AND TACKBOARDS
10 13 00	DIRECTORIES AND BULLETIN BOARDS
10 14 03	IDENTIFICATION DEVICES – EXTERIOR
10 14 06	IDENTIFICATION DEVICES – INTERIOR
10 14 16	PLAQUES
10 14 23	SIGNS
10 14 43	PHOTOLUMINESCENT EGRESS MARKINGS
10 21 11	SOLID PHENOLIC TOILET PARTITIONS
10 21 12	METAL TOILET PARTITIONS

10 21 15 SOLID SURFACE TOILET PARTITIONS
10 22 55 PARTITION CLOSURES
10 26 00 WALL PROTECTION SPECIALTIES
10 51 13 METAL LOCKERS
10 55 36 DROP BOX
10 57 00 WARDROBE SPECIALTIES
10 71 13 EXTERIOR SUN CONTROL DEVICE
10 75 00 FLAGPOLES
10 81 13 BIRD CONTROL DEVICE
10 95 00 MISCELLANEOUS SPECIALTIES

DIVISION 11 – EQUIPMENT
11 12 00 PARKING EQUIPMENT
11 13 21 SCISSOR LIFT
11 24 26 SAFETY TIE-BACKS
11 52 13 PROJECTION SCREENS
11 82 26 WASTE COMPACTOR

DIVISION 12 – FURNISHINGS
12 05 01 FURNITURE AND FURNISHINGS – GENERAL REQUIREMENTS
12 05 03 CURTAINS AND WINDOW COVERINGS – GENERAL REQUIREMENTS
12 24 14 ROLLER SHADES
12 32 00 ARCHITECTURAL CASEWORK
12 36 43 GRANITE COUNTERTOPS
12 36 63 SOLID SURFACE FABRICATIONS (SSF)
12 48 13 ENTRANCE MATS (EM)
12 48 23 ENTRANCE GRIDS (EG)
12 53 85 DISPLAY WALL
12 61 13 AUDITORIUM SEATING

DIVISION 13 – SPECIAL CONSTRUCTION
13 48 13 SOUND ISOLATING FLOOR SYSTEM
13 48 14 SOUND ISOLATING FLOOR SYSTEMS – SPRING LIFT

DIVISION 14 – CONVEYING EQUIPMENT
14 21 26 GEARLESS TRACTION ELEVATORS – PASSENGER
14 48 00 MECHANICAL VERTICAL LIFT

DIVISION 22 – PLUMBING
22 05 00 COMMON WORK RESULTS FOR PLUMBING
Describes the vibration and seismic control for piping and equipment, piping and equipment identification and pipe wall penetration sleeve types.
22 05 03 PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT
Describes pipe, tube, joints and fittings materials and installation requirements.
22 05 13 COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
22 05 16 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
Section describes flexible pipe connectors, expansion joints, expansion compensators, pipe alignment guides, swivel joints and pipe anchors.
22 05 23 GENERAL-DUTY VALVES FOR PLUMBING PIPING
Section describes gate valves, ball valves, plug valves, butterfly valves and check valves.
22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

Section describes pipe hangers and supports, hanger rods, inserts, flashing, sleeves, mechanical sleeve seals and formed steel channel.

22 05 48 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
Section describes inertia bases and vibration isolators.

22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
Section describes nameplates, tags, stencils, pipe markers, ceiling tacks, labels and lockout devices.

22 07 00 PLUMBING INSULATION
Section describes piping and plumbing equipment insulation, jackets and accessories.

22 08 00 COMMISSIONING OF PLUMBING SYSTEMS

22 11 00 FACILITY WATER DISTRIBUTION
Section describes Domestic water piping, unions and flanges, valves, pipe hangers and supports, pressure gages and taps, thermometers, flow control valves, water pressure reducing valves, relief valves, strainers, hose bibs, hydrants, recessed valve box, backflow preventers, water hammer arrestors, thermostatic mixing valves, pressure balanced mixing valves, diaphragm-type compression tanks, water softeners , system lubricated circulators, in-line circulator pumps, close-coupled pumps, base-mounted pumps, in-line circulator pumps, pressure booster systems, underground pipe markers and bedding and cover materials.

22 13 00 FACILITY SANITARY SEWERAGE
Section describes sanitary sewer piping above and below grade, unions and flanges, valves, pipe hangers and supports, floor drains, cleanouts, backwater valves, sumps, sewage ejectors and bedding and cover materials.

22 14 00 FACILITY STORM DRAINAGE
Section describes storm water piping above and below grade, unions and flanges, valves, pipe hangers and supports, roof drains, parapet drains, canopy and cornice drains, downspout covers and nozzles, area drains, planter drains, cleanouts, sumps, sump pumps and bedding and cover materials.

22 30 00 PLUMBING EQUIPMENT
Section describes hot water storage tanks.

22 35 00 DOMESTIC WATER HEAT EXCHANGERS

22 40 00 PLUMBING FIXTURES

22 56 13 SOLAR HOT WATER HEATING SYSTEM

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 05 00 COMMON WORK RESULTS FOR HVAC

23 05 01 SCOPE OF WORK

23 05 03 PIPES AND TUBES FOR HVAC PIPING AND EQUIPEMNT
Describes the various types of piping on the project.

23 05 13 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
Describes the requirements for electrical motors including efficiencies.

23 05 14 MOTOR CONTROLS
Describes the variable frequency drives and their requirements.

23 05 16 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

23 05 23 GENERAL-DUTY VALVES FOR HVAC PIPING
The various types and requirements for the valves are described here.

23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

23 05 48 NOISE AND VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

23 05 49 NOICE CONTROLS FOR HVAC PIPING AND EQUIPMENT
Describes the requirements for noise control of HVAC equipment including duct silencers and external soundproofing.

23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

23 07 00 HVAC INSULATION
Describes the ductwork, piping, and equipment insulation requirements.

23 08 00 COMMISSIONING OF HVAC

23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

The new Direct Digital Control (DDC) system devices, including actuators, dampers, control valves, measuring devices, etc., as part of the overall Building Management System (BMS) will be described here. We will have two bidders for the project – Honeywell and Johnson Control – who are qualified to bid and can interface with the existing control infrastructure.

23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

The section includes control (computer controllers) equipment and software.

23 09 53 PNEUMATIC AND ELECTRIC CONTROL SYSTEMS FOR HVAC

23 09 93 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

23 11 13 FACILITY FUEL-OIL PIPING

23 12 13 FACILITY FUEL - OIL PUMP

23 13 00 FACILITY FUEL – OIL STORAGE TANKS AND ACCESSORIES

23 21 16 HYDRONIC PIPING SPECIALTIES

The various types of chilled water and hot water pipes are described here.

23 21 23 HYDRONIC PUMPS

The various types of chilled water and hot water pumps are described here.

23 25 00 HVAC WATER TREATMENT

The section describes the chemical water treatment systems required.

23 31 00 HVAC DUCTS AND CASINGS

The sheet metal supply, return and exhaust ducts will be described in this section.

23 33 00 AIR DUCT ACCESSORIES

The various types of control dampers, fire dampers, duct access doors, flexible duct connectors, etc. are described here.

23 34 00 HVAC FANS

The various types of supply, return, and exhaust fans are described here.

23 36 00 AIR TERMINAL UNITS

The control boxes (Variable Air Volume – VAV) are described here.

23 37 00 AIR OUTLETS AND INLETS

The various types of supply, return and exhaust diffusers, grilles and registers are described here.

23 40 00 HVAC AIR CLEANING DEVICES

The section describes the filters for the air handling units and other pieces of equipment.

23 51 00 BREECHINGS, CHIMNEYS, AND STACKS

The boiler flue system is described here.

23 52 16 CONDENSING BOILERS

The hot water boilers are described here

23 57 00 HEAT EXCHANGERS FOR HVAC

Heat exchangers for transferring heat between water systems is described here. This section includes plate and frame heat exchangers for chilled water, hot water, domestic hot water and condenser water systems.

23 64 12 PACKAGE WATER CHILLERS – CENTRIFUGAL

The electric water chillers is described here.

23 65 00 COOLING TOWERS

The open, evaporative, cross flow cooling towers are described here.

23 73 00 INDOOR CENTRAL-STATION AIR-HANDLING UNITS

This section describes the indoor air handling units and related equipment.

23 73 13 AIR TO AIR ENERGY RECOVERY EQUIPMENT

23 82 00 CONVECTION HEATING AND COOLING UNITS

This section describes air coils, finned tube radiation, unit heaters and similar types of equipment.

23 83 00 RADIANT HEATING UNITS

The snow melt heating system is described here.

DIVISION 25 – INTEGRATED AUTOMATION

25 05 00 COMMON WORK RESULTS FOR INTEGRATED EQUIPMENT

25 08 00 COMMISSIONING OF INTEGRATED AUTOMATION

25 31 00 INTEGRATED AUTOMATION INSTRUMENTATION AND TERMINAL DEVICES FOR FACILITY EQUIPMENT
This Section includes electric control switches, pushbuttons, relays, time-delay relays, timers, counters, control power transformers, and control panels.

25 36 13 INTEGRATED AUTOMATION POWER METERS
This Section includes instrument transformers, switches, relays, transducers, and meters for sensing and measuring electrical energy in buildings, facilities, and processes.

25 50 00 INTEGRATED AUTOMATION FACILITY CONTROLS
This Section includes central building management system to supervise temperature control, energy management, fire and smoke alarm, and other building systems.

DIVISION 26 - ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

26 05 03 EQUIPMENT WIRING CONNECTIONS
Acceptable types of connectors and installation requirements for connecting and splicing power cables.

26 05 13 MEDIUM-VOLTAGE CABLES
Acceptable types of medium Voltage (15kV nominal) power cables and installation requirements.

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
Acceptable types of low voltage (600V nominal or less) power cables and installation requirements.

26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
Acceptable types of grounding and bonding connectors and installation requirements.

26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
Acceptable types of hangers and supports including threaded rods, metal channel, beam clamps, etc. and installation requirements.

26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
Acceptable types of raceways, including conduit, wireways and boxes and a schedule of where different types are allowed to be installed.

26 05 34 FLOOR BOXES FOR ELECTRICAL SYSTEMS
Acceptable types of flush floor boxes and installation requirements.

26 05 36 DATA VOICE ELECTRICAL REQUIREMENTS

26 05 48 VIBRATION AND SEISMIC CONTROL OF ELECTRICAL SYSTEMS

26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
Acceptable types of field identification requirements for devices, boxes, raceways, panelboards, switchboards, transformers, etc.

26 05 73 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
Formal written study with calculations and curves required from contractor's switchgear manufacturer to determine all project specific circuit breaker, relay, and trip settings for a coordinated system as well as confirm all short circuit current ratings for all equipment.

26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS

26 09 23 LIGHTING CONTROL DEVICES
Acceptable types of lighting control devices to be coordinated with those indicated on drawings.

26 09 26 LIGHTING CONTROL PANELBOARDS

26 12 00 MEDIUM-VOLTAGE TRANSFORMERS
Acceptable types of medium Voltage Vacuum Pressure Impregnated (VPI) power service transformers that step the voltage down to 480/277 utilization and installation requirements.

26 13 13 MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR
Acceptable types of medium Voltage (15kV nominal) switchgear, circuit breakers, meters and relays and installation requirements.

26 22 00 LOW-VOLTAGE TRANSFORMERS
Acceptable types of low Voltage (600V nominal or less) power transformers for stepping down from 480V to 208/120V, 3-Phase, 4-Wire and installation requirements.

26 22 03 LOW-VOLTAGE TRANSFORMERS FOR NONLINEAR LOADS

Acceptable types of low Voltage (600V nominal or less) power transformers for stepping down from 480V to 208/120V, 3-Phase, 4-Wire where nonlinear loads are likely to be predominant and installation requirements.

26 24 13 SWITCHBOARDS

Acceptable types of low Voltage (600V nominal or less) switchboards for low voltage power distribution and installation requirements.

26 24 16 PANELBOARDS

Acceptable types of low Voltage (600V nominal or less) panelboards for low voltage power distribution and installation requirements.

26 25 00 ENCLOSED BUS ASSEMBLIES

Acceptable types of low Voltage (600V nominal or less) enclosed plug-in type busway assemblies for low voltage power distribution and installation requirements.

26 27 16 ELECTRICAL CABINETS AND ENCLOSURES

Acceptable types of cabinets and enclosures for housing electrical components and installation requirements.

26 27 26 WIRING DEVICES

Acceptable types of wiring devices, including receptacles and switches for power branch circuits to point of use locations as shown on plans and installation requirements.

26 28 13 FUSES

Acceptable types of fuses for power distribution equipment and installation requirements.

26 28 19 ENCLOSED SWITCHES

Acceptable types of low Voltage (600V nominal or less) safety switches for low voltage power equipment disconnect and installation requirements.

26 28 23 ENCLOSED CIRCUIT BREAKERS

Acceptable types of low Voltage (600V nominal or less) circuit breakers separately mounted in individual enclosures and installation requirements.

26 28 26 ENCLOSED TRANSFER SWITCHES

Acceptable types of low Voltage (600V nominal or less) automatic transfer switches to select power between two sources and installation requirements.

26 29 13 ENCLOSED CONTROLLERS

Acceptable types of low Voltage (600V nominal or less) motor starters as specified on drawings and installation requirements.

26 29 16 ENCLOSED CONTACTORS

Acceptable types of low Voltage (600V nominal or less) contactors for use in lighting and power circuits and installation requirements.

26 32 13 ENGINE GENERATORS

Acceptable types of low Voltage (600V nominal or less) electrical generators for producing power for emergency (life safety) and standby applications and installation requirements.

26 33 00 BATTERY EQUIPMENT

Station Battery System for DC controls for Medium Voltage Switchgear operation and installation requirements.

26 41 19 LIGHTNING PROTECTION

26 43 13 SURGE PROTECTION DEVICES

26 51 00 INTERIOR LIGHTING

Acceptable types of “back of house” area interior lighting fixtures and installation requirements. Refer to Lighting Designer’s specifications for all general area lighting.

26 52 00 EMERGENCY LIGHTING

Acceptable types of emergency lighting fixtures and installation requirements.

26 56 00 EXTERIOR LIGHTING

Acceptable types of “back of house” area exterior lighting fixtures and installation requirements. Refer to Lighting Designer’s specifications for all general area lighting.

DIVISION 27 - COMMUNICATIONS

27 15 00 TELECOM CABLING SYSTEM

27 05 33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

Acceptable types of raceways and boxes for communications as indicated on drawings and installation requirements.

27 13 43 COMMUNICATIONS SERVICES CABLING

Acceptable types of communications cabling, including fiber optic cabling and Cat 6 cabling and installation requirements.

DIVISION 28 – ELECTRONIC SAETY AND SECURITY

28 31 00 FIRE DETECTION AND ALARM SYSTEM

Automatic, addressable Fire Alarm system with smoke detector coverage, manual pull stations and audio/visual notification appliances and installation requirements.

SECTION 4.1
PROJECT SCHEDULE

PART 1 - GENERAL

1.1 SCHEDULE IS BEING DEVELOPED

SECTION 5.1
PROJECT BUDGET

PART 1 - GENERAL

1.1 BUDGETS

A. Per the Level I/II Study, the approved Series 3 construction budgets are:

1.	Herschler Renovation	$48,100,000
2.	Herschler Addition	$12,100,000
3.	CUP and Connector	$25,800,000
4.	Total	$76,000,000

SECTION 6.1
GEOTECHNICAL REPORT

PART 1 - GENERAL

1.1 TERRACON GEOTECHNICAL REPORT DATED AUGUST 22, 2014.

Geotechnical Engineering Report

Capitol and Herschler Buildings Improvements

Cheyenne, Wyoming

August 22, 2014

Terracon Project No. 24149127/81149127

Prepared for:

Wyoming Department of Administration & Information
700 West 21st Street
Cheyenne, Wyoming 82002

Prepared by:

Terracon Consultants, Inc.
1505 Old Happy Jack Road
Cheyenne, Wyoming 82001

Offices Nationwide
Employee-Owned
Established in 1965
terracon.com

Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

August 22, 2014

State of Wyoming Department of Administration & Information
700 West 21st Street
Cheyenne, Wyoming 82002

Attention: Mr. Dennis Egge
Phone: (307) 777-5691
E-mail: dennis.egge@wyo.gov

Re: Geotechnical Engineering Report
Capitol and Herschler Buildings Improvements
Cheyenne, Wyoming
Terracon Project No. 24149127/81149127

Dear Mr. Egge:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our proposal number P24140079, dated March 14, 2014. This geotechnical engineering report presents the results of the field exploration and provides geotechnical recommendations concerning earthwork, the design and construction of foundations and soil-retaining walls, the assessment of changing load conditions on existing foundations, and the effects of dewatering for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Brent F. Wilkins, P.E.
Geotechnical Department Manager

Richard T. Shimono, E.I.T.
Staff Geotechnical Engineer

Copies to: Addressee (1 via e-mail)

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Appendix C – SUPPORTING DOCUMENTS

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EXECUTIVE SUMMARY

A geotechnical investigation has been performed for the proposed Capitol and Herschler Building improvements in Cheyenne, Wyoming. Sixteen borings were conducted to depths of approximately 15 to 41 feet below the existing ground surface. Eight test pits were also excavated to confirm the location of existing foundations within the Capitol Building footprint. This report specifically addresses the foundation, earthwork, dewatering, and retaining wall recommendations for the proposed structures.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- The proposed foundations and retaining walls appear feasible from a geotechnical standpoint.
- Based on the results of the borings and test pits, subsurface conditions on the project site can be generalized as primarily consisting of sandy lean clay, clayey sand, and poorly graded sand with silt and gravel soils, typically overlying lean clay and clayey to silty clayey sand soils. Fill was disclosed in the test pits adjacent to the footings of the Capitol Building and sporadically in borings near the Herschler and Capitol Buildings.
- Temporary dewatering will be required to facilitate construction of the north access drive and central utility plant (CUP).
- Based on the pump testing results, it appears that the north access drive and CUP can be designed and constructed as “drained” structures. A dewatering system, consisting of drains, sumps, and pumps, is required to permanently lower the groundwater table.
- Temporary shoring will likely be required to facilitate construction of the north access drive and CUP. Temporary open cuts are feasible from a geotechnical standpoint; however, site constraints will likely limit their use.
- Lowering the groundwater table will result in some settlement of the ground surface directly adjacent to areas that are dewatered; however, the zone of influence is estimated to be limited to approximately 50 feet based on the pump test results.
- Improvements within the historic Capitol building will require lowering the basement grades. In order to minimize resultant settlement of the existing building foundations, underpinning is recommended for foundations for which a 1.5H:1V (horizontal:vertical) zone of influence down and out from the foundation base intersects adjacent excavations.

- Portions of the existing below-grade area located between the Herschler Building and the Capitol Building (west access ramp and a portion of the Connector Link) are proposed to be demolished and backfilled with the mat foundation to remain. Provided drainage provisions are incorporated into the design, backfilling over the mat foundation appears feasible from a geotechnical standpoint. The backfill will need to be engineered fill to limit future settlement of the area.

- The project will involve construction of underground utilities, including utility tunnels from the CUP to the Capitol Building and surrounding area. Depending on the depth and location of the proposed utilities, temporary dewatering and shoring may be required to facilitate construction. The tunnel may be designed as an undrained structure, provided design considerations are made for hydrostatic lateral and uplift pressures, and soil pressure from fill soils over the tunnel.

- The majority of the site soils are silty and moisture sensitive; consequently, the soils may be problematic in regard to placement and compaction as structural fill behind walls or under foundations.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We recommend that Terracon be retained to monitor this portion of the work. In addition, optical surveying of critical structures adjacent to shoring and to areas that are dewatered should be performed on a regular basis to monitor deformations and to confirm design assumptions.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
Capitol and Herschler Buildings Improvements
Cheyenne, Wyoming

Terracon Project No. 24149127/81149127

August 22, 2014

1.0 INTRODUCTION

This report presents the results of the geotechnical engineering services we performed for the proposed improvements to the Capitol and Herschler Buildings in Cheyenne, Wyoming. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- construction dewatering
- permanent dewatering
- site grading and backfill
- shoring design and construction
- foundation design and construction
- lateral earth pressures
- underground utility installation
- settlement monitoring

Our geotechnical engineering scope of work for this project included the advancement of 16 test borings to depths ranging from approximately 15 to 41 feet below existing site grades, lab testing for soil engineering properties, ground penetrating radar (GPR) and excavations (test pits) to confirm the geometry, depth, and condition of the existing stone foundations under the Capitol Building, pump testing, and shear wave velocity (i.e., ReMi) testing for engineering analyses to provide geotechnical design and construction recommendations.

A previous subsurface investigation, consisting of three hollow stem auger borings and three hand augers, was conducted at the site by Terracon and is titled “Geotechnical Exploration Summary, Capitol Building Renovations”, dated December 2, 2013.

Logs of the borings along with Boring Location Diagrams are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Shear wave velocity survey and pump test results, as well as the results of the previous investigation (Borings B-1 through B-6, and associated laboratory testing), are included in Appendix C.

2.0 PROJECT INFORMATION

2.1 Site Location and Description

ITEM	DESCRIPTION
Location	The project site is located between Central Avenue, Carey Avenue, West 24th Street, and West 26th Street in Cheyenne.
Existing site features	The Herschler Building is located at the north end of the project site. Entry to and exit from the below-grade Herschler parking garage is currently handled via the centrally located Connector Link from the west and east central access drives. This Connector Link connects the Herschler Building to the Capitol Building below surface grade. The Capitol Building is located on the south end of the site. Dewatering is currently handled through two sets of dewatering pumps, one set centrally located within the Herschler garage, and one set located in the Connector Link. The garage dewatering system it reported to pump at a rate of approximately 10,000 gallons per day (approximately 7 gallons per minute), and the Link system is estimated to pump at a comparable rate.
Current ground cover	The ground surface is covered by a combination of turf and concrete surfacing.
Existing topography	Overall, the site slopes gently to the south with an elevation change from approximately 6093 feet on the north side of the property to 6089 feet on the south side of the project site. The site is sloped to drain away from the two buildings.

2.2 Project Description

ITEM	DESCRIPTION
Site layout	Proposed project site development includes the North Addition expansion to the Herschler Building and construction of an underground central utility plant (CUP) on the east side of the site, adjacent to the Herschler Building. Also included in the development is the creation of mechanical distribution space beneath the Capitol Building, which will comprise construction of an additional lowered slab that will act as a local slab-on-grade below the existing floor elevation. The Connector Link will be stripped to its mat foundation and rebuilt with new below-grade rooms within the existing mat footprint. The west and east access ramps will be demolished, and the east access ramp will be rebuilt after construction of the utility tunnel that extends from the CUP. The tunnel will extend from the south end of the CUP and connect to an existing utility tunnel that trends north to south along the east side of the Capitol Building. A recessed access drive will be constructed north of the Herschler Building. This drive will connect into the Herschler Parking Garage from West 26th Street. The new Connector Link will have a smaller footprint than the existing Link, and all existing slab elements will be retained. Voids from the footprint modification and west access ramp demolition will be filled with soil. A permanent dewatering system is to be added to the north access drive, the CUP, as well as possibly additional dewatering in the margin between the CUP and the Herschler garage.
Structures	The North Addition will consist of 4 floors above grade, with relatively high loads on the east portion of the fourth floor. Columns may be reconfigured below the ground level within the existing parking area below grade. The recessed access drive will involve the construction of retaining walls along the north and south sides of the drive. The CUP will consist of an area at the same grade as the Herschler parking garage that extends about 17 feet from the edge of the Herschler parking garage, after which the grade drops approximately 11 feet to accommodate large machinery. The portion of the CUP that supports machinery is likely to be supported on a mat foundation. Two staircases will be added along the south side of the Herschler Building, approximately centered along the west and east wings. The utility tunnel is likely to have dimensions similar to the existing tunnel, approximately 7½ feet high by 5 feet wide.

ITEM	DESCRIPTION
Finished grade elevation	The upper CUP slab, the base of the recessed access drive, and Herschler staircases will be at the same elevation as the Herschler garage, around 6083 ½ feet. The lower CUP mat is proposed to have a slab elevation of about 6072 ½ feet, and a thickness of approximately 3 feet. For all other built areas, typically within about 1 foot of existing grade (assumed).
Maximum allowable settlement	Assumed 1 inch total settlement for all new foundation systems. Settlement of existing foundations is to be minimized, especially at the Capitol Building (assumed).

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs included in Appendix A of this report. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual.

Based on the results of the borings, subsurface conditions on the project site generally consist of soft to very stiff sandy lean clay, loose to medium dense clayey sand, and medium dense to very dense poorly graded sand with silt and gravel soils to depths of 4 to 17½ feet, typically overlying very stiff to hard sandy lean clay and dense to very dense clayey to silty clayey sand soils. Up to 5 feet of fill was disclosed below the Capitol Building, and up to 13 feet of soils were interpreted as fill throughout the rest of the site. Thin discontinuous lenses of cemented soil were encountered at various depths throughout the site.

3.2 Laboratory Test Results

Laboratory tests were performed on select samples throughout the borings. Gradation tests were performed on 21 samples, Atterberg index tests were performed on 16 samples, direct shear tests were performed on six samples, and dry densities were acquired for six samples. Granular soils typically had 8 to 46 percent fines. Liquid limits ranged from 32 to 54, and plastic limits ranged from 14 to 20. None of the soil samples that were submitted to Atterberg index testing were found to be non-plastic.

Direct shear tests, which were selected from samples at depths between 14 and 25 feet, displayed cohesion values ranging from 400 to 1350 psf and friction angles between 22 and 33.

Moisture test results indicate that the soils above the ground water table are likely to be generally at or above the anticipated optimum moisture content. The soils below the water table were near, or at, saturation levels and therefore were above the anticipated optimum moisture content.

3.3 Groundwater

Groundwater was encountered while drilling in May 2014 at depths of 12 ½ feet to 37 ½ feet. Subsequent well and piezometer readings in select borings revealed steady-state groundwater depths of 16 ¾ feet to 21 ½ feet near the east wing of the Herschler Building, and 11 ¾ feet to 13 ¾ feet at the north access drive. Groundwater levels are summarized in the table below.

The variance in groundwater levels across the site is at least in part attributable to the permanent dewatering systems at the Connector Link and the Herschler parking garage. Based on review of the geotechnical report for the Herschler Building (Empire Laboratories, Inc. 1980), groundwater levels ranged from 7 ½ feet to 11 ½ feet below the existing ground surface prior to dewatering.

Groundwater levels summary (all readings are in units of feet, and in chronological order left to right)											
Boring	Depth (ft)	Moni-toring Type	WD (11/15/2013)	Readings				WD (5/12-5/17)	Pump Test (5/19-5/20)	Readings	
				11/20	2/26	4/4	5/1			6/12	6/25
1	3.8	None	nw								
2	2	None	nw								
3	1.6	None	nw								
4	30.5	Piezo	nw	16.80	16.78	14.99	14.94		N/A	14.42	N/A
5	30.5	Piezo	9.5	10.28	9.98	fr	9.99		N/A	9.38	N/A
6	29.4	Piezo	nw	18.70	14.09	13.77	13.67		N/A	13.44	N/A
7	15.5	None						14.0			
8	31	2” Piezo						nw	N/A	16.50	N/A
9	15.5	None									
10	15.5	None									
11	15	None									
12	15.5	None									
13	40.5	4” Well						12.5	12.88	13.05	N/A
14	30	None						28.5			
15	31	2” Piezo						nw	14.60	14.76	N/A
16	30	None						14.3			
17	31	None									
18	41	4” Well						37.5	20.60	nw	17.50
19	28.5	None						23.0			

Groundwater levels summary (all readings are in units of feet, and in chronological order left to right)											
Boring	Depth (ft)	Moni-toring Type	WD (11/15/2013)	Readings				WD (5/12-5/17)	Pump Test (5/19-5/20)	Readings	
				11/20	2/26	4/4	5/1			6/12	6/25
20	31	2" Piezo						nw	21.83	nw	22.55
21	30.5	None									
22	35.5	2" Piezo						22.7	12.70	13.15	N/A
*nw = no water observed; fr = frozen; WD = while drilling											

These observations represent groundwater conditions at the time of the observations only, and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors. The possibility of groundwater fluctuations should be considered when developing design and construction plans for the project.

3.4 Pump Test Results

Two pump tests were conducted at the site to measure the aquifer properties. One pump test was conducted in the vicinity of the proposed north access drive (Boring B-13) and the other in the vicinity of the proposed CUP building (Boring B-18). Based on the pump test results, the following hydraulic conductivities were calculated:

- North Access Drive: k = 0.19 ft/day (6.7 x 10^{-5} cm/s)
- CUP building: k = 0.10 ft/day (3.5 x 10^{-5} cm/s)

Details of the pump test results are contained in Appendix C.

3.5 ReMi Test Results

Refraction Microtremor (ReMi) is a surface-wave seismic method for estimating in-situ Rayleigh-wave (shear-wave) velocities. Testing is performed at the surface using a seismograph and vertical P-wave geophones. The seismic source consists of ambient seismic noise, or microtremors, which are constantly generated by cultural and natural sources. A ReMi test was conducted at the site to estimate the seismic shear wave (v_s) of the upper 100 feet of soil and thereby determine the International Building Code (IBC) site classification. Nine ReMi tests were conducted at the site, designated H1, H2, H3, C1, C2, C3, C4, C5, and C6. The measured shear wave velocities ranged from over 300 ft/s near surface to over 2,500 ft/s at 100 feet below the existing ground surface.

Mapped ReMi testing locations and details of the ReMi test results are contained in Appendix C.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on information from the geotechnical engineering analyses, subsurface exploration, and laboratory testing results, it is our opinion that construction of the proposed north addition, central utility plant, utility tunnel, staircases, and recessed access drive are feasible from a geotechnical perspective. Additionally, the proposed new loads within the Capitol Building can feasibly be supported on new foundation elements without appreciable settlement, contingent upon construction practices. Primary geotechnical considerations are discussed below.

- Temporary dewatering will be required to facilitate construction of the north access drive and the CUP building.
- Depending on whether the site can accommodate cut slopes, shoring may be required to create a safe working excavation for the Connector Link construction, CUP, and north access drive.
- Based on the pump test results, permanent dewatering consisting of under-slab drains and sumps for pumping appears feasible.
- It is reported that the historic Capitol has experienced settlement over the years; thus, underpinning of the existing foundations will be required for footings adjacent to excavations that are located within a zone of influence defined by a slope down and out from the edge of the base of the footing equal to 1.5H:1V (horizontal:vertical).
- The 100-year flood level across the site varies from 6089 feet south of the site to 6095.1 feet at the northeast portion of the site (NAVD88), according to a Flood Hazard Assessment map prepared for the project site by BenchMark Engineers, PC on April 5, 2014. The proposed retaining wall on the north side of the access drive may stick up as much as 5 feet past the elevation behind the wall, in which case the surcharge load from the flood must be accounted for in the wall design.
- The City of Cheyenne plans to install a new storm line along West 26th Street. Construction of the new utility will need to be coordinated with construction of the north access ramp retaining wall.
- Frost depth maps for the project region indicate an average frost depth of about 35 inches with an extreme frost depth of about 50 inches. It is our understanding that projects commonly employ a frost depth of 36 inches for design, which should be adequate for frost protection.

Design and construction recommendations for foundation systems and other earth related phases of the project are outlined below.

4.2 Earthwork

The following subsections present recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented

for design and construction of foundations are contingent upon following the recommendations outlined in this section. All grading for each structure should incorporate the limits of the proposed foundations plus a minimum lateral pad expansion of five feet beyond proposed footing areas.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

With the exception of gravel road base under roadway sections, and backfill for footings uncovered during test pit excavation at the Capitol Building, fill was not observed during the exploration program. If encountered, all existing fill materials and any other deleterious materials should be removed from proposed foundation areas.

The silty and clayey sand and lean clay soils encountered in the borings will be sensitive to disturbance from construction activity and increased moisture. If precipitation occurs prior to or during construction, the exposed soils could increase in moisture content and become more susceptible to disturbance. Construction activity should be monitored, and should be curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to aid in limiting subgrade disturbance.

4.2.2 Excavation

The soils encountered in the proposed excavations may vary significantly across the site. The soil classifications are based solely on the materials encountered in the exploratory test borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

A storm sewer line is documented in the area of the proposed CUP. When this feature is encountered, the line should be temporarily rerouted and removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction. If any unexpected features are encountered, they should be removed, and the excavation should be similarly cleaned out.

All existing uncontrolled fill material should be over-excavated under the foundation areas, including exterior slabs. Any over-excavation that extends below the bottom of foundation or exterior slab elevation should extend laterally beyond all edges of the footings at least 8 inches per foot of over-excavation depth below the footing base elevation. The over-excavation should be backfilled to the footing base elevation in accordance with the recommendations presented in this report.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. As per OSHA standards, all excavations greater than 20 feet in depth must have their sides designed by a registered professional.

4.2.3 Subgrade Preparation

The top 8 inches of the exposed ground surface should be scarified, moisture conditioned, and recompacted to 95% of the maximum dry unit weight as defined by ASTM D-698 before any new fill or foundation is placed.

If pockets of soft, loose, or otherwise unsuitable materials are encountered at the bottom of the footing excavations and it is inconvenient to lower the footings, the proposed footing elevations may be reestablished by overexcavating the unsuitable soils and backfilling with compacted engineered fill or lean concrete. Any overexcavation should be performed in accordance with the excavation recommendations given below.

After the bottom of the excavation has been compacted, engineered fill can be placed to bring the structure pads to the desired grade. Engineered fill should be placed in accordance with the recommendations given below.

The stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Alternatively, over-excavation of wet zones and replacement with granular materials may be used, or crushed gravel and/or rock can be tracked into the unstable surface soil until a stable working surface is attained. Use of fly ash, cement or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction. Lightweight excavation equipment may also be used to reduce subgrade pumping.

4.2.4 Fill Materials and Placement

Based on the conditions encountered in the soil borings and the nature of the on-site soils, the site soils will likely require reworking to adjust the moisture content to meet the compaction criteria. Clay soils or sands with a high clay or silt content may be difficult to dry, so we caution against the re-use of these on-site soils as fill material. As the on-site soils may be problematic in regard to placement and compaction, we suggest that imported materials be considered for structural fill applications.

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer. Imported soils for use as engineered fill material or general fill should conform to the following specifications, unless approved by the geotechnical engineer:

Gradation	Percent Finer by Weight (ASTM C 136)
3”	100
No. 4 Sieve	50-100
No. 200 Sieve	55 (max)

- Liquid Limit ..... 30 (max)
- Plasticity Index ..... 15 (max)

Fill soils placed behind retaining walls should be granular material meeting the requirements of Grading Aggregate specified in the Wyoming Department of Transportation (WYDOT) *Standard Specifications*, Table 803.4.4-1.

Engineered fill should be placed and compacted in horizontal lifts, not exceeding eight inches in loose thickness, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

The recommendations for placement and compaction criteria presented assume that fill depths may approach 15 feet at the Connector Link and the west access drive. Fills on the order of 15 feet in depth, when placed and compacted as recommended in this report, will experience some settlement, generally 1½ inch or less. The amount and rate of settlement will be increased if water is introduced into the fill. It is noted that settlement of the fill material due to self-weight is in addition to settlements due to structurally induced loads. It is possible to reduce the settlement due to self-weight by increasing the compactive effort when placing the fill. To this end, the compaction criteria have been increased beneath all foundation areas.

4.2.5 Compaction Requirements

Recommended compaction criteria for engineered fill materials are as follows:

	Minimum Percent (ASTM D698)
Scarified subgrade soils	95
On-site and imported fill soils:	
Beneath foundations	100
Beneath slabs	100
General backfill, non-structural areas	95

Approved on-site soils and imported low plasticity soils placed as engineered fill should be compacted within a moisture range of 3 percent below to 2 percent above optimum unless modified by the project geotechnical engineer.

4.2.6 Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the proposed project, with the exception of structures designed to resist hydrostatic loads. Infiltration of water into utility or foundation excavations must be prevented during construction. Surface features which could retain water in areas adjacent to the structures should be sealed or eliminated. We recommend that protective slopes be provided with a minimum grade of approximately 10 percent for at least 10 feet beyond the perimeter of the structures.

All grades must provide effective drainage away from the structures during and after construction. After construction activities and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved.

Water permitted to pond next to the structures can result in greater soil movements than those discussed in this report. Estimated movements described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

4.2.7 Corrosion Protection

Terracon recommends the use of fly ash or lithium admixture if alkali silica reactive aggregate is used in concrete for proposed foundations and slabs. Mortar bar tests should be performed on the concrete to evaluate the effectiveness of the mitigation process. In most cases, expansions less than 0.1% are considered tolerable for most structures. Foundation concrete should be designed in accordance with the provisions of the most recent version of the ACI Design Manual, Section 318, Chapter 4.

4.3 Seismic Considerations

We understand the site will be designed to conform to the 2012 International Building Code (IBC) which is based on designing for an event with a 2 percent chance of exceedance in 50 years. The following discusses the soil site class and seismic hazard potential at the site:

- **Site Class** - The subsurface soils may be considered a Site Class C soil profile for IBC code-based seismic design, based on shear wave velocity test results.

- **Liquefaction** - The liquefaction potential at the site, in response to the design seismic event, is considered to be negligible as the foundation soils are generally clayey.

- **Fault Rupture** – Fault rupture is not a concern at this site, based on review of available fault maps and deaggregation of seismic hazard sources.

4.4 Foundations

4.4.1 Central Utility Plant Mat Foundation Design Recommendations

Our understanding is that a mat foundation will be used for the lower level of the CUP. This foundation element is anticipated to be about 3 feet thick and bear on soils at an approximate elevation of 6069½ feet. To prevent hydrostatic lateral or uplift forces from developing on foundations and below-grade walls, foundation underdrains and a perimeter wall drainage system are required. Alternatively, depending on anticipated dead loads, the foundation system could be designed to resist hydrostatic forces, in which case tie down anchors should be used to resist floatation of the foundations and floor slab. Shear wave velocity tests on subgrade soils in the area revealed that the soils are less compressible than would be suggested by the blow counts. Recommended strength parameters have accordingly been adjusted in the table below.

DESCRIPTION	VALUE
Slab support	Native clayey sand to sandy lean clay soils
Modulus of subgrade reaction	225 pounds per cubic inch (pci) may be used for slabs supported on native soils or a crushed stone drainage layer placed between the base of the mat and native soils.
Allowable bearing pressure[1]	6,500 psf

1. Based on a minimum factor of safety of 3 and minimum dimension of 15 feet.

4.4.2 Foundation Design Recommendations

We recommend that shallow foundations be used for the stairwell additions and the upper level of the CUP. Depending on anticipated dead loads, hydrostatic forces from the 100-year flood may cause undesirable uplift of the CUP at this level, in which case tiedown anchors should be used to resist floatation of the foundations and slab-on-grade. Shallow foundation recommendations are summarized below.

DESCRIPTION	CUP Upper Level Foundations
Bearing material	Loose to medium dense clayey sand, with scarified and compacted base (see Section 4.2.3)
Allowable bearing pressure[1]	2500 psf

DESCRIPTION	CUP Upper Level Foundations
Modulus of subgrade reaction	100 pci
Minimum width	2 feet
Maximum width	8 feet
Minimum depth of embedment	3 feet
Estimated total settlement	<1 inch
Estimated differential settlement	< 1/2 inch
Allowable coefficient of sliding friction[2]	0.30
Allowable passive earth pressure[2]	200 pcf

1. Based upon a minimum factor of safety of 3.
2. Based upon a minimum factor of safety of 1.5.

Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction. Footings should be proportioned to reduce differential foundation movement. Proportioning on the basis of equal total settlement is recommended; however, proportioning to relative constant dead-load pressure will also reduce differential movement between adjacent footings. Footings should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

4.4.3 North Addition Subgrade Parameter Recommendations

We recommend that the soil reaction from additional loads imposed on the existing mat foundation by the North Addition of the Herschler Building be initially estimated using the following soil parameters.

DESCRIPTION	VALUE
Slab support	Native clayey sand soils
Modulus of subgrade reaction	150 pounds per cubic inch (pci)
Allowable bearing pressure[1]	4,500 psf
Initial Shear Modulus	4,500 ksf

1. Based on a minimum factor of safety of 3.

It is our understanding that a computer model, either finite element or finite difference, will be used to model the new loads that will be imposed onto the existing mat foundation and underlying soils. We recommend that Terracon be consulted to provide any additional soil input parameters that may be required as input to the computer model.

4.4.4 Capitol Building Foundation Recommendations

4.4.4.1 Existing Foundations

We understand that improvements within the historic Capitol Building will require lowering the basement grades. In areas adjacent to existing spread footing foundations where a 1.5H:1V (horizontal:vertical) native soil slope cannot be maintained from the top edge of the existing foundations, we recommend that the foundations be underpinned prior to excavation with small diameter pipe piles, commonly referred to as "pin" piles, which typically range in diameter from 2 to 6 inches. The following table presents recommended pin pile capacities for 2- to 6-inch diameter steel pipe.

Pile Diameter (inches)	Allowable Pile Capacity* (kips)
2	5
3	10
4	20
6	30

* Based on a factor of safety of 2, and "Extra Strong"-class pipe per AISC.

We recommend a testing program be implemented to verify the driven capacity and required depth of pin piles in accordance with ASTM D1143/D1143M -07 (Reapproved 2013), following the Quick Test procedure. For testing, we recommend the piles be tested to 150 percent and 200 percent of the allowable axial pile capacity for temporary and permanent piles, respectively. We recommend that 3 percent of the piles be tested, with a minimum of one and maximum of five.

Typically pin piles are installed with a pneumatic hammer mounted on a small piece of equipment, such as a Bobcat excavator. Pile lengths of 5 to 10 feet are commonly used. Successive pile lengths are either compression coupled or welded. Once the piles are installed, they are cut off at the bottom of footing elevation and connected to the existing footing with angle bracket to transfer the foundation loads to the pile. As the pile diameters increase, larger pneumatic hammers are required to achieve the allowable design values presented above.

The lateral capacity of pin piles is low, and therefore is generally ignored for design purposes. If lateral capacity is required, we recommend the use of "battered" piles, which are piles driven at an inclination from vertical. We do not recommend using battered piles that are inclined greater than 0.25H:1V (horizontal:vertical) or 14 degrees, from vertical.

We recommend that Terracon review all pin pile designs to confirm that our recommendations have been interpreted correctly and incorporated into the plans and specifications.

4.4.4.2 New Foundations

If new foundations are required, we recommend that they be designed in accordance with the recommendations provided in section 4.4.2, "Shallow Foundation Design Recommendations", of this report.

4.4.5 Existing Connector Link Mat Backfill Recommendations

We understand that the existing Connector Link and access drives will be stripped down to the mat foundation as part of the proposed improvements. Although the new Connector Link will have a smaller footprint than the existing Connector Link, the additional mat area will be left in place to minimize dewatering system impacts, and backfill will be placed on the mat. It is our opinion that the additional loads imposed by the backfill will have a negligible effect on the mat in terms of settlement. We base this opinion on the assumption that native soils under the Connector Link are comparable to soils on the east central portion of the site at the mat elevation, and that backfilling over the mat will essentially be restoring the stress state that existed before the construction of the Connector Link.

4.4.6 Foundation Construction Recommendations

If soft, loose, or other unsuitable bearing soils are encountered in footing excavations, the excavations should be extended to suitable soils in accordance with the Earthwork recommendations given herein. If water over a depth of 3 inches for shallow or mat foundations collects at the base of an excavation, water should be pumped out before placing concrete.

All foundation footings should extend to a minimum depth of 36 inches below finished grade or be placed on non-frost susceptible soils (such as "W" grading aggregate) to that depth for frost protection.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

4.5 Lateral Earth Pressures

We understand that grading cuts at the recessed north access drive, and likely the CUP, will require retaining walls to lower site grades to their design elevation. Depending on whether site geometry allows for stable cut slopes into the excavation, a conventional retaining wall or a soldier pile and lagging system may be used for the north access drive. A soldier pile and lagging shoring system may be used for similar reasons at the CUP, particularly for the lower machinery supporting area.

All walls discussed in this section should be provided with drainage per Section 4.8 of this report.

4.5.1 Retaining Wall Design Recommendations

Retaining wall earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction, and the strength of the materials being restrained. If the retaining walls are free to yield at the top in an amount equal to approximately 0.002 times the height of the wall, then the soil pressure will be less than if the movement is limited by the wall stiffness or the structural floor network.

Retaining walls should be designed for equivalent fluid pressures of 35 pcf and 55 pcf for yielding and non-yielding backfilled walls, respectively. Backfill placed against retaining structures should consist of granular soils as outlined in section 4.2.4 above. The granular backfill must extend out from the base of the wall at an angle of at least 45 degrees from vertical. To calculate the resistance to sliding, a value of 0.30 should be used as the allowable coefficient of friction between the footing and the underlying soil. Lateral resistance can also be provided by passive earth pressure acting on the embedded portion of the wall. An allowable passive earth pressure, presented as an equivalent fluid weight equal to 250 pcf, is recommended for design.

If the recessed access drive's northern retaining wall exceeds the height of the retained soil such that water could pond behind it (i.e., the wall stickup is not freely draining), we recommend that the wall be designed for surcharge pressures that would result from ponding water due to the 100-year design flood. This surcharge should be modeled as a triangular pressure distribution of 62.4 psf per foot from the design flood level to the ground surface. We also recommend that a lateral surcharge load be added to account for roadway traffic behind retaining walls, as appropriate. The uniform lateral traffic surcharge loads should be 75 psf for the yielding wall case and 100 psf for the non-yielding wall case.

The equivalent fluid pressures given are based on the assumption of a uniform backfill and no buildup of hydrostatic pressures in the fill behind the wall. To prevent the buildup of lateral earth pressures in excess of the above designed pressures, over compaction of fill behind the walls should be avoided. This can be accomplished by placing the backfill within 24 inches of the wall in lifts not exceeding 8 inches in loose depth and compacting with hand-operated equipment.

Care should be taken where utilities penetrate through basement walls. Minor settlement of the backfill can put significant soil loading on utilities, and some form of flexible connection may be appropriate at backfilled wall penetrations.

4.5.2 Soldier Pile Shoring Design Recommendations

Based on the soil conditions observed at the exploration locations and the proposed slab elevations, soldier pile shoring may be considered to support the excavation of the CUP and the north access drive during construction. The shoring required to support the excavation is typically used as back forms for the permanent basement or retaining walls. It is feasible to

make the shoring system for the north access drive a permanent shoring wall, provided long-term corrosion protection of the steel beams and anchors is incorporated into the design and construction. If anchors are incorporated into the shoring design, permission would be required for anchors located within the right of way.

Soldier piles for shoring are typically set in drilled holes and backfilled with lean or structural concrete. Soldier pile installation may involve casing the holes and/or drilling with a mud slurry to cut off groundwater seepage.

Design of temporary shoring using soldier piles could be based on either “active” or “at-rest” lateral earth pressures, depending on the degree of deformation that can be tolerated. Shoring which is free to deform on the order of 0.001 to 0.002 times the height of the shoring is considered to be capable of mobilizing active earth pressures. This lateral deformation is likely to be accompanied by vertical settlement of up to roughly 0.005 times the height of the shoring, which may extend back from the side of the cut a distance equal to roughly the height of the cut. Lesser degrees of settlement may also occur within a setback extending twice as far back. A greater amount of lateral deformation could result in greater vertical settlements. If no structures or utilities are located within this zone, or if any structures or utilities within the zone are considered to be insensitive to this degree of settlement, then it would be appropriate to design utilizing active earth pressures. An assumed “at-rest” earth pressure condition theoretically assumes no movement of the soil behind the shoring; however, some settlement should realistically be anticipated due to construction practices and/or the fact that it is not possible to construct a perfectly rigid shoring system.

We recommend that shoring be designed using active earth pressures provided lateral movement and vertical settlement to the degree described above is considered tolerable. Note that all excavations involve a certain amount of risk and the selection of active or at-rest earth pressures does affect the level of risk. The following pressure distribution recommendations assume active earth pressure design for soils behind the shoring wall.

For a shoring system with multiple rows of tieback anchors, we recommend the use of a trapezoidal pressure distribution with a maximum pressure equal to 26 H in psf, where H is the height of the excavation in feet, with a truncated top beginning at 2/3 H_1, where H_1 is the depth to the first tieback, and truncated at the bottom at 2/3 H_{n+1}, where H_{n+1} = the height to the last row of tiebacks from the base of the excavation. For a cantilever shoring system, or shoring with one row of tiebacks, we recommend the use of a triangular pressure distribution with an earth pressure equal to 35 (H + D) in psf, where H is the height of the excavation in feet, and D is the depth of soldier pile embedment below the base of the excavation. The pressure will act over the full face above the excavation line and one pile diameter below.

In either type of shoring system, we recommend a triangular passive pressure equal to 250 pcf acting over two times the concreted pile diameter or the pile center to center spacing, whichever

is less, on the embedded portion of the soldier pile. If street loads are present adjacent to the shoring, the addition of a uniform lateral surcharge load of 75 psf is recommended. For other loads adjacent to the shoring (e.g., heavy construction loads or building foundations), please contact Terracon to estimate appropriate surcharge pressures.

For tieback anchors, the anchor portion of the tieback should be located sufficiently far behind the excavation shoring to stabilize the excavation face. The “no load” zone limit is the area behind the soldier pile equal to the lateral distance from the base of the excavation equal to the exposed wall height (H in feet) divided by five, or 5 feet, whichever is greater, and a line sloping up and back at 60 degrees from horizontal from that point. A minimum bonded anchor length of 10 feet is recommended.

A minimum anchor spacing of four feet center to center is recommended for tieback anchors. The anchor holes should be drilled at an angle of 15 to 45 degrees down from horizontal. The location and presence of existing features such as utilities and foundations should be checked during the design as these may affect the location and length of tieback anchors.

The selection of the tieback materials and installation methods should be the responsibility of the contractor. The actual adhesion values will depend on the materials and installation method and should be confirmed by testing. For non-pressure grouted anchors, the allowable design concrete/soil adhesion value of 1,000 psf can be used for preliminary design and cost estimating purposes. For pressure grouted anchors, this value can typically be increased by two to three times. We recommend all tieback anchors be proof tested to at least 130% of the design capacity prior to locking off at the specified post tensioned design load. Prior to installation of production anchors, two verification tests to 200% of the design pull out capacity are recommended for each soil type in order to confirm the design capacity.

Vertical capacity of the soldier piles may be provided by a combination of end bearing and side friction below the base of the excavation. The piles can be designed for an allowable end bearing resistance of 12 ksf, with an allowable side friction of 0.5 ksf for that portion of the pile embedded into the dense to very dense clayey sand and 1 ksf for very stiff to hard sandy lean clay layers. Factors of safety of 2 and 3 apply to the side friction and end bearing, respectively.

We recommend timber lagging, or some other form of protection, be installed in all areas. Due to soil arching effects, lagging may be designed with a large reduction in lateral earth pressure used for design of the shoring beams and anchors. For spans of 8 feet or less, the lagging can be designed for a maximum pressure of 400 psf. Prompt and careful installation of lagging will reduce potential loss of ground. The requirements for lagging should be made the responsibility of the shoring subcontractor to prevent soil failure, sloughing, and loss of ground.

4.5.3 Soldier Pile Shoring Installation

The contractor should be required to prevent caving and loss of ground in all soldier pile drill holes. The shoring contractor will need to use methods to minimize caving and sloughing of the drill holes, such as the use of augercast methods or installation of casing. If more than one foot of water is present in the bottom of the hole, placement of concrete from the bottom of the hole will be required.

When drilling tieback anchor holes, casing may be required to prevent caving and loss of ground. The anchor grout should be pumped into the anchor zone by tremie methods in order to remove water from the hole and to provide a continuous grouted anchor.

Proper installation of lagging is critical to provide safe working conditions. We recommend that any voids between the lagging and soil be backfilled promptly with a granular material or lean concrete mix that does not allow hydrostatic pressure to build up behind the wall. The excavation height prior to lagging installation should not exceed 5 feet to maintain stability of the cut face.

4.5.4 Permanent Basement Wall Design Recommendations

The majority of the permanent basement walls for the building will be cast directly against the shoring walls. For basement walls cast directly against shoring, we recommend they be designed for a uniform earth pressure equal to 25 H in psf, where H equals the wall height in feet. For walls adjacent to streets, we recommend a traffic surcharge equal to 100 psf uniform lateral pressure, assuming the wall is restrained against lateral deflection at the top and therefore cannot mobilize active earth pressures.

Permanent backfilled basement walls should be designed per our recommendations for retaining walls in Section 4.5.1, for soils at an at-rest condition.

4.5.5 Passive Resistance of Basement Walls

Although the site subsurface soils can resist significant basement wall loads, full soil resistance is only achieved at sizeable deflections that are usually deemed unacceptable. Therefore, we recommend an allowable average lateral pressure of 1000 psf be used for design, which is intended to limit lateral deflections to ½ inch. This value can be increased by 1/3 for handling seismic loads.

4.5.6 Seismic Surcharge for Permanent Basement and Shoring Walls

A lateral seismic surcharge should be added in calculating seismically induced loads, using a uniform surcharge pressure of 6 H in psf, where H is the height of the wall in feet. Bending moments in basement walls restrained from movement at the top and bottom may be reduced to 80% of the calculated design moment for the seismic case.

4.6 Utility Tunnel

We understand that a utility tunnel will be built connecting the CUP to an existing utility tunnel near the Capitol Building. This utility tunnel should be designed to resist any hydrostatic lateral or uplift pressures that exist, depending on the depth of the tunnel, and additionally should be designed to withstand the soil backfill above the tunnel. The load from the soil backfill over the roof the tunnel should be modeled as a vertical pressure of 125 psf per foot of soil.

Lateral earth pressures should be designed for per Section 4.5.1, using the recommendations for non-yielding walls.

4.7 Construction Dewatering

4.7.1 General

Temporary dewatering during construction will be required for the north access drive, CUP, and also for any other excavations that go below the water table. All footing excavations and floor slabs should be dewatered to a level at least 2 feet below the bottom of the excavation, prior to preparing the subgrade and placement of concrete.

4.7.2 Dewatering Considerations

The proposed excavation depth for the CUP will be approximately 10 feet below the water table we observed at the times of our investigations, whereas the excavation for the north access ramp will be on the order of 5 feet.

The steady state groundwater inflow to the excavation was estimated using a “large well” equation that describes the steady state groundwater flow to a large well, following removal of groundwater from storage and establishment of a drained condition. The large well equation assumes the following:

- The aquifer is flat, unconfined, and infinite in extent, and the water table is flat prior to excavation;
- Recharge is not considered; and
- Flow into the excavation is radial.

Although some of these assumptions are not met at the site because of the sloping water table and the presence of the existing Herschler building permanent dewatering system, this method provides a useful approximation of the magnitude of potential groundwater inflows.

For construction of the north access ramp, a steady state inflow into the excavation of 10 to 20 gpm is estimated. For construction of the CUP, a steady state inflow into the excavation of 50

to 70 gpm is estimated. During initial dewatering, the flow may be higher during the transient condition as the water is removed from storage.

4.7.3 Dewatering Criteria

Groundwater inflow into the excavations will become a major construction problem unless active measures are taken to control the inflow and buildup of water in the area of the excavation. The use of sumps inside the excavation will have limited success, especially as the excavation is advanced more than a few feet below the water table. Drilled wells or well points located around the perimeter of the excavation will be the most effective methods for dewatering the site. The choice between wells and well points depends on a range of variables such as site geometry, access limitations, groundwater inflow rate, depth of excavation, aquifer thickness, and the depth to the base of the aquifer. We recommend that an experienced dewatering contractor select and design the construction dewatering system.

The contractor should be made responsible for the control of all ground and surface water with the project site. The contractor should be responsible for the provision and maintenance of pumping equipment, wells, well points, suction and discharge lines, and other dewatering system components as necessary to keep the excavation free of water. In addition, the contactor should be required to obtain discharge permits for the pumped water and maintain any water-quality testing that may be required. We recommend that the contractor be provided this geotechnical report to assist in the design of the dewatering system.

4.8 Subsurface Drainage

We recommend that walls, mat foundations, footings, and slab on grade floors are positively drained to collect and convey groundwater seepage that may be present. The drainage system should consist of a combination of freely-draining structural fill, wall drainage, footing drains, slab underdrains, and a sump collection system. Under-slab drainage is recommended beneath the CUP building and the north access ramp below an elevation of 6085 feet.

4.8.1 Wall Drainage

Drainage should be provided for basement walls poured flush against the shoring by fully covering the shoring wall with geocomposite drainage. The geocomposite drains should be tied into the footing drainage system. It is important to provide a good connection between the wall drain and the footing drainage system. The detail of the wall/footing drain connection will depend on the type of shoring, basement wall type, and perimeter footing. Drainage behind walls cast in open excavations should consist of either geocomposite drainage as discussed above or backfill behind the wall consisting of free draining clean sand and gravel material with less than 5 percent passing the No. 200 sieve. If a moisture-free wall is desired, a waterproof barrier, such as plastic or bentonite panels, should be incorporated into the wall design.

4.8.2 Footing Drains

A perimeter footing drain should also be provided that consists of a minimum 6-inch diameter heavy walled perforated PVC pipe or equivalent. We recommend that the footing drains have a minimum slope of 0.5 percent, and that the pipe invert is at least 12 inches below the finish floor slab. The pipe should be bedded in at least 4 inches and surrounded by at least 6 inches of drainage material consisting of 1-inch minus washed drain rock. We recommend that nonwoven filter fabric (Mirafi 140N or equivalent) be wrapped around the drain gravel to limit infiltration of fines into the drains. Cleanouts are recommended for the footing drain system.

4.8.3 Under-Slab Drainage

A drainage system should be provided below basement floor slabs and mat foundations. We recommend the floor slab be underlain by cross drains consisting of 6-inch perforated pipes placed at about 30-foot centers and underlain by at least 6 inches of drainage gravel. We recommend that the underdrains have a minimum slope of 0.5 percent, and that the pipe invert is at least 12 inches below the finish floor slab. In addition, slabs on grade and mat foundations should be underlain by a minimum 12-inch continuous drainage blanket of clean, free-draining, crushed stone. Cleanouts are recommended for the under-slab drainage system.

4.8.4 Sumps

If gravity flow is not possible, the below-slab and wall drainage systems should drain to a sump for pumping. The steady-state or long-term groundwater flow rate should be evaluated during design and the permanent drainage system sized for that flow. For estimating purposes and minimum design criteria, a steady state flow rate of 10 gallons per minute (gpm) and 40 gpm can be used for the north access drive and CUP building, respectively. The design flow number should be verified once the excavation is completed. This can be accomplished by measuring the flow of the temporary dewatering system. If a sump system is used, a backup pump with emergency power is recommended in case of mechanical breakdown. The dewatering system should be vented to the atmosphere in case of mechanical or electrical failure. As a minimum, we recommend that the sump and drain pipe clean outs be vented to the atmosphere to reduce the buildup of hydrostatic pressure below the floor slab.

4.9 Roadway Sections

Listed below are pavement component thicknesses, which may be used as a guide for pavement systems at the site for typical light traffic patterns. It should be noted that these systems were derived based on general characterization of the subgrade as predominantly lean clay and clayey sand soils. No specific testing (such as CBR, resilient modulus test, etc.) was performed for this project to quantify the support characteristics of the subgrade.

Project specific traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. When the actual traffic design information is available Terracon should be contacted so that the design recommendations can be reviewed and revised if necessary. It is our understanding that road sections are to be designed as paved with asphalt or concrete.

Each pavement alternative should be evaluated with respect to current material availability and economic conditions. The pavement sections presented herein are based on design parameters selected by Terracon based on experience with similar projects and soil conditions. Design parameters may vary and thus change the thickness of the pavement sections presented. Terracon is prepared to discuss the details of these parameters and their effects on pavement design and reevaluate pavement design as appropriate.

We have prepared recommended preliminary sections for both flexible (asphalt-concrete) and rigid (cement-concrete) pavement sections. Recommended pavement sections are as follows:

Traffic Area	Recommended Pavement Section Thickness (inches)			
	Asphalt Concrete Surface	Portland Cement Concrete	Aggregate Base Course	Total
North Access Drive	--	6	4	10
Other Paved Areas	3	--	5	8
	--	6	4[1]	6

[1] Optional

Prior to placement of the aggregate base course, the pavement subgrades should be prepared as per the recommendations in the Earthwork Section of this report. All of the paving materials and pavement construction should meet the requirements of the City of Cheyenne Construction Standards and Specifications. In addition, mix designs should be submitted prior to construction to verify their adequacy. The aggregate base course should consist of a blend of sand and gravel which meets the specifications for Grading W. The aggregate base course should be compacted to a minimum of 95% of ASTM D698.

Asphalt concrete should be composed of a mixture of aggregate, filler and additives, if required, and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Marshall properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures. Aggregate used in plant-mixed asphalt concrete should meet particular gradations. Material meeting City of Cheyenne ¾" or ½" nominal maximum size specifications is recommended for asphalt concrete. The asphalt should be supplemented with 1½% hydrated lime if the aggregate is known to have stripping issues. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material

should be placed in maximum 2-inch lifts and should be compacted to a minimum of 92% Maximum Theoretical Specific Gravity.

Where rigid pavements are used, the concrete should be obtained from an approved mix design conforming to the City of Cheyenne specifications, including the following minimum properties:

- Compressive Strength @ 28 days: 4,500 psi minimum
- Entrained Air Content: 4.5% to 7.5%

Long term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered the minimum:

- The subgrade and the pavement surface have a minimum ¼ inch per foot (2 percent) slope to promote proper surface drainage;
- Consider appropriate edge drainage and pavement underdrain systems;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements to minimize or prevent moisture migration to subgrade soils.

Preventive maintenance should be planned and completed through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventative maintenance.

Subgrades below new pavement sections should be graded to promote drainage under the pavement section as described above, and not allow for ponding of water beneath the section. If drainage is not provided and ponding occurs, the subgrade soils could become saturated, lose strength, and result in premature distress to the road/parking areas. In addition, the pavement surfacing should be graded or crowned to promote drainage and reduce the potential for ponding of water on the pavement surface.

4.10 Construction Monitoring

Any time an excavation is made below the level of existing buildings, utilities, or other structures, there is risk of damage even if a well-designed shoring system has been planned. This risk is also present during and subsequent to dewatering activities. We recommend, therefore, that a systematic program of observations be conducted on adjacent facilities and structures. The monitoring program should include measurements of the horizontal and vertical

movements of structures within a 2H radius of the shoring system, where H is the final excavation height; structures within 100 feet of dewatering points; and the shoring system itself. At least two reference lines should be established adjacent to the excavation at horizontal distances back from the excavation space of about 1/3H and H, where H is the final excavation height. Monitoring of the shoring system should include measurements of horizontal movements at the top of every other soldier pile. If local wet areas are noted within the excavation, additional monitoring points may be recommended by Terracon.

We also recommend the installation of crack monitors where cracks currently exist in structures adjacent to excavations. All monitors should be read prior to and during critical stages of construction.

The measuring system used for shoring monitoring should have an accuracy of at least 0.01 feet. All reference points on the existing structures should be installed and readings taken prior to commencing the excavation, as well as during critical stages of construction. The frequency of readings will depend on the results of previous readings and the rate of construction. As a minimum, readings should be taken about once per week throughout construction until the permanent soil-retaining walls are completed. All readings should be reviewed by Terracon.

In order to establish the condition of existing facilities prior to construction, we recommend that a complete inspection and evaluation of pavements, structures, utilities, and other facilities near the project improvement areas be made. This inspection should be directed toward detecting any existing signs of damage, particularly those caused by settlement or lateral movement. The observations should be documented by pictures, notes, survey drawings, or other means of verification. The contractors should also establish the existing conditions prior to construction for their own records.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

Exhibit A-1

Field Exploration

The scope of services performed for this project included site reconnaissance by a senior geotechnical engineer, subsurface exploration program and laboratory testing.

Sixteen test borings were performed between May 12 and May 17, 2014, 11 test pits were excavated near existing stone foundations within the Capitol Building on May 13 and 14, 2014, Siesmic refraction surveys were conducted aound the Capitol and Hershcler buildings on May 21 to 23, 2014 and ground penetrating radar surveys were conducted within the Capitol building on May 5, 2014.

The borings were advanced to approximate depths of 15 to 41 feet at the approximate locations shown on the Boring Location Diagrams. The borings were advanced with a truck-mounted drilling rig, utilizing 3.25-inch and 4.25-inch-diameter, hollow-stem augers.

The borings were located in the field by Terracon. Approximate ground surface elevations at the boring locations were obtained by BenchMark Engineers. The accuracy of boring locations and elevations should only be assumed to the level implied by the methods used to determine each.

A lithologic log of each boring was recorded by the geotechnical engineer during the drilling operation. The logs of borings are presented in Appendix A. Relatively undisturbed samples were obtained at selected intervals utilizing a standard split-spoon and ring barrel samplers. Penetration resistance values were recorded in general accordance with the standard penetration test (SPT) or similar manner with the ring barrel. This test consists of driving the sampler into the ground with a 140-pound hammer free-falling through a distance of 30 inches. The number of blows required to advance the sampler the final 12 inches, or the interval indicated on the boring log, is recorded as the penetration resistance value which is recorded or correlated to a standard penetration resistance value (N-value). The blow count values are indicated on the boring logs at the respective sample depths. Ring barrel sample blow counts are not considered N-values.

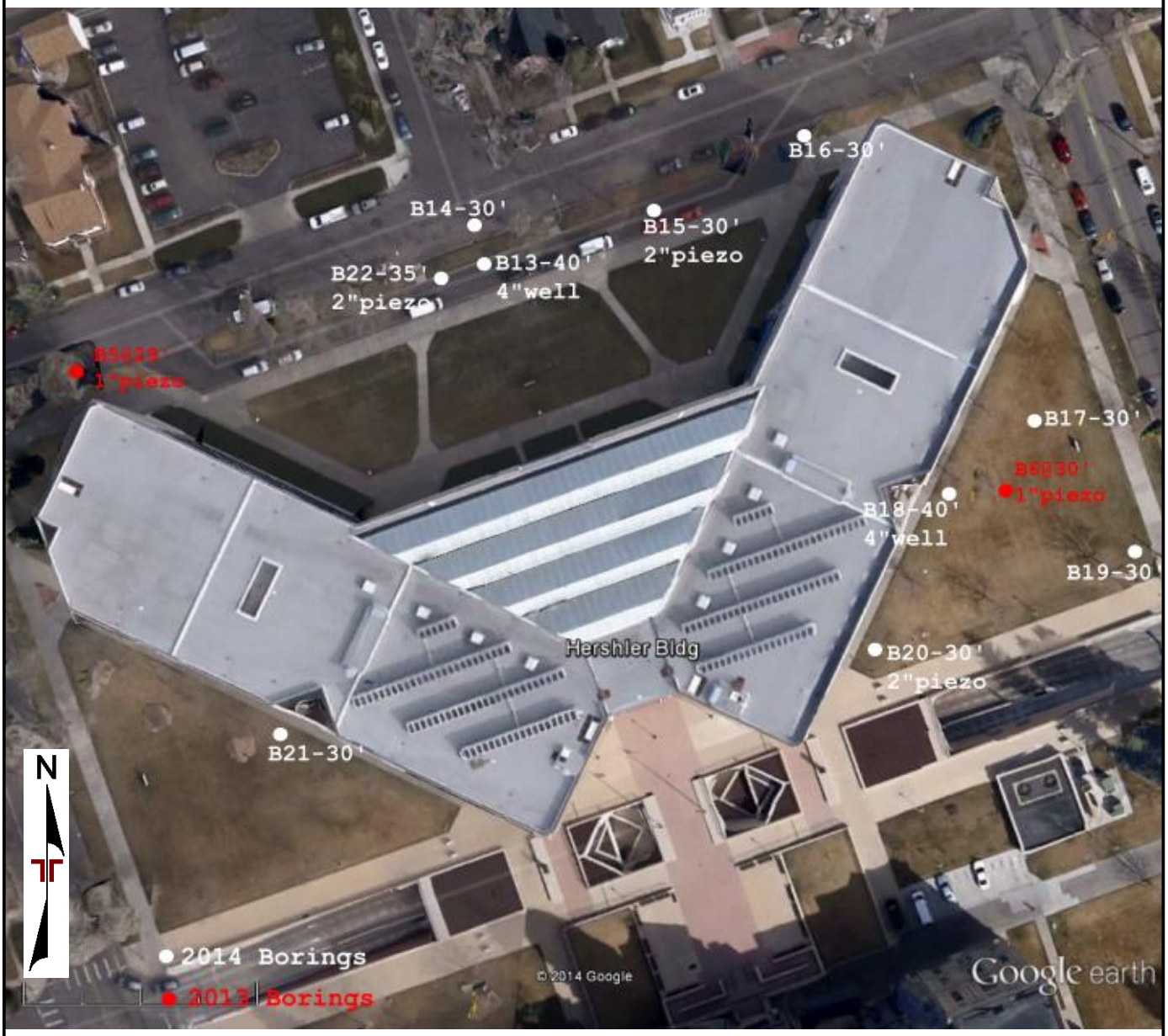
The penetration test provides a reasonable indication of the in-place density of sandy type materials, but only provides an indication of the relative stiffness of cohesive materials since the blow count in these soils may be affected by the soils' moisture content. In addition, considerable care should be exercised in interpreting the blow counts in gravelly soils, particularly where the size of the gravel particle exceeds the inside diameter of the sampler.

Hand excavated test pits were performed at 8 locations inside the Capitol and four backhoe excavated test pits were conducted around the exterior of the Capitol. Locations of the test pits are indicated on the Test Pit Location Plan in Appendix A. The purpose of the test pits was to expose the existing stone foundations for observations and documentation by the structural team.

Refraction Microtremor (ReMi) geophysical refraction testing was performed to assist in characterizing deeper soil layers as the basis for calculating settlement and further defining the seismic site classification. The ReMi analysis measured both the compressional (P-wave) and shear (S-wave) velocities of the subsurface materials as a function of depth. The S-wave velocity and calculated shear modulus curves are presented in Appendix C.

Ground penetrating radar surveys were conducted in the interior and around the exterior of the Capitol building in order to locate the lateral extent of the existing footings. Due to the size of the footings and limits of the radar instrument equipment, the surveys could not definativley define the extent of the foundations. For this reason, data from the GPR surveys is not presented in this report.

Project Manager: BW	Project No. 24149127	Terracon 1505 Old Happy Jack Road Cheyenne, WY	BORING LOCATION DIAGRAM	Exhibit
Drawn by: TO	Scale: AS SHOWN		Capitol and Hershler Building Improvements 24th Street Cheyenne, WY	A-2
Checked by: BW	File Name: 24149127 BLD			
Approved by: BW	Date: 8/21/14			



Project Manager: BW	Project No. 24149127	Terracon 1505 Old Happy Jack Road Cheyenne, WY	BORING LOCATION DIAGRAM	Exhibit
Drawn by: TO	Scale: AS SHOWN		Capitol and Hershler Building Improvements 24th Street Cheyenne, WY	A-3
Checked by: BW	File Name: 24149127 BLD			
Approved by: BW	Date: 8/21/14			

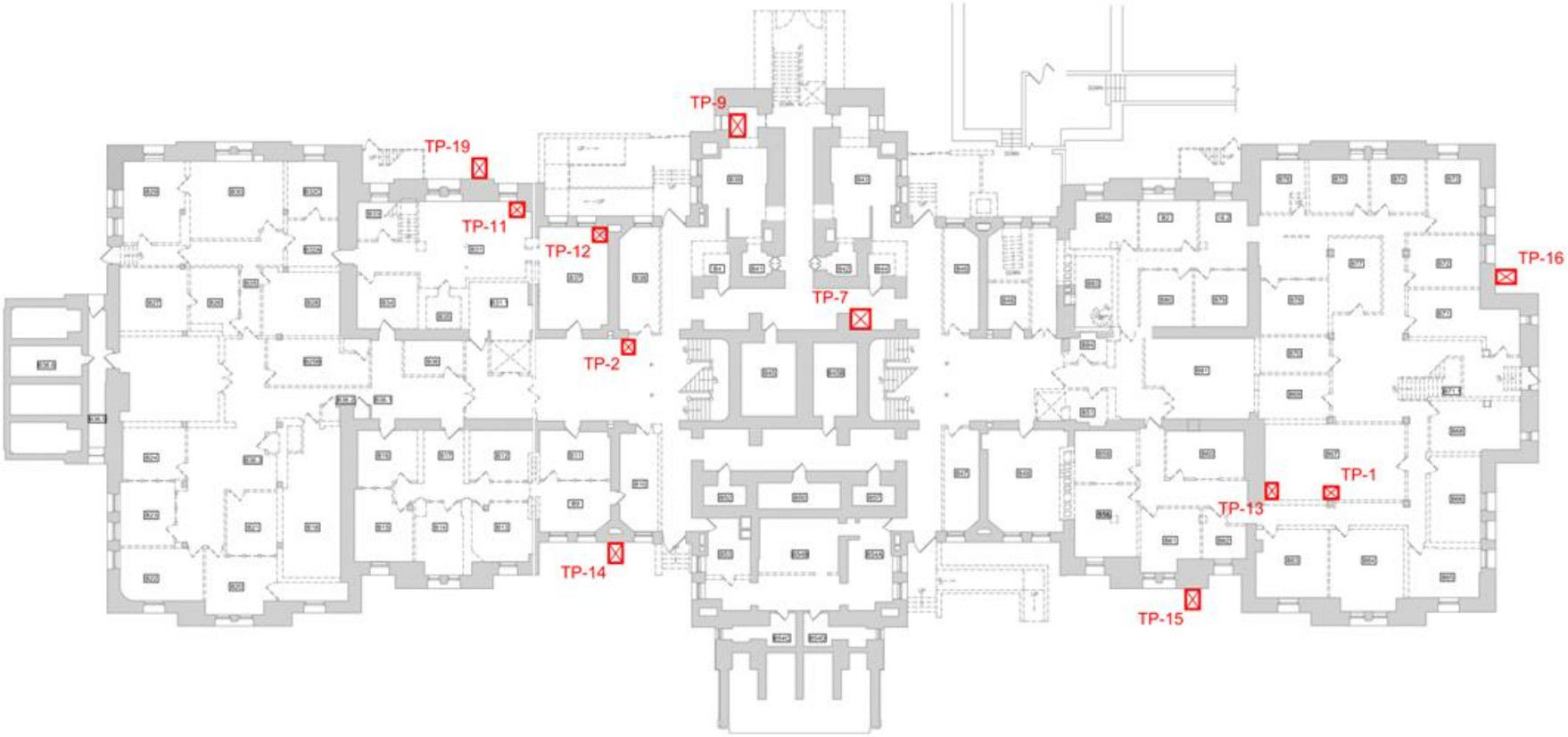


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	BW
Drawn by:	TO
Checked by:	BW
Approved by:	BW

Project No.	24149127
Scale:	AS SHOWN
File Name:	24149127 BLD
Date:	8/21/14

Terracon

1505 Old Happy Jack Road

Cheyenne, WY

Test Pit Location Plan

Capitol and Hershler Building Improvements

24th Street

Cheyenne, WY

Exhibit

A-4

BORING LOG NO. 7

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7 **VEGETATIVE LAYER**										
POORLY GRADED SAND WITH GRAVEL (SP), light brown, medium dense to very dense					16	5-4-5 N=9	12			
		5			17	14-24-29 N=53	3			
7.0 **LEAN CLAY WITH SAND (CL)**, occasional gravel, brown to olive brown, stiff, decrease in sand with depth										
		10			16	5-5-5 N=10	25			
			▽							
15.5		15			17	4-5-6 N=11	41			
Boring Terminated at 15.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater observed at 14' ATD*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/16/2014
Boring Completed: 5/16/2014
Drill Rig: CME-75
Driller: D.E.
Project No.: 24149127
Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 8

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**CONCRETE**						6			
1.5	**AGGREGATE BASE**, gravel base				7	2-2-3 N=5	15			
	SANDY LEAN CLAY (CL), brown, medium stiff									
5.3	**POORLY GRADED SAND (SP)**, light brown, medium dense, medium to coarse sand	5			13	1-4-16 N=20	15			
10.0	**CLAYEY SAND (SC)**, light brown, very dense to medium dense, fine sand	10			12	3-28-37 N=65	26			
		15	▽		18	4-6-8 N=14	24			
19.0	**SILTY SAND (SM)**, light brown, very dense, fine sand, weakly cemented, increasing cementation with depth	20			18	24-39-40 N=79	19			
		25			2	50/2" N=50/2"	6			
27.5	**LEAN CLAY WITH SAND (CL)**, light brown, very stiff, fine sand									
31.0		30			18	6-11-14 N=25	21			
	Boring Terminated at 31 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
2" Piezometer

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

▽ *Groundwater observed at 15.90' (6/12/14)*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/13/2014 | Boring Completed: 5/13/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 9

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**VEGETATIVE**									
	CLAYEY SAND (SC), brown, loose				14	4-3-2 N=5	13			
4.5	**POORLY GRADED SAND WITH GRAVEL (SP)**, light brown, medium dense to dense	5			16	6-12-12 N=24	9			
		10			17	21-21-15 N=36	3			
12.5	**CLAYEY SAND (SC)**, light brown, medium dense									
15.5		15			17	5-8-9 N=17	31			
	Boring Terminated at 15.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/16/2014 | Boring Completed: 5/16/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 10

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**VEGETATIVE**									
	SANDY LEAN CLAY (CL), with gravel, dark brown, medium stiff				14	5-4-2 N=6	15			
4.5	**POORLY GRADED SAND WITH GRAVEL (SP)**, light brown, dense to very dense, coarse sand	5			17	8-12-19 N=31	22			
		10			17	24-27-41 N=68	3			
12.5	**CLAYEY SAND (SC)**, light brown, medium dense, fine sand									
15.5		15			14	3-5-6 N=11	9			
	Boring Terminated at 15.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/17/2014
Boring Completed: 5/17/2014
Drill Rig: CME-75
Driller: D.E.
Project No.: 24149127
Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 11

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**VEGETATIVE**									
	CLAYEY SAND (SC), dark brown, loose, coarse grained				17	1-2-3 N=5	16			
4.2										
	POORLY GRADED SAND WITH GRAVEL (SP), light brown, loose to dense, medium grained sand	5			8	2-2-4 N=6	2			
		10			17	19-29-16 N=45	4			
12.0										
	CLAYEY SAND (SC), light brown to dark brown, very dense, fine sand, weakly cemented									
15.0		15			12	10-26-30 N=56	17			
	Boring Terminated at 15 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/17/2014 | Boring Completed: 5/17/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 12

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.5 **VEGETATIVE**									
	CLAYEY SAND (SC), dark brown, loose, fine sand				12	9-4-3 N=7	13			
	4.2									
	POORLY GRADED SAND WITH GRAVEL (SP), light brown, medium dense, fine gravel, coarse sand grading to fine sand below 9'2"	5			16	9-15-14 N=29	3			
		10			17	10-8-13 N=21	12			
	14.0									
	15.5 **LEAN CLAY (CL)**, brown, very stiff	15			17	9-9-10 N=19	21			
	Boring Terminated at 15.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/16/2014 | Boring Completed: 5/16/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 13

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**ASPHALT**									
	SANDY LEAN CLAY WITH GRAVEL (CL), brown, medium stiff to stiff									
		5			6	5-6	9			
8.0	**SANDY FAT CLAY (CH)**, brown, medium stiff									
		10			12	2-3-4 N=7	34		54-20-34	70
13.0	**SANDY LEAN CLAY (CL)**, brown, stiff to very stiff									
	cemented lense from 15'-15.5'	15			6	4-10	24	100		
		20			18	4-6-11 N=17	31			
		25			14	5-7-12 N=19	20			
		30			18	6-10-14 N=24	35			
		35			12	5-10-14 N=24	19			
40.5		40			12	5-8-10 N=18	21			
	Boring Terminated at 40.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
4" Well

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *Groundwater observed at 12.5' ATD*
- *Groundwater observed at 11.58' (5/19/14)*
- *Groundwater observed at 11.75' (6/12/14)*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/12/2014 | Boring Completed: 5/12/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-11

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 14

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**									
0.7	**FILL**, gravel base									
	POORLY GRADED SAND WITH GRAVEL (SP), light brown, loose to medium dense				14	5-5-5 N=10	11			
5.0	**CLAYEY SAND (SC)**, light brown, loose to dense, fine sand	5			16	9-5-4 N=9	7			
		10			2	3-3-5 N=8	14			
		15			18	15-16-25 N=41	19			
	weakly cemented layer at approximately 19'	20			18	9-12-13 N=25	23			
		25			18	9-13-14 N=27	18			
30.0		30	▽		18	9-15-16 N=31	20			
	Boring Terminated at 30 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater observed at 28.5' ATD*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/14/2014	Boring Completed: 5/14/2014
Drill Rig: CME-75	Driller: D.E.
Project No.: 24149127	Exhibit: A-12

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 15

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT**									
1.2	**FILL**, gravel base									
	LEAN CLAY WITH GRAVEL (CL), brown, soft to stiff				18	5-3-3 N=6	5			
		5			14	1-1-1 N=2	20			
7.5	**CLAYEY SAND (SC)**, light brown, loose to medium dense									
		10			18	2-3-2 N=5	15			
		15			14	2-4-11 N=15	23			
		20			12	9-15	22	98	36-14-22	39
		25			12	12-20	21	101		
31.0		30			18	7-11-14 N=25	20			
	Boring Terminated at 31 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
2" Piezometer

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD
Groundwater observed at 13.60' (5/19/14)
Groundwater observed at 13.76' (6/12/14)

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/13/2014
Boring Completed: 5/13/2014
Drill Rig: CME-75
Driller: D.E.
Project No.: 24149127
Exhibit: A-13

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 16

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**ASPHALT**									
0.7	**FILL**, gravel base									
1.7	**LEAN CLAY WITH GRAVEL (CL)**, light brown to brown, very stiff, medium to coarse sand				18	2-5-18 N=23	21			
	POORLY GRADED SAND (SP), light brown to brown, dense, medium to coarse sand	5			14	19-26-20 N=46	6			
6.5	**SANDY LEAN CLAY (CL)**, light brown, very stiff to hard, fine sand									
	weakly cemented lense at 9'	10			8	20-50/2" N=50/2"	23			
		15	▽		18	8-9-11 N=20	23			
		20			18	8-10-14 N=24	19			
		25			18	9-12-15 N=27	19			
30.0		30			14	9-16-17 N=33	19			
	Boring Terminated at 30 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater observed at 14.3' ATD*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/14/2014	Boring Completed: 5/14/2014
Drill Rig: CME-75	Driller: D.E.
Project No.: 24149127	Exhibit: A-14

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 17

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**VEGETATIVE**								
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP), light brown, medium dense, lean clay lense at 1' to 1.5'			16	4-7-5 N=12	12			
		5		12	4-4-5 N=9	5			8
7.5	**SANDY LEAN CLAY (CL)**, brown, stiff, fine sand								
		10		18	3-5-7 N=12	20			
15.0	**CLAYEY SAND (SC)**, brown, medium dense to dense weakly cemented at 16'	15		18	32-32-18 N=50	23			
	weakly cemented at 19.5'	20		0.08	50	9			
		25		12	7-16	21 21	105	36-16-20	44
31.0		30		18	7-12-12 N=24	20			
	Boring Terminated at 31 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/15/2014
Boring Completed: 5/15/2014
Drill Rig: CME-75
Driller: D.E.
Project No.: 24149127
Exhibit: A-15

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 18

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.0	**VEGETATIVE**									
	SANDY LEAN CLAY (CL), gray to brown, stiff				15	3-3-6 N=9	1			
		5			16	4-4-4 N=8	18			
9.0	**CLAYEY SAND (SC)**, trace fine gravel, brown, very loose to loose	10			15	2-1-2 N=3	10		32-15-17	27
15.2	**CLAYEY SAND (SC)**, brown, medium dense to dense, fine sand, some cemented lenses	15			18	3-6-8 N=14	33			
		20			8	26-38	13 10	106		
22.5	**SANDY LEAN CLAY (CL)**, brown, very stiff, fine sand	25			18	4-8-11 N=19	36			
30.0	**CLAYEY SAND (SC)**, brown, medium dense to dense, fine sand, thin cemented lenses throughout gravel lense at 32'	30			6	45-50/1" N=50/1"	20			
		35			12	12-30	22	97	36-17-19	41
41.0		40			18	6-11-15 N=26	24			
	Boring Terminated at 41 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.
No groundwater observed on 6/12/14

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
4" Well

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *Groundwater observed at 37.5' ATD*
- *Groundwater observed at 19.80' (5/20/14)*
- *Groundwater observed at 16.70' (6/25/14)*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/15/2014 | Boring Completed: 5/15/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-16

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 19

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**VEGETATIVE**						
	POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC), light brown, loose to dense, medium to coarse sand	16	2-2-2 N=4	15			
		15	5-21-22 N=43	7			8
6.0	**CLAYEY SAND (SC)**, light brown to dark brown, loose, fine sand						
		13	9-4-5 N=9	11			
10.0	**SANDY LEAN CLAY (CL)**, light brown to brown, very stiff						
		18	9-8-20 N=28	46		45-14-31	63
15.0	**CLAYEY SAND (SC)**, light brown, medium dense to very dense						
		12	10-19	20	105	35-16-19	46
	weakly cemented below 23'	16	35-38-50 N=88	15			
29.0		1	50	29			
	Boring Terminated at 29 Feet						

DEPTH (Ft.): 5, 10, 15, 20, 25

WATER LEVEL OBSERVATIONS: ▽

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater observed at 23' ATD*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/14/2014 | Boring Completed: 5/14/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-17

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 20

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.0	**VEGETATIVE**									
	CLAYEY SAND (SC), with gravel, brown to gray, loose, less sand and gravel below 12'				14	2-3-5 N=8	20			
		5			17	3-3-6 N=9	14		34-17-17	27
		10			16	7-4-3 N=7	21		23-13-10	27
		15			17	3-4-5 N=9	33			
17.5	**CLAYEY SAND (SC)**, brown, medium dense to dense, cemented lenses below 20'									
		20			8	20-50	10	108		
							16			
		25			8	29-19	25	103	40-18-22	48
31.0		30			18	5-6-11 N=17	21			
	Boring Terminated at 31 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.
No groundwater observed on 6/12/14

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
2" Piezometer

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD
Groundwater observed at 20.77' (5/20/14)
Groundwater observed at 21.49' (6/25/14)

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/14/2014 | Boring Completed: 5/14/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-18

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 21

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**VEGETATIVE**									
	POORLY GRADED SAND (SP), light brown to gray, loose to medium dense				17	7-7-6 N=13	9			
4.0										
5.0	**CLAYEY SAND (SC)**, light brown, loose				15	5-4-4 N=8	18			
	POORLY GRADED SAND (SP), light brown to brown, medium dense to dense, gravel at 9'-9.5', medium to coarse sand	5								
		10			13	6-12-19 N=31	2			
14.2										
	SANDY LEAN CLAY (CL), brown, very stiff, fine sand	15			17	9-10-9 N=19	6			
17.5										
	CLAYEY SAND (SC), brown, medium dense to dense, fine sand, isolated thin cemented lenses									
		20			17	8-8-10 N=18	18			
		25			17	7-12-12 N=24	20			
30.5		30			17	9-14-24 N=38	19			
	Boring Terminated at 30.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
SFA

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not observed ATD

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/16/2014 | Boring Completed: 5/16/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-19

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

BORING LOG NO. 22

PROJECT: Capitol and Herschler Building Improvements

CLIENT: State of Wyoming Depart of Admin. & Info.

SITE: 24th Street
Cheyenne, Wyoming

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5	**ASPHALT**									
	SANDY LEAN CLAY WITH GRAVEL (CL), medium brown, stiff, increase in gravel at 5'									
		5			12	3-4-5 N=9	16			
7.0	**CLAYEY SAND (SC)**, medium brown, medium dense to dense, fine sand									
		10			6	6-5	41	77		
		15			12	3-5-7 N=12	23		31-19-12	29
		20			6	18-30	23	100		
		25			18	6-9-12 N=21	23			
		30			18	6-12-17 N=29	19			
35.5		35			12	6-13-17 N=30	20			
	Boring Terminated at 35.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
2" Piezometer

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *Groundwater observed at 22.7' ATD*
- *Groundwater observed at 12.30' (5/19/14)*
- *Groundwater observed at 12.65' (6/12/14)*

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 5/12/2014 | Boring Completed: 5/12/2014
Drill Rig: CME-75 | Driller: D.E.
Project No.: 24149127 | Exhibit: A-20

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24149127 CAPITOL HERSCHLER.GPJ TEMPLATE UPDATE 3-31-14.GPJ 8/21/14

APPENDIX B

LABORATORY DATA

Exhibit B-1

Laboratory Testing

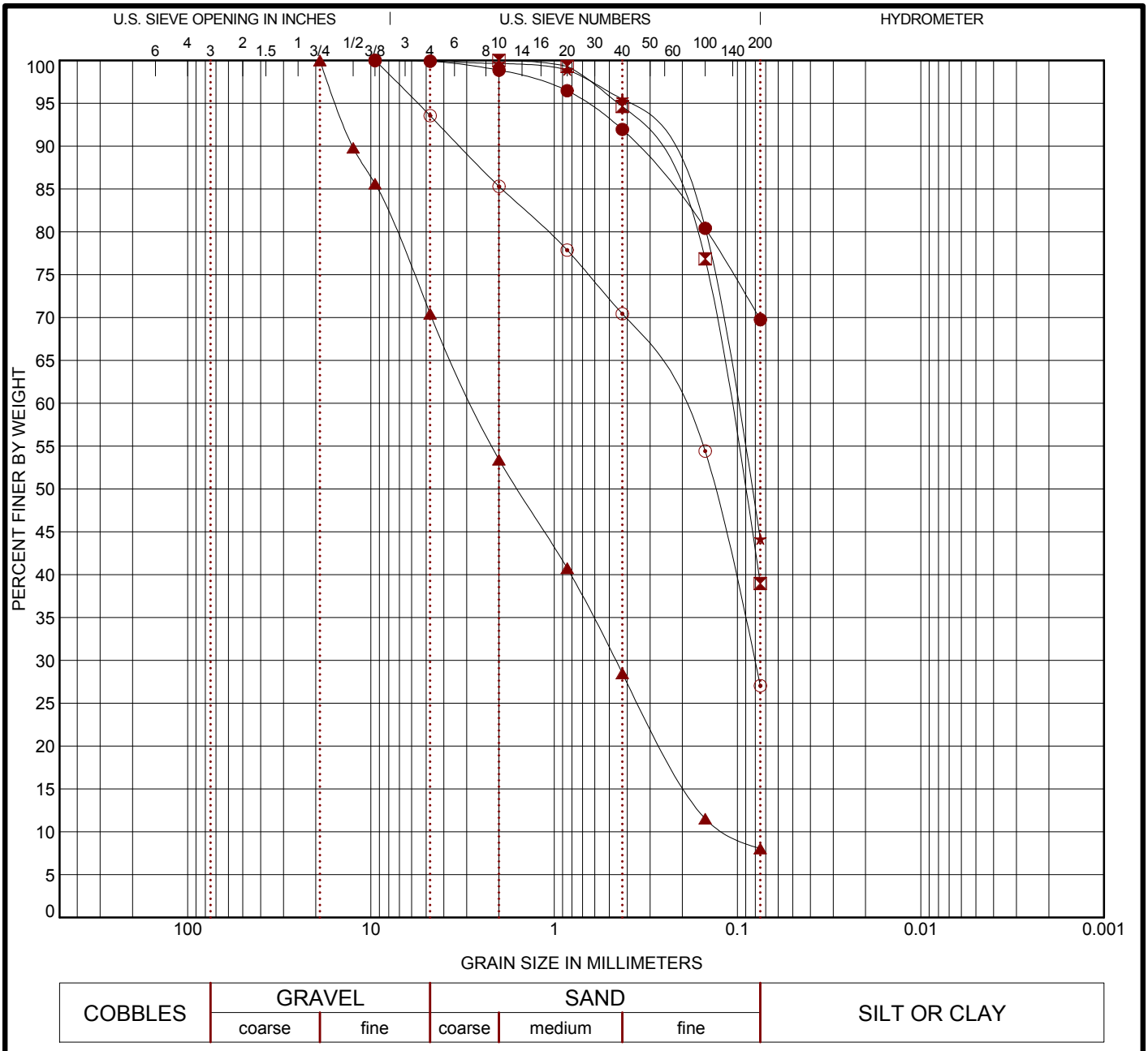
The soil samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer. At that time, the field descriptions were reviewed and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples. The results of these tests are presented in Appendix B. The test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. The laboratory tests were performed in general accordance with applicable locally accepted standards. Soil samples were classified in general accordance with the Unified Soil Classification System described in Appendix C.

- Water Content
- Grain Size Distribution
- Shear Strength
- Atterberg Limits
- Soil Unit Weight

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	13	9.0	SANDY FAT CLAY(CH)	54	20	34		
⊠	15	20.0	CLAYEY SAND(SC)	36	14	22		
▲	17	4.5	POORLY GRADED SAND with SILT and GRAVEL(SP-SM)				0.69	25.26
★	17	24.5	CLAYEY SAND(SC)	36	16	20		
⊙	18	9.5	CLAYEY SAND(SC)	32	15	17		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	13	9.0	9.5				0.1	30.2	69.8	
⊠	15	20.0	2	0.11			0.0	61.0	39.0	
▲	17	4.5	19	2.794	0.463	0.111	29.5	62.4	8.0	
★	17	24.5	4.75	0.101			0.0	55.8	44.2	
⊙	18	9.5	9.5	0.216	0.081		6.5	66.5	27.0	

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

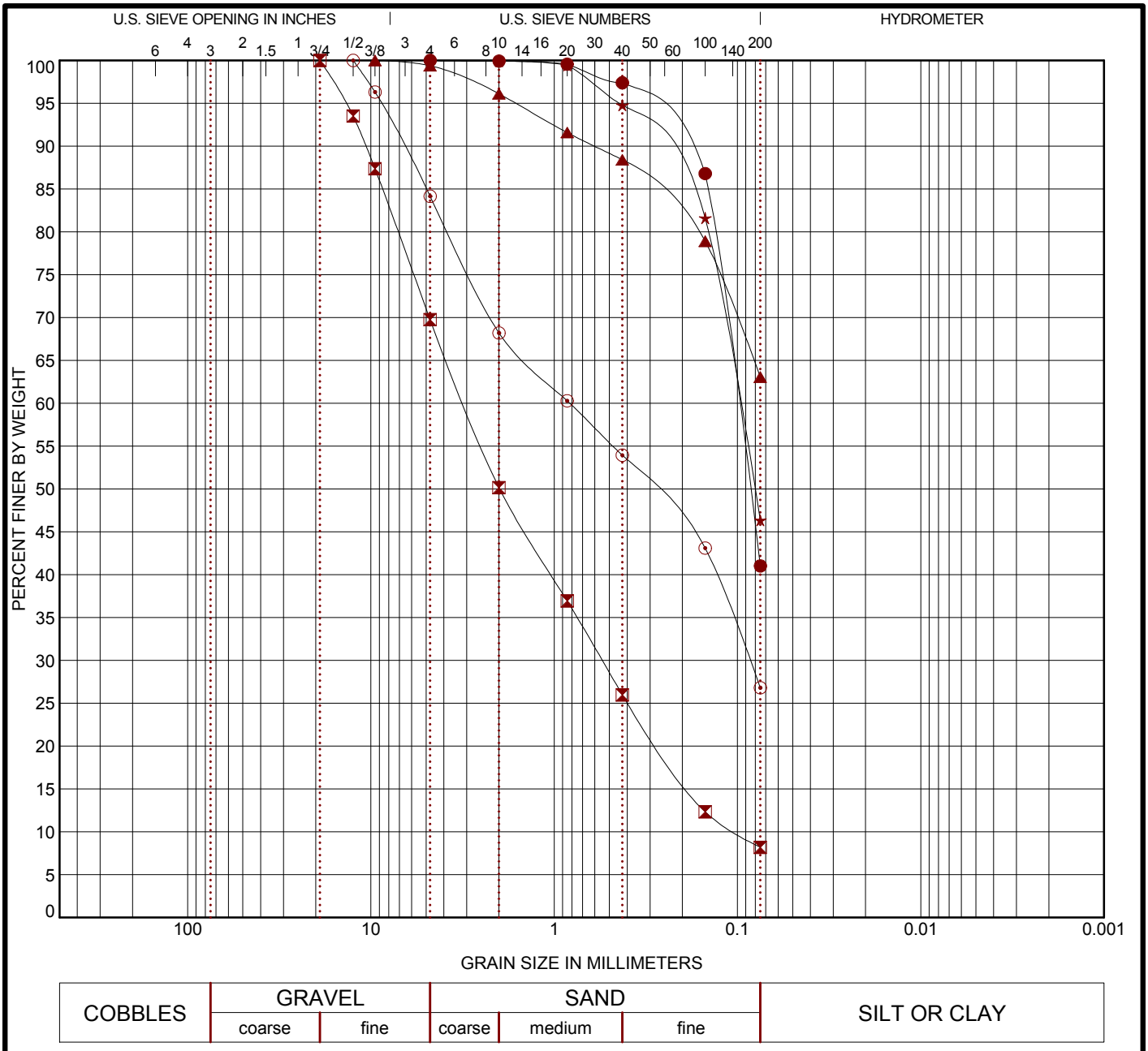
CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	18	34.5	CLAYEY SAND(SC)	36	17	19		
⊠	19	3.5	POORLY GRADED SAND with CLAY and GRAVEL(SP-SC)				0.96	30.39
▲	19	13.5	SANDY LEAN CLAY(CL)	45	14	31		
★	19	18.5	CLAYEY SAND(SC)	35	16	19		
⊙	20	4.5	CLAYEY SAND with GRAVEL(SC)	34	17	17		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	18	34.5	4.75	0.1			0.0	59.0	41.0	
⊠	19	3.5	19	3.089	0.548	0.102	30.3	61.6	8.2	
▲	19	13.5	9.5				0.6	36.3	63.1	
★	19	18.5	4.75	0.098			0.0	53.6	46.4	
⊙	20	4.5	12.5	0.824	0.086		15.8	57.4	26.8	

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

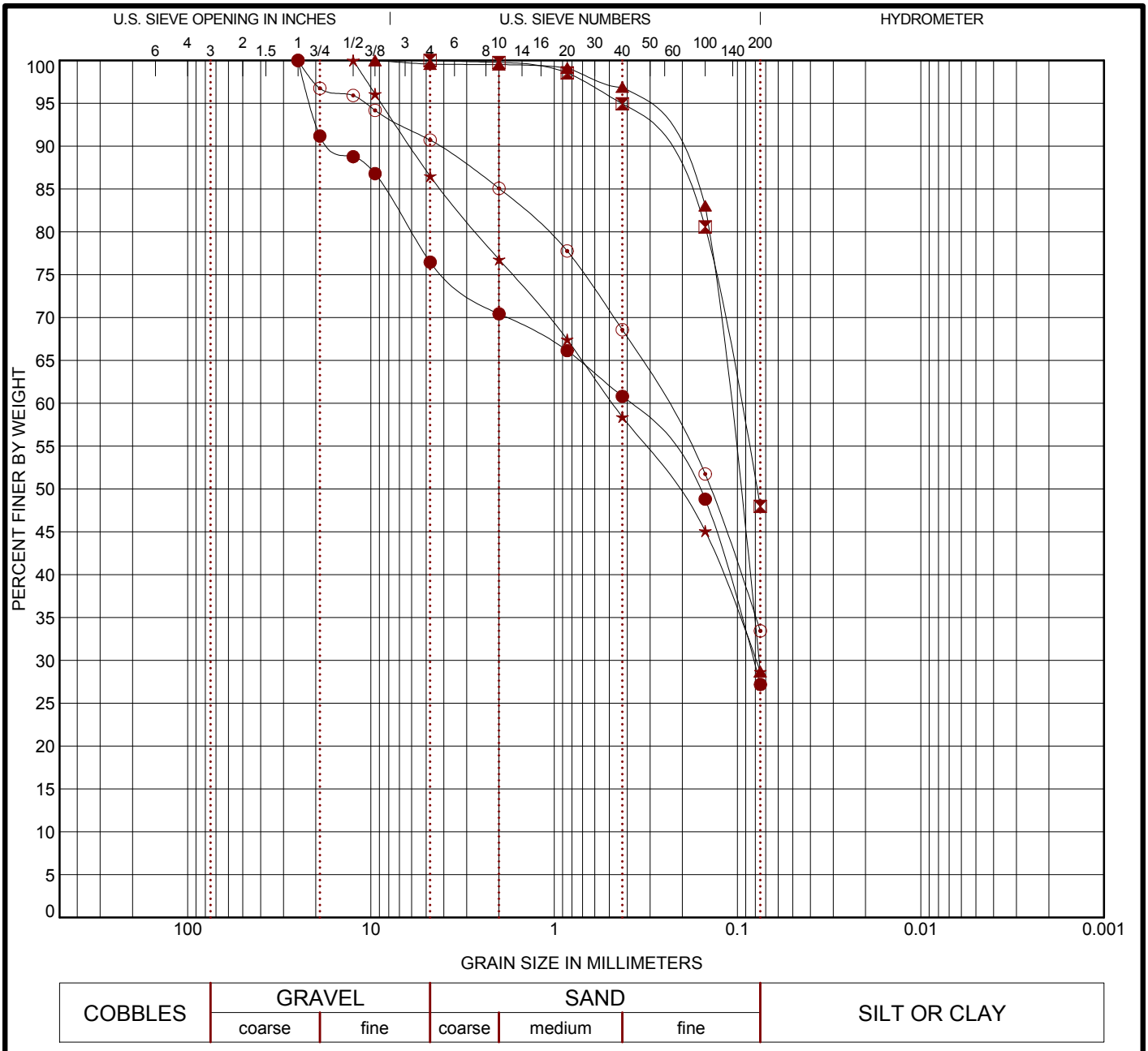
CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	20	9.5	CLAYEY SAND with GRAVEL(SC)	23	13	10		
⊠	20	24.5	CLAYEY SAND(SC)	40	18	22		
▲	22	14.0	CLAYEY SAND(SC)	31	19	12		
★	TP-15	4.0	CLAYEY SAND(SC)	31	14	17		
⊙	TP-16	4.0	SILTY, CLAYEY SAND(SC-SM)	24	18	6		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	20	9.5	25	0.396	0.082		23.5	49.3	27.2	
⊠	20	24.5	4.75	0.097			0.0	52.0	48.0	
▲	22	14.0	9.5	0.112	0.076		0.4	70.9	28.7	
★	TP-15	4.0	12.5	0.48	0.079		13.5	57.8	28.7	
⊙	TP-16	4.0	25	0.25			9.3	57.3	33.4	

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

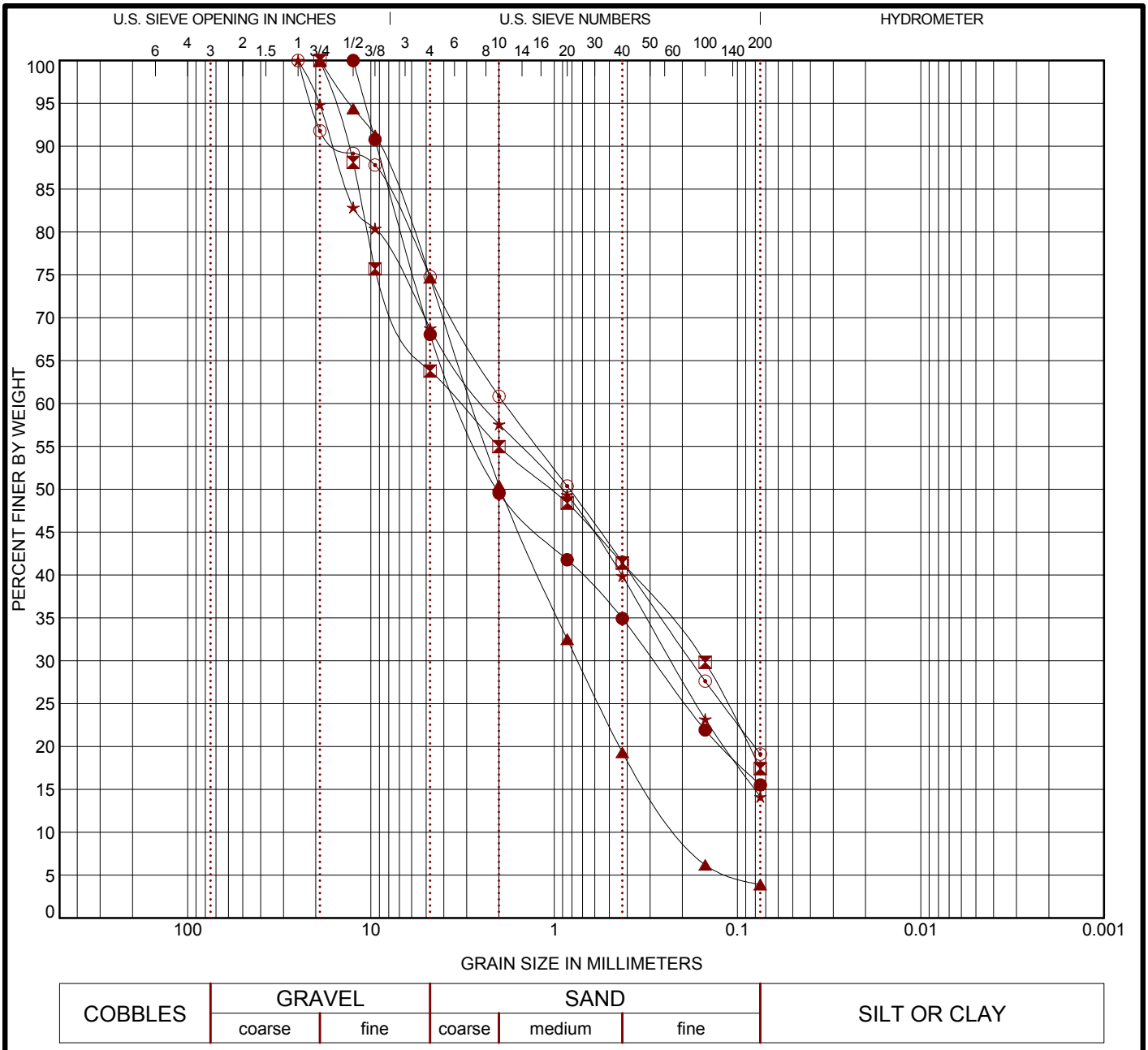
CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-4

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	TP-19	4.0	SILTY CLAYEY SAND with GRAVEL(SC-SM)					
⊠	TP-2	4.0	CLAYEY SAND with GRAVEL(SC)	32	15	17		
▲	TP-7	4.0	POORLY GRADED SAND with GRAVEL(SP)				0.97	13.86
★	TP-9	4.0	SILTY CLAYEY SAND with GRAVEL(SC-SM)					
⊙	TP-11	4.0	CLAYEY SAND with GRAVEL(SC)	32	12	20		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	TP-19	4.0	12.5	3.261	0.286		32.0	52.5	15.5	
⊠	TP-2	4.0	19	3.274	0.152		36.2	46.4	17.4	
▲	TP-7	4.0	19	2.812	0.745	0.203	25.3	70.8	3.9	
★	TP-9	4.0	25	2.412	0.229		31.2	54.6	14.1	
⊙	TP-11	4.0	25	1.868	0.179		25.2	55.7	19.1	

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

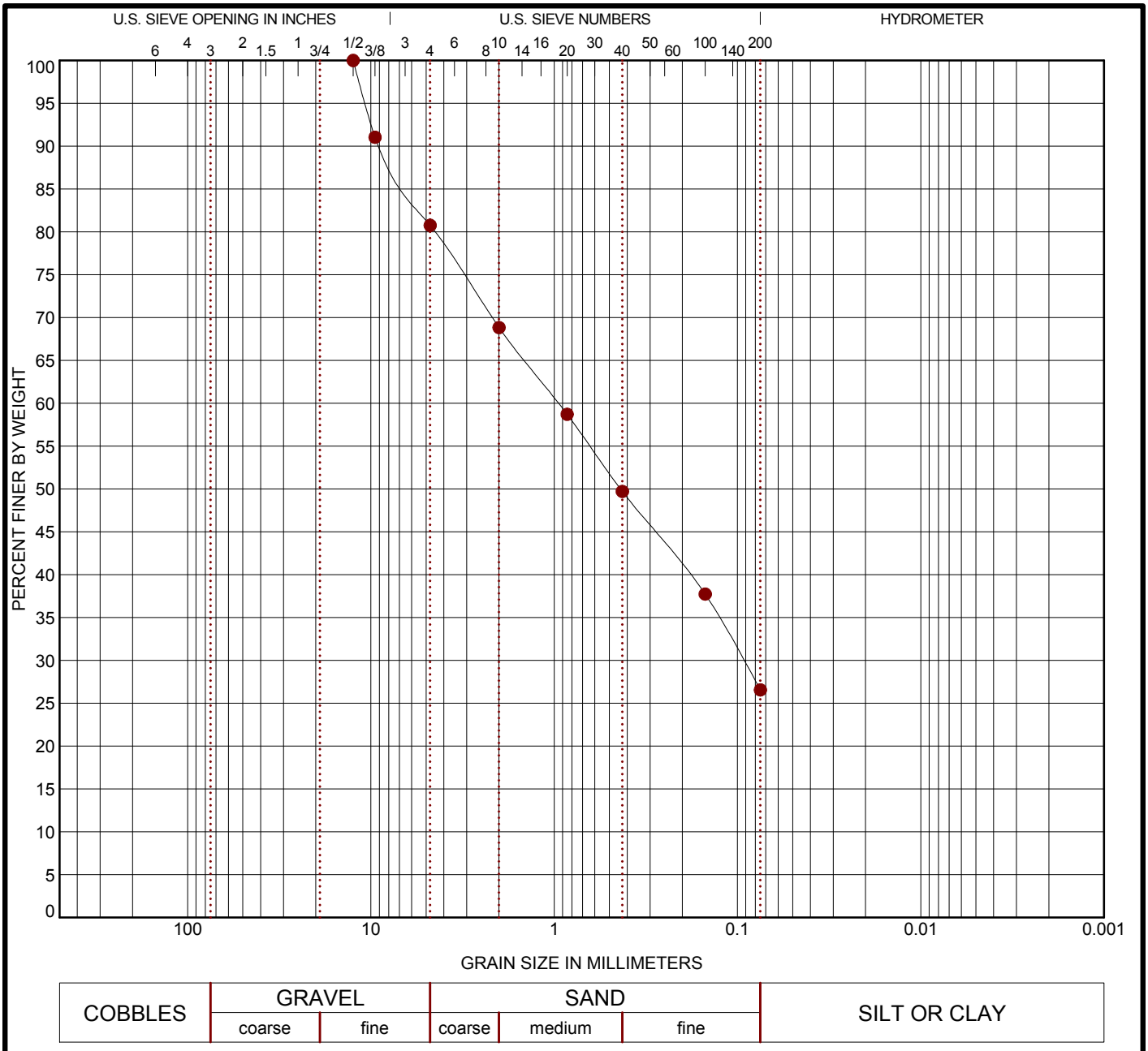
CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-5

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
● TP-13A	4.0	SILTY, CLAYEY SAND with GRAVEL(SC-SM)	21	16	5		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
● TP-13A	4.0	12.5	0.947	0.093		19.2	54.2	26.6	

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

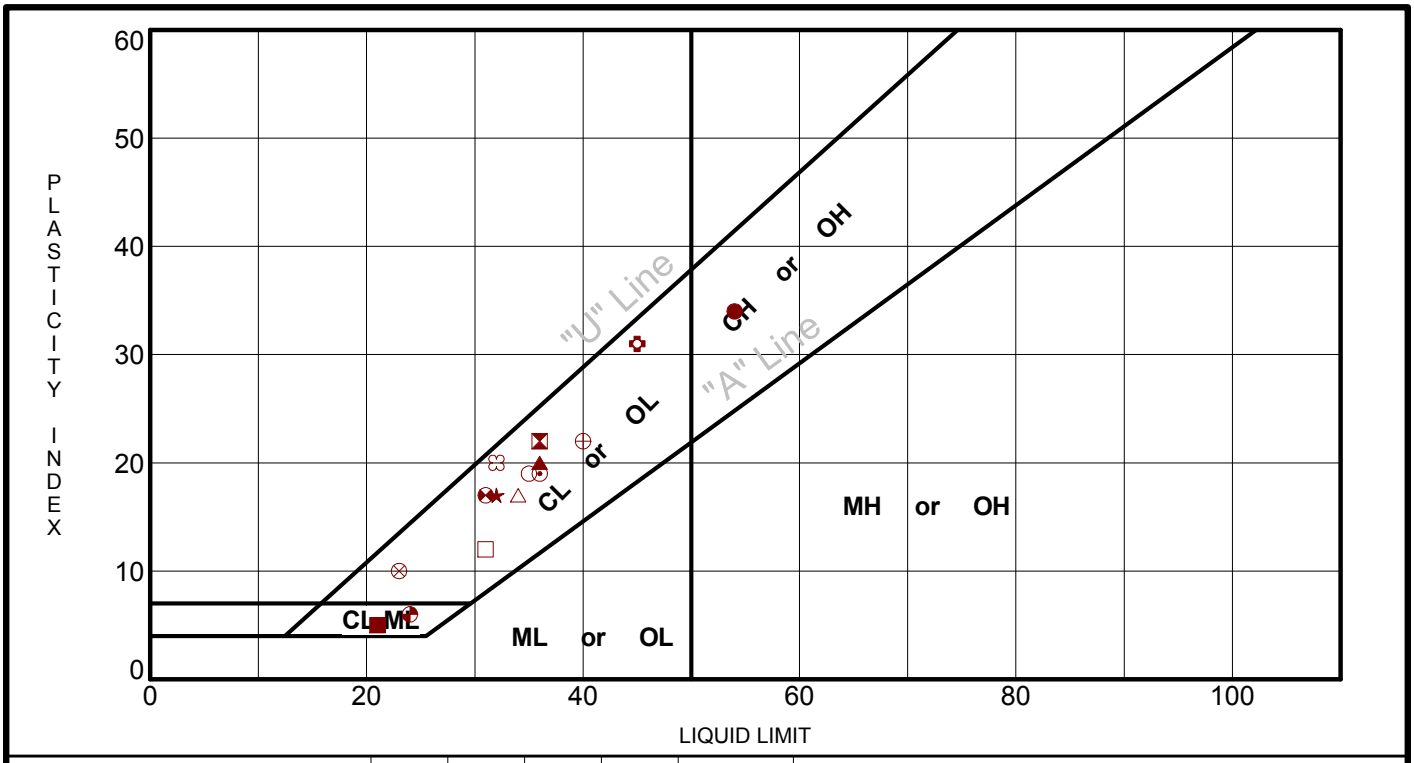
CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-6

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	13	9.0	54	20	34	70	CH	SANDY FAT CLAY
⊠	15	20.0	36	14	22	39	SC	CLAYEY SAND
▲	17	24.5	36	16	20	44	SC	CLAYEY SAND
★	18	9.5	32	15	17	27	SC	CLAYEY SAND
⊙	18	34.5	36	17	19	41	SC	CLAYEY SAND
✿	19	13.5	45	14	31	63	CL	SANDY LEAN CLAY
○	19	18.5	35	16	19	46	SC	CLAYEY SAND
△	20	4.5	34	17	17	27	SC	CLAYEY SAND with GRAVEL
⊗	20	9.5	23	13	10	27	SC	CLAYEY SAND with GRAVEL
⊕	20	24.5	40	18	22	48	SC	CLAYEY SAND
□	22	14.0	31	19	12	29	SC	CLAYEY SAND
⊗	TP-15	4.0	31	14	17	29	SC	CLAYEY SAND
◕	TP-16	4.0	24	18	6	33	SC-SM	SILTY, CLAYEY SAND
☆	TP-2	4.0	32	15	17	17	SC	CLAYEY SAND with GRAVEL(SC)
✿	TP-11	4.0	32	12	20	19	SC	CLAYEY SAND with GRAVEL
■	TP-13A	4.0	21	16	5	27	SC-SM	SILTY, CLAYEY SAND with GRAVEL

PROJECT: Capitol and Herschler Building Improvements

SITE: 24th Street
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

PROJECT NUMBER: 24149127

CLIENT: State of Wyoming Depart of Admin. & Info.

EXHIBIT: B-7

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 24149127 CAPITOL HERSCHLER.GPJ TERRACON2012.GDT 8/21/14

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/5/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-13 at 14 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	CL

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
NORMAL PRESSURE (psf)	1253	2456	3989
SHEAR STRESS (psf)	1410	2140	2931
ULTIMATE FRICTION ANGLE	28		
EFFECTIVE COHESION (psf)	735		

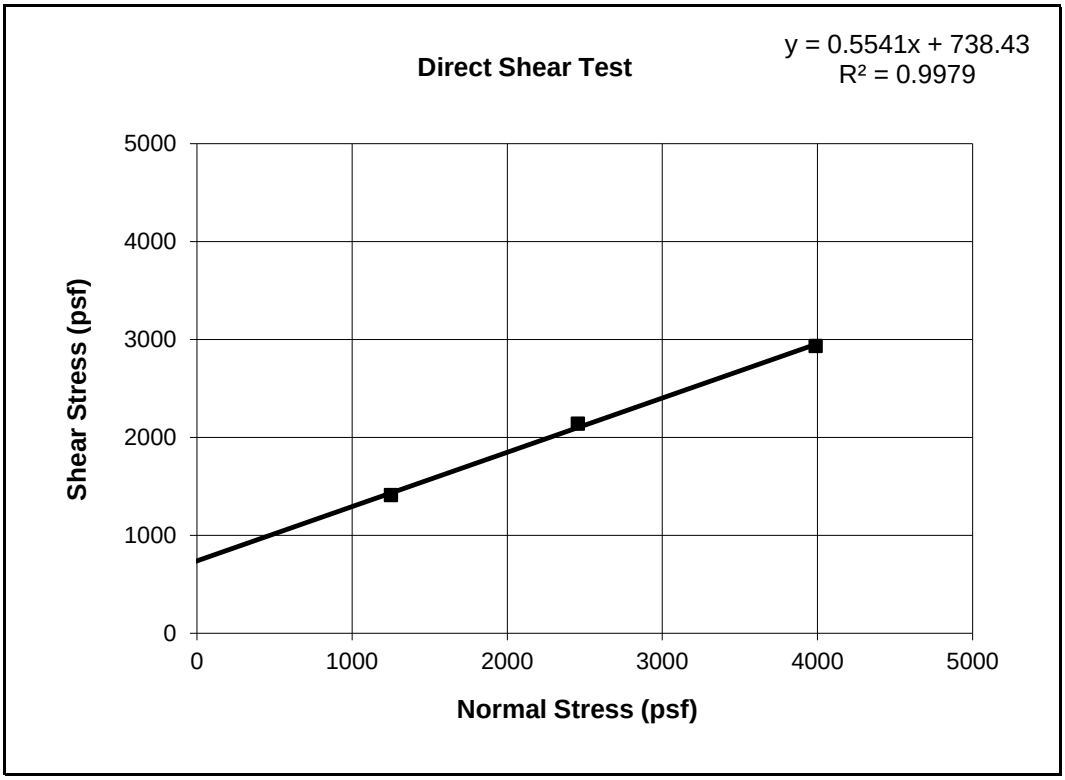


Exhibit B-8

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT: State of Wyoming
PROJECT: Capitol and Herschler Improvements
LOCATION: Boring B-13 at 14 feet
TERRACON NO. 24149127
DATE OF TEST: 6/5/14
CLASSIFICATION: CL

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	99.8	99.8	99.8
INITIAL WATER CONTENT (%)	23.3	23.3	23.3
FINAL WATER CONTENT (%)	23.3	23.3	23.3
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density	123.1		

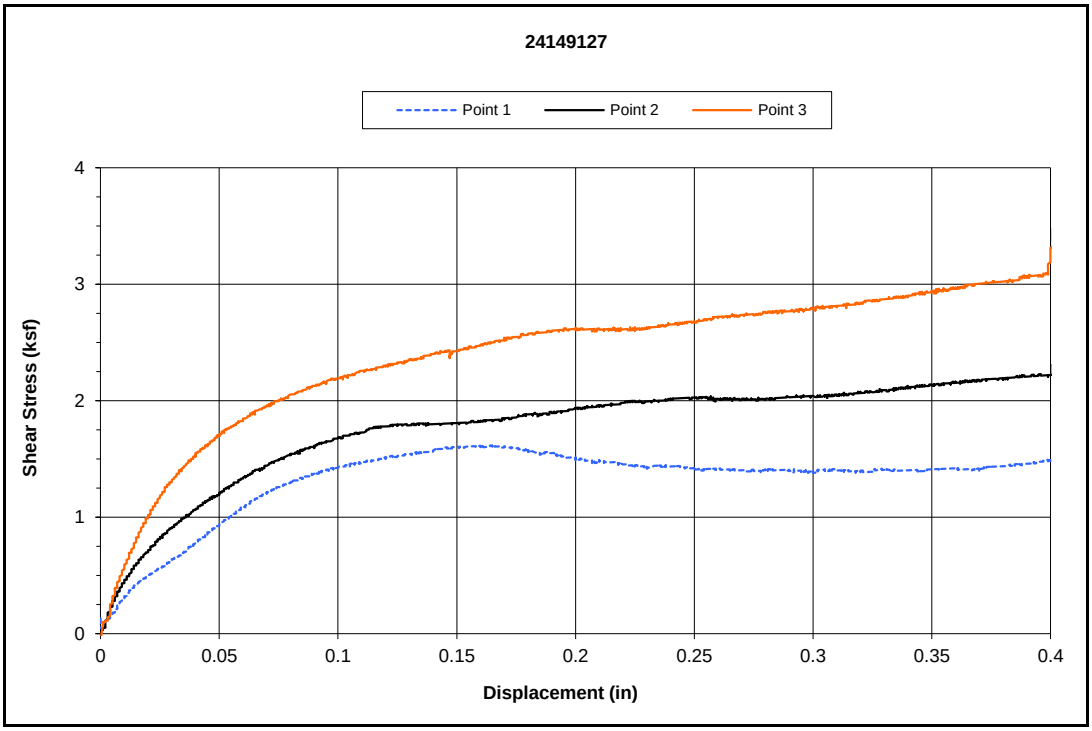


Exhibit B-8

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/16/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-17 at 25 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
NORMAL PRESSURE (psf)	2225	4122	8002
SHEAR STRESS (psf)	2225	3684	5120
ULTIMATE FRICTION ANGLE	25		
EFFECTIVE COHESION (psf)	1350		

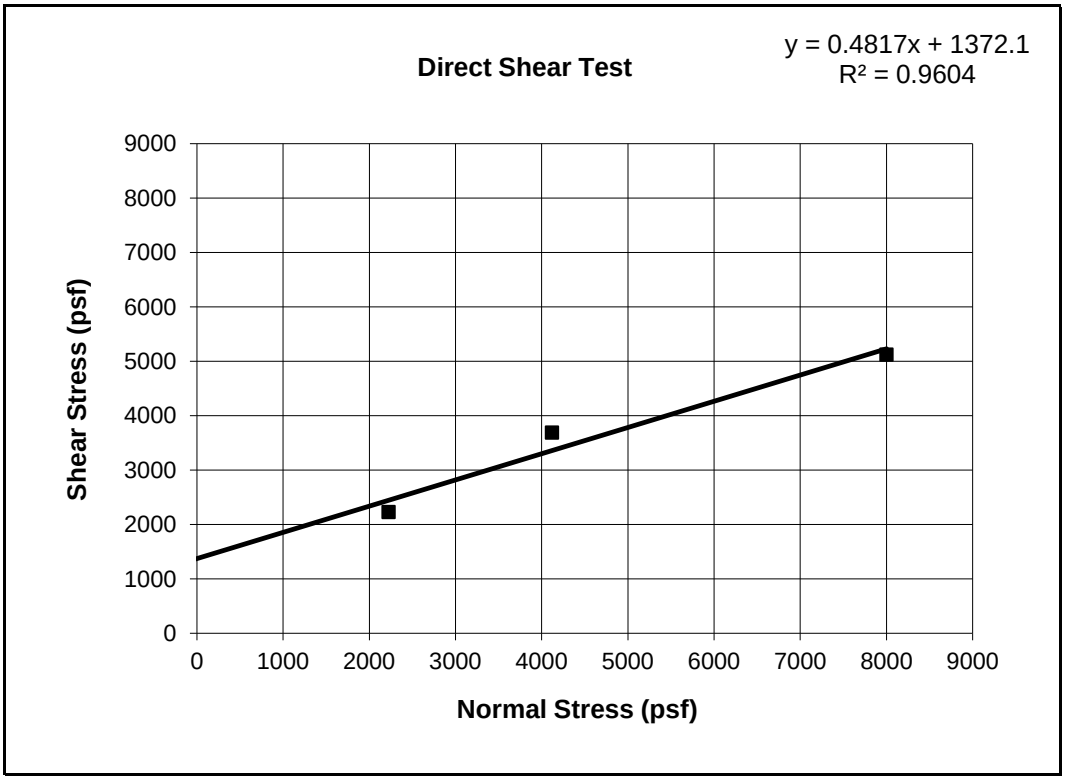


Exhibit B-9

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT: State of Wyoming
PROJECT: Capitol and Herschler Improvements
LOCATION: Boring B-17 at 25 feet
TERRACON NO. 24149127
DATE OF TEST: 6/16/14
CLASSIFICATION: SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	104.8	104.8	104.8
INITIAL WATER CONTENT (%)	21.3	21.3	21.3
FINAL WATER CONTENT (%)	21.3	21.3	21.3
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density (pcf)	127.1		

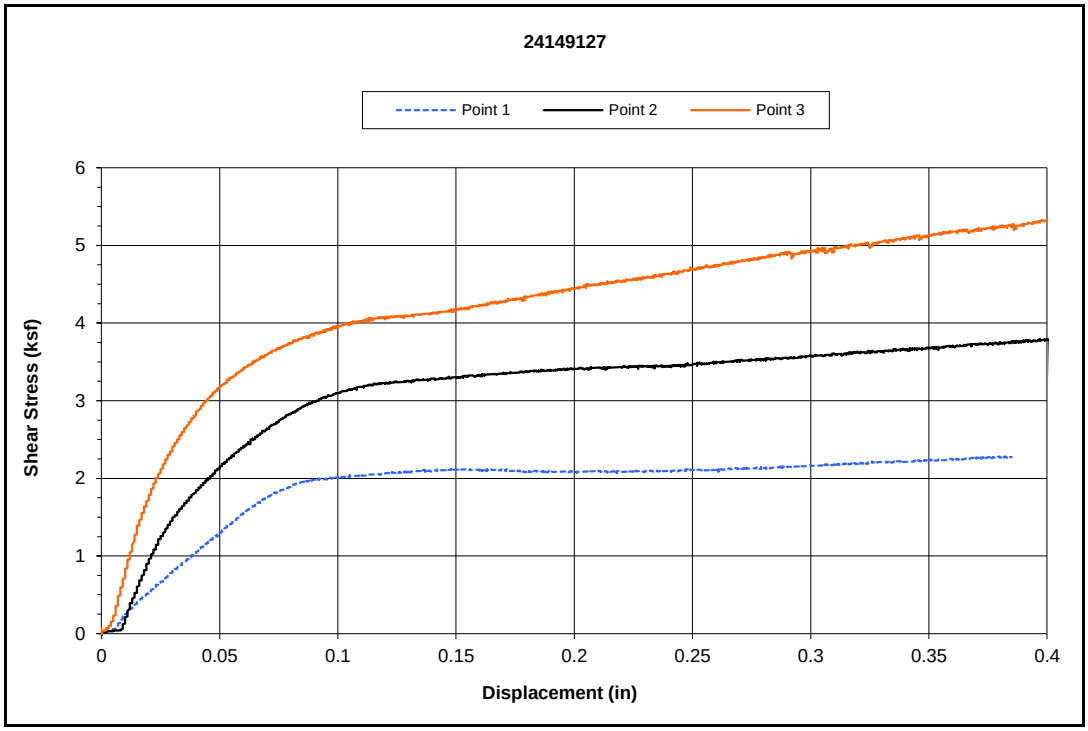


Exhibit B-9

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-18 at 20 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
NORMAL PRESSURE (psf)	1933	3551	7539
SHEAR STRESS (psf)	1933	3540	5434
ULTIMATE FRICTION ANGLE	30		
EFFECTIVE COHESION (psf)	1000		

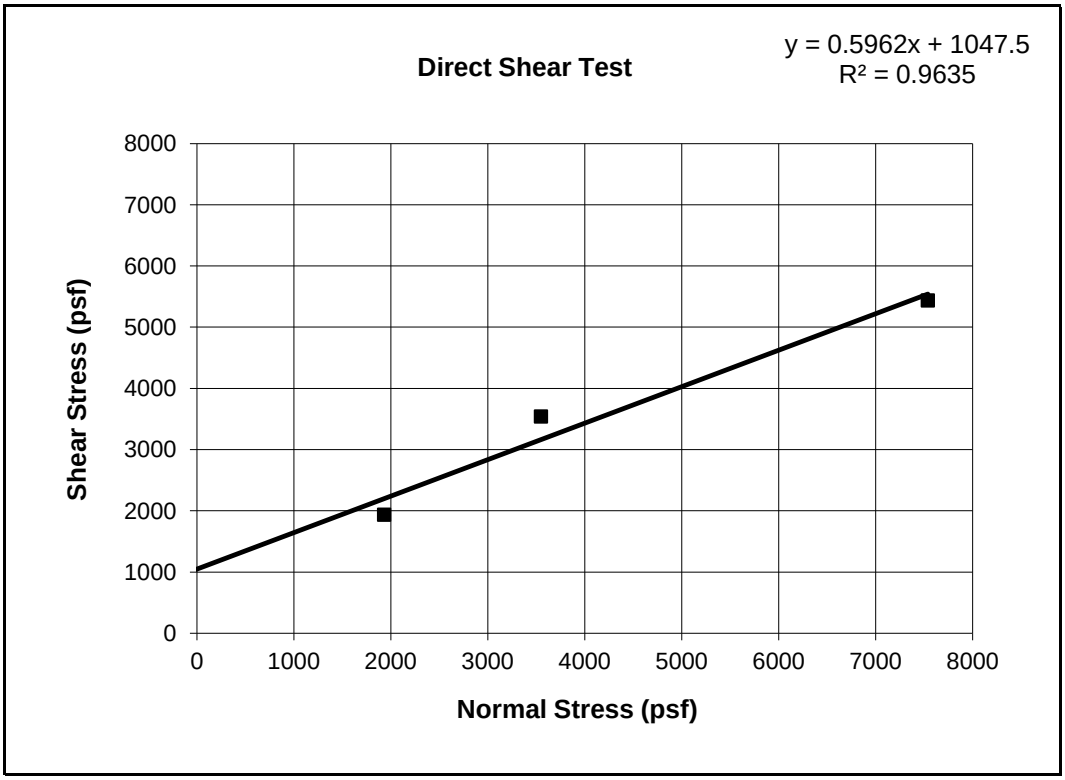


Exhibit B-10

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-18 at 20 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	105.9	105.9	105.9
INITIAL WATER CONTENT (%)	9.2	9.2	9.2
FINAL WATER CONTENT (%)	9.2	9.2	9.2
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density	115.6		

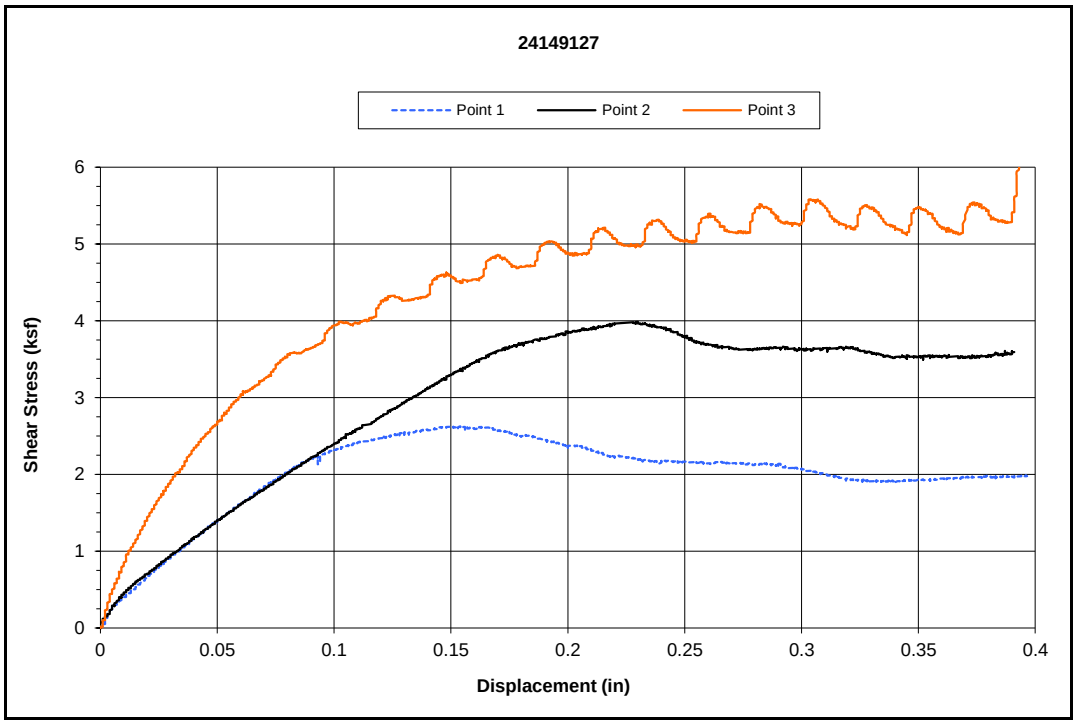


Exhibit B-10

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-19 at 19 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
NORMAL PRESSURE (psf)	1848	3393	6883
SHEAR STRESS (psf)	1909	2615	4050
ULTIMATE FRICTION ANGLE	22		
EFFECTIVE COHESION (psf)	1100		

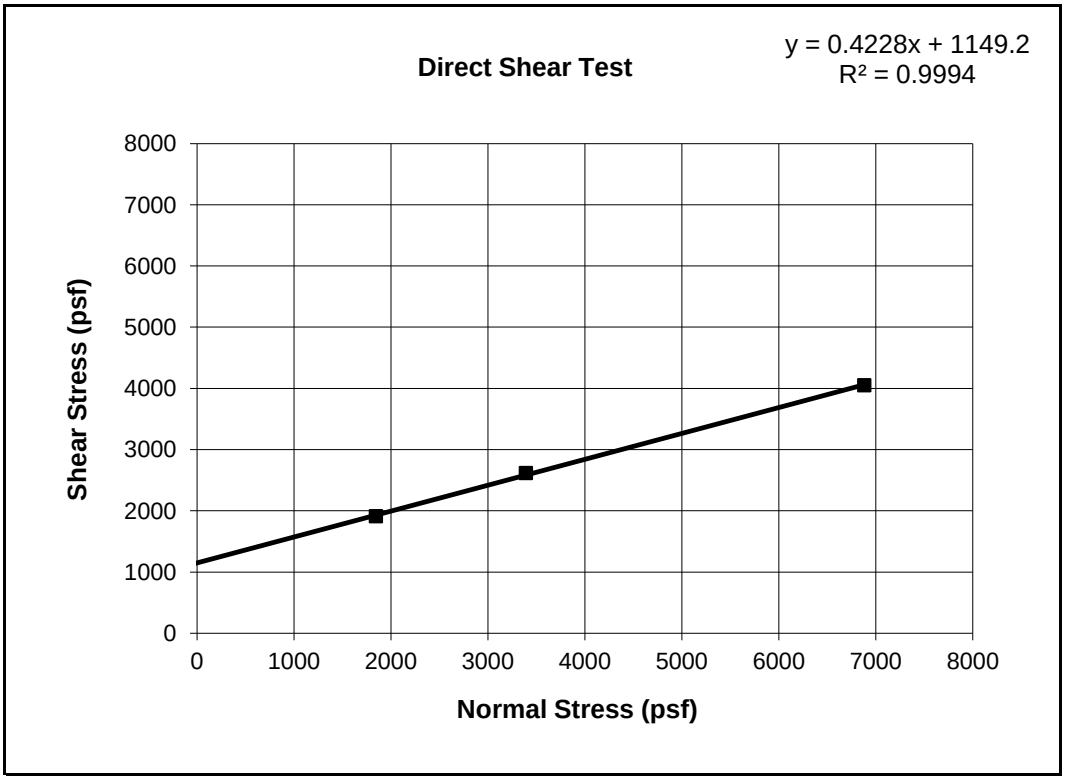


Exhibit B-11

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-19 at 19 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	105.0	105.0	105.0
INITIAL WATER CONTENT (%)	21.0	21.0	21.0
FINAL WATER CONTENT (%)	21.0	21.0	21.0
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density	127.1		

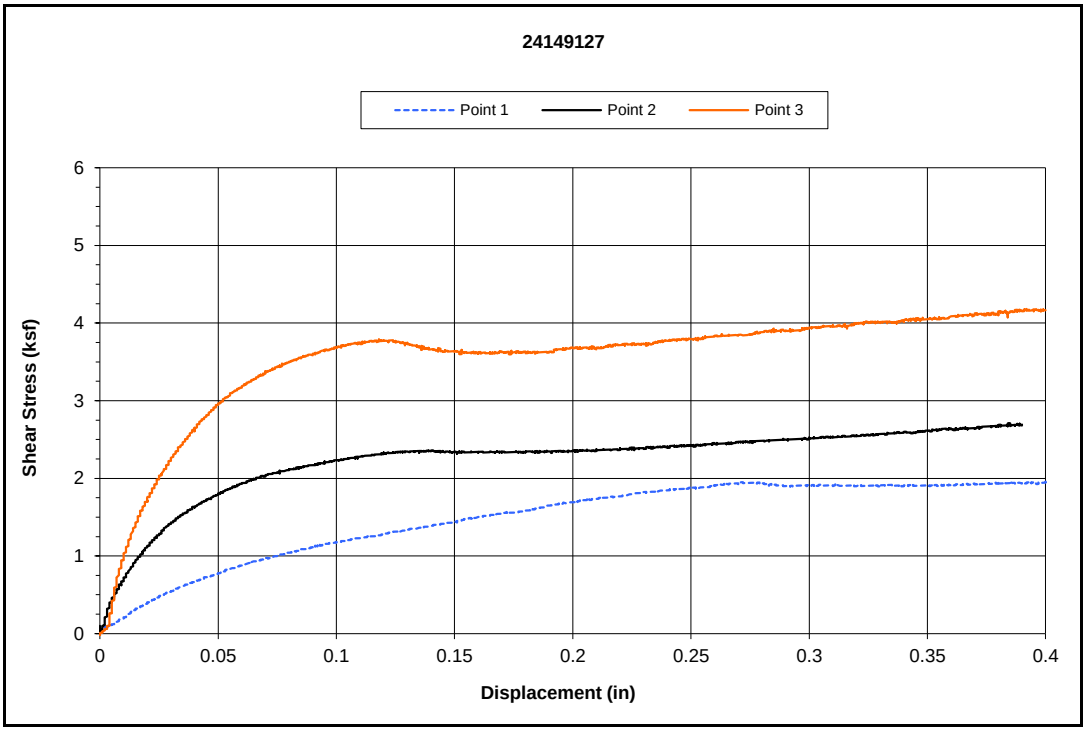


Exhibit B-11

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-20 at 25 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1		2		3
NORMAL PRESSURE (psf)	2140		4386		6579
SHEAR STRESS (psf)	1788		1518		4718
ULTIMATE FRICTION ANGLE	31	or	33		
EFFECTIVE COHESION (psf)	0	or	375		

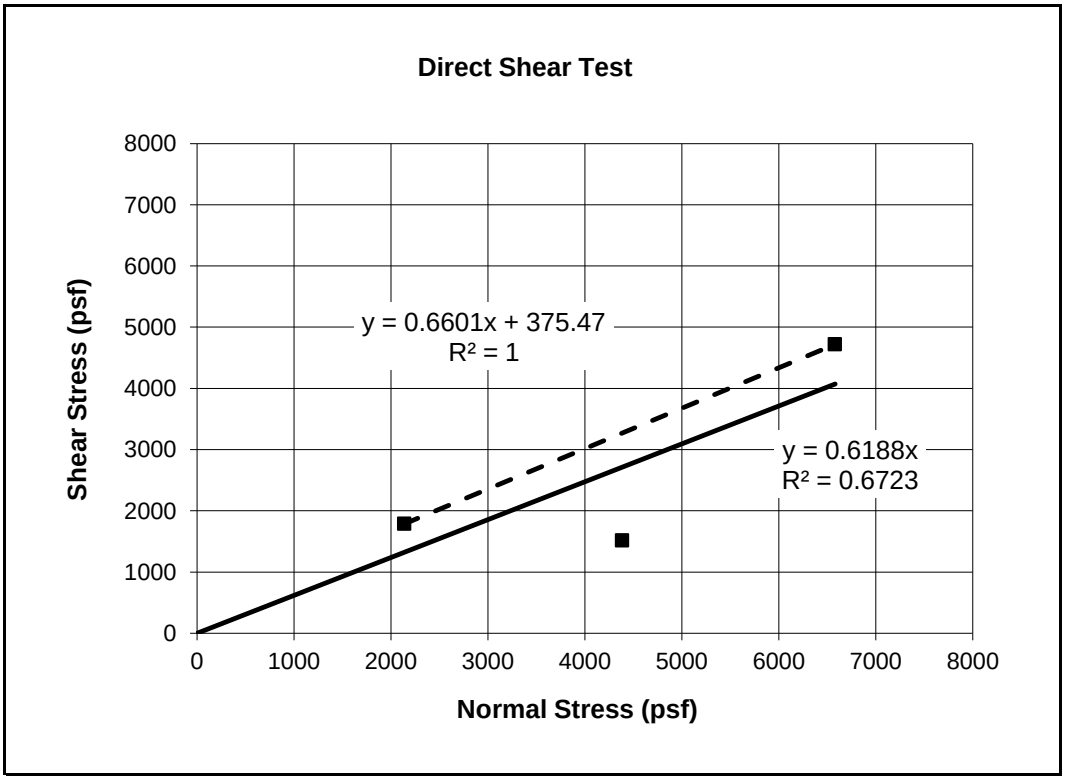


Exhibit B-12

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/9/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-20 at 25 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	103.2	103.2	103.2
INITIAL WATER CONTENT (%)	18.7	18.7	18.7
FINAL WATER CONTENT (%)	18.7	18.7	18.7
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density	122.5		

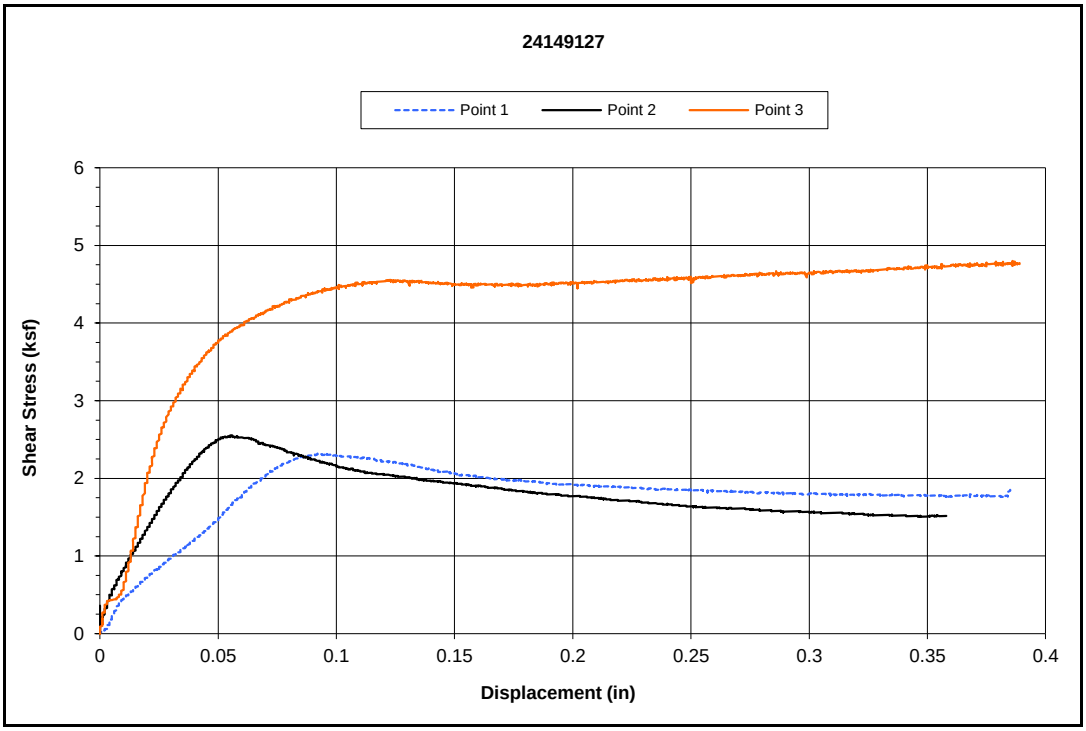


Exhibit B-12

Terracon

4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/6/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-22 at 19 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1		2	3
NORMAL PRESSURE (psf)	1848		3563	6477
SHEAR STRESS (psf)	1678		2481	7297
ULTIMATE FRICTION ANGLE	45	or	25	
EFFECTIVE COHESION (psf)	0	or	813	

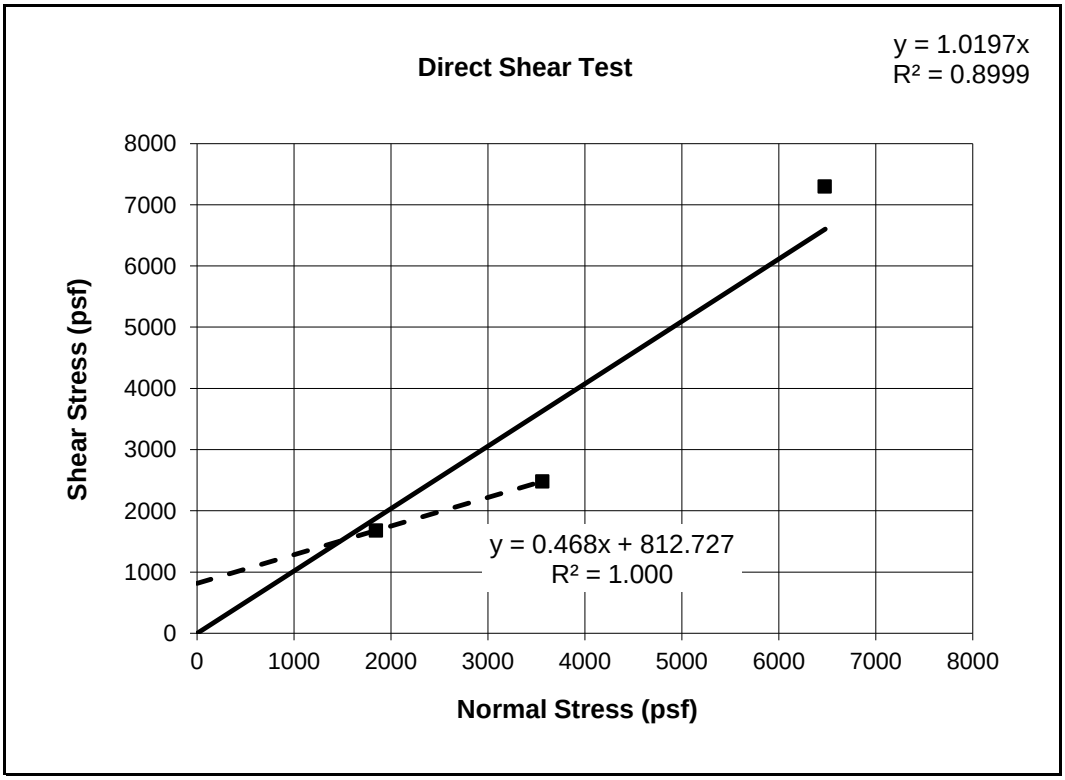


Exhibit B-13

Terracon
4172 Center Park Drive
Colorado Springs, Colorado 80917
Ph (719) 597-2116 Fax (719) 597-2117

DIRECT SHEAR
ASTM D 3080

CLIENT:	State of Wyoming	**DATE OF TEST:**	6/6/14
PROJECT:	Capitol and Herschler Improvements		
LOCATION:	Boring B-22 at 19 feet		
TERRACON NO.	24149127	**CLASSIFICATION:**	SC

SAMPLE DATA TEST RESULTS

TEST SPECIMEN NO.	1	2	3
DRY DENSITY BEFORE TEST (pcf)	100.3	100.3	100.3
INITIAL WATER CONTENT (%)	15.9	15.9	15.9
FINAL WATER CONTENT (%)	15.9	15.9	15.9
SHEAR RATE (mm/min)	0.026	0.026	0.026
Wet Density	116.2		

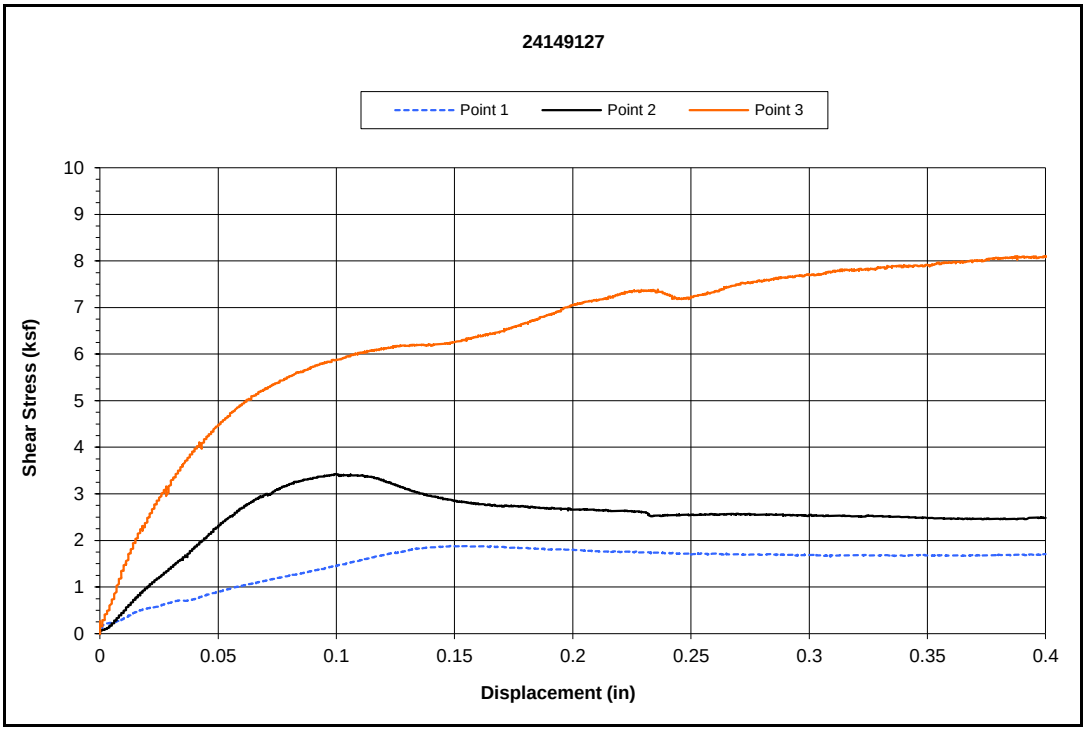


Exhibit B-13

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

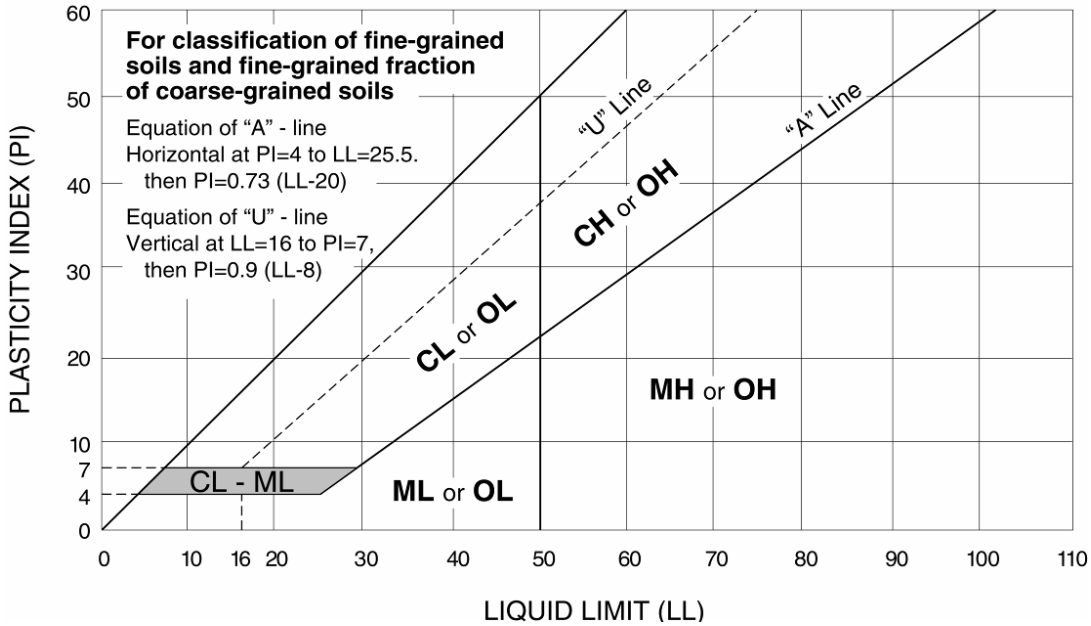
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N]
						Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P]
						Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

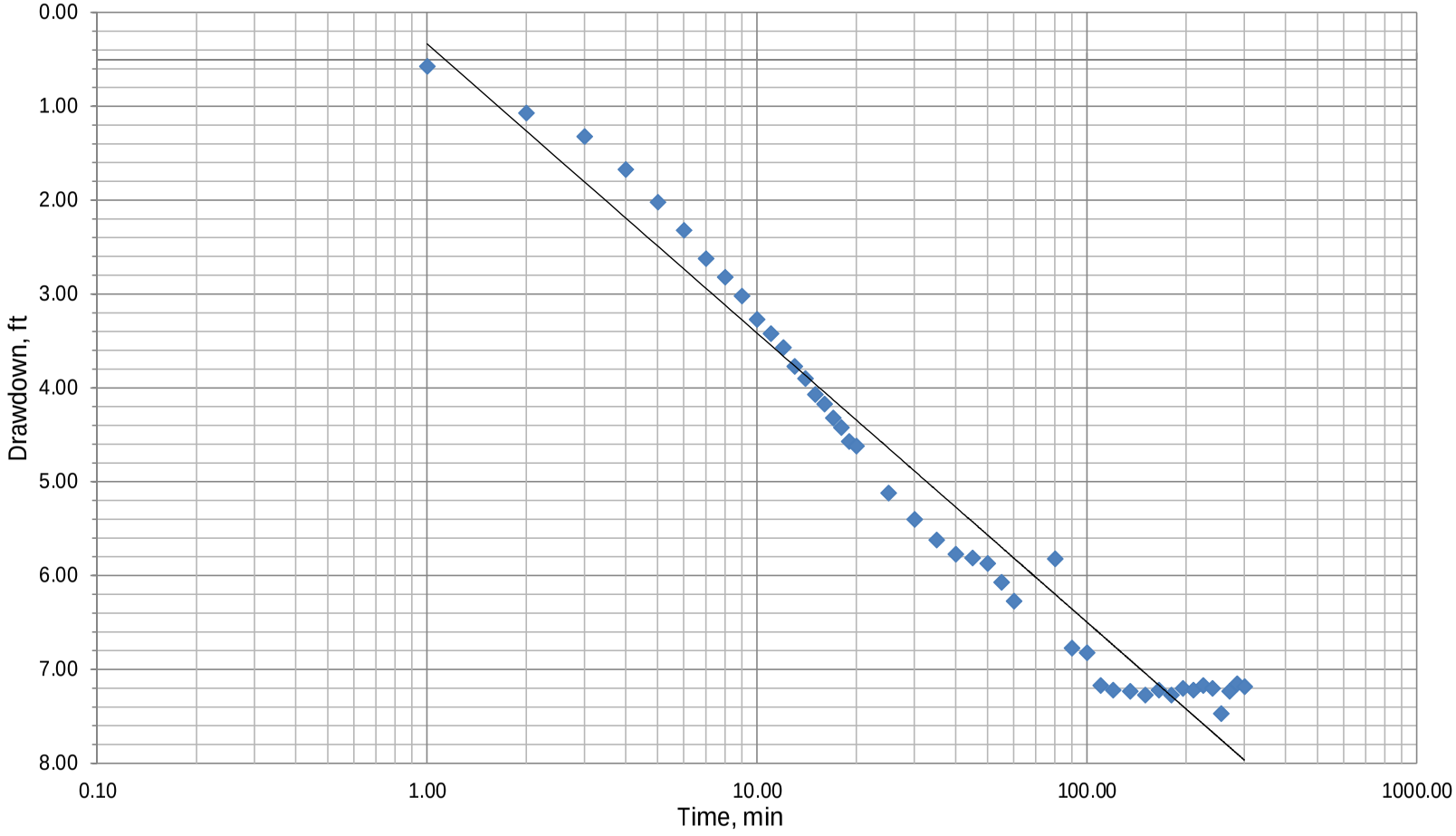
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

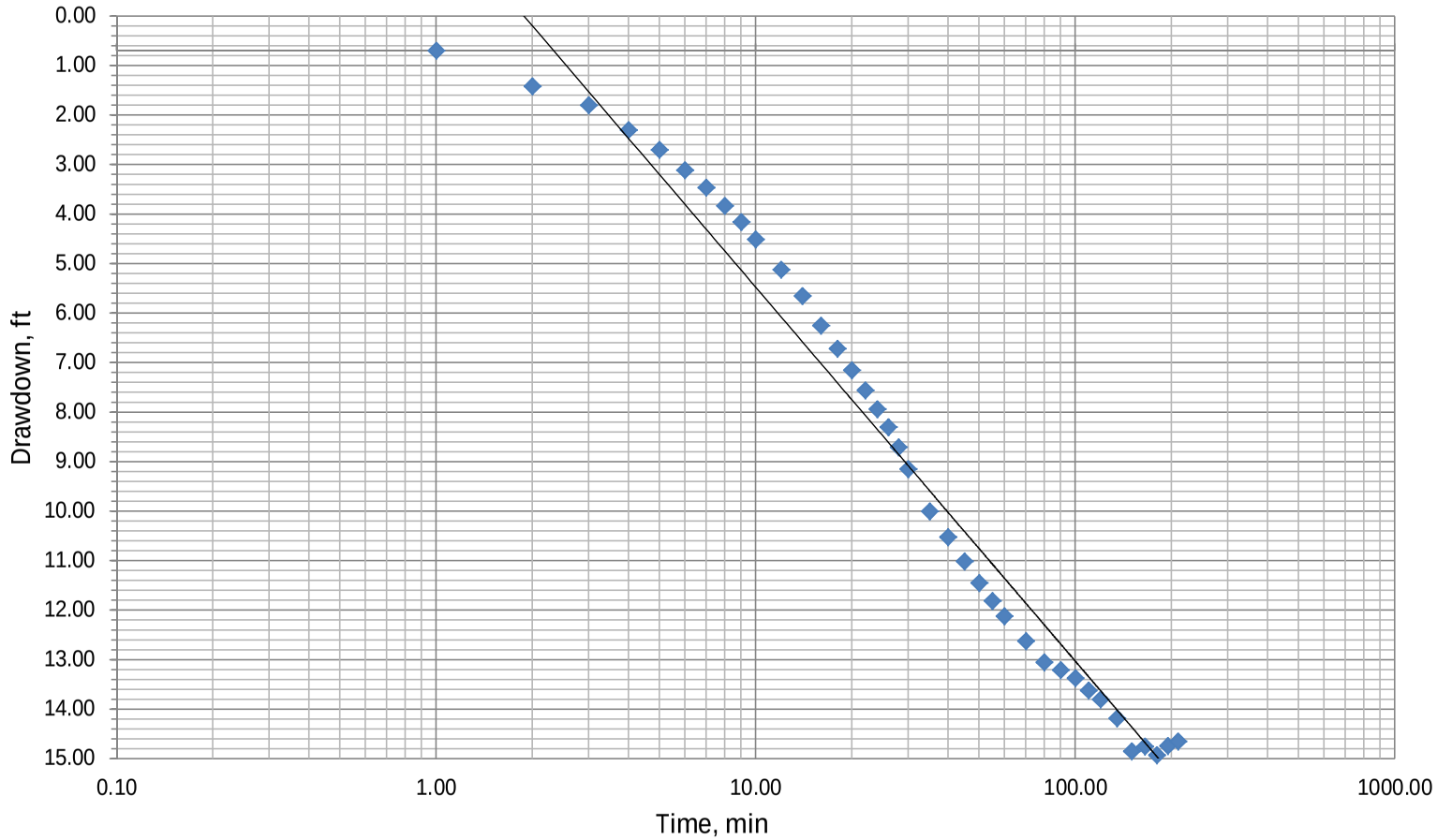


Terracon

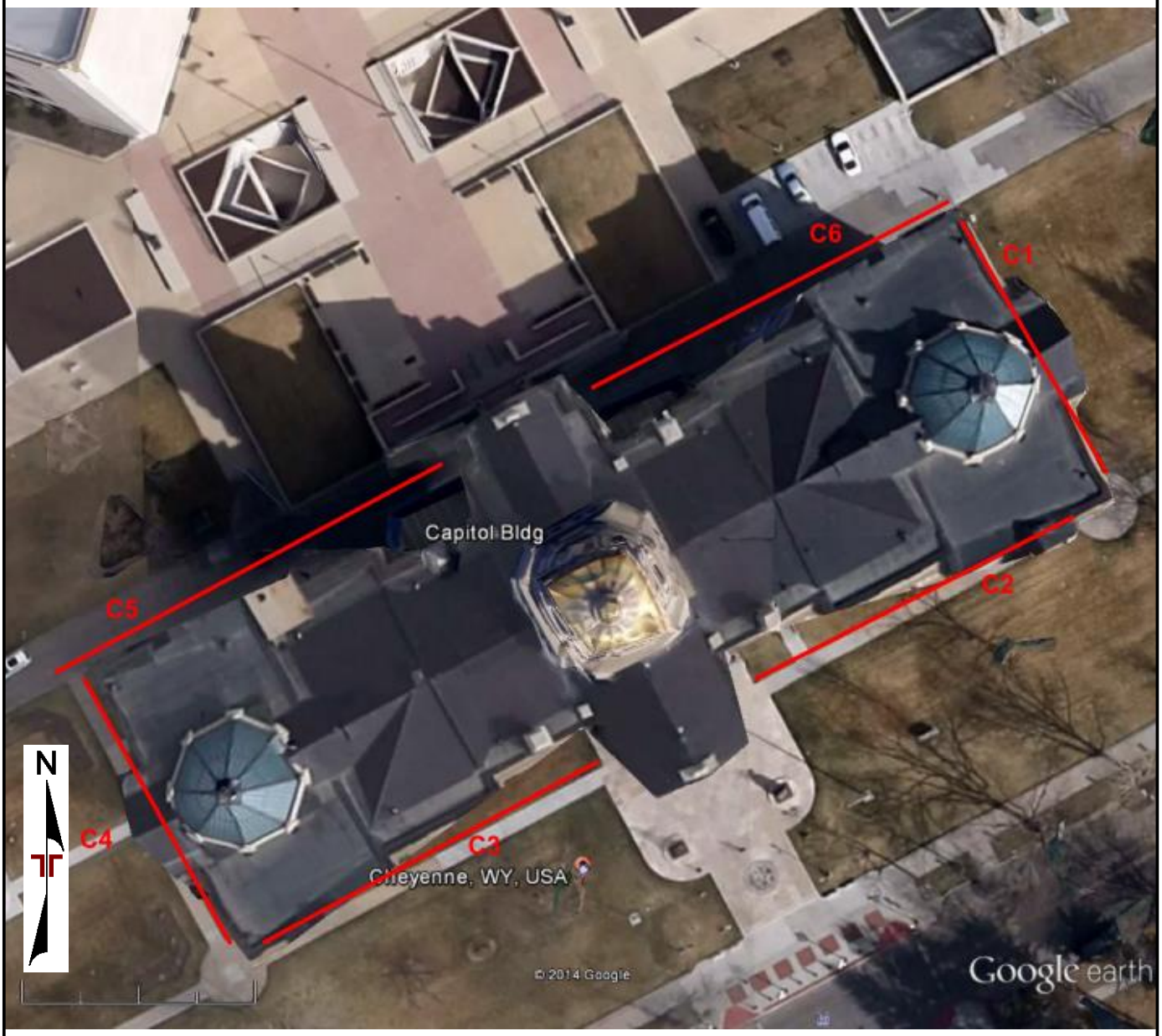
Exhibit C-2



Aquifer & Test Parameters			*Calculations*		
Q =	120	ft^3/d	T =	5.63	ft^2/day
r =	25	feet	K =	0.19	ft/day
b =	30	feet	S =	2.1E-05	
$\Delta(h_0-h)$ =	3.9	feet	u-Criterion =	0.059	days
t_0 =	0.0010417	days	u-Criterion =	84.4	minutes

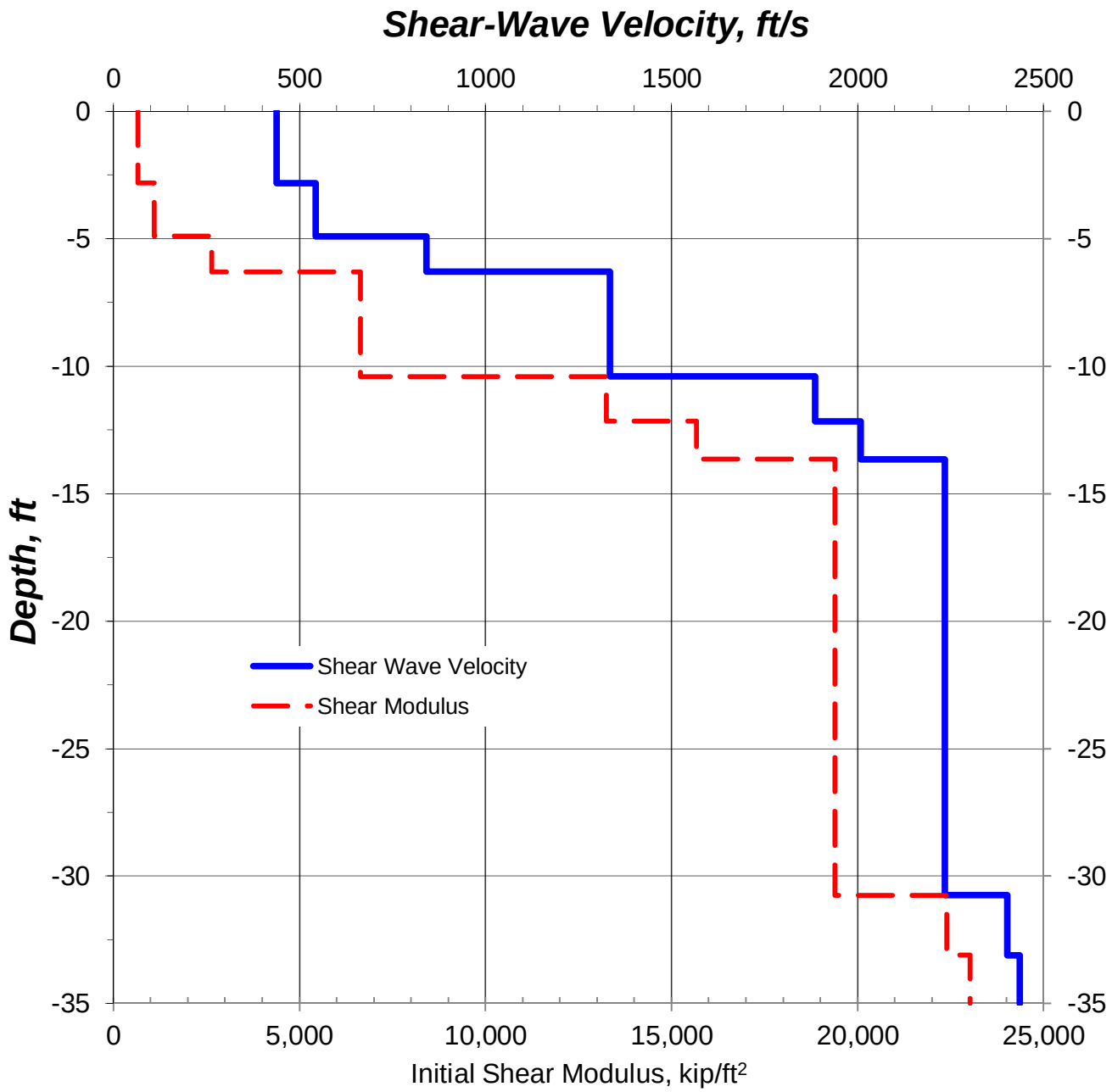


Aquifer & Test Parameters			*Calculations*		
Q =	144	ft^3/d	T =	2.96	ft^2/day
r =	68	feet	K =	0.10	ft/day
b =	30	feet	S =	2.5E-06	
$\Delta(h_0-h)$ =	8.9	feet	u-Criterion =	0.098	days
t_0 =	0.001736	days	u-Criterion =	140.6	minutes



Project Manager: BW	Project No. 24149127	Terracon 1505 Old Happy Jack Road Cheyenne, WY	ReMi SURVEY LOCATION DIAGRAM	Exhibit
Drawn by: TO	Scale: AS SHOWN		Capitol and Hershler Building Improvements **24th Street** **Cheyenne, WY**	C-5
Checked by: BW	File Name: 24149127 BLD			
Approved by: BW	Date: 8/21/14			

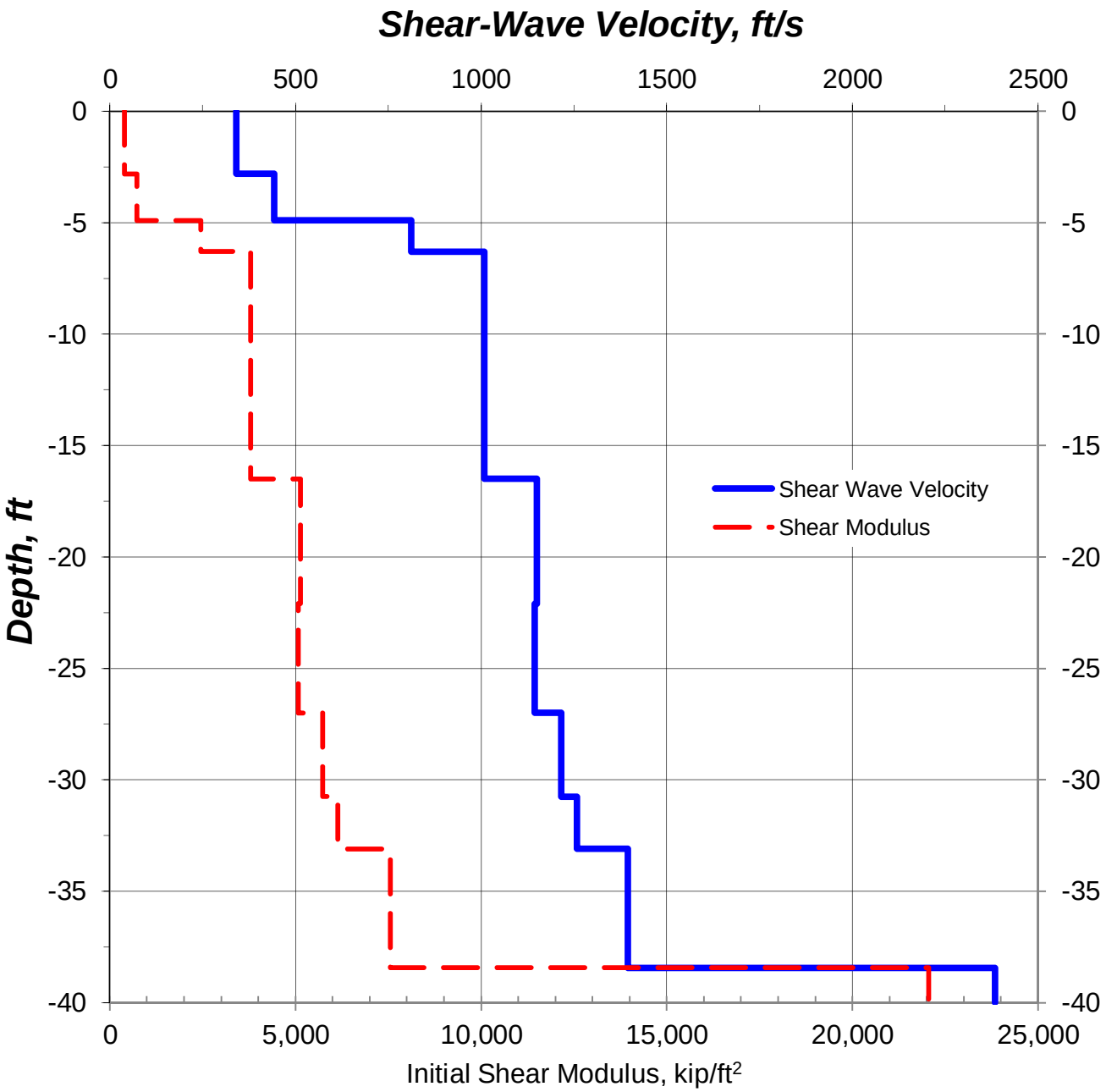
Project Manager: BW	Project No. 24149127	Terracon 1505 Old Happy Jack Road Cheyenne, WY	ReMi SURVEY LOCATION DIAGRAM	Exhibit
Drawn by: TO	Scale: AS SHOWN		Capitol and Hershler Building Improvements **24th Street** **Cheyenne, WY**	C-6
Checked by: BW	File Name: 24149127 BLD			
Approved by: BW	Date: 8/21/14			



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

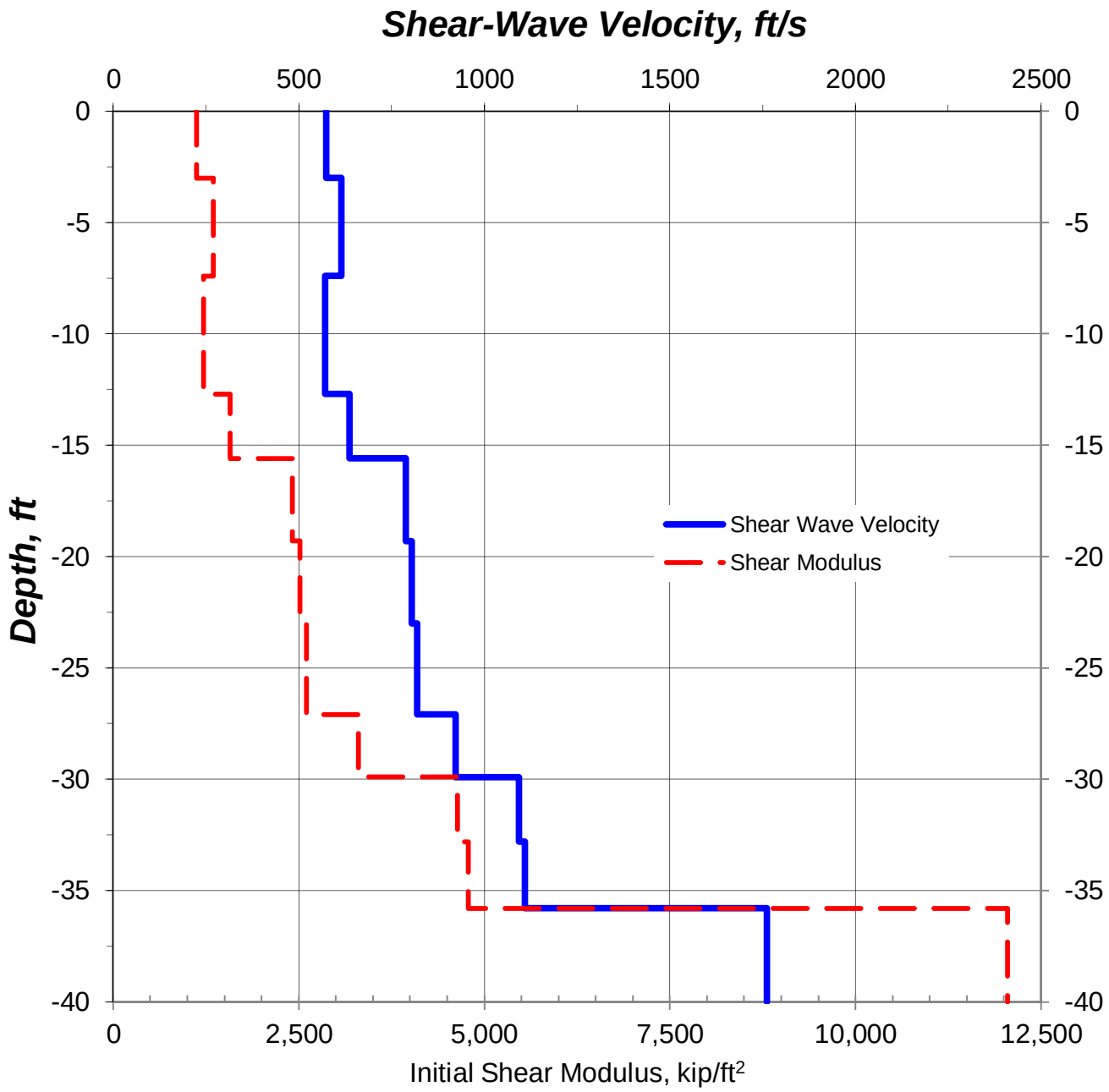
ReMi Survey: C-1
Exhibit: C-7



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

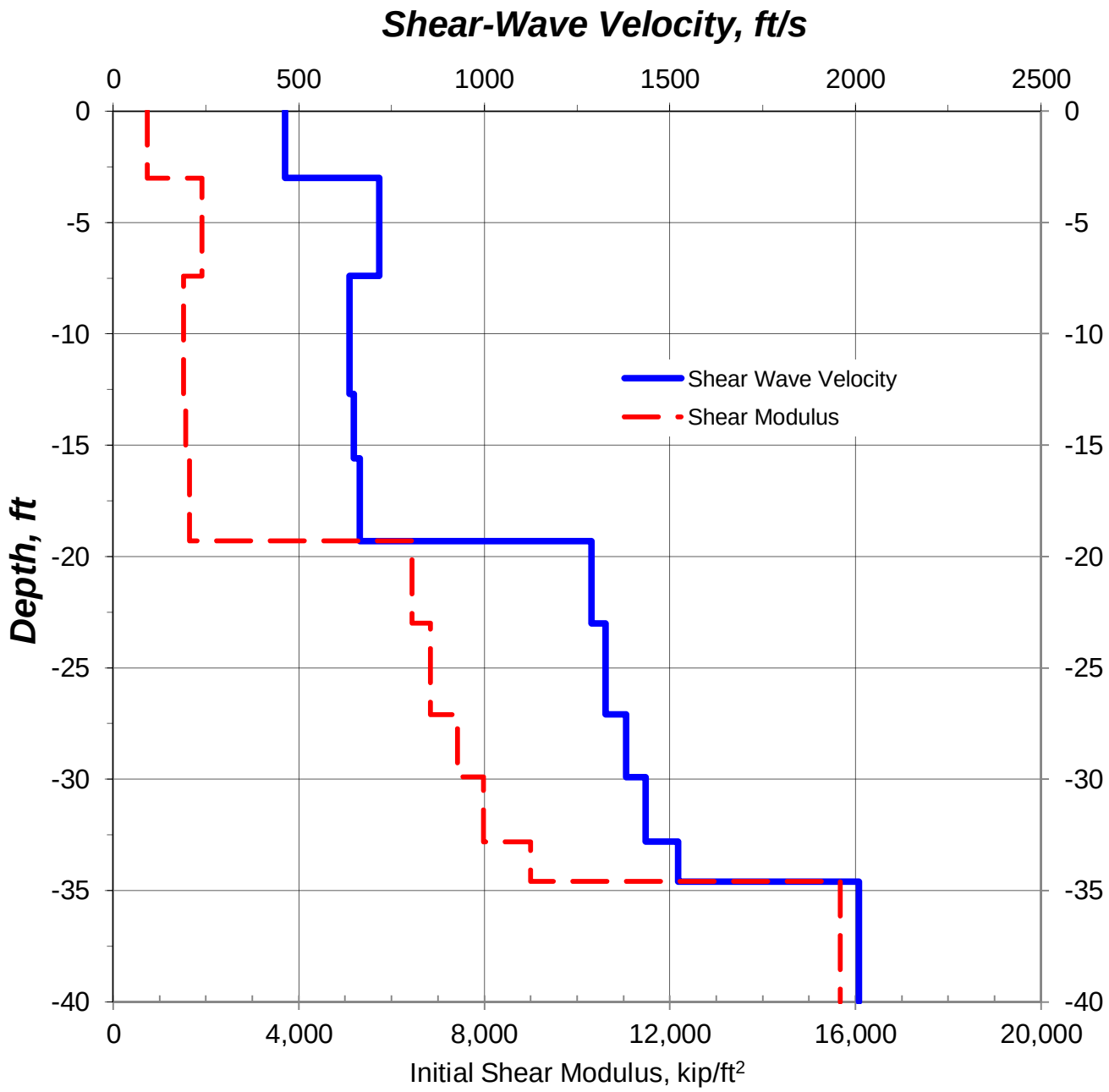
ReMi Survey: C-2
Exhibit: C-8



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

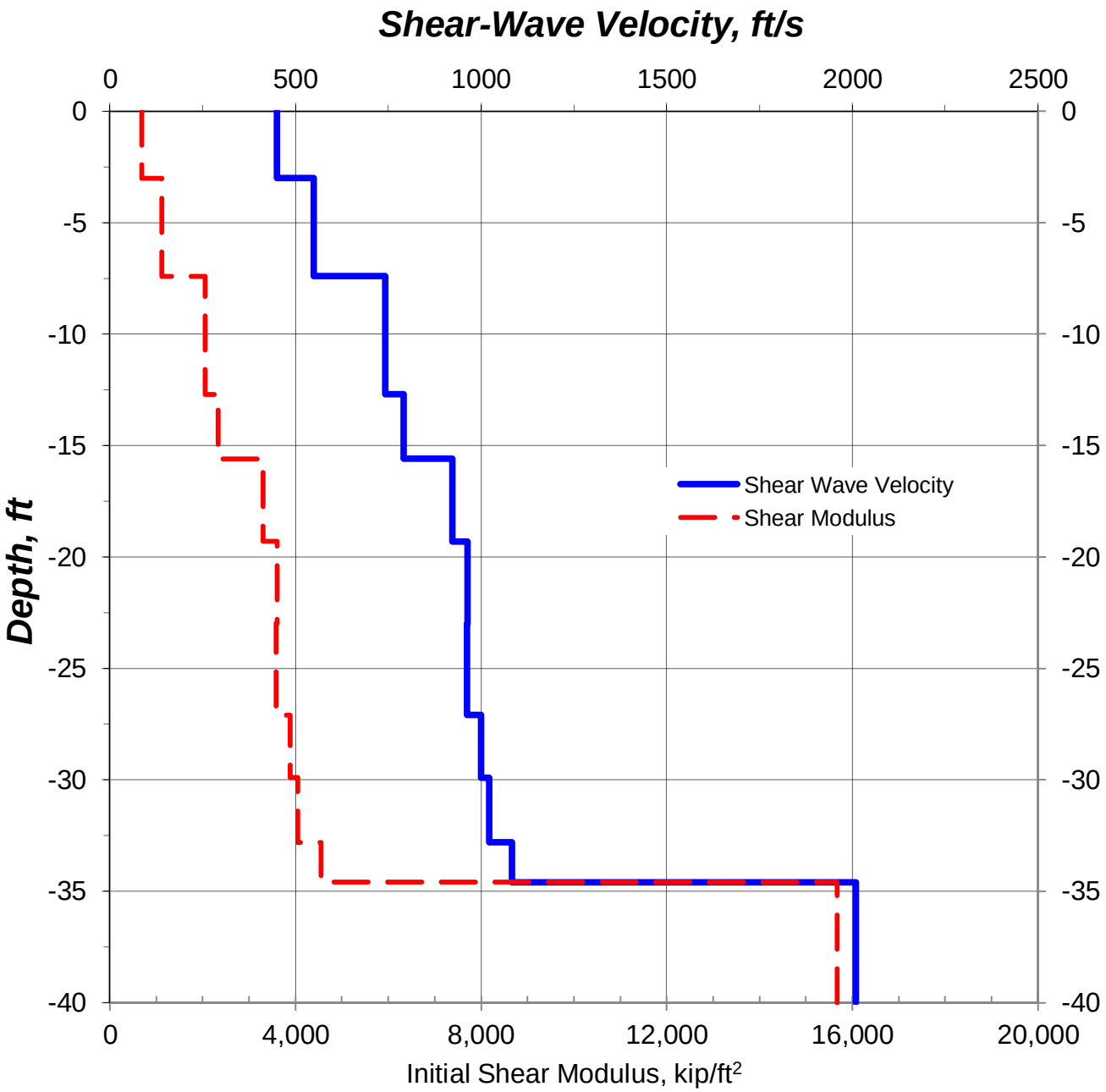
ReMi Survey: C-3
Exhibit: C-9



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

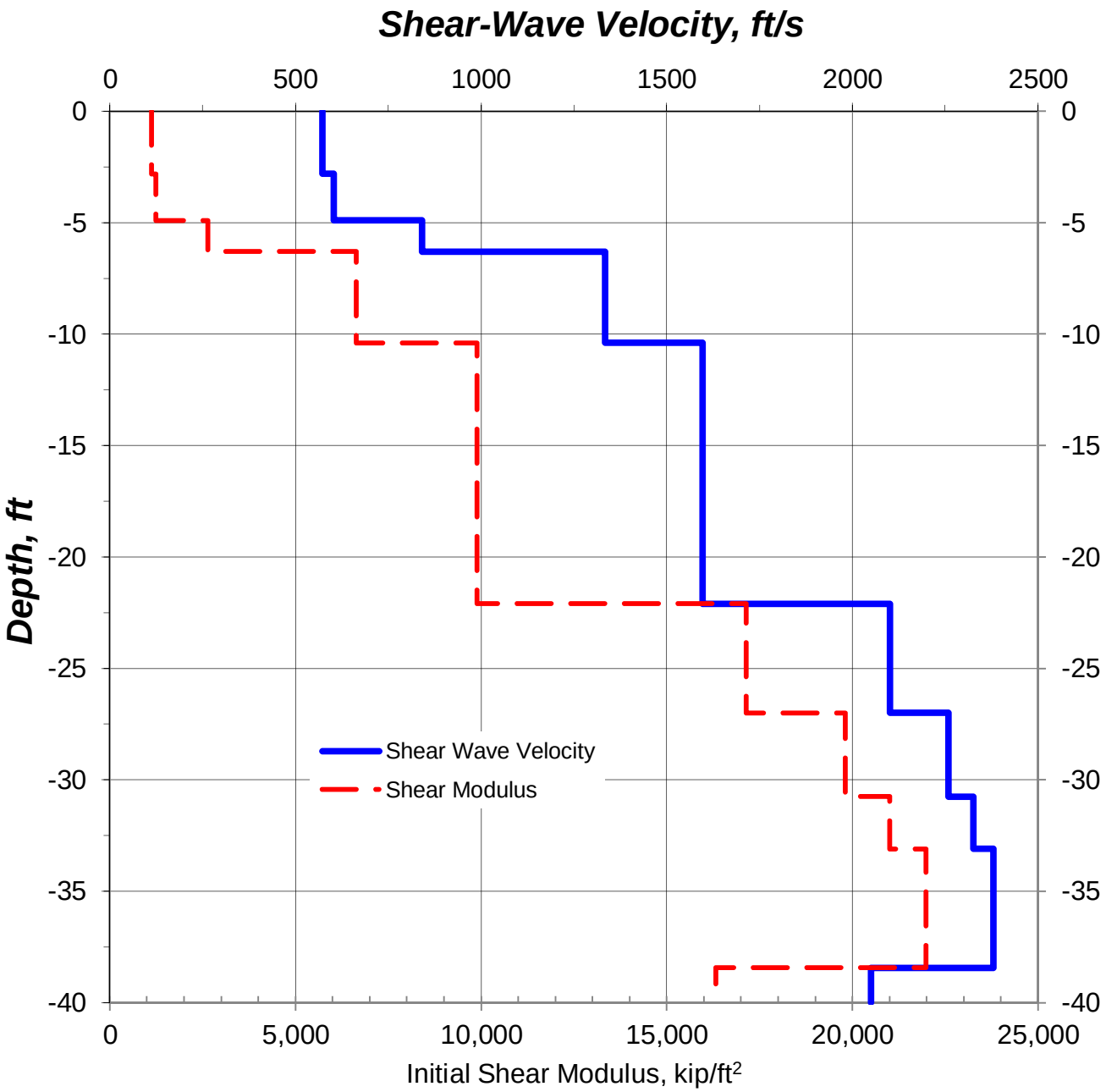
ReMi Survey: C-4
Exhibit: C-10



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

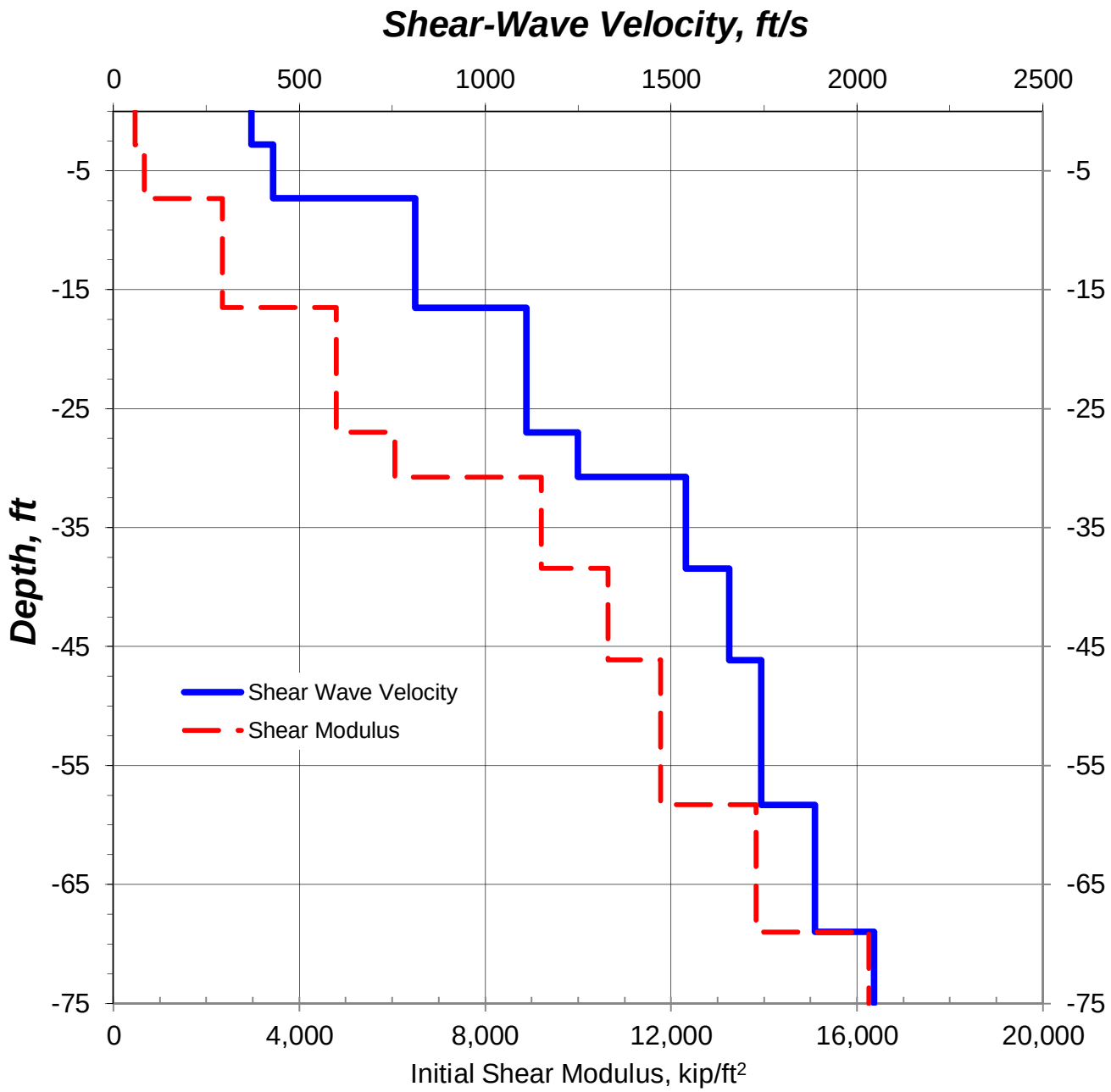
ReMi Survey: C-5
Exhibit: C-11

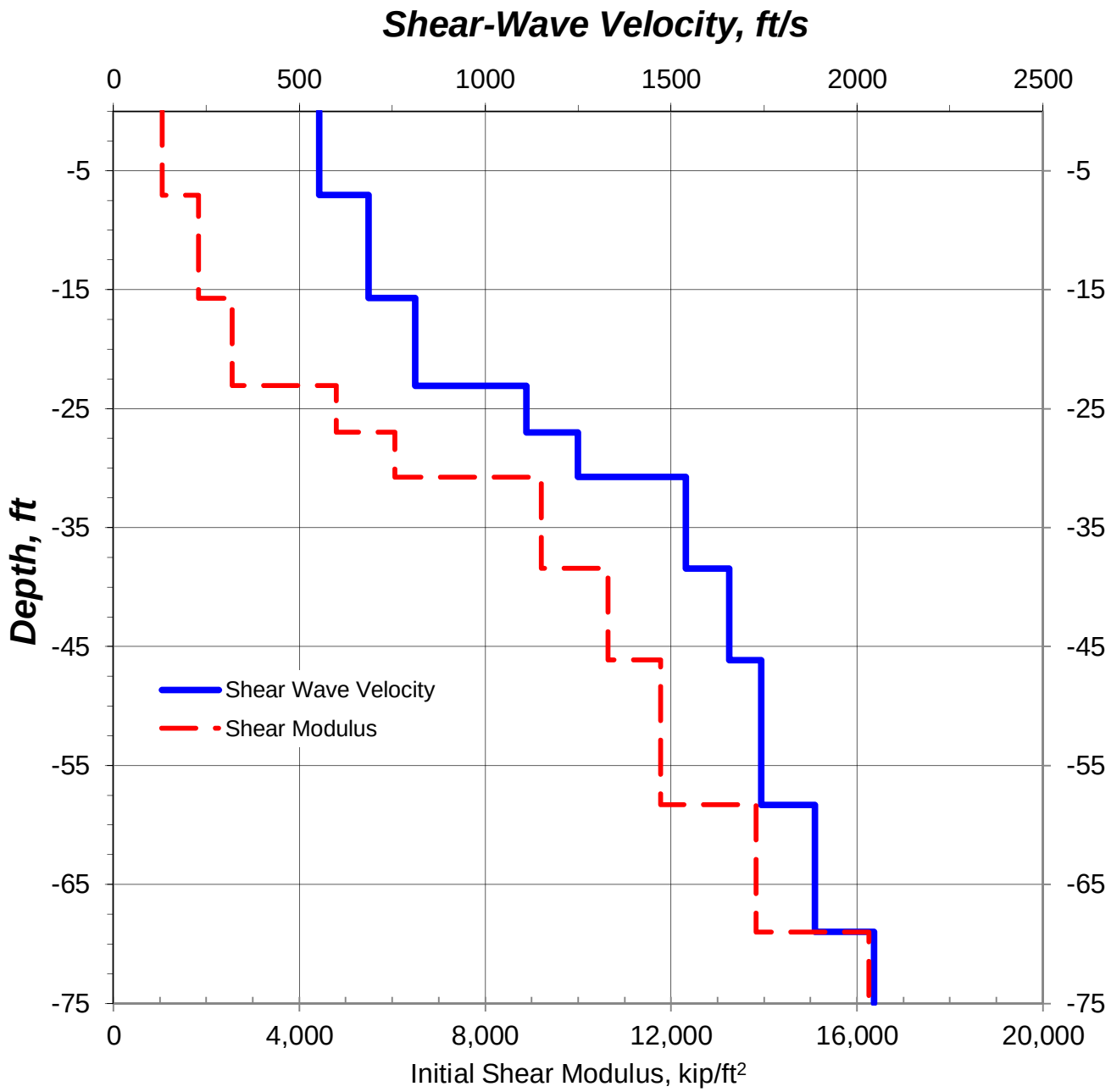


Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

ReMi Survey: C-6
Exhibit: C-12

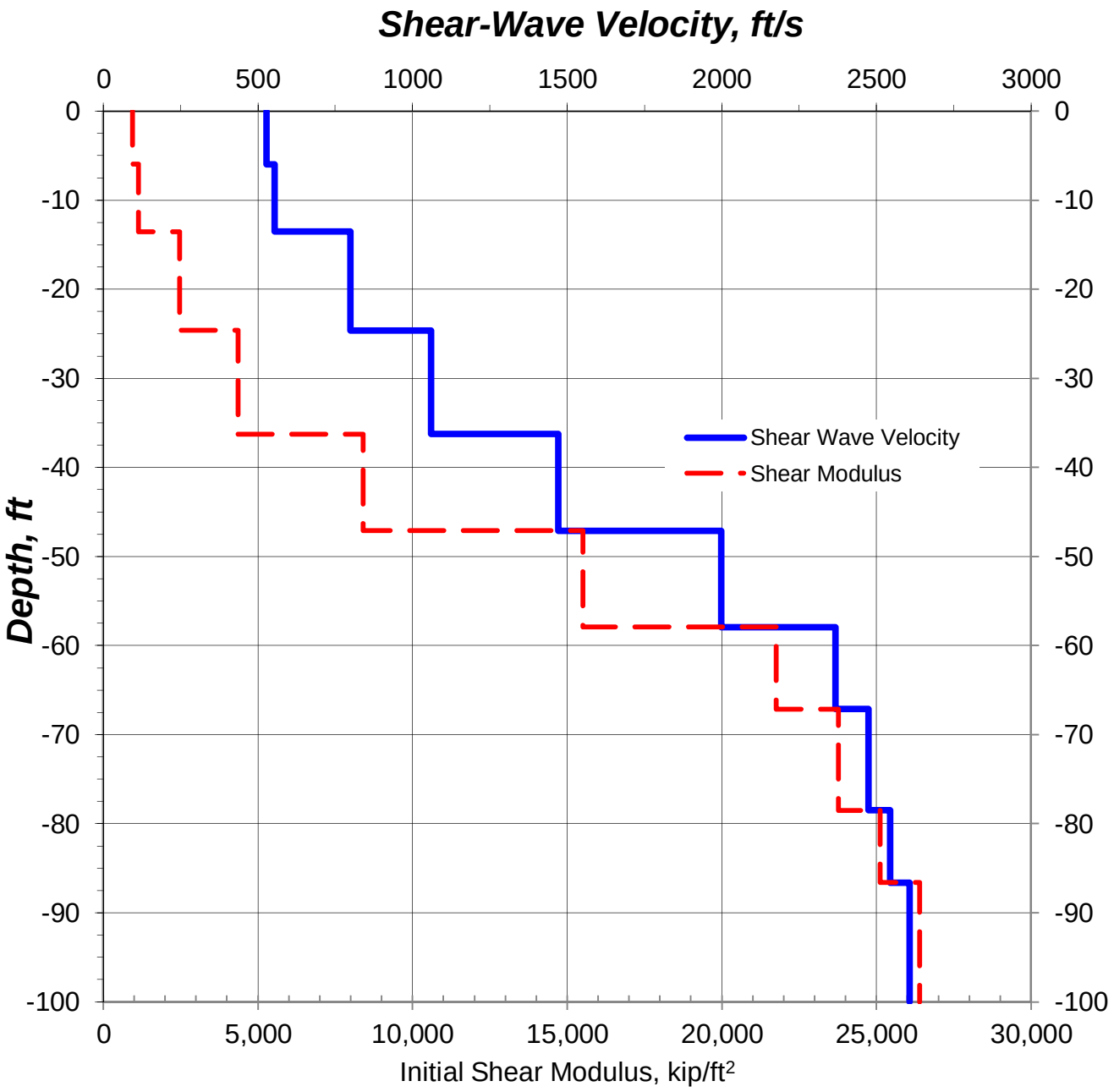

Shear-Wave Velocity, ft/s
0
500
1000
1500
2000
2500
-5
-15
-25
-35
-45
-55
-65
-75
Depth, ft
Shear Wave Velocity
Shear Modulus
0
4,000
8,000
12,000
16,000
20,000
Initial Shear Modulus, kip/ft2



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

ReMi Survey: H-2
Exhibit: C-14



Terracon Project #: 81149127

Project Name: Capitol and Herschler Buildings Improvements

ReMi Survey: H-3
Exhibit: C-15

Exhibit C-16

December 02, 2013

State of Wyoming Department of Administration and Information
Divison of Construction Management
700 West 21st Street
Cheyenne, Wyoming 82002

Attn: Mr. Dennis Egge

Re: Geotechnical Exploration Summary
Capitol Building Renovations
Cheyenne, Wyoming
Terracon Project No. 24135052

Dear Mr Egge:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical exploration services for the above referenced project. These services were performed in general accordance with our proposal number P24130241 dated September 14, 2013 and signed contract between the State of Wyoming and Terracon dated March 28, 2012.

The scope of services performed for this project included site reconnaissance by a geotechnical engineer, subsurface exploration program and limited laboratory testing.

Three test borings were performed on November 7, 2013 and three test broings were performed on November 15, 2013. The borings were advanced to approximate depths of 1.5 to 3.75 feet inside the Capitol Building and to an approximate depth of 35.5 feet outside the Capitol Building at the approximate locations shown on the Boring Location Diagrams. The borings inside the Capitol Building were advanced with a hand auger and the borings outside the Capitiol Buidling were advanced with a truck-mounted drill-rig, utilizing 4-inch diameter, solid-stem augers. The borings were located in the field by personnel with the Department of Administration and Information Constuction Management.

Observations for the presence of groundwater were performed in each boring during drilling operations and five days after. Groundwater observation wells were constructed in each of the three borings outside the building.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Terracon

Sincerely,
Terracon Consultants, Inc.

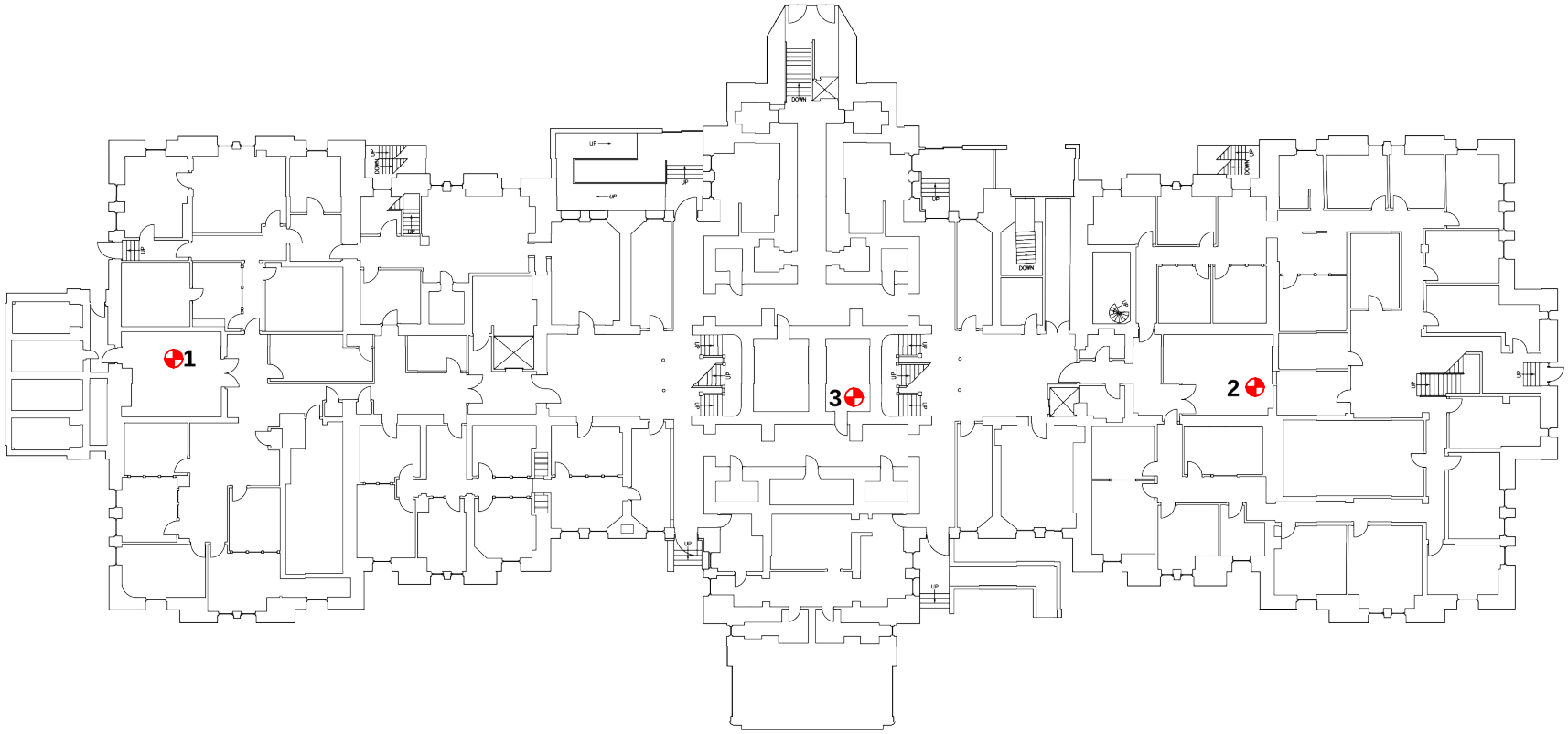
Brian Olson
Staff Geotechnical Engineer

Brent F. Wilkins, P.E.
Geotechnical Department Manager

bjo/bfw

Copies to: Addressee, electronic copy only

Attachments: Boring Location Diagrams
Boring Logs
Lab Data
General Notes



1 BASEMENT LEVEL PLAN
2013 3/32" = 1'-0"

APPROXIMATE LOCATION OF BORING.

NOTE: Site plan based on information provided by the client. Diagram is for general location only, and is not for construction purposes.

Project Mngr:	BJO
Drawn By:	BJO
Checked By:	BFW
Approved By:	BFW

Project No.	24135052
Scale:	NOT TO SCALE
Date:	NOVEMBER 26, 2013
File No.	24135052 CAPITOL BUILDING RENOVATION

Terracon
Consulting Engineers and Scientists
1505 Old Happy Jack Rd. Cheyenne, WY 82001
PH. (307) 632-9224 FAX. (307) 635-5756

BORING LOCATION DIAGRAM

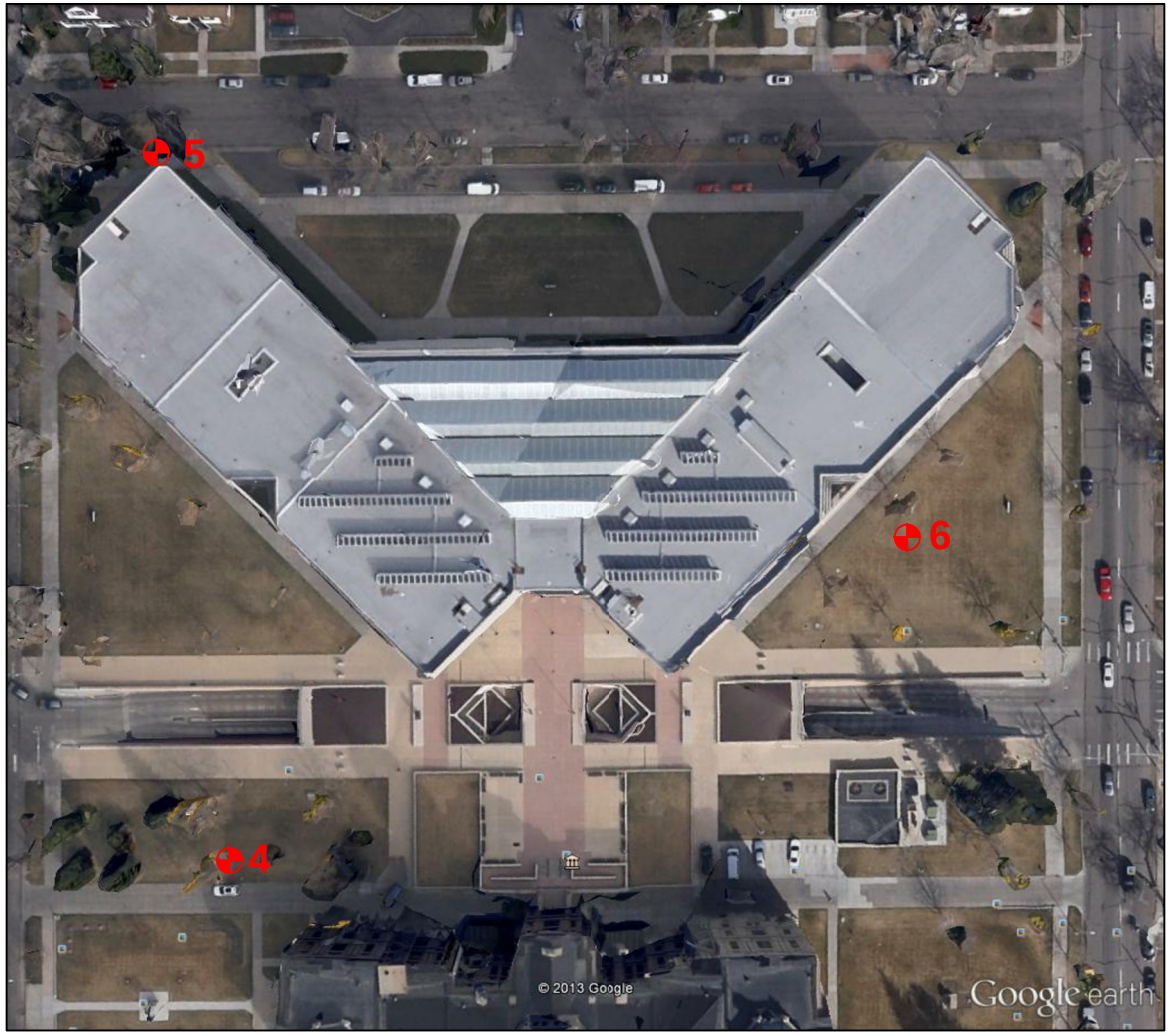
CAPITOL BUILDING RENOVATIONS

24TH STREET AND CAPITOL AVENUE

CHEYENNE, WYOMING

EXHIBIT

1



N

APPROXIMATE LOCATION OF BORING.

NOTE: Site plan based on information provided by the client. Diagram is for general location only, and is not for construction purposes.

Project Mngr:	BJO
Drawn By:	BJO
Checked By:	BFW
Approved By:	BFW

Project No.	24135052
Scale:	NOT TO SCALE
Date:	NOVEMBER 26, 2013
File No.	24135052 CAPITOL BUILDING RENOVATION

Terracon
Consulting Engineers and Scientists
1505 Old Happy Jack Rd. Cheyenne, WY 82001
PH. (307) 632-9224 FAX. (307) 635-5756

BORING LOCATION DIAGRAM

CAPITOL BUILDING RENOVATIONS

24TH STREET AND CAPITOL AVENUE

CHEYENNE, WYOMING

EXHIBIT

2

BORING LOG NO. 1

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue Cheyenne, Wyoming

GRAPHIC LOG	LOCATION DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	0.4 **CONCRETE**, approximate 4.5"	0											
	FILL - SILTY CLAYEY SAND WITH GRAVEL (SC-SM), fine-medium-coarse sand, fine gravel, medium brown					11-4-4-5				8			
						2-3-3-6				6		22-16-6	27
						5-7-8-6				6			
	3.8	0				5-18-18-7				7			
	Boring Terminated at 3.75 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:
Borings were advanced with a hand auger. Blow counts were obtained using a Portable Dynamic Hand Cone Pentrometer and should not be relied upon for N-values.

WATER LEVEL OBSERVATIONS

Water was not observed during DCP operations

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/7/2013 | Boring Completed: 11/7/2013
Drill Rig: DCP | Driller: Brian
Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

BORING LOG NO. 2

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue
Cheyenne, Wyoming

GRAPHIC LOG	LOCATION DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	0.4 **CONCRETE**, approximate 4.4"	0				19-22-16-19				3			
	FILL - SILTY SAND WITH GRAVEL (SM), fine-medium sand, coarse gravel, brick, stone, wood debris, light brown					11-30/.25"				1		NP	17
	2.0	0				30/.25"				3			
	Boring Terminated at 2 Feet									1			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:
Borings were advanced with a hand auger. Blow counts were obtained using a Portable Dynamic Hand Cone Pentrometer and should not be relied upon for N-values.

WATER LEVEL OBSERVATIONS

Water was not observed during DCP operations

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/7/2013 | Boring Completed: 11/7/2013
Drill Rig: DCP | Driller: Brian
Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

BORING LOG NO. 3

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue Cheyenne, Wyoming

GRAPHIC LOG	LOCATION DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
	0.8 **CONCRETE**, approximate 1"	0				15-30/.25"				3			
	1.6 **FILL - SILTY SAND WITH GRAVEL (SP)**, fine-medium sand, coarse gravel, brick, stone, wood debris, light brown	0				7-8-9-12				3			
	Boring Terminated at 1.58 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

Notes:
Borings were advanced with a hand auger. Blow counts were obtained using a Portable Dynamic Hand Cone Pentrometer and should not be relied upon for N-values.

WATER LEVEL OBSERVATIONS

Water was not observed during DCP operations

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/7/2013 | Boring Completed: 11/7/2013
Drill Rig: DCP | Driller: Brian
Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

BORING LOG NO. 4

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue
Cheyenne, Wyoming

LOCATION:

DEPTH	ELEVATION (Ft.)	Description
0	2.5	**FILL - CLAYEY SAND WITH GRAVEL (SC)**, vegetative layer approximately 2", fine-medium sand, fine gravel, dark brown, medium dense
2.5	0	**WELL GRADED SAND WITH CLAY AND GRAVEL (SW-SC)**, fine-medium-coarse sand, fine gravel, dark brown, medium dense
9.0	0	**POORLY GRADED SAND WITH GRAVEL (SP)**, fine-medium-coarse sand, fine gravel, trace silt, light brown, very dense
13.0	0	**CLAYEY SAND (SC)**, fine-medium sand, medium brown, medium dense
30.5	0	***Boring Terminated at 30.5 Feet***

INSTALLATION DETAILS: 10" Dia. by 12" deep flush mounted cover; Solid PVC riser pack with benonite seal; Slotted PVC riser pack with sand

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		5-7-6 N=13	21			
5		5-6-8 N=14	5			
10		28-28-25 N=53	3		NP	14
15		6-7-8 N=15	23			
20		5-5-7 N=12	23			
25		14-9-10 N=19	24			
30		6-8-10 N=18	20			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" SFA

Abandonment Method:
Piezometer installed

Notes:

WATER LEVEL OBSERVATIONS

Water not observed during drilling operations.

Water level checked on 11/20/2013

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/15/2013 | Boring Completed: 11/15/2013

Drill Rig: CME-75 | Driller: Brian

Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

BORING LOG NO. 5

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue
Cheyenne, Wyoming

LOCATION: DEPTH	ELEVATION (Ft.)	Description	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.0	0	**FILL - CLAYEY SAND WITH GRAVEL (SC)**, vegetative layer approximately 2", fine-medium-coarse sand, fine gravel, dark brown, medium dense	10" Dia. by 12" deep flush mounted cover								
							3-6-7 N=13	14			
		WELL GRADED SAND WITH GRAVEL (SW), fine-medium-coarse sand, fine gravel, trace clay, light brown, medium dense	Solid PVC riser pack with benonite seal								
				5			10-13-14 N=27	4		NP	5
9.0	0										
9.5	0	**SILTY CLAYEY SAND (SC-SM)**, fine-medium sand, trace fine gravel, light brown, medium dense		10			14-14-10 N=24	2		14-10-4	37
		WELL GRADED SAND WITH GRAVEL (SW), fine-medium-coarse sand, fine grave, trace clay, light brown, medium dense									
12.5	0	**CLAYEY SAND (SC)**, fine-medium sand, medium brown, medium dense	Slotted PVC riser pack with sand	15			4-6-7 N=13	16			
				20			4-6-7 N=13	34			
				25			5-7-7 N=14	22		34-17-17	34
30.5	0			30			5-7-13 N=20	21			
		Boring Terminated at 30.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" SFA

Abandonment Method:
Piezometer installed

Notes:

WATER LEVEL OBSERVATIONS

Water observed on augers and in samples

Water level checked on 11/20/2013

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/15/2013 | Boring Completed: 11/15/2013

Drill Rig: CME-75 | Driller: Brian

Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

BORING LOG NO. 6

PROJECT: Capitol Building Renovations

CLIENT: State of Wyoming Department of A&I

SITE: 24th Street & Capitol Avenue
Cheyenne, Wyoming

LOCATION:

DEPTH	ELEVATION (Ft.)	Description	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	0	**FILL - CLAYEY SAND (SC)**, fine-medium-coarse sand, trace fine-coarse gravel, trace clay, dark brown, medium dense	6" Dia. by 12" deep flush mounted cover								
							13-5-5 N=10	5		NP	15
5.0	0	**FILL - CLAYEY SAND (SC)**, fine sand, medium brown, medium dense	Solid PVC riser pack with benonite seal								
				5			3-6-12 N=18	13			
9.5	0	**WELL GRADED SAND WITH GRAVEL (SW)**, fine-medium-corase sand, fine gravel, trace clay, light brown, medium dense									
				10			4-8-10 N=18	6			
		CLAYEY SAND (SC), fine-medium sand, medium brown, medium dense to very dense	Slotted PVC riser pack with sand								
				15			4-4-4 N=8	29			
					▽						
		approximately 2" cemented lense at 20.25'		20			5-9-24 N=33	21		34-20-14	43
				25			6-7-10 N=17	21			
29.4	0	cemented lense at 29.25'					50/5" N=50/5"	10			
		Boring Terminated at 29.4 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" SFA

Abandonment Method:
Piezometer installed

Notes:

WATER LEVEL OBSERVATIONS

Water not observed during drilling operations.

▽ *Water level checked on 11/20/2013*

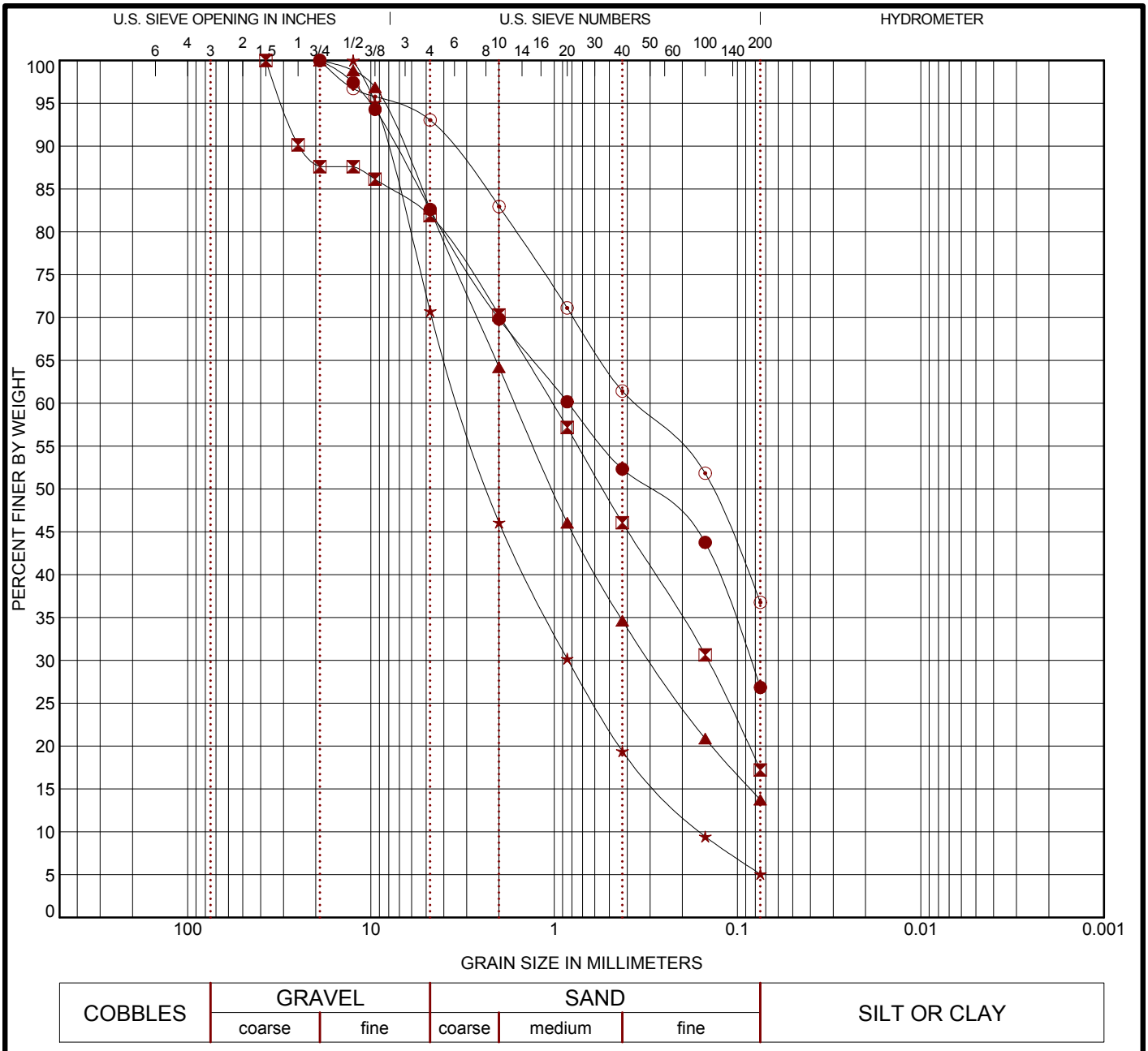
Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

Boring Started: 11/15/2013
Boring Completed: 11/15/2013
Drill Rig: CME-75
Driller: Brian
Project No.: 24135052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON_STD_TEMPLATE.GDT 12/2/13

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	1	1.0	SILTY, CLAYEY SAND with GRAVEL(SC-SM)	22	16	6		
⊠	2	1.3	SILTY SAND with GRAVEL(SM)	NP	NP	NP		
▲	4	9.0	POORLY GRADED SAND WITH GRAVEL (SP)	NP	NP	NP		
★	5	4.0	WELL GRADED SAND WITH GRAVEL (SW)	NP	NP	NP	1.36	20.50
⊙	5	9.0	SILTY, CLAYEY SAND(SC-SM)	14	10	4		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	1	1.0	19	0.837	0.085		17.4	55.8	26.8	
⊠	2	1.3	37.5	1.022	0.145		18.1	64.7	17.2	
▲	4	9.0	19	1.641	0.299		17.3	69.0	13.7	
★	5	4.0	12.5	3.258	0.84	0.159	29.2	65.7	5.1	
⊙	5	9.0	19	0.364			7.0	56.3	36.8	

PROJECT: Capitol Building Renovations

SITE: 24th Street & Capitol Avenue
Cheyenne, Wyoming

Terracon
1505 Old Happy Jack Road
Cheyenne, Wyoming

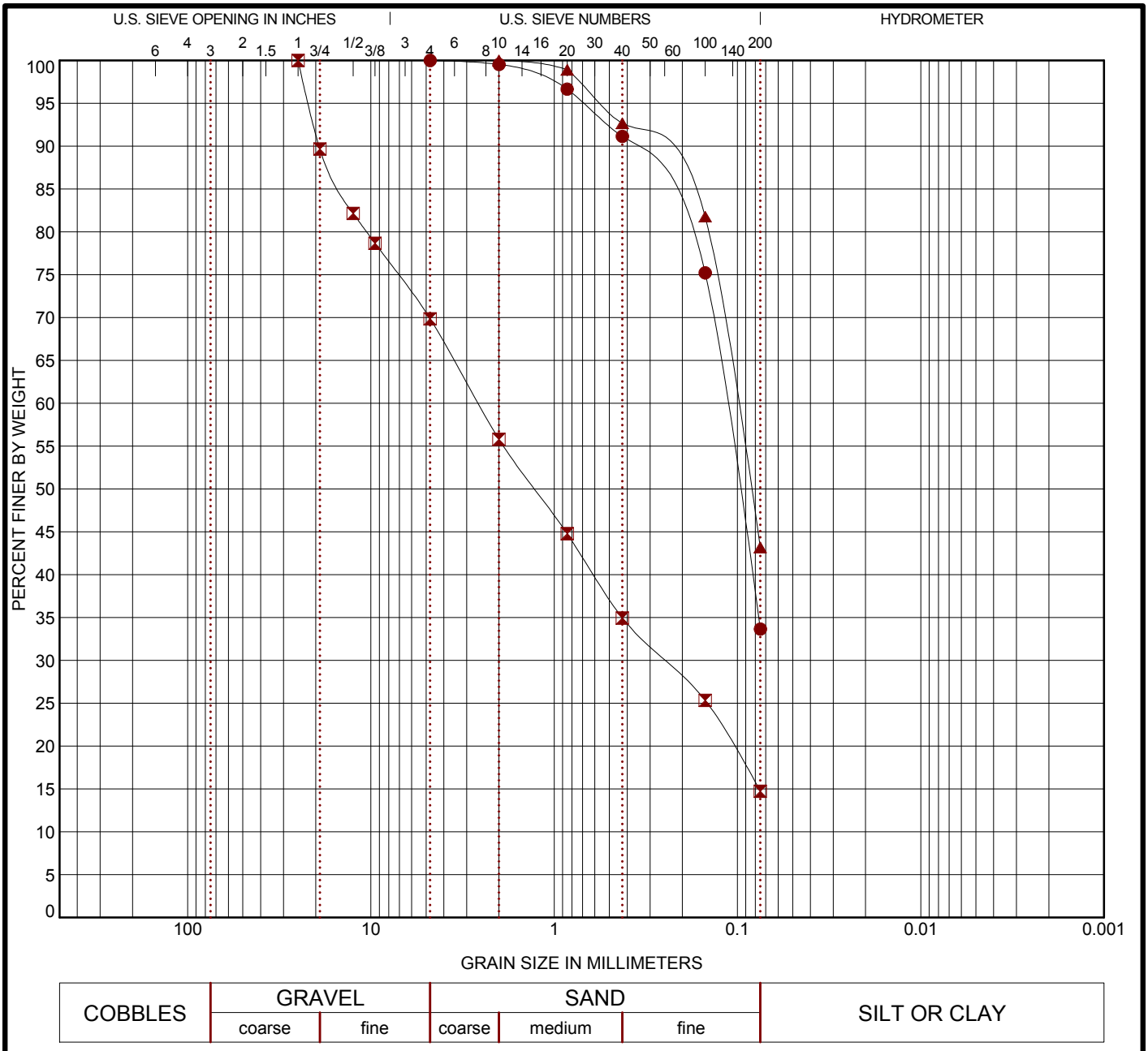
PROJECT NUMBER: 24135052

CLIENT: State of Wyoming Department of A&I

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON2012.GDT 12/2/13

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	5	24.0	CLAYEY SAND(SC)	34	17	17		
⊠	6	1.0	SILTY SAND with GRAVEL(SM)	NP	NP	NP		
▲	6	19.0	CLAYEY SAND(SC)	34	20	14		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	5	24.0	4.75	0.116			0.0	66.3	33.7	
⊠	6	1.0	25	2.592	0.249		30.1	55.1	14.7	
▲	6	19.0	2	0.101			0.0	56.8	43.2	

PROJECT: Capitol Building Renovations

SITE: 24th Street & Capitol Avenue
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LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 24135052 CALIPTOL BUILDING RENOVATIONS.GPJ TERRACON2012.GDT 12/2/13

SECTION 6.2
BUILDING EXTERIOR EVALUATION

PART 1 - GENERAL

1.1 TERRACON- LIMITED SCOPE EVALUATION OF BUILDING EXTERIOR DATED AUGUST 20, 2014.

LIMITED SCOPE EVALUATION OF BUILDING EXTERIOR - FINAL

Herschler Building

125 W. 25th Street

Cheyenne, Wyoming 82001

August 20, 2014

Terracon Project No. F6149127

Prepared For:

Mr. Dennis Egge

State of Wyoming Office of Construction Management

Cheyenne, Wyoming

Prepared By:

Terracon Consultants, Inc.

Wheat Ridge, Colorado

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

August 20, 2014

Mr. Dennis Egge
Project Manager
ph: 307.777.5691
em: dennis.egge@wyo.gov

Re: **Limited Scope Evaluation of Building Exterior/Interior**
Herschler Building
125 W. 25th Street
Cheyenne, Wyoming 82001
Terracon Project No. F6149127

Dear Mr. Egge:

Terracon Consultants, Inc. (Terracon) has completed a visual evaluation with limited instrument testing of the exterior walls and associated interior elements relative to the reported presence of moisture at the above-referenced property. The focus of this assessment was to determine the source(s) of the on-going water infiltration issues occurring at the property. Our scope also included an assessment of the as-built condition of the exterior walls to determine if conditions exist that would affect the long-term performance of the installed assemblies (i.e. roof, walls, windows, sealants, etc.). This work was performed in general accordance with the scope of services first outlined in Terracon Proposal No. PF6140009, dated March 21, 2014.

This document includes background information, a discussion of field activities, data collected during field activities, a discussion/analysis of findings, and recommendations for repair.

We appreciate the opportunity to be of service to you on this project. In addition to Facilities Services, our professionals provide geotechnical, environmental, construction materials services on a wide variety of projects locally, regionally and nationally. For more detailed information on all of Terracon's services please visit our web site at http://www.terracon.com. If you have any questions concerning this Report, or if we may be of further service, please do not hesitate to contact us.

Sincerely,
Terracon Consultants, Inc.

Ryan M. Cates, EIT
Staff Professional
Facilities Engineering Services

Brent A. Bell, PE
Senior Structural Project Engineer
Facilities Engineering Services

Attached: Limited Scope Evaluation of Building Exterior Report

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1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) is pleased to submit this Report of our findings to the State of Wyoming Office of Construction Management for the Herschler Building, located at 125 W. 25th Street, in Cheyenne, Wyoming. This work was performed in general accordance with the scope of services outlined in Terracon Proposal No. PF6140009, dated March 21, 2014.

1.1 Building / Property Information

The subject property consists of a four-story office building, separated into two wings (east and west) with a central lobby core. There is an underground, concrete parking garage that is constructed integrally with the main building. The property was constructed in 1983. The building has precast concrete cladding walls and aluminum-framed storefront windows.

1.2 Objective

Terracon has been requested to assess the condition of the subject building's roof, windows, cladding, planters, and underground parking garage, as water intrusion has been observed to have occurred at these areas in recent years. The time frame in which water infiltration first began is unknown. The Client has requested Terracon to identify possible sources of the moisture infiltration issues and provide recommendations for repairs. To help reveal, observe and evaluate the current conditions, Terracon used a borescope to capture pictures and videos at select locations.

1.3 Scope

The purpose of these services is to estimate the magnitude and cause(s) of water damage and infiltration in a wide array of in-situ construction assemblies. Additionally, possible remedies and repairs are to be identified to assist in rectifying the situation. The work performed consisted of:

- General visual observations of existing conditions of the exterior walls and window systems at both the exterior and, where accessible, the interior perimeter of the building;
- Visual observations of roof condition;
- Comparison of architectural drawings to 'as-built' conditions;
- Cutting observation openings at multiple locations in cladding to expose areas of concern.

In their examination of the building, HDR, Inc., the current project architect, identified precast fins, limestone base panels, planters, precast soffits, parapet walls, soffit fin tubes, a limestone wall and its base, the garage expansion joint, and the garage-to-plaza-deck connection as being areas of concern. Within these areas, Terracon was tasked with observing and evaluating the following items and issues:

- Extent and possible cause of water infiltration in each area;
- Connections of the precast fins and limestone panels;
- Precast panels at head and sill;

- Adjacent structural elements;
- Metal studs in cladding;
- Steel fireproofing;
- Wall and roof insulation (including “R”-values, if available);
- Flashing and waterproofing;
- Weeps (where installed);
- Soffit and soffit ventilation;
- Parapet walls;
- Discoloration of limestone;
- Garage expansion joints;
- Waterproofing at garage-to-plaza-deck connection;
- Drainage grade/slope of building elements and adjacent grade;
- Visibly identifying potential mold in each area.

This Report documents visual observations, descriptions of the conditions encountered, opinions as to the condition of the system observed, recommendations for appropriate follow-up actions, and general repair options.

Specifically excluded from this scope of work are testing or sampling beyond that referenced above, and evaluation of components and systems that comprise the overall building and site that are unrelated to the exterior wall, window and roof assemblies.

The scope of services for this Report did not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, or bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. Terracon can provide separate environmental services as part of a different scope, addressed by a different Report, including on-going testing, and which is fully outside of the scope of this Report.

2.0 BACKGROUND INFORMATION

2.1 Documents Reviewed

Terracon was provided with the following documentation for this property, which we have relied upon in providing our services and the assembly of this Report.

Documentation	Source
Limited As-Built Drawings, prepared by *HDR Architects*, dated January 6, 2014*	HDR Architects

***** Original As-Built Drawings were unavailable

2.2 Interviews

In conjunction with our on-site visits and while gathering pertinent information on this property, the following personnel were interviewed or have provided information, which we have relied upon in performing our services and preparing this Report. These individuals were designated as knowledgeable about the site and related improvements.

Name	Title	Telephone
Oley Person	Facility Maintenance Manager	307.286.6342
Dennis Egge	Project Manager – State of Wyoming Office of Construction Management	307.777.5691
Armando Risi	Senior Project Coordinator – HDR, Inc.	303.764.1520

The following information is based upon the reports, emails, and verbal conversations provided by these individuals:

A. The building was completed in 1983 and was occupied by the current Owner.
B. The Herschler State Office Building at the Wyoming State Capitol in Cheyenne, WY is currently experiencing problematic water infiltration into soffit spaces, exterior wall panel void spaces, and into the building.

2.3 Site Visits

Site visits were performed on the following dates by the Terracon individuals shown below. The other identified parties were present at the times of the site visits.

Monday, April 28, 2014		Josh Feider– Terracon – Staff Professional Brent Bell – Terracon – Structural Engineer, PE Dennis Egge – State of Wyoming Representative

		Armando Risi – Senior Project Coordinator Oley Person – Herschler Building Maintenance Personnel
Purpose		Pre-test conference & initial site walk-through to discuss the ongoing issues and develop an efficient schedule to move forward in the investigation.

Monday, May 5, 2014		Josh Feider– Terracon – Staff Professional Brent Bell – Terracon – Structural Engineer, PE Dennis Egge – State of Wyoming Representative Armando Risi – Senior Project Coordinator Oley Person – Herschler Building Maintenance Personnel
Purpose		Interior building walk-through.

Tuesday, May 6, 2014		Josh Feider– Terracon – Staff Professional Dennis Egge – State of Wyoming Representative Armando Risi – Senior Project Coordinator Oley Person – Herschler Building Maintenance Personnel
Purpose		Continuation of interior building walk-through. Accessed building components with the borescope. Accessed the roof, including inside the parapet wall.

Tuesday, May 13, 2014		Josh Feider – Terracon – Staff Professional Ryan Cates – Terracon – Staff Engineer, EIT
Purpose		Accessed the exterior of the building using a 65' boom lift.

2.4 Dew Point Calculations

Terracon analyzed five (5) different wall assemblies to calculate the potential of condensing water vapor. Dew point studies of multiple existing wall assemblies requested by HDR Architects. For each wall assembly analyzed, three (3) separate temperature gradients were considered and graphed. Moisture was anticipated to be present where the vapor pressure exceeded the saturation pressure. Please refer to Appendix A for dew point calculations and corresponding graphs.

Each graph assumes "as-built" conditions. No weathering effects (e.g. sealant degradation) are considered in the calculations. Because the conditions analyzed represent what is essentially a newly-installed condition, the analysis represents "bounding conditions", in which design deficiencies are considered separately from weathering effects.

3.0 OBSERVATIONS

3.1 Observed Site Conditions

Terracon investigated thirteen (13) selected areas that appeared visually compromised across the entirety of the exterior building. Many other areas were broadly observed, but not specifically sought for investigation. A borescope was used to aid in the examination of hidden voids and spaces of various building assemblies. Visual observations were more successful than borescope readings in determining the underlying moisture infiltration issues. During the assessment of the building's perimeter walls, planters, roof, and parking garage, the following observations were noted. Please refer to Appendix B for photographs of general conditions. Borescope information, video, and a memory stick are included with this Report.

Underground Parking Garage

1) The edges of the parking garage are in vertical alignment with the edges of the planters, which are located adjacent to the exterior of the building, on the first level.

2) Terracon observed several cracks on the ceiling and perimeter walls of the underground parking structure in the area of the planters. The structural engineer, Brent Bell, noted that the cracks were not structural concerns, but should be sealed to avoid future freeze-thaw degradation.

3) The majority of the cracks exhibited water infiltration, as evidenced by salt/mineral deposits along the crack lines.

4) Garage level drainage system functions (drains, gutters, etc.) were examined, and some leaking was observed in the drainage system piping.

Roof

5) The building's low-slope roof system generally consists of a built up roof system with a granular top layer (reportedly installed two years ago), covering the two wings and the south portion of the atrium area of the building.

6) The roof drains appeared to be functioning properly.

7) The roof over the central lobby is comprised of several rows of skylights set in painted metal frames.

8) The membrane base flashing extends up the perimeter parapet walls and terminates under a pre-finished painted aluminum cap.

9) Flashing on top and around the parapet walls is not completely sealed, and has several missing screws creating open holes.

10) At the building entrance (southwest corner of the east wing), the parapet wall was not insulated. There was also no insulation observed in the parapet wall, when viewed from the fourth floor below.

Exterior/Interior Walls and Windows

11) The cladding consists of both precast concrete and limestone panels with interconnecting storefront windows and curtain wall system.

12) Precast "C" sections form horizontal soffits between floors, and vertical precast fins form sun shades for the windows between the first and fourth floors.

13) Open void spaces and a 4-inch layer of fiberglass insulation separate the precast "C" sections from the inside of the building. The fiberglass insulation was observed to have had striations of discoloration, a possible indication of mold, in some locations. No laboratory testing was performed to determine the presence/absence of mold or mildew. The mitigation of the problem is the preferred action. Testing for specific mold type is unnecessary so long as proper PPE is used in correcting the condition.

14) The insulation, steel braces and kickers behind the soffits appeared to be dry. No visible mold was observed behind in the soffits except the possibility as noted in Item 13 above. The area behind the soffits also appeared to be dry.

15) Steel kickers brace the precast concrete and limestone panels to the main steel frame of the building. It appears that nearly all of the kickers have visible surface rust, although the Terracon structural engineer noted that the steel kicker shape and function did not appear to be compromised. It is likely that the kickers were installed without a rust-proof paint system. The main steel frame is painted and sprayed with fireproofing and did not show signs of rust. Some concerns were raised about the fireproofing of the steel, which had spalled in some locations. The severity of the spalling is of such a small distribution in the building, so as to be considered insignificant.

16) The precast concrete panels have joint sealant in between them. The sealant was observed to be highly weathered, deteriorated, and missing in many areas. The sealant was thought to be urethane-based, not silicone-based, when photos were subsequently reviewed by Terracon engineers. Further discussion on sealants can be found in the Recommendations section of this Report.

17) The limestone panels have either sealant or mortar between them. Approximately 10% of the sealant and mortar joints are cracked or deteriorated to the point that a credit card could be inserted through them.

18) The exterior windows (which are believed to be a Manko 2450FS model) are set in an anodized aluminum curtain wall system.

19) Throughout the interior of the building, wall heaters were installed directly behind (heating the back of) the windows.

20) Several window gaskets around the perimeter of the building had failed, and the glass had become loose, which was likely the result of long-term exposure to ultra-violet radiation from sunlight. The windows did not appear to be thermally broken (i.e. no gaskets, wood

setting blocks).

21) In many areas around the building, light gage steel in the cladding appeared to be loose, bent, and not flush with the windows.

22) One side of the limestone cladding is provided with a vapor barrier. No other vapor barrier was found on other cladding systems. These areas were covered with a thin, black, bituminous coating which appeared to serve as a vapor barrier.

23) The only exterior weeps observed were located in the sealant joints along the bottom of the parapet walls. While the weeps appeared to be intact, their function could not be fully assessed due to surrounding problems observed.

Planters

24) Prior to field observation, a portion of a planter was excavated and exposed. The exposed area was on the west side platform, on the north side of the building, adjacent to the entrance.

25) The exposed area revealed a waterproof membrane/sheet with a 1-inch layer of rigid foam insulation covering it. The planter bottoms were capped with a concrete topping slab. At the time of observation, the topping slab was submerged in approximately 2-inches of water.

26) It is believed that a waterproof membrane/sheet is concealed beneath the concrete topping slab. The thickness of the concrete and any other components underlying the concrete are considered hidden conditions. The planters are to be removed as part of a building addition project; therefore, coring through the topping slab to obtain a cross section was deemed unnecessary.

27) The expansion joint outside the building appeared to be adequately covered by the water proofing membrane that extends up the planter walls from the base.

4.0 ANALYSIS

On-going water infiltration of the subject building is the result of multiple sources. Upon examining all of the study data, the dew point calculations reveal that inherent design flaws add to the already considerable effects of weathering in the overall picture. Due to the nature of the construction, and our understanding of the wall assemblies, water infiltration may be from rainwater penetration through the windows into the walls, it may be caused by wall joint sealant deficiencies or failures, it may be the result of water condensing inside the walls, or it may be some combination thereof. The cracked, damaged, and/or missing joint sealants, along with the large gaps in the curtain wall systems, allows air infiltration/exfiltration into the wall and has the potential to be the primary source of condensation forming in the open ceiling areas and wall cavities.

Given the local climate, the vapor drive direction will change depending on the time of year. In summer, hot and humid air on the exterior will be driven to the cooler, conditioned interior. In winter, the vapor drive will reverse; the warmer conditioned air on the interior will be driven to the colder and dryer exterior. If some location in the interior of the wall reaches the dew point temperature, water vapor in the wall system will condense within the wall assembly.

Once water infiltrates a wall cavity, conditions conducive to the growth of mold and mildew can proliferate. On the north side of the first floor, the wall cavity is more prone to trap moisture, because the vinyl wall paper, installed on the interior face, acts as a vapor barrier, trapping the moisture in the cavity. Evaporation and drying rates of a wall will differ due to compass orientation and season. A wall's permeability and vapor diffusion characteristics will vary with many other factors, such as rainfall and interior heating/cooling and humidity conditions.

The dark striations observed on the fiberglass insulation inside the wall cavities and open ceiling areas could result from a variety of issues, including mold. Studies 4 and 9, Cases 1 and 3 and Study 6, Case 1 of the dew point calculations illustrate that the potential exists for water to condense within the wall. It cannot be shown conclusively that condensation or mold produced the striations. The area where the fiberglass insulation was observed is well ventilated with sufficient air flow and the insulation sample was dry to the touch.

Most areas observed did not have visible mold present. Terracon Industrial Health and Safety professionals were interviewed in the preparation of this Report to address mold issues, specifically. From that interview, it was learned that to *quantify* the hazards associated with mold would require further testing. Specifically, the collection of background air and surface samples, and the performance of any one of many mold-specific tests (petri dish growth, microscopic evaluation, etc.) to determine mold type, and associated health risk, would be necessary. However, such testing would not address mitigation or prevention. Those would be covered in a *qualitative* assessment.

The qualitative assessment of the mold issues addresses the immediate mitigation of the areas of concern. The localized wall areas which seem to be developing mold can be cleaned with commercial cleaners, by trained personnel wearing proper Personal Protective Equipment (PPE). Affected ceiling tiles and suspect insulation should be disposed of and replaced, while wearing proper PPE. A commercial cleaning contractor is recommended for that purpose. It should be noted that, while no immediate health risks were identified, the mitigation recommended is preferred to performing a quantitative assessment

Terracon's structural engineer did not feel that the missing fireproofing constituted any appreciable risk, particularly because it is present in areas where cladding kickers are not fireproofed. This construction technique is not uncommon in buildings of this age and as such, would not be

considered unsafe

The condition of the precast and limestone panel interior support system indicates the presence of moisture due to the high amount of surface rust present. As demonstrated in the dew point calculations of the various building assemblies, water vapor is condensing within the building and forming on the interior building components. The support system was installed without any protection against rust and is therefore slowly deteriorating. Furthermore, due to the age of the building, and the apparent lack of maintenance, the conditions for condensation have significantly increased.

The rust seen in the kickers is what would be anticipated for any unprotected steel in similar conditions. The Society for Protective Coatings (SSPC – formerly Steel Structures Painting Council) has information on appropriate steel paint systems.

5.0 RECOMMENDATIONS

While the exact cause of excess moisture in the wall may be able to be determined with additional investigation, hygrothermal analysis, and laboratory testing, the additional information will likely not change the core recommendations for resolving these issues. However, further investigation may reveal more details about the past presence of moisture in the walls and would help to develop a more tailored repair recommendation. Given the limited scope of the investigation, it should be understood that the following repair recommendations may not resolve all moisture issues nor eliminate the possibility of unanticipated future repairs and/or replacement.

With the known information to date, the following are Terracon's recommendations:

5.1 Underground Parking Garage Repairs

The cracks in the underground parking garage are not indications of structural deficiencies, but appear to be more of an aesthetic issue. When the planter systems get removed and repaired, moisture infiltration into the garage should cease. The cracks then should be cleaned of accumulated mineral deposits and debris, and a concrete sealant should be applied. The sealant recommended is ICO Primer LV or LVFC, as manufactured by International Coatings of Frank Park. IL, or approved equivalent epoxy resin floor coating.

5.2 Roof Repairs

The roof appeared to be in generally good condition with the exception of several missing screws in the perimeter flashing and parapet flashing, which could allow moisture infiltration. These open holes should be filled with new screws, or sealed with a ultra-violet resistant sealant. The existing coping is generally in acceptable condition, although some spot replacement may be needed where new screws will not re-adhere the coping.

5.3 Interior/Exterior Wall and Window Repairs

First and foremost, the deferred maintenance on the exterior sealant joints between both the concrete and limestone panels needs to be performed on the entirety of the building, and maintained. The existing urethane sealants need to be removed completely, which will likely

require grinding. Terracon recommends installing new sealants with silicone, as this sealant material has approximately a 20-year life expectancy compared to urethane, which has approximately a 7-year life expectancy. The grinding may be necessary because silicone will not adhere to a urethane base.

Window replacement is recommended, the selection of which may be based on cost. However, Terracon recommends windows by the following manufacturers be considered for the replacement option:

- YKK- America
- Oldcastle
- Vista Wall

Once the exterior sealants and window systems have been repaired or replaced, Terracon recommends performing an infrared thermographic survey of the exterior of the building. This will help to identify specific areas where heat is escaping, and where blown-in insulation may be the most effectively applied. Blown in or spray foam insulation is preferable in areas that are mostly inaccessible for other insulation applications.

Shop refurbishment of cladding, or complete cladding replacement is an architectural option that has been suggested for aesthetic and building performance purposes, but is considered beyond the scope of this Report. This Report specifically addresses engineering and building performance problems, causes, and remedies. Precast sections are not structurally damaged. Their replacement, if considered, is an architectural consideration.

Localized areas of delaminating vinyl wallpaper, paint, and drywall on the interior of the cladding, should be repaired as necessary. As the exterior of the building at these locations gets repaired, water intrusion issues should cease. Stained ceiling tiles should be replaced after other repairs have taken place.

Although the observed discoloration in the fiberglass insulation does not visually suggest the growth of mildew or mold, a more extensive investigation, such as field and laboratory testing, is recommended to further our understanding and safety of the employees and the building.

Although the level of intensity of rust is unknown, Terracon recommends removing the rust by means of sand blasting and then following up with an application of rust protective paint or applied coating.

5.4 Planters

Plans include the removal of existing planters, but they are to be replaced with a different system. However, it is recommended not to place new planters above the underground parking structure.

5.5 Maintenance System

A maintenance system is to be developed to ensure that the building envelope performs as intended.

QUALIFICATION STATEMENT

The observations, findings, analyses and recommendations contained within this Report are based on our professional judgment and information obtained during the course of this assessment based on the scope of work authorized. The recommendations presented herein are based on our observations, evaluation of the information provided, and the interviews with personnel familiar with the property. No design calculations were made to determine the adequacy of the in-place system(s) or compliance with current or previous building code requirements.

It is possible that defects and/or deficiencies exist that were not readily accessible or visible. Problems may develop with time, which were not evident at the time of this assessment. The opinions and recommendations in this Report should not be construed in any way to constitute a warranty or guarantee regarding the current or future performance of any system identified.

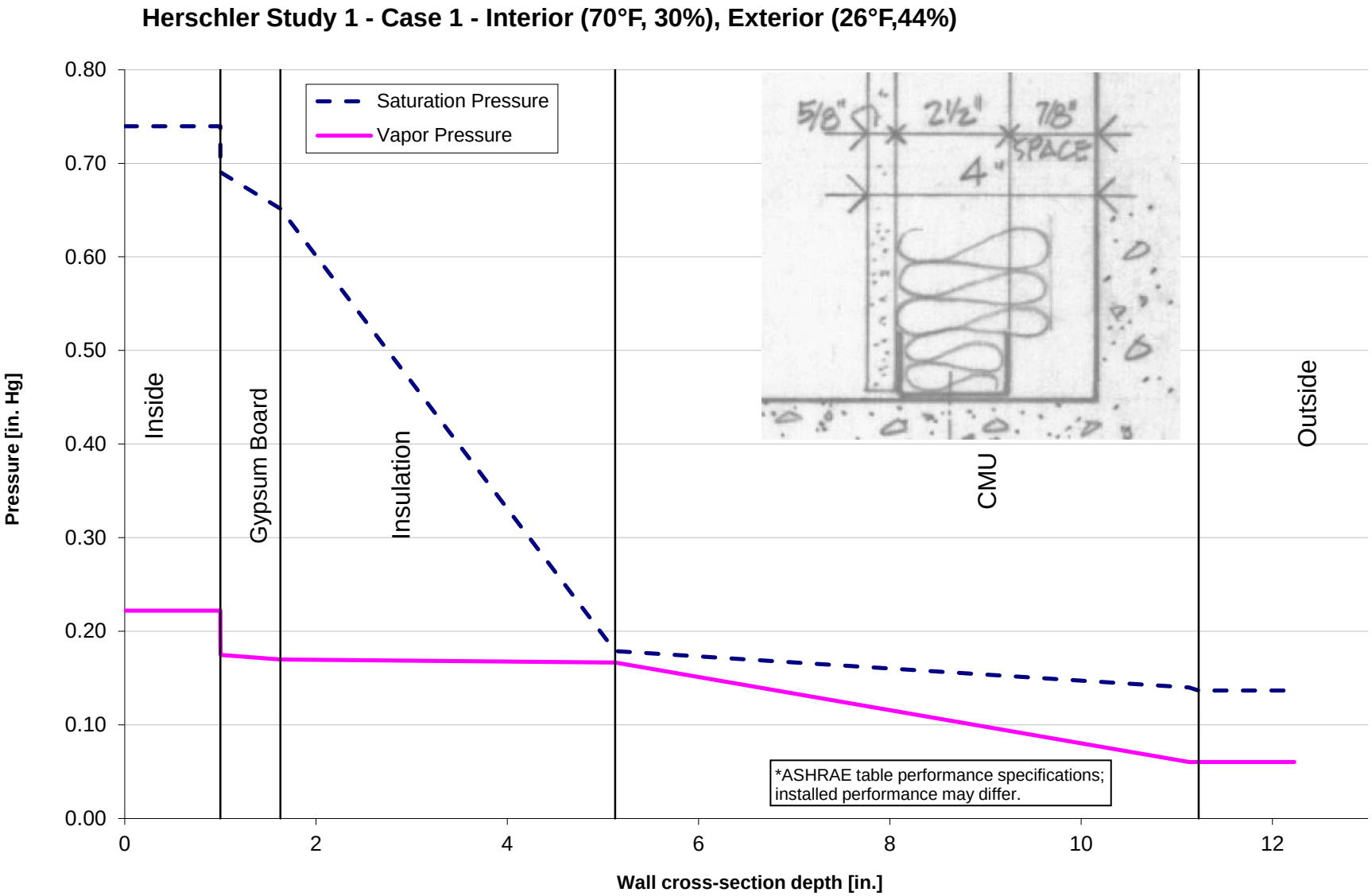
Neither the loss to contents or equipment within the building, nor the monetary loss due to business interruption, has been considered in this assessment. This document is a Report of our findings including general recommendations. Recommendations included herein are based upon the limited information made available to Terracon by the client and by our observations, which are also limited in nature. Recommendations included herein should not be construed or be used as specifications for completing the work.

This Report does not reflect variations that may occur across the site. The nature and extent of such variations may not become evident until re-construction, repairs or replacement occurs. If variations appear, it will be necessary to re-evaluate the recommendations of this Report.

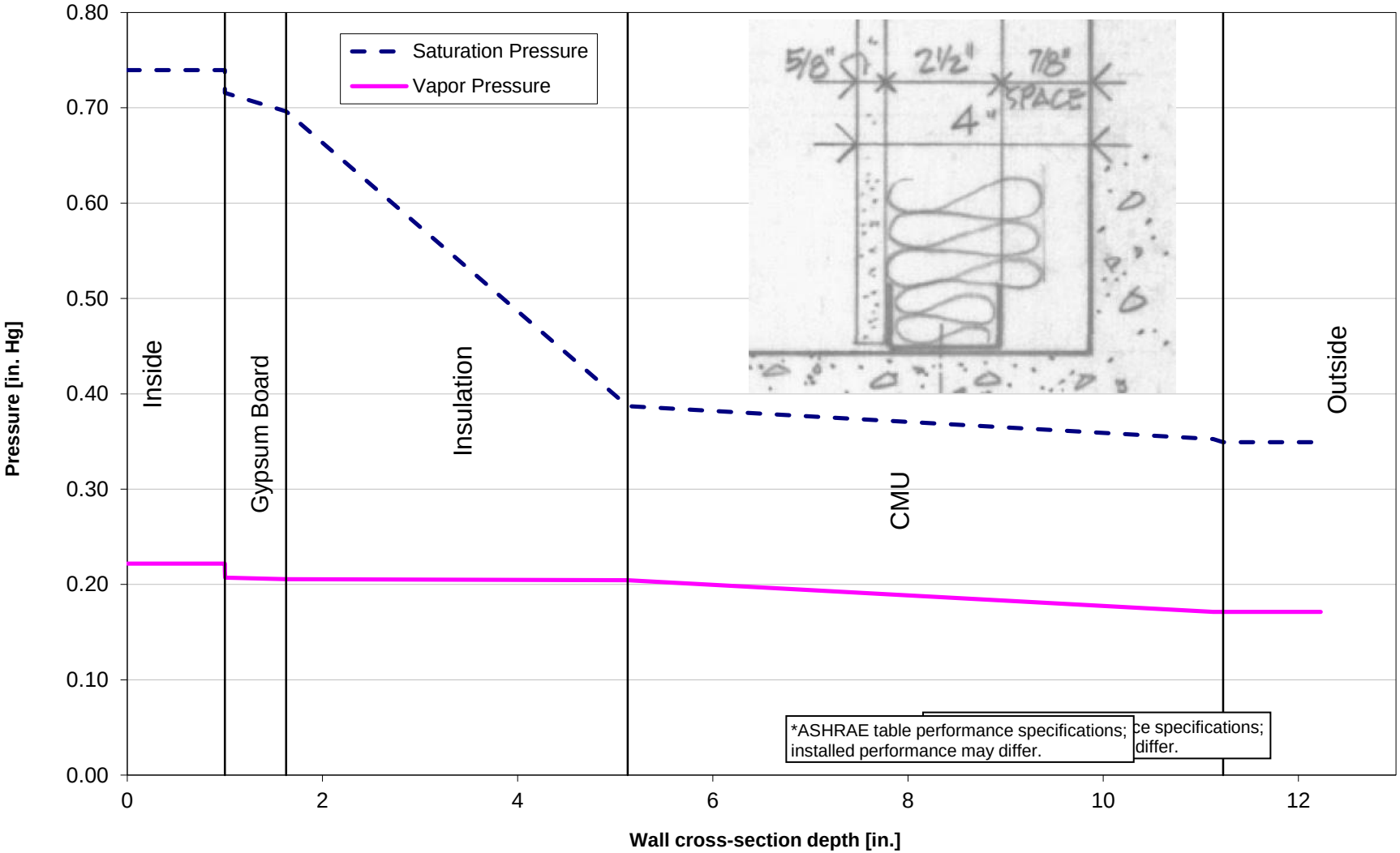
In the event that changes in the nature, design, or location of the project as outlined in this Report are planned, the analyses and recommendations contained in this Report shall not be considered valid unless the Consultant reviews the changes and either verifies or modifies the conclusions of this Report in writing.

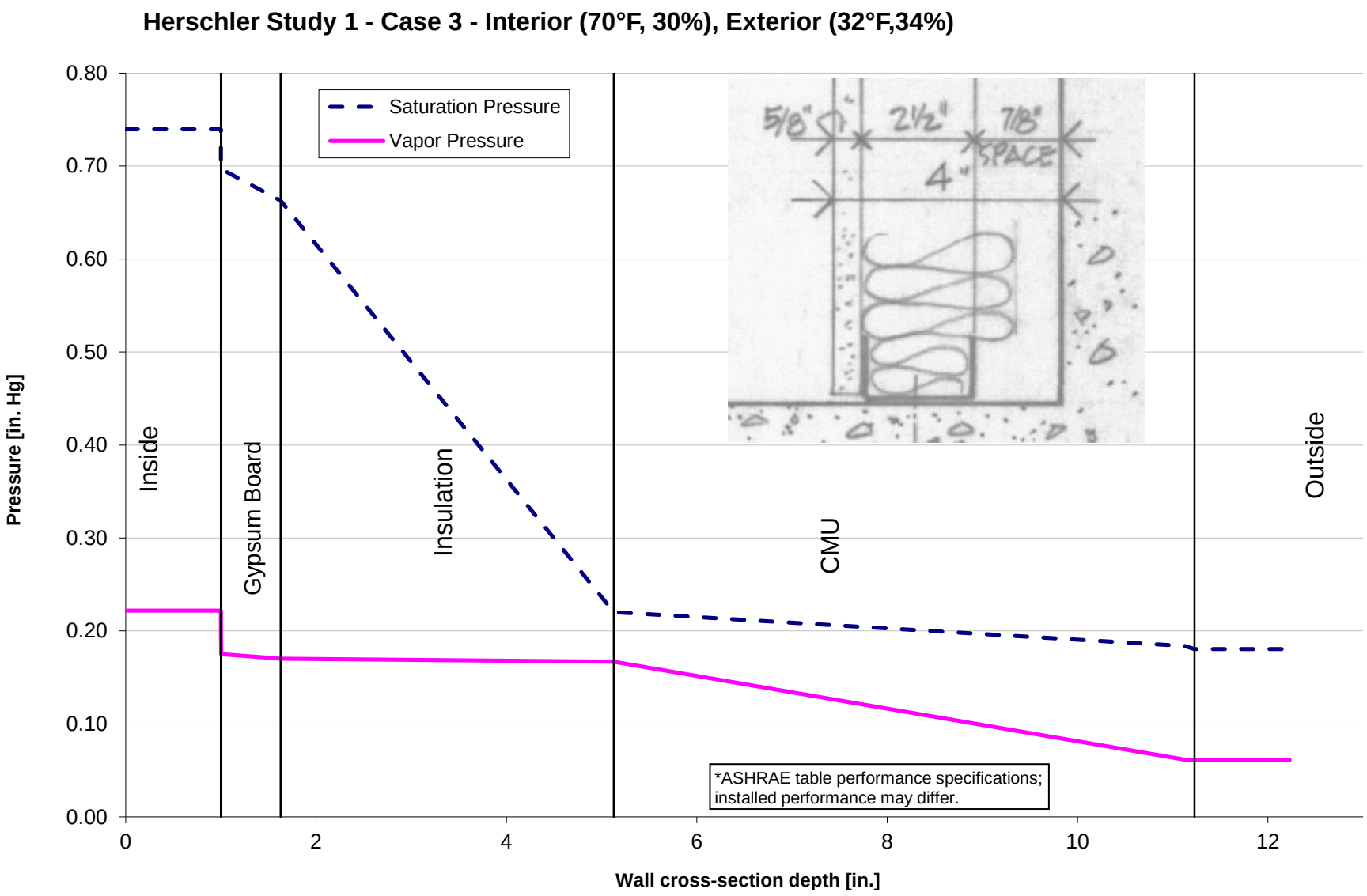
Terracon has provided consulting services for this assessment in general accordance with the Client's request for a site visit and a Report of our findings based on preliminary visual observations, limited moisture testing, and air leakage testing, subject to the extent that access was provided to the facility. The scope of services for this Report did not include, either specifically or by implication, any environmental or biological (e.g. mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the Client is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Appendix A
Dew Point Calculations and Graphs

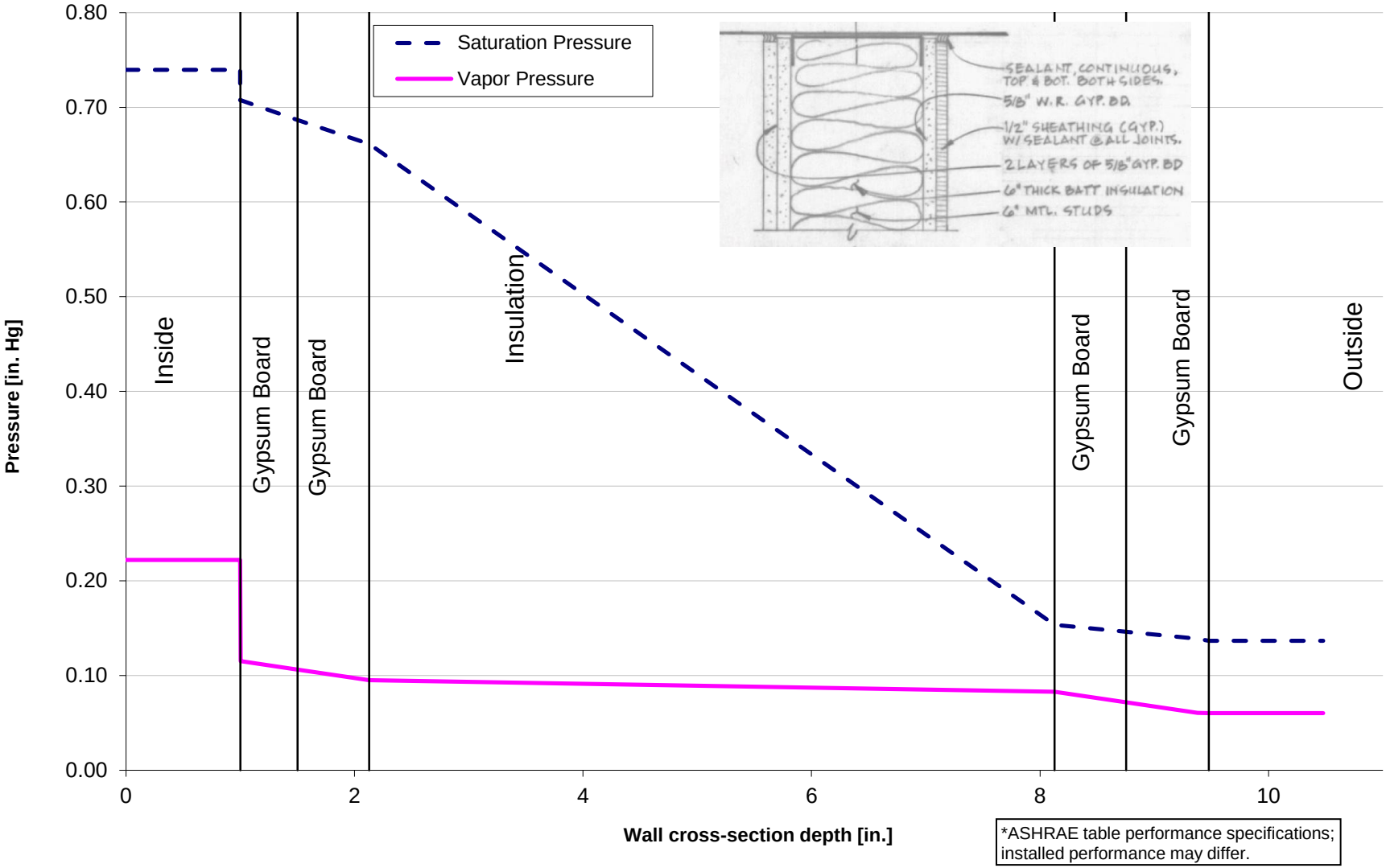

Herschler Study 1 - Case 1 - Interior (70°F, 30%), Exterior (26°F,44%)
Saturation Pressure
Vapor Pressure
Pressure [in. Hg]
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
Wall cross-section depth [in.]
Inside
Gypsum Board
Insulation
CMU
Outside
5/8"
2½"
7/8"
SPACE
4"
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 1 - Case 2 - Interior (70°F, 30%), Exterior (49°F,49%)



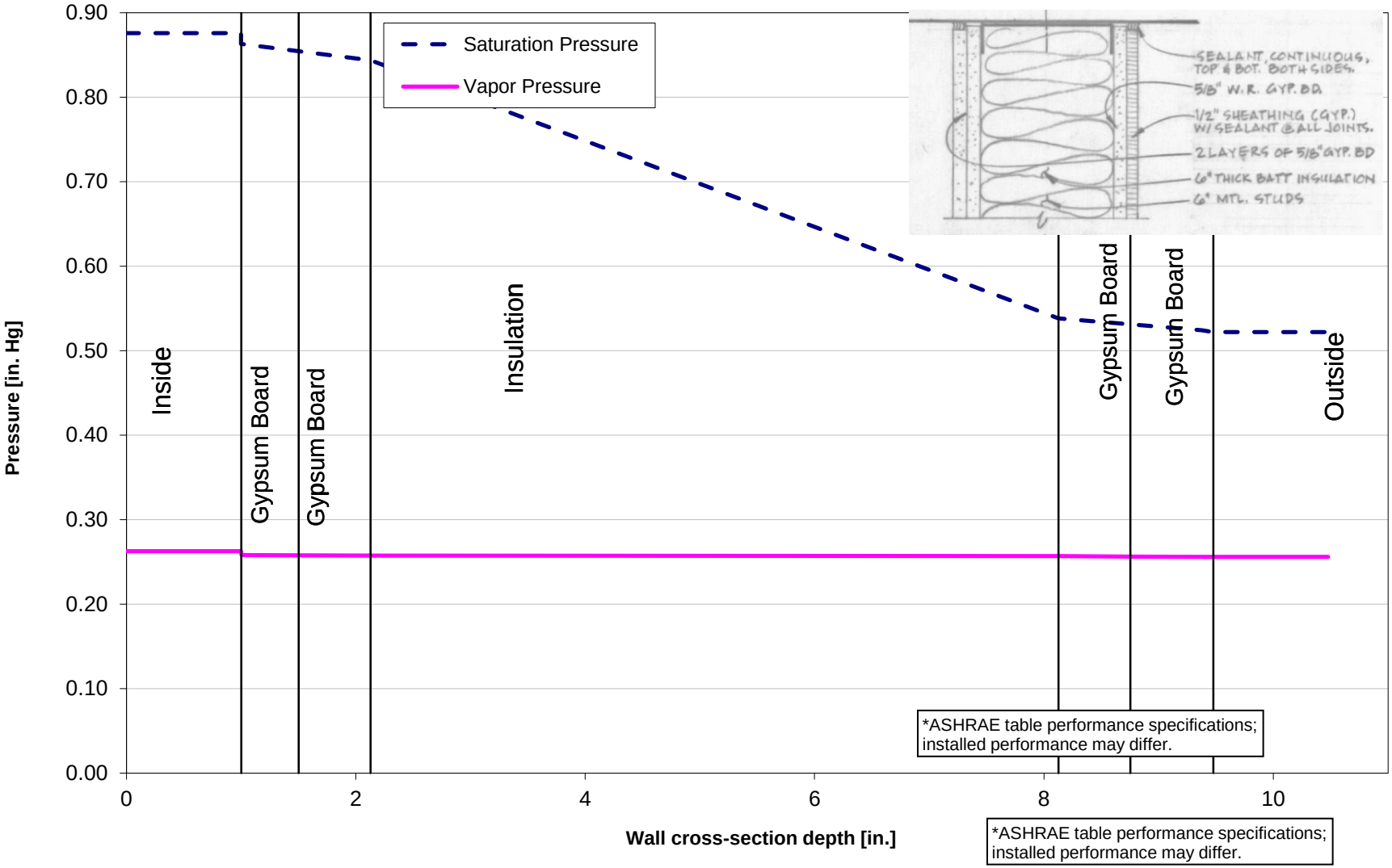

Herschler Study 1 - Case 3 - Interior (70°F, 30%), Exterior (32°F,34%)
Saturation Pressure
Vapor Pressure
Pressure [in. Hg]
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2
4
6
8
10
12
Wall cross-section depth [in.]
Inside
Gypsum Board
Insulation
CMU
Outside
5/8"
2½"
7/8"
SPACE
4"
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 2 - Case 1 - Interior (70°F, 30%), Exterior (26°F, 44%)



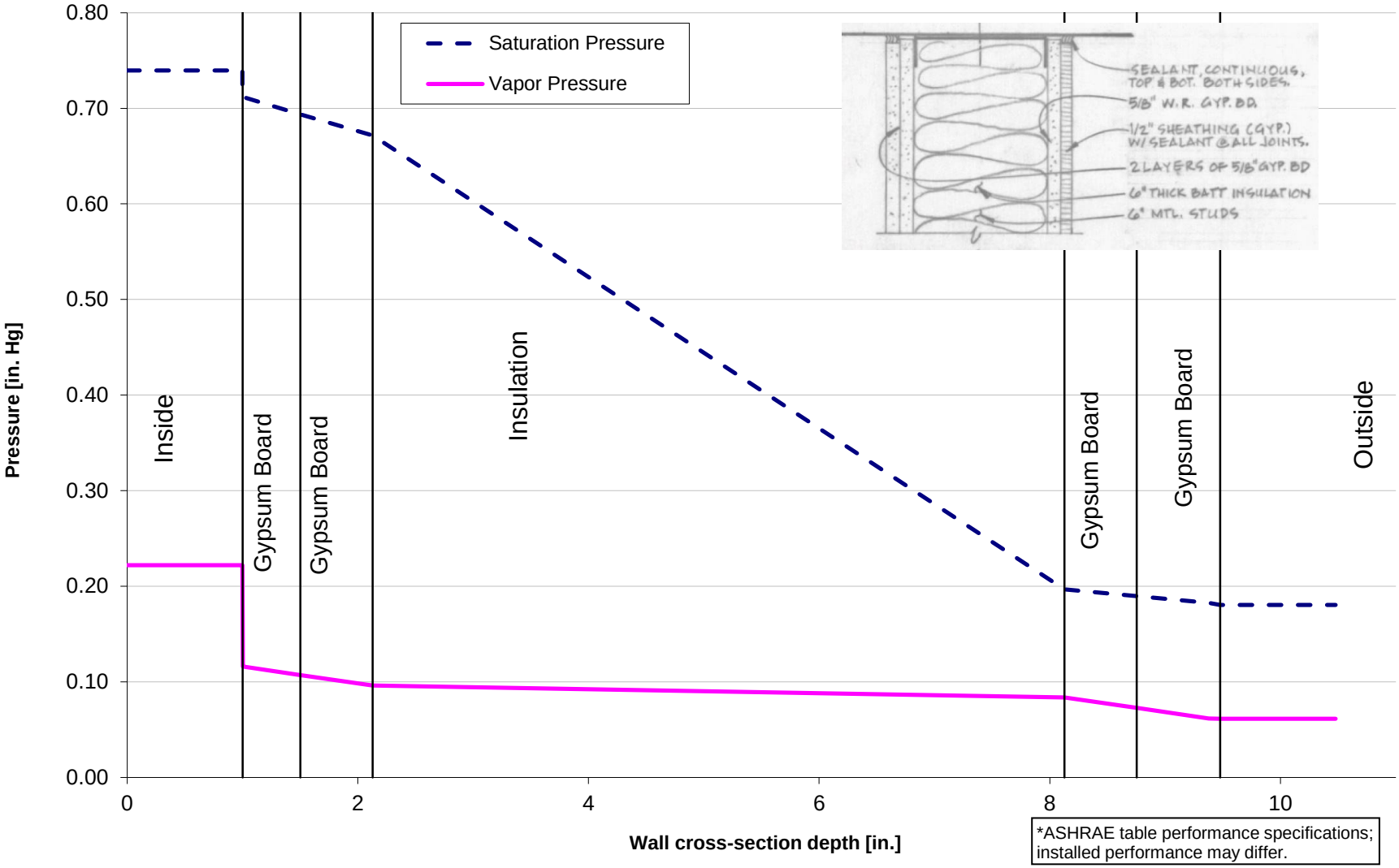
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 2 - Case 2 - Interior (75°F, 30%), Exterior (60°F, 49%)



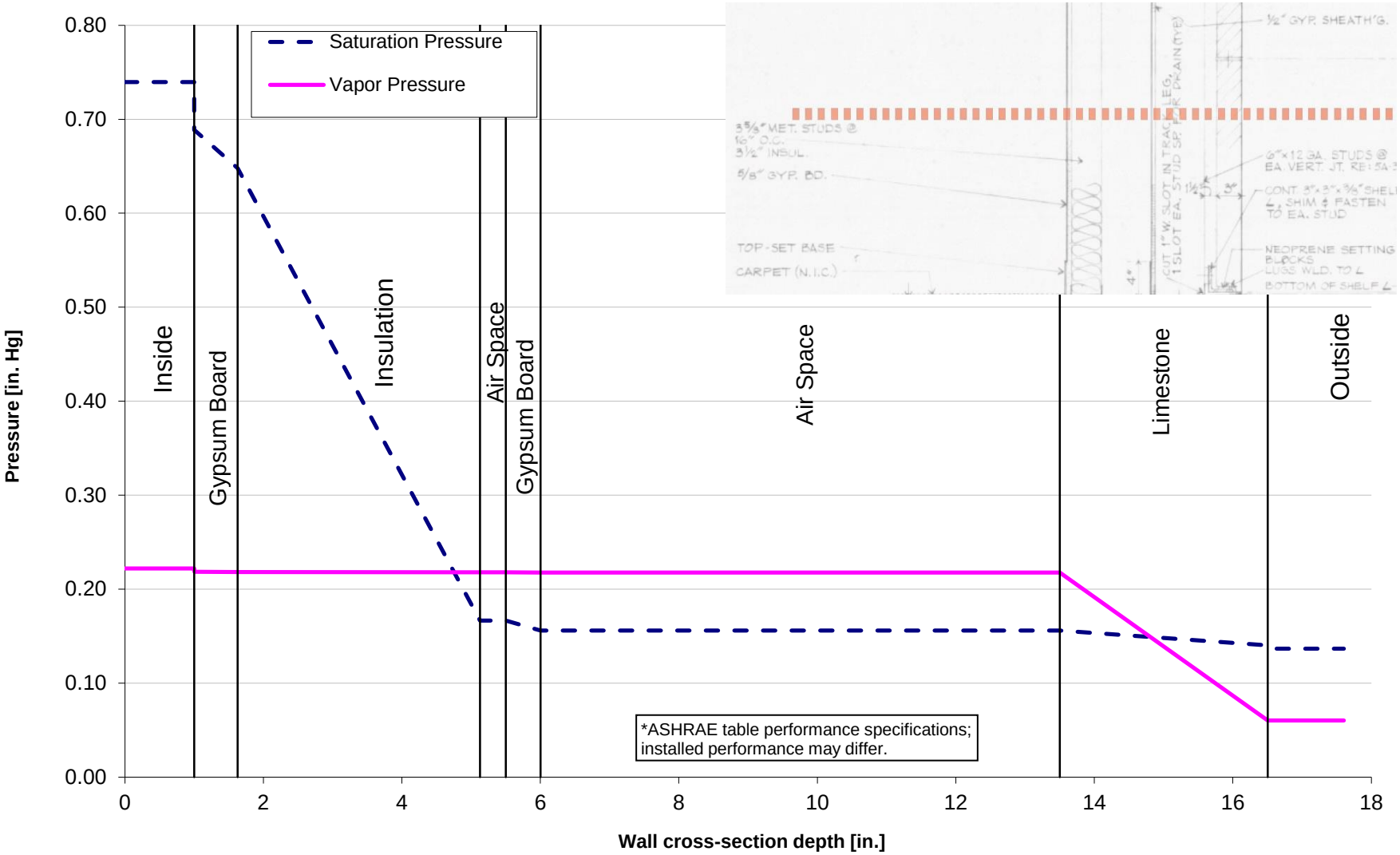
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 2 - Case 3 - Interior (70°F, 30%), Exterior (32°F, 34%)

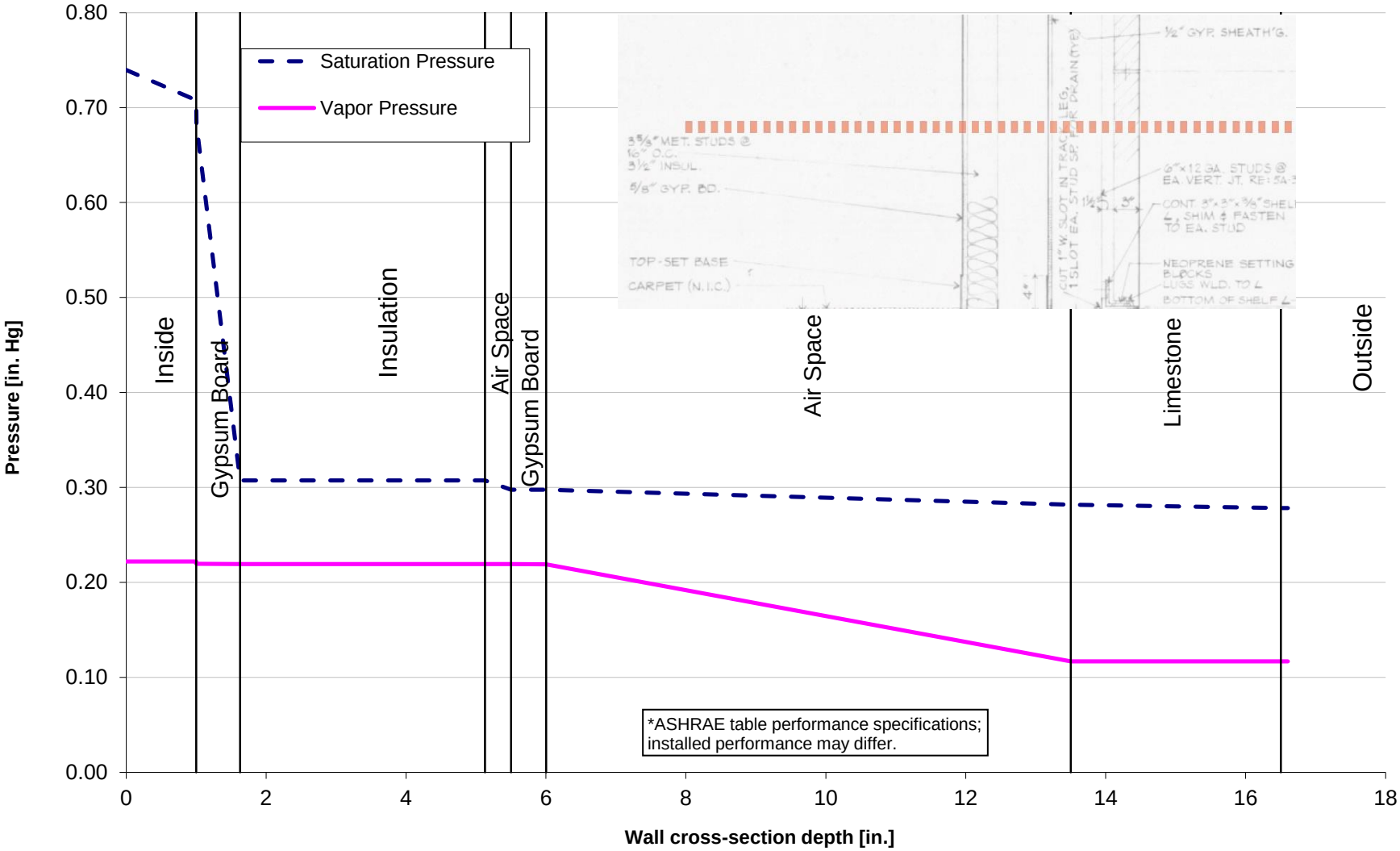


*ASHRAE table performance specifications; installed performance may differ.

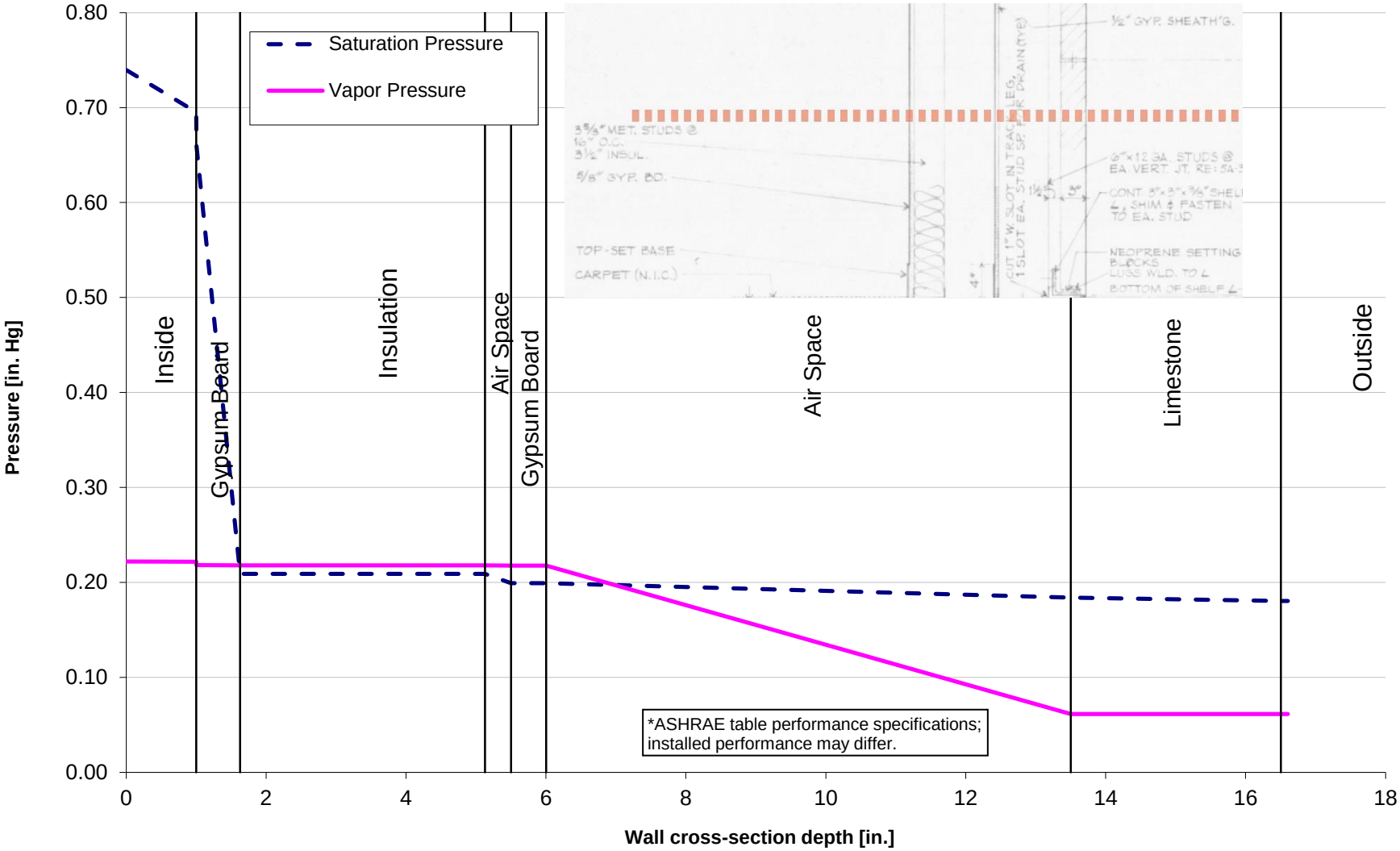
Herschler Study 4 - Case 1 - Interior (70°F, 30%), Exterior (26°F, 44%)



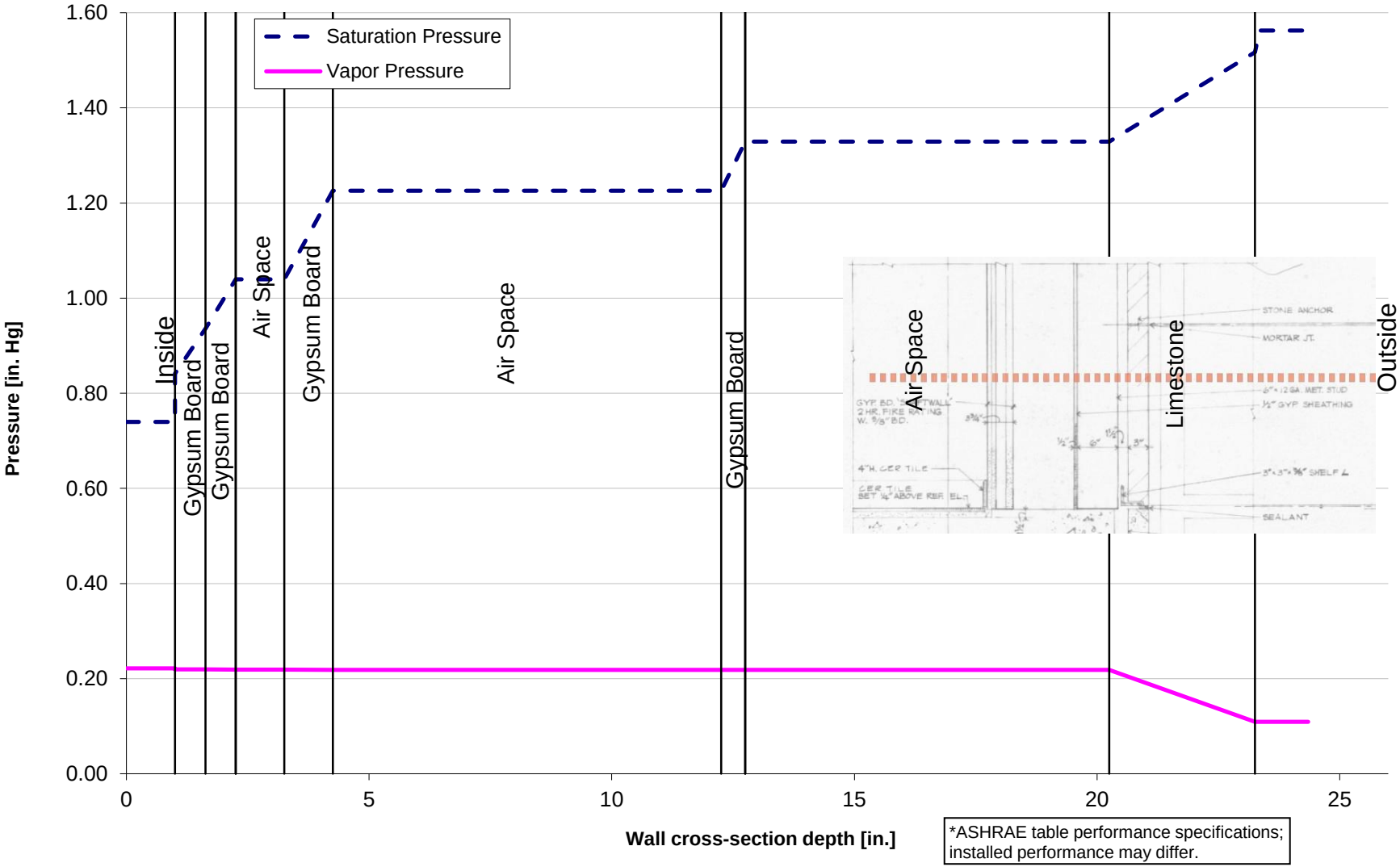
Herschler Study 4 - Case 2 - Interior (70°F, 30%), Exterior (43°F, 42%)



Herschler Study 4 - Case 3 - Interior (70°F, 30%), Exterior (32°F, 34%)

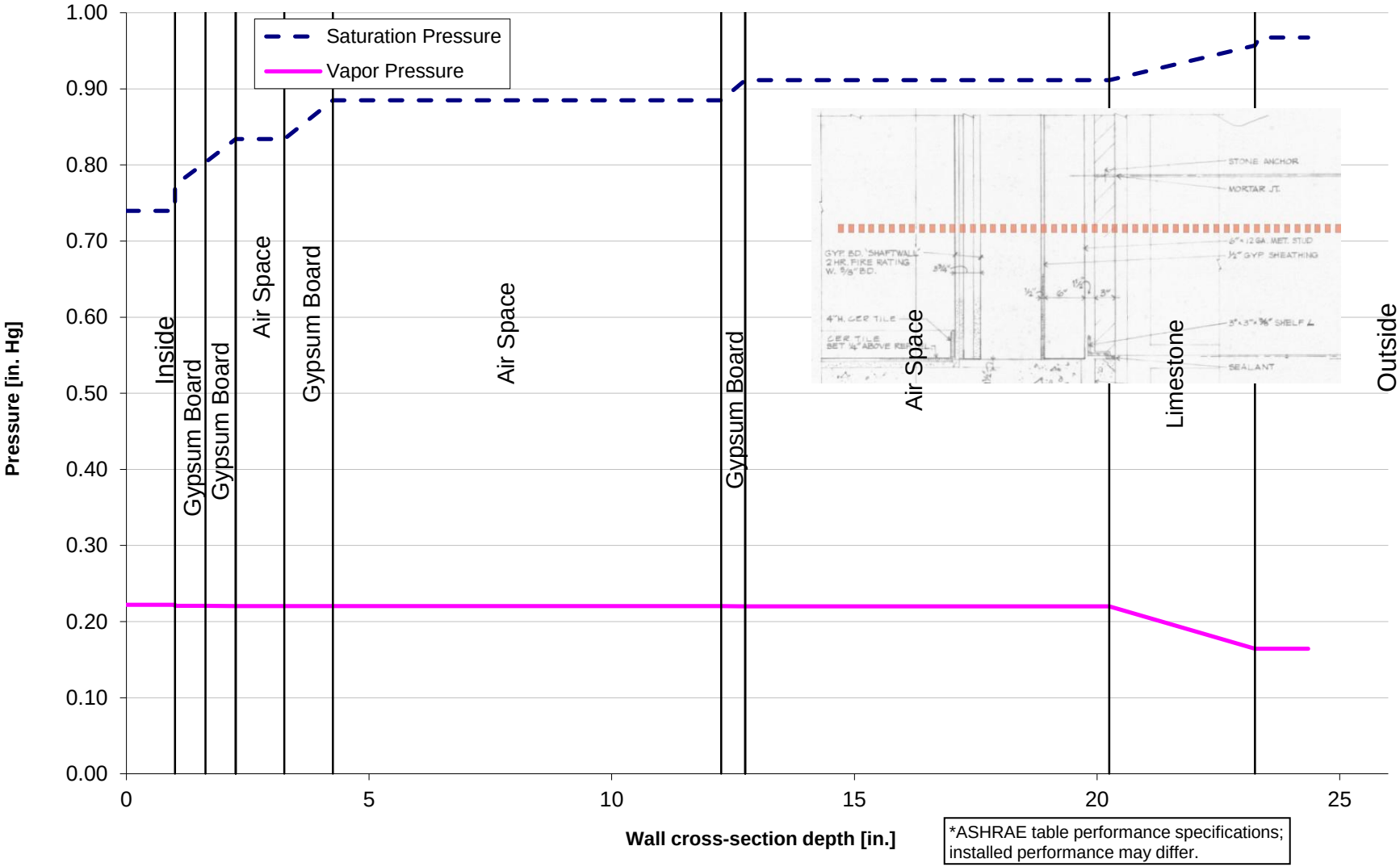


Herschler Study 6 - Case 1 - Interior (70°F, 30%), Exterior (93°F, 7%)



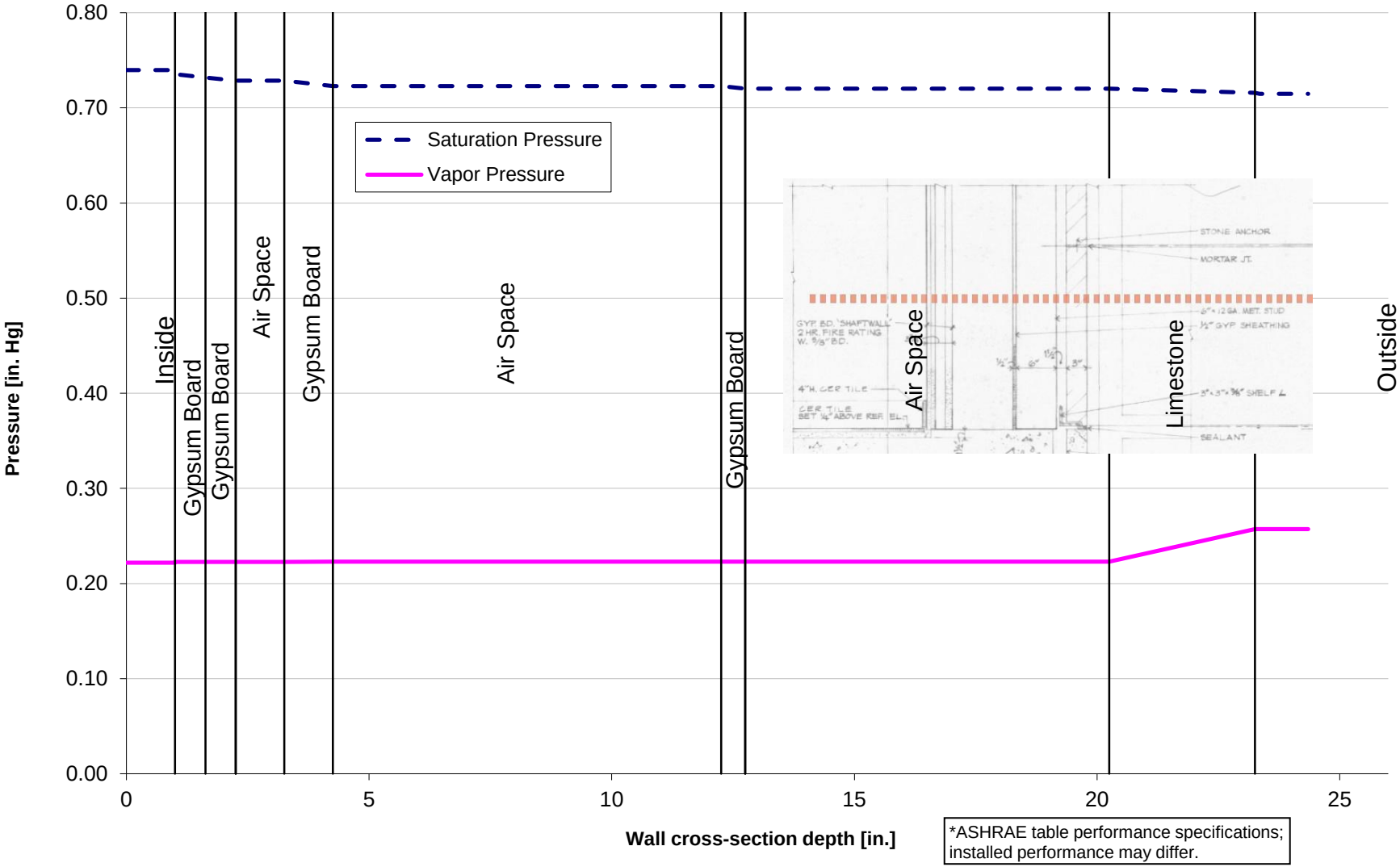
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 6 - Case 2 - Interior (70°F, 30%), Exterior (78°F, 17%)

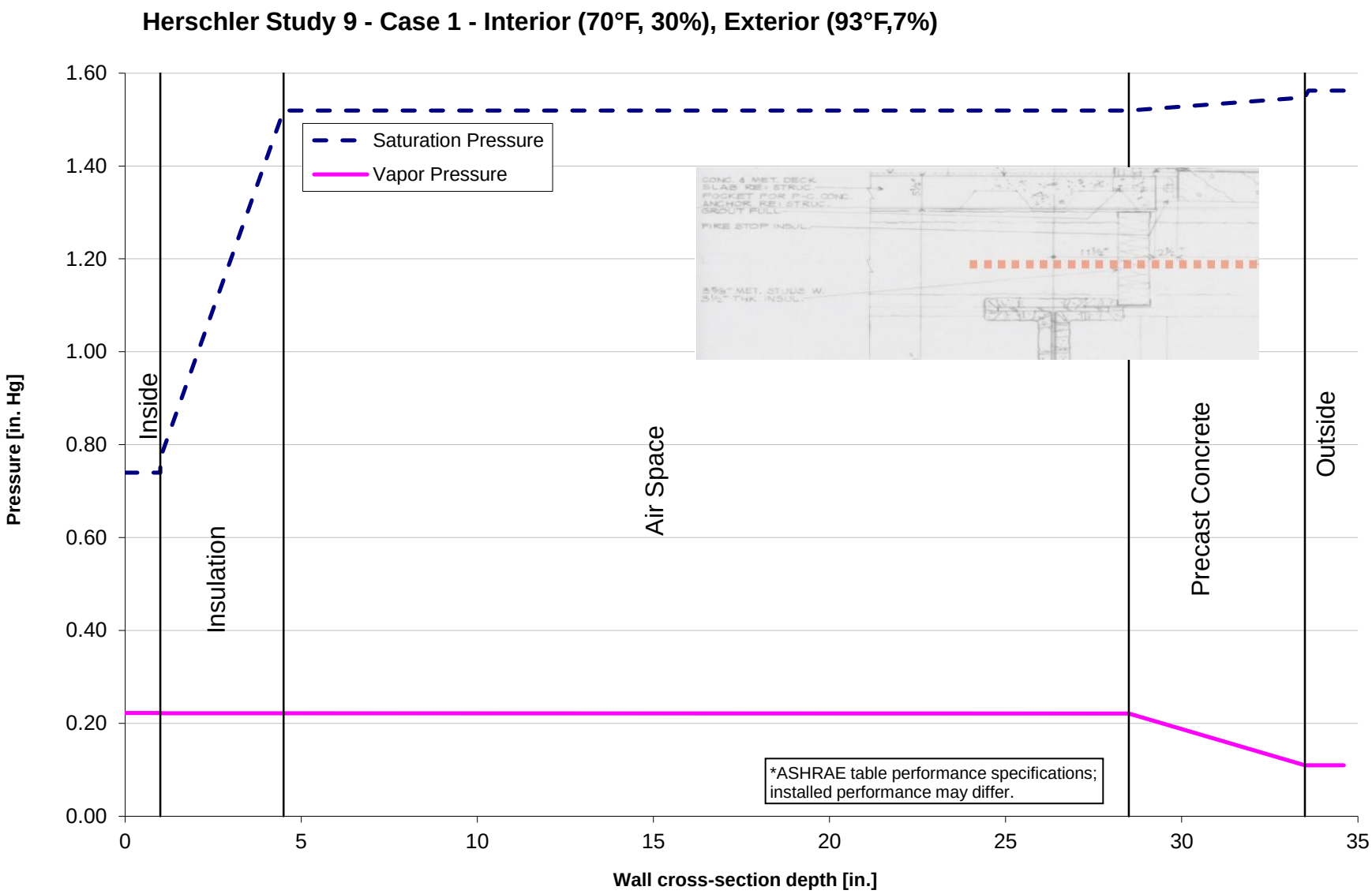


*ASHRAE table performance specifications; installed performance may differ.

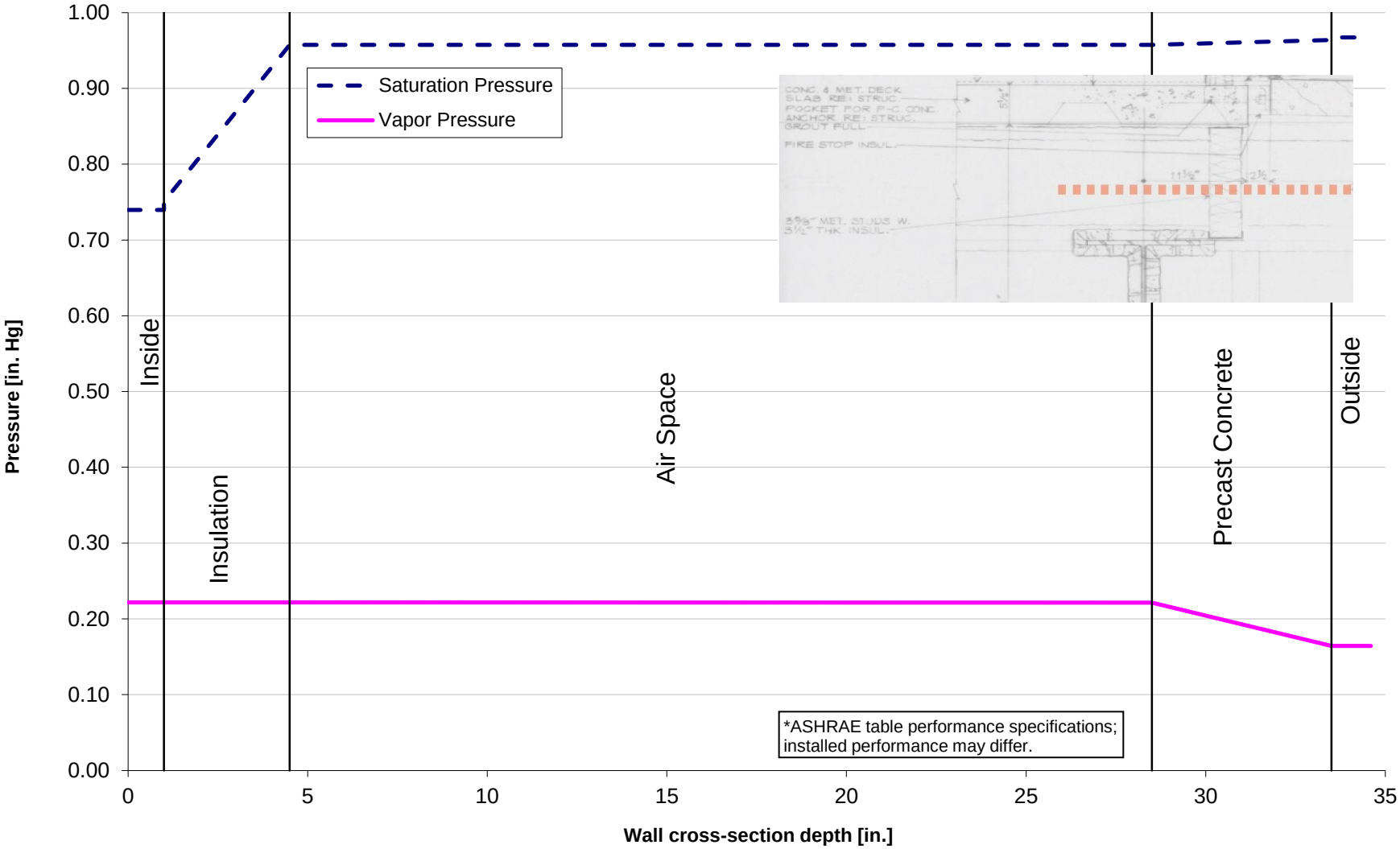
Herschler Study 6 - Case 3 - Interior (70°F, 30%), Exterior (69°F, 36%)



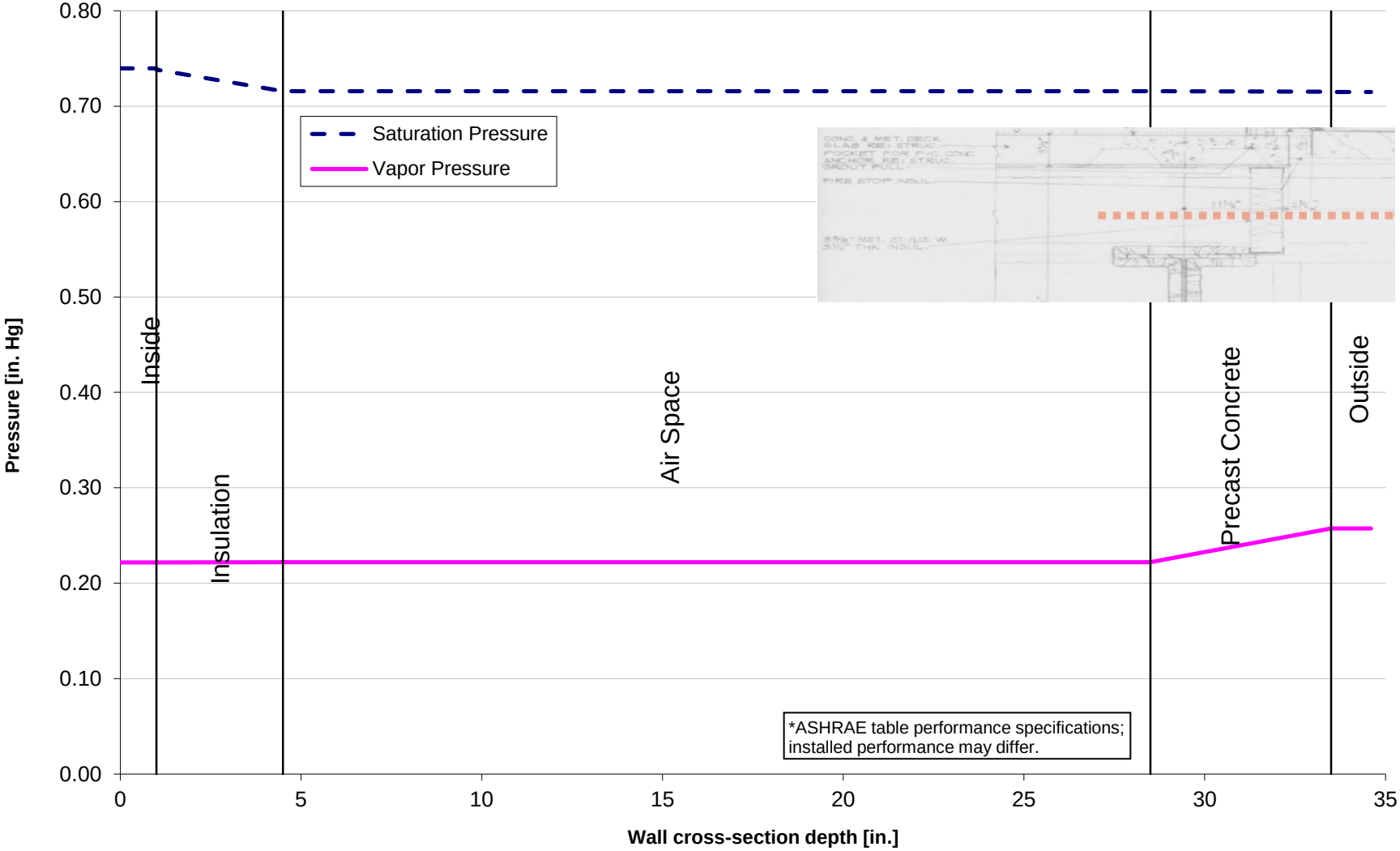
*ASHRAE table performance specifications; installed performance may differ.


Herschler Study 9 - Case 1 - Interior (70°F, 30%), Exterior (93°F,7%)
Pressure [in. Hg]
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
15
20
25
30
35
Wall cross-section depth [in.]
Saturation Pressure
Vapor Pressure
Inside
Insulation
Air Space
Precast Concrete
Outside
*ASHRAE table performance specifications; installed performance may differ.

Herschler Study 9 - Case 2 - Interior (70°F, 30%), Exterior (78°F,17%)



Herschler Study 9 - Case 3 - Interior (70°F, 30%), Exterior (69°F,36%)



Appendix B
Photographic Documentation

Photo #1 Exterior weep holes at the base of the parapet wall (typical).

Photo #2 Typical separation of window from frame multiple observed at multiple locations.

Photo #3 Typical condition of the exterior joint sealants. (Approx. 1.25 in. X 0.375 in.)

Photo #4 Typical condition of the exterior joint sealants.

Photo #5 Typical condition of the exterior joint sealants.

Photo #6 Typical condition of the exterior joint sealants. (Approx. 0.375 in. X 1.5 in.)

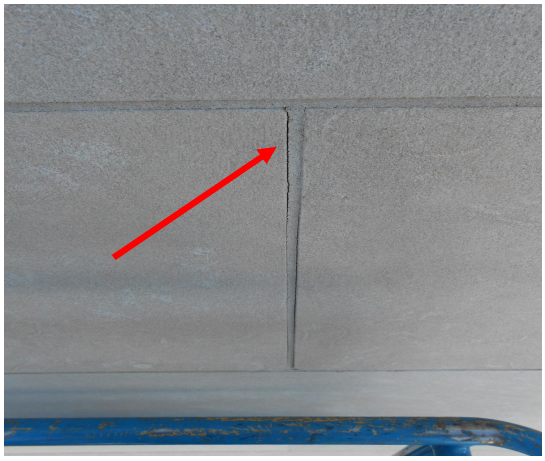


Photo #7 Representative cracking (approx. 0.125 in. X 4 in.) in the mortar joints of the limestone panels.

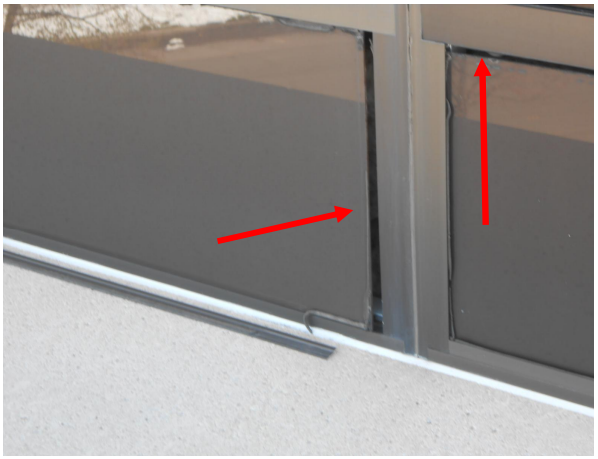


Photo #8 Large gaps created by weathering of the window gaskets, typical at multiple locations.

Photo #9 Typical condition of the exterior joint sealants.

Photo #10 Typical condition of the exterior joint sealants.

Photo #11 Large gaps created by weathering of the window gaskets, typical at multiple locations.

Photo #12 Weathered confining gasket in the window panes of the curtain wall system.

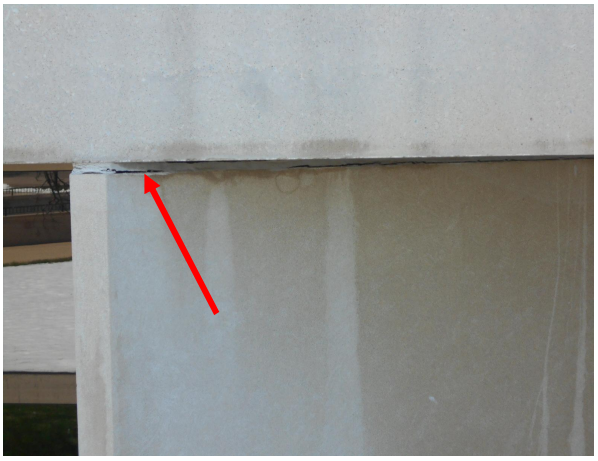


Photo #13 Typical weathered sealant joints between the precast fins on the south side.

Photo #14 Representative cracking in the mortar joints of the limestone panels.

Photo #15 Typical condition of the exterior joint sealants.

Photo #16 Typical condition of the exterior joint sealants. (Approx. 0.625 in. X 1.5 in.)

Photo #17 Typical condition of the exterior joint sealants.

Photo #18 Representative area where water penetrates through a weathered sealant joint.

Photo #19 Large gaps were observed at the sides of multiple windows.

Photo #20 Representative area of loose mullions in the curtain wall system.

Photo #21 Interior area where the paint is delaminating. Same area as seen in photo #20, but on the inside.

Photo #22 Representative view of inside the precast soffit. Typical surface rust on the steel bracing.

Photo #23 Representative view of inside the precast soffit. Typical surface rust on the steel bracing. Note the stain on the fireproofing.

Photo #24 Evidence of interior water intrusion.

Photo #25 Representative view above the drop-ceiling, where the exterior precast panels tie into the steel bracing; typical surface rusting.

Photo #26 Representative view above the drop-ceiling, where the exterior precast panels tie into the steel bracing; typical surface rusting.

Photo #27 Fiberglass insulation separating the precast soffit area and drop-ceiling area with 4-inch max thickness.

Photo #28 Representative view of inside the precast soffits. Typical surface rust is visible on steel bracing.

Photo #29 Exposed waterproofing liner in the planter over the underground parking structure.

Photo #30 Exposed waterproof liner in the planter. Concrete covers the planter bottom. The presence of waterproofing beneath the concrete is unknown.

Photo #31 Roof membrane termination at the top of the parapet wall.

Photo #32 One of many open screw holes in the roof membrane/counter flashing interface.

Photo #33 Opening in the parapet wall coping cap.

Photo #34 Representative view above the drop-ceiling, where the precast panels tie into the steel bracing; typical surface rusting.

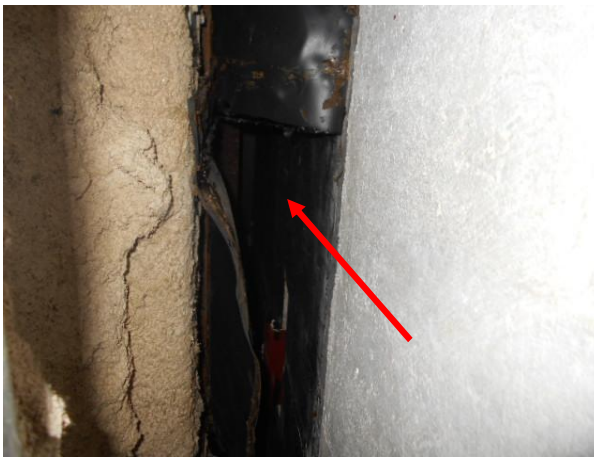


Photo #35 Looking up into the parapet wall. The arrow denotes the open space.

Photo #36 Representative view above the drop ceiling. Typical water stains in the fireproofing are visible.

Photo #37 Efflorescence through cracks in the parking garage walls.

Photo #38 Deposits from the leaking water in the parking garage forming around ceiling cracks.

Photo #39 Looking up at the concealed expansion joint in the parking garage ceiling by PVC pipe. The pipe is leaking.

Photo #40 Efflorescence as a result of the parking garage ceiling cracks.

Photo #41 PVC piping that conceals the expansion joint in the parking garage ceiling.

Photo #42 Efflorescence in the parking garage ceiling cracks.

Photo #43 Efflorescence in the parking garage ceiling cracks under planters.

Photo #44 Efflorescence in the parking garage ceiling cracks.

Photo #45 Efflorescence in the parking garage ceiling cracks under planters.

Photo #46 Surface drain in the parking garage.

SECTION 6.3
TRAFFIC STUDY

PART 1 -

1.1 HDR – TRAFFIC IMPACT STUDY- DATED SEPTEMBER 12, 2014

Traffic Impact Study Final Draft

Wyoming Capitol and Herschler Building

September 12, 2014

A traffic impact study on the effects of the proposed alternative on the traffic surrounding the Wyoming Capitol campus in Cheyenne, Wyoming

Prepared by: HDR Engineering

1670 Broadway Suite 3400
Denver, CO 80202-4824 (303) 303.764.1520

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Project Description

The State of Wyoming has hired HDR to develop design plans for the expansion of the Herschler Building in downtown Cheyenne, Wyoming. This expansion includes adding two floors to Herschler, modifying the usage of the existing floors of the building to increase the number of offices on each floor, and modifying the vehicular access to and parking configuration of the existing parking structure beneath Herschler to improve security and to improve the surface landscaping around Herschler and the State Capitol campus. The project also includes providing additional off-site parking at what will be called the Pioneer Parking Lot west of Herschler and the St. Mary's Parking Lot east of Herschler.

The City of Cheyenne has requested that HDR perform a traffic analysis to assess the traffic impacts associated with the additional office space, the parking structure access modifications and the additional off-site parking. This traffic study report documents the analysis methodologies, findings and recommendations associated with these improvements. The traffic analyses contained within this report were developed in accordance with the Transportation Impact Studies requirements as outlined in Article 3 of the City of Cheyenne Unified Development Code.

The parcel of land that houses the Herschler Building and the State Capitol is bounded by 26th Street on the north, 24th Street on the south, Carey Avenue on the west and Central Avenue on the east. Twenty-fourth Street and 26th Street are two-lane, two-way roadways that provide one lane in each direction, Carey Avenue is a three-lane, one-way roadway that moves traffic in the northbound direction, and Central Avenue is a two-lane, one-way roadway that moves traffic in the southbound direction. All four streets provide on-street parking on both sides of the street, except for Carey Avenue, where on-street parking is permitted on the campus side of the street only. Access to the existing parking structure that is beneath the Herschler Building is provided via signalized intersections along 25th Street at Carey Avenue and at Central Avenue. Public vehicular access can be taken from either intersection, with truck traffic permitted only from the Carey Avenue side and the Governor/VIP traffic using the Central Avenue side.

Existing traffic control of the intersections adjacent to the project site includes signalized intersections at Carey Avenue & 24th Street, Carey Avenue & 25th Street, Central Avenue & 24th Street and Central Avenue & 25th Street, and unsignalized intersections at Carey Avenue & 26th Street and Central Avenue & 26th Street. The speed limit along these streets is 30 mph.

The heart of downtown Cheyenne is just five blocks to the south of the campus, while two libraries, the Wyoming State Museum and the post office are within two blocks of the campus.

The Cheyenne Transit Program operates two bus routes that run adjacent to the campus, including the Northwest Route and the Downtown Route. The Northwest Route runs along Central and Warren Avenues and 24th Street on its way to/from the mall area, while the Downtown Route runs along 24th Street to/from the eastern parts of the city.

The project site and elements of the surrounding transportation network can be found in **Figure 1**.

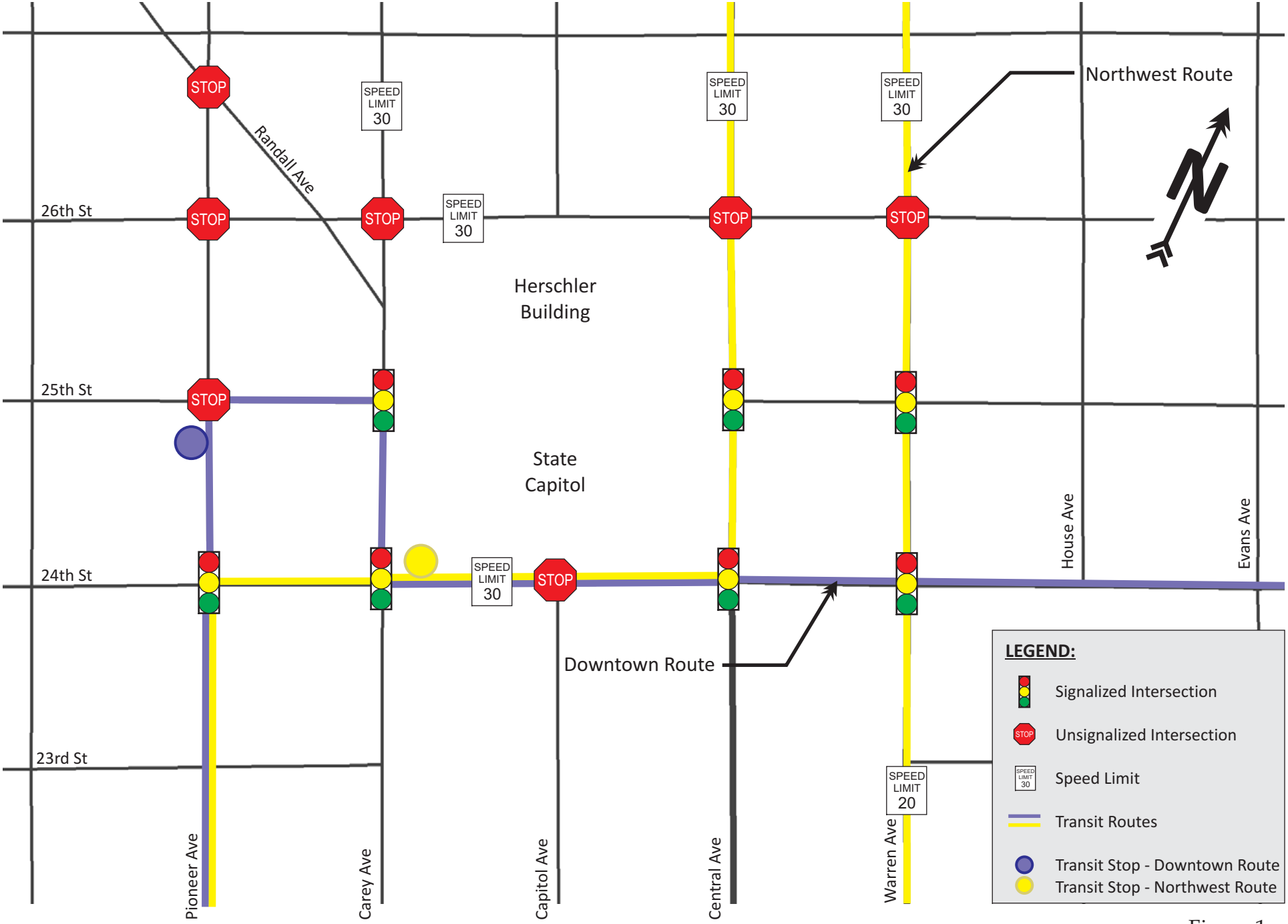


Figure 1
Project Area Map

Proposed changes to the parking structure access would consolidate all vehicular ingress to the existing westbound down ramp at Central Avenue and 25th Street, and vehicular egress would occur exclusively via a new access to 26th Street at the north of the parking structure. Truck loading/unloading docks would be located at the new entrance from 26th Street, relegating truck ingress at a new ramp from 26th Street, just east of Carey Avenue, and truck egress along the same exit ramp to be used by vehicular traffic.

Access to the Pioneer Parking Lot will be provided via Pioneer Avenue and 26th Street, while access to the St. Mary's Parking Lot will be provided via 25th Street, just west of House Avenue.

Analysis Horizons

The State anticipates that improvements to the Herschler Building, and corresponding access improvements to the underground parking structure, will be completed by 2018. The Cheyenne MPO's latest travel demand model projects traffic volumes to the Year 2040. As such, traffic operations for the following time frames will be analyzed:

- Existing Conditions
- Future-Year Conditions at Build-Out (2018)
- Future-Year Conditions at Long-Range (2040)

The Cheyenne MPO's travel demand model depicts that the average growth rate for roadways in the portion of downtown near the Herschler Building will be 1.25 percent. For the Year 2018, the growth factor that will be applied to the existing traffic volumes will be 1.051. For the Year 2040, the growth factor that will be applied to the existing traffic volumes will be 1.381. These rates will be applied to existing traffic volumes to generate future-year no-build traffic volumes. Existing traffic volumes will also be redistributed based on the proposed access changes to Herschler; the growth rates will be applied to these volumes to generate the future-year build traffic volumes.

Study Area

The area of influence that could be affected by the changes in land use intensity and parking conditions extends beyond the limits of the project area described above. Based on discussions with the State, it is understood that the majority of State employees who work in the Herschler Building and the State Capitol live in the northern and eastern parts of town. As a result, most of the traffic to and from the parking structure and lots will come from the north along Central Avenue and depart north along Warren Avenue. A lesser amount of traffic will use Central and Warren to get to parts of the city that are to the south of the site. Given the nature of expanding the parking options to the Pioneer lot, it is also anticipated that a notable amount of traffic will use Pioneer Avenue and Carey Avenue adjacent to the Pioneer lot.

Based on discussions with City Engineering, the limits of the study area where traffic impacts needed to be analyzed extend to Lincolnway on the south, Pershing Boulevard on the north, Pioneer Avenue on the west and Warren Avenue on the east. In total, this study area encompasses 12 signalized intersections and seven unsignalized intersections that must be analyzed, including:

Signalized Intersections

- Pershing Boulevard & Carey Avenue
- Pershing Boulevard & Central Avenue
- Pershing Boulevard & Warren Avenue
- 25th Street & Carey Avenue
- 25th Street & Central Avenue
- 24th Street & Pioneer Avenue
- 24th Street & Carey Avenue
- 24th Street & Central Avenue
- 24th Street & Warren Avenue
- Lincolnway & Carey Avenue
- Lincolnway & Central Avenue
- Lincolnway & Warren Avenue

Unsignalized Intersections

- Pioneer Avenue & Randall Avenue
- 26th Street & Pioneer Avenue
- 26th Street & Carey Avenue/Randall Avenue
- 26th Street & Central Avenue
- 26th Street & Warren Avenue
- 25th Street & Pioneer Avenue
- 25th Street & Warren Avenue

These locations are depicted in **Figure 2**. These intersections were analyzed as part of the vehicular traffic analysis for the project. The limits of analysis for pedestrian traffic focused on the ability for pedestrians to travel between the campus and the two off-site parking lots. Bicycle traffic access will remain largely unchanged with the proposed site improvements, so bicycle traffic analyses were not performed for this project. Given the establishment of fixed-route bus transit adjacent to the site, transit service analyses were also not performed.

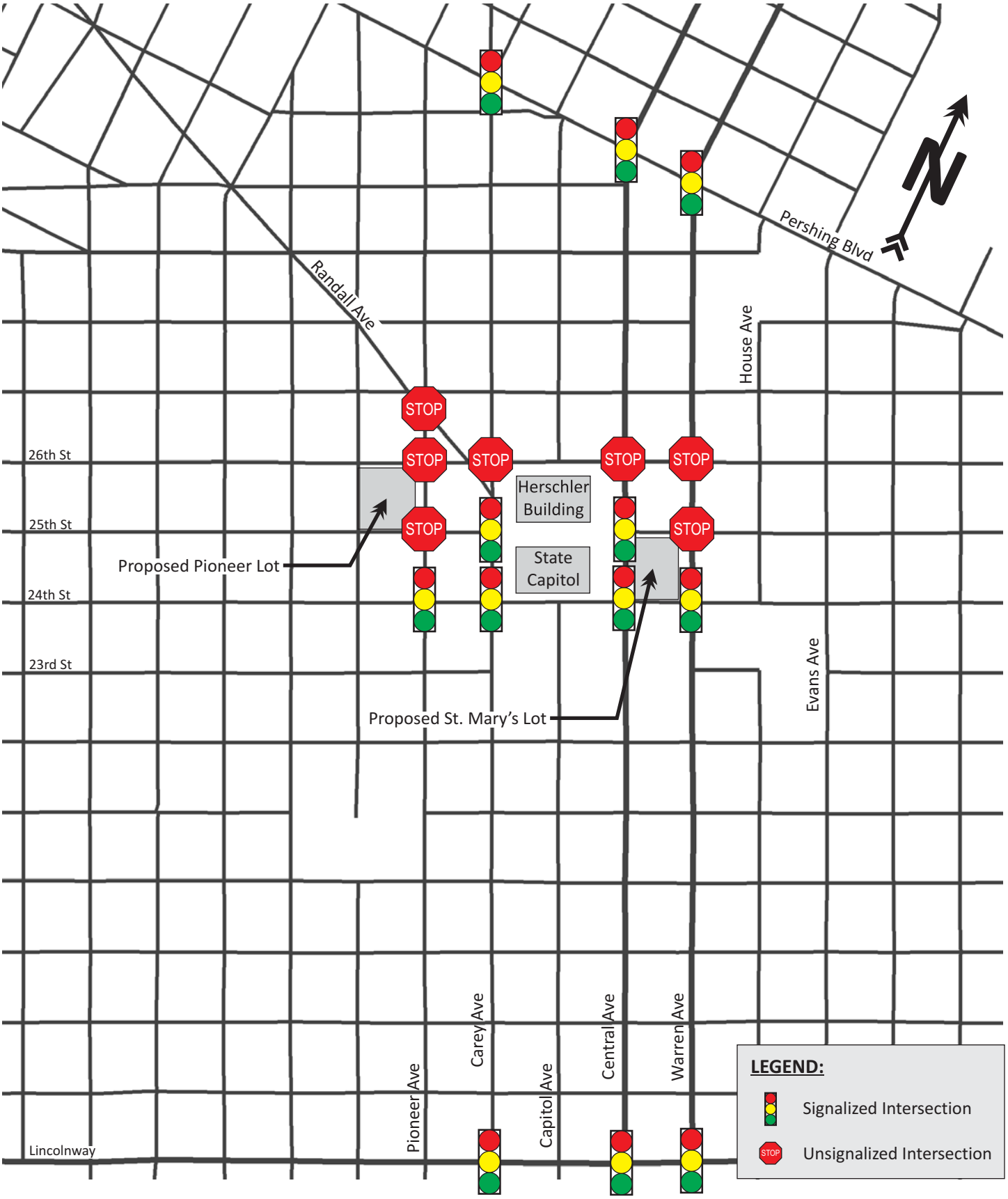


Figure 2
Study Area Map

Existing and Proposed Uses in Vicinity of Site

The City Transportation Planning Department was contacted to determine if there were any proposed land use developments within the vicinity of the Herschler Building site. According to City Planning, there is one land use proposal within two blocks of the site and two others that are seven or eight blocks from the site. These developments include:

- Cheyenne Regional Medical Center Expansion
- Police Station Relocation and Expansion
- Hilton Garden Inn

The Cheyenne Regional Medical Center currently occupies most of the block between Warren and Evans Avenues and between 22nd and 24th Streets. The Medical Center is expanding to the north to 25th Street, consuming both city blocks between Warren and Evans Avenues. The existing surface parking lot between 24th and 25th Streets and between Warren and House Avenues is being removed to make way for expanded medical center uses and a parking structure, while the existing building to the east of this block, between House and Evans Avenues, is being renovated and expanded.

The existing police station is located in the city block between Capitol and Central Avenues and between 20th and 21st Streets. The police station is being relocated a few blocks south and west of the existing site to a building in the city block near 18th Street and Pioneer Avenue, and the new police station will be larger than existing.

The proposed Hilton Garden Inn will be an eight-story structure in the southwest corner of the 17th Street and Pioneer Avenue intersection. This hotel would utilize the existing parking structure across Pioneer Avenue, accessed via a porte cochere along Pioneer Avenue that would reduce the number of through lanes along Pioneer from three to two.

A map depicting these proposed land use improvements can be found in **Figure 3**.

Committed Transportation Improvements

According to the latest Transportation Improvement Program (TIP) listing provided by the Cheyenne MPO, there are not any committed transportation improvements within the vicinity of the study area of this project. As a result, the base configuration for the background transportation system is the same as the existing roadway network and intersection configurations.

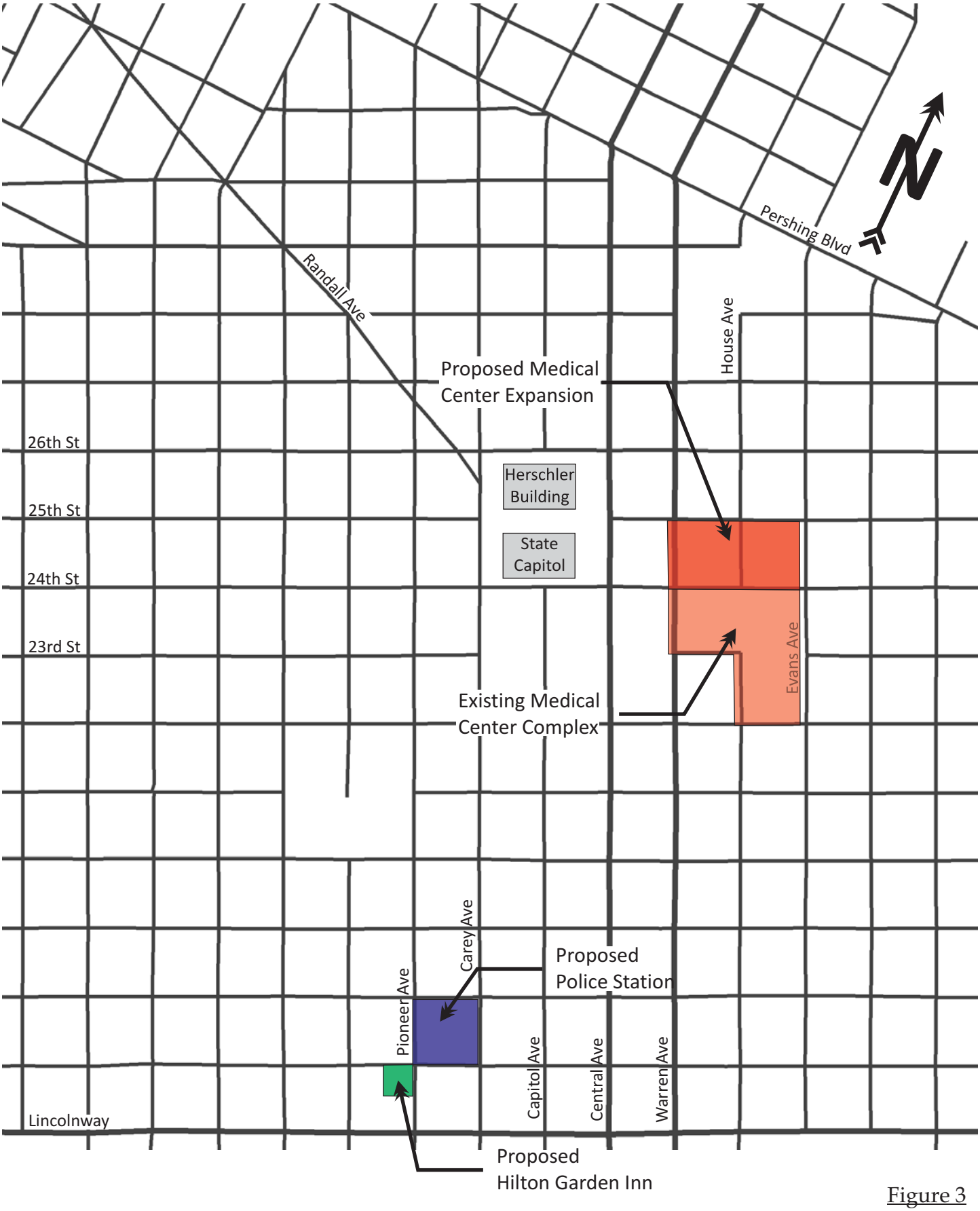


Figure 3
Proposed Uses in Vicinity of the Site

Existing Traffic Conditions

This section of the report details the methodologies and findings of existing conditions analyses and recent crash history analysis.

Traffic Counts

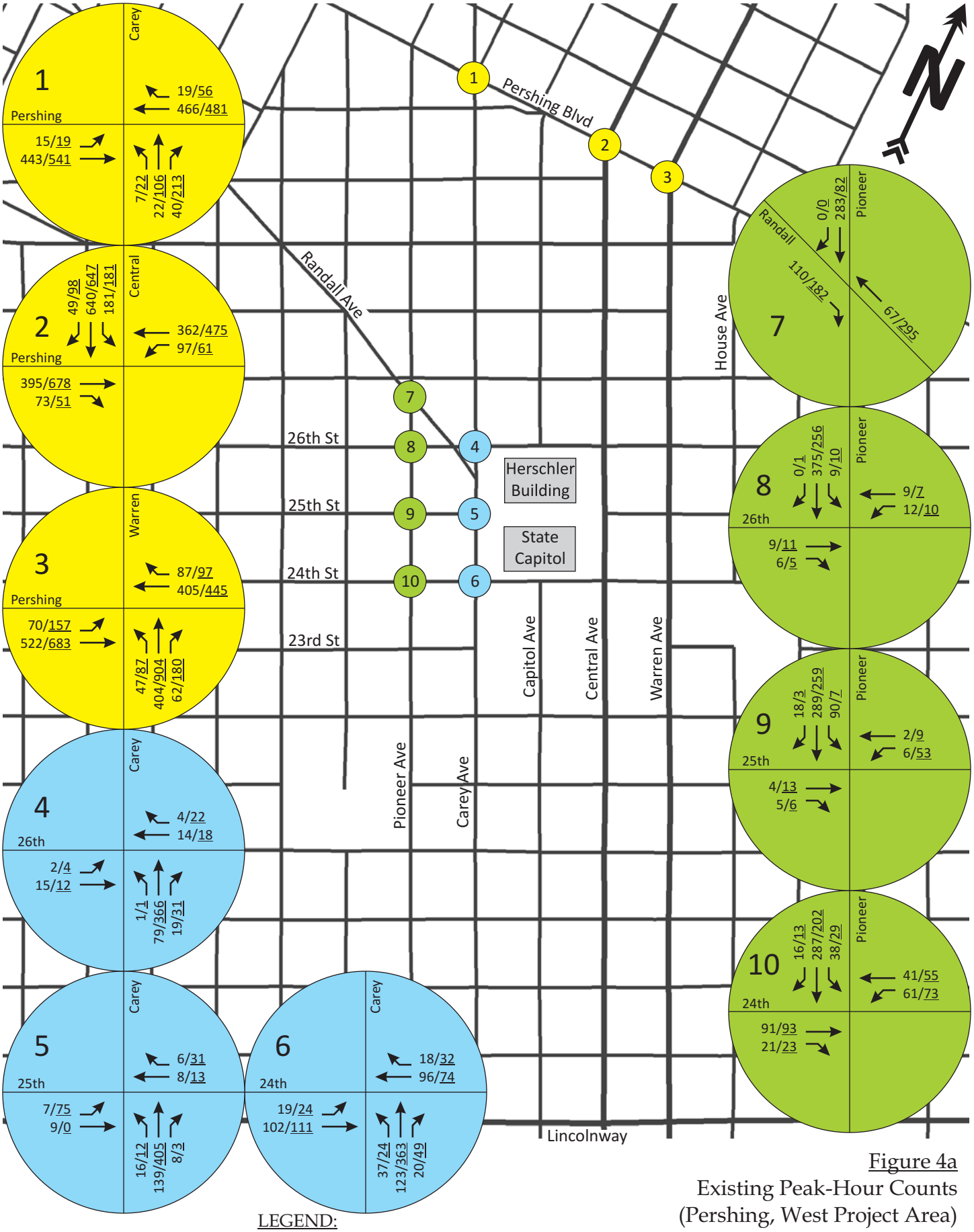
The existing AM and PM peak hour traffic counts that were gathered for this project were compiled from multiple sources, including:

- HDR-gathered counts at 26th Street & Carey Avenue, 26th Street & Central Avenue, 26th Street & Warren Avenue and 25th Street & Warren Avenue; these counts were gathered in June 2014
- City-provided counts at all signalized intersections within the study area; these counts were collected in 2013
- HDR-gathered counts at the four intersections along Pioneer Avenue (at 24th Street, 25th Street, 26th Street and Randall Avenue); these counts were gathered in July 2014

Some smoothing was performed to bring the City-provided counts current with the HDR-gathered counts. These traffic volumes can be found in **Figures 4a and 4b** for the entire study area.

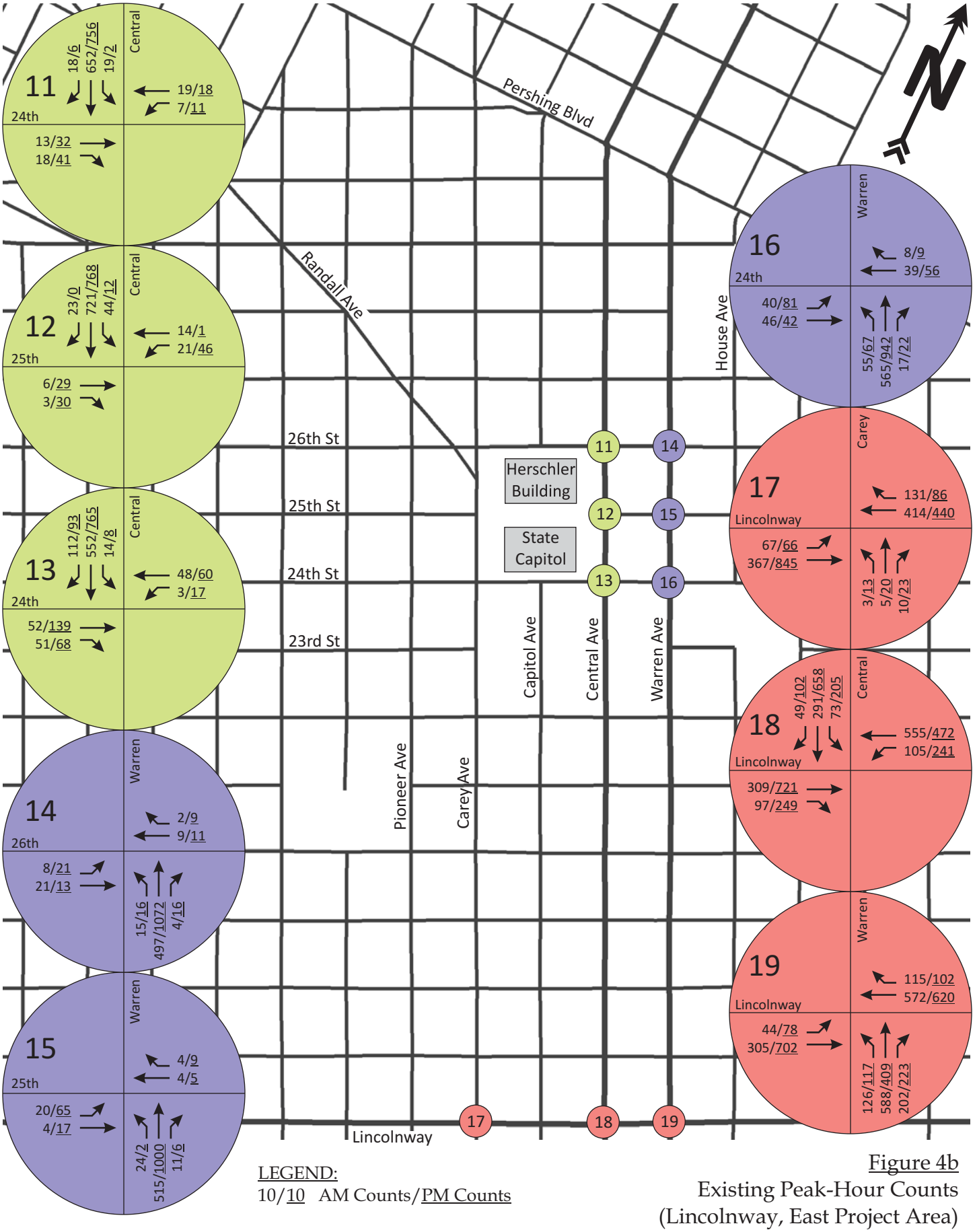
According to the "Cheyenne Urban Roadway Existing Functional Classification Map" (prepared by the Cheyenne Metropolitan Planning Organization, 2010), there are four types of functional classification within the project area: Principal arterial, minor arterial, collector and local roads. "Arterials" provide the greatest mobility with limited access to parcels. "Collector" roads connect local roads to arterials. Roads classified as "Local" are primarily used for access to different land use areas and do not provide as much throughput as an arterial or a collector. The functional classifications of roadways around the project area are as follows:

- Prinicpal Arterials:
  - Central Avenue
  - Warren Avenue
  - Lincolnway
  - Pershing Boulevard
- Minor Arterials:
  - Carey Avenue
  - Pioneer Avenue
  - Randall Avenue
- Collectors:
  - Carey Avenue (north of Randall Avenue)
  - Pioneer Avenue (north of Randall Avenue)
  - 24th Street
- Local Roads:
  - 26th Street
  - 25th Street



LEGEND:
10/10 AM Counts/PM Counts

Figure 4a
Existing Peak-Hour Counts
(Pershing, West Project Area)



LEGEND:
10/10 AM Counts/PM Counts

Figure 4b
Existing Peak-Hour Counts
(Lincolnway, East Project Area)

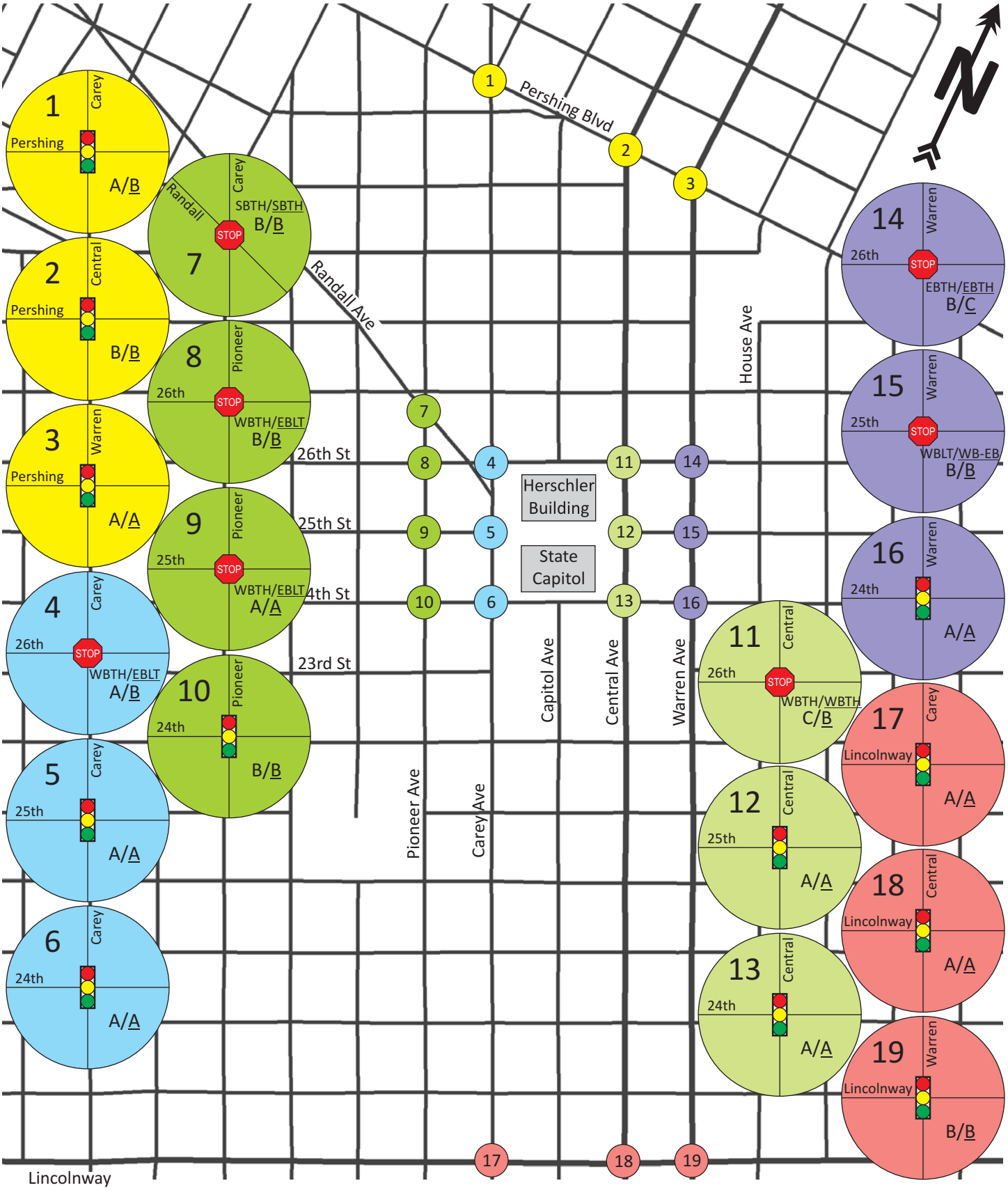
Existing Peak-Hour LOS

The primary methodology that is used to evaluate an intersection's performance is to conduct a traffic operations analysis using turning movement counts and an assumed lane configuration for the intersection. The industry standards for evaluating an intersection's performance are the requirements that are outlined in the latest edition of the Highway Capacity Manual (HCM). These requirements use calculated control delay to assign a qualitative performance measure known as Level of Service (LOS), where a range from LOS A to LOS F defines whether an intersection is performing with little or no delay, LOS A, excessive delay and breakdown flow, LOS F, or somewhere in between. The HCM methodologies were used to determine levels of service for the intersections within this project's study area.

There are several traffic analysis software programs on the market that utilize the HCM methodologies and some even have their own methodologies. For this project, the Synchro/SimTraffic suite was used to perform these analyses to be consistent with what the City of Cheyenne uses to perform their analyses and to maintain their signal timing system. Synchro offers an HCM output for its users, which is what was used for this project.

The existing lane configurations for the intersections within the study area and the traffic volumes from Figures 4a and 4b were coded into the Synchro traffic operations model. Levels of service were taken from the Synchro run and the results can be found in **Figure 5.**

The level of service around the project area is reported to be an LOS A or an LOS B for almost the entire project area, with the exception of two intersections (Central Avenue & 26th Street and Warren Avenue & 26th Street), both reporting an LOS C. The higher delay comes from the vehicles on the local road waiting longer for a gap between vehicles in the arterial so that they can either drive through the intersection or turn onto the arterial.



LEGEND:
A/A AM LOS/PM LOS

Figure 5
Existing Peak-Hour
Levels of Service

Crash Analysis

WYDOT provided three-and-a-half years of crash history for the intersections within the study area. The provided crash data extends from January 2011 to August 2014. **Figure 6** displays the crash severity graphically, while Appendix X provides more detail related to these crashes, including crash types and the direction of travel for those vehicles involved in the crashes; the appendix material is in tabular format.

Fifteen of the 19 intersections within the study area experienced seven or fewer crashes over the 3.5-year study period. The remaining four intersections experienced 65 percent of all of the crashes that occurred within the entire study area. The most common crash type at these intersections was the right angle crash, which accounted for roughly 53 percent of all crashes. This seems unusual given that these four intersections are controlled by traffic signals and that the north-south street at each intersection is a one-way street, but perhaps this speaks to the nature of congested conditions along these two corridors. The second most common crash type that occurred was the rear end crash, which is typical in congested, peak-hour conditions at signalized intersections. Rear end crashes accounted for over 30 percent of the recorded crashes, without a discernible pattern of occurring either on the one-way street or the two-way street.

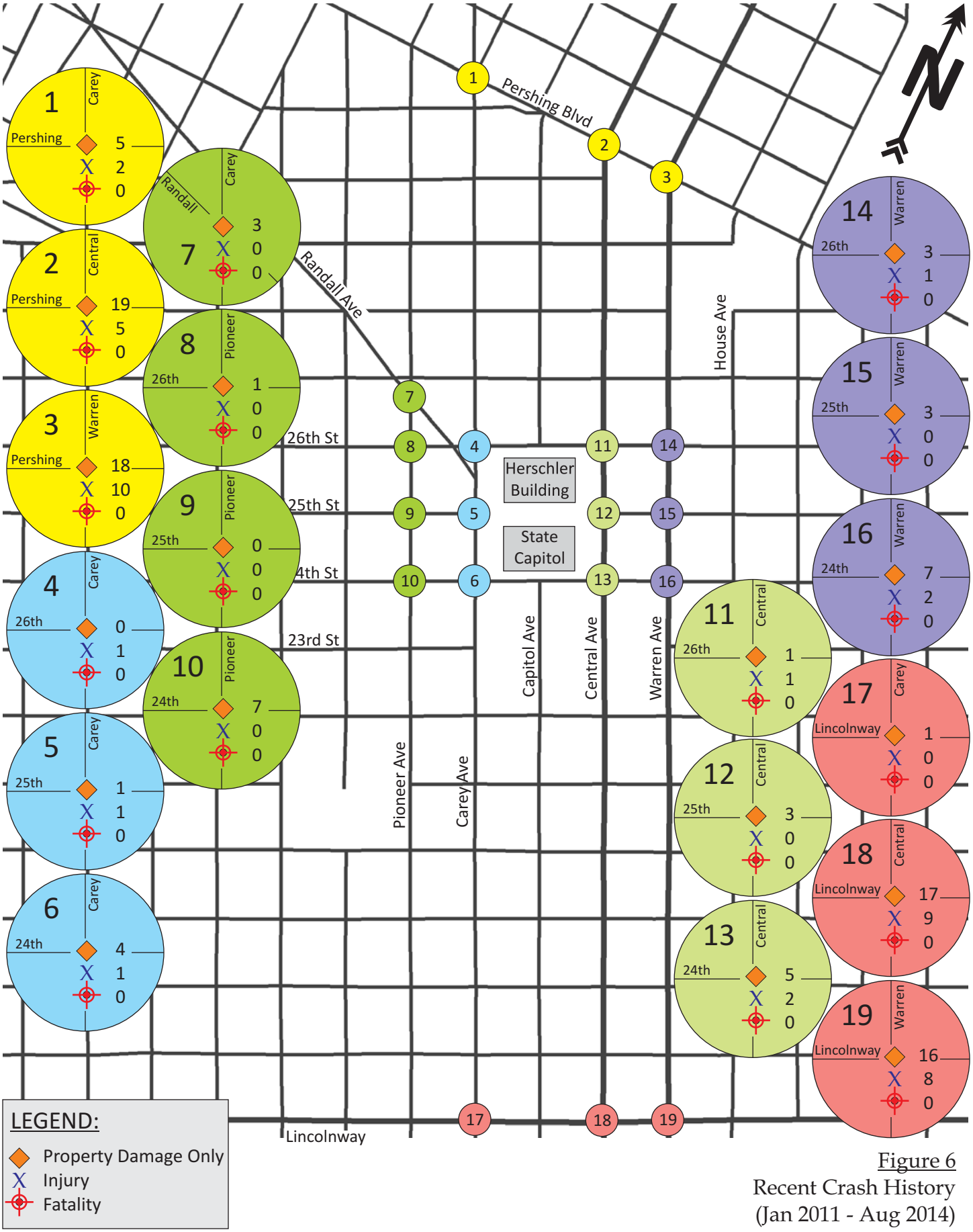


Figure 6
Recent Crash History
(Jan 2011 - Aug 2014)

Future-Year Traffic Conditions

This section of the report details the methodologies and findings of future-year traffic analyses.

Future-Year Traffic Forecasts without Development

Future-year traffic forecasts were assembled for the study area without the proposed changes to the Herschler Building and the associated parking changes. These forecasts were developed using the future-year traffic projections from the Cheyenne MPO's travel demand model. As noted earlier in this report, the MPO's model projects an average annual growth rate of 1.25 percent through the 2040. As such, the existing traffic counts from Figures 4a and 4b were increased by this annual growth rate to the Year 2018 and the Year 2040 to estimate traffic volumes for both future years. These traffic volumes can be found in **Figures 7a thru 8b**.

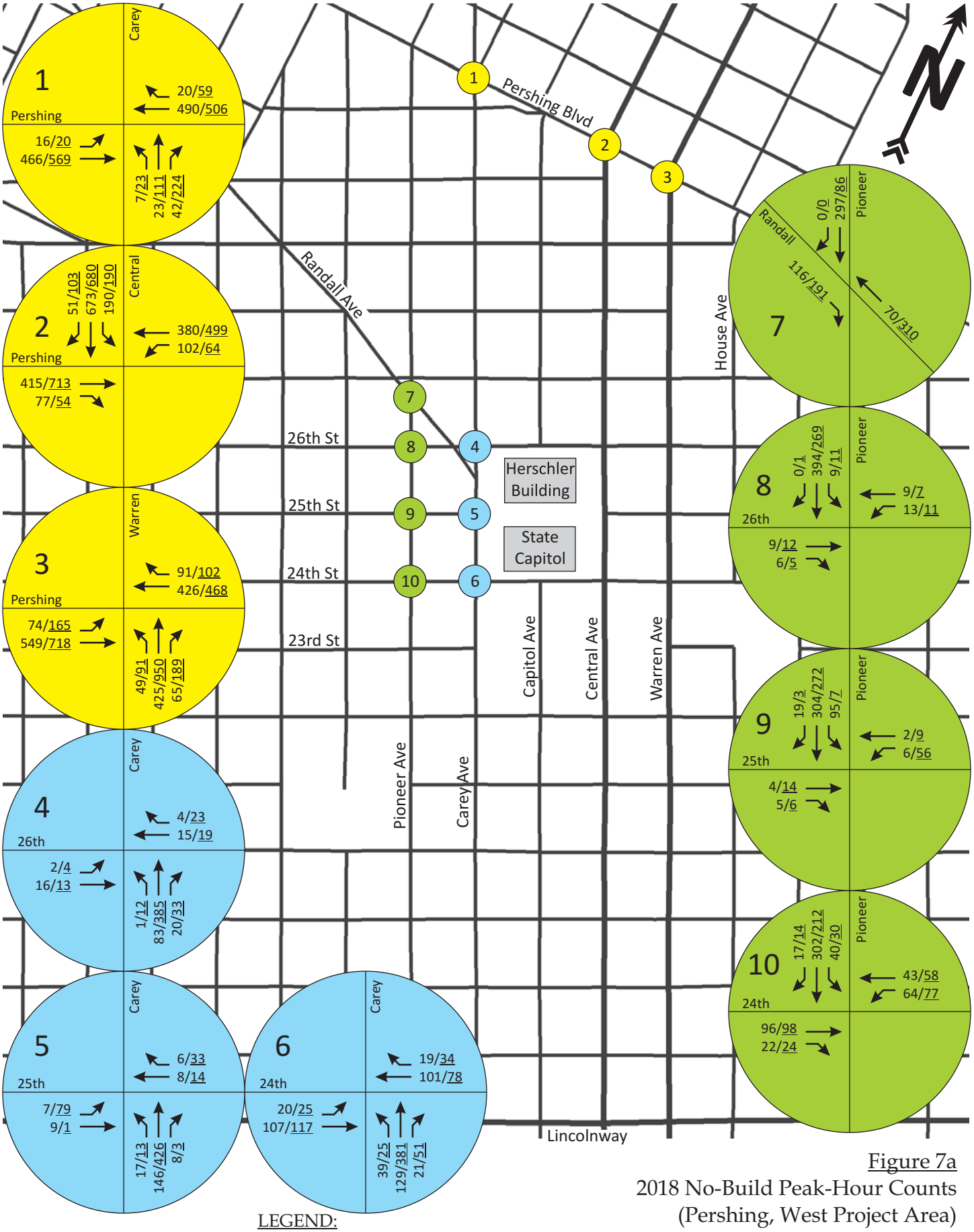
Trip Generation

Trip generation is the estimation of the amount of traffic that a particular development will add to the surrounding roadway network. This estimation is based on the density of the development and the nature of the land uses within it. Procedures found in the latest edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual are often used for trip generation calculations when local data is not available. In this case, local traffic data is available, so that data is what was used to estimate trip generation for this project.

The existing use for which data is available is the existing parking structure beneath the Herschler Building. The existing number of parking spaces in this structure is 226, so the existing counts at both accesses to the structure were compared to this number of spaces to calculate a defensible trip generation rate per parking space. Using those numbers, the trip generation rates for the AM and PM peak hours were calculated and are presented below in **Table 2.** These rates were applied to the 160 proposed parking spaces underneath the Herschler building, 144 proposed parking spaces in the Pioneer parking lot, and the 169 proposed parking spaces in the St. Mary's parking lot. The trip generation for each of these lots can also be found in Table 2. The number of trips to the Herschler garage will decrease with the proposed alternative since the capacity of the garage will be reduced from 226 parking spots to 160 parking spots.

Table 2. Trip Generation

	AM In	AM Out	PM In	PM Out
Herschler Garage	42	17	3	78
Pioneer Lot	37	16	3	70
St. Mary's Lot	44	18	3	82



LEGEND:
10/10 AM Counts/PM Counts

Figure 7a
2018 No-Build Peak-Hour Counts
(Pershing, West Project Area)

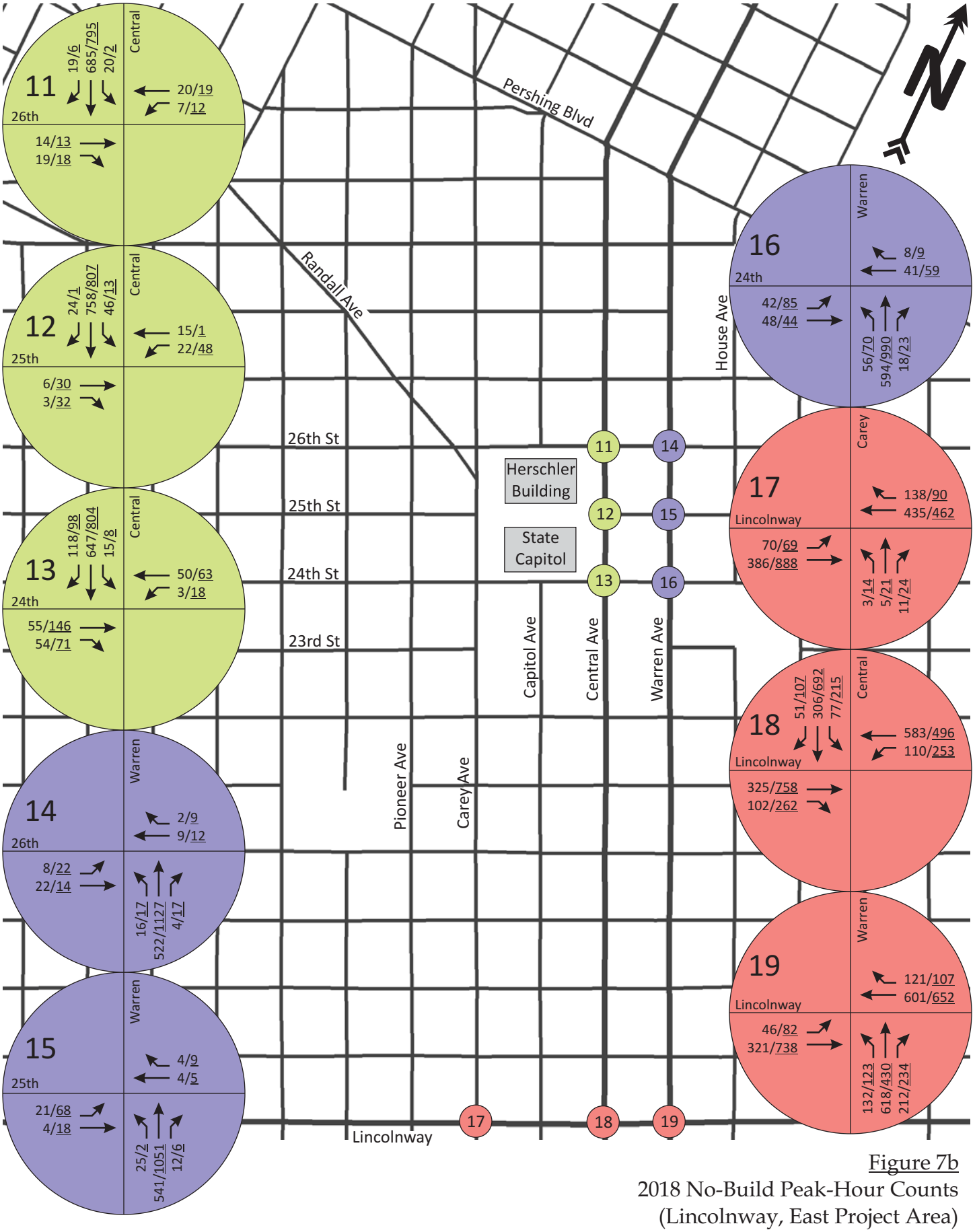
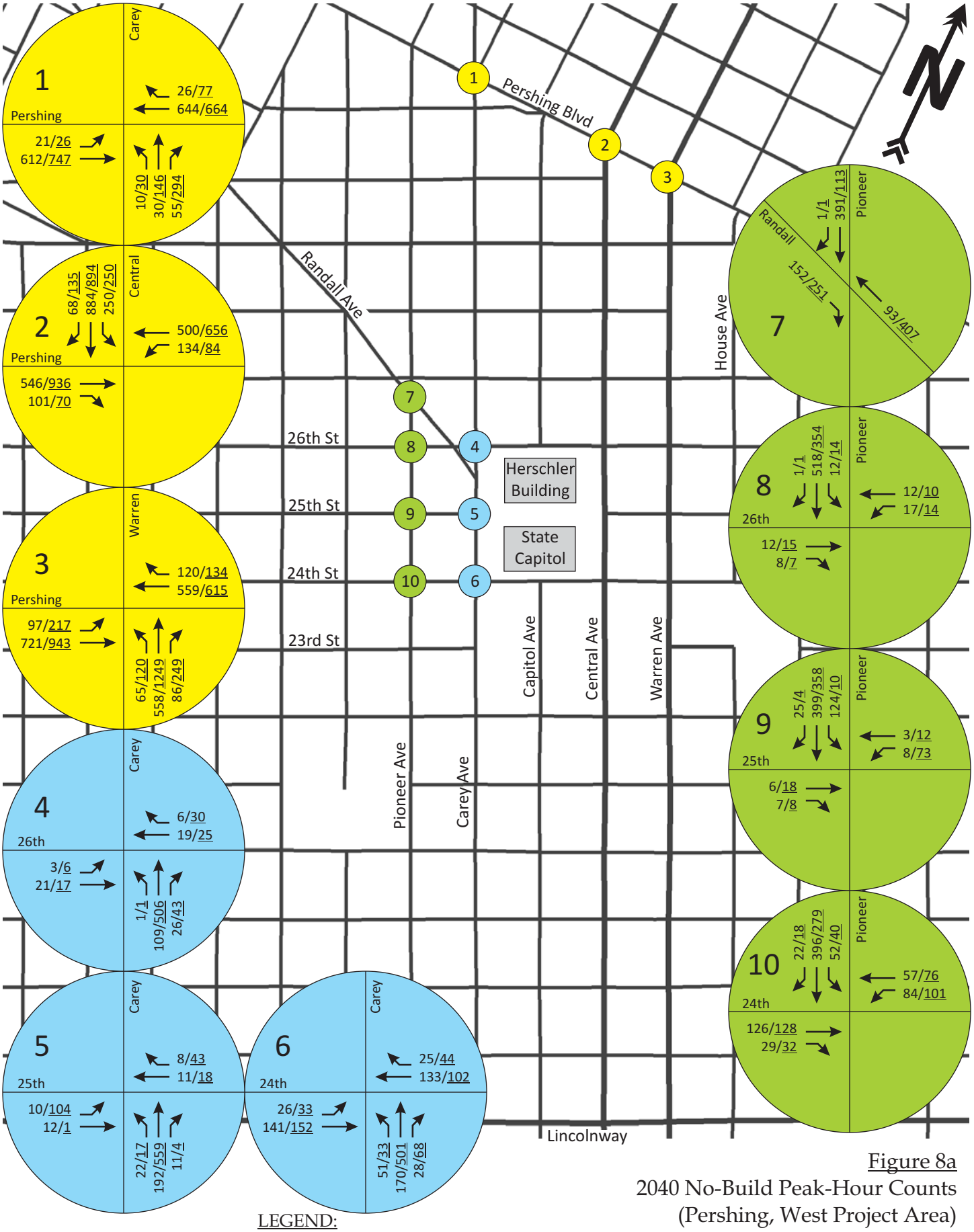
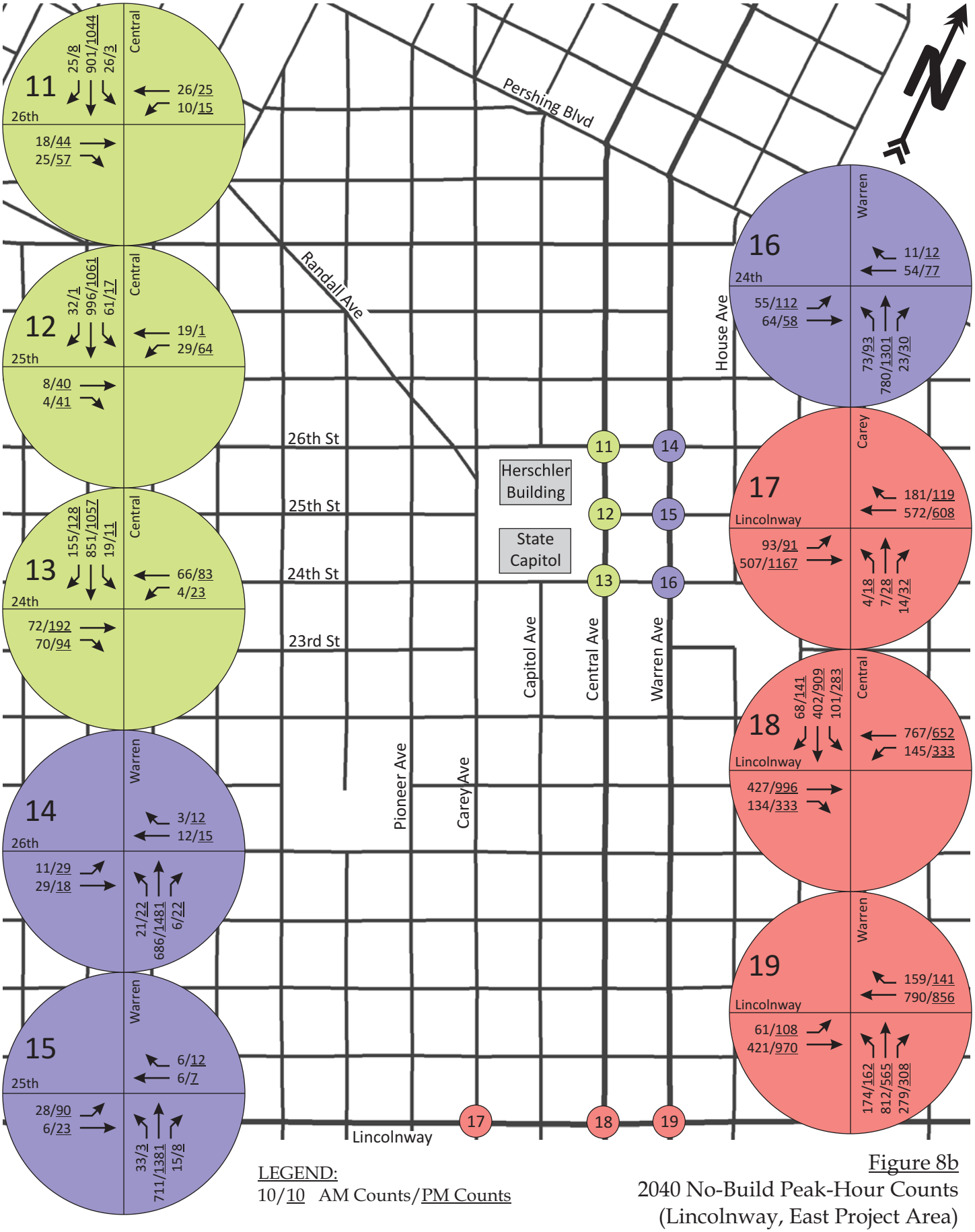


Figure 7b
2018 No-Build Peak-Hour Counts
(Lincolnway, East Project Area)



LEGEND:
10/10 AM Counts/PM Counts

Figure 8a
2040 No-Build Peak-Hour Counts
(Pershing, West Project Area)



LEGEND:
10/10 AM Counts/PM Counts

Figure 8b
2040 No-Build Peak-Hour Counts
(Lincolnway, East Project Area)

Trip Distribution

Assigning the trip generation to the roadway network requires a directional distribution assumption. The directional distribution used in this project was based on the State's understanding of where the Herschler Building employees reside. Based on this information from the State, the trip distribution assumed that 85 percent of the State employees originate from and are destined to the north and east of the campus, while the remaining 15 percent originate from and are destined to the south and west.

Trip Assignment

The trips that were generated were assigned to the roadway network using the trip distribution percentages noted above. The resultant trip assignment can be found in **Figure 9**, along with the generation and distribution numbers.

Future-Year Traffic Forecasts with Development

In 2018, the proposed changes to lane configurations and parking areas will create new traffic patterns around the study area. These proposed changes include:

- Closing the west entrance to the Herschler Building from Carey Avenue
- Redesigning the Central Avenue entrance as the only entrance to the structure
- Creating a new access at the north end of the structure, beneath the existing truck parking lane
- Constructing ramps between 26th Street and the new parking structure access to provide an exit to 26th Street
    - The ramp from the west will provide truck access to the new loading dock
    - The ramp to the east will provide egress for vehicular traffic and trucks
- Constructing the proposed Pioneer parking lot at the old Safeway shopping center
- Creating the proposed St. Mary's parking lot by redesigning the existing parking lot between 24th and 25th Streets, east of Central Avenue

These proposed changes will modify traffic patterns around the Herschler building. Decreasing the number of entrances in the Herschler building from two to one will move all the entering traffic to the east side of the garage at 25th Street and Central Ave. However, since the capacity of the underground garage is being reduced from 226 to 160, the traffic added to the east entrance will be minimal. Traffic will also be added to intersections due to a redistribution of traffic from the Herschler garage to the two new surface parking lots and the addition of the two new floors of the Herschler building. The intersections closest to these parking lots will be the most impacted. The trip generation and trip assignment applied to the project area is shown in **Figure 9**. **Figure 10a** and **Figure 10b** show the projected traffic volumes in 2018 when a growth factor and trip assignment is applied to the existing traffic counts. **Figure 11a** and **Figure 11b** show similar traffic patterns for the future year 2040.

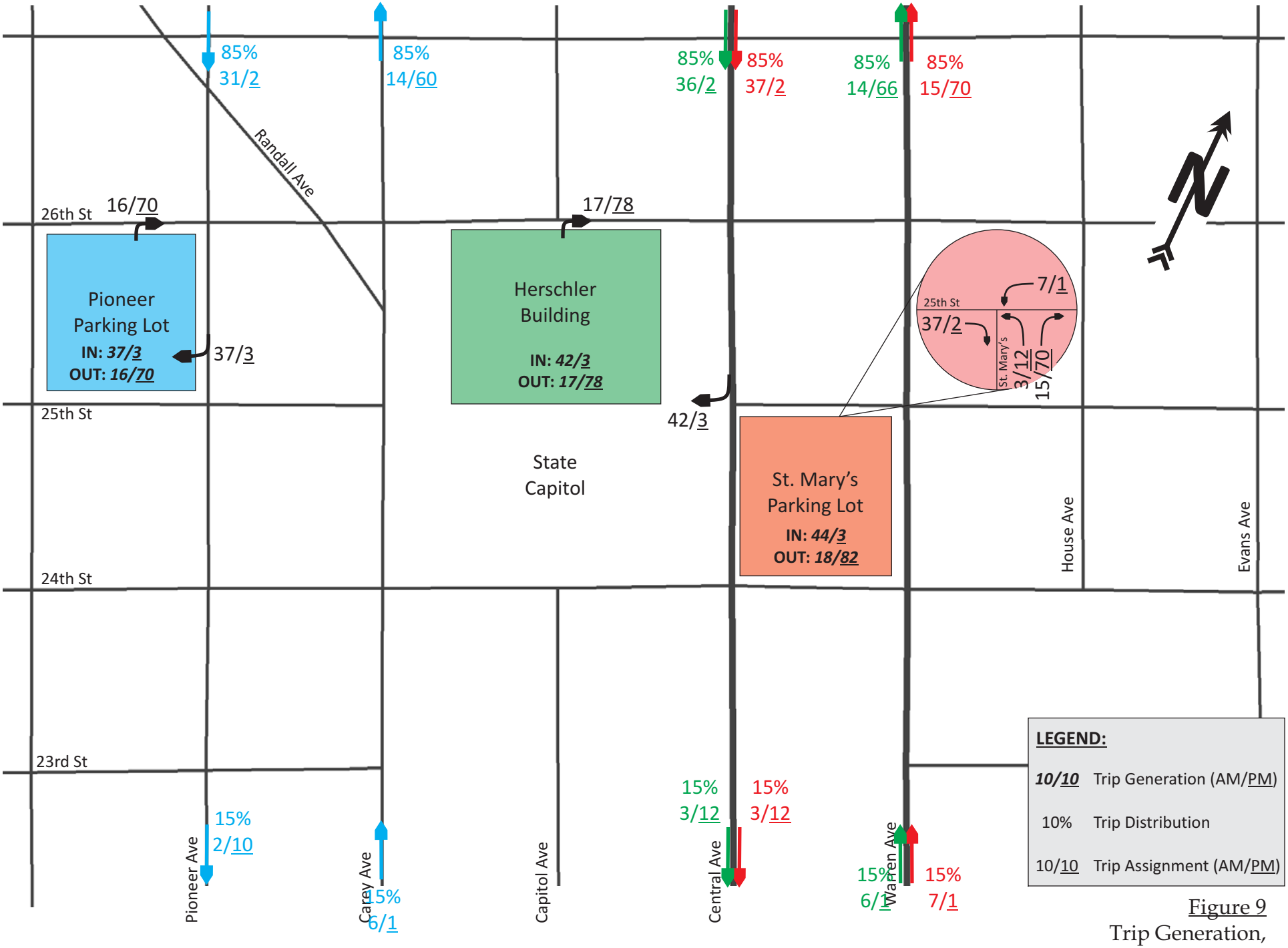
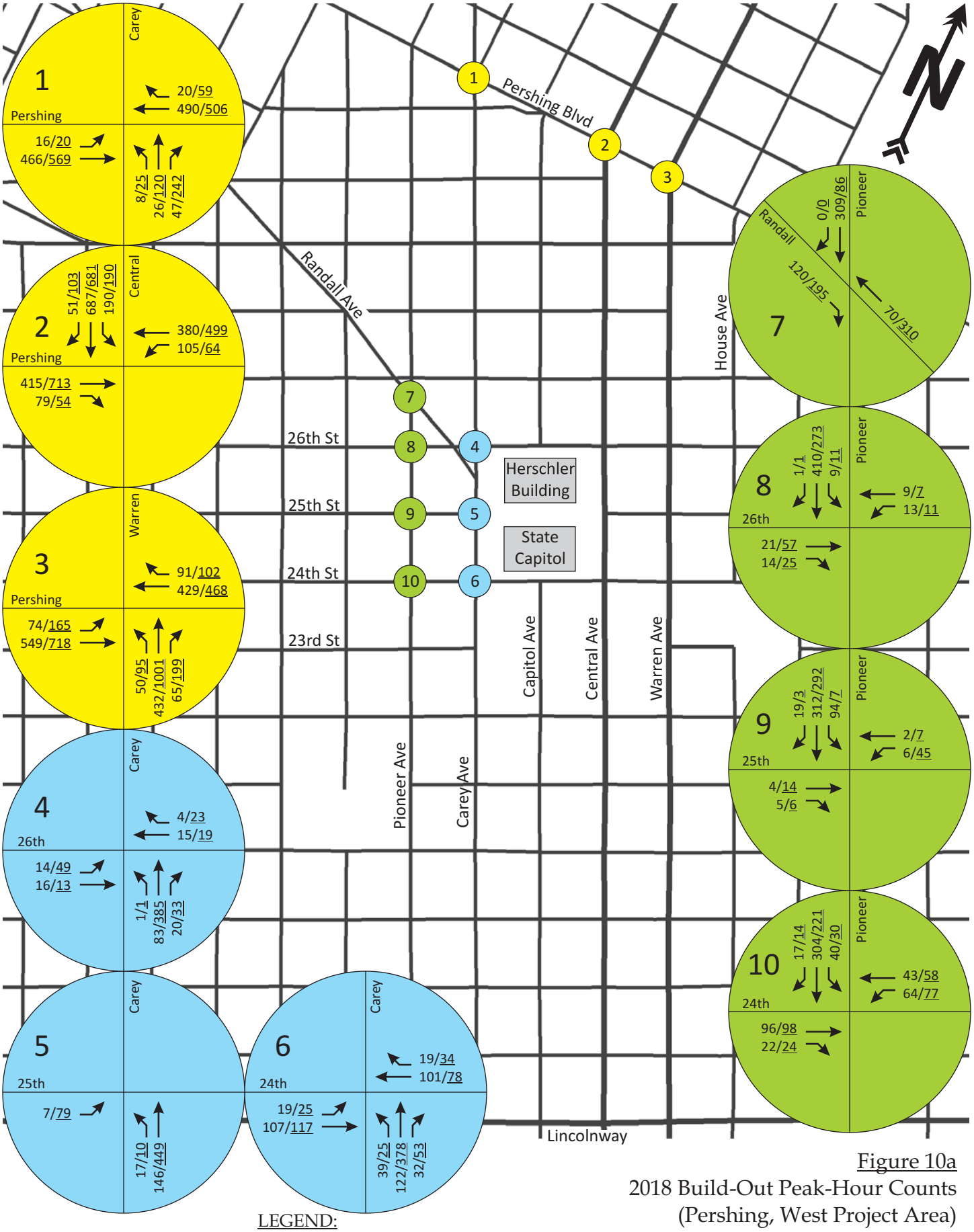
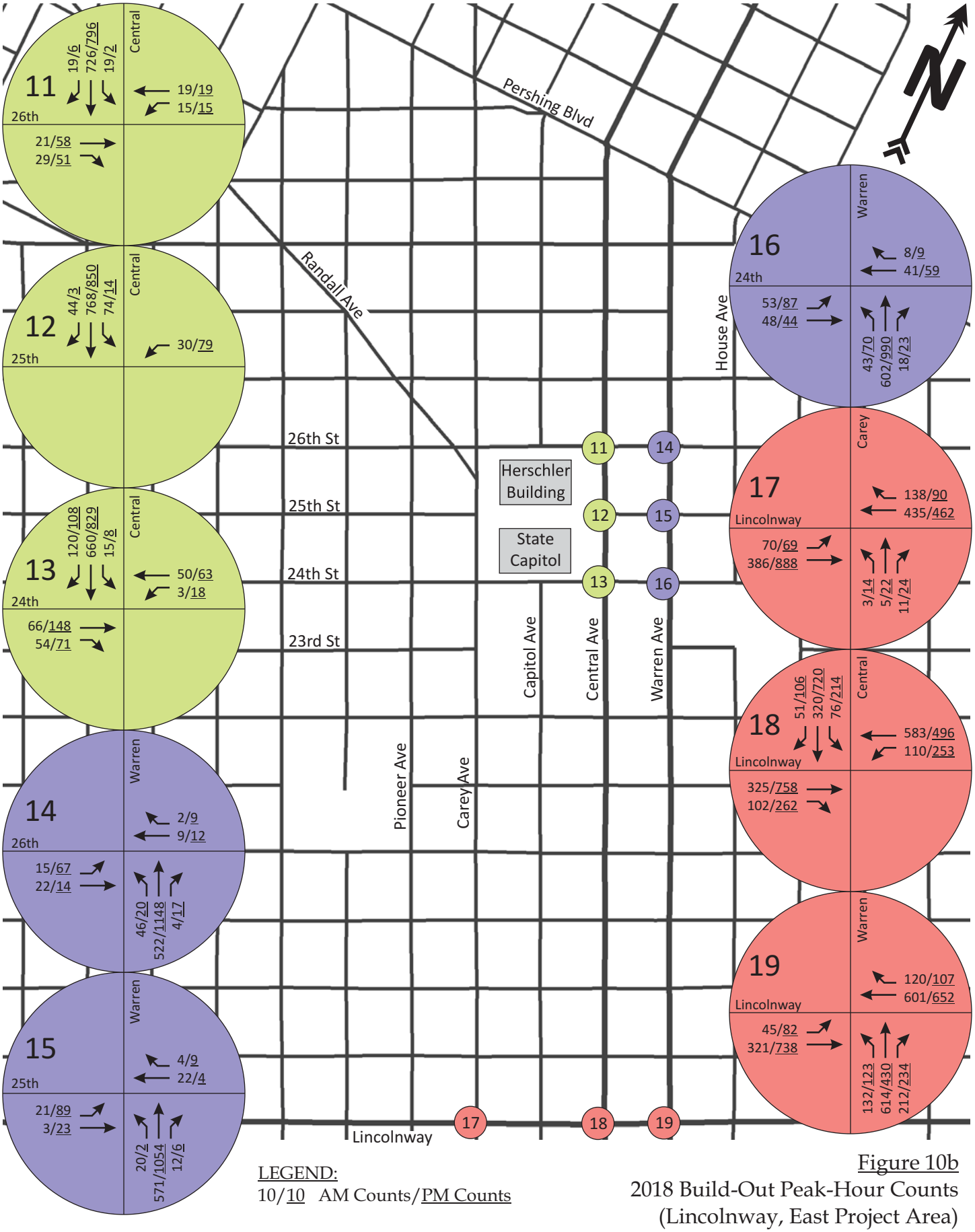


Figure 9
Trip Generation,
Distribution and Assignment



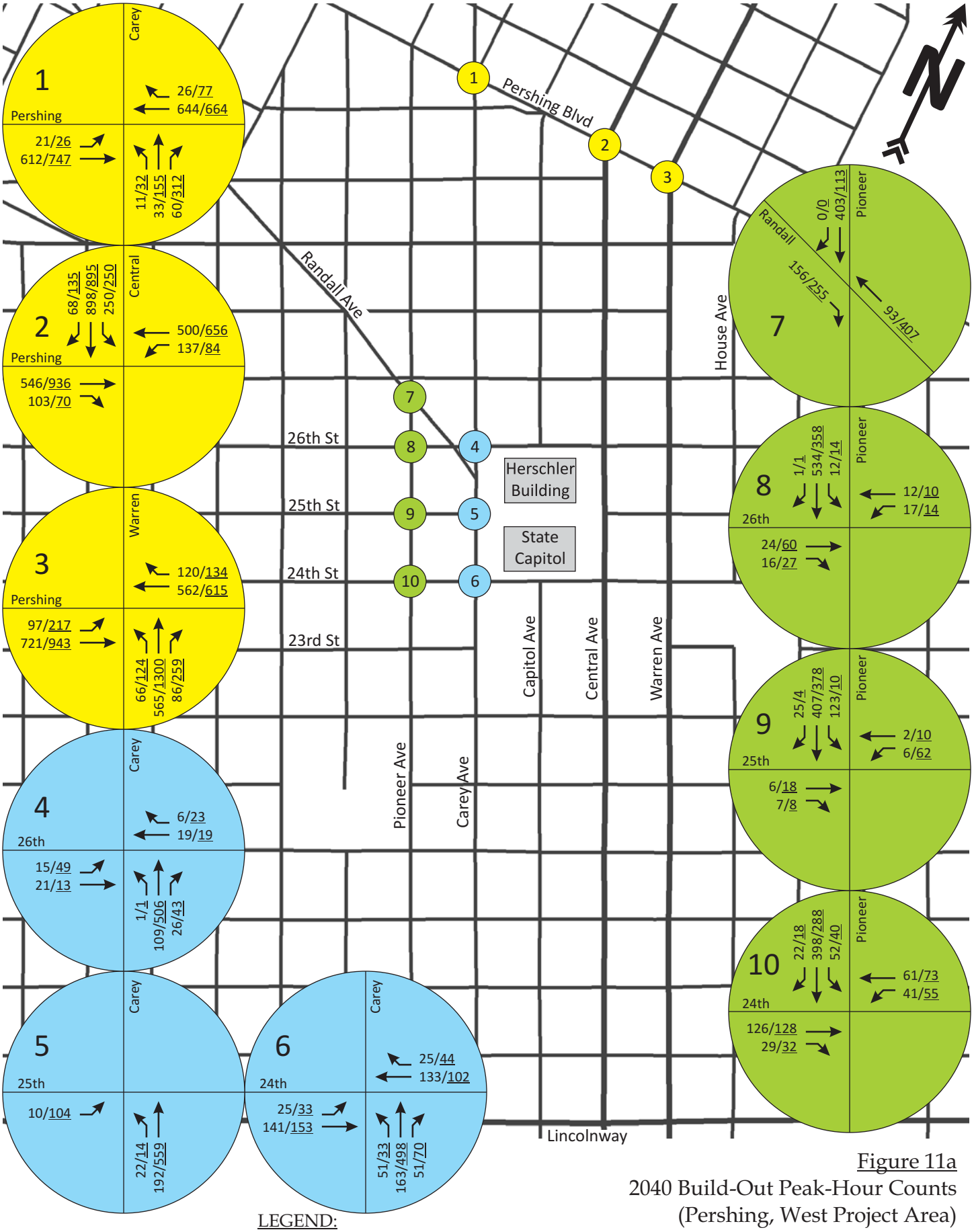
LEGEND:
10/10 AM Counts/PM Counts

Figure 10a
2018 Build-Out Peak-Hour Counts
(Pershing, West Project Area)



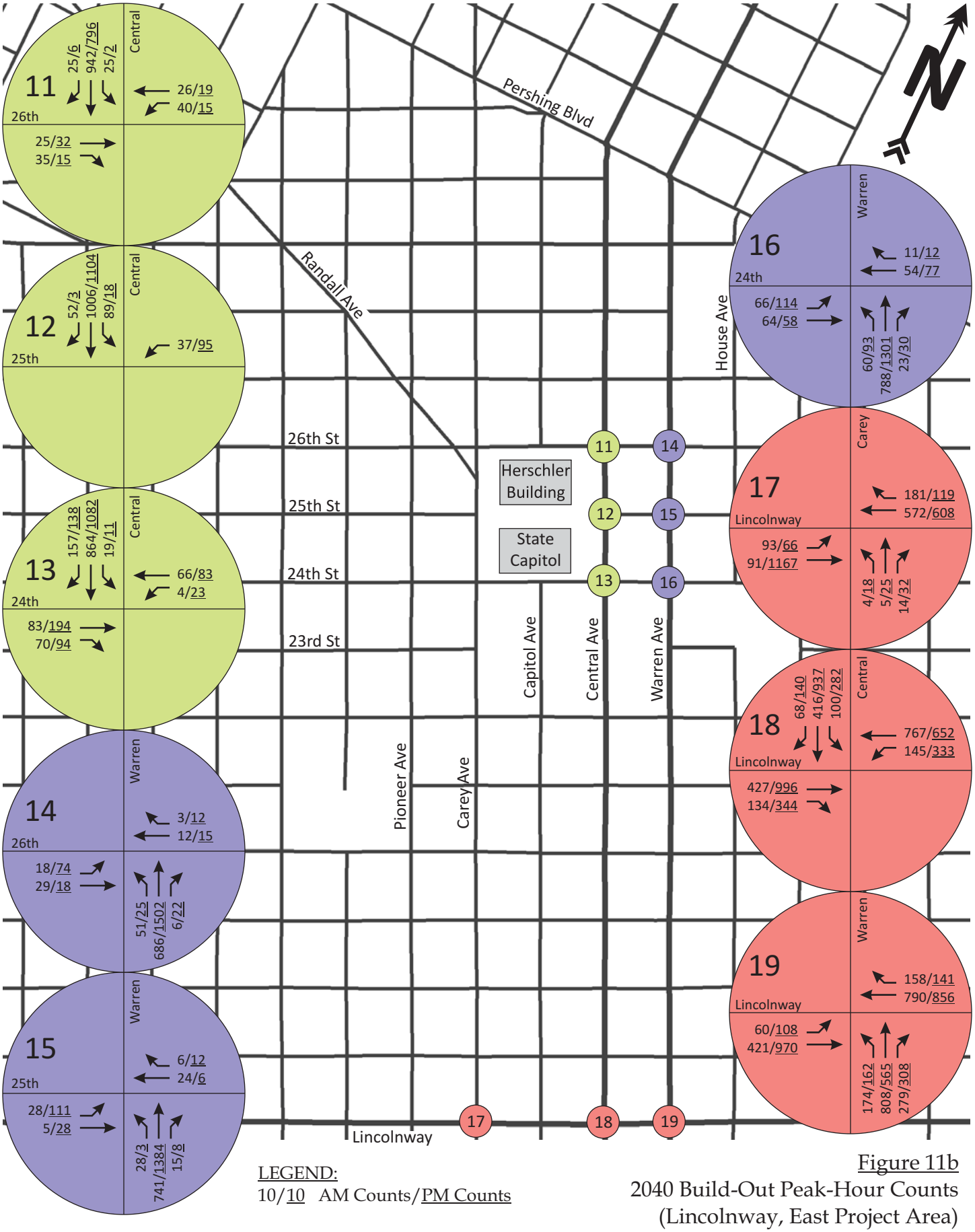
LEGEND:
10/10 AM Counts/PM Counts

Figure 10b
2018 Build-Out Peak-Hour Counts
(Lincolnway, East Project Area)



LEGEND:
10/10 AM Counts/PM Counts

Figure 11a
2040 Build-Out Peak-Hour Counts
(Pershing, West Project Area)



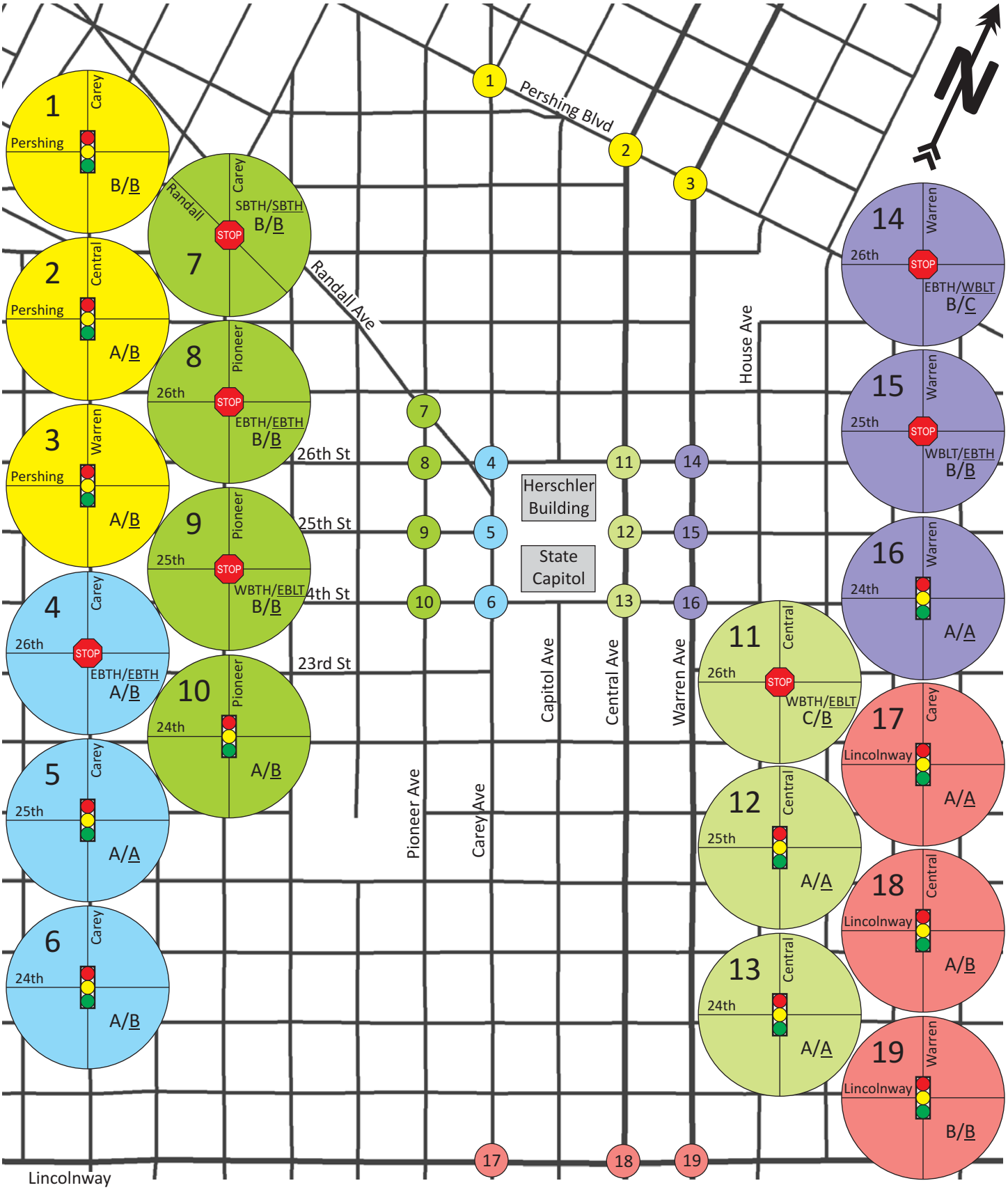
LEGEND:
10/10 AM Counts/PM Counts

Figure 11b
2040 Build-Out Peak-Hour Counts
(Lincolnway, East Project Area)

Future-Year Peak Hour LOS

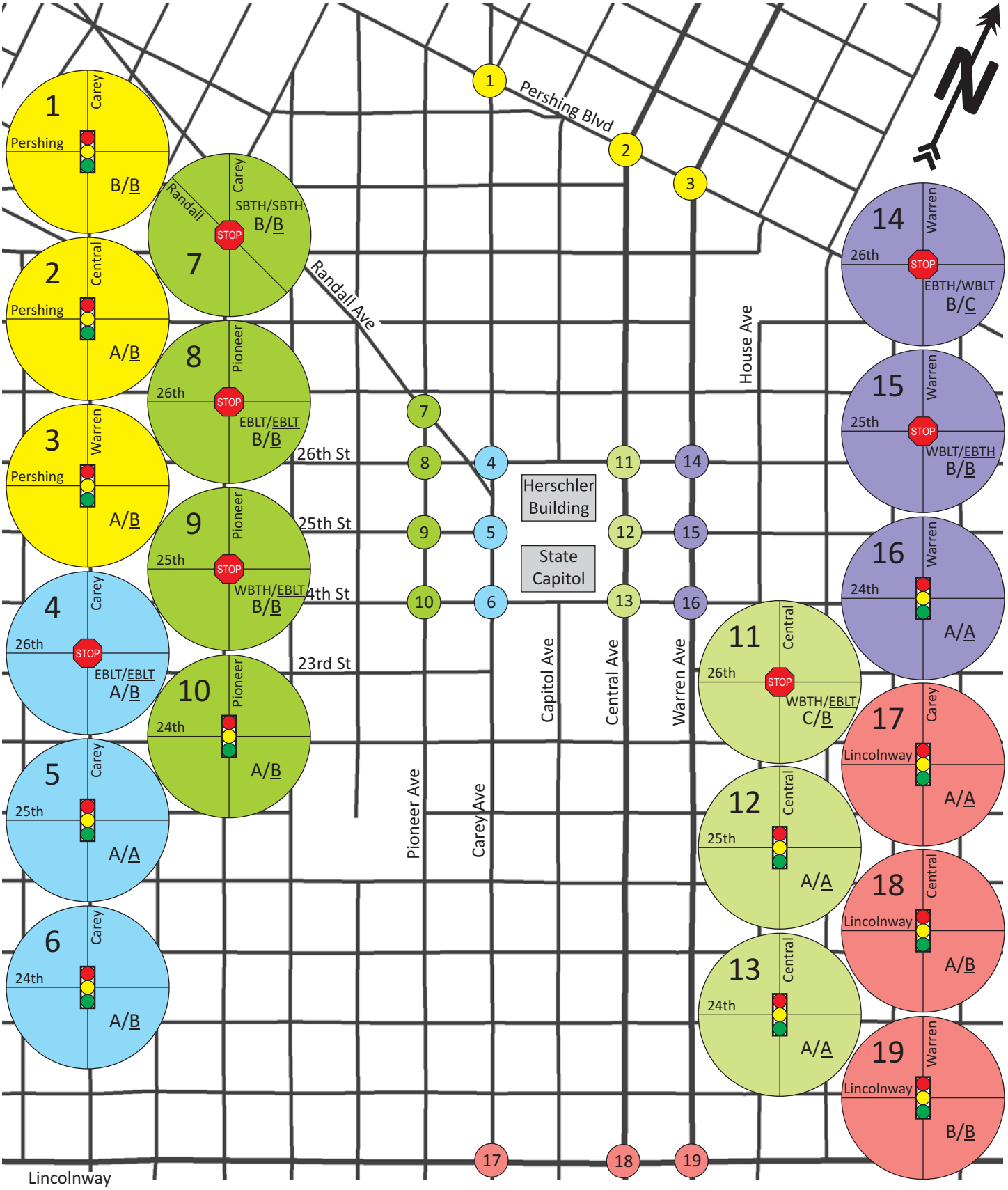
The traffic volumes provided in the previous four figures were input into the traffic software program Synchro for analysis. The results from this analysis show that most intersections within the study area are projected to operate at an LOS A or LOS B for all scenarios, with only a couple of instances of an LOS C. Out of the 19 total intersections analyzed during the AM peak hour, three intersections improved their LOS (Pershing Boulevard and Central Avenue, Pershing Boulevard and Warren Avenue, and 24th Street and Pioneer Avenue) and two intersections had a decrease in LOS (Pershing Boulevard and Carey Avenue, and 26th Street and Central Avenue) when comparing the No-Build to the Build alternatives. The results of the Build alternative analysis for the PM peak hour show one intersection with a decrease in LOS (Pershing Boulevard and Carey Avenue) and one intersection with an improved LOS (24th Street and Warren Avenue) compared to the No-Build. Full operational performance results can be seen in **Figures 12 and 13** for 2018.

The 2040 scenario sees a more dramatic change in operational performance since 20 percent more vehicles are being added to the network due to the projected growth factor. The 19 intersections in the AM peak hour still operate at a very good LOS B or better, with only three instances of LOS C (compared to two from the 2018 operational performance analysis). Operations at Lincolnway and Central Avenue decrease to an LOS D during the PM peak hour in the No-Build and the Build scenarios. This shows that the LOS D is being caused by the 20 percent growth factor and not the additional traffic volumes generated by the proposed improvements. There are four improvements in LOS and four decreases in LOS combined between the AM and PM peak periods. **Figures 14 and 15** show the difference in LOS between the No-Build and Build situations for each intersection for 2040.



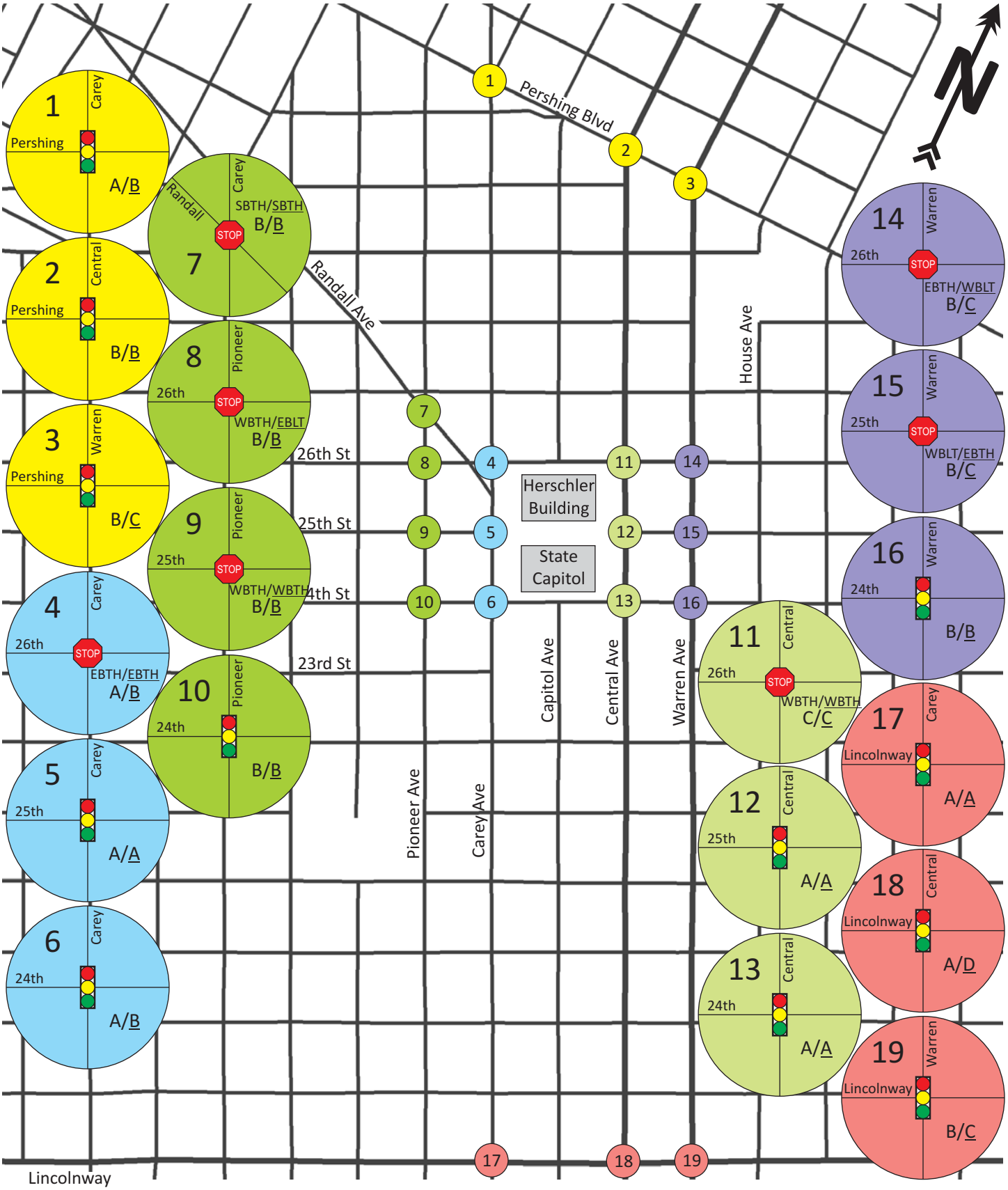
LEGEND:
A/A AM LOS/PM LOS

Figure 12
2018 No-Build Peak-Hour
Levels of Service



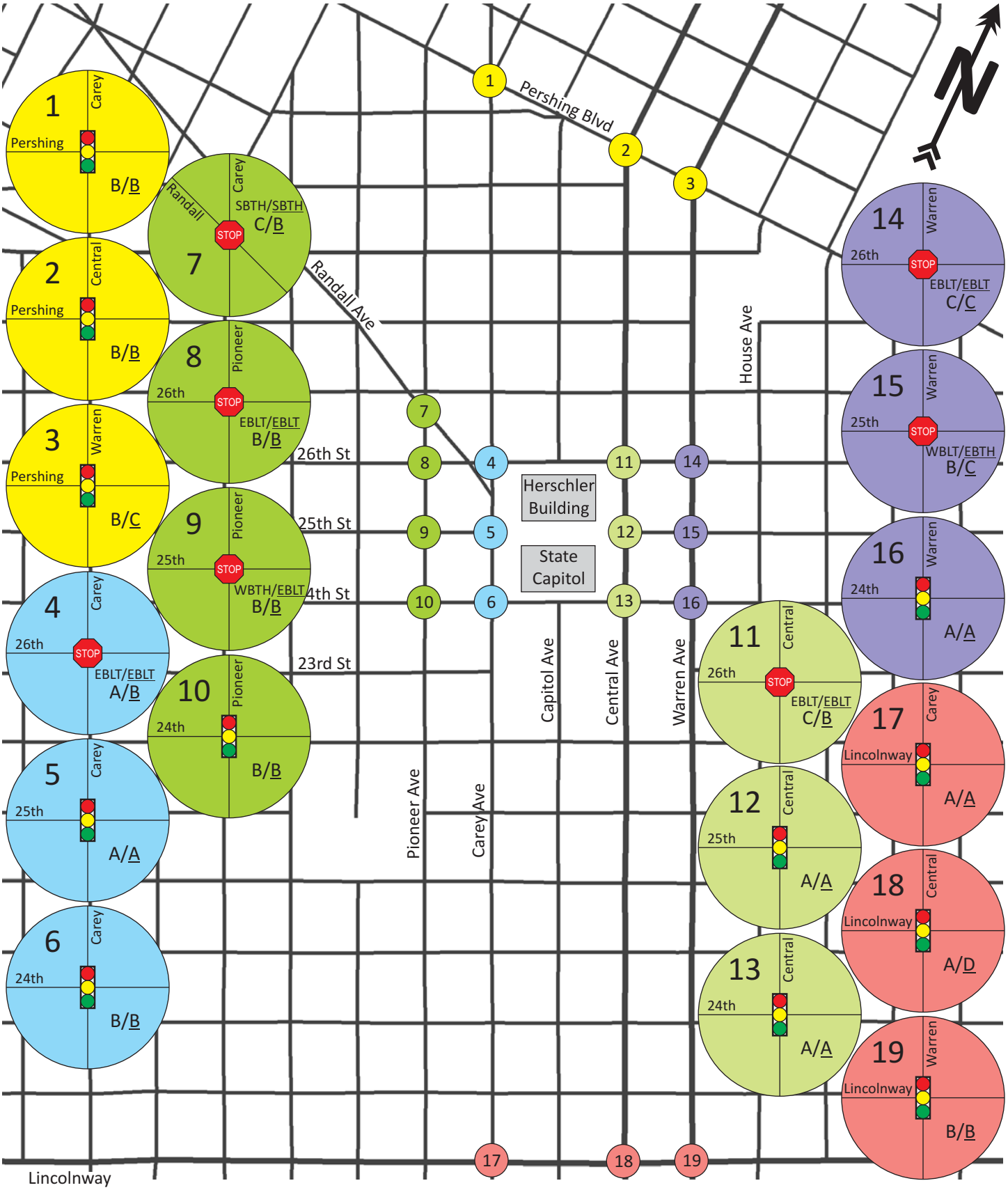
LEGEND:
A/A AM LOS/PM LOS

Figure 13
2018 Build-Out Peak-Hour
Levels of Service



LEGEND:
A/A AM LOS/PM LOS

Figure 14
2040 No-Build Peak-Hour
Levels of Service



LEGEND:
A/A AM LOS/PM LOS

Figure 15
2040 Build-Out Peak-Hour
Levels of Service

Access Locations and Circulation

As noted earlier, the changes in access to the parking structure beneath the Herschler Building involve removal of one access, modification of an existing access, and addition of a new access. Access to the Pioneer parking lot will be gained via Pioneer Avenue, while egress traffic will use 26th Street. The St. Mary's parking lot will provide ingress and egress from 25th Street, just west of House Avenue.

The access to be removed is the access to the structure from Carey Avenue. This ramp will be removed and the space above it used as additional turf and open space.

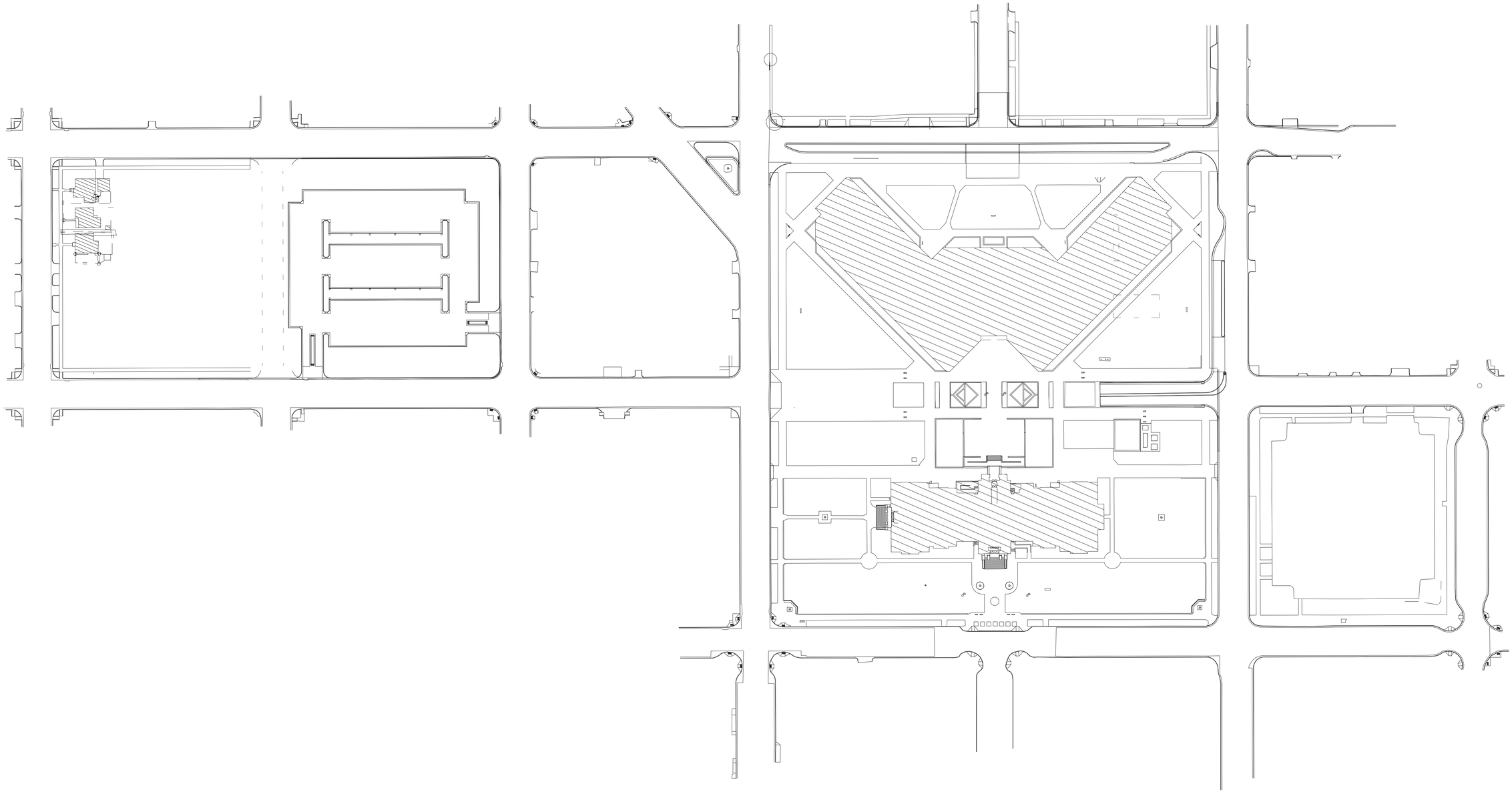
The existing access that will remain but be modified is the access from Central Avenue. Currently, this access provides ingress to and egress from the parking structure, but the proposed configuration would convert this to ingress only. The State intends to restrict all access to this parking structure for security purposes, so this access to the structure will be gated, which will require a secure access lane along Central Avenue. Traffic bound for the structure will enter this access lane from southbound Central Avenue (this lane will not be accessible via 25th Street), present their security card at the card reader, and enter the parking structure once cleared by security. If a person enters this lane and is rejected by security, then the driver must exit the access lane and re-enter southbound Central Avenue.

The added structure access will serve as the egress for vehicular traffic and the ingress and egress for trucks bound for the loading dock. This access will be on the north side of the Herschler Building, adjacent to 26th Street, roughly in line with Capitol Avenue, and approximately 12 feet beneath existing grade. Trucks with deliveries to the Herschler Building will enter the ramp from 26th Street to the loading dock via Carey Avenue. Once deliveries have occurred, trucks will exit the loading dock via another ramp to the east that merges with eastbound 26th Street west of Central Avenue. Vehicular traffic exiting the parking structure will use the same ramp to gain access to the street system at Central Avenue. Truck and vehicular traffic exiting the structure must yield to eastbound traffic before merging onto 26th Street.

These access changes and parking lot locations are shown in **Figure 16**.

Pedestrian and Bicycle Analysis

The intent of this analysis is to determine if proposed on-site connections to the existing off-site pedestrian and bicycle facilities are sufficient to provide pedestrian and bicycle access to significant local destinations, such as schools, parks, local commercial centers and bicycle trails. The bicycle trails around the city of Cheyenne are part of the Greater Cheyenne Greenway. This greenway uses bike paths and designated bike areas on streets to connect bicyclists with parks around the cities. The two closest parks (connected through the Greenway system) to the study area are Holliday Park (1.5 miles to the Southeast) and Lions Park (1.8 miles north on Carey Avenue). There are no bike lanes or bike trails within the project area, but the Greenway does designate Carey Avenue, Pioneer Avenue, and 24th Street as bike routes that can be taken to connect to the Greater Cheyenne Greenway.



Cheyenne Public City Bus Connections

The purpose of this analysis is to ensure that the project identifies direct and continuous pedestrian pathways from the project site to existing and future bus transit stops adjacent to the site. Three bus routes go through the project area: purple, yellow and blue. The purple and yellow bus routes have stops near the capitol building, whereas the blue route uses Lincolnway with no stops inside the project area. The Cheyenne Transit Program has a five-year plan that shows little change in service adjacent to the Herschler Building. The two existing stops near the capitol building are at Carey Avenue & 24th Street and Pioneer Avenue & 25th Street. These two stops are connected to the Wyoming State Capitol through a series of continuous sidewalks and crosswalks. With the closure of the 25th Street parking garage access, the east leg of the Carey Avenue and 25th Street intersection will be removed and replaced with a continuous sidewalk along Carey Avenue. This will improve the connectivity of the Wyoming Capitol campus to the bus stop at 24th Street and Carey Avenue, and the connectivity to the 25th Street and Pioneer Avenue bus stop will remain the same.

Proposed Traffic Control

Based on the analyses and results documented throughout this report, it is recommended that the following intersection traffic control improvements be evaluated further:

- 25th Street and Carey Avenue (signalized): It is recommended that a signal warrant be performed at this intersection after the build-out year (2018) to determine whether or not an unsignalized intersection would be more appropriate.
- 25th Street and Central Avenue (signalized): It is recommended that a signal warrant be performed at this intersection after the build-out year (2018) to determine whether or not an unsignalized intersection would be more appropriate.

It should be noted that these recommendations are based on future background (no-build) traffic conditions and are not associated with the proposed changes at the Wyoming Capitol campus.

Progression Analysis for Signalized Intersections

This project does not propose additional traffic signals, so a progression analysis was not performed.