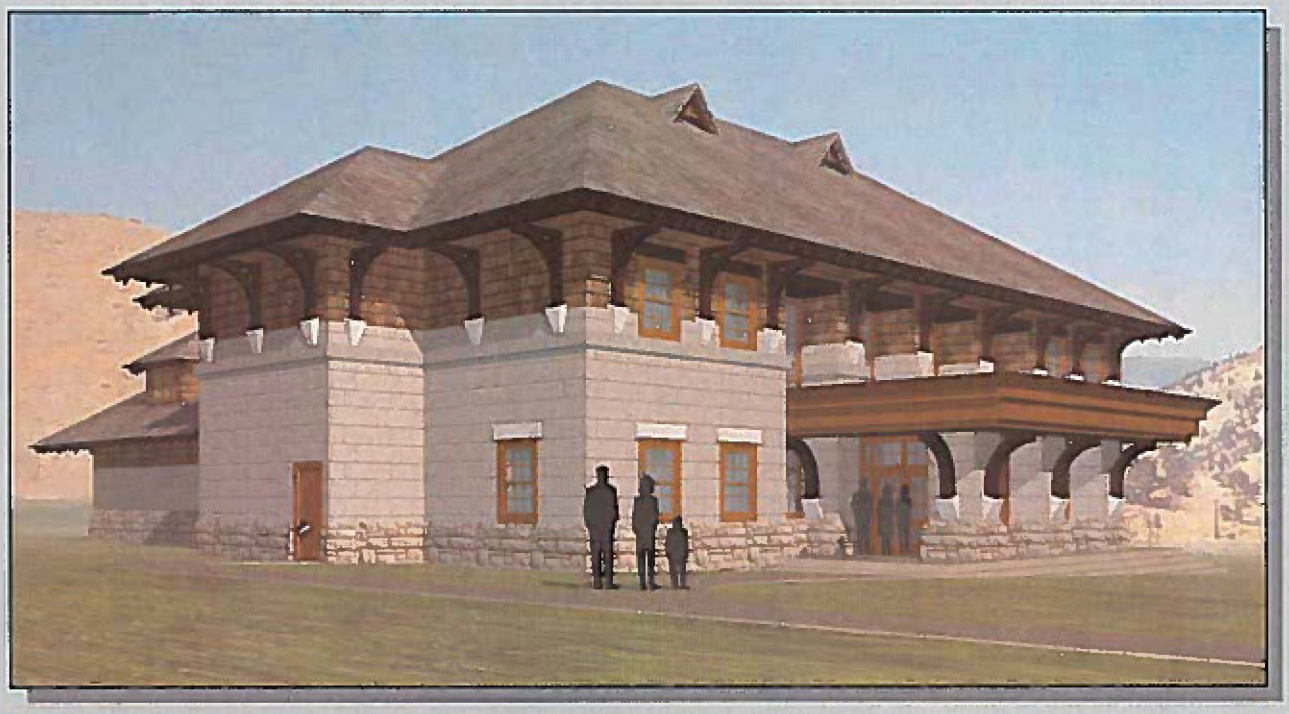
Mammoth Courthouse
Yellowstone National Park



Schematic Design Submittal
June 27, 2003

CTA
ARCHITECTS
ENGINEERS
P.O. Box 1439
Billings, Montana 59103
(406) 248-7455
www.ctagroup.com

TABLE OF CONTENTS

Site Design Narrative
- Site Context
- Existing Site Conditions
- Proposed Site Plan

Building Design Narratives
- Architectural
- Structural
- Mechanical
- Electrical

Sustainable Design
- LEED Evaluation Narrative
- LEED Evaluation Score Sheet

Building Code Analysis
- Code Analysis Narrative
- Code Review Spreadsheets

Program of Spaces
- Room Areas
- Detailed Room Descriptions
- Design Standards

Construction Cost Estimate
- Estimate Narrative
- Summary of Construction Costs
- Site Construction Cost
- Building Construction Cost

Appendix
- 8-1/2 by 11 Drawings
- Site Photography
- Geotechnical Investigation
- Mechanical Equipment Information

YELLOWSTONE RESEARCH LIBRARY

725.1
C959
19-11

Site Design Narrative

SITE DESIGN NARRATIVE

Site Context

The site proposed for the new Courthouse is located on the main access road leading into Yellowstone National Park's Mammoth Hot Springs from the North Entrance at Gardner, Montana. Fronting on the west side of the historic "Promenade" the site will put the building at a prominent location near the entrance of the Mammoth Hot Springs. The site is in a relatively flat area of the plateau that has been fostered by the development of the National Park Service Administration complex of buildings. Bounded on the west by the two-story Aspen Dormitory and two (2) smaller buildings occupied by Xanterra. To the south along the promenade is a small icehouse and the existing Civil Engineering building that currently houses the Court facilities. Across the promenade, to the east, is the two-story Post Office building and the Clinic. North along the promenade is open space that tapers off then slopes down to the valley below.

Existing Site Conditions

The site is an unimproved, grassy, open area with the exception of a small building used as an icehouse for park visitors. There is also a group of native trees and shrubs that were planted as part of a project to display the natural species for the area. The site is relatively flat with 6 feet, 8 inches of slope to the southeast. There is also a 4 foot, 6 inch mound to the southwest that leads up to the Aspen Dormitory building. The existing access road that leads to the buildings and parking on the north edge of the site would be relocated farther to the north and aligned with an access road on the east side of the promenade. The proposed building site is the first site visitors to the park would see as they round the turn leading into Mammoth.

The site fronts on the promenade that includes street side parking. All visitors to the site would likely find parking on the promenade and walk up to the building. The relocated access road would provide access for the law enforcement activities proposed for this building. There is currently no new parking proposed at the site. To comply with U.S. Marshals Service security requirements some of the existing street side parking, directly in front of the building, would be eliminated.

Solar access to the site is good during most of the day and year. The mountains to the northwest would shade the site in late afternoon and earlier in the winter when the solar angel decreased with the change of season. The building's orientation with its windows and entrance to the southeast takes advantage of the morning sun and shade in the hot summer afternoons.

Proposed Site Plan

The site design continues the established pattern of building and entrances fronting the promenade. The development pattern for the Mammoth area reflects this traditional "Main Street" pattern of street to building relationship. The proposed 50 foot setback also responds to the security needs for the Federal Courthouse and allows for an entry plaza that incorporates non-intrusive vehicle barriers to protect the front of the building. The building design also locates the garage like "sally port" feature to be at the back of the building and accessed from the relocated road by a short paved driveway.

The Gardiner/Mammoth Area is the hottest and driest area of Yellowstone National Park. Indigenous vegetation surrounding the site consists of native grasses, sagebrush, and occasional junipers. Elk and bison wintering in the area tend to eat young deciduous plantings. Rather then fighting nature, the proposed landscaping will be native grasses and bushes in harmony with the surroundings. A temporary

irrigation system will be installed. Once the native vegetation is established, the irrigation system can be removed. The existing grouping of native trees and shrubs would be transplanted in new locations around the building to better fit with the building and site.

The design would include a paved plaza that leads up to the front of the building from the street. The design would include a low stone wall or boulders organized to limit the potential for vehicles from getting too close to the building. A similar plaza element exists in front of the Post Office.

The site affords the front of the building a beautiful view across the valley below and to the mountains to the north. The plan was orientated to allow the Judge's chambers, located on the upper level, to the best location for the view.

Noise should not be a concern. Normal operations in the Courthouse building will not generate significant noise. All operations, with the exception of the transport vehicles driving in and out of the sally port, are inside of the building.

Building security is addressed by incorporating the specific requirements of the U.S. Marshals Service. These include the barriers in the plaza and along the relocated access road along with security camera monitoring of both the interior and exterior of the building. The building will include low-level nighttime illumination that will function for security lighting.

Pedestrian access to the building is good. An on-grade access walk would provide for ADA wheelchair access to the front entry doors of the building. With the proximity to the street-side parking, walk-up traffic is simple and logical.

END OF SITE DESIGN NARRATIVE

Building Design Narratives

BUILDING DESIGN NARRATIVE

Design Considerations

The Project's design approach responds to the inquiry "what would a courthouse in Yellowstone look like?" This philosophy says that courthouse defining elements can be reinterpreted into a style that is intuitively identifiable as a federal courthouse while saying it is uniquely "Yellowstone." The design for the exterior represents this approach. The philosophy incorporates order, balance, rhythm, permanence, and solidity as appropriate judicial elements. These are also identifying elements of federalist architecture common to turn-of-the-century courthouses. The elements are interpreted into styles and materials that are contextual to Mammoth.

The Exterior Design and materials are "contextual," meaning they respond to their environment and the notable architecture of Mammoth. The contextual architectural elements include hipped roofs, broad roof overhangs, multi-pane divided-lite windows, stone walls, belt courses and building bases, dormers, and pronounced stone window sills and lintels.

The Building layout and massing needed to address three (3) unique but interrelated functions; the first being the U.S. District Court functions, second Law Enforcement Activities for U.S. Marshals Service and Park Service, and lastly Jail or Detention Facilities. All of these functions have unique security and safety requirements that influenced their relationship and the final plan layout. There were three (3) separate circulation patterns within the building with the primary focus being protecting the Judge, then the public, and lastly but most importantly separating the prisoners from both the Judge and public.

The building is organized vertically with the courts and law enforcement functions located on the second floor. These include a small Courtroom, Chambers for one (1) Judge and his support staff. The NPS Law Enforcement Offices that are located on this level, include primarily investigative offices, and work areas. The public restrooms are on this level as well. ADA access is provided via elevator. Prisoner access is in a separate specialized elevator on the backside of the floor.

The main floor serves as the public entrance and includes a lobby with building security screening. The balance of the floor contains the U.S. Marshals Suite that contains the detention facilities and offices for enforcement and court security personnel. The single-story profiles wing to the back of the building houses the vehicle sally port used for loading and unloading prisoners for transportation off site. The remote location of Yellowstone National Park and the extreme weather conditions often require the Detention Facility to house prisoners overnight. The existing Yellowstone National Park Jail facilities are undersized and considered dangerous by law enforcement staff. The new detention facilities could replace the existing

The building also includes a partial basement that houses most of the storage needs of the building occupants. There is also a Fitness Center required by the U.S. Marshals Service that will be made available for joint use by the building occupants.

The steep pitched roof design allows for a useable attic that will house most of the buildings Mechanical Systems.

Architectural Narrative

Exterior Materials

Exterior materials specified for the Courthouse will be very durable and should withstand the harsh climate and provide a building with a sense of history and longevity that is common to significant Park Service structures. Materials and systems selected will be low in maintenance cost.

Roofing assembly for the 8:12 pitched roof is proposed as a flat clay tile with a shake texture and color. The interlocking tiles systems generally include a 50 year to lifetime warranty and are installed over a ice and water shield membrane that performs well in the extreme climate. The assembly would include proper cavity venting and a vapor barrier.

Exterior walls will be constructed using concrete masonry units for the lower floor and metal framing on the upper level. The masonry lower floor wall structure is in response to the needs of the detention uses that are adjacent to most of the exterior walls. Wall insulation on the lower floor would be foam boards between the structure and stone veneer. Fiberglass batt insulation and an air infiltration barrier would be installed on the upper level walls and a vapor barrier would be installed on all exterior walls. The lower three-quarter (3/4) would include natural and cut stone veneer. The upper portion would be wood shingles left to turn to their natural weathered color; the extra wide overhangs shelter this portion of the wall.

Windows would be aluminum clad wood framed units Pre-finished, low maintenance, aluminum cladding protects the window exterior. Wood is exposed on the interior side of the windows. The windows would be both fixed and operable units glazed with insulated glass with a low-E coating to reduce radiant heat gain, reduce heat loss, and screen UV light.

Interior Finishes

Interior material selections are primarily based upon the functional demands of the spaces and are described in more detail in the Detailed Room and Space Requirements in a later section of this document. Long term durability, low maintenance cost, thermal mass and earth-friendly characteristics are also attributes that have been considered in the materials proposed for the project.

Entry Lobby: Stone flooring for thermal mass and durability, suspended acoustical panel ceiling to reflect light and stone wainscoted walls, again for mass and durability.

Detention Spaces: Glazed CMU and Terrazzo floors provide security as well as durability. The metal security panel ceiling also is secure and very durable.

Office Suites on Both Levels: Typical finishes include carpet flooring, acoustical panel ceilings, and painted gypsum board walls, windows are to have blinds to control sunlight and privacy.

Basement Storage Spaces: Typical finishes include sealed concrete floors, acoustical panel ceilings, and painted gypsum board walls.

Locker Rooms and Public Restrooms: Typical finishes to include ceramic tile floors and walls and painted gypsum board ceilings.

Hallways Basement Level: Typical finishes include resilient flooring, suspended acoustical panel ceilings, and painted gypsum board walls.

Courtroom Finishes: Carpeted flooring with pad, wood paneled walls, and exposed wood ceilings with decorative wood framing.

Structural Narrative

The proposed building design has two occupied levels above grade plus a partial basement and a usable attic under a steeply sloping hipped roof. The roof is framed with structural steel beams supporting wood rafters with wood sheathing panels. Wood sheathing and rafters facilitate the construction of the vented cold roof design. The attic floor, second floor and ground floor over the basement will be concrete slabs on steel deck composite with structural steel beams. Vertical support is provided by steel columns. Lateral resistance to seismic and wind forces is provided by steel braced frames which provide a high level of lateral stiffness to protect the relatively brittle exterior wall finishes.

The geotechnical report describes the potential for soluble travertine deposits under the building; however, based on the performance of older buildings in the area, the recommendation in the report is to found the building on a shallow spread footing foundation constructed on a 3 foot layer of engineered fill. In order to minimize the potential for localized differential movement, the foundation will be designed with some of the characteristics of a rigid raft foundation, such as casting the slabs on grade monolithically with the footings and providing heavier reinforcing in the slabs on grade and foundation walls.

Design Criteria

The structural design conforms to the structural provisions of the 2000 International Building Code (IBC 2000).

Ground Snow Load:	62psf
Snow Exposure Coefficient :	0.6
Snow Importance Factor:	1.2
Floor Live Load:	100 psf
Seismic Acceleration (2% probability/50 year):	Ss = 1.22g S1 = 0.61g
Soil Site Class:	D
Seismic Importance Factor:	1.15
Wind Speed (3 second gust):	90 mph
Esposure Category:	B
Wind Importance Factor:	1.15
Maximum Soil Bearing Pressure:	2000 psf
Minimum Depth for Frost Protection:	48 inches

Mechanical Systems Narrative

Design Criteria
The International Mechanical Code and the International Plumbing Code will be used as a basis of design for the mechanical and plumbing systems. Energy conservation will be based on ASHRAE Standard 90.1-1989. The design of the automatic fire sprinkler system will be based on NFPA 13.

Heating System
The heating source for the building will be liquefied petroleum gas (LPG) stored in (4) new 1,000 gallon underground tanks. The gas will be piped underground into the building to the attic to serve (2) 501,000 btuh input copper fin hot water boilers, each sized for 50% of the building load. A single inline pump will be used to maintain constant water flow through the boiler. Two base-mounted or vertical inline

pumps will be installed for the heating water system to circulate hot water to heating coils throughout the building. Each pump will be sized for 100 percent of the calculated flow rate. Pump motors will be high efficiency type. Hydronic system accessories will include an expansion tank, air separator and chemical feed tank. A solution of 30 percent propylene glycol and 70 percent de-ionized water will be used in the heating system to prevent frozen coils since the air-handling unit could experience below freezing air temperatures.

Heating water piping will be copper with soldered fittings in sizes 2 inches and smaller. Piping 2-1/2 inch and larger will be Schedule 40 steel with grooved "Victaulic" type fittings. Formed fiberglass pipe insulation with all service jacketing will cover the entire piping system.

Cooling System
A 28-ton air-cooled chiller will be located behind the building outside to provide mechanical air conditioning of the building. The chiller will have 2 circuits with 2 compressors each allowing for good part-load efficiency and redundancy. A single, vertical, in-line pump will circulate chilled water to the VAV air-handling units.

Typical hydronic accessories such as an expansion tank, air separator, chemical feed tank, etc. will be provided for the CWS system. Freeze protection will be provided by a solution of 30 percent propylene glycol and 70 percent de-ionized water.

CWS piping will be copper with soldered fittings in sizes 2 inch and smaller. Piping 2-1/2 inches and larger will be Schedule 40 steel with grooved "fittings. Fiberglass pipe insulation with vapor barrier and all-service jacketing will cover the piping system.

Heating Ventilating and Air Conditioning (HVAC) System
The HVAC system will consist of a single variable air volume (VAV) air-handling unit located in the attic space. The unit will include a supply fan, economizer/mixing section, medium efficiency filter section, return/relief fan, diffuser section, heating coil and cooling coil. Supply and return fans will be centrifugal, forward curved type with high efficiency motors and variable speed drives. Return, relief and outside air dampers in the economizer section will modulate to provide 100 percent outside air for free cooling during mild outdoor temperatures. During very cold weather, the outdoor air damper will be in a minimum position.

The air-handling units will discharge into a medium pressure supply ductwork system for distribution to VAV boxes throughout the building. Each zone shall have a separate VAV box with thermostatic control. Duct mounted coils at each VAV box will provide zone heating.

Ductwork materials will be galvanized metal as follows:

- Supply duct between AHU and VAV terminal box: Round or flat-oval with duct-wrap insulation.
- Supply duct downstream of VAV terminal box: Rectangular with acoustical lining.
- Return and exhaust ducts: Rectangular with acoustical lining where indicated.
- Outside air ducts -Round or rectangular with duct-wrap insulation.

Building General Exhaust Systems
A single exhaust system will be provided for all men's and women's toilet rooms, janitor rooms, and the elevator equipment room. An in-line exhaust fan will be located in the attic space and will discharge directly to the outdoors. This system will operate only during occupied building hours.

A separate exhaust system shall serve the five jail cells in the building, an in-line exhaust fan also located in the attic space will discharge this air directly to the outdoors. This system shall operate continuously.

Secondary HVAC Systems
Hydronic cabinet heaters will be installed in the building entrance vestibules and connected to the heating water distribution system. These units will provide extra heat at the exterior doors during cold weather. Convectors also utilizing the heating water system will be used for small storage rooms with an outside exposure.

Direct Digital Control System
A complete automatic temperature control system will be installed. We propose to specify direct digital controls provided by "Mechanical Technologies Inc. of Billings, MT." This is the same vendor and manufacturer recently selected by low bid for the Heritage Research Building. The system will provide a computer based graphical display to be located in a Maintenance Office. This system will be capable of being accessed over any Internet connection using a standard web browser such as Netscape or Internet Explorer. Passwords would be used to prevent unauthorized access.

The air-handling system will operate continuously. A duct-mounted static pressure sensor will control the supply fan speed by repositioning its variable frequency drive. The return fan's variable frequency drive will maintain a fixed differential between the supply and return airflows through a control strategy called volumetric synchronization. Return, relief and outside air dampers will modulate to maximize the concept of "free cooling" and to maintain adequate building ventilation. Heating and cooling coils will have 3-way control valves. A temperature sensor in the supply duct will modulate the valves to maintain a discharge air temperature of 55 deg F. A night setback program may be used for reduced energy consumption.

The boilers will fire in stages to maintain a reset hot water supply temperature based on outdoor air temperature. The supply temperature will be 180F at 0 deg F outdoors and 100F at 50 deg F outdoors. The circulation pump will operate continuously whenever the boiler is energized. The main heating water distribution pump shall run continuously and the standby pump will start if the primary pump fails. They will be programmed to alternate monthly.

Convectors will have 2-way heating water control valves and will cycle as necessary to maintain space temperature. Cabinet heaters will also have 2-way control valves and the fan will cycle in response to a wall thermostat.

The chiller and chilled water pumps shall operate whenever the AHU economizers are inadequate and discharge air temperature rises above 58 deg f.

Domestic Water Piping
There will be a single domestic water entrance serving the entire building at the basement level on the south side. A backflow preventer and pressure-reducing valve will be installed at this location.

Domestic water piping for the building will be type "L" copper with fiberglass insulation. Ball valves will be used for shutoff valves through out the facility on 2 inch piping and smaller. Butterfly valves will be used on pipe sizes 2-1/2 inches and larger.

Domestic hot water will be provided by a single 150,000 btuh LPG-fired hot water heater located in the attic. A hot water circulation line will provide constant hot water availability to restroom groups.

Waste & Vent Piping
D-W-V piping will be cast iron no-hub with Made In America stamping on it. The vent piping will be strategically located to avoid roof penetrations on the front of the building.

Plumbing Fixtures
Plumbing fixtures will be of commercial grade quality. Water closets, urinals and lavatories will be made of vitreous china with manual flush valves on water closets and urinals. Manual faucets with ADA

handles will be provided for the lavatories. Sinks will be stainless steel. All fixtures shall be water conservation type.

Fire Sprinklers
An automatic fire sprinkler system is proposed to sprinkle the entire building since this facility is occupied year-round. The coverage includes the cold attic, the basement storage areas, and all occupied spaces. The proposed system will be a wet-pipe installation since the building is occupied year-round. A dry-pipe extension will be provided from the wet system to serve the cold attic area.

The fire water entrance and wet-pipe riser will be in the basement. The dry-pipe extension riser, with an air compressor and 30-gallon storage tank, will also be installed in the basement to provide air for the extension system. The system will be comprised of black steel pipe with semi-recessed sprinkler heads. Water pressure at the site will be adequate for this type of system without the installation of a fire pump. The fire water entrance will be at the same location as the building domestic water.

Plumbing Site Work
There will be one sanitary sewer exit from the building on the south side, connecting to an existing clay tile sewer main.

Domestic and fire sprinkler water will come from the water main on the south side of the building. Two separate lines will run from the "City" main to the basement water entrance. The 6" fire sprinkler main will have a Post Indicator Valve installed outside of the building. A free standing Fire Department Connection will be located on the south side of the building. A curb stop will be installed on the domestic water main outside of the building. Site water piping material will be C900 PVC, class 150.

Equipment
HVAC and plumbing equipment catalog data are included in the Appendix of this Design Basis Document.

Electrical Narrative

Service
The building will be served by NorthWestern Energy with an underground feed to a pad mounted transformer located near the building. The electrical service will be sized to accommodate the building loads, plus allowances for future growth. Preliminary design calculations indicate that the service size will be 800 amps at 120/208V, three phase.

Lighting
The majority of the building lighting will be fluorescent fixtures utilizing electronic ballasts and T8 lamps. Occupancy sensors will control the lighting in offices, storage and bathrooms. Decorative direct/indirect type fixtures will be used in the courtroom area along with a combination of down lights and wall sconce fixtures. Lighting in detention areas will be fluorescent maximum-security type fixtures. Exterior lighting will be sensitive to light trespass and Dark Sky initiatives. Exterior fixtures shall utilize cutoff fixtures and automatic controls to reduce lighting in late hours.

Emergency lighting will be provided throughout the building as required by code and the user's requirements. The emergency lighting will be supplied from the building emergency generator.

Receptacles
General purpose outlets will be provided throughout the facility. Locations that need special electrical provisions for equipment will be accommodated. Color of devices will be coordinated with interior design. All wiring will be conduit, EMT minimum standard.

Emergency Generator
The generator will be sized to operate the emergency lighting and the special systems items required by the U.S. Marshals space. It is anticipated that the generator will be propane fueled and installed in a weatherproof enclosure located on the building exterior.

Fire Alarm System
The fire alarm system will be addressable and programmable. Manual pull stations will be installed at all exits to building and alarm horn/strobes will be located throughout the building for occupant notification. A telephone dialer will be included for notification to a remote location or monitoring site.

Security System
Empty conduit will be installed for the U.S. Marshals security systems - intercom, duress alarms, access control, camera surveillance, door releases, and door position systems.

Lightning Protection
A lightning protection will be provided consisting of roof mounted air terminals, interconnecting grounding cables, and ground rods.

Data and Telephone
Voice and data jacks will be installed throughout the building as required by the users. Each jack will have one voice and two data receptacles at each location. Category 5e cable will be installed from each jack, back to a patch panel and terminated on each end. Telephone and data equipment will be provided by the Owner.

END OF BUILDING DESIGN NARRATIVE

Sustainable Design

LEED EVALUATION NARRATIVE

Introduction

The Mammoth Courthouse is to incorporate sustainable design issues that enhance the indoor environmental quality with minimal impact on the external environment. The US Green Building Council's Leadership in Energy and Environmental Design (LEED) Program is the current tool for measuring the achievement of sustainability.

LEED is divided into six parts, five of which are related to specific design criteria, and the sixth toward innovation and professional accreditation. There are seven prerequisites that must be met in order to achieve LEED certification. Points are earned for the credits that meet the LEED design criteria. LEED certification is based on the total number of points earned. The preliminary goal for this building was LEED Certified, requiring 26-32 points. This will be a challenge due to the project location, design concepts, and sustainable design opportunities.

Green Building Concepts

Prerequisites

Erosion and sedimentation control will need to be addressed in the drawings and specifications. Since there will be a significant amount of excavation, methods of erosion control must be identified and detailed. The construction plan will have to follow through on the erosion control methods.

Energy efficiency exceeding the requirements of ASHRAE Standard 90.1-1999 is a part of the design criteria. CFC based refrigerants will not be used in any HVAC equipment. Building commissioning will be required to ensure proper installation and control of HVAC equipment.

Space for the storage and collection of recyclable materials has not been specifically identified. Approximately 100 square feet should be dedicated to this purpose.

The indoor environmental quality will be based on ventilation requirements that meet or exceed the minimum standards established by ASHRAE Standard 62-1999. The building should be designated as a non-smoking facility.

Site Selection

The Courthouse building is a new two-story building within Yellowstone National Park. The site meets the requirements for sustainable site selection, utilizing the exemption for park projects. The major focus for earning credits for sustainable sites will rely on site development and stormwater management. These strategies need to be developed during the design process and carried out through the construction process. Exterior lighting places security needs over light pollution. However, the potential for earning this credit exists through the selection of appropriate fixtures.

Water Efficiency

Landscape plant material will be native and adaptive species that are tolerant of the dry climate. This will eliminate the need for irrigation.

Waste water and potable water use can be reduced through the use of low-flow plumbing fixtures. Waterless or low-flow urinals, low-flow toilets, low-flow showerheads, and controlled lavatory faucets may reduce water use by 20 percent.

Energy and Atmosphere

Energy efficiency is a key component of the building design. The ASHRAE Standard is the minimum requirement, but the design targets a 20 percent reduction in the energy cost for the regulated systems. This conservative goal is worth two points toward LEED certification. Lighting system design and control, including day lighting and task lighting, are central to this energy reduction goal. Other factors include high efficiency HVAC equipment and high performance glazing. The design intent is to use HVAC equipment free of HCFCs.

Materials and Resources

Since this is a new building, there is no opportunity for building reuse. A construction waste management plan should be developed to reduce the quantity of construction and land clearing waste from the site.

Materials selection should include preference for recycled content as well as their ability to be recycled. Many of the new materials will be manufactured regionally. Lumber, petroleum, gravel, stone, and other materials that are used as building products are extracted regionally.

Indoor Environmental Quality

Comfort and air quality are key factors in occupant satisfaction. Comfort will be a factor in HVAC system selection and design. However, individual control will not be able to be provided due to security (cells) and system cost. Humidity control also will not be provided, thereby eliminating other potential credits. Ventilation rates and effectiveness will exceed ASHRAE guidelines. Flushing the building prior to occupancy is proposed; however, filter efficiencies are likely to be less than MERV 13 (80 to 85 percent).

Low-emitting materials are proposed to help maintain good indoor air quality over time. These materials include adhesives and sealants, paints and other coatings, carpet systems, and wood products free from added formaldehyde. Some aspects of indoor pollution control will be incorporated (potentially chemical source control), but will fall short of the credit criteria. The major issues of enclosed copy/print rooms will not be addressed in this project.

The window openings will provide an opportunity for natural day lighting as well as views. Operable windows will be provided to all regularly occupied perimeter rooms. The main exception will be cells and the courtroom due to security reasons.

Innovation and Accredited Professional

The design team includes a LEED Accredited Professional to ensure that the LEED requirements are included in the design. Documentation, correspondence, and other related issues are also the responsibility of the LEED Accredited Professional. Innovation credits will be identified throughout the design process based on sustainable design intent and application to this project.

END OF SUSTAINABLE DESIGN

	Possible Credits	Potential Credits
Sustainable Sites		
Site Prerequisite: Erosion and Sedimentation Control *Need to provide thorough construction documents and specifications. Enforce during construction.*	Required	N/A
Site Credit 1: Site Selection 1.0 *Need to review habitat, but likely to be acceptable.*	1	1
Site Credit 2: Urban Redevelopment 2.0 *(2 points) 60,000 sq. ft. Building/Acre* *Not applicable.*	1	
Site Credit 3: Brownfield Redevelopment 3.0 *Not applicable.*	1	
Site Credit 4: Alternative Transportation		
4.1 *Public Transportation* *Not Applicable*	1	
4.2 *Bicycle Storage & Facilities* *Could be provided, but not likely to be feasible.*	1	
4.3 *Alternative Fuel Vehicles* *Not in Plan.*	1	
4.4 *Parking Capacity* *Not Applicable - No minimum zoning requirements and carpooling unlikely.*	1	
Site Credit 5: Reduced Site Disturbance		
5.1 *Limited Greenfield Disturbance* *Must be detailed in drawings and specifications.*	1	1
5.2 *Reduced Footprint/Development* *Possible to designate open space adjacent to building equal to footprint.*	1	1
Site Credit 6: Stormwater Management		
6.1 *Reduce Runoff 25% / No Net Increase* *Existing imperviousness is assumed to be less than 50% requiring no change in peak discharge rate.*	1	1

	Possible Credits	Potential Credits
6.2 *Remove 80% TSS, 40% TP* *May consider means of removing TSS and phosphates.*	1	1
Site Credit 7: Landscape and Exterior Design to Reduce Heat Islands		
7.1 *Non-Roof Impervious Area Shade/Reflectance* *Not included in Design, but shade could be provided.*	1	
7.2 *Energy Star / Green Roofs* *Clay tile roof does not comply.*	1	
Site Credit 8: Light Pollution Reduction		
8.0 *May be done with appropriate design and selection of fixtures.*	1	1
Water Efficiency		
Water Credit 1: Water Efficient Landscaping		
1.1 *50% Recycled / Captured* *High efficiency irrigation system may be installed .*	1	1
1.2 *No Potable Use or No Irrigation System* *Potential for no irrigation system.*	1	1
Water Credit 2: Innovative Wastewater Technologies		
2.0 *Reduce 50% or Treat 100%* *Will require high efficiency fixtures.*	1	1
Water Credit 3: Water Use Reduction		
3.1 *20%* *Will require high efficiency fixtures, not likely to be met.*	1	
3.2 *30%* *Not likely to be met.*	1	
Energy and Atmosphere		
Energy Prerequisite 1: Fundamental Building Systems Commissioning *Commissioning to be included.*	Required	N/A
Energy Prerequisite 2: Minimum Energy Performance *ASHRAE 90.1 - 1999 or Greater* *ASHRAE Standard is minimum.*	Required	N/A

	Possible Credits	Potential Credits
Energy Prerequisite 3: CFC Reduction in HVAC&R Equipment	Required	N/A
No CFC to be used.		
Energy Credit 1: Optimize Energy Performance		
1.1 *(2 points) 20% Cost Reduction*	10	2
Assume 20% reduction in energy cost through design.		
1.2 *(2 points) 30% Cost Reduction*		
1.3 *(2 points) 40% Cost Reduction*		
1.4 *(2 points) 50% Cost Reduction*		
1.5 *(2 points) 60% Cost Reduction*		
Energy Credit 2: Renewable Energy		
2.1 *5% Energy Cost*	1	
Not likely, although PV is possible.		
2.2 *10% Energy Cost*	1	
2.3 *20% Energy Cost*	1	
Energy Credit 3: Additional Commissioning		
3.0 *Third Party with Recommissioning Plan*	1	
Third party commissioning by owner.		
Energy Credit 4: Ozone Depletion - No HCFCs or Halons	1	1
4.0 *Need to specify no HCFCs or Halons in project.*		
Energy Credit 5: Measurement and Verification	1	
5.0 *Cost constraints may prohibit M&V.*		
Energy Credit 6: Green Power		
6.0 *Green Power is not available.*	1	
Materials and Resources		
Materials Prerequisite: Storage and Collection of Recyclables	Required	N/A
Location to be determined.		
Materials Credit 1: Building Reuse		
1.1 *75% Existing Structure and Shell (Excludes Windows)*	1	
No existing building.		

	Possible Credits	Potential Credits
1.2 *100% Existing Structure and Shell (Excludes Windows)* *No existing building.*	1	
1.3 *100% Existing Structure/Shell And 50% Non-Shell* *No existing building.*	1	
Materials Credit 2: Construction Waste Management		
2.1 *Recycle/Salvage 50%* *Specify recycling, particularly of land clearing waste.*	1	
2.2 *Recycle/Salvage Additional 25%* *Not likely.*	1	
Materials Credit 3: Resource Reuse		
3.1 *Salvaged / Refurbished Materials for 5%* *No materials available for salvage.*	1	
3.2 *Salvaged / Refurbished Materials for 10%*	1	
Materials Credit 4: Recycled Content		
4.1 *25% Minimum Average 20% / 40% Recycled Content* *Specify recycled content.*	1	
4.2 *50% Minimum Average 20% / 40% Recycled Content*	1	
Materials Credit 5: Local / Regional Materials		
5.1 *20% Manufactured within 500 Miles* *Most materials should be available in 500 mile radius.*	1	1
5.2 *50% MRc5.1 Extract / Harvest / Recover 500 Miles* *Wood products likely to be harvested within 500 miles.*	1	1
Materials Credit 6: Rapidly Renewable Materials	1	
6.0 *5% Total Building Materials*		
Materials Credit 7: Certified Wood		
7.0 *50% Wood-Based Materials Certified FSC* *Wood products to be specified FSC certified.*	1	

Indoor Environmental Quality

IEQ Prerequisite 1: Minimum IAQ Performance *ASHRAE 62-1999* *Ventilation design per Standard.*	Required	N/A

	Possible Credits	Potential Credits
IEQ Prerequisite 2: Environmental Tobacco Smoke Control *Non-smoking facility.*	Required	N/A
IEQ Credit 1: Carbon Dioxide Monitoring		
1.0 *May provide CO2 monitoring.*	1	1
IEQ Credit 2: Increase Ventilation Effectiveness	1	1
2.0 *0.9 per ASHRAE 129-1997* *Calculations to be provided.*		
IEQ Credit 3: Construction IAQ Management Plan		
3.1 *SMACNA IAQ & Filters* *Specify construction management plan. Need MERV 13 filters (80 to 85% efficient).*	1	
3.2 *Flush or Treat Before Occupancy* *Specify flush or test before occupancy. Need MERV 13 filters.*	1	
IEQ Credit 4: Low-Emitting Materials		
4.1 *Adhesives and Sealants* *Low emitting materials are to be specified and used throughout building.*	1	1
4.2 *Paints and Coatings* *Low emitting materials are to be specified and used throughout building.*	1	1
4.3 *Carpet Systems* *Low emitting materials are to be specified and used throughout building.*	1	1
4.4 *Composite Wood and Agrifiber Formaldehyde* *Low emitting materials are to be specified and used throughout building.*	1	1
IEQ Credit 5: Indoor Chemical and Pollutant Source Control		
5.0 *Review copy room and waste piping designs.*	1	
IEQ Credit 6: Controllability of Systems		
6.1 *Operable Window & Light Control per 200 SF* *Most perimeter spaces will comply.*	1	1

	Possible Credits	Potential Credits
6.2 *Ind Control Air / Temp / Lights 50% Non-Perim* *HVAC system does not allow for zoning to comply (cells).*	1	
IEQ Credit 7: Thermal Comfort		
7.1 *ASHRAE 55* *No humidity control.*	1	
7.2 *Monitoring of Temperature and Humidity* *No humidity control.*	1	
IEQ Credit 8: Daylight and Views		
8.1 *Daylight Factor 2% for 75% Space* *Not likely to achieve.*	1	
8.2 *Direct Line of Sight to Glazing on 90% Area* *Not likely to achieve.*	1	
Innovation and Design Process		
Innovation Credit 1: Innovation in Design		
1.1 *LEED Innovation Credits*	4	
1.2 *LEED Innovation Credits*		
1.3 *LEED Innovation Credits*		
1.4 *LEED Innovation Credits*		
Innovation Credit 2: LEED Accredited Professional		
2.0 *LEED AP on Staff*	1	1

Total Possible Points	**69**	
Total Points for HRC Project		**22**

LEED Green Building Certification Levels		
LEED Certified	26-32 Points	**NO**
LEED Certified Silver Level	33-38 Points	
LEED Certified Gold Level	39-51 Points	
LEED Certified Platinum Level	52+ Points	

Building Code Analysis

BUILDING CODE ANALYSIS

Building Code Requirements

The Courthouse at Mammoth design is based on compliance with the following codes:

International Building Code (IBC), 2000 Edition (contains ADA requirements)
Uniform Fire Code (UFC), 1997 Edition
Uniform Mechanical Code (UMC), 1997 Edition
Uniform Plumbing Code (UPC), 1997 Edition
National Electrical Code (NEC), 1999 Edition

Building Occupancy

The Courthouse will be a mixed occupancy - Group B, Group S-1, and Group I-3. Approximately 65 percent of the Courthouse building will be used for office related activities, which is Group B Occupancy. The detention area is about 10 percent of the building, which is Group I-3. The remaining 25 percent of the building will be used for storage of materials classified as combustible, which is Group S-1 Occupancy. The building use shall be considered a "mixed occupancy" (UBC 504.3.2).

A two-hour fire rated separation is required between the B and I-3 Occupancies, a three-hour fire rated separation between I-3 and S-1, and a no fire rated separate between B and S-1 (UBC Table 302.3.3).

It is assumed that any chemicals and materials that will be used in the building would be in quantities less than allowed per UBC Table 3-D. If hazardous material quantities exceed maximum allowed, the use or storage areas would require a one-hour or two-hour fire resistive separation from the Group B Occupancies of the building. Use of approved chemical and flammable storage cabinets is allowed.

The emergency generator room and the mechanical-boiler room will require one-hour fire resistive occupancy separations from adjacent spaces.

Building Construction Type

The Courthouse may be classified as Building Construction Type V-N.

IBC categorizes "building construction types" according to structural framework material (i.e.: wood, steel, concrete, masonry) and the fire resistive nature of the components used to construct the building (i.e.: combustible or non-combustible). Building type requirements mandate the materials allowed to construct exterior and interior walls, floors, roofs, and restricts the number and location of openings in exterior walls.

The building type and occupancy are used to determine the amount of floor area and number of stories that are allowed for a particular building. Typically, a building that is constructed of non-combustible materials will be allowed to be larger in area and have more stories than a building constructed of combustible materials.

IBC allows unlimited building area regardless of building construction type for one or two story buildings with Group B or S-1 occupancies if the building has an automatic fire sprinkler system throughout and is surrounded by a yard or public way at least 60 feet in width (per IBC 507.2 and 3). The Courthouse may take advantage of this provision of unlimited area as the building will be protected with a fire sprinkler system and it is assumed that building development beyond Phase II will maintain the minimum yard width.

Using the mixed-occupancy factors required by IBC, the Courthouse may be constructed as a Type V-N building. Refer to the Allowable Building Area calculation sheets that follow this narrative.

Type V-N construction is the least restrictive construction type category and allows the greatest latitude in selecting materials and components.

Exterior bearing walls must be one-hour rated if closer than 20 feet to a property line.
Exterior non-bearing walls must be one-hour rated if closer than 20 feet to a property line.
Openings in exterior walls are not permitted if the wall is closer than 5 feet to a property line.
(Note that property lines will be greater than 20 feet from the Courthouse on all sides)

Although building code allows combustible materials to be used in the construction of the Courthouse under Type V-N, non-combustible materials are planned to be used throughout the building: steel and concrete structural elements, metal stud framing with gypsum board, and masonry.

Egress

The occupant load and precipitate exit width requirements for the Courthouse have been calculated per IBC Table 1003.2.2.2.

Upper Floor	61 occupants
Main Floor	39 occupants
Basement Floor	28 occupants
Bldg Total	128 occupants

The upper floor is provided with two exits via stairs down to the main floor. Main floor has two exits directly to the exterior. The lower level (code defines this floor as a "basement") has two exits, two via stairways up to the Main Floor.

Individual room occupant loads have been calculated to determine exit requirements. Fifty occupants is the threshold in needing to provide two exits from a room. None of the Courthouse rooms have a Code-defined occupant load over fifty. The largest and most populated spaces in the Courthouse (i.e.: courtroom) has an occupancy load of only twenty-one occupants and only one exit is proposed.

For All Occupancy Groups: Corridors must be 44 inches minimum width; the narrowest hallway planned for the Courthouse is 48 inches wide.

Stairways must have 44 inches minimum clear width (IBC 1003.3.3.1). Areas of refuge within the stair enclosure will be provided as required per code for non-ambulatory persons. 48 inch wide stairs as planned will handle the exit loads calculated at the Courthouse stairways.

Maximum travel distance allowed to an exit-way in a sprinklered building is 250 feet (IBC Table 1004.2.4). Travel distances from all areas of the Courthouse to exit-ways are well under the maximum allowed.

Structure

The Courthouse structural systems will be designed in accordance with IBC criteria.

Seismic Zone 4
Wind Exposure 110 mph
Snow load 38 psf
Frost Depth 42 inches (approx depth)

END OF BUILDING CODE ANALYSIS

Preliminary Building Code Analysis **UBC 1997 Edition**
Allowable Building Area Based on proportional B, I-3 and S-1 Occupancies

Type V-N	S-1	B	I-3	
1. Base Area Allowed	9,000	9,000	5,000	
Area Increase w/ Eq. 5-1 (175%)	15,750	15,750	8,750	
Two Floors (x2)	31,500	31,500	17,500	
Actual Bldg Area (Phase I)	4,411	11,115	1,589	ALLOWED
Allowable Bldg Area	31,500	31,500	17,500	
Ratio of Actual to Allowed	0.14 +	0.35 +	0.09 =	0.58 < 1.0

Type II-N	S-1	B	I-3	
2. Base Area Allowed	17,500	23,000	10,000	
Area Increase w/ Eq. 5-1 (175%)	35,000	46,000	20,000	
Two Floors (x2)	70,000	92,000	40,000	
Actual Bldg Area (Phase I)	4,411	11,115	1,589	ALLOWED
Allowable Bldg Area	70,000	92,000	40,000	
Ratio of Actual to Allowed	0.06 +	0.12 =	0.04 =	0.22 < 1.0

Type III-N	S-1	B	I-3	
3. Base Area Allowed	17,500	19,000	7500	
Area Increase w/ Eq. 5-1 (175%)	35,000	38,000	15,000	
Two Floors (x2)	70,000	76,000	30,000	
Actual Bldg Area (Phase I)	4,411	11,115	1,589	ALLOWED
Allowable Bldg Area	70,000	76,000	30,000	
Ratio of Actual to Allowed	0.06 +	0.15 =	0.05 =	0.26 < 1.0

Frontage Increase Calculation - Equation 5-2	
Building Perimeter fronting on 60' R/W or open space	412 SF
Building Perimeter fronting	412 SF
Min. Width of R/W (max. 30 if mixed use)	30
CALCULATION = 100 X (.75 - .25) X 1	75 %

Area Increase Calculation - Equation 5-1	
Base Area Allowed	1000
Yard separation Eq. 5-2	75%
Sprinkler increase (+100%)	200%
CALCULATION = 1 x (1 x .75)/ 100 + 1 x (1 x 200)/ 100	175 %

Notes:

A. Courthouse total area is	17,115			
Subtract basement area	4,411	"S-1"	"B"	"I-3"
Above grade building area	12,704 =	0 +	11,115 +	1,589

B. Basement area is not counted toward building total area and is not counted as a floor.

C. B Occupancy is general "office-business" use. S-1 Occupancy is moderate-hazard "storage" use

Program of Spaces

PROGRAM OF SPACES

	Program	Actual Building
A. NATIONAL PARK SERVICE		
NPS Secure Storage (Basement)		545
NPS Case File Storage (Basement)		451
NPS Secure Storage (Basement)		545
NPS Equipment (Basement)		545
Special Agent #1		96
Special Agent #2		144
Special Agent #3		112
Special Asst. DA		127
Files		252
Invest. #2		101
Invest #1		106
Copy Room		87
Clerk & Waiting		472
Total	-	3,583
B. U.S. MARSHALS SERVICE		
USMS Equipment (Basement)		310
Women's FIT Locker Room (Basement)		234
Men's FIT Locker Room (Basement)		234
FIT Room (Basement)		579
Prisoner Elevator Equip.		52
USMS Vehicle Sally Port		672
Weapons Vault		88
ISO Cell #1 and #2		296
Secure Corridor (Main Floor)		207
Release Corridor		60
Processing		311
Holding Cell #1, #2, & #3 (148 SF Each)		444
Weapons Clearing/Storage		33
Galley		140
SDUSM/Office		140
Squad Room Control Room Files & Copier		76
Squad Room Control Room Files & Copier		896
USMS Public Entry		110

	Program	Actual Building
Toilet		32
Secure Corridor (Upper Floor)		123
CSO Office		410
Corridor Salley Port		51
Total	-	5,498

C. U.S. DISTRICT COURTS

Interview AW Conf.		133
Courtroom		826
Waiting & Clerk & Files		381
Storage/Coats		20
Judge's Office		295
Toilet Room		35
Total	-	1,690

D. JOINT USE

Lobby		610
Janitor (Main Floor)		132
Women		145
Men		145
Janitor (Upper Floor)		30
Waiting		558
Basement Stair		138
Public Stair		113
Vestibule		218
Total	-	2,089

E. GROSS AND NET BUILDING AREAS

FLOOR AREA MATRIX - Plan dated 5/22/2003

Building Components	Area by Floor				TOTAL AREA
	Basement	Main	Second	Attic	Sq. Ft.
Magistrate Judges Facilities	-	-	1,593	-	1,593
U.S. Marshals	1,360	3,540	140	-	5,040
NPS Law Enforcement	1,933	383	1,720	-	4,036
Subtotal Tenant Area	3,293	3,923	3,453	-	10,669
Shared Facilities (Circulation, Restrooms & Public Areas)	1,118	1,148	897	2,179	5,342
Subtotal Shared & Unassigned Areas	1,118	1,148	897	2,179	5,342
TOTAL NET AREAS	4,411	5,071	4,350	2,179	16,011
Net To Gross Variance	-	650	454	-	1,104
Total Gross Building Area	4,411	5,721	4,804	2,179	17,115

PROGRAM OF SPACES

BASEMENT LEVEL

ROOM: NPS SECURE STORAGE

CLASSIFICATION: Storage.

USUAL ACTIVITY: Low usage storage space for confiscated materials and items requiring controlled access.

AREA (SQ.FT.): 545 Sq. Ft.

ADJACENCIES: None.

DESCRIPTION: Rectangular room on northwest corner of basement.

PROPOSED OCCUPANCY: Group "S".

FLOORING: Sealed concrete.

WALLS: Metal Framing with 5/8-inch Type "X" gypsum board. Inside face of studs would have security mesh fastened under gypsum board.

CEILING: Ceiling at 9 feet, 0 inches of 2 by 4 lay-in acoustical panel ceiling with metal grid centered in room.

LIGHTING: 2 by 4 recessed parabolic fixture in ceiling assembly.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Hardware to include door lock protector plates.

ELECTRICAL: Power outlets on wall spaces one (1) per wall.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Heating and cooling would use base building system.

SECURITY: Special door latching device and monitoring of door by Court Security personnel.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A

FURNISHINGS: None.

Accessible by elevator.

ROOM: USMS EQUIPMENT

CLASSIFICATION: Equipment room.

USUAL ACTIVITY: Equipment.

AREA (SQ.FT.): 310 Sq. Ft.

ADJACENCIES: Near U.S. Marshals suite.

DESCRIPTION: A secure room for housing voice / data and computer equipment and wiring racks for the U.S. Marshals suite.

PROPOSED OCCUPANCY: Group "U".

FLOORING: Sealed concrete.

WALLS: Metal Framing with 5/8-inch Type "X" gypsum board. Inside face of studs would have security mesh fastened under gypsum board.

CEILING: Ceiling at 9 feet, 0 inches of 2 by 4 lay-in acoustical panel ceiling with metal grid centered in room.

LIGHTING: 2 by 4 recessed parabolic fixture in ceiling assembly.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Hardware to include door lock protector plates.

ELECTRICAL: Power outlets on wall spaces one (1) per wall.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Cooling to maintain equipment at operating temperature between 65 to 75 degrees.

SECURITY: Special door latching device and monitoring of door by Court Security personnel.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: None.

ROOM: PRIS. ELEV. EQUIP.

CLASSIFICATION: Equipment.

USUAL ACTIVITY: Occasional access for maintenance of equipment.

AREA (SQ.FT.): 52 Sq. Ft.

ADJACENCIES: Below elevator.

DESCRIPTION: Rectangular room sized to match elevator shatft.

PROPOSED OCCUPANCY: Group "U".

FLOORING: Sealed concrete.

WALLS: One-hour rated shaft wall system with painted 5/8-inch Type "X" gypsum board on exposed surface.

CEILING: None.

LIGHTING: Wall mounted strip fixture.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Hardware, standard lockable latch.

ELECTRICAL: Power devices for elevator controller and as required for service.

COMMUNICATIONS: Phone as needed for monitoring equipment.

PLUMBING: None.

HVAC: Ventilation at top shaft only.

SECURITY: Door lock only.

FIRE DETECTION: Smoke detector.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: None.

ROOM: NPS CASE FILE STORAGE

CLASSIFICATION: Storage.

USUAL ACTIVITY: Occasional access to archived case files.

AREA (SQ.FT.): 451 Sq. Ft.

ADJACENCIES: None.

DESCRIPTION: West side of basement corridor.

PROPOSED OCCUPANCY: Group "S".

FLOORING: Sealed concrete.

WALLS: Non rated assembly of metal framing with painted 5/8-inch gypsum board, continuous floor to bottom of structure above.

CEILING: Ceiling at 9 feet, 0 inches of 2 by 4 lay-in acoustical panel ceiling with metal grid centered in room.

LIGHTING: 2 by 4 recessed parabolic fixture in ceiling assembly.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Provide protectors on both sides of door.

ELECTRICAL: Typical for storage with one (1) outlet on each wall.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Typical HVAC system.

SECURITY: Door lockable only.

FIRE DETECTION: Smoke detector.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: None.

ROOM: WOMEN'S F.I.T. LOCKER ROOM

CLASSIFICATION: Locker room / shower / restroom.

USUAL ACTIVITY: Showering and changing facility for use with fitness room; will be regularly used at all hours of day and night by tenant.

AREA (SQ.FT.): 234 Sq. Ft.

ADJACENCIES: Direct access to fitness room.

DESCRIPTION: Multiple rooms that include tiled shower / drying area, private toilet and locker/dressing area.

PROPOSED OCCUPANCY: Group "B" - locker room.

FLOORING: Quarry tile with non-slip surface.

WALLS: Non-rated metal-framed partitions to above ceiling with ceramic tile up to 48 inches above floor (full height at shower) and epoxy painted gypsum board to ceiling.

CEILING: Suspended furring at 8 feet, 6 inches with epoxy painted gypsum board.

LIGHTING: Water resistant recessed fluorescent lights.

WINDOWS: None.

DOORS/HARDWARE: Typical hollow metal frame and flush wood door (painted), door to restroom to have privacy lock.

ELECTRICAL: Power at sink and in dressing area.

COMMUNICATIONS: Intercom and phone.

PLUMBING: Counter mounted lavatory, floor mounted flush valve type water closet, terrazzo-base shower unit with anti scald fixture and three (3) floor drains.

HVAC: Typical heating and cooling at dressing area and special exhaust fans at shower and restroom.

SECURITY: None.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: Non-slip flooring.

FURNISHINGS: Solid surface counter in restroom and metal lockers in dressing area. Accessories would include typical restroom grab bar, toilet tissue dispenser and coat/robe hook. Locker room / dressing area would include towel hooks and soap holders along with full height mirror.

ROOM: MEN'S F.I.T. LOCKER ROOM

CLASSIFICATION: Locker room / shower / restroom.

USUAL ACTIVITY: Showering and changing facility for use with fitness room; will be regularly used at all hours of day and night by tenant.

AREA (SQ.FT.): 234 Sq. Ft.

ADJACENCIES: Direct access to fitness room.

DESCRIPTION: Multiple rooms that include tiled shower / drying area, private toilet and locker/dressing area.

PROPOSED OCCUPANCY: Group "B" - locker room.

FLOORING: Quarry tile with non-slip surface.

WALLS: Non-rated metal-framed partitions to above ceiling with ceramic tile up to 48 inches above floor (full height at shower) and epoxy painted gypsum board to ceiling.

CEILING: Suspended furring at 8 feet, 6 inches with epoxy painted gypsum board.

LIGHTING: Water resistant recessed fluorescent lights.

WINDOWS: None.

DOORS/HARDWARE: Typical hollow metal frame and flush wood door (painted), door to restroom to have privacy lock.

ELECTRICAL: Power at sink and in dressing area.

COMMUNICATIONS: Intercom and phone.

PLUMBING: Counter mounted lavatory, floor mounted flush valve type water closet, terrazzo-base shower unit with anti scald fixture and three (3) floor drains.

HVAC: Typical heating and cooling at dressing area and special exhaust fans at shower and restroom.

SECURITY: None.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: Non-slip flooring.

FURNISHINGS: Solid surface counter in restroom and metal lockers in dressing area. Accessories would include typical restroom grab bar, toilet tissue dispenser and coat/robe hook. Locker room / dressing area would include towel hooks and soap holders along with full height mirror.

ROOM: NPS SECURE STORAGE

CLASSIFICATION: Storage.

USUAL ACTIVITY: Low usage storage space for confiscated materials and items requiring controlled access.

AREA (SQ.FT.): 545 Sq. Ft.

ADJACENCIES: None.

DESCRIPTION: Rectangular room on northwest corner of basement.

PROPOSED OCCUPANCY: Group "S".

FLOORING: Sealed concrete.

WALLS: Metal Framing with 5/8-inch Type "X" gypsum board. Inside face of studs would have security mesh fastened under gypsum board.

CEILING: Ceiling at 9 feet, 0 inches of 2 by 4 lay-in acoustical panel ceiling with metal grid centered in room.

LIGHTING: 2 by 4 recessed parabolic fixture in ceiling assembly.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Hardware to include door lock protector plates.

ELECTRICAL: Power outlets on wall spaces one (1) per wall.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Heating and cooling would use base building system.

SECURITY: Special door latching device and monitoring of door by Court Security personnel.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A

FURNISHINGS: None.

ROOM: NPS EQUIPMENT

CLASSIFICATION: Storage.

USUAL ACTIVITY: Low usage storage space for confiscated materials and items requiring controlled access.

AREA (SQ.FT.): 545 Sq. Ft.

ADJACENCIES: None.

DESCRIPTION: Rectangular room on northwest corner of basement.

PROPOSED OCCUPANCY: Group "S".

FLOORING: Sealed concrete.

WALLS: Metal Framing with 5/8-inch Type "X" gypsum board. Inside face of studs would have security mesh fastened under gypsum board.

CEILING: Ceiling at 9 feet, 0 inches of 2 by 4 lay-in acoustical panel ceiling with metal grid centered in room.

LIGHTING: 2 by 4 recessed parabolic fixture in ceiling assembly.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame with solid wood door. Hardware to include door lock protector plates.

ELECTRICAL: Power outlets on wall spaces one (1) per wall.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Heating and cooling would use base building system.

SECURITY: Special door latching device and monitoring of door by Court Security personnel.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A

FURNISHINGS: None.

ROOM: F.I.T. ROOM

CLASSIFICATION: Exercise room / gym.

USUAL ACTIVITY: Exercise and weight lifting equipment for building tenants only. Possibly used at all hours of day and night.

AREA (SQ.FT.): 579 Sq. Ft.

ADJACENCIES: Locker rooms.

DESCRIPTION: Room located northeast of basement at end of corridor. Space used by tenants for maintaining physical fitness.

PROPOSED OCCUPANCY: Group "A - B", gymnasium.

FLOORING: Rubber gym flooring.

WALLS: Non-rated full height metal framed walls with painted 5/8-inch gypsum board on each side.

CEILING: Non-rated metal furring tight to structure to allow maximum ceiling height, with painted 5/8-inch gypsum board.

LIGHTING: Surface mounted fluorescent light fixtures with abuse resistant wrap covers.

WINDOWS: None.

DOORS/HARDWARE: Typical hollow metal frame with solid wood door, lockable door hardware.

ELECTRICAL: Office type power with two (2) outlets minimum per wall and additional for special exercise equipment.

COMMUNICATIONS: Voice data, cable television, and intercom to be available in room.

PLUMBING: None.

HVAC: Standard HVAC system with heating and cooling. This would be supplemented with added ventilation equipment.

SECURITY: Lockable door hardware only.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: Equipment by U.S. Marshals Service (not in Project).

GROUND LEVEL

ROOM: USMS VEHICLE SALLYPORT

CLASSIFICATION: Garage for secure prisoner loading.

USUAL ACTIVITY: Semi-regular (1 to 2 times per day).

AREA (SQ.FT.): 672 Sq. Ft.

ADJACENCIES: To secure corridor leading to holding cells or prisoner processing.

DESCRIPTION: Large room at end of west wing on the main floor of building.

PROPOSED OCCUPANCY: Group "U" - garage.

FLOORING: Sealed concrete.

WALLS: Glazed concrete masonry units.

CEILING: Suspended metal furring at +10 feet, 0 inches with metal security mesh under epoxy painted 5/8-inch gypsum board.

LIGHTING: Recessed fluorescent security type fixtures.

WINDOWS: None.

DOORS/HARDWARE: Wood sectional rollup door on heavy-duty metal track with high speed motorized operator. Door to suite would be hollow metal frame and steel door painted with security hardware.

ELECTRICAL: Storage type power, one (1) outlet per wall, connected to emergency power system.

COMMUNICATIONS: Voice data and intercom outlets required.

PLUMBING: Floor drain or trench drain for snowmelt and drop-off. This must be connected to sand-oil separator, also hose bib for washing vehicle and space.

HVAC: Heating only and special exhaust.

SECURITY: Security door hardware, intercom, keypad access, and monitored by U.S.M.S. camera system.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: Same as security, also provide carbon dioxide detector.

FURNISHINGS: Pistol lockers.

ROOM: WEAPONS VAULT

CLASSIFICATION: Secure room - vault.

USUAL ACTIVITY: Occasional use daily.

AREA (SQ.FT.): 88 SF

ADJACENCIES: Central location and near squad room.

DESCRIPTION: Secure storage for weapons, ammunition, and miscellaneous Law Enforcement equipment.

PROPOSED OCCUPANCY: Group "S" - storage (hazardous materials).

FLOORING: Vinyl composition floor tile.

WALLS: Epoxy painted concrete masonry.

CEILING: Building standard 2 by 4 acoustic ceiling panels at 9 feet, 6 inches.

LIGHTING: Building standard recessed lights.

WINDOWS: None.

DOORS/HARDWARE: Class 5 vault door with magnetic shut lock and include a metal daygate.

ELECTRICAL: Extra power outlets for battery charges.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Building standard heating and cooling.

SECURITY: Electronic monitoring and video camera system.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: Electronic monitoring and video camera system.

FURNISHINGS: Built-in metal shelving, gun locker (by U.S.M.S.)

ROOM: ISO CELL #1 and #2

CLASSIFICATION: Institutional detention cells.

USUAL ACTIVITY: Prisoner detention as needed.

AREA (SQ.FT.): 148 Sq. Ft. (each cell)

ADJACENCIES: Prisoner processing, prisoner elevator, and connected with secure corridor.

DESCRIPTION: Rectangular holding cell with adjacent sally port space located adjacent to vehicle sally port.

PROPOSED OCCUPANCY: Group "I-3", detention area.

FLOORING: Epoxy terrazzo.

WALLS: Glazed concrete masonry units.

CEILING: Cast concrete at + 9 feet, 0 inches.

LIGHTING: Surface mounted detention maximum security lighting fixtures.

WINDOWS: None.

DOORS/HARDWARE: Detention type hollow metal frames and doors with high security door hardware. Door to include vision panel of laminated security glass.

ELECTRICAL: None.

COMMUNICATIONS: Intercom.

PLUMBING: Security / detention type combination toilet and lavatory with all piping concealed behind wall (ADA unit). Also provide floor drain and hose bib outside cell area.

HVAC: Standard HVAC heating and cooling. System will be modified as required for "airborne pathogen control." System must supply air from sally port through cell front to low-level exhaust / return at back of cell.

SECURITY: Detention door and cell hardware, intercom, duress video telecommunications system, conduit and power to be provided with building shell (R.I. conduit by NPS).

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system with detention type heads.

SAFETY: Detention door and cell hardware, intercom, duress video telecommunications system, conduit and power to be provided with building shell.

FURNISHINGS: A detention grade stainless steel grill assembly to separate cell from sally port area and include door unit with special hardware including ports for shackles, food, and cuffs. A one piece bench, steel detention type privacy screen and security type grab bars will also be required.

ROOM: SECURE CORRIDOR

CLASSIFICATION: Secure circulation corridor.

USUAL ACTIVITY: Occasional use to access adjacent rooms.

AREA (SQ.FT.): 207 Sq. Ft.

ADJACENCIES: As needed.

DESCRIPTION: Access corridor from sally port to detention cells.

PROPOSED OCCUPANCY: Group "B".

FLOORING: Epoxy terrazzo with covered base.

WALLS: Non-rated full height glazed concrete masonry units and grouted solid.

CEILING: Acoustical metal security ceiling system at +9 feet, 0 inches high above floor.

LIGHTING: Recessed fluorescent security fixtures.

WINDOWS: None.

DOORS/HARDWARE: Detention type hollow metal frames and doors with high security door hardware. Door to include vision panel of laminated security glass.

ELECTRICAL: Power outlets as needed, connected to emergency power.

COMMUNICATIONS: Voice / data, intercom and security camera system by U.S.M.S.

PLUMBING: None.

HVAC: Standard HVAC heating and cooling. System will be modified as required for "airborne pathogen control."

SECURITY: Detention grade door hardware. Access control and camera monitoring system by U.S.M.S. (R.I. conduit by NPS).

FIRE DETECTION: Smoke detectors. Note: no pull stations shall be access able to prisoner.

FIRE SUPPRESSION: Automatic fire sprinkler system with detention type heads.

SAFETY: Same as security and added duress alarm by U.S.M.S.

FURNISHINGS: None.

ROOM: PRISONER ELEVATOR

CLASSIFICATION: Equipment

USUAL ACTIVITY: Used to transport prisoners only

AREA (SQ.FT.): 52 SF

ADJACENCIES: Secure corridor.

DESCRIPTION: Specialty electric traction type elevator with self contained equipment on cab. Includes detention screen and doors to isolate prisoner in separate space.

PROPOSED OCCUPANCY: N/A.

FLOORING: Stainless steel checker plate.

WALLS: Stainless steel wall panels.

CEILING: Metal security panel ceiling.

LIGHTING: Same as Sally Port.

WINDOWS: None.

DOORS/HARDWARE: Stainless steel and sound insulated for elevator and high security locks and gate.

ELECTRICAL: None.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Special ventilation.

SECURITY: Special hardware door on prisoner area, electronic monitoring and duress (R.I. conduit by NPS).

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: None.

SAFETY: Special hardware door on prisoner area, electronic monitoring and duress (R.I. conduit by NPS).

FURNISHINGS: A detention grade stainless steel grill assembly with separate cell from sally port and include door unit with special hardware including ports for shackles, food, and cuffs.

ROOM: PROCESSING

CLASSIFICATION: Office / detention area.

USUAL ACTIVITY: Occasional daily use.

AREA (SQ.FT.): 311 Sq. Ft.

ADJACENCIES: Prisoner holding cells and secure access corridor in sally port.

DESCRIPTION: Room to process detainees located near center of the main floor.

PROPOSED OCCUPANCY: Group "B" - office type.

FLOORING: Epoxy terrazzo with covered base.

WALLS: Non-rated full height glazed concrete masonry units and grouted solid.

CEILING: Acoustical metal security ceiling system at +9 feet, 0 inches high above floor.

LIGHTING: Recessed fluorescent security fixtures.

WINDOWS: None.

DOORS/HARDWARE: Detention type hollow metal frames and doors with high security door hardware. Door to include vision panel of laminated security glass.

ELECTRICAL: Power outlets as needed, connected to emergency power.

COMMUNICATIONS: Voice / data, intercom and security camera system by U.S.M.S.

PLUMBING: Stainless steel sink at counter and detention type cabinet shower. Area near shower to have floor drain. Space will also have eye wash unit.

HVAC: Standard HVAC heating and cooling. System will be modified as required for "airborne pathogen control."

SECURITY: Detention grade door hardware. Access control and camera monitoring system by U.S.M.S. (R.I. conduit by NPS).

FIRE DETECTION: Smoke detectors. Note: no pull stations shall be accessible to prisoner.

FIRE SUPPRESSION: Automatic fire sprinkler system with detention type heads.

SAFETY: Same as security and added duress alarm by U.S.M.S.

FURNISHINGS: Plastic laminate base and upper cabinet unit and solid surface counter top. Grab bar unit (security grade). U.S.M.S. also required. Two (2) desks with stools built in to meet detention equipment standards, this need to be reviewed to confirm who will provide these.

ROOM: PUBLIC ELEVATOR

CLASSIFICATION: Equipment

USUAL ACTIVITY: Occasional use on daily basis.

AREA (SQ.FT.): 48 SF

ADJACENCIES: Public circulation corridors and lobby.

DESCRIPTION: Public elevator for 6 to 8 passengers with ADA accessibility.

PROPOSED OCCUPANCY: N/A.

FLOORING: Stone to match lobby.

WALLS: Wood grain plastic laminate.

CEILING: Stainless steel metal ceiling.

LIGHTING: Elevator standard.

WINDOWS: None.

DOORS/HARDWARE: Standard stainless steel.

ELECTRICAL: None.

COMMUNICATIONS: None.

PLUMBING: None.

HVAC: Vent at top of shaft.

SECURITY: None.

FIRE DETECTION: Smoke detector.

FIRE SUPPRESSION: None.

SAFETY: Elevator standard.

FURNISHINGS: None.

ROOM: GROUND LEVEL CELL #1, #2, & #3

CLASSIFICATION: Institutional detention cells.

USUAL ACTIVITY: Prisoner detention as needed.

AREA (SQ.FT.): 148 Sq. Ft. (each cell).

ADJACENCIES: Prisoner processing, prisoner elevator, and connected with secure corridor.

DESCRIPTION: Rectangular holding cell with adjacent sally port space located adjacent to vehicle sally port.

PROPOSED OCCUPANCY: Group "I-3", detention area.

FLOORING: Epoxy terrazzo.

WALLS: Glazed concrete masonry units.

CEILING: Cast concrete at + 9 feet, 0 inches.

LIGHTING: Surface mounted detention maximum security lighting fixtures.

WINDOWS: None.

DOORS/HARDWARE: Detention type hollow metal frames and doors with high security door hardware. Door to include vision panel of laminated security glass.

ELECTRICAL: None.

COMMUNICATIONS: Intercom.

PLUMBING: Security / detention type combination toilet and lavatory with all piping concealed behind wall (ADA unit). Also provide floor drain and hose bib outside cell area.

HVAC: Standard HVAC heating and cooling. System will be modified as required for "airborne pathogen control." System must supply air from sally port through cell front to low-level exhaust / return at back of cell.

SECURITY: Detention door and cell hardware, intercom, duress video telecommunications system, conduit and power to be provided with building shell.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system with detention type heads.

SAFETY: Detention door and cell hardware, intercom, duress video telecommunications system, conduit and power to be provided with building shell.

FURNISHINGS: A detention grade stainless steel grill assembly with separate cell from sally port and include door unit with special hardware including ports for shackles, food, and cuffs. A one piece bench, steel detention type privacy screen and security type grab bars will also be required.

ROOM: JANITOR

CLASSIFICATION: Joint use utility space.

USUAL ACTIVITY: Daily use.

AREA (SQ.FT.): 132 SF

ADJACENCIES: Public access corridor and restrooms.

DESCRIPTION: Room for storage of building maintenance equipment and support.

PROPOSED OCCUPANCY: Group "B" accessory to office.

FLOORING: Vinyl composition tile.

WALLS: Non-rated wall with metal framing and epoxy painted gypsum board walls.

CEILING: Suspended metal furring with painted gypsum board.

LIGHTING: Surface mounted fluorescent.

WINDOWS: None.

DOORS/HARDWARE: Standard hollow metal frame, solid wood door and locking hardware. Metal kick panels to be installed each side.

ELECTRICAL: Building standard with one (1) outlet per wall.

COMMUNICATIONS: Phone only.

PLUMBING: Janitor's mop sink.

HVAC: Ventilation / exhaust only.

SECURITY: None.

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: Shelving and broom / mob rack.

ROOM: CSO OFFICE

CLASSIFICATION: Office break room and control / monitoring equipment.

USUAL ACTIVITY: Regular daily use.

AREA (SQ.FT.): 410 SF

ADJACENCIES: U.S. Marshals suite and public lobby.

DESCRIPTION: Room to house Court Security Officers with lockers, conference table, and to accommodate security console for monitoring U.S.M.S. security system.

PROPOSED OCCUPANCY: Group "O" - Office.

FLOORING: Carpet.

WALLS: Non-rated metal frame with painted gypsum board.

CEILING: Building standard.

LIGHTING: Building standard recessed parabolic light fixtures.

WINDOWS: Building standard aluminum clad wood frame with metal horizontal mini blinds. ***Bullet resistant glass not proposed.***

DOORS/HARDWARE: Hollow metal frame, solid wood door, and special card access lock.

ELECTRICAL: Building standard two (2) outlets per wall. Plus extra at control panel.

COMMUNICATIONS: Building standard voice data, in addition to conduit runs to all security equipment and devices.

PLUMBING: None.

HVAC: Building standard heating and cooling.

SECURITY:

FIRE DETECTION: Smoke detectors.

FIRE SUPPRESSION: Automatic fire sprinkler system.

SAFETY: N/A.

FURNISHINGS: Lockers by U.S.M.S.

ROOM: BASEMENT STAIR

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 138 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: PUBLIC STAIR

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 113 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: VESTIBULE

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.):

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: WEAPONS CLRG.

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 33 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: GALLEY

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 140 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SDUSM

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 140 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SQUAD ROOM CONTROL ROOM FILES & COPIER

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 896 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: USMS PUBLIC ENTRY / INTERVIEW ROOM

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 110 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

Upper Level

ROOM: SPECIAL AGENT #1

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 96 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SPECIAL AGENT #2

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 144 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SPECIAL AGENT #3

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 112 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SPECIAL ASST. D.A.

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 127 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: FILES

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 252 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: INVEST. #2

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 101 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: INVEST. #1

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 106 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

:

ROOM: ILE OF NATED WING *DRAWING CUT OFF COLUMN TREAD*

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 132 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: INTERVIEW AW CONF.

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 133 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

:

ROOM: WOMEN

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 145 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: MEN

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 145 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: JANITOR

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 30 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: OPEN

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 210 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: WAITING

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 558 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: PUBLIC ELEVATOR

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 48 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: CLERK & WAITING

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 472 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: PRIS. ELEV

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 52 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: COPY ROOM

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 87 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SECURE CORRIDOR

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 123 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: COURTROOM

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 826 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: WAITING & CLERK & FILES

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 381 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: STORAGE

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 20 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: JUDGE'S OFFICE

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.): 295 SF

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

ROOM: SECOND FLOOR ATTIC

CLASSIFICATION:

USUAL ACTIVITY:

AREA (SQ.FT.):

ADJACENCIES:

DESCRIPTION:

PROPOSED OCCUPANCY:

FLOORING:

WALLS:

CEILING:

LIGHTING:

WINDOWS:

DOORS/HARDWARE:

ELECTRICAL:

COMMUNICATIONS:

PLUMBING:

HVAC:

SECURITY:

FIRE DETECTION:

FIRE SUPPRESSION:

SAFETY:

FURNISHINGS:

END OF PROGRAM OF SPACES

Construction Cost Estimate

CONSTRUCTION COST ESTIMATE

Estimate Overview

The estimate of construction cost for the Courthouse in Mammoth is organized into three parts: Summary of Construction Costs, Site Construction Cost, and Building Construction Cost.

Summary of Construction Costs

The estimate summary lists the major work category sums and total estimated costs for both Site and Building portions of the project.

General conditions costs to the project are incorporated as eight percent (8%) of the direct construction costs of labor and materials. General conditions costs include contractor's bonds, insurance, on-site office and storage trailers, cost of supervision, cost to mobilize equipment and materials to the site and cost to demobilize, etc.

The General Contractor's overhead and profit is included at eight percent (8%) of the direct construction costs of labor and materials. Recent projects of similar scope bid in the Montana-Wyoming region carry similar overhead and profit margins.

A fifteen percent (15%) remote factor is added to the direct labor and materials costs due to the site's location in Yellowstone National Park. General contractors currently working in the Park report that they typically increase their estimated construction costs by a twenty percent (20%) factor to compensate for increased cost of labor, transportation inefficiencies, and the short summer construction season. The labor force required for the Mammoth Courthouse will demand hefty per diem compensation and work incentives similar to other Yellowstone National Park projects. Compared to other Yellowstone National Park locations, the Mammoth Courthouse site near Gardiner will not be as heavily impacted by the summer travel delays and winter road closures.

The estimated costs are calculated at today's value (July 01, 2003). With the assumption that the project design would be completed by spring of 2004, Mammoth project would be bid in March of 2005. A cost of inflation of 5 percent (5%) is added.

Site Construction Cost

The Site Construction Cost estimate is broken into five main categories of work: Earthwork, Utilities, Paving, Landscape, and Site Improvements.

Work included in the Site Cost is typically everything outside of the building. Rough site grade shaping is included in site costs. Excavation and backfill for the building are included in the building costs. Fine grading next to the building is a site cost.

The Mammoth municipal water system will be tapped to provide domestic and fire suppression water service to the building. The Mammoth system is assumed to have capacity for the current demand.

Line item costs provided in the estimate typically include all related costs. For example, the sanitary sewer line item includes trenching, bedding, the pipe material and labor to install, and backfill.

At Schematic Design, there remain many unknowns that will influence construction costs. Note that a fifteen percent (15%) design contingency is built into each line item cost to address the unknown and unforeseen.

Building Construction Cost

The building Construction Cost estimate is broken down into six (6) main categories of work: Structural, Exterior Shell, Interior Construction, Elevator, Mechanical and Plumbing, and Electrical.

The building structure must be designed to meet the requirements mandated for Seismic Zone 4.

The HVAC system is required to provide not only a comfortable work environment, it will also need to address the specific ventilation, filtering for airborne pathogen requirements of U.S.M.S.

Protection from fire damage is among the principal concerns of the Yellowstone National Park. A traditional wet-pipe system (water is present in pipe at all times), will be used in the building. Activation of the suppression systems is controlled by smoke and flame detectors and by heat melting specific heads.

Materials and systems proposed for the Mammoth Courthouse are typically of high quality and durable in nature; characteristics that usually carry a greater initial cost but over the life of the facility will cost less in terms of maintenance, repairs, and replacement.

Utilization of sustainable building materials and energy efficient systems increases the initial construction costs when compared to the initial costs of traditional materials and systems. Availability, increased documentation (i.e. chain of command tracking) and a smaller industry demand push up the costs of "green" products. However, the long-term environment-wide cost of sustainable materials is far less than that of traditional materials.

The electrical system is designed to allow for flexibility to accommodate new technologies and include a fire alarm system. Lightning protection is provided for the building and the building and specific spaces will be protected by a security system. The estimate assumes that wiring and devices for the U.S. Marshal Service security systems are in a separate budget. This estimate would include conduit and power to the proposed termination points and empty boxes to mount devices in places.

At Schematic Design, there remain many unknowns that will impact construction costs. Note that a fifteen (15%) design contingency is built into each line item cost to address the unknown and unforeseen.

END OF CONSTRUCTION COST ESTIMATE

SUMMARY of CONSTRUCTION COSTS

Schematic Design

Project Site Area	150,000 SF		
Building Area	16,358 SF		

SITE WORK

Earthwork	13,743		
Utilities	124,641		
Paving	45,278		
Landscaping	48,000		
Site Improvements	64,525		
	$ 309,514		Includes 15% Design Contingency
	24,761	8%	General Conditions
	24,761	8%	General Contractor Overhead & Profit
	46,427	15%	Remote factor Mammoth, WY
	$ 405,464		Site work Construction Cost (if bid 03/01/05)
	$ 20,273	5.0%	Escalate Project Cost to March '05 Bid Date
	$ 425,737		**Site work Construction Cost**

BUILDING

Structural	388,815		
Exterior Shell	765,269		
Interior Construction	612,017		
Elevator	122,500		
Mechanical and Plumbing	579,421		
Electrical	378,956		
	$ 2,846,978		>Includes 15% Design Contingency<
	227,758	8%	General Conditions
	227,758	8%	General Contractor Overhead & Profit
	427,047	15%	Remote factor Mammoth, WY
	$ 3,729,541		Building Construction Cost (if bid 03/01/05)
	$ 186,477	5.0%	Escalate Project Cost to March '05 Bid Date
	$ 3,916,018		**Building Construction Cost**
	$ 239.39		**per SF Building Cost**

CONSTRUCTION COST ESTIMATE TOTAL

Site work Construction	**$425,737**
Building Construction	**$3,916,018**
Total Construction Cost	**$4,341,756**

SITE CONSTRUCTION COSTS					
Project Site Area +/- 7.2 acres	150,000	SF			
Design Contingency Included	15.0%				
EARTHWORK					**$13,743**
See Building Estimate for building excavation					
Site clearing	1	LS	$1,725.00	$1,725	
Rough grading	3,000	CY	$3.91	$11,730	
Fine grading	2,500	CY	$0.12	$288	
UTILITIES					**$124,641**
Water loop	90	LF	$65	$5,850	
Sanitary sewer	90	LF	$38	$3,416	
Power, UG service	90	LF	$200	$18,000	
Telephone & Security to NPD Center	1,200	LF	$50	$60,000	
Site lighting	2	EA	$2,875	$5,750	
LP tank pads, LP lines	1	LS	$2,875	$2,875	
Relocate Utilities Allowance	1	LS	$28,750	$28,750	
PAVING					**$45,278**
3" Asphalt paving w/ 6" base	3,280	SF	$2	$5,658	
Conc curb & gutter	500	LF	$12	$6,000	
Concrete Plaza sidewalk w/ base	4,000	SF	$5	$21,620	
Concrete Steps	500	LF	$24	$12,000	
LANDSCAPE					**$48,000**
Landscape prep, plant material and temp irrigation by NPS	2.5	Ac	$10,000	$25,000	
Temporary irrigation	1	LS	$11,500	$11,500	
Boulders	1	LS	$11,500	$11,500	
SITE IMPROVEMENTS					**$64,525**
Building monument sign	1	LS	$11,500	$11,500.00	
Traffic signage, bollards, etc	1	LS	$4,025.00	$4,025.00	
Security Barriers/Wall	140	LF	$350.00	$49,000.00	
END					

BUILDING CONSTRUCTION COSTS					
Total Building Area	16,358	SF			
Building Footprint	5,721	SF			
Building perimeter	412	LF			
Design Contingency Included	15%				
STRUCTURAL					**$388,815**
See Site Estimate for non-building earthwork					
Excavation 1:1 around bldg	2,560	CY	3.91	$10,010	
Haul over-excav	1,660	CY	4.25	$7,055	
Hand excav	50	CY	51.75	$2,588	
3ft Eng fill & comp at over-excavation	5,800	SF	3.5	$20,300	
Backfill & compaction at fnd walls	900	CY	11.0975	$9,988	
Continuous Footings	320	LF	13.62	$4,357	
Pad footings	14	CY	172.5	$2,415	
12" Foundation walls	3,862	SF	11.87	$45,834	
Damproofing	3,862	SF	1.04	$3,997	
Foundation insulation	3,862	SF	1.27	$4,885	
Slab on grade	5,721	SF	2.96	$16,908	
Composite slab & Floor Beams	12,680	SF	8.40	$106,449	
Steel columns & Bracing	5,721	SF	2.65	$15,132	
Steel roof structure	5,721	SF	11.21	$64,147	
Misc Steel - stairs, guard rails	1	LS	74750.00	$74,750	

EXTERIOR SHELL				$765,269
Roof				**$124,496**
Clay Roofing Tile	10,378	SF	4.50	$46,701
15# felts, 2 layers	10,378	SF	0.35	$3,580
Slip sheet	10,378	SF	0.17	$1,790
Ice dam	4,200	SF	1.44	$6,038
Vapor barrier	10,378	SF	0.63	$6,564
Ureath Foam insul R-34	10,378	SF	4.60	$47,739
Memb Roofing mech fasten	400	SF	3.57	$1,426
Tapered insul	400	SF	3.01	$1,205
Vapor barrier	400	SF	0.63	$253
Barrel Skylight	0	SF	46.00	$0
Misc (curbs, flshg)	1	LS	9200.00	$9,200
Walls				**$603,947**
Stone column bases	576	SF	46.23	$26,628
Stone (ext wall)	8,762	SF	46.23	$405,067
Wood Corbels And Beams	36	SF	1200.00	$43,200
Wood Outrigger	205	SF	45.00	$9,225
CMU Ext. Wall (main floor)	5,356	SF	9.50	$50,882
Air infiltration barrier	10,940	SF	0.16	$1,761
Gypsum sheathing	10,940	SF	1.25	$13,713
6" mtl studs	2,170	SF	5.06	$10,980
6" batt	7,960	SF	0.69	$5,492
Vapor barrier	7,960	SF	0.14	$1,098
Interior gyp bd surface	7,960	SF	1.45	$11,534
Misc (sealant, trim, flsh'g)	1	LS	11500.00	$11,500
Cav Insul (Main Floor ext wall)	5,356	SF	1.15	$6,159
Wood Shingle Siding	2,170	SF	3.09	$6,705
Exterior Doors & Windows				**$36,826**
Steel Coiling Door (Hi-speed & secure)	1	SF	25000.00	$25,000
Alum framed windows - Operable	446	SF	40.00	$17,840
Alum framed windows - All fixed	512	SF	35.00	$17,920
Alum framed entry doors	8	EA	1293.75	$10,350
Door Opener - ADA	2	EA	2328.75	$4,658
Steel Exit Door	2	EA	1949.25	$3,899

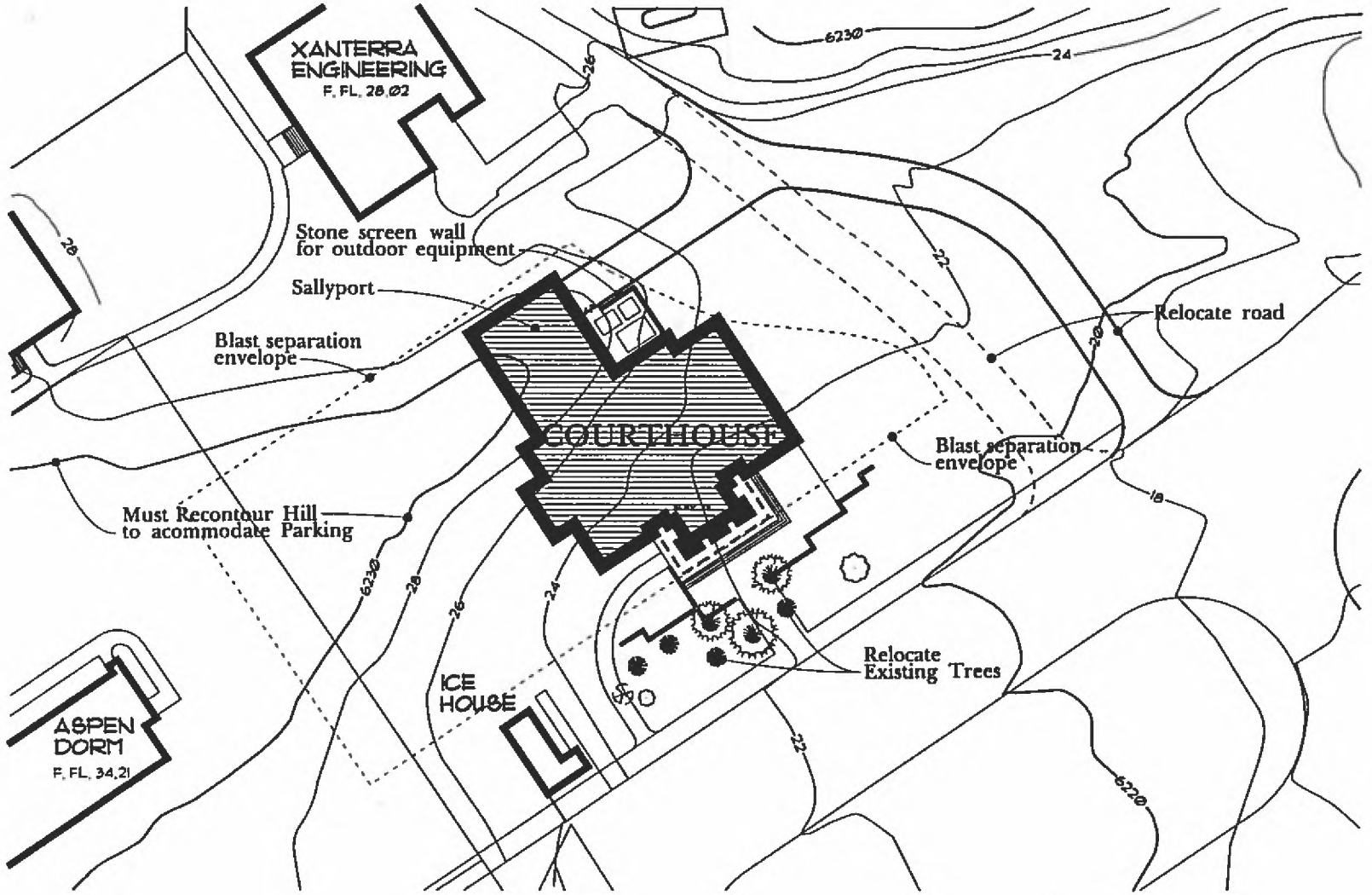
INTERIOR CONSTRUCTION				$612,017
Walls, Floors, Ceilings				**$387,791**
Mtl framed wall w/ gyp bd B/S & paint	16,876	SF	3.51	$59,193
Batt insul & vapor barrier	8,156	SF	0.48	$3,939
6" Glazed block walls (holding Cells)	3,400	SF	19.50	$66,300
6" Concrete block - Stair Walls	675	SF	8.63	$5,822
Terrazzo Flooring -Holding	1,586	SF	22.00	$34,892
Mtl wall furring w/ batt, gyp bd, paint	3,862	SF	2.59	$9,993
Ceramic tile wall w/ studs & bkg	1,360	SF	9.89	$13,450
Ceramic tile floor	286	SF	10.35	$2,960
Lobby- tile floor	612	SF	16.50	$10,098
Carpet, base & accessories	8,361	SF	4.31	$36,057
Rubber/linoleum flooring & base	880	SF	5.92	$5,212
Sealed concrete floor	5,140	SF	0.35	$1,773
Acoustic panel ceilings	9,421	SF	2.23	$21,018
Gypsum board ceiling - painted	660	SF	1.86	$1,230
Secure Ceiling- Holding	1,586	SF	39.00	$61,854
Security Mesh in walls	1,000	SF	39.00	$39,000
Up-grade Finishes in Courtroom	1	LS	10000.00	$10,000
Up-grade Finishes in Chamber	1	LS	5000.00	$5,000
			S3	
Interior Doors & Windows				**$64,117**
Wood doors w/ hrdwr & finish	39	EA	442.75	$17,267
Steel doors w/ hrdwr & finish	3	EA	471.50	$1,415
Security Windows	2	EA	4500.00	$9,000
Security Doors - Entry to Secure	12	EA	2500.00	$30,000
Wood framed int windows w/ finish	84	SF	14.03	$1,179
Window coverings	446	SF	11.79	$5,257
Miscellaneous				**$160,108**
Toilet Rms -part'ns, mirrors, pt. tp, etc	4	EA	2800.25	$11,201
Woodwork-cabinetry, trim	1	LS	28750.00	$28,750
Fire ext, flr mats, appliances, lkrs	1	LS	8625.00	$8,625
Signage, tack-mrkr bds, display	1	LS	2500.00	$2,500
Cell Equipment	5	EA	1500.00	$7,500
Cell Fronts	5	EA	3655.00	$18,275
Interview Window & Stool	1	EA	4800.00	$4,800
Secure Walls at Weapons Vault	525	SF	32.00	$16,800
Lockers in Training	20	EA	95.00	$1,900
CSO Security Station -Walls & Cab.	1	LS	3500.00	$3,500

ELEVATOR					**$122,500**
	3-Stop, 4500# hydr elev, jack hole	1	EA	57500.00	$57,500
	Prisoner Elevator	1	EA	65000.00	$65,000
MECHANICAL & PLUMBING					**$579,421**
	Plumbing Systems				**$185,646**
	See Site work Estimate for water, sewer service to building				
	LP gas system	1	LS	17250.00	$17,250
	Dom H&C, Fixtures	16,358	SF	2.13	$34,802
	Detention Fixtures	3	EA	3500.00	$10,500
	Radon venting	16,358	SF	0.58	$9,406
	Waste & vent	16,358	SF	1.84	$30,099
	Foundation drain system	16,358	SF	0.50	$8,179
	Wet-pipe fire sprinkler system	16,358	SF	2.88	$47,111
	Domestic Water Heating System	1	SF	6000.00	$6,000
	Shower Units	3	EA	5300.00	$15,900
	Private Bathrooms	2	EA	1200.00	$2,400
	Misc.(Mop, Jan. Floor Drain)	1	LS	4000.00	$4,000
	HVAC Systems				**$393,775**
	Mechanical Identification	16,358	EA	0.05	$818
	Valves	16,358	SF	0.25	$4,090
	Meter, Gauges, Thermometers	16,358	SF	0.10	$1,636
	Insulation, piping, ducts, equip.	16,358	SF	1.40	$22,901
	Piping, Hydronic, Accessories	16,358	SF	3.70	$60,525
	Pumps HVAC	16,358	EA	0.65	$10,633
	Boiler, cast iron, LPG, 640MBH	2	EA	12000.00	$24,000
	Chiller, Air Cooler, 20 ton	1	LS	24000.00	$24,000
	Ductwork, metal	16,358	SF	4.50	$73,611
	Duct Accessories	16,358	EA	1.20	$19,630
	Finned Tube Radiation & Cab. Heaters	16,358	LS	0.20	$3,272
	Air Terminals, VAV	16,358	SF	0.35	$5,725
	Centrifugal Fans	16,358	SF	0.20	$3,272
	Air Handling Unit, Htg & Clg Coils	1	EA	22500.00	$22,500
	Diffusers, Grills, and Registers	16,358	SF	0.65	$10,633
	Louvers	16,358	SF	0.15	$2,454
	DDC Control System	16,358	SF	5.00	$81,790
	Test, Adjusting and Balancing	16,358	SF	0.50	$8,179
	Final System Commissioning	16,358	SF	0.86	$14,109

ELECTRICAL					$378,956
Service & Distribution				**$154,346**	
See Site work Estimate for UG service					
Service & Distribution	16,358	SF	2.40	$39,316	
Basic Materials	16,358	SF	2.88	$47,029	
Emergency generator	1	EA	68000	$68,000	
Lighting				**$79,582**	
Lighting - Simple	7,480	SF	1.80	$13,464	
Lighting - Medium	8,267	SF	4.60	$38,028	
Lighting - Detention	3,680	SF	5.75	$21,160	
Lighting - Courtroom	900	SF	7.70	$6,930	
Devices & Equipment				**$33,396**	
Devices	19,360	SF	0.58	$11,132	
Equipment connections	19,360	SF	1.15	$22,264	
Special Systems				**$145,028**	
Fire alarm	19,360	SF	1.50	$29,040	
Security	19,360	SF	1.44	$27,830	
Voice/ Data	19,360	SF	0.75	$14,520	
Lightning Protection system	33,136	SF	1.15	$38,106	
USMS - Intercom (Rough-in)	5,040	SF	1.00	$5,040	
USMS - Access Control (Rough-in)	5,040	SF	3.80	$19,152	
USMS - Camera Surveillance (R-I)	5,040	SF	2.25	$11,340	
END					

Appendix

Drawings



SITE PLAN

NORTH REF.

0' 10' 60' 120'

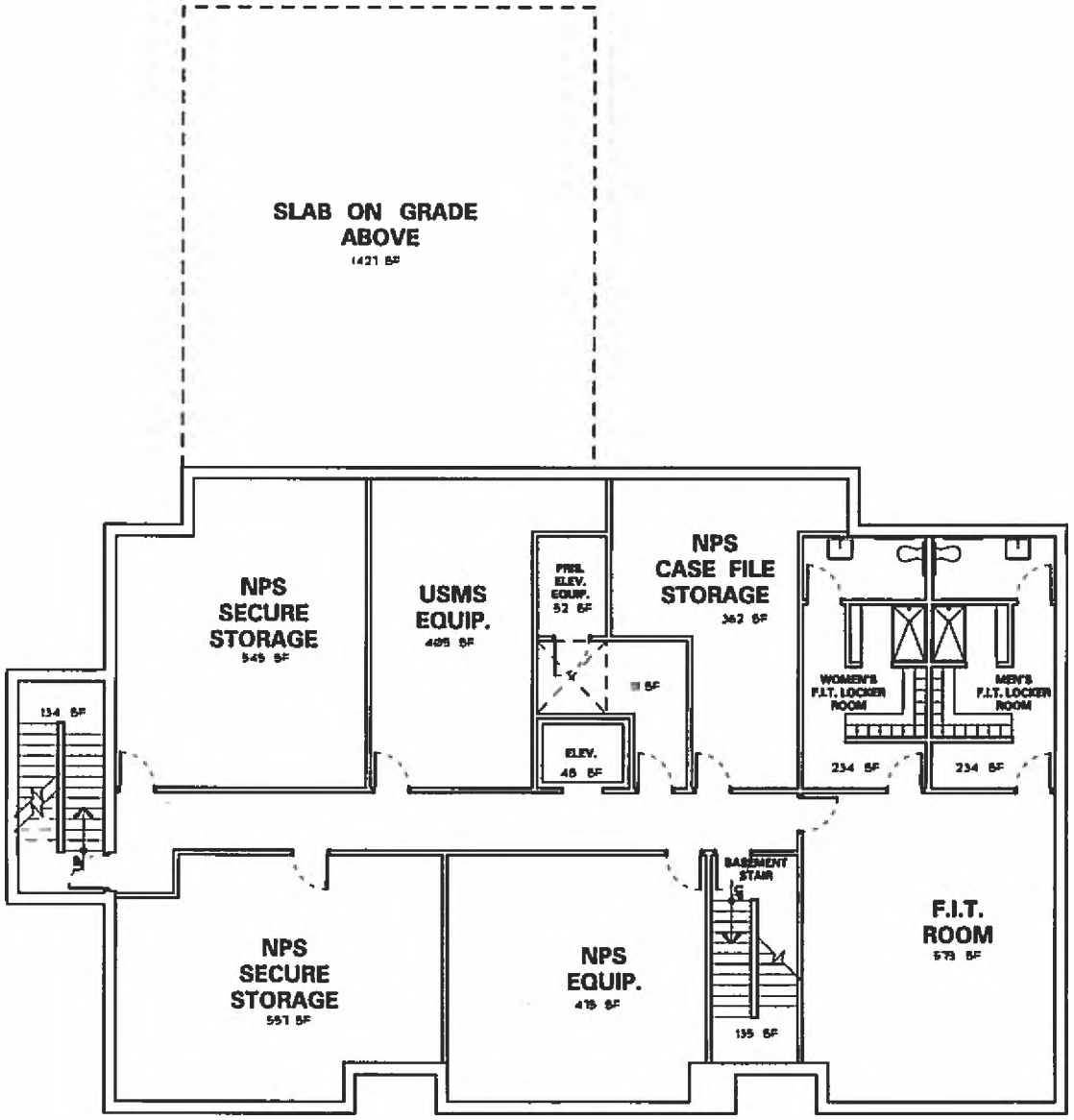
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:

C1



BASEMENT PLAN

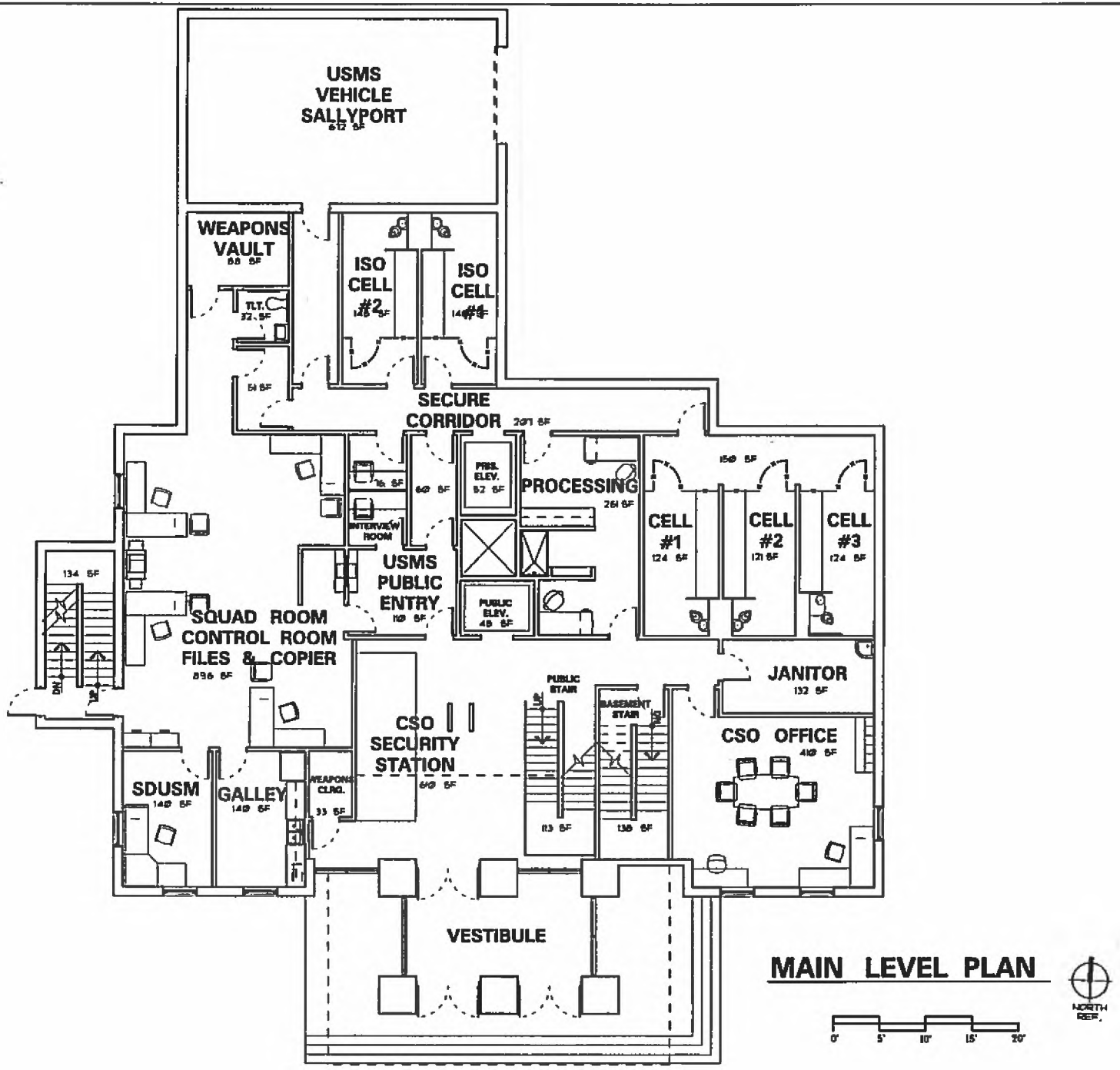
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
SPOKANE • JACKSON
BOZEMAN

Date: 6–25–03

Sheet No.:

A0



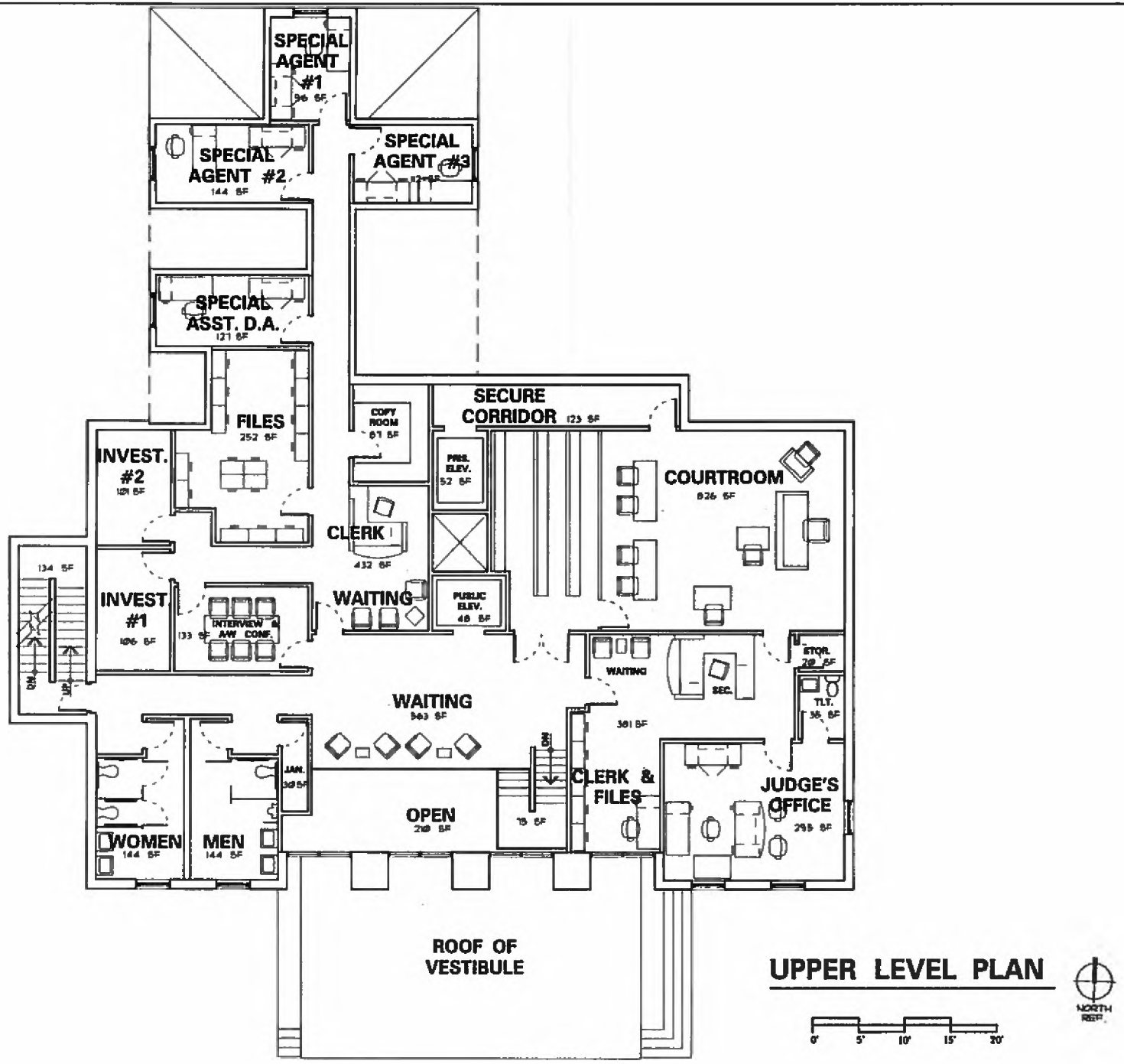
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
SPOKANE • JACKSON
BOZEMAN

Date: 6-25-03

Sheet No.:

A1



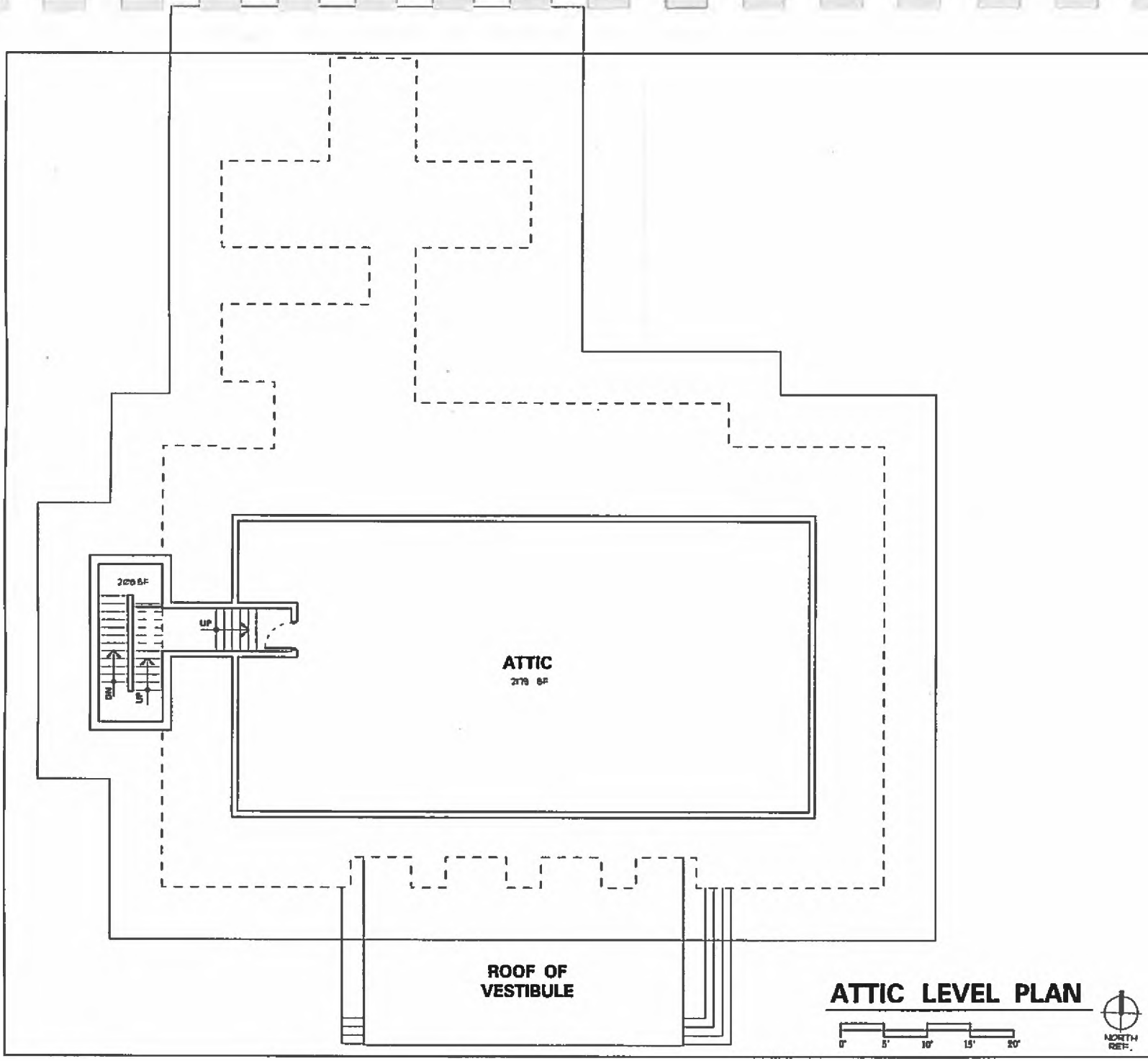
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
SPOKANE • JACKSON
BOZEMAN

Date: 6-25-03

Sheet No.:

A2

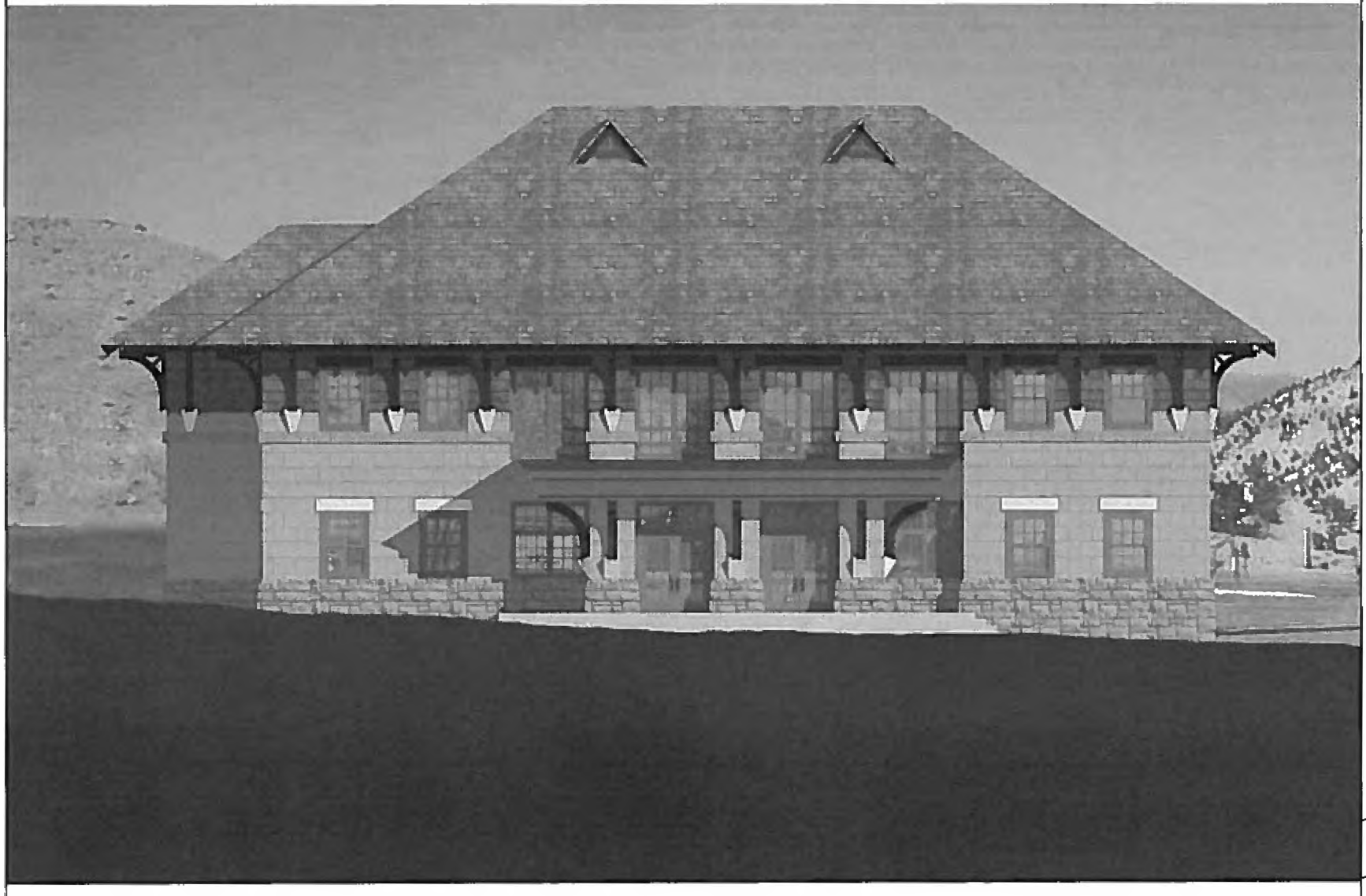


MAMMOTH COURTHOUSE
Yellowstone National Park

CTA
ARCHITECTS
ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
SPOKANE • JACKSON
BOZEMAN

Date: 6–25–03

Sheet No.:
A3



1/A4 FRONT ELEVATION

MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:

A4



1/A5 LEFT-FRONT ELEVATION

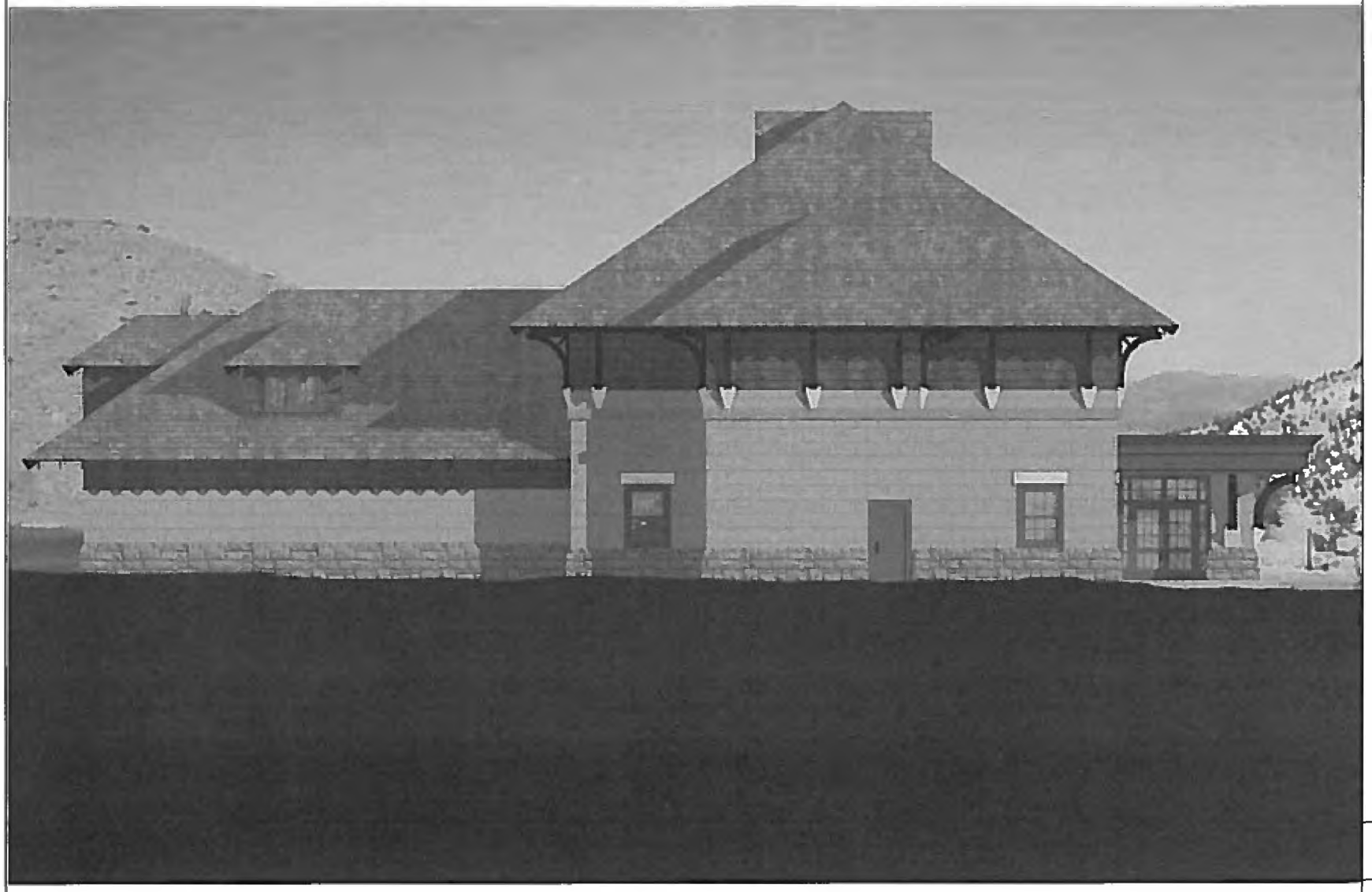
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:

A5



LEFT ELEVATION

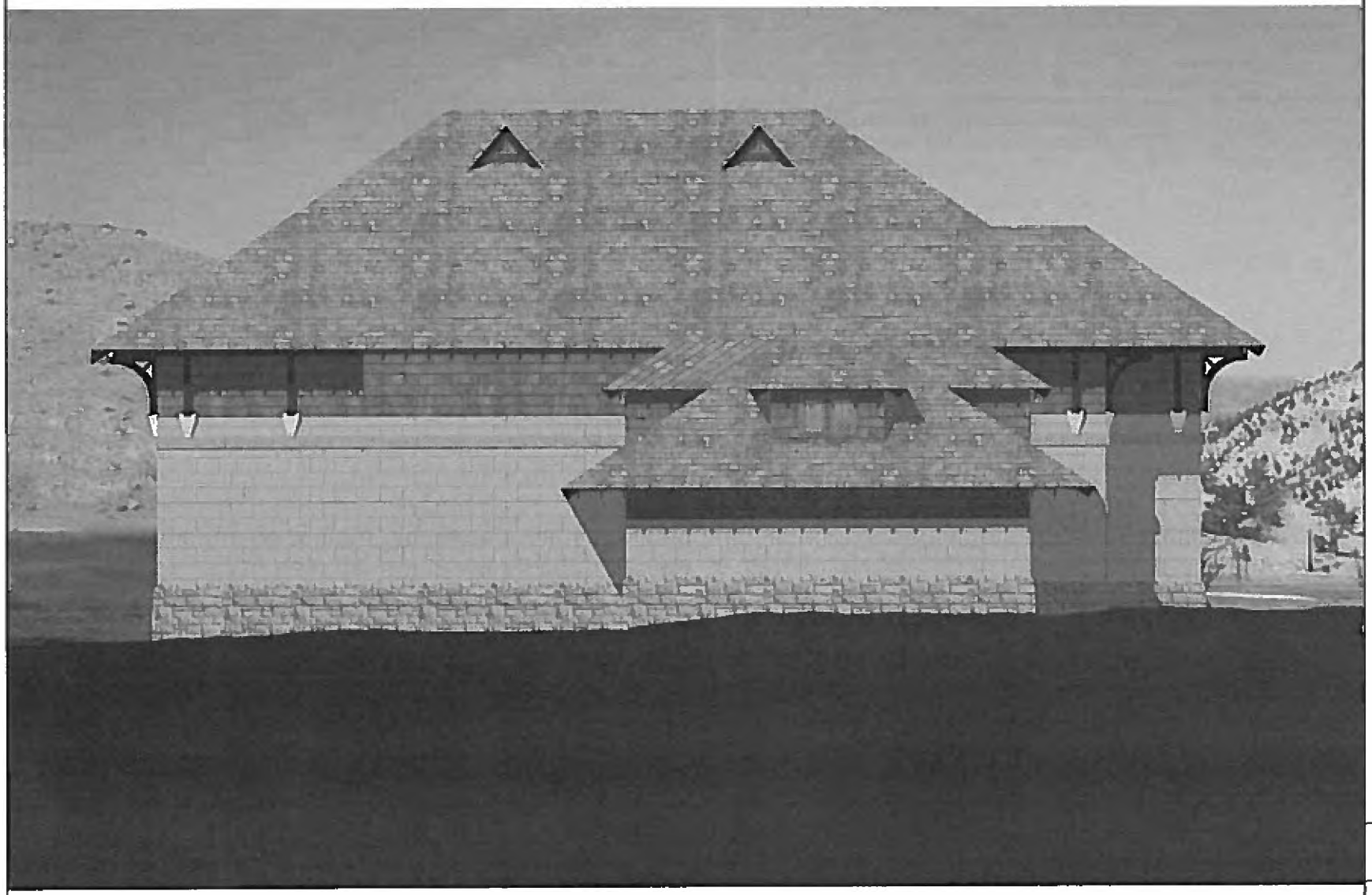
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:

A6



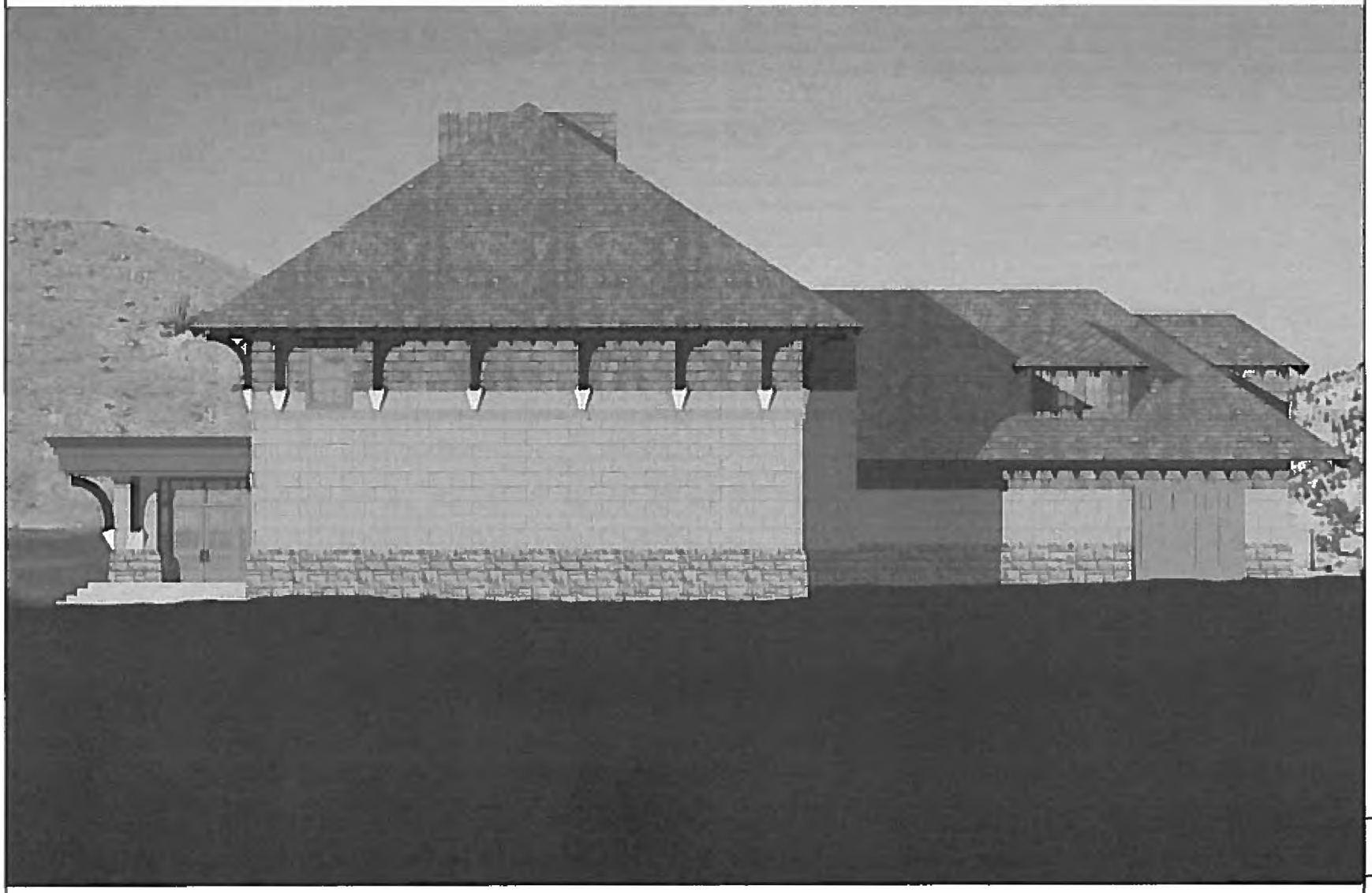
1/A7 REAR ELEVATION

MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:
A7



1/A8 RIGHT ELEVATION

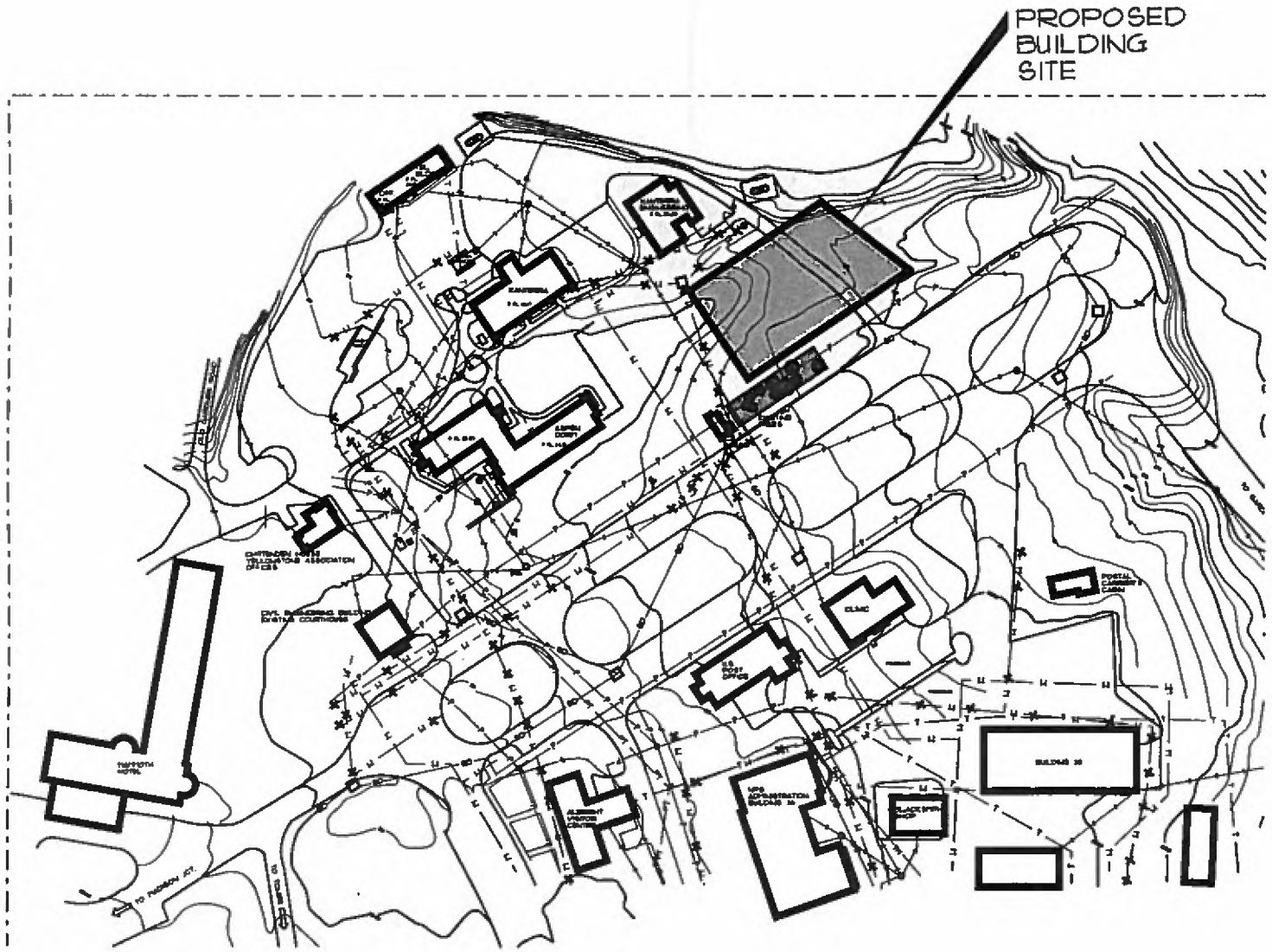
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:
A8

Site Photos



1/M1 LOCATION PLAN

NORTH REF.

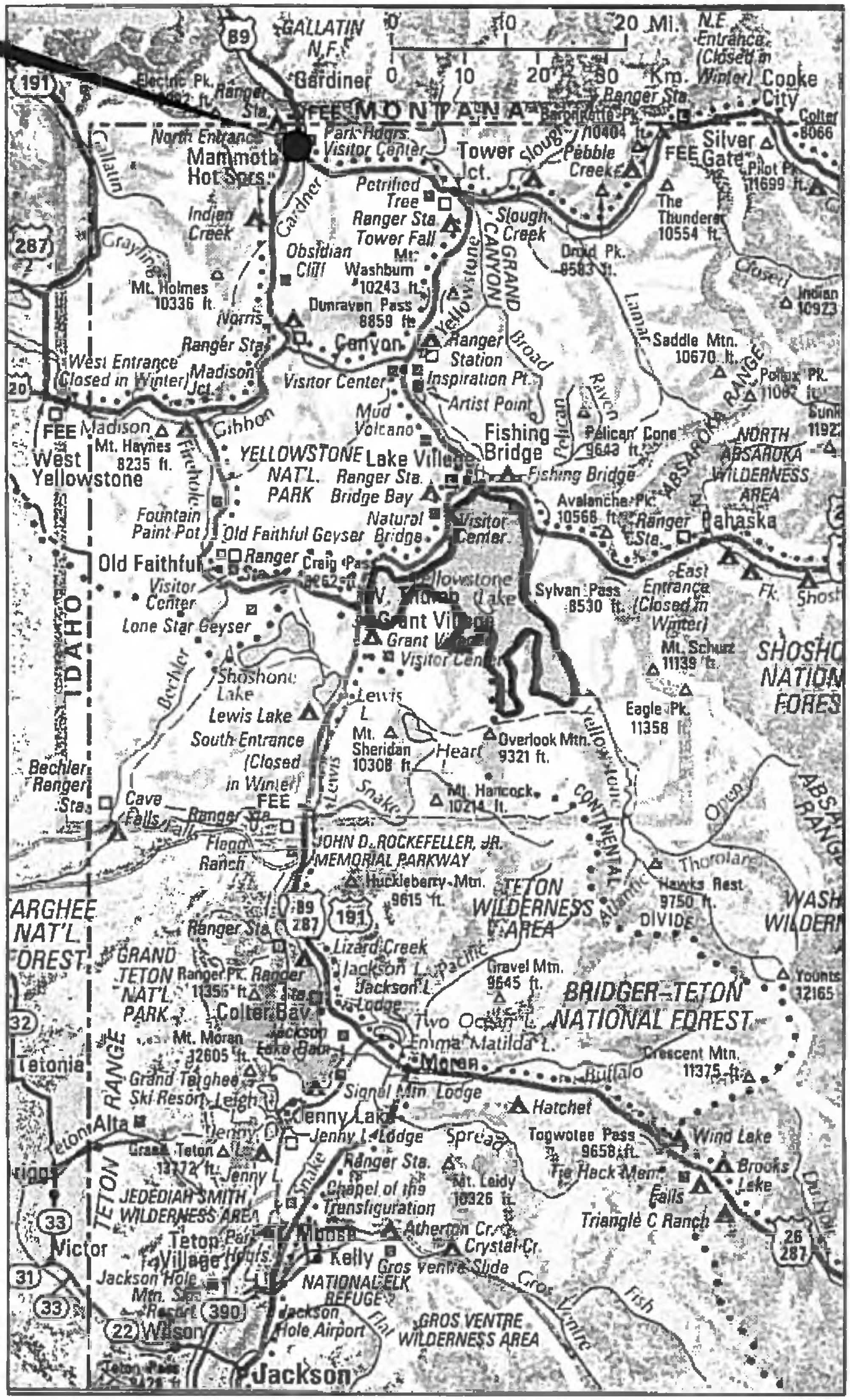
MAMMOTH COURTHOUSE
Yellowstone National Park

CTA ARCHITECTS ENGINEERS
BILLINGS • MISSOULA
BOISE • GREAT FALLS
HELENA • KALISPELL
BOZEMAN • JACKSON

Date: 6-25-03

Sheet No.:
M1

PROPOSED PROJECT SITE



VICINITY MAP

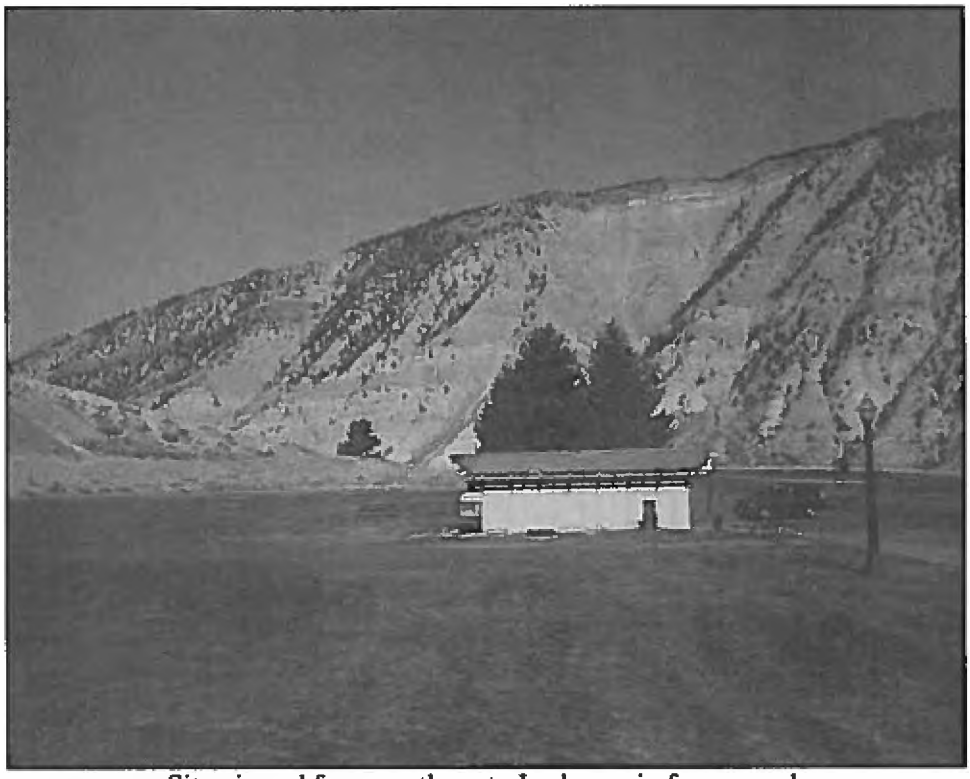
NORTH REF.

Date: 6-25-03

Sheet No.: M2

CTA ARCHITECTS ENGINEERS

MAMMOTH COURTHOUSE
Yellowstone National Park



Site viewed form southwest. Ice house in foreground.



Site viewed from northeast edge. Xanterra engineering and office buildings in background.



Site viewed from southwest.



Site Viewed from northwest, Aspen Dorm in background.



U.S. Post Office located to south of proposed building, across from promenade.
This is a building of similar scale.



Civil Engineering Building / existing Courthouse located west of proposed site
and next building on west side of promenade.



Aspen Dorm located north and adjacent to proposed site.
This building fronts on parking lot north of site.

Geotechnical Investigation

A Geotechnical Evaluation Report for National Park Service

Site A: Ice House/Corner Lot Site
Mammoth Hot Springs
Yellowstone National Park, Wyoming

COPY

Project BHXX-98-149
October 23, 1998

SK Geotechnical Corporation

SK Geotechnical

October 23, 1998

Project BHXX-98-149
Purchase Order 1443PX157098380

Mr. Clifford Ludwig (3)
National Park Service
P. O. Box 168
Yellowstone National Park, Wyoming 82190

Dear Mr. Ludwig:

Re: Geotechnical Evaluation, Site A: Ice House/Corner Lot Site, Mammoth Hot Springs, Yellowstone National Park, Wyoming

We have completed the geotechnical evaluation authorized by the National Park Service on August 13, 1998. The purpose of the evaluation was to assist the National Park Service and the project architect/structural engineer in designing foundations, floors and pavements, and in preparing plans and specifications for construction of the new building on Site A. The evaluation was completed in accordance with the above-referenced purchase order.

Summary of Results

Thirteen soil borings were completed on Site A. The general soil profile encountered by the borings was 1 to 6 inches of topsoil and root zone underlain by decomposed travertine. The decomposed travertine consisted of loose to medium dense silty sands and poorly graded sand with silt. Groundwater was not encountered in any of the borings to their termination depths of 20 1/2 feet.

Some of the borings encountered existing fill to depths up to 6 feet. The existing fill consisted of clayey sand, sand, and lean clay. The borings conducted on the north side of the site, near the existing hillside, encountered alluvial and/or bedrock below the 0- to 9-foot depths.

Summary of Analysis and Recommendations

The decomposed travertine is considered water soluble, i.e., it dissolves when saturated with water, causing foundations and floors supported above it to settle excessively. The attached report contains a number of techniques which are used to construct buildings on these types of sites.

It is our opinion that the proposed building can be supported on shallow spread footings. To reduce the risk of excessive settlement and to increase bearing capacity, we recommend providing a minimum of 3 feet of compacted on-site backfill directly beneath foundations and earth-supported floors. After necessary subgrade improvements, it is our opinion that shallow-spread footings can be designed for a net allowable bearing pressure up to 2,000 pounds per square foot (psf).

Good drainage of surface water away from the proposed building is essential in preventing excessive moisture from reaching footing and floor subgrades, and potentially causing settlement. We recommend compacting perimeter foundation wall backfill and providing a 1-foot clay cap on the exterior sides of foundation walls to reduce infiltration and percolation.

2611 Gabel Road, P.O. Box 80190, Billings, Montana 59108-0190 Phone: (406) 652-3930; Fax: (406) 652-3944
603 Nikles Drive, P.O. Box 5005, Bozeman, Montana 59715-5005 Phone: (406) 585-3411; Fax: (406) 585-5855
1911 Meadowlark Lane, P.O. Box 3026, Butte, Montana 59702-3026 Phone: (406) 494-1675; Fax: (406) 494-1678

It is our opinion the best type of construction for buildings on the soluble travertine is with the use of crawl space floor systems. For this method, the floors are structurally supported on the foundation walls and span over the soluble travertine. If settlement due to dissolution of the travertine occurs, it is easier to underpin the combined foundation and floor system.

Earth-supported floors for basement or above-grade floors can also be used. We recommend earth-supported floors be reinforced to help provide some rigidity in spanning potential losses of support beneath them. Providing 3 feet of compacted backfill directly beneath floors will also result in a more uniform subgrade.

General

Please refer to the attached report for more detailed results of our field work, engineering analyses and recommendations. Lateral earth pressures for basement walls and retaining walls are included in the report. We have also included pavement sections for automobile and truck driveway areas.

Thank you for using SK Geotechnical. If you have any questions regarding this report, or require our services during the construction phase of this project, please call Greg Staffileno at (40) 652-3930.

Sincerely,

Gregory T. Staffileno, PE
Principal, Geotechnical Engineer

Cory G. Rice, PE
Senior Engineer

gts/cgr:khr

Attachment:
Geotechnical Evaluation Report

Table of Contents

Description	Page
A. Introduction	1
A.1. Project	1
A.2. Purpose of this Evaluation	1
A.3. Scope	1
A.4. Documents Provided	2
A.5. Locations and Elevations	3
B. Results	3
B.1. Logs	3
B.2. Site Conditions	3
B.3. GPR Study	4
B.4. Soils	4
B.5. Groundwater Observations	6
B.6. Laboratory Tests	6
C. Analyses and Recommendations	7
C.1. Proposed Construction	7
C.2. Discussion	8
C.3. Site Preparation	10
C.4. Foundations	11
C.5. Seismic Considerations	13
C.6. Basements	13
C.7. Crawl Space	14
C.8. Retaining Walls	14
C.9. Earth-Supported Floor	15
C.10. Exterior Slabs	16
C.11. Site Grading and Drainage	17
C.12. Utilities	18
C.13. Pavement	18
C.14. Concrete	19
D. Construction	20
D.1. Excavation	20
D.2. Observations	20
D.3. Moisture Conditioning	20
D.4. Subgrade Disturbance	21
D.5. Testing	21
D.6. Cold Weather Construction	21
E. Procedures	22
E.1. Drilling and Sampling	22
E.2. Soil Classification	22
E.3. Groundwater Observations	22

Table of Contents (continued)

Description	Page
F. General Recommendations	23
F.1. Basis of Recommendations	23
F.2. Review of Design	23
F.3. Groundwater Fluctuations	23
F.4. Use of Report	23
F.5. Level of Care	24

Professional Certification

Appendix

- Figure 1: Site Location Sketch
- Figure 2: Aerial Photograph
- Figure 3: Boring Location Sketch
- Descriptive Terminology
- Log of Boring Sheets
- Swell Test

A. Introduction

A.1. Project

The National Park Service is planning to construct a new visitor use facility and collection storage building. Three different sites are being considered for the structures, Sites A, B and E. This report contains our recommendations related to constructing on Site A, referred to as the "Ice House/Corner Lot Site." Site A is located southeast of the AMFAC building in Mammoth Hot Springs, Yellowstone National Park. The approximate location of the site is shown on the attached Site Location Sketch.

A.2. Purpose of this Evaluation

The purpose of the geotechnical evaluation was to assist the National Park Service and their project architect and structural engineer in designing foundations and slabs, and in preparing plans and specifications for construction of the proposed building on Site A.

A.3. Scope

The desired scope of services was outlined in Request for Quotation (RFQ) 1443RQ157098011, dated June 17, 1998. We completed the RFQ, and it was submitted on July 8, 1998. Purchase Order 1443PX157098380, dated August 13, 1998, authorized us to proceed in accordance with the RFQ scope of services.

Our scope of services was limited to:

- staking the boring locations and determining ground surface elevations at the boring locations,
- coordinating the locating of underground utilities near the boring locations,
- conducting 15 penetration test borings to a depth of 20 feet in the proposed building area,
- taking two thin-walled tube samples of fine-grained soils to provide relatively undisturbed samples for consolidation/swell tests,
- returning the samples to our laboratory for visual classification and logging by a geotechnical engineer,
- conducting one swell test on a thin-walled tube sample, one Atterberg limits test, one corrosion test and two percent-finer-than-a-200-sieve tests,

- analyzing the results and formulating recommendations for earthwork, spread footing foundations and slabs,

- discussing the analysis and project with Ms. Laura Joss with the National Park Service, and

- submitting a geotechnical evaluation report containing logs of the borings, our analysis of the field and laboratory tests, and recommendations for earthwork, spread footing foundations, slabs, basements, retaining walls and pavement.

Borings ST-A10 and ST-A15 were not performed because these areas were inaccessible to our truck-mounted drill rig. This was discussed with Mr. Clifford Ludwig of the National Park Service at the time of the field work. Also, Borings ST-A4 and ST-A5 were terminated at depths of 9 and 12 1/2 feet due to auger refusal.

A.4. Documents Provided

The following documents were provided for our use:

- An 8 1/2- by 11-inch sketch showing the locations of the desired borings at Sites A and B. We enlarged this sketch and used it for our Boring Location Sketch located in the Appendix of this report.

- A Mammoth Hot Springs Area Map.

- A Location Map of Potential Sites.

- A Location of Old Building Sites drawing.

- After completion of the drilling, we were provided with an aerial photograph with global positioning survey (GPS) points showing the boring locations. This aerial photograph is Figure 2 in the Appendix.

- The National Park Service also provided us with a copy of the "Ground-Penetrating-Radar Study" performed for Site B. This report was prepared by students at Montana Tech of the University of Montana and dated June 1997.

- The RFQ also included requirements and task details for the geotechnical evaluation.

A.5. Locations and Elevations

Boring locations were selected by the National Park Service. The locations are shown on the Boring Location Sketch in the Appendix. The sketch is referred to as Figure 3. The locations were referenced to the existing AMFAC building. Penetration test borings are designated by the prefix "ST." Borings with piezometers are designated by the suffix "P."

The planned locations of Borings ST-A6 and ST-A14 were not accessible to our truck-mounted drill rig. Boring ST-A6 was inaccessible due to dense shrubs. Boring ST-A14 was inaccessible because of the steep sloping ground surface. We therefore moved both borings, and the locations drilled were designated as ST-A6A and ST-A14A.

The ground surface elevations at the borings were referenced to the base flange of a fire hydrant located near the southwest corner of Site A. We assumed the elevation of this reference was 150.0. The approximate location of this reference is shown on the sketch in the Appendix.

B. Results

B.1. Logs

Log of Boring sheets indicating the depths and identifications of the various soil strata, the penetration resistances, laboratory test data and water level information are attached. It should be noted the depths shown as boundaries between the strata are only approximate. The actual changes may be transitions and the depths of the changes vary between borings.

Geologic origins presented for each stratum on the Log of Boring sheets are based on the soil types, blows per foot, and available common knowledge of the depositional history of the site. Because of the complex volcanic, glacial and post-glacial depositional environments, geologic origins are frequently difficult to ascertain. A detailed evaluation of the geologic history of the site was not performed.

B.2. Site Conditions

Site A is referred to as the Ice House/Corner Lot site. It is located northeast of the Aspen Dorm, east of the AMFAC building and southeast of the engineering building. The majority of the site is sloping downwards towards the northeast at a slope ranging from 3 to 4 percent. A toe of a hill forms the north boundary of the site, and has a slope of about 25 percent downward towards the south and east. This slope was too steep to access with our drill rig. Ground surface elevation variation between the borings was 14.4 feet. Most of the site was covered with lawn at the time of

our field work, and plywood sheeting was used to help avoid rutting when moving the drill rig. Near the hill, the site was covered with native grasses. Several underground utilities are currently situated on the site.

The Location of Old Building Sites drawing indicated four larger buildings were partially and/or completely located on the site. One smaller building was also shown. Therefore, we anticipate buried foundations may exist in these areas.

B.3. GPR Study

Montana Tech conducted a Ground Penetrating Radar (GPR) study of Site B, and contains a good description of the existing geologic conditions. The report indicates the predominant surface rock in the Mammoth Hot Springs area is layered limestone known as travertine. The origin of travertine is associated with circulating hot groundwater, becoming enriched with calcium and bicarbonate. As the heated groundwater nears the surface, the bicarbonate partitions into carbon dioxide and carbonate, which combines with the calcium to precipitate travertine.

The travertine is water soluble, i.e., it basically dissolves when saturated with water. This dissolution is known to have created underground channels and voids, which appear at the surface as sinkholes. We are familiar with a project at the Accounting Building where it was necessary to underpin a portion of the building due to a sinkhole. Apparently, this sinkhole occurred due to the dissolution of the travertine, and likely occurred at a depth below 50 feet, then extended to the surface to cause the building to settle. Foundation settlement of the southeast portion of the Old Fire Cache Building is also occurring, and is related to the dissolving travertine. The source of water in this instance is likely a nearby sewer line that was leaking.

The dissolution properties of the travertine can create "cavities" and "soil-filled cavities" below the surface. The cavities are basically voids and tunnels in the travertine. With time, some of the cavities and tunnels may fill with unconsolidated soils, which are referred to as *soil-filled cavities* in the report. The report indicates that "...subsurface cavities are likely present in the Mammoth Hot Springs area. These cavities could lead to subsidence and possible collapse [of structures] in the future."

B.4. Soils

One to three inches of topsoil and root zone were encountered at the borings. Beneath the topsoil and root zone, the general soil profile encountered at the borings was existing fill underlain by decomposed travertine. Some of the borings encountered claystone and sandstone bedrock. One of

the borings encountered high plasticity fat clay with bentonitic properties. These strata are described in more detail below.

B.4.a. Existing Fill. Existing fill consisting of clayey sand was encountered in Borings ST-A2 and ST-A3 to depths of 1 1/2 and 4 1/2 feet, respectively. Boring ST-A4 encountered existing fill consisting of poorly graded sand to a depth of 3 1/2 feet underlain by clayey sand to 6 feet. Sandy lean clay fill was encountered in Boring ST-A11 to a depth of 1/2 foot. Clayey sand fill was also encountered in Boring ST-A13P to a depth of 2 feet.

Penetration resistances in the clayey sand fill generally ranged from 2 to 4 blows per foot (BPF), indicating it was soft to rather soft. The clayey sand fill in Borings ST-A4 and ST-A13P had resistances of 13 and 22 BPF, indicating these layers were stiff to very stiff. The penetration resistances in the sand fill in Boring ST-A4 were 29 and 9 BPF, indicating it was loose to medium dense.

B.4.b. Decomposed Travertine. Decomposed travertine consisting of poorly graded sand and silty sand was the predominant soil encountered by the borings. The soil samples received from the borings indicated that partially cemented travertine gravels were present. In some instances, the travertine was cemented such that it couldn't be penetrated with our hollow-stem auger. Boring ST-A4 encountered refusal at a depth of 9 feet, and Boring ST-A5 encountered refusal at 12 1/2 feet in the travertine. Penetration resistances in the decomposed travertine generally ranged from 5 to 37 BPF, indicating the travertine was generally loose to medium dense. Some very dense layers of travertine were encountered, and penetration resistances in these layers ranged from 50 blows for 6 inches of penetration to 50 blows for no penetration.

It also appears that several of the borings encountered *soil-filled cavities* in the travertine. The penetration resistances in these areas ranged from weight-of-hammer to 2 BPF. These layers were encountered in Boring ST-A1 from 3 1/2 to 6 feet, ST-A3 below 13 1/2 feet, ST-A7 from 6 1/2 to 11 feet, and ST-A12 from 3 1/2 to 6 feet and below 17 feet. The sands encountered in the *soil-filled cavities* should be considered unconsolidated and are very loose.

B.4.c. Bedrock. Bedrock consisting of claystone and weathered sandstone was encountered in the borings conducted near the toe of the existing hillside. Claystone bedrock with a soil consistency of lean clay with gravel was encountered in Boring ST-A9 below 1 1/2 feet to the boring's termination depth of 20 1/2 feet. In Boring ST-A11, claystone was encountered from 3 1/2 to 11 feet and 13 1/2 to 20 feet. A layer of weathered sandstone was encountered in the boring from 11 to 13 1/2 feet.

Decomposed bedrock consisting of clayey gravel, clayey sand and silty gravel was also encountered in Boring ST-A14A below 3 1/2 feet. At 17 1/2 feet, claystone was encountered.

Penetration resistances in the claystone generally ranged from 18 BPF to 50 blows for 6 inches of penetration. Pocket penetrometer strength estimates of the unconfined compressive strength generally exceeded 4 tons per square foot (tsf). These values indicated the claystone was very hard by soil consistency standards. The penetration resistance in the weathered sandstone was 45 BPF, indicating it was dense. Penetration resistances in the clayey gravel and clayey sand were 8 and 23 BPF, indicating it was medium to very stiff. Penetration resistances in the silty gravel bedrock ranged from 22 to 52 BPF, indicating it was medium dense to very dense.

B.4.d. Fat Clay. Fat clay was encountered in Boring ST-A13P below 8 1/2 feet to a depth of 19 1/2 feet. The penetration resistances in this layer of fat clay ranged from 9 to 16 BPF, indicating it was rather stiff to very stiff. The fat clay appeared to be an alluvial deposit, likely associated with the swale running along the toe of the hillside near the northeast corner of the site.

B.5. Groundwater Observations

Groundwater was not observed in any of the borings performed to depths ranging from 9 to 20 1/2 feet at the time of our field work. Groundwater is likely below the termination depths of the borings. Temporary piezometers were installed in Borings ST-A8P and ST-A13P to permit future observations of groundwater levels on the site. These piezometers were rechecked about two weeks after they were installed, and groundwater was still not observed to a depth of 19 1/2 feet in both piezometers.

B.6. Laboratory Tests

The results of the laboratory tests are presented on the boring logs and on the swell graph in the Appendix.

B.6.a. Pocket Penetrometer Tests. The clay samples were tested with a pocket penetrometer to estimate their unconfined compressive strengths. A pocket penetrometer consists of a 1/4-inch diameter rod which is pushed 1/4 inch into the clay soil by a spring. Compression of the spring has been correlated with the unconfined compressive strength of clay soils by the manufacturer. The results of the pocket penetrometer tests are presented on the Log of Boring sheets in the Appendix.

B.6.b. Classification Tests. Classification tests consisting of Atterberg limits and percent-finer-than-a-200-sieve were conducted on a fat clay sample from Boring ST-A13P. The liquid limit of the sample was 147, the plastic limit was 20 and the plasticity index was 127. The percent-finer-than-a-200-sieve of this sample was 96 percent. Based on these test results, the material classifies as very

high plasticity fat clay and has bentonitic swelling properties. The American Society for Testing and Materials (ASTM) symbol for this soil is CH.

Several other samples were also tested. It was quite noticeable that the decomposed travertine was nonplastic. The percent-finer-than-a-200-sieve of several other samples tested ranged from 12 to 14 percent. Based on these tests, the decomposed travertine classifies as poorly graded sand with silt and silty sand. The ASTM symbols for these soils are SP-SM and SM.

B.6.c. Swell Test. A swell test was conducted on a thin-walled tube sample obtained from Boring ST-A13P from 16 1/2 to 17 1/2 feet. As previously indicated, this is the fat clay encountered by the boring. The sampled swelled about 4 1/2 percent when inundated under a load of 1,000 psf. This is a high value. The sample partially swelled out of the confining ring, and the actual swell value is likely somewhat higher. The swell pressure was approximately 7,500 psf. This is a very high value.

The initial moisture content and dry density of the sample was determined as part of the test. The initial moisture content of the sample was 27 percent, indicating it was moist. The initial dry density was 94 pounds per cubic foot (pcf). This is a typical value for alluvial clays.

C. Analyses and Recommendations

C.1. Proposed Construction

It is our understanding the proposed construction will include a storage building and a visitor's use facility. These facilities may be in one or two buildings, and three sites are being considered for construction. One or more of the sites may be utilized.

The new buildings will likely be one- to two-story structures with plan areas up to 30,000 to 40,000 square feet. Basements for storage and underground parking are being considered for the buildings. The visitor use facility will likely have a transportation museum to exhibit old stagecoaches and buses. The buildings will likely be constructed of steel framing and masonry and have a historic appearance to match the existing buildings in the area.

Mr. Duane Cromner of Barker Rinker Seacat Architects was contacted regarding the buildings. He indicated design of the buildings was in the preliminary stages, and they were interested in reviewing this geotechnical report prior to further design. The floor elevations, design loads and actual building locations and dimensions have not yet been determined.

We have therefore assumed that a building on Site A will be located near the middle or southwest side of the site. (Highly expansive fat clay was encountered near the far northeast corner of the site and should be avoided.) Elevation relief in this area is approximately 10 feet, and a balanced cut/fill may be used to level the site. Therefore, we assumed the first floor elevation will be approximately 149 to 150 on the assumed datum. This elevation will result in a cut of about 5 feet near the northwest corner and a fill of approximately 5 feet near the southeast corner.

We have also assumed: (1) wall loads will be less than 5 kips per linear foot, (2) column loads (if any) will be less than 80 kips, (3) distributed floor loads will be less than 500 psf, (4) concentrated floor loads will be less than 1,000 pounds, (5) axle loads in automobile parking areas will not exceed 4 tons, and (6) axle loads in the truck areas will not exceed 10 tons.

Once the final building sizes, locations and floor elevations have been determined, we should be contacted. Additional analysis and recommendations may be necessary.

C.2. Discussion

C.2.a. Soluble Travertine. As previously indicated, the decomposed travertine is water soluble, i.e., it dissolves when saturated, creating voids and sinkholes, which can cause foundations and floors supported above it to settle excessively. A number of ground modification techniques have been applied in sinkhole regions, and they are briefly described below.

Deep dynamic compaction is a process to densify granular soils in building pads. It basically consists of using a crane to lift a 10- to 30-ton weight, then drop it on the surfaces to densify the underlying soils to depths of 10 to 40 feet. *Vibro-compaction* uses a large diameter vibrator to densify portions of the underlying soils. High pressure jetting (water injection) is used to advance the vibrator below the surface to assist in densifying the soils at depth.

Slurry and compaction grouting are also used to improve soils in sinkhole regions. Both methods basically consist of injecting cement grout into the subsurface soils, primarily to fill known voids and cavities, and to form seals.

Deep foundations can also be used to extend foundations through the soluble travertine down to a dense bearing stratum. Typical types of deep foundations used in these instances are driven piling, such as H-piles and pipe piles. The floors in these instances are then structurally supported on grade beams, which in turn are supported on the driven piling. Therefore, the floors span over the soluble travertine.

It is our opinion these techniques may reduce the risk of excessive settlement, but not eliminate it. Deep dynamic compaction is extremely disruptive (loud) and can improve soil density to depths up to 40 feet. It has been our experience, however, that the sinkholes may form at considerable depth in the area due to the geologic and geothermal activity, and this method would likely have little affect on a sinkhole forming at a depth of 50 feet or more. Deep dynamic compaction also causes significant vibrations, which could damage other historic buildings in the area.

Vibro-compaction, and slurry and compaction grouting require the injection of water and/or cementatious materials. It is our opinion that these fluids may dissolve the travertine and actually aggravate the situation.

Deep foundations could be considered, but these foundations could penetrate into unknown geothermal structures and affect the hydrogeologic conditions in the area. Driven piling can also be fairly disruptive and causes vibrations. Deep foundations will also increase the design and construction costs.

It is our understanding that most of the buildings in the area are supported on shallow-spread footings. Sinkholes (dissolving travertine) has caused some foundations and floors to settle excessively, but the majority of the buildings supported on the travertine have performed quite well. Many of these buildings are 50 years or older.

For these reasons, it is our opinion the building on Site A can be supported on shallow-spread footings. To provide a uniform subgrade and to increase bearing capacity, we recommend subexcavating 3 feet beneath the proposed footings, then replacing these soils as compacted backfill. The foundation walls should be designed as grade beams and contain sufficient reinforcing steel to span relatively small sinkholes.

It is our opinion that crawl space flooring systems are the best type of floor for these buildings. These floors are structurally supported by the foundations, and therefore span over the travertine. Structurally connected foundations and floors will be easier to relevel should a sinkhole and settlement develop. Mudjacking or underpinning with shallow piling can be used to relevel the foundation and floor supported on it.

Earth-supported floors can also be used, either at grade or in basements. We recommend providing reinforcing steel in the floors to allow them to span small sinkholes. Therefore, the earth-supported floors will likely be thicker than typical floors. If a sinkhole does develop beneath the floor, it will be easier to mudjack and relevel a reinforced slab, than an unreinforced slab.

To reduce the risk of water dissolving the travertine and the potential excessive settlement, it is essential that good drainage of surface water be provided. Good drainage of surface water away from the buildings is necessary, as well as gutters and downspouts. Our recommendations regarding surface water drainage are discussed in more detail later in this report.

C.2.b. Existing Fill. Existing fill consisting of clayey sand and poorly graded sand was encountered in several of the borings. Old foundations and buried basements may also be present. Compressible or decomposable materials may be buried in or beneath the existing fill. It is also likely the fill was not adequately compacted when placed. Uncompacted fill, compressible and decomposable materials can consolidate, causing structures supported above it to settle excessively.

To reduce the risk of excessive settlement, we recommend removing all existing fill from beneath foundations and floors, then replacing it with compacted backfill.

C.2.c. Fat Clay. Boring ST-A13P encountered fat clay at a depth of 8 1/2 feet. It appears this fat clay is fairly localized within that borings' area. The high plasticity fat clay can undergo significant volume changes with changes in moisture. When covered with the slab, the underlying fat clay can absorb moisture and swell, causing foundations and floors supported on or above it to heave excessively.

For these reasons, we recommend avoiding locating a building in this area, particularly if it has a basement. This boring was performed near the northeast corner of the site, indicating the majority of the site is available for construction.

C.3. Site Preparation

C.3.a. Stripping. We recommend vegetation, topsoil and root zone be removed from beneath proposed footings, slabs and pavement. Up to 6 inches of topsoil and root zone were encountered at the borings. Actual depth of removal across the site should be determined by observations during stripping.

C.3.b. Existing Fill. As indicated in Section B.3, existing fill is present on Site A. We recommend all existing fill be removed from beneath the proposed footings and earth-supported floors down to natural soils. The fill should be removed from within an oversize zone extending 1/2 foot (horizontal) beyond the footings and slab for every foot of subexcavation below the footings and slab. The excavated material may be saved and reused as compacted backfill, if topsoil, oversize cobbles and boulders, foreign materials and other unsuitable materials are removed.

C.3.c. Subexcavation/Backfill. To provide a more uniform subgrade beneath shallow-spread footings and earth-supported floor slabs, we recommend subexcavating 3 feet below the bottoms of footings and floor slabs, scarifying and compacting the bottom of the subexcavation, and then replacing the soils as compacted backfill. Subexcavations beneath footings and floors should be oversized to extend 3 feet beyond the footings and slabs (1 horizontal:1 vertical) to a depth of 3 feet.

We recommend the excavated material (decomposed travertine) be reused as compacted backfill beneath the foundations and floors. We anticipate considerable shrinkage of the travertine will occur when reused as compacted backfill. For estimating purposes, we suggest assuming 30 percent shrinkage. It therefore may be necessary to import material to reuse as compacted backfill beneath foundations and floors. We recommend importing similar silty sand and poorly graded sand with silt. Gravels, sands, silts or clays having more than 12 percent passing a 200 sieve can be used. Clean gravels and sands should *not* be used. These materials are highly permeable and could provide a rapid conduit for water to reach the underlying unimproved travertine.

We recommend backfill and fill beneath foundations and floors be placed at a moisture content at or near optimum moisture content. We recommend it be placed in lifts not exceeding 8 inches uncompacted thickness. Backfill and fill for the building pads should be compacted to a minimum of 95 percent of its maximum dry density determined in accordance with American Society for Testing and Materials (ASTM) Method of Test D 698 (standard Proctor).

C.4. Foundations

C.4.a. Depth. We recommend providing a minimum of 4 feet of earth cover over the bottoms of perimeter footings for frost protection. Interior footings (if any) may be placed immediately beneath the earth-supported floor slabs, provided they bear on compacted backfill as described in Section C.3.c.

C.4.b. Footing Subgrade. As previously indicated in Section C.3.c, "Subexcavation/Backfill," we recommend providing a minimum of 3 feet of compacted backfill directly beneath proposed footings. We also recommend compacting the bottoms of the subexcavations prior to placing the compacted backfill.

Footing subgrade observations are very important during construction. We recommend a geotechnical engineer or experienced engineering assistant observe the footing subgrade (bottoms of subexcavations) to evaluate the presence of *soil-filled cavities*. If observed, we will likely recommend additional subexcavation beneath the proposed footings to remove the unconsolidated material and

reduce the risk of settlement. The depth of additional subexcavation will have to be determined during construction. We therefore suggest including a line item in the project contract for additional subexcavation.

C.4.c. Bearing Pressure. After necessary subgrade improvements, it is our opinion that footings may be designed for a net allowable bearing pressure up to 2,000 psf (two thousand pounds per square foot). (Net allowable bearing pressure is defined as that bearing pressure in excess of the final minimum overburden pressure.) This bearing pressure includes a factor of safety of at least three against bearing capacity failure.

C.4.d. Anticipated Settlement and Heave. As previously indicated, the travertine is water soluble. If it gets wet, several inches or more of foundation settlement could occur. Assuming the travertine does not get wet, we anticipate total and differential settlement and heave of foundations designed and placed as recommended above will be less than 3/4 inch under the assumed loads. Buildings of this type can generally tolerate movements of this magnitude.

C.4.e. Reinforcement. We recommend sufficient reinforcing steel be placed in the foundation walls to span the loss of support under a footing over a zone 20 feet long at any point along the wall (grade beam action) or loss of support over a zone 15 feet long at a corner (cantilever action). As previously indicated, the grade beam and cantilever design of foundation walls is essential for these buildings to help span sinkholes which could develop. The reinforcing steel will also reduce the widths of cracks created by shrinkage of the concrete, and local settlement and heave of the soils.

C.4.f. Foundation Wall Backfill.

C.4.f.1. Clay Cap. We recommend providing a minimum of 1 foot of clay cover on all exterior foundation wall backfill to reduce the infiltration of surface water. Lean clay, clayey sand and clayey gravel having a plasticity index between 7 and 20 and a minimum of 30 percent of its particles by weight passing a 200 sieve can be used for the clay cap. It will likely be necessary to import this material, however, the clayey sand fill and claystone encountered by the borings will likely meet this requirement.

Below the cap, on-site soils may be used as backfill. As previously indicated, we anticipate considerable shrinkage of these soils when compacted. Therefore, it may be necessary to import additional backfill meeting the requirements described in Section C.3.c.

C.4.f.2. Compaction. We recommend backfill placed on the exterior sides of foundations walls be compacted to a minimum of 95 percent of its standard Proctor maximum dry density. This degree of compaction will help reduce the infiltration of surface water. The levels of exterior and interior backfills should not differ by more than 8 inches during placement, or the walls should be braced, otherwise the foundation walls may be displaced.

C.5. Seismic Considerations

Mammoth Hot Springs is considered to be in Seismic Zone 4. For a soil profile consisting of very loose to medium dense silty sands and sands, we recommend using a site coefficient (S factor) of 1.5 for design.

Our opinion related to the liquefaction potential of the subsurface soils was also requested in the scope of work. It is our opinion that the silty sands and poorly graded sands with silt have a good distribution of grain sizes, i.e., they are not all one size. Also, groundwater was not encountered on the site to depths of 20 feet. For these reasons, it is our opinion that there is a low risk for soil liquefaction during an earthquake on the site, based on the soil conditions encountered by the 20-foot deep borings.

There are likely several smaller cavities and/or tunnels throughout the travertine. Larger caverns could also exist at depth. A significant earthquake could partially or completely collapse these cavities or tunnels and cause structures supported above them to settle excessively.

C.6. Basements

C.6.a. Seepage Control and Backfill. The majority of the borings encountered decomposed travertine consisting of silty sand and poorly graded sand with silt. As previously indicated, fat clay was encountered in the northeast corner of the site in Boring ST-A13P, and building construction should avoid this area. In the northeast corner of the site, the borings encountered claystone bedrock consisting of sandy lean clay. Water percolating down alongside basement walls can become perched on the clay layers, or silty sand, then enter the basement through shrinkage cracks in the concrete. Collecting roof run-off and discharging it well away from the foundations and sloping the ground surface down and away from the basement walls are two common methods of reducing infiltration and percolation, and are essential on this site.

As a precaution against seepage, we recommend installing a perimeter foundation drain system around basements. We recommend using the on-site silty sand and poorly graded sand with silt as backfill. We do not recommend using relatively clean sand or sandy gravel as backfill, which could provide a

conduit for water to reach footing and basement floor subgrades. We recommend using a synthetic drain system which runs vertically along the basement wall, and has a collection pipe in the bottom wrapped in a geotextile. The collection pipe should be placed within 2 inches of bottom-of-footing level. The collection pipe should be routed to a sump and pump, or drained by gravity to a storm sewer or low point away from the building and basement. We recommend the backfill be compacted to a minimum of 95 percent of its standard Proctor maximum dry density. We recommend it be capped by a minimum of 1 foot of clay at the surface to reduce infiltration. The wall should be braced prior to backfilling.

C.6.b. Lateral Earth Pressures. Assuming on-site silty sands and poorly graded sands with silt compacted to 95 percent will be placed against the basement walls, we recommend using the following parameters for estimating lateral forces.

- Active earth pressure (wall free to move away from backfill): 35 pounds per square foot per foot of depth (psf/ft) plus 0.31 times surcharge load.
- At-rest earth pressure (wall restrained): 55 psf/ft plus 0.5 times surcharge load.
- Passive earth pressure: 350 psf/ft plus 5.8 times surcharge load.
- Coefficient of sliding friction: 0.58.

The values indicated above do not include factors of safety. Appropriate factors of safety should be included when designing basement walls to resist lateral earth forces.

C.7. Crawl Space

As previously indicated, crawl space flooring systems are the preferred method for the construction of buildings supported on the soluble travertine. We recommend backfill be compacted against the sides of the footings to provide resistance to lateral movement and reduce moisture changes in the footing subgrades. We recommend a vapor barrier be placed over the earth floor of the crawl space. We suggest it be protected with a layer of sand or gravel. The crawl space should be ventilated.

C.8. Retaining Walls

C.8.a. Footings. We recommend footings for retaining walls be designed and supported as described in Sections C.3 and C.4. In summary, these recommendations are:

- provide 4 feet of earth cover over the tops of retaining wall footings for frost protection,
- subexcavate 3 feet beneath proposed retaining walls footings, then replace the soils as compacted backfill to provide a uniform subgrade, and
- footings can be designed for a net allowable bearing pressure of 2,000 psf.

C.8.b. Backfill. We typically recommend using nonfrost-susceptible sand or sandy gravel as backfill behind retaining walls to reduce the heaving and lateral forces due to freezing soils. Nonfrost-susceptible backfill materials are clean sands or sandy gravels. However, these sands or sandy gravels are highly permeable and could create conduits for water to reach the footing and floor subgrades. It is therefore our opinion that on-site silty sand and poorly graded sand be used as backfill behind the retaining walls. Installing polystyrene foam insulation behind the retaining walls will reduce frost penetration and heaving/lateral forces. Foam insulation should be placed vertically along the buried side of the wall, and should cover that portion of the wall which is exposed. Foam insulation should also be placed horizontally behind the wall to reduce frost penetration from the surface. The foam insulation should extend 5 feet beyond the wall, and be covered with a 1-foot clay cap, as previously described.

Backfill behind the retaining walls should be placed in lifts and at a moisture content at or slightly above optimum moisture content. The backfill should be compacted to a minimum of 95 percent of its standard Proctor maximum dry density.

C.8.c. Lateral Earth Pressures. The same lateral earth pressure used for the basement wall design (Section C.6.b) can be used for design of retaining walls.

C.9. Earth-Supported Floor

C.9.a. Subgrade. The subgrade preparation for earth-supported floors is described in Section C.3, "Site Preparation." As indicated, we recommend removing all existing fill from beneath proposed floors down to natural soils. We also recommend providing a minimum of 3 feet of compacted backfill beneath proposed floors to provide a more uniform subgrade. The subgrade in the bottom of the subexcavation should be observed and recompacted prior to placing the backfill.

C.9.b. Fill. Some fill will likely be required beneath the proposed floor. It is our opinion that on-site soils from the footing excavations may be used as fill. Imported materials such as sandy gravel, sand, silt or clay having a minimum of 12 percent passing the 200 sieve may be used as fill. We

recommend fill materials be moistened to a moisture content near or slightly above the optimum moisture content, then compacted to a minimum of 95 percent of the standard Proctor maximum dry density.

C.9.c. Backfill. We recommend that backfill in footing and mechanical trenches also be moistened to a moisture content near or slightly above the optimum moisture content and compacted to a minimum of 95 percent.

C.9.d. Vapor Retarder. If floor coverings or coatings less permeable than the concrete slab will be used, or if moisture is a concern, we recommend a vapor retarder be placed directly beneath the slab. (Some coverings, coatings or situations may require a vapor *barrier*, i.e., a membrane with a permeance less than 0.3 perms.)

C.9.e. Subgrade Modulus. If the slab is placed directly on compacted silty sands or poorly graded sand with silt, it is our opinion that a modulus of subgrade reaction, k, of 200 pounds per square inch per inch of deflection (pci) may be used to design the floor. If a minimum of 6 inches of compacted crushed gravel road base is placed over the on-site soils, it is our opinion that a modulus of 250 pci may be used to design the floor.

C.9.f. Reinforcing Steel. We recommend providing reinforcing steel in earth-supported slabs to allow them to span small sinkholes (assume 5 feet in diameter) which could occur beneath them. The reinforced slabs will also be easier to relevel should mudjacking be required.

C.9.g. Anticipated Settlement and Heave. As previously indicated, several inches or more of settlement could occur if the travertine gets wet. Providing good drainage away from the building and high quality utility connections are essential to reduce this risk. Assuming the travertine does not get wet, we anticipate total and differential settlement of earth-supported floors will not exceed 1/2 inch.

C.10. Exterior Slabs

C.10.a. Subgrade. Non-critical exterior slabs may be supported on undisturbed natural soils and existing fill after the vegetation, topsoil and root zone have been removed. Critical exterior slabs, such as those at entrances, will likely require some additional subgrade preparation as described below.

As previously indicated, the existing fill encountered on the site could result in excessive settlement of exterior slabs. To reduce this risk, we recommend subexcavating the existing fill beneath critical exterior slabs down to natural soils, then replacing it with suitable compacted backfill as described in Section C.3.c.

C.10.b. Backfill and Fill. Backfill and fill beneath proposed exterior slabs and their oversize zones should be placed in lifts and at a moisture content near or slightly above optimum moisture content. We recommend all fill and backfill beneath exterior slabs be compacted to a minimum of 95 percent of its standard Proctor maximum dry density.

C.10.c. Frost Protection. Silty sand and poorly graded sand with silt are moderately to highly frost-susceptible soils. If these soils become wet and freeze, several inches of frost heave may occur. Heaving of slabs during the winter can be a nuisance or hazard where doors open outward and at other critical grade areas.

One way of reducing frost heave is to place a minimum of 2 inches of extruded polystyrene foam insulation beneath the slabs and extending about 4 feet beyond the slabs. Insulation will reduce frost penetration into the underlying subgrade and thereby reduce heave. A leveling course of sand is generally required to seat the insulation panels. Eight to twelve inches of crushed roadbase material should be placed over the panels to protect them during construction.

Consideration can also be given to supporting the slabs on frost-depth footings. A void space of at least 4 inches should be provided between the bottoms of the slabs and the frost-susceptible subgrade to allow them to heave without affecting the slabs. The stem walls should be tied to the footings with sufficient reinforcing to prevent frost from heaving the walls off of the footings.

C.11. Site Grading and Drainage

As previously indicated, extreme attention has to be made towards the site grading and drainage for buildings constructed on the soluble travertine. We recommend the site be graded to provide positive run-off away from the proposed building. We recommend landscaped areas have a slope of at least 5 percent for the first 10 feet away from the building, then 2 percent, to carry run-off away. To maintain this slope, it is essential that backfill against the foundation walls be adequately compacted. If it is not adequately compacted, exterior foundation wall backfill will likely consolidate and water may pond and soak into the soil, causing settlement. In addition, we recommend gutters and downspouts with long splash blocks or extensions. Good site drainage is of paramount importance for the proposed building. Underground sprinkler systems near the building should be avoided, if possible.

Discharge of collected surface water has to be carefully controlled. It should not be discharged near or towards an existing building, where it could cause problems.

C.12. Utilities

C.12.a. General. High quality utility lines and connections are essential to reduce the risk of leaking utility lines, causing settlement. All utilities, particularly water and sewer utilities entering the building and below floor slabs should be capable of tolerating several inches of movement and should not leak. If a crawl space system is used, it is our opinion flexible connections only need to be provided where the utilities enter the building.

C.12.b. Materials. Silty sand, poorly graded sand with silt and claystone bedrock were encountered by the borings. Laboratory tests indicated the silty sand and poorly graded sand were generally not corrosive to metallic conduits. The claystone bedrock is likely corrosive to metallic conduits. Even so, we recommend specifying noncorrosive materials or providing corrosion protection unless additional tests are performed to demonstrate the soils are not corrosive.

We recommend using on-site travertine soils from the trench excavations as bedding. Soils from the trench excavations may be used as backfill above bedding.

C.12.c. Backfilling and Compaction. We recommend bedding material be thoroughly compacted around the pipes. We recommend trench backfill above the bedding be compacted to a minimum of 90 percent in landscaped areas and 95 percent beneath proposed footings, slabs and pavements. Backfilling around and above utilities should meet the requirements of *Wyoming or Montana Public Works Standard Specifications*.

C.13. Pavement

C.13.a. Subgrade Preparation. After stripping the topsoil and root zone, we recommend the upper 6 inches of the resulting subgrade be scarified, moistened to a moisture content near optimum, and compacted to a minimum of 95 percent of the standard Proctor maximum dry density. Where fill is required, we recommend it be similarly moistened and compacted. If there are areas which cannot be compacted, we recommend the unstable materials be subexcavated to a depth of 2 feet and be replaced by materials which can be compacted.

C.13.b. Sections. Table 1 below contains our pavement thickness recommendations for automobile, truck traffic and driveway areas. As can be seen, we have provided alternative sections for crushed base course and subbase.

Table 1. Alternative Pavement Sections

Alternative	Thickness, inches	
	Automobile Areas	Truck Areas
Crushed Base Course Section		
Asphalt Surface	2 1/2"	3"	3"
3/4" or 1 1/2" Crushed Base	6"	5"	10"
Subbase Section		
Asphalt Surface	2 1/2"	3"	3"
3/4" or 1 1/2" Leveling Course	3"	3"	3"
3" Sandy Gravel Subbase	4"	3"	9"

C.13.c. Materials and Compaction. Since we anticipate the majority of the imported materials will come from Gardiner or Livingston, Montana, we recommend using the *Montana Public Works Standard Specifications*. We recommend specifying crushed gravel base and sandy gravel subbase meet the requirements of *Montana Public Works Standard Specifications* Sections 02235 and 02234. We recommend the asphaltic concrete meet the requirements of Section 02545. We recommend the gravel base and subbase be compacted to a minimum of 95 percent of the standard Proctor maximum dry density. We recommend the asphaltic concrete surface be compacted to a minimum of 97 percent of the Marshall density.

C.14. Concrete

Corrosion tests indicated the silty sands and poorly graded sands were not corrosive to concrete. The claystone bedrock may be corrosive to concrete. We recommend using cement meeting the requirements of ASTM C 150 Type II to provide moderate resistance to sulfate attack. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration. We recommend using a water-cement ratio of 0.50 or less for exposed concrete and a water-cement ratio of 0.45 or less for concrete exposed to deicers.

D. Construction

D.1. Excavation

It is our opinion that the soils encountered by the borings can be excavated with a backhoe, front-end loader or scraper. The borings indicate the decomposed travertine consisting of silty sand and poorly graded sand with silt as well as the existing fill in the sidewalls of excavations over 5 feet deep will be Type C soils under Department of Labor Occupational Safety and Health Administration (OSHA) guidelines. The claystone bedrock, if encountered, can be considered Type A soils under OSHA guidelines. All earthwork and construction should be performed in accordance with OSHA guidelines.

D.2. Observations

We recommend footing, slab and pavement subgrades be observed by a geotechnical engineer or an engineering assistant working under the direction of a geotechnical engineer to see if the subgrade soils are similar to those encountered by the borings. There are two critical elements of these observations, as outlined below.

- It should be observed that all existing fill is removed from beneath proposed foundations, floors and pavement.

- Observations are necessary of subexcavations below footings and floors to evaluate the presence of soil-filled cavities. If encountered, additional subexcavation will likely be recommended.

During excavation for footings, we recommend tests be conducted on the subgrades to evaluate subgrade strength. Typical instruments used for these tests include hand augers, penetrometers and sample tubes.

D.3. Moisture Conditioning

Site soils which will be excavated and reused as backfills and fills appeared to be moist, however, are likely below optimum moisture content. We anticipate it will be necessary to add moisture to these soils to achieve a moisture content near or slightly above optimum.

It should also be anticipated that imported fill and backfill materials will be below optimum moisture content and additional moisture will be necessary to achieve a moisture content near or slightly above optimum.

D.4. Subgrade Disturbance

The borings indicated the surficial subgrade will be silty sand and poorly graded sand with silt. These fine-grained soils are considered to be moisture sensitive and are easily disturbed when wet. We therefore recommend good drainage of surface water be provided during construction to help avoid ponding areas. Ponding water will result in saturation of the sand subgrade, creating soft spots. Construction traffic driving across these soft spots can create large ruts and excessively disturb the areas. It is then very difficult to recompact these areas to specification and they can result in construction delays.

D.5. Testing

We recommend density tests of fills and backfills placed beneath footings, slabs and pavements. Density tests should also be performed on foundation wall backfill. We also recommend density testing of the compacted pavement subgrade and gravel base course. Samples of proposed backfill and fill materials should be submitted to our testing laboratory at least three days prior to placement on the site for evaluation, and determination of their optimum moisture contents and maximum dry densities.

We recommend density testing of the asphaltic concrete surface and Marshall tests on the asphaltic concrete mix to evaluate strength and air voids. We recommend slump, air content and strength tests on Portland cement concrete.

D.6. Cold Weather Construction

If site grading and construction is anticipated during cold weather, we recommend good winter construction practices be observed. All snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on soils which have frozen or contain frozen material. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed upon frozen soils or soils which contain frozen material. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings bearing on frost-susceptible soil since such freezing could heave and crack the footings and/or foundation walls.

E. Procedures

E.1. Drilling and Sampling

The penetration test borings were performed on August 18 through August 24, 1998, with a truck-mounted core and auger drill. Sampling for the borings was conducted in accordance with ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils." Using this method, we advanced the bore hole with hollow-stem auger to the desired test depth. Then an automatic 140-pound hammer falling 30 inches drove a standard, 2-inch OD, split-barrel sampler a total penetration of 1 1/2 feet below the tip of the hollow-stem auger. The blows for the last foot of penetration were recorded and are an index of soil strength characteristics.

Two 3-inch diameter thin-walled tube samples were taken in clay soils in general accordance with ASTM D 1587, "Thin-walled Tube Sampling of Soils." The tubes were slowly pushed into undisturbed soils below the hollow-stem auger. After they were withdrawn from the boreholes, the ends of the tubes were sealed and the tubes were carefully transported to our laboratory.

Prior to withdrawing the hollow-stem auger from Borings ST-A8 and ST-A13, a PVC pipe with a well-screen section at the bottom was placed in the borings to permit long-term monitoring of the groundwater level.

Several of the borings encountered very dense travertine and claystone bedrock. When the sampler could not be driven 6 inches with 50 blows of the hammer, the distance the sampler was advanced with 50 blows was recorded. When this situation occurred during the first 6 inches of the drive, it was noted as occurring within the "set."

E.2. Soil Classification

The drill crew chief visually and manually classified the soils encountered in the borings in accordance with ASTM D 2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)." A summary of the ASTM classification system is attached. All samples were then returned to the laboratory for a review of the field classifications by a geotechnical engineer. Representative samples will remain in our office for a period of 60 days to be available for your examination.

E.3. Groundwater Observations

About 10 minutes after taking the final sample in the bottom of a boring, the driller probed through the hollow-stem auger to check for the presence of groundwater. Immediately after withdrawal of the auger, the driller again probed the depth to water or cave-in. The boring was then backfilled.

F. General Recommendations

F.1. Basis of Recommendations

The analyses and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated on the attached sketch. Often, variations occur between these borings, the nature and extent of which do not become evident until additional exploration or construction is conducted. A reevaluation of the recommendations in this report should be made after performing on-site observations during construction to note the characteristics of any variations. The variations may result in additional foundation costs, and it is suggested a contingency be provided for this purpose.

It is recommended that we be retained to perform the observation and testing program for the site preparation phase of this project. This will allow correlation of the soil conditions encountered during construction to the soil borings, and will provide continuity of professional responsibility.

F.2. Review of Design

This report is based on the design of the proposed structure as related to us for preparation of this report. It is recommended that we be retained to review the geotechnical aspects of the designs and specifications. With the review, we will evaluate whether any changes in design have affected the validity of the recommendations, and whether our recommendations have been correctly interpreted and implemented in the design and specifications.

F.3. Groundwater Fluctuations

We made water level observations in the borings at the times and under the conditions stated on the boring logs. These data were interpreted in the text of this report. The period of observation was relatively short, and fluctuation in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw, drainage, and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

F.4. Use of Report

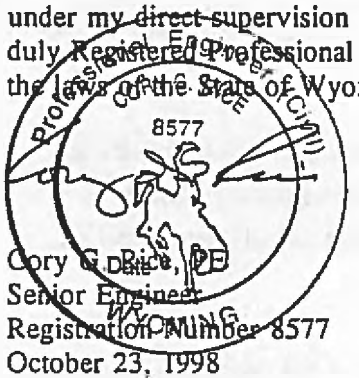
This report is for the exclusive use of the National Park Service to use to design the proposed structure and prepare construction documents. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. The data, analyses and recommendations may not be appropriate for other structures or purposes. We recommend parties contemplating other structures or purposes contact us.

F.5. Level of Care

Services performed by SK Geotechnical Corporation personnel for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.

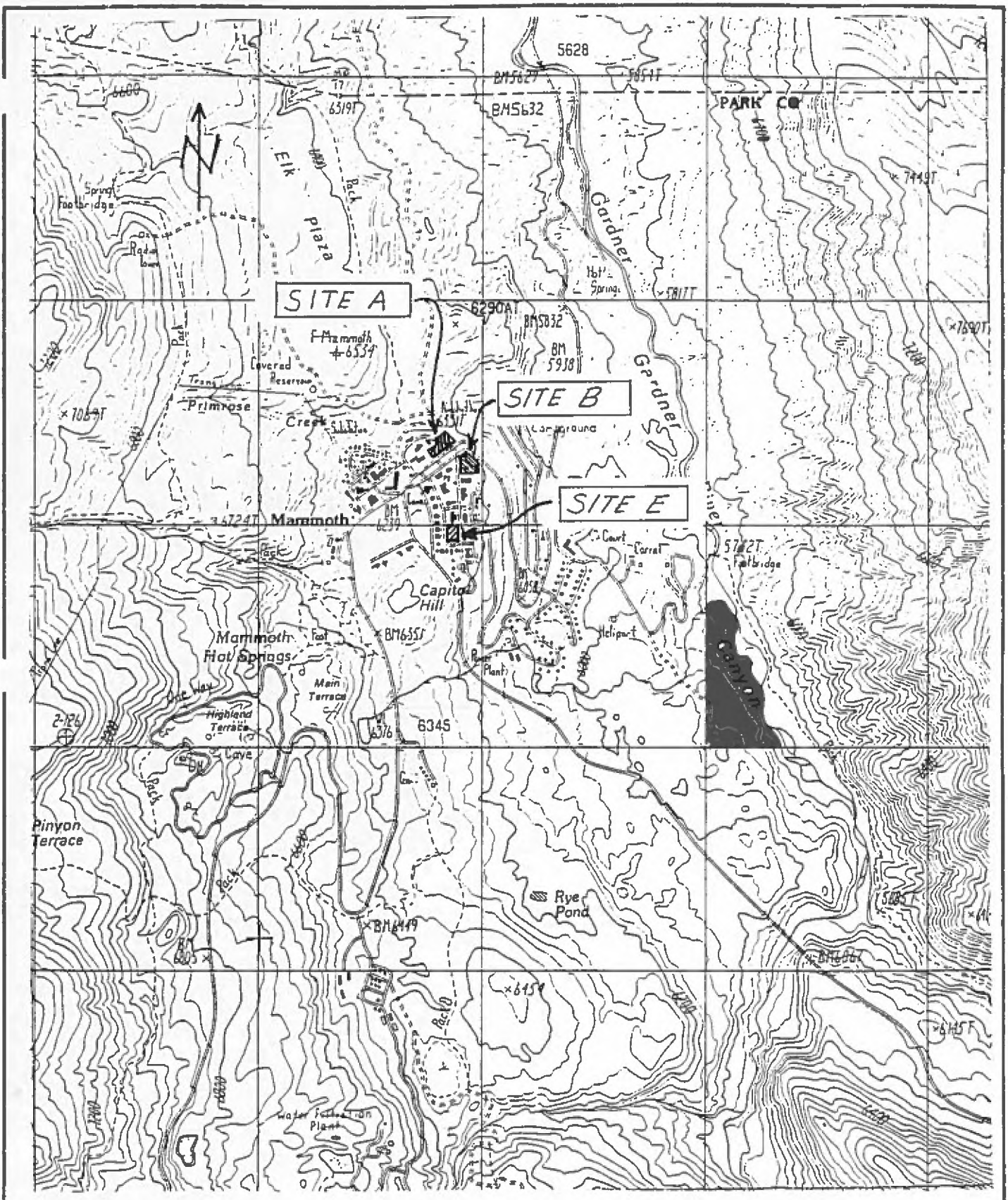
Professional Certification

I hereby certify that this report was prepared under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Wyoming.



Cory G. Rice, PE
Senior Engineer
Registration Number 8577
October 23, 1998

Appendix

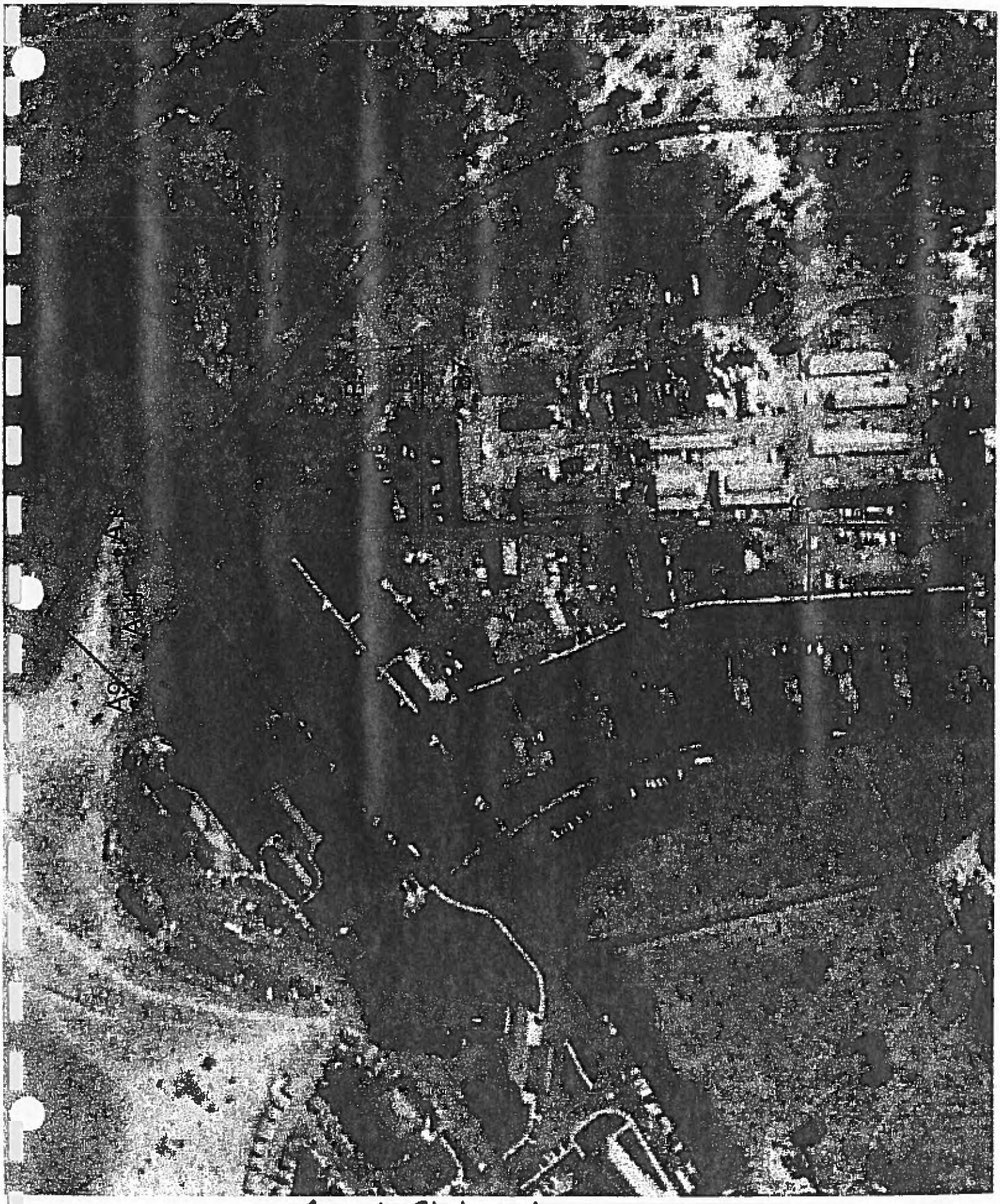


Site Location Sketch

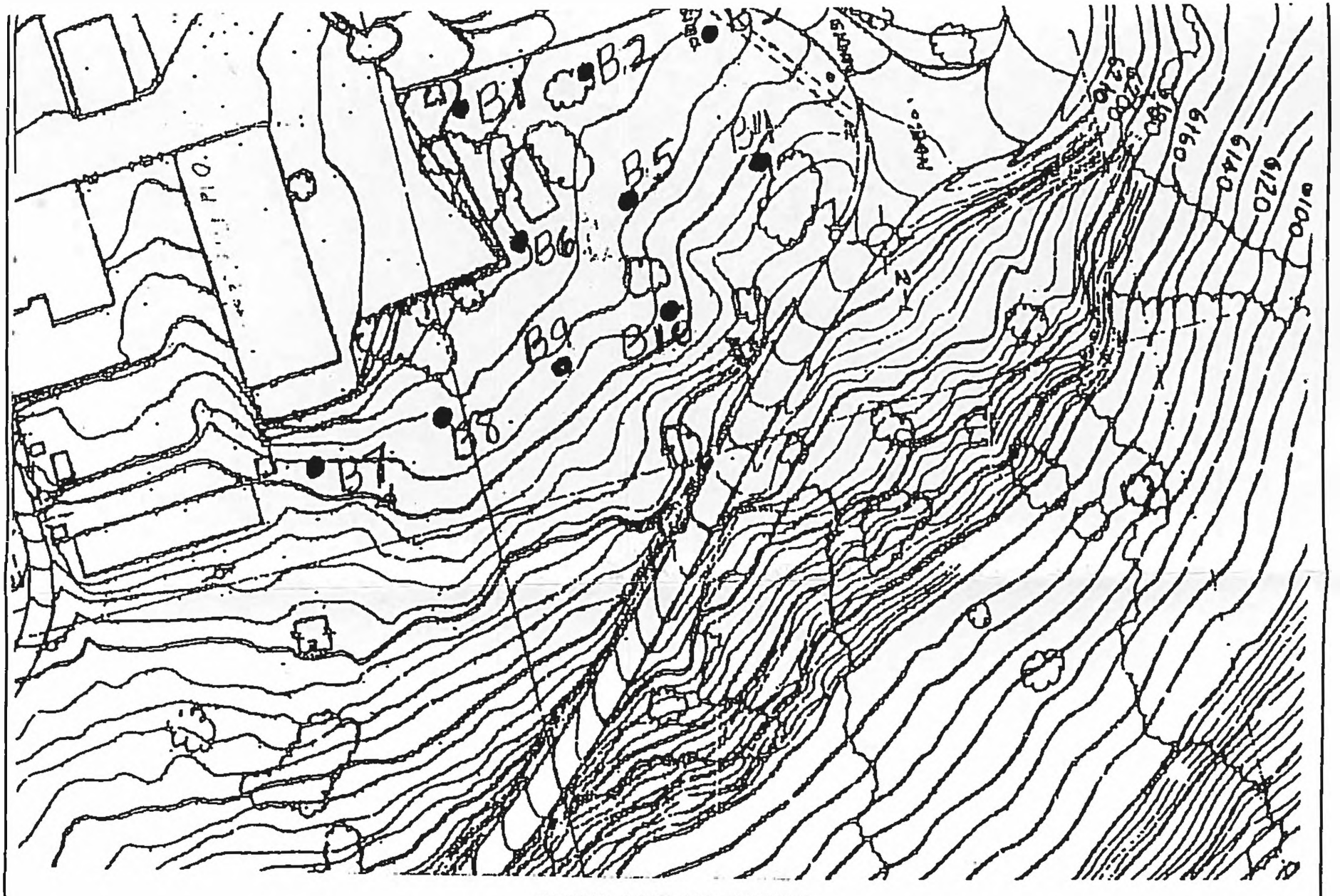
SK Geotechnical Corporation	Geotechnical Evaluation Sites A, B & E Mammoth Hot Springs Yellowstone National Park, Wyoming

INT	DATE	SHEET
DRAWN BY: USGS		
APP'D BY:		OF
JOB No. BHXX-98-149		
DWG. No.	FIGURE#	1
SCALE 1" = 2,000'		

Figure 2



Aerial Photograph
Geotechnical Evaluation, Sites A, B + E



BORING LOCATION SKETCH

INT		DATE
DRAWN BY: ?		
APP'D BY:		
JOB No. BHXX-98-149		
DWG.No.	SHEET	OF
SCALE 1" = 100'		

FIGURE # 3

Geotechnical Evaluation
Site A: Ice House & Corner Site
Mammoth Hot Springs
Yellowstone National Park, Wyoming

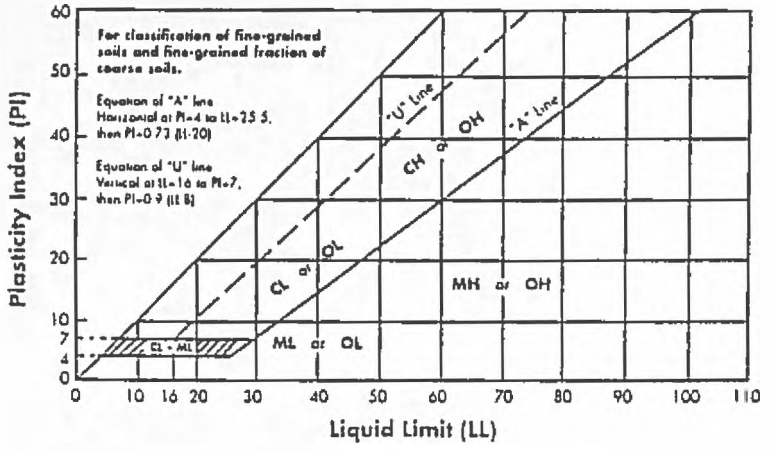
SK
Geotechnical Corporation

Descriptive Terminology

Standard D 2487 - 93
Classification of Soils for Engineering Purposes
(Unified Soil Classiication System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soil Classification [a] 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]	$C_u \geq 4$ and $1 \leq C_c \leq 3$	GW	Well graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [c]	Fines classify as ML or MH	GM	Silty gravel [e,f,g]
			Fines classify as CL or CH	GC	Clayey gravel [e,f,g]
	Sands 50% or more of coarse fraction passes No 4 sieve	Clean Sands less than 5% fines [h]	$C_u \geq 6$ and $1 \leq C_c \leq 3$	SW	Well graded sand [i]
			$C_u < 6$ and/or $1 > C_c > 3$	SP	Poorly graded sand [i]
		Sands with Fines More than 12% fines [h]	Fines classify as ML or MH	SM	Silty sand [e,f,g]
			Fines classify as CL or CH	SC	Clayey sand [e,f,g]
Fine-grained Soils 50% or more passed 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 in (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. $C_u = D_{60}/D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
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 limit plot in hatched 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



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liquid limit, %	C	Cohesion, psf
PL	Plastic limit, %	Ø	Angle of internal friction
PI	Plasticity index, %	qu	Unconfined compressive strength, psf
P200	% passing 200 sieve	qp	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3"
Fine	No 4 to 3/4"
Sand	
Coarse	No 4 to No 10
Medium	No 10 to No 40
Fine	No 40 to No 200
Silt	No. 200 to .005 mm
Clay	less than 005 mm

Relative Density of Cohesionless Soils

very loose	0 to 4 BPF
loose	5 to 10 BPF
medium dense	11 to 30 BPF
dense	31 to 50 BPF
very dense	over 50 BPF

Consistency of Cohesive Soils

very soft	0 to 1 BPF
soft	2 to 3 BPF
rather soft	4 to 5 BPF
medium	6 to 8 BPF
rather stiff	9 to 12 BPF
stiff	13 to 16 BPF
very stiff	17 to 30 BPF
hard	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube).

Power auger borings were advanced by 4" or 6" diameter, continuous-flight, solid stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B".

Hand auger borings were advanced manually with a 1 1/2" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H".

Sampling: All samples were taken with the standard 2" OD split-tube sampler, except where noted. TW indicates thin-walled (undisturbed) tube sample.

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone, driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone, hammer weight and driving not required.

Note: All tests were run in general accordance with applicable ASTM standards.

Rev 2/97

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A1 LOCATION: See attached sketch.
DRILLER: WHN — METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/21/98 — SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
150.6	0.0	SP SM	2" topsoil and root zone over POORLY GRADED SAND with SILT, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to very dense. (Decomposed Travertine)	26 8 1 WH/1 22 15 5			Elevation Reference: base flange of fire hydrant near SW corner of Site A, assumed elevation = 150.0.
130.6	20.0			8/25-0"			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 11' immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A2 LOCATION: See attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/20/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
152.2	0.0		2" topsoil and root zone over FILL: Clayey Sand with Gravel, fine- to coarse-grained, dark brown, moist, rather soft.	4			
150.7	1.5	SM	SILTY SAND, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to dense. (Decomposed Travertine)	10			
				5			
				4/2			
				26/7			
				37			
				39			
131.7	20.5			6/2			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: **BHXX-98-149** **GEOTECHNICAL EVALUATION** **Proposed Building Sites** **Mammoth Hot Springs** **Yellowstone National Park, Wyoming**	BORING: **ST-A3** LOCATION: See attached sketch.
DRILLER: WHN — METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/20/98 — SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
154.4	0.0		1" topsoil and root zone over FILL: Clayey Sand, fine- to medium-grained, trace Gravel, dark gray, wet, soft.	2 3			
149.9	4.5	SM	SILTY SAND, fine- to coarse-grained, with cemented Travertine Gravel, pale yellow, moist, dense to very loose. (Decomposed Travertine)	37 25/10			P200 = 14%
			-yellowish brown between 11 and 17 1/2'.	3 8 2			
133.9	20.5		END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 12' immediately after withdrawal of auger. Boring then backfilled.	5			

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A4 LOCATION: See attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/20/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
154.0	0.0		6" topsoil and root zone over FILL: Poorly Graded Sand with Silt, fine- to coarse-grained, with cemented Travertine Gravel, pale yellow, rather dry, medium dense.	9/20			
150.5	3.5		FILL: Clayey Sand with Gravel, fine- to coarse-grained, medium plasticity, dark grayish brown, moist, stiff.	9			
148.0	6.0	SP SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with cemented Travertine Gravel, pale yellow, moist, loose to very dense. (Decomposed Travertine)	13			
145.0	9.0		END OF BORING - Auger Refusal Water not observed with 9' of hollow-stem auger in the ground. Water not observed to cave-in depth immediately after withdrawal of auger. Boring then backfilled.	5 50-0" set			

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A5 LOCATION: See attached sketch.
DRILLER: WHN — METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/24/98 — SCALE: 1" = 4'

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
148.4	0.0	SP SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to very dense. (Decomposed Travertine)	12 2 3/7 15 11/3			P200 = 12%
135.9	12.5		END OF BORING - Auger Refusal Water not observed with 12 1/2' of hollow-stem auger in the ground. Water not observed to cave-in depth of 5 1/2' immediately after withdrawal of auger. Boring then backfilled.	8/50-0"			

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: **ST-A6A** LOCATION: 25'W of desired location, see attached sketch.
DRILLER: WHN — METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/21/98 — SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
148.1	0.0	SM	6" topsoil and root zone over SILTY SAND, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to very dense. (Decomposed Travertine)	12 5 50-6" 6			
139.6	8.5	SP SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to medium dense. (Decomposed Travertine) -light yellowish brown layer at 12 1/2'.	17 4 21			
127.6	20.5		END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 11 1/2' immediately after withdrawal of auger. Boring then backfilled.	3			

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A7 LOCATION: See attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/21/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
146.1	0.0	SM	6" topsoil and root zone over SILTY SAND, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, loose to very loose. (Decomposed Travertine)	8			
				6			
				5			
				2			
				1			
			-yellowish brown layer at 12 1/2'.	2			
			-medium dense to loose below 13 1/2'.	13			
125.6	20.5			10/3			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 11' immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A8P LOCATION: See attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/20/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
147.4	0.0	SM	3" topsoil and root zone over SILTY SAND, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to medium dense. (Decomposed Travertine)	8/4			
				9/3			Resistivity = 19,000 ohm-cm pH = 8.5 Sulfate = 0.0015%
				17			
				3/1			
				17			
				9			
				7			
			-yellowish brown below 17 1/2'.				
T26.9	20.5			WH			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. 1 1/4" piezometer then installed. Water not observed to 19 1/2' depth on 9/3/98.				

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A9 LOCATION: See attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/18/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp*	Tests or Notes
150.3	0.0	CL	1" topsoil and root zone over SANDY LEAN CLAY, medium plasticity, dark brown, rather dry, rather stiff.	12			
148.8	1.5		CLAYSTONE, conglomerate mix of Claystone and Sandstone, dark grayish brown, dry, moderately soft (Soil Class: Lean Clay with Gravel, medium plasticity, hard).	18			
				22			
				26			
141.8	8.5		CLAYSTONE, interbedded with Siltstone and Sandstone, dark gray, moist, soft (Soil Class: Sandy Lean Clay, low to medium plasticity, very stiff).	21			
138.8	11.5		CLAYSTONE, very dark gray, moist, soft (Soil Class: Lean Clay, medium plasticity, very stiff to hard).	23		4 1/2+	
				36		4 1/2+	
129.8	20.5			44		4 1/2+	*qp=pocket penetrometer estimate of unconfined compressive strength, tons per square foot.
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: **BHXX-98-149** **GEOTECHNICAL EVALUATION** **Proposed Building Sites** **Mammoth Hot Springs** **Yellowstone National Park, Wyoming**	BORING: **ST-A11** LOCATION: See attached sketch.
DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr
DATE: 8/18/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
144.4	0.0						
143.9	0.5		FILL: Sandy Lean Clay, trace Gravel, gray, dry.				
142.9	1.5	SP SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace to with Cemented Travertine Gravel, pale yellow, rather dry, medium dense. (Decomposed Travertine)	30			
140.9	3.5	SM	SILTY SAND, fine- to coarse-grained, with some cemented Travertine Gravel, brown, rather dry, medium dense.	17			
			CLAYSTONE, dark grayish brown, moist, medium soft (Soil Class: Lean Clay, medium plasticity, hard). -conglomerate of Sandstone and Claystone at 7 1/2'.	20		4 1/2+	
				55		4 1/2+	
133.4	11.0			34		4 1/2+	
130.9	13.5		WEATHERED SANDSTONE, dark brown, dry, moderately hard (Soil Class: Silty Gravel, fine- to coarse-grained, dense).	45			
			CLAYSTONE, some Sand and Travertine Gravel, dark brown, dry, soft (Soil Class: Lean Clay with Sand, medium plasticity, hard).	38			
124.4	20.0			50-6"			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 19 1/2' immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A12 LOCATION: See attached sketch.
DRILLER: WHN — METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/18/98 — SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
142.6	0.0	SM	3" SILTY SAND with GRAVEL over POORLY GRADED SAND with SILT, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist, very loose to medium dense. (Decomposed Travertine)	6/1			
				4/1			
				5			
				2			
				6			
			-mixed with some brown at 12 1/2'.	11			
				12			
122.1	20.5			2			
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 12' immediately after withdrawal of auger. Boring then backfilled.				

LOG OF BORING

PROJECT: **BHXX-98-149** **GEOTECHNICAL EVALUATION** **Proposed Building Sites** **Mammoth Hot Springs** **Yellowstone National Park, Wyoming**	BORING: **ST-A13P** LOCATION: See attached sketch.
DRILLER: WHN | METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/18/98 | SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
141.2	0.0						
			FILL: Clayey Sand with Gravel, fine- to medium-grained, medium plasticity, dark gray, rather dry, very stiff.	22			
139.2	2.0	SP SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace to with cemented Travertine Gravel, pale yellow, moist. (Decomposed Travertine)	5/2			
				2			
				10			
132.7	8.5	CH	FAT CLAY, high plasticity, grayish brown, moist, rather stiff to very stiff. (Alluvium)	9		4	
			-Gravels at 12 1/2'.	16			
				16		41/2+	See swell test. LL = 147, PL = 20, PI = 127, P200 = 96%
				TW			
				9			
121.7	19.5						
120.7	20.5	GP GM	POORLY GRADED GRAVEL with SILT, fine- to coarse-grained, dark brown, rather dry, very dense. (Weathered Bedrock)	82		2 3/4	
			END OF BORING Water not observed with 19' of hollow-stem auger in the ground. 1 1/4" piezometer then installed. Water not observed to 19 1/2' depth on 9/3/98.				

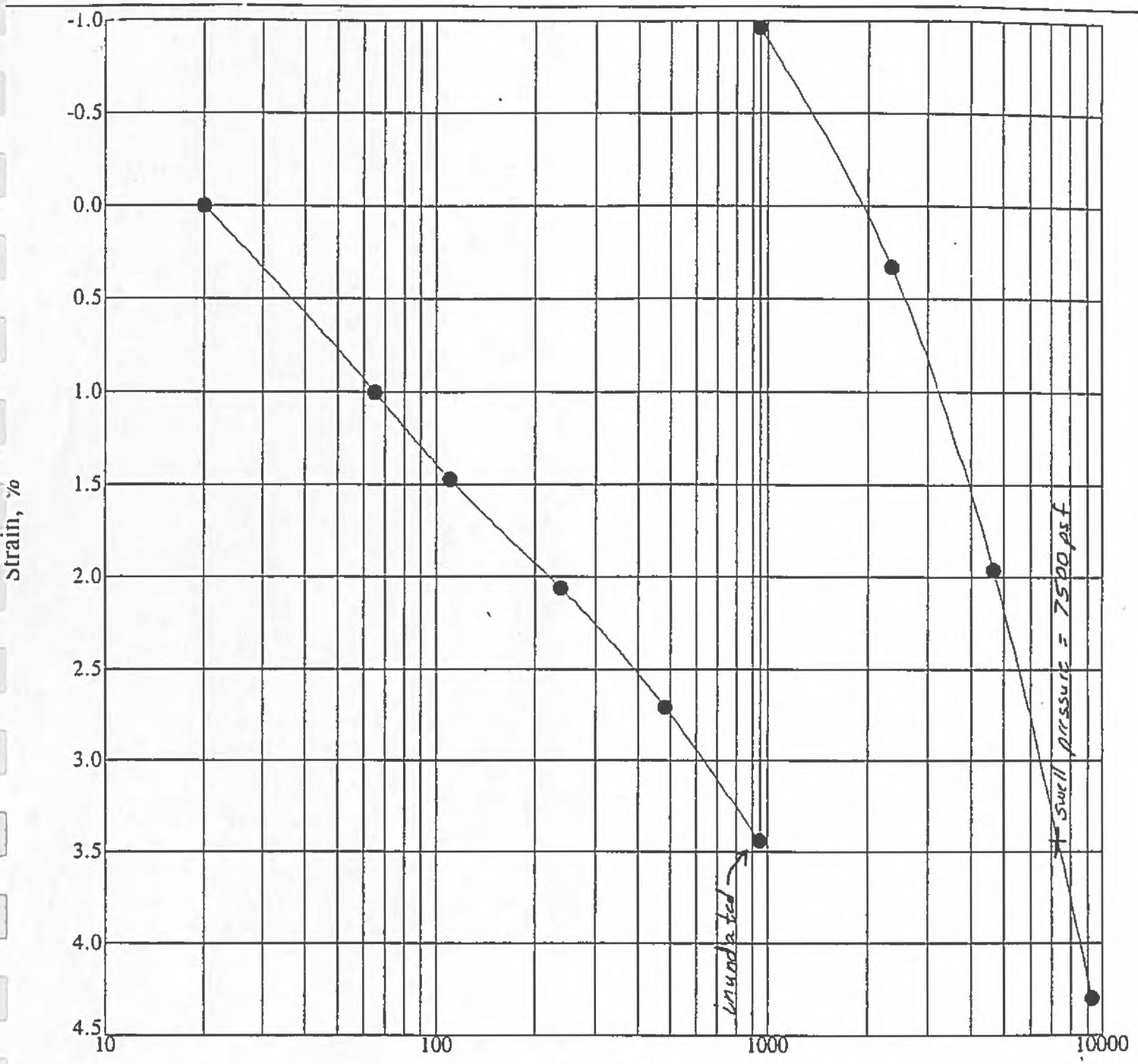
LOG OF BORING

PROJECT: BHXX-98-149 GEOTECHNICAL EVALUATION Proposed Building Sites Mammoth Hot Springs Yellowstone National Park, Wyoming	BORING: ST-A14A LOCATION: 20'S and 20'W of desired location, see attached sketch.

DRILLER: WHN	METHOD: 3 1/4" HSA,Auto Hmr	DATE: 8/18/98	SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	qp	Tests or Notes
140.0	0.0	CL	SANDY LEAN CLAY, medium plasticity, trace roots, dark brown, rather dry, rather stiff. (Alluvium)	12 12			Ground surface elevation estimated from contour lines.
136.5	3.5	GC	CLAYEY GRAVEL, fine- to coarse-grained, dark brown, rather dry, medium. (Decomposed Bedrock)	8			
134.0	6.0	SC	CLAYEY SAND, fine- to medium-grained, medium plasticity, dark brown, rather dry, very stiff. (Decomposed Bedrock)	TW 23			
131.5	8.5	GM	SILTY GRAVEL, fine- to coarse-grained, dark brown, rather dry, medium dense to very dense. (Decomposed Bedrock)	22 52 15/30			
122.5	17.5		CLAYSTONE, laminated, very dark gray, dry, soft (Soil Class: Lean Clay, medium plasticity, very stiff to hard).	10/26			
119.5	20.5		END OF BORING Water not observed with 19' of hollow-stem auger in the ground. Water not observed to cave-in depth of 12' immediately after withdrawal of auger. Boring then backfilled.				



Initial Dry Density (pcf) 94

Initial Moisture Content (%) 27

Boring: ST-A13P Sample: TW Depth: 16 1/2' to 17 1/2'

Soil Description: Fat Clay, high plasticity, pale yellow, moist. (CH)

October 19, 1998

Swell Test

Proposed Building Sites, Mammoth Hot Springs

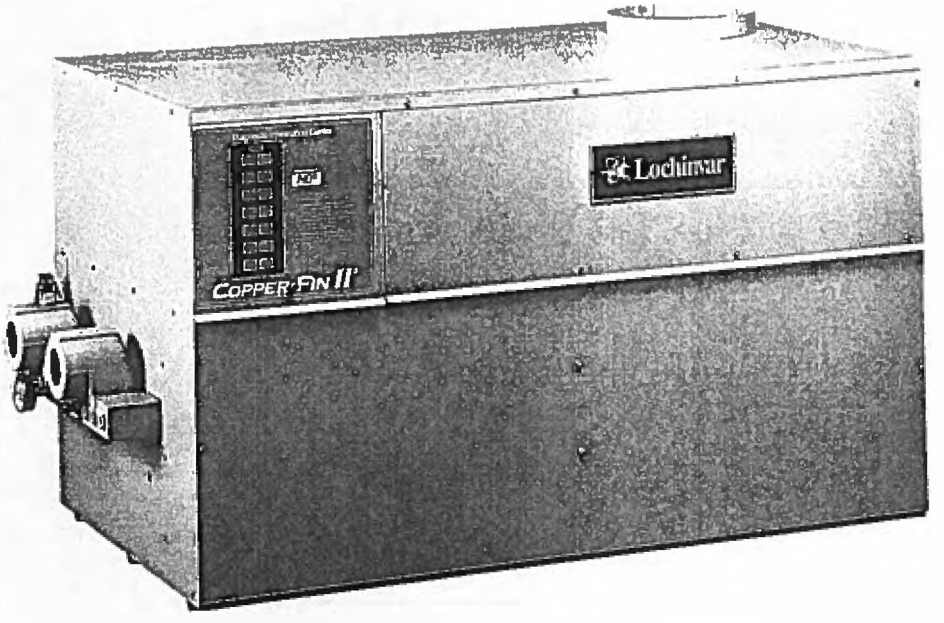
Braun Intertec, Billings, Montana (406) 652-3930 Project BHXX-98-149

Mechanical Equipment Information

Lochinvar®
High Efficiency Water Heaters And Boilers

COPPER-FIN II®

Commercial Gas Boilers





From 300,000 to 2,070,000 BTUs
84% Thermal Efficiency
Less Than 20 ppm NOx Rating
Category I Venting

Copper-Fin II® Boilers—The Proven Performer

Thermal efficiency is higher...while footprint and vents are smaller

Lochinvar's Copper-Fin II line of commercial boilers gives you all the advantages of Copper-Fin technology, combined with the benefits of a sealed combustion system. And now we have enhanced our 400,000 through 750,000 BTU models with our revolutionary proportional firing technology. This proven innovation provides energy-saving performance and Lochinvar reliability. All Copper-Fin II models offer four major advantages: higher efficiency, a smaller footprint, smaller vents, and a wide variety of venting options.

84% Thermal Efficiency

Copper-Fin II boilers offer a remarkable 84% thermal efficiency. Thanks to a specially-designed, Lochinvar blower assembly, they deliver the ideal gas/air ratio to the high-grade stainless-steel burners. This precise system produces an extremely efficient, low profile flame that not only raises efficiency, but also lowers operation and maintenance costs.

The sealed combustion chamber virtually eliminates heat loss. This means that more of every energy dollar actually goes into heating water. It also means the jacket stays cooler, providing greater safety and requiring less clearance from combustible walls, 1" in some cases.

Higher efficiency also means a more compact design. Our Copper-Fin II units will fit almost anywhere, and with so many venting options to choose from, they can be installed in even the trickiest situations, including alcove installations!

NOx Rating Less Than 20

Because of our unique fan-assisted combustion process, Copper-Fin II produces less NO_x. In fact, an independent certification laboratory test gave us a 9.9 ppm rating—corrected to 3% O_2. Less NO_x means a cleaner environment.

A Space-Saving, Money-Saving Design

The entire Copper-Fin II product line offers you greater flexibility and ease of installation. These high efficiency units are also compact enough to fit through standard 36" doorways intact. Even our 2 million BTU model is only 33 ½" wide.

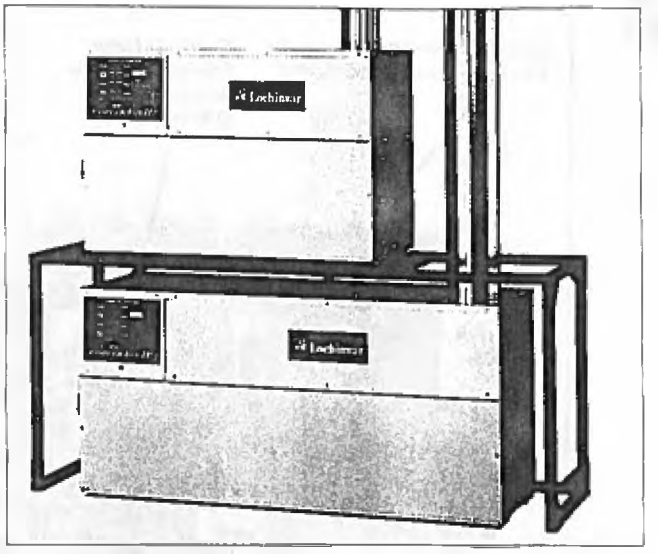
The space-saving design of Copper-Fin II leaves more space in the mechanical room. Plus, the Copper-Fin II offers five indoor venting options, including Lochinvar's own power-assisted DirectAire® system. Or use them outside with the optional outdoor vent hood.

The sealed combustion chamber minimizes heat loss so dramatically that smaller units require only 1" clearance from combustible walls. And with the optional Multi-Stack™ stand you can put two units in the footprint normally required for one.

Vent Cost Savings

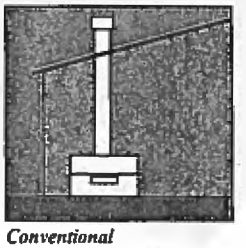
INPUT	CONVENTIONAL VENT SIZE	COPPER-FIN II VENT SIZE	$ SAVINGS*
300,000	8"	5"	$ 253.00
399,999	10"	6"	$ 657.00
500,000	10"	6"	$ 657.00
650,000	12"	8"	$ 731.00
750,000	14"	8"	$ 1,450.00
990,000	16"	10"	$ 1,790.00
1,260,000	16"	12"	$ 1,463.00
1,440,000	18"	12"	$ 2,432.00
1,800,000	20"	14"	$ 3,526.00
2,070,000	22"	14"	$ 3,738.00

**Comparison based on 25' vent system using Type "B" double wall vent material, storm collar and vent cap.*

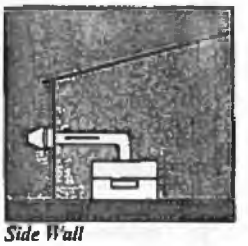


Multi-Stack Stand with CH501 and CH751

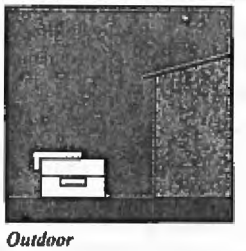
Venting Options



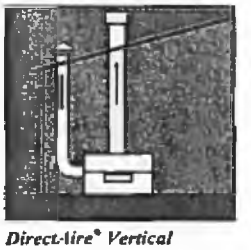
Conventional
Vents into conventional flue or vent breaching using Type B double-wall vent.



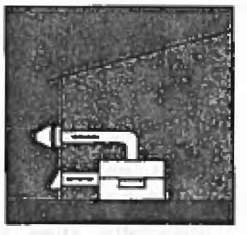
Side Wall
Vents directly through the outside wall using the optional powered side wall cap. Ideal when a vent stack is not practical.



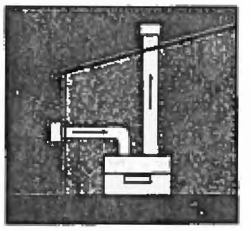
Outdoor
Requires an optional outdoor vent cap. Use when indoor space is a problem or if outdoor location gives better access.



Direct-Aire® Vertical
Draws fresh combustion air from outside, and vents combustion by-products through conventional vertical flue.



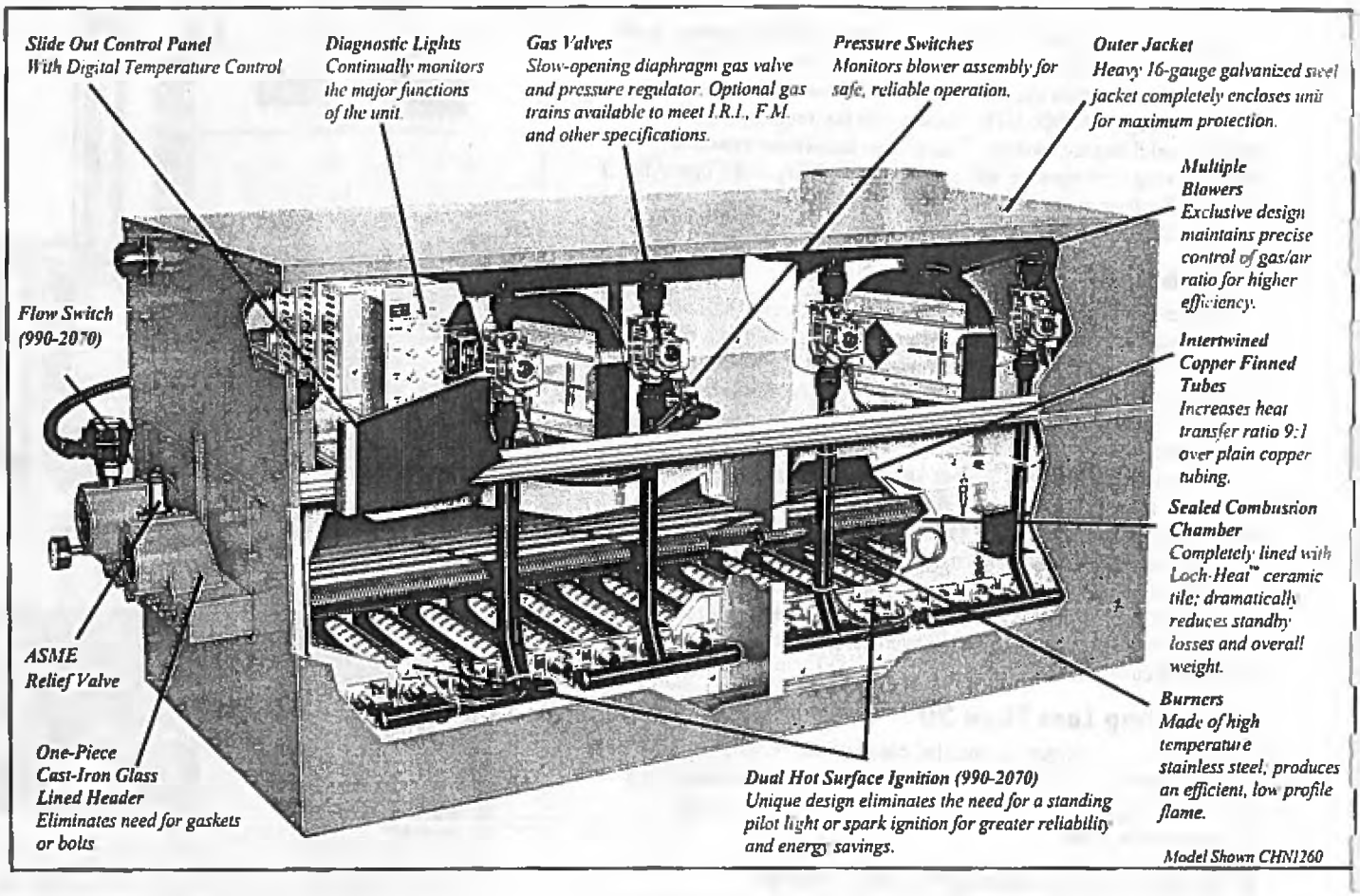
DirectAire® Horizontal
Again, draws fresh combustion air from outside, then vents by-products through side wall using optional powered vent cap.



Direct-Aire® Horizontal/Vertical
Draws fresh combustion air from an outside wall horizontally, and vents combustion by-products through a vertical flue. (401-2070)

Copper-Fin II® 401-2070

Featuring Proportional Firing & Variable Speed



What Is Proportional Firing?

All Copper-Fin II boilers feature a sealed combustion chamber to minimize heat loss, and a power-assisted fan provides just the right amount of combustion air to ensure the best combustion. But now we've taken that one step further.

Our models 401-2070 not only maintain the ideal blend of gas and air for combustion, they do so in proportional amounts. They provide a measured response to the demand for heat—as much or as little as needed—while always maintaining the ideal gas/air ratio.

How It Works

Multiple gas valves supply gas to the burners in stages, and multiple blowers† maintain the proper airflow to ensure the most efficient combustion at each level of use. Our built-in sequencer controls each of these functions*. With digital accuracy, it carefully monitors the need for heat, and as demand increases or decreases, it automatically adjusts the blower output and gas valves.

As the demand is met, the system shuts down gradually, turning off gas valves and reducing combustion air intake in direct proportion. This allows the Copper-Fin II to maintain a virtually constant setting. In fact, it's accurate to within 1° Fahrenheit—a remarkable achievement for units of this capacity!

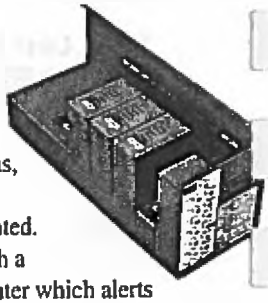
†Variable Speed Blower on Models 401-751.
* Featuring Digital Temperature Control (DTC).

Consistent Performance

Conventional boilers achieve peak efficiency only when they're running at maximum capacity. When the demand for hot water is lower, the efficiency is lower, too. But our Copper-Fin II models with proportional firing not only offer more accurate temperature control, they consistently provide peak performance even while operating at lower inputs.

Plus, our Copper-Fin heat exchanger provides superior heat transfer. In fact, it's nine times more efficient than conventional copper tubing.

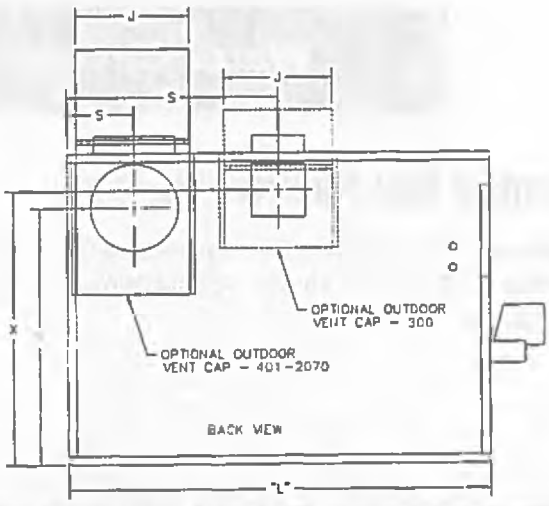
Total System Redundancy

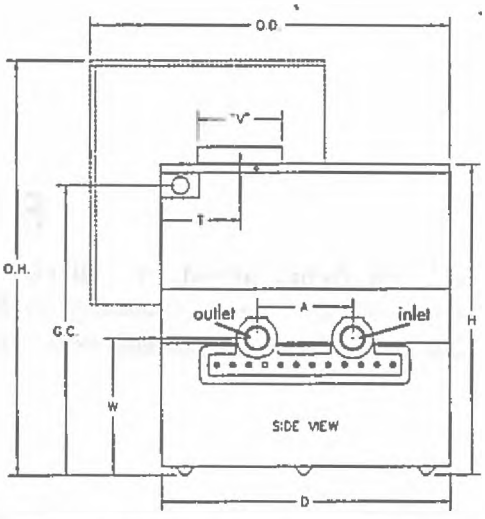


Proportional firing also means unmatched reliability. In our larger 990-2070 models every major component has a back-up—multiple gas valves, multiple fans, even redundant dual Hot Surface Ignition Systems—so downtime is virtually eliminated.

What's more, every unit is equipped with a comprehensive Diagnostic Information Center which alerts the operator if there is a problem and helps to isolate it quickly. The 401-2070 models also feature the industry's first slide-out control panel with plug-in components. A built-in circuit breaker eliminates fuses, too—making servicing fast and easy.

Copper-Fin II® Boiler Dimensions & Specifications





MODEL NO.	BTU INPUT	BTU OUTPUT	GAS CONN.	WATER CONN.	A	D	O.D.	G.C.	H	O.H.	CAP J	L	VENT V*	W	S	T	X	WT.
CHN0300**	300,000	252,000	¾"	2"	6 ½"	22 ¼"	27 ⅛"	21 13⁄16"	29 ⅜"	35 3⁄16"	12 ¼"	30 ¼"	5"	12 ⅛"	15 ⅛"	9 7⁄16"	25 5⁄16"	328
CHN0401	399,999	336,000	1"	2"	6 ½"	22 ¼"	27 ¾"	29"	31 ½"	37 ½"	10 ¼"	37 ½"	6"	12 ⅛"	6"	7 ⅜"	26 ¾"	351
CHN0501	500,000	420,000	1"	2"	6 ½"	22 ¼"	27 ¾"	29"	31 ½"	37 ½"	12 ¼"	45 ⅜"	6"	12 ⅛"	6"	7 ⅜"	26 ¾"	401
CHN0651	650,000	546,000	1 ¼"	2"	6 ½"	22 ¼"	27 ¾"	29"	31 ½"	37 ½"	15 9⁄16"	56 ¾"	8"	12 ⅛"	7"	8 ⅜"	25 ¾"	498
CHN0751	750,000	630,000	1 ¼"	2"	6 ½"	22 ¼"	27 ¾"	29"	31 ½"	37 ½"	17 ¾"	64"	8"	12 ⅛"	7"	8 ⅜"	25 ¾"	524
CHN0990	990,000	831,600	1 ½"	2 ½"	11 ⅝"	33 ½"	41 ¾"	33 13⁄16"	35 15⁄16"	48 1⁄16"	14"	48 3⁄16"	10"	15 13⁄16"	8"	9 ¼"	29 1⁄16"	802
CHN1260	1,260,000	1,058,400	1 ½"	2 ½"	11 ⅝"	33 ½"	41 ¾"	33 13⁄16"	35 15⁄16"	48 1⁄16"	16"	58 ½"	12"	15 13⁄16"	9"	10 ¼"	28 1⁄16"	914
CHN1440	1,440,000	1,209,600	2"	2 ½"	11 ⅝"	33 ½"	41 ¾"	33 13⁄16"	35 15⁄16"	48 1⁄16"	16"	68 ⅝"	12"	15 13⁄16"	9"	10 ¼"	28 1⁄16"	1033
CHN1800	1,800,000	1,512,000	2"	2 ½"	11 ⅝"	33 ½"	41 ¾"	33 13⁄16"	35 15⁄16"	48 1⁄16"	18"	82 ⅛"	14"	15 13⁄16"	10"	11 ½"	28 1⁄16"	1177
CHN2070	2,070,000	1,738,800	2"	2 ½"	11 ⅝"	33 ½"	41 ¾"	33 13⁄16"	35 15⁄16"	48 1⁄16"	18"	92 ⅜"	14"	15 13⁄16"	10"	11 ½"	28 1⁄16"	1300

**Air intake is the same as "V" dimension, except models 1800 and 2070, where it is 12". ** Available in On/Off firing only*
• Change "N" to "L" to denote L.P. model. No deration on L.P. models.

Standard Features

- 84% Thermal Efficiency
- 10-Year Warranty
- Hot Surface Ignition
- Stainless Steel Burners
- Redundant Gas Valves
- Unique Gasketless Copper-Fin Heat Exchanger
- Loch-Heat™ Ceramic Tile Sealed Combustion Chamber
- ASME 160# W.P.
- 50# ASME Pressure Relief Valve
- NOx Rating of 9.9 ppm
- 24v Controls
- Inlet/Outlet Temperature Gauge
- Air Pressure Switch
- Guaranteed Against Thermal Shock
- Fits Through Standard 36" Doorframe
- 1" Clearance To Combustibles (3" on 300 and 990-2070)
- Terminal Strip for E.M.S. Interface
- Diagnostic Control Panel

Additional Features (401-2070)

- Proportional Firing
- Category 1 Venting
- Dual Hot Surface Ignition Systems (990-2070 only)
- Multiple Blowers
- Built-In Sequencer
- Digital Temperature Control (DTC)
- Slide-Out Control Panel With Plug-In Components
- Flow Switch (990-2070 only)
- Manual Reset High Limit (990-2070 only)

FOR EASE IN ORDERING BY MODEL NUMBER

CH N 300 F9

MODEL · FUEL TYPE · BTU INPUT · FIRING CONTROLS

This unit is 300,000 BTU natural gas Copper-Fin II® boiler. It has F9 firing controls.

Optional Equipment

- Powered Vent Cap For Horizontal DirectAire® Venting (110v)
- Manual Reset High Limit (300-751)
- Alarm Bell
- Flow Switch (300-751 Models)
- Low Water Cut-Off
- Mod-U-Pak™ Sequencer (See Accessories)
- Multi-Stack™ Stand (See Accessories)
- Outdoor Reset

Available Firing Systems

300	401-2070	
F9	M9	Electronic Control with Hot Surface Ignition (Standard)
F13	M13	FM Approved*
F14	M14	IRI*
F7	M7	California Code

* Indoor only.
Patent Pending

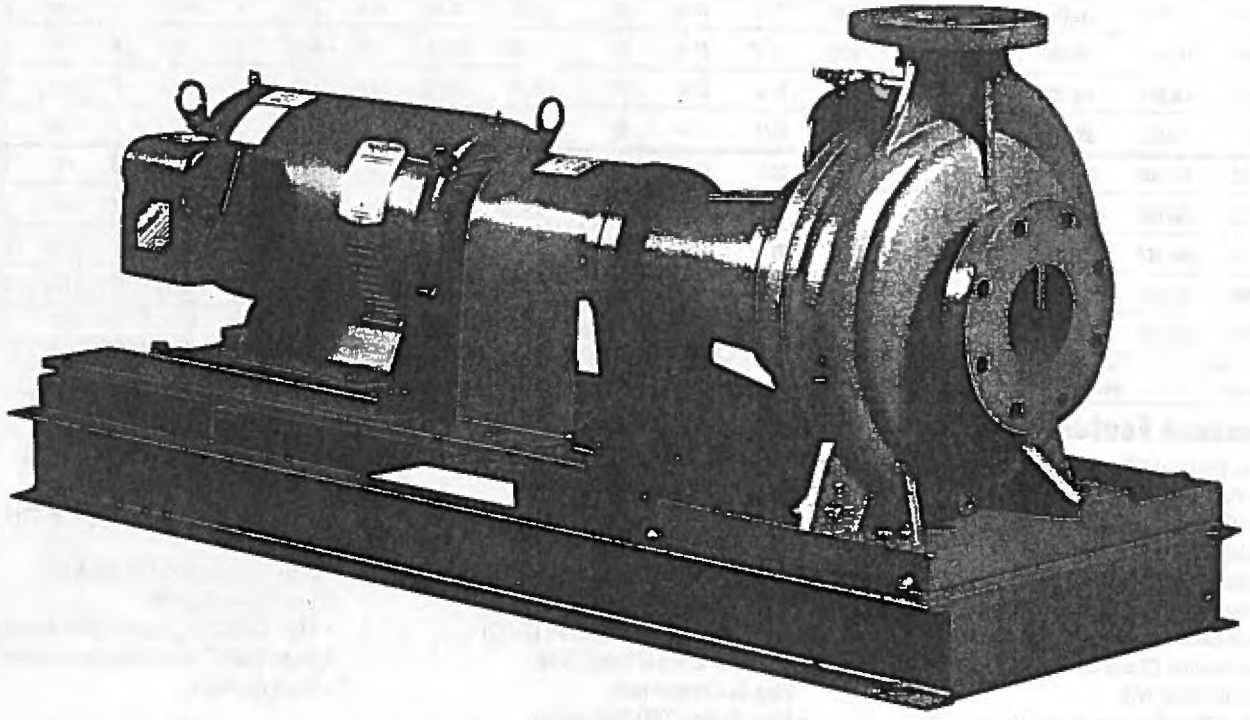
Lochinvar®
High Efficiency Water Heaters And Boilers
The Built-In Advantage™

Lochinvar Corporation • 2005 Elm Hill Pike • Nashville, TN 37210 • 615/889-8900 Fax 615/885-4403
www.Lochinvar.com

HP-2M-12/01–Printed In U.S.A.

FI Frame-Mounted End Suction Pumps

FI Series Pumps provide the ultimate in reliability and ease of installation for heating, air conditioning, pressure boosting, cooling water transfer, and water supply applications. Quiet, dependable and proven performance: that's the FI Series.



Do it once.
Do it right.

Taco®

©Taco Catalog # 300-2.4

Effective Date: 3/31/02
Printed in USA

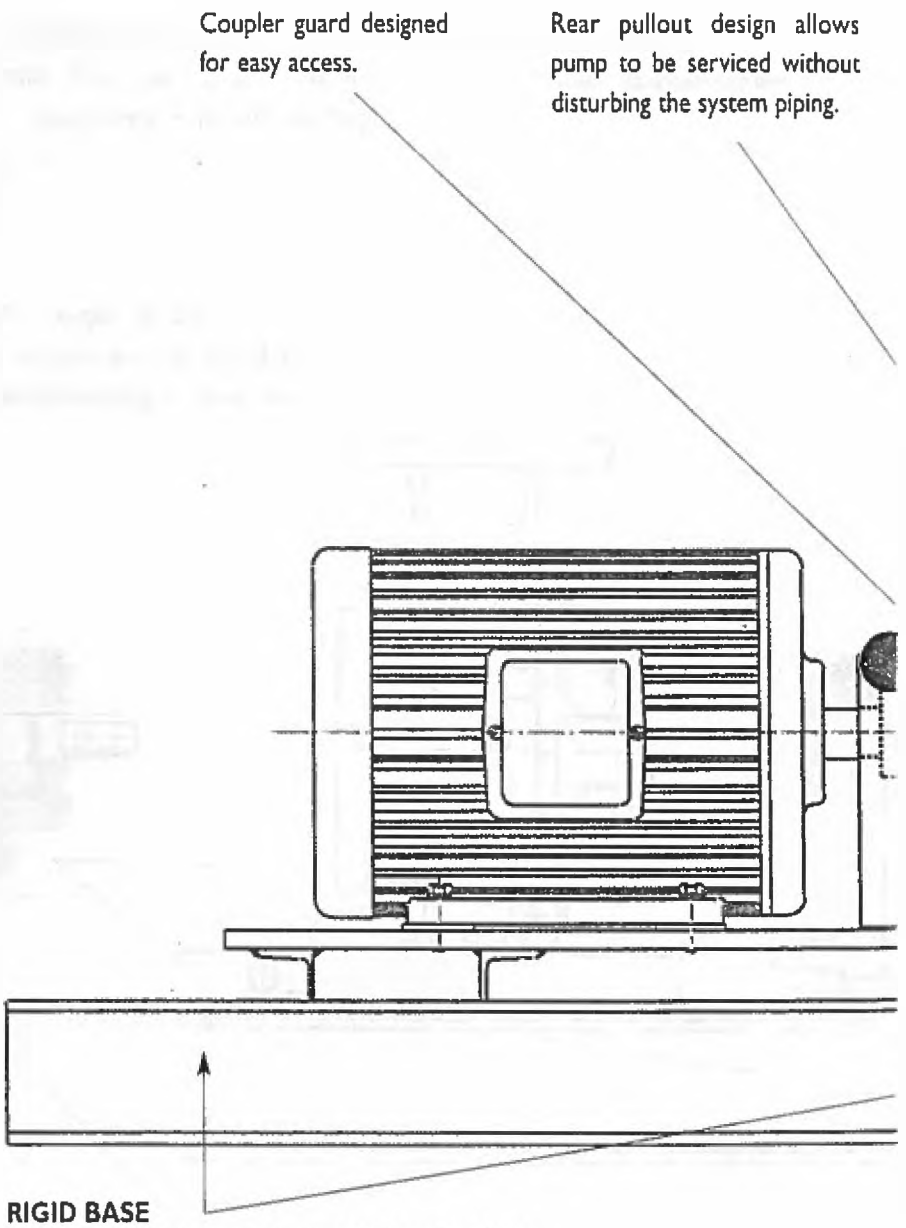
Quiet, dependable power and proven performance.

FI Series Pumps meet the latest standards for hydraulic performance and dimensional characteristics. Each is backed by Taco, Inc., a worldwide leader in heating and cooling equipment for more than eight decades.

Improved bearing frame design features sealed for life bearings meeting all industry requirements for a minimum L 10 life of 60,000 hours. Optional regreaseable bearings are also available. Improved design also incorporates a unique sealing system which prevents the migration of water into the bearing frame. An easy-to-replace, slip-on shaft sleeve facilitates seal maintenance in the field and lowers maintenance costs. The exclusive dry shaft design protects the pump shaft by eliminating contact between the shaft and the circulating fluid. Corrosion-resistant shaft materials are generally not required. FI Pumps also feature flush seal line taps, allowing the installation of a filter to protect the seal from non-condensible particles present in open systems. In addition, pressure tappings on suction and discharge connections are provided as a standard feature.

All FI Pumps are provided with a fully welded, rigid structural steel base, with enclosed ends and open grouting area. This combination reduces vibration and improves alignment.

Taco FI Pumps are ideally suited for a variety of applications, including heating, air conditioning, pressure boosting, cooling water transfer, and water supply.



RIGID BASE

- Steel construction provides for rigid base installation.
- Built in drain pan (with 3/4" drain connection), Collects all condensate and seal leakage.
- Ample open space for easy grouting.
- The heavy-duty compact design provides a more stable platform, which meets or exceeds hydraulic institute and industry standards for rigidity and vibration dampening, the base design is an ideal solution for those tight mechanical room installations.
- Facilitates improved alignment and ease of grouting.

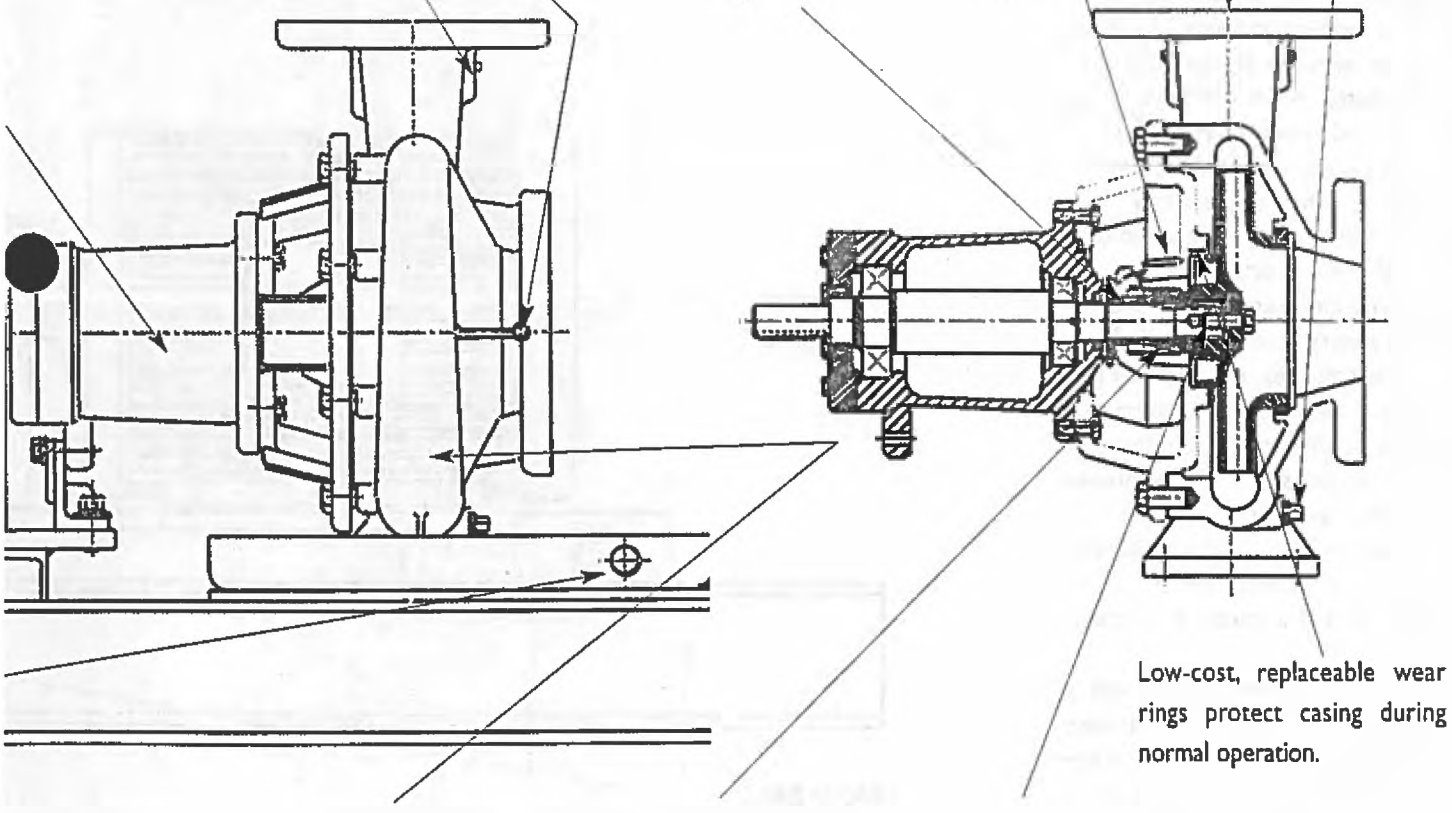
1/4 NPT pressure tapping on suction and discharge connections.

Flush seal line tap allows installation of filter to protect seal from particles present in open system.

Top center line discharge design simplifies piping layouts, reduces piping strain, and makes the pump self-venting.

Easy-to-replace slip-on shaft sleeve facilitates seal maintenance in the field and lowers long-term maintenance costs.

1/4 NPT Casing drain plug.



Low-cost, replaceable wear rings protect casing during normal operation.

Cast iron casing with integrally cast feet enables pump to be bolted to base for sturdier installation and still allow back pull out without disturbing the piping.

Standard ceramic seals promote product flexibility: enables basic product offering to meet a wide range of application requirements.

DRY SHAFT DESIGN

- Ensures shaft is not exposed to the system fluid.
- Eliminates need for expensive corrosion-resistant shaft.
- Simplifies sleeve and seal removal/reinstallation.

McQUAY VISION AIR HANDLING UNIT

Date Saved : 6/26/03 4:38 PM

JOB NAME	KA6081(XE.000)	REP. OFFICE	-
JOB DESCRIPTION	Mammoth Court House	SALESPERSON	-
MODEL NUMBER	CAH030FDAC	CUSTOMER	Stephen B. Smith
UNIT TAGGING	AHU-1	UNIT VERSION	6.12

Unit configuration	Inline horizontal	
Supply external dimensions	(HxW) ins	60 x 98
Exhaust external dimensions	(HxW) ins	60 x 98

FAN PERFORMANCE		SUPPLY	RETURN / EXHAUST
Air volume	cfm	16000	13600
Altitude	ft	6230	6230
Turning loss	in WC	0.00	0.00
External static	in WC	5.00	1.25
Total static	in WC	6.02	1.32
Fan diameter / type	ins	24.00 / AF	18.03 / FC
Fan power	HP	20.86	11.31
Motor power	HP	25.00	15.00
Motor voltage	V/Hz/P	230-460/60/3	230-460/60/3

COIL PERFORMANCE	IN ORDER OF AIR FLOW	1st COIL	2nd COIL	3rd COIL	4th COIL
Coil model		5WH0702C	5WH0903C		
Total capacity	Btu/hr	719490	308597		
Sensible capacity	Btu/hr	-	304216		
Entering db / wb	F	40.0 / -	80.0 / 61.0		
Leaving db / wb	F	91.8 / -	58.1 / 53.7		
Face area	sqft	27.33	31.88		
Face velocity	fpm	585	502		
Air pressure drop	in WC	0.28	0.40		
EWT / LWT	F	160.0 / 139.3	45.0 / 55.4		
Flow rate	gpm	69.40	59.10		
Glycol type / %		- (0 %)	- (0 %)		
Water pressure drop	ftHD	6.50	8.10		
Suction temp / Refrig	F	-	-		
Steam pressure	psig	-	-		

FILTER DATA		STAGE 1	STAGE 2	STAGE 3
Type		Throwaway (5700)		
Efficiency		-		
Face area	sqft	32.8		
Face velocity	fpm	488		

COMPONENT SUPPLY	APD (in WC)	WEIGHT (lbs)	COMPONENT RET/EXH	APD (in WC)	WEIGHT (lbs)
Economizer	0.10	281.79	Fan Section	0.00	583.99
Panel Filter	0.24	71.71	Economizer	0.07	-
Hot Water Coil	0.28	311.62			
Access section	0.00	0.00			
Chilled Water Coil	0.40	719.43			
Fan Section	0.00	853.38			

SHIPPING SECTION DETAILS	Length (ins)	Weight (lbs)		Length (ins)	Weight (lbs)
Section 1	78	1669			
Section 2	72	1634			
Section 3	88	2857			
TOTALS (Lower level total length, entire unit total weight)				238.00	6160

UNIT SOUND	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Radiated	77	76	71	68	63	52	45	39
Unit discharge	94	96	94	95	89	83	79	71
Unit return	91	91	89	89	89	85	82	77

NOTES

Liner material is 20 Gauge nom. G90 galv perforated
Insulation is 2 ins, 1.5lb fiberglass
Supply fan performance is certified in accordance with the Central Station Air-Handling Unit Certification Program, which is based on ARI Standard 430.

McQuay Air Conditioning

JOB NAME	KA6081XE.000	REP. OFFICE	-
JOB DESCRIPTION	Mammoth Court House	SALESPERSON	-
ENGINEER	Stephen B. Smith		
UNIT TAGGING	AHU-1;		

UNIT TAGGING: All Units

UNIT CONSTRUCTION

McQuay Vision air handlers are tested and rated in accordance with ARI standard 430 and are ETL listed.

Unit fabrication is of galvanized steel channel posts and panels. W-shaped bulb type gasketing provided between each frame channel and unit panel to provide thermal integrity and prevent air leakage. Gasketing meets UL 723 for surface burning characteristics.

The casing leakage rate will not exceed .5 cfm per square foot of cabinet area at 5" static pressure (.0025 m3/s per square meter of cabinet area at 1.24 kPa static pressure).

The external casing is constructed of 16 gauge nominal (1.5 mm) G90 galvanized steel frame channels with 18 gauge nominal (1.2 mm) panels, 16 gauge nominal (1.5 mm) optional.

Field shipping modules are sealed with an internal splice connector. The splice connector extends across the section-to-section joint, and is sealed with bulb type gasketing to prevent air leakage.

Access doors are double wall and constructed of galvanized steel, flush mounted to the cabinetry, and provided with gasketed seal. Heavy duty stainless steel hinges, door latch and full size handle assembly are factory installed.

The following options may vary by unit, check the technical data sheet for specific unit information.

[1] [2] inch ([25] [50] mm) thick, [¾], [1-1/2], [3] lb. per ft3 ([12] [24] [48] kg per m3) density, neoprene coated, glass fiber insulation. Insulation is secured to the inner casing with glue. Insulation pins can be provided as an option.

The optional inner liner is constructed of 20 gauge nominal (0.94 mm) G90 solid or perforated galvanized steel.

Formed galvanized steel base rail is available, minimum height of 4" (102 mm), maximum of 12" (305 mm) on unit sizes 003-021. Unit sizes 025 and larger require a base rail. Minimum of 6" (152 mm) high, maximum of 12" (305 mm). The base rail is an integral part of each shipping section. The variable base rai height will provide additional height for condensate trapping requirements.

Optional inspection window is provided where detailed.

UNIT TAGGING: AHU-1

HEATING COIL SECTION

Coils are accessible from the [opposite connection side] [optional connection side] [both sides] of unit fo service and cleaning. The coil headers and return bends are fully enclosed within unit casing. The air handling unit is furnished with coil connections that extend a minimum of 5" (127 mm) beyond unit casing for easy installation. Drain and vent connections are located on the coil connections. The coil connections are factory sealed with grommets where the piping extends through the unit casing to avoid air leakage and comply with indoor air quality standards. Coils are removable through side panels and/or top panels (if sectionalized) of unit without removal and disassembly of entire unit.

Coils are ARI certified and Underwriters Laboratories, Inc. listed. Capacities, pressure drops, and selection procedures are in accordance with ARI 410.

WATER COILS
Fins have a minimum thickness of [.006" (.15 mm)], [.0075" (.19 mm)], [.0095" (.24 mm)], of [aluminum] [copper] plate construction. Fins have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes are constructed of 5/8" OD seamless copper mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes are not visible between fins.

Water coils provided with round seamless 5/8" OD copper tubes on 1 1/2" (38 mm) centers, staggered in the direction of airflow. All joints brazed.

Water coils are provided with headers of seamless copper tubing with intruded tube holes that permit expansion and contraction without creating undue stress or strain. The casing is formed channel frame of [galvanized] [stainless steel] [aluminum] [copper]. Coil connection size provided by manufacturer based upon the most efficient coil circuiting. Coil vents and drains are provided on the coil connection outside the unit casing. Vent connections provided at the highest point to assure proper venting. Drain connections provided at the lowest point to insure drainage and prevent freeze-up.

STEAM COILS
Fins have a minimum thickness of [.006" (.15 mm)], [.0075" (.19 mm)], [.0095" (.24 mm)], of [aluminum] [copper] plate construction. Fins have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes are mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tube are not visible between fins.

Steam coils are provided with round seamless [5/8"] [1"] OD [copper] [cupronickel] [admiralty] tubes on 1 1/2" (38 mm) centers (5/8" coils) or 3" (76 mm) centers (1" coils). Tubes on two-row coils are staggered in the direction of airflow. All joints are brazed.

Steam coil headers are made of nonferrous materials using seamless copper tubing with a floating core design and intruded tube holes that permit expansion and contraction without creating undue stress or strain. The casing is formed channel frame of [galvanized] [stainless steel] [aluminum] [copper]. Both the supply and return headers are completely encased by the coil casing. The coil is pitchedin the unit to assure positive condensate drainage. Orificed baffle plates are installed in the supply connection to ensure proper diffusion of entering steam.

Steam coils are tested with 315 pounds (2172 kPa) of air pressure under warm water and guaranteed for 150 (1034 kPa) psig working pressure.

UNIT TAGGING: AHU-1
COOLING COIL SECTION
Coils are accessible from the [opposite connection side] [optional connection side] [both sides] of unit for service and cleaning. The coil headers and return bends are fully enclosed within unit casing. The air handling unit is furnished with coil connections that extend a minimum of 5" (127 mm) beyond unit casing for easy installation. Drain and vent connections are located on the coil connections. The coil connections are factory sealed with grommets where the piping extends through the unit casing to avoid air leakage and comply with indoor air quality standards. Coils are removable through side panels and/or top panels (if sectionalized) of unit without removal and disassembly of entire unit.

Coils are ARI certified and Underwriters Laboratories, Inc. listed. Capacities, pressure drops, and selection procedures are in accordance with ARI 410.

Drain pans are constructed from coated galvanized steel or stainless steel, cross broken and pitched (double sloped) to the drain connection. The drain pan extends the full depth of the cooling coil section to

completely drain any condensate. Intermediate drain pans are provided for cooling coil banks two coils high Galvanized drain pan coating is microbial resistant. The drain connection center line is a minimum of 3" (7(mm) above finished floor for trapping. The variable base rail height will provide additional height fo trapping.

Optional moisture eliminators are constructed of three break galvanized steel, and mounted over drain pan and on the leaving air side of the coil casing.

WATER COILS
Fins have a minimum thickness of [.006" (.15 mm)], [.0075" (.19 mm)], [.0095" (.24 mm)], of [aluminum] [copper] plate construction. Fins have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes are constructed of 5/8" OD seamless copper mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes are not visible between fins.

Water coils provided with round seamless 5/8" OD copper tubes on 1 1/2" (38 mm) centers, staggered in the direction of airflow. All joints brazed.

Water coils are provided with headers of seamless copper tubing with intruded tube holes that permit expansion and contraction without creating undue stress or strain. The casing is formed channel frame of[galvanized] [stainless steel] [aluminum] [copper]. Coil connection size provided by manufacturer based upon the most efficient coil circuiting. Coil vents and drains are provided on the coil connection outside the unit casing. Vent connections provided at the highest point to assure proper venting. Drain connections provided at the lowest point to insure drainage and prevent freeze-up.

REFRIGERANT COILS
Refrigerant coils are designed for use with refrigerant [R-22] [R-134a]. Fins have a minimum thickness of [.006" (.15 mm)], [.0075" (.19 mm)], [.0095" (.24 mm)], of [aluminum] [copper] plate construction. Fins have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes are constructed of 5/8" OD seamless copper mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes are not visible between fins.

Refrigerant coils provided with round seamless 5/8" OD copper tubes on 1 1/2" (38 mm) centers, staggere in the direction of airflow. All joints brazed.

Sweat type copper suction connections are located at the bottom of the suction headers for gravity oil drainage. The casing is formed channel frame of [galvanized] [stainless steel] [aluminum] [copper]. Coils are circuited to [row] [face] [interlaced] control capacity reduction. Pressure type liquid distributors are used. Coils are tested with 315 pounds (2172 kPa) air pressure under warm water, and suitable for 250 psig (1724 kPa) working pressure. Evaporator coils are circuited in a counterflow manner with uniform circuits.

UNIT TAGGING: AHU-1
SUPPLY/RETURN FANS
Double width, double inlet, forward curved fan is dynamically balanced as an assembly. Maximum fan RPM is always below the first critical fan speed. Forward curved fans with inlet vanes will have a heavy duty linkage connecting both vane assemblies. The inlet vane actuating mechanism ispermanently lubricated and interconnected by a solid steel shaft through oil impregnated bronze bushings mounted in the fan housing.

Double width, double inlet, airfoil fan is dynamically balanced as an assembly. Maximum fan RPM is always below the first critical fan speed. Airfoil fans with variable inlet vanes are controlled with a center hub linkage. Vanes are fabricated from steel with a baked enamel finish capable of withstanding entering air

temperature up to 200° F (93° C). The inlet vane actuating mechanism is permanently lubricated and interconnected by a solid steel shaft through oil impregnated bronze bushings mounted in the fan housing.

Single width, single inlet, airfoil fan is dynamically balanced before and after installation in the fan cabinet section. Maximum fan RPM is always below the first critical fan speed. Airfoil fans with variable inlet vanes are controlled with a center hub linkage. Vanes are fabricated from steel with a baked enamel finish capable of withstanding entering air temperature up to 200° F. The inlet vane actuating mechanism is permanently lubricated and interconnected by a solid steel shaft through oil impregnated bronze bushings mounted in the fan housing.

Drive
The fan and motor are internally mounted on a steel base. The motor base can be slid out the side of unit if removal is required. Access is provided to motor, drive, and bearings through a hinged access door. Fan and motor assembly [secured to cabinet structure for external isolation], [mounted on spring vibration isolators inside cabinetry], [mounted on rubber in shear vibration isolators inside cabinetry]. Optional seismic snubbers.

Fan bearings are sealed, self-aligning, grease lubricated, ball bearings. The extended copper lubrication lines are furnished on the access side of unit. The grease fittings are attached to fan base assembly, near the access door.

The bearing load rating is computed in accordance with AFBMA - ANSI Standards, [L-50 life at 200,000 hours], [L-50 life at 500,000 hours], [L-50 life at 1,000,000 hours]. It is a heavy duty pillow block type, self-aligning, grease-lubricated ball bearing.

The V-belt drive has cast iron or steel sheaves, dynamically balanced, and bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive are rated as recommended by manufacturer. Optional, variable and adjustable pitch sheaves are selected so that the required rpm is obtained with sheaves set at mid-position. The standard drive service factor is 1.1 (7 1/2 HP & smaller) or 1.3 (10 HP & larger) times fan brake horsepower, or optional customer specified service factor.

The shaft is solid, hot rolled steel, ground and polished, keyed to the shaft, and protectively coated with lubricating oil.

Motors
Electrical Characteristics: [115] [200] [230] [380] [460] [575] volts, [single] [three] phase, [50] [60] Hz.

Motor type [open drip proof] [TEFC] [2 Speed, 1 Winding] [2 Speed, 2 Winding]
[explosion proof]. Efficiency [Standard] [High] [Premium].

Drain Pan
Optional drain pan is constructed from galvanized or stainless steel, cross broken and pitched (double sloped) to the drain connection. The drain pan is provided with a microbial resistant coating, or of stainless steel construction without a coating. The drain connection center line is a minimum of 3" (76 mm) above finished floor for proper trapping. The variable base rail height can provide additional height for trapping.

UNIT TAGGING: AHU-1
ACCESS
Section to provide access between components is a minimum of 16" (406 mm) and a maximum of 54" (1372 mm) deep. Access doors are doubled wall and constructed of galvanized steel and flush mounted. Fabricated with gasketing between door and frame channel, latch and handle assembly. Optional drip pan of [galvanized] [stainless] steel.

UNIT TAGGING: AHU-1

FLAT AND ANGULAR FILTERS

The filter section includes filter racks, and hinged and latching access doors on either, or both sides of the section for side loading and removal of filters. Flat and angular filter arrangements are provided with [2 (50 mm)] [4 (100 mm)] inch deep [pleated panel filters.] [disposable panel filters.] Filter media is U.L. Class 2, and tested according to U.L. Standard 900.

UNIT TAGGING: AHU-1

ECONOMIZER

Economizer section with factory mounted low leak hollow core airfoil blade, outside air and return air dampers, and exhaust air damper. Dampers constructed of galvanized steel in galvanized frame. Dampers are fully gasketed and have continuous vinyl seals between damper blades. Stainless steel end seals are provided along the end of the dampers. Linkage is provided when the return air and outside air dampers are both sized for full airflow. The return air and outside air dampers are linked together. The exhaust damper will require a separate actuator. Return air and outside air dampers of different sizes are not linked together.

The damper leakage rate is less than two tenths of one percent leakage at 2 inches (.5 kPa) static pressure differential. The leakage rate is tested in accordance with AMCA Standard 500.

McQuay Air Conditioning

JOB NAME	KA6081(XE.000)	**REP. OFFICE**	-
JOB DESCRIPTION	Mammoth Court House	**SALESPERSON**	-
MODEL NUMBER	CAH030FDAC	**ENGINEER**	Stephen B. Smith
UNIT TAGGING	AHU-1	**UNIT VERSION**	6.12

Unit configuration	Inline horizontal		
Drive (handing) location	Right		
	SUPPLY	**RETURN / EXHAUST**	
Air volume	16000	13600	s cfm
Altitude	6230	6230	ft
Turning loss	0.00	0.00	in WC.
External static	5.00	1.25	in WC.
Total static	6.02	1.32	in WC.
External H x W	60 x 98	60 x 98 (Not including base rails)	ins

CASING DETAILS	
Outer panel	18 Gauge nom. G90 galv steel
Liner	20 Gauge nom. G90 galv perforated (Unless noted per section)
Insulation	2 ins, 1.5lb fiberglass (Unless noted per section)
Frame	2 ins
Base	6" formed galv channel
Heavy duty floor liner	None

1 RETURN/EXHAUST FAN SECTION(46 ins) — SECTION 1

Air volume	13600	cfm	Motor power	15.0	HP
External static pressure	1.25	ins WC	Motor type	ODP	
Total static pressure	1.32	ins WC	Frame size	254 T frame	
			Electrical supply	230-460/60/3	
Type	Centrifugal		Motor efficiency	High	
Blade type/Class	Forward curved / 2		Motor speed	1750	rpm
Fan wheel diameter	18.03	ins	Motor pole	4	
Brake horsepower	11.31	HP	Full load current	40.6 / 20.3	A
Operating/Max speed	996 / 1450	rpm	Lock rotor current	301 / 150.5	A
Orientation	Top horizontal		Motor supplier	Generic	
Air modulation	None		Actual drive service fac.	1.31	
Drain pan	None		Bearing type	Standard - L50 (200K)	
Drain pan side	-		Outlet velocity	4706	ft/m
Wheel guard	None		Inlet screen	None	
Belt guard	None		Outlet screen	None	
Inspection port	None				

DRIVES

Fan sheave	2B5V86	Motor sheave	2B5V48
Number of belts	2	Belt	5VX470

ANTI-VIBRATION MOUNTS / SPRINGS

Type	Spring
Seismic restraint	None

DOOR DATA

Door location	Drive side		Window size	None
Door width	30	ins	Light	None
Door opening	Outward			

2 ECONOMIZER(64 ins) SECTION 1 & 2

Drain pan	None	Drain side	-

	OUTSIDE AIR	RETURN AIR	EXHAUST AIR	
Length x Width	28.00 x 94.00	28.00 x 94.00	28.00 x 94.00	ins
Location	Top	Internal	Top	
Dampers	UltraSeal Low Leak	UltraSeal Low Leak	UltraSeal Low Leak	
Actuation	None - damper mechanically linked	None - damper mechanically linked	None - damper mechanically linked	
Hoods	None	N/A	None	
16000	13600	13600		cfm
0.10	0.10	0.07		in WC

DOOR DATA

Door location	Drive side		Window size	6 x 12 ins
Door width	28	ins	Light	Marine light kit and switch only
Door opening	Outward			

3 PANEL FILTER(12 ins) SECTION 2

Type	Throwaway (5700)		**Clean air press. drop**	**0.24**	**ins WC**
Efficiency	-	%	Mean air press. drop	0.62	ins WC
Face velocity	488	fpm	Dirty air press. drop	1.00	ins WC
Face area	32.8	ft2	Access	Side	

BANK ARRANGEMENT

No. of Filters	Size H x W x D	
8	20.00 x 24.00 x 2.00	ins
4	12.00 x 24.00 x 2.00	

DOOR DATA

Door location	Drive side		Window size	None
Door width	8	ins	Light	None
Door opening	Outward			

SPECIAL

-

Heavy duty floor liner	(As casing details)			
Liner	20 Gauge nom. G90 galv steel			
Insulation	(As casing details)			
Special static pressure	-	ins WC	Filter Gauge	Minihelic II 0-2"

4 HOT WATER COIL(12 ins) SECTION 2

Coil model	5WH0702C		Number of coils	2	
Capacity	719490	Btu/h	Number of rows	2	
			Fins per inch	7	
Entering db	40.0	F	Entering water	160.0	F
Leaving db	91.8	F	Leaving water	139.3	F
Finned height x length	24 x 82	ins	Water flow rate	69.40	gpm
Face area	27.33	ft2	Water pressure drop	6.50	ftHD
Face velocity	585	ft/m	Water velocity	4.60	ft/s
Coil air pressure drop	0.28	ins WC	Piping vestibule	-	ins
Connection type	Threaded		Fin material	Aluminum (.0075)	
Connection Qty x size	2 x 2.5	ins	Tube material	Copper (.020)	
Connection location	Drive side		Header material	Copper	
Glycol type (%)	- (0 %)		Case material	Galvanized track	
			Drain pan	None	
			Drain pan side	-	
			Turbospirals	None	
Coil code	5WH0702C				

5 ACCESS SECTION(16 ins)					SECTION 2
Drain pan	None		Drain side	-	
DOOR DATA					
Door location	Drive side		Window size	None	
Door width	12	ins	Light	None	
Door opening	Outward				

6 CHILLED WATER COIL(30 ins)					SECTION 3
Coil model	5WH0903C		Number of coils	2	
Total capacity	308597	Btu/h	Number of rows	3	
Sensible capacity	304216	Btu/h	Fins per inch	9	
Entering db/wb	80.0 / 61.0	F	Entering water	45.0	F
Leaving db/wb	58.1 / 53.7	F	Leaving water	55.4	F
Finned height x length	27 x 85	ins	Water flow rate	59.10	gpm
Face area	31.88	ft2	Water pressure drop	8.10	ftHD
Face velocity	502	ft/m	Water velocity	3.50	ft/s
Coil air pressure drop	0.40	ins WC	Piping vestibule	-	ins
Connection type	Threaded		Fin material	Aluminum (.0075)	
Connection Qty x size	2 x 1.5	ins	Tube material	Copper (.020)	
Connection location	Drive side		Header material	Copper	
Glycol type (%)	- (0 %)		Case material	Galv. steel	
			Drain pan	Microbial resistant coated galvanized	
			Drain pan side	Drive side	
Coil code	5WH0903C		Turbospirals	None	

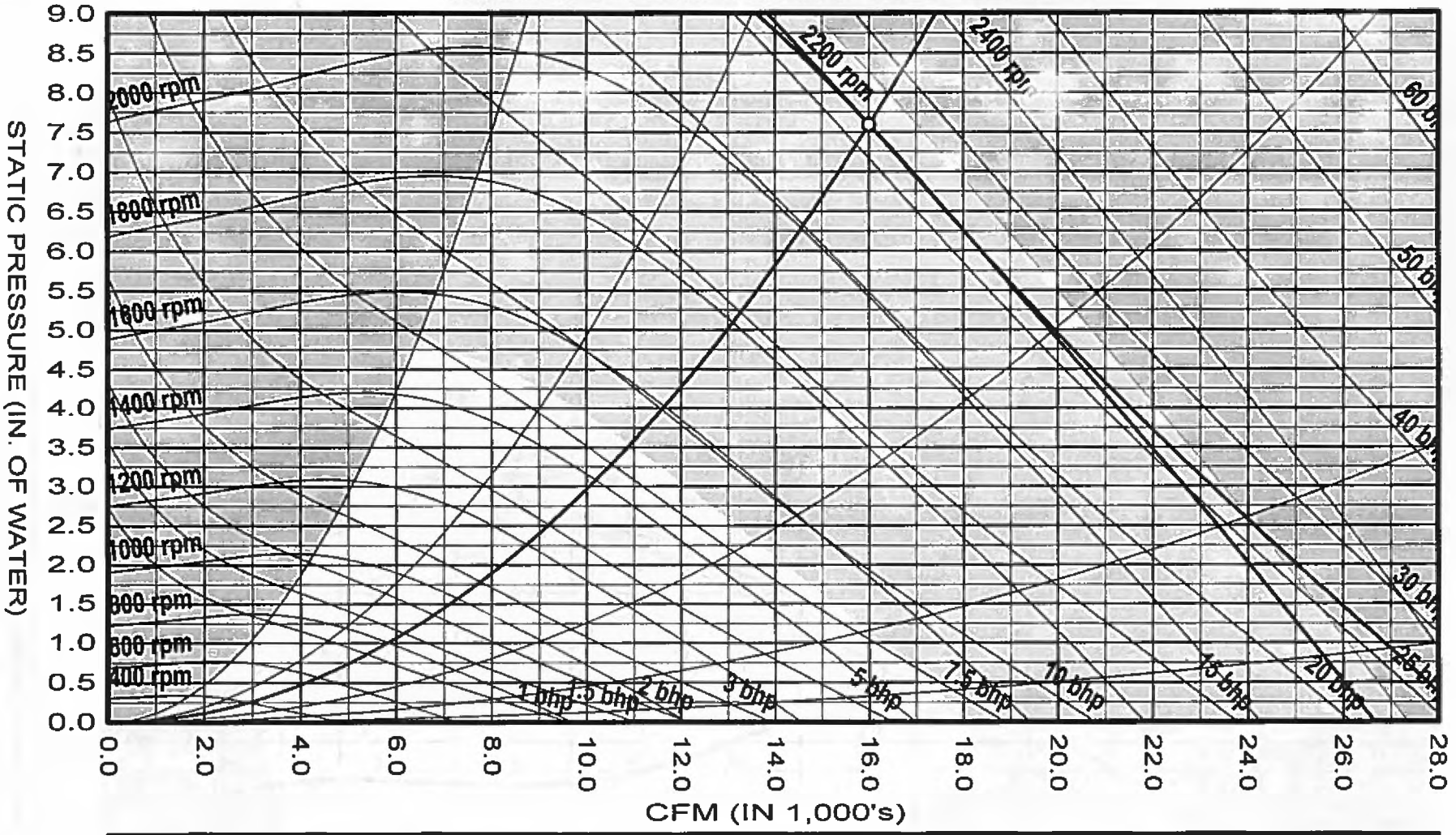
7 SUPPLY FAN SECTION(58 ins)					SECTION 3
Air volume	16000	cfm	Motor power	25.0	HP
External static pressure	5.00	ins WC	Motor type	ODP	
Total static pressure	6.02	ins WC	Frame size	284 T frame	
			Electrical supply	230-460/60/3	
Type	-		Motor efficiency	High	
Blade type/Class	Airfoil / 2		Motor speed	1750	rpm
Fan wheel diameter	24.00	ins	Motor pole	4	
Brake horsepower	20.86	HP	Full load current	62 / 31	A
Operating/Max speed	2198 / 2255	rpm	Lock rotor current	382 / 191	A
Orientation	Up blast CCW		Motor supplier	Generic	
Air modulation	None		Actual drive service fac.	1.32	
Drain pan	None		Bearing type	Standard - L50 (200K)	
Drain pan side	-		Outlet velocity	2273	ft/m
Wheel guard	None		Inlet screen	None	
Belt guard	None		Outlet screen	None	
Inspection port	None				
DRIVES					
Fan sheave	2B5V56		Motor sheave	2B5V68	
Number of belts	2		Belt	5VX630	
ANTI-VIBRATION MOUNTS / SPRINGS					
Type	Spring				
Seismic restraint	None				
DOOR DATA					
Door location	Drive side		Window size	None	
Door width	30	ins	Light	None	
Door opening	Outward				

NOTES
Supply fan performance is certified in accordance with the Central Station Air-Handling Unit Certification Program, which is based on ARI Standard 430. Important Notice This unit may not meet ASHRAE Standard 90.1 - 1999 fan motor power limitations. If that code applies, alternate fan selections may be required. The designer and installer must ensure compliance with applicable codes. A component supplier cannot determine the brake horsepower ("BHP") for other motors in the air handling system. Before approving this unit, determine whether ASHRAE Standard 90.1 - 1999 has been adopted in the specific jurisdiction or contract specifications in which the unit will be installed.

SHIPPING SECTION DETAILS			
	Length (inches)	Weight (lb)	
Section 1	78	1669	
Section 2	72	1634	
Section 3	88	2857	
TOTALS	**238.00 (Lower level total)**	**6160 (Entire unit weight)**	

UNIT SOUND	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Radiated	77	76	71	68	63	52	45	39
Unit discharge	94	96	94	95	89	83	79	71
Unit return	91	91	89	89	89	85	82	77

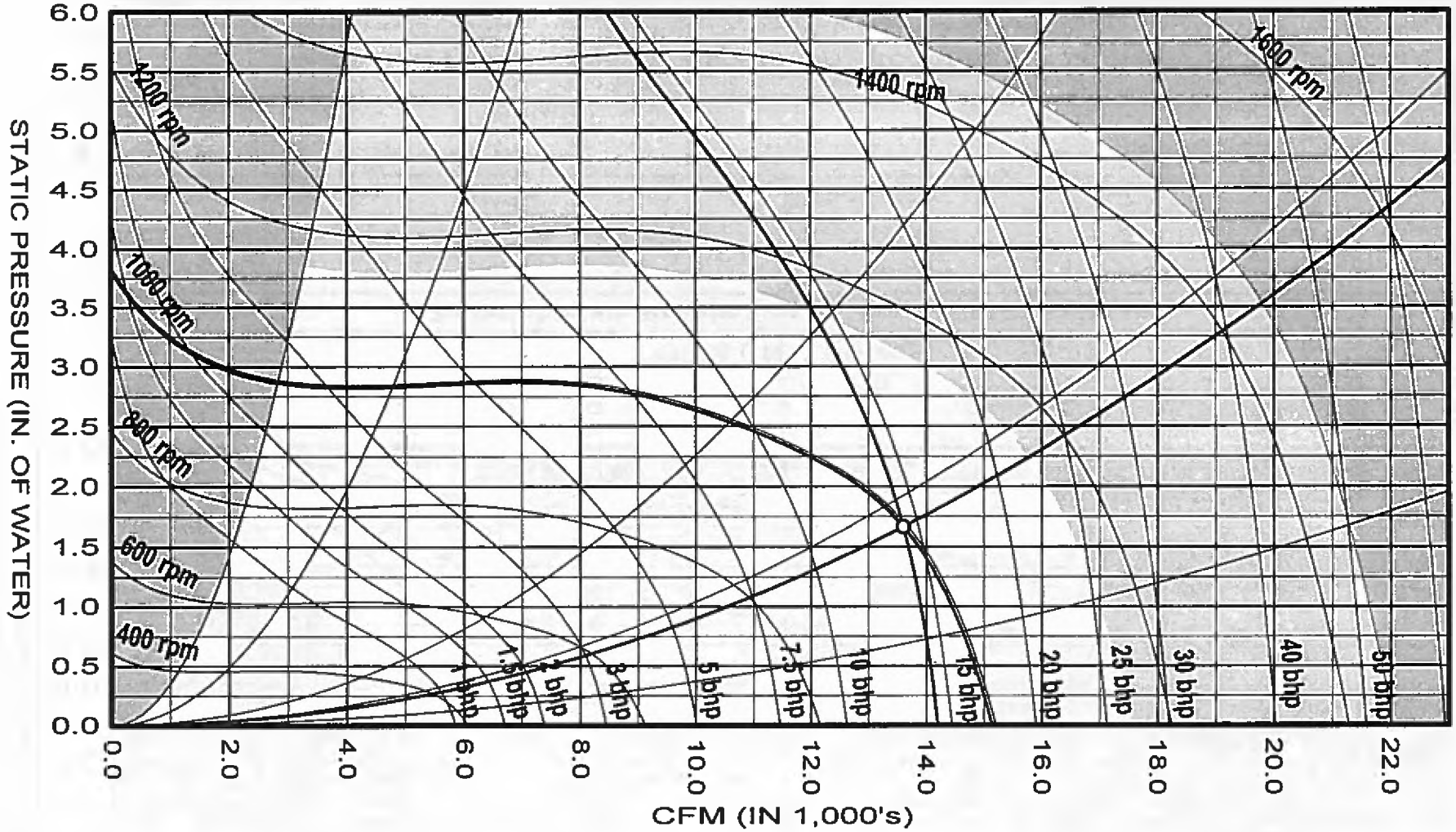
McQUAY INTERNATIONAL FAN SELECTION



24.00" Airfoil Supply Fan at Standard Conditions					
Air volume	16000	cfm	Fan speed	2198	rpm
Total static	7.59	insWg	Max speed	2255	rpm
Brake horsepower	26.3	bhp	Efficiency	72.7	%
Unit tagging	AHU-1		Date	26-June-2003	
Job name	Mammoth Court House		Time	16:38	

Supply fan performance is certified in accordance with the Central Station Air-Handling Unit Certification Program, which is based on ARI Standard 430.

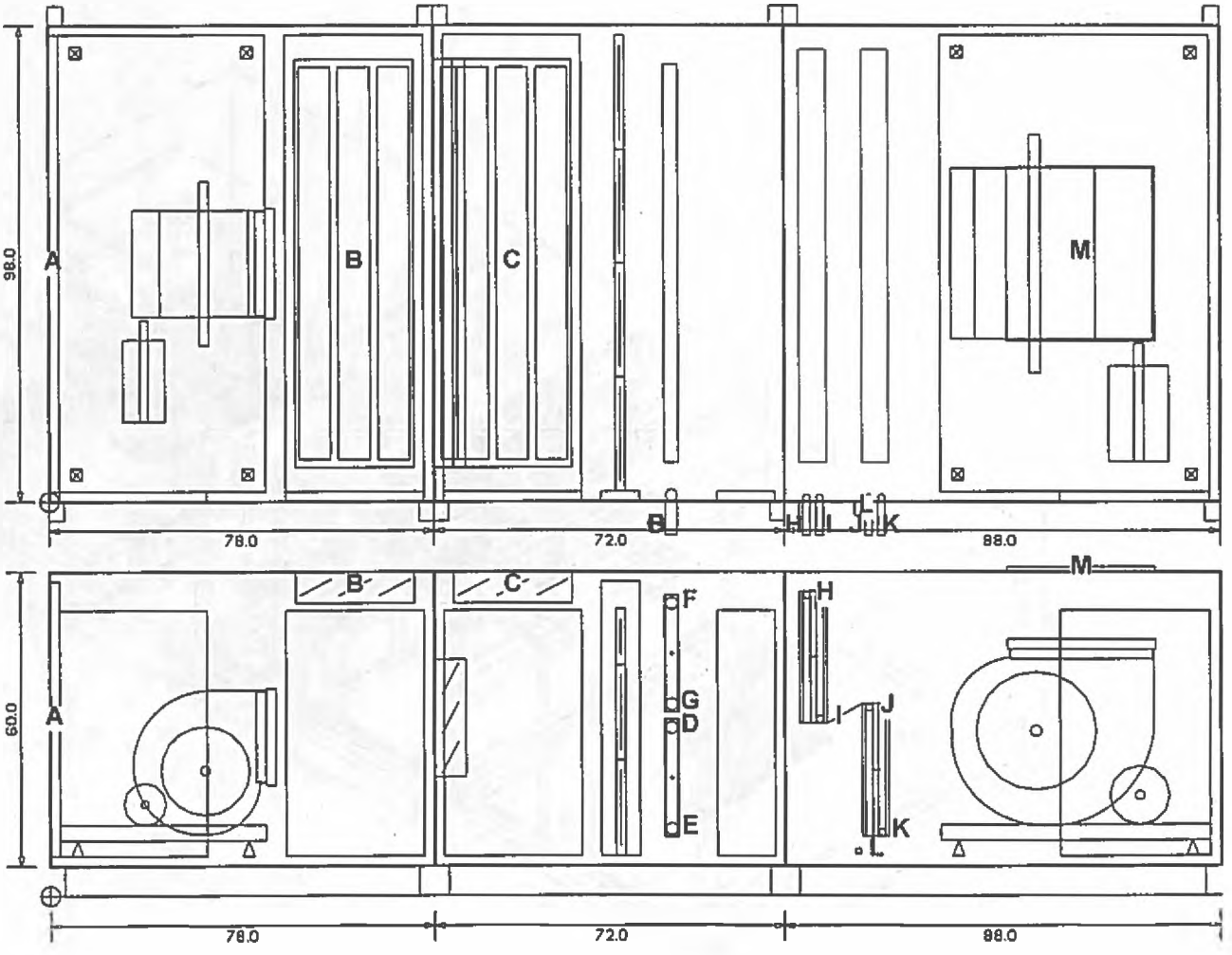
McQUAY INTERNATIONAL FAN SELECTION



18.03" Forward Curved Ret/Exh Fan at Standard Conditions					
Air volume	13600	cfm	Fan speed	996	rpm
Total static	1.67	insWg	Max speed	1450	rpm
Brake horsepower	14.3	bhp	Efficiency	25.0	%
Unit tagging	AHU-1		Date	26-June-2003	
Job name	Mammoth Court House		Time	16:38	

	Opening	X	Y	Z	W(Width)	H(Height)
A	Exhaust inlet	0.00	2.00	8.00	94.00	56.00
B	Damper	48.00	2.00	66.00	94.00	28.00
C	Damper	80.00	2.00	66.00	94.00	28.00
D	Hot water outlet	126.57	-7.00	34.05	2.50ins. MPS	-
E	Hot water inlet	126.57	-7.00	13.40	2.50ins. MPS	-
F	Hot water outlet	126.57	-7.00	59.45	2.50ins. MPS	-
G	Hot water inlet	126.57	-7.00	38.80	2.50ins. MPS	-
H	Cold water outlet	154.54	-7.00	61.19	1.50ins. MPS	-
I	Cold water inlet	157.16	-7.00	35.81	1.50ins. MPS	-
J	Cold water outlet	167.29	-7.00	38.19	1.50ins. MPS	-
K	Cold water inlet	169.91	-7.00	12.81	1.50ins. MPS	-
L	Condensate drain conn.	165.00	-2.90	9.00	1.25ins. MPS	-
M	Fan discharge	195.56	33.02	67.00	35.95	29.51

Dimensions measured from ⊕



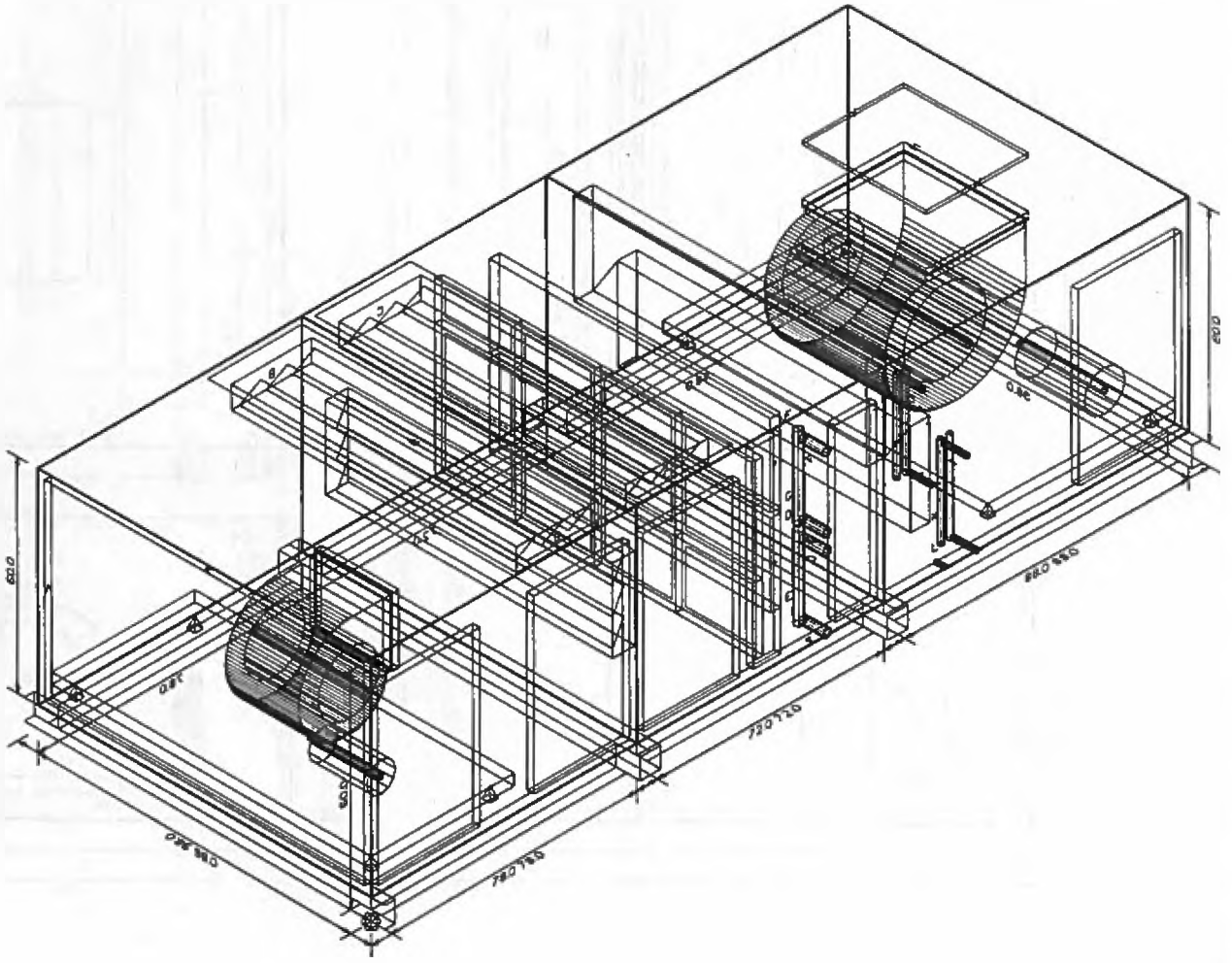
Note: Base 6.00ins deep, Cross members extend 4ins on each side of the unit.

VIEW:	General Arrangement No Ends
DRAWN:	26-June-2003 (16:38)
JOB NAME:	Mammoth Court House
UNIT TAGGING:	AHU-1
MODEL:	CAH030FDAC

McQuay Air Conditioning

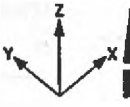
	Opening	X	Y	Z	W(Width)	H(Height)
A	Exhaust inlet	0.00	2.00	8.00	94.00	56.00
B	Damper	48.00	2.00	66.00	94.00	28.00
C	Damper	80.00	2.00	66.00	94.00	28.00
D	Hot water outlet	126.57	-7.00	34.05	2.50ins. MPS	-
E	Hot water inlet	126.57	-7.00	13.40	2.50ins. MPS	-
F	Hot water outlet	126.57	-7.00	59.45	2.50ins. MPS	-
G	Hot water inlet	126.57	-7.00	38.80	2.50ins. MPS	-
H	Cold water outlet	154.54	-7.00	61.19	1.50ins. MPS	-
I	Cold water inlet	157.16	-7.00	35.81	1.50ins. MPS	-
J	Cold water outlet	167.29	-7.00	38.19	1.50ins. MPS	-
K	Cold water inlet	169.91	-7.00	12.81	1.50ins. MPS	-
L	Condensate drain conn.	165.00	-2.90	9.00	1.25ins. MPS	-
M	Fan discharge	195.56	33.02	67.00	35.95	29.51

Dimensions measured from ⊕



Note: Base 6.00ins deep, Cross members extend 4ins on each side of the unit.

VIEW:	3-D
DRAWN:	26-June-2003 (16:37)
JOB NAME:	Mammoth Court House
UNIT TAGGING:	AHU-1
MODEL:	CAH030FDAC



McQuay® Air Conditioning

Product Manual

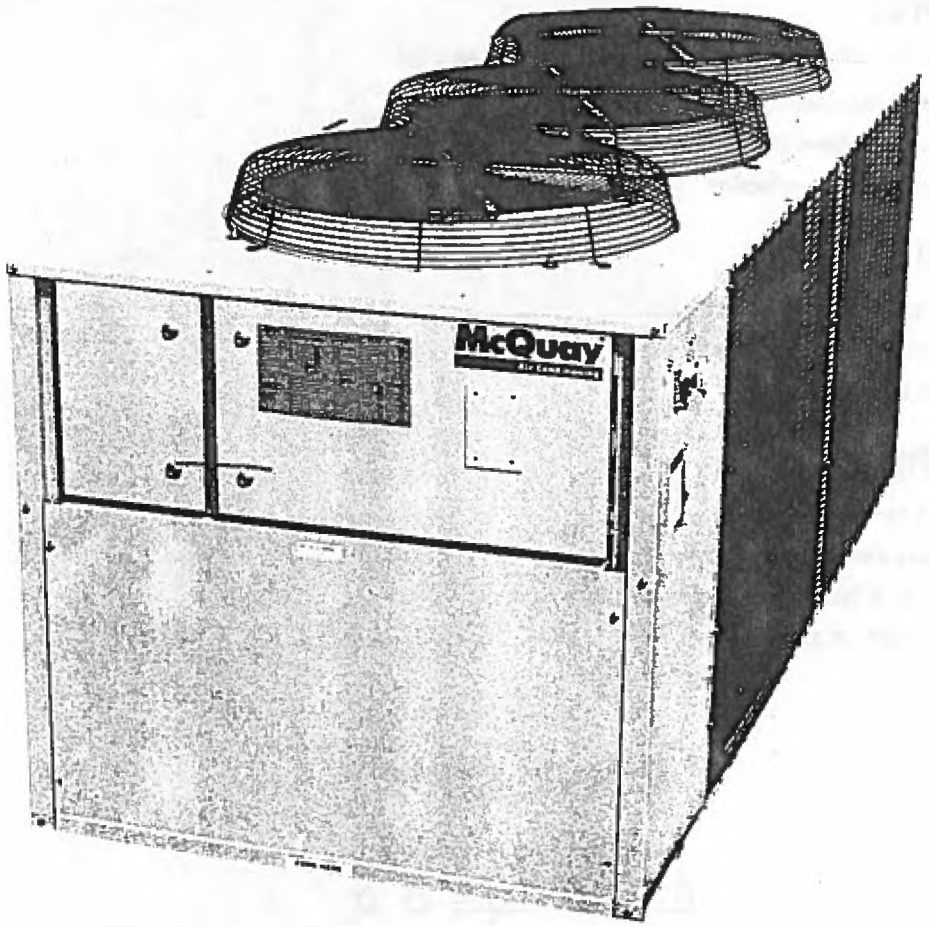
PM AGZ1

Air-Cooled Scroll Compressor Water Chillers

AGZ 010A - AGZ 034A

10 to 34 Tons, 35 to 120 kW
R-22, 60 Hertz





McQuay
Air Conditioning

Introduction

McQuay International offers a complete line of air-cooled chillers from 10 to 425 tons (35 to 1500 kW) utilizing scroll, reciprocating and rotary-screw compressors.

This manual contains information on Models AGZ 010A through AGZ 034A, 10 to 34 tons (35 through 120 kW). These units are also available with the evaporators shipped separately for remote mounting. Contact the local McQuay sales office for details.

The McQuay AGZ air-cooled chillers are a product of the McQuay commitment to offer reliable, energy efficient equipment design incorporating high quality compressors and platform components with uncompromised operating efficiency.

ARI Standard 550/590-98 Certified

Efficiency

- Meets or exceeds ASHRAE 90.1-1999 efficiency standard
- Oversized condenser coils
- Copeland Compliant Scroll® compressors
- Maximum capacity reduction

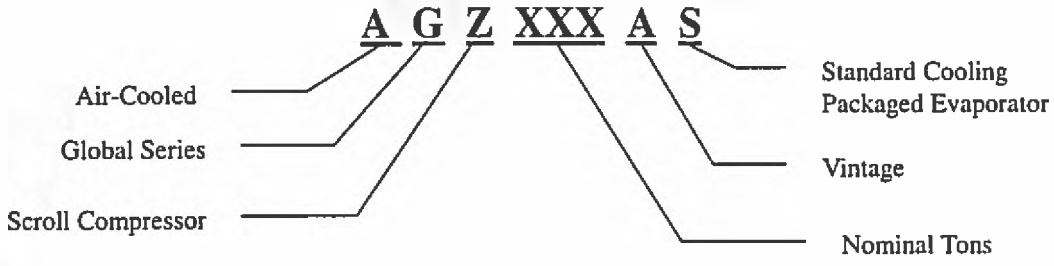
Reliability

- Rugged, proven compressor design
- Microprocessor operating and equipment protection controls
- Code and agency approval

Flexibility

- Complete factory assembly
- Seven sizes available from 10 to 34 tons
- Wide range of factory- and field installed-options
- Stock available in all sizes

MODEL CODE



Standard Construction

Construction

The AGZ 010A through 034A air-cooled water chillers are factory assembled and mounted on heavy-gauge steel channel base. This base distributes the unit weight for more even roof loading.

Compressors

All models use Copeland's Compliant Scroll® tandem compressors. These rugged hermetic compressors are constructed with an integral cast iron frame, cast iron scrolls, three Teflon® impregnated bearings, and three oil filtration devices for each compressor.

Using Copeland Compliant Scroll tandems provides two steps of modulation. One or both compressors can run, depending on the load of the system, resulting in part-load efficiency that is greater than full-load efficiency. Oil migration is controlled with two specially designed oil and gas equalization lines.

The design also offers radial and axial compliance (no tip seals), a large internal volume for liquid handling, a removable suction screen, and a rotary dirt trap and oil screen. In addition, the compressor is self-compensating for wear, handles liquid and debris, and inherently yields the highest efficiency for its class.

The compressor includes a solid-state motor protection module (Models AGZ 013 through 034 and internal power breakage on the AGZ 010) four individual motor-winding sensors, a patented internal discharge temperature probe, and a patented shutdown feature that prevents reverse rotation. An internal discharge check valve helps prevent shutdown noise and comes standard with high- and low-pressure taps with Shrader valves, a sight glass, an oil level adjustment valve, and an off-cycle crankcase heater.

Condenser Coils

Condenser coils have internally enhanced, seamless copper tubes arranged in a staggered row pattern. The coils are mechanically expanded into McQuay's lanced and rippled aluminum fins with full fin collars. Copper fins and coated fins are available options. Coil guards providing fin protection are standard equipment.

Condenser Fans and Motors

Multiple direct-drive propeller fans operate in formed bell-shaped orifices at low tip speeds for maximum efficiency and minimum noise and vibration. A heavy-gauge close mesh fan guard protects each fan.

Each condenser fan has a heavy-duty, three-phase TEAO motor with permanently lubricated ball bearings and inherent overload protection. Optional SpeedTrol motors are weather-protected.

Evaporator

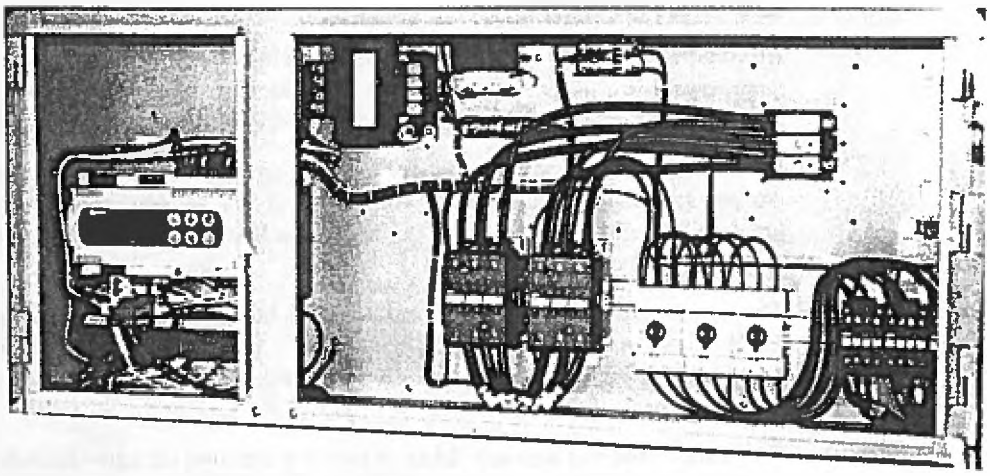
The evaporator is a compact, high efficiency, single circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates.

The evaporator is protected with an electric resistance heater and insulated with 3/4"(19mm) thick closed-cell polyurethane insulation. This combination provides freeze protection down to -20°F (-29°C) ambient air temperature.

The water side working pressure is 350 psig (2413 kPa). Evaporators are designed and constructed according to, and listed by, Underwriters Laboratories (UL).

Electrical Control Center

Operating controls, equipment protection controls, and motor starting equipment are factory wired, operationally tested, and ready for service. A state-of-the-art microprocessor with a 4-line by 20-character liquid crystal display provides the operating and protection functions. Across-the-Line compressor starters, fan contactors, evaporator heater fusing, control power transformer, and FanTrol discharge pressure control to 35°F are included as standard. Power and control components are housed in separate compartments, each with its own door.



Control System

The MicroTech II™ advanced DDC chiller controller surpasses all other microprocessor-based chiller control systems available today on this class of equipment. This powerful, user-friendly control system provides the flexibility and performance needed for a stand-alone unit as well as multiple units tied into a network system.

MicroTech II's state-of-the-art design will not only permit the chiller to run more efficiently, but will also simplify troubleshooting if a system failure occurs. Every MicroTech II controller is programmed and tested prior to shipment to provide a trouble-free start-up.

Operator-friendly

The MicroTech II menu structure is separated into four distinct categories which provide the operator or service technician with a full description of current unit status, control parameters, and alarms. Security protection helps prevent unauthorized changing of the setpoints and control parameters.

MicroTech II continuously performs self-diagnostic checks, monitoring system temperatures, pressures and protection devices, and it will automatically shutdown a compressor, a refrigerant circuit or the entire unit if a fault occurs. The cause of the shutdown will be retained in memory and can be easily displayed in plain English or metric units for operator review. The MicroTech II chiller controller can also retain and display the time the fault occurred and the operating conditions that were present at the time of the fault, which is an extremely useful feature for troubleshooting. In addition to displaying alarm diagnostics, the MicroTech II chiller controller also provides the operator with a warning of pre-alarm conditions.

Staging

The two scroll compressors are staged on and off as a function of leaving chilled water temperature. Lead/lag is automatic and switched every ten starts.

Equipment Protection

The unit is protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms activate an alarm signal.

Shutdown Alarms

- No evaporator water flow
- Low evaporator pressure
- High condenser pressure
- Motor protection system
- Phase voltage protection (Optional)
- Outside ambient temperature
- Evaporator freeze protection
- Sensor failures

Limit Alarms

- Condenser pressure stage down, unloads unit at high discharge pressures
- Low ambient lockout, shuts off unit at low ambient temperatures
- Low evaporator pressure hold, holds stage #1 until pressure rises
- Low evaporator pressure unload, shuts off stage #2

Unit Enable Selection

Enables unit operation from either local keypad, digital input, or BAS

Unit Mode Selection

Selects standard cooling, ice, glycol, or test operation mode

Analog Inputs

- Reset of leaving water temperature, 4-20 mA

Digital Inputs

- Unit off switch
- Remote start/stop
- Flow switch
- Ice mode switch, converts control operation and setpoints for ice production
- Motor protection

Digital Outputs

- Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
- Evaporator pump; field wired, starts pump when unit is set to start

Condenser fan control

Control of condenser fans is provided by the MicroTech II controller. The control steps condenser fans based on discharge pressure.

Building Automation System (BAS) Interface

The following BAS protocols are supported:

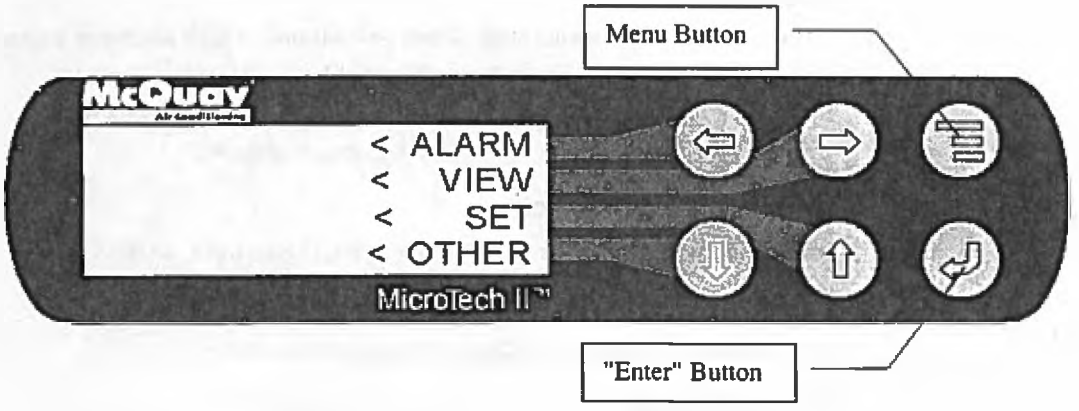
- BACnet®
- LonMark®

The following functions are generally available depending on the application and protocol in use:

- Enable/disable operation
- Select operating mode
- Set chilled water setpoint
- Set the network limit variable
- Read all digital and analog inputs and outputs
- Read operating mode and status
- Send a description of each alarm when it occurs

Keypad/Display

A 4-line by-20 character/line liquid crystal display and 6-key keypad is mounted on the unit controller. Its layout is shown below.



The four arrow buttons (UP, DOWN, LEFT, RIGHT) have three modes of use.

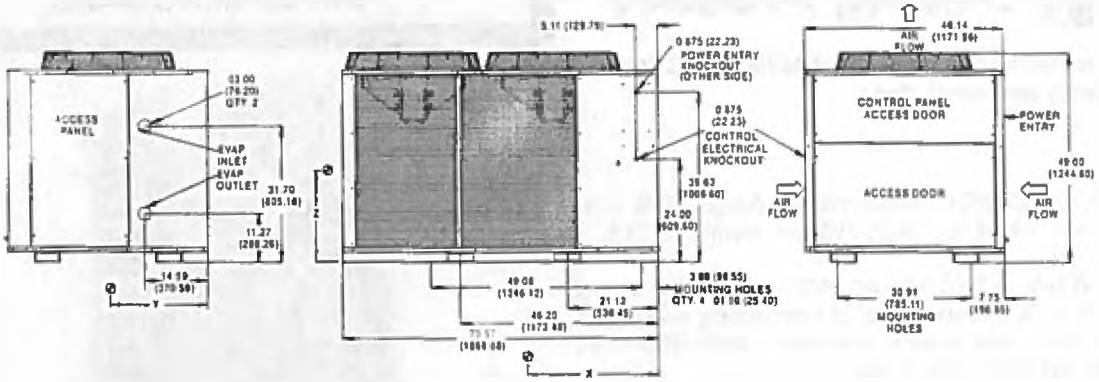
- Scroll between data screens as indicated by the arrows (default mode).
- Select a specific data screen in a hierarchical fashion using dynamic labels on the right side of the display (this mode is entered by pressing the MENU button).
- Change field values in edit mode.

Refrigerant Piping

Includes insulated suction line, sealed filter-drier, sightglass, solenoid valve, expansion valve, charging valves and relief valves.

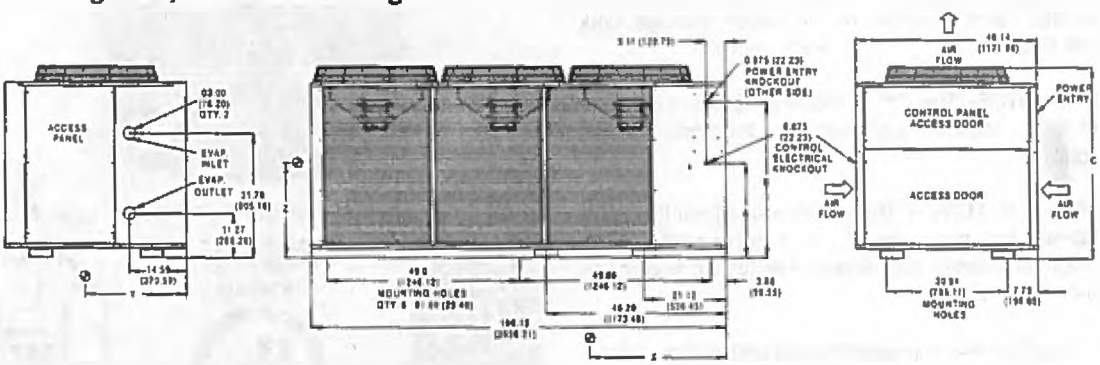
Dimensional Data

Figure 3, AGZ 010A through 017A



AGZ Unit Size	Center of Gravity Inches (mm)			Evaporator Connection Size Inch Victaulic
	X	Y	Z	
AGZ 010	27.80 (706.12)	22.70 (576.58)	19.20 (487.68)	2
AGZ 013	24.30 (617.22)	22.50 (571.50)	19.10 (485.14)	2
AGZ 017	24.40 (619.76)	22.40 (568.96)	19.10 (485.14)	2

Figure 4, AGZ 020A through 034A



AGZ Unit Size	Dimensions Inches (mm)			Center of Gravity Inches (mm)			Evaporator Connection Size Inch Victaulic
	A	B	C	X	Y	Z	
AGZ 020	24.00 (609.60)	39.63 (1006.60)	50.75 (1289.05)	33.80 (858.52)	22.40 (568.96)	20.20 (513.08)	2
AGZ 025	24.00 (609.60)	39.63 (1006.60)	50.75 (1289.05)	33.70 (855.98)	22.20 (563.88)	20.10 (510.54)	2
AGZ 029	33.00 (838.20)	47.63 (1209.80)	58.75 (1492.25)	36.50 (927.10)	23.10 (586.74)	22.60 (574.04)	2
AGZ 034	33.00 (838.20)	47.63 (1209.63)	58.75 (1492.25)	35.00 (889.00)	23.10 (586.74)	21.40 (543.56)	2

A.O.SMITH

Energy Saving Product

CYCLONE XHE™

99% EXTRA HIGH EFFICIENCY
TANK-TYPE WATER HEATER
BTH-300 AND BTH-400

Exceeds the minimum requirements of ASHRAE/IES 1999 for thermal efficiency and standby loss.

FEATURES

99% THERMAL EFFICIENCY - Fully condensing design is 21% more efficient than the ASHRAE/IES 90.1b-1992 requirement of 78%.

FLEXIBLE VENTING – 4" PVC, ABS or CPVC pipe is recommended. The CYCLONE XHE™ vents vertically, horizontally and is also approved for direct vent sealed combustion applications. 80 equivalent feet maximum using 4" vent.

ADVANCED ELECTRONIC CONTROLS – A microprocessor controls the ignition and thermostat allowing precise setting of water temperatures from 80°F to 180°F. A digital display panel shows the operating mode, all user settings and any failure modes for ease of service.

PRESET POWER BURNER – Developed for the CYCLONE XHE™, a turbulent jet flame shoots down the submerged combustion chamber in a spiral action. This turbulence causes a thorough mixing of the gas and air for optimum combustion and high heat transfer efficiencies.

SUBMERGED COMBUSTION CHAMBER – Submerging the combustion chamber in the center of the water storage tank minimizes radiant heat loss and improves efficiency.

ZERO INCH CLEARANCE – The CYCLONE XHE™ jacket is cool and is approved for zero inches to combustibles for unsurpassed installation flexibility.

SPIRAL WOUND FLUE TUBE – The continuous spiral flue tube keeps the hot combustion gases moving at a high velocity. The combination of high turbulence and velocity causes an enormous rate of heat transfer into the water.

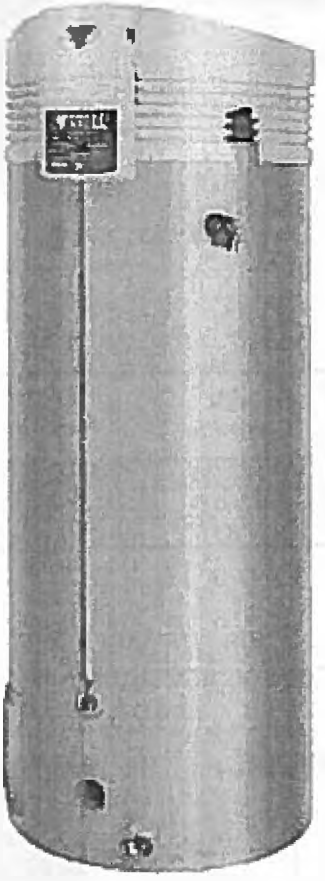
SCALE FREE – This flue design prevents scale and sediment from forming on the flue tube and reducing efficiency over time.

GLASS LINED TANK – Proprietary ceramic coating developed by A.O. Smith's ceramic engineers specifically for this heater is applied after the complete tank has been assembled to give a seamless barrier against corrosion by hot water. The maximum working pressure is 160 psi.

HANDHOLE CLEANOUT – Allows easy inspection and cleaning of the tank.

FOAM INSULATION – Thick foam insulation protected by a heavy gauge steel jacket contributes to low standby losses.

EASY INSTALLATION – All components are factory assembled and 100% tested prior to shipment. Only gas, water, electrical and venting connections need to be made. No major field adjustments are required for proper operation. Includes T&P valve and drain valve.



SCAQMD Approved, Rule 1146.2 Low NOx

SANITATION CLASSIFIED UL

ASME
(OPTIONAL)

c UL us

L W

AGENCY APPROVALS PENDING FINAL CERTIFICATION

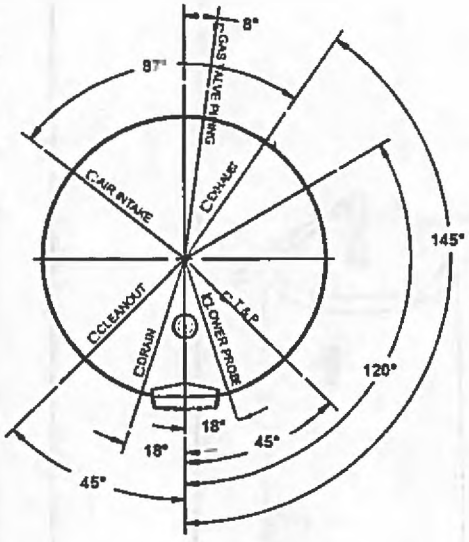
LIMITED WARRANTY OUTLINE

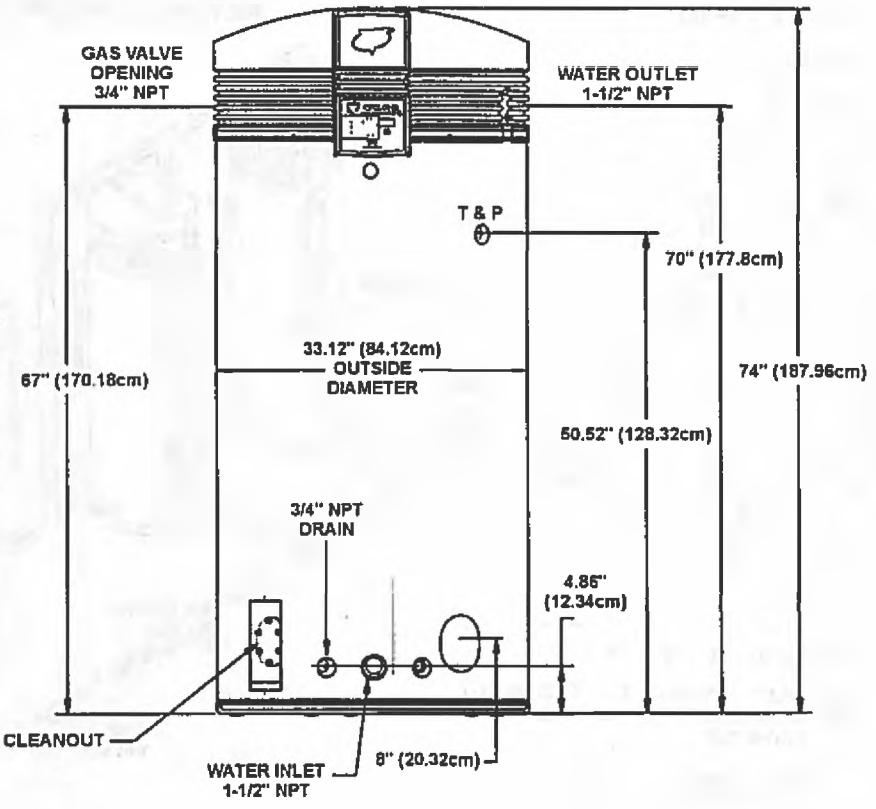
If the tank assembly which includes the combustion chamber and flue should leak any time during the first three years, under the terms of the warranty, A.O. Smith will furnish a replacement tank assembly. Installation, labor, handling and local delivery are extra. **THIS OUTLINE IS NOT A WARRANTY.** For complete information, consult the written warranty or A.O. Smith Water Products Company.

Warranty does not apply to product installed outside of the United States of America or its territorial possessions and Canada.

PATENTS PENDING

ROUGH-IN DIMENSIONS





RECOVERY CAPACITIES

				U.S. Gallons/Hr and Litres/Hr at TEMPERATURE RISE INDICATED																	
MODEL	BTUH	INPUT KW	Approx. Capacity	F°	20F°	30F°	35F°	40F°	50F°	54F°	60F°	70F°	72F°	80F°	90F°	100F°	108F°	110°	120F°	125F°	130F°	140F°
				C°	11.1C°	16.6C°	20C°	22.2C°	27.7C°	30C°	33.3C°	38.8C°	40C°	44.4C°	50C°	55.5C°	60C°	61.1C°	66.6C°	70C°	72.2C°	77.7C°
BTH-300	300,000		130 US Gals.	GPH	1800	1200	1000	900	720	667	600	514	500	450	400	360	333	327	300	286	277	257
		88	227 Litres	LPH	6814	4543	3785	3407	2726	2525	2271	1946	1893	1703	1514	1363	1261	1238	1136	1083	1049	973
BTH-400	400,000		130 US Gals	GPH	2400	1600	1333	1200	960	899	800	686	667	600	533	480	444	436	400	381	369	343
		88	227 Litres	LPH	9085	6057	5046	4543	3634	3365	3028	2597	2525	2271	2018	1817	1681	1650	1514	1442	1397	1298

Recovery capacities are based on heater performance at 99% thermal efficiency.

GAS VALVE PIPING	
BTH-300	3/4" NPT
BTH-400	3/4" NPT

INSTALLATION CLEARANCES

Sides	0"
Front	Alcove
Rear	0"
Top	2"

Combustible clearances 0".

GAS SPECIFICATIONS

GAS SUPPLY — MINIMUM 6.2" W.C.
MAXIMUM 11" W.C.

1" MINIMUM GAS SUPPLY LINE
MANIFOLD PRESSURE 5" W.C.

ELECTRICAL SPECIFICATIONS

120 VOLTS AC

BLOWER	2.2 AMPS FL
IGNITER	3.5 AMPS
PUMP	.53 AMPS

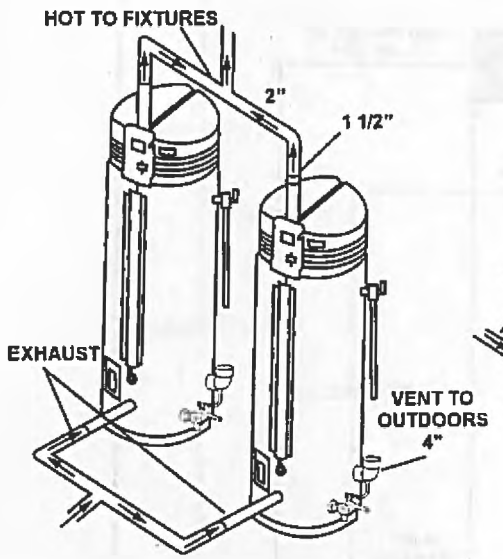
AIR INTAKE 4" PVC, CPVC, ABS,
80' EQUIVALENT MAXIMUM.

80' EQUIVALENT MAXIMUM.

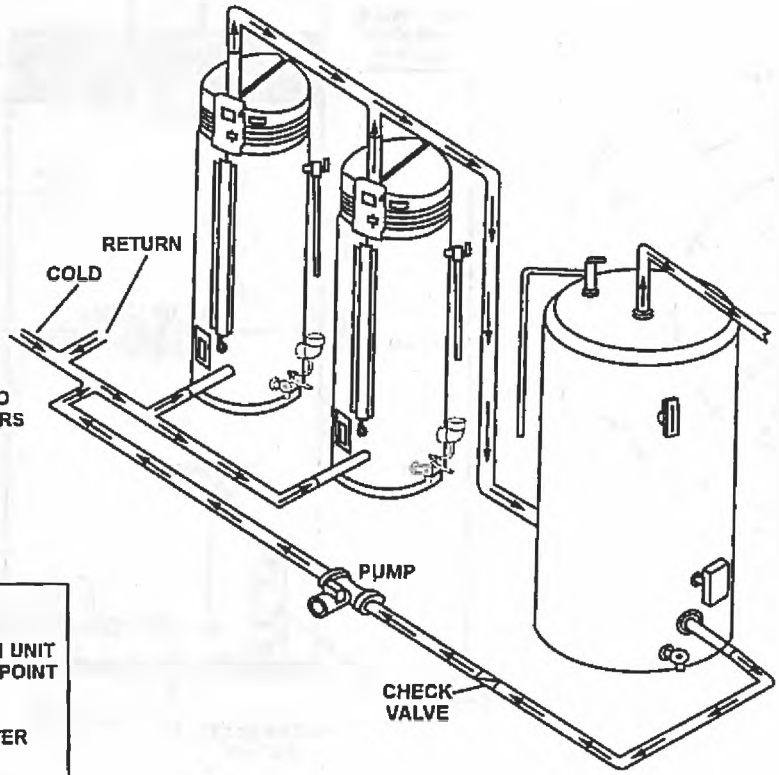
INTAKE AND EXHAUST TERMINALS
ARE 3" PVC.

MULTIPLE UNIT - WATER PIPING

PARALLEL PIPING



REVERSE RETURN PIPING



NOTES APPLY TO ALL SYSTEMS:

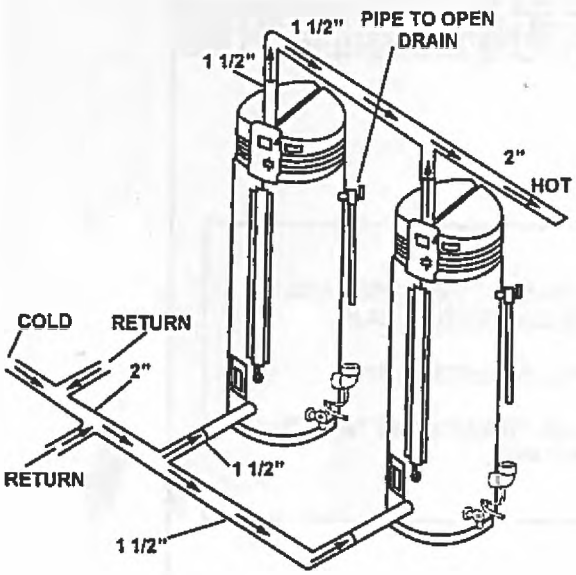
*ADD GATE VALVES TO INLET AND OUTLET OF EACH UNIT FOR ISOLATION FLEXIBILITY. LOCATE AT THE SAME POINT FROM TEE.

**ADD THERMAL EXPANSION TANK TO COLD WATER SUPPLY IF NECESSARY.

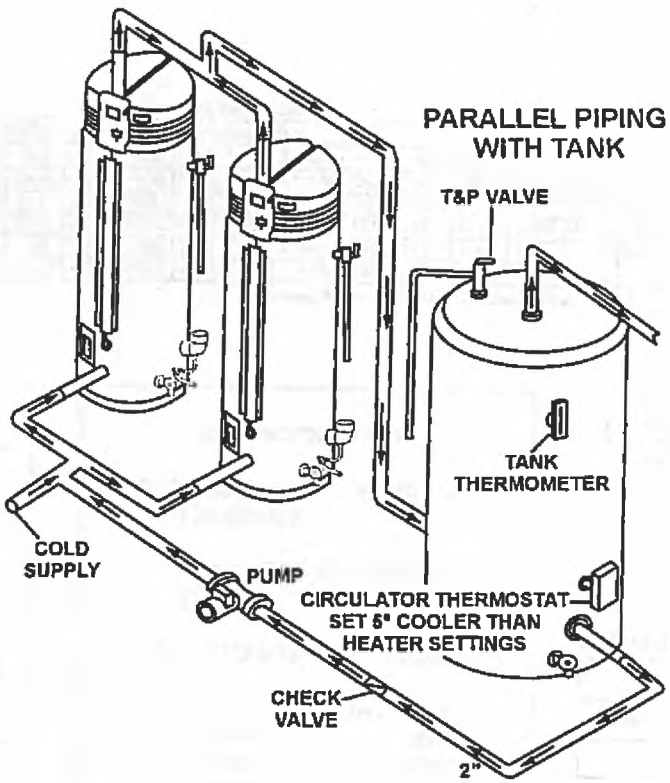
CONDENSATION HOSE MUST BE ALLOWED TO DRAIN.

NOTE: T&p VALVES MUST BE PIPED TO OPEN DRAIN OR PER LOCAL CODE.

REVERSE RETURN PIPING WITH TANK



PARALLEL PIPING WITH TANK



SPECIAL CONSTRUCTION FEATURES

All functional controls are located at the top of the heater for ease of service and protection from water damage in equipment rooms that have potential for flooding. The top cover comes off quickly to provide convenient access for all serviceable parts.

This is a fully condensing water heater. The latent heat energy which holds water in the vapor state in the combustion process is effectively scavenged. This means that water which would normally escape up the flue as vapor in a conventional heater is condensed into its liquid state prior to exiting the heater. The spiral flue tube coils downward to permit natural drainage of the condensate. As a result the flue exits at the bottom of the heater. The heater should be located near a drain to enable the condensate to be properly disposed of.

The exhaust gases of this heater are less than 140 degrees F, much lower than a standard water heater. In cold climates any water vapor remaining in the flue gases will condense into a cloud of vapor at the point where the vent system exits the building. This vapor can discolor exterior building surfaces over a period of time. The flue exhaust should be located in an area where the water vapor cloud or potential discoloration of the walls is not a concern. Locating the vent termination out from the wall by six or more inches helps prevent the vapor from being trapped in the layer of air that sometimes forms along a buildings face. The vent can also be terminated on the roof to avoid any problems. Always keep the vent above the maximum snow line so it cannot get covered up. Do not locate the exhaust above a walkway.

Avoid locating the air intake too close to the exhaust of this unit or any other exhaust terminations that discharge moisture laden air such as clothes dryers, in very cold climates. The intake can freeze over if the moisture is drawn through the screen required to prevent foreign objects from getting sucked into the fan. A separation of three feet is usually adequate to prevent intake freezing. Locate the intake above the maximum snow line also. The heater is equipped with sensors to shut it down if any blockage of the vent or intake occurs. A light on the diagnostic panel will alert the maintenance people to the problem.

Avoid locating the exhaust terminals close to bedroom windows or areas where blower noise will be objectionable. Venting into corners or confined areas will amplify the sound. Anchoring the intake or exhaust to walls or ceilings can cause noise to be transmitted to living areas. Where this must be done - use isolation mounts. Consult us if you have any questions.

SUGGESTED SPECIFICATIONS

Water Heater(s) shall be model BTH-300/BTH-400 as manufactured by A.O. Smith. Water heater(s) shall be of the seamless glass lined steel tank construction in which the glass coating is applied to the water side surfaces of the tank after the tank has been assembled and welded. The condensing flue coil shall be coated on the flue gas side with A.O. Smith's proprietary acid resistant glass lining designed for use in condensing heaters.

The heater(s) shall be suitable for venting with 4" diameter PVC pipe for a total equivalent distance of 80' equivalent feet. [*alternative venting* the heater shall be suitable for sealed combustion direct venting using a 4" diameter PVC air intake pipe and 4" diameter PVC exhaust pipe for a total distance of 80' equivalent feet of vent and 80' equivalent feet of intake.] The heater shall be factory assembled and tested. The power burner shall be of a design that requires no special calibrations on start up. The heater(s) shall be approved for 0" clearances to combustibles.

The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.

The tanks shall be foam insulated and equipped with a ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 1999.

This heater shall be listed by SCAQMD Rule 1146.2 Low NOx.

Operation of the heater in a closed system where thermal expansion has not been compensated for with a properly sized thermal expansion tank will void the warranty.

A.O. Smith Water Products Co., Inc. On Line
www.hotwater.com

For Technical Information and Automated Fax Service,
Phone: 800-527-1953

A. O. Smith
Water Products Company
Ashland City, TN
A Division of A. O. Smith Corporation

A. O. Smith Corporation reserves the right to make product changes or improvements at any time without notice.

© A. O. Smith Corp., 2003
Printed in U.S.A.