

TIMPANOGOS CAVE NATIONAL MONUMENT

VISITOR CENTER INVESTIGATION: ANALYSIS, CONCEPT, FEASIBILITY



Preservation Studies | Drachman Institute
College of Architecture & Landscape
Architecture
The University of Arizona

In conjunction with:
Desert Southwest/Cooperative Ecosystem
Studies Unit (DS/CESU)

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This site analysis and conceptual design investigation was carried out between the National Park Service (NPS) and The University of Arizona (UA) through the Desert Southwest/Cooperative Ecosystem Study Unit (DS/CESU) and Joint Ventures Agreement.

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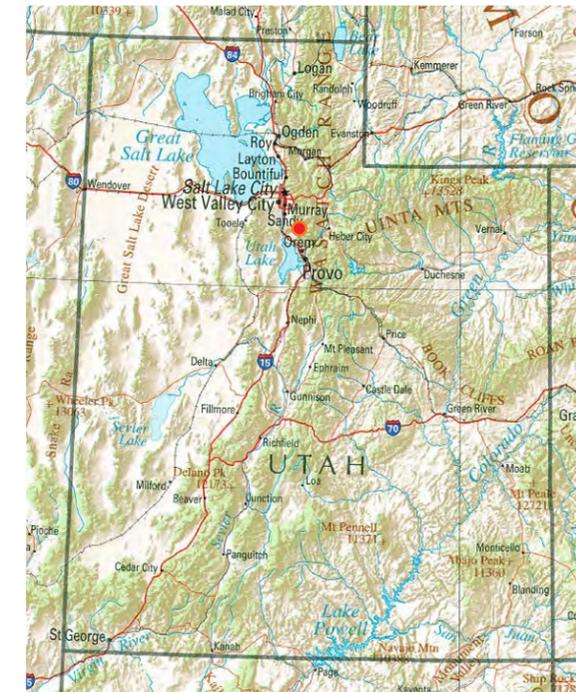
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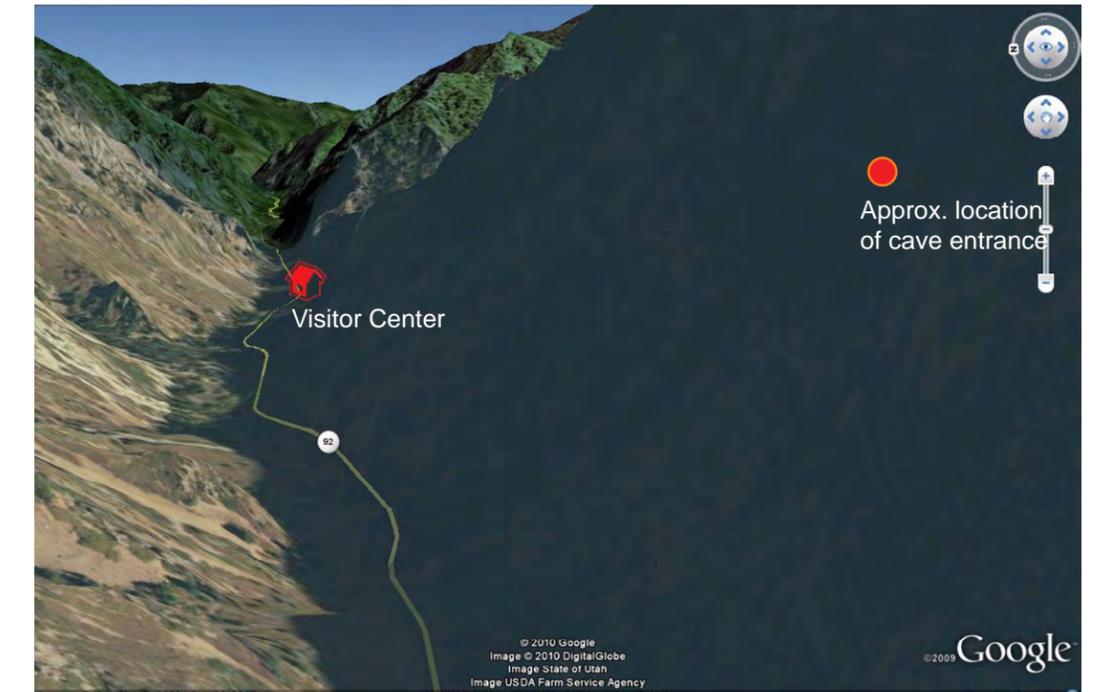
BACKGROUND

Location

The Timpanogos Cave National Monument is situated high on the south wall of American Fork Canyon in the Wasatch Mountain Range, approximately thirty-five miles southeast of Salt Lake City, Utah. The location is remarkable in terms of the beautiful setting that feels remote, yet is so close to a major metropolitan area. This proximity, coupled with the draw of the unique formations within the caves and a dedicated population of return visitors, has greatly increased the numbers of people coming to the Monument during its annual open season between May and September. In 2009, there were an estimated 130,000 visitors received at the Visitor Center, 80,000 of whom also toured through the caves. School groups are also recognized as being an important visitor demographic. Increased visitor and associated vehicle traffic are taxing the Monument's current facilities.



Monument's location SE of Salt Lake City. Map from http://www.lib.utexas.edu/maps/us_2001/utah_ref_2001.jpg



Visitor Center at the base of the south canyon wall; cave entrance high up the wall to the west. Image from Google Earth.

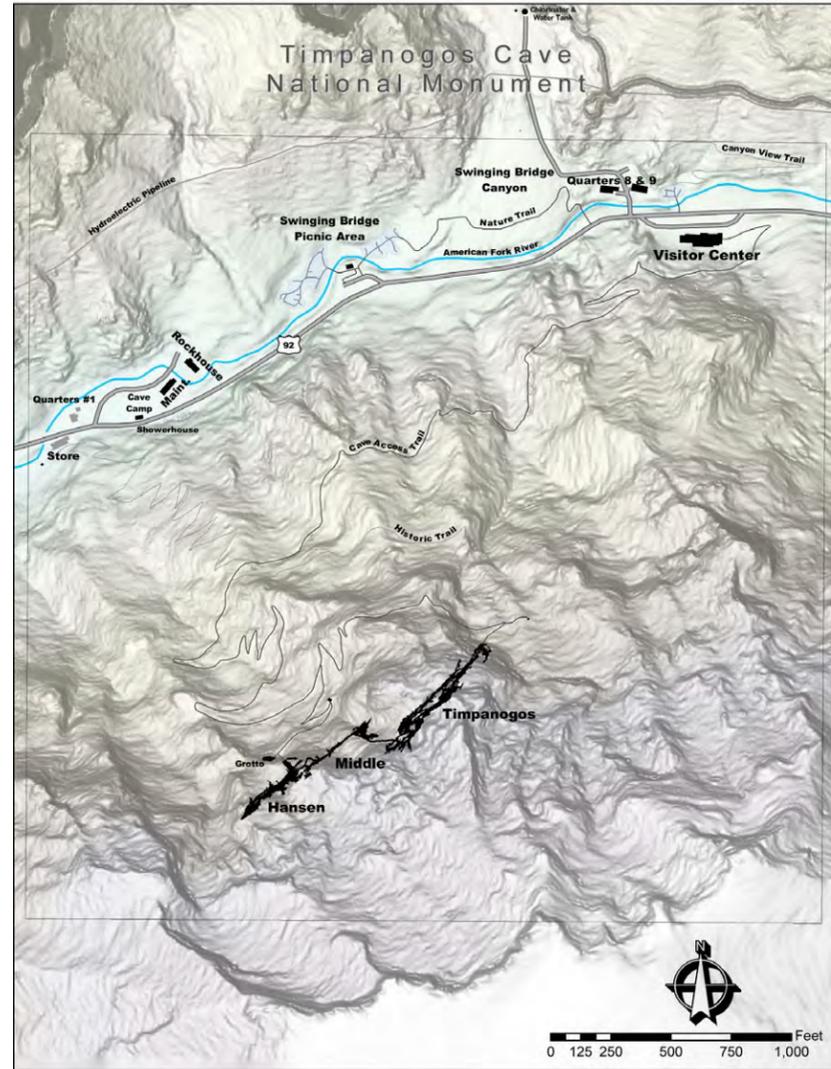
Location: Utah County, Utah. Latitude 40°27'00 N; Longitude 111°42'00 W. Visitor Center is approximately 2.7 miles from the mouth of the canyon, on the south side of Rt. 92 (American Fork Canyon Road/Alpine Scenic Hwy).

Elevation: Elevations within the Monument range from 5,480 feet to 8,050 feet above sea level.

Season of Operation: May through Labor Day

Relationship of Visitor Center to Caves: The caves are accessed by a 1.5 mile paved trail that gains 1,065 vertical feet from its start at the Visitor Center to the cave entrance. The cave system consists of three main caves: Hansen Cave, Middle Cave, and Timpanogos Cave. Each cave has its own natural entrance, but human-made tunnels connect all three. The tunnels create a one-way tour which takes about 45-60 minutes to complete with tours running every 10 minutes.

As illustrated with the graphics of this section, the Visitor Center and the caves are physically separated. However, the Visitor Center should reflect and showcase the reason for the Monument's existence: the distinctive nature of the caves and the environment that created them. It should also be realized that the Visitor Center is the cave experience for those who are not able to journey to the caves.



Major features, topography, and boundary of Timpanogos Cave National Monument. Map courtesy of Timpanogos Cave National Monument.

History and Need

The three Timpanogos caves were discovered over time between 1887 and 1921. The area was designated a National Monument by presidential proclamation in 1922 in order to preserve “unusual scientific interest and importance.”¹ Formal tours of the caves began around the same time, and facilities were developed to support this activity. As numbers of people coming to the Monument have increased over the years, so have the needs for built space. Several buildings were added during the Mission 66 program (1956-1966) of the National Park Service, including the trademark of that movement: the Visitor Center (see design drawing on the following page).

The Visitor Center served the park until 1991, when it burned down. The adjacent Mission 66 concessionaire building survives, and will be addressed in this plan. The Visitor Center itself was replaced with a modular unit. This substitution was intended to be temporary. However, the unit continues to function as the Visitor Center, and has become increasingly inadequate for both staff and visitor needs. This situation is neither sustainable nor desirable. According to Monument documents, “[the Visitor Center] is the only contact point for visitor information, education, cave tour ticket sales, book sales, and safety messages. The cave trailhead Visitor Center is essential for the operation of cave tours and service to our visitors.”²

Timpanogos Cave National Monument has a good rapport and working relationship with the Uinta National Forest (US Forest Service) which surrounds the Monument. In 2001, Congress passed the *Timpanogos Interagency Land Exchange Act* recognizing that both the National Park Service (NPS) and US Forest Service (USFS) were in need of new service and administrative facilities, agreeing that they should be combined in an Interagency Center outside the canyon.

1 NCPN Phase III Report Appendix E
2 Scope of work.



View looking south toward the current modular Visitor Center. The Mission 66 concessionaire can be seen at right. Photo Drachman Institute (DI) 2009.

Originally, the Timpanogos Cave Visitor Center functions were to be included in this interagency building. While some visitor and interpretive services are still slated to reside in the Interagency Center, it was decided that the Visitor Center should remain a separate entity at its present location at the cave trailhead. More details regarding these two facilities can be found in the “Program” section of this document. Preliminary investigations and design for the Interagency Center and Visitor Center began in 2006. Realignment of Rt. 92 near the Visitor Center for pedestrian safety was also considered. The work generated several questions regarding viability that this project seeks to address.

Scope, Goals, and Objectives

This project is intended to be a study examining various aspects of the site and potential building technologies for a new Visitor Center. As written in the scope, the chief goal of the investigation is to provide “enough information to determine whether the building techniques will be a cost effective approach or cost prohibitive.”³ To achieve this, “the UA will not conduct a detailed engineering study, but will take a more practical approach. UA will discuss the site with construction contractors...and get an estimate of what they think the costs would be.” The objectives developed by the Monument do not call for highly detailed design.

The following objectives were derived from those generated by the Monument in the agreed scope of work, with additional clarification achieved through interviews during the site visit.

For the Visitor Center at the cave trailhead, the objectives for this investigation are to:

1. Determine the extra costs of integrating the building into the hillside.
 - Excavation vs. blasting techniques
 - Maximizing area for parking
2. Determine the possibility and cost of utilizing a living roof.
 - Minimize energy needs
 - Protection from rock fall hazards
3. Determine the techniques and cost required to make the building resistant to rock fall.

4. Determine the strategies to achieve LEED Gold or better.
 - Minimize utility load (offsetting heating/cooling demands)
5. Evaluate the feasibility of designing the Visitor Center to give the feel of a cave.

³ Scope of work.

CASE STUDIES

The project team looked at several other Visitor Center facilities. Many of the cases were recommended by Monument staff as being good examples of what they would like to see accomplished at Timpanogos Cave National Monument. Each case was selected for exceptional qualities that also align with the objectives of this project. The successes and lessons learned at these other centers serve to inform the design of the Timpanogos Cave Visitor Center.



Zion National Park



Blue Ridge Parkway



Swaner EcoCenter

Zion National Park Visitor Center

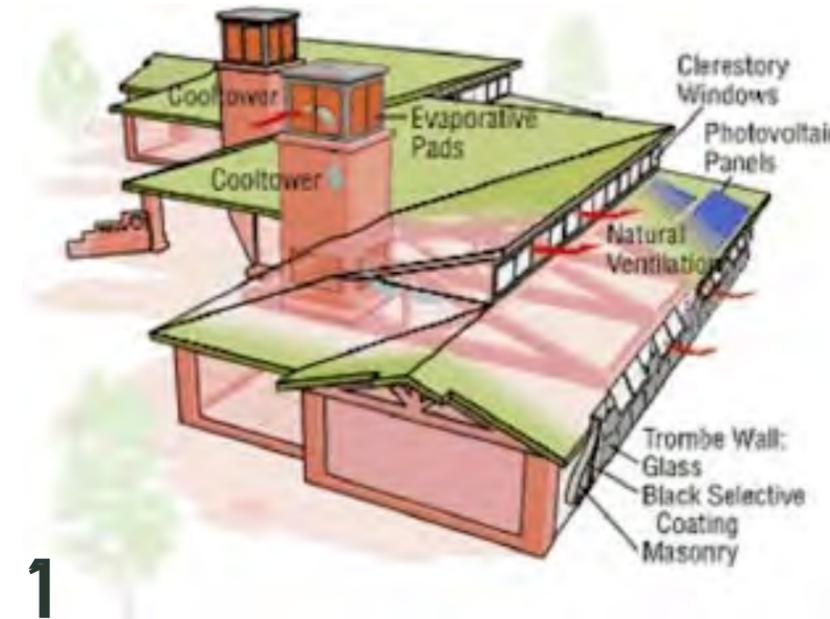
Location:	Springdale, Utah
Opened:	2000
Stats:	7,600 SF, 2.5 million visitors annually
Designers:	NPS Denver Service Center
Sustainable Design:	Environmental rating on Green Building Challenge system, cost 30% less to build than a comparable National Park Visitor Center

Goal of Design:
 “The Denver Service Center, working with the U.S. Department of Energy’s National Renewable Energy Laboratory, created a sustainable building that incorporates the area’s natural features and energy-efficient building concepts into an attractive design that saves energy and operating expenses while protecting the environment” (http://www.nps.gov/dsc/b_what/b_5_za_zion.htm).

- Elements of Design:**
- Indoor Spaces: Lobby/reception (50%), Retail general (40%), Office (5%), Restrooms.
 - Outdoor Spaces: Pedestrian/non-motorized vehicle path, wildlife habitat, parking, drives/roadway, interpretive landscape, garden decorative, shade structures/outdoor rooms.
 - Environmental Strategies: daylighting, trombe walls for passive solar heating, operable clerestory windows, downdraft cooltowers for natural ventilation cooling, energy-efficient lighting, advanced building controls, and roof-mounted photovoltaic (PV) system.
 - Transportation: clean-running propane buses shuttle the park’s visitors throughout the area and reduce traffic and the need for parking.

- Lessons Learned:**
- Incorporation of environmental design strategies: passive heating/cooling, natural ventilation, solar orientation, etc.
 - Benefits of energy modeling
 - Positive impacts from traffic mitigation/mass transit
 - Lobby/reception largest area of building
 - Importance of expanding interior space through outdoor programming and planned spaces

- Images on opposite page:**
- Diagram detailing energy-saving elements of the building design. http://www.nps.gov/dsc/b_what/b_5_za_zion.htm
 - Outdoor “rooms” for permanent displays allow for a smaller building design as well as lower capital and operation costs. http://www.nrel.gov/data/pix/collections_zion.html
 - Vents of one of the passive down-draft cooltowers inside the Visitor Center. http://www.nrel.gov/data/pix/collections_zion.html
 - Exterior of the building showing cooltower and operable celestory windows. http://www.nrel.gov/data/pix/collections_zion.html



Blue Ridge Parkway Visitor Center

Location:	Asheville, NC
Opened:	2008
Stats:	13,000 SF, \$9.8 million, 11 million visitors annually
Designers:	Lord, Aeck & Sargent (Architecture), and The Jaeger Co. (Landscape Architecture)
Sustainable Design:	LEED Gold Certified 2009, 75% in energy savings over comparable conventional buildings

Goal of Design:
 “Reflect the heritage and development of the Parkway...nestled into a hill, the building evokes a ‘tree house’ atmosphere that allows visitors to experience the majestic vistas and surrounding woodlands for which the Parkway is known. The Visitor Center is a showcase for sustainable design” (<http://www.lordaecksargent.com/>).

Elements of Design:
 Indoor Spaces: Separation of visitor and staff spaces (located on different levels), open floor plan, hands-on interpretive exhibits.

Outdoor Spaces: 10,000 SF green roof with native, drought tolerant plants, storm water runoff system that captures rainwater in two ways - a cistern, and directing water from the parking lots into a bioswale, sunken plaza area.

Site Design: Uses site topography to integrate passive solar strategies, increase water harvesting, and capture views.

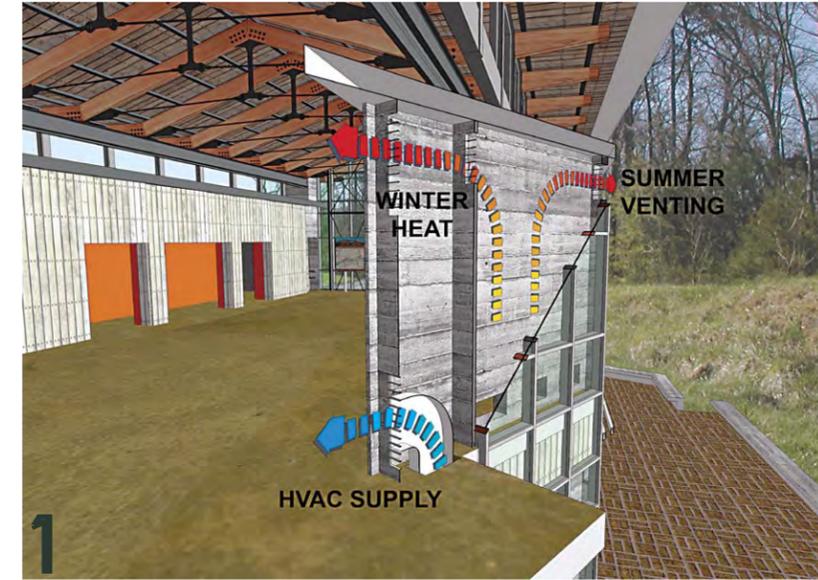
Environmental Strategies: HVAC system that uses an energy recovery unit, hydronic radiant heated floors, trombe walls for passive solar heating, operable windows for ventilation, as-needed lighting

strategies, daylighting, zero VOC paint and sealants, increased wall insulation and high-performance glazing, appropriate building orientation.

- Lessons Learned:**
- Combination of strategies needed for maximum energy savings
 - Importance of building orientation
 - Precedent for hillside integration and green roof in the NPS
 - Setting the building within landscape context
 - Incorporate rainwater harvesting

Images on opposite page:

1. Diagram detailing active and passive heating and cooling strategies integrated into building design. http://www.edcmag.com/EDC/Home/Images/edc0508_ft_8lg.jpg
2. Daylighting makes the interior pleasant and welcoming while saving energy. <http://www.pbjrconstruction.com/Images/BRPW-DC.jpg>
3. Image showing extensive green roof and scale of building (note pedestrians in foreground). http://www.romanTimpanogosCaveNationalMonumentsheville.com/images2009/parkway_visitor_center3.jpg
4. Sunken area to south of building allows broad views. Behind the windows are passive heating trombe walls. http://images.google.com/imgres?imgurl=http://farm3.static.flickr.com/2159/2184160300_c3cf728cb5_o.jpg&imgrefurl=http://flickr.com/photos/gocardusa/2184160300/&usg=__H3O2eRwo0Yv7EF2NVLgn2CSILEo=&h=3872&w=2592&sz=132&hl=en&start=55&um=1&tbnid=1VqFs0wvH14CiM:&t
5. Water harvesting: a rain chain provides an aesthetically-pleasing way to efficiently direct water from the roof to a collection point or planted area. http://images.google.com/imgres?imgurl=http://farm3.static.flickr.com/2159/2184160300_c3cf728cb5_o.jpg&imgrefurl=http://flickr.com/photos/gocardusa/2184160300/&usg=__H3O2eRwo0Yv7EF2NVLgn2CSILEo=&h=3872&w=2592&sz=132&hl=en&start=55&um=1&tbnid=1VqFs0wvH14CiM:&t



Swaner EcoCenter

Location: Park City, Utah
 Opened: 2009
 Stats: 10,000 SF
 Designers: CRSA
 Sustainable Design: LEED Platinum Certified 2009, 90% water savings and 54% energy savings over comparable conventional buildings, 75% reclaimed materials

Goal of Design:
 “Green Building that Teaches.” Our EcoCenter is a living demonstration of green building, and was designed to test new materials and energy technologies (<http://www.swanerecocenter.org/>). Swaner is an environmental education and outreach facility run by a non-profit organization founded in 1993.

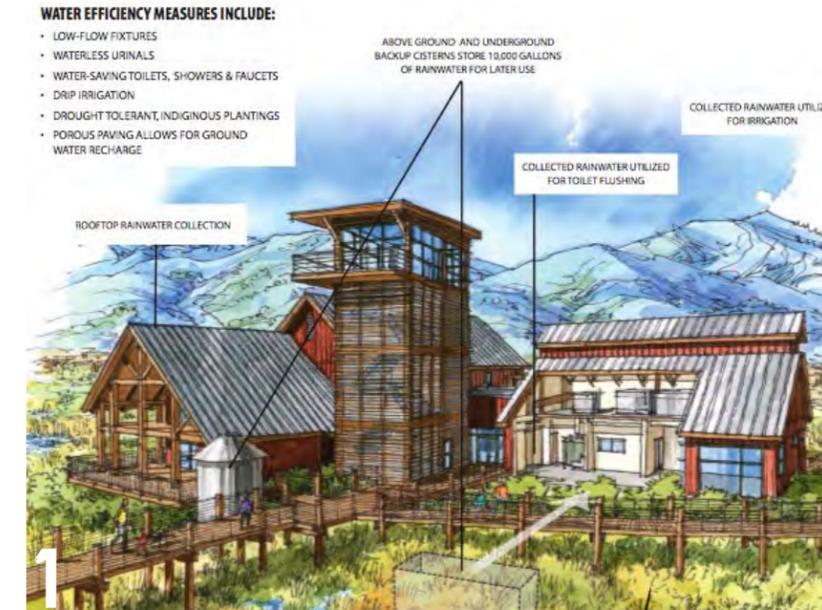
Elements of Design:
 Indoor Spaces: Exhibit space, small theater, classrooms, building gives feeling of a barn.

Outdoor Spaces: 1,200-acre nature preserve, raised boardwalk, field labs, viewing platform, drought-tolerant landscaping.

Environmental Strategies: Low-flow and waterless plumbing fixtures, year-round rooftop water collection and storage system, smart lighting, highly efficient cooling, insulation and glass, solar collection panels - heat water, provide radiant heat, melt snow and generate electricity on-site, reclaimed or rapidly renewable building resources, no formaldehyde, refrigerants, or chemicals.

- Lessons learned:
- Incorporate multiple systems that address environmental strategies
 - Positive visual and environmental impact of material choices
 - Importance of educating visitors and the methods to do so
 - Building orientation to capture viewshed
 - Visitor movement through space – changing perspectives (tower, board walk, etc.)

- Images on opposite page:
1. Diagram detailing water efficient design elements. <http://www.jetsongreen.com/2008/10/swaner-ecocente.html>
 2. Image showing the different types of recycled or renewable materials used in building finishes. <http://www.jetsongreen.com/2008/10/swaner-ecocente.html>
 3. A “truth window” shows visitors what the building is really made of; in this particular case, recycled fabric insulation. <http://www.jetsongreen.com/2008/10/swaner-ecocente.html>
 4. Exterior of the building showing its relationship to the site, including viewing tower and boardwalk. <http://www.jetsongreen.com/2008/10/swaner-ecocente.html>



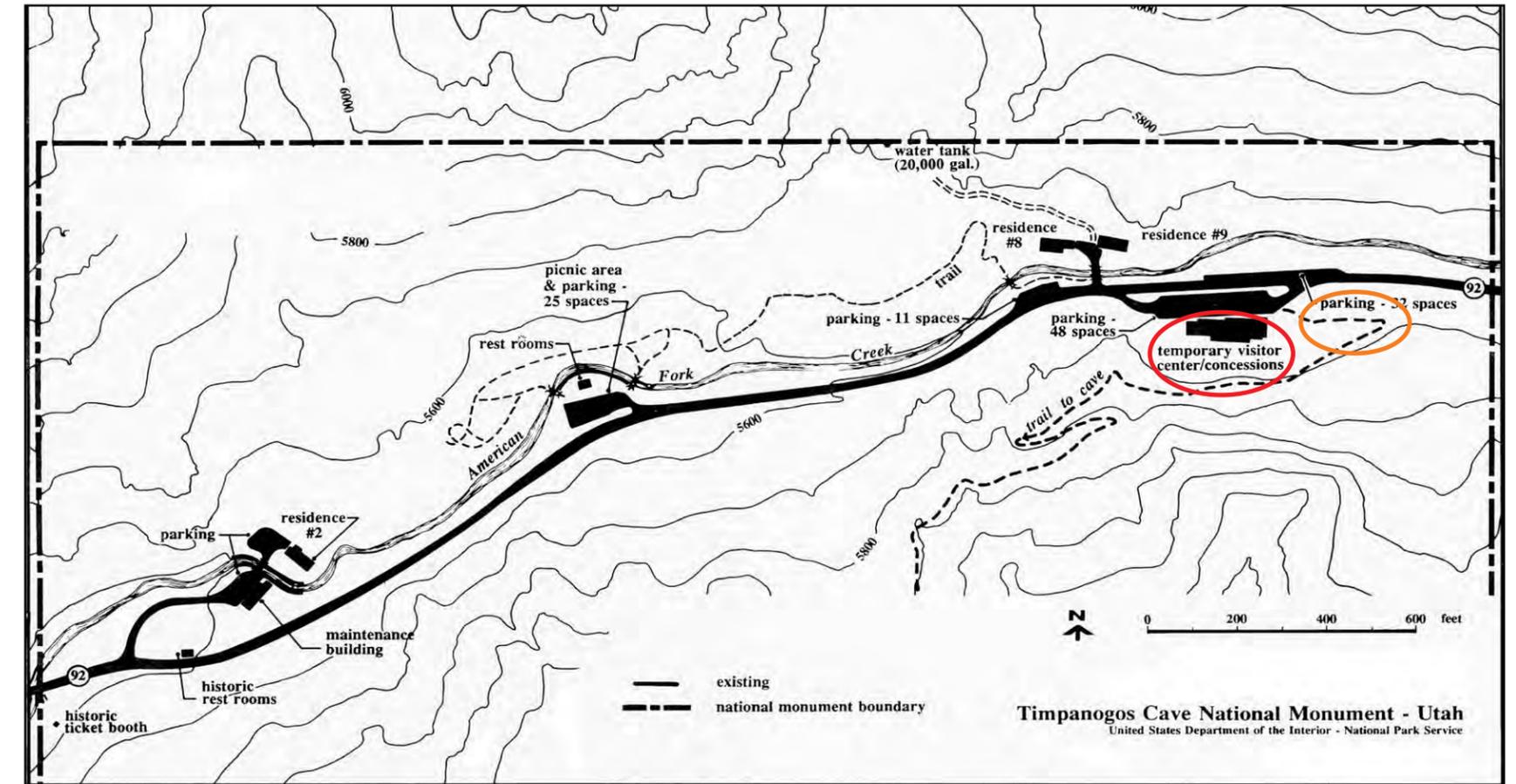
SITE ANALYSIS

Site analysis is an essential piece for both assessing project feasibility and creating design determinants. However, the site analysis has been somewhat complicated by the lack of specific information, such as an accurate site survey, topographical map, or geotechnical report. This section, therefore, will orient the reader to the site location and highlight both the challenges and opportunities identified in during the site analysis process based on the information available.

The current temporary Visitor Center sits on the site where the original Mission 66 Visitor Center was located. The location has proved problematic in that it experiences high incidence of rock fall, and does not maximize the potential for visitor parking. The Monument is aware that increasing parking is not ideal for the visitor's aesthetic experience, but is a necessary functional accommodation to increased visitor demand. A shuttle service from the proposed Interagency Center outside the canyon was evaluated by the Monument prior to this study, and was found to not be viable at present. It is the recommendation of this report that a shuttle service, such as is provided at Zion National Park, be reevaluated at the completion of the Interagency Center. Reducing parking at the Visitor Center has the potential to improve traffic flow and decrease the visual and environmental impacts of vehicles.

An alternative site was suggested by the Monument for investigation in this project. This site lies slightly to the east of the current site, on a heavily-wooded slope along the cave trail, and presents several advantages over the existing site. In order to be thorough and determine the best possibility for design, additional alternative locations were investigated as well, though ultimately declined in favor of the hillside site proposed by Timpanogos Cave National Monument.

Site Location



Existing Visitor Center Proposed Site

Partial map of the Monument showing existing and proposed site locations. Courtesy of Timpanogos Cave National Monument.

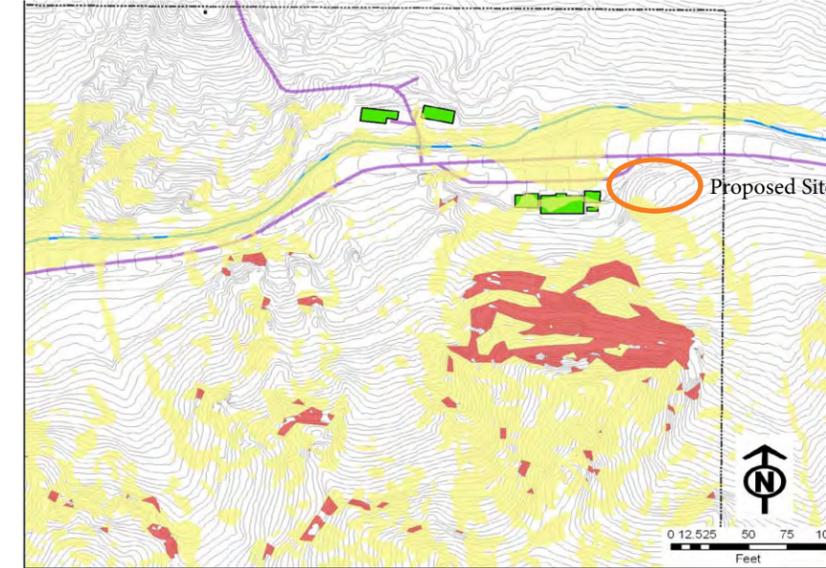
The Visitor Center is located near the eastern boundary of the Monument, just south of Rt. 92. Across the road are two residence buildings, one of which currently functions at the Monument's administrative headquarters. Future plans by the Monument call for the building to become a storage area with offices for interpretive functions, making access to it important for Monument staff. Most visitors approach the Visitor Center from the west, passing several other buildings along the way. A smaller percentage come from up-canyon to the east, and encounter the Visitor Center almost immediately after passing the Monument sign. Highly visible orientation signage and features will be important for all visitors.

Site Location



Imagery courtesy of Utah County Information Systems

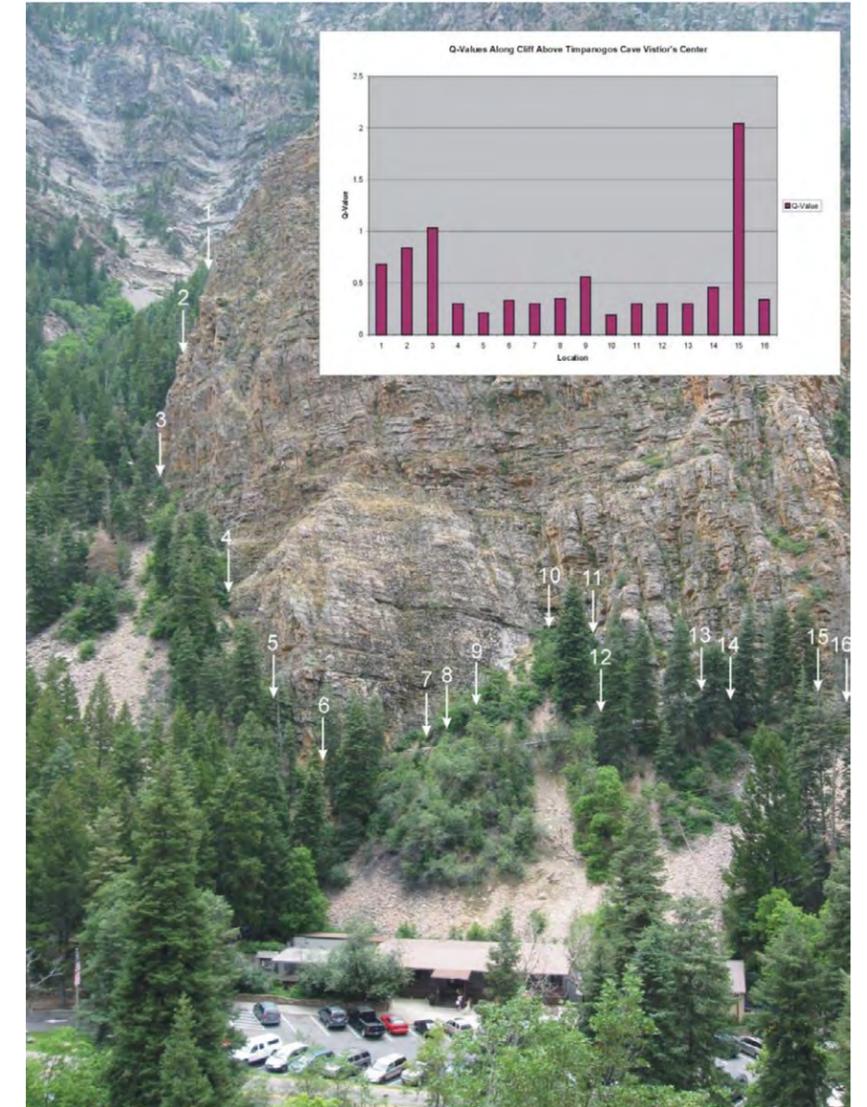
This high-resolution aerial shows approximately the same area as the map on the previous page. The American Fork River, vegetative cover, geologic formations, and Monument buildings and parking lots can be seen in relationship to each other. The Visitor Center is in the center of the image, at the base of the large rock outcropping. The aerial also highlights how narrow the bottom of the canyon is, and the limited possibilities for growth or expansion of facilities.



The above rock fall map was generated using GIS data layers created by Timpanogos Cave National Monument. It shows the current Visitor Center and two residence buildings in green. The yellow indicates a risk of rock fall, with red showing high risk areas. The current Visitor Center lies in a yellow zone, and rocks have penetrated the roof several times. The proposed site lies just out of any indicated rock fall areas. Additional alternative sites reviewed in the site analysis were situated near the river and therefore also within the designated hazard zone.

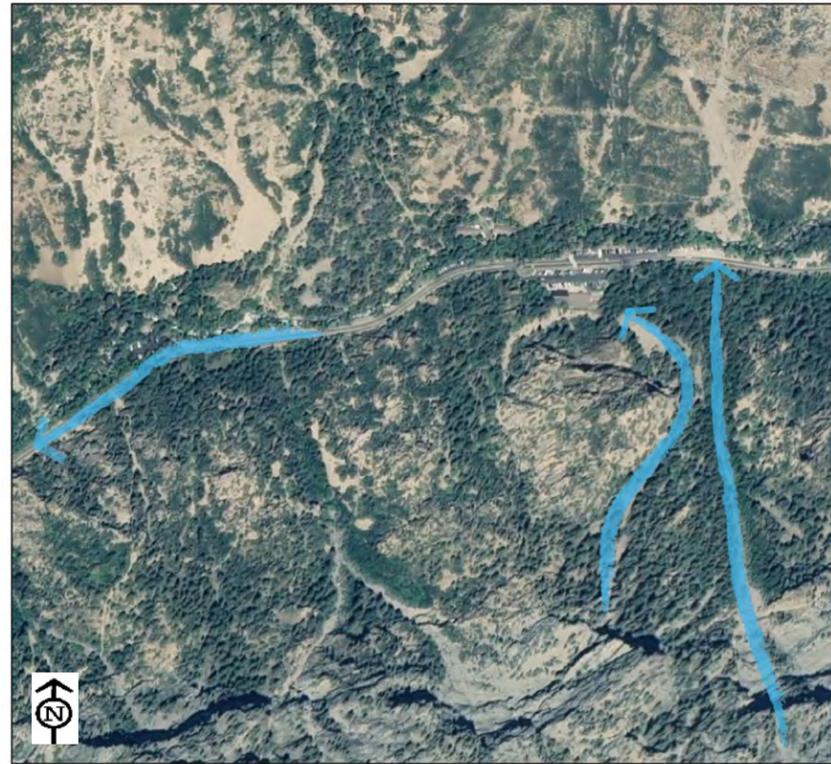
The image at right appeared in a 2009 US Geological Survey report analyzing the slope above the Visitor Center. Each numbered arrow corresponds with a bar on the chart indicating “susceptibility.” The report determined that the whole formation risks rock fall. The Visitor Center is further impacted by being in the talus runout area. These dangers may be decreased at the proposed site, which is slightly to the side of the slope face, and is protected by dense tree canopy.

Rock Fall Hazard



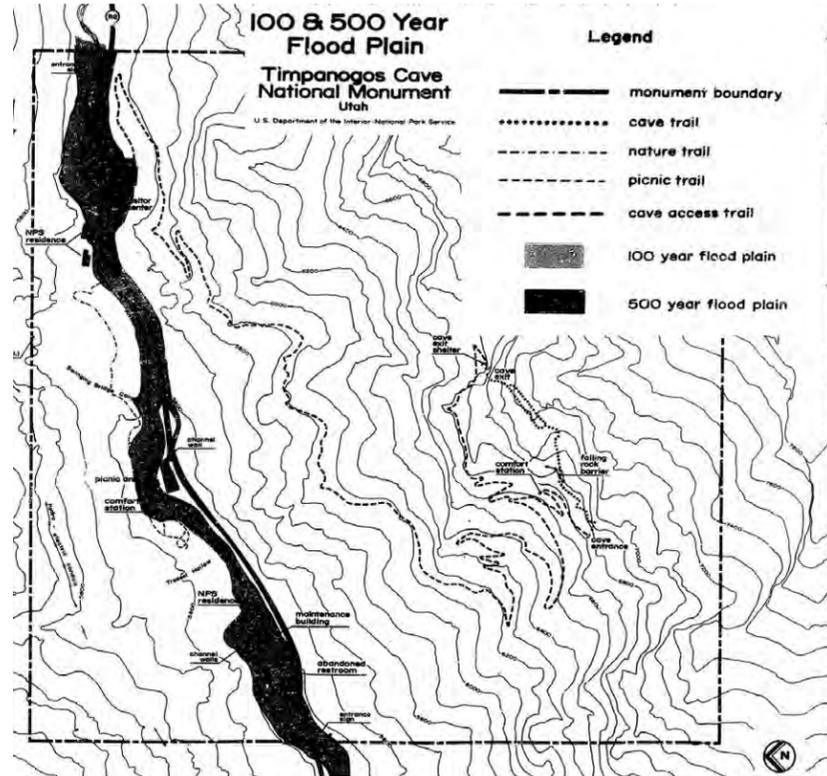
USGS Report “Rock-Fall Susceptibility of Cliffs Above Visitor Center at Timpanogos Cave National Monument, Utah”, by Edwin Harp. August 2009.

Flooding & Drainage



National Agriculture Imagery Program (NAIP) 2008 Imagery. DI flow arrows.

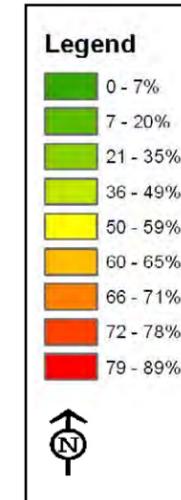
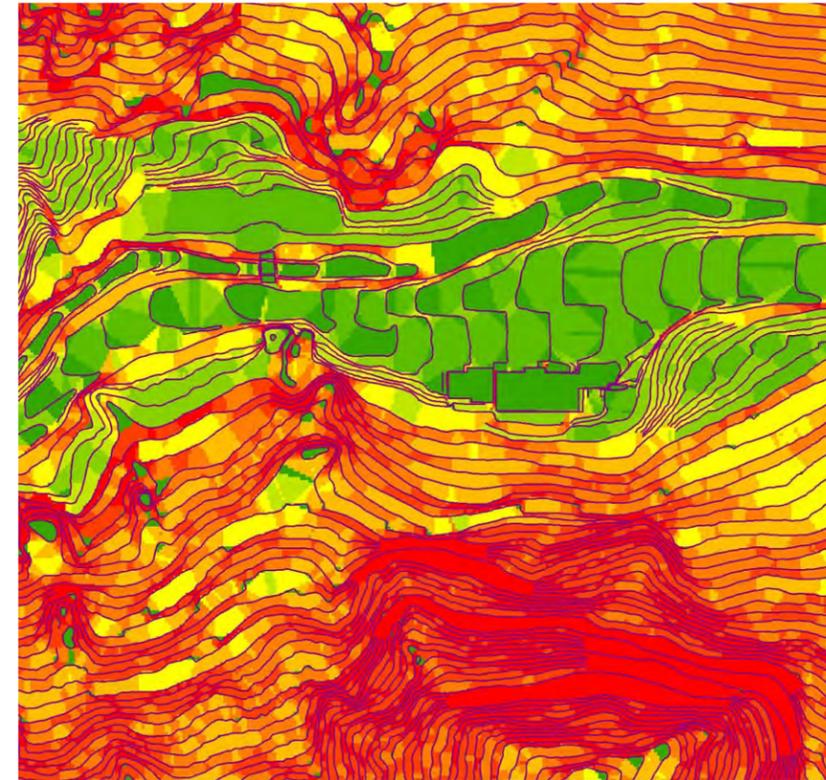
American Fork Canyon is a major drainage, containing not only the perennial flow of the American Fork River, but channeling additional water that falls up-canyon and on the canyon slopes in a rain event. It appears that water may be directed to the current Visitor Center site, but would primarily flow around the proposed site.



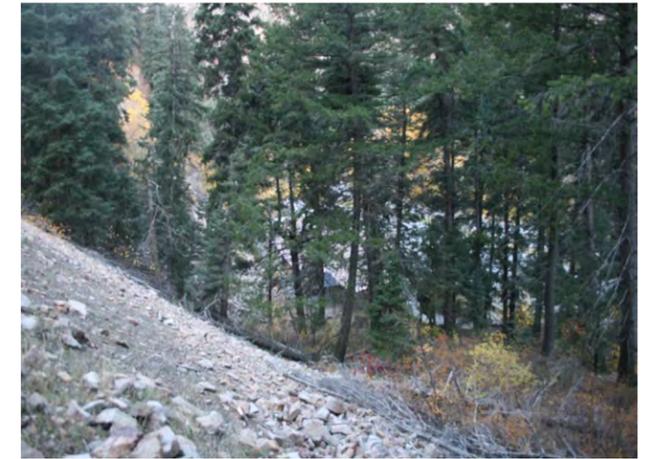
Map courtesy of Timpanogos Cave National Monument. Note that North is to the left.

The canyon is thus prone to flooding, with all of the relatively flat bottom lands lying within the 500 year flood plain. This includes the parking lot of the current Visitor Center. The flood plain imposes major restrictions, necessitating that any building be placed above the canyon floor or be raised significantly above grade.

Slope



This slope map was generated using GIS data layers created by Timpanogos Cave National Monument. The current Visitor Center footprint can be seen at the base of the geologic formation. The map demonstrates the extreme slopes that characterize the canyon, and the limited opportunities for building. Maximum buildable slope is generally considered to be 10% or less, which roughly corresponds to the darkest green areas of the figure. However, most of this area also falls within the floodplain. The proposed site, while on a hill, is not too steep to preclude construction.



Looking down the talus slope. The proposed site is slightly to right of frame; the existing Visitor Center is visible through the trees. Photo DI 2009.

In addition, the talus slope behind the Visitor Center must be considered. The proposed new site will require a geotechnical report to determine if it is composed of this fallen rock or bedrock. Though the new site is not as directly in the rock fall zone, this loose talus slope will need to be retained to ensure safety and protect the built environment from damage. Existing tree cover will provide some of this protection, but as stated in the project goals, the new building will need to incorporate strategies to withstand rock fall.

Site Survey

As previously mentioned, one challenge of this project was the need for an accurate understanding of the site buildability (soil composition, geotechnical analysis, and topography). However, as this is a conceptual study, total precision was not necessary. In order to proceed with a final architectural design, however, a full site survey by a licensed civil engineer will be needed. The Monument has begun this work by interacting with the proper specialists. The following excerpt is from a recent Timpanogos Cave National Monument summary of the preliminary findings:

Approach to Excavation of Slope for Cave Trailhead Visitor Center

To determine an appropriate approach to the excavation of the slope for the cave trailhead Visitor Center, several contractors and engineers were consulted. Each was asked how they would proceed to develop plans to excavate the slope for the Visitor Center? And, would they do seismic testing, drilling, or any other work prior to excavation to determine whether the slope was talus and soil or if there was bedrock that would need to be blasted away or special engineering or construction needed? The results of those conversations follow.

Joseph Moffat, Moffat Developments & Excavation, Alpine, UT – Site looks like it is soil and talus and there is not any bedrock or large boulders visible. From a pragmatic point of view he would probably just have a large track hoe begin excavation. If bedrock was encountered, the excavation process would have to be stopped until blasting could be completed. The blasting could be preformed via change order and the schedule would have to be altered to allow for the blasting. This would be the most cost effective approach.

Kevin Malaska, McCollough Engineering and Contracting, Salt Lake City, UT – You can't tell much by looking at the site. Cheapest approach would be to bring in a small track hoe and dig some test pits. That would give a pretty good idea if there were any bedrock problems that would need blasting. It would also allow soil samples from several depths in the test pit column. However, the best and most appropriate approach would be to drill test holes in a grid pattern to determine if any bedrock exists that may need to be blasted. This is far more expensive, but needed to eliminate uncertainty.

Scott Anderson, Applied Geotechnical Engineering Consultants, Sandy, UT – While the surface looks like it would be an easy slope to excavate, that can be misleading. Does not recommend ground penetrating radar or seismic testing because they will not yield good enough information to really tell what is underground. Would recommend either test pit excavations or drilling in a grid pattern to determine if there are large boulders or bedrock that would require blasting or special construction techniques. Soil samples would be taken with either method. That would yield enough information to engineer the foundations/walls of the structure, and develop excavation cost estimates and blasting cost estimates if needed.

-Memo received from Denis Davis
Monument Superintendent
January 2010

Views



View from eye-height looking NE from proposed site. Photo DI 2009.

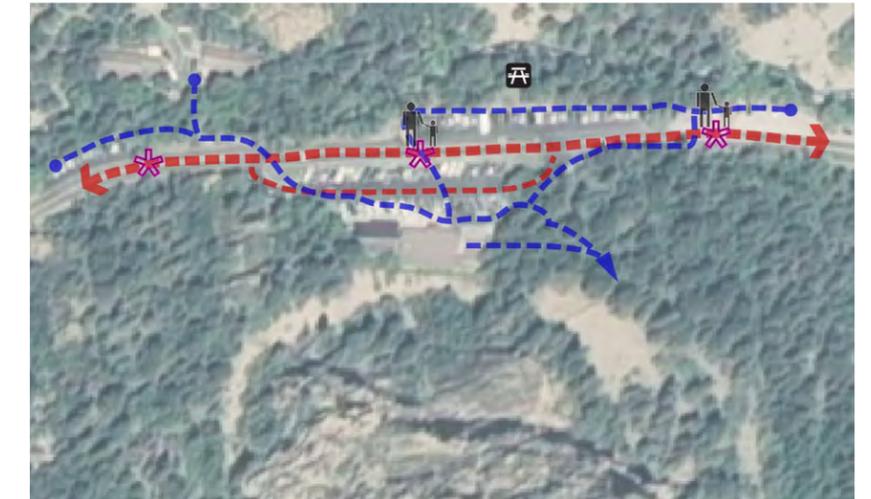
View looking down canyon (west) along Rt. 92. Photo DI 2009.

Views from the existing visitor are unobstructed due to the parking lot. However, this also means unsightly views of cars and paving in the foreground, as well as those of the canyon.

The proposed site has more limited views, both into and out of the area. This is because the hill is thickly vegetated. While the site vegetation, and particularly trees, should be retained as much as possible, there may need to be strategic removals to the north of the proposed building footprint. As they approach, visitors should be able to catch a glimpse of the Visitor Center through the trees. In addition to other orienting devices, this will direct them to their destination. Raising the building above the parking lot, and maintaining much of the plant cover will both serve to screen undesirable views.

The spectacular views up and down the canyon should be taken advantage of if possible.

Circulation

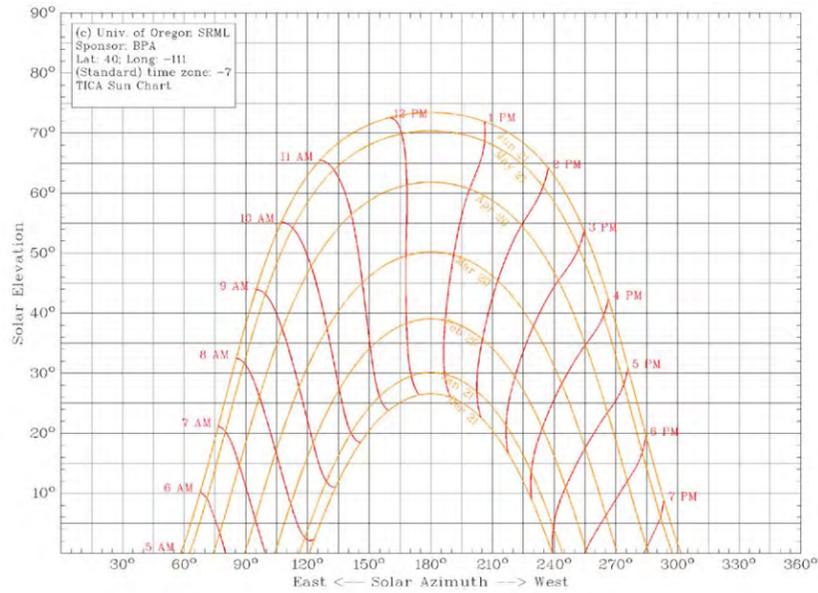


Red dashed line: Vehicular Traffic; Blue dashed line: Pedestrian Traffic; Pink asterisk: High Hazard

At present, the circulation patterns surrounding the Visitor Center cause many potential conflicts. The American Fork Canyon Road (Rt. 92) is a busy road with a relatively high speed limit. Large vehicles, at times hauling trailers or campers travel at high speed through the section past the Visitor Center. A horizontal curve and rock outcropping block driver's view of the Visitor Center when approaching from the west. There is also a similarly dangerous curve for those approaching the Visitor Center from the east.

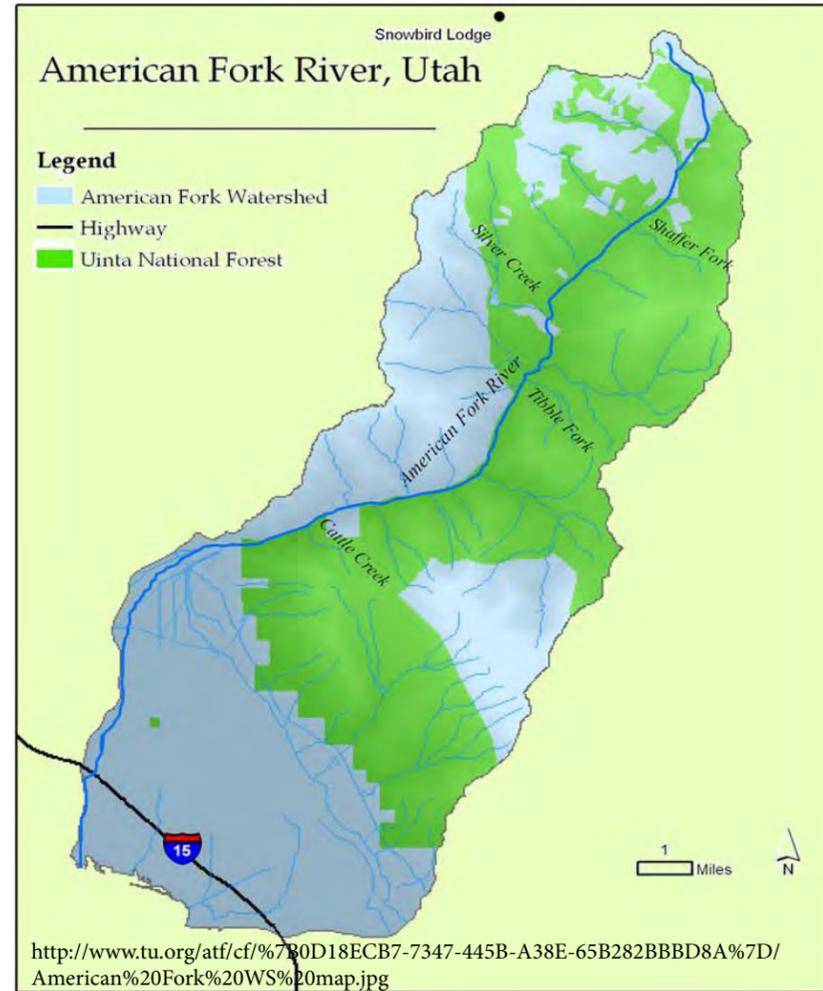
These existing site conditions pose a threat to pedestrians crossing the road. Crossings are frequent due to spread-out parking areas and need to access Monument offices down-canyon. Timpanogos Cave National Monument staff are aware of the dangers and have considered realignment of the road to improve safety. This report recommends realignment of Rt. 92, as well as the installation of traffic calming measures such as rumble strips, to slow cars as they pass the Visitor Center.

Natural Resources



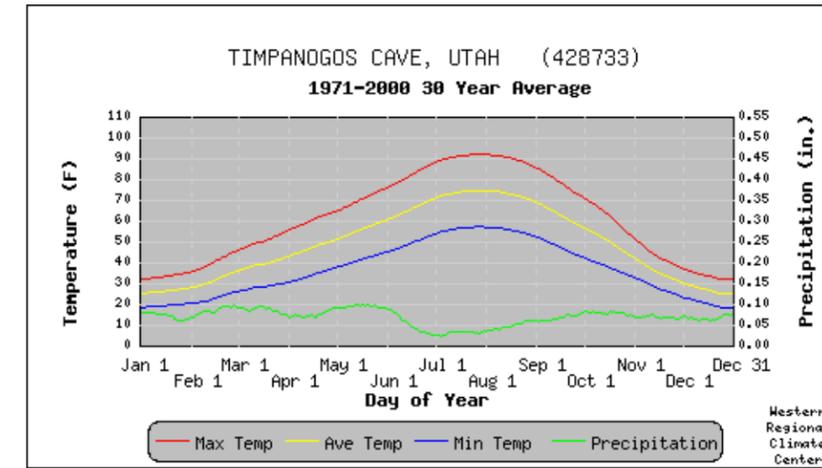
<http://solar.dat.uoregon.edu/SunChartProgram.html>

This sun chart shows the angle of the solar path throughout the year. Ideally, the new Visitor Center should be situated so that it could take advantage of photovoltaic energy production. The sun is at its highest elevation during the summer months when the Visitor Center is in operation. However, the steep and narrow configuration of the canyon means the floor of the canyon is often in shadow, particularly on the southern side. If solar panels cannot be placed on the new building itself where the current and proposed Visitor Center is located, they could be considered for placement elsewhere, such as on the north canyon wall where land has already been disturbed by a removed gas line.



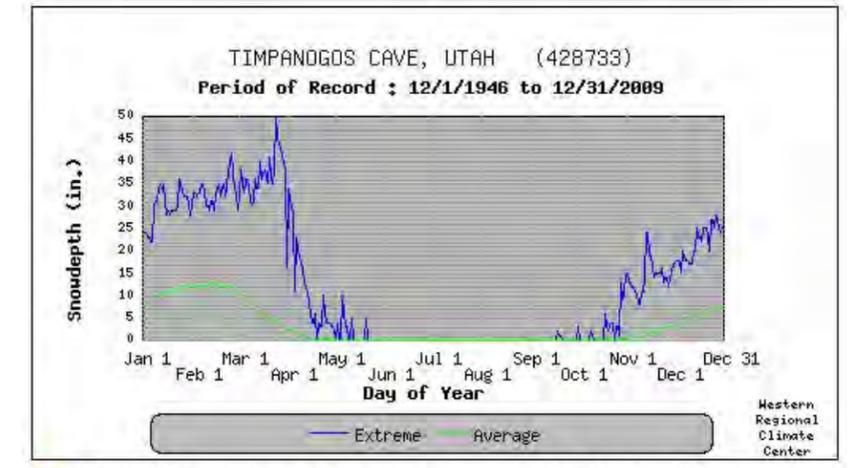
The American Fork River, like all water, is a very valuable resource. There is an opportunity for the new Visitor Center to allow visitors greater access to the river, and to have a light ecological impact by using water-saving fixtures and strategies whenever possible.

Climate

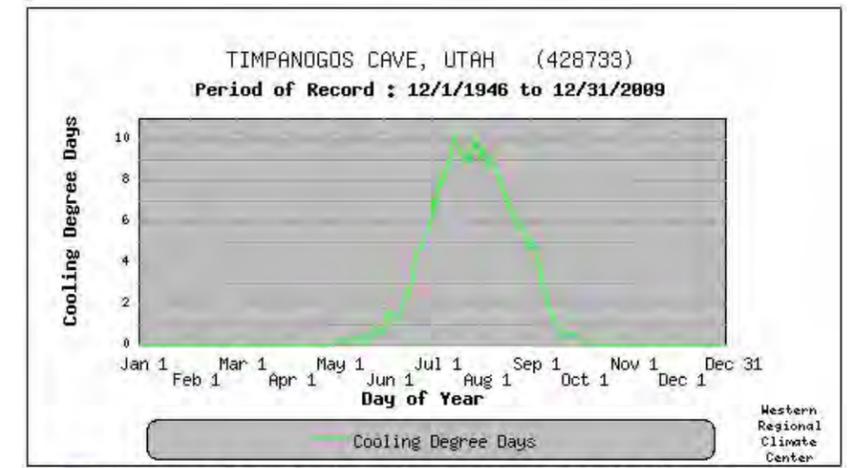


The Monument experiences all four seasons. Spring and fall are generally mild. Winters can be quite cold, with a sustained snow load frequently about four feet deep. As the new Visitor Center will be structurally engineered to resist rock fall, bearing this weight should not be an issue. Timpanogos Cave National Monument does not anticipate using the Visitor Center during the winter months when the Monument is closed. Therefore, heating needs will be minimal.

Summer temperatures can reach into the 90s F. As shown in the chart at right, the days with cooling needs correspond almost exactly to the period of time the Monument is open. The Visitor Center will need to be cooled in a highly energy-efficient way to meet the goals of the project.



- Extreme is the greatest daily snowdepth recorded for the day of the year.
- Average is the average of all daily snowdepth recorded for the day of the year.



- Average of all cooling degree day units recorded for the day of the year.

Photographs and Site Characteristics

The Wasatch Mountains and American Fork Canyon form a spectacular setting, and the Timpanogos Caves are a justly treasured place. Included here are some of the photographs and ideas that inspired the design team during the fall site visit.



Geology; layering; strong diagonal lines



Existing built features - rugged; local materials; heavy stone but open, light feeling; human scale



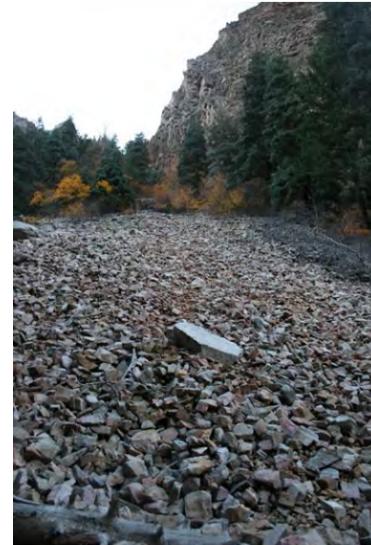
Progression: vast, open spaces; majestic views, power of water to shape and form



Unique formations; passion for caves; iconic forms; slow movement of water



Progression: small, constricted areas opening out into large spaces



Geologic process and forces



Progression: constricted tunnels open into large rooms; sense of mystery

PROGRAM

The program, or compilation of desired spaces and functions, was provided to Drachman Institute by the Monument. The National Park Service has a requisite formula for determining space requirements which was used to generate the program described in this section. Drachman Institute was also informed that additional elements could be considered if there was sufficient demonstrated need for them.

This project approached the program as applying to two user groups: Monument staff and visitors. The two aspects of the program are intertwined, and should flow smoothly, creating ease of use and a seamless experience. In addition to existing programmatic analysis conducted by the National Park Service, Drachman Institute spoke with Monument administration, rangers, and interpretive staff regarding the current Visitor Center facility and the proposed program for the new Visitor Center.

Table X - Visitor Functions & Building Space Comparison Details

	ALTERNATIVE A - EXISTING CONDITIONS	ALTERNATIVE B - EMPHASIS AT INTERAGENCY CENTER PER 2006 PRE-DESIGN	ALTERNATIVE C - EMPHASIS PROPORTIONATE TO EXPECTED VISITATION
INTERAGENCY CENTER (visitor space)			
Entry vestibule		150	0
Lobby & info desk		350	200
Exhibit area		800	300
Multi purpose room		900	800
Public restrooms		480	300
Office space		200	100
Sales area		200	200
Storage area		200	200
Fee counting room		0	80
Mechanical & break area in Admin building		0	0
Total		3370 net square feet (nsf)	2180 nsf
VISITOR FACILITY AT CAVE TRAILHEAD			
Lobby, info & ticket sales counter	796	460	500
Video viewing area	180	0	180
Exhibit area	0	0	300
Public restrooms	365	630	360
Employee restroom	22	65	55
Office space	220	0	200
Sales area	202	0	240
Sales /interp storage	55	0	55
Storage - cave operations staging	484	90	400
Fee counting room	66	80	x 0
Employee break rm	104	0	0*
Mail, radios, lockers	82	0	0*
First aid	20	0	40
Mechanical, phone, computer, electrical	14	80	80
Total	2610 nsf	1405 nsf	2420 nsf

Proposed Program

This chart shows the existing and proposed program of allowable functions and corresponding spaces requirements (in square feet) generated using the NPS system. The Monument had previously determined that they wished to follow Alternative C. This project therefore used the space allocations in the right-hand column when conceptualizing the proposed design.

This diagram also begins to show which functions will be placed at the proposed Interagency Center rather than at the Visitor Center. Some activities will need to be accommodated at both locations, such as interpretive educational sessions.

Parking is a further important program element. While there is not a prescriptive quantity, the goal is to maximize parking capacity.

Interagency Center

- To be located at the mouth of the American Fork Canyon
- Provide infrastructure for NPS, US Forest Service, Pleasant Grove District Ranger Office, American Fork Canyon Search and Rescue, and Fire Department
- Cultural history interpretation for visitors
- Interpretation aspects for the canyon as a whole
- All season access
- Ranger training

Monument Visitor Center

- Create a sense of arrival and provide orientation for cave visitors (regardless if visitor proceeds to the caves or not)
- Provide customer service for all visitors for the canyon year-round, whether they are looking for NPS or US Forest Service information.
- More emphasis on environmental interpretation (vs. cultural)
- Seasonal access to Monument and Visitor Center; open May – Labor Day (closed during winter)
- Ranger point of departure for caves

Interior Spaces

Visitor (+ Ranger)	Ranger/Staff Only
Public restrooms	Staff restroom
Interactive tour area	Supervisor office
Exhibit/Interpretive space	Storage
Movie area (semi-enclosed)	WNPA cashier desk
Ticket sales desk	Ranger radio/hat storage
First aid station	Phone desk
Merchandise sales	

The program was then considered in terms of interior and exterior space programming. Additionally, the user groups were determined. From conversations with Monument personnel, no additional elements were identified as being needed for the interior of the building, assuming that additional storage will be available at the residence facility north of Rt. 92 where administration is currently housed.

Exterior Spaces

Visitors + Rangers
Outdoor amphitheater
Outdoor classroom (School groups and junior rangers)
Outdoor exhibit/interpretation space/play space (“squeeze box”)
Transition from parking lot to ticket sales to cave (Creation of a sense of entry)
Ticket sales
Kennel
Garbage/loading dock
Payphones
24 hour information kiosk

While the Monument recognizes the importance of outdoor elements, they are not part of the NPS space computation and do not appear in the program on the preceding page. This chart contains exterior components both as requested by the Monument and determined during the Drachman Institute site visit.

The Concessionaire Building

The existing concessionaire building is the one remaining piece of the original Mission 66 Visitor Center. It is situated immediately to the south of the Visitor Center, and shares the same parking lot. The concessionaire building includes a kitchen, sales area, and covered seating, and provides snacks, water, and warm clothing for sale. It is the only source for these items in the canyon. While sales revenue is modest, the concessionaire serves an important role as many visitors forget essentials, like preparing for cave temperatures in the 40s when outside temperatures are in the 90s. Visitors must also sacrifice a parking space if they leave to purchase food in town. The Monument has therefore decided that they wish to keep this function present in the new Visitor Center design.

The concessionaire building poses unique challenges for consideration. Though it is not considered eligible for or listed on the National Register of Historic Places, Mission 66-era buildings are now coming into consideration for this designation. It is important to preserve some aspect of that chapter of NPS history. The Timpanogos Cave National Monument concessionaire building is representative of the style of that time, and remains in good condition with little alteration to its original character. However, it has little protection from rock fall, and is located on land wanted for additional parking. It is discontinuous with the proposed site for the new Visitor Center, and would create unnecessary pedestrian/vehicle conflicts.



This project, being conceptual, remains flexible as to the future of the existing concessionaire. If desired, the building could easily be retained, though sidewalks and more protective rock fencing should be installed to increase safety. However, the design concept as presented in this document envisions moving the concessionaire to a location closer to the new Visitor Center. This was done to maintain visitor flow, create design continuity, increase safety, and improve/modernize facilities.

If the existing concessionaire building is demolished, it should first be well documented, both photographically and perhaps with Historic American Building Survey (HABS) Level 1 drawings.

Existing Visitor Center

As previously stated, the current Visitor Center was intended to be temporary, and is not an ideal building for Monument needs. Discussion with Monument staff and investigation during the site visit revealed several drawbacks to the present set up that should be addressed through the design of the new Visitor Center. There are some aspects of the current facility that do work, and these also informed the design concept.

The modular unit has an open floor plan, which does not create clear circulation or appropriately separate different activities. Staff reported that the space can become very noisy, and that visitors are not always sure where to go to buy tickets or access the trail.

Ways to improve:

- One point of purchase for ticket sales
- A more efficient sequence through the space for the visitor
- Ticket sales and phone ranger in close proximity, but with privacy barrier/sound control
- Create more productive and functional working areas for staff
- Fulfill the need for a waiting area for members of families that could not make the tour
- Maintain flexibility through the multi-use aspect of spaces

Things that work:

- Interpretive displays, particularly interactive
- Visibility through building and from interior to exterior spaces



View of ticket sales desk and door leading to trail head. There is also a ticket window (left of desk) and a separate trail access point. Open floor plan is noisy, but flexible.



Staff areas also need better flow. Visibility from employee to visitors areas should be maintained (note interior window at right).

The exterior spaces of the existing Visitor Center were also studied. Again, sequencing and flow through spaces arose as a primary issue to be addressed.

Ways to improve:

- Create a welcoming place with clear sense of arrival and entry
- Better integration of universal design
- More seating/waiting space
- Design multi-use outdoor spaces
- Limit trailhead to one access point
- Outdoor year-round, 24 hour access to information via interpretative materials and digital kiosk

Things that work:

- Shaded group gathering areas
- Visibility through building and from interior to exterior spaces
- Maintain exterior-only access public restrooms
- Historic character of Mission 66-era rock planters and retaining walls (these should be retained to greatest extent possible)



Front of the current Visitor Center as seen from the parking lot upon arrival. The main doors are at left, and access to the public restrooms are to the right. Note rock wall in front.



Standing on the porch to the north of the building. This area is used for information sessions and people waiting. It receives moderate shade and minimal rock protection from a ramada structure. Stairway access to the trailhead is located in the background.

INITIAL CONCEPTS

The information contained in this document was presented at a charrette with other Drachman Institute staff, including architects, landscape architects, planners, and resource conservationists. Their input was considered during the initial design stage. The result was two preliminary concepts - one of which explored an alternative to the proposed site - that were then presented to Timpanogos Cave National Monument for comment. This section will discuss these two concepts and their relative merits and drawbacks. Analyzing these qualities is crucial in developing a sound, well-informed final design.

The site visit, site analysis, and charrette all contributed to the definition of design goals. The previously established goals for this project were, for the most part, not explicitly design-oriented. However, they have design implications. To briefly restate these goals:

1. Integrate the building into the hillside.
2. Examine possibility of utilizing a living roof.
3. Make the building resistant to rock fall.
4. Achieve LEED Gold or better.
5. Design the Visitor Center to give the feel of a cave.

The last goal clearly involves design, while the others have bearing on the building form and placement. The research process led Drachman to define further design goals which guided concept development. These are:

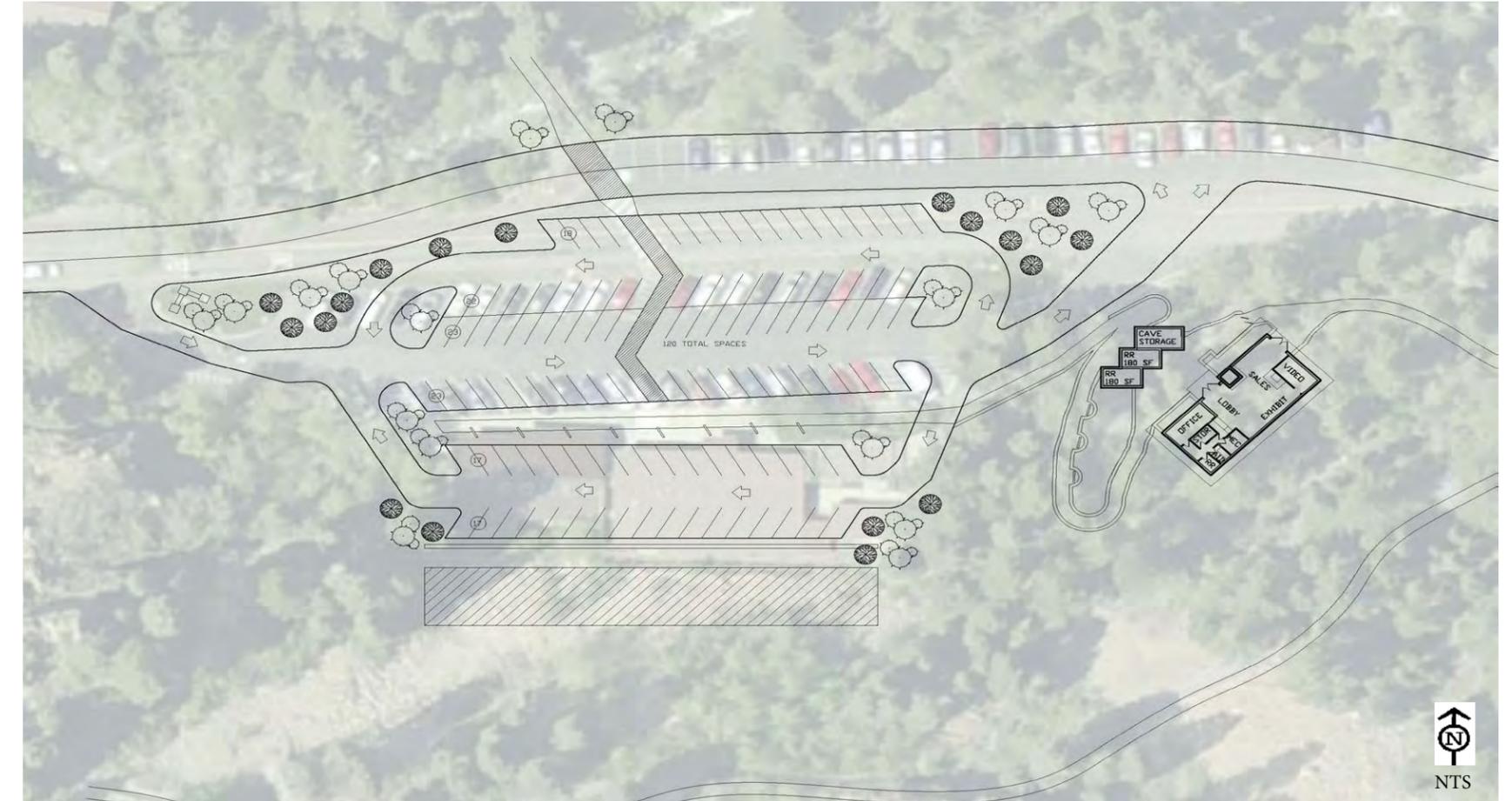
- Maximize visitor safety (from rock fall and vehicular traffic)
- Create one clear and welcoming point of entry/trailhead
- Use the building or other iconic wayfinding devices to attract and direct visitors (enhance flow)
- Whenever possible, utilize land that has already been impacted (minimize site damage and disturbance)
- Draw inspiration from the setting in building design
- Embrace the natural features of the canyon, including the geology and the American Fork River

Finally, “feel of a cave,” was interpreted in this project to be the entire experience of visiting Timpanogos Cave National Monument, not necessarily a literal reading of a dark, enclosed space. The experience for the Drachman team was marked by a progression, or movement through space from constricted places to open places. Some sense of mass and enclosure is appropriate, but the intent was to create an abstraction rather than a truly cave-like space.

It should be emphasized that the initial concepts were intended to test site viability and layout using drawings and massing models. Form and aesthetics were not explored at this stage of design.

Concept A: “Hillside Habitat”

This concept explored a building on the site to the east of the current Visitor Center as proposed by the Monument. The overall site plan suggested realigning Rt. 92 to the north, or closer to American Fork River. All parking and facilities would then be on the south side of the road in order to minimize road crossings. The depicted layout maximized the quantity of parking spaces for the Visitor Center and assumes the demolition of the concessionaire building. As drawn, there are 97 parking stalls.



The building in this concept was visualized as nestling into the hillside. Breaking the square footage into two separate buildings allowed both to be earth-integrated, rather than making one large building that would either become very long along the face of the hill, or extend far back into it. The building is oriented to the northwest to better conform to the natural site topography, to orient it toward approaching visitors, and to take advantage of views. The separate buildings also achieve other design goals, particularly as far as they help establish a progression through a sequence of spaces.

The presence of buildings on the hillside directs visitors upwards. The experience begins as visitors climb the winding path at ADA compliant grade from the parking lot. They first pass the rest rooms, which are easily reached from the parking lot. There are opportunities for interpretive signage and seating along the path. The path turns a corner and reveals the Visitor Center. In front of the building extends a courtyard, utilizing the roofs of the lower buildings as open space.

Ticket sales occur at a sheltered exterior window, indicated on the drawing with a thin line on the eastern wall of the Office area of the main building. "Sales" on the figures at right indicate WNPA rather than ticket sales. The cave trail is only accessible by passing through the Exhibit and WNPA Sales areas of the building. Returning traffic must pass through a one-way turnstile at the end of the path.

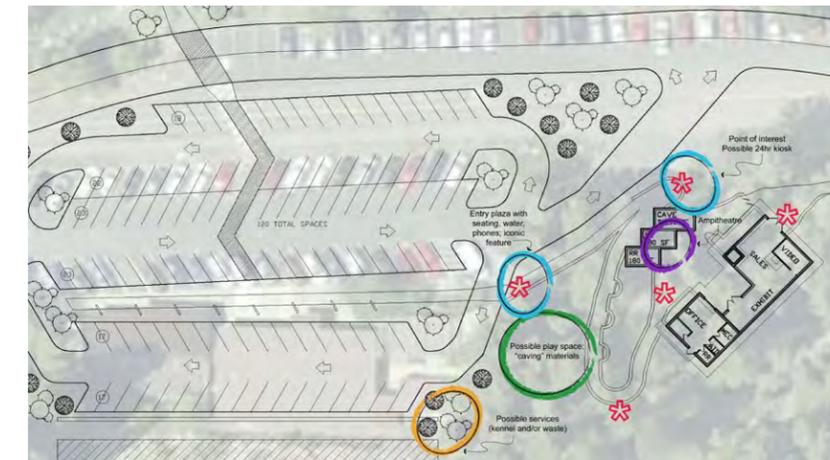
Two conceptual floor plans were prepared for this site layout. Both have a similar flow and division of spaces. The rest rooms and storage are kept as a group along the lower portion of the path. Office and visitor spaces are separated within the main building. Layout A is a rectangular building with an enclosed lobby, while layout B is a U-shaped building with a covered, but not enclosed, lobby/interpretive space.



Floor Plan A



Floor Plan B



Starting at the upper left and going clockwise around, the images on this page depict: general form of the preferred Floor Plan B; a section showing how the buildings would fit into the landscape; and a site diagram demonstrating locations where key activities could occur or outdoor program elements could be placed.



Due to the conceptual nature of this design proposal, only a preliminary LEED analysis could be undertaken, whose purpose is to determine strengths and weaknesses of the design concept. It is included to help determine strengths and weaknesses of the concept only. The exercise shows that the hillside layout would lose LEED points on:

- Disturbing a greenfield site
- Not having access to alternative energy (south side of canyon would not receive sufficient sun exposure for solar)
- Decreased ventilation resulting from earth integration.

While the first two drawbacks cannot be remedied in this design, a cooltower has been added to the building in order to increase air flow while also decreasing energy demand. Overall, this preliminary analysis yields a score of 43, which would put the building in the Gold certification range.

Timpanogos Cave Visitor Center

Timpanogos Cave National Monument - Option A

LEED-NC Version 2.2 Registered Project Checklist

6 Sustainable Sites		14 Points
Y	Prereq 1 Construction Activity Pollution Prevention	Req'd
0	Credit 1 Site Selection	1
0	Credit 2 Development Density & Community Connectivity	1
0	Credit 3 Brownfield Redevelopment	1
0	Credit 4.1 Alternative Transportation, Public Transportation Access	1
0	Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms	1
0	Credit 4.3 Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles	1
0	Credit 4.4 Alternative Transportation, Parking Capacity	1
0	Credit 5.1 Site Development, Protect or Restore Habitat	1
1	Credit 5.2 Site Development, Maximize Open Space	1
1	Credit 6.1 Stormwater Design, Quantity Control	1
1	Credit 6.2 Stormwater Design, Quality Control	1
1	Credit 7.1 Heat Island Effect, Non-Roof	1
1	Credit 7.2 Heat Island Effect, Roof	1
1	Credit 8 Light Pollution Reduction	1

4 Water Efficiency		5 Points
1	Credit 1.1 Water Efficient Landscaping, Reduce by 50%	1
1	Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation	1
1	Credit 2 Innovative Wastewater Technologies	1
1	Credit 3.1 Water Use Reduction, 20% Reduction	1
0	Credit 3.2 Water Use Reduction, 30% Reduction	1

9 Energy & Atmosphere		17 Points
Y	Prereq 1 Fundamental Commissioning of the Building Energy Systems	Req'd
Y	Prereq 2 Minimum Energy Performance	Req'd
Y	Prereq 3 Fundamental Refrigerant Management	Req'd
1	Credit 1 Optimize Energy Performance 10.5%	1
1	Optimize Energy Performance 14%	1
1	Optimize Energy Performance 17.5%	1
1	Optimize Energy Performance 21%	1
1	Optimize Energy Performance 24.5%	1
0	Optimize Energy Performance 28%	1
0	Optimize Energy Performance 31.5%	1
0	Optimize Energy Performance 35%	1
0	Optimize Energy Performance 38.5%	1
0	Optimize Energy Performance 42%	1
0	Credit 2 On-Site Renewable Energy 2.5%	1
0	On-Site Renewable Energy 7.5%	1
0	On-Site Renewable Energy 12.5%	1
1	Credit 3 Enhanced Commissioning	1
1	Credit 4 Enhanced Refrigerant Management	1
1	Credit 5 Measurement & Verification	1
1	Credit 6 Green Power	1

7 Materials & Resources		13 Points
Y	Prereq 1 Storage & Collection of Recyclables	Req'd
0	Credit 1.1 Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	1
0	Credit 1.2 Building Reuse, Maintain 100% of Existing Walls, Floors & Roof	1
0	Credit 1.3 Building Reuse, Maintain 50% of Interior Non-Structural Elements	1
1	Credit 2.1 Construction Waste Management, Divert 50% from Disposal	1
1	Credit 2.2 Construction Waste Management, Divert 75% from Disposal	1
1	Credit 3.1 Materials Reuse, 5%	1
0	Credit 3.2 Materials Reuse, 10%	1
1	Credit 4.1 Recycled Content, 10% (post-consumer + ½ pre-consumer)	1
0	Credit 4.2 Recycled Content, 20% (post-consumer + ½ pre-consumer)	1
1	Credit 5.1 Regional Materials, 10% Extracted, Processed & Mfg'd Regionally	1
0	Credit 5.2 Regional Materials, 20% Extracted, Processed & Mfg'd Regionally	1
1	Credit 6 Rapidly Renewable Materials	1
1	Credit 7 Certified Wood	1

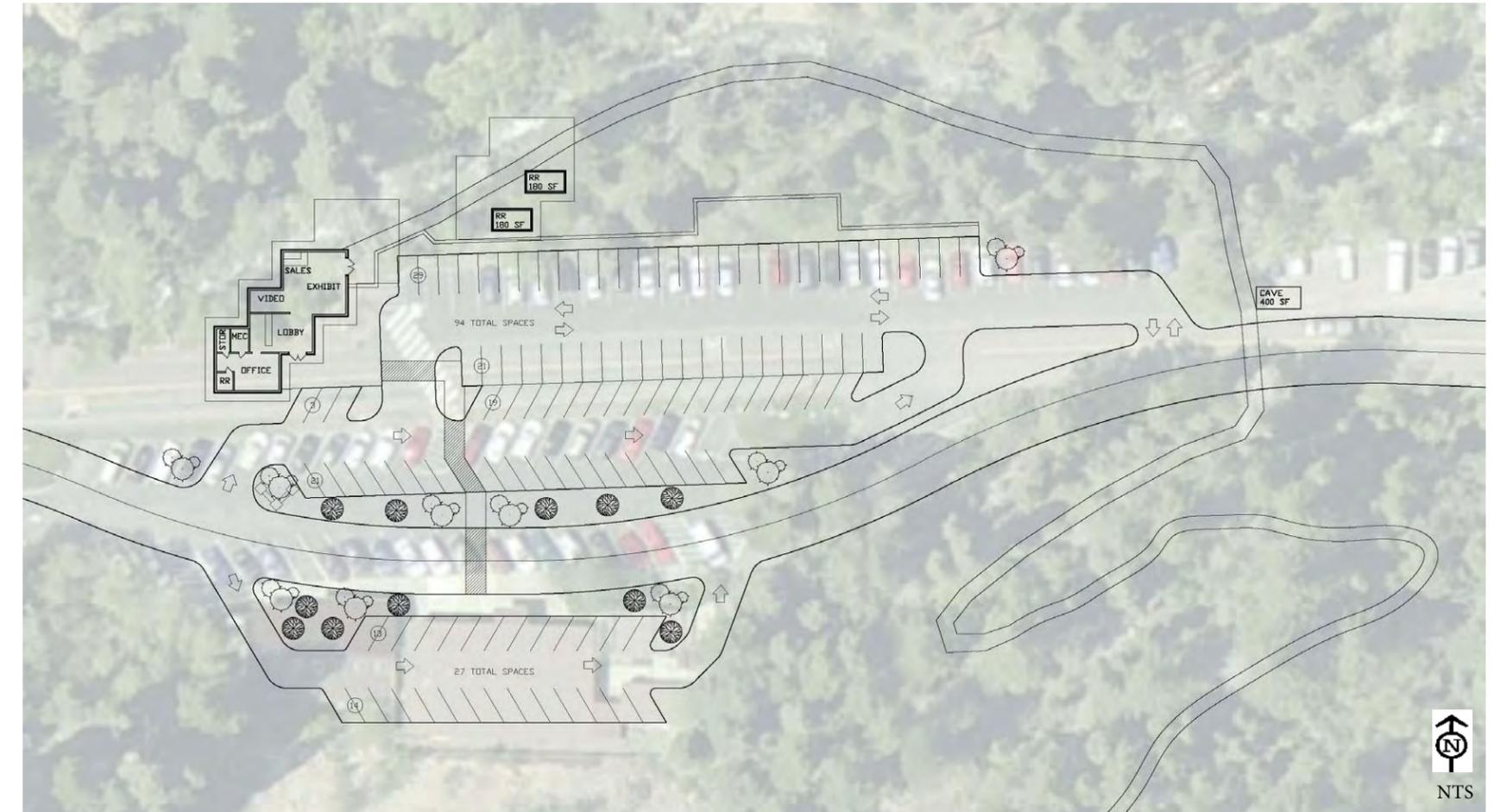
14 Indoor Environmental Quality		15 Points
Y	Prereq 1 Minimum IAQ Performance	Req'd
Y	Prereq 2 Environmental Tobacco Smoke (ETS) Control	Req'd
1	Credit 1 Outdoor Air Delivery Monitoring	1
0	Credit 2 Increased Ventilation	1
1	Credit 3.1 Construction IAQ Management Plan, During Construction	1
1	Credit 3.2 Construction IAQ Management Plan, Before Occupancy	1
1	Credit 4.1 Low-Emitting Materials, Adhesives & Sealants	1
1	Credit 4.2 Low-Emitting Materials, Paints & Coatings	1
1	Credit 4.3 Low-Emitting Materials, Carpet Systems	1
1	Credit 4.4 Low-Emitting Materials, Composite Wood & Agrifiber Products	1
1	Credit 5 Indoor Chemical & Pollutant Source Control	1
1	Credit 6.1 Controllability of Systems, Lighting	1
1	Credit 6.2 Controllability of Systems, Thermal Comfort	1
1	Credit 7.1 Thermal Comfort, Design	1
1	Credit 7.2 Thermal Comfort, Verification	1
1	Credit 8.1 Daylight & Views, Daylight 75% of Spaces	1
1	Credit 8.2 Daylight & Views, Views for 90% of Spaces	1

3 Innovation & Design Process		5 Points
1	Credit 1.1 Innovation in Design: Provide Specific Title	1
1	Credit 1.2 Innovation in Design: Provide Specific Title	1
1	Credit 1.3 Innovation in Design: Provide Specific Title	1
1	Credit 1.4 Innovation in Design: Provide Specific Title	1
1	Credit 2 LEED® Accredited Professional	1

43 Project Totals (pre-certification estimates)		69 Points
Certified	26-32 points	Silver 33-38 points
Gold	39-51 points	Platinum 52-69 points

Concept B: "River Walk"

This concept investigated using an alternative site. During the charrette process, a strong theme emerged that the Visitor Center should have an improved connection to the surrounding environment, especially the American Fork River. The team also wanted to consider a design that would place the new building in a highly visible location while trying to minimize the visual impact of increased parking. This concept also assumes the demolition of the concessionaire building in order to maximize the number of parking spaces; however, it could be retained by eliminating the southernmost parking area (27 parking spaces). As drawn, there are 121 parking stalls.



In terms of site layout, the River Walk concept places the building along the American Fork River to the northwest of the current site. This placement allowed for maximum usage of previously-disturbed land, both for the building footprint and the additional parking. Rt. 92 is realigned to dip in as closely to the south canyon wall as possible while still maintaining a feasible curve. This site also places the building closer to existing park facilities, providing ease of access for staff.

As visitors approach from down-canyon, the Visitor Center is the first thing they see. The prominent building location helps create an orienting device and a showcase the Visitor Center, and becomes a clue to slow down. Visitors would park behind the building, then enter it from the east. After passing through the building, visitors could then walk a path that follows the river, crossing over Rt. 92 on an elevated pedestrian bridge. Cave trailhead access would be controlled via this bridge (single point of entry).

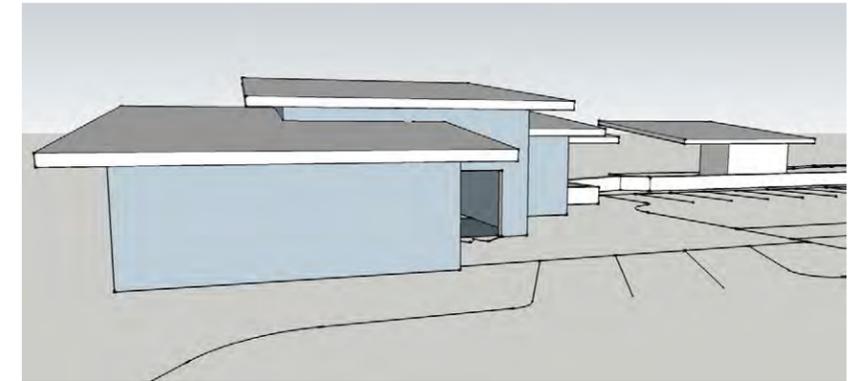
The building was envisioned as a consolidated floor plan where bathrooms could be included or detached. The north facade would create an interaction with the river, possibly through a deck extending up to the riverbank or over the water. The microclimate produced by the water would help to keep the building a comfortable temperature. The location on the canyon floor opens up much more space for visitors to walk, mingle, picnic, engage in interpretive programs, or wait for others. The processional experience from the Visitor Center to the trailhead helps incorporate the natural amenities within the Monument.



The building form for the River Walk is very conceptual. Though it is not portrayed in these images, the building would need to be elevated out of the flood plain. FEMA data and a site-specific hydrological study would be required to determine just what this floor grade elevation must be. Though costly, this condition has the potential to produce a very interesting and elegant design. If raised substantially, the space underneath the building would create a cave-like feeling.

In both initial concepts, the design team wanted to bring the strong geological lines of the canyon into the building. The roof was visualized as being a powerful statement of diagonal planes. The building is stepped back in order to respond to the course of the river.

As with the previous concept, a preliminary LEED analysis was performed, and the results are presented on the following page. Again, this is for informational purposes only. Based on the simple parameters of the concept, this design qualifies for more LEED points than the Hillside Habitat. The River Walk design concept received a preliminary LEED score of 46 - compared to 43 for Hillside - but still within the Gold category of LEED. In effect, the River Walk building gains the three points lost on the Hillside building, including on-site renewable energy. Because a building in this location would receive some sun exposure, this concept could integrate active and passive solar strategies.





Timpanogos Cave Visitor Center

LEED-NC Version 2.2 Registered Project Checklist

Timpanogos Cave National Monument - Option B

7	Sustainable Sites	14 Points
Y	Prereq 1 Construction Activity Pollution Prevention	Req'd
0	Credit 1 Site Selection	1
0	Credit 2 Development Density & Community Connectivity	1
0	Credit 3 Brownfield Redevelopment	1
0	Credit 4.1 Alternative Transportation, Public Transportation Access	1
0	Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms	1
0	Credit 4.3 Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles	1
0	Credit 4.4 Alternative Transportation, Parking Capacity	1
1	Credit 5.1 Site Development, Protect or Restore Habitat	1
1	Credit 5.2 Site Development, Maximize Open Space	1
1	Credit 6.1 Stormwater Design, Quantity Control	1
1	Credit 6.2 Stormwater Design, Quality Control	1
1	Credit 7.1 Heat Island Effect, Non-Roof	1
1	Credit 7.2 Heat Island Effect, Roof	1
1	Credit 8 Light Pollution Reduction	1

4	Water Efficiency	5 Points
1	Credit 1.1 Water Efficient Landscaping, Reduce by 50%	1
1	Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation	1
1	Credit 2 Innovative Wastewater Technologies	1
1	Credit 3.1 Water Use Reduction, 20% Reduction	1
0	Credit 3.2 Water Use Reduction, 30% Reduction	1

10	Energy & Atmosphere	17 Points
Y	Prereq 1 Fundamental Commissioning of the Building Energy Systems	Req'd
Y	Prereq 2 Minimum Energy Performance	Req'd
Y	Prereq 3 Fundamental Refrigerant Management	Req'd
1	Credit 1 Optimize Energy Performance 10.5%	1
1	Optimize Energy Performance 14%	1
1	Optimize Energy Performance 17.5%	1
1	Optimize Energy Performance 21%	1
1	Optimize Energy Performance 24.5%	1
0	Optimize Energy Performance 28%	1
0	Optimize Energy Performance 31.5%	1
0	Optimize Energy Performance 35%	1
0	Optimize Energy Performance 38.5%	1
0	Optimize Energy Performance 42%	1
1	Credit 2 On-Site Renewable Energy 2.5%	1
0	On-Site Renewable Energy 7.5%	1
0	On-Site Renewable Energy 12.5%	1
1	Credit 3 Enhanced Commissioning	1
1	Credit 4 Enhanced Refrigerant Management	1
1	Credit 5 Measurement & Verification	1
1	Credit 6 Green Power	1

7	Materials & Resources	13 Points
Y	Prereq 1 Storage & Collection of Recyclables	Req'd
0	Credit 1.1 Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	1
0	Credit 1.2 Building Reuse, Maintain 100% of Existing Walls, Floors & Roof	1
0	Credit 1.3 Building Reuse, Maintain 50% of Interior Non-Structural Elements	1
1	Credit 2.1 Construction Waste Management, Divert 50% from Disposal	1
1	Credit 2.2 Construction Waste Management, Divert 75% from Disposal	1
1	Credit 3.1 Materials Reuse, 5%	1
0	Credit 3.2 Materials Reuse, 10%	1
1	Credit 4.1 Recycled Content, 10% (post-consumer + 1/2 pre-consumer)	1
0	Credit 4.2 Recycled Content, 20% (post-consumer + 1/2 pre-consumer)	1
1	Credit 5.2 Regional Materials, 10% Extracted, Processed & Mfg'd Regionally	1
0	Credit 5.2 Regional Materials, 20% Extracted, Processed & Mfg'd Regionally	1
1	Credit 6 Rapidly Renewable Materials	1
1	Credit 7 Certified Wood	1

15	Indoor Environmental Quality	15 Points
Y	Prereq 1 Minimum IAQ Performance	Req'd
Y	Prereq 2 Environmental Tobacco Smoke (ETS) Control	Req'd
1	Credit 1 Outdoor Air Delivery Monitoring	1
1	Credit 2 Increased Ventilation	1
1	Credit 3.1 Construction IAQ Management Plan, During Construction	1
1	Credit 3.2 Construction IAQ Management Plan, Before Occupancy	1
1	Credit 4.1 Low-Emitting Materials, Adhesives & Sealants	1
1	Credit 4.2 Low-Emitting Materials, Paints & Coatings	1
1	Credit 4.3 Low-Emitting Materials, Carpet Systems	1
1	Credit 4.4 Low-Emitting Materials, Composite Wood & Agrifiber Products	1
1	Credit 5 Indoor Chemical & Pollutant Source Control	1
1	Credit 6.1 Controllability of Systems, Lighting	1
1	Credit 6.2 Controllability of Systems, Thermal Comfort	1
1	Credit 7.1 Thermal Comfort, Design	1
1	Credit 7.2 Thermal Comfort, Verification	1
1	Credit 8.1 Daylight & Views, Daylight 75% of Spaces	1
1	Credit 8.2 Daylight & Views, Views for 90% of Spaces	1

3	Innovation & Design Process	5 Points
1	Credit 1.1 Innovation in Design: Provide Specific Title	1
1	Credit 1.2 Innovation in Design: Provide Specific Title	1
1	Credit 1.3 Innovation in Design: Provide Specific Title	1
1	Credit 1.4 Innovation in Design: Provide Specific Title	1
1	Credit 2 LEED® Accredited Professional	1

46	Project Totals (pre-certification estimates)	69 Points
	Certified 26-32 points	Silver 33-38 points
	Gold 39-51 points	Platinum 52-69 points

Initial Concepts Compared

Hillside Habitat

Pros

- Sequential progress of entry sequence
- Earth integration for protection from rockfall
- Parking area confined to one side of the road
- Use of multiple ground planes and outdoor areas
- Circulation through the Visitor Center similar to that of the cave experience

Cons

- Large parking area before entry to Visitor Center
- Low visibility of Visitor Center from orientation/wayfinding perspective
- Switchbacks to allow the Visitor Center to be ADA accessible
- Disassociation with the river
- Poor visibility from the Visitor Center to the trail and parking lot due to vegetation
- Multiple building footprints
- No availability to passive or active solar techniques
- Limited choice for locating new concessionaire; need to maximize parking makes demolition of old concessionaire more of a necessity

River Walk

Pros

- Connection to the water element of the site to initiate the cave interpretation experience
- Building serves as a clear destination
- Visibility to the parking field and the trail
- Strong sense of arrival
- Inclusion of the vehicle in the sequence of visitor experience
- A single building with a continuous footprint
- Opportunity for solar strategies
- Greater flexibility in terms of locating a new concessionaire or retaining the existing one

Cons

- Parking area split by the road
- Repetition of sequence due to location of parking and building
- Lack of integration to the hillside
- Poor management of trail access
- Every visitor must cross the road to get to the trailhead
- Flood plain complications
- Higher expense

Conclusions

The notion to develop a visitors center within the flood plain, north of the road and closer to the canyon drainage has, at its root, the *experience of the visitor* in mind. The intention was to achieve an experience rich in the inherent qualities which attract people to natural phenomena:

- Immersion in the resource
- Multidimensional natural and cultural experience; Canyon Riparian to Cave

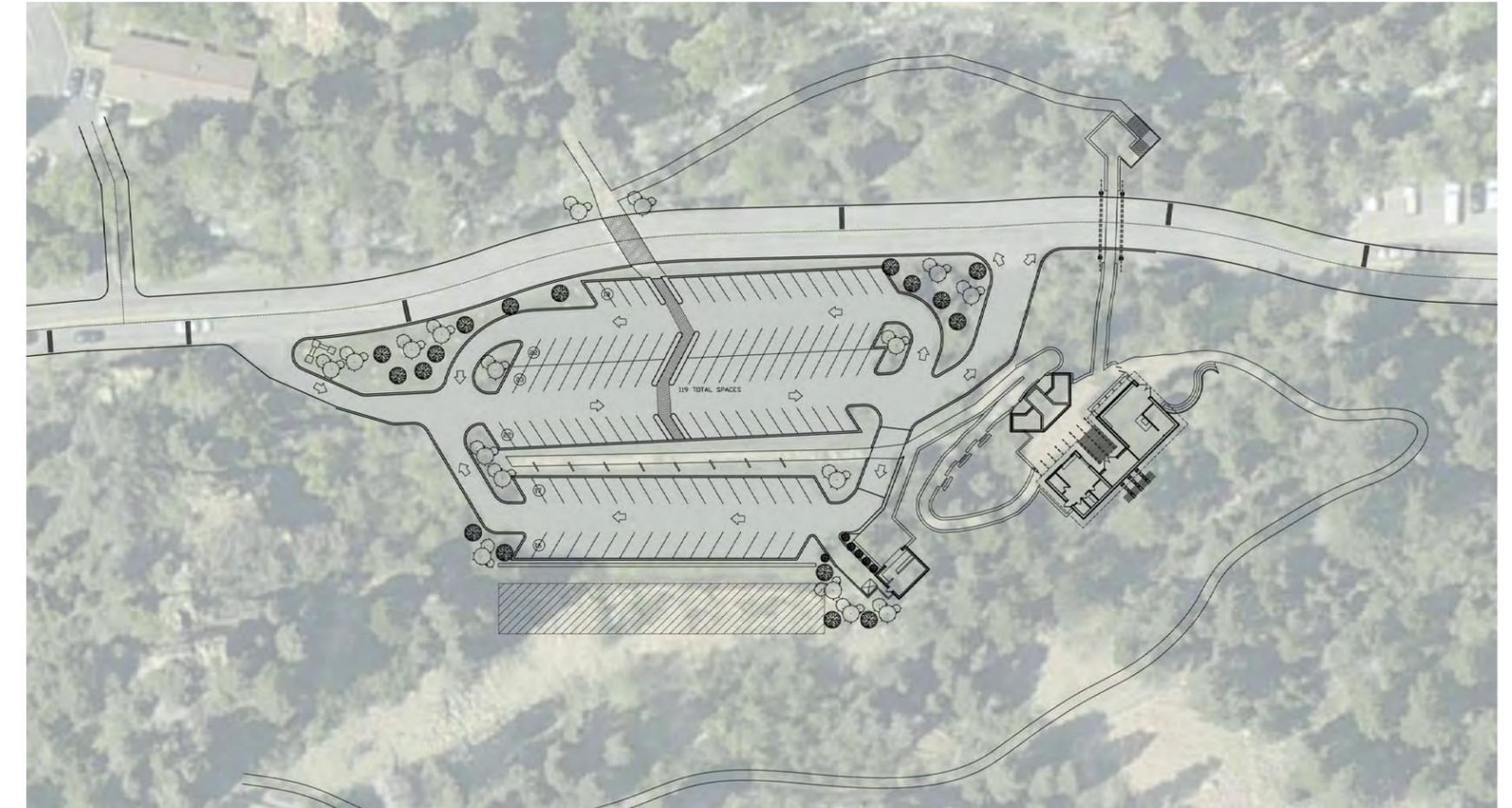
For this reason, the preliminary concept inquiry was pursued cognizant of the implicit difficulties in engaging such a strategy:

- Cost of road realignment and required hydrological/structural engineering.
- Cost of foundation system necessary to accommodate and/or withstand flooding of water course and scour depth of flooding while complying with county flood plain regulations.
- Complexity and cost of vertical circulation necessary to accommodate an anticipated elevated building solution which addresses the above concerns.
- Additional cost of developing a safe road crossing link to access the cave as the primary attraction of the user experience.
- Increased energy load due to cavity under elevated building.

In summary, though it can be assumed that all of the difficulties stated above add depth to the nature of the architectural/engineering challenge and its potential solution, the Drachman Institute team determined that the high financial cost may be too great to justify the River Walk strategy. The Monument also expressed reservations about the feasibility of this concept. Therefore, the Hillside concept was pursued, with some elements of the River Walk incorporated.

FINAL CONCEPT

Feedback from the Monument regarding the initial concepts, coupled with further investigation regarding feasibility, led to a synthesis and refinement of design. The final conceptual design brings the objectives of the project to a strong connection to the site and the cave experience. The Mission 66 concessionaire building has been removed and replaced with a new stand-alone building at the east end of the parking area. The final concept includes 119 parking stalls.



The attention of visitors is first caught as they approach the Visitor Center area. A striking pedestrian bridge over Rt. 92 engages their interest and naturally causes traffic to slow. Additionally, there are rumble strips in the road to further reduce speed. The circulation through the site begins in the parking lot, where visitors are directed to the beginning of the path. A planted island takes them through the parking lot in safety and presents opportunities for interpretive material to be displayed. Where the path crosses the drive aisle of the parking lot, it is paved in a different manner to give precedence to the pedestrian.

At the east end of the parking lot is the new concessionaire building, with an accompanying outdoor seating patio. The proximity to parking allows easy access to this function for both visitors and services such as delivery and waste collection.

From here, the visitor continues the journey towards the cave on a segment of trail that winds up towards the Visitor Center, encountering various functions like seating and the rest rooms along the way. The rest rooms have been designed to blend into the landscape, and are completely integrated into the surrounding earth. This design decision allows for decreased cost for heating and cooling, places the rest rooms on their own dedicated pressure zone, and creates a dual use for the roof as part of the building envelope below and a viewing platform above.

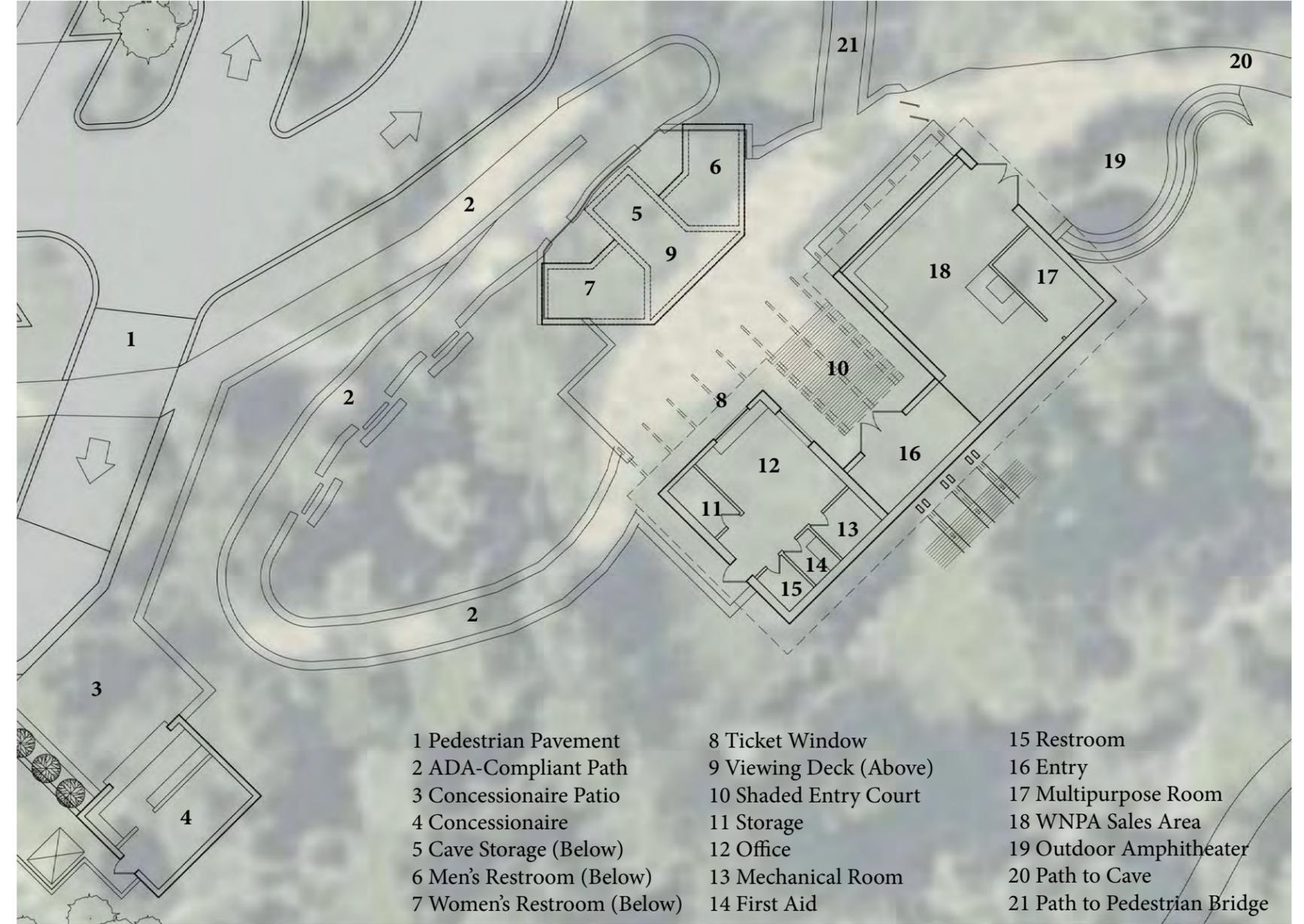
The visitor continues along the path, passing additional interpretative material, towards the Visitor Center above. The building is still partially concealed by the native vegetation until the visitor turns the last corner. The profile view first encountered by the visitor emulates the exposed cliff faces of the canyon. The concrete roof emerging from the hillside is supported by steel members that pierce the sky and cast shadows onto the ground below.

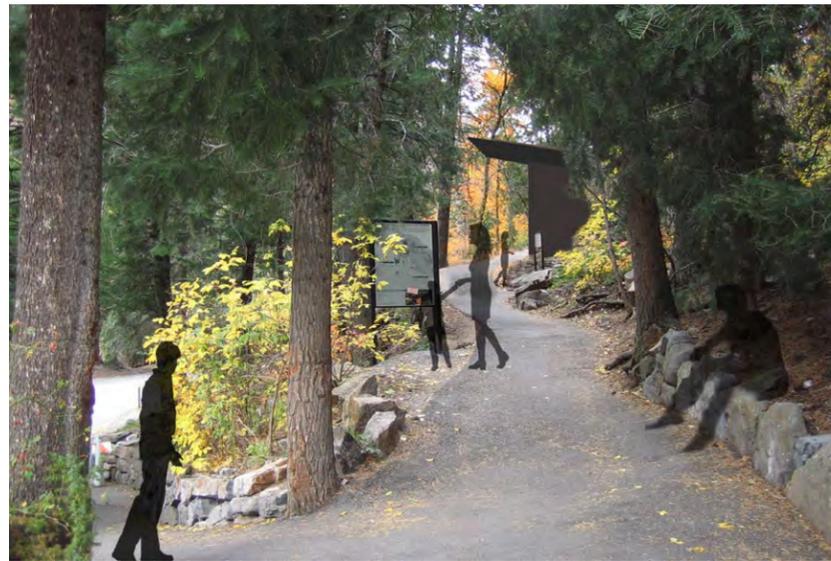
As the visitor moves underneath the shade of the overhanging roof



structure, he/she naturally finds him/herself in the line for ticket purchase. Once purchase is complete the visitor has a choice to wander towards the viewing platform over the rest rooms or to enter into the building through the exterior court, a space created by the U-shaped floor plan and protected and shaded by a steel structural lattice in place of a roof. The views from the entry space are directed towards the towering hillside beyond. In addition to the view, the covered entry court provides additional daylighting and increased ventilation into the interior spaces.

The visitor then moves into the building interior through the main doors. Here, additional interpretation displays, WNPA merchandise, a video viewing room and indoor seating options are located. Through this space and just outside of the trailhead doors lies the new outdoor amphitheater that emerges from the natural hillside. It is partially shaded by the adjacent building and the native vegetation towering above. At this point the visitor makes his/her way up the winding trail to the cave. A continuity of experience has been created: the progression through spaces of compression and release begun at the Visitor Center will be continued along the trail and through the caves.





Starting at the upper left and going clockwise around, the images on this page depict:

The re-alignment of the road provides maximized area for the needed parking demand. The site plan shows conceptual vegetation added to the parking to eliminate the pavement overpowering the site. The concessionaire has not been included in this image. The ADA-compliant path winds past the earth integrated restrooms and cave storage. The local stone walls have been utilized along the circulation path. Interpretative elements have been installed along the way to eliminate increased need for interior interpretation space within the Visitor Center. The viewing deck above shows the dual function of the restroom roof.

The Visitor Center begins to come into view. The slope of the roof emulates the slope of the layers of rock in the neighboring cliff faces. The rock walls provide additional seating along the path in the shade of the native vegetation.



The section taken through the site shows the true integration of the building components and how the layering of spaces develops. The lower building is at the same elevation as the east end of the parking lot. The rest rooms and cave storage are integrated into the hillside. The facade of the lower building along the path is composed of the same natural rock as the lower retaining walls in order to blend into the hillside more effectively. The visitor takes the ADA-compliant path from the lower level to the upper level where the Visitor Center is located.

Once on the upper level, the visitor has many options for exploration. The roof of the lower level is accessed to allow for additional gathering space as well as a viewing platform both up and down the canyon. The roof of the Visitor Center slopes to mimic the layers of rock found in the neighboring canyon walls. At its low point the roof anchors into the hillside. The lattice portion of the roof provides visitors the view of the steep canyon walls to the south. The vertical steel elements seen toward the back of the building provide structural support for the roof structure while also creating protection from potential rock fall on the site.



This image is looking southeast and displays the courtyard in front of the Visitor Center. The roof plane and structural supporting members create a strong presence over the visitor and helps to establish the perception of a cave like experience. The image shows the placement of the structural walls needed to support the roof structure. The image remains conceptual in that the remaining infill walls and glazing are not shown. These walls could be transparent in nature, blurring the line of interior and exterior enclosure. The first open space represents the office for the park rangers, the middle space is the shaded entry court leading to the main doors, and the third space in the background represents the open floor plan for the WNPA and interior visitor gathering area.



This image is a view looking southwest towards the amphitheater. The seating for the amphitheater is composed of the same stone used throughout the site for the retaining walls. It follows the curves of the natural contours of the hillside. The nearest interior portion of the Visitor Center that can be seen represents the WNPA space/open gathering space. The right portion of this image is the entry of the building where light filters in from the unfolded roof. In the lower corner, turnstiles are located to control one way traffic, helping ensure that visitors proceeding up the path have tickets. Again, the walls shown in this image represent the structural walls needed to support the roof above. The lack of infill walls and glazing demonstrates a desire of transparency from the interior to the exterior.



A further element of the final design concept is the pedestrian bridge over Rt. 92 (see item #21 of the concept plan on pg. 47). This bridge could be built as a later phase of development, and would allow visitors to cross safely from the Visitor Center over to the river, picnic area, and any additional interpretive space. The increased connectivity helps to achieve the greater integration of experience explored in the River Walk concept. It would also cause drivers to naturally slow, and act as an orienting device helping visitors locate amenities. Due to the topography to the south of the road, the bridge could connect at grade on the Visitor Center side, requiring steps and an ADA ramp or elevator only on the north side.

A GREEN ROOF RECONSIDERED

Paul Weiner, RA, AIA, General Contractor

Item #2 of the scope of work requested the following:

Determine what building design/construction techniques would be required for a soil covered living roof, and what extra costs that would add.

In order to properly address this goal, an understanding of the motivation behind the request was needed. Discussions with Monument staff revealed that a living roof was desired for rock fall protection, hillside integration, high insulation value, opportunities for additional open space and water harvesting, and to bring attention to sustainability. With these considerations in mind, the team began to research the implications of a living roof and the possible advantages of implementing one as an aspect on an overall design strategy. Ultimately, it was decided that the design objectives could be better achieved without utilizing a full living roof. However, the design does intend to become “living” in a sense that the debris and eventually plant life from the surrounding forest floor will, over time, come to cover part of the roof where it is buried into the hillside. This section will provide an explanation as to why the conceptual Visitor Center design has deviated from using a traditional green roof to using a composite roof system (concrete steel structural deck capped with a rigid insulation and waterproof membrane).

The first stage of the research process investigated the components of a living roof. This included the specific systems in terms of roof structure, drainage necessity, soil composition, vegetation, and the cost and maintenance estimates. There are two types of general assemblies: intensive and extensive. The extensive green roof system uses a thin growing medium, and has little to no irrigation, with can

present a stressful condition for plant matter. Due to the thin soil, the roof structural system would not need to be reinforced from the standard structural framing in this instance where the building is already constructed to withstand rock fall. The installation process is less technical than an intensive roof and does not generally require specialized installation contractors. However, this system has less energy efficiency benefits and does not allow for roof access.

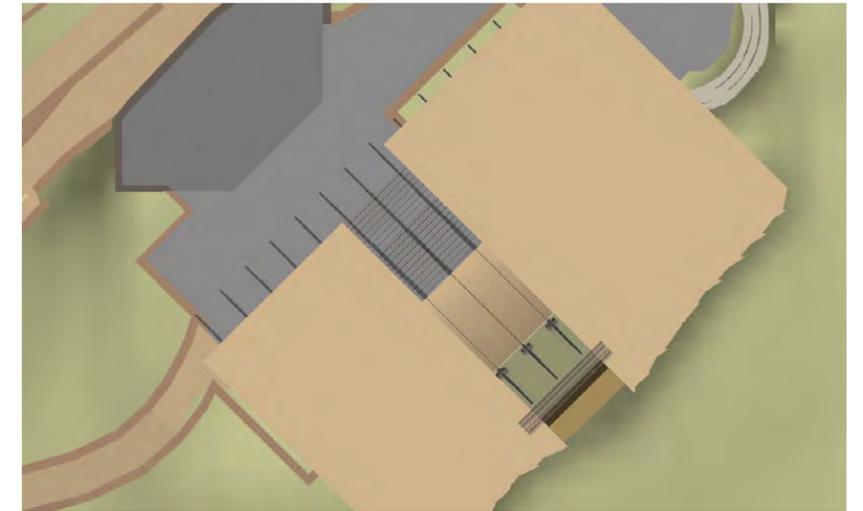
The intensive green roof utilizes deep soil, needs an irrigation system, provides a good atmosphere for plant growth, and can be an accessible space. The insulation properties of this system are greater than that of the extensive system. The other main advantage to using this system is the longer membrane life. However, the disadvantages are also great. The thick soil layer requires additional roof structure and an integrated irrigation and drainage system. The system is more complex and must be installed by specialized contractors, raising costs. Finally, maintenance costs are also higher with this system, which adds additional concern in utilizing a living roof. Once these potential benefits and drawbacks were understood, the team was able to weigh them as options for the design solution.

The design process is one of evolution. The initial design solutions assumed a living roof with an understanding that the specific systems would require research and justification. As the design evolved to properly address the spatial and conceptual considerations, the living roof became a forced element in the design that was no longer justified in terms of concept, aesthetic, and financial considerations. However, the advantages gained from a living roof needed to be incorporated in the design proposal. The final concept proposes a composite roof system which provides rock fall protection, both through the slope of the roof which extends back into the hillside

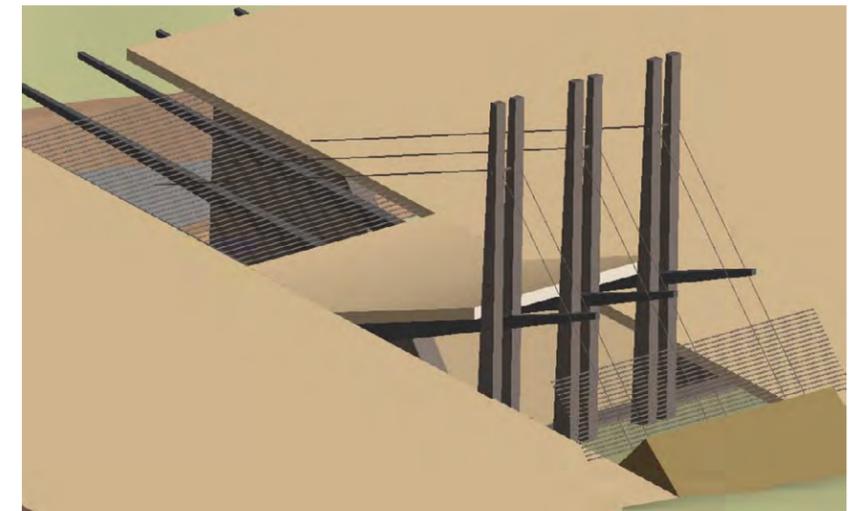
and with an integrated vertical steel element at the back, or south side of the building. The shape of the roof is “hinged” at about a third of the way along its length from the earth-integrated portion. This keeps tension on the upright steel elements, stops falling or sliding rubble, creates a place for water catchment, and beautifully captures the sense of the rugged canyon walls.

The composite concrete/steel/insulation roof system not only allows for protection from rock fall but has a high thermal resistivity and a low thermal transmittance. This creates similar advantages to the living roof. The insulation value is high, resulting in less heat gain on the interior spaces. The slope of the roof also allows for a natural venting process to occur, where the hot air on the underside of the roof can be vented towards openings in the north façade. The low thermal transmittance helps to regulate temperature extremes. The thermal mass of the composite roof will allow for mitigation of the high and low temperatures through the operating season of the Visitor Center, minimizing the need for mechanical ventilation.

The proposed formal roof design also allows for a substantial, but not complete, hillside integration. A complete building integration was determined to be impractical given the slope of the site and the structural and functional implications associated with such a solution. The final concept partially integrates the building envelope to maintain an appropriate floor to ceiling height and then to extend the roof assembly into the hillside beyond the interior building envelope. Within the proposed design, the roof deck’s concrete mass appears to emerge from the hillside, complimenting the qualities of the local rock. The primary structural steel roof members are attached to the vertical rock fall abatement members, and the entire assembly is connected to an earth-bound concrete buttress with supporting cables. The resultant roof system is lighter weight, and light-introducing.



Plan view of the Visitor Center roof. The entry court covered by the protective steel lattice can be seen in the center of the image. Where the roof meets the hillside, natural ground-cover would accumulate on the roof plane, creating a different concept of a living roof.



Perspective view of the roof assembly, looking to the northeast. The vertical steel rock fall protection elements can be seen the foreground attached to a concrete buttress set into the earth. Past them is the “hinged” portion of the roof, and then the steel lattice.

There is an opening in the roof over the covered entry court of the building. This space is protected with a lattice of steel reinforcing bars that also function as shading devices here, as well as safety railings and earth retention at other locations on the site. The lattice would protect the visitors and the glazing elements from any stray rock fall.

Conceptually, the rock fall/roof assembly reinforces the mass and function of the ground connection. Rather than literally cutting a cave into the hillside and attending to the multiple issues that would be generated by doing so, the proposed solution merges a literal earth integration with an implied integration, and renders a cost effective and site responsive solution. The proposed design allows for a more slender roof plane to emerge from the hillside that relates more towards the natural layering of the rock found within the surrounding environment. The surface of the roof plane is also more appropriate to the site. A lush green plane would be a drastic difference from the existing ground cover. The proposed design allows the roof to disappear into the hillside and, with time, will develop the same ground cover as the surrounding area.

The formal architectural/structural solution proposed is anchored within and receptive to the site context. The composition of low shrubs, decaying organic matter, field stone and top soil that defines the adjacent landscape will find its way onto the roof plane of the structure, thus integrating the built and natural elements of the site. In one way of thinking, this is a living roof in that the landscape within the canyon is in a constant state of subtle flux.

Rather than creating an artificial medium and structural assembly to sustain an introduced floral population, our solution suggests the creation of a “vessel” which is at once intended to receive the existing landscape as it evolves, and provide enclosure and protection for the visitors. One could further enhance this notion with a planting

of native understory species on the section of the roof plane that reaches out to the hillside. This approach would keep maintenance and cost down to a reasonable level. The soil-bearing roof structure would itself bear on the ground plane as opposed to the building enclosure, and any breach of the moisture barrier would occur outside the building envelope.

In terms of sustainability, the proposed roof design presents multiple advantages. The high R-Value and low U-Value provide savings by optimizing energy performance. The sloping roof surface also allows for capturing of storm water for reuse on-site. This would in turn allow for water use reduction and gain additional LEED points. The disadvantage presented by this design as regards sustainability is the visual effect a living roof elicits. While highly effective in terms of performance, the proposed roof design is not as obvious of a sustainable feature. However, we feel that this shortcoming can be supplemented with interpretive material the visitor could reference while viewing the roof plane from the trail above.

While the performance criteria are important to consider, the financial implications also need to be assessed. One can assume that the design and construction costs of an elevated, extensive, green roof system, (exclusive of structure) would run \$40 to \$60 per square foot beyond that of this proposal.

The proposed design is an appropriate response to rock fall protection, hillside integration, high insulation value and sustainable opportunities. The original concept of a living roof has been the motivation and inspiration behind the proposed design. While the materials and roof system might differ, the original goals of a living roof have been accomplished.

ENERGY ANALYSIS

In order to determine the energy savings of a sustainable building, an energy analysis needs to be completed. This analysis takes many aspects into consideration such as building orientation, climate data, materiality, insulation values of the building envelope, and the mechanical equipment servicing the spaces. Each of these aspects factors into the design and assists in maximizing the performance of the building while minimizing the dependency on energy. Multiple energy analyses can be completed during the design development phase of a project to determine the best design solutions. These design solutions are then justified in terms of the hard cost energy savings presented by the completed simulations.

To generate an accurate energy analysis there must be adequate information for both the base building and the design building. Comprehensive data, such as insulation values for each façade and the roof, the square footage of each façade, the number and size of openings, the square footage of glazing per façade, the shading strategies and the specification of the mechanical equipment used to heat and cool the space, are needed. The simulations will not run without data for all of these fields in order to guarantee an accurate representation of energy savings.

While it is an advantage to run simulations to test building design concepts during the design development phase, a comprehensive understanding must be in place to complete this task. At the time of submission of this report, the Visitor Center building was a conceptual model that represented cost estimates based on square footage values rather than per material and assembly cost. Due to this reality, the building envelope and design did not have enough representation and data to perform a proper energy analysis. What is included here in Appendix A is a basic analysis generated using

approximations in Energy-10 software. In order to demonstrate possible energy savings, these general findings are included on the following pages. These results should not be taken as authoritative, but rather as preliminary estimates. It should also be noted that energy conscious decisions were made throughout the conceptual design process.

The initial conceptual designs presented two building sites. The first site was located adjacent to the river within the 100 year flood plain. This site required an elevated building that exposed every façade of the building to heat loss and gain including the floor plane. The flood plain location did present the design with passive solar and passive ventilation opportunities, but they were not dramatic enough to overcome the complications of construction within a high hazard zone.

The second site placed the building across the road from the river. A discussion occurred in which a determination was made to design the building with earth integration along the south façade. This decision was made to not only maximize the available parking area, but as a conscious design decision to maximize the energy efficiency of the building envelope. With the topography information provided, it was determined that a cut and fill approach to the building site would allow for full height integration along the south façade. The geothermal advantages of a single wall integration are not substantial, but using the earth as an insulation material provides a great increase to a standard cavity wall construction or frame and infill wall system. A basic cavity wall construction can struggle to achieve a resistivity value (R-value) higher than 10. A frame and infill wall system can achieve R-values close to 20. A wall that is integrated into the earth can achieve R-values up to 40.

APPENDICES

There are other considerations that need to be weighed with an earth integrated wall. There is an issue regarding moisture management and ensuring the proper techniques are utilized to guarantee moisture will not penetrate the wall system. Another consideration is that of ventilation, and ensuring the natural release of subsurface gas is not ventilated into the building. A third concern is excess insulation in a wall system. Typically the south façade of a building presents opportunities for passive solar heating. These strategies were dismissed with this building site due to the fact the Visitor Center will not be open in the winter when the heating demand is the greatest; the dense vegetation would provide too much shade to allow sunlight penetration; and the shadow cast from the mountain itself does not allow for solar gain on the south wall of the canyon. All of these considerations provide justification for integrating the building into the hillside to maximize the insulation properties of the sloped earth.

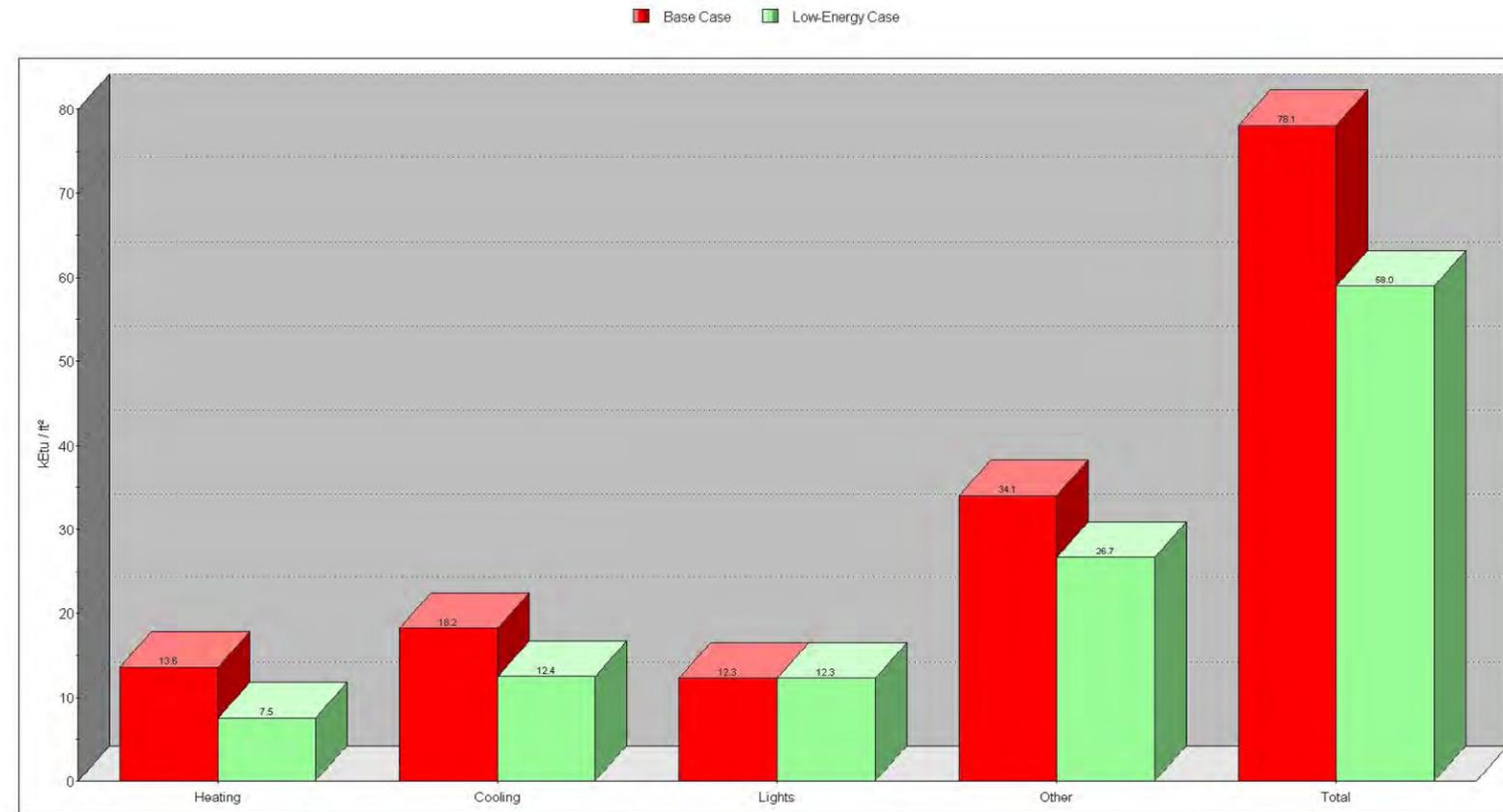
Additional sustainable features were developed with the final design concept. The angle and slope of the roof work both as a conceptual link to the surrounding rock wall formations and as a natural cooling strategy. The fact that the roof emerges from the hillside helps to create passive ventilation for the interior spaces by allowing a natural stack effect to occur. The hot air on the interior of the space continues to rise with the slope of the underside of the roof. Vents can be located along the top of the north façade to eject the hot air from the space. This strategy is assisted with the opening of the roof at the point of entry. As the roof becomes porous (steel lattice) to allow the incoming visitor a view up the dramatic slope of the hillside, ventilation opportunities are also presented. Wind currents traveling down the hillside can be channeled through the opening and provide fresh air into the space. This air circulation would flush the hot air out of the upper wall vents. Without this roof opening, mechanical ventilation would need to be introduced at the base of the southern façade to assist the natural stack ventilation.

Simulations from energy analysis programs are ideal for determining the extent of improvement in administering sustainable design solutions. When a formal design is developed for the building envelope, these strategies will supply additional advantages in the energy analysis simulations.

This section contains two appendices. Appendix A is the preliminary energy analysis evaluating the outcome of partially integrating the Visitor Center into the hillside as is proposed in the Final Concept. Appendix B is the preliminary cost estimate prepared by Paul Weiner, RA, AIA, General Contractor, which includes all the building elements of the Visitor Center as well as the proposed pedestrian bridge over Rt. 92.

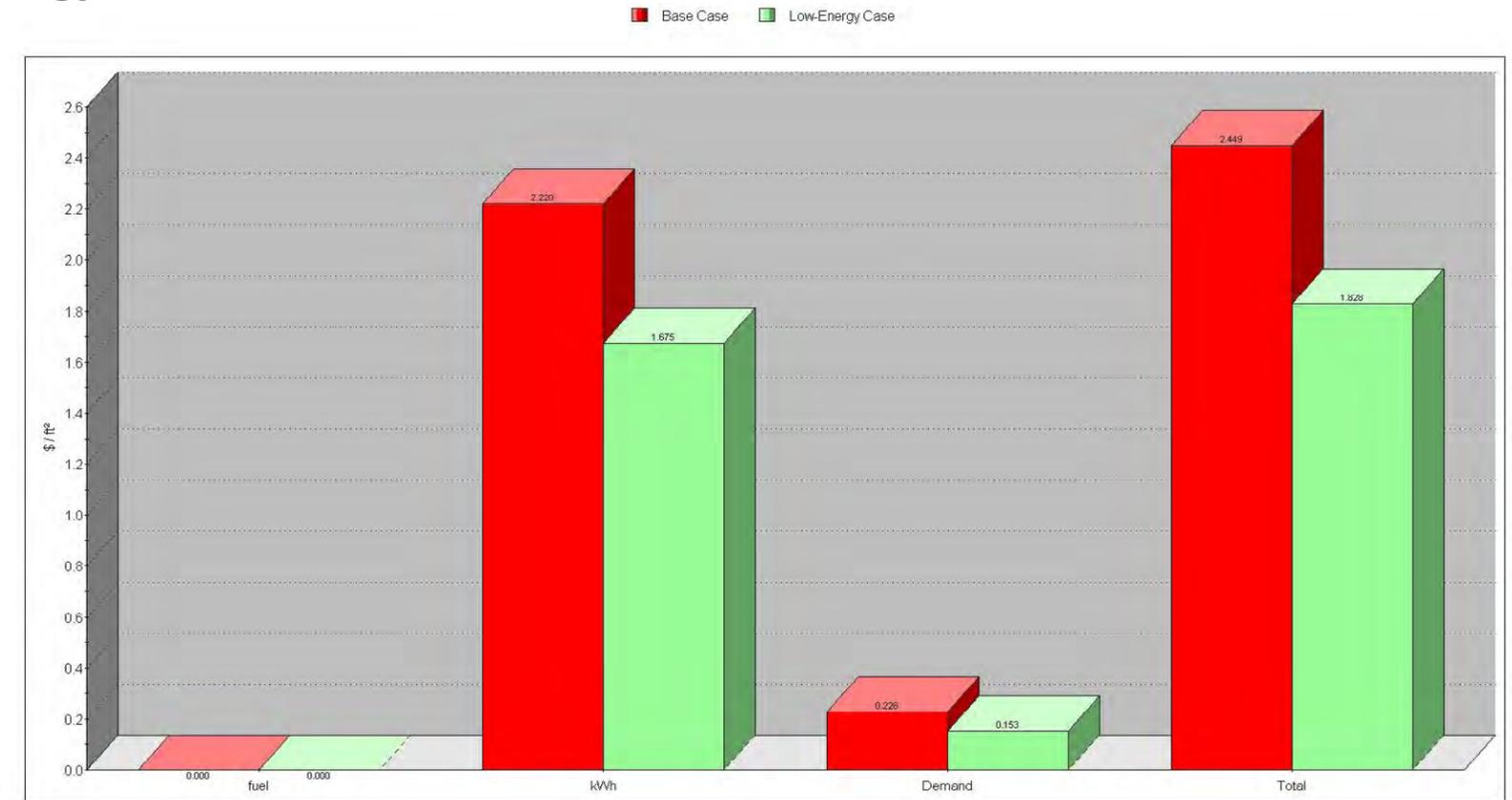
Appendix A: Energy Analysis

Energy Use



This graph represents the energy use of the base building (red) and the low energy building (green). The base building is the basic building that satisfies the programmatic elements at a minimal scale. The low energy building has the same dimension and orientation as the base building but low energy strategies are applied. The results of this graph show how the assumptions for building materials dramatically reduce the demand for heating, cooling and other energy demands of the structure. The base building is composed of a non-insulated concrete slab, concrete masonry unit walls, roof insulation that meets code, single-pane windows and standard mechanical equipment. The low energy building is composed of an insulated concrete slab, earth integrated south wall, rasta exterior walls, maximum roof insulation, multiple-pane windows with low-E properties, and energy efficient mechanical equipment. The bar representing lighting remains equal because internal lighting equipment has not been established.

Energy Cost



With the assumption that all mechanical equipment will be electric, this graph represents the fuel cost between the base building and the low energy building. The fuel category remains at zero due to only using electric equipment. The significant difference between the total energy demands shows how applying energy solutions are advantageous. Once building materials and methods have been determined, running this simulation would allow for a cost analysis to be preformed. The cost analysis would determine the life-cycle cost and the time it would take for the payback on the up-front costs of energy efficient components.

Appendix B: Cost Estimate

TICA				
Cost Estimate				
<u>Parking lot</u>				
Curbing	2259	linear feet	\$ 10.00	\$ 22,590.00
Pavement	39432.5	sf	\$ 1.50	\$ 59,148.75
Path	1280	sf	\$ 15.00	\$ 19,200.00
Rock fall retaining wall	190	linear feet	\$ 200.00	\$ 38,000.00
Subtotal Parking				\$ 138,938.75
<u>Landscaping</u>				
Vegetation	30	or so full size trees	\$ 1,000.00	\$ 30,000.00
Retaining wall	694	Linear Feet	\$ 75.00	\$ 52,050.00
Paved path	2040	340'-0" @ 6'-0" wide	\$ 10.00	\$ 20,400.00
Subtotal Landscape				\$ 102,450.00
<u>Concessionaire</u>				
Patio	601		\$ 15.00	\$ 9,015.00
Floor SF	414		\$ 200.00	\$ 82,800.00
Wall SF			\$ -	\$ -
Subtotal Concessionaire				\$ 91,815.00
<u>Restrooms</u>				
Floor SF	715	SF	\$ 200.00	\$ 143,000.00
Wall	135	Linear Feet	\$ -	\$ -
Subtotal Restroom				\$ 143,000.00
<u>Main Building</u>				
Roof	3183	SF	\$ 50.00	\$ 159,150.00
Structural Roof Members	14	custom members		

Cables over entry					536.5	linear feet (37 @ 14'-6")		
Roof Cables					198	linear feet		
Rear protection cables					195	linear feet		
Rear Structural Posts					6	26-0" tall		
Amphitheater					150	linear feet	\$ 25.00	\$ 3,750.00
Exterior Pavement					3872	sf	\$ 15.00	\$ 58,080.00
Patio Railing over RR					70	linear feet	\$ 30.00	\$ 2,100.00
Floor Area					1923	SF	\$ 300.00	\$ 576,900.00
office					667			
entry					240			
main public					1016			
Wall Perimeter					275	linear feet		
Wall SF		north	east	south	west	3227	Total SF	
office		360	334	275	334	1303	SF	
entry		288		144		432	SF	
main public		496	393	338	265	1492	SF	
Glazing						96	SF	
Doors								
interior						4	single solid wood core	
exterior						2	Double, glazed	
						1	single hollow core metal	
Interior Walls						75'4"	Linear feet	
Subtotal Main								\$ 799,980.00
<u>River Connection</u>								
Path					792	SF (132 LF x 6'-0")	\$ 10.00	\$ 7,920.00
Bridge					400	Span	\$ 200.00	\$ 80,000.00
Platform					400	SF	\$ 100.00	\$ 40,000.00
Stairs					22	Tread		\$ 15,000.00
Path Along River					1944	SF (324 LF x 6'-0")		
Landscape walls					240	LF	\$ 75.00	\$ 18,000.00

PRESERVATION
S T U D I E S



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