



# CENE 476 - Project Proposal

## Montezuma Castle National Monument Parking Lot Redesign

By: Fahad Alkhalidi, Brian Hernandez-Ng, Rae Johnson, Andrew McLaughlin, Jacob Robinson,  
Cayla Washington



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## Table of Abbreviations

**ADA:** Americans with Disabilities Act

**CSP:** Corrugated Steel Pipe

**FEMA:** Federal Emergency Management Agency

**FHA:** Federal Highway Association

**GIS:** Geographic Information System

**GPS:** Global Positioning System

**Hr.:** Hour

**LIDAR:** Light Detection and Ranging

**Min.:** Minute

**MCNM:** Montezuma Castle National Monument

**MTE:** Multicultural Technical Engineers

**NOAA:** National Oceanic and Atmospheric Administration

**NPS:** National Park Services

**RV:** Recreational Vehicle

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## Acknowledgments

The Multicultural Technical Engineers (MTE) would like to thank and acknowledge: 1) Richard Geoprigh Jr., the facility manager at Montezuma Castle National Monument for coordinating site visits and offering assistance as needed. 2) Stephen Irwin for providing excellent guidance on technical aspects of our project. 3) Alarick Reiboldt (Lar) for keeping the team on track through the grading process and providing the resources to get the team to and from the project site. 4) Lar and Mark Lamer for providing assistance in the teams presentation skills.

## 1.0 Project Introduction

The Montezuma Castle National Monument is in central Arizona along the I-17 Highway in Camp Verde. Figure 1 displays the location of Montezuma Castle National Monument in Arizona. Figure 2 displays the parking lot to be redesigned. The team will closely be working with the National Park Service. Our client, Richard Goepfrich Jr., who is the facility manager at Montezuma Castle, has the following concerns about the existing conditions of the visitor parking lot: poor striping and signage, no accessible picnic area for visitors, poor pedestrian facilities, no bus drop off area, and insufficient space for large quantities of buses/RV's and passenger cars. Due to these limitations, when the parking lot fills up, visitors are forced to park on the road shoulder during busy visitation days or even turned away from the site. Frequently, buses giving field trips will have to idle at the Cliff Castle Casino approximately 2.7 miles away.



Figure 1: Statewide view of Montezuma Castle National Monument in Arizona



*Figure 2: Parking Lot to be Redesigned*

## **1.1 Project Objectives**

The objectives of this project are to:

- Provide a design for improved parking lot layout through a striping and signage plan.
- Provide a design for a new bus, RV, and overflow parking lot.
- Provide a design for bus drop off zone in the existing lot.
- Provide a design for additional sidewalks for pedestrian usage.
- Provide a plan to increase sidewalk usage through improved pedestrian facilities including striping and signage.
- Design a usable and accessible picnic area in the existing center island with an interior sidewalk.
- Verify that proposed changes do not affect the archaeological, ecological, and natural characteristics of the surrounding area through following applicable codes.
- Improve aesthetic appearance of the existing center island in the existing parking lot.
- Not change the existing road alignment that enters/exits the park.
- Provide a safe stopping sight distance and road conditions for drivers turning into and out of the proposed parking lot.
- Determine if a controlled intersection is required for safety of traffic leaving the monument and parking lots.

The intent of this project is to improve the overall accessibility of the Montezuma Castle National Monument parking lot in accordance with the design code for the Federal Highway Administration and applicable ADA regulations. These improvements are: to provide more parking spaces reflective of the traffic flow and projected growth of the site, design a picnic area that will be available for visitors, improve facilities for pedestrians within the parking area, and

provide better accommodations for large vehicles with a drop off zone and additional parking facilities.

## 1.2 Project Understanding

The following section will provide background on Montezuma Castle National Monument, the current conditions of site, and technical aspects for this project.

### 1.2.1 Site Background

Montezuma Castle is home to some of the most magnificent cliff dwellings made of local clays, wood, and stone created by the Sinagua people. Estimated to be nearly 800 years old, the structure consists of 45 – 50 rooms that are hidden in the side of the cliff walls. A significant amount of artifacts found within the ruins of the once thriving culture and are now on display at the visitor center of the park [1]. Since Montezuma Castle is in a relatively hidden location it quickly became an adventure from reality for many. On December 8, 1906, Montezuma Castle was officially registered as a National Monument under the authority of President Theodore Roosevelt. Since then it has continued to attract visitors and grow as a landmark of the Southwest.

The peak visitation months for the park are March, April, and October. Figure 3 below conveys the number of visitors for the year of 2016. These months attract visitors for their cool, moderate temperature compared to alternate times of the year. The most popular month was March at 52,776 visitors. The lowest three months are December, January, and August, mainly because they offer the harshest of temperatures from both freezing to heat. The least visited in a month was December at 21,874 visitors. These counts include employee, non-recreational and recreation vehicles on top of the passenger car total.

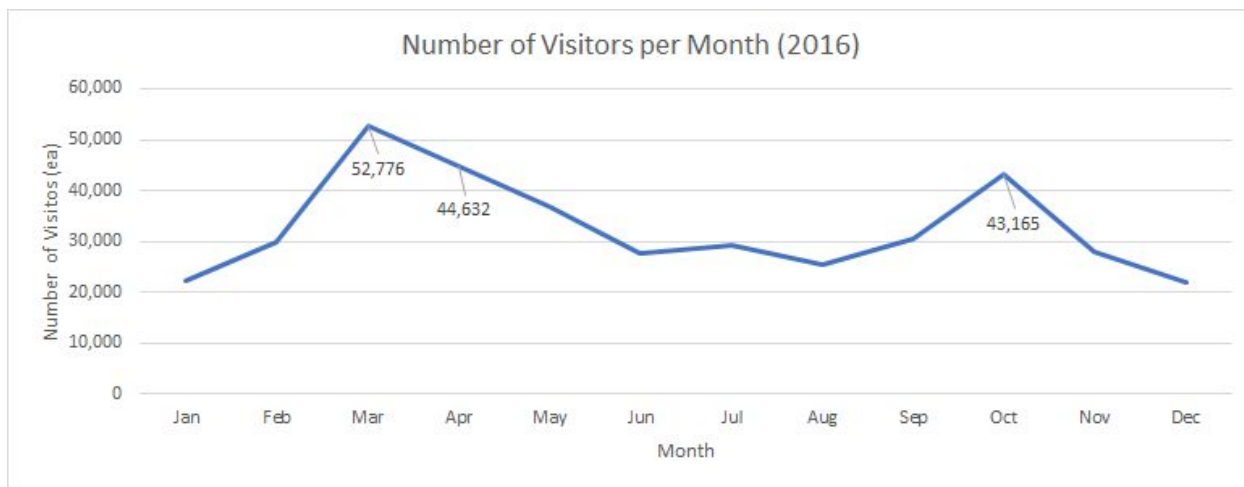


Figure 3: Number of Visitors of Montezuma Castle per Month



### 1.2.2 Site Description

The parking lot is currently equipped with 60 regular parking spaces, four ADA parking spaces, and four large spaces available for buses/RV's. In the middle of the parking lot there is a small vegetation area. Being that buses/RV's share the parking lot with passenger cars, it is difficult for large vehicles to safely navigate the tear-dropped shaped bend due to their high turning radii, which poses safety threats to passengers and visitors. Pictures of the existing conditions of the site are available in *Figure 4* and more pictures are available in Appendix I.



*Figure 4: Existing Site Features*

The surrounding topography of the existing parking lot are steep, leading to a very deliberate existing design that fits within the natural features of the area. Beaver Creek, a nearby stream, flows into the Verde River southwest of the site. All existing runoff from the impervious surfaces of the existing parking lot currently flow into Beaver Creek. To assist in the comprehension of the features on site, an existing site schematic has been prepared. The schematic conveys existing passenger car parking, bus/RV parking, the vegetation area, the existing intersection, and beaver creek which runs adjacent to the site. The schematic shows a birds-eye view of the area and it available in Appendix I. The site schematic was developed in BlueBeam Revu.

### 1.2.3 Technical Aspects

The project has several aspects that will require technical expertise. These technical aspects include: surveying, drainage analysis, drafting, and complying with regulations/codes, which the primary areas of focus.

### **1.2.3.1 Site Survey**

A topographic site survey is critical because of the precarious location of the site and its unconventional arrangement of natural features. The boundaries of the existing parking lot appear to be steep, which explains the unorthodox design. This could potentially cause problems for the new proposed parking lot. It will be important to get precise topographic information to have a clear understanding of the existing conditions. Using GPS surveying technology, the team expects to survey 350-400 points.

### **1.2.3.2 Drainage Analysis**

A drainage analysis of the site will involve considering the changes in impervious area and determining the effect of storm water flow as a result of the proposed design. The site is a National Monument and therefore site design will be under federal jurisdiction, specifically the Federal Highway Administration. For this site, it could become challenging as there is a nearby water source where drainage will end up unless directed elsewhere. If the governing requirements do not allow stormwater to drain to this nearby river, a detention basin may have to be designed to accommodate drainage. There could be potential need for an environmental study evaluating the runoff, which will have to fall outside of the scope of this project.

To assist in the Hydraulics and Hydrology analysis of the site, the team will contact the GIS department in Yavapai County. The team will seek recent LIDAR data in the area which will convey

### **1.2.3.3 Site Plan Design**

Design software such as AutoCAD and Civil 3D will be critical to delivering the final set of construction documents for this project. This construction documents will convey the complete Site Plan Design. Ultimately the goal is to produce a set of plans that can effectively show the proposed changes to the site. The team will have to rely heavily on survey and drafting skills to produce an acceptable set of plans. The complete set of plans will include: a cover sheet, general notes conveying applicable FHA codes, site details, grading/drainage plan, and improvements/demolition plan. The grading/drainage sheets will convey new surfaces and vertical control along with proposed storm drainage containment. The improvements/demolition plan will convey new striping and signage along with any new curbs, gutters, sidewalks, a drop off zone, pedestrian facilities, and any demolition needed to the existing lot.

#### **1.2.3.4 Governing Regulations and Codes**

The site is in an interesting jurisdictional position. Though it lies in Yavapai County, research indicates that the National Monument is on federal land. Therefore, all components of the design will be compliant with federal standards. Specifically, the Federal Highway Administrative codes [2]. In design, it is important to have a set of codes to abide by that give direction to the general development of the site.

#### **1.2.4 Potential Challenges and Limitations**

The following section discusses the potential challenges the team will encounter during the project. Firstly, the leading challenge the team will face is coordination of all schedules. The team contains six members, which is 1.5 times the typical capstone team. Coordinating each other's schedules to where all members can meet at one time will present problems. For example, conflicting class schedules and work schedules will make meeting times difficult. Secondly, a prominent potential challenge is travel constraints. Montezuma Castle National Monument is located 53 miles South of Flagstaff. Not all team members have access to a personal vehicle, therefore this will make site visits more difficult. Minor challenges for the group include harsh weather impacts and limiting factors of the department such as building availability, limited computer availability and other resource availability such as survey equipment.

## **2.0 Technical Analysis**

The following sections will provide insight on all of the technical design work that is required to be completed for this project.

### **2.1 Field Work**

The following subsections will discuss the field work that be performed for preliminary design.

#### **2.1.2 Site Reconnaissance and Analysis**

Before any design can begin, the team will need to become experts of the site and its surrounding features. To do this, multiple site visits are necessary. Per the schedule of the project, a minimum of three site visits will take place. During these site visits, a site survey will take place, team members will walk the site and note all hydrologic features such as culverts, drainage basins, etc., and data collection regarding traffic analysis will be performed. The team may also need to be on site for a client meeting.

### **2.1.3 Site Survey**

The team

## **2.3 Hydrology & Hydraulics**

### **2.3.1 Existing Drainage Basin**

### **2.3.2 Proposed Drainage Basin**

## **2.4 Traffic Analysis**

### **2.4.1 Vehicle Type**

### **2.4.2 Vehicle Duration**

### **2.4.3 Stopping Sight Distance and Turning Movements**

### **2.4.4 Pedestrian Movements**

## **2.5 Codes and Regulations**

## **2.6 Design Alternatives**

### **2.6.1 Design Matrix**

## **2.7 Final Design**

### **2.7.1 Cost of Implementation**

### **2.7.3 Statistical Analysis**

## **3.0 Summary of Engineering Work**

## **4.0 Summary of Engineering Costs**

## **5.0 Conclusion**

## **6.0 References**

[] “Park Statistics,”

## **7.0 Appendices**

### **7.1 Construction Plans**

#### **7.1.1 General Notes (FHA Standards)**

#### **7.1.2 Site Details**

#### **7.1.3 Grading and Drainage**

#### **7.1.4 Improvements**