LAKE PUEBLO
ACCESS IMPROVEMENT
PUEBLO, COLORADO

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A report submitted to the University of Colorado at Denver, Civil Engineering Department in partial fulfillment of the Senior Design course

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Dedication and Acknowledgement

POAST Eng. would like to thank James Herlyck, Adam Rosener, the Bureau of Reclamation, and the Federal Highway Administration – Central Federal Lands Highway Division for their support and guidance throughout the Lake Pueblo State Park (LPSP) Intersection Improvement project.

Professor Peter Marxhausen for the continued guidance throughout this semester to make this project possible.

University of Colorado Denver Civil Engineering Department for giving their future civil engineers the tools to succeed in their future endeavors.
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May 2021

Mr. Adam Rosener  
Central Federal Lands Highway Division (CFLHD)  
12300 W Dakota Ave  
Lakewood, Colorado 80228

RE: Final Report of Findings and Recommendations  
Lake Pueblo Access Improvements  
Lake Pueblo State Park, Pueblo, Colorado  
640 Pueblo Reservoir Rd, Pueblo, CO 81005

Dear Mr. Rosener,

Team POAST would like to thank you and the Central Federal Lands Highway Division for providing a design opportunity in the Lake Pueblo State Park for our Senior Design project. It is our understanding you wish to create a safe pedestrian trail to make Lake Pueblo State Park more accessible to the local residents and the expansion and pavement of Nichol’s Road. The mission of our involvement was to provide design ideas to alleviate traffic congestion turning into McCulloch Boulevard and provide a safe walking trail for local residents. As part of our investigation, we performed a site visit on March 6th, 2021. In this site visit we were able to take specific measurements, walk the trail we were to design, and gain a better perspective for our project. This report contains our findings, conclusions, and recommendations for Lake Pueblo State Park.

Sincerely,

POAST Eng.
Section 1: Introduction

Lake Pueblo State Park is in Pueblo, Colorado, and is one of the state’s most visited state parks with over two million visitors every year. The state park was created in 1975, making it a more recent establishment. The only entrance through the North side of Lake Pueblo is located through Nichol’s Road intersecting with McCulloch Boulevard. The intersection only has one lane each way, congesting the area with traffic as turning left can be difficult. These two main access roads create a T-Intersection where there is no traffic control system other than a stop sign facing Northbound Nichol’s Road.

There is not a safe way to commute on foot or bike to the state park at this moment from Pueblo West to Lake Pueblo State Park. This requires residents to commute to the park by vehicle adding unnecessary traffic counts to the area. The main point of access to Lake Pueblo State Park access is through I-25 to Pueblo and US Highway 50.

The Lake Pueblo Access Improvement Project includes the expansion of Nichol’s Road turning into McCulloch Boulevard as well as a safe walking and cycling trail to incentivize the residents of Pueblo West to commute to the state park through a mode of transportation that does not include a vehicle.
Section 2: Project Background

Lake Pueblo State Park is in Pueblo County in the Pueblo West Area. The state park consists of 60 miles of shoreland, 10,000 acres of land, 2 full-service marines, for a total of 16.02 square miles as well as many recreational activities offered. Lake Pueblo State Park was established in 1975 opening itself to its visitors on July 1st of that year. The state park is also the habitat of many protected wildlife creatures. This will be taken into consideration when determining the construction time and schedule. Lake Pueblo State Park receives over two million visitors per year, and that number is increasing every year. Lake Pueblo Reservoir is a man-made reservoir that serves as flood control for the Pueblo Area as well as a water supply for municipal and industrial use.

One challenge is the increasing visitation and demand of the park. With the many amenities, the park offers the visitation increases and many informal agreements have happened between the Colorado Parks and Wildlife. There are many stakeholders involved in the Lake Pueblo State Park like the U.S. Bureau of Reclamation, Pueblo County, City of Pueblo, Pueblo West Metropolitan District, Pueblo Board of Waterworks, Goodnight Barn Restoration Stakeholders, Southeastern Colorado Water Conservancy District, Southern Colorado Trail Builders Club, Rocky Mountain Back Country Horseman Association, Trout Unlimited, Greater Pueblo Chamber of Commerce, and Destination Pueblo. There are many stakeholders or partners involved in the Lake Pueblo State Park improvements.
There is currently a long-term agreement started in 1975 when the park was opened that the U. S. Bureau of Reclamation that the Colorado Parks and Wildlife are responsible for the operation, management, and administration of Pueblo Reservoir, also known as Lake Pueblo State Park.

The Lake Pueblo Access Improvement Project is located about 2 hours away south of Denver. It is a T-shaped intersection with Nichols Road being the main road and the entry access road is McCulloch Boulevard. The intersection turning southwest can get very busy and back up the entire traffic flow for Nichols Road as it is only a one-lane road. Some potential limitations are private property surrounding the intersection, which might need to be acquired for expansion. This is also considered federal land as it is shared with the United States Bureau of Reclamation, there is a current challenge between them and local authorities to be able to assist in rehabilitating area and operating expenses. As park traffic increases to over two million visitors each year, the state park needs to have a specific point of access as Nichols Road and McCulloch Boulevard are the most used entryway to the park. Traffic can be alleviated by expanding the road as visitor counts increase from local, state, and out-of-state residents.

We have been provided with traffic counts in the area and have determined the dire need for the expansion, because it is a smaller intersection there are multiple opportunities for different designs.
From the first observation it appears that hot mixed asphalt was poured on an existing subgrade without any earthwork done to prevent shifting of pavement, and able to withstand the daily traffic counts. There have been minimal revisions to the existing road, assuming that the original design was for a twenty-design year period the area is well overdue for reexamination to be upgraded to withstand current loads.

The secondary scope of the project is to create a pedestrian trail that goes from Pueblo West Highschool to the entryway of Lake Pueblo State Park. With current traffic counts increasing there is no safe way for the residents of Pueblo to walk to the state park. In the event of the pedestrian trail created, traffic counts are expected to be reduced greatly as Pueblo residents may walk to the trail beginning at Pueblo West and bike, or horse ride there. Considering that Pueblo is a rural area we must consider all types of commute other than by foot. The trail must be wide enough to accommodate bikers, equestrians, and residents who choose to walk.

The mission of our involvement is to provide potential design recommendations to the Federal Highway and Land Administration to expand and redirect traffic turning onto McCulloch Boulevard as well the grade differentiated pedestrian trail.

Section 3: Purpose

Since the opening of Lake Pueblo State Park in July of 1975, the visitation and demand for the park’s amenities have grown exponentially creating a need for improvements to the entire state park. Our engineers are currently examining the area designated to POAST Eng. which starts at Pueblo West Highschool and goes to the entrance of the state park.
There is currently an at-intersection at McCulloch Boulevard and Nichols Road where McCulloch Boulevard is a single lane that accommodates traffic heading straight through as well as people turning left. Currently, there is not a designated left turn lane, which can back up the traffic heading north through McCulloch Boulevard. The Nichols Road pavement structure has to be redesigned as well, the road seems to be past its typical 20-year design period and there is a lot of damage and cracking in the pavement.

There are a lot of trailers and boat users that use this access road which increases the weight that a normal residential pavement structure would endure. There is a need for a pedestrian trail from Pueblo West Highschool to the entrance of the state park to make it more accessible by bike, equestrian riders, and residents who decide to walk. This trail will alleviate traffic in the t-intersection as well as parking in the state park. The trail will be shared by the equestrian riders, bikers, and walking residents. This trail includes a pedestrian bridge that is to go over the Union Pacific Railroad tracks. There is currently a traffic bridge, but it is very limited in the space available and is not safe for the mentioned pedestrians to use. The POAST Team will deliver a design for the expansion and traffic improvements to the Nichols and McCulloch Boulevard intersection as well as a complete design of the Pedestrian trail from Pueblo West Highschool to Lake Pueblo State Park, a pedestrian bridge, as well as a pavement design for the existing structure. The team will also prepare a preliminary cost for the project and a construction sequence which includes scheduling.
Section 4: Jurisdictions Having Authority

Lake Pueblo State Park is under the jurisdiction of the United State Bureau of Reclamation and the Colorado Parks and Wildlife. Nichols Road and McCulloch Boulevard are under the Jurisdiction of Pueblo West Metropolitan District.

Section 5: Applicable Building Codes

U.S. Department of Transportation Federal Highway Administration Federal Lands Highway

Tubular Steel-Backed Timber Bridge Rail 556-1

Wheelchair Ramp Curb Cut Standard 615-1

Colorado Park Road Standards

Colorado Department of Transportation

Colorado Bridge Enterprise

Pueblo County

Chapter 16.76 General Engineering Specifications

Federal Emergency Management Agency

Flood Zone Designations

US Department of Transportation (USDOT)

Roundabouts: An Informational Guide - Chapter 3: Planning - US Department of Transportation (USDOT)

Roundabouts: An Informational Guide - Chapter 6: Geometric Design - USDOT
Section 6: Findings
Section 6.1 Traffic Analysis

Traffic Volume and Crash History

Case Number: 22789

This accident took place at Nichols Road South at Garcia Court on dated: 10/3/2015 04:35 A.M having one injury and no fatality. Only one vehicle was involved in the accident and the person driving the vehicle was 21 years of age. The vehicle ran off the road on the left side due to overturning at a road intersection, straight On-level road contour, having blacktopped road surface in dry condition however insufficient /dark lightning conditions were present on the road. Weather conditions were fine, and the vehicle involved in the accident was a Pickup truck/Utility van traveling north, making a left turn. The most apparent driver contributing factor was DUI however accident was non-collusive and no defects in the vehicle occurred due to this accident.
Case Number: 10533

This accident took place at Nichols Road and Bella Casa Drive on date: 05/11/2018 at 06:27 P.M having no injury or fatality. Two vehicles were involved in the accident and persons driving the vehicles were 50-62 of age. Vehicles crossed the center median into opposing lanes and collision occurred front to rear on non-intersecting, curved On-Grade road contour having blacktopped road surface in dry condition and daylight. Weather conditions were fine, and the vehicles involved in the accident were motorcycle traveling north and passenger car/van traveling south-going straight, both at maximum speed limit which is 35 mph. This accident most probably occurred due to careless driving of motorcycle and other factors however no defects in both vehicles occurred due to this accident.
**Summary of Traffic Volume at Various Locations:**

Brief summary of traffic volumes at various locations at different time intervals is given in the below table.

<table>
<thead>
<tr>
<th>Location Name</th>
<th>Traffic Report Duration</th>
<th>Total Vehicles</th>
<th>Daily Average of Vehicles</th>
<th>Peak Hours</th>
<th>85th Percentile Speed (mph)</th>
<th>% over Speed Limit</th>
<th>Max. Vehicle Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nichols and Bella Casa</td>
<td>04/09/2019 to 04/16/2019</td>
<td>13,803</td>
<td>1,804</td>
<td>7:00 A.M 5:00 P.M</td>
<td>40</td>
<td>74.4</td>
<td>Medium (96.9 %)</td>
</tr>
<tr>
<td></td>
<td>07/18/2019 to 07/25/2019</td>
<td>20,617</td>
<td>2,782</td>
<td>11:00 A.M 5:00 P.M</td>
<td>40</td>
<td>74.4</td>
<td>Medium (95 %)</td>
</tr>
<tr>
<td>1133 S Nichols</td>
<td>07/18/2019 to 07/25/2019</td>
<td>21,078</td>
<td>2,842</td>
<td>11:00 A.M 5:00 P.M</td>
<td>39</td>
<td>86.1</td>
<td>Medium (96 %)</td>
</tr>
<tr>
<td></td>
<td>04/09/2019 to 04/16/2019</td>
<td>14,128</td>
<td>1,842</td>
<td>7:00 A.M 5:00 P.M</td>
<td>39</td>
<td>83.5</td>
<td>Medium (95.8 %)</td>
</tr>
<tr>
<td>889 Capistrano FLAP</td>
<td>03/22/2019 to 03/29/2019</td>
<td>8,904</td>
<td>1,203</td>
<td>7:00 A.M 3:00 P.M</td>
<td>46</td>
<td>95.4</td>
<td>Medium (96.9 %)</td>
</tr>
<tr>
<td>889 Capistrano</td>
<td>06/20/2019 to 06/28/2019</td>
<td>6,903</td>
<td>792</td>
<td>11:00 A.M 5:00 P.M</td>
<td>46</td>
<td>95.3</td>
<td>Medium (96.6 %)</td>
</tr>
<tr>
<td>McCulloch and Caliente</td>
<td>04/01/2019 to 04/08/2019</td>
<td>22,416</td>
<td>2,963</td>
<td>7:00 A.M 3:00 P.M</td>
<td>49</td>
<td>39.2</td>
<td>Medium (95.8 %)</td>
</tr>
<tr>
<td></td>
<td>07/09/2019 to 07/16/2019</td>
<td>20,099</td>
<td>2,664</td>
<td>10:00 A.M 5:00 P.M</td>
<td>48</td>
<td>39.5</td>
<td>Medium (96 %)</td>
</tr>
<tr>
<td>873 W McCulloch Blvd</td>
<td>04/01/2019 to 04/08/2019</td>
<td>31,524</td>
<td>4,176</td>
<td>8:00 A.M 4:00 P.M</td>
<td>46</td>
<td>19.5</td>
<td>Medium (96.1 %)</td>
</tr>
<tr>
<td>873 W McCulloch</td>
<td>07/09/2019 to 07/16/2019</td>
<td>32,126</td>
<td>4,283</td>
<td>9:00 A.M 5:00 P.M</td>
<td>46</td>
<td>18.4</td>
<td>Medium (95.9 %)</td>
</tr>
</tbody>
</table>
It can be observed from the above-mentioned data that ‘873 W McCulloch’ had maximum traffic volume having the lowest percentage of speed limit violations i-e around 19% whereas ‘889 Capistrano’ had minimum traffic volume with the highest percentage of speed limit violations i-e around 95%. Peak traffic hours of all locations are almost the same i-e 7:00/11:00 A.M and 3:00/5:00 P.M. Moreover, major traffic volume comprises medium class vehicles (around 96%) at all locations.

**Section 6.2: Roadway Design**

**Proposed Nichols Roadway Design**

As proposed design for this project, we recommend to rehabilitated and narrow Nicholas road. Nichol’s road is functionally classified as a local and major collector respectively. The ADT on Nicholas road is approximately 1663 with a 20 yr. projection of 2300. The seasonal ADT is 3750 with a 20 yr. projection of 5100. Most of the horizontal alignments on Nichols Road are adequate to have it as a 35 miles per hour design speed road.

**Nichols Road Parameters**

- A standard lane width of 11.0 feet
- 2.0 foot of the buffer space.
- 2.0 feet of the shoulder width.
This figure illustrates how variations in shoulder width can affect safety on rural two-lane streets. The "x" axis is labeled "Average Daily Traffic Volume (vehicle/day)," and is marked in increments of 500; 1000; 1500; 2000; and 2500. The "y" axis is "labeled Accident Modification Factor,". The Accident Modification Factor of Nichols road is 1.30 and the ADT is between 1500-2000 so the shoulder width is 2ft. According to Geometric Policy on Design Highway and street (AASHTO), the range of shoulder-width for local and collector roadways is 2-8 feet. Partially paved shoulders on these rural local streets improve bicycle accommodation and reduce risky passing maneuvers. In a capacity sense, the effective width of the traveled way is thus reduced, and the resultant erratic operation has an undesirable effect on driver comfort and crash rates.
However, lane width should be chosen to reflect the roadway type. AASHTO states the rural two-lane roadway travel lane should be 12 feet or less for a 45 mile per hour speed. A large study of crash data from all 50 U.S. states over 14 years by Robert Noland showed that those states Lane widths of 10 feet or 11 feet are associated with fewer injuries and fatalities compared to 12 feet lanes. Narrower lanes will potentially boost safety in rural environments with pedestrians and local cross streets! Roads with lane widths of less than 12 feet, when properly built, improve driver awareness, and deter speeding, resulting in less serious collisions. Narrower streets encourage safer and more careful driving.

Section 6.2.1: Alternate Analysis/Design

![Diagram of normal solid white line]

Source: AASHTO

The alternative design to the road is to incorporate dedicated bike lanes.

According to AASHTO bike lanes make the road safer for bicyclists by increasing their survivability by 90% and while also improving accessibility. According to Flexibility in Highway Design (FHWA), the advantages of having bike lanes are reduced vehicle speeds, reduced conflict points, improved access, and improved safety.

Section 6.3: Roundabout Design
The existing intersection of McCulloch Boulevard and Nichols Road has a few notable problems we wanted to take care of. Due to the combination of there being only one traffic control device being the stop sign on Nichols Road and the speed limit of McCulloch Boulevard being 45 miles per hour some drivers were unable to make a left turn safely without causing a potential accident. Also, the plan for a north trail (north of Nichols Road) and the trail along Nichols Road would need to have a safe way for pedestrians to cross McCulloch Boulevard without risking their lives. To tackle all these issues and more we decided to go with a single lane roundabout design.

One of the main reasons why the roundabout design was chosen was because of its increase in safety. To measure safety looked at the existing vehicular conflict points. The current intersection has nine vehicular conflict points (three crossing, three merging, and three diverging) which can be seen in exhibit “Roundabout Calculations, E-CPoints”. If we were to add traffic lights or stop signs to accommodate for a single crossing the conflict points will increase by two if placed on the East side of McCulloch Blvd where there are only two lanes and by three if placed on the Westside. This would only increase the crossing conflict points which tend to be more deadly than the merging and diverging conflicts. The roundabout design that includes a pedestrian crossing, will only have eight conflict points (two crossing, three merging, and three diverging) which can be seen in exhibit “Roundabout Calculations, R-CPoints”. To assure a respite and haven for the pedestrian we have also designed a raised island following the U.S. Department of Transportation (USDOT) guidelines. The crossing island respite area is 10 ft wide and 6 ft long from edge to edge of the tactile paving (or truncated domes) and is 8 ft long from either road line. The crossing is also kept 25 ft from the inscribed diameter of the
roundabout to give drivers enough time to stop. We suggest installing button-activated pedestrian crossing signs and even recommend dual height buttons option for equestrian users to make sure they do not have to dismount to use the crossing as well.
The roundabout design has an inscribed diameter of 80 feet, with an inner diameter of 52 feet. The width of the entrances, exits and roundabout lanes are all 14 feet wide to give the drives a bit of wiggle room. The smaller size of the roundabout was chosen to force drivers to slow down as the size diameter and approach angles directly impact the fastest route path and their correlated radiiuses. The radiiuses of the fastest route when approaching the intersection from all three different paths can be seen on exhibit “Roundabout Calculations”. Using these radiiuses shows that the maximum speed when making a left or U-turn is about 12 miles per hour. While traveling straight through the roundabout the calculated maximum speed is about 14 miles per hour. With the idea that drivers tend to about 5–10 miles per hour faster than the suggested speed limit, our recommendation for the roundabout speed limit be 10 miles per hour. This will further keep the pedestrians safer when crossing the road, as well as lower the chances of merging and diverging vehicle conflicts since the drivers have more time to react when driving slower. To make sure drivers cannot speed into the roundabout we also have made sure the approach angles were within the minimum specifications set by the USDOT.

Many individuals either wanting to gain access or to cut through the park to get to different locations in Pueblo cause them to use this intersection. This is probably why there currently a dedicated right turn lane onto Nichols Rd. from McCulloch Blvd. The Average Daily Traffic (ADT) of Nichols Rd. is 2,842 vehicles per day with an average left-hand turn percentage of 22%, and the ADT of McCulloch Blvd is 4,283 vehicles per day with a left-hand turn percentage of 45%. To make sure we accounted for a very high
seasonal travel since more people are likely to use the park during warmer months, we used a generous seasonal coefficient of 1.5.

The potential maximum Average Annual Daily Traffic (AADT) of Nicholas Rd. was 4,263 vehicles per day while McCulloch Blvd has an AADT value of 6,425 vehicles per day. This meant that at most our design should support up to 10,700 vehicles per day. To make sure a single lane roundabout design could accommodate for this amount of traffic we extrapolated the data from a table provided by the USDOT shown in the exhibit “Roundabout Calculations, USDOT Table”. To account for the fact that our design was a “three legged” roundabout we used 75% of the capacity shown in the table when calculating for its maximum AADT, which came out to be about 15,000 vehicles per day. Even with further residential development increasing the overall use of the roundabout, our design should be able to handle it for future years.
With the intersection being one of the main accesses to park and lake, many drivers will be trailering their boats through this location. To assure that these individuals will have easy access when turning through the roundabout we have incorporated a truck apron with mountable curbs for the center island. The truck apron is designed with a 38 ft diameter equating to a 19 ft radius. With McCulloch Blvd. being a collector road, we expect at the largest vehicles that might end up using the intersection are WB-40 semi-trailer trucks. The 19 ft apron radius and the designed 80 ft inscribed diameter (40 ft radius) can accommodate up to a WB-40 semi-trailer truck. The truck apron is also designed with a -4% grade, and the calculations show that the allowable speed through the apron at the smallest radius with the -4% superelevation is 10 mph seen in exhibit “Roundabout Calculations”. The truck apron even allows for even larger semi-trucks to drive straight though using the truck mount. Even though this design should meet the needs of the day-to-day users we also have considered even larger vehicles that might end up attempting to make a left or U-turn. To accommodate for the larger semi-trucks left and U-turns, we have also chosen mountable curbs for the outermost curbs and have also made the curbs for the islands that are within 45 ft from the center to the mountable curbs. We also recommend that all decoration or structure that might be placed within the island be inside 16~17 ft from the center of the island as well as, having a 3 ft buffer from the outermost curb in the roundabout for any obstructions. This is to allow for extreme cases of if WB-50 semi-trailer trucks attempt to make a left or U-turn. By incorporating the apron and mountable access, most large vehicles up to WB-50 semi-trailer trucks have access through this roundabout, meaning that all trucks trailing boats and emergency vehicles have the same access.
The markings and signs in the design follow the MUTCD standards and guidelines. With white triangular yield lines to alert drivers, and yield signs accompanying them. The wide dotted white extension edge lines denote the inscribed diameter for the drivers. The central and approaching islands were designed not only to give pedestrians a place for respite but also to make sure drivers cannot fly through the roundabout. The reason why the approach-island on Nichols Rd. was designed to be shorter was mainly to make sure the existing driveway wasn’t fully obstructed. The open central island will have three signs showing the one-way direction of travel for each approaching lane set 14 ft from the center and the space in the center is suggested to be filled in with low lying shrubbery, or rocks. This keeps the sight distance clear through the roundabout and keeps drivers aware of their surroundings at all times. The roundabout signs and the speed limits are designed to be placed 350 ft and 450 ft (270 ft and 370 ft from roundabout entry) from the center of the roundabout for Nichols Rd. and McCulloch Blvd respectively. The roundabout should be visible when approaching, and the signs are an additional way to make drivers aware of the slowing down of traffic and change coming up in the road.
The final goal of our design was to also allow for future growth in development in the area and not hamper it. The curbs are not only there to make sure drivers do not drive off the roundabout and onto potential pedestrians but also for further development in storm drainage was to occur in this area. The northern trail also starts with a concrete trail/sidewalk before it tapers into the trail. This was to make sure there was enough space for additional sidewalks to be added or connected in the future without causing any issues, and the approaching island on the east can also be converted to provide a crossing in the future if there is a need for it.

The roundabout design has many positives with a few downsides. Without any stop signs or traffic lights that can cause unnecessary waiting, this design should keep the backups to a minimum and the flow of traffic consistent. This is while also slowing down the speed thus increasing the overall safety of the intersection for both drivers and pedestrians.

Section 6.4: Trail Design

The trail that starts on McCulloh Road and Nichols Rd leading towards Pueblo West High School and ends on W El Nido Dr. It is currently a dirt road and is used by pedestrians, equestrians, and cyclist. The trail measures 12 feet wide and about 1 mile long. In case of stormwater the existing trail becomes a safety hazard and inconvenience for users as it becomes wet and turns into mud. As a recommendation for our clients, I recommend we use stone crushed gravel and keeping an existing 12 feet of width for the existing trail. The stone crushed and compacted gravel will allow extend life of trail while reducing inconvenience and hazard to potential users. The stone crushed and
compacted gravel is an adequate choice for the trail as it is designed to absorb water and leave trail intact.

Stone crushed and compacted gravel is multi-use friendly and gives users, including equestrian’s safety trail usage. In accordance with Pueblo trail standards, the minimum width of a trail is 8 ft for a single-use lane. Our priority when designing the trail was to have it accessible to all users going in both directions, a 12 feet wide trail will allow space for multi directional users which include pedestrians, cyclists, and equestrians. As the trail approaches the roundabout, Nichols Road that leads down to Lake Pueblo State Park. There is no safe trail for the residents to use as they approach the Lake Pueblo area. During our site visit we observed cyclist and joggers share the road with motorists as there is no sidewalk along Nichols Road for them to safely access Lake Pueblo. We recommended having the width of the trail along Nichols Road be constructed 8 feet in width as it is within Pueblo trail standards which will still allow for multidirectional travel.

This trail will continue all through Nichols Rd up until the bridge we recommend adding.

Section 6.5: Bridge Design

As we investigated the bridge, there is a huge issue for users because there’s no current trail that leads up the bridge. Only a very steep dirt shoulder. Therefore, we recommend adding a bridge that fits the needs and safety of the public that fits all users except vehicles. Also, one occurring issue with the bridge is that it currently habitats protected wildlife birds. Therefore, making an extension of the bridge is very difficult. We propose making an entirely separate bridge.
When designing the bridge our main concern was the safety for the public and making it fit the purpose with all trying to stay within the client’s budget. The bridge will measure 124 feet in length and 10 feet in width. The bridge will space 150 ft W apart from the current bridge. To support the vertical load, we recommend having a strip foundation as a substructure since it provides support for linear structures. Currently, the bridge does cross train tracks, then we must follow the current CDOT bridge manual that says the minimum height of the bridge that goes over the train track must be 23 feet minimum height. As for the material of the bridge, We recommend we use galvanized W10X15 steel beams as the members. We recommend this because galvanized steel beams will not start to rust within 50 years. Our bridge decking will consist of galvanized steel plates to support the weight of users. As with any bridge over 6 ft, there must be safety measures to ensure no one falls over, and to support ABA standards, we must include guardrails and the minimum height of the guardrail must be a minimum of 3 feet. We want to make sure that all recommendations mentioned in the improvement of Lake Pueblo State Park, meet minimum state standards, and exceed the safety of the public and have a usage that will carry on for years.

Section 6.5.1: Alternative Trail & Bridge Design Analysis

The integration of the project was being able to design a trail from W El Nido Dr and” Nichola Dr” and stops at the beginning of Pueblo Reservoir Rd which is about approximately 1.7 miles of trail, and we designed a new bridge in which is meant for multi-use (pedestrians, cyclist, etc....). When designing my trail, I did a 12 feet wide trail which the minimum standard. 8ft wide for one-way traffic.
We recommend making the trail 12 feet so that there would be enough spacing for two-way travel for anyone and including equestrian usage. Given that information, the alternative design for the trail would have been able to have two 8-foot trails on opposing sides of the road made from a concrete path, not compacted stones we have suggested to have for our trail. As this may be an alternative design, there is no right answer to designing the trail.

It comes down more toward how efficient we can make the trail and convenient we can make it for civilians. As for when designing the bridge, we had an issue with the current bridge as there is no path to walk up to the trail because of how steep the dirt trailhand using the road as this extremely dangerous as they are 11 feet wide and are being used by vehicles passing by and that creates a huge discomfort for pedestrians, cyclist, and equestrians using it.

Therefore, we suggest creating a separately attached bridge that will only accommodate pedestrians, cyclists, joggers, equestrians, etc. It measures in 10 feet wide lane and 124 feet long bridge. The material used was W10x15 steel beams and the decking consists of steel plates to accommodate for the weight. An alternative design for the bridge, but not limited to, is having the bridge be made from different materials such as woodland concrete, etc. Also, another alternative was having an extension of the existing bridge and adding lanes to it. All in all, there exist many other design alternatives for our situation, and we suggest this design to our clients as we want to provide safe travel for everyone that still follows state standards.
Section 6.6: Pavement Design

The restructuring of Nichols Road presented a couple of challenges as there a considerable amount of alligator cracking in the existing asphalt. After our site visit, we were able to see the pavement in person and some potential issues regarding the pavement structure.

There was a lot of cracking that can be due to a lack of drainage and superelevation in the existing pavement structure. To complete this design, we used traffic data provided by our clients. For this design, we will be referring to “Exhibit 4: Pavement Calculations, Traffic Data”. The pavement structure was designed for a standard 20-year design period, estimated to be completed in 2022. We used an Average Annual Daily Traffic (AADT) of 3047. The traffic data showed 96% of vehicles driving through Nichols Road were medium-sized vehicles as classed by CDOT. 2.8% of vehicles were of the large class and only 1.2% of the cars were in a small class. This shows that our pavement structure needs to be able to handle a large traffic volume of medium-sized cars which include boats, recreational vehicles, trailers attached.

Using PaveXpress, pavement calculating software we were able to find an appropriate thickness for the new pavement structure. After inputting the given data as shown in the Pavement Calculations Exhibit, the pavement structure should have a surface layer of 6 inches. For the surface layer, we designed the pavement structure to be paved with hot mixed asphalt, which is the standard for flexible pavements in local rural areas.
To take care of any drainage concerns we designed an aggregate subbase that will act as a drainage layer to help the water filter through the top layer of asphalt. The drainage layer allows any stormwater to filter through the top layer rather than sit on top of the asphalt, creating drainage cracks. The drainage layer should be 4.5 inches thick and shall consist of well-graded gravel and clean sand. The subgrade for the pavement structure will just need to be recompacted 10.5 inches deep from the existing pavement structure to allow space for the asphalt and drainage layer.

Section 7: Recommendations

Section 7.1 Expansion of McCulloch Boulevard and Nichols Road

As an engineering firm, we recommend the roundabout because it promotes safety without compromising the flow of the intersection. With an incorporation of a pedestrian crossing lower speeds and less points of conflict are imperative for safety which the roundabout provides. Also, the absence of traffic lights, means less maintenance, and completely stopped vehicles, and the central island can be decorated (within limitation) to add a pleasing aesthetic to the residential community. This is a more expensive alternative but in the long run, it is the most efficient to the traffic and pedestrian usage.

Section 7.2 Pedestrian Trail and Bridge Recommendation

Our final recommendation for the pedestrian trail is the trail from Pueblo West Highschool leading to Nichols Road will be 12 feet wide and made up of stone crushed and compacted gravel. From Nichols Road to the existing concrete trail entrance of Lake Pueblo State Park we recommend having an 8 feet wide trail made of concrete.
We recommend constructing a pedestrian bridge separate from the current traffic bridge. Our proposed pedestrian bridge will be 124 feet long and 10 feet wide. The substructure will be 23 feet tall which give plenty of clearance for the train to pass under safely. The bridge will have a zinc coating to extend the lifetime of the bridge by 15 years.
Section 7. 3 Nichol’s Road Rehabilitation

For the rehabilitation of Nichol’s Road our recommendation of the roadway design is to narrow the roads to 12 feet wide with 2 feet of shoulders and 2 feet of buffer space. The pavement structure is recommended to be a total of 10.5 inches thick on top of the existing compacted subgrade. The pavement structure will consist of a surface layer that is 6 inches thick made up of hot mix asphalt, the second layer will be an aggregate base made up of clean well graded gravel and clean sand. This will enact as our drainage layer to filter water through and preserve the life of the pavement.

Section 8: Sequence

The scheduling of the reconstruction of Nichol’s Road includes building a bridge, creating a roundabout to promote a faster flow of traffic, the rehabilitating Nichol’s Road. Roundabouts are a higher cost because they are time-consuming and more technical to design. Work packages were created to help separate the tasks that could be done and the critical tasks in the project to assure the reconstruction to be built within the time frame provided.

As seen in Exhibit 7, all tasks could start at the same time after the soil compaction has been done. This helps the completion of the project, for this project, it is estimated to use a crew per task. During the reconstruction of Nichol’s Road, we recommend the road be worked on one lane at a time to decrease inconvenience to residents of the area. When the roundabout is constructed, residents will have to enter through the South entrance of Lake Pueblo State Park.
Section 9: Cost Estimation

The preliminary cost is built from two primary things, the work and the material being used. In the cost estimation we are including the materials that would take to build the formwork of the roundabout and the trail. Using Worldwide Machinery, we were able to see the basics of all the heavy machinery equipment that will be used during the road reconstruction. In regards of Asphalt cost, it is subject to change because the soil levels are not always 100% accurate. As seen in Exhibit 6, you can see the breakdown of the cost estimation regarding the reconstruction.

Section 10: Future Work/Study

We recommend having a licensed engineer review the work prior to construction or planning.
Section 11: References


“COLORADO PARKS & WILDLIFE.” Colorado Parks and Wildlife, cpw.state.co.us/placestogo/parks/LakePueblo/Pages/MapsDirections.aspx.


“Galvanized Steel.” Global Industrial, Global Equipment Company Inc, www.globalindustrial.com/p/steel-deck-12-w-x-36-d-3-pack-
Lake Pueblo State Park, Colorado Parks and Wildlife,
cpw.state.co.us/placestogo/parks/LakePueblo/Documents/LakePuebloFactSheet.pdf.


U.S. Department of Transportation. “Roundabouts: An Informational Guide - Chapter 6-Geometric Design.” FHWA,

Section 12: Disclaimer

The assumptions, findings, calculations, and conclusions expressed and described in this report and its exhibits were developed by undergraduate civil engineering students who are not licensed, professional engineers. This report was prepared as an academic exercise as partial fulfillment of the Civil Engineering Senior Design course. Pursuant to C.R.S. §12-25, no part of this report should be used for planning, budgeting, construction, or related fiscal decisions without a complete review and written endorsement from an independent, qualified, and licensed engineer who can assume responsible charge of the project and who is willing and able to become the engineer of record for all aspects of the study, calculations, findings, recommendations, and the project in part and in whole.

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Section 13: Conclusion & Summary

Lake Pueblo State Park is a heavily trafficked park, one of Colorado’s most visited during the summers. There are many amenities that park has to offer and at POAST Engineering we have made recommendations made upon our best judgement to be able to provide safe and optimal ways for the residents of Pueblo West to access the lake. We believe we have made great efforts to increase the safety of the public by reducing the vehicular conflict points with the proposed roundabout, improved trail conditions, and pedestrian bridge.
Section 15: Exhibits

Exhibit 1: Site Map
Exhibit 2: Aerial Photograph

Exhibit 3: Site Photographs

Picture above shows where the pedestrian trial will end and meet with existing trail leading to Lake Pueblo entrance.
Picture above shows existing traffic bridge for Nichol’s road, bridge goes over rail road.

Picture above shows swallow nesting under bridge, impacts project schedule and when project can be completed. Current habitats cannot be disturbed, recommend adding netting to nest to avoid creatures creating a habitat during construction.
Picture above shows proposed area for pedestrian trail along Nichols Road.

Pictures above shows intersection of McCulloch Boulevard and Nichols Road. This is where the proposed roundabout will be.
Picture above shows current trail leading to Pueblo West Highschool.

Picture above shows current Nichols Road pavement structure. Asphalt and concrete have no curb. This affects pavement life and durability.
Picture above shows current roadway leading to traffic bridge on Nichols Road.

Picture above shows current spacing on Nichols Road bridge.
Picture above shows current spacing on existing traffic bridge, gap between fence and concrete barrier is about 3 feet. There is also a water mainline affecting accessibility.

Picture above shows the railroad area, highlighting need for pedestrian bridge.
Picture above shows railroad area blocked off, inaccessible for pedestrians.

Picture above highlights lack of drainage affecting current pavement structures cracking.

This could also be due to old age.
Picture above shows crossing required for trail from Pueblo West Highschool to Nichols Road Lake Pueblo Entrance.

Picture above highlights danger of crossing through pedestrian bridge.
Exhibit 4: Calculations
Exhibit 4.1 Pavement Design Calculations

Project Information

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Nichols Road Pavement Design</th>
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<tr>
<td>Scenario Description</td>
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<td>State</td>
<td>Colorado</td>
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Traffic Data

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<td>Completion Year ESALs</td>
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<td>Design Period</td>
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<td>ESAL Growth Rate (%)</td>
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Pavement Structure

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<tr>
<td>Aggregate Base</td>
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Resilient Modulus (MR) | 4800 psi

Design Guidance

- **Surface**
- **Aggregate Base**
- **Subgrade**

Required minimum design SN: 4.30
Layer Thicknesses (in)
- Surface: 6.00
- Aggregate Base: 4.50
Total SN: 4.49

Design Notes

Look at CDOT rec dependent on Geotech recommendations look up specific sub grade thickness recommended by CDOT
Pavement Design Notes & Assumptions:

Assumed 1% population growth rate.

Area is considered a local rural road, recommended to use 50-80% reliability in accordance with CDOT recommendations. Reliability used was 75% as recommended with CDOT Vehicle Class 2 and 3, 2 being the majority.

Resilient modulus calculated with an R-Value of 6.9 which was given in the Geotech report from Shannon & Wilson.

Drainage Layer was added to accommodate any stormwater that is not collected by existing open channel on Nichols Road. The drainage layer should consist of an aggregate base of clean gravel and sand to allow the water filter through to the water table. In Geotech report there was no ground water hit during test.
### Section 4.2: Roundabout Calculations

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<th>Velocity [mph]</th>
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<th>Side Friction Factor</th>
<th>Radius [ft]</th>
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<td>10</td>
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<td>0.39</td>
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<td>-0.02</td>
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<th>Rad Diff.</th>
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<td>17</td>
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<td>WB-40</td>
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<tr>
<td>Going North Approach Angle</td>
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<tr>
<td>Going West Approach Angle</td>
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<tr>
<td>Going East Approach Angle</td>
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</tbody>
</table>

### Going North Fastest Route Radius (ft)

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<th>R1 (S-Enter)</th>
<th>R2 (S-Mid)</th>
<th>R3 (S-Exit)</th>
<th>R4 (L-Turns)</th>
<th>R4 min (Uturn)</th>
<th>R5 (R-Turn)</th>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>32</td>
<td>31</td>
<td>52.1</td>
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### Going West Fastest Route Radius (ft)

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<th>R3 (S-Exit)</th>
<th>R4 (L-Turns)</th>
<th>R4 min (Uturn)</th>
<th>R5 (R-Turn)</th>
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<tbody>
<tr>
<td>82.1</td>
<td>41</td>
<td>126</td>
<td>32.5</td>
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<td>NA</td>
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### Going East Fastest Route Radius (ft)

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<th>R4 (L-Turns)</th>
<th>R4 min (Uturn)</th>
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<tr>
<td>64.6</td>
<td>40</td>
<td>92.6</td>
<td>NA</td>
<td>31</td>
<td>89.4</td>
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</table>
Approach Angle

E-C Points

R-C Points
USDOT Table
Exhibit 4. 3 Bridge Extension Calculations

Bridge length = 124ft
Bridge width = 10 ft

Min W section required calculation
LRFD : 1.2DL + 1.6LL
LRFD : 1.2(1000lb) + 1.6(1000lb) = 2.8 Kips

\[ M_a = P_a \]
\[ M_a = 14 \text{ k-ft} \]

Chose a random section (W10x15)
\[ Z_a = (16 \text{in}^3)(50 \text{ksi}) = (800 ktn * 0.9) / 12 = 60 \text{ k-ft} > M_a \]

\[ \frac{b}{t} = 7.41 \]
\[ \lambda_p = 0.38 * \left( \frac{29 \times 10^6}{50 \text{ksi}} \right)^{1/2} \]
\[ \lambda_p = 9.15 > \frac{b}{t} \]
\[ M_a = F_y Z_a \]
\[ M_a = (60 \text{ k-ft}) (> M_a) = 14 \text{ k-ft} \text{ (yielding)} \]

LTB:

<table>
<thead>
<tr>
<th>L_p</th>
<th>L_a</th>
<th>L_b</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.86</td>
<td>8.61</td>
<td>186</td>
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</tbody>
</table>

\[ L_a > L_a \rightarrow \phi M_a = F_c * S_t \]
\[ S_t = 138 \text{ in}^3 \]
\[ F_{cr} = \frac{(C_0 \times \pi^2 \times E)}{(L_0 \times \gamma)} \times \phi \times (Z \text{ table}) \]

\[ F_{cr} = \frac{(1.0 \times \pi^2 \times (29 \times 10^{6} \text{psi}))}{(144/1.04)} = 15 \text{ksi} \]

\[ \phi M_n = 15 \text{ksi} \times (13.8) \times (0.9) / 12 \]

\[ \phi M_n = 15.6 > 14k \times \text{ft} \]

\[ \therefore \phi M_n > M_u \]

**Shear:**

\[ \phi W_n = 0.6 F_y \times A_w \times C_v \]

\[ u/t_w = 38.5 < 2.24 \times \sqrt[3]{(E/E_y)(1/2)} = 53.9 \]

\[ A_w = (10^{n})(0.25^{n}) = 2.5 \text{ in}^{2} \times \phi = 0.9 \]

\[ F_y = 50 \text{ksi} \]

\[ \phi V_n = 112.5 k > V_e = 2.8k \]

\[ \therefore \text{W10x15 works!} \]
## Exhibit 6: Cost Estimation

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<thead>
<tr>
<th>Item Number</th>
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<th>Price</th>
<th>Unit</th>
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<td>hr</td>
<td>200</td>
<td>$35,000.00</td>
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<td></td>
<td>Project Manager</td>
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<td>--------</td>
</tr>
<tr>
<td>202-00220</td>
<td>Removal of Asphalt Mat</td>
<td>$11.98</td>
<td>sq. yard</td>
<td>3333</td>
<td>$39,929.34</td>
</tr>
<tr>
<td>202-00240</td>
<td>Removal of Asphalt Mat (planning)</td>
<td>$2.07</td>
<td>sq. yard</td>
<td>6500</td>
<td>$13,455.00</td>
</tr>
<tr>
<td>202-00710</td>
<td>Removal of Power Pole</td>
<td>$572.13</td>
<td>ea</td>
<td>1</td>
<td>$572.13</td>
</tr>
<tr>
<td>203-00062</td>
<td>Embankment Material</td>
<td>$8.72</td>
<td>Yard</td>
<td>10000</td>
<td>$87,200.00</td>
</tr>
<tr>
<td>208-00021</td>
<td>Silt Fence</td>
<td>$2.34</td>
<td>Lin. Ft</td>
<td>1000</td>
<td>$2,340.00</td>
</tr>
<tr>
<td>208-00045</td>
<td>Concrete washout structure</td>
<td>$829.89</td>
<td>ea</td>
<td>1</td>
<td>$829.89</td>
</tr>
<tr>
<td>212-00006</td>
<td>Seeding (Native)</td>
<td>$561.83</td>
<td>acre</td>
<td>1</td>
<td>$561.83</td>
</tr>
<tr>
<td>304-06000</td>
<td>Aggregate Base Course (Class 6)</td>
<td>$13.44</td>
<td>Ton</td>
<td>2500</td>
<td>$33,600.00</td>
</tr>
<tr>
<td>403--34701</td>
<td>Hot bituminous pavement (Grading SX) (75)</td>
<td>$50.05</td>
<td>Ton</td>
<td>3300</td>
<td>$165,165.00</td>
</tr>
<tr>
<td>412-01200</td>
<td>Concrete pavement</td>
<td>$180.00</td>
<td>CY</td>
<td>14908.44</td>
<td>$2,683,520.00</td>
</tr>
<tr>
<td>613-70250</td>
<td>Luminaire High pressure sodium (400 watt)</td>
<td>$470.00</td>
<td>ea</td>
<td>8</td>
<td>$3,760.00</td>
</tr>
<tr>
<td>614-00011</td>
<td>Sign panel (Class I)</td>
<td>$17.24</td>
<td>sq. ft</td>
<td>538</td>
<td>$9,275.12</td>
</tr>
<tr>
<td>614-01502</td>
<td>Steel Sign support (2 in round) (post and socket)</td>
<td>$14.86</td>
<td>Lin. Ft</td>
<td>300</td>
<td>$4,458.00</td>
</tr>
<tr>
<td>627-00000</td>
<td>Flagging</td>
<td>$21.72</td>
<td>hr.</td>
<td>3500</td>
<td>$76,020.00</td>
</tr>
<tr>
<td>627-30410</td>
<td>Performed thermoplastic pavement marking (x-walk)</td>
<td>$10.66</td>
<td>sq. ft</td>
<td>800</td>
<td>$8,528.00</td>
</tr>
<tr>
<td>627-00002</td>
<td>Thermoplastic pavement making</td>
<td>$5.07</td>
<td>sq. ft</td>
<td>320</td>
<td>$1,622.40</td>
</tr>
<tr>
<td>630-00012</td>
<td>Traffic control management</td>
<td>$551.37</td>
<td>day</td>
<td>30</td>
<td>$16,541.10</td>
</tr>
<tr>
<td>630-80335</td>
<td>Barricade (Type 3 M-A) (temporary)</td>
<td>$167.26</td>
<td>ea</td>
<td>4</td>
<td>$669.04</td>
</tr>
<tr>
<td>630-80336</td>
<td>Barricade (Type 3 M-B) (temporary)</td>
<td>$176.11</td>
<td>ea</td>
<td>4</td>
<td>$704.44</td>
</tr>
<tr>
<td>630-80341</td>
<td>Construction traffic sign (Panel size A)</td>
<td>$67.83</td>
<td>ea</td>
<td>33</td>
<td>$2,238.39</td>
</tr>
<tr>
<td>630-80342</td>
<td>Construction traffic sign (Panel size B)</td>
<td>$77.55</td>
<td>ea</td>
<td>71</td>
<td>$5,506.05</td>
</tr>
<tr>
<td>630-80343</td>
<td>Construction traffic sign (Panel size C)</td>
<td>$102.88</td>
<td>ea</td>
<td>16</td>
<td>$1,646.08</td>
</tr>
<tr>
<td>630-80344</td>
<td>Construction traffic sign (Special)</td>
<td>$17.42</td>
<td>sq. ft</td>
<td>267</td>
<td>$4,651.14</td>
</tr>
<tr>
<td>630-80355</td>
<td>Portable message sign Panel</td>
<td>$5,678.30</td>
<td>ea</td>
<td>2</td>
<td>$11,356.60</td>
</tr>
<tr>
<td>630-80358</td>
<td>Advance warning flashing or sequencing arrow panel</td>
<td>$1,344.18</td>
<td>ea</td>
<td>2</td>
<td>$2,688.36</td>
</tr>
</tbody>
</table>
### Items and Costs

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Price</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>630-80360</td>
<td>Drum Channelizing device</td>
<td>$34.41</td>
<td>ea 150</td>
<td>$5,161.50</td>
</tr>
<tr>
<td>630-80363</td>
<td>Drum Channelizing device (with light, flashing)</td>
<td>$73.66</td>
<td>ea 6</td>
<td>$441.96</td>
</tr>
<tr>
<td>630-80370</td>
<td>Concrete Barrier (Temporary)</td>
<td>$26.33</td>
<td>Lin. Ft 1000</td>
<td>$26,330.00</td>
</tr>
<tr>
<td>604-20000</td>
<td>Outlet Structure</td>
<td>$72,990.25</td>
<td>ea 1</td>
<td>$72,990.25</td>
</tr>
<tr>
<td>630-80380</td>
<td>Traffic Cone</td>
<td>$9.18</td>
<td>ea 450</td>
<td>$4,131.00</td>
</tr>
</tbody>
</table>

**Total:** $5,510,957.15

### Note
The cost estimation has been done with the basic material needs and equipment. This is a preliminary cost estimation to the project.

### Area Calculations

<table>
<thead>
<tr>
<th>Description</th>
<th>Length (Ft)</th>
<th>Width (Ft)</th>
<th>Area (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nichols Rd. Trail (Concrete):</td>
<td>4193</td>
<td>8</td>
<td>402528 ft²</td>
</tr>
<tr>
<td>Nichols Rd. and Roundabout</td>
<td>3680</td>
<td>26</td>
<td>95680 ft²</td>
</tr>
<tr>
<td>North Trail (Gravel)</td>
<td>4889</td>
<td>12</td>
<td>352008 ft²</td>
</tr>
<tr>
<td>Bridge</td>
<td>124</td>
<td>10</td>
<td>7440 ft²</td>
</tr>
</tbody>
</table>

**Total Area:** 857656 ft²
## Exhibit 7: Project Schedule & Gantt Chart

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predec.</th>
<th>Resource Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Meet with Client</td>
<td>0.75 days</td>
<td>1/28/21 8:00 AM</td>
<td>1/28/21 3:00 PM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Site Visit</td>
<td>0 days</td>
<td>3/6/21 3:00 PM</td>
<td>3/8/21 5:00 PM</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Design</td>
<td>26 days</td>
<td>3/9/21 8:00 AM</td>
<td>4/13/21 5:00 PM</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Start Up Meeting</td>
<td>5 days</td>
<td>4/12/21 3:00 PM</td>
<td>4/18/21 3:00 PM</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Nichols Road Restruct...</td>
<td>121 days</td>
<td>12/6/21 9:00 AM</td>
<td>5/24/22 9:00 AM</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Demolition &amp; Removal of</td>
<td>14 days</td>
<td>12/6/21 9:00 AM</td>
<td>12/24/21 9:00 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Excavation</td>
<td>21 days</td>
<td>1/24/21 9:00 AM</td>
<td>1/24/22 9:00 AM</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Grading and Sloping</td>
<td>21 days</td>
<td>1/24/22 9:00 AM</td>
<td>2/22/22 9:00 AM</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Prepare the Sub Base</td>
<td>7 days</td>
<td>2/22/22 9:00 AM</td>
<td>3/5/22 9:00 AM</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Binder and Surface Course</td>
<td>7 days</td>
<td>3/3/22 9:00 AM</td>
<td>3/14/22 9:00 AM</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>Install New Paving</td>
<td>30 days</td>
<td>3/14/22 9:00 AM</td>
<td>4/25/22 9:00 AM</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Butt Joints and Transitions</td>
<td>15 days</td>
<td>4/25/22 9:00 AM</td>
<td>5/16/22 9:00 AM</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>13</td>
<td>Painting and Design</td>
<td>2 days</td>
<td>5/16/22 9:00 AM</td>
<td>5/18/22 9:00 AM</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>Drainage Test</td>
<td>1 day</td>
<td>5/18/22 9:00 AM</td>
<td>5/19/22 9:00 AM</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>15</td>
<td>Open to Traffic</td>
<td>1 day</td>
<td>5/19/22 9:00 AM</td>
<td>5/20/22 9:00 AM</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>Nichols Bridge Constr...</td>
<td>65 days</td>
<td>2/22/22 9:00 AM</td>
<td>5/24/22 9:00 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Pour Abxtriments</td>
<td>14 days</td>
<td>2/22/22 9:00 AM</td>
<td>3/14/22 9:00 AM</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>18</td>
<td>Deck Planing</td>
<td>14 days</td>
<td>3/14/22 9:00 AM</td>
<td>4/1/22 9:00 AM</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>19</td>
<td>Railimg Instalment</td>
<td>30 days</td>
<td>4/1/22 9:00 AM</td>
<td>5/13/22 9:00 AM</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>20</td>
<td>Painting and Design</td>
<td>2 days</td>
<td>5/13/22 9:00 AM</td>
<td>5/17/22 9:00 AM</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td>Bridge Testing</td>
<td>5 days</td>
<td>5/17/22 9:00 AM</td>
<td>5/24/22 9:00 AM</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>22</td>
<td>Nichols Pedestrian T...</td>
<td>35 days</td>
<td>3/14/22 9:00 AM</td>
<td>5/2/22 9:00 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Framing</td>
<td>30 days</td>
<td>3/14/22 9:00 AM</td>
<td>4/23/22 9:00 AM</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>24</td>
<td>Install Gravel/Concrete</td>
<td>2 days</td>
<td>4/25/22 9:00 AM</td>
<td>4/27/22 9:00 AM</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>25</td>
<td>Strip Formwork</td>
<td>2 days</td>
<td>4/27/22 9:00 AM</td>
<td>4/29/22 9:00 AM</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>26</td>
<td>Open to Pedestrians</td>
<td>1 day</td>
<td>4/29/22 9:00 AM</td>
<td>5/2/22 9:00 AM</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>27</td>
<td>Nichols Roundabout...</td>
<td>10 days</td>
<td>3/14/22 9:00 AM</td>
<td>3/28/22 9:00 AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Framing</td>
<td>5 days</td>
<td>3/14/22 9:00 AM</td>
<td>3/21/22 9:00 AM</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>29</td>
<td>Install New Pavement</td>
<td>2 days</td>
<td>3/21/22 9:00 AM</td>
<td>3/23/22 9:00 AM</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>30</td>
<td>Strip Formwork</td>
<td>2 days</td>
<td>3/23/22 9:00 AM</td>
<td>3/25/22 9:00 AM</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>31</td>
<td>Open to Traffic</td>
<td>1 day</td>
<td>3/25/22 9:00 AM</td>
<td>3/28/22 9:00 AM</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>---</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td>W</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lake Pueblo Access Improvements - page 5
Exhibit 8: Team Member Resumes/CV

Azucena Ochoa
Thornton, CO 80241 | azucena-ochoa@outlook.com | 720-431-5312

EDUCATION
B.S. Civil Engineering University of Colorado, Denver August 2016-May 2021
Construction Management Minor

RELEVANT ACADEMIC PROJECTS
Lake Pueblo Access Improvements, Senior Design
- Designed a pavement structure in alignment with Pueblo codes and standards
- Created an accurate cost estimation and schedule for Lake Pueblo Access Improvements construction sequence
- Drafted work packages for each phase in project to accurately depict schedule and scope of work

Mancoves Stamped Drawings, Cost Estimation
- Read technical specifications in manuals, resulting in stronger project cost estimates.

CNG Infrastructure, Project Management Systems
- Designed a compressed natural gas project from cradle to grave, resulting in knowledge about stakeholders, work packages, Gantt Charts, project milestones, and closeout documents organization

EMPLOYMENT EXPERIENCE
Waste Management September 2019-Present
Compressed Natural Gas Intern- Project Manager Assistant
- Process invoices, manage invoice log, file in secure system, organize closeout documents
- Review and track various reports weekly checking for policy and compliance updates
  - EPA RINs Credits, Truck Fire Report, Depreciation, Retail Gallons Monthly
- Assist with accounting procedures ensuring projects are in budget and invoices are processed correctly
- Build constructive working relationships with all levels of personnel in company fostering effective communication and teamwork
- Track Flame Detector Recertifications for 172 sites to make sure all sites are within safety compliance

Sephora inside JCPenney July 2016-February 2021
Sephora Merchandise Operations Supervisor
- Lead a team of 8 Beauty Advisors to drive sales and metrics to exceed company core standards and lead to team reaching bonus goals for 10 out of 12 months of fiscal year
- Completed tasks efficiently and logged metrics, improving the store performance.
- Organized and delegated weekly tasks, meeting company deadlines
- Analyzed and prioritized the procedures, allowing for more efficient task completion
- Acknowledged customer issues and concerns to find an appropriate solution

TECHNICAL SKILLS
AutoCAD, Project Libre, EPANet, Spanish Fluent, High Proficiency in MS Excel, Revitt Exposure

PROFESSIONAL ORGANIZATIONS
Society of Hispanic Professional Engineers: Student Chapter at CU Denver: Secretary
CU Denver Mentor Collective: First Year Engineering Student Mentor
National Society of Leadership & Success: Student Member
Alexis Torres  
(720) 364 - 3874 | alexis.2.torres@ucdenver.edu | Denver, CO

Profile Summary

- Moderate proficiency in AutoCAD. Interested in applying knowledge to Civil Engineering field
- Bilingual in Spanish, written & verbal.
- Strong interpersonal skills
- Academic leader in managing, vision creativity & organizing
- Excellent customer service skills

Education

Bachelor of Science in Civil Engineering with a minor in Math & Construction Management

- University of Colorado Denver (UCD)  
  Denver Scholarship Foundation  
  Associate of Science from Red Rocks Community College  
  Graduation: May 2021  
  August 2016  
  August 2019

Relevant pre-graduation Experience

- Worked in Ironworker for one year and worked up to an Iron-worker apprentice II
- Worked in Concrete for 1 ½ years and worked up to a concrete finisher
- Worked in Roofing for 3 years and became a project manager
- Worked in Framing/Carpenter for 2 years and became a Carpenter apprentice II

Relevant Courses

- AutoCAD  
  Steel Design  
- Python  
  Concrete Design  
- Transportation  
  Construction Eng. Systems

Professional Organizations and Honors

- Society of Professional Hispanic Engineers  
  April 2020-Present

Skills and Abilities

- Excellent Communication  
  Time Management  
  Fast Learner  
- Microsoft Software  
  Read and Understand Plans
Young J. Park, EIT
(267) 466-8834, P4rk.YoungJ@gmail.com

SKILLS

- ArcGIS
- R7/R8 GPS Surveying
- AutoCAD
- Total Station Surveying
- Auto Level Surveying
- Bilingual (Korean)
- Microsoft Office Suite

EDUCATION & CERTIFICATIONS

Bachelor of Civil Engineering
University of Colorado Denver, Denver, CO

Passed Fundamentals of Engineering Exam
Board: Colorado

Anticipated Graduation May 2021

Associate of Science
Community College of Denver, Denver, CO

December 2018

Associate of Applied Science
Community College of the Air Force, Montgomery, AL

July 2015

Airman Leadership Training
Mathies Airman Leadership School, RAF Feltwell, United Kingdom

March 2014

EXPERIENCE

Geobase Mapping Specialist / Construction Manager
8th Civil Engineer Squadron | Kunsan Air Base, Republic of Korea
April 2015 - May 2016

- Managed a $163K asphalt road project by crafting a phasing plan covering 3800 square feet eliminating traffic safety hazards.
- Devised construction project map identifying 68 active and 96 future projects providing upper-level management a $540M planning tool.
- Mobilized with utility crews to survey utility failures and update data for performance and trend analysis.

Geobase Mapping Specialist / Resources and Operations Manager
51st Civil Engineer Squadron | Osan Air Base, Republic of Korea
March 2014 - April 2015

- Reinforced traffic safety and fulfilled numerous modified driving and parking map requests, ensuring the safety of 11,000 personnel.
- Supervised a six-member team survey on Gayasan Mountain capturing 202 points of geospatial data which accurately located telecommunication facility assets.
- Utilized GIS and CAD software to support civil engineering operations mapping and maintenance requirements.

Geobase Mapping Specialist / Service Contract Representative
100th Civil Engineer Squadron | Royal Air Force Mildenhall, England
February 2011 - March 2014

- Developed parking and taxiway lines for CV-22 Osprey aircraft and assessed 178 geospatial data points, saving $6K in contract costs.
- Executed 137-acre topographic survey and verified accuracy on 130 utility assets which improved data quality by 45%.
- Modified $825K base custodial contract and validated 500+ facility floor plans, streamlining custodial contract efficiency by 11%.
- Identified essential snow removal routes and strategically relocated 3 million pounds of cleared snow over a 4-month period; efforts led to base being honored with Balchen/Post Award.
- Evaluated water lines and valves base-wide to identify all active and abandoned utility assets for future planning purposes.

Geobase Mapping Specialist
12th Civil Engineer Squadron | Ellsworth AFB, SD
February 2010 - February 2011

- Conducted 60-acre bomb range survey and reduced targeting system training cost which saved the US Air Force $25K per training.
- Executed 26-hour GPS survey and initialized reference base station by providing a 0.1-inch accuracy to the existing mapping system.
- Provided drafting and surveying support for 12 engineers; efforts kept $60M in construction projects within time and cost.
HAIA ALHASAWY
(720) 305-1979 | haia.alhasawy@ucdenver.edu

Objective: To get full-time job in Civil Engineering in Transportation

Skills:
• Able to work independently & as a team
• Auto CAD 2D and Productivity Tools
• Building information Modeling
• Microsoft Windows, and Suite
• Rivet 2D, 3D
• Auto CAD Civil 3D
• EPANET
• CATME
• RISA 2D and 3D
• MS Project
• Bluebeam

Education
Pursing Master of Science | Civil Engineering 2022
University of Colorado Denver

Bachelor of Science | Civil Engineering 2021
University of Colorado Denver

Associate of Science Degree | Pre-Engineering 2018
University of Colorado Denver

Extracurricular Activities
Silver Medal horse show jumping 2010
National Association of Underwater Instructors 2012

Fatima Sandoval Torres
535 Osceola St, Denver, CO. 80204 | (720) 671-3633 | fatima.sandovaltorres@ucdenver.edu

Education
UNIVERSITY OF COLORADO DENVER
- Bachelor of Science in Civil Engineering
- Minor in Construction Management

DENVER, CO. MAY OF 2021