

Civil Engineering Department

Memo

To: Kevin Davidson, Hualapai Tribe Planning & Economic Development Director
& Phil Wisely, Philip Wisely PE, Public Services Director

From: Peach Springs Railroad Grade- Capstone Team

CC: Dr. Charles Schlinger, Ph.D., P.E., R.G., P.Gp.

CC: Breanna Smith- bs667@nau.edu, Meshal Alotaiby- mfa87@nau.edu, Verneon
Reed- var28@nau.edu, Alex Goodman- adg72@nau.edu

Date: May 5, 2015

Topic: Final Proposal

Dear Kevin Davidson and Phil Wisely:

We are pleased to provide our final proposal enclosed in this document. The sections included in this document are: Project Understanding, Scope of Work, Project Schedule, Staffing and Cost of Engineering Services, References and Appendices. The purpose of the Capstone project is to obtain a better understanding of how tasks and proposals are planned and executed in the professional world. Since the process is slightly unfamiliar, the team will be relying on the client to give feedback and direction for the project. The final proposal outlines all tasks and subtask to be completed during the course of the project. This includes all work to be completed organized in a list for the client of specific tasks that will be accomplished by the team in order to complete the final design. The project schedule identifies; tasks, goals, staffing, planning and resources in both a flow chart as well as a Gantt chart that will be needed for the project. The document also includes an overview of the comprehension of the project and its elements. This includes a project total cost of \$46,817 and a staffing plan of personnel including each individual member. It is intended that this document be used as a guide for future events related to the planning of Peach Springs Railroad grade separation. If there are any questions regarding the contents of this document, please feel free to contact any of the team members at the email addresses listed above.

Sincerely,

Peach Springs Rail Road Grade, Capstone Team

Civil Engineering Department

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To: Kevin Davidson & Philip Wisely
From: Peach Springs Railroad Grade Separation Team
CC: Breanna Smith, Meshal Alotaiby, Verneon Reed, Alex Goodman
Date: May 5, 2015
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Photograph Provided by: Kevin Davidson

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1. Project Understanding

1.1. Project Purpose

An at-grade railway-roadway can pose numerous obstacles to safety and efficient urban activity for the community and travelers. Pedestrian and vehicular access to either side of the crossing can be significantly delayed during train crossings. This impedes traffic and can have a negative impact on local commerce. Even the safety of the community is affected, since special and emergency vehicles such as ambulances, fire trucks, law enforcement vehicles, and hazardous waste transport are also delayed during at the crossing.

To improve transit efficiency and safety for the community, a grade separated crossing is being considered in place of the existing crossing. A grade separation railway crossing is a height differentiation of both vehicle and railway traffic by adjusting the roadway as an underpass or overpass. The conversion to a grade separated crossing alleviates congestion caused by railway crossings and improves roadway functionality for all modes of transportation. A grade separation crossing provides the highest level of crossing safety, because the intersection between the roadway and railroad is eliminated. Major potential benefits of a grade separation crossing include reductions in collisions, vehicle delay, rail traffic delay, and maintenance costs of crossing surfaces and traffic control devices [1].

1.2. Project Background

The Burlington Northern and Santa Fe Railway, BNSF, runs through Peach Springs, Arizona, which is located 113 miles from Flagstaff and 50 miles from Kingman. Peach Springs is a small town of approximately 1,100 people consisting of solely the Hualapai Indian Reservation and it is within Mohave County. The elevation for the site is approximately 4,800 feet to 4,840 feet. The project site to be studied is located at the intersection of the BNSF railroad tracks and Diamond Creek Road. The existing structure of the railway is an at-grade railroad crossing, which has many of the associated problems mentioned above. The decision between converting the at-grade intersection to an underpass or overpass has not yet been determined. *(Please refer to Figure 7.1 in Appendix 7 to see a satellite photo of the project site and surrounding area)* [2].

1.3. Technical Considerations

The project requires technical work spanning a wide variety of engineering disciplines. Early on, the project site needs to be surveyed. This may be facilitated to some extent if approval to use a Lidar Scanner may be acquired. Traffic studies, similar to those done in the Long Range Transportation Plan, LRTP, should be completed [3]. Geotechnical analysis will be conducted in areas surrounding the at-grade railroad-roadway crossing as well as information from the NRCS web soils survey will be studied [4]. In addition to NRCS, existing geotechnical reports have been done in the area on the new Hualapai Cultural Center that previous Capstone teams have completed.

Hydrological reports may be used in the same way, but due to drainage concerns, additional hydrological analysis of the area is advisable. Lastly, existing underpasses and overpasses will be studied in detail where similar drainage infrastructure and soil classifications exist.

1.4. Potential Challenges

The primary foreseeable challenge of the project is the limited space in which to construct an underpass or overpass crossing due to the available road length on both the north and south side of the railroad tracks. Since two design options are currently being analyzed for an underpass or an overpass, the roadway and railway design requirements will be taken into consideration. Depending on which design option is chosen, the grade required to achieve sufficient vertical separation could be excessive. Similarly, BNSF holds rights to an easement on both the north and south side of the railroad tracks in which the team will have to coordinate with BNSF to obtain permits. In either case, utilities and other infrastructures may require the involvement of additional stakeholders.

The location of site itself is another major concern. Peach Springs is relatively isolated from project personnel, requiring significant travel time for all visits. Additional safety precautions during site visits may also be obligatory because of railroad requirements and restrictions.

1.5. Stakeholders

As the railway runs through Peach Springs, it primarily affects the community of Hualapai Indian Reservation. Other stakeholders include the BNSF railway, Arizona Department of Transportation (ADOT), the Federal Highway Administration (FHWA), Bureau of Indian Affairs (BIA): Division of Transportation and the County of Mohave. The highway stakeholders are in charge of traffic control and pedestrian crossings, daily commuters of emergency personnel commercial vehicle operators.

Since BNSF has a right of way on the Hualapai Indian Reservation the railway is responsible for all railroad transportation activity. State Route 66 near the railroad crossing is operated by ADOT, FHWA and BIA who are responsible for roadways within the Indian Reservations. While Mohave County is responsible for the safety of highway and pedestrian traffic.

Another group of highway stakeholders are organizations which use the highway transportation system, but are not involved in its operation. These users include the Northern Arizona Consolidated Fire Station 38, the Hualapai Tribe Health Department and Public Schools.

2. Scope of Work

The scope of work for this project will illustrate the goals and needs of the project by explicitly identifying each task needed to complete the final design. Since there were four initial designs for the Peach Springs Railroad Crossing At-Grade Project, the team first had to identify two crossing that were selected by the client. During the site visit the

client expressed the needs of the reservation, in which the selected crossings would benefit the community as far as the cost benefit analysis and the town's people's proximity to the crossings. The two selected crossing the team will focus on is the Diamond Creek Road Overpass and Underpass. The team then clearly identified needs and requirements that will be required to complete the final design for the two selected crossings. *(Please refer to Figure 7.2 in Appendix 7 on page 13, to see the ADOT LRTP design alternatives.*

2.1. Task 1: Site Evaluations

2.1.1. Railroad

2.1.1.1. The project team will evaluate the existing BNSF railroad crossings at the four potential crossing designs, implemented by the ADOT LRTP Study. The evaluation will include the number of track lanes, size of site, infrastructure availability, as well as impacts on railroad operations and the community.

2.1.2. Roadway

2.1.2.1. Analysis will be prepared to evaluate the existing roadways and the surrounding locations at the four potential crossing designs, implemented by the ADOT LRTP Study. The evaluation will include the existing road conditions and the traffic design.

2.1.3. Hydrology

2.1.3.1. The team will evaluate the existing hydraulic infrastructure at the site. This will include locating existing culverts, as well as the location and dimensions of the wash and stream beds.

2.1.4. Existing Utilities

2.1.4.1. Analysis will be conducted by locating and identifying existing utility infrastructures and the impacts on the surrounding structures.

2.2. Task 2: Standards and Requirements

2.2.1. Hualapai Indian Reservation Standards

2.2.1.1. Due to the project site located on Federal land, reserved for the Hualapai Indian Tribe, the project team will consult with the tribe representatives and determine the land and roadway constraints. Coordinating with the Tribe representatives will also determine the right-of-way for Federal jurisdiction. The project team will coordinate closely with the Tribe's Planning Director and the Tribe's Public Works Director, as needed.

2.2.2. BNSF Railroad Requirements

2.2.2.1. The project team will research and coordinate with the BNSF railroad to determine the right-of-way jurisdiction within the range of the potential design sites. The standards and specifications of railroad designs will be evaluated. With assistance from BNSF Railroad and a field observation, the description of the existing track condition and any proposed infrastructure improvements or required signal improvements will be determined. Any railroad involvement with the project will be

consulted and verified with the Tribe's Planning Director and discussed Public Works Director.

2.2.3. ADOT Requirements

2.2.3.1. From the established ADOT LRTP Study for Peach Springs, two potential designs are to be carefully evaluated. Upon coordinating with the Tribe's project representatives, coordination with the ADOT project representatives will also be established. Consulting with ADOT will determine the right-of-way for the State of Arizona's land and roadway jurisdictions.

2.2.4. Mohave County Requirements

2.2.4.1. Due to the project site located within Mohave County, the project team will consult with the Tribe's project representatives to determine the involvement and right-of-way for the land, roadway, and other surrounding infrastructures affecting the project site.

2.3. Task 3: Design Alternatives

2.3.1. LRTP Four Technical Designs

2.3.1.1. Diamond Creek Road

2.3.1.1.1. A 500ft. railroad overpass in which will replace the current at-grade crossing.

2.3.1.1.2. Approximate cost of construction is \$3.7 million.

2.3.1.2. Rodeo Way to State Route 66

2.3.1.2.1. A 450 ft. railroad overpass will extend Rodeo Way to State Route 66.

2.3.1.2.2. Approximate cost of construction is \$3.8 million.

2.3.1.3. Rodeo Way to Nelson Road

2.3.1.3.1. A 250 ft. railroad overpass in which realigns Rodeo Circle to connect to Nelson Road.

2.3.1.3.2. Approximate cost of construction is \$2.2 million.

2.3.1.4. WEST of Diamond Creek Road

2.3.1.4.1. Underpass just west of the existing at-grade railroad crossing at Diamond Creek Road.

2.3.1.4.2. Approximate cost of construction is \$6.0 million.

2.4. Task 4: Final Designs

2.4.1. The client expressed the needs of the community for two design alternatives the team will be focusing on during the course of the project. Ultimately, one final design will be chosen based off of a decision matrix, to be completed after a community engagement survey and further analysis of the project site. The two design alternatives in which the team will be studying are listed below.

2.4.1.1. Design Option 1: Diamond Creek Road

2.4.1.2. Design Option 2: WEST of Diamond Creek Road

2.5. Task 5: Intersection/Crossing Improvement Analysis

2.5.1. Railroad

2.5.1.1. In the LRTP report there are two different design ideas to study for the railroad traffic analysis, particularly for the underpass or overpass design idea. In this case, a study should be done for price, safety, hydrology and geotechnical reports and most importantly BSNF's requirements to ensure that the design meets all requirements and standards.

2.5.2. Vehicular

2.5.2.1. A traffic analysis will be conducted at the Diamond Creek Road north and south of the at-grade railroad-roadway crossing. An hourly average of cars, pedestrian and bicycle traffic will be assessed in order to properly design the underpass or overpass. This information also will help account for designing a potential traffic light before and after the intersection.

2.5.3. Pedestrian

2.5.3.1. A pedestrian traffic analysis will be done in conjunction with the vehicular traffic analysis and will include the pedestrian movement to the north and south of the at-grade crossing. This will help the team to decide if the design should include a pedestrian bridge or not.

2.5.4. Safety

2.5.4.1. The team will analyze the safety aspect of existing railroad underpasses and overpasses in the Flagstaff and Kingman areas. The items taken into account will be vehicular, bicycle, pedestrian and railway traffic, as well as the overall area relating to the stretch of roadway along the railway traffic. When evaluating the site, all safety conditions will be considered to ensure the overall welfare of the town in regards to the underpass or overpass.

2.6. Task 6: Hydrology and Hydraulic Design

2.6.1. Hydraulic Structure Plan

2.6.1.1. The existing infrastructure consists of evaluating the Truxton wash, which crosses a two-lane bridge on Diamond Creek Road, south of the railroad. The evaluation also includes analyzing the Truxton wash open-channel and using the contributing watershed data for flow conveyance of the channel and bridge.

2.6.2. Hydrology Analysis

2.6.2.1. Erosion Control

2.6.2.1.1. The team will evaluate the controlling wind and water erosion of agriculture and land development for the area. This effective erosion control technique will help prevent water pollution and soil loss in and around the site.

2.6.2.2. Sediment Control

2.6.2.2.1. In order to prevent soil from being washed away from existing roads and the railroad, sedimentation control must be

analyzed. This design will help keep erosion of the soil down on the site, in order to prevent sedimentation build up in drainage infrastructure and minimize water pollution.

2.7. Task 7: Environmental Analysis

2.7.1. Arizona Department of Environmental Quality- ADEQ

2.7.1.1. The team should contact ADEQ in order to get the specific environmental quality information to complete the design. This step will help to identify the needs to analyze the environment at the locations of the site. Additional information is required to get an idea of what needs to be done towards the environmental issues in the studied location.

2.7.2. Local Endangered Species

2.7.2.1. The team has to study the environment conditions for the area related to the endangered species. As mentioned in the site visit the black-footed ferret is amongst the endangered species that lives in the area and special considerations will be taken into concern.

2.8. Task 8: Project Management

2.8.1. Project Schedule

2.8.1.1. Network Diagram

2.8.1.1.1. A flow chart of tasks was generated in order to properly assess the critical path of the project.

2.8.1.2. Gantt Chart

2.8.1.2.1. The team will use this chart in order to manage the tasks that will needed to be completed for the project. The team will use this as a guide for future events related to the planning and completion of the design.

2.8.2. Website

2.8.2.1. A website will be populated in order to keep the client, technical advisor and the team up to date with items that have been completed during the course of the project.

2.8.3. 50% Design Report

2.8.3.1. A preliminary design report will be completed in the middle of the second semester of Capstone in order to receive feedback from the client and the technical advisor of the work the team has completed and will complete for the final design.

2.8.4. Design Report Final

2.8.4.1. The final design report will be complete during reading week which includes the overall design in which the team has accomplished during the course of the two semesters of Capstone.

2.8.5. Final Presentation

2.8.5.1. The team will conduct a presentation for the client, technical advisor and other people of interest for the final design and work accomplished.

3. Project Schedule

The team has completed a flow chart and Gantt chart that is to be followed during the second semester of Capstone. Where the team will be performing and completing tasks in order to finish the final design for the project. A flow chart was initially prepared to provide the team with necessary paths of work to be completed and can be seen on attached document. Next, the Gantt chart was then drawn to show the time reference in conjuncture with tasks that need to be completed and can be seen in Figure 7.4 on attached document.

4. Staffing and Cost of Engineering Services

The engineering work in its entirety will be completed by the Peach Springs Railroad Grade Separation Team. The design phase will be conducted during the beginning of the fall 2015 semester and be completed by the end of the fall 2015 semester. A complete staff and cost matrix can be seen in Appendix 7 in Figure 7.5 on attached document, which encompasses all engineering work to be completed for the project. All references pertaining to the expenses were found using the Internal Revenue Service and the United States General Services Administration [5, 6]. Similarly, billable rates for each personnel were determined in CENE-476 class discussion with Mark Lamer on April 7, 2015 [7]. All tasks can be referenced in detail in the Scope of Services and Schedule Section.

4.1. Statement of Qualifications:

4.1.1. Breanna Smith is qualified to work in the hydrology field from the following experiences at Northern Arizona University: CENE 333, Water Resources I, CENE 333L, Water Resources Lab, CENE 336, Water Resources II and CENE 460, Open Channel Flow. Also qualified to work in the project management and design field from the following experiences at Northern Arizona University: CENE 186, Introduction to Engineering, CENE 286, Civil and Environmental Engineering Design: The Process and EGR 386W, Engineering Design: The Methods.

4.1.2. Meshal Alotaiby is qualified to work in the field doing site evaluations from the following experience at Northern Arizona University; CENE 270, Surveying. Also qualified to complete work in regards to traffic and intersection analysis by CENE 420, Traffic Study and Signal completed at Northern Arizona University. Lastly, Meshal is qualified to complete work in the environmental field by taking CENE 150, Introduction to Environmental Engineering.

4.1.3. Verneon Reed is qualified to work in the hydrology field from the following courses at Northern Arizona University: CENE 333, Water Resources I,

CENE 333L, Water Resources Lab, CENE 336, Water Resources II and CENE 460, Open Channel Flow. Qualifications also include project management and design from the following engineering courses at Northern Arizona University: CENE 186, Introduction to Engineering, CENE 286, Civil and Environmental Engineering Design: The Process and EGR 386W, Engineering Design: The Methods. Verneon qualifications also include traffic analysis from course CENE 420, Traffic Study and Signal taken at Northern Arizona University.

- 4.1.4. Alex Goodman is qualified to work in the project management and design field from: CENE 186, Introduction to Engineering, CENE 286, Civil and Environmental Engineering Design: The Process and EGR 386W, Engineering Design: The Methods, courses completed at Northern Arizona University. Also qualified to work doing traffic analysis from CENE 420, Traffic Study and Signal completed course at Northern Arizona University.

5. Closing Remarks

The goal of this project is to improve the functionality of the existing at grade road to railroad crossing by designing an overpass or an underpass. Currently, there are 125 railroad train cars crossing through the intersection in a 24-hour period in which take 10-15 minutes on average to cross and is approximately $\frac{1}{8}$ of the each day where the intersection is blocked. The team will eliminate the problem in its entirety by the design of the overpass or underpass.

6. References

- [1] Wikipedia The Free Encyclopedia, *Underpass and Overpass*, Accessed 24 February 2015, Retrieved from: <http://en.wikipedia.org/wiki/Underpass-Overpass>
- [2] Google Earth, Peach Springs, AZ, Accessed: January 27, 2014, Retrieved from: <https://www.google.com/maps/d/viewer?oe=UTF8&t=m&ie=UTF8&msa=0&mid=zY6W5JWZWOTw.kX8bcZaFy6Ak>
- [3] Arizona Department of Transportation (2014), *Hualapai Indian Tribe Long –Range Transportation Plan*, ADOT. Retrieved 21 Jan. 2015, Retrieved from: <http://azdot.gov/planning/CurrentStudies/PARASTudies/hualapai-indian-tribe-long-range-transportation-plan>.
- [4] National Cooperative Soil Survey. "Peach Springs Series". *USDA*. Accessed 21 Jan. 2015, Retrieved from: https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PEACHSPRINGS.html.
- [5] Internal Revenue Service, *New Standard Mileage Rates Now Available; Business Rate to Rise in 2015*, IR-2014-114, December 10, 2014, Retrieved from: <http://www.irs.gov/uac/Newsroom/New-Standard-Mileage-Rates-Now-Available;-Business-Rate-to-Rise-in-2015>
- [6] U.S. General Services Administration, *FY 2015 Per Diem Rates for Arizona*, Accessed: April 6, 2015, Retrieved from: <http://www.gsa.gov/portal/category/100120>
- [7] Mark Lamer, Classroom Discussion Billable Rates for Staff, March 24, 2015

7. Appendix: Satellite Map of Roadway System at Peach Springs

7.1. Figure 4.1: Peach Springs Aerial Map of site [2].



7.2. LRTP Design Alternatives [3]



