PROJECT PROPOSAL

Page Roundabout

To: Nathan Reisner
Client
Date: 4/27/2021

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1.0 Project Understanding

1.1 Project Purpose

Page is the gateway to the Glen Canyon National Recreation Area and Lake Powell and attracts more than three million tourists every year [1]. Traffic on Highway 89, the main road to/from Page, is increasing, resulting in a decreased level of service (LOS) on the highway. ADOT has requested a proposal to build a roundabout at the Hwy 89 and North Lake Powell Blvd / Scenic View Rd intersection in Page, Arizona.

1.2 Project Background

A roundabout is being considered for this intersection due to traffic conflicts and incidence of crashes. The current intersection is a four -way intersection with stop signs on the North Lake Powell Boulevard and Scenic View Road, while traffic travelling North and South on US89 do not stop. The roundabout will allow vehicles to travel more efficiently along Highway 89 and cut down the congestion seen at the intersection for vehicles entering/exiting the highway.

Figure 1-1 below presents the location of Page within Arizona relative to Phoenix and Flagstaff.

Figure 1-1 Location of Page within Arizona. Image credit Google Maps

Figure 1-2 shows the roads near the station, marked with curves of different colors, and shows the name of the road. The site is marked with a blue pin.

Figure 1-2 Location of the project within Page. Image credit Google Maps

The traffic volume is relatively large (7500 vehicles in 2019 and an annual growth rate of 20% since 2015 [1]); and Highway 89 is a 4-lane highway. The speed limit difference between Highway 89 (65mph) and North Lake Powell Boulevard (40mph) is large [2].

Figure 1-3 shows a detailed view of the intersection. Since there is no traffic signal on Highway 89 at the intersection, stopped traffic at North Lake Powell Blvd attempting to enter Hwy 89 encounters high-speed traffic. This is not safe for any pedestrians and bicycles who want to cross Highway 89. There is a slip lane into Highway 89 northbound (NB) from Lake Powell Blvd. The Scenic road has two lanes. At the westbound (WB) of the site, the Scenic road has a right turn lane/straight lane and a left turn-only lane. Lake Powell Blvd is a three-lane road. There are two lanes from west to east and one lane from east to west.

Figure 1-3 Aerial view of the study intersection. Image credit Google Maps

1.3 Technical Considerations

During the design of the roundabout, the design team must consider hydraulic analysis, analysis of traffic conditions, drainage design and the use of software and analysis tools such as ArcGIS map, AutoCad, Traffic Count Databas System (TCDS) and traffic-monitoring. Data will be collected that details the traffic volumes during the different periods of the days, total traffic counts, and crash data. The design will consider the number of lanes, speed limit, and other factors based on the given volume counts of the intersection. These items are detailed in Section 2.0.

1.4 Potential Challenges

Potential challenges to the project include obtaining the correct volume counts for the intersection and an accurate geotechnical report.

1.5 Stakeholders

The stakeholders of this project include the City of Page, ADOT, and roadway users. The City of Page must receive a functional and useful roundabout design that fits well within the topography of the location. ADOT guidelines must be followed to ensure safety and vehicles must be served with minimal delay. Roadway users must experience a reduction in traffic delays and congestion as well as improved roadway characteristics around North Lake Powell Blvd. and Page US-89.

2.0 Scope of Services

2.1 Task 1.0: Obtain Existing Data

This task includes obtaining existing data provided by the client, survey and topo-graphic data, geotechnical data, and traffic data. Relevant city codes and standards such as MUTCD standards and national building codes will be obtained.

2.1.1 Task 1.1: Traffic Data

Existing traffic data includes pedestrian counts, vehicle turning counts, and peak hour volumes. These data are essential in determining the necessary number and type of lanes and the type of pedestrian crossing required. Historical traffic data, Average Annual Daily Traffic (AADT) will be obtained from ADOT-maintained roadways website and will yield different types of vehicles, traffic counts, and pedestrian counts [3].

2.1.2 Task 1.2: City Codes and Standards

There are regulations and requirements that affect the final design to ensure that the design meets federal, state, and local requirements. The Federal Highway Administration (FHWA) and the City of Page allocate funds for projects related to the Highway 89 system. At a minimum, the following regulations will be consulted:

- Manual on Uniform Traffic Control Devices (MUTCD): Standards for signal, geometry, and sign setback.
- Page, Arizona Code of Ordinances: International building code adopted. The copy of code shall be on file with the office of the City Building Department and kept available for public uses and inspection within City Hall.
- County Codes

2.1.3 Task 1.3: Survey Data

Existing topographic data will help with identifying elevations, grading, curb faces, edge of the pavement, roadway lane markings, existing bike lanes, nearby crosswalks, drainage structures, right way constraints and roadway alignments. The survey data will be obtained through US Topo, maps for America [4]. The term "US Topo" specifically refers to the quadrilateral topographic maps released in 2009 and later. These maps are modeled on the familiar 7.5-minute quadrilateral maps from 1947 to 1992. Many USGS websites can download US Topo maps for free, such as map locator on the USGS store, topo view and the Geographic Names Information System (GNIS).

2.1.4 Task 1.4: Geotechnical Data

Existing geotechnical data will be obtained from the reference site that is just due North of our project location, that will provide all the necessary information about the soil classification, soil characteristics for hydraulic analysis, and suitability of the soil as subgrade material.

2.2 Task 2.0: Site Visit

A site visit will be made to visualize the physical aspects of the project site, taking note of existing conditions, and obtaining area measurements. This information will aid in developing drawings of the site. Prior to the visit, a Field Safety Plan will be prepared as required by NAU.

2.3 Task 3.0: Hydrology Assessment

Hydrologic analysis is required to determine the required storm event flow rates on site. This will be completed through a process of finding contributing watershed areas, rainfall intensities, weighted runoff coefficients, storm durations, and detention volumes.

2.3.1 Task 3.1: Basin Area Delineation

The watershed will be found by using an overhead view of the project site using Google Earth. When the watershed is identified, the watershed area will be determined using Google Earth and topographic lines. A map will be constructed showing the watershed for the project site.

2.3.2 Task 3.2: Rainfall Intensity & Time of Concentration

NOAA Atlas 14 [5] will be used to identify the rainfall intensity in inches of rain falling per hour for different storm events. The time of concentration will be found by analyzing each flow path of the watershed area using the Coconino County Drainage Design Manual [6]. The time of concentration is the shortest time for water to travel from the inlet to the outlet of the watershed. The information will be provided using AutoCad which will show the watershed area as well as the flow paths.

2.3.3 Task 3.3: Detention Volume

Detention volume is the amount of water being temporarily stored in the watershed area. It is necessary to design the inlet and outlet for controlled release so that there is no flooding in the area. Detention volume will be determined by using the rational runoff method and time of concentration. The detention basin design will be dependent on the final roundabout design.

2.4 Task 4.0: Roundabout Design

A preliminary design is necessary to grasp an understanding of how the roundabout will play a role in the intersection regarding things like crosswalk locations, roadway alignments, drainage, and alternative designs.

2.4.1 Task 4.1: Determine Projected 20-yr Traffic Counts

A projected traffic volume for 20 years into the future will be determined based upon current traffic data and expected growth rates. Projected traffic counts for each vehicle class will be determined.

2.4.2 Task 4.2: Alternative Designs

A VISSIM model will be created to assess the current intersection's level of service (LOS) as well as with the 20-year projected traffic volumes. This will serve as a comparison for the different roundabout alternatives that will be created. At least two roundabout option will be developed and a preliminary design for each will be completed. The option will be analyzed in VISSIM using the 20-year projected traffic volumes.

2.4.3 Task 4.3: Selection of Alternative

The selected designs must consider constructions cost, LOS, safety, and ease of use.

2.4.3.1 Task 4.3.1: Creation of Decision Matrix

A decision matrix will be created representing the significant criteria for roundabout selection. Criteria and weighting will be developed with input from the client.

2.4.3.2 Task 4.3.2: Evaluate Alternatives and Selection of Final Design

Data for each criterion will be obtained for each design and input into the matrix. The highest scoring design will be selected.

2.4.4 Task 4.4: Final Roundabout Design

Once selected, the final roundabout design will incorporate all including safety checks, roadway geometry, roundabout location, and will meet applicable city codes and FHWA standards.

2.4.4.1 Task 4.4.1: Roundabout Geometry

The geometry of the roadway is the physical element, such as the width and number of lanes, the location of separated islands, crosswalks, bicycle lanes, and the radii of roundabout curvatures.

2.4.4.2 Task 4.4.2: Alignment of Roadway

When the center lines pass through the center of the inscribed circle, the roundabout is in the best position. The inscribed circle is the portion of the roundabout that is enclosed within each street corner. This position can usually be appropriately designed for the geometry so that the vehicle can maintain a low speed when entering and exiting. The radial alignment, which is how the path of the road is centered with the middle of the roundabout, also makes the central island more visible to an approaching driver. It is proposed to determine the center of the inscribed circle at the existing intersection, and the location of the center point will be determined from the geographic information provided by the client and the survey data provided in the topo map. Four suitable points on the northbound, southbound, westbound, and eastbound intersections will be determined and then linked to determine the center point and the radius of the inscribed circle. Iterative methods will be used for design.

2.4.4.3 Task 4.4.3: Stopping Site Distance

The stopping site distance refers to the distance along the lane required for the driver to perceive and respond to an object in the lane and brake to a complete stop before reaching the object. Each intersection should provide stopping sight distance at roundabouts and points on each type of entry and exit route. The stopping sight distance is determined according to the National Highway Cooperation Research Project (NCHRP) report 400. This helps to ensure the safety of users and can also be used to design speed limits when vehicles are approaching roundabouts. The proposed stopping site distance will be designed after determining the roundabout geometry described in Task 4.5.1.

2.4.4.4 Task 4.4.4: Pedestrian and Bicycle Considerations

Pedestrians and bicycles want to cross as close as possible to the roundabout to minimize a need to make the intersection any larger than it already is. Both the location and the roadside crossing distance are important. The crossing distance should be minimized to reduce the conflict between pedestrians and vehicles. This research will influence the design of roadway geometry. To improve the safety of pedestrians and bicycles as much as possible, the distance of pedestrian crossing will be determined based on previous intersection geometry.

2.4.5 Task 4.5: Hydraulic Assessment

Once the final design is selected, the flow of water through the site will be analyzed and systems will be designed so that the roadway does not flood.

2.4.5.1 Task 4.5.1: Storm Water Flow

The proposed roundabout will be evaluated to ascertain its effect on storm water flow at the site by utilizing the runoff time of concentration and the rational runoff method.

2.4.5.2 Task 4.5.2: Drainage Systems

Drainage systems such as channels and culverts will be considered to determine the most effective way to assure that the roundabout does not flood in a storm event. Each drainage type will be modeled and designed and included in the plan set.

2.4.6 Task 4.6: Plan Set

All physical components required for the project are to be drawn in the plan set.

2.5 Task 5.0: Project Impacts

The social, economic, and environmental impacts will be evaluated as part of this project.

2.6 Task 6.0: Deliverables

2.6.1 Task 6.1: 30% Report, Presentation

The following tasks will be completed in the 30% report and presentation:

- Task 1.0: Obtaining data
- Task 2.0: Site visit
- Task 3: Hydrology assessment

Completion of these tasks constitutes the 30% milestones.

2.6.2 Task 6.2: 60% Report, Presentation

The following tasks will be completed in the 60% report and presentation:

- Task 4.1: 20-year traffic count

- Task 4.2: Alternative Designs
- Task 4.3: Selection of Alternative
- Task 4.4: Final Roundabout Design

Completion of these tasks constitutes the 60% milestones.

2.6.3 Task 6.3: 90% Report, 90% Plan Set, 90% Web Site

All project tasks through 5.0 will be completed in the 90% report. The project website will be completed at 90%:

- Task 5: Project Impacts

2.6.4 Task 6.4: Final Submittals

A final report, final presentation, and final website will be provided to the client at the project end date.

2.7 Task 7.0: Project Management

2.7.1 Task 7.1: Meetings

Meetings with the Client, technical advisor, grader and team meetings will happen regularly to ensure the client objectives are met and that the project is on the right path. Agenda will be forwarded 24 hours prior to the meetings, meeting minutes will be prepared after each meeting and archived in a Meeting Memo Binder.

2.7.2 Task 7.2: Resource Management

Staff time will be tracked during the project to guarantee that tasks are completed to a high level of quality.

2.7.3 Task 7.3: Schedule Management

The Gantt chart (see section 3.0) will be rigorously followed and updated as needed.

2.8 Exclusions

The following aspects of the project are not included in this scope of work.

- Construction Plan
- Permitting
- Pavement Design

3.0 Schedule

The project will start on August 23, 2021 and will be complete by December 9th, 2021. The project schedule is shown in the Gantt Chart in Appendix 1. The critical path, highlighted in the Gantt Chart in red, consists of the following tasks: 1.1-traffic data, 1.2-city codes and standards, 1.3-survey data, 4.1-projected 20-year traffic data, 4.2-alternative designs, 4.3.2-evaluate alternative designs and selection of final design, 4.4.1-roundabout geometry, 4.4.2-alignment of roadway, 4.4.3-stopping sight distance, 4.4.4-pedestrian and bicycle considerations, 5.0-project impacts, 6.4.2-final plan set, 6.4.3-final presentation, and 6.4.4-final website.

4.0 Staffing Plan

The following positions identified are necessary for completion of the project:

Tabl 4-1: Staff Positions

Position	Abbreviation
Project Engineer	PE
Engineer in Training	EIT
Intern	INT
Technician	TCN

4.1 Qualifications for all Personnel

The qualifications for each position are shown below:

4.1.1 Project Engineer (PE)

The Project Engineer is responsible for various tasks and shall be the main source of communication between the team and the client(s). The Project Engineer shall also assign responsibilities amongst the engineering team and supervise the team to make sure the work is of high quality. This position requires a Professional Engineers license (PE), as well as 6+ years of experience as a PE.

4.1.2 Engineer in Training (EIT)

The EIT is responsible for determining the design of a project as well as conducting all analysis that is required for each project. They shall also monitor project progress and assure that deadlines are met. This position requires a bachelor's degree in related engineering fields as well as an EIT certification.

4.1.3 Intern (INT)

An intern is responsible for conducting most of the hands-on work of the project. An intern's main role is to get exposure in the work force and grasp new perspectives of the engineering field. With the help and guidance from the rest of the team, the intern is expected to complete most of the required work to a level of high quality.

4.1.4 Technician (TCN)

The technician will be responsible for using AutoCad and or any other Cad program to draw the design that is determined by the Engineer. The technician will be responsible for collaborating with the Engineers on the team as well as the Project Manager to ensure the design being drawn is correct and related to what the client is requesting. The specification for a technician includes a bachelor's degree in an engineering field, an EIT certification, as well as work related experience with AutoCad.

ARNA Engineering

4.3 Staffing Matrix

Table 4-2 below indicates the total number of hours for each position by task:

Table 4- 2: Staffing Matrix

Task	PE	EIT	INT	TCN
Task 1.0: Obtain Existing Data	-	18	18	6
Task 1.1: Traffic Data	-	8	8	2
Task 1.2: City Codes and Standards	-	4	4	2
Task 1.3: Survey Data	-	6	6	2
Task 2.0: Site Visit	1	3	3	1
Task 3.0: Hydrology Assessment	10	20	25	15
Task 3.1: Basin Area Delineation	3	6	12	5
Task 3.2: Rainfall Intensity & Time of Concentration	3	6	6	5
Task 3.3: Detention Volume	4	8	7	5
Task 4.0: Roundabout Design	60	104	113	92
Task 4.1: Determine Projected 20-yr Traffic Counts	-	8	10	6
Task 4.2: Alternative Designs	3	5	10	3
Task 4.3: Selection of Alternative	3	15	11	6
Task 4.3.1: Creation of Decision Matrix	3	5	10	3
Task 4.3.2: Evaluate Alternatives & Selection of Final Design	5	6	12	5
Task 4.4: Final Roundabout Design	13	18	16	18
Task 4.4.1: Roundabout Geometry	3	4	4	5
Task 4.4.2: Alignment of Roadway	3	4	4	5
Task 4.4.4: Stopping Sight Distance	3	6	4	5
Task 4.4.4: Pedestrian & Bycicle Considerations	4	4	4	8
Task 4.5: Hydraulic Assessment	8	15	15	12
Task 4.5.1: Storm Water Flow	5	5	5	8
Task 4.5.2: Drainage Systems	0	4	3	0
Task 4.6: Plan Set	7	5	5	8
Task 5.0: Project Impacts	2	2	12	-
Task 6.0: Deliverables	10	10	15	10
Task 6.1: 30% Report, Presentation	2	2	3	2
Task 6.2: 60% Report, Presentation	2	2	3	2
Task 6.3: 90% Report, 90% Plan Set, 90% Web Site	2	2	3	2
Task 6.4: Final Submittals	4	4	6	4
Task 7.0: Project Management	20	20	20	10
Task 7.1: Meetings	5	5	5	4
Task 7.2: Resource Management	5	5	5	4
Task 7.3: Schedule Management	10	10	10	2
Total	103	177	206	134
Total of All Tasks (hours)				**620**

This project is estimated to take a total of about 620 hours to complete. The hours are based off the duration of days it takes for each task, directly from the schedule in Appendix 1. The task with the highest number of hours is Task 4.0 – Roundabout Design at about 369 total hours, followed by Task 7.0 – Project Management sitting at about 70 hours.

5.0 Cost of Engineering Services

Table 5-1 below summarizes the cost of engineering services for the Page Roundabout project.

Table 5-1: Cost of Engineering Services

Positions	Classification	Rate/Hour	Quantity	Cost
	Project Engineer (PE)	$180.00	103	$18,540.00
	Engineer in Training (EIT)	$125.00	177	$22,125.00
	Intern (INT)	$40.00	206	$8,240.00
	Technician (TCN)	$95.00	134	$12,730.00
	Total			$61,635.00
Travel	**Classification**	**Rate/Mile**	**Miles**	**Cost**
	1 Vehicles, 1 Round Trip, 260 miles round trip	$0.57	260	$148.20
	Total			$148.20
Supplies	**Classification**	**Rate/Day**	**Days**	**Cost**
	Lab Access for 20 Days	$100.00	20	$2,000.00
	NAU Rental Vehicle	$34.00	1	$34.00
	Total			$2,034.00
Total Cost of Engineering Sevices				**$63,817.20**

The total cost of engineering services is $63,817.20.

6.0 References

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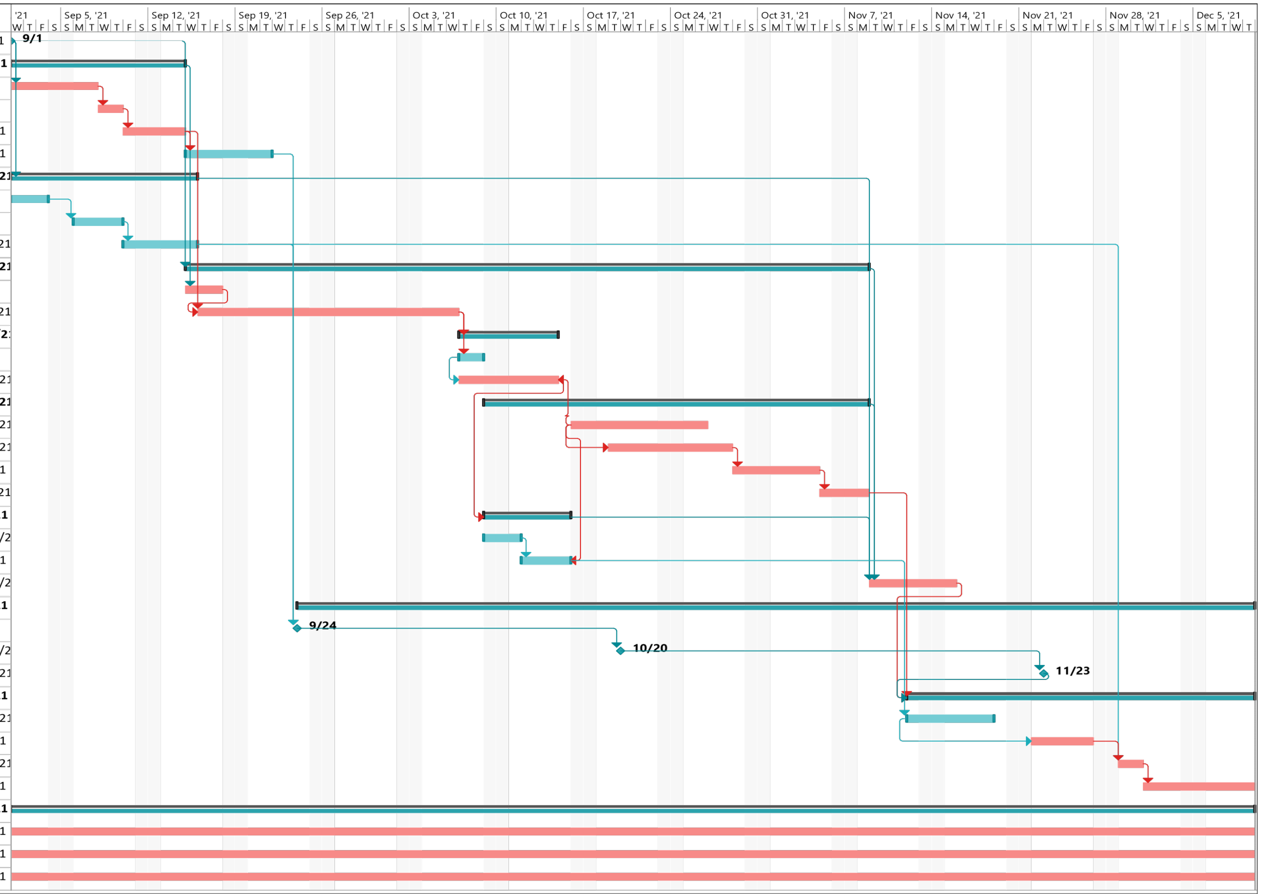
7.0 Appendices

Appendix 1: Gantt Chart

ID	Task Name	Duration	Start	Finish
1	Project Start	0 days	Wed 9/1/21	Wed 9/1/21
2	**Task 1: Obtain Existing Data**	**10 days**	**Wed 9/1/21**	**Tue 9/14/21**
3	Task 1.1: Traffic Data	5 days	Wed 9/1/21	Tue 9/7/21
4	Task 1.2: City Codes and Standards	2 days	Wed 9/8/21	Thu 9/9/21
5	Task 1.3: Survey Data	3 days	Fri 9/10/21	Tue 9/14/21
6	**Task 2: Site Visit**	5 days	Wed 9/15/21	Tue 9/21/21
7	**Task 3: Hydrology Assessment**	**11 days**	**Wed 9/1/21**	**Wed 9/15/21**
8	Task 3.1: Water Basin Area & Extent of Runoff	3 days	Wed 9/1/21	Fri 9/3/21
9	Task 3.2: Rainfall Intensity & Time of Concentration	4 days	Mon 9/6/21	Thu 9/9/21
10	Task 3.3: Detention Volume	4 days	Fri 9/10/21	Wed 9/15/21
11	**Task 4: Roundabut Design**	**39 days?**	**Wed 9/15/21**	**Mon 11/8/21**
12	**Task 4.1: Project 20-yr Traffic Counts**	3 days	Wed 9/15/21	Fri 9/17/21
13	**Task 4.2: Alternative Designs**	15 days	Thu 9/16/21	Wed 10/6/21
14	**Task 4.3: Selection of Alternative**	**6 days**	**Thu 10/7/21**	**Thu 10/14/2**
15	Task 4.3.1: Creation of Decision Matrix	2 days	Thu 10/7/21	Fri 10/8/21
16	Task 4.3.2: Evaluate Alternative and Selection of Final Des	6 days	Thu 10/7/21	Thu 10/14/21
17	**Task 4.4: Final Roundabout Design**	**22 days**	**Sat 10/9/21**	**Mon 11/8/21**
18	Task 4.4.1: Roundabout Geometry	8 days	Sat 10/16/21	Tue 10/26/21
19	Task 4.4.2: Alignment of Roadway	8 days	Tue 10/19/21	Thu 10/28/21
20	Task 4.4.3: Stopping Site Distance	5 days	Fri 10/29/21	Thu 11/4/21
21	Task 4.4.4: Pedestrian and Bicycle Considerations	2 days	Fri 11/5/21	Mon 11/8/21
22	**Task 4.5: Hydraulic Assessment**	**6 days**	**Sat 10/9/21**	**Fri 10/15/21**
23	Task 4.5.1: Storm Water Flow	2 days	Sat 10/9/21	Mon 10/11/2
24	Task 4.5.2: Drainage Systems	4 days	Tue 10/12/21	Fri 10/15/21
25	**Task 5: Project Impacts**	5 days	Tue 11/9/21	Mon 11/15/2
26	**Task 6: Deliverables**	**55 days**	**Fri 9/24/21**	**Thu 12/9/21**
27	Task 6.1: 30% Report, Presentation	0 days	Fri 9/24/21	Fri 9/24/21
28	Task 6.2: 60% Report, Presentation	0 days	Wed 10/20/2	Wed 10/20/2
29	Task 6.3: 90% Report, 90% Plan Set, 90% Website	0 days	Tue 11/23/21	Tue 11/23/21
30	**Task 6.4: Final Submittals**	**20 days**	**Fri 11/12/21**	**Thu 12/9/21**
31	Task 6.4.1: Final Report	5 days	Fri 11/12/21	Thu 11/18/21
32	Task 6.4.2: Final Plan Set	5 days	Mon 11/22/2	Fri 11/26/21
33	Task 6.4.3: Final Presentation	2 days	Mon 11/29/2	Tue 11/30/21
34	Task 6.4.4: Final Website	7 days	Wed 12/1/21	Thu 12/9/21
35	**Task 7: Project Management**	**72 days**	**Wed 9/1/21**	**Thu 12/9/21**
36	**Task 7.1: Meetings**	72 days	Wed 9/1/21	Thu 12/9/21
37	**Task 7.2: Resource Management**	72 days	Wed 9/1/21	Thu 12/9/21
38	**Task 7.3: Schedule Management**	72 days	Wed 9/1/21	Thu 12/9/21



Project: 476 Page Capstone Pro
Date: Tue 4/13/21

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Critical, Critical Split, Progress, Manual Progress

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