SINCLAIR WASH RESTORATION PROJECT

PROJECT PROPOSAL

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1.0 Project Understanding

1.1 Project Purpose

The intent of this project is to restore a section of the Sinclair Wash near the I-17 culvert back to its proper riparian habitat through an area assessment and the completion of in-depth restoration plan. The assessment will collect data on the current channel conditions, adjacent infrastructure, and problematic stream crossings to provide design alternatives for the client. This will be completed to improve the natural riparian ecosystem within and around the channel section, reduce flooding, erosion, and sedimentation produced by rainfall events, and promote recreational use.

1.2 Project Background

The client has requested Red Rock Engineering to continue previous capstone teams' efforts to address an area of concern within the project bounds and create a final plan set. At the conclusion of the previous teams' capstone, three sites were found that needed to be further assessed to improve the stability of the channel, restore the riparian habitat, and ensure the channel is functioning properly during storm events. Red Rock Engineering determined that of the three sites available, Site 1 (from here on referred to as the site) would be selected, analyzed and a final construction plan set would be completed and provided to the client. The project site is located in Flagstaff, Arizona on the Northern Arizona University campus. It is a section of the Sinclair Wash. This can be seen in Figure 1, below.

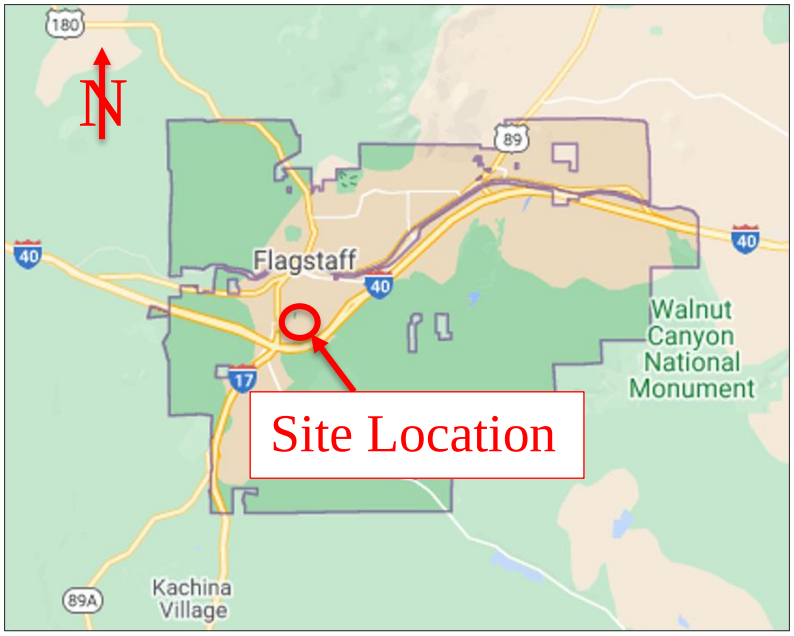


Figure 1: Site Location with Respect to Flagstaff Boundary [1]

Figure 1 shows the site location with respect to Flagstaff's boundary. Figure 2 shows the site location with respect to Northern Arizona University's boundary.

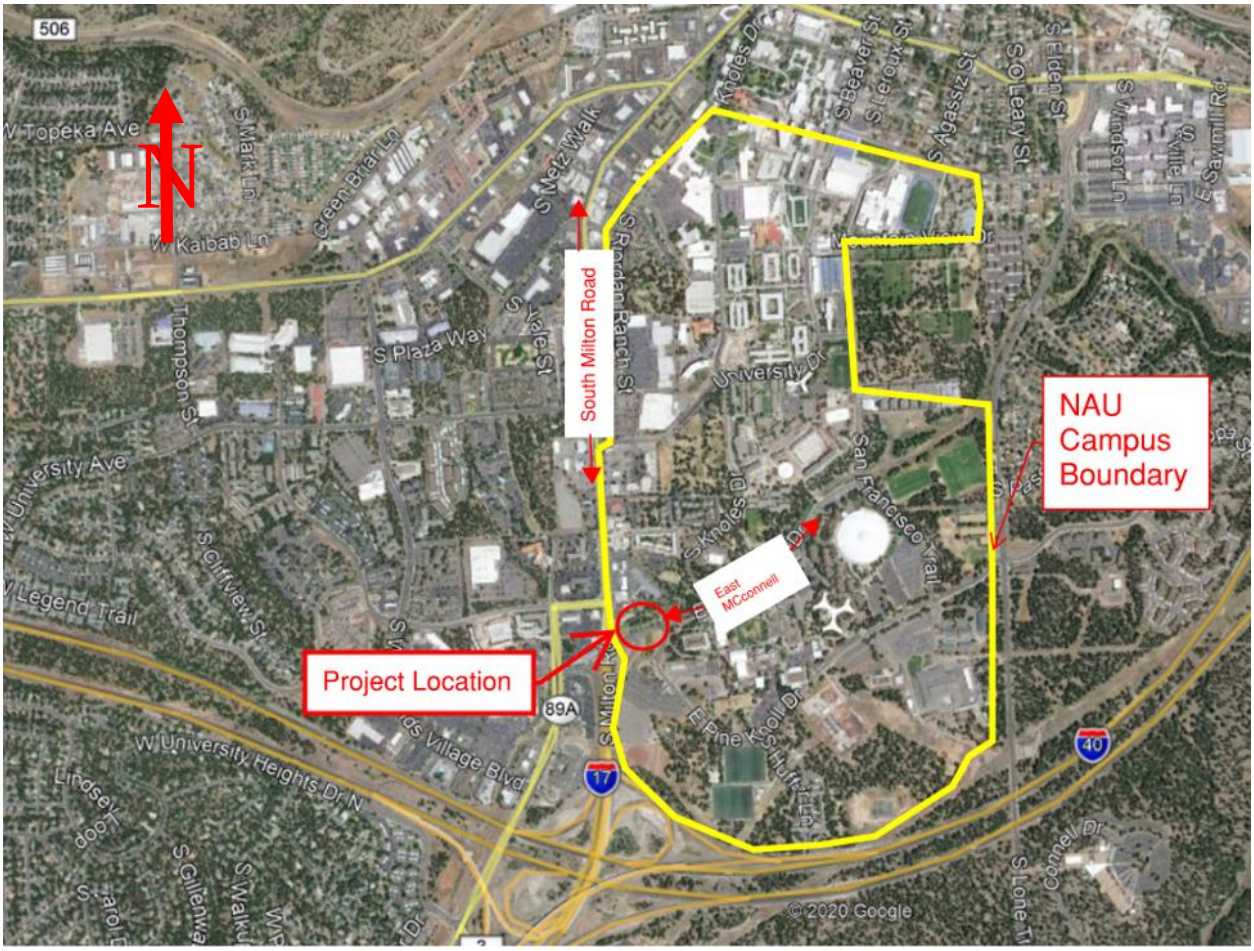


Figure 2: Site Location with Respect to NAU's Boundary [1]

The site location is circled in red and can be seen in Figures 1 and 2.

The next figure, Figure 3, depicts the site location with respect to I-17.

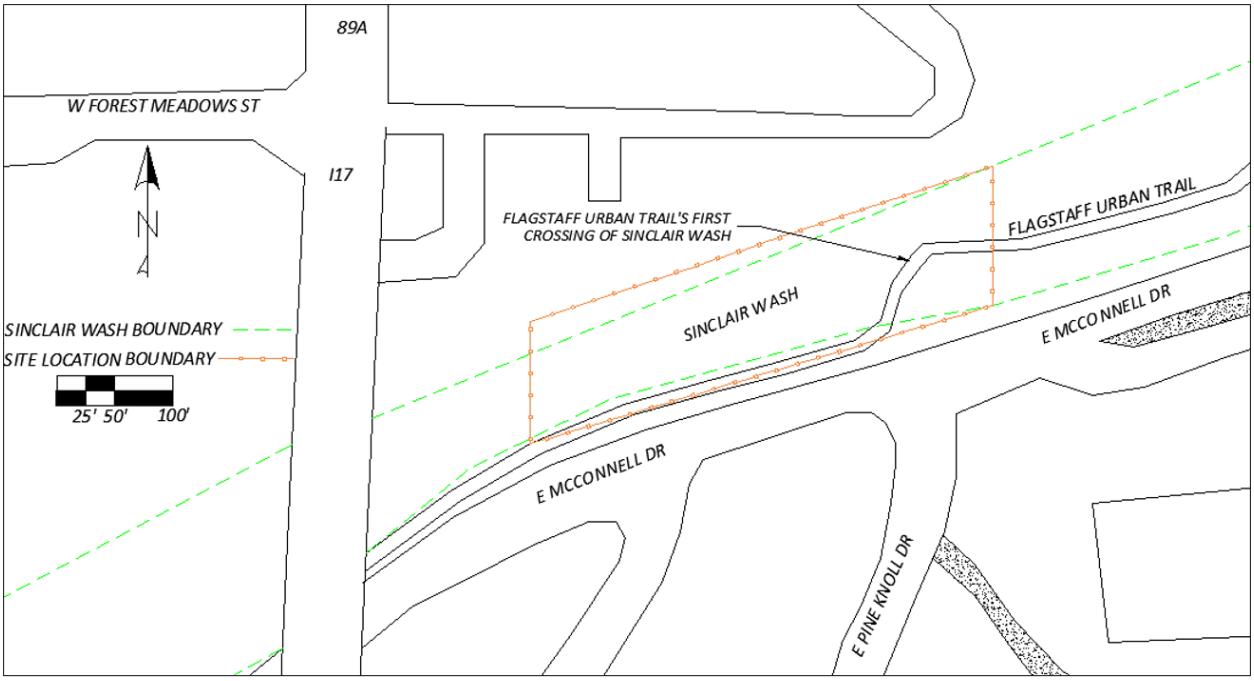


Figure 3: Site Boundary

The site boundary is 156 feet East of the I-17 culvert and continues past the Flagstaff Urban Trail System's first crossing of the wash. This can be seen in Figure 3.

The previous team selected this location due to multiple low points that are not on the thalweg which would result in ponding and the large amounts of vegetation that would hinder any flow in the channel. These areas of concern will be addressed by Red Rock Engineering and a final construction plan set will be provided to the client. See *Appendix A: Site Images* Figures 5-A through 12-A for pictures of the site.

1.3 Technical Considerations

1.3.1 Geotechnical Evaluation

A geotechnical evaluation will be undertaken of the proposed design area to determine several pieces of information including existing slope stability, current level of aggradation/degradation, and the erodibility of the channel invert. All information gathered will be used in developing a geomorphic channel design i.e. maintaining the channel reach's natural meander and grade, to mitigate such issues as undercutting of the banks, or severe aggradation/ degradation.

1.3.2 Ecological Assessments

An ecological assessment will be completed to identify how human induced stressors, produced from the completion of the restoration project, will affect the selected section of habitat. This allows the best management strategies to be implemented throughout and after the restoration design has been completed [3].

1.3.3 Biological Assessments

A biological assessment will be completed to determine the flora and fauna that live in the study area. This will aid with the ecological assessment by introducing native species of flora back into the channel section and eradicating invasive species of flora along the channel section to promote a healthy riparian habitat [4].

1.3.4 Hydrologic Analysis

A hydrologic assessment will be completed to determine the movement and distribution of water to the reach of channel at any given time via surface runoff. Storm event data will be researched and used to find the flow rate of water through the channel for specified storm durations.

1.3.5 Hydraulic Analysis

A hydraulic analysis will be completed to assess the existing and proposed level of flow functionality through the reach of channel. This will be done by utilizing existing surveying and hydrologic data to run the HEC-RAS modeling software and find design values such as average water velocity.

1.3.6 Geomorphic Assessment

A geomorphic assessment will be completed to improve the overall channel function such as ponding due to low points, vegetation and debris blocking flow paths. Utilizing data collected from the geotechnical evaluation and modeling software from the hydraulic and hydrologic analyses, the channels functionality can be determined and improved if necessary. The bank stability, channel slopes, erosion rates, and sediment depositions will be considered to identify necessary improvements.

1.3.7 Open Channel Design

The section of the open channel that has been identified will be restored to allow for stabilization and a continuous unhindered flow path. The channel will stay as a natural channel and design will be based on standards that NAU, the stakeholder, requires. This will be completed by using data gathered from the hydrological, hydraulic, and geotechnical analysis as well as software to improve upon the existing channel cross section.

1.3.8 Plan Production

The final goal for this project is a high-quality, accurate plan set detailing a cost-effective design for the identified project area. The client has requested an open channel plan set that meets minimal functionality and stability requirements. Production of this plan set will be supplemented with cross-sections and plan and profile views and incorporate additional hydraulic, hydrologic, geotechnical, biological, and ecological data collected by Red Rock Engineering. The final plan will illustrate a geomorphic design that optimizes stream function and stability.

1.4 Potential Challenges

There are multiple challenges the team has discussed that may hinder the completion of this project. First, due to Sinclair Wash being an ephemeral stream there will only be flow within the channel after a rain event or when there is snow melt. Due to this, it will be crucial for the team to take advantage of any storm event that occurs so that there is flow data. If there are no storm events or the team does not get data during one, assumptions on the flow will have to be made to the best of the team's ability. Another problem that may occur is an accumulation of snow/ice within the channel that will not allow for the team to collect pertinent data. Field work is currently planned to begin in January. During this time of the year the location is susceptible to long periods of snow/ice.

1.5 Stakeholders

There are three stakeholders regarding this project. The first is Northern Arizona University which is the major stakeholder this is because the project area lies directly on NAU property. The second primary stake holder is the public due to the educational features of the design. The third stake holder is the Federal government or more specifically FEMA because Sinclair wash is deemed a navigable water way.

2.0 Scope of Services

The services that will be completed during this project are outlined below. These tasks have been considered necessary for satisfactory completion of the project purpose.

2.1 Task 1 – Site Investigation

A site investigation will be done to provide a general sense of the overall health and functionality of the channel. The channel inventory will be taken to assess the drainage course, site conditions, and inventory areas of concern. This will be accomplished by a site visit by the team, and by visually inspecting the site to look for indicators such as, debris or litter in the channel reach.

2.2 Task 2 – Previous Studies

Previous studies will be analyzed to determine a logical starting point and progression plan for the project. These studies will consist primarily of findings published by previous undergraduate teams.

2.2.1 Task 2.1 – Feasibility Study

Previous capstone studies will be looked at to identify the scope of work, cost of project, time required, and value attained to complete a restoration project for the identified reach of Sinclair Wash. This information will be used to determine current changes that need to be addressed to make the restoration project successful in scope, time, cost, value, and design.

2.2.2 Task 2.2 – Surveying

Surveying data and topographic maps from previous capstone teams and other NAU sources will be utilized to create channel profiles. These profiles will be used for further channel analysis.

2.2.3 Task 2.3 – Hydrologic

Hydrologic data from previous capstone studies, previous Sinclair Wash research, and FEMA FIS documents will be utilized to determine the ideal channel conditions and culvert sizes required, to properly convey and withstand the design and check storm events outlined in the Flagstaff Stormwater Management Design Manual.

2.2.4 Task 2.4 – Hydraulic

Hydraulic data from previous capstone studies will be looked at to determine what channel conditions are still applicable for open channel analyzation. New conditions will be determined based on the validity of the previous ones.

2.2.5 Task 2.5 – Modeling

Previous hydraulic models will be looked at and utilized as a base or reference to determine if the proposed models account for previous, as well as newly identified channel conditions. Discrepancies in models will be analyzed and used to determine the best design for the channel.

2.2.6 Task 2.6 – Geomorphologic Design

Geomorphic data from previous capstone studies will be looked at to determine the existing erosion and sedimentation conditions within the channel. The geomorphic designs will be analyzed and compared to newly proposed designs.

2.3 Task 3 – Geomorphic Assessment

To address the client's concern of geomorphic stability the team will perform a geomorphic assessment. In doing this information will be collected that will influence decision making during the final design.

2.3.1 Task 3.1 – Identify and Catalogue Instability Areas

Identifying and cataloging instabilities will be completed by making a site visit. The team will be looking for areas of high or low sedimentation where aggradation or degradation can be seen. In addition, areas within the reach that are low points not along the thalweg will be documented.

2.3.2 Task 3.2 – Channel Conditions

In conjunction with identifying and cataloguing instability areas, a site visit will be done to identify channel conditions that impact the geomorphic stability. The following channel conditions that will be identified in AutoCAD include overbank elevations, slope of the channel bed and banks, as well as vegetative cover of the channel banks.

2.3.3 Task 3.3 – Restoration Targets/Priorities

By identifying and evaluating the existing geomorphic condition the team will be able to set and assess margins of improvement (if needed) in the reach. As well as being able to prioritize existing channel features that have the largest impacts on geomorphic stability.

2.4 Task 4 – Geotechnical Analysis

The geotechnical analysis outlines the required sampling methodology outlined in the Field Sampling Plan as well as the testing analysis to be performed on the collected samples.

2.4.1 Task 4.1 – Field Sampling Plan

A Field Sampling Plan will be completed prior to visiting the Sinclair Wash. The Field Sampling Plan will detail the sampling methodology, required materials, and number of samples. This document will be completed and signed by each member of the team.

2.4.2 Task 4.2 – Data Collection

Data collection will be completed following the procedures outlined within the Field Sampling Plan. It will be completed before the winter months to avoid complications caused by freezing conditions. Random sampling will be performed to prevent sampling bias. There will be five cross-sections in which samples will be divided amongst.

2.4.3 Task 4.3 – Sample Testing

Sample testing will be conducted to identify properties of the soil.

2.4.3.1 Task 4.3.1 – Sieve Analysis: ASTM C136

To determine suitable coefficients to utilize in analysis, it will be necessary to conduct a sieve analysis to map soil characteristics at different locations within the site.

2.4.3.2 Task 4.3.2 – Soil Classification

Soil classification of each sample will be conducted using physical characteristics of the soil. Soil samples will be classified using the ASTM 2487 USCS Method and ASTM 3282 AASHTO Method. Characteristics included within these classifications include color, structure, porosity, density, temperature, and consistency.

2.4.4 Task 4.4 – Analysis

The results obtained during sample testing will be analyzed. This analysis will illustrate the differences in soil characteristics throughout the area. Understandings following analysis will be implemented as a guide for the final proposed design.

2.5 Task 5 – Biological and Ecological Assessment

A biological and ecological assessment is needed for the identified reach of the channel. Field work will include a site visit and identification.

2.5.1 Task 5.1 – Identify Surrounding Interactions with Site

The site will be assessed to determine any added stresses from surrounding interactions. These outside stressors can impact the site and will need to be addressed.

2.5.2 Task 5.2 – Existing Flora Identification

The flora, plant life present, will be identified during a site visit. In depth notes will be taken during the site visit. A CAD rendering of the site with the identified flora will be created with their location.

2.5.3 Task 5.3 – Existing Fauna Identification

The fauna, animal life present, will be determined based on research in addition to the flora that are present. Observations will be made during the site visit, but natural fauna may not be present at the site visit.

2.5.4 Task 5.4 – Invasive Species Abatement

All invasive species that have been identified will need to be removed to ensure that the habitat is healthy and functional. These invasive species will be identified on the CAD rendering of the site and will be further addressed in Task 7 – Plan Set.

2.5.5 Task 5.5 – Native Species Re-Vegetation Plan

A re-vegetation plan will be created based on the CAD rendering of the site. Areas that are missing flora due to the invasive species being removed will need to be repopulated with native species. Native species that are already in the channel will be included. Research into compatible native species not currently present as well as flora that will aid fauna local to the channel will be done.

2.6 Task 6 – Open Channel Design

The open channel design will incorporate characteristics of previous capstone studies to devise an open channel design specific for the Sinclair Wash.

2.6.1 Task 6.1 – Materials

Materials that line the channel will be determined based on the geotechnical analysis. Materials addressed as incompatible for the channel lining will be removed or changed. Materials addressed as compatible for channel lining will stay in place.

2.6.2 Task 6.2 – Geomorphic Stability

A geomorphic stability analysis will analyze the instability areas identified in the Geomorphic assessment. Based on this analysis a feasible level of improvement will be determined and the information will be utilized in preparing the final open channel design.

2.6.3 Task 6.3 – Hydraulics

A hydraulic analysis will be completed on the identified reach of Sinclair Wash, to determine the current flow and channel conditions necessary to meet the design and check storm events identified in the Flagstaff Stormwater Management Design Manual. The HEC-RAS modeling software as well as FlowMaster and CulvertMaster will be utilized for this analysis and previous models will be compared to the current one.

2.6.3.1 Task 6.3.1 - FlowMaster and Culvert Master Analysis

The FlowMaster and CulvertMaster software will be used to analyze and model the current culverts spanning underneath the low water crossing of the flagstaff urban trail system. Design values such as maximum head water, overtopping elevation, and culvert lengths and diameters

will be measured via survey and AutoCAD data, as well as field measurements. The existing culverts as well as any new culvert design iterations will be evaluated per the flagstaff drainage code for the specified design storm, check storm, overtopping conditions, as well as weir effects before they are implemented into the final HEC-RAS model.

2.6.3.2 Task 6.3.2 - HEC-RAS Analysis

HEC-RAS will be used to model the existing function and flow conditions of the wash, as well as modeling the final chosen design. At least 5 cross sections will be taken along the wash, including immediately upstream and downstream of the low water crossing of the flagstaff urban trail system. For each cross section, the team will define the downstream reach lengths, manning's values, channel bank stations, and contraction/expansion coefficients. The FEMA FIS and *Flagstaff Stormwater Management Design Manual* will be utilized to determine what storm events need to be modeled.

2.7 Task 7 – Plan Set

The client has requested a plan set for the reach of the channel. The design will be based off analysis and goals from previous tasks. The design will be a natural channel that is geomorphically stable and addresses problem areas within the channel.

2.7.1 Task 7.1 – Template

A template on AutoCAD will be created by the team. This template will be used for all pages in the plan set that will be submitted to the client. The template will be created for a 22” x 34” paper. The template of the title block will include the revision number, drawing scale, engineering company and project name.

2.7.2 Task 7.2 – Cover Page

The location of the site will be identified on this part of the plan set. A map of Flagstaff will be provided with the site identified. In addition, a closer look at the location will identify the site location as well as the extents of the reach. It will also include pertinent information on the site. AutoCAD will be used to complete the cover page.

2.7.3 Task 7.3 – Construction Notes

Construction notes will be incorporated to relay technical information needed to construct the changes needed to be implemented. AutoCAD will be used to complete the construction notes. .

2.7.4 Task 7.4 – Channel Plan, Profile, and Cross-Sections

The plan and profile of the channel reach will be identified in the plan set. All five cross sections will be included following the plan and profile. The existing versus the proposed will be clearly

identified. This will include the necessary measurements and values to the contractor that they will need to build the design. AutoCAD will be used to complete the channel plan profile and cross section sheets.

2.7.5 Task 7.5 – Re-Vegetation Plan

The re-vegetation plan will include details on what flora will be added to the site and where it will go as well as what it would replace. The goal of the re-vegetation plan is to minimize the impact on the existing riparian habitat due to construction. AutoCAD will be used to complete the re-vegetation plan.

2.7.6 Task 7.6 – Construction Details

This page in the plan set will incorporate details that are needed to complete construction. These details will provide pertinent information and values necessary for the contactor to complete construction. AutoCAD will be used to complete the construction details.

2.8 Task 8 – Project Impacts

The proposed design will undergo a broad impact analysis. The information obtained within project impacts will be provided to the stakeholders to ensure project completion will be beneficial to all parties involved.

2.8.1 Task 8.1 – Regulatory

This project is expected to follow regulations established by the City of Flagstaff. Regulations implemented by Northern Arizona University as the primary stakeholder will also be followed accordingly.

2.8.2 Task 8.2 – Health

Restoration of the Sinclair Wash is expected to impact local health conditions. The health impact will be used to identify impacts on the surrounding community.

2.8.3 Task 8.3 – Environmental

Considerable environmental impact is expected following restoration of the Sinclair Wash. Environmental efforts within this project include reducing the buildup of garbage, reducing invasive species, and introducing new vegetation.

2.8.4 Task 8.4 – Economic

The project is anticipated to have minimal economic impact. This is because stream restoration will not attract new tourists to the area. Public access to the Sinclair Wash is also free.

2.8.5 Task 8.5 – Social

Significant social impacts are anticipated during and following restoration of the Sinclair Wash. Geomorphologic design alternatives may cause homes within close proximity to be impacted by nearby construction operations. These impacts will be negative during construction operations and become positive following implementation of the design. Increased functionality and an aesthetic appearance of the area is expected following restoration.

2.9 Task 9 – Project Deliverables

Provided below are the project deliverables necessary for satisfactory completion of this project. These deliverables have been distinguished between client and course deliverables.

2.9.1 Task 9.1 – Client Deliverables

The client has requested an end product of a final plan set. Throughout the semester multiple versions of the plan set will be submitted to get redlined so the final plan set is up to standards.

2.9.1.1 Task 9.1.1 – 30% Plan Set

The 30% plan set should have the completed template that will be utilized as well as the completed cover page.

2.9.1.2 Task 9.1.2 – 60% Plan Set

The 60% plan set should include a revised cover page in addition to the construction notes, a plan and profile of the channel, cross sections, a re-vegetation plan, and construction details.

2.9.1.3 Task 9.1.3 – 90% Plan Set

The 90% submittal will include the entire revised plan set to ensure that all details are up to the client's needs.

2.9.1.4 Task 9.1.4 – Final Plan Set

The final plan set will incorporate the findings from the semester and relay to the client what the reach of channel would be post construction.

2.9.2 Task 9.2 – Course Deliverables

Throughout CENE 486 there are main deliverables that will be completed throughout the semester. At each deliverable’s due date certain tasks listed above will need to be completed.

2.9.2.1 Task 9.2.1 – 30% Deliverables

A 30% report and presentation are due. At the due date of the 30% deliverables the following tasks should be completed: site investigation, previous studies, geomorphic assessment,

geotechnical analysis, and biological and ecological assessment. Aspects of the plan set that are to be completed at this point include the completed template that will be utilized as well as the completed cover page.

2.9.2.2 Task 9.2.2 – 60% Deliverables

A 60% report and presentation are due. The team will start with reviewing and revising the previous submittal. At the due date of the 60% deliverables the following tasks should be completed in addition to those previously listed: open channel design and project impacts.

2.9.2.3 Task 9.2.3 – 90% Deliverables

A 90% report and website are due. The team will start with reviewing and revising the previous submittal. A presentation will be done to show the work that has been done up to this point. At the due date of the 90% deliverables all tasks will be completed and will have been revised.

2.9.2.4 Task 9.2.4 – Final Deliverables

A complete report and website will be due. A final presentation will also be done. This will entail that all previous revisions needed have been addressed and fixed. The website will need to be accessible and fully functional.

2.10 Task 10 – Project Management

Project Management outlines the duties required for satisfactory project management during the completion of this project. Tasks pertaining to project management include meetings, correspondence, and management of scheduling and resources.

2.10.1 Task 10.1 – Client Meetings

Client meetings will be held bi-weekly via zoom. Meetings will be held in order to receive feedback from the client, as well as update the client on deadlines and milestones throughout the project duration.

2.10.2 Task 10.2 – Team Meetings

Team meetings will be held weekly via zoom to delegate and discuss upcoming or completed work. Meeting minutes are recorded and saved.

2.10.3 Task 10.3 – Technical Advisor Meetings

Technical Advisor meetings will be held Bi-weekly via zoom. These meetings will be held to discuss the technical challenges or aspects of the project.

2.10.4 Task 10.4 – Grading Instructor Meetings

Grading Instructor meetings will be held bi-weekly via zoom. These meetings will be held to receive feedback on submittals and deliverables. As well as receiving guidance for upcoming deliverables/submittals.

2.10.5 Task 10.5 – Correspondence

Correspondence between the team and all parties will be done in majority by Hannah Fischer. This will be done via email or phone. Correspondence methods are used to set meeting dates with the GI, TA, and Client.

2.10.6 Task 10.6 – Schedule Management

Schedule management will be completed by weekly and bi-weekly meetings as well as the creation of a Gantt chart. This will be done to ensure all deadlines and milestones will be completed on time.

2.10.7 Task 10.7 – Resource Management

Resource management will be completed by weekly and bi-weekly meetings. This will include acquiring access to labs, software, and equipment (if necessary). It is necessary that resource management be completed in conjunction with schedule management to ensure resources such as lab access will be available at times when they are required.

2.11 Exclusions

Exclusions for completion of the Sinclair Wash restoration have been provided below. These tasks will not be completed during this project as they have already been completed and provided using available resources.

2.11.1 Surveying

Surveying along the identified reach of Sinclair Wash will not be performed due to already existing data. This data is relatively new and will help the team create a topographic map, profiles along the section and site plan drawings.

2.11.2 Permitting

Permitting will not be considered for this project due to its irrelevance to the restoration. While most projects account for permitting, it is not necessary for this because construction will not take place for this restoration.

2.11.3 Traffic Assessment

A traffic assessment will not be performed because it is not necessary for our site's restoration plan. This plan will outline what will be restored and completed for the project, but a traffic plan will not be needed until construction occurs along the identified reach of the wash.

2.11.4 Aggradation and Degradation Rates

Quantifying the aggradation and degradation rates will not need to be completed for this project. This assessment is hard to complete and is not feasible for this project. To determine this information previous research on the area will be utilize. In the case of little to no information, supplemental analysis will be performed.

3.0 Schedule

3.1 Duration, Tasks, and Deliverables

The total duration of this project is projected to take 141 days, starting October 19, 2020, ending April 23, 2021, and excluding winter break (45 days). A typical work week, five, eight-hour days are considered working days for the completion of this project, which brings the duration to a total of 131 working days. The three longest duration tasks are the geotechnical analysis, ecological and biological assessment, and the plan set completion. The durations and dates of completion for all project tasks, subtasks, deliverables, and project management are listed in the scope can be seen in *Appendix B: Schedule for the Sinclair Wash Restoration Project*. For each deliverable see the respective scope subsection for what work will be completed for the client and course deliverables.

3.1.2 Critical Path

A Gantt Chart seen in *Appendix B: Schedule for the Sinclair Wash Restoration Project*, was completed to schedule each task identified in the scope and a critical path was identified to aid Red Rock Engineering with the timely completion of the project. The critical path can be seen in red and identifies the tasks that can be completed no later than their specified date. This allows tasks that are based on the critical ones to be completed within their allowable lag time. Following this path and staying on schedule ensures the completion of the project by April 23, 2021.

4.0 Staffing Plan

4.1 Staffing Positions

The following are the various staff positions that will be utilized in the completion of this project. The training and qualifications needed for each position are identified.

4.1.1 Senior Engineer (SE)

The Senior Engineer position will have the minimum qualifications of; B.S. in Civil or Environmental Engineering, a registered P.E in the state of Arizona with at least 10 years' experience who is self-motivated with managerial skills.

4.1.2 Project Engineer (PE)

The Project Engineer position will have the minimum qualifications of; a B.S in Civil or Environmental Engineering, a registered P.E in the state of Arizona with at least 5 years of experience, who works well in teams and with others.

4.1.3 Intern (INT)

The Intern position will have the minimum requirements of; pursuing a B.S in Civil or Environmental Engineering, with a cumulative GPA of at least a 3.1, and will be familiar with AutoCAD or similar drafting software and Microsoft Excel.

4.1.4 Lab Technician

The Lab Technician position will have the minimum qualifications of; an associate's degree in Civil Engineering, 5 years' experience in testing with a clear general knowledge and understanding of geotechnical testing methods.

4.2 Personnel Qualifications

The Personnel experience and qualifications of each team member are provided below. These credentials influence appropriate position distribution.

4.2.1 Jakob Brischke

Jakob Brischke is a senior Civil Engineering student at Northern Arizona University. The following are his experience and qualifications:

- Geotechnical Engineering I and II
- Geotechnical Engineering Lab
- Waters Resources I and II

- Water Resources Lab I and II
- Computer Aided Drafting
- Land Surveying
- Municipal Engineering
- Internship: Project Engineer for Sukut Construction

4.2.2 Hannah Fischer

Hannah Fischer is a senior Environmental Engineering student at Northern Arizona University. The following are her experience and qualifications:

- Waters Resources I and II
- Water Resources Lab I and II
- Environmental Engineering Lab II
- Computer Aided Drafting
- Land Surveying
- Undergraduate Research on Sinclair Wash and Oak Creek
- Internship: District Conservation Technician for NRCS
- Internship: Development Services Intern for Kimley-Horn Association

4.2.3 Kylie Hemmele

Kylie Hemmele is a senior Civil and Environmental Engineering student at Northern Arizona University. The following are her experience and qualifications:

- Geotechnical Engineering I and II
- Geotechnical Engineering Lab
- Waters Resources I and II
- Water Resources Lab I and II
- Computer Aided Drafting
- Land Surveying
- Municipal Engineering

4.2.4 Stephanie Seymour

Stephanie Seymour is a senior Civil and Environmental Engineering student at Northern Arizona University. The following are her experience and qualifications:

- Civil Engineer in Training
- Geotechnical Engineering I and II
- Geotechnical Engineering Lab
- Waters Resources I and II
- Water Resources Lab I and II
- Environmental Engineering Lab II

- Computer Aided Drafting
- Land Surveying
- Municipal Engineering
- Internship: Structural Engineering Intern for Hubbard Merrell Engineering

4.3 Staffing Matrix

Staffing broken down for each task and subtask can be found in *Appendix C: Staffing for the Sinclair Wash Restoration Project*. The following table, Table 1, shows the total number of hours anticipated for each position.

Table 1: Staffing Summary

Staffing Summary	
Position	Hours
Senior Engineer	95
Project Engineer	182
Lab Technician	79
Intern	146
Total Hours	**502**

A total of 502 hours are anticipated to be spent on completing this project. This breaks down to approximately 63 working days on the project. From above, the total duration of this project is projected to take 103 days. The staffing decided upon is conservative and leaves room for adjustments. The main way the team is planning to save time and money for the client is splitting into teams and working on different aspects of the project concurrently.

5.0 Budget/Cost of Services

The cost of services includes a breakdown of personnel work, geotechnical lab use, and supplies needed for soil sampling.

The following table, Table 2, shows the total cost that is anticipated for this project.

Table 2: Cost of Engineering Services Summary

Cost of Engineering Services Summary				
Personnel	**Classification**	**Hours**	**Rate ($/Hour)**	**Cost**
	Senior Engineer	95.25	$ 218.79	$ 20,840
	Project Engineer	182	$ 141.68	$ 25,786
	Lab Technician	79	$ 98.01	$ 7,743
	Intern	146	$ 32.13	$ 4,691
Sub-total				$ 59,059
Lab Facilities	**Classification**	**Days**	**Rate ($/Days)**	**Cost**
	Geotechnical Lab	3	$ 100.00	$ 300
Sub-total				$ 300
Supplies	**Classification**	**Quantity**	**Rate ($/Quantity)**	**Cost**
	Shovel	4	$ 50.00	$ 200
	Gallon Ziploc Bags	25	$ 0.13	$ 3
Sub-total				$ 203
Total Cost				**$ 59,563**

The final cost of the project amounts to $59,563. The majority of the cost will come from personnel work and starts at $59,059, use of the geotechnical lab will be $300.00, and the cost of supplies will come out to $203. These amounts were calculated based on average rates for the above classifications. Rates for personnel work were broken down into base pay, benefits, actual pay, and overhead (OH), and can be seen in *Appendix D: Billing Rate Breakdown for Personnel Work.*

6.0 References

[1] M. H. M. A. S. H. S. Q. Fahad Alyatama, "Sinclair Wash Riparian Habitat Enhancement Feasibility Study," Northern Arizona University, Flagstaff, 2016.

[2] B. W. Lima, "Sinclair Wash Restoration Feasibility Study," Flagstaff, 2020.

[3] General Multilingual Environmental Thesarus (GEMET), "Ecological Assessment," GEMTE, 13 Feburary 2020. [Online]. Available: https://www.eionet.europa.eu/gemet/en/concept/2440. [Accessed 31 August 2020].

[4] Environmental Protection Agency, "Biological Assessments: Key Terms and Concepts," EPA.gov, 2011.

7.0 Appendices

Appendix A: Site Images

Figure 4-A: Sinclair Wash looking Towards the I-17 Overpass

Figure 5-A: Channel of Wash looking Down-Stream

Figure 6-A: Channel of Wash looking Up-Stream

Figure 7-A: Sanitary Sewer #1

Figure 8-A: Sanitary Sewer #2

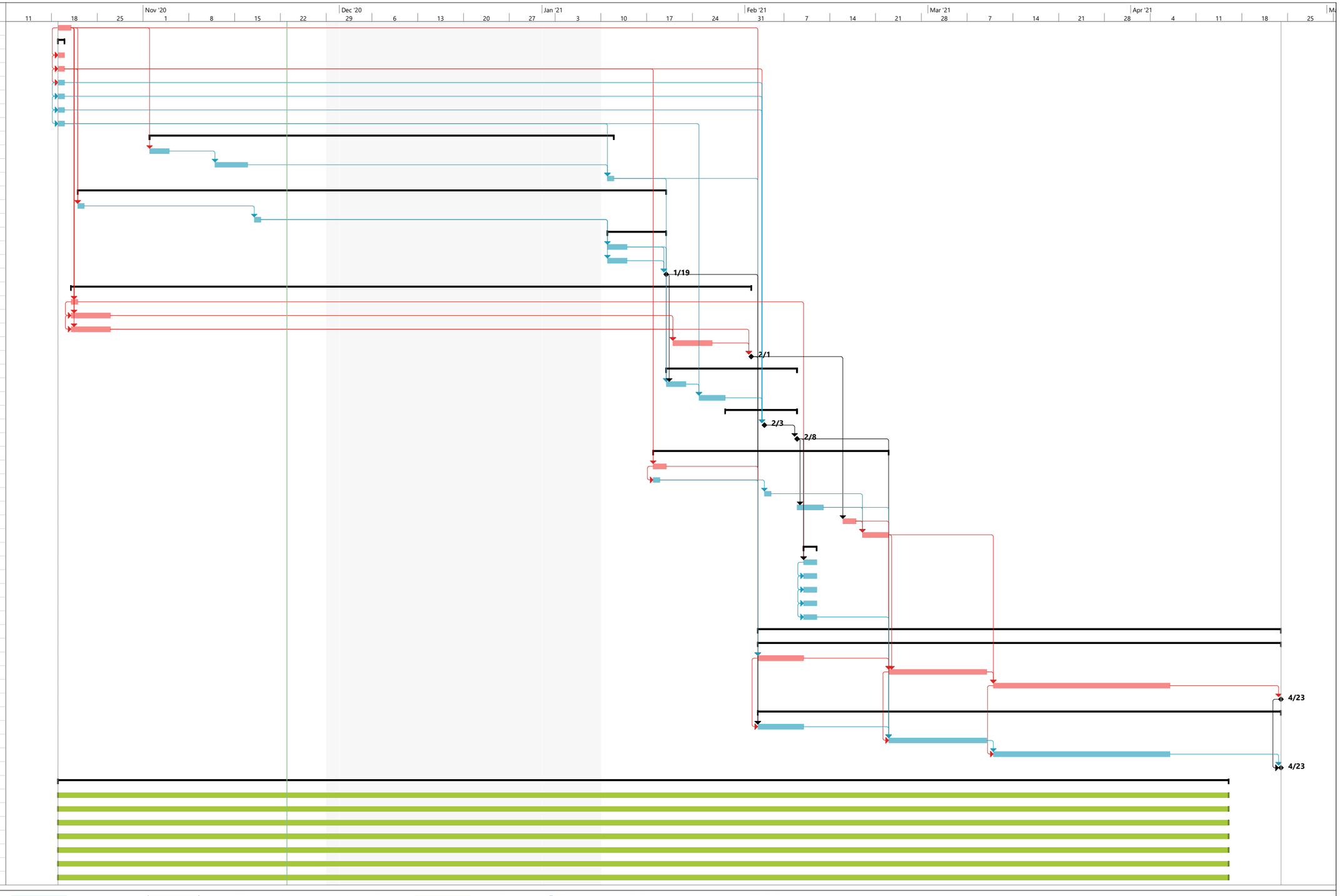
Figure 9-A: Upstream Culvert Undercrossing Bike Path

Figure 10-A: Culvert on Embankment along McConnell Drive

Figure 11-A: Downstream Channel Area by I-17 Overpass

Appendix B: Schedule for the Sinclair Wash Restoration Project

WBS	Task Name
1	Site Investigation
2	**Previous Studies**
2.1	Feasibility Study
2.2	Surveying
2.3	Hydrologic
2.4	Hydraulic
2.5	Modeling
2.6	Geomorphologic Design
3	**Geomorphic Assessment**
3.1	Identify and Catalouge Instability Areas
3.2	Channel Conditions
3.3	Restoration Targets/Priorities
4	**Geotechnical Analysis**
4.1	Field Sampling Plan
4.2	Data Collection
4.3	**Sample Testing**
4.3.1	Sieve Analysis: ASTM C136
4.3.2	Soil Classification
4.3.3	Analysis
5	**Biological and Ecological Assessment**
5.1	Identify Surrounding Site Interactions
5.2	Exsisiting Flora Identification
5.3	Exsisting Fauna Identification
5.4	Invasive Species Abatement
5.5	Native Species Re-Vegitation Plan
6	**Open Channel Design**
6.1	Materials
6.2	Geomorphic Stability
6.3	**Hydraulics**
6.3.1	FlowMaster and Culvert Master
6.3.2	HEC-RAS Analysis
7	**Plan Set**
7.1	Template
7.2	Cover Page
7.3	Construction Notes
7.4	Channel Plan, Profile, and Cross-Sections
7.5	Re-Vegitation Plan
7.6	Construction Details
8	**Project Impacts**
8.1	Regulatory
8.2	Health
8.3	Environmental
8.4	Economic
8.5	Social
9	**Project Deliverables**
9.1	**Client Deliverables**
9.1.1	30% Plan Set
9.1.2	60% Plan Set
9.1.3	90% Plan Set
9.1.4	Final Plan Set
9.2	**Course Deliverables**
9.2.1	30% Deliverables
9.2.2	60% Deliverables
9.2.3	90% Deliverables
9.2.4	Final Deliverables
10	**Project Management**
10.1	Client Meetingigs
10.2	Team meatings
10.3	Technical Advisor Meetings
10.4	Gradingin Instructor Meetings
10.5	Correspondence
10.6	Schedule Management
10.7	Resource Management



Project: Capstone Schedule - N
Date: Mon 11/23/20

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

Appendix C: Staffing

Table 3-C: Summary of Staffing

POSITION	SENIOR EGR	PROJ EGR	LAB TECH	INTERN
HOURLY WAGE ($)	218.79	141.68	98.01	32.13
Σ DURATION (hour)	95	182	79	146
Σ COST ($)	$20,839.75	$25,785.76	$7,742.79	$4,690.98

Table 4-C: Task Staffing

TASK	SCHEDULED DURATION (day)	BILLABLE DURATION (hours)			
Task 1 – Site Investigation	2		**4**		
Task 2 – Previous Studies			**2**		**24**
Task 2.1 – Feasibility Study	1		0.25		4
Task 2.2 – Surveying	1		0.25		4
Task 2.3 – Hydrologic	1		0.25		4
Task 2.4 – Hydraulic	1		0.5		4
Task 2.5 – Modeling	1		0.5		4
Task 2.6 – Geomorphologic Design	1		0.25		4
Task 3 – Geomorphic Assessment		**2**	**21**	**0**	**4**
Task 3.1 – Identify and Catalogue Instability Areas	3		10		
Task 3.2 – Channel Conditions	3		10		
Task 3.3 – Restoration Targets/Priorities	1	2	1		4
Task 4 – Geotechnical		**2**	**0**	**44**	**5**
Task 4.1 – Field Sampling Plan	1	1			3
Task 4.2 – Data Collection		1			2
Task 4.3 – Sample Testing					
Task 4.3.1 – Sieve Analysis: ASTM C136	4			25	
Task 4.3.2 – Soil Classification	3			15	
Task 4.4 – Analysis	3			4	
Task 5 – Biological and Ecological Assessment		**2**	**18**	**0**	**6**
Task 5.1 – Identify Surrounding Site Interactions	1				
Task 5.2 – Existing Flora Identification	4		10		
Task 5.3 – Existing Fauna Identification	4				2
Task 5.4 – Invasive Species Abatement	4		4		2

Task 5.5 – Native Species Re-Vegetation Plan	4	2	4		2
Task 6 – Open Channel Design		**2**	**57**	**0**	**0**
Task 6.1 – Materials	3		5		
Task 6.2 – Geomorphic Stability	4		20		
Task 6.3 – Hydraulics					
Task 6.3.1 – FlowMaster and CulvertMaster Analysis	4	1	20		
Task 6.3.2 – HEC-RAS Analysis	3	1	12		
Task 7 – Plan Set		**3**	**17**	**1**	**10**
Task 7.1 – Template	2		0.5		2
Task 7.2 – Cover Page	1		0.5		2
Task 7.4 – Construction Notes	1		0.5		2
Task 7.5 – Channel Plan, Profile, and Cross-Sections	4	1	10		0.5
Task 7.6 – Re-Vegetation Plan	2	1	5		0.5
Task 7.7 – Construction Details	2	1	0.5	1	3
Task 8 – Project Impacts		**1.25**	**0**	**0**	**20**
Task 8.1 – Regulatory	2	0.25			4
Task 8.2 – Health	2	0.25			4
Task 8.3 – Environmental	2	0.25			4
Task 8.4 – Economic	2	0.25			4
Task 8.5 – Social	2	0.25			4
Task 9 – Project Deliverables		**23**	**33**	**4**	**47**
Task 9.1 – Client Deliverables					
Task 9.1.1 – 30% Plan Set	2	3			
Task 9.1.2 – 60% Plan Set	3	4			
Task 9.1.3 – 90% Plan Set	2	2			
Task 9.1.4 – Final Plan Set	2	1			
Task 9.2 – Course Deliverables					
Task 9.2.1 – 30% Deliverable	5	3	8	2	12
Task 9.2.2 – 60% Deliverable	7	5	10	2	17
Task 9.2.3 – 90% Deliverable	5	3	10		10
Task 9.2.4 – Final Deliverables	3	2	5		8
Task 10 – Project Management		**60**	**30**	**30**	**30**
Task 10.1 – Client Meetings	Ongoing	8	8	8	8
Task 10.2 – Team Meetings	Ongoing	15	15	15	15
Task 10.3 – Technical Advisor Meetings	Ongoing	4	4	4	4
Task 10.4 – Grading Instructor Meetings	Ongoing	3	3	3	3
Task 10.5 – Correspondence	Ongoing				

Task 10.6 – Schedule Management	Ongoing	15			
Task 10.7 – Resource Management	Ongoing	15			

Appendix D: Billing Rate Breakdown for Personnel Work

Table 5-D: Billing Rates for Personnel

Title Abbreviations	Position Title	Base Pay ($/Hr)	Benefits % of base pay	Actual Pay	OH % of base pay	Actual Pay +Oh ($/hr)	Profit % of actual pay + OH	Billing Rate ($/Hr)
SEN.	Senior Engineer	$90.00	30%	$117.00	70%	$198.90	10%	**$218.79**
Eng. 1	Engineer 1	$70.00	60%	$112.00	15%	$128.80	10%	**$141.68**
LT	Lab Tech	$45.00	80%	$81.00	10%	$89.10	10%	**$98.01**
INT	Intern	$25.00	20%	$30.00	5%	$31.50	2%	**$32.13**