

# Coyote Springs HOA

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Dear Coyote Springs HOA,

The Northern Arizona University College of Engineering, Forestry, and Natural Sciences team, AARK Stream Restorations, LLC, is writing this letter of transmittal to the Homeowners Association with regards to the Coyote Springs habitat located near your residences. Attached you will find the proposal entitled "Coyote Springs Riparian Habitat Restoration." This proposal explains in detail the work to be completed by AARK Stream Restorations, LLC, a team consisting of both Civil and Environmental Engineering students, during the spring of 2015 and fall of 2015 semesters, per the Coyote Springs Homeowners Association.

We would appreciate if you consider our proposal carefully, complete the section below, and email it to Rachel Joaquin at [RJ324@nau.edu](mailto:RJ324@nau.edu) to ensure you have read and received the proposal.

Should you have any questions or comments about this proposal, do not hesitate to contact Rachel Joaquin.

Sincerely,

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Abdullatif Albeaijan

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Alexander Comito

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Rachel Joaquin

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Kyle Depugh

I have read the enclosed proposal and have the following comments:

I accept the proposal.

I decline the proposal.

I accept the proposal with the changes/comments shown below (feel free to include any and all comments in separate page as necessary).

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Coyote Springs Homeowners Association

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Signature / Date

# COYOTE SPRINGS RIPARIAN STREAM HABITAT RESTORATION

Northern Arizona University Engineering Capstone

AARK STREAM RESTORATIONS, LLC

We strive for excellence in every project small or large. In order to make every stream the best that it can be.

Abdullatif Albeijan, Alexander  
Comito, Rachel Joaquin, Kyle  
Depugh

5 May 2015

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## List of Abbreviations

ADOT - Arizona Department of Transportation  
HWY - Highway  
LLC - Limited Liability Corporation  
EPA - Environmental Protection Agency  
CFR - Code of Federal Regulations  
HOA - Home Owners Association  
ADEQ - Arizona Department of Environmental Quality  
ADWR - Arizona Department of Water Resources  
AARK - Abdullatif, Alex, Rachel, and Kyle  
SENG - Senior Engineer  
ENG - Engineer  
EIT - Engineer in Training  
INT - Intern

# 1.0 Project Understanding

Between the Coyote Springs property area and HWY 180 in Flagstaff, AZ is a riparian habitat. This riparian habitat has become diminished, possibly due to construction in the area. Being that this area is frequented by wildlife, AARK Stream Restorations, LLC will be working to repair the stream, as well as be ecologically friendly to not disturb the existing vegetation and environment. The purpose of this project is to design and analyze the Coyote Spring stream reach, its outlet, ponding area, and channel for habitat restoration. The design to alter the existing stream must be natural and aesthetically pleasing, while complying with regulations for the Coyote Springs HOA, the City of Flagstaff, and ADOT.

## 1.1 Project Background

The Coyote Springs stream restoration project is located approximately 2.6 miles Northwest of Flagstaff City Hall, shown in Appendix A Figure 4. There is a well house built where the stream begins, built by the late Dr. Harold S. Colton, one of the founding members of the Museum of Northern Arizona. Figure 1 below shows the start and end points of the Coyote Spring stream reach.



Figure 1) Start and end of design reach for Coyote Springs



The spring has an abundance of grasses, shrubs, and other vegetation. Sediment has accumulated in some areas: clogging culverts and filling the pond area at the entrance of Coyote Springs. Figure 2 shows a culvert that is obstructed by sediment.



*Figure 2) Culvert under Colton Ct.*

## 1.2 Technical Considerations

The project is a riparian habitat and restoration assessment, so existing rules and regulations for the City of Flagstaff, Arizona Department of Transportation, and other involved parties will be examined. The AARK Stream Restorations team is referencing guidelines for erosion management, storm water discharge, re-vegetation, habitat restoration, and aesthetic appearances altering the stream and existing area.

According to ADOT's guidelines for encroachment permittee's state and federal regulations, the area that is to be worked on should not breach any historic land on the National Register of Historic Places [1]. The Coyote Range, also known as the Colton House, is on the National Register of Historic Places list in Arizona, meaning ADOT had to have followed the regulations to not encroach the historic area involved; the Arizona Historic Preservation Act of 1966 ensures ADOT considers the effects of its actions when building in this area [2].



Since the encroachment is dealing with a right-of-way, ADOT's Title 17 Transportation deals with the highway encroachment permits necessary for landscaping the area in question, in this case, the stream [5].

The Environmental Protection Agency's Code of Federal Regulations, 40 CFR 122.26 designates the storm water discharge that needs to be considered when creating the corrected culvert, and channel geometry to hold a storm event [3]. Along with the water flow rate in the stream itself, the channel banks that have been altered drastically must be analyzed. ADOT placed mesh netting on the steep banks of the lower section of the stream. This unnatural netting is not aesthetically pleasing, as agreed upon by the client, so the team will work with the ADOT regulations for re-vegetation of possible native species [4]; seeding the area will stabilize the slope and allow for retention of the stream banks.

### 1.3 Potential Challenges

Potential challenges for this project may include weather, survey equipment availability and functionality, modeling software functionality, and utility interference. Surveying equipment shall be protected from harsh weather, therefore survey days will be weather permitting. Stream reach modeling software (HEC-RAS) can involve technical difficulties in the software or user error which may cause for extra work hours. On site there are electrical, water, and communication utilities close to the streams banks; these utilities may make it difficult to access with equipment and will be considered during stream design. Communication is key and may be difficult getting accurate and timely responses from all involved parties. Allowance of time will be allocated to accommodate for delayed responses. Getting accurate responses from Coyote Springs HOA, not just individual opinions on what he/she wants may also be a challenge. This could be resolved by meeting with all residents at one time to satisfy everyone's needs together. Previous construction plans in the area will need to be acquired to accommodate for underground utilities and structures for future design. Limited space is a major constraint as well; Highway 180 is on one side and historic land on the other, making for a narrow margin of land to design around.

### 1.4 Stakeholders

The stakeholders in this project are Cindy Perin, the Museum of Northern Arizona, ADOT, and the City of Flagstaff. The Coyote Springs property incorporates the stream, causing Coyote Springs HOA (Cindy Perin) to be a major stakeholder. The Museum of Northern Arizona owns part of the water rights to the stream, and therefore are partial stakeholders. Arizona Department of Transportation has developed in the vicinity of the stream. The project is partially on Flagstaff property, so the City of Flagstaff is involved as well. The team will need to discuss with the Museum of Northern Arizona, as well as the Coyote Springs HOA, the limitations for this stream reach and the property that is allowed to be altered. Arizona Game and Fish may have an interest in the riparian habitat rehabilitation for any existing and future wildlife that the new design brings.

## 2.0 Scope of Services

The Coyote Spring stream reach is roughly 1,650 feet long, and runs along HWY 180. The area that the stream inhabits is narrow and runs between a walking path and Coyote Springs property lines. The increased sediment in the stream reach has caused water to pool; which may have allowed plants, both native and non-native species, to accumulate in certain areas of the reach. The stream will be analyzed and redesigned to: promote proper function of the channel and reduce pooling, enhance riparian habitat through the establishment of native vegetation and removal of non-native vegetation, and increase aesthetic appearance. The floodplain function and conditions will be modeled by a HEC-RAS model for both the existing and proposed conditions.

### Task 1.0 - Field Evaluation

This task involves visiting the site to collect existing data and familiarize all parties with the area, vegetation, and topography.

#### 1.1 - Spring

The spring is to be evaluated, to determine its flow and where the water comes from. The spring is currently surrounded by a well house. The staff working on this project will determine who is responsible for the well house to better view the site, and get access for testing purposes.

#### 1.2 - Stream

The extents and reach, as well as the flow will be evaluated. The vegetation surrounding the stream will also be taken into account and analyzed.

#### 1.3 - Culverts

The culvert infrastructures will be observed and surveyed to determine the effectiveness on site.

#### 1.4 – Surveying/General Site Constraints

The surveying will start at the upstream end of the stream at the well house, and end downstream at the end of the culvert crossing HWY 180, shown in Figure 3. Both the industrial and environmental elements surrounding the stream will be surveyed and analyzed. This will allow the staff working on this project to determine what needs to be fixed and what doesn't need to be fixed.

### Task 2.0 – Coordination

Close coordination with stakeholders including city, state, and federal agencies will be critical to design completion while accommodating the needs and concerns involved in the project. Keeping a positive working relationship with Coyote Springs residents and satisfying the needs will be important in designing a sufficient solution.

## Task 3.0 - Permitting, Standards, Codes

### 3.1 - Construction Requirements

ADOT and the City of Flagstaff regulation documents must be utilized in order for legal standards to be adhered to and approved for the project.

### 3.2 - Property Standards

Coyote Springs HOA standards will be inspected as well as landscape parameters in order to make sure the stream does not cross property lines or violate any of HOA standards.

### 3.3 - Hydrologic

AARK Restorations, LLC will follow proper design standards to comply with all regulations for the City of Flagstaff and the state of Arizona.

### 3.4 - Hydraulic

AARK Restorations, LLC will follow proper design standards to comply with all regulations for the City of Flagstaff and the state of Arizona.

### 3.5 - Arizona Department of Environmental Quality

There are laws, policies, rules, and permits that need to be examined and possibly obtained in the event that the stream reach and surrounding environment will be altered.

### 3.6 - Arizona Department of Water Resources

Flagstaff is under the area of the Eastern Plateau according to the ADWR. The ADWR must be researched to ensure the stream flow is not extremely altered or the possible geographical change will impact the groundwater aquifer.

## Task 4.0 - Hydrologic Analysis

### 4.1 - Rainfall and Snowfall

Annual precipitation and snowfall as well as snowmelt runoff will be analyzed to design around. This will add to the discharge of the stream.

### 4.2 - Spring and Stream Discharge

The spring's discharge will contribute to the stream reach being analyzed. This flow rate will be identified to understand the amount of perennial flow the stream has. The source of the spring will be researched in order to determine contributing surface area. The overall discharge from the stream will be a sum of the rainfall and snowfall, the spring's source of water, and the surrounding watershed runoff.

### 4.3 - Watershed

Delineation needs to be complete to determine what encompasses the stream and affects the flow regime. This will be completed using online resources.

## Task 5.0 - Hydraulic Analysis

### 5.1 - Culvert

The culvert sizing will be analyzed to determine if they are the correct sizes and materials for the areas as well as the flow rates they will convey so there is no overbanking of water onto the streets using Bentley Culvertmaster.

### 5.2 - Channel

The channels sinuosity and slope will be analyzed to determine if the conveyance is low or high for this stream. This will help determine if the stream will have any aggradation or degradation in the future. The analysis of the data for the channel will be done using HEC-RAS

## Task 6.0 - Site Analysis

### 6.1 - Geological Report

Geologic reports will show soil properties and characteristics of the surrounding area. These reports will be obtained from previous construction.

### 6.2 - Plant Classification

Plants in the area, both native and non-native, will be researched to determine their speciation according to the website *Non-native, Invasive Plants of Arizona* [8].

### 6.3 - Utilities Report

Reports for existing utilities on-site will be obtained through ADOT, the City of Flagstaff, APS, and UniSource Energy Services.

## Task 7.0 - Hydrologic Design

The Coyote Springs stream reach will be designed to accommodate high and low flow storm events determined from the watershed delineation and past storm events.

## Task 8.0 - Hydraulic Design

The stream slope and sinuosity will be designed so the water flows without pooling in certain areas, and causing minimal aggradation or degradation. The survey data will be in put into HEC-RAS in order to develop 3D models of the stream, and analyze all the flow scenarios.

## Task 9.0 - Site Design

The site will be designed in a way that it appears nothing man made has been put into the stream reach, this will create a more natural appearance as it may have looked before human involvement.

### 9.1 - Landscape

The landscape of Coyote Springs stream reach will be put back to its natural conditions. This may include: removal of non-native species of plants, use of native rocks surrounding the stream (if needed), and replanting of native plant species to restore the stream reach to its riparian habitat.

## Task 10.0 - Final Concepts

The team will conclude their findings from evaluating and analyzing the site, along with the research conducted for the existing reach. The AARK Restorations team will deduce multiple solutions and formulate the most sustainable, eco-friendly solution. The broader impacts of the proposed solutions will be evaluated to ensure the participation of the public for educational purposes, further research opportunity possibilities, and directly enhancing the habitat for perpetuating the wildlife. Depending on the findings, the team will then present the progress and plan to move forward and begin the alterations of the reach if necessary.

## Task 11.0 - Project Management

### 11.1 - Schedule

The proposed schedule must be planned to determine the start and end dates of the project, the tasks and subtasks, the durations of the tasks, task dependencies, and task milestones.

### 11.2 - 50% report

The 50% report allows for both the client and team to determine if they are on task according to the proposed schedule. This report may include technical analyses, cost analyses, and any other information started or finished by the half way point of the project time frame. This report is due on October 16, 2015.

### 11.3 - Final Report

The final report will conclude all analyses, due on December 4, 2015.

### 11.4 - Final Presentation

AARK Restorations, LLC will propose the final design to the client on December 4, 2015.

### 11.5 - Website

The website will include: a homepage which include the title of the project and a description, the client contact info, the team contact info, the technical advisor contact info and link to other pages. It will also include a project information's page which include project constraint, alternative design and final design, HEC-RAS model, photo gallery and Gantt chart and internal team budgeting. It will also include a document page



which include the final report and the presentation in PDF form. The final website will be available to the public on Friday, December 4, 2015.

### 3.0 Exclusions

- Final design will not be implemented during this capstone project year. This is for informational purposes only.
- Ponding area on west side of HWY 180 will not be analyzed since it is on private property and not part of the project reach. The only analysis done on the west side of HWY 180 will be to determine the exit conditions from the culvert.
- Soil property analysis will be based on previous existing geotechnical reports.

### 4.0 Schedule

The schedule shows the due dates, task durations, and milestones for the project, including the critical path for the overall project. The critical path method utilizes item dependencies and their duration to determine the shortest period of time until completion of the project. Beginning with coordination, the team has to meet with each other and schedule times to meet with the technical advisor and client, as well as schedule a date and time to evaluate the site. The site evaluation must involve the team walking the site and determining the areas of interest, as well as meeting with the client and technical advisor for what it looks like needs to be completed. Permitting, standards, and codes must be checked for constraints before any hydrologic analyses can be completed. The hydrologic analysis for rainfall and snow runoff must be examined before the spring and source discharge, as well as the watershed can be determined. Surveying must be completed by the team before any analysis or design processes can begin. The culvert and channel must be analyzed before the design processes as well. Both the geological and utility reports must be submitted to the team in order to move forward with site design. The Gantt chart is in Appendix B with the detailed tasks and dates that may be subject to change.



*Figure 3) Coyote Spring Well House*

## 5.0 Staffing and Cost of Engineering Services

Four personnel will be working on this project directly from AARK Stream Restorations, LLC. The SENG will be the overall lead for the final design and documentation. The ENG work will be modeling, final design, and a portion of the document. The EIT will be doing most of the field analysis work along with some data entry for the modeling. The EIT will also provide some entries into the final design and documentation. An INT hired by the company will experience more research and field analysis versus the modeling and final report. A total of 75 days or 601 working hours is the approximated labor for the Coyote Springs Riparian Habitat Restoration, shown in Table 3.

Tasks	SENG Hours	ENG Hours	EIT Hours	INT Hours
Research: Codes	0	4	4	8
Research: Riparian Habitat	0	4	4	8
Field Analysis	4	8	96	40
Modeling	4	200	24	0
Final Design	22	56	16	3
Documentation	8	40	32	16
Subtotal (hours)	38	312	176	75
Total (Hours)				601

Table 1) AARK Personnel Work Tasks and Hours – [See Appendix C for Breakdown](#)

The pay for each member follows approximated Flagstaff, Arizona rates for professional engineers employed at W.L. Gore. Overhead costs consider surveying equipment for field usage and AutoCAD and HEC-RAS modeling software for analyzing the stream was determined to be a one-time charge of \$490.00 for this project. The total of cost for staffing and overhead for the Coyote Springs Riparian Habitat restoration is \$51,000.00, shown in Table 2.

	Classification	Hours	\$ Rate/Hour	Cost
1.0 Personnel	SENG	38	\$130.00	\$4,940.00
	ENG	312	\$97.00	\$30,264.00
	EIT	176	\$73.00	\$12,848.00
	INT	75	\$33.00	\$2,475.00
	Total Personnel			\$50,527.00
2.0 Overhead				\$490.00
3.0 Total				\$51,017.00

Table 2) Staffing and Overhead Cost Breakdown – [See Appendix D for Breakdown](#)



## 5.0 References

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- [10] “Flagstaff.” 35°13'57.81" N and 111°39'37.04" W. Google Earth. 31 January 2015.
- [11] AutoCAD [computer software]. (2015). San Rafael, California: Autodesk, Inc.
- [12] Microsoft Excel [computer software]. (2013). Redmond, Washington: Microsoft.

[Appendix A: Site Maps](#)



Figure 4) Site Overview



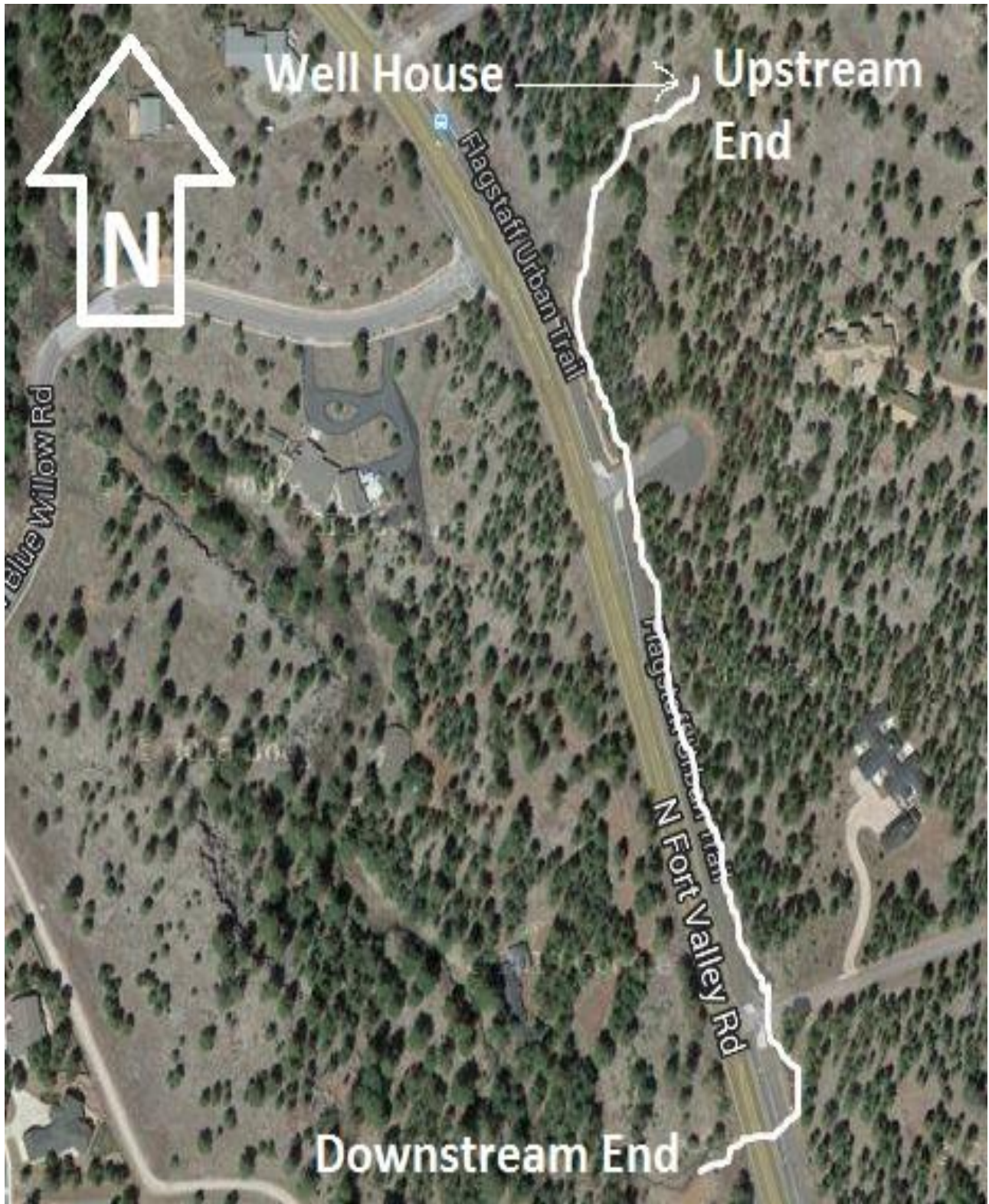


Figure 5) Project Site End Points

## Appendix B: Gantt Chart

## Appendix C: Staffing Hours for Project

Tasks	SENG Hours	ENG Hours	EIT Hours	INT Hours
<b>Research</b>				
Construction Requirments	0	0	2	0
Property Standards	0	0	2	2
Hydrologic	0	0	2	3
Hydraulic	0	0	2	2
ADEQ	0	2	0	1
ADWR	0	2	0	1
Geological Reports	0	2	0	0
Utility Reports	0	2	0	0
Plant Classification	0	0	0	4
Riparian Habitat Standards	0	0	0	3
<b>Field Analysis</b>				
Stream	0	0	2	2
Culverts	0	0	1	2
Spring	0	0	2	1
Surveying	1	0	60	25
General Site Constraints	1	0	4	1
Watershed Delineation	1	2	8	0
Rainfall/Snowfall	0	4	6	1
Spring and Source Discharge	1	2	8	1
Culvert Analysis	0	0	3	3
Channel analysis	0	0	2	4
<b>Modeling</b>				
Channel Design	1	48	1	0
Culvertmaster	1	24	8	0
AutoCAD Survey Points	0	8	8	0
HEC-RAS	1	80	2	0
AutoCAD Environment	0	16	1	0
AutoCAD Landscape	1	24	4	0
<b>Final Designs</b>				
Culvert Sizing	4	8	8	1
Verify AutoCAD Landscape	2	16	6	1
Verify HEC-RAS Models	16	32	2	1
<b>Documents</b>				
50% Report	1	24	10	4
Final Report	5	12	4	1
Final Presentation	2	4	6	1
Website	0	0	12	10
<b>Subtotal</b>	<b>38</b>	<b>312</b>	<b>176</b>	<b>75</b>
<b>Total (Hours)</b>				<b>601</b>

Table 3) Staffing Hours for Project

## Appendix D: Pay Rate and Overhead Breakdown

Classification	Base Pay Rate \$/hr	Benefits % of Base Pay Rate	Actual Pay \$/hr	Profit % of Actual Pay	Billing Rate \$/hr
SENG	84	40	117.6	10	129.36
ENG	53	65	87.45	10	96.195
EIT	40	65	66	10	72.6
INT	25	20	30	10	33

Table 4) Employee Pay Rate Breakdown

Overhead	Use	Cost
AutoCAD	Landscape/Survey Modeling	\$5.50/day
HEC-RAS	Stream Modeling	\$1/day
	Total/Day	\$6.50
	Total For 75 Days	\$490

Table 5) Overhead Cost Breakdown