Proposal For
Chiricahua National Monument RV Housing Utility Design

CENE 476

Prepared by:

Chiricahua Wastewater Wizards (C3W)

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Final Proposal

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List of Abbreviations

NP: National Park

C3W: Chiricahua Wastewater Wizards

NPS: National Park Service

ADEQ: Arizona Department of Environmental Quality

EPA: Environmental Protection Agency

ADA: The Americans with Disabilities Act

RV: Recreational Vehicles

SAR: Soil Absorption Rate

UPRR: Union Pacific Railroad

PE: Professional Engineer

1.0 Project Understanding

1.1 Project Purpose

The goal of this project is to design a wastewater treatment system and utility hookups for new RV pads for Chiricahua National Monument on a 1.5-acre parcel located near the front of the monument. The purpose of the treatment system is to provide 5-7 RV pads with full hookups that serve as housing for volunteers and staff. The development will include full utility hookups, covering water distribution from an existing wellhead, wastewater collection, and on-site wastewater treatment.

1.2 Project Background

The project is located at Chiricahua National Monument, in the southeast corner of Arizona, about 30 miles southeast of Wilcox, Arizona, shown in Figure 1-1 below. The natural environment and historical significance of the monument add additional regulations to the

design, both in terms of environmental protection and compliance with local, state, and federal regulations.

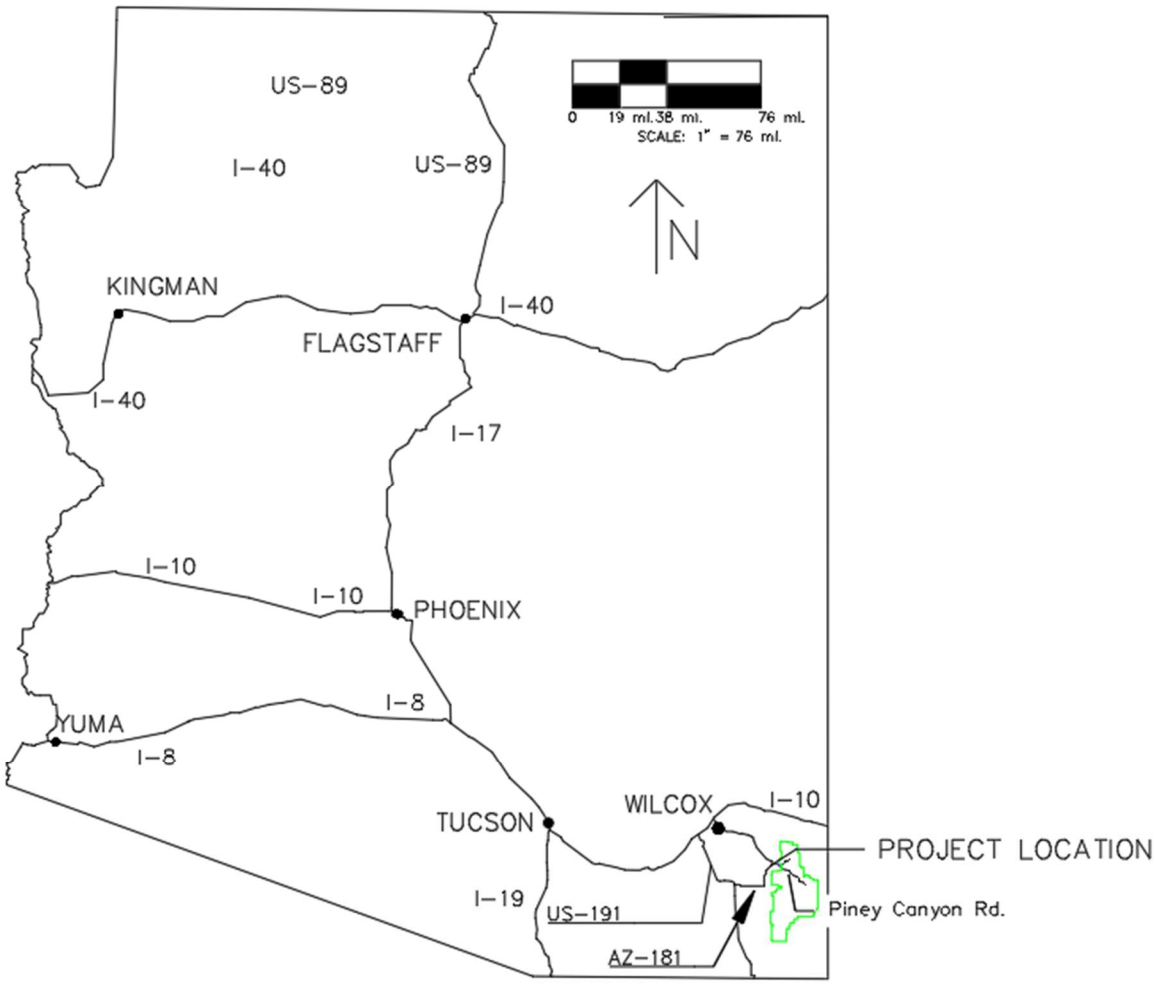


Figure 1- 1: Project Location Map

Figure 1-2 below shows the project location within the monument, at the corner of Pinery Canyon Road.

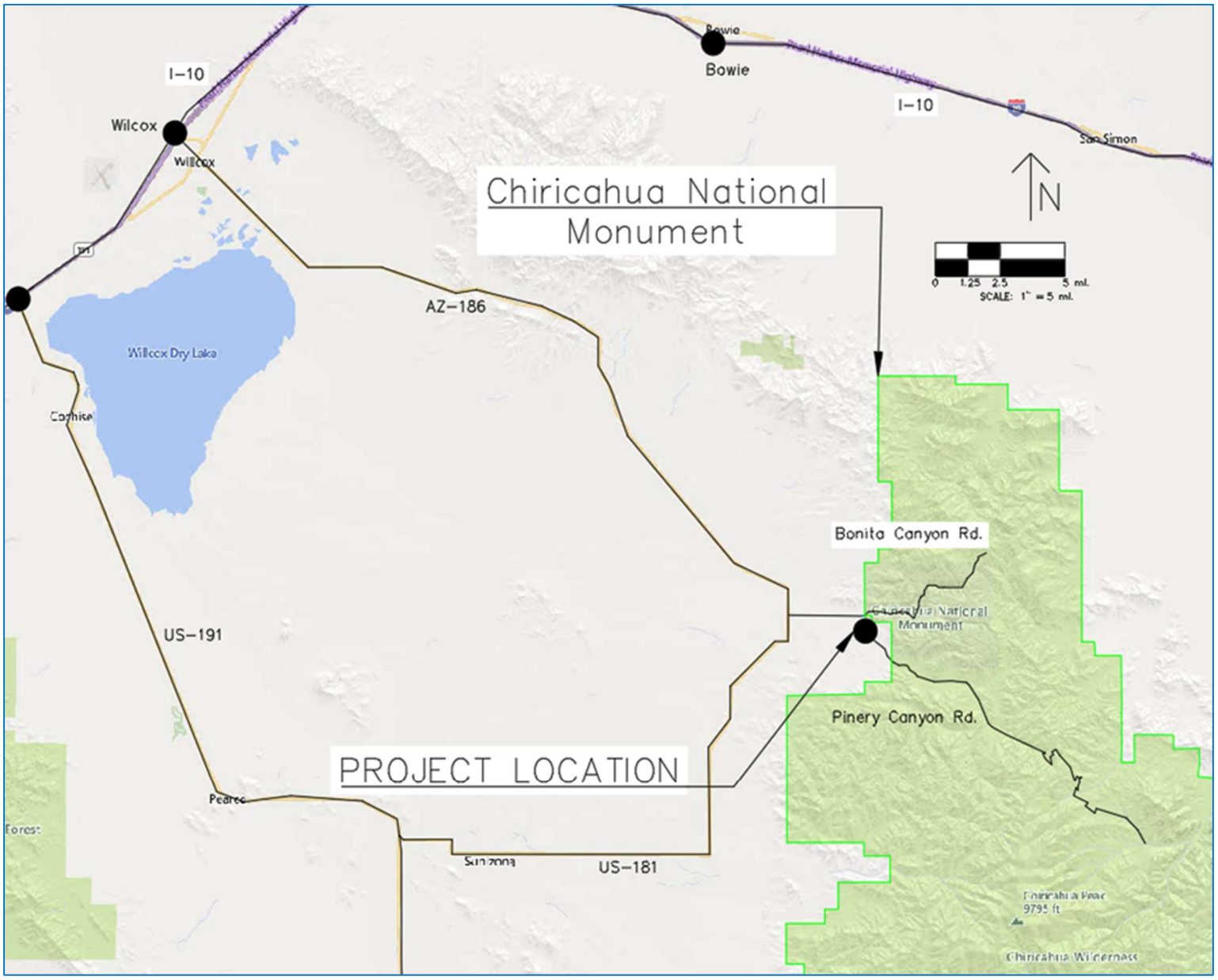


Figure 1- 2: Location Map

The site is bound between Park Service and private land as shown in Figure 1-3 below.

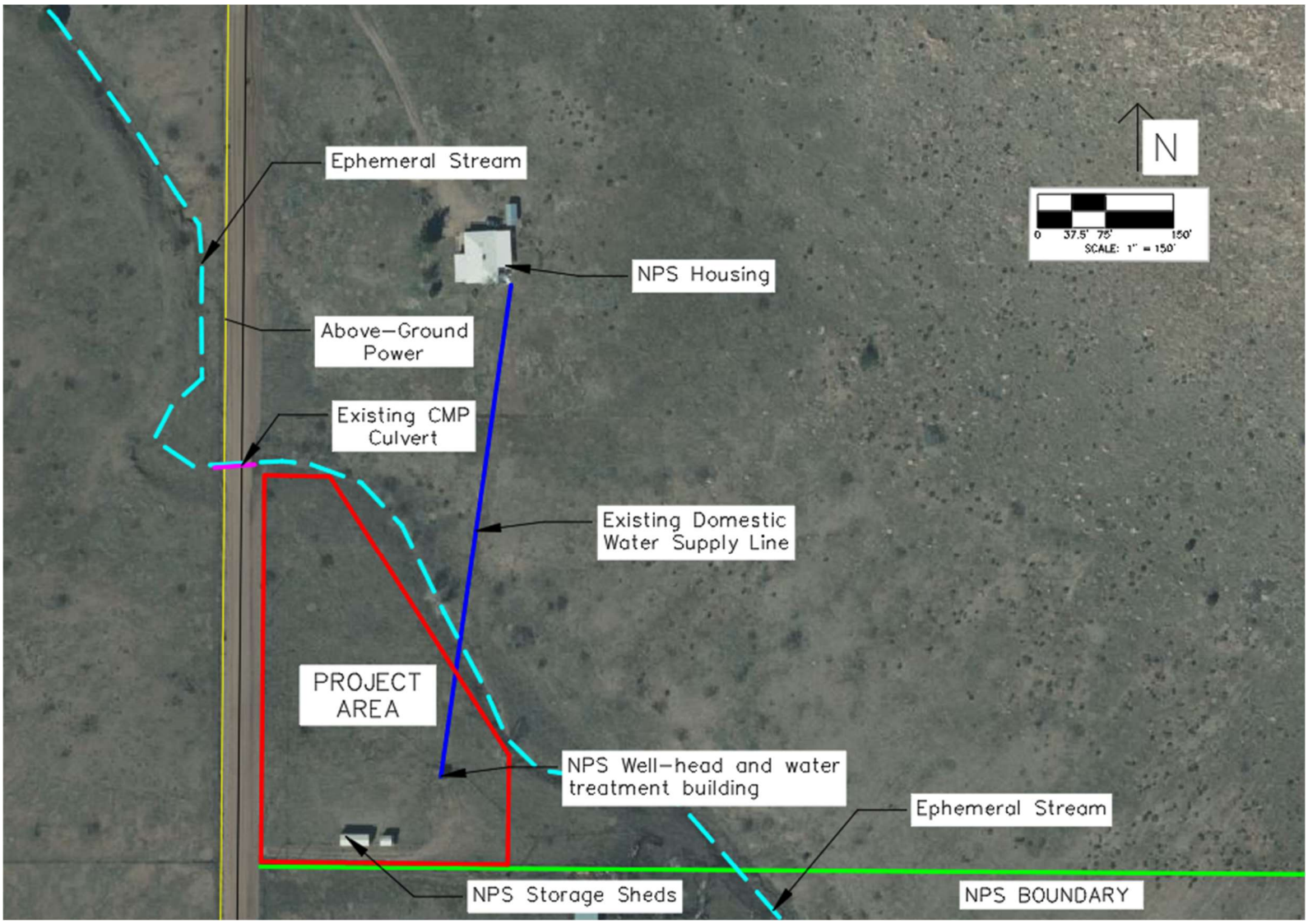


Figure 1- 3: Project Site Map

As shown in Figure 1-3, there are NPS (National Park Service) storage sheds that are within the bounds of the project area that must be accounted for in the design. The current water supply line runs to the North, from the NPS well-head to the monument housing building. There is also an ephemeral stream channel that is running along the northeast portion of the project area. This and the existing wellhead may have potential standoff, up to one hundred and fifty feet, that will be considered within the project design.

1.3 Technical Considerations

The technical considerations and design requirements for the project are as follows. Because of the project's nature, which requires designing a wastewater treatment system, site surveying and soil analysis will be conducted.

Site Surveying: Utilizing a total station, elevations are taken for the site to be used in the design of both the water collection and wastewater distribution systems, in addition to determining the location of the wastewater treatment system.

Geotechnical Analysis: Conduct soil testing, such as permeability tests, to evaluate the site's suitability for wastewater absorption and overall structural stability.

Water Distribution Design: Designing the water supply layout and connections from the existing wellhead to each RV pad, ensuring proper flow rates, supply pressures, backflow prevention, and meeting regulatory standards. The freshwater distribution design is required to comply with demand flow rates, while maintaining reliability, safety, and cost effectiveness.

Wastewater Collection Design: Design an efficient gravity wastewater collection system, including pipe sizing, slope, and connection to the on-site wastewater treatment system. Develop a system that meets ADEQ (Arizona Department of Environmental Quality) regulatory requirements for wastewater flows, including considering freeboard and slope of pipes, and velocities.

On-site Wastewater Treatment Design: Treatment design at the site must effectively treat the expected design flow and discharge effluent that meets all ADEQ regulatory standards.

1.4 Potential Challenges

The project includes multiple challenges that require proactive planning and adaptive strategies. First, site sensitivity issues must be carefully managed. Because the project is located within a national monument and near an ephemeral stream, sensitive ecosystems are considered in all aspects of the project. This includes minimizing disturbance to soils, vegetation, and local wildlife while ensuring compliance with environmental regulations through detailed impact assessments and mitigation plans. Another challenge is geometric constraints, as the project site is located in the corner of the monument and cannot be extended to private land for wastewater treatment systems or infiltration fields. This requires efficient use of land through innovative and compact system design.

In addition to these inherent challenges, unpredictable factors such as weather, equipment availability, illness, and personal emergencies can further complicate fieldwork. These uncertainties must be addressed through detailed contingency plans. For example, flexible scheduling with built-in buffer days, cross-training personnel to ensure uninterrupted workflow, and backup resources for critical equipment will help minimize construction disruptions.

1.5 Stakeholders

Stakeholders for this project include the National Park Service and Chiricahua National Monument, as designing an efficient wastewater treatment system allows for the monument to provide housing for both park staff and seasonal volunteers. Maintenance workers for the design are also primary stakeholders.

2.0 Project Scope

2.1 Task 1: Research and Existing Data

The purpose of this task is to research regulatory requirements and potential treatment options. It will also include reviewing all existing information and data provided by the project client to determine potential gaps to provide better focus on the site visit.

2.1.1 Task 1.1: Regulatory Research

The purpose of this subtask is to review applicable local, state, and federal regulations governing RV pad installation and wastewater management systems. Regulatory agencies include the Environmental Protection Agency (EPA) and the Arizona Department of Environmental Quality (ADEQ). The project must comply with relevant sections of the Clean Water Act (CWA) regarding the protection of water quality in nearby ecosystems.

2.1.2 Task 1.2: Research Onsite Wastewater Treatment Options

The purpose of this subtask is to identify the variety of onsite treatment options and determine which of the options are the most appropriate in the situation. This will enable the ideal option to be designed for the site.

2.2 Task 2: Site Visit

The purpose of this task is to conduct a site visit to Chiricahua National Monument. During the site visit all surveying, soil testing, and site analysis will be conducted.

2.2.1 Task 2.1: Site Visit Planning

The purpose of this subtask is to obtain all materials and testing equipment necessary before heading to the monument site.

2.2.2 Task 2.2: Land Survey

During the site visit, a preliminary land survey should be conducted to obtain basic information about the site's topography and boundaries. The team will use tools such as a total station or GPS surveying device to collect data about the site's elevation, slope, and any existing structures or landmarks.

2.2.3 Task 2.3: Existing Infrastructure Assessment

This task will determine the location of wellheads, water treatment buildings, and other structures on site. Establish material and size data of the existing water line as well as the flow capacity of the existing wellhead.

2.2.4 Task 2.4: Percolation Test

The percolation test measures the rate at which water will drain through soil. This is critical to determine the best design for the septic system, as certain percolation rates prohibit the use of traditional septic systems. This project will follow ADEQ's R-18-9-A310 "Site Investigation for Type 4 Wastewater Treatment Facilities." [1] An onsite percolation test will be done either using a small, 12"x12"x12" hole, assuming applicable site conditions. If necessary, ASTM D5921 will be used to determine infiltration rate. This requires a backhoe.

2.2.5 Task 2.5: Geotechnical Observations and Sampling

This task first involves preliminary visual inspection of soils for signs of erosion, compaction, or poor drainage. As well as collection of soil samples for laboratory testing. The methods to obtain the soil samples are detailed in the ADEQ site investigation guidance manual [2], seen between pages 93 and 94. In summary, soil samples will be collected using 20-quart Ziploc bags, which will be collected in a 5-gallon bucket. These samples will be taken back to NAU's soils lab for further testing.

2.2.6 Task 2.6: Environmental and Ecological Considerations

Given the sensitive nature of the Chiricahua National Monument environment, a site visit is required to identify any potential ecological impacts. Observe protected plant species, wildlife habitat, or waterways that construction activities and soil testing may impact.

2.3 Task 3: Geotechnical Sampling Analysis

The purpose of this task is to conduct all geotechnical analysis from the test samples collected during the site visit to the monument.

2.3.1 Task 3.1: Obtain Lab Access

To perform geotechnical soils testing at Northern Arizona University, where the soils lab is located, lab access will be obtained. This is done by completing a lab safety form and coordinating with the lab manager on revisions needed for the agreement.

2.3.2 Task 3.2: Compaction Testing

In addition to percolation testing, compaction testing will be conducted to evaluate the bearing capacity of the soil. This will determine if the ground allows for excavation and backfill for the waterlines, as well as construction of the onsite treatment system. The primary test for this will be ASTM D698. This test involves proctor compaction, using a mechanical soil compactor and set molds to compact the soil to approximately 95% compaction, then performing testing to determine strength of soil.

2.3.3 Task 3.3: Soil Classification

The primary soil classification test that will be done here is the USCS soil classification test, ASTM D2487 will be used in this case. This will enable us to determine important soil characteristics and necessary design information. This test uses sieves to determine soil classification, taking masses of each sieve before and after to determine the amount of mass in that soil classification.

2.4 Task 4: Topographical Map Development

The purpose of this task is to develop a topographical map with all necessary and relevant data including survey data and site infrastructure. Coordination with the site design team will be required to determine RV pad information and gravel road locations. Once this information is determined, utility routing information and RV hookup locations will then be supplied to the site design team.

2.4.1 Task 4.1: Import Map Data

Once surveying data is collected and site visit completed, the data will need to be imported from the Data Collector for use in 3D Drafting software. This data is imported from the data collector into a Comma Separated Values (CSV) file, openable with Excel. From here, that CSV file is saved and imported into a drafting program of choice (e.g. Civil3D).

2.4.2 Task 4.2: Create Relevant Map Features

To make the base topographical map understandable and readable, important context must be added. This will help with the topographic map, as well as other designs in the future. These typically will remain on an existing topographic set of layers when drafting for ease of understanding.

2.5 Task 5: Freshwater Distribution Design

This task is to provide a design for the freshwater distribution and waterline on site at the monument.

2.5.1 Task 5.1: Determine Water Demand

The required flow rate for the RV units will be determined from the number of fixture units chosen by the site design team. This value will be in gallons per day.

2.5.2 Task 5.2: Complete Pipe System Design

Waterline analysis involves determining the location and depth of the water line around the site. This includes determining the capacity of the existing waterline and whether it is capable of handling increased flow. This will similarly determine optimal pipe depth, slope, characteristics, size, and location. This design must adequately deliver in compliance with all pressure and pipe design requirements. At the same time, it must also do so in a way that is minimally invasive to the surrounding environment and maintains reliability. This also includes design of the pump connections and hydrants.

2.6 Task 6: Onsite Wastewater Treatment Design

Given the sensitive environment and specific site conditions of the National Monument, the wastewater treatment design must ensure that wastewater is collected, treated, and disposed of in a manner that protects surrounding ecosystems, particularly groundwater resources. The wastewater design will also comply with local, state, and federal regulations, including those established by the Environmental Protection Agency (EPA) and ADEQ.

2.6.1 Task 6.1: Develop Treatment Alternative Concepts

Determine multiple concepts compliant with local, state, and federal regulations. These do not need to be completed designs but need to be functional and viable alternatives.

2.6.2 Task 6.2: Identify Criteria for Alternatives

Develop criteria for the determination of the best alternatives. These will be scored on a points system.

2.6.3 Task 6.3: Select Best Alternative

A decision matrix will be created, and the best design will be selected based on the criteria found in Section 2.6.2 and will move forward to the following task.

2.6.4 Task 6.4: Final Treatment Design

The purpose of this task is to design the final treatment system, such as features/components, their sizes, locations, pumps, and other items.

2.7 Task 7: Wastewater Collection System Design

The purpose of this task is for wastewater collection system design, all necessary variables such as design flow and pipe sizing and all material requirements will be selected in this task.

2.7.1 Task 7.1: Calculate Wastewater Design Flow

The design flow will be calculated for the collection system design. Wastewater generated by RVs typically includes toilet sewage and wastewater from other non-toilet uses such as sinks and showers and is largely equal to the amount of drinking water supplied.

2.7.2 Task 7.2: Piping and Hookup Design

The pipe size must be able to accommodate the expected wastewater flow rate and leave some margin for peak flow. Larger diameter pipes will be required for the main collection line, which will carry wastewater from multiple RV pads, while smaller pipes can be used for individual connections.

PVC pipes are commonly used in wastewater systems due to their durability, corrosion resistance, and ease of installation. PVC is also resistant to harsh chemicals and biological agents present in sewage. Pipe materials meet local and national plumbing standards.

2.8 Task 8: Develop Construction Cost Estimate

The purpose of this task is to develop a cost estimate. This task will account for all construction costs accrued both before, during, and after construction.

2.9 Task 9: Plan Set Development

Plans will be developed in AutoCAD Civil3D, with a 30%, 60%, 90%, and Final Submission as per required. Each submittal will be prepared in AutoCAD Civil3D and submitted to the client. There will be an internal redline for team members prior to the final submission. All sheets will include a standard plan set border.

2.9.1 Task 9.1 Cover Sheet Development

The cover sheet for this submittal will include maps detailing the location and vicinity of the project, the names of the team, and a project title.

2.9.2 Task 9.2 Existing Site Plan

The existing site plan sheets will provide the existing topography, including elevations, buildings, roadways, and other natural features.

2.9.3 Task 9.3 Proposed Site Plan

The proposed site plan sheets will include any proposed excavations, changes to existing geometry, the onsite wastewater treatment system, the water distribution, wastewater collection, and RV hookup layouts with the RV pad and onsite roadway locations.

2.9.4 Task 9.4 Treatment System Plan and Profile

The treatment system plan will detail tank sizes and locations, and where the pipes, hookups, and junctions are. It will also detail any other information relevant to the design.

The system profile details the depth, slope, and characteristics of the pipe, as well as the hydraulic profile. In essence, it is a side profile of the pipe system.

2.9.5 Task 9.5 Detail Sheet Development

The project details sheet will include any specific item details too small to show on sheet. This might include valves, pipe fittings, etc.

2.10 Task 10: Evaluate Project Impacts

This task assesses the positive and negative social, environmental, and economic impacts of the final project.

2.11 Task 11: Deliverables

This task provides the necessary deliverables for the report.

2.11.1 Task 11.1: 30% Submittal

The 30% submittal will include 30% report and presentation. Tasks 1–4 will be completed. It will include a report, construction drawings, and presentation.

2.11.2 Task 11.2: 60% Submittal

This submittal will include all of Task 5 and goes into Task 6.3. Also included in this submittal will be the completed construction drawings of any items in Tasks 1-6.X, a report, and a presentation.

2.11.3 Task 11.3: 90% Submittal

For the 90% submittal, the remainder of Task 6.4 to Task 10. By this submittal, all construction drawings will be completed, cost estimates completed, a draft of the final report, and a draft presentation.

2.11.4 Task 11.4: Final Submittal

The final submittal will include the final report, website, presentation, and all corrections made from the 90% submission. Additionally, the final submittal will include the final draft of the report, the final website, presentation, and any missed deliverables from the 90% submission.

2.12 Task 12: Project Management

The purpose of this task is to ensure project management, accomplished through the subtasks below.

2.12.1 Task 12.1: Meetings

Weekly and monthly meetings will occur for the team and the respective parties: Client, TA, and GI. Meetings will include the agenda and meeting minutes for each meeting.

2.12.2 Task 12.2: Schedule Management

The project schedule will be used to track dates for the project and will be updated as needed.

2.12.3 Task 12.3: Resource Management

To ensure all cost needs are met, expense and personnel hours will be tracked over the course of the project.

2.13 Exclusions

This project will exclude conducting an environmental impact assessment. Electrical distribution system design and electrical RV hookup design are also an exclusion as all electricity analysis will be conducted by the site design team.

3.0 Project Schedule

3.1 Overview:

The project will start on January 13, 2025, and be completed on May 10, 2025, with a total construction period of 117 days (about 4 months). The Gantt chart is found in Appendix A.

3.2 Major Tasks

There are twelve major tasks as listed below, and although all are critical some will be completed concurrently on a start-to-start basis.

- Task 1: Research and existing data
- Task 2: Site visit
- Task 3: Geotechnical sampling analysis
- Task 4: Topographical map development
- Task 5: Freshwater distribution design
- Task 6: Onsite wastewater treatment design
- Task 7: Wastewater collection system design
- Task 8: Develop construction cost estimate
- Task 9: Plan set development
- Task 10: Evaluate project impacts
- Task 11: Deliverables
- Task 12: Project management

3.3 Project Deliverables

There will be four primary deliverables for this submittal, the work that will be completed for each is detailed in the following sections.

3.3.1 30% Submission

The 30% submission will be submitted on Tuesday, February 18th, 2025. This submission shall include information on Tasks 1-3, which include all research, and information from our site visit and all geotechnical sampling analysis. By this submittal, it is expected that all deliverables for these tasks will be completed.

3.3.2 60% Submission

The 60% submission will be submitted on Thursday, March 13th, 2025. This submission shall include information on Tasks 4 to Task 6.3. This means that development of the topographical map and freshwater distribution design will be completed, and a final alternative for the treatment system selected.

3.3.3 90% Submission

The 90% submission will be submitted on Friday, May 2nd, 2025. This submission shall include information on Tasks 6.4 to Task 10. This submission calls for the completion of the treatment system design, wastewater treatment collection design, final cost estimates and plan sets, and project impacts evaluation completed.

3.3.4 Final Submission

The final submission will be submitted on Tuesday, May 6th, 2025. This submission shall include all deliverables and tasks, and all required corrections made from all previous submissions.

3.4 Critical Path

The critical path is the tasks that must be completed on time to ensure the project is completed by the end date. The GANTT chart can be found in **Appendix A** and the critical path is shown in red**.** Prominent tasks on the critical path include Tasks 1-9, and Task 11. Not included in the critical path are the evaluation of project impacts and project management, as both can be done independently of tasks before them.

The schedule has some float time available, both in the form of extra days in the schedule and in the form of spring break and weekends. Work can be performed during this time if needed, and the schedule will be changed to include these times. Microsoft Teams will be used to

coordinate and maintain internal deadlines and external submission guidelines. Designs can be simplified in certain areas with client permission to maintain the schedule as needed.

4.0 Staffing Plan

This project will be staffed and completed by four engineers, including the senior engineer, engineer, engineer in training and an engineering intern.

4.1 Staffing Qualifications

Senior Engineer – SENG:

The Senior Engineer (SENG) is responsible for overseeing the entire project. Additionally, the SENG handles client interaction and project management, ensuring the project is completed in a prompt and cost-effective manner. The ideal candidate for this role will have a Bachelor of Science degree in civil engineering or environmental engineering, a professional engineer license (PE) in civil engineering or environmental engineering, and a minimum of 10 years of industry experience and ability in a range of engineering project software such as AutoCAD, and Civil3D.

Engineer – ENG:

The Engineer will handle the technical core and most of the project's technical work, including the development of design plans and drafting plan documents. The engineer must have a bachelor's degree in civil or environmental engineering and a professional engineer license (PE) in civil or environmental engineering. Also, they must have at least five years of professional engineering experience and have comprehensive knowledge of the software needed for the project.

Engineer-In-Training – EIT:

Engineers-In-Training aid engineers in design and drafting, but also with other activities such as research, project management, etc. It is expected that an EIT has already passed the Fundamentals of Engineering Examination (FE). A Bachelor of Science in civil or environmental engineering is required for this position.

Engineering Intern – INT:

Engineering interns are expected to aid engineers and engineers-in-training with tasks related to technical design, research, drafting, and other activities. INTs will have the chance to gain hands-on experience in projects and complete assigned tasks under a supervisor's guidance. Consequently, engineering interns are currently pursuing a Bachelor of Science in either civil

engineering or environmental engineering, with an anticipated graduation date within the next year.

A full table detailing all tasks and subtasks with their corresponding staffing position can be found in **Appendix B**.

4.2 Staffing Matrix

A summary table for staffing hours is shown in the below table,

Table 4- 1: Staffing Summary Table

Task Name	Senior Engineer	Engineer	EIT	Intern	TOTAL HOURS BY TASK
Task 1 Research and Existing Data	0	2	7	8	17
Task 2 Site Visit	1	8	26	13	48
Task 3 Geotechnical Sampling Analysis	2	3	4	4	13
Task 4 Topographical Map Development	1	1	4	16	22
Task 5 Freshwater Distribution Design	10	21	66	33	130
Task 6 Onsite Wastewater Treatment Design	11	19	19	15	64
Task 7 Wastewater Collection System Design	2	5	2	3	12
Task 8 Develop Construction Cost Estimate	1	2	5	2	10
Task 9 Plan Set Development	3	13	38	43	96
Task 10 Evaluate Project Impacts	3	6	2	0	11
Task 11 Deliverables	8	8	16	24	56
Task 12 Project Management	6	11	3	0	20
TOTAL	51	103	196	165	514

5.0 Cost of Engineering Services

The total cost of engineering services for this project is detailed in the table below, including personnel, travel, and supplies costs.

The total project cost is broken down into personnel, travel, and supplies.

Personnel costs include billing rates for SENG, ENG, EIT, and INT. Personnel billing rates are based on employee hourly wage rates, benefits, company overhead, and profit. Cost data is from the previous project report and totals $71,736.

Travel costs include 1 round trip to Chiricahua National Monument for field assessment. Gas, vehicle rental, per diem, and housing costs total $1,700. Cost data is from NAU Fleet Services, and the State of Arizona based on Manual 5095: Travel Reimbursement Rates.

Supply costs include 5-gallon buckets, quart seal bags, survey equipment, soil lab rentals, totaling $1,038, and cost data is from a web resource search.

Overall, the total cost of engineering services is estimated to be approximately $74,774 and can be found in **Table 5-1** below.

Table 5- 1: Cost of Engineering Services

1.0 Personnel	Classification	Hours	Rate, $/Hour	Cost, $
	SENG	50.5	240	$12,120
	ENG	102.5	180	$18,450
	EIT	196	141	$27,636
	INT	165	82	$13,530
			Personnel Total	$71,736
2.0 Travel	Classification	Items	Cost Per, $	Cost, $
	Car Rental	Mini Van, 3 Days	$49.75/day	$150
	Hotel	3 Rooms, 2 Nights	$145/room/day	$870
	Mileage	744 miles	$0.26/mile	$194
	Per Diem	3 Person, 3 Days	$54/person/day	$486
			Travel Total	$1,700
3.0 Supplies	Classification	Items	Cost Per, $	Cost, $
	5 Gallon Bucket	1 Unit	$4.00	$4
	Quart Ziplock Bags	40 bags	$0.1/bag	$4
	Surveying Equipment	3 Days	$100/day	$300
	Soils Lab Rental	10 Days	$100/day	$1,000
			Supplies Total	$1308
Total Cost				$74,774

References

[1] "Residential Onsite Wastewater Treatment: Conducting a Soil Percolation Test," [Online]. Available: https://extensionpubs.unl.edu/publication/g1472/na/html/view. [Accessed 23 October 2024].

[2] "Site Investigation Guidance Manual," [Online]. Available: https://legacy.azdeq.gov/environ/waste/cleanup/download/si_guidance_manual.pdf. [Accessed 2024].

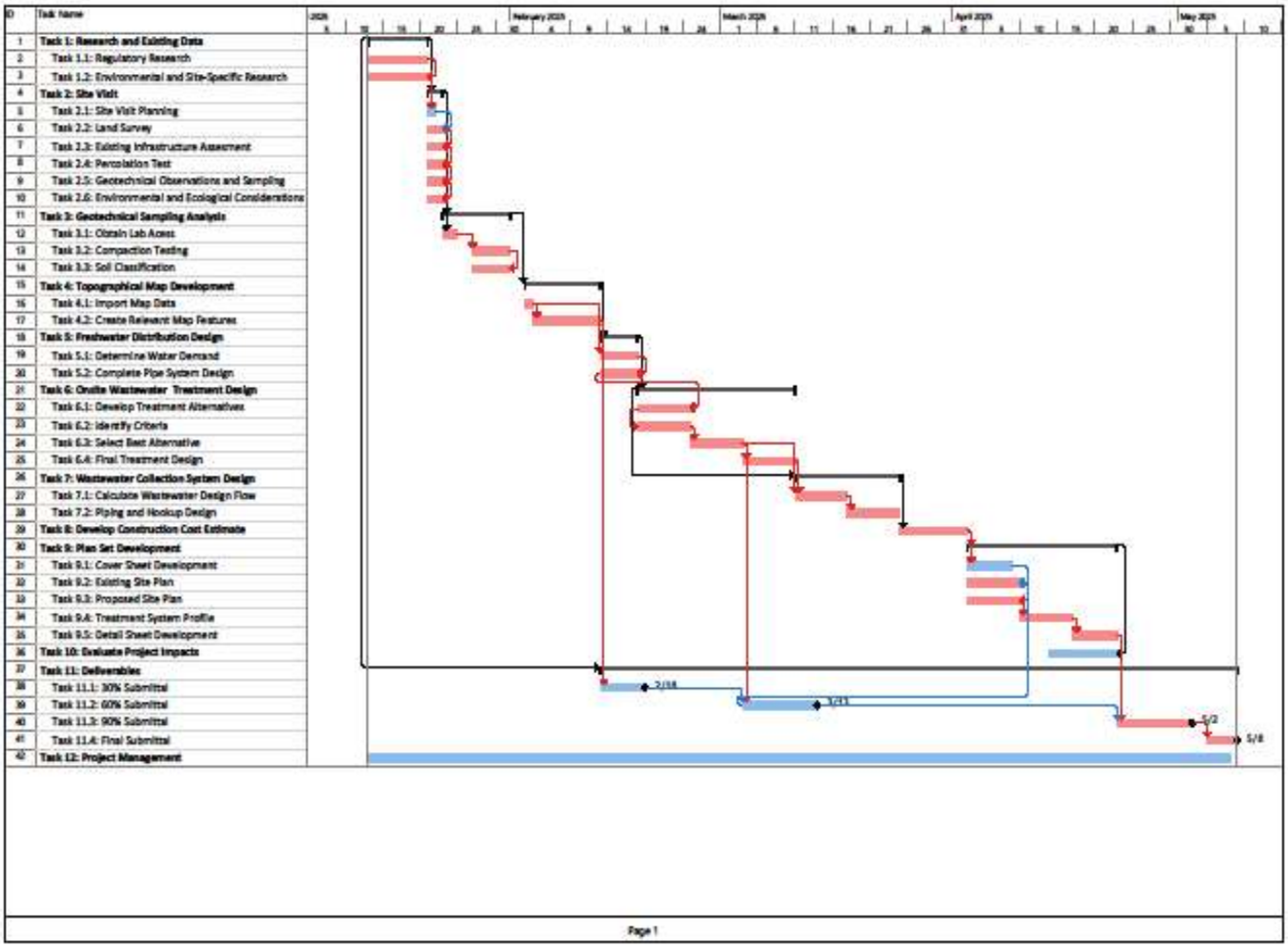
[3] National Cooperative Soil Survey, U.S.A., "Soil Data Explorer - Chiricahua," 2013. [Online]. Available: https://casoilresource.lawr.ucdavis.edu/sde/?series=Chiricahua#osd.

[4] "What Is The Best pH Level of Water For Drinking?," [Online]. Available: https://drinkflowater.com/what-is-the-best-ph-level-of-water-for-drinking/#:~:text=The%20U.S.%20Environmental%20Protection%20Agency,the%20middle%20at%20a%207.

[5] "Coliform Bacteria In Drinking Water," [Online]. Available: https://www.healthvermont.gov/environment/drinking-water/coliform-bacteria-drinking-water#:~:text=Fecal%20coliform%20from%20human%20or,for%20long%20periods%20of%20time.

Appendix:

Appendix A: GANTT Chart


ID
Task Name
1 Task 1: Research and Existing Data
2 Task 1.1: Regulatory Research
3 Task 1.2: Environmental and Site-Specific Research
4 Task 2: Site Visit
5 Task 2.1: Site Visit Planning
6 Task 2.2: Land Survey
7 Task 2.3: Existing Infrastructure Assesment
8 Task 2.4: Percolation Test
9 Task 2.5: Geotechnical Observations and Sampling
10 Task 2.6: Environmental and Ecological Considerations
11 Task 3: Geotechnical Sampling Analysis
12 Task 3.1: Obtain Lab Acess
13 Task 3.2: Compaction Testing
14 Task 3.3: Soil Classification
15 Task 4: Topographical Map Development
16 Task 4.1: Import Map Data
17 Task 4.2: Create Relevant Map Features
18 Task 5: Freshwater Distribution Design
19 Task 5.1: Determine Water Demand
20 Task 5.2: Complete Pipe System Design
21 Task 6: Onsite Wastewater Treatment Design
22 Task 6.1: Develop Treatment Alternatives
23 Task 6.2: Identify Criteria
24 Task 6.3: Select Best Alternative
25 Task 6.4: Final Treatment Design
26 Task 7: Wastewater Collection System Design
27 Task 7.1: Calculate Wastewater Design Flow
28 Task 7.2: Piping and Hookup Design
29 Task 8: Develop Construction Cost Estimate
30 Task 9: Plan Set Development
31 Task 9.1: Cover Sheet Development
32 Task 9.2: Existing Site Plan
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34 Task 9.4: Treatment System Profile
35 Task 9.5: Detail Sheet Development
36 Task 10: Evaluate Project Impacts
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38 Task 11.1: 30% Submittal
39 Task 11.2: 60% Submittal
40 Task 11.3: 90% Submittal
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Appendix B: Engineering Hours

Task	Senior Engineer	Engineer	EIT	Intern	TOTAL HOURS BY TASK
Task 1 Research and Existing Data	0	2	7	8	17
Task 1.1 Regulatory Research	0	1	2	5	8
Task 1.2 Research Onsite Wastewater Treatment Options	0	1	5	3	9
Task 2 Site Visit	1	8	26	13	48
Task 2.1 Site Visit Planning	0	2	2	1	5
Task 2.2 Land Survey	0	0	10	10	20
Task 2.3 Existing Infrastructure Assessment	0	3	8	2	13
Task 2.4 Percolation Test	0	0	3	0	3
Task 2.5 Geotechical Observations and Sampling	0	0	3	0	3
Task 2.6 Enviornmental and Ecological Considerations	1	3	0	0	4
Task 3 Geotecnical Sampling Analysis	2	3	4	4	13
Task 3.1 Obtain Lab Access	1	1	0	0	2
Task 3.2 Compaction Testing	1	1	2	2	6
Trask 3.3 Soil Classification	1	1	2	2	6
Task 4 Topographical Map Development	1	1	4	16	22
Task 4.1 Import Map Data	1	1	2	8	11
Task 4.2 Create Relevant Map Features	1	1	2	8	11
Task 5 Freshwater Distribution Design	10	21	66	33	130
Task 5.1 Determine Water Demand	0	1	1	3	5
Task 5.2 Complete Pipe System Design	10	20	65	30	125
Task 6 Onsite Wastewater Treatment Design	11	19	19	15	64
Task 6.1 Develop Alternative Concepts	2	4	2	3	11
Task 6.2 Identify Criteria for Alternatives	3	3	1	0	7

Task 6.3 Select Best Alternative	3	4	0	0	7
Task 6.4 Final Treatment Design	3	8	16	12	39
Task 7 Wastewater Collection System Design	2	5	2	3	12
Task	**Senior Engineer**	**Engineer**	**EIT**	**Intern**	**TOTAL HOURS BY TASK**
Task 7.1 Calculate Wastewater Design Flow	0	1	1	3	5
Task 7.2 Piping and Hookup Design	2	4	1	0	7
Task 8 Develop Construction Cost Estimate	1	2	5	2	10
Task 9 Plan Set Development	3	13	38	43	96
Task 9.1 Cover Sheet Development	0	1	2	8	11
Task 9.2 Existing Site Plan	0	2	8	6	16
task 9.3 Proposed Site Plan	2	8	20	6	36
Task 9.4 Treatment System Plan and Profile	1	1	4	8	14
Task 9.5 Detail Sheet Development	0	1	4	15	20
Task 10 Evaluate Project Impacts	3	6	2	0	11
Task 11 Deliverables	8	8	16	24	56
Task 11.1 30% Submittal	2	2	4	6	14
Task 11.2 60% Submittal	2	2	4	6	14
Task 11.3 90% Submittal	2	2	4	6	14
Task 11.4 Final Submittal	2	2	4	6	14
Task 12 Project Management	6	11	3	0	20
Task 12.1 Meetings	4	4	4	4	16
Task 12.2 Schedule Management	3	8	2	0	13
Taskl 12.3 Resource Management	3	3	1	0	7
TOTAL	51	103	196	165	514