East Flagstaff Nestle Purina Facility Retaining Wall

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CENE476 Final Proposal

Proposal

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1.0 Project Understanding

This section addresses the project purpose and provides an overview of the Nestle Purina Retaining Wall project including the background, technical considerations, stakeholders, and constraints.

1.1 Project Purpose

Nestle Purina's East Flagstaff plant is becoming increasingly busy and requires a new truck access. A previous CENE 486C team designed a new access road to the site to address this problem [6]. This project focuses on the design of a retaining wall needed for the newly designed truck entrance. The new access road will require a 25-foot-deep cut that will need to be stabilized with a massive concrete or masonry reinforced retaining wall. The wall must fulfill the criteria of the City of Flagstaff, facilitate adequate drainage, and be structurally sound based on soil/use characteristics.

1.2 Project Background

The Purina facility is located on the east side of Flagstaff, Arizona. Figure 1.1 shows the location of the Purina Facility within Flagstaff, Arizona, including the major highways that lead to the location such as Interstate 17 and Interstate 40.

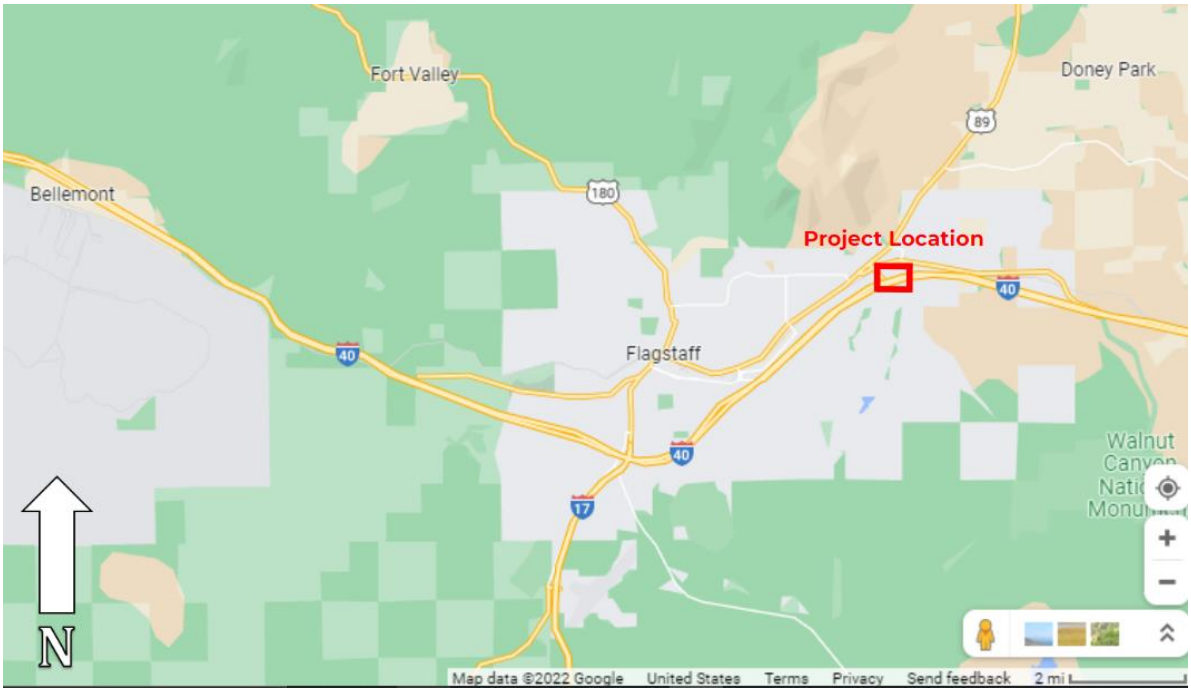


Figure 1.1: Project Location [4]

Figure 1.2 is the vicinity map of the project. The facility is accessed via Industrial Drive and E. Nestle Purina Ave., near the intersection of Interstate 40 and Country Club Road. The proposed retaining wall is located where the proposed truck entrance road was designed by the previous CENE486C Purina team.

Figure 1.2: Project Vicinity (Flagstaff) [4]

1.3 Technical Considerations

This project will require geotechnical engineering including soil and cut-and-fill analyses, structural engineering including the use of reinforced concrete and/or masonry, and hydraulic/hydrologic engineering to assure appropriate drainage for the soil behind the retaining wall as well as drainage possibly through the retaining wall.

1.4 Potential Challenges

The new entrance road the client preferred will require a cut of up to 25 feet in depth. This is considered a very tall retaining wall and thus will present design challenges due to the extreme lateral soil loads expected.

1.5 Stakeholders

The stakeholders for the project include Nestle Purina as well as the City of Flagstaff and residents/business owners in the nearby surrounding area that may be affected by potential changes to local hydrology and hydraulic structures.

2.0 Scope of Services

The Scope of Services section summarizes all the necessary tasks involved in completing the design project. This includes investigating the proposed site and conducting engineering analysis for each observed technical area (structural, hydrologic, hydraulic, and geotechnical). Additionally, significant factors such as plan set production, impact analysis, project management, and exclusions are also addressed.

2.1 Task 1.0: Research and Data Collection

This task includes researching federal, state, and local codes to ensure necessary guidelines will be abided in the retaining wall design.

2.1.1 Task 1.1: Research Relevant Codes and Standards

This includes site and construction details as well as Arizona health codes that are necessary for the design. The sections that pertain to retaining wall design and analysis will be obtained from the City of Flagstaff 2019 amendments to Flagstaff City Code (Title 4) [2] and the 2018 International Building Code® [1].

2.1.2 Task 1.2: Retaining Wall Design Research

Retaining wall design parameters will be researched to inform future design decisions. Details will include types of retaining walls and foundations, materials, costs, failure modes, reinforcement, computations of forces, safety factors, and hydraulic considerations in design.

2.1.3 Task 1.3: Obtain Data

As the site is not accessible to the team, survey data will be obtained directly from USGS datasets and plan sets from the previous CENE 486C team as well as the City of Flagstaff. Geotechnical data will not be collected; the wall will be designed in accordance with “Worst Case Scenario Conditions" per Flagstaff City Code and International Building. If

hydrologic data are available from the previous CENE 486C team, those data will be collected.

2.2 Task 2.0: Create Topographic Map

Based on the topographic data obtained, a topographic map will be created in Autodesk Civil 3D to identify local elevations and create a three-dimensional surface.

2.3 Task 3.0: Hydrologic Analysis – Current Conditions

The watershed above the site will be determined, and the maximum flow for the 100-year storm event (compliant with the City of Flagstaff standards) will be determined.

2.4 Task 4.0: Design and Selection of Preferred Alternative

Alternate wall designs will be developed for further evaluation.

2.4.1 Task 4.1: Alternative Design Development

Three to five alternative retaining walls will be preliminarily designed for the site, including height, width/thickness of base/toe/stem, materials, and hydraulic considerations. All alternatives will meet code.

2.4.2 Task 4.2: Decision Matrix and Criteria

Detailed criteria needed to assess the preliminary wall designs will be developed and a decision matrix will be created so that the preliminary designs can be compared.

2.4.3 Task 4.3: Preferred Alternative Selection

Preliminary designs will be scored against the decision matrix in order to identify the preferred alternative

2.5 Task 5.0: Design and Analysis

The preferred alternative selected in Task 3.3 will be fully designed. Additionally, post-development hydrologic and hydraulic analyses will be conducted to ensure that Flagstaff City codes are met.

2.5.1 Task 5.1: Retaining Wall Design

The preferred alternative will be fully designed, including final check of preliminary design calculations for overturning moment, sliding, shear, flexure and bearing pressure. Angle of cut, fill compaction and water seepage will also be checked. Required cut and fill volumes will be completely detailed. A cost estimate of construction will be determined.

2.5.2 Task 5.2: Post-Development Hydraulic and Hydrologic Analyses

A post-development topographic map will be created. The designed wall and surrounding area will include appropriate hydraulic structures to assure that all City codes for water management are met due to development at the site.

2.6 Task 6.0: Plan Set Production

A Plan Set will be created using Civil 3D. Various notes pertaining to site preparation and stabilization, retaining wall installation, and drainage will be included. Additional details such as utilities near spread footings (sewers and culverts), stationing, elevations, cross sections, and stream locations will be documented as well.

2.7 Task 7.0: Impacts Analysis

Economic, environmental, and social impacts of the proposed design will be discussed.

2.8 Task 8.0: Deliverables

2.8.1 Task 8.1: 30% Deliverables

The 30% deliverable includes the 30% Report and presentation. Tasks 1.0- 3.0 will be completed for this deliverable. The expected completion is Sep 27, 2022.

2.8.2 Task 8.2: 60% Deliverables

The 60% deliverable will include the 60% Report and presentation. Task 4 will be completed for this deliverable. The expected completion is Oct 27, 2022.

2.8.3 Task 8.3: 90% Deliverables

The 90% deliverable will include completing the final report up to Task 7.0. The 90% website and practice presentation are also included. All technical tasks will be completed for this deliverable. The expected completion is Nov 30, 2022.

2.8.4 Task 8.4: Final Submission

The final submission deliverable consists of the Final Report and Plan Set, final presentation and website. The expected completion date is Dec 13, 2022.

2.9 Task 9.0: Project Management

2.9.1 Task 9.1: Meetings

Weekly team meetings will be scheduled to discuss progress and address concerns. Additionally, meetings with Dr, Bero (grading instructor) and Dr. Ho (technical advisor) will be scheduled for additional advice and recommendations.

2.9.2 Task 9.2: Schedule Management

Project tasks will be tracked to assure that deadlines will be completed in a timely manner.

2.9.3 Task 9.3: Resources Management

Staffing hours and budget will be tracked so that the completed project will be within the budget.

2.10 Exclusions

Nestle Purina has not granted permission for the team to enter the property to investigate the site; thus, a site survey and geotechnical data sampling will not be performed for this project.

3.0 Schedule

The project will begin on August 29, 2022, and is anticipated to be completed by December 13, 2022. Thus, the total duration of the project will be 106 days. Appendix A shows the Project Gantt Chart. The critical path is shown in red on the chart. The critical path includes Tasks 1.0-7.0.

4.0 Staffing

This section addresses the roles, responsibilities, and qualifications for each staff position. Also included is an estimated breakdown by task of the working hours for each staff member.

4.1 Staff Positions

Four staff members will be assigned to the project: A Senior Engineer, an Engineer-in-Training (EIT), a drafter, and an intern. Table 4.1, below, shows the abbreviated position codes that will be used throughout the project.

Table 4.1: Abbreviated Position Codes

Position	Code
Senior Engineer	SENG
Engineer in Training	EIT
Drafter	DFT
Engineering Intern	EI

4.4.1 Senior Engineer

This position requires a bachelor's degree in civil engineering, additional preference of obtaining a master’s degree as well as 7+ years of experience. The senior engineer will serve as the project manager and team leader, and will be primarily involved in wall design approval. They are responsible for keeping the design team on course, reaching milestones, and ensuring deliverables are submitted promptly and professionally. They are also the point of contact for the client.

4.4.2 Engineer in Training

This position requires a bachelor's degree in civil engineering and 3-4 years' experience. The EIT must have completed and passed their Fundamentals of Engineering Exam and is on track to obtain a Professional Engineer (PE) license. They will work under the supervision of the Senior Engineer and will perform much of the data collection and design tasks, and will supervise the drafter and intern.

4.4.3 Drafter

This position requires an associate degree in engineering technology as well as 2+ years of experience with developing and preparing technical drawings in Civil 3D. The CAD Drafter will develop all project drawings, data, and technical notes to develop construction plans. They are responsible for generating the final version of the construction project, incorporating measurements, codes, manufacturing procedures, and materials. Their work will be supervised by the EIT to ensure all standards and specifications are met.

4.4.4 Engineering Intern

This position is for an individual who recently graduated from a civil engineering program and has 0-1 years of professional work experience. The EI will be supervised and guided by the EIT and PE when working on the design and analysis of the project. They will also work with the drafter utilizing Civil 3D and performing design analysis for the wall. They will also be responsible for managing records: keeping records of meetings, and organizing the meeting memo binder.

4.2 Estimated Staffing Hours

Table 4.2 shows the estimated hours for each position. The total amount of hours here is 625 hours. EI adds up to 250 hours, DFT adds up to 200 hours, EIT adds up to 90 hours, and lastly SENG adds up to 85 hours.

Table 4.2: Scheduling

Purina Retaining Wall Project	SENG	EIT	DFT	EI
Task 1.0 Research and Data Collection	-	-	-	-
Task 1.1: Research Relevant Codes and Standards	8	8		8
Task 1.2: Retaining Wall Design Research	8	8	8	8
Task 1.3: Obtain Data				32
Task 2.0: Create Topographic Map		4	40	
Task 3.0: Hydrologic Analysis – Current Conditions		8		32
Task 4.0: Design and Selection of Preferred Alternative	-	-	-	-
Task 4.1: Alternative Design Development		24	16	40
Task 4.2: Decision Matrix and Criteria	8	4		
Task 4.3: Preferred Alternative Selection	8			
Task 5.0: Design and Analysis	-	-	-	-
Task 5.1: Retaining Wall Design		24	64	
Task 5.2: Post-Development Hydraulic/Hydrologic Analyses		8		40
Task 6.0: Plan Set Production			32	
Task 7.0: Impacts Analysis		8		8
Task 8.0: Deliverables	-	-	-	-
Task 8.1: 30% Deliverables	4	8		16
Task 8.2: 60% Deliverables	4	2	24	16
Task 8.3: 90% Deliverables	4	2	8	8
Task 8.4: Final Submission	4	4		4
Task 9.0: Project Management	-	-	-	-
Task 9.1: Meetings	8	8	8	8
Task 9.2: Schedule Management	16			
Task 9.3: Resources Management	15			
TOTAL	85	120	200	220
CUMULATIVE TOTAL	625			

5.0 Cost of Engineering Services

The total estimated project cost is $65,680. Table 5.1 below shows the cost breakdown for each staff position. The overhead and additional fees were accounted for with the hourly rate.

Table 5.1 Personnel Costs

Cost of Services			
Position	Hourly Rate	Project Hours	Cost
Senior Engineer	$199	85	$16,902
Engineer in Training	$153	120	$18,317
Drafter	$93	200	$18,588
Intern	$54	220	$11,873
Cumulative		625	$65,680

6.0 References

[1] *International Building Code® 2018*. International Code Council, Inc., 2018.

[2] *City of Flagstaff 2019 amendments to Flagstaff City Code, Title 4, building code*. Flagstaff, Arizona: City of Flagstaff, 2011.

[3] *Nestle Purina - Flagstaff, AZ*. Flagstaff, 2018.

[4] *Google Maps*. [Online]. Available: https://maps.google.com/. [Accessed: 10-Mar-2022].

[5] *Google Earth*. [Online]. Available: https://earth.google.com/. [Accessed: 10-Mar-2022].

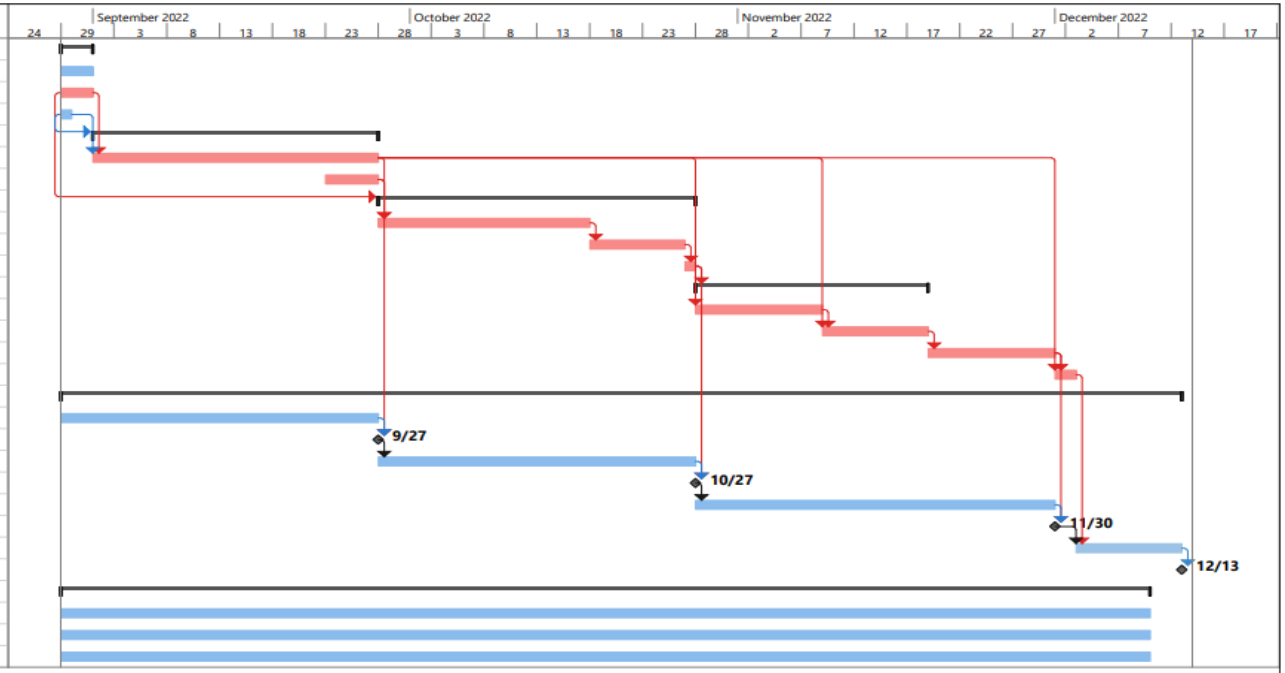
[6] J. Sandoval, K. Rhoads, E. LaTurco, and M. Ingersoll, Nestle Purina Entrance Site Design Northern Arizona University, Flagstaff, AZ, rep., 2021.

7.0 Appendices

Appendix A: Project Gantt Chart

The Gantt Chart can be seen on the next page.

ID	Task Name
1	**Task 1.0 Research and Data Collection**
2	Task 1.1 Research Relevant Codes and Standards
3	Task 1.2 Retaining Wall Design Research
4	Task 1.3 Obtain Data
5	**Task 2.0 Create Topographic Map**
6	Task 2.0 Create Topographic Map
7	**Task 3.0 Hydrological Analysis - Current Conditions**
8	**Task 4.0 Design and Selection of Preferred Alternative**
9	Task 4.1 Alternative Design Development
10	Task 4.2 Decision Matrix and Criteria
11	Task 4.3 Preferred Alternative Selection
12	**Task 5.0 Design and Analysis**
13	Task 5.1 Retaining Wall Design
14	Task 5.2 Post-Development Hydraulic and Hydrologic Analyses
15	**Task 6.0 Plan Set Production**
16	**Task 7.0 Impacts Analysis**
17	**Task 8.0 Deliverables**
18	Task 8.1 30% Timeframe
19	Task 8.1 30% Milestone
20	Task 8.2 60% Timeframe
21	Task 8.2 60% Milestone
22	Task 8.3 90% Timeframe
23	Task 8.3 90% Milestone
24	Task 8.4 100% Timeframe
25	Task 8.4 100% Milestone
26	**Task 9.0 Project Management**
27	Task 9.1 Meetings
28	Task 9.2 Schedule and Managing Upcoming Tasks
29	Task 9.3 Resources Management



Project: Gantt Chart Final
Date: Mon 5/2/22

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

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