Fanning Wash Low-Water Crossing Design

Figure 1: I-40E Existing Culvert [1]

Austin Simmons, Preston Meek, Abdalla Alatar, Muhammad Muhammad

AAMP Engineering Inc.

Introduction

Purpose

- Create design alternatives for the Low-Water Crossing at Fanning Wash & Soliere Rd to mitigate flooding.

Client/Technical Advisor

- Edward Schenk; Project Manager for City of Flagstaff Stormwater Division

Background/Goals

- Improve on various hydraulic factors.
- Create an accurate flow model.
- Proposed culvert designs.

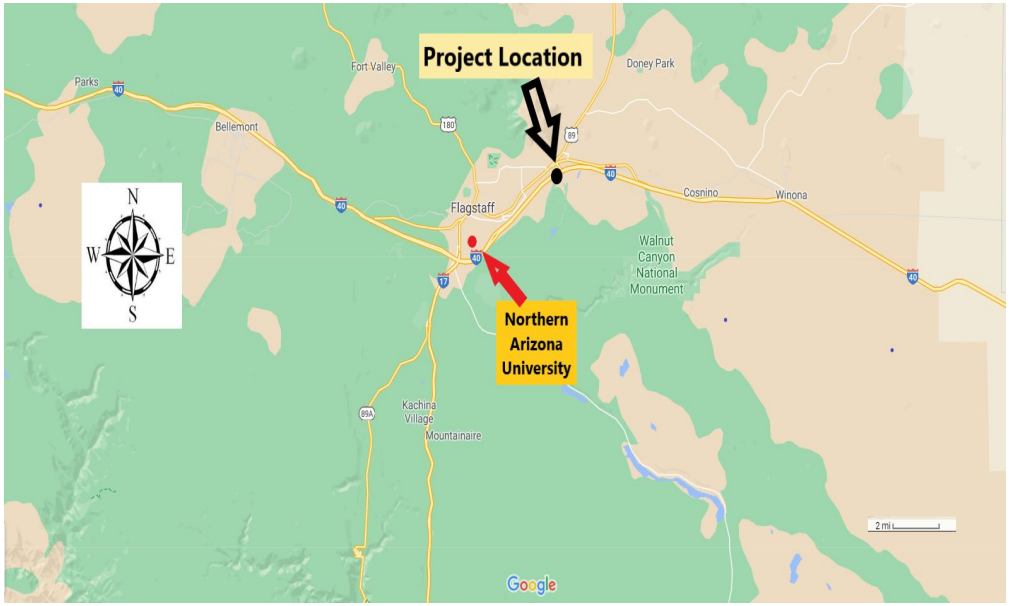


Figure 2: Project Location in relation to Flagstaff, Arizona [1]

Fanning Wash and Soliere Rd. Project Location

Figure 4: Aerial Image of Fanning Wash & Project Location [1]

Figure 3: Erosion at Low-water crossing [1]

Figure 5: Aerial Image of Zoomed in Project location [1]

Scope of Services

Task 1.0: Preliminary Site Research

- Existing I-40 Culvert Research
- Standards and Codes Research

Task 2.0: Field and Lab Work

- **Task 2.1 Site Mapping**
  - Site Inventory
  - Survey Site
  - Create Topographic Map
- **Task 2.2 Geotechnical Analysis**
  - Sampling Plan
  - Sampling
  - Particle Size Distribution and Sieve Analysis
  - Atterberg Limits Test

Figure 6: Sieve Analysis Equipment [2]

Figure 7: Atterberg Limits Equipment [3]

Scope of Services

Task 3.0 HEC-RAS Hydraulic Analysis

Task 4.0 Design Alternatives & Selection of Final Design

- **Task 4.1 Design Alternatives**
- **Task 4.2 Analyze Alternatives**
  - Preliminary Hydraulic Models
  - Decision Matrix
  - Select Final Design

Scope of Services

Task 5.0 Final Design

- Task 5.1 Plan Set Development
- Task 5.2 Construction Cost Estimate

Task 6.0 Impacts

- Environmental
- Economic
- Societal

Scope of Services

Task 7.0: FEMA Floodplain Analysis

. Floodplain analysis post-construction will be discussed.

Task 8.0: Deliverables

- **Task 8.1 30% Submittal**
  - Design Report
  - Presentation
  - Plan Set
- **Task 8.2 60% Submittal**
  - Design Report
  - Presentation
  - Plan Set
- **Task 8.3 90% Submittal**
  - Design Report
  - Presentation
  - Plan Set
  - Website
- **Task 8.2 Final Submittal**
  - Final Report
  - Final Presentation
  - Completed Plan Set
  - Completed Website

Scope of Services

Task 9.0: Project Management

- Task 9.1 Resource Management
- Task 9.2 Team Management and Meetings

Figure 8: Resource Management [4]

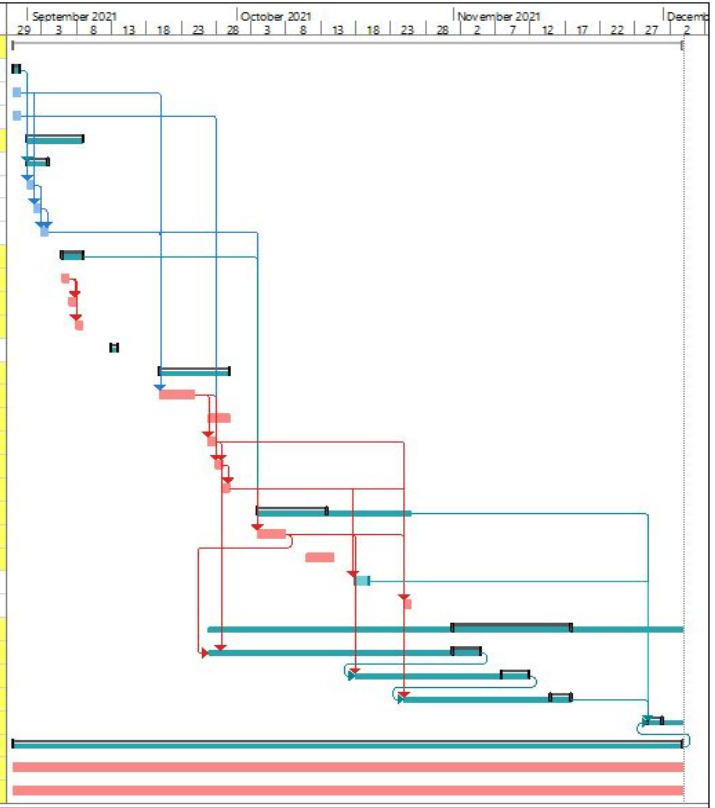
Exclusions

- **Roadway Design**
- **Construction**
- **Unforeseen Site Conditions**

Figure 8: Roadway Construction (Flagstaff) [5]

Schedule

ID	Task Mode	Task Name	Duration	Start	Finish	Predecess	Resource Names
0		Project Gantt Chart	70 days	Mon 8/30/21	Fri 12/3/21		
1		**Task 1: Preliminary Site research**	**1 day**	**Mon 8/30/21**	**Mon 8/30/21**		
2		1.1 Existing I-40 Culvert Research	1 day	Mon 8/30/21	Mon 8/30/21		
3		1.2 Standards and Codes Research	1 day	Mon 8/30/21	Mon 8/30/21		
4		**TASK 2: Field and Lab Work**	6 days	Wed 9/1/21	Wed 9/8/21		
5		**2.1 Site Mapping**	**3 days**	**Wed 9/1/21**	**Fri 9/3/21**	**1**	
6		2.1.1 Site Inventory	1 day	Wed 9/1/21	Wed 9/1/21	2	
7		2.1.2 Survey Site	1 day	Thu 9/2/21	Thu 9/2/21	2	
8		2.1.3 Topographic Map	1 day	Fri 9/3/21	Fri 9/3/21	7,6	
9		2.2 Geotechnical Analysis	3 days	Mon 9/6/21	Wed 9/8/21		
10		2.3.1 Sampling Plan	1 day	Mon 9/6/21	Mon 9/6/21		
11		2.3.2 PSD and Sieve Analysis Test	1 day	Tue 9/7/21	Tue 9/7/21	10	
12		2.3.3 Soil Limits Testing	1 day	Wed 9/8/21	Wed 9/8/21	10	
13		**TASK 3: Hydraulic Analysis of Existing Crossing**	**1 day**	**Mon 9/13/21**	**Mon 9/13/21**		
15		**TASK 4: Design Alternatives & Selection of Final**	18 days	Mon 9/20/21	Wed 9/29/21		
16		**4.1 Develop Alternatives**	**5 days**	**Mon 9/20/21**	**Fri 9/24/21**	**2,8,14**	
17		**4.2 Analysis Alternatives**	**3 days**	**Mon 9/27/21**	**Wed 9/29/21**		
18		4.2.1 Preliminary Hydraulic Models	1 day	Mon 9/27/21	Mon 9/27/21	16	
19		4.2.2 Decision Matrix	1 day	Tue 9/28/21	Tue 9/28/21	16,3,18	
20		4.2.3 Select Final Design	1 day	Wed 9/29/21	Wed 9/29/21	19	
21		**TASK 5: Final Design**	8 days	Mon 10/4/21	Wed 10/13/21		
22		5.1 Plan Set Development	4 days	Mon 10/4/21	Thu 10/7/21	20,8,9	
23		5.2 Construction Cost Estimate	4 days	Mon 10/11/21	Thu 10/14/21		
24		**Task 6: Impacts of Design**	**2 days**	**Mon 10/18/21**	**Tue 10/19/21**	**20**	
25		**Task 7.0: FEMA Floodplain Analysis**	**1 day**	**Mon 10/25/21**	**Mon 10/25/21**	**18,20**	
26		**TASK 8: Deliverables**	13 days	Mon 11/1/21	Wed 11/17/21		
27		8.1 30% Submittal	4 days	Mon 11/1/21	Thu 11/4/21	18,22	
32		8.2 60% Submittal	4 days	Mon 11/8/21	Thu 11/11/21	22,27	
37		8.3 90% Submittal	3 days	Mon 11/15/21	Wed 11/17/21	22,32	
43		8.4 Final Submittal	2 days	Mon 11/29/21	Tue 11/30/21	37,24,49,:	
49		**TASK 9: Project Management**	70 days	Mon 8/30/21	Fri 12/3/21		
50		9.1 Resource Management	70 days	Mon 8/30/21	Fri 12/3/21		
51		9.2 Team Management and Meetings	70 days	Mon 8/30/21	Fri 12/3/21		



Project: Project Gantt Chart
Date: Wed 4/7/21

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

Staffing Plan

- **Chief Engineer (CEN)**
- **Project Engineer (PEN)**
- **Intern Engineer (INT)**
- **Technician (TEC)**

Table 1: Summary of Work Hours

Staff	Hours
CEN	141
PEN	166
INT	213
TEC	239
Total	**759**

Cost of Engineering Services

Table 2: Cost of Engineering Services

	Classification	Hours	Rate, $/hr	Cost
Personnel	CEN	141	190	26790
	PEN	166	120	19920
	INT	213	75	15975
	TEC	239	60	14340
Supplies	Surveying Equipment Rental	24	100	2400
Cost of Engineering Services Total				79425

References

[1] "Google Maps", *Google Maps*, 2021. [Online]. Available: https://www.google.com/maps. [Accessed: 15- Feb- 2021].

[2] 2021. [Online]. Available: https://basiccivilengineering.com/2017/06/sieve-analysis-test.html. [Accessed: 08- Apr- 2021].

[3]"Atterberg Limits", *Humboldtmfg.com*, 2021. [Online]. Available: https://www.humboldtmfg.com/atterberg-limits/. [Accessed: 08- Apr- 2021].

[4] J. Trout, “Maintenance Management: An Overview,” *Reliable Plant*, 01-Apr-2020. [Online]. Available: https://www.reliableplant.com/maintenance-management-31856. [Accessed: 07-Apr-2021].

[5] P. Meek, “Photos of SR-89A Deck Construction”, [Photographed]. Taken: May 21st, 2020.