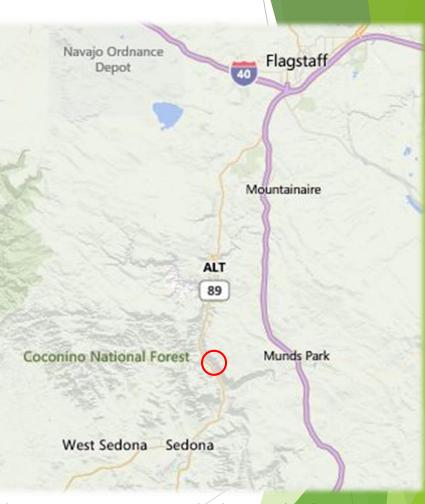
Arizona Water Jacks: Oak Creek Low Water Crossing

Devin Kelley Hilary Sizemore Fawaz Alotaibi Bruce Connolly

About the Project

- Low water crossing through Oak Creek
- Service the Rancho Mission/Shangri-La Subdivision
- Floods are problematic in the area
 - Flood of 1993
- Only egress and ingress to subdivision



The project site (circled in red) showing its relation to Flagstaff and Sedona

Courtesy of Bing Maps

Client and Technical Advisor

Client - Beth Ann Dzierson, Head of POA

Technical Advisor - Mark Lamer, P.E., MEng., Instructor at NAU

Needs of the Client

Protect the current crossing
 Scouring
 Geomorphology
 Design a new crossing



The geomorphology of Oak Creek (notice the natural beach on the left side)

Stakeholders

- Client Beth
 Ann Dzierson
 (Head of POA)
- Shangri-La residents



The road heading down towards the water crossing

Existing Conditions

- 40 feet long and 14 ¹/₂ feet wide
- Four 48" concrete culverts
- Weight limit of 30 tons

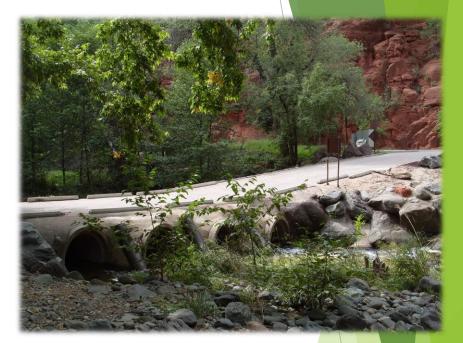


The sign shown the weight limit of the current crossing

Existing Conditions



The view of the crossing looking towards 89-A



The crossing as seen from the natural beach

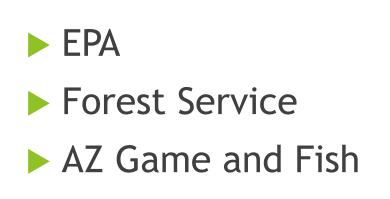
Scope (Research)





The flora in the crossing's surrounding area

Scope (Research)









Scope (Modeling)

Project Survey
USGS
HEC-HMS
HEC-RAS



Surveying around Oak Creek at the project site

Scope (Impacts)



Economy





Oak Creek is vital to many aspects of the local community, such as Slide Rock State Park which attracts tourists

http://northernword.com/2009/01/more_from_sedona/

Scope (Analysis and Design)

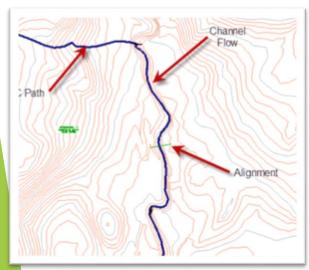
- Low Water Crossing Designs
- Techniques to Armor Existing Crossing

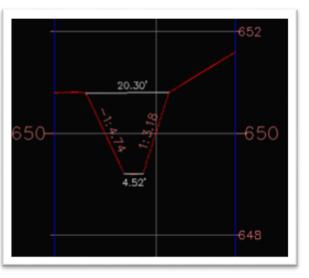


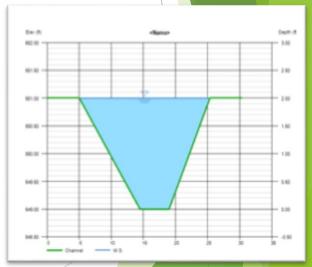
The large rocks are piled on the banks to prevent soil erosion

Scope (Analysis and Design)

- AutoCAD
- Hydraflow Express
- Bentley WaterGEMS
- Culvert Master







Scope (Exclusions)

Geotechnical Evaluation

Traffic Control

Structural Design



Schedule

ask						Oct 13, '13		v 3, 13		v 24, '13	Dec 15		Jan 5, '14		an 26, '14	Feb 16,		Mar 9, '14		ar 30, '14	Apr 20, '1
		Duration			Predecessors	7 15 23	31	8	16 24	2	10 18	26	3 11	19	27 4	12 20	28	8 16	24	1 9	17 25
	WEBSITE	112 days	Fri 10/18/13																		
	▲ Research	51 days		8 Mon 1/20/14	•																
	Army Corps	50 days	Mon 11/11/13					_													
•	AZ DEQ	50 days	Mon 11/11/13		3SS			-													
	ADOT	50 days	Mon 11/11/13		4SS			-													
	EPA	50 days	Mon 11/11/13		5SS			-													
	Forest Service	50 days	Mon 11/11/13		6SS			-													
	Game & Fish	50 days	Mon 11/11/13	8 Fri 1/17/14	7SS			-													
•	Safety	50 days	Mon 11/11/13		8SS			-													
•	Research Complete	50 days	Mon 11/11/13	Fri 1/17/14	9SS			4							,						
•	▲ MODELING	63 days	Sat 11/16/13	Wed 2/12/14	L I			Г								1					
	Project Survey	23 days	Sat 11/16/13	Wed 1/29/14																	
•	USGS Data	10 days	Thu 1/30/14	Wed 2/12/14	10										+	•					
	HEC-HMS	10 days	Thu 1/30/14	Wed 2/12/14	10,12										+						
•	HEC-RAS	10 days	Thu 1/30/14	Wed 2/12/14	10,12										4						
•	Modeling Complete	0 days	Wed 2/12/14	Wed 2/12/14												2/12					
	▲ IMPACTS	15 days	Fri 1/24/14	Thu 2/13/14																	
	Political	15 days	Fri 1/24/14	Thu 2/13/14]															
	Social	15 days	Fri 1/24/14	Thu 2/13/14]															
k.	ANALYSIS	16 days	Sat 2/15/14	Fri 3/7/14		1															
•	Geomorph	16 days	Sat 2/15/14	Fri 3/7/14	10]										+					
	AutoCAD	15 days	Mon 2/17/14	Fri 3/7/14	10	1										+					
•	Hydraflow Express	16 days	Sat 2/15/14	Fri 3/7/14	10	1										+					
	Bently W. Gems	16 days	Sat 2/15/14	Fri 3/7/14	10	1										+					
	Culvert Master	16 days	Sat 2/15/14	Fri 3/7/14	10	1										-					
	Analysis Complete	0 days	Fri 3/7/14	Fri 3/7/14													•	3/7			
	4 DESIGN	16 days	Sat 3/8/14	Fri 3/28/14																	
	Structure	16 days	Sat 3/8/14	Fri 3/28/14	10,16,26												- +	-			
	Armor Existing Stucture	16 days	Sat 3/8/14	Fri 3/28/14	10,16,26	1															
	Design Complete	0 days	Sat 3/8/14	Sat 3/8/14														3/8			
	4	54 days	Mon 2/17/14	Thu 5/1/14																	
•	50% Design Report	19 days	Mon 2/17/14																		
	Interim Presentation	19 days	Mon 2/17/14	Thu 3/13/14																	
	Final Presentation	20 days			1,30,10,16,26														-		
	UGRADS Presentation	0 days	Fri 4/25/14	Fri 4/25/14		1															4/
	Final Report	24 days			1,30,10,16,26	1													-		
<i>•</i>	Project Complete	0 days	Thu 5/1/14	Thu 5/1/14		1															

Schedule showing Critical Path in dark orange

Hours Worked Estimate

- Hours assigned per subject per task
- Task hours totaled

	Senior Engineer	Engineer	Intern	Administrative
Research				
Army Corps	1.5	4	5	0.5
AZDEQ	1.5	4	5	0.5
ADOT	1.5	4	5	0.5
EPA	1.5	4	5	0.5
Forest Service	1.5	4	5	0.5
Game & Fish	1.5	4	5	0.5
Safety	1.5	4	5	0.5
Total	10.5	28	35	3.5

Complete Estimate	d Hours per Task p	per Role		
	Senior Engineer	Engineer	Intern	Administrative
Research				
Army Corps	1.5	4	5	0.5
AZDEQ	1.5	4	5	0.5
ADOT	1.5	4	5	0.5
EPA	1.5	4	5	0.5
Forest Service	1.5	4	5	0.5
Game & Fish	1.5	4	5	0.5
Safety	1.5	4	5	0.5
Total	10.5	28	35	3.5
Modeling				
HEC-HMS	2	7	7	(
HEC-RAS	2	7	7	(
USGS DATA	2	7	7	(
Land Survey	8	20	20	(
Total	14	41	41	(
Impact		-		
Political	0.5	0.5	2	
Social	0.5	0.5	2	3
Total	0.3	0.5	4	6
10101	-			
Analysis				
AutoCAD 3D	4	8	8	0.5
Geomorphology	4	8	8	0.5
Culvert Master	4	8	8	0.5
Hydraflow Express	4	8	8	0.5
Bentley W. Gems	4	8	8	0.5
Documentation	2	8	8	5
Total	22	48	48	10.5
Docign				
Design				
Structure	4	11	11	(
Armoring Exist.	4	11		
Documentation Total	10	10 32		

Cost Estimate

1.0 Personnel										
Tasks	Senior Engineer	Engineer	Intern	Administrative	Total Per Task (hrs)					
Research (hrs)	10.5	28	35	3.5	77					
Modeling (hrs)	14	41	41	0	96					
Impact (hrs)	1	1	4	6	12					
Analysis (hrs)	22	48	48	10.5	128.5					
Design (hrs)	10	32	32	2	76					
Total Per Role (hrs)	57.5	150	160	22	389.5					
Pay Scale Per Role	\$ 170.00	\$ 90.00	\$ 30.00	\$ 45.00						
Cost	\$ 9,775.00	\$ 13,500.00	\$ 4,800.00	\$ 990.00	\$ 29,065.00					
Total Personnel Cost	\$ 1 29,000.00									
2.0 Reimbursment										
Not to exceed	\$ 1,000.00									
3.0 Subcontracts										
Structural Analysis	\$ 15,000.00									
Geotechnical Analysis	\$ 15,000.00									
Total Subcontracts	\$ 30,000.00									
4.0 Total Service Cost	\$ 60,000.00									
5.0 Comparison	Clients Budget									
	\$ 80,000.00	>	\$ 60,000.00							
Remaining Budget	\$ 20,000.00									

Budget Comparison

5.0 Comparison	-	Clients Budget		
	\$	80,000.00	>	\$ 60,000.00
Remaining Budget	\$	20,000.00		

- The budget allocated by Property Association
- Services are within budget

Conclusion

Armoring Current Crossing
New Crossing Design
Thorough Analysis
Below Budget