City of Sedona
102 Roadrunner Dr.
Bldg. 108
Sedona, AZ 86336
(928) 204-7111
sedonaaz.gov

To Whom It May Concern:

The City of Sedona, Arizona is issuing **Addendum #1** to the plans and specifications as originally issued at the time of solicitation for bids for the **SD-03 Back O' Beyond Low Water Crossing Improvements Project.** For any bid to be considered responsible and responsive, receipt of this addendum must be acknowledged.

As specified in the Instructions to Bidders, this Addendum, upon issuance, has become a part of the Contract Documents.

This Addendum contains 52 pages, and affects 0 changed bid sheet, 0 plan sheets, and 1 Technical Specification.

This Addendum corrects the following Technical Specification

1. 2.2.7 Construct asphalt pavement section

   Original- Work under this item shall consist of placement of a 2" asphaltic concrete surface on top of a 4" aggregate base course to match the existing pavement per the Geotechnical Evaluation Report.

   Change to- *Work under this item shall consist of the placement of a 4" asphaltic concrete surface on top of a 6" aggregate base course per the project plans.*

This Addendum provides the following information

1. A City of Sedona Temporary Use Permit will be required for any laydown/staging yard. Contractor to coordinate location with Back O' Beyond Ranch HOA/owners in the area. Potential lots are APN 401-34-10D and 408-13-040.
2. Contractor water source to be coordinated with Arizona Water Company (928) 282-7092.
3. Drainage Design Report.
4. Geotechnical Evaluation Report.
5. Pre-Bid Meeting Agenda and Sign-in Sheet.
6. City of Sedona will provide community outreach and information through Beta PR.

ACKNOWLEDGEMENT

I have received **Addendum #1** for the **SD-03 Back O' Beyond Low Water Crossing Improvements Project** as described above and acknowledge it as part of the Contract Documents for the project.

_____ _____
Signature **Date**

_____
Print Business Name

Addendum # 1 issued by J. Andy Dickey, PE, Assistant City Manager / Director of Public Works

_____ 3/23/23
J. Andy Dickey, PE Date
Assistant City Manager / Director of Public Works

Public Works Department

improvements. Payment will be made at the contract unit price bid, and such payment shall be compensation in full for the complete removal and disposal of this item.

2.2.5 Remove and dispose miscellaneous traffic barrier posts

This work shall consist of removing and disposing of the existing traffic barrier posts within the demolition area per the project plans. Contractor is responsible for damage to adjacent improvements. Payment will be made at the contract unit price bid, and such payment shall be compensation in full for the complete removal and disposal of this item.

2.2.6 Earthwork cut/fill/rock removal

Work under this item shall be in accordance with MAG Specification Sections 201, 206, 211, and 215, and General Conditions Section 58. This item of work includes excavation, embankment, and rock removal for the construction of the shotcrete channel bank, bottom protection, and concrete box culvert. Contractor is responsible for damage to adjacent improvements. Payment will be made at the contract unit price bid, and such payment shall be compensation in full for the complete excavation of this item.

2.2.7 Construct asphalt pavement section

Work under this item shall consist of the placement of a 4" asphaltic concrete surface on top of a 6" aggregate base course per the project plans. Asphaltic concrete shall be placed in conformance with MAG Specification Sections 321 and 322 and per the project plans. The surface course mix shall be a Marshall Mix Design in accordance with MAG Section 710. Aggregate base course shall be placed in conformance with MAG Specification Sections 310 and the material shall meet Section 702. The maximum plasticity index shall not exceed 7. Base material shall be placed in uniform layers not to exceed 6" in depth. Each layer shall be bladed to a smooth surface conforming to the cross section shown on the plans and shall be watered and thoroughly rolled to obtain a compaction of 100% maximum density, based on a modified proctor
Payment will be made at the contract unit price bid, and such payment shall be compensation in full for the complete construction of this item.

2.2.8 Install Precast 3'x12' concrete box culvert

Work under this item shall consist of the installation of a 12' span and a 3' rise Jensen Precast Type 1 and headwalls or approved equivalent concrete box culvert per the design and approved specifications and shop drawings provided by Jensen Precast to the Engineer, Contractor and the City of Sedona. Contractor is responsible for damage to adjacent improvements. Payment will be made at the contract unit price bid, and such payment shall be compensation in full for the complete construction of this item.

Shephard Wesnitzer, Inc.

75 Kallof Place
Sedona, AZ 86336

P.O. Box 3924
Sedona, AZ 86340

928.282.1061
www.swiaz.com

Engineering an environment of excellence.

Drainage Design Report

Back O' Beyond Low Water Crossing

Back O' Beyond Road
Sedona, AZ
Yavapai County

Prepared for:

City of Sedona
102 Roadrunner Drive
Sedona, AZ 86336

Job #21240

TABLE OF CONTENTS

APPENDIX

INTRODUCTION

The existing low water crossing channel on Back O Beyond Road in Sedona, Arizona conveys stormwater runoff primarily from the Chapel of the Holy Cross residential area that is east of Hwy 179. During large storm events, the low water crossing floods, preventing residents and tourists from being able to cross the roadway. A large amount of sediment is usually deposited in the roadway after the storm events, and requires the Public Works department to clear the roadway. The proposed project involves placing a concrete box culvert beneath the roadway in order to pass stormwater runoff, sediment and debris under the road while allowing safe travel during storm events.

The project area is located in Section 25, Township 17 North, Range 5 East, of the Gila and Salt River Meridian, Yavapai County, Arizona. A vicinity map can be found in the Appendix.

OBJECTIVE

The purpose of this report is to summarize the major design components of the proposed project. The proposed culvert is intended to provide capacity to pass the 25-year storm event, with the 100-year storm event overtopping the roadway with a depth not exceeding 12 inches.

PROCEDURE

The existing site was surveyed by Shephard Wesnitzer, Inc. to provide topographic and Right of Way background for the construction plans. A geotechnical investigation was conducted by Western Technologies Inc. to provide soil and rock information in the drainage channel and road crossing area.

Existing drainage reports and studies were reviewed in order to determine the design flowrates for the existing low water crossing on Back O Beyond Road. The 1994 SCS study shows a flowrate of 344 cubic feet per second (cfs) for the 25-year storm event, and 680 cfs for the 100-year storm event. The Stream Stats regression data shows a flowrate of 364 cfs for the 25-year storm event, and 724 cfs for the 100-year storm event. The preliminary Flow2D model shows a flowrate of 329 cfs for the 25-year storm event, and 586 cfs for the 100-year storm event. The 2005 Sedona Storm Water Master Plan study shows a flowrate of 1580 cfs for the 100-year storm event. Excerpts from these studies and models can be found in the Appendix.

An existing 6” high pressure gas line runs along the northern edge of Back O Beyond Road at a depth of approximately 6’. The gas main is the only utility line in the roadway and is the main design constraint. UniSource potholed the gas main on June, 9th 2022, and SWI field surveyed the elevation of the top of the pipe.

In order to provide capacity to pass the 25-year storm event beneath the roadway without disrupting the gas line, a 3' x 12' precast concrete box culvert was selected. A precast concrete box culvert will expedite the construction timeframe and accept traffic loading for the roadway which has to remain open during construction. A drop inlet placed immediately downstream of an existing rock shelf will collect stormwater runoff into the box culvert. Stormwater will then pass through the culvert, and outlet into the existing drainage channel on the south side of the roadway.

Existing drainage easements on APNs 408-13-044 and 408-13-042 provide access to the existing drainage channel. An additional easement on APN 408-13-052 has been obtained in order to construct the proposed culvert crossing. See the Improvement Plans in the Appendix for easement locations.

RESULTS

Bentley's CulvertMaster was used to determine the size of the proposed culvert. In order to both provide capacity for the 25-year storm event, and stay above the existing high pressure gas line, a 3' x 12' box culvert was selected. The 12' span was selected to minimize the width of potential rock excavation required for the culvert installation, and provide for sediment conveyance. The culvert capacity is 386 cfs with 6 feet of headwater depth at the inlet. The drop inlet for the box culvert will be cut into the existing rock shelf on the upstream side of the roadway in order to collect stormwater runoff into the box culvert. The banks of the drainage channel adjacent to the box culvert will be stabilized with shotcrete to help prevent erosion.

A 3' rock gabion basket barrier wall is proposed on the upstream eastern side of the culvert to direct runoff into the drop inlet and protect the roadway. Guardrails are proposed to be located on both the northern and southern edge of the roadway over the box culvert.

During larger storm events, the culvert will overtop, and drainage will flow over the roadway as it does currently in the historic condition. The box culvert has a capacity of 435 cfs with 7 feet of headwater depth at the inlet. The roadway cross section at the centerline has a capacity of 337 cfs with a depth of 12". The total capacity for the culvert and the roadway is approximately 772 cfs, which exceeds the anticipated 100-year storm flows for the 1994 SCS study, Stream Stats model, and preliminary Flow2D model. CulvertMaster and FlowMaster reports for the culvert and roadway capacity can be found in the Appendix.

The inclusion of safety railing on the inlet and outlet headwalls, along with guardrails on either side of the roadway, will provide pedestrian protection and assist in keeping larger debris from collecting on the roadway during larger storm events.

CONCLUSION AND RECOMMENDATIONS

Various existing drainage reports and studies were reviewed to determine the design flow and required capacity for the proposed culvert to pass the 25-year storm event. A 3' x 12' precast concrete box culvert is proposed to pass these flows underneath the roadway and into the existing drainage channel. The anticipated 100-year stormwater flow rates will overtop the culvert as it does in the existing condition, with a depth of less than 12" over the roadway. The flowline of the channel will be reduced by more than 4 feet with the installation of the box culvert which is designed for the 25 year storm event. Overtopping of the roadway will occur during larger storm events but the backwater and floodplain limits currently shown by the City of Sedona will be reduced from the current conditions.

The design concepts in this report will ensure that the drainage integrity of the site is sustained with proper maintenance activity. Periodic inspections of the drainage infrastructure should be performed particularly after heavy monsoon season rains. Sediment should be regularly removed from the drainage infrastructure to ensure proper working operation.

REFERENCES

Floodplain Management Study, City of Sedona, May 1994

Stormwater Master Plan, City of Sedona, 2005

Sedona Stormwater Master Plan Update – Phase II, JE Fuller

Yavapai County Drainage Criteria Manual, Yavapai County Flood Control District, July 2015

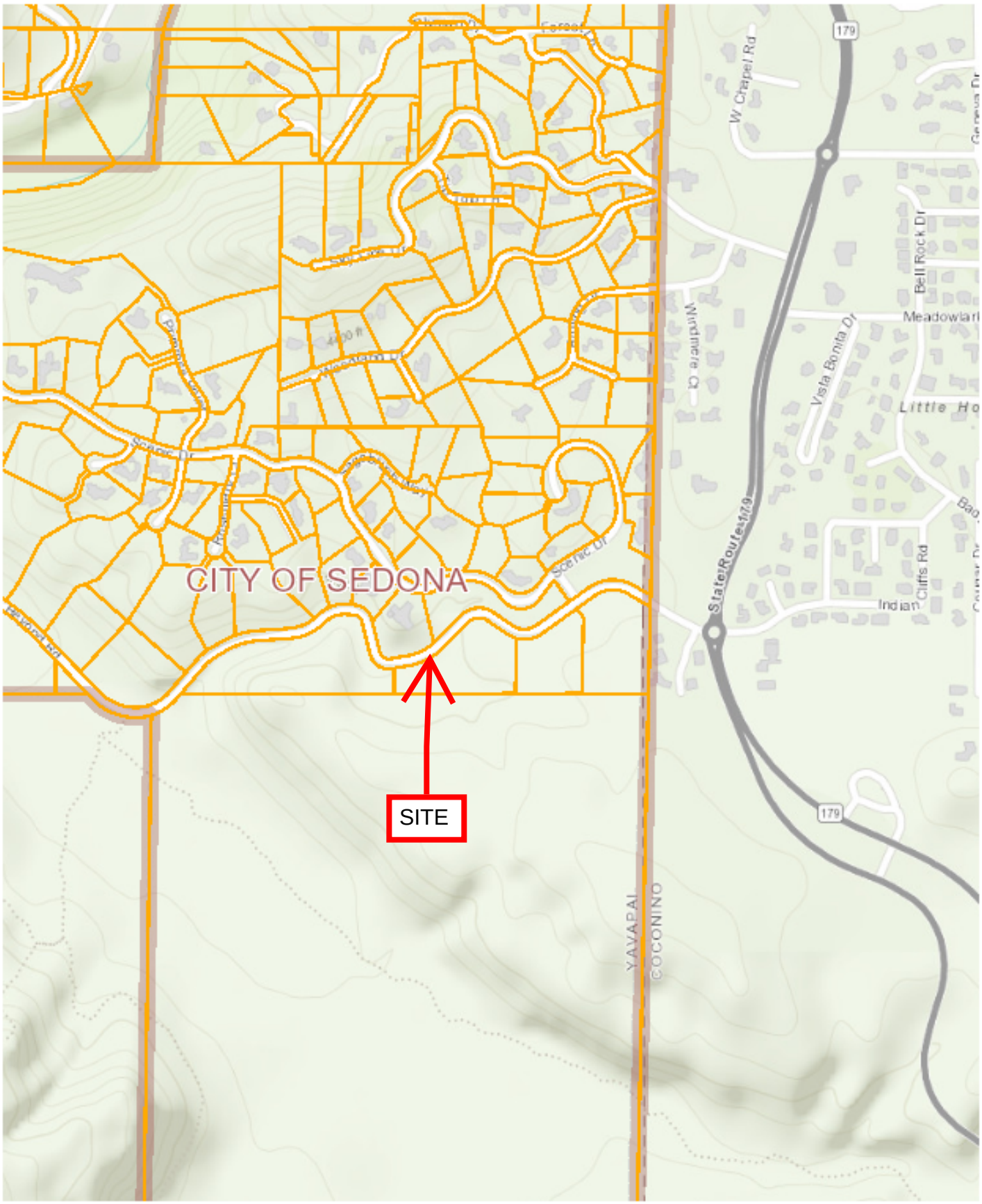
SOFTWARE

Bentley CulvertMaster CONNECT Edition

Bentley OpenFlows Flowmaster CONNECT Edition Update 3

StreamStats Website

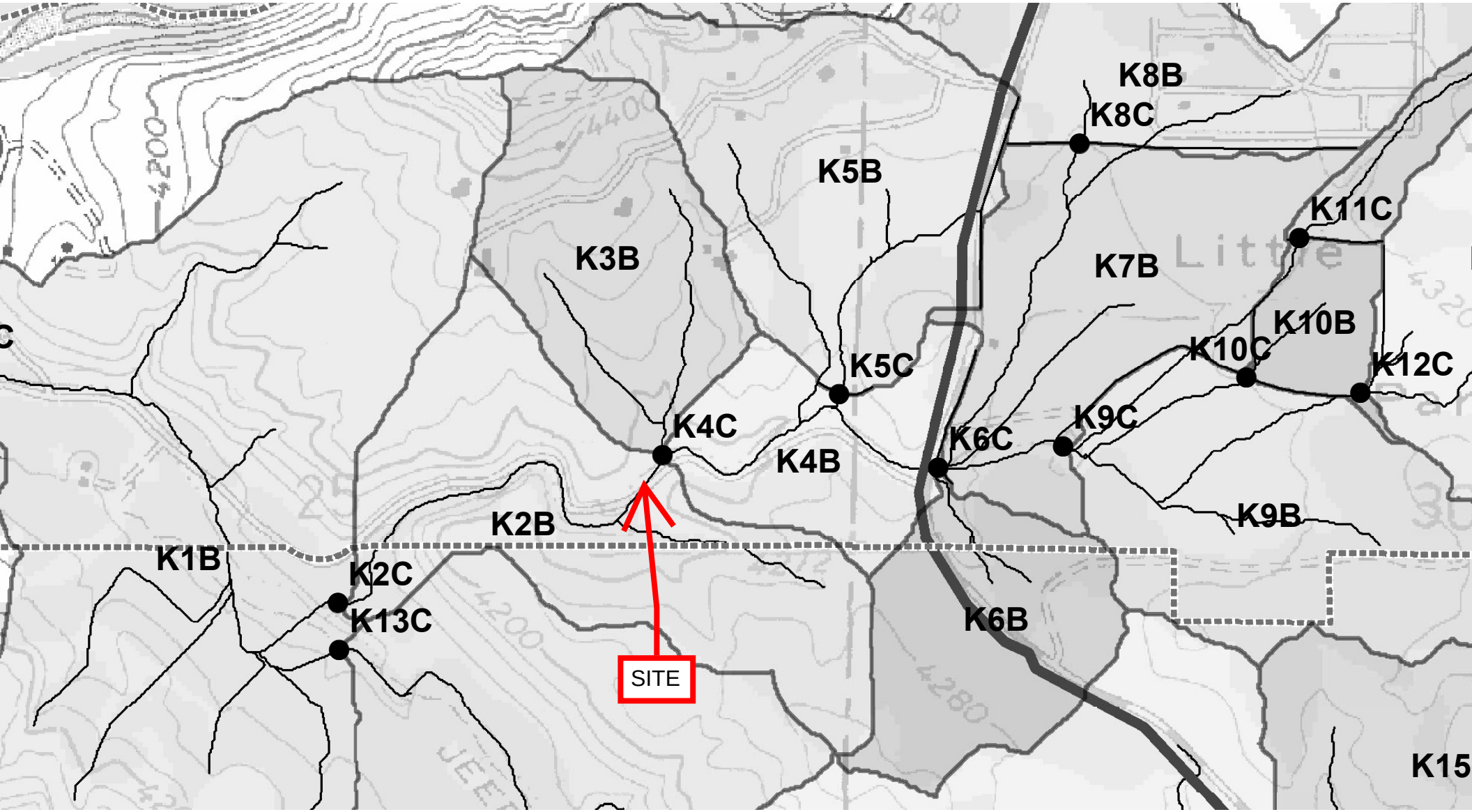
APPENDIX



Disclaimer: Map and parcel information is believed to be accurate but accuracy is not guaranteed. No portion of the information should be considered to be, or used as, a legal document. The information is provided subject to the express condition that the user knowingly waives any and all claims for damages against Yavapai County that may arise from the use of this data.

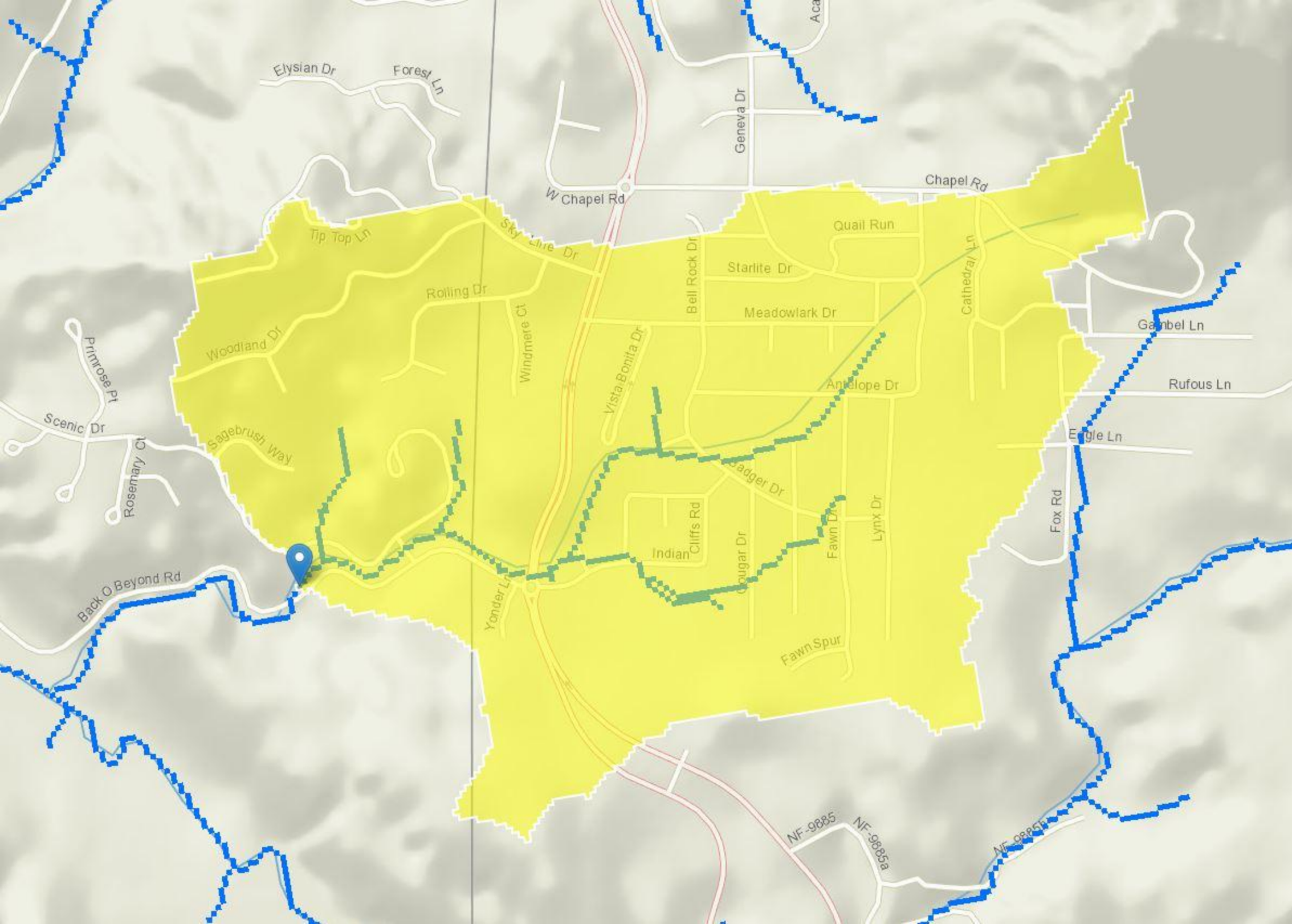
TABLE C-1: SUMMARY OF PEAK DISCHARGES BY FREQUENCY
TYPE II, ARC II, 24-HOUR RAINFALL

	HEC-2 X-SECTION (NO.)		1\	DRAINAGE AREA (SQ MILES)	2-YEAR DISCHARGE (CFS)	5-YEAR DISCHARGE (CFS)	10-YEAR DISCHARGE (CFS)	25-YEAR DISCHARGE (CFS)	50-YEAR DISCHARGE (CFS)	100-YEAR DISCHARGE (CFS)	500-YEAR DISCHARGE (CFS) 2/
PROFILE 100	101		A	4.57	69	432	1026	2330	3419	5072	10079
	125	Hwy 179	Y	0.53	23	114	240	482	681	926	1495
PROFILE 200	204	Hwy 179	D	0.63	19	118	283	551	812	1125	1932
PROFILE 200 A	220		A	0.07	3	18	37	66	100	141	268
PROFILE 300	301		A	0.16	8	44	102	200	280	380	621
	310	Rufous Ln	L	0.10	9	30	78	147	204	278	440
PROFILE 400	401		A	0.62	36	142	257	497	725	1137	1856
	412	Hwy 179	L	0.36	37	123	196	344	498	680	1041
PROFILE 500	504		F	0.11	14	35	60	114	178	248	386
PROFILE 600	604		D	0.03	3	11	21	40	57	78	125
PROFILE 700	703	Meadow Lark Dr	C	0.06	7	26	47	88	125	157	254
PROFILE 900	901		A	0.37	12	80	181	360	528	730	1279
	905.1	Hwy 179	G	0.24	10	62	137	266	382	521	897
PROFILE 1000	1001		A	0.55	15	104	243	472	667	866	1578
	1018.1	Hwy 179	AI	0.31	9	70	163	319	459	624	1081
	1021.1	Pine Dr	AM	0.14	8	44	92	173	246	336	574
	1025.1	Painted Canyon Dr	AQ	0.05	4	17	35	64	91	126	208
PROFILE 1000 A	1030		A	0.09	5	27	57	109	155	210	366
PROFILE 1000 C	1050.1		B	0.12	9	42	74	143	203	283	466
	1057	Hwy 179	J	0.12	10	44	81	157	221	303	488
PROFILE 1100	1101		A	7.44	193	905	1941	3994	5600	7794	12842
PROFILE 1100 A	1123	Margs Draw	D	1.34	48	200	387	783	1120	1565	2577


K8B
K8C
K5B
K11C
K3B
K7B
K10B
K10C
K12C
K5C
K4C
K9C
K6C
K4B
K9B
K2B
K1B
K2C
K13C
K6B
SITE
K15

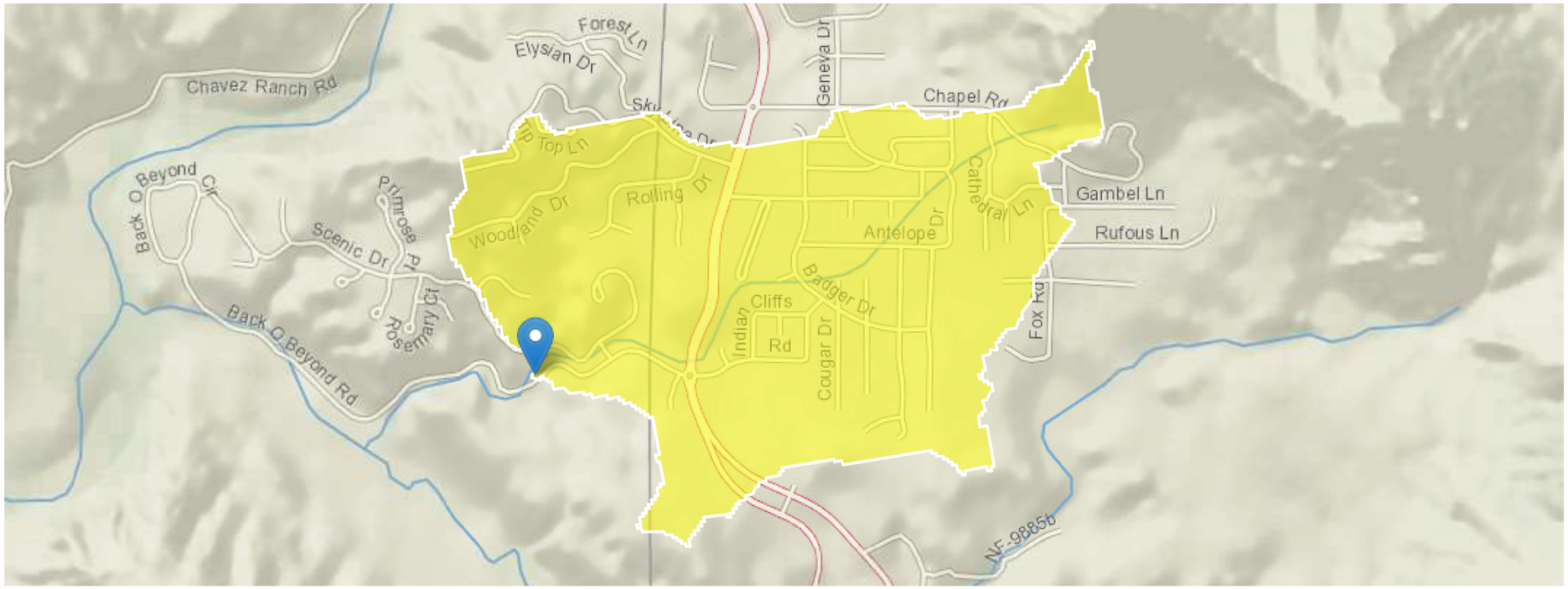
	ROUTED TO						
+		K12R	234.	11.95	16.	5.	3.	.06
	HYDROGRAPH AT						
+		K11B	87.	12.00	8.	3.	1.	.03
	ROUTED TO						
+		K11R	87.	12.00	8.	3.	1.	.03
	HYDROGRAPH AT						
+		K10B	61.	11.95	5.	2.	1.	.02
	3 COMBINED AT						
+		K10C	372.	11.95	29.	9.	5.	.11
	ROUTED TO						
+		K10R	364.	12.00	29.	9.	5.	.11
	HYDROGRAPH AT						
+		K9B	230.	12.00	17.	5.	3.	.07
	2 COMBINED AT						
+		K9C	594.	12.00	46.	15.	7.	.18
	ROUTED TO						
+		K9R	590.	12.00	46.	15.	7.	.18
	HYDROGRAPH AT						
+		K8B	203.	11.90	15.	5.	2.	.06
	ROUTED TO						
+		K8R	193.	12.00	15.	5.	2.	.06
	HYDROGRAPH AT						
+		K7B	203.	12.00	18.	6.	3.	.07
	HYDROGRAPH AT						
+		K6B	128.	12.05	8.	2.	1.	.04
	4 COMBINED AT						
+		K6C	1104.	12.00	87.	28.	13.	.35
	ROUTED TO						
+		K6R	1079.	12.05	87.	28.	13.	.35
	HYDROGRAPH AT						
+		K5B	260.	12.00	20.	6.	3.	.08
	ROUTED TO						
+		K5R	260.	12.00	20.	6.	3.	.08
	HYDROGRAPH AT						
+		K4B	94.	12.05	8.	3.	1.	.04
	HYDROGRAPH AT						
+		K3B	180.	11.95	12.	4.	2.	.06
	4 COMBINED AT						
+		K4C	1580.	12.05	128.	40.	19.	.52
	ROUTED TO						
+		K4R	1519.	12.10	128.	40.	19.	.52
	HYDROGRAPH AT						
+		K2B	187.	12.10	17.	5.	2.	.08
	2 COMBINED AT						
+		K2C	1706.	12.10	145.	46.	22.	.61
	ROUTED TO						
+		K2R	1640.	12.20	145.	46.	22.	.61
	HYDROGRAPH AT						
+		K1B	737.	12.05	65.	20.	10.	.28
	3 COMBINED AT						
+		K1C	5717.	12.45	884.	256.	123.	4.48
	ROUTED TO						
+		K1R	5717.	12.45	884.	256.	123.	4.48

*** NORMAL END OF HEC-1 ***


Elysian Dr
Forest Ln
Geneva Dr
W Chapel Rd
Chapel Rd
Tip Top Ln
Sky Line Dr
Quail Run
Bell Rock Dr
Starlite Dr
Cathedral Ln
Rolling Dr
Meadowlark Dr
Gambel Ln
Woodland Dr
Windmere Ct
Vista Bonita Dr
Primrose Pl
Antelope Dr
Rufous Ln
Scenic Dr
Sagebrush Way
Rosemary Ct
Badger Dr
Eagle Ln
Fox Rd
Indian Cliffs Rd
Cougar Dr
Fawn Dr
Lynx Dr
Back O Beyond Rd
Yonder Ln
Fawn Spur
NF-9885
NF-9885a

StreamStats Report

Region ID:	AZ
Workspace ID:	AZ20210929193436815000
Clicked Point (Latitude, Longitude):	34.82640, -111.78325
Time:	2021-09-29 12:35:00 -0700



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CONTDA	Area that contributes flow to a point on a stream	0.51	square miles
ELEV	Mean Basin Elevation	4307.382	feet
PRECIP	Mean Annual Precipitation	17.7	inches

Peak-Flow Statistics Parameters [Peak Region 4 Central Highland 2014 5211]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	0.51	square miles	0.059	18044
ELEV	Mean Basin Elevation	4307.382	feet	3274	7451
PRECIP	Mean Annual Precipitation	17.7	inches	10.8	33.5

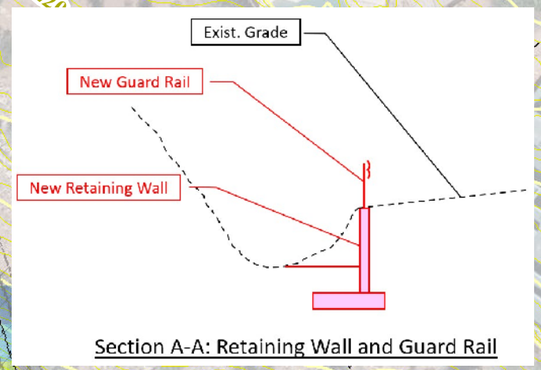
Peak-Flow Statistics Flow Report [Peak Region 4 Central Highland 2014 5211]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	35	ft^3/s	8.46	145	101
20-percent AEP flood	115	ft^3/s	46.6	284	57
10-percent AEP flood	201	ft^3/s	105	386	40.3
4-percent AEP flood	364	ft^3/s	225	589	29
2-percent AEP flood	526	ft^3/s	334	828	27.1
1-percent AEP flood	723	ft^3/s	459	1140	27.1
0.5-percent AEP flood	954	ft^3/s	576	1580	28.9
0.2-percent AEP flood	1340	ft^3/s	752	2390	35

Peak-Flow Statistics Citations

Paretti, N.V., Kennedy, J.R., Turney, L.A., and Veilleux, A.G.,2014, Methods for estimating magnitude and frequency of floods in Arizona, developed with unregulated and rural peak-flow data through water year 2010: U.S. Geological Survey Scientific Investigations Report 2014-5211, 61 p., http://dx.doi.org/10.3133/sir20145211. (http://pubs.usgs.gov/sir/2014/5211/)



Section A-A: Retaining Wall and Guard Rail

Install guard rail along edge of pavement

Q25: 339 cfs

Install vertical concrete retaining wall on road-side of wash to increase cross sectional area and flow capacity per Section A-A

New Channel 6' w x 4.5' d Drainage Easement will need to be acquired

Install 3-54" CMP culvert underneath roadway

Ex. 3-36" CMP

Raise road profile to acomodate new culvert crossing

Q25: 329 cfs
Q100: 586 cfs

Q25: 37 cfs

SCENIC DR

BACK O' BEYOND RD

Legend

- Raise Roadway
- Proposed Culvert
- Guard Rail
- Channel
- Retaining
- Existing Culverts
- Existing Storm Drain
- Sewer Lift Station
- Sewer Manhole
- Sanitary Sewer
- Easement
- SedonaParcels
- Peak Flows

25Y24H Depth (ft)

- < 0.15
- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- > 10

2-ft C.I. Topo

- Index
- Intermed.

N

Flood Mitigation Alternative Summary

Q25: 329 cfs
Primary Features: 3-54" Dia CMP
Guard Rail
Retaining Wall to increase channel capacity

0 30 60 120
Feet

JE FULLER

SEDONA STORMWATER MASTER PLAN UPDATE - PHASE II

CONCEPTUAL NOT FOR CONSTRUCTION

CITY OF SEDONA

AoMI 3 - Back O' Beyond Rd and SR179

Culvert Calculator Report
BACK O BEYOND ROAD

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	4,178.50	ft	Headwater Depth/Height	2.00	
Computed Headwater Elevation	4,178.50	ft	Discharge	386.65	cfs
Inlet Control HW Elev.	4,178.50	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,178.19	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	4,172.50	ft	Downstream Invert	4,171.50	ft
Length	68.00	ft	Constructed Slope	0.014706	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.37	ft
Slope Type	Steep		Normal Depth	2.04	ft
Flow Regime	Supercritical		Critical Depth	3.00	ft
Velocity Downstream	13.60	ft/s	Critical Slope	0.008829	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 3 ft		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	4,178.19	ft	Upstream Velocity Head	1.79	ft
Ke	0.50		Entrance Loss	0.90	ft

Inlet Control Properties					
Inlet Control HW Elev.	4,178.50	ft	Flow Control	Submerged	
Inlet Type	45° bevels; 10 - 45° skewed headwall		Area Full	36.0	ft²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

Culvert Calculator Report
BACK O BEYOND ROAD

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	4,179.50	ft	Headwater Depth/Height	2.33	
Computed Headwater Eleva	4,179.50	ft	Discharge	434.89	cfs
Inlet Control HW Elev.	4,179.50	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	4,178.90	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	4,172.50	ft	Downstream Invert	4,171.50	ft
Length	68.00	ft	Constructed Slope	0.014706	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.57	ft
Slope Type	Steep		Normal Depth	2.22	ft
Flow Regime	Supercritical		Critical Depth	3.00	ft
Velocity Downstream	14.10	ft/s	Critical Slope	0.011170	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	6 x 3 ft		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	4,178.90	ft	Upstream Velocity Head	2.27	ft
Ke	0.50		Entrance Loss	1.13	ft

Inlet Control Properties					
Inlet Control HW Elev.	4,179.50	ft	Flow Control	Submerged	
Inlet Type	45° beveled; 10 - 45° skewed headwall		Area Full	36.0	ft²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

Worksheet for Back O Beyond Road CL Cross Section

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	12.0 in

Section Definitions

Station (ft)	Elevation (ft)
0+00	4,180.60
0+08	4,180.00
0+13	4,177.70
0+21	4,176.90
0+45	4,176.90
0+55	4,177.00
0+73	4,181.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 4,180.60)	(0+73, 4,181.00)	0.016

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Discharge	337.52 cfs
Roughness Coefficient	0.016
Elevation Range	4,176.9 to 4,181.0 ft
Flow Area	40.2 ft²
Wetted Perimeter	46.7 ft
Hydraulic Radius	10.3 in
Top Width	46.48 ft
Normal Depth	12.0 in
Critical Depth	15.9 in
Critical Slope	0.004 ft/ft
Velocity	8.40 ft/s
Velocity Head	1.10 ft
Specific Energy	2.10 ft
Froude Number	1.594

Worksheet for Back O Beyond Road CL Cross Section

Results	
Flow Type	Supercritical

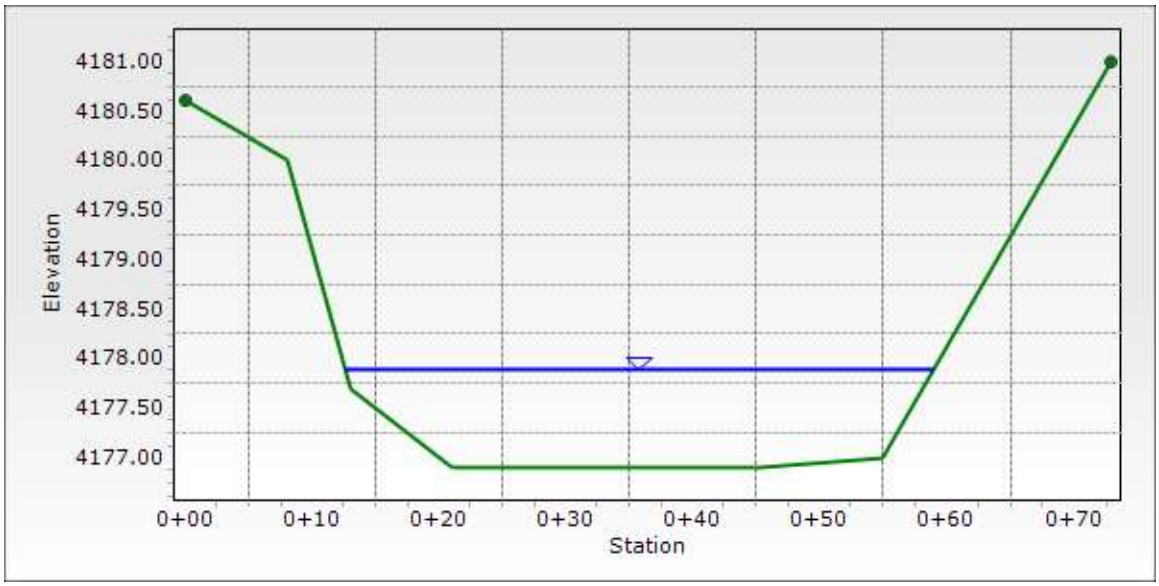
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	15.9 in
Channel Slope	0.010 ft/ft
Critical Slope	0.004 ft/ft

Cross Section for Back O Beyond Road CL

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	12.0 in
Discharge	337.52 cfs



Western Technologies Inc.

GEOTECHNICAL EVALUATION REPORT

BACK O' BEYOND BOX CULVERT
Back O' Beyond Road
Sedona Arizona
WT Reference No. 2521JB288

PREPARED FOR:
Shephard-Wesnitzer, Inc.
75 Kallof Place
Sedona, Arizona 86336
Attn: Mr. Art H. Beckwith, P.E.
February 10, 2022

Gregory L. E. Burr, R.G., E.I.T.
Director of Geotechnical Services

Craig P. Wiedeman, P.E.
Senior Geotechnical Engineer

Western Technologies Inc.
The Quality People
Since 1955

2400 East Huntington Drive
Flagstaff, Arizona 86004-8934
(928) 774-8700 • fax 774-6469

February 10, 2022

Shephard-Wesnitzer, Inc.
75 Kallof Place
Sedona, Arizona 86336

Attn: Mr. Art H. Beckwith, P.E.

Re: Geotechnical Evaluation
Back O' Beyond Box Culvert
Back O' Beyond Road
Sedona Arizona

Job No. 2521JB288

Western Technologies Inc. has completed the geotechnical evaluation for the proposed box culvert to be located in Sedona, Arizona. This study was performed in general accordance with our proposal number 2521PW380R dated October 1, 2021. The results of our study, including the boring location diagram, laboratory test results, boring logs, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. If design conditions change, or if you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us. We look forward to working with you on future projects.

Sincerely,
WESTERN TECHNOLOGIES, INC.
Geotechnical Engineering Services

Gregory L. E. Burr, R.G., E.I.T.
Director of Geotechnical Services

Copies to: Addressee (emailed)

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

GEOTECHNICAL EVALUATION
BACK O' BEYOND BOX CULVERT
BACK O' BEYOND ROAD
SEDONA, ARIZONA
JOB NO. 2521JB288

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed box culvert to be located on Back O' Beyond Road in Sedona, Arizona. The purpose of these services is to provide information and recommendations regarding:

- wing-wall foundation design parameters
- slab-on-grade support
- lateral earth pressures
- seismic considerations
- earthwork
- corrosivity to concrete

Results of the field exploration, field tests, and laboratory testing program are presented in the Appendices.

2.0 PROJECT DESCRIPTION

Based on information provided by Mr. Arthur H. Beckwith, P.E., the proposed project will consist of a new box culvert approximately 60 feet long, 8 feet wide and 4 feet tall to replace an existing low water crossing. The structure will use cast-in-place concrete construction. Maximum wingwall loads for the structure are assumed to be 2.0 kips per linear foot. We anticipate that the finished bottom of box culvert will be a maximum of 9 feet below the existing low water crossing grade. Should any of our information or assumptions not be correct, we request that the Client notify Western Technologies (WT) immediately.

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Three borings were auger drilled to depths of about 2 to 6 feet below existing site grades at the approximate locations shown on the attached boring location diagram. Logs of the borings are presented in Appendix A. Subsoils encountered during drilling were examined visually and sampled at selected depth intervals. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained. The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate the seismic design criteria and liquefaction potential.

3.2 Laboratory Analyses

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable standard test methods. The following tests were performed and the results are presented in Appendix B.

- Gradation
- Expansion
- Maximum density/optimum moisture
- Plasticity
- Corrosivity

Test results were utilized in the development of the recommendations contained in this report.

3.3 Analyses and Report

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as appropriate to the purpose. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site, discovery of underground storage tanks or other underground structures, or identification of contaminated or hazardous materials or conditions. If there is concern about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

4.0 SITE CONDITIONS

4.1 Surface

At the time of our field exploration, the site was an existing low water crossing that directs water southwest across Back O' Beyond Road. The low water crossing was bordered on the north by a northeast-southwest oriented wash about 20 feet wide and 5 to 10 feet deep, on the south and west by developed residential lots, and on east by an undeveloped residential lot. The ground surface surrounding the previously developed area contained embedded gravel, cobbles, boulders, and sandstone outcrops, and exhibited a gentle to moderate slope down to the south-southwest. Site surface drainage appeared to be good by means of sheet flow in the wash to the southwest. No water was present in the wash at the time of our field exploration. Vegetation on the site surrounding the developed areas consisted of a sparse to moderate growth of native juniper trees, bushes, weeds and grasses.

4.2 Subsurface

As presented on the boring logs, 2 to 2.5 inches of asphalt over 2.5 to 4 inches of aggregate base course were encountered at the surface in the borings. Subsoils extending to the full depth of exploration in all borings were found to be non-plastic Silty SANDS and low plasticity Silty, Clayey SANDS, both with variable amounts of gravel, cobbles and boulders. Refusal to auger penetration occurred in all borings at depths of about 2 to 6 feet on SANDSTONE. Groundwater was not encountered in any boring at

the time of exploration. The logs in Appendix A show details of the subsurface conditions encountered during the field exploration.

The boring logs included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the borings may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.

5.0 GEOTECHNICAL PROPERTIES AND ANALYSIS

5.1 Laboratory Tests

Near-surface soils contain non-plastic to low plasticity fines. These soils exhibit low expansion potential when recompacted, confined by loads approximating floor loads and saturated in accordance with standard Arizona test methods. Densification of the soil by the passage of construction equipment will increase the expansion potential of the soil.

5.2 Field Tests

On-site subsoils located near and below shallow foundation level exhibited high resistance to penetration using the standard penetration test method (ASTM D1586). One refraction micro-tremor (ReMi) seismic test was performed to estimate the shear wave velocity profile at the site. The approximate location of the seismic test is shown on Plate 1.

6.0 RECOMMENDATIONS

6.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0 and the assumption that the soil and subsurface conditions are those disclosed by the explorations. Others may change the plans, final elevations, number and type of structures, foundation loads, and structure levels during design or construction. Substantially different subsurface conditions from those described

herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

6.2 Design Considerations

Cobbles and some boulders may likely be encountered during construction. These oversized materials, greater than 3 inches, could present construction difficulties for foundation, utility trenches and other excavations. In cut areas and excavations, exposed oversized materials should be removed.

6.3 Wingwall Foundations

If the recommendations contained in this report are followed, the proposed structure wingwalls can be supported by conventional shallow spread footings bearing on dense sandstone and/or lean mix (2-sack) concrete backfill extending to dense sandstone. Footings should bear at least 2 feet below the lowest adjacent finished grade. Footings may be designed to impose a maximum dead plus live load pressure of up to 3500 pounds per square foot.

Total and differential settlement of foundation elements bearing on dense sandstone or on lean mix concrete backfill extending to dense sandstone should be nominal. Finished grade is the lowest grade adjacent to the footings. The design bearing capacity applies to dead loads plus design live load conditions.

The recommended minimum width of wall footings is 16 inches. The bearing value given is a net bearing value and the weight of the concrete in the footings may be ignored. All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

We recommend that the geotechnical engineer or his representative observe the footing excavations before reinforcing steel and concrete are placed. It should be determined whether the rock materials exposed are similar to those anticipated for support of the footings. Any soft, loose or unacceptable materials should be undercut to suitable materials and backfilled with either lean mix or structural concrete.

6.4 Lateral Design Criteria

For retaining walls located above any free water surface with no surcharge loads, recommended equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
  Undisturbed subsoil .....36 psf/ft
  Compacted granular backfill .....30 psf/ft
  Compacted site soils .....36 psf/ft

- Passive:
  Shallow wall footings .....225 psf/ft
  Dense rock .....500 psf/ft

- Coefficient of base friction
  Soil.....0.35*
  Rock.....0.55

  * The coefficient of base friction should be reduced to 0.25 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- At-rest:
  Undisturbed subsoil .....62 psf/ft
  Compacted granular backfill .....55 psf/ft

The equivalent fluid pressures presented herein do not include the lateral pressures arising from the presence of:

- hydrostatic conditions, long-term submergence or partial submergence
- sloping backfill, positively or negatively
- surcharge loading, permanent or temporary
- seismic or dynamic conditions

We recommend a free-draining soil layer or manufactured geocomposite material, be constructed adjacent to the back of the retaining wall. A filter may be required between the soil backfill and drainage layer. This drainage zone should help prevent hydrostatic pressure buildup. This vertical drain should be tied into a gravity drainage system at the base of the retaining wall. It is important that all backfill be properly placed and compacted. Backfill should be mechanically compacted in layers. Flooding or jetting should not be permitted. Care should be taken not to damage the walls when placing the backfill. Backfills should be inspected and tested during placement.

Fill against footings, stem walls and retaining walls should be compacted to densities specified in **EARTHWORK**. Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures which could result in wall movements.

6.5 Seismic Considerations

One refraction micro-tremor (ReMi) seismic test was performed to estimate the shear wave velocity profile at the site. The array consisted of twelve 10-Hertz geophones spaced at 8 meters (26.2 feet). Background vibrations were generated along the length of the line repeatedly, and measured and recorded by a Seismic Source DAQ-Link II seismograph. The data was analyzed using the SeisOpt ReMi v4.0 software package and a seismic shear wave velocity profile was generated for the array.

Based upon the interpreted shear wave velocity profile (see Plate C-1), the average velocity, using the IBC calculation method, between the approximate depths of 0 and 100 feet was estimated to be 2702 feet per second. Based upon the calculated average shear wave velocity and the 2018 IBC, the site may be assigned a B soil classification.

Structures should be designed in accordance with applicable building codes. The seismic design parameters presented in the following table, in accordance with the 2018 International Building Code and ASCE 7-16, are applicable to the project site:

Seismic Design Parameters International Building Code 2018, ASCE 7-16	
Soil Site Class	B
Mapped Spectral Response Acceleration at 0.2 sec period (S_s)	0.293g
Mapped Spectral Response Acceleration at 1.0 sec period (S_1)	0.092g
Site Coefficient for 0.2 sec period (F_a)	0.9
Site Coefficient for 1.0 sec period (F_v)	0.8
Design Spectral Response Acceleration at 0.2 sec period (S_{DS})	0.176g
Design Spectral Response Acceleration at 1.0 sec period (S_{D1})	0.049g

The soil site class is based upon conditions identified in shallow exploratory borings and local knowledge of the geotechnical conditions in the vicinity of the site. Conditions extending beyond the depth of our borings to a depth of 100 feet were assumed for the purposes of providing the information presented in the table. Based upon the density of the on-site soils and lack of groundwater, the potential settlement and lateral spread due to liquefaction is not a considered to be a significant concern on this site.

6.6 Corrosivity

The chemical test results indicate that the soils at the site classify as Class S0 in accordance with Table 19.3.1.1 of ACI 318-19. However, in order to be consistent with standard local practice and for reasons of material availability, we recommend that Type II Portland cement be used for all concrete on and below grade.

Test results indicate the on-site soils exhibit low corrosive potential to underground piping. The information derived from this testing should be used as an aid in choosing the construction materials that will be in contact with these soils and that will need to be resistant to various corrosive forces. Manufacturer's representatives should be contacted regarding the specific corrosivity resistance for their particular product.

7.0 EARTHWORK

7.1 General

The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section. Any excavating,

trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities or backfilling occurs.

7.2 Site Clearing

Strip and remove all vegetation, organics, fill, asphalt and any other deleterious materials from the structure area. The structure area is defined as that area within the footprint plus 5 feet beyond the perimeter of that footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

7.3 Excavation

We anticipate that excavations into the shallow site soils for the proposed construction can be accomplished with conventional equipment. Excavations penetrating the underlying sandstone will require the use of heavy-duty, specialized equipment to facilitate rock break-up and removal.

On-site soils may pump or become unworkable at high water contents. Workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with drier granular materials may be necessary. The use of lightweight excavation and compaction equipment may be required to minimize subgrade pumping.

7.4 Wingwall Foundation Preparation

Specialized treatment of dense sandstone within foundation areas is not required. Remove all loose or disturbed materials from the bottoms and sides of the excavations prior to the placement of foundation concrete. If desired, lean mix (2-sack) concrete backfill may be used between the design bottom of footing elevation and the top of the dense rock.

7.5 Slab-on-Grade Preparation

Scarify, moisten or dry as required, and compact all subgrade soils to a minimum depth of 12 inches. The subgrade preparation should be accomplished in a manner which will

result in uniform water contents and densities after compaction. Scarification and recompaction is not required in areas where dense sandstone is encountered.

7.6 Materials

a. Clean on-site soils with a maximum dimension of 6 inches or imported materials may be used as fill material for the following:

- Slab areas
- Backfill

b. Frozen soils should not be used as fill or backfill.

c. Lean mix (2-sack) concrete backfill should consist of aggregate base course type material combined with 2 sacks of cement per cubic yard. A coarse rock mix should not be used.

d. Imported soils should conform to the following:

- Gradation (ASTM C136): percent finer by weight

6"	100
4"	85-100
¾”	70-100
No. 4 Sieve	50-100
No. 200 Sieve	40 (max)

- Maximum expansive potential (%)[1] 1.5

- Maximum soluble sulfates (%) 0.10

e. Base course should conform to current City of Sedona specifications.

[1] Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

7.7 Placement and Compaction

a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

b. Uncompacted lift thickness should not exceed 8 inches.

c. No fill should be placed over frozen ground.

d. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
• On-site or imported soil, reworked and fill: Below slabs-on-grade	90
• Aggregate base	95
• Backfill:	
Structural	95
Nonstructural	90

e. On-site and imported soils with low expansive potential and aggregate base course materials should be compacted with a moisture content in the range of 3 percent below to 3 percent above optimum.

7.8 Compliance

Recommendations for foundations and slabs-on-grade supported on compacted fills or prepared subgrade depend upon compliance with the **EARTHWORK** recommendations. To assess compliance, observation and testing should be performed under the direction of a WT geotechnical engineer. Please contact us to provide these observation and testing services.

8.0 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that a sufficient schedule of tests and observations will be performed during construction to verify compliance. At a minimum, these tests and observations should be comprised of the following:

- Observations and testing during site preparation and earthwork,
- Observation of foundation excavations, and
- Consultation as may be required during construction.

Retaining the geotechnical engineer who developed your report to provide construction observation is the best way to verify compliance and to help you manage the risks associated with unanticipated conditions.

9.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **2.0 PROJECT DESCRIPTION**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

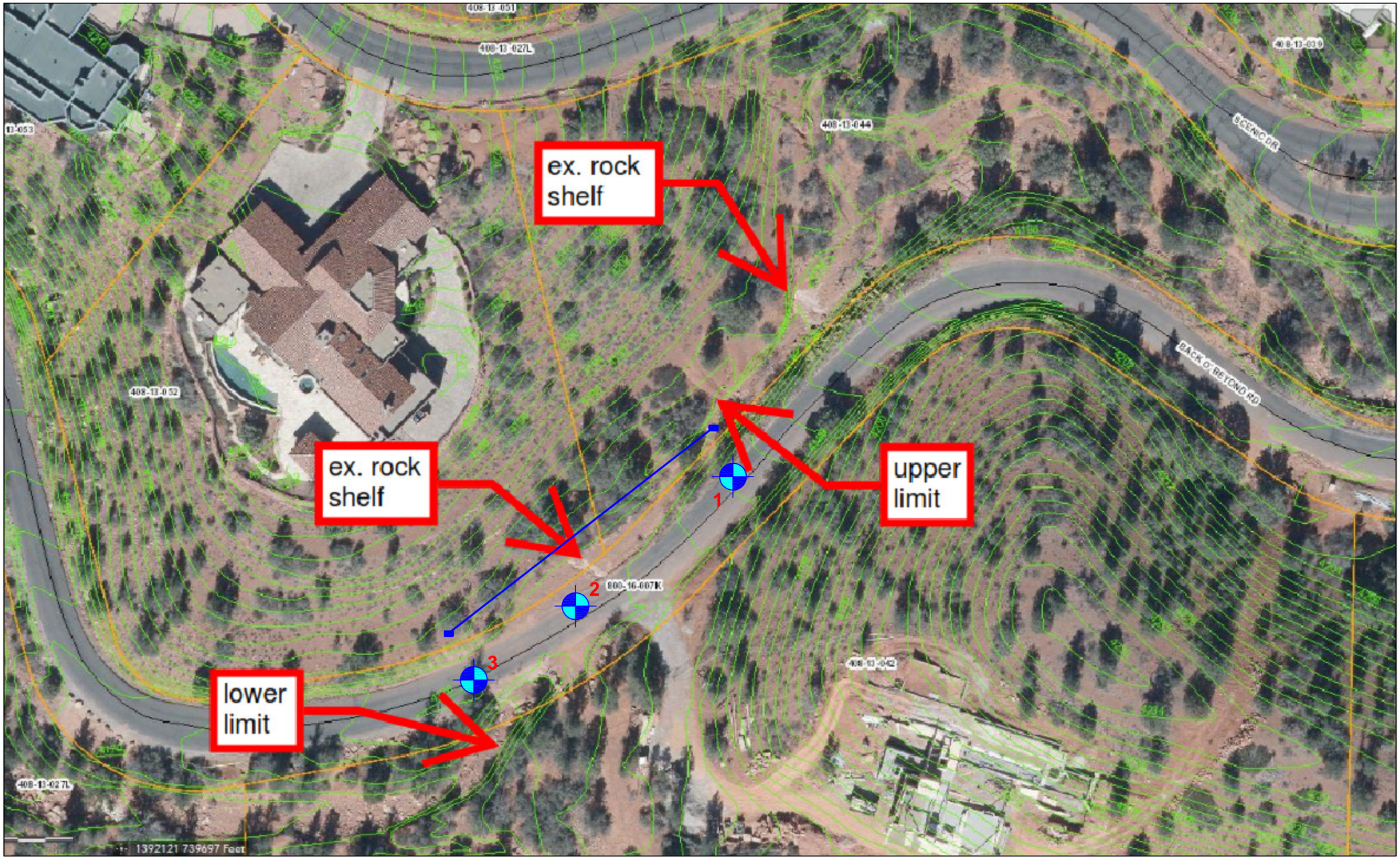
The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced explorations. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between explorations, however variations can and often do exist. Whenever any deviation, difference, or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.

10.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the location of the explorations, and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.



Not to Scale

Approximate Test Boring Location

Approximate Seismic Line Location

Geotechnical Environmental Inspections Materials

Western Technologies Inc. The Quality People Since 1955

BACK O'BEYOND BOX CULVERT

Boring Location Diagram

Western Technologies Inc.

Job No.: 2521JB288 | Plate: 1

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified aggregate material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson/Drilled Shaft	A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson).
Concrete Slabs-On-Grade	A concrete surface layer cast directly upon base course, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand and Gravel Base Course	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

COARSE-GRAINED SOILS

LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE
GP	POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	
GM	SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES	
GC	CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES	
SW	WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE
SP	POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	
SM	SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES	
SC	CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES	

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS

MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
CL	LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY	
OL	ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY	
MH	ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
CH	FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY	
OH	ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY	
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	¾ in. – 3 in.
Fine	No. 4 – ¾ in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT
VERY SOFT	0 – 2
SOFT	3 – 4
FIRM	5 – 8
STIFF	9 – 15
VERY STIFF	16 – 30
HARD	OVER 30

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1⅜-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 – 7	LOW
8 – 20	MEDIUM
Over 20	HIGH

DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED

The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features.

"DRILLING TYPE" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"N" in "BLOW COUNTS" refers to a 2-inch outside diameter split-barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows, or "blow count", of the hammer is recorded for each of three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2^{nd} and 3^{rd} increments) is defined as the Standard Penetration Test (SPT) "**N**"-Value. Refusal to penetration is considered more than 50 blows per 6 inches. (Ref. ASTM D1586). A double vertical line within the symbol indicates no sample recovery.

"SAMPLE TYPE" refers to the form of sample recovery, in which **N** = Split-barrel sample, **G** = Grab sample.

"USCS" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

DATE DRILLED: **12-23-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

BORING NO. 1

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

MOISTURE CONTENT (% OF DRY WT)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
								ASPHALT (2.5 Inches thick)
								AGGREGATE BASE COURSE (2.5 Inches thick)
						SC-SM		Silty Clayey SAND; with gravel, cobbles and boulders, red, very dense, slightly damp
		G						
		N		50/2"				
								Auger Refusal at 2 Feet on SANDSTONE
					5			
					10			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.
2400 Huntington Drive
Flagstaff, AZ 86004-8934

PROJECT: **BACK O'BEYOND BOX CULVERT**
PROJECT NO.: **2521JB288**

PLATE **A-4**

BORING LOG

DATE DRILLED: **12-23-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

BORING NO. 2

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

MOISTURE CONTENT (% OF DRY WT)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
								ASPHALT (2 Inches thick)
								AGGREGATE BASE COURSE (4 Inches thick)
						SM		Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp
		G						
		N		82/10"				
					5			**Auger Refusal at 3 Feet on SANDSTONE**
					10			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

WESTERN TECHNOLOGIES INC.
2400 Huntington Drive
Flagstaff, AZ 86004-8934

PROJECT: **BACK O'BEYOND BOX CULVERT**
PROJECT NO.: **2521JB288**

PLATE **A-5**

BORING LOG

DATE DRILLED: **12-23-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

BORING NO. 3

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

MOISTURE CONTENT (% OF DRY WT)	DRY DENSITY (LBS/CU FT)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
								ASPHALT (2.5 Inches thick)
								AGGREGATE BASE COURSE (2.5 Inches thick)
						SM		Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp
		G						
		N		50/4"				
		G						
					5			
		N		50/1"				
								Auger Refusal at 6 Feet on SANDSTONE
					10			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.
2400 Huntington Drive
Flagstaff, AZ 86004-8934

PROJECT: **BACK O'BEYOND BOX CULVERT**
PROJECT NO.: **2521JB288**

PLATE **A-6**

BORING LOG

Boring No.	Depth (ft)	USCS Class.	Particle Size Distribution (%) Passing by Weight							Atterberg Limits		Laboratory Compaction Characteristics			Remarks
			3"	¾"	#4	#10	#40	#200	2µ	LL	PI	Dry Density (pcf)	Optimum Moisture (%)	Method	
1	1-2	SC-SM	100	95	64	54	40	28.2		20	4				2
3	3-6	SM	100	99	85	79	71	34.2			NP				2

NOTE: NP = Non-plastic
µ = microns (2µ = 0.002mm)

REMARKS

Classification / Particle Size / Moisture-Density Relationship

1. Visual
2. Laboratory Tested
3. Minus #200 Only
4. Test Method ASTM D698/AASHTO T99
5. Test Method ASTM D1557/AASHTO T180
6. From the ADOT Family of Curves

Geotechnical Environmental Inspections Materials

Western Technologies Inc. The Quality People Since 1955

wt-us.com

PROJECT: BACK O'BEYOND BOX CULVERT

JOB NO.: 2521JB288

PLATE

B-1

SOIL PROPERTIES

Boring No.	Depth (ft.)	USCS Class.	Initial Dry Density (pcf)	Initial Water Content (%)	Laboratory Compaction Characteristics			Expansion Properties		Plasticity		Soluble		Remarks
					Dry Density(pcf)	Optimum Moisture(%)	Method	Surcharge (ksf)	Expansion (%)	LL	PI	Salts (ppm)	Sulfate (ppm)	
1	1-2	SC-SM	123.4	6.2	130.1	9.2	A	0.1	0.6					1,2,3

Notes: Initial Dry Density and Initial Water Content are remolded.

Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.
3. Test Method ASTM D698/AASHTO T99
4. Test Method ASTM D1557/AASHTO T180
5. From the ADOT Family of Curves

Geotechnical Environmental Inspections Materials

Western Technologies Inc.

The Quality People Since 1955

wt-us.com

PROJECT: BACK O'BEYOND BOX CULVERT

JOB NO.: 2521JB288

SOIL PROPERTIES

PLATE

B-2

CORROSIVITY TEST RESULTS

The procedures for soil survey tests and observations can be found in Appendix X1.1 of ASTM A674-10 and includes five soil properties: earth resistivity • pH • redox potential • sulfides • moisture.

Boring 1(1-2):

Analysis	Results		Points
Resistivity (ohm-cm)	4474		0
pH	9.0		3
Redox Potential (mV)	+313		0
Sulfides	trace		2
Moisture	fair		1
		Total Points	6

Boring 3(3-6):

Analysis	Results		Points
Resistivity (ohm-cm)	6565		0
pH	9.2		3
Redox Potential (mV)	+298		0
Sulfides	trace		2
Moisture	fair		1
		Total Points	6

The test procedure states that if the sum of the points is greater than 10, the soil is considered corrosive to ductile iron pipe and special protection against exterior corrosion is necessary. This conclusion is limited to soil corrosion and does not include consideration of stray direct current.

MOTZZ LABORATORY, INC.

Laboratory Analysis Report

Western Technologies - Flagstaff
Gregory L. E. Burr
2400 East Huntington
Flagstaff, AZ 86004-8934

Project: 2521JB288
Date Received: 1/12/2022
Date Reported: 1/14/2022
PO Number: 2522P002

Lab Number: 940165-1 **1 (1-2')**

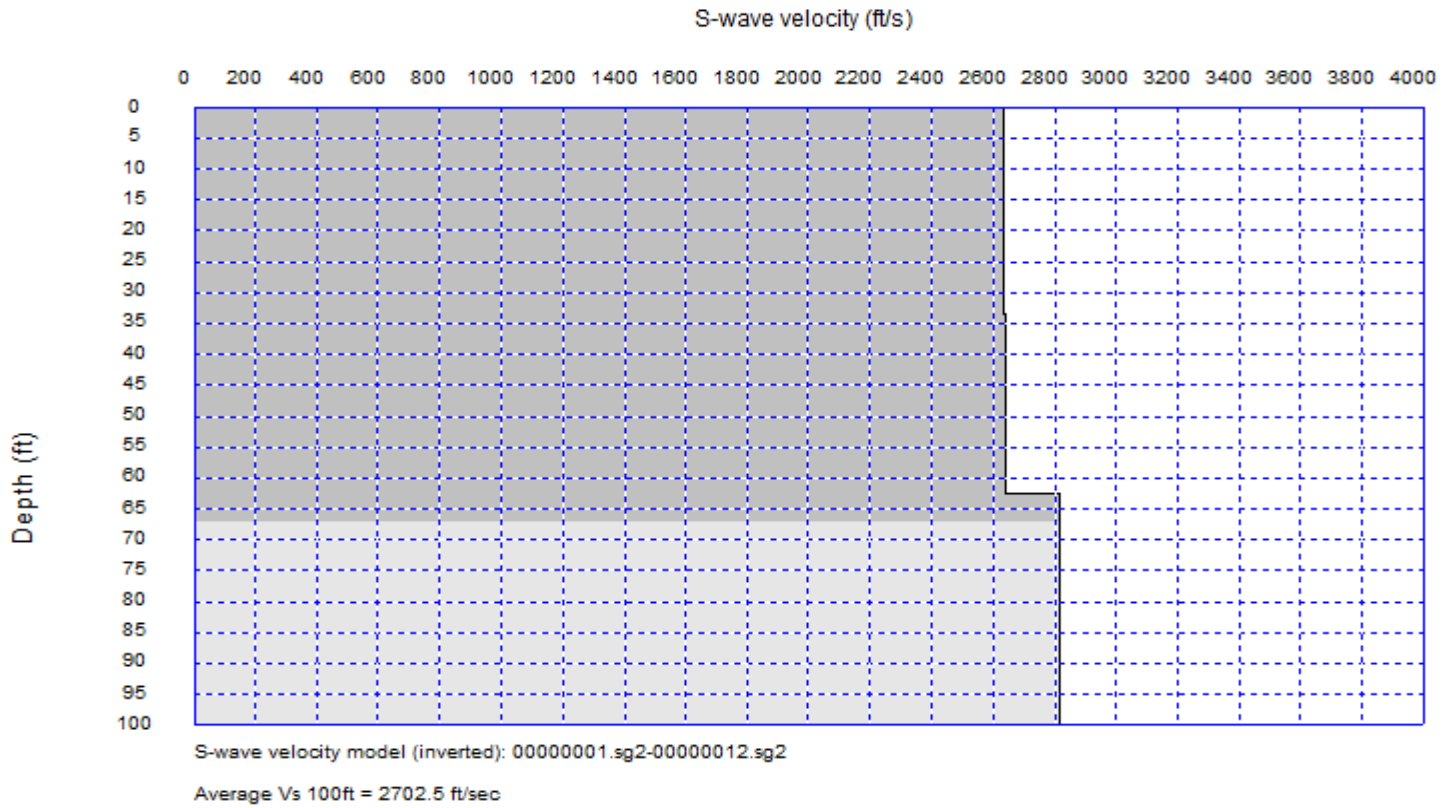
Test Parameter	Method	Result	Units	Levels
Soluble Salts	ARIZ 237b	231	ppm	
Sulfate	ARIZ 733b	7	ppm	
Chloride	ARIZ 736b	7	ppm	
Redox Potential	ASTM G200-09	313	(Eo) mV	

Lab Number: 940165-2 **3 (3-6')**

Test Parameter	Method	Result	Units	Levels
Soluble Salts	ARIZ 237b	240	ppm	
Sulfate	ARIZ 733b	8	ppm	
Chloride	ARIZ 736b	11	ppm	
Redox Potential	ASTM G200-09	298	(Eo) mV	

Plate B-4

Line 1



Average Shear Velocity = 2702 ft/sec
IBC 2018/ASCE 7-16 Soil Site Class B

Geotechnical Environmental Inspections Materials **Western Technologies Inc.** The Quality People Since 1955 wt-us.com	PROJECT: BACK O' BEYOND BOX CULVERT JOB NO.: 2521JB288	PLATE **C-1**
	SHEAR WAVE VELOCITY PROFILE	

SD-03 Back O' Beyond Low Water Crossing Improvements Project 3/14/2023
PRE-BID MEETING 2:00 pm
DATE: 3/14/2023
LOCATION: 221 Brewer Rd. (Moriarty Conference Room)

AGENDA

1. Introduction (Be sure to sign in)
2. Description of project and discussion of the project schedule
   A. Contract Time – 123 days after Notice to Proceed
      I. Final Questions Due- Tuesday, March 21
      II. Bids due- Tuesday, March 28
      III. Council Approval- Tuesday, April 11
      IV. Notice to Proceed- Anticipated Monday, April 24
3. Discussion of General Issues-
   A. (From the Contract Documents) Bidders are required prior to submitting a bid to inspect the site of the work and satisfy themselves by personal examination or by such other means they may prefer, as to the location of proposed work and the actual field conditions.
   B. Submit all questions in writing to Johnathan Hoffman, jhoffman@sedonaaz.gov (928) 203-5124
   C. The contractor will be expected to coordinate and work closely and harmoniously with residents and visitors in the area.
   D. Past Performance Questionnaires page 50 (3 are due prior to bid opening)
   E. Application Certificate for Payment- Pages 45 and 46
4. Special Conditions- Starts on page 40
   A. Section 3- Start of Construction List of Items
      I. Traffic Control
      II. Storm Water Pollution Control Plan
      III. Minimum of 2 working days written notice delivered to property owners, residents, and HOA.
      85 Scenic Drive Easement approved by owners and HOA
      (AJ Cook board member for Back O' Beyond Ranch HOA, noofficeaj@gmail.com)
5. General Conditions Section 9- Schedule of Construction
      I. Contractor regular work hours- Monday thru Thursday 7:00am to 5:30pm. Friday work is allowed that does not require COS inspections.
      II. Weekly Progress Meetings with Superintendent of Contractor to discuss progress, schedule, billing, RFI, change orders, etc.
      III. Pre-Construction Video
      IV. Record Drawings (GC Section 15, 26, 31)
         A. Redline drawings submitted with each pay application (GC Section 26)
         B. Submit as-built drawings upon completion (GC Section 15)
6. No addenda at this time
7. Bid opening on Tuesday, March 28 at 2:00pm.
8. Misc.
   I. Coordinate with AZ Water for water supply
   II. City of Sedona Temporary Use Permit will be required for staging area/laydown yard.

SIGN IN SHEET

SD-03 Back O' Beyond Low Water Crossing Improvements Project
Mandatory Pre-Bid Meeting 3/14/2023

NAME	FIRM NAME	TEL. NO.	E-MAIL
James Crowley JC	City of Sedona	928-203-5092	jcrowley@sedonaaz.gov
Sandy Phillips	City of Sedona	928-203-5076	sphillips@sedonaaz.gov
John Hoffman	City of Sedona	928-203-5124	jhoffman@sedonaaz.gov
TRAE TAYLOR	BANECKI CONSTRUCTION	480-320-4373	TRAE@BANECKI.COM
Makena Rettke	Beta PR	928-707-3748	mrettke@betapublicrelations.com
Michael Paganik	AJP Electric, Inc.	602-703-8216	Michael@ajpelectric.com
Scott Auchter	Vastco Inc	928-830-1158	Sauchter@Vastco.com
Jenaca Durnez	Tierra Verde Builders	928-567-2477	bbassous@tierraverdebuilders
DELL DEAN	STANDARD CONSTRUCTION	623-696-9828	ESTIMATING@STANDARDAZ.COM
RYAN ADAMS	TIFFANY CONSTRUCTION	928-204-9817	RADAMS@TIFFANYCONST.COM
TRAVIS ZELLNER	CITY OF SEDONA	928-203-5030	TZELLNER@SEDONAAZ.GOV
SAL VALENZUELA	CITY OF SEDONA	928-203-5030	SVALENZUELA@SEDONAAZ.GOV