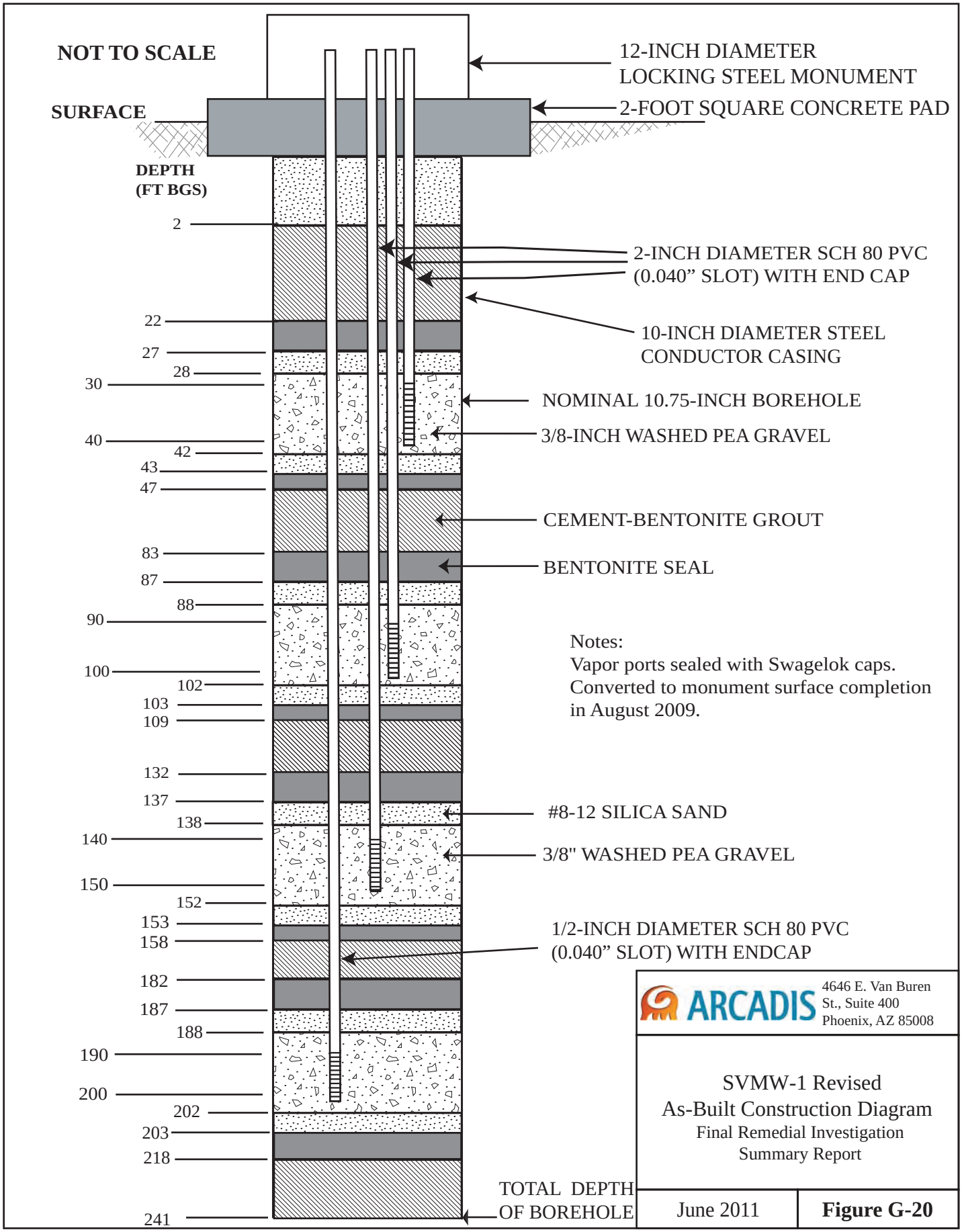
Appendix A

As-Built SVMW-1 Construction Diagram (on CD)



M:\3994003\300 Monitor Well Install\As Builts

Appendix B

CMS Report, March 2012
(Excerpt) (on CD)

3.3.2. Well Installations

To further support the CMS alternatives evaluation, UPCO installed two additional groundwater monitoring wells, MW-20 and MW-21, in the C-Complex and the New Burn Area, respectively. These areas were identified in the Final RI Report (ARCADIS 2011a) as source areas and the monitoring wells were used to confirm perchlorate concentrations and to assess groundwater extraction. The wells were designed for use as potential extraction wells and were similar in design to monitoring well MW-19, located in the Waterbore Area. Well construction details for MW-20 and MW-21 are discussed in Section 3.3.2.2.

The boreholes for monitoring wells MW-20 and MW-21 were drilled using a conventional air-rotary method. The nominal 10-inch-diameter borings had a total depth objective of approximately 50 feet below the first observed occurrence of groundwater. At each location, a 20-foot section of low carbon steel conductor casing was grouted in place to provide a surface seal and prevent collapse of the borehole. The borings for MW-20 and MW-21 were drilled to total depths of 295 and 277 feet bgs, respectively. Grab samples of the borehole cuttings were collected at regular intervals and logged using the Unified Soil Classification System method. If bedrock was encountered in the borehole, it was logged using USGS descriptions. Lithologic logs for each borehole will be provided in an updated Groundwater Monitoring Plan for the Site that will incorporate the new wells into the groundwater monitoring program.

3.3.2.1. Borehole Geophysics

Geophysical surveys were performed in the MW-20 and MW-21 boreholes. The suite of geophysical techniques used included:

- E-Log-Gamma-Temp-Fl Resistivity
- Caliper
- Density
- Guard Resistivity
- Neutron
- 3 Rx Sonic
- Dual Induction
- Optical.

Based on a review of the soil cuttings and the borehole geophysics, bedrock was encountered at approximately 92 feet bgs and groundwater was encountered at approximately 229 feet bgs in the MW-20 borehole. Bedrock was encountered at approximately 87 feet bgs and groundwater was encountered at approximately 213 feet bgs in the MW-21 borehole. The geophysical data was collected by a variety of sources and receivers and will be included in the First Quarter 2012 Monitoring Report. This data will be used for remedy design.

3.3.2.2. Monitoring Well Construction

Monitoring wells were installed in each borehole following completion of drilling and geophysical survey activities. Based on the data from soil cuttings and borehole geophysics, MW-20 and MW-21 were completed as shallow wells in the bedrock unit, which is consistent with monitoring wells previously installed on the eastern half of the Site. The wells were constructed with 5-inch-diameter Schedule 80 polyvinyl chloride (PVC) casings and 50-foot well screens. MW-20 was screened from 235 to 285 feet bgs and MW-21 was screened from 215 to 265 feet bgs. A 0.050-inch slotted screen was used for each well with a #8-12 Colorado silica sand pack to allow for potential future use as groundwater extraction wells. The sand pack extends 3 to 5 feet above the top of the screen, topped by approximately 3 to 5 feet of bentonite pellets as a seal. The bentonite pellets were hydrated with potable water and allowed to hydrate for at least 30 minutes. Neat cement grout was placed into the annular space above the bentonite to groundwater surface. The grout was pumped into place via tremie pipe. The as-built well construction figures for these wells will be included in an updated Groundwater Monitoring Plan for the Site.

3.3.2.3. Monitoring Well Development and Sampling

Each monitoring well was developed using surging and bailing techniques, followed by continuous pumping. The following procedures were used:

- The well screen was surged in 10-foot sections from the top of the interval to the bottom.
- A bailer was used to remove settled solids that had entered the casing during surging.
- Surging and bailing was conducted for approximately 1 hour depending on the condition of the well.
- A temporary submersible pump was used to dislodge the finer grained materials from the filter pack and to clarify the water.

- Development was considered complete when the turbidity was measured at approximately 1 Nephelometric Turbidity Unit or after a minimum of 8 hours of pumping had occurred.

At the completion of well development, each well was sampled for perchlorate, volatile organic compounds, metals, and general water quality. Monitoring well MW-20 was developed and sampled on February 3, 2012 and monitoring well MW-21 was developed and sampled on February 9, 2012. The data collected at MW-20 and MW-21 in support of the CMS activities is provided in Appendix B and discussed in Section 3.2.2.

3.3.2.4. Well Head Completion and Pump Installation

Dedicated submersible pump assemblies were installed and surface completions were added following well construction and development activities. Each dedicated stainless steel submersible pump (Grundfos Model 15SQ) was set on a Schedule 80 PVC drop pipe with the inlet approximately 3 feet above the bottom of the screen. A sounding tube for water level measurement was lowered into the well to a depth directly above the pump. The sounding tube is constructed of Schedule 40 PVC with 50 feet of 0.01-inch slotted screen at the bottom. A watertight seal was placed at the top of the well casing. The seal has capped ports for a removable dedicated sample tee and for access to the sounding tube. Twelve-inch-diameter steel monuments extending approximately 4 feet abovegrade and surrounded by 3- by 3-foot at-grade concrete pads were installed around the well casing for surface completion. Stamped steel plates with the monitoring well identification number and Arizona Department of Water Resources (ADWR) registration number were attached to the monuments.

3.3.2.5. Survey

A state registered land surveyor (A-Team) established horizontal and vertical control at monitoring wells MW-20 and MW-21. The vertical coordinate of the sounding port, top of casing, and ground surface was surveyed in the Arizona State Plane Coordinate System, National Geodetic Vertical Datum of 1929 with units of international feet above mean sea level (amsl). The measuring point elevation of the PVC sounding tube port contained in the well seal was measured to the nearest 0.01 foot. The measuring point was marked on the north side of the port. The horizontal coordinate of the well was surveyed in the Arizona State Plane Coordinate System, Central Zone, North American Datum of 1983 with units of international feet.

3.3.3. Pumping Test

In February, 2012, a pumping test was performed at shallow well MW-19 using the dedicated purge/sampling pump installed at the well. The pumping test consisted of a step-drawdown test to determine the optimal pumping rate for the pump test, a 24-hour

constant-rate pumping test, and a recovery test. Summaries of the methodologies used for each phase of testing in MW-19 are presented below. Data from the constant-rate pumping test were used to evaluate aquifer hydraulic conductivity, as presented in Appendix B and summarized below.

3.3.3.1. Monitoring Network

During both the step-drawdown and constant-rate pumping tests, water levels were monitored in the pumping well and in adjacent observation wells (deep wells MW-13 and MW-14 and shallow monitoring wells MW-1, MW-2, MW-4, MW-5, MW-11, MW-15, and MW-20) through the use of manual water level meters and data-logging pressure transducers (data loggers). Monitoring well MW-1 was used to record background water levels beyond the expected influence of the pumping tests.

3.3.3.2. Step-Drawdown Test

Prior to beginning the constant-rate pumping test, an 8-hour step-drawdown test was performed to assess the optimum pumping rate for the constant-rate test. Four pumping rates (4, 6, 8, and 10 gallons per minute [gpm]) were evaluated in MW-19 for at least 2 hours each. Water levels in MW-19 and the observation wells were monitored throughout the step-drawdown test. The data logger in MW-19 collected data every minute, while the data logger in the observation well network collected data at 5-minute intervals. Manual water level measurements were collected at MW-19 every 5 minutes for the first hour of each pumping step and every 10 minutes for the second hour of each pumping step. MW-13 was measured manually at the beginning of the step-drawdown test (before the pump was started) and when it was complete (just prior to stopping the pump). The results of the step-drawdown tests are presented in Appendix B.

Based on the results of the analysis, a pumping rate of 8 gpm was selected for the constant-rate pumping test in MW-19. As shown on the water level drawdown curves in Appendix B, a rate of 10 gpm was likely not sustainable for the 24-hour period and the lower pumping rates may not have induced enough drawdown in the surrounding formation to adequately stress the aquifer.

3.3.3.3. Constant-Rate Pumping and Well Recovery Test Monitoring

The pump test was performed over a 24-hour period between February 9 and 10, 2012; water level recovery in MW-19 was monitored for an additional 24-hour period after pumping stopped. Prior to beginning the pump test, more than 48 hours of ambient water level conditions were recorded with data loggers in the pumping well and the observation wells. During the constant-rate pumping test, water level data was recorded by data loggers and supplemented by manual measurements in the event of equipment failure.

The 1-inch sounding tubes installed in the wells were used to obtain manual water level measurements and to install the data loggers.

The data loggers at the pumping well and at the closest observation well, MW-13, recorded water levels at 1-minute intervals during the tests. The data loggers in the remaining observation wells recorded water levels at 5-minute intervals. Water levels at the pumping well and at MW-13 were measured manually at varying frequencies during each test (see Appendix B), with measurements taken at a higher frequency during the beginning of each test and at a reduced frequency as the testing progressed.

Monitoring of the recovery phase was performed for 24 hours following the end of the constant-rate pumping test. Water levels in the wells were measured manuallly for the first 2 hours of recovery following termination of pumping.

In addition to monitoring water levels during testing, well MW-19 was sampled for perchlorate prior to the beginning of the constant-rate pumping test, during pumping, (after 2, 4, 6, 8, and 12 hours of pumping), and just prior to termination of pumping at the end of the 24-hour test period.

3.3.3.4. Pumping Test Results and Analysis

After 24 hours of pumping at 8 gpm, approximately 13 feet of drawdown was observed in the pumping well (MW-19) and approximately 0.6 foot of drawdown was observed in the closest observation well (MW-13), located 20 feet from MW-19 and screened from 440 to 490 feet bgs. Drawdown was not observed in the other observation wells during the constant-rate test (see Appendix B). Graphs of drawdown versus time after pumping started were used to evaluate the relationship between storage coefficient, transmissivity, pumping rate, and drawdown.

Two parameters, transmissivity (T), and the average hydraulic conductivity (K), were estimated based on the aquifer responses observed during this test. As shown in Appendix B, T was estimated to be approximately 110 square feet per day (ft^2/day) and K was estimated to be approximately 0.6 to 0.8 foot per day (ft/day), assuming an aquifer thickness of 50 feet (screened interval of pumping well). These values are higher than the T and K ranges estimated during RI aquifer testing at MW-14 (0.30 to 0.39 ft^2/day and 6.6×10^{-3} to 7.7×10^{-3} ft/day, respectively, based on pump and hydrogeophysical testing); however, this variability is consistent with the fractured bedrock environment and anticipated spatial variability of aquifer properties. In general, these results indicate that the UAU can sustain the modest pumping rates (i.e., several gpm) that will be associated with extraction-based groundwater remedies. However, variability in well yields is expected.

Appendix C

Well Construction Details (on CD)

Table 1
Well Details

Universal Propulsion Company, Inc.
Phoenix, Arizona

Well		RW-1	RW-2	EW-1	EW-2	IW-1	IW-2	IW-3	MW-22	IN-1Ad	IN-1As	DR-01d	DR-01s
ADWR Number		55-223676	55-223677	55-222510	55-222511	55-222512	55-222513	55-222514	55-222509	555-222518	55-222517	55-222516	55-222515
Measuring Point Elevation (feet amsl)		1605.41	1605.31	1594.88	1560.92	1595.52	1593.68	1568.96	1598.46	1548.1	1548.05	1547.79	1547.81
Survey	Northing	988477.203	988671.195	988356.042	987245.445	988468.696	988583.305	987836.161	654091.455	987504.167	987506.892	987504.697	987508.302
	Easting	654327.565	654020.893	654177.509	653307.216	654312.214	654022.985	653463.055	988555.437	652377.897	652381.950	652362.237	652366.218
	Datum	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29	NGVD29
Approximate Bedrock Contact (feet bgs)		10	10	250	123	111	not encountered	78	not encountered	not encountered	not encountered	not encountered	not encountered
Total Borehole Depth (feet bgs)		342	360	304	310	346	290	266	285	210	185	212	180
Screen	Diameter	5-inch	5-inch	5-inch	5-inch	5-inch	5-inch	5-inch	5-inch	4-inch	4-inch	4-inch	4-inch
	Type	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap	SS vee-Wire Wrap
	Slot Size	0.05-inch	0.05-inch	0.05-inch	0.05-inch	0.05-inch	0.05-inch	0.05-inch	0.05-inch	0.02"-inch	0.02"-inch	0.02"-inch	0.02"-inch
	Interval (feet bgs)	265-340	252-332	250-300	210-305	250-335	210-285	180-255	210-280	185-205	155-175	185-205	155-175
Blank Casing	Type	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC	Sch 80 PVC
	Interval	to 265	to 252	to 250	to 210	to 250	to 210	to 180	to 210	to 185	to 155	to 185	to 155
Centralizers	Screen	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'
	Blank	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'	Every 40'
Filter Pack	Type	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12	#8-12
	Interval	260-345	247-332.8	245-304	205-310	245-346	205-290	174-266	204.75-284.4	180-210	150-185	180-212	150-180
Transition Sand	Type	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica	#60 silica
	Interval (feet bgs)	255-260	255-247	238-245	200-205	238-245	200-205	169-174	198.25-204.75	175-180	141-150	175-180	145-150
Bentonite Seal	Type	3/8" Chips	3/8" Chips	3/8" Chips	3/8" Chips	none	none	none	none	none	none	none	none
	Interval (feet bgs)	80-100	88-150.5	238-229	195-200	none	none	none	none	none	none	none	none
Grout Seal	Type	Cement	Cement	Cement	Cement	Cement	Cement	Cement	Cement	Cement	Cement	Cement	Cement
	Interval (feet bgs)	0-80; 100-255	0-88; 150.5-255	0-229	0-195	0-238	0-200	0-169	0-198.25	0-175	0-141	0-175	0-145
Conductor Casing	Type	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel	10" dia steel
	Interval (feet bgs)	0-20	0-20	0-20	0-20	0-20	0-20	0-20	0-20	0-20	0-20	0-20	0-20
Surface Completion	Type	12"-dia flush mount	12"-dia flush mount	12"-dia Monument	12"-dia Monument	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount	12"-dia flush mount
	Pad	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete	3'-dia concrete
Televiewer Logs	Optical	yes	yes	yes	yes	yes	yes	yes	yes	none	none	none	none
	Acoustic	yes	yes	yes	yes	yes	yes	yes	yes	none	none	none	none
Development	Surge	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Bail	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Pump	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes:
ADWR = Arizona Department of Water Resources
amsl = above mean sea level
bgs = below ground surface
dia = diameter
NGVD29 = National Geodetic Vertical Datum of 1929
PVC = polyvinyl chloride
Sch = Schedule
SS = stainless steel

Appendix D

Soil Analytical Data (on CD)

Table D-1

B-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate (mg/kg)	Acetate (mg/L)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**NE**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring BC-SB01												
BC-SS01-0	0	<0.04	NA	NA	8.9	92	<0.5	27	9.9	<0.02	<5	<0.5
BC-SB01-1	1	<0.04	NA	NA	7.4	100	<0.5	19	10	<0.02	<5	<0.5
BC-SB01-3	3	<0.04	NA	NA	9	110	<0.5	20	7.9	<0.02	<5	1.4
Soil Boring BC-SB02												
BC-SB02-0	0	<0.04	NA	NA	8.9	100	<0.5	22	9	<0.02	<5	3.3
BC-SB02-1	1	<0.04	NA	NA	7.6	110	<0.5	31	10	<0.02	<5	4.3
Soil Boring BC-SB03												
BC-SB03-0	0	<0.04	NA	NA	7.5	94	<0.5	19	10	<0.02	<5	3.2
BC-SB03-1	1	<0.04	NA	NA	8.4	110	<0.5	22	9.7	<0.02	<5	3.2
Soil Boring BC-SB04												
BC-SB04-0	0	<0.04	<1	NA	5.9	130	<0.5	30	8.8	<0.02	<5	<0.5
BC-SB04-10	10	<0.04	<1	NA	7	100	<0.5	21	8.1	<0.02	<5	<0.5
Soil Boring BC-SB05												
BC-SB05-0	0	<0.04	18	NA	6.5	120	<0.5	31	9.7	<0.02	<5	<0.5
BC-SB05-10	10	<0.04	<1	NA	5.3	96	<0.5	17	<5	<0.02	<5	<0.5
Soil Boring BC-SB06												
BC-SB06-0	0	<0.04	12	NA	6.1	96	<0.5	13	6.2	<0.02	<5	<0.5
BC-SB06-10	10	<0.04	2.7	NA	6.3	110	<0.5	9.6	5.2	<0.02	<5	<0.5
Soil Boring BC-SB07												
BC-SB07-0	0	0.056	82	NA	5.5	160	<0.5	28	12	0.025 J	<5	<0.5
BC-SB07-10	10	<0.04	2.6	NA	5.7	81	<0.5	19	<5	<0.02	<5	0.62
BC-SB07-20	20	<0.04	2.8	NA	6.8	97	<0.5	16	5.1	<0.02	<5	<0.5
BC-SB07-30	30	<0.04	4.1	NA	6.2	220 J	<0.5	20	5.4	<0.1	<5	<0.5
BC-SB07-40	40	<0.04	2	NA	5.3	160	<0.5	21	5.3	<0.02	<5	1.6
BC-SB07-50	50	<0.04	3.1	NA	5.2	170	<0.5	17	5.6	<0.02	<5	0.59
Soil Boring BC-SB08												
BC-SB08-0	0	<0.04	1.9	NA	7.4	130	<0.5	25	12	<0.02	<5	<0.5
BC-SB08-10	10	<0.04	<1	NA	7	130	<0.5	13	6.2	<0.02	<5	<0.5
Soil Boring BC-SB09												
BC-SB09-0	0	<0.04	9.9 J	NA	5.8	91	<0.5	19	7.7	<0.02	<5	<0.5
BC-SB09-10	10	<0.04	1.3	NA	6.3	78	<0.5	13	6	<0.02	<5	<0.5
BC-SB09-20	20	<0.04	6	NA	7.5	68	<0.5	14	5.8	<0.02	<5	<0.5
BC-SB09-30	30	<0.04	3.1	NA	<5	120	<0.5	13	5.3	<0.02	<5	<0.5
BC-SB09-40	40	<0.04	4.8	NA	5.9	71	<0.5	15	6.5	<0.02	<5	<0.5
BC-SB09-50	50	<0.04	3.4	NA	6.1	160	<0.5	11	5.6	<0.02	<5	<0.5

Table D-1

B-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate (mg/kg)	Acetate (mg/L)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**NE**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring BC-SB10												
BC-SB10-0	0	<0.04	<1	NA	6.6	160	<0.5	23	8.2	<0.02	<5	0.57
BC-SB10-10	10	<0.04	1.3	NA	6.5	81	<0.5	14	5.2	<0.02	<5	<0.5
Soil Boring BC-SB11												
BC-SB11-0	0	<0.04	<1	NA	7.4	110	<0.5	20	7.9	<0.02	<5	<0.5
BC-SB11-10	10	<0.04	<1	NA	8.2	86	<0.5	13	<5	<0.02	<5	<0.5
Soil Boring BC-SB12												
BC-SB12-0	0	<0.04	1.7	NA	6.9	110	<0.5	18	9.8	<0.02	<5	<0.5
BC-SB12-10	10	<0.04	<1	NA	10	120	<0.5	17	6.3	<0.02	<5	<0.5
Soil Boring BC-SB13												
BC-SB13-0	0	0.24	7.6	NA	5.6	130	<0.5	16	6.8	<0.02	<5	<0.5
BC-SB13-10	10	<0.04	<1	NA	7.1	110	<0.5	14	5.5	<0.02	<5	<0.5
Soil Boring BC-SB14												
BC-SB14-0	0	0.089	4.3	NA	5.4	110	<0.5	20	7.7	<0.02	<5	<0.5
BC-SB14-10	10	<0.04	<1	NA	8.1	220	<0.5	16	5.6	<0.02	<5	<0.5
Soil Boring BC-SB15												
BC-SB15-0	0	<0.04	8.3	NA	6.7	110	<0.5	11	6.7	<0.02	<5	<0.5
BC-SB15-10	10	<0.04	1.4	NA	9.3	110	<0.5	13	5.5	<0.02	<5	<0.5
BC-SB15-20	20	<0.04	<1	NA	7.7	91	<0.5	12	6.9	<0.02	<5	<0.5
BC-SB15-30	30	<0.04	<1	NA	8	110	<0.5	14	<5	<0.02	<5	<0.5
Soil Boring BC-SB16												
BC-SB16-0	0	<0.04	2.6	NA	8.5	140	<0.5	20	11	<0.02	<5	<0.5
BC-SB16-10	10	<0.04	<1	NA	8.5	330	<0.5	22	8.6	<0.02	<5	<0.5
BC-SB16-20	20	<0.04	<1	NA	7.5	83	<0.5	16	6.4	<0.02	<5	<0.5
BC-SB16-30	30	<0.04	<1	NA	8.2	200	<0.5	15	12	<0.02	<5	<0.5
Soil Boring BC-SB17												
BC-SB17-0	0	0.25	11	NA	6.8	110	<0.5	17	9.1	<0.02	<5	<0.5
BC-SB17-10	10	<0.04	2.1	NA	8.1	85	<0.5	11	<5	<0.02	<5	<0.5
BC-SB17-20	20	<0.04	<1	NA	8.9	92	<0.5	14	6.8	<0.02	<5	<0.5
BC-SB17-30	30	<0.04	<1	NA	6.8	98	<0.5	11	6.3	<0.02	<5	<0.5
Soil Boring BC-SB18												
BC-SB18-0	0	0.39	38	NA	7.5	110	<0.5	18	9.7	<0.02	<5	<0.5
BC-SB18-10	10	<0.04	1.1	NA	7.4	87	<0.5	9.4	6.8	<0.02	<5	<0.5
BC-SB18-20	20	<0.04	<1	NA	7.9	76	<0.5	11	7.3	<0.02	<5	<0.5
BC-SB18-30	30	<0.04	<1	NA	8.6	110	<0.5	16	<5	<0.02	<5	<0.5

Table D-1

B-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate (mg/kg)	Acetate (mg/L)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**NE**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring BC-SB19												
BC-SB19-0	0	<0.04	6.7	NA	7.9	130	<0.5	22	8.1	<0.02	<5	<0.5
BC-SB19-10	10	<0.04	<1	NA	9.1	140	<0.5	33	<5	<0.02	<5	<0.5
BC-SB19-20	20	<0.04	<1	NA	8.4	88	<0.5	10	<5	<0.02	<5	<0.5
BC-SB19-30	30	<0.04	<1	NA	6.9	120	<0.5	18	<5	<0.02	<5	<0.5
Soil Boring BC-SB20												
BC-SB20-0	0	<0.04	1.2	NA	7.8	120	0.66	23	9.7	<0.02	<5	18
BC-SB20-10	10	<0.04	<1	NA	7.6	120	<0.5	17	7.9	<0.02	<5	<0.5
BC-SB20-20	20	<0.04	<1	NA	8	100	<0.5	13	7.6	<0.02	<5	6.3
BC-SB20-30	30	<0.04	1.1	NA	7.8	89	<0.5	10	5.9	<0.02	<5	2.5
Soil Boring BC-SB21												
BC-SB21-0	0	<0.04	1.2	10.6	7.3	110	<0.5	16	5.7	<0.02	<5	<0.5
BC-SB21-10	10	<0.04	<1	6.3	9.4	130	<0.5	21	11	<0.02	<5	0.51
BC-SB21-20	20	<0.04	<1	5	9.8	98	<0.5	18	<5	<0.02	<5	<0.5
BC-SB21-30	30	<0.04	<1	3.8	8.3	85	<0.5	17	<5	<0.02	<5	<0.5
BC-SB21-40	40	<0.04	12	4.2	6.3	120	<0.5	13	<5	<0.02	<5	<0.5
BC-SB21-50	50	<0.04	12	14.8	9.9	690	<0.5	24	11	<0.02	<5	<0.5
Soil Boring BC-SB22												
BC-SB22-0	0	0.15	9.2	NA	6.9	99	<0.5	19	14	<0.02	<5	<0.5
BC-SB22-10	10	<0.04	1.1	NA	6.6	100	<0.5	9.9	6	<0.02	<5	<0.5
Soil Boring BC-SB23												
BC-SB23-0	0	0.071	12	NA	7.9	110	<0.5	25	10	<0.02	<5	<0.5
BC-SB23-10	10	<0.04	1.2	NA	6.9	130	<0.5	16	<5	<0.02	<5	<0.5
Soil Boring BC-SB24												
BC-SB24-0	0	0.09	<1	NA	5.9	130	<0.5	15	9.4	<0.02	<5	<0.5
BC-SB24-10	10	<0.04	<1	NA	6.3	74	<0.5	17	5.8	<0.02	<5	<0.5
BC-SB24-20	20	<0.04	2.3	NA	5.2	64	<0.5	9.9	5.4	<0.02	5.1	<0.5
BC-SB24-30	30	<0.04	1.3	NA	<5	99	<0.5	13	6.2	<0.02	<5	<0.5
BC-SB24-40	40	<0.04	4	NA	6.8	370	<0.5	17	7.4	<0.02	<5	<0.5
BC-SB24-50	50	<0.04	<1	NA	9.1	330	<0.5	26	9	<0.02	<5	0.52 J
Soil Boring BC-SB25												
BC-SB25-0	0	<0.04	NA	NA	<5	120	<0.5	15	5.5	<0.02	<5	<0.5
BC-SB25-10	10	<0.04	NA	NA	6.1	140	<0.5	20	5.9	<0.02	<5	<0.5
Soil Boring BC-SB26												
BC-SB26-0	0	<0.04	NA	NA	8.2	110	1.1	22	9.5	<0.02	<5	1
BC-SB26-10	10	<0.04	NA	NA	8	150	<0.5	20	5.8	<0.02	<5	<0.5

Table D-1

B-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate (mg/kg)	Acetate (mg/L)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**NE**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring BC-SB27												
BC-SB27-0	0	0.043	NA	NA	8.6	110	<0.5	21	11	<0.02	<5	<0.5
BC-SB27-10	10	<0.04	NA	NA	6.6	110	<0.5	14	5.8	<0.02	<5	<0.5
Soil Boring BC-SB28												
BC-SB28-0	0	<0.04	NA	NA	8.6	180	<0.5	21	9.3	<0.02	<5	<0.5
BC-SB28-10	10	<0.04	NA	NA	7.9	180	<0.5	17	<5	0.52	<5	<0.5
Soil Boring BC-SB29												
BC-SB29-0	0	<0.04	3.1	NA	6.5	87	<0.5	26	14	<0.02	<5	<0.5
BC-SB29-10	10	<0.04	<1	NA	6.2	130	<0.5	15	5.4	<0.02	<5	<0.5
Soil Boring BC-SB30												
BC-SB30-0	0	0.16	47	NA	<5	120	<0.5	19	7.6	<0.1	<5	<0.5
BC-SB30-10	10	<0.04	<1	NA	5.5	90	<0.5	18	<5	<0.1	<5	<0.5
BC-SB30-20	20	<0.04	5.5	NA	5.2	110	<0.5	14	<5	<0.1	<5	<0.5
BC-SB30-30	30	<0.04	7.4	NA	<5	530	<0.5	16	<5	<0.02	<5	<0.5
BC-SB30-40	40	<0.04	4.8	NA	6.1	200	<0.5	26	6.5	<0.02	<5	<0.5
BC-SB30-50	50	<0.04	4.5	NA	6.7	170	<0.5	20	6.4	<0.02	<5	<0.5
Soil Boring BC-SB31												
BC-SB31-0	0	<0.04	<1	NA	5	110	<0.5	30	<5	<0.02	<5	<0.5
BC-SB31-10	10	<0.04	<1	NA	<5	78	<0.5	15	<5	<0.02	<5	<0.5
BC-SB31-20	20	<0.04	<1	NA	5.7	81	<0.5	15	<5	<0.02	<5	<0.5
BC-SB31-30	30	<0.04	<1	NA	6.6	110	<0.5	20	<5	<0.02	<5	<0.5
BC-SB31-40	40	<0.04	<1	NA	<5	91	<0.5	9.7	<5	<0.1	<5	<0.5
BC-SB31-50	50	<0.04	<1	NA	<5	150	<0.5	12	<5	<0.02	<5	0.67
Soil Boring BC-SB32												
BC-SB32-0	0	<0.04	<1	NA	12	120	<0.5	32	14	<0.02	<5	<0.5
BC-SB32-1	1	<0.04	<1	NA	11	130	<0.5	27	17	<0.02	<5	<0.5
Soil Boring BC-SB33												
BC-SB33-0	0	<0.04	7.2	NA	6.3	130	<0.5	23	8.8	<0.02	<5	<0.5
BC-SB33-10	10	<0.04	<1	NA	5.2	120	<0.5	13	5	<0.02	<5	<0.5
Soil Boring BC-SB34												
BC-SB34-0	0	<0.04	21	NA	5.7	100	<0.5	21	7.3	<0.02	<5	<0.5
BC-SB34-10	10	<0.04	<1	NA	5.8	140	<0.5	18	5.8	<0.02	<5	<0.5
Soil Boring BC-SB45												
BC-SB45-0	0	NA	NA	NA	6.2	NA	NA	NA	NA	NA	NA	NA
BC-SB45-1	1	NA	NA	NA	<5.0	NA	NA	NA	NA	NA	NA	NA

Table D-1

B-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate (mg/kg)	Acetate (mg/L)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**NE**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring BC-SB46												
BC-SB46-0	0	NA	NA	NA	7.2	NA	NA	NA	NA	NA	NA	NA
BC-SB46-1	1	NA	NA	NA	5.9	NA	NA	NA	NA	NA	NA	NA
Soil Boring BC-SB47												
BC-SB47-0	0	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC-SB47-1	1	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC-SB47-2	2	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring BC-SB48												
BC-SB48-0	0	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC-SB48-1	1	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC-SB48-2	2	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring BC-SB49												
BC-SB49-0	0	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BC-SB49-1	1	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NA = not analyzed
NE = not established

Table D-2

C-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring CC-SB01											
CC-SB01-0	0	0.52	9.6	5.6	120	<0.5	25	15	<0.02	<5	<0.5
CC-SB01-10	10	<0.04	2	6.4	96	<0.5	12	<5	<0.02	<5	<0.5
CC-SB01-20	20	<0.04	3.4	<5	320	<0.5	16	5.3	<0.02	<5	<0.5
CC-SB01-30	30	0.057	1.2	6.8	250	<0.5	26	7.2	<0.02	<5	<0.5
CC-SB01-40	40	<0.04	<1	5.8	240	<0.5	20	6.5	<0.02	<5	<0.5
CC-SB01-50	50	<0.04	<1	6.5	240	<0.5	15	6.7	<0.02	<5	<0.5
CC-SB01-60	60	<0.04	<1	6.1	240	<0.5	17	6.9	<0.02	<5	<0.5
CC-SB01-70	70	<0.04	<1	6.2	260	<0.5	17	7.1	<0.02	<5	<0.5
CC-SB01-80	80	<0.04	<1	5.9	260	<0.5	17	6.8	<0.02	<5	11
CC-SB01-90	90	<0.04	<1	5.5	210	<0.5	15	7.5	<0.02	<5	<0.5
CC-SB01-100	100	<0.04	<1	<5	210	0.84	20	5.9	<0.04	<10	52
Soil Boring CC-SB02											
CC-SB02-0	0	0.14	43	6	120	1.5	32	16	<0.02	<10	<0.5
CC-SB02-10	10	<0.04	<1.1	<5	90 J	<0.5	8.9	<5	<0.02	<5	<0.5
CC-SB02-20	20	0.052	<1.1	<5	360	0.58	20	8.1	<0.02	<5	<0.5
CC-SB02-30	30	<0.04	<1.1	<5	220	<0.5	16	8.3	<0.02	<5	<0.5
CC-SB02-40	40	<0.04	<1.1	5.2	260	0.5	17	8.4	<0.02	<5	3.6
CC-SB02-50	50	<0.04	<1.1	5.2	230	0.57	15	7	<0.02	<5	<0.5
Soil Boring CC-SB03											
CC-SB03-0	0	0.042	<1	7.2	120	1.2	22	24	<0.02	<5	<0.5
CC-SB03-10	10	0.062	1.7	<5	71 J	<0.5	7.3	<5	<0.02	<5	<0.5
CC-SB03-20	20	0.11	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB03-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB04											
CC-SB04-0	0	<0.04	<1	<5	110	1.2	16	16	<0.02	<5	<0.5
CC-SB04-10	10	<0.04	<1	<5	680	<0.5	19	<5	<0.02	<5	<0.5
CC-SB04-16	16	<0.04	<1	6	770	<0.5	17	8.2	<0.02	<5	0.53
Soil Boring CC-SB05											
CC-SB05-0	0	<0.04	<1	7.2	130	1.3	22	21	<0.02	<10	<0.5
CC-SB05-10	10	0.16	<1	6.3	130	0.72	23	<5	<0.02	<10	<0.5
CC-SB05-20	20	<0.04	1.4	<5	680	<0.5	28	6.2	<0.02	<5	<0.5
CC-SB05-30	30	<0.04	1.4	5.9	300	<0.5	31	7.3	<0.02	<5	<0.5
CC-SB05-36	36	<0.04	1.2	<5	190 J	<0.5	15	6.1	<0.02	<5	<0.5

Table D-2

C-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring CC-SB06											
CC-SB06-0	0	<0.04	<1	<5	120	0.76	21	17	<0.02	<10	<0.5
CC-SB06-10	10	0.16	30	<5	140	<0.5	8.5	<5	<0.02	<5	<0.5
CC-SB06-20	20	0.34	2.7	6.5	1100	<0.5	23	12	<0.02	<5	<0.5
CC-SB06-30	30	0.16	<1	<5	280	0.5	15	5.6	<0.02	<5	3.4
Soil Boring CC-SB07											
CC-SB07-0	0	<0.04	<1	7	150	0.95	21	12	0.02	<5	<0.5
CC-SB07-10	10	0.045	<1	7	130	<0.5	7.4	6	<0.02	<5	0.71
CC-SB07-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB07-25	25	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB08											
CC-SB08-0	0	330	140	8.3	110	<0.5	24	8.8	0.022	<5	<0.5
CC-SB08-10	10	5.3	<1.1	<5	82	0.96	13	<5	<0.02	<5	<0.5
CC-SB08-20	20	7.6	1.4	6.2	100	0.66	15	<5	<0.02	<5	<0.5
CC-SB08-30	30	0.19	<1.1	7.3	200	0.52	7.7	5.8	<0.02	<5	1.7
Soil Boring CC-SB09											
CC-SB09-0	0	0.26	1.1	7.7	140	0.52	20	7.3	0.02	<5	<0.5
CC-SB09-10	10	0.16	<1.1	<5	110	0.55	9.2	<5	<0.02	<5	<0.5
CC-SB09-20	20	3.6	1.5	<5	120	0.87	13	<5	<0.02	<5	<0.5
CC-SB09-30	30	0.25	<1	<5	1400	<0.5	11	6.7	<0.02	<5	0.74
Soil Boring CC-SB10											
CC-SB10-10	10	23	6.9	<5	110	<0.5	17	<5	<0.02	<5	<0.5
CC-SB10-20	20	0.5	1.2	<5	890	0.56	16	5.3	<0.02	<5	<0.5
CC-SB10-30	30	0.34	<1.1	<5	240	0.67	15	8.3	<0.02	<5	<0.5
CC-SB10-40	40	0.12	<1.1	5.1	280	0.66	17	9.3	<0.02	<5	<0.5
CC-SB10-50	50	0.074	<1.1	7	260	0.72	16	9.2	<0.02	<5	<0.5
CC-SB10-59	59	0.23	2.6	5.5	120	<0.5	12	8.2	<0.02	<5	0.88 J
Soil Boring CC-SB11											
CC-SB11-10	10	0.078	1.5	<5	94	<0.5	16	<5	<0.02	<5	<0.5
CC-SB11-20	20	<0.04	<1	5.3	790	<0.5	20	5.9	<0.02	<5	<0.5
CC-SB11-30	30	<0.04	<1	5.3	240	<0.5	18	6.3	<0.02	<5	2.9
CC-SB11-40	40	<0.04	<1	<5	280	<0.5	18	7.7	<0.02	<5	0.83
CC-SB11-50	50	<0.04	<1	6.7	280	0.51	17	8.1	<0.02	<5	<0.5

Table D-2

C-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring CC-SB12											
CC-SB12-0	0	0.11	4.5	5.3	120	0.7	20	15	<0.02	<5	<0.5
CC-SB12-10	10	0.17	<1	5.5	110	0.62	14	<5	<0.02	<5	<0.5
CC-SB12-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB12-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB13											
CC-SB13-0	0	<0.04	1.7	5.5	93	<0.5	15	7.5	<0.02	<5	<0.5
CC-SB13-10	10	<0.04	<1	<5	110	0.56	15	<5	<0.02	<5	<0.5
Soil Boring CC-SB14											
CC-SB14-0	0	0.74	3.8	5.9	110	1.1	37	61	<0.02	<5	<0.5
CC-SB14-10	10	1.5 J	1.2	<5	100	<0.5	14	<5	<0.02	<5	<0.5
CC-SB14-20	20	83	10	6.4	770	<0.5	22	6	<0.02	<5	<0.5
CC-SB14-30	30	1.3	1.6	5.6	210	<0.5	22	6.6	<0.02	<5	0.69
CC-SB14-40	40	0.074	<1	<5	250	<0.5	21	6.2	<0.02	<5	<0.5
CC-SB14-50	50	<0.04	<1	6	240	0.51	21	7.9	<0.02	<5	0.89
Soil Boring CC-SB15											
CC-SB15-0	0	0.053	1.5	5.6	100	<0.5	19	33	<0.02	<5	<0.5
CC-SB15-10	10	15	4.6	<5	190	<0.5	13	<5	<0.02	<5	<0.5
CC-SB15-20	20	26	3.6	5.6	670	<0.5	23	7.7	<0.02	<5	<0.5
CC-SB15-30	30	0.38	<1	5.3	200	<0.5	19	5.5	<0.02	<5	<0.5
CC-SB15-40	40	<0.04	<1	5.4	250	<0.5	21	6.4	<0.02	<5	<0.5
CC-SB15-50	50	<0.04	<1	6.1	250	0.5	20	7.3	<0.02	<5	<0.5
Soil Boring CC-SB16											
CC-SB16-0	0	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB16-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB16-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB16-30	30	0.38	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB17											
CC-SB17-0	0	4.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB17-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB17-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB17-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB18											
CC-SB18-0	0	43	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB18-10	10	0.067	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB18-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB18-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table D-2

C-Complex Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring CC-SB19											
CC-SB19-0	0	3.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB19-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB19-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB19-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB20											
CC-SB20-0	0	0.44	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB20-10	10	7.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB20-20	20	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB21											
CC-SB21-0	0	0.058	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB21-10	10	1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB21-20	20	0.63	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring CC-SB25											
CC-SB25-0	0	0.031	NA	NA	NA	NA	NA	NA	NA	NA	NA
CC-SB25-1	1	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed

Table D-3

Old Burn Area Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring OB-SB01													
OB-SB01-0	0	<0.04	<1	25,000	7.2	140	<0.5	20	26	6.2	<0.02	<5	<0.5
OB-SB01-10	10	0.061	<1	30,000	7.9	240	<0.5	23	11	<5	<0.02	<5	<0.5
Soil Boring OB-SB02													
OB-SB02-0	0	<0.04	<1	19,000	9.6	110	<0.5	21	27	100	<0.02	<5	<0.5
OB-SB02-8	8	<0.04	<1	21,000	<5	150	0.73	20	27	<5	<0.02	<5	<0.5
Soil Boring OB-SB03													
OB-SB03-0	0	<0.04	<1	18,000	5.4	110	<0.5	18	22	14	<0.02	<5	<0.5
OB-SB03-1	1	<0.04	<1	18,000	<5	130	<0.5	14	24	11	<0.02	<5	<0.5
Soil Boring OB-SB04													
OB-SB04-0	0	0.1	<1	22,000	5.4	120	<0.5	20	29	48	<0.02	<5	<0.5
OB-SB04-1	1	0.052	3.6	28,000	6.4	140	<0.5	20	31	<5	<0.02	<5	<0.5
OB-SB04-5	5	0.16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB04-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB05													
OB-SB05-0	0	<0.04	<1	19,000	6.7	110	<0.5	17	22	35 J	<0.02	<5	<0.5
OB-SB05-1	1	<0.04	<1	21,000	5.6	140	<0.5	16	29	<5	<0.02	<5	<0.5
Soil Boring OB-SB06													
OB-SB06-0	0	0.052	<1	21,000	5.3	150	<0.5	17	31	57	<0.02	<5	<0.5
OB-SB06-1	1	<0.04	<1	24,000	5.4	160	<0.5	20	26	<5	<0.02	<5	<0.5
Soil Boring OB-SB07													
OB-SB07-0	0	<0.04	<1	18,000	5.5	110	<0.5	15	31	76	<0.02	<5	<0.5
OB-SB07-1	1	<0.04	<1	20,000	5.5	120	<0.5	15	34	21	<0.02	<5	<0.5
Soil Boring OB-SB08													
OB-SB08-0	0	<0.04	<1	21,000	5.9	110	<0.5	16	33	450	<0.02	<5	<0.5
OB-SB08-1	1	<0.04	<1	21,000	<5	120	<0.5	18	33	130	<0.02	<5	<0.5
Soil Boring OB-SB09													
OB-SB09-0	0	<0.04	<1	20,000	5.9	100	0.97	17	130 J	100 J	<0.02	<5	<0.5
OB-SB09-1	1	<0.04	<1	22,000	6.4	120	<0.5	17	35	13	<0.02	<5	<0.5
OB-SB09-2	2	<0.04	<1	21,000	<5	82	<0.5	16	30	18	<0.02	<5	<0.5
Soil Boring OB-SB10													
OB-SB10-0	0	<0.04	<1	16,000	8.6	120	<0.5	15	26	150	<0.02	<5	<0.5
OB-SB10-1	1	<0.04	<1	19,000	5.8	110	0.98	15	31	30	<0.02	<5	<0.5
OB-SB10-2	2	<0.04	<1	18,000	7	110	<0.5	14	32	44	<0.02	<5	<0.5
Soil Boring OB-SB11													
OB-SB11-0	0	<0.04	1.6	18,000	6.8	110	0.96	16	47	98	<0.02	<5	<0.5
OB-SB11-1	1	<0.04	<1	19,000	6.6	110	<0.5	14	32	13	<0.02	<5	<0.5
OB-SB11-2	2	<0.04	<1	21,000	6	110	<0.5	16	33	11	<0.02	<5	<0.5
Soil Boring OB-SB12													
OB-SB12-0	0	<0.04	1.6	20,000	5.4	110	1.8	21	26	230	<0.02	<5	<0.5
OB-SB12-1	1	<0.04	<1	30,000	<5	150	<0.5	32	15	7	<0.02	<5	<0.5
Soil Boring OB-SB13													
OB-SB13-0	0	<0.04	<1	24,000	<5	120	<0.5	22	29	<5	<0.02	<5	<0.5
OB-SB13-1	1	<0.04	<1	24,000	<5	130	<0.5	24	22	<5	<0.02	<5	<0.5

Table D-3

Old Burn Area Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring OB-SB14													
OB-SB14-0	0	<0.04	<1	20,000	6.2	120	<0.5	17	23	<5	<0.02	<5	<0.5
OB-SB14-1	1	<0.04	<1	12,000	11	95	<0.5	9.5	9.7	<5	<0.02	<5	<0.5
Soil Boring OB-SB15													
OB-SB15-0	0	<0.04	<1	24,000	<5	98	<0.5	20	28	11	<0.02	<5	<0.5
OB-SB15-1	1	<0.04	<1	19,000	6.9	79	<0.5	16	27	10	<0.02	<5	<0.5
Soil Boring OB-SB16													
OB-SB16-0	0	<0.04	<1	31,000	5.7	140	0.51	23	36	7.8	<0.02	<5	<0.5
OB-SB16-1	1	<0.04	<1	27,000	5.5	150	<0.5	18	28	<5	<0.02	<5	<0.5
Soil Boring OB-SB17													
OB-SB17-0	0	<0.04	1.7	20,000	6.1	110	<0.5	23	30	68	<0.02	<5	<0.5
OB-SB17-1	1	<0.04	<1	21,000	6.1	110	<0.5	16	31	11	<0.02	<5	<0.5
Soil Boring OB-SB18													
OB-SB18-0	0	<0.04	1.1	19,000	6.1	150	0.53	17	31	310	<0.02	<5	<0.5
OB-SB18-1	1	<0.04	<1	20,000	5.5	120	<0.5	15	31	6.1	<0.02	<5	<0.5
Soil Boring OB-SB19													
OB-SB19-0	0	<0.04	<1	19,000	<5	150	<0.5	18	39	<5	<0.02	<5	<0.5
OB-SB19-1	1	<0.04	<1	23,000	6.2	160	<0.5	22	58	<5	<0.02	<5	<0.5
Soil Boring OB-SB20													
OB-SB20-0	0	<0.04	<1	22,000	5.4	120	<0.5	23	37	630	<0.02	<5	<0.5
OB-SB20-1	1	<0.04	<1	24,000	<5	140	<0.5	18	31	5.2	0.023	<5	<0.5
Soil Boring OB-SB21													
OB-SB21-0	0	<0.04	<1	23,000	<5	110	<0.5	19	27	15	<0.02	<5	<0.5
OB-SB21-1	1	<0.04	<1	20,000	<5	110	<0.5	16	25	5.2	0.028	<5	<0.5
Soil Boring OB-SB22													
OB-SB22-0	0	<0.04	<1	22,000	5.2	120	<0.5	14	31	<5	<0.02	<5	<0.5
OB-SB22-1	1	<0.04	<1	22,000	6	110	<0.5	17	29	<5	<0.02	<5	<0.5
Soil Boring OB-SB23													
OB-SB23-0	0	<0.2	48	23,000	5.8	120	<0.5	21	41	18	<0.02	<5	<0.5
OB-SB23-1	1	<0.04	5	24,000	6	140	<0.5	20	30	<5	<0.02	<5	<0.5
Soil Boring OB-SB24													
OB-SB24-0	0	<0.04	<1	23,000	<5	120	<0.5	20	28	<5	<0.02	<5	<0.5
OB-SB24-1	1	0.8	76	24,000	<5	120	<0.5	18	28	<5	<0.02	<5	<0.5
OB-SB24-5	5	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB24-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB25													
OB-SB25-0	0	<0.04	<1	25,000 J	5.3 J	120	<0.5	22	32 J	5.5 J	0.025	<5	<0.5
OB-SB25-1	1	0.061	<1	19,000	<5	110	<0.5	14	22	<5	<0.02	<5	<0.5
OB-SB25-5	5	0.046	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB25-10	10	0.052	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB25-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB25-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB26													
OB-SB26-0	0	0.072	1.6	20,000	6.3	120	<0.5	21	29	28	0.022 J	<5	<0.5
OB-SB26-1	1	<0.04	10	22,000	5	140	<0.5	19	29	<5	<0.02	<5	<0.5

Table D-3

Old Burn Area Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring OB-SB27													
OB-SB27-0	0	<0.04	<1	20,000	<5	95	0.55	18	25	19	<0.02	<5	<0.5
OB-SB27-1	1	<0.04	<1	22,000	<5	120	<0.5	16	44	<5	<0.02	<5	<0.5
Soil Boring OB-SB28													
OB-SB28-0	0	<0.04	1.1	28,000	5.4	140	0.62	24	30	6.8	<0.02	<5	<0.5
OB-SB28-1	1	0.065	78	25,000	5.4	140	0.52	17	28	<5	<0.02	<5	<0.5
OB-SB28-5	5	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB28-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB29													
OB-SB29-0	0	<0.04	5.8	23,000	5.7	120	<0.5	22	29	14	<0.02	<5	<0.5
OB-SB29-1	1	0.44	73	25,000	5.1	130	0.51	16	29	<5	0.068	<5	<0.5
OB-SB29-5	5	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB29-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB30													
OB-SB30-0	0	<0.04	1.5	19,000	<5	130	<0.5	33	23	8.2	<0.02	<5	<0.5
OB-SB30-1	1	<0.04	6.2	26,000	<5	140	<0.5	35	33	5.9	0.022	<5	<0.5
Soil Boring OB-SB31													
OB-SB31-0	0	<0.04	<1	23,000	6.1	83	<0.5	35	81	<5	<0.02	<5	<0.5
OB-SB31-1	1	<0.04	2.8	24,000	<5	120	<0.5	45	30	11	<0.02	<5	<0.5
Soil Boring OB-SB32													
OB-SB32-0	0	<0.04	1.7	21,000	6	110	<0.5	17	89	100	<0.02	<5	<0.5
OB-SB32-1	1	<0.04	<1	24,000	6.8	99	<0.5	17	58 J	110 J	<0.02	<5	<0.5
Soil Boring OB-SB33													
OB-SB33-0	0	<0.04	<1	23,000	6	100	<0.5	17	34	140	<0.02	<5	<0.5
OB-SB33-1	1	<0.04	1.2	21,000	5.6	100	<0.5	16	42	46	<0.02	<5	<0.5
Soil Boring OB-SB34													
OB-SB34-0	0	<0.04	2.8	15,000	5.4	110	<0.5	13	25	<5	<0.02	<5	<0.5
OB-SB34-1	1	0.052	<1	23,000	7.2	130	<0.5	18	35	<5	<0.02	<5	<0.5
OB-SB34-5	5	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB34-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB35													
OB-SB35-0	0	<0.04	<1	19,000	6.5	99	<0.5	16	31	17	<0.02	<5	<0.5
OB-SB35-1	1	<0.04	<1	21,000	5	110 J	<0.5	18	30	320 J	<0.02	<5	<0.5
Soil Boring OB-SB36													
OB-SB36-0	0	NA	NA	NA	NA	NA	NA	NA	NA	15	NA	NA	NA
Soil Boring OB-SB37													
OB-SB37-0	0	NA	NA	NA	NA	NA	NA	NA	NA	20	NA	NA	NA
Soil Boring OB-SB38													
OB-SB38-0	0	NA	NA	NA	NA	NA	NA	NA	NA	36	NA	NA	NA
Soil Boring OB-SB39													
OB-SB39-0	0	NA	NA	NA	NA	NA	NA	NA	NA	11	NA	NA	NA
Soil Boring OB-SB40													
OB-SB40-0	0	NA	NA	NA	NA	NA	NA	NA	NA	2,800	NA	NA	NA
OB-SB40-1	1	NA	NA	NA	NA	NA	NA	NA	NA	4,500	NA	NA	NA
OB-SB40-2	2	NA	NA	NA	NA	NA	NA	NA	NA	230 J	NA	NA	NA

Table D-3

Old Burn Area Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring OB-SB41													
OB-SB41-0	0	NA	NA	NA	NA	NA	NA	NA	NA	460	NA	NA	NA
OB-SB41-1	1	NA	NA	NA	NA	NA	NA	NA	NA	28 J	NA	NA	NA
Soil Boring OB-SB42													
OB-SB42-0	0	NA	NA	NA	NA	NA	NA	NA	NA	140 J	NA	NA	NA
Soil Boring OB-SB43													
OB-SB43-0	0	NA	NA	NA	NA	NA	NA	NA	NA	340	NA	NA	NA
Soil Boring OB-SB44													
OB-SB44-0	0	NA	NA	NA	NA	NA	NA	NA	NA	170	NA	NA	NA
Soil Boring OB-SB45													
OB-SB45-0	0	NA	NA	NA	NA	NA	NA	NA	NA	4,800	NA	NA	NA
OB-SB45-1	1	NA	NA	NA	NA	NA	NA	NA	NA	200 J	NA	NA	NA
OB-SB45-2	2	NA	NA	NA	NA	NA	NA	NA	NA	66 J	NA	NA	NA
Soil Boring OB-SB46													
OB-SB46-0	0	NA	NA	NA	NA	NA	NA	NA	NA	420	NA	NA	NA
OB-SB46-1	1	NA	NA	NA	NA	NA	NA	NA	NA	16 J	NA	NA	NA
Soil Boring OB-SB47													
OB-SB47-0	0	NA	NA	NA	NA	NA	NA	NA	NA	18 J	NA	NA	NA
Soil Boring OB-SB48													
OB-SB48-0	0	NA	NA	NA	NA	NA	NA	NA	NA	180 J	NA	NA	NA
Soil Boring OB-SB50													
OB-SB50-0	0	NA	NA	NA	7.9 J	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB50-1	1	NA	NA	NA	5.0 J	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB51													
OB-SB51-0	0	NA	NA	NA	7.0 J	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB51-1	1	NA	NA	NA	6.5 J	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring OB-SB52													
OB-SB52-0	0	NA	NA	NA	6.3 J	NA	NA	NA	NA	NA	NA	NA	NA
OB-SB52-1	1	NA	NA	NA	5.5 J	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed

Table D-4

Thermal Treatment Unit Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring TT-SB01													
TT-SB01-0	0	0.053	<1	24,000	<5	140	<0.5	19	24	12	0.021	<5	<0.5
TT-SB01-1	1	0.14	<1	30,000	5.5	260	<0.5	39	Corrective	5.9	0.036	<5	<0.5
TT-SB01-5	5	0.25	NA	NA	NA	NA	NA	NA	42,186.00	NA	NA	NA	NA
TT-SB01-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB02													
TT-SB02-0	0	0.18	<1	23,000	<5	99	<0.5	16	25	5.9	0.026	<5	<0.5
TT-SB02-1	1	0.28	1.1	21,000	<5	100	<0.5	20	28	11	0.029	<5	<0.5
TT-SB02-5	5	0.27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB02-10	10	0.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB02-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB02-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB03													
TT-SB03-0	0	<0.04	<1	26,000	<5	130	<0.5	21	29	8	0.023	<5	<0.5
TT-SB03-1	1	<0.04	<1	26,000	5.7	140	<0.5	20	32	<5	<0.02	<5	<0.5
Soil Boring TT-SB04													
TT-SB04-0	0	0.044	<1	21,000	<5	100	<0.5	18	24	5.3	<0.02	<5	<0.5
TT-SB04-1	1	0.071	<1	19,000	<5	110	<0.5	15	24	<5	<0.02	<5	<0.5
TT-SB04-5	5	1.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB04-10	10	0.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB04-20	20	0.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB04-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB05													
TT-SB05-0	0	<0.04	<1	17,000	<5	110	0.53	16	23	8.4	<0.02	<5	<0.5
TT-SB05-1	1	<0.04	<1	18,000	<5	110	<0.5	16	23	8.5	<0.02	<5	<0.5
Soil Boring TT-SB06													
TT-SB06-0	0	<0.04	<1	21,000	5	120	<0.5	18	28	9.2	<0.02	<5	<0.5
TT-SB06-1	1	<0.04	<1	18,000	<5	120	0.58	18	20	5.1	0.02	<5	<0.5
Soil Boring TT-SB07													
TT-SB07-0	0	<0.04	<1	19,000	5.6	110	0.56	18	31	7.9	<0.02	<5	<0.5
TT-SB07-1	1	<0.04	<1	22,000	5.5	110	0.52	17	25	<5	<0.02	<5	<0.5
Soil Boring TT-SB08													
TT-SB08-0	0	<0.04	<1	20,000	<5	130	0.79	16	26	12	<0.02	<5	<0.5
TT-SB08-1	1	<0.04	<1	17,000	<5	120	<0.5	13	15	<5	<0.02	<5	<0.5
Soil Boring TT-SB09													
TT-SB09-0	0	0.05	<1	15,000	5	94	<0.5	13	18	6.4	<0.02	<5	<0.5
TT-SB09-1	1	0.49	<1	18,000	<5	98	<0.5	15	16	<5	0.038	<5	<0.5
TT-SB09-5	5	2.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB09-10	10	0.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB09-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB09-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table D-4

Thermal Treatment Unit Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring TT-SB10													
TT-SB10-0	0	0.099	2	21,000	5.9	110	0.86	22	25	22	<0.02	<5	<0.5
TT-SB10-1	1	0.31	1.9	22,000	<5	110	<0.5	18	28	<5	0.022	<5	<0.5
TT-SB10-5	5	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB10-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB11													
TT-SB11-0	0	<0.04	<1	18,000	<5	120	<0.5	16	22	8.2	<0.02	<5	<0.5
TT-SB11-1	1	<0.04	<1	15,000	<5	100	<0.5	12	18	<5	<0.02	<5	<0.5
Soil Boring TT-SB12													
TT-SB12-0	0	<0.04	<1	21,000	5.2	110	<0.5	20	30	5.3	<0.02	<5	<0.5
TT-SB12-1	1	<0.04	<1	15,000	5.3	110	<0.5	12	20	<5	0.02	<5	<0.5
Soil Boring TT-SB13													
TT-SB13-0	0	0.045	<1	25,000	5.4	100	<0.5	20	24	5.3	0.025	<5	<0.5
TT-SB13-1	1	4.9	100	18,000	<5	99	<0.5	17	25	12	<0.02	<5	<0.5
TT-SB13-5	5	0.57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB13-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB14													
TT-SB14-0	0	<0.04	<1	22,000	5.2	120	<0.5	15	31	9.9	0.027	<5	<0.5
TT-SB14-1	1	<0.04	<1	24,000	6	110	<0.5	20	27	<5	<0.02	<5	<0.5
Soil Boring TT-SB15													
TT-SB15-0	0	<0.04	<1	23,000	5.9	100	0.54	21	26	6.4	<0.02	<5	<0.5
TT-SB15-1	1	0.079	<1	18,000	<5	130	<0.5	15	24	<5	<0.02	<5	<0.5
TT-SB15-5	5	1.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB15-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB16													
TT-SB16-0	0	0.055	<1	21,000	<5	100	0.76	26	24	7.3	0.03	<5	<0.5
TT-SB16-1	1	2.4 J	1.5	22,000	5.4	130	<0.5	19	24	<5	<0.02	<5	<0.5
TT-SB16-5	5	0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB16-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB17													
TT-SB17-0	0	<0.04	<1	23,000	<5	110	0.62	19	25	<5	<0.02	<5	<0.5
TT-SB17-1	1	0.37	<1	23,000	6.2	120	0.69	23	25	<5	<0.02	<5	<0.5
TT-SB17-5	5	0.65	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB17-10	10	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB17-20	20	0.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB17-30	30	0.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB17-40	40	0.077	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB17-50	50	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB18													
TT-SB18-0	0	<0.04	<1	22,000	<5	95	<0.5	22	27	8.3	<0.02	<5	<0.5
TT-SB18-1	1	<0.04	<1	21,000	<5	100	<0.5	19	24	7.7	<0.02	<5	<0.5

Table D-4

Thermal Treatment Unit Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring TT-SB19													
TT-SB19-0	0	<0.04	<1	18,000	<5	100	<0.5	18	23	<5	<0.02	<5	<0.5
TT-SB19-1	1	<0.04	<1	17,000	<5	120	<0.5	15	28	<5	<0.02	<5	<0.5
Soil Boring TT-SB20													
TT-SB20-0	0	<0.04	<1	19,000	<5	100	<0.5	16	21	<5	<0.02	<5	<0.5
TT-SB20-1	1	<0.04	<1	17,000	<5	130	<0.5	16	18	<5	<0.02	<5	<0.5
Soil Boring TT-SB21													
TT-SB21-0	0	<0.04	<1	22,000	<5	110	<0.5	17	26	<5	<0.02	<5	<0.5
TT-SB21-1	1	<0.04	<1	16,000	<5	120	<0.5	12	24	<5	<0.02	<5	<0.5
Soil Boring TT-SB22													
TT-SB22-0	0	<0.04	<1	19,000	9.7	110	0.52	14	21	<5	<0.02	<5	<0.5
TT-SB22-1	1	<0.04	<1	16,000	<5	110	<0.5	11	18	<5	<0.02	<5	<0.5
Soil Boring TT-SB23													
TT-SB23-0	0	<0.04	<1	17,000	<5	93	<0.5	14	21	<5	<0.02	<5	<0.5
TT-SB23-1	1	<0.04	<1	18,000	7.1	130	<0.5	14	30	<5	0.025	<5	<0.5
Soil Boring TT-SB24													
TT-SB24-0	0	<0.04	<1	16,000	<5	280	<0.5	14	23	<5	0.02	<5	<0.5
TT-SB24-1	1	0.14	<1	15,000	<5	220	0.58	15	24	<5	<0.02	<5	<0.5
TT-SB24-5	5	0.55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB24-10	10	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB24-20	20	0.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB24-30	30	0.73 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB24-40	40	0.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB24-50	50	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB25													
TT-SB25-0	0	1.4	1.3	25,000	<5	130	<0.5	21	29	5.3	0.028	<5	<0.5
TT-SB25-1	1	0.82	<1	27,000	7.9	140	<0.5	22	34	<5	<0.02	<5	<0.5
TT-SB25-5	5	11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB25-10	10	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB25-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB25-30	30	0.057	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB25-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB25-50	50	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB26													
TT-SB26-0	0	<0.04	<1	25,000	<5	130	<0.5	49 J	27	12	0.021	<5	<0.5
TT-SB26-1	1	<0.04	1	26,000	5.9	170	<0.5	41	27	5.3	<0.02	<5	<0.5
Soil Boring TT-SB27													
TT-SB27-0	0	0.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB27-5	5	4.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB27-10	10	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table D-4

Thermal Treatment Unit Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring TT-SB28													
TT-SB28-0	0	0.089	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB28-5	5	0.11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB28-10	10	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB29													
TT-SB29-0	0	0.051	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB29-5	5	1.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB29-10	10	<0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring TT-SB30													
TT-SB30-0	0	0.020	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB30-10	10	0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TT-SB30-20	20	0.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring WB-SB01				
WB-SB01-10	10	1.9	<5	2.9
WB-SB01-20	20	2.8	<5	1.6
WB-SB01-30	30	0.28	<5	<1
WB-SB01-40	40	0.14	<5	<1
WB-SB01-50	50	0.15	<5	<1
WB-SB01-60	60	0.093	<5	<1
WB-SB01-70	70	<0.04	6.4	<1
WB-SB01-80	80	<0.04	8.9	<1
WB-SB01-90	90	<0.04	8.8	<1
WB-SB01-100	100	<0.04	8.8	<1
WB-SB01-125	125	<0.04	7.1	<1
WB-SB01-150	150	<0.04	6.7	<1
WB-SB01-165	165	<0.04	5.6	<1
Soil Boring WB-SB02				
WB-SB02-10	10	0.9 J	<5	2.8
WB-SB02-20	20	<0.04 UJ	<5	<1
WB-SB02-30	30	<0.04 UJ	<5	<1
WB-SB02-40	40	<0.04 UJ	<5	<1
WB-SB02-50	50	<0.04 UJ	<5	<1
WB-SB02-60	60	<0.04 UJ	<5	<1
WB-SB02-70	70	<0.04	5.1	<1
WB-SB02-80	80	<0.04	<5	<1
WB-SB02-90	90	<0.04	<5	<1
WB-SB02-100	100	<0.04	<5	<1
WB-SB02-125	125	<0.04	<5	<1
WB-SB02-150	150	<0.04	<5	<1
WB-SB02-175	175	<0.04	<5	<1
Soil Boring WB-SB03				
WB-SB03-10	10	0.77	<5	<1
WB-SB03-20	20	0.089	<5	<1
WB-SB03-30	30	0.084	<5	<1
WB-SB03-40	40	<0.04	<5	<1
WB-SB03-50	50	<0.04	<5	<1
WB-SB03-60	60	<0.04	<5	<1
WB-SB03-70	70	<0.04	<5	<1
WB-SB03-80	80	<0.04	<5	<1
WB-SB03-90	90	<0.04	<5	<1
WB-SB03-100	100	<0.04	<5	<1
WB-SB03-125	125	<0.04	<5	<1
WB-SB03-150	150	<0.04	<5	<1
WB-SB03-175	175	<0.04	<5	<1
WB-SB03-200	200	<0.04	5.8	<1
WB-SB03-216	216	0.14	<5	<1

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring WB-SB04				
WB-SB04-10	10	0.077	6.9	<1
WB-SB04-20	20	<0.04	6.9	<1
WB-SB04-30	30	<0.04	7.6	<1
WB-SB04-40	40	<0.04	6.2	<1
WB-SB04-50	50	<0.04	7.3	<1
WB-SB04-60	60	<0.04	7	<1
WB-SB04-70	70	<0.04	8.2	<1
WB-SB04-80	80	<0.04	7.9	<1
WB-SB04-90	90	<0.04	6.9	<1
WB-SB04-100	100	<0.04	8.5	<1
WB-SB04-125	125	<0.04	8.1	<1
WB-SB04-150	150	<0.04	9.1	<1
WB-SB04-175	175	<0.04	6.5	<1
Soil Boring WB-SB05				
WB-SB05-10	10	2.9	8.6	1.9
WB-SB05-20	20	0.35	9.9	<1
WB-SB05-30	30	0.094	9.1	<1
WB-SB05-40	40	0.16	11	<1
WB-SB05-50	50	<0.04	9	<1
WB-SB05-60	60	0.3	7.6	<1
WB-SB05-70	70	<0.04	11 J	<1
WB-SB05-80	80	0.068	6.6	<1
WB-SB05-90	90	0.64	8.3	<1
WB-SB05-100	100	0.041	<5	<1
Soil Boring WB-SB06				
WB-SB06-10	10	130	<5	18
WB-SB06-20	20	53	<5	86
WB-SB06-30	30	21	<5	3.9
WB-SB06-40	40	34	<5	4.3
WB-SB06-50	50	51	<5	8.4
WB-SB06-60	60	84	<5	15
WB-SB06-70	70	98	<5	17
WB-SB06-80	80	85	<5	9
WB-SB06-90	90	93	<5	8.5
WB-SB06-99	100	61	<5	4.3
WB-SB06-125	125	35	<5	3.5
WB-SB06-150	150	8.9	<5	1.1
WB-SB06-175	175	32	<5	2.6

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring WB-SB07				
WB-SB07-10	10	4.8	<5	1.5
WB-SB07-20	20	92	<5	7
WB-SB07-30	30	41	5.1	1.9
WB-SB07-40	40	39	<5	5
WB-SB07-50	50	7.1	<5	1.2
WB-SB07-60	60	24	<5	2.6
WB-SB07-70	70	13	<5	1.1
WB-SB07-80	80	2.2	<5	<1
WB-SB07-90	90	0.065	<5	<1
WB-SB07-100	100	2	<5	<1
WB-SB07-125	125	0.52	<5	<1
WB-SB07-150	150	1.5 J	<5	<1
WB-SB07-175	175	0.7	<5	<1
Soil Boring WB-SB08				
WB-SB08-10	10	<0.04	7	<1
WB-SB08-20	20	0.67	9.1	<1
WB-SB08-30	30	0.053	7.7	<1
WB-SB08-40	40	<0.04	7.3	<1
WB-SB08-50	50	<0.04	8.4	<1
WB-SB08-60	60	<0.04	7.7	<1
WB-SB08-70	70	<0.04	8.3	<1
WB-SB08-80	80	0.047	8.8	<1
WB-SB08-90	90	<0.04	7.7	<1
WB-SB08-100	100	<0.04	7.9	<1
WB-SB08-125	125	<0.04	8.9	<1
WB-SB08-150	150	<0.04	7.5	<1
WB-SB08-175	175	<0.04	8.1	<1
Soil Boring WB-SB09				
WB-SB09-10	10	<0.04	<5	<1
WB-SB09-20	20	0.049	<5	<1
WB-SB09-30	30	<0.04	<5	<1
WB-SB09-40	40	0.3	<5	<1
WB-SB09-50	50	0.36	6.5	<1
WB-SB09-60	60	<0.04	<5	<1
WB-SB09-70	70	<0.04	<5	<1
WB-SB09-80	80	<0.04	<5	<1
WB-SB09-90	90	<0.04	7.7	<1
WB-SB09-100	100	<0.04	6.1	<1

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring WB-SB10				
WB-SB10-10	10	<0.04	7.4	<1
WB-SB10-20	20	0.068	8	<1
WB-SB10-30	30	0.87	7.3	<1
WB-SB10-40	40	1.8	8.3	<1
WB-SB10-50	50	1.3	7.3	<1
WB-SB10-60	60	0.45	7.8	<1
WB-SB10-70	70	2	<5	<1
WB-SB10-80	80	2	<5	<1
WB-SB10-90	90	2.1	5.6	<1
WB-SB10-100	100	4.2	<5	<1
Soil Boring WB-SB11				
WB-SB11-10	10	0.081	5.3	<1
WB-SB11-20	20	0.061	8.2	<1
WB-SB11-30	30	0.34	8.3	<1
WB-SB11-40	40	4.3	8.3	1.8
WB-SB11-50	50	9.4	<5	<1
WB-SB11-60	60	15	8.8	1.1
WB-SB11-70	70	40	8.5	3.2
WB-SB11-80	80	32	<5	3.3
WB-SB11-90	90	13	6.9	<1
WB-SB11-100	100	0.64	7.9	<1
Soil Boring WB-SB12				
WB-SB12-10	10	<0.04	7.6	<1
WB-SB12-20	20	0.42	7.1	<1
WB-SB12-30	30	0.67	8.2	<1
WB-SB12-40	40	0.78	7	<1
WB-SB12-50	50	<0.04	7.7	<1
WB-SB12-60	60	<0.04	10	<1
WB-SB12-70	70	<0.04	7.7	<1
WB-SB12-80	80	<0.04	8.9	<1
WB-SB12-90	90	<0.04	9.9	<1
WB-SB12-100	100	<0.04	7	<1
WB-SB12-125	125	<0.04	8.2	<1
WB-SB12-150	150	<0.04	7.6	<1
WB-SB12-175	175	<0.04	11	<1
Soil Boring WB-SB13				
WB-SB13-0	0	NA	20	NA
WB-SB13-01	1	NA	57 J	NA
WB-SB13-10	10	NA	<5.0 UJ	NA
WB-SB13-20	20	NA	<5.0 UJ	NA
Soil Boring WB-SB14				
WB-SB14-0	0	NA	21	NA
WB-SB14-1	1	NA	<5.0	NA
WB-SB14-2	2	NA	<5.0	NA

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring WB-SB15				
WB-SB15-0	0	NA	31	NA
WB-SB15-1	1	NA	22	NA
Soil Boring A				
A	0.25	<2	NA	NA
A	1	<2	NA	NA
Soil Boring B				
B	0.25	7.95	NA	NA
B	1	150	NA	NA
Soil Boring C				
C	0.25	<2.0	NA	NA
C	1	35	NA	NA
Soil Boring D				
D	0.25	1800	NA	NA
D	1	390	NA	NA
Soil Boring A				
E	0.25	1200	NA	NA
E	1	380	NA	NA
Soil Boring F				
F	0.25	26	NA	NA
F	1	200	NA	NA
Soil Boring G				
G	0.25	<2.0	NA	NA
G	1	<2.0	NA	NA
Soil Boring H				
H	0.25	<2.0	NA	NA
H	1	<2.0	NA	NA
Soil Boring I				
I	0.25	<2.0	NA	NA
I	1	<2.0	NA	NA
Soil Boring J				
J	0.25	<2.0	NA	NA
J	1	<2.0	NA	NA
Soil Boring K				
K	0.25	<2.0	NA	NA
K	1	<2.0	NA	NA
Soil Boring L				
L	0.25	<2.0	NA	NA
L	1	<2.0	NA	NA
Soil Boring M				
M	0.25	<2.0	NA	NA
M	1	<2.0	NA	NA
Soil Boring N				
N	0.25	<2.0	NA	NA
N	1	<2.0	NA	NA

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring O				
O	0.25	<2.0	NA	NA
O	1	<2.0	NA	NA
Soil Boring P				
P	0.25	<2.0	NA	NA
P	1	<2.0	NA	NA
Soil Boring Q				
Q	0.25	<2.0	NA	NA
Q	1	<2.0	NA	NA
Soil Boring R				
R	0.25	<2.0	NA	NA
R	1	NA	NA	NA
Soil Boring S				
S	0.25	<2.0	NA	NA
S	1	<2.0	NA	NA
Soil Boring T				
T	0.25	<2.0	NA	NA
T	1	<2.0	NA	NA
Soil Boring U				
U	0.25	<2.0	NA	NA
U	1	2.4	NA	NA
Soil Boring V				
V	0.25	<2.0	NA	NA
V	1	<2.0	NA	NA
Soil Boring W				
W	0.25	<2.0	NA	NA
W	1	<2.0	NA	NA
Soil Boring X				
X	0.25	<2.0	NA	NA
X	1	<2.0	NA	NA
Soil Boring B, B1, B7				
B, B1, B7	1	150	NA	NA
B, B1, B7	2	152	NA	NA
B, B1, B7	3	173	NA	NA
B, B1, B7	5	40	NA	NA
B, B1, B7	7	23	NA	NA
Soil Boring B2				
B2	1	13	NA	NA
B2	2	48	NA	NA
B2	3	85	NA	NA
Soil Boring B3				
B3	1	<2	NA	NA
B3	2	<2	NA	NA

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring B4				
B4	1	23	NA	NA
B4	2	27	NA	NA
Soil Boring B5				
B5	0.5	19.7	NA	NA
B5	5	3	NA	NA
B5	7.5	0.19	NA	NA
Soil Boring B6				
B6	2.5	0.41	NA	NA
B6	5	<1	NA	NA
B6	7.5	<1	NA	NA
Soil Boring B8				
B8	2.5	22.3	NA	NA
B8	5	46	NA	NA
B8	7.5	24	NA	NA
Soil Boring C5				
C5	2.5	54.1	NA	NA
C5	5	49	NA	NA
C5	7.5	46	NA	NA
C5	10	1.8	NA	NA
Soil Boring D, D1, D5				
D, D1, D5	2	122	NA	NA
D, D1, D5	5	163	NA	NA
D, D1, D5	7.5	236	NA	NA
D, D1, D5	10	193	NA	NA
D, D1, D5	15	358	NA	NA
D, D1, D5	20	369	NA	NA
D, D1, D5	25	232	NA	NA
D, D1, D5	30	255	NA	NA
D, D1, D5	40	150	NA	NA
D, D1, D5	50	20	NA	NA
D, D1, D5	59	5	NA	NA
D, D1, D5	67	0.1	NA	NA
Soil Boring D4				
D4	0.25	22	NA	NA
D4	1	176	NA	NA
D4	2	115	NA	NA
Soil Boring E, E1				
E, E1	2	107	NA	NA
E, E1	3	149	NA	NA
E, E1	4	158	NA	NA

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring E5				
E5	2.5	10.9	NA	NA
E5	5	5	NA	NA
E5	7.5	3	NA	NA
E5	10	0.19	NA	NA
Soil Boring E6				
E6	5	87.4	NA	NA
E6	7.5	95.4	NA	NA
E6	10	53.8	NA	NA
E6	15	55	NA	NA
E6	20	30.7	NA	NA
Soil Boring ED2				
ED2	0.25	270	NA	NA
ED2	1	55	NA	NA
ED2	2.0	101	NA	NA
ED2	3	95	NA	NA
Soil Boring ED3				
ED3	0.25	3	NA	NA
ED3	1	2.9	NA	NA
ED3	2	9	NA	NA
Soil Boring F, F1, F7				
F, F1, F7	2	154	NA	NA
F, F1, F7	5	73	NA	NA
F, F1, F7	7.5	35	NA	NA
F, F1, F7	10	9	NA	NA
Soil Boring F2				
F2	1	2.1	NA	NA
F2	2	65	NA	NA
Soil Boring F3				
F3	1	<2	NA	NA
F3	2	9	NA	NA
Soil Boring F5				
F5	1	22	NA	NA
F5	2	148	NA	NA
F5	3	203	NA	NA
Soil Boring F8				
F8	2.5	3.2	NA	NA
F8	5	41	NA	NA
F8	7.5	50	NA	NA
F8	10	21	NA	NA
Soil Boring F9				
F9	2.5	23.8	NA	NA
F9	5	2	NA	NA
F9	7.5	<0.1	NA	NA
F9	10	<0.1	NA	NA

Table D-5

Waterbore Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Lead (mg/kg)	Nitrate-N (mg/kg)
Residential Soil Remediation Level		**55**	**400**	**100,000**
Soil Boring FE4				
FE4	0.25	82	NA	NA
FE4	1	73	NA	NA
FE4	2	88	NA	NA
FE4	3	72	NA	NA
Soil Boring SH-1				
SH-1	0-10	2.3	NA	NA
SH-1	10-20	2.6	NA	NA
SH-1	20-30	0.4	NA	NA
SH-1	30-40	0.13	NA	NA
SH-1	40-50	0.1	NA	NA

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
NA = not analyzed
mg/kg = milligrams per kilogram
UJ = Estimated laboratory detection limit.

Table D-6

Waterbore Area Supplemental Soil Analytical Results for Metals

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring WB-SB13									
WB-SB13-0	0	<5.0	130	<0.50	17	20	<0.020	<5.0	<0.50
WB-SB13-1	1	5.8	110	<0.50	13	57 J	<0.10	<5.0	<0.50
WB-SB13-10	10	5.7	170	<0.50	10	<5.0 UJ	<0.10	<5.0	<0.50
WB-SB13-20	20	7.8	180	<0.50	15	<5.0 UJ	<0.10	<5.0	<0.50
Soil Boring WB-SB14									
WB-SB14-0	0	<5.0	96	0.88	15	21	<0.020	<5.0	<0.50
WB-SB14-1	1	<5.0	110	<0.50	15	<5.0	<0.020	<5.0	<0.50
WB-SB14-2	2	<5.0	110	<0.50	14	<5.0	<0.020	<5.0	<0.50
Soil Boring WB-SB15									
WB-SB15-0	0	<5.0	100	<0.50	14	31	<0.020	<5.0	<0.50
WB-SB15-1	1	<5.0	120	<0.50	17	22	<0.020	<5.0	<0.50

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
UJ = Estimated laboratory detection limit.

Table D-7

Storage Magazine Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Barium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Lead (mg/kg)
Residential Soil Remediation Level		**55**	**15,000**	**16,000**	**39**	**120,000**	**900**	**400**
Soil Boring SMA-SB01								
SMA-SB01-0	0	<0.04	160	<50	<0.5	16	11	16
SMA-SB01-0.5	1	0.042	140	<50	<0.5	13	12	11
Soil Boring SMA-SB02								
SMA-SB02-0	0	<0.04	100	<50	<0.5	12	8.6	15
SMA-SB02-0.5	1	<0.04	91	<50	<0.5	12	5	7.7
Soil Boring SMA-SB03								
SMA-SB03-0	0	0.041	87	<50	<0.5	11	5.6	9.8
SMA-SB03-1	1	<0.04	97	<50	<0.5	13	6.9	11
Soil Boring SMA-SB04								
SMA-SB04-0	0	0.23	57	<50	<0.5	5.3	<5	6.1
SMA-SB04-1	1	<0.04	120	<50	<0.5	15	7.1	11
Soil Boring SMA-SB05								
SMA-SB05-0	0	2.5	150	<50	<0.5	24	15	29
SMA-SB05-1	1	0.37	130	<50	<0.5	19	11	13
SMA-SB05-5	5	6.2	100	<50	<0.5	6.5	6.1	6.3
SMA-SB05-10	10	1.6	86	<50	<0.5	6.2	<5	5.3
SMA-SB05-20	20	0.64	NA	NA	NA	NA	NA	NA
Soil Boring SMA-SB06								
SMA-SB06-0	0	5.1 J	130	<50	<0.5	17	10	100 J
SMA-SB06-1	1	0.52	120	<50	<0.5	15	8.5	35
SMA-SB06-5	5	0.036	100	<50	<0.5	<1	5	17
SMA-SB06-10	10	0.032	110	<50	<0.5	17	5	5.1
Soil Boring SMA-SB07								
SMA-SB07-0	0	0.49	110	<50	<0.5	16	6.4	15
SMA-SB07-1	1	0.23	110	<50	<0.5	17	7.6	12
Soil Boring SMA-SB08								
SMA-SB08-0	0	2.1 J	110	<50	<0.5	19	6.9	21
SMA-SB08-0.5	1	1.3	110	<50	<0.5	18	7.7	14
Soil Boring SMA-SB09								
SMA-SB09-0	0	0.47	120	<50	<0.5	22	7.9	15
SMA-SB09-1	1	0.67 J	130	<50	<0.5	22	8.8	15

Table D-7

Storage Magazine Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Barium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Lead (mg/kg)
Residential Soil Remediation Level		**55**	**15,000**	**16,000**	**39**	**120,000**	**900**	**400**
Soil Boring SMA-SB10								
SMA-SB10-0	0	0.92 J	110	<50	<0.5	16	8.6	29 J
SMA-SB10-1	1	1.0 J	100	<50	<0.5	18	7.6	15
Soil Boring SMA-SB11								
SMA-SB11-0	0	0.16 J	120	<50	<0.5	15	6.9	17
SMA-SB11-1	1	0.040 J	120	<50	<0.5	20	7.7	16
Soil Boring SMA-SB12								
SMA-SB12-0	0	<0.04 UJ	83	<50	<0.5	8.8	6.0	12
SMA-SB12-1	1	<0.04 UJ	92	<50	<0.5	8	5.4	13
Soil Boring SMA-SB13								
SMA-SB13-0	0	0.088 J	58	<50	<0.5	5.6	<5.0	9.2
SMA-SB13-1	1	<0.04 UJ	110	<50	<0.5	17	8.1	15
Soil Boring SMA-SB14								
SMA-SB14-0	0	<0.04 UJ	120	<50	<0.5	21	7.1	12
SMA-SB14-1	1	<0.04 UJ	110	<50	<0.5	20	6.6	9.4
Soil Boring SMA-SB15								
SMA-SB15-0	0	<0.04	110	<50	<0.5	22	7.6	15
SMA-SB15-1	1	<0.04	110	<50	<0.5	23	8.4	9
Soil Boring SMA-SB16								
SMA-SB16-0	0	0.76	100	<50	<0.5	9	7.3	11
SMA-SB16-1	1	0.18	110	<50	<0.5	22	7.5	9.7
Soil Boring SMA-SB17								
SMA-SB17-0	0	0.24	120	<50	<0.5	27	8.8	10
SMA-SB17-1	1	2.9	120	<50	<0.5	25	9.3	11
SMA-SB17-5	5	0.071	NA	NA	NA	NA	NA	NA
SMA-SB17-10	10	0.05	NA	NA	NA	NA	NA	NA
Soil Boring SMA-SB18								
SMA-SB18-0	0	0.086	110	<50	<0.5	15	6.4	14
SMA-SB18-1	1	<0.04	92	<50	<0.5	23	5.7	10
Soil Boring SMA-SB19								
SMA-SB19-0	0	<0.04	90	<50	<0.5	11	<5	10
SMA-SB19-1	1	0.044	95	<50	<0.5	14	6.2	11

Table D-7

Storage Magazine Area Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Barium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Lead (mg/kg)
Residential Soil Remediation Level		**55**	**15,000**	**16,000**	**39**	**120,000**	**900**	**400**
Soil Boring SMA-SB20								
SMA-SB20-0	0	0.07	89	<50	<0.5	15	5.7	12
SMA-SB20-1	1	0.095	110	<50	<0.5	18	8.2	11
Soil Boring SMA-SB21								
SMA-SB21-0	0	0.098	85	<50	<0.5	15	6.2	10
SMA-SB21-1	1	<0.04	86	<50	<0.5	17	5.7	9.5
Soil Boring SMA-SB22								
SMA-SB22-0	0	0.25	130	<50	<0.5	20	9.1	13
SMA-SB22-1	1	0.066	140	<50	<0.5	29	11	12
Soil Boring SMA-SB23								
SMA-SB23-0	0	0.21	100	<50	<0.5	20	8.4	15
SMA-SB23-1	1	0.12	87	<50	<0.5	16	21	11
Soil Boring SMA-SB24								
SMA-SB24-0	0	<0.04	150	<50	<0.5	31	8.9	16
SMA-SB24-1	1	<0.04	120	<50	<0.5	19	9.2	13
Soil Boring SMA-SB25								
SMA-SB25-0	0	<0.04	87	<50	<0.5	16	6.9	9.4
SMA-SB25-1	1	<0.04	84	<50	<0.5	17	5.3	9.5
Soil Boring SMA-SB26								
SMA-SB26-0	0	<0.04	110	<50	<0.5	20	9.5	11
SMA-SB26-1	1	<0.04	87	<50	<0.5	17	7.6	9.6
Soil Boring SMA-SB27								
SMA-SB27-5	5	<0.04	76	<50	<0.5	3	<5	<5
SMA-SB27-10	10	<0.04	79	<50	<0.5	12	<5	<5

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed
SMA = Storage Magazine Area
UJ = Estimated laboratory detection limit.

Table D-8

F-Complex Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring FC-SB01											
FC-SB01-0	0	0.047	<1	8.3	140	<0.5	8.5	12	<0.02	<5	<0.5
FC-SB01-10	10	0.86	<1	8	170 J	<0.5	24	12	<0.02	<5	<0.5
FC-SB01-20	20	0.71	<1	6.1	160	<0.5	25	9.8	<0.02	<5	<0.5
FC-SB01-30	30	<0.04	<1	5.2	200	<0.5	17	11	<0.02	<5	<0.5
Soil Boring FC-SB02											
FC-SB02-0	0	6.3	43	<5	340	<0.5	20	6.9	0.031	<5	<0.5
FC-SB02-10	10	<0.04	<1	7.9	340	<0.5	28	8.5	<0.02	<5	<0.5
FC-SB02-20	20	<0.04	<1	12	250	<0.5	30	6.2	<0.02	<5	1.1
FC-SB02-30	30	1.2	4.8	10	130	<0.5	50	6.5	<0.02	<5	3.1
FC-SB02-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB02-50	50	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring FC-SB03											
FC-SB03-0	0	2	4.5	6	210	<0.5	16	47	0.037	<5	<0.5
FC-SB03-10	10	0.092	<1	6.9	100	<0.5	23	8.4	<0.02	<5	1.7
FC-SB03-20	20	0.074	<1	6.5	180	<0.5	31	10	<0.02	<5	0.64
FC-SB03-30	30	0.97	<1	6.5	180	<0.5	31	8.5	<0.02	<5	<0.5
Soil Boring FC-SB04											
FC-SB04-0	0	<0.04	<1 UJ	5.3	380	<0.5	20	6	<0.02	<5	<0.5
FC-SB04-10	10	<0.04	<1 UJ	5.6	200	<0.5	27	7.4	<0.02	<5	<0.5
FC-SB04-20	20	<0.04	<1	7.1	180	<0.5	24	6.4	<0.02	<5	<0.5
FC-SB04-30	30	<0.04	<1	7.3	190	<0.5	28	7	<0.02	<5	<0.5
Soil Boring FC-SB05											
FC-SB05-0	0	0.049	<1	5.9	420	<0.5	22	6.4	<0.02	<5	<0.5
FC-SB05-10	10	<0.04	<1	5.7	190	<0.5	25	6.9	<0.02	<5	<0.5
FC-SB05-20	20	<0.04	<1	6.7	160	<0.5	27	6.8	<0.02	<5	<0.5
FC-SB05-30	30	0.12	<1	7	140	<0.5	26	9.4	<0.02	<5	<0.5
Soil Boring FC-SB06											
FC-SB06-0	0	0.05	8	6.3	310	<0.5	18	8.1	0.023	<5	<0.5
FC-SB06-10	10	<0.04	<1	6.1	210	<0.5	27	9.8	<0.02	<5	<0.5
FC-SB06-20	20	<0.04	<1	11	130	<0.5	17	10	<0.02	<5	<0.5
FC-SB06-30	30	<0.04	<1	5.9	160	<0.5	28	9	<0.02	<5	<0.5
FC-SB06-40	40	<0.04	<1	6.8	210	<0.5	23	12	0.044 J	<5	<0.5
FC-SB06-50	50	<0.04	<1	10	170	<0.5	22	7.5	<0.02	<5	<0.5

Table D-8

F-Complex Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring FC-SB07											
FC-SB07-0	0	<0.04	<1	5.3	140 J	<0.5	15	5.6 J	<0.02 J	<5	<0.5
FC-SB07-10	10	<0.04	<1	6.1	350	<0.5	22	6.6	<0.02	<5	<0.5
Soil Boring FC-SB08											
FC-SB08-0	0	0.13	<1	9.9	310	<0.5	11	14	<0.02	<5	<0.5
FC-SB08-10	10	0.12	<1	6.9	200	<0.5	40	9.2	<0.02	<5	0.52
FC-SB08-20	20	0.04	<1	5.9	190	<0.5	27	11	<0.02	<5	<0.5
FC-SB08-30	30	0.056	<1	7.5	180	<0.5	34	11	<0.02	<5	1.9
FC-SB08-40	40	0.53	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB08-50	50	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring FC-SB09											
FC-SB09-0	0	0.19	<1	<5	300	<0.5	18	10	0.024	<5	<0.5
FC-SB09-10	10	<0.04	<1	8.1	200	<0.5	26	9.7	<0.02	<5	<0.5
FC-SB09-20	20	<0.04	<1	5.4	140	<0.5	18	8.5	<0.02	<5	16
FC-SB09-30	30	<0.04	<1	6.9	200	<0.5	21	11	<0.02	<5	1
Soil Boring FC-SB10											
FC-SB10-0	0	<0.04	<1 UJ	6	210	<0.5	21	9.3	<0.02	<5	<0.5
FC-SB10-10	10	<0.04	<1	<5	220	<0.5	17	5.2	<0.02	<5	<0.5
Soil Boring FC-SB11											
FC-SB11-0	0	<0.04	1.3	6.8	240	<0.5	23	12	0.021	<5	<0.5
FC-SB11-10	10	0.12	1.1	6.5	210	<0.5	22	9.8	<0.02	<5	<0.5
FC-SB11-20	20	0.19	<1	7	190	<0.5	19	11	0.02	<5	<0.5
FC-SB11-30	30	0.23	<1	5	150	<0.5	17	8.7	<0.02	<5	<0.5
Soil Boring FC-SB12											
FC-SB12-0	0	0.11	<1	6.5	250	0.59	19	9.8	<0.02	<5	<0.5
FC-SB12-10	10	0.047	1.1 J	8.1	150	<0.5	14	11	0.031	<5	<0.5
FC-SB12-20	20	<0.04	<1 UJ	<5	200	<0.5	14	6.6	<0.02	<5	<0.5
FC-SB12-30	30	<0.04	2.9 J	5.1	300	<0.5	19	9.7	<0.02	<5	<0.5
Soil Boring FC-SB13											
FC-SB13-0	0	0.16	<1	5.2	71	<0.5	6.5	6.7	<0.02	<5	<0.5
FC-SB13-5.5	5.5	<0.04	<1	<5	87	<0.5	14	<5	<0.02	<5	0.52
Soil Boring FC-SB14											
FC-SB14-15.5	15.5	<0.04	4.9	6.8	120	<0.5	17	11	<0.02	<5	<0.5
Soil Boring FC-SB15											
FC-SB15-0	0	0.092 J	<1	<5	150	<0.5	14	54	<0.02	<5	<0.5
FC-SB15-1	1	<0.04	<1	<5	78	<0.5	13	25	<0.02	<5	<0.5

Table D-8

F-Complex Soil Analytical Results for Inorganics

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**10**	**15,000**	**39**	**120,000**	**400**	**23**	**390**	**390**
Soil Boring FC-SB16											
FC-SB16-0	0	5.3	2.8	<5	500	<0.5	18	5	<0.02	<5	<0.5
FC-SB16-1	1	5.3	1.4	<5	690	<0.5	19	<5	<0.02	<5	<0.5
Soil Boring FC-SB17											
FC-SB17-0	0	2.8	<1	<5	250	<0.5	8.5	<5	0.025	<5	<0.5
FC-SB17-1	1	6.5	<1	<5	270	<0.5	14	<5	0.021	<5	<0.5
Soil Boring FC-SB18											
FC-SB18-0	0	0.63	2.9	<5	240	<0.5	12	6.7	0.028	<5	<0.5
FC-SB18-1	1	0.13	3	<5	220	<0.5	13	<5	0.02	<5	<0.5
Soil Boring FC-SB19											
FC-SB19-0	0	0.24	6.4	<5	270	<0.5	13	6.6	0.021	<5	<0.5
FC-SB19-1	1	<0.04	3.3	<5	160	<0.5	11	5.4	<0.02	<5	<0.5
Soil Boring FC-SB20											
FC-SB20-0	0	0.38	6.1	<5	240	<0.5	15	<5	<0.02	<5	<0.5
FC-SB20-1	1	0.3	4.2	<5	200	<0.5	15	5.2	0.04 J	<5	<0.5
Soil Boring FC-SB24											
FC-SB24-40	40	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB24-50	50	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB24-60	60	0.47	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring FC-SB25											
FC-SB25-40	40	0.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB25-50	50	0.42	NA	NA	NA	NA	NA	NA	NA	NA	NA
FC-SB25-60	60	<0.040	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed
UJ = Estimated laboratory detection limit.

Table D-9

New Burn Area (OBU) Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring NB-SB01													
NB-SB01-0	0	15	13 J	12,000	15	69	<0.5	22	40	15	<0.02 UJ	<5	<0.5
NB-SB01-10	10	1.8	<1	20,000	7.8	390	<0.5	25	53	8.4	<0.02	<5	<0.5
NB-SB01-20	20	3.8	<1	15,000	<5	140	<0.5	9.7	12	<5	<0.02 UJ	<5	4.1
NB-SB01-30	30	7.9	1.4 J	20,000	6.9	200	<0.5	20	32	8.1	<0.02 UJ	<5	<0.5
NB-SB01-40	40	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB01-50	50	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB01-56	56	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB02													
NB-SB02-0	0	150 J	27 J	17,000	9.2	120	3.9	35 J	35	40 J	<0.02 UJ	<5	<0.5
NB-SB02-10	10	19	1.2	19,000	<5	470	<0.5	17	25	11	<0.02	<5	<0.5
NB-SB02-20	20	15	2.3	21,000	<5	200	<0.5	13	16	8.6	<0.02	<5	3.1
NB-SB02-30	30	6.8	2.1	39,000	<5	240	<0.5	30	12	15	<0.02	<5	4.8 J
NB-SB02-40	40	0.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB02-50	50	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB03													
NB-SB03-0	0	27	5.6 J	20,000	<5	200	<0.5	15	28	6.9	<0.02	<5	<0.5
NB-SB03-10	10	3.5	1.6	21,000	5.4	380	<0.5	22	44	9.4	<0.02	<5	<0.5
NB-SB03-20	20	2.9	<1	18,000	7.7	120	<0.5	21	34	9.6	<0.02	<5	<0.5
NB-SB03-30	30	12	<1	34,000	<5	310	<0.5	18	16	13	<0.02	<5	<0.5
NB-SB03-40	40	6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB03-45	45	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB04													
NB-SB04-0	0	0.15	<1	19,000	6.5	120	2.4	21	28	110	<0.02	<5	<0.5
NB-SB04-1	1	14	9.6 J	10,000	<5	120	<0.5	7.8	13	5.4	<0.02	<5	<0.5
NB-SB04-5	5	7.6	7.3 J	12,000	5	130	<0.5	22	17	21	<0.02	5.7	<0.5
NB-SB04-10	10	0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB04-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB04-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB04-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB04-50	50	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB04-60	60	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB05													
NB-SB05-0	0	0.085 J	<1	21,000	5.8	150	1.7	20	28	130 J	<0.02	<5	<0.5
NB-SB05-1	1	1.3	<1	18,000	<5	130	<0.5	11	22	10	0.033	<5	<0.5
Soil Boring NB-SB06													
NB-SB06-0	0	2.4	<1	19,000	5.9	120	1.2	19	26	82	0.075	<5	<0.5
NB-SB06-1	1	0.49	<1	18,000	<5	95	<0.5	16	21	7.3	<0.02	<5	<0.5
NB-SB06-5	5	18 J	3.5 J	6,100	<5	140 J	<0.5	8.2	7	7.4	0.078 J	8.4	<0.5
NB-SB06-10	10	5.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB06-20	20	2.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB06-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB06-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB06-50	50	0.57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB07													
NB-SB07-0	0	0.25	<1	19,000	5.5	120	2.8	20	29	140	0.068	<5	<0.5
NB-SB07-1	1	6.9	<1	23,000	6	200	1.2	21	29	280	0.053	<5	<0.5

Table D-9

New Burn Area (OBU) Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring NB-SB08													
NB-SB08-0	0	0.065	<1	16,000	5.8	120	5.9	19	28	130	<0.02	<5	<0.5
NB-SB08-0A	0	9.8	2.8 J	13,000	<5	110	<0.5	12	20	8	<0.02	<5	<0.5
NB-SB08-1A	1	26	8 J	12,000	<5	110	<0.5	13	18	<5	<0.02	<5	<0.5
NB-SB08-5A	5	61	10 J	14,000	<5	150	<0.5	16	21	<5	<0.02	6.2	<0.5
NB-SB08-10	10	32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB08-20	20	9.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB08-30	30	0.33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB08-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB09													
NB-SB09-0	0	0.11	<1	17,000	6.2	120	3.9	20	28	650	0.057	<5	<0.5
NB-SB09-1	1	<0.04	<1	18,000	5.2	130	1.8	16	26	270	0.035	<5	<0.5
Soil Boring NB-SB10													
NB-SB10-0	0	0.098	<1	19,000	<5	160	1.7	17	43	58	0.076	<5	<0.5
NB-SB10-1	1	1.3	3.2 J	20,000	<5	130	<0.5	12	36	<5	<0.02	<5	<0.5
NB-SB10-5	5	7	4 J	19,000	5.3	130	<0.5	27	27	12	<0.02	<5	<0.5
NB-SB10-10	10	36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB10-20	20	6.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB10-30	30	0.33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB10-40	40	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB11													
NB-SB11-0	0	0.91	<1	22,000	6	140	2.4	24	30	93	0.069	<5	<0.5
NB-SB11-1	1	0.22	<1	22,000	5.7	130	0.63	19	27	23	0.039	<5	<0.5
Soil Boring NB-SB12													
NB-SB12-0	0	3.2	1	21,000	6.2	130	5.1	22	28	140	0.053	<5	<0.5
NB-SB12-1	1	0.18	1.3 J	13,000	<5	98	<0.5	11	17	<5	<0.02	<5	<0.5
NB-SB12-5	5	41	17 J	18,000	6.3	570	<0.5	25	31	6.4	<0.02	<5	<0.5
NB-SB12-10	10	38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB12-20	20	6.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB12-30	30	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB13													
NB-SB13-0	0	0.081	<1	24,000	6.7	140	7.9	23	31	100	0.045	<5	<0.5
NB-SB13-1	1	0.11 J	<1	18,000	5	150	1.4 J	23	26	20	0.028	<5	<0.5
Soil Boring NB-SB14													
NB-SB14-0	0	<0.04	<1	27,000	5.9	160	2.3	22	30	33	0.02	<5	<0.5
NB-SB14-1	1	<0.04	<1	21,000	<5	130	0.54	18	22	12	0.029	<5	<0.5
Soil Boring NB-SB15													
NB-SB15-0	0	<0.04	<1	24,000	5	160	1.3	21	34	20	0.027	<5	<0.5
NB-SB15-1	1	<0.04	<1	24,000	<5	150	<0.5	21	26	7	0.023	<5	<0.5
Soil Boring NB-SB16													
NB-SB16-0	0	<0.04	<1	24,000	<5	160	0.82	20	26	17	0.02	<5	<0.5
NB-SB16-1	1	0.05	<1	20,000	<5	130	0.59	22	22	8.3	0.024	<5	<0.5
NB-SB16-5	5	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB16-10	10	0.046	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB16-13	13	0.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB17													
NB-SB17-0	0	<0.04	<1	13000	5.8	120	<0.5	9.8	20	26	<0.02	<5	<0.5
NB-SB17-1	1	<0.04	<1	12,000	6.3	89	<0.5	12	21	25	<0.02	<5	<0.5

Table D-9

New Burn Area (OBU) Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring NB-SB18													
NB-SB18-0	0	<0.04	<1	14,000	5.7	110	<0.5	13	23	38	0.041	<5	<0.5
NB-SB18-1	1	<0.04	<1	13,000	<5	110	<0.5	11	21	35	0.036	<5	<0.5
Soil Boring NB-SB19													
NB-SB19-0	0	<0.04	<1	15,000	7.5	130	<0.5	22	26	37	0.024	<5	<0.5
NB-SB19-1	1	0.049	<1	16,000	<5	120	0.5	16	26	15	0.041	<5	<0.5
NB-SB19-5	5	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB19-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB20													
NB-SB20-0	0	<0.04	<1	16,000	7.2	130	0.53 J	21	18	45	<0.02	<5	<0.5
NB-SB20-1	1	<0.04	<1	18,000	<5	110	<0.5	16	22	5.2	0.023	<5	<0.5
Soil Boring NB-SB21													
NB-SB21-0	0	<0.04	<1	19,000	6	110	0.6	17	30	30	0.034	<5	<0.5
NB-SB21-1	1	<0.04	<1	14,000	<5	110	<0.5	14	19	<5	0.033	<5	<0.5
Soil Boring NB-SB22													
NB-SB22-0	0	0.48	<1	23,000	7.2	130	0.7	22	32	27	0.046	<5	<0.5
NB-SB22-1	1	0.37	<1	21,000	6	97	<0.5	16	27	6.6	0.033	<5	<0.5
NB-SB22-5	5	0.071	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB22-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB23													
NB-SB23-0	0	0.09	<1	17,000	5.8	130	<0.5	16	23	14	0.032	<5	<0.5
NB-SB23-1	1	<0.04	<1	10,000	<5	150	<0.5	10	14	<5	<0.02	<5	<0.5
Soil Boring NB-SB24													
NB-SB24-0	0	0.07	<1	28,000	7	140	<0.5	24	33	27	0.032	<5	<0.5
NB-SB24-1	1	<0.04	<1	20,000	7.3	92	<0.5	17	29	12	0.038	<5	<0.5
Soil Boring NB-SB25													
NB-SB25-0	0	0.22	<1	18,000	<5	99	0.6	17	26	12	0.021	<5	<0.5
NB-SB25-1	1	0.073	<1	17,000	5.2	110	<0.5	17	21	6.1	<0.02	<5	<0.5
NB-SB25-5	5	0.16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB25-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB26													
NB-SB26-0	0	<0.04	<1	22,000	5.8	130	0.91	19	31	21	0.025	<5	<0.5
NB-SB26-1	1	<0.04	<1	20,000	5	140	0.58	17	27	12	<0.02	<5	<0.5
Soil Boring NB-SB27													
NB-SB27-0	0	0.087	<1	19,000	5.3	120	1.1	18	26	42	0.078	<5	<0.5
NB-SB27-1	1	<0.04	<1	20,000	5	110	0.65	18	25	26	0.03	<5	<0.5
Soil Boring NB-SB28													
NB-SB28-0	0	0.076 J	<1	25,000	6.1	150	0.92	23	33	23	0.02	<5	<0.5
NB-SB28-1	1	<0.04	<1	21,000	<5	120	0.53	17	31	7.1	<0.02	<5	<0.5
Soil Boring NB-SB29													
NB-SB29-0	0	<0.04	<1	29,000	8.3	180	1.1	28	38	48	0.029 J	<5	<0.5
NB-SB29-1	1	<0.04	<1	23,000	6.8	130	<0.5	19	35	13	0.033	<5	<0.5
Soil Boring NB-SB30													
NB-SB30-0	0	<0.04	<1	25,000	7.4	140	<0.5	25	28	13	0.046	<5	<0.5
NB-SB30-1	1	<0.04	<1	22,000	6.3	140	<0.5	23	26	10	0.041	<5	<0.5
Soil Boring NB-SB31													
NB-SB31-0	0	<0.04	<1	16,000	5.9	120	<0.5	14	27	13	<0.02	<5	<0.5
NB-SB31-1	1	<0.04	<1	20,000	7.6	120	<0.5	17	32	13	0.028	<5	<0.5

Table D-9

New Burn Area (OBU) Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring NB-SB32													
NB-SB32-0	0	0.086	<1	19,000	7.1	140	0.69	19	30	27	0.026	<5	<0.5
NB-SB32-1	1	<0.04	<1	17,000	6.1	130	0.51	16	26	16	0.023	<5	<0.5
Soil Boring NB-SB33													
NB-SB33-0	0	0.14	<1	20,000	6.4	140	<0.5	20	31	16	0.026	<5	<0.5
NB-SB33-1	1	<0.04	<1	19,000	6.6	120	<0.5	18	29	7.7	<0.02	<5	<0.5
Soil Boring NB-SB34													
NB-SB34-0	0	0.28	<1	21,000	6.3	130	<0.5	22	29	19	<0.02	<5	<0.5
NB-SB34-1	1	0.2	<1	16,000	<5	140	<0.5	14	25	6.7	0.02	5.8	<0.5
NB-SB34-5	5	0.067	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB34-10	10	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB35													
NB-SS35-0	0	0.048	<1	20,000	8	120	<0.5	19	26	13	<0.02	<5	<0.5
NB-SB35-1	1	<0.04	<1	20,000	5.4	110	<0.5	17	22	9.2	<0.02	<5	<0.5
Soil Boring NB-SB36													
NB-SB36-0	0	<0.04	<1	22,000	6.3	130	1.3	18	29	17	<0.02	<5	<0.5
NB-SB36-1	1	<0.04	<1	22,000	6.7	150	0.71	18	29	12	<0.02	<5	<0.5
Soil Boring NB-SB37													
NB-SB37-0	0	<0.04	<1	15,000	5.8	110	0.63	13	24	50	<0.02	<5	<0.5
NB-SB37-1	1	<0.04	<1	12,000	5.1	100	<0.5	10	20	32	<0.02	<5	<0.5
Soil Boring NB-SB38													
NB-SB38-0	0	NA	NA	NA	NA	NA	NA	NA	NA	46	NA	NA	NA
Soil Boring NB-SB039													
NB-SB39-0	0	0.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB39-10	10	33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB40													
NB-SB40-0	0	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB40-7	7	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB41													
NB-SB41-0	0	0.068	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB41-10	10	0.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB41-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB42													
NB-SB42-0	0	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB42-10	10	0.053	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB42-20	20	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB43													
NB-SB43-0	0	0.078	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB43-5	5	54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table D-9

New Burn Area (OBU) Soil Sample Analytical Results for Inorganics

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Sample ID	Sample Depth (feet bgs)	Perchlorate (mg/kg)	Nitrate-N (mg/kg)	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
Residential Soil Remediation Level		**55**	**100,000**	**76,000**	**10**	**15,000**	**39**	**120,000**	**3,100**	**400**	**23**	**390**	**390**
Soil Boring NB-SB44													
NB-SB44-0	0	14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB44-5	5	26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB45													
NB-SB45-0	0	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB45-5	5	<0.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB46													
NB-SB46-0	0	0.041	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB46-10	10	0.58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Boring NB-SB47													
NB-SB47-0	0	0.043	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NB-SB47-10	10	0.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
< = Analyte not reported above the listed laboratory detection limit.
bgs = below ground surface
J = The analyte was positively identified; however, the result should be considered an estimated value.
mg/kg = milligrams per kilogram
NA = not analyzed
UJ = Estimated laboratory detection limit.

Table D-10
New Burn Area Soil Boring Analytical Data for Perchlorate

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Boring ID	Boring Depth (feet bgs)	Total Samples Collected	Analysis	Sample Depth (feet bgs)					
				5	10	15	20	25	30
				Concentrations (mg/kg)					
NB-SB72	30	6	Perchlorate	**143**	**69.1**	**17.0**	**8.54**	NA	NA
NB-SB73	30	6	Perchlorate	**251**	**136**	**17.3**	**10.1**	NA	NA
NB-SB74	30	6	Perchlorate	**0.141**	**5.83**	**21.8**	**33.5**	**22.8**	**18.6**
NB-SB75	30	6	Perchlorate	**3.34**	**6.41**	**3.08**	**17.0**	**28.1**	**16.9**
NB-SB76	30	6	Perchlorate	NA	NA	**0.591**	**5.86**	NA	NA
NB-SB77	30	6	Perchlorate	NA	NA	**7.16**	**6.43**	NA	NA
NB-SB78	30	6	Perchlorate	NA	NA	**4.00**	**6.43**	NA	NA
Perchlorate Cleanup Standard				**16 mg/kg**					

Notes:

Bold results depict detected concentrations.
Highlighted concentrations exceed cleanup standard.

* = duplicate results

< = Analyte was not detected at or above the method reporting limit.

bgs = below ground surface

mg/kg = milligrams per kilogram

NA = soil sample not analyzed

Table D-11A

Old Burn Area Soil Analytical Data for Arsenic and Total Lead

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Boring ID	Boring Depth (feet bgs)	Total Samples Collected	Analysis	Sample Depth (feet)					
				1	2	3	5	7	10
				Concentrations (mg/kg)					
OB-SB53	2	2	Arsenic	**7.0**	NA	NC	NC	NC	NC
OB-SB54	2	2	Arsenic	**5.8**	NA	NC	NC	NC	NC
OB-SB55	2	2	Arsenic	**7.2 / 7.3***	NA	NC	NC	NC	NC
OB-SB56	2	2	Arsenic	**18.6**	**14.2**	NC	NC	NC	NC
OB-SB64	10	5	Arsenic	**9.2**	**9.7**	**7.8**	NA	NA	NA
OB-SB57	2	2	Total Lead	**27.4**	**3.9 / 3.7***	NC	NC	NC	NC
OB-SB58	2	2	Total Lead	**<1.8**	**<1.6**	NC	NC	NC	NC
OB-SB59	2	2	Total Lead	**5.4**	**3.8 / 4.7***	NC	NC	NC	NC
OB-SB60	2	2	Total Lead	**25.0**	**1950**	NC	NC	NC	NC
OB-SB61	2	2	Total Lead	**3.9**	**4.4**	NC	NC	NC	NC
OB-SB62	2	2	Total Lead	**4.5**	**4.5**	NC	NC	NC	NC
OB-SB63	2	2	Total Lead	**4.4**	**1.8**	NC	NC	NC	NC
OB-SB65	10	5	Total Lead	NC	**13**	**14**	NA	NA	NA
Arsenic Cleanup Standard				**10 mg/kg**					
Lead Cleanup Standard				**400 mg/kg**					

Notes:

* = Duplicate results.

< = Analyte was not detected at or above the method reporting limit.

BOLD = Bold type depicts detected concentrations.

Highlighted concentration exceeds cleanup standard.

Acronyms and Abbreviations:

bgs = below ground surface

mg/kg = milligrams per kilogram

NA = soil sample not analyzed

NC = soil sample not collected

Table 11B
C-Complex Area Soil Analytical Data for Perchlorate

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Boring ID	Boring Depth (ft bgs)	Total Samples Collected	Analysis	Sample Depth (ft bgs)						
				0	2	5	10	15	20	25
				Concentrations (mg/kg)						
CC-SB26	5	3	Perchlorate	**<0.0084**	**1.14**	NA	NC	NC	NC	NC
CC-SB27	5	3	Perchlorate	**0.0473**	**10.8**	NA	NC	NC	NC	NC
CC-SB28	15	3	Perchlorate	NC	NC	**14.6**	**1.44 / 1.31***	**6.66**	NC	NC
CC-SB29	15	3	Perchlorate	NC	NC	**15.1**	**1.26**	**2.41**	NC	NC
CC-SB30	5	3	Perchlorate	**4.77**	**26.9**	**0.395**	NC	NC	NC	NC
CC-SB31	5	3	Perchlorate	**15.1**	**5.81**	**0.337**	NC	NC	NC	NC
CC-SB32	25	3	Perchlorate	NC	NC	NC	NC	**0.834**	**2.75**	**6.25**
CC-SB33	25	3	Perchlorate	NC	NC	NC	NC	**33.5**	**20.4**	**11.7**
CC-SB34	25	3	Perchlorate	NC	NC	NC	NC	**0.584**	**0.547 / 0.481***	**0.683**
CC-SB35	25	3	Perchlorate	NC	NC	NC	NC	**0.0602**	**0.0579**	**<0.01**
CC-SB36	25	3	Perchlorate	NC	NC	NC	NC	**48**	**83.2**	**5.07**
Perchlorate Cleanup Standard				**16 mg/kg**						

Notes:

* = Duplicate results.

< = Analyte was not detected at or above the method reporting limit.

BOLD = Bold type depicts detected concentrations.

Highlighted concentration exceeds cleanup standard.

Acronyms and Abbreviations:

ft bgs = feet below ground surface

mg/kg = milligrams per kilogram

NA = soil sample not analyzed

NC = soil sample not collected

Table 11C
Storage Magazine Area (E-Complex) Soil Analytical Data For Perchlorate

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Boring ID	Boring Depth (ft bgs)	Total Samples Collected	Analysis	Sample Depth (ft bgs)		
				0	1	2
				Concentrations (mg/kg)		
SMA-SB28	2	3	Perchlorate	0.0128	0.0649	NA
SMA-SB29	2	3	Perchlorate	<0.0083	<0.0085	NA
SMA-SB30	2	3	Perchlorate	0.146	0.0469	NA
SMA-SB31	2	3	Perchlorate	<0.0085	0.0173 / 0.0147*	NA
SMA-SB32	2	3	Perchlorate	<0.0085	<0.0082	NA
SMA-SB33	2	3	Perchlorate	<0.0083	<0.0081	NA
SMA-SB34	2	3	Perchlorate	<0.0082	<0.0085	NA
SMA-SB35	2	2	Perchlorate	0.0733	0.900	NC
SMA-SB36	2	2	Perchlorate	0.0249	0.0509	NC
SMA-SB37	2	2	Perchlorate	<0.030	<0.031	NC
SMA-SB38	2	2	Perchlorate	<0.030	<0.031	NC
Perchlorate Cleanup Standard				**16 mg/kg**		

Notes:

* = Duplicate results.

< = Analyte was not detected at or above the method reporting limit.

Acronyms and Abbreviations:

ft bgs = feet below ground surface

mg/kg = milligrams per kilogram

NA = soil sample not analyzed

NC = soil sample not collected

Table 11D
New Burn Area Soil Analytical Data for Perchlorate

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Boring ID	Boring Depth (ft bgs)	Total Samples Collected	Analysis	Sample Depth (ft bgs)					
				0	5	10	15	20	21
				Concentrations (mg/kg)					
NB-SB48	10	3	Perchlorate	<0.0085	**2.46**	**0.48**	NC	NC	NC
NB-SB49	10	3	Perchlorate	<0.0084	**41.4**	**46.6**	NC	NC	NC
NB-SB50	10	3	Perchlorate	**0.0108**	**43**	NA	NC	NC	NC
NB-SB51	10	3	Perchlorate	<0.0086	**4.05**	**16.3**	NC	NC	NC
NB-SB52	10	3	Perchlorate	**0.0648**	**1.56**	NA	NC	NC	NC
NB-SB53	10	3	Perchlorate	NC	**4.3**	**10**	NA	NC	NC
NB-SB54	10	3	Perchlorate	NC	**1.54**	**2.07**	NA	NC	NC
NB-SB55	15	3	Perchlorate	**0.0244**	**3.77**	NA	NC	NC	NC
NB-SB56	15	3	Perchlorate	**0.173**	**2.41**	NA	NC	NC	NC
NB-SB57	10	3	Perchlorate	**61.6**	**29**	**45.9**	NC	NC	NC
NB-SB58	15	3	Perchlorate	NC	**0.0274**	**2.48 / 2.25***	NA	NC	NC
NB-SB59	10	3	Perchlorate	NC	**0.015**	**0.584**	NA	NC	NC
NB-SB60	15	3	Perchlorate	NC	**1.48**	**0.822 / 0.943***	NA	NC	NC
NB-SB61	15	3	Perchlorate	NC	**0.792**	**0.104**	NA	NC	NC
NB-SB62	15	3	Perchlorate	NC	**20.6**	**7.49 / 5.33***	NA	NC	NC
NB-SB63	15	3	Perchlorate	NC	**1.69**	**0.832**	NA	NC	NC
NB-SB64	15	3	Perchlorate	NC	**1.46**	**0.11**	NA	NC	NC
NB-SB65	15	3	Perchlorate	NC	**0.303**	**0.0963**	NA	NC	NC
NB-SB66	15	3	Perchlorate	NC	**0.0732**	<0.010	NA	NC	NC
NB-SB67	15	3	Perchlorate	**0.0806**	**0.0736**	<0.0098	NC	NC	NC
NB-SB68	15	3	Perchlorate	**0.919**	**0.014**	<0.010	NC	NC	NC
NB-SB69	20	4	Perchlorate	NC	**3.8**	**0.1**	<0.032	NC	NC
NB-SB70	20	4	Perchlorate	NC	**31.7**	**3.8**	**1.6**	NC	NC
NB-SB71	20	4	Perchlorate	NC	**57.3**	**44.0**	**29.0**	**27.3**	**14.3**
Perchlorate Cleanup Standard				**16 mg/kg**					

Notes:
* = Duplicate results.
< = Analyte was not detected at or above the method reporting limit.
BOLD = Bold type depicts detected concentrations.
Highlighted concentration exceeds cleanup standard.

Acronyms and Abbreviations:
ft bgs = feet below ground surface
mg/kg = milligrams per kilogram
NA = soil sample not analyzed
NC = soil sample not collected

Table 11E
Waterbore Area Soil Analytical Data for Perchlorate

Former Universal Propulsion Company, Inc.
Phoenix, Arizona

Boring ID	Boring Depth (ft bgs)	Total Samples Collected	Sample Depth (ft bgs)																												
			0	1	3	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100	110	120	130	140	150	160	173	180
			Concentrations (mg/kg)																												
Conceptual Soil Cap																															
WB-SB13	70	9	**120**	NC	NC	**47.7**	**16.7**	NC	**0.498**	NC	**1.87**	NC	**5.62**	NC	**8.43**	NC	**0.0706**	NC	**0.433/0.35***	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB14	70	9	**0.425**	NC	NC	**13**	**2.21**	NC	**3.97**	NC	**0.236**	NC	**0.129**	NC	**0.0245**	NC	<0.008	NC	**0.0179/0.0142***	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB15	90	11	**0.0588**	NC	NC	**0.323**	**0.993**	NC	**0.134**	NC	**1.05**	NC	**0.725**	NC	**1.08**	NC	**0.424**	NC	**0.425**	NC	**0.259**	**0.0329 / 0.0215***	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB16	90	11	**0.698**	NC	NC	**<0.0082**	**<0.009**	NC	**0.0385**	NC	**0.0758**	NC	**0.133**	NC	**0.469**	NC	**0.443**	NC	**2.79**	NC	**6.1**	**10.1 / 9.41***	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB17	180	20	**6.74**	NC	NC	**7**	**8.59**	NC	**10**	NC	**3.21**	NC	**6.16**	NC	**6.39**	NC	**30.2**	NC	**62.6**	NC	**103**	**37.9**	**26.8**	**46.4**	**40.6**	**21.9**	**14.9**	**13.6**	**5.95**	**2.24**	**10.4 / 8.72***
Former Water Wand																															
WB-SB20	5	3	NC	**0.66 [a]**	**2.91 [a]**	**2.78**	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB21	5	3	NC	**106 [a]**	**85.8 [a]**	**103 [a]**	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB24	40	9	NC	8.1	NC	**11**	**0.3**	NA	NA	NA	NA	NA	NA	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Former Thermal Treatment Unit																															
WB-SB22	15	3	NC	NC	NC	**0.366**	**0.0294**	**0.301**	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB23	15	3	NC	NC	NC	**3.41**	**0.142**	**1.5**	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
In-Situ Biological Reduction																															
WB-01A	65	9	NC	NC	NC	NC	NC	NC	**42.9**	**55.8**	**57.5**	**31.2**	**15.2**	**41.6**	**42.9**	**63.5**	**28.9/25***	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB18	80	13	NC	NC	NC	NC	NC	NC	**5.9**	**9.78**	**66.3**	**67.9**	**78.4**	**82.3**	**61.7**	**42.7**	**73**	**47.3**	**9.02**	**38.9**	**42.7**	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
WB-SB19	80	0	**Confirmation Soil Boring Not Conducted**																												
Perchlorate Cleanup Standard			**16 mg/kg**																												

Notes:

* = Duplicate results.

[a] = Soil samples were collected by both direct-push and sonic drilling methods. Highest concentration was reported.

< = Analyte was not detected at or above the method reporting limit.

BOLD = Bold type depicts detected concentrations.

Highlighted concentration exceeds cleanup standard.

Acronyms and Abbreviations:

ft bgs = feet below ground surface

mg/kg = milligrams per kilogram

NC = soil sample not collected

NA = soil sample not analyzed

Table D-12

Old Burn Area Soil Analytical Data for Arsenic and Total Lead

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Boring ID	Boring Depth (feet bgs)	Total Samples Collected	Analysis	Sample Depth (feet)					
				1	2	3	5	7	10
				Concentrations (mg/kg)					
OB-SB53	2	2	Arsenic	**7.0**	NA	NC	NC	NC	NC
OB-SB54	2	2	Arsenic	**5.8**	NA	NC	NC	NC	NC
OB-SB55	2	2	Arsenic	**7.2 / 7.3***	NA	NC	NC	NC	NC
OB-SB56	2	2	Arsenic	**18.6**	**14.2**	NC	NC	NC	NC
OB-SB64	10	5	Arsenic	**9.2**	**9.7**	**7.8**	NA	NA	NA
OB-SB57	2	2	Total Lead	**27.4**	**3.9 / 3.7***	NC	NC	NC	NC
OB-SB57	2	2	Arsenic	**6.2**	**5.0 / 7.3***	NC	NC	NC	NC
OB-SB58	2	2	Total Lead	<1.8	<1.6	NC	NC	NC	NC
OB-SB58	2	2	Arsenic	**4.1**	**7.7**	NC	NC	NC	NC
OB-SB59	2	2	Total Lead	**5.4**	**3.8 / 4.7***	NC	NC	NC	NC
OB-SB59	2	2	Arsenic	**5.5**	**6.6 / 5.9***	NC	NC	NC	NC
OB-SB60	2	2	Total Lead	**25.0**	**1950**	NC	NC	NC	NC
OB-SB60	2	2	Arsenic	**8.2**	**6.6**	NC	NC	NC	NC
OB-SB61	2	2	Total Lead	**3.9**	**4.4**	NC	NC	NC	NC
OB-SB61	2	2	Arsenic	**5.8**	**5.1**	NC	NC	NC	NC
OB-SB62	2	2	Total Lead	**4.5**	**4.5**	NC	NC	NC	NC
OB-SB62	2	2	Arsenic	**6.4**	**6.5**	NC	NC	NC	NC
OB-SB63	2	2	Total Lead	**4.4**	**1.8**	NC	NC	NC	NC
OB-SB63	2	2	Arsenic	**7.0**	**4.9**	NC	NC	NC	NC
OB-SB65	10	5	Total Lead	NC	**13**	**14**	NA	NA	NA
Arsenic Cleanup Standard				**10 mg/kg**					
Lead Cleanup Standard				**400 mg/kg**					

Notes:

Bold results depict detected concentrations.

Highlighted concentrations exceed cleanup standard.

* = Duplicate results.

< = Analyte was not detected at or above the method reporting limit.

bgs = below ground surface

mg/kg = milligrams per kilogram

NA = soil sample not analyzed

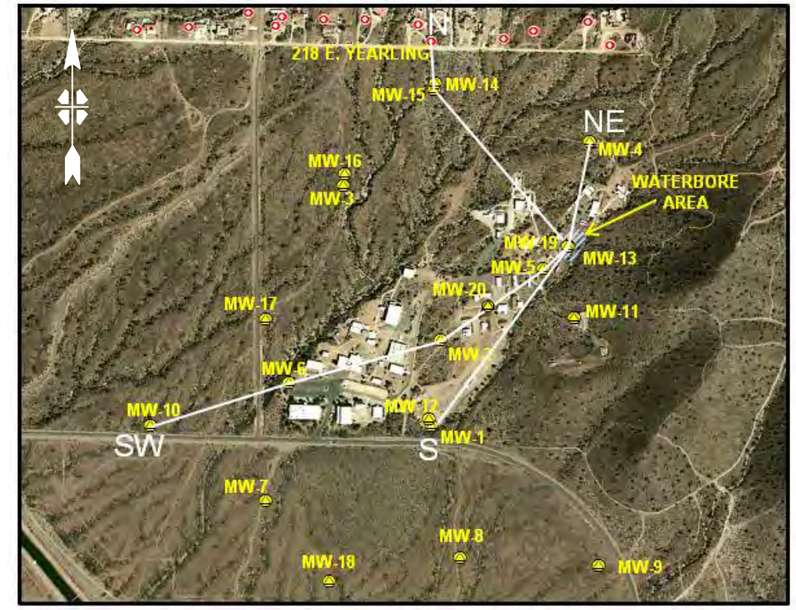
NC = soil sample not collected

Appendix E

Hypothetical Cross-Sections (on CD)

HYPOTHETICAL CONDITIONS PRIOR TO WATERBORE OPERATIONS

- Historical groundwater head conditions prior to active residential pumping or waterbore operations.
- Water table gradient generally mimics topography, dipping gradually from north to south.
- Discontinuity near MW-6 and local recharge effect from wash cause elevated water table west of the inferred fault zone.



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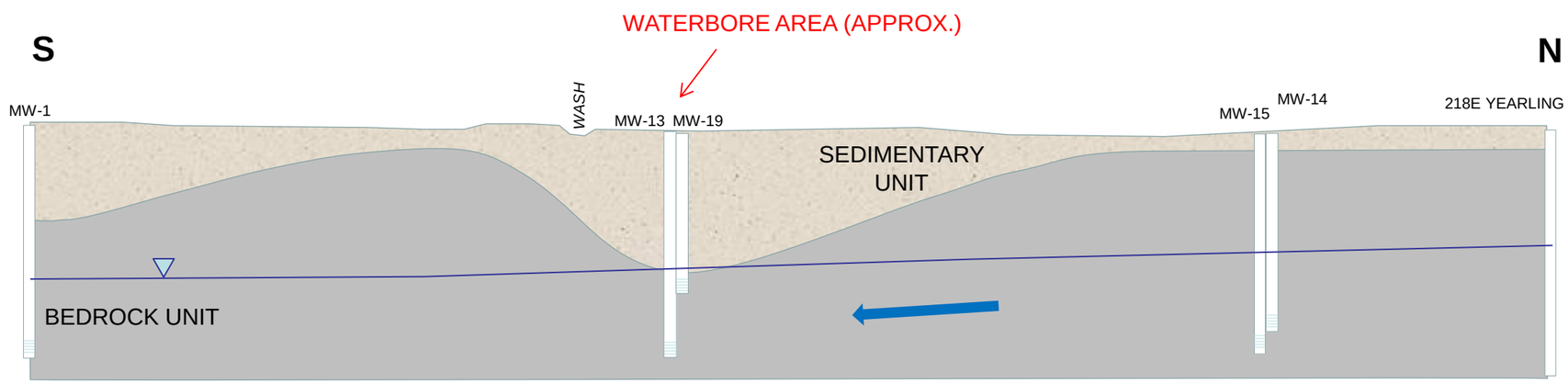
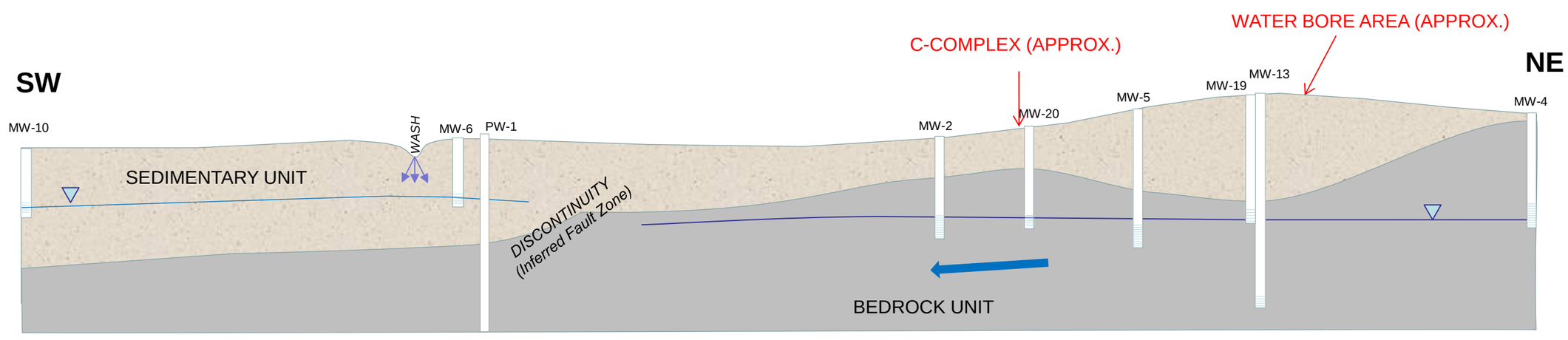
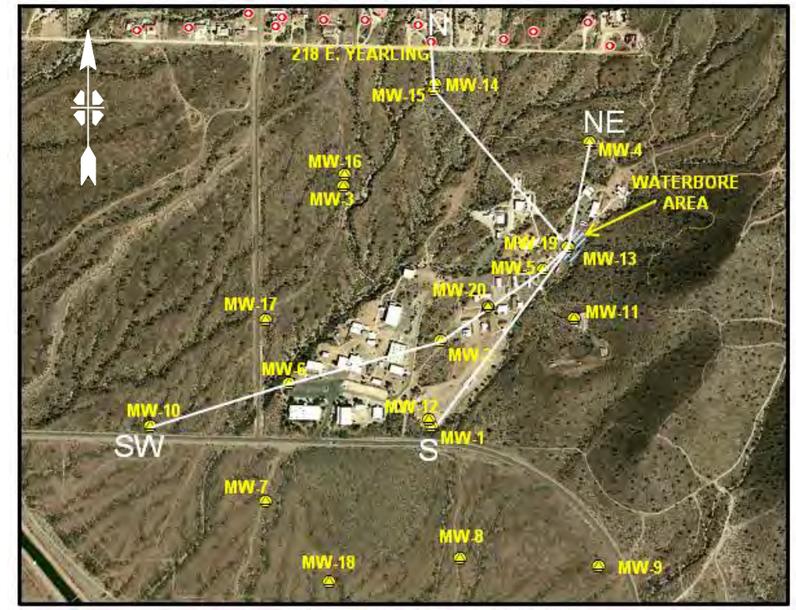




HYPOTHETICAL CONDITIONS DURING WATERBORE OPERATIONS

- Operations in Waterbore Area begin to cause local mounding effect in the water table due to enhanced recharge.
- Pumping of on-site bedrock supply well PW-1 begins to locally lower heads in rock.
- A release from operations in C-Complex and a release from wash near MW-6.



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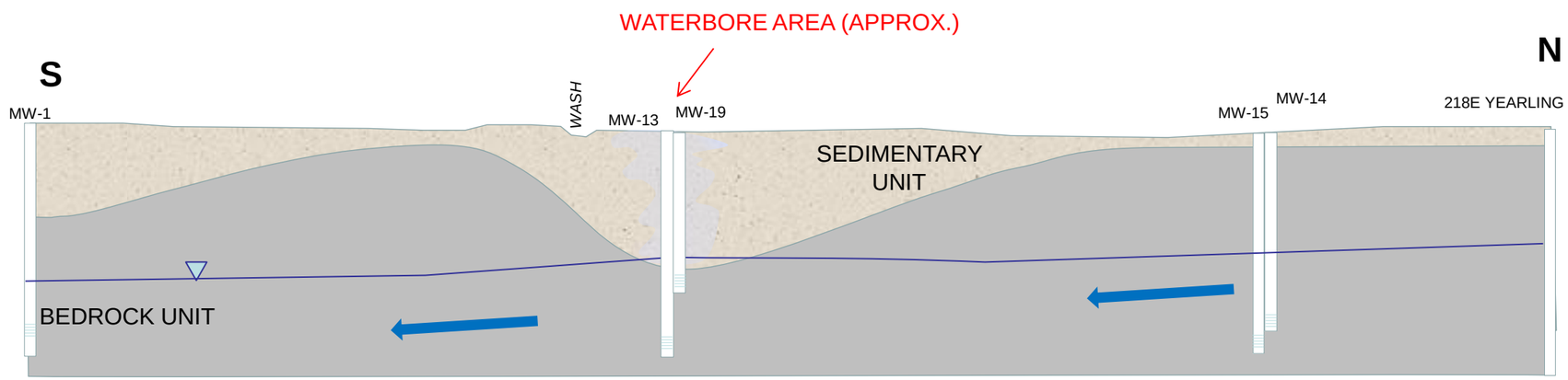
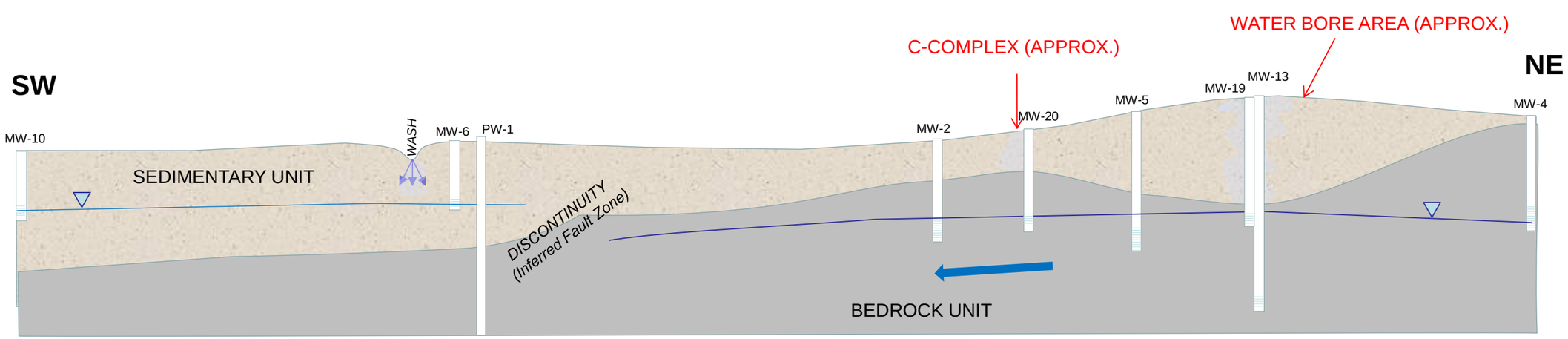
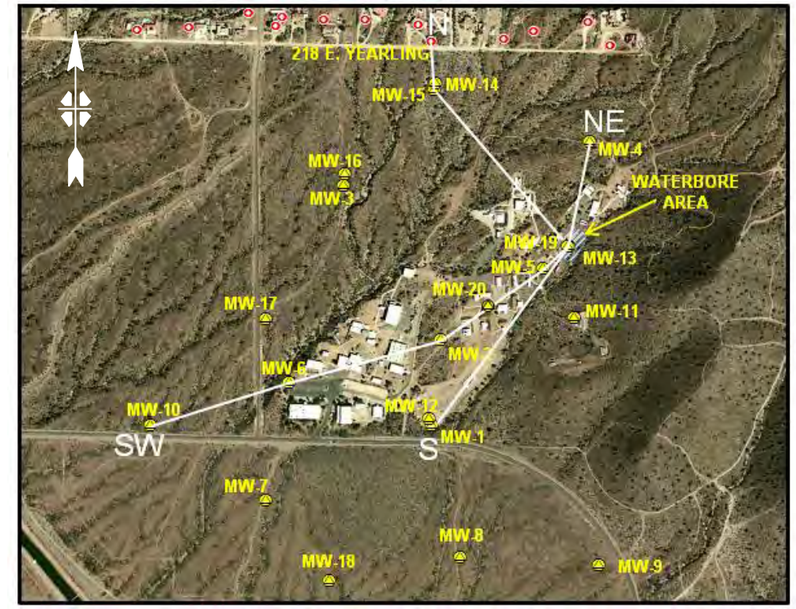




HYPOTHETICAL CONDITIONS DURING WATERBORE OPERATIONS

- Pumping in residential area to north of Site begins to flatten gradient just north of the Site – steeper local gradient adjacent to pumping wells in residential area.
- Local water table mounding causes constituents to move outward from point of release within the Waterbore Area.
- Pumping in residential area continues to lower heads as water is pumped from aquifer storage.



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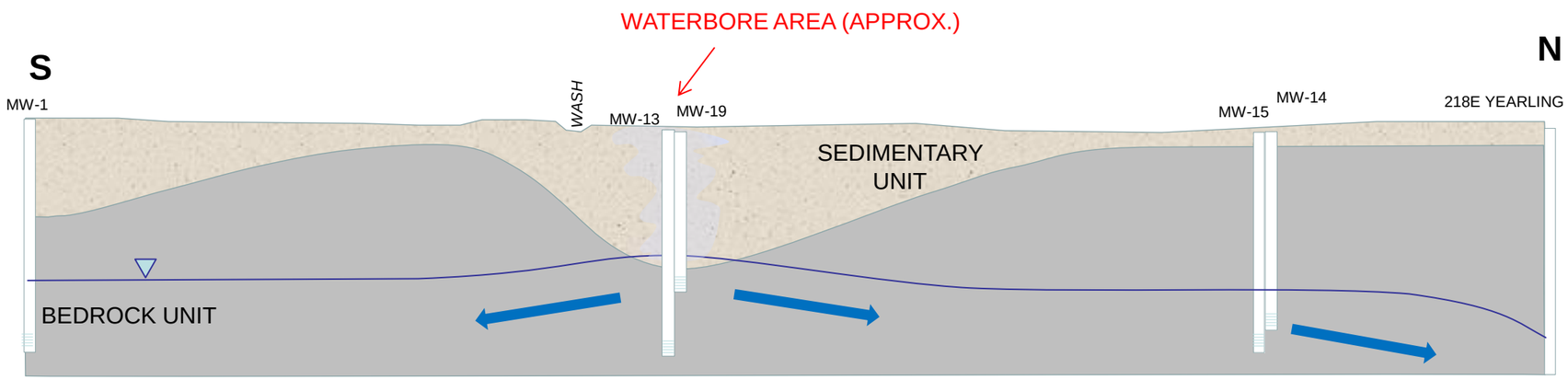
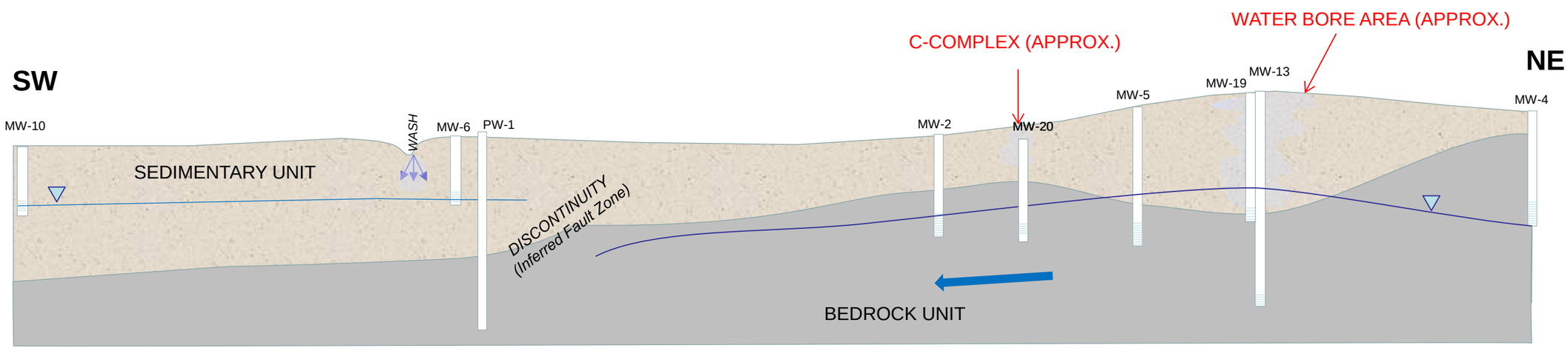
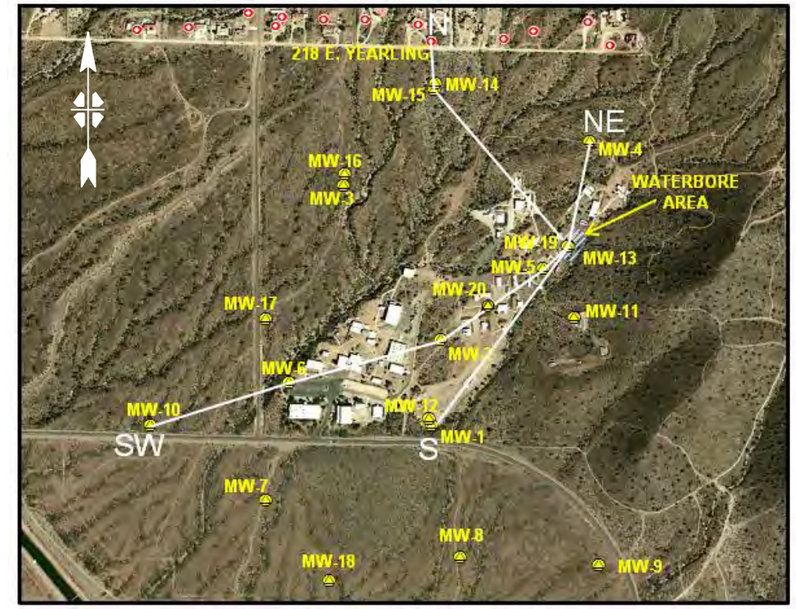




HYPOTHETICAL CONDITIONS DURING WATERBORE OPERATIONS

- Constituents in groundwater begin migrating semi-radially and slowly along gradient created between the water table mound within the Waterbore Area and inferred drawdown from on-site pumping.

- Constituent movement in groundwater is almost equally driven by both advection and diffusion due to relatively low transmissive flux.



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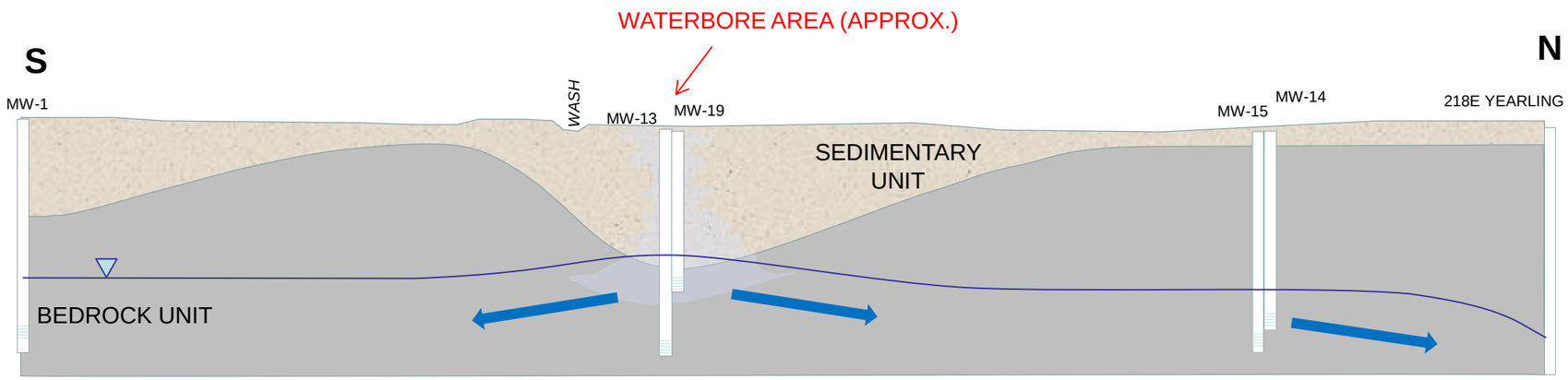
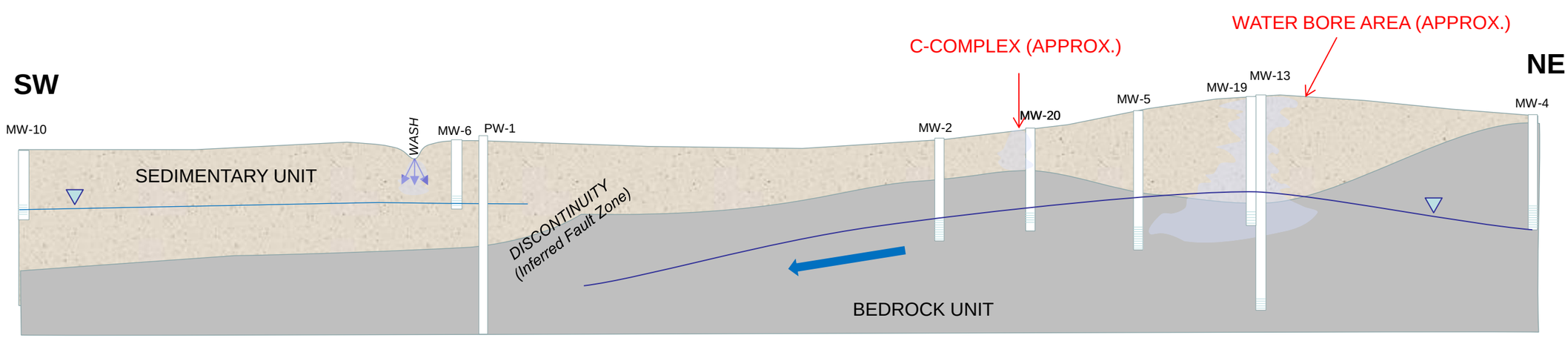
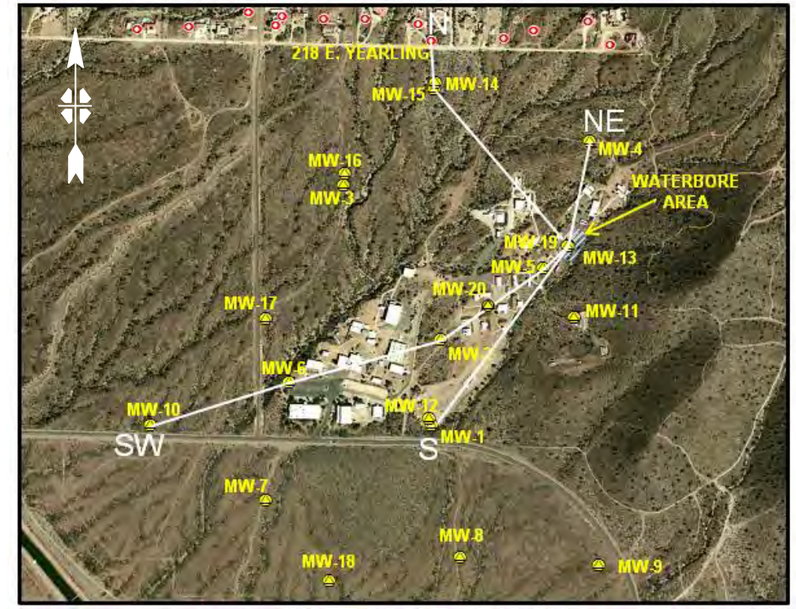




CURRENT CONDITIONS - WATERBORE OPERATIONS CEASED

- Water table mound has subsided with cessation of Waterbore Area operation.
- The gradient between residential area and Waterbore Area continues to increase gradually, but remains relatively flat in the Waterbore Area.



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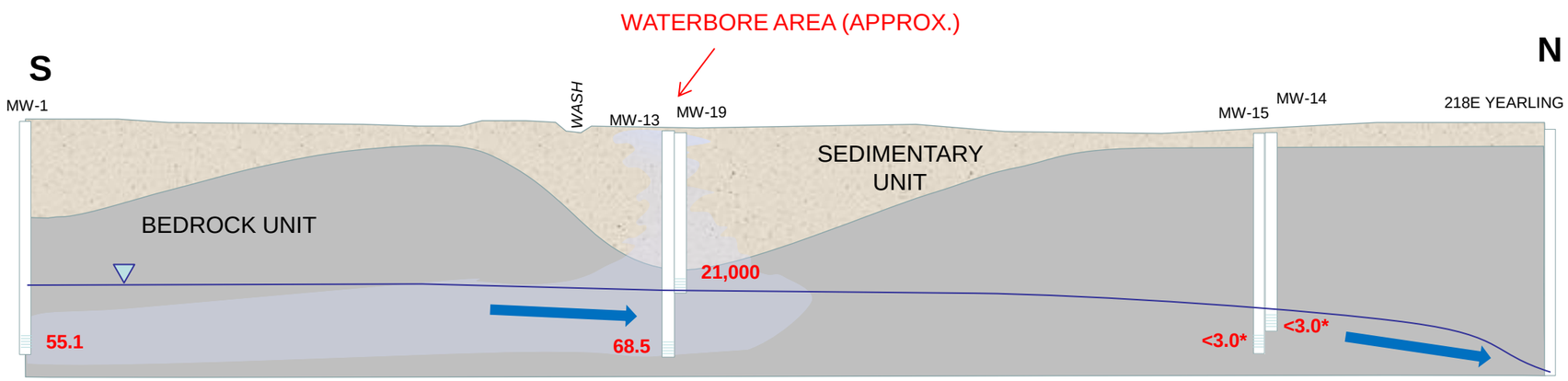

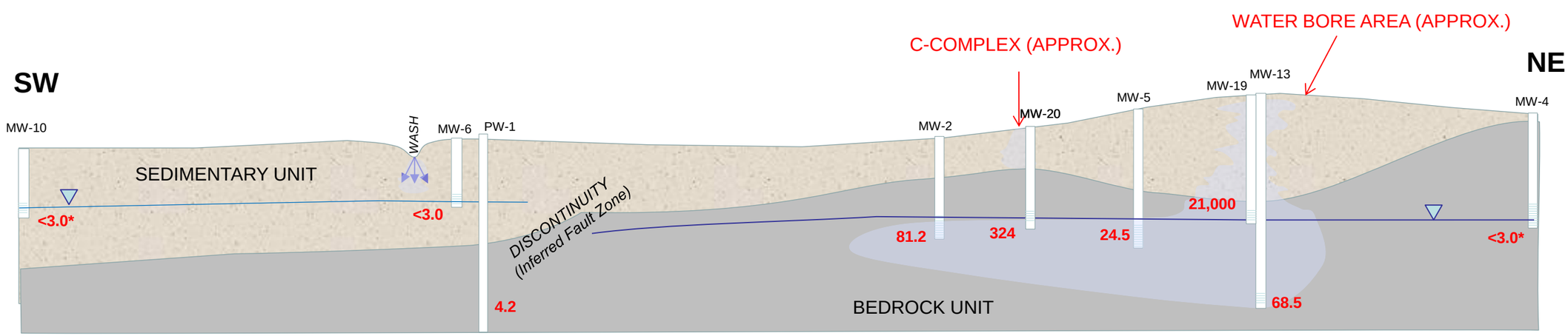

7 - PERCHLORATE CONCENTRATION, IN MICROGRAMS PER LITER (ug/l)

Note: Wells were sampled for perchlorate from 10/10/2014 through 10/15/2014 unless denoted with an asterisk (*); these wells were sampled from 7/8/2014 through 7/15/2014.

Appendix F

Engineered Cap Design Basis Report
(on CD)

Imagine the result

Universal Propulsion Company, Inc.

Engineered Cap
Design Basis Report

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

October 2015

ARCADIS

Michael P. Nesky, PE
Principal Environmental Engineer

Engineered Cap
Design Basis Report

Former Universal Propulsion Company, Inc. Facility
Phoenix, Arizona

Prepared for:
Universal Propulsion Company, Inc.

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Our Ref.:
03994018.0015

Date:
October 30, 2015

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Figure 10 Watershed Delineation

Appendices

A Manufacturer Product Information

B Flood Insurance Rate Map

C Rational Method Analysis

D FlowMaster™ Analysis

E Scour Analysis

F HEC-RAS Analysis

Acronyms and Abbreviations

ARCADIS	ARCADIS U.S., Inc.
ASTM	ASTM International
bgs	below ground surface
cfs	cubic feet per second
COC	constituent of concern
CWA	Clean Water Act
D_{50}	Cumulative particle size distribution at 50 percent.
DDM Hydraulics	Drainage Design Manual for Maricopa County, Hydraulics
DDM Hydrology	Drainage Design Manual for Maricopa County, Arizona, Hydrology
DEM	digital elevation model
FEMA	Federal Emergency Management Agency
ft/s	feet per second
HDPE	high density polyethylene
HEC-RAS	Hydrologic Engineering Center River Analysis System
LLDPE	linear low density polyethylene
NOAA	National Oceanic and Atmospheric Administration
NWP	Nationwide Permit
PI	plasticity index
SA-2	Soil Alternative-2

Site	Former UPCO Facility located at 25401 North Central Avenue in Phoenix, Arizona
SPT	standard penetration test
UPCO	Universal Propulsion Company, Inc.
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WVT	water vapor transmission

1. Introduction

On behalf of Universal Propulsion Company, Inc. (UPCO), ARCADIS U.S., Inc. (ARCADIS) has prepared this Engineered Cap Design Basis Report for the former UPCO Facility located at 25401 North Central Avenue in Phoenix, Arizona, near the intersection of Central Avenue and Happy Valley Road (Site; Facility ID Number AZD 980 814 479) (Figure 1). As presented in the Supplemental Soil Pre-Design Study Summary Report (ARCADIS 2014) and Additional Soil Characterization at Proposed Deep Excavation Areas letter (ARCADIS 2015), engineered caps were proposed for the Waterbore Area, C-Complex Area, and New Burn Area at the Site to limit infiltration of precipitation runoff and reduce the potential for direct contact with constituents of concern (COCs) in soil by potential receptors. The location and layout of each cap are shown on Figure 2.

The engineered caps will control potential hazards by eliminating routes of exposure to soil containing COCs and by potentially reducing constituent migration through isolation and elimination of surface water infiltration. The construction of an engineered cap over COCs above cleanup levels will reduce the potential for direct contact of COCs in soil by receptors. The low permeability of the engineered cap will also reduce surface water infiltration and prevent potential leaching of COCs from soil to groundwater. A construction specification document with construction drawings will be provided to Arizona Department of Environmental Quality (ADEQ) for review and approval as part of the Corrective Measures Implementation Plan to guide construction of the caps. Sections 2 through 6 of this report provide a technical evaluation for the following:

- Engineered cap design
- Hydrology and scour analysis
- Hydraulic evaluation
- Permitting

2. Engineered Cap Design

The engineered caps (proposed as part of Soil Alternative-2 [SA-2]) consist of a relatively impermeable geomembrane liner (linear low density polyethylene [LLDPE] with MicroSpike®), woven geotextile, and a HydroTurf™ CS surface layer to minimize erosion of the soil and surface water infiltration. Geomembrane liners are nonporous homogeneous materials, and transmission of permeating species through geomembranes without holes occurs by absorption of the species in the geomembrane and diffusion through the geomembrane on a molecular basis. Geomembranes possess permeability values (as measured by water-vapor transmission [WVT} test) in the range of 1×10^{-12} meters per second (m/s) to 1×10^{-15} m/s, which are one thousand to one million times lower than a typical clay liner (Scheirs, J. 2009). WVT is tested in accordance with ASTM International (ASTM) D96. Tests performed on AGRU America 40 mil smooth high density polyethylene (HDPE) geomembrane and a 60 mil MicroSpike® HDPE geomembrane demonstrated average permeabilities of 5.8×10^{-15} centimeters per second (cm/s) and 5.08×10^{-15}, respectively. AGRU America certifies that that geomembrane will meet or exceed a permeability of 1×10^{-7}. The manufacturer's product information and testing is provided in Appendix A. Since a geomembrane liner is integrated as part of the cover, which is directly below the HydroBinder, no permeability testing has been performed on the HydroTurf™ CS with the HydroBinder infill. The HydroTurf™ CS with the HydroBinder infill is estimated to have permeability in the range of 1×10^{-4} cm/s to 1×10^{-5} cm/s. Transmissivity tests have been conducted on this material, and the results are also provided in Appendix A for reference.

Existing soil in the cap layout areas will be excavated approximately 2 feet below ground surface (bgs) at the Waterbore and C-Complex Areas, and 5 feet bgs in the New Burn Area, and replaced with compacted native clean fill as necessary prior to placement of each respective cap. The engineered cap systems will be anchored on all sides by a concrete anchor trench. The anchor trench design is a 2-foot-deep by 5-foot-wide anchor; however, as noted in Section 3.5, the portion of the cap located within the wash in the Waterbore Area must incorporate a 3.80-foot-deep anchor trench upstream and downstream of the cap due to calculated scour potential within the wash. The Waterbore Area cap will cover an area of approximately 15,450 square feet, extending across the ephemeral wash and approximately 10 feet up the slope of the wash to the east. Figure 3 shows the proposed area to be capped in the Waterbore Area including the ephemeral wash. Figures 4 and 5 show the cross-sections and preliminary plan details for the Waterbore Area cap.

Sections 3.3.2 and 4.2 of the Supplemental Soil Pre-Design Study Summary Report (ARCADIS 2014) discuss the methods and results of geotechnical sampling conducted in the Waterbore Area for SA-2. As noted, one standard penetration test (SPT) boring (WB-01A) was drilled, together with two additional soil borings (WB-15 and WB-16). Soils recovered during drilling were field classified, and select portions of each sample were submitted for laboratory analysis of index properties, such as moisture content (ASTM D2216), grain size (ASTM C136/C117), Atterberg limits (liquid limit, plastic limit [ASTM D4318]), and specific gravity (ASTM D854).

In general, the soils in the three borings drilled for geotechnical analysis were described as follows:

- *Layer 1* – Approximately 6 feet of very dense clayey and silty sands (SC, SM, and SC-SM). Moisture content ranges from 1.5% to 6%, specific gravity ranges from 2.650 to 2.687, and the plasticity index (PI) ranges from non-plastic to 8.

- *Layer 2* – Greater than 14 feet of very dense clayey and silty gravels (GC, GC-GM). Moisture content ranges from 4.7% to 6.1%, specific gravity ranges from 2.640 to 2.721, and the PI ranges from 5 to 10.

SPT blow counts (N-values) in soil boring WB-01A were greater than 50 blows per foot, indicating the soil is very dense.

The quantity of data and level of testing conducted during the pre-design phase of the project are adequate to provide a basis for the development of the hydrology and scour analyses and the soil hydraulic analyses that are further discussed below.

2.1 C-Complex and New Burn Area Engineered Caps

Following the April 2015 soil investigations in the C-Complex Area and New Burn Area, it was determined that engineered caps would also be required in these areas (ARCADIS 2015). The caps in these areas will be located where soils with COC concentrations higher than the cleanup goal for perchlorate are to remain in place (Figure 2). Unlike the Waterbore Area, the caps in these two areas will not be constructed within any washes, and will only be affected by localized precipitation and surface water runoff. Soil characteristics identified in the C-Complex Area and New Burn Area are similar to the soil characteristics within the Waterbore Area. Therefore, the engineered cap design, as modeled for the Waterbore Area, is applicable to these areas, and will provide similar protection against surface water infiltration and potential

leaching of COCs from soil to groundwater. Like the cap design for the Waterbore Area, the design of the caps in these areas will incorporate the same geomembrane liner, woven geotextile, and a HydroTurf™ CS surface layer to minimize erosion of the soil and surface water infiltration, and to reduce the potential for direct contact with COCs in soil by potential receptors. The caps will be anchored on all sides by a 2-foot-deep by 5-foot-wide concrete anchor, similar to the cap design for the Waterbore Area outside of the extents of the ephemeral wash. The caps and surrounding areas will be graded and sloped to ensure positive drainage. The C-Complex Area cap will cover an area of approximately 6,637 square feet (Figure 6). Figure 7 shows the cross-section and preliminary plan detail for the C-Complex Area cap. The New Burn Area cap will cover an area of approximately 1,159 square feet (Figure 8). Figure 9 shows the cross-section and preliminary plan detail for the New Burn Area cap.

3. Hydrology and Scour Analysis

This section presents a discussion of the anticipated hydrology within the Waterbore Area, specifically a portion of an existing ephemeral wash that will be disturbed with the excavation of soil and the installation of an engineered cap as indicated in the Supplemental Soil Pre-Design Study Summary Report (ARCADIS 2014). The ephemeral wash under consideration is located on the east side of the Waterbore Area (Figure 2). This section discusses the methods and analyses used to determine the peak flow rate for the design storm and a scour analysis performed to determine the depth to which the cap must be protected against potential scour in the wash.

3.1 Federal Emergency Management Agency Floodplain Classification

The Waterbore Area is located in Zone X (designated as “Other Flood Areas”) according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map number 04013C1280L dated October 16, 2013. Zone X is defined as “Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot, or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.” A copy of Flood Insurance Rate Map number 04013C1280L is provided in Appendix B.

3.2 Drainage Description

A United States Geological Survey (USGS) digital elevation model (DEM) was used to determine the limits of the contributory watershed to the ephemeral wash within the Waterbore Area. Figure 10 shows this DEM and the watershed delineation. The total contributory area to the ephemeral wash is approximately 56 acres or 0.09 square miles. The contributory watershed consists of two sub-basins that combine into the ephemeral wash in the Waterbore Area. The sub-basins both drain north to south and combine at the start of the third sub-basin. The third sub-basin encompasses the ephemeral wash where the cap will be installed (Figure 10). The DEM was used to determine the route of both of the contributory washes that combine into the ephemeral wash and to determine the ephemeral wash as well.

3.3 Hydrology

Because this contributory watershed is so small, the Rational Method is an acceptable method to estimate the flow rate in the ephemeral wash. According to the Drainage Design Manual for Maricopa County, Arizona, Hydrology (DDM Hydrology; Flood

Control District of Maricopa County 2013a), the Rational Method may be used for watersheds up to 160 acres in size. The Rational Method computes the anticipated flow in the wash based on a coefficient relating runoff to rainfall and is an empirical number based on the type of ground cover and topography and the intensity of the rainfall based on an estimated time of concentration. The Rational Method analysis is provided in Appendix C.

The coefficient used for this analysis was based on Table 3.2 of DDM Hydrology (Flood Control District of Maricopa County 2013a). The hydrology is considered to be Hillslopes, Sonoran Desert, which has a 100-year coefficient of 0.70. The maximum coefficient was used as a conservative measure.

The intensity for each of the sub-basins was determined through development of a site-specific depth-duration-frequency table using National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (NOAA 2004). Intensity was then determined iteratively through use of a time of concentration calculation per Equation 3.2 in DDM Hydrology (Flood Control District of Maricopa County 2013a).

The anticipated 100-year, 24-hour flow rate was calculated for each sub-basin per Equation 3.1 in DDM Hydrology (Flood Control District of Maricopa County 2013a). These flows were then added to determine the flow rate through the ephemeral wash for this storm event. In this case, the anticipated flow for the 100-year, 24-hour storm event is approximately 235 cubic feet per second (cfs). Pre- and post-conditions remain the same because there are no changes made to the upstream Sub-basins 1 and 2, and the installation of an engineered cap in Sub-basin 3 is not anticipated to significantly change the hydrologic conditions in terms of the anticipated flow rate in the natural ephemeral wash.

3.4 Hydraulics

Once the flow rate had been estimated for the design storm, the FlowMaster™ program and Manning's equation were used to determine the anticipated velocity of the flow in the channel. Manning's equation relies on a roughness coefficient that is empirically derived based on the type of conditions encountered in the channel. For the natural channel, a coefficient of 0.035 is generally considered typical given the topography and vegetation indicated at the Site. For the portion of the channel where HydroTurf™ CS will be used, the manufacturer recommends a roughness coefficient of 0.02. The velocity was calculated for the natural channel upstream of the proposed cap and for the portion of the channel where the cap will be installed. The velocity in the

natural channel is calculated to be approximately 9.34 feet per second (ft/s) and is supercritical flow. The velocity anticipated for the channel where the cap will be installed is calculated to be approximately 12.77 ft/s and is supercritical flow. Since the flow velocity is increased to 12.77 ft/s from the existing 9.34 ft/s in the channel, rip rap erosion protection is proposed downstream of the cap. The velocity with the rip rap is calculated to be approximately 3.97 ft/s. Beyond the rip rap, the velocity is dependent on the natural channel. The FlowMaster ™ analysis is a one-dimensional analysis and does not provide an indication of how far the rip rap must extend beyond the soil cap, nor does it fully describe the flow characteristics as the wash transitions from native existing condition to the soil cap then to the rip rap and back to a native existing condition. Therefore, the FlowMaster ™ analysis, provided in Appendix D, is a preliminary analysis and a different hydraulic model is needed to determine these flow characteristics. A United States Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS) model was developed.

In order to perform the HEC-RAS analysis, a development of cross-sections of the drainage flow path was required. The watershed and the ephemeral wash development for the hydrology analysis were used as a starting point. The ephemeral wash as defined for the hydrology was assigned an alignment using AUTOCAD® Civil 3D and cross-sections begin at the downstream termination of Sub-Basin 3 (Figure 8) and were manually interpreted from the DEM model beginning at Station 500 and then cut at the following stations; 600, 700, 800, 1100, 1200, 1205 and 1400. Additional cross sections were interpolated in between these manual sections by the HEC RAS program. The manually defined cross sections were chosen in locations that best represent the ephemeral channel and that occur immediately before and after the proposed engineered cap in order to better define the flows and velocities in the wash at those locations. The engineered cap is approximately located between station 10+60 and station 11+75. The assignment of the alignment and stationing was not tied to any survey monumentation or any other drainage studies.

The velocities predicted in the channel were revised as a result of the HEC-RAS model and thus were reduced predicting a velocity in the native channel of approximately 7.79 ft/s, a velocity across the soil cap of approximately 13.95 ft/s and the flow velocity across the proposed rip rap section reduces the velocity to 2.95 ft/s before entering the existing channel section again where the velocity increases to approximately 5.73 ft/s at the furthest downstream section analyzed.

3.5 Scour

A scour analysis was performed upstream of the engineered cap to determine to what depth scour could occur upstream of the engineered cap, given that no riprap or other protection is anticipated at the interface between the natural wash and the portion of the channel with the engineered cap. Estimation of scour is based on Section 11.8 of the Drainage Design Manual for Maricopa County, Hydraulics (DDM Hydraulics; Flood Control District of Maricopa County 2013b). Total scour is estimated per Equation 11.41, which includes long-term scour, general scour, bend scour, bedform scour, and low-flow scour. Not all types of scour are applicable in every situation. The types of scour calculated for the ephemeral scour include long-term scour, general scour, bedform scour, and low-flow scour. There are no significant bends within the wash; therefore, the ephemeral wash is not subject to bend scour, (Figure 10). Local scour is intended for use where localized obstructions exist within the wash (i.e., bridge piers). The ephemeral wash does not have any of these obstructions.

Because there are no downstream control structures on the ephemeral wash and there is no pivotal point on the channel, the simplified method based on Level 1 analysis from Arizona State Standard 5-96 may be used for the estimation of long-term scour. The long-term scour was estimated to be approximately 0.53 feet. Limits on the long-term scour from natural armoring in the wash are not applicable based on aerial photographs of the ephemeral wash.

For general scour, the Lacey Equation (Equation 11.56; Flood Control District of Maricopa County 2013b) is the most applicable to a natural system, as there are no upstream features that capture sediment (Figure 10). The cumulative particle size passing at 50 percent (D_{50}), 2.36 inches, was determined from the grain size distribution analysis of sample WB-SB 15-10 obtained as part of the Supplemental Soil Pre-Design Study Summary Report (ARCADIS 2014). The general scour was estimated to be approximately 0.52 feet.

The bedform scour equation is Equation 11.61 in DDM Hydraulics (Flood Control District of Maricopa County 2013b) and is estimated based on a dune or anti-dune height that is typically measured in the channel during a site visit. This information was not available; therefore, a calculated value was used based on the calculated Froude number. The FlowMaster^{TM} hydraulic analysis for the ephemeral wash calculated a Froude number of approximately 1.16, and according to DDM Hydraulics, Equation 11.63 is the appropriate equation based on the Froude number. The estimated bedform scour is approximately 0.82 feet.

Low-flow or incisement scour is typically measured in the field during a site visit. However, when this data is not available, an estimation of 1 foot for the ephemeral wash is permitted for design and planning purposes according to Section 11.8.2.5 of DDM Hydraulics (Flood Control District of Maricopa County 2013b).

The total scour is the sum of the scours identified above, with a factor of safety applied. In this case, DDM Hydraulics (Flood Control District of Maricopa County 2013b) recommends a factor of safety of 1.3. The estimated total scour is approximately 2.87 feet without the factor of safety applied; therefore, the minimum depth of the cap concrete anchor should be a minimum of 3.73 feet. The scour analysis is provided in Appendix E.

The scour analysis above estimates the scour upstream of the proposed engineered cap. Because of the higher velocity that occurs in the channel as a result of the cap (approximately 13.59 ft/s), the natural channel immediately downstream of the cap requires protection from scour as well. A United States Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS) evaluation of the proposed final conditions was performed to determine the length of channel that will need to be protected downstream of the proposed channel cap. An angular riprap is proposed to line the channel to provide that protection. The HEC-RAS analysis indicates that a length of 30 feet of protection will be adequate.

In order to perform the HEC-RAS analysis, a development of cross-sections of the drainage flow path was required. The watershed and the ephemeral wash development for the hydrology analysis were used as a starting point. The ephemeral wash as defined for the hydrology was assigned an alignment using AUTOCAD Civil 3D and cross-sections begin at the downstream termination of Sub-Basin 3 (Figure 10) and were manually interpreted from the DEM model beginning at Station 500 and then cut at the following stations; 600, 700, 800, 1100, 1200, 1205 and 1400 (Appendix F). Additional cross sections were interpolated in between these manual sections by the HEC-RAS program. The manually defined cross sections were chosen in locations that best represent the ephemeral channel and that occur immediately before and after the proposed engineered cap in order to better define the flows and velocities in the wash at those locations. The engineered cap is approximately located between station 10+60 and station 11+75. The assignment of the alignment and stationing was not tied to any survey monumentation or any other drainage studies.

After the length of required protection was determined, the average size of riprap was calculated using Hydraulic Engineering Circular No. 15, Third Edition – Design of

Roadside Channels with Flexible Linings (U.S. Department of Transportation, Federal Highway Administration 2005). The calculated average size of the riprap should be a minimum of 12 inches in diameter and should be placed to a minimum depth of 24 inches (2 feet), for a minimum distance of 30 feet to provide adequate protection against erosion downstream of the soil cap. This will reduce the velocity of the flow adequately enough to match existing conditions prior to installation of the engineered cap. The HEC-RAS analysis is provided in Appendix F.

3.6 Conclusions and Recommendations

The flow rate has been quantified to be approximately 235 cfs for the 100-year, 24-hour storm event, with a velocity of approximately 7.79 ft/s in the natural ephemeral wash and approximately 13.59 ft/s in the portion of the wash with the engineered cap. The velocity increase at the engineered cap is due to the reduced roughness in the channel as a result of the cap. Therefore, it is recommended that riprap be placed immediately downstream of the proposed engineered cap to protect the existing wash downstream of the engineered cap from erosion due to the higher velocity. A minimum length of 30 feet of channel should be protected downstream with angular riprap, with a minimum average size of 12 inches to a minimum depth of 2 feet to provide protection against erosion immediately downstream of the engineered cap. The terminal velocity at the end of the rip rap is approximately 2.95 ft/s which then increases downstream of the rip rap in the existing native channel again to approximately 5.73 ft/s and continues in the current existing conditions downstream from the proposed improvements.

Based on the scour analysis performed upstream of the proposed engineered cap, the approximate total scour is estimated to be 3.73 feet. Therefore, it is recommended that the upstream concrete anchor in front of the engineered cap be extended to a total depth of 3.8 feet across the channel where the natural channel and the engineered cap interface.

4. Soil Moisture Monitoring

To address concerns of potential lateral infiltration of water originating from the wash during storm flow events within the Waterbore Area, soil moisture monitoring will be implemented beneath the engineered cap. During final remedy operation a neutron probe will be used to estimate the volumetric water content of the soil based on the thermalization of neutrons colliding with atomic nuclei in the soil. Neutrons emitted by the probe enter the soil and are thermalized by the hydrogen present in water. These thermalized neutrons enter the helium-3 detector and are registered as a count. Using a calibration program, the detected counts are converted into soil moisture readings. The objective of neutron monitoring is to provide a correlation with laboratory-measured soil moisture content and provide the means of continuing moisture content monitoring to assess soil moisture trends and changes. The recommended approach involves advancing three 20-foot soil borings within cap at the Waterbore Area (Figure 3). During installation, soil samples will be collected at 5-foot intervals to a total depth of 20 feet in the boring. Soil samples will be analyzed for soil moisture following ASTM D2216 and for total porosity following ASTM D7263. Upon completion of drilling the boreholes, a 2 inch blank PVC access tube casing will be installed. The casing is well suited for continued moisture content monitoring using a standard Troxler-type monitoring device (Model 4301/02), or equivalent (www.troxlerlabs.com). A calibrated neutron probe is lowered into the access tube and readings taken in one foot intervals used to estimate the volumetric water content of the soil.

Initial measurements will be collected monthly for 12 consecutive months in order to establish a baseline soil moisture trend. Following baseline data collection, monitoring will be dependent upon water flow in the wash. Moisture monitoring will be performed within 30 days following flow events in the wash. A minimum of three and a maximum of ten monitoring events will be performed within a twelve month period following baseline monitoring. ADEQ and UPCO will review the data to determine the significance of the changes in moisture and agree what additional actions, if any, should be taken. Moisture monitoring may be discontinued if data shows moisture content does not increase significantly after a flow event in the wash.

5. Permitting

In the Waterbore Area, the eastern side of the cap will be constructed in an ephemeral wash (Figure 2). Activities in waters of the United States are regulated under the Clean Water Act (CWA). Section 404 of the CWA requires a permit (i.e., 404 Permit) to

dredge material from, or discharge fill material into, waters of the United States, unless the activity is exempt from Section 404 regulations.

Consultation with Sallie Diebolt of USACE (email dated February 12, 2015) has concluded that the ephemeral wash in the Waterbore Area is likely jurisdictional under Section 404 of the CWA. Excavation activities and construction of the engineered cap within the wash are covered under Nationwide Permits (NWP) 38 and 13, both of which are granted statutory authority under Section 10 of the Rivers and Harbors Act of 1899 (33 United States Code [U.S.C.] 403) and Section 404 of the CWA (33 U.S.C. 1344). The NWPs are administered by USACE and incorporate a standardized review process for approval of permit applications. NWP 38 covers “specific activities required to effect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority” (Decision Document Nationwide Permit 38). NWP 13 covers bank stabilization activities necessary for erosion prevention (Decision Document Nationwide Permit 13). Following approval of recommended soil remedial alternative SA-2 by the Arizona Department of Environmental Quality, an application package will be prepared and submitted to USACE for review and approval of cap construction within the ephemeral wash in accordance with the requirements of NWP 38 and NWP 13.

6. References

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National Oceanic and Atmospheric Administration, 2004, Precipitation-Frequency Atlas of the United States, Volume 1 Version 5.0: Semiarid Southwest (Arizona, Southeast California, Nevada, New Mexico, Utah). Revised 2011.

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U.S. Department of Transportation, Federal Highway Administration. 2005. Hydraulic Engineering Circular No. 15, Third Edition – Design of Roadside Channels with Flexible Linings. September 2005.

Figures

Scale: 1" = 200 miles

LEGEND

★ Approximate site location

NOTES

· Basemap source: ESRI National Geographic World Map

N

Miles
0 4 8

Scale: 1" = 8 mi

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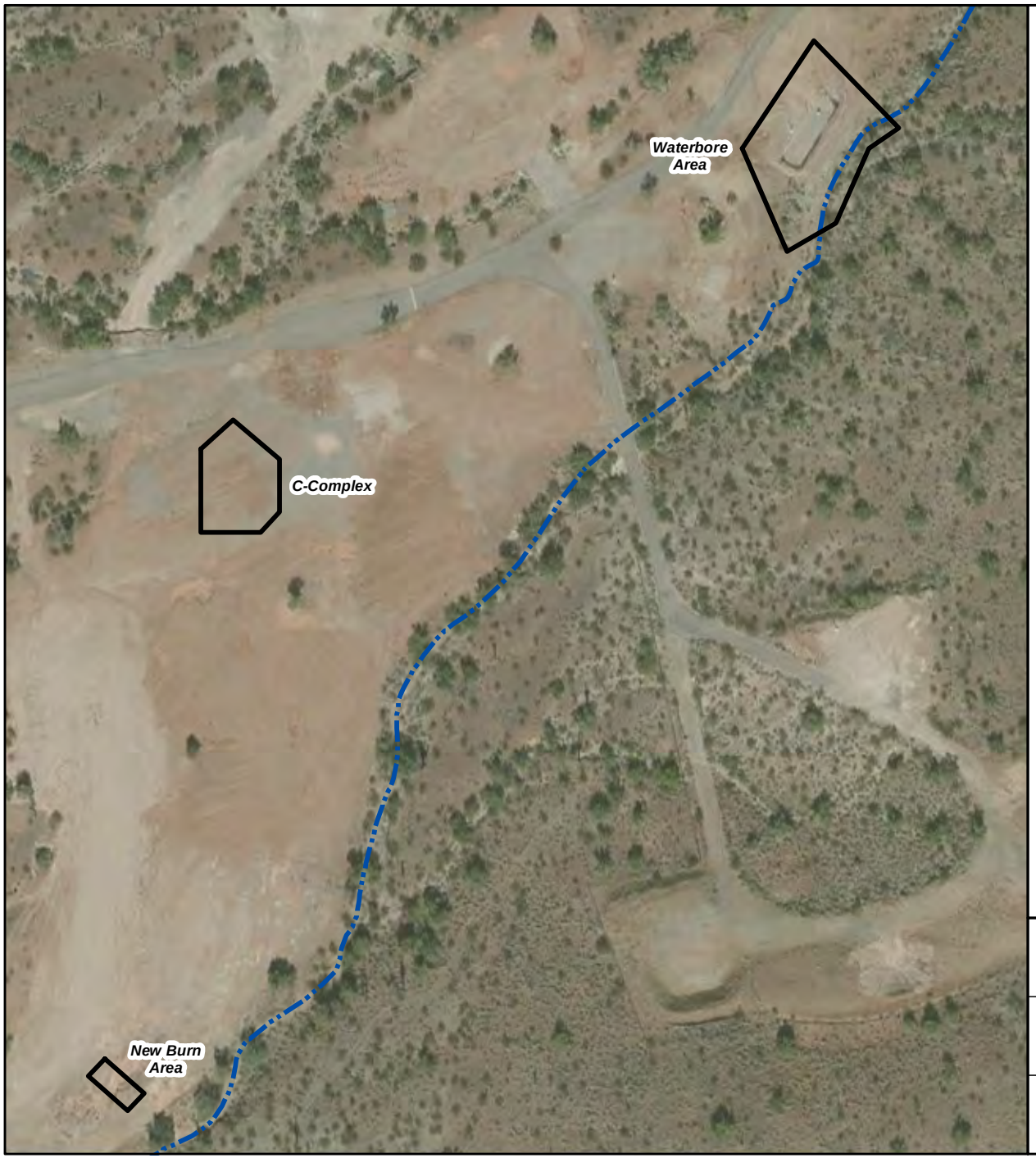
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
1

\\Scottsdale-AZ\Project\UPCO\GIS\Projects\Cap Design Basis Report 06-2015\Figure 2 proposed soil cap locations.mxd 6/18/2015



LEGEND

Proposed soil cap extent

Ephemeral wash (approximate location)

NOTES

· Aerial photo source: ESRI World Imagery.

N

Feet

0 75 150

Scale: 1" = 150'

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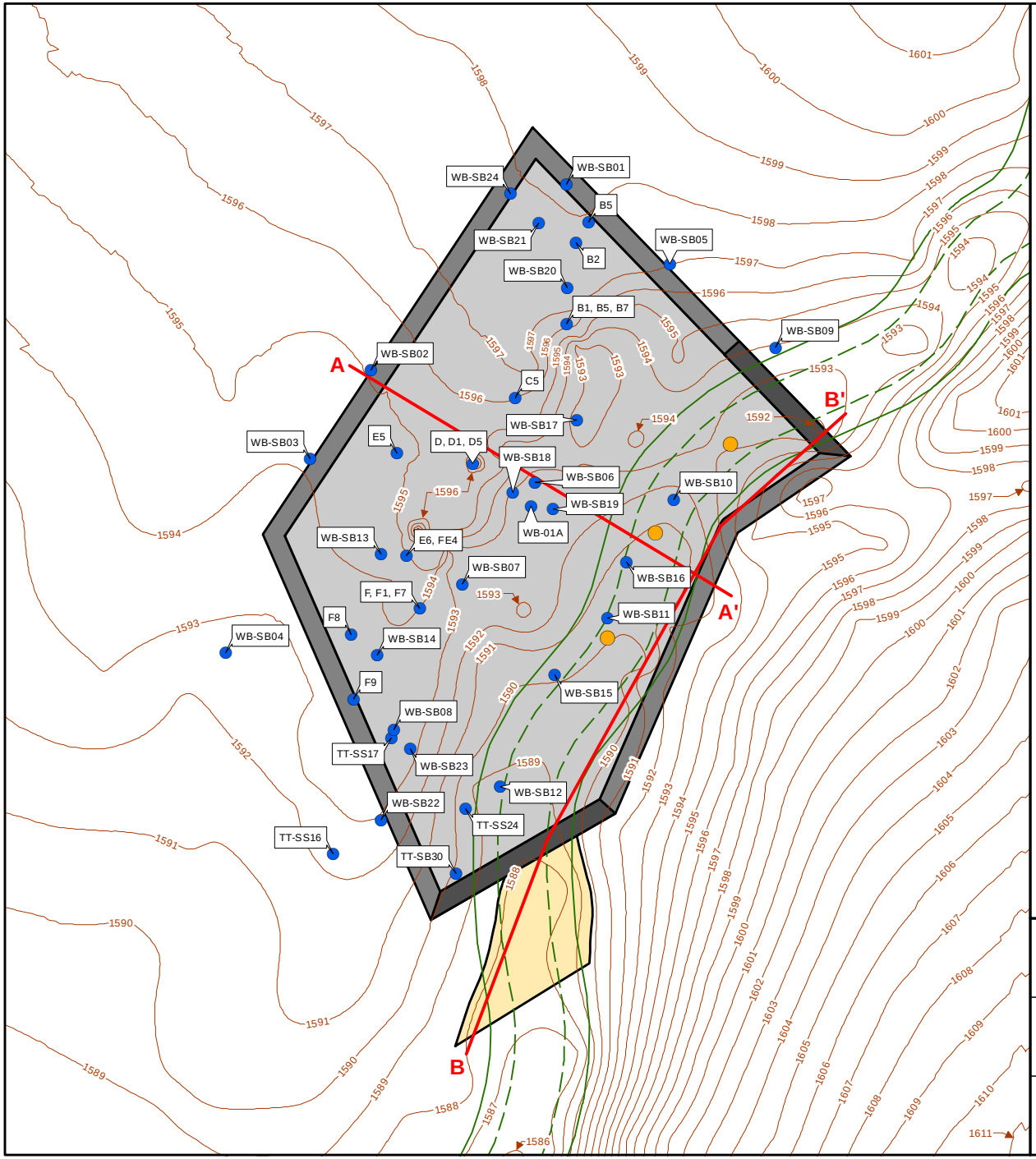
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

PROPOSED SOIL CAP LOCATIONS

ARCADIS

FIGURE
2



LEGEND

- Proposed SA-2 cap
- Proposed SA-2 cap anchor trench (2 feet deep)
- Proposed SA-2 cap anchor trench (3.8 feet deep)
- Proposed riprap
- Proposed moisture monitoring tube (approximate location)
- Existing topographic surface elevation contour
- Soil boring location
- WB-SB05 Location ID
- Approximate edge of top of existing channel
- Approximate edge of bottom of existing channel
- Cross-section location line

NOTES

- Existing topographic surface contours are derived from surveyed ground surface elevations of the displayed soil boring locations.
- Topographic surface elevations are expressed in feet above mean sea level (ft amsl).
- Positive drainage will be maintained across and around the cap area as determined by a surface re-grading plan to be prepared prior to cap construction.
- SA-2 = Soil Alternative 2.

N

0 20 40 Feet

Scale: 1" = 40'

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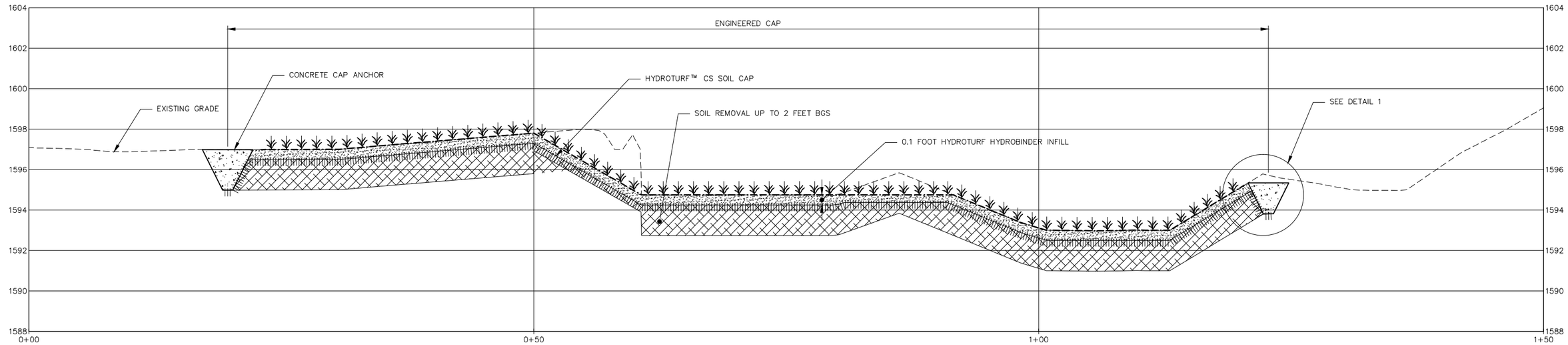
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

WATERBORE AREA CAP LAYOUT (PLAN VIEW)

ARCADIS

FIGURE
3



LEGEND:

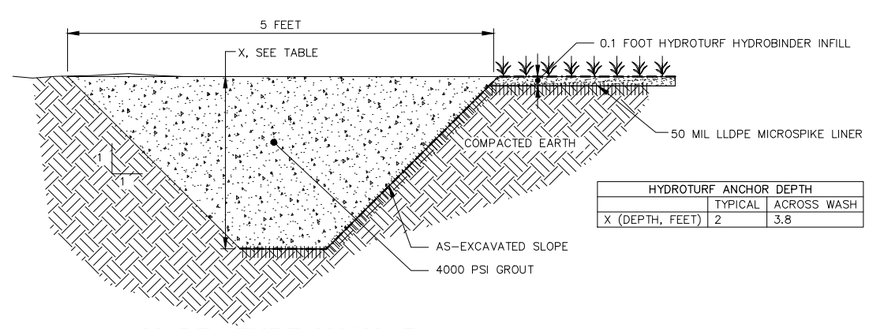
	SOIL REMOVAL UP TO 2 FEET BGS
	CONCRETE CAP ANCHOR
	HYDROTURF™ CS SOIL CAP
BGS	BELOW GROUND SURFACE
PSI	POUNDS PER SQUARE INCH
LLDPE	LINEAR LOW DENSITY POLYETHYLENE

WATERBORE CAP AREA SECTION (A)

0 5' 10'
APPROXIMATE SCALE: 1"=5' HORIZONTAL
0 2.5' 5
SCALE: 1"=2.5' VERTICAL

NOTES:

1. REMOVED SOIL SHALL BE REPLACED WITH FREE DRAINING ROCK FILL.
2. ALL COORDINATES LISTED ARE 1983 (2007 EPOCH) STATE PLANE GROUND COORDINATES ARIZONA CENTRAL ZONE, STANDARD TRANSVERSE MERCATOR PROJECTION, WITH A SCALE OF ORIGIN POINT OF X=0.0000 Y=0.0000, USING A GRID ADJUSTMENT FACTOR OF 1.00016. THESE COORDINATES CAN BE UTILIZED AS GROUND DATUM. TO CONVERT BACK TO GRID COORDINATES DIVIDE EACH COORDINATE VALUE BY 1.00016.
3. UNITS = INTERNATIONAL FEET, 1 FOOT = 0.3048 METER EXACTLY.
4. ALL BEARINGS ARE GRID BEARINGS, DISTANCES ARE GROUND DISTANCES AND COORDINATES ARE GROUND COORDINATES.
5. THE FIELD PORTION OF THIS SURVEY WAS PERFORMED JANUARY 2014.
6. VERTICAL DATUM IN NORTH AMERICAN VERTICAL DATUM OF 1988.
7. HYDROTURF™ CS = SYSTEM TYPICALLY USED FOR HIGH VELOCITY CONDITIONS AND FOR PROTECTION OF CRITICAL STRUCTURES.
8. POSITIVE DRAINAGE WILL BE MAINTAINED.



HYDROTURF ANCHOR DEPTH		
	TYPICAL	ACROSS WASH
X (DEPTH, FEET)	2	3.8

HYDROTURF ANCHOR (1)

NOT TO SCALE

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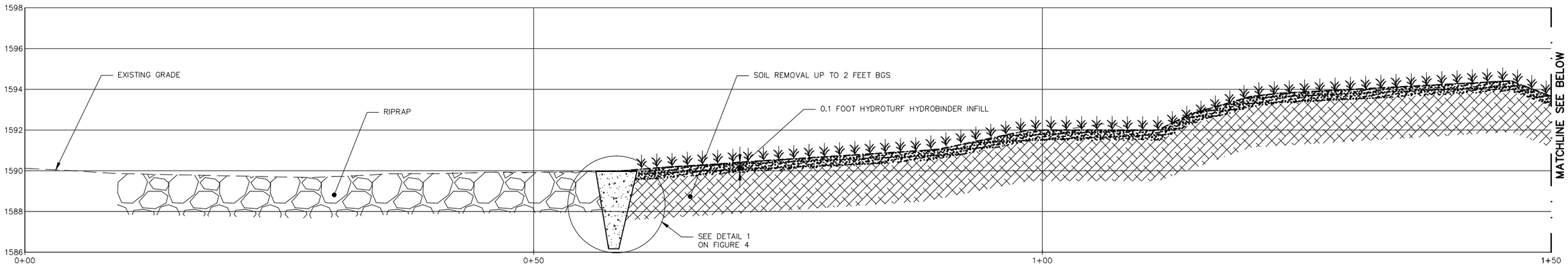
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

WATERBORE AREA CAP SECTION A AND DETAIL

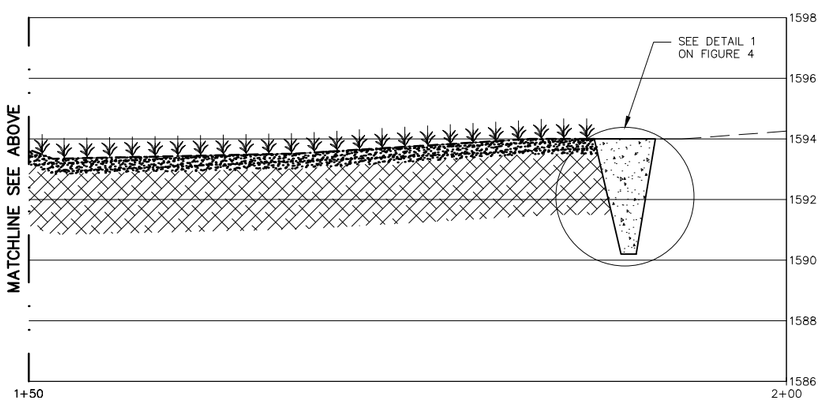
ARCADIS

FIGURE
4



WATERBORE CAP AREA SECTION (B)

0 5' 10'
APPROXIMATE SCALE: 1"=5' HORIZONTAL
0 2.5' 5
SCALE: 1"=2.5' VERTICAL



LEGEND:

SOIL REMOVAL UP TO 2 FEET BGS

CONCRETE CAP ANCHOR

HYDROTURF™ CS SOIL CAP

BGS	BELOW GROUND SURFACE.
PSI	POUNDS PER SQUARE INCH.
LLDPE	LINEAR LOW DENSITY POLYETHYLENE.

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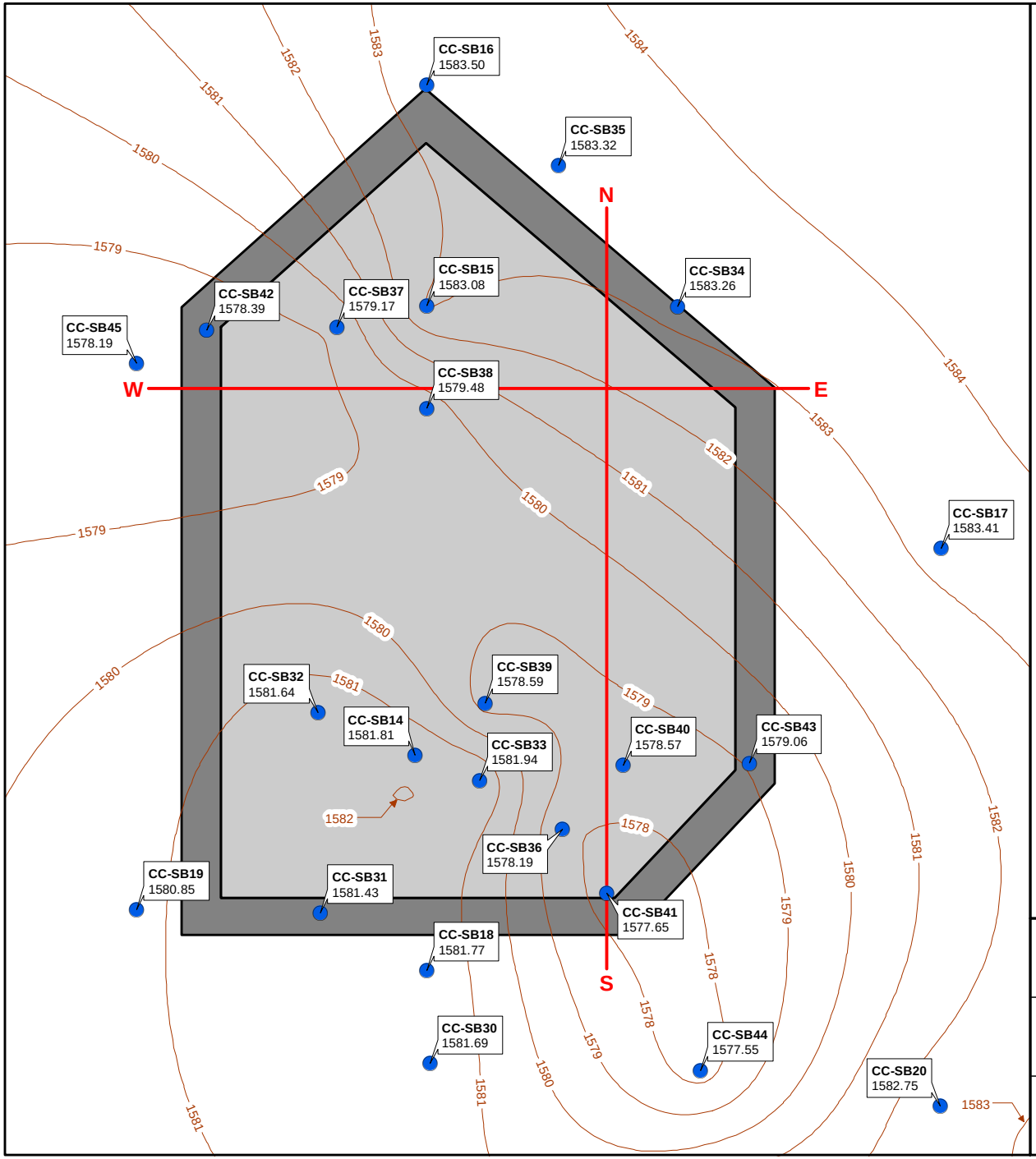
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

WATERBORE AREA CAP SECTION B AND DETAIL

ARCADIS

FIGURE
5



LEGEND

- Proposed SA-2 cap
- Proposed SA-2 cap anchor trench
- Existing topographic surface elevation contour
- Soil boring location
- CC-SB34 1583.26 — Location ID with topographic surface elevation
- Cross-section location line

NOTES

- Existing topographic surface contours are derived from surveyed ground surface elevations of the displayed soil boring locations.
- Topographic surface elevations are expressed in feet above mean sea level (ft amsl).
- Positive drainage will be maintained across and around the cap area as determined by a surface re-grading plan to be prepared prior to cap construction.
- SA-2 = Soil Alternative 2.

N

Feet
0 10 20
Scale: 1" = 20'

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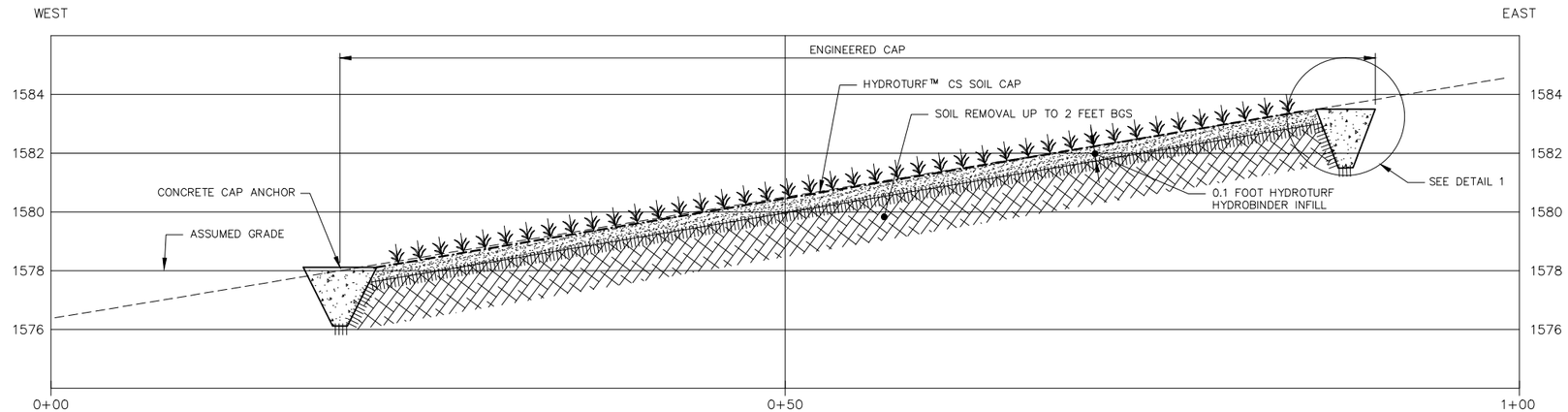
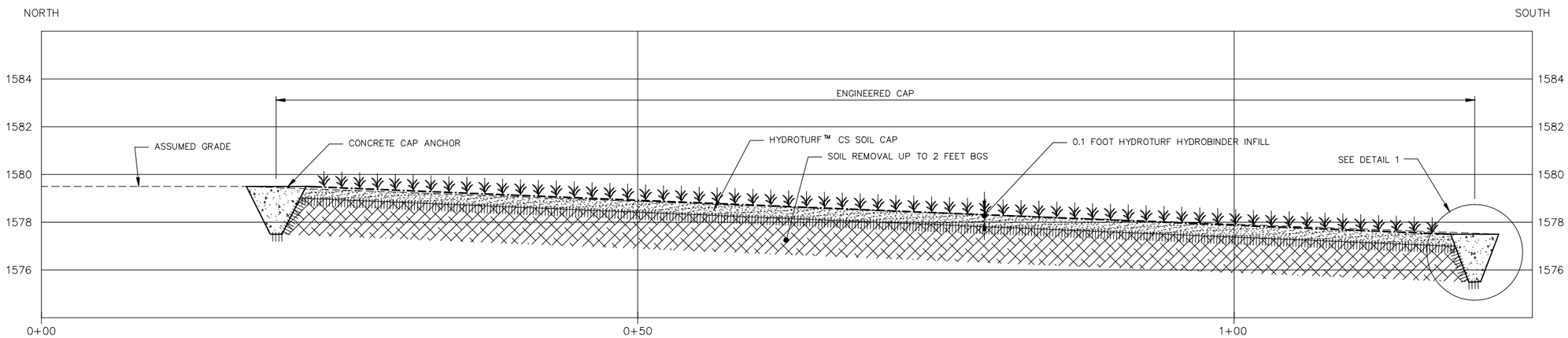
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

C-COMPLEX CAP LAYOUT (PLAN VIEW)

ARCADIS

FIGURE
6





C-COMPLEX AREA CROSS SECTIONS

0 5' 10'
APPROXIMATE SCALE: 1"=5' HORIZONTAL
0 2.5' 5
APPROXIMATE SCALE: 1"=2.5' VERTICAL

NOTES:

1. REMOVED SOIL SHALL BE REPLACED WITH CLEAN NATIVE BACKFILL.
2. GENERAL SECTION SHOWN. SURVEY WILL BE CONDUCTED PRIOR TO CONSTRUCTION.
3. HYDROTURF™ CS = SYSTEM TYPICALLY USED FOR HIGH VELOCITY CONDITIONS AND FOR PROTECTION OF CRITICAL STRUCTURES.
4. POSITIVE DRAINAGE WILL BE MAINTAINED.

LEGEND:

SOIL REMOVAL UP TO 2 FEET BGS

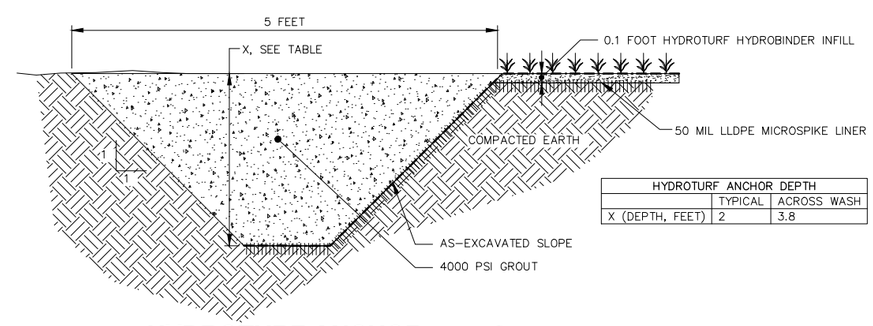
CONCRETE CAP ANCHOR

HYDROTURF™ CS SOIL CAP

BGS BELOW GROUND SURFACE.

PSI POUNDS PER SQUARE INCH.

LLDPE LINEAR LOW DENSITY POLYETHYLENE.



HYDROTURF ANCHOR DEPTH		
	TYPICAL	ACROSS WASH
X (DEPTH, FEET)	2	3.8

HYDROTURF ANCHOR

NOT TO SCALE

1

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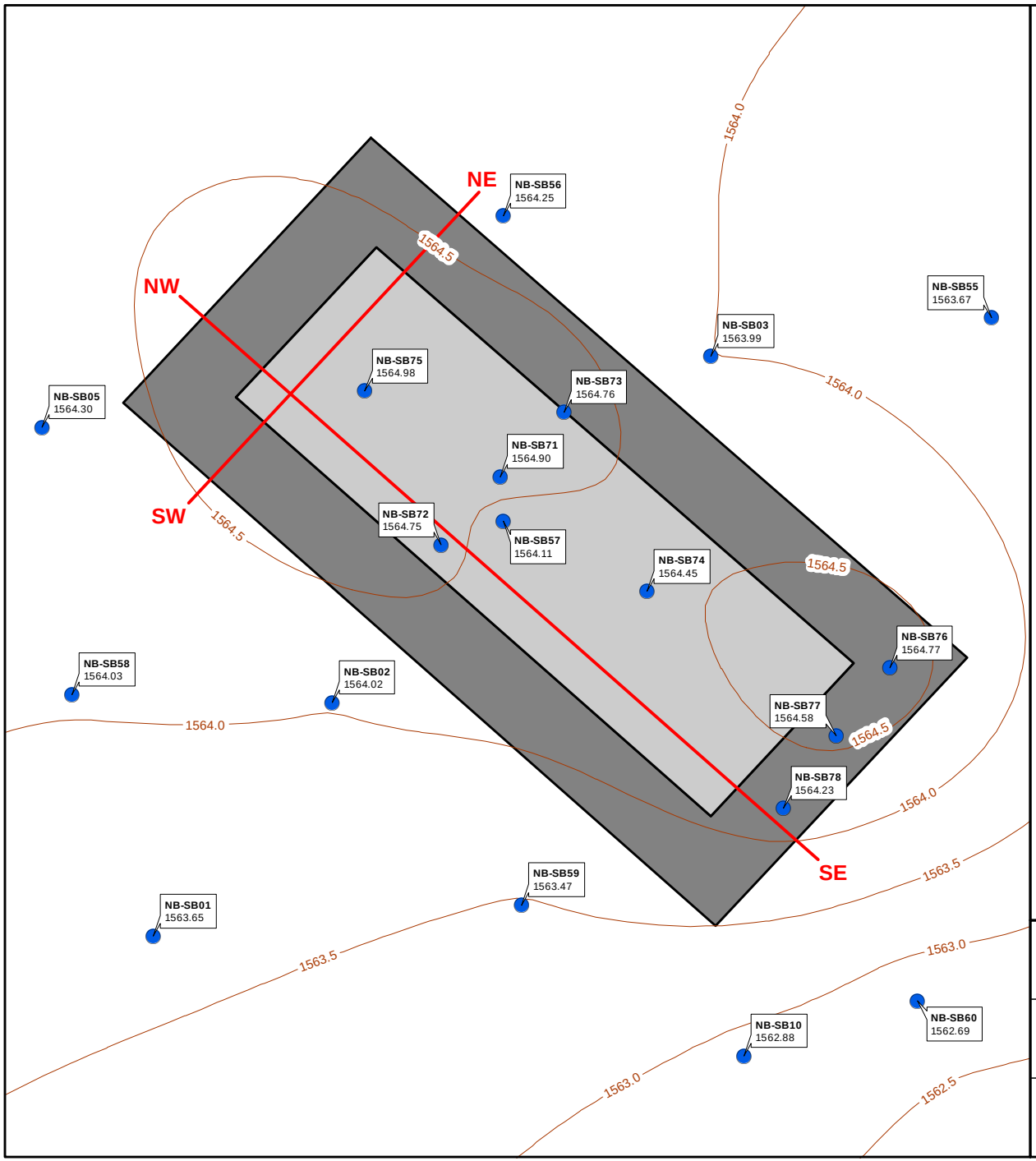
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

C-COMPLEX AREA CAP SECTION AND DETAIL

ARCADIS

FIGURE
7



LEGEND

- Proposed SA-2 cap
- Proposed SA-2 cap anchor trench
- Existing topographic surface elevation contour
- Soil boring location
- NB-SB03 1563.99 — Location ID with topographic surface elevation
- Cross-section location line

NOTES

- Existing topographic surface contours are derived from surveyed ground surface elevations of the displayed soil boring locations.
- Topographic surface elevations are expressed in feet above mean sea level (ft amsl).
- Positive drainage will be maintained across and around the cap area as determined by a surface re-grading plan to be prepared prior to cap construction.
- SA-2 = Soil Alternative 2.

N

Feet
0 5 10
Scale: 1" = 10'

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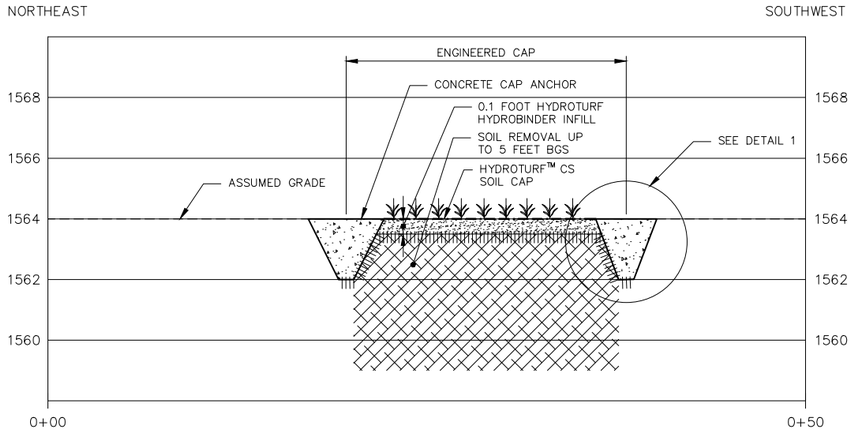
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

NEW BURN AREA CAP LAYOUT (PLAN VIEW)

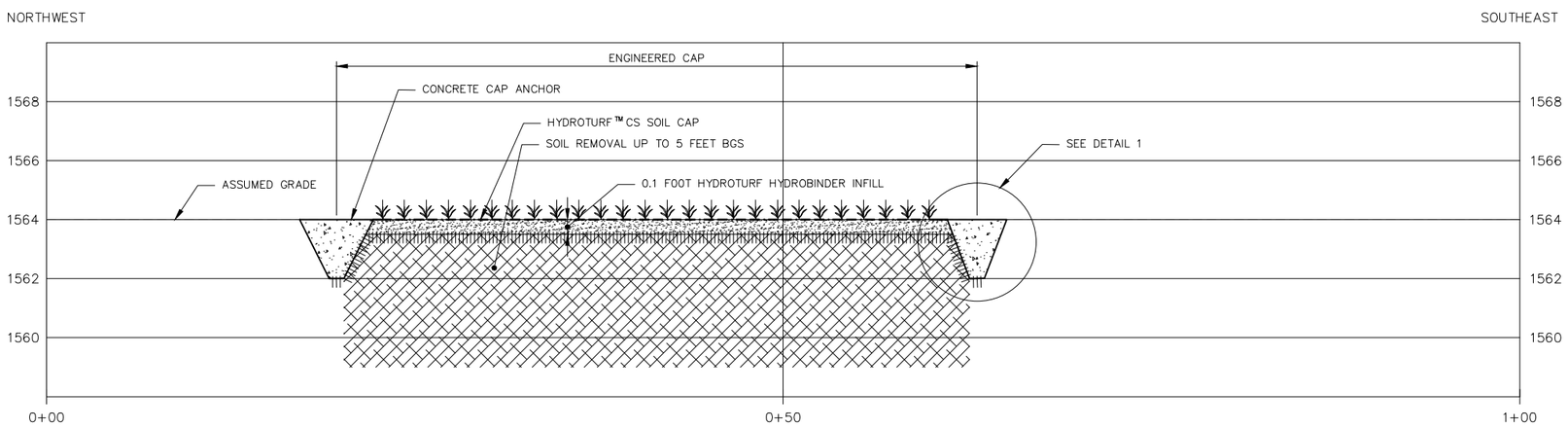
ARCADIS

FIGURE
8



NOTES:

1. REMOVED SOIL SHALL BE REPLACED WITH CLEAN NATIVE BACKFILL.
2. GENERAL SECTION SHOWN. SURVEY WILL BE CONDUCTED PRIOR TO CONSTRUCTION.
3. HYDROTURF™ CS = SYSTEM TYPICALLY USED FOR HIGH VELOCITY CONDITIONS AND FOR PROTECTION OF CRITICAL STRUCTURES.
4. POSITIVE DRAINAGE WILL BE MAINTAINED.

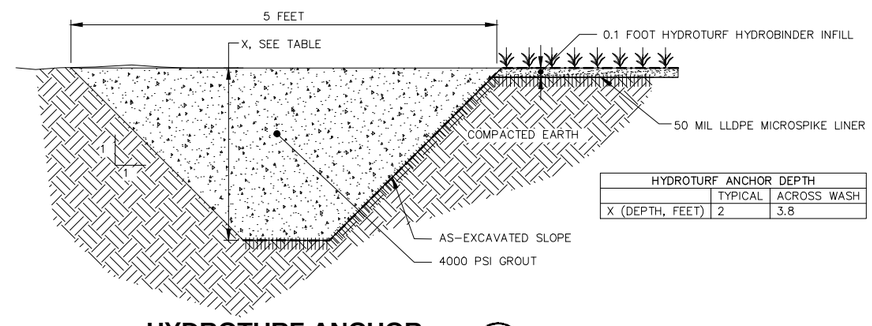


NEW BURN AREA CROSS SECTIONS

0 5' 10'
APPROXIMATE SCALE: 1"=5' HORIZONTAL
0 2.5' 5
APPROXIMATE SCALE: 1"=2.5' VERTICAL

LEGEND:

	SOIL REMOVAL UP TO 2 FEET BGS
	CONCRETE CAP ANCHOR
	HYDROTURF™ CS SOIL CAP
BGS	BELOW GROUND SURFACE.
PSI	POUNDS PER SQUARE INCH.
LLDPE	LINEAR LOW DENSITY POLYETHYLENE.



HYDROTURF ANCHOR DEPTH		
	TYPICAL	ACROSS WASH
X (DEPTH, FEET)	2	3.8

HYDROTURF ANCHOR

NOT TO SCALE

1

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
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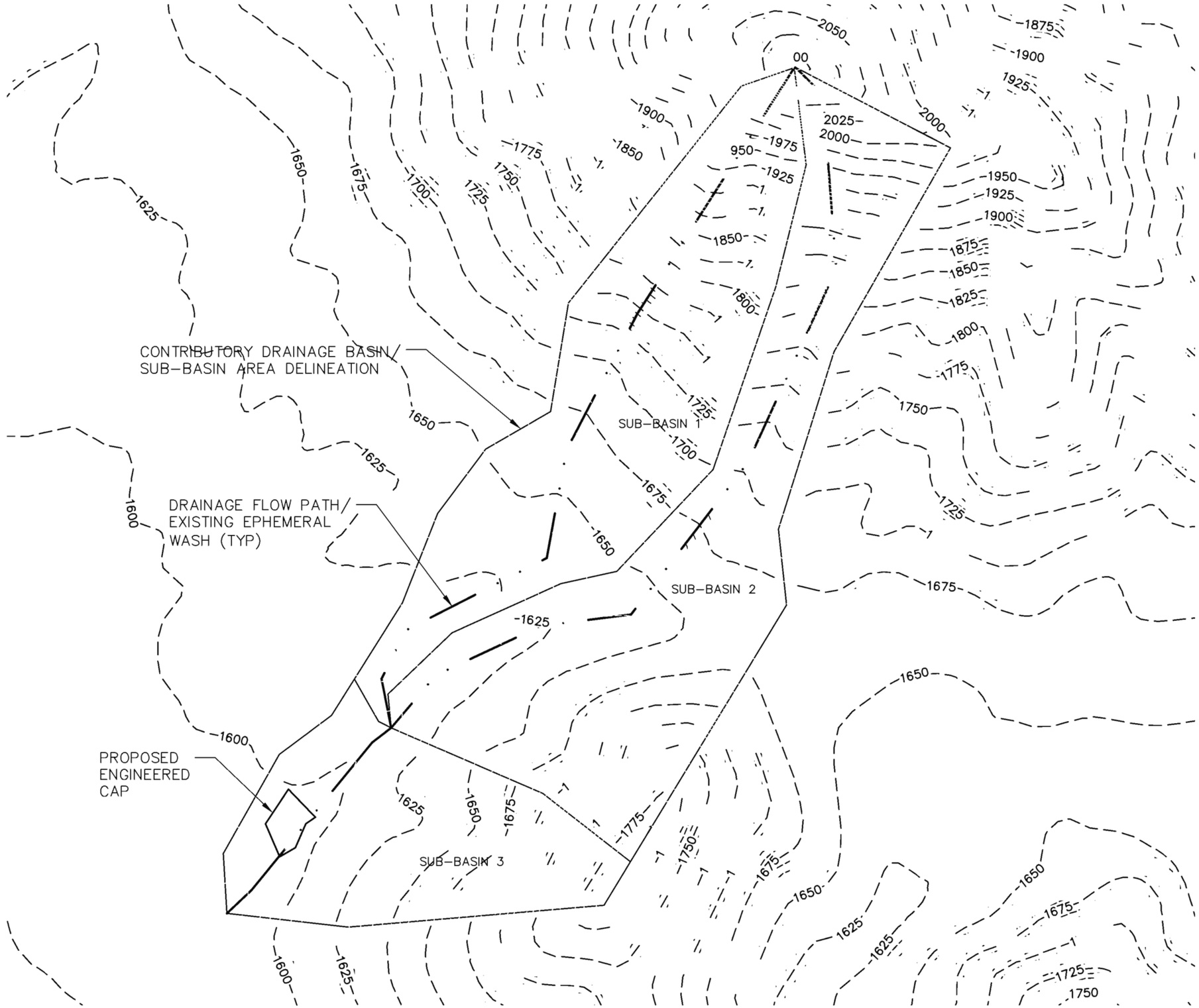
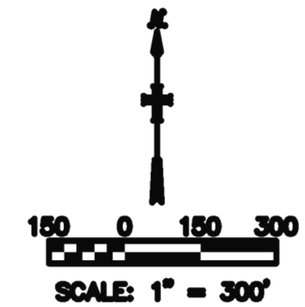
CAP DESIGN BASIS REPORT

NEW BURN AREA CAP SECTION AND DETAIL

ARCADIS

FIGURE
9





LEGEND

— — 1700 — — MAJOR CONTOUR (25-FT INTERVAL)

MINOR CONTOUR (5-FT INTERVAL)

NOTE:
CONTOURS ARE BASED ON THE NATIONAL ELEVATION DATASET AND WERE IMPORTED FROM GIS.

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

WATERSHED DELINEATION

ARCADIS

FIGURE
10

Appendix A

Manufacturer Product Information

8 October 2015

Brad Cooley
Watershed Geosynthetics, LLC

RE: WATER VAPOR TRANSMISSION CERTIFICATION

Dear Mr. Cooley,

The water vapor transmission rate of Agru 50 mil Super Gripnet will be < 1 x 10^{-7} cm/s when tested according to ASTM D96.

Sincerely,

Nathan Ivy
Corporate Quality Control/Technical Manager
Agru America

Executive Offices: 500 Garrison Road, Georgetown, SC 29440 • 843 546-0600 • 800 321-1379 •
Sales Office: 700 Rockmead, Suite 150, Kingwood, TX 77339 • 281 358-4741 • 800 373-2478 •
Email: salesmkg@agruamerica.com

March 5, 2014
June 20, 2014 Updated with E 96 result

Mail To:

Grant Palmer
Agru
500 Garrison Road
Georgetown, SC 29440

email: gp@agruamerica.com

Bill To:

<= Same (P O# : 6333-14)

Dear Mr. Palmer:

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs.
TRI is pleased to submit this final report of the laboratory testing for the sample(s) listed below.

Project:	**Ardaman 2014 Testing**
TRI Job Reference Number:	E2386-82-05
Material(s) Tested:	One, Agru 60 mil Microspike HDPE Geomembrane(s)
Test(s) Requested:	Modulus of Elasticity (ASTM D 638) Low Temperature Brittleness (ASTM D 746, NSF 54, -70C) Volatile Loss (ASTM D 1203) Water Absorption (ASTM D 570) Updating==> Water Vapor Transmission (E 96)

If you have any questions or require any additional information, please call us at 1-800-880-8378

Sincerely,

MPatel

Mansukh Patel
Laboratory Manager
Geosynthetic Services Division
www.GeosyntheticTesting.com

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

GEOMEMBRANE TEST RESULTS
TRI Client: Agru
Project: Ardaman 2014 Testing

Material: Agru 60 mil Microspike HDPE Geomembrane
Sample Identification: G14C082021 **Resin: CP Chem Marlex K307** **Resin Lot# H8232868**
TRI Log #: E2386-82-05

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.
Modulus of Elasticity (ASTM D 638)												
MD Modulus of elasticity (psi)	109814	99268	94039	119201	125591						**109583**	13199
MD Modulus of elasticity (ppi)	6589	6532	6235	8487	7535						**7076**	928
TD Modulus of elasticity (psi)	120409	97905	91309	118017	121089						**109746**	14062
TD Modulus of elasticity (ppi)	7754	6726	6355	8061	8016						**7382**	788
Low Temperature Brittleness (ASTM D 746, NSF 54, -70C)											**% passing**	
MD (Pass/Fail)	Pass	Pass	Pass	Pass	Pass						**100**	
TD (Pass/Fail)	Pass	Pass	Pass	Pass	Pass						**100**	
Volatile Loss (ASTM D 1203)												
% Volatile Loss - 48 hr	0.073	0.096	0.093								**0.087**	0.013
Water Aborption (ASTM D 570)												
Immersion Procedure:	Specimens were exposed in deionized water for 24 hours at 23 degrees C.											
Initial mass (g)	3.0032	3.2669	3.0086									
Post immersion mass (g)	3.0061	3.2680	3.0095									
Percentage Water Absorbed (%)	0.10	0.03	0.03								**0.05**	0.04
Water Vapor Transmission (ASTM E 96, Procedure BW)												
WVT (gm/h-m2)	0.0018	0.0017	0.0016								**0.00170**	0.00010
WVT (gm/day-m2)	0.0429	0.0419	0.0378								**0.04087**	0.00270
WVT (grains/h*ft2)	0.00260	0.00250	0.00230								**0.00247**	0.00015
Metric Perms (gm/Pa*hr*m2)	1.26E-06	1.23E-06	1.11E-06								**1.20E-06**	7.94E-08
Perms (inch-pounds)	0.0061	0.006	0.0054								**0.00583**	0.00038
Permeability (cm/s)	5.33E-15	5.22E-15	4.70E-15								**5.08E-15**	3.37E-16

MD Machine Direction TD Transverse Direction

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

September 1, 2014
September 29, 2014 Updated with E 96 Result
October 1, 2014 Updated with typo correction for Perm.

Mail To:

Grant Palmer
Agru America
500 Garrison Road
Georgetown, SC 29440

email: gp@agruamerica.com
cc email: cArnold@AgruAmerica.com
cc email: nivy@agruamerica.com

Bill To:

<= Same (P O # 6939 - 14)

Dear Mr. Palmer:

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs.
TRI is pleased to submit this final report of the laboratory testing for the sample(s) listed below.

Project:		**Ardaman**
TRI Job Reference Number:		E2394-37-03
Material(s) Tested:		One, Agru 40 mil Smooth HDPE Geomembrane
Test(s) Requested:		Modulus of Elasticity (ASTM D 638, 2 ipm strain rate)
		Low Temperature Brittleness (ASTM D 746, NSF 54, -70C)
		Volatile Loss (ASTM D 1203)
		Water Extraction (ASTM D 570)
	Updating = =>	Water Vapor Transmission (E 96, Proc. BW)

If you have any questions or require any additional information, please call us at 1-800-880-8378

Sincerely,

Mansukh Patel
Laboratory Manager
Geosynthetic Services Division
www.GeosyntheticTesting.com

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

GEOMEMBRANE TEST RESULTS
TRI Client: Agru
Project: Ardaman

Material: Agru 40 mil Smooth HDPE Geomembrane
Sample Identification:Roll # G14B303044 Resin CP Chem Marlex K307 Resin Lot#: H7140771
TRI Log : E2394-37-03

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.
Modulus of Elasticity (ASTM D 638, 2 ipm strain rate)												
MD Tangent Modulus (psi)	121765	115942	121329	102528	121124						**116538**	8184
TD Tangent Modulus (psi)	98588	99357	112112	136708	65717						**102496**	25694
Low Temperature Brittleness (ASTM D 746, NSF 54, -70C)											**% passing**	
MD (Pass/Fail)	Pass	Pass	Pass	Pass	Pass						**100**	
TD (Pass/Fail)	Pass	Pass	Pass	Pass	Pass						**100**	
Volatile Loss (ASTM D 1203)												
% Volatile Loss	0.073	0.068	0.072								**0.071**	0.003
Water Extraction (ASTM D 570)												
Initial mass (g)	1.9865	1.8217	1.8170									
Post immersion mass (g)	1.9869	1.8219	1.8171									
Soluble matter lost (g)	0.0201	0.0109	0.0055									
Percentage Water Absorbed (%)	0.02	0.01	0.01								**0.01**	0.01
Water Vapor Transmission (ASTM E 96, Procedure BW)												
WVT (gm/h-m2)	0.0047	0.0013	0.0028								**0.00293**	0.00170
WVT (gm/day-m2)	0.1125	0.0314	0.066								**0.06997**	0.04070
WVT (grains/h*ft2)	0.00670	0.00190	0.00390								**0.00417**	0.00241
Metric Perms (gm/Pa*hr*m2)	3.31E-06	9.22E-07	1.94E-06								**2.06E-06**	1.20E-06
Perms (inch-pounds)	0.0161	0.0045	0.0094								**0.01000**	0.00582
Permeability (cm/s)	9.33E-15	2.60E-15	5.47E-15								**5.80E-15**	3.38E-15

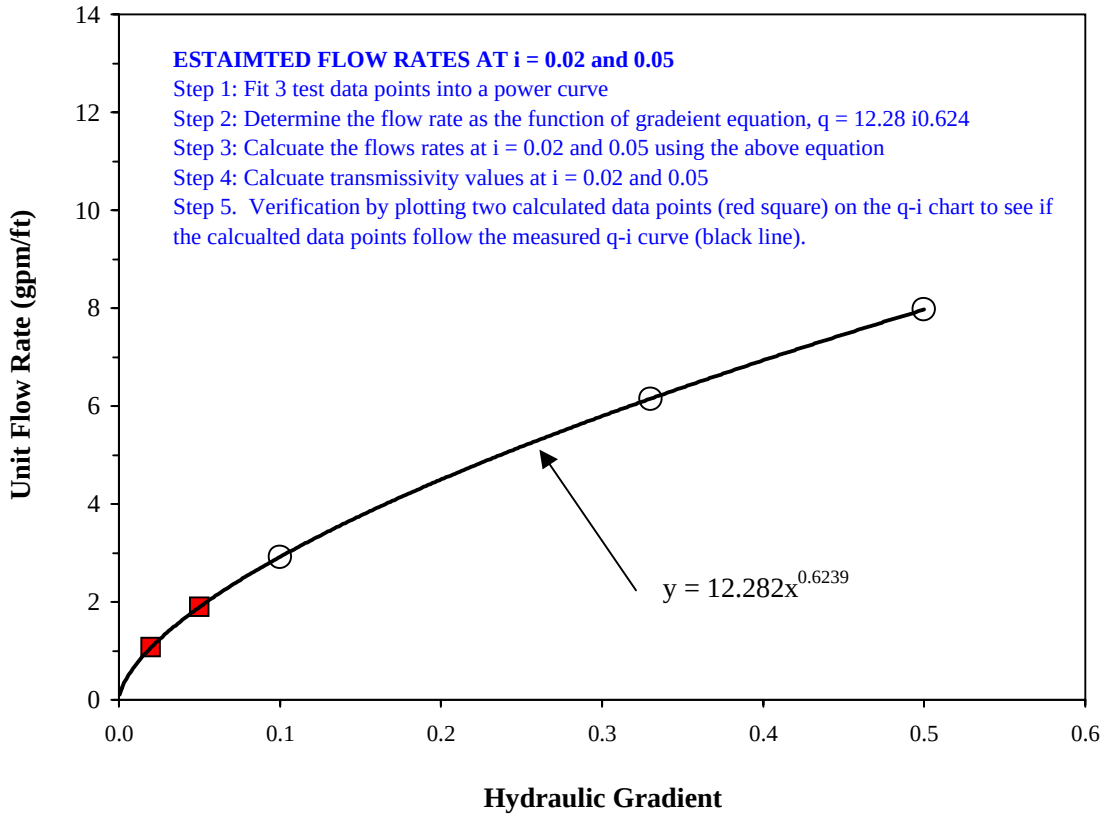
The data point collected for each specimen is sporadic , test value calculated is based on Trend of the data point s.

MD Machine Direction TD Transverse Direction

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

CLOSURETURF LLC -LANDFILL COVER SYSTEM
HYDRAULIC TRANSMISSIVITY TESTING (ASTM D 4716)

Test Configuration (from Top to Bottom): Sand Layer/Polytex Artificial Grass with Geotextile Side Down/ Agru 50-mil Super Gripnet LLDPE Geomembrane with Studs Side Up



Test No.	Flow Direction	Specimen Size Width x Length (in. x in.)	Total Normal Stress[1] σ_n (psf)	Seating Time t (hour)	Hydraulic Gradient i (-)	Transmissivity $\theta = 0.00020697\left(\frac{q}{i}\right)$ (m^2/sec)	Flow Rate $q = 12.28i^{0.624}$ (gpm/ft)	Flow Rate q' (l/min/m)
					0.02	1.11E-02	1.07	
					0.05	7.84E-03	1.89	
1	MD	12 x12	47	0.25	0.10	6.04E-03	2.92	36.3
2	MD	12 x12	47	0.25	0.33	3.86E-03	6.15	76.4
3	MD	12 x12	47	0.25	0.50	3.30E-03	7.97	99.0

NOTE:
Total normal stress = total weight (sand + steel plate + surcharge) divided by the plan area of test specimen (1 square ft). A normal stress of 47 psf is approximately the minimum total stress required to keep the specimen from uplifting.

DATE TESTED:	1/11/2013
FIGURE NO.	A-1
PROJECT NO.	SGI10007
DOCUMENT NO.	
FILE NO.	

SGI TESTING SERVICES, LLC

Taking Erosion Protection to a Whole New Level

HydroTurf™

Advanced Revetment Technology

U.S. Patent Nos. 7,682,105 & 8,403,597
U.S. & International Patents Pending

Superior Armoring Technology

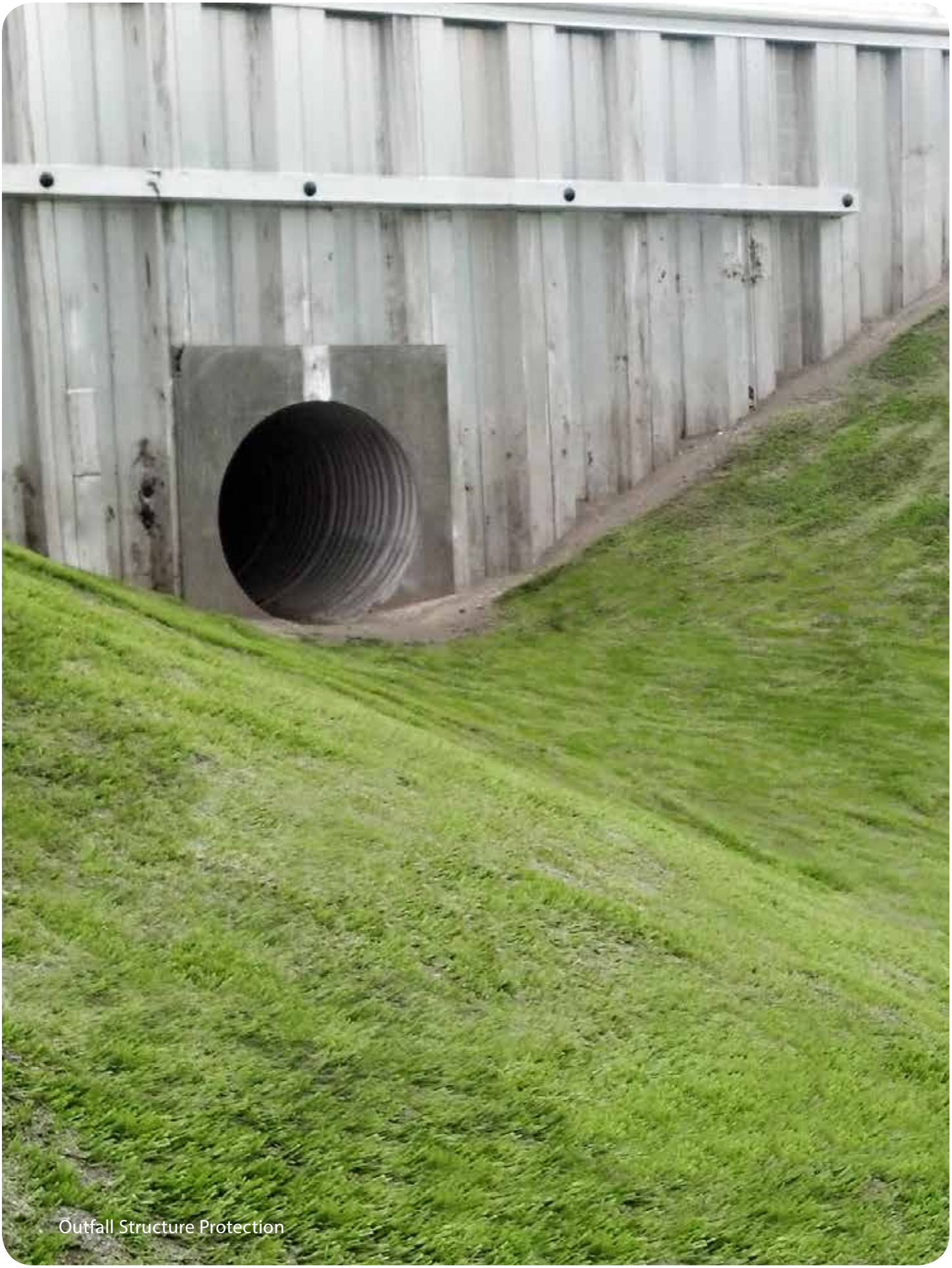
HydroTurf™ is an economically, environmentally friendly hardened erosion armoring technology, specifically designed to reduce construction and long-term maintenance costs. It combines engineered synthetic turf with a high friction geomembrane that are locked into place with a specially designed HydroBinder™ high-strength infill.

HydroTurf offers the best of both worlds—the environmental and aesthetic benefits of vegetation as well as the performance and maintenance benefits of hard armor. By offering superior erosion control, pointedly less turbidity, and significantly less maintenance, HydroTurf eliminates the headaches of traditional vegetative erosion control systems. HydroTurf is also a more sustainable solution than other hard armor revetment systems since it has a lower carbon footprint.

HydroTurf is used in the following applications:

- Protection from wave overwash/overtopping on the landward side of levees and embankments
- Lining of drainage channels, swales, and canals
- Spillways and slopes on dams for overtopping protection
- Shoreline protection within basins, impoundments and reservoirs
- Facing slopes and mechanically stabilized earth walls
- Cart paths, drainage channels and lake banks on golf courses


Levee Embankment Protection



Outfall Structure Protection

HydroTurf™ has a number of benefits over other revetment solutions.

Excellent Hydraulic Performance—HydroTurf has been extensively tested in full-scale laboratories and project applications for extreme hydraulic performance.

50+ Year Functional Longevity—Through long-term weathering tests, HydroTurf is designed to have a 50+ year functional longevity when properly maintained.

Less Costly Construction—HydroTurf is significantly less costly than hard armor revetment systems (i.e. concrete, rock riprap, and articulated concrete block). Installed cost for HydroTurf is typically up to 50% less than that for traditional hard armor systems.

Rapid, Low Impact Construction—Construction and installation of the HydroTurf system are rapid and low impact. Only small, light-weight construction equipment is needed for installation. On large projects, one (1) construction crew is able to install approximately 1 acre per day. Additional crews can be added to increase this rate.

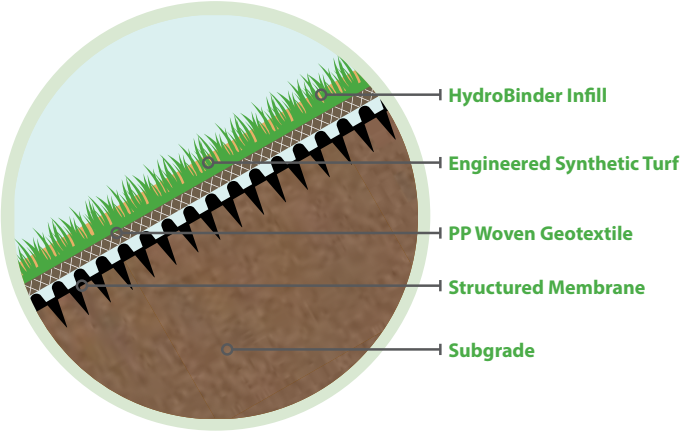
Significant Long Term Maintenance Cost Savings—Vegetation management and erosion control are significant maintenance costs for Anchored Turf Reinforcement Mat (TRM) products. Maintenance costs for these TRMs may be as high as $1,500/acre/year. HydroTurf requires minimal maintenance and will drastically lower long-term maintenance budgets.

Reduction in Carbon Footprint—HydroTurf has a lower carbon footprint (1/4 to 1/8) than that of other traditional hardened revetment solutions.

Aesthetics—HydroTurf looks and feels like natural vegetation.

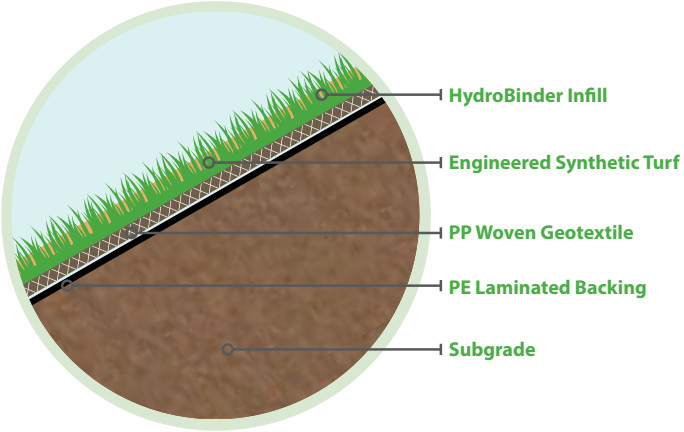
Shoreline/Lake Bank Protection

HydroTurf is available in two system configurations.



HydroTurf™ CS

HydroTurf CS is typically used for high velocity conditions and for protection of critical structures.



HydroTurf™ Z

HydroTurf Z is ideal for less critical applications involving lower velocities and flow conditions.

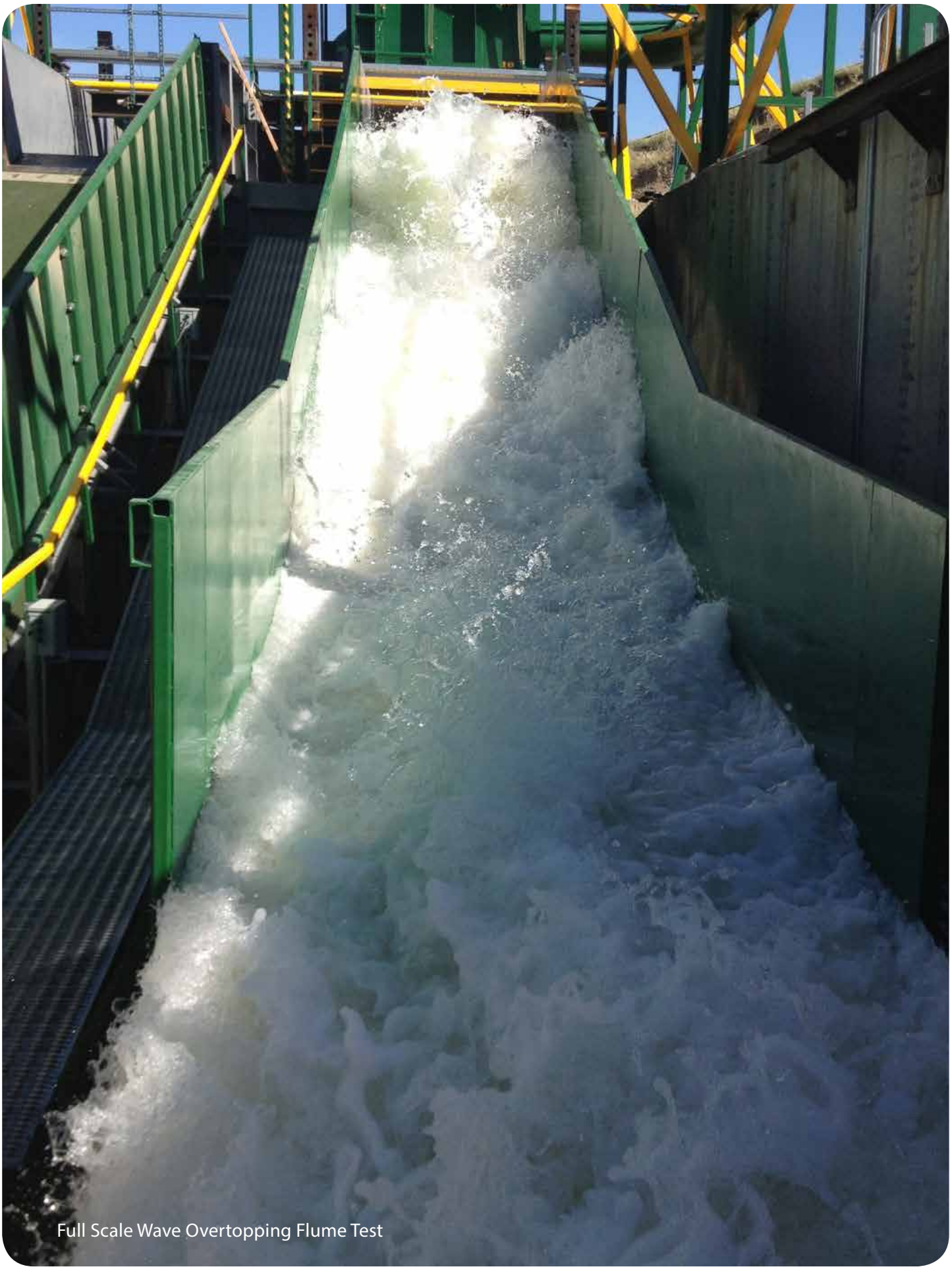
HydroTurf™ has been extensively tested in the laboratories and project applications for extreme performance and real-world durability. From extensive 5-ft overtopping flows to simulated 500 year hurricanes, HydroTurf™ has established a new standard in the most comprehensive array of testing in the industry.

Full-Scale Hydraulic Testing:

- Wave Overtopping for Levee Landward-Side Slope Protection
- Steady State Overtopping
- Hydraulic Jump
- Simulated Heavy Debris Loads
- Intentionally Damaged Conditions

Other Testing & Evaluations:

- Aerodynamic Wind Tunnel
- Weathering and Functional Longevity
- Vehicle Loading
- Carbon Footprint



Full Scale Wave Overtopping Flume Test

HydroTurf™ PATENT PENDING

SYNTHETIC TURF COMPONENT

Product Data	Test Method	Values
CBR Puncture	ASTM D6241	900 lb., (MARV)
Tensile Product (MD/XD)	ASTM D4595	1,000 lb/ft min (MARV)
Aerodynamic Evaluation	GTRI Wind Tunnel	120 mph with maximum uplift of 0.12 lb/sf
Synthetic Turf Fiber UV Stability	ASTM G147	> 60% retained tensile strength at 100 years (projected)
Full Scale Steady State Hydraulic Overtopping	ASTM D7277 / ASTM D7276	5 ft overtopping resulting in 29 ft/s velocity for Manning's N Value of 0.02
Full Scale Wave Overtopping Test— Cumulative Volume	Colorado State University Wave Simulator	165,000 ft^3/ft
Full Scale Wave Overtopping Test— Maximum Average Wave Overtopping Discharge	Colorado State University Wave Simulator	4.0 ft^3/s/ft
Transmissivity w/ underlying structured geomembrane	ASTM D4716	2.5E -03m^2/sec., min.
Normal stress 50 psf and 0.33 gradient (m^2/sec)		
Internal Friction of combined components (Low Confining Stress)	ASTM D5321	38° min. (peak)
HydroBinder™ Infill	Compressive Strength	5,000 psi
Hydraulic Jump Test	Colorado State University	Dissipates 120 horsepower envelope curve of energy ratio as a function of Froude Ratio (available upon request)

STRUCTURED GEOMEMBRANE

Product Data	Test Method	LLDPE Values	HDPE Values
Thickness (min. avg.), mil (mm)	ASTM D5994	50 (1.25)	50 (1.25)
Thickness (lowest indiv.), mil (mm)	ASTM D5994	45 (1.15)	45 (1.15)
Drainage Stud Height (min. avg.), mil (mm)	ASTM D7466	130 (3.30)	130 (3.30)
Friction Spike Height (min. avg.), mil (mm)	ASTM D7466	175 (4.45)	175 (4.45)
Density, g/cc	ASTM D792, Method B	0.939 (max)	0.94 (min)
Tensile Properties (avg. both directions)	ASTM D6693, Type IV		
Strength @ Yield (min. avg.), lb/in width (N/mm)	ASTM D6693, Type IV	N/A	110 (19.3)
Elongation @ Yield (min. avg.), % (GL=1.3in)	ASTM D6693, Type IV	N/A	13
Strength @ Break (min. avg.), lb/in width (N/mm)	ASTM D6693, Type IV	110 (19.3)	110 (19.3)
Elongation @ Break (min. avg.), % (GL=2.0in)	ASTM D6693, Type IV	300	200
Tear Resistance (min. avg.), lbs. (N)	ASTM D1004	30 (133)	38 (169)
Puncture Resistance (min. avg.), lbs. (N)	ASTM D4833	55 (245)	80 (356)
Carbon Black Content (range in %)	ASTM D4218	2-3	2-3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3	
Stress Crack Resistance (Single Point NCTL), hours	ASTM D5397, Appendix	N/A	300
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O_2	≥140	≥140
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0
Oven Aging	ASTM D5721	60	80
with HP OIT, (% retained after 90 days)	ASTM D5885, 150°C, 500psi O_2		
UV Resistance	ASTM D7238	20 hr. Cycle @ 75° C/4 hr. dark condensation @ 60°	
with HP OIT, (% retained after 1600 hours)	ASTM D5885, 150°C, 500psi O_2	35	50
2% Secant Modulus (max), lb/in (N/mm)	ASTM 5323	3000 (520)	N/A
Axi-Symmetric Break Resistance Strain, % (min)	ASTM D5617	30	N/A

Geomembranes are certified to pass Low Temp. Brittleness via ASTM D746 (-80˚C), and Dimensional Stability via ASTM D1204 (± 2% @ 100˚C)

SUPPLY INFORMATION (Standard Roll Dimensions)

Thickness	Thickness		Width		Length		Area (approx.)		Weight (avg.)	
	mil	mm	ft	m	ft	m	ft^2	m^2	lbs	kg
Super Gripnet	50	1.25	23	7	300	91.44	6,900	640	2,855	1,300
Turf Component	N/A	N/A	15	4.6	300	91.44	4,500	418	840	381

Notes:

All liner and turf roll lengths and widths have a tolerance of ±1%. All liner rolls are supplied with 2 slings. Both liner and turf rolls are wound on a 6 inch core. Turf rolls are strapped and wrapped for shipment. Special roll lengths are available upon request. Turf component height = 2'6" diameter per roll.

770.777.0386 • watershedgeo.com • info@watershedgeo.com

Linear Low Density Polyethylene MicroSpike® Liner

Product Data

Property	Test Method	Values			
Thickness, nominal, (mm)		40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Thickness (min. ave.), mil (mm)	ASTM D5994*	38 (.95)	57 (1.43)	76 (1.90)	95 (2.38)
Thickness (lowest indiv. for 8 of 10 spec.), mil (mm)	ASTM D5994*	36 (.90)	54 (1.35)	72 (1.80)	90 (2.25)
Thickness (lowest individual), mil (mm)	ASTM D5994*	34 (.85)	51 (1.28)	68 (1.70)	85 (2.13)
*The thickness values may be changed due to project specifications (i.e., absolute minimum thickness)					
Asperity Height (min. ave.), mil (mm)	ASTM D7466	16 (.41)	16 (.41)	16 (.41)	16 (.41)
Density, g/cc, maximum	ASTM D792, Method B	0.939	0.939	0.939	0.939
Tensile Properties (ave. both directions)	ASTM D6693, Type IV				
Strength @ Break (min. ave.), lb/in width (N/mm)	2 in/minute	112 (19.6)	168 (29.4)	224 (39.2)	280 (49.0)
Elongation @ Break (min. ave.), % (GL=2.0in)	5 specimens in each direction	400	400	400	400
Tear Resistance (min. ave.), lbs. (N)	ASTM D1004	25 (111)	36 (160)	50 (222)	60 (267)
Puncture Resistance (min. ave.), lbs. (N)	ASTM D4833	50 (222)	70 (310)	90 (400)	115 (512)
Carbon Black Content (range in %)	ASTM D4218	2 - 3	2 - 3	2 - 3	2 - 3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3			
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O_2	≥140	≥140	≥140	≥140
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0	≤1.0	≤1.0
Oven Aging	ASTM D5721	60	60	60	60
with HP OIT, (% retained after 90 days)	ASTM D5885, 150°C, 500psi O_2				
UV Resistance	ASTM D7238	20hr. Cycle @ 75°C/4 hr. dark condensation @ 60°C			
with HP OIT, (% retained after 1600 hours)	ASTM D5885, 150°C, 500psi O_2	35	35	35	35
2% Secant Modulus (max.), lb/in. (N/mm)	ASTM D5323	2400 (420)	3600 (630)	4800 (840)	6000 (1050)
Axi-Symmetric Break Resistance Strain, % (min.)	ASTM D5617	30	30	30	30

Agru America's geomembranes are certified to pass Low Temp. Brittleness via ASTM D746 (-80°C), and Dimensional Stability via ASTM D1204 (±2% @ 100°C).

These product specifications meet or exceed GRI's GM17

Supply Information (Standard Roll Dimensions)

Thickness		Width		Length		Area (approx.)		Weight (average)*	
mil	mm	ft	m	ft	m	ft^2	m^2	lbs	kg
40	1.0	23	7	710	216.40	16,330	1,514.87	3,900	1,770
60	1.5	23	7	505	153.90	11,615	1,078	3,900	1,770
80	2.0	23	7	385	117.35	8,855	821	3,900	1,770
100	2.5	23	7	310	94.49	7,130	661	3,900	1,770

Notes:

All rolls are supplied with two slings. All rolls are wound on a 6 inch core. Special lengths are available on request. All roll lengths and widths have a tolerance of ±1%
**The weight values may change due to project specifications (i.e. absolute minimum thickness or special roll lengths) or shipping requirements (i.e. international containerized shipments).*

500 Garrison Road, Georgetown, South Carolina 29440 843-546-0600 800-373-2478 Fax: 843-527-2738
email: salesmkg@agruamerica.com www.AgruAmerica.com

Appendix B

Flood Insurance Rate Map

NOTES TO USERS

This map is for use in administering the Nation Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Central zone (FIPSZONE 0202). The **horizontal datum** was NAD 83 HARN, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988 (NAVD 88). These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. Map users wishing to obtain flood elevations referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) may use the following Maricopa County website application: http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm

This web tool allows users to obtain point-specific datum conversion values by zooming in and hovering over a VERTCON checkbox on the layers menu on the left side of the screen. The VERTCON grid referenced in this web application was also used to convert existing flood elevations from NGVD 29 to NAVD 88.

To obtain current elevation, description, and/or location information for National Geodetic Survey bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov. To obtain information about Geodetic Densification and Cadastral Survey bench marks produced by the Maricopa County Department of Transportation, please visit the Flood Control District of Maricopa County website at:
http://www.fcd.maricopa.gov/Maps/gismaps/apps/gdacs/application/index.cfm.

Base map information shown on this FIRM was derived from multiple sources. Aerial imagery was provided in digital format by the Maricopa County Department of Public Works, Flood Control District. The imagery is dated October 2009 to November 2009. Additional National Agricultural Imagery Program (NAIP) imagery was provided by the Arizona State Land Department (ALRIS) and is dated 2007. The coordinate system used for the production of the digital FIRM is State Plane Arizona Central NAD83 HARN, International Feet.

The **profile baseline** depicted on this map represents the hydraulic modeling baselines that match flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

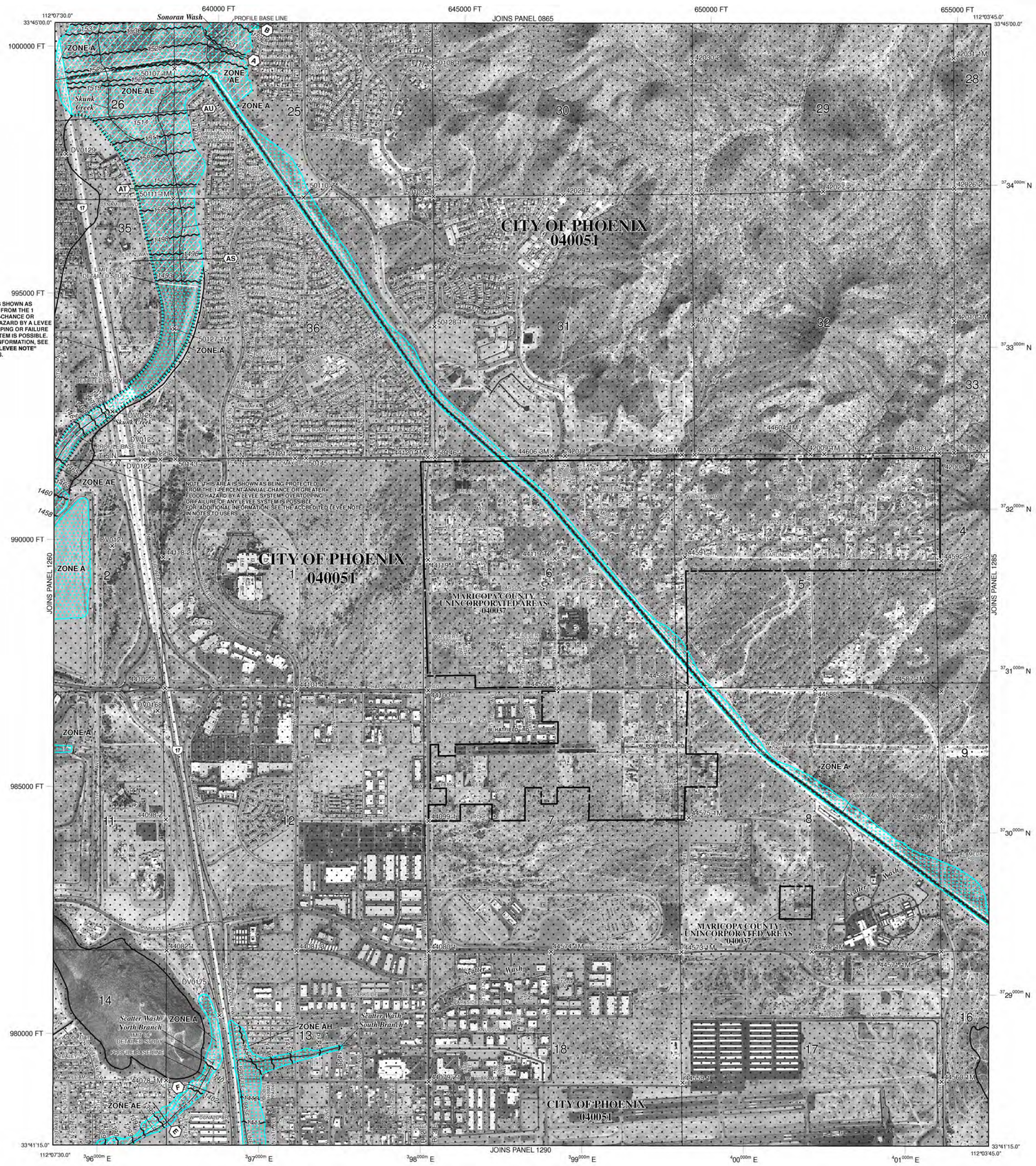
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For Information on available products associated with this FIRM, visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 12
6000000 M	5000-foot grid ticks: Arizona State Plane coordinate system, central zone (FIPSZONE 0202), Transverse Mercator
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
April 15, 1988
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
December 3, 1993 July 19, 2001 September 30, 2005
October 16, 2013 -to add special flood hazard areas, to change floodway, to add floodway, to add roads and road names, to advance suffix, to incorporate previously issued letters of map revision, to update corporate limits, to change base flood elevations, and to add base flood elevation.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1280L

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1280 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1280	L
PHOENIX, CITY OF	040051	1280	L

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C1280L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

Appendix C

Rational Method Analysis

UPCO

Flood Control District of Maricopa County
Drainage Design Manual Volume 1 Hydrology (August 2013)

Rational Method is appropriate as total drainage area analyzed is approximately 0.09 sq mi

Rational Method

Q-CiA (3.1)

Q	peak discsharge in cfs
C	runoff c oefficient
i	average rainfall intensity in in/hr
A	drainage area in acres

$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$ (3.2)

T_c	Time of Concentration in hours
L	Length of longest flow path in miles
K_b	Watershed resistance coefficient
S	Watercourse slope in ft/mile
i	rainfall intensity in in/hr

A	55.97	acres	Total overall
C	0.7		Table 3.2 DDMMC Hydrology Rational Method
i			
L			
K_b			Figure 3.1 DDMMC Hydrology Rational Method
S			
P	2.85	in	100-yr, 6-hr
P	3.89	in	100-yr, 24-hr

IDF based on PPFE estimates

Duration (min)	Rainfall Depth (100-yr)	Rainfall Intensity (in/hr)
5	0.714	8.57
10	1.09	6.54
15	1.35	5.40
30	1.81	3.62
60	2.25	2.25
120	2.52	1.26
180	2.61	0.87
360	2.85	0.48
720	3.09	0.26
1440	3.89	0.16

Initial i based on Point Precipitation Fequency Estimates (PPFE) from NOAA Atlas 14

Sub Basin	Area (acres)	S (ft/mile)	$S_{adjusted}$	K_b	C	L (miles)	i (in/hr)	T_c (hr)	T_c (min)	Q (cfs)
1	20.1	1087.63	313.00	0.1174	0.7	0.46	5.803	0.22	13	81.65
2	23.8	994.58	313.00	0.1156	0.7	0.50	5.664	0.23	14	94.36
3	12.1	142.51	142.51	0.1229	0.7	0.14	6.995	0.15	9	59.25
									Total	235.26

$S_{adjusted}$ is per Section 5.5.1 Time of Concentration Figure 5.4 where the curve appears to be asymtotic and reaches a maximum value of 313 ft/mile
The equation indicated for this figure and Table 5.2 does not calculate beyond 600 ft/mile natural slope

Appendix D

FlowMaster™ Analysis

Section A-A Native Wash Upstream

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03050	ft/ft
Discharge	256.37	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1601.46
0+10	1601.30
0+20	1600.80
0+30	1598.21
0+35	1596.00
0+43	1596.00
0+49	1598.00
0+56	1601.00
0+64	1604.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 1601.46)	(0+64, 1604.00)	0.035

Options

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

Results

Normal Depth	2.05	ft
Elevation Range	1596.00 to 1604.00 ft	
Flow Area	27.44	ft^2
Wetted Perimeter	19.39	ft

Section A-A Native Wash Upstream

Results

Hydraulic Radius		1.41	ft
Top Width		18.59	ft
Normal Depth		2.05	ft
Critical Depth		2.43	ft
Critical Slope		0.01592	ft/ft
Velocity		9.34	ft/s
Velocity Head		1.36	ft
Specific Energy		3.40	ft
Froude Number		1.36	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.05	ft
Critical Depth	2.43	ft
Channel Slope	0.03050	ft/ft
Critical Slope	0.01592	ft/ft

Section A-A Native Wash Upstream

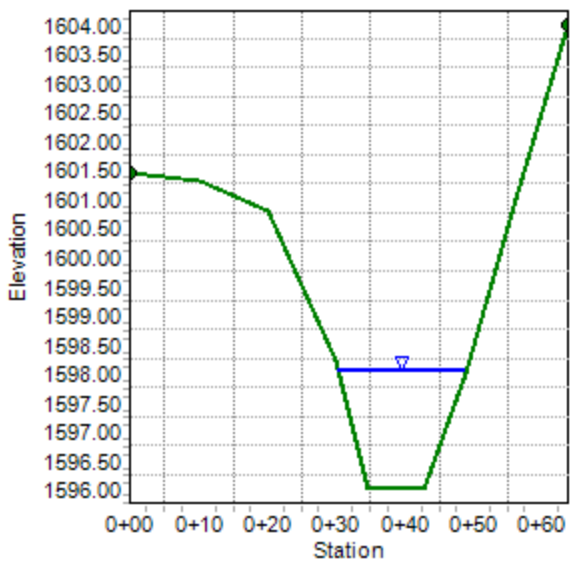
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03050	ft/ft
Normal Depth	2.05	ft
Discharge	256.37	ft³/s

Cross Section Image



Section B-B Engineered Cap

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03219	ft/ft
Discharge	256.37	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1595.00
0+10	1595.00
0+22	1595.00
0+32	1593.25
0+42	1593.25
0+50	1596.25
0+56	1595.86
0+64	1595.31
0+68	1595.62
0+75	1598.00
0+80	1599.49

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 1595.00)	(0+50, 1596.25)	0.020
(0+50, 1596.25)	(0+80, 1599.49)	0.035

Options

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

Results

Normal Depth	1.27	ft

Section B-B Engineered Cap

Results

Elevation Range	1593.25 to 1599.49 ft		
Flow Area		20.08	ft²
Wetted Perimeter		21.41	ft
Hydraulic Radius		0.94	ft
Top Width		21.07	ft
Normal Depth		1.27	ft
Critical Depth		2.07	ft
Critical Slope		0.00605	ft/ft
Velocity		12.77	ft/s
Velocity Head		2.53	ft
Specific Energy		3.80	ft
Froude Number		2.31	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	2.07	ft
Channel Slope	0.03219	ft/ft
Critical Slope	0.00605	ft/ft

Section B-B Engineered Cap

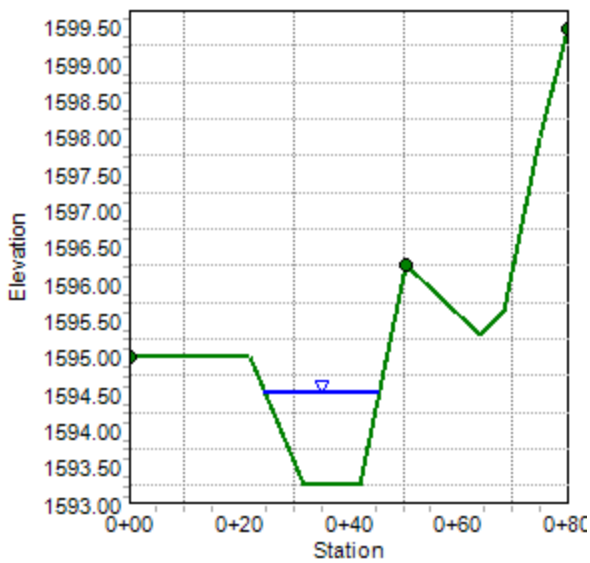
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03219	ft/ft
Normal Depth	1.27	ft
Discharge	256.37	ft^3/s

Cross Section Image



Section C-C Native Wash Downstream

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02620	ft/ft
Discharge	256.37	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	1592.38
0+10	1591.41
0+20	1590.47
0+25	1590.00
0+31	1589.51
0+42	1589.00
0+50	1591.21
0+60	1594.43
0+70	1597.72

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 1592.38)	(0+70, 1597.72)	0.078

Options

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

Results

Normal Depth	2.65	ft
Elevation Range	1589.00 to 1597.72 ft	
Flow Area	64.61	ft^2
Wetted Perimeter	44.26	ft

Section C-C Native Wash Downstream

Results

Hydraulic Radius		1.46	ft
Top Width		43.79	ft
Normal Depth		2.65	ft
Critical Depth		2.08	ft
Critical Slope		0.08536	ft/ft
Velocity		3.97	ft/s
Velocity Head		0.24	ft
Specific Energy		2.89	ft
Froude Number		0.58	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.65	ft
Critical Depth	2.08	ft
Channel Slope	0.02620	ft/ft
Critical Slope	0.08536	ft/ft

Section C-C Native Wash Downstream

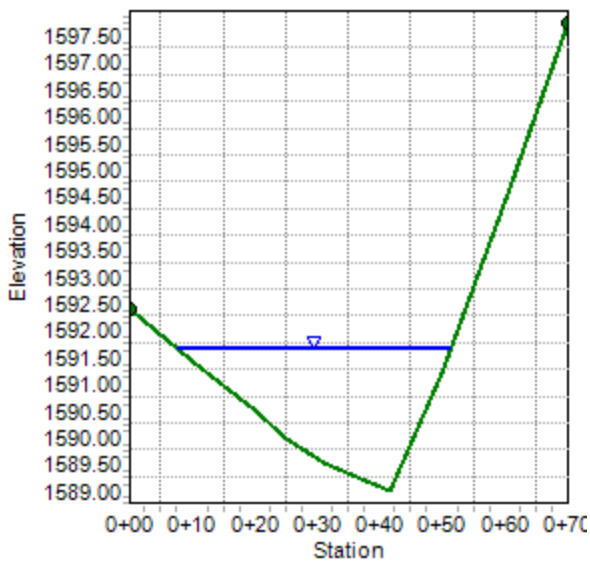
Project Description

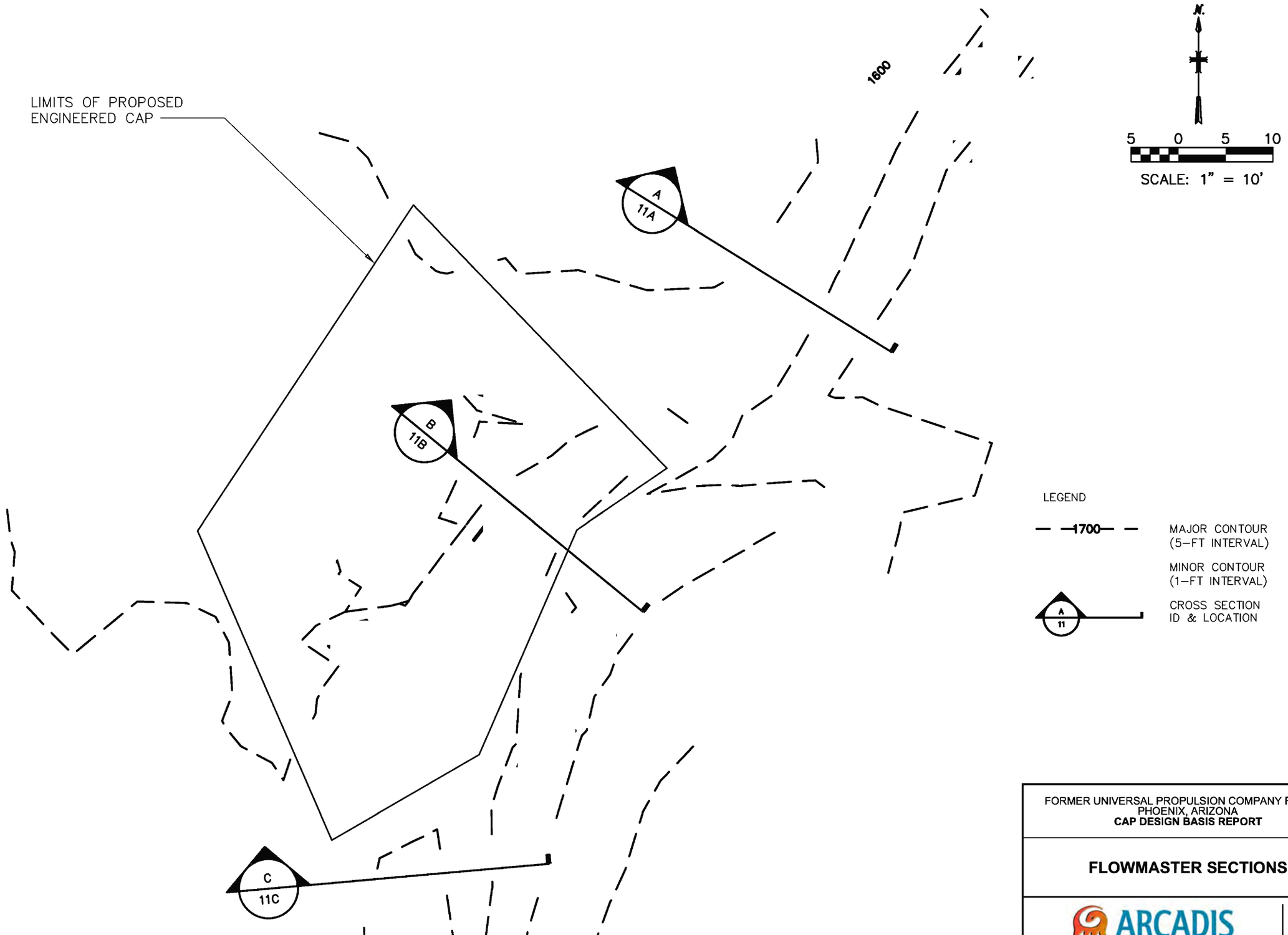
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02620	ft/ft
Normal Depth	2.65	ft
Discharge	256.37	ft³/s

Cross Section Image



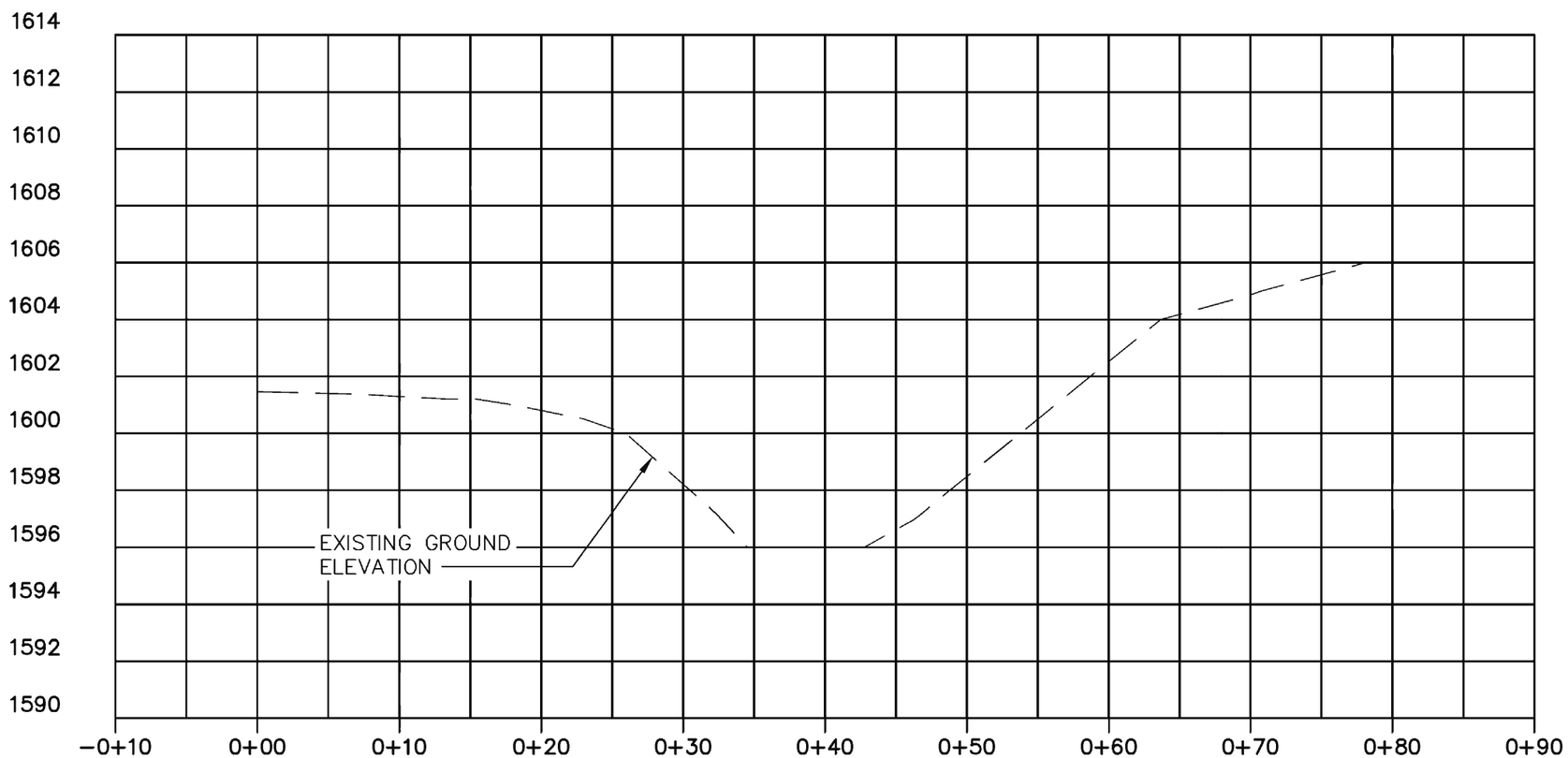


FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

FLOWMASTER SECTIONS

ARCADIS

FIGURE
11



HORIZONTAL

0 10' 20'

VERTICAL

0 2' 4'

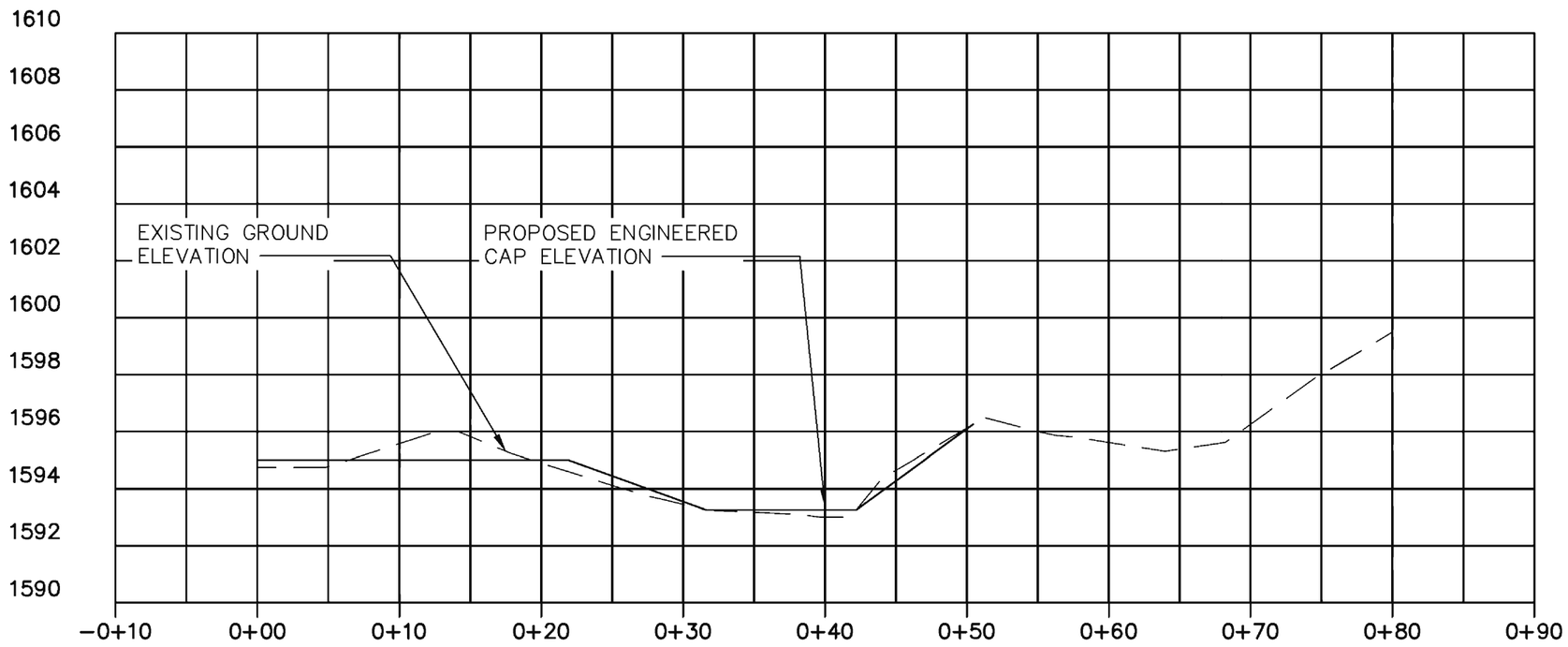
SECTION A–A NATIVE WASH UPSTREAM

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

SECTION A-A

ARCADIS

FIGURE
11A



HORIZONTAL

0 10' 20'

VERTICAL

0 2' 4'

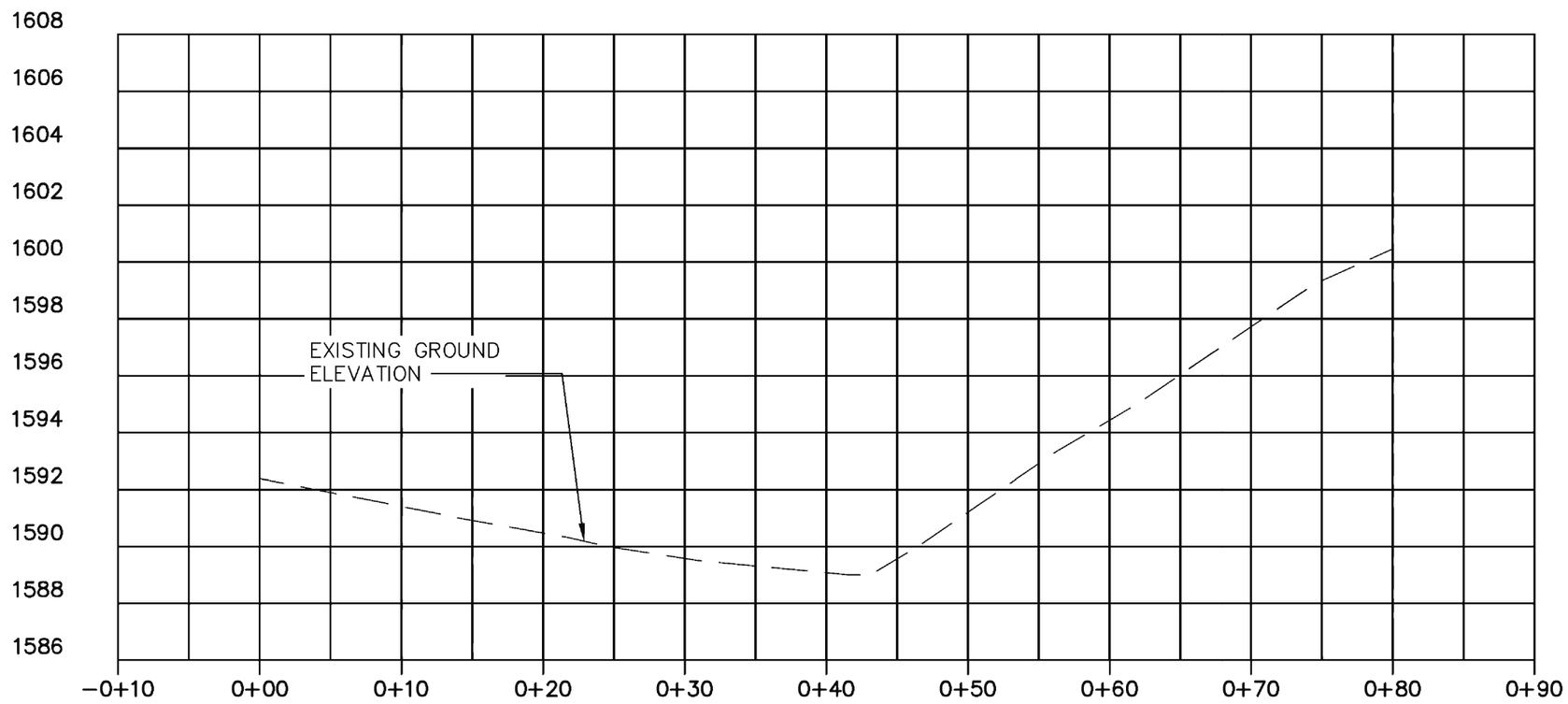
SECTION B–B ENGINEERED CAP

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

SECTION B-B

ARCADIS

FIGURE
11B



HORIZONTAL

0 10' 20'

VERTICAL

0 2' 4'

SECTION C–C NATIVE WASH DOWNSTREAM

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

SECTION C-C

ARCADIS

FIGURE
11C

Appendix E

Scour Analysis

Scour Analysis for UPCO Soil Alternattive SA-2

This analysis is based on Section 11.8 of the Drainage Design Manual
Volume 2: Hydraulics

Total Scour:

$Z_t = FS(Z_{LT}+Z_g+Z_{bend}+Z_{bedform}+Z_{LF})+FS_L*Z_L$ (11.41)

Where:

Z_t	Total Scour	Local scour not applicable (no structures)
FS	Factor of safety for all but local scour (1.3)	
FS_L	Factor of safety for local scour	
Z_{LT}	Long term scour (1.3)	Bend scour not applicable (no significant bends)
Z_g	General scour	
Z_{bend}	Bend scour	
$Z_{bedform}$	Bed form scour	
Z_{LF}	Low flow scour	

Long term Scour:

Level 1 Analysis from Arizona State Standard 5-96

Z_{LT} $0.02Q_{100}^{0.6}$

Where:

Q_{100} 100-year design storm

Z_{LT} 0.53 ft (DDM Volume 2 pg 11-94)

Limits to long term Scour from Armoring

d_{50} $kV_a^2(\gamma_w/\gamma_s-\gamma_w)$ (11.46)

d_{50} medial sediment particle diameter (from grain size distribution analysis)
k 0.0191 for straight channel
V_a average velocity (ft/s) [from HEC RAS analysis]
γ_s specific weight of stone lb/ft^3 (from grain size distribution analysis)
γ_w specific weight of water lb/ft^3

Determined to be non-applicable based on aerial and photographic evidence

General Scour

Lacey Equation is applicable

$Z_g = z(0.47(Q/f)^{1/3})$ (11.56)

$f = 1.76(D_m)^{0.5}$ Lacey's silt factor

D_m mean grain size (from grain size distribution)

Q design discharge

z multiplying factor (0.25 for straight reach)

Z_g 0.52 ft

Bedform Scour

$Z_{bedform}$ $0.5*d_h$ (11.61)

d_h dune or antidune height

$d_h = 0.027V_a^2$ (11.63)

froude number 0.96 per Flowmaster analysis

V_a average channel velocity (7.79 ft/s per Flowmaster analysis)

d_h 1.64 ft

Since the froude number is between 0.7 and 1.0 dune height the equation for the case where the froude number is less than 0.7 must be checked

$0.15 < d_h/y_h < 0.3$ (11.62)

	d_h	y_h
0.16	0.32	2.03
0.17	0.35	2.03
0.18	0.37	2.03
0.19	0.39	2.03
0.20	0.41	2.03
0.21	0.43	2.03
0.22	0.45	2.03
0.23	0.47	2.03
0.24	0.49	2.03
0.25	0.51	2.03
0.26	0.53	2.03
0.27	0.55	2.03
0.28	0.57	2.03
0.29	0.59	2.03

Since all calculated d_h between 0.15 and 0.3 are less than 1.64, use d_h of 1.64

$Z_{bedform}$ 0.82 ft

Low Flow Scour

1 ft per Section 11.8.2.5

Total Scour

Z_t 2.87 ft (11.41)

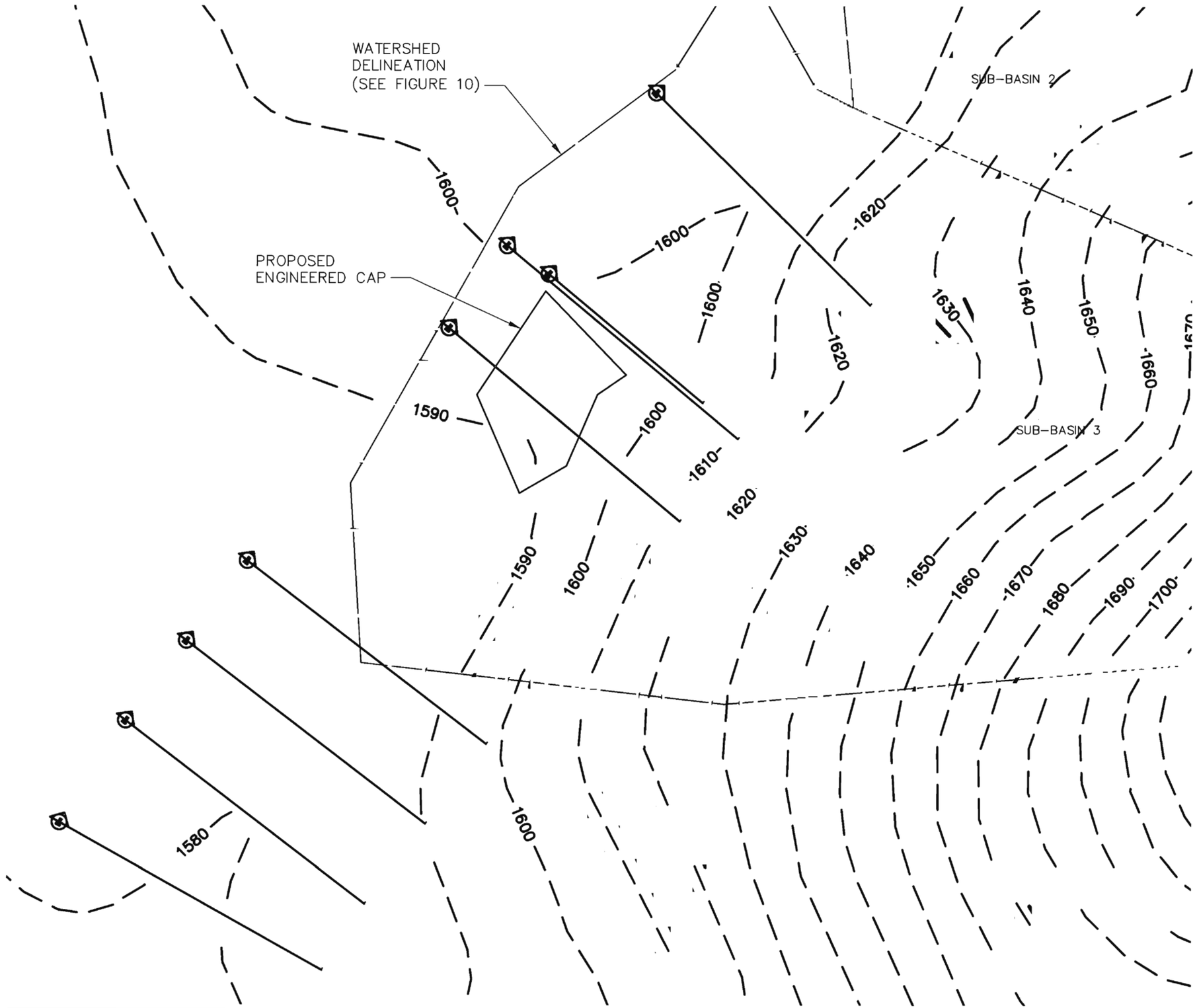
Applying a factor of safety of 1.3 per Section 11.8.2 of the DDM

Z_t 3.73 ft

The 4,000 psi grout wedge at the edge of the hydroturf should extend a minimum of 3.8 feet below ground surface to adequtely protect against scour.

Appendix F

HEC-RAS Analysis



N

50 0 50 100

SCALE: 1" = 100'

LEGEND

—1700— MAJOR CONTOUR 10-FT INTERVAL)

MINOR CONTOUR (2-FT INTERVAL)

NOTE:
CONTOURS ARE BASED ON THE NATIONAL ELEVATION DATASET AND WERE IMPORTED FROM GIS.

FORMER UNIVERSAL PROPULSION COMPANY FACILITY
PHOENIX, ARIZONA
CAP DESIGN BASIS REPORT

HEC-RAS DEFINED CROSS SECTIONS

ARCADIS

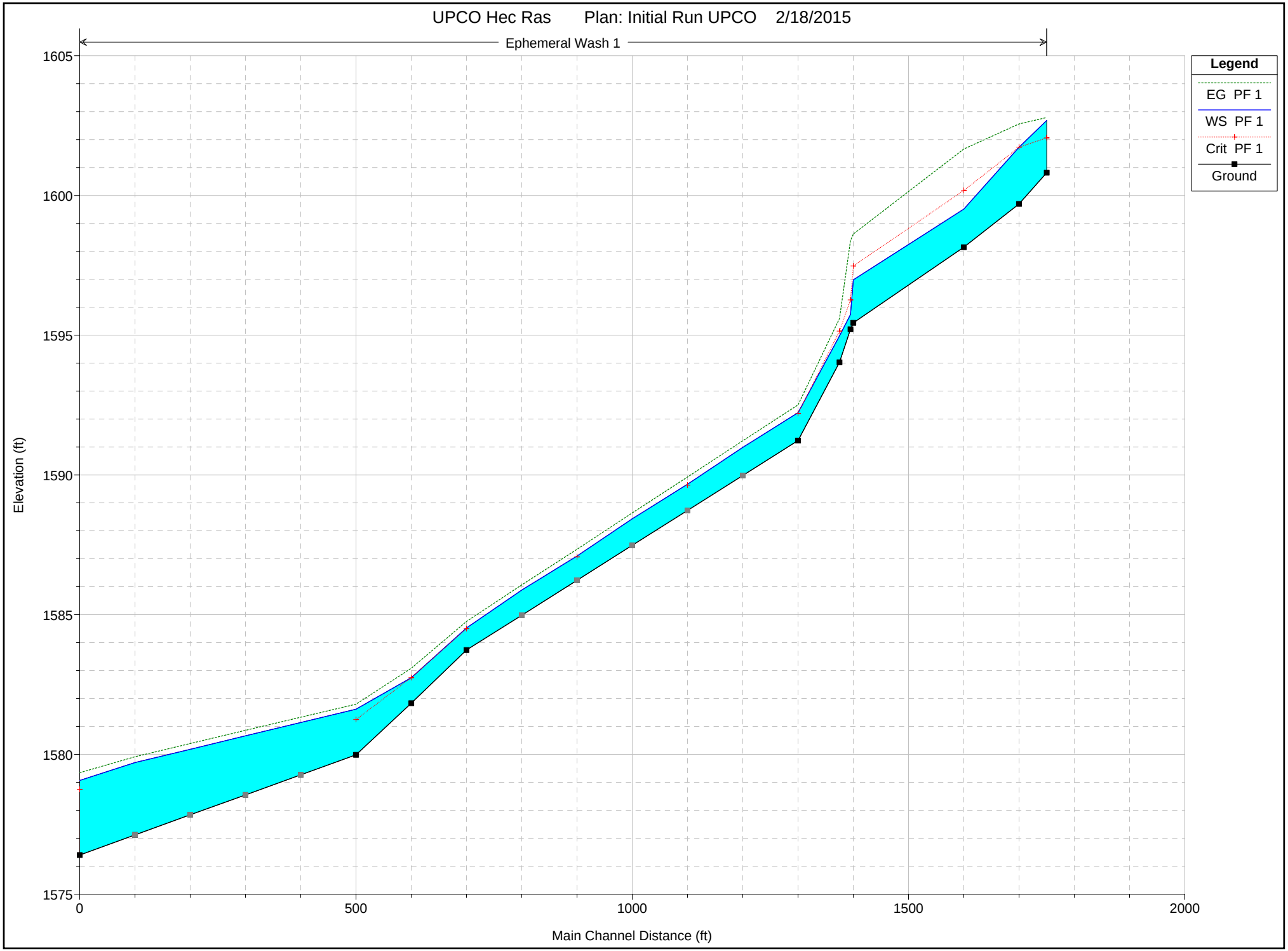
FIGURE
1

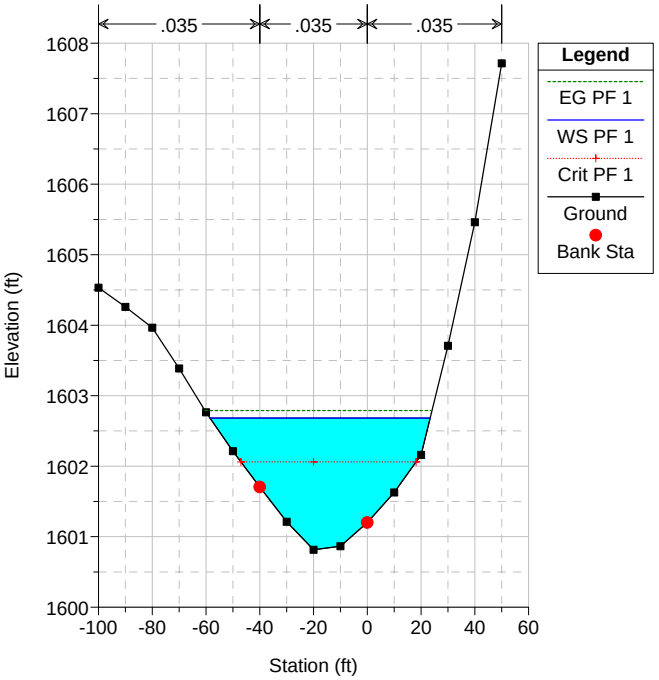
Hydraulic Engineering Circular 15 (HEC-15)
Flexible Channel Lining Stability Calculation Sheet

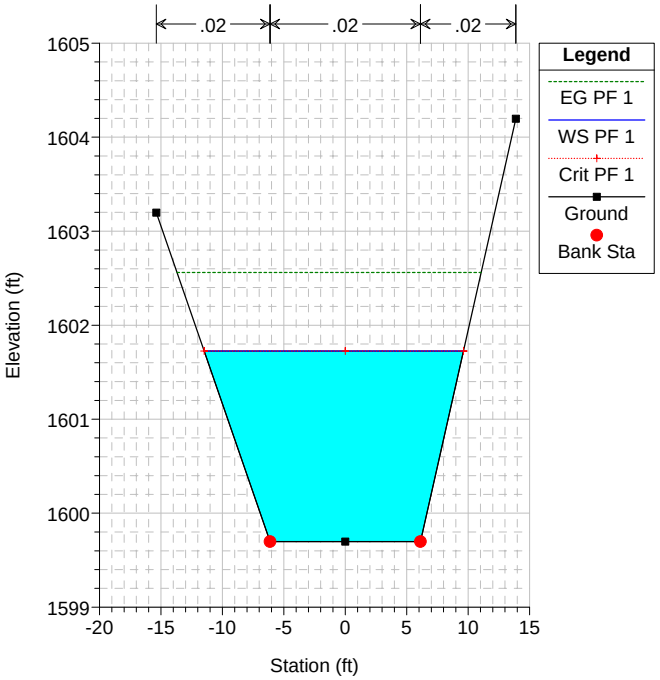
Main Channel						
Q	235	cfs	Peak Flowrate			
b	20	ft	Bottom Width			
Z	15	:1	Side Slopes			
S_0	0.02699053	ft/ft	Channel Slope			
D_{50}	12	in	Average Stone Size			
φ	42	deg	Angle of Repose			
SG	2.65		Stone Specific Gravity			
γ	165.4	pcf	Stone Specific Weight			
d_i	1.77	ft	Assumed Depth			
d_a	1.12	ft	Average Depth			
d_a/d_{50}	1.12					
n	0.092		Computed 'n' (Equ. 6.1 or 6.2)			
A	82.10	sf	Flow Area			
P_w	73.10	ft	Wetted Perimeter			
R_h	1.12	ft	Hydraulic Radius			
Q	235.00	cfs	Computed Flowrate			
v	2.86	fps	Velocity			
Error	0.0	%	Percent Error			
d_{i+1}	1.766	ft	Iterative Depth			
τ_d	2.97	psf	Shear Stress at Maximum Depth (Equ. 2.4)			
τ_p	8.94	psf	Permissible Shear Stress (Equ. 6.7)			
V_*	1.24	fps	Shear Velocity (Equ. 6.10)			
Re	101798		Reynolds Number	ν = 1.217x10-5 sf/s @ 60°		
F*	0.087		Shields' Parameter			
SF	1.19		Safety Factor	Re	F*	SF
				40000	0.047	1
	D50 OK			200000	0.15	1.5
$D_{50,b}$	4.77	in	D_{50} Required for a stable channel bottom, SF = 1.0			
SF	**3.0**					
Side Slope						
K1	1.66		Equ. 3.4			
K2	1.00		Equ. 6.16			
$D_{50,s}$	7.95	in	D_{50} Required for stable side slope (Equ. 6.15)			
K1'	1.00		Ratio of channel side to bottom shear stress			
τ_s	2.97	psf	Side Shear Stress on the Channel (Equ. 3.3)			
	D50 OK					
SF	**3.0**					
b	0.26		Parameter (Bathurst) (Equ. 6.6)			
T	72.98	ft	Top Width			
Fr	0.48		Froude Number			
f(Fr)	0.73		Equ. 6.3			
f(REG)	11.18		Equ. 6.4			
f(CG)	0.38		Equ. 6.5			
n	0.092		Manning's 'n' (Equ. 6.2)	Bathurst		0.3 <= d_a
d_a/d_{50}	1.12					
n	0.106		Manning's 'n' (Equ. 6.1)	Blodgett		1.5 <= d_a
NOTE:						
	Computations from USDOT, FHWA Hydraulic Engineering Circular (HEC) 15:					
		Design of Roadside Channels with Flexible Linings				
	Publication No. FHWA-NHI-05-114, September 2005					

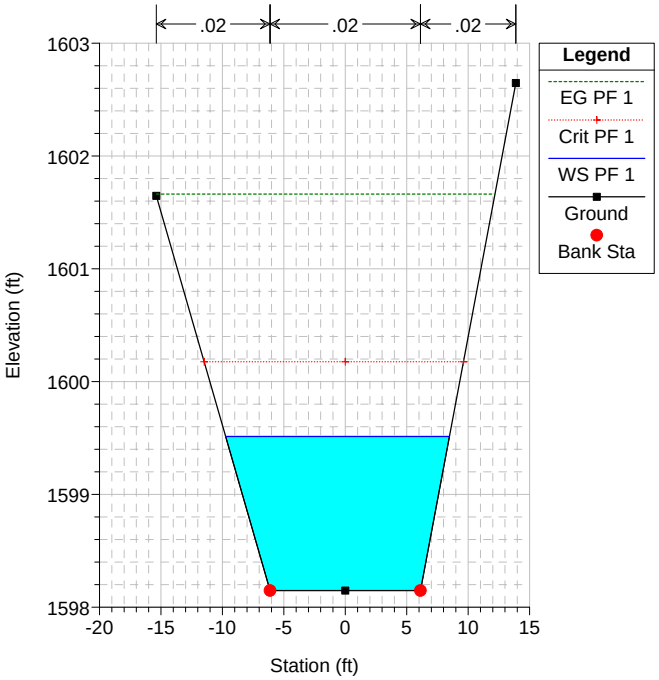
HEC-RAS Plan: InitRun River: Ephemeral Wash Reach: 1 Profile: PF 1

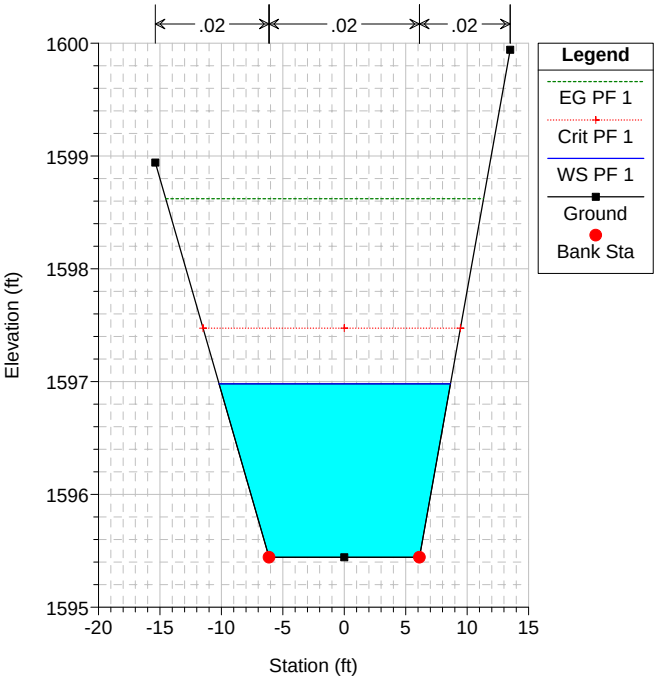
Reach	River Sta	Profile	Q Total	W.S. Elev	Max Chl Dpth	Invert Slope	Crit W.S.	E.G. Elev	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)		(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
1	1400	PF 1	235.00	1602.68	1.87	0.0223	1602.06	1602.79	2.83	94.57	81.89	0.40
1	1350	PF 1	235.00	1601.73	2.03	0.0155	1601.73	1602.56	7.79	33.84	21.11	0.96
1	1300	PF 1	235.00	1599.51	1.37	0.0135	1600.18	1601.66	12.28	20.81	18.21	1.85
1	1205	PF 1	235.00	1596.98	1.54	0.0458	1597.47	1598.62	10.77	23.90	18.83	1.53
1	1200	PF 1	235.00	1595.74	0.55	0.0591	1596.27	1598.38	13.59	18.52	50.65	3.61
1	1175	PF 1	235.00	1594.98	0.94	0.0374	1595.15	1595.60	6.62	38.72	64.46	1.33
1	1100	PF 1	235.00	1592.23	1.00	0.0125	1592.20	1592.51	4.67	59.16	93.67	0.87
1	1050.*	PF 1	235.00	1590.99	1.01	0.0125		1591.22	4.35	64.24	100.50	0.80
1	1000.*	PF 1	235.00	1589.67	0.94	0.0125	1589.63	1589.92	4.56	61.54	103.38	0.87
1	950.*	PF 1	235.00	1588.43	0.95	0.0125		1588.64	4.17	67.88	111.83	0.78
1	900.*	PF 1	235.00	1587.10	0.87	0.0125	1587.07	1587.34	4.48	63.41	113.95	0.88
1	850.*	PF 1	235.00	1585.88	0.90	0.0125		1586.07	3.96	72.45	125.43	0.76
1	800	PF 1	235.00	1584.53	0.79	0.0190	1584.50	1584.76	4.43	64.62	125.32	0.90
1	700	PF 1	235.00	1582.75	0.91	0.0185	1582.75	1583.08	5.04	52.94	81.31	0.96
1	600	PF 1	235.00	1581.62	1.63	0.0072	1581.25	1581.80	3.59	74.85	77.72	0.54
1	580.*	PF 1	235.00	1581.14	1.87	0.0072		1581.33	3.66	72.03	72.21	0.54
1	560.*	PF 1	235.00	1580.67	2.12	0.0071		1580.86	3.70	69.99	67.66	0.54
1	540.*	PF 1	235.00	1580.18	2.34	0.0072		1580.39	3.75	67.94	63.68	0.55
1	520.*	PF 1	235.00	1579.71	2.59	0.0072		1579.92	3.75	66.99	60.11	0.54
1	500	PF 1	235.00	1579.07	2.67		1578.75	1579.35	4.27	57.36	52.21	0.65

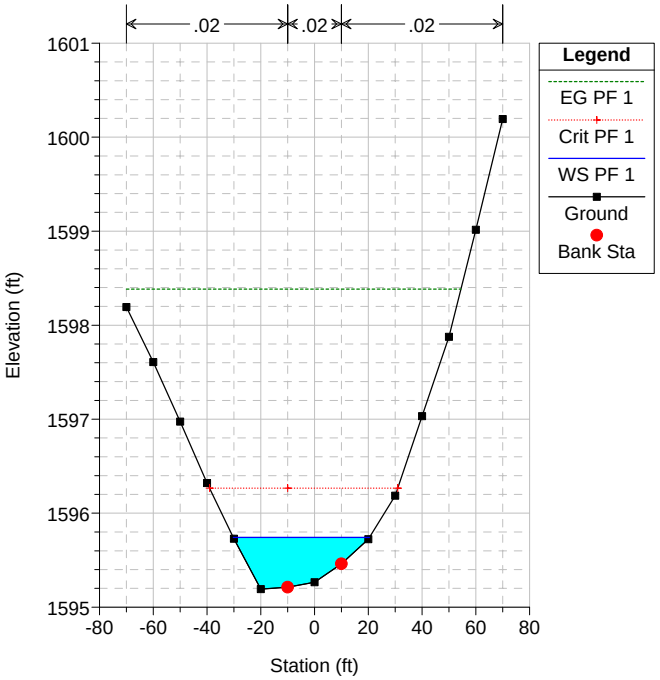

UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
Ephemeral Wash 1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
0
500
1000
1500
2000
Main Channel Distance (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1608
1607
1606
1605
1604
1603
1602
1601
1600
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.02
.02
.02
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1605
1604
1603
1602
1601
1600
1599
-20
-15
-10
-5
0
5
10
15
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.02
.02
.02
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1603
1602
1601
1600
1599
1598
-20
-15
-10
-5
0
5
10
15
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.02
.02
.02
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1600
1599
1598
1597
1596
1595
-20
-15
-10
-5
0
5
10
15
Station (ft)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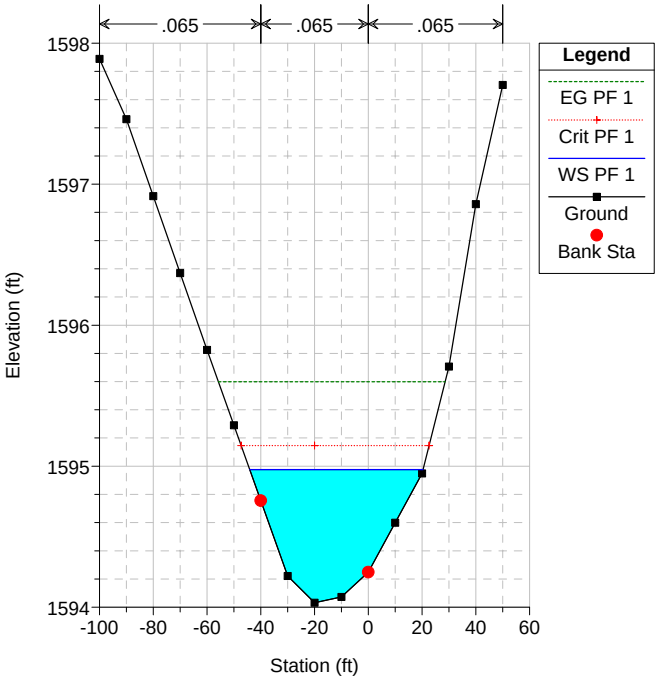
.02
.02
.02
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1601
1600
1599
1598
1597
1596
1595
-80
-60
-40
-20
0
20
40
60
80
Station (ft)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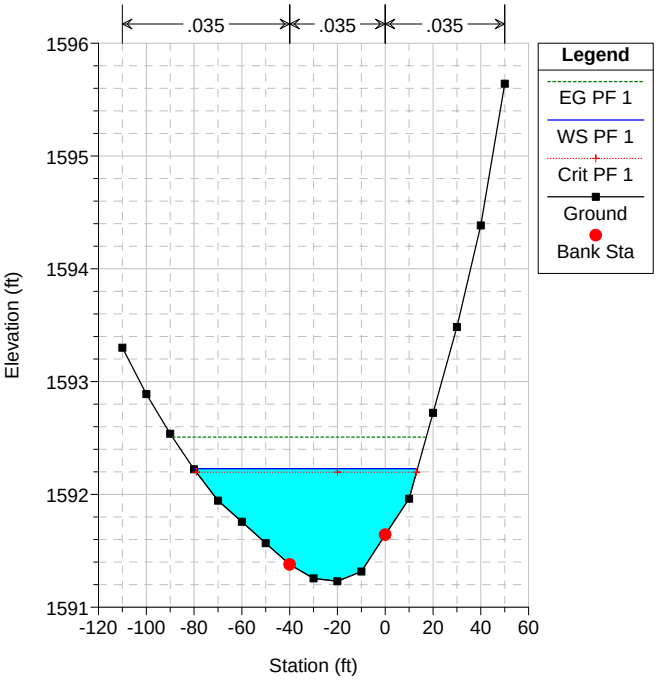
.065
.065
.065
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1598
1597
1596
1595
1594
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)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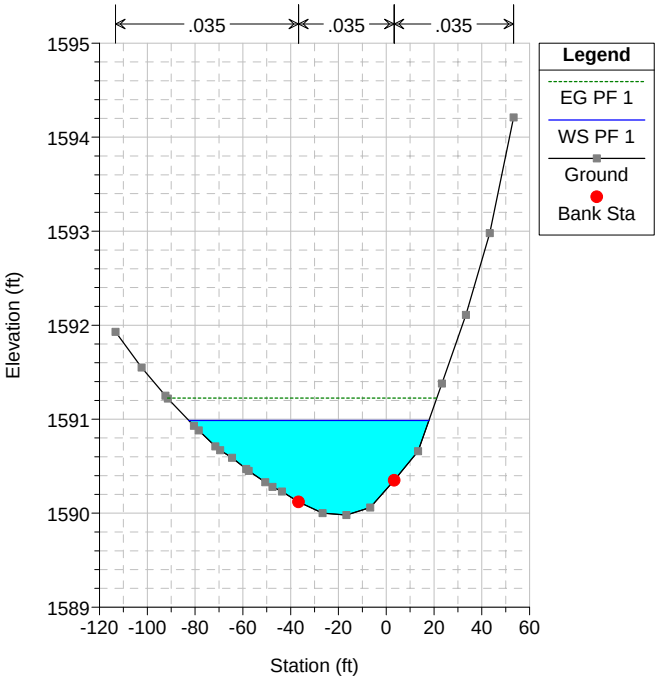
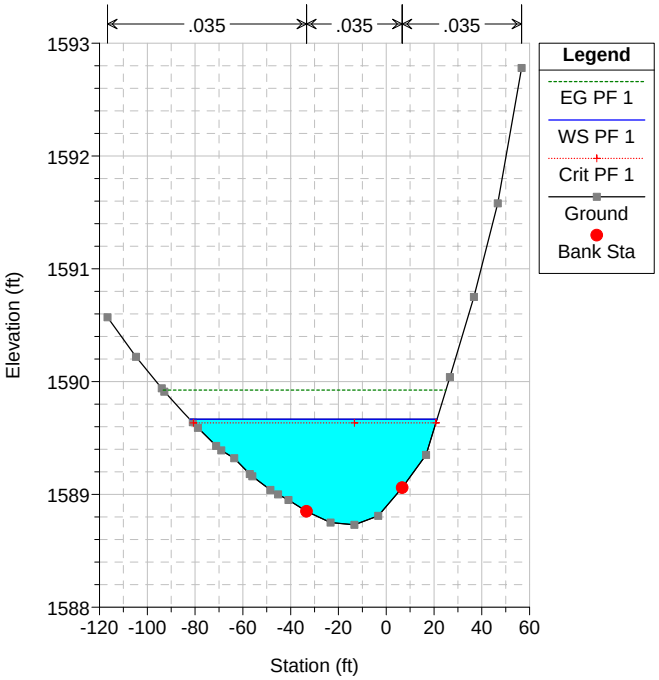
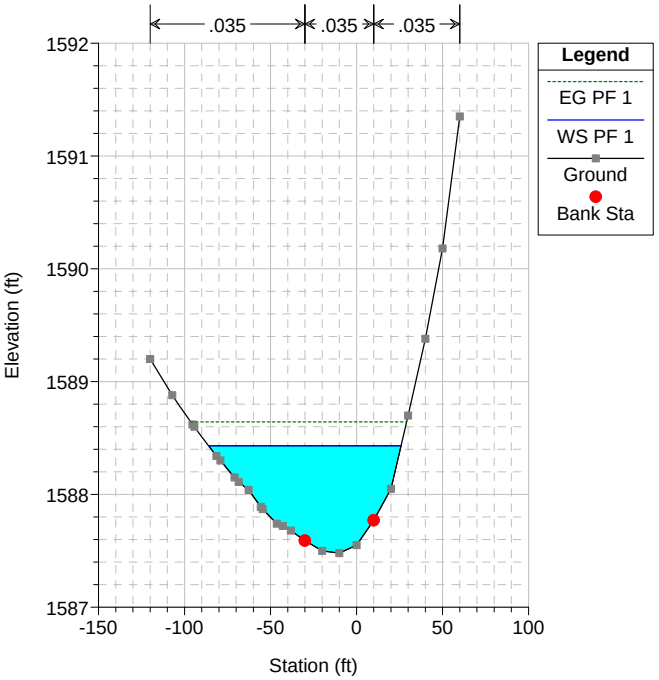
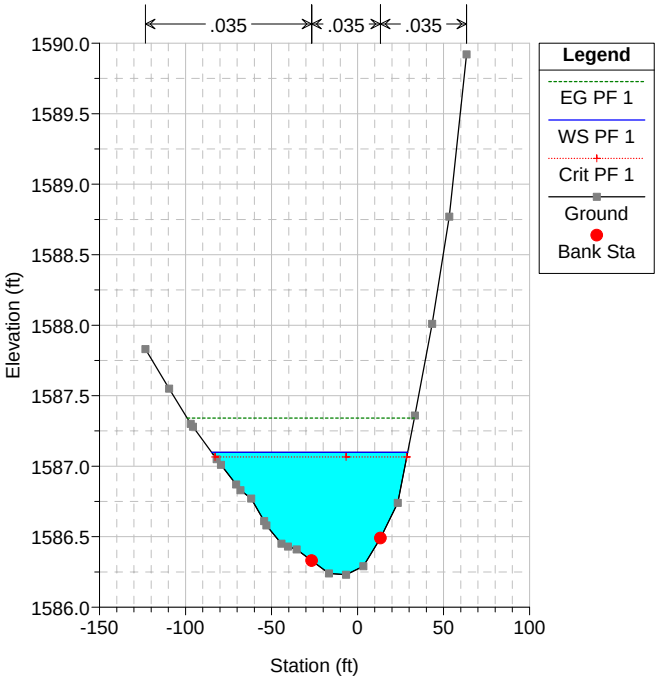
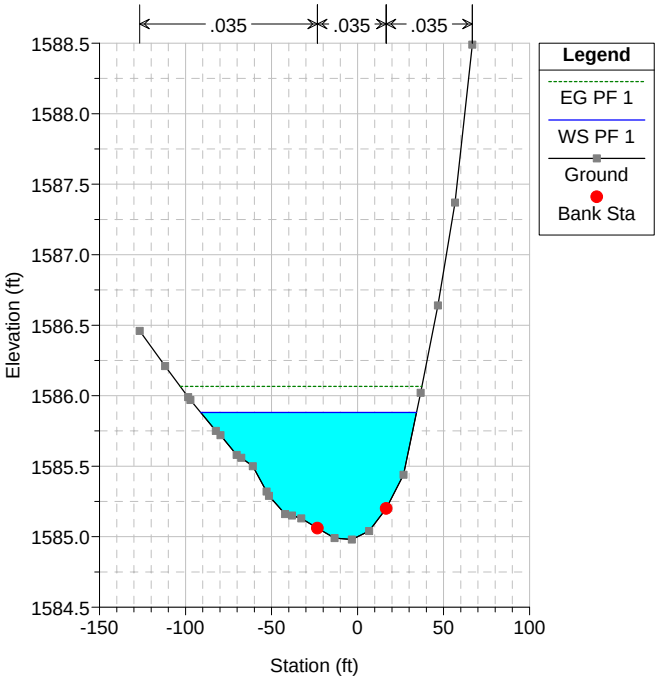
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1596
1595
1594
1593
1592
1591
-120
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1595
1594
1593
1592
1591
1590
1589
-120
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)

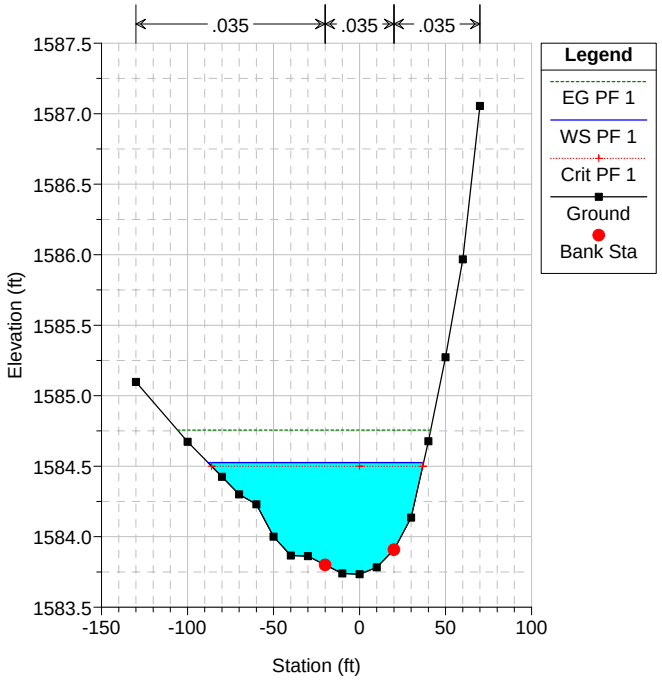

UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1593
1592
1591
1590
1589
1588
-120
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1592
1591
1590
1589
1588
1587
-150
-100
-50
0
50
100
Station (ft)

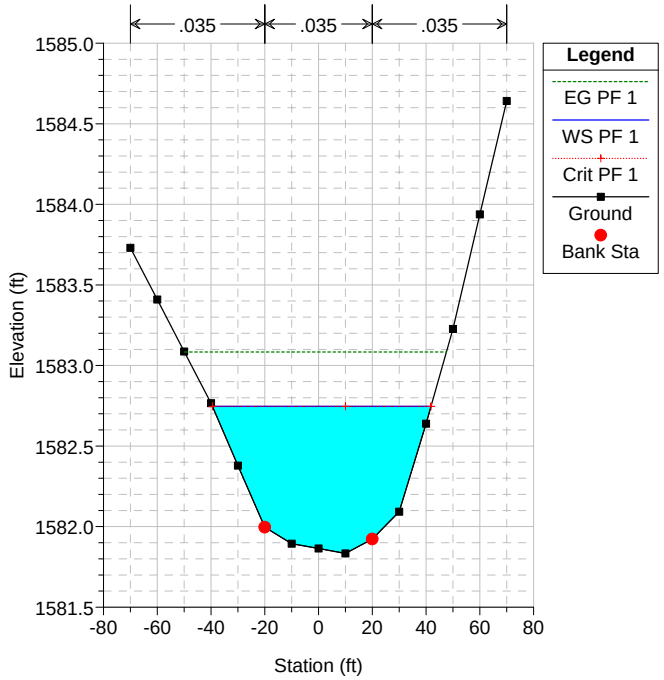

UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1590.0
1589.5
1589.0
1588.5
1588.0
1587.5
1587.0
1586.5
1586.0
-150
-100
-50
0
50
100
Station (ft)


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
.035
.035
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1588.5
1588.0
1587.5
1587.0
1586.5
1586.0
1585.5
1585.0
1584.5
-150
-100
-50
0
50
100
Station (ft)

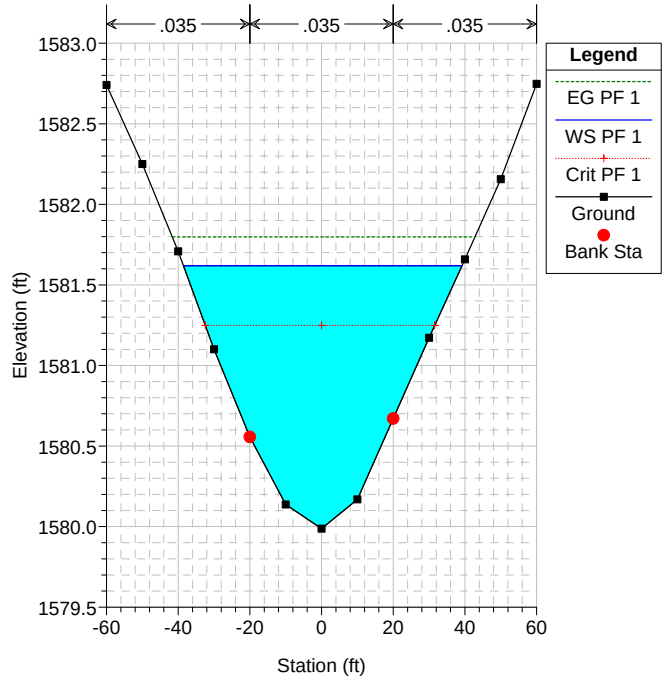
UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015



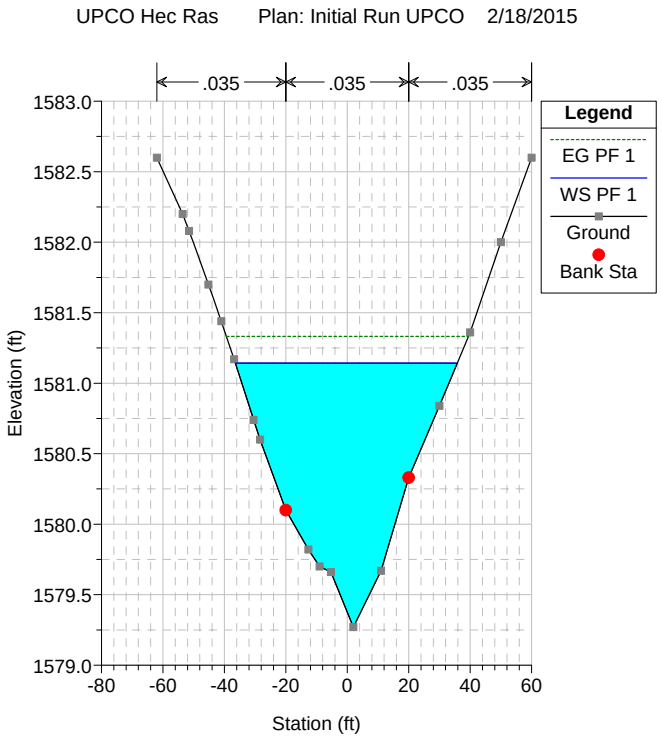
UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015



UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015



UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015



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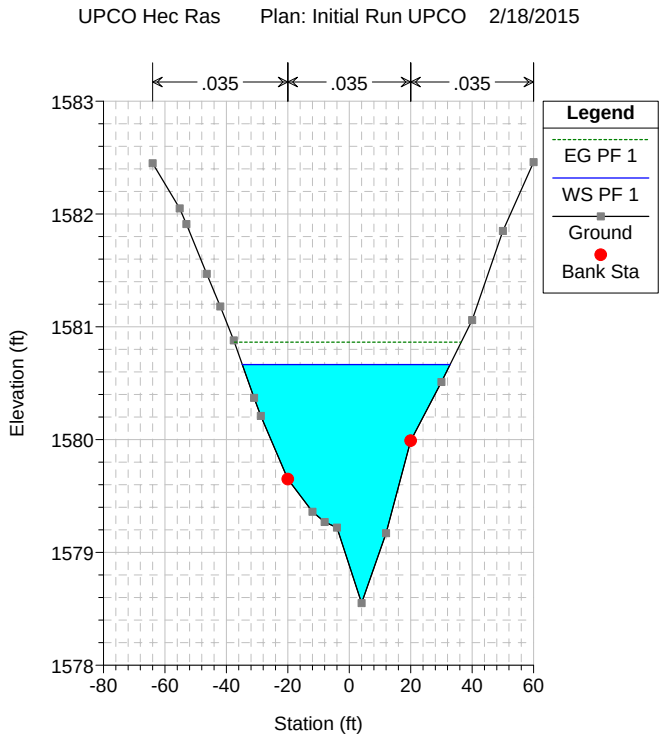
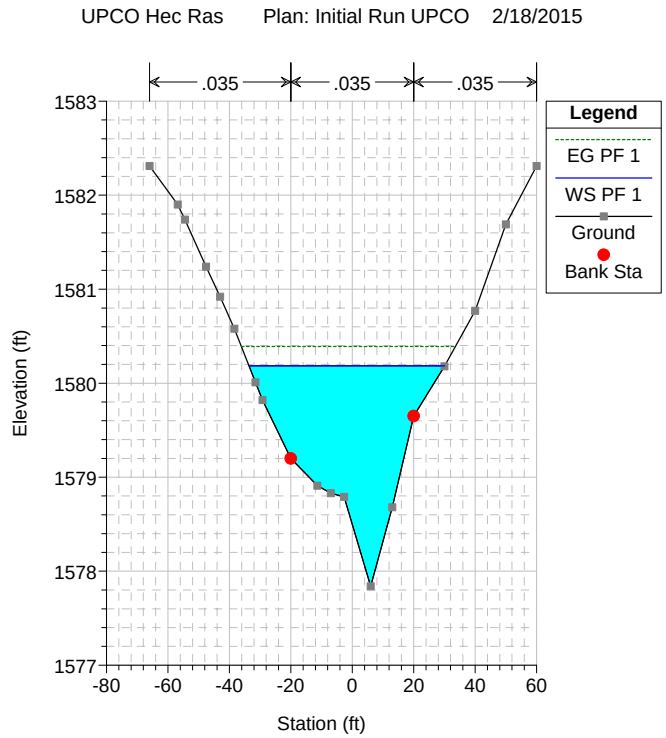
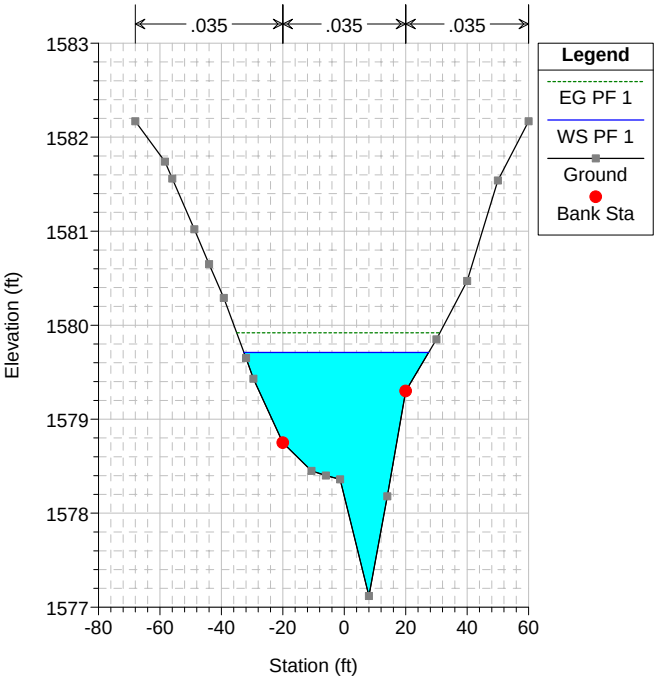


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015

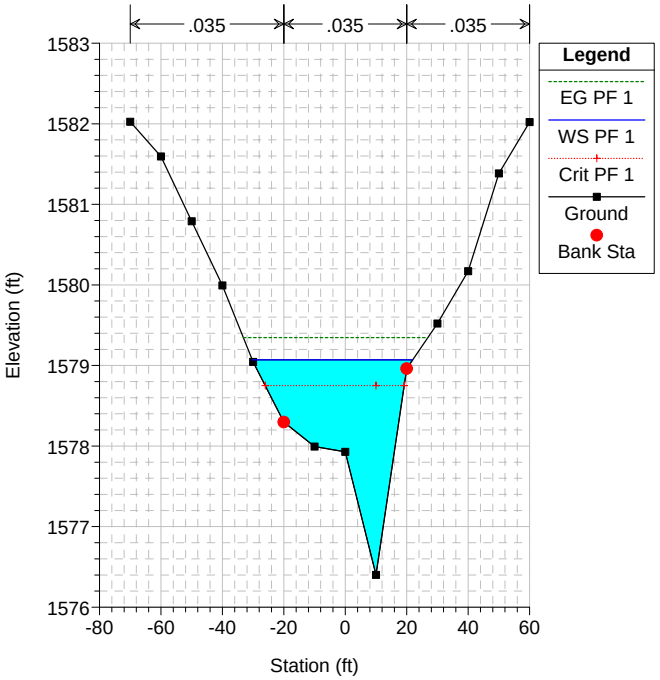


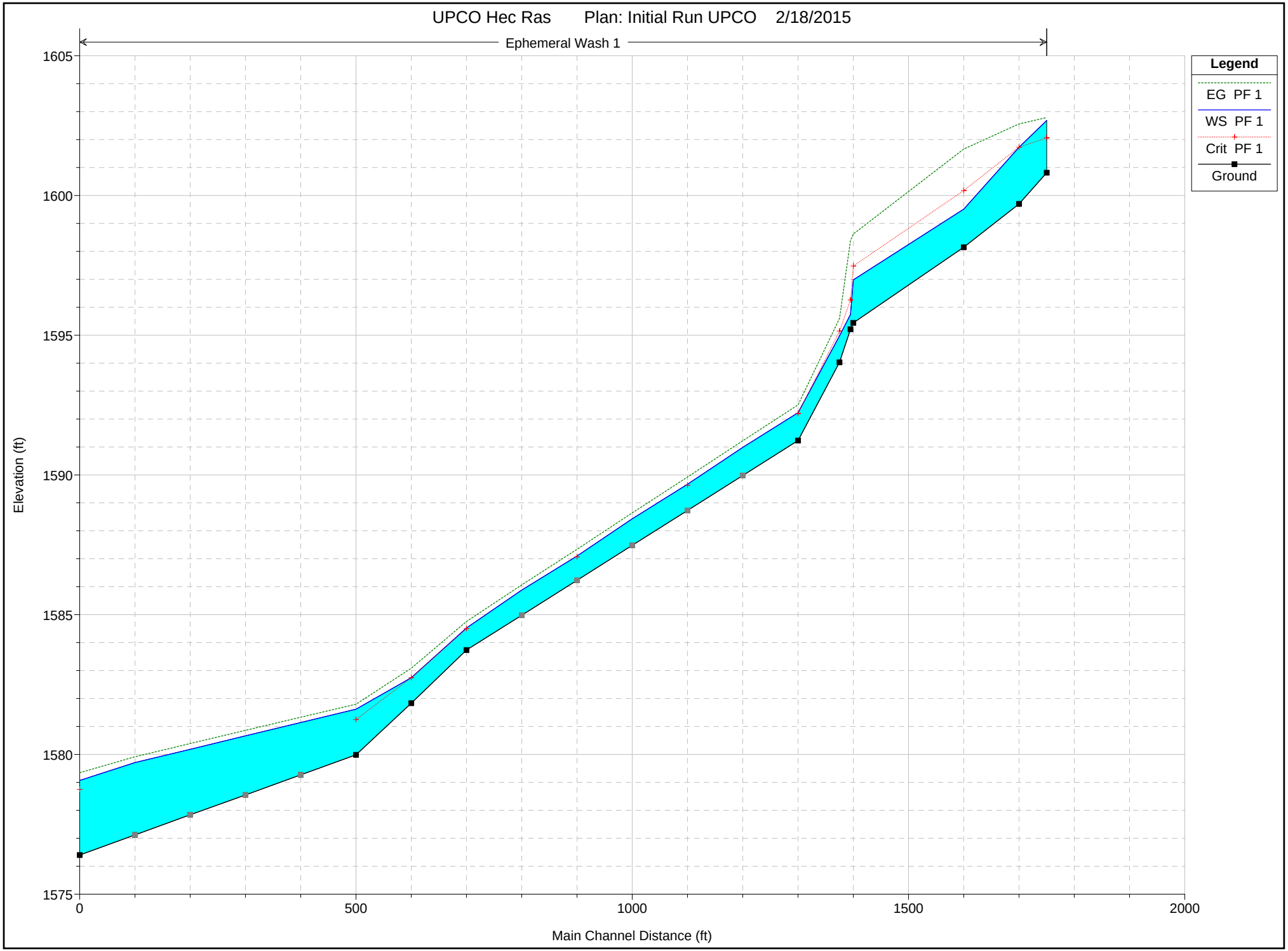
UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015

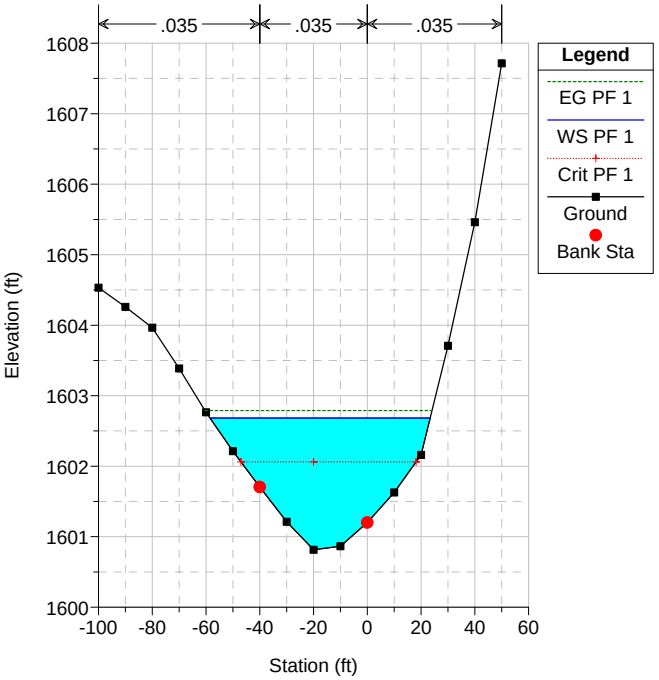


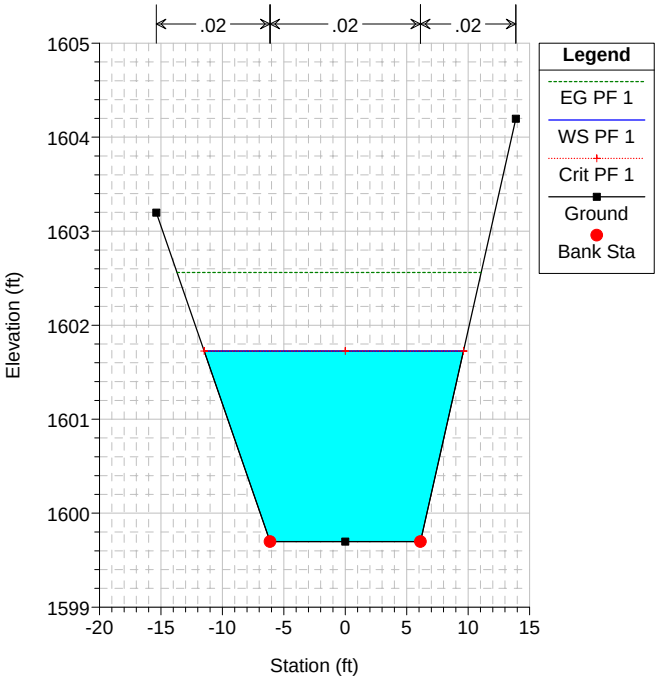
UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015

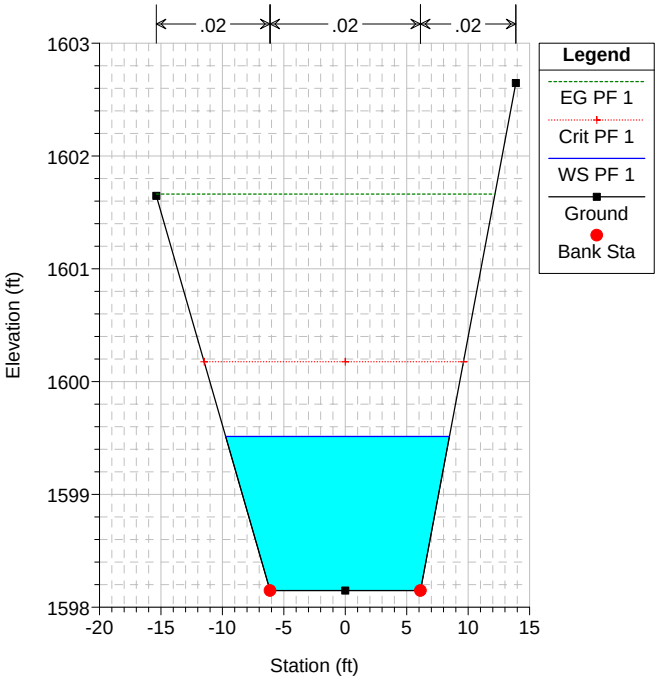
Downstream Section

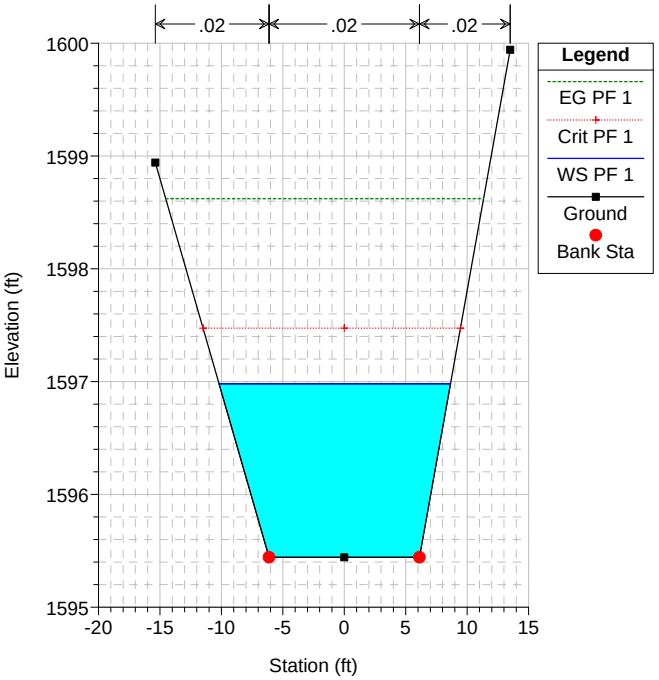


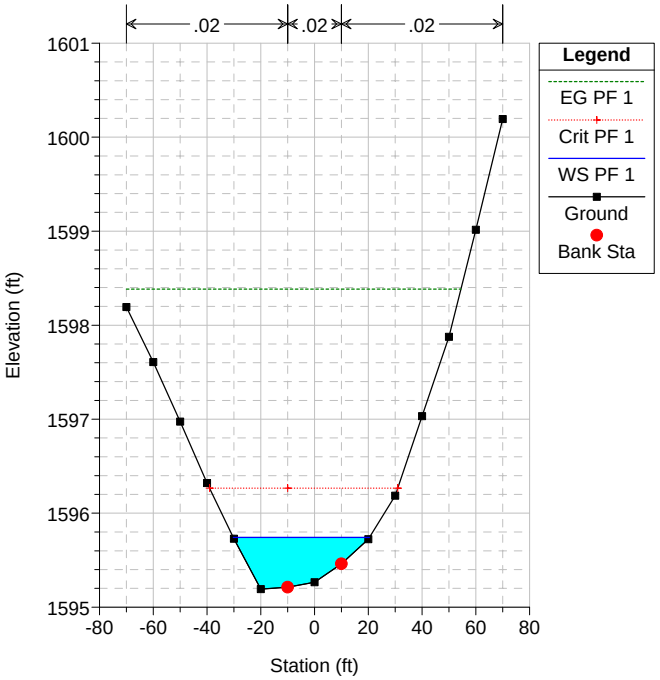

UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015
Ephemeral Wash 1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1605
1600
1595
1590
1585
1580
1575
0
500
1000
1500
2000
Main Channel Distance (ft)

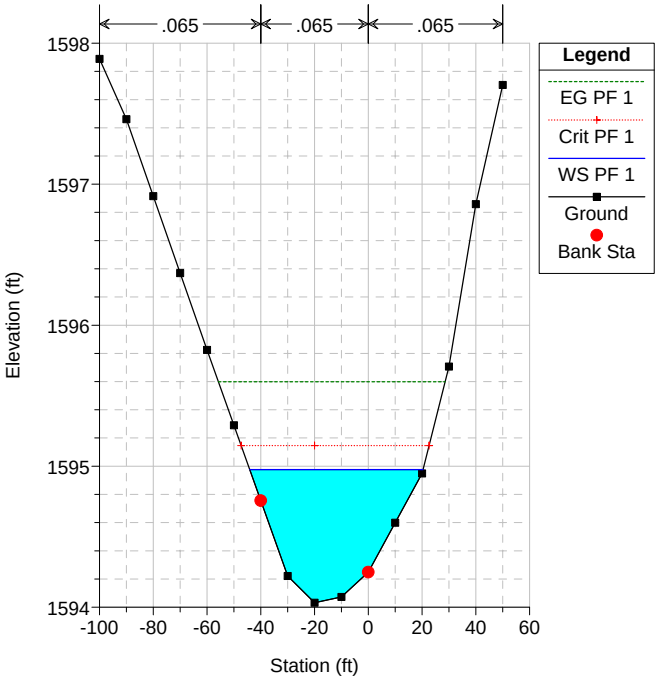

UPCO Hec Ras
Plan: Initial Run UPCO
2/18/2015
.035
.035
.035
1608
1607
1606
1605
1604
1603
1602
1601
1600
Elevation (ft)
-100
-80
-60
-40
-20
0
20
40
60
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


UPCO Hec Ras
Plan: Initial Run UPCO
2/18/2015
.02
.02
.02
1605
1604
1603
1602
1601
1600
1599
Elevation (ft)
-20
-15
-10
-5
0
5
10
15
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


UPCO Hec Ras
Plan: Initial Run UPCO
2/18/2015
.02
.02
.02
1603
1602
1601
1600
1599
1598
Elevation (ft)
-20
-15
-10
-5
0
5
10
15
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


UPCO Hec Ras
Plan: Initial Run UPCO
2/18/2015
.02
.02
.02
1600
1599
1598
1597
1596
1595
Elevation (ft)
-20
-15
-10
-5
0
5
10
15
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


UPCO Hec Ras
Plan: Initial Run UPCO
2/18/2015
.02
.02
.02
1601
1600
1599
1598
1597
1596
1595
Elevation (ft)
-80
-60
-40
-20
0
20
40
60
80
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta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Plan: Initial Run UPCO
2/18/2015
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1598
1597
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Elevation (ft)
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-80
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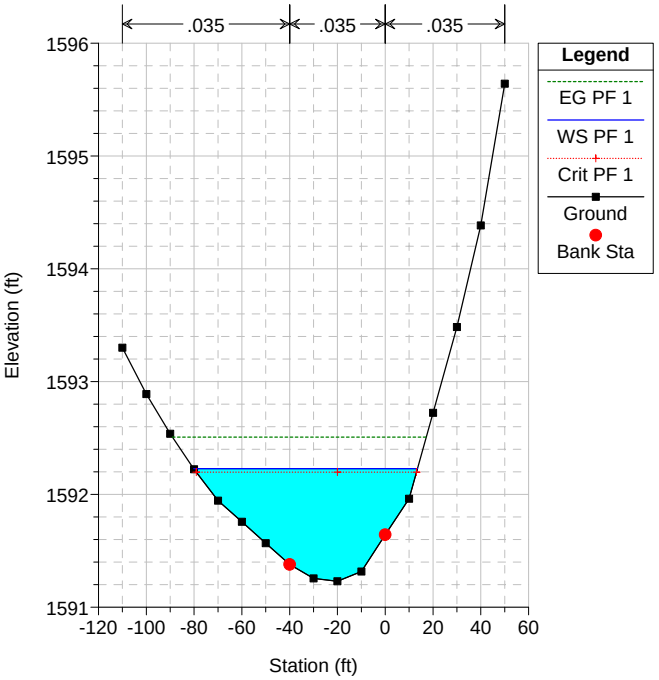
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta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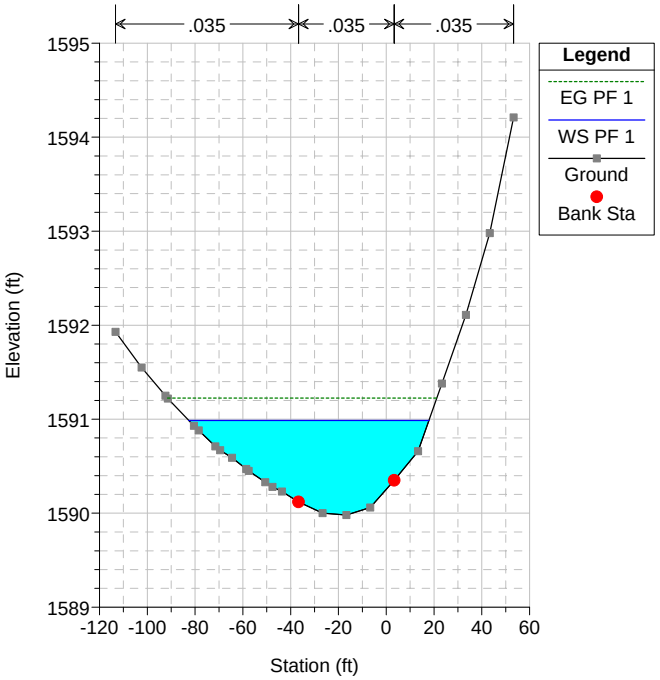
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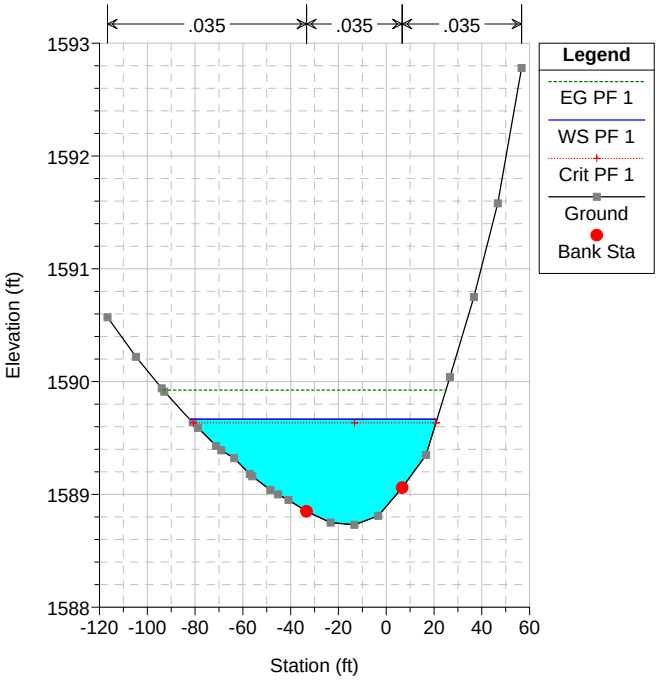
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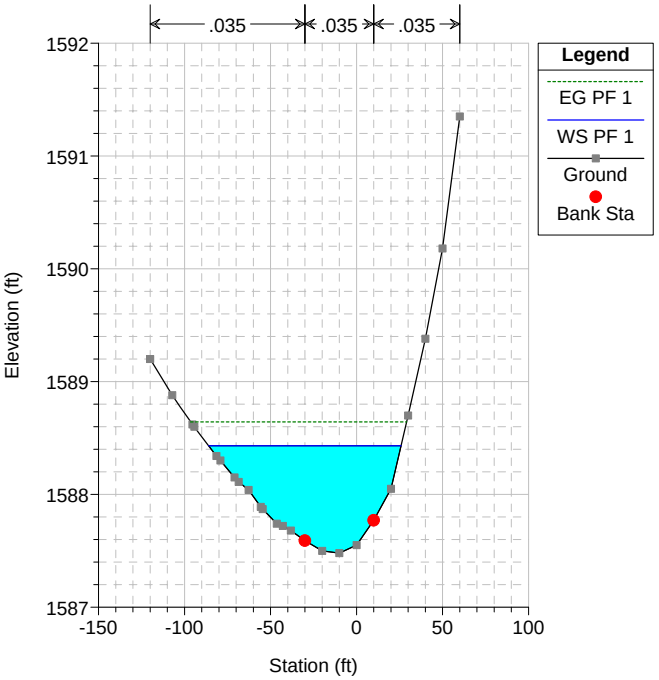
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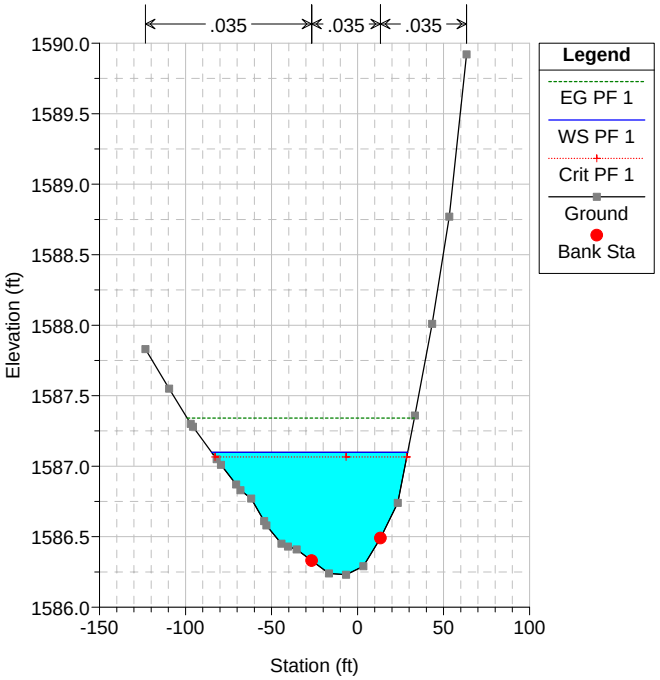
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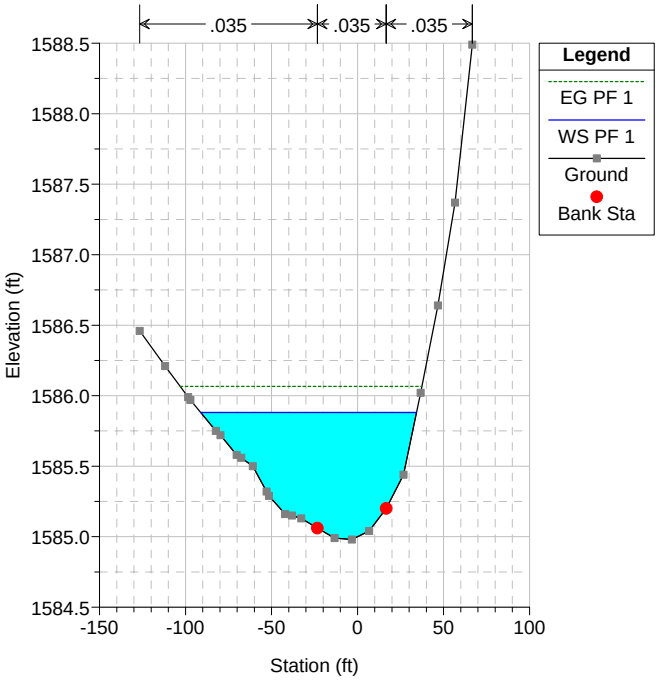
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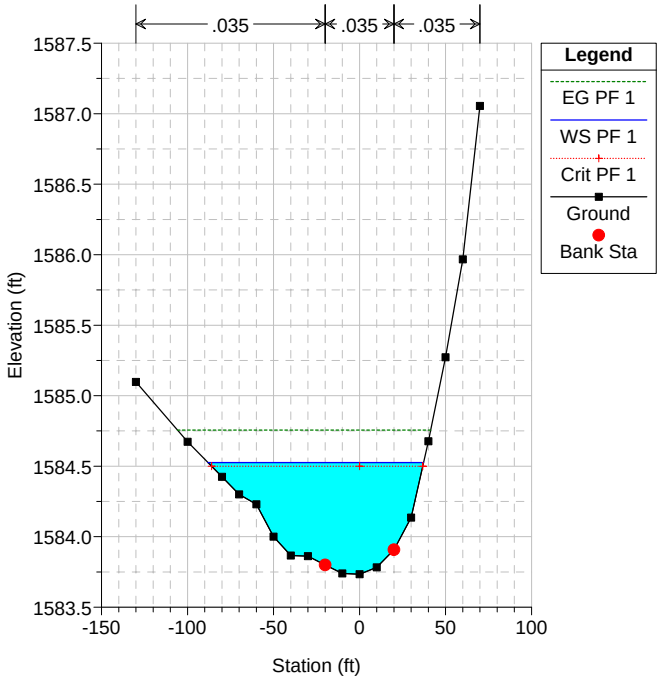

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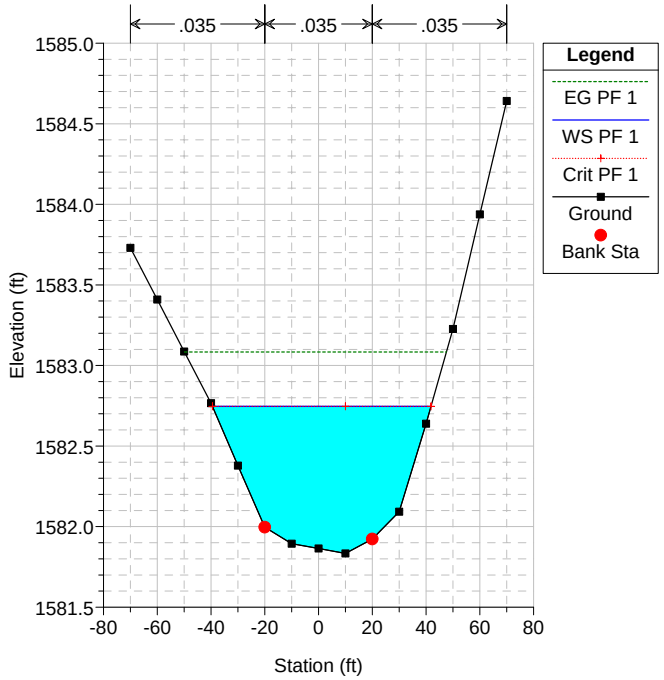

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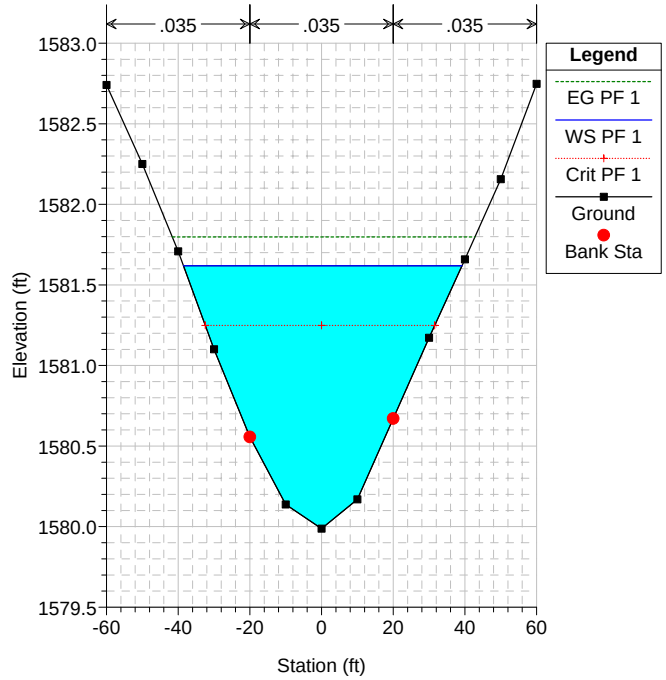

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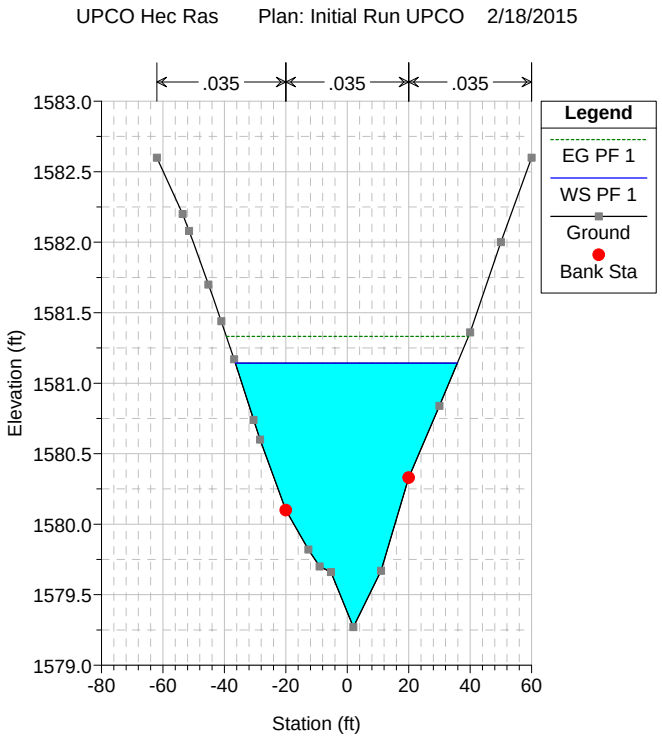

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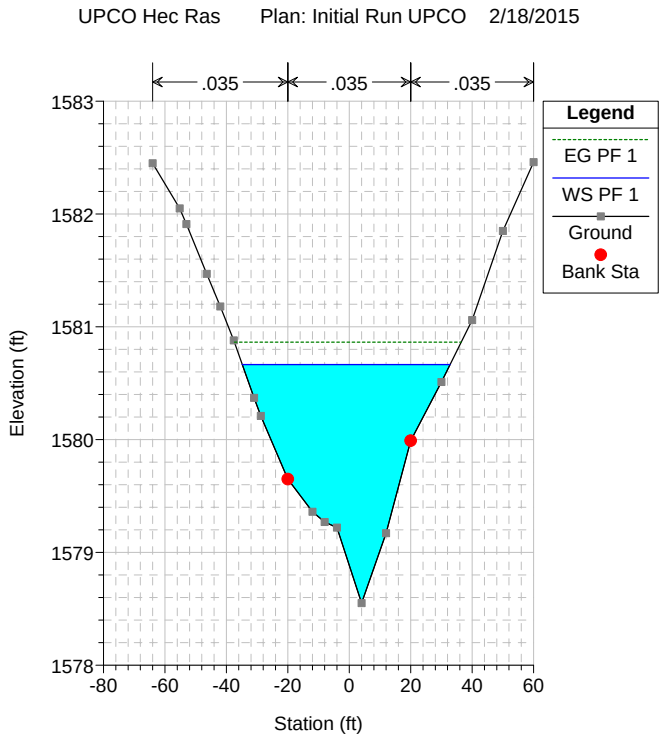

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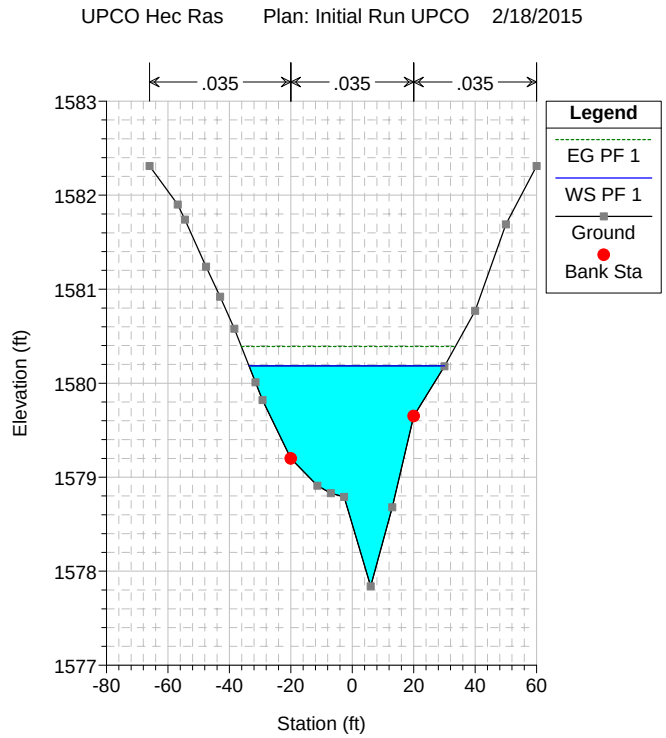

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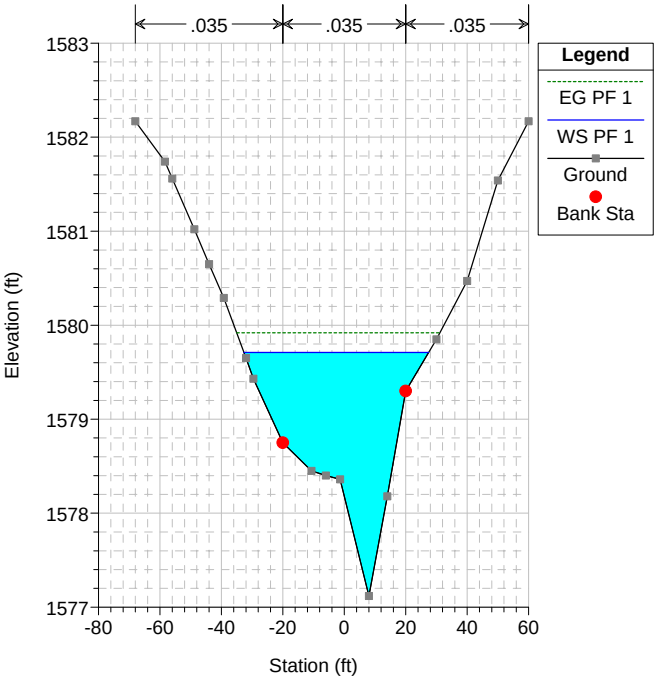
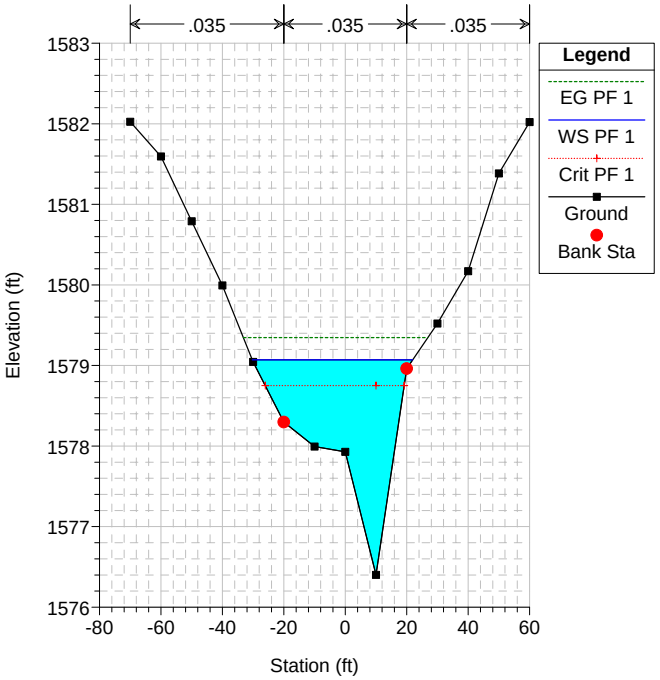


UPCO Hec Ras Plan: Initial Run UPCO 2/18/2015

Downstream Section



Appendix G

Cost Estimates (on CD)

Table G-1
Summary of Soil Costs for Corrective Measures
Corrective Measures Study

Remedial Alternatives	Capital Cost	O&M Cost	Periodic Cost	Total Project Cost	Net Present Value
Alternative SA-1: No Action	$0	$0	$0	$0	$0
Alternative SA-2: Soil Excavation, Soil Capping, Deed Restrictions	$2,026,950	$459,000	$35,000	$2,521,000	$2,089,000
Alternative SA-3: Soil Excavation, In Situ Biological Reduction	$2,602,386	$1,063,300	$198,750	$3,864,000	$3,010,000
Alternative SA-4: ADEQ Soil Treatment Scenario	$4,484,250	$270,000	$0	$4,754,000	$4,303,000

Notes:
ADEQ = Arizona Department of Environmental Quality
O&M = Operation and Maintenance

Table G-2
Summary of Groundwater Costs for Corrective Measures
Corrective Measures Study

Remedial Alternatives	Capital Cost	O&M Cost	Periodic Cost	Total Project Cost	Net Present Value
Alternative GW-1: No Action	$0	$0	$0	$0	$0
Alternative GW-2: Bedrock Source Area Groundwater Extraction, Ex Situ Treatment with Anaerobic Bioreactor, Reinjection, and Alluvium In Situ Biological Reduction	$3,221,900	$6,697,500	$313,200	$10,233,000	$6,669,000
Alternative GW-3: Bedrock Source Area Hydraulic Control and In Situ Biological Reduction and Alluvium In Situ Biological Reduction	$1,584,300	$5,856,800	$313,200	$7,754,000	$4,750,000
Alternative GW-4: ADEQ Groundwater Treatment Scenario	$5,261,400	$10,006,900	$0	$15,268,000	$8,770,000

Notes:
ADEQ = Arizona Department of Environmental Quality
O&M = Operation and Maintenance

Table G-3
Summary of Soil Costs for Soil Alternative SA-2:
Soil Excavation, Soil Capping, and Deed Restrictions
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
PRE-DESIGN INVESTIGATION				
Pre-Design Investigation Mob and Drill Rig		LS	1	$0
Pre-Design Laboratory Fees		LS	1	$0
COMPLETED			**Investigation Subtotal**	**$0**
			Health & Safety/Air Monitoring/Security (3%)	$0
			Engineering Design and Permitting (10%)	$0
			Investigation Management (10%)	$0
			Subtotal	**$0**
PRE-DESIGN INVESTIGATION CAPITAL COST SUBTOTAL				**$0**
SOIL EXCAVATION AND OFF-SITE DISPOSAL (NON-CAP AREAS)				
Mobilization/Demobilization	$5,889	LS	1	$5,889
Excavation	$22	Ton	3,506	$77,132
Surveying\Utility Location	$18,250	LS	1	$18,250
ISM Sampling Laboratory Fees	$27,570	LS	1	$27,570
Off-Site Soil Transportation/Disposal	$44	Ton	3,506	$152,616
Backfill	$13.40	Ton	3,506	$46,980
Restoration	$0.25	sf	9,835	$2,459
Labor	$147,745	LS	1	$147,745
Expenses (PPE, Truck Rental, etc)	$11,920	LS	1	$11,920
			Construction Subtotal	**$491,000**
Contingency (15% of Construction Costs)				$48,450
			Construction Total	**$539,450**
			Institutional Controls	$1,000
			Health & Safety/Air Monitoring/Security (3%)	$16,200
			Engineering Design and Permitting (10%)	$53,900
			Construction Management (10%)	$53,900
			Subtotal	**$125,000**
SOIL EXCAVATION AND DISPOSAL CAPITAL COST SUBTOTAL				**$664,450**
SOIL EXCAVATION OF SOIL CAP AREA				
Pre-Design Investigation Mob and Rig	$8,000	LS	0	$0
Mobilization/Demobilization	$4,574	LS	1	$4,574
Clear/Spray Vegetation	$500	Acre	0.52	$260
Excavation	$22	Ton	2,723	$59,906
Surveying	$3,600	LS	1	$3,600
Pre-Design and Confirmatory Sampling Laboratory Fees	$4,690	LS	0	$0
Off-Site Soil Transportation/Disposal	$44	Ton	2,723	$118,532
Restoration	$0.25	sf	0	$0
Labor	$36,936	LS	1	$36,936
Expenses (PPE, Truck Rental, etc)	$2,980	LS	1	$2,980
			Construction Subtotal	**$227,000**
Contingency (15% of Construction Costs)				$27,300
			Construction Total	**$254,300**
			Institutional Controls	$1,000
			Health & Safety/Air Monitoring/Security (3%)	$7,600
			Engineering Design and Permitting (10%)	$25,400
			Construction Management (10%)	$25,400
			Subtotal	**$59,000**
SOIL EXCAVATION AND DISPOSAL CAPITAL COST SUBTOTAL				**$313,300**

Table G-3
Summary of Soil Costs for Soil Alternative SA-2:
Soil Excavation, Soil Capping, and Deed Restrictions
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
ENGINEERED CAP INSTALLATION				
Mobilization/Demobilization	$25,000	LS	1	$25,000
Equipment (Dozer, Compactor, Grader, Front End Loader)	$43,500	LS	1	$43,500
Site Preparation	$2,500	Acre	0.52	$1,300
Backfill (compacted sub-grade)	$13.40	Ton	819	$10,975
CAP Installation	$8	sf	22815	$182,520
CAP Anchor (preparation and installation)	$1,500	CY	285	$427,500
Erosion Control	$11	CY	1815	$20,092
Labor	$26,618	LS	1	$26,618
Expenses (PPE, Truck Rental, etc)	$2,598	LS	1	$2,598
Deed Restrictions	$1,500	LS	1	$1,500
			Construction Subtotal	**$742,000**
Contingency (15% of Construction Costs)				$111,000
			Construction Total	**$853,000**
			Health & Safety/Air Monitoring/Security (3%)	$25,600
			Engineering Design and Permitting (10%)	$85,300
			Construction Management (10%)	$85,300
			Subtotal	$196,200
			SOIL CAPPING CAPITAL COST SUBTOTAL	**$1,049,200**
ANNUAL OPERATION & MAINTENANCE (O&M)				
O&M Labor (Quarterly Cap Inspections)	$7,218	LS	1	$7,218
Annual Purge Water Storage and Disposal	$4,440	Annual	1	$4,440
Laboratory Fees (Annual Sampling)	$525	Annual	1	$525
O&M Expenses	$1,072	LS	1	$1,072
			Annual O&M Subtotal	$13,255
Contingency 15% of O&M Subtotal				$2,000
			ANNUAL O&M COSTS: Years 1-30	**$15,300**
			SOIL CAPPING O&M SUBTOTAL	**$459,000**

Table G-3
Summary of Soil Costs for Soil Alternative SA-2:
Soil Excavation, Soil Capping, and Deed Restrictions
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
Closure Report				
Draft Demobilization Plan Labor and Communications	$21,538	LS	1	$21,538
Draft Final Demobilization Plan Labor and Communications	$4,759	LS	1	$4,759
Final Demobilization Plan Labor and Communications	$4,178	LS	1	$4,178
			Periodic Cost Subtotal	**$30,500**
Contingency (15% of Periodic Costs)				$4,500
			Periodic Cost Total	**$35,000**
			PERIODIC COST SUBTOTAL	**$35,000**
			CAPITAL COST	**$2,026,950**
			OPERATION AND MAINTENANCE COSTS	**$459,000**
			PERIODIC COSTS	**$35,000**
			TOTAL PROJECT COST	**$2,521,000**
	7% Discount rate		**PRESENT VALUE**	**$2,089,000**

Assumptions:
Excavation and Disposal
1. The estimated volume of impacted soil to be removed is based on evaluation of data collected during pre-design soil investigation.
2. The actual volume removed, and the volume of unimpacted soil to remain in place (if any), determined based on the results of pre-design soil sampling and additional soil characterization.

3. Excavated soil assumed to weigh 1.5 tons per cubic yard of moist unexcavated soil. Backfill soil assumed to have same weight of the soil disposed.
4. The soil disposal and transportation costs are $44 per ton for excavation.

Soil Excavation of Engineered Cap Area
1. The estimated volume of impacted soil to be removed is based on evaluation of data collected during soil investigation.
2. Excavated soil assumed to weigh 1.5 tons per cubic yard of moist unexcavated soil. Backfill soil assumed to have same weight of the soil disposed.

Engineered Capping Installation
1. Dimensions of engineered caps are approximately 150*102 feet, 80*77 feet, and 45*25 feet.
2. Engineered cap installation includes clearing the area of vegetation, procuring and placing a protective cover.
3. Engineered caps will include erosion control.
4. The area to be capped based on location of perchlorate in soil above the cleanup standard and presented on the attached figure.

Engineered Capping O&M
1. Duration of engineered capping operations and maintenance is 30 years.
2. Groundwater sampling at 5 wells for perchlorate will be conducted annually for 30 years.
3. Quarterly engineered cap inspections will be conducted for 30 years.

Periodic Costs
1. Closure report to be completed after 30 years.

Table G-4
Summary of Soil Costs for Soil Alternative SA-3:
In-Situ Biological Reduction and Excavation
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
PRE-DESIGN INVESTIGATION				
Pre-Design Investigation Mob and Drill Rig	$62,000	LS	0	$0
Pre-Design Laboratory Fees	$10,000	LS	0	$0
COMPLETED			**Investigation Subtotal**	**$0**
			Health & Safety/Air Monitoring/Security (3%)	$0
			Engineering Design and Permitting (10%)	$0
			Investigation Management (10%)	$0
			Subtotal	**$0**
PRE-DESIGN INVESTIGATION CAPITAL COST SUBTOTAL				**$0**
SOIL EXCAVATION AND OFF-SITE DISPOSAL				
Mobilization/Demobilization	$20,769	LS	1	$20,769
Excavation	$22	Ton	13,201	$290,422
Surveying	$15,120	LS	1	$15,120
ISM Sampling Laboratory Fees	$28,245	LS	1	$28,245
Off-Site Soil Transportation/Disposal	$44	Ton	13,201	$574,640
Backfill	$13	Ton	13,201	$176,893
Restoration	$0.25	SF	19,561	$4,890
Labor	$101,112	LS	1	$101,112
Expenses (PPE, Truck Rental, etc)	$12,516	LS	1	$12,516
			Construction Subtotal	**$1,225,000**
Contingency (15% of Construction Costs)				$163,500
			Construction Total	**$1,388,500**
			Institutional Controls	$1,000
			Health & Safety/Air Monitoring/Security (3%)	$41,700
			Engineering Design and Permitting (10%)	$138,900
			Construction Management (10%)	$138,900
			Subtotal	**$321,000**
SOIL EXCAVATION AND DISPOSAL CAPITAL COST SUBTOTAL				**$1,709,500**
IN SITU BIOLOGICAL TREATMENT INSTALLATION				
Mobilization/Demobilization	$3,500	LS	2	$7,000
Well Installation and Development (50 ft screens)	$15,100	EA	30	$453,000
Well Installation and Development (30 ft screens)	$9,570	EA	4	$38,280
Lysimeter Installation (Shallow)	$1,000	EA	7	$7,000
Lysimeter Installation (Deep)	$2,000	EA	8	$16,000
Molasses (includes delivery)	$375	Ton	8	$3,000
Laboratory Fees (includes waste characterization sampling)	$23,280	LS	1	$23,280
Waste Storage, Transportation, and Disposal	$121	Ton	189	$22,869
Labor	$53,576	LS	1	$53,576
Expenses (PPE, Truck Rental, etc)	$23,026	LS	1	$23,026
			Construction Subtotal	**$647,031**
Contingency (15% of Construction Costs)				$97,055
			Construction Total	**$744,086**
			Health & Safety/Air Monitoring/Security (3%)	$19,400
			Engineering Design and Permitting (10%)	$64,700
			Construction Management (10%)	$64,700
			Subtotal	**$148,800**
IN SITU BIOLOGICAL TREATMENT CAPITAL COST SUBTOTAL				**$892,886**

Table G-4
Summary of Soil Costs for Soil Alternative SA-3:
In-Situ Biological Reduction and Excavation
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
IN SITU BIOLOGICAL TREATMENT O&M				
Quarterly Injection for 5 Years				
Carbon Source Injection Labor	$15,088	event	4	$60,352
Molasses	$220	event	4	$880
Performance Monitoring				
Laboratory Analysis (Quarterly Sampling of 25 Lysimeters)	$3,240	event	4	$12,960
Field Monitoring Equipment and Expenses	$914	event	4	$3,656
Process Monitoring& Data Evaluation (labor)	$3,654	event	4	$14,616
			Subtotal	**$92,464**
Contingency (15%)				$13,870
			ANNUAL INJECTION COSTS:	**$106,334**
IN SITU BIOLOGICAL TREATMENT O&M SUBTOTAL (10 YEARS)				**$1,063,300**
CONFIRMATION SAMPLING AND CLOSEOUT COSTS				
Confirmation Sampling				
Mobilization/Demobilization	$3,500	LS	2	$7,000
Boring Installation -Waterbore Area (6 borings)	$11,000	each	6	$66,000
Boring Installation - New Burn Area (2 borings)	$2,750	each	2	$5,500
Permitting (Well Permits and Air Permit) & Implementation	$13,650	LS	1	$13,650
Laboratory Fees (includes waste characterization sampling)	$2,040	LS	1	$2,040
Waste Disposal (includes drums, purge water)	$44	Ton	13	$566
Labor	$22,152	LS	1	$22,152
Expenses (PPE, Truck Rental, etc)	$10,022	LS	1	$10,022
Closeout Reporting	$31,885	LS	1	$31,885
			Subtotal	**$159,000**
Contingency (15%)				$39,750
			Total	**$198,750**
CONFIRMATION SAMPLING AND CLOSEOUT COST SUBTOTAL				**$198,750**

	CAPITAL COST	**$2,602,386**
	OPERATION AND MAINTENANCE COSTS	**$1,063,300**
	PERIODIC COSTS	**$198,750**
	TOTAL PROJECT COST	**$3,864,000**
7% Discount Rate	**PRESENT VALUE**	**$3,010,000**

Table G-4
Summary of Soil Costs for Soil Alternative SA-3:
In-Situ Biological Reduction and Excavation
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL

Assumptions:
Excavation and Disposal

1. The estimated volume of impacted soil to be removed is based on evaluation of data collected during the pre-design soil investigations.
2. The actual volume removed, and the volume of unimpacted soil to remain in place (if any), will be determined based on the results of pre-design soil sampling.
3. Excavated soil assumed to weigh 1.5 tons per cubic yard of moist unexcavated soil. Backfill soil assumed to have same weight of the soil disposed.
4. The soil disposal and transportation costs are $44 per ton for excavation and $121 per ton for well drilling installation.

In Situ Biological Treatment Installation (Waterbore Area)

1. A total of 10 pairs of 3-dual nested wells will be installed.
2. Screen intervals for each well pair include, 1 well screened 10-60 ft bgs, 1 well screened 60-110 ft bgs, and 1 well screened 110-160 ft bgs.
3. A radius of influence of 5 ft.
4. A total of 12 lysimeters will be installed in 4 boreholes. 1 deep and 2 shallow lysimters in each borehole.
5. Installation costs include first injection event.
6. Assumed costs: 2015 Drilling costs from proposal.
7. Molasses is used as the source of carbon.

In Situ Biological Treatment Installation (New Burn Area)

1. A total of 3 single wells will be installed.
2. Screen intervals for each well is 10-40 ft bgs.
3. A radius of influence of 5 ft.
4. A total of 3 lysimeters will be installed in 3 boreholes. 1 shallow lysimters in each borehole.
5. Installation costs include first injection event.
6. Assumed costs: 2015 Drilling costs from proposal.
7. Molasses is used as the source of carbon.

In Situ Biological Treatment O&M

1. Duration of In Situ Biological Treatment is 5 years
2. Injections will be conducted quarterly for the 5 years.
3. A total of 1,586 gallons of a molasses solution will be injected in the New Burn Area per event.
4. A total of 44,061 gallons of a molasses solution will be injected in the Waterbore Area per event.
5. All lysimters will be sampled quarterly and analyzed for Perchlorate and TOC.
6. Assumed that all the molasses solution can be injected every event.
7. Molasses is used as the source of carbon.

Table G-5
Summary of Soil Costs for Soil Alternative SA-4:
ADEQ Soil Treatment Scenario
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
SOIL EXCAVATION AND OFF-SITE DISPOSAL-WATERBORE				
Mobilization/Demobilization	$28,589	LS	1	$28,589
Clear/Spray Vegetation	$500	Acre	0.35	$175
Excavation	$22	Ton	17,018	$374,396
Confirmatory Sampling Laboratory Fees	$1,595	LS	0	$0
Off-Site Soil Transportation/Disposal	$44	Ton	17,018	$740,794
Backfill	$13	Ton	17,018	$228,041
Surveying/Utility Location	$20,520	LS	1	$20,520
Labor	$123,115	LS	1	$123,115
Expenses	$16,986	LS	1	$16,986
			Construction Subtotal	**$1,533,000**
Contingency (15% of Construction Costs)				$204,600
			Construction Total	**$1,737,600**
			Institutional Controls	$1,000
			Health & Safety/Air Monitoring/Security (3%)	$52,100
			Engineering Design and Permitting (10%)	$173,800
			Construction Management (10%)	$173,800
			Subtotal	**$401,000**
SOIL EXCAVATION AND DISPOSAL CAPITAL COST SUBTOTAL				**$2,138,600**
SOIL EXCAVATION AND OFF-SITE DISPOSAL-NEW BURN				
Mobilization/Demobilization	$28,505	LS	1	$28,505
Excavation	$22	Ton	13890	$305,580
Confirmatory Sampling Laboratory Fees	$16,385	LS	1	$16,385
Off-Site Soil Transportation/Disposal	$44	Ton	13,890	$604,632
Surveying/Utility Location	$16,800	LS	1	$16,800
Backfill	$13	Ton	13,890	$186,126
Seeding and Vegetative Cover	$8,476	LS	1	$8,476
Labor	$101,244	LS	1	$101,244
Expenses (PPE, Truck Rental, etc)	$11,374	LS	1	$11,374
			Construction Subtotal	**$1,279,000**
Contingency (15% of Construction Costs)				$141,750
			Construction Total	**$1,420,750**
			Institutional Controls	$1,000
			Health & Safety/Air Monitoring/Security (3%)	$42,600
			Engineering Design and Permitting (10%)	$142,100
			Construction Management (10%)	$142,100
			Subtotal	**$328,000**
SOIL EXCAVATION AND DISPOSAL CAPITAL COST SUBTOTAL				**$1,748,750**

Table G-5
Summary of Soil Costs for Soil Alternative SA-4:
ADEQ Soil Treatment Scenario
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
ENGINEERED CAP INSTALLATION - WATERBORE				
Mobilization/Demobilization	$3,500	LS	1	$3,500
Equipment (Dozer, Compactor, Grader, Front End Loader)	$23,200	LS	1	$23,200
Site Preparation	$2,500	Acre	0.35	$875
Surveying	$2,880	LS	1	$2,880
CAP Installation	$8	sf	15450	$123,600
CAP Anchor (preparation and installation)	$1,500	CY	150	$225,000
Erosion Control	$11	CY	1145	$12,675
Labor	$26,618	LS	1	$26,618
Expenses (PPE, Truck Rental, etc)	$3,200	LS	1	$3,200
			Construction Subtotal	**$422,000**
Contingency (15% of Construction Costs)				$63,300
			Construction Total	**$485,300**
			Health & Safety/Air Monitoring/Security (3%)	$14,600
			Engineering Design and Permitting (10%)	$48,500
			Construction Management (10%)	$48,500
			Subtotal	$111,600
			SOIL CAPPING CAPITAL COST SUBTOTAL	**$596,900**
ANNUAL OPERATION & MAINTENANCE (O&M)				
O&M Labor (Monthly Inspections)	$7,218	LS	1	$7,218
O&M Expenses (PPE, Truck Rental, etc)	$592	LS	1	$592
			Annual O&M Subtotal	$7,810
Contingency 15% of O&M Subtotal				$1,200
			ANNUAL O&M COSTS: Years 1-30	**$9,000**
			SOIL CAPPING O&M SUBTOTAL	**$270,000**
			CAPITAL COST	**$4,484,250**
			OPERATION AND MAINTENANCE COSTS	**$270,000**
			TOTAL PROJECT COST	**$4,754,000**
	7% Discount rate		**PRESENT VALUE**	**$4,303,000**

Assumptions:

Excavation and Disposal

1. The estimated volume of impacted soil to be removed is based on ADEQ RACER output volumes.

Engineered Cap Installation

1. Engineered cap is approximately 15450 square feet.
2. Engineered cap includes removal of soil down to approximately 20 feet, concrete anchor trench, and HydroTurf™ or similar.
3. Engineered cap only installed in the Waterbore Area.

Soil Capping O&M

1. Duration of engineered cap operations and maintenance is 30 years.
3. Monthly engineered cap inspections will be conducted for 30 years.

Table G-7
Summary of Costs for Groundwater Alternative GW-2:
Bedrock Source Area Groundwater Extraction, Ex-Situ Treatment with Anaerobic Bioreactor, Reinjection, and Alluvium In-Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
PRE-DESIGN INVESTIGATION				
Pre-Design Investigation and Tracer Testing	$0	LS	0	$0
COMPLETED				
PRE-DESIGN INVESTIGATION CAPITAL COST SUBTOTAL				**$0**
GROUNDWATER EXTRACTION, EX SITU TREATMENT AND REINJECTION-SYSTEM INSTALLATION				
Drilling Mobilization/Demobilization	$4,250	LS	1	$4,250
Permitting (UIC Permit, Air Permit, Well Permit)	$9,900	LS	1	$9,900
Well Installation and Development (1 Injection Well)	$59,930	Each	1	$59,930
Laboratory Analysis (includes waste characterization samples)	$4,345	LS	1	$4,345
Trenching, Pipe and Conduit Installation	$207,400	LS	1	$207,400
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	4	$42,000
Injection Wellhead	$500	EA	6	$3,000
APTWater ARoPer Reactor (capital)	$1,300,000	LS	1	$1,300,000
System Equipment (includes instrumentation and controls)	$111,000	LS	1	$111,000
Treatment Building (includes power drop)	$222,000	LS	1	$222,000
Waste Storage, Transportation, and Disposal	$121	Ton	40	$4,840
Labor	$244,752	LS	1	$244,752
Expenses (PPE, Truck Rental, etc)	$35,250	LS	1	$35,250
RCRA Reporting (includes Statement of Basis and CMI)	$230,700	LS	1	$230,700
			Construction Subtotal	**$2,479,367**
Contingency (15% of Construction Costs)				**$371,905**
			Construction Total	**$2,851,272**
			Health & Safety/Air Monitoring/Security (3%)	$85,500
			Installation Management (10%)	$285,100
			Subtotal	**$370,600**
PUMP & TREAT WITH REINJECTION CAPITAL COST SUBTOTAL				**$3,221,900**
GROUNDWATER EXTRACTION, EX SITU TREATMENT AND REINJECTION-O&M (10YEARS)				
O&M Labor	$216,580	annual	1	$216,580
Laboratory Costs	$28,200	annual	1	$28,200
APTWater ARoPer Reactor (annual O&M)	$70,000	annual	1	$70,000
Maintenance (equipment replacement)	$13,000	annual	1	$13,000
Expenses (includes electricity)	$40,400	annual	1	$40,400
Annual Reporting	$26,598	annual	1	$26,598
			Subtotal	$394,778
			Contingency (15%)	$59,217
			ANNUAL COSTS:	**$454,000**
PUMP & TREAT WITH REINJECTION O&M (10 YEARS)				**$4,540,000**
ALLUVIUM INJECTION WELL INSTALLATION (TARGETING MW-06)				
Mobilization/Demobilization	$0	LS	0	$0
Permitting (Well Permits and UIC Permit)	$0	LS	0	$0
Well Installation and Development	$0	LS	0	$0
Laboratory Analysis (includes waste characterization sampling)	$0	LS	0	$0
Waste Transportation and Disposal	$0	Ton	0	$0
COMPLETED			**Construction Subtotal**	**$0**
Contingency (15% of Construction Costs)				**$0**

Table G-7
Summary of Costs for Groundwater Alternative GW-2:
Bedrock Source Area Groundwater Extraction, Ex-Situ Treatment with Anaerobic Bioreactor, Reinjection, and Alluvium In-Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
			Construction Total	**$0**
			Health & Safety/Air Monitoring/Security (3%)	$0
			Engineering Design (10%)	$0
			Construction Management (10%)	$0
			Subtotal	**$0**
ALLUVIUM INJECTIONS CAPITAL COST SUBTOTAL				**$0**
ALLUVIUM INJECTION O&M (TARGETING MW-06)				
Sampling Equipment (Quarterly)	$1,285	Qrtly	4	$5,140
Laboratory Analysis (Quarterly)	$1,590	Qrtly	4	$6,360
Annual Storage and Disposal	$750	Annual	1	$750
Labor (sampling)	$2,258	Qrtly	4	$9,032
Expenses (PPE, Truck Rental, etc)	$5,393	LS	1	$5,393
			Subtotal	**$26,700**
			Contingency (15%)	**$4,050**
			Annual Costs	**$30,750**
ALLUVIUM INJECTIONS O&M COST SUBTOTAL (2 YEARS)				**$61,500**
GROUNDWATER MONITORING ANNUAL COSTS				
For Years 1 and 2				
Laboratory Analyses (quarterly)	$6,500	Qrtly	4	$26,000
Quarterly Storage and Disposal	$10,537	Qrtly	4	$42,148
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$160,364
			Contingency (15%)	$24,100
			ANNUAL COSTS:	$184,000
			GROUNDWATER MONITORING (Years 1 and 2)	**$368,000**
For Years 3 through 12				
Laboratory Analyses (quarterly)	$6,500	Qrtly	4	$26,000
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$118,216
			Contingency (15%)	$17,700
			ANNUAL COSTS:	$136,000
			GROUNDWATER MONITORING (Years 3 through 12)	**$1,360,000**
For Year 13 and 14				
Laboratory Analyses (quarterly)	$6,500	Qrtly	4	$26,000
Quarterly Storage and Disposal	$10,537	Qrtly	4	$42,148
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$160,364
			Contingency (15%)	$24,100
			ANNUAL COSTS:	$184,000
			GROUNDWATER MONITORING (Years 13 and 14)	**$368,000**
GROUNDWATER MONITORING O&M (14 YEARS)				**$2,096,000**

Table G-7
Summary of Costs for Groundwater Alternative GW-2:
Bedrock Source Area Groundwater Extraction, Ex-Situ Treatment with Anaerobic Bioreactor, Reinjection, and Alluvium In-Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
SYSTEM DECOMISSIONING AND CLOSURE REPORTING				
Mobilization/Demobilization	$4,400	LS	1	$4,400
Well Abandonment	$15	LF	8700	$130,500
Well Abandonment Equipment	$9,600	LS	1	$9,600
System Decommissioning	$15,000	LS	1	$15,000
Labor	$36,269	LS	1	$36,269
Expenses	$3,090	LS	1	$3,090
Closure Report	$41,953	LS	1	$41,953
			Subtotal	**$241,000**
			Contingency (15%)	**$36,150**
			Subtotal	**$277,150**
			Health & Safety/Air Monitoring/Security (3%)	$8,300
			Decommissioning Management (10%)	$27,700
			Subtotal	**$36,000**
			SYSTEM DECOMMISSIONING AND CLOSURE REPORTING COST	**$313,200**

	CAPITAL COST	**$3,221,900**
	OPERATION AND MAINTENANCE COSTS	**$6,697,500**
	PERIODIC COST	**$313,200**
	TOTAL PROJECT COST	**$10,233,000**
7% Discount rate	**PRESENT NET VALUE**	**$6,669,000**

Assumptions:

Groundwater Extraction, Ex Situ Treatment and Reinjection-System Installation

1. Only 1 new well installed.
2. Well depth of the new well is 400 ft, with 75 ft screen intervals.
3. Assumed costs: 2015 Drilling costs from proposal.
4. Waste generated during system installation will be transported and disposed off-site and costs are $44 per ton.
5. An APTWater ARoPer Reactor will be used for ex situ treatment, capital costs include control panel, booster pumps, plumbing, valves, and controls to operate system, set of basins with hollow fiber modules and aeration, onsite hydrogen supply system, re-aeration system to replenish dissolved oxygen that is removed along with perchlorate, and hydrogen detector and safety gear.

Groundwater Extraction, Ex Situ Treatment and Reinjection-O&M (10 Years)

1. Duration of groundwater extraction, ex situ treatment and reinjection is 10 years.
2. APTWater ARoPer Reactor O&M includes power and consumables.
3. Monthly sampling will be conducted to evaluate system performance.
4. Parameters to be analyzed during monthly sampling include perchlorate, 1,4-dioxane, chloride, sulfate and nitrate.

Alluvium Injections (Targeting MW-06)

1. No perchlorate remains in the alluvium near MW-06 following the pilot test.
2. No further alluvium injections.
3. Quarterly samples will be collected from each well to evaluate system performance for 2 years.

Groundwater Monitoring

1. Duration of Groundwater Sampling is 12 years, quarterly sampling.
2. Purge water will be transported and disposed off-site during first years prior to system installation, and last years following system shutdown.
3. Purge water will be treated along with extracted water and reinjected during 10 years of system operation.
4. Parameters to be analyzed include VOCs, 1,4-dioxane, perchlorate and RCRA metals.

System Decommissioning and Closure Reporting

1. Assumes well abandonment and system decommissioning following 10 years of system operations.
2. Includes closure reporting costs.

Table G-8
Summary of Costs for Groundwater Alternative GW-3:
Bedrock Source Area Hydraulic Control and In Situ Biological Reduction and Alluvium In Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
PRE-DESIGN INVESTIGATION				
Pre-Design Investigation and Tracer Testing	$0	LS	0	$0
PRE-DESIGN INVESTIGATION CAPITAL COST SUBTOTAL				**$0**
GROUNDWATER EXTRACTION AND IN SITU BIOLOGICAL REDUCTION-SYSTEM INSTALLATION				
Mobilization/Demobilization	$4,250	LS	1	$4,250
Permitting (UIC Permit, Air Permit, Well Permit)	$9,900	LS	1	$9,900
Well Installation (1 Injection Well)	$59,930	Each	1	$59,930
Laboratory Analysis (includes waste characterization samples)	$4,345	LS	1	$4,345
Trenching, Pipe and Conduit Installation	$207,400	LS	1	$207,400
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	4	$42,000
Injection Wellhead	$500	EA	8	$4,000
In-Line Mixing Tanks and Major Infrastructure	$35,000	LS	1	$35,000
System Fabrication (includes instrumentation and controls)	$114,500	LS	1	$114,500
Treatment Building (includes power drop)	$222,000	LS	1	$222,000
Waste Storage, Transportation, and Disposal	$121	Ton	40	$4,840
Labor	$244,752	LS	1	$244,752
Expenses (PPE, Truck Rental, etc)	$35,250	LS	1	$35,250
RCRA Reporting (includes Statement of Basis and CMI)	$231,000	LS	1	$231,000
			Construction Subtotal	**$1,219,167**
Contingency (15% of Construction Costs)				**$182,875**
			Construction Total	**$1,402,042**
			Health & Safety/Air Monitoring/Security (3%)	$42,100
			Installation Management (10%)	$140,200
			Subtotal	**$182,300**
GROUNDWATER EXTRACTION & IN SITU BIOLOGICAL REDUCTION CAPITAL COST SUBTOTAL				**$1,584,300**
GROUNDWATER EXTRACTION AND IN SITU BIOLOGICAL REDUCTION-O&M (10 YEARS)				
O&M Labor	$179,928	annual	1	$179,928
Laboratory Costs	$36,976	annual	1	$36,976
Molasses	$300	Ton	14	$4,200
Maintenance (equipment replacement)	$13,000	annual	1	$13,000
Well Rehab and Replacement	$11,511	annual	1	$11,511
Expenses (includes electricity)	$40,944	annual	1	$40,944
Annual Reporting	$26,598	annual	1	$26,598
			Subtotal	**$313,157**
			Contingency (15%)	**$46,974**
			ANNUAL COSTS:	**$360,131**
GROUNDWATER EXTRACTION & IN SITU BIOLOGICAL REDUCTION O&M (10 YEARS)				**$3,601,300**
ALLUVIUM INJECTION WELL INSTALLATION (TARGETING MW-06)				
Mobilization/Demobilization	$0	LS	0	$0
Permitting (Well Permits and UIC Permit)	$0	LS	0	$0
Well Installation and Development	$0	LS	0	$0
Laboratory Analysis (includes waste characterization sampling)	$0	LS	0	$0
Waste Transportation and Disposal	$0	Ton	0	$0
			Construction Subtotal	**$0**

Table G-8
Summary of Costs for Groundwater Alternative GW-3:
Bedrock Source Area Hydraulic Control and In Situ Biological Reduction and Alluvium In Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
Contingency (15% of Construction Costs)				**$0**
			Construction Total	**$0**
COMPLETED				
			Health & Safety/Air Monitoring/Security (3%)	$0
			Engineering Design (10%)	$0
			Construction Management (10%)	$0
			Subtotal	**$0**
			ALLUVIUM INJECTIONS CAPITAL COST SUBTOTAL	**$0**
ALLUVIUM INJECTION O&M (TARGETING MW-06)				
Sampling Equipment (Quarterly)	$1,285	Qrtly	4	$5,140
Laboratory Analysis (Quarterly)	$1,590	Qrtly	4	$6,360
Annual Storage and Disposal	$750	Annual	1	$750
Labor (sampling)	$2,258	Qrtly	4	$9,032
Expenses (PPE, Truck Rental, etc)	$5,393	LS	1	$5,393
			Subtotal	**$26,700**
			Contingency (15%)	**$4,050**
			ANNUAL COSTS:	**$30,750**
			ALLUVIUM INJECTIONS O&M COST SUBTOTAL (2 Years)	**$61,500**
GROUNDWATER MONITORING ANNUAL COSTS				
For Years 1 and 2				
Laboratory Analyses (quarterly)	$8,000	Qrtly	4	$32,000
Quarterly Storage and Disposal	$10,537	Qrtly	4	$42,148
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$166,364
			Contingency (15%)	$25,000
			ANNUAL COSTS: Years 1-2	$191,000
			GROUNDWATER MONITORING (Years 1 and 2)	**$382,000**
For Years 3 through 12				
Laboratory Analyses (quarterly)	$8,000	Qrtly	4	$32,000
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$124,216
			Contingency (15%)	$18,600
			ANNUAL COSTS:	$143,000
			GROUNDWATER MONITORING (Years 3 through 12)	**$1,430,000**
For Year 13 and 14				
Laboratory Analyses (quarterly)	$8,000	Qrtly	4	$32,000
Quarterly Storage and Disposal	$10,537	Qrtly	4	$42,148
Labor	$17,096	Qrtly	4	$68,384
Expenses (PPE, Truck Rental, etc)	$5,958	Qrtly	4	$23,832
			Subtotal	$166,364
			Contingency (15%)	$25,000
			ANNUAL COSTS:	$191,000
			GROUNDWATER MONITORING (Years 13 and 14)	**$382,000**

Table G-8
Summary of Costs for Groundwater Alternative GW-3:
Bedrock Source Area Hydraulic Control and In Situ Biological Reduction and Alluvium In Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
GROUNDWATER MONITORING O&M (14 YEARS)				**$2,194,000**
SYSTEM DECOMISSIONING AND CLOSURE REPORTING				
Mobilization/Demobilization	$4,400	LS	1	$4,400
Well Abandonment	$15	LF	8700	$130,500
Well Abandonment Equipment	$9,600	LS	1	$9,600
System Decommissioning	$15,000	LS	1	$15,000
Labor	$36,269	LS	1	$36,269
Expenses	$3,090	LS	1	$3,090
Closure Report	$41,953	LS	1	$41,953
			Subtotal	**$241,000**
			Contingency (15%)	**$36,150**
			Subtotal	**$277,150**
			Health & Safety/Air Monitoring/Security (3%)	$8,300
			Decommissioning Management (10%)	$27,700
			Subtotal	**$36,000**
SYSTEM DECOMMISSIONING AND CLOSURE REPORTING COST				**$313,200**

	CAPITAL COST	**$1,584,300**
	OPERATION AND MAINTENANCE COSTS	**$5,856,800**
	PERIODIC COST	**$313,200**
	TOTAL PROJECT COST	**$7,754,000**
7% Discount rate	**PRESENT NET VALUE**	**$4,750,000**

Assumptions:

Groundwater Extraction, Ex Situ Treatment and Reinjection-System Installation

1. Only 1 new well installed.
2. Well depth of the new well is 400 ft, with 75 ft screen intervals.
3. Assumed costs: 2015 Drilling costs from proposal.
4. Waste generated during system installation will be transported and disposed off-site and costs are $44 per ton.
5. Molasses will be used as the carbon source.
6. System equipment includes tanks and major infrastructure for in-line molasses mixing system.

Groundwater Extraction, Ex Situ Treatment and Reinjection-O&M (10 Years)

1. Duration of groundwater extraction, ex situ treatment and reinjection is 10 years.
2. Molasses will be used as the carbon source.
3. Monthly sampling will be conducted to evaluate system performance.
4. Parameters to be analyzed during monthly sampling include perchlorate, 1,4-dioxane, chloride, sulfate and nitrate.
5. Assumed that each injection well will be redeveloped once in the 10 years of system operations.
5. Assumed that one well will need to be replaced in the 10 years of system operations.

Alluvium Injections (Targeting MW-06)

1. No perchlorate remains in the alluvium near MW-06 following the pilot test.
2. No further alluvium injections.
3. Quarterly samples will be collected from each well to evaluate system performance for 2 years.

Groundwater Monitoring

1. Duration of Groundwater Sampling is 14 years, quarterly sampling.
2. Purge water will be transported and disposed off-site during first years prior to system installation, and last years following system shutdown.
3. Purge water will be treated along with extracted water and reinjected during 10 years of system operation.
4. Parameters to be analyzed include VOCs, 1,4-dioxane, perchlorate, total and dissolved organic carbon, and RCRA metals.

Table G-8
Summary of Costs for Groundwater Alternative GW-3:
Bedrock Source Area Hydraulic Control and In Situ Biological Reduction and Alluvium In Situ Biological Reduction
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL

System Decommissioning and Closure Reporting

1. Assumes well abandonment and system decommissioning following 10 years of system operations.
2. Includes closure reporting costs.

Table G-9
Summary of Groundwater Costs for Groundwater Alternative GW-4:
ADEQ Groundwater Treatment Scenario
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
BEDROCK GROUNDWATER EXTRACTION AND EX SITU TREATMENT SCENARIO-SYSTEM INSTALLATION				
Waterbore				
Mobilization/Demobilization	$4,250	LS	1	$4,250
Permitting (Well Permits)	$250	EA	3	$750
Well Installation and Development (3 Injection Wells)	$274,470	LS	1	$274,470
Air Permit	$3,150	LS	1	$3,150
Laboratory Analysis (includes waste characterization samples)	$2,275	LS	1	$2,275
Trenching, Pipe and Conduit Installation	$103,823	LS	1	$103,823
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	2	$21,000
Injection Wellhead	$500	EA	5	$2,500
Waste Storage, Transportation, and Disposal	$121	Ton	120	$14,520
Expenses (PPE, Truck Rental, etc)	$17,100	LS	1	$17,100
			Subtotal	$443,838
New Burn				
Mobilization/Demobilization	$4,250	LS	1	$4,250
Permitting (Well Permits)	$250	EA	1	$250
Well Installation (1 Extraction Wells)	$74,090	LS	1	$74,090
Laboratory Analysis (includes waste characterization samples)	$1,435	LS	1	$1,435
Trenching, Pipe and Conduit Installation	$103,823	LS	1	$103,823
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	2	$21,000
Waste Storage, Transportation, and Disposal	$121	Ton	40	$4,840
Expenses (PPE, Truck Rental, etc)	$17,100	LS	1	$17,100
			Subtotal	$226,788
C-Complex				
Trenching, Pipe and Conduit Installation	$103,823	LS	1	$103,823
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	2	$21,000
Expenses (PPE, Truck Rental, etc)	$17,100	LS	1	$17,100
			Subtotal	$141,923
Plume Control				
Mobilization/Demobilization	$4,250	LS	1	$4,250
Permitting (Well Permits)	$250	EA	3	$750
Well Installation and Development (3 Extraction Wells)	$222,270	LS	1	$222,270
Laboratory Analysis (includes waste characterization samples)	$1,645	LS	1	$1,645
Trenching, Pipe and Conduit Installation	$107,635	LS	1	$107,635
Extraction Wellhead (includes downhole piping and pump)	$10,500	EA	4	$42,000
Waste Storage, Transportation, and Disposal	$121	Ton	40	$4,840
Expenses (PPE, Truck Rental, etc)	$17,100	LS	1	$17,100
			Subtotal	$400,490
Central Treatment System				
APTWater ARoPer Reactor (capital)	$1,300,000	LS	1	$1,300,000
System Equipment (includes instrumentation and controls)	$200,000	LS	1	$200,000
Treatment Building (includes power drop)	$592,500	LS	1	$592,500
Labor	$244,752	LS	1	$244,752
RCRA Reporting (includes Statement of Basis and CMI)	$169,304	LS	1	$169,304
			Subtotal	$2,506,556
			Construction Subtotal	**$3,719,595**
Contingency (15% of Construction Costs)				**$557,939**
			Construction Total	**$4,277,534**
			Health & Safety/Air Monitoring/Security (3%)	$128,300
			Engineering Design and Permitting (10%)	$427,800
			Installation Management (10%)	$427,800
			Subtotal	**$983,900**
GROUNDWATER EXTRACTION AND EX SITU TREATMENT CAPITAL COST SUBTOTAL				**$5,261,400**

Table G-9
Summary of Groundwater Costs for Groundwater Alternative GW-4:
ADEQ Groundwater Treatment Scenario
Corrective Measures Study

	UNIT COST	UNIT	REQ'D	SUBTOTAL
BEDROCK GROUNDWATER EXTRACTION AND EX SITU TREATMENT SCENARIO-O&M (28 YEARS)				
O&M Labor	$54,880	annual	1	$54,880
APTWater ARoPer Reactor (annual O&M)	$52,000	annual	1	$52,000
Maintenance (equipment replacement)	$47,548	annual	1	$47,548
Expenses	$3,800	annual	1	$3,800
			Subtotal	$158,228
			Contingency (15%)	$23,734.20
			ANNUAL COSTS: 28 Years	**$181,962**
GROUNDWATER EXTRACTION AND EX SITU TREATMENT O&M SUBTOTAL				**$5,094,900**
GROUNDWATER MONITORING ANNUAL COSTS				
For Years 1 and 2				
Laboratory Analyses (quarterly)	$9,405	Qrtly	4	$37,620
Quarterly Storage and Disposal	$12,257	Qrtly	4	$49,028
Labor	$18,736	Qrtly	4	$74,945
Expenses (PPE, Truck Rental, etc)	$6,620	Qrtly	4	$26,480
			Subtotal	$188,073
			Contingency (15%)	$28,200
			ANNUAL COSTS: Years 1-2	$216,000
			GROUNDWATER MONITORING (Years 1 and 2)	**$432,000**
For Years 3 through 30				
Laboratory Analyses (quarterly)	$9,405	Qrtly	4	$37,620
Labor	$18,736	Qrtly	4	$74,944
Expenses (PPE, Truck Rental, etc)	$6,620	Qrtly	4	$26,480
			Subtotal	$139,044
			Contingency (15%)	$20,900
			ANNUAL COSTS: Years 3-30	$160,000
			GROUNDWATER MONITORING (Years 3 through 30)	**$4,480,000**
GROUNDWATER MONITORING O&M (30YEARS)				**$4,912,000**

	CAPITAL COST	**$5,261,400**
	OPERATION AND MAINTENANCE COSTS	**$10,006,900**
	TOTAL PROJECT COST	**$15,268,000**
7% Discount rate	**PRESENT NET VALUE**	**$8,770,000**

Assumptions:

Groundwater Extraction and Ex Situ Treatment- Installation

1. Two extraction wells each at Waterbore, C-Complex, and New Burn (six total with one being new)
2. Four extraction wells downgradient of existing monitoring well MW-1, to control groundwater contamination (3 new wells).
3. An injection well field northeast of Waterbore consisting of five injection wells (3 new wells).
4. Groundwater extraction well costs are based on 400 ft deep with 150 ft screens.
5. Groundwater injection well costs are based on 400 ft deep with 300 ft screens.
6. An APTWater ARoPer Reactor will be used for ex situ treatment, capital costs include control panel, booster pumps, plumbing, valves, and controls to operate system, set of basins with hollow fiber modules and aeration, onsite hydrogen supply system, re-aeration system to replenish dissolved oxygen that is removed along with perchlorate, and hydrogen detector and safety gear.

Groundwater Extraction and Ex Situ Treatment- O&M (30 years)

1. Duration of groundwater extraction and ex situ treatment is 30 years.
2. APTWater ARoPer Reactor O&M includes power and consumables.

Groundwater Monitoring

1. Duration of Groundwater Sampling is 30 years at 33 wells.
2. Purge water will be transported and disposed off-site during first years prior to system installation.
3. Purge water will be treated along with extracted water and reinjected during 30 years of system operation.
4. Parameters to be analyzed include VOCs, 1,4-dioxane, perchlorate and RCRA metals.