APPENDIX A

Field Explorations

This appendix documents the processes Hart Crowser used to determine the nature (and quality) of the soil and groundwater underlying the project site addressed by this report. The discussion includes information on the following subjects.

- Explorations and Their Locations
- Hollow-Stem Auger Borings
- Standard Penetration Test (SPT) Procedures

Explorations and Their Locations

Observed subsurface explorations for this project included borings HC-1 through HC-2. The exploration logs in this appendix show our interpretation of the explorations, sampling, and testing data. The logs indicate the depths where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 Key to Exploration Logs. This key also provides a legend explaining the symbols and abbreviations used in the exploration logs.

Figure 2 of the report shows the locations of explorations as determined by Hart Crowser field staff, based on approximate distances from existing mapped objects.

Hollow Stem Auger Borings

Two borings designated HC-1 and HC-2 were drilled between July 2 and 30, 2019, using an 8-inch-diameter hollow stem auger and NQ rock coring tools advanced with a truck-mounted drill rig subcontracted by Hart Crowser. The drilling was continuously observed by a geologic staff member from Hart Crowser and detailed field logs of the borings were prepared.

Standard Penetration Test (SPT) Procedures

Using an SPT sampler, we obtained soil samples in 2.5-foot sampling intervals from depths of 5 to 10 feet bgs and at 5-foot sampling intervals below that depth. The SPT test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT (as described in American Society for Testing and Materials [ASTM] D 1586) was used to obtain disturbed samples. This test employs a standard 2-inch outside-diameter split-spoon sampler. Using a 140-pound manual hammer, free-falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths.

Soil samples were recovered from the split-barrel samplers, field classified, and placed into watertight bags. They were then taken to our soils laboratory for further testing. Laboratory test results are included on the boring logs.

Sample Description

Identification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. ASTM D 2488 visual-manual identification methods were used as a guide. Where laboratory testing confirmed visual-manual identifications, then ASTM D 2487 was used to classify the soils.

Relative Density/Consistency

Soil density/consistency in borings is related primarily to the standard penetration resistance (N). Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Relative Density	N (Blows/Foot)	SILT or CLAY Consistency	N (Blows/Foot)
Very loose	0 to 4	Very soft	0 to 1
Loose	5 to 10	Soft	2 to 4
Medium dense	11 to 30	Medium stiff	5 to 8
Dense	31 to 50	Stiff	9 to 15
Very dense	>50	Very stiff	16 to 30
		Hard	>30

Moisture

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

USCS Soil Classification Chart (ASTM D 2487)

Major Divisions			Symbols: Graph	Symbols: USCS	Typical Descriptions
Coarse Grained Soils: More than 50% of Material Retained on No. 200 Sieve	Gravel and Gravelly Soils: More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels (<5% fines)		GW	Well-Graded Gravel; Well-Graded Gravel with Sand
				GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Gravels (5-12% fines)		GW-GM	Well-Graded Gravel with Silt; Well-Graded Gravel with Silt and Sand
				GW-GC	Well-Graded Gravel with Clay; Well-Graded Gravel with Clay and Sand
				GP-GM	Poorly Graded Gravel with Silt; Poorly Graded Gravel with Silt and Sand
				GP-GC	Poorly Graded Gravel with Clay; Poorly Graded Gravel with Clay and Sand
		Gravels with Fines (>12% fines)		GM	Silty Gravel; Silty Gravel with Sand
				GC	Clayey Gravel; Clayey Gravel with Sand
	Sand and Sandy Soils: More than 50% of Coarse Fraction Passing No. 4 Sieve	Sands with few Fines (<5% fines)		SW	Well-Graded Sand; Well-Graded Sand with Gravel
				SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Sands (5-12% fines)		SW-SM	Well-Graded Sand with Silt Well-Graded Sand with Silt and Gravel
				SW-SC	Well-Graded Sand with Clay; Well-Graded Sand with Clay and Gravel
				SP-SM	Poorly Graded Sand with Silt; Poorly Graded Sand with Silt and Gravel
				SP-SC	Poorly Graded Sand with Clay; Poorly Graded Sand with Clay and Gravel
		Sands with Fines (>12% fines)		SM	Silty Sand; Silty Sand with Gravel
				SC	Clayey Sand; Clayey Sand with Gravel
Fine Grained Soils: More than 50% of Material Passing No. 200 Sieve	Silts			ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
				MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
	Silty Clay (based on Atterberg Limits)			CL-ML	Silty Clay; Silty Clay with Sand or Gravel; Gravelly or Sandy Silty Clay
	Clays			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
				CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
	Organics			OL/OH	Organic Soil; Organic Soil with Sand or Gravel; Sandy or Gravelly Organic Soil
Highly Organic (>50% organic material)				PT	Peat - Decomposing Vegetation - Fibrous to Amorphous Texture

Minor Constituents

	Estimated Percentage
Sand, Gravel	
Trace	<5
Few	5 - 15
Cobbles, Boulders	
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45

Soil Test Symbols

%F	Percent Passing No. 200 Sieve
AL	Atterberg Limits (%)
	Liquid Limit (LL)
	Water Content (WC)
	Plastic Limit (PL)
CA	Chemical Analysis
CAUC	Consolidated Anisotropic Undrained Compression
CAUE	Consolidated Anisotropic Undrained Extension
CBR	California Bearing Ratio
CIDC	Consolidated Drained Isotropic Triaxial Compression
CIUC	Consolidated Isotropic Undrained Compression
CK0DC	Consolidated Drained k0 Triaxial Compression
CK0DSS	Consolidated k0 Undrained Direct Simple Shear
CK0UC	Consolidated k0 Undrained Compression
CK0UE	Consolidated k0 Undrained Extension
CRSCN	Constant Rate of Strain Consolidation
DSS	Direct Simple Shear
DT	In Situ Density
GS	Grain Size Classification
HYD	Hydrometer
ILCN	Incremental Load Consolidation
K0CN	k0 Consolidation
kc	Constant Head Permeability
kf	Falling Head Permeability
MD	Moisture Density Relationship
OC	Organic Content
OT	Tests by Others
P	Pressuremeter
PID	Photoionization Detector Reading
PP	Pocket Penetrometer
SG	Specific Gravity
TRS	Torsional Ring Shear
TV	Torvane
UC	Unconfined Compression
UUC	Unconsolidated Undrained Triaxial Compression
VS	Vane Shear
WC	Water Content (%)

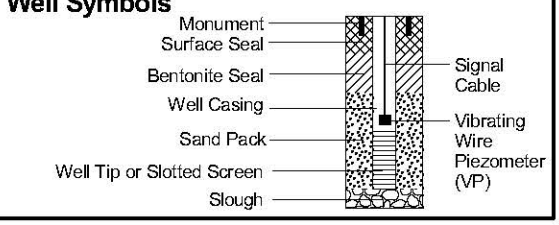
Groundwater Indicators

- Groundwater Level on Date or At Time of Drilling (ATD)
- Groundwater Level on Date Measured in Piezometer
- Groundwater Seepage (Test Pits)

Sample Symbols

- 1.5" I.D. Split Spoon
- 3.25" O.D. Split Spoon
- Modified California Sampler
- Rock Core Run
- Sonic Core
- Thin-walled Sampler
- Grab
- Cuttings
- Push Probe

Well Symbols



Rock Descriptions

	BASALT		FINGER CORAL
	BOULDERS		LIMESTONE
	BRECCIA		SANDSTONE
	CLINKER		SILTSTONE
	COBBLES		TUFF
	CORAL		VOID/CAVITY

Rock Fracture Characteristics

Term	Description
Massive	Greater than 24 inches apart
Slightly Fractured	12 to 24 inches apart
Moderately Fractured	6 to 12 inches apart
Closely Fractured	3 to 6 inches apart
Severely Fractured	Less than 3 inches apart

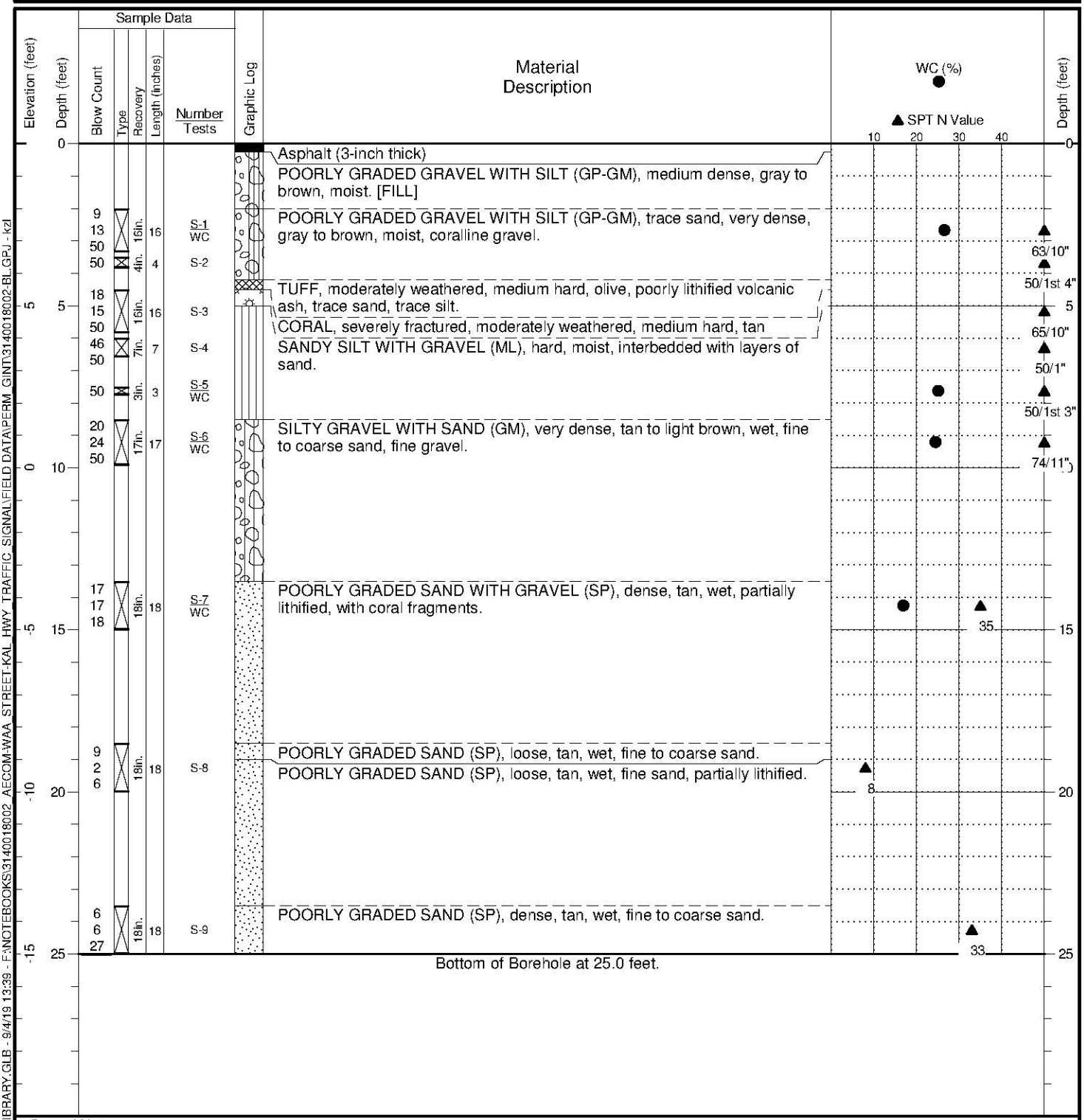
Scale of Relative Rock Weathering

Term	Description
Unweathered	Rock shows no sign of discoloration or loss of strength.
Slightly Weathered	Slight discoloration inwards from open fractures.
Moderately Weathered	Discoloration throughout and noticeably weakened though not able to break by hand.
Highly Weathered	Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.
Extremely Weathered	Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

Scale of Relative Rock Hardness

Term	Field Identification
Very Soft	Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure. Example: Saprolite
Soft	Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot. Example: Weathered rock, chalk-like coral reef
Medium Hard	Can be broken by one hammer blow. Cannot be scrape by knife. SPT may penetrate by ~25 blows per inch with bounce. Example: Porous rock such as clinker, cinder, and coral reef
Hard	Breaks with some difficulty after several hammer blows. Example: Vesicular, vugular, coarse-grained rock
Very Hard	Breaks with difficulty after several "pinging" hammer blows. Example: Dense, fine grain volcanic rock

Date Started: 7/2/19	Date Completed: 7/30/19	Drilling Contractor/Crew: Valley Well Drilling, LLC / Steve & Drew	
Logged by: S. Ueno	Checked by: J. Jacobe	Drilling Method: Hollow Stem Auger	
Location: Lat: 21.276178 Long: -157.763959 (WGS 84)		Rig Model/Type: Mobile B-57 / Track-mounted drill rig	
Ground Surface Elevation: 10 feet (NAVD 88)		Hammer Type:	
Comments:		Hammer Weight (pounds): 140	Hammer Drop Height (inches): 30
		Measured Hammer Efficiency (%): NA	
		Hole Diameter:	Casing Diameter: NA
		Total Depth: 25 feet	Depth to Groundwater: Not Identified



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER	Project: Waa Street Kal Hwy Traffic Signal Location: Project No.: 3140-018-002	Boring Log **HC-1**	Figure **A-2** Sheet **1 of 1**

Date Started: 7/30/19	Date Completed: 7/30/19	Drilling Contractor/Crew: Valley Well Drilling, LLC / Steve & Drew	
Logged by: S. Ueno	Checked by: J. Jacobe	Drilling Method: Hollow Stem Auger	
Location: Lat: 21.276218 Long: -157.763470 (WGS 84)		Rig Model/Type: Mobile B-57 / Track-mounted drill rig	
Ground Surface Elevation: 10 feet (NAVD 88)		Hammer Type:	
Comments:		Hammer Weight (pounds): 140	Hammer Drop Height (inches): 30
		Measured Hammer Efficiency (%): NA	
		Hole Diameter:	Casing Diameter: NA
		Total Depth: 18.5 feet	Depth to Groundwater: Not Identified

Elevation (feet)	Depth (feet)	Sample Data: Blow Count	Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description
	0							Asphalt (3-inch thick)
								Concrete (3-inch thick)
								Base aggregate (8-inch thick)
								POORLY GRADED GRAVEL (GP), tan, moist, coralline gravel and rubble.
	5							CORAL, severely fractured, moderately weathered, medium hard, tan.
0				6in.	60	S-1		POORLY GRADED SAND WITH GRAVEL (SP), tan, wet, fine to coarse sand, with coralline fragments.
								grades to fine sand
-5	10			6in.	60	S-2		
	15			7in.	48	S-3		
		4 10 50		13in.	18	S-4		POORLY GRADED GRAVEL WITH SILT (GP-GM), tan, wet, coralline gravel.
-10	20							Bottom of Borehole at 18.5 feet.
-15	25							

SPT N Value: 10, 20, 30, 40 — ▲ 60

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
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3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER	Project: Waa Street Kal Hwy Traffic Signal Location: Project No.: 3140-018-002	Boring Log **HC-2**	Figure **A-3** Sheet **1 of 1**