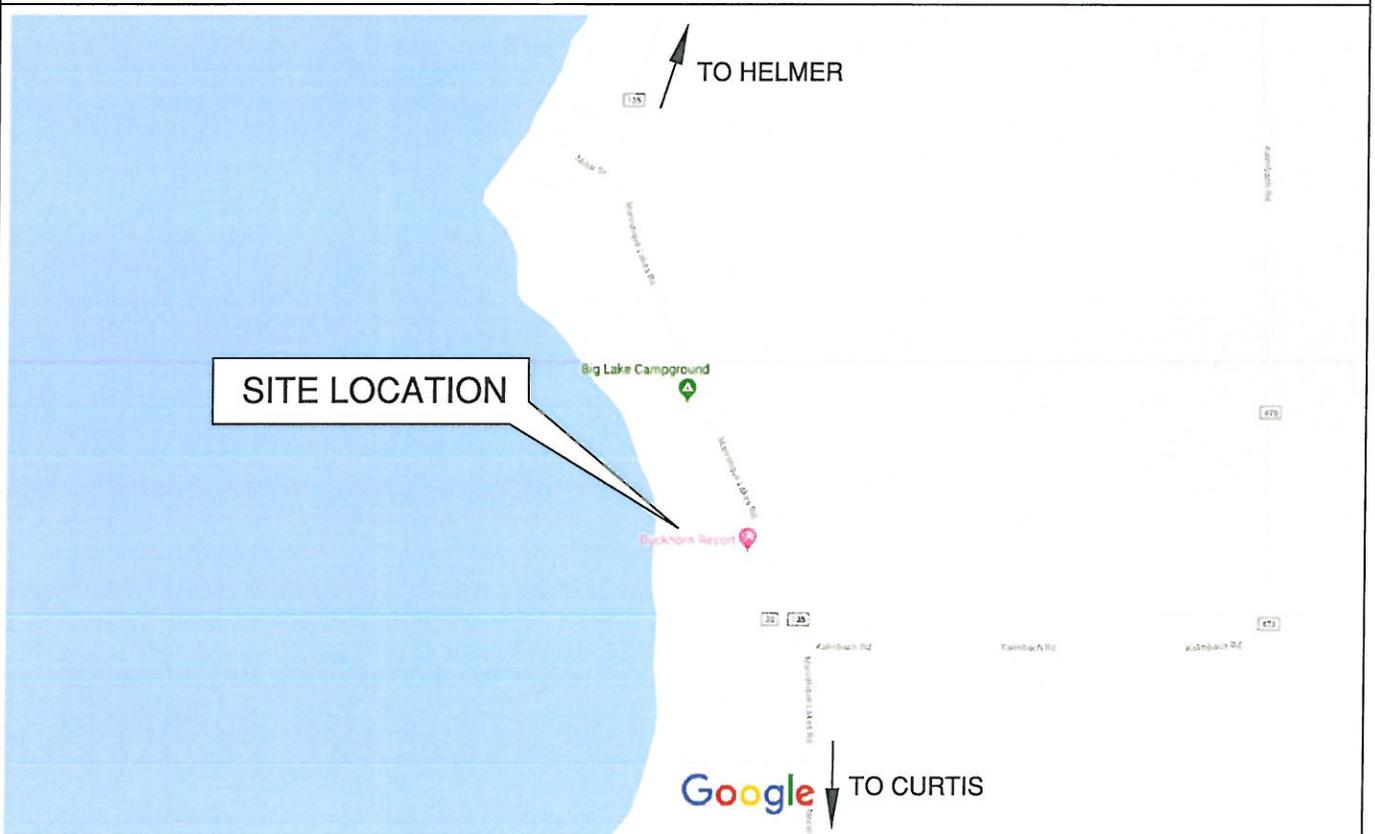
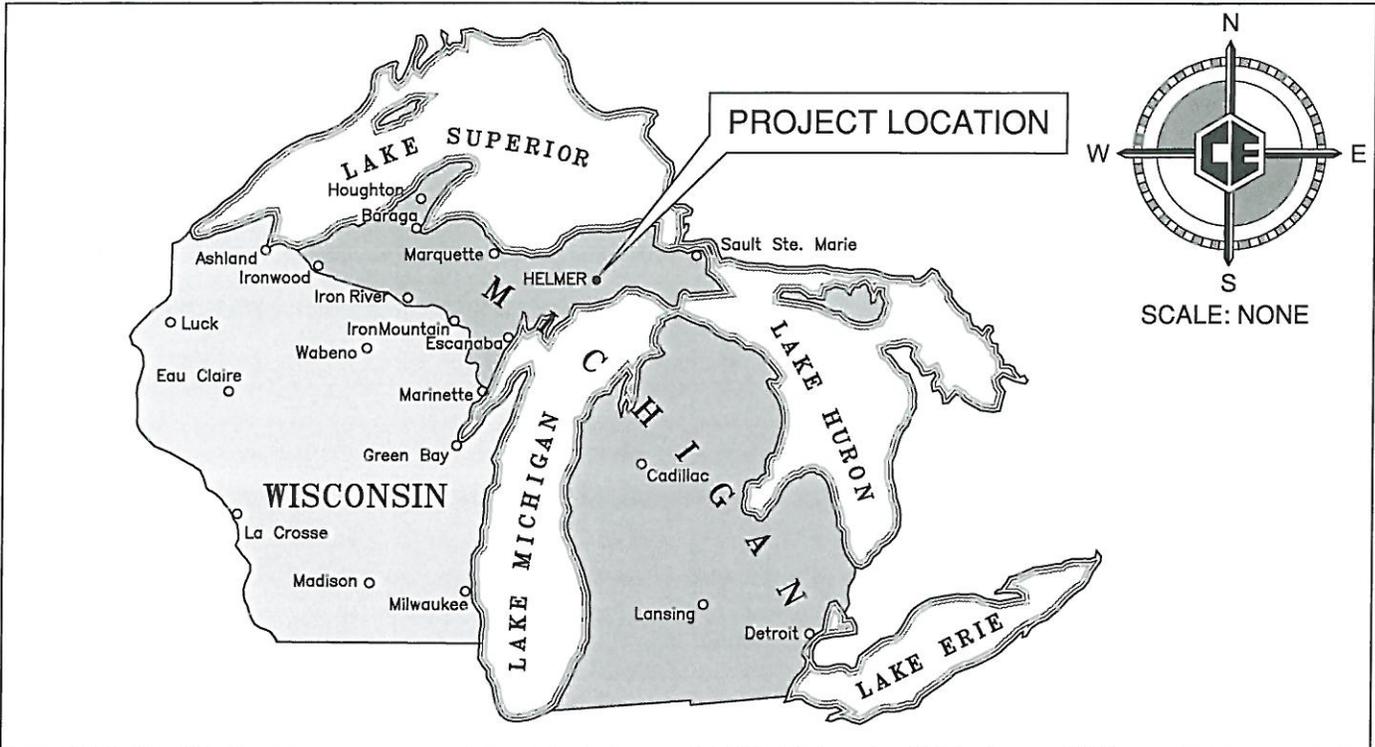


APPENDIX A

PROJECT LOCATION MAPS

- Project Location Map
- Boring Location Map



GOOGLE MAPS

PROJECT LOCATION MAP
SIDOCK GROUP
COUNTY LINE BOATING ACCESS SITE
LUCE COUNTY, MI

GRAPHIC SCALE
(IN FEET)

0 40 80

APPROXIMATE
SOIL BORING
LOCATION



GOOGLE EARTH

SOIL BORING LOCATION MAP
SIDOCK GROUP
COUNTY LINE BOATING ACCESS SITE
LUCE COUNTY, MI

DATE 10/22/2019
 JOB NO 190908
 CADD FILE 190908-BORELOC.DWG
 PDF FILE 190908-BORELOC.PDF

COLEMAN ENGINEERING COMPANY
 IRON MOUNTAIN • IRONWOOD • NEAUWEE • GREEN BAY
www.coleman-engineering.com

APPENDIX B

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
(UNIFIED SOIL CLASSIFICATION SYSTEM)

COLEMAN ENGINEERING COMPANY

635 Circle Drive
Iron Mountain, Michigan 49801

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D-2487 - 83
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F
			$Cu < 4$ and/or $1 > Cc > 3$ ^E	GP	Poorly graded gravel ^F
		Gravels with Fines more than 12 % fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F,G,H}
		Fines classify as CL or CH	GC	Clayey gravel ^{F,G,H}	
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I
Sands with Fines More than 12 % fines ^D		Fines classify as ML or MH	SM	Silty sand ^{G,H,I}	
		Fines classify as CL or CH	SC	Clayey sand ^{G,H,I}	
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Sils and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OL	Organic clay ^{K,L,M,N} Organic silt ^{K,L,M,O}
	Sils and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay ^{K,L,M}
			PI plots below "A" line	MH	Elastic silt ^{K,L,M}
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OH	Organic clay ^{K,L,M,P} Organic silt ^{K,L,M,Q}
	Highly organic soils	Primarily organic matter, dark in color, and organic odor		PT	Peat

^A Based on the material passing the 3-in. (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

^D Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

$$^E C_u = D_{60}/D_{10} \quad \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soils contains ≥ 15 % sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains ≥ 15 % gravel, add "with gravel" to group name.

^J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel", whichever is predominant.

^L If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.

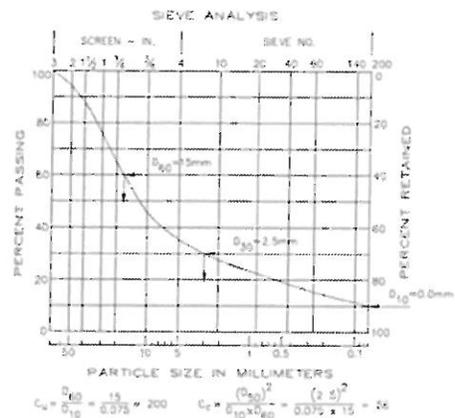
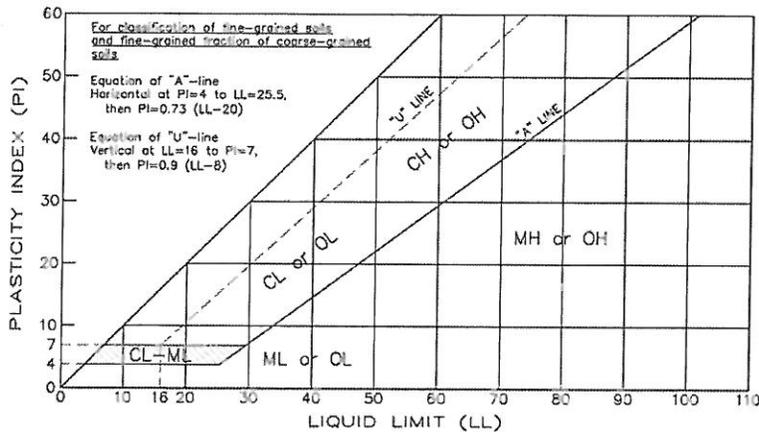
^M If soil contains ≥ 30 % plus No. 200, predominately gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



APPENDIX C

SOIL EXPLORATION-GENERAL NOTES AND LEGEND

SOIL EXPLORATION GENERAL NOTES AND LEGEND



COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE - IRON MOUNTAIN, MICHIGAN 49801 (906) 774-3440
200 EAST AYER STREET - IRONWOOD, MICHIGAN 49938 (906) 932-5048

DESCRIPTIVE SOIL CLASSIFICATION ASTM D2487 / 2488

GRAINSIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	3/4" to 3"	3/4" to 3"
Fine	4.75mm to 3/4"	#4 to 3/4"
Sand: Coarse	2.00mm to 4.75mm	#10 to #4
Medium	0.42mm to 2.00mm	#40 to #10
Fine	0.075mm to 0.42mm	#200 to #40
Silt	0.005mm to 0.075mm	Smaller than #200
Clay	Smaller than 0.005mm	Smaller than #200

GENERAL TERMINOLOGY

RELATIVE DENSITY

Physical Characteristics
Color, moisture, grain shape, fineness, etc.

Major Constituents
Clay, silt, sand, gravel

Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.

Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Term	"N" Value
Very Loose	0-4 BPF
Loose	5-10 BPF
Medium Dense	11-30 BPF
Dense	31-50 BPF
Very Dense	Over 50 BPF

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

CONSISTENCY

Proportional Terms	Defining Range By Percentages of Weight	Term	"N"-value	qa (tsf)
Trace	0%-5%	Very Soft	0-1 BPF	0.0 to 0.25
With	5%-12%	Soft	1-4 BPF	0.25 to 0.50
-Y	12%-50%	Medium	5-8 BPF	0.50 to 1.0
		Stiff	8-16 BPF	1.0 to 2.0
		Very Stiff	17-31 BPF	2.0 to 4.0
		Hard	Over 32 BPF	Over 4.0

ORGANIC CONTENT BY COMBUSTION METHOD

PLASTICITY

Soil Description	Loss on Ignition	Term	Plastic Index
Non-Organic	Less than 4%	None to Slight	0-4
Organic Silt / Clay	4% - 12%	Slight	5-7
Sedimentary Peat	12% - 50%	Medium	8-22
Fibrous and Woody Peat	More than 50%	High to Very High	Over 22

The penetration resistance, N-value, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler or blows per foot (BPF). The sampler is typically driven 18" with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test. When driven 24" the "N" is the sum of the blow of the second and third 6" increment.

SYMBOLS DRILLING AND SAMPLING

RB	Roller Bit
RC	Rock Coring
RQD	Rock Quality Designator
CW	Clear Water
DM	Drilling Mud
HSA	Hollow Stem Auger
SSA	Solid Stem Auger
HA	Hand Auger
SPT	Standard Penetration Test
2SS	2" Diameter Split-Barrel Sample
3SS	3" Diameter Split-Barrel Sample
2ST	2" Diameter Shelby Tube Sample
3ST	3" Diameter Shelby Tube Sample
PS	3" Diameter Piston Tube Sample
AS	Auger Sample
WS	Wash Sample
NR	No Recovery
VS	Vane Shear Test
T	Torvane Shear Test
BS	Bag Sample
GS	Grab Sample
q _a	Penetrometer Reading, tsf
q _u	Unconfined Strength, tsf

LABORATORY TEST

W	Moisture Content, %
LL	Liquid Limit, %
PL	Plastic Limit, %
SL	Shrinkage Limit, %
LI	Loss on Ignition, %
DD	Dry Density, psf

WATER LEVEL MEASUREMENT

▽	Water Level During Drilling
▽	Water Level After Drilling
▽	Water Level at Time Shown 1
▽	Water Level at Time Shown 2
▽	Water Level at Time Shown 3
▽	Water Level at Time Shown 4
NW	No Water Encountered
BCR	Before Casing Removal
ACR	After Casing Removal

NOTE: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

APPENDIX D

BORING LOGS



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 190908.GPJ

PROJECT: County Line Boating Access Site - Big Manistique Lake BORING NO.: B-1
 CLIENT: Sidock Group 1 OF 1
 BORING LOCATION: 46.247220859° N., -85.721543411° W. - See soil boring location drawing ELEV.: _____
 RIG TYPE: Geoprobe 7822 DT DRILL CREW: J. Lantagne
 DRILLING METHOD: 3-1/4" Hollow Stem Auger BORING DEPTH: 11.5
 DATE STARTED: 10/10/19 DATE COMPLETED: 10/10/19 REVIEWED BY: D. Edlebeck DATE: 10/22/19
 HOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4 -200	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf) q _u (tsf)	
1	12-8-5 (13)	1.0	0	AGGREGATE BASE COURSE - 12"			3-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
			1	(SP) POORLY GRADED SAND, light grayish brown, fine, loose	1.0'									
2	5-3-2 (5)	1.0	2	...wet at 2.5'			Driller's note: Samples wet 2.5' to 11.5'							
			3											
			4	(Glacial Outwash) ± 4.5'										
3	1-2-3 (5)	1.5	5	(CL) SANDY LEAN CLAY, light grayish brown, trace gravel, wet, medium stiff										3/4
			6											
			7											
4	1-1-4 (5)	1.5	8											
			9	(Glacial Outwash) ± 9.5'										
5	5-7-8 (15)	1.5	10	(SM) SILTY SAND, light grayish brown, fine, wet, medium dense										
			11	(Glacial Outwash) 11.5'										
			12	End of Boring										
			13											
			14											
			15											
			16											
			17											
			18											
			19											
			20											

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube

while drilling 2.5
 after drilling
 after hours

BORING NO.:
B-1



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 190908.GPJ

PROJECT: County Line Boating Access Site - Big Manistique Lake BORING NO.: B-2

CLIENT: Sidock Group 1 OF 1

BORING LOCATION: 46.247052094° N., -85.721321416° W. - See soil boring location drawing ELEV.: _____

RIG TYPE: Geoprobe 7822 DT DRILL CREW: J. Lantagne

DRILLING METHOD: 3-1/4" Hollow Stem Auger BORING DEPTH: 16.5

DATE STARTED: 10/10/19 DATE COMPLETED: 10/10/19 REVIEWED BY: D. Edlebeck DATE: 10/22/19

HOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS							
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4 -200	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf) q _u (tsf)		
1	12-8-3 (11)	1.0	0	AGGREGATE BASE COURSE - 8"			3-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer								
			1	(FILL) SAND, brown, fine to medium, with silt, moist		0.67'									
			2			± 2.5'									
2	1-3-4 (7)	0.3	3	(SP) POORLY GRADED SAND, light grayish brown, fine to medium, with a 3" inclusion of black amorphous peat at ± 2.5', wet, loose											
			4	(Glacial Outwash)		± 4.5'									
3	1-1-2 (3)	1.0	5	(CL) SANDY LEAN CLAY, light grayish brown, with gravel, wet, soft			Driller's note: Samples wet 4.0' to 16.5'								1/2
			6												
			7												
4	1/1'-1 (-)	1.5	8	...very soft											1/4
			9												
			10	...soft											1/2
			11												
			12												
			13												
			14												
6	2-3-5 (8)	1.5	15	...lean clay, light brown, trace sand, trace fine gravel, medium stiff											
			16	(Glacial Outwash)		16.5'									
			17	End of Boring											
			18												
			19												
			20												

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube

while drilling after hours

after drilling 4.0

BORING NO.:
B-2



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 190908.GPJ

PROJECT: County Line Boating Access Site - Big Manistique Lake

BORING NO.: B-3

CLIENT: Sidock Group

1 OF 1

BORING LOCATION: 46.247175861° N., -85.720897950° W. - See soil boring location drawing

ELEV.: _____

RIG TYPE: Geoprobe 7822 DT

DRILL CREW: J. Lantagne

DRILLING METHOD: 3-1/4" Hollow Stem Auger

BORING DEPTH: 11.5

DATE STARTED: 10/10/19

DATE COMPLETED: 10/10/19

REVIEWED BY: D. Edlebeck

DATE: 10/22/19

HOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	q _u (tsf)
1	15-6-5 (11)	1.2	0	AGGREGATE BASE COURSE - 6"			3-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
			1	(FILL) SILTY SAND, brown, fine, moist	0.5'									
2	1-2-4 (6)	0.8	3	(PT) PEAT, black, amorphous, with sand, trace fine gravel, moist, loose			Driller's note: Samples wet 4.5' to 11.5'							
			4	...wet at 4.5'	± 2.5'									
3	5-7-8 (15)	1.5	5	(Swamp Deposits)			Driller's note: Samples wet 4.5' to 11.5'							
			6	(SP) POORLY GRADED SAND, strong brown, fine to medium, wet, medium dense	± 5.5'									
4	3-5-6 (11)	1.0	8				Driller's note: Samples wet 4.5' to 11.5'							
			9											
5	7-7-8 (15)	1.0	10				Driller's note: Samples wet 4.5' to 11.5'							
			11	(Glacial Outwash)	11.5'									
			12	End of Boring										
			13											
			14											
			15											
			16											
			17											
			18											
			19											
			20											

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube

while drilling 4.5
 after drilling

after hours

BORING NO.:
 B-3



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 190908.GPJ

PROJECT: County Line Boating Access Site - Big Manistique Lake BORING NO.: B-4
 CLIENT: Sidock Group 1 OF 1
 BORING LOCATION: 46.247248993° N., -85.719463430° W. - See soil boring location drawing ELEV.: _____
 RIG TYPE: Geoprobe 7822 DT DRILL CREW: J. Lantagne
 DRILLING METHOD: 3-1/4" Hollow Stem Auger BORING DEPTH: 11.5
 DATE STARTED: 10/10/19 DATE COMPLETED: 10/10/19 REVIEWED BY: D. Edlebeck DATE: 10/22/19
 HOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS							
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4	-4	MOISTURE CONTENT (%)	LL	PL	T (tsf)	q _a (tsf)
1	2-3-2 (5)	1.0	0	TOPSOIL - 8"			3-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer								
			1	(ML) SANDY SILT, dark brown, moist	0.67'										
2	2-2-5 (7)	1.0	3	...light grayish brown, with a 1" lens of reddish brown, clay, moist, loose											
			4	(Glacial Outwash)	± 4.5'										
3	7-9-10 (19)	1.0	5	(SM) SILTY SAND, light brown, fine, moist, medium dense											
			6												
			7												
4	7-7-9 (16)	1.0	8												
			9	(Glacial Outwash)	± 9.5'										
5	7-8-9 (17)	1.2	10	(SP) POORLY GRADED SAND, light brown, fine, moist, medium dense											
			11	(Glacial Outwash)	11.5'										
			12	End of Boring											
			13												
			14												
			15												
			16												
			17												
			18												
			19												
			20												

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube

while drilling after drilling

after hours

BORING NO.:
B-4

Submittal Log

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
- 2. Demolition and removal of selected site elements.
- 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 1. Before selective demolition, Contractor shall remove and load vault toilet structure (concrete floor and up) on Owner provided truck or trailer.
- B. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
- D. Storage or sale of removed items or materials on-site is not permitted.

1.6 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations. Coordinate with Owner on date available to transport vault toilet structure.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

3.2 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.7 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: Vault
- B. Remove and Salvage: Toilet Structure.
- C. Remove and Reinstall: Signage.
- D. Existing to Remain: N/A
- E. Dismantle: N/A

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- C. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.4 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150, Type I, Type II, or Type III, gray.
 - 2. Fly Ash: ASTM C 618, Class F or C.
 - 3. Slag Cement: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C 33, Class 4S, coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
- F. Water: ASTM C 94 and potable.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Slag Cement: 15 percent.
 - 4. Combined Fly Ash or Pozzolan and Slag Cement: 75 percent portland cement minimum, with fly ash or pozzolan not exceeding 20 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.8 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Slabs-on-Grade: Normal-weight concrete.
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.45.
 - 3. Minimum Cementitious Materials Content: 520 lb/cu. yd.
 - 4. Slump Limit: 5 inches, plus or minus 1 inch.
 - 5. Air Content: 5 percent, plus or minus 1.0 percent at point of delivery for 1-inch nominal maximum aggregate size.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F , reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.6 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.7 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 1. Verification of use of required design mixture.
 2. Concrete placement, including conveying and depositing.
 3. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd, plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and two specimens at 28 days.
 - a. Should the average strength of the two specimens be below the design strength a third specimen shall be tested. If average is still below the design strength the final specimen shall be tested.
 7. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer..
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description and dimensions of luminaire.
 - 3. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 4. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - 5. Photoelectric relays.

6. Solar Panels.
7. Storage Battery(s).
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays.

1. Provide a technical manual describing system features and specifications.
2. Provide a complete installation manual with parts lists, assembly instructions, wiring diagrams, testing instructions, and troubleshooting guide.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 2 year(s) from date of Substantial Completion.
 - a. Solar Panel Assembly – 10 years.
 - b. Battery Assembly – 2 year full; pro-rated to 7 years.
 - c. Control Electronics – 5 years.

- d. Light Fixture – 5 years.
- e. LED's – 10 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 SOLAR PANEL ASSEMBLY

- A. Solar panel(s) shall be of single crystal technology, with power output of the solar panel degradation less than 10% for 10 years and less than 20% over 25 years.
- B. It shall be sized to operate the specified lighting system from dusk for an additional 6 plus hours, year round, with a minimum overcharge of 25% at the tilt angle of 45 Degrees.
- C. All panel(s) within the array shall be mechanically bonded together to form a single flat array which shall be capable of being mounted at a fixed angle of 45, 15, or 5 Degrees.
- D. The solar array shall be constructed such that one panel may be removed and replaced without the need of removing adjacent panels.

2.3 BATTERY ASSEMBLY

- A. The storage battery(s) shall be of a sealed valve regulated thixotropic gel lead acid type. It shall be pressurized through the use of bunsen type vents, maintenance free, air shippable, 100% recyclable, and capable of a minimum of 1500 cycles in this application.
- B. The battery(s) shall be of a capacity capable of operating the specified fixture for a minimum of 12 nights of operation through inclement weather, using a 10% of average for the sun factor.
- C. The battery shall be mounted in a vented aluminum box constructed of .090 aluminum sheet and of a high quality marine grade to a minimum temper of 5052-H32. The battery box shall be vented in at least eight locations using a minimum 3" machine punch vent placed in such a fashion as to allow cooling air to circulate through the battery box and to minimize rain water intrusion. The storage battery shall be mounted in the shade behind the solar panel assembly and separated from the panel assembly so that the battery will not be in thermal communication with the solar panels. The battery box shall contain a preformed and welded back mounting plate for easy attachment to the pole. The Battery Assembly shall contain a "Through the Pole" rear wire routing output for no exposed wiring to provide a neat clean appearance for the

finished installation. All metal crafting shall be performed by high speed robotic presses using computer programmed instructions. Lockable hinged door. Battery box can mount anywhere on the pole. Aluminum hinged keyed lockable door for ease of access to batteries.

- D. The batteries shall be field replaceable through the use of an internal wiring harness which shall be of 12 Gauge THHN wire. The harness shall terminate in a weather proof electrical connector used to disconnect the solar power assembly from the controller and the controller from the battery. The harness shall be equipped with a fuse located in a waterproof fuse holder with a positive sealing cover. The battery assembly shall contain a spare fuse. The electrical connectors on the harness shall consist of copper bladed terminals that are crimped and soldered to the wires. These copper bladed terminals shall use positive contact spring pressure and a minimum of 75% surface contact area with the mating terminal. The connector shall have a captive device to mechanically lock connector to mating plug.
- E. The battery shall be designed for 7 years of operation.

2.4 CONTROL ELECTRONICS

- A. The entire charge and load control electronics shall be housed in an ABS case which is totally encapsulated with a U.L. approved polymer epoxy for protection from weather, which shall render the control electronics as waterproof to the point whereby it actually can be used underwater. No exposed circuit boards, even with conjugal coating will be allowed. Each of four input leads shall be lightning protected and the controller shall be equipped with a four prong blade type plug with captive mechanical locking mechanism to provide for quick disconnect to facilitate installation and service.
- B. The charge controller shall have a minimum current rating of 10 amps and the current from the solar panel shall be controlled in a 3-Stage, PWM Pulse Width Modulation fashion to charge the Gel battery to a float of 14.1 VDC. The series charge shall not be allowed to resume unless the battery voltage falls below 13.4 VDC. The charge shall not connect unless the solar panel can actually charge the battery with a current of at least 200ma. The charge condition shall be indicated by a Green micro L.E.D. and there shall also be an L.E.D. of Red to indicate a divert or OFF charge condition. At no time shall the charge control use more than 3 ma. of power from the battery during the charge process and the controller shall not represent more than .003 Ohms of resistance in the charge path.
- C. The load function shall use the output of the solar panel to determine when dusk will turn the fixture "ON" and when dawn will turn the fixture "OFF". This is to eliminate any photo-cell operation to insure proper performance even when other types of natural or ambient light are present. There shall be a Green micro L.E.D. to indicate a load "ON" condition.
- D. As the load is functioning during the dark hours, the battery voltage will be monitored by the ALC12 controller. If at any time during the load cycle the battery voltage falls below 10.85 VDC the fixture will switch off. This prolongs battery life by turning "OFF" power from the batteries to the fixture when the end of the storage capacity is reached, usually after 12 nights of Autonomy operation during inclement weather.
- E. The control shall be entirely solid state and constructed with no relays, blocking diodes, or wire crimp/screw terminal connectors. The entire control shall be sealed as indicative of its ability to

operate completely submerged in salt water. The entire charge electronics shall be life cycle tested to over 15 years of operation.

2.5 LIGHT FIXTURE

- A. **Bezel Optical System:** Each luminaire is supplied with a one piece optical cartridge system consisting of an LED engine, LED lamps, optics, gasket and stainless steel bezel. The cartridge shall be held together with internal brass standoffs soldered to the board so that it can be field replaced as a one piece optical system. Two-piece silicone and microcellular polyurethane foam gasket to ensure a weather-proof seal around each individual LED. The optical cartridge is to be secured to the die cast housing with fasteners. The optics shall be held in place without the use of adhesives. The cartridge assembly is available in various lighting distributions using TIR designed acrylic optical lenses over each LED.
- B. **Printed Circuit Board (PCB):** Aluminum thermal clad board with 0.062” thick aluminum base layer, thermally conductive dielectric layer, 0.0014” thick copper circuit layer circuit layer designed with copper pours to minimize thermal impedance across dielectric. Board will be mounted to the heat sink using minimum 12 #4-40 screws to ensure contact with thermal pad and heat sink. Use of thermal grease will not be allowed.
- C. **Housing and LED Thermal Management:** The fixture shall have a monolithic housing design to create over 4.5 square feet. Vertical fins, combined with flow-thru openings to prevent sediment and moisture buildup on critical heat sinking surfaces without the need for grates, screens or other debris control tactics. The fixture housing, electrical compartment and fitter are to be made from die cast aluminum that is pre-treated and powder-coated to meet the most rugged industry standards. The finish is to be corrosion resistant to meet ASTM-B-117, resist cracking or loss of adhesion per ASTM D522, and resist surface impacts of up to 160 inch-pound. All external hardware to be corrosion resistant. The housing serves as a heat-sink for the LED bezel with a separate compartment for the drivers
- D. **Accessibility:** The luminaire shall be designed to provide accessibility in its design. The Drivers shall be mounted on a removable door that is secured with keyslotted screws that hinge down for access. The drivers are to be field replaceable using quick disconnects.
- E. **Fasteners:** All fasteners shall be stainless steel. When tamper resistant fasteners are required, spanner HD (snake eye) style shall be provided.
- F. **The lumen output of the LED array shall be that which is the emitted quantity operable from a current and voltage controlled regulated circuit. The LED fixture shall exhibit the same full lumen intensity throughout 9 hours of the night and shall be allowed to reduce intensity 60% after 7 hours of full intensity, then resume full intensity 2 hours pre-dawn.**
- G. **The LED Array shall be installed into a commercial night sky compliant Roadway fixture in such a manner as to allow the LED’s focal pattern to be a type 2 distribution for spreading the light out in a long even pattern best suited to Roadway Lighting/path lighting.**
- H. **The fixture(s) shall be capable of mechanical attachment to a horizontal section having a minimum diameter of 2-3/8” to allow fixture(s) to attach to a utility standard fixture bracket.**

- I. Fixture calculated L70 rating shall be 317,000 hours. Fixture to have 115 Lumens per Watt average.

2.6 POWER BRACKET

- A. The solar panel assembly and battery assembly with lighting controller shall be mounted upon an aluminum power bracket constructed of T6063 Tempered extrusions. The bracket shall consist of a substantial vertical aluminum channel with like channels horizontally oriented at the distal ends of the substantial channel. The double support bracket shall be capable of attachment to any pole or wall with a section of 4" or greater. The horizontal substantial channel members shall have a single triangular disposed aluminum pipe section. This section shall be circumference welded in six places and formed in such a manner that the power bracket can be installed to allow the solar panel assembly to be a fixed mount of 5, or 45 degrees of tilt. The power bracket shall be of sufficient strength for the solar panel and battery to withstand 150 MPH winds. All associated hardware shall be of stainless steel.

2.7 SYSTEM REQUIREMENTS

- A. The system shall be a mass-produced, standard system of a type which has been in production for a minimum of 20 years. The material requirements shall include complete installation instructions, fixture photometry reports in .IES format, a complete testing procedure and operating instructions pamphlet including troubleshooting instructions and replacement parts list and information on how to replace each individual component in the system.

2.8 MOUNTING POLE

- A. The mounting pole shall be a 20' tall brushed aluminum tapered anchor base pole. It shall be 2013 AASHTO rated for weight and EPA of the solar power system and fixture with bracket for the location area for 90MPH winds with design life of 50 years.
- B. Pole shall be constructed of 0.156 inch thick wall of aluminum alloy 6063-T6 with internal dampers with a nominal diameter of 6 inches at the base and 4.5 inches at the top.
- C. Access hole shall be located at the base of the pole for attachment of ground wire. It shall include a removable cover and stainless steel hardware.
- D. Galvanized anchor bolts with double flat washers, double hex nuts, and caps for each for the base of the pole shall be included. Template for anchor bolt pattern to be provided.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- G. Coordinate layout and installation of luminaires with other construction.
- H. Ground in accordance with requirements of local codes and manufacturers recommendation.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Stripping and stockpiling aggregate base.
 - 6. Removing above- and below-grade site improvements.
 - 7. Disconnecting, capping or sealing, and removing or abandoning site utilities in place.
 - 8. Temporary erosion and sedimentation control.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- C. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises. Assist Owner in loading salvaged items indicated to be removed from premises by Owner.
- C. Utility Locator Service: Notify One Call for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified.
- C. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 1. Arrange with utility companies to shut off indicated utilities.

- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
- C. Excavate for and remove underground utilities indicated to be removed.
- D. Removal of underground utilities is included in earthwork sections, Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below proposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove or till sod and grass before stripping topsoil.
- B. Strip topsoil to depth as required and in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 8 feet.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK/AGGREGATES

- A. Remove from area indicated on Drawings without intermixing with other materials.
 - 1. Limit height of stockpiles to 12 feet.
 - 2. Do not stockpile within protection zones.
 - 3. Dispose of surplus and contaminated aggregates. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused. Contaminated aggregates are those that no longer meet the gradation requirements for MDOT 22A or 21AA.

3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil and aggregate, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Subbase course for concrete walks.
5. Subbase course and base course for asphalt paving.
6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
4. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
5. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each imported soil material proposed for fill and backfill as follows to verify conformance with specifications:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 1557.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify utility locator service, "One Call" for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.
- E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- F. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.

- 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
 - H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, SW, SP, and according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GM, GC, SM, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-inch sieve and not more than 7 percent passing a No. 200 sieve. (Modified MDOT Class II)
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294; with 100 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve. (MDOT 22A or 21AA)
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 2-inch sieve and not more than 5 percent passing a No. 200 sieve. (MDOT Class I)
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. (Modified MDOT Class II)
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve. (MDOT Class 6A)
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve. (MDOT 17A is Acceptable)
- J. Sand: ASTM C 33; fine aggregate.

- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile (Mirafi 160N): Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: As follows:
 - a. Grab Tensile Strength: 160 lbf; ASTM D 4632.
 - b. Grab Tensile Elongation: 50%; ASTM D 4632
 - c. Trapezoid Tear Strength: 60 lbf; ASTM D 4533.
 - d. CBR Puncture Strength: 410 lbf; ASTM D 6241.
 - 2. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 1.5 per second, minimum; ASTM D 4491.
 - 4. Flow Rate: 110 gal/min/ft²; ASTM 4491
 - 5. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile (Mirafi 600X): Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: As follows:
 - a. Grab Tensile Strength: 315 lbf; ASTM D 4632.
 - b. Grab Tensile Elongation: 15%; ASTM D4632
 - c. Trapezoid Tear Strength: 120 lbs; ASTM D4533
 - d. CBR Puncture Strength: 900 lbf; ASTM 6241
 - 2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 0.05 per second, minimum; ASTM D 4491.
 - 4. Flow Rate: 4 gal/min/ft²; ATMD 4491
 - 5. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 9 inches each side of pipe or conduit.

- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

- D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.

- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

- D. Maintain ground water a minimum of 18 inches below vibratory compaction equipment as well as 12 inches below the bottom of all excavations.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1/2 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified geotechnical engineering testing agency to perform tests and inspections.

- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1500 sq. ft. 12 inches or less of paved area or building slab but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 250 feet or less of trench length but no fewer than two tests.
 - 4. Hot Mix Asphalt: One test per lift per 500 syd.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000