New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D, 12th Floor
625 Broadway, Albany, New York 12233-7013
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Joe Martens
Commissioner

May 14, 2013

Mr. John P. McAuliffe, P.E.
Program Director, Syracuse
Honeywell
301 Plainfield Road, Suite 330
Syracuse, NY 13212

Re: Onondaga Lake Phase II – Sediment Consolidation Area Construction, Construction Quality Assurance Final Report, Dated April 2013

Dear Mr. McAuliffe:

We have received and reviewed the above-referenced document, which was transmitted on your behalf by David Bonnett (Geosyntec) on April 15, 2013, and find that the revised Report has addressed our previous comments. Therefore, the Onondaga Lake Phase II – Sediment Consolidation Area Construction, Construction Quality Assurance Final Report, Dated April 2013, is hereby approved. Please see that copies of the approved Report, along with this approval letter, are transmitted to the distribution list and document repositories selected for this site.

Sincerely,

Timothy J. Larson, P.E.
Project Manager

ec:
B. Israel, Esq, - Arnold & Porter
R. Nunes - USEPA, NYC
M. Sergott - NYSDOH, Albnay
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M. McDonald – Honeywell
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June 27, 2012

Mr. Timothy J. Larson
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau D
625 Broadway, 12th Floor
Albany, NY 12233-7016

**RE: Onondaga Lake Phase II – Sediment Consolidation Area Construction
Construction Quality Assurance Final Report
Consent Decree 89-CV-815
April 2013**

Dear Mr. Larson:

Enclosed you will find two bound copies and two electronic versions of the Onondaga Lake Phase II – Sediment Consolidation Area Construction, Construction Quality Assurance Final Report, dated April 2013. Per your request, we are sending to your attention one bound copy to the DEC trailer at the SCA. This document is being submitted in accordance with the above-referenced Consent Decree. We are distributing per your instructions.

Please feel free to contact Thomas Drachenberg at 315-552-9688 or me if you have any questions.

Sincerely,

John P. McAuliffe

John P. McAuliffe, P.E.
Program Director, Syracuse

Enclosure

cc:
Bob Paneuff, NYSDEC Albany (1 PDF)
Tom Annal, NYSDEC (1 bound, 1 PDF)
Tara Blum, NYSDEC (1 bound, 1 PDF)
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Prepared for

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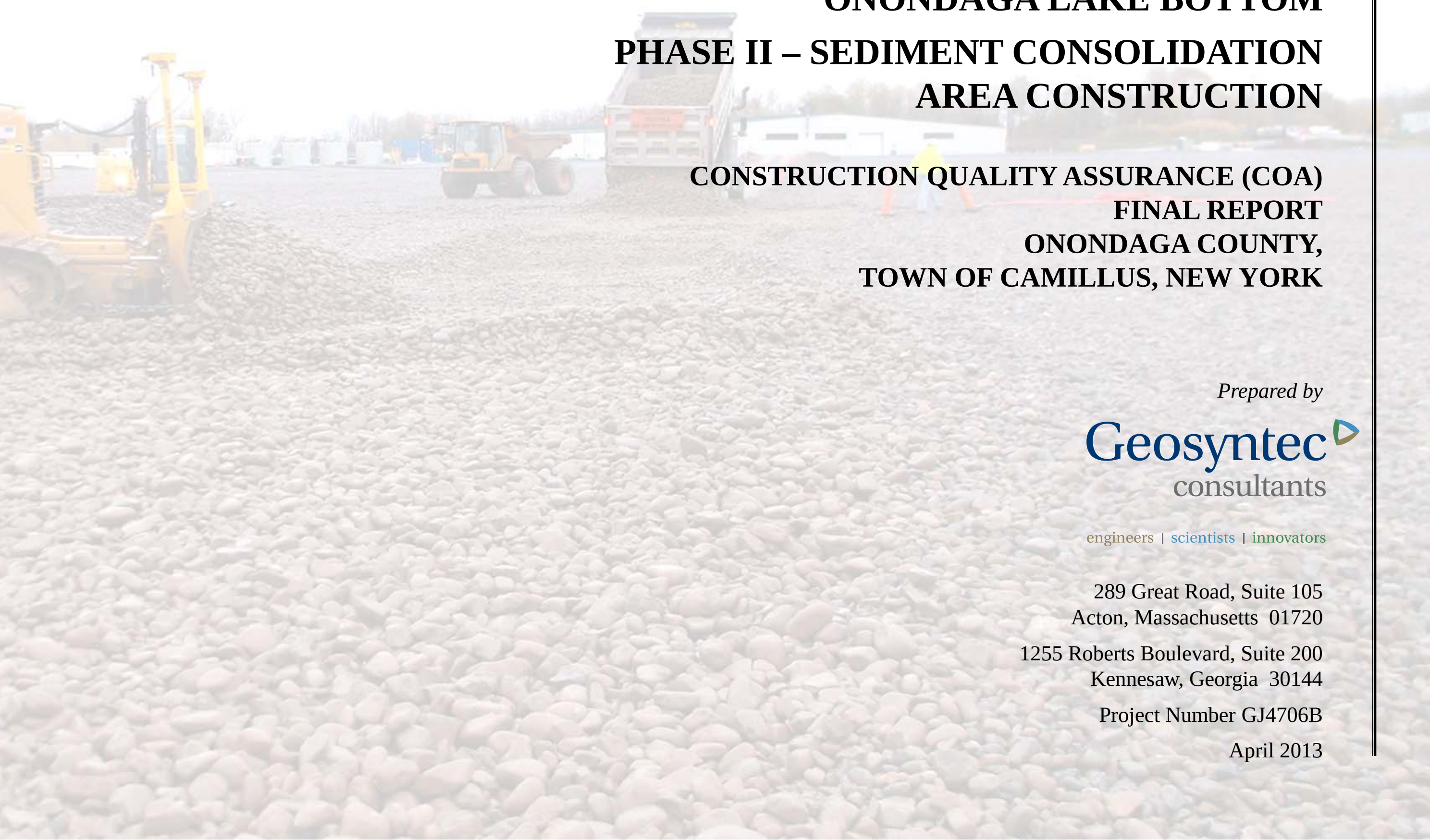

ONONDAGA LAKE BOTTOM
PHASE II – SEDIMENT CONSOLIDATION AREA CONSTRUCTION

CONSTRUCTION QUALITY ASSURANCE (COA) FINAL REPORT ONONDAGA COUNTY, TOWN OF CAMILLUS, NEW YORK

Prepared by

Geosyntec consultants

engineers | scientists | innovators

289 Great Road, Suite 105
Acton, Massachusetts 01720

1255 Roberts Boulevard, Suite 200
Kennesaw, Georgia 30144

Project Number GJ4706B

April 2013

Prepared for

Honeywell International Inc.
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ONONDAGA LAKE BOTTOM PHASE II – SEDIMENT CONSOLIDATION AREA CONSTRUCTION

CONSTRUCTION QUALITY ASSURANCE (COA) FINAL REPORT

ONONDAGA COUNTY, TOWN OF CAMILLUS, NEW YORK

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April 2013

EXECUTIVE SUMMARY

Honeywell International Inc. (Honeywell) entered into a Consent Decree (United States District Court, Northern District of New York, 2007) (89-CV-815) with the New York State Department of Environmental Conservation (NYSDEC) to implement the selected remedy for Onondaga Lake as outlined in the Record of Decision (ROD) issued on 1 July 1 2005. Under the agreement, Honeywell is required to construct a sediment consolidation area (SCA) over Wastebed 13, located in the Town of Camillus, New York. The SCA is being constructed to accept sediments dredged from nearby Onondaga Lake (reference Figure 1, Site Location Map)

The SCA is being developed in several phases of construction, dependent of the area needed; they are numbered one through three. This Construction Quality Assurance (CQA) Final Report presents a summary of the Phase II area construction activities for the Onondaga Lake SCA. It is noted that a debris management area (DMA) is located in the western edge of Phase II and has been previously certified under a separate cover, dated 12 June 2012. Due to operational constraints, Phase II was subdivided into Phase IIA, the eastern portion, and Phase IIB, the western portion (reference Figure 2, Limits of Phase II). Phase IIB was certified under separate cover, dated 12 October 2012. The data contained within this report covers Phase II of construction. The construction activities discussed in this report include: (i) engineered fill; (ii) low-permeability soil layer; (iii) gravel drainage layer; and (iv) installation of geosynthetics (i.e., geotextile, and geomembrane liner). As appendices to the report, quality assurance/quality control (QA/QC) documentation is provided.

This report provides certification by an engineer, registered in the State of New York, that the area was constructed in accordance with the approved plans and specifications, and modifications approved by the Designer and NYSDEC. The test requirements for each of the major components of the lining system are summarized on the tables that follow.

TABLE 1
Geotechnical Laboratory Testing Summary
Honeywell / Parsons
Sediment Consolidation Area - Phase II
Camillus, NY

DESCRIPTION	TEST STANDARD	PROJECT SPECIFICATIONS	UNITS	FREQUENCY QUALITY CONTROL	FREQUENCY QUALITY ASSURANCE	ESTIMATED No. of QC TESTS REQUIRED (1)	ESTIMATED No. of QA TESTS REQUIRED (1)	No. of QC TESTS PERFORMED	No. of QA TESTS PERFORMED (failures)
A. Engineered Fill - Perimeter Berm (reference Tables A-1 & A-2 of CQA Plan and Section 02200 of Specifications)									
Estimated CQA volume (1) of less than:	1,700	cyd over an area of:	5	acres (per cyd)					
Estimated QC volume (1) of less than:	1,198	cyd							
a. Restricted Use Soil Cleanup Objectives (Reference RFI No. 1)	Table 375-6.8(b) NYSDEC Subpart 375	less than Industrial Standards	-	2,500	-	1	-	1	-
b. Soil Classification (Reference RFI Nos. 2 & 15)	ASTM D2487	SC, SM, ML, CL, GM, GC, or GW GPw/sand, GP-GM, GP-GM w/sand, SP-SM w/Gravel, or SW-SM w/Gravel	USCS	2,500	1 per 10 QC tests	1	1	12	1
c. Sieve Analysis	ASTM D422	remove visible rocks max. clod - 3 for 8-in thick lift max. 4 for 4-in thick lift max. 2	in.	2,500	1 per 10 QC tests	1	1	12	1
d. Standard Proctor	ASTM D698	–	lb/ft^3	2,500	1 per 10 QC tests	1	1	12	1
e. Atterberg Limits	ASTM D4318A	–	%	2,500	1 per 10 QC tests	1	1	11	1
f. Organic Content / Loss of Ignition	ASTM D2974	–	%	2,500	1 per 10 QC tests	1	1	12	1
g. Moisture Content	ASTM D2216	-2 to +2	%	2,500	1 per 10 QC tests	1	1	12	1
h. Nuclear Field Moisture/Density (FDT)	ASTM D3017/2922	≥ 95 R.C. (non-bridge lift)	%	NP	5 tests/acre	-	25	-	64
i. Sand Cone/Drive Cylinder	ASTM D1556/2937	≥ 95 R.C. (non-bridge lift)	%	NP	1 per 25 FDT	-	3	-	4
j. Thickness (Reference RFI Nos. 3 & 16)	visual	Bridge Lift: 22 to 26-in (loose) Typical Lift: 7 to 10-in (loose) Hand Compacted: 3 to 5-in (loose)	-	during construction	during construction	-	-	-	-
k. Survey	Record Drawings	+0.3% of designed slope along 50-ft edge	-	-	-	-	-	-	-
B. Low Permeability Soil Layer (reference Tables A-1 & A-2 of CQA Plan and Section 02250 of Specifications)									
Estimated CQA volume (1) of less than:	57,500	cyd over an area of:	24.5	acres (per cyd)					
Estimated QC volume (1) of less than:	51,071	cyd							
a. Restricted Use Soil Cleanup Objectives	Table 375-6.8(b) NYSDEC Subpart 375	less than Industrial Standards		1 per source	-	Reference Phase I CQA Final Report, Appendix C	-	-	-
b. Soil Classification (Reference FCF No. 2 - not implemented)	ASTM D2487	SC, SM, ML, or CL	USCS	2,500	1 per 10 QC tests	21	3	22	4
c. Sieve Analysis	ASTM D422	remove visible rocks >1-in 100% 1-in. 100-50% No. 200 sieve	in.	2,500	1 per 10 QC tests	21	3	23	4
d. Standard Proctor	ASTM D698	–	lb/ft^3	5,000	1 per 10 QC tests	11	2	11	2
e. Atterberg Limits	ASTM D4318A	-	%	1,000	1 per 10 QC tests	52	6	52	10
f. Organic Content / Loss of Ignition	ASTM D2974	-	%	5,000	1 per 10 QC tests	11	2	11	4
g. Moisture Content	ASTM D2216	-3 to +3	%	1,000	1 per 10 QC tests	52	6	52	10
h. Permeability @3,000 psf / i ≤ 30	ASTM D5084	≤ 10-6	cm/s	5,000	1 per 10 QC tests	11	2	11	2
i. Permeability- Shelby tubes	ASTM D5084	upper 6-in ≤ 10-6	cm/s	NP	1 test/acre top lift	-	25	-	28
j. Nuclear Field Moisture/Density (FDT)	ASTM D3017/2922	≥ 95 R.C. top 6-in ≥ 90 R.C. mid lifts	%	NP	9 test/acre top lift 9 test/acre/lift	- -	221 100	- -	303 (12) 115 (5)
k. Sand Cone/Drive Cylinder	ASTM D1556/2937	see above	%	NP	1 per 25 FDT	-	9	-	33
l. Interface Direct Shear (700, 2100, 3500 psf @ 0.004 in/min)	ASTM D5321	peak: 14.5 - 18.5 deg residual: 12 - 16 deg	-		1	-	-	1	
m. Thickness (Reference RFI No. 3 and FCF No. 3)	visual	Minimum: 12-in Top: 6-in must meet perm req. with desiccation cracks less than width of dime Bridge Lift: 10 to 14-in (loose) Typical Lift: 6 to 10-in (loose) Hand Compacted: 3 to 5-in (loose)	-	during construction scarify min. 2-in moisture condition	during construction	-	-	-	-
n. Survey	Top Surface: measure 50 by 50-ft grid thickness cals 100 by 100-ft grid (see Appx. N - Geot. Monit. Plan) For less than 18-in thick LP - install square steel plate and auger on 100 by 100-ft grid	+0.2% of designed slope along 50-ft edge	-	-	-	-	-	-	-
C. Gravel Drainage Layer (reference Tables A-1 & A-2 of CQA Plan and Section 02300 of Specifications)									
Estimated CQA volume (1) of less than:	46,800	cyd over an area of:	24.5	acres (per cyd)					
Estimated QC volume (1) of less than:	66,442	cyd							
a. Restricted Use Soil Cleanup Objectives	Table 375-6.8(b) NYSDEC Subpart 375	less than Industrial Standards		Reference FCF No. 10	-	-	-	-	-
b. Soil Classification	ASTM D2488	GW or GP	USCS	1,000	1 per 10 QC tests	67	5	74	9
c. Sieve Analysis (Reference RFI No. 17)	ASTM C136	100% +4-in. 0-5% No. 4 sieve 0-3% No. 200 sieve	in.	1,000	1 per 10 QC tests	67	5	74	9
d. Hydraulic Conductivity	ASTM D 2434	≥ 10	cm/s	2,500	1 per 10 QC tests	27	2	35	5
e. Interface Direct Shear (Reference RFI Nos. 12, 14 & 21)	ASTM D5321	peak: 14.5 - 18.5 deg residual: 12 - 16 deg	-		1	-	-	1	
f. Thickness (Reference FCF Nos. 1 & 7)	visual	Minimum: 12-in / 24-in under access roads	-	during construction	during construction	-	-	-	-
g. Survey	Record Drawings	+/-0.2% of designed slope along 50-ft edge	-	-	-	-	-	-	-

Notes:

(1) Based upon received volume during construction. Reference FCF No. 5 regarding QA test frequency reliant on volumes and Table 4.1 of Parsons' Contractor Quality Control Plan, Rev0.
During construction CQA personnel tracked soil volumes by either obtaining volume from field personnel or the number of truck deliveries in a day. By using a conversion factor (e.g., 1.5 tons/cyd for soils and 1.6 tons/cyd for rock) estimates of loose volume was tracked on a daily basis. This tracked volume was used to obtain CQA samples.
Parsons independently tracked volumes of soil deliveies that was used to collect QC samples.

(2) First lift of LP soil is considered a bridge lift and not subjected to compaction requirement.
The lifts between the upper and bridge lifts are considered mid-lifts. Portions deeper than 3-ft below surface shall be less than 2-in dia.,
50% or greater passing No. 200 sieve, and be classified as SC, SM, ML or CL. Reference FCF No. 2 for details.
Assume final lift and at least one mid-lift exist for the entire cell for FDT estimate.

(3) The LP soil sample shall be compacted at 95 percent and at approximately +3% of the maximum as determined by the standard Proctor compaction test.
Reference Request For Information (RFI) and Field Change Form (FCF) for additional details.

NA-Not Applicable; NP-Not Provided; NR-Not Required

TABLE 2
Geosynthetic Laboratory Testing Summary
Honeywell / Parsons
Sediment Consolidation Area - Phase II
Camillus, NY

DESCRIPTION	TEST STANDARD	PROJECT SPECIFICATIONS	UNITS	MQC TEST FREQUENCY	MQC UNIT	QA TEST FREQUENCY	QA UNIT	MQC No. of TESTS REQUIRED (1)	QA No. of TESTS REQUIRED (1)	MQC No. of TESTS PERFORMED	QA No. of TESTS PERFORMED (failures)
A. Geomembrane (reference Part 4/Table A-4 of CQA Plan & Section 02070 of Specifications)											
Estimated area of less than:	1,602,870	sft to cover:	24.5	acres for Phase II and DMA				Assume 138 Agru America rolls, each roll 505 by 23-ft			
	53,287	lft seams welded						See RFI No. 25 regarding four sacrificial geomembrane ro			
a. Thickness	ASTM D5994	MARV 60	mil	50,000	SF	250,000	SF	33	7	138	7
b. Asperity Height	ASTM D7466	MARV 10	mil	50,000	SF	NR	-	33	-	138	-
c. Tensile Properties	ASTM D6693			50,000	SF	250,000	SF	33	7	40	7
Strength at Break	-Type IV	≥ 90	lb/in								
Elongation at Break		100	%								
Strength at Yield		≥ 126	lb/in								
Elongation at Yield		12	%								
d. Density/Specific Gravity	ASTM D792A / D1505	≥ 0.940 (sheet) 0.93 (resin)	g/cm^3	50,000	SF	250,000	SF	33	7	40	7
e. Melt Flow	ASTM D1238E	≤ 1.0	g/10 min	certify	-	-	-		-		-
f. Carbon Black Content (Reference RFI No. 13)	ASTM D1603 / 4218	2 to 3	%	50,000	SF	250,000	SF	33	7	40	7
g. Carbon Black Dispersion	ASTM D5596	9 out of 10-Cat 1, 2 10 out of 10-Cat 1, 2, 3	Cat.	50,000	SF	250,000	SF	33	7	40	7
h. Tear Resistance	ASTM D1004C	≥ 42	lb	50,000	SF	250,000	SF	33	7	40	7
i. Puncture Resistance	ASTM D4833	≥ 90	lb	NA	SF	250,000	SF	-	7	5	7
j. Oxidative Induction Time	ASTM D3895	MARV 100	min	batch	-	NR	-	4	-	40	-
k. Stress Crack Resistance	ASTM D5397	≥ 300 (on smooth edges)	hrs	batch	-	NR	-	4	-	Certified 1500 hrs	-
l. Seam Destructive Tests (2) (see FCF No. 9)	ASTM D6392	fusion peel - 91 extrusion peel - 78 fus./ext. shear - 120	ppi	NA	-	500	LF	-	107	-	114+27 (15)
m. Field Conditions	6-in above surface	weld 40 - 104 degrees wind 0 to 20 mph GRI GM9 below 32 deg	F	-	-	-	-	-	-	-	-
n. Non-Destructive Tests	-	5 psi-Vacuum 25-30 (±3) psi-Air Leak Location Survey	20-secs 5min -	every seam	-	-	-	-	-	-	-
o. Interface Friction Angle-Geosynthetic/Soil	ASTM D5321	See Spec. 02250			1		-	-	-	-	1
Interface Friction Angle-Geosynthetic	ASTM D5321	peak: 14.5 - 18.5 deg residual: 12 - 16 deg					-	-	-	-	
(Reference RFI No. 12, 14 & 21)											
B. Nonwoven Geotextile Cushion (reference Part 4/Table A-5 of CQA Plan & Section 02074 of Specifications)											
Estimated area of less than:	1,217,250	sft, a total of	267	rolls		supplied by Skaps (GE240) and 7 rolls supplied by GSE (GEO-240E) 15'X150'					
a. Mass Per Unit Area	ASTM D5261	≥ 24	oz/yd^2	90,000	SF	250,000	SF	14	5	55	6
b. Grab Strength	ASTM D4632	≥ 230	lb	90,000	SF	250,000	SF	14	5	55	6
c. Puncture Resistance	ASTM D4833	≥ ~~5,000~~ 250	lb	90,000	SF	250,000	SF	14	5	27	6
d. Trapezoidal Tear Strength	ASTM D4533	≥ 95	lb	90,000	SF	250,000	SF	14	5	55	6
e. UV Resistance (Reference FCF Nos. 6 and 11)	ASTM D4355	≥ 70	%	Batch	-	Certify	-	-	-	-	-
f. Seaming	ASTM D6193	single thermal weld (6-in overlap seam Stitch Type 401 / 3-ft overlap of butt seams shingled in direction of fill placement)	-	visual	-	visual	-	-	-	-	-
g. Interface Direct Shear	ASTM D5321	peak: 14.5 - 18.5 deg residual: 12 - 16 deg	-		1			-	-	1	
(Reference RFI Nos. 12, 14 & 21)											

Notes:

(1) Based upon the testing frequency presented in the Project Documents. Material quantities provided by Site.
Basic area is assumed to be: 24.5 acres or 1,067,220 sft

(2) Assume geomembrane sheet width of 21 ft and destructive seam test frequency of 1 sample per 500 ft.
Trial seams were performed at the beginning of each seam period; min. 15-ft long with two & two samples tested in shear & peel, respectively.

(3) Reference Request For Information (RFI) and Field Change Form (FCF) for additional details.
ARV- Min. Average Value; NA-Not Applicable; NP-Not Provided; NR-Not Required

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1. INTRODUCTION

1.1 Overview

This final report summarizes the Construction Quality Assurance (CQA) activities performed by Geosyntec Consultants (Geosyntec) of Acton, Massachusetts and Kennesaw, Georgia during construction of Phase II at the Honeywell International Inc. (Honeywell) Onondaga Lake Sediment Consolidation Area (SCA) in Camillus, Onondaga County, New York. Honeywell entered into a Consent Decree (CD) (United States District Court, Northern District of New York, 2007) (89-CV-815) with the New York State Department of Environmental Conservation (NYSDEC) to implement the selected remedy for Onondaga Lake as outlined in the Record of Decision (ROD) issued 1 July 2005. The following documents are appended to the CD: ROD, Explanation of Significant Differences (ESD), Statement of Work (SOW), and Environmental Easement and can be referenced for additional information.

The CQA activities performed by Geosyntec included monitoring of: (i) engineered fill construction; (ii) low-permeability soil layer construction; (iii) gravel drainage layer construction; and (iv) installation of geosynthetics (i.e., geotextile and geomembrane liner). The CQA activities were performed to confirm construction materials and procedures that were monitored were in compliance with the Subpart 360 Regulations, as required by NYSDEC Solid Waste Management.

This report was prepared for Mr. Larry Somer of Honeywell by Mr. Marcus Fountain, Mr. David Williams, Mr. Doug Hamilton, and Mr. Billy Carruth, and was reviewed by Mr. David Bonnett, P.E., all of Geosyntec.

1.2 Report Organization

This final report is organized as described below.

- A description of the project is provided in Section 2.
- A summary description of the CQA program is presented in Section 3.
- A description of the CQA monitoring and testing activities performed during the earthwork portion of the project is provided in Section 4.
- A description of the CQA monitoring and testing activities performed during the geosynthetics installation is provided in Section 5.

- A summary of the observations resulting from the CQA monitoring and testing activities performed by Geosyntec and a certification statement signed and sealed by a professional engineer registered in the State of New York are presented in Section 6.

Documentation and record drawings presenting the results of the CQA monitoring and testing activities performed by Geosyntec are contained in the appendices to this report. Construction quality control (QC) information provided by Parsons is also presented for completeness.

2. PROJECT DESCRIPTION

The Onondaga Lake is a 4.6 square mile (approximately 3,000 acre) lake located in central New York State, immediately northwest of the City of Syracuse. Honeywell is currently working on a sediment removal and lake remediation project to restore the lake. Parsons of Syracuse, New York and Geosyntec are members of the team assisting Honeywell in this effort. The remediation of the Onondaga Lake bottom is on the New York State Registry of Inactive Hazardous Waste Sites and is part of the Onondaga Lake National Priorities List site. As specified in the ROD [NYSDEC and USEPA, 2005], the major components of the remedy include construction of a hydraulic control system (consisting of a hydraulic barrier wall and a groundwater collection system); hydraulic dredging of contaminated sediments on the lakeside of the barrier wall; pumping of the dredge material to a sediment consolidation area (i.e., SCA); placing of the sediments within geotextile tubes for the purpose of dewatering in the SCA; and the collection and treatment of the decanted water through an on-site treatment facility.

The SCA is located on Wastebed 13, which encompasses approximately 163 acres. It is bordered to the north by Ninemile Creek and the CSX Railroad tracks; to the west by an Onondaga County Garage property and a former gravel excavation owned by Honeywell; and to the east and south by Wastebeds 12 and 14, respectively. (Reference Figure 1 – Site Location Map.) Wastebed 13 was originally designed as a settling basin for the disposal of Solvay waste and has recently been used by the State University of New York College of Environmental Science and Forestry (SUNY ESF) and Honeywell for willow/evapotranspiration cover pilot test plots. The SCA has been designed to provide long-term containment of the dredged sediment. The SCA has been designed to hold up to the ROD specified volume of 2,653,000 cubic yards (cyd) of dredged sediment.

The base liner system design of the SCA incorporates a single-composite liner system and other engineering controls that meet the requirements established in the New York State approved "Onondaga *Lake Sediment Consolidation Area (SCA) Civil and Geotechnical Final Design*", dated March 2011. The design of the SCA includes a centrally located 200 foot wide (east-west direction) sump corridor. The single-composite liner system consists of the following components (from top to bottom):

- 12-in thick (minimum) gravel drainage layer with 24-in minimum in traffic areas, having a minimum permeability of 10 cm/sec;
- 24 oz/syd nonwoven, needle-punched geotextile cushion;
- 60-mil thick textured high density polyethylene (HDPE) geomembrane liner;

- geosynthetic clay liner (GCL) in sump areas only;
- 12-in (minimum) outside of the sump corridor and 18-in thick (minimum) within the sump area of a low-permeability (LP) soil layer, the upper six inches of which requiring permeability not exceeding 1 x 10^{-6} cm/sec;
- varying thickness of low-permeability soil bridge lift over existing Solvay waste; and
- varying thickness of engineered fill along the perimeter.

The Phase II footprint has a rectangular configuration and is approximately 1,700-ft long (east-west) and approximately 700-ft wide (north-south). Phase I and future Phase III are located to the north. Two SCA basins have been constructed adjacent to the eastern and western extents of Phase I. These basins are considered part of the sediment management system (SMS) for the SCA. Construction details of the SMS basins was presented in an 11 July 2012 report. It is noted that a debris management area (DMA) is located in the western edge of Phase II and has been previously certified under a separate cover. Due to operational constraints, Phase II was subdivided into Phase IIA and Phase IIB along the crest line separating drainage to the east and west. Phase IIB, the western portion, was certified under separate cover on 12 October 2012. Reference Figure 2 – Limits of Phase II. The data presented within this report supplements the previous Phase II submittals.

The original design and construction drawings were prepared by Geosyntec and Parsons. Parsons performed construction of the majority of the Phase II earthwork components, including the engineered fill, low-permeability soil, and gravel drainage layers. The geosynthetics installer for the project was Chenango Contracting (Chenango or installer), of Johnson City, New York. Parsons retained THG Geophysics (THG) of Murrysville, Pennsylvania to conduct the liner integrity or leak location testing. The surveyor retained by Parsons for the project was Thew Associates (Thew) of Canton, New York. Thew performed initial site control and occasionally verified elevations. As required by the Phase II project documents, Parsons surveyed the required layers of the low-permeability soil and drainage layers and prepared certified record drawings. Parsons used global positioning system (GPS) based survey equipment to accomplish this task. Geosyntec provided the construction quality assurance (CQA) monitoring, testing, and documentation. A list of personnel involved in construction of Phase II is included in Section 3.2 of this report.

A list of the key construction activities and associated dates are provided below.

- Geosyntec arrived on site to observe earthwork construction associated with Phase II occurring within the 2012 construction season on 26 March 2012, when construction of the low-permeability soil layer resumed following the winter shutdown. A portion of the initial lift of the low-permeability soil layer was constructed during the 2011 construction season concurrent with Phase I construction.

- Geomembrane installation commenced on 15 May 2012.

- Gravel drainage layer placement began on 4 June 2012.

- Construction of Phase II was substantially completed on 14 November 2012.

- An inclinometer, referred to as SI-G1, was decommissioned (by others) in March 2013; Geosyntec monitored the repairs to the lining system conducted on 3 and 4 April 2013.

This Final Report pertains to construction of Phase II of the SCA, monitored by Geosyntec, which primarily occurred in 2012. However, due to the nature of the construction, activities overlapped and some information is included that is inter related to Phase I or the SMS construction. Reports generated during Phase I construction and submitted previously under separate cover contain some information regarding observations of the initial low-permeability soil layer placement activities occurring within that time period.

3. CONSTRUCTION QUALITY ASSURANCE PROGRAM

3.1 Scope of Services

3.1.1 Overview

The scope of CQA monitoring, testing, and documentation services performed by Geosyntec during Phase II construction included review of documents, field CQA operations, and preparation of this Final Report and record drawings. These are described in the following subsections.

3.1.2 Review of Documents

As previously noted, this final report summarizes the CQA activities performed by Geosyntec during Phase II construction. The CQA activities conducted by Geosyntec were intended to satisfy the requirements of the following documents:

- Permit Drawings entitled "*Sediment Consolidation Area Final Design, Camillus, New York*", dated July 2010, revised April 2011, prepared by Parsons and Geosyntec;
- "*Construction Quality Assurance Plan, Onondaga Lake Sediment Consolidation Area (SCA) Final Design*", prepared by Geosyntec, dated April 2011; and
- Specifications entitled "*Onondaga Lake Sediment Consolidation Area (SCA) Final Design Submittal*", prepared by Parsons and Geosyntec, dated April 2011.

Geosyntec reviewed the above documents for familiarity prior to the commencement of on-site CQA activities. During construction, clarifications of the project specifications and drawings were typically requested in the form of Request for Information (RFI). Changes to the design documents were handled through Construction Field Change Forms (FCF). The RFIs and FCFs were issued by the contractor with responses by the Designer. The FCFs were also signed by the Owner and the NYSDEC. The design changes were typically reviewed routinely during weekly progress meetings. Copies of the RFIs and FCFs relating to Phase II construction are provided in Appendix B.

A major change to the CQC and CQA testing program included the following:

- FCF No. 5: "in lieu of using the number of CQC samples, CQA sample frequency will be tied to the delivered volumes such that the test frequency shall become: volume of soil delivered to the site divided by CQC test frequency and divided by ten".

Reference to the various RFIs and FCFs are provided throughout the report in the various related sections as well as in the material tables found in the executive summary.

All of the above documents will be collectively referred to as the CQA Plan in this final report.

3.1.3 Field CQA Operations

The following activities were performed as part of Geosyntec's on-site CQA services:

- attending daily health and safety meetings;
- attending weekly progress meetings;
- maintaining photographic documentation of the construction;
- summarizing construction and CQA activities in weekly field reports;
- documenting construction progress and CQA activities in daily field reports;
- conducting field density tests of the engineered fill and low-permeability soil layer;
- collecting samples of soils and geosynthetics; and
- coordinating geomembrane as-built surveys.

Earthwork:

- collecting samples of soils considered for use as engineered fill (i.e., berms), low-permeability soil layer, and gravel drainage layer for testing at either an on-site or off-site geotechnical laboratory;
- reviewing and evaluating geotechnical laboratory test results for compliance with the requirements of the CQA Plan;
- visual monitoring of placement, grading, and compaction operations of the soil layers of the cell;
- visually monitoring site preparation; and
- selective monitoring perimeter berms.

Geosynthetics:

- monitoring and tracking the inventory of geosynthetic materials delivered to the site;
- collecting geosynthetic conformance samples from delivered rolls and forwarding samples to an off-site geosynthetics testing laboratory;
- collecting and reviewing geosynthetic manufacturers' certification documents (through contractor's submittals) and geosynthetic laboratory conformance test results for compliance with the requirements of the CQA Plan;
- monitoring installation of geosynthetic materials, including trial seaming, destructive and nondestructive sampling, and repair operations; and
- selective monitoring of the anchorage of the geosynthetics in the perimeter anchor trench.

During construction activities involving monitoring and/or testing, the observations made and results obtained by Geosyntec CQA personnel were compared to the CQA Plan. The construction manager, and/or the appropriate contractor were notified of deficiencies in construction practices and/or materials so the contractor or installer could implement the appropriate corrective actions. The corrective actions were monitored and/or tested by CQA personnel for compliance with the CQA Plan.

3.1.4 Final Report and Record Drawings

Record drawings and this Final CQA Report were prepared as the final task of the CQA program. During construction, CQA documentation of on-site activities was maintained by CQA personnel in Daily Field Reports (DFRs) and summarized in weekly reports. In addition, quality control (QC) certificates for the geosynthetic materials and as-built drawings were provided to Geosyntec for review. The weekly reports are included in the appendices to this report. CQA personnel also documented the results of on-site and off-site geotechnical testing conducted as part of the CQA program. Descriptions of the construction activities and the CQA documentation are presented in this Final CQA Report which contains the report text, summary tables, and Appendices A through P.

3.2 <u>Personnel</u>

3.2.1 Project Personnel

Senior personnel or representatives for the firms involved in the project are as follows:

Honeywell International Inc. (Owner)

- Larry Somer

New York State Department of Environmental Conservation (Regulatory Agency)

- Tom Annal
- Jim Christopher
- Bob Edwards
- Donald Hesler
- Marleiah O'Neal
- Timothy Larson
- Robert Phaneuf
- William Zeppetelli

Parsons and Geosyntec (Designer)

- Paul Blue
- Laura Brussel
- Xiaodong Huang
- David Steele
- John (Jay) Beech
- Ramachandran Kulasingam
- Joseph Sura
- Ming Zu

Geosyntec (CQA Consultant)

- David Bonnett
- Joshua Bullock
- John (Billy) Carruth
- Marcus Fountain
- Douglas Hamilton
- David Williams

Parsons (Earthwork Contractor)

- Adam Dorn
- Josh Hawley
- Dhana Hillenbrand
- Xiaodong Huang
- William Mathe
- Bill Moon
- Ron Prohaska
- Ken Sommerfield
- David Steele
- Al Steinhoff
- Sean Sullivan
- Scott Swift

Thew Associates (Surveyor)

- Michael Merithew

GeoTesting Express (Off-site Geotechnical Laboratory)

- Mark Dobday
- Joe Tomei

SGI Testing Services, Inc. (Off-site Geotechnical Laboratory)

- Zehong Yuan

Chenango Contracting (Installer, senior personnel only)

- Matt Bilodeau
- Nick Brechko
- Carl Burdick
- Martin Bystrak
- Rod Parker
- Charlie Parks
- Joe Randall
- Peter Ward

THG Geophysics Ltd (Leak Location Surveyor)

- Maggie Beird
- Heather Kribos
- Peter Hutchison
- Simon Eydlin

4. CONSTRUCTION QUALITY ASSURANCE - EARTHWORK

4.1 Overview

As described in Section 3.1 of this report, several administrative activities were routinely performed by CQA personnel throughout the duration of construction. Many of these administrative activities were related to documenting overall construction status and progress. Other activities presented under general CQA services included monitoring of the related components and facilities for the construction project. Photographs of the construction were obtained on a regular basis and select photographs are presented in Appendix A. CQA personnel summarized the daily construction and CQA activities in weekly field reports. Weekly field reports are presented in Appendix B.

The contractor was responsible for performing general civil site work for the project. The work included site preparation (dewatering, excavating, relocating Solvay waste onsite, preparing subgrade, including clearing and grubbing); provision of imported fills (such as stockpiling, placing and compacting engineered fill and low-permeability soil layer, and screening and placing gravel drainage layer); establishment of infrastructure; and survey control associated with earthworks and as-built drawings.

As part of the site preparation that occurred in 2011, Parsons removed oversized and woody vegetation by various means, including manually and using compact track loader mounted with a Bradco or Caterpillar BR166 brush cutter, Caterpillar SG18 stump grinder, or a landscape rake (see RFI No. 10). NYSDEC along with CQA personnel would typically approve an area referred to using a grid layout. If areas required additional work, the area of concern was identified using survey flags. Once a grid area had been deemed suitable, the contractor was notified that the area was approved for placement of low-permeability material. The initial lift of low-permeability material was placed in 2011. Upon remobilization to the site in 2012, the previously placed material was observed and deficient areas were reworked by Parsons.

Geosyntec's CQA personnel visually monitored the construction of the various earthwork components. Different material types were used to construct the various components of the single-composite liner system. These materials included clay for the low-permeability soil layer, gravel for the gravel drainage layer, and engineered fill material for the perimeter berm. Various sources were pre-qualified to supply the soils by Parsons. The earthwork construction activities using these materials are described below.

- The perimeter berms were constructed using engineered fill material obtained from the Granby and Sennett sources or re-used from previous construction, placed and compacted initially in approximately 14-in thick (loose) bridge lift (that was not required to be tested) and subsequent in approximately 10-in thick (loose) lifts.

- The cell area was cleared and partially grubbed of vegetation, a bridge lift of low-permeability material was placed and compacted (that was not required to be tested) over the prepared subgrade with soils obtained from the Marcellus and Black Creek sources (note the Black Creek source was only used in 2011).

- The minimum 12-in thick low-permeability layer was constructed using 8- to 10-in thick lifts (loose) material obtained from the Marcellus source.

- The minimum 12-in thick gravel drainage layer was constructed in one lift using material obtained from the Granby, Lake Road, Amboy, Orin Delphi, Hayes Road, County Road 6 sources.

CQA personnel observed these earthwork construction activities and tested the soil materials to confirm that the material properties conformed to the CQA Plan, specific lift thicknesses were not exceeded, and compaction requirements were met. Geosyntec personnel also performed geotechnical soil tests during construction. The testing was performed either: (i) in-place; (ii) on-site; or (iii) off-site, at GeoTesting Express (GTX) in Acton, Massachusetts. The contractor was responsible for obtaining and testing QC samples. The geotechnical QC samples were tested by Atlantic Testing Laboratories Inc. (ATL) in Syracuse, New York or P-W Laboratories, Inc. (PW) in East Syracuse, New York. These laboratories also supported Parsons in various capacities such as collecting samples and monitoring borrow sources. The QC laboratory results are presented in Appendix D.

Variation exists between the soil quantities used for CQA and QC testing. Geosyntec used a conservative approach by basing CQA quantities on truck counts using an assumed volume per truckload that was agreed upon by Parsons. QC test frequencies were based upon actual weights of materials delivered, later converted to a volume. Due to the different approaches to managing the process, volumes presented as a basis for CQA testing and QC testing differ.

Separately, the contractor was required to perform analytical testing at each source at a minimum frequency of one representative composite sample per 2,500 cyd for engineered fill and one per source for low-permeability material. The sampling was done internally by Parsons to ensure samples met the NYSDEC Subpart 375, Table 375-6.8(b). No new low-permeability sources were used so no additional testing was conducted in 2012 (see Phase I report for test results). The analytical testing from an engineered fill sample is presented in Appendix C.

During construction, the contractor was responsible for erecting and maintaining erosion and sediment (E&S) controls. The E&S controls that were installed included: silt fence, temporary soil diversion berms, and operation of a wheel wash located at the main entrance. Geosyntec field personnel were not actively engaged in monitoring E&S activities. However, recommendations were occasionally made in an effort to minimize potential damage to the single-composite lining system.

4.2 Soil Source Sampling Activities

Representative samples of engineered fill, low-permeability material, and drainage material were obtained from their respective sources and tested to verify conformance with the CQA Plan. Soils for the project were provided by Riccelli Enterprises, Inc. (Riccelli) of Syracuse, New York. Riccelli excavated and transported material from several sources to meet the needs of the project. The source and associated layer are listed below, followed by the common reference in parentheses.

Engineered Fill:

- Riccelli Syracuse Sand & Gravel, 489 County Rt 85, Granby, New York 13069 (Granby source)

Low-Permeability Soil:

- County Rt 174, Marcellus, New York (Marcellus source)

Drainage Gravel:

- Riccelli Syracuse Sand & Gravel, 489 County Rt 85, Granby, New York 13069 (Granby source)
- Lake Road Pit, Phelps, New York 14533 (Lake Road source)
- Amboy Pit, Finnerty Road, Amboy, New York 13493 (Amboy source)
- Oran Delphi / Kinsella, 2308 Oran Delphi Road, Malius, New York 13104 (Oran Delphi source)
- Hayes Road, 1850 Hayes Road, Geneva, New York 14456 (Hayes Road source)
- County Route 6 / Dendis, Geneva, New York 14456 (Route 6 source)

The geotechnical tests were performed to confirm that the following requirements were met.

- Engineered fill material used in construction classified as SC, SM, ML, CL, GM, or GW (reference RFI Nos. 2 and 15 for additional classifications for GP, SP and SW) according to the Unified Soil Classification Systems (USCS) when evaluated in accordance with ASTM D2487; had a nominal dimension less than 4 inches for 8 inches ± 2 inches thick loose lifts and 2 inches for 4 inches ± 1 inch thick loose lifts.

- Low-permeability soil material used in construction classified as SC, SM, ML, or CL according to the Unified Soil Classification Systems (USCS) when evaluated in accordance with ASTM D2487; had a maximum particle size of 1-in diameter and had not less than 50 percent of the particles, by weight, passing through the standard U.S. No. 200 standard sieve when evaluated in accordance with ASTM D422 (sieve analysis); and the hydraulic conductivity (i.e., permeability) requirement of the upper 6 inches was 1×10^{-6} cm/s or less, when evaluated in accordance with ASTM D5084.

- The material used in construction of the gravel drainage layer was classified as GW or GP according to the USCS when evaluated in accordance with ASTM D2487; had a nominal particle size of 4-in diameter, maximum of five percent and three percent passing the No. 4 and No. 200 sieves, respectively, when tested in accordance with ASTM C136/C117 (reference RFI No. 17 for maximum diameter acceptance); and the hydraulic conductivity requirement was 10 cm/s or greater when evaluated in general accordance with ASTM D2434. (Note that the test method was modified by the testing laboratories due to the ‘oversized’ particles contained in the gravel.)

A description of the geotechnical tests performed on placed materials and results of these tests are presented in the next section of this report. Details of construction of the perimeter termination trench for anchorage of the geosynthetic components of the single-composite liner are described in Section 4.4 of this report.

4.3 Field Monitoring and Testing

4.3.1 General

Geosyntec’s CQA personnel monitored the placement of soil as described in Section 3.1.3. At times, several earthwork construction operations were conducted simultaneously in the Phase II area. When this occurred, the on-site personnel monitored the operations considered most critical to the performance of the liner system. Potentially nonconforming or questionable practices observed by CQA personnel were brought to the attention of the concerned parties for review and correction.

As part of CQA activities, geotechnical testing was performed on each of the soil components of the Phase II single-composite liner system. Depending on the specific test, testing was performed either in-place, at the on-site laboratory, or off-site at GTX.

The following geotechnical tests were performed:

- In-place nuclear moisture/density tests were performed on compacted lifts of engineered fill, and low-permeability layer. The tests were performed in general accordance with ASTM D2922 and ASTM D3017.

- Standard Proctor compaction tests were conducted on the soils used for engineered fill and low-permeability layer. The tests were performed in general accordance with ASTM D698.

- Moisture content tests were performed on engineered fill and low-permeability soil material. The tests were performed in general accordance with ASTM D2216. On-site oven moisture content tests were occasionally run in general accordance with ASTM D2216 as a periodic check during construction.

- Particle-size distribution tests were conducted on engineered fill, low-permeability soil layer, and gravel drainage layer. The tests were performed in general accordance with ASTM D422 or C136/C117.

- Atterberg limits tests were conducted on the soils used for low-permeability material. The tests were performed in general accordance with ASTM D4318.

- Soil classification was performed on soils used for engineered fill, low-permeability soil layer, and gravel drainage layer in general accordance with ASTM D2487.

- Hydraulic conductivity tests were performed on the low-permeability and drainage material. The hydraulic conductivity tests on low-permeability soil material were conducted in accordance with ASTM D5084. The hydraulic conductivity test on granular material (i.e., gravel drainage material) was performed in general accordance with ASTM D2434. The test method for granular materials was modified slightly by the testing laboratories to accommodate the larger particles contained in the gravel.

The results of the geotechnical laboratory tests are presented in Appendix D. The results of the in-place nuclear moisture/density tests are presented in Appendix E. A grid layout of the site, presented in Appendix E, was used to visually locate the in-place tests and sample locations. CQA personnel used the physical features, such as toe of slope to estimate the test locations. Since only visual positioning of test locations was used, the test and sample locations given in the appendices are approximate.

In 2012, Geosyntec mobilized a nuclear gauge (i.e., Troxler model 3440, Serial No. 28800) that was used to perform the moisture/density tests. Standard counts were performed daily prior to use of the gauge. These counts were recorded on a standard count log, which is presented in Appendix E. The accuracy of the nuclear gauge was checked periodically by comparing test results with results observed using the drive cylinder method (conducted in general accordance with ASTM D2937) and with moisture content tests (conducted in general accordance with ASTM D2216 or D4643).

The moisture results are presented along with the in-place moisture/density test results in Appendix D.

4.3.2 Engineered Fill

CQA personnel monitored the placement of the fill for perimeter berms when on-site. Geosyntec observed the placement of fill, and performed in-place testing of the material.

Construction of the perimeter berm consisted of the following activities:

- Engineered fill material was hauled directly from the Granby source or re-used from the Phase I construction and unloaded;
- Lifts of material were typically spread using Caterpillar D-5 or D-6 low ground pressure (LGP) bulldozers and were compacted using a Caterpillar CS56 smooth drum roller; and
- The surface of each lift was typically scarified with tracks of a bulldozer or disked prior to placement of subsequent lifts or layers.

Engineered fill was required to be compacted to a minimum relative compaction of 95 percent of the maximum dry unit weight at a moisture content ±2 percent of the optimum moisture content, as determined by the Standard Proctor compaction test method (ASTM D698). CQA personnel conducted in-place nuclear moisture/density tests at a frequency of 5 tests per acre (estimated one test per 200 feet of berm per lift along the perimeter berms). A total of 64 field moisture/density tests were performed, of which meet the minimum compaction requirement. Drive cylinder tests were periodically performed; a total of four tests were conducted. The results of the field moisture/density tests are presented in Appendix E.

In addition to the in-place density testing, grain-size distribution test, soil classification, and standard Proctor compaction tests were performed on the engineered fill material. The results of these geotechnical tests are presented in Appendix D.

4.3.3 Low-Permeability Soil Layer

After completing the removal of woody vegetation, CQA personnel observed the placement of the low-permeability soil layer. RFI No. 3 and FCF No. 3 provided topographic surveys of the subgrade and top of low-permeability soil layer. The difference between the layers determined the thickness of the low-permeability soil layer. The Specification (Section 2250 Part 3.02.B) allowed the first lift (referred to as a bridge lift) to be placed without compaction requirements in a 10 to 14-in thick (loose) lift. The intermediate lifts, placed in 6 to 10-in thick (loose) lifts, were required to be compacted to 90 percent of the maximum dry density at a moisture content ±3% of optimum moisture, as determined by the standard Proctor test (ASTM D698). The upper lift was to be compacted to 95 percent of the maximum dry density at a moisture content ±3% of optimum moisture, as determined by ASTM D698, and achieve a maximum permeability of 1×10^{-6} cm/s.

The construction sequence of the compacted low-permeability soil layer is described below.

- Low-permeability material was delivered directly from the Marcellus source. At the source, an excavator loaded the material into various sized on-road trucks. Trucks were weighed before being unloaded.

- The top surface of each lift was typically scarified with the tracks of a bulldozer or with a disk prior to placement of the subsequent lift.

- Low-permeability material was placed in appropriately 10 to 14-in for bridge lift and 6 to 10-in for other lifts. Typically the lifts were placed using Caterpillar D-5 or D-6 LGP bulldozers. Occasionally, laborers were used to manually remove rocks and roots from materials placed.

- After spreading, if necessary, water was added to increase the soil moisture content or if too wet, a tractor with a draw type disc harrow was used to mix the water, break up the clods or dry the material.

- Each lift of soil was compacted using a Caterpillar CS56 smooth drum or pad-foot vibratory compactor.

- A Caterpillar D-5 or D-6 LGP bulldozer (equipped with GPS) was used to fine grade the low-permeability material. The final lift was rolled with a smooth drum roller (including an attachment on a compact loader) to seal the top surface of the compacted low-permeability soil liner in preparation for geosynthetics deployment.

- The contractor confirmed the final grade elevations using GPS methods.

Prior to deployment of the geosynthetics, the compacted low-permeability soil layer surface was visually observed by the installer and CQA personnel for surface cracks (e.g., less than the width of a dime) and greater than 1-in diameter particles. If drying or cracking of the surface was observed, the contractor was required to moisture condition and rework the affected area. Observed oversized particles were manually removed.

A series of tests were performed on the material used to construct the compacted low-permeability soil liner. Grain-size distribution tests, moisture-density relationships (i.e., Proctor tests) and remolded permeability tests were performed. In addition Atterberg limits tests were performed on the low-permeability liner material to classify the material. The geotechnical test results are presented in Appendix D.

Off-site geotechnical laboratory permeability tests were performed on thin-walled (i.e., Shelby) tube samples to confirm the material met the permeability criterion. Samples were obtained from the upper lift during cell construction. Tubes were obtained on a minimum one per acre basis for the final lift of installed LP soil liner. A total of 28 thin-walled tube sample pairs were removed from the compacted low-permeability layer. Samples were tested by the independent laboratory and all met the hydraulic conductivity criterion of 1×10^{-6} cm/s or less.

CQA personnel performed in-place nuclear moisture/density tests on a frequency of nine tests per acre for each lift above the bridge lift of the compacted low-permeability layer including the final lift. A total of 418 field moisture/density tests were performed by Geosyntec, 17 tests failed to meet the minimum compaction requirement of 95 or 90 percent. Failures were typically attributed to the material being too wet or to dry. In each case of a failing test, the contractor reworked, removed and replaced, or recompacted the area represented by the failure before the area was retested by field personnel. This procedure was repeated until satisfactory moisture/density test results were obtained in each test location. Drive cylinder tests were periodically performed; a total of five tests were conducted along with 28 Shelby tubes. The results of the field moisture/density tests are presented in Appendix E. Moisture content samples, obtained periodically to verify the accuracy of the nuclear moisture/density gauge, indicated a correction was necessary. A moisture correction formula was developed for low-permeability materials by plotting the results of the moisture content tests to the nuclear gauge moisture content readings. Assuming a linear relationship, the formula was used to correct the nuclear gauge moisture readings. The correction formula was periodically updated as additional data was collected.

To verify that the minimum thickness was achieved, the contractor used various methods to measure the thickness in Phase II. The contractor surveyed the low-permeability layer on 50 foot grid pattern, performed thickness calculations on 100-ft grid pattern, and in areas with design thickness of less than 18 inches, installed 12-in square steel plates on a 100-ft grid pattern. Initially, a hand drill with a 24-in long drill bit was used to bore into the low-permeability soil. If the plate had not been reached at a depth of 24 inches, then a pointed rod was hammered down to the plate. Once the bit or rod had been driven to the steel plate, a mark was made on the bit or rod. The bit or rod was extracted and a measurement was made to determine the low-permeability soil layer thickness. The thickness verification results are presented in Appendix E.

Perforations in the low-permeability soil were filled with bentonite/soil material. The material was manually tamped into the perforations.

4.3.4 Gravel Drainage Layer

CQA personnel periodically monitored the placement of the gravel drainage material for the Phase II area. The 12-in thick (minimum) gravel drainage layer was constructed using material obtained from several sources, with the majority of material being provided by the Granby source supplemented by the Lake Road, Amboy, Oran Delphi, Hayes Road, and Route 6 sources. The construction sequence of gravel drainage was as follows:

- Gravel was screened and washed, as necessary, at the source (e.g., Turbo Chieftain 1400 power screener) and stockpiled at the quarry;

- Front-end loaders or tracked excavators loaded on-road live bottom trucks or end dump trucks at the source. Each truck was weighed and the trucks hauled the material to the cell area; and

- The gravel was either spread in one 12-in thick (minimum) lift using a Caterpillar D-5 or D-6 LGP bulldozer (equipped with GPS) or processed in-place through a flip screen attached to compact loader.

The contractor used spotters to assist with off-loading activities. The spotters would direct traffic to ensure trucks operated on greater than 2-ft thick minimum roads/ramps and occasionally reject loads with observed high fines content. A sacrificial geotextile was deployed under the gravel at access ramps. In long ramp areas of high traffic, the gravel was observed to have a higher fines content and therefore it was necessary to re-process the material using a flip screen attachment equipped compact loader or removed and replaced with new material.

During placement of the gravel drainage layer, CQA personnel periodically monitored the contractor's activities to assure that the risk of damage to the underlying geosynthetics was minimized. CQA personnel also confirmed that the contractor operated bulldozers in areas where at least 1-ft thick layer of gravel was maintained over the geosynthetics, and that a minimum 2-ft thick layer of gravel was maintained over the geosynthetics in heavily trafficked areas.

During placement, discussions were held between parties regarding the fines content of the gravel. As indicated above, delivered loads containing high fines content were periodically observed and when observed, the load was rejected. Visits to the quarry confirmed that, on occasion, front-end loader operators were too aggressive by loading from the base of the stockpile (an area of fines accumulation) or fine grain material accumulated in the loading bucket (from previous loading operations) and were mixed in with the gravel.

Areas within the cell with observed high fines content were identified and were removed using low ground pressure equipment. The determination of these areas of concern was subjective (i.e., through observation). Results of the CQA tests indicated the fines content (by weight) was in compliance with the requirements of the CQA Plan. However, to mitigate observed pockets of fines, a mini-excavator (Caterpillar 307D) or a compact track loader (Caterpillar 299C) was used to excavate the area of concern and load low-ground pressure vehicles (i.e., Hydrema 912HM rubber tired vehicle) which typically transported the material to a stockpile area located west of Phase I.

Geosyntec had off-site laboratory geotechnical tests performed on the material used for the gravel drainage layer as part of the CQA activities during Phase II construction. Samples were obtained directly from the soil source and from the in-place material and typically included two to twelve 5-gallon sized buckets. GTX performed an off-site hydraulic conductivity tests and grain size distribution tests on representative samples. The laboratory test results are presented in Appendix D.

4.4 Soil Anchorage of Geosynthetics

4.4.1 General

Geosyntec CQA personnel periodically monitored the method of anchorage for the geosynthetic material around the Phase II perimeter. Along the north, the geosynthetic layers were tie-in to the Phase I geosynthetic layers. Along the remaining perimeter, the layers of geosynthetics were terminated in an anchor trench. Soil was subsequently placed and compacted in the trench to provide permanent anchorage of the single-composite liner system. Details of the anchoring are discussed below.

4.4.2 Perimeter Anchor Trench

As required by the CQA Plan, a permanent anchor trench was constructed around the southern, eastern and western perimeter of the Phase II construction area. The construction sequence of the perimeter anchor trench was as follows:

- a 2-ft deep by 2-ft wide (minimum) trench was excavated approximately 4-ft from the crest of slope of perimeter berm;
- the geosynthetic components were subsequently placed in and across the bottom of the anchor trench (including a sacrificial geomembrane) and ballasted with sandbags; and
- lifts of LP soil and/or engineered fill were placed over the geosynthetic materials and compacted.

The anchor trench backfill was compacted using various means including the bucket of an excavator and a vibratory plate tamper. No in-place tests were conducted on the material.

5. CONSTRUCTION QUALITY ASSURANCE - GEOSYNTHETICS

5.1 General

The following types of geosynthetic materials were deployed in Phase II:

- 60-mil thick textured HDPE geomembrane liner was installed over the low-permeability soil layer; and
- 24 oz/sy non-woven geotextile cushion was installed over the geomembrane liner.

Geosyntec CQA personnel monitored installation of geosynthetic components of the SCA. Field and laboratory tests were conducted to assure that the material properties were in compliance with construction documents and that prescribed installation procedures were followed. The specific geosynthetic monitoring and testing activities are described in the following subsections.

As part of the initial design, a hydrostatic puncture test was performed on a geosynthetic sandwich with gravel over an extended duration (e.g., minimum 50 hours) to verify that no puncture or holes were observed in the geomembrane after the application of a 5,000 lb/ft^2 normal stress. The tests were performed by SGI Testing Services, LLC (SGI) of Norcross, Georgia and were conducted in general accordance with ASTM D5514 (modified). Reference FCF Nos. 6 and 11 and Section 5.3 for additional details. The puncture test results are presented in Appendix G.

Interface direct shear testing was conducted on the liner system (i.e., gravel, geotextile cushion, geomembrane, and Marcellus LP soil). During construction the CQC and CQA requirements were modified to run one set of tests. The tests were performed by SGI, conducted in general accordance with ASTM D5321, under normal stresses of 700, 2,000, and 3,500 lb/ft^2. The peak and residual (or long-term) friction angles measured using the Marcellus low-permeability soil source indicated angles of 28 and 25 degrees, respectively; reference RFI Nos. 12 and 14 for additional details. The interface friction test results are presented in Appendix G.

Periodically during construction, temperatures fell below 40 degrees Fahrenheit (°F) and occasionally were below 32°F. As indicated in Geosynthetic Research Institute (GRI) Test Method GM9 – *Cold Weather Seaming Geomembranes*, the installation and seaming procedures were modified to take into consideration the colder temperatures (e.g., slower welding speeds) and increased moisture (e.g., panel edges were dried). However the installer did not use nor require moveable enclosures. The installer would typically conduct his production welding well after sunrise and well before sunset. Trial welds were used to confirm a welder's ability to seam in the actual field conditions.

During seaming operations in the morning of 1 June 2012, light precipitation occurred periodically. Being at a critical location (i.e., adjacent to the highest elevation in the central portion of the cell), the installer completed deployment of the geomembrane (i.e., extend over past the high point) and seamed the deployed panels. After the installer non-destructively tested the seam, QC destructive samples were obtained. Based on passing results, Geosyntec marked out destructive seam samples on the required frequency, with additional samples obtained from the last four seams that were welded. See FCF No. 9 for further details.

5.2 CQA of Geomembrane

5.2.1 Conformance Testing and Documentation

A textured geomembrane was installed directly over the low-permeability layer. The geomembrane liner, Micro Spike®, was supplied by Agru America Inc. (Agru) of Georgetown, South Carolina. A total of 138 rolls were produced for the project, totaling 1,602,870 ft^2 in area. A total of 132 rolls were delivered initially, totaling 1,533,180 ft^2 in area. Near the end of the installation, the installer delivered the additional six rolls (Nos. 312330 through 312335) along with four additional rolls (Nos. 424799, 425101 through 425103). These additional rolls were used as part of the sacrificial flap that was installed on the exposed portions of the perimeter berms. No conformance samples were obtained from these final four additional rolls; see RFI No. 26 for details.

Geomembrane conformance samples were taken from the 60-mil thick HDPE textured geomembrane rolls used to construct the lining system in the manufacturer's plant. A total of seven (7) conformance samples were obtained (not including one sample obtained for interface friction testing). The sample frequency of one sample per 228,981 ft^2 of produced material exceeds the minimum acceptable sample frequency of one sample per 250,000 ft^2 required by the CQA Plan. A total of 1,087,333 ft^2 was installed, as observed by CQA personnel.

The conformance test results for the 60-mil thick liner and the manufacturer's QC certificates were reviewed by CQA personnel and were found to be in compliance with the CQA Plan. The geomembrane manufacturer's QC documentation, including the resin and geomembrane certifications, and the conformance tests are presented in Appendix F and Appendix G, respectively.

5.2.2 Field Monitoring Activities

5.2.2.1 Delivery and On-Site Storage

Upon delivery to the site, geomembrane rolls were stored in an area located to the southeast of the construction area. The rolls were typically transported by a Caterpillar 299C compact track loader or a Caterpillar TL943 telehandler. CQA personnel periodically monitored the installer's delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner. The CQA personnel also compared the roll numbers of the geomembrane rolls delivered to the manufacturer's bill of lading and maintained an inventory of delivered materials.

5.2.2.2 Deployment

Prior to geomembrane deployment, the surface of the LP soil barrier layer was visually checked for cracks and sharp objects. The installer signed certificates of acceptance of the subgrade surface, which are presented in Appendix H. The geomembrane rolls were lifted using a spreader bar attached to a tracked excavator or compact track loader. Prior to deployment and when needed, the surface of the low-permeability soil layer was prepared by pulling a weighted, chain link fence behind a four-wheel, low-ground pressure, all-terrain vehicle (ATV) or with a compact track loader with a smooth drum attachment.

During deployment, a 16 gauge, solid, type S wire was installed under geomembrane panels on approximately 200-ft centers. The installer connected one end with the existing Phase I wires and marked the south end of the wire for future reference for the leak location survey. Details of the leak location survey are provided in Section 5.2.3.2.

CQA personnel monitored the deployment of geomembrane panels. During deployment, the CQA personnel checked for the following:

- manufacturing defects;
- damage that may have occurred during shipment, storage, and handling; and
- damage resulting from installation activities, including damage as a consequence of panel placement, seaming operations, or weather.

If materials were observed to be damaged or deficient, the installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed and documented the repair locations to verify compliance with the CQA Plan. Details of the geomembrane panel placement were recorded by CQA personnel on panel placement logs, which are presented in Appendix I.

5.2.2.3 Trial Seams

Prior to production seaming, the installer prepared geomembrane trial seams for each technician using each piece of seaming equipment. Typically, either a Demtech Services Inc. Pro-Wedge or a Concord Geotech Services, LLC, welder was used. Additional trial seams were prepared every four to five hours or less during cold weather seaming. CQA personnel evaluated the trial seams as follows:

- trial seam samples in the beginning of the day were typically 15-ft long for fusion and 3 ft long for extrusion and over 12 in. wide;
- trial seams were welded under similar conditions as for seaming;
- test strips were cut from the trial seams at random locations across each trial-seam weld using a manual die press; each strip was 1 in. wide and 6 in. long; and
- test strips were tested for seam strength using a calibrated field tensiometer; two of the weld test strips were tested two in peel and two were tested in shear; the passing criteria for the tests were as follows:

  Fusion

  - *Peel tests* - a minimum bonded seam strength of 91 lb/in - Film Tear Bond (FTB); and
  - *Shear test* - a minimum bonded seam strength of 120 lb/in.

  Extrusion

  - *Peel test* - a minimum bonded seam strength of 78 lb/in - FTB; and
  - *Shear test* - a minimum bonded seam strength of 120 lb/in.

A total of 289 trial seams were observed by CQA personnel during Phase II construction; 183 trial seams were made using double-track fusion (i.e., hot wedge) welders and 106 were made using extrusion welders. All of the trial welds meet the criteria above.

Trial seam samples were not archived. Details of the trial seams, including the trial seam test results, are presented in Appendix J. The calibration certificates for the tensiometers are also provided.

5.2.2.4 Production Seams

Geomembrane production seaming operations were monitored by CQA personnel. The majority of the geomembrane production seams were fabricated using double-track fusion welders. Seam repairs were made using hand-held extrusion welders. Rub sheets were periodically used during production seaming to provide a clean surface to weld over. During or after fabrication, the geomembrane seams were visually examined for workmanship and continuity. Geomembrane seaming logs are presented in Appendix K.

5.2.3 Nondestructive Testing

5.2.3.1 Scope

Nondestructive testing of geomembrane was periodically monitored by CQA personnel. Leak location survey was performed on the geomembrane liner. Spark test was conducted on temporary pipe boot. Geomembrane seams were nondestructively tested for continuity by the installer using the air pressure procedure for double-track fusion seams and the vacuum-box test procedure for extrusion-welded seams. Failed air-pressure test seams, if applicable, were capped and then retested using vacuum-box test methods after determining the failed seam length. Leaks identified using the vacuum-box method were repaired and retested as described in Section 5.2.5.

5.2.3.2 Leak Location Survey

As required by the CQA Plan, an electrical leak location method was used to survey the installed geomembrane liner. An independent contractor, THG Geophysics Ltd (THG) of Murrysville, Pennsylvania, conducted the surveys. The surveys were performed following ASTM D7703 - *Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance System* (water lance method) and ASTM D7007 - *Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials* (dipole method).

On the exposed geomembrane on the east and west berms, the water lance method was performed by applying a 12 volt direct current to a flow of water between two electrodes.

After placement of the gravel drainage layer, THG re-mobilized several times to perform dipole method survey that involved establishing a direct current was between a stainless steel cathode (installed in the gravel) and the anode (16-gauge wire under the liner). Water was added, as needed, using a water truck or sprinkler. Anomalies in the potentiometric measurements caused by electrical current flowing through probable holes were monitored.

During surveys of the geomembrane liner, nine defects were positively identified. The contractor removed the overlying drainage gravel and geotextile in the identified areas and the geomembrane was observed by project personnel for obvious holes or tears. The located damage was repaired and vacuum-tested by the installer as described in Section 5.2.5. Resurvey of the repaired area and areas disturbed during rework of the gravel drainage layer was conducted.

5.2.3.3 Air Pressure Testing

Accessible double-track fusion seams were nondestructively tested using the air pressure test. The procedure used by the installer for air pressure testing was as follows:

- visually observe the integrity of the annulus of the section of seam being tested and isolating the section by sealing the ends using heat and pressure;
- insert the needle of a pressure test apparatus into the annulus at one end of the seam;
- inflate the annulus to a gauge pressure of a minimum 25 - 30 psi with an air pump and maintain the gauge pressure for at least five minutes;
- if the pressure loss exceeded 3-psi, or if the pressure did not stabilize, the faulty area was repaired in accordance with Section 5.2.5 of this report; and
- confirm airflow through the entire annulus by releasing the air from the seam at the opposite end from where the needle was inserted.

Nondestructive test results are presented with the production seam logs in Appendix K.

5.2.3.4 Vacuum-Box Testing

The vacuum-box was used by the installer to nondestructively test extrusion seams and repairs. The procedure used by the installer for vacuum testing was as follows:

- wet a strip of seam with a soapy solution;
- place the vacuum-box assembly over the wetted area, close the bleed valve and open the vacuum valve;
- force the box onto the sheet until 5-psi vacuum is observed;
- examine the seam through the viewing window for a period of approximately 20 seconds (when observed by CQA personnel) for the occurrence of air bubbles;
- remove the assembly and continue the process over the entire seam with a typical 3-in wide overlap; and
- record the location of any leaks.

If nondestructive testing indicated repairs were necessary, repairs were made in accordance with procedures presented in Section 5.2.5 of this report and vacuum testing was repeated. Vacuum test results are presented with the production seam logs and repair summary logs in Appendices K and L, respectively.

5.2.3.4 Spark Testing

Geomembrane boots were welded around pipe penetrations (e.g., inclinometer located in Phase II). A spark test was used to nondestructively test extrusion seams used to fabricate the pipe boots. The spark test requires a continuous copper wiring to be extrusion welded into the seam. An electric current is applied while a probe is passed next to the seam. Any seam discontinuity is detected by the generation of a spark passing between the wire and the probe. When a spark was observed, repairs were made and the seam re-tested. After being non-destructively tested, three stainless steel straps with neoprene gaskets were installed and the ends of the pipe penetration were sealed using a silicone sealant. The pipe boot for inclinometer, S1-G1, was later removed and repaired (see Section 5.2.5 for details).

5.2.4 Destructive Seam Sample Testing

5.2.4.1 Scope

In accordance with the CQA Plan, CQA personnel identified and collected geomembrane seam samples for destructive testing. The samples were tested in the field prior to being forwarded to the independent laboratory, GTX.

During Phase II construction, 114 geomembrane seam samples were taken initially from approximately 53,286 linear ft of production seams constructed. This corresponds to an approximate sample frequency of one per 467 linear ft of production seams. This frequency meets the minimum acceptable sample frequency of one per 500 linear ft of production seams, as required by the CQA Plan. Prior to the removal of the full seam sample, two geomembrane test strips were taken by the installer from either end of the destructive sample. Each strip was peel-tested in the field. If the peel samples exhibited passing results, the adjacent destructive seam sample was shipped to the laboratory for testing.

For a destructive seam sample to be considered as passing, the seam strength criteria, which are described in Section 5.2.4.3, had to be met.

5.2.4.2 Sampling Procedures

At each destructive seam sample location, a test sample measuring approximately 12 in. across the seam and 42 in. along the seam was obtained. The sample was divided into three pieces and distributed to: (i) the geosynthetics laboratory for testing, (ii) the installer, and (iii) for an on-site archive.

5.2.4.3 Test Results

Off-site laboratory testing of geomembrane seam samples was performed in accordance with the CQA Plan. At the testing laboratory (i.e., GTX), 1-in wide test specimens were removed from the destructive seam sample using a die press. On a calibrated tensiometer, five test specimens were peel-tested for adhesion strength. For fusion seams, peel tests were performed on both the inside and outside tracks. Additionally, five specimens were tested for shear strength. The seam strength acceptance/rejection criteria described in Section 5.2.2.3 were used to evaluate the destructive seam samples.

For Phase II, a total of 114 initial destructive sample locations were selected of which eight samples failed (DS Nos. 34, 49, 55, 72, 73, 88, 97, and 108). Several of these failures were observed along the Phase I tie-in even though the installer took measures to clean the Phase I edge.

During testing operations, five samples (DS 49, 55, 88, 97 and 108) were observed to fail field-testing; while three original samples were noted to fail laboratory testing. In the case of failed samples, additional test strips were taken from the seam at locations approximately 10 ft from each side of the failing sample location. If the additional test strips had passing results, a full destructive seam sample was taken. If the samples did not pass, test strips were obtained at another location approximately 10 ft further from the failure, repeating until passing samples were obtained and the failing area was localized (an additional seven bounding samples initially failed in the laboratory). Once the bounds of the failing seam were determined, the entire seam length between the passing samples was repaired by the procedures described in the following subsection. For extended repairs (i.e., greater than 150-ft), a destructive sample was obtained from the repair. A total of four destructive samples were removed from capped areas (DS Nos. 49C, 72C, 97C, and 108C); all passed the seam strength acceptance/rejection criteria described in Section 5.2.2.3. The destructive seam test results and the panel layout drawings are presented in Appendix L and Appendix P, respectively.

5.2.5 Geomembrane Repairs

The repair procedures presented in this subsection were used by the installer to patch holes and tears, spot-extrude impact damage or other minor scratches. In the cases where patches or caps were used to repair the damaged geomembrane (i.e., small holes, tears, or on seams which failed nondestructive or destructive testing), an approximately 12-in wide capping strip was used.

During the repair or panel tie-in operations, the following procedures were implemented:

- technicians and seaming equipment used were required to pass trial welds;
- patches or caps extended at least 6-in beyond the edge of the defect and all corners were rounded; and
- repairs were vacuum tested and visually observed for continuity.

As previously mention, an existing inclinometer, SI-G1, had a temporary geomembrane boot installed. RFI-026 required that the inclinometer be decommissioned. At Parson's direction, ATL monitored the inclinometer's abandonment that required removal of the boot; see Appendix O for a copy of their report. On 3 and 4 April 2013, Geosyntec monitored the repairs to the geomembrane and geotextile as well as placement of the gravel layer.

Seam and panel repair logs are presented in Appendix M. Complete panel layout drawings illustrating the location of seam and panel repairs are shown in the record drawings in Appendix P.

5.3 CQA of Geotextile

5.3.1 Conformance Testing and Documentation

A non-woven geotextile was used as a cushion between the gravel drainage layer and geomembrane liner. The majority of the non-woven geotextile (267 rolls of GE-240) was manufactured by Skaps of Athens, Georgia. At the end of the project additional geotextile (seven rolls of GSE NW24) was manufactured by GSE Lining Technology, LLC (GSE) of Kingstree, South Carolina. The needle-punched, non-woven geotextile has a nominal weight per unit area of 24-oz/yd^2.

A total of six (6) passing conformance samples were obtained (not including one sample obtained for interface friction testing) from the 274 rolls delivered; totaling 1,217,250 ft^2 in area. The sampling frequency of one sample per 202,875 ft^2 of material exceeds the minimum acceptable sample frequency of one per 250,000 ft^2 required by the CQA Plan.

During the design phase, a hydrostatic puncture test, ASTM D5514 (modified), was performed on a geosynthetic sandwich over a 55 hour duration to verify that no puncture or holes were observed in the geomembrane after the application of a 5,000 lb/ft^2 normal stress. During Phase II geotextile installation and prior to placement of the gravel drainage layer, the geotextile exposure exceeded the ultraviolet (UV) exposure requirement of fourteen days (reference Section 02710 Part 3.01.c). To confirm the now-woven geotextile would function as intended after exposure, an exposed geotextile sample was obtained and a similar hydrostatic puncture test, ASTM D5514 (modified), was performed to verify that no puncture or holes were observed in the geomembrane after the application of a 5,000 lb/ft^2 normal stress; see FCF Nos. 6 and 11 for details and Appendix G for results.

The conformance test results and the manufacturer's quality control (QC) letters and certificates were reviewed by CQA personnel and were found to be in compliance with the CQA Plan. The manufacturer's QC certificates and the results of the conformance tests were presented in Appendices F and G, respectively.

5.3.2 Field Monitoring Activities

5.3.2.1 Delivery and On-Site Storage

Upon delivery to the site, geotextile rolls were typically stored in an area located south of the construction area. The geotextile rolls were transported on site by a Caterpillar 299C compact loader or Caterpillar TL 943 telehandler. CQA personnel periodically monitored the delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner. An inventory of delivered rolls was maintained by CQA personnel.

5.3.2.2 Deployment and Seaming

The non-woven geotextile was manually unrolled over the geomembrane liner. CQA personnel monitored the deployment of the non-woven geotextile rolls for manufacturing defects, damage that may have occurred during shipment, storage, and handling, and damage resulting from installation activities. If any materials were observed to be damaged, the installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed repair locations to verify conformance with the requirements of the CQA Plan.

After deployment of the geotextile, CQA personnel observed that the installer overlapped geotextile panels a minimum of 4 to 6-in then used a wedge welder to seam the panels together. As a precaution prior to placement of gravel, tarpaulins were deployed over central and eastern portions of installed geotextile as ultra-violet protection. The temporary tarpaulins were ballasted with sand bags. The tarpaulins were re-located typically eastwards as gravel placement proceeded.

As required by the CQA Plan, Parsons prepared a geotextile panel layout. A copy of the panel layout is presented in Appendix P.

7. SUMMARY AND CONCLUSIONS

Observation of the construction of Phase II at the Onondaga Lake Sediment Consolidation Area was performed by Geosyntec during the period of 26 March to 14 November 2012 and 3 and 4 April 2013 for a repair. During this time, CQA personnel monitored the installation of the following components:

- earthwork (subgrade preparation, engineered fill, compacted low-permeability soil liner, and gravel drainage layer construction); and
- geosynthetics (geomembrane liner and geotextile cushion).

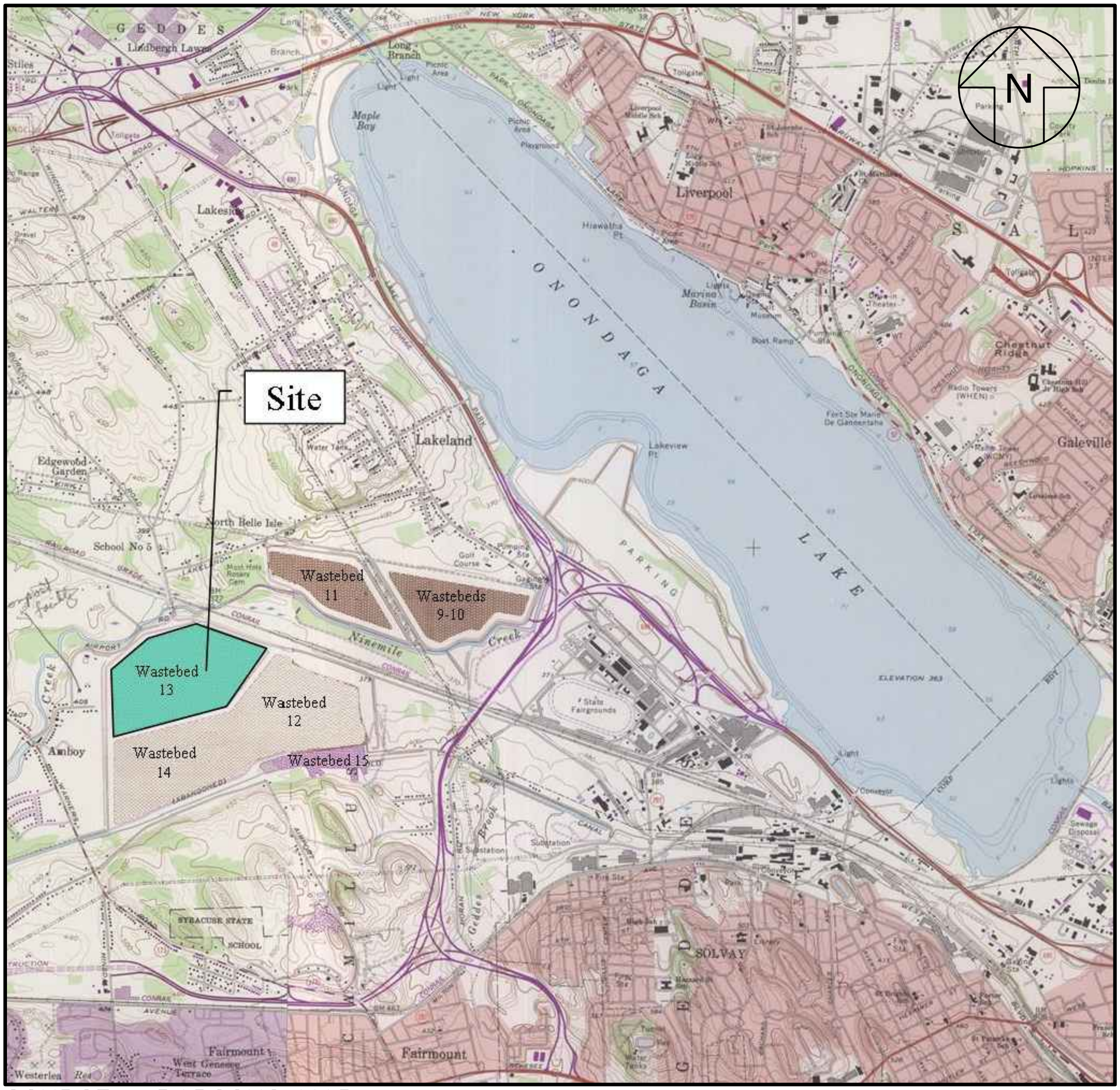
During construction of the above components, CQA personnel verified that conformance and CQA testing were performed on the construction materials at the frequencies required in the CQA Plan (as defined in Section 3.1.2 of this report), and that materials meeting the CQA Plan requirements were used. CQA personnel also verified that conditions or materials identified as not conforming to the CQA Plan were replaced, repaired, and/or retested, as described in this report.

The results of the CQA activities undertaken by Geosyntec as described in this report indicate that Phase II of the Onondaga Lake Sediment Consolidation Area was constructed in accordance with the Specifications, as well as the design clarification (i.e., RFIs and FCFs).

Marcus Fountain CQA Manager	David J. Bonnett, P.E. CQA Engineer-of-Record New York PE #89889

I, David J. Bonnett, certify that I am currently a New York State Registered Professional Engineer, who had primary responsibility to ensure implementation of the subject construction program, and that I certify that the Remedial Design Plans and Specifications were implemented and that construction activities were completed in substantial conformance with the approved NYSDEC approved Remedial Design and Specifications including modifications approved by the Designer and/or NYSDEC.

SITE LOCATION MAP



SOURCE: PARSONS MAP

L:\CADD\O\ONONDAGA LAKE\PERMIT\SCA GEOTUBES\ISSUED FOR CONSTRUCTION REV-0\REDUCED SET (NO FINAL COVER)\4706F001

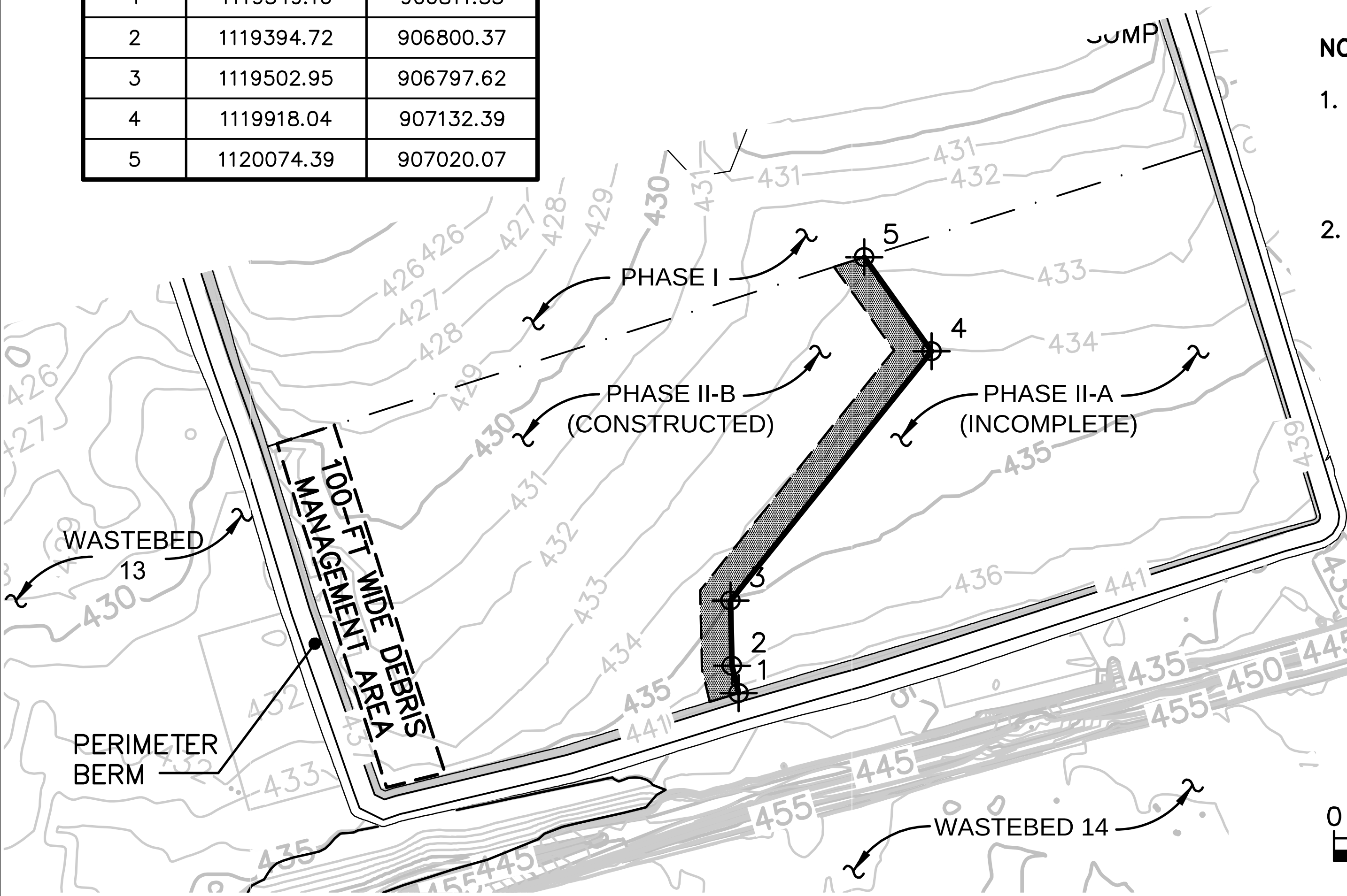
Geosyntec consultants

KENNESAW, GA

DATE:	May–12	SCALE:	NTS
PROJECT NO.	GJ4706B	FILE NO.	4706f001
DOCUMENT NO.	–	FIGURE NO.	1

LIMITS OF PHASE II

SURVEY CONTROL DATA		
NAME	NORTHING	EASTING
1	1119349.16	906811.53
2	1119394.72	906800.37
3	1119502.95	906797.62
4	1119918.04	907132.39
5	1120074.39	907020.07



NOTES:

1. TOP OF LOW PERMEABILITY SOIL LAYER CONTOURS ARE SHOWN WITHIN PHASES I AND II.
2. WATER PRODUCED BY OPERATION OF PHASE II–B SHALL BE CONTROLLED TO PREVENT OVERFLOW INTO PHASE II–A

0 300' 600'
SCALE IN FEET

LEGEND

430 ELEVATION CONTOUR (FEET)

PHASE BOUNDARY

LIMIT OF PHASE II–B CERTIFICATION

50–FT OPERATIONAL BUFFER

CONTROL POINT

Geosyntec consultants

KENNESAW, GA

DATE:	Oct–12	SCALE:	AS SHOWN
PROJECT NO.	GJ4706B	FILE NO.	4706F001
DOCUMENT NO.	GA120495	FIGURE NO.	2

L:\CADD\O\ONONDAGA LAKE\PERMIT\SCA GEOTUBES\CQA\PHASE II CERTIFICATION\DRAWINGS\4706F001