

**Conceptual Closure Plan for
Cell 1 of Horizontal Expansion of
Original Combustion Waste Storage Area**

**Orlando Utilities Commission
Stanton Energy Center
Orange County, Florida**

October 14, 2016



Ardaman & Associates, Inc.

Geotechnical, Environmental, and
Materials Consultants
A Tetra Tech Company

OFFICES

Orlando, 8008 S. Orange Avenue, Orlando, Florida 32809, Phone (407) 855-3860
Alexandria, 3609 Mac Lee Drive, Alexandria, Louisiana 71302, Phone (318) 443-2888
Bartow, 1525 Centennial Drive, Bartow, Florida 33830, Phone (863) 533-0858
Baton Rouge, 316 Highlandia Drive, Baton Rouge, Louisiana 70884, Phone (225) 752-4790
Cocoa, 1300 N. Cocoa Blvd., Cocoa, Florida 32922, Phone (321) 632-2503
Fort Myers, 9970 Bavaria Road, Fort Myers, Florida 33913, Phone (239) 768-6600
Miami, 2608 W. 84th Street, Hialeah, Florida 33016, Phone (305) 825-2683
Monroe, 1122 Hayes Street, West Monroe, Louisiana 71292, Phone (318) 387-4103
New Orleans, 1305 Distributors Row, Suite I, Jefferson, Louisiana 70123, Phone (504) 835-2593
Port St. Lucie, 460 Concourse Place NW, Unit 1, Port St. Lucie, Florida 34986, Phone (772) 878-0072
Sarasota, 78 Sarasota Center Blvd., Sarasota, Florida 34240, Phone (941) 922-3526
Shreveport, 7222 Greenwood Road, Shreveport, Louisiana 71119, Phone (318) 636-3673
Tallahassee, 3175 West Tharpe Street, Tallahassee, Florida 32303, Phone (850) 576-6131
Tampa, 3925 Coconut Palm Drive, Suite 115, Tampa, Florida 33619, Phone (813) 620-3389
West Palm Beach, 2200 N Florida Mango Road, Suite 101, West Palm Beach, Florida 33409, Phone (561) 687-8200

MEMBERS:

ASCE Geo-Institute
ASTM International
ACEC of Louisiana
American Concrete Institute
Florida Institute of Consulting Engineers
ASFE/The Geoprofessional Business Association



Ardaman & Associates, Inc.

Geotechnical, Environmental, and
Materials Consultants

A Tetra Tech Company

October 14, 2016
File Number 16-13-0099

Orlando Utilities Commission
P.O. Box 3193
Orlando, FL 32802-2723

Attention: Mr. Charles W. Doud, P.E.
Senior Environmental Engineer

Subject: Conceptual Closure Plan for Cell 1 of Horizontal Expansion of Original Combustion Waste Storage Area, Orlando Utilities Commission, Stanton Energy Center, Orange County, Florida

Gentlemen/Ladies:

As requested and authorized by Orlando Utilities Commission (OUC), Ardaman & Associates, Inc., a Tetra Tech Company (TT-AAI) presents herein a conceptual closure plan for the active coal combustion residuals (CCR) landfill unit at the Stanton Energy Center (SEC), in Orange County, Florida. The plan was required by the CCR rule issued by the United States Environmental Protection Agency (EPA), and published in the Federal Register on April 17, 2015.

Regulatory Requirements

Excerpts of the CCR rule requirements under *40 CFR § 257.102 Criteria for conducting the closure or retrofit of CCR units*, which are pertinent to closure plans for CCR landfills that receive wastes on or after October 19, 2015, are as follows:

40 CFR § 257.102 (b) Written closure plan—(1) Content of the plan. The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.

- (i) A narrative description of how the CCR unit will be closed in accordance with this section.*
- (ii) If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.*
- (iii) If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.*
- (iv) An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.*

- (v) *An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life.*
- (vi) *A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR unit closure. ...*

The owner or operator of the CCR unit must submit an initial written closure plan consistent with the above requirements no later than October 17, 2016. The owner or operator may amend the initial or any subsequent written closure plan at any time, and must amend the written closure plan whenever there is a change in the operation of the CCR unit that would substantially affect the plan; or if unanticipated events necessitate a revision of the plan.

Applicable requirements for the final closure system are stipulated under *40 CFR § 257.102(d) Closure performance standard when leaving CCR in place*, as follows:

40 CFR § 257.102 (d) (1) *The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:*

- (i) *Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;*
- (ii) *Preclude the probability of future impoundment of water, sediment, or slurry;*
- (iii) *Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;*
- (iv) *Minimize the need for further maintenance of the CCR unit; and*
- (v) *Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.*

40 CFR § 257.102 (d) (3) *Final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.*

- (i) *The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.*
 - (A) *The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.*
 - (B) *The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.*

- (C) *The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.*
- (D) *The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.*

CCR Landfill Units

As shown in Figure 1, the area that was designated for disposal or storage of combustion wastes generated at the SEC is located on the west side of the facility. Initially, the entire combustion waste storage area (CWSA) occupied approximately 312 acres. However, construction of Innovation Way to the west of the SEC and development of the solar energy site in the northern part of the CWSA have reduced the footprint of the designated CWSA to approximately 250 acres.

Waste materials that have been landfilled within the designated CWSA since commencement of commercial operation of the first coal-fired generating unit in 1987 include fixated flue gas desulfurization (FGD) sludge (ProMat), unsold bottom ash, fly ash, and miscellaneous power plant wastes.

An annotated 2016 aerial photograph that shows the existing and planned CCR landfill units, which are all located on the south side of the designated CWSA footprint, is displayed in Figure 2. As shown, these landfill units consist of the original combustion waste storage area (original CWSA), the vertical expansion above the original CWSA (vertical expansion), and the horizontal expansion on the west side of the original CWSA (horizontal expansion). The north side of the designated CWSA footprint remains undeveloped at this time.

The original CWSA, which was placed in service in 1987 when the SEC began commercial operation, was lined with a layer of ProMat with a thickness of more than 18 inches and a hydraulic conductivity of less than 1×10^{-7} cm/sec across the entire cell bottom. It occupies an area of approximately 90 acres, and was designed to have a top elevation of approximately +150 feet (NAVD88). In 2010, OUC planned to construct and operate a lined horizontal expansion on the west side of the original CWSA. To ensure uninterrupted waste disposal operation during planning, design, permitting, and construction of the horizontal expansion, OUC constructed a vertical expansion on top of the original CWSA. The vertical expansion consists of three cells referred to as Sequences 1 through 3, with a top elevation of approximately +175 feet (NAVD88), and two lower plateaus on the north side of Sequences 1 through 3, with a top elevation of approximately +158 feet (NAVD88).

The vertical expansion has a base area of approximately 34 acres, and a top area of approximately 20 acres, which comprise 16 acres of the top area of Sequences 1 through 3 plus 4 acres of the top area of the two lower plateaus. The development plan for the vertical expansion was approved by the Florida Department of Environmental Protection (FDEP) on April 8, 2011. Waste disposal in the vertical expansion occurred in three sequences, beginning with Sequence 1 in the south and proceeding northward through Sequences 2 and 3. The vertical expansion ceased to receive wastes on August 28, 2015. Final closure of the original CWSA and vertical expansion was substantially completed in January 2016, and was documented in a TT-AAI report titled "Certification of Closure of Original Combustion Waste Storage Area at the Orlando Utilities Commission, Stanton Energy Center," dated March 12, 2016. After closure, each sequence of the

vertical expansion has a top area of approximately 5 acres. The access ramp to the top of the closed vertical expansion is located on the north side.

The horizontal expansion consists of three landfill cells designated Cells 1, 2, and 3. Each cell has a base area of approximately 27 acres, and piggybacks on the western slope of the original CWSA and the vertical expansion. The design of Cells 1, 2, and 3 was approved by the FDEP on March 16, 2012. It incorporates a double geomembrane liner system at the base and a single geomembrane liner system on the slope that are consistent with applicable requirements of Chapter 62-701, F.A.C., which governs design, construction, and operation of solid waste management facilities in Florida. Construction of Cell 1 was completed on December 31, 2012. Cell 1 was divided into four sub-cells, each with its own leachate collection system and sump. The collected leachate is discharged to the CWSA Runoff Ponds located to the east of the designated CWSA. The construction completion report for Cell 1 was submitted to the FDEP Siting Coordination Office on October 16, 2013. Upon approval by the FDEP, Cell 1 began to receive wastes on May 28, 2015. At this time, Cells 2 and 3 have not yet been constructed.

Because the original CWSA and vertical expansion ceased to receive waste materials prior to October 19, 2015, these CCR landfill units are exempt from the CCR rule. However, Cell 1 of the horizontal expansion is an active CCR landfill unit and, therefore, is subject to the CCR rule requirements.

Existing Condition of Cell 1

Results of the latest topographic survey of the original CWSA, vertical expansion, and Cell 1, which was performed by Mikon Corporation on December 10-12, 2015, are presented in Figure 3. As shown, the top of the vertical expansion had an elevation of approximately +175 feet (NAVD88). The survey revealed that approximately 13 acres (i.e., approximately half of the total base area) of Cell 1 had been covered with wastes, with a maximum waste elevation of approximately +103 feet (NAVD88), which corresponds to an average waste height of approximately 10 feet. Waste placement has occurred mostly in the eastern portion of Cell 1, with no wastes along the northern, western, and southern borders of Cell 1; including, the areas on top of the four leachate collection sumps, which are located on the west side of the four sub-cells. Wastes have also not yet been placed on top of the east slope area of Cell 1 that piggybacks on the west slope of the original CWSA and vertical expansion.

Conceptual Closure Plan for Cell 1

The conceptual closure plan and associated cross sections for Cell 1 are depicted in Figures 4 and 5, respectively. As shown, Cell 1 is planned to be raised on a sideslope of 3.0 horizontal to 1.0 vertical (3.0H:1.0V) to a slope crest elevation of approximately +175 feet (NAVD88), with one 20-foot wide reverse sloping bench (i.e., a bench that is graded towards the inside to create a drainage swale) at approximate elevations of +142 to +140 feet (NAVD88).

The top of the Cell 1 will have an elevation that varies from +169 to +175 feet (NAVD88), and an average slope of approximately 0.65 percent to promote surface drainage towards an inlet structure located at the southwest corner. The inlet structure will be connected to an 18-inch diameter HDPE pipe for conveyance of the collected runoff down the slope to a stormwater runoff ditch that runs along the toe on the south and west sides of Cell 1.

The reverse sloping bench on the south and west sides of Cell 1 will be provided with two inlet structures to convey the collected runoff from the upslope areas into the stormwater runoff ditch that runs along the toe on the south and west sides of Cell 1. The water in the stormwater runoff ditch eventually discharges into the wet detention pond located to the south of the designated CWSA via two Type-D FDOT drainage control structures and two 36-inch diameter HDPE pipes. The locations of the drainage control structures and associated piping are shown in Figure 4.

The horizontal expansion, which consists of Cells 1, 2, and 3, was designed with base and slope liner systems that are consistent with applicable requirements in Chapter 62-701, F.A.C. Cell 2 of the horizontal expansion will be constructed before Cell 1 reaches the final design elevation. After Cell 1 has reached the final design elevation, the south slope, the west slope, and the top area of Cell 1, with a combined area of approximately 23 acres, will be closed. However, wastes will be placed against the north slope during operation of Cell 2, which abuts Cell 1 on the north side.

The final cover system for the south slope, the west slope, and the top area of Cell 1 will consist of the following key components in descending order:

- A sod cover for erosion protection.
- A minimum 2-foot thick protective soil layer for stormwater drainage and liner protection.
- A double-sided HDPE geocomposite connected to a gravel drain system for stormwater drainage and protective soil layer stability on the slope area.
- A 40-mil textured HDPE liner for infiltration control.
- A minimum 6-inch thick bedding soil layer for liner protection and support.

The proposed final cover system will extend beyond the liner anchor trench of the bottom liner system for Cell 1. The gravel drain system that will be installed along the inside of the reverse sloping bench and along the toe of slope will consist of a slotted HDPE pipe surrounded by gravel wrapped in a geotextile. The slotted HDPE pipes will be connected to a solid pipe that will discharge the infiltrated stormwater collected in the drains either to the inlet structures or to the stormwater runoff ditch that runs along the toes on the south and west sides of Cell 1.

The proposed closure design complies with the standards of § 257.102 (d)(3)(i)(A) through (D) cited previously, as well as the requirements of Rule 62-701.600(3)(g), F.A.C. Specifically, to comply with the requirements under § 257.102 (d)(3)(i)(A), the closure design incorporates an HDPE liner as the infiltration barrier because a geomembrane liner system was used as the bottom liner system.

Maximum Inventory of CCR in Cell 1

As noted previously, Cell 1 is currently the only active CCR landfill unit at the SEC. If Cell 1 is filled to the final design elevations shown in Figure 4, the total waste storage volume would be approximately 3 million cubic yards. Based on previous quality control testing by OUC and core borings through the original CWSA, the average dry density of the waste materials is on the order of 1 ton per cubic yard.

Based on the data provided by OUC, the amount of ProMat produced for the period of record varied from approximately 140,000 to 390,000 dry tons per year. The lowest annual ProMat production (140,000 dry tons) was recorded in 2012, and the highest annual ProMat production (234,000 dry tons) since 2012 occurred in 2014. Considering a landfill airspace of 3 million cubic yards and a total waste generation rate of 350,000 dry tons per year (i.e., an airspace consumption rate of 350,000 cubic yards per year), the storage life in Cell 1 is projected to be on the order of 8 years. Therefore, Cell 1 is expected to reach the final design elevations circa May 2023.

Schedule for Closure Activities

The closure activities for Cell 1 will involve planning, design, permitting, and construction. Assuming that Cell 1 will be filled to capacity and ready for closure in May 2023, the closure planning should begin around the middle part of 2022, and the closure design should be completed before the end of 2022 to provide 5 months for regulatory review and approval, and construction bidding. Closure construction for 23 acres of the south slope, the west south, and the top area may take up to 8 months. If Cell 1 is ready for closure in May 2023 and closure construction could proceed shortly thereafter, completion of the closure construction for Cell 1 would be in the early part of 2024. Preparation of the as-built survey and completion of the certification of closure construction will likely require approximately 2 months after closure construction has been completed. Allowing 3 months for regulatory review and approval of the closure construction, it is anticipated that Cell 1 can be considered officially closed by the summer of 2024.

It should be noted that fly ash production and waste generation are tied to power generation. Therefore, OUC should be cognizant of any plans that may increase or decrease energy production from coal in the future. Furthermore, OUC should periodically review the operation data, including airspace consumption, to make sure that the waste generation rate used in storage life projection continues to be valid, note any changes in processes that may affect waste generation and waste management planning and, if needed, update this conceptual closure plan periodically.

Closure

OUC should be cognizant of the following CCR rule requirements that relate to filings and notifications of closure plans for CCR landfills: (i) The most recent closure plan, including any amendment of the plan, must be maintained in the operating record at the facility as stipulated in 40 CFR § 257.105(i)(4); (ii) the State Director¹ must be notified of the availability of the written closure plan, and any amendment of the plan, as stipulated in 40 CFR § 257.106(i)(4); and (iii) the written closure plan, and any amendment of the plan, must be posted on the OUC website as stipulated in 40 CFR § 257.107(i)(4) no later than October 17, 2016.

To allow the operators to be aware of the final geometrical configuration of Cell 1, TT-AAI recommends that the conceptual closure plan be referenced or incorporated in the Landfill Operation Plan.

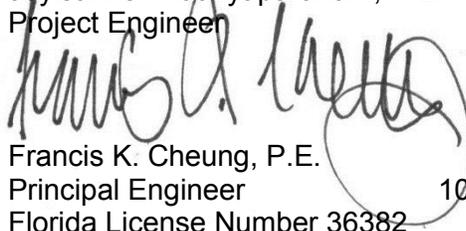
¹ In the CCR Rule, the State Director refers to “the chief administrative officer of the lead state agency responsible for implementing the state program regulating disposal in CCR landfills, CCR surface impoundments, and all lateral expansions of a CCR unit.”

TT-AAI appreciates the opportunity of providing our service to OUC. If you have any questions or need additional information, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC. – A Tetra Tech Company
Certificate of Authorization No. 5950



Jeyisanker Mathiyaparanam, P.E.
Project Engineer

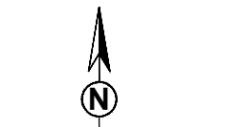
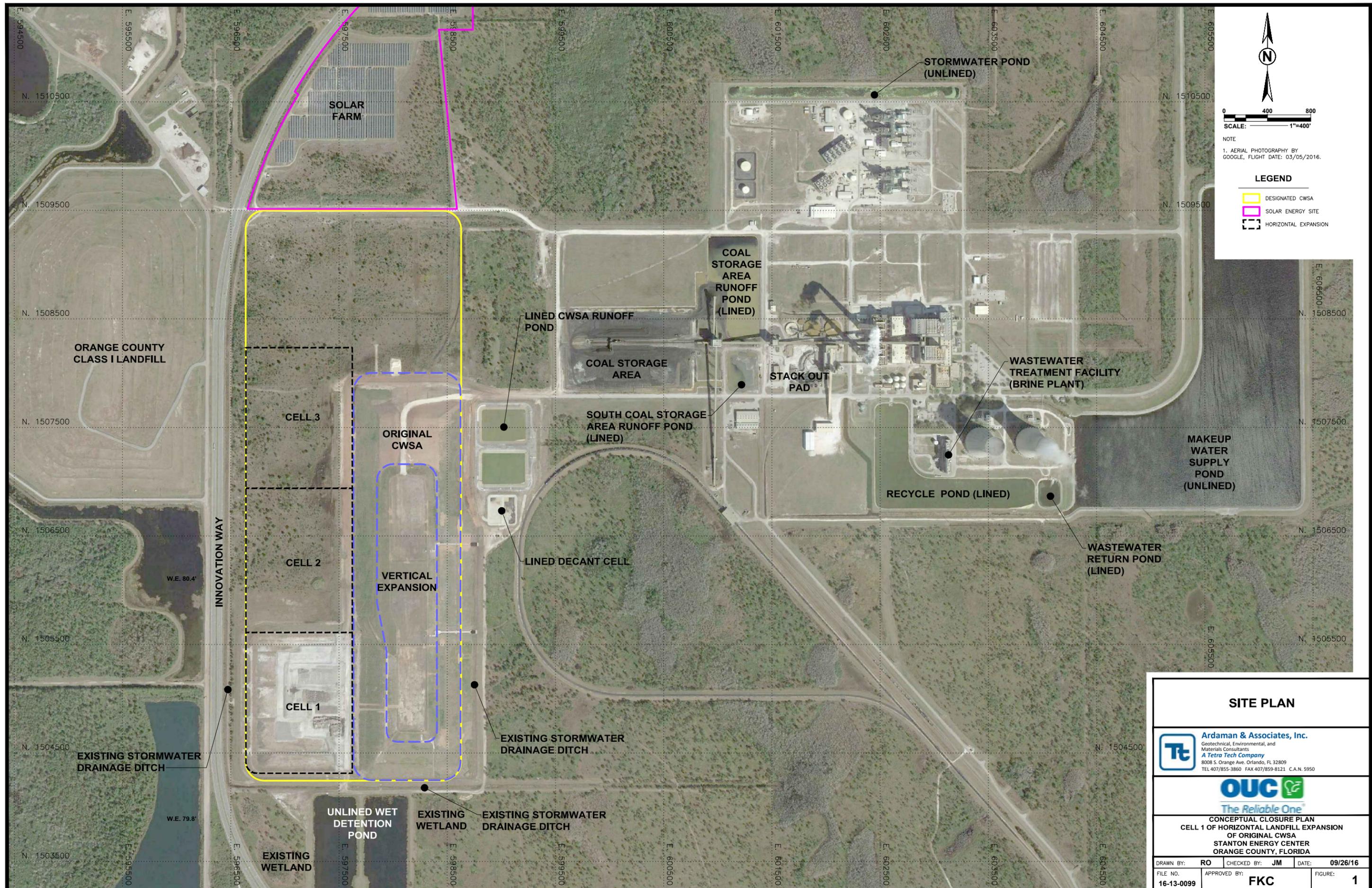


Francis K. Cheung, P.E.
Principal Engineer
Florida License Number 36382

10/14/16



Enclosures



0 400 800
SCALE: 1"=400'

NOTE
1. AERIAL PHOTOGRAPHY BY GOOGLE, FLIGHT DATE: 03/05/2016.

LEGEND

- DESIGNATED CWSA
- SOLAR ENERGY SITE
- HORIZONTAL EXPANSION

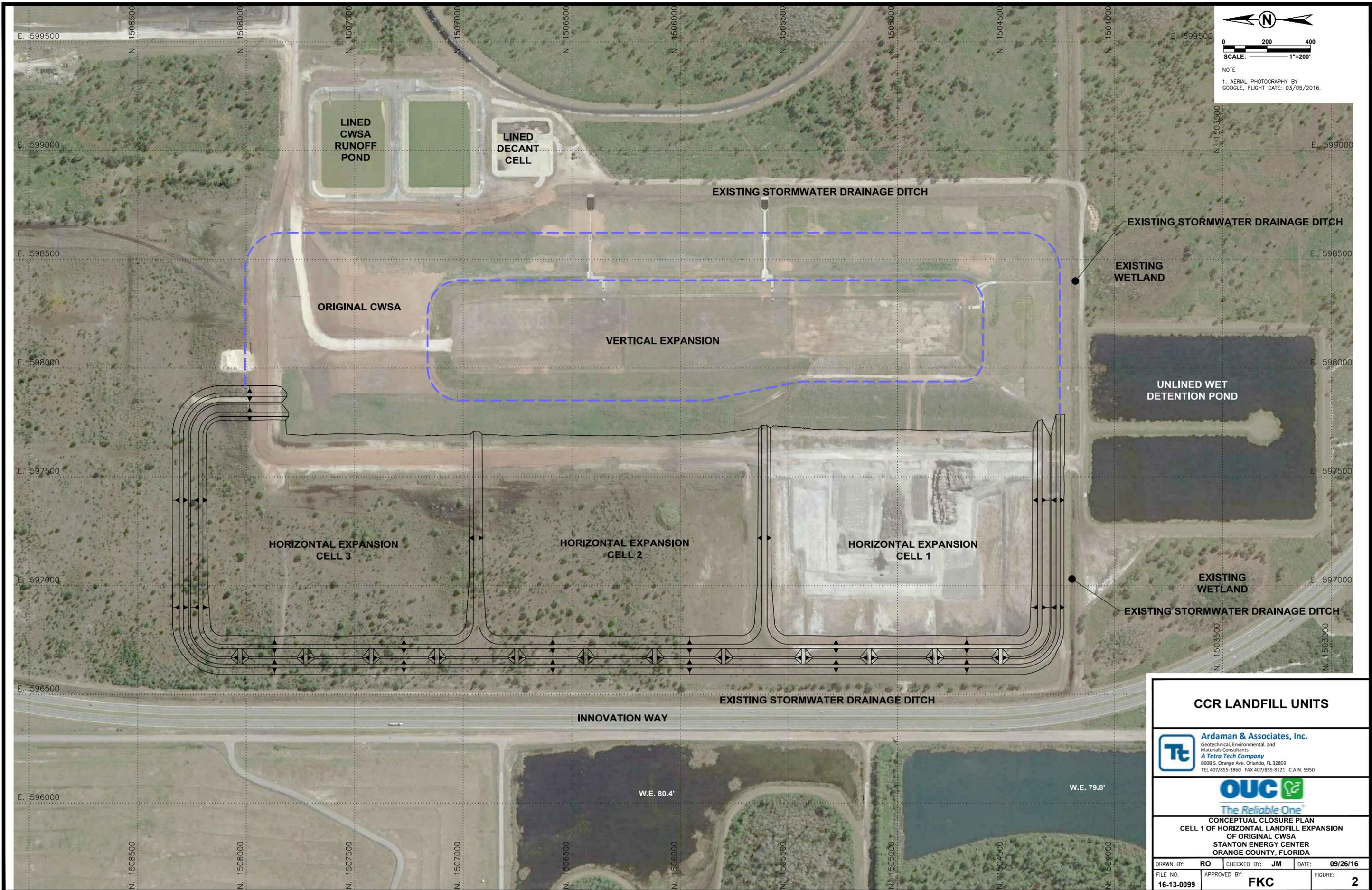
SITE PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental, and
Materials Consultants
A Tetra Tech Company
8008 S. Orange Ave. Orlando, FL 32809
TEL 407/855-3860 FAX 407/859-8121 C.A.N. 5950



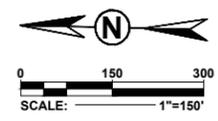
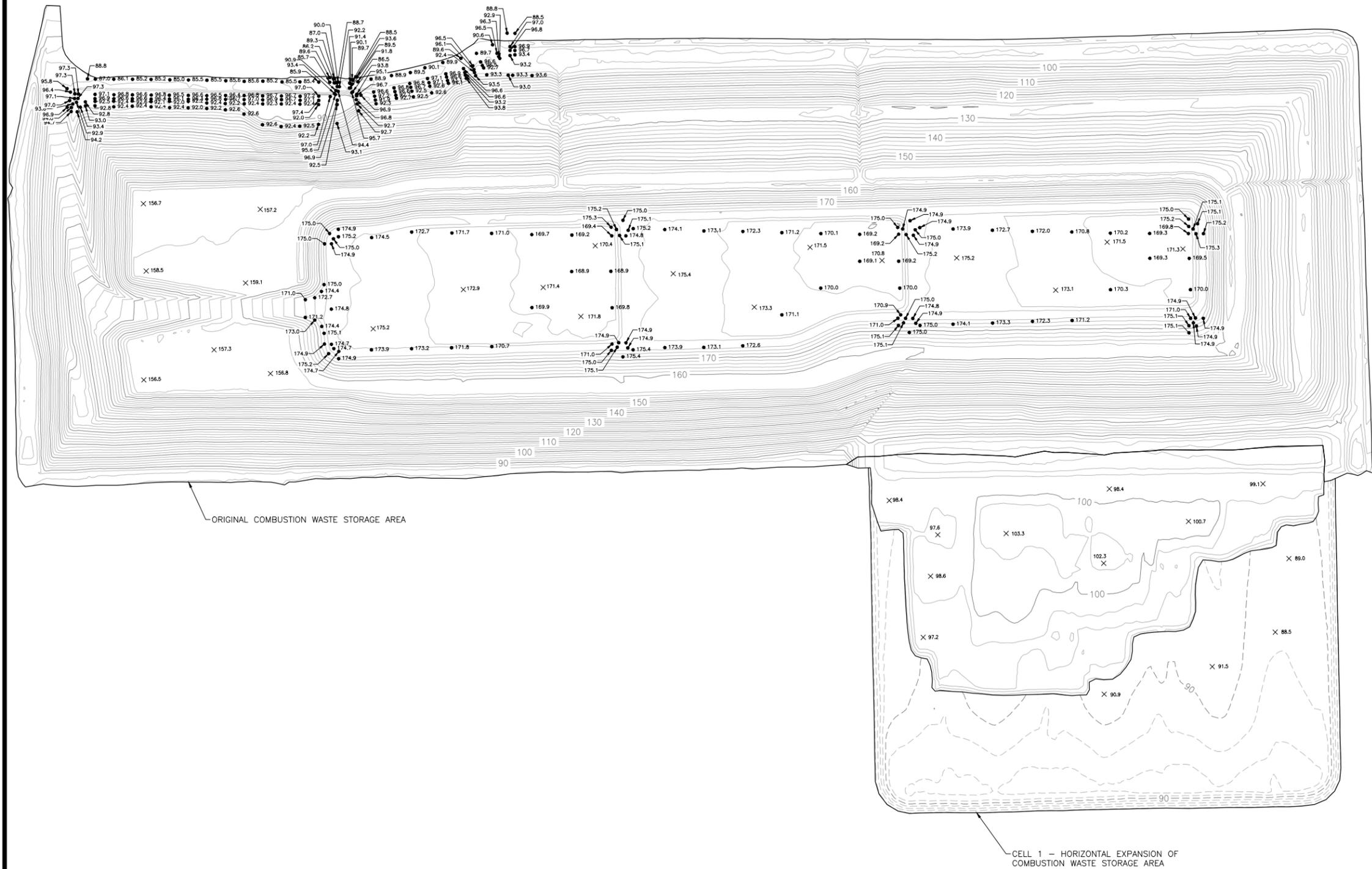
**CONCEPTUAL CLOSURE PLAN
CELL 1 OF HORIZONTAL LANDFILL EXPANSION
OF ORIGINAL CWSA
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA**

DRAWN BY: RO	CHECKED BY: JM	DATE: 09/26/16
FILE NO. 16-13-0099	APPROVED BY: FKC	FIGURE: 1




 0 200 400
 SCALE: 1"=200'
 NOTE
 1. AERIAL PHOTOGRAPHY BY GOOGLE, FLIGHT DATE: 03/05/2016.

CCR LANDFILL UNITS		
 Ardaman & Associates, Inc. <small>Geotechnical, Environmental, and Materials Consultants A Tetra Tech Company 8008 S. Orange Ave. Orlando, FL 32809 TEL 407/855-3860 FAX 407/859-8121 C.A.N. 5950</small>		
 OUC <small>The Reliable One</small>		
CONCEPTUAL CLOSURE PLAN CELL 1 OF HORIZONTAL LANDFILL EXPANSION OF ORIGINAL CWSA STANTON ENERGY CENTER ORANGE COUNTY, FLORIDA		
DRAWN BY: RO	CHECKED BY: JM	DATE: 09/26/16
FILE NO. 16-13-0099	APPROVED BY: FKC	FIGURE: 2



DATE OF MIKON SURVEY: DECEMBER 10 - 12, 2015

SHEET NOTES:

1. FIELD WORK AND MAPPING FOR LANDFILL TOPOGRAPHY PROVIDED BY MIKON CORPORATION.
2. EXPANSION AREA CONTOURS DEPICT SURFACE OF SOIL FILL AT TIME OF SURVEY ON SEPTEMBER 14 & 15, 2013.

X 173.1 SPOT ELEVATION BY MIKON

DATE OF AMEC SURVEY: MARCH 12, 2016

● 170.3 SPOT ELEVATION BY AMEC

ORIGINAL COMBUSTION WASTE STORAGE AREA

CELL 1 - HORIZONTAL EXPANSION OF COMBUSTION WASTE STORAGE AREA

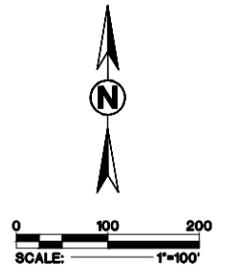
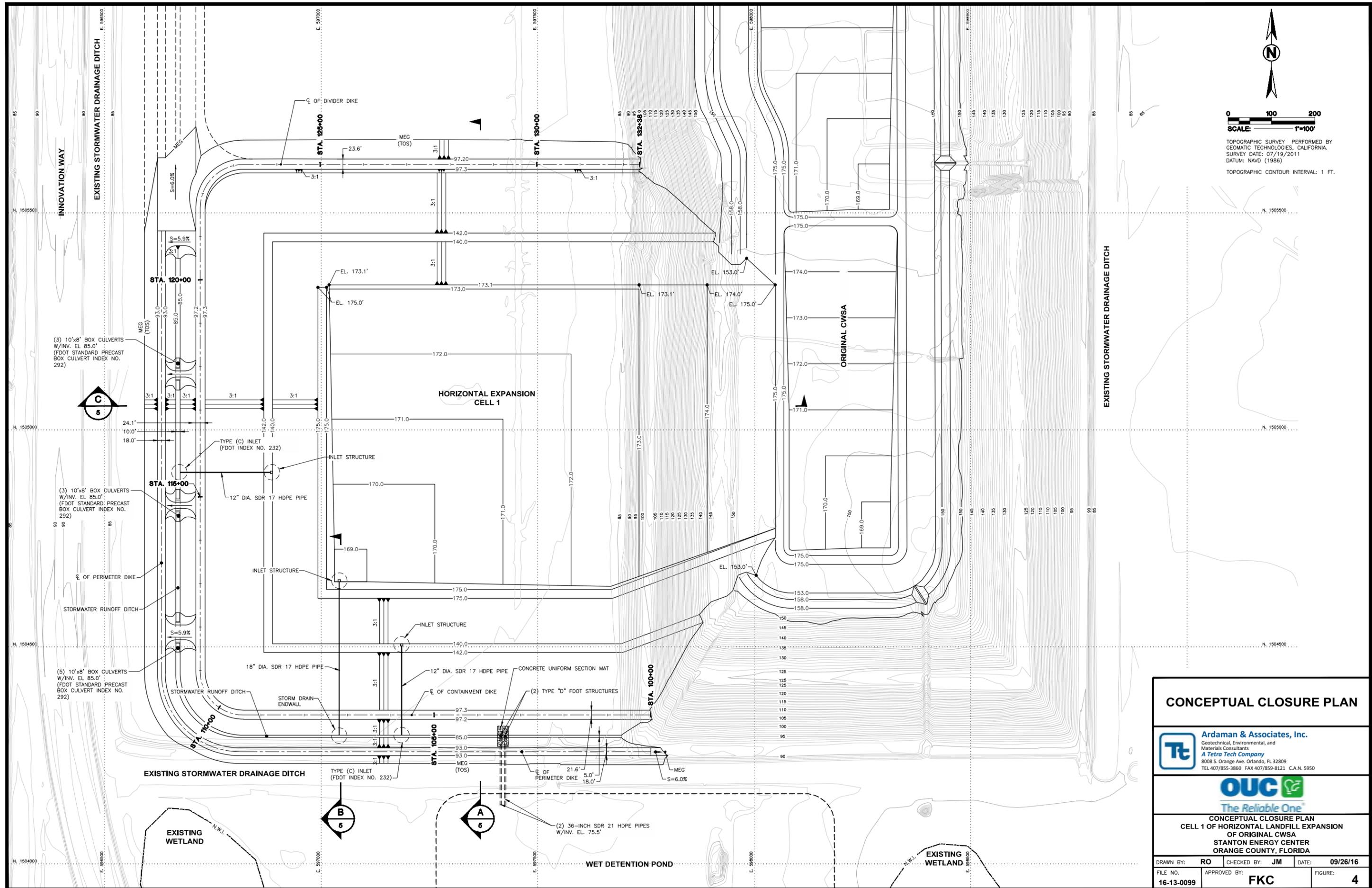
TOPOGRAPHIC SURVEY

Ardaman & Associates, Inc.
 Geotechnical, Environmental, and
 Materials Consultants
A Tetra Tech Company
 8008 S. Orange Ave. Orlando, FL 32809
 TEL 407/855-3860 FAX 407/859-8121 C.A.N. 5950



**CONCEPTUAL CLOSURE PLAN
 CELL 1 OF HORIZONTAL LANDFILL EXPANSION
 OF ORIGINAL CWSA
 STANTON ENERGY CENTER
 ORANGE COUNTY, FLORIDA**

DRAWN BY: RO	CHECKED BY: JM	DATE: 09/26/16
FILE NO. 16-13-0099	APPROVED BY: FKC	FIGURE: 3



TOPOGRAPHIC SURVEY PERFORMED BY
 GEOMATIC TECHNOLOGIES, CALIFORNIA.
 SURVEY DATE: 07/19/2011
 DATUM: NAVD (1986)
 TOPOGRAPHIC CONTOUR INTERVAL: 1 FT.

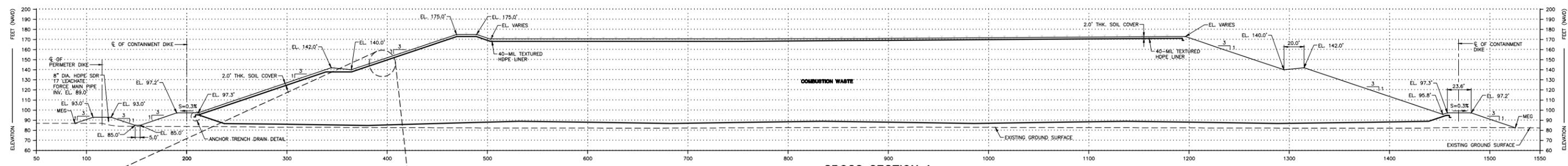
CONCEPTUAL CLOSURE PLAN

Ardaman & Associates, Inc.
 Geotechnical, Environmental, and
 Materials Consultants
A Tetra Tech Company
 8008 S. Orange Ave. Orlando, FL 32809
 TEL 407/855-3860 FAX 407/859-8121 C.A.N. 5950

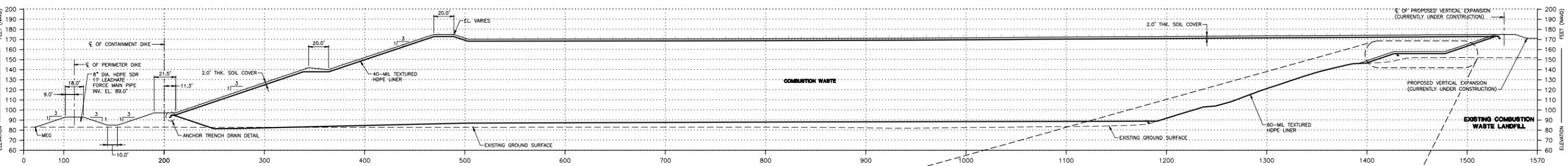
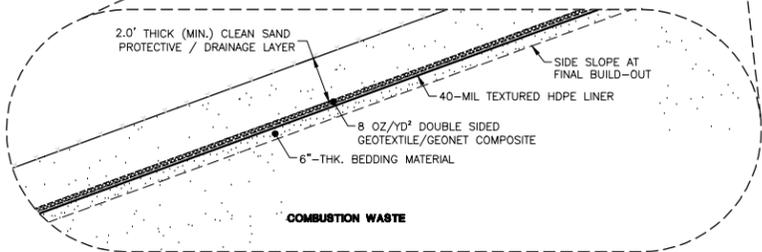


CONCEPTUAL CLOSURE PLAN
CELL 1 OF HORIZONTAL LANDFILL EXPANSION
OF ORIGINAL CWSA
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

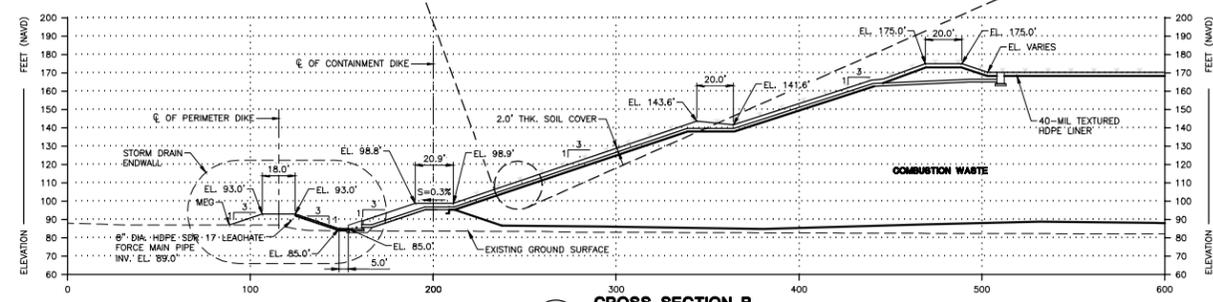
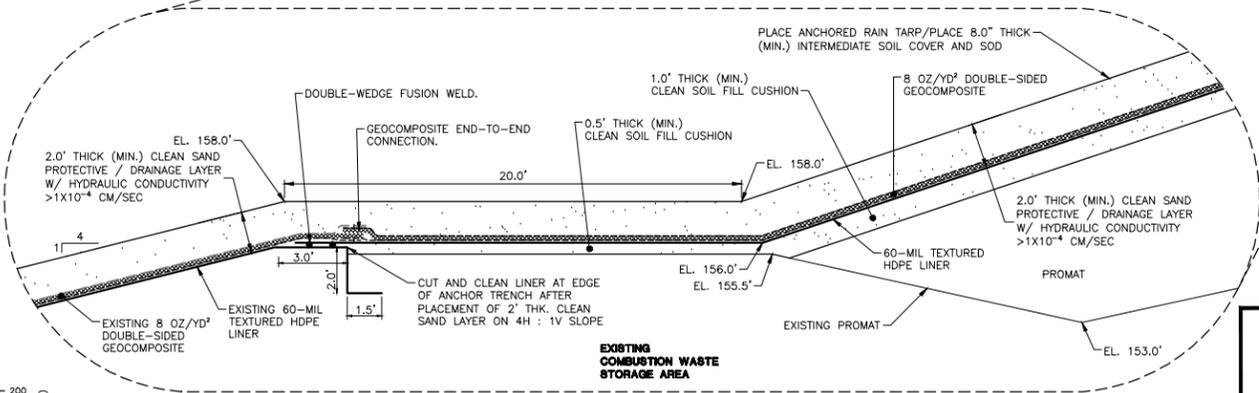
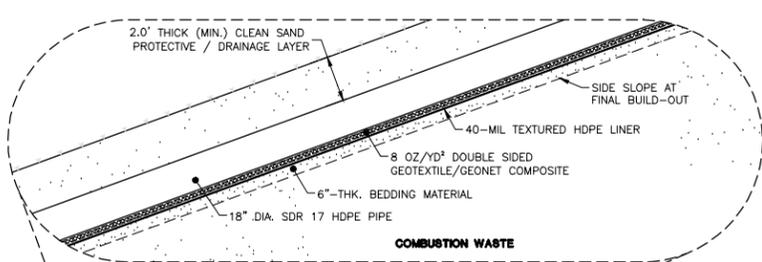
DRAWN BY: RO	CHECKED BY: JM	DATE: 09/26/16
FILE NO. 16-13-0099	APPROVED BY: FKC	FIGURE: 4



A
4
SCALE: 1" = 50'



C
4
SCALE: 1" = 50'



B
4
SCALE: 1" = 50'

CLOSURE CROSS SECTIONS

Ardaman & Associates, Inc.
Geotechnical, Environmental, and
Materials Consultants
A Tetra Tech Company
8008 S. Orange Ave. Orlando, FL 32809
TEL 407/855-3860 FAX 407/859-8121 C.A.N. 5950



CONCEPTUAL CLOSURE PLAN
CELL 1 OF HORIZONTAL LANDFILL EXPANSION
OF ORIGINAL CWSA
STANTON ENERGY CENTER
ORANGE COUNTY, FLORIDA

DRAWN BY: RO	CHECKED BY: JM	DATE: 09/26/16
FILE NO. 16-13-0099	APPROVED BY: FKC	FIGURE: 5