Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

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October 17, 2016
File: 21.0056798.00

Mr. Kevin Schroeder
Kevin.schroeder@nrgenergy.com
Dunkirk Power LLC
106 Point Drive North
Dunkirk, NY 14048

Re: CCR Landfill Run-On and Run-Off Control System Plan
Dunkirk Power CCR Landfill
Van Buren Road
Pomfret, New York

Dear Mr. Schroeder:

GZA GeoEnvironmental of New York (GZA) presents this Initial Run-On and Run-Off Control System Plan to Dunkirk Power LLC (Dunkirk) for the existing coal combustion residuals (CCR) landfill located at the Dunkirk Power facility in Pomfret, New York (Site). This Initial Run-On and Run-Off Control System Plan is required by the United States Environmental Protection Agencies (USEPAs) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, as presented in the Federal Register Volume 80 No 74 dated April 17, 2015. In accordance with the CCR Rule (40 CFR §257.81(c)), owners/operators of CCR units must prepare an initial run-on and run-off control system plan to document how the control systems have been designed and constructed to meet the applicable requirements of the CCR Rule and supported by engineering calculations.

In accordance with §257.81, the owner or operator and an existing CCR landfill must design, construct, operate and maintain the landfill in accordance with the following:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hr, 25-year storm; and

- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hr, 25-year storm. The run-off from the active portion of the CCR unit must be handled in accordance with surface water requirements under §257.3-3.

1.0 Site Background

The active CCR landfill cells for the Site are identified as Phase 2, Cells A and B-1. The Site landfill cells identified as Phase 1, Cells A and B (excluding a small portion of the northern Phase I Cells A and B) and the eastern portion of Phase 2, Cell A are already closed and therefore are not addressed in this run-on and run-off control system plan. We note that a constructed cell designated as Phase 2, Cell B-2, located adjacent to the west of Phase 2, Cell B-1, has never received CCR waste. However, this cell is connected to the Site landfill leachate collection system and is permitted (ID#9-0658-00021/00008) with the New York State

Department of Environmental Conservation (NYSDEC) to accept CCR and other associated wastes generated from the Dunkirk Power facility through May 22, 2021. A Site location map for the Dunkirk CCR landfill is attached at Figure 1.

The Dunkirk landfill is operated to limit the mixing of contact water (i.e., stormwater from active CCR cells) and stormwater from closed portions of the CCR landfill. Stormwater emanating from closed areas is directed to surface water body discharge points by perimeter berms and ditches. Contact water from the active CCR areas are be collected on the ash waste disposal areas and contained and managed as landfill leachate. Through site grading activity and the creation of small berms, contact water is directed down the side slopes to the bottom of the slope where a perimeter ditch and/or berm is created at the topographic low point. Here, the contact water is allowed to infiltrate and become part of the leachate that is eventually pumped to the settling pond located on the southern portion of the property, beyond the landfill. Discharge from the leachate settling pond is done in accordance with the facility's NYSDEC SPDES permit.

2.0 RUN-ON CONTROL SYSTEM

The run-on control system for the Dunkirk Landfill consists of perimeter roads, ditches and grading sloped away from the disposal area to prevent and minimize stormwater run-on. As a practical matter, the majority of the active portions of the landfill (i.e. designated "SB" areas) are at high points and surrounded by closed, covered cell areas and perimeter access roads. Thus, there is no appreciable opportunity for stormwater run-on to the active cells. Figure 2 shows the general surface topography around the Site. Groundwater generally flows away from the Site and to Lake Erie. The CCR Landfill is comprised of portion of Phase 2 Cell A and a portion of Phase 2 Cell B. As shown in Figure 3, the Active portions of CCR Cells A&B are bounded by an access roadway and ditch along the north side, an intermediate berm along the west side adjacent to the unused Cell B2, and the ground surface slopes away from the disposal area along the east and south sides. Perimeter ditches intercept whatever run-on may be generated from the roadway embankments. Stormwater around the cell will flow west or south along the access roadway and into surface body discharge points. Run-on control systems in place prevent the flow of stormwater onto the active portion of the CCR unit.

3.0 RUN-OFF CONTROL SYSTEM

Contact water generated from the design storm is collected and conveyed in a manner that does not allow contact water to discharge to a surface water body. Storm water that is mixed with contact water is to be considered contact water. Contact water generated from the 25-year, 24-hour storm will be conveyed into the perimeter ditches between the landfill and the access road/berm where it is allowed to percolate into the landfill to be managed as leachate. These ditches act as temporary storage areas for the contact stormwater. In certain cases, the 25-year runoff from the active areas cannot be fully contained in the specific storage ditches. Under those instances, excess contact storm water shall be collected in the adjacent, un-used cell B-2 located to the west of the Active Cells which is connected to the active leachate transfer system. Calculations and management of stormwater run-off from the active portion of the Cells are further described in Section 4.

4.0 HYDROLOGIC & HYDRAULIC CALCULATIONS

The inputs for this analysis were based on the information gathered by GZA, upon reviewing historical drawings and other design documents made available to GZA by NRG Energy. The computer software HEC-HMS (v.3.5) developed by US Army Corps of Engineers Hydrologic Engineering Center was utilized for the analysis.

All elevations refer to the vertical datum of IGLD 1955 to be consistent with previous design drawings and documents, unless otherwise noted.

4.1 25-YEAR 24-HOUR DESIGN STORM

The 25-year 24-hour storm required for the run-off analysis for the CCR landfills. The 25-year 24-hour design storm was obtained by GZA from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Volume 10 precipitation frequency (PF) estimates. Table 1 provides the precipitation frequency estimates for the 2-, 5-, 10-, 25-, 50-, and 100-year 24-hour storm event. A design storm of 4.42inches was used to develop a rainfall distribution. The Natural Resources Conservation Service (NRCS), standard rainfall distribution type III curve was used in this analysis to develop the Site's hyetograph.

Table 1: NOAA Atlas 14 Rainfall Depths

Recurrence Interval	24 Hours Rainfall depth (in)
2-year	2.23
5-year	3.02
10-year	3.62
25-year	**4.42**
50-year	5.02
100-year	5.62

4.2 HEC-HMS ANALYSIS

The Active Cell A and B were analyzed as one hydrologic systems in HEC-HMS. The setup for the landfill model are included in Attachment A. A summary of the hydrologic elements used for the analysis and the outputs are given below.

4.2.1 Inputs and Outputs for Active Cell A

Active Cell A&B consists of three Subbasins which contains the contact stormwater within approximate 2-foot ditches around the north and west sides. The berm dimensions are provided in Attachment A and the available storage between the berm and the landfill is provided in Table 2. Runoff from SB-1 discharges to a drainage channel along the north side at the toe of the slope. SB-2 contact stormwater discharges to a drainage channel along the western Active Cell boundary. Contact water from SB-3 discharges into a drainage channel at the southern end of an un-used cell identified as Phase 2 Cell B-2 on Figure 3. A runoff Curve Number (CN) of 80 was used for the exposed coal residual. Subbasin 3 is comprised of exposed coal residuals and vegetated land cover. A weighted CN value of 77 was used for Subbasin 3. The Active Cell A&B parameters are identified below in Table 2. The input parameters from Table 2 and the specified hyetograph were run through the HEC-

HMS model. Outputs from the model are summarized in Table 3. The total volume in cubic feet is calculated from the total direct runoff over the sub-basin area.

Key elevations are as follows:

Subbasin Storage Area	Top Elevation at Maximum Storage Volume (ft, IGLD 1955)
SB-1 Ditch	632.0
SB-2 Ditch	632.0
SB-3 Ditch	634.0

Table 2: HEC-HMS Watershed Input – Active Cell A

HEC-HMS Model	Subbasin	Drainage Area		Runoff Potential (SCS Curve Number)*	Watershed Lag Time (min)	Storage Capacity (cu.ft.)
		(sq mi)	(Acre)			
Active Cell A&B	SB-1	0.007319	4.68	80	4.5	11,840
	SB-2	0.005562	3.56	80	3.18	20,160
	SB-3	0.006846	4.38	77	8.7	9,600

*For the hydrologic analysis a curve runoff number (CN) of 80 was used for exposed ash area and 70 for closed and vegetated landfill slopes.

Table 3: HEC-HMS Watershed Outputs – Active Cell A

HEC-HMS Model	Subbasin	Peak Discharge (cfs)	Time of Peak	Total Direct Runoff (in)	Total Runoff Volume (cu.ft.)
Active Cell A&B	SB-1	6.0	12:30	2.39	40,638
	SB-2	4.5	12:30	2.39	30,885
	SB-3	5.1	12:30	2.15	34,195

The total runoff from the Site is approximately 48-54% of the total precipitation from the 25 year, 24hour storm event.

5.0 RESULTS

The results for the Active Cells A & B are summarized in **Table 4** below. The table below compares the storage capacity for each Subbasins, the available storage within the Sedimentation Basin, and the volume of storage needed from the 25-year, 24-hour storm event.

Table 4: HEC-HMS Results for Subbasins

HEC-HMS Model	Subbasin	Storage Capacity (cu.ft.)	Storage Needed (cu.ft.)	Storage Difference (cu.ft.)
Active Cell A&B	SB-1	11,840	40,638	(-28,798)
	SB-2	20,160	30,885	(-10,725)
	SB-3	9,600	34,195	(-24,595)

These results indicate the storage capacity within the drainage channels do not have the capacity to fully collect and control the contact stormwater from the 25-year, 24-hour storm. However, overflow from the drainage channels has the ability to drain into the un-used cell B-2, located west of the Active Cells where it will be collected in the leachate collection system and managed by the leachate settling pond. The storage capacity within the un-used cell has the capacity of approximately 325,561 cu. ft., based on provided documents. The un-used cell B-2 has the capacity to store the storage difference needed for the 25-year, 24-hour storm.

Attachment A

HEC-HMS Basin Model [Cell A&B]

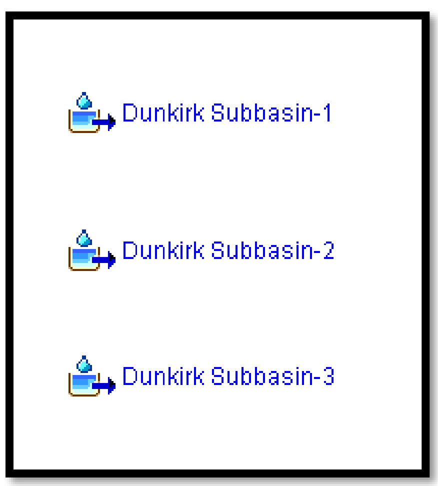


Table A1: Cell A&B Subbasin Storage Calculations

HEC-HMS Model	Subbasin	b (ft)	y (ft)	z	Length	Volume (cf)
Active Cell A&B	SB-1	10	2	3	370	11,840
	SB-2	10	2	3	630	20,160
	SB-3	10	2	3	300	9,600

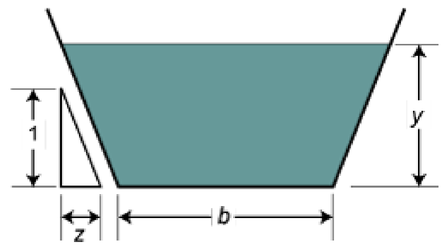


Table A-2: Un-used Cell Storage Calculation

Un-used Cell Storage Capacity	
Elevation	Area (cu.ft.)
626	1,308
627	30,596
628	59,884
629	97,886
630	135,888
Total	**325,561**

PROFESSIONAL ENGINEER CERTIFICATION

The undersigned registered professional engineer is familiar with the requirements of §257.81(c) *Run-on and run-off controls for CCR landfills*. The undersigned registered professional engineer attests that this CCR Landfill Plan has been prepared in accordance with good engineering practice, including consideration of applicable state regulatory requirements and meets the requirements of §257.81(c), and that this plan is adequate for the NRG - Dunkirk Power. This certification was prepared as required by §257.81(c)(5).

Name of Professional Engineer: Daniel J. Troy, P.E.
Company: GZA GEOENVIRONMENTAL OF NEW YORK

Signature: ___________________________________
Date: October 17, 2016
PE Registration State: New York
PE Registration Number: 081139-1
Professional Engineer Seal:

We trust this information satisfies your needs for this project.

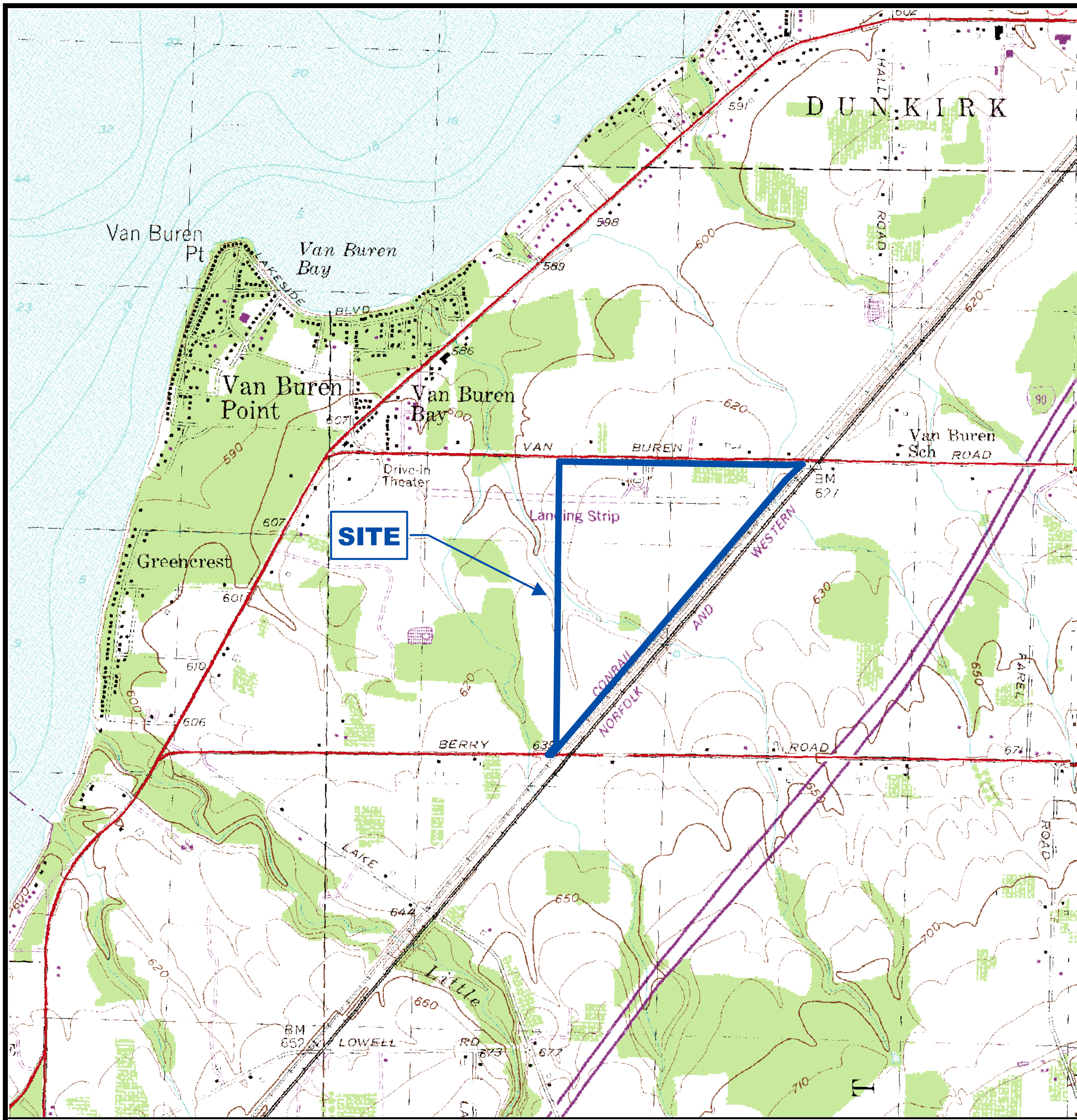
Sincerely,

GZA GEOENVIRONMENTAL OF NEW YORK

Daniel J. Troy, P.E.
Senior Project Manager

Bart A. Klettke, P.E.
Principal

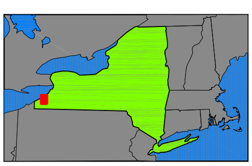
Attachments: Figure 1 - Site Location Map
Figure 2 – Area Topography
Figure 3 - Active Cells A and B



SOURCE:

BASE MAP FROM THE FOLLOWING USGS QUADRANGLE MAP:

BROCTON, N.Y. (1954)



0 1,000 2,000 4,000

SCALE IN FEET

N S W E

DIGITAL TOPOGRAPHIC MAPS PROVIDED BY USGSSTORE.GOV

CONTOUR ELEVATIONS REFERENCE NAVD 88,
CONTOURS ARE SHOWN IN FEET AT 10' INTERVALS

DUNKIRK POWER LLC
106 POINT DRIVE NORTH
DUNKRIK, NY 14048

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
NRG ENERGY

SITE LOCATION MAP

PROJ MGR: DJT	REVIEWED BY: BAK	CHECKED BY: DJT	FIG
DESIGNED BY: DJT	DRAWN BY: KLK	SCALE: 1 in = 2,000 ft	1
DATE: 10/11/2016	PROJECT NO. 21.0056798.00	REVISION NO.	SHEET NO. 1 OF 3

LEGEND

- APPROXIMATE SURFACE WATER FLOW
- APPROXIMATE SURFACE CONTOURS
- APPROXIMATE ACTIVE CELL AREA

SOURCE

1) THIS MAP CONTAINS THE ESRI ArcGIS ONLINE WORLD IMAGERY MAP SERVICE, PUBLISHED DECEMBER 12, 2009 BY ESRI ARCIMS SERVICES AND UPDATED OFTEN. THIS SERVICE USES UNIFORM NATIONALLY RECOGNIZED DATUM AND CARTOGRAPHY STANDARDS AND A VARIETY OF AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS.

2) THE USE OF AERIAL PHOTOGRAPHY CAN OFTEN MAKE BUILDINGS AND OTHER SITE FEATURES APPEAR TO BE OVERLAPPING AND DISTORTED WHEN OVERLAID WITH ACTUAL SITE FEATURES.

3) THE APPROXIMATE LOCATION OF THE SITE BOUNDARY WAS OBTAINEDTHROUGH THE NEW YORK ONLINE GIS CLEARING HOUSE. THE PROGRAM NOTES THAT ALL PROPERTY BOUNDARIES ARE NOT SURVEYED AND ARE ONLY APPROXIMATE REPRESENTATIONS OF ACTUAL BOUNDARIES.

NO.	ISSUE / DESCRIPTION	BY	DATE
XX	XXXX	XX	XX

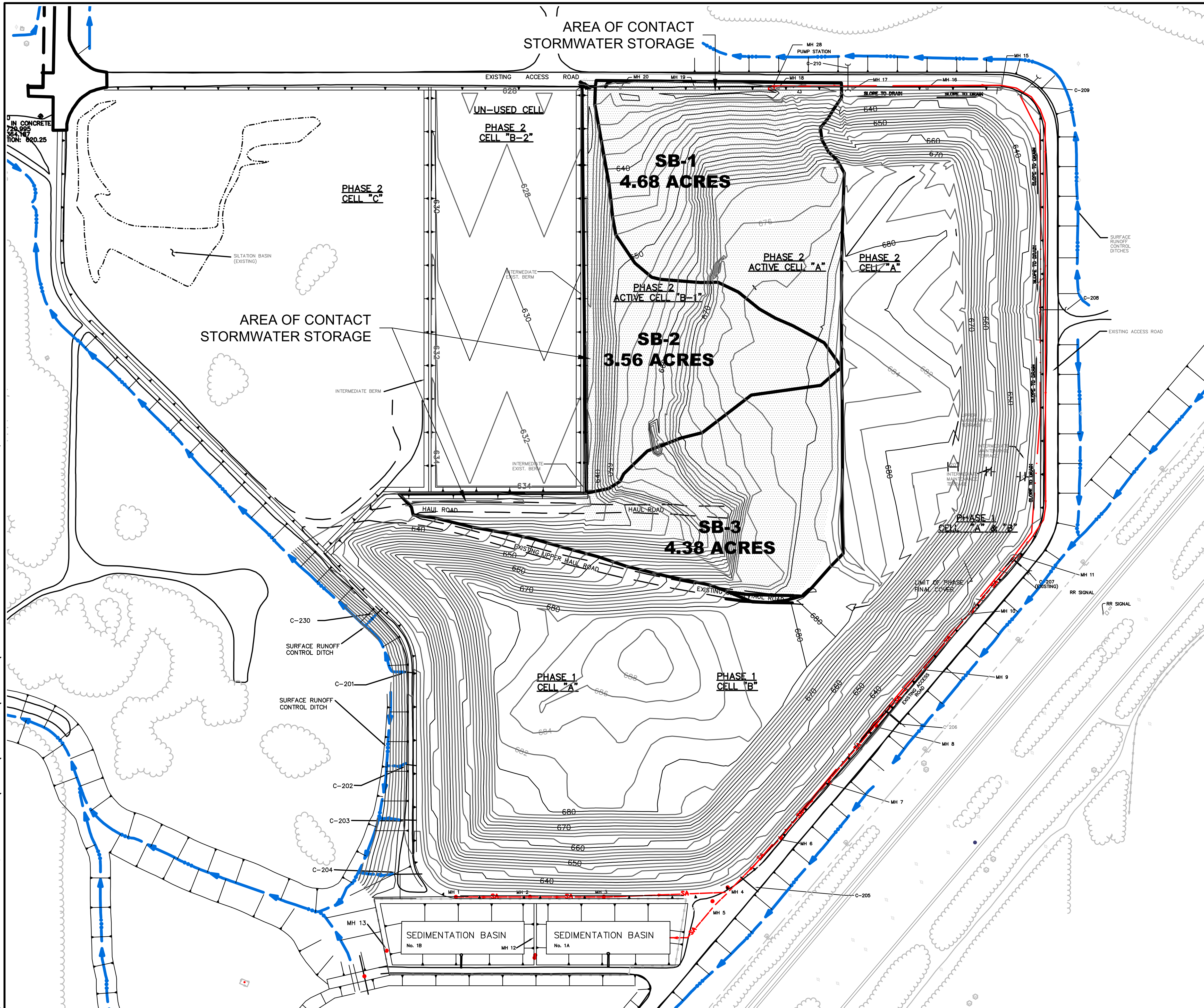
DUNKIRK POWER LLC
106 POINT DRIVE NORTH
DUNKRIK, NY 14048

AREA TOPOGRAPHY

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com

PREPARED FOR: NRG ENERGY

PROJ MGR: DJT	REVIEWED BY: BAK	CHECKED BY: DJT	FIG
DESIGNED BY: DJT	DRAWN BY: KLK	SCALE: 1 " = 800 FEET	2
DATE: 10/14/2016	PROJECT NO. 21.0056798.00	REVISION NO.	SHEET NO. 2 OF 3



LEGEND:

- ACTIVE AREA
- 650 — 10' CONTOUR INTERVAL (MAJOR)
- 652 — 2' CONTOUR INTERVAL (MINOR)
- SURFACE RUNOFF CONTROL DITCH
- MH 10 — MANHOLE
- C-207 — CULVERT
- UTILITY POLE
- BRUSH ROW
- CP 000 — CONTROL POINT

NOTES:

1. BASE MAP WAS OBTAINED FROM DRAWING 151229-DUN-SITE PLAN.dwg PROVIDED BY NRG ENGERGY.
2. ALL ELEVATIONS REFER TO THE VERTICAL DATUM OF IGLD 1955.

N S E W

0 100' 200' 400'

SCALE IN FEET 1" = 200'

NO.	ISSUE/DESCRIPTION	BY	DATE

DUNKIRK POWER LLC
106 POINT DRIVE NORTH
DUNKIRK, NY 14048

PHASE 2
ACTIVE CELLS A & B

PREPARED BY:	PREPARED FOR:
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PROJ MGR: DJT	REVIEWED BY: BAK	CHECKED BY: DJT	FIG
DESIGNED BY: DJT	DRAWN BY: KLK	SCALE: see above	3
DATE: OCTOBER, 2016	PROJECT NO. 21.0056798.00	REVISION NO.	SHEET NO. 3 OF 3