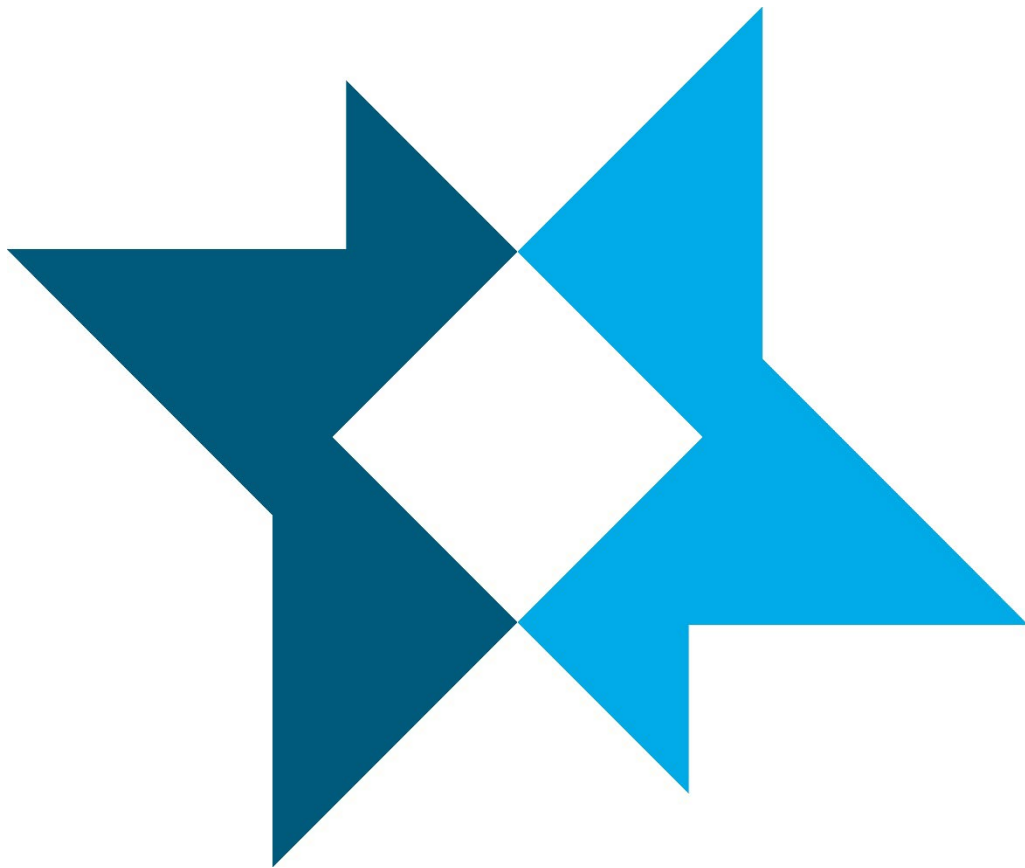




Hydrogeologic Investigation Work Plan Carroll County Landfill



Carroll County Solid Waste Management Commission

Carroll, Iowa

September 2026

IDNR Permit No. 14-SDP-01-74P

Project ID: 26C003.00

**Solving our clients' toughest
science and engineering challenges.**



411 6th Avenue SE, Suite 400
Cedar Rapids, IA 52401
(319) 365-9565
foth.com

September 14, 2026

Khalid Al Gharrawi
Iowa Department of Natural Resources
6200 Park Avenue, Suite 200
Des Moines, IA 50321

Re: Hydrogeologic Investigation Work Plan – Carroll County Landfill Western Expansion Area
Carroll County Solid Waste Management Commission – Permit Number 14-SDP-01-74P

Dear Khalid Al Gharrawi:

On behalf of the Carroll County Solid Waste Management Commission (Commission), Foth Infrastructure & Environment, LLC (Foth) is submitting the following Hydrogeologic Investigation Work Plan (Work Plan) to describe the proposed field activities, investigative methods, and technical approach for conducting a soil and hydrogeologic investigation of approximately 73 acres encompassed by Parcels 06-22-100-004 and 06-22-300-001. The Commission has entered into a lease-to-purchase agreement for these parcels and intends to use the property for future lateral expansion of the Carroll County Landfill (Landfill or Site). This Work Plan was developed in accordance with the requirements of 567 Iowa Administrative Code (IAC) Chapter 39, 101.106(2) and is intended to satisfy the soil and hydrogeologic investigation provisions.

Prompt review of the enclosed Work Plan would help maintain the current schedule for initiating field investigations this fall.

Thank you for your attention to this matter. Please contact us at the numbers listed below if you have any questions or need additional information.

Sincerely,

Foth Infrastructure & Environment, LLC

A handwritten signature in blue ink, appearing to read "Hannah Dubbs".

Hannah Dubbs
Project Environmental Scientist
(319) 297-2055

A handwritten signature in blue ink, appearing to read "Gina Wilming".

Gina Wilming
Senior Project Manager
(319) 297-2065

cc: Trevor Reece, Carroll County Solid Waste Management Commission
Iowa Department of Natural Resources Field Office #4

Hydrogeologic Investigation Work Plan

Distribution

<u>No. of Copies</u>	<u>Sent To</u>
1	Khalid Al Gharrawi Iowa Department of Natural Resources 6200 Park Avenue, Suite 200 Des Moines, IA 50321
1	Iowa Department of Natural Resources Field Office #4 1401 Sunnyside Lane Atlantic, IA 50022
1	Trevor Reece Carroll County Solid Waste Management Commission 19111 Kittyhawk Avenue Carroll, IA 51401

Hydrogeologic Investigation Work Plan

Project ID: 26C003.00

Prepared for
Carroll County Solid Waste Management Commission
19111 Kittyhawk Avenue
Carroll, IA 51401

Prepared by
Foth Infrastructure & Environment, LLC

September 2026

REUSE OF DOCUMENTS

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Hydrogeologic Investigation Work Plan

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Figure 3	Proposed Soil Boring Locations
Figure 4	Proposed Monitoring Well Locations

Appendices

Appendix A	Previous Hydrogeologic Figures
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List of Abbreviations, Acronyms, and Symbols

ASTM	ASTM International
bgs	below ground surface
CL	USCS classification for lean clay
Commission	Carroll County Solid Waste Management Commission
Foth	Foth Infrastructure & Environment, LLC
HIR	Hydrogeologic Investigation Report
HMSP	Hydrogeologic Monitoring System Plan
HRG	Howard R. Green Company
IAC	Iowa Administrative Code
IDNR	Iowa Department of Natural Resources
Landfill or Site	Carroll County Landfill
ML	USCS classification for silt
NAVD 88	North American Vertical Datum 1988
USCS	Unified Soil Classification System

Certifications

I hereby certify that this document was prepared by me or under my direct supervision and that I am a qualified groundwater scientist as defined in 567 Iowa Administrative Code 100.2.



Name: Gina Wilming

Date: September 14, 2026

C.G.P. No. 2099

Expires: December 31, 2027

For the purposes of 567 Iowa Administrative Code 100.2 a "qualified groundwater scientist" means a scientist or engineer who has received a baccalaureate or postgraduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields demonstrated by state registration, professional certifications, or completion of accredited university programs that enable that individual to make sound professional judgments regarding groundwater monitoring, contaminant fate and transport, and corrective action.

1. Introduction

Carroll County Solid Waste Management Commission (Commission) has retained Foth Infrastructure & Environment, LLC (Foth) to conduct a soil and hydrogeologic investigation of approximately 73 acres encompassed by Parcels 06-22-100-004 and 06-22-300-001. The Commission has entered into a lease-to-purchase agreement for these parcels and intends to use the property for future lateral expansion of the Carroll County Landfill (Landfill or Site). The investigation will characterize Site geologic and hydrogeologic conditions, evaluate suitability of the proposed expansion area, support future permitting and design, and establish the hydrogeologic framework for a groundwater monitoring program. This Work Plan describes the proposed field activities, investigative methods, and technical approach for completing the soil and hydrogeologic investigation.

Iowa's solid waste regulations are currently being revised. Accordingly, this Work Plan references the draft rules anticipated to become effective in September 2026 and is intended to satisfy the soil and hydrogeologic investigation requirements set forth in 567 Iowa Administrative Code (IAC) Chapter 39, 101.106(2).

1.1 Site Location and Background

The Landfill is owned and operated by the Commission. The Landfill is located in Section 22, Township 84 North, Range 35 West in Carroll, Iowa. An aerial of the Landfill in relation to the surrounding area is provided in Figure 1.

The Carroll County Landfill has been in operation since 1972 and has accepted municipal, commercial, and industrial wastes from Buena Vista, Carroll, Crawford, Sac, and Shelby Counties and parts of Adair, Audubon, Calhoun, Guthrie, Pocahontas, and Pottawattamie Counties. The Landfill has been regulated by the Iowa Department of Natural Resources (IDNR) since 1974. The Western Expansion Area is a Subtitle D-compliant, composite-lined municipal solid waste landfill unit opened in 2002 and continues to accept waste. The Closed Eastern Area was closed in October 2007. A Site map depicting the Closed Eastern Area, the Western Expansion Area, the proposed hydrogeologic investigation area, and other components of the Carroll County Landfill is provided in Figure 2.

1.2 Scope of Work

The purpose of this Hydrogeologic Investigation Work Plan is to define the methods, procedures, and technical approaches that will be used to conduct a soil and hydrogeologic investigation of approximately 73 acres encompassed by Parcels 06-22-100-004 and 06-22-300-001 for future lateral expansion of the Carroll County Landfill. The investigation will be completed through:

- ◆ Advance soil borings with continuous sampling across the proposed expansion area.
- ◆ Collect soil samples for laboratory analysis in accordance with 567 IAC 101.6(2)c(5).
- ◆ Properly seal soil borings not converted to groundwater monitoring wells pursuant to 567 IAC Chapter 39, 101.8(3) and 101.10(2).

- ◆ Convert select soil borings to groundwater monitoring wells. Construct the groundwater monitoring wells in accordance with 567 IAC 101.8(2).
- ◆ Survey the horizontal and vertical location of each soil boring and groundwater monitoring well.
- ◆ Develop the groundwater monitoring wells in accordance with 567 IAC 101.8(2)j.
- ◆ Measure the groundwater elevation in each groundwater monitoring well.
- ◆ Prepare soil boring logs pursuant to 567 IAC 101.106(3)c(2), and monitoring well construction logs pursuant to 567 IAC 101.8(2)c(3).
- ◆ Identify the stratigraphic and hydrogeologic conditions and develop a conceptual site model.
- ◆ Prepare and submit a Hydrogeologic Investigation Report pursuant to 567 IAC 101.106(2)e.

Although 567 IAC 101.106(2)e(3) requires identification of concentrations of Appendix I constituents in groundwater, these determinations are typically addressed through the Hydrogeologic Monitoring System Plan (HMSP). Accordingly, characterization of Appendix I constituents will be completed through monitoring initiated prior to construction of the lateral expansion to establish background and incorporated in the HMSP.

1.3 Previous Investigations

A preliminary Hydrogeologic Investigation Report (HIR) for the Carroll County Sanitary Landfill was prepared in May 1991 (Howard R. Green Company [HRG], 1991). This report could not be located and, therefore, was not used in developing this Work Plan. An HIR was developed in 2001 for the Western Expansion Area (Foth, 2001) and approved by the IDNR in the permit renewal issued in June 2001. Results from this investigation were utilized to assist with planning the hydrogeologic investigation.

2. Hydrogeologic Investigation Overview

2.1 Summary of Previous Investigations

The HIR developed in 2001 for the Western Expansion Area (Foth, 2001) indicates that the soil profile consists of a surficial loess layer classified as silt (ML) under the Unified Soil Classification System (USCS) underlain by a minimum of 120 feet of till classified as lean clay (CL) with occasional sand lenses present. The soil boring location map and cross sections from the 2001 HIR are included in Appendix A.

A total of 19 soil borings were completed for the Western Expansion Area HIR (Foth, 2001), which encompassed approximately 50 acres. The soil borings, as shown in the cross sections, indicate that the sand lenses are not continuous. The quantity and spacing of soil borings completed during the 2001 HIR were sufficient to identify potential units of preferential groundwater flow.

Subsequent investigation refined the surficial layer characterization to be sandy to clayey silt deposited through colluvial and alluvial processes. The sandy to clayey silt is found along the sides of the topographic ridges and thickens at lower elevations, as expected from the gravity-based depositional environment.

Bedrock was not encountered during the previous investigations. The deepest well installed was 120 feet below ground surface (bgs). According to the Iowa Geological Survey database, depths to bedrock in the vicinity of the hydrogeologic investigation study area range from approximately 105 to 140 feet bgs.

During the 2001 HIR (Foth, 2001), groundwater levels were measured between approximately 10 to 50 feet bgs. Eight groundwater monitoring wells were installed as part of the investigation. Subsequent monitoring indicated that groundwater flow was generally easterly. Groundwater elevations and flow directions have been consistent during recent monitoring events, with groundwater ranging from approximately 10 to 50 feet bgs and flow continuing toward the east.

2.2 Investigative Approach

Based on the 2001 HIR (Foth, 2001), three geologic units are expected to be encountered during this investigation: surficial silt layer and underlying till with localized sand lenses. Bedrock is not likely to be encountered. The technical approach for this investigation is as follows:

- ◆ Determine the lower limit of the surficial silt (ML), if present, within the proposed expansion area.
- ◆ Verify that the till (CL) is present beneath the surficial silt and determine characteristics of the till.
- ◆ Identify sand lenses within the till and determine continuity, if present.
- ◆ Determine hydrogeologic conditions of the till and sand lenses.

Field conditions may alter the technical approach.

3. Sampling and Analysis Plan

3.1 Soil Investigation

3.1.1 Soil Boring Locations

The hydrogeologic investigation study area and the proposed soil boring locations are depicted in Figure 3. The investigation area consists of approximately 73 acres, and the proposed waste limits would encompass approximately 49 acres. Based on the known subsurface conditions, 18 soil borings are proposed. Soil boring locations were selected to capture spatial and elevation variability across the Site, support development of geologic cross sections, and provide adequate coverage to identify the lower limit of surficial silt, verify till thickness, and delineate sand lenses. The locations may be modified in the field based on conditions observed during drilling.

3.1.2 Soil Boring Depths

In accordance with 567 IAC 101.106(2)b(1), all borings will extend a minimum of 25 feet deep and at least 10 feet below the water table. In addition, half of the borings will extend 20 feet into the uppermost aquifer per 567 IAC 101.106(2)b(2). As a result, borings are anticipated to be advanced between 40 – 80 feet at 17 of the 18 boring locations. Actual depths will be determined based on apparent groundwater elevation measured in the field.

Bedrock is not expected to be encountered; therefore, a minimum of one soil boring is planned to be terminated at 100 feet bgs in accordance with 567 IAC 101.106(2)b(3). If bedrock is encountered, the soil boring will be terminated 10 feet into bedrock.

3.1.3 Drilling Procedures

Drilling equipment will be decontaminated prior to or upon arrival onsite.

Soil borings will be drilled primarily using hollow-stem auger technology. For deeper soil borings, mud rotary techniques may be utilized to maintain borehole stability and ensure recovery of soil samples. If mud rotary techniques are used at a location intended for conversion to a monitoring well, the boring will be offset and redrilled using dry drilling methods to allow proper monitoring well installation in accordance with 567 IAC 101.8(2). While not anticipated, if bedrock is encountered during the deeper soil borings, air rotary, sonic, or similar techniques will be utilized for drilling into bedrock.

3.1.4 Soil Sample Collection

Continuous soil samples will be collected using a split-spoon sampler pursuant to 567 IAC 101.106(2)c(1). Soil samples will be logged in accordance with USCS. In addition, blow counts will be measured for each sample in accordance with ASTM International (ASTM) D1586. In accordance with 567 IAC 101.15(2)c(4), soil boring samples will be retained until at least 30 days after the permit is issued.

Soil samples of coarse-grained soil obtained from the split-spoon sampler will be bagged, labeled, and transported to the laboratory. Undisturbed samples will be collected from each stratum containing fine-grained soil, as identified through the continuous sampling. Sampling will be conducted using thin-walled Shelby tubes in accordance with ASTM D1587. Shelby tubes will be labeled, sealed, and transported to the laboratory.

Approximately four soil samples from the till layer within the horizontal and vertical extents likely to be used for the clay liner will be collected. These samples will be used to characterize potential clay liner material.

3.1.5 Laboratory Analysis

Disturbed soil samples containing coarse-grained soil will be analyzed for falling-head hydraulic conductivity following ASTM D2434 and for grain-size analysis following ASTM D6913. The undisturbed soil samples collected using Shelby tubes will be analyzed for falling-head hydraulic conductivity following ASTM D5084 and for grain-size distribution in accordance with ASTM D6913.

The soil samples collected to characterize potential clay liner material will be analyzed for Standard Proctor compaction (ASTM D698), grain size distribution (ASTM D6913), Atterberg limits (ASTM D4318), and hydraulic conductivity (ASTM D5084) conducted at optimum water content and 4% greater than optimum. The analyses are not required for the soil and hydrogeologic investigation but will support landfill design decisions.

3.1.6 Borehole Plugging

Borings not being converted to monitoring wells will be plugged in accordance with 567 IAC Chapter 39, 101.8(3) and 101.10(2). The borehole will be sealed with bentonite grout via a tremie tube. Soil borings should be clearly identified with a survey stake or marker following plugging.

Borings converted to monitoring wells may need to be partially plugged in accordance with 567 IAC Chapter 39, 101.8(3) and 101.10(2), depending on the depth of the boring.

3.2 Hydrogeologic Investigation

3.2.1 Monitoring Well Locations

The proposed monitoring well locations are depicted in Figure 4. A total of 14 monitoring wells are proposed, including 4 nested well pairs. Based on the previous hydrogeologic investigation results, the water table aquifer is the uppermost aquifer, which is encountered between 10-50 feet bgs, and no other aquifers were identified. The shallow wells will be screened to target the water table, while the screen depths of the deeper wells in the nested pairs will be determined in the field. Actual well locations of the nested pairs may be adjusted based on field conditions.

Additional monitoring wells will be installed at a later date for compliance with the HMSP requirements. A separate Work Plan will be prepared detailing the locations, depths, and installation requirements for the HMSP monitoring wells.

3.2.2 Monitoring Well Construction

Monitoring wells will be constructed by an Iowa-certified well contractor registered with the IDNR in accordance with 567 IAC Chapter 82 and will comply with the requirements of 567 IAC 101.8(2). In accordance with 567 IAC 101.8(2)f(3), monitoring wells will be screened to intercept the water table, with screens generally installed 5 feet above and 5 feet below the observed water table. To accommodate anticipated groundwater fluctuations and the relatively low-yield glacial till, shallow monitoring wells will utilize a 15-foot screen length. For nested well pairs, the deeper wells will be constructed with a 10-foot screen.

Each monitoring well will be protected with brightly colored bollards with reflectors to ensure visibility and prevent damage, and signage clearly identifying the well.

3.2.3 Well Development

Groundwater monitoring wells will be developed in accordance with 567 IAC 101.8(2)j, using the following procedures.

Monitoring wells will be developed at least 24 hours after the grout has set during well installation. Well development will be conducted by alternatively surging and over-pumping the

monitoring well to agitate the filter pack and the bottom of the well to remove fines. No additional water will be utilized during well development. Well development may be conducted using surge blocks, Waterra tubing, bailers, monsoon pumps, or other applicable submersible pumps.

If low recharge prevents removal of one or more volumes, alternate procedures may be implemented. For example, the well may be surged and purged until dry, allowed to recover, and repeated until little or no suspended solids are observed in the purge water.

Field personnel will record equipment used, time intervals, volumes purged, and procedures.

3.2.4 Groundwater Level Measurements

Upon completion of well installation, well development, and aquifer stabilization, groundwater level measurements will be collected. Groundwater level measurements will be collected after the water levels have stabilized in each well and no sooner than 24 hours after well installation and development. At least 30 days is recommended for aquifer stabilization prior to water level measurement. Each set of water level measurements will be collected in the shortest possible timeframe, not to exceed 24 hours. The number of groundwater level measurements collected will be sufficient for hydrogeologic assessment.

3.2.5 Bail or Slug Tests

Since previous investigations identified moderate to low permeability materials in the subsurface, slug testing will be conducted at the four nested well pairs to determine hydraulic conductivity and transmissivity. If additional strata are encountered during monitoring well installation, slug testing will be conducted to characterize each stratum. Slug testing will be performed in accordance with ASTM D4043-17.

4. Documentation

4.1 Survey

Soil boring and monitoring well locations will be staked before drilling and installation occur. Locations may be adjusted based on field conditions.

Groundwater monitoring wells and soil boring locations will be surveyed using North American Vertical Datum 1988 (NAVD 88), Iowa State Plane North coordinates. Horizontal coordinates will be surveyed to the nearest 0.1 foot, and vertical coordinates will be surveyed to the nearest 0.01 foot. Surveying of the monitoring and boring locations will be conducted by or under the supervision of an Iowa-licensed Land Surveyor.

4.2 Boring Logs and Well Construction Forms

Soil boring logs will be prepared for each soil boring pursuant to 567 IAC 101.106(3)c(2). In addition, IDNR Form 542-1277 will be prepared for each monitoring well in accordance with 567 IAC 101.8(2)c(3). Local well permitting will be obtained from Carroll County prior to well installation activities.

4.3 Soil and Hydrogeologic Investigation Report

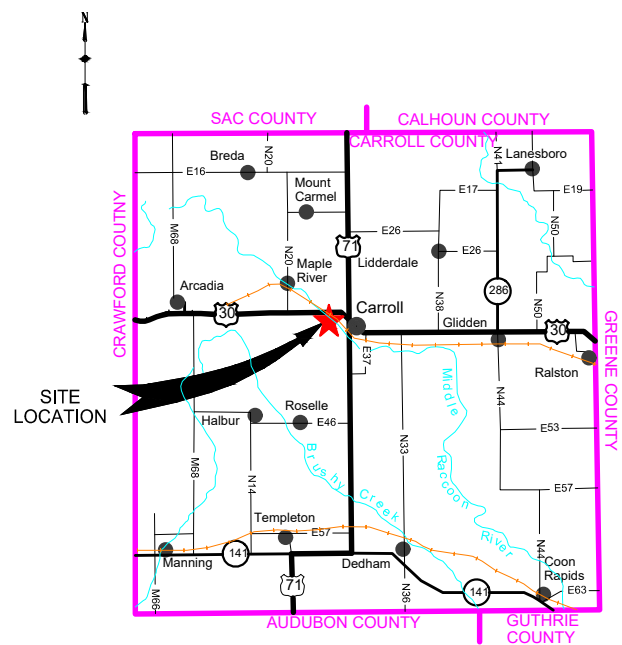
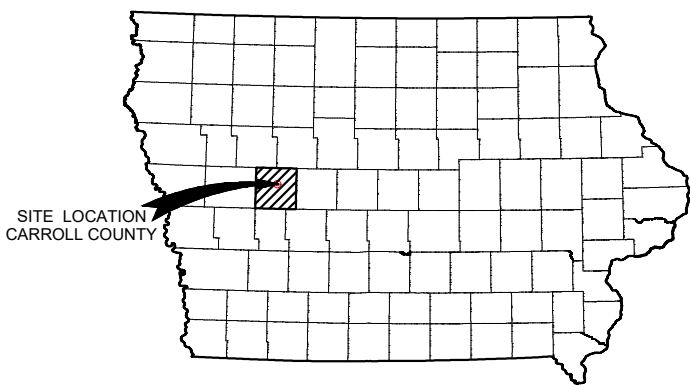
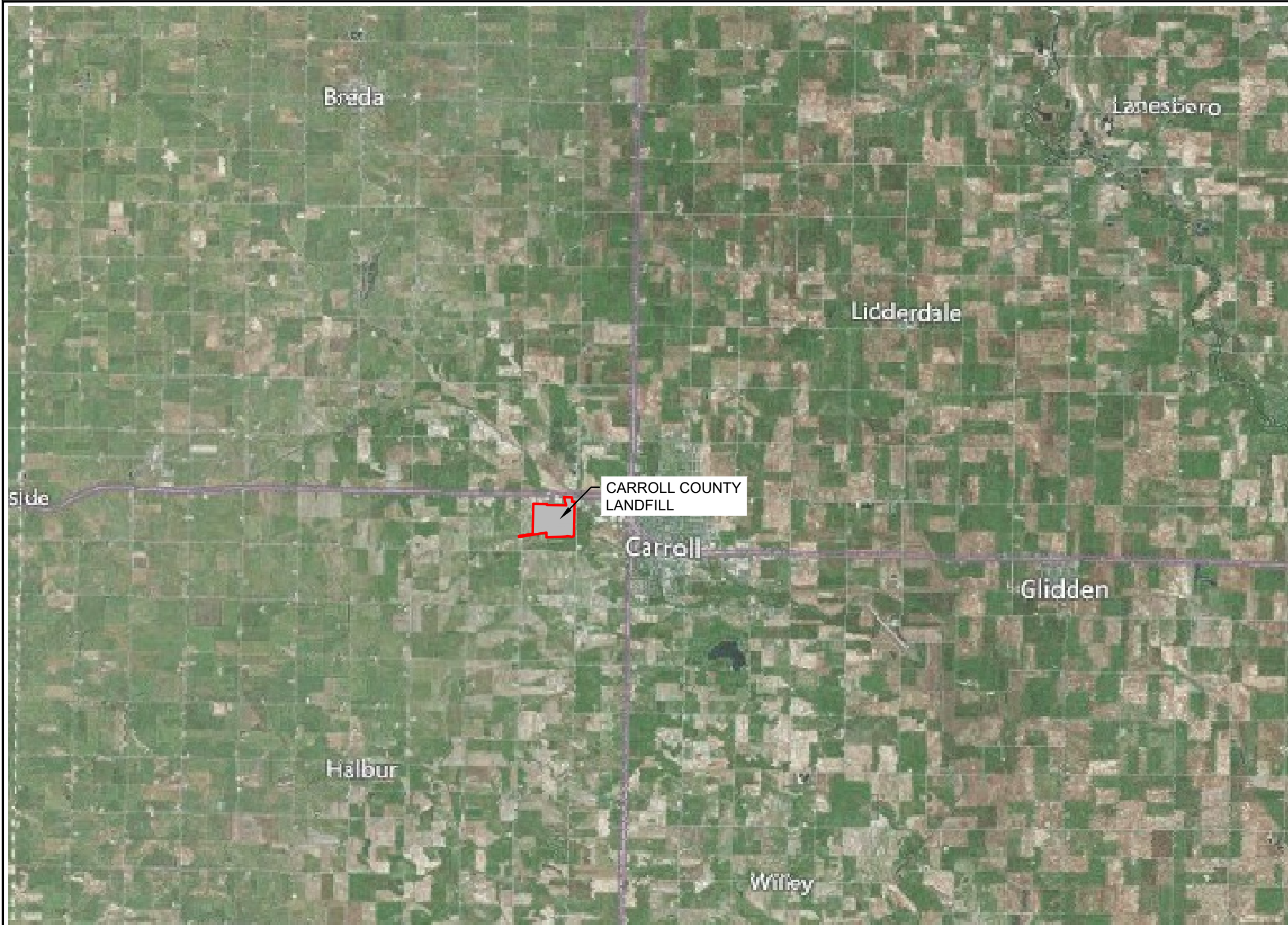
Following completion of the fieldwork and laboratory analysis, a description and analysis of the soil and hydrogeologic investigation will be detailed in a report pursuant to 567 IAC Chapter 39, 101.106(2)e.

5. References

Foth Infrastructure & Environment, LLC (Foth), 2001. *Permit Renewal Documentation Report, Carroll County Sanitary Landfill, Carroll, Iowa*. February.

Howard R. Green Company (HRG), May 1991. *Hydrogeologic Investigation Report and Hydrologic Monitoring System Plan, Carroll County Sanitary Landfill*.

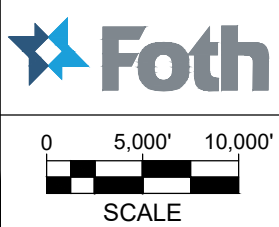
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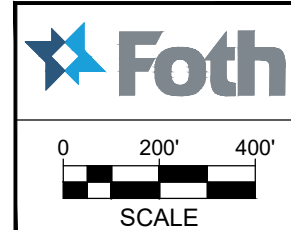
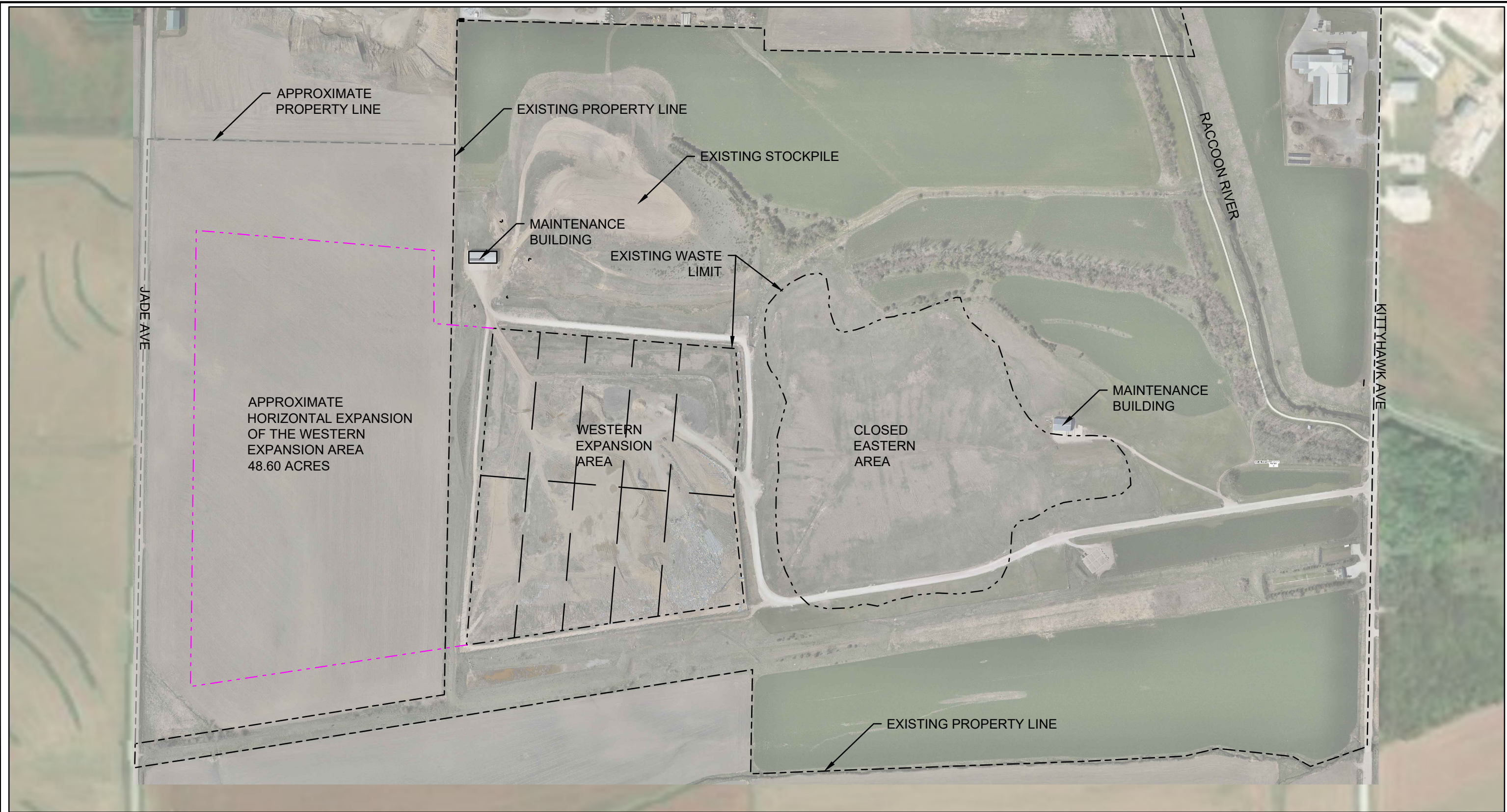


CARROLL COUNTY LANDFILL

FIGURE 1
SITE LOCATION MAP

Date Completed:	08/12/2026	Revision Date:	
Drawn By:	CKV	Checked By:	
		Project No:	26C003.00

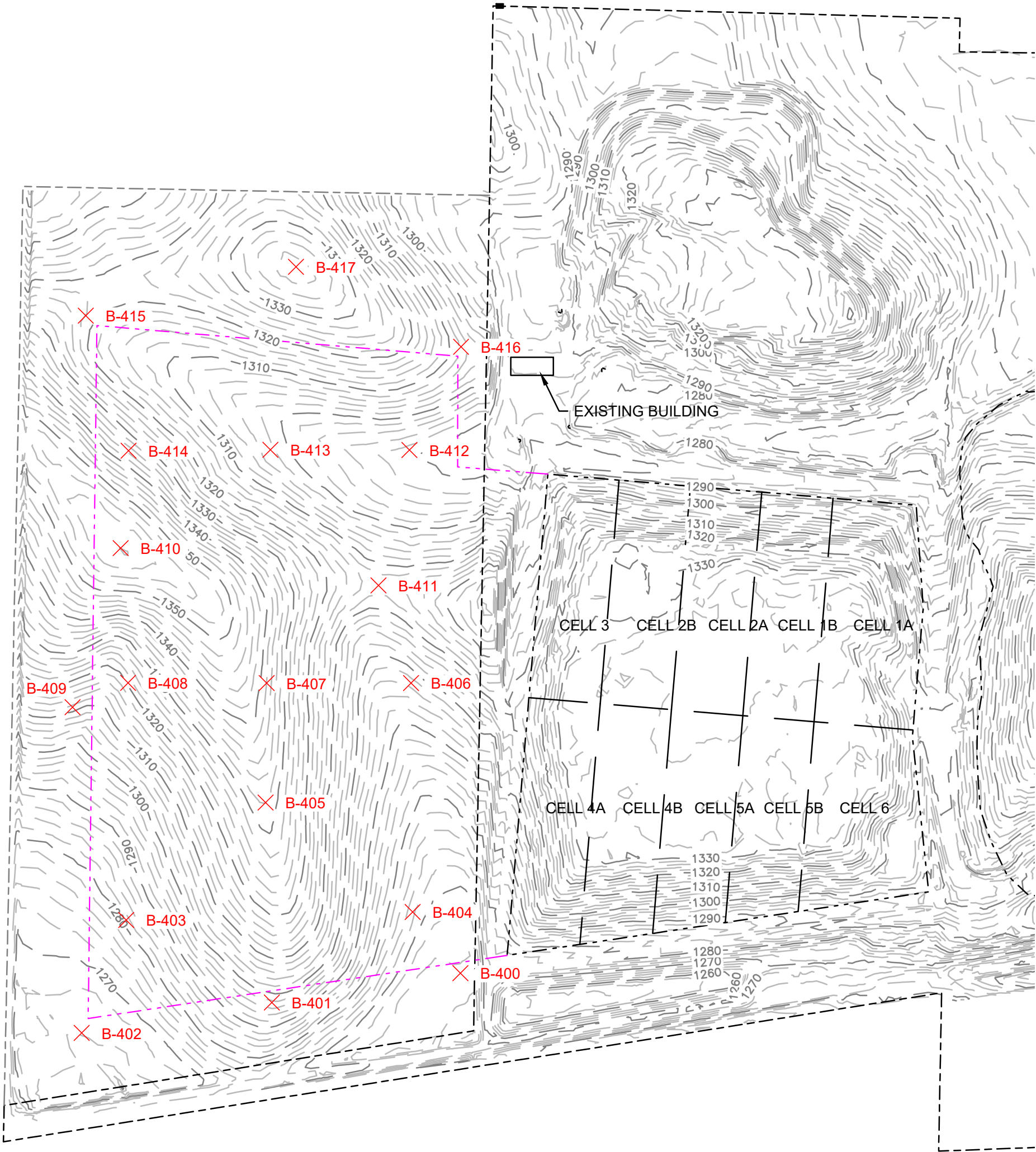




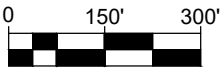
CARROLL COUNTY LANDFILL

FIGURE 2
FACILITY LAYOUT MAP

Date Completed: 08/17/2026	Revision Date:
Drawn By: CKV	Checked By:
Project No: 26C003.00	



Point Table			
Northing	Easting	Elevation	Description
3491376.3327	4537716.6848	1265.523	B-400
3491294.0834	4537189.6725	1297.476	B-401
3491209.1618	4536658.2899	1266.192	B-402
3491524.8154	4536782.7185	1281.194	B-403
3491547.2585	4537583.0210	1272.576	B-404
3491853.2086	4537171.9094	1332.019	B-405
3492187.2890	4537578.6546	1296.895	B-406
3492187.0108	4537175.3099	1337.950	B-407
3492187.7900	4536787.8452	1320.477	B-408
3492119.8581	4536632.6543	1311.337	B-409
3492564.4446	4536767.1121	1357.978	B-410
3492460.1317	4537487.4896	1312.889	B-411
3492838.5379	4537574.0366	1291.175	B-412
3492839.2401	4537185.7061	1302.529	B-413
3492836.7753	4536789.1078	1335.319	B-414
3493214.2102	4536669.7680	1321.923	B-415
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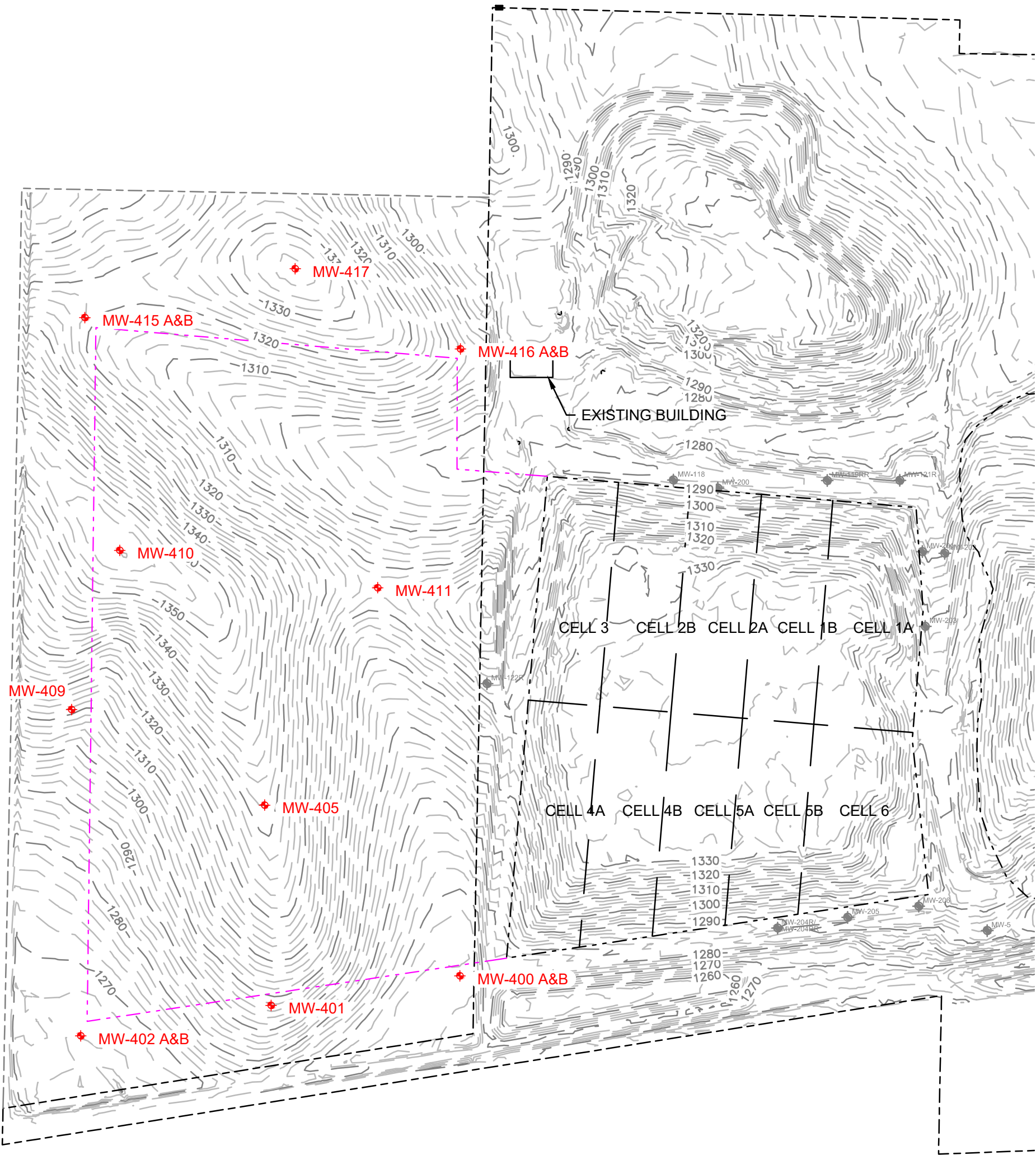


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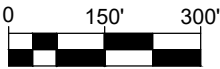
CARROLL COUNTY

FIGURE 3
PROPOSED SOIL BORING LCOATIONS

Date Completed: 08/18/2026		Revision Date:	
Drawn By: CKV	Checked By:	Project No: 26C003.00	



Point Table			
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3491376.3327	4537716.6848	1265.523	MW-400 A&B
3491294.0834	4537189.6725	1297.476	MW-401
3491209.1618	4536658.2899	1266.192	MW-402 A&B
3491853.2086	4537171.9094	1332.019	MW-405
3492119.8581	4536632.6543	1311.337	MW-409
3492564.4446	4536767.1121	1357.978	MW-410
3492460.1317	4537487.4896	1312.889	MW-411
3493214.2102	4536669.7680	1321.923	MW-415 A&B
3493126.9630	4537718.3444	1307.535	MW-416 A&B
3493350.7580	4537257.0863	1336.678	MW-417



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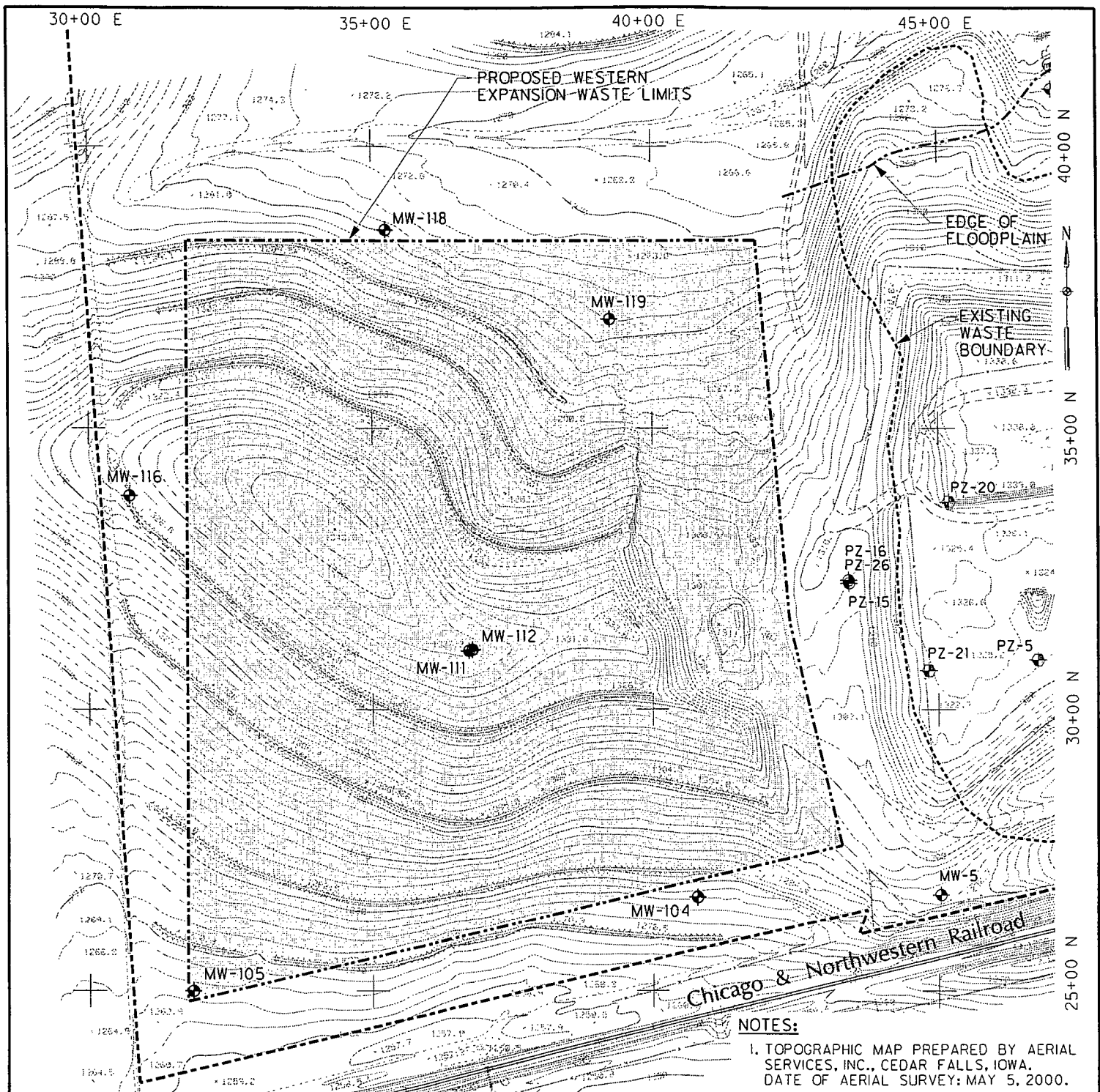
CARROLL COUNTY

FIGURE 4
PROPOSED MONITORING WELL LCOATIONS

Date Completed: 08/18/2026		Revision Date:	
Drawn By: CKV	Checked By:	Project No: 26C003.00	

Appendix A

Previous Hydrogeologic Figures



NOTES:

1. TOPOGRAPHIC MAP PREPARED BY AERIAL SERVICES, INC., CEDAR FALLS, IOWA. DATE OF AERIAL SURVEY: MAY 5, 2000.
2. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
3. FLOOD PLAIN BOUNDARY DATA, WASTE BOUNDARY DATA, AND SOME UTILITY DATA SHOWN UTILIZES DATA GATHERED FROM MISCELLANEOUS SOURCES. ACCURACY AND COMPLETENESS OF INFORMATION IS NOT GUARANTEED.

LEGEND

- ACCESS ROAD
- TREES OR BRUSH
- EXISTING CONTOUR
- PZ-21
PIEZOMETER LOCATION AND NUMBER
- MW-10
MONITORING WELL LOCATION AND NUMBER
- PROPERTY LINE
- PROPOSED WESTERN EXPANSION WASTE AREA

CARROLL COUNTY SANITARY LANDFILL

FIGURE 8-1

WESTERN EXPANSION WELL LOCATIONS

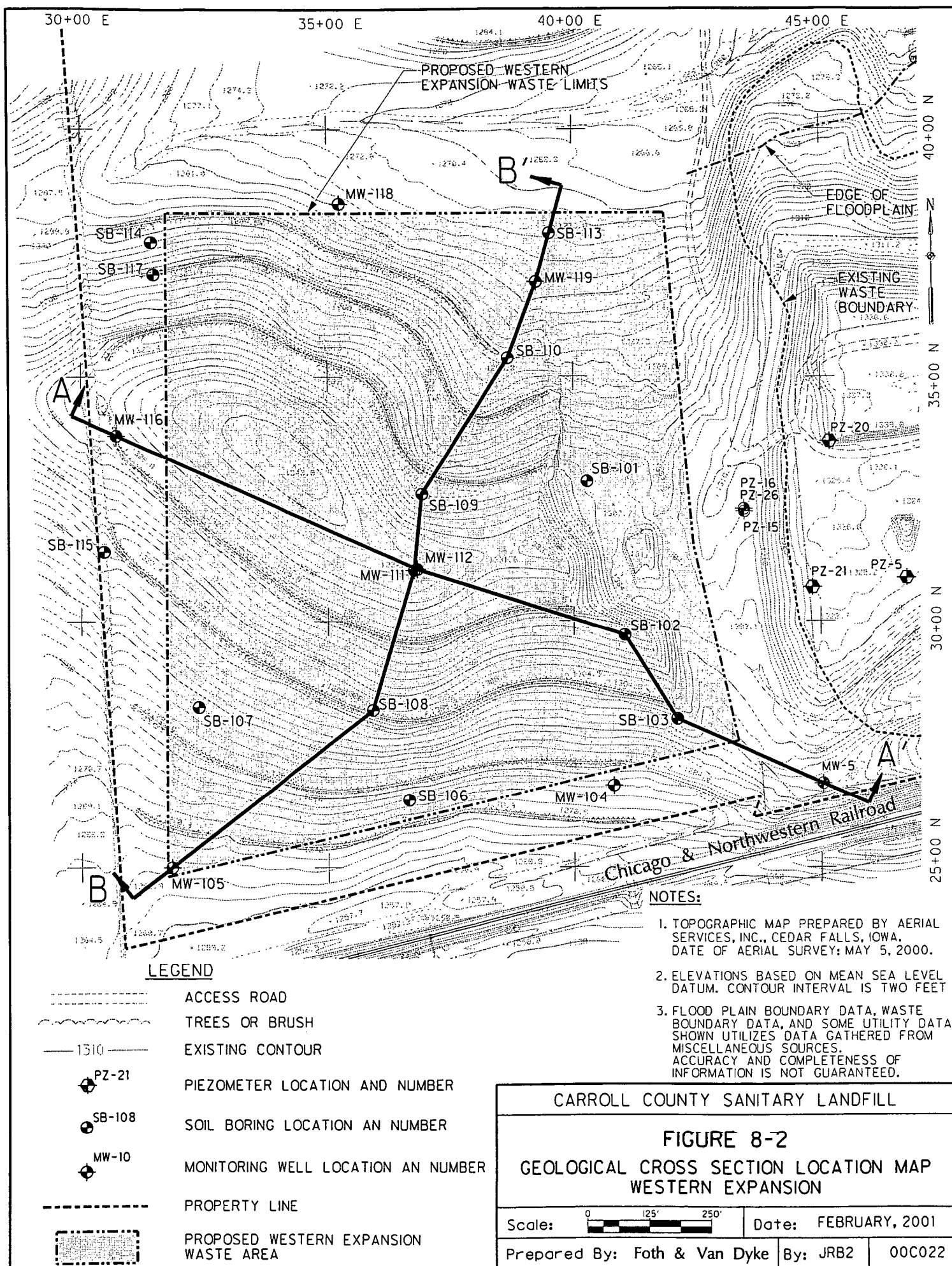
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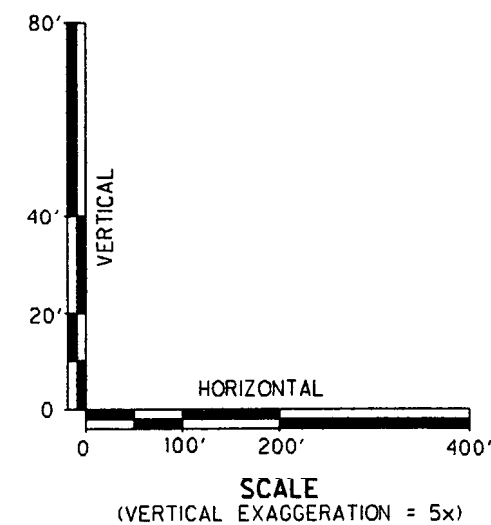
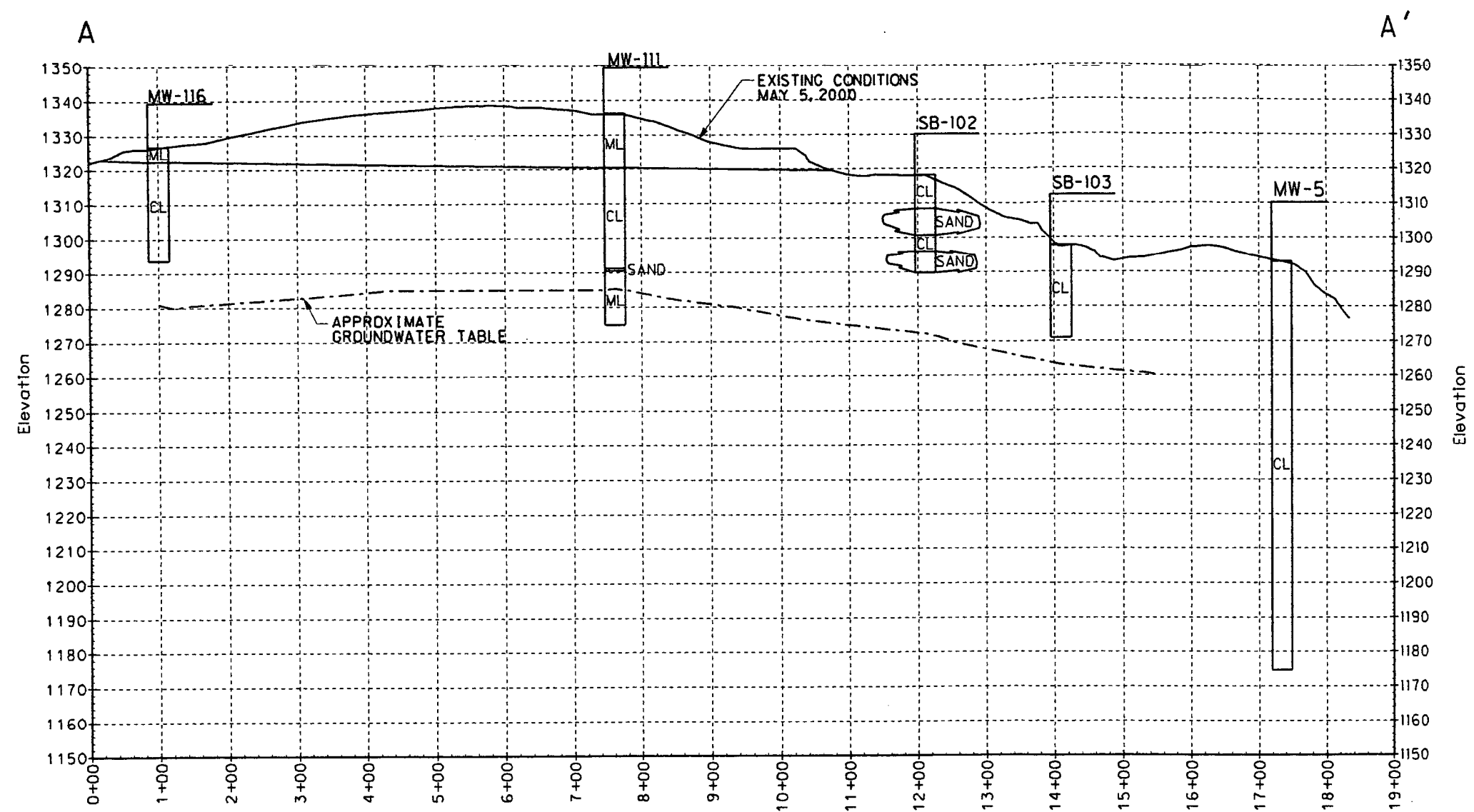
Date: FEBRUARY, 2001

Prepared By: Foth & Van Dyke

By: JRB2

00C022



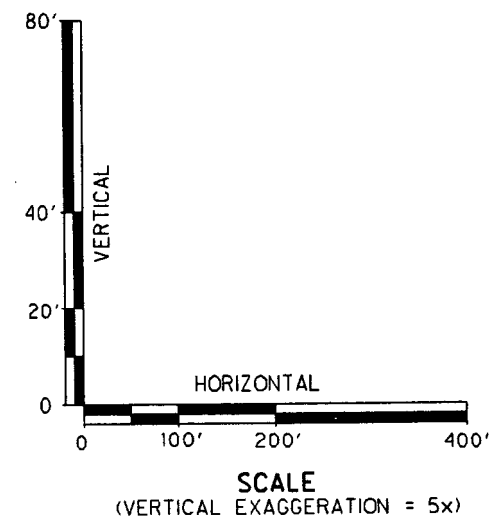
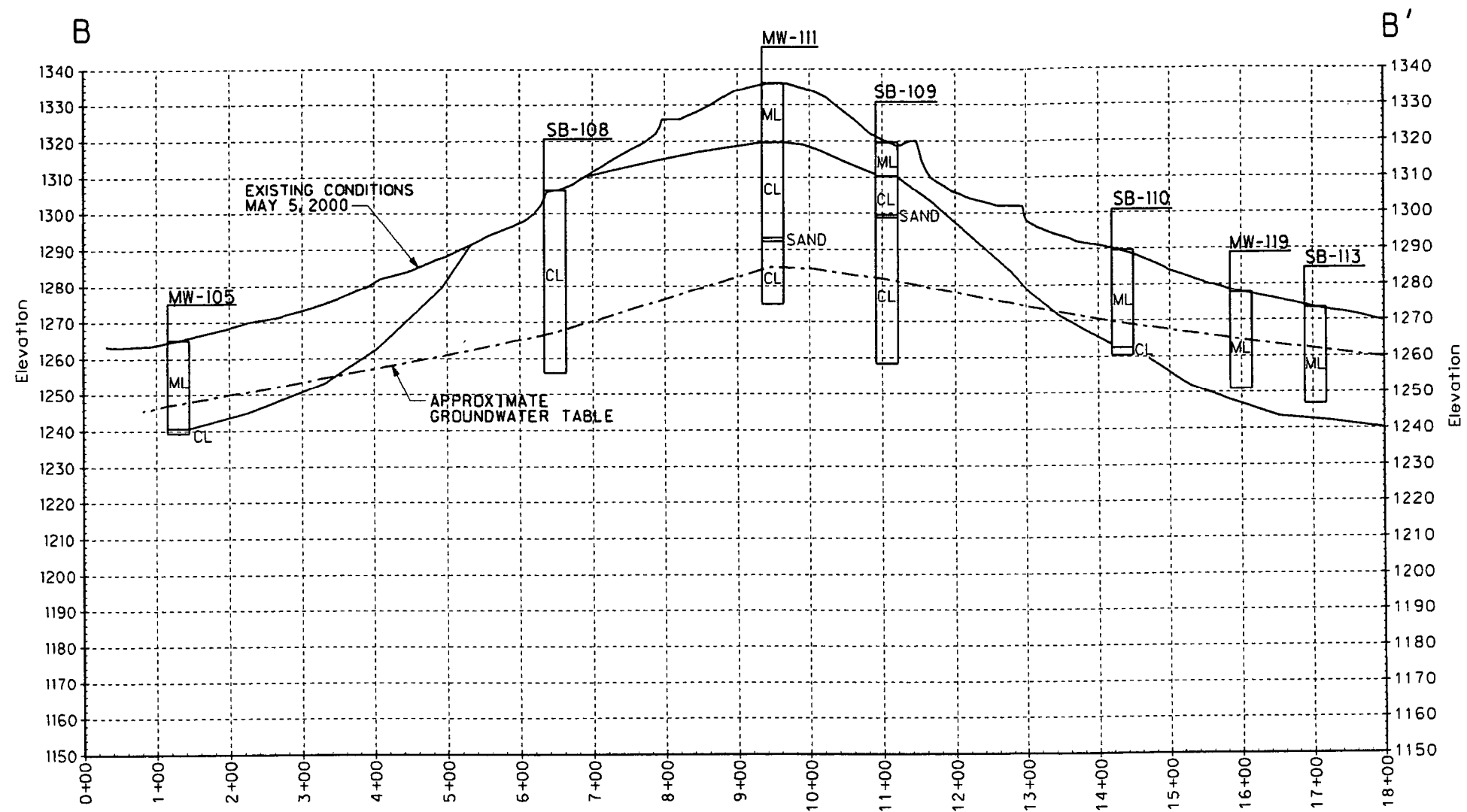


NOTE:
SEE FIGURE 8-2 FOR GEOLOGICAL CROSS SECTION LOCATION MAP.

CARROLL COUNTY SANITARY LANDFILL

FIGURE 8-3
CROSS SECTION A - A'

Scale: SEE BAR SCALE	Date: FEBRUARY, 2001
Prepared By: Foth & Van Dyke	By: JRB2 00C022



NOTE:
SEE FIGURE 8-2 FOR GEOLOGICAL CROSS SECTION LOCATION MAP.

CARROLL COUNTY SOLID WASTE COMMISSION

FIGURE 8-4
CROSS SECTION B - B'

Scale: NOT TO SCALE Date: FEBRUARY, 2001

Prepared By: Foth & Van Dyke By: JRB2 00C022