GRAYMONT

December 23, 2015

Michigan Department of Natural Resources-Real Estate
Attention: Steve Sutton
Constitution Hall, 5th Floor
525 West Allegan Street
Lansing, Michigan 48933

Re: Designation Notice for Operating Area 1

Graymont is submitting this "Designation Notice" of an Operating Area adjacent to, and including a portion of, the existing Hendricks Quarry in Tract A. Included in this designation notice package are the documents required by Exhibit D to the Addendum to Land Transaction Application dated March 19, 2015.

We are submitting this designation notice pursuant to Exhibit D, section 5 in order to initiate limestone extraction operations in 2015.

2015 Requirements (Section 5)	Comment
Adjacent to the existing Hendricks Quarry	Yes
Comprises an area less than 50 acres	Yes

Standard Requirements

Description of Operating Area (map & legal)	Exhibit A
Mine Plan with outline of operations	Exhibit B
Mining Sequence	Exhibit B
Closing and Relocation of Trails	Exhibit B
Hydrology Report	Exhibit C
Archeology Report	Exhibit D
Reclamation Plan	Exhibit E
Security for Reclamation Assessment	Exhibit F
Security - Letter of Credit	To be delivered directly by issuing Bank

Graymont (MI) LLC

Garry Kehler
Vice President Business Development

LTA Exhibits

Exhibit A

Designation Notice

Land Transaction Application

Description of the Operating Area

For the:

Graymont Borgstrom Road Quarry

Operating Area 1

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources

State of Michigan

December 2015

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Description of Graymont Borgstrom Road Quarry Operating Area

The purpose of this document is to describe Operating Area 1 designated in the Designation Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement). Operating Area 1 and each subsequent Operating Area designated within Tract A will be commonly referred to as the "Graymont Borgstrom Road Quarry" or "GBRQ".

Operating Area 1 is located on property owned by Graymont (MI) LLC (Graymont) located in the townships of Garfield and Hudson, in Mackinac County, Michigan. Operating Area 1 is comprised of approximately 50 acres, approximately 16 acres of which are located within the Hendricks Quarry and approximately 34 acres of which are located adjacent to and south of the existing Hendricks Quarry. **Figure A-1 – *Description of Operating Area 1*** shows Operating Area 1

Operating Area 1 is located within portions of the parcels described below which are owned by Graymont:

- NE ¼, NE ¼, Sec 1, T 44 N, R 9 W, Garfield Township
- SE ¼, NE ¼, Sec 1, T 44 N, R 9 W, Garfield Township
- NW ¼, NW ¼, Sec 6, T 44 N, R 8 W, Hudson Township
- SW ¼, NW ¼, Sec 6, T 44 N, R 8 W, Hudson Township

Operating Area 1 is shown on the 1973 United States Geological Survey 7.5 minute 'Garnet' Topographical Quadrangle map as shown on **Figure A-2 – *Site Location Map***. The metes and bounds description of Operating Area 1 is as follows:

> "Beginning at a point 270 feet west and 530 feet north of the southeast corner of the NW ¼, NW ¼ of Section 6, Township 44N, Range 8W, thence south 1,325 feet, thence west 1,605 feet, thence north 1,325 feet, thence east 1,605 to point at the beginning (approximately 50 acres)."

NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16 Acres)
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

FIGURE A-1

DESCRIPTION OF OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

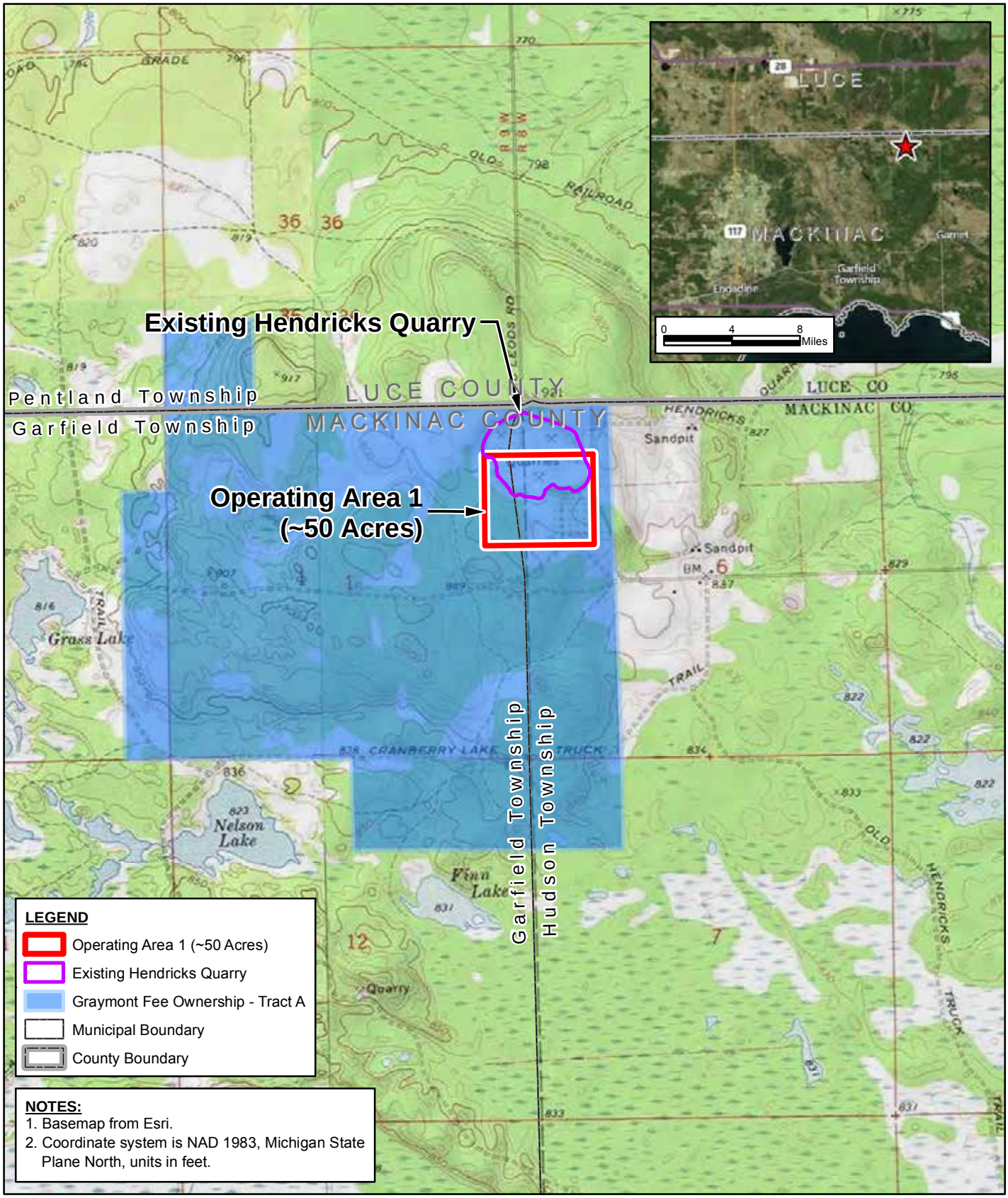
Scale: 0 150 300 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure A-1 BorgstromRdQuarry_site_layout_11x17.mxd Date: 12/13/2015



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Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	RWS3	DATE:	DEC.'15
REVIEWED BY:		DATE:	
APPROVED BY:		DATE:	

GRAYMONT (MI) LLC

FIGURE A-2
SITE LOCATION MAP
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet		Date:	DECEMBER 2015
Drafted by:	BJW1	Project No:	14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure A-2 BorgstromRdQuarry_site_location_a-size.mxd Date: 12/13/2015

Exhibit B

Designation Notice

Land Transaction Application

Mine Plan

For the:

Graymont Borgstrom Road Quarry

Operating Area 1

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources

State of Michigan

December 2015

GRAYMONT

Graymont Borgstrom Road Quarry Mine Plan

The purpose of this document is to present describe the "Mine Plan, Outline of Operations, and Mining Sequence" for the limestone quarry defined as Operating Area 1 designated in the Designation Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement). Operating Area 1 and each subsequent Operating Area designated within Tract A will be commonly referred to as the "Graymont Borgstrom Road Quarry" or "GBRQ".

Operating Area 1 is located on property owned by Graymont (MI) LLC (Graymont) located in the townships of Garfield and Hudson, in Mackinac County, Michigan. Operating Area 1 is comprised of approximately 50 acres, approximately 16 acres of which are located within the Hendricks Quarry and approximately 34 acres of which are located adjacent to and south of the existing Hendricks Quarry. **Figure B-1 – *Quarry Plan – Pre-Quarrying Conditions*** shows the quarry and operational extent of Operating Area 1 of the GBRQ.

Designation Area Geology

The target limestone is part of the Hendricks Formation. This formation consists of gray and buff dolomitic and lime mudstone and wackestones. In the proposed 50-acre quarry area defined as Operating Area 1, the target limestone is found at the top of the Hendricks Formation. It is characterized as buff to grayish buff colored, high calcium lime mudstones and wackestones with some calcite crystals and is targeted for its suitability for industrial mineral uses.. In the Operating Area 1 vicinity the target limestone is either exposed at the ground surface or overlain by thin mantle of glacial till. The average overburden is expected to be 10 to 12 feet thick.

Quarrying Sequence

After preliminary stone extraction for testing purposes, quarry development for production in Operating Area 1 will consist of a southerly advance starting from the existing Hendricks Quarry and extend to the south, east, and west to the Operating Area 1 boundary.

The initial advance will include an approximate 10 acre band along the southern boundary of the existing Hendricks pit. **Figure B-2 - *Quarry Plan – Initial Quarry Advance***, shows the initial advance. Overburden from the initial advance will be placed along the northern edge of Operating Area 1 within the existing Hendricks pit using excavator / truck / wheel loader operations. Overburden created throughout the quarrying sequence will also be used to construct sight / safety berms where needed as the quarry advances proceed across Operating Area 1. The overburden will become part of the reclaimed surface and is shown in plan view and cross sectional view in Figure B-2. Once overburden is removed from a portion of the initial advance, the target limestone is blasted and transported via wheel loaders or trucks to the in-pit processing area where crushing, screening, and loading for off-site transportation occurs (see figure B-2 for the location of the processing area). Once the initial advance reaches its ~10

acre footprint (Figure 2), production will be advanced by removing overburden and placing this overburden behind the production advance either on the existing Hendricks pit floor or newly quarried areas where target limestone has been removed. Overburden produced during this phase may also be placed against the edge of Operation Area 1 where adjacent limestone is insufficient for future production. The production phase will be maintained in approximate equilibrium where the exposure of new bedrock surface is approximately equal to the amount of previously exposed bedrock covered with overburden. This balance between creating new exposed bedrock and reclaiming previously mined bedrock surfaces will result in a relatively constant total area for reclamation management. As the working quarry face advances, the processing area may also be re-positioned closer to the face and the area previously used for processing would be subject to overburden placement / reclamation. Quarrying activities will proceed until target limestone is removed to the southern, western, and eastern boundaries of Operating Area 1. It is anticipated that at the completion of Operating Area 1 extraction activities, a narrow cut will be left along adjacent commercial target limestone to allow future quarrying of those reserves. **Figure B-3 – *Quarry Plan – Final Quarry Advance*** shows the final pit panels and quarry configuration adjacent to the western and southern edges of Operating Area 1. Those future quarrying activities will be described and itemized in future Designation Notices. At the end of Operating Area 1 quarrying activities, the majority of the 50 acre Operating Area will be reclaimed and only the narrow access panels adjacent to commercial, un-quarried rock will remain to facilitate future development. It is the intent of Graymont to cover all exposed bedrock within the 50 acre Operating Area 1 with an average of at least 12 inches of overburden to serve as a growth medium for vegetation and the majority of the reclaimed overburden placement will occur contemporaneously with quarrying activities. The only portion of the 50 acre Operating Area not subject to overburden placement and reclamation is the approximate 1 acre area within the existing Hendricks quarry which contains historic structures and foundations from past quarrying activities (see Figures B-1, B-2, and B-3). This area will remain undisturbed from proposed Operating Area 1 activities.

Quarry Operations

Quarrying methods are expected to include drilling and blasting, excavator / truck / wheel-loader material handling, in-pit ore preparation (crushing and screening), certified on-site scales / weighing, and truck transport of target limestone to off-site facilities as follows:

- Removal of overburden from the initial advance quarry area and subsequent production panel areas and placement of overburden within Operating Area 1.

- Transportation of overburden to construct perimeter safety/sight berms, temporary material stockpiles, or directly to reclamation where the extraction of target limestone has been completed. The sight safety berms would be constructed prior to pit advancement as per accepted industry standards and best management practices and local, state, or federal requirements. Figures B-1, B-2, and B-3 illustrate typical safety/sight berms.

- Sight/safety/runoff buffers will be employed as reasonable and practical along the boundaries of the quarrying operation.

- Establishment of a mobile / portable, self-contained crushing, screening, and truck loading facility within the Operating Area 1 pit. This processing facility will include conveyors for material handling and a certified on-site scale.

- Drilling and blasting will be managed by a licensed blaster in compliance with federal, state, and local requirements. Blasting may be conducted up to several times per week and a blasting schedule will be posted at quarry entrance and electronically to a publicly accessible website.

- Excavation and transportation of blasted rock to the crushing and screening plant.

- Processed stone from screening plant fed by conveyors to stockpiles for in-pit storage or to tractor-trailer trucks for transport off-site.

- Stone not suitable for sale and overburden may be used to construct safety/sight berms, transported for quarry reclamation, or stockpiled in the pit.

Tailings ponds, or dedicated sediment ponds are not proposed for Operating Area 1 operations. Temporary overburden or product stockpiles may be located within Operating Area 1 as required to facilitate material handling. No permanent structures or equipment infrastructure will be constructed in Operating Area 1.

Quarry Equipment

Major quarrying equipment proposed for the GBRQ may include:

- Front end loader(s)
- Bulldozer
- Excavator
- Water truck(s)
- Drill(s)
- Off-Road haul trucks
- Tractor double-trailer haul trucks or similar
- Service and supervisory vehicles
- Mobile, self-contained crushing, screening, conveyor loading plant
- Certified truck / equipment scale

Noise and Dust Control

The location of and the type of quarry operation proposed will assist in the mitigation of noise and dust control. Based upon the proposed depth of the operation, and through the construction of berm barriers, noise and dust will be primarily directed upward and contained within the quarry. If necessary, Graymont will utilize general controls, to reduce potential fugitive dust emissions and noise at the site. Controls may include:

Truck Traffic Control - Vehicle speed may be reduced during dry weather periods to help minimize dust from equipment traffic within the Operating Area.

Watering – If dust generation at the site is determined to be problematic, water will be utilized to suppress roadway dust by a water truck that will be kept on-site. Watering may be suspended during low temperatures as needed for safety (icy roadways).

Back-up Alarm Noise Reduction – Equipment back-up alarms may be configured to reduce noise levels.

Road Grading – Road grading will be performed as-needed to help minimize the potential for dust generation. When grading, water will be used if necessary to prevent excess dust generation.

Processing Area Dust Suppression – The crushing and screening plants may utilize a water spray system or a bag house dust collection system to control fugitive dust as needed.

Blasting

Blasting activities will be conducted at the proposed quarry operation by a licensed blaster. The effects of blasting such as dust and fly rock generation will be minimized through proper blast design. All blasting activities will be controlled and monitored as required by MSHA regulations and per accepted industry standards and best management practices and local, state, or federal requirements.

Site Access and Management

Egress and ingress to the site will be primarily from the existing Hendricks Quarry entrance/exit ramp connected to Borgstrom Road. The entrance will posted with signage regarding limitation of access, emergency contact information, operating hours, and other appropriate information. Two additional access trails enter Operating Area 1 from the south and the east and terminate within Operating Area 1. Public access to the active quarry area via these access trails will be blocked using berms and/or fencing.

Toxic and Hazardous Materials Management

The target limestone and adjacent bedrock does not contain acid-forming materials or metals that can be released to the environment once exposed to oxidation. Conversely, limestone and dolomite products are typically used to purify drinking water, treat wastewater, and neutralize acidic conditions. During quarrying operations, only minor, localized spills of fuels or lubricants would be categorized as potential contaminants.. Fuels and lubricants will be handled and managed as per industry standards, best management practices, and established regulatory requirements. Spills will be minimized by the impermeable nature of the bedrock and the natural containment offered by the pit. Blasting will be designed for complete ignition of all explosives.

Site Drainage

Significant surface water runoff emanating from undisturbed areas will be diverted around disturbed areas and allowed to flow naturally within established drainage systems. This "undisturbed water" routing will minimize changes to the natural drainage system.

Water emanating from disturbed areas will be contained and allowed to settle prior to discharge via permitted discharges, directed through engineered energy dissipation zones to remove sediment, or captured and used for dust suppression/quarry operations.

The lack of horizontal and vertical permeability are anticipated to naturally limit groundwater inflows into the quarry, mitigate effects to local surface water / wetland features, and negate effects to local domestic water supply wells.

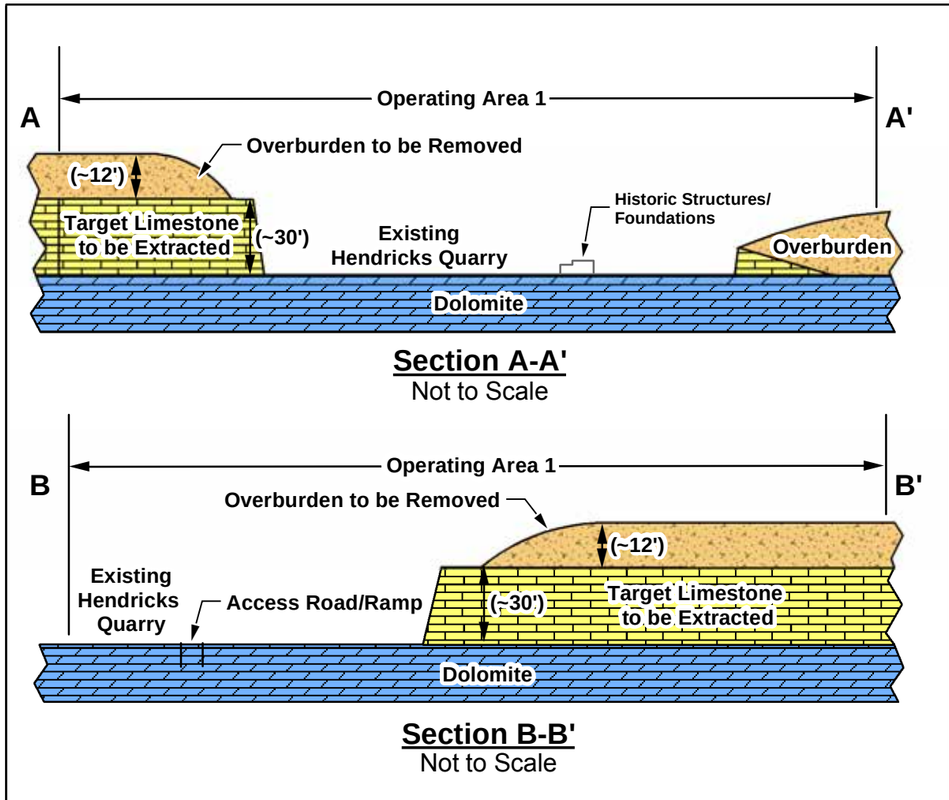
Graymont will submit a Soil Erosion and Sedimentation Control (SESC) Plan to the Luce, Mackinac, Alger, Schoolcraft District Health Department. Part 91 of the Natural Resources and Environmental Protection Act requires the submittal of the plan to address activities associated with the quarrying operation. The SESC Plan, once approved, will become part of the Storm Water Permit Application as required by the State of Michigan.

Public Utilities

No public utilities are planned for the GBRQ operation. The operation will utilize self-powered portable equipment and/or a portable generator plant. Any required supplemental water will be provided by truck delivery

Operational Schedule

The quarry will operate up to 12 months per year with product production dictated by market conditions. The quarry will operate up to 7 days-per-week, 24 hours-per-day. General hours of operation are anticipated to be from 7:00 a.m. to 8:00 p.m., however, certain conditions may require operational hours to be extended.



NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16Acres)
- Historic Structures/Foundations
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

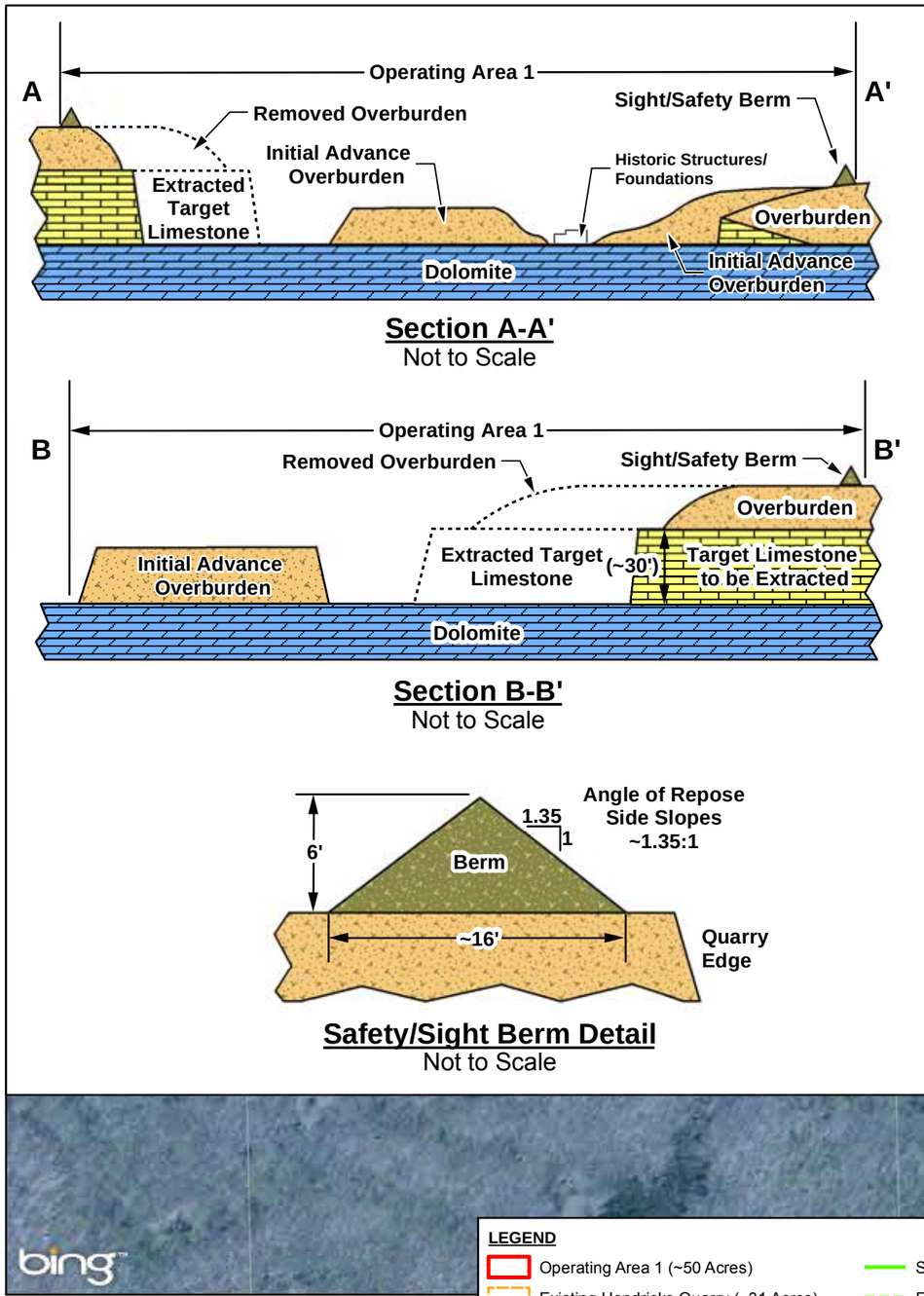
FIGURE B-1

QUARRY PLAN - PRE-QUARRY CONDITIONS
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 150 300 Feet | Date: DECEMBER 2015

Drafted by: BJW1 | Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure B-1 BorgstromRdQuarry_quarry_plan_pre_11x17.mxd Date: 12/14/2015



LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16 Acres)
- Initial Quarry Advance (~10 Acres)
- Overburden Placement
- Limestone Processing and Loading Area
- Historic Structures/Foundations
- Safety/Sight Berm
- Future Safety/Sight Berm
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

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Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC
REVISED	DATE	BY	DESCRIPTION	**FIGURE B-2** QUARRY PLAN - INITIAL QUARRY ADVANCE OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI
PREPARED BY: RWS3			DATE: DEC.'15	Scale: 0 150 300 Feet — Date: DECEMBER 2015
REVIEWED BY:			DATE:	Drafted by: BJW1 — Project No: 14W777
APPROVED BY:			DATE:	

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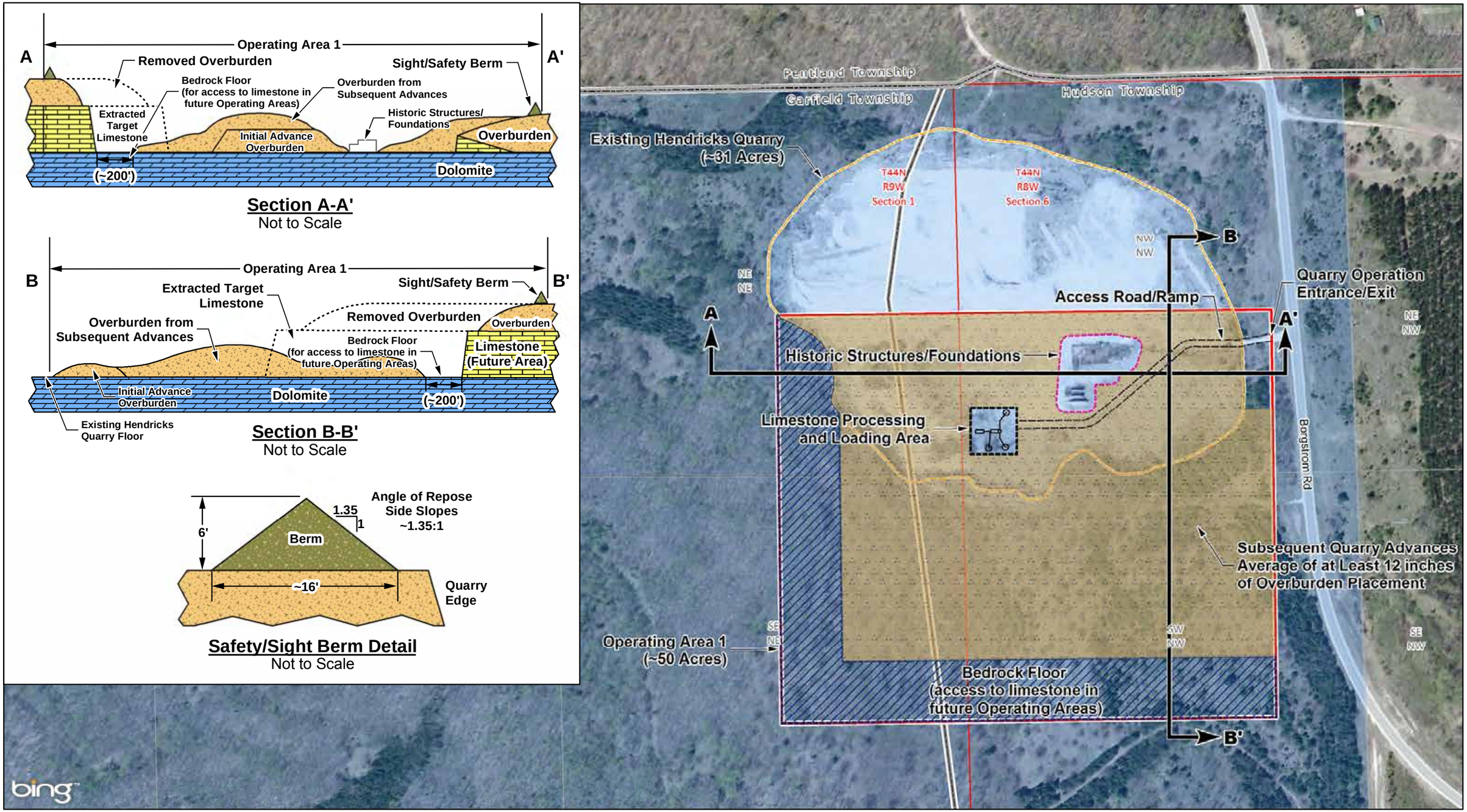
Section A-A'
Not to Scale

Section B-B'
Not to Scale

Safety/Sight Berm Detail
Not to Scale



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4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

LEGEND
- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Overburden Placement
- Limestone Processing and Loading Area
- Historic Structures/Foundations
- Bedrock Floor
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	RWS3			DATE:	DEC.'15
REVIEWED BY:				DATE:	
APPROVED BY:				DATE:	

GRAYMONT (MI) LLC

FIGURE B-3
QUARRY PLAN - FINAL QUARRY ADVANCE
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 150 300 Feet
Date: DECEMBER 2015
Drafted by: BJW1
Project No: 14W777

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Report

Graymont Borgstrom Road Quarry

Operating Area 1

Hydrologic/Hydrogeologic Evaluation

Graymont (MI) LLC

Project I.D.: 14W777

December 2015

Foth

Graymont Borgstrom Road Quarry
Operating Area 1
Hydrologic/Hydrogeologic Evaluation

Graymont (MI) LLC

Project ID: 14W777

Prepared for
Graymont (MI) LLC
Rexton, Michigan

Prepared by
Foth Infrastructure & Environment, LLC

December 2015

Graymont Borgstrom Road Quarry Hydrologic/Hydrogeologic Evaluation
Graymont (MI) LLC

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Graymont Borgstrom Road Quarry
Hydrologic/Hydrogeologic Evaluation – Operating Area 1
Graymont (MI) LLC

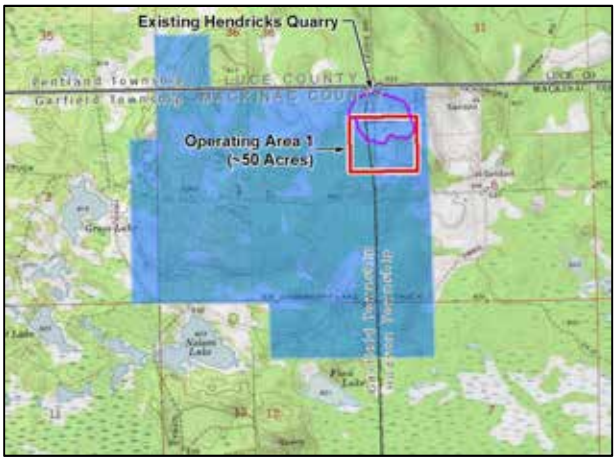
Executive Summary

The purpose of this document is to provide a report prepared by a professional hydrologist identifying the hydrological conditions in Operating Area 1 and recommend monitoring and mitigation measures appropriate for such conditions for the limestone quarry defined as Operating Area 1 designated in the Designation Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement).

The intent of this evaluation was to review the proposed quarry development and existing geologic, hydrologic, and hydrogeologic data to provide an independent assessment of the potential for surface quarrying activities associated with the proposed Quarry to affect adjacent hydrologic conditions.

The Graymont (MI) LLC Borgstrom Road Quarry is a proposed surface limestone extraction operation located in Mackinac County, Michigan.

The target limestone is part of the Hendricks Formation and this formation is typically 60-120 feet thick and consists of gray and buff dolomitic and lime mudstones and wackestones. The target limestone is typically up to 60 feet thick and is characterized by buff-colored, high calcium lime mudstones and wackestones with some calcite crystals. This zone is targeted for its high calcium content and suitability for industrial mineral needs.



The proposed quarry is situated in a topographically high area where the target limestone outcrops as a series of discontinuous ridges, and is exposed in the existing Hendricks Quarry.

The immediate vicinity can be characterized as an area of shallow glacial till overlaying several sequences of carbonate bedrock deposition. The general area contains several wetland areas and surface water features due to the presence of shallow groundwater overlaying relatively impermeable, shallow bedrock. The system is recharged by significant quantities of annual precipitation. The proposed quarrying operation is situated at the top of

the Tahquamenon Watershed which drains to Lake Superior.

Groundwater generally occurs at shallow depths within a few feet of ground surface with the exception of areas where the more-resistant target limestone outcrops as topographic highs or where a significant thickness of till exists where groundwater can be deeper. The groundwater table is situated below the base of the proposed Graymont Borgstrom Road Quarry. Carbonate bedrock formations generally exhibit very low permeability in the horizontal direction and virtually no permeability vertically due to the crystalline composition and the depositional bedding planes. Localized areas of enhanced permeability can be present as fractures, solution cavities, or along formation changes. Most water supply wells produce from the till and upper several feet of the first bedrock encountered and demonstrate low production rates.

The proposed quarrying operation is located outside of and topographically higher than wetland and surface water features.

The existing domestic water supply systems (wells) produce from outside the quarry footprint and laterally distant from the proposed quarry operation and it is unlikely that any wells will be affected due to the depth of groundwater, the elevation of proposed quarrying operations, and the distance of the wells from the quarry

Existing water resources and water supplies are not expected to be materially affected from the proposed Graymont Borgstrom Road Quarry. Surface water bodies are expected to maintain their current functions. Groundwater is expected to be below the base of proposed quarrying operations and it not expected to be impacted during quarrying activities or after quarrying and reclamation are complete.

List of Abbreviations, Acronyms, and Symbols

b	saturated aquifer thickness
bgs	below ground surface
BMP	Best Management Practices
E	east
FKP	Fiborn Karst Preserve
Foth	Foth Infrastructure & Environment, LLC
ft/day	feet per day
GBRQ	Graymont Borgstrom Road Quarry
gpm	gallons per minute
Graymont	Graymont (MI) LLC
K	hydraulic conductivity
LTA	Land Transaction Agreement
MDEQ	Michigan Department of Environmental Quality
MI	Michigan
msl	mean sea level
N	north
NWI	National Wetlands Inventory
Project	Graymont Borgstrom Road Quarry
Q	discharge or pumping rate in gpm
S	south
S_y	specific yield
t	duration
W	west

1 Project Overview

The proposed Graymont Borgstrom Road Quarry (GBRQ) (Project) Operating Area 1 is located on property owned by Graymont (MI) LLC (Graymont) located in the townships of Garfield and Hudson, in Mackinac County, Michigan (MI). Operating Area 1 is comprised of approximately 50 acres, approximately 16 acres of which are located within the existing Hendricks Quarry and approximately 34 acres of which are located adjacent to and south of the existing Hendricks Quarry. **Figure 1-1 – *Site Location Map*** shows the quarry and operational extent of Operating Area 1. Graymont proposes to conduct limestone quarrying activities within the area (approximately 50 acres shown on Figure 1-1).

Foth Infrastructure & Environment, LLC (Foth) was contracted by Graymont to complete an independent review of geologic and hydrogeologic conditions, as required by the Land Transaction Agreement between the state of Michigan and Graymont, using available existing information within the project area to address potential effects to hydrologic resources adjacent to the proposed development.

The purpose of this evaluation was to review available project planning, geologic and hydrogeologic information, and provide an independent assessment regarding the potential for surface quarrying activities to affect surrounding groundwater and surface water resources, including domestic water supplies.

This report provides an overview of the hydrologic environment and presents the findings of the subject hydrological/hydrogeological evaluation.

1.1 Target Resource

The target resource is contained in Hendricks Formation carbonate sequences which outcrop in or are present near the surface within the GBRQ Operating Area 1. The carbonate sequence is composed of high calcium limestone and occurs as deposits, which can be economically extracted via surface quarrying techniques. The target limestone has been identified for its suitability for industrial mineral use.

1.2 Project Location

The Project is located in the Upper Peninsula of MI approximately 7 miles north of Lake Michigan and 40 miles northwest of St. Ignace, MI. The Project is situated in Garfield and Hudson Townships within Mackinac County. Rexton and Garnet are the closest communities to the Project. Rexton and Garnet are both unincorporated communities within Hudson Township. Local residents proximal to Operating Area 1 obtain their water from individual private wells.

1.3 Project Operations

The Project area is shown on Figure 1-1. The GBRQ, approximately 50 acres in extent, is located within and adjacent to the existing Hendricks Quarry. Graymont is proposing to expand the existing Hendricks Quarry approximately 34 acres to the south to extract high-calcium limestone. Operating Area 1 also contains about 16 acres of the existing Hendricks quarry and

will use that area for equipment staging and to serve as an entry point for limestone reserves to the south.

A generalized depiction of the aerial extent and the subsurface till/bedrock structure in the vicinity of Operating Area 1 is shown on **Figure 1-2 – *Generalized GBRQ Area.*** The target limestone in this area outcrops or immediately underlies the till/overburden in discontinuous higher ridges. The limestone and adjacent dolomite bedrock dip to the south causing the target limestone to deepen southward. The GBRQ operation is not expected to encounter groundwater even at the furthest southern extent. Moving away from the more resistant (to weathering) outcrop, glacial erosive/deposition features, cause the ground surface elevation to decrease and shallow lakes and/or wetlands occur. In the area of the GBRQ, the structure and targeted limestone production area/depth is expected to elevate the quarry operations above the water table and well away from lower elevation wetlands and lakes. This is evidenced by the lack of water or seeps within the existing Hendricks Quarry, in fact portions of the Hendricks Quarry were known to have been advanced more than 10 feet below the base of the target limestone without encountering groundwater. Figure 1-2 also conceptually shows typical quarrying industry BMPs such as buffer strips and barrier berms which would aide in the mitigation of hydrologic impacts. Given the proposed GBRQ Operating Area 1operation location and extent, the natural conditions are expected to negate hydrologic effects.

2 Background Site Characterization

The following sections characterize the geologic and hydrogeologic conditions in the vicinity of the GBRQ Operating Area 1.

2.1 Geology

A general Michigan stratigraphic section is provided on **Figure 2-1 – *Michigan Stratigraphic Nomenclature***. The target limestone is a member of the Hendricks Formation within the Burnt Bluff Group, in the Niagaran Stage of the middle Silurian Period. **Figure 2-2 – *Local Sloped Dolomite and Limestone Bedding*** is a geologic bedrock map showing the local slopped dolomite and limestone formations. The Hendricks Formation is typically 60-120 feet thick and consists of gray and buff dolomitic and lime mudstones and wackestones. The target limestone is typically up to 60 feet thick and is characterized by buff-colored, high calcium lime mudstones and wackestones with some calcite crystals. This zone is targeted for its suitability for industrial mineral needs and is found at the top of the Hendricks Formation.

A cross section location map is provided as **Figure 2-3 – *Cross Section Location Map***. Two geologic cross sections; one, north (N) – south (S) and one, east (E) – west (W) were developed and are provided as **Figure 2-4 – *Geological Cross Sections C-C'*** and **Figure 2-5 – *Geological Cross Section E-E'*** which show the inferred subsurface geologic and hydrogeologic conditions within and adjacent to Operating Area 1 and in the vicinity of the existing Hendricks Quarry from N-S and E-W.

The stratigraphy in the region consists of Quaternary glacial till overlying the Silurian Engadine, Manistique, and Burnt Bluff Groups.

2.1.1 Engadine Group

The Engadine Group consists of the Bushbay Formation, Rapson Creek Formation, and Rockview Formations. The Engadine is characterized as bluish to buff massive, hard, crystalline dolomite, almost free of impurities with poorly developed and irregular joints (Smith, 1916).

2.1.2 Manistique Group

The Manistique Group consists of the Cordell and Schoolcraft Formations. The Manistique is characterized by a thick succession of white to buff to brown colored, finely bedded or thinly laminated dolomites and high magnesium limestones with conchoidal fracturing. Some beds are extremely cherty and siliceous and it extends from the Engadine down to the Hendricks Formation. Joints are varied from regular to very irregular (Smith, 1916).

2.1.3 Hendricks Formation

The target limestone is present at the top of the Hendricks Formation. The target limestone is characterized as buff to grayish buff dense grained to lithographic limestone containing small crystals of calcite. The joint systems are very irregular and poorly developed and the stone is brittle and fractures conchoidally (Smith, 1916). The remainder of the Hendricks Formation is characterized by gray dolomitic and dolomitic lime mudstones, wackestones, and packstones.

2.1.4 Hydrogeology

Regionally, groundwater is relatively shallow and found within a few feet of the ground surface to about 60 feet below the ground surface. The topography of the region is relatively flat with subdued ridges exhibiting higher topography. The region is poorly drained and is characterized by many wetlands and shallow lakes. Water wells in the area are typically set at the till/bedrock interface or in the shallow bedrock and receive their water from the glacial till and top, irregularly fractured portion of the shallow bedrock. As evidenced by local hydrologic features such as the elevation of adjacent wetlands, streams, and lakes; the occurrence and elevation of groundwater in local domestic wells; and the elevation of the bottom of the proposed Operating Area 1 pit floor, the groundwater table is expected to be positioned below the deepest extension of the pit floor (see Figures 2-4 and 2-5). Given this elevation contrast, groundwater is not expected to be encountered and potential impacts associated with quarrying are negligible.

Groundwater flow through the crystalline bedrock is expected to be very limited or non-existent. Groundwater flow (where present) through the bedrock comes primarily via secondary porosity from fracture flow within networks of joints and fractures. The flow predominantly occurs as irregular, non-continuous thin zones of low permeability rock (<1.9 feet per day [ft/day]) (Muldoon, 2005). The majority of the formation displays negligible permeability with virtually no vertical permeability due to bedding and crystalline deposition. Zones of potentially enhanced hydraulic conductivity can occur typically at the surface of the bed, which has been exposed to alteration from weathering. Secondary permeability can also be created by karst/cave mechanics and connected fractures. The carbonate sequences are largely a low permeability crystalline system and these secondary permeability features are not typically connected for substantial distances/areas.

2.2 Hydrology

The hydrology of the area is characterized by small, shallow lakes, wetlands creeks, and rivers which are likely connected to the groundwater system and recharged by the large amount of annual precipitation. Surface water is poorly drained due to low topographical relief, shallow/ impermeable bedrock, and high recharge rates.

2.2.1 Karst

Extensive karst features have not been documented in the immediate area of Operating Area 1 or within the exposed existing Hendricks Quarry. There is one notable karst feature in the region approximately 9½ miles from Operating Area 1. The Fiborn Karst Preserve (FKP) is a 480-acre preserve near the Fiborn Quarry Hydrogeologic and geologic conditions in the FKP are significantly different those observed in the GBRQ in terms of limestone extent, permeability, and water occurrence and are not anticipated to be encountered in Operating Area 1.

2.2.2 Drainage Network

The general project area is located at the conjunction of three sub-basins draining to Lake Michigan, Lake Huron, and Lake Superior. The Operating Area 1 is located in the Tahquamenon Watershed. The drainage basins and sub-watersheds are shown on **Figure 2-6 – *Drainage Basins/Surface Water Bodies***. The Tahquamenon sub-basin drains surface water north primarily via the Tahquamenon River into Tahqemenon Bay in Lake Superior. The

Brevort-Millecoquins sub-basin is positioned south of Operating Area 1 and drains to Lake Michigan.

2.2.3 Surface Water Bodies

There are a number of small lakes located near Operating Area 1, which are shown on Figure 2-6. Finn Lake, Nelson Lake, Grass Lake and Goat Lake are the closest in proximity to the GBRQ but are all located at least 5,000 feet away from the Operating Area 1 southern boundary and associated quarrying activities. The elevation of these surface water bodies are well below the deepest extent Operating Area 1 quarrying operations.

2.2.4 Wetlands

As shown on **Figure 2-7 – *National Wetlands Inventory Map***, wetland areas have been identified in the area characteristic of Quaternary glaciated areas. The wetlands nearest to Operating Area 1 are comprised of Freshwater Emergent Wetland and Freshwater Forested/Shrub Wetland. No wetlands have been mapped within the 50-acre Operating Area 1 parcel and the nearest mapped wetlands occur within approximately 1,615 feet of the proposed quarry activities. Both the shallow lakes and wetlands in the region are the result of relatively flat topography and shallow, generally impermeable bedrock which maintain a high elevation water table. Graymont supplemented the National Wetlands Inventory (NWI) mapping in August 2014 via a site specific wetlands delineation effort conducted by a professional wetlands scientist (ASTI, 2014). The supplemental inventory effort generally conformed to the NWI mapping however extent of the delineated wetlands were reduced or found to be discontinuous in several areas as compared to the NWI boundaries. **Figure 2-8 – *Site Specific Wetlands Delineation*** shows the results of the field mapping effort. Similar to the lakes discussed above, the closest wetlands are situated well below the elevation of the Operating Area 1 area.

3 Proposed Quarry Operations

The extent of proposed quarrying activities are depicted on Figures 1-1, 1-2 and **Figure 3-1 – *Quarry Plan - Initial Advance***. Operating Area 1 consists of approximately 16 acres within the existing Hendricks pit and approximately 34 acres of new quarry area for a total of approximately 50 acres of operational area. Operating Area 1 will extend approximately 50 deep once target limestone is extricated.

3.1 Graymont Borgstrom Road Quarry

The GBRQ Operating Area 1 involves conducting limestone quarrying within approximately 50 acres in Garfield and Hudson Townships within Mackinac County, Michigan. Operating Area 1 is located within portions of the parcels described below which are owned by Graymont:

- NE ¼, NE ¼, Sec 1, T 44 N, R 9 W, Garfield Township
- SE ¼, NE ¼, Sec 1, T 44 N, R 9 W, Garfield Township
- NW ¼, NW ¼, Sec 6, T 44 N, R 8 W, Hudson Township
- SW ¼, NW ¼, Sec 6, T 44 N, R 8 W, Hudson Township

The Hendricks Formation, which contains the target limestone at the top of the Hendricks Formation, can be seen in the existing Hendricks Quarry. Figure 3-1 the Operating Area 1 GBRQ location, boundaries, and presents two generalized cross sectional views. The existing Hendricks Quarry is not currently flooded and it is anticipated that quarrying operations would initiate within the southern portion of the existing pit and would progress southward into adjacent economic deposits and continue south and west to the Operating Area 1 boundary.

As shown on Figures 1-2, 2-4, and 2-5, the target limestone generally occurs continuously throughout the GBRQ and is locally thinned by depositional and surface erosional features. In addition, the target limestone in the vicinity of the GBRQ can be locally thinned and overlain by the occurrence of surface water bodies and wetlands as a result of glacial erosion and deposition (see Figures 2-6, 2-7, and 2-8). The areas containing wetlands and surface water features are typically situated in topographically low elevation areas created by glacial activity and lie to the southeast of the Operating Area 1.

Accordingly, GBRQ quarry activities will be limited to higher elevation, upland areas where the target limestone outcrops or is near the surface. The resulting quarry footprint is limited to an upland pit on a subtle, topographically high ridge where the target limestone is present (see Figures 2-4 and 2-5). The upland position of the actual proposed quarry expansion area is anticipated to be above the local water table (as illustrated by the lack of water within the existing Hendricks Quarry). Lower portions of the pit floor or walls are not expected to intersect the water table as quarrying operations progress south (get deeper with the dip of the limestone) and influence to the groundwater system is expected to be negligible due to the upland position of the pit.

As quarry activity progresses from the Hendricks Quarry, unsuitable rock and overburden will be placed in stockpiles within the pit or used to reclaim quarried-out areas behind the advance Unsuitable rock and overburden may also be used for perimeter sight/safety/buffer berms or

surface hydrologic feature buffer/control berms as shown on Figures 1-2. Quarrying methods are expected to include typical drilling and blasting, excavator /truck/wheel-loader material handling, in-pit ore preparation (crushing and screening), and truck transport of target limestone to off-site facilities for shipping and further processing. Runoff from disturbed areas associated with quarrying activities will be routed to the pit. Pit flooding is unlikely to occur even in the deepest portions of the pit, however, if perched groundwater was intercepted it would be expected to be of limited extent and quality due the impermeable nature of the host rock and minor amount of hydraulic head expected.

4 Analysis of Potential Hydrological Effects Resulting from the Proposed Quarry Operations

Based on the extraction activities proposed for the GBRQ Operating Area 1 quarrying operation and the local hydrologic characteristics, potential effects to the hydrologic regime are presented in the following subsections. The current (pre-quarrying) geologic, hydrogeologic, and hydrologic characteristics are described in Section 2 using available information. The proposed operations area presented in Section 3 is based on the current level of planning available. The intent of this section is to characterize potential effects to the hydrologic system utilizing the information currently available.

4.1 Graymont Borgstrom Road Quarry

The GBRQ will consist of an open pit surface quarry in an area where the Hendricks Formation target limestone outcrops or is near the surface in a topographically elevated position. Hydrologic features are not expected to be significantly influenced since:

- the surface disturbance will occur at the top of drainage basin;
- surface water bodies fall within topographic low areas located away from the pit;
- the water table is expected to be below the projected pit floor elevation;
- the host rock will not yield water quality contributions which will degrade background characteristics;
- the low permeability of the target limestone is generally expected to inhibit groundwater occurrence and movement.

4.1.1 Watershed Position

The entire Operating Area 1 is positioned within the upper portion of the Tahquamenon Watershed as shown on Figure 2-8.

Given this upland position located at the top of the watershed boundary, effects to stream channel and basin characteristics are not expected. Developed stream channels are well outside Operating Area 1 and any secondary or tertiary channels are located in low topographical positions well outside of active quarrying activities.

No stream channel alteration will be required as part of quarrying operations or associated with transportation aspects. The entire area of the GBRQ is considered a watershed contribution and recharge area and quarry activities do not alter this function.

4.1.2 Topographical Position – Proximity to Surface Water and Wetlands

Two recognized surface water bodies occur south of Operating Area 1: Finn Lake, approximately 1½ miles south; and Nelson Lake, approximately 1½ miles to the southwest. As shown on Figure 2-6, two lakes are present south of Operating Area 1: Finn Lake and Nelson

Lake. Both of these lakes are over 5,000 feet away from the Operating Area 1 southern border and elevations of the lakes are lower than the projected bottom of the Operation Area 1 quarry. Both of these lakes exhibit northwest/southeast oriented wetlands but are not connected based on the wetland delineation mapping conducted in 2014. Figures 2-6, 2-7, and 2-8 shows the designated wetlands and surface water features.

The Operating Area 1 operation will not intersect any delineated wetland area (based on the NWI mapping and the site-specific wetland delineation mapping previously described) and is not expected to influence adjacent wetland systems due to the relative topographic elevation of the quarry. The closest mapped wetland is approximately 1,615 feet southeast of the Operating Area 1 boundary.

The precipitation recharge function and the connectivity of the surface water system are anticipated to continue to maintain the water supply that creates the existing surface water regime. Based on the aerial position and elevation of the nearest lakes and wetlands as compared to the Operating Area 1 quarry, adverse effects to the lakes and wetlands are not expected.

4.1.3 Water Table Depth and Shape

The water table depth is shown on Figures 2-4 and 2-5 and is projected to be situated below the deposits to be extracted. Figure 2-4 illustrates that even with complete target limestone removal, the water level would still be approximately 20 feet below the lowest point of extraction and therefore no water table decline is foreseen associated with the Operating Area 1 activities.

Given the expected lack of communication with the water table, the discontinuity of the target limestone in the outcrop area, the low intrinsic permeability of the limestone, and the prolific amount of precipitation recharge to the hydrologic system each year, effects to the water table surface are considered negligible.

4.1.4 Simulated Cone-of-Depression

To assess the drawdown due to potential dewatering in the vicinity of the GBRQ, an analytical solution for a pumping well was modeled. The computer program AQTESOLV Version 4.5 (HydroSOLVE, 2007) was used to provide the analytical solution. The program requires aquifer characteristic and pumping rate information as inputs, and then calculates drawdown versus time and distance.

The Neuman solution for a pumping test in an unconfined aquifer (Neuman, 1972) was used in the analysis. The solution employs the following simplifying assumptions:

- The aquifer has infinite areal extent.
- The aquifer is homogeneous and has uniform thickness.
- The aquifer water table surface is initially horizontal.
- The aquifer is unconfined with delayed gravity response.
- The pumping well is either fully or partially penetrating.
- Flow is unsteady and well storage is neglected.

Although the assumptions are not stringently achieved and seldom perfectly witnessed in nature, the conditions reasonably and conservatively reflect the actual conditions in the vicinity of the GBRQ.

The following data inputs are required to run the solution:

- Saturated aquifer thickness (b)
- Hydraulic conductivity (K)
- Specific yield (S_y)
- Pump well radius and penetration
- Pumping rate (Q) and duration (t)

The saturated thickness was taken to be the depth from the water table to the surface of the quarry floor if groundwater was encountered in the Operating Area pit. The solution was run for thicknesses of both 25 and 50 feet. Hydraulic conductivity was taken from a University of Wisconsin-Oshkosh study on Silurian dolomite in Door County, Wisconsin (Muldoon, 2005) and aquifer test data obtained from recent dolomite bedrock testing in New Mexico. Values of both 0.26 and 1.90 (ft/day) were used as lower and upper estimates, respectively. A specific yield of 0.10 was used based on literature values (Anderson and Woessner, 2002). A fully penetrating pump well was used (well extended to the base of the quarry), and a well radius of 6 inches was assumed. Pumping rates varied from 2 to 20 gallons per minute (gpm) depending on the combination of aquifer parameters used in each solution scenario. The pumping rate approximates the values reported in well logs for the area. Pumping rates were generally adjusted until the maximum allowable drawdown was obtained (either 25- or 50-foot saturated thickness). A pumping duration of five years was used for all scenarios. Distances to an expected 5-foot decrease in the water table were then calculated. The 5-foot drawdown extent was selected as the boundary at which domestic wells could reasonably expect an effect.

Results of the Neuman analytical drawdown solution can be found on **Figure 4-1 – *West-East Cross Section Conceptual Drawdown Analysis*** and show that for the scenarios that maximized drawdown at the well, the distance to the 5-foot drawdown radius ranged from 200 to 1,000 feet, depending on the hydraulic conductivity, saturated thickness, and pumping rate used. At the lower hydraulic conductivity value (0.26 ft/day) and a 50-foot saturated thickness, the 5-foot drawdown occurred at a radius of 200 feet with a 2 gpm pumping rate. At the higher hydraulic conductivity value (1.90 ft/day) with a 50-foot thickness, the 5-foot drawdown occurred at a radius of 1,000 feet with a 20 gpm rate. The most conservative drawdown extent of 1,000 feet would require a continuous pumping rate of 20 gpm which is likely unsustainable. Using very conservative values of b=25 feet, Q=5 gpm, and a hydraulic conductivity of 1.9 ft/day, the resulting maximum distance to a 5-foot drawdown limit would be 350 feet. Accordingly, if groundwater was encountered within the pit, water supply wells outside of 350 feet away from the edge of the quarry would not be expected to be materially affected. Since the GBRQ only would be expected to exhibit a maximum of 5 feet of saturated thickness (instead of the modeled 25 feet) the distance would be expected to be less than 350 feet.

4.1.5 Water Quality

Surface water chemical characteristics are a result of bedrock, shallow till and precipitation chemistry. Organic matter accumulations in lower, stagnant areas and carbonate influenced groundwater interactions further define the surface water chemical composition. Quarry activities are not anticipated to directly disturb the surface water system since quarrying activities are not proposed to intersect surface water bodies and wetlands.

Increased exposure to limestone and dolomite from rock stockpiles and quarry surfaces offers the potential to add carbonate rock constituents to the system. The carbonate constituents would largely be limited to calcium and magnesium cations and carbonate anions. These constituents are not associated with liberating unwanted metals and are buffering compounds typically used to treat acid conditions. In addition, the quantity of quarry discharge water loading will be insignificant as compared to the precipitation recharge component to the surface water system.

No effects are anticipated to background surface or groundwater quality associated with the proposed Operational Area 1 quarrying operations.

4.2 Analysis of Water Supplies in the Vicinity of the Quarry Operation

Well records for water supply systems in the vicinity of the GBRQ Operating Area 1 were researched to determine locations and pertinent well construction and production zone information. Wells within one mile of the proposed GBRQ operation boundary were further analyzed to determine if quarrying operations could be expected to influence the capability of the water supply well to continue to produce groundwater. The records were obtained from the Michigan Department of Environmental Quality's (MDEQ), Wellogic online database and supplemental scanned records. Pertinent information was reviewed and summarized on **Figure 3-2 – *Domestic Water Supply Well Locations***. The information summarized includes:

- Well Location (coordinates MI GeoRef)
- Well Elevation (feet mean sea level [msl])
- Top of Bedrock (feet below ground surface [bgs] and feet msl) (if encountered)
- Total Drill Hole Depth (feet bgs and feet msl)
- Screened Interval (if installed) (feet bgs and feet msl)
- Static Water Level (feet bgs and feet msl)

Not all the well records are complete – portions of the data were either lacking or set to a default value that may not be representative of actual conditions. Any wells not reported to or entered into the MDEQ database or contained in the scanned well records have not been included in this analysis.

A total of nine wells were found to be present within one mile of the proposed quarry activities associated with the GBRQ and summarized and displayed on Figure 3-2.

None of the nine wells are located within the proposed quarry operations and would not be physically damaged by quarry operations. The closest well (#1155) is approximately 1,520 feet

from the Operating Area 1 boundary (see Figure 3-2), which is outside the 350 foot or even the most conservative 1,000-foot drawdown extent. Given that the groundwater table has not been encountered in the existing Hendricks pit, the Operating Area 1 pit is not expected to intersect the water table, and the maximum cone of depression would not be expected to extend to existing domestic wells (even if groundwater was encountered); impacts to wells resulting from Operating Area 1 quarrying activities are not expected to occur.

5 Quarry Design and Operational Mitigation

One of the objectives of the proposed Operating Area 1quarry component locations, design, and operations is to economically extract limestone while minimizing effects to natural resources and local domestic water supply systems.

5.1 Effective Utilization of Natural Conditions

The target limestone areas amenable for surface extraction generally coincide with topographic high points. Operating Area 1 is positioned at a topographic high area which avoids surface water features and wetlands.

Groundwater occurrence and flow is not anticipated to be affected by quarry activities associated with Operating Area 1due to the elevation of the target limestone and the current observed characteristics of the Hendricks Quarry. Surface water and groundwater chemistry are not expected to be materially affected due to the chemical composition of the local carbonate water bearing units and the dilution effect of the surface water/glacial till system. The target limestone does not contain constituents that would be considered to be harmful to the native system.

5.2 Surface Water Containment and Control

Surface water and runoff control is typically conducted in a three-tiered approach, as needed.

- Significant surface water runoff emanating from undisturbed areas is diverted around disturbed areas and allowed to flow naturally within established drainage systems. This "undisturbed water" routing will minimize changes to the natural drainage system.
- Disturbed runoff water would be expected to be contained within Operating Area 1.
- If excess water is encountered, runoff from disturbed areas is contained and allowed to settle prior to discharge via permitted discharges or captured and used for dust suppression/quarry operations.

5.3 Pit Dewatering

Quarry dewatering is not expected to be required within Operating Area 1 as discussed in Sections 3 and 4. Precipitation contributions would typically be routed to a low point in the pit and used for dust suppression and operational needs or allowed to evaporate.

5.4 Institutional Controls

Institutional controls and operational practices typical to standard industry practices may be utilized as needed to further contain and control potential effects associated with quarrying activities. Controls and operations typical of quarrying operations should be considered as appropriate and may include accepted quarry Best Management Practices (BMPs) such as diversion berms and ditches, use of rock rip rap, erosion control of exposed stockpiles, dust suppression, etc.

5.5 Barriers to Groundwater Flow

The lack of horizontal and vertical permeability of the bedrock are anticipated to naturally limit effects from groundwater inflows to the quarry, diminishment of groundwater flow to local surface water features, and decrease groundwater availability to water supply wells as discussed in Section 4. In the event that saturated, localized, high permeability zones are encountered within the unconsolidated materials or bedrock, several options are available to retard flow rates and manage water table elevations adjacent to excavations and may be employed as necessary.

5.6 Monitoring/Testing/Analysis

Groundwater is not evident within the existing Hendricks pit and portions of the existing Hendricks quarry were advanced below the target limestone to depths anticipated to be below the deepest portion of the proposed Operating Area 1 quarry. Accordingly, a groundwater monitoring program would be limited to zones below the quarry. Based on these conditions, an additional groundwater monitoring program is not warranted. Graymont should regularly assess pit conditions within Operating Area 1 as the pit advances south to evaluate the occurrence of groundwater.

5.7 Water Supply System Mitigation

As described in Section 4, the closest domestic water supply wells are located outside the quarry operations and outside the projected drawdown associated with the operation should groundwater be encountered in the pit. Should it be determined that a domestic water supply was altered by Operating Area 1 activities, Graymont can mitigate the effect by drilling a new well or pursuing remedial measures that would restore groundwater production.

6 Reclamation and Hydrologic Restoration

As required by the Land Transaction Agreement (LTA), quarry infrastructure will be removed following permanent completion of extraction and processing activities. Re-vegetation will be allowed to colonize naturally.

6.1 Hydrologic and Hydrogeologic Restoration

The post-quarry topography will reflect a dampened expression of the pit extent with vegetated safety berms to promote public safety. The pit floor will exhibit a subdued hummocky topography based on the final distribution of the reclamation material. All areas within Operating Area 1 would be covered with an average minimum of 12 inches (with the exception of the defined historic foundations in the existing Hendricks pit) of overburden to serve as plant growth medium. Some areas within the 50-acre Operating Area 1 footprint would receive more than 12 inches of overburden. **Figure 6-1 – *Post-Quarrying Conditions*** presents the reclaimed Operating Area 1 quarry.

Precipitation falling within the quarried/reclaimed area of Operating Area 1 will evaporate and/or seep into pit floor materials. Even during heavy precipitation events or snowmelt, meteoric water from precipitation is expected to be consumed within the reclaimed materials. As the reclaimed materials become vegetated, meteoric water is expected to be consumed via evapotranspiration and evaporation. Depending on final pit floor/residual bedrock elevations, localized, temporary ponding may occur on the floor of the existing, exposed Hendricks pit outside of Operating Area 1 but would be expected to dry up as currently witnessed via evaporation. Precipitation occurring outside the pit and remaining safety barriers will infiltrate into surficial soils, concentrate as runoff away from the pit, or enter the pit depending on grade and precipitation intensity. Groundwater is not expected to be encountered and sustainable hydrologic conditions for ponds or wetlands are not anticipated.

Water quality is not expected to be materially affected by surface quarrying operations. The host rock and aquifer material is composed of limestone and dolomite. Both source materials are soluble in water and their constituents will undoubtedly contribute to the constituency of the groundwater and surface water chemistry. The groundwater in the area is expected to be dominated by calcium, magnesium cations, and carbonate anions creating calcium/magnesium carbonate waters. This chemical composition constitutes oxidized, buffering characteristics and does not promote the creation of acid runoff or metals dissolution common with other types of metallic quarrying operations. The surface water system receives such a large quantity of precipitation recharge that any influences would be readily diluted. Based on the chemistry of the host rock material and the prolific recharge characteristics, post-quarrying material, short or long-term effects to the surface and groundwater hydrologic regime are not expected.

Based on the upland position of the proposed quarry along with proposed quarrying and reclamation activities proposed, post-quarrying hydrologic and hydrogeologic conditions are expected to maintain approximate pre-quarrying characteristics.

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7 Authors

This report has been prepared by Richard Schowengerdt and Brooke Lund, Foth Infrastructure & Environment, LLC.

Richard Schowengerdt

Richard Schowengerdt is a Principal Engineer and Hydrogeologist within the Foth Quarrying Group. He offers over 35 years of applied quarrying experience specializing in quarrying design and reclamation applications. Mr. Schowengerdt provides extensive experience in the, quarrying, synfuels, water supply development, and water control/treatment arena throughout the western and mid-western United States. Specific applications include quarry development and design, state and federal quarry permitting, baseline investigations and data analysis, dewatering analysis and design, and impacts analysis. Mr. Schowengerdt has been utilized as an expert associated with quarry design, permitting and, potential impacts to water supplies associated with limestone and dolomite quarry development and expansion in Illinois and Wisconsin as well as numerous quarry design support applications throughout the U.S. and internationally.

Brooke Lund

Brooke Lund is a Geologist within Foth Infrastructure & Environment, LLC. She offers 6 years of applied geological experience specializing in complex bedrock hydrogeologic investigations, field applications, and exploratory geology. She has extensive experience in drilling oversight, field program management, well construction oversight, extensive experience in surface and underground quarrying environments, reporting, data management, and regulatory compliance monitoring and reporting for quarrying clients in Nevada, Missouri, Alaska, Wisconsin, and Minnesota. Additionally, she spent time working for quarrying clients on managing and implementing field operations for deep bedrock hydrogeologic investigations in Colombia and Mexico.

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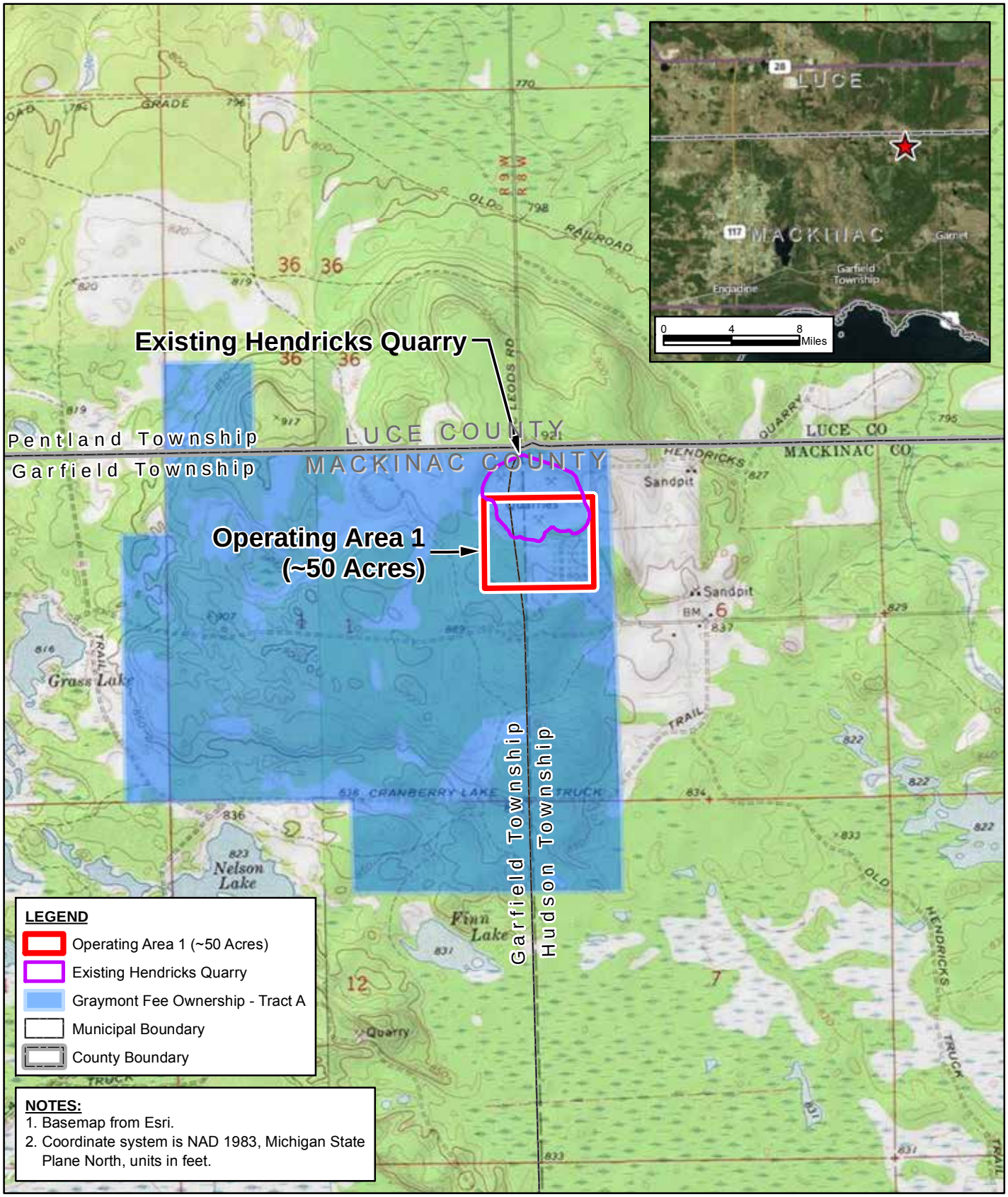
Figures



GRAYMONT

Foth

N

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PREPARED BY: BAL3			DATE: DEC.'15
REVIEWED BY: RWS3			DATE: DEC.'15
APPROVED BY: RWS3			DATE: DEC.'15

GRAYMONT (MI) LLC

FIGURE 1-1

SITE LOCATION MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

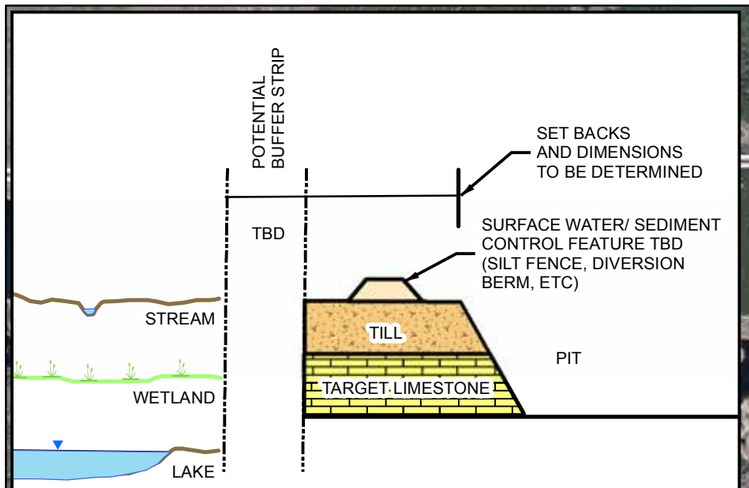
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

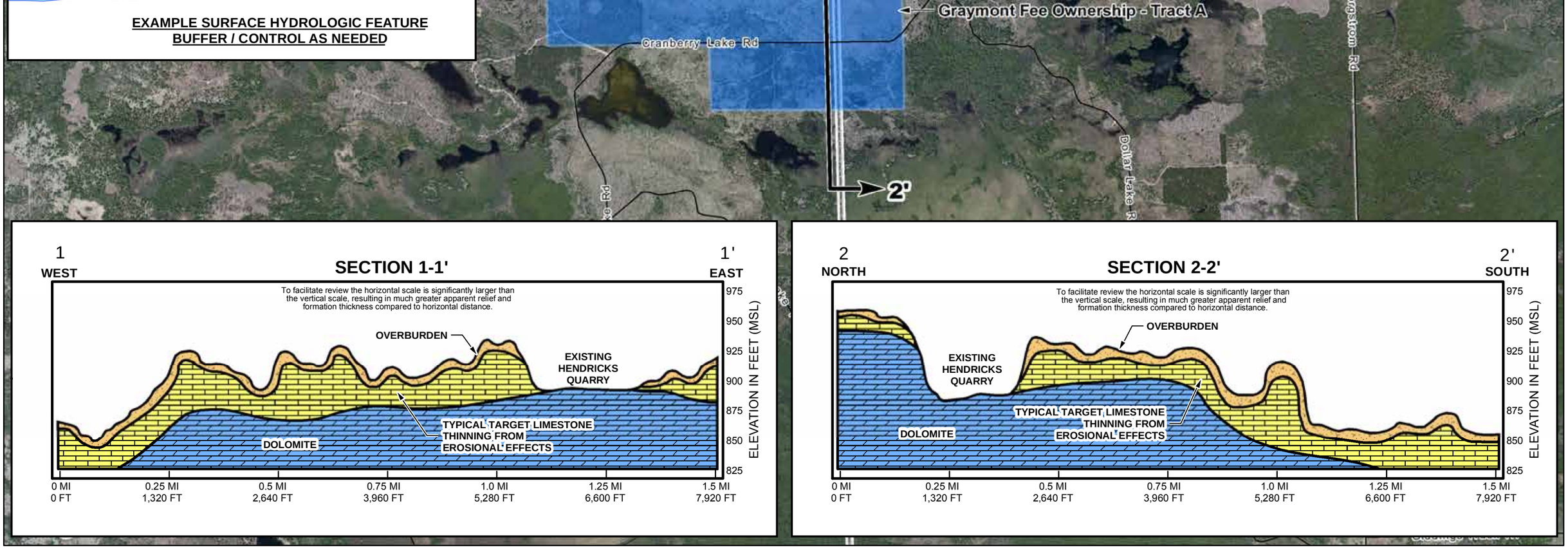
Drafted by: BJW1

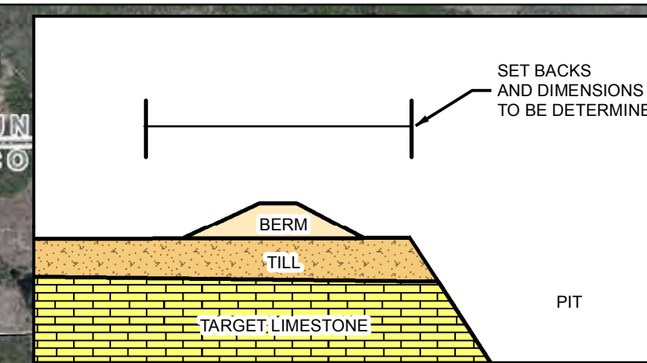
Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\site_location_map_a-size.mxd Date: 12/14/2015



EXAMPLE SURFACE HYDROLOGIC FEATURE BUFFER / CONTROL AS NEEDED





EXAMPLE PERIMETER / PIT HIGHWALL BERM AS NEEDED

NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.t
4. The quarry area boundaries lines of section and other details are preliminary, conceptual depictions for illustrative purposes. Final designs, locations and corresponding details will be defined based on supplemental information acquisition and final engineering.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

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Foth Infrastructure & Environment, LLC					
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PREPARED BY:	BAL3		DATE:	DEC.'15	
REVIEWED BY:	RWS3		DATE:	DEC.'15	
APPROVED BY:	RWS3		DATE:	DEC.'15	

GRAYMONT (MI) LLC

FIGURE 1-2

GENERALIZED GBRQ AREA
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

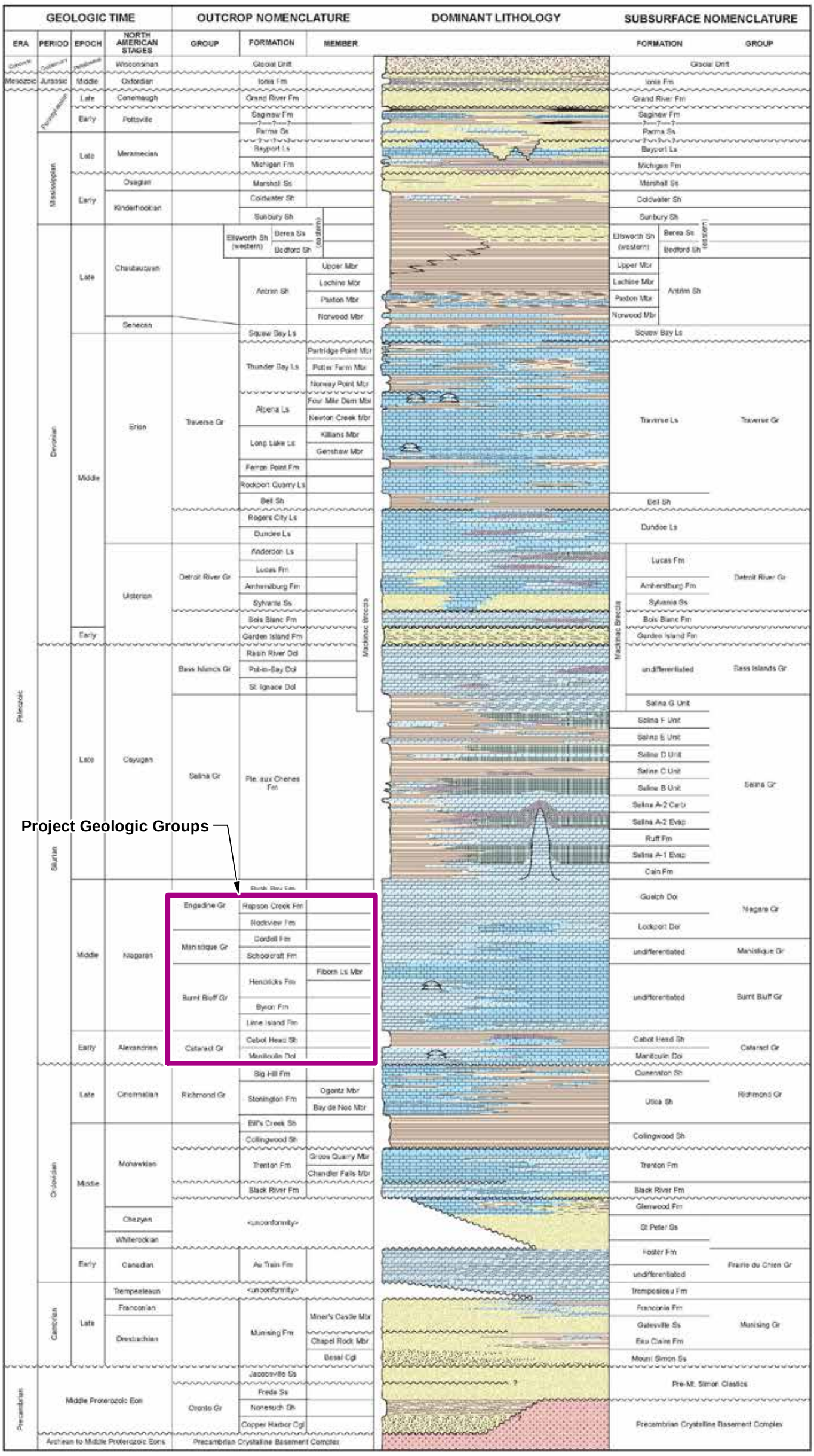
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\hendricks_surface_quarry_area.mxd Date: 12/14/2015



STRATIGRAPHIC NOMENCLATURE FOR MICHIGAN

Michigan Dept. of Environmental Quality
Geological Survey Division
Harold Fitch, State Geologist
and
Michigan Basin Geological Society

Stratigraphic Nomenclature Project Committee:
Dr. Paul A. Catacosinos, Co-chairman
Mr. Mark S. Wollensak, Co-chairman

Principal Authors:
Dr. Paul A. Catacosinos
Dr. William B. Harrison III
Mr. Robert F. Reynolds
Dr. David B.Westjohn
Mr. Mark S. Wollensak

2000

Acknowledgements

This work is the product of the combined efforts of the geological communities of Michigan and the surrounding states and provinces. Below are given just a representative few of the contributors:

Academia: Dr. Aureal T. Cross, Michigan State University; Dr. Robert H. Dott, Jr., University of Wisconsin; Mr. William D. Everham, Ph.D. Candidate, Michigan Technological University.

Government: Dr. Terry R. Carter, Ontario Ministry of Natural Resources; Mr. John M. Esch, Michigan Department of Environmental Quality; Dr. Brian D. Keith, Indiana Geological Survey; Mr. Lawrence H Wickstrom, Ohio Geological Survey.

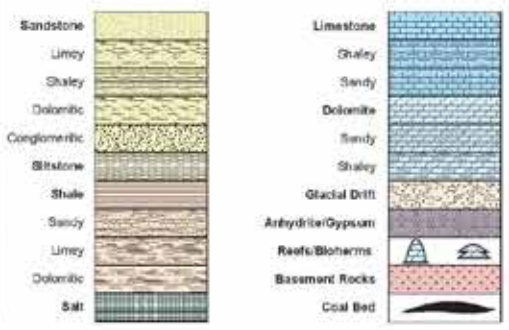
Industry: Mr. Donald J. Bailey, Consultant; Mr. Jimmy R. Myles, Scot Energy; Mr. Dan E. Pfeiffer, Pfeiffer Exploration Services.

A complete listing of all contributors will be found in the Stratigraphic Lexicon for Michigan, of which this column is an integral part.

RELATED TERM CORRELATION

STRATIGRAPHIC POSITION	RELATED TERMS
Ionia Fm	Jurassic Red Beds
Michigan Fm	Clare Dolomite, Brown Lime, Stray Dolomite, Stray Sandstone, Stray-Stray Sandstone, Stray-Stray-Stray Sandstone, Triple Gyp
Coldwater Sh	Coldwater Red Rock, Speckled Dolomite, Vitler Sand
Antrim Sh	Charlton Black Shale Member, Elliton, Chester Black Shale Member, Upper Black Shale, Light Antrim, Lower Black, Lower Antrim, Middle Antrim, Middle Gray Antrim, Dark Antrim, Middle Gray Shale, Unit 1A, Unit 1B, Unit 1C, Crappo Creek Grey Shale Member
Dundee Ls	Reed City Member/Dolomite/Anhydrite
Lucas Fm	Freer Sandstone, Homer Member, Iutz Member, Massive Salt/Anhydrite, Sour Zone, Big Anhydrite, Richfield Zone/Member/Sandstone, Big Salt
Amherstburg Fm	Filer Sandstone, Meldrum Member, Black Lime
St. Ignace Dolomite	Salina H Unit
Salina B Unit	Big Salt, B Salt
Ruff Formation	Salina A-1 Carbonate, Rabbit Ears Anhydrite,
Cain Fm	Salina A-0 Carbonate
Guelph Dolomite	Brown Niagara, Niagaran Reef, Pinnacle Reef, Engadine Dolomite
Lockport Dolomite	Gray Niagara, White Niagara
Burnt Bluff Gr	Clinton Formation
Trenton Fm	Cap Dolomite
Black River Fm	Van Wert Zone, Shoshky Peak, Black River Shale
Glenwood Fm	Goodwell Unit, Zone of Unconformity
St. Peter Sandstone	Bruggers Sandstone, Jordan Sandstone, Knox Sandstone, Massive Sand
Prairie du Chien Gr	Foster Formation, New Richmond Sandstone, Lower Knox Carbonate, St. Lawrence Formation, TPDC, Oneota Dolomite, Brazos Shale
Trempealeau Fm	Lodi Formation
Galesville Ss	Dresbach Sandstone
Pre-Mt. Simon Clastics	Precambrian "Red Beds"

LEGEND (See Note 2)



NOTES:
1. Michigan Stratigraphic Column supplied by MDEQ, Geological Survey Division.
2. Upper formations may not be present due to erosional activity.

GRAYMONT

Foth

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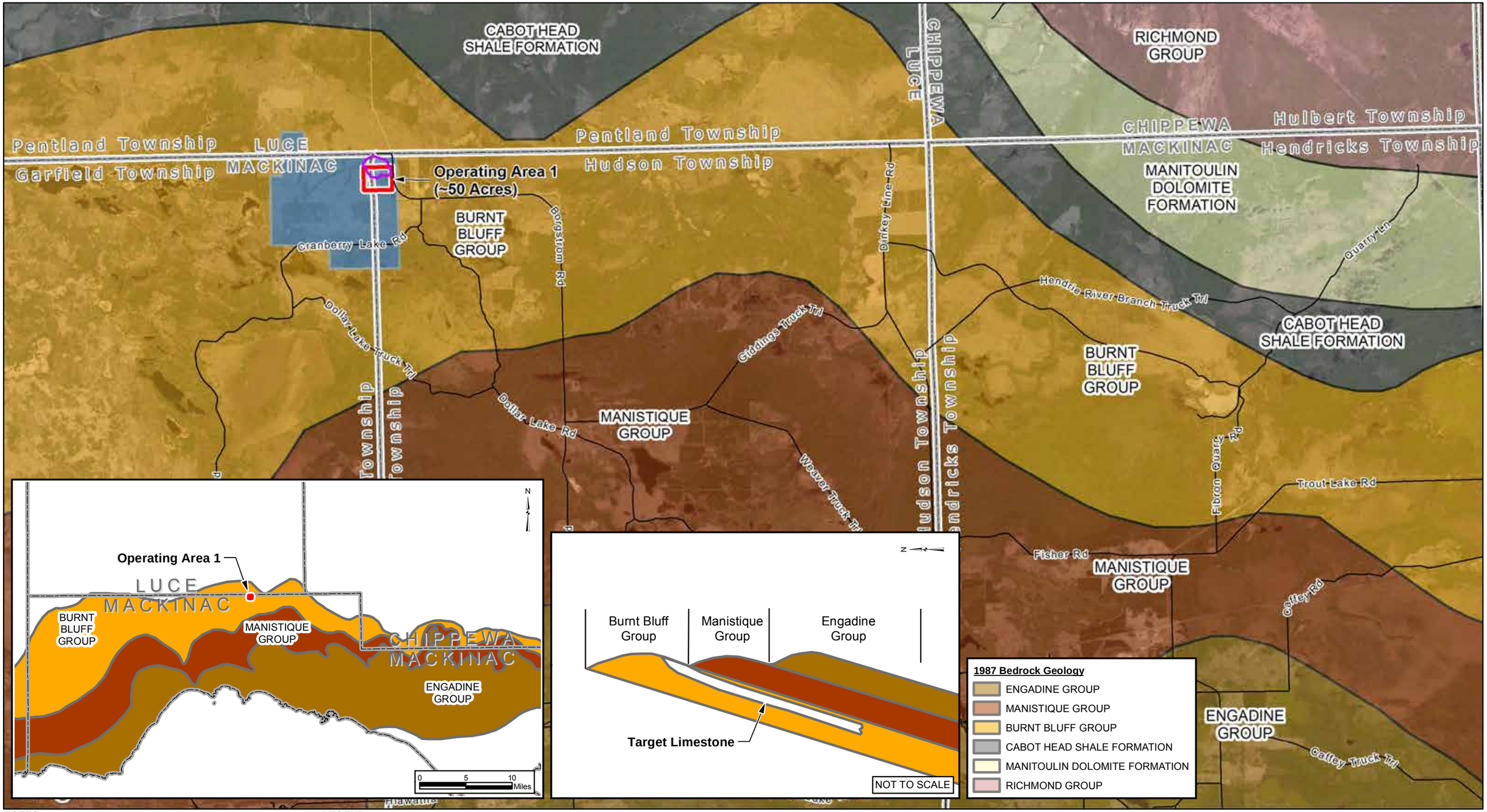
PREPARED BY: BAL3			DATE: DEC.'15
REVIEWED BY: RWS3			DATE: DEC.'15
APPROVED BY: RWS3			DATE: DEC.'15

GRAYMONT (MI) LLC

FIGURE 2-1
MICHIGAN STRATIGRAPHIC NOMENCLATURE
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: NOT TO SCALE	Date: DECEMBER 2015
Drafted by: BJW1	Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\stratigraphic_column.mxd Date: 12/9/2015



NOTES:

1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Road and boundary data from Michigan Center for Geographic Information.
4. 1987 Bedrock Geology supplied by Michigan Center for Geographic Information
5. Inset diagrams are approximate representations, are provided for illustrative purposes, and do not reflect actual locations and depths.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

Middle Silurian Age

- Engadine Dolostone Group
- Manistique Group
- Burnt Bluff Group

GRAYMONT

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PREPARED BY:	BAL3	DATE:	DEC.'15
REVIEWED BY:	RWS3	DATE:	DEC.'15
APPROVED BY:	RWS3	DATE:	DEC.'15

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FIGURE 2-2
LOCAL SLOPED DOLOMITE AND LIMESTONE BEDDING
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

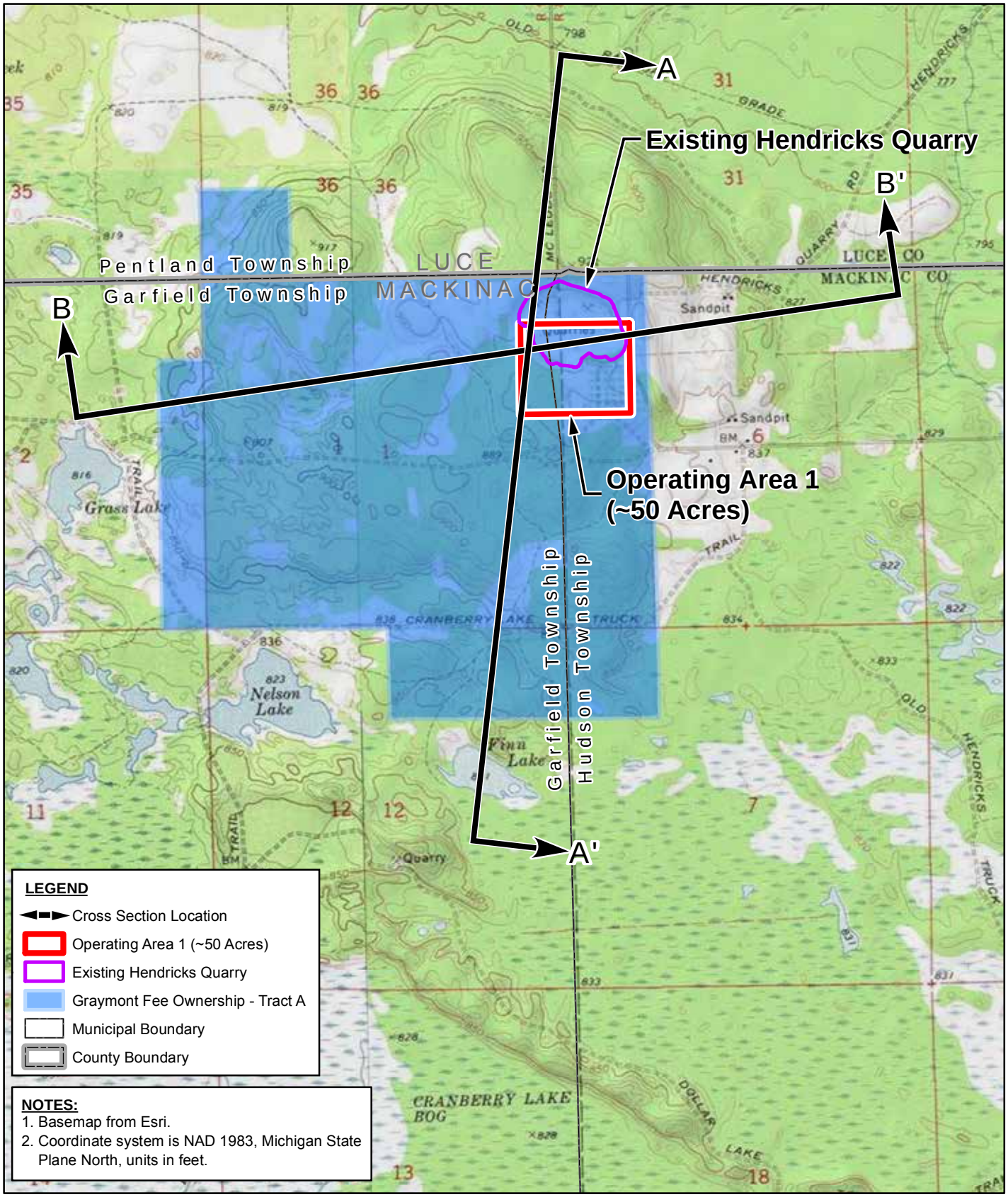
Scale: 0 0.5 1 Miles

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\sloped_dolomite_and_limestone_bedding.mxd Date: 12/14/2015



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REVIEWED BY:	RWS3	DATE:	DEC.'15
APPROVED BY:	RWS3	DATE:	DEC.'15

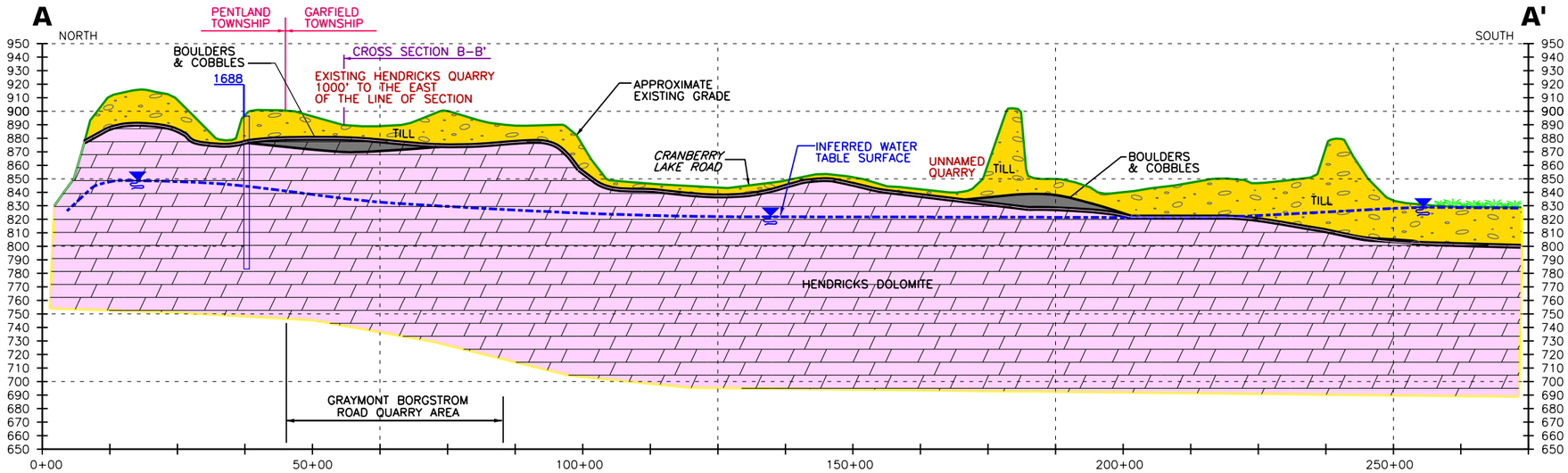
GRAYMONT (MI) LLC

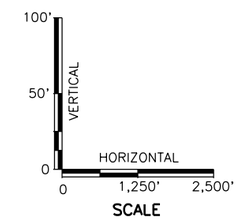
FIGURE 2-3

CROSS SECTION LOCATION MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet		Date:	DECEMBER 2015
Drafted by:	BJW1	Project No:	14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\cross_section_location_map_a-size.mxd Date: 12/14/2015





LEGEND

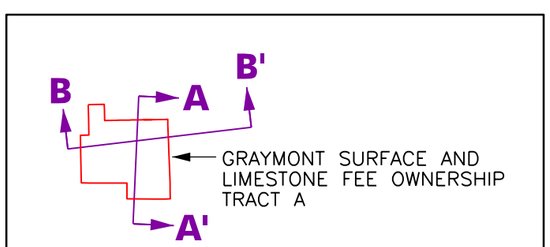
- WETLAND (FROM USGS TOPO)
- ESTIMATED WATER TABLE (ESTIMATED FROM STATIC WATER LEVELS AND TOPOGRAPHIC FEATURES)
- TILL/OVERBURDEN
- BOULDERS AND COBBLES
- HENDRICKS DOLOMITE

NOTE:

TO FACILITATE REVIEW, THE HORIZONTAL SCALE IS 25 TIMES LARGER THAN THE VERTICAL SCALE RESULTING IN AN EXAGGERATED SECTION INDICATING MUCH GREATER RELIEF AND FORMATION THICKNESS AS COMPARED TO THE HORIZONTAL DISTANCE.

NOTES:

1. CROSS–SECTIONS ARE INTERPOLATED FROM AVAILABLE GEOLOGIC DATA. SUBSURFACE CONDITIONS HAVE BEEN INFERRED.
2. SURFACE TOPOGRAPHY GENERATED FROM A COMBINATION OF LIDAR DATA AND USGS TOPO.
3. INFORMATION FOR WELL DATA FROM MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY ONLINE WELL DATABASE AND HAS BEEN PROJECTED ONTO THE SECTION FOR ILLUSTRATIVE PURPOSES ONLY.
4. HENDRICKS FORMATION CONTAINS THE TARGET LIMESTONE.



CROSS SECTION LOCATION MAP

NOT TO SCALE

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC					
REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	BAL3			DATE:	DEC.'15
REVIEWED BY:				DATE:	DEC.'15
APPROVED BY:	RWS3			DATE:	DEC.'15

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FIGURE 2–4

GEOLOGICAL CROSS SECTION A – A'
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	SEE BAR SCALE	Date:	DECEMBER 2015
Drafted By:	JRB2	Project No:	14W777

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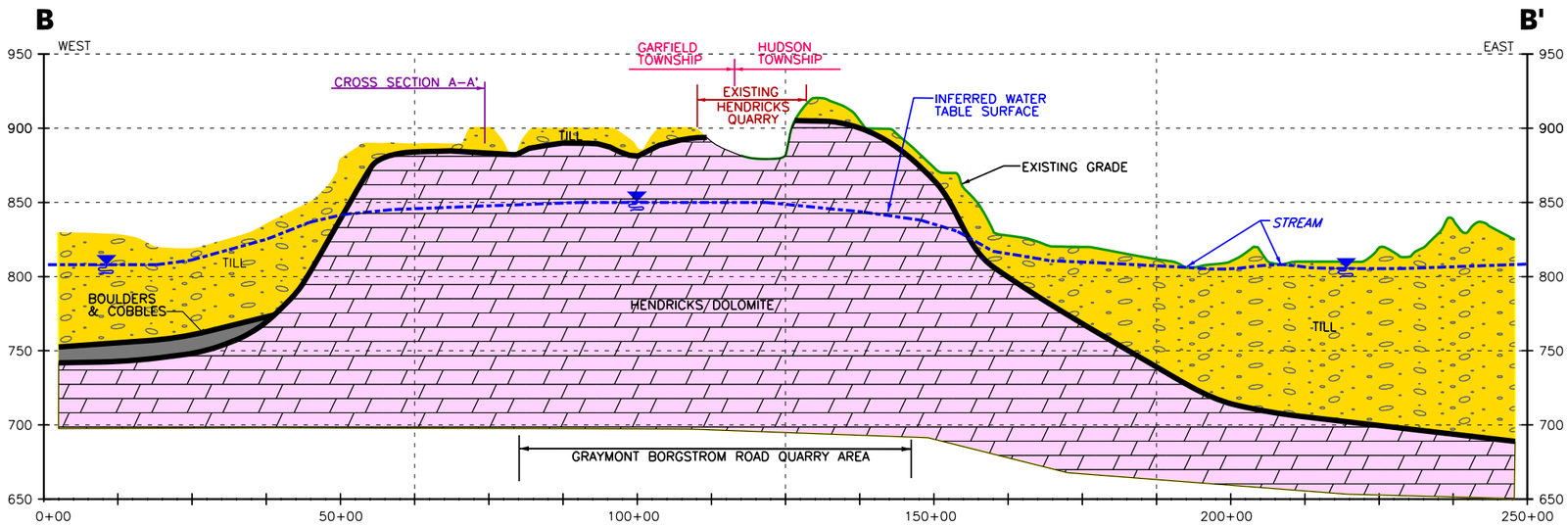
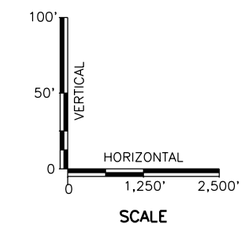




LEGEND

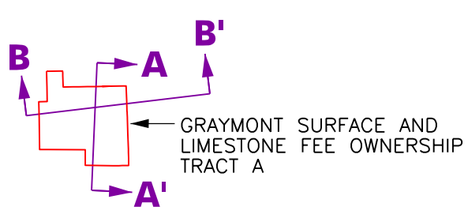
- TILL/OVERBURDEN
- BOULDERS AND COBBLES
- HENDRICKS DOLOMITE

NOTE:

TO FACILITATE REVIEW, THE HORIZONTAL SCALE IS 25 TIMES LARGER THAN THE VERTICAL SCALE RESULTING IN AN EXAGGERATED SECTION INDICATING MUCH GREATER RELIEF AND FORMATION THICKNESS AS COMPARED TO THE HORIZONTAL DISTANCE.

NOTES:

1. CROSS–SECTIONS ARE INTERPOLATED FROM AVAILABLE GEOLOGIC DATA. SUBSURFACE CONDITIONS HAVE BEEN INFERRED.
2. SURFACE TOPOGRAPHY GENERATED FROM A COMBINATION OF LIDAR DATA AND USGS TOPO.
3. HENDRICKS FORMATION CONTAINS THE TARGET LIMESTONE.



CROSS SECTION LOCATION MAP

NOT TO SCALE

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC					
REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	BAL3			DATE:	DEC.'15
REVIEWED BY:	RWS3			DATE:	DEC.'15
APPROVED BY:	RWS3			DATE:	DEC.'15

GRAYMONT (MI) LLC

FIGURE 2–5

GEOLOGICAL CROSS SECTION B – B'
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	SEE BAR SCALE	Date:	DECEMBER 2015
Drafted By:	JRB2	Project No:	14W777

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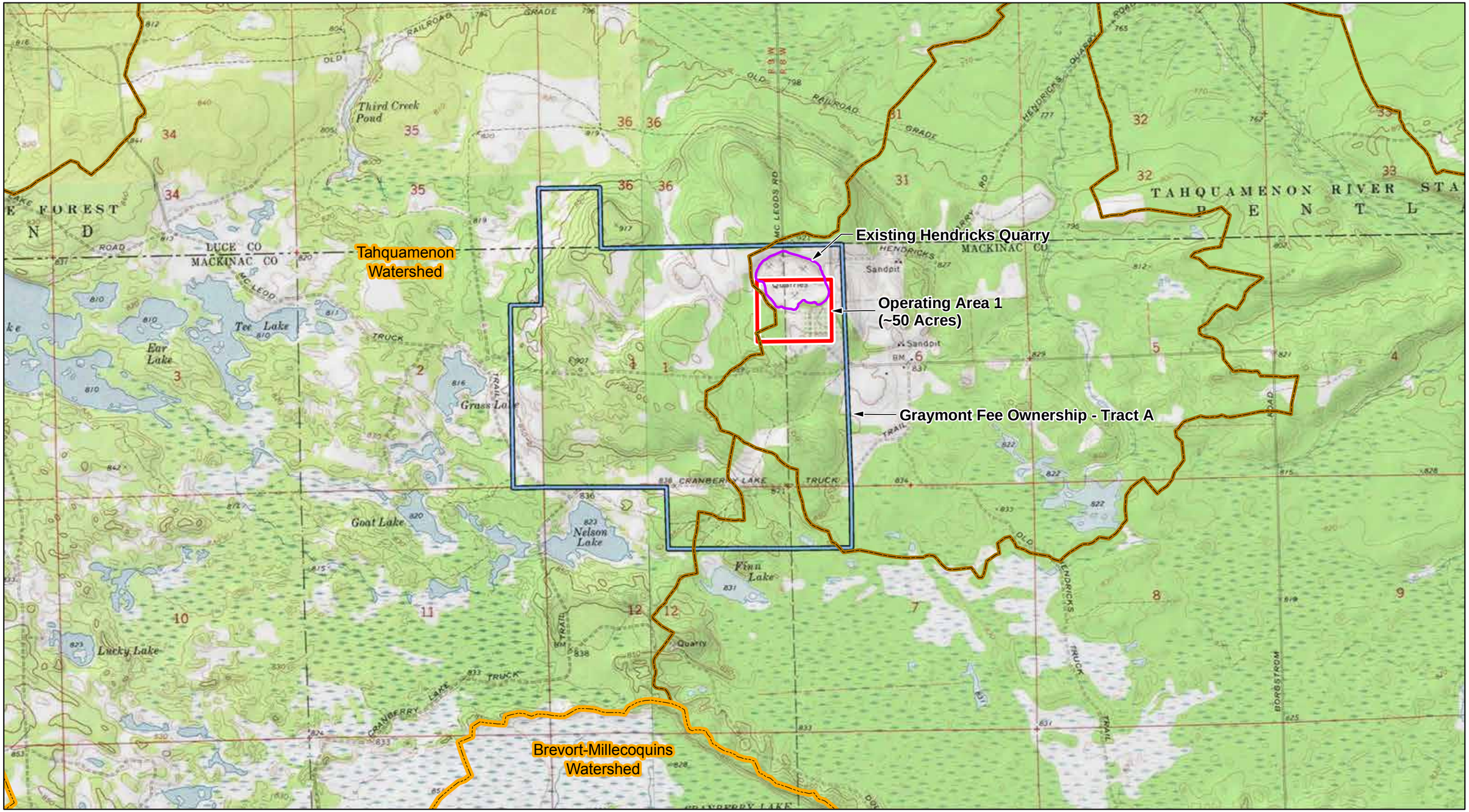

NOTES:

1. Basemap from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Watershed data from the Michigan Center for Geographic Information.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Primary Watershed Boundary
- Secondary Watershed Boundary

GRAYMONT

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Foth Infrastructure & Environment, LLC					
REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	BAL3			DATE: DEC.'15	
REVIEWED BY:	RWS3			DATE: DEC.'15	
APPROVED BY:	RWS3			DATE: DEC.'15	

GRAYMONT (MI) LLC

FIGURE 2-6

DRAINAGE BASINS/SURFACE WATER BODIES
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

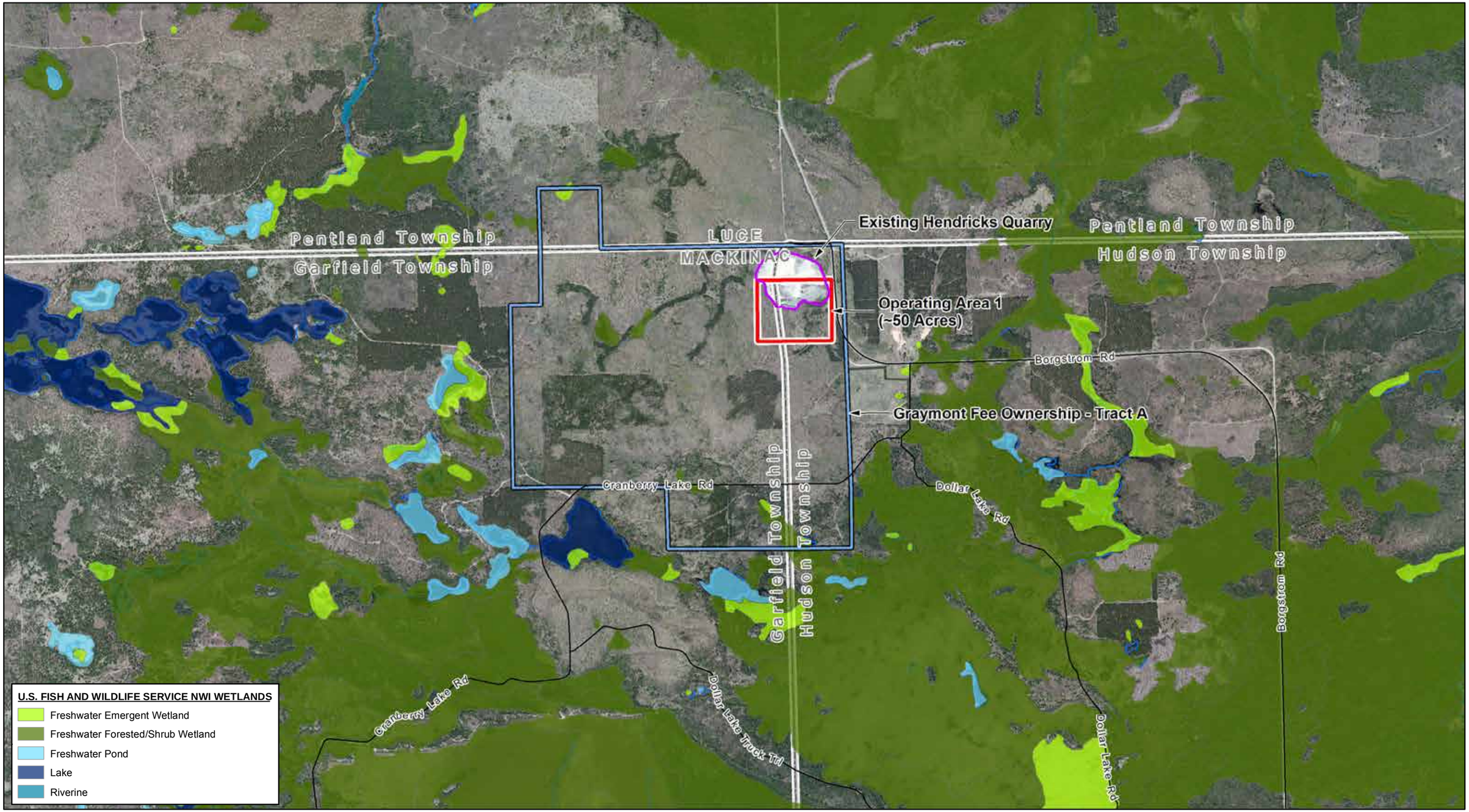
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\drainage_basins_surface_water_features.mxd Date: 12/14/2015



NOTES:

1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Road and boundary data from Michigan Center for Geographic Information.
6. Wetlands data from U.S. Fish and Wildlife Service.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Stream/River
- Municipal Boundary
- County Boundary

GRAYMONT

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REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	BAL3	DATE:	DEC.'15
REVIEWED BY:	RWS3	DATE:	DEC.'15
APPROVED BY:	RWS3	DATE:	DEC.'15

GRAYMONT (MI) LLC

FIGURE 2-7

NATIONAL WETLANDS INVENTORY MAP
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

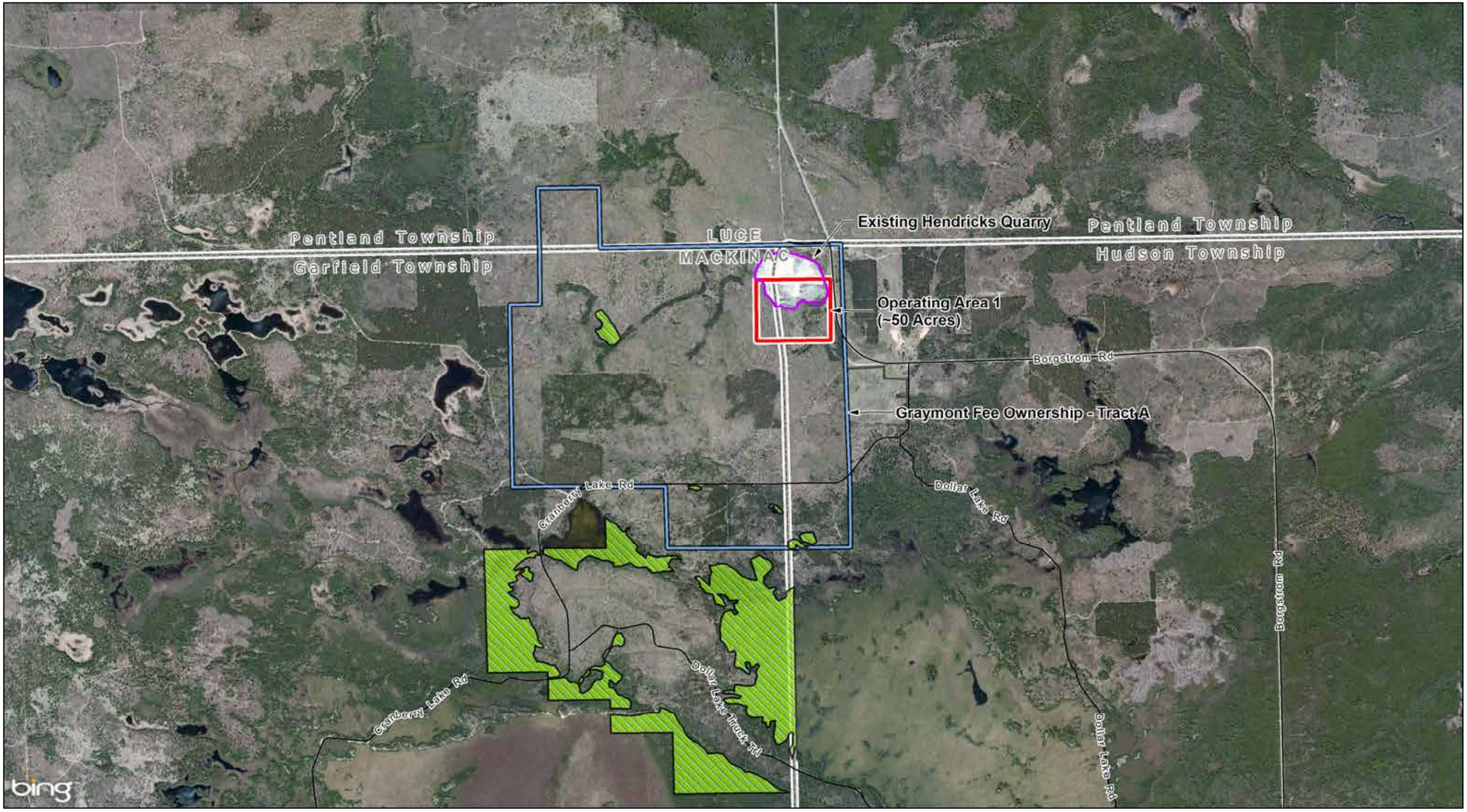
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\nwi_wetlands.mxd Date: 12/14/2015



NOTES:

1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Road and boundary data from Michigan Center for Geographic Information.
5. Delineated wetland data from ASTI Environmental.

LEGEND

- Delineated Wetlands (August 2015)
- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Municipal Boundary
- County Boundary

GRAYMONT

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PREPARED BY:	BAL3	DATE:	DEC.'15
REVIEWED BY:	RWS3	DATE:	DEC.'15
APPROVED BY:	RWS3	DATE:	DEC.'15

GRAYMONT (MI) LLC

FIGURE 2-8

SITE SPECIFIC DELINEATED WETLANDS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

Drafted by: BJW1

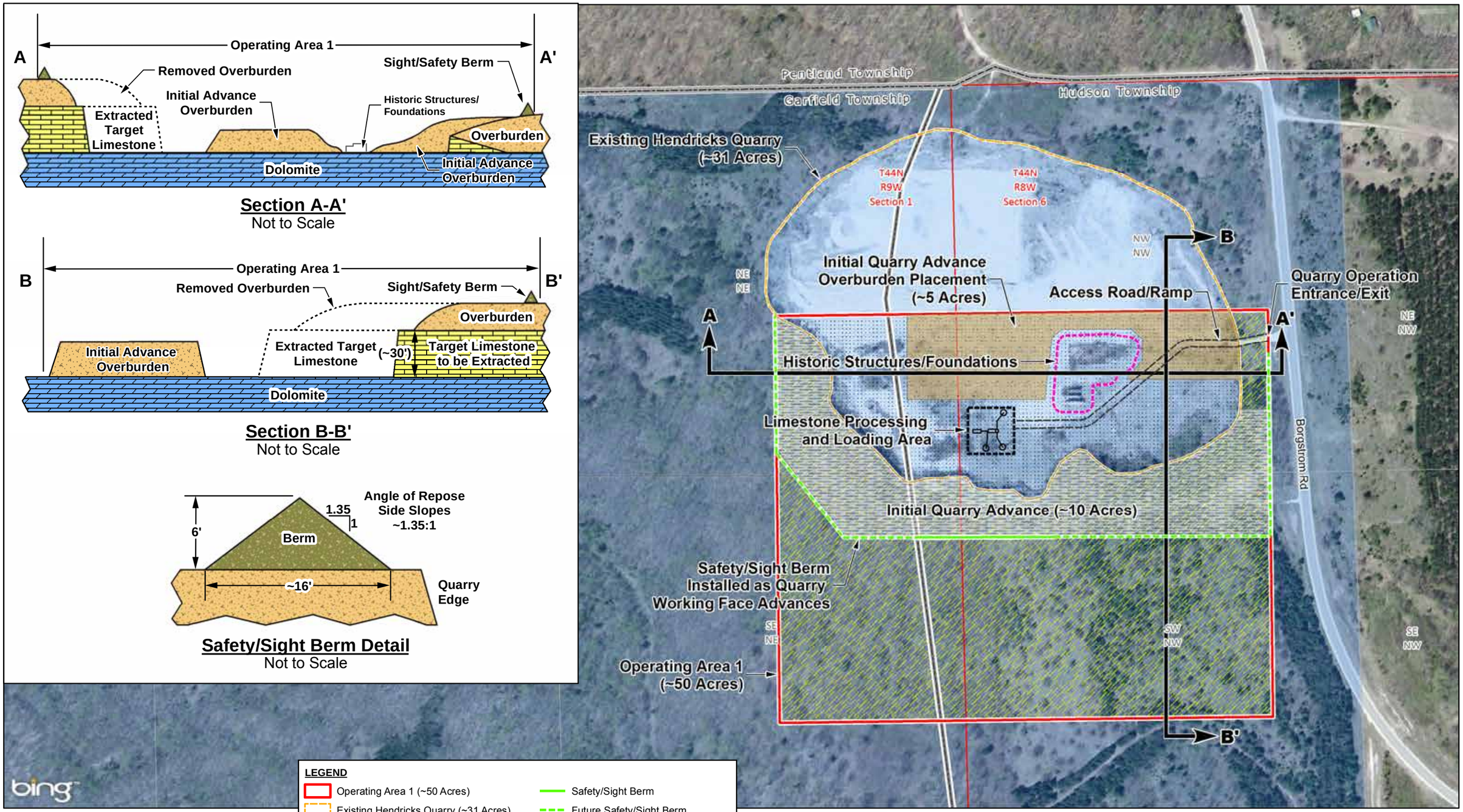
Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\delineated_wetlands_map.mxd Date: 12/14/2015

Section A-A'
Not to Scale

Section B-B'
Not to Scale

Safety/Sight Berm Detail
Not to Scale



LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16 Acres)
- Initial Quarry Advance (~10 Acres)
- Overburden Placement
- Limestone Processing and Loading Area
- Historic Structures/Foundations
- Safety/Sight Berm
- Future Safety/Sight Berm
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

NOTES:
1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

GRAYMONT

Foth

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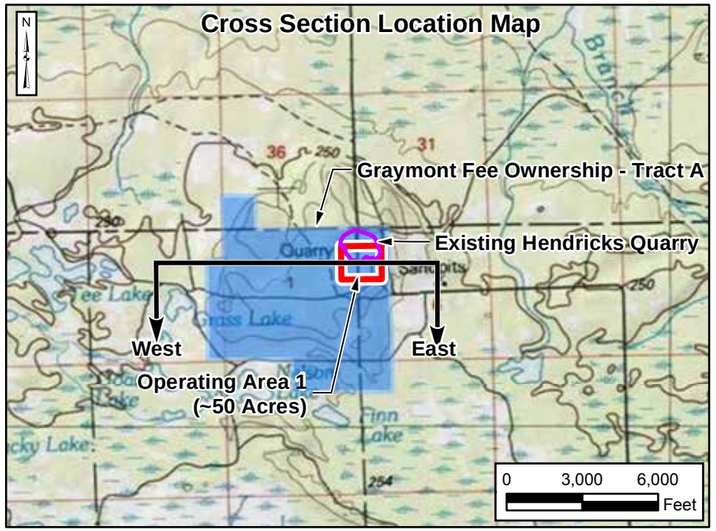
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

FIGURE 3-1
QUARRY PLAN - INITIAL QUARRY ADVANCE
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 150 300 Feet
Date: DECEMBER 2015
Drafted by: BJW1
Project No: 14W777

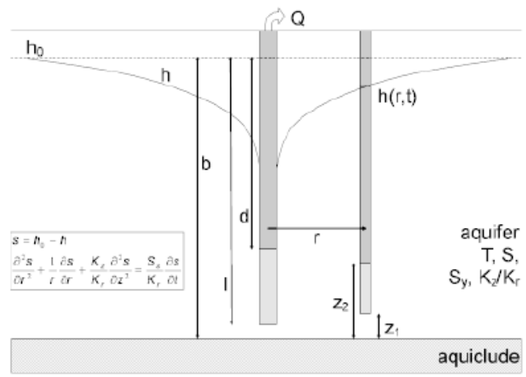
Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\quarry_plan_initial_11x17.mxd Date: 12/16/2015

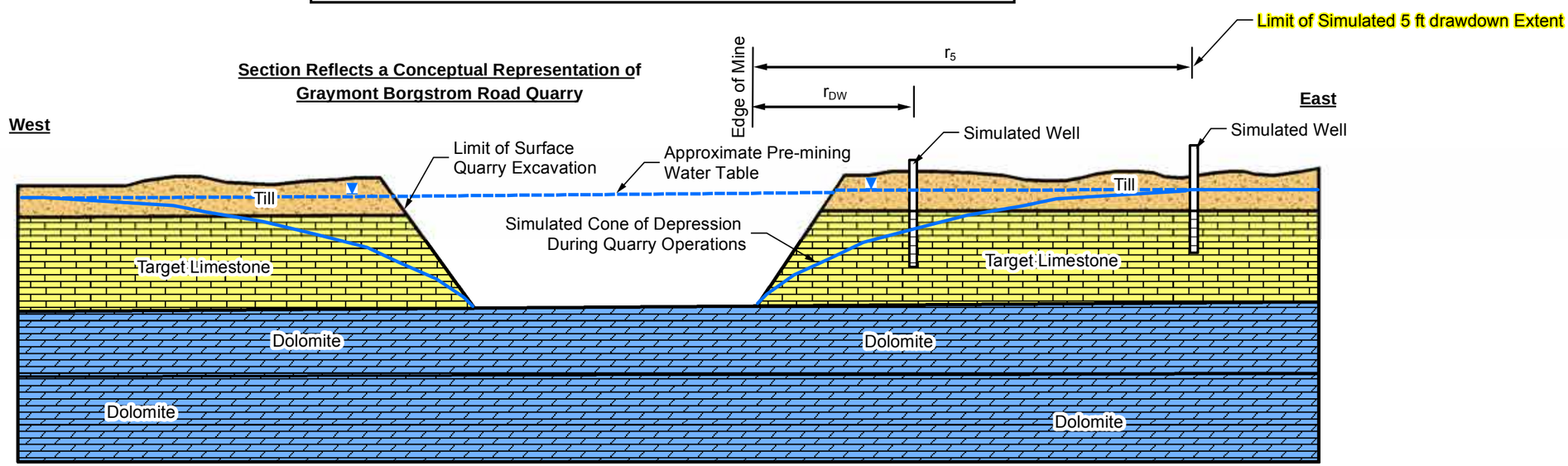


AQTESOLV Unconfined Solution - Neuman

K (ft/day)	b (ft)	T (ft^2/day)	Sy (v/v)	Q (gpm)	Pump Time (yrs)	Well Radius (ft)	dd @ well (ft)	distance to 5' dd (ft)
0.26	50	13.0	0.1	2	5	0.5	35	200
0.26	50	13.0	0.1	3	5	0.5	53	450
1.90	25	47.5	0.1	2	5	0.5	10	30
1.90	25	47.5	0.1	5	5	0.5	24	350
1.90	50	95.0	0.1	20	5	0.5	51	1000

Neuman Illustration





NOTES:

1. The quarry area boundaries lines of section and other details are preliminary, conceptual depictions for illustrative purposes. Final designs, locations and corresponding details will be defined base on supplemental information acquisition and engineering.
2. The information presented herein is for conceptual, illustrative purposes only. Hydrogeologic simulations presented are based on interpolated data approximately representative of local limestone and dolomite and will be finalized using actual, site specific data.

LEGEND

- Till/Overburden
- Dolomite
- Target Limestone

GRAYMONT

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: BAL3		DATE: DEC.'15	
REVIEWED BY: RWS3		DATE: DEC.'15	
APPROVED BY: RWS3		DATE: DEC.'15	

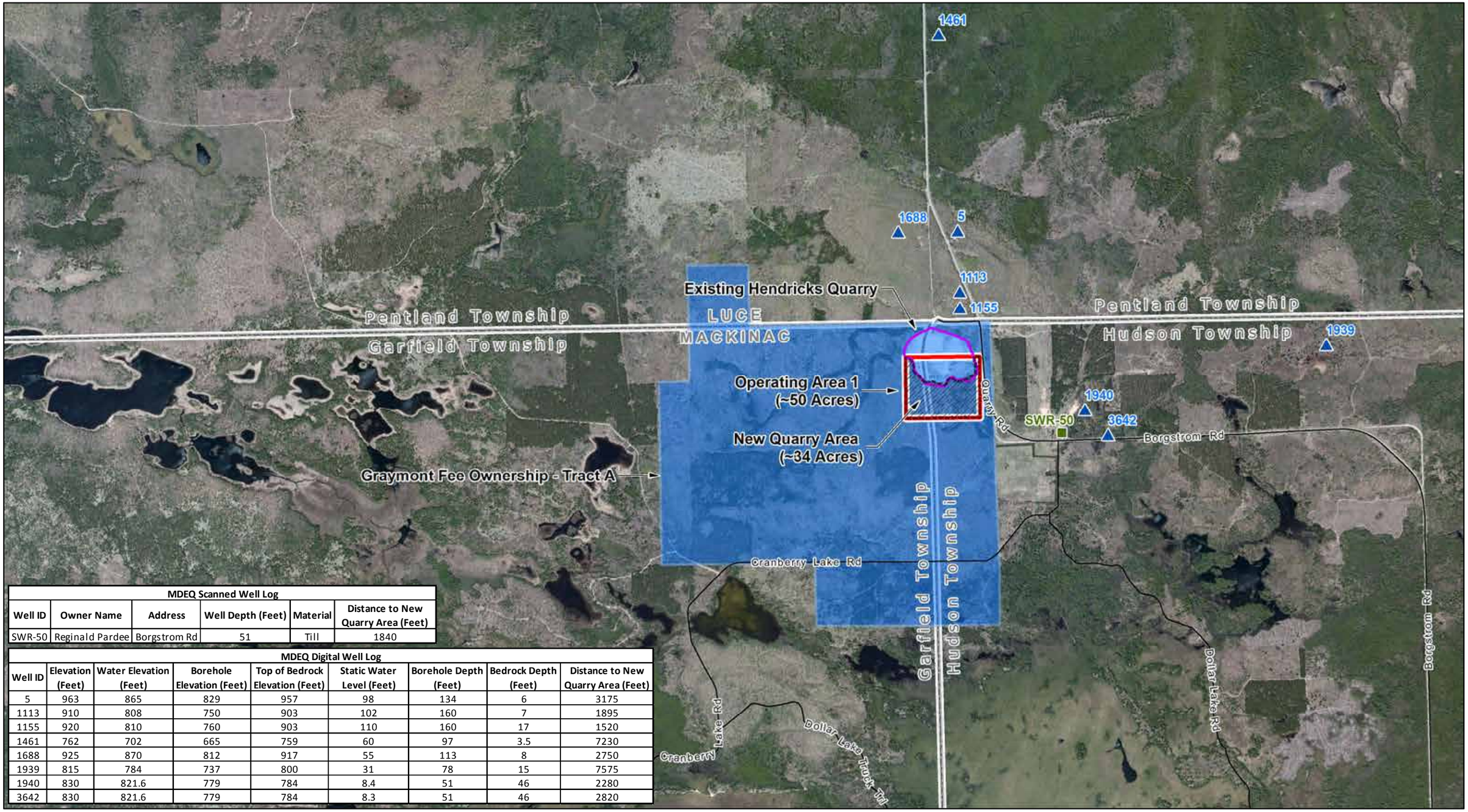
GRAYMONT (MI) LLC

FIGURE 4-1

CONCEPTUAL DRAWDOWN ANALYSIS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale:	NOT TO SCALE	Date:	DECEMBER 2015
Drafted by:	BJW1	Project No:	14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\conceptual_drawdown_analysis.mxd Date: 12/16/2015



MDEQ Scanned Well Log					
Well ID	Owner Name	Address	Well Depth (Feet)	Material	Distance to New Quarry Area (Feet)
SWR-50	Reginald Pardee	Borgstrom Rd	51	Till	1840

MDEQ Digital Well Log								
Well ID	Elevation (Feet)	Water Elevation (Feet)	Borehole Elevation (Feet)	Top of Bedrock Elevation (Feet)	Static Water Level (Feet)	Borehole Depth (Feet)	Bedrock Depth (Feet)	Distance to New Quarry Area (Feet)
5	963	865	829	957	98	134	6	3175
1113	910	808	750	903	102	160	7	1895
1155	920	810	760	903	110	160	17	1520
1461	762	702	665	759	60	97	3.5	7230
1688	925	870	812	917	55	113	8	2750
1939	815	784	737	800	31	78	15	7575
1940	830	821.6	779	784	8.4	51	46	2280
3642	830	821.6	779	784	8.3	51	46	2820

NOTES:
1. Base imagery from Esri.
2. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
3. Mineral, surface and option areas should be considered approximate.
4. Road and boundary data from Michigan Center for Geographic Information.

LEGEND
- MDEQ Digital Well Log
- MDEQ Scanned Well Log
- Operating Area 1 (~50 Acres)
- New Quarry Area (~34 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Road
- Municipal Boundary
- County Boundary

GRAYMONT

Foth

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	BAL3	DATE:	DEC.'15
REVIEWED BY:	RWS3	DATE:	DEC.'15
APPROVED BY:	RWS3	DATE:	DEC.'15

GRAYMONT (MI) LLC

FIGURE 4-2

DOMESTIC WATER SUPPLY WELL LOCATIONS
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

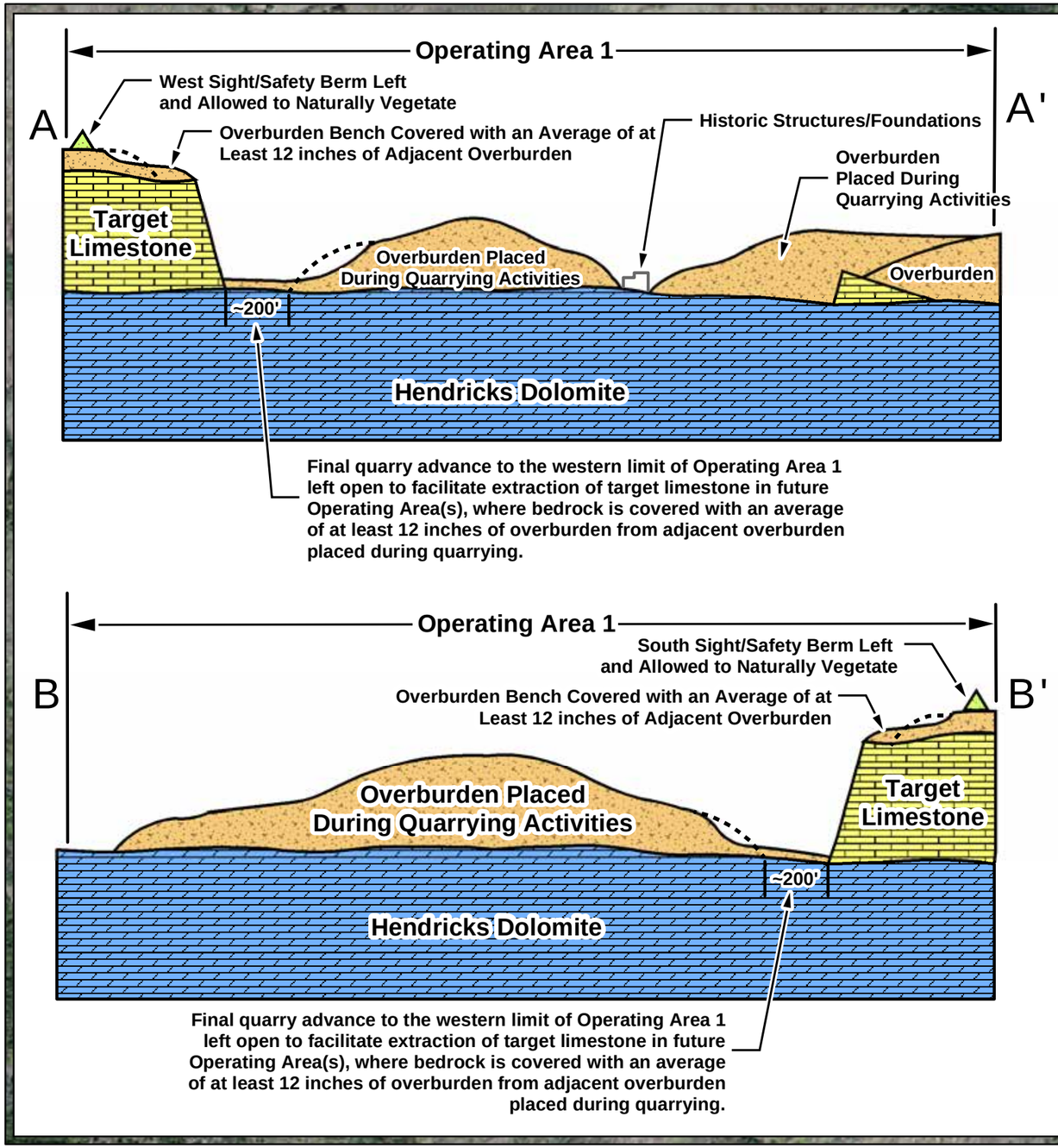
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\domestic_water_supply_wells_11x17.mxd Date: 12/16/2015



NOTES:

1. The groundwater table is expected to be situated below the Graymont Borgstrom Road Quarry floor based on local topographic features and the lack of water or seeps in the existing Hendricks Quarry.
2. All overburden and permanent sight/safety berms to be re-vegetated via natural processes.
3. Base imagery from Esri.
4. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Quarry Floor (Hendricks Dolomite) Covered with an Average of at Least 12 inches of Overburden
- Historic Structures/Foundations
- Operating Area 1 (~50 Acres)
- Municipal Boundary

GRAYMONT

Foth

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

FIGURE 6-1
POST-QUARRYING CONDITIONS FOR
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 200 400 Feet

Date: DECEMBER 2015

Drafted by: BJW1

Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\HGR_Oct2015\post_quarrying_conditions_11x17.mxd Date: 12/18/2015

106GROUP

PHASE I ARCHAEOLOGICAL RESOURCES SURVEY FOR THE REXTON PROJECT – GRAYMONT BORGSTROM ROAD QUARRY AREA (OPERATING AREA #1)

Mackinac County, Michigan

November 2015

PHASE I ARCHAEOLOGICAL RESOURCES SURVEY FOR THE REXTON PROJECT – GRAYMONT BORGSTROM ROAD QUARRY AREA (OPERATING AREA #1)

Mackinac County, Michigan

106 Group Project No. 1990-1827

SUBMITTED TO:
Graymont (MI) LLC
Mackinac Co

SUBMITTED BY:
106 Group
1295 Bandana Blvd
Suite #335
St. Paul, MN 55108

PRINCIPAL INVESTIGATOR:
Adam Kaeding, Ph.D., RPA

REPORT AUTHOR:
Peer Halvorsen, B.A.

December 2015

MANAGEMENT SUMMARY

During October of 2015, The 106 Group Ltd. (106 Group) conducted a Phase I archaeological resources survey for the Rexton project. The proposed action consists of the designation of approximately 50 acres adjacent to and including part of the existing Hendricks Quarry in order to conduct limestone extraction operations. This area is to be designated as the Graymont Borgstrom Road Quarry, Operating Area #1. The survey was conducted on behalf of Graymont (MI) LLC (Graymont).The purpose of the archaeological resources investigation was to determine whether the survey area contains previously recorded or unrecorded archaeological resources that may be *potentially* eligible for listing in the National Register of Historic Places (NRHP), and to propose appropriate measures for the protection and/or preservation of such resources.

The survey area is located in T44N R8W Section 6 and T44N R9W Section 1, Mackinac County, Michigan (Figure 1). The area of potential effect (APE) for archaeology is the same as the survey area, and it includes all areas of proposed construction activities or other potential ground disturbing activities associated with the quarry activities within and adjacent to the Hendricks Quarry pursuant to the designation of the area as the Graymont Borgstrom Road Quarry, Operating Area #1. The study consisted of a review of documentation of previously recorded sites within one mile (1.6 kilometers [km]) of the survey area and of surveys previously conducted within the survey area, as well as a Phase I archaeological field survey to identify any intact archaeological sites within the APE. The archaeological survey area included approximately 50 acres (20 hectares [ha]) within Mackinac County in Michigan's Upper Peninsula. Adam Kaeding, Ph.D., RPA served as principal investigator.

One new site (20MK527) was identified during the Phase I archaeological investigation. The foundation remains of two structures were identified within the Hendricks Quarry. It is our understanding that the structures will not be affected by Graymont's planned operations. If Graymont's plans change and these structures are going to be affected by the proposed action, the 106 Group recommends that additional research be conducted to further assess their potential NRHP eligibility.

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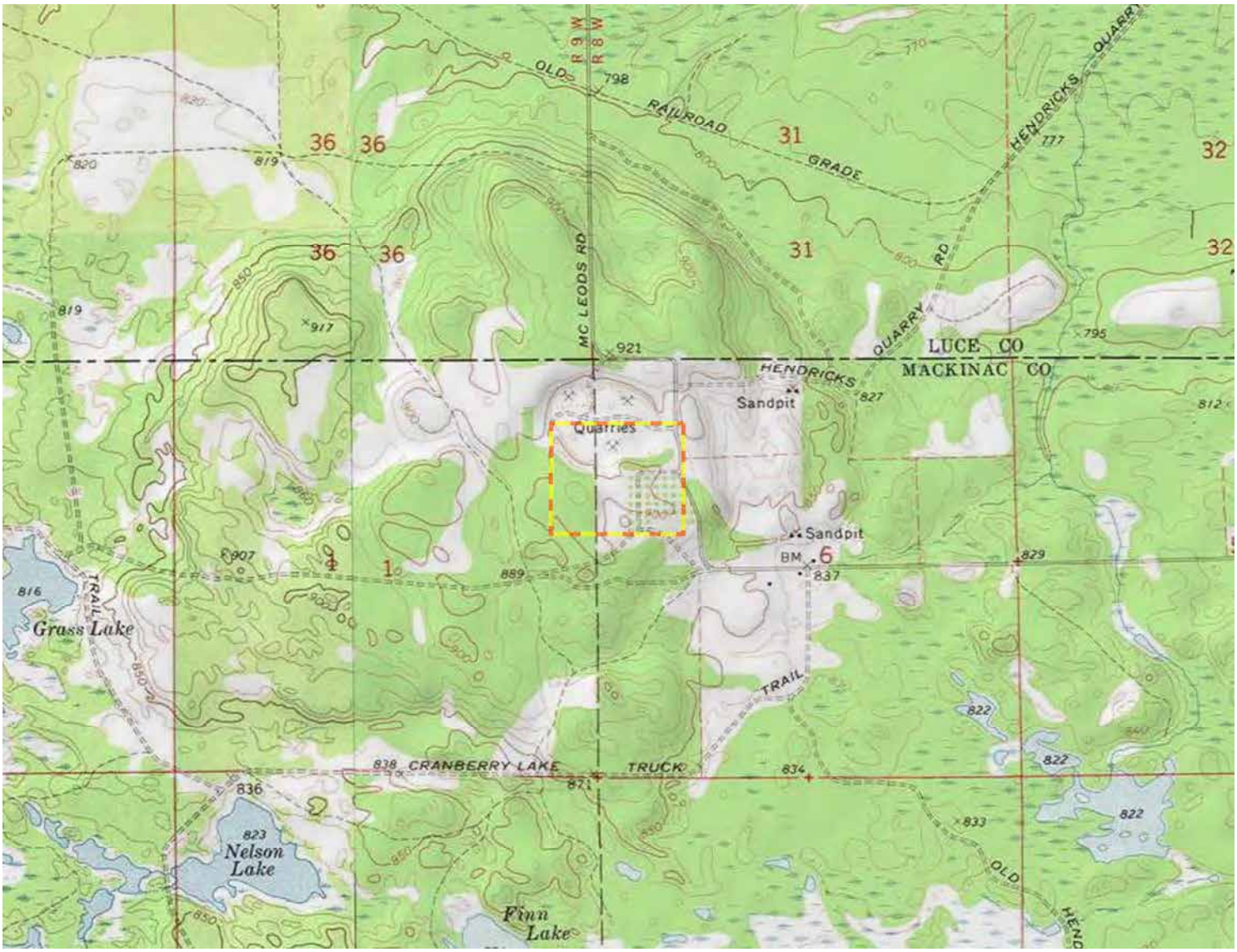
1.0 INTRODUCTION

During October of 2015, The 106 Group Ltd. (106 Group) conducted a Phase I archaeological resources survey for the Rexton project. The proposed action consists of the designation of approximately 50 acres adjacent to and including part of the existing Hendricks Quarry in order to conduct limestone extraction operations. This area is to be designated as the Graymont Borgstrom Road Quarry, Operating Area #1. The survey was conducted on behalf of Graymont (MI) LLC (Graymont).The purpose of the archaeological resources investigation was to determine whether the survey area contains previously recorded or unrecorded archaeological resources that may be *potentially* eligible for listing in the National Register of Historic Places (NRHP), and to propose appropriate measures for the protection and/or preservation of such resources.

The survey area is located in T44N R8W Section 6 and T44N R9W Section 1, Mackinac County, Michigan (Figure 1). The area of potential effect (APE) for archaeology is the same as the survey area, and it includes all areas of proposed construction activities or other potential ground disturbing activities associated with the quarry activities within and adjacent to the Hendricks Quarry pursuant to its designation as the Graymont Borgstrom Road Quarry, Operating Area #1. The study consisted of a review of documentation of previously recorded sites within one mile (1.6 kilometers [km]) of the survey area and of surveys previously conducted within the survey area, as well as a Phase I archaeological field survey to identify any intact archaeological sites within the APE. The archaeological survey area included approximately 50 acres (20 hectares [ha]) within Mackinac County in Michigan's Upper Peninsula. The archaeological survey consisted of:

- a thorough surface reconnaissance of the entire survey area to identify areas possessing high potential to contain intact archaeological sites,
- systematic pedestrian surface reconnaissance of high potential areas with adequate surface visibility,
- and shovel testing in high potential areas with poor ground surface visibility.

The following report describes project methodology, environmental setting, previous investigations, results, and recommendations for the Rexton Project – Graymont Borgstrom Road Quarry, Operating Area #1**.** Since only post-contact period archaeological resources were encountered in the survey area, only post-contact period contexts are presented in this report.



Source: 106 Group

Map Produced by 106 Group 12/15/2015

Rexton Project - Graymont Borgstrom Road Quarry Phase I Archaeological Resources Survey

Mackinac County, Michigan

0 43,000 Meters

0 100,000 Feet

1:2,400,000

Survey Location

Survey Area

106GROUP

Figure 1

2.0 METHODS

2.1 Objectives

The primary objectives of the archaeological resources investigation were to identify if the area to be potentially affected by the proposed activities contains any archaeological resources, and to assess whether those resources are potentially eligible for listing in the NRHP. All work was conducted in accordance with the The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation [48 *Federal Register* 44716-44740] (National Park Service [NPS] 1983).

2.2 Area of Potential Effect

The APE for archaeology is the same as the survey area and includes all areas of proposed construction activities or other potential ground disturbing activities associated with the proposed quarry operations (see Figure 1).

2.3 Background Research

During June, July, and November of 2014, the 106 Group conducted a cultural resources literature review for 10,000 acres within the vicinity of Rexton, Michigan. The approximately 50 acre survey area presented in this report lies within these 10,000 acres. For more information, please see *Cultural Resources Literature Review for the Rexton Project MDNR Land Transaction* (Halvorsen and Bring 2014).

2.4 Field Methods

Intensive field investigation focused on areas assessed as possessing a greater probability to contain significant archaeological sites. These areas included undisturbed portions of the survey area:

- within 150 meters (m) (500 feet [ft.]) of an existing or former water source of 40 acres (19 ha) or greater in extent, or within 150 m (500 ft.) of a former or existing perennial stream;
- located on topographically prominent landscape features;
- located within 100 m (300 ft.) of a previously reported site; or
- located within 100 m (300 ft.) of a former or existing historic structure or feature (such as a building foundation or cellar depression).

Areas assessed as having a relatively low potential for containing archaeological resources included inundated areas, former or existing wetland areas, poorly drained areas, and areas with a 20 percent or greater slope. Low potential areas and areas in which Holocene (less than 10,000 years old) deposits have been significantly disturbed were excluded from intensive field survey.

2.4.1 SURFACE RECONNAISSANCE

Surface reconnaissance was conducted across the entire approximately 50 acre survey area. The objective of the surface reconnaissance was to ascertain whether above-ground features, such as earthworks or abandoned structural foundations, were present within the survey area. Pedestrian transects were placed 15 m (50 ft.) apart to ensure adequate coverage.

2.4.2 SHOVEL TESTING

One hundred shovel tests were excavated in areas exhibiting greater potential to contain intact archaeological deposits where less than 25 percent of the ground surface was visible. Tests were small, circular excavations, measuring approximately 35-45 centimeters (cm) in diameter. A 15-m (50-ft.) testing interval was employed for shovel tests, with test transects placed 15 m (50 ft.) apart.

All excavated soil matrices were passed through ¼-inch hardware mesh to ensure the consistent recovery of artifacts. Tests were excavated down to the level of culturally sterile subsoil.

Survey data were recorded through standardized forms and the field director's daily log. Recorded information included: test locations and methods of testing; the numbers, types and locations of recovered cultural materials; the depth of shovel tests and the thickness of excavated soil layers; soil textures and inclusions (both natural and cultural); and soil color according to Munsell color charts.

3.0 LITERATURE SEARCH

3.1 Previous Archaeological Studies

Research indicated that no previous archaeological surveys have been conducted within the survey area.

No sites have been recorded (confirmed) and no sites have been reported (not field checked) within the current survey area. In addition, no sites have been recorded (confirmed) and no sites have been reported (not field checked) within one mile of the survey area.

3.2 Environmental History Overview

The survey area is located in T44N R8W Section 6 and T44N R9W Section 1, Mackinac County, Michigan (Figure 1).

Geologically, the project area lies within a bedrock-controlled ground moraine region, which consists of thin till deposits overlying bedrock. However, in some areas sandy drift overlying the bedrock dominates the landscape (Jerome 2006).

The soils within the survey area are largely composed of Armadon and Longrie soil associations, which are sandy loams over bedrock formed on terraces and till plains (USDA Web Soil Survey, accessed 10/22/15).

3.3 Cultural History Overview

Michigan's developmental sequence is divided into three broad contexts: precontact (ca. 12,000 years before present [B.P.] to.250 B.P.), contact (ca. 320 B.P. to 130 B.P.), and post-contact (ca.130 B.P. to the present). The precontact contexts emphasize patterns of regional adaptation or technological and cultural traditions, whereas the contact and post-contact contexts are generally organized by themes addressing different interactions and industries. Since only post-contact features were encountered during the survey, only the post-contact contexts are presented below.

3.3.1 CONTACT PERIOD CONTEXTS

The contact period marks the arrival of Europeans to the Upper Peninsula and the archaeological record not only contains the activities of Native peoples during this time, but the activities of these immigrants as well. This period begins with the arrival of French fur traders, explorers, and priests in the seventeenth century and is marked by the establishment of various missions, forts, and villages alongside Native American villages, such as the mission at St. Ignace and the adjacent Fort de Buade located approximately 40 miles southeast of the survey area (Heldman 1999). The French and Indian War (1754-1761 CE) effectively ended the French influence in this region. This period is followed by a relatively short period of British involvement in Michigan until the Americans took control of Detroit in 1794 (Piling and Anderson 1999).

3.3.2 POST-CONTACT PERIOD CONTEXTS

Michigan's first state geologist, Douglass Houghton, brought national attention to the state's copper deposits in 1841. The copper mining industry took off in the 1840s with the first successful mines opening near Eagle River in Keweenaw County and Rockland in Ontonagon County. Copper mining in Michigan declined in the twentieth century as competition from mines in Montana and Arizona, as well as workers strikes contributed to a decrease in Michigan's share of the national total. Keweenaw and Ontonagon Counties are located approximately 180 miles to the northwest of the survey area.

Iron Mining also played a significant role in the Upper Peninsula with some of the first specimens of magnetic ore discovered in 1844. By 1890, Michigan's iron mines produced 80 percent of the nation's ore, but Michigan lost its lead to Minnesota's more easily mined Mesabi Range in 1900. However, production increased during World War II with new methods of processing low-grade ore in open pit mines, which continues today (Michigan Department of Natural Resources 2014b). As with the copper mines in the Upper Peninsula, the iron ranges are located to the west of the survey area, the nearest being the Marquette Iron Range, which is approximately 100 miles northwest.

Large-scale alteration of the landscape in the Upper Peninsula started when the logging industry spread to the region in the 1870s and 1880s, after the industry's focus shifted away from the valleys of the Saginaw and the Muskegon (Franzen 1999; Karamanski 1984). The logging industry declined sharply after 1900 as the massive deforestation and a series of devastating wildfires diminished yields. However, policies enacted in the early twentieth century stabilized the forest products industry in the local economy (Karamanski 1984).

Review of Hinsdale's Archaeological Atlas of Michigan (1931) shows one potential historical feature within the survey area: the Hendricks Quarry. The Hendricks Quarry was a limestone mine that opened circa 1915. Historically, limestone was shipped to the Union Carbide Company plant in Sault Ste. Marie, Michigan in order to produce calcium carbide (Johnson and Sorensen 1978). Graymont had a limestone mineral lease with the MDNR for the Hendricks Quarry, but has recently purchased the quarry from the MDNR. While the previous lease owner extracted stone in recent years, Graymont has not extracted any stone since acquiring the lease (John Maitland, personal communication November 13, 2015).

4.0 RESULTS

Staff from the 106 Group conducted a Phase I archaeological survey of the Rexton Project – Graymont Borgstrom Road Quarry, Operating Area #1 survey area from October 8th to 12th, 2015. Adam Kaeding, Ph.D., RPA served as principal investigator and the fieldwork was conducted under the direction of Peer Halvorsen, B.A. (See Appendix A for a list of project personnel).

Approximately 20 acres of the survey area consists of an existing limestone quarry. Accordingly, the ground surface of the quarry area is exposed limestone bedrock. As such, this portion of the project has very low potential for any buried precontact or contact period archaeological resources.

The remaining acres consisted of maple, birch, and pine forest, interspersed with large mossy clearings. Initial surface reconnaissance identified a raised clearing beside a potential former streambed as an area of increased archaeological potential (central shovel tested area on Figure 2). All shovel tests in this area yielded negative results.

Two areas assessed as possessing high potential to contain post-contact archaeological resources were also investigated. The first area is a large clearing running north-south in the center of the survey area (easternmost shovel test area on Figure 2). An apple tree was observed within this area with an edible cultivar growing off the tree. Apple trees require grafting to grow edible varieties, so this indicated an intentional planting of this tree. The area was investigated with shovel tests to identify any potential post-contact archaeological resources, however, no such resources were found.

The second area investigated was a heavily overgrown road running through a forest in the western portion of the survey area (westernmost shovel test area on Figure 2). Shovel tests were placed at 15 m intervals in three transects, one down the center of the road and two placed on the sides of the road in order identify any archaeological resources associated with the road. However, all shovel tests yielded negative results.

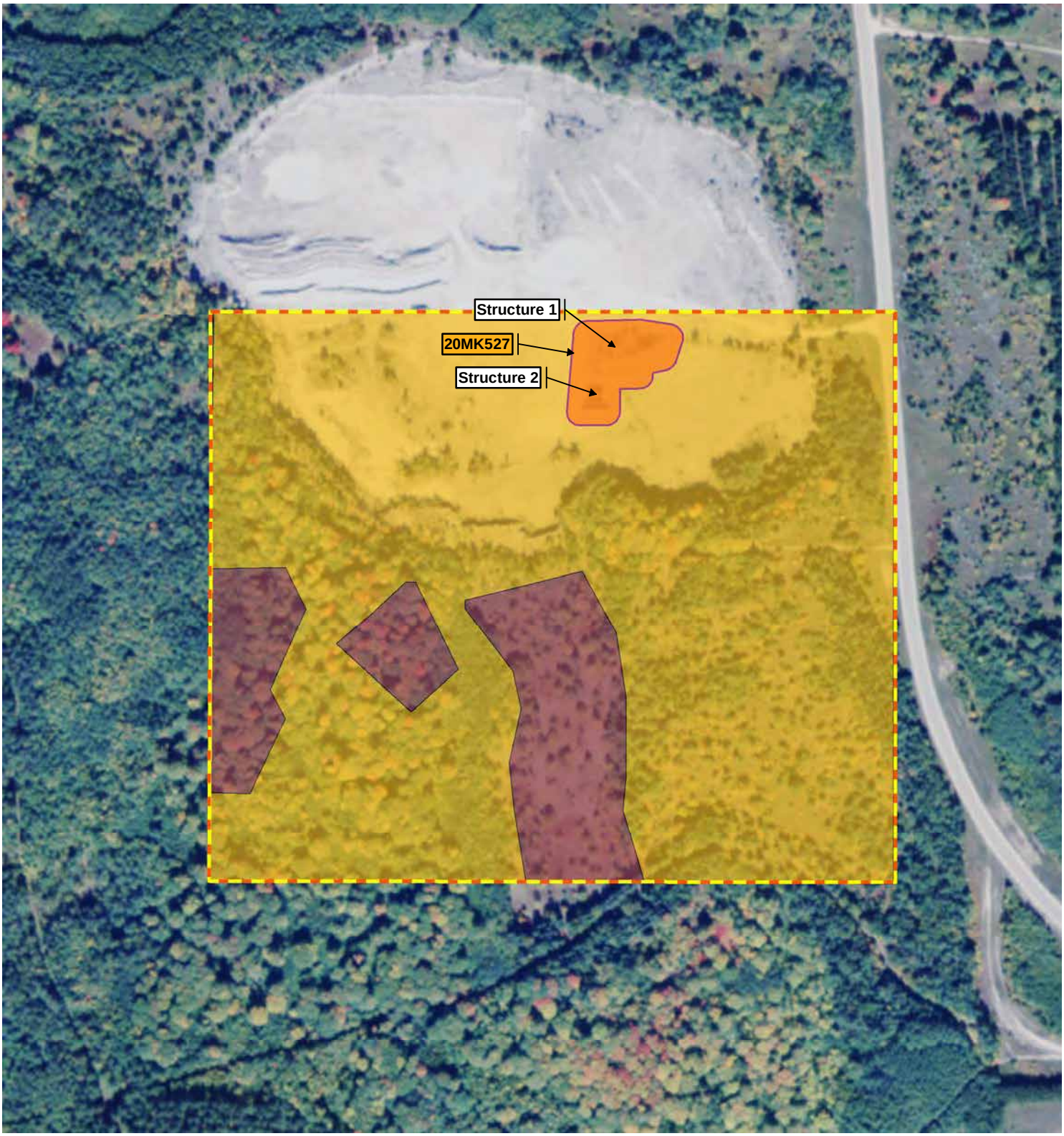
4.1 20MK527: Quarry Structures

The remains of two structures were found within the southeast portion of the quarry. The location of the remains of these two structures has been designated with the official Michigan State archaeological site number 20MK527. The first structure (Structure 1) is located approximately 500 ft. west from the entrance gate at the eastern edge of the existing Hendricks Quarry. The second structure (Structure 2) is located approximately 48 ft south of Structure 1 (Figure 2). Both structures are composed of limestone and chert aggregate with a concrete skim coat covering.

Structure 1 consists of a foundation about 3.5 ft. high. Two sets of stairs are located on the northern side of the structure and a larger staircase is located on the western side of a large three-walled room on the southern half of the structure. Large numbers of burned limestone pieces were observed within this room (Figures 3, 4, 5, and 6).

Structure 2 consists of three large parallel, east-west walls or pylons made of the same aggregate material as Structure 1. These walls appear to have once held a roof, which has since collapsed, but it is not clear whether they had perpendicular walls with which to create an enclosed space. They are thicker at the base and tapering towards the top. The southernmost wall is 6 ft. thick at the base, the middle wall 2 ft. thick, and the northernmost wall 2.5 ft. thick (Figures 7, 8 and 9).

As ruins, the integrity of these structures is so compromised that they are not considered potentially eligible for listing in the NRHP as Architecture/History resources. However, as a historical archaeological site possessing integrity of location, setting, and association, the site may be potentially eligible for listing in the NRHP, although further information would be necessary to make a recommendation (see Appendix A).



Source: 106 Group

Map Produced by 106 Group 12/15/2015

Rexton Project - Graymont Borgstrom Road Quarry
Phase I Archaeological Resources Survey
Mackinac County, Michigan

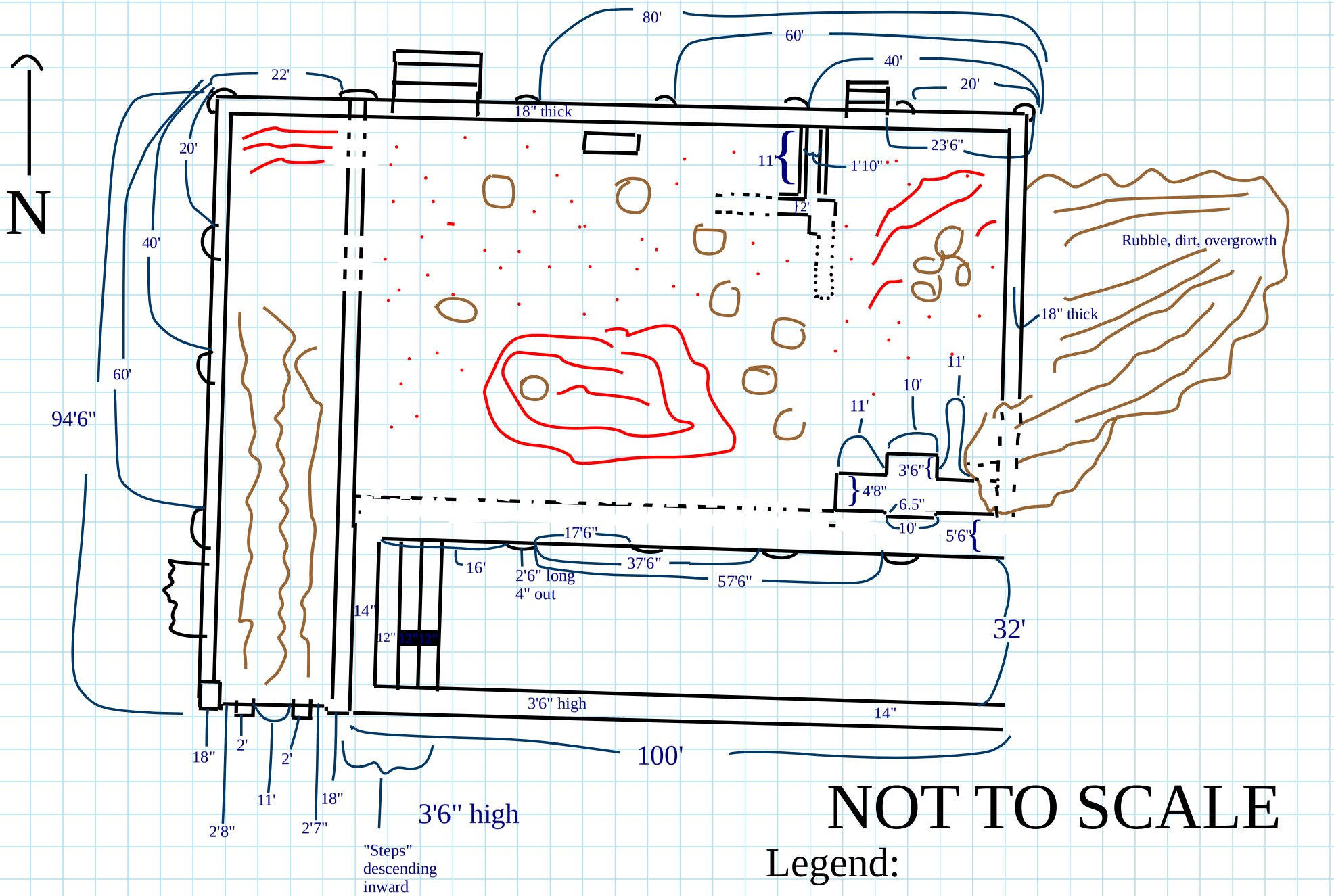
Results

- Survey Area
- Shovel Tested Area
- Surface Reconnaissance Area
- Site Boundary

0 80 Meters
0 210 Feet
1:4,000

106GROUP

Figure 2



Map by Ken Henry 10/12/2015

Figure 3. Structure 1 Sketch Map

Figure 4. 20MK527: Northern Side of Structure 1 Facing South

Figure 5. 20MK527: Southern Side of Structure 1 Facing North

Figure 6. 20MK527: Open Area on South Side of Structure 1 Facing East

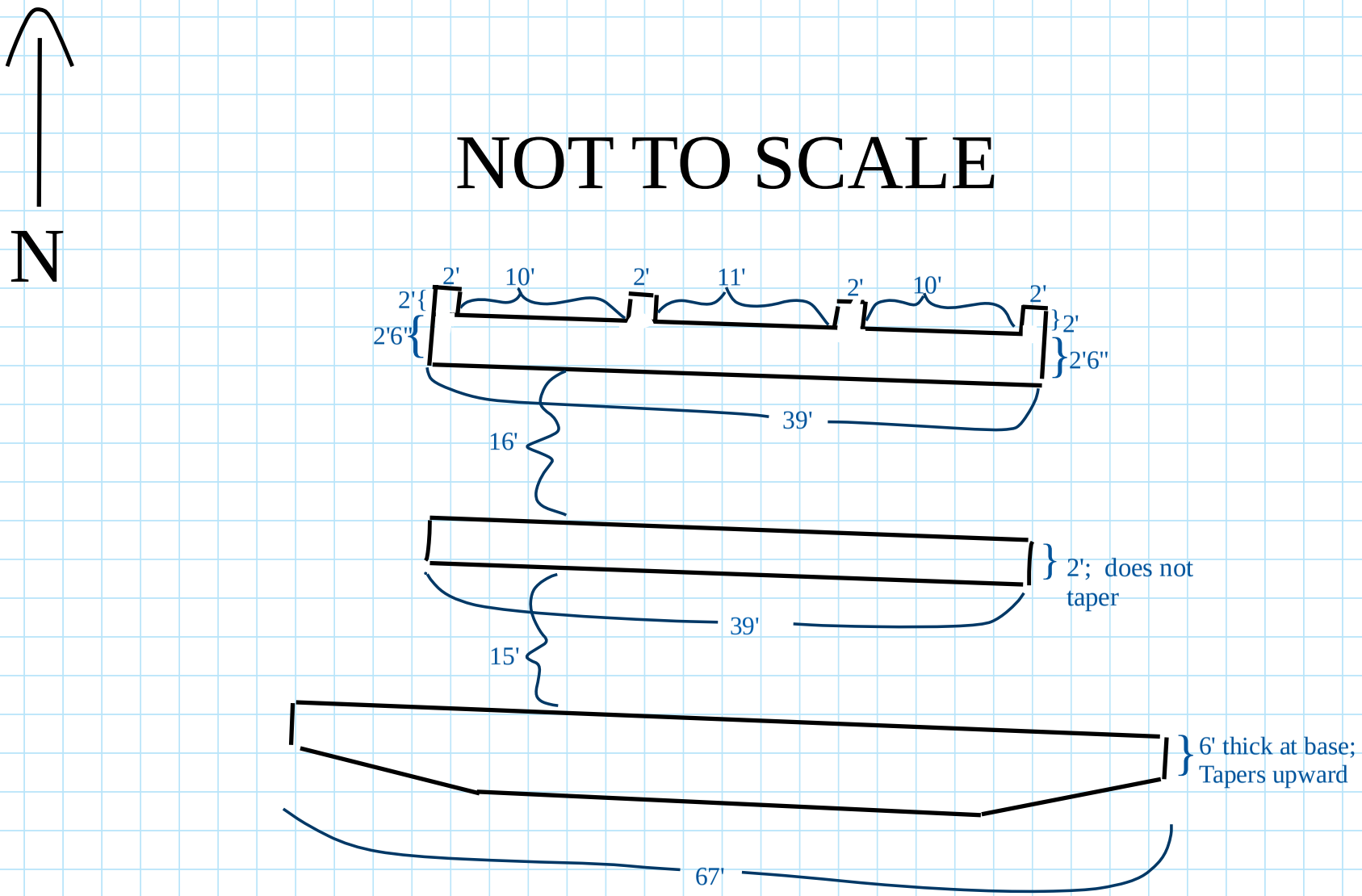


Figure 7. Structure 2 Sketch Map

Map by Ken Henry 10/12/2015

Figure 8. 20MK527: Eastern Side of Structure 2 Facing West

Figure 9. 20MK527: South Side of Structure 2 Facing North

5.0 RECOMMENDATIONS

The 106 Group excavated one hundred shovel tests in three areas containing moderate to high potential for precontact archaeological resources. No resources were identified and the remainder of the survey area outside of the existing quarry possesses low potential to contain precontact archaeological resources. The 106 Group recommends that no further work is necessary in this area.

The remains of two structures were identified within the portion of the survey area encompassed by the Hendricks Quarry. It is our understanding that the structures will not be affected by Graymont's planned operations. If Graymont's plans change and the proposed activities are going to adversely affect these resources, then the 106 Group recommends further historical research is conducted to further assess the potential NRHP eligibility of this historical archaeology site (20MK527).

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APPENDIX A: ARCHAEOLOGICAL SITE FORM

STATE SITE NO. _____

MICHIGAN ARCHAEOLOGICAL SITE FORM

SITE NAME:	Hendricks Quarry Site
OTHER NAMES OR NUMBERS:	20MK527
SITE DESCRIPTION:	Structural ruins associated with the Hendricks Quarry, established circa 1915
COUNTY:	Mackinac County
TOWNSHIP NAME:	Hudson Township
SITE ADDRESS (if applicable):	
USGS 7.5 MIN. TOPOGRAPHIC QUADRANGLE MAP NAME and DATE:	Garnet 1973

**Include map showing site location and boundaries when submitting site form*

TOWNSHIP/RANGE/SECTION (QUARTER-SECTION)	T44N R8W Section 6
UTM/LAT.-LONG. COORDINATES	Easting 626321, Northing 5122350
UTM DATUM YEAR	Nad 1983
UTM ZONE	16
DIRECTIONS FROM NEAREST STATE OR COUNTY ROAD INTERSECTION:	0.21 miles to the southwest of the intersection of N. Borgstrom Rd (Hwy 393) and Quarry Rd.
NEAREST WATER SOURCE:	Nelson Lake
DISTANCE TO NEAREST WATER SOURCE (in feet and meters):	6,600 feet (2,012 meters) SW
SITE SIZE IN METERS AND FEET (length x width x diameter):	250 feet x 265 feet (76 meters x 81 meters)
FIELD EVIDENCE (surface scatter, stratification, features, exposed by construction, etc.):	Visible foundation remains
FIELDWORK (year, site visit/survey type/ excavation, institution, principal investigator):	2015, Phase I Archaeology Survey, The 106 Group Ltd., Adam Kaeding
SITE INTEGRITY OR CONDITION:	Site may have integrity of Location, Setting, and Association
COLLECTIONS (private or institutional):	N/A
DIAGNOSTIC ARTIFACTS:	N/A
COMPONENTS (list period and site function for each):	foundation ruins are related to limestone mining in the post-contact period

DATES (list radiocarbon dates with lab numbers and associations):	N/A
HUMAN REMAINS PRESENT?	No
IF YES, DETAILS:	
OWNERSHIP (LIST NAME OF PERSON OR AGENCY):	Private Owner
NATIONAL REGISTER (NR) SIGNIFICANCE RECOMMENDATION:	More information needed for evaluation
Person making NR evaluation	N/A
Date of NR evaluation	
EXPLANATION OF SIGNIFICANCE RECOMMENDATION:	N/A

APPEND A LIST OF REPORTS AND OTHER DOCUMENTATION ABOUT THE SITE, BOTH PUBLISHED AND UNPUBLISHED, INCLUDING PHOTOS, CORRESPONDENCE, NEWSPAPER ARTICLES, CRM REPORTS, JOURNAL ARTICLES, ETC.

COMMENTS:	The remains of two structures were found within the southeast portion of the Hendricks Quarry. The first structure (Structure 1) is located approximately 500 ft. west from the entrance gate at the eastern edge of the quarry. The second structure (Structure 2) is located approximately 48 ft south of Structure 1. Both structures are composed of limestone and chert aggregate with a concrete skim coat covering.

RECORDED BY

NAME:	Peer Halvorsen
INSTITUTION/COMPANY:	The 106 Group Ltd.
DATE:	11/02/2015

TO SUBMIT THIS FORM:

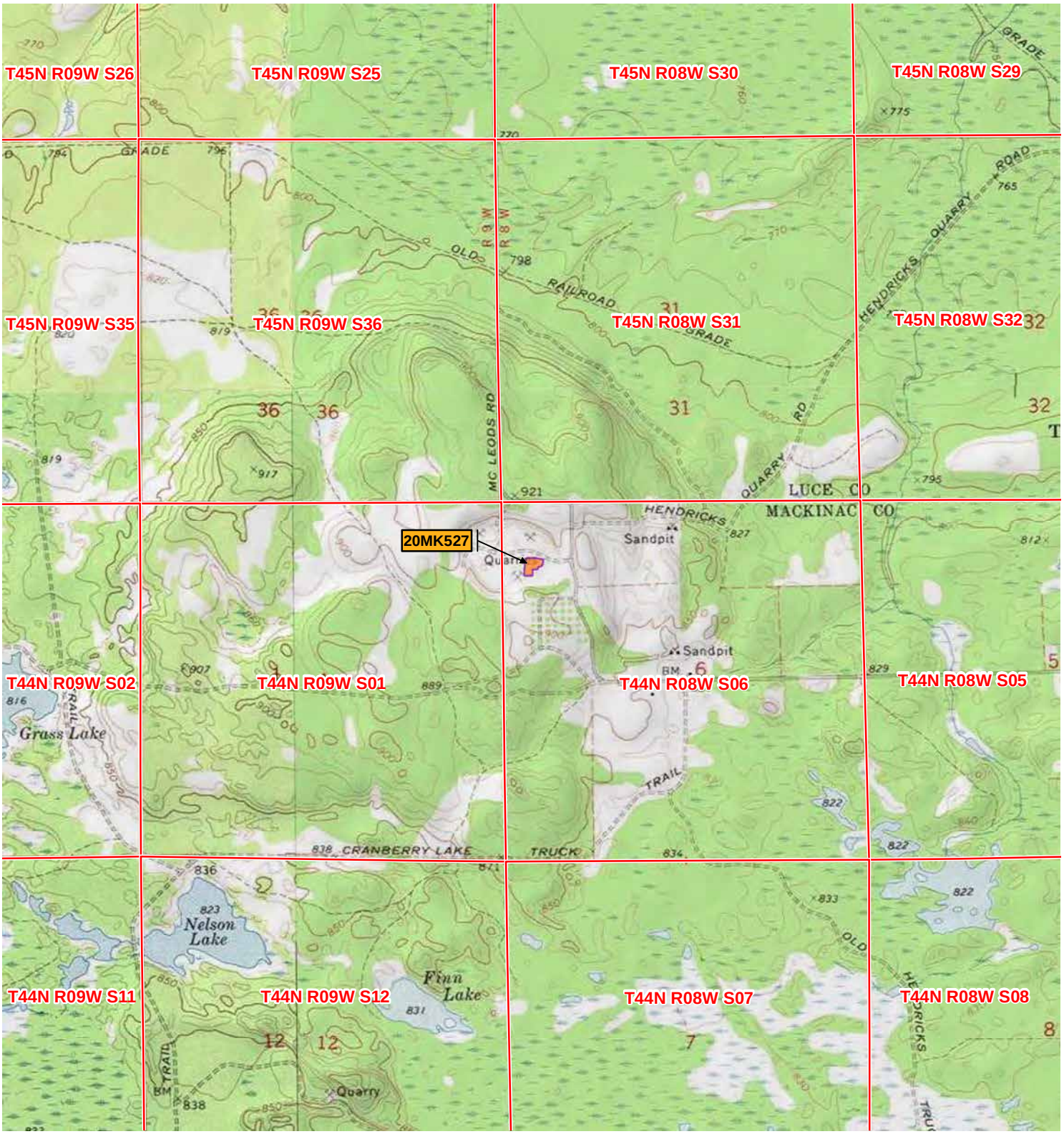
e-mail: Dr. Dean Anderson, State Archaeologist, andersond15@michigan.gov

Fax: (517) 335-0348

Mail: State Archaeologist, SHPO, Michigan State Housing Development Authority, P.O. Box 30740, Lansing, MI 48909 -8240.

FORM INSTRUCTIONS & INFORMATION

1) This form may be completed on your computer, tablet, or other device, or it may be printed as a blank form and completed by hand.
2) Date fields require a two-digit day and month and a four-digit year. For example, 01/01/2013.
3) Please attach additional sheets as necessary.



Source: 106 Group

Map Produced by 106 Group 12/15/2015

Rexton Project - Graymont Borgstrom Road Quarry Phase I Archaeological Resources Survey

Mackinac County, Michigan

Site 20MK527 Location

Site Boundary

0 475 Meters

1:24,000

0 1,100 Feet

106GROUP

Source: 106 Group

Map Produced by 106 Group 12/15/2015

Rexton Project - Graymont Borgstrom Road Quarry
Phase I Archaeological Resources Survey
Mackinac County, Michigan

Site 20MK527

Site Boundary
Above Ground Structural Element

0 40 Meters
0 100 Feet
1:2,000

106GROUP

APPENDIX B: PROJECT PERSONNEL

LIST OF PERSONNEL

Principal Investigator	Adam Kaeding, Ph.D., RPA
Archaeology Field Director	Peer Halvorsen, B.A.
Field Archaeologists	
Crew Leader	Julia Palmquist, M.A.
Field Technicians	Bob Thompson, Ph.D., RPA Ken Henry, B.A.
Graphics and GIS	Nathan Moe, B.A.

Exhibit E

Designation Notice
Land Transaction Application

Reclamation Plan

For the:

Graymont Borgstrom Road Quarry

Operating Area 1

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources
State of Michigan

December 2015

GRAYMONT

Graymont Borgstrom Road Quarry Reclamation Plan

The purpose of this document is to present describe the "Reclamation Plan - concurrent or "rolling" reclamation for the limestone quarry defined as Operating Area 1 designated in the Designation Notice and located adjacent to and partially contained within the existing Hendricks Quarry in Tract A (as defined in the Land Transaction Agreement). Operating Area 1 and each subsequent Operating Area designated within Tract A will be commonly referred to as the "Graymont Borgstrom Road Quarry" or "GBRQ".

Operating Area 1 is located on property owned by Graymont (MI) LLC (Graymont) located in the townships of Garfield and Hudson, in Mackinac County, Michigan. Operating Area 1 is comprised of approximately 50 acres, approximately 16 acres of which are located within the Hendricks Quarry and approximately 34 acres of which are located adjacent to and south of the existing Hendricks Quarry. **Figure E-1 – *Post-Quarrying Conditions*** shows the quarry and the final reclaimed surface at the completion of Operating Area 1 activities at the GBRQ.

Reclamation and Hydrologic Maintenance

All quarry infrastructure assembled and used by Graymont will be removed after permanent completion of quarrying and processing activities within Operating Area 1. Safety/sight berms will be employed throughout the quarrying process as sections of the quarry advance to restrict public access to the active quarry areas for public safety. Safety/sight berms, where appropriate, will be left in place and allowed to naturally and passively re-vegetate.

No Named Trails as defined in the Land Transaction Agreement (LTA) occur within Operating Area 1. However, two Recreational Trails enter and terminate in Operating Area 1 as shown on Figure E-1. These two Recreation Trails will be bermed and posted with signage to prohibit public access to active quarry operations.

Graymont will place an average of at least 12" of overburden or rock not suitable for processing or sale to serve as a growth medium. Overburden placement / reclamation will occur both during active quarrying operations and as a final step once all limestone is extracted. The placement of rock and overburden will be designed to minimize erosion and slope instability by utilizing appropriate slopes and sufficiently sized materials. Other Best Management Practices (BMPs) designed to reduce erosion may be applied to facilitate the establishment of natural vegetation. Measures will be taken to reduce the introduction of invasive plant species including avoiding the use of imported fill. In addition, mining equipment will be required to be inspected and cleaned prior to entry onto the site to minimize introduction of invasive plant species.

Hydrologic conditions are not expected to materially change during the operation or post-quarrying period due to the relative upland position of Operating Area 1 and the GBRQ, the shallow depth of the quarry, the significant recharge from precipitation, and the hydrologic characteristics adjacent to the quarry operation. Surface hydrologic characteristics are expected to return approximate pre-quarrying characteristics and functions. Quarrying activities are not expected to extend deep enough to intersect the local groundwater table.

The on-going reclamation process is expected to achieve a “rolling” reclamation / quarrying sequence with sufficient margins for continued quarrying and related operations within the GBRQ – as overburden is removed to expose target limestone it is then used to reclaim areas where the target limestone had already been extracted.

.

Overburden Management

Overburden will be removed in advance to expose target limestone and either permanently placed or stockpiled for later use in reclamation activities within Operating Area 1. Safety/sight berms will also be constructed with overburden. Silt fencing or other runoff control Best Management Practices (BMPs) will be installed as necessary to minimize erosion.

Final Site Topography and Potential Water Features

The post-quarrying topography will reflect a dampened expression of the pit extent with localized areas of pit wall slope reductions and safety/sight berms. The quarry floor will exhibit a subdued hummocky topography based on the final distribution of the reclamation material.

The reclaimed surface configuration at completion of Operating Area 1 quarry activities is expected to look like an overburden-filled 50 acre footprint of the Operating Area, with the exception of two open panels along the west and south edges. These open panels would be about 200 feet wide and extend the entire length of the west and south boundaries to allow quarrying to continue to proceed to the west and south under future Operating Area designations. Figure E-1 illustrates the position of the final Operating Area 1 panels.

If operations permanently terminate at the end of limestone extraction activities associated in Operating Area 1, overburden placed immediately behind the two final panels would be pushed west and south onto the exposed quarry floor with an average of at least 12” of overburden. The safety/sight berm along the west and southern boundaries would remain in place and allowed to naturally vegetate. This reclamation scenario is also illustrated on Figure E-1.

Precipitation falling within the quarried / reclaimed area of Operating Area 1 will evaporate and/or seep into pit floor materials. Even during heavy precipitation events or snowmelt, meteoric water from precipitation is expected to be consumed within the reclaimed materials. As the reclaimed materials become vegetated, meteoric water is expected to be consumed via evapotranspiration and evaporation. Depending on final pit floor / residual bedrock elevations, localized, temporary ponding may occur on the floor of the existing, exposed Hendricks quarry outside of the north boundary of Operating Area 1, but would be expected to dry up as currently witnessed via evaporation. Precipitation occurring outside the pit and remaining safety barriers will infiltrate into surficial soils, concentrate as runoff away from the pit, or enter the pit depending on grade and precipitation intensity. Groundwater is not expected to be encountered and sustainable hydrologic conditions for ponds or wetlands are not anticipated.

Surface Water

Operating Area 1 is situated in the upper portions of the drainage basin in a very flat topographical setting, so changes in watershed morphology are not expected. The proposed quarry in Operating Area 1 does not come into contact with any wetlands or shallow lakes/ponds. The nearest surface water feature is a National Wetlands Inventory (NWI) mapped freshwater emergent wetland located over 1,600 feet away, down-gradient, to the southeast as shown on **Figure E-2 – *Wetlands and Surface Water Features***. Site specific wetland delineation studies conducted in 2014 confirmed this distance (see Figure E-2). Downstream channels and surface water basins are not expected to change as the surface quarry area does not materially influence the contributing drainage basins. The nearest lakes are over 4000 feet to the south (see Figure E-2) and water levels in local surface water bodies are well below the bottom of the Operating Area 1 pit and should not be lowered by quarrying activities.

Groundwater

As previously described the local groundwater table is expected to be well below the deepest portion of the quarry within Operating Area 1 and is not expected to be encountered. Given this characteristic, sustained pit seepage is not expected and hydrologically sustainable ponds and wetlands are unlikely to occur. Locally, groundwater can be encountered at the overburden / bedrock interface and this zone can be locally perched depending on bedrock geometry and till composition. However any such encountered perched water is expected to be limited in extent and would drain / dissipate quickly. By its perched nature, such groundwater is generally limited by the bedrock geometry and is relatively isolated from other hydrologic features.

Historic Structure

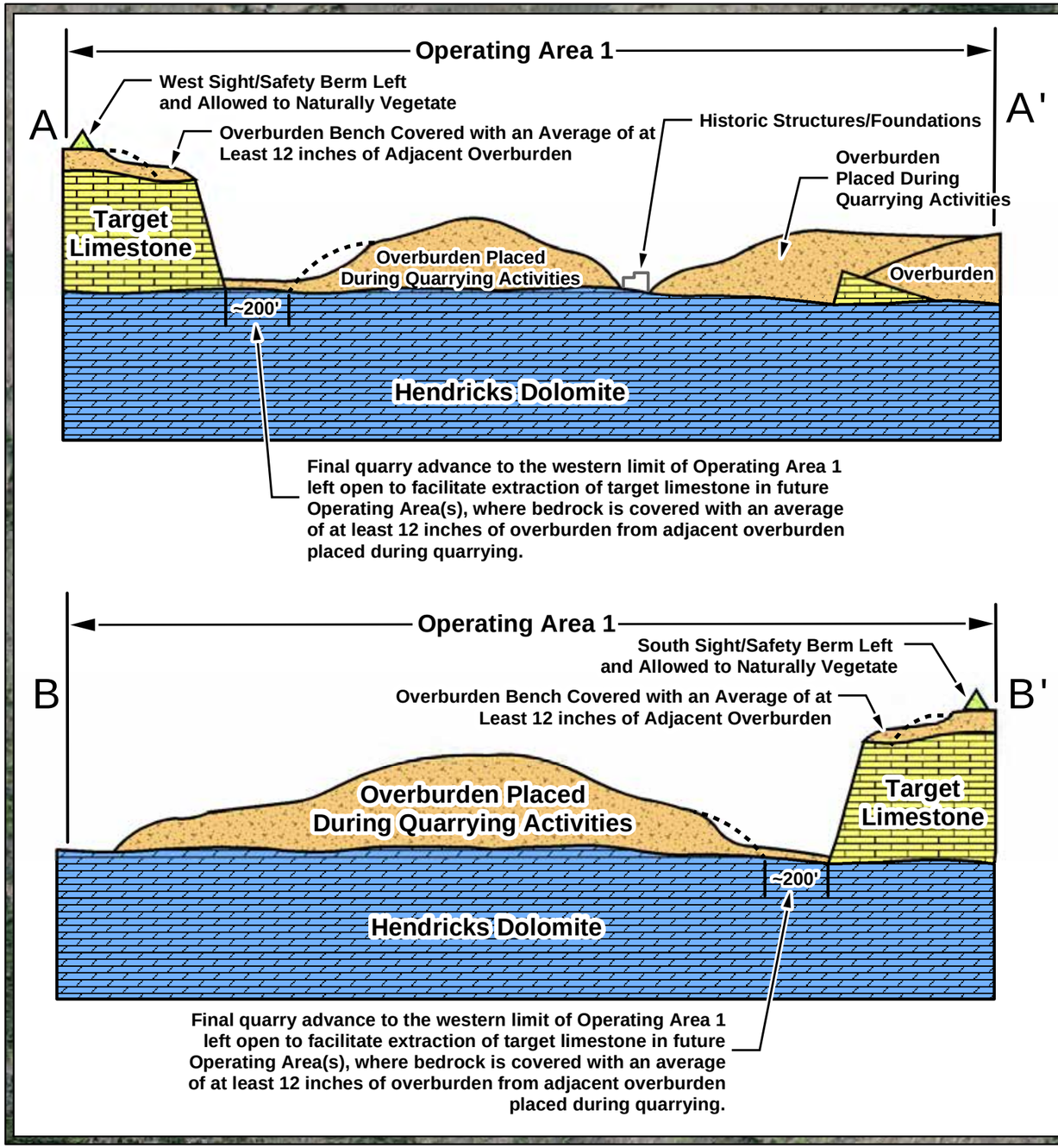
The historic features (concrete foundations and associated residual structure remnants – See Exhibit D – Archeology Report) associated with past Hendricks Quarry operations will not be disturbed and left in place as is. Overburden placement associated with reclamation activities will not occur within the area of the subject historical features as shown in Figure E-1.

Toxic and Hazardous Materials Management

The target limestone and adjacent bedrock does not contain acid-forming materials or metals that can be released to the environment once exposed to oxidation. Conversely, limestone and dolomite products are typically used to purify drinking water, treat wastewater, and neutralize acidic conditions. During quarrying operations, only minor, localized spills of fuels or lubricants would be categorized as potential contaminants.. Fuels and lubricants will be handled and managed as per industry standards, best management practices, and established regulatory requirements. Spills will be minimized by the impermeable nature of the bedrock and the natural containment offered by the pit. Blasting will be designed for complete ignition of all explosives.

Reclamation Timetable

All GBRQ Operating Area 1 infrastructure and equipment will be removed after completion of all quarrying, processing, and transportation activities. Graymont will provide the State of Michigan "Confirmation" of the boundaries and acreage for "Reclamation Area(s) within Operating Area 1 in which Graymont has completed all quarrying, processing, and transportation activities within an Operating Area or a designated portion of an Operating Area. Reclamation will be initiated within two years of Confirmation of a Reclamation Area. Reclamation of the Reclamation Area will be completed within four years of the corresponding Confirmation Notice. All reclamation designation definitions and time frames are set forth in the LTA.



NOTES:

1. The groundwater table is expected to be situated below the Graymont Borgstrom Road Quarry floor based on local topographic features and the lack of water or seeps in the existing Hendricks Quarry.
2. All overburden and permanent sight/safety berms to be re-vegetated via natural processes.
3. Base imagery from Esri.
4. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Quarry Floor (Hendricks Dolomite) Covered with an Average of at Least 12 inches of Overburden
- Historic Structures/Foundations
- Operating Area 1 (~50 Acres)
- Municipal Boundary

GRAYMONT

Foth

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Foth Infrastructure & Environment, LLC					GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION		**FIGURE E-1** POST-QUARRYING CONDITIONS FOR OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY:	RWS3			DATE: DEC.'15		
REVIEWED BY:				DATE:	Scale: 0 200 400 Feet	Date: DECEMBER 2015
APPROVED BY:				DATE:	Drafted by: BJW1	Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure E-1 BorgstromRdQuarry_post_quarrying_conditions_11x17.mxd Date: 12/18/2015

NOTES:

1. Base imagery from Esri.
2. Wetlands data from U.S. Fish and Wildlife Service.
3. Delineated wetland data from ASTI Environmental.
4. There are no mapped surface water features within the above map extent.
5. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Stream/River (See Note 3)
- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry
- Graymont Fee Ownership - Tract A
- Municipal Boundary
- Lake/Pond (See Note 3)
- Delineated Wetlands (August 2015)

U.S. Fish and Wildlife Service NWI Wetlands

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

GRAYMONT

Foth

N

Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC
REVISED	DATE	BY	DESCRIPTION	**FIGURE E-2** WETLANDS AND SURFACE WATER FEATURES OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI
PREPARED BY: RWS3			DATE: DEC.'15	
REVIEWED BY:			DATE:	Scale: 0 250 500 Feet — Date: DECEMBER 2015
APPROVED BY:			DATE:	Drafted by: BJW1 — Project No: 14W777

Path: \\foth.com\projects\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure E-2 BorgstromRdQuarry_NWI_Wetlands_11x17.mxd Date: 12/14/2015

Exhibit F

Designation Notice

Land Transaction Application

Security for Reclamation

For the:

Graymont Borgstrom Road Quarry

Operating Area 1

Graymont (MI) LLC

Mackinac County, Michigan

Submitted to:

Department of Natural Resources

State of Michigan

December 2015

GRAYMONT

Foth Infrastructure & Environment, LLC

2794 Highway 93 South
Salmon, ID 83467
(208) 894-4572 • Cell: (262) 844-1543
www.foth.com

December 17, 2015

TO: Paul E. Stoll, Jr. Graymont (MI) LLC

CC: Nick Glander, Foth Infrastructure & Environment. LLC

FR: Rich Schowengerdt, Foth Infrastructure & Environment, LLC

RE: Financial Assurance Assessment for the Graymont Borgstrom Road Quarry – Operating Area 1

This Technical Memorandum presents an estimate of the cost ("Reclamation Cost") that the State of Michigan would incur to complete reclamation as prescribed in the Land Transaction Agreement (LTA) and in accordance with the Reclamation Plan (Exhibit E) for Operating Area 1 at the point in the quarrying sequence at which those costs would be the highest. The Graymont Borgstrom Road Quarry (GBRQ) - Operating Area 1 is located near Rexton, Michigan and is on property owned by Graymont (MI) LLC (Graymont). Three reclamation scenarios have been analyzed and are outlined in **Table 1 – *Assumptions for Financial Assurance Calculations***. Utilizing standardized reclamation cost estimate templates and applicable references, the reclamation costs have been calculated and result in a bond requirement of $163,000 as presented in **Table 2A – *Bond Calculation.***

The evaluation and calculation of reclamation liabilities associated with Operating Area 1 of the GBRQ presented herein are based on the current configuration and proposed advances of Operating Area 1 as shown in **Figure F-1 – *Quarry Plan – Pre-Quarry Conditions,* Figure F-2 *Quarry Plan – Reclamation of the Existing Hendricks Quarry Floor, Figure* F-3 - *Quarry Plan – Initial Quarry Advance,* Figure F-4 – *Quarry Plan – Final Quarry Advance, and* Figure F-5 – *Post Quarry Conditions.*** Reclamation costs were calculated at three points during the mining sequence to determine at which point in the quarrying process the reclamation costs would be the highest for a third party (State of Michigan) to complete reclamation activities as described in the Reclamation Plan (Exhibit E).

The following subsections summarize the reclamation activities and associated costs as required by the LTA and typically required for a third party Reclamation Plan financial assurance calculation.

Reclamation Model Plan

Operating Area 1 is approximately 50 acres with approximately 16 acres previously quarried (part of the existing Hendricks Quarry). The remaining approximately 34 acre parcel is intended to be quarried for target limestone. The approximately 34 acres intended for quarrying will be quarried as described in the Mine Plan (Exhibit B). The Reclamation Plan for Operating Area 1 is presented in Exhibit E.

The Reclamation costs for Operating Area 1 have been calculated for three reclamation scenarios to determine the highest reclamation cost:

> **Scenario #1** Reclamation occurs before any overburden removal or placement occurs in Operating Area 1 – This would require an average of at least 12 inches of overburden to be placed in the portion of the existing Hendricks quarry within Operating Area 1 (16 acres less 1 acre associated with the historic features). This overburden would be taken from Operating Area 1 south of the existing Hendricks quarry.
>
> **Scenario #2** Reclamation occurs after the completion of the initial advance during the new quarry overburden removal / placement in previously quarried areas within Operating Area 1 (equilibrium period). Interval between Figures F-2 and F-3.
>
> **Scenario # 3** Reclamation occurs at the end of Operating Area 1 limestone extraction. As shown in Figure F-4.

The assumptions used to calculate costs for each Scenario are set out in Table 1.

Cost Estimate Spreadsheets

The cost estimate worksheets are presented in a standardized format as outlined in 49 CFR 3601 used to calculate the financial assurance required for third party reclamation on public lands associated with mineral extraction.

Standardized direct cost estimate worksheets have been used to develop the cost of demolition, earthwork, and other support activities associated with site reclamation. **Tables 2A, 2B, and 2C – *Bond Calculation***, summarize the direct costs for each reclamation scenario and then applies various indirect cost and escalation factors to determine the surety bond (or other approved financial assurance instrument) amount.

Demolition and Miscellaneous Costs

With only portable / mobile structures and equipment proposed for the GBRQ- Operating Area 1 operation, the only demolition costs applicable are for removal of portable/mobile structures and equipment and for a small crew of laborers (estimated at 3 laborers) to pick

up / remove quarry debris from the site. **Tables 3A, 3B, and 3C, *Summary of Demolition and Miscellaneous Costs***, present the cost build-up for the site for each of the three reclamation scenarios. The equipment cost rates were determined using the Caterpillar Performance Handbook Edition 45. The pricing for the labor crew was determined using Michigan's 2015 Prevailing Wage Rate Schedule for Laborers Class 1, Zone 3 & 4. The associated labor cost is $46.42 per hour labor rate for a one week period. The pricing for the disposal fee was provided by Waste Management, Newberry, MI Landfill.

The cost for demolition and miscellaneous activities is summarized below:

Scenario #1	$1,180
Scenario #2	$8,196
Scenario #3	$8,466

Earth Work Costs

An Earth Work Spreadsheet was completed for three reclamation scenarios to determine the highest reclamation cost The Earth Work Spreadsheet follows the scope of work as described above and itemizes the earthwork associated with placing overburden as generally outlined in the attached Reclamation Schedule.

Tables 4A, 4B, and 4C – *Summary of Earth Work* present the reclamation cost build-up for reclamation scenario. The production rates were determined using the Caterpillar Performance Handbook Edition 45. The equipment costs used for the earth moving were determined by using the Equipment Watch Rental Rate Blue Book, Volume 1 (2nd half of 2015 rates).

The cost for earth work for each reclamation scenario is itemized below:

Scenario #1	$112,288
Scenario #2	$84,558
Scenario #3	$47,048

Total Reclamation Cost

The total cost using the build-up of the Demolition / Miscellaneous and Earth Work Spreadsheets in 2015 dollars was totaled for each reclamation scenario. After the application of 5 years of escalation, the Bond Amount (rounded to the nearest one thousand dollars) was plotted for each reclamation scenario (see **Figure F-6 – *Reclamation Cost Analysis***). As illustrated in Figure 5, the worst case reclamation scenario occurs after Operating Area 1 is designated but prior to any new quarrying activities. This is due to the cost to excavate, haul and place overburden on the floor of the portion of the existing Hendricks Quarry within Operating Area 1. All later reclamation scenarios have the benefit of having overburden already placed in a

reclamation position during active quarrying activities resulting in a lower cost to cover any incrementally exposed bedrock at the time of reclamation. As shown in Figure F-5, $163,000 represents the highest reclamation costs and will be used to establish the financial assurance instrument.

Attachments:

Table 1	Assumptions for Financial Assurance Calculations
Table 2A	Bond Calculation – Scenario #1
Table 3A	Summary of Demolition Cost – Scenario #1
Table 4A	Summary of Earth Work Costs – Scenario #1
Table 2B	Bond Calculation – Scenario #2
Table 3B	Summary of Demolition Cost – Scenario #2
Table 4B	Summary of Earth Work Costs – Scenario #2
Table 2C	Bond Calculation – Scenario #3
Table 3C	Summary of Demolition Cost – Scenario #3
Table 4C	Summary of Earth Work Costs – Scenario #3
Figure F-1	Quarry Plan – Pre-Quarry Conditions
Figure F-2	Quarry Plan - Reclamation of the Existing Hendricks Quarry Floor
Figure F-3	Quarry Plan – Initial Quarry Advance
Figure F-4	Quarry Plan – Final Quarry Advance
Figure F-5	Post-Quarry Conditions
Figure F-6	Reclamation Cost Analysis

Tables, and Figures

Table 1

Assumptions for Financial Assurance Calculations

Graymont (MI) LLC

Graymont Borgstrom Road Quarry - Operating Area 1

2015 50 Acre Tract

December 2015

Base Information

50 acre quarry operations parcel

16 acres within the parcel has already been quarried and remains as the existing Hendricks Quarry

34 acres within the parcel are scheduled to be quarried

Average overburden (topsoil / till/ unmarketable rock) depth 12'

Quarrying will be conducted in multiple advances with the initial advance being 10 Ac

After initial advance, subsequent advances are in equilibrium - new ft^2 rock exposed equal to ft^2 of overburden placed in exposed pit floor for reclamation

Final advance will leave 200' wide exposed bedrock surface at the western and southern portions of Operating Area 1 to allow future quarrying to access rock.

All equipment and infrastructure is mobile / portable.

No Named Trails are intersected by the Quarry. Recreational Trails will be closed and posted prior to quarry advancement

An average of at least 12" of overburden will be placed over Operating Area 1 media

The historical features within the existing Hendricks Quarry will be left undisturbed (~1 acre)

Reclamation - Scenario 1 after Designation Notice

No new quarrying activities - cover 15 acres (16 ac - historical buffer 1 ac) in Operating Area 1 of the existing Hendricks Quarry with an average of at least 12 inches of overburden to facilitate natural vegetation

1. Construct ramp on southern boundary to provide access for overburden south of the existing Hendricks Quarry to cover existing 15 ac Hendricks Quarry floor (ramp 42' tall x 168' long x 30' wide) (excavator / dozer)
2. Strip, load, and haul (excavator / truck) 653,400 ft^3 overburden from area south of the existing Hendricks Pit to the exposed pit floor and spread ~1 ft thick
3. Place 653,400 ft^3 on bottom of existing Hendricks Pit overburden barrow pit from adjacent material (dozer, average push 200')
4. Berm and post signage at eastern trail at top of pit.
5. Procure / install perimeter signs (2000' perimeter, sign every 300 ft)
6. Removal of all mobile/portable structures and equipment.

Reclamation - End of Initial Advance

Placement of an average of at least 12 inches of overburden from in-pit stockpiles on exposed existing Hendricks Quarry bedrock within Operating Unit 1 and on newly quarried exposed bedrock in Operating Unit 1

1. Clean-up crew and disposal of residual quarrying debris.
2. Push overburden from existing, in-pit stockpiles to adjacent exposed bedrock within the existing Hendricks Quarry within Operating Area 1 (dozer, 323,400 ft^2, an average of at least 12 inches thick, average push 200 ft)
3. Push overburden from existing, in-pit stockpiles to adjacent exposed bedrock from newly quarried areas within Operating Area 1 (wheel loader, 435,600 ft3, an average of at least 12 inches thick, average distance 400 ft)
4. Bevel / cover bedrock at perimeter bench (dozer, 6000 liner ft)
5. Procure / install perimeter signs (2000' perimeter, sign every 300 ft)
6. Removal of all mobile/portable structures and equipment.

Reclamation - End of Operating Area 1 Quarrying

Placement of minimum average of at least 12 inches of overburden from adjacent in-pit stockpiles on exposed bedrock within the western and southern edges of Operating Area 1

1. Clean-up crew and disposal of residual quarrying debris.
2. Push overburden from existing, in-pit stockpiles to adjacent exposed bedrock within the existing, last quarried advance along the south and west edges of Operating Unit 1 (dozer, 546000 ft^2, an average of at least 12 inches thick, average push 100 ft)
3. Bevel / cover bedrock at perimeter bench (dozer, 9000 linear ft)
4. Procure / install perimeter signs (3000' perimeter, sign every 300 ft)
5. Removal of all mobile/portable structures and equipment.

Table 2A

Bond Calculation - Scenario 1

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$112,288.00	
3	Demolition and Miscellaneous Cost	$1,180.00	
4	Mobile Equipment Dismantlement and Removal	$3,800.00	
5	Subtotal Direct Costs	$117,268.00	
5	**Indirect Costs**		
6	Mob/Demob	$11,727.00	10.0%
7	Contingency	$8,209.00	7.0%
8	Engineering Redesign	$3,518.00	3.0%
9	Main Office Expense	$8,209.00	7.0%
10	Project Management Fee	$3,518.00	3.0%
11	Subtotal Indirect Costs	$35,181.00	30.0%
12	**Total Cost 2015**	**$152,449.00**	
13	**Escalation**		
14	Number of years		5
15	Escalation factor		0.013
16	Escalation	$10,170.00	
17	Reclamation Cost Escalated	$162,619.00	
18	**Bond Amount (rounded to nearest $1,000) 2015 Dollars**	**$163,000.00**	

Table 3A

Summary of Demolition and Miscellaneous Cost - Scenario 1

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
1	Installation of Site Signage																			
	Labors	2 Person Crew	MI Prevailing Wage Rates	$46.42	HR									10	2			20	HR	$928.00
		Signs	Note 2.	$22	ea.													9	Ea.	$198.00
		Sign Stakes	Note 3.	$6	ea.													9	Ea.	$54.00
	Total																			$1,180.00

Notes:

1. Disposal Cost based on 2015 current rates of the Waste Management (Newberry, MI) Landfill.
2. Cost for signage provided by local sign store.
3. General metal stake cost is provided based on local hardware store rates.

Table 4A

Summary of Earth Work Reclamation Cost - Scenario 1

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Construction of Access Ramp															
1	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	3,920.00	CY	438	CY/HR	8.9	HR	$3,284.00
2	336DL Excavator	$12,305.00	$76.95	0.1	$76.75	$238.30	1	$238.30	$/HR	3,920.00	CY	250	CY/HR	15.7	HR	$3,737.00
	Strip, Load, Haul Overburden															
4	336DL Excavator	$12,305.00	$76.95	0.1	$76.75	$238.30	1	$238.30	$/HR	24,200.00	CY	250	CY/HR	96.8	HR	$23,067.00
5	773E Off-Hwy Dump Truck	$12,800.00	$82.50	0.1	$76.75	$247.50	1	$247.50	$/HR	24,200.00	CY	138	CY/HR	175.4	HR	$43,402.00
	Backfilling & Grading Hendricks Pit Floor															
3	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	24,200.00	CY	243	CY/HR	99.6	HR	$36,546.00
	Grading Barrow Pit															
6	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	2,259.00	CY	438	CY/HR	5.2	HR	$1,893.00
	Construction of Eastern Trail Ramp															
7	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	200.00	CY	438	CY/HR	0.5	HR	$168.00
8	336DL Excavator	$12,305.00	$76.95	0.1	$76.75	$238.30	1	$238.30	$/HR	200.00	CY	250	CY/HR	0.8	HR	$191.00
	Subtotal															$112,288.00

Table 2B

Bond Calculation - Scenario 2

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$84,558.00	
3	Subtotal of Demolition and Miscellaneous Cost	$8,196.00	
4	Mobile Equipment Dismantlement and Removal	$3,800.00	
5	Subtotal Direct Costs	$96,554.00	
6	**Indirect Costs**		
7	Mob/Demob	$9,655.00	10.0%
8	Contingency	$6,759.00	7.0%
9	Engineering Redesign	$2,897.00	3.0%
10	Main Office Expense	$6,759.00	7.0%
11	Project Management Fee	$2,897.00	3.0%
12	Subtotal Indirect Costs	$28,967.00	30.0%
13	**Total Cost 2015**	**$125,521.00**	
14	**Escalation**		
15	Number of years		5
16	Escalation factor		0.013
17	Escalation	$8,374.00	
18	Reclamation Cost Escalated	$133,895.00	
19	**Bond Amount (rounded to nearest $1,000) 2015 Dollars**	**$134,000.00**	

Table 3B

Summary of Demolition and Miscellaneous Cost - Scenario 2

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
1	Miscellaneous Scrap																			
	Demolition Cost - Laborers	3 Person Crew	MI Prevailing Wage Rates	$46.42	HR									40	3	HR		120	HR	$5,570.00
	Rubble's Weight (exclude steel)											14000						7	Tons	
	Truck's Capacity	18 CY																		
	Haulage	1 Load/ HR - 1 Truck	EQ. Watch Bluebook	$151.38	HR													4	Trips	$606.00
	Disposal Cost Non Steel	Miscellaneous Scrap	Note 1.	$120	Ton													7	Tons	$840.00
2	Installation of Site Signage																			
	Labors	2 Person Crew	MI Prevailing Wage Rates	$46.42	HR									10	2			20	HR	$928.00
		Signs	Note 2.	$22	ea.													9	Ea.	$198.00
		Sign Stakes	Note 3.	$6	ea.													9	Ea.	$54.00
	Total																			$8,196.00

Notes:

1. Disposal Cost based on 2015 current rates of the Waste Management (Newberry, MI) Landfill.
2. Cost for signage provided by local sign store.
3. General metal stake cost is provided based on local hardware store rates.

Table 4B

Summary of Earth Work Reclamation Cost for End of Initial Advance - Scenario 2

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Backfilling & Grading Hendricks Pit Floor															
1	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	11,977.78	CY	243	CY/HR	49.3	HR	$18,088.00
2	962H Loader	$5,930.00	$40.70	0.1	$76.75	$158.58	1	$158.58	$/HR	5,988.89	CY	150	CY/HR	39.9	HR	$6,331.00
	Backfilling & Grading Newly Quarried															
1	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	8,066.67	CY	139	CY/HR	58.0	HR	$21,297.00
2	962H Loader	$5,930.00	$40.70	0.1	$76.75	$158.58	1	$158.58	$/HR	16,133.33	CY	100	CY/HR	161.3	HR	$25,584.00
	Bevel / Cover Exposed Bedrock at Perimeter															
3	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	11,111.11	CY	315	CY/HR	35.3	HR	$12,944.00
	Construction of Eastern Trail Ramp															
4	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	200.00	CY	438	CY/HR	0.3	HR	$110.00
5	336DL Excavator	$12,305.00	$76.95	0.1	$76.75	$238.30	1	$238.30	$/HR	200.00	CY	252	CY/HR	0.9	HR	$204.00
	Subtotal															$84,558.00

Table 2C

Bond Calculation - Scenario 3

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Reference	Cost Element	Cost	Factor
1	**Direct Costs**		
2	Subtotal Backfilling and Grading	$47,048.00	
3	Subtotal of Demolition and Miscellaneous Cost	$8,466.00	
4	Mobile Equipment Dismantlement and Removal	$3,800.00	
5	Subtotal Direct Costs	$59,314.00	
6	**Indirect Costs**		
7	Mob/Demob	$5,931.00	10.0%
8	Contingency	$4,152.00	7.0%
9	Engineering Redesign	$1,779.00	3.0%
10	Main Office Expense	$4,152.00	7.0%
11	Project Management Fee	$1,779.00	3.0%
12	Subtotal Indirect Costs	$17,793.00	30.0%
13	**Total Cost 2015**	**$77,107.00**	
14	**Escalation**		
15	Number of years		5
16	Escalation factor		0.013
17	Escalation	$5,144.00	
18	Reclamation Cost Escalated	$82,251.00	
19	**Bond Amount (rounded to nearest $1,000) 2015 Dollars**	**$82,000.00**	

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Table 3C

Summary of Demolition and Miscellaneous Cost - Scenario 3

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
1	Miscellaneous Scrap																			
	Demolition Cost - Laborers	3 Person Crew	MI Prevailing Wage Rates	$46.42	HR									40	3	HR		120	HR	$5,570.00
	Rubble's Weight (exclude steel)											14000						7	Tons	
	Truck's Capacity	18 CY																		
	Haulage	1 Load/ HR - 1 Truck	EQ. Watch Bluebook	$151.38	HR													4	Trips	$606.00
	Disposal Cost Non Steel	Miscellaneous Scrap	Note 1.	$120	Ton													7	Tons	$840.00
2	Installation of Site Signage																			
	Labors	2 Person Crew	MI Prevailing Wage Rates	$46.42	HR									12	2			24	HR	$1,114.00
		Signs	Note 2.	$22	ea.										12			12	Ea.	$264.00
		Sign Stakes	Note 3.	$6	ea.													12	Ea.	$72.00
	Total																			$8,466.00

Notes:

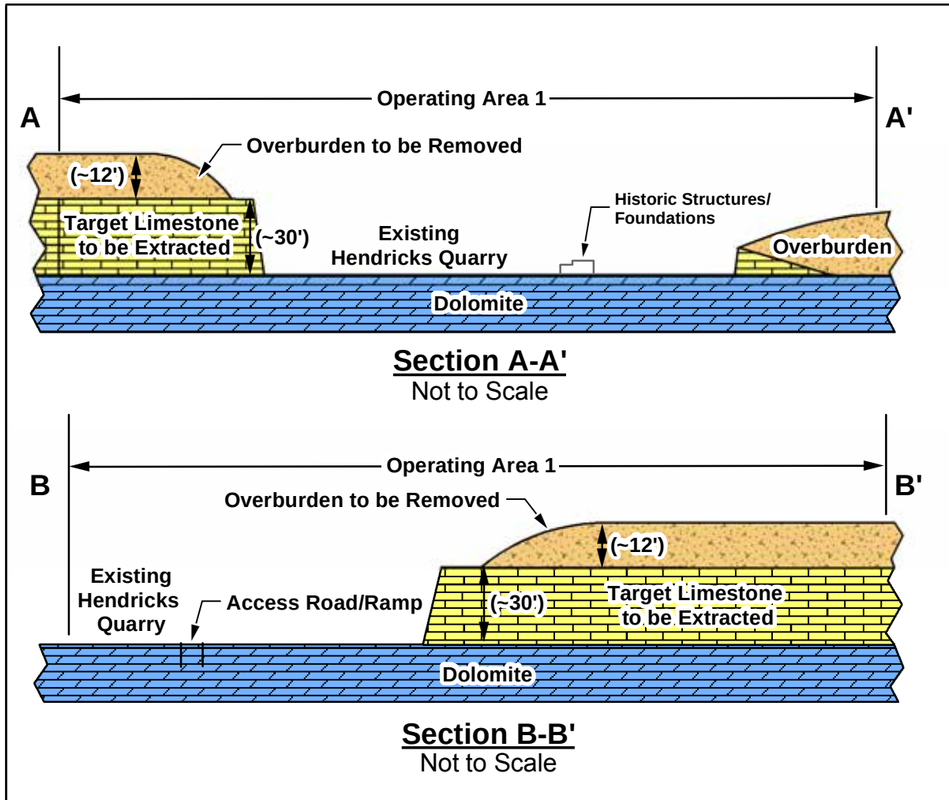
1. Disposal Cost based on 2015 current rates of the Waste Management (Newberry, MI) Landfill.
2. Cost for signage provided by local sign store.
3. General metal stake cost is provided based on local hardware store rates.

Table 4C

Summary of Earth Work Reclamation Cost - Scenario 3

2015 Bond Calculation
Graymont LLC. - Borgstom Road Quarry
Graymont, LLC.
December 2015

Ref.		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Backfilling & Grading Last Quarried Advance															
1	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	20,222.22	CY	438	CY/HR	46.2	HR	$16,943.00
2	962H Loader	$5,930.00	$40.70	0.1	$76.75	$158.58	1	$158.58	$/HR	10,111.11	CY	150	CY/HR	67.4	HR	$10,689.00
	Bevel / Cover Exposed Bedrock at Perimeter															
5	Dozer D-9R	$24,400.00	$125.20	0.1	$76.75	$366.97	1	$366.97	$/HR	16,666.67	CY	315	CY/HR	52.9	HR	$19,416.00
	Subtotal															$47,048.00



NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16Acres)
- Historic Structures/Foundations
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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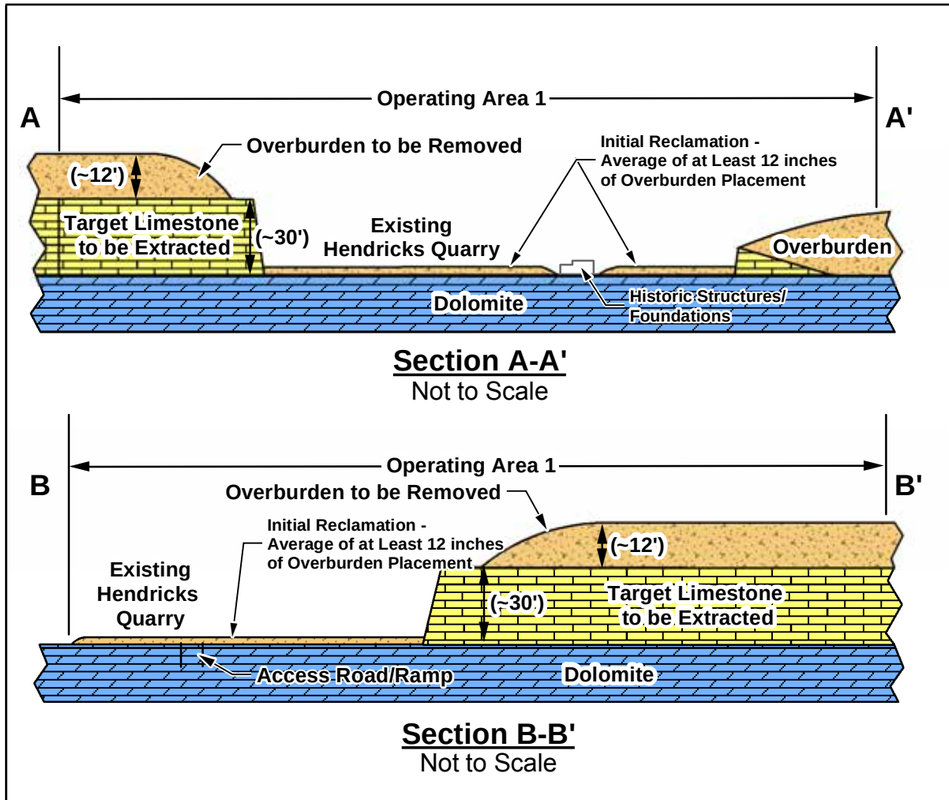
Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	**FIGURE F-1** QUARRY PLAN - PRE-QUARRY CONDITIONS OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY: RWS3			DATE: DEC.'15		
REVIEWED BY:			DATE:	Scale: 0 150 300 Feet	Date: DECEMBER 2015
APPROVED BY:			DATE:	Drafted by: BJW1	Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure F-1 BorgstromRdQuarry_quarry_plan_pre_11x17.mxd Date: 12/17/2015



NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Initial Reclamation
- Historic Structures/Foundations
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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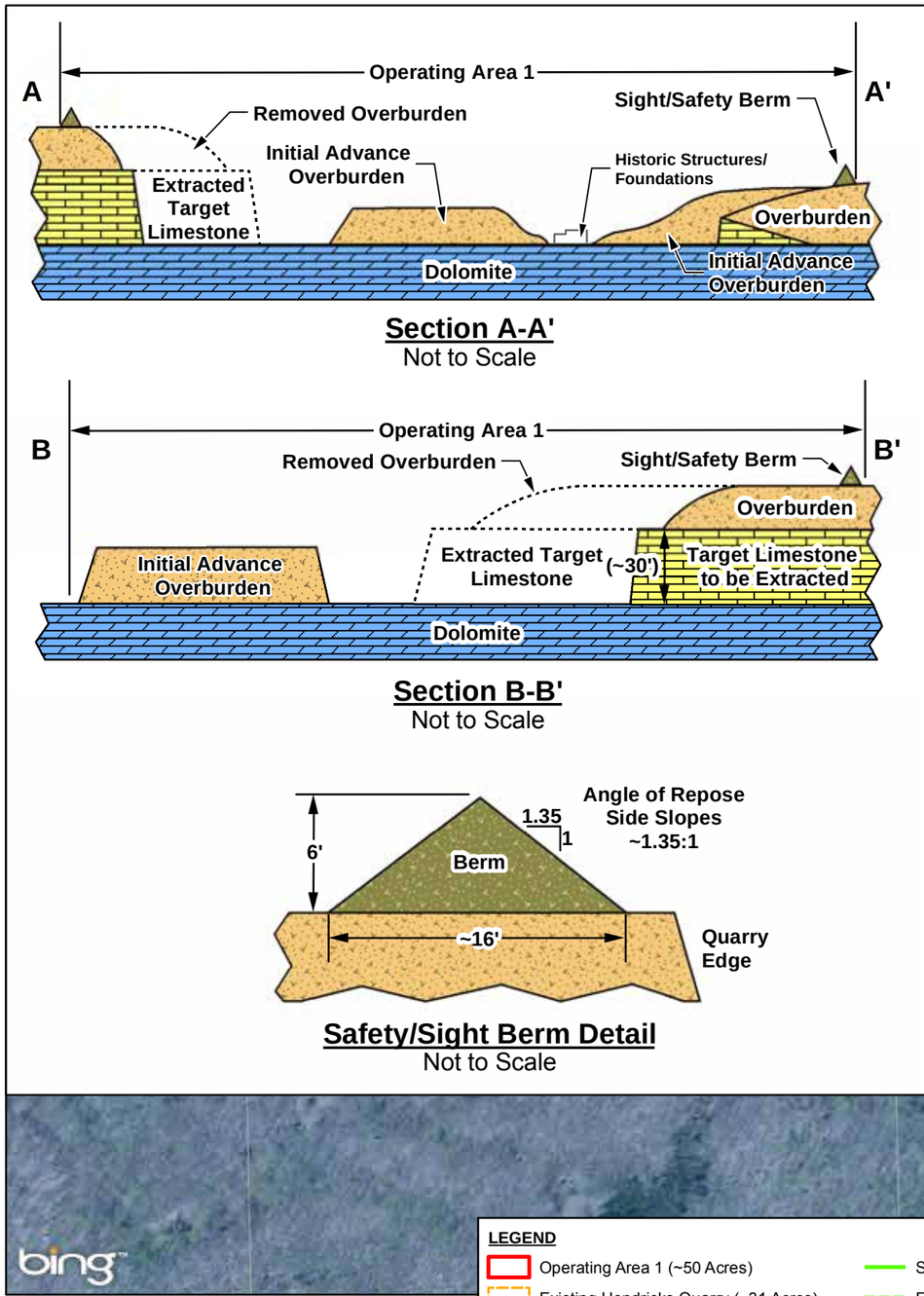
Foth Infrastructure & Environment, LLC				GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION	**FIGURE F-2** RECLAMATION OF THE EXISTING HENDRICKS QUARRY FLOOR IN OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY: RWS3			DATE: DEC.'15		
REVIEWED BY:			DATE:	Scale: 0 150 300 Feet	Date: DECEMBER 2015
APPROVED BY:			DATE:	Drafted by: BJW1	Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure F-2 BorgstromRdQuarry_quarry_plan_overburden_11x17.mxd Date: 12/18/2015



LEGEND

- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Area to be Quarried (~34 Acres)
- Area Previously Quarried (~16 Acres)
- Initial Quarry Advance (~10 Acres)
- Overburden Placement
- Limestone Processing and Loading Area
- Historic Structures/Foundations
- Safety/Sight Berm
- Future Safety/Sight Berm
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

NOTES:

1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

FIGURE F-3

QUARRY PLAN - INITIAL QUARRY ADVANCE
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 150 300 Feet

Date: DECEMBER 2015

Drafted by: BJW1

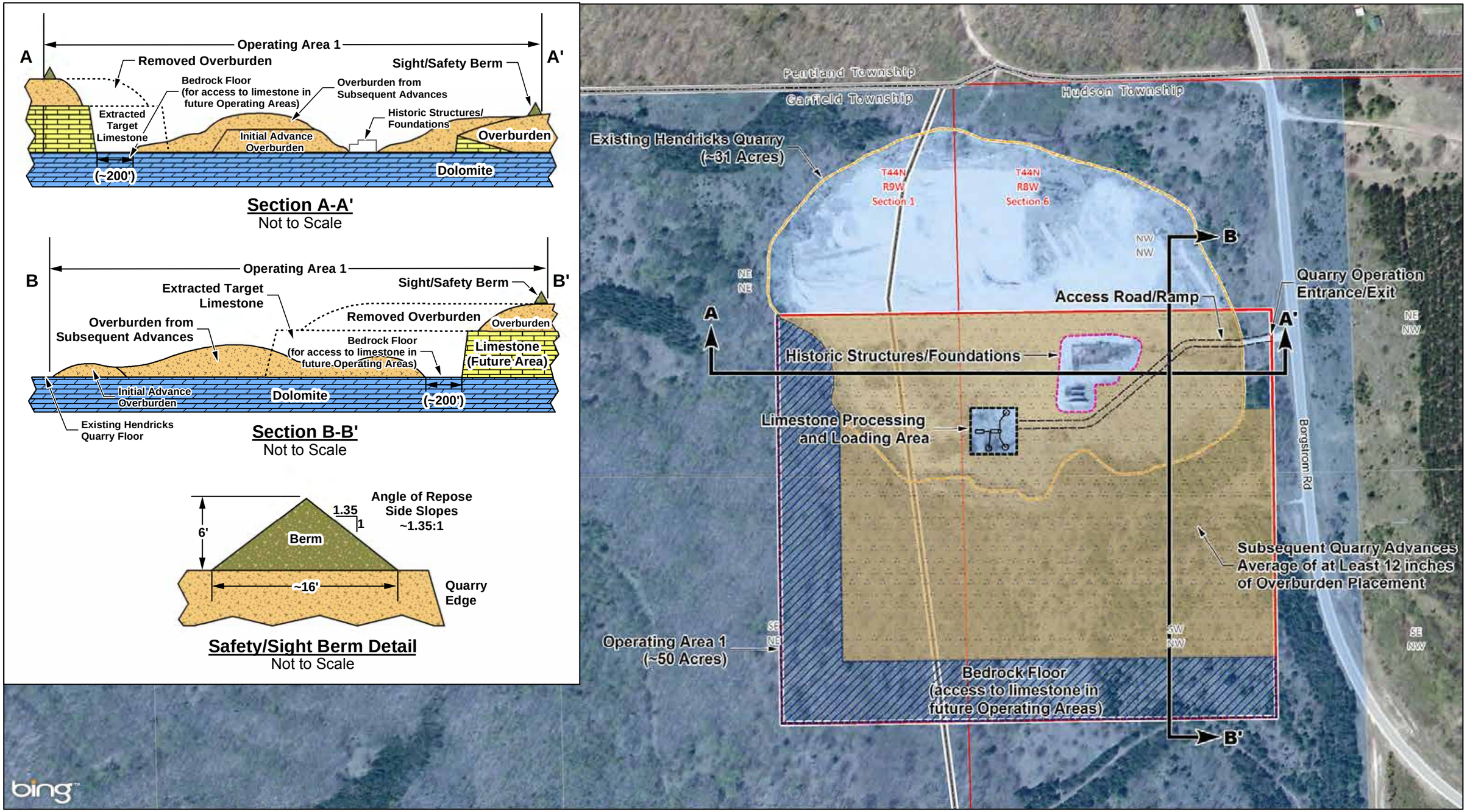
Project No: 14W777

Path: X:\GB\IE\2014\14W777-00\GIS\mxd\LTA_Exhibits\Figure F-3 BorgstromRdQuarry_quarry_plan_initial_11x17.mxd Date: 12/17/2015

Section A-A'
Not to Scale

Section B-B'
Not to Scale

Safety/Sight Berm Detail
Not to Scale



NOTES:
1. Base imagery from Esri.
2. Boundary and PLSS data from the Michigan Center of Geographic Information.
3. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.
4. Existing ramp off of Borgstrom Road to be used for Operating Area 1 quarry access.
5. Historic structures and foundations to be left in-place with no disturbance buffer.

LEGEND
- Operating Area 1 (~50 Acres)
- Existing Hendricks Quarry (~31 Acres)
- Overburden Placement
- Limestone Processing and Loading Area
- Historic Structures/Foundations
- Bedrock Floor
- Graymont Fee Ownership - Tract A
- Quarter-Quarter Section
- Section Line
- Municipal Boundary
- County Boundary

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REVISED	DATE	BY	DESCRIPTION		
PREPARED BY:	RWS3			DATE:	DEC.'15
REVIEWED BY:				DATE:	
APPROVED BY:				DATE:	

GRAYMONT (MI) LLC

FIGURE F-4
QUARRY PLAN - FINAL QUARRY ADVANCE
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: 0 150 300 Feet		Date:	DECEMBER 2015
Drafted by:	BJW1	Project No:	14W777

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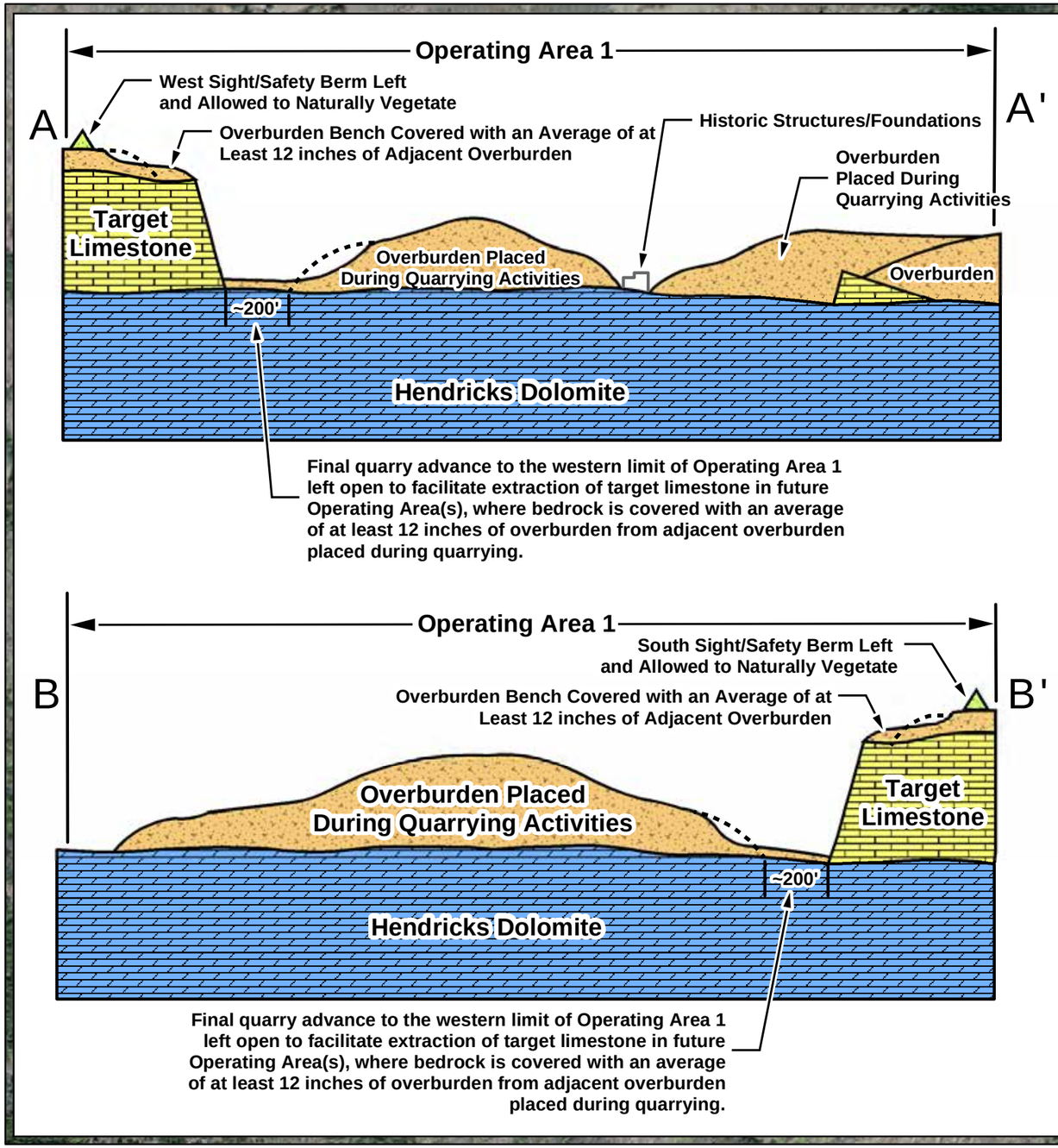

NOTES:

1. The groundwater table is expected to be situated below the Graymont Borgstrom Road Quarry floor based on local topographic features and the lack of water or seeps in the existing Hendricks Quarry.
2. All overburden and permanent sight/safety berms to be re-vegetated via natural processes.
3. Base imagery from Esri.
4. Coordinate system is NAD 1983, Michigan State Plane North, units in feet.

LEGEND

- Quarry Floor (Hendricks Dolomite) Covered with an Average of at Least 12 inches of Overburden
- Historic Structures/Foundations
- Operating Area 1 (~50 Acres)
- Municipal Boundary

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Foth Infrastructure & Environment, LLC					GRAYMONT (MI) LLC	
REVISED	DATE	BY	DESCRIPTION		**FIGURE F-5** POST-QUARRYING CONDITIONS FOR OPERATING AREA 1 GRAYMONT BORGSTROM ROAD QUARRY MACKINAC COUNTY, MI	
PREPARED BY:	RWS3			DATE: DEC.'15		
REVIEWED BY:				DATE:	Scale: 0 200 400 Feet	Date: DECEMBER 2015
APPROVED BY:				DATE:	Drafted by: BJW1	Project No: 14W777

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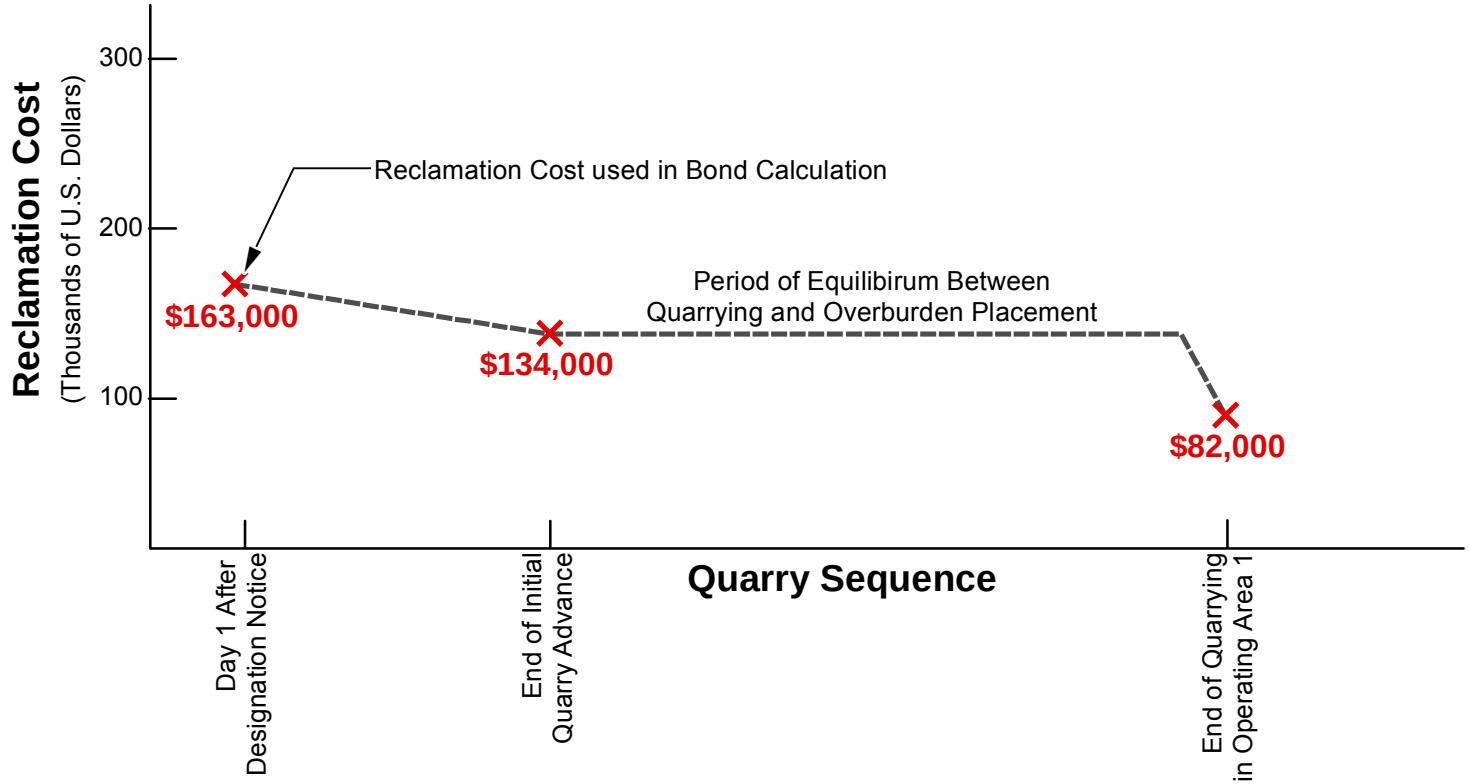

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Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: RWS3			DATE: DEC.'15
REVIEWED BY:			DATE:
APPROVED BY:			DATE:

GRAYMONT (MI) LLC

FIGURE F-6
RECLAMATION COST ANALYSIS
OPERATING AREA 1
GRAYMONT BORGSTROM ROAD QUARRY
MACKINAC COUNTY, MI

Scale: NOT TO SCALE	Date: DECEMBER 2015
Drafted by: BJW1	Project No: 14W777

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