GREEN LAKE COUNTY

571 County Road A, Green Lake, WI 54941

The following documents are included in the packet for the *Green Lake County Board of Adjustment* business meeting that is scheduled for Thursday December 22, 2022. The meeting begins at 9:30 a.m.

The Board has also reviewed the record pertaining to the July 7th Planning & Zoning Committee Meeting. These documents can be found in the 7/7/22 date of the County Events Calendar.

Packet Pages:

If you have questions or need additional information, please contact the Land Use Planning & Zoning Department at (920) 294-4156.

GREEN LAKE COUNTY
Board of Adjustment
571 County Road A, Green Lake, WI 54941

Office: (920) 294-4156 FAX: (920) 294-4198

Email: zoning@greenlakecountywi.us

Board of Adjustment Meeting Notice

Date: December 22nd, 2022 Time: 9:30 AM
Green Lake County Government Center, Room #0902
571 County Road A, Green Lake, WI 54941

AGENDA

Board of Adjustment Members:

Ron Triemstra, Chair

Rick Dornfeld, Vice-Chair

Brian Zimmerman

BJ Zirger

Karen Werlein, BOA Secretary

Virtual attendance at meetings is optional. If technical difficulties arise, there may be instances when remote access may be compromised. If there is a quorum attending in person, the meeting will proceed as scheduled.

1. Call to order
2. Roll call
3. Pledge of Allegiance
4. Certification of open meeting law
5. Approval of Minutes: 9/16/2022 & 11/10/2022
6. Public Hearing (Not to begin before 9:30AM)

Appellants: Green Lake Association, Inc. Green Lake Conservancy, Inc. Green Lake Sanitary District, Ernie Neuenfeldt **Owner/applicant:** Donald Kinas, Michael McConnell **General legal description:** 004-00787-0000, *004-00786-0000 (*identified due to Stormwater Plans), part of the SW1/4 S36 T16N, R13E, Town of Brooklyn **Administrative Appeal:** The Board of Adjustment will conduct a de novo (new) hearing to determine whether to approve (with or without conditions) an application for a conditional use permit filed by Donald Kinas for a non-metallic mining operation at the subject property.

   a. Public Hearing
   b. Board Discussion & Deliberation
   c. Board Decision

7. Adjourn

This meeting will be conducted through in person attendance or audio/visual communication. Remote access can be obtained through the following link:

Topic: Board of Adjustment Meeting
Time: December 22, 2022 09:30 AM Central Time (US and Canada)

Microsoft Teams meeting

Join on your computer, mobile app or room device

Click here to join the meeting

Meeting ID: 271 720 908 058

Passcode: hbQKox

Download Teams | Join on the web

Or call in (audio only)

+1 920-659-4248,,44784009# United States, Green Bay

Phone Conference ID: 447 840 09#

Find a local number | Reset PIN

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Green Lake County
BOARD OF ADJUSTMENT
Meeting Minutes - Friday, September 16, 2022

The meeting of the Green Lake County Board of Adjustment was called to order by Matt Kirkman on Friday, September 16, 2022 at 9:00 AM in the Green Lake County Board Room, Green Lake County Government Center, 571 County Road A, Green Lake, WI. The requirements of the open meeting law were certified as being met. The pledge of allegiance was recited.

Present:
- Ron Triemstra
- Ed Roepsch
- Rick Dornfeld
- BJ Zirger (Alternate)

Absent:
- Brian Zimmermann (Alternate)

Other County employees present:
- Karen Werlein, BOA Secretary
- Matt Kirkman, P&Z Director
- Noah Brown, Land Use Specialist

ELECTION OF CHAIR

Matt Kirkman called nominations for Chair. Member Ed Roepsch nominated Ron Triemstra. Kirkman called for nominations 3 more times. ***Motion/Second (Dornfeld/Roepsch)*** to close nominations and cast a unanimous ballot for Ron Triemstra. Motion carried with no negative vote. Ron Triemstra seated as Chair.

ELECTION OF VICE CHAIR

Chair Triemstra called for nominations for Vice Chair. Member Triemstra nominated Rick Dornfeld. Triemstra called for nominations 3 more times. ***Motion/Second (Triemstra/Roepsch)*** to close nominations and cast a unanimous ballot for Rick Dornfeld. Motion carried with no negative vote. Rick Dornfeld seated as Vice Chair.

MINUTES

Motion/second (Triemstra/Dornfeld) to approve minutes of March 18th with no additions or corrections.
Motion carried with no negative vote.

ADJOURN FOR FIELD INSPECTION

Chair Triemstra called recess for field inspection at 9:04AM

PUBLIC HEARING – 10:24AM

Board of Adjustment reconvened at 10:24AM for the Public Hearing.

- **Owner: KE JO Family Enterprises LLC**

- **Applicant: Keith Frederick**
- **Site Description: W4564 Cty. Rd. B, Parcel# 014-00769-0000**
- **Request: Variance from Section 350-50A of the County Zoning Ordinance to construct a bunker silo wall with the county highway setback.**

Chair Triemstra called for public comment:
Keith Frederick, applicant, spoke in approval of the request.
Derek Huseboe, Skunk Hallow Rd, questioned how much of the set back the applicant's wall would be within.

Matt Kirkman read the staff report.

Motion/second (Triemstra/Dornfeld) to approve the request for a variance of the highway setback.

The board deliberated the variance criteria including unnecessary hardship, unique property limitations, and harm to public.

Roll call vote –Roepsch-nay, Triemstra-nay, Dornfeld-nay.
Variance denied.

NEXT MEETING DATE
October 21st, 2022

ADJOURNMENT
Chair Triemstra adjourned the Board of Adjustment meeting at 11:10AM

Submitted by,
Karen Werlein
BOA Secretary

Green Lake County
BOARD OF ADJUSTMENT
Meeting Minutes - Thursday, November 10, 2022

The meeting of the Green Lake County Board of Adjustment was called to order by Vice Chair Rick Dornfeld on Thursday, November 10, 2022 at 4:30PM in the Green Lake County Board Room, Green Lake County Government Center, 571 County Road A, Green Lake, WI. The requirements of the open meeting law were certified as being met. The pledge of allegiance was recited.

Present:	Absent:
Brian Zimmermann (Alternate)	Ron Triemstra
Rick Dornfeld	BJ Zirger
Andy Phillips, BOA counsel	

Other County employees present:
Karen Werlein, BOA Secretary   Matt Kirkman, P&Z Director

DISCUSSION AND CONFER with counsel to the Board of Adjustment regarding process to be utilized for hearing and decision on Appeal of Planning and Zoning Committees decision to grant Conditional Use Permit to Donald Kinas, parcel no. 004-00787-0000, *004-00786-0000 (*identified due to Stormwater Plans) and official action, if any, on process.

BOA to meet December 22nd to hear CUP appeal

Site visit to be held on December 20th 10am, weather permitting. Alternate date is December 21st 2pm.

BOA Packet to be dispersed December 12th

NEXT MEETING DATE

December 22nd at 9:30am with a site visit happening on the 20th.

ADJOURNMENT

Vice Chair Dornfeld adjourned the Board of Adjustment meeting at 4:58pm.

Submitted by,
Karen Werlein
BOA Secretary

NOTICE OF PUBLIC HEARING

The Green Lake County Board of Adjustment will hold a Public Hearing in County Board Room #0902 of the Green Lake County Government Center, 571 County Road A, Green Lake, Wisconsin, on ***Thursday, December 22, 2022**, at **9:30 a.m.*** to consider the following:

Item I: Appellants: Green Lake Association, Inc. Green Lake Conservancy, Inc. Green Lake Sanitary District, Ernie Neuenfeldt **Owner/applicant:** Donald Kinas, Michael McConnell **Site location:** Intersection of CTH K & Brooklyn G Rd **General legal description:** 004-00787-0000, *004-00786-0000 (*identified due to Stormwater Plans), part of the SW1/4 S36 T16N, R13E, Town of Brooklyn **Administrative Appeal:** The Board of Adjustment will conduct a de novo (new) hearing to determine whether to approve (with or without conditions) an application for a conditional use permit filed by Donald Kinas for a non-metallic mining operation at the subject property.

All interested persons wishing to be heard at the public hearing are invited to attend. Please note that *it is not uncommon for an owner/applicant to withdraw a request at the last minute.* For further detailed information concerning this notice contact **Land Use Planning and Zoning** at (920) 294-4156.

Publish: December 8, 2022

SUMMARY NOTICE OF PUBLIC HEARING

The Green Lake County Board of Adjustment will hold a public hearing in room #0902 at 571 County Road A, Green Lake, WI, on ***Thursday, December 22, 2022,*** *at* ***9:30 a.m.*** to consider the following:

Item I: Appellants: Green Lake Association, Inc. Green Lake Conservancy, Inc. Green Lake Sanitary District, Ernie Neuenfeldt **Owner/applicant:** Donald Kinas, Michael McConnell **Site:** Intersection of CTH K & Brooklyn G Rd **Administrative Appeal:** The Board of Adjustment will conduct a de novo (new) hearing to determine whether to approve (with or without conditions) an application for a conditional use permit filed by Donald Kinas for a non-metallic mining operation at the subject property.

On December 8, 2022 the full text of the Notice of Public Hearing was published in Berlin Journal Newspapers and is viewable at the Berlin Journal, at www.greenlakecountywi.gov, at www.wisconsinpublicnotice.org and the public meeting notices board at the Green Lake County Government Center.

Publish: December 15, 2022

AXLEYATTORNEYS

Axley Brynelson, LLP

KATHRYN SAWYER-GUTENKUNST
(262) 409-2292
ksg@axley.com

December 8, 2022

Green Lake County Board of Adjustment
571 County Road A
Green Lake, WI 54941

RE: Appeal of Conditional Use Permit Approval
Intersection of County Highway K and Brooklyn G Road
Tax Key No.: 004-00787-0000

Dear Board of Adjustment:

Our office represents Kopplin & Kinas Co., Inc. ("Kopplin") in regard to the hearing before the Green Lake County Board of Adjustment ("BOA") on December 22, 2022. This correspondence summarizes the applicable law for the BOA to consider when reviewing the approved Conditional Use Permit for property located at the intersection of County Highway K and Brooklyn G Road (Tax Key No.: 004-00787-0000) (the "Property").

As the BOA is aware, Wis. Stat. § 59.69(5e) authorizes the County to approve a Conditional Use Permit. Under the statute, a Conditional Use Permit **must** be granted if an applicant "meets or agrees to meet all the requirements and conditions specified in the county ordinance or those imposed by the county zoning board." Any condition must be "related to the purpose of the ordinance and be based on substantial evidence."

Substantial evidence means "facts and information, other than merely personal preferences or speculation, directly pertaining to the requirements and conditions an applicant must meet to obtain a conditional use permit and that reasonable persons would accept in support of a conclusion." Further, any requirements or conditions must be reasonable, practical, and measurable. Lastly, a decision by the County to deny a Conditional Use Permit must be supported by substantial evidence.

As the BOA is aware, on July 7, 2022, the Green Lake County Planning & Zoning Committee conditionally approved the Conditional Use Permit, subject to satisfying certain objective conditions.

The Appellants have appealed the Committee's decision seeking the Board deny the Conditional Use Permit request based on assertions that are not factually supported by substantial evidence. The information submitted will demonstrate that Kopplin is entitled to a Conditional Use Permit as requested. Therefore, the BOA's approval of the Conditional Use Permit is appropriate.

We are happy to answer any questions you may have at the upcoming hearing.

Sincerely,

AXLEY BRYNELSON, LLP

/s/Kathryn Sawyer-Gutenkunst

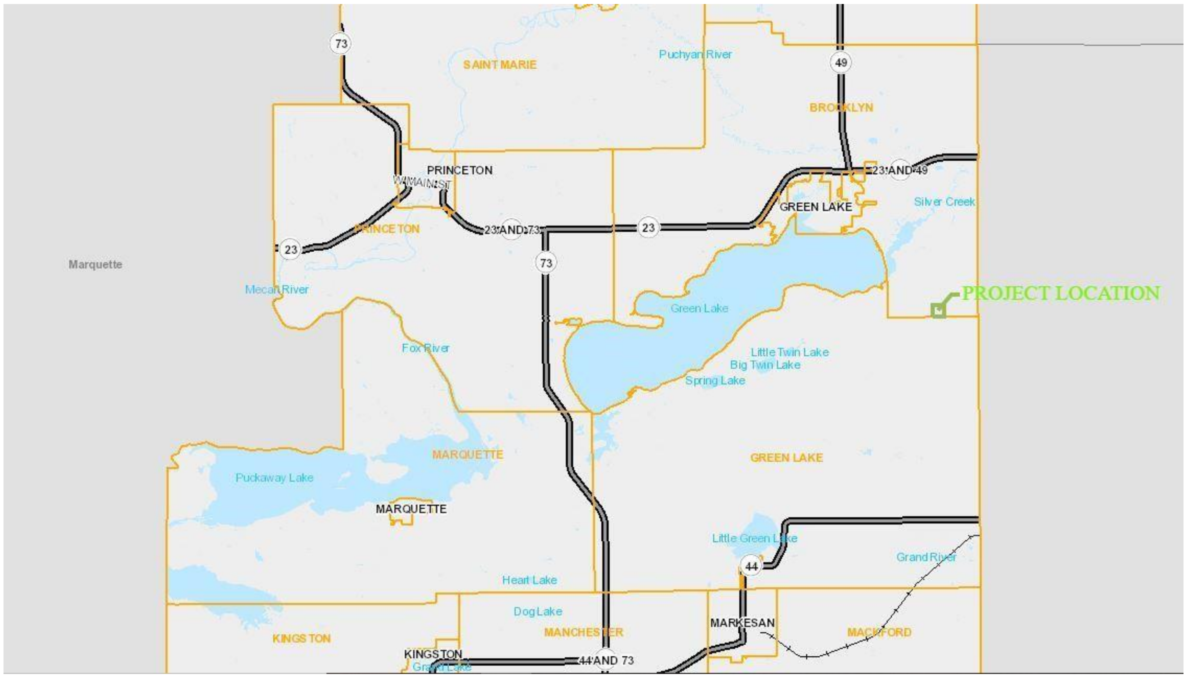
Kathryn Sawyer-Gutenkunst

KSG/caf

Badger Engineering & Construction, LLC.
1432 Country Club Lane, Watertown, WI 53098
920.229.7128 BadgerEngineeringWI@gmail.com

EROSION CONTROL AND STORM WATER MANAGEMENT PLAN

SKUNK HOLLOW QUARRY



Prepared for:

KOPPLIN & KINAS CO., INC.
W1266 NORTH LAWSON DRIVE
GREEN LAKE, WI 54941
PHONE: (920)294-6451
FAX: (920)294-6489
https://kkci.us

Prepared by:

Badger Engineering & Construction, LLC
1432 Country Club Lane
Watertown, WI 53098
PHONE: (920)229-7128
Email:BadgerEngineeringWI@gmail.com

Table of Contents

Appendices

SKUNK HOLLOW QUARRY - SITE & CONTACT INFORMATION

SITE LOCATION: SW ¼ OF THE SW ¼, SECTION 36, T16N-R13E
TOWN OF BROOKLYN, GREEN LAKE COUNTY, WISCONSIN
TAX PARCEL NUMBER: 004-00787-0000

CURRENT SITE ADDRESS: THE NE QUADRANT OF THE INTERSECTION OF
CTH K & BROOKLYN "G" ROAD

OPERATOR: KOPPLIN & KINAS CO., INC.
W1266 NORTH LAWSON DRIVE
GREEN LAKE, WI 54941
PHONE: (920)294-6451
FAX: (920)294-6489
https://kkci.us

DONALD E. KINAS, JR. – PRESIDENT
CHRISTOPHER KINAS – AGGREGATE OPERATIONS
MIKE MCCONNELL – PERMIT COMPLIANCE, SITE DESIGN

PROPERTY OWNER: DONALD E. KINAS, JR.
W1266 NORTH LAWSON DRIVE
GREEN LAKE, WI 54941
PHONE: (920)294-6451

Introduction

Other plans incorporated by reference –

1. Operation, Environmental Control & Reclamation Plan for the Skunk Hollow Quarry, February 2022, by Kopplin & Kinas Company Incorporated (KKCI).
2. Stormwater Pollution Prevention Plan (SWPPP), April 2022, by Badger Engineering and Construction, LLC.

Site Location

The proposed Skunk Hollow Quarry located at the intersection of County Highway K and Brooklyn G Road, Township of Brooklyn, Green Lake County, Wisconsin.

Purpose

This Erosion Control and Stormwater Management Plan is prepared to mitigate potential impacts to the receiving waters of Green Lake and area streams, resulting from the operations at the Skunk Hollow Quarry.

Water quality, drainage, monitoring, and pollution control are addressed in this Plan. Adherence to this plan will allow KKCI to contain potential pollutants on the site and have a plan of action for minimizing the risk of contaminating surface waters. This Plan includes stormwater, process water and groundwater.

Regulatory Requirements

In addition to the Conditional Use Permit, the applicant must obtain permits from the State of Wisconsin before mining can begin. These requirements have been addressed within this document or in Operation, Environmental Control & Reclamation Plan for the Skunk Hollow Quarry, February 2022, by Kopplin & Kinas Company Incorporated (KKCI) and/or Stormwater Pollution Prevention Plan (SWPPP), April 2022, by Badger Engineering and Construction, LLC.

Key requirements for the proposed mine are summarized below.

Wisconsin Administrative Code Chapter NR135: non-metallic mine reclamation surface

water and wetlands protection.

- Comply with water quality standards for surface waters and wetlands. No wetlands identified within the project scope.
- Prevent pollution of waters of the state through runoff diversion and drainage before land disturbance and removal of topsoil.
- Do not adversely affect neighboring properties by diversion or channelization of runoff.

Groundwater protection

- Do not cause permanent lowering of the water table.
- Do not cause groundwater quality standards in NR140 to be exceeded.

Topsoil management

- Replace topsoil after final grading has been completed.

Final grading and stabilization

- Grade final slopes no steeper than 3:1, unless otherwise approved.

- Stabilize with vegetation areas affected by the mining.

Wisconsin Administrative Code Chapter NR216: stormwater and discharge general permit WI0046515-5

- Direct drainage to seep into the soil within the mining site, to the extent practicable.
- Contain within the site stormwater from events up to the 25-year, 24-hour storm.
- Use sediment control practices to reduce the amount of sediment discharged to surface waters and wetlands.
- Use pollution prevention practices to prevent contamination from fuel and other potential contaminants to the extent practicable.
- Test wastewater to ensure minimization of impacts to groundwater and surface water, as detailed in the general permit.
- Conduct annual inspections by a qualified individual to document compliance with permit requirements.

Stormwater Management Practices Design

During initial land disturbance and mining operations, this project site is classified as externally drained by DNR. Therefore, this stormwater management practices design will detain and treat stormwater runoff from this mine site per DNR standards prior to discharge. As this quarry begins and continues its mining operations, it will convert to an internally drained classification.

Erosion Control Plan

Erosion control BMPs are designed to limit off-site effects of erosion, aid in project construction while minimizing overall cost, and to comply with federal, state, and local laws and regulations.

BMPs can be generally classified into two categories, erosion control and sediment control.

- Erosion Control - Directly protect the disturbed soil surface from erosion. They are the best measure for preventing erosion.
- Sediment Control - Aid in removal of sediments from water after the erosion process has already begun. This is accomplished by using barriers, containments, or other devices to filter or reduce the velocity of the water so soil particles can no longer remain suspended.

“The landowner has the responsibility to oversee the development of a site-specific erosion control and storm water management plan and the installation, maintenance, and inspection of all Best Management Practices (BMPs). These BMPs include structural and non-structural measures, practices, techniques or devices used to avoid or minimize soil, sediment or pollutants carried in runoff to waters of the state.

The erosion control plan for a construction site, in accordance with s. NR 216.46, Wis. Adm. Code, addresses the discharge of sediment and other pollutants that are carried in runoff from the construction site. The plan details how to control sediment and other pollutants on the construction site by using control practices throughout the duration of the construction project and stabilization of the site. Erosion and sediment control Best Management Practices (BMPs) include sediment ponds, tracking pads, silt fences and temporary seeding. Sequencing, inspection, and maintenance procedures for BMPs must be included in the erosion control plan.”

Water quality, drainage, monitoring, and pollution control are addressed in this Plan. Adherence to this plan will allow KKCI to contain potential pollutants on the site and have a plan of action for minimizing the risk of contaminating surface waters. This Plan includes stormwater, process water and groundwater.

During the construction process, soil is highly vulnerable to erosion by wind and water. Eroded soil endangers water resources by reducing water quality and causing the siltation of aquatic habitat for fish and other desirable species. Eroded soil also necessitates repair of sewers and ditches and the dredging of lakes.

This Erosion Control and Stormwater Management Plan has been developed to address the requirements under in accordance with s. NR 216.46, Wis. Adm. Code and in accordance with good engineering practices.

Key Elements of this Plan

Erosion control features will include (See Appendix D):

- Non-Channel Erosion Mat (WDNR T.S. 1052)
- Channel Erosion Mat (WDNR T.S. 1053)
- Vegetative Buffer for Construction Sites (WDNR T.S. 1054)
- Sediment Bale Barrier (WDNR T.S. 1055)
- Silt Fence (WDNR T.S. 1056)
- Trackout Control Practices (WDNR T.S. 1057)
- Mulching for Construction Sites (WDNR T.S. 1058)
- Seeding (WDNR T.S. 1059)
- Dewatering (WDNR T.S. 1061)
- Ditch Checks (WDNR T.S. 1062)
- Sediment Trap (WDNR T.S. 1063)
- Sediment Basin (WDNR T.S. 1064)
- Construction Site Diversion (WDNR T.S. 1066)
- Grading Practices for Erosion Control (WDNR T.S. 1067)
- Dust Control (WDNR T.S. 1068)
- General Inspection and Maintenance Guidance

Basic Principles (WDNR Guidance)

1. Minimize open area by phasing or sequencing construction and preserving existing vegetation where possible.
2. Divert storm water away from disturbed or exposed areas when possible.
3. Install BMPs to control erosion and sediment and manage storm water.
4. Inspect the site regularly and properly maintain BMPs, especially after rainstorms.
5. Revise the plan as site conditions change during construction and improve the plans if BMPs are not effectively controlling erosion and sediment.
6. Keep the construction site clean by putting trash in trash cans, keeping storage bins covered, and preventing or removing excess sediment on roads and other impervious surfaces.

Construction Scheduling

Refer to construction plan set which includes additional construction notes and reclamation information.

The following outlines the primary construction schedule for this nonmetallic mine from initial land disturbance through mining operations:

1. *Install erosion control measures* including tracking pad, silt fence, straw bales, and sediment trap.
2. Phase I – Initial 10 acres
    - *Clear and grub vegetation, trees, and stumps*.
    - *Strip topsoil and stockpile* (for berms). Topsoil to be used in quarry reclamation per plan. Surround low end of stockpile with silt fence. Stabilize topsoil stockpiles within 7 days with temporary seeding. BMPs include:
        - Silt Fence (WDNR T.S. 1056), Construction Site Diversion (WDNR T.S. 1066) and Grading Practices for Erosion Control (WDNR T.S. 1067).
    - *Develop access road* and install appropriate BMP's including:
        - Channel Erosion Mat (WDNR T.S. 1053), Sediment Bale Barrier (WDNR T.S. 1055), Trackout Control Practices (WDNR T.S. 1057) and Ditch Checks (WDNR T.S. 1062)
    - *Create earthen containment berms* around quarry edges per plan to prevent off-site waters from entering quarry and to direct runoff from the quarry site to the sediment trap. Trap location to be adjusted and maintained to accommodate mining operations. BMPs include:
        - Non-Channel Erosion Mat (WDNR T.S. 1052), Silt Fence (WDNR T.S. 1056), Mulching for Construction Sites (WDNR T.S. 1058), Seeding (WDNR T.S. 1059) and Grading Practices for Erosion Control (WDNR T.S. 1067).
    - *Construct sediment basin and grass swale*. BMPs include:
        - Non-Channel Erosion Mat (WDNR T.S. 1052), Channel Erosion Mat (WDNR T.S. 1053), Vegetative Buffer for Construction Sites (WDNR T.S. 1054), Sediment Bale Barrier (WDNR T.S. 1055), Mulching for Construction Sites (WDNR T.S. 1058), Seeding (WDNR T.S. 1059) and Ditch Checks (WDNR T.S. 1062).
    - *Proceed with mining operations* to design quarry depth.

Stormwater Management Plan

"The storm water management plan should include a description of management practices that will be installed during the construction phase to address the discharge of total suspended solids, control peak flow, provide for infiltration, and maintain protective areas from the post-construction site.

In addition, the plan must comply with s. NR 216.47 and the applicable post-construction performance standards in ch. NR 151, Wis. Adm. Code."

Post-construction storm water management involves having BMPs designed, installed, and maintained to meet NR 151 performance standards in four areas:	
1. Water quality	Reduce total suspended solids (TSS) carried in runoff from the site.
2. Water quantity	Maintain peak runoff rates to the pre-development conditions.
3. Infiltration	Infiltrate a sufficient amount of runoff volume from the post-developed site as compared to pre-development conditions.
4. Protective areas for lakes, streams and rivers, and wetlands*	Maintain a vegetated area to serve as a transitional zone between urban development and water resources that will both filter pollutants and reduce flow velocity.

The plan may include BMPs such as wet ponds, infiltration structures, grass swales, vegetative filter strips and biofilters to control runoff from the site after construction is completed."

Key Elements of this Plan

Process Water (water used for rock washing, dust control, and surface runoff) shall be contained within disturbed areas with sumps and sediment trap. The active mining bench sump will typically not discharge. Process water on the mill level will be contained in the sediment trap on that level. Discharges from any sump or trap will only take place following settling of sediment in said sump or trap. Water is recycled as much as possible on-site, further reducing discharge. The SWMP Maps show the location of all stormwater control structures and discharge points.

Stormwater from rainfall or snowmelt shall be contained within the sediment trap and sumps. The active mining bench will have sufficient sump capacity to contain the stormwater runoff of the bench and immediate upslope disturbed areas.

The nature of the mining sequence will regularly renew the location of the sump, negating the need for most maintenance and cleanout. The mining bench sump will be able to be pumped out to the main drainage on the existing hillside. This discharge will take place if a particularly large runoff event necessitates it. All stormwater from the mill level will be trapped in the sediment trap located on said level. This sediment trap will be in existence the entire life of the operation. Periodic inspections of the sediment trap will be made. Maintenance will take place as needed to maintain the necessary capacity and freeboard for the sump to operate effectively.

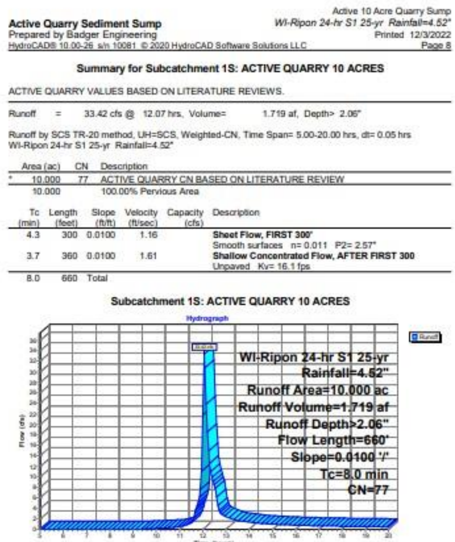
Any discharge to surface waters or to groundwater will be regulated through the Wisconsin Pollution Discharge Elimination System (WPDES) general permit for discharges associated with aggregate production operations for stormwater and process water and requires a permit.

Any discharge of from the site shall be sampled and tested for all analytes as dictated by the DNR Discharge Permit. The person sampling the discharge shall evaluate the flow rate and look for the presence of any oils (oily sheen).

Runoff Volumes – Sediment Trap

Runoff volumes were calculated for the 25 year – 24-hour storm. A CN value of 77 was used based upon an online search of accepted Wisconsin values for an active quarry.

<u>25 Year – 24 hour (Ripon, WI)</u>



Active Quarry Sediment Sump
Prepared by Badger Engineering
HydroCAD® 10.00-26 s/n 10081 © 2020 HydroCAD Software Solutions LLC

Active 10 Acre Quarry Sump
WI-Ripon 24-hr S1 25-yr Rainfall=4.52"
Printed 12/3/2022
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Summary for Subcatchment 1S: ACTIVE QUARRY 10 ACRES

ACTIVE QUARRY VALUES BASED ON LITERATURE REVIEWS.

Runoff = 33.42 cfs @ 12.07 hrs, Volume= 1.719 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
WI-Ripon 24-hr S1 25-yr Rainfall=4.52"

	Area (ac)	CN	Description
*	10.000	77	ACTIVE QUARRY CN BASED ON LITERATURE REVIEW
	10.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	300	0.0100	1.16		**Sheet Flow, FIRST 300'** Smooth surfaces n= 0.011 P2= 2.57"
3.7	360	0.0100	1.61		**Shallow Concentrated Flow, AFTER FIRST 300** Unpaved Kv= 16.1 fps
8.0	660	Total			

Subcatchment 1S: ACTIVE QUARRY 10 ACRES

Storage Volumes

We estimated runoff volumes from the pit for the 25-year and 100-year storms using the Natural Resource Conservation Service curve number method and compared them to the approximate volume of the sediment trap.

The proposed sediment trap is adequate to capture runoff from the 25-year event, as required.

Sizing Sediment Trap (1063)

All WDNR TS guidance shall be followed.

"Sizing Criteria – Properly sized sediment traps are relatively effective at trapping medium and coarsegrained particles. To effectively trap fine-grained particles, the sediment trap must employ a large surface area or polymers. The specific trapping efficiency of a sediment trap varies based on the surface area, depth of dead storage, and the particle size distribution and concentration of sediment entering the device.

<u>Surface Area</u> – The minimum surface area of a sediment trap shall be based on the dominant textural class of the soil entering the device. The surface area calculated below represents the surface for the

permanent pool area (if wet) or the surface area for the dead storage. This surface area is measured at the invert of the stone outlet.

a. For coarse textured soils (loamy sand, sandy loam, and sand): As (coarse) = 625 * Adr
b. For medium textured soils (loams, silt loams, and silt): As (medium) = 1560 * Adr
c. For fine textured soils (sandy clay, silty clay, silty clay loam, clay loam, and clay): As (fine) = 5300 * Adr

For the equations above:

As = surface area of storage volume in square feet

Adr = contributory drainage area in acres."

As the active quarry floor will be a limestone surface, the middle value (medium) of 1560 was used.

Then the area minimum of the trap, As = 1560*10 acres = 15,600 sf. With an average 3-foot depth, the basin volume would be 46,800 CF or 1.07 AF.

As the 25 year – 24 hour calculated runoff volume is 1.7 AF, then the larger value shall be used.

Sizing Sediment Basin (1064)

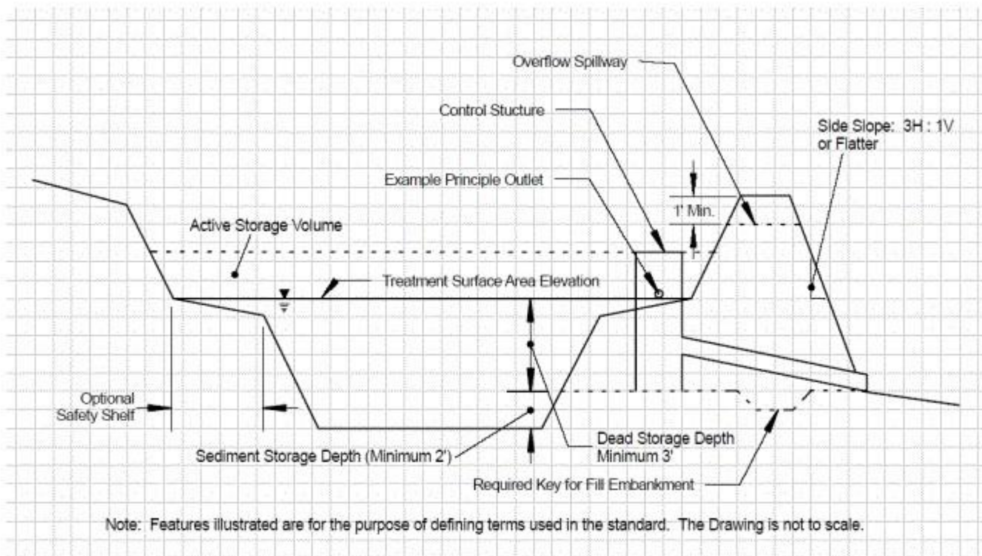
All WDNR TS guidance shall be followed.

"A sediment control device constructed with an engineered outlet, formed by excavation or embankment to intercept sediment-laden runoff and retain the sediment.

When constructing a sediment basin that will also serve as the long-term stormwater detention pond, build the sediment basin to the larger of the two sizes required either for stormwater control or erosion control."

As the sediment basin is to serve a dual purpose, it was decided to size the structure to accommodate the 25-year storm event.

Clarification of Sediment Basin Terminology



INSPECTION, MAINTENANCE, & PROHIBITIONS

All components of the storm water system shall be inspected at least semi-annually in early Spring and early Autumn. Repairs will be made whenever the performance of a storm water control device is compromised as described below. Owner shall maintain records of all inspection and maintenance activities.

Wet Detention Pond

- The Owner shall visually inspect the pond outlet structure and pond perimeter annually.
- The pond perimeter area shall be mowed a minimum of twice per year.
- Mowing shall maintain a minimum grass height of 6 to 8 inches. All undesirable
- vegetation and volunteer tree growth shall be removed, including close proximity to the • outlet structure.
- No plantings or structures of any kind are permitted within the detention pond area, without prior written approval of the Approving Agency.
- Siltation in the pond shall be dredged and disposed offsite in accordance with NR 347.
- Dredging shall be required on a frequency as described in WIDNR Wet Detention Pond Standard 1001or at a minimum when pond wet-storage depth is decreased by 2 feet or as required by the Approving Agency.
- The Owner shall maintain records of inspections.

Culverts and Storm Sewer:

- Visual inspection of components shall be performed, and debris removed from inlets and storm sewer manholes.
- Repair inlet/outlet areas that are damaged or show signs of erosion.
- Repairs must restore the component to the specifications of the original plan.

Riprap

- Riprap should be inspected after all storm events for displaced stones and erosion. All necessary repairs should be made immediately. Accumulated sediment should be removed periodically.

Grassed Swales:

- Swales should be inspected periodically during the first year of use and after all major storm events in perpetuity for possible erosion to the channel.
- Trash and other debris should be removed seasonally.
- Gabion Dams and Rock Check Dams should be inspected for evidence of bypassing.
- 2” washed stone shall be removed and replaced if accumulated biomass prevents drainage.
- Channelization, barren areas, and low spots within the channel should be repaired and reseeded.
- Accumulated biomass should be removed periodically.
- All undesirable vegetation and volunteer tree growth shall be removed.
- Mowing shall maintain a minimum grass height of 6 to 8 inches.

Earth Diversion Berm

- A 2-foot-high vegetated earth diversion berm shall be maintained at the locations shown on the approved Erosion Control and Stormwater Management Plan.
- The berm should be inspected annually and after storm events greater than 0.5 inches to ensure it is operating properly and to check for any potential problems, such as the formation of rills and gullies, bare spots, and sediment accumulation.
- Mowing should be performed during dry periods using lightweight equipment to prevent soil compaction and damage to vegetation.

Sediment Basins - Operation and Maintenance

Sediment basins shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

A. Sediment shall be removed to maintain the three-foot depth of the treatment surface area as measured from the invert of the principal outlet. Sediment may need to be removed more frequently.
B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.
C. Provisions for proper disposal of the sediment removed shall be made.
D. Maintenance shall be completed as soon as possible with consideration to site conditions.

25-year storm event

Active Quarry Sediment Sump
Prepared by Badger Engineering
HydroCAD® 10.00-26 s/n 10081 © 2020 HydroCAD Software Solutions LLC

Active 10 Acre Quarry Sump
WI-Ripon 24-hr S1 25-yr Rainfall=4.52"
Printed 12/3/2022
Page 8

Summary for Subcatchment 1S: ACTIVE QUARRY 10 ACRES

ACTIVE QUARRY VALUES BASED ON LITERATURE REVIEWS.

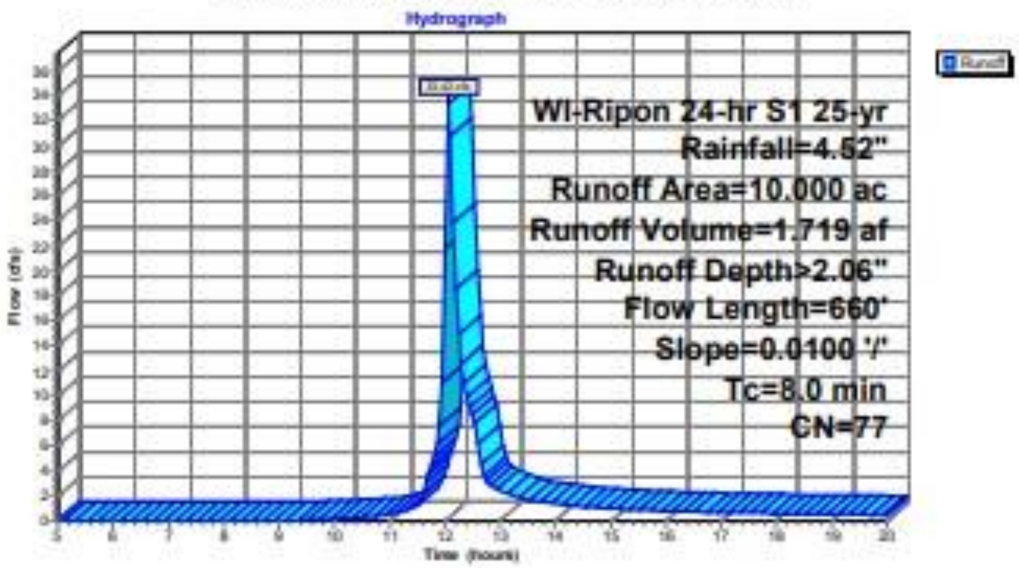
Runoff = 33.42 cfs @ 12.07 hrs, Volume= 1.719 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
WI-Ripon 24-hr S1 25-yr Rainfall=4.52"

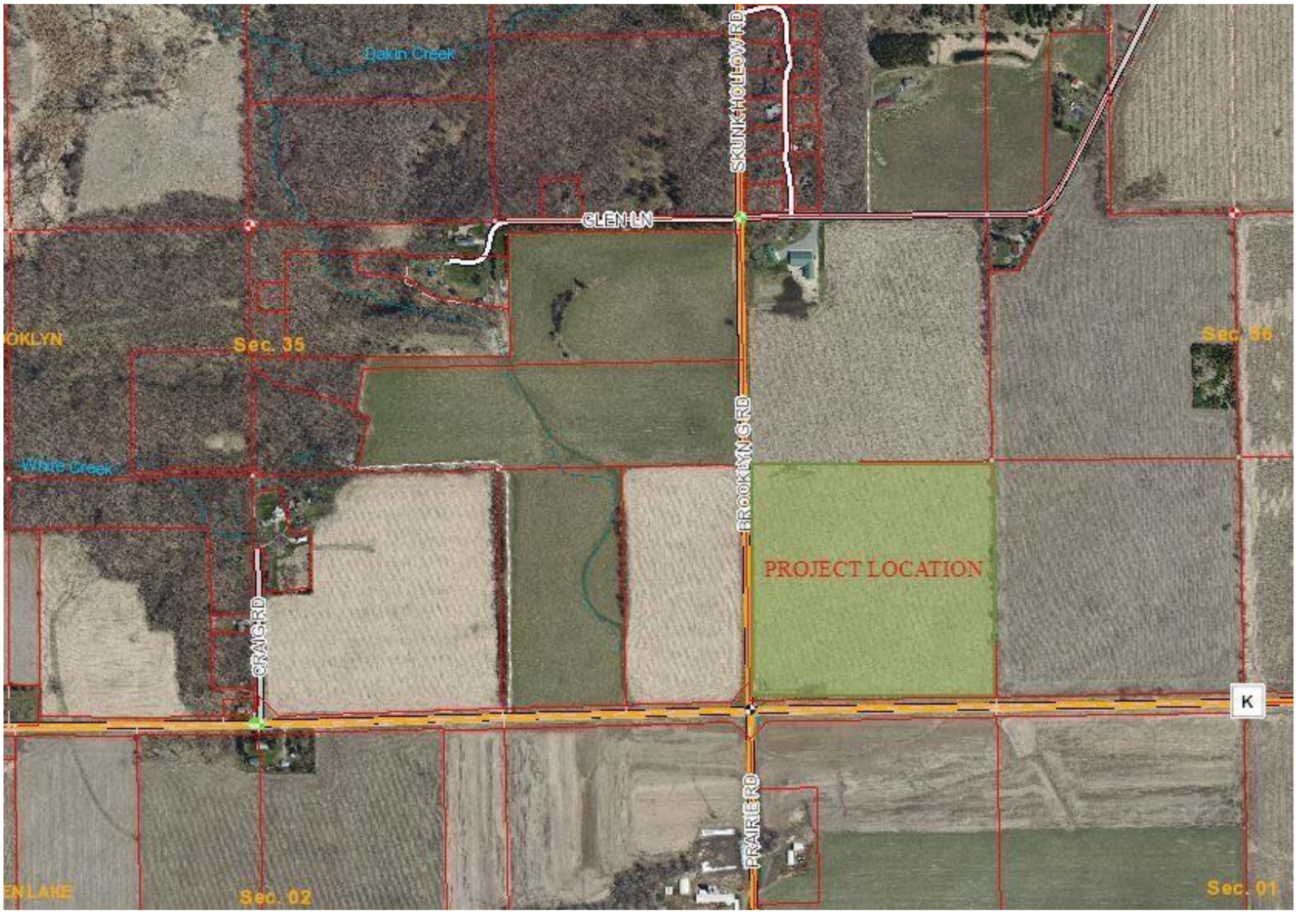
	Area (ac)	CN	Description
*	10.000	77	ACTIVE QUARRY CN BASED ON LITERATURE REVIEW
	10.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	300	0.0100	1.16		**Sheet Flow, FIRST 300'** Smooth surfaces n= 0.011 P2= 2.57"
3.7	360	0.0100	1.61		**Shallow Concentrated Flow, AFTER FIRST 300** Unpaved Kv= 16.1 fps
8.0	660	Total			

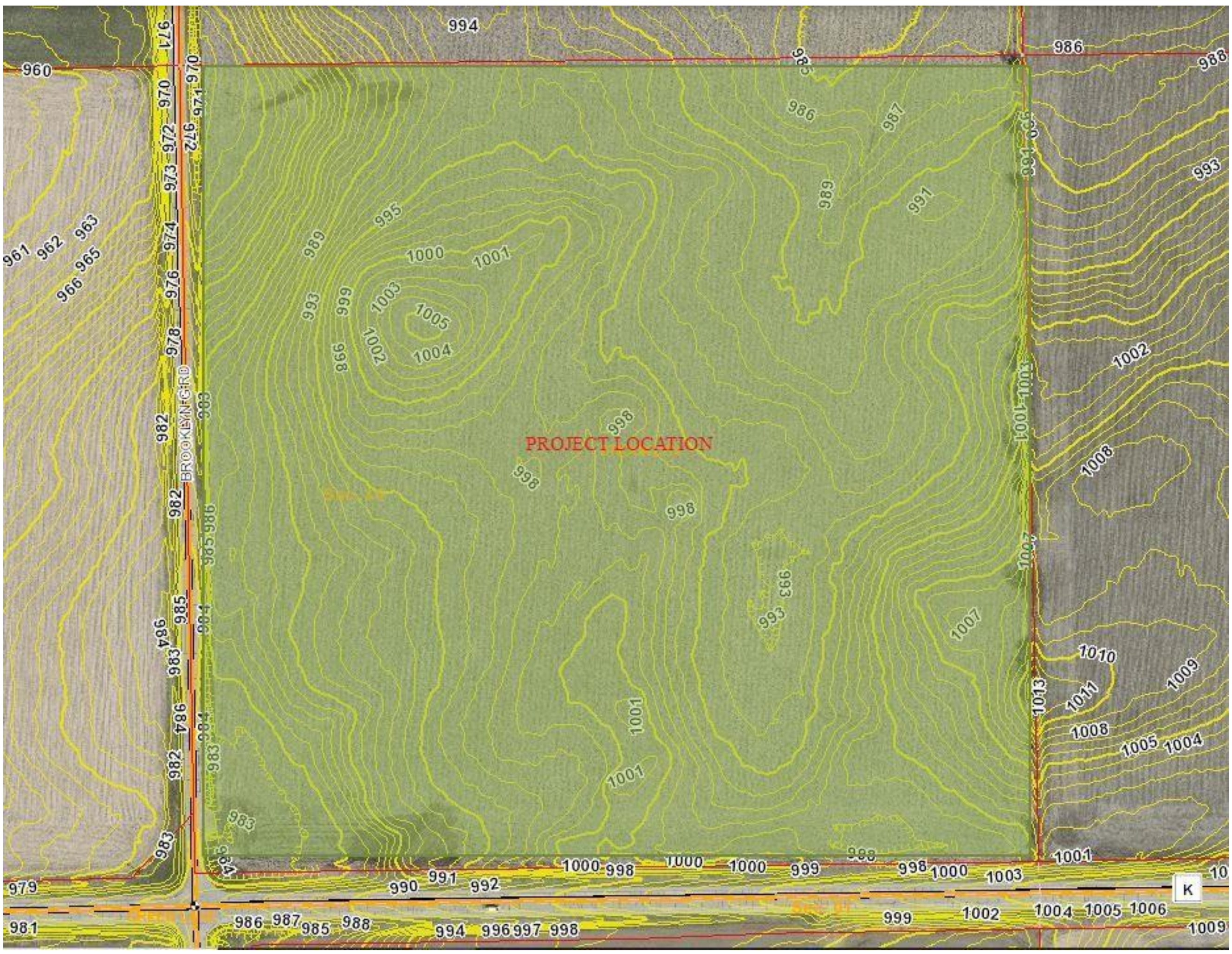
Subcatchment 1S: ACTIVE QUARRY 10 ACRES



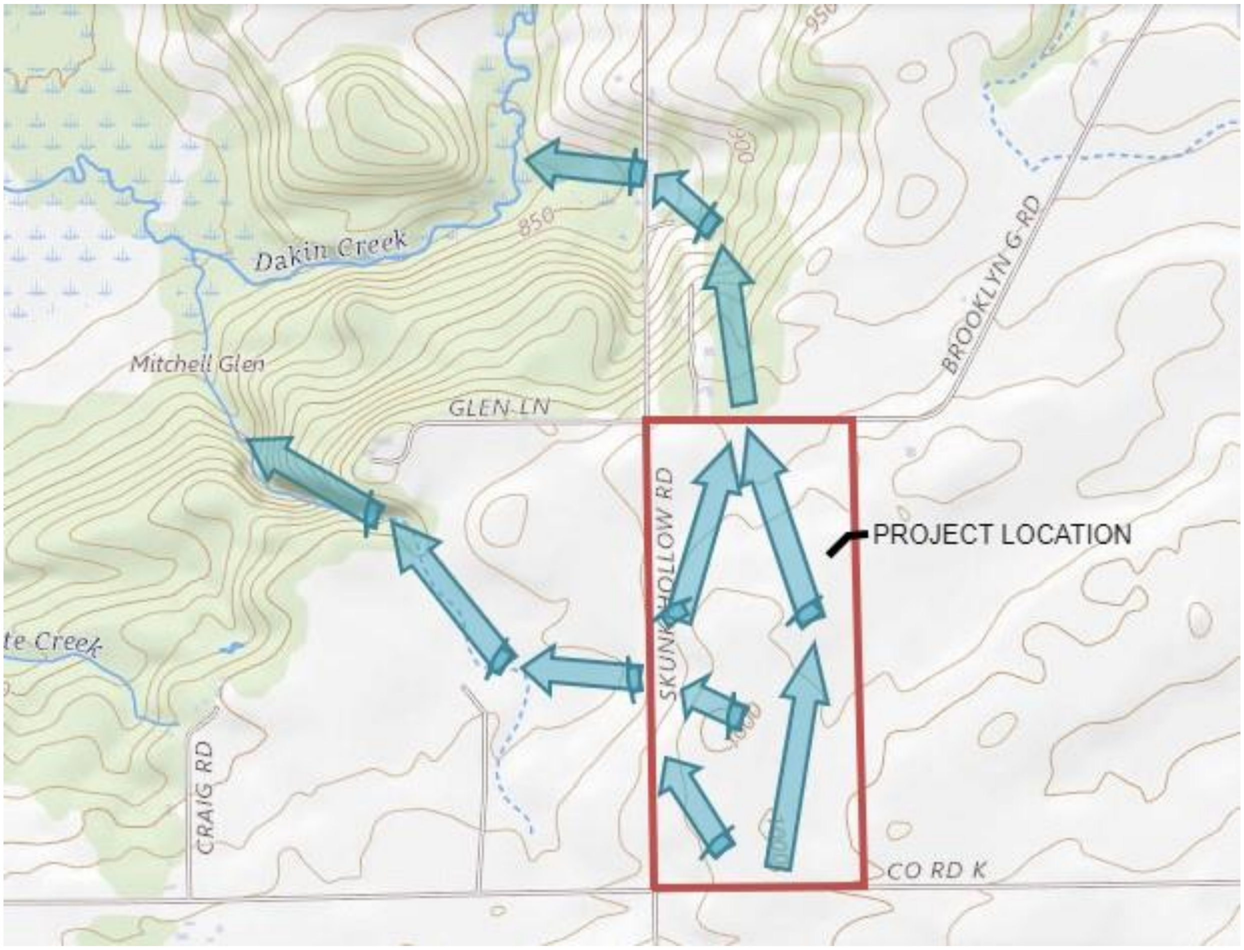
Appendix A - Maps Project Location



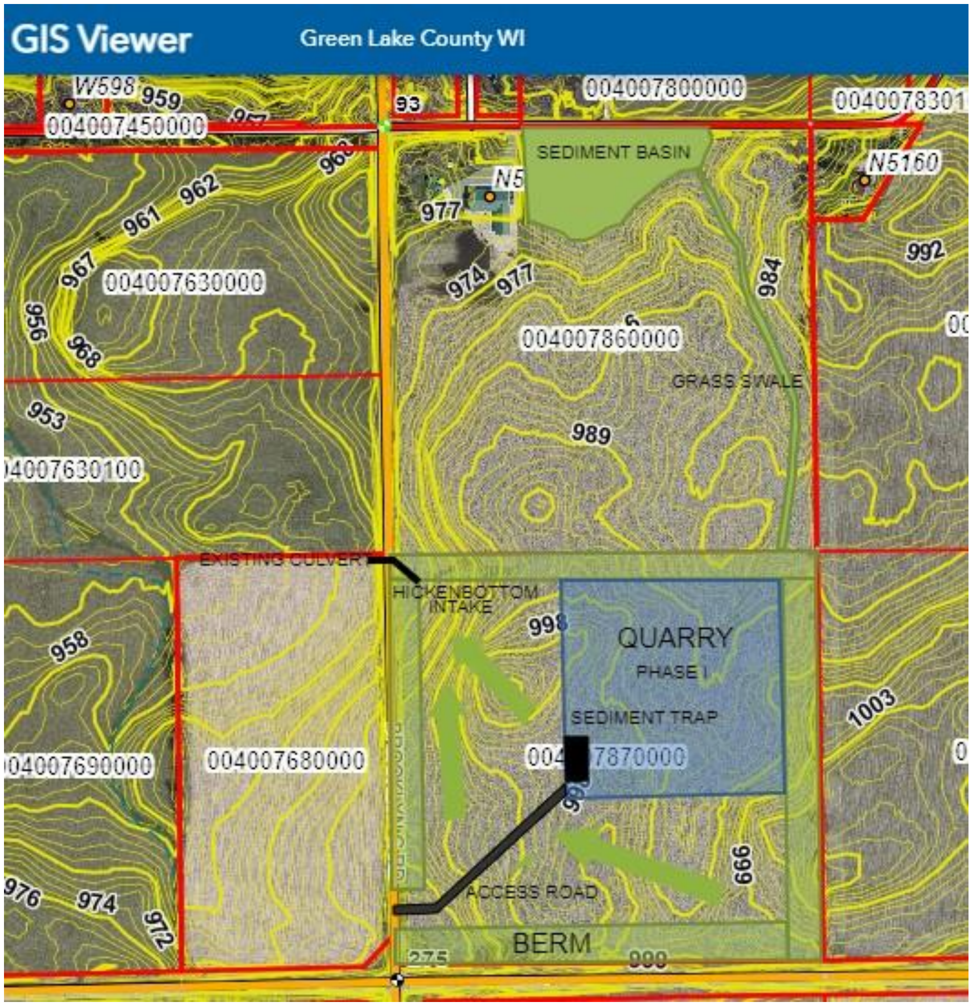
Project Topo – GLC GIS



Existing Drainage Patterns



General Development Site Map



Appendix B – Forms

Wet Detention Basin Maintenance & Inspection Checklist/Report

[Note: a separate form must be used for each BMP]

Project Name: ____________________
Project Address: ____________________
Owner's Name: ____________________
Owner's Address: ____________________
Recorded Book and Page Number of the Lot: ____________________
BMP Name and Location: ____________________
Inspection Date: ____________________
Inspector: ____________________
Inspector Address/Phone Number: ____________________
Date Last Inspected: ____________________

Maintenance Item	Satisfactory	Unsatisfactory	Inspection Frequency	Comments/Actions Required
1. Debris Clean out				
Clear of trash and debris			M	
2. Vegetation Management				
Banks / surrounding areas mowed			M	
Unwanted vegetation present			M	
Condition of wetland plants			M	
3. Erosion				
Evidence of soil erosion on banks or contributing drainage areas and outlet			M	
4. Sedimentation				
Forebay inspection (Remove sediment when 2-foot dedicated sediment storage area is full.)			M	
Pond inspection (Remove sediment when 2-foot dedicated sediment storage area is full.)			Y	
5. Energy dissipaters				
Condition of dissipater at inlets			M	
Condition of dissipater at outfall			M	
6. Inlet				
Condition of pipe and / or swale (cracks, leaks, sedimentation, woody vegetation)			M	
7. Outlet				
Condition of orifice (drawdown device)			M	
Condition of riser outlet and trash rack			M	
8. Emergency spillway and dam				
Condition of spillway			Y	
Condition of dam (i.e., leaks, holes, woody vegetation, rodent infestation)			Y	
9. Mechanical devices				
Inspect and exercise all valves and mechanical devices			Y	

10. Visual Inspection				
Appearance of water (i.e., sheen, muddy, oily, clear, algae, etc)			M	
Mosquito larvae present?			M	
11. Forebay embankment				
Condition of forebay embankment (breached?)			M	
12. Water elevation				
Is pond at normal pool elevation?			M	
13. Miscellaneous				
Maintenance responsibility sign in place and legible			M	

W=Weekly, M=Monthly, Q=Quarterly, Y=Yearly

If applicable: Attach to this form documentation of BMP maintenance escrow account activity. This may be provided in the form of a bank statement which includes the current balance, as well as deposits and withdraws for the previous 12 months.

Maintenance Actions Taken: [If any of the above items were marked "U" for unsatisfactory, explain the actions taken and timetable for correction. Attach additional pages as necessary.]

____

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Additional Comments:

____

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I do hereby certify that I conducted an inspection of the BMP described herein. I further certify that at the time of my inspection said BMP was performing properly and was in compliance with the terms and conditions of the approved maintenance agreement.

Certification:

______________________________ (Seal)

Inspectors Signature

____

Date

APPENDIX C Hydrocad Output

Summary for Subcatchment 1S: ACTIVE QUARRY 10 ACRES

ACTIVE QUARRY VALUES BASED ON LITERATURE REVIEWS.

Runoff = 33.42 cfs @ 12.07 hrs, Volume= 1.719 af, Depth> 2.06"

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	10.000		100.00% Pervious Area

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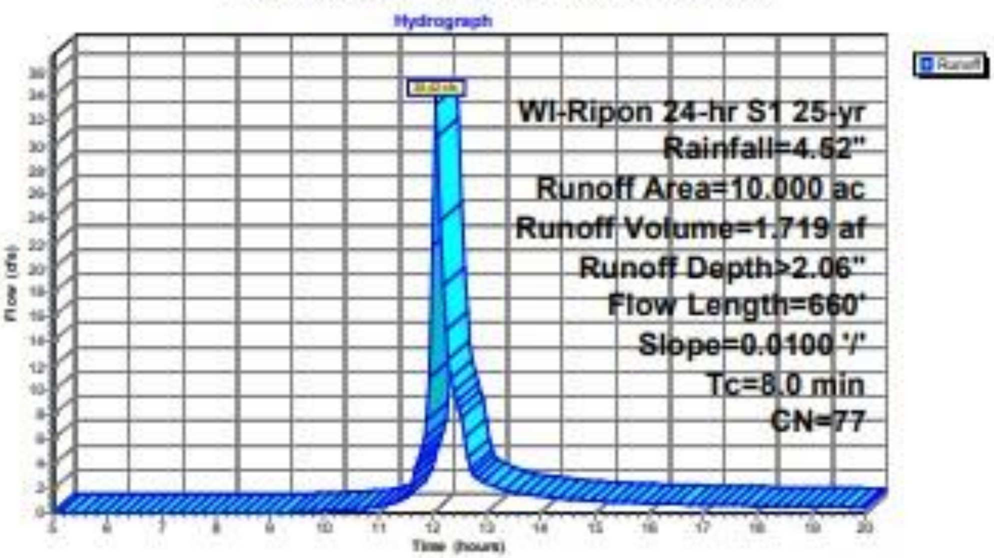
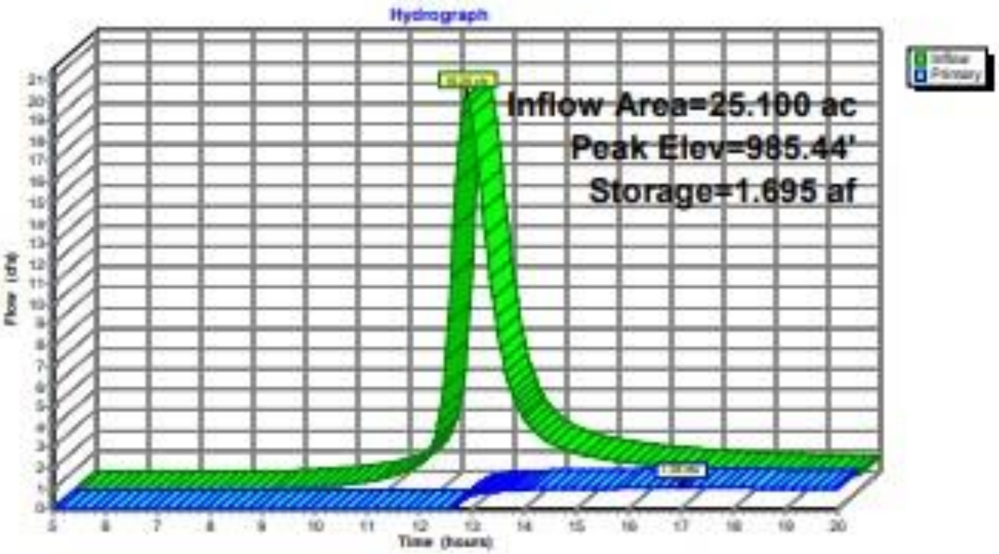
8.0	660	Total			

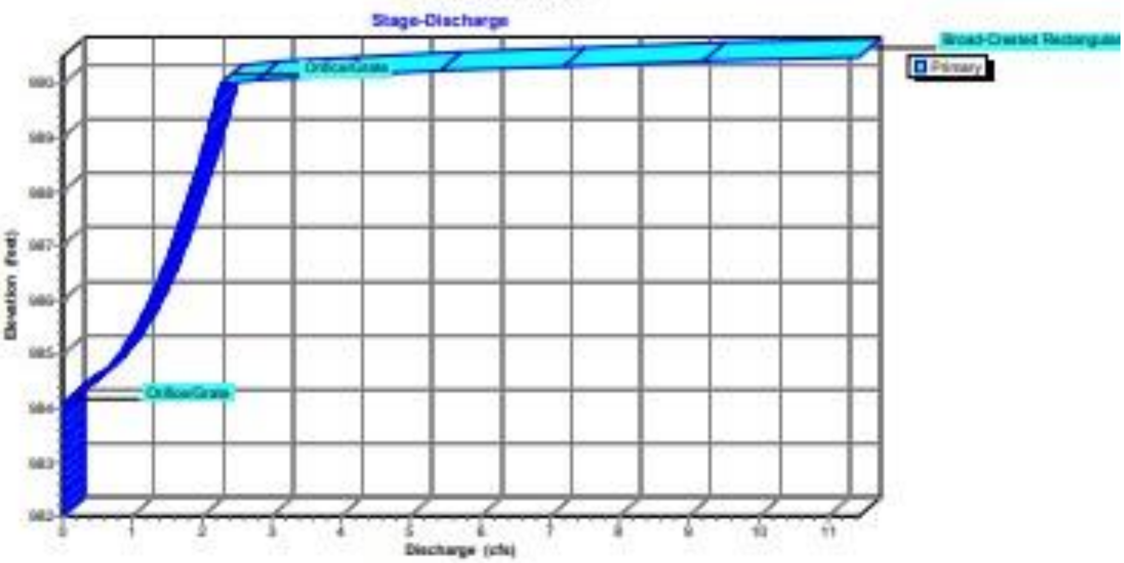
Subcatchment 1S: ACTIVE QUARRY 10 ACRES



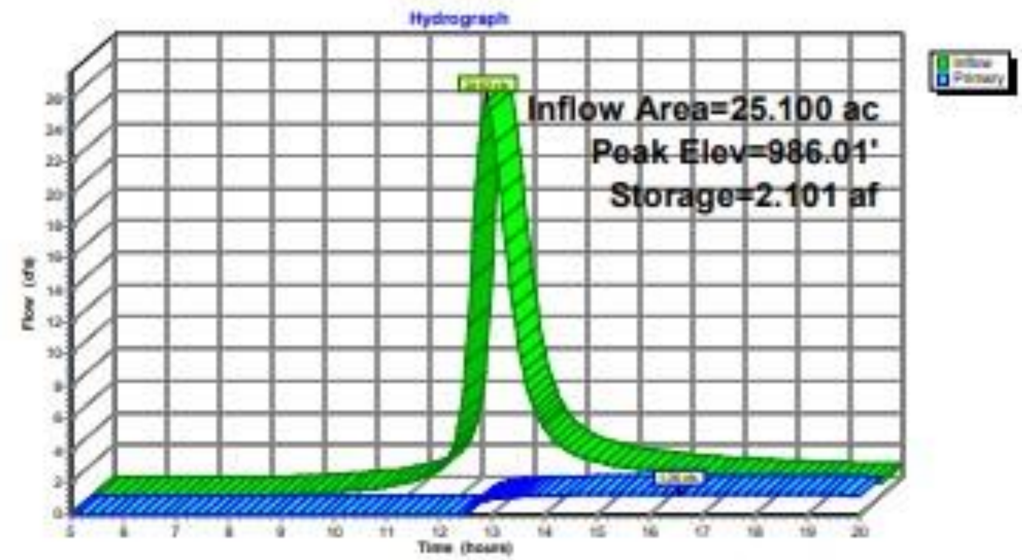
Pond 5P: POND



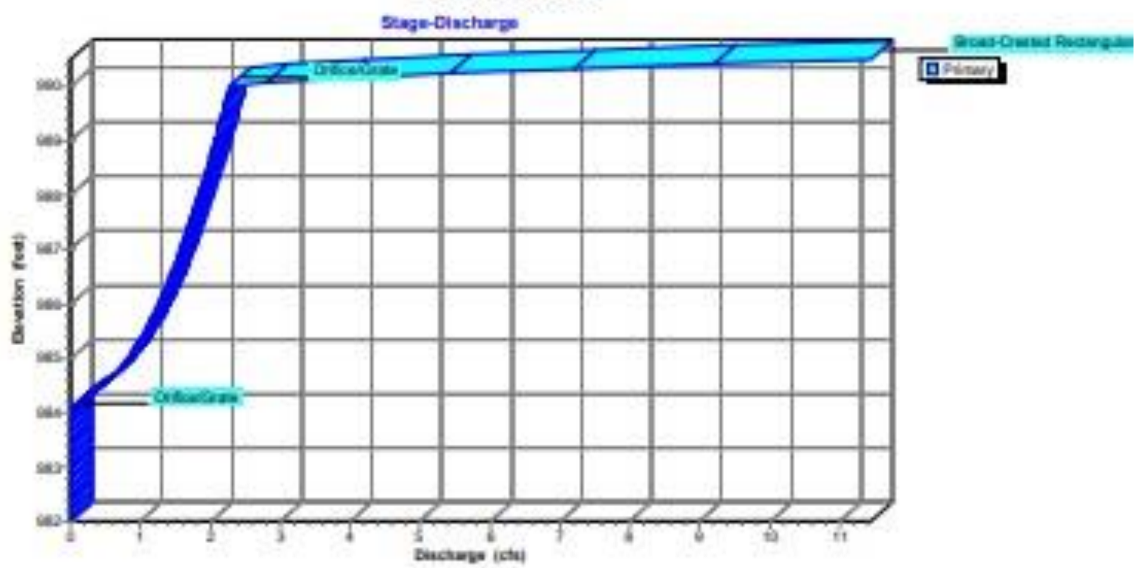
Pond 5P: POND



Pond 5P: POND



Pond 5P: POND



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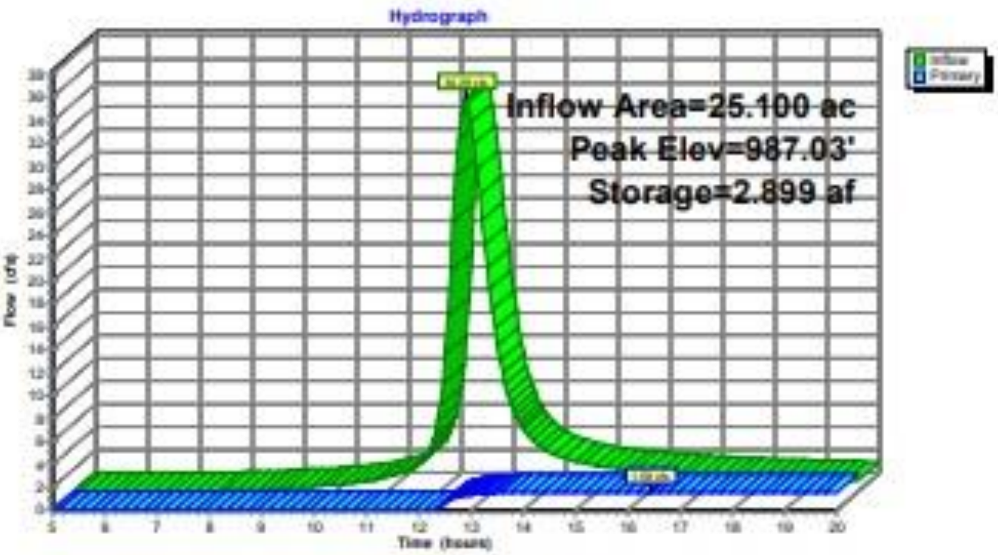

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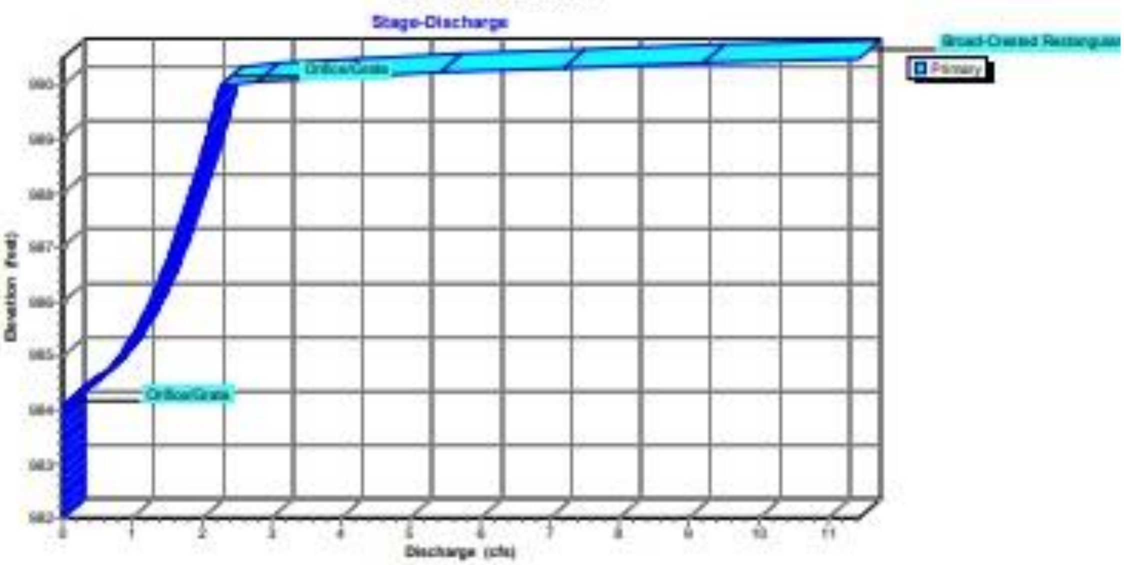
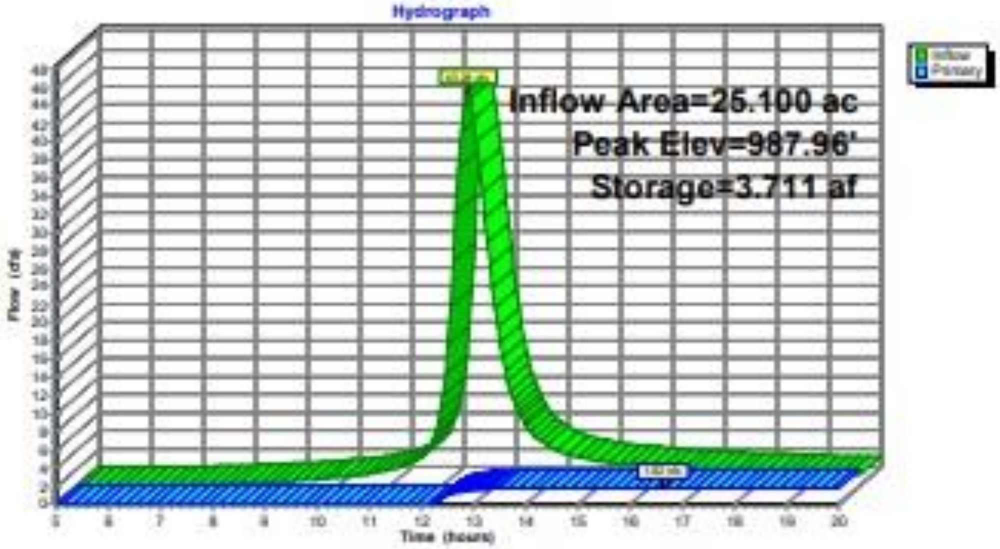
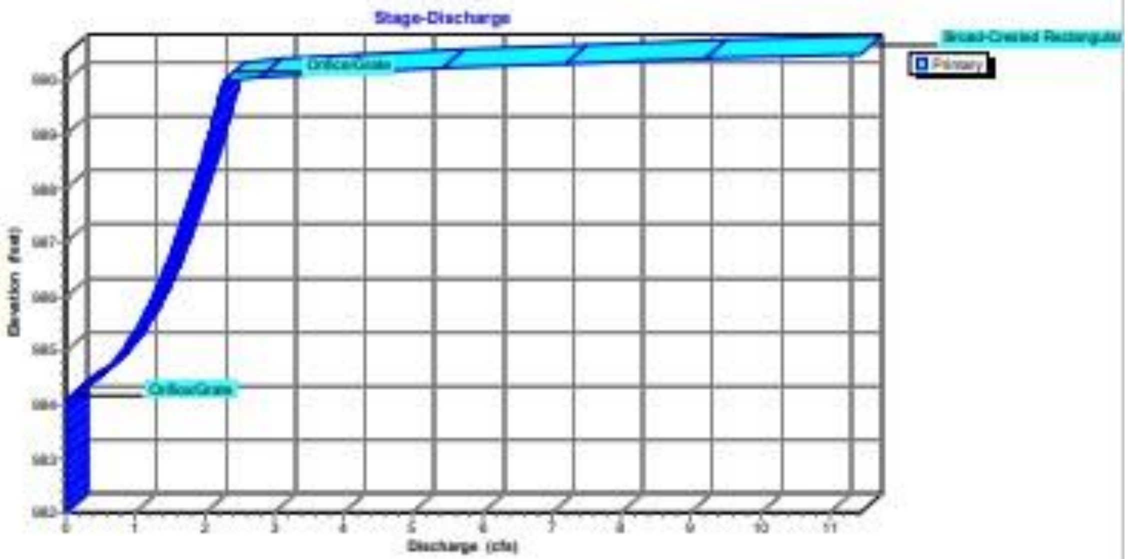
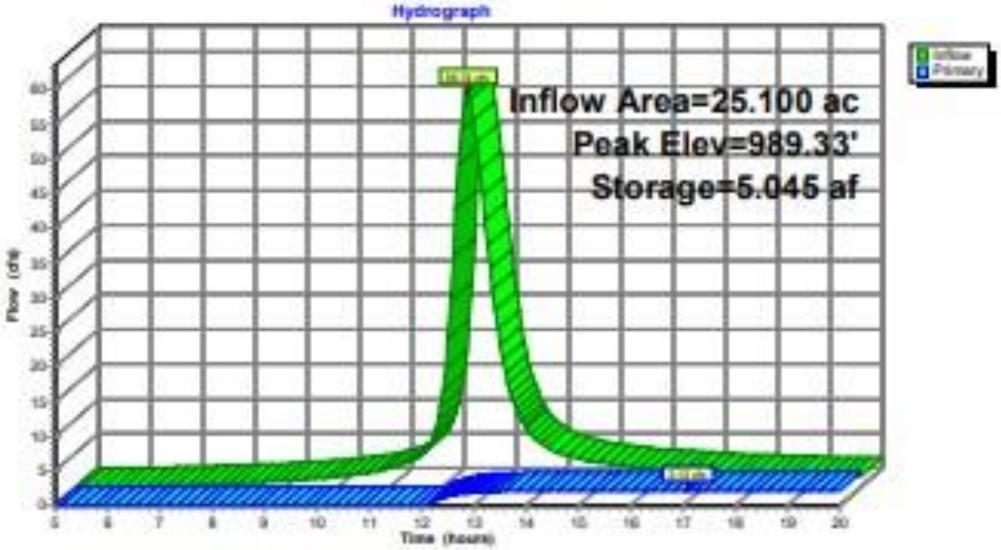


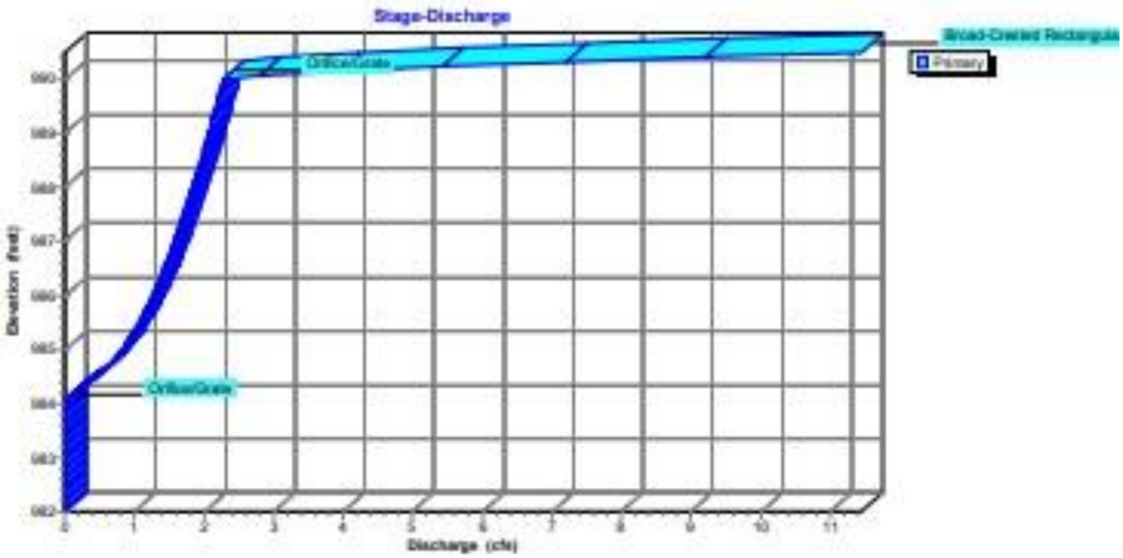
Pond 5P: POND



Pond 5P: POND

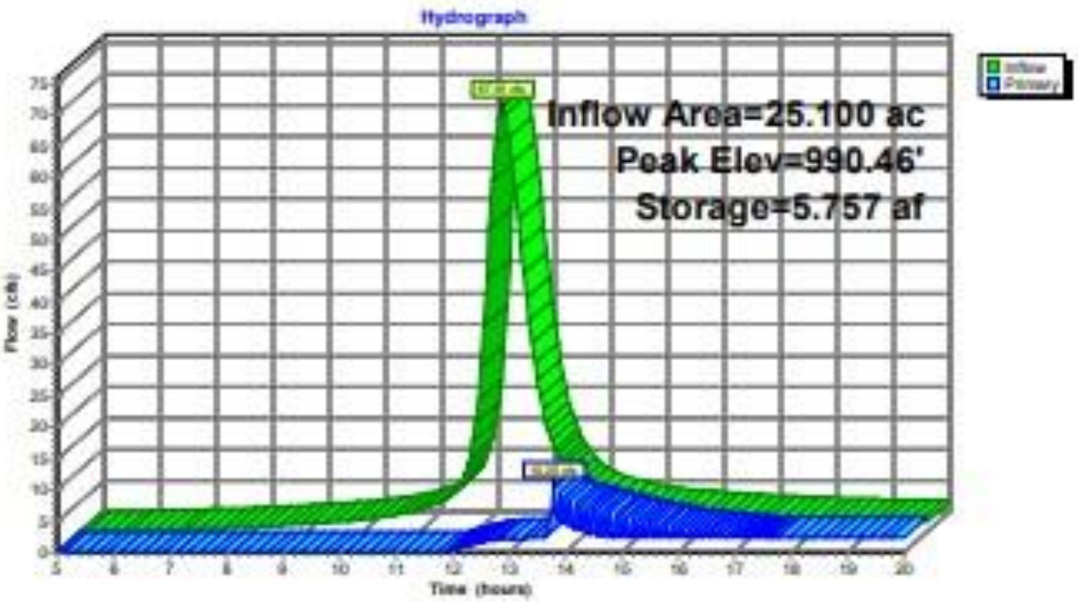



Pond 5P: POND
Hydrograph
Inflow
Primary
Inflow Area=25.100 ac
Peak Elev=989.33'
Storage=5.045 af
Flow (cfs)
Time (hours)


Pond 5P: POND
Stage-Discharge
Broad-Crested Rectangular
Primary
Orifice/Grate
Orifice/Grate
Elevation (feet)
Discharge (cfs)

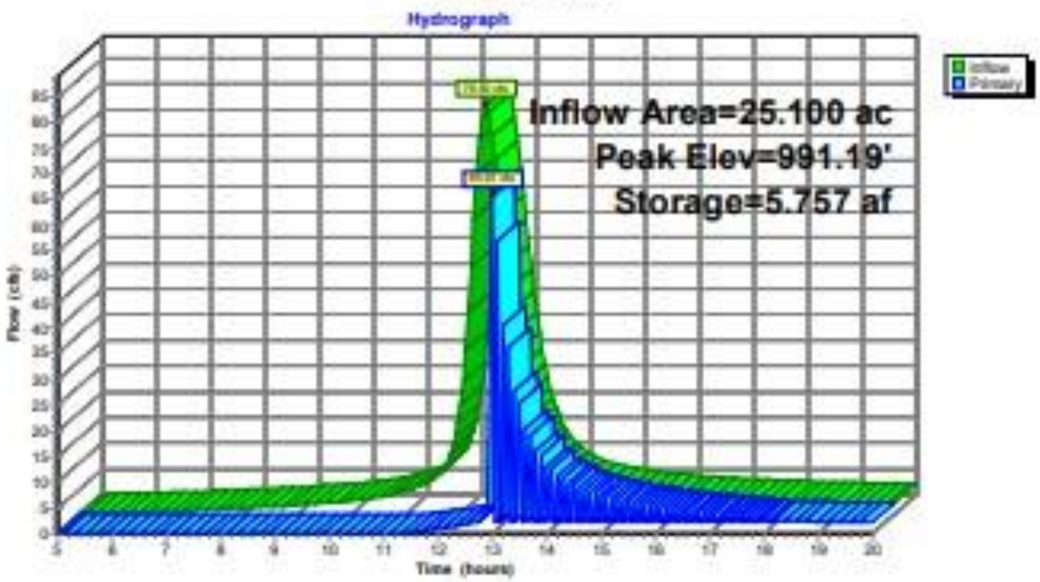
Primary OutFlow Max=9.47 cfs @ 13.81 hrs HW=990.43' (Free Discharge)
1=Culvert (Passes 9.47 cfs of 69.20 cfs potential flow)
2=Orifice/Grate (Orifice Controls 2.35 cfs @ 11.97 fps)
3=Orifice/Grate (Weir Controls 7.12 cfs @ 2.13 fps)
4=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 5P: POND



Primary OutFlow Max=63.51 cfs @ 13.00 hrs HW=991.15' (Free Discharge)
1=Culvert (Passes 27.87 cfs of 70.71 cfs potential flow)
2=Orifice/Grate (Orifice Controls 2.48 cfs @ 12.65 fps)
3=Orifice/Grate (Orifice Controls 25.39 cfs @ 5.17 fps)
4=Broad-Crested Rectangular Weir (Weir Controls 35.64 cfs @ 2.18 fps)

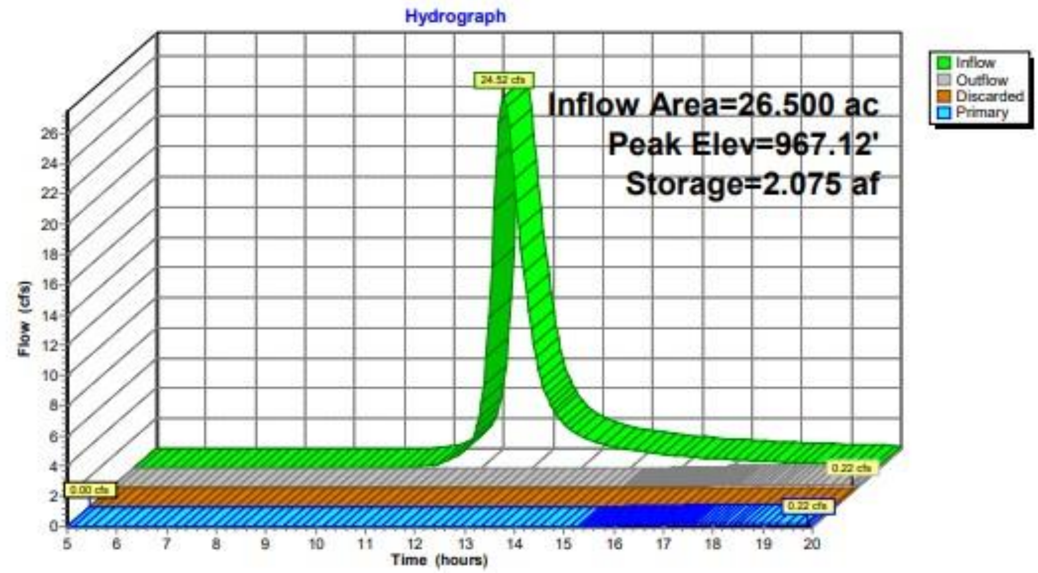
Pond 5P: POND



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=0.22 cfs @ 19.89 hrs HW=967.12' (Free Discharge)
└─**1=Culvert** (Passes 0.22 cfs of 20.09 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 0.22 cfs @ 1.15 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

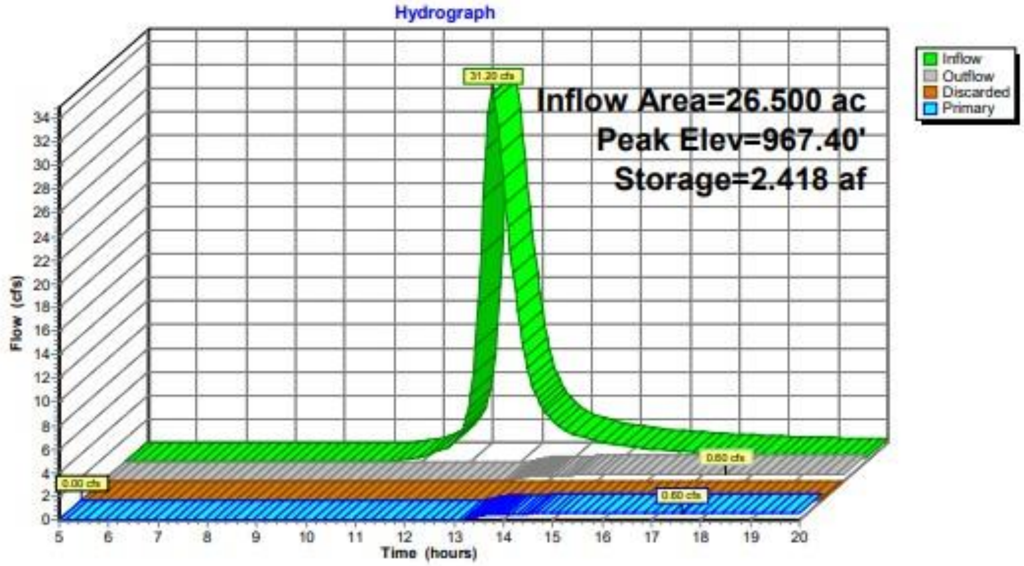
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
↑—**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=0.60 cfs @ 17.61 hrs HW=967.40' (Free Discharge)
↑—**1=Culvert** (Passes 0.60 cfs of 22.11 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.60 cfs @ 3.04 fps)
—**3=Orifice/Grate** (Controls 0.00 cfs)

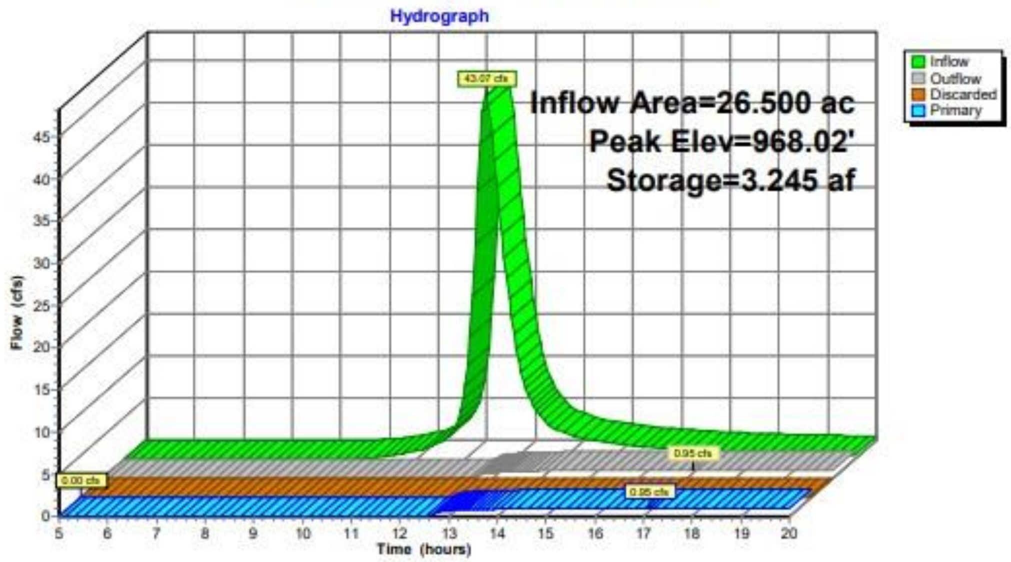
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=0.95 cfs @ 17.12 hrs HW=968.02' (Free Discharge)
└─**1=Culvert** (Passes 0.95 cfs of 26.29 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.95 cfs @ 4.86 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

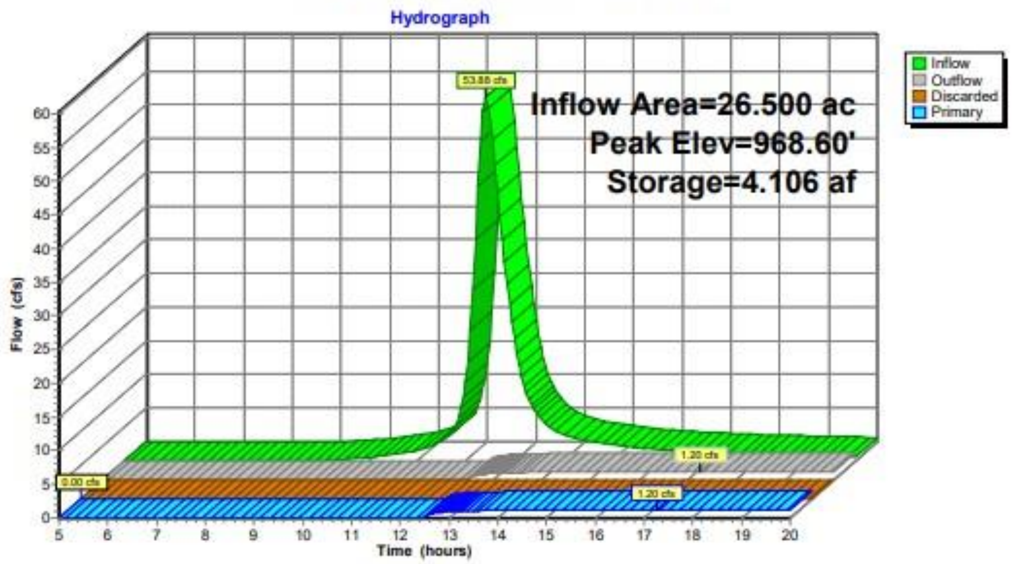
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=1.20 cfs @ 17.25 hrs HW=968.60' (Free Discharge)
└─**1=Culvert** (Passes 1.20 cfs of 31.11 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.20 cfs @ 6.09 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

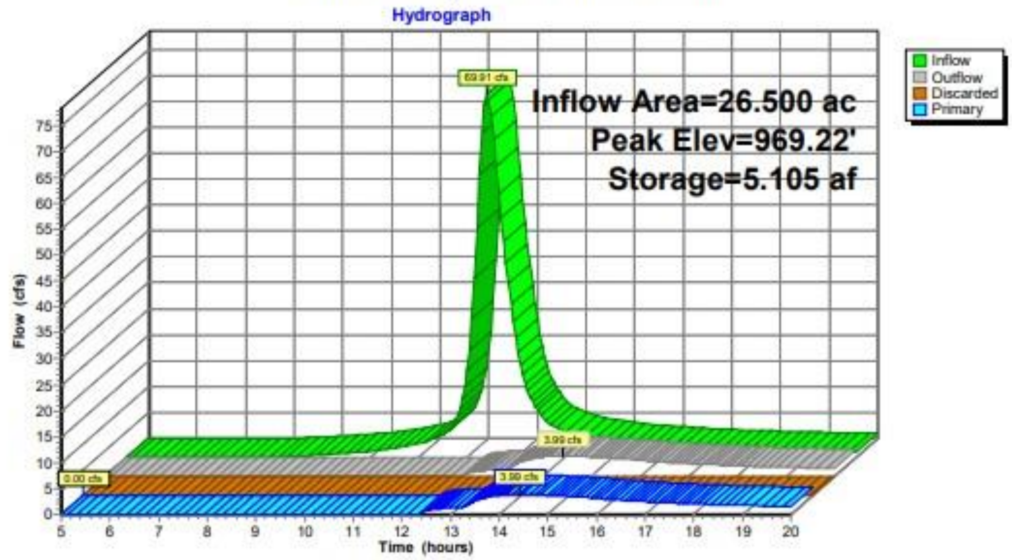
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=3.97 cfs @ 14.42 hrs HW=969.22' (Free Discharge)
└─**1=Culvert** (Passes 3.97 cfs of 35.50 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.41 cfs @ 7.17 fps)
  └─**3=Orifice/Grate** (Weir Controls 2.57 cfs @ 1.52 fps)

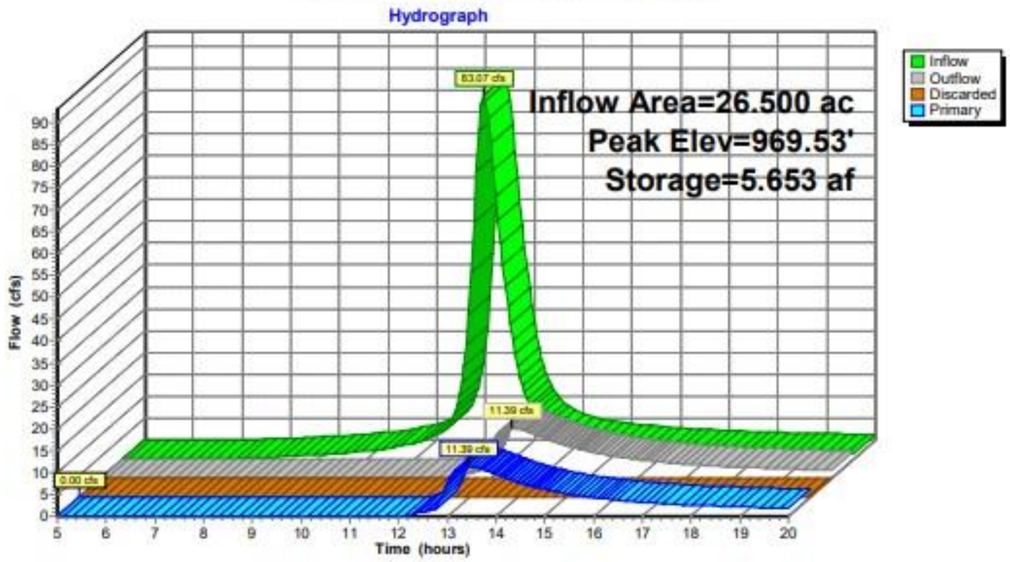
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=11.38 cfs @ 13.41 hrs HW=969.53' (Free Discharge)
└─**1=Culvert** (Passes 11.38 cfs of 37.27 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.50 cfs @ 7.66 fps)
  └─**3=Orifice/Grate** (Weir Controls 9.87 cfs @ 2.38 fps)

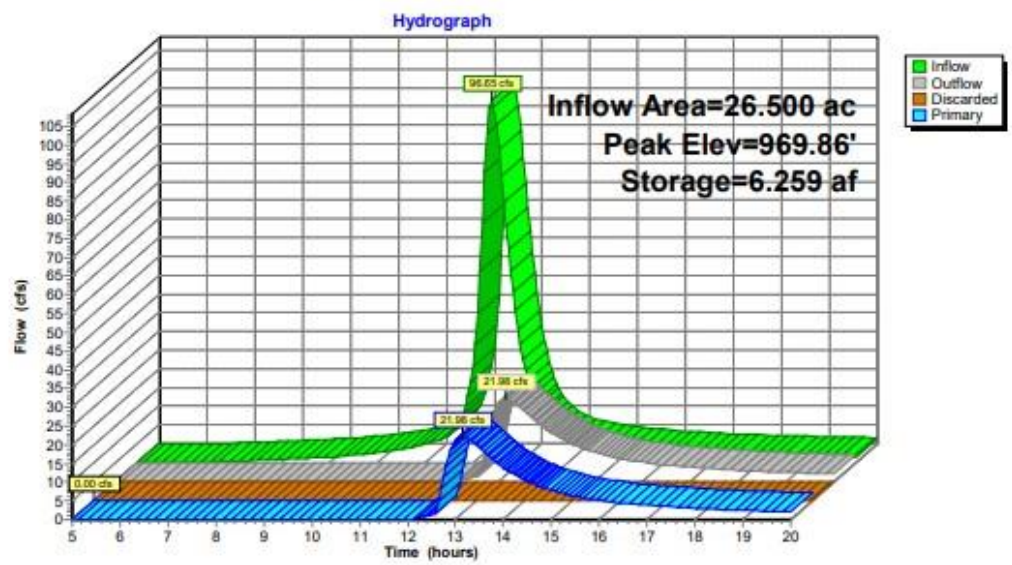
Pond 1P: Proposed Sediment Basin



Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=964.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Primary OutFlow Max=21.97 cfs @ 13.15 hrs HW=969.86' (Free Discharge)
└─**1=Culvert** (Passes 21.97 cfs of 38.77 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.60 cfs @ 8.14 fps)
  └─**3=Orifice/Grate** (Weir Controls 20.38 cfs @ 3.03 fps)

Pond 1P: Proposed Sediment Basin



APPENDIX D
WDNR Technical Standards

12

Non-Channel Erosion Mat (WDNR T.S. 1052)

DEFINITION

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Rolled products are available in many varieties and combinations of material and with varying life spans.

PURPOSE

To protect the soil surface from the erosive effect of rainfall and prevent sheet erosion during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. Applies to both Erosion Control Revegetative Mats (ECRM) and Turf-Reinforcement Mats (TRM).

CONDITIONS WHERE PRACTICE APPLIES

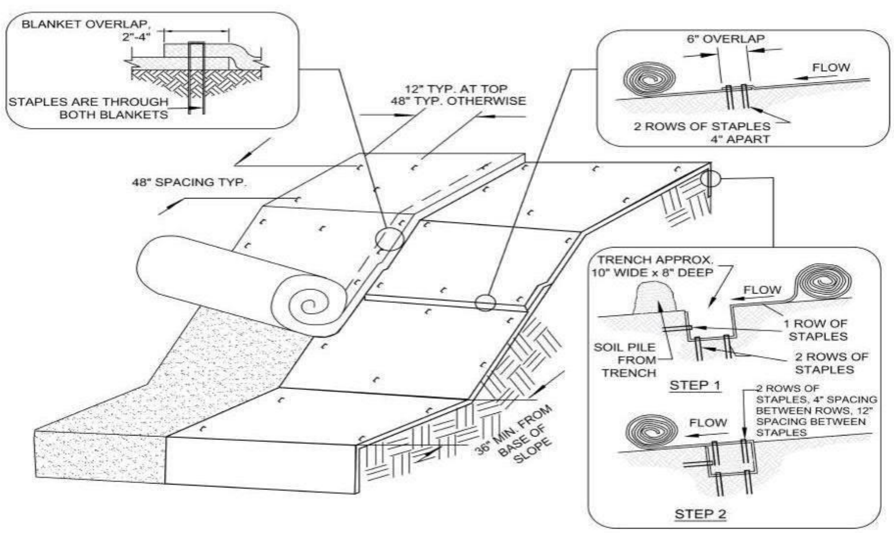
Erosion mats for use on erodible slopes. Not for channel erosion; for channel applications see WDNR T.S. Channel Erosion Mat (1053).

NON-CHANNEL EROSION CONTROL MAT INSTALLATION

- Use only products listed in the WisDOT PAL.
- Erosion mat shall be in firm and continuous contact with the soil and extend upslope one-foot from land disturbance.
- Where possible, use a single roll of EC mat to span the disturbed area.

NON-CHANNEL EROSION CONTROL MAT INSTALLATION

- Staples used for erosion mats shall be 1-2 inch wide, U-shaped, made of No.11 (3.05mm) or larger diameter steel wire, and not less than 6 inches long for firm soils and 12 inches long for loose soils.
- In areas with mowed turf or where animal entrapment is possible, use urban mats. Urban mats and associated anchoring devices shall be selected based upon the WisDOT PAL.
- Erosion mat shall be anchored, overlapped, staked and entrenched per the manufacturer's recommendations.
- This detail is an example of typical installation guidance.



INSPECTION AND MAINTENANCE

Install additional anchoring in areas of rilling and concentrated flow beneath the mat. If rilling is preventing vegetation establishment, remove erosion mat, regrade, compact, re-seed, and replace the section of mat.

14

Channel Erosion Mat (WDNR T.S. 1053)

DEFINITION

A protective soil cover of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Rolled products are available in many varieties and combination of materials and with varying life spans.

PURPOSE

To protect the channel from erosion or act as turf reinforcement during and after the establishment of grass or other vegetation in a channel. Applies to erosion control revegetative mats (ECRM) and turf-reinforcement mats (TRM).

CONDITIONS WHERE PRACTICE APPLIES

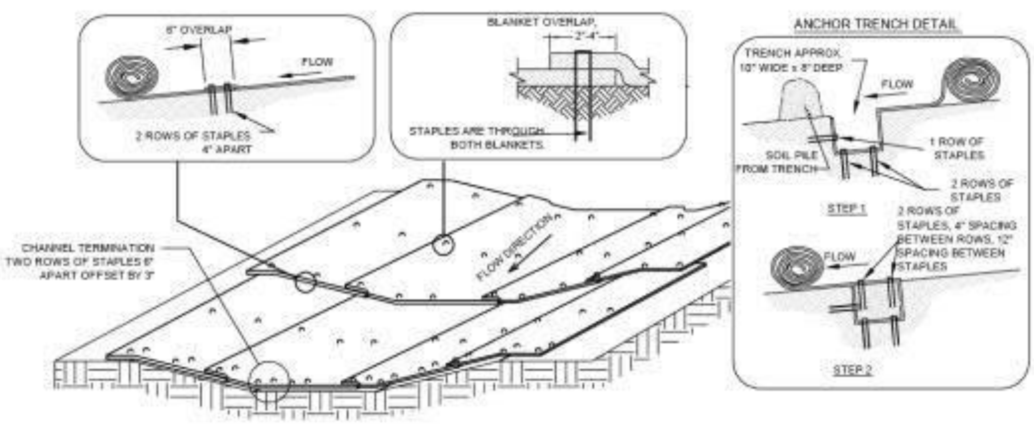
Where runoff channelizes in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable waters due to potential wildlife entrapment.

- Use channel erosion mat products identified on the WisDOT PAL.
- Use WisDOT PAL classes and types to select and specify erosion mat.
- Select an erosion mat based on the calculated shear stress, given drainage area characteristics and channel geometry for the design storm depth.
- Select erosion mat that will last until turf grass or other vegetation becomes densely established.

CHANNEL EROSION MAT INSTALLATION

- Install and anchor erosion mat in accordance with manufacturer's instructions.
- At time of installation, retain material labels and manufacturer's installation instructions until the site has been stabilized.
- Install ECRMs after topsoil is placed and seeding is complete.
- Install TRMs in conjunction with placement of topsoil, followed by ECRM installation.
- Install erosion mat so that it bears completely on the soil surface.
- Use staples that are at least 6 inches long.

- This detail is an example of typical installation guidance.



INSPECTION AND MAINTENANCE

Install additional anchoring in areas of rilling and concentrated flow beneath the mat. If rilling is preventing vegetation establishment, remove erosion mat, regrade, compact, re-seed, and replace the section of mat.

15

16

Vegetative Buffer (WDNR T.S. 1054)

DEFINITION

An area of dense vegetation intended to slow runoff and trap sediment. Vegetative buffers are commonly referred to as filter or buffer strips.

PURPOSE

To remove sediment in sheet flow by velocity reduction.

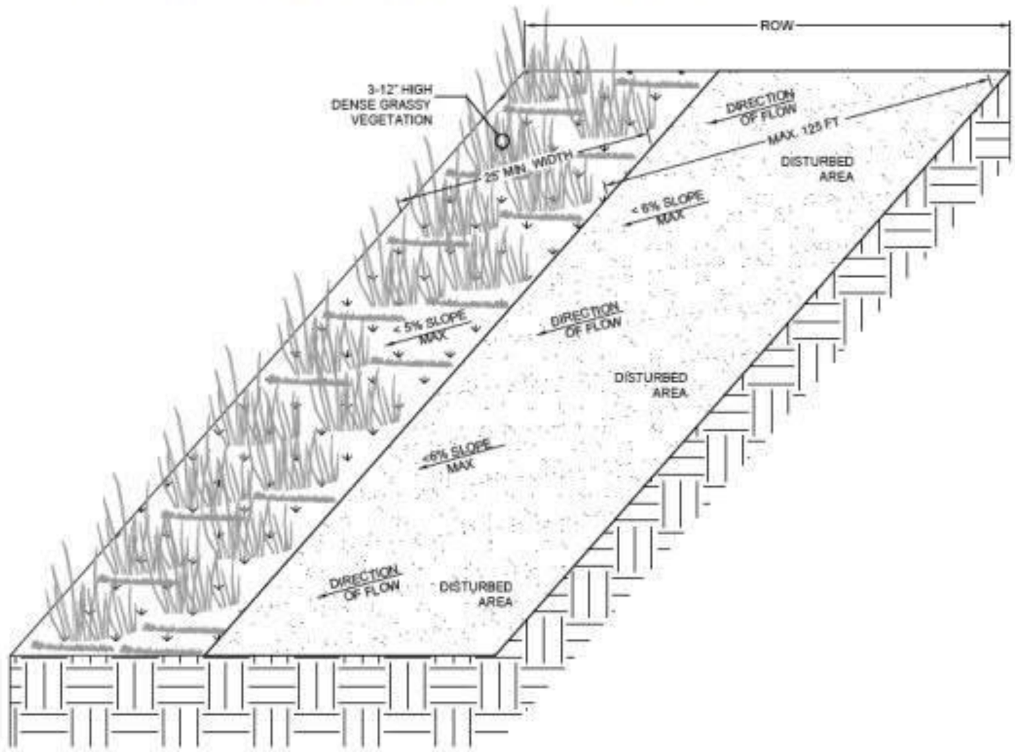
CONDITIONS WHERE PRACTICE APPLIES

Areas where sediment delivery is in the form of sheet and rill erosion from disturbed areas.

VEGETATIVE BUFFER INSTALLATION

- Shall consist of a dense stand of existing grassy vegetation or vegetation established during the project provided sufficient vegetative cover is established prior to land disturbing activities.
- Must be clearly marked as area of no disturbance, including vehicle traffic.
- Vegetative buffers are only effective if sheet flow conditions are present.

- This detail is an example of typical installation guidance.



INSPECTION AND MAINTENANCE

Look for improper distribution of flows, sediment accumulation, and rill erosion. If the vegetative buffer becomes sediment covered, shows rill erosion, or is ineffective, other practices must be implemented.

18

Sediment Bale Barrier (WDNR T.S. 1055)

DEFINITION

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales, hay bales or equivalent material used to intercept sediment-laden sheet flow from small drainage areas of disturbed soil.

PURPOSE

To reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the following applications where:

- Erosion occurs in the form of sheet and rill erosion. There is no concentration of water flowing to the barrier (channel erosion).
- Where adjacent areas need protection from sediment-laden runoff.
- Effectiveness is required for less than 3 months.
- Conditions allow for the bales to be properly entrenched and staked as outlined in Criteria Section V of WDNR T.S. Sediment Bale Barrier (1055).

Under no circumstance shall products be used in the following applications:

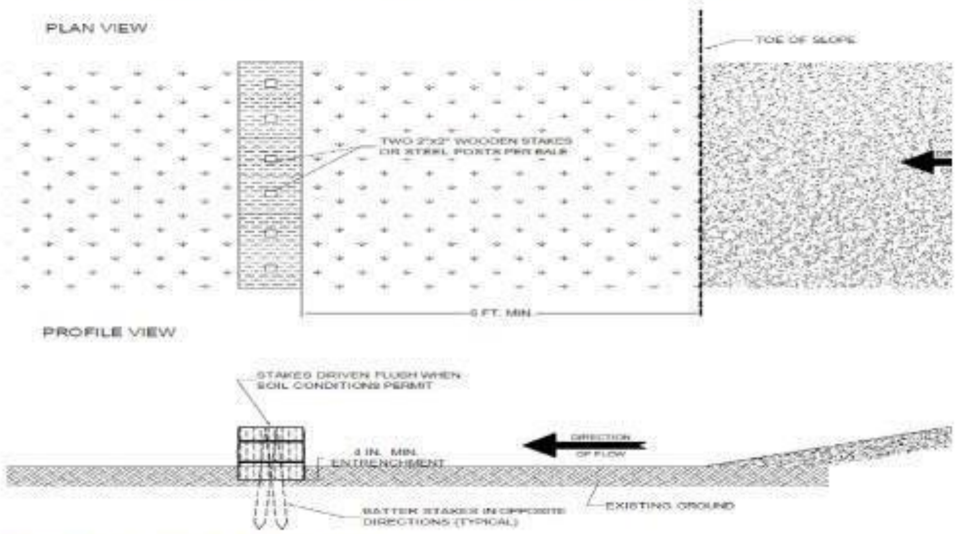
- Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
- Where the maximum gradient upslope of the fence is >50% (2:1).

SEDIMENT BALE BARRIER INSTALLATION

- Install materials per manufacturer's recommendations.
- When joints are necessary, overlap and secure to minimize potential for concentrated flow. Ends should tie into the slope to prevent erosion from concentrated flow around the ends.
- Should be used in conjunction with permanent restoration practices.
- When not used in conjunction with other practices, install spacing per:

Slope	Spacing
< 2 %	100 feet
2 - 5 %	75 feet
5 - 10 %	50 feet

- This detail is an example of typical installation guidance.



INSPECTION AND MAINTENANCE

Look for indicators that water is eroding around the ends, undercutting the barrier, or erosion is occurring downslope. Remove sediment from behind barrier when reaching 1/2 the height. Remove when permanent vegetation is established.

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Silt Fence (WDNR T.S. 1056)

DEFINITION

Silt fence is a temporary sediment barrier of entrenched permeable geotextile fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff from small areas of disturbed soil to create ponding.

PURPOSE

Reduce slope length and intercept and retain sediment from disturbed areas.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the following applications where:

- Erosion occurs in the form of sheet and rill erosion. There is no concentration of water flowing to the barrier (channel erosion).
- Where adjacent areas need protection from sediment-laden runoff.
- Where effectiveness is required for one year or less.
- Where conditions allow for silt fence to be properly entrenched and staked as outlined in Criteria Section V of WDNR T.S. Silt Fence (1056).

Under no circumstance shall products be used in the following applications:

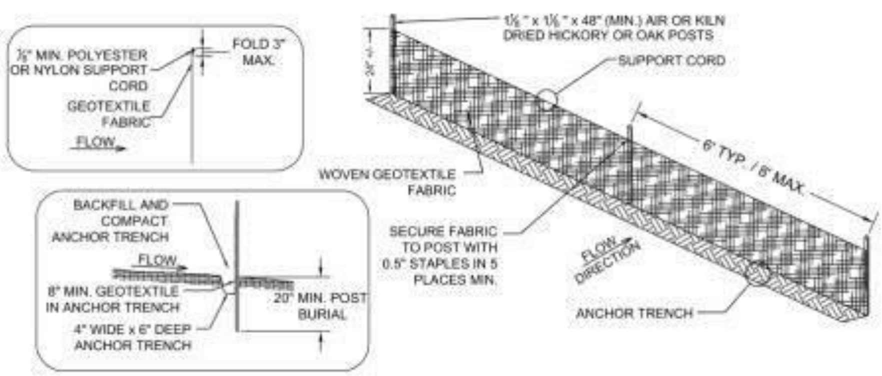
- Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
- Where the maximum gradient upslope of the fence is >50% (2:1).
- Lettering on the fence is not permissible on WisDOT projects.
- Must have support cord.

SILT FENCE INSTALLATION

- Construct in an arc with the ends pointing upslope to avoid erosion around ends of the fence. Best installation method is static slicing. Failure to properly anchor silt fence could result in water and sediment release beneath the silt fence. It is critical to backfill and compact the trench.
- Construct from a continuous roll of geotextile to avoid joints. Where joints are necessary, overlap to the next post or wrap adjoining fabrics together around the joint post and tightly fasten.
- When not used in conjunction with other practices and when using for slope interruption, install spacing per:

Slope	Fence Spacing
< 2 %	100 feet
2 - 5 %	75 feet
5 - 10 %	50 feet
10 - 33 %	25 feet
> 33 %	20 feet

- This detail is an example of typical installation guidance.



INSPECTION AND MAINTENANCE

Look for indicators that water is eroding around the ends, undercutting the barrier, or erosion downslope. Remove sediment behind silt fence when reaching 1/2 the height. Remove when permanent vegetation is established.

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Trackout Control Practices (WDNR T.S. 1057)

DEFINITION
A practice or combination of practices used to prevent, reduce, or mitigate trackout of sediment.

GENERAL CRITERIA
Trackout is best managed by implementing controls in the order below:
1. Prevent trackout with stabilized work surfaces and reduced vehicle contact with soil;
2. Reduce trackout with stone tracking pad, manufactured trackout control devices, or tire washing;
3. Mitigate trackout with street cleaning.

INSTALLATION
Stabilized Work Surfaces
- Install aggregate, concrete, asphalt, manufactured mats, or other material in work areas and haul roads to minimize contact of vehicles with exposed soils and standing water.
- Stabilized work surfaces may be used as a stand-alone practice if vehicles leaving the site are restricted to the stabilized surface and the surface is properly maintained.

Stone Tracking Pads

- Install the stone tracking pad to ensure vehicles that drive over exposed soil exit along the full length of the pad.
- Use hard, durable, angular stone or recycled concrete meeting the gradation in Table 1. Driving surface shall be at least 12 feet wide, 1 foot thick and 50 feet long.
- Where warranted due to soil type or high groundwater, underlay the stone tracking pad with geotextile fabric to minimize migration of underlying soil into the stone. Select fabric type based on soil conditions and vehicle loading.

Table 1

Sieve Size	% passing by weight
3"	100
2-1/2"	90-100
1-1/2"	25-60
3/4"	0-20
3/8"	0-5

- Rocks lodged between the tires of dual wheel vehicles shall be removed prior to leaving the construction site.

Manufactured Trackout Control Devices

- Install the manufactured trackout control device on a surface capable of supporting anticipated loads per manufacturer recommendations.
- Provide a minimum device length of 32 feet for stand-alone installations.
- Add length if needed to reduce trackout in adverse conditions.

Tire Washing

- Shall be located on site in an area that is stabilized and drains into suitable sediment trapping or settling device;
- Monitor tire washing station for sediment accumulation, clogged hoses, appropriate water levels, and effectiveness.
- For manufactured tire washing stations, operate per manufacturer's recommendations.

Street/Pavement Cleaning

- Scrape and/or sweep pavements and gutters until a shovel-clean or broom-clean condition is obtained. Repeat as needed to maintain public safety and reduce sediment delivery to drainage infrastructure or water resources, and at the end of each work day.

23

Mulch (WDNR T.S. 1058)

DEFINITION
Mulching is the application of organic material to the soil surface to protect it from raindrop impact and overland flow. Mulch covers the soil and absorbs the erosive impact of rainfall and reduces the flow velocity of runoff.

PURPOSE
To reduce soil erosion, aid in seed germination and establish plant cover or conserve soil moisture.

CONDITIONS WHERE PRACTICE APPLIES
May be applied on exposed soils as a temporary control where soil grading or landscaping has taken place or in conjunction with temporary or permanent seeding. Mulching is not appropriate in areas of concentrated flow.

ACCEPTABLE MULCH TYPES
- Straw or hay in air-dry condition, wood excelsior fiber or wood chips, or other suitable material of a similar nature that the engineer approves. Use of marsh hay will not be accepted. All mulch material shall be free of noxious weeds and objectionable foreign matter.
- Wood chips or wood bark should be used for temporary stabilization only and should not be used in conjunction with seeding.

MULCH INSTALLATION

Prepare area to remove gullies/rills. If seeding, apply prior to mulch.

Wood Chips or Bark Mulch

- Apply at uniform rate of 9 tons/acre. Mulch should cover a minimum of 80% of the soil surface with an applied thickness of 0.5 - 1.5 inches.

Straw Mulch

- Apply at a uniform rate of 2 tons/acre. Mulch should cover a minimum of 70% of the soil surface with an applied thickness of 0.5 - 1.5 inches.
- If straw mulch is used without seeding, apply at a uniform rate of 3 tons/acre. Mulch should cover a minimum of 80% of the soil surface with an applied thickness of 1.5 - 3.0 inches.
- Anchor by crimping or with a tackifier.

Straw Mulch Crimping

- Just after spreading, anchor mulch using a crimper or equivalent device consisting of a series of dull flat discs with notched edges spaced approximately 8 inches apart to impress mulch in the soil to a depth of 1 - 3 inches.

Straw Mulch Tackifiers

- Select from the approved list in the WisDOT PAL. Apply at a uniform rate.
- Spray tackifier at the same time as the mulch application or just after. Do not spray during conditions preventing proper placement of adhesive.
- Apply at manufacturer's recommended rate or at the rate per acre specified below, whichever is greater:
    - » Latex base: mix 15 gallons adhesive and a minimum of 250 pounds recycled newsprint (pulp) as tracer with 375 gallons water;
    - » Guar gum: mix 50 pounds dry adhesive and a minimum of 250 pounds recycled newsprint (pulp) as tracer with 1,300 gallons water;
    - » Other tackifiers: mix 100 pounds dry adhesive and a minimum of 250 pounds recycled newsprint (pulp) as tracer with 1,300 gallons water.

INSPECTION AND MAINTENANCE

Reapply as needed.

Seeding (WDNR T.S. 1059)

DEFINITION

Planting seed to establish temporary/permanent vegetation for erosion control.

PURPOSE

Temporary Seeding reduces runoff and erosion until permanent vegetation or other erosion control practices can be established.
Permanent Seeding permanently stabilizes areas of exposed soil.
Nurse Crop is seeded with a permanent mix to provide fast-growing cover to protect the soil surface until permanent vegetation becomes established.

CONDITIONS WHERE PRACTICE APPLIES

Areas of exposed soil where the establishment of vegetation is desired.

- Temporary seeding: disturbed areas that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 30 days and requires vegetative cover for less than one year.
- Permanent seeding: where perennial vegetative cover is needed.

SEED

- Seed shall conform to WI statutes and WI Administrative Code ch. ATCP 20 regarding noxious weed seed content and labeling.
- Use seed within one year of test date appearing on the label.
- Store seed to protect it from damage by heat, moisture, rodents. Discard and replace previously tested and accepted seed that becomes damaged.

SEEDING INSTALLATION

Seedbed Preparation

- Permanent seeding needs a seedbed of at least 4 inches of loose topsoil.
- Necessity of fertilizer application should be based on soil testing results. Prior to seeding, work the area being seeded with appropriate equipment to prepare a tilled fine, but firm, seedbed. Remove rocks, twigs, foreign materials, and dirt clods >2 inches diameter that cannot be broken down.

Sowing

- Apply uniformly over the seedbed at the correct seeding rate. Appropriate seed mixes should be lightly incorporated into the seedbed.

DOT Seed Mixture	Sowing Rate [pounds/1,000 square feet]
10	1.5
20	3
30	2
40	2
60	equivalent seeding rate of 1.5
70 and 70A	0.4
75	0.7
80	0.8
Temporary Seeding	3
Nurse Crop Seeding	0.8

- Seed when soil temperatures remain consistently above 53° F. Avoid seeding during periods where seedlings could be damaged or killed by frost (usually late September to early November).
- Dormant seed after November 1. Do not sow seeds over snow cover.

Seed Protection

- Protect seed using mulch (WDNR T.S. 1058) or erosion mat (WDNR T.S. 1052). Limit vehicle traffic in areas that have been permanently seeded.

INSPECTION AND MAINTENANCE

Inspect per permit requirements. Verify seed germination and vegetation establishment. Maintenance includes reapplying mulch and matting, irrigating, regrading, and reseeding.

Dewatering (WDNR T.S. 1061)

DEFINITION
A practice or combination of practices that are used to prevent or reduce the discharge of sediment-laden water from dewatering operations.

PURPOSE
Land-disturbing construction activity can create conditions where runoff and/or groundwater accumulates in ponds, pits, trenches or other excavations and needs to be removed by pumping or other means of dewatering. The purpose of this standard is to identify common methods which may be used to prevent or reduce the discharge of sediment-laden water from dewatering operations.

CONDITIONS WHERE PRACTICE APPLIES
This standard applies where sediment-laden water needs to be removed by pumping or other means for construction operations or maintenance activities.

Dewatering practices shall meet criteria in the WDNR T.S. Dewatering (1061) Dewatering Practice Selection Matrix.

This practice does not apply to water being discharged directly to groundwater or karst features (see NR140) or well dewatering systems (see NR 812).

CONSIDERATIONS

- Municipal storm drainage system may need cleaning prior to/after discharging to prevent scouring solids from the drainage system.
- Do not use geotextile bags when discharging to Exceptional Resource Waters, Outstanding Resource Waters, waterbodies supporting cold water communities, trout streams, or susceptible wetlands.
- Pressurized filtration is most efficient for removing fine sediments.
- Portable sediment tanks may be appropriate when other sediment trapping practices cannot be installed.
- Filtration is not an efficient treatment of water with heavy sediment loads. Use a settling tank or sand filter as pretreatment when possible.
- Practices may need to be combined to achieve intended results.

DEWATERING INSTALLATION

- Select practices based on soil texture at the dewatering site with consideration of pumping or flow rates, volumes and device effectiveness.
- WDNR T.S. Dewatering (1061) Dewatering Practice Selection Matrix illustrates acceptable dewatering options and their effective ranges.
- Practices selected that are not on the matrix must provide an equivalent level of control, with justification provided to the reviewing authority.

INSPECTION AND MAINTENANCE

- If the dewatering effluent is discolored, has an odor, an oily sheen, or other toxins are present, notify the DNR immediately:
  - **24 Hours Spills Reporting Hotline 1-800-943-0003**
- Remove sediment from devices. Properly dispose of all sediment collected.
- Document test results on a daily log and keep on site:
  - Discharge duration and specified pumping rate;
  - Observed water table at time of dewatering;
  - If used, type and amount of chemical used for pH adjustment;
  - If used, type and amount of polymer used for treatment;
  - Maintenance activities.

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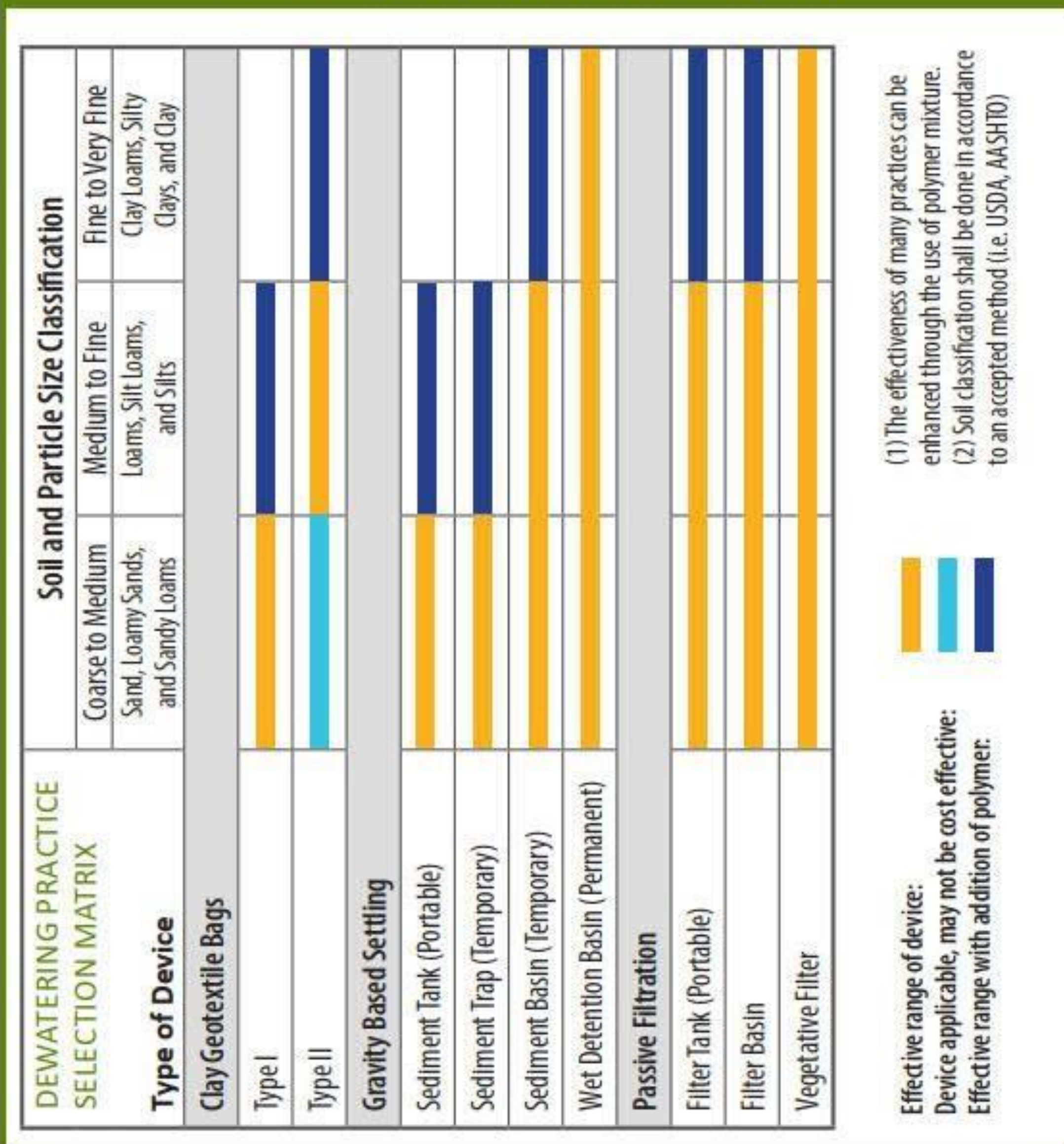
Dewatering Practice Selection Matrix



DEWATERING PRACTICE SELECTION MATRIX	Soil and Particle Size Classification		
	Coarse to Medium	Medium to Fine	Fine to Very Fine
Type of Device	Sand, Loamy Sands, and Sandy Loams	Loams, Silt Loams, and Silts	Clay Loams, Silty Clays, and Clay
Pressurized Filtration			
Portable Sand Filter			
Wound Cartridge Units			
Membranes and Micro-filtration			
Other Practices			
Sanitary Sewer Discharge			
Pump Truck			
Alternative Method	Discuss with regulatory authority.		

Effective range of device:
Device applicable, may not be cost effective:
Effective range with addition of polymer:

(1) The effectiveness of many practices can be enhanced through the use of polymer mixture.
(2) Soil classification shall be done in accordance to an accepted method (i.e. USDA, AASHTO)

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Ditch Check (WDNR T.S. 1062)

DEFINITION

A temporary dam constructed across a swale, drainage ditch, channel or other area of concentrated flow to reduce the velocity of water. Ditch checks can be constructed out of stone, a double row of straw bales or from manufactured products found on the WisDOT PAL.

PURPOSE

To reduce flow velocity and to pond water, thereby reducing active channel erosion and promoting settling of suspended solids behind the ditch check.

GENERAL CRITERIA

- Ditch checks shall have a minimum height of 10 inches after installation.
- Ditch checks shall not cause ponding that adversely impact or damage adjacent areas.
- Design and install ditch checks to be capable of withstanding anticipated flow, volume and velocity.
- Do not use silt fencing or single rows of straw bales as ditch checks.
- Under no circumstance shall ditch checks be placed in intermittent or perennial stream without permission from WDNR. This practice may not be substituted for sediment control measures such as sediment basins.
- Do not use steel posts or rods to stake ditch checks to avoid safety hazards.

DESIGN CRITERIA

Use the following equation to calculate ditch check spacing in channels:

$$L = H / S$$

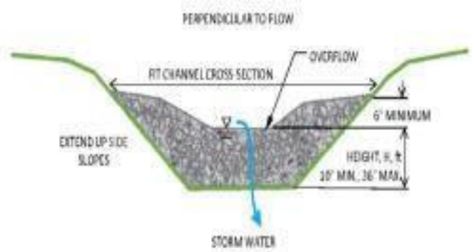
Where:

- **L** = distance between ditch checks, in feet
- **H** = height of the ditch check measured from the ditch check overflow invert to the channel bottom on the downslope side of the ditch check, in feet.
- **S** = longitudinal slope of the channel in decimal form (e.g. 2% = 0.02)

MANUFACTURED DITCH CHECKS

- Use products identified on the WisDOT PAL
- Shall be installed in accordance with manufacturer's recommendations
- Entrench manufactured products at least 2 inches or install over erosion matting

STONE DITCH CHECKS



Shall have a minimum top width of 2-ft with a maximum slope of 2:1 on the upslope and downslope sides. Stone shall meet any of the following criteria:

1. Well-graded angular stone with a D_{50} of 3 inches or greater with no more than 5% passing the #4 sieve.
2. 1-foot layer of 1-inch (#2) washed stone over 3 to 6-inch clear stone.
3. Angular stone meeting the gradation for WisDOT Specification 312 select crush or local equivalent.

Stone ditch checks may be constructed using bags or socks filled with stone.

INSPECTION AND MAINTENANCE

Look for indicators that water is eroding around the ends, undercutting, or erosion is occurring downslope. Remove sediment from behind ditch check when reaching 1/2 the height. Remove when channel permanent vegetation is established, unless part of a permanent plan.

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Sediment Trap (WDNR T.S. 1063)

DEFINITION

A temporary sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and to retain the sediment.

PURPOSE

To detain sediment-laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

CONDITIONS WHERE PRACTICE APPLIES

- Areas of concentrated flow or points of discharge during construction activities. Construct sediment traps at locations accessible for clean out.
- Sediment traps are designed to be in place until the contributory drainage area has been stabilized.
- The contributory drainage area shall be a maximum of five acres. For concentrated flow areas smaller than one acre, ditch checks may be installed; refer to WDNR T.S. Ditch Check (1062).
- For larger drainage areas and/or for sediment basins requiring an engineered outlet structure refer to WDNR T.S. Sediment Basin (1064) or Wet Detention Basin (1001).

SEDIMENT TRAP CRITERIA

Timing

- Constructed prior to disturbance of up-slope areas and placed so they function during all phases of construction and in locations where runoff from disturbed areas can be diverted into the traps.
- Remove and stabilize the sediment trap after the disturbed area draining to sediment trap is stabilized.

Sizing Criteria

- Properly sized sediment traps are relatively effective at trapping medium and coarse-grained particles.
- To effectively trap fine-grained particles, the sediment trap must employ a large surface area or polymers.
- See WDNR T.S. Sediment Trap (1063) for specific design criteria. Based on:
  - » Surface area;
  - » Depth;
  - » Shape;
  - » Side slopes.

Embankments

- Not to exceed five feet in height measured from the downstream toe of the embankment to the top of the embankment. Construct with a minimum top width of four feet, and side slopes of 2:1 or flatter.
- Earthen embankments shall be compacted.
- Where sediment traps are employed as a perimeter control, the embankments shall have stabilization practices in place prior to receiving runoff.

Outlet

- Need both a principal outlet and emergency spillway and shall meet WDNR T.S. Sediment Trap (1063) design criteria.

INSPECTION AND MAINTENANCE

Remove and properly dispose of sediment deposits when it accumulates to a depth of one foot. Clean outlet when clogged.

Sediment Basin (WDNR T.S. 1064)

DEFINITION

A temporary or permanent device constructed with an engineered outlet, formed by excavation or embankment to intercept sediment-laden runoff and retain sediment.

PURPOSE

Detain sediment-laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

CONDITIONS WHERE PRACTICE APPLIES

- Utilize in areas of concentrated flow or points of discharge during construction activities. Construct at locations accessible for clean out.
- Site conditions must allow for runoff to be directed into the basin.
- Sediment basins are designed to be in place until the contributory drainage area has been stabilized. Temporary sediment basins serve drainage areas <100 acres (other practices are often more economical).
- For drainage areas <5 acres, sediment traps or ditch checks may be applicable; for design criteria refer to WDNR T.S. Sediment Trap (1063) or Ditch Check (1062). Design to WDNR T.S. Wet Detention Basin (1001) when a permanent stormwater basin is required.
- Minimum standards for design, installation and performance requirements are deemed 80% effective by design in trapping sediment.

SEDIMENT BASIN CRITERIA

Timing

- Construct prior to disturbance and place to function during all phases of construction, and in locations where runoff can be diverted into the basin.

Sizing Criteria

- Specific trapping efficiency varies based on the surface area and the particle size distribution of the sediment entering the device.
- Permanent sediment basins must be designed by an engineer.
- See WDNR T.S. Sediment Basin (1064) for specific design criteria. Based on:
  - » Treatment surface area and depth below treatment surface area;
  - » Active storage volume and shape.

Embankments

- Design earthen embankments to address potential risk and structural integrity issues such as seepage and saturation, and meet WDNR T.S. Sediment Basin (1064) design criteria.

Outlet

- Need both a principal outlet and an overflow spillway meeting WDNR T.S. Sediment Basin (1064) design criteria.

Inlet Protection

- Designed to prevent scour and reduce velocities during peak flows.
- Possible design options include flow diffusion, plunge pools, directional berms, baffles, or other energy dissipation structures.

Location

- Located to provide access for cleanout and disposal of trapped sediment.

Removal

- After the contributing drainage area has been stabilized, if temporary.
- Complete final grading and restoration according to the site plans. If standing water needs to be removed see WDNR T.S. Dewatering (1061).

INSPECTION AND MAINTENANCE

Remove and properly dispose of sediment to maintain three foot depth of the treatment surface area. Clean outlet when clogged.

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Construction Site Diversion (WDNR T.S. 1066)

DEFINITION

A temporary berm or channel constructed across a slope to collect and divert runoff.

PURPOSE

To intercept, divert, and safely convey runoff at construction sites in order to divert clean water away from disturbed areas, or redirect sediment laden waters to an appropriate sediment control facility.

CONDITIONS WHERE PRACTICE APPLIES

- Where temporary surface water runoff control or management is needed.
- Locations and conditions include:
  - » Above disturbed areas, to limit runoff onto the site;
  - » Across slopes to reduce slope length;
  - » Below slopes to divert excess runoff to stabilized outlets;
  - » To divert sediment-laden water to sediment control facilities;
  - » At or near the perimeter of the construction area to keep sediment from leaving the site.
- Does not pertain to permanent diversions. Refer to appropriate design criteria and local regulations when designing permanent diversions.

CONSTRUCTION SITE DIVERSION INSTALLATION

- Shall have stable side slopes and shall not be overtopped during a 2-year frequency, 24-hour duration storm.
- The minimum berm cross section shall be as follows:
  - » Side slopes of 2:1 (horizontal:vertical) or flatter;
  - » Top width of two feet;
  - » Berm height of 1.5 feet.
- Sediment-laden runoff from disturbed areas shall be diverted into a sediment control practice. For typical sediment control practices see WDNR T.S. Sediment Trap (1063) or Sediment Basin (1065) for design criteria.
- When diverting clean water, the diversion channel and its outfall shall be immediately stabilized for the 2-year frequency, 24-hour duration storm.
- Build and stabilize clean water diversions before initiating down slope land-disturbing activities.
- Diversions shall be protected from damage by construction activities.
- At all points where diversion berms or channels will be crossed by construction equipment, the diversion shall be stabilized or shaped appropriately.
- Temporary culverts of adequate capacity may be used.
- For diversions that are to serve longer than 30 days, the side slopes including the ridge, and down slope side of the diversion shall be stabilized as soon as they are constructed.
- For diversions serving less than 30 days, the down slope side of the diversion shall be stabilized as soon as constructed.
- The diversion channel should be stabilized (i.e. erosion mat) or an additive sediment control practice, such as ditch checks, shall be installed.

INSPECTION AND MAINTENANCE

Remove sediment from behind diversion berm when reaching 1/2 the height.

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Grading Practices for Erosion Ctrl. (WDNR T.S. 1067)

DEFINITION
Temporary grading practices used to minimize construction site erosion. These practices include, but are not limited to surface roughening (directional tracking and tillage) and temporary ditch sumps.

PURPOSE
To minimize erosion and sediment transport during grading operations on construction sites.

CONDITIONS WHERE PRACTICE APPLIES
Where land disturbing activities occur on construction sites, to be used in conjunction with other erosion control practices.

TEMPORARY GRADING PRACTICES INSTALLATION

- These interim practices may be employed in addition to the approved grading plan to reduce erosion and sediment transport.

Surface Roughening

- Abrading the soil surface with horizontal ridges and depressions across the slope to reduce runoff velocities.
  - » Directional tracking: the process of creating ridges with tracked vehicles by driving up and down unvegetated slopes, used for short durations on sites actively being graded. Use in conjunction with other practices, and place at the end of each workday;
  - » Tillage: utilizing conventional tillage equipment to create a series of ridges and furrows on the contour no more than 15 inches apart.

Temporary Ditch Sump

- » Temporary ditch sumps are ½ to 5 cubic yard excavations made in a drainageway during earthmoving operations. Their purpose is to slow and pond runoff during the time that drainageways are being graded;
- » Place sumps prior to anticipated rain events;
- » Construction involves excavating sumps in the rough ditch grade, and using the excavated material to form a dike on the downstream side of the sump;
- » Temporary ditch sumps are not effective perimeter controls. Utilize other sediment control practices prior to channels discharging into public waterways.

INSPECTION AND MAINTENANCE

Inspect and repair/reinstall after every runoff event.

Dust Control (WDNR T.S. 1068)

DEFINITION

Dust control includes practices used to reduce or prevent the surface and air transport of dust during construction. Includes minimization of soil disturbance, applying mulch and establishing vegetation, water spraying, surface roughening, applying polymers, spray-on tackifiers, chlorides, and barriers.

PURPOSE

- Reduce wind erosion and dust.
- Minimize deposition of dust and wind transported soils into water bodies through runoff or wind action.
- Reduce respiratory problems.
- Minimize low visibility conditions caused by airborne dust.

CONDITIONS WHERE PRACTICE APPLIES

At any construction site, but is particularly important for sites with dry exposed soils which may be exposed to wind or vehicular traffic.

DUST CONTROL INSTALLATION

- Implementation limits the area exposed for dust generation.
- Asphalt and petroleum based products cannot be used.

Mulch and Vegetation

- Mulch or seed and mulch may be applied to protect exposed soil from both wind and water erosion. Refer to WDNR T.S. Mulching (1058) and Seeding (1059) for criteria.

Water

- Water until the surface is wet and repeat as needed, applied at rates so that runoff does not occur. Treated soil surfaces that receive vehicle traffic require a stone tracking pad or tire washing at all point of egress. Refer to WDNR T.S. Trackout Control Practices (1057) for criteria.

Tillage

- Performed with chisel type plows on exposed soils, beginning on the windward side of the site. Only applicable to flat areas.

Additives

- Can be effective for areas that do not receive vehicle traffic. Dry applied additives must be initially watered for activation to be effective for dust control. Refer to WDNR T.S. Land Applied Additives for Erosion Control (1050) for criteria.

Tackifiers and Soil Stabilizers Type A

- Products must be selected from and installed at rates conforming to the WisDOT PAL. Example products include Latex-based and Guar Gum.

Chlorides

- Apply according to the Wis DOT Standard Specifications for Highway and Bridge Construction.

Barriers

- Place barriers at right angles to prevailing wind currents at intervals of about 15 times the barrier height. Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and blown soil.

INSPECTION AND MAINTENANCE

Inspect daily at a minimum.

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General Inspection and Maintenance Guidance

- The environmental monitor will inspect erosion and sediment control practices a minimum of:
  - » Once a week;
  - » Within 24 hours following a rainfall of 0.5 inches or more.
- Take corrective action as soon as possible with consideration of site conditions, at the most within 24 hours of the inspection.
- Maintain written documentation of the inspection at the construction site describing:
  - » Date, time, and location of construction site inspection;
  - » Name of individual performing inspection;
  - » Assessment of the condition of erosion and sediment controls;
  - » Description of any corrective erosion and sediment control implementation or maintenance performed;
  - » Description of the current location and phase of land disturbing activity.
- For a sample construction site inspection report form: **https://dnr.wi.gov/files/PDF/forms/3400/3400-187.pdf**

State of Wisconsin
Department of Natural Resources (DNR)
PO Box 7921, Madison WI 53707-7921
dnr.wi.gov

CONSTRUCTION SITE INSPECTION REPORT

Form 3400-187 (R 11/16) Page 1 of 2

Notice: This form was developed in accordance with s. NR 216.48 Wis. Adm. Code for WPDES permittees' convenience; however, use of this specific form is voluntary. Multiple copies of this form may be made to compile the inspection report. Inspections of the construction site and implemented erosion and sediment control best management practices (BMPs) must be performed weekly and within 24 hours after a rainfall event 0.5 inches or greater.

Construction Site Name and Location (Project, Municipality, and County):

Site/Facility ID No. (FIN):

Onsite Contact/Contractor:

Onsite Phone/Cell:

Note: Inspection reports, along with erosion control and storm water management plans, are required to be maintained on site in accordance with s. NR 216.48 (4) and made available upon request. PLEASE PRINT LEGIBLY.

Date of Inspection:

Time of inspection: Start: ____ ○ am ○ pm End: ____ ○ am ○ pm

Type of inspection: ○ Weekly ○ Precipitation Event ○ Other (specify)

Weather/Site Conditions: ○ Dry ○ Variable ○ Wet ○ Frozen or snow covered ○ Frozen (Thaw predicted in next week) ○ Melting Snow/slush

Temp. ____ °F **Antecedent Soil Moisture**

Last Rainfall Depth: ____ **inches**

Last Rainfall Date: ____

Describe current phase of construction:

Scheduled Final Stabilization Date for Universal Soil Loss Equation (USLE) [1]:

Project on Schedule[2]? ○ Yes ○ No

Name(s) of individual(s) performing inspection:

Inspector Phone/Cell:

I certify that the information contained on this form is an accurate assessment of site conditions at the time of inspection:

Inspector Signature ____ **Date:** ____

Inspection Questions:	Yes	No (Identify Actions Required):	Location/Comments:	Actions Completed by Date & Initials
1. Is the erosion control plan accessible to operators?	☐	☐ Provide onsite copy		
2. Is the permit certificate posted where visible?	☐	☐ Post certificate		
3. Is the current phase of construction on sequence with the site-specific erosion and sediment control plan, including installation/stabilization of ponds and ditches?	☐	☐ Add sediment control ☐ Install missing ditch/pipe/pond ☐ Stabilize bare soil		
4. Are all erosion and sediment control BMPs shown on plan properly installed and in functional condition?	☐	☐ Repair ☐ Modify ☐ Install/Replace		
5. Is inlet protection properly installed and functioning in all inlets likely to receive runoff from the site?	☐	☐ Clean ☐ Replace ☐ Install		
6. Is the air free of fugitive dust resulting from construction activity and bare soil exposure?	☐	☐ Apply water ☐ Apply dust control product		

[1] The Universal Soil Loss Equation (USLE) model and the Construction Site Soil Loss and Sediment Discharge Guidance are available at: http://dnr.wi.gov/topic/stormwater/standards/const_standards.html
[2] If the project is not on schedule then the soil loss summary for the project should be reviewed and schedule, plan or practices modified accordingly.

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Skunk Hollow Quarry

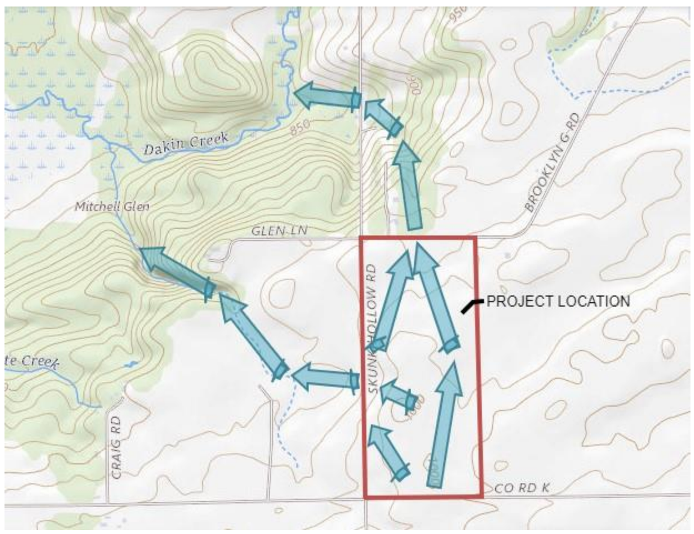
Erosion Control, Stormwater Management and Stormwater Pollution Prevention Plan (SWPPP)

EXECUTIVE SUMMARY

Overview – Proposed Site

The proposed quarry site (Phase I) is located north of County Road K, east of Skunk Hollow Road and south of Brooklyn G Road and is comprised of approximately 38.9 acres (Town of Brooklyn 004-00787-0000). Additionally, a wet sediment basin and grassed swale will be constructed on the parcel to the north (Town of Brooklyn 004-00786-0000).

Existing surface drainage runs both north (under Brooklyn G Road) and west (under Skunk Hollow Road) and into Dakin Creek. Dakin Creek then flows into the easterly end of Green Lake.



Existing Stormwater Discharge and Pollutant Loading

Existing peak discharge of stormwater from the sites ranges from 14,500 gpm (1 Year Event) to 60,400 gpm (100 Year Event) to the north and 8650 gpm (1 Year Event) to 35,700 gpm (100 Year Event) to the west.

Rainfall Event	North(Existing) (cfs/gpm)	North (Proposed) (cfs/gpm)
1 Year	32.39/14,500	0.22/100
2 Year	41.39/18,500	0.60/300
5 Year	57.63/25,900	0.95/425
10 Year	72.85/32,700	1.20/550
25 Year	95.72/43,000	3.99/1,800
50 Year	114.80/51,500	11.39/5,100
100 Year	134.65/60,400	21.98/9,900

Rainfall Event	West Existing (cfs/gpm)	West Proposed (cfs/gpm)
1 Year	19.25/8650	1.46/660
2 Year	24.62/11,000	1.65/750
5 Year	34.29/15,400	1.90/850
10 Year	43.26/19,500	2.09/950
25 Year	56.74/25,500	9.16/4,100
50 Year	67.91/30,500	63.87/28,700
100 Year	79.50/35,700	79.50/35,700

Existing pollutant loading is estimated to be approximately 26 lbs. phosphorus and 5300 lbs. total suspended solids (TSS) to the north and 14 lbs. phosphorus and 2800 lbs. total suspended solids (TSS) to the west.

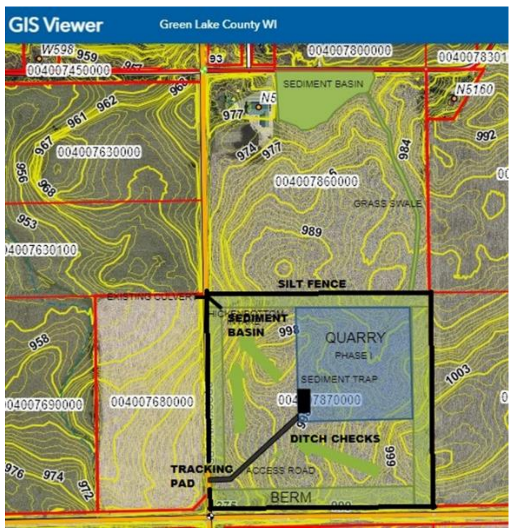
Proposed Treatment Methods

The proposed active quarry (Phase I) will be internally drained and in compliance with all WDNR requirements for internal drainage. No stormwater discharge from the active site is anticipated. Should any be required, all necessary permits shall be obtained.

Lands outside the active quarry and within the earthen berm (southerly parcel) will be treated in the westerly sediment basin prior to discharge (under Skunk Hollow Road).

In addition, the northerly parcel agricultural lands runoff will pass through the wet basin prior to discharge (under Brooklyn G Road).

Furthermore, WDNR Best Management Practices (BMPs) will be incorporated for erosion control, stormwater management and stormwater pollution prevention as outlined in the SWPPP.



Estimated Treatment Results – Proposed Improvements

Estimated peak discharge of stormwater after treatment from the sites ranges from 100 gpm (1 Year Event) to 10,000 gpm (100 Year Event) to the north and 700 gpm (1 Year Event) to 35,700 gpm (100 Year Event) to the west.

These values represent a 99% (north, 1 Year Event) to 92% (west, 1 Year Event) reduction in peak stormwater discharge.

Estimated pollutant loading after treatment is estimated to be approximately 14 lbs. phosphorus and 1000 lbs. total suspended solids (TSS) to the north and 5 lbs. phosphorus and 400 lbs. total suspended solids (TSS) to the west.

These values represent a 48% to 65% reduction in phosphorus and 81% to 86% reduction in total suspended solids (TSS).

Conclusions

In conclusion, the proposed Skunk Hollow Quarry stormwater treatment systems will -

- Reduce peak discharges.
- Reduce pollutant loadings.
- Provide inspection and sampling points prior to discharge.
- Comply with and exceed WDNR Stormwater Permit requirements.

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December 8, 2022
File No. 20.0158031.00

Mr. Michael McConnell, Project Manager
Kopplin & Kinas Co., Inc.
W1266 North Lawson Drive
Green Lake, Wisconsin 54941

Re: Hydrogeologic Summary
Skunk Hollow Quarry
Town of Brooklyn, Green Lake County, Wisconsin

Dear Mr. McConnell,

On Monday, November 28 to Wednesday, November 30, 2022, GZA GeoEnvironmental, Inc. (GZA) oversaw the advancement of 15 borings conducted at the proposed Skunk Hollow Quarry located in the town of Brooklyn, Green Lake County, Wisconsin ("Site"). The work was performed in accordance with our September 30, 2022 Proposal for Services, GZA File No. 20.P000400.23, recent discussions and correspondence with Mr. Dave Johnson, Hydrogeologist with the Wisconsin Department of Natural Resources (WDNR), and discussions and planning with Kopplin & Kinas Co., Inc. ("Client"). Borings were advanced by Falcon Drilling & Blasting (Falcon) of Oshkosh, Wisconsin and were observed by a GZA Hydrogeochemist. The drilling and sampling were conducted to address conditions set forth by the Green Lake County Land Use Planning & Zoning Committee ("Committee") during its meeting on July 7, 2022, in regards to the proposed Skunk Hollow Quarry aggregate mine Conditional Use Permit (CUP). Specifically, borings were advanced to meet the following CUP conditions, set forth by the Committee:

> Condition 14. *"The elevation of groundwater within the proposed mining site shall be determined. This shall be accomplished by installing two groundwater monitoring wells, one in the NW corner and the other in the SE corner of the proposed site. Each well to be constructed from the anticipated terminal depth of the quarry to the ground surface."*
>
> Condition 16. *"A site-specific study to be provided to the Land Use Planning & Zoning Department, performed by a qualified professional and reviewed and approved by the WDNR's hydrogeologist Dave Johnson, to study the site for sulfides. If the study indicates the site contains unsafe levels of sulfide minerals, and will be environmentally adverse to the nearby springs or groundwater the CUP shall be deemed void."*

FIELD METHODS

Falcon drilled 15 borings, at locations shown on Figure 1, using a FlexiROC D60 air drilling rig and 4.5-inch-diameter tri-cone bit. Boreholes were drilled to depths ranging from 65 to 120 feet below ground surface (bgs).

The drill shaft was run through an approximate 5-foot by 5-foot plywood board with a 6-inch-diameter, circular opening. After each successive 5-foot depth interval, the plywood board was cleared such that representative cuttings were obtained from each interval. Drill cuttings were collected from each borehole every 5 feet and placed on a clean table for observation by GZA for the presence of sulfide minerals. Observations are summarized in field notes shown in Attachment 1. Representative photographs of select interval cuttings were collected throughout the course of the drilling process, which are included in Attachment 2. Samples from each 5-foot interval were collected in labeled, quart-sized, plastic bags for later subsampling.

Thirteen boreholes were abandoned upon completion by filling with bentonite chips to the ground surface. Two boreholes, SH-3 and SH-13, were drilled to depths of 120 feet bgs and 70 feet bgs, respectively, and completed as groundwater monitoring wells. Groundwater monitoring wells were constructed of 1-inch PVC pipe with 10 feet of 1-inch, 0.010-inch slotted screen. Filter pack sand consisting of #40 Red Flint Well Slot was placed in each monitoring well borehole around the well screen to approximately 9 feet above the well screen. The well boreholes were then completed with ⅜-inch bentonite chips from 9 feet above the well screen to ground surface. Monitoring wells were completed with riser approximately 3 to 4 feet above ground surface, which were encased in a 5-foot, 4.5-inch ProTop protective casing and well caps.

Composite samples were compiled for each quadrant (northeast, northwest, southeast, southwest) of the Site. First, composite samples of each boring were compiled by subsampling equal volumes from each depth interval in a clean, stainless-steel bowl and mixed until evenly composited. Each boring-specific composite sample was collected in labeled, gallon-size, plastic bags. Equal volumes were then collected from each boring-specific composite sample to generate representative composite samples for each quadrant of the Site. The sample quadrants are identified on Figure 1.

Samples were submitted to ALS Laboratories (ALS) in Reno, Nevada for direct analysis of sulfide concentrations (ALS analysis S-IR06a) and the Modified Sobek Test, which determines a net neutralization potential (NNP) indicating the potential ability of the Site bedrock to produce acid rock drainage. Analytical results from ALS were not received by the issuance of this report and are anticipated to be received in approximately eight weeks.

CONCLUSIONS

The following conclusions are based on field observations:

1. Subsurface conditions at the Site generally consisted of less than 5 feet of fine, silty sand overburden overlying limestone or dolostone bedrock.
2. Three borings encountered overburden between 5 and 10 feet thick and one boring (SH-9) encountered overburden to 18 feet.
3. Groundwater was not encountered in the overburden.
4. Intermittent layers of shale were encountered within the limestone or dolostone bedrock at varying depths.
5. The bedrock ranged in color from white, to gray, to brown, as show in photographs provided in Attachment 2.
6. No visual evidence of the presence of sulfide minerals were observed during drilling activities. For reference, we included two photographs from the WDNR Green Lake Case Study of an irrigation well located approximately 1 mile northeast of the proposed quarry where sulfide minerals were identified in the bedrock.
7. Depth to groundwater was measured in each of the installed monitoring wells on December 6, 2022. Depth to groundwater in the southeast monitoring well location (SH-3) was measured to be 91.30 feet bgs, and depth to groundwater in the northwest monitoring well location (SH-13) was measured to be 64.82 feet bgs.

8. Based on the measurements above, groundwater elevations at the Site were estimated to be 912.70 feet at SH-3 (southeast) and 910.31 feet at SH-13 (northwest).

Thank you for the opportunity to be of service. Please reach out to the undersigned if you have any questions.

Best regards,

GZA GeoEnvironmental, Inc.

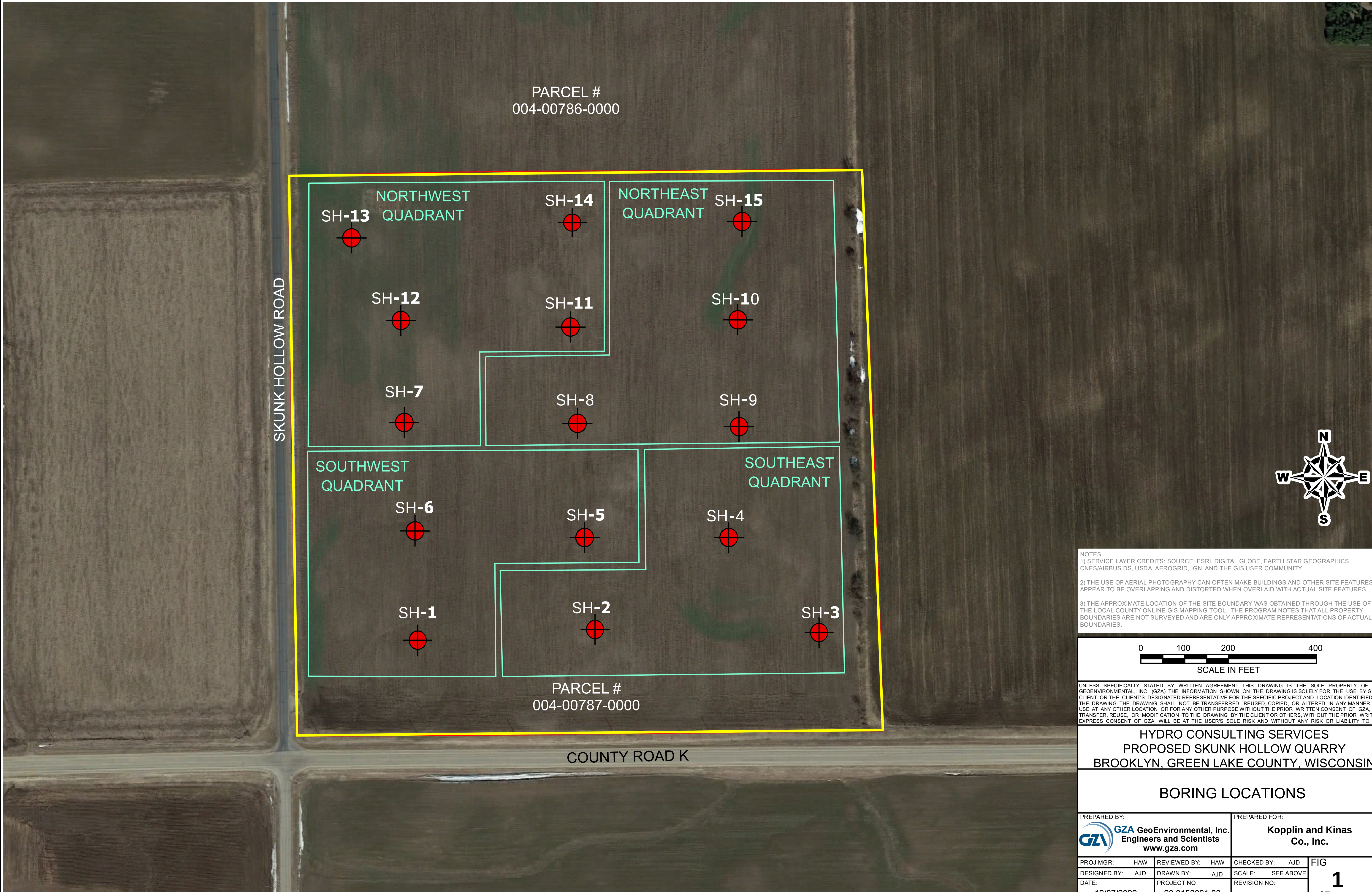
Aubrey Dunshee, GIT
Project Hydrogeochemist
(612)-532-6854 / aubrey.dunshee@gza.com

Mark Krumenacher, PG
Senior Principal/Senior Vice President
(262)-424-2046 / mark.krumenacher@gza.com

J:\158000to158099\158031 Skunk Hollow\Report\Hydrogeologic Summary\Final\FINAL 20.0158031.00 Hydrogeologic Summary Rpt_Skunk Hollow Quarry 12-8-22.docx

Attachments: Figure 1
Field Notes
Photographs

FIGURES



NOTES

1) SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITAL GLOBE, EARTH STAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

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

3) THE APPROXIMATE LOCATION OF THE SITE BOUNDARY WAS OBTAINED THROUGH THE USE OF THE LOCAL COUNTY ONLINE GIS MAPPING TOOL. THE PROGRAM NOTES THAT ALL PROPERTY BOUNDARIES ARE NOT SURVEYED AND ARE ONLY APPROXIMATE REPRESENTATIONS OF ACTUAL BOUNDARIES.

HYDRO CONSULTING SERVICES
PROPOSED SKUNK HOLLOW QUARRY
BROOKLYN, GREEN LAKE COUNTY, WISCONSIN

BORING LOCATIONS

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

PREPARED FOR:
Kopplin and Kinas
Co., Inc.

PROJ MGR: HAW	REVIEWED BY: HAW	CHECKED BY: AJD	FIG
DESIGNED BY: AJD	DRAWN BY: AJD	SCALE: SEE ABOVE	1
DATE: 12/07/2022	PROJECT NO: 20.0158031.00	REVISION NO: OF	SHEET NO: 87

ATTACHMENT 1

Field Notes

Skunk Hollow Proposed Limestone Quarry

Drilling Observations - Sulfide Mineral Exploration

BEDROCK OBSERVATIONS - SULFIDE MINERALS PRESENT Yes/No

Boring Number	Overburden Description	Overburden Thickness (ft)	0-5 ft	Photo?	5-10 ft	10-15 ft	15-20 ft	20-25 ft	25-30 ft	30-35 ft	35-40 ft	40-45 ft	45-50 ft	50-55 ft	55-60 ft	60-65 ft	65-70 ft	70-75 ft	75-80 ft	80-85 ft	85-90 ft	90-95 ft	95-100 ft	100-105 ft	105-110 ft	110-115 ft	115-120 ft	Total Depth (feet bgs)	Comments
SH-1	Fine grained silty sand	4.5	OB		N	N	N	N	N	N	N	N	N	N	N	N												65	
SH-2	Fine grained silty sand	3	OB + NS		N	N	N	N x	N x	N x	N x	N x	N x	N x	N x	N	N x	N x										75	
SH-3	Fine grained silty sand	3	OB + NS		N x	N x	N x	N x	N	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	NS	NS	NS	NS	NS	NS	NS	NS	120	1" PVC well installed water 90.6 bgs in well
SH-4	Fine grained silty sand	3	OB + NS		N	N x	N	N x	N x	N x	N x	N	N x	N x	N x	N x	N x	N x										72.5	
SH-5	Fine grained silty sand	3	OB + NS		N	N	N	N x	N	N	N x	N x	N x	N x	N x	N x	N x	N										75.5	
SH-6	Fine grained silty sand	6	OB		N	N	N x	N	N x	N x	N x	N x	N x	N x	N x	N x	N x											70	
SH-7	Fine grained silty sand	4	OB + NS		N	N x	N	N	N	N x	N x	N x	N x	N x	N x	N x	N x	N x										74.5	
SH-8	Fine grained silty sand	4	OB + NS		N	N	N	N	N	N x	N x	N x	N x	N x	N x	N x	N x	N x										74.5	
SH-9	Fine grained silty sand	18	OB		OB	OB	OB + N	N	N	N	N	N	N	N	N	N	N	N										75	
SH-10	Fine grained silty sand	9	OB		OB + NS	N	N	N	N	N x	N x	N x	N x	N x	N x	N x												66.5	
SH-11	Fine grained silty sand	4	OB + N		N x	N x	N	N	N x	N x	N x	N x	N x	N	N	N x	N x											70	
SH-12	Fine grained silty sand	2	OB + N x	X	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x									78.5	
SH-13	Fine grained silty sand	10	OB		OB	N x	N x	N x	N x	N x	N x	N x	N x	NS	NS	NS	NS											70	1" PVC well installed water 65.0 bgs in well
SH-14	Fine grained silty sand	5.5	OB		OB + N	N	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x	N x											69.5	
SH-15	Fine grained silty sand	5	OB		N	N	N	N	N	N	N	N	N	N	N													60	

Notes

OB	Overburden
N	No Sulfides Present
Y	Sulfides Present
NS	Not Sampled
x	Photo of cuttings
bgs	Below ground surface

ATTACHMENT 2

Photographs

Photographic Log

Client Name:	Site Location	Project No.
Kopplin and Kinas Co., Inc.	Proposed Skunk Hollow Quarry, Brooklyn, Green Lake County, Wisconsin	20.0158031.00

Photo No.	Date:
1	11/28/22

Direction Photo Taken:
N/A

Description:
Drill cuttings – eroded/degraded bedrock, SH-2 (20-25’).

Photo No.	Date:
2	11/28/22

Direction Photo Taken:
N/A

Description:
Drill cuttings – typical limestone/dolostone bedrock cuttings at Site. SH-2 (40-45’).

Client Name: Kopplin and Kinas Co., Inc.	Site Location Proposed Skunk Hollow Quarry, Brooklyn, Green Lake County, Wisconsin	Project No. 20.0158031.00

Photo No. 3

Date: 11/28/22

Direction Photo Taken:
N/A

Description:
Drill cuttings – eroded/degraded bedrock, SH-3 (10-15’).

Photo No. 4

Date: 11/28/22

Direction Photo Taken:
N/A

Description:
Drill cuttings – typical limestone/dolostone bedrock cuttings at Site. SH-2 (45-50’).

Client Name:	Site Location	Project No.
Kopplin and Kinas Co., Inc.	Proposed Skunk Hollow Quarry, Brooklyn, Green Lake County, Wisconsin	20.0158031.00

Photo No.	Date:
5	11/29/22

Direction Photo Taken:
N/A

Description:
Typical dark-gray limestone/dolostone coloration encountered at Site. SH-6 (15-20’).

Photo No.	Date:
6	11/29/22

Direction Photo Taken:
N/A

Description:
Close up photograph of drill cuttings from limestone bedrock at Site. SH-4 (60-65’).

Reference Photos

Photo depicting drill cuttings in bedrock believed to be collected in Green Lake County and reported in the Green Lake County Irrigation Well Case Study presentation prepared by Dave Johnson, WDNR.

Photo depicting examples of sulfide minerals within bedrock believed to be collected in Green Lake County and reported in the Green Lake County Irrigation Well Case Study presentation prepared by Dave Johnson, WDNR.

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December 8, 2022
GZA File No. 20.0158034.00

In re Appeal of CUP Issued to Kopplin & Kinas Co., Inc.
Green Lake Board of Adjustment
Date of Hearing: December 22, 2022
PRE-HEARING OVERVIEW

Consideration and Response to Applicable Statute, Ordinances and Standards prepared by GZA GeoEnvironmental, Inc. on behalf of the Applicant for the Green Lake County Board of Adjustment

11. Applicable Statute, Ordinances and Standards

a. Wis. Stat. § 91.46(6) – CUP will not issue unless BOA determines all of the following apply:

i. ***"The operation complies with subch. I of ch. 295 and rules promulgated under that subchapter, with applicable provisions of the local ordinance under s. 295.13 or 295.14, and with any applicable requirements of the department of transportation concerning the restoration of nonmetallic mining sites."***

The land will be reclaimed to agricultural use upon completion of mining as described in the February 2, 2022, Operation, Environmental Control & Reclamation Plan prepared in general accordance with WAC NR 135 and Green Lake County Chapter 323 Nonmetallic Mining Reclamation.

ii. ***"The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district."***

Nonmetallic mining is an allowed use in the AG-1 district, making it consistent with the district. The proposed use will occupy only a portion of the property at a time and will be compatible and consistent with the agricultural use of the Site and the adjoining properties.

The Applicant recognizes the importance of maintaining agricultural use of the property during and after mining. Upon completion of mining, whether the property is partially or wholly mined as intended, the entire property will be reclaimed to agricultural use.

The proposed use is a temporary use of the land. As a temporary use, the intended purpose of the AG-1 Prime Agricultural District will be preserved as specified in Green Lake County Section 350-27 A "to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program."

Activities typically associated with working farms should be expected in the AG-1 district, including noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation. The activities proposed in the mine Application are more highly restricted than the activities expected in the AG-1 district, and unlike agricultural operations, will be subject to the terms and conditions of a special exception permit regulating noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation, activities unregulated by the County when under agricultural use.

The Applicant:

1. Must utilize equipment subject to emission control and noise suppression devices more stringent than agricultural equipment to, at a minimum, meet United States Department of Labor, Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and/or National Institute for Occupational Safety and Health (NIOSH) standards;
2. Must control dust in accordance with state laws unlike the agricultural uses;
3. Will not emit odors;
4. Will use heavy equipment primarily at grades well below the surrounding ground surface where agricultural equipment operates;
5. Will not use chemicals across the property; and
6. Will have restricted hours of operation – which will be specified in the Conditional Use Permit.

iii. "The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law."

There are no abutting residences to the proposed mine. Due to the unique extremely low density of neighboring residences to the proposed mine area, the location is deemed reasonable and appropriate, especially considering that it is impossible to have a property with no neighbors.

The proposed operation is consistent with the placement of aggregate quarries. The need for construction aggregate is directly proportional to the number of residences in an area or community. If there were no residences or villages nearby, there would be little need for construction aggregate.

The Wisconsin Department of Natural Resources (WDNR) estimates that there are more than 2,500 nonmetallic mines in Wisconsin. That means there is an average of 35 mines per County and two mines per Township, numbers that do not come close to Green Lake County. Each Township is no greater than 6 miles by 6 miles square. On average, the 6 million citizens of Wisconsin live within about 3 miles of a mine and about one-third of us live within 1 mile of a mine; that is about 2 million people within 1 mile of a mine and tens of thousands within 500 feet.

Alternative properties were considered and after evaluation of many factors, permitting was only pursued on this property. There are other properties that could be permitted, but in the end, the same challenges will remain with permitting due to zoning boundaries that render aggregate resources inaccessible, organized opposition, and other factors. A proposed mine can only be developed on property where the minerals are located, and a property owner will allow mine development. Other considerations include property size, highway access, residential density, wetlands and other surface water and ecological resources, and water availability, or in this case, lack of water that can become impacted. Many factors determine the location of an aggregate mining operation, and these many factors overlap, but are not necessarily sequential.

iv. "***The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use."***

The proposed mine creates no conceivable means of conversion of land around the Site from agricultural use or open space use.

v. "The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use."

The proposed use will not affect the surrounding parcels of land.

vi. "The farmland preservation zoning ordinance requires the owner to restore the land to agricultural use, consistent with any required locally approved reclamation plan, when extraction is completed."

The land will be reclaimed to agricultural use upon completion of mining as described in the February 2, 2022, Operation, Environmental Control & Reclamation Plan prepared in general accordance with WAC NR 135 and Green Lake County Chapter 323 Nonmetallic Mining Reclamation.

b. Ordinance 350-27 (A-1 Farmland Preservation District)

i. Sec. 2(e) – Nonmetallic mineral extraction is allowed as a conditional use if all of the following apply:

1. ***"The operation complies with Subchapter I of Chapter 295, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats. (including all applicable provisions of this chapter), and with any applicable requirements of the Wisconsin Department of Natural Resources concerning the restoration of nonmetallic mining sites."***

   The land will be reclaimed to agricultural use upon completion of mining as described in the February 2, 2022, Operation, Environmental Control & Reclamation Plan prepared in general accordance with WAC NR 135 and Green Lake County Chapter 323 Nonmetallic Mining Reclamation.

2. ***"The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district."***

   Nonmetallic mining is an allowed use in the AG-1 district, making it consistent with the district. The proposed use will occupy only a portion of the property at a time and will be compatible and consistent with the agricultural use of the Site and the adjoining properties.

   The Applicant recognizes the importance of maintaining agricultural use of the property during and after mining. Upon completion of mining, whether the property is partially or wholly mined as intended, the entire property will be reclaimed to agricultural use.

   The proposed use is a temporary use of the land. As a temporary use, the intended purpose of the AG-1 Prime Agricultural District will be preserved as specified in Green Lake County Section 350-27 A "to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program."

   Activities typically associated with working farms should be expected in the AG-1 district, including noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation. The activities proposed in the mine Application are more highly restricted than the activities expected in the AG-1 district, and unlike agricultural operations, will be subject to the terms and conditions of a special exception permit regulating noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation, activities unregulated by the County when under agricultural use. The Applicant:

   a. Must utilize equipment subject to emission control and noise suppression devices more stringent than agricultural equipment to, at a minimum, meet OSHA, MSHA, and/or NIOSH standards;

b. Must control dust in accordance with state laws unlike the agricultural uses;

c. Will not emit odors;

d. Will use heavy equipment primarily at grades well below the surrounding ground surface where agricultural equipment operates;

e. Will not use chemicals across the property; and

f. Will have restricted hours of operation – which will be specified in the Conditional Use Permit.

3. ***"The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law."***

   There are no abutting residences to the proposed mine. Due to the unique extremely low density of neighboring residences to the proposed mine area, the location is deemed reasonable and appropriate, especially considering that it is impossible to have a property with no neighbors.

   The proposed operation is consistent with the placement of aggregate quarries. The need for construction aggregate is directly proportional to the number of residences in an area or community. If there were no residences or villages nearby, there would be little need for construction aggregate.

   The WDNR estimates that there are more than 2,500 nonmetallic mines in Wisconsin. That means there is an average of 35 mines per County and two mines per Township, numbers that do not come close to Green Lake County. Each Township is no greater than 6 miles by 6 miles square. On average, the 6 million citizens of Wisconsin live within about 3 miles of a mine and about one-third of us live within 1 mile of a mine; that is about 2 million people within 1 mile of a mine and tens of thousands within 500 feet.

   Alternative properties were considered and after evaluation of many factors, permitting was only pursued on this property. There are other properties that could be permitted, but in the end, the same challenges will remain with permitting due to zoning boundaries that render aggregate resources inaccessible, organized opposition, and other factors. A proposed mine can only be developed on property where the minerals are located, and a property owner will allow mine development. Other considerations include property size, highway access, residential density, wetlands and other surface water and ecological resources, and water availability, or in this case, lack of water that can become impacted. Many factors determine the location of an aggregate mining operation, and these many factors overlap but are not necessarily sequential.

4. ***"The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use."***

   The proposed mine creates no conceivable means of conversion of land around the Site from agricultural use or open space use.

5. ***"The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use."***

   The proposed use will not affect the surrounding parcels of land.

6. ***"The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed."***

   The land will be reclaimed to agricultural use upon completion of mining, as described in the February 2, 2022, Operation, Environmental Control & Reclamation Plan prepared in general accordance with WAC NR 135 and Green Lake County Chapter 323 Nonmetallic Mining Reclamation.

7. "Compliance with Chapter 323 (Nonmetallic Mining Reclamation)."

The land will be reclaimed to agricultural use upon completion of mining as described in the February 2, 2022, Operation, Environmental Control & Reclamation Plan prepared in general accordance with WAC NR 135 and Green Lake County Chapter 323 Nonmetallic Mining Reclamation.

c. Ordinance 350-56

i. 350-56(B)(1) – CUP will not issue unless BOA finds substantial evidence that the following standards are satisfied:

1. "If an applicant for a conditional use permit meets or agrees to meet all of the requirements and conditions specified in this chapter or those imposed by the Land Use Planning and Zoning Committee, the Land Use Planning and Zoning Committee shall grant the conditional use permit. Any condition imposed must be related to the purpose of the ordinance and be based on substantial evidence."

The Applicant is prepared to accept the conditions proposed by the County.

2. "The requirements and conditions described in the preceding paragraph must be reasonable and, to the extent practicable, measurable and may include conditions such as the permit's duration, transfer, or renewal."

Understood.

3. "The applicant must demonstrate that the application and all requirements and conditions established by the Land Use Planning and Zoning Committee, relating to the conditional use, are or shall be satisfied, both of which must be supported by substantial evidence. The Land Use Planning and Zoning Committee's decision to approve or deny the conditional use permit must be supported by substantial evidence."

Understood.

ii. 350-56(B)(2) – CUP will not issue unless BOA finds the conditional use:

1. "Will not have a negative effect upon the health, safety, and general welfare of occupants of surrounding lands;"

The proposed use will not be detrimental to the public health, safety, or general welfare of occupants of surrounding land. The proposed use will be on private property with no public access allowed during non-operating hours. The mining operation must comply with strict MSHA and State of Wisconsin regulations.

The Applicant participated in a public hearing with the County. All concerns raised by the public, Township, and County regarding public health and safety and harm to the general welfare of occupants on adjacent properties have been addressed. We understand that there will be additional public meetings and at least one more public hearing on the Application and we will be prepared to address any additional concerns.

2. "Will be designed, constructed, operated, and maintained so as to be harmonious and be appropriate in appearance with the existing or intended character of the general vicinity and that such a use will not change the essential character of the same area;"

Activities typically associated with working farms should be expected in the AG-1 district, including noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation. The activities proposed in the mine Application are more highly restricted than the activities expected in the AG-1 district, and unlike agricultural operations, will be subject to the terms and conditions of a special exception permit regulating noise, dust, odors, heavy equipment, use of chemicals, and long hours of operation, activities unregulated by the county when under agricultural use. The Applicant:

a. Must utilize equipment subject to emission control and noise suppression devices more stringent than agricultural equipment to, at a minimum, meet OSHA, MSHA, and/or NIOSH standards;

b. Must control dust in accordance with state laws unlike the agricultural uses;

c. Will not emit odors;

d. Will use heavy equipment primarily at grades well below the surrounding ground surface where agricultural equipment operates;

e. Will not use chemicals across the property; and

f. Will have restricted hours of operation – which will be specified in the Conditional Use Permit.

3. "***Will not be hazardous or disturbing to existing or future neighboring uses;"***

The proposed mining activities will not be hazardous or disturbing to existing neighbors, or conceivably to future neighbors that have a reasonable degree of common sense and general awareness of their surroundings prior to relocation.

4. "Will not be detrimental to property in the immediate vicinity or to the community as a whole;"

There is no conceivable means by which the proposed mine could be detrimental to the property being mined, to other property in the immediate vicinity or to the community as a whole or in part.

5. "Will be served adequately by essential public facilities and services, such as highways, streets, police and fire protection, drainage structures, and schools, and that the persons or agencies responsible for the establishment of the proposed use shall be able to provide adequately any such service; and"

The proposed mine will be served adequately by local highways, streets, police and fire protection, and drainage structures.

6. "Will have vehicular approaches to the property which shall be so designed as not to create an interference with traffic on surrounding public or private streets or roads."

The proposed mine will have vehicular approaches to the property which shall be so designed as not to create an interference with traffic on surrounding public or private streets or roads

iii. 350-56(C)

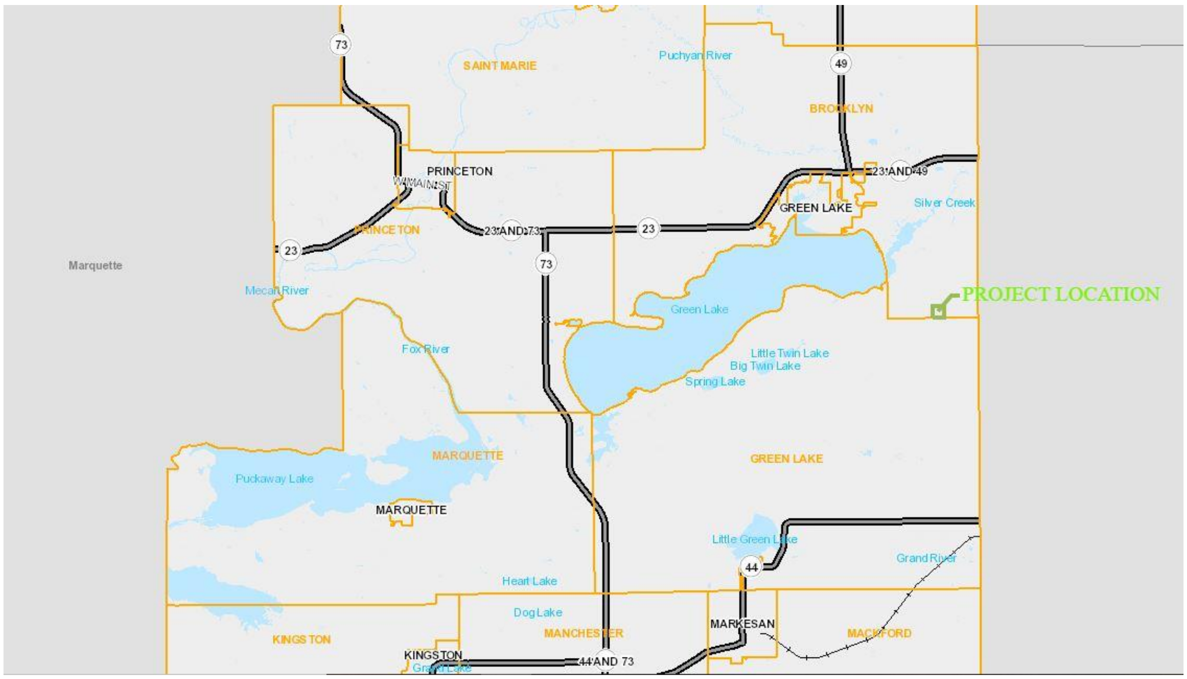
The BOA may require additional standards and conditions that may be deemed necessary for the conditional use requested to meet the standards of this article. Such additional standards and conditions may include, but not be limited to, requirements pertaining to lot coverage, lot area, setbacks, building height, off-street parking and loading, pedestrian and vehicular accessways, storage, fencing, screening, landscaping, open space, height limitations, lighting, and hours of operation.

Understood.

Badger Engineering & Construction, LLC.
1432 Country Club Lane, Watertown, WI 53098
920.229.7128 BadgerEngineeringWI@gmail.com

STORMWATER POLLUTION PREVENTION PLAN

SKUNK HOLLOW QUARRY



Prepared for:
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Table of Contents

Appendices

SWPPP SKUNK HOLLOW QUARRY - SITE & CONTACT INFORMATION

SITE LOCATION:	**SW ¼ OF THE SW ¼, SECTION 36, T16N-R13E** **TOWN OF BROOKLYN, GREEN LAKE COUNTY, WISCONSIN** **TAX PARCEL NUMBER: 004-00787-0000**
CURRENT SITE ADDRESS:	**THE NE QUADRANT OF THE INTERSECTION OF** **CTH K & BROOKLYN "G" ROAD**
OPERATOR:	**KOPPLIN & KINAS CO., INC.** **W1266 NORTH LAWSON DRIVE** **GREEN LAKE, WI 54941** **PHONE: (920)294-6451** **FAX: (920)294-6489** https://kkci.us **DONALD E. KINAS, JR. – PRESIDENT** **CHRISTOPHER KINAS – AGGREGATE OPERATIONS** **MIKE MCCONNELL – PERMIT COMPLIANCE, SITE DESIGN**
PROPERTY OWNER:	**DONALD E. KINAS, JR.** **W1266 NORTH LAWSON DRIVE** **GREEN LAKE, WI 54941** **PHONE: (920)294-6451**

Introduction

Other plans incorporated by reference –

This report was written in conjunction with the Operation, Environmental Control & Reclamation Plan for the Skunk Hollow Quarry, February 2022, by Kopplin & Kinas Company Incorporated (KKCI) and the Erosion Control and Stormwater Management Plan, April 2022, by Badger Engineering and Construction, LLC. Portions of this report were therefrom obtained as well as excerpts from WDNR guidance documents.

Site Location

This Stormwater Pollution Prevention Plan (SWPPP) is for the operation of the proposed Skunk Hollow Quarry located at the intersection of County Highway K and Skunk Hollow Road, Township of Brooklyn, Green Lake County, Wisconsin (See Appendix A).

Purpose

Kopplin & Kinas Company Incorporated (KKCI) is an aggregate producer and heavy/civil construction company serving communities in Green Lake and the surrounding counties since 1926. As the cost of transporting aggregates to construction sites steadily increases, KKCI must work to secure new sources of crushed stone, sand, and gravel to meet the needs of their customers by producing aggregates at locations closer to the geographic markets which they serve. The Donald E. Kinas property located at the intersection of CTH K and Skunk Hollow Road, contains a commercial grade limestone deposit. The site's location is ideal to service customers in Green Lake, Markesan, Fairwater, and Ripon.

This SWPPP has been developed to address the requirements under Part III of the Wisconsin Pollution Discharge Elimination System (WPDES) general permit for stormwater discharges and in accordance with good engineering practices.

This SWPPP defines and describes this facility and its operations, identifies potential sources of stormwater pollution, provides for the implementation of appropriate Best Management Practices (BMPs) and/or measures to reduce the discharge of pollutants in the stormwater discharge and provides for periodic review and revision of this SWPPP.

Summary of Site

Background

The Kinas property has historically been an agricultural field. The proposed nonmetallic mine is located on approximately 40 acres of open land in Brooklyn Township, Green Lake County, Wisconsin. The legal mine site extents contain approximately 40 acres with approximately 28 acres designated for the quarry pit itself.

It is noted that the parcel to the north (Parcel: 004-00786-0000, Legal Desc: NW1/4 OF THE SW1/4 SEC 36, Appendix A) is owned by Mr. DONALD E. KINAS, JR. and a drainage easement will be granted for the construction and maintenance of all required stormwater facilities (sediment basin, grassed swale, See Appendix A).

The limestone formation beneath the field is very shallow to the surface. The rock is shallow enough that there are gravelly/rocky spots that occur in the field from loose fragmented rock being worked to the surface by agriculture or natural means.

The site is zoned A-1 Farmland Preservation and is predominantly surrounded by agricultural zoning and land use, and some amounts of rural residential housing.

Limestone is the primary targeted mineral in this mine site and ranges in depth from the surface to just below existing grade. The limestone will be processed to produce the following:

- Dimensional stone and riprap for shoreline stabilization,
- Breaker run and road gravel for road and driveway base,
- Crushed stone for building slab and foundation support, and
- Screenings for patios and driveway surface course.
- Ag lime

The glacial till that overlays the property is classified as part of the Horicon member of the Holy Hill Formation. The property is underlain by Ordovician aged dolomitic limestone presumed to be of the Sinnipee Group containing the Galena, Decorah, and Platteville formations. The top of the limestone formation lies approximately between 990 and 1003 U.S. Feet above mean sea level. The well reports for the immediate area show the limestone formation to be 100'+ thick (See Local Well Construction Reports, Appendix B). The Proposed Mineral Extraction will not extend into the underlying St. Peter Sandstone formation. The proposed extraction will terminate at an approximate elevation 928', above the aquifer and above the elevations of the spring orifices at Mitchell Glen and White Creek. The Wisconsin Geological and Natural History Survey lists the elevations of the spring orifices as follows:

Mitchell Glen: 852.72 U.S. Feet (259.91 Meters)

White Creek: 923.43 U.S. Feet (281.46 Meters)

Drainage Patterns

Surface water at the site currently drains to the west and north-west, split by the ridge that runs across the property and is collected by the ditches along Brooklyn G Road, which carry it west to the drainage ditch that flows into Mitchell Glen and north to lowlands that flow to Dakin Creek. There are no known or mapped wetlands on the property (See Appendix A).

Receiving Waters

The nearest receiving water is an unnamed creek which flows NW into Dakin Creek. It is located approximately 700' from the entrance to the proposed quarry. Dakin Creek flows westerly into Big Green Lake.

*It is noted that Big Green Lake is listed as an "impaired waters" per the 2020 WDNR list (TMDL for phosphorus).

Maps

See Appendix A for locational, topographical, wetland, zoning, and other maps.

Construction Scheduling - Proposed Operations

The following plan of operation has been developed to efficiently utilize the site's natural and agricultural resources, protect human health and the environment, and minimize long-term operational costs.

The site will be accessed from Brooklyn G Road, near the intersection with CTH K. The entrance will be constructed out of crushed stone to minimize tracking debris onto local roads.

The site will be developed incrementally to minimize disturbed areas and preserve farmland. Topsoil and overburden will be stripped to access the limestone formation. Removed topsoil and overburden will be separated and used to construct screening berms surrounding the property. The berms will be built incrementally as operations progress.

The screening berms will serve multiple functions, first they will serve as a safety barrier from mining operations, second, they will provide an aesthetic buffer from site operations, third they will be used as topsoil and overburden storage for later use in the reclamation stages of the operation. The berms will range from 10' to 30' in height and have a maximum 3H:1V slope. As the sections of berm are completed, they will be seeded down to establish vegetation and stabilize the soil from erosion.

Aside from constructing the screening berms, no mining activity will take place within one-hundred feet of any right of way line or exterior property line.

Pollution Prevention Best Management Practices and erosion controls outlined in the Wisconsin Department of Natural Resources (WDNR), "Wisconsin Construction Site Erosion Control Field Guide" will be utilized, as needed, to prevent sediment loss during all phases of the site's operational lifespan.

Such measures include the utilization of seeding, mulching, sediment basins, grassed swales, and crushed stone checks.

Aggregate Removal & Processing

Extraction of the limestone will begin in the north-east corner of the site. The extraction operation will progress incrementally to the west and south in accordance with local demand.

The limestone will be intermittently "drilled and blasted". This process involves drilling holes into the limestone and loading the holes with a blasting agent. The blasting agent is detonated by trained and licensed blasters. The blasts are designed to displace the rock from the solid formation, fragmenting it to a size that permits efficient crushing and sizing of the rock. All blasting in the State of Wisconsin is performed in accordance with COM 7 of the Mine Safety and Health Administration Code, which is published and routinely updated by the Wisconsin Department of Commerce.

The limestone will be extracted to a maximum depth of five feet above the elevation of the spring orifice at White Creek, or five feet above the St. Peter Sandstone that lies below the limestone formation. This will ensure that the extraction operation maintains an adequate buffer above the aquifer that feeds the local wells, and the springs at Mitchell Glen and White Creek.

When needed, a portable processing plant will be brought in to crush and size the blasted limestone into stockpiles of the finished products. Portable processing equipment and stockpiles are staged within the area of extraction, and set-up to accommodate the working face of the quarry. A list of equipment that could be utilized on-site for aggregate processing is included in Appendix E- Aggregate Processing & Construction Equipment List.

(3) Portable Asphalt & Concrete Batch Plant Operation

There may be local projects from time to time that require enough pavement material to move a portable asphalt or concrete batch plant to the site. These plants will be operated in accordance with the Wisconsin DNR regulations that pertain to them. There will be no permanent asphalt or concrete production plants at the site.

(4) Support Structures

There will be no permanent buildings of structures within the extraction area. All the processes conducted on the site utilize completely portable equipment. A gate and proper signage will be at the entrance of the site. A portable scale house and scale will be positioned near the site entrance to weigh the materials as they leave the site. A portable sanitary station will be set-up for employees/customers on an as needed basis.

A water supply well may be needed to supply water for dust suppression, washing aggregates, and portable pavement plants. A licensed well driller will construct the well, if needed, in compliance with Wisconsin Administrative Code requirements.

Objectives

Purpose

This SWPPP will:

1. identify sources of storm water and non-storm water contamination to the storm water drainage system.
2. identify and prescribe appropriate "source area control" type best management practices designed to prevent storm water contamination from occurring.
3. identify and prescribe "storm water treatment" type best management practices to reduce pollutants in contaminated storm water prior to discharge.
4. prescribe actions needed either to bring non-storm water discharges under WPDES permit or to remove these discharges from the storm drainage system.
5. prescribe an implementation schedule to ensure that the storm water management actions prescribed in the Storm Water Pollution Prevention Plan are carried out and evaluated on a regular basis.

"Pollutants carried in storm water runoff from industrial facilities threaten or degrade water quality in many areas of the state. Because of this problem, state and federal laws require that certain dischargers of industrial storm water have a storm water discharge permit. The purpose of the permit is to identify conditions under which industrial storm water can be discharged so that the quality of surface waters, wetlands and groundwater is protected."

Goal

Due to the wide variety of nonmetallic mining (NMM) facilities in Wisconsin, this general permit has significant complexity. However, there are two overreaching goals for mining wastewater and storm water contaminant discharges from nonmetallic mining facilities: (1) prevent pollution of water, when possible (salt, petroleum products, solvents, etc.), and (2) control sediment and suspended solids discharges as much as possible by seeping excess water into the mining site.

Industrial facilities subject to the WPDES permit must prepare and implement a SWPPP for their facility. Nonmetallic mining falls under the requirements for a Tier 2 permit.

TABLE 1
Comparison of Industrial Storm Water Discharge General Permit Requirements by Tier

Requirements	Tier 1	Tier 2	No Exposure
Identify & Eliminate Non-Storm Water Discharges	Yes	Yes	Yes
Develop a Storm Water Pollution Prevention Plan [PDF]	Yes	Yes	No
Document source-areas and implement BMPs per the SWPPP*	Yes	Yes	No
Complete Quarterly Visual Inspection*	Yes	Yes	No
Complete Annual Facility Site Compliance Inspections*	Yes	Yes	No
Perform Chemical Monitoring*	Yes	No	No
No Exposure Certification every 5 years*	No	No	Yes
Submit an Annual Permit Fee	$260	$130	None

WDNR Industrial Permit

"Natural Resources Chapter 216, Wis. Adm. Code, (NR 216) lists certain types of industries in the state that need to obtain storm water discharge permits from the Department of Natural Resources. Permits are issued under a tiered system that groups industries by type and by how likely they are to contaminate storm water. NR 216 lists industries by Standard Industrial Classification (SIC) code.

Tier 1 permits cover various "heavy" manufacturers such as paper manufacturing, chemical manufacturing, petroleum refining, shipbuilding/repair, and bulk storage of coal, minerals and ores.

Tier 2 includes "light" industries that engage in activities that may contaminate storm water or have materials exposed to storm water. The potential for storm water exposure to industrial materials at these sites, while still a concern, is less than at Tier 1 sites. The Tier 2 group includes:

- Facilities engaged in food processing, furniture manufacturing, paper products, or electronics.
- Non-metallic mineral mining (e.g., sand, gravel, rock, and other aggregate).
- Transportation facilities with vehicle maintenance areas, and other industrial activities listed in NR 216.

WDNR General Permit Guidance –

1. APPLICABILITY CRITERIA

"Activities Covered Unless otherwise excluded from coverage under section 1.3, this permit applies to the discharge of pollutants associated with storm water and wastewater from any active and inactive nonmetallic mining operation as defined by Standard Industrial Classification (SIC) Code 1400 to

1499, except SIC Code 1446, to waters of the state either directly or indirectly via a storm sewer or other conveyance. For the purposes of this permit, storm water co-mingled with a wastewater described in sections 1.1.2 through 1.1.7 below is considered wastewater. Additionally, storm water collected and used for washing, cleaning, separating, or processing nonmetallic minerals is considered process wastewater when discharged.

Note: Nonmetallic mining operations as defined under SIC Code 1446 (Industrial Sand) are covered under WPDES Permit No. WI-B046515-6.

Nonmetallic mining operations covered by this permit include sites and equipment engaged in excavation, dredging, or processing of sand, gravel, dimension stone, crushed stone, rotten granite, clay, concrete rubble/aggregate recycle piles or other similar activities, that result in a discharge to waters of the state of one or more of the following:

1.1.1 Contaminated storm water.

1.1.2 Process wastewater associated with washing, cleaning, drying, separating, or processing nonmetallic minerals.

1.1.3 Dewatering activities.

1.1.4 Contact and noncontact cooling water, condensate, or boiler water.

1.1.5 Dust suppression water.

1.1.6 Water from the outside washing of vehicles, equipment, or other objects except as provided in section 1.3.8.

1.1.7 Other similar wastewaters.

Stormwater Pollution Prevention Team

"The stormwater pollution prevention team is responsible for assisting the facility manager in developing the facility's SWPPP as well as implementing and maintaining stormwater control measures, taking corrective action where necessary to address permit violations or to improve the performance of control measures, and modifying the SWPPP to reflect changes made to the control measures.

Since industrial facilities differ in size and complexity, the number of team members will also vary. The stormwater pollution prevention team should consist of those people on-site who are most familiar with the facility and its operations and responsible for ensuring that necessary controls are in place to eliminate or minimize the impacts of stormwater from the facility."

OPERATOR:	KOPPLIN & KINAS CO., INC. W1266 NORTH LAWSON DRIVE GREEN LAKE, WI 54941 PHONE: (920)294-6451 FAX: (920)294-6489 https://kkci.us
TEAM:	DONALD E. KINAS, JR. – PRESIDENT CHRISTOPHER KINAS – AGGREGATE OPERATIONS MIKE MCCONNELL – PERMIT COMPLIANCE, SITE DESIGN

Potential Sources of Contamination

The following have been identified as potential sources of stormwater contamination.

- Equipment used for operations.
- Stockpiled materials.
- Dewatering.
- Vehicle fueling and lubrication.

Best Management Practices

The following are “source area control” type best management practices designed to prevent stormwater contamination from occurring due to the identified sources. These practices will be implemented as part of this SWPPP.

- Equipment used for operations. All equipment used at the facility will be properly maintained. Any equipment with visible leakage will be immediately taken offline and repaired. Any spills that occurred will addressed by the “Spill Prevention and Response Procedures” section of this SWPPP.
- Stockpiled materials. Topsoil will be used to create a vegetated berm around the site, making this facility internally drained. After construction of the berms, they will be immediately seeded and mulched as needed. All other stockpiled material will be confined within the site.
- Dewatering. If any dewatering occurs, all applicable WDNR practices and standards will apply.
- Vehicle fueling and lubrication. Fueling will be completed using a portable delivery service as needed. Fueling will be accomplished by a licensed fuel hauler on level ground. Any spills that occur will follow the “Spill Prevention and Response Procedures” section of this SWPPP.

To supplement these BMPs, also see Appendix D - KKCI practice standards are incorporated into this SWPPP:

Source Area Control

To the maximum extent practicable, and to the extent that it’s cost effective, the use of source area control best management practices designed to prevent stormwater and groundwater from becoming contaminated will be used. Source area control practices incorporated with this SWPPP include earth berms around the project area and use of a settling area to keep the facility internally drained.

Erosion Control

Erosion control features will include temporary seeding, silt fence, straw bales, and tracking pad. Also refer "BMPs for Soil Erosion & Sediment Control", above. All erosion control practices are to be installed and maintained in accordance with DNR technical standards.

In addition, KKCI has developed an **Erosion Control and Stormwater Management Plan** to be implemented in conjunction with the SWPPP.

Good Housekeeping

Good housekeeping practices are designed to maintain a clean and orderly work environment. This will reduce the potential for significant materials to come in contact with storm water.

The follow practices are included in our good housekeeping routine. (Examples: keeping the pump area clean, keeping an accurate inventory, sweeping paved areas and floors, picking up repair facilities, etc.)

Area/Equipment	Tasks	Frequency
Stockpiling Materials: Vegetated Earth Berms	Seed and mulch as needed to maintain stable slope.	As needed. Address erosion immediately.
Stockpiling Materials: Excavated Materials.	Maintain stockpiles.	As needed. Address erosion immediately.

Preventive Maintenance

Preventive Maintenance involves the regular inspection, testing, and cleaning of facility equipment and operational systems. These inspections will help to uncover conditions that might lead to a release of materials. Thus, allowing for maintenance to prevent such a release.

The following equipment/activities will be included in the preventive maintenance program. (Examples: fuel pumps, storage tanks for waste fluids, all structural controls, etc.)

Equipment	Tasks	Frequency
Machinery: See Appendix C	Thorough and professional inspection of all equipment.	A minimum of Quarterly or as needed.

To supplement these BMPs, also see Appendix D - BMPs for Maintenance & Repair of Equipment.

Quarterly Visual Comprehensive Inspections

The permit requires a quarterly inspection of the stormwater runoff. These inspections must be conducted during a runoff event. Records of the inspections must be kept on file with the SWPPP. The water must be checked for physical properties such as odor, color, turbidity, suspended solids, or foam.

See Appendix F – Forms.

Spill Prevention and Response Procedures

Spills and leaks together are the largest industrial source of storm water pollution. Thus, this SWPPP specifies material handling procedures and storage requirements for significant materials. Equipment and procedures necessary for cleaning up spills and preventing the spilled materials from being discharged have also been identified. All employees have been made aware of the proper procedures.

The following procedures have been developed for spill response for our facility. (Examples of areas to include: pumping station, maintenance and repair areas, wash areas, etc.)

Area	Materials Present	Response Plan Location
Machinery: Leakage/spill.	Grease, oils, chemicals.	SWPPP to be kept on site and in a labeled container.
Fueling.	Diesel, gas.	SWPPP to be kept on site and in a labeled container.

Also see Appendix D – BMPs.

Employee Training

The following is a description of the employee training programs to be implemented to inform appropriate personnel at all levels of responsibility of the components and goals of the SWPPP. (Examples: good housekeeping practices, spill prevention and response procedures, waste minimization practices, informing customers of facility policies, etc.)

Topic	Employees Included	Frequency
Good Housekeeping.	All on-site employees.	Annual and at start of employment.
Spill Prevention and response.	All on-site employees.	Annual and at start of employment.

It is the responsibility of all employees to recognize and respond to potential environmental concerns. Pollution prevention plans are reviewed annually by executive and field personnel and updated as needed to protect surface water and groundwater resources. Field crews are trained about the importance of pollution prevention at routine tailgate safety meetings. Topics for discussion include good housekeeping practices, safe petroleum product handling, and proper maintenance and inspection procedures.

Bulk Storage

Bulk storage piles will be managed following the best management practices described in WDNR publication "Storage Pile Best Management Practices" WT-468-96.

Residual Pollutants

There are no known residual pollutants currently.

Stormwater Treatment Best Management Practices

Good housekeeping will be maintained. Vegetated earth berms will be constructed around the site to keep it internally drained. If the berms are damaged, they will be immediately reshaped, reseeded, and mulched as needed. A settling basin will be constructed to contain the 25 year – 24-hour stormwater event to treat contaminated stormwater prior to surface discharge. All equipment will be properly maintained and immediately repaired if any leakage is present.

Also see Appendix D – BMPs.

Preventive Measures

Preventive measures are controls that are intended to prevent the exposure of storm water to contaminates.

The following preventive measures have been chosen for this facility.
(Examples: signs and labels, safety posts, fences, a security system, coverings over areas of concern, etc.)

The safety aspects of nonmetallic mining are regulated by the Occupational Safety and Health Administration as well as the Mine Safety and Health Administration. The primary safety features proposed for the Kinas property are the installation of berms, a locking gate, and proper signage around the site. Posted notices and signs will increase awareness and improve safety. These include:

1. Notice of the required site-specific safety training for those entering the site.
2. Signs with "No Trespassing" and "Danger Active Quarry" posted on the gate, berms, and perimeter of active operations.

Diversions

Diversion practices are structures (including grading and paving) that are used to divert storm water away from high-risk areas and prevent contaminants from mixing with the runoff, or to channel contaminated storm water to a treatment facility or containment area.

The following areas are to be protected using diversion structures.
(Examples: storage areas, processing areas, past spills, etc.)

Area	Material	Control Measure
Stockpiles, processing areas, haul road.	Limestone materials, dust, etc.	Grading and erosion control BMPs

Containment

Containment areas are structures designed to hold pollutants or contaminated storm water to prevent it from being discharged to surface waters. These structures can range from drip pans to large containment areas.

Containment structures will be/have been installed in the following areas. (Examples: containment around waste fluid storage areas, drip pans under valves and pipe connections, curbing around dismantling areas or parts storage areas, etc.)

Area	Material	Control Measure
Processing equipment.	Oil, grease and fluids.	Drip Pans.

Other Controls

None planned.

Facility Monitoring

The owner or other designated person shall inspect, document, and maintain onsite BMPs and stormwater practices so they are in compliance with this SWPPP and are performing as designed.

Annual and quarterly visual inspections and reports shall be performed and documented as required under sections 3.2 and 3.7 of the Nonmetallic Mining General Permit WI-A046515-6, respectively. These sections are included in Appendix D of this SWPPP for reference along with DNR forms for documenting these inspections.

Annual visual inspections shall include observations and maintenance of the following items, including by not limited to:

- Stormwater drainage areas and patterns remain accurate with design.
- Erosion control features are working as designed.
- Sediment basin is receiving stormwater runoff from mine site as designed.
- Sediment basin integrity and functionality of features including:
    - Trash and debris removal
    - Berm
    - Spillway
    - Riprap
    - Side slopes
    - Any areas that may have experienced erosion, washout, and/or undercutting
    - Remove accumulated sediment in bottom of basin.

Quarterly visual inspections shall include annual visual inspection listed items along with observing and documenting stormwater discharge quality at each outfall. These water quality inspections shall be conducted within the first 30 minutes or as soon thereafter as practical, but not to exceed 60 minutes after runoff begins discharging at the outfall. Observations shall include:

- Color
- Odor
- Turbidity
- Floating solids
- Foam
- Oil sheen, and/or
- Other obvious indicators associated with contaminated stormwater.

All inspection reports shall include the inspection date, inspection personnel, scope of the inspection, major observations, and a schedule for implementing any further actions necessary. All reports and records pertaining to the permit coverage under this general permit shall be kept onsite for a minimum of 5 years, along with this SWPPP. These records shall be made available to the DNR upon request.

Evaluation of Non-Stormwater Discharges

Monitoring includes site inspections as well as the collection and analysis of storm water samples.

The purpose of monitoring is to: a) evaluate storm water outfalls for the presence of non-storm water discharges, and b) evaluate the effectiveness of the company's pollution prevention activities in controlling contamination of storm water discharges.

Monitoring must include:

NON-STORM WATER DISCHARGES
All storm water outfalls shall be evaluated for non-storm water contributions to the store drainage system for the duration of this permit. Any monitoring shall be representative of non-storm water discharges from the facility. Any unauthorized storm water discharges must be eliminated, or covered under another WPDES permit.

The following is a list of non-storm water discharges or flows that are not considered illicit (Unless identified as a significant source of contamination).

Water line flushing, landscape irrigation, diverted stream flows, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, de-chlorinated swimming pool water, street wash water, and firefighting.

1) Evaluations shall take place during dry periods, and may include either end of pipe screening or detailed testing of the storm sewer collection system.
2) Either of the following monitoring procedures is acceptable:
a) A detailed testing of the storm sewer collection system may be performed. Acceptable testing methods include dye testing, smoke testing, or video camera observation. A re-test shall be done every 5 years or a lesser period as deemed necessary.
b) End of pipe screening shall consist of visual observations made at least twice per year at each outfall of the storm sewer collection system. Instances of dry weather flow, stains, sludge, color, odor, or other indications of a non-storm water discharge shall be recorded.

The following table summarizes the evaluation results.

Date	Outfall	Method	Evaluator	**Observations** (are there any non-storm water discharges? Authorized or unauthorized?)	Date Corrected

If outfalls cannot be evaluated for non-storm water discharges the Permit Compliance Manager shall sign a statement certifying an inability to comply with this requirement and include a copy of the statement in the SWPPP. In this case, the SWPPP shall be submitted to the department.

Annual Facility Site Compliance Inspection

The Permit Compliance Manager shall make an annual inspection to evaluate the effectiveness of the SWPPP. The inspection shall be adequate to verify that the site drainage conditions, and potential pollution sources identified in the SWPPP remain accurate, and that the best management practices prescribed in the SWPPP are being implemented, properly operated and adequately maintained. Information reported shall include the inspection date, inspection personnel, scope of the inspection, major observations, and revisions needed in the SWPPP.

Quarterly Visual Monitoring

Quarterly visual inspections shall include annual visual inspection listed items along with observing and documenting stormwater discharge quality at each outfall. These water quality inspections shall be conducted within the first 30 minutes or as soon thereafter as practical, but not to exceed 60 minutes after runoff begins discharging at the outfall.

Notes:

1. Annual and quarterly visual inspections and reports shall be performed and documented as required under sections 3.2 and 3.7 of the Nonmetallic Mining General Permit WI-A046515-6, respectively. These sections are included in Appendix F of this SWPPP for reference along with DNR forms for documenting these inspections.

2. All inspection reports shall include the inspection date, inspection personnel, scope of the inspection, major observations, and a schedule for implementing any further actions necessary.

3. All reports and records pertaining to the permit coverage under this general permit shall be kept onsite for a minimum of 5 years, along with this SWPPP. These records shall be made available to the DNR upon request.

Implementation Schedule

This SWPPP becomes effective as of insert date. The non-structural controls will be implemented by insert date. Structural controls will be in place by insert date.

Record keeping and reporting

All reports and records pertaining to the permit coverage under this general permit shall be kept onsite for a minimum of 5 years, along with this SWPPP. These records shall be made available to the DNR upon request.

A current copy of the Stormwater Pollution Prevention Plan Summary must be sent to the Department of Natural Resources.

Amending a Stormwater Pollution Prevention Plan

Unless an alternate timeframe is specified by the Department, the permitee shall amend the SWPPP within 30 days of the occurrence of any of the following circumstances:

1. When expansion, production increases, process modifications, changes in material handling or storage, or other activities are planned which will result in significant increases in the exposure of pollutants to stormwater discharged either to waters of the state or to stormwater treatment devices. The amendment shall contain a description of the new activities that contribute to the increased pollutant loading, planned source control activities that will be used to control pollutant loads, an estimate of the new or increased discharge of pollutants following treatment, and when appropriate, a description of the effect of the new or increased discharge on existing stormwater treatment facilities.
2. The comprehensive annual facility site compliance inspection, quarterly visual inspection of stormwater quality, or other information reveals that the provisions of the SWPPP are ineffective in controlling stormwater pollutants discharged to waters of the state.
3. Under written notice that the Department finds the SWPPP to be ineffective in achieving the conditions of this permit.

STORMWATER POLLUTION PREVENTION PLAN
SKUNK HOLLOW QUARRY

Certification of the SWPPP

I certify under penalty of law that this document and attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information contained in the plan. Based on my inquiry of the person, or persons, who manage the system, or those persons directly responsible for gathering the information: the information contained in this document is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for providing false information, including the possibility of fine and imprisonment. In addition, I certify under penalty of law that, based upon inquiry of persons directly under my supervision, to the best of my knowledge and belief, the provisions of this document adhere to the provisions of the storm water permit for the development and implementation of a Storm Water Pollution Prevention Plan and that the plan will be complied with."

____
(Signature of Plan Preparer)

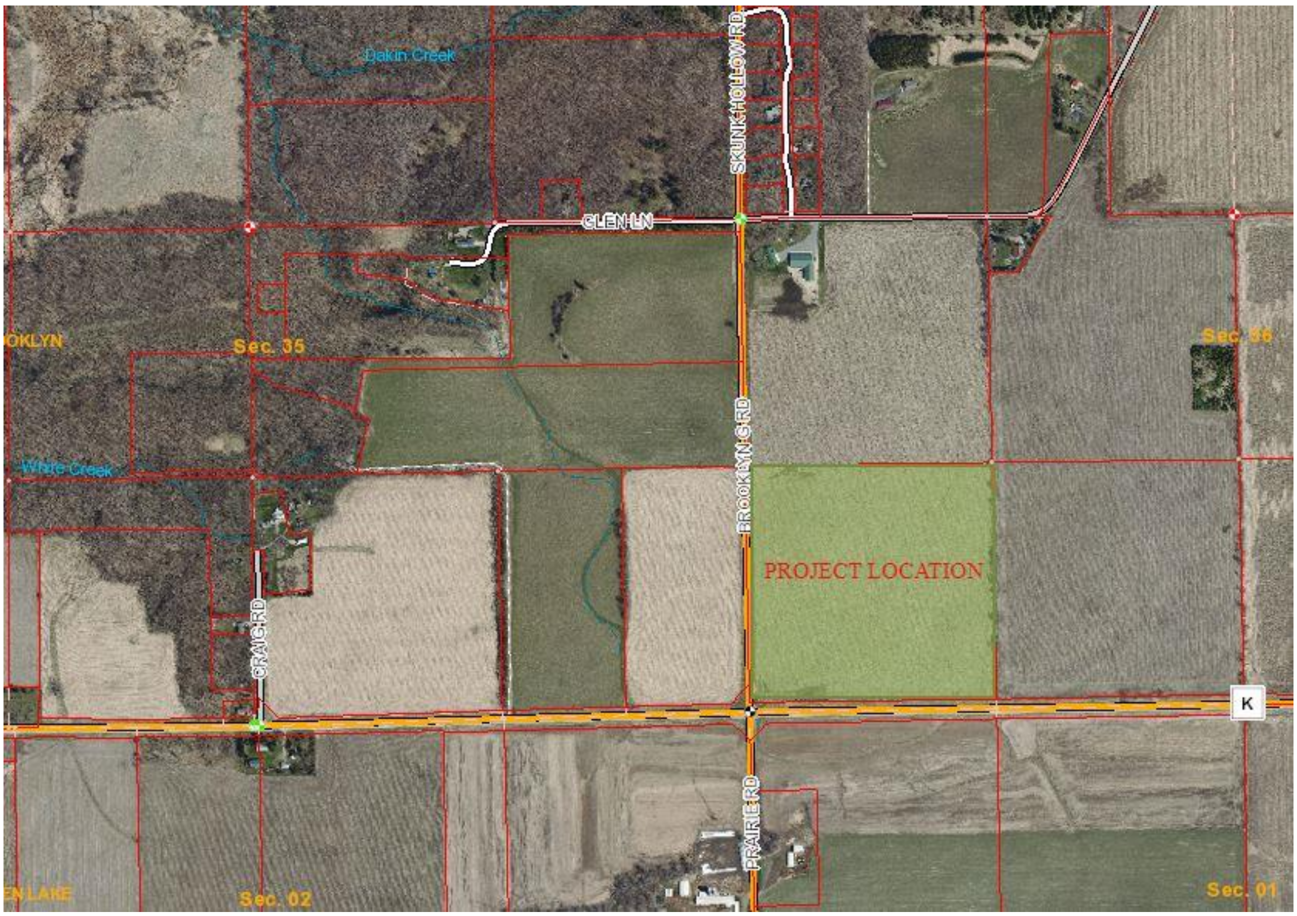
____________________________________ __________________
(Printed Name) (Date)

____________________________________ __________________
(Signature of Authorized Representative) (Date)

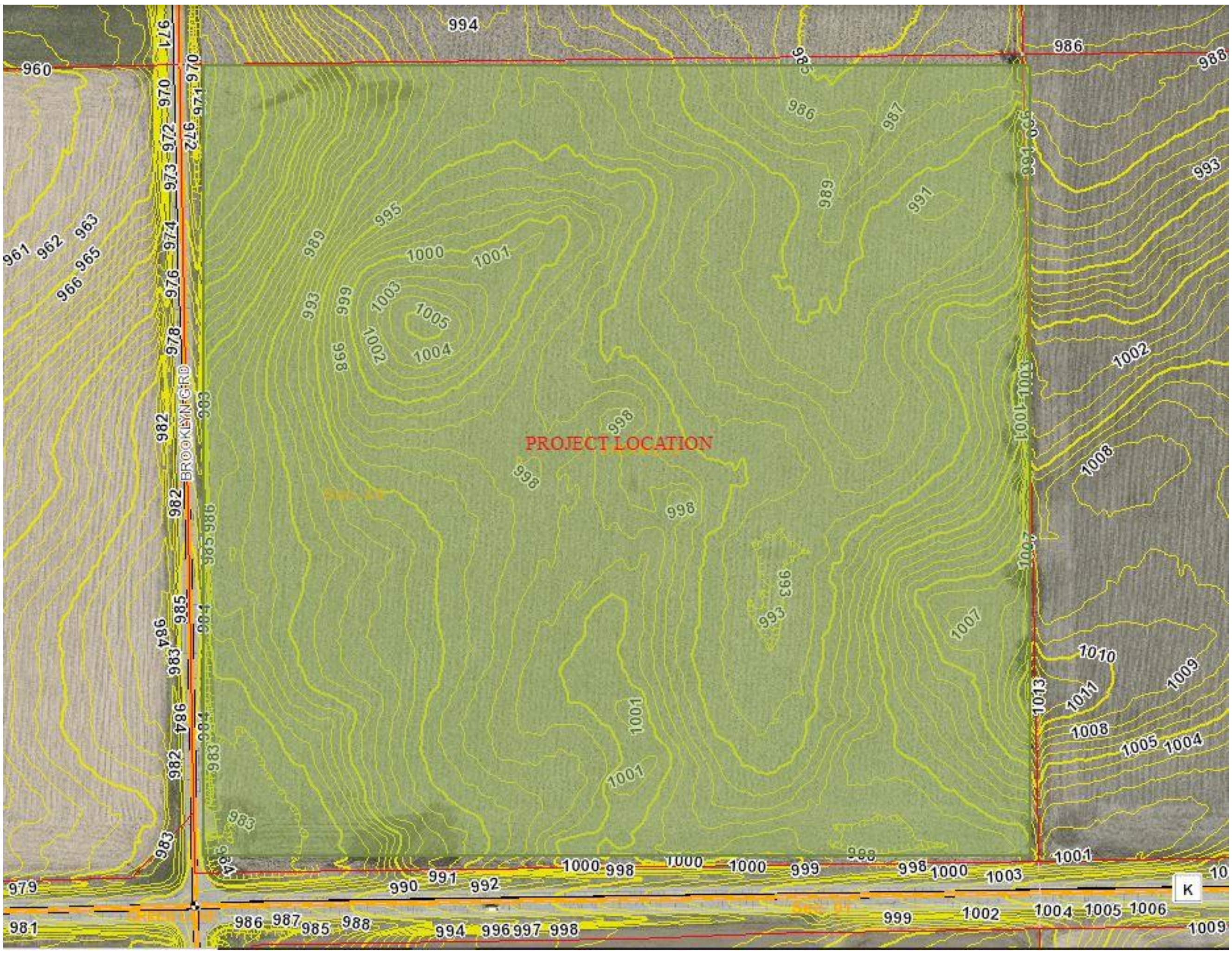
____________________________________ __________________
(Printed Name) (Title)

Appendix A - Maps

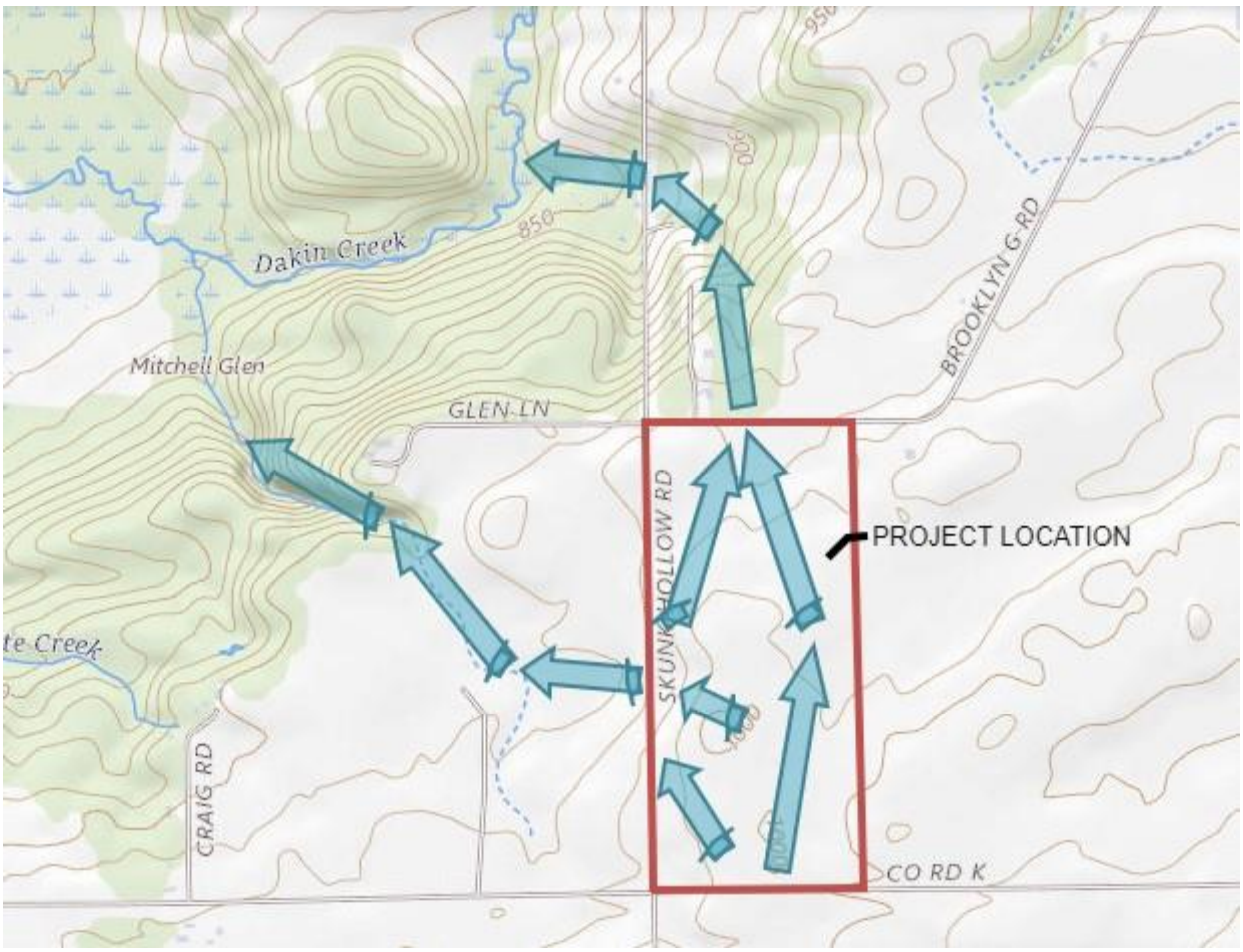
Project Location



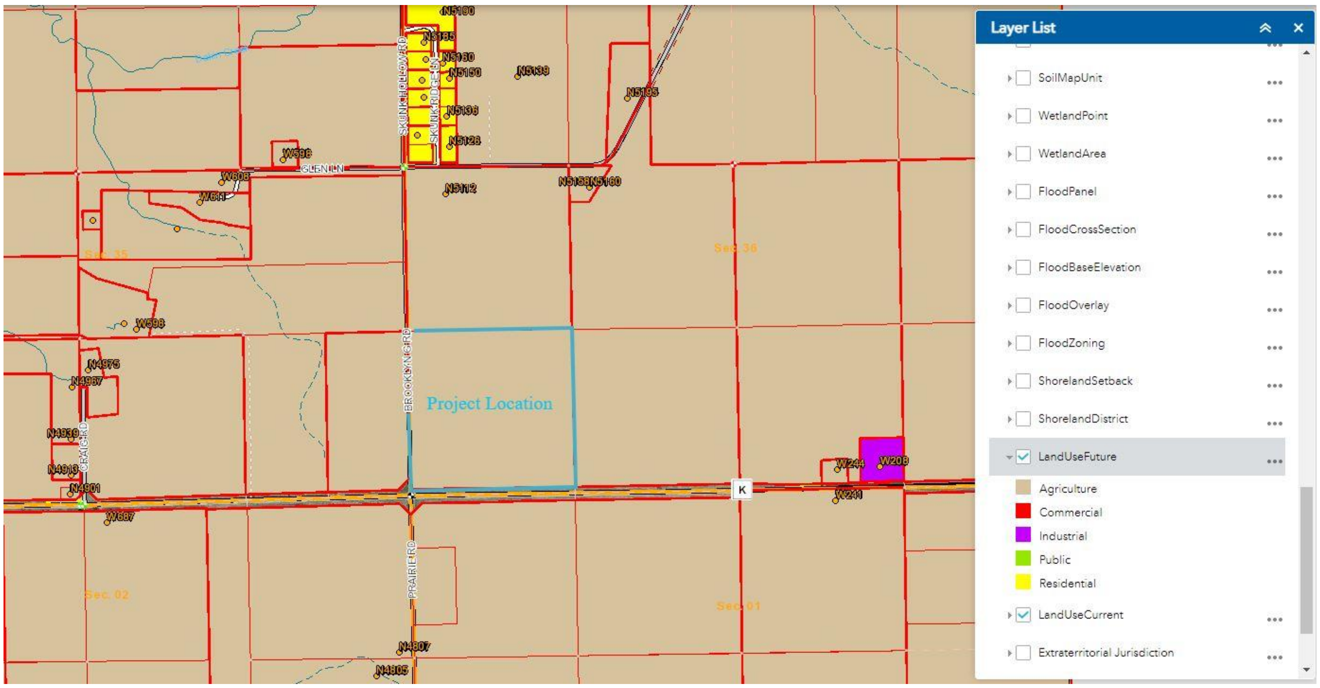
Project Topo – GLC GIS



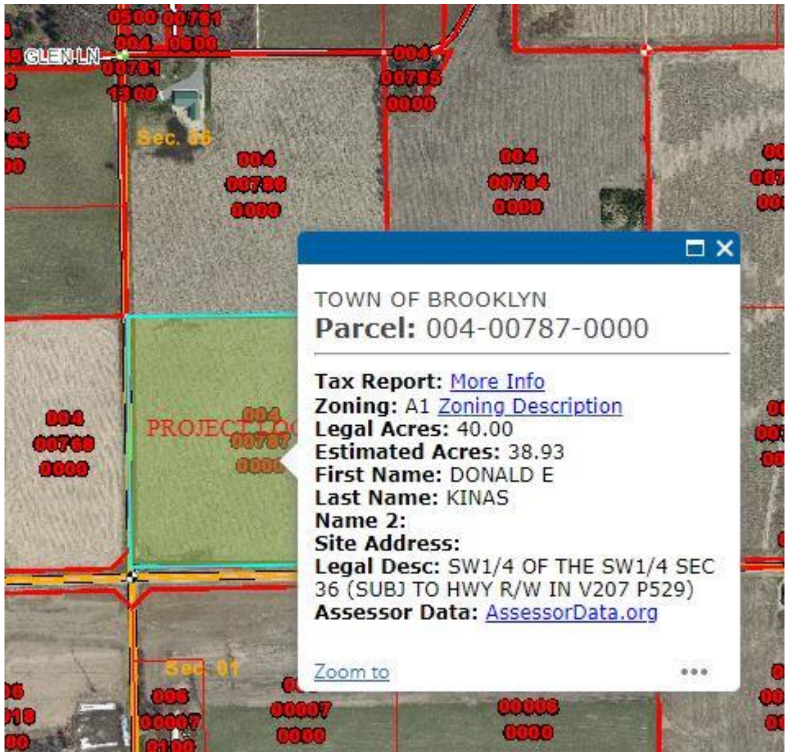
Drainage Patterns

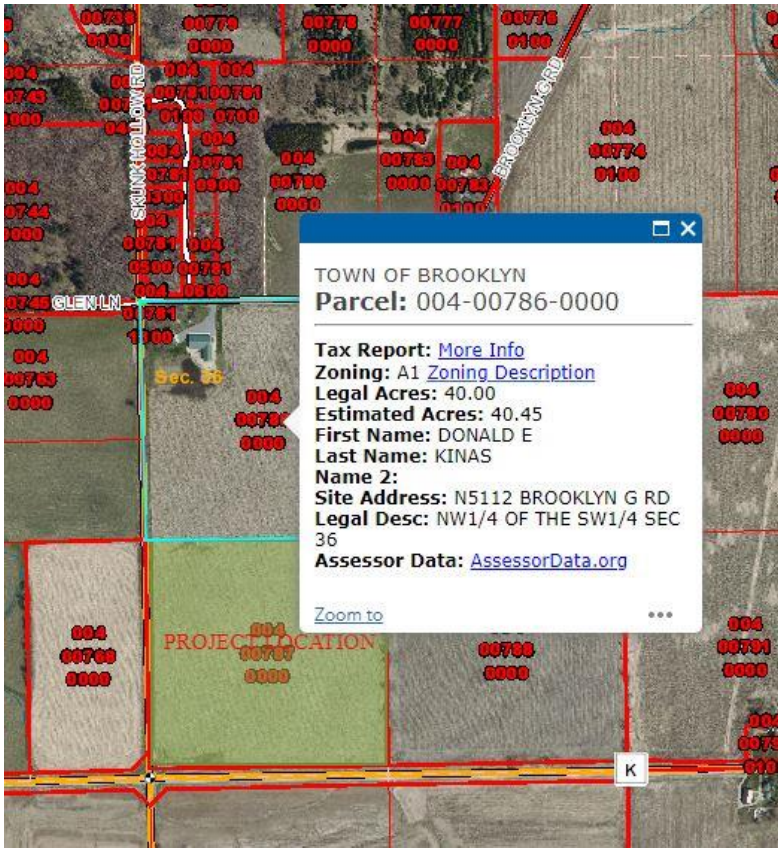


Land Use


Project Location
K
Layer List
SoilMapUnit
WetlandPoint
WetlandArea
FloodPanel
FloodCrossSection
FloodBaseElevation
FloodOverlay
FloodZoning
ShorelandSetback
ShorelandDistrict
LandUseFuture
Agriculture
Commercial
Industrial
Public
Residential
LandUseCurrent
Extraterritorial Jurisdiction

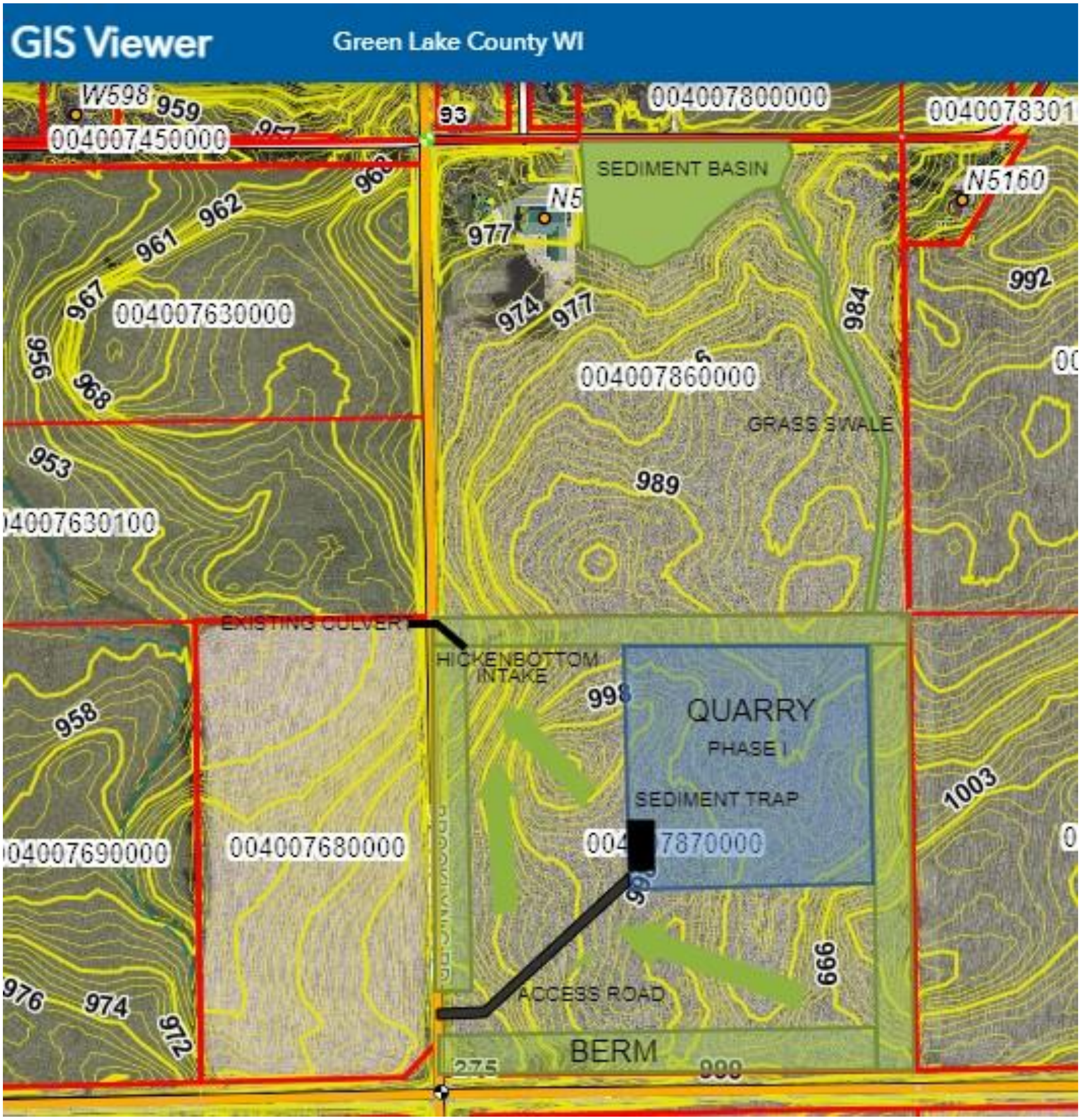
Parcel Ownership





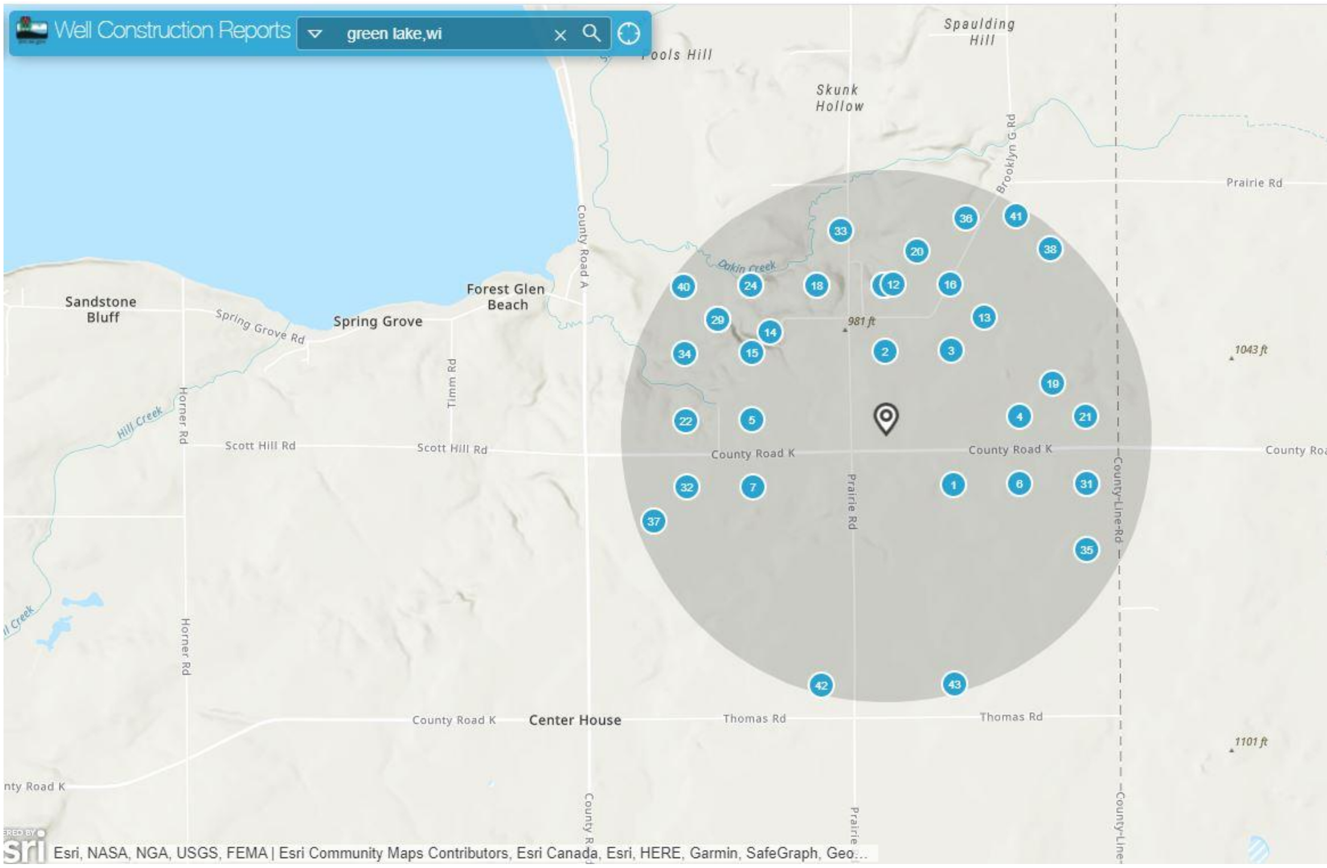
TOWN OF BROOKLYN
Parcel: 004-00786-0000
Tax Report: More Info
Zoning: A1 Zoning Description
Legal Acres: 40.00
Estimated Acres: 40.45
First Name: DONALD E
Last Name: KINAS
Name 2:
Site Address: N5112 BROOKLYN G RD
Legal Desc: NW1/4 OF THE SW1/4 SEC 36
Assessor Data: AssessorData.org
Zoom to
SKUNK HOLLOW RD
GLEN LN
BROOKLYN G RD
PROJECT LOCATION
K

General Development Site Map



Appendix B
LOCAL WELL CONSTRUCTION REPORTS

WELL LOCATIONAL MAP



Well 3

T16N R13E

Wel. 6 33

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side

1. County Green Lake — Town [X] Village [ ] City [ ] ~~Green Lake~~ BROOKLYN (Check one and give name)

T16N R13E — 2. Location 3 miles S.E. of Green Lake on H.W.K. — NW, NE, SW, Sec.36 (Name of street and number of premise or Section, Town and Range numbers)

3. Owner [X] or Agent [ ] Oaken School Dist (Name of individual, partnership or firm)

4. Mail Address C/o Wm Kochler - Green Lake (Complete address required)

RECEIVED SEP 2 1954 ENVIRONMENTAL SANITATION

5. From well to nearest: Building 8 ft; sewer ...... ft; drain ...... ft; septic tank ...... ft; dry well or filter bed ...... ft; abandoned well ...... ft.

6. Well is intended to supply water for: School

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
10	0	48	6	48	178

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
6	steel	0	48

9. GROUT:

Kind	From (ft.)	To (ft.)
neat cement	20	48

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Drift	0	27
Solid Rock	27	178

Construction of the well was completed on: Aug 24 1954

The well is terminated 12 inches [X] above, below [ ] the permanent ground surface.

Was the well disinfected upon completion? Yes X No ......

Was the well sealed watertight upon completion? Yes Capped No ......

11. MISCELLANEOUS DATA:

Yield test: 24 Hrs. at 15 GPM.

Depth from surface to water-level: 48 ft.

Water-level when pumping: 150 ft.

Water sample was sent to the state laboratory at: Madison (City) on Aug 24 1954

Signature Ira E. Brown (Registered Well Driller) — Brandon Wis (Complete Mail Address)

Please do not write in space below

Rec'd AUG 25 1954 No. 25580

Ans'd SAFE

Interpretation

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.	0				
48 hrs.	0				
Confirm					
B. Coli	0/5				

Examiner ......

4422 100' 1377061 plot

Well 4

Well Construction Report
WISCONSIN UNIQUE WELL NUMBER **LX386**

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner	HERSCHBERGER, ART
Phone #	(414)295-6220
Mailing Address	W208 CTY RD K
City	RIPON
State	WI
Zip Code	54971
County	Green Lake
Co. Permit #	
Notification #	
Completed	07-03-1997
Well Constructor (Business Name)	SAMS ROTARY DRILLERS INC
Lic. #	370
Facility ID # (Public Wells)	
Well Plan Approval #	
Address	PO BOX 150, RANDOLPH WI 53956-0150
Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	
Common Well #	
Specific Capacity	0.1

1. Well Location

Town of BROOKLYN	Fire # (if avail.)
Street Address or Road Name and Number	CTY HWY K
Subdivision Name	
Lot #	
Block #	
Latitude / Longitude in Decimal Degree (DD)	°N °W
Method Code	GPS008
SW SE or Govt Lot #	
Section	36
Township	16 N
Range	13 E

2. Well Type New Well

of previous unique well # constructed in

Reason for replaced or reconstructed well ?

Construction Type Drilled

3. Well serves 1 # of BUSINESS

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
8.75	Surface	103
6	103	177

Upper Enlarged Drillhole / Lower Open Bedrock

- Rotary - Mud Circulation ....
- Yes Rotary - Air ....
- Rotary - Air & Foam ....
- Drill-Through Casing Hammer
- Reverse Rotary
- Cable-tool Bit ____in. dia...
- Dual Rotary ....
- Yes Temp. Outer Casing 10in. dia
- Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes		**8. Geology** Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
	Z	CLAY @ GRAVEL	Surface	3
	L	LIMEROCK	3	120
	N	SANDROCK	120	177

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	STD BLK PIPE 280 WALL WLD JTS A53 SAWHILL	Surface	103
Dia. (in.)	**Screen type, material & slot size**	**From (ft.)**	**To (ft.)**

9. Static Water Level

85 ft. below ground surface

10. Pump Test

Pumping level 120 ft. below surface

Pumping at 2 GP M for 1 Hrs.

Pumping Method ?

11. Well Is

24 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

7. Grout or Other Sealing Material

Method TREMIE PUMPED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
CEMENT	Surface	103	21 S

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed?

13. Constructor / Supervisory Driller	Lic #	Date Signed
SVJ		07-15-1997
Drill Rig Operator	Lic or Reg #	Date Signed
RH		07-15-1997

WISCONSIN UNIQUE WELL NUMBER **LX386**

Well 5

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH

See Instructions on Reverse Side [BROOKLYN]

1. County Green Lake Town ☒ Village ☐ City ☐ — Check one and give name

2. Location Highway X [NW, SW, SE, Sec. 35, T16N R13E] — Name of street and number of premise or Section, Town and Range numbers

3. Owner ☐ or Agent ☐ Craig Bros. — Name of individual, partnership or firm

4. Mail Address R. R. 2 Ripon, Wisconsin — Complete address required

5. From well to nearest: Building 4 ft; sewer ___ ft; drain ___ ft; septic tank ___ ft; ___ dry well or filter bed ___ ft; abandoned well ___ ft.

6. Well is intended to supply water for: home

RECEIVED MAY 15 1953 ENVIRONMENTAL SANITATION

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8	0	66			
6	66	113			

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind	From (ft.)	To (ft.)
6	steel pipe	0	66

9. GROUT:

Kind	From (ft.)	To (ft.)
Cement	0	66

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
Drift	0	4
Shell rock	4	36
Solid rock	36	113

Construction of the well was completed on: May 8 1953

The well is terminated 8 inches ☐ above, below the permanent ground surface.

Was the well disinfected upon completion? Yes X No ___

Was the well sealed watertight upon completion? Yes X No ___

11. MISCELLANEOUS DATA:

Yield test: 24 Hrs. at 10 GPM.

Depth from surface to water-level: 50 ft.

Water-level when pumping: 52 ft.

Water sample was sent to the state laboratory at: ___ (City) on ___ 19__

Signature I. E. Brown (Registered Well Driller) Brandon, Wisconsin (Complete Mail Address)

Please do not write in space below

Rec'd MAY 14 1953 No. 2527

Ans'd

Interpretation S. f.

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.	O	O	O	O	O
48 hrs.	O	O	O	O	O
Confirm					
B. Coli					

Examiner ___

Well 14

Well Construction Report — WISCONSIN UNIQUE WELL NUMBER OE090

Drinking Water and Groundwater - DG/5
Department of Natural Resources, Box 7921
Madison WI 53707
Form 3300-077A

Property Owner	SMITH, KATHY
Phone #	(920)748-4115
Mailing Address	W611 GLEN LN
City	RIPON
State	WI
Zip Code	54971
County	Green Lake
Co. Permit #	
Notification #	
Completed	09-25-2000
Well Constructor (Business Name)	CENTRAL WELL DRILLING LLC
Lic. #	4231
Facility ID # (Public Wells)	
Well Plan Approval #	
Address	PO BOX 405 400 S WOODWARD ST BRANDON WI 53919-0405
Approval Date (mm-dd-yyyy)	
Hicap Permanent Well #	
Common Well #	
Specific Capacity	0.6

1. Well Location

Town of	BROOKLYN
Fire # (if avail.)	
Street Address or Road Name and Number	W611 GLEN LN
Subdivision Name	
Lot #	
Block #	
Latitude / Longitude in Decimal Degree (DD)	43.8143 °N -88.912 °W
Method Code	GCD013
NE SE or Govt Lot #	
Section	35
Township	16 N
Range	13 E

2. Well Type New Well

of previous unique well # constructed in

Reason for replaced or reconstructed well ? OLD WELL NOT UP TO CODE

Construction Type Drilled

3. Well serves 1 # of

Private,potable

Heat Exchange____# of drillholes

Hicap Well ? No

Hicap Property ? No

Hicap Potable ?

4. Potential Contamination Sources - ON REVERSE SIDE

5. Drillhole Dimensions and Construction Method

Dia. (in.)	From (ft.)	To (ft.)
8.75	Surface	62
6	62	227

Upper Enlarged Drillhole / Lower Open Bedrock

- Yes — Rotary - Mud Circulation
- Rotary - Air
- Rotary - Air & Foam
- Drill-Through Casing Hammer
- Reverse Rotary
- Cable-tool Bit ____in. dia...
- Dual Rotary
- Temp. Outer Casing ____in. dia
- Removed? ____depth ft. (If NO explain on back side)

8. Geology

Geology Codes		8. Geology Type, Caving/Noncaving, Color, Hardness, etc...	From (ft.)	To (ft.)
C		CLAY	Surface	2
C	G	GRAVEL & BOULDERS	2	14
L	H	LIMEROCK & SHALE	14	36
N		SANDROCK	36	227

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
6	NEW BLACK STEEL 18.97# PER FT 1780 PSI ASTM A-53 GR B PE USA IPSCO	Surface	62

Dia. (in.)	Screen type, material & slot size	From (ft.)	To (ft.)

9. Static Water Level

96 ft. below ground surface

10. Pump Test

Pumping level 120 ft. below surface

Pumping at 15 GP M for 1 Hrs.

Pumping Method ?

11. Well Is

12 in. above grade

Developed ? Yes

Disinfected ? Yes

Capped ? Yes

7. Grout or Other Sealing Material

Method TREMIE PIPE-PUMPED

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
MUD & CUTTINGS	Surface	6	
CEMENT	6	62	10 S

12. Notified Owner of need to fill & seal ?

Filled & Sealed Well(s) as needed? Yes

13. Constructor / Supervisory Driller	Lic #	Date Signed
TRO		09-25-2000

Drill Rig Operator	Lic or Reg #	Date Signed

WISCONSIN UNIQUE WELL NUMBER OE090

Well 15

County Gr. Lake Twp. Brooklyn Sec.

(NE, NW, SE, Section 35 T16N R13E)

TO THE WISCONSIN STATE BOARD OF HEALTH,
WELL DRILLING DIVISION, MADISON, WIS. JUN 19 1939

WELL LOG PREMISES DIAGRAM, and REPORT

For Official Record of the Board
(TO BE USED FOR THAT PURPOSE ONLY)

Owner David Cole Driller Pat McHugh
(If a joint ownership give name of responsible official. Also name of each individual holding an interest. Use a separate sheet and attach hereto.)
Address Oshkosh

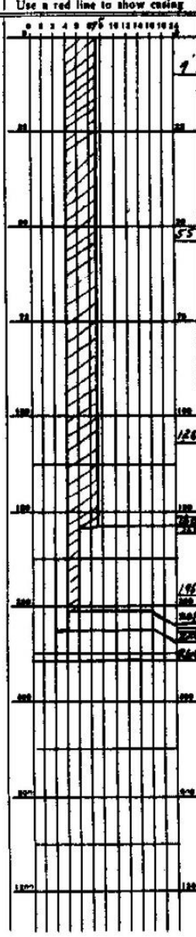
Address Ripon, Wis.
(City, village, township, county)

Date of Report June 18 1939
Registration No. 268

Give below the location of the property on which well is drilled.

If incorporated village or city: Name, Lot, Blk., Street and No.
If unincorporated hamlet: Name, County, Twp., Highway
If Lake Shore Plat: Name of Plat, Lake, Lot, Blk., Street
If Subdivision: Name, County, Twp., Sec., Lot, Blk.
If Farm: Green Lake (County), Brooklyn (Twp.), 35 (Sec.), Highway
If School: County, Twp., Sec., District
If other public building: Kind, County, Twp., Sec.

WELL LOG and REPORT

Kind of casing and liner in feet. Kind of shoe. Indicate grout, screen, seal, etc.	WELL DIAGRAM Vertical Lines = in. Dia. Horizontal Lines = ft. Depth Use a red line to show casing	Give depth of formations in feet. State if dry or water bearing.	Record of FINAL Pumping Test
20' 4" Steel casing pipe "Drillers Special" Youngstown 65' - 3" Steel casing pipe "Drillers Special" Youngstown 4" Forged steel drive shoe		Topsoil - 9' Creviced Limestone dry. - 44' Sandstone - little water - 70 Marl - 30' Limestone - 12' Marl - 20' Limestone - 11' Marl - 4' Sandstone - water bearing 50'	Duration of test. Hours 6 Pumping Rate. G.P.M. 13½ Depth of pump in well. Ft. 140 Standing water-level (from surface.) Ft. 125 Water level when pumping Ft. 129 Water. End of test. Check: Clear X Cloudy Turbid Was well sterilized before test? Yes X No Date May 25, 1939 To which Laboratory was sample sent? Oshkosh Date May 25, 1939 Was the well sealed on completion? Yes X No X How high did you leave casing above grade? 4'-0" Well was completed May 25 1939 Well Driller: Pat McHugh Signature. (Be sure to complete the report on the reverse side)

Well 18

JUL 17 1970

WELL CONSTRUCTOR'S REPORT
Wel-6

WHITE COPY – DIVISION'S COPY
GREEN COPY – DRILLER'S COPY
YELLOW COPY – OWNER'S COPY

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
Box 450
Madison, Wisconsin 53701

1. COUNTY: Green Lake — CHECK ONE: [x] Town [ ] Village [ ] City — NAME: Brooklyn

2. LOCATION (Number and Street or ¼ section, section, township and range. Also give subdivision name, lot and block numbers when available.)
Sec. 35 T16N - R13E / SW SE ¼ of the NE ¼, Sec. 35

3. OWNER AT TIME OF DRILLING
James Clark Jr.

4. OWNER'S COMPLETE MAIL ADDRESS
R. 2 Ripon, Wis.

5. Distance in feet from well to nearest: (Record answer in appropriate block)

BUILDING	SANITARY SEWER C. I.	SANITARY SEWER TILE	FLOOR DRAIN C. I.	FLOOR DRAIN TILE	FOUNDATION DRAIN SEWER CONNECTED	FOUNDATION DRAIN INDEPENDENT	WASTE WATER DRAIN C. I.	WASTE WATER DRAIN TILE
12	39							

CLEAR WATER DRAIN C. I.	CLEAR WATER DRAIN TILE	SEPTIC TANK	PRIVY	SEEPAGE PIT	ABSORPTION FIELD	BARN	SILO	ABANDONED WELL	SINK HOLE
		40			50			14	

OTHER POLLUTION SOURCES (Give description such as dump, quarry, drainage well, stream, pond, lake, etc.)

6. Well is intended to supply water for:
Residence

7. DRILLHOLE

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8 3/4	Surface	117			
6	117	260			

8. CASING, LINER, CURBING, AND SCREEN

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
6	New, Black, Steel	Surface	117
	18.97 lbs. per ft.		
	P E		
	Rotary		

9. GROUT OR OTHER SEALING MATERIAL

Kind	From (ft.)	To (ft.)
Cuttings & Drillmud	Surface	7
Neat Cement	7	117

10. FORMATIONS

Kind	From (ft.)	To (ft.)
Clay	Surface	3
Gravel & Clay	3	16
Limerock	16	203
Sandstone	203	260

Well construction completed on 6-19 1970

Well is terminated 12 inches [x] above [ ] below final grade

Well disinfected upon completion [x] Yes [ ] No

Well sealed watertight upon completion [x] Yes [ ] No

11. MISCELLANEOUS DATA

Yield test: 8 Hrs. at 12 GPM

Depth from surface to normal water level 108 ft.

Depth to water level when pumping 117 ft.

Water sample sent to Madison laboratory on: 7-15 1970

Your opinion concerning other pollution hazards, information concerning difficulties encountered, and data relating to nearby wells, screens, seals, type of casing joints, method of finishing the well, amount of cement used in grouting, blasting, sub-surface pumprooms, access pits, etc., should be given on reverse side.

SIGNATURE: Howard L. Zoellner Registered Well Driller

COMPLETE MAIL ADDRESS: Brandon, Wisconsin

Please do not write in space below

COLIFORM TEST RESULT	GAS — 24 HRS.	GAS — 48 HRS.	CONFIRMED	REMARKS
4419				100' 1377062

REV. 11-68

Appendix C

Kopplin & Kinas Co., Inc.
Aggregate Processing & Construction Equipment

Site Development

Dozers

Scrapers

Excavators

Haul Trucks

Graders

Processing & Material Transport

Drill Rigs

Crushing Units (Primary, Secondary, Tertiary)

Screening Units

Washing Units

Conveyors

Wheeled Loaders

Skid-Loaders

Service Trucks

Crane

Haul Trucks

Generators

Pumps

Aggregate & Product Transport

Truck Scale

Scale House

Dump Trucks

Forklifts

Equipment for Environmental Control

Tractor & Seed Spreader

Roller

Water Truck

Sweeper

Kopplin & Kinas Co., Inc. Annotated Product List

Shot Rock
Rip-Rap- Various Sizes
Breaker Run
Dense Base- Various Sizes
Clear Stone- Various Sizes
Screenings
Ag-Lime
Asphalt & Concrete Aggregate
Recycled Concrete
Recycled Asphalt
Crushed Chips- Various Sizes
Crushed Granular Fill

Appendix D

Kopplin & Kinas Company Inc.
Pollution Prevention Best Management Practices

Introduction & Purpose

Kopplin & Kinas Company Incorporated (KKCI) is an aggregate production and heavy/civil construction company serving the communities of Green Lake and the surrounding counties since 1926.

KKCI's business is reliant upon an available supply of sand and crushed stone to complete their projects and service their customers. Crushed stone and sand and gravel are intermittently excavated from local stone and glacial deposits. They are processed and delivered using one or more combinations of stripping, excavating, crushing, screening, washing, and load-out equipment.

KKCI has prepared the following plan to identify potential pollutants at these work sites and minimize their exposure to sensitive waters of the State through employee education, sound planning, and the best management practices (BMPs) described herein.

Responsibility & Training

It is the responsibility of all employees to recognize and respond to potential environmental concerns. Pollution prevention plans are reviewed annually by executive and field personnel and updated as needed to protect surface water and groundwater resources. Field crews are trained about the importance of pollution prevention at routine tailgate safety meetings. Topics for discussion include good housekeeping practices, safe petroleum product handling, and proper maintenance and inspection procedures.

Erosion control measures outside of plant and equipment work areas may be identified by field personnel. In these situations, company officials are notified so that site specific BMPs can be implemented.

Potential Pollutants & Best Management Practices

There are two general types of pollutants at every crushed stone or sand and gravel facility. These include: (1) Sediment, and (2) petroleum products such as fuels and/or lubricants. The following section describes potential pollutant sources and BMPs for prevention of their release to sensitive waters of the State.

BMPs for Soil Erosion & Sediment Control

Site preparation activities at new nonmetallic mine sites or previously undisturbed portions of an existing nonmetallic mine site can release sediments, allowing their capture into storm water. These activities include topsoil and/or overburden stripping, berm construction, and the establishment of an access drive. Soils containing a high percentage of silt or clay, and those located near waterways or on steep slopes pose the highest risk for erosion and sediment runoff, particularly during periods of high precipitation.

Proper site planning is the best approach to prevention. For new and existing sites, KKCI personnel may elect to implement any one or more of the following BMPs for storm water control under changing site conditions:

- Develop the site incrementally, preserving vegetation (where Possible) along the perimeter of the excavation.
- Divert surface water away from disturbed areas.
- Prevent tracking of sediment from the entrance of the site. This can be done several ways: (1) Restricting on-road vehicles to stabilized areas, (2) Diverting surface water runoff from the roadway into the facility, (3) Constructing a gravel tracking pad, or (4) Inspecting and cleaning up any residual material tracked onto adjacent roadways.
- Contain surface water runoff within the overall excavation (below grade) so sediments in surface water will be captured and filtered before they are discharged to groundwater.
- Construct berms with stable slopes (typically 3:1 or less), away from sensitive wetlands or waterways.
- Stabilize berm areas upon construction with perennial vegetative cover, mulching as needed.
- Evaluate runoff at outfalls, near wetlands and waterways, or areas of steep slopes to evaluate the need for additional erosion controls such as those outlined in the Wisconsin Construction Site Erosion Control Field Guide, and Wisconsin DOT handbook. These controls may include but are not limited to the temporary erection of silt fence, sediment traps, straw bales or natural or synthetic matting or netting, or the permanent construction of sediment retention ponds.

BMPs for Material Processing & Loading

Aggregate processing requires the physical reduction, sizing and/or washing of natural earth materials. Portable processing equipment is used to produce various sized material stockpiles. The equipment is used intermittently at KKCI's facilities to produce the needed construction aggregates. In general, processing is conducted below grade within the area of extraction. KKCI may elect to implement any one or more of the following BMPs to minimize risk from sediment to storm water and nearby surface water bodies during processing and loading:

- Consider environmental impacts when selecting plant sites. Site all processing equipment away from surface water bodies; preferably below grade within the area of extraction.
- Maintain internal drainage of the site for the duration of the processing cycle.
- Construct berms or dikes around processing equipment and/or wash ponds if surface water runoff is not adequately contained onsite.
- Use conveying equipment to stockpile sand and crushed stone products away from major transportation routes within the facility.
- Manage bulk storage piles following the BMPs described in Wisconsin DNR publication "Storage Pile Best Management Practices" WT-468-96, When placed outside of the internally drained limits of the excavation.
- Properly size wash ponds to have sufficient storage capacity for wash out purposes, as well as a 25-year storm event.
- Routinely remove fines generated from crushing, screening, or conveying operations to prevent buildup and off-site tracking.
- Loadout within the area of extraction, being careful to avoid spilling from trucks.

BMPs for Maintenance of Roads, Erosion Controls, & Wash Ponds

Roadways, temporary and permanent erosion control structures, and wash ponds need to be maintained to ensure optimum performance. Routine Maintenance is scheduled on an as needed basis and may include any one or more of the following:

- Refresh the tracking pad and/or sweep sediment from paved roadways.
- Remove silt fence, straw bales or other temporary erosion controls when surface soils have been stabilized.
- Clean out sediment from retention and/or wash ponds as needed and store in a secure area of the site within the area of extraction.

BMPs for Mobile Fueling of Generators, Engines, and Heavy Equipment

Fuel is delivered to KKCI work sites as it is in other rural areas. A local supply truck arrives during working hours to fuel necessary equipment and fuel transfer tanks. BMPs associated with fueling may include:

- Assisting tanker drivers as needed to provide safe and effective transfer of fuels.
- Monitoring fuel deliveries at all times to prevent overfilling.
- Providing spill containment and recovery equipment in the event of a spill.

BMPs for Maintenance & Repair of Equipment

Petroleum fluids such as oil lubricants and grease can impact sensitive waters of the State. The Following BMPs have been provided as a means of prevention:

- Avoid overfilling gearboxes and crankcases.
- Follow manufacturer's specifications when greasing bearings and wear surfaces.
- Repair leaking seals on mechanical equipment.
- Prevent spills during oil changes.
- Maintain an adequate supply of absorbent material and spill kits for routine maintenance and petroleum spills.
- Properly store and secure petroleum products to avoid their contact with storm water.
- Store waste oil in spill proof containers for offsite disposal.
- Discard soiled towels in receptacles provided.
- Fully service and inspect engines and gearboxes in the off-season to eliminate leaking seals, fuel lines, and gaskets; annual repairs such as these are to be conducted in the shop or other appropriate facility.

APPENDIX E
EMISSION CONTROL PLAN

Emission Control Plan

1. Site Roadways
   - A. The dust on site roadways shall be controlled by applications of water, calcium chloride or other acceptable and approved fugitive control compounds. Applications of dust suppressants shall be done as often as necessary to meet all applicable emission limits.
   - B. All paved roadways shall be swept as needed between applications.
   - C. Any material spillage on roads shall be cleaned up immediately.

2. Plant
   - A. The drop distance at each transfer point shall be reduced to the minimum the equipment can achieve.

3. Storage Piles
   - A. Stockpiling of all nonmetallic minerals shall be performed to minimize drop distance and control potential dust problems.

4. Truck Traffic
   - A. Onsite: Vehicles shall be loaded to prevent their contents from dropping, leaking, blowing, or otherwise escaping. This shall be accomplished by loading so that no part of the load shall come in contact within six (6) inches of the top of any sideboard, side panel, or tailgate.

APPENDIX F – Forms

Excerpts from DNR Nonmetallic Mine General Permit WPDES Permit No. WI-A046515-6

3.2 Annual Facility Site Compliance Inspections

The permittee shall conduct an annual facility site compliance inspection required under s. NR 216.28(2), Wis. Adm. Code, for each calendar year of coverage under this permit and document the results by February 15 for the previous calendar reporting year. The SWPPP contact identified in section 3.3.3 shall perform and/or coordinate the inspections. The SWPPP contact shall verify that all pollution sources are correctly identified and that the site drainage pattern description remains accurate. The SWPPP contact shall also check that appropriate source area pollution prevention controls and storm water BMPs have been chosen, and the practices are being implemented, properly operated and adequately maintained. For sites that are internally drained, the SWPPP contact shall confirm and document that the conditions for internal drainage remain in place. The timing of inspections shall include seasonal or cyclical activities at the facility so the inspections are representative of the full range of activities at the site. An annual facility site compliance inspection report shall be completed for each inspection and shall include the inspection date, inspection personnel, scope of the inspection, major observations, and a schedule for implementing any further actions needed to control storm water contaminants. The annual facility site compliance inspection reports shall be retained for 5 years beyond the date the record was made and shall be provided to the Department upon request. For inactive internally drained nonmetallic mining sites where inspections are impractical, inspections may be performed within 10 days of changing to active status or, at a minimum, once every 3 years if remaining inactive.

Note: The annual facility site compliance inspection report form (Form 3400-176) is available on the Department website at: http://dnr.wi.gov/topic/stormwater/industrial/forms.html

3.7 Quarterly Visual Inspections

3.7.1 The permittee shall perform and document the results of the quarterly visual inspections required under s. NR 216.28(3), Wis. Adm. Code, for all nonmetallic mining operations covered under this permit. The SWPPP contact shall perform and/or coordinate the inspections. The SWPPP contact or SWPPP contact designee shall check that site drainage conditions and potential pollution sources identified in the SWPPP remain accurate, and that appropriate storm water pollution prevention controls and storm water BMPs are being implemented, properly operated and adequately maintained. Documentation of each quarterly visual inspection shall be completed and shall include the inspection date, inspection personnel, scope of the inspection, major observations, possible sources of any observed contaminated storm water, any appropriate revisions needed to the SWPPP, and a schedule for implementing any further actions needed to control storm water contaminants. Quarterly visual inspection documentation shall be included with the annual facility site compliance inspection report required in section 3.2. Quarterly visual inspection documentation shall also be provided to the Department upon request.

3.7.2 Once per quarter, the SWPPP contact or SWPPP contact designee shall perform and document quarterly visual inspections of storm water discharge quality at each outfall. Inspections shall be conducted within the first 30 minutes or as soon thereafter as practical, but not to exceed 60 minutes, after runoff begins discharging at an outfall. A visual observation record shall be created for each visual check that includes the discharge outfall location and any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators associated with contaminated storm water. The visual observation record shall be included with the quarterly visual inspection documentation described in section 3.7.1 above. Visual observation records shall also be provided to the Department upon request. Excerpts from DNR Nonmetallic Mine General Permit WPDES Permit No. WI-A046515-

Note: The Quarterly Visual Inspection Field Sheet (Form 3400-176A) is available on the Department website at: http://dnr.wi.gov/topic/stormwater/industrial/forms.html

3.7.3 A quarterly visual inspection and/or visual check is not required if any of the following apply: (1) the SWPPP contact or SWPPP contact designee could not reasonably be present at the time of a storm water event; (2) the permittee determined that attempts to complete the inspection would endanger employee safety or well-being; (3) no storm water events large enough to conduct a visual check at an outfall occurred; (4) the quarterly visual inspection or visual check is impractical or unnecessary at an inactive or remote facility and an alternate inspection frequency of at least once every three years is established; or (5) the permittee determined that a source of contaminated storm water was outside the site's property boundary and is not associated with the permittee's activities. Quarterly visual inspections and/or visual checks not performed for any reason listed above shall be documented and included with the annual facility site compliance inspection report required in section 3.2.

State of Wisconsin
Department of Natural Resources

Quarterly Visual Inspection - Field Sheet

Form 3400-176A (R 3/01)

This form is for your own use and should be kept as part of your Storm Water Pollution Prevention Plan. It **does not** have to be submitted to the Department unless requested. If false information from quarterly visual inspections is reported to the Department, you could be subject to penalties up to $10,000 pursuant to s. 283.91(4), Wis. Stats.

Use one form per outfall.

Quarterly Visual Inspections at each storm water discharge outfall on your site can be a valuable assessment tool and are required by the Tier 1 and Tier 2 Industrial Storm Water General Permits. This inspection should be performed when sufficient runoff occurs during daylight hours. Try to make observations within the first 30 minutes after runoff begins discharging from the outfall, or as soon as practical, but no later than 60 minutes. If you find visible pollution, note the probable source and list any possible Best Management Practices that could be used to reduce or eliminate the problem.

Make any necessary changes to your **Storm Water Pollution Prevention Plan** as needed.

Facility Name

Street Address	City	State	ZIP Code

Name of Person Conducting Inspection	Inspection Date
Employer	Telephone Number

Outfall Number (make reference to site map)	Description of Outfall (e.g., ditch, concrete pipe, grassed swale, etc.)

Time of Rainfall Event	Time of Visual Inspection	**Optional:** Amount of Rainfall at the Time of Observation (nearest tenth of an inch)

Describe your observations. An easy way to conduct this inspection is to use a glass jar to collect a sample of the storm water being discharged from the facility and visually inspect the water. Include any observations of color, odor, turbidity, floating solids, foam, oil sheen or any other visual indicators of storm water pollution and the probable sources of any observed storm water contamination.

Color:	☐ Clear	☐ Red	☐ Yellow	☐ Brown	☐ Other:
Odor:	☐ None	☐ Musty	☐ Sewage	☐ Rotten Egg	☐ Other:
Clarity:	☐ Clear	☐ Cloudy	☐ Opaque	☐ Suspended Solids	☐ Other:
Floatables:	☐ None	☐ Foam	☐ Garbage	☐ Oily Film	☐ Other:
Deposits / Stains:	☐ None	☐ Oily	☐ Sludge	☐ Sediments	☐ Other:

Comments:

This outfall could not be evaluated during this quarter due to the following reason:

State of Wisconsin
Department of Natural Resources
dnr.wi.gov

Annual Facility Site Compliance Inspection Report (AFSCI)

For Storm Water Discharges Associated With Industrial Activity Under Wisconsin Pollutant Discharge Elimination System (WPDES) Permit

Form 3400-176 (R 8/10)

Notice: This form is authorized by s. NR 216.29(2), Wis. Adm. Code. Submittal of a completed form to the Department is mandatory for industrial facilities covered under a Tier 1 storm water general permit. Facilities covered under a Tier 1 permit are not required to submit AFSCI reports after submittal of the second AFSCI report, unless so directed by the Department. However, these inspections and quarterly visual inspections shall still be conducted and results shall be kept on site for Department inspection. Facilities covered under a Tier 2 storm water general, industry-specific general or individual permit shall keep the results of their AFSCI and quarterly visual inspections on site for Department inspection. Failure to comply with these regulations may result in fines up to $25,000 per day pursuant to s. 283.91, Wis. Stats. Personally identifiable information on this form may be used for other water quality program purposes.

Please type or clearly print your answers to all questions.

Section I: Facility/Site Information			
Facility/Site Name (As Appears on Permit Authorization)		County	
Location Address/Description (if different from mailing address below)		State	ZIP Code
Municipality	☐ City ☐ Village ☐ Township	Facility Identification (FID) and/or FIN Number (if known) FIN:	
Section II: Facility/Site Contact Person			
Local Contact Person		Mailing Address (if different than site location address)	
Title		Municipality (if different than above)	
Telephone (include area code)		State	ZIP Code (if different than above)
E-mail address or Website (if applicable)		Fax (include area code)	

Section III: Certification & Signature (Person attesting to the accuracy and completeness of Annual Facility Site Compliance Inspection Report.)

This form must be signed by an official representative of the permitted facility in accordance with s. NR 216.22(7), Wis. Adm. Code. See instructions on page 4. If this form is not signed, or is found to be incomplete, it will be returned

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature of Authorized Representative	Telephone Number (include area code)		
Type or Print Name	Company Name		
Position Title	Mailing Address		
Date Signed	Municipality	State	ZIP Code

How to Use this Form:

The first level of storm water monitoring consists of a comprehensive annual facility site compliance inspection (AFSCI) to determine if your facility is operating in compliance with your Storm Water Pollution Prevention Plan (SWPPP). You should use the results of this inspection to determine the extent to which your SWPPP needs to be updated to prevent pollution from new source areas, as well as to correct any inadequacies that the plan may have in handling existing source areas. This first level of monitoring is addressed in Section IV of this Annual Report on page 2.

The second level of storm water monitoring consists of quarterly visual observations of storm water leaving the site during runoff events caused by snow-melt or rainfall. This is a practical, low cost tool for identifying obvious contamination of storm water discharges, and can also help identify which practices are ineffective. The goal of quarterly inspections is to obtain results from a set of four inspections that are distributed as evenly as possible throughout the year and which depict runoff quality during each of the four seasons. This second level of monitoring is addressed in Section V of this Annual Report on page 3.

Annual Facility Site Compliance Inspection Report (AFSCI)

Section IV: Annual Facility Site Compliance Inspection

The Annual Facility Site Compliance Inspection shall be adequate to verify that: your Storm Water Pollution Prevention Plan (SWPPP) remains current; potential pollution sources at your facility are identified; the facility site map and drainage map remain accurate; and that the Best Management Practices prescribed in your SWPPP are being implemented, properly operated, and adequately maintained. Name of Person Conducting Inspection Inspection Date

Employer Telephone Number

Your inspection should start with a review of your written SWPPP kept at your facility. The SWPPP should be amended if, through these inspections, you find that the provisions in your SWPPP are ineffective in controlling contaminated storm water from being discharged from your facility.

1.	Has your SWPPP been updated to include current Non-Storm Water Discharge Evaluation results?	☐Yes	☐No	☐N/A
2.	Has your SWPPP been amended for any new construction that would affect the site map or drainage conditions at the facility?	☐Yes	☐No	☐N/A
3.	Has your SWPPP been amended for any changes in facility operations that could be identified as new source areas for contamination of storm water?	☐Yes	☐No	☐N/A
5.	Are there any maintenance or material handling activities conducted outdoors that have not been addressed in your SWPPP?	☐Yes	☐No	☐N/A
6.	Are outside areas kept in a neat and orderly condition?	☐Yes	☐No	☐N/A
7.	Are regular housekeeping inspections made?	☐Yes	☐No	☐N/A
8.	Do you see spots, pools, puddles, or other traces of oils, grease, or other chemicals on the ground?	☐Yes	☐No	☐N/A
9.	Are particulates on the ground from industrial operations or processes being controlled?	☐Yes	☐No	☐N/A
10.	Do you see leaking equipment, pipes or containers?	☐Yes	☐No	☐N/A
11.	Do drips, spills, or leaks occur when materials are being transferred from one source to another?	☐Yes	☐No	☐N/A
12.	Are drips or leaks from equipment or machinery being controlled?	☐Yes	☐No	☐N/A
13.	Are cleanup procedures used for spilled solids?	☐Yes	☐No	☐N/A
14.	Are absorbent materials (floor dry, kitty litter, etc.) regularly used in certain areas to absorb spills?	☐Yes	☐No	☐N/A
15.	Can you find discoloration, residue, or corrosion on the roof or around vents or pipes that ventilate or drain work areas?	☐Yes	☐No	☐N/A
16.	Are Best Management Practices implemented to reduce or eliminate contamination of storm water from source areas at the facility?	☐Yes	☐No	☐N/A
17.	Are Best Management Practices adequately maintained?	☐Yes	☐No	☐N/A
18.	Are there significant changes to your SWPPP needed to correct plan inadequacies to effectively control a discharge of contaminated storm water from your facility?	☐Yes	☐No	☐N/A

Acid Base Accounting

Acid Base Accounting (ABA) is a set of laboratory methods which are used to identify the acid-production and acid-consumption properties of a geological material. The methods are designed to produce the best estimate of how likely a material is to be a net acid producer or net acid consumer, therefore how likely to produce Acid Rock Drainage (ARD). If minerals that neutralise acid are pres-ent, then the hydrogen ions produced by the breakdown of sulphides will not migrate as they will be buffered. To prevent the occurrence of ARD during mining and storage of waste and ore, the charac-teristics of the rocks being disturbed needs to be determined to effectively plan mitigation measures.

ARD can occur when sulphide minerals are exposed to oxygen and water (surface conditions) and break down, releasing H^+ ions. These H^+ ions decrease the pH and can result in acidic waters which can maintain more elevated concentrations of metals than would occur in neutral pH water. These metals can have an adverse impact on aquatic life along with the low pH of water itself. Other impacts of low pH can be the corrosive effect on pipes, and concrete infrastructure (Tarr and White, 2015).

ABA laboratory methods produce values for both Maximum Potential Acidity (MPA) and Neutralisation Potential (NP) which can then be used to calculate the Net Neutralisation Potential (NNP) of the material (balance between acid production and acid neutralisation). As the NNP is the NP minus the MPA, it can be a positive (net acid neutralising), zero (neither neutralising or acid producing) or negative number (net acid producing). The MPA is often referred to as the Acid Production Potential (AP). The unit of measurement for these values is kg $CaCO_3$ per ton. or $tCaCO_3$/1000t ore.

Methods for determining the NNP have been proposed by multiple research groups and some have been selected by government organisations to be part of mine development reporting requirements. The method required in a particular jurisdiction varies, and this information should be obtained from the relevant government organisations. ALS offers a wide range of methods for ABA estimation: Sobek, Modified Sobek, Siderite correction, Modified Neutralisation Potential from MEND, and EN 15875 methods. A brief description of these methods and how they differ from one another is given on the following page.

Sobek Method

The ABA method proposed by Sobek et.al. (1978) assumes all sulphur in a sample is present as pyrite and the oxidation of that pyrite by oxygen. Each mole of sulphur produces two moles of acid which is neutralised by one mole of calcium carbonate. The molar ratio of sulphur to calcium carbonate is therefore 1:1. This gives a weight ratio of 100 g $CaCO_3$/mole $CaCO_3$ to 32g S/mole S, or in standard AP units 31.25 kg/tonne $CaCO_3$ per % S. To perform a Sobek measurement a known amount of hydrochloric acid (HCl) is added to the sample and reacted. The amount of HCl that is added to the sample is determined by a preliminary fizz test. After the HCl-sample mixture is combined, it is heated to near boiling to facilitate the reaction. When the reaction has reached completion it is titrated with a base (sodium hydroxide NaOH) to pH7.

This test has an upper boundary of sulphide content, if >9% of the material is sulphide sulphur it will be acid producing. This is because if ~9.5% of material is sulphide sulphur (assumed to be pyrite) the rest of the material would have to be $CaCO_3$ to neutralise the amount of acid produced.

Modified Sobek (M)

The Modified Sobek method bases the AP on sulphide sulphur instead of total sulphur. A total sulphur method does not take non-acid producing sulphates (e.g. gypsum and barite) into consideration and can overestimate the AP of a sample. The Modified Sobek method uses a fizz test to determine how much HCl is added to a sample (Lawrence and Wang, 1997). However, the titration endpoint is 8.3 instead of 7.0 as in the standard Sobek method. Also the temperature of reaction, 25-30° C (room temperature), is lower than the standard Sobek method which heats the sample to near boiling.

Siderite Correction (S)

Meek (1981) suggested that the NP of rock units is overestimated when siderite ($FeCO_3$) is present. During the standard Sobek method there is insufficient time for ferrous iron oxidation and subsequent precipitation of ferric hydroxide. Therefore, only half of the siderite reaction is considered, the base generating step of the reaction. If precipitation of ferric hydroxide has time to occur, then an equal amount of acid is generated, resulting in a net zero NP for siderite. As only the base generating part of the reaction is counted an erroneously high NP values can be reported for samples containing siderite (Fey, 2003).

To compensate for the short analysis time that doesn't allow the full reaction to occur, a small quantity of 30% hydrogen peroxide (H_2O_2) is added to the filtrate of hydrochloric acid (HCl) digested siderite sample in order to oxidise ferrous iron to ferric iron before back-titration. Because the resulting ferric iron is precipitated as iron hydroxide ($Fe(OH)_3$) upon titration, the solution yields a more accurate NP value for siderite bearing material.

MEND Method (B)

This method uses the modified neutralisation potential as outlined in MEND (1991). Two grams of pulverised sample are treated with an appropriate amount of HCl at ambient temperature. The pH of the slurry is checked twice to ensure the HCl levels in the flask are sufficient for the reaction to proceed and the resulting slurry is titrated with sodium hydroxide (NaOH) to a pH endpoint of 8.3. The measured neutralisation potential is reported as calcium carbonate equivalents. This method uses the total sulphur determined for the calculation of MPA.

EN15875 Method

The method developed by Technical Committee CEN/TC 292 2011 is the European Standard (EN 15875, "Characterisation of waste – Static test for determination of acid potential and neutralisation potential of sulphidic waste"). The main difference between this method and others offered is that the amount of HCl added to the sample is not estimated using a fizz test but is calculated based on the amount of carbonate in the sample. The digestion pH range is from 2- 2.5 and the end point of the titration is pH 8.3.

Paste pH

Paste pH is measured on a mixture of sample and deionised water before any reactions are performed. This value is used to indicate if there is readily available acidity or alkalinity in the sample material (MEND 1991). A pH below 5 is used to suggest that the material contains acidity due to acid generation prior to the test. The measurement is performed on 10g of sample material and saturated to form a paste which is measured with a pH electrode (method code OA-ELE07).

Total Sulphur

The sample is heated to greater than 1000°C in an induction furnace while passing a stream of oxygen through the sample. Sulphur dioxide formed by combustion is measured by an infrared detection system and the total S from the sample reported.

Sulphur in Sulphate

All ABA methods estimate how much S is present in the sample and most assume all is hosted in sulphide minerals. This can overestimate the acid production potential of a sample and so methods to determine how much of the total S in a sample is hosted in sulphates are available. This can be useful as sulphates will not form part of the acid generating component of a material so can be excluded from the estimate for MPA (or AP).

Sulphate content can be determined in several ways, total sulphate by carbonate leach (S-GRA06), when measured by ICP-AES (S-ICP19) and HCl leachable sulphate (S-GRA06a). The HCl leachable sulphate doesn't fully dissolve barite and celestite so where these minerals are expected S-GRA06 is recommended. Also, by performing both analyses (as is the case in ABA-PKG05) it is possible to estimate the species of sulphate minerals present (e.g. proportion of sulphate in gypsum vs barite).

Carbonate Carbon

Many ABA packages include measurement of inorganic C. This is carbon in carbonate minerals, and it is determined by reacting the sample with an acid in a heated container and then measuring the evolved CO_2. Alternatively, the C in carbonate minerals can be calculated by determining total C and organic C, the difference is then the inorganic C in the sample.

Other methods

Net Acid Generation (NAG) is the quantitative estimate of acid that can be generated by a material. This is a stand-alone package in which H_2O_2 is used to rapidly oxidise sulphides in a sample. After the room temperature reaction has ceased, the slurry is then heated until the reaction reaches completion. On cooling the pH of the solution is read and then it is titrated to an end pH of 4.5 using NaOH. The concentration of the NaOH used for titration is based on the pH reading taken after the reaction finalised (Miller et al., 1997). Titration to an end point pH 7 and the associated NAG value can also be reported. Values from NAG analysis are reported in H_2SO_4/tonne. ABA and NAG tests are referred to as static tests as they record a single measurement for how a rock is expected to behave. Other more involved methods such as Humidity Cell use customised testing and take measurements over time.

These tests are referred to as kinetic testing because of the time component of the measurement. They are designed to mimic the weathering of samples (typically tailings or crushed rock) in a controlled fashion at bench scale. Humidity Cell tests determine the rate of acid generation and the variation over time in leachate water quality. Typically one kilogram of dry, crushed (< 6.5 mm) rock samples is placed into a specially designed humidity cell apparatus, and is then subjected to weekly cycles that alternate between the circulation of dry air and moist air over the samples to simulate precipitation cycles.

PARAMETERS	ABA-PKG01 (M/S)	ABA-PKG02 (M/S)	ABA-PKG03 (M)	ABA-PKG04 (M/S)	ABA-PKG05 (M/S/B)	ABA-PKG06E*
Net Neutralisation Potential (NNP)	√	√	√	√	√	
Maximum Potential Acidity (MPA)	√	√	√	√	√	
Neutralisation Potential (NP) & Fizz	√	√	√	√	√	
Ratio (NP : MPA)	√	√	√	√	√	
Neutralisation Potential (EN 15875 NP)						√
Acid Potential (EN 15875 AP)						√
Maximum Acid Potential (EN 15875 AP Max)						√**
Neutralisation Potential Ratio (EN 15875 NPR)						√
Net Neutralisation Potential (EN 15875 NNP)						√
Paste pH	√	√	√	√	√	
Sulphate by ICP						√
HCl-leachable Sulphate		√	√	√	√	
Total Sulphate (Carbonate Leach)			√		√	
Sulphide (calculated)				√	√	√
Sulphide (analysed)	√**	√**	√	√**	√**	
Total Sulphur	√	√	√**	√	√	√
Inorganic Carbon (CO2)				√	√	
Inorganic Carbon (calculated)						√
Organic Carbon						√
Total Carbon						√

*meets EU regulations
** optional parameter, use A after the package name to indicate the optional extra analysis.

References

Fey, D.L., 2003. Acid-Base Accounting. Billings Symposium/ASMR Annual Meeting. Assessing the Toxicity Potential of Mine-Waste Piles Workshop. U.S. Department of the Interior. https://pubs.usgs.gov/of/2003/ofr-03-210/Section508/IX_Acid-base_Accounting-508.pdf

Lawrence, R.W., and Wang Y., 1997. Determination of Neutralization Potential in the Prediction of Acid Rock Drainage, Proceedings of the 4th International Conference on Acid Rock Drainage, Vancouver, 31 May-6 June 1997, p449-464.

Lawrence, R.W., Poling, G.P., and Marchant, P.B., 1980. Investigation of predictive techniques for acid mine drainage. Report on DSS Contract No. 23440-7-9178/01-SQ. Energy Mines and Resources, Canada, MEND Report 1.16.1(a).

Meek, F.A., 1981. Development of a procedure to accurately account for the presence of siderite during mining overburden analysis. In: Proceedings of 2nd Annual West Virginia Surface Mine Drainage Task Force Symposium. 27 Apr. 1981. West Virginia University., Morgantown.

MEND Project 1.16.1b., 1991. Acid Rock Drainage Prediction Manual. A Manual of Chemical Evaluation Procedures for the Prediction of Acid Generation from Mine Wastes. CANMET-MSL Division. Department of Energy, Mines and Resources, Canada.

Miller, S., Robertson, A., and Donahue, T., 1997. Advances in acid drainage prediction using the net acid generation (NAG) test. Proceedings of the 4th International Conference on Acid Rock Drainage, Vancouver, 31 May-6 June 1997, 533-549.

Skousen, J., Renton, J., Brown, H., Evans, P., Leavitt, B., Brady, K., Cohen, L. and Ziemkiewicz, P., 1997. Neutralization Potential of Overburden Samples containing Siderite, Journal of Environmental Quality, v26, n3, p673-681.

Sobek, A.A., Schuller, W.A., Freeman, J.R., and Smith, R.M., 1978. Field and laboratory methods applicable to overburdens and mine-soils. WPA 600/2-78-054. U.S. Gov. Print. Office, Washington, DC.

Tarr, C and White, C.E., 2016. Acid Rock Drainage in the Chain Lakes Watershed, Halifax Regional Municipality, Nova Scotia: in Geoscience and Mines Branch, Report of Activities 2015; Nova Scotia Department of Natural Resources, Report ME 2016-001, p. 109-119.

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EFFECTIVENESS OF THE ADDITION OF ALKALINE MATERIALS AT SURFACE COAL MINES IN PREVENTING OR ABATING ACID MINE DRAINAGE: PART 1. GEOCHEMICAL CONSIDERATIONS[1]

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Abstract. The addition of alkaline materials to supplement deficient "neutralization potential" (NP) of mine spoil, and thus to prevent or abate acid mine drainage, has not been successful at most surface coal mines in Pennsylvania. A basic problem may have been improper accounting for acid-production potential and thus inadequate addition rates of calcium carbonate ($CaCO_3$), calcium oxide (CaO), or calcium hydroxide [$Ca(OH)_2$] at many mines. The commonly used acid-base accounting method is based on the following overall reaction:

$$FeS_2 + 2\ CaCO_3 + 3.75\ O_2 + 1.5\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 2\ Ca^{+2} + 2\ CO_2(g),$$

where the acidity from 1 mole of pyrite (FeS_2) is neutralized by 2 moles of $CaCO_3$. This method presumes that gaseous carbon dioxide (CO_2) will exsolve, and therefore may underestimate by up to a factor of 2 the quantity of $CaCO_3$ required to neutralize the "maximum potential acidity" (MPA) in the mine spoil. This paper reviews some geochemical reactions involving FeS_2 and various alkaline additives that support the argument that the acid-base accounting method for computing MPA from overburden analyses should be revised. Considering the stoichiometry of the following overall reaction:

$$FeS_2 + 4\ CaCO_3 + 3.75\ O_2 + 3.5\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 4\ Ca^{+2} + 4\ HCO_3^{-},$$

4 moles of $CaCO_3$ are required to neutralize the maximum potential acidity produced by the oxidation of 1 mole of FeS_2. Therefore, the multiplication factor for computing MPA from the overburden sulfur concentration, in weight percent, should be increased from 31.25 to 62.5.

Introduction

Acid mine drainage (AMD), in which total mineral acidity exceeds alkalinity, is a persistent problem associated with many surface coal mines. AMD typically contains large concentrations of sulfate, iron, and other metals, and results mainly from the exposure and accelerated oxidation of pyrite (FeS_2) and additional iron-sulfide or -sulfate minerals in the coal and overburden. However, where substantial calcium- or magnesium-carbonate materials, such as limestone strata, overlie the coal, mine drainage is commonly alkaline. By corollary, where mined strata contain pyrite but lack naturally occurring calcareous material, the importation and addition of alkaline material to the mine spoil should offset the deficiency and prevent or abate AMD. However, where alkaline additives have been incorporated with mine spoil at surface coal mines in Pennsylvania, few sites have shown improvement in water quality or abatement of AMD (Brady et al. 1990).

This paper describes the chemical reactions that are the basis for computing the maximum potential acidity and net neutralization potential of mine spoil. Emphasis is placed on evaluating reactions with calcite (calcium carbonate, $CaCO_3$), "quick lime" (calcium oxide, CaO), and "hydrated lime" [calcium hydroxide, $Ca(OH)_2$], which are used as alkaline additives intended to produce near-neutral (6 < pH < 8) discharge water from surface coal mines.

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Acid-Base Accounting

Acid-base accounting (ABA), which simplifies the complex hydrogeochemical system through use of a limited number of variables, has been used extensively in the past to estimate the quantity of alkaline material required to neutralize the potential acidity of mine spoil (diPretoro 1986; diPretoro and Rauch 1988; Skousen et al. 1987; Erickson and Hedin 1988; Ferguson and Erickson 1988; Brady and Hornberger 1989; Smith and Brady 1990; Brady et al. 1990). ABA was developed on the assumption that the stoichiometry of the following overall reaction of FeS_2 and $CaCO_3$ applies (Sobek et al. 1978; Williams et al. 1982):

$$FeS_2 + 2\ CaCO_3 + 3.75\ O_2 + 1.5\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 2\ Ca^{+2} + 2\ CO_2(g). \quad (1)$$

The implication of reaction 1 is that acidity produced from 1 mole (mol) of FeS_2 [64 grams (g) of sulfur (S)] is neutralized by 2 mol of $CaCO_3$ (200 g), or 1 g S to 3.125 g $CaCO_3$. On this basis, 31.25 tons of calcium carbonate ($CaCO_3$) will neutralize the acidity from 1,000 tons of rock that contains 1.0 weight percent (%) pyritic sulfur. In accordance with accepted ABA methods (Sobek et al. 1978), the total sulfur concentration in weight percent is multiplied by 31.25 to obtain a "maximum potential acidity" (MPA), which has units of tons of $CaCO_3$ per 1,000 tons of overburden (tons $CaCO_3$/1,000 tons) and which assumes that the sulfur is pyritic and acid producing. The 31.25 multiplication factor was intended to provide equivalent units for direct comparison with "neutralization potential" (NP), which has units of tons $CaCO_3$/1,000 tons. Subsequent workers computed the "net neutralization potential" (NNP) for coal-bearing strata by subtracting volume- or weight-weighted MPA from NP (NNP = NP - MPA) (Erickson and Hedlin 1988; diPretoro and Rauch 1988; Brady et al. 1990). A negative, or deficient, NNP has been interpreted as the quantity of $CaCO_3$ that must be added to abate or prevent AMD. For example, if weight-weighted NP is 30 tons $CaCO_3$/1,000 tons and total sulfur concentration is 1.0%, then MPA = 31.25 tons $CaCO_3$/1,000 tons and NNP = -1.25 tons $CaCO_3$/1,000 tons. To create a net neutral mine spoil, 1.25 tons of $CaCO_3$ would need to be added to every 1,000 tons of overburden. However, the ABA method based on the stoichiometry of reaction 1 may underestimate MPA because of the presumption that CO_2 will exsolve, and thus may underestimate the $CaCO_3$ required to supplement deficient NNP.

Previous Work

Although not originally intended for the purpose, ABA following the method of Sobek et al. (1978) has been used in attempts to predict post-mining water quality. However, several researchers have arrived independently at the conclusion that equal quantities of NP and MPA (computed by multiplying the total sulfur in percent by a factor of 31.25) do not prevent AMD. Brady and Hornberger (1989) identified a given stratum as potentially acid or alkaline producing by using threshold concentrations for total sulfur or NP, respectively, of 0.5 % or 30 tons $CaCO_3$/1,000 tons (and which reacted with dilute hydrochloric acid). These threshold concentrations were corrorabated by laboratory experiments by Williams et al. (1982) and Morrison (1988) and also by Pennsylvania Department of Environmental Resources data on overburden and water quality at numerous surface coal mines. Note that 0.5 percent total sulfur, when multiplied by 31.25 to compute MPA, equals 15.6 tons $CaCO_3$/1,000 tons, roughly half the guideline number of 30 tons $CaCO_3$/1,000 tons for NP. Skousen et al. (1987, p.4) suggested that a stratum which contains values greater than 5 tons $CaCO_3$/1,000 tons as "Max Needed" (negative NNP) produced acid; conversely, values greater than 20 tons $CaCO_3$/1,000 tons as "Excess" (positive NNP) produced alkaline drainage.

diPretoro (1986) and diPretoro and Rauch (1988) showed that NP and MPA were not equivalent in using the ratio derived by dividing the cumulative volume-weighted NP by MPA for composite strata. diPretoro and Rauch (1988) found that sites having a NP/MPA ratio of less than about 2.4 produced acidic drainage, whereas most sites having a ratio greater than 2.4 produced alkaline drainage. Ferguson and Erickson (1988) showed that mine sites with a multiple-strata average NNP of 30 tons $CaCO_3$/1,000 tons or greater always produced alkaline drainage. They also found that 59 percent of mine sites with NNP of 7 to 30 tons $CaCO_3$/1,000 tons produced alkaline drainage, and only 11 percent of the sites with NNP less than 7 tons $CaCO_3$/1,000 tons produced alkaline drainage. Weighted NP in "equivalent" amounts as MPA was not sufficient to prevent AMD.

Geochemistry of Acid Mine Drainage and Alkaline Additives

The following discussion reviews some overall acid-forming and neutralizing reactions that are relevant to AMD, ABA, and the addition of alkaline materials at surface coal mines. No effort is made to account for hydrogeochemical variables such as surface- and ground-water flow paths, proximity and distribution of reacting minerals, solubilities and reaction rates of minerals, or the wide range of hydrochemical conditions in mine spoil.

Production of Acidity

AMD results from the interactions of oxygen, water, bacteria, and sulfide minerals (Singer and Stumm 1970a, 1970b; Nordstrom et al. 1979; Kleinmann et al. 1980; Cathles 1982). Pyrite (FeS_2), and less commonly, marcasite (FeS_2) are the principal sulfur-bearing minerals in bituminous coal (Davis 1981; Hawkins 1984), and because of its wide distribution, pyrite is recognized as the major source of AMD in the eastern United States (Stumm and Morgan 1981, p. 469-471). The following overall stoichiometric reactions may characterize the oxidation of pyrite and other FeS_2 minerals:

$$FeS_2 + 3.5\ O_2 + H_2O \Longrightarrow Fe^{+2} + 2\ SO_4^{-2} + 2\ H^+, \quad (2)$$

$$Fe^{+2} + 0.25\ O_2 + H^+ \Longrightarrow Fe^{+3} + 0.5\ H_2O, \quad (3)$$

$$Fe^{+3} + 3\ H_2O \Longrightarrow Fe(OH)_3 + 3\ H^+. \quad (4)$$

The oxidation of sulfide in pyrite to sulfate (reaction 2) releases dissolved ferrous iron (Fe^{+2}) and "acidity" (H^+) into the water. Subsequently, ferrous iron is oxidized to ferric iron (Fe^{+3}) (reaction 3), which if separated from the pyrite surface, hydrolyzes and forms insoluble ferrihydrite [$Fe(OH)_3$)] (reaction 4), and releases more acidity. The overall combination of reactions 2 through 4 may be written as follows:

$$FeS_2 + 3.75\ O_2 + 3.5\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 4\ H^+. \quad (5)$$

In reaction 5, 3.75 mol of oxygen are consumed to oxidize 1 mol of pyrite, and 2 mol of sulfate, 4 mol of acidity, and 1 mol of ferrihydrite are produced.

Neutralization of Acidity

Acidity produced by the aqueous oxidation of pyrite may react with carbonate, silicate, and hydroxide minerals composing the sedimentary rocks in the coal-bearing sequence. Dissolution of these acid-soluble minerals neutralizes acidity and produces the other major ions in AMD in addition to sulfate and iron, such as manganese, aluminum, calcium, magnesium, sodium, potassium, and silica.

The most acid-reactive minerals are the carbonates: calcite ($CaCO_3$), dolomite [$CaMg(CO_3)_2$], and siderite ($FeCO_3$). Carbonates are present in variable quantities as individual mineral grains and as cementing agents in limestone, dolostone, sandstone, and shale. Limestone and dolostone are composed predominantly of calcite and dolomite, respectively; shale and sandstone are composed predominantly of silicate minerals, but may contain some carbonate as cement or matrix. Dissolution of calcite, dolomite, and other calcium- or magnesium-bearing carbonate minerals tends to reduce acidity, increase alkalinity, and raise pH; however, dissolution of siderite and the subsequent hydrolysis of iron may increase acidity, and reduce pH. The dissolution of calcite by the following sequence of reactions serves as an example:

$$CaCO_3 + 2\ H^+ \Longrightarrow Ca^{2+} + H_2CO_3^*, \quad (6)$$

$$CaCO_3 + H_2CO_3^* \Longrightarrow Ca^{2+} + 2\ HCO3^-. \quad (7)$$

Reaction 6 represents acidic conditions (pH < 6.4) where calcite is not abundant and is totally dissolved by reacting 1 mol of calcite and 2 mol of free acidity and producing 1 mol of dissolved calcium and 1 mol of dissolved carbon dioxide {$[H_2CO_3^*] = [CO_2(aq) + [H_2CO_3^o]]$}, which is a weak acid (Krauskopf 1979, p. 40-42; Stumm and Morgan 1981, p. 171-214; Hem 1985, p. 92, 105-111). Note that gaseous CO_2 is not indicated as the product in reaction 6. In practice, during laboratory determination of overburden NP, CO_2 may be exsolved when calcite and other carbonate minerals are reacted with dilute acid. However, CO_2 may concentrate in both the gaseous and aqueous phases in mine spoil. Elevated partial pressure of CO_2 in the unsaturated zone of mine spoil is common (Lusardi and Erickson 1985), especially during the growing season, and will cause a concomitant increase in the concentration of $H_2CO_3^*$ and other aqueous carbon-dioxide species (Langmuir 1971; Shuster and White 1972; Harmon et al. 1975).

If calcite is abundant, the dissolved carbon dioxide will continue to react with calcite (reaction 7) producing bicarbonate ions and raising pH. The overall combination of reactions 6 and 7 represents the condition where dissolution of calcite produces "alkalinity" in excess of "acidity" and raises the pH above 6.4 where bicarbonate (HCO_3^-) is the dominant dissolved carbon-dioxide species:

$$CaCO_3 + H^+ \Longrightarrow Ca^{2+} + HCO3^-. \quad (8)$$

Reaction 8 shows that 1 mol of calcite will neutralize 1 mol of free acidity and produce 1 mol each of dissolved calcium and bicarbonate. Reactions 5 and 8 may be combined to indicate a "maximum" neutralization potential of calcite, where no CO_2 is exsolved:

$$FeS_2 + 4\ CaCO_3 + 3.75\ O_2 + 3.5\ H_2O \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 4\ Ca^{+2} + 4\ HCO3^-. \quad (9)$$

Reaction 9 shows that the acidity produced from the oxidation of 1 mol of FeS_2 (64 g S) may be neutralized by 4 mol of $CaCO_3$ (400 g), which is a mass ratio of 6.25 g of calcite to 1 g of pyritic sulfur. The calcite-to-sulfur mass ratio of 6.25 is twice the ratio of 3.12 which would be derived considering the unlimited exsolution of CO_2 (Williams et al. 1982).

On the basis of the calcite-to-sulfur mass ratio of 6.25, a multiplication factor of 62.5 to compute MPA from total sulfur is appropriate for ABA if all sulfur is from pyrite. Therefore, considering the earlier example for overburden, where NP = 30 tons $CaCO_3$/1,000 tons and total sulfur = 1 % (only now using the 62.5 factor), then MPA = 62.5 tons $CaCO_3$/1,000 tons and NNP = -32.5 tons $CaCO_3$/1,000 tons. Instead of the previously computed 1.25 tons, now 32.5 tons of $CaCO_3$ per 1,000 tons overburden would be required to supplement the deficient NNP.

"Quick lime" (calcium oxide, CaO) and "hydrated lime" [calcium hydroxide, $Ca(OH)_2$] (Rochow 1977, p. 129), which compose lime-kiln flue dust, have twice the neutralization potential as calcite. Because the lime compounds have lower unit mass than $CaCO_3$, they are required in equivalent ratios less than 3.12 according to the following reactions:

$$Ca(OH)_2 + 2\ H^+ \Longrightarrow Ca^{+2} + 2\ H_2O, \quad (10)$$

$$CaO + 2\ H^+ \Longrightarrow Ca^{+2} + H_2O. \quad (11)$$

Reactions 10 and 11 show that 1 mol of hydrated lime (74 g) or 1 mol of quick lime (56 g) may neutralize 2 mol of free acidity. Combining reactions 10 and 5:

$$FeS_2 + 2\ Ca(OH)_2 + 3.75\ O_2 \Longrightarrow Fe(OH)_3 + 2\ SO_4^{-2} + 2\ Ca^{+2} + 0.5\ H_2O. \quad (12)$$

Reaction 12 shows that the acidity produced from the oxidation of 1 mol of pyrite (64 g S) may be neutralized by 2 mol of calcium hydroxide (148 g), which is a mass ratio of 2.31 g of calcium hydroxide to 1 g of pyritic sulfur. Analogously, from combining reactions 5 and 11, a mass ratio of 1.75 g of calcium oxide to 1 g of pyritic sulfur is required to attain neutralization. Thus on a weight basis, 1 ton of $Ca(OH)_2$ has the neutralization equivalent of 2.7 tons of $CaCO_3$.

Siderite ($FeCO_3$) is common in coal-bearing strata and is frequently cited as having no net effect on acid-production or neutralization where CO_2 gas is exsolved (Stumm and Morgan, 1981; Williams et al. 1982). However, considering the argument for conditions with elevated partial pressure of CO_2, oxidation of siderite may produce net acidity in the form of dissolved carbon dioxide:

$$FeCO_3 + 0.25\ O_2 + 2.5\ H_2O \Longrightarrow Fe(OH)_3 + H_2CO_3^*. \quad (13)$$

The $H_2CO_3^*$ generated in reaction 13 may react with additional carbonate, silicate, or hydroxide minerals. The effect of siderite as a potential acid-forming mineral is apparent by combining reactions 7 and 13 as follows:

$$FeCO_3 + CaCO_3 + 0.25\ O_2 + 2.5\ H_2O \Longrightarrow Fe(OH)_3 + Ca^{+2} + 2\ HCO3^-. \quad (14)$$

In reaction 14, the acidity produced from 1 mol of siderite is neutralized by 1 mol of calcite. Thus, if siderite is present, additional alkaline material beyond that required to neutralize the acidity from pyrite may be necessary. Impurities such as Mn, Mg, and to a lesser extent Ca, may substitute for Fe in siderite (Morrison et al. 1990). The Fe and Mn may hydrolyze and produce acid; however, the Mg and Ca may have neutralizing ability similar to dolomite and calcite.

Discussion

The presentation of acid-forming and acid-neutralizing reactions was simplified by writing and then combining independent equations as "neutral overall" reactions that eliminated H^+ as a reactant or product. Thus, the overall stoichiometries in reactions 1 and 9 equate quantities of acid-producing and -neutralizing materials and are useful for acid-base accounting application. However, reactions 1 and 9 are "end-member" reactions; the hydrogeochemical relations in mine-spoil ground water or discharge probably lie soemwhere between the two end members because some CO_2 will exsolve and some will dissolve.

No attempt has been made in the above review to discuss the combined effects of variable purities, degrees of crystallinity, and particle sizes of minerals; microbiological catalysis of reactions; or relative reaction rates. For example, the presumption that 4 mol of $CaCO_3$ are required to neutralize the acidity from 1 mol of FeS_2 (reaction 9) implies that the production of acidity is rate limiting, or slow relative to neutralization, and that neutralization is instantaneous. Furthermore, the computation of <u>maximum</u> potential acidity (MPA) as 62.5 times the total sulfur concentration, in weight percent, should yield a conservative estimate, because not all CO_2 will dissolve nor will all sulfur be pyritic and acid producing. To determine quantities of alkaline additives required at surface coal mines, site-specific characteristics such as mining method, pre- and post-mining overburden composition, post-mining reclamation and hydrogeology, and alkaline additives used and placement technique also must be evaluated. The companion paper by Brady et al. (1990) reviews some of the site-specific factors and compares post-mining water quality and ABA computations of MPA using the conventional and newly proposed multiplication factors of 31.25 and 62.5, respectively, for selected surface coal mines in Pennsylvania.

Summary and Conclusions

In summary, the ABA method currently in use, which presumes 2 mol of H^+ may be neutralized by 1 mol of $CaCO_3$, may underestimate by up to a factor of 2 the $CaCO_3$ required to neutralize the <u>maximum</u> potential acidity from the oxidation of pyrite and the hydrolysis and precipitation of iron, because of the presumption that all CO_2 will exsolve. However, some CO_2 will dissolve forming a weak acid that reacts with carbonate minerals. Assuming no exsolution of CO_2, 1 mol of FeS_2 will produce 4 mol of H^+, which may be neutralized by 4 mol of $CaCO_3$ (reaction 9), 2 mol of $Ca(OH)_2$ (reaction 12), or 2 mol of CaO. On a weight basis then, 1 g of pyritic sulfur may be neutralized by 6.25 g of $CaCO_3$, 2.31 g of $Ca(OH)_2$, or 1.75 g of CaO. Considering these equivalent weights, MPA as tons of $CaCO_3$ deficiency per 1,000 tons of overburden should be computed by multiplying total sulfur, in weight percent, by 62.5. The above discussion is based only on the stoichiometry of the overall reactions (9 and 12) and assumes that the rate of acid production will not exceed the rate of acid neutralization. The actual acidity may be less than the computed MPA because not all CO_2 dissolves and not all sulfur generates acidity. Finally, dissolution of siderite will produce net acidity when the partial pressure of CO_2 becomes elevated and the iron is hydrolyzed and precipitated.

In conclusion, for conservative estimates of overburden net neutralization potential (NNP), a revised multiplication factor of 62.5 should be used to compute maximum potential acidity (MPA) from the total sulfur concentration, in weight percent.

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Literature Cited

Brady, K.B.C., and R.J. Hornberger. 1989. Mine drainage prediction and overburden analysis in Pennsylvania. In Proceedings: West Virginia Surface Mine Drainage Task Force Symposium. (Morgantown, WV, April 25-26, 1989).

Brady, K.B.C., M.W. Smith, R.L. Beam, and C.A. Cravotta III. 1990. Effectiveness of the addition of alkaline materials at surface coal mines in preventing or abating acid mine drainage—Part II. Mine site case studies. In Proceedings of the 1990 Mining and Reclamation Conference and Exhibition. (Charleston, WV, April 23-26, 1990).
http://dx.doi.org/10.21000/JASMR90010227

Cathles, L.M. 1982. Acid mine drainage. The Pennsylvania State University Earth and Mineral Sciences 51(4):37-41.

Davis, Alan. 1981. Sulfur in coal. The Pennsylvania State University Earth and Mineral Sciences 51(2):13-21.

diPretoro, R.S. 1986. Premining prediction of acid drainage potential for surface coal mines in northern West Virginia. M.S. thesis. West Virginia University. 217 p.

diPretoro, R.S., and H.W. Rauch. 1988. Use of acid-base accounts in premining prediction of acid drainage potential. p. 2-10. In Proceedings: Mine Drainage and Surface Mine Reclamation, Vol. 1. Mine Water and Mine Waste (Pittsburgh, PA, April 19-21, 1988) U.S. Bureau of Mines Information Circular 9183.
http://dx.doi.org/10.21000/JASMR88010002

Erickson, P.M., and R. Hedin. 1988. Evaluation of overburden analytical methods as means to predict post-mining coal mine drainage quality. p. 11-19. In Proceedings: Mine Drainage and Surface Mine Reclamation, Vol. 1. Mine Water and Mine Waste (Pittsburgh, PA, April 19-21, 1988) U.S. Bureau of Mines Information Circular 9183.
http://dx.doi.org/10.21000/JASMR88010011

Ferguson, Keith, and P.M. Erickson. 1988. Approaching the AMD problem--from prediction and early detection. International Conference on Control of Environmental Problems from Metals Mines (Roros, Norway, June 20-24, 1988).

Harmon, R.S., W.B. White, J.J. Drake, and J.W. Hess. 1975. Regional hydrochemistry of North American carbonate terrains: Water Resources Research 11(6):963-967.

Hawkins, J.W. 1984. Iron disulfide characteristics of the Waynesburg, Redstone, and Pittsburgh coals in West Virginia and Pennsylvania. M.S. thesis. West Virginia University. 195 p.

Hem, J.D. 1985. Study and interpretation of the chemical characterisics of natural water (3d). U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Kleinmann, R.L.P., D.A. Crerar, and R.R. Pacelli. 1980. Biogeochemistry of acid mine drainage and a method to control acid formation. Mining Engineering 33:300-306.

Krauskopf, K.B. 1979. Introduction to geochemistry. New York, McGraw-Hill, 617 p.

Langmuir, Donald. 1971. The geochemistry of some carbonate groundwaters in central Pennsylvania. Geochimica et Cosmochimica Acta 35:1023-1045.
http://dx.doi.org/10.1016/0016-7037(71)90019-6

Lusardi, P.J., and P.M. Erickson. 1985. Assessment and reclamation of an abandoned acid-producing strip mine in northern Clarion County, Pennsylvania. p. 313-321. In Proceedings: 1985 Symposium on Surface Mining Hydrology, Sedimentology, and Reclamation. (Lexington, KY, University of Kentucky).

Morrison, J.L. 1988. A study of factors controlling the severity of acid mine drainage in the Allegheny Group of western Pennsylvania. M.S. thesis. Pennsylvania State University. 145 p.

Morrison, J.L., S.D. Atkinson, Alan Davis, and B.E. Scheetz. 1990. The use of CO_2 coulometry in differentiating and quantifying the carbonate phases in the coal-bearing strata of western Pennsylvania--its applicability in interpreting and modifying neutralization potential (NP) measurements. In Proceedings of the 1990 Mining and Reclamation Conference and Exhibition (Charleston, WV, April 23-26, 1990).
http://dx.doi.org/10.21000/JASMR90010243

Nordstrom, D.K., E.A. Jenne, and J.W. Ball. 1979. Redox equilibria of iron in acid mine waters. p. 51-79. In Jenne, E.A., ed., Chemical modeling in aqueous systems--Speciation, sorption, solubility, and kinetics. American Chemical Society Symposium Series 93.

Rochow, E.G. 1977. Modern descriptive chemistry. Philadelphia, W. B. Saunders Co., 253 p.

Shuster, E.T., and W.B. White. 1972. Source areas and climatic effects in carbonate groundwaters determined by saturation indices and carbon dioxide pressures. Water Resources Research 8(4):1067-1073.
http://dx.doi.org/10.1029/WR008i004p01067

Singer, P.C., and Werner Stumm. 1970a. Acidic mine drainage--the rate-determining step. Science 167:1121-1123.

Singer, P.C., and Werner Stumm. 1970b. Oxygenation of ferrous iron. U.S. Department of the Interior, Federal Water Quality Administration (U.S. Environmental Protection Agency) Water Pollution Control Research Report 14010--067/69.

Skousen, J.G., J.C. Sencindiver, and R.M. Smith. 1987. A review of procedures for surface mining and reclamationin areas with acid-producing materials. West Virginia Surface Mine Drainage Task Force, 39 p.

Smith, M. W., and K.B.C. Brady. 1990. Review and summary of acid base accounting data using computer spreadsheets. In Proceedings of the 1990 Mining and Reclamation Conference and Exhibition (Charleston, WV, April 23-26, 1990).
http://dx.doi.org/10.21000/JASMR90010213

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. Field and laboratory methods applicable to overburdens and minesoils. Cincinnatti, Ohio, U.S. Environmental Protection Agency Environmental Protection Technology EPA-600/2-78-054, 203 p.

Stumm, Werner, and J.J. Morgan. 1981. Aquatic chemistry--an introduction emphasizing chemical equilibria in natural waters (2nd). New York, John Wiley and Sons, 780 p.

Williams, E.G., A.W. Rose, R.R. Parizek, and S.A. Waters. 1982. Factors controlling the generation of acid mine drainage. Final report to the U. S. Bureau of Mines, Research Grant No. G5105086, 256 p.

EFFECTIVENESS OF THE ADDITION OF ALKALINE MATERIALS AT SURFACE COAL MINES IN PREVENTING OR ABATING ACID MINE DRAINAGE: PART 2. MINE SITE CASE STUDIES[1]

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Abstract. The effectiveness of preventing or ameliorating acid mine drainage (AMD) through the application of alkaline additives is evaluated for eight surface coal mines in Pennsylvania. Many of the mine sites had overburden characteristics that made prediction of post-mining water quality uncertain. Alkaline materials were applied at rates ranging from 42 to greater than 1,000 tons as calcium carbonate per acre. In addition, two sites that were mined and reclaimed without alkaline additives are included for comparative purposes.

Overburden sulfur concentration and "neutralization potential" (NP) data for multiple strata at each mine site were used to compute the cumulative, mass-weighted "maximum potential acidity" (MPA) and "net neutralization potential" (NNP = NP - MPA) by using three different calculation methods. Post-reclamation water-quality data were used to compute the net alkalinity (= alkalinity - acidity). The most conservative determination of NNP, whereby MPA is calculated by multiplying the total sulfur concentration, in weight percent, by 62.5 instead of 31.25, yielded the best agreement with net alkalinity (matching signs on NNP and net alkalinity). The error in prediction using each method was that the reclaimed overburden was computed to be alkaline overall (NNP > 0), but the post-reclamation water was acid (net alkalinity < 0).

In general, alkaline addition rates were probably insufficient to neutralize, or too late to prevent, acid production in the mine spoil. At six of the seven mine sites that had overburden with insufficient NP relative to MPA (NNP < 0), the addition of alkaline materials failed to create alkaline mine drainage; AMD was formed or persisted. A control site which also had insufficient alkaline material, but did not incorporate alkaline additives, generated severe AMD. Two sites that had substantial, natural alkaline overburden produced alkaline drainage. Although the addition rates appear to be inadequate, other factors, such as unequal distribution and exposure of the acid-forming or neutralizing materials and hydrogeological variability, complicate the evaluation of relative effectiveness of using different alkaline materials and placement of the acid- or alkaline-producing materials.

Introduction

Acid mine drainage (AMD) from surface coal mines is a severe problem in Pennsylvania as well as other Appalachian coal mining states. Discharges of water from reclaimed mine sites must meet acceptable effluent limits; treatment of the discharges can be a major financial burden to a coal mine operator.

In Pennsylvania, the strata at some mine sites cannot be mined without causing AMD pollution because insufficient quantities of naturally alkaline material are present to neutralize the AMD. At coal mines with abundant naturally alkaline strata, mine drainage is commonly alkaline. Therefore, the importation and addition of alkaline

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material to alkaline-deficient mine spoil may produce sufficient neutralization potential to prevent or abate AMD. However, the majority of mine sites that have been reclaimed using imported alkaline materials produce AMD. One problem is knowing the quantity of alkaline material that must be added to produce the desired effect. Another problem is knowing the best place to add alkaline material within a mine site.

This paper summarizes the history of alkaline addition as a reclamation technique, and presents the results of a study of overburden and water-quality data at 10 reclaimed surface coal mines in the bituminous coal fields of Pennsylvania (fig. 1). Emphasis is placed on evaluating the recommended alkaline-addition rates as compared to the calcium-carbonate deficiency calculated by acid-base accounting (Sobek et al. 1978; Smith and Brady 1990; Cravotta et al. 1990). Factors such as the mine hydrogeology, operational history, mining method, placement and type of imported alkaline material, and selective handling of strata are evaluated. The study sites include mines where alkaline addition was used in an attempt to abate existing AMD problems, as well as mines where alkaline addition was used in an attempt to prevent AMD in areas not previously mined.

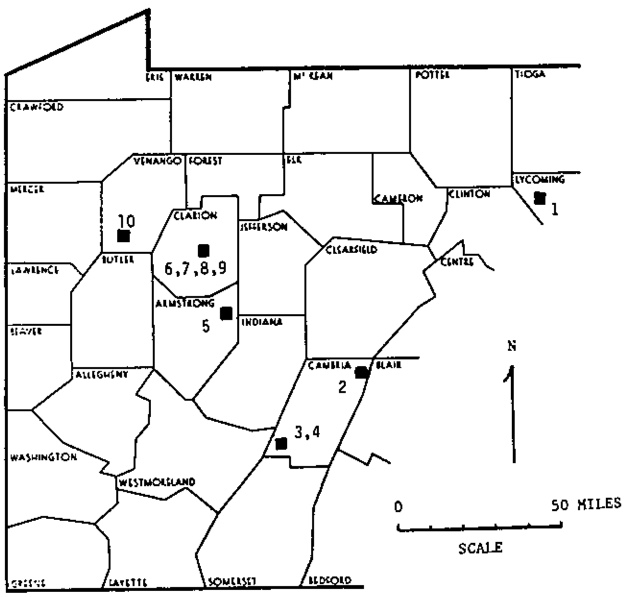


Figure 1. Map showing the locations of mine sites 1 through 10 in western Pennsylvania.

Historical Background on Alkaline Addition in Pennsylvania

The Pennsylvania Department of Environmental Resources (PaDER) is responsible for the review and approval of permits for surface coal mines in Pennsylvania. The PaDER developed procedures for review of plans for alkaline addition on the basis of two reports. The first report is, "Suggested Guidelines for Method of Operation in Surface Mining of Areas with Potentially Acid-Producing Materials," by the West Virginia Surface Mine Drainage Task Force (1979). In "Appendix C" entitled "Immediate Lime Requirement" was the suggestion that, "A realistic lime requirement figure is probably a third of the maximum potential acidity from total sulfur." The second report is, "The Application of Limestone and Lime Dust in the Abatement of Acidic Drainage in Centre County, Pennsylvania" by Waddell et al. (1980). Rock, stratigraphically lower than the coal-bearing units, was excavated and redeposited during construction of Interstate 80. Acidic discharges flowed from the toe of this spoil. A mixture of limestone and lime-kiln flue dust was added to part of the spoil at the rate of 267 tons per acre (tons/acre). Although improvements in water quality were observed within the treated and untreated areas, the improvements in the treated areas were thought to be the most significant.

These early suggestions of success in correcting AMD encouraged the PaDER to permit alkaline addition at surface coal mines where the strata, according to acid-base accounting (ABA), showed only a slight deficiency of calcareous material. ABA considers two variables--neutralization potential (NP), in tons of calcium carbonate per 1,000 tons of overburden (tons $CaCO_3$/1,000 tons), and total sulfur, in weight percent (%), which is converted to "maximum potential acidity" (MPA) reported as tons $CaCO_3$/1,000 tons. A detailed discussion of the chemical stoichiometric relations that are assumed in ABA is given in Cravotta et al. (1990). The net neutralization potential (NNP) of mine spoil is computed by subtracting mass-weighted MPA from NP. A negative, or deficient, NNP has been interpreted as the quantity of $CaCO_3$ that must be added to prevent or abate AMD. Alkaline addition rates were generally calculated at one-third the NNP as suggested by the West Virginia Surface Mine Drainage Task Force (1979), although sometimes the addition rate was increased slightly as a "safety factor." As this study clearly shows, most reclamation using alkaline addition at surface coal mines in Pennsylvania has failed to prevent or abate AMD.

Previous studies focused on alkaline addition as a means of abating existing AMD problems (Geidel 1982; Lusardi and Erickson 1985; Caruccio and Geidel 1984, 1986; Waddell et al. 1980) and not as part of the ongoing mining operation. In general, two alkaline-treatment schemes were advanced: (1) Waddell et al. (1980) hypothesized that it was unnecessary to neutralize all the potential acidity in pyritic spoil because the addition of alkaline materials to create pH greater than 4.5 would inhibit the bacterial catalysis of pyrite oxidation. (2) Lusardi and Erickson (1985) assumed that most acid is produced near the surface and that it was only necessary to add sufficient limestone to balance the net deficiency in the upper spoil zone. However, these attempts to abate AMD by adding alkaline material to pyritic spoil resulted in limited, if any, success because effluent limits were seldom met or maintained.

The advent of alkaline addition and selective handling, as well as the poor success of literal interpretation of ABA, necessitated the development of guidelines for understanding which strata were potentially alkaline or acid producing. On the basis of PaDER's experience it was concluded that a NP of 30 tons $CaCO_3$/1,000 tons (and "fizz", effervescence during reaction with dilute hydrochloric acid) and a total sulfur content of 0.5% were reasonable guidelines to be used in defining strata that were potentially alkaline or acid producing (Brady and Hornberger 1989). Addition rates were generally calculated on the basis of total sulfur values greater than 0.5%; the permittee was given "credit" for strata with NP's greater than 30 tons $CaCO_3$/1,000 tons.

Methods

The method of selection of mine sites for this study was one of gathering data and then eliminating sites for which necessary information was lacking. The data required for site selection included ABA overburden data and post-mining discharge or ground-water-quality data (pH and concentrations of alkalinity, acidity, iron, manganese, and sulfate). Overburden samples must have been collected from drill holes no farther than a few hundred feet from the area mined. Furthermore, the mining methods and plans must have been documented and the alkaline addition must have been performed as specified in the permit. All sites that met the selection criteria were included.

Overburden analysis data for total sulfur and NP at sites 1 through 8 and 10 (fig. 1) were obtained from PaDER permit files. Data for mine site 9 were obtained from U.S. Geological Survey (USGS) project files. Cumulative mass-weighted NNP was calculated by using a computer-spreadsheet program (Smith and Brady 1990) that included multiplication factors of 31.25 and 62.5 to compute MPA from the total sulfur data (Cravotta et al. 1990).

Water-quality data were obtained from coal-company files and PaDER permit or USGS project files; PaDER and USGS samples were analyzed by the PaDER laboratory. Water samples were collected from toe-of-spoil seeps, monitor wells, and (or) deep mine discharges that were downflow from the mine site. Net alkalinity [in milligrams per liter as calcium carbonate (mg/L $CaCO_3$)] was calculated by subtracting acidity (base-neutralizing capacity) from alkalinity (acid-neutralizing capacity) (Stumm and Morgan 1981, p. 163-166). Net alkalinity was used in previous AMD studies (diPretoro 1986; diPretoro and Rauch 1988; Erickson and Hedin 1988) because it reflects the regulatory requirement that alkalinity exceed acidity, and it allows comparison of a single water-quality parameter with overburden NNP.

Water-quality data were evaluated using "notched" boxplots (Velleman and Hoaglin 1981; Helsel 1987) (fig. 2). The box is defined by the interquartile range (IQR = 25th to 75th percentiles). The median (50th percentile) is shown as a "+" within the box. Notches "()" identify the 95-percent confidence interval around the median (Hettmansperger and Sheather 1986) and are useful in testing the difference between median values for data subsets. For example, a pair of boxplots in figure 2 shows that the medians for two subsets of data are significantly different at the 95-percent confidence level. The notches enclosing the median do not overlap--the right-side notch of the upper box is not greater than the left-side notch of the lower box. However, if the notches for a pair of boxplots overlap, then the medians for the two subsets are not significantly different at the 95-percent confidence level.

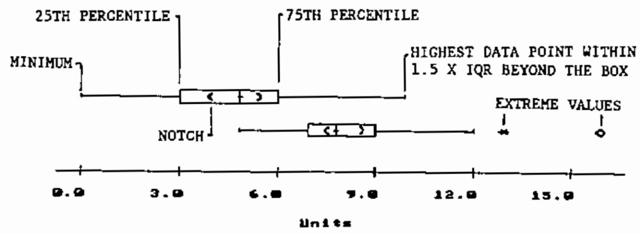


Figure 2. Explanation of boxplots showing median "+" (50th percentile), interquartile range (IQR = 25th to 75th percentile), notches "( )", and extreme values "*" and "o". Horizontal lines are drawn to the data points farthest from the box, yet within a distance 1.5 times the IQR beyond the box. Extreme values beyond this distance are plotted individually.

The mining history for individual case studies was determined from permit-file inspection reports, discussions with coal-company personnel and PaDER mine inspectors, and field investigations by the authors. The historical information gathered includes the area mined, mining method and equipment used, compliance record, hydrologic conditions during mining, speed of the operation, and size of the active mine.

Case Studies

Eight surface-coal mines where alkaline addition was permitted by the PaDER met the selection criteria for inclusion in this study. Two additional mines, where alkaline materials were not added, are also included: Mine site 3 is a control for comparison with site 4, and site 10 is an example with abundant naturally alkaline strata. For comparison of similarities and differences of the ten mine sites selected for study, table 1 lists site characteristics, and table 2 lists the NNP of the overburden and net alkalinity of post-mining water samples. Each mine site is unique in terms of mining methods, size of the mine, hydrogeology, stratigraphic interval, overburden quality, pre- and post-mining water quality, monitoring programs, and so forth. With the exception of mine sites 3 and 9, the mines were developed after 1980, and modern mining and reclamation practices were used. Overburden NP and total sulfur data were available for all sites except site 2, for which only total sulfur data were available. Pre- and post-mining water-quality information was available for all sites except mine site 10. References to MPA and NNP are based on the revised chemical stoichiometry of Cravotta et al. (1990). The following discussions are provided to address the mine and overburden characteristics, methods and materials used for alkaline additives, and related water-quality data.

<u>Mine Site 1: Lycoming County</u>. Mine site 1 is situated on a relatively flat, isolated hilltop. Approximately 210 acres of the lower Kittanning (Bloss) coal were mined, along with lesser acreages of the overlying middle Kittanning, upper Kittanning, and lower Freeport coals. Maximum highwall height was about 135 ft. The mining area includes an abandoned deep-mine complex of approximately 70 acres in the lower Kittanning coal. It also

Table 1: Mine Site Characteristics

MINE SITE	COUNTY	AREA (ACRES)	NO. OF OVERBURDEN HOLES	-------Tons as CaCO3 per acre------- ALKALINE ADDITION TOTAL	PIT FLOOR	SPOIL	SPOIL SURFACE	QUALITATIVE OVERBURDEN COMPOSITION**	SELECTIVE OVERBURDEN HANDLING
1	Lycoming	45	3	500	50	350	100	Low NP/Low S	NO
2	Cambria	26	1	42	22	10	10	Low NP/Low S	YES
3	Cambria	47	2	0	0	0	0	Low NP/Med S	NO
*4	Cambria	75	2	648	54	0	594	Low NP/Med S	YES
5	Armstrong	19	1	140	0	0	140	Med NP/Med S	NO
6A	Clarion	54	2	100	20	0	80	Low NP/Low S	NO
7	Clarion	60	2	300	20	0	280	Low NP/Low S	NO
*8	Clarion	29	2	54	0	0	54	Low S/Low NP	YES
*9A	Clarion	2.5	2	1.120	0	0	1,120	Low NP/High S	NO
*9B	Clarion	2.5	2	724	0	0	724	Low NP/High S	NO
*9C	Clarion	2.5	2	6	0	0	6	Low NP/High S	NO
10	Venango	41.5	2	0	0	0	0	High NP/Med S	YES

*Alkaline material includes hydrated lime, $Ca(OH)_2$, which is reported as equivalent tons $CaCO_3$ (see Cravotta et al., 1990).

**NP = neutralization potential, in tons $CaCO_3$/1000 tons; S = total sulfur concentration, in weight percent.

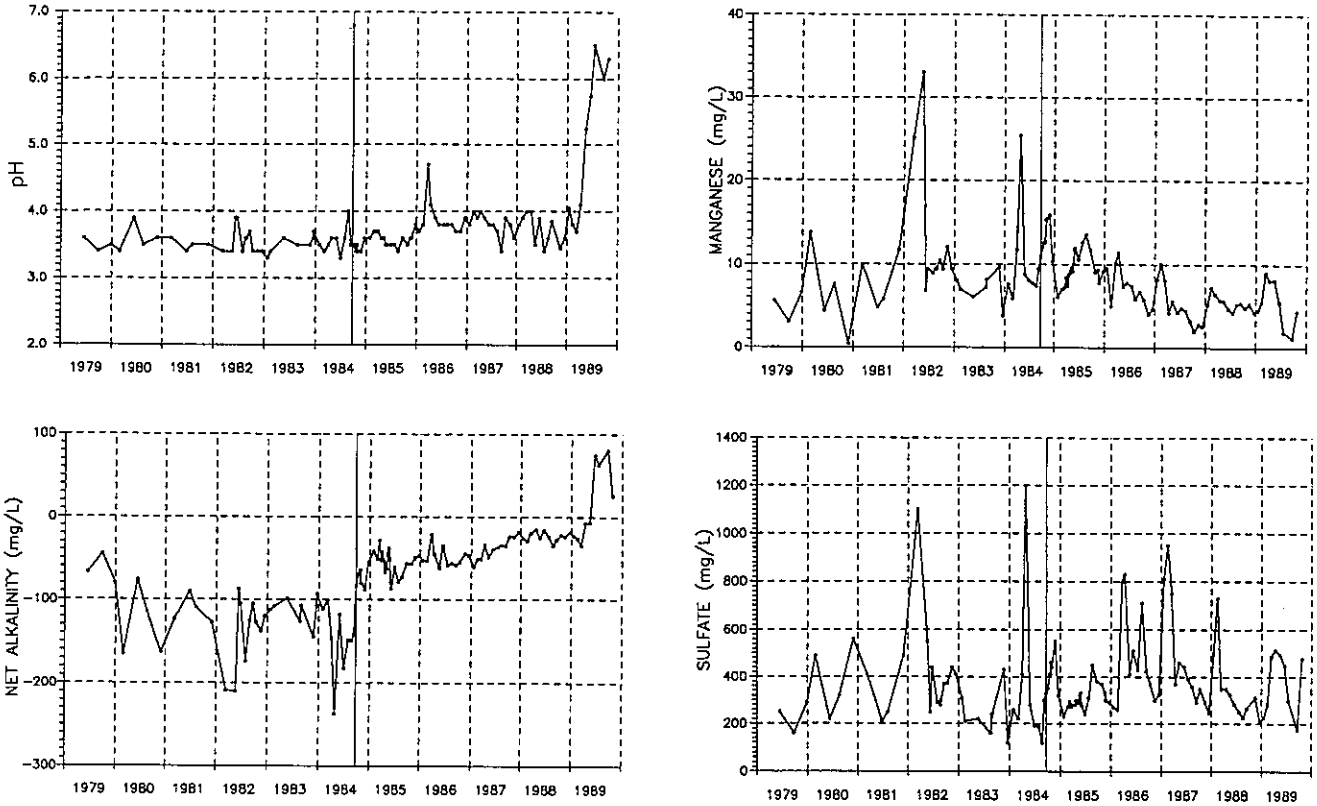
Table 2: Comparison of net neutralization potential of overburden [1, 2] and post-treatment net alkalinity[3] of coal-mine drainage

Mine Site[5]	NNP Before Alkaline Addition (no thresholds) MPA = 31.25 x %S	MPA = 62.5 x %S	NNP After Alkaline Addition MPA = 31.25 x % S (no threshold)	(thresholds)[4]	NNP After Alkaline Addition MPA = 62.5 x % S (no threshold)	(thresholds)[4]	Post-treatment Median Net Alkalinity of Coal-Mine Drainage
1	+6.03	+1.51	+6.90	-0.31	+2.31	-1.43	+67
2	-3.92	-7.84	-3.06	-1.73	-6.98	-4.32	-62
3	+2.85	-4.97	+2.85	-3.76	-4.97	-7.71	-468
4	+2.77	-10.81	+4.91	-6.07	-7.97	-13.03	-74
5	+15.69	+3.91	+16.68	+14.65	+4.91	+7.06	+11
6 A	+4.10	-3.82	+4.36	+2.88	-3.56	-1.71	-55
7	-3.88	-11.67	-1.14	-1.03	-9.43	-4.30	-685
8	+5.55	+1.90	+5.76	+3.17	+2.32	+1.88	-184
9 A	-3.40	-7.92	-0.81	+0.61	-2.91	+1.04	-2190
B	-6.16	-13.23	-3.65	-2.20	-9.99	-6.19	-860
C	-9.68	-20.74	-9.66	-6.83	-20.70	-13.65	-3332
10	+170.47	+156.81	+170.47	+168.77	+156.81	+156.6	+118

1 "Net neutralization potential" (NNP = NP-MPA) reported in tons $CaCO_3$/1,000 tons (Smith and Brady 1990); "maximum potential acidity" (MPA) computed by multiplying total sulfur (S), in weight percent by 31.25 and 62.5, respectively (Cravotta et al. 1990).
2 An appendix with the actual overburden analysis data is available from the authors.
3 Net alkalinity (= alkalinity - acidity) in mg/L as $CaCO_3$.
4 Threshold where total S<0.5%, calculated MPA=O; where NP<30 or no effervesence reaction with dilute HCl, calculated NP=0.
5 Mine sites 3 and 10 did not have alkaline additives incorporated with the mine spoil. These sites are included for comparative purposes.

includes approximately 34 acres where the lower Freeport coal was previously surface mined; drainage was diverted from the surface mined lower Freeport to the deep mine via an underdrain system. Mining has taken place continuously since the early 1970s and continues to date. Underground mine workings were first encountered in late 1984. Approximately 45 acres have been daylighted using a dragline.

Most ground water from the site discharges from the abandoned underground mine via an air shaft. Water quality was monitored at this discharge point since 1979, and flow rates were monitored continuously since 1982. Prior to the 1985 water year (October 1, 1984 through September 30, 1985), pH and net alkalinity were relatively constant, while iron and manganese concentrations varied by a factor of 10 (fig. 3).



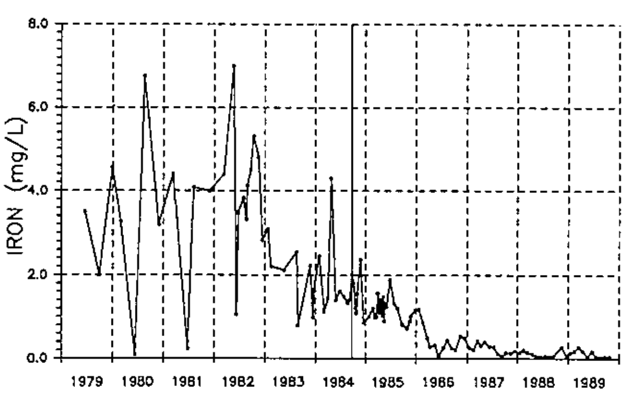


Figure 3. Changes in selected water-quality characteristics over time at mine site 1 in Lycoming County. The vertical line in 1984 indicates the time when deep mine daylighting and increased alkaline addition began.

Overburden from the three drill holes sampled is characterized by low total sulfur and low NP contents. However, many samples are composites of strata from large intervals (up to 28 ft thick). The highest total sulfur content measured was 1.29%. Only one sample, other than the coals, contained sulfur exceeding 0.5%. The highest NP was 33 tons $CaCO_3$/1,000 tons.

Pit cleanings were segregated from the overburden using a loader and were placed high in the backfill. The operator initially applied nearly-pure $CaCO_3$ (a limestone crusher screening waste product) to the pit floor and upper part of the backfill at a total rate of about 50 tons/acre. In late 1984, roughly at the same time the deep mine complex was encountered, this rate was increased to approximately 500 tons/acre, a rate that exceeded permit requirements. Approximately 50 tons/acre were spread on the pit floor and 100 tons/acre were applied to the upper surface of the rough backfill. The remaining 350 tons/acre were distributed through the backfill using limestone crusher screenings as blast hole stemming. From January 1985 through September 1989, a total of 19,000 tons of calcareous material were applied over 48 acres. Table 2 indicates that the overburden NNP increases, and is positive, after the addition of limestone on the basis of MPA computed by multiplying total sulfur by 31.25 or 62.5; however, NNP is negative if thresholds are used. For site 1 the NNP computed using the thresholds is unreliable because large intervals of strata were sampled and composited causing the possible dilution of high-sulfur or high-NP concentrations.

Figure 3 shows that a dramatic increase in net alkalinity, accompanied by a decrease in iron concentrations, occurred during the 1985 water year and continued through the 1989 water year. Sulfate and manganese concentrations, however, show little change (fig. 3). Manganese has a tendency to remain dissolved in acidic to neutral solutions (pH < 8) whereas iron will readily precipitate at pH > 4.5 (Hem, 1985). This increase in alkalinity is concurrent with the deep-mine daylighting and the application of alkaline material at a rate of 500 tons/acre. The increasing alkalinity of the water in combination with the persistently elevated sulfate concentrations indicates that acid production continues in the spoil but is neutralized.

Since 1988, water quality at the deep-mine discharge has attained "conventional mine-drainage effluent standards" (alkalinity > acidity; 6 < pH < 8; Fe < 6 mg/L; Mn < 4 mg/L).

The apparent neutralization of acidity indicates that the addition of alkaline materials played the dominant role in effecting the water-quality improvement. The removal of unmined, pyritic coal pillars by daylighting may have reduced that contribution of sulfate; however, surface mining may have produced additional sulfate which offsets the daylighting reduction. Furthermore, if neutralizers were liberated from the overburden, net alkalinity would have increased prior to the alkaline addition.

Mine Site 2: Cambria County. Site 2 encompassed 26 acres of Mercer coal removal by surface mining. No part of the permit area had been previously mined, although the adjacent property had been extensively mined, with AMD resulting. A period of 43 months elapsed from initiation of mining on mine site 2 to final backfilling (0.6 acres/month). Maximum highwall height was 45 ft.

Site 2 occupies the crest of a gently sloping hill and recharge to the site is predominantly from precipitation. Because AMD occurred at an adjacent mine, the permit approval for mining at site 2 required overburden analysis and alkaline addition. The strata were assumed to lack substantial carbonate minerals, so only total sulfur was determined in the overburden samples.

The sulfur concentrations and lithologic descriptions of samples from one overburden hole drilled within the area mined were used in ABA calculations (table 2); however, additional lithologic data from other drill holes were used to define the stratigraphy. The overburden composition and thickness differed across the site, because of removal of strata by erosion and replacement by channel sandstones, and because of bifurcation (splitting) of the coal seam. The number of splits in, and thickness of the coal (2 to 5 ft), differed from hole to hole. The majority of the strata consists of sandstone, with "coal spars" at the base. In most drill holes a 0.5- to 3-ft-thick, black, carbonaceous shale was encountered immediately above the coal. The overburden hole encountered 1.5 ft of this black shale, which contains 1.12% total sulfur, and 2 ft of coal, which contains 2.64% total sulfur. Because of the numerous binders in the coal, approximately 30 percent of the coal horizon was spoiled as "pit cleanings." The pit cleanings were segregated and placed in pods a minimum of 10 ft above the pit floor to keep them above the water table after the mine was reclaimed. Because of the large amount of pit cleanings and the thin cover, some of this material was placed within a few ft of the final graded surface.

The alkaline material consisted of baghouse limestone (captured air-borne particulate material), which was applied at a rate of 42 tons/acre. About 22 tons/acre were added to the pit floor; about 10 tons/acre were added to the tops of the pit-cleaning pods and to the backfilled surface prior to replacement of topsoil.

About 200 ft downslope and downdip from mine site 2, water discharges from a seep on the adjacent, previously mined area. Samples collected over 3.5 years define conditions prior to mining at site 2 (fig. 4). Since mining at site 2, the pH of the seep has decreased, and acidity, sulfate, iron, and manganese concentrations have increased. Following backfilling, the seep water quality has maintained significantly lower pH and net alkalinity and greater iron, manganese, and sulfate concentrations than are present in the premining samples (fig. 4). Water from a monitor well screened through the backfill was similar in quality to that from the seep. Alkaline addition has not prevented acid formation at this mine site. AMD may have been predicted on the basis of the negative NNP (table 2).

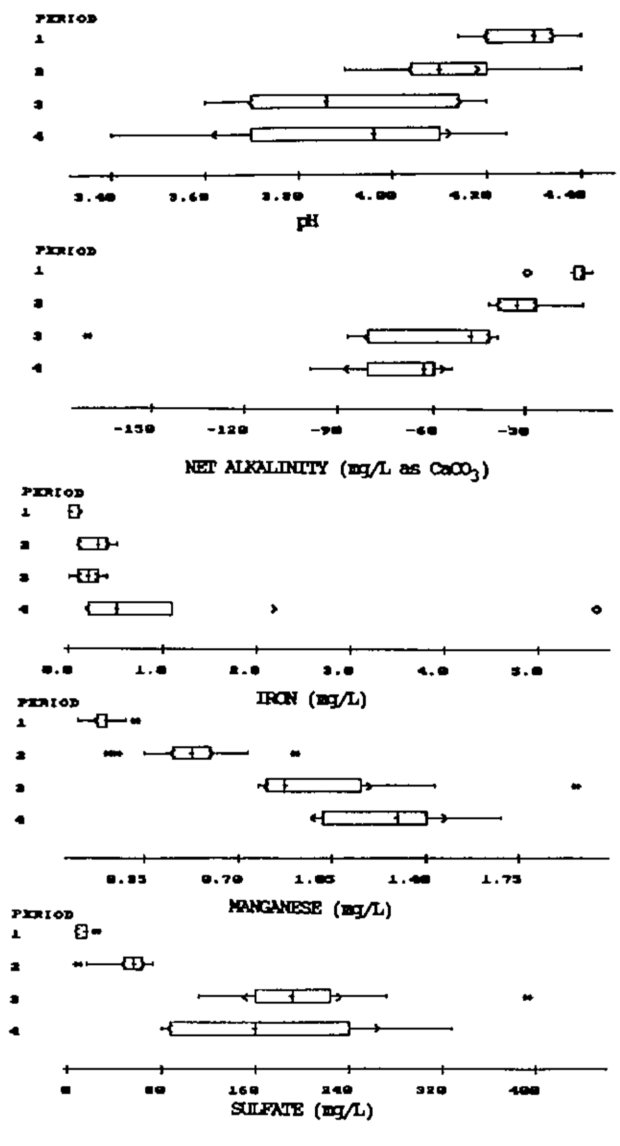


Figure 4. Boxplots showing changes in water quality at mine site 2 in Cambria County. Period 1 represents data collected over a 3-year period prior to activation of mining (N=14). Period 2 is the first 20 months of mining (N=14), and period 3 is the second 20 months of mining (N=11). Period 4 represents post-mining water quality (N=6).

Mine Sites 3 and 4. Cambria County. Site 3 is an unreclaimed mine similar in size and configuration to the adjacent mine site 4. No alkaline addition or special handling was conducted at mine site 3, and the backfilling and reclamation are incomplete. In contrast, mine site 4 is a recently reclaimed mine where alkaline materials have been added to a 75-acre area where the lower Kittanning, lower Kittanning rider, and upper Kittanning coals were mined. The site was active for 60 months (1.25 acres/month). Site 4 can be categorized as a contour block-cut operation with a maximum highwall height of 125 ft. Mining and backfilling were on a continuous basis; the open pit area did not exceeded 100 ft by 300 ft.

Surface and ground waters affected by nearby deep mining or surface mining of the lower Kittanning are severely degraded, whereas waters from unmined areas have near-neutral pH, low buffering capacity, and low concentrations of metals. Although mine site 4 is adjacent to previously affected areas (including mine site 3), it is neither upflow nor downflow from preexisting AMD.

Overburden-analysis data for mine sites 3 and 4 indicate the presence of some potentially acid-producing strata associated with and overlying the lower Kittanning and lower Kittanning rider seams and the absence of strata having NP greater than 30 tons $CaCO_3$/1,000 tons. Overburden quality is summarized in tables 1 and 2. Selective handling of pyritic materials, removal of pit cleanings, and alkaline addition were performed at mine site 4 to avoid post-mining water-quality problems associated with mine site 3. Hydrated lime was added at a total rate of 240 tons/acre [648 tons $CaCO_3$/acre, assuming $Ca(OH)_2$ has 2.7 times the neutralization capacity of $CaCO_3$ (Cravotta et al. 1990)]—a rate that exceeded permit requirements. The alkaline material was distributed on the pit floor at a rate of 54 tons $CaCO_3$/acre; the remaining 594 tons $CaCO_3$/acre were spread over the surface of the rough backfill prior to topsoil replacement (table 1). In accordance with the $CaCO_3$ deficiency, the above alkaline addition rate represented 44% of the total calculated deficiency. The plans for special handling and alkaline addition were diligently implemented, and most of the pyritic materials associated with the lower Kittanning coal were exported from the mine site.

Figure 5 compares the post-mining water quality for two toe-of-spoil discharges at the downdip boundaries of mines 3 and 4. Both sites have AMD; except for iron, the water quality at the alkaline addition site 4 is significantly better than that at site 3. The traditional method of computing the overburden MPA yields positive NNP (table 2); however, use of thresholds or a multiplication factor of 62.5 in ABA computations yields negative NNP values (table 2), which are consistent with the negative value for post-treatment net alkalinity at both sites. The water-quality difference between sites 3 and 4 is attributable to the addition of alkaline materials and the different mining and reclamation methods employed at the two sites.

Mine Site 5: Armstrong County. Mine site 5 encompasses 19 acres. The lower and middle Kittanning coal were removed by surface mining of cover that was 30 to 80 ft thick. The area had been mined previously to a depth of 30 to 40 ft. Eight months elapsed from initiation of mining to completion of backfilling (2.4 acres/month). Reclamation was concurrent with mining.

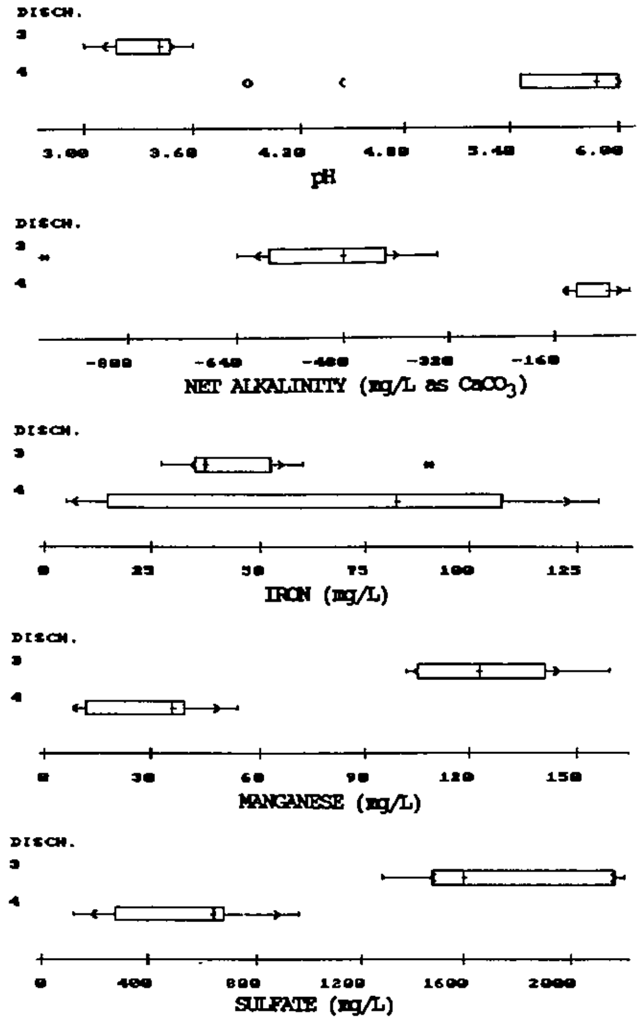


Figure 5. Boxplots showing comparison of water quality data for mine sites 3 (N=8) and 4 (N=5) in Cambria County. Mine site 4 had alkaline addition; mine site 3 did not and served as a control.

Several toe-of-spoil discharges emanated from the previously mined area. The water quality was generally alkaline, and the pH was 5 to 6. Site 5 is located on a hillside with a substantial area upslope from the mine. Ground-water recharge to the site is from direct precipitation and from the drainage of upslope areas.

The overburden hole closest to the area mined was drilled above the highwall through strata that were not mined. The unmined, upper cover was not included in the ABA calculation, and the top part of the hole, to the weathered depth of 20 ft, was assumed to be inert (NP and sulfur are 0). Nine ft of shale above the lower Kittanning coal had total sulfur content ranging from 0.69 to 1.36%, and 28 ft of overlying strata had NP ranging from 30 to 72 tons $CaCO_3$/1,000 tons. The composite strata from this hole contained an equivalent NP as 3,875 tons $CaCO_3$/acre extrapolated over the area mined. Although the overburden analysis for the area mined shows an overall excess of neutralizers (table 2), overburden holes outside the area mined lacked alkaline strata, and AMD discharges from nearby mines. Therefore, alkaline addition was performed at mine site 5 because of the uncertain effect of mining on water quality and the variable overburden composition. The alkaline material consisted of imported limestone dust that was added at a rate of 140 tons/acre to the backfill surface prior to topsoil replacement.

Boxplots in figure 6 show the quality water from a toe-of-spoil seep below mine site 5. The initial water quality is representative of the effects of the preexisting shallow-cover mining on water quality. The subsequent samples illustrate water quality during and after the thick-cover mining. There is no significant difference between the pre- and post-mining water quality (pH, net alkalinity, iron, manganese, and sulfate) at the 95-percent confidence level. Even the lowest pH and highest concentrations of sulfate and metals measured during the post-mining period meet conventional effluent limits. The positive net

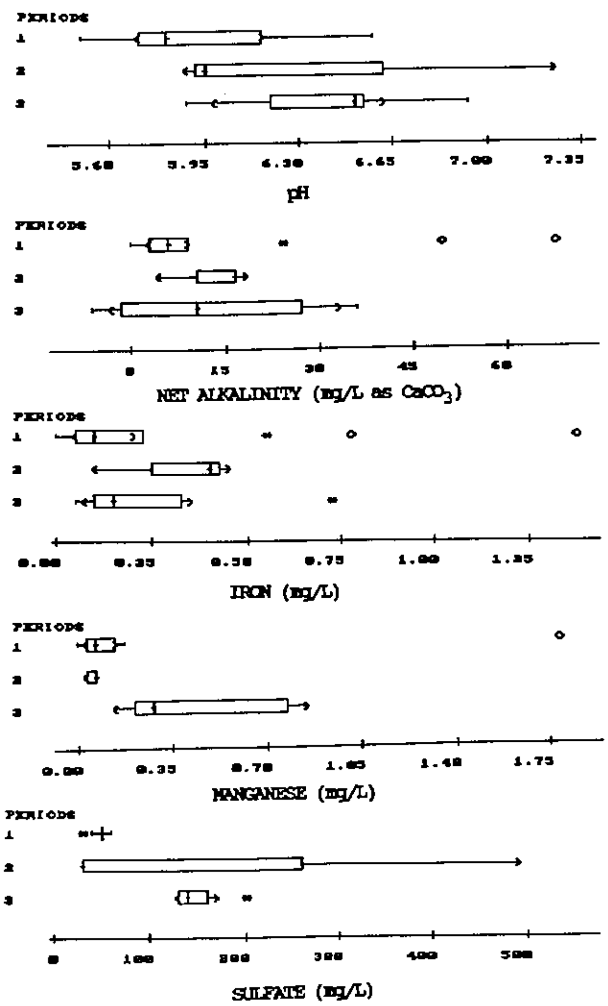


Figure 6. Boxplots showing changes in water quality through time for mine site 5 in Armstrong County. Time 1 represents "premining" data (N=13) over a 2-year period. Time 2 is data collected during mining (N=3), and time 3 is 1 year of post-mining water quality (N=7).

alkalinity of the post-treatment drainage is consistent with positive NNP computed by any method (table 2).

The mining and reclamation at site 5 did not cause degradation of the seep; however, the remedial effects of alkaline addition cannot be isolated from those of naturally occurring calcareous strata. The quantity of naturally alkaline material in the mine spoil was much greater than that of imported alkaline material. Additionally, ground water seepage to the open pit was probably alkaline, and the mining operation proceeded very quickly, thus limiting the aeration of the spoil.

<u>Mine Site 6: Clarion County</u>. Mine site 6 consists of two adjacent, similarly-sized mines, 6A and 6B. Approximately 54 acres of upper and lower Clarion coal were mined at site 6A where alkaline materials were applied during mining and reclamation. The same seams of coal were removed at mine site 6B, but alkaline addition was not implemented; mine site 6B serves as a control. Both mines are located on the side of a hill, and both mines receive some recharge from areas above the area mined. Prior to mining at site 6A, water did not discharge from the coal outcrop, but during mining, seepage(?) water was observed in the open pit.

Rock samples from the two overburden holes indicate considerable differences in the stratigraphic positions of the high-sulfur and alkaline strata. The strata with the highest sulfur content were encountered between the lower and upper Clarion coal seams. Other than the coal samples, no strata contain sulfur greater than 1.0%. Drill hole 1 encountered a 12-ft-thick shale between the Clarion coals that had NP of 36 to 43 tons $CaCO_3$/1,000 tons. Drill hole 2 encountered strata between the coals that had a maximum NP of 21 tons $CaCO_3$/1,000 tons and strata immediately above the upper Clarion coal that had a NP of 32 tons $CaCO_3$/1,000 tons. The amount of naturally alkaline material (composite NP for all strata) was equivalent to 1,925 tons $CaCO_3$/acre for the mined area. A summation of the overburden quality is given in table 2.

Approximately 21 months elapsed from initiation of mining to completion of backfilling at mine site 6A (2.6 acres/ month). Maximum highwall height was about 85 ft. Pit cleanings were selectively handled, and placed at least 10 ft above the pit floor. Alkaline materials were applied as a "safety factor." Baghouse limestone with a $CaCO_3$ equivalent of nearly 100 percent was applied to the pit floor at a rate of 20 tons $CaCO_3$/acre and near the top of the backfilled spoil, but beneath the topsoil, at a rate of 80 tons $CaCO_3$/acre. Application rates on the pit floor on at least one occasion were greater than 20 tons $CaCO_3$/acre. Nevertheless, the quantity of alkaline material added to the spoil may not have been adequate to offset the pre-treatment, negative NNP (table 2). If MPA is computed by multiplying total sulfur by 31.25, then NNP is positive after alkaline addition; however, if MPA is computed by multiplying total sulfur by 62.5, then NNP is negative. Addition of limestone increased the overburden NNP from -3.82 to only -3.56 tons $CaCO_3$/1,000 tons on the basis of the 62.5 factor (table 2).

Discharges from mine sites 6A and 6B were both alkaline and acidic. Special handling of overburden or addition of alkaline material was not performed at mine site 6B, which serves as a control. Post-treatment water-quality data for several discharges are grouped by mine site and are shown as boxplots in figure 7. There is no significant difference between the post-treatment water quality of sites 6A and 6B at the 95-percent confidence level. The negative values of NNP after alkaline addition, on the basis of MPA computed using the factor of 62.5 (table 2), suggest that acidic discharge from mine site 6A may have been predicted. Thus, the alkaline-addition rate at site 6A may not have been adequate to cause substantial improvement in the water quality.

<u>Mine Site 7: Clarion County</u>. Minesite 7 encompassed a mined area of approximately 60 acres of lower Clarion coal and 31 acres of upper Clarion coal. A period of 20 months elapsed from initiation of mining to completion of backfilling (3 acres/month). The maximum highwall height was 60 ft. Although mine site 7 is situated on a hilltop, in a groundwater recharge area, considerable water was encountered during mining. The downflow monitor well consistently had a static water level of 0.5 to 1 ft above the bottom of the coal.

A 2- or 3-acre portion of site 7 was previously mined and abandoned. It had developed a mildly acidic discharge, which could possibly be eliminated by additional mining and reclamation. Because the overburden analysis characterized this site as low sulfur and low NP (tables 1 and 2), mining of the additional 60 acres was planned with an alkaline addition rate of 300 tons $CaCO_3$/acre (about 19 percent of the calculated NNP, where MPA is computed using a factor of 62.5). A 2-ft-thick sandstone stratum contained total sulfur of 0.78% and NP of 28 tons $CaCO_3$/1,000 tons, the highest measured in the overburden, respectively. A 5-ft-thick shale stratum had 0.53% total sulfur. Other than the coal, these are the only strata that contained greater than 0.5% total sulfur.

There was no selective handling plan, however the rock between the Clarion coal seams was routinely placed high in the backfilled mine spoil above the mine floor. Baghouse limestone with a $CaCO_3$ equivalent of nearly 100 percent was applied at a total rate of 300 tons $CaCO_3$/acre. Approximately 280 tons $CaCO_3$/acre were placed on the backfilled surface, below the topsoil, and an additional 20 tons $CaCO_3$/acre were spread on the pit floor.

Figure 8 shows temporal variations in concentrations of acidity and iron in water sampled from a downflow monitor well from 1982 through 1986. Water quality of seepage prior to mining in 1982 can be characterized as mildly acidic with moderate metals and sulfate concentrations, which indicate some effects from previous mining. Figure 8 shows that the concentrations of acidity and iron increased through the period of mining, and then decreased following backfilling. The addition of

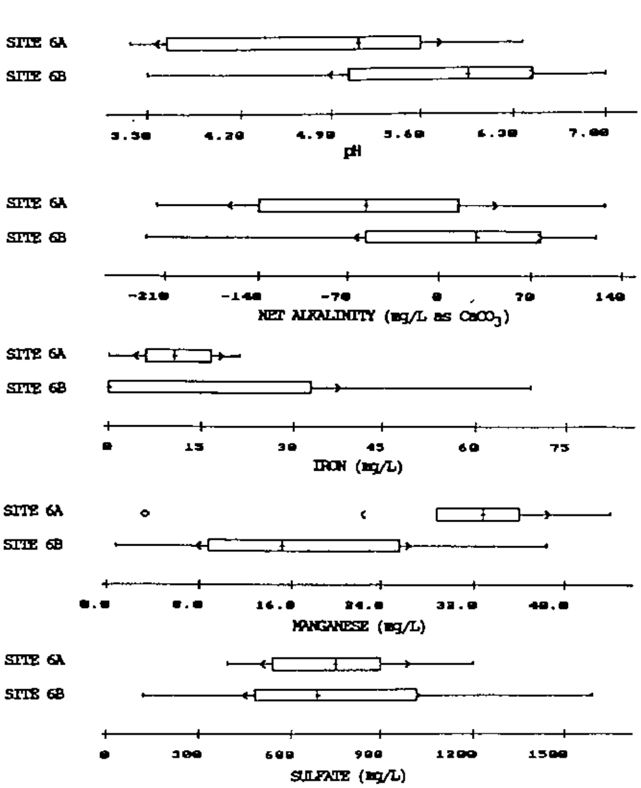


Figure 7. Boxplots comparing water quality of multiple discharges from mine site 6A (N=6) with those from mine site 6B (N=11) in Clarion County. Mine site 6A had alkaline addition; mine site 6B did not and served as a control.

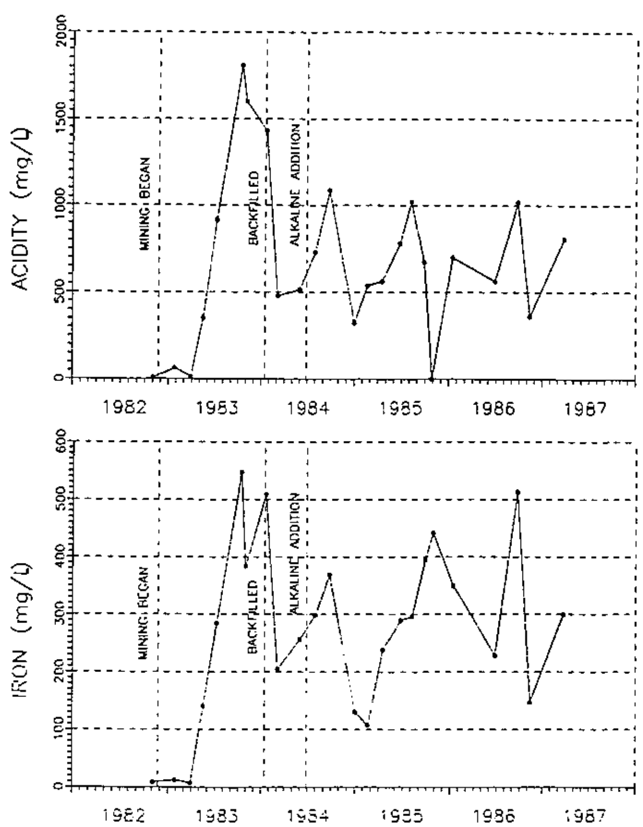


Figure 8. Acidity and iron concentrations over time for a downflow monitor well at mine site 7 in Clarion County.

alkaline materials had no apparent effect on the water quality, which remained considerably worse than that of the pre-mining period. Although the preexisting discharge disappeared, alkaline addition failed to prevent or abate acid ground water. The negative NNP after alkaline addition (table 2) suggests that insufficient quantities of alkaline materials were added and that acidic, post-mining water quality may have been predicted.

Mine Site 8. Clarion County. Mine site8 encompassed a 29-acre area mined for the middle Kittanning coal, 2 acres of which were mined for the upper Kittanning coal. The mine site can be characterized as a hilltop removal/block-cut operation. The maximum overburden thickness was 85 ft. Mining occurred on a continuous basis over a 22 month period (1.3 acres/month), and the open pit area did not exceed 300 by 500 ft. The premining water quality at site 8 can be characterized by near-neutral pH, positive net alkalinity, and low concentrations of iron, manganese, and sulfate (fig. 9).

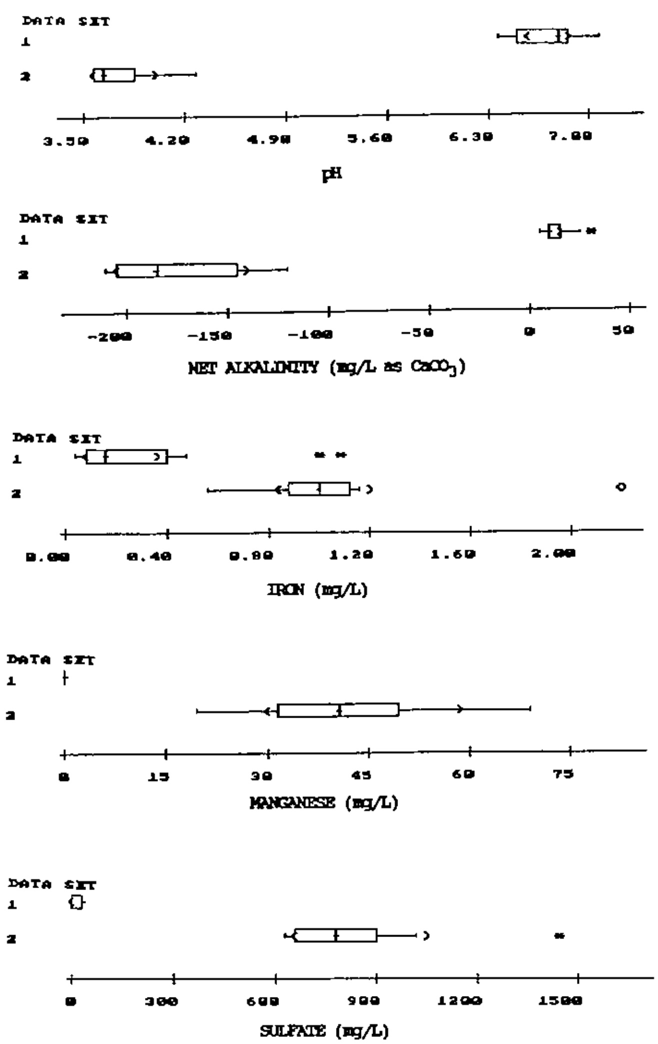


Figure 9. Comparison of pre- (data set 1) and post-mining (data set 2) water quality at mine site 8 in Clarion County. Data set 1 is for a monitor well (subsequently mined through) (N=12). Data set 2 is for a toe of spoil discharge (N=6).

Two holes were drilled in overburden at or near the maximum anticipated final highwall. One of the holes penetrated some strata with NP exceeding 30 tons $CaCO_3$/1,000 tons, but overall the strata had only a slight positive NNP; however, the overburden penetrated by the other hole exhibited a negative NNP (alkaline deficiency). Table 2 summarizes the ABA results of the overburden analysis. The overburden is predominantly sandstone, which contains carbonaceous inclusions and which extends down to the middle Kittanning coal. The sandstone interval from the top of the coal to 2.5 ft above the coal had total sulfur contents ranging from 0.56 to 2.63%.

Most mining took place in the alkaline-deficient area; only a small part of the mine uncovered alkaline strata. Table 2 shows a positive NNP, which is probably higher than was actually encountered by mining. The alkaline-deficient strata encountered by one overburden hole are probably representative of the majority of the strata mined. However, overburden data for samples from both holes were used in ABA calculations.

The 2-ft thick sandstone stratum overlying the middle Kittanning coal seam was selectively handled and segregated. For the alkaline-deficient part of the permit area, alkaline materials were applied a rate of 52 tons $CaCO_3$/acre over the surface of the backfill prior to topsoil replacement.

Following backfilling and reclamation, acidic water began to discharge from an adjacent area downflow from site 8. Figure 9 compares the pre-mining quality of water from a well within the area mined with that from the post-mining discharge. The pH is lower, and concentrations of net alkalinity, iron, manganese, and sulfate are higher in the post-mining discharge than in pre-mining water at the 95-percent confidence level. No mitigative effects are apparent following the alkaline addition. Furthermore, alkaline, not acidic, discharge would be predicted on the basis of the positive NNP data in table 2; however, the calculated NNP may not be accurate because few alkaline strata were mined.

Mine Site 9. Clarion County. Approximately 48 acres of upper and (or) lower Clarion coals were mined intermittently from 1961 through 1975 at mine site 9. About half the area was mined for the lower Clarion coal leaving a 70-ft highwall separating an upper and lower bench. At the completion of mining, the mine was backfilled with overburden and coal waste, including tipple refuse from other mines, and was regraded to the original hillside configuration. A toe-of-spoil seep produced severe AMD that required treatment. In 1984, calcareous waste materials were applied to the surface in quantities that were not sufficient to neutralize MPA but sufficient to produce alkaline water in the unsaturated zone (pH > 4.5) that would presumably inhibit bacteria thought to catalyze pyrite oxidation (Waddell et al. 1980).

The mine receives recharge from the reclaimed hillside and undisturbed hilltop. The reclaimed mine spoil has a total thickness ranging from about 10 to 70 ft, in which ground-water saturation varies from less than 5 to nearly 20 ft. The lower Clarion coal crops out along an intermittent stream at the southern boundary of the mine. The coal was not mined near the stream channel in an attempt to restrict the discharge of ground water from the mine; this ground water is acidic (pH < 3) and contains substantial concentrations of dissolved sulfate, iron, and manganese (Williams et al. in press).

The overburden and coal are characterized as having high sulfur and negligible calcareous contents (tables 1 and 2). Eleven samples collected during drilling of a 90-ft-deep drill hole through the highwall represent a relatively complete stratigraphic column; typical concentrations of total sulfur range from 0.05 to 4.77%. The highest sulfur concentrations were from the lower Clarion coal and from strata about 1 ft above and below the coal. None of the sampled strata had a NP greater than 3.5 tons $CaCO_3$/1,000 tons. Samples of the tipple refuse had a sulfur content of 1.5 to 2.18%.

In the spring of 1984, limestone fragments (nearly pure $CaCO_3$) and lime-kiln flue dust [$Ca(OH)_2$] were applied on the land surface within two 2.5-acre treatment plots and a control plot. ABA computations were performed using overburden analyses of samples from two or more drill holes in each 2.5-acre plot. Treatment plot 9A had a net deficiency of -1,769 tons/acre and received 40 tons/acre limestone plus 400 tons/acre hydrated lime. Treatment plot 9B had a net deficiency of -2,955 tons/acre and received 400 tons/acre limestone plus 120 tons/acre hydrated lime. However, the control plot 9C had a net deficiency of -3,990 tons/acre and received only 2.4 tons/acre hydrated lime (to allow grass planting). Thus, after alkaline addition, assuming hydrated lime has 2.7 times the neutralization capacity as $CaCO_3$, the net neutralization potentials for plots 9A, 9B, and 9C, respectively, were about -649, -2,231, and -3,984 tons $CaCO_3$/acre.

Ground-water-quality data were collected from two or three monitor wells in each of plots 9A, 9B, and 9C that were screened through the spoil to the mine floor (bedrock). Data for plots 9A and 9B were collected monthly during 1 year before and 3 years after surficial treatment with calcareous materials; however, monthly data for plot 9C were collected only 1 month before but 3 years after treatment. Figure 10 shows that the ground water in the mine spoil, before and after treatment, contained high concentrations of acidity (pH < 4.5; net alkalinity < 0) and of dissolved sulfate, iron, and manganese and that the water-quality generally differed between 9A, 9B, and 9C, reflecting variations in overburden composition and possibly other factors. A comparison of data before and after alkaline addition at plot 9B, shows that none of the parameters (pH, net alkalinity, Fe, Mn, or SO_4) is significantly different at the 95-percent confidence level. Data collected at plots 9A and 9C before and after treatment indicate that pH increased, and Mn concentrations decreased significantly after treatment. However, because the water quality at the control plot 9C may have improved, the improvement in water quality at treatment plot 9A cannot be attributed solely to the addition of alkaline material. Because pyrite and leachable minerals will be depleted as the spoil weathers, a gradual improvement in water quality is expected in both untreated and treated spoil. Nevertheless, if alkaline additives were to prevent or slow the oxidation of pyrite, a difference in the rate of improvement would be expected for the treatment plots 9A and 9B compared with the control plot 9C.

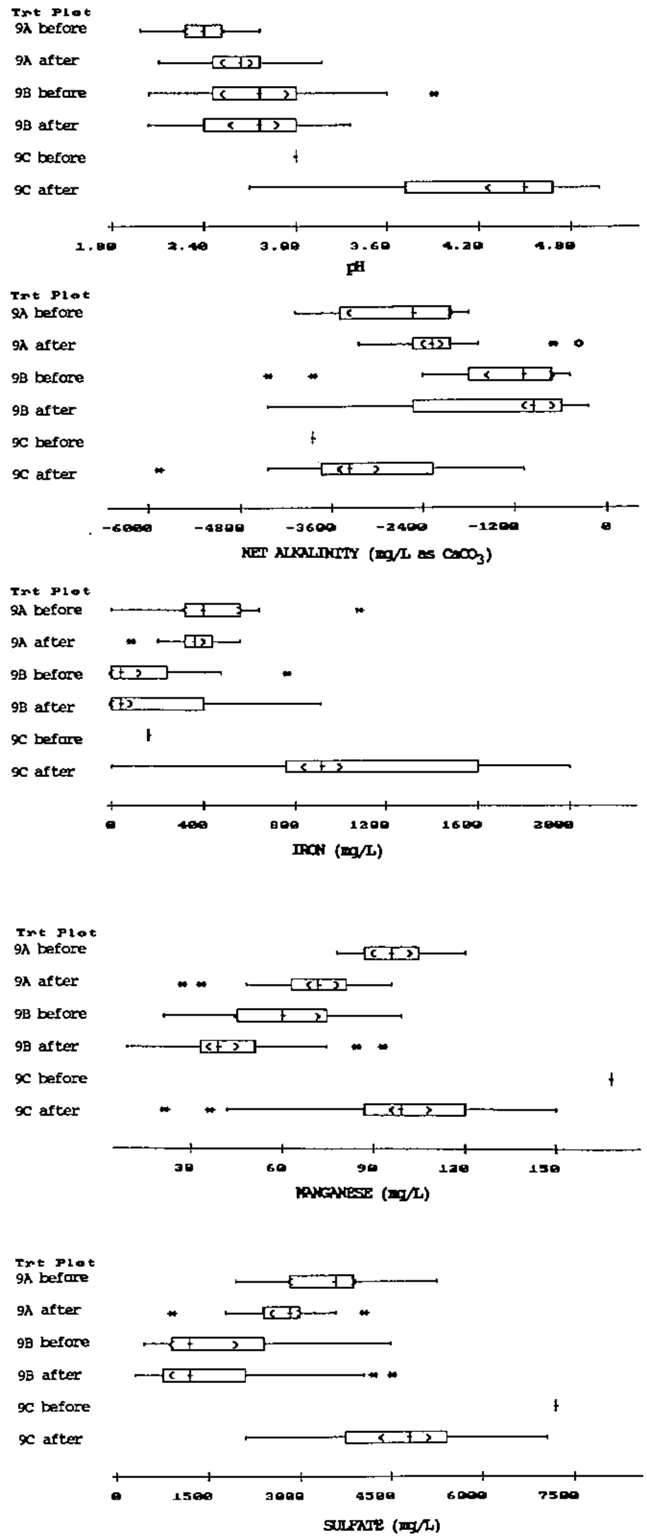


Figure 10. Boxplots of water quality from monitor wells for three 2.5-acre plots at mine site 9 in Clarion County. Plots 9A and 9B had alkaline addition, plot 9C served as a control. The boxplots compare water quality before and after treatment with alkaline additives. Number of samples for each boxplot are as follows: 9A before (N=12), after (N=39); 9B before (N=23), after (N=70); 9C before (N=1), after (N=61).

However, nonparametric trend tests of the post-treatment data indicate that the rates of concentration changes are not significantly different between treated and untreated plots (Cravotta, U.S. Geological Survey, written commun., 1989).

Acid-mine drainage was not abated nor ground-water quality noticeably improved by the surficial application of alkaline materials at mine site 9. The NNP data in table 2 suggest that acidic ground water at each plot likely could have been predicted considering the MPA computed using the factor of 62.5 following the method of Cravotta et al. (1990). One possible explanation for the persistent acidic ground water in the reclaimed mine spoil is that prior to treatment, pyrite in the stockpiled overburden or mine spoil had been oxidized to ferric-sulfate minerals, which then provided a source of long-term, leachable acid, sulfate, and iron; the alkaline materials may have been applied too late to inhibit the oxidation of pyrite. Another explanation is that the rate of pyrite oxidation exceeds the rate of dissolution of calcareous materials.

<u>Mine Site 10: Venango County</u>. Mine site 10 was included in the study because limestone and other calcareous rock were present and abundant relative to potentially acid-producing strata. Forty-one acres of Brookville coal were mined, using the box cut method, with trucks and loaders. Maximum highwall height was about 50 ft.

About 8 to 10 ft of marine limestone strata is present about 25 ft above the coal at site 10. The limestone has NP ranging from 536 to 932 tons $CaCO_3$/1,000 tons. Another 7 to 13 ft of strata has NP over 100 tons $CaCO_3$/1,000 tons. However, a 1-to-1.5-ft-thick stratum immediately above the coal contains 1.09 to 5.5% sulfur, and underclay below the coal contains 1.53 to 2.9% sulfur. No alkaline addition was proposed because the natural strata contained the equivalent of about 18,000 tons $CaCO_3$/acre. The sulfur-bearing strata immediately overlying the coal were segregated and placed high above the mine floor in the backfilled mine spoil.

The NNP and net alkalinity data in table 2 indicate that the discharge would be alkaline on average. Post-mining discharge quality, however, has varied from highly alkaline to moderately acid (fig. 11). The most acidic water was collected after heavy rains. The acidity probably result from recharge that dissolves ferric-sulfate minerals that had accumulated in the unsaturated zone during drier periods and from unequal rates of pyrite oxidation and dissolution of limestone. The water samples contain iron and manganese concentrations that exceed conventional effluent limits (6 and 4 mg/L, respectively). These metals and the elevated sulfate indicate that the abundant alkaline material has not prevented the oxidation of pyrite in the backfill, but has neutralized the acidity produced by the oxidation reaction.

Results and Discussion

Every mine site is unique. Overburden composition, mining methods employed, volume of rock disturbed, pre- and post-mining ground-water chemistry, hydrogeology, weathering, and many other factors differ among the sites. Each of these factors affects the associated post-mining water

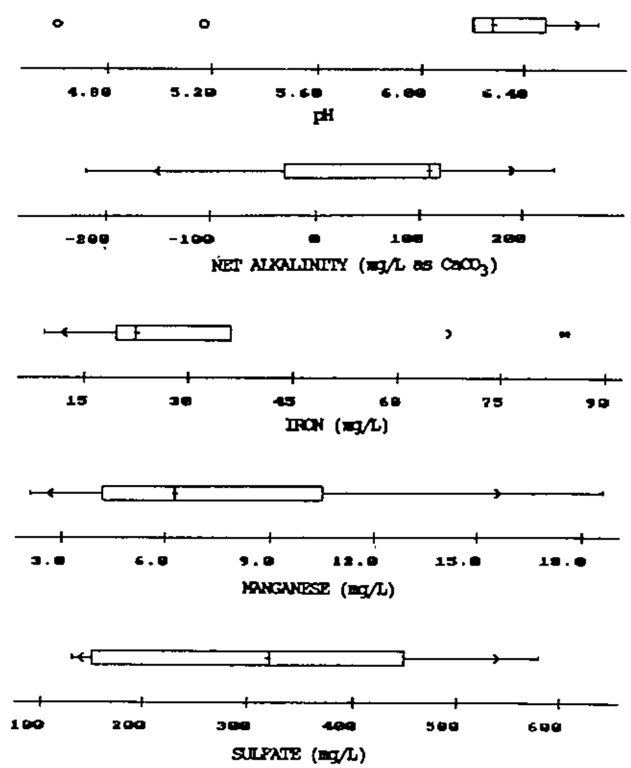


Figure 11. Post-mining water quality of discharge from mine site 10 in Venango County (N=5). This mine had abundant naturally occurring alkaline strata.

quality. Consequently the water quality at each mine site is monitored according to a unique program. Table 1 illustrates some similarities and differences among mine sites in this study. Alkaline-addition rates ranged from zero at sites 3 and 10, which were included for comparative purposes, to greater than 1,000 tons $CaCO_3$/acre for a part of site 9.

The uniqueness of the mines and number of variables to be considered makes a comparison of mine sites difficult; however, some relations between post-treatment, cumulative NNP of overburden and median net alkalinity of mine drainage from the 10 mine sites are apparent (table 2). Six of the eight alkaline-addition plans (mine sites 2, 4, 6, 7, 8, and 9) failed to prevent AMD. Of the two sites where post-treatment discharge water was alkaline (sites 1 and 5), site 5 has a substantial thickness of naturally alkaline strata, which were likely to produce alkaline drainage without the supplemental addition of limestone. After alkaline addition, the overburden NNP at mine site 1 was positive (+6.90 tons $CaCO_3$/1,000 tons) if calculated by the traditional methods of ABA; however, NNP was slightly negative (-0.31 tons $CaCO_3$/1,000 tons) if calculated using thresholds (table 2). The water quality at site 1 improved after the addition of alkaline material (fig. 3). The formerly acidic discharge from the deep mine that underlies much of the site now meets conventional mine-drainage effluent standards. Although discharges from alkaline-addition site 4 do not meet conventional effluent limits, the water quality is substantially better than that of nearby discharges from mine site 3, an untreated control (fig. 5).

Mine sites 1 and 4, the two sites where water quality improved after the addition of imported alkaline materials, had several things in common: (1) They were treated with the largest total quantities and the second and third largest alkaline-addition rates of the sites studied (table 1). (2) The mining and reclamation techniques used at both sites included selective handling of pyritic materials, timely backfilling, and alkaline-addition rates that exceeded permit requirements. (3) Some potentially acid-forming strata were removed from the mine sites. The coal seam on mine site 1 that was causing acid water to emanate from the deep-mine discharge was removed from the mine site by daylighting. Mine site 4 included removal of most of the pit cleanings.

Two adjacent mine sites were also examined in Clarion County. Mine site 6A received alkaline additives, and mine site 6B did not. No observable improvement in water quality is apparent from the alkaline additives, which may not have been applied in adequate amounts.

Mine site 9 is the only site in this study where alkaline material was applied solely as a remedial measure 9 years after completion of mining and reclamation. Three 2.5-acre plots were studied, two with alkaline addition and one without. All three continued to produce severe AMD through 1987 fig. 10). The AMD production results from the limited amount of alkalinity generated from the limestone relative to the amount of acidity produced by pyrite oxidation and by leaching of previously formed ferric-sulfate minerals in the mine spoil.

Alkaline materials were not added at mine site 10, but the site was included in this study to illustrate the potential effect of large amounts of naturally alkaline strata on water quality at a site where there is also some potentially acid-producing strata. The strata at site 10 contained the equivalent of 18,000 tons $CaCO_3$/acre. On average, the post-mining water quality was alkaline, but the concentrations of metals and sulfate were elevated (fig. 11). Apparently, the presence of large amounts of naturally alkaline material do not always preclude pyrite oxidation and the dissolution of metals and sulfate from the mine spoil.

The variable alkaline and acidic water quality of several discharges from site 6 show that alkaline and acid conditions can be created within the same spoil. Mine site 10, which had an abundance of limestone strata, had a single discharge that varied from alkaline to acid following recharge events. Alkaline-addition sites also have produced alkaline and acidic discharges, but with median net alkaline discharge. Clearly, the processes of pyrite oxidation and carbonate neutralization are complicated by the unequal distribution of acid-forming and neutralizing materials. Under some conditions, alkaline waters need to contact the locally pyritic zones of the mine spoil to prevent or neutralize AMD. Hydrogeochemical factors such as the microbial activity; mineral-surface areas; O_2, CO_2, nutrient, and moisture contents; temperature; and pH of mine spoil also must be considered.

Table 1 generally indicates mine sites where imported alkaline materials were placed, and if special overburden handling was implemented. Each of the eight alkaline-addition sites, except site 1, had alkaline materials placed entirely, or mostly, at the spoil surface—the easiest method of application. Alkaline materials were incorporated on the pit floor and within the spoil at five and two of the sites, respectively. Although alkaline-materials were spread on the pit floors at mine sites 1 and 4, where water quality improved after alkaline addition, alkaline materials were also incorporated with the backfill at site 1 and pyritic materials were selectively handled at site 4. Furthermore, sites 2 and 8 also employed selective handling of pyritic material and small amounts of variably placed alkaline additives, but both produced AMD (table 2). Therefore, effects of placement of alkaline materials or selective handling of acidic materials cannot be readily evaluated in this study.

Table 2 shows the overall mass-weighted NNP for each study site before and after alkaline addition. Although total quantities, or rates of application, of alkaline materials appear to be large, they generally are insignificant relative to the NP or NNP of the entire overburden volume before alkaline addition. Table 2 also shows the median post-mining net alkalinity of associated mine drainage or ground water for the 10 mine sites. Mine site 9 was subdivided into three plots 9A, 9B, and 9C, which in combination with mine sites 1-8 and 10, allows comparison of overburden NNP and water-quality net alkalinity for 12 sets of data. By comparing the sign on NNP and net alkalinity values in table 2, it is apparent that the traditional ABA computation of MPA, by multiplying total sulfur, in weight percent, by 31.25, results in mismatched signs—a wrong prediction of water quality—for 4 of the 12 sites. The errors in prediction are that the mine spoil is alkaline (NNP > 0), whereas the associated water is acidic (net alkalinity < 0). Prediction was not improved by using thresholds, where only values of NP greater than 30 tons $CaCO_3$/1,000 tons (with fizz) and of total sulfur greater than 0.5% are used to compute NNP, although substantially different values of NNP resulted. However, if MPA is calculated by multiplying total sulfur, in weight percent, by 62.5 following the method of Cravotta et al. (1990), then the sign of NNP matched the sign of the overall net alkalinity of waters at 11 of 12 sites (table 2). The acidic discharge from mine site 8 was not predicted by any of the acid-base accounting computation methods, possibly because of an inaccurate estimate of NNP.

The method of ABA calculation that used "thresholds" eliminated some of the problems associated with low-NP overburden, which typically produces AMD even though the sulfur content may be low. For example, mine sites 3 and 4 produced AMD which was correctly predicted by the NNP "with thresholds" (table 2). Using only NP values greater than 30 tons $CaCO_3$/1,000 tons, with a "fizz," eliminated much of the presumed influence of siderite on NP determinations (Morrison et al. 1990). Unless the influence of siderite in NP determinations can be eliminated, thresholds remain a useful concept. However, a disadvantage of assuming strata are inert if total sulfur and NP content do not exceed the threshold values is when large intervals of strata are sampled and composited, causing dilution of high-sulfur or high-NP concentrations. For example, the NNP calculated using thresholds are unreliable for mine sites 1 and 9, for which large thicknesses (up to 28 ft) of composite overburden samples were analyzed.

The results of this study are consistent with previous reports that concluded that NP and "traditional" MPA values, despite being reported in the same units (tons $CaCO_3$/1,000 tons), are not equivalent. In previous practice, it appeared that overburden NP must be at least twice MPA to produce alkaline mine drainage (diPretoro 1986; Skousen et al. 1987; Brady and Hornberger 1989; Ferguson and Erickson 1988). The observed inequality in NP and MPA is partly attributable to the incorrect assumption that CO_2 is completely exsolved during neutralization. Cravotta et al. (1990) argue that some CO_2 will dissolve in the ground water and form $H_2CO_3^*$, a weak acid. Therefore, MPA should be computed by multiplying total sulfur, in weight percent, by a factor of 62.5 instead of the traditional factor of 31.25. Use of the 62.5 factor assumes that the total sulfur is pyritic and that 4 moles of $CaCO_3$ are required to neutralize the acidity from 1 mole of pyrite.

Mining practices such as selective handling of coal pit cleanings, removal of acidic material from the mine site, and concurrent reclamation, appear to have enhanced the success of the alkaline addition.

Summary and Conclusions

In summary, empirical as well as theoretical considerations suggest that alkaline-addition rates are typically inadequate to neutralize AMD. Application rates for alkaline additives are best computed by considering a conservative estimate of MPA, which may be computed by multiplying total sulfur, in weight percent, by a factor of 62.5 (Cravotta et al. 1990; Smith and Brady 1990). Furthermore, the alkaline material may be most effective if incorporated concurrent with mining and backfilling, when and where the acid-production reactions occur. The alkalinities that can be generated from alkaline additives may be insufficient to abate the acidity of severe AMD and the localized production of acidity from reactive pyrite and ferric-sulfate minerals. Adequate alkaline-addition rates that create positive NNP at mine sites containing acidic strata may neutralize acidity and produce alkaline effluent water, which still contains unacceptable concentrations of sulfate, iron, and other metals.

On the basis of this study of the addition of alkaline materials to selected surface coal mines in western Pennsylvania, the following conclusions were made:

1) Previous methods for determining alkaline-addition rates, especially the concept that only one-third the calculated deficiency was necessary, have failed to prevent or abate AMD. Most alkaline addition rates are negligible relative to calculated deficiencies (NNP < 0) and insufficient to prevent or neutralize AMD.

2) The addition of alkaline materials to prevent AMD from surface coal mines may be effective providing that the alkaline-addition rates are sufficient (to offset negative NNP) and the overburden has relatively low-sulfur content. Alkaline materials added to high-sulfur mine spoil, even if sufficient to neutralize acid water, may not reduce concentrations of dissolved iron, manganese, and sulfate.

3) Certain mining practices, such as addition of more alkaline material than required by permit conditions, selective handling of pit cleanings, removal of pyritic material from the mine site, and concurrent reclamation appeared to enhance the effect of alkaline addition on reducing acidity.

4) There is good agreement of signs on post-treatment overburden NNP and median net alkalinity of associated mine-drainage water when overburden MPA is computed by multiplying total sulfur, in weight percent, by 62.5.

5) Additional studies are needed to determine the most beneficial rates of application and placement of the alkaline materials. Calculations of deficiencies (NNP) and application rates should be conservative and consider the theoretical arguments given by Cravotta et al. (1990) and the empirical results of this study.

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Literature Cited

Brady, K.B.C., and R.J. Hornberger. 1989. Mine drainage prediction and overburden analysis in Pennsylvania. In Proceedings: West Virginia Surface Mine Drainage Task Force Symposium. Morgantown, WV, 25-26, April, 1989.

Caruccio, F.T., and G. Geidel. 1984. Induced alkaline recharge zones to mitigate acid seeps. p. 43-47. Symposium on Surf. Mining Hydrology, Sedimentology, and Reclamation. Lexington, KY, December, 1984.

Caruccio, F.T., and G. Geidel. 1986. Reclamation strategies as applied at the DLM properties. In Proceedings: 7th Annual West Virginia Surface Mine Drainage Task Force Symposium, Morgantown, WV, April, 1986.

Cravotta, C.A. III, K.B.C. Brady, M.W. Smith, and R.L. Beam. 1990. Effectiveness of alkaline addition at surface coal mines in preventing and abating acid mine drainage: Part 1. Geochemical considerations. In Proceedings: The 1990 Mining and Reclamation Conference and Exhibition. Charleston, WV, 23-26, April, 1990.
http://dx.doi.org/10.21000/JASMR90010221

diPretoro, R.S. 1986. Premining Prediction of Acid Drainage Potential for Surface Coal Mines in Northern West Virginia. M.S. Thesis, West Virginia University, Morgantown, WV.

diPretoro, R.S. and H.W. Rauch. 1988. Use of acid-base accounts in premining prediction of acid drainage potential. p. 2-10. In Proceedings: Mine Drainage and Surface Mine Reclamation, Vol. 1: Mine Water and Mine Waste. Pittsburgh, PA, 19-21 April, 1988. U.S. Bur. of Mines Inform. Circ. 9183.
http://dx.doi.org/10.21000/JASMR88010002

Erickson, P.M., and R. Hedin. 1988. Evaluation of overburden analytical methods as means to predict post-mining coal mine drainage quality. p. 11-19. In Proceedings: Mine Drainage and Surface Mine Reclamation, Vol. 1: Mine Water and Mine Waste. Pittsburgh, PA, 19-21 April, 1988. U.S. Bur of Mines Inform. Circ. 9183.
http://dx.doi.org/10.21000/JASMR88010011

Ferguson, Keith, and P.M. Erickson. 1988. Approaching the AMD problem - from prediction and early detection. In Proceedings: International Conference on Control of Environmental Problems from Metals Mines. Roros, Norway, June 20-24, 1988.

Geidel, G. 1982. An Evaluation of a Surface Application of Limestone for Controlling Acid Mine Discharges from Abandoned Strip Mines, Sewellsville, Ohio. Ph.D. Dissertation, Univ. of South Carolina, Columbia, S.C.

Helsel, D.R. 1987. Advantages of nonparametric procedures for analysis of water quality data. Hydrological Sciences Journal 32(2):179-190.
http://dx.doi.org/10.1080/02626668709491176

Hem, J.D. 1985. Study and interpretation of the chemical characteristics of natural water (3d). U.S. Geological Survey Water Supply Paper 2254, 263 p.

Hettmansperger, T.P., and S.J. Sheather. 1986. Confidence intervals based on interpolated order statistics. Statistics and Probability Letters. 4(2):75-79.
http://dx.doi.org/10.1016/0167-7152(86)90021-0

Lusardi, P.J., and P.M. Erickson. 1985. Assessment and reclamation of an abandoned acid-producing strip mine in northern Clarion County, Pennsylvania. p. 313-321. In Proceedings: 1985 Symposium Surface Mining Hydrology, Sedimentology, and Reclamation, Univ. of Kentucky, Lexington, KY.

Morrison, J.L., S.D. Atkinson, A. Davis, and B.E. Sheetz. 1990. The use of CO_2 coulometry in differentiating and quantifying the carbonate phases in the coal-bearing strata of western Pennsylvania: its applicability in interpreting and modifying neutralization potential. In Proceedings: The 1990 Mining and Reclamation Conference and exhibition. Charleston, WV, 23-26, April, 1990.
http://dx.doi.org/10.21000/JASMR90010243

Skousen, J.G., J.C. Sencindiver, and R.M. Smith. 1987. A Review of Procedures for Surface Mining and Reclamation in Areas with Acid-Producing Materials. W. Va. Surf. Mine Drainage Task Force, 39 p.

Smith, M.W., and K.B.C. Brady. 1990. Review and summary of acid base accounting data using computer spreadsheets. In Proceedings: The 1990 Mining and Reclamation Conference and Exhibibition. Charleston, WV, 23-26, April, 1990. http://dx.doi.org/10.21000/JASMR90010213

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. Field and Laboratory Methods Applicable to Overburden and Minesoils. U.S. E.P.A. Report EPA-600/2-78-054.

Stumm, Werner, and J.J. Morgan. 1981. Aquatic chemistry--an introduction emphasizing chemical equilibria in natural waters (2nd): New York, John Wiley and Sons, 780 p.

West Virginia Surface Mine Drainage Task Force. 1979. Suggested Guidelines for Method of Operation in Surface Mining of Areas With Potentially Acid-Producing Materials. Green Lands, 9:21-40.

Velleman, P.F., and D. Hoaglin. 1981. Applications, Basics, and Computing of Exploratory Data Analysis. Duxbury Press, Boston, MA, 354 p.

Waddell, R.K., R.R. Parizek, and D.R. Buss. 1980. The Application of Limestone and Lime Dust in the Abatement of Acidic Drainage in Centre County, Pennsylvania. Final Report Research Project 73-9. Commonwealth of Pennsylvania, Department of Transportation, Office of Research and Special Studies, 245 p.

Williams, J.H., J.H. Henke, K.L. Pattison, R.R. Parizek, R.J. Hornberger, and C.A. Cravotta III. (in press). Hydrogeology and water quality at a surface coal mine in Clarion County, Pennsylvania: Pennsylvania State University Coal Research Report.

RESUME

Education

B.S., 1985, Geological and Geophysical Sciences, University of Wisconsin-Milwaukee

M.S., 1987, Geological and Geophysical Sciences, University of Wisconsin-Milwaukee

Professional Registration

Professional Geologist, Wisconsin, No. 133

Professional Geologist, Illinois, No. 196.001157

Professional Geologist, Kentucky, No. 110946

Professional Geologist, Mississippi, No. 0693

Professional Geologist, North Carolina, No. 1936 (inactive)

Professional Geologist, Pennsylvania, No. PG004834

Professional Geologist, Tennessee, No. 5706

Certified Professional Geologist, American Institute of Professional Geologists, No. 10081

Certified Ground Water Professional, Association of Groundwater Scientists and Engineers, No. 117676 (inactive)

Certified Hazardous Materials Manager, Institute of Hazardous Materials Management, No. 7749 *(inactive)*

Areas of Specialization

Mining Geology and Hydrogeology

US Geology and Hydrogeology

Pre-Acquisition Environmental Due Diligence

Property Redevelopment Support

Remedial Investigations/Feasibility Studies

Solid and Hazardous Waste RI/FS/RA

Professional Associations

Industrial Minerals Association-North America

National Industrial Sand Association

Wisconsin Industrial Sand Association

National Stone Sand and Gravel Association

Illinois Association of Aggregate Producers

Michigan Aggregate Association

American Institute of Professional Geologists

Illinois Association of Groundwater Professionals

Society for Mining Metallurgy and Exploration

Federation of Environmental Technologists

LaSalle County Mining Coalition

Mark J. Krumenacher, PG, CPG
Senior Principal/Senior Vice President/Hydrogeologist

GZA Board of Directors Since June 2017

Wisconsin Industrial Sand Association Board of Directors Since April 2017

Summary of Experience

Mr. Krumenacher has served as Principal, Senior Project Manager and Project Hydrogeologist for more than 35 years on geologic, hydrogeologic, engineering and environmental projects throughout North America. Mr. Krumenacher is a Professional Geologist with licensure nationally and in several states and is a Certified Hazardous Materials Manager (CHMM) (inactive). He has managed and conducted geologic studies, hydrogeological studies, engineering studies, remedial investigations, environmental assessments, ecological studies including wetlands, and threatened and endangered species, pre-acquisition environmental due diligence and hazardous waste management at various sites including large industrial, commercial and urban redevelopment projects, Federal Superfund sites and state-lead projects.

Experience includes work in almost every state and properties in Canada, Mexico and South America. Responsibilities have involved consultant/owner/designer/developer partnering, contract management and development and implementation of remedial investigations, remedial actions, RCRA Post-Closure Care and Corrective Action, subcontractor management; health and safety monitoring; implementation of remedial technologies including in-situ treatment technologies, slurry cutoff walls, vapor extraction systems and groundwater pumping and treatment systems; design and implementation of focused investigations; monitoring well installation; soil and groundwater sampling and testing; underground storage tank removal; soil-gas surveys; soil and groundwater screening; waste/drum sampling; site reconnaissance; and report preparation.

Relevant Project Experience

<u>Nonmetallic Mining</u>

The combined geologic, groundwater, environmental, engineering and collective experience of college education and more than three decades of professional consulting has been applied to nonmetallic mining as a primary focus of Mr. Krumenacher's profession over more than half his career.

Mining-related services include more than 100 properties in Wisconsin, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Oklahoma, Pennsylvania, Tennessee, Texas and elsewhere throughout the US, Canada, South America, and Australia. Services include geologic mapping above and below ground, reserve analysis, mine planning, reclamation planning, exploration of reserves, hydrogeologic studies, environmental due diligence, slope stability analyses and engineering,

engineering analysis of overburden placement, berm embankment and levee design and construction, foundation engineering, wetland permitting, threatened and endangered species evaluation, noise studies, visual impact assessments, local land use permitting and other related services. Services have included work in open pit quarries and carbonate and sandstone underground mines. This work has included open pits and quarries and underground carbonate bedrock and sandstone mines. Geological interpretation, groundwater and permitting are a specialty through education and 30 years of experience

Mining-related services include work for aggregate producers (sand and gravel and carbonate rock), cement and industrial lime producers (limestone and marble quarries), industrial sand (sandstone) and dimension stone industries (carbonate rock). Mr. Krumenacher also maintains GZA's Mine Safety Health Administration (MSHA) Training Manual for Midwest-based staff and has a current training certificate under MSHA Part 46 and 48.

Mr. Krumenacher's involvement with various mining associations goes beyond the membership roster. He is donated significant amount of time with active engagement in various committees, sub-committees and task forces and founded and for 6 years chaired the Sustainability Committee of the Illinois Association of Aggregate Producers. He has drafted white papers and a book on technical issues pertaining to the regulatory and control of quarries and presents frequently on issues critical to mining as outlined at the end of the resume.

<u>Nonmetallic Mining Testimony</u>

Mr. Krumenacher has prepared numerous nonmetallic mining permit applications and support documents and provided testimony at public meetings/public hearings before City Councils, Township Planning Commissions and Boards of Supervisors, County Zoning, Land Management Committees, and other Boards as well as before schools, community forums, open houses, and stakeholder groups.

Experience includes testimony associated with nonmetallic mining regulations before the Illinois Pollution Control Board and Wisconsin Senate Committee on Workforce Development, Forestry, Mining, and Revenue. In addition, Mr. Krumenacher routinely reviews and comments on draft nonmetallic mining legislation and ordinances. In addition, Mr. Krumenacher lobbies in defense of sound science before federal lawmakers in Washington and state law makers in the Midwest. During 2014 and 2015 Mr. Krumenacher served on the Minnesota Silica Sand Rule Making Advisory Panel.

In addition to testimony, Mr. Krumenacher present regularly on mining matters at professional association meetings such as the Industrial Minerals Association-North America, National Industrial Sand Association, Wisconsin Industrial Sand Association, National Stone Sand and Gravel Association, Aggregate producers of Wisconsin, Michigan Aggregate Association, Illinois Association of Aggregate Producers, American, Society for Mining Metallurgy and Exploration and other professional meetings such as Transportation Research Board, Proppants Summit, Industrial Minerals, American Planning Association, and others.

<u>Geology and Hydrogeology</u>

Mr. Krumenacher has applied his education in general geology, hydrogeology, petroleum geology and geophysics and varied experiences to the interpretation of geologic settings to provide clients and regulators with an understanding of the glacial and bedrock geology, structural geology and hydrogeology on a regional and local level. Those interpretations are necessary for each geologic, environmental and engineering project that involve GZA and range from relatively simple urban settings to expansive multi-acre properties, or multiple properties.

Hydrogeology is typically considered a study of the surface water – groundwater interaction and relationship – it is all the same water. Whether the water is above ground, within 12-inches of the ground surface, deep within the ground, controlled by wells, levees, dams or dikes, water flow has universal physical characteristics that are well understood and considered in essentially every project over the past three decades.

Geology and Structural Geology

Complex geologic and engineering projects require an understanding of geologic environments and structure. These types of projects include proposed and existing sand and gravel pits and rock quarries and underground mines and other underground structures such as tunnels and caverns. Work has included evaluation of regional and local structural features that influence migration of groundwater, mine stability, and resource evaluation.

Ecological Resources

The presence of ecological resources in the form of wetlands, springs, streams and threatened and endangered species must be considered in every land use and land development project. Although Mr. Krumenacher does not have institutional education or training in wetlands and the endangered species act, the federal and state rules and guidance are black and white and three decades of rule interpretation and application with the support of technical experts within and outside of GZA has provided varied and deep experience on the subject matter. Threatened and Endangered species considerations have included the American Bald Eagle and Blue Karner Butterfly in Wisconsin, Dune Sagebrush Lizard in Texas, endangered clams in the Ohio River, bats throughout the Midwest, and Kitten Tails in Minnesota.

Hydrology is a critical aspect of all land development projects and an area of wetland expertise within the training and experience of Mr. Krumenacher. Work with wetlands and other sensitive aquatic ecosystems wetlands across the United States includes primarily the management of delineation surveys, jurisdictional determinations, evaluation of the impact of well and mine dewatering, and usually avoidance. Work included design of compensatory wetland mitigation bank sites, in Wisconsin, Illinois and Michigan, development of the RFD,II commercial wetland mitigation bank in Southeastern Wisconsin, artificial wetland determinations and environmental remediation within wetlands.

Hydrogeology

Understanding the hydrogeologic setting is essential on every project where groundwater contamination is a concern, sensitive environmental ecosystems are nearby or groundwater is used a resource. Mr. Krumenacher has interpreted the hydrogeologic setting and developed and described hydrogeologic models for hundreds of properties in multiple states and countries. Soil conditions, groundwater characteristics and contaminant migration have been evaluated and described. The properties have included industrial properties that included plating, painting, degreasing, hazardous waste generation and management; sanitary and hazardous waste landfills; and hundreds of underground storage tanks. Oftentimes, the soil and groundwater required development of practical management solutions to enable an engineering design to be implemented. Essentially, all the project descriptions provided below include an evaluation and description of the hydrogeologic setting.

Associate Principal/Geologist - Proposed Theta 13 Neutrino Project, Braidwood, Illinois. The University of Chicago, Fermi Lab and other partners were evaluating the feasibility of constructing two 33-foot diameter vertical shafts and 40-foot span base of shaft caverns to depths of about 650 feet outside the high security perimeter of the Exelon Nuclear Power Generating Station in Braidwood, Illinois. To support the feasibility study, GZA provided geological and engineering field services during rock coring up to 650 feet deep, core hole hydrogeologic and geophysical testing, laboratory testing of soil and rock samples and preparation of a Geotechnical Data Report.

Associate Principal/Geologist - Proposed Underground Aggregate Mine, Illinois; Confidential Client. Provided description of geology, structural geology and hydrogeology for a several hundred-acre proposed underground mine in northeastern Illinois. Interpretations were based on regional studies and reports and rock cores from the property. Challenges included potential complex geologic setting due to location relative to nearby rock quarries, nearby major surface water body, a regional fault zone and sensitive industrial operations.

Associate Principal/Geologist - Active Underground Aggregate Mine, Illinois; Confidential Client. Provided geology, structural geology and hydrogeology interpretation for an active underground mine in northern Illinois. Challenges involved interpretation of groundwater infiltration from several hydrostratigraphic units encountered in and associated with the mine. These units include the overburden, Silurian bedrock and multiple Ordovician bedrock groups; complicated by regional faulting, sensitive nearby ecosystem and local groundwater use.

Associate Principal/Geologist - Geologic and Hydrogeologic Evaluations, Multiple Sites; Confidential Clients. Provided geologic interpretation for multiple clients where a general and specific understanding of the local geology were necessary for assessment and development of open pit and underground mines for aggregate, decorative stone and industrial sand. Interpretations were based on review of regional reports and site-specific data obtained from site reconnaissance and drilling records. Assessments included evaluation of bedrock thicknesses and overburden thickness, structural geologic concerns and hydrogeologic concerns.

Associate Principal/Geologist - Reserve Analysis, Multiple Sites; Confidential Clients. Provided geologic interpretation at multiple sites for estimating reserves of sand and gravel, carbonate rock, or industrial sand. This work was typically done associated with due diligence of the property associated with potential acquisition. In many cases, this work was performed on a fast-track acquisition schedule with results used for negotiating purchase of the assets.

<u>Remedial Investigations/Feasibility Studies</u>

Associate Principal/Project Manager - Wisconsin; Confidential Client. During construction at an industrial facility in Wisconsin, PCB-containing soil was encountered at the Site. To estimate the volume of PCB-containing soil remaining in the ground at the facility, a site investigation was completed which included approximately 100 soil borings, field screening for PCBs and diesel range organics and analytical testing. The PCB contamination will be addressed by completion of a risk assessment in accordance with the Draft PCB risk assessment guidance established by the USEPA Region 5.

Associate Principal/Project Manager - United Kingdom; Confidential Clients. Plan and manage the implementation of remedial investigations associated with the acquisition or sale of manufacturing facilities across the United States, Canada, Mexico and Brazil. The majority of facilities are various metalworking industries that involve parts degreasing, painting and plating, and also include paint manufacturing, assembly and research and development operations. The predominant chemicals addressed at the contaminated sites include chlorinated solvents, PCBs and metals.

Project Manager - Superfund Site, Spring Arbor, Michigan. Managed two phases of field work and performed report preparation for a hydrogeological and feasibility study that included soil borings, test pits, monitoring well installation/sampling, soil-gas surveys, geophysical seismic surveys, packer/pump groundwater sampling and an extensive residential water supply well sampling program. This study evaluated the hydrogeological condition of a fractured bedrock aquifer and assessed the extent of tetrachloroethylene contamination in the aquifer in Spring Arbor.

Project Manager - Detroit, Michigan; Confidential Client. Developed and implemented a hydrogeological/remedial investigation and remedial action plan for a 17+ acre industrial site in Detroit, Michigan. This study involved over 40 test borings, monitoring wells and soil and groundwater analyses and review of historical geographic and demographic use of the site. The study identified filled-in river channels in an area of industrial fill, which controlled the shallow groundwater flow condition of the site area.

Project Manager - Detroit, Michigan; Confidential Industrial Client. Serving first as Project Geologist and later as Project Manager as part of sale/purchase agreement of a 2+ million square-foot production facility between a large automobile manufacturer and a large engine manufacturer since 1988. Activities associated with the project included a comprehensive environmental site assessment, remedial investigations, remedial engineering design services and remedial system construction oversight. Remedial activities include a groundwater recovery trench, groundwater and oil recovery well systems, removal and closure of underground storage tank systems, and asbestos sampling and abatement. Ongoing activities include remedial system monitoring and interface with the Michigan Department of Natural Resources.

Health and Safety Officer - Bofors-Nobel Superfund Site, Muskegon, Michigan. Level B health and safety monitoring of subcontractor activities associated with installation of field equipment. Implementation of remedial technologies, set-up and utilization of geotechnical soils laboratory, and subcontractor supervision.

Detroit River Study, Detroit, Michigan; Confidential Client. Completed an extensive geophysical study along the Detroit River to determine whether the induced polarization method could be used to detect organic groundwater contamination. Procedures involved and dated analyzed included the following: data sonics and AquaPulse sub-bottom profilers; Elliot Time Demain Induced Polarization Transmitter; and a Computer-Automated Marine Electrical Resistivity System which consisted of spontaneous potential, longitudinal conductance, apparent resistivity and chargeabilities.

Solid/Hazardous Waste RI/FS/RA

Associate Principal/Project Manager - RCRA Post-Closure Care, Corrective Action and Interim Measures, Former Hallmack Facility, Harrodsburg, Kentucky. Transitioned the project from the previous consultant of six years and developed summary of environmental work dating from the 1970s. Currently manage RCRA Post-Closure Care of three former surface impoundments used to store wastewater sludge from metal plating operations, RCRA Corrective Action consisting of source reduction and hydraulic containment groundwater remediation systems for chlorinated solvent contaminated groundwater from karst limestone bedrock, RCRA Permit Management and general property management. Managed the Interim Measures/Stabilization activities associated with an outdoor area of plating-type waste disposal and a former plating line area; asbestos and lead-based paint abatement, aboveground storage tank closure and industrial hygiene survey. Work completed at the property is overseen by the Kentucky Department for Environmental Protection, Division of Waste Management.

Associate Principal/Project Manager - PCB-Containing Soil Disposal, Wisconsin; Confidential Client. During construction at an industrial facility in Wisconsin, several thousand tons of excavated soil were stockpiled off the property pending evaluation of disposal options. Subsequent analytical testing of the stockpiled soil detected the presence of PCBs. GZA was contracted to oversee the disposal of the excavated soil and subsequent removal of any residual PCB-containing soil from the vicinity of the soil stockpiles. Since the source of the PCB-containing soil was not known, soil containing greater than 25 ppm PCBs required disposal at a facility licensed under the Toxic Substances Control Act (TSCA). Soil containing less than 25 ppm PCBs could be disposed of at a Wisconsin licensed landfill. There was approximately one order of magnitude cost differential between the two disposal options.

To reduce disposal costs, a detailed soil sampling and disposal work plan was developed to thoroughly characterize the stockpiled soil and the areas where PCB-containing soil was stockpiled. Utilizing the results of field screening and GC analyses, GZA coordinated with the contractor to minimize the volume of soil requiring disposal at a TSCA facility. PCB-containing soil was removed from beneath and surrounding the soil stockpiles to a concentration less than 1 ppm. During the soil removal process, standing water due to a high groundwater table and considerable precipitation, required implementation of a water management plan. In accordance with USEPA policy, GZA established a water treatment system to remove most PCBs from the water prior to discharge at the local publicly owned water treatment works (POTW). During the soil removal process, approximately 100,000 gallons of PCB-containing water were treated.

Project Manager - Gratiot County Landfill, Michigan Superfund Site. Responsible for field activities involved with the evaluation of the effectiveness of the present slurry cutoff wall and landfill cap which included test borings, monitoring well installation/sampling, site surveys, packer/pump groundwater sampling, downhole geophysical testing, in-situ testing for determination of hydrogeological properties, design/installation of long-term multiple pressure transducer network and data evaluation. The data collected by GZA was compiled and evaluated with the historical data for the site and a comprehensive final report prepared for the Michigan Department of Natural Resources (MDNR). Also prepared a groundwater monitoring plan for MDNR which is being implemented at the site.

Project Manager - Montmorency/Oscoda Joint Sanitary Landfill, Montmorency County, Michigan. Performed hydrogeologic and engineering analyses of existing site data, prepared a comprehensive hydrogeologic report, and demonstrated to MDNR, on behalf of the County, that perceived groundwater contamination was not an issue due to QA/QC problems associated with groundwater samples and the complex hydrogeologic conditions at the site. Completed a remedial investigation to verify the engineering analysis and prepared a remedial action plan (RAP) which concluded groundwater monitoring was sufficient to address the regulatory and environmental concerns. The RAP was approved by MDNR. Also prepared a groundwater monitoring plan acceptable to MDNR for implementation. Also responsible for development, implementation and report preparation for a complete hydrogeological investigation and environmental assessment for a proposed 40-acre expansion. The groundwater monitoring plan was revised to provide a comprehensive plan for the existing and proposed landfill areas.

Project Geologist - South Macomb Disposal Authority Landfill Slurry Wall, Macomb Township, Michigan. Managed drilling operations during geotechnical explorations and seismic surveys; aided in preparation of slurry wall design; oversight of slurry wall construction and on-site QA control and field laboratory testing (including API permeability, gradation and slurry and backfill characteristic testing). Assisted with the preparation of a QA/QC report documenting the cutoff wall construction for submittal to the MDNR on behalf of the owner. Managed and implemented geophysical seismic refraction surveys to relate seismic velocities of a highly indurated glacial till to rippability. The objective of the survey was to demonstrate to MDNR that the underlying glacial till which the slurry wall was keyed into had a rippability equivalent to limestone bedrock and that extending the wall through the till was impractical.

Project Manager - RCRA Closure of Hazardous Waste Surface Impoundment, Indianapolis, Indiana; Confidential Industrial Client. Provided QA/QC field and engineering consulting services during the closure of an 8-acre hazardous waste surface impoundment. The surface impoundment formerly received an estimated 100,000 yd^3 of F007 and F009 waste, as defined by RCRA. Activities included pre-remediation sampling and on-site QA control and field laboratory testing (including API permeability, gradation and slurry and backfill characteristic testing) during cutoff wall installation (approximately 120,000 ft^2) surrounding the surface impoundment and keyed into an underlying clay layer (50 to 60 feet deep); and preparation of a QA/QC report documenting the cutoff wall construction for submittal to Indiana Department of Environmental Management on behalf of the owner.

Project Manager - Northern Oaks Recycling and Disposal Facility, Clare County, Michigan. Responsible for development, implementation and report preparation for a complete hydrogeological investigation and an environmental assessment at this 160-acre landfill site in support of the 641 construction permit application to

MDNR. Also prepared the Site-Specific Environmental Monitoring Plan for the site which is being implemented in accordance with the operating license. All reports were completed on time and received minimal comment from MDNR despite well organized opposition to the landfill development by a local group.

Project Manager - Michigan; Confidential Landfill Client. Performed engineering and hydrogeologic analyses of site data and a comprehensive hydrogeologic report for an existing 20+ year old landfill site. Initiated a remedial investigation to verify and supplement the engineering analysis and prepared a remedial action plan for the site which was subsequently implemented by the Client.

Pre-Acquisition Environmental Due Diligence

Associate Principal/Project Manager - Former UK-Based Industrial Conglomerate. Completed pre-acquisition and pre-divestiture environmental due diligence of more than 50 sites prior to property transactions throughout the United States, Canada, Mexico and South America. Assessments were generally completed in accordance with ASTM Standards and concentrated on site history reviews, interviews with site personnel, state and local regulatory agency file review where possible, preliminary assessment of on-site hazardous materials and disposal records, underground storage tank compliance issues and preparation of documentation prior to sale or acquisition of properties. Due diligence at industrial locations included a survey of environmental and health and safety compliance and identification of appropriate corrective actions where necessary. Several of the properties involved fast-track Phase II and Phase III site assessments and subsequent remedial action. One site also included remediation of PCB-containing soil on a fast-track basis with issue closure in less than one month. Residual remedial actions are ongoing for the residual companies formed when the industrial conglomerate de-merged in 2000.

Associate Principal/Project Manager - Various Clients. Completed numerous environmental due diligence activities including Phase I ESAs and Environmental and Health and Safety Compliance Surveys for various industries, lenders and legal counsel in the United States and the United Kingdom. The majority of assessments were completed in accordance with the requirements of the ASTM standard for Phase I ESAs. Many ESAs required Phase II and Phase III assessments in order to quantify the environmental liabilities present at the properties. Where remediation was not completed, allocation of costs were evaluated and included in the purchase agreements.

Property Re-Development Support

Project Manager - The University of Toledo, Toledo, Ohio. Prepared and implemented a soil management plan during renovation of an existing building and construction of a new building at the University. The building and property were located at the site of a former glass and plastics research and development facility dating back to the early 1930s, which is listed as a RCRA facility. The site is also situated in an area which was filled between 1900 and 1920, using slag material. Evaluated historical site conditions, hydrogeology and environmental data, completed a geophysical survey and limited site investigation and based on the subsurface conditions present at the site, prepared and implemented a soil management plan which was followed during renovation building construction. Worked closely with the University, their construction management firm, the General Contractors and their subcontractors to manage and integrate subsurface activities such that the construction schedule was not impacted. Through strategic planning and negotiations with the Ohio EPA, demonstrated that the majority of soil which was excavated, could be safely used as fill on University property. Site-specific remediation goals were developed which allowed impacted soil that was not excavated to be left in-place. As such, additional soil was not excavated beyond what was required to facilitate construction. The rationale for allowing impacted soil to remain in-place was based on comparisons of the new building plans, hydrogeologic conditions, and concentrations of the chemical constituents in the soil and groundwater, and an evaluation of the potential health risks to the public and building occupants.

Project Manager/Geologist - Jefferson-Conner Industrial Revitalization Project, Detroit, Michigan. The site consisted of approximately 300 acres of industrial, commercial and residential property in Detroit, Michigan which was targeted for revitalization; the majority of which required characterization and remediation. During the seven-year history of the project, implemented ESAs and parcel sampling plans at approximately 50 industrial and commercial parcels within the project area, developed and implemented strategic Remedial Investigation Plans for each parcel, evaluated the environmental conditions and prepared Remedial Action Plans (RAPs) for each parcel, provided engineering and remedial construction management services during implementation of the RAPs and prepared closure report documentation following completion of remedial activities. Mr. Krumenacher continues to provide assistance to the City of Detroit with issues relating to cost recovery for the environmental aspects of the project.19

Publications

Reality Check on a Purported Global Sand Shortage: Sensationalism Extrapolated From Isolated Occurrences to Global Phenomena, UCLA Library, Electronic Green Journal, Volume 1, Issue 47, November/December 2022.

Quarry Regulatory Control and Permitting – Defending the Foundation of a Sustainable Society, 250 pages, published April 2021; Second Edition November 2021.

Comprehensive Regulatory Control and Oversight of Industrial Silica Sand (Frac Sand) Mining, Policy Study published by the Heartland Institute, December 2016, coauthored with Isaac Orr, Research Fellow at the Heartland Institute.

Technical reviewer and contributor to the *Health Impact Assessment of Industrial Sand Mining in Western Wisconsin*, February 2016, by the Institute for Wisconsin's Health, Boerner, A., Young, N., & Young, D.

Social Impacts of Industrial Silica Sand (Frac Sand) Mining: Land Use and Value, Policy Study published by the Heartland Institute, February 2016, coauthored with Isaac Orr, Research Fellow at the Heartland Institute.

Environmental Impacts of Industrial Sand Mining, Krumenacher, Mark J.; in 2016 *Industrial minerals of the Upper Midwest; Proceedings of the 51st Forum on the Geology of Industrial Minerals*, presented in cooperation with the Annual Conference of the Twin Cities Subsection of the Society for Mining, Metallurgy & Exploration (SME), August 17 – 20, 2015, Minnesota Geological Survey Open File Report OFR-16-2, 76 p.

Roadway Impacts of Industrial Silica Sand (Frac Sand) Mining, Policy Study published by the Heartland Institute, September 2015, coauthored with Isaac Orr, Research Fellow at the Heartland Institute.

Economic Impacts of Industrial Silica Sand (Frac Sand) Mining, Policy Study published by the Heartland Institute, June 2015, coauthored with Isaac Orr, Research Fellow at the Heartland Institute.

Environmental Impacts of Industrial Silica Sand (Frac Sand) Mining, Policy Study published by the Heartland Institute, May 2015, coauthored with Isaac Orr, Research Fellow at the Heartland Institute.

Awards

2017 - Recognition of Excellence Award, National Industrial Sand Association

2019 – Associate Member Industry Leadership Award, Illinois Association of Aggregate Producers

Presentations

Innovative Application of Induced Polarization for Detecting Organic Ground Water Contamination, Presented at the Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration Conference, November 9-11, 1988, Houston, Texas.

Improved Extraction Efficiency of Polychlorinated Biphenyls from Contaminated Soil Using a Total Halogen Screening Method, Presented at the 13th Annual Waste Testing & Quality Assurance Symposium, July 6-9, 1997, Arlington, Virginia.

Sustainable Aggregate Resource Management, Challenges Obtaining Special Use Permits for Aggregate Mining and Development Encroachments on Current and Future Aggregate Extraction Sites, Transportation Research Board 90th Annual Meeting, January 2011, Washington DC.

Obtaining Special Use Permits for Mineral Sources and Development Encroachments on Current and Future Mineral Extraction Sites, The 47th Forum on the Geology of Industrial Minerals, May 2011, Champaign, Illinois.

Economic Benefits of Planning for Sustainable Aggregate Production, Challenges Obtaining Special Use Permits for Aggregate Mining and Development Encroachments on Current and Future Aggregate Extraction Sites, American Planning Association, Upper Midwest APA Conference, October 2011, Davenport, Iowa.

Obtaining Special Use Permits for Aggregate Sources and Development Encroachments on Current and Future Aggregate Extraction Sites, National Stone Sand and Gravel Association, AGG1 Academy, March 2012, Charlotte, North Carolina.

Challenges Obtaining Special Use Permits, National Industrial Sand Association, Minnesota/Wisconsin New Entrants Conference, March 2012, Eau Claire, Wisconsin.

Regulatory and Strategic Aspects of Siting and Permitting New Frac Sand Mines, Challenges Obtaining Special Use Permits, Proppants Summit, July 2012, Denver, Colorado.

Economic Benefits of Planning for Sustainable Aggregate Production, Obtaining Special Use Permits for Aggregate Sources and Development Encroachments on Current and Future Aggregate Extraction Sites, Illinois Association of County Zoning Officials, 2012 Seminar, Starved Rock Lodge and Conference Center, Starved Rock State Park, September 2012, Utica, Illinois.

Economic Analysis of Industrial Sand Operations, Economic Benefits and Costs to State and Local Communities, Conference on the Silica Sand Resources of Minnesota and Wisconsin, Society for Mining, Metallurgy and Exploration, October 2012, Brooklyn Park, Minnesota.

Challenges Obtaining Special Use Permits for Industrial Sand Mining, 2nd Proppants Summit, December 2012, Houston, Texas.

Obtaining Special Use Permits for Aggregate Source, National Stone Sand and Gravel Association, Legal Symposium, March 2013, San Antonio, Texas.

Planning for Sustainable Aggregate Production, Sustainable Construction Aggregate Production and Development Encroachments on Current and Future Aggregate Extraction Sites, American Planning Association, National Planning Conference, April 2013, Chicago, Illinois.

Economic Analysis of Industrial Sand Operations: Benefits and Costs to State and Local Communities, Frac Sand Insider 2013 Conference & Exhibition, June 2013, Pittsburgh, Pennsylvania.

Overcoming Challenges Obtaining Special Use Permits for Industrial Sand Mining, Frac Sand Insider 2013 Conference & Exhibition, June 2013, Pittsburgh, Pennsylvania.

Regulatory Overview of Industrial Sand Operations, Frac Sands Conference, Industrial Minerals Events, September 2013, Minneapolis, Minnesota.

Moderator Session 1 Keynote Presentations - Future Prospects for the Frac Sand Industry, Frac Sands Conference, Industrial Minerals Events, September 2013, Minneapolis, Minnesota.

Regulatory Overview of Industrial Sand Operations, Society for Mining, Metallurgy and Exploration Conference, Introductory Conference, Wisconsin Section, September 2013, Brookfield, Wisconsin.

Planning for Sustainable Aggregate Production, Sustainable Construction Aggregate Production and Development Encroachments on Current and Future Aggregate Extraction Sites, Illinois Association of County Engineers, 99th Annual Fall Meeting, October 2013, Collinsville, Illinois.

Sustainable Construction Aggregate Production – Impact of Development on Future Supply, Illinois Chapter, Inc. – American Concrete Pavement Association, Annual Meeting and Workshop, January 27-28, 2014, Springfield, Illinois.

Economic Analysis of Industrial Sand Operations, Economic Benefits and Costs to State And Local Communities, Industrial Minerals Events 2nd Frac Sands Conference, September 23-24, 2014, Minneapolis, Minnesota.

Industrial Sand Operations, Current and Evolving Permitting Regulations, Industrial Minerals Events 2nd Frac Sands Conference, September 23-24, 2014, Minneapolis, Minnesota.

Environmental Impacts of Industrial Sand Mining, Society for Mining, Metallurgy and Exploration Twin Cities 2015 Annual Conference and 51st Forum on Industrial Minerals, Earle Brown Heritage Center, August 18, 2015, Brooklyn Center, Minnesota.

Moderator, Session III, *The Economics of Frac Sand and Investment*, Industrial Minerals Events 3rd Frac Sand Conference, September 2-3, 2015, Minneapolis, Minnesota.

Community Relations and Sustainable Practices, with Lauren Evans, Fairmount Santrol and Brett Skilbred, Jordan Sands, Industrial Minerals Events 3rd Frac Sand Conference, September 2-3, 2015, Minneapolis, Minnesota.

Recent Rule Making Affecting Silica Sand Operations: State and Federal, Industrial Minerals Events 3rd Frac Sand Conference, September 2-3, 2015, Minneapolis, Minnesota.

Economic and Environmental Impacts of Silica Sand Mining, Industrial Minerals Association-North America and National Industrial Sand Association - Industrial Sand Challenges and Opportunities Task Force and Silica Health Effects Committee, September 17-18, 2015, West Palm Beach, Florida.

Discussing New Research on the Economic and Environmental Impact of Frac Sand Mining, Petroleum Connection, Frac Sand Supply & Logistics 4th Annual Conference, September 23-25, 2015, San Antonio, Texas

Environmental Impacts of Industrial Sand Mining, Wisconsin Industrial Sand Association, October 7, 2015, Tomah, Wisconsin.

Discussing New Research on Impacts of Industrial Sand Operations; Environmental, Economic and Roadways, Wisconsin Industrial Sand Association, October 7, 2015, Tomah, Wisconsin.

Opposition to Frac Sand Mining Continues Despite Facts and Market Changes, Petroleum Connection, 2016 Frac Sand Industry Update, March 10, 2016, Houston, Texas

Overview of the Institute for Wisconsin's Health, Inc. Health Impact Assessment of Industrial Sand Mining in Western Wisconsin, Industrial Sand Mining Training, Hosted by Axley Brynelson and Weld Riley, March 24, 2016, Eau Claire, Wisconsin.

Addressing Challenges and Concerns Obtaining Special Use Permits for Nonmetallic Mining, Michigan Aggregate Association 2016 Environmental Summit, April 14, 2016, Ann Arbor, Michigan.

Opposition to Frac Sand Mining Continues Despite Facts and Market Changes, The North American Frac Sand Exhibition & Conference, April 19-20, 2016, Minneapolis, Minnesota.

Industrial Sand Mining: Why Is the Headwind So Strong? Opposition to Frac Sand Mining Continues Despite Facts and Market Changes, Industrial Minerals Events, 4th Frac Sand Conference September 12 -13, 2016, Minneapolis, Minnesota.

Frac Sand: How Technology and Market Dynamics Will Drive Future Success - Addressing Challenges Obtaining Special Use Permits For Nonmetallic Mining Operations, CONEXPO-CON/AGG, Las Vegas, Nevada, March 7-11, 2017.

Industrial Sand Mining, Why Is the Headwind So Strong? Opposition to Frac Sand Mining Continues Despite Facts and Market Changes, Industrial Mineral Association – North America, Industrial Minerals Technology Workshop, St. Paul, Minnesota, April 25, 2017.

Addressing Challenges Obtaining Special Use Permits For Nonmetallic Mining Operations, Industrial Mineral Association – North America, Industrial Minerals Technology Workshop, St. Paul, Minnesota, April 26, 2017.

Planned and Moderated *Wisconsin Pollutant Discharge Elimination System (WPDES) Nonmetallic Mining Permit Process Seminar*, half day seminar, American Institute of Professional Geologists, Eau Claire, Wisconsin, May 11, 2017.

Planned and Moderated Sand Mine Life Cycle Seminar, American Institute of Professional Geologists, Eau Claire, Wisconsin, May 12, 2017.

Overview of Newly Revised WPDES Program, Sand Mine Life Cycle Seminar, American Institute of Professional Geologists, Eau Claire, Wisconsin, May 12, 2017.

Mining Operations, Public Roadways and Overview of Methods Used to Minimize Potential Impacts, Sand Mine Life Cycle Seminar, American Institute of Professional Geologists, Eau Claire, Wisconsin, May 12, 2017.

Regulatory and Community License Updates From the Region of the Northern White, Industrial Minerals Events, 5^{th} Frac Sand Conference, Denver, Colorado, September 12-14, 2017.

The Role of Proppants, What They Are and How They Work, Benefits to America; America First Energy Conference, November 9, 2017, Houston, Texas.

Planned and moderated Wisconsin Industrial Sand Association, Technical Seminar Membership Meeting, February 20, 2018, Eau Claire, Wisconsin.

Mine Planning Overview, Michigan Aggregate Association 2018 Summer Conference, July 21, 2018, Mackinac Island, Michigan.

Keynote Speaker - *Addressing Challenges and Concerns Obtaining Special Use Permits for Nonmetallic Mining,* Aggregate Producers of Wisconsin, Annual Convention, November 29, 2018, Stevens Point, Wisconsin.

Reclamation Roundtable - Geology, Engineering, Science, Illinois Association of Aggregate Producers, Annual Convention, March 7, 2019, Springfield, Illinois.

Planned and moderated Wisconsin Industrial Sand Association, Technical Seminar Membership Meeting, February 20, 2019, Eau Claire, Wisconsin.

In Defense of Mining, Wisconsin Industrial Sand Association, Technical Seminar Membership Meeting, February 20, 2019, Eau Claire, Wisconsin.

Planned and moderated Wisconsin Industrial Sand Association, Technical Seminar Membership Meeting, February 26, 2020, Eau Claire, Wisconsin.

Addressing Challenges and Concerns Obtaining Special Use Permits for Mining Operations, Illinois Association of Aggregate Producers Annual Convention, March 5, 2020, Springfield, Illinois.

Quarry Regulatory Control and Permitting - Defending the Foundation of a Sustainable Society - Need and Importance of Industry Advocacy and Education, Aggregate Producers of Wisconsin 2021 Annual Convention, December 2, 2021, Stevens Point, Wisconsin.

Keynote Speaker - *Quarry Regulatory Control and Permitting - Defending the Foundation of a Sustainable Society - Need and Importance of Industry Advocacy and Education*, Illinois Association of Aggregate Producers Annual Convention, December 15, 2021, Springfield, Illinois.

Keynote Speaker - *Quarry Regulatory Control and Permitting - Defending the Foundation of a Sustainable Society*, Wisconsin State Capitol, Legislature Day, January 19, 2022.

How to Mitigate the New Nonmetallic Mining Permit (General Permit to Discharge Under the Wisconsin Pollutant Discharge Elimination System, General Permit No. WI-0046515-07-0), Aggregate Producers of Wisconsin 2022 Annual Convention, November 30, 2022, Wisconsin Dells, Wisconsin

STATE OF WISCONSIN | GREEN LAKE COUNTY | BOARD OF ADJUSTMENT

In Re Appeal of: Conditional Use Permit Issued to
Donald Kinas, Parcel Nos. 004-00787-0000, 786-000

POSITION STATEMENT OF GREEN LAKE ASSOCIATION, GREEN LAKE CONSERVANCY, GREEN LAKE SANITARY DISTRICT, AND ERNIE NEUENFELDT

This case presents the perfect storm: a uniquely risky proposed use in an extraordinarily sensitive environmental setting. The proposed use, a non-metallic mine, is risky because mining below the groundwater table would likely mobilize sulfide minerals that would in turn contaminate local springs and drinking water supplies. Even if mining occurred above the groundwater table, sulfide minerals in any exposed rock would cause acid mine drainage, and stormwater runoff would eventually discharge onto neighbors' properties. This is even before neighborhood impacts like noise, dust, truck traffic, blasting, and lights are considered. Meanwhile, the mine would be less than a half-mile from two rare surface water resources, Powell Spring and Mitchell Glen, and the area also hosts trout streams that eventually feed Green Lake.

Against this backdrop, the Green County Land Use Planning & Zoning Committee ("LUPZC") approved a conditional use permit ("CUP") for the mine in a rushed process and deferred findings about the mine's environmental impact to a future date. This Board should not make the same mistake. It must determine whether the Applicants Donald Kinas and Kopplin & Kinas ("Applicants") have shown they will satisfy the County's many standards that apply to this mine by substantial evidence. For the reasons stated below, Applicants have not. Moreover, other substantial evidence shows that the standards cannot be met. Appellants

Green Lake Association, Green Lake Conservancy, Green Lake Sanitary District, and Ernie Neuenfeldt ("Appellants") respectfully request that the Board deny the CUP.

I. FACTUAL BACKGROUND[1]

a. The Proposal

On March 30, 2022, landowner Donald E. Kinas and operator Kopplin & Kinas Co., Inc. applied for a CUP to construct and operate a non-metallic mine ("Mine") on Green Lake County Parcel Nos. 004-00787-0000 and 004-00786-000 (together, "the Site").[2] The Site is currently an open agricultural field in the A-1 Farmland Preservation district; 40 of those acres would be disturbed by the project. Applicants propose to mine various forms of limestone aggregate at the Site six days per week, from 5:30a.m.-6:30p.m. Monday through Friday, and 6:00a.m.-3:00p.m. on Saturday. The Site is directly across the road from three residential properties, including Ernie & Ida Neuenfeldt's, and within ½-mile of 10 more residential properties, two family dairy farms, and two conservation properties with critical water resources, Powell Spring (0.44 mile) and Mitchell Glen (0.32 mile). The Site is higher in elevation than the springs, and groundwater flows northwest from the site, into Green Lake, approximately one mile downgradient.

According to the application, mining would begin on the southern 40-acre parcel and the Applicant would construct a significant drainage swale on the northern 40 acres, emptying into a large sediment basin adjacent to Brooklyn G Road. The topography north and west of

[1] Appellants rely on the CUP application submitted earlier this year, other information before the LUPZC that has been provided to the Board, evidence Appellants anticipate will be offered to the Board, and the reports of their experts that are submitted herewith: Dr. Steve Gaffield of Emmons Olivier Resources ("EOR Report"), Craig Hungerford of Real Estate Dynamics, Inc. ("REMI Report"), and Dr. Seth Schneider of the University of Wisconsin-Milwaukee (UW-Milwaukee Report"). Appellants reserve the right to present additional evidence at hearing and make argument based on evidence presented by others.

[2] The application was internally inconsistent, depicting the Proposal as concerning only parcel no. 004-00787-000, but also showing that parcel no. 004-00786-0000 is an integral part of the operation.

the Site is significant, with the northern 40 acres of the Site situated at the top of a ridge that sharply descends toward neighboring residential properties. As a result, the existing stormwater drainage patterns travel away from the Site to the north and west, toward the Neuenfeldt and neighboring properties. The application contains no information about water consumption, or how the Mine's substantial water requirements will be met.

b. The Appellants and Their Properties

The **Green Lake Conservancy (GLC)** is a 501(c)(3) all-volunteer, non-profit land trust with a mission to preserve and protect special places throughout and around Green Lake County. GLC owns the scenic, high value 6-acre property known as Powell Spring. The property protects a large cold-water spring, which is highly sensitive to groundwater and surface water disruptions. GLC purchased Powell Spring in 2021 by leveraging existing resources to obtain a $299,500 loan. In March 2022, GLC secured a Wisconsin Department of Natural Resources ("WDNR") grant to partially fund the purchase. This property is now protected and will remain as conservation land in perpetuity. GLC is currently removing all human developments and restoring the property to a natural state. Any change in water quality or quantity would undermine the public's and GLC's significant investment, and the current fundraising effort to repay the loan secured for the purchase.

The **Green Lake Sanitary District (GLSD)** is a governmental entity organized under Wis. Stat. § 60.71. The GLSD was established in 1964 and includes all existing areas around Green Lake, excluding the City of Green Lake. The GLSD was formed as a means to protect Big Green Lake and its associated resources with respect to sanitation and related land, air, and water quality. The GLSD owns the scenic, high value 11.6-acre property known as Mitchell Glen. Its intent in purchasing Mitchell Glen was to ensure the protection of the origin of Glen

Creek which flows into Dakin Creek, a Class II trout stream and significant tributary into Big Green Lake. According to WDNR partners and local biologists, Mitchell Glen is possibly the most significant natural area in southcentral WI after the Parfrey's Glen State Natural Area near Baraboo, due in part to its 40 to 50 foot waterfall and 100 foot sandstone walls.

The Glen was purchased in 2004 through a mix of public and private funding provided by the WDNR ($75,000), GLA ($10,000), GLC ($7,500), and GLSD ($7,500). The GLSD began efforts to protect and enhance the property for the future by working closely with the Green Lake County Land Conservation Department to complete a $27,000 stabilization project to limit erosion. $16,000 was spent on a raised boardwalk to provide public access, and countless hours were donated by community members to clear invasive species from the edges of the Glen. In recent years, the GLSD has worked with the WDNR to monitor the flow of the springs at Mitchell Glen as they are highly sensitive to groundwater and surface water disruptions.

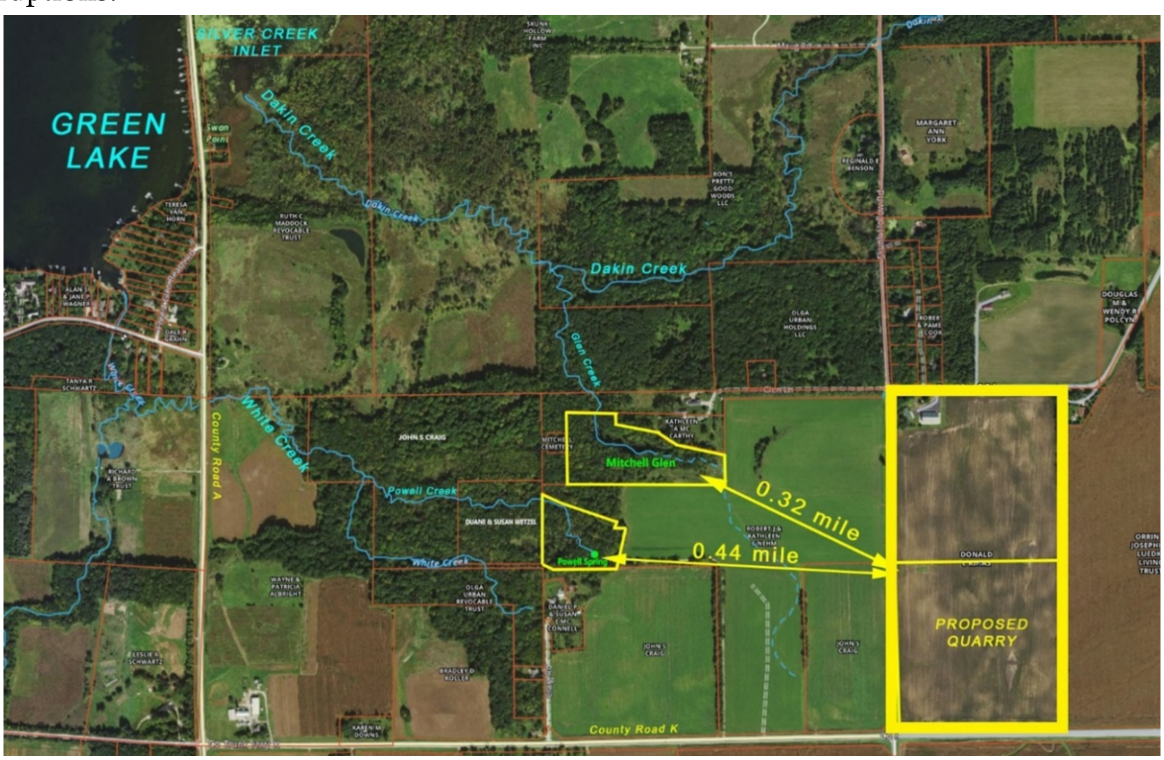

FIGURE 1. Mine proximity to Mitchell Glen and Powell Spring.

The **Green Lake Association (GLA)** is a 501(c)(3) non-profit organization founded in 1951. With 956 members, GLA is dedicated to improving, protecting, and ultimately restoring the water quality in Green Lake, a vital part of life in Green Lake County. GLA does so through education, outreach, research, and projects designed to improve the quality of water in and entering Green Lake.

One of those projects is the "Bring Back the Brookies" initiative, to bring back brook trout to Dakin Creek, a Class II trout stream and a tributary of Green Lake, located 0.75 miles north and downgradient of the Site. GLA has invested more than $102,000 in the project since 2018 (including $50,000 in funding from the WDNR) to add trout habitat, restore eroding stream banks, and install a larger culvert on Skunk Hollow Road. The culvert project required the GLA to partner with the Town of Brooklyn, which used tax dollars to fund improvements. The project has been a success, as brook trout have been restored on Dakin Creek after being absent for 70 years, and the WDNR found indications in 2022 that the brook trout are naturally reproducing. This success remains fragile; brook trout are sensitive to temperature and nutrient levels, and need clean, cool water to survive. Dakin Creek would be negatively affected by disrupted ground water and surface water flow to the Creek, and such disruptions would likely reverse the hard-won progress in the brook trout project.

Finally, **Ernie Neuenfeldt** is a property owner residing at N5139 Brooklyn G Road, Ripon, Wisconsin, within 300 feet of the Site. The entrance to the Neuenfeldts' property is a 620-foot gravel lane descending from Brooklyn G Road, directly across from the Site. Two culverts running underneath Brooklyn Road G from the proposed sediment basin for the Mine will empty directly onto Ernie's property.

Ernie's wife, Ida Mae, was born and raised on the 76.4-acre property. Ernie and Ida bought the property from Ida's mother in 1985 and raised their three children spending weekends on the property planting trees, clearing brush, hunting deer and turkey, and performing other improvements. They planted two-thirds of the property with a pine forest and other hardwoods, which are now full-grown. Ten acres of the property is old growth hardwood timber that has never been cleared or plowed and is situated where the Mine's culverts will empty onto the property. Over the years, Ernie and Idea spent countless hours installing dikes and diversions to control water flow and prevent erosion from their property to Dakin Creek. They also have two small agricultural fields (13 and 15 acres), which are planted each year to hay and corn by a farmer and neighbor.

In 2012 and 2013, Ernie and Ida built their permanent home and shop on the property. They now depend on the land for most of their sustenance. They tend to two large vegetable gardens and make all of their own wine from fruits they grow on the land and pristine water from their wells. Their three grandchildren, many nieces and nephews, and one great-grandchild visit frequently, and the property holds a special place in the hearts of the entire extended family.

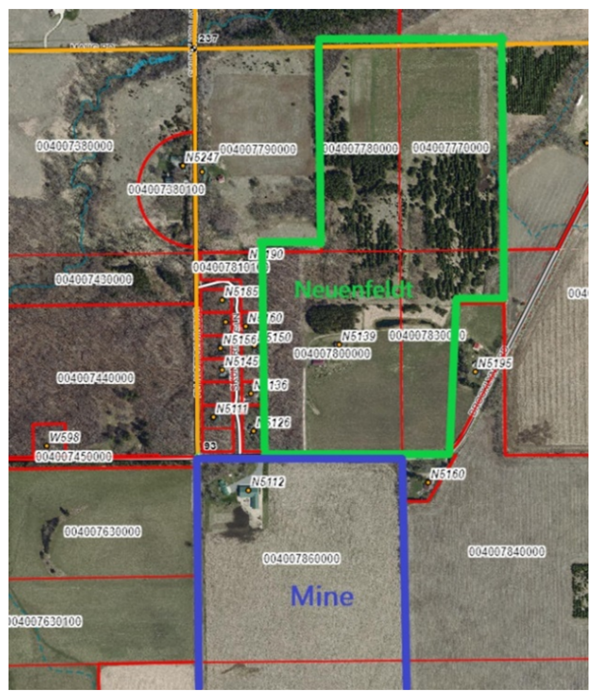

FIGURE 2. Ernie and Ida Neuenfeldt property.

II. LEGAL BACKGROUND

The Board has elected to review this matter de novo and decide anew whether the CUP should be granted. There are many rules that guide the Board's decision, starting with the definition of a "conditional use permit" in the Zoning Code:

> A use that may be considered in a particular zoning district if it is adaptable to the limitations of a particular site or made to be complimentary to adjacent land uses. The Land Use Planning and Zoning Committee … shall only grant a conditional use permit if the use is consistent with the purpose and intent of this chapter, and may impose conditions that are related to the requested use and reasonable to ensure compliance with this chapter. The applicant must provide substantial evidence the conditions are or will be satisfied.

Zoning Ord. § 350-77; *see also id*. § 350-56(B)(1) (requiring consideration of "the particular facts and circumstances of each proposed use" when deciding a conditional use).

The term "substantial evidence" as used in the ordinance is a term of art, created in 2017 Wis. Act 67. "'Substantial evidence" means facts and information, other than merely personal preferences or speculation, directly pertaining to the requirements and conditions an applicant must meet to obtain a conditional use permit and that reasonable persons would accept in support of a conclusion." Wis. Stat. § 59.69(5e)(a)2. Before a decision to grant or deny a CUP may even be made, "[a]n applicant for a conditional use permit must demonstrate, with substantial evidence, that an application and all requirements and conditions relating to the conditional use are, or will be, satisfied."[3]

While the same standard applies to CUP opponents, there is a common misconception that testimony of neighbors is not substantial evidence. This is not true. For example, when the Town of Cedarburg rejected a CUP for a cell tower in an A-1 district because it was not "compatible" with the surrounding area, the court found a similar statutory requirement for substantial evidence was satisfied:

> The simple undisputed facts are the Akerlund farm is surrounded by areas zoned residential, and the Town has been trying to keep this area rustic and rural. . . . [A]lthough the tower itself will not be placed in the residential areas, it will be very

[3] *See* Memo fr. Wis. Legislative Council to Senator Janet Bewley re: Local Government Discretion When Reviewing Conditional Use Permit Applications (Mar. 17, 2020) (copy attached).

> close by, and **it was reasonable for the Town to conclude that the tower was incompatible with many of the neighboring homeowners' residential lifestyle, and for some, the values of their homes would be diminished by the ominous, shadow-casting tower. Several people at the hearings spoke out on these terms**.

Eco-Site, LLC v. Town of Cedarburg, 2019 WI App 42, ¶ 27, 388 Wis. 2d 375, 933 N.W.2d 179. (emphasis added); *see also Town of Hudson v. Hudson Town Bd. of Adjustment*, 158 Wis. 2d 263, 277, 461 N.W.2d 827 (Ct. App. 1990) (affirming denial based on personal knowledge of area traffic congestion). The Court of Appeals has also recently confirmed that state law does not prevent considering decreased property values. *Scenic Ridge of Big Ben Homeowner's Assoc., Inc. v. Village of Vernon*, 2022 WI App 55, ¶¶ 14-15, 2022 WL 4232437 (Ct. App. Sept. 14, 2022) (unpublished, per curiam opinion).

There are numerous Ordinance provisions that the Applicants here must satisfy with substantial evidence. Some of these are general standards that apply to all proposed conditional uses:

> No conditional use shall be approved or approved with conditions by the Land Use Planning and Zoning Committee **unless it shall find** the conditional use:
>
> (a) Will not have a negative effect upon the health, safety, and general welfare of occupants of surrounding lands;
>
> (b) Will be designed, constructed, operated, and maintained so as to be harmonious and be appropriate in appearance with the existing or intended character of the general vicinity and that such a use will not change the essential character of the same area;
>
> (c) Will not be hazardous or disturbing to existing or future neighboring uses;
>
> (d) Will not be detrimental to property in the immediate vicinity or to the community as a whole;
>
> (e) Will be served adequately by essential public facilities and services, such as highways, streets, police and fire protection, drainage structures, and schools, and that the persons or agencies responsible for the establishment of the proposed use shall be able to provide adequately any such service; and

> (f) Will have vehicular approaches to the property which shall be so designed as not to create an interference with traffic on surrounding public or private streets or roads.

Ord. § 350-56(B)(2) (emphasis added). Because the Ordinance uses the term "shall," it is mandatory that the Board find each of these standards is met. *See Hayen v. Hayen*, 2000 WI App 29, ¶ 18, 232 Wis. 2d 447, 606 N.W.2d 606; *Schroeder v. Dane Cnty. Bd. of Adjustment*, 228 Wis. 2d 324, 333, 596 N.W.2d 472 (Ct. App. 1999).

Additional Ordinance requirements apply to proposed CUPs in the F-1 Farmland Preservation District, such as the mine here. This is required by Wisconsin's Working Lands law, which only permits local governments to approve non-metallic mines as conditional uses in farmland preservation districts if they meet certain criteria. *See* Wis. Stat. § 91.46(6). The Green Lake County ordinances recite these criteria, only allowing mines if:

(1) The operation complies with Subchapter I of Chapter 295, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats. (including all applicable provisions of this chapter), and with any applicable requirements of the Wisconsin Department of [Transportation] concerning the restoration of nonmetallic mining sites.

(2) The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.

(3) The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law.

(4) The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use.

(5) The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

(6) The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed.

(7) Compliance with Chapter 323 (Nonmetallic Mining Reclamation)

Ord. § 350-27(A)(2)(e).

Applicants cannot obtain a conditional use permit just by saying, because they are allowed in the district in some fashion, they must receive their permit. *See Eco-Site*, 388 Wis. 2d 375, ¶ 19 (describing such arguments as "overreach"). Only non-metallic mines that are "consistent with the purposes of the farmland preservation zoning district" may be located in the district as conditional uses. Wis. Stat. § 91.46(4)(a). "The ordinance permits [mines], if the conditions are met, but it does not rubber stamp them." *See Eco-Site*, 288 Wis. 2d, ¶ 19.

Finally, because the Board has elected to hear this matter de novo and decide whether or not the CUP should be issued, two votes of the Board are necessary to grant the CUP. *See* Ord. § 350-63(B)(4) ("The concurring vote of two members of the Board shall be necessary to . . . decide in favor of the applicant on any matter on which it is required to pass, or to effect any variation in the requirements of this chapter.") In other words, while this matter has come to the Board on an appeal of the CUP, the question is not whether the Committee's decision should be reversed or affirmed, but whether the CUP should be granted. This is consistent with the Board's broad authority in Wis. Stat. § 59.694(7)-(10).

III. THE PROPOSAL FAILS TO MEET REQUIRED STANDARDS FOR A CONDITIONAL USE PERMIT.

a. <u>The Proposal does not meet the standard CUP requirements of Green Lake Co. Ord. § 350-56(B)(2).</u>

The Applicants do not meet their burden to show they can satisfy the standard requirements that apply to a CUP by substantial evidence. Moreover, other substantial evidence shows they cannot meet these requirements, as further explained below.

i. The Proposal lacks substantial evidence that it will not have a negative effect upon the health, safety, and general welfare of occupants of surrounding lands.

Applicants have provided little evidence that they will comply with the first CUP standard, and substantial evidence shows the project creates health, safety, and welfare risks through groundwater and surface water quality impacts.

Applicants claim they will mine to just five feet above the groundwater table, which would be important to avoid mobilizing arsenic and other metals in the bedrock and delivering them to groundwater. (EOR Report § 2.1.) Sulfide minerals are well documented in the formations the Applicants are intending to mine, and about 30% of drinking water wells in the county are already contaminated with excess levels of arsenic. (EOR Report § 3.1.) Arsenic levels in an immediately adjacent property to the Site have been documented at a concentration of 101-150 parts per billion, well above the enforcement standard of 10 parts per billion. (EOR Report, Attachment B at 29.) An irrigation well just a mile from the Mine site had to be abandoned in 2012 because of high levels of sulfides in the water that corroded brand-new irrigation equipment after just 106 hours of pumping. (EOR Report, Attachment B at 35.)

Data indicate groundwater at the site is higher than the Applicants believe, and higher than elevation of Powell Spring. (EOR Report § 2.1.) Even if well levels showed lower groundwater, however, groundwater in the area is known to fluctuate, risking that mining will occur in groundwater at some point in the future. (*Id.*) Mining under these conditions then risks releasing arsenic to groundwater in ways that would harm drinking water resources as well as groundwater-fed surface water resources such as Mitchell Glen and Powell Spring, along with area creeks. (*Id.* § 3.1.) So would installation of a water supply well at the mine site for washing and other purposes, though Applicants have not elaborated on their water supply plans. (*Id.*) Such a well may also disrupt groundwater supply in area drinking water wells. (*Id.* § 2.2.) The CUP should be rejected for this reason alone.

Even if Applicants manage to stay above groundwater, there are still risks from excavated and exposed rock. Exposing sulfide minerals to oxygen mobilizes metals in the rock such that they are carried off-site by stormwater, at which point they could enter drinking water wells, creeks, springs, and ultimately Green Lake. (EOR Report § 3.2.) While monitoring systems can be set up to detect acid mine drainage, they are complicated and would require long-term monitoring and enforcement and may not detect drainage before it becomes a problem. (*Id*.) Such programs are also not typical functions of County zoning departments. Because conditions that could help ensure the safety of the population and environment around the Mine are unfeasible, the CUP should simply be denied.

In addition to these impacts, blasting itself involves chemicals—ammonium nitrate and fuel oil—that can contaminate and have contaminated groundwater, according to the DNR. (EOR Report § 3.3.) Blasting also dislodges sediment and rust, disrupting drinking water sources. Applicants have not addressed these issues, but they must be known and understood before any CUP should be issued. (*Id*.)

Finally, while the Applicants have submitted an Erosion Control and Storm Water Management Plan to DNR, it is of limited value in addressing the critical questions presented by the Mine. These questions include the amount of stormwater, the effectiveness of proposed stormwater treatment devices, and the chemical content of stormwater. (EOR Report § 4.) The proposed settling ponds will not treat contaminants that are dissolved in water, such as nitrates and petroleum components, and contamination of groundwater and local trout streams is again a concern, as is impact to downgradient properties like the Neuenfeldts.' (*Id*.) The CUP cannot be approved under these circumstances.

ii. The Proposal lacks substantial evidence that it will be designed, constructed, operated, and maintained so as to be harmonious and be appropriate in appearance with the *existing or intended character of the general vicinity and that such a use will not change the essential character of the same area.*

Applicants only point to best management practices they "may" observe, but not only is there no evidence these practices would mitigate impacts to the point they will satisfy the Ordinance, but the Applicants do not actually commit to following them. Their proposed documents say only that Applicants "may elect" to use some or all of the practices. These wiggle words do not assure this standard is satisfied.

Meanwhile, dozens of neighbors testified before the LUPZC and are expected to

provide comments to the Board. Their testimony about expected impacts and the detrimental effects these impacts will have on the neighborhood are substantial evidence that the Board must consider. So is the testimony of Appellants' real estate expert, Mr. Hungerford, which demonstrates the highest and best use of land in the area is agricultural and conservation. Applicants cannot meet this standard.

[redacted]

iii. The Proposal lacks substantial evidence that it will not be hazardous or disturbing to existing or future neighboring uses.

The Applicants have not showed, and cannot show, they will meet this standard, for the reasons described in i-ii, above, and throughout this position statement.

iv. The Proposal lacks substantial evidence that it will not be detrimental to property in the immediate vicinity or to the community as a whole.

The Mine will have immediate and significant detrimental effects on the surrounding properties, diminishing their market values and severely reducing the landowners' use and enjoyment of their property. Well-known impacts of mining operations to nearby properties include noise pollution and dust from blasting, crushing, and hauling, heavy traffic due to machinery and trucking the aggregate, decreased wildlife, and disrupted surface and ground water flow. (REMI Report at 27; *see also* EOR Report §§ 3.2, 4.)

The first and perhaps most directly impacted property will be Ernie and Ida Neuenfeldt's. The 27-acre parcel on which their recently built home and shop building are situated will plummet in value from $665,000 to $465,500 due to the Mine, a loss of 30% of its value. (REMI Report at 29.) This is a result of the market shock to land situated adjacent to a nuisance industrial use like mining, which causes increased traffic and dust and substantial noise disturbance due to blasting, crushing, and hauling aggregate materials. (*Id*. at 25-28.) The Mine may further devalue the Neuenfeldt's property due to flooding, decreased water quality and quantity, and erosion of surface features. (*Id*. at 31-32; *see also* EOR Report.) Necessary improvements to prevent or lessen these negative effects to the Neuenfeldts' property, including constructing a 3-4-foot-high berm along its southern edge, will cost approximately $125,000. (REMI Report at 32.) In short, the Mine will devastate Ernie and Ida's lifetime of investment in their land.

In addition to the diminution of their property value, the Neuenfeldts will suffer a loss of use and enjoyment of their property. Currently, they utilize the property for sustenance, including by harvesting fruits, vegetables, deer and turkey. Mines and their accompanying noise pollution due to blasting and truck traffic are known to have detrimental effects on wildlife, which will be driven away from the property. Flooding and erosion may also decrease the Neuenfeldts' corn and hay yields, affecting the profitability and, thus, desirability of the two farm fields they rent out to local farmers. Noise from blasting and traffic will also impair the Neuenfeldts' peaceful enjoyment of their land, which until now has been quiet, wild, scenic, and secluded. The Mine will threaten the Neuenfeldts' way of life, in addition to gutting the property's market value.

The Mine will have a significant detrimental effect on residential properties other than the Neuenfeldts' as well. Studies show that residences within one half-mile of a mine experience drops in market value of 25%. (REMI Report at 28-29.) There are 28 homes located within one half-mile of the Mine. (*Id*. at 29.) Even accepting their county assessed values as market value, an unlikely scenario, these properties will drop collectively at least $909,500 in value. (*Id*. at 29-30.) If their assessed values are actually just 50% of market value, which is more likely and was the case for the Neuenfeldts' property, the collective property value loss to these 28 homes will be $1,819,000. (*Id*.) These homeowners, too, will suffer a loss of use and enjoyment of their properties due to noise pollution, dust and traffic, and similar effects.

Finally, two family dairy farms are located across Skunk Hollow Road and south from the Site less than one half-mile. In addition to the property value their residences will lose, these farmers' livelihoods depend on their dairy cows. Their cows, in turn, depend on clean and plentiful well water. Should the Mine contaminate reduce water supply or quality in wells at these farms, as possible due to the Mine's position near a groundwater divide mapped by USGS (EOR Report at §§ 2.2, 3.1, 3.3), dairy farming will become impossible, as trucking in an alternative source of water for the herds will be economically infeasible.

v. *The Proposal lacks substantial evidence that it will be served adequately by essential public facilities and services, such as highways, streets, police and fire protection, drainage structures, and schools, and that the persons or agencies responsible for the establishment of the proposed use shall be able to provide adequately any such service.*

vi. *The Proposal lacks substantial evidence that it will have vehicular approaches to the property which shall be so designed as not to create an interference with traffic on surrounding public or private streets or roads.*

The application makes no mention of its use of public facilities and services, like the public highways and country roads its many trucks and heavy equipment will utilize and, ultimately, degrade. The Applicants clearly intend for Green Lake County and the Town of Brooklyn to bear the brunt of the costs of this degradation to County Highway K and Brooklyn G, respectively. Furthermore, the application does not address the Mine's water consumption at all, or how it will meet its substantial water needs. The conspicuous omission of this information is grounds itself for denial of the CUP. *See Weber v. Town of Saukville*, 209 Wis. 2d 214, 237–38, 562 N.W.2d 412 (1997) ("[A] court should measure the sufficiency of a conditional use application at the time that notice of the final public hearing is first given… Here, the conditional use application was incomplete because it did not contain information regarding the quantity of water to be used in the quarrying operation…").

The proposed vehicular entrance to the Site is located immediately north of the intersection of County Highway K and Brooklyn G. However, the application also makes clear that the Applicants own a property at the intersection of Skunk Hollow Road and Brooklyn G, immediately north of the Mine. This purportedly residential parcel contains an approximately 11,580 square-foot garage with eight garage doors, plus three 1,000-gallon propane tanks. Given that a residential property would not require such significant facilities, it is reasonable to assume this is intended to store equipment from the proposed Mine.

Heavy machinery and quarry trucks at the intersection of Skunk Hollow Road and Brooklyn G would be disastrous. The section of Skunk Hollow Road leading to the intersection is a blind hill with a 9% grade, over 100 feet of elevation change, and only a two-way stop sign. It is a popular road for bicyclists and a busy one for vehicles. This steep road has been notorious for vehicular accidents, accounting for at least one death (Kris Greening, 1997) and three serious accidents. The addition of heavy machinery and trucks to the already dangerous Skunk Hollow/Brooklyn G intersection would introduce intolerable risk for local residents.

b. <u>The Proposal does not meet the farmland preservation requirements of Green Lake Co. Ord. § 350-27(A)(2)(e) and Wis. Stat. § 91.46(6).</u>

The CUP application does not show Applicants can meet the farmland preservation standards—in fact, the application barely even mentions those standards. While the proposal fails out of the gate, other evidence shows Applicants cannot meet these standards.

i. The Proposal lacks substantial evidence that it complies with Subchapter I of Chapter 295, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats., and with any applicable requirements of the Wisconsin Department of Transportation concerning the restoration of nonmetallic mining sites.

Chapter 295 of the Wisconsin Statutes addresses reclamation requirements after the mine closes. The Applicants have not provided a reclamation permit, have not demonstrated to the County that they can comply with all state law provision regarding reclamation, and no County entity has determined that the Applicants can comply with reclamation requirements. Moreover, the Applicants say the Mine will operate for thirty or more years, making reclamation a remote future event. Appellants further address reclamation below.

ii. The Proposal lacks substantial evidence that the operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.

The Applicants have not shown they satisfy this factor by substantial evidence, or even acknowledged the purpose of the County's Farmland Preservation zoning district, which is "to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program." Ord. § 350-27(A). To be consistent with this purpose, the Applicants must show the mine "furthers or does not contradict objectives, goals, and policies" of the Farmland Preservation ordinance. Wis. Admin. Code § ATCP 49.01(5) (emphasis added).

Nothing about the mine, which is an industrial use, promotes the area for uses of a generally exclusive agricultural nature in order to protect farmland and participation in the farmland preservation program. In fact, the Applicants admitted before the LUPZC that "[m]ining will have an impact on farmland loss," but essentially claimed this impact did not matter because "crushed stone and gravel are important materials in supporting local economic development." This is not the standard.

iii. The Proposal Lacks substantial evidence that the operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district.

Applicants have made no showing on this factor. Applicants did not explain whether they reviewed other, non-Farmland Preservation locations in Green Lake County, which is known to have substantial reserves of limestone throughout the County. In fact, Applicants admitted to the LUPZC that there are 18 existing active non-metallic mines in the County already. Rather, Applicants appear to have chosen this site for their own personal convenience because they already own it.

Under these circumstances, there is no need for the proposed mine to be located in the Farmland Preservation district. At a minimum, Applicants must show why they could not use a different parcel, outside of the Farmland Preservation District, rather than the site most convenient to them. Otherwise, the purpose of the Farmland Preservation District will be meaningless, contrary to the Ordinance.

iv. *The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use.*

v. *The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agriculture.*

The Applicant has not presented substantial evidence to show these standards are met. To the contrary, relevant to standard iv., and as explained above, the Mine puts open space use (at Powell Spring and Mitchell Glen) at risk due to its groundwater and potential acid mine drainage effects. Relevant to standard v., the above has already demonstrated that the property of Ernie and Ida Neuenfeldt, which is zoned A-1, will be substantially impaired by the mine. This land is used for agricultural purposes such as cropping, growing fruit trees, and gardening. The Nehm dairy farm south/southwest of the Site may also see disruptions to groundwater supply wells that the Applicants have not studied, but should have through a proper hydrologic study. (EOR Report § 2.2.)

vi. *The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed.*

vii. *Compliance with Chapter 323 (Nonmetallic Mining Reclamation)*

The Applicants acknowledged in their presentation to the LUPZC that "mining reclamation projects on occasion are converted into agricultural uses," such that reclamation to agricultural use appears to be the exception and not the rule. Applicants claim they will restore the land here to agricultural use, but the Board must closely scrutinize this claim. A table provided with the application materials shows the costs to restore the land to agriculture will be significant—mostly attributable to bringing in fill material (about 95,000 cubic yards/acre) to restore the land to grade.

Multiplying the cost of reclamation per the 40 active acres the mine will disturb, it does not seem

Hauling of Imported Fill Material	**$70,000.00/Acre**
Leveling of Imported Fill Material	**$1000.00/Acre**
Redistribute Overburden, Topsoil, & Grade	**$1,375.00/Acre**
Modify Erosion Control Measures for Agriculture	**$50.00/Acre**
Total Cost Per Active Acre	**$72,425.00/Acre**

credible or realistic that the Applicants will spend over $2.8 million in 2022 dollars to restore the land to agricultural use. Moreover, generously assuming that a dump truck carries 30 cubic yards, it will take over 3,100 dump trucks to reclaim just one acre. This will only exacerbate the neighborhood impacts of the mine from traffic, noise, and dust.

CONCLUSION

"Available information suggests that the Skunk Hollow Mine cannot be operated as proposed without adverse impacts on the health and welfare of nearby residents or without degradation of aquatic resources," and "application materials lack important information" regarding risks to public health and the environment. (EOR Report, § 5.) For these reasons and the reasons stated above, the Applicants cannot show they are entitled to a CUP for a mine at the proposed location. The CUP should be denied.

Dated this 8th day of December, 2022.

PINES BACH LLP

Electronically signed by Leslie A. Freehill

Christa O. Westerberg
Leslie A. Freehill

Attorneys for the Appellants

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Wisconsin Legislative Council

Anne Sappenfield
Director

TO: SENATOR JANET BEWLEY

FROM: Anna Henning, Senior Staff Attorney, and Scott Grosz, Principal Attorney

RE: Local Government Discretion When Reviewing Conditional Use Permit Applications

DATE: March 17, 2020

You requested an overview regarding county and municipal authority to deny an application for a conditional use permit or to impose conditions when granting such a permit. As is described in greater detail below, current law, as affected by 2017 Wisconsin Act 67, requires counties and municipalities to issue a conditional use permit if an applicant for the permit satisfies conditions specified by local ordinance or imposed by a local zoning board. However, counties and municipalities retain the authority to deny conditional use permits and impose application-specific conditions, if the conditions are related to the purpose of the relevant local zoning ordinance and are supported with "substantial evidence."

Conditional Use Permit Process

Generally, a conditional use permit must be issued by the zoning authority in the relevant city, village, town, or county before a person may use property in a manner that is designated as a conditional use within a given zoning district.

Wisconsin law, as affected by 2017 Wisconsin Act 67[1], requires a city, village, town, or county to grant a conditional use permit if an applicant meets, or agrees to meet, all of the requirements and conditions specified in the relevant ordinance or imposed by the relevant zoning board. Any such conditions must be related to the purpose of the ordinance and based on substantial evidence.[2] In addition, those requirements and conditions must be reasonable and, to the extent practicable, measurable.

An applicant for a conditional use permit must demonstrate, with substantial evidence, that an application and all requirements and conditions relating to the conditional use are, or will be, satisfied.

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[1] 2017 Wisconsin Act 67 was prompted, in part, by the Wisconsin Supreme Court's decision in *AllEnergy Corporation v. Trempealeau County Environment and Land Use Committee*, 2017 WI 52. In *AllEnergy*, a majority of Wisconsin Supreme Court justices rejected an argument that, in that particular case, a land use committee acted outside the scope of its authority because it denied a conditional use permit application based in part on general concerns raised by the public.

[2] The Act defines "substantial evidence" to mean facts and information, other than merely personal preference or speculation, directly pertaining to the requirements and conditions an applicant must meet to obtain a conditional use permit and that reasonable persons would accept in support of a conclusion.

The city, village, town, or county must then demonstrate that its decision to approve or deny the permit application is supported by substantial evidence. [ss. 59.69 (5e), 60.61 (4e), 60.62 (4e), and 62.63 (7) (de) 2., Stats.]

A conditional use permit may remain in effect as long as the conditions upon which the permit was issued are followed, except that a city, village, town, or county may impose conditions relating to the permit's duration, and the ability of the applicant to transfer or renew the permit, as well as any other additional, reasonable conditions specified in the relevant zoning ordinance or by the relevant zoning board.

The city, village, town, or county must hold a public hearing on a conditional use permit application and authorize a person whose conditional use permit application is denied to appeal the decision in circuit court.

LOCAL DISCRETION TO DENY OR IMPOSE CONDITIONS

As described above, local units of government retain meaningful discretion in setting requirements and conditions through the conditional use permitting process. Retention of that discretion is supported by the legislative history for 2017 Wisconsin Act 67.

Between introduction as 2017 Assembly Bill 479 and enactment as 2017 Wisconsin Act 67, the legislation was subject to significant amendment, particularly with respect to its effect on local approval of conditional use permits. With respect to conditional use permits, Assembly Substitute Amendment 1, as amended by Assembly Amendment 4, modified the bill to: retain the continued ability of a zoning board to impose conditions on a particular application in addition to conditions specified by ordinance; allow for conditions that may not be "measurable"; and remove limits on the use of public testimony as the basis for denial of a conditional use permit. As evidenced by the public testimony on the bill, retention of local discretion was a key aspect of compromise between the Wisconsin Realtors Association and various municipal groups, resulting in changes to the municipal groups' positions on the amended bill with respect to the treatment of conditional use permits. That local discretion is evident in the relevant provisions of current law, as affected by 2017 Wisconsin Act 67 and described above.

If you have any questions, please feel free to contact us directly at the Legislative Council staff offices.

AH:SG:jal

UNIVERSITY of WISCONSIN UWMILWAUKEE

Archaeological Research Laboratory Center

Cultural Resource Management

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PO Box 413
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53201-0413
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www.uwm.edu
www.uwm.edu/archaeology-laboratory/

December 13, 2022

Stephanie Prellwitz
Green Lake Association
492 Hill Street, Suite 205
PO Box 364
Green Lake, WI 54941
stephanie@greenlakeassociation.org

RE: Cultural Resources Review TM#2022-0514
Green Lake Proposed Quarry
Green Lake Association
Town of Brooklyn, Green Lake County
T16N R13E Section 36
UWM-CRM Project 2022-0786

Dear Ms. Prellwitz,

The following presents the results of the cultural resources review for the proposed Green Lake Quarry in the Town of Brooklyn, Green Lake County, Wisconsin.

Project Description

The Green Lake Association seeks a literature review for cultural resources within and adjacent to an 80 acre proposed quarry, located in Green Lake County. [redacted] (Attachment 1). The project is situated north of CTH-K, east of Skunk Hollow Road, and south of Brooklyn G Road in Green Lake County (Attachment 2 and Attachment 3).

The project was reviewed for compliance with Wisconsin Statutes §44.40 and §157.70.

Architecture/History Review

As part of this review the Wisconsin Historic Preservation Database (WHPD) and the National Register of Historic Places (NRHP) were consulted. No previously surveyed historic properties that are listed as potentially eligible, eligible, or listed in the NRHP are coincident or immediately adjacent to the project area. The closest previously surveyed properties are approximately 6,000 feet to the west and south (Attachment 4).

Archaeological Review

As part of this review the Wisconsin Historic Preservation Database (WHPD) and the National Register of Historic Places (NRHP) were consulted, as well as relevant previous reporting and archival materials, to assess the presence of previously reported archaeological and burial sites within the proposed project areas. The review indicated that 19 previously recorded archaeological are within one-mile of the project area (Attachment 5). One archaeological/ burial site is coincident with project area: 47GL0025/ BGL-0071 Military Road Mounds (Attachment 6 and Attachment 7).

Military Road Mounds (47GL0025/ BGL-0071)

This site consists of a small group of mounds, including a turtle or panther effigy and between one and three conicals, and corn hills. [redacted] All were plowed over by 1916. [redacted] They ranged between nine and ten inches high and were destroyed prior to 1862 (WHPD 2022).

In 1917, Brown published on the mounds and the corn hills reported to him by S. D. Mitchell as the Military Road Planting Grounds and the Military Road Mounds (Brown 1917:11-12) (Attachment 9). Brown also noted the mounds and corn hills on a county plat map, which is highlighted in red (Attachment 10). Mitchell provided Brown with specific locational information and descriptions of the mounds:

[redacted]

[redacted] (Attachment 10). Mitchell indicated to Brown that the corn hills were completely disturbed from agricultural cultivation by 1862.

Two anomalies are evident in a 1937 historic aerial imagery that might be potential mound remnants. [redacted] (Attachment 11). However, Mitchell notes that the mounds were plowed away and only a slight soil discoloration provided where the mounds were located (Brown 1917). Mitchell's report to Brown provides the most accurate location of 47GL0025/ BGL-0071 Military Road Mounds.

Based on these historic documents and Mitchell's measurements to the location of the mounds, it is recommended that [redacted] (Attachment 12). An Archaeological Site Inventory (ASI) update was sent to the Office of the State Archaeologist on September 24, 2022 with the recommended site boundaries updates.

The Office of the State Archaeologist updated the archaeological site boundaries for 47GL0025/ BGL-0071. A map showing the updated site boundaries in relation to project activities is attached (Attachment 14).

Recommendations

Relative to architecture/history resources, there are no previously surveyed historical properties coincident or immediately adjacent to the project area. Therefore, the project has no potential to affect historic resources and no further investigations are required or recommended.

Relative to archaeological resources to comply with Wis Stats. §44.40, one previously recorded archaeological/burial site 47GL0025/ BGL-0071 Military Road Mounds. Based on historic documentation [redacted] However, the historic documents indicate that the corn hills were completely disturbed by 1862 from agricultural activities and there is low probability any significant subsurface cultural deposits to be intact so no further work is recommended within the proposed site area for the corn hills.

Relative to archaeological resources to comply with Wis Stats. §157.70, burial site 47GL0065/ BGL-0071 is coincident with the project area. Authorization from the Wisconsin Historical Society (WHS) is required prior to any ground disturbing work within the burial site boundaries.

Please contact Seth Schneider, at sethas@uwm.edu or at (414) 251-7061, with any questions and/or concerns.

Sincerely,

Seth A. Schneider, Ph. D., RPA
Principal Investigator

References Cited

Brown, Charles E.

1917 Antiquities of Green Lake. The Wisconsin Archeologist 16(1):1-55.

Wisconsin Historic Preservation Database (WHPD)

2022 Archaeological Site Inventory, https://www.wisahrd.org/ASI/Sites/Primary.aspx?id=8379, date accessed September 2, 2022.

Table 1. Previously Recorded Archaeological Sites within One Mile of the Project Location.

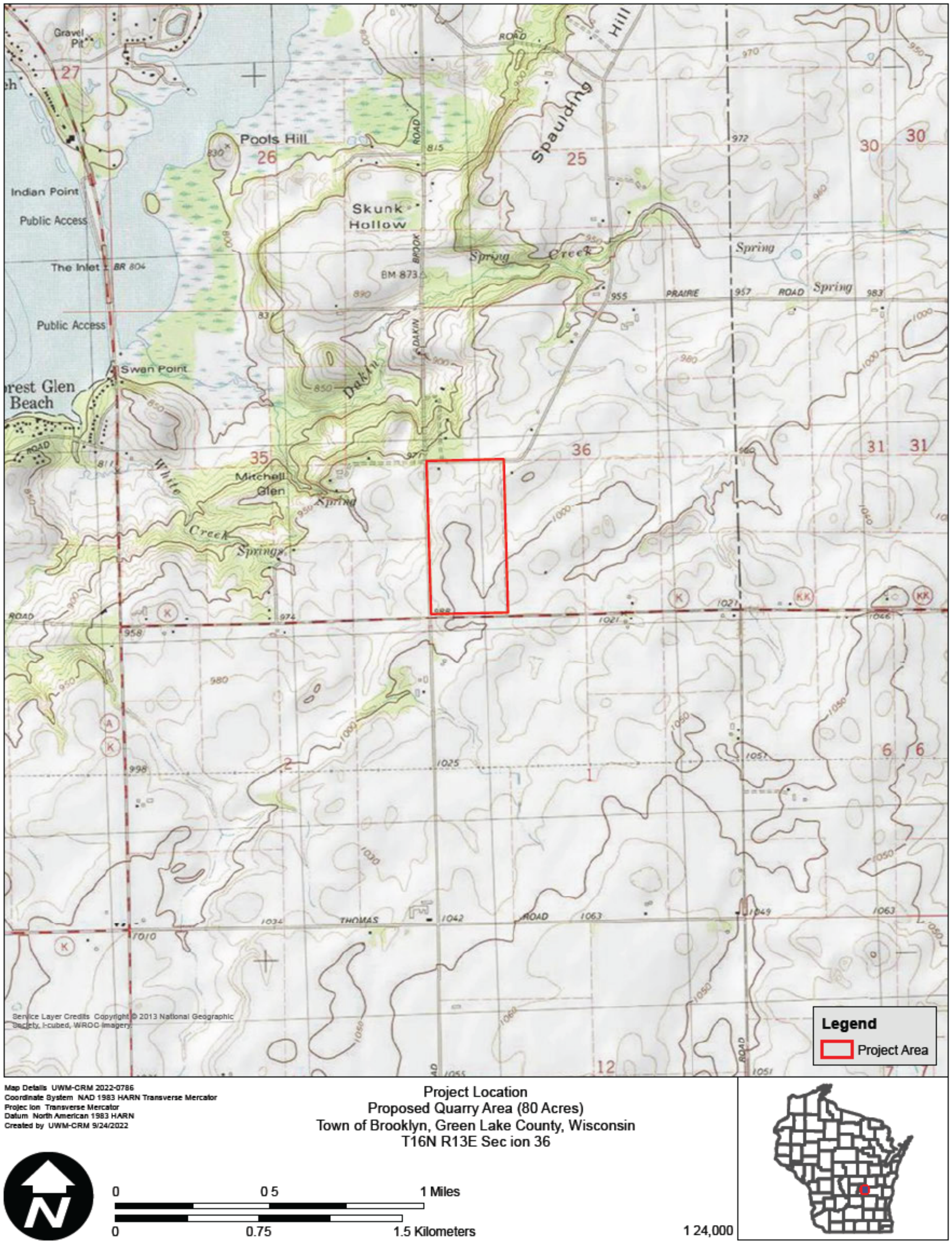
State Site	Burial Site	Site Name	Site Type	Culture
GL-0029		Satterlee Clark Corn Hills	Corn hills/garden beds	Unknown
GL-0022		Saterlee Clark Cornhills	Corn hills/garden beds	Postcontact Indian
GL-0028	BGL-0079	Satterlee Clark Mound	Mound(s) - Conical	Woodland
GL-0170	BGL-0087	Silver Creek Outlet Mound	Mound(s) - Conical; Campsite/ village	Postcontact Indian; Unknown Precontact; Woodland
GL-0031		Mitchell Garden Beds	Corn hills/garden beds	Late Woodland; Oneota
GL-0021		Military Roads Planting Grounds	Corn hills/garden beds	Oneota; Late Woodland
GL-0007		Dakin Creek Site	Campsite/village	Unknown Precontact
GL-0231		Craig	Campsite/village	Late Archaic; Late Paleo-Indian; Middle Archaic
GL-0018		Clark Campsite	Campsite/village	Unknown Precontact
GL-0023		Dakin Creek Caches	Campsite/village; Cache/pit/ hearth	Unknown; Unknown Precontact
GL-0020		Burlingame Creek Village	Campsite/village	Unknown
GL-0014	BGL-0078	Crook Mounds and Village.	Campsite/village; Cache/pit/ hearth; Mound(s) - Conical; Mound(s) - Linear; Corn hills/ garden beds;Cemetery/burial	Postcontact Indian; Unknown Precontact; Late Woodland
GL-0016		Glen Creek Campsite	Campsite/village; Sugar bush	Woodland; Post-contact Indian
GL-0019		Powell Creek Caches	Cache/pit/hearth	Unknown
GL-0015	BGL-0077	Glen Creek Mound	Mound(s) - Conical	Woodland; Late Woodland
GL-0171		Powell Trading Post	Trading/fur post; Cache/pit/ hearth	Historic Euro-American
	BGL-0012	MITCHELL CEMETERY	Cemetery/burial	Historic Euro-American
GL-0017		Glen Creek Caches	Cache/pit/hearth	Unknown

Table 2. Previously Recorded Archaeological Sites Coincident with the Project Location.

State Site	Burial Site	Site Name	Site Type	Culture
GL-0025	BGL-0071	Military Road Mounds	Corn hills/garden beds; Mound(s) - Effigy; Mound(s) - Conical	Late Woodland; Postcontact Indian

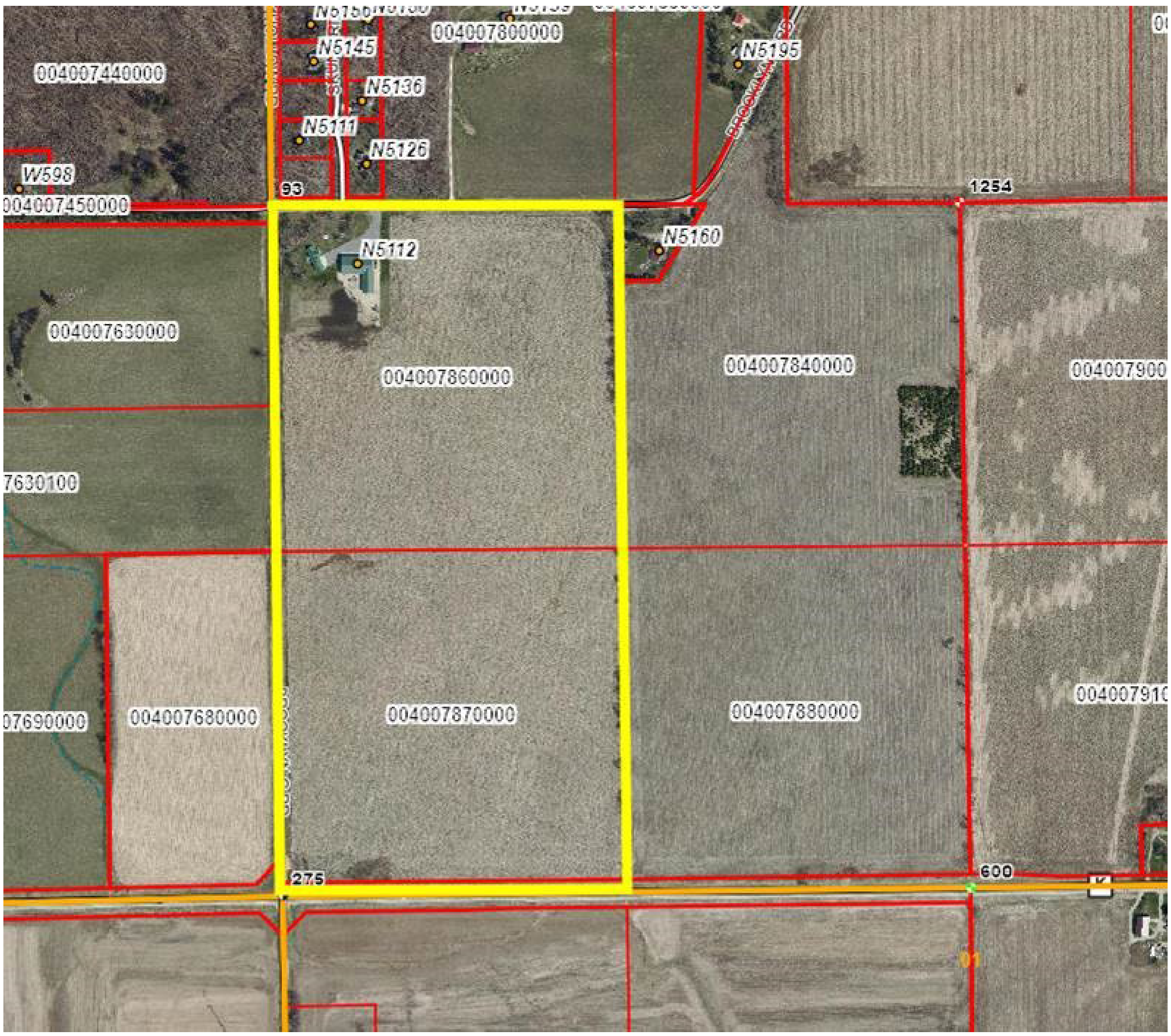
List of Attachments

Attachment 1. Project location (topographic).

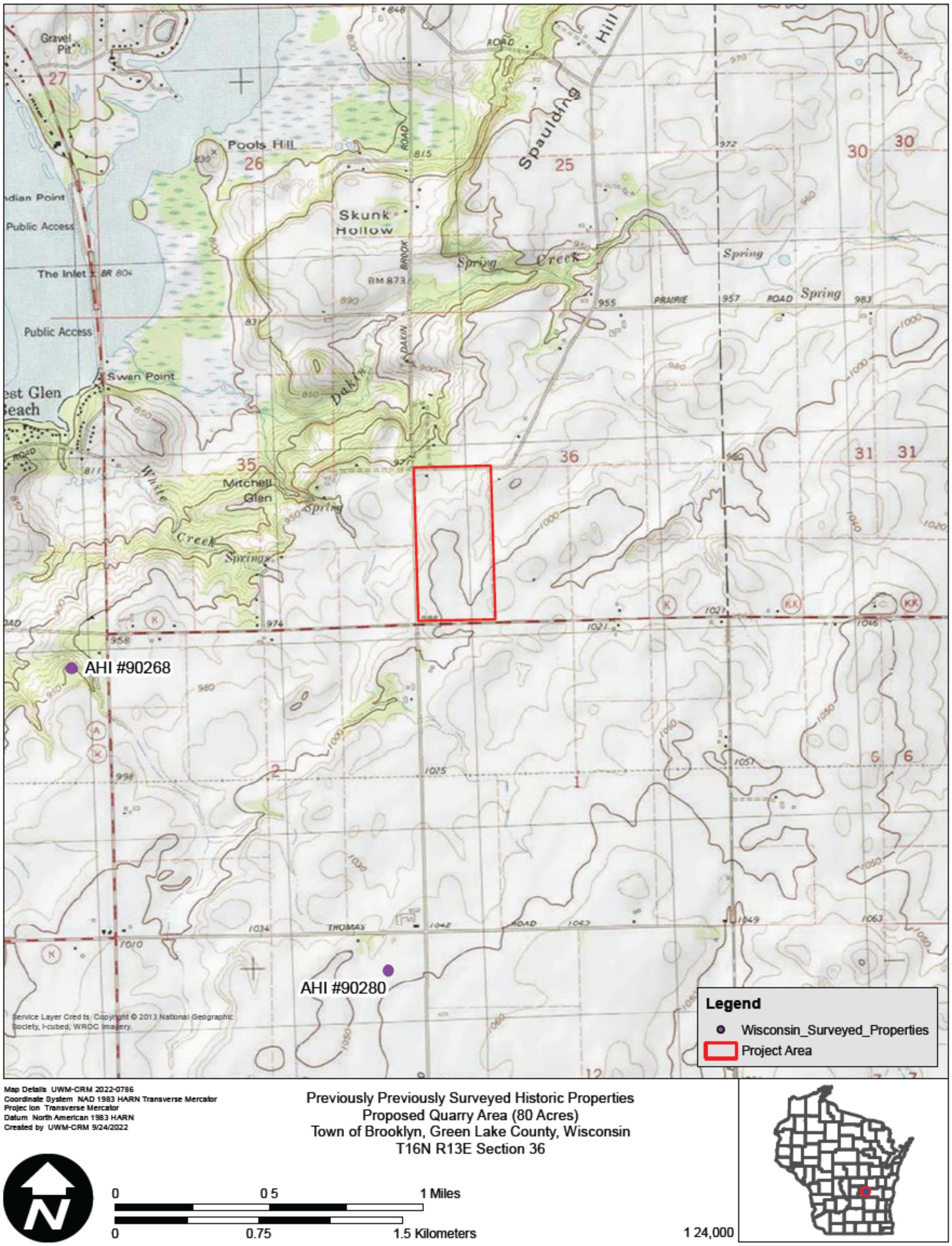


Attachment 2. Project location and proposed activities (aerial).

Attachment 3. Project area.



Attachment 4. Previously surveyed historic properties.



Attachment 5. Previously recorded archaeological sites within one mile.

[redacted]

Attachment 6. Archaeological site(s) relative to project area.

[redacted]

Attachment 7. Archaeological site relative to project area - detail.

[redacted]

Attachment 8. Hillshade map overlay of archaeological site relative to project area.

[redacted]

Attachment 9. Map and descriptions of archaeological sites around Green Lake Military Road Mounds and Military Road Planting Grounds circled in red (Brown 1917:4, 11&12) (3 pages).

[redacted]

[redacted]

[redacted]

Attachment 10. Charles E. Brown map ca. 1924 showing archaeological sites with mounds and corn fields in Section 36, Township of Brooklyn in Green Lake County circled in red (2 pages).

[redacted]

[redacted]

Attachment 11. 1937 Historic aerial imagery with potential mound remnants circled in blue.

[redacted]

Attachment 12. Recommended site location and boundaries for 47GL0025/ BGL-0071 Military Road Mounds and corn hills as Military Road Planting Grounds in relation to project area.

[redacted]

Attachment 13. ASI Update for 47GL0025/ BGL-0071 (2 pages).

[redacted]

[redacted]

Attachment 14. Updated site boundaries for 47GL0025/ BGL-0071 Military Road Mounds by the Office of State Archaeologist at the Wisconsin Historical Society to proposed project areas.

[redacted]

Attachment 15. ARI.

[redacted]

ESTIMATING PROPERTY VALUE IMPACTS FROM THE PROPOSED SKUNK HOLLOW MINE ON A PROPERTY LOCATED AT N5139 BROOKLYN G ROAD IN THE TOWN OF BROOKLYN, GREEN LAKE COUNTY, WISCONSIN

Prepared for: Neuenfeldt Family Irrevocable Trust,
c/o Pines Bach LLP

December 7, 2022

Real Estate Dynamics, Inc.

448 West Washington Avenue
Madison, WI 53703

Real Estate Dynamics, Inc.

December 7, 2022

Ernie Neuenfeldt
Neuenfeldt Family Irrevocable Trust
c/o Pines Bach LLP
122 W Washington Ave, Ste 900
Madison, WI 53703

Re: The estimate of the property value impacts from a proposed limestone mine to the market value of the property located at N5139 Brooklyn G Road in the Town of Brooklyn, Green Lake County, Wisconsin

Dear Mr. Neuenfeldt:

At your request, Real Estate Dynamics, Inc. (REDI) has appraised the property impacts to the market value of the above-mentioned property. The property was appraised for the purpose of documenting any change in market value given the proximity of the property to the proposed Skunk Hollow Mine (the Mine).

The date of value is November 25, 2022. We have performed a highest and best use analysis as a prelude to our value estimate in which we address the use issues facing the property, within the constraints of market forces. Craig D. Hungerford inspected the property on November 25, 2022. We estimate the damages to the market value of your property to be $324,500 based on the potential impacts from the proposed Mine.

The report summarizes our methodology, data, analysis and conclusions. If we can be of any additional service, please feel free to contact us.

Sincerely,

REAL ESTATE DYNAMICS, INC.

Craig D. Hungerford

Craig D. Hungerford, CRE
President

448 W. Washington Ave ● Madison, WI 53703 ● (608) 255-4676 ● (FAX) 255-7384

Executive Summary

- Real Estate Dynamics, Inc. (REDI) has estimated the impact to market value caused by the proposed and adjacent Skunk Hollow Mine on a property located at N5139 Brooklyn G Road, in the Town of Brooklyn, Green Lake County, Wisconsin. The property is identified as parcel number 004-00780-0000.

- The purpose of the report is to estimate market value and assist the owner, the Neuenfeldt Family Irrevocable Trust, and their agent(s) with concerns over damages that may result from the proposed Skunk Hollow Mine on the adjacent property. The Skunk Hollow Mine is a proposed 80 acre non-metallic limestone mine located near residential homes and environmentally sensitive areas, including Powell Spring, Mitchell Glen, White Creek and Dakin Creek.

- The subject property consists of one parcel, 004-00780-000, which is improved with a single family home and a detached garage.

- The subject property is zoned A-1 Farmland Preservation District. Nonmetallic mining is considered a conditional use and must comply with the requirements in the A-1 district.

- Given the property's location, surrounding uses and zoning we believe that agriculture and residential use would be most appropriate and most probable for the subject property as vacant or improved. Therefore, the highest and best use of the subject site is as agriculture and residential use.

- The Sales Comparison Approach is used to estimate value.

- Given the rural nature of the property and the potential impact of the nonmetallic mine on the subject property, we estimate the damages to the market value of your property to be $324,500.

- We have applied the proximity analysis to other rural residential properties in the immediate area of the mine including the adjacent Skunk Ridge Lane neighborhood. The value estimates are based on 2022 assessed values. The value impact is estimated at $909,500. If damages were based on market value, they could be at least double the assessed value, or approximately $1,819,000.

VALUE SUMMARY	
Value of N5139 Brooklyn G Road	$665,000
Proximity Damages	$199,500
Flooding Damages	$125,000
Total Damages	$324,500
Net Value of N5139 Brooklyn G Road assuming the Mine is developed	$340,500

Table of Contents

List of Appendices

Introduction

Real Estate Dynamics, Inc. (REDI) has estimated the impact to market value caused by the proposed and adjacent Skunk Hollow Mine on a property located at N5139 Brooklyn G Road in the Town of Brooklyn, Green Lake County, Wisconsin. The property is identified as parcel number 004-00780-000. A complete legal description of the property is located in Appendix E. The date of value is November 25, 2022.

Craig D. Hungerford inspected the subject property on November 25, 2022. Subject property maps and photographs are provided in Appendix D.

SCOPE OF WORK

This document and supporting analysis is to function as the basis for estimating market value. Authorized by Ernie Neuenfeldt, property trustee, this appraisal has been prepared to estimate market value and assist the owner, the Neuenfeldt Family Irrevocable Trust, and their agent(s) with concerns over damages that may result from the proposed Skunk Hollow Mine on the adjacent property. While the Mine may be a conditional use recently approved by the Green Lake County Planning & Zoning Committee on July 7, 2022, it has been introduced into a residential and rural farmland area with high environmental values as well as an area with rural residential character thus potentially impacting the use and enjoyment of adjacent and nearby property.

INTEREST(S) VALUED AND DEFINITIONS

We have estimated the market value of the Fee Simple Estate of the subject parcels as of November 25, 2022. This is defined in the

Appraisal of Real Estate, 12th Edition, published by the Appraisal Foundation as follows:

> A fee simple estate implies absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power and escheat.
>
> A leased fee estate is an ownership interest held by a landlord with the right of use and occupancy conveyed by lease to others; the rights of lessor (the leased fee owner) and leased fee are specified by contract terms contained within the lease.

This report has been written in compliance with the Uniform Standards of Professional Appraisal Practice (USPAP) of the Appraisal Foundation and is considered to be an Appraisal Report. This report is subject to the Statement of Assumptions and Limiting Conditions contained in Appendix A.

DATE OF VALUE

The market value conclusions presented herein are based on economic conditions prevailing in the four weeks preceding the date of value and perceptions of future events existing as of November 25, 2022.

SCOPE OF ANALYSIS

We have investigated the overall health of the Towns of Brooklyn and Green Lake, City of Green Lake, the County of Green Lake and Fond du Lac for sales data from similar market rate sales. We have applied one of the three approaches to value, the Sales Comparison Approach to value the property. Consideration was given primarily to overall investment similarity, property type and location. Adjustments were considered for market conditions (time) in the Sales Comparison Approach to help set a market-based framework for comparison. The Cost and Income Approaches to value are typically not considered by buyers and sellers of property similar to the subject property. We, however, utilized the cost approach, in part, to estimate some of the damages.

The organization of this report parallels our valuation process and summarizes our methods, data, analyses, and conclusions. This introductory section defines the problems and provides an overview of our primary assumptions. The following section provides a physical description of the site and demographic data on the surrounding area. The next section describes the Highest and Best Use analysis for the property. Finally, the Valuation of the subject property describes our valuation processes, including the method(s) of approach, data used, and estimated values for the property.

This appraisal is subject to General Assumptions and Limiting Conditions presented in Appendix A. Craig D. Hungerford and other members of the Real Estate Dynamics, Inc. staff have prepared this report in accordance with appropriate valuation standards.

SPECIAL VALUATION ASSUMPTIONS

There are no extraordinary assumptions and one hypothetical condition impacting this analysis and valuation. First, the Mine has not been fully approved and commenced operation and the estimate of damages assumes the Mine is in operation.

Other general assumptions are as follows:

1. We have relied on the plat as well as the Green Lake, and other County GIS programs to confirm the acreage of the subject property and comparable sales.

2. We are unaware of any current environmental issues with respect to the subject property. We have not made any adjustments to value to account for such concerns.

3. If any of these assumption change or are deemed incorrect, we reserve the right to make changes or adjustments to our report and/or values.

STATEMENT OF COMPETENCY

Craig D. Hungerford has valued a wide variety of residential, commercial, and vacant property in Wisconsin over the past 35 years. He is a former Certified General Appraiser in Wisconsin and many other States. He currently holds a CRE (Counselor of Real Estate) designation.

> Those designated a "Counselor of Real Estate" are prominent real estate practitioners recognized for their expertise, experience, and ethics in providing advice that influences real estate decisions.

MARKET EXPOSURE PERIOD

A reasonable exposure period is the amount of time necessary to expose a property to the open market in order to achieve a sale. The estimate of a reasonable exposure time is not intended to be a prediction of a date of sale. Furthermore, exposure time is always presumed to occur prior to the effective date of the appraisal. Implicit in this definition are the following characteristics:

1. The property is actively exposed and aggressively marketed to potential purchasers through marketing channels commonly used by sellers of similar property.

2. The property is offered at a price reflecting the most probable markup over market value used by sellers of similar property.

3. Sale is consummated under the terms and conditions of the definition of Market Value.

After speaking with local Realtors and reviewing prior transactions, the market exposure period, or the length of time necessary for the subject property to be exposed to the market prior to an arm's length sale occurring at the market value as concluded herein, is three to six months.

DEFINITION OF VALUE

Market value as used in this analysis is defined as:

the most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

1. Buyer and seller are typically motivated;

2. Both parties are well informed or well advised, and acting in what they consider their own best interests;

3. A reasonable time is allowed for exposure in the open market;

4. Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and

5. The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.[1]

PROPERTY RIGHTS APPRAISED

The right or interest being valued is a fee simple interest in the subject property. A fee simple estate is defined as an absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.[2] Except for standard utility easements, any mortgages on the property, and those noted in this report, there are no other known encumbrances on this project.

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[1] The Appraisal Institute, The Appraisal of Real Estate, Twelfth Edition 2001, p. 23. Definition taken from Federal Register, Vol. 55, No. 163, August 22, 1990, p.p. 34228 and 34229.

[2] The Appraisal Institute, The Appraisal of Real Estate, Twelfth Edition, 2001, p. 69.

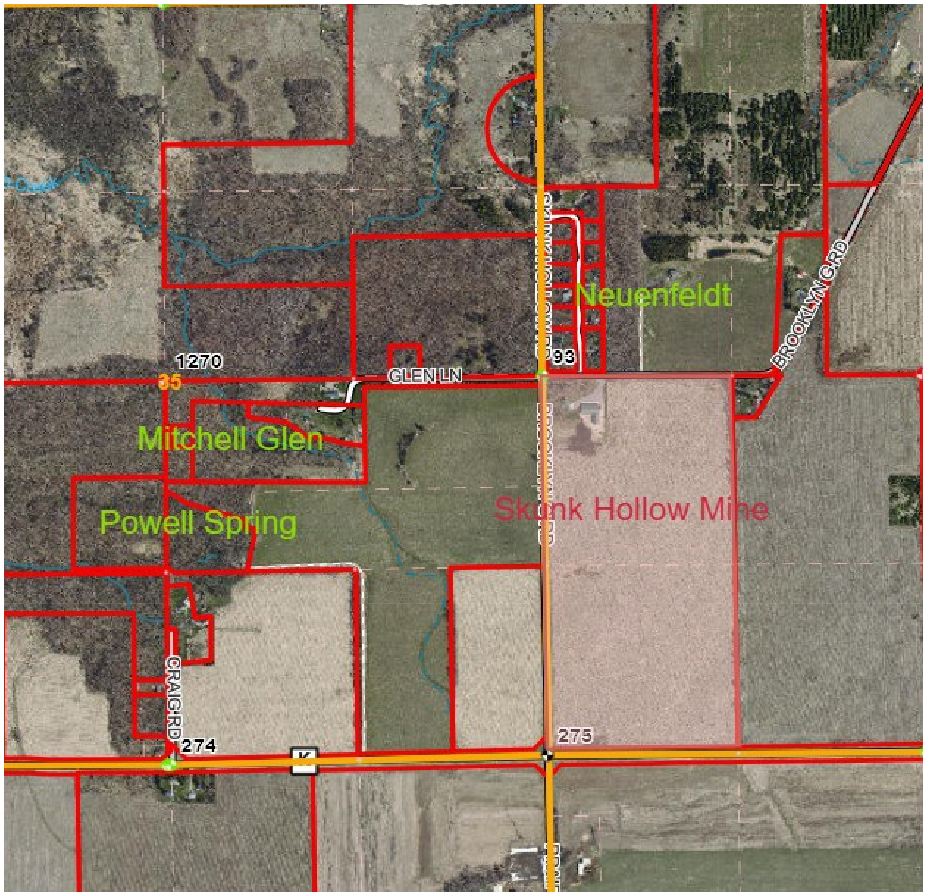
Description and Analysis of the Subject Property

THE PROPOSED PROJECT

The Skunk Hollow Mine is a proposed 80 acre non-metallic limestone mine located near environmentally sensitive areas, including Powell Spring, Mitchell Glen, White Creek and Dakin Creek. Non-metallic mining is the extraction of stone, sand, rocks, and other similar minerals. The most common example of a non-metallic mine is a quarry. These mines extract minerals such as limestone, granite, gravel, or sand which are used for road building, landscaping, building supplies for homes, and other everyday uses. The Mine location is on the east side of Brooklyn G Road between County Road K and where Brooklyn G Road becomes Skunk Hollow Road.

POTENTIAL IMPACTS

The proposed mine may cause negative disruptions to groundwater flow to Mitchell Glen and Powell Spring, as well as base stream flow to Dakin Creek and White Creek, while potential sulfide minerals in the area's bedrock could negatively impact surface water quality. Further, the subject property will be harmed by the additional noise, traffic, dust, vibration, and other disturbances caused by the proposed Mine, along with potential runoff from the outlet structure of the Mine's detention pond or an over topping of the pond in a significant rain event.



SUBJECT PROPERTY CHARACTERISTICS

The subject property is defined as parcel 004-00780-000 which is improved with a single family home and a detached garage.

<u>SIZE AND SHAPE</u>

Parcel 004-00780-000 located at N5139 Brooklyn G Rd., is rectangular in shape, 27.00 acres in size, and accessed from Brooklyn G Road. Approximately 40% of the total acreage is tillable and the remainder is either open or wooded acreage.

<u>TOPOGRAPHY AND FLOODING</u>

The site topography for parcel 004-00780-000 ranges from approximately 977 to 887 from southeast to northwest across the property. The western and northern areas of the site have significant down slope topography. See Appendix D.

ENVIRONMENTAL CONCERNS

There are no known environmental concerns with respect to the subject property. REDI has not performed or reviewed a Phase I environmental review.

UTILITIES

Well water, on-site septic, telephone, and electric utilities are available to the site.

LINKAGES

The property is adjacent to Brooklyn G Road which connects to STH 23/49 to the northeast and the City of Ripon, and connects to CTH K to the south via Skunk Hollow Road and CTH A to the west via CTH K and STH 23 and the City of Green Lake to the northwest. STH 23 is a regional arterial connecting Mauston, WI via I-90 to the west and Fond du Lac via STH 41 to the east.

ZONING

The subject property is zoned A-1 Farmland Preservation District.

> The purpose of this district is to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program. Land zoned under this district must comply with the following:
>
> (1)Permitted uses:
>
> (a) Agricultural uses. See Subsection D for agricultural use definitions.
>
> (b) Not including the specified accessory uses identified in Subsection A(2), other accessory uses, including the farm residence. See Subsection D for "accessory use"definition.
>
> © Upon prior notification to the county, transportation, utility, communication, or other uses that are required under state or federal law to be located in a specific place or that are authorized to be located in a specific place under a state or federal law that preempts the requirement of a conditional use permit for those uses.
>
> (d) [Subsection A(1)© acknowledges that state or federal law may sometimes preempt local authority to restrict the siting of certain facilities. It does not purport to determine which state or federal actions are

preemptive. It merely says that if state or federal action is preemptive, no local permit is required and there is no need to rezone the site out of the farmland preservation district. Uses covered by Subsection A(1)© might include, for example, state and federal highways, federally mandated pipelines, and energy generation and transmission facilities whose location and design are specifically mandated by the Wisconsin Public Service Commission pursuant to a certificate of convenience and necessity.

(e) Undeveloped natural resource and open space areas.

(f) Nonfarm residences built prior to January 1, 2014.

Nonmetallic mining is considered a conditional use and must comply with the following requirements in the A-1 district.

Nonmetallic mineral extraction, if all of the following apply:

[1] The operation complies with Subchapter I of Chapter 295, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats. (including all applicable provisions of this chapter), and with any applicable requirements of the Wisconsin Department of Natural Resources concerning the restoration of nonmetallicmining sites.

[2] The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.11/21/22, 1:46 PM Green Lake County, WI A-1 Farmland Preservation District.

[3] The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law.

[4] The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use.

[5] The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

[6] The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed.

[7] Compliance with Chapter 323 (Nonmetallic Mining Reclamation).

SURROUNDING USES/CONFLICTS

Surrounding uses include rural residential, agricultural, and conservancy uses. Proposed mining operations immediately south of Parcel 004-00780-000 risks flooding the residential property and eliminating or contaminating the well-water servicing the residential property as well as potential effects to Green Lake downstream.

SUBJECT PROPERTY IMPROVEMENTS

The subject improvements on Parcel 004-00780-0000 are a residential dwelling unit with a detached garage and a utility garage with three bays and a workshop area.

Year Constructed	2011 and 2013
Number of Buildings	One two-level ranch style building with a partially finished full basement.
Gross Building Area	1,886 SF ground living area. 1,336 finished basement living area.
Foundation	Concrete
Framing	Wood
Exterior Walls	Aluminum/Vinyl
Windows	Casement and double hung
Interior Walls	Painted drywall, ceramic tile
Roof	Asphalt shingle
Interior Walls/Ceiling	Drywall/Plaster
Flooring	Carpet/Ceramic Tile/Vinyl Plank

Building Layout	Kitchen, dining, living, family, laundry room, 3-bedrooms, 2-full baths and 1 half bath.
HVAC	Geothermal and forced air LP gas, and central A/C.
Finishes	Flooring and doors, typical. Chrome finish plumbing fixtures, standard fixtures, solid surface countertops, and standard appliances.
Plumbing/Electrical	200 amp service and 2-80 gallon water heaters-one for the geothermal system and a water softener.
Parking/Storage	2-car attached garage, 3+car detached garage and 1 storage shed, paved drive and parking area.

PROPERTY HISTORY AND ASSESSMENTS

PROPERTY HISTORY

Parcel 004-00780-000 has been owned by the Neuenfeldt Family Irrevocable Trust for more than five years. County records show that they originally purchased the property in 1998 and the owner and assessment records indicate the house was built in 2011, the garage in 2011 and the utility shed in 2013. There have been no recent arms-length transactions involving this parcel.

ASSESSMENT

The subject property's total assessment from Green Lake County Treasurer's Property Tax Data for 2022 is shown as follows:

PROPERTY ASSESSMENT 2022				
Parcel #	Acres	Improvements	Land	Total
004-00780-0000	27.000	$241,300	$23,800	$265,100

AREA CHARACTERISTICS

NEIGHBORHOOD

The subject parcels is located on Brooklyn G Road in the Town of Brooklyn, Green Lake County, Wisconsin. The subject property is surrounded by farmland, woodlands, and some scattered rural residential development.

TOWN OF BROOKLYN

As of 2022, Brooklyn's population is1,890 people. Since 2020, it has had a population decline of 4.5%. The median home cost in Brooklyn is $193,100. Home appreciation in the last 5 years has averaged 6.0%. Brooklyn's cost of living is 16.3% lower than the U.S. average. Green Lake County public schools spend $25,979 per student. The average school expenditure in the U.S. is $12,383. There are about 10.2 students per teacher in Brooklyn. The unemployment rate as 2021 in Green lake County was 4.3% whereas the U.S. average was 3.2%. Recent job growth is positive. Brooklyn jobs have increased by .8% in the past 12 months.

GREEN LAKE COUNTY

The following tables and information, which is compiled from the Green Lake County 2021 Workforce Profile prepared by the Wisconsin Department of Workforce Development, summarize labor force trends in Green Lake County and Wisconsin.

Wisconsin's workforce and employment numbers attained new highs in 2019. The state's unemployment rate was 2.8% in the months of April and May of 2019. The COVID-19 pandemic ended the longest economic expansion on record. The state’s unemployment rate skyrocketed to 14.8% in April 2020. However, by November 2021, statewide unemployment had returned to historic lows of 3.0%. The outlook for the state's economy is positive, with it's GDP on the verge of overtaking pre-COVID levels. The state economy however shares the global challenge of attracting talent and workers in the face of demographic shifts resulting in a declining workforce.

Green Lake County's population growth has been flat from 2010 to 2020 at 0.67%. Green Lake County had an unemployment rate of 4.3% in 2021. Berlin is the largest municipality with 28.74% of the county's population. The Town of Brooklyn is the second largest municipality with 9.72% of the county's population. The City of Green lake is the county seat and home to the Green Lake Conference Center, the county's largest employer. Green Lake itself is the second deepest lake in the state. At 236 feet deep it is over 100 feet deeper than fourth deepest Lake Geneva, and is a regional tourist destination.

Industry	2020 Green Lake County
Trade, Transportation, Utilities	1,209
Education & Health	1,284
Manufacturing	953
Leisure & Hospitality	443
Construction	247
Public Administration	488
Natural Resources	180
Professional & Business Services	198
Financial Activities	250
Information	59
Other	164
Total	5,476

The largest employers in the area are listed in the following table.

Employer	2022 Employees
Green Lake Conference Ctr	250-499
Markesan School District	100-249
Flash Inc	100-249
Clay Lamberton Elementary Sch	100-249
Bank First	100-249
Markesan Resident Home	100-249
Mashuda Contractors	100-249
Ripon Jacket Co	100-249
Walmart Supercenter	100-249
Wilson-Hurd Manufacturing Co	100-249
Berlin High School	50-99

CONCLUSION

Brooklyn township is economically tied to the cities of Green Lake, Ripon and Berlin. While unemployment rates are low, Brooklyn and Green Lake County at large faces an uncertain economic climate with a declining workforce and stagnant population growth. Nevertheless, there continues to be a robust real estate market around Green Lake with some of the highest prices for lake front property in the state.

Highest and Best Use

Five attributes determine the full value potential for real estate. They are: (1) utility, (2) effective demand, (3) relative scarcity, (4) transferability, and (5) an environment of law and order so no sense of loss will occur due to legal or political uncertainty. Generally accepted appraisal principles hold that "real estate should be appraised at its highest and best use for market valuation purposes."[3] The term highest and best use is defined in Real Estate Appraisal Terminology as:

> The reasonable and probable use that will support the highest present value, as defined, as of the effective date of appraisal.
>
> Alternatively, that use, from among reasonably probable and legal alternative uses, found to be physically possible, appropriately supported, financially feasible, and which results in highest land value.
>
> The definition immediately above applies specifically to the highest and best use of land. It is to be recognized that, in cases where a site has existing improvements on it, the highest and best use may very well be determined to be different from the existing use. The existing use will continue, however, unless and until land value in its highest and best use exceeds the total value of the property in its existing use.
>
> Implied within these definitions is recognition of the contribution of that specific use to community environment or to community development goals in addition to wealth maximization of individual property owners. Also implied is that the determination of highest and best use results form the appraiser's judgement and analytical skill, i.e., that the use determined from analysis represents an opinion, not a fact to be found. In appraisal practice, the concept of highest and best use represents the premise upon which value is based. In the context of most probable selling price (market value), another appropriate term to reflect highest and best use would be

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[3]Jerome Dasso and Alfred Ring, Real Estate Principles and Practices, 10th ed., Prentice Hall, Inc., Englewood Cliffs, N.J., p. 404.

most probable use. In the context of investment value, an alternative term would be most profitable use.[4]

One method for selecting highest and best use is a sequential application of the following four analytic steps:[5]

1. Physically Possible: The site must possess adequate size, shape and soil conditions to support the proposed use.

2. Legally Permissible: The proposed use of the property must conform to all local and state zoning and use restrictions for the site.

3. Financially Feasible: The proposed use must be capable of providing a net return to the property owner.

4. Maximally Productive: Of those legally permissible, physically possible, and financially feasible uses, the highest and best use for a property is that use which provides the greatest net return to the property owner over a period of time.

Typically, the criteria are applied to the site to determine its highest and best use as if vacant and as improved. In cases of vacant land valuation, the latter step is excluded.

SUBJECT PROPERTY AS IMPROVED

The analysis begins with a description of the legal constraints affecting the property.

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[4]Byrl N. Boyce, Real Estate Appraisal Terminology, Revised Edition, AIREA, SREA, Ballinger, Cambridge, Mass., 1981, p.p. 126-127.

[5]The four criteria test is discussed in the Appraisal of Real Estate, Twelfth Edition, p. 307-308, Copyright 2001, by the American Institute of Real Estate Appraisers (now known as the Appraisal Institute).

LEGAL CONSTRAINTS

The subject property is zoned A-1 Farmland Preservation District. The purpose and permitted uses include the following:

> The purpose of this district is to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program. Land zoned under this district must comply with the following:
>
> (1)Permitted uses:
>
> (a) Agricultural uses. See Subsection D for agricultural use definitions.
>
> (b) Not including the specified accessory uses identified in Subsection A(2), other accessory uses, including the farm residence. See Subsection D for "accessory use"definition.
>
> © Upon prior notification to the county, transportation, utility, communication, or other uses that are required under state or federal law to be located in a specific place or that are authorized to be located in a specific place under a state or federal law that preempts the requirement of a conditional use permit for those uses.
>
> (d) [Subsection A(1)© acknowledges that state or federal law may sometimes preempt local authority to restrict the siting of certain facilities. It does not purport to determine which state or federal actions are preemptive. It merely says that if state or federal action is preemptive, no local permit is required and there is no need to rezone the site out of the farmland preservation district. Uses covered by Subsection A(1)© might include, for example, state and federal highways, federally mandated pipelines, and energy generation and transmission facilities whose location and design are specifically mandated by the Wisconsin Public Service Commission pursuant to a certificate of convenience and necessity.
>
> (e) Undeveloped natural resource and open space areas.
>
> (f) Nonfarm residences built prior to January 1, 2014.

Nonmetallic is considered a conditional use and must comply with the following requirements in the A-1 district.

> Nonmetallic mineral extraction, if all of the following apply:
>
> [1] The operation complies with Subchapter I of Chapter 295, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats. (including all

applicable provisions of this chapter), and with any applicable requirements of the Wisconsin Department of Natural Resources concerning the restoration of nonmetallicmining sites.

[2] The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.11/21/22, 1:46 PM Green Lake County, WI A-1 Farmland Preservation District.

[3] The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law.

[4] The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use.

[5] The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

[6] The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed.

[7] Compliance with Chapter 323 (Nonmetallic Mining Reclamation).

Given the existing residential and agricultural uses, the use of the property as rural residential and agriculture is the legal use of the property.

PHYSICAL CONSTRAINTS

Site topography is conducive to agriculture and residential use and we assume soil conditions are sufficient to support these uses.

FINANCIAL CONSTRAINTS

Of the physically possible and legally permissible uses such as residential and agriculture, all may be expected to generate a net return to a property owner. These uses require capital improvements; therefore, at some acquisition price the property can be expected to generate a net return. Agricultural and residential properties are frequently sold, traded, or leased, thereby generating a net return to the property owner.

MAXIMAL PRODUCTIVITY CONSTRAINTS

The maximally productive use is determined by that use which generates the greatest demand and net return. Given the property's location, surrounding uses and zoning we believe that agriculture and residential use would be most appropriate and most probable for the subject property as vacant. Therefore, the highest and best use of the subject site is as agricultural and residential use.

SUBJECT PROPERTY AS IMPROVED

The subject property is improved with a single family residence, detached garage/utility shed. Given the property's location, surrounding uses, and zoning, we believe that agriculture and residential use would be most appropriate and most probable for the subject property as improved. Therefore, the highest and best use of the subject site is as agriculture and residential use.

Valuation of the Subject Property

The Cost, Sales Comparison, and Income Approaches to valuation have been considered for this appraisal. All three approaches were considered to directly value the subject property.

The Cost Approach simulates the build versus buy alternative available to some buyers. The Sales Comparison Approach is an analysis of comparable transactions which simulates buyer and seller behavior. In applying the Income Approach, the appraiser simulates the investment analysis of the most probable buyer group to derive an estimate of the price that they would be willing to pay.

The Sales Comparison Approach simulates buyer and seller behavior. The assumption that buyers and sellers will make a reasonable effort to educate themselves about current market behavior is implicit in this approach. Well informed purchasers are less likely to bid a sale price that significantly exceeds prices they would have to pay for property of equivalent utility in the same marketplace. Likewise, sellers who are informed will know the minimum price they may reasonably expect to receive upon sale of the property. The Sales Comparison Approach reflects the spectrum of information available to and the decision process used by these parties to act prudently.

As previously stated, we have prepared this report after considering all three approaches to value. We have applied one approach to value; the Sales Comparison Approach, to value the property. Consideration was given primarily to overall investment similarity, property type and location. The Cost Approach was used, in part, to estimate a component of damages. The Cost Approach and Income Approach to value are typically not considered by buyers and sellers of vacant land or rural residential properties similar to the subject property.

COMPARABLE SALES APPROACH

We have valued the land as though vacant and available according to its highest and best use, which is for residential and agriculture use to support the existing single family home, the surrounding woodlands and agriculture uses. We focused our search on sales in areas of Green Lake and Fond du Lac Counties for the agricultural and single family properties. Six relevant agricultural land sales and four single family sales were found and they are presented in the tables below.

AGRICULTURAL LAND

There has been modest sales activity in the past five years. The sales represent suitable alternative rural land sites that are not exclusively tillable acreage. We have considered the site size differences in pricing per square foot between the sales and the subject site as smaller sites tend to sell for higher unit prices than larger properties and concluded there was no consistent quantifiable adjustment. Further, we considered an adjustment for market conditions and concluded that based on data from the Wisconsin Policy Forum 2022 Property Values and Taxes for all properties in Green Lake County, the 5 year average price adjustment was 5.78% or 6.00% rounded, which corresponds with the dates of sale of the comparables.

COMPARABLE AGRICULTURAL LAND SALES					
Location	Acres	Sale Date	Sale Price	Time Adj Price	$/Acre
1. Irving Park Rd Brooklyn, WI	37.20	9/5/20	$93,000	$106,262	$2,857
2. Brooklyn J Rd Brooklyn, WI	26.66	2/14/20	$130,000	$153,603	$5,762
3. Dakin Brook Rd Brooklyn, WI	17.66	8/14/18	$85,000	$109,917	$6,224
4. Brooklyn J Rd Brooklyn, WI	20.00	10/30/19	$110,000	$132,278	$6,614
5. Brooklyn J Rd Brooklyn, WI	27.30	10/30/19	$152,763	$183,701	$6,729
6. Sunnyside Rd Brooklyn, WI	28.00	3/9/18	$225,000	$298,612	$10,665

COMPARABLE SALE 1

Comparable Sale 1, a 37.2 acre site located on Irving Park Road in the Town of Brooklyn in Green Lake County, sold for $93,000 on October 5, 2020, or $2,857 adjusted per acre.

COMPARABLE SALE 2

Comparable Sale 2, a 26.66 acre site located on Brooklyn J Road in the Town of Brooklyn in Green Lake County, sold for $130,000 on February 14, 2020, or $5,762 adjusted per acre.

COMPARABLE SALE 3

Comparable Sale 3, a 17.66 acre site located on Dakin Brook Road in the Town of Brooklyn in Green Lake County, sold for $85,000 on August 14, 2018, or $6,224 adjusted per acre.

COMPARABLE SALE 4

Comparable Sale 4, a 20 acre site located on Brooklyn J Road in the Town of Brooklyn in Green Lake County, sold for $110,000 on October 30, 2019, or $6,614 adjusted per acre.

COMPARABLE SALE 5

Comparable Sale 5, a 27.3 acre site located on Brooklyn J Road in the Town of Brooklyn in Green Lake County, sold for $152,763 on October 30, 2019, or $6,729 adjusted per acre.

COMPARABLE SALE 6

Comparable Sale 6, a 28 acre site located on Sunnyside Road in the Town of Brooklyn in Green Lake County, sold for $225,000 on March 9, 2018, or $10,665 adjusted per acre.

RECONCILIATION OF COMPARABLE SALES

All comparables suggest a price range for the subject property as an agricultural use. The range of data is from $2,857 to $10,665 per acre with a mean of $6,475 and a midpoint of $6,761 per acre. There appeared to be no difference between parcels with tillable acreage, pasture or wooded areas. Sizes are similar to the subject and there is not a price/size adjustment that is warranted. All properties reflect agricultural zoning. The size and location of the residential subject property land suggests a price between the midpoint and the mean of the range data or $6,600 per acre rounded. The data is used to make adjustment to the single family comparables below.

SINGLE FAMILY

All the following sales reflect sales for residential single family use. Four comparable sales were found to value the residential property and the results are presented in the table below.

There has been significant sales activity in the past three years. The single family sales represent suitable alternative sites for residential use. We have considered the size differences in pricing per square foot between the sales and the subject site as smaller properties tend to sell for higher unit prices than larger properties. We concluded that there is no general size and price relationship adjustment required. Further, we considered an adjustment for market conditions and concluded based on data from the Wisconsin Policy Forum 2022 Property Values and Taxes for all properties in Green Lake County, and the fact that the sales all occurred in the past three years, that the three year average price adjustment was 8.03%, or 8.00% rounded, which corresponds with the dates of sale of the comparables. These adjusted sales were then adjusted for the $6,600 per acre land adjustment estimated above, and for variations in garage/storage buildings in the amount of $15,000 per stall.

SINGLE FAMILY COMPARABLE SALES											
Location	Year Built	Lot Size	Fin SF	# Stalls	Sale Date	Sale Price	Time Adj	Land Adj	Garage Adj	Adj Price	Price /SF
1. W1388 Cty Rd K Green Lake, WI	2005	8.00	3,048	4.5	12/28/20	$360,000	$419,412	$125,400	$22,500	$567,312	$186
2. W1315 Scott Hill Rd Green Lake, WI	2004	42.12	3,590	6.0	3/31/21	$692,000	$789,938	($99,792)	$0	$690,146	$192
3. W121978 Sunny Knoll Rd Metomen, WI	2006	5.00	2,867	6.0	5/7/21	$433,250	$490,574	$145,200	$0	$635,774	$222
4. W13864 Karau Ave Ripon, WI	2006	0.74	2,598	3.0	8/12/22	$365,000	$373,496	$173,316	$45,000	$591,812	$228

COMPARABLE SALE 1

Comparable Sale 1, an 8 acre parcel with 3,048 square feet of finished space constructed in 2005 and located at W1388 County Road K in Green Lake, Wisconsin, sold for $360,000 on December 28, 2020, or $186 adjusted per square foot. Comparable 1 has a 3-car attached garage and a detached garage that is approximately 1.5 stalls. There is approximately 2,048 square feet of main floor finished space and 1,000 square feet of lower level finished space. This is the oldest comparable selling in December of 2020.

COMPARABLE SALE 2

Comparable Sale 2, a 42.12 acre parcel with 3,590 square feet of finished space constructed in 2004 and located at W1315 Scott Hill Road in Green Lake, Wisconsin, sold for $692,000 on March 31, 2021, or $192 adjusted per square foot. Comparable 2 has a 3-car attached garage and a detached garage that is approximately 3 stalls. There is approximately 2,274 square feet of main floor finished space and 1,316 square feet of lower level finished space.

COMPARABLE SALE 3

Comparable Sale 3, a 5 acre parcel with 2,867 square feet of finished space constructed in 2006 and located at W121978 Sunny Knoll Road in Metomen, Wisconsin, sold for $433,250 on May 7, 2021, or $222 adjusted per square foot. Comparable 3 has a 2-car attached garage and a large (60' x100') detached pole building with multiple doors that we determined is the equivalent of a 4-car detached garage. There is approximately 1,648 square feet of main floor finished space and 1,219 square feet of lower level finished space.

COMPARABLE SALE 4

Comparable Sale 4, a .74 acre parcel with 2,598 square feet of finished space constructed in 2006 and located at W13864 Karau Avenue in Ripon, Wisconsin, sold for $365,000 on August 12, 2022, or $228 adjusted per square foot. Comparable 4 has a 3-car attached garage and no additional detached garage space. There is approximately

1,600 square feet of main floor finished space and 998 square feet of lower level finished space.

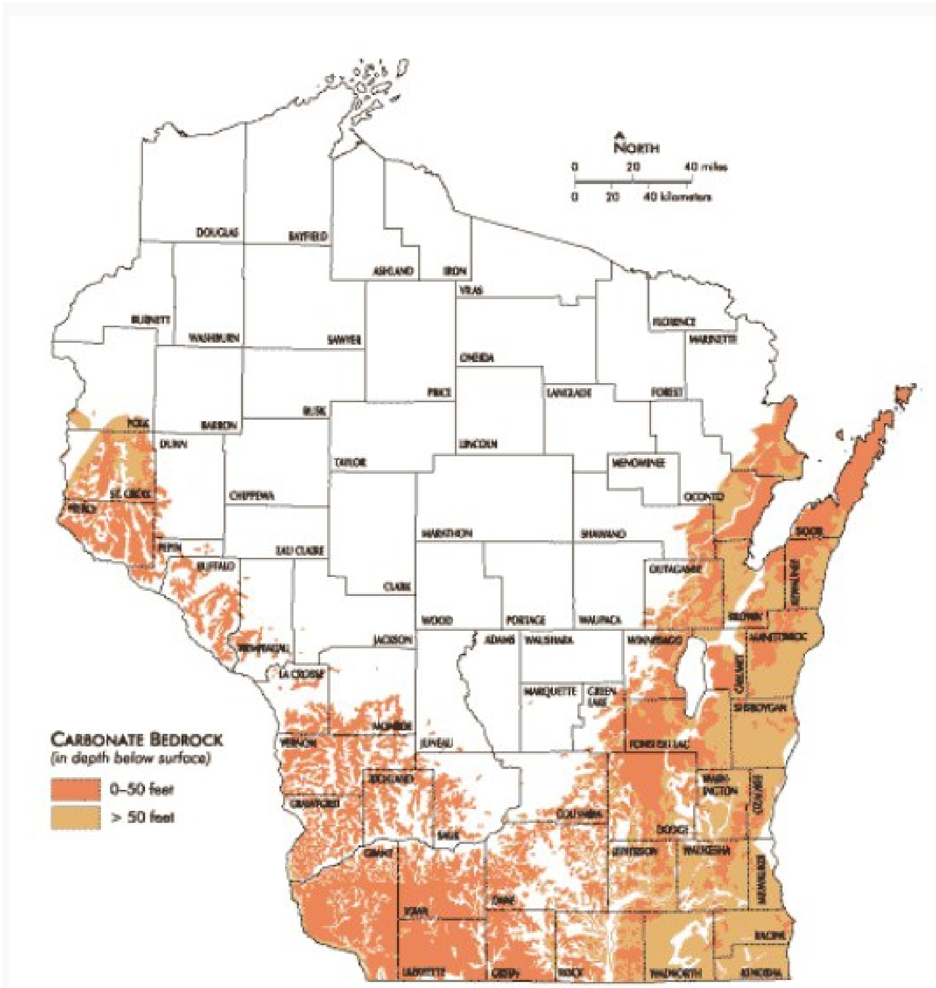
RECONCILIATION OF COMPARABLE SALES

All comparables suggest a price range for the subject property as residential use. The range of adjusted data is from $186.13 to $227.80 per square foot with a mean of $206.98 and a midpoint of $206.96 per square foot. All the properties have similar features with lower level finished space and access. Comparable 4 is the only property without a detached garage. Given the size of the subject property at 3,222 square feet, which is slightly greater than the average of the comparables at 3,026 square feet, a price between the midpoint and the mean of $206.97 or $207 rounded per square foot is appropriate. Therefore, applying $207 per square foot to the 3,222 finished square feet of subject property, yields a value of $666,954 or $665,000 rounded for the single family property including a lot area of 27 acres and a detached garage before considering any impact from the proposed mine operation.

IMPACTS OF NONMETALLIC MINES

Quarrying or nonmetallic mining is obviously harmful where and when it destroys karst landforms and negatively impacts karst ecosystems. "Karst" is a landscape created when water dissolves rocks. In Wisconsin, dolomite and some limestone are typical soluble rocks. The rocks are dissolved mostly along fractures and create caves and other conduits that act as underground streams. Water moves readily through these openings, carrying sediment (and pollutants) directly into our groundwater.

Karst landscapes may have deep bedrock fractures, caves, disappearing streams, springs, or sinkholes. These features can be isolated or occur in clusters, and may be open, covered, buried, or partially filled with soil, field stones, vegetation, water or other miscellaneous debris. Green Lake County is on the edge of the karst region in Wisconsin.



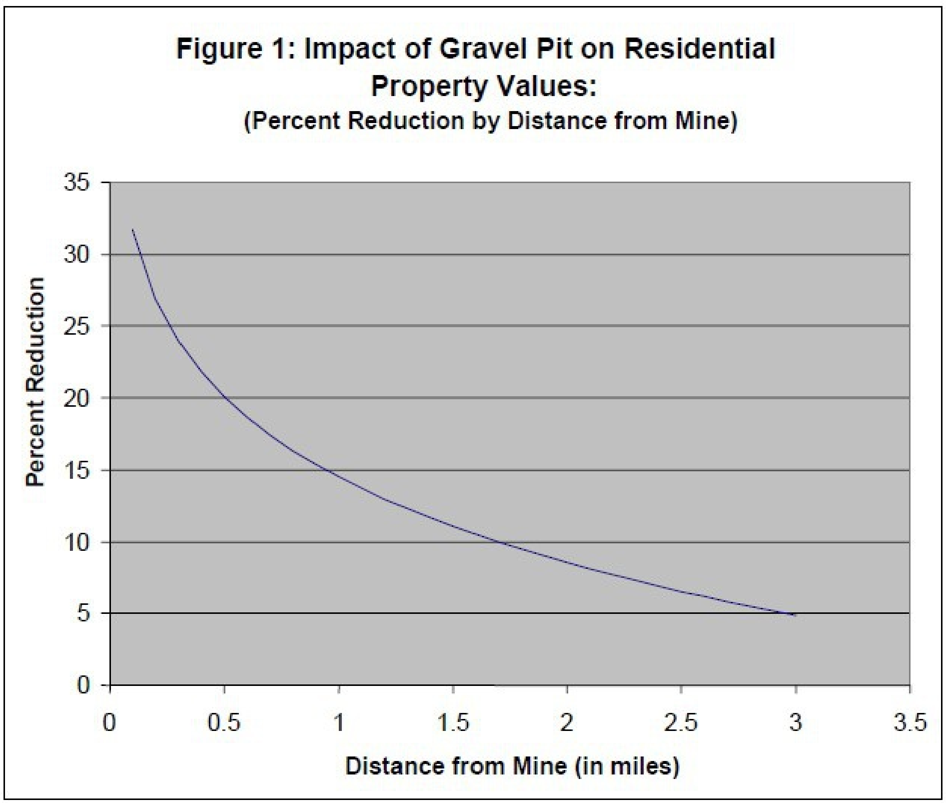
Quarrying is obviously harmful where and when it destroys karst landforms and negatively impacts karst ecosystems. One major potential environmental impact is that quarrying may change groundwater flow patterns, potentially dewater aquifers and/or cause degradation of groundwater quality, particularly if quarries are extensive and deep. Similarly, quarrying may influence surface drainage systems and/or affect the quality of surface water, and cases of this are well documented in the karst of southeast Minnesota. One notable example of this occurred in Vernon County, Wisconsin in 2004 and 2005, when pumping from a high capacity well for gravel washing at the Kraemer Company's Mollett quarry resulted in temporary cessation of flow in nearby Coon Creek.

More specifically, nonmetallic mining can impact the adjacent properties as follows:

1. Interrupt natural water recharge which can lead to drops in the water table.
2. This can lead to a reduction of drinking water available to those living near the quarry.
3. Residential wells can run dry and the base flow of regional streams can be reduced.
4. A disruption in the movement of surface water.
5. Contaminated or polluted wells.
6. Silt carried by surface drainage can affect the quality of ground water.
7. Increased road traffic and roadway wear from hauling activities.
8. Increased noise from blasting, crushing and hauling of material.
9. Impact on the natural environment including wildlife from the mining activity.
10. Negative impact on property values.

Our analysis focuses on this last item, negative impact on property values. As with other nuisance uses introduced to the physical landscape of everyday life, the effect of industrial activities such as power lines, waste disposal sites, and here nonmetallic mining, are considered minimal or no impact on property values if the industry is supporting the analysis. While it boggles the mind that no negative impact on property values could be the immediate result of the activities of a large industrial user, it is reasonable to assume that over time, typically years, there is some acceptance to the market place to the activity and the initial shock to the market gets baked into the market pricing over time. Simply put, there is a shock to the market from the initial industrial activity that will lower prices and/or make the sale of the property more difficult. While markets adapt over time, the market is never the same as is if the shock had never occurred. That is why real estate prices can go up over time after the market place resets to a lower price point as a result of the initial introduction of the negative activity.

The studies that most analysts point to when estimating damages from nonmetallic mining is contained in the article "An Assessment of the Economic Impact of the Proposed Stoneco Gravel Mine Operation on Richland Township." Report prepared for the Richland Township Planning Commission by George A. Erickcek, Senior Regional Analyst W.E. Upjohn Institute for Employment Research 2006. Further, this report cites a study by Diane Hite, 2006. "Summary Analysis: Impact of Operational Gravel Pit on House Values, Delaware County, Ohio," Auburn University. This study contains a summary figure below that reflect prices changes with proximity to a Mine. See Appendix G.



Specifically, Hite examines the effects of distance from a 250-acre gravel mine on the sale price of 2,552 residential properties from 1996 to 1998. Her model controls for a large set of other factors that estimate a house's sale price, including number of rooms, number of bathrooms, square footage, lot size, age of home, sale date, and other factors specific to the locality, so that she can focus solely on the effect of proximity to the gravel mine on house values. The data reveals a large, statistically significant effect of distance from a mine on home sale price when controlling for other determinants of residential value, as the proximity to a gravel mine reduces sale price.

APPLICATION TO THE SUBJECT PROPERTY

The chart indicates that properties in close proximity to the Mine experience more than a 30 percent reduction in property values. Given that the Neuenfeldt property is across Brooklyn G Road from the proposed mine and directly adjacent to the proposed detention pond, we conservatively estimate a 30% reduction in the value of their property. Applying 30% to the $665,000 value results in a damage estimate for proximity of $199,500 or a reduction in market value to $465,500.

APPLICATION TO AREA RESIDENTIAL PROPERTIES

In addition, we have applied this analysis to other rural residential properties in the immediate area of the mine including the adjacent Skunk Ridge Lane neighborhood. A non exhaustive list is presented below. The value estimates are based on 2022 assessed values. We assume the average property value impact is 25%, as most properties are within ½ mile of the Mine. The value impact is estimated at $909,500. Based on our analysis of the N5139 Brooklyn G Road, property assessments appear to be less than 50% of market value. Each property would need to be appraised to have an accurate estimate of its market value. Nevertheless, if market values were at least double the assessed value, the damages from proximity would total $1,819,000. This estimate does not include any damages that may result from flooding discussed in the next section.

Address/Parcel #	Assessed Value	Property Impact at 25%
N5126 Skunk Ridge Ln	$290,100	$72,525
004007811300	$19,800	$4,950
N5111 Skunk Ridge Ln	$199,100	$49,775
N5136 Skunk Ridge Ln	$152,100	$38,025
004007810500	$19,800	$4,950
004007811500	$17,100	$4,275
N5145 Skunk Ridge Ln	$174,200	$43,550
N5150 Skunk Ridge Ln	$132,000	$33,000
N5156 Skunk Ridge Ln	$173,200	$43,300
N5160 Skunk Ridge Ln	$100,400	$25,100
004007810200	$169,700	$42,425
004007810700	$19,100	$4,775
N5185 Skunk Ridge Ln	$114,400	$28,600
N5190 Skunk Ridge Ln	$140,500	$35,125
N5158 Brooklyn G Rd	$141,000	$35,250
N5195 Brooklyn G Rd	$160,700	$40,175
W598 Glen Ln	$128,900	$32,225
W598 Glen Ln	$286,500	$71,625
W611 Glen Ln	$149,500	$37,375
N4975 Craig Rd	$149,000	$37,250
N4967 Craig Rd	$25,200	$6,300
N4939 Craig Rd	$118,100	$29,525
N4913 Craig Rd	$129,500	$32,375
N4901 Craig Rd	$54,200	$13,550
W687 Cty Rd K	$120,300	$30,075
N 4805 Prairie Rd	$188,500	$47,125
W244 Cty Rd K	$128,800	$32,200
W241 Cty Rd K	$136,300	$34,075
Total	$3,638,000	$909,500

POTENTIAL FOR FLOODING

The "Erosion Control and Storm Water Management Plan" analysis provided by the applicant from Badger Engineering & Construction, LLC indicates that the detention pond or sediment basin that will be across the road from the subject property, is designed to accommodate a 10-year storm event. In light of changing weather patterns in recent years this capacity would seem woefully inadequate to handle a 50, 100 or 500 year storm event which are happening more frequently than 50,100 or 500 years. Additionally, the property owner notes that they have already had flooding in front of his property that covered the roadway. Given that the subject property is down slope from the sediment basin and the western edge of the subject property has significant down slope topography, an overtopping of the basin could have significant detrimental effects.

A solution to this risk of potential flooding is to create a berm on the property at the road edge to act as a barrier against potential flooding. This was an engineering solution proposed by EOR Inc., of Cottage Grove WI, for a flooding issue in Fitchburg, WI, to protect rural properties including a single family residence from flood waters.

While the following analysis should be reviewed by a qualified third party, we have estimated, based on topography, that a 3-4 foot high berm from the western boundary of the property along Brooklyn G Road east approximately 850 feet may suffice. Properties to the west would no doubt have similar issues, and this solution may impact their surface drainage, however that impact is not within the scope of our analysis. The topography climbs as one move east from the current driveway. Also the existing driveway entrance would need to be relocated the east edge of the property and a new drive will need to be constructed that runs parallel with the berm running west to the existing drive or approximately 625 feet. Based on previous work in our files we estimate the cost of the berm to be $90 per linear foot and the gravel drive to be $65 per linear foot. The estimated cost of the berm is $76,500 and the estimated cost of the gravel drive is $40,625. The total estimated cost-to-cure for the potential flooding condition is

$117,125. There will be some engineering cost to design both projects, therefore we estimate the total cost at $125,000.

GROUND WATER CONTAMINATION

Detrimental effects to the ground water remain a concern and we have detailed the potential hazards facing the subject properties. Until a detrimental event occurs, whether it be water contamination, well draw down or some other harm to the property, and until a corresponding remediation plan is established and priced, it is difficult to assess the financial ramifications to the property, That said, if the water at the residential property was contaminated and unusable the property would essentially be valueless. Cures may be possible, however, until a proposal is developed the property would not be habitable. Therefore, our damage estimate does not include any detrimental ground water conditions.

RECONCILIATION AND SUMMARY

The following table summarizes the results of our valuation analysis and shows the total estimated market value and damages. We have considered all approaches and conclude that the value derived by the sales comparison approach is the most reliable estimate.

Given the rural nature of the properties and the potential impact of the nonmetallic mine on the subject properties, we estimate the damages to the market value of your property to be $324,500.

VALUE SUMMARY	
Value of N5139 Brooklyn G Road	$665,000
Proximity Damages	$199,500
Flooding Damages	$125,000
Total Damages	$324,500
Net Value of N5139 Brooklyn G Road assuming the Mine is developed	$340,500

Certification of Value

We certify that, to the best of our knowledge and belief:

- The statements of fact contained in this report are true and correct.
- The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, unbiased professional analyses, opinions, and conclusions.
- We have no present or prospective interest in the property that is the subject of this report, and we have no personal interest or bias with respect to the parties involved.
- Our compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.
- Our analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Code of Professional Ethics and the Uniform Standards of Professional Appraisal Practice.
- Craig Hungerford made a personal inspection of the property that is the subject of this report.
- The appraisal assignment was not based on a requested minimum valuation, a specific valuation, or the approval of a loan.

- No one provided significant professional assistance to the undersigned. However, technical assistance was provided by other members of the Real Estate Dynamics, Inc. staff in regards to data collection, report writing, property description, and cost estimates.

- We have performed no valuation services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.

Craig D. Hungerford, CRE
President
Real Estate Dynamics, Inc.

APPENDIX A

General Assumptions and Limiting Conditions

GENERAL ASSUMPTIONS AND LIMITING CONDITIONS

- No investigation was made for environmental hazards such as underground fuel tanks, asbestos, urea-formaldehyde foam insulation, dump sites, or other hazardous materials, and no responsibility is assumed for hazardous waste water quality or adequacy of the septic system.

- Where the property being considered is part of a larger parcel or tract, any values reported relate only to the portion being considered and should not be construed as applying with equal validity to other portions of the larger portion or tract.

- Opinions expressed regarding legal attributes of the subject property are based on the consultant's best judgement given the available information and do not represent professional legal counsel. No warranty or representation is made regarding the accuracy of these legal opinions.

- We have made no survey of the property. If a survey should show a difference in acreage, the value should be adjusted accordingly.

- Data will be included only if believed reliable, but its accuracy cannot be guaranteed. No warranty or representation is made regarding the accuracy of data, and information submitted may be subject to errors, omissions, changes of price, prior sales, leases, financing, or withdrawals without notice.

- Any projections of future rents, expenses, net operating income, mortgage debt service, capital outlays, cash flows, inflation, capitalization rates, discount rates, or interest rates are intended solely for analytical purposes and are not to be construed as predictions of Real Estate Dynamics, Inc. They represent only the judgment of the authors as to the assumptions likely to be used by purchasers and sellers active in the marketplace, and their accuracy is not guaranteed.

- Conclusions of the analysis assume competent management and responsible ownership of the property.

- Conclusions of the analysis will represent the best judgement of the consultant given all available data. Real Estate Dynamics, Inc. will not alter conclusions at the request of any person or corporation.

- To the best of our knowledge and belief, the statements of fact contained in this report, upon which the analyses, opinions and conclusions expressed herein are based, are true and correct.

- The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, unbiased professional analyses, opinions, and conclusions.

- We have no present or prospective interest in the property that is the subject of this report, and we have no personal interest or bias with respect to the parties involved.

- Our compensation is not contingent upon the reporting of a predetermined opinion or direction in value that favors the cause of the client, the amount of any value estimates, the attainment of a stipulated result, or the occurrence of a subsequent event.

- REDI staff provided professional assistance to the person(s) signing this report.

APPENDIX B

Qualifications

Craig D. Hungerford, ASLA, CRE

448 West Washington Avenue
Suite 200
Madison, WI 53703

Telephone: (608) 255-4676 x11
Fax: (608) 255-7384
E-Mail: craig@realestateproswisconsin.com

EXPERIENCE

TRIO DEVELOPMENT, LLC, Real Estate Development, Madison, WI

Partner, 2004 to Present
- Development Manager

REAL ESTATE DYNAMICS, INC., Real Estate Consulting, Madison, WI

President/Partner, 1989 to Present
- Consultant, Feasibility Analyst, Appraiser, and Expert Witness

Vice President/Partner 1986 to 1989
- Consultant, Market Analyst, and Appraiser

LANDMARK RESEARCH, INC., Real Estate Consulting, Madison, WI

Appraiser/Real Estate Analyst, 1984 to 1986

UNIVERSITY OF WISCONSIN-MADISON, Guest Lecturer, Madison, WI

Guest Lecturer, 1985 to Present
- Residential Development
- Market Analysis for Retail Centers
- Valuation of Unique Properties
- Advanced Consulting and Appraisal Seminar
- Residential Tax Credit Development
- Real Estate Valuation

UNIVERSITY OF WISCONSIN-MILWAUKEE, Instructor, Milwaukee, WI

Instructor, 1985 to 1986
- The Real Estate Process

EARTHWORKS, Landscape Architecture, River Falls, WI

Landscape Architect, 1978 to 1980

EDUCATION

UNIVERSITY OF WISCONSIN-MADISON
Masters of Science May 1984
- Real Estate Appraisal and Investment Analysis

Masters of Arts May 1984
- Landscape Architecture

UNIVERSITY OF WISCONSIN-MADISON
Bachelor of Science May 1977
- Major: Landscape Architecture

PROFESSIONAL AFFILIATIONS/BOARDS

American Society of Landscape Architects (ASLA)
The Counselors of Real Estate (CRE)
Attic Angel Prairie Point Board Member

APPENDIX C

Zoning Code

Green Lake County, WI
Monday, November 21, 2022

Chapter 350. Zoning

Article IV. Zoning Districts

§ 350-27. A-1 Farmland Preservation District.

[Amended 6-17-2008 by Ord. No. 935-08; 2-15-2011 by Ord. No. 989-2011; 11-14-2017 by Ord. No. 22-2017]

A. Purpose. The purpose of this district is to promote areas for uses of a generally exclusive agricultural nature in order to protect farmland and to allow participation in the state's farmland preservation program. Land zoned under this district must comply with the following:

(1) Permitted uses:

(a) Agricultural uses. See Subsection **D** for agricultural use definitions.

(b) Not including the specified accessory uses identified in Subsection **A(2)**, other accessory uses, including the farm residence. See Subsection **D** for "accessory use" definition.

(c) Upon prior notification to the county, transportation, utility, communication, or other uses that are required under state or federal law to be located in a specific place or that are authorized to be located in a specific place under a state or federal law that preempts the requirement of a conditional use permit for those uses.

(d) [Subsection **A(1)(c)** acknowledges that state or federal law may sometimes preempt local authority to restrict the siting of certain facilities. It does not purport to determine which state or federal actions are preemptive. It merely says that if state or federal action is preemptive, no local permit is required and there is no need to rezone the site out of the farmland preservation district. Uses covered by Subsection **A(1)(c)** might include, for example, state and federal highways, federally mandated pipelines, and energy generation and transmission facilities whose location and design are specifically mandated by the Wisconsin Public Service Commission pursuant to a certificate of convenience and necessity.]

(e) Undeveloped natural resource and open space areas.

(f) Nonfarm residences built prior to January 1, 2014.

(2) Conditional uses:

(a) Agriculture-related uses. (See Subsection **D** for "agriculture-related use" definition.)

(b) A business, activity, or enterprise, whether or not associated with an agricultural use, and is not a dog breeding facility or a dog breeder as defined in ATCP 16, which meets all of the following requirements:
[Amended 9-21-2021 by Ord. No. 30-2021]

[1] It is conducted on a farm by an owner or operator of that farm.

[2] It requires no buildings, structures, or improvements other than those described in Subsection D(1) and (3) of the definition of "accessory use."

[3] The total cumulative hours worked by paid employees, excluding the owner(s), shall not exceed 160 hours per week.

[4] It does not impair or limit the current or future agricultural use of the farm or other protected farmland.

(c) Upon prior notification to the County, transportation, communication, pipeline, electric transmission, utility, or drainage uses, facilities for the generation from sunlight, wind, coal or natural gas, if all the following apply:

[1] The use and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.

[2] The use and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations, or are specifically approved under state or federal law.

[3] The use is reasonably designed to minimize conversion of land at and around the site of the use, from agricultural use or open space use.

[4] The use does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

[5] Construction damage to land remaining in agricultural use is minimized and repaired, to the extent feasible.

(d) Governmental, institutional, religious, or nonprofit community uses, if all of the following apply:

[1] The use and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.

[2] The use and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations, or are specifically approved under state or federal law.

[3] The use is reasonably designed to minimize the conversion of land, at and around the site of the use, from agricultural use or open space use.

[4] The use does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

[5] Construction damage to land remaining in agricultural use is minimized and repaired to the extent feasible.

(e) Nonmetallic mineral extraction, if all of the following apply:

[1] The operation complies with Subchapter I of Chapter **295**, Wisconsin Statutes, and rules promulgated under that subchapter, with applicable provisions of local ordinances under § 295.14, Wis. Stats. (including all applicable provisions of this chapter), and with any applicable requirements of the Wisconsin Department of Natural Resources concerning the restoration of nonmetallic mining sites.

[2] The operation and its location in the farmland preservation zoning district are consistent with the purposes of the farmland preservation zoning district.

[3] The operation and its location in the farmland preservation zoning district are reasonable and appropriate, considering alternative locations outside the farmland preservation zoning district, or are specifically approved under state or federal law.

[4] The operation is reasonably designed to minimize the conversion of land around the extraction site from agricultural use or open space use.

[5] The operation does not substantially impair or limit the current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

[6] The owner agrees to restore the land to agricultural use, consistent with any required reclamation plan, when extraction is completed.

[7] Compliance with Chapter **323** (Nonmetallic Mining Reclamation).

(f) Oil and gas exploration or production that is licensed by the Department of Natural Resources under Subchapter II of Chapter **295**, Wisconsin Statutes.

(g) Private airport or air strip qualifying as an accessory use under § 91.01(1), Wis. Stats.

(h) Dog kennels qualifying as an accessory use under § 91.01(1), Wis. Stats. Dog breeder(s) or dog breeding facility(ies) as defined in ATCP 16.01 are not allowed in the A-1, Farmland Preservation Zoning District.
[Amended 9-21-2021 by Ord. No. 30-2021]

(i) Game farms/shooting preserves qualifying as an accessory use under § 91.01(1)(b), Wis. Stats. To meet the definition of agricultural use, the game birds or cervids must be raised on the farm for release for hunting.

(j) Shooting ranges meeting the requirements in § 91.01(1)(d), Wis. Stats.

(k) Manure storage systems. (Please note that permits for manure storage systems are subject to § ATCP 50.56 and Ch. ATCP 51, Wis. Adm. Code.)

(l) Slaughtering of livestock from the A-1 District.

(m) Processing agricultural by-products or wastes received directly from farms, including farms in the A-1 District.

Note: The County may issue a conditional use permit for a proposed land use not identified in this section if the proposed land use meets applicable conditions under this section. Before issuing a conditional use permit, the County shall determine, in writing, that the proposed use meets applicable conditions under this section. The County may issue the permit subject to conditions designed to carry out the purposes of this chapter. Dog breeder or dog breeding facility as defined in ATCP 16 are exempt from this provision.
[Amended 9-21-2021 by Ord. No. 30-2021]

(3) Area, height and setback requirements:

(a) Dimensional standards: A lot or parcel shall have no less than eight acres of contiguous land area.
[Amended 5-21-2019 by Ord. No. 11-2019]

(b) All principal structures shall be on a lot consistent with the principal use permitted on such lot by the regulations of the district in which it is located.

Note: The area within the road right(s)-of-way shall not be included for the standards of this subsection. Design standards pursuant to Chapter **315**, Code of Green Lake County, Land Division and Subdivision, shall apply to a newly created lot or parcel for this subsection.

(c) Principal structure setback and height standards.

[1] Highway setbacks: Refer to § **350-50A**.
[Amended 9-21-2021 by Ord. No. 30-2021]

[2] Rear yard setback: 25 feet minimum.

[3] Side yard setback: 12 feet minimum.

[4] Structure height, dwelling structure: 35 feet.

(d) Accessory building structure standards. An accessory building structure shall satisfy all of the following standards:

[1] Setbacks: same as principal structure.

[2] Height: none.

[3] Structure footprint area: none.

[4] Volume: none.

[5] Human habitation of a detached accessory building structure may be allowed; however, it shall be limited to 20% of the footprint area or 300 square feet, whichever is less. This standard shall apply to only one detached accessory building structure per lot or parcel.

B. Rezoning land out of the A-1 Farmland Preservation Zoning District. Land may be rezoned out of the A-1 Farmland Preservation Zoning District if the County, through their review and recommendation, and after a public hearing, finds that all of the following apply:

(1) The land is better suited for a use not allowed in the A-1 Farmland Preservation Zoning District.

(2) The rezoning is consistent with the Green Lake County Comprehensive Plan.

(3) The rezoning is substantially consistent with the Green Lake County Farmland Preservation Plan, certified under Ch. 91, Wis. Stats., which is in effect at the time of zoning.

(4) The rezoning will not substantially impair or limit current or future agricultural use of surrounding parcels of land that are zoned for or legally restricted to agricultural use.

(5) Note: The above Subsection **B(1)** through **(4)** does not apply to any of the following situations:

(a) A rezoning that is affirmatively certified by the Wisconsin Department of Agriculture, Trade and Consumer Protection under Ch. 91, Wis. Stats.

(b) A rezoning that makes the farmland preservation zoning ordinance map more consistent with the Green Lake County farmland preservation plan map, certified under Ch. 91, Wis. Stats., which is in effect at the time of the rezoning.

C. Certification of ordinance and amendments by DATCP.

(1) This Zoning Ordinance must be certified by the State of Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) in order for owners of land that is zoned A-1 Farmland Preservation in the Green Lake County to be eligible to claim tax credits under the State of Wisconsin's Farmland Preservation Program.

(2) Green Lake County shall notify DATCP of any amendments as required by § 91.36(8), Wis. Stats.

(3) Green Lake County shall notify DATCP by March 1 annually of any acres rezoned out of a farmland preservation zoning district during the previous year and a map that clearly shows the location of those acres as required by §§ 91.48(2) and 91.48(3), Wis. Stats.

D. Farmland preservation definitions. For the purposes of § **350-27** of this chapter, the following definitions shall be used. Please see § **350-77** for conventional zoning district definitions.

ACCESSORY USE

Within the A-1 Zoning District, any of the following land uses on a farm:

(1) A building, structure, or improvement that is an integral part of, or is incidental to, an agricultural use. This may include, for example:

(a) A facility used to store or process raw agricultural commodities, all of which are produced on the farm.

(b) A facility used to keep livestock on the farm.

(c) A facility used to store or process inputs primarily for agricultural uses on the farm.

(d) A facility used to keep or service vehicles or equipment primarily employed in agricultural uses on the farm.

(e) A wind turbine or solar energy facility that collects wind or solar energy on the farm, and uses or transforms it to provide energy primarily for use on the farm.

(f) A manure digester, bio-fuel facility, or other facility that produces energy primarily from materials grown or produced on the farm, primarily for use on the farm.

(g) A waste storage or processing facility used to store or process animal waste produced solely from livestock kept on the farm.

(2) An activity or business operation that is an integral part of or incidental to an agricultural use.

(3) A farm residence, including normal residential appurtenances.

(4) Any other use that DATCP, by rule, identifies as an accessory use.

AGRICULTURAL USE

Any of the following activities conducted for the purpose of producing an income or livelihood:

(1) Crop or forage production.

(2) Keeping livestock.

(3) Beekeeping.

(4) Nursery, sod, or Christmas tree production.

(5) Floriculture.

(6) Aquaculture.

(7) Fur farming.

(8) Forest management.

(9) Enrolling land in a federal agricultural commodity payment program or a federal or state agricultural land conservation payment program.

(10) Any other use that the Department of Agriculture, Trade and Consumer Protection, by rule, identifies as an agricultural use.

AGRICULTURE-RELATED USE

An agricultural equipment dealership, facility providing agricultural supplies, facility for storing or processing agricultural products, or facility for processing agricultural wastes. In addition, any use that the Department of Agriculture, Trade and Consumer Protection identifies by rule as an agriculture-related use. An "agriculture-related use" must be primary (not just incidentally) related to agriculture, and must have a direct connection to agriculture uses in the A-1 Zoning District.

CERTIFIED FARMLAND PRESERVATION PLAN

A farmland preservation plan that is certified as determined under § 91.12, Wis. Stats.

CERTIFIED FARMLAND PRESERVATION ZONING ORDINANCE

A zoning ordinance that is certified as determined under § 91.32, Wis. Stats.

COMMON OWNERSHIP

(1) Ownership by the same person or persons, or by persons that are all wholly owned by the same person or persons. "Common ownership" includes joint tenancy and tenancy in common. Solely for purposes of this definition, a parcel owned by one member of a married couple is deemed to be owned by the married couple.

(2) Land is deemed to be under "common ownership," for purposes of this chapter, if it is all owned by the same individual, married couple, joint tenants, and tenants in common, corporation, LLC, partnership, estate or trust. If land parcels are owned by separate legal entities, but those legal entities are all wholly owned by exactly the same person or persons, those land parcels are deemed to be under "common ownership" for purposes of this chapter.

CONDITIONAL USES

Uses of a special nature as to make impractical their predetermination as a permitted use in a district. Conditional uses as used in the A-1 Farmland Preservation Zoning District must meet the requirements of § 91.46, Wis. Stats.

CONTIGUOUS

Adjacent to or sharing a common boundary. "Contiguous" land includes land that is separated only by a river, stream, section line, public road, private road, railroad, pipeline, transmission line, or transportation or transmission right-of-way. Parcels are not "contiguous" if they meet only at a single point.

DOG BREEDER

A person who in any license year sells at least 25 dogs, from more than three litters, which that person has bred and raised in this state. A person has bred and raised dogs for purposes of this definition if that person has owned the dogs from birth until sale, regardless of whether the person has contracted with an agent to raise the dogs on real estate owner or occupied by that agent.
[Added 9-21-2021 by Ord. No. 30-2021]

DOG BREEDING FACILITY

A place in this state where dogs are bred and raised and from which at least 25 dogs from more than three litters are sold in a license year.
[Added 9-21-2021 by Ord. No. 30-2021]

DOG KENNEL

An establishment, that is not a dog breeding facility, in which dogs are housed, boarded, groomed, sheltered, protected, trained or sold for fee or compensation.
[Added 9-21-2021 by Ord. No. 30-2021]

FARM

(1) All land under common ownership that is primarily devoted to agricultural use. For the purpose of this definition, land is deemed to be primarily devoted to agricultural use if the following apply:

(a) The land produces at least $6,000 in annual gross farm revenues to its owner or renter, regardless of whether a majority of the land area is in agricultural use; or

(b) A majority (greater than 50%) of the land is in agricultural use.

(2) In determining whether land is in agricultural use for purposes of the definition of "agricultural use," a zoning authority may consider how the land is classified for property tax purposes. (See Ch. Tax 18, Wis. Adm. Code.)

FARM RESIDENCE

(1) A single-family or two-family residence that is the only residential structure on the farm or is occupied by any of the following:

(a) An owner or operator of the farm.

(b) A parent or child of an owner or operator of the farm.

(c) An individual who earns more than 50% of his or her gross income from the farm.

(2) To qualify as a "farm residence," a residence must be located on a "farm." If a farm owner deeds off a residential parcel to another person (even if that person is the farm owner's parent, child or employee), the separately owned parcel is no longer part of the original "farm." A residence built on that parcel does not qualify as a "farm residence" unless the parcel qualifies as a "farm" in its own right.

GROSS FARM REVENUES

Gross receipts from agricultural use of a farm, excluding rent receipts, less the cost or other basis of livestock or other agricultural items purchased for resale which are sold or otherwise disposed of during the taxable year. Gross farm revenue includes receipts accruing to a renter, but does not include rent paid to the landowner.

LICENSE YEAR

Means the twelve-month period ending on September 30 for a license granted by the Department of Agriculture, Trade and Consumer Protection to operate as a dog dealer, dog breeder or as a dog breeding facility.
[Added 9-21-2021 by Ord. No. 30-2021]

LIVESTOCK

Includes bovine animals, equine animals, goats, poultry, sheep, swine, farm-raised deer, farm-raised game birds, camelids, ratites and farm-raised fish.

NONCONFORMING USES OR STRUCTURES

Any structure, land, or water lawfully used, occupied, or erected at the time of the effective date of this chapter which does not conform to the regulations of this chapter. Any such structure conforming in respect to use, but not in respect to frontage, width, height, area, yard, parking, loading, or distance requirements shall be considered a nonconforming structure and not a nonconforming use.

NONFARM RESIDENCE

Any residence other than a farm residence.

OPEN SPACE PARCEL

A parcel on which no buildings, other than hunting blinds or small sheds, have been constructed or approved for construction.

PERSON

An individual, corporation, partnership, limited liability company (LLC), trust, estate or other legal entity.

PROTECTED FARMLAND

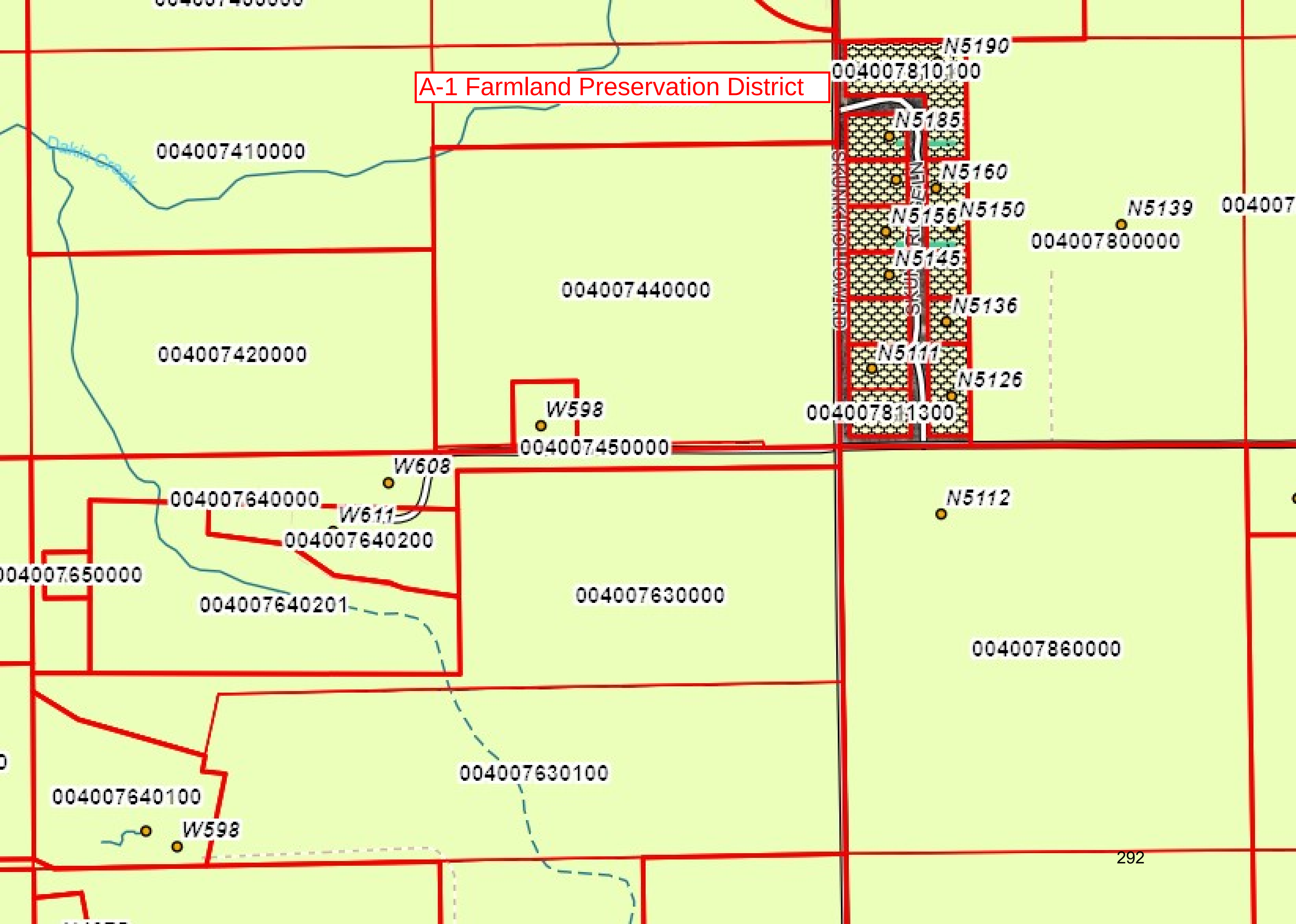
Land that is any of following:

(1) Land that is located in the A-1 Farmland Preservation Zoning District certified under Ch. 91, Wis. Stats.

(2) Covered by a farmland preservation agreement under Ch. 91, Wis. Stats.

(3) Covered by an agricultural conservation easement under § 93.73, Wis. Stats.

(4) Otherwise legally protected from nonagricultural development.



A-1 Farmland Preservation District
N5190
004007810100
N5185
N5160
N5150
N5156
N5139
004007800000
N5145
N5136
N5111
N5126
004007811300
004007410000
004007440000
004007420000
W598
004007450000
W608
004007640000
W611
004007640200
004007650000
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004007630000
004007860000
N5112
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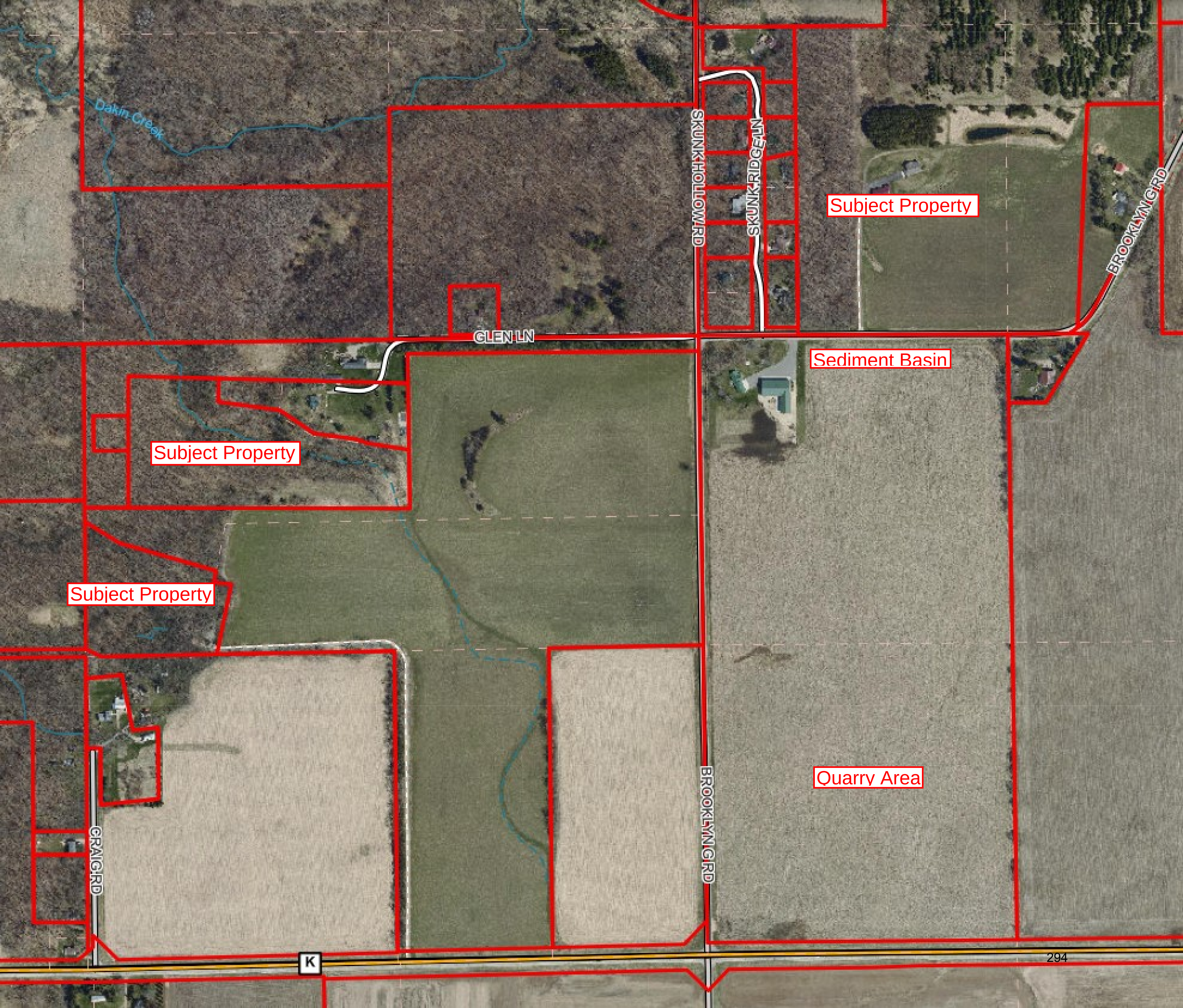
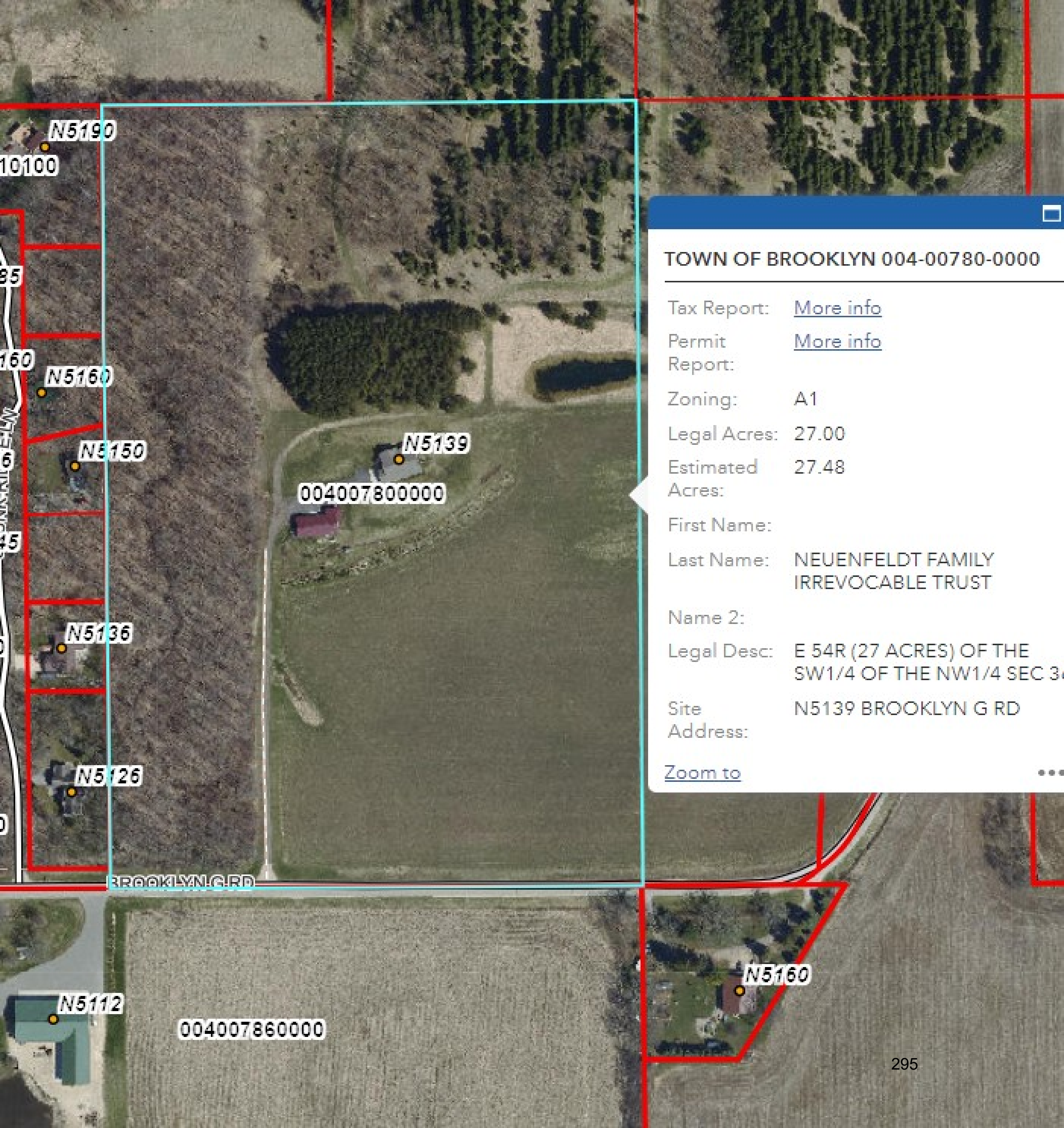
W598

APPENDIX D

Subject Property Maps and Photographs

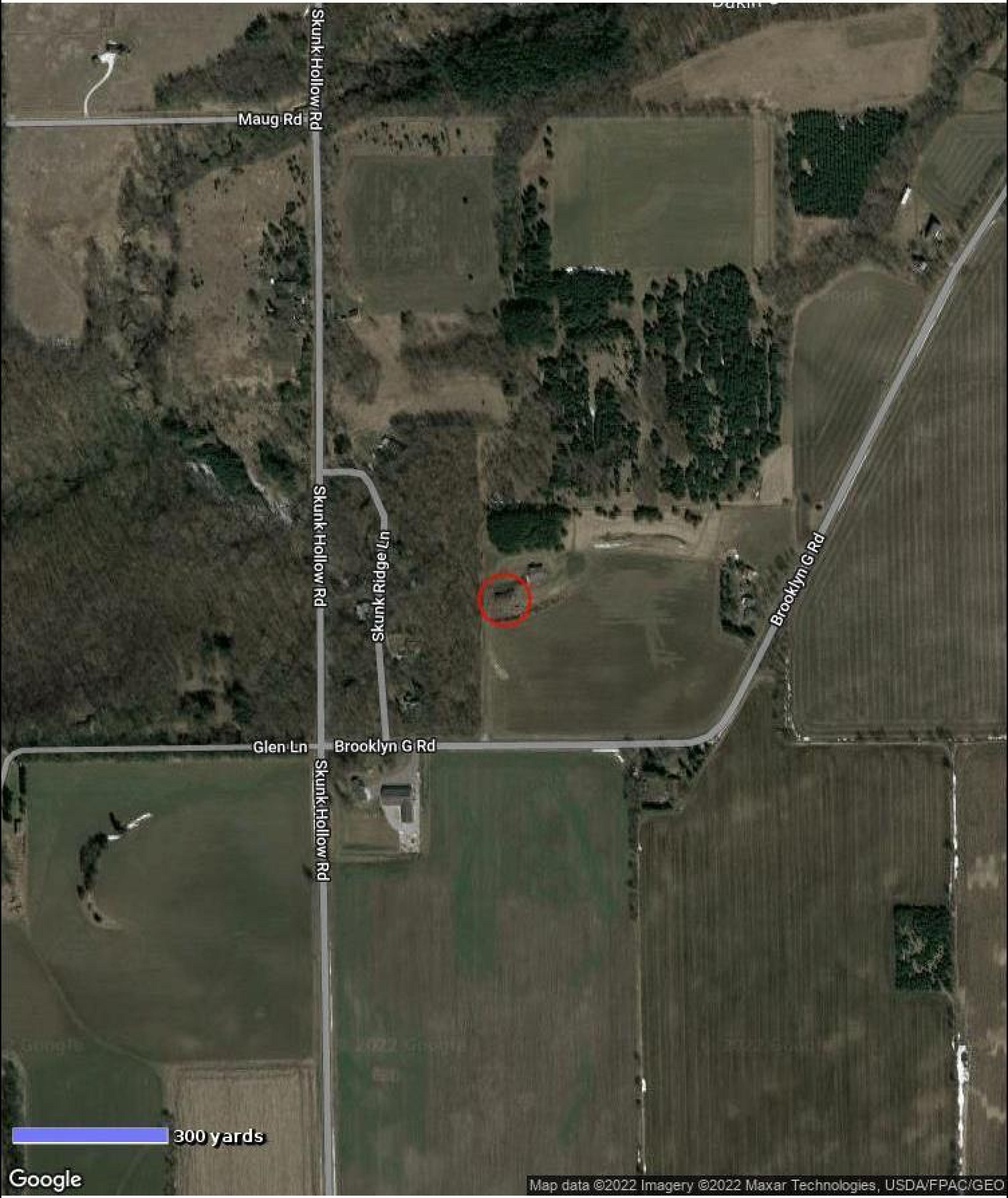


Dakin Creek
SKUNK HOLLOW RD
SKUNK RIDGE LN
Subject Property
BROOKLYN G RD
GLEN LN
Sediment Basin
Subject Property
Subject Property
Quarry Area
BROOKLYN G RD
CRAIG RD
K
294


N5190
10100
N5160
N5150
N5139
004007800000
N5136
N5126
BROOKLYN G RD
N5112
004007860000
N5160
TOWN OF BROOKLYN 004-00780-0000
Tax Report: More info
Permit Report: More info
Zoning: A1
Legal Acres: 27.00
Estimated Acres: 27.48
First Name:
Last Name: NEUENFELDT FAMILY IRREVOCABLE TRUST
Name 2:
Legal Desc: E 54R (27 ACRES) OF THE SW1/4 OF THE NW1/4 SEC 3
Site Address: N5139 BROOKLYN G RD
Zoom to

InterFlood by a la mode

Prepared for: Real Estate Dynamics
N5139 Brooklyn G Rd
Ripon, WI 54971-9447



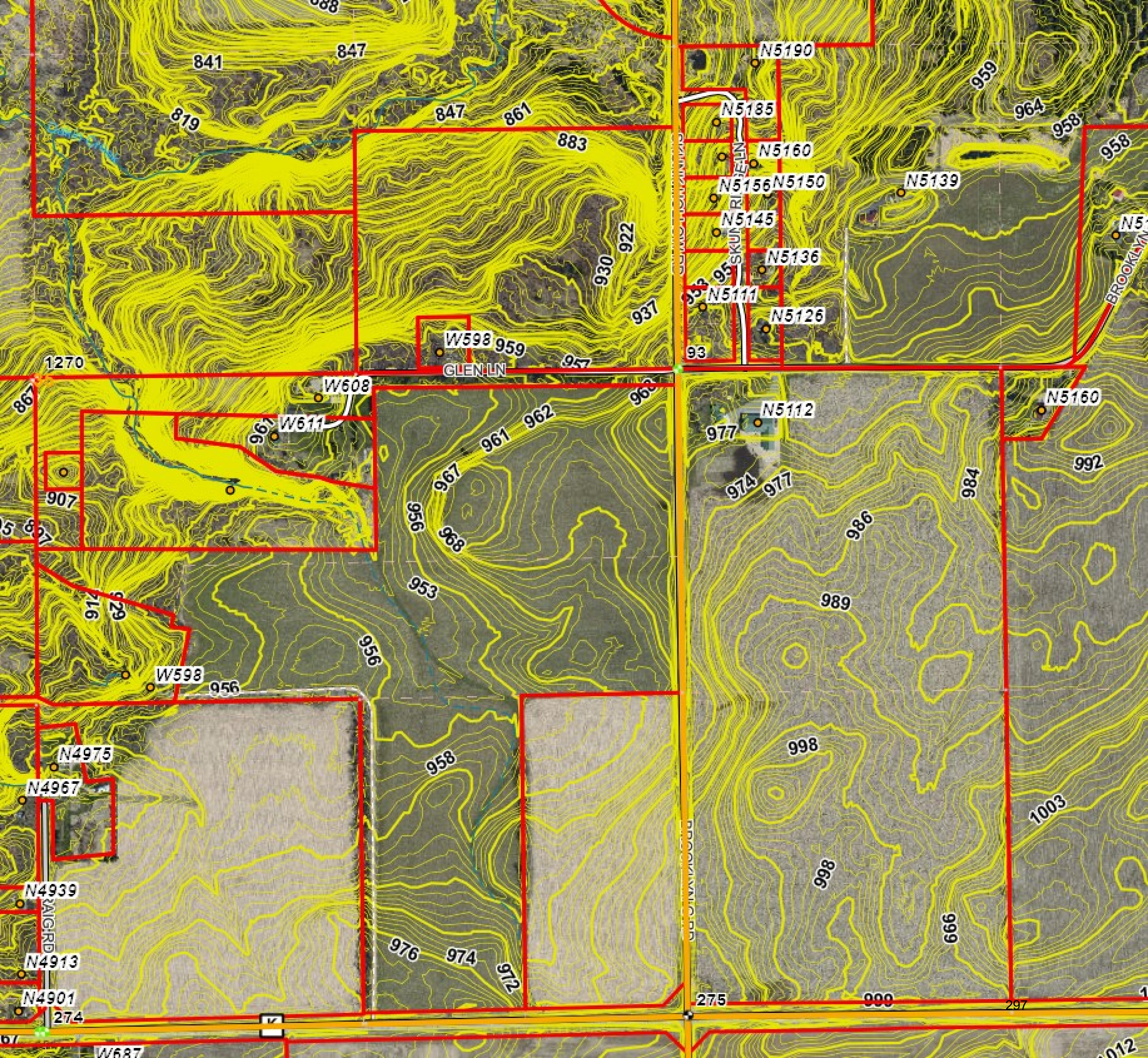
Powered by CoreLogic®

MAP DATA

FEMA Special Flood Hazard Area: **No**
Map Number: **55047C0134C**
Zone: **X**
Map Date: **February 03, 2010**
FIPS: **55047**

MAP LEGEND

- Areas inundated by 500-year flooding
- Areas inundated by 100-year flooding
- Velocity Hazard
- Protected Areas
- Floodway
- Subject Area



N5190
N5185
N5160
N5156
N5150
N5145
N5139
N5136
N5111
N5126
W598
GLEN LN
W608
W611
N5112
N5160
W598
N4975
N4967
N4939
N4913
N4901
K
W687
SKUNK RIDGE LN
BROOKLYN RD
KAIG RD
841
847
819
847
861
883
922
930
937
959
964
958
958
1270
867
961
907
959
957
962
962
961
967
956
968
953
956
977
974
977
984
986
992
989
998
998
1003
956
958
976
974
972
274
275
999
297

Front Elevation

South Elevation

East Elevation Looking North

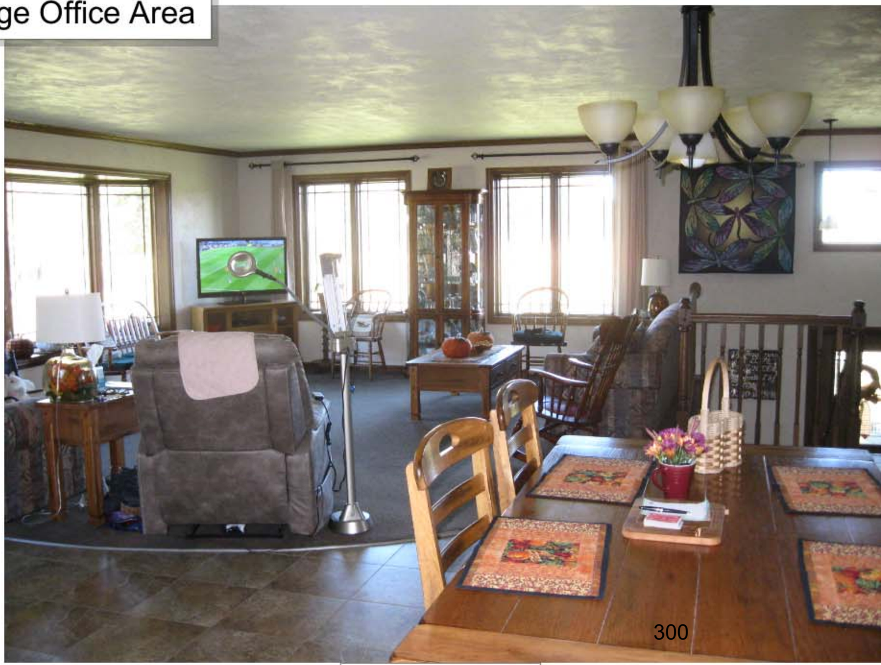
Back Yard

Side Yard Looking East

Additional Garage Storage Structure

Interior Garage Building

Garage Office Area



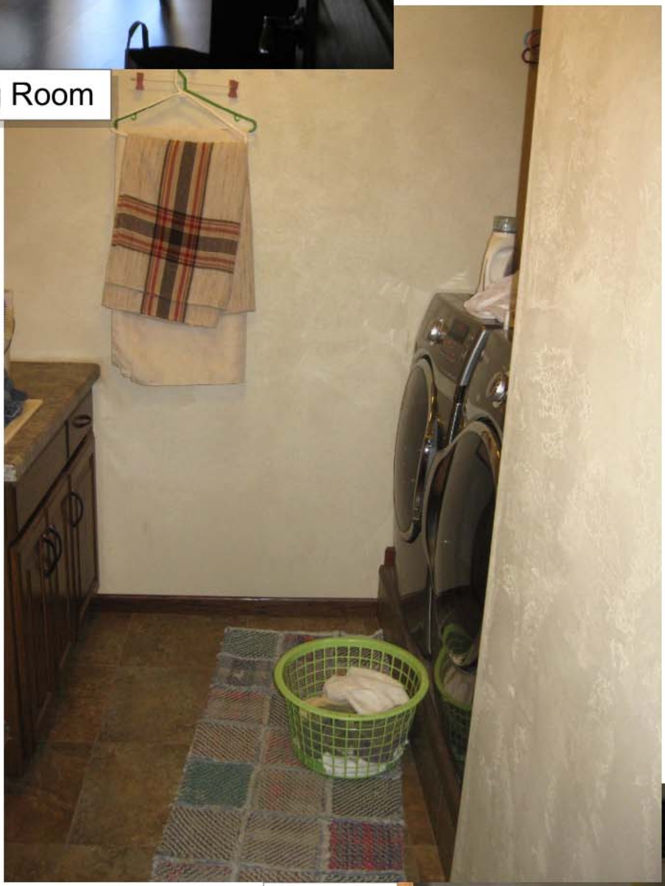
Living Room

Kitchen

Master Bedroom & Bath

Main Floor Bath

Office\Sewing Room



Laundry

Lower Level Bedroom

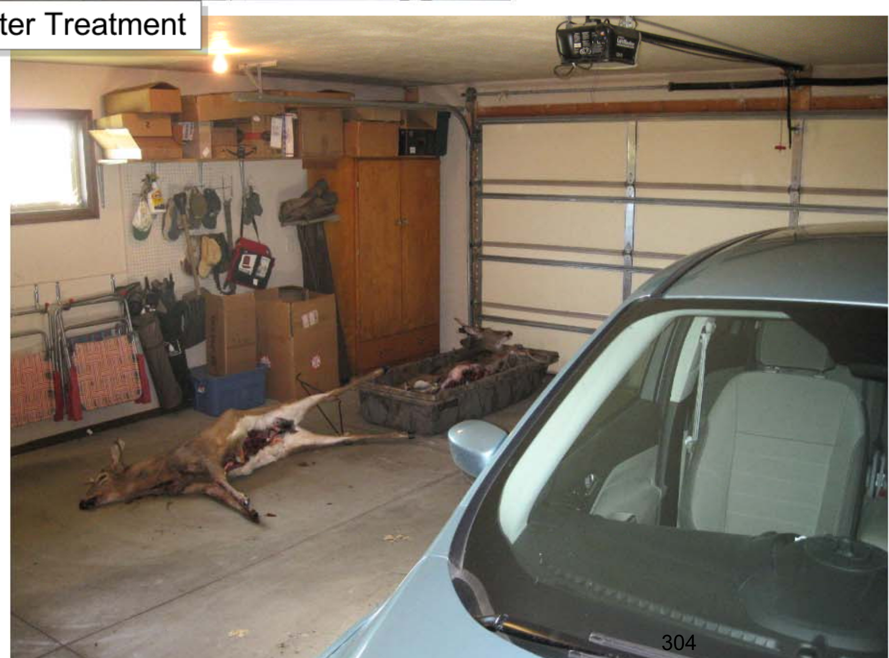
Lower Level Bath

Lower Level Family Room

Utility Storage Area

Geothermal System


Water Treatment


Garage Interior

Looking South at the Detention Pond Site

Garage & House Looking North From Brooklyn G Rd

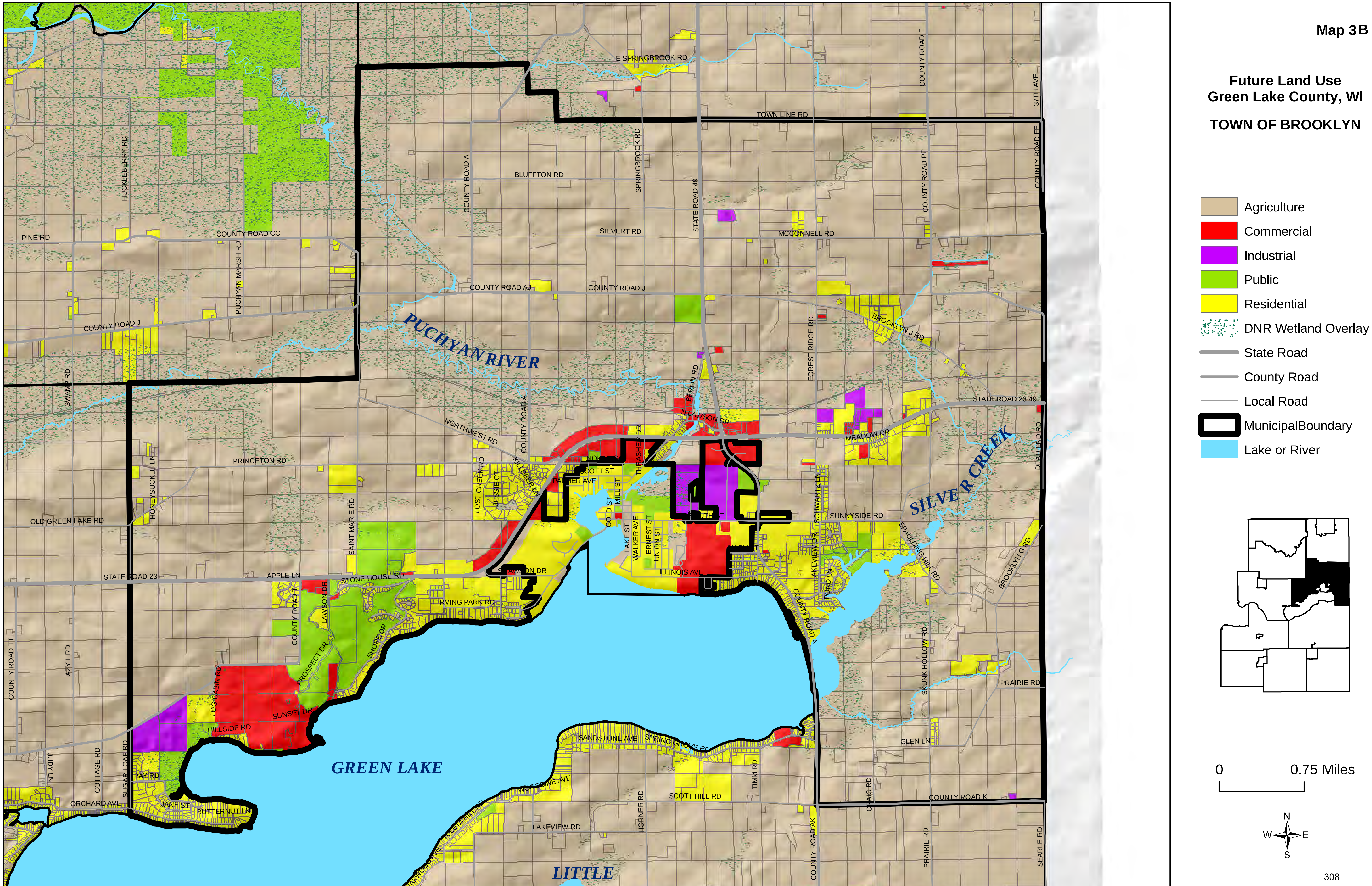
Looking West at Future Location of the Detension Pond

APPENDIX E

Legal Description

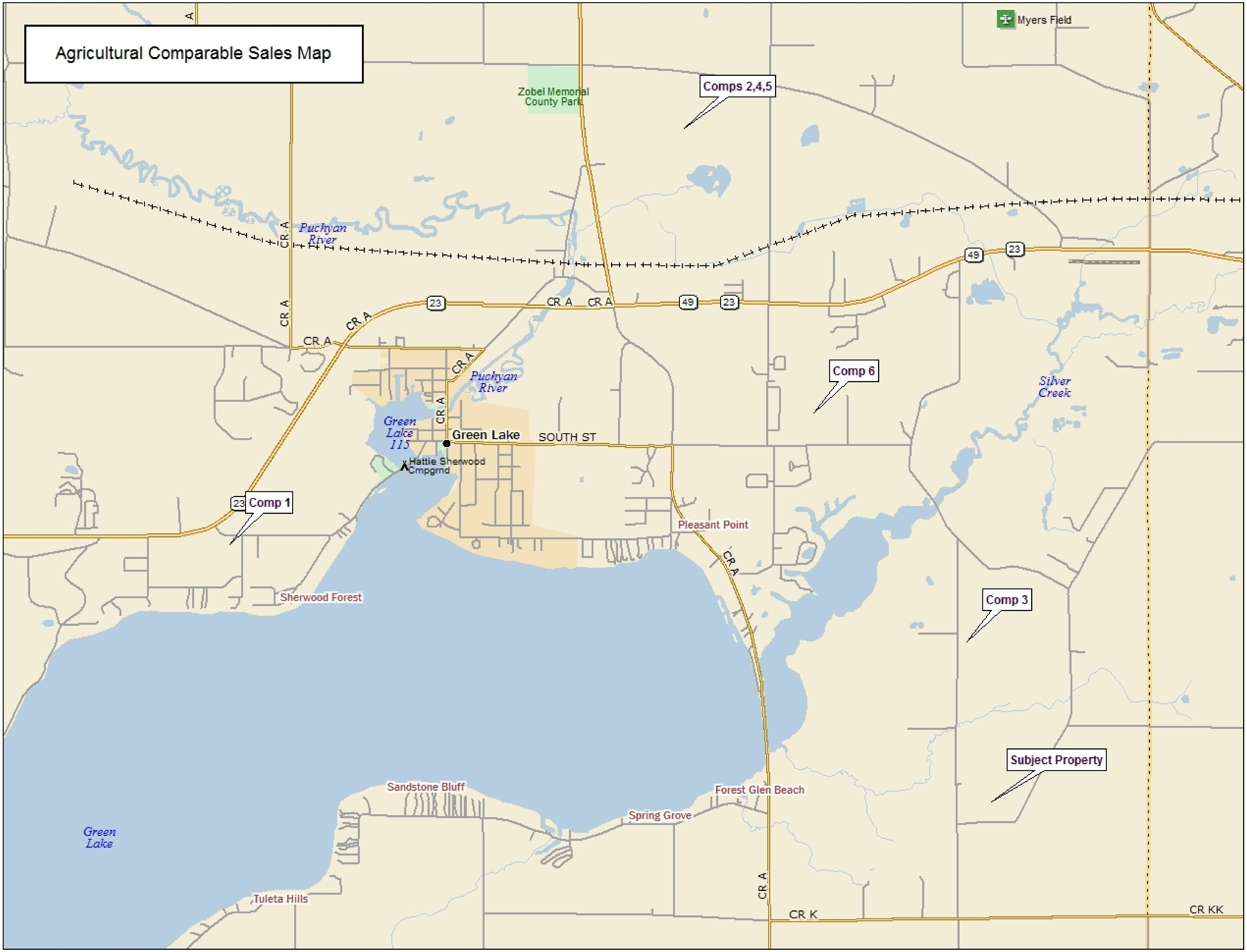
Legal Description

004-00780-0000
E 54R (27 ACRES) OF THE SW1/4 OF THE NW1/4 SEC 36


Map 3B
Future Land Use
Green Lake County, WI
TOWN OF BROOKLYN
Agriculture
Commercial
Industrial
Public
Residential
DNR Wetland Overlay
State Road
County Road
Local Road
MunicipalBoundary
Lake or River
0
0.75 Miles
N
W
E
S
PUCHYAN RIVER
SILVER CREEK
GREEN LAKE
LITTLE
E SPRINGBROOK RD
TOWN LINE RD
COUNTY ROAD F
37TH AVE
COUNTY ROAD FF
COUNTY ROAD PP
BLUFFTON RD
COUNTY ROAD A
SPRINGBROOK RD
STATE ROAD 49
SIEVERT RD
MCCONNELL RD
PINE RD
COUNTY ROAD CC
HUCKLEBERRY RD
PUCHYAN MARSH RD
COUNTY ROAD AJ
COUNTY ROAD J
BROOKLYN J RD
FOREST RIDGE RD
BERLIN RD
STATE ROAD 23 49
N LAWSON DR
MEADOW DR
NORTHWEST RD
SWAMP RD
HONEYSUCKLE LN
PRINCETON RD
OLD GREEN LAKE RD
SAINT MARIE RD
LOST CREEK RD
JESSIE CT
KILLDEER LN
THRASHER DR
MILL ST
GOLD ST
LAKE ST
WALKER AVE
ERNEST ST
UNION ST
ILLINOIS AVE
SCHWARTZ LN
SUNNYSIDE RD
SPAULDING HILL RD
BROOKLYN G RD
DEAD END RD
STATE ROAD 23
APPLE LN
STONE HOUSE RD
IRVING PARK RD
LAWSON DR
COUNTY ROAD T
PROSPECT DR
SHORE DR
LAKEVIEW DR
POND LN
COUNTY ROAD A
SKUNK HOLLOW RD
PRAIRIE RD
GLEN LN
COUNTY ROAD TT
LAZY L RD
LOG CABIN RD
SUNSET DR
HILLSIDE RD
SANDSTONE AVE
SPRING GROVE RD
BAY RD
JUDY LN
COTTAGE RD
SUGAR LOAF RD
ORCHARD AVE
JANE ST
BUTTERNUT LN
TIMM RD
SCOTT HILL RD
HORNER RD
LAKEVIEW RD
CRAIG RD
COUNTY ROAD K
COUNTY ROAD AK
PRAIRIE RD
SEARLE RD

APPENDIX F

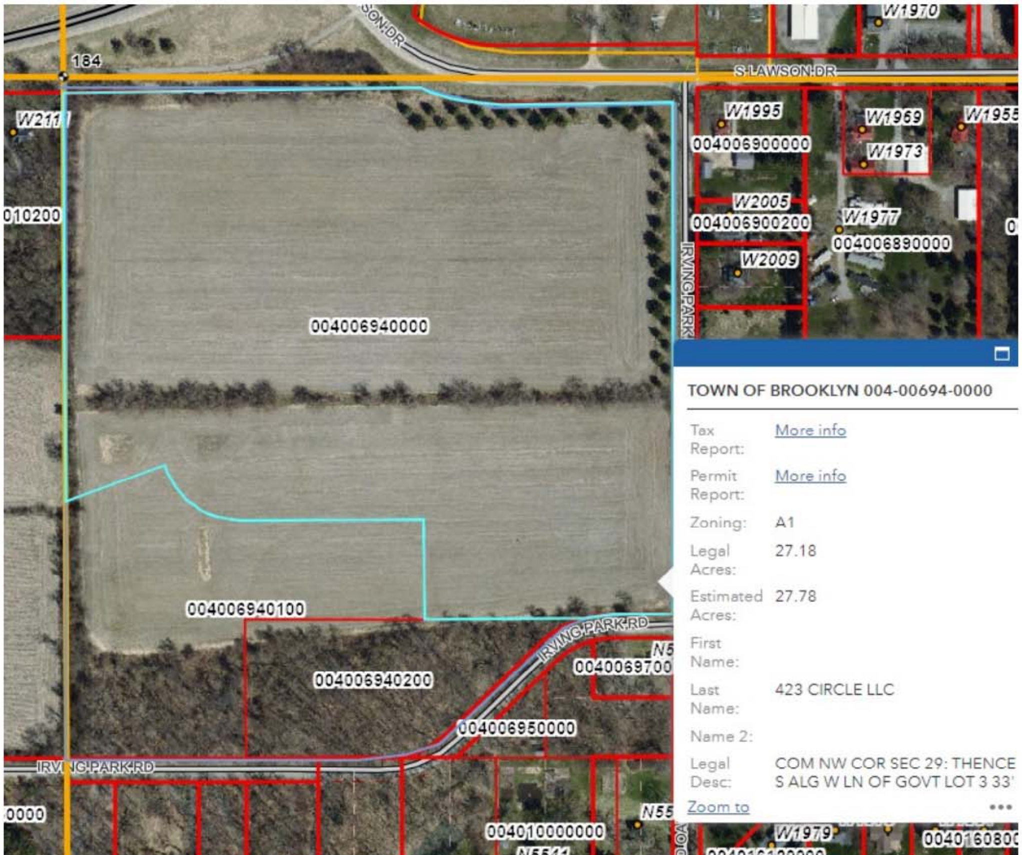
Comparable Sales Map and Photographs



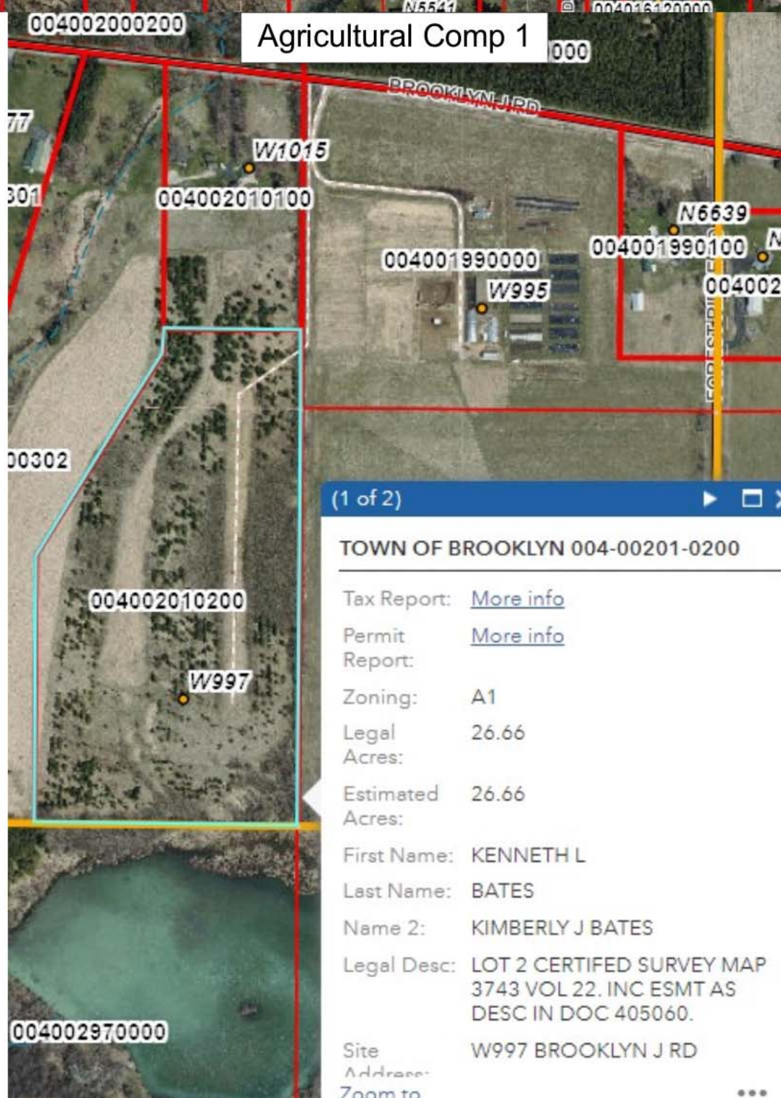
MN (3.8° W)

0 ¼ ½ ¾ 1 1¼ mi

Data Zoom 12-2

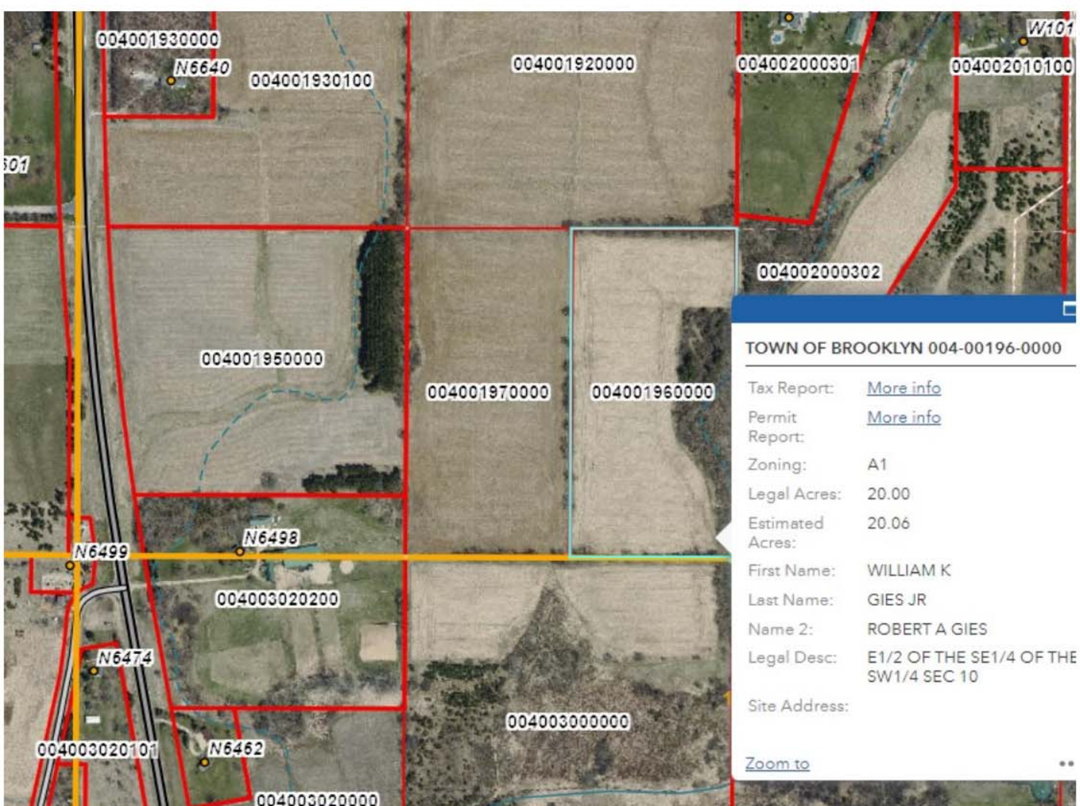


Agricultural Comp 1

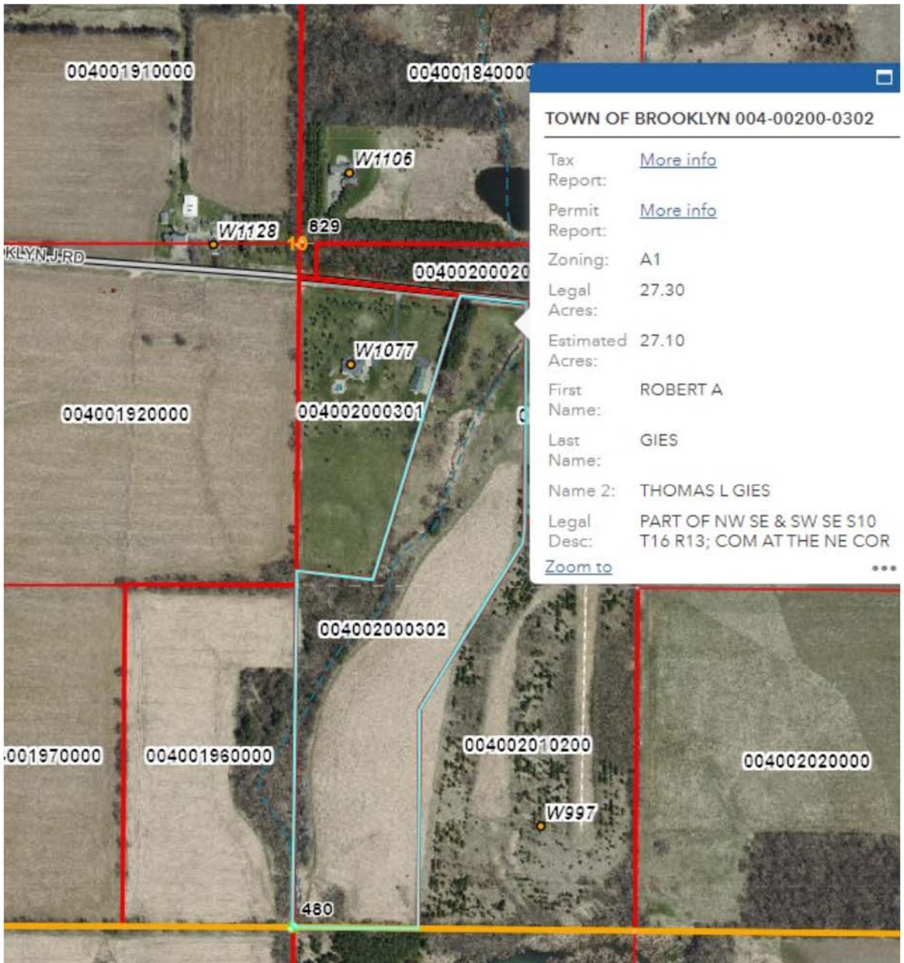


Agricultural Comp 2

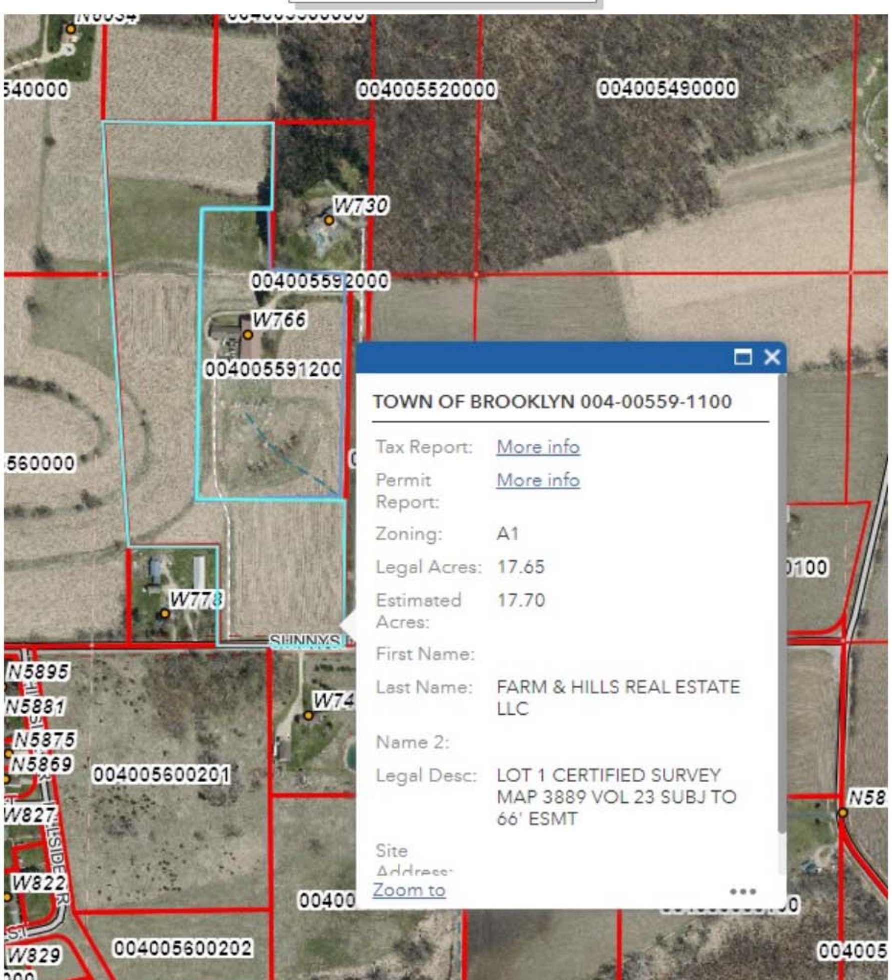
Agricultural Comp 3



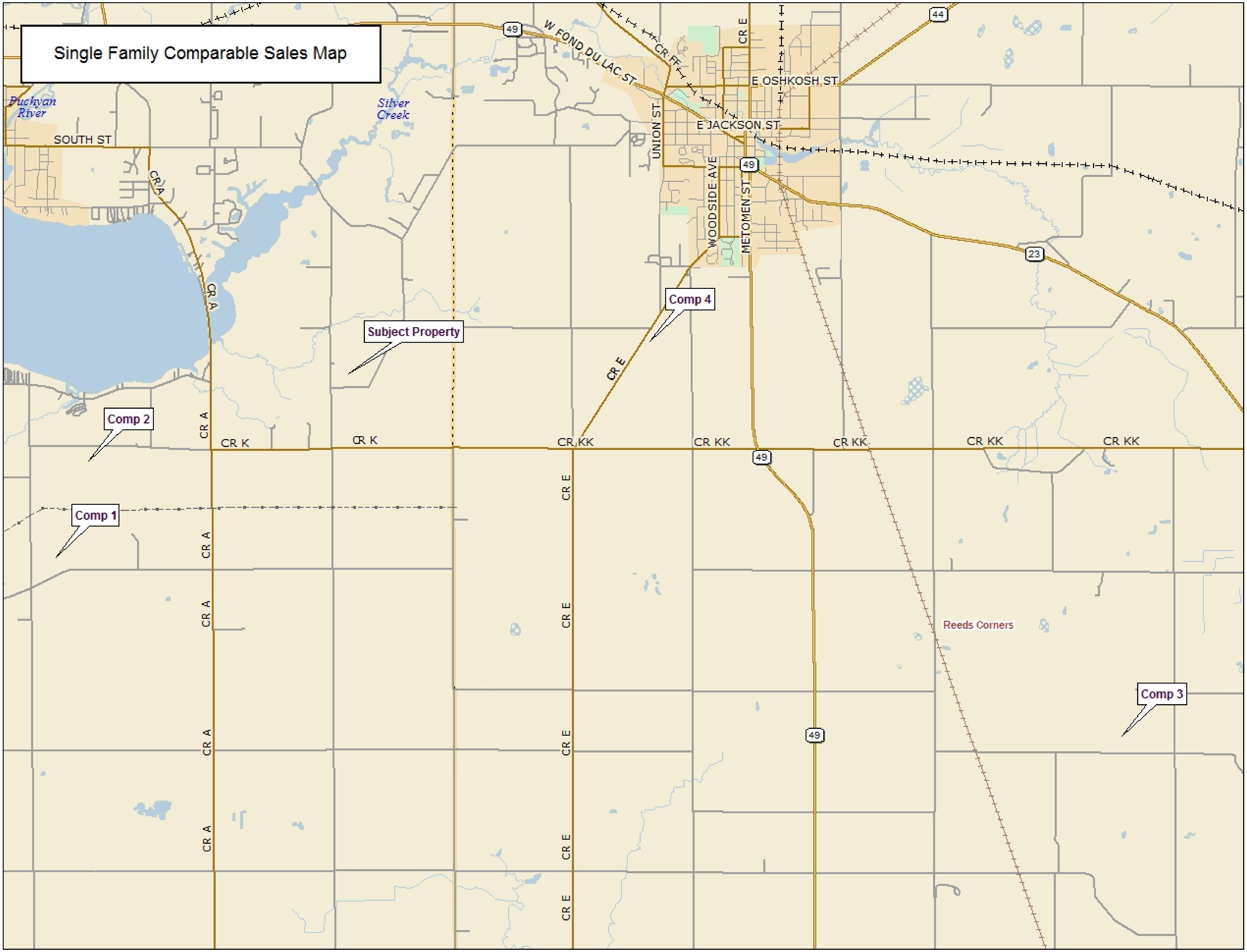
Agricultural Comp 4



Agricultural Comp 5



Agricultural Comp 6



MN (3.8° W)

0 ½ 1 1½ 2 mi

Data Zoom 11-5

Single Family Comparable Sale 1

Single Family Comparable Sale 2

Single Family Comparable Sale 3

Single Family Comparable Sale 4

APPENDIX G

Supporting Documents

1-1-2006

An Assessment of the Economic Impact of the Proposed Stoneco Gravel Mine Operation on Richland Township

George Erickcek
W.E. Upjohn Institute for Employment Research, erickcek@upjohn.org

An Assessment of the Economic Impact of the Proposed Stoneco Gravel Mine Operation on Richland Township

August 15, 2006

George A. Erickcek
Senior Regional Analyst
W.E. Upjohn Institute for Employment Research

An Activity of the W.E. Upjohn Unemployment Trustee Corporation

W.E. Upjohn Institute for Employment Research

300 South Westnedge Avenue ● Kalamazoo, Michigan 49007-4686 ● U.S.A.
Telephone (269) 343-5541 ● FAX (269) 342-0672

An Assessment of the Economic Impact of the Proposed Stoneco Gravel Mine Operation on Richland Township

George A. Erickcek
Senior Regional Analyst
W.E. Upjohn Institute for Employment Research

Executive Summary/Introduction

This report, which was completed at the request of the Richland Township Planning Commission, provides an estimation of the economic impact of the proposed Stoneco Gravel Mine Operation on Richland Township.[1] The following impacts are assessed in this study:

1. The potential impact on residential property values in Richland Township.
2. The potential employment impact of the proposed gravel mine on the area's economy.

In addition, we carefully reviewed the economic impact reports provided by Stoneco for consideration.

In the preparation of this impact analysis we used nationally-recognized modeling techniques that are the standard for academic research.

We estimate that the proposed gravel mine will have a significant negative impact on housing values in Richland Township. Once in full operation, the gravel mine will reduce residential property values in Richland and Richland Township by $31.5 million dollars, adversely impacting the values of over 1,400 homes, which represent over 60 percent of the Richland residences.

In addition, the mining operation will have an insignificant impact on area employment and personal income. At most, we estimate that only 2 additional jobs will be created in Kalamazoo County due to the mining operation. The mining operation serves the local

[1] The report was completed without charge as part of the W.E. Upjohn Institute's community service commitment. The Institute has prepared requested reports and analyses for the City of Kalamazoo, theCity of Hastings, the City of Battle Creek, the City of Grand Rapids as well as other local governmental units and school districts.

market, and analysis based on the Institute's econometric regional model for the Kalamazoo region shows that it will bring in an insignificant amount of new income into the area's economy, $58,000. Although the mine will employ an estimated 5 to 10 workers and require drivers to haul an estimated 115 to 120 truck loads of gravel per day, most all of these jobs would simply "displace" any employment growth in the county's 15 existing gravel pits.

Stoneco has not established a need for new aggregate capacity. Kalamazoo County is currently serviced by 15 gravel operations, and in recent years, employment in the county has been shrinking and the population has been stagnant. Consequently, there is no *prima facie* case that new capacity is needed. To definitively determine whether such a need exists, we would need to have information on projected demand for aggregated material in the county and capacity of the gravel pits currently servicing the county.

Finally, a careful evaluation of the five impact studies presented by the Stoneco finds that their methodologies are seriously flawed, and thus conclusions drawn from the analyses are invalid.

Qualifications

The W.E. Upjohn Institute for Employment Research is an internationally-recognized independent, non-profit economic research organization established in 1945 for the sole purpose of conducting research into the causes and effects of unemployment and measures for the alleviation of unemployment. The Institute currently has a staff of 60 including 10 senior-level economists, and its research agenda includes issues on the international, national, state, and local levels.

For the past 20 years the W.E. Upjohn Institute has maintained a strong research focus on west Michigan which includes

- The publication of its quarterly economic report: *Business Outlook for West Michigan.*
- The preparation of short- and long-term employment forecasts for all of the metropolitan areas in west Michigan including Kalamazoo, Battle Creek, Grand Rapids, Muskegon, and Holland.
- The completion of numerous economic impact reports and economic development strategies for communities in Michigan.

George Erickcek, the Institute's Senior Regional Analyst, was the lead researcher for this study. He received his Masters of Economics at the University of Pittsburgh and has been with the Institute since 1987. George has prepared numerous economic impact, benchmarking, and forecasting studies for the west Michigan region, and has conducted research on the national and international level.

Methodological Approach to Estimating the Impact on Housing Values of the Proposed Gravel Mine

Many factors influence housing prices. These include, of course, the characteristics of the house or dwelling unit, such as size, age, lot size, number of bedrooms and bathrooms, as well as its upkeep. In addition, the house's proximity to amenities such as a lake or pleasing neighborhood or "disamenities" (e.g. landfills, pollution sites) can have a substantial impact on its price.[2]

Economists have found that "hedonic pricing models" are extremely useful in isolating the contribution of specific factors on the price of housing, as well as other goods. First developed by University of Chicago economist Sherwin Rosen in 1974, hedonic pricing models use a statistical regression technique that allows the researcher to estimate the impact of one factor, e.g. the proximity of a neighborhood park, on the value of a house while holding all of the other factors impacting the house's value constant. There is an extensive literature applying hedonic pricing models to study the effects of environmental disamenities on residential property values. These studies generally show that proximity to landfills, hazardous waste sites, and the like has a significant negative effect on the price of a residential property.[3]

Professor Diane Hite, an economist who has published widely in the area of property value impact analysis, has recently applied hedonic pricing methodology to study the effects of a gravel mine on nearby residential values. This appears to be the only rigorous study to date of gravel mine impacts on property values.[4] Her study is based on detailed data from Delaware County, Ohio that were collected by the Ohio State University for the purposes of studying land use planning.

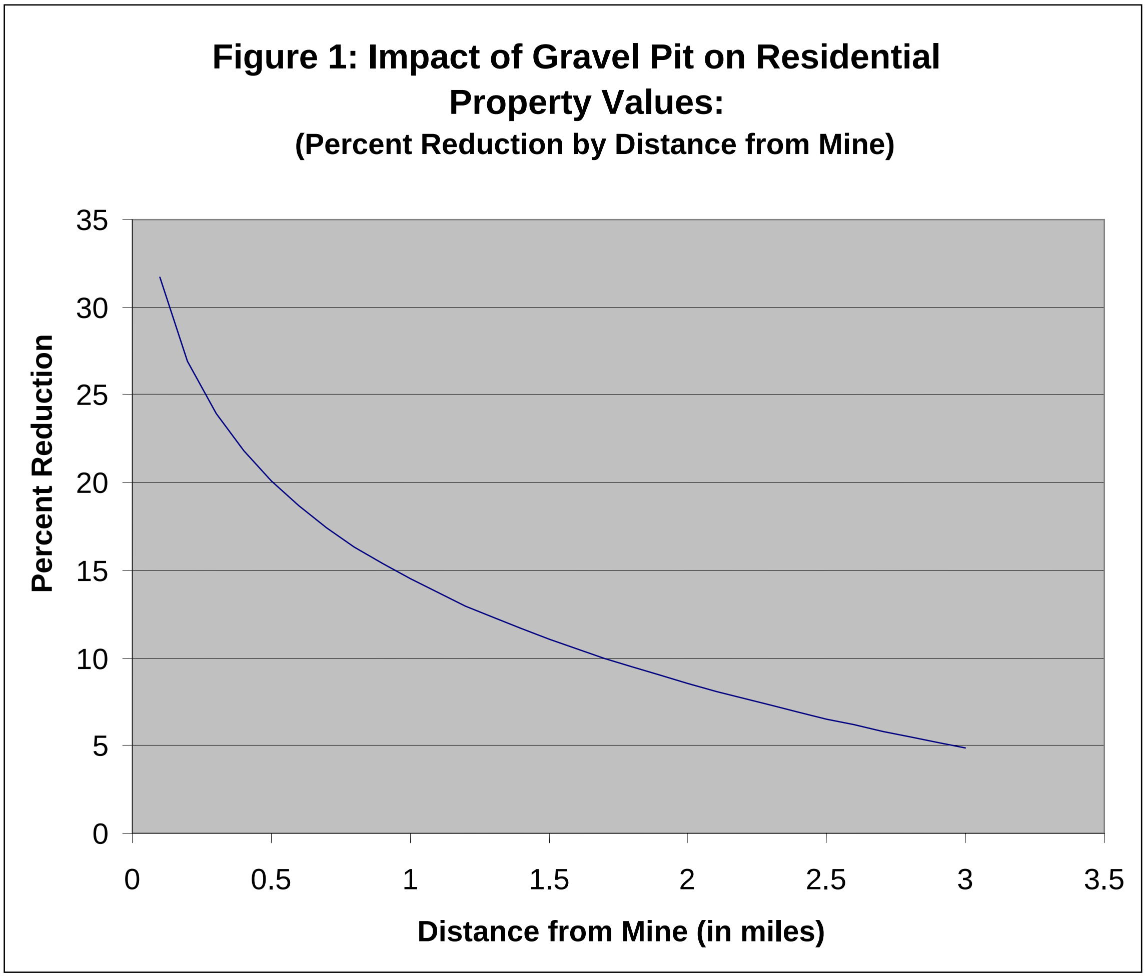
Hite examines the effects of distance from a 250-acre gravel mine on the sale price of 2,552 residential properties from 1996 to 1998. Her model controls for a large set of other factors that determine a house's sale price, including number of rooms, number of bathrooms, square footage, lot size, age of home, sale date, and other factors specific to the locality, so that she can focus solely on the effect of proximity to the gravel mine on house values. She finds a large, statistically significant effect of distance from a gravel mine on home sale price: controlling for other determinants of residential value, proximity to a gravel mine reduces sale price. Specifically, Hite reports that the elasticity of house price with respect to distance from a gravel mine is .097, implying that a 10 percent increase in distance from the gravel mine is associated with slightly less than a 1

---

[2] In a recent study of the impact of housing programs in the City of Kalamazoo, we found that moving a house from one neighborhood to another can add or subtract as much as $20,000 from its value.
[3] For reviews of some of this literature, see Arthur C. Nelson, John Genereux, and Michelle Genereux, "Price Effects of Landfills on House Values," *Land Economics,* 1992 68(4): 359-365 and Diane Hite, Wen Chern, Fred Hitzhusen, and Alan Randall, "Property-Value Impacts of an Environmental Disamenity: The Case of Landfills," *The Journal of Real Estate Finance and Economics* 22, no. 2/3 (2001): 185-202
[4] Diane Hite, 2006. "Summary Analysis: Impact of Operational Gravel Pit on House Values, Delaware County, Ohio," Auburn University.

percent increase in home value, all else the same.[5] Conversely, the closer the house to the proximity to the mine, the greater the loss in house value.

Figure 1 displays the estimated effects of distance from the gravel pit on house price. A residential property located a half mile from the gravel mine would experience an estimated 20 percent reduction in value; one mile from the mine, a 14.5 percent reduction; 2 miles from the mine, an 8.9 percent reduction; and 3 miles from the mine, a 4.9 percent reduction. These estimates are similar to estimates published in academic journals on the effects of landfills on nearby property values.



[5] This estimate is based on a constant elasticity model specification. At the Upjohn Institute's request, Professor Hite tested the sensitivity of these findings to model specification, and in all specifications finds a large, statistically significant negative effect of proximity to gravel pit on house prices. The simulations for Richland Township reported below are based on the estimates from the constant elasticity specification and yield slightly lower estimated negative property value impacts than those based on models using other functional forms. We consider this number to be a conservative estimate.

The loss in property value results from the negative consequences of the mining operation and reflects the deterioration in the area's quality of life due solely to the operation of the gravel mine. In other words, the loss in house value is a way to quantify in dollars the deterioration in quality of life, as capitalized in the price of the house. It captures the price reduction the homeowner would have to offer to induce a new buyer to purchase the property. Even if homeowners do not move as a result of the gravel mine, they will lose homeowner equity as the potential sale price of their house is less.[6] Therefore, regardless of whether or not a person actually sells their property, it measures the adverse effects in their quality of life in being subjected to the disamenities introduced into the area by the gravel mine.

The policy implications of Hite's study are clear: because property value losses are higher the closer to the gravel mine, all else the same, new sites should be located far from existing residences so as to minimize adverse consequences for homeowners.

Simulation of Gravel Mine on Residential Property Values in Richland

Utilizing the estimates from the Hite study and data on 2006 assessed values provided by Richland Township, the Upjohn Institute simulated the effects of the proposed gravel mine on residential property values in Richland Village and Richland Township. Our analysis is based on 2005 assessed values of single-family homes in Richland Township and Richland Village obtained from the Township's assessor office in June and July. In total 2,319 single-family homes, 88.7 percent of all single-family residences in the township and village, were geo-coded using the ArcView© mapping program, manually matched using Yahoo© maps and, finally, through drive-by inspection of addresses. Once all of the homes were mapped, the distance between each of the residences and the closest boundary of proposal Stoneco gravel mine was determined.

As shown in Table 1, more than 1,400 homes will be negatively impacted by the proposed gravel mine with the total cost reaching $31.5 million dollars.

[6] Only those owning property at the time of the establishment of the gravel mine would experience a loss in equity. Those purchasing property near an established mine would not experience an equity loss because any negative effects from the mine's operation would have been incorporated into the purchase price. By implication, few property owners near long-established mines could claim loss of property value from the mine because few would have owned the properties at the time the mine went into operation.

Table 1
Estimated Impact on Housing Values of the Proposed Stoneco Gravel Mine

Distance (miles from Stoneco Site)	Number of Houses Affected	Estimated Loss in Value	Distance (miles from Stoneco Site)	Number of Houses Affected	Estimated Loss in Value
0.1	2	$211,703	1.6	73	$1,207,011
0.2	3	$106,428	1.7	128	$2,500,456
0.3	2	$134,894	1.8	99	$1,630,149
0.4	9	$522,981	1.9	70	$1,146,761
0.5	3	$389,319	2	34	$633,720
0.6	8	$598,518	2.1	105	$952,068
0.7	24	$831,338	2.2	98	$1,311,040
0.8	25	$798,108	2.3	99	$2,843,845
0.9	27	$1,085,190	2.4	72	$2,699,584
1	22	$918,374	2.5	34	$912,133
1.1	75	$2,428,602	2.6	12	$377,548
1.2	62	$1,688,031	2.7	23	$373,873
1.3	45	$1,146,920	2.8	80	$939,861
1.4	32	$824,928	2.9	55	$944,061
1.5	30	$712,731	3	70	$655,846
			Total	1,421	$31,526,020

While Hite's original study covered a 5-mile radius from the gravel mine in Ohio, we chose to examine only a 3-mile area from the boundaries of the proposed Stoneco site.[7] Only properties located in Richland and Richland Township are included. Property values in other townships, notably Prairieville Township, also could be adversely affected by the location of a gravel mine near its border with Richland Township but were not included in the study. In addition, the analysis does not consider possible effects on commercial property. Our estimates do not factor in the likely negative impact on property values along the truck routes used for the mine. Finally, although Stoneco has proposed to reclaim some of the land for a lake and residential development, its proposed timeframe for this development would occur too far into the future to mitigate adverse property value impacts for current Richland area residents.

[7]Hite's statistical analysis intentionally includes homes at a distance deemed unaffected by the gravel operation. Our choice to study the impacts up to 3 miles is based on Nelson, et al. (1992) and the fact that estimated impacts for individual homeowners are still relatively large out to three miles in all of Hite's models.

Employment and Personal Income Impact

Stoneco estimates that 5 to 10 permanent jobs will be created at the proposed mine. In addition, truck drivers will be required for the 115 to 120 truck loads of gravel that will be hauled from the mine daily.

To measure the potential employment and income impact of the gravel mine, we used the Institute's econometric regional model of the Kalamazoo area.[8] Because of its weight and low-value, gravel is hauled for only short distances. It is not a part of the area's economic base that brings new monies into the area. Therefore, it is an activity that does not generate any significant new income or employment opportunities. We estimate that only 2 additional new jobs will be created in Kalamazoo County due to the gravel mine and personal income in the county will increase by only $58,000. In short, the jobs created at the gravel mine will displace jobs elsewhere in Kalamazoo County or the immediate region. The proposed mine would not result in any significant net benefit to the area from job or income creation.

Need for the Proposed Mine

Adverse economic effects of the proposed gravel mine to the Richland community must be balanced against the county's broader needs for aggregate material for road construction. Currently, 15 gravel mines operate in Kalamazoo County according to the Kalamazoo County Planning Department (Table 2). Stoneco's application materials do not provide any evidence for the need for additional capacity. Statistics were cited on projected needs, but no evidence was presented as to whether existing capacity could cover anticipated needs.

The need for additional capacity of gravel production is not supported by current and projected population or employment trends in Kalamazoo County. Population growth in Kalamazoo County has been modest during the past five years, and well below the national rate. From 2000 to 2005, population in the county increased annually at a rate of below 0.2 percent, compared to 0.9 percent nationwide.[9] An analysis of the individual components of population change—births, deaths, net migration—shows that individuals and households, on net, are leaving the county. From 2000 to 2005, the county's population increased by 6,342 individuals due to number of births surpassing the number of deaths. However, on net, 4,150 individuals moved out of the county.[10]

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[8] The Upjohn Institute maintains a regional economic impact and forecasting model for the Kalamazoo metropolitan area which was built by Regional Economic Models Incorporated (REMI) especially for the Upjohn Institute. The REMI modeling approach, which incorporates an input-output model with a forecasting model and a relative cost of production model, has been repeatedly reviewed and upheld as the industry standard.

[9] U.S. Census Bureau.

[10] U.S. Census Bureau. Furthermore, Internal Revenue Service (IRS) data from 2000 to 2004 shows that the majority of the individuals leaving the county are moving outside the greater Kalamazoo region.

Table 2

Kalamazoo County Gravel Pits		
Owner Name	Site Address	Site Township
Aggregate Industries	C Ave. Near 6th St	Alamo
Art Austin	6287 K Avenue	Comstock
Triple B Aggregates	2702 Ravine Rd.	Kalamazoo
Thompson McCully Co	3800 Ravine Rd.	Kalamazoo
Byholt, Inc.	1600 Sprinkle Rd.	Brady
Byholt, Inc.	4th St	Prairie Ronde
Fulton Brothers Gravel	4th St	Prairie Ronde
Balkema Excavating	8964 Paw Paw Lk.	Prairie Ronde
Balkema Excavating	6581 E. K Ave	Comstock
Balkema Excavating	4274 Ravine Rd	Kalamazoo
Balkema Excavating	40th St. & I-94	Charleston
Balkema Excavating	14500 E. Michigan	Charleston
Balkema Excavating	15600 E. Michigan	Charleston
Consumer Concrete	10328 East M-89	Richland
Consumer Concrete	700 Nazareth Rd	Kalamazoo

Source: Kalamazoo County Planning Department July 2006

During the same time period, employment declined by 3.4 percent, a loss of 5,000 jobs. The Michigan Department of Labor and Economic Growth estimates that from 2002 to 2012, total employment in Kalamazoo and St. Joseph counties will increase at a rate of 0.8 percent—substantially below the 1.3 percent rate of growth projected for the nation as a whole. If this rate of employment growth holds true for the future, it will be not until 2010 that the county will reach its 2000 employment level.

Thus, economic projections do not, in and of themselves, indicate a need for expanded aggregate capacity. However, we emphasize that any definitive determination of need would require information on the capacity and life expectancy of existing area gravel pits, to which the Institute does not have access.[11]

Review of Stoneco's Property Value Impact Analysis

The Environmental Study submitted by Stoneco in connection with its special use permit application concludes that gravel mining operations have no adverse impact on the value of nearby properties. This conclusion is based on five reports included in Appendix J of Stoneco's Environment Study:

[11] Note that whether there is a public need for additional capacity and whether it is in Stoneco's interest to develop a new mine are distinctly different issues. Stoneco has indicated that it would reduce its transportation costs by operating at the proposed Richland location. The degree to which any lower transportation costs translate into lower prices of aggregate material—and hence broadly benefit the public—versus increased company profits will depend on the competitive structure of the industry in this region.

1. "Impacts of Aggregate Mine Operations: Perception or Reality?" Anthony Bauer, 2001.[12]

2. "Social, Economic, and Legal Consequences of Blasting in Strip Mines and Quarries," Bureau of Mines, 1981.

3. "Impact of Rock Quarry Operations on Value of Nearby Housing," Joseph Rabianski and Neil Carn, 1987.

4. "Impacts of Rock Quarries on Residential Property Values, Jefferson County, Colorado," Banks and Gesso, 1998.

5. "Proposed Fuquay-Varina Quarry: Analysis of Effect on Real Estate Values," Shlaes & Co., 1998.

These reports, in fact, fail to show that mining operations have no adverse impact on property values. None uses the standard methodology (the hedonic pricing model, described above) for evaluating property value impacts. Four of the five reports are based on flawed logic (as explained below) and hence cannot be used to draw any conclusions about property value effects. Only one report, commissioned by the U.S. Bureau of Mines, used a defensible methodology, although this report also suffers from serious limitations. Notably, this study found some evidence of adverse impacts of gravel mining operations on property values in six out of the seven sites examined.

The Bauer, Rabianski and Carn, Banks and Gesso, and Shlaes & Co. reports rely on one or both of the following types of observations to argue that gravel mining operations have minimal adverse impact on nearby property values:

- Over time, housing and commercial developments have moved closer to and sometimes adjacent to aggregate mine operations.
- For property values in the vicinity of mining operations that have existed for many decades, the rate of growth in property values does not increase with distance from the mining site.

In neither case do such observations have any bearing on the impact of aggregate mine operations on nearby property values.

1. Residential and commercial developments have located closer to and sometimes adjacent to mines over time.

   Economic or real estate analysis does not predict that properties near mines have no value or no development potential. Rather, one would expect that nearby property values would be lower to compensate for any costs (e.g. noise, pollution, unsightly landscapes, and traffic congestion) associated with the mine. This reflects the

[12]Bauer (2001) is a two-page statement that in large part summarizes the results of a 1984 study by a Michigan State University student.

common sense observation that property that is near sources of noise, pollution, traffic congestion, and blight will (all other things being equal) be less valuable. Of course, these lower property values, in turn, will help lure development, especially over time, but the development more than likely will include non-residential activities, which are not affected by the disamenities generated by the mine.

Two studies (Bauer 2001; Banks and Gesso 1998) examined aerial photographs taken over the course of several decades that showed housing and commercial developments moving closer to mining operations. As the population has expanded, land values near central cities have increased, and transportation infrastructures have improved, development has fanned out all across the country. Any study would inevitably find that over the course of the last 20, 30, or 40 years, housing developments have moved closer to mines (and any other less desirable location), and such observations have no relevance to the question posed by Stoneco's application—whether the establishment of mining operations will lower nearby property values.

2. Near well-established mines, the year-to-year change of property values is no less for properties located close to mines than for those located somewhat farther away from mines.

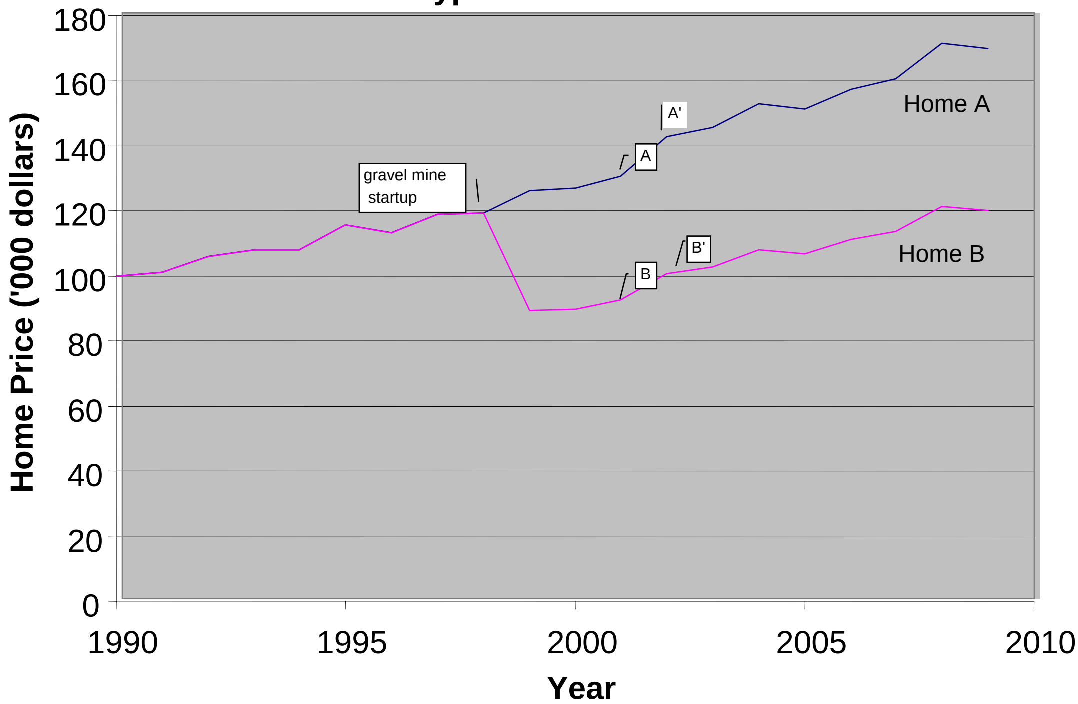
The adverse impact that a mine will have on nearby property values will occur within a short period of time following the establishment or announcement of the mine. After the adverse effects of being located near a mine have been capitalized into the property value—that is, after the negative effects of being close to a mine operation has resulted in a decrease in property values—we would not expect the future rate of change of nearby properties to be different from those of other properties, all else the same.

The analyses in Rabianski and Carn (1987), Shlaes & Co. (1988), and Banks and Gesso (1998) look at whether the relative difference in property values between properties close to and farther from a mine continue to widen 30, 50, even 100 or more years after the mine was established. All of these studies conclude that because we do not see continued widening of these differentials many decades after the establishment of mines, mines have no adverse effect on property values. This argument makes no sense: the adverse impact on property values would have occurred decades before. These studies shed no light on possible adverse impacts of mining operations on property values.

Figure 2 illustrates this point. This figure depicts the prices of two hypothetical homes over a 20-year period. Home B is affected by the opening of a gravel mine in the middle of the time period; otherwise the homes are identical. Except in the year when the gravel mine is introduced, the annual *percentage changes* in the prices of the two homes are the same. The methodology used in the reports cited in the Stoneco environmental study compared the percentage change of homes near the gravel mine (percent change from B to B′ in Figure 2) to the percentage change in home prices farther from the gravel pit (percent change from A to A′ in Figure 2).

But even with adverse property value effects, these percentage differences should be approximately equal. To capture any adverse impact, one must measure the difference in values of otherwise comparable properties close to and farther from the gravel mine at a point in time. In Figure 2, the difference between points A and B or between A′ and B′ measure the true property value impact, which conceptually is what is measured in the hedonic pricing model used in the analysis reported above.

Figure 2: Methodology for Evaluating Gravel Mine Impact on House Prices: Hypothetical Case



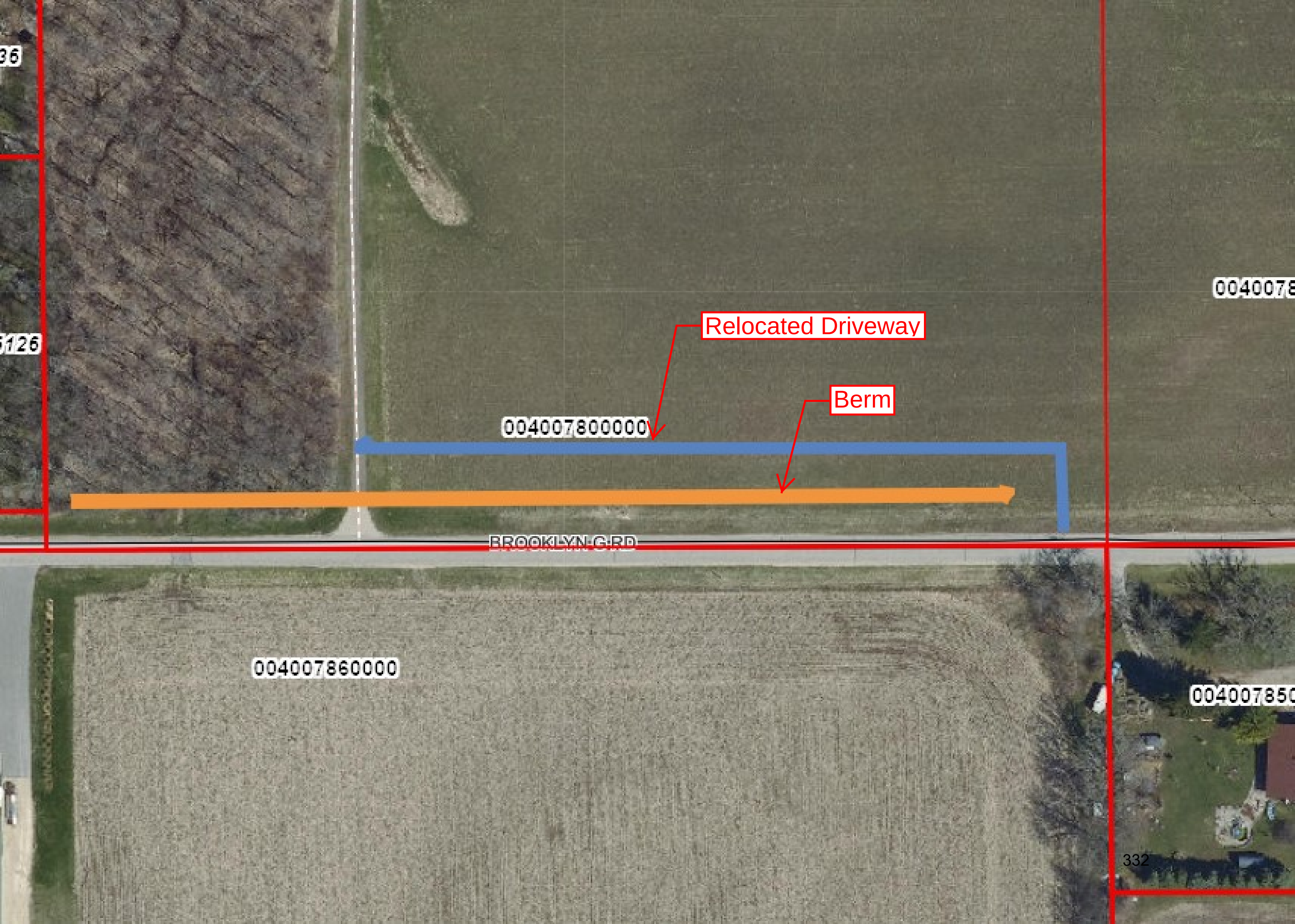
Only the study commissioned by the U.S. Bureau of Mines attempted to assess how the value of comparable homes varied with distance from the mine. However, the Bureau of Mines study suffered from several serious shortcomings:

- The sample size at each of seven sites was very small, and hence no statistically valid conclusions could be drawn.
- Homes were classified into rough typologies, and hence controls for other factors affecting home prices were crude.
- The study was based on assessed values rather than on more accurate sale price data.
- The study only examined potential property value impacts within approximately a half mile of the mine site. More recent research shows that property value effects

may be significant up to two or three miles from such sites.[13] Limiting analysis to properties within a half mile of the mine site could lead to a significant understatement of any property value impacts.
- Researchers used subjective assessments to discount findings of adverse impacts on property values.

With these shortcomings in mind, the Bureau of Mines study found some evidence that the value of comparable homes increased with distance from the mine site in six of the report's seven case-study sites. In some cases, the differences in values were described as large.

[13] See, for example, Arthur C. Nelson, John Genereux, and Michelle Genereux, "Price Effects of Landfills on House Values," *Land Economics,* 1992 68(4): 359-365.


Relocated Driveway
Berm
004007800000
BROOKLYN-G RD
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Prepared by: EOR

For the Green Lake Association, Green Lake Conservancy, and Green Lake Sanitary District

Hydrologic Evaluation of the Proposed Skunk Hollow Mine, Green Lake County, Wisconsin

December 8. 2022

water ecology community

Cover Images

Mitchell Glen

TABLE OF CONTENTS

1. PURPOSE AND SCOPE

Emmons and Olivier Resources, Inc. (EOR) conducted this review of the proposed Skunk Hollow Mine under contract with the Green Lake Association. We were asked to address concerns about potential water resource impacts of the proposed mine. These include acid mine drainage and related metals contamination, sediment impacts on surface water and groundwater, and the supply of groundwater to springs and streams.

EOR's lead investigator for this report was Water Resources Engineer Steve Gaffield, PE, PhD (resume included in Attachment A). This report has been peer reviewed within EOR, and its conclusions and recommendations represent the collective experience of the firm.

Steve Gaffield of EOR visited the area on November 18, 2022 to observe conditions. In addition, we reviewed the Conditional Use Permit (CUP) application materials, information on the mine site provided by the Wisconsin Department of Natural Resources (DNR; Attachment B), and literature on the area including the mine site, nearby natural resources including Powell Spring and Mitchell Glen, the local bedrock geology, and risks related to mining. Many of these references are cited in footnotes throughout this report.

2. GROUNDWATER QUANTITY

2.1. Depth to water table

The proposed mining plan described in the CUP application materials is to terminate the pit above the water table, which is important to avoid aerating the aquifer and potentially mobilizing arsenic and other metals, as described in more detail later in this report. Kopplin & Kinas' Drawing 8 shows a proposed quarry floor elevation of 928.43 ft and a static water level of 918 ft. The source of the 918 ft static water level estimate appears to be from an observation in the on-site water supply well, as discussed in more detail below.

It is unlikely that the water table at the proposed mine site is as deep as estimated in the CUP application. An elevation of 918 ft is lower than Powell Spring. Available information indicates that groundwater flows from the area including the mine site toward Powell Spring, White Creek, Mitchell Glen, and Dakin Creek, which means that the water table at the mine site would be higher than the spring. Figure 1 illustrates a typical groundwater flow system, with the water table sloping downward toward streams and lakes. A statewide water table map from the US Geological Survey[1] (Figure 2) shows that the mine site is near a groundwater divide, with a water table slope to the northwest driving groundwater flow toward Green Lake. The water table elevation at the mine site therefore must be higher than the Powell Spring elevation of 923.4 ft, listed in the spring survey report by the WGNHS.

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[1] Kammerer, PA, 1995. Ground-Water Flow and Quality in Wisconsin's Shallow Aquifer System. US Geological Survey, Water-Resources Investigations Report 90-4171.

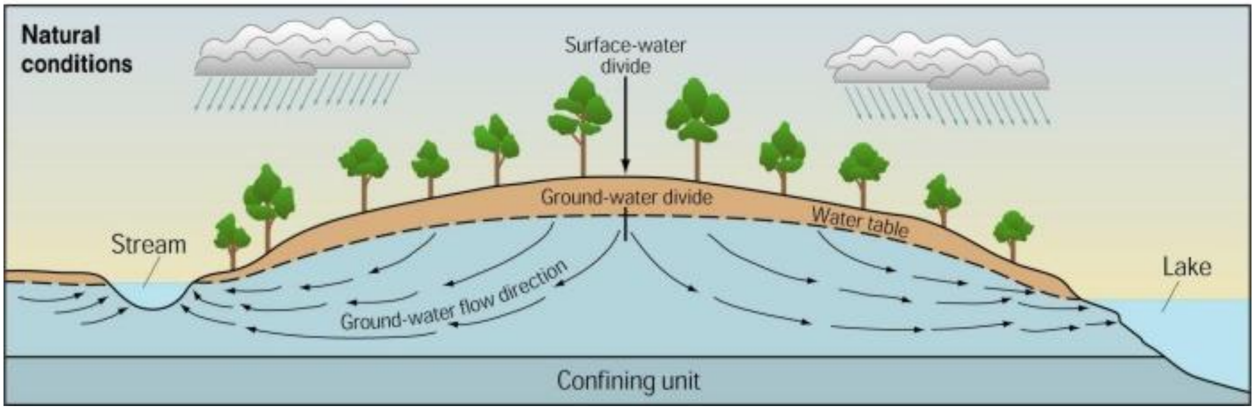

Figure 1. [USGS Ground water in the Great Lakes Basin: the case of southeastern Wisconsin]

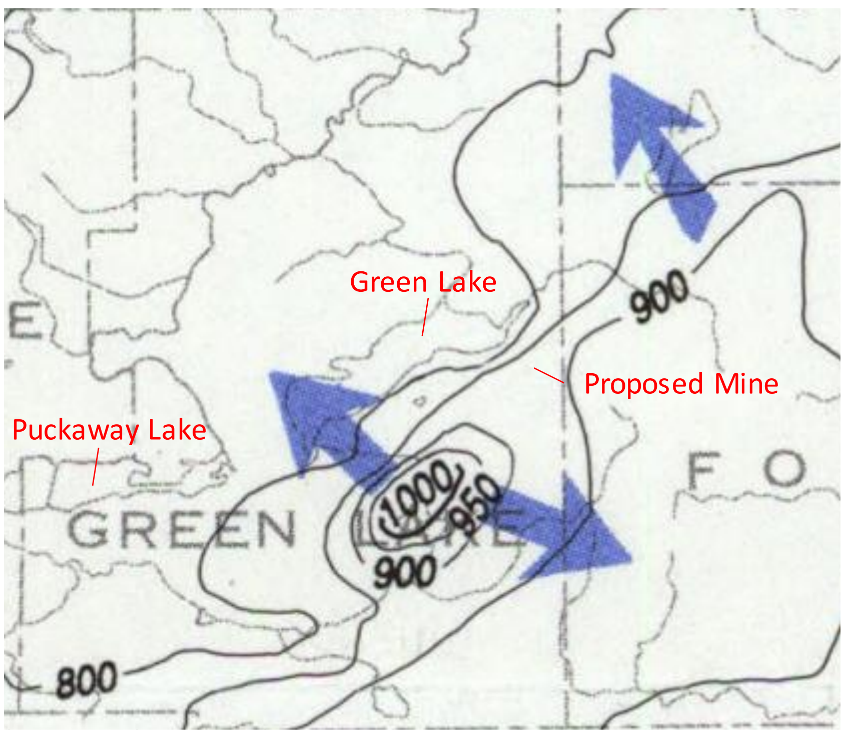

Figure 2. Water table elevation contours and generalized groundwater flow direction. From USGS, 1995. Location notation added by EOR. Note drop in water table from mine site toward Green Lake.

Additional information on groundwater levels in the area can be obtained from Well Construction Reports available on the DNR website. These reports include well drillers' measurement of the depth to the static water level at the time of drilling. EOR estimated the static water level elevation by locating the house associated with each well record, where possible, and determining the ground surface elevation from topographic maps. Estimated water levels near the mine site (Figure 3) show that groundwater drops from the mine site to the north and west, toward Dakin Creek, White Creek, and Green Lake. Static water elevations estimated for the three WCRs closest to the mine site, south and east of Brooklyn G Rd. and north of CTH K, are 935 ft, 942 ft, and 954 ft. The latter well is on the Kinas property, and the CUP application reports an observed depth to water of 60 ft in January 2022, without describing measurement methods. The static depth to water reported on the WCR in 1976 was only 26 ft. The difference in water levels between this reported water level and the deeper measurement reported by Kinas may be related to errors in either or both measurements and/or groundwater level fluctuations over time.

It is important to note that water levels in water supply wells are commonly lower than the water table. The water level in a well represents an average hydraulic head across the depth interval to which it is open to the aquifer. In upland areas, such as the proposed mine site, the groundwater gradient is commonly downward, and lower heads at depth cause the water level in the well to be below the water table. This is well known by researchers that use these wells for water table mapping and groundwater model calibration, and it is why groundwater monitoring wells are constructed with short open intervals. A local example of this effect is the WCR for well 8DI608 near Powell Spring. The reported depth to water of 50 ft in this well corresponds to an elevation of approximately 900 ft, which is 23 ft below Powell Spring where the water table intersects the ground surface.

Water table elevations naturally fluctuate in response to wet and dry periods. This can be seen in groundwater monitoring data from the U.S. Geological Survey for a well in Dodge County completed in the St. Peter Sandstone to a depth of 125 ft (Figure 4). Between 1964 and 2022, water levels in that well varied more than 12 ft. Therefore, groundwater levels in the future are likely to range above and below levels that are measured today.

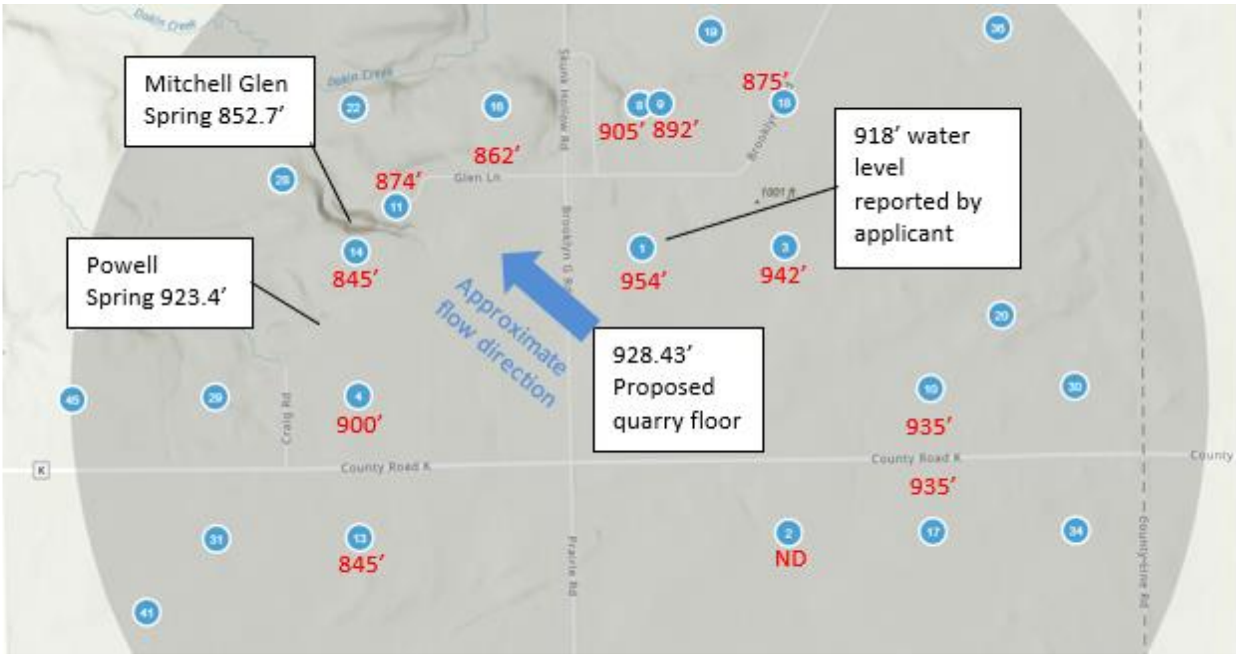

Figure 3. Comparison of water level data and proposed quarry elevation. Static water level elevations estimated from selected Well Construction Reports are labeled in red. Note drop in water levels to the north and west toward Dakin Creek and White Creek.

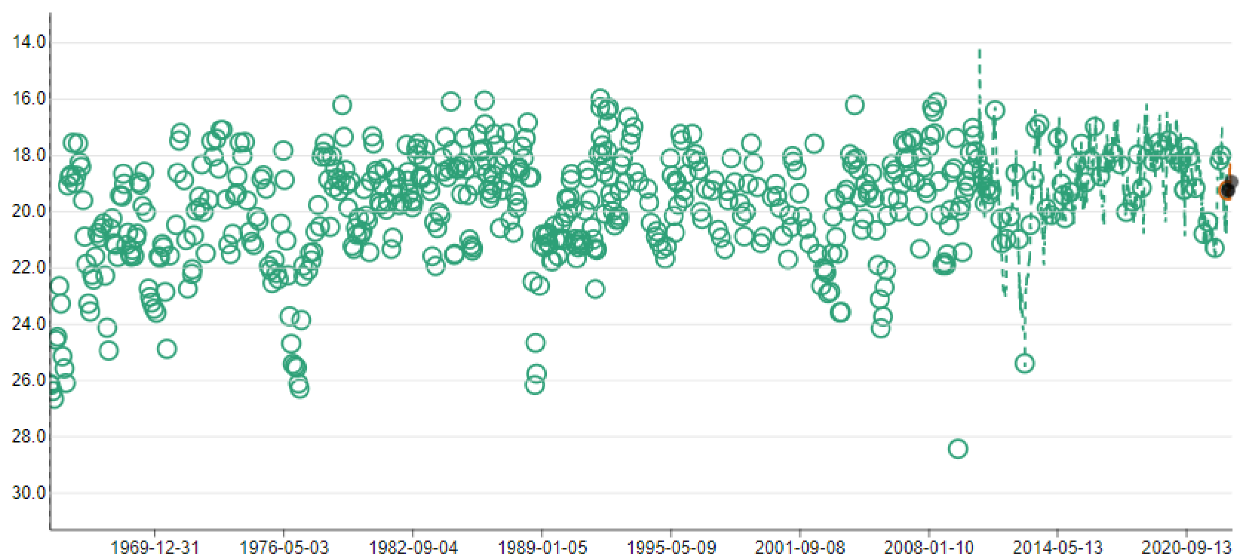

Figure 4. Variations in depth to water (in feet below ground surface) in a Dodge County well completed in the St. Peter Sandstone from 1964 to 2022 (from US Geological Survey)

Conclusions and Recommendations

1. Available information indicates that the water table at the mine site is higher than the proposed pit floor elevation.
2. Available data are not adequate to precisely determine the water table elevation at the site, and monitoring wells should be installed.
3. The water table elevation naturally fluctuates with wet and dry cycles, and it is likely that the water table elevation in the future will fluctuate above and below the level that is measured now.

2.2. Potential Groundwater Use

No groundwater dewatering is proposed, because the plan calls for the mine to be above the water table. However, the available data described above indicate that dewatering would likely be necessary to mine to the proposed depth of 928.43 ft. If ground dewatering were to be employed at the mine, this would lower the water table at the mine site and drawdown groundwater levels for some distance around the mine. This would create the potential for water availability impacts at neighboring wells and downgradient springs, as well as water quality impacts discussed in Section 3.1.

In addition, the CUP application describes the potential to install a new water well as a supply for aggregate processing, dust suppression, and portable pavement plants. No information has been provided by the applicant as to whether or not this would be a high capacity well, expected pumping rates, or the frequency of use of such a well. This makes it impossible to evaluate the potential impact of a new well on neighboring water supply wells or flow to local springs and streams. Pumping of a well would also draw down the water table with potential to affect neighboring wells and the springs.

The private water supply well at the Nehm farm is located approximately 1300 ft south-southwest of the mine site property, and DNR Well Construction Reports indicate that 13 more private water supply wells are located within 2500 ft the mine site. Potential drawdown impacts on these wells and the springs should be evaluated with a hydrologic study that includes:

a) collection/interpretation of data from monitoring wells at the mine site to estimate aquifer transmissivity (e.g. by conducting well hydraulic tests and evaluating drilling logs);
b) a drawdown analysis (e.g. the Theis method) for the proposed well to estimate drawdown at nearby wells and the springs; and
c) calculation of the expected pumping rate of the well as a percentage of the flow rates from local springs to quantify the potential reduction in spring flow that groundwater pumping at the mine could cause.

At present, no details are available on the potential pumping rate, duration, and frequency for dewatering and/or water supply pumping at the mine, so that it is not possible to evaluate potential drawdown impacts on neighboring wells and the springs.

Conclusions and Recommendations

1. If the mine is excavated to the depth proposed in the CUP application (928.43 ft), groundwater dewatering pumping is likely to be necessary.
2. No information is available on the rate, duration, or frequency of pumping from a new water supply well for the mine.
3. Before groundwater pumping at the mine is approved, a hydrologic study should be conducted to predict impacts on neighboring wells and the springs.
4. There is not sufficient information on potential groundwater pumping at the mine to evaluate these impacts.
5. It is unclear who would review this information to approve installation of a well.

3. GROUNDWATER QUALITY

3.1. Mobilization of Metals Below the Water Table

Concerns have been raised about the potential for the Skunk Hollow Mine to contaminate groundwater with arsenic and other metals. Drinking water contaminated with arsenic has been associated with cancer and other health problems, and this issue has gotten a lot of attention in eastern Wisconsin over the past 20 years or more. Arsenic is present in naturally occurring sulfide minerals in the dolomite and sandstone bedrock, and human activities that introduce oxygen into the aquifer can cause chemical reactions that release arsenic into the groundwater. Mining at or below the water table would have potential to trigger this process, as could pumping of a water supply well at the mine site. Mobilization of metals in groundwater at mines below the water table has been documented by the DNR in southwestern Wisconsin in the same rock formations as present at the mine site.[2]

Elevated arsenic concentrations occur in Green Lake County's groundwater. Wisconsin Department of Natural Resources data[3] for water supply wells in the county from 2014 – 2021 show that about 4% of samples had arsenic above the state drinking water Enforcement Standard of 10 ug/L, which is based on public health recommendations, with a maximum of 601 ug/L. An additional 29% of samples were above the state's Preventive Action Limit of 1 ug/L, which is a threshold that can trigger additional investigation

[2] Johnson, DM, 2009. Water supply and water quality issues in southwestern Wisconsin. In The Upper Mississippi Valley lead-zinc district revisited: mining history, geology, reclamation, and environmental issues thirty years after the last mine closed. Illinois State Geological Survey, Guidebook 38.

[3] Johnson, DM, Wisconsin Department of Natural Resources, written communication, November 18, 2022.

and corrective action. An irrigation well on the Machovich property approximately 1 mile northeast of the proposed mine site had very high concentrations of arsenic (2310 ug/L) and nickel (4310 ug/L) in 2012.

As noted in the CUP application, the bedrock that is proposed to be quarried is presumed to be the Sinnipee Group dolomite. The literature indicates that sulfide minerals can be present in the Sinnipee Group. Gotkowitz (2002) notes the source of arsenic in wells in the Fox Valleys is believed to be a sulfide-rich horizon at the base of the Platteville Formation, which is the lowest formation in the Sinnipee Group.[4] Brown and Maass (1992)[5] found that the iron sulfide mineral pyrite was abundant in rock cuttings from the Sinnipee Group in 53 water wells examined in Dodge, Fond du Lac, and Winnebago Counties. They also noted that pyrite is commonly observed in quarries in the Sinnipee dolomite, including a quarry in Dodge County, and that it occurs as coatings along joints and replacing fossils.

The CUP application notes that a water supply well could be installed at the site as a source of water for washing and processing aggregate materials and for dust suppression. A new supply well at the site would presumably be drilled into the bedrock units underlying the Sinnipee Group, which include the St. Peter Sandstone, Prairie du Chien Group dolomites, and the Cambrian Sandstone units. The Machovich well with the high arsenic and nickel concentrations noted above was also open to these rock units. Use of well water with elevated metal concentrations in the mine would result in exposure risks to groundwater (through infiltration to the water table) and surface water (through pumping out of the pit). If a new well were to be installed, it should be constructed based on DNR recommendations for the Arsenic Advisory Area of northeastern Wisconsin and tested for metals annually. Re-using stormwater from the pit would be preferable to a new water supply well for quarry operations to reduce the potential to mobilize metals.

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[4] Gotkowitz, M, 2002. Report on the preliminary investigation of arsenic in groundwater near Lake Geneva, Wisconsin. Wisconsin Geological and Natural History Survey, Open-File Report 2000-02.

[5] Brown, BA and RS Maass, 1992. A reconnaissance survey of wells in eastern Wisconsin for indications of Mississippi Valley type mineralization. Wisconsin Geological and Natural History Survey, Open-File Report 92-3.

Conclusions and Recommendations

1. Mining should not occur below the water table due to the risk of mobilizing metals in groundwater. The current plan does not appear to meet this criterion.
2. The areas at highest risk of groundwater contamination from the mine are north and west of the mine site, including White Creek, Powell Spring and Creek, Mitchell Glen, Glen Creek, and Dakin Creek.
3. The potential risk of groundwater impacts on other properties should be evaluated through installation of monitoring wells to identify the groundwater flow direction(s). Because the mine site is located near a groundwater divide on the USGS water table map (Figure 2), groundwater flow in multiple directions from the mine site is possible.

3.2. Mobilization of Metals Above the Water Table

Contamination of groundwater by metals is possible even if the mining is above the water table. Acid rock drainage (ARD) can occur where sulfide minerals are exposed to air and water, which is accelerated by excavation of rock. Oxidation of sulfide minerals is often accompanied by mobilization of metals.[6] As noted above, the Sinnipee Group dolomite that would be quarried commonly contains sulfide minerals, and these could be exposed to air and water from rainfall and runoff in the quarry walls and in rock stockpiles.

Acid rock drainage is a common problem well studied by the global mining industry. In the upper Midwest, this issue mainly gets attention in mines and road cuts in crystalline rocks in northern Minnesota and Wisconsin. Less information is available about the occurrence of acid rock drainage in dolomite and limestone bedrock areas, such as Green Lake County. Limestone and dolomite are composed of carbonate minerals that consume acid, reducing acidity of drainage and metals mobilization. The Minnesota Department of Transportation has a guidance document for acid rock drainage from road cuts which is focused on northern Minnesota, where rocks tend to have higher prevalence of sulfide minerals (acid generators) than carbonate minerals (neutralizing agents).[7] However, even mine drainage that is buffered to a neutral pH can contain elevated metal concentrations (Figure 5).[8] Abandoned roaster waste rock piles from an old zinc mine in dolomite at Mineral Point, Wisconsin created acid drainage and high

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[6] Global Acid Rock Drainage Guide, 2014. The International Network for Acid Prevention. www.gardguide.com

[7] MnDOT, 2019. Guidance Manual for Potentially Acid Generating Materials in Northern Minnesota. Report 2019-40.

[8] www.gardguide.com

concentrations of heavy metals that caused Brewery Creek to become sterile until the site was reclaimed by the DNR in 1993.[9]

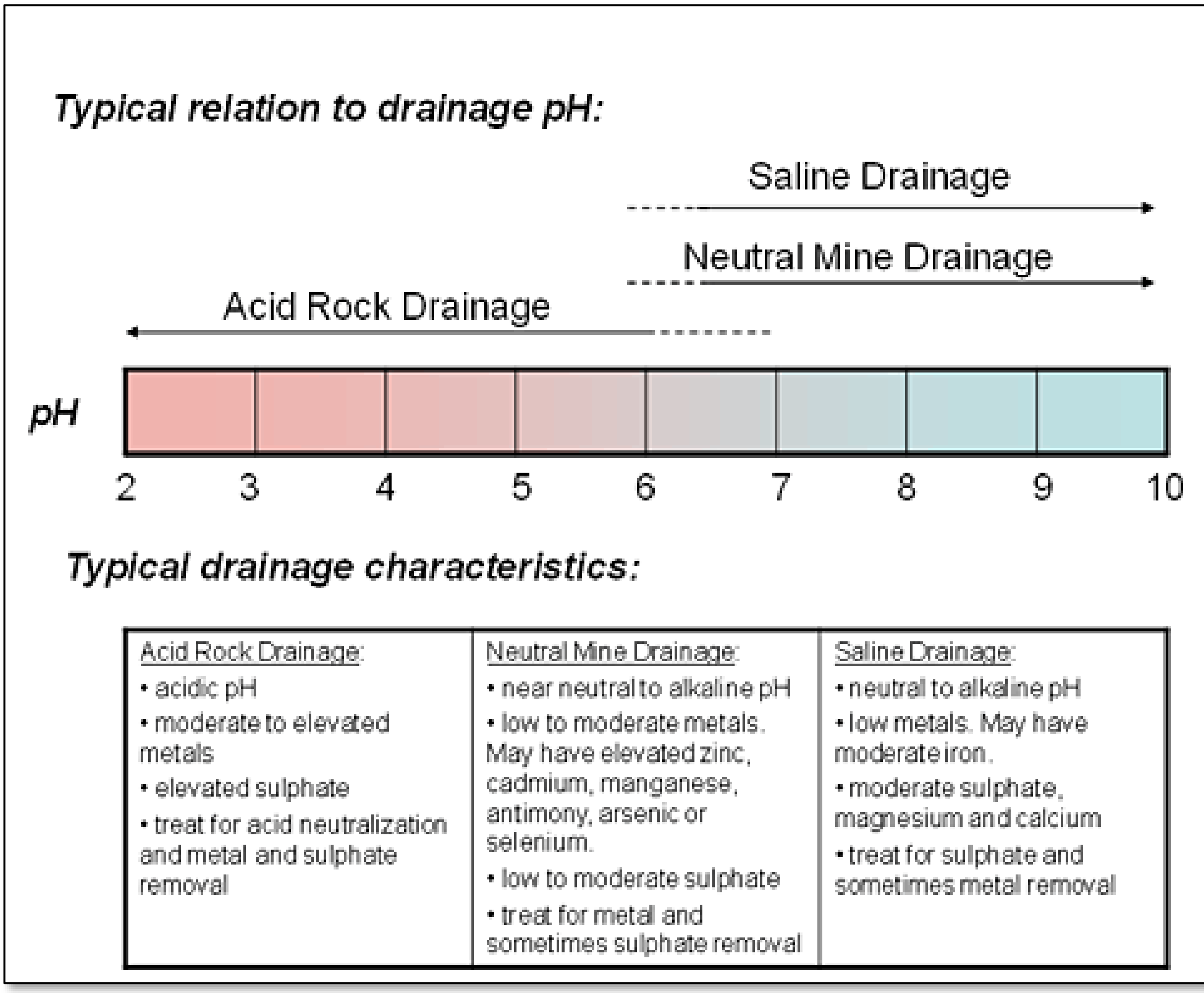

Figure 5. Types of drainage produced by sulfide oxidation (www.gardguide.com).

It takes time for sulfide minerals to oxidize enough to generate acid drainage, and EOR's experience is typically takes 5 – 10 years for acid mine drainage to be detected. It is also possible for the rate of acid drainage development to increase over the years as different rock weathering and acid buffering mechanisms take effect.[10] The mine is proposed for operation for more than 30 years, and rock materials

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[9] Hunt, TC, 2009. Reclamation of zinc roaster waste, Mineral Point, Wisconsin. In The Upper Mississippi Valley lead-zinc district revisited: mining history, geology, reclamation, and environmental issues thirty years after the last mine closed. Illinois State Geological Survey, Guidebook 38.

[10] www.gardguide.com

will be stockpiled in the mine where they will be exposed to air and water. The length of time that rock materials are stockpiled will likely depend on the demand for aggregate products. The reclamation plan is to incrementally fill the quarry throughout its life as mining is completed in different parts of the pit. This would reduce the time that quarry walls are exposed to air and water, reducing acid rock drainage risk. Details are not available about how long quarry walls would typically be exposed.

Acid drainage and metals from the quarry could infiltrate downward to the water table and migrate downgradient in the groundwater to private wells, the springs, streams, and Green Lake. Movement of an acidification front in groundwater will be slower in a well-buffered environment, but as noted above even neutralized mine drainage can contain elevated concentrations of metals.[11] Dissolution of carbonate minerals by acid drainage can increase the potential to develop sinkholes and other karst solution features; monitoring for development of these features should be conducted if the mine is approved.

Measures that can be used in mines to reduce the risk of acid drainage and metals mobilization include monitoring water draining from stockpiles and pit walls for pH and metals, and sampling groundwater in monitoring wells downgradient of a mine for metals and sulfides. Note that multiple wells are prudent in fractured rock settings, such as typically formed by the Sinnipee Group dolomite, because of the chance for preferential groundwater flow paths to bypass a well. Monitoring downstream receiving waters, such as streams and springs, for changes in temperature, metals, or other water quality parameters, such as sulfate can detect and track impacts once they have occurred. Aggregate stockpiles containing sulfide minerals can be placed on liners to collect and treat acidic water that leaches through them before it drains off-site. Finally, reclaiming areas of the pit where mining is completed as soon as practicable reduces the time that sulfide minerals are exposed to air and water.

Conclusions and Recommendations

1. The literature demonstrates that sulfide minerals are present in the Sinnipee Group dolomite that is proposed for mining.
2. Mobilization of metals through the acid rock drainage process is possible at this site, even with buffering by the carbonate minerals in the dolomite bedrock.
3. Humidity cell testing of rock samples from the proposed mine site following ASTM Method D5744-07e1 is recommended to evaluate the risk of acid rock drainage at the site. It could take multiple years for acidification to occur, so a long-term test is recommended. This is administratively challenging, and it is unclear what organizations would conduct the testing, review the results, and act upon them.

[11] www.gardguide.com

4. Because acid rock drainage can take years to develop, if the mine is approved, it could already be in operation before laboratory testing and/or field monitoring detects a problem with acid rock drainage.

3.3. Blasting

Blasting is part of the proposed quarrying operations. Blasting is regulated by Wisconsin Administrative Code Chapter SPS 307, which addresses potential physical effects on neighboring properties, including vibrations and damage to structures. Monitoring of vibrations with a seismograph is required, which would provide data on the timing of blasts and magnitude of ground vibrations.

It is uncertain how the blasting might affect water supply wells and springs in the area. Blast vibrations have potential to change the nature of fractures through which groundwater flows, which could affect the quality or quantity of flow to wells and springs. Information provided by the DNR (Attachment B) shows monitoring well sampling data for a sand mine in western Wisconsin with large nitrate increases after blasting. A mixture of ammonium nitrate and fuel oil is the most common explosive used in quarries, creating a nitrate source.[12] The petroleum compounds in the explosives are another potential contaminant of concern. The DNR information also notes that the Department commonly receives complaints about silt and rust in wells related to blasting. These impacts could occur downgradient of the mine as well as in other areas that are disturbed enough by vibrations to cause physical and chemical changes to the aquifer.

Conclusions and Recommendations

1. Blasting is a potential source of nitrates and petroleum compounds.
2. The DNR has documented contamination of groundwater with nitrates after blasting at a Wisconsin sand mine.
3. The DNR reports that they commonly receive complaints about sediment and metal staining in well water near blasting sites.
4. Powell Spring and Mitchell Glen are located downgradient of the mine site, and physical or chemical changes in the aquifer due to mining could affect the springs.
5. The risk of impacts on groundwater quality, neighboring wells, and the springs should be understood and considered in reviewing the CUP application.

[12] Illinois Department of Natural Resources, FAQ Aggregate Blasting. https://www2.illinois.gov/dnr/mines/EAD/Pages/FAQAgreggateBlasting.aspx

4. STORMWATER RUNOFF

Stormwater runoff from the mine site currently flows north across Brooklyn G Rd. through the property of Ernie Neuenfeldt at N5139 Brooklyn G Rd. and northwest across Skunk Hollow Rd. to Mitchell Glen, as indicated by topographic contours and the CUP application. Stormwater and wastewater at the mine site would be regulated by the DNR under General Permit WI-0046515-07-0 for Mineral (Nonmetallic) Mining and/or Processing. The DNR is in the process of reviewing the Erosion Control and Storm Water Management Plan for the Skunk Hollow Quarry (the Plan) and has not yet issued the permit. The permit regulates discharges to both surface water and groundwater and includes requirements for water quality sampling for common contaminants of concern. These include pH, Total Suspended Solids, nitrate, sulfate, arsenic, and other metals.

The Plan describes a containment berm around the quarry site, a sediment trap on the mill level that will discharge off-site (location not identified on drawings), a sediment trap and sump located on the pit floor, a sediment basin situated north of the site, and a drainage swale to convey water pumped from the sump in the quarry to the sediment basin. Overflow from the sediment basin would flow northwest through the Neuenfeldt property to Dakin Creek. The Plan states that water will be pumped from the sediment trap and sump in the quarry only after a 10-yr or larger rainfall, but no other details of the pumping system operation are provided to evaluate the frequency, discharge, or duration of pumping to the surface drainage swale. No information is provided to determine whether the drainage swale or downstream channel would be subjected to erosive conditions during these pumping episodes. Pumping would likely be necessary more frequently if water in the pit does not seep away to groundwater quickly enough to provide storage volume for the next rainfall. No analysis is provided on the rate at which water is expected to seep into the pit floor to back up the assertion that pumping will only be necessary after the 10-yr or larger event. Similarly, the level of detail in the Plan is insufficient to determine if the proposed sediment trap(s) and basin will provide adequate settling treatment.

Neither the Erosion Control and Storm Water Management Plan nor the Stormwater Pollution Prevention Plan address any of the chemicals contained in blasting agents or if the sediment trap and basin would provide adequate treatment for them. The contaminants of concern in blasting agents – nitrates and petroleum compounds – are typically dissolved in water, and particulate settling is not an effective treatment for them. Contamination of groundwater is therefore a concern, particularly if process water rapidly infiltrates from the pit into fractures in the bedrock.

Conclusions and Recommendations

1. The locations and characteristics of all the proposed discharges to surface water and groundwater are not adequately described in the Erosion Control and Storm Water Management Plan.
2. The timing, amount, and quality of water that would be discharged from the pit to the surface drainage system off-site is not described in enough detail to understand risks of impacts.

3. Treatment of chemicals used in blasting is not addressed in the Erosion Control and Storm Water Management Plan nor in the Storm Water Pollution Prevention Plan. The particulate settling in the proposed sediment traps and sediment basin are not effective for treating these dissolved pollutants (nitrate and petroleum compounds).
4. Infiltration of stormwater and process water in the pit poses a water quality risk to groundwater, and the downgradient springs and streams.

5. SUMMARY

Our specific conclusions and recommendations are summarized in the preceding sections of this report. Available information suggests that the Skunk Hollow Mine cannot be operated as proposed without adverse impacts on the health and welfare of nearby residents or without degradation of aquatic resources including Powell Spring and Creek, White Creek, Mitchell Glen, Glen Creek, and Dakin Creek. The CUP application materials lack important information needed to provide confidence that the public health and the environment can be protected with the mine in operation.

ATTACHMENT A

Resume for Steve Gaffield

Project Experience

Groundwater Modeling, Analysis, and Planning

Black Earth Creek Watershed Green Infrastructure Plan
Capital Area Regional Planning Commission / Project Manager
Coordinated technical analysis and engagement of farmers and other stakeholders. Developed hydrologic modeling approach to evaluate benefits of urban and rural green infrastructure for flood reduction and water quality improvement. Presented project information to stakeholder steering committee and general public. Developed green infrastructure recommendations, including funding, and implementation planning.

Little Plover River Restoration Plan
Village of Plover, WI / Project Manager
Leading analysis of streamflow and habitat restoration alternatives for trout stream heavily impacted by groundwater pumping. Performing QA/QC on MODFLOW transient groundwater modeling and other water budget analyses. Coordinating with team of local & state government, non-profits and agricultural industry group.

Cheryl Drive
City of Fitchburg, WI / Project Manager
Provided QA/QC and technical oversight for the SWMM modeling of the storm drainage system, including model design, hydraulic modeling results, diagnosis of critical infrastructure limitations, and infrastructure maintenance, and upgrade recommendations.

Middleton Floodplain Study, Scenarios, and Costing
City of Middleton, WI / Project Manager
Coordinated planning, development, and calibration of a 1D/2D PCSWMM model of the Pheasant Branch Creek watershed. Oversaw mapping of the 1% and 0.2% annual chance floodplains. Led use of model to evaluate benefits of potential flood mitigation projects and conceptual cost estimates. Presented project findings to City commission and at public meetings, and discussed the potential project mitigation with dairy farm representatives.

Cross Plains Flood Mitigation
Jewell Associates Engineers / Principal-in-Charge
Provided technical advice and QA/QC review for hydrologic and hydraulic analysis of potential flood mitigation projects in the Village of Cross Plains, WI, including green infrastructure (wetland/floodplain restoration), and gray infrastructure (flood control dam and street crossing improvements).

Private Wetland Mitigation Bank in Dodge County, WI
Eco-Resource Consulting / Project Manager
Reviewed soil test pit and groundwater monitoring well data. Conducted groundwater modeling using analytic element code GFLOW to evaluate groundwater rise from proposed drainage disablement. Reviewed and drafted hydrologic and hydraulic sections of the draft Mitigation Bank Instrument. Oversaw development of restoration grading design and plan sheets.

Spring Harbor Watershed Study in Madison, WI
AE2S / Project Manager
Led EOR's support to AE2S' development of a SWMM watershed model for the City of Madison, WI. Participated in 3 public stakeholder meetings to gather input from break-out groups. Led development of conceptual design drawings and cost estimates for potential infrastructure improvements for flood mitigation.

Stephen J. Gaffield, PhD, PE, CFM

Water Resources Engineer

Steve has 28 years of experience in hydrogeology and water resources engineering. He has been project lead for many groundwater protection, floodplain, stormwater design and wetland restoration projects. He is active on research committees at the University of Wisconsin, presents frequently at technical conferences, and contributes to technical journals. Steve also has extensive experience with public participation and education.

Education

1988 Bachelor of Arts in Geology and Physics Albion College

1991 Masters of Sciences in Geology University of Wisconsin-Madison

2000 Doctor of Philosophy in Geological Engineering University of Wisconsin-Madison

Professional Registration

#39140 WI Professional Engineer: civil
US-16-09286 Certified Floodplain Mgr.

Professional Activities

2012-22 Univ. of Wisc. Groundwater Research Advisory Council

2009-22 Wisconsin Geological & Natural History Survey Geologic Mapping Committee

2011 American Water Resources Assoc. WI - former president

Areas of Expertise

- Groundwater Analysis
- Watershed Planning
- Stormwater Management
- Floodplain & Dam Hydraulics
- Non-point Source Monitoring & Analysis
- Project Management

McCandless Remap Feasibility
Village of Plover, WI / Project Manager
Planned and reviewed evaluation of the accuracy of Flood Insurance Study hydrologic and hydraulic models. Provided advise on actions the City could take to improve the accuracy of floodplain maps.

Evansville Wetland Mitigation Design
Heartland Ecological Group / Principal-in-Charge
Provided technical input and review for wetland mitigation site grading and drainage disablement at a Wisconsin Department of Natural Resources mitigation site. Planned and reviewed Lateral Effect modeling of the effect of breaking drain tiles.

Plover Wetland Mitigation
Village of Plover, WI / Project Manager
Leading development of wetland mitigation plan with subconsultants, Wisconsin DNR and Portage County. Coordinated wetland design and site preparation with farmer selling the land. Planned and reviewed MODFLOW groundwater modeling of restoration and developing transient spreadsheet screening model. Lead restoration design, including ditch fill and irrigation well shut-down.

Big Hollow Wetland Mitigation Bank
Black Bear Enterprises / Project Manager
Led hydrologic monitoring, modeling, and civil site design for a proposed 190-acre wetland mitigation bank near Spring Green, WI, in collaboration with a restoration ecology partner. Supported submittal of a draft Mitigation Bank Instrument to the Interagency Review Team. Coordinated 2D modeling of surface runoff with PCSWMM and performed groundwater analysis with the analytical Theis equation and MODFLOW. Coordinated design and submittal activies closely with the landowner, who has actively farmed the site.

F&A Dairy Groundwater Review
The Probst Group/ Project Manager
Led groundwater review components of a WPDES permit renewal for a Wisconsin dairy that land-applies process water to farm fields. Reviewed water quality data for groundwater monitoring wells and the irrigation water, as well as details of wastewater application locations and timing. Coordinated evaluation of regional groundwater flow system and analysis of contamination risk for local water supply wells.

Stormwater Infiltration Mounding and Design
Terravessa Plat, Fitchburg, WI / Technical Advisor
Modeled groundwater mounding below regional infiltration basins with analytical equations and MODFLOW, including interference with system performance and off-site impacts. Developed iterative approach to balance infiltration volume from WinSLAMM design model with groundwater mounding constraints.

PolyMet Mine Groundwater Review
Great Lakes Indian Fish & Wildlife Commission / Project Manager & Technical Lead
Reviewed MODFLOW groundwater model of proposed mine under closure conditions. Critiqued analysis of mining company's consultant and tested their assumptions through a model sensitivity analysis to identify substantial risk of contaminated groundwater migration off-site under the proposed plan.

Proposed Non-Metallic Mine Environmental Review
Town of Vienna, WI / Project Manager & Technical Lead
Evaluated potential groundwater impacts related to three proposed quarry sites, including two sand and gravel pits and a dolomite bedrock quarry. Evaluated water quantity and quality impacts through site inspections, review of the proposed operating plans, and analysis of available hydrogeologic data. Key issues included the depth of mines relative to the water table, management of potential contaminant sources such as fuel for equipment, washing operation details, and design of site erosion control and stormwater management plans. Presented findings to the Town planning commission.

Proposed Gravel Pit Environmental Review
Town of Milton, WI / Project Manager & Technical Lead
Evaluated potential groundwater and surface water impacts related to a proposed gravel pit on behalf of the Town, as part of their condition use permit process. Inspected the site and reviewed applicant's plans for excavation, equipment operation and reclamation. Reviewed data on soils and hydrology to identify potential impacts on a stream, wetlands and groundwater. Coordinated wetland ecological evaluation and impact analysis. Presented findings to the Town planning commission in a condition use permit hearing.

Utility Construction Dewatering
Village of Cross, WI / Project Manager
Worked with Village public works director, Village engineer, and contractor/technical advisor to scope potential dewatering system issues and designs. Constructed GFLOW analytic element groundwater model of dewatering systems to predict pumping rates and impact on adjacent trout stream flow and temperature. Led permitting with Wisconsin Dept. of Natural Resources for high capacity wells and discharge to creek.

Stevens Point Municipal Well Impact Analysis
Town of Hull, WI / Technical Lead
Provided groundwater expert support to the Town and its legal counsel in dispute with the City of Stevens Point over loss of water in dozens of private residential wells after the City started operation of a large collector well nearby. Reviewed monitoring well data trends to identify drawdown impacts of the City well and refined and calibrated an existing MODFLOW groundwater model to simulate potential future drawdown impacts. Represented the Town in numerous settlement negotiation meetings and presented at a public meeting to describe the agreement.

Richfield Dairy Groundwater Impact Expert Testimony
Pleasant Lake Management District / Project Manager & Technical Lead
Reviewed groundwater modeling and reports by proposed dairy's consultants to evaluate expected impacts on lake level and flow in a trout stream and springs. Evaluated modeling assumptions, hydrologic data and scientific literature. Inspected hydrologic conditions at the site. Testified in a State of Wisconsin contested case hearing that led to a decision that the State must consider cumulative impacts of high capacity wells.

Madison Water Utility East Side Master Plan
Black & Veatch, Inc. / Technical Lead
Analyzed PCE, Mn and Fe trends in 3 water supply wells and recommended plan to evaluate PCE reduction alternatives. Evaluated hydrogeologic, land use, and infrastructure factors for potential sites for a new well in an urban area with a long history of industrial use. Presented in a series of public meetings to gather input and provide project details.

Groundwater Susceptibility Mapping
Calumet County, WI / GIS Specialist at the Wisconsin Geological & Natural History Survey
Assisted in identifying key risk factors for glacial and dolomite aquifers. Conducted GIS analysis of geologic and hydrologic factors to map the water table and susceptibility of both aquifers to contamination by human activities. Resulted in publication of WGNHS Miscellaneous Map 56.

Wetland & Lake Restoration

Plover Wetland Mitigation
Village of Plover, WI / Project Manager
Leading development of wetland mitigation plan with subconsultants, Wisconsin DNR and Portage County. Planning and reviewing MODFLOW groundwater modeling of restoration and developing transient spreadsheet screening model. Leading restoration design, including ditch fill and irrigation well shut-down.

Leopold Memorial Reserve Treatment Wetland
Sand County Foundation / Project Manager
Planned design for 4-acre wetland enhancement demonstration project to remove nitrogen from agricultural runoff in Sauk County, WI near Aldo Leopold's famous farm. Planned and assisted hydrologic and water quality monitoring pre- and post-project, including selection, purchase and installation of flow meter, automated sampler, telemetry, monitoring wells and water level loggers. Evaluated cost, performance and permitting feasibility of several designs. Led construction drawing and specification preparation, performed construction observation, and worked with subconsultants to establish native vegetation. Directed four years of performance monitoring and data analysis. Planned and edited Journal of Soil and Water Conservation paper describing successful denitrification results.

Stormwater BMP Feasibility & Design

Warner Lagoon Water Quality Study
City of Madison, WI / Project Manager
Performed evaluation of water quality and fishery improvement options for 30-acre wetland/pond system adjacent to Lake Mendota, in collaboration with fisheries experts and graphic designer. Directed stormwater treatment design and WinSLAMM modeling and performed QC model review. Synthesized data and recommendations from biologist team members for carp control and exclusion, including a physical barrier and baited trap netting. Estimated costs for stormwater treatment, habitat dredging, and mechanical aeration. Led 3 stakeholder meetings. Planned and directed preparation of 30% drawings of stormwater treatment and dredging projects and wrote feasibility report.

UW-Madison Neighborhood Stormwater Study
UW-Madison & WI Dept. of Administration / Project Manager
Planned and directed WinSLAMM model analysis of stormwater runoff volume and sediment controls for 6 parcels on the UW-Madison campus planned for future redevelopment. Researched performance of green infrastructure / low-impact development options including green roofs and walls, permeable pavement and water harvesting and reuse. Directed installation and sampling of monitoring wells to evaluate subsurface hydraulic properties of fine-grained glacial lake sediment and performed groundwater mounding analysis to determine limitations of stormwater infiltration. Simulated green roof performance with EPA's Stormwater Calculator. Developed new technique to model tree canopy interception over impervious surfaces to evaluate quantity and quality benefits in WinSLAMM; published in the Center for Watershed Protection's Watershed Science Bulletin in collaboration with U.S. Forest Service. Developed integrated conceptual stormwater plan for campus neighborhood, including several options for future site design evaluation, and cost per gallon of runoff reduced and pounds of sediment removed.

Floodplain Modeling, Planning & Management

Steve has performed floodplain modeling and permitting analyses for nearly 20 projects over the past 15 years, and he is a Certified Floodplain Manager. His experience includes hydrologic modeling of flood discharge with HEC-HMS, NRCS methods and statistical regression, and hydraulic modeling of flood elevations and mitigation alternatives using HEC-RAS. Steve's role in floodplain projects commonly include evaluating existing Flood Insurance Study models, modifying models to simulate proposed floodplain fill and stream crossings, designing mitigation alternatives to minimize floodplain impacts, QA/QC review, and helping clients understand the opportunities and constraints of floodplain regulations.

- ***Lake Belle View Restoration*** *(for Village of Belleville, WI)*
- ***Front St. Development*** *(Clifton Corporation, Watertown, WI)*
- ***Rowan and Hinkson Creeks Letter of Map Amendment*** *(for Town of Dekorra, WI)*
- ***Cell Tower Permitting*** *(Edge Consulting, Oneida County, WI)*
- ***Clark Creek Flood Study*** *(for Sauk County, WI)*
- ***Bike Trail Floodplain Permitting*** *(for City of Jefferson, WI)*
- ***Campground Fill Permitting*** *(Riverbend RV Resort, Watertown, WI)*
- ***Blackhawk Island Floodplain Permitting*** *(Luke Purucker, Jefferson County, WI)*
- ***Tenney Avenue Crossing*** *(Smart Realty Company, Waukesha, WI)*
- ***Traynor Aggregate Pit Bridge*** *(Dodge Concrete, Rock County, WI)*
- ***Brewing Expansion Permit Scoping*** *(New Glarus Brewing, New Glarus, WI)*
- ***Drumlin Grove Floodplain Delineation*** *(Burse Surveying & Engineering, Cottage Grove, WI)*
- ***Kinnickinnic River Restoration Design*** *(Milwaukee Metropolitan Sewerage District, Milwaukee, WI)*
- ***McCoy Property Development Permitting*** *(D'Onofrio Kottke Assoc., Sun Prairie, WI)*
- ***Zander Farms Development Permitting*** *(D'Onofrio Kottke Assoc., Cross Plains, WI)*
- ***Three Waters Reserve Flood Impact Analysis*** *(Applied Ecological Services, Brodhead, WI)*
- ***After-the-Fact Floodplain Permitting*** *(Ripon Rifle & Pistol Club, Fond du Lac County, WI)*
- ***Warner Park Channel Restoration Design*** *(for City of Madison, WI)*
- ***Powerplant Floodplain Analysis*** *(SCS Engineers, WI)*

Publications and Research Activities

Steve has been an active member of the University of Wisconsin-Madison's Groundwater Research Advisory Council since 2012. Each year, he reviews approximately 15 groundwater research proposals submitted to the UW-Madison Water Resources Institute (WRI) for funding, participates in discussion of the strengths and weaknesses of the proposals with other Council members, and provides recommendations to WRI for funding priorities. This experience provides valuable insights into current groundwater research topics and methods in Wisconsin.

Gaffield, Wudel & Kuehler, Dec. 2017. *Calculating stormwater volume and Total Suspended Solids reduction under urban tree canopy in Wisconsin using available research*. Watershed Sci. Bull.

Fehling, Gaffield & Laubach, 2014. *Using enhanced wetlands for nitrogen removal in an agricultural watershed.* Jour. Soil & Water Conservation 69(5): 145A-148A.

Gotkowitz, MB and SJ Gaffield, 2006. *Water-Table and Aquifer-Susceptibility Maps of Calumet County, Wisconsin*. Wisc. Geol. & Nat. History Survey Miscellaneous Map 56.

Gaffield, SJ, KW Potter and L Wang, 2005. *Predicting the Summer Temperature of Small Streams in Southwestern Wisconsin*. Jour. Amer. Water Res. Assoc. 41(1): 25-36.

Coauthor of Ch. 7: Water Quantity and Quality, in H Frumkin, L Frank and R Jackson, 2004, *Urban Sprawl and Public Health*. Island Press.

Gaffield, SJ, RL Goo, LA Richards and RJ Jackson, 2003. *Public Health Effects of Inadequately Managed Stormwater Runoff*. Amer. Jour. of Public Health 93(9): 1527-1533

Potter, KW and SJ Gaffield, 2001. Watershed assessment with synoptic base-flow surveys. In Geomorphic Processes and Riverine Habitat, American Geophysical Union, Water Science Application Volume 4, p. 19-25.

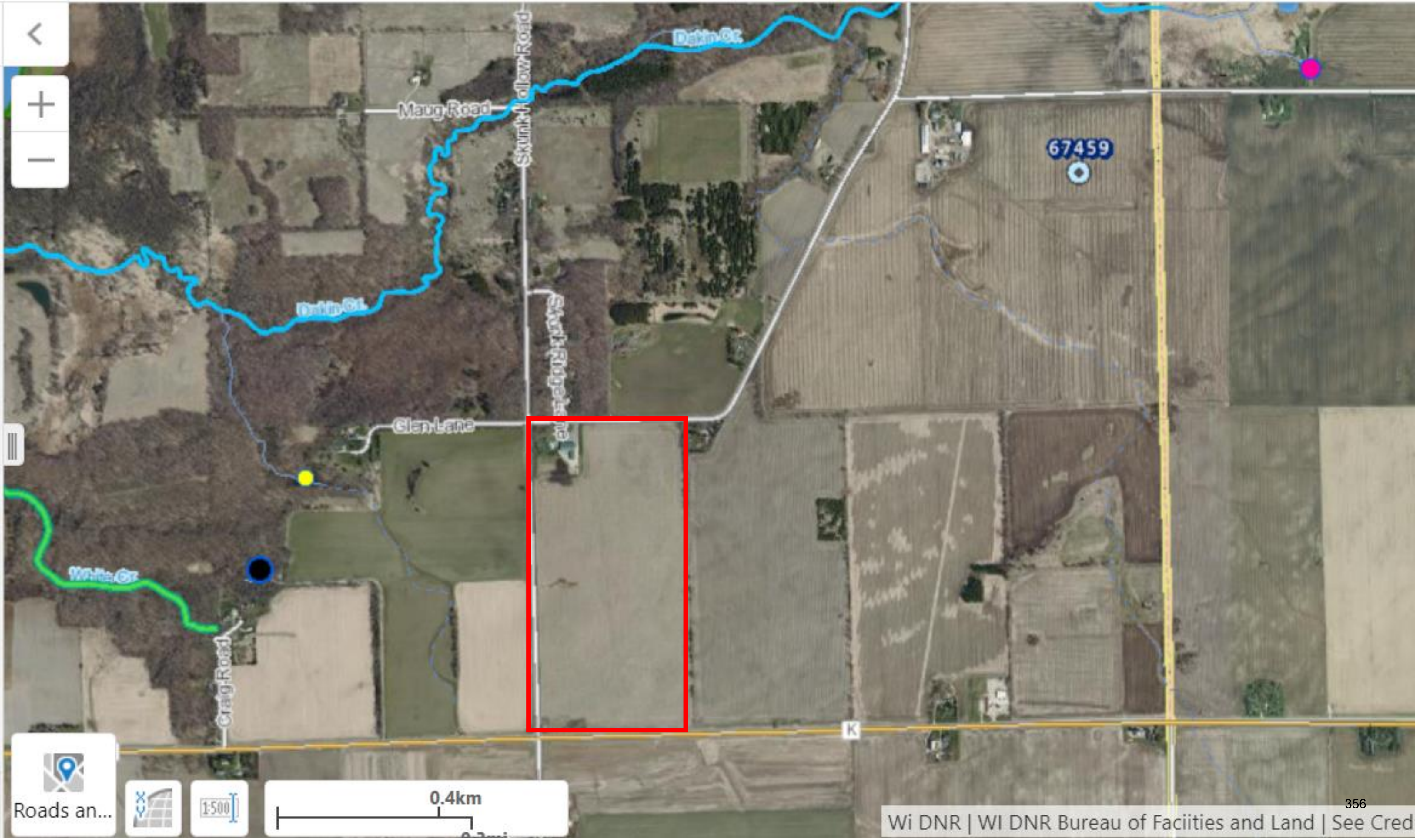
Syverson, KM, SJ Gaffield, and DM Mickelson, 1994. Comparison of esker morphology and sedimentology with former ice-surface topography, Burroughs Glacier, Alaska. Geological Society of America Bulletin, v 106, p 1130-1142.

Gaffield, SJ and DM Mickelson, 1995. Driving stress, hydraulic head and landform genesis at the southeastern Burroughs Glacier. Proceedings of the Third Glacier Bay Science Symposium, 1993. DR Engstrom (Ed.), Anchorage, Alaska.

ATTACHMENT B

Presentation on Powell Spring and the Proposed Skunk Hollow Mine from the Wisconsin Department of Natural Resources.

Powell Spring


Dakin Cr.
Maug Road
Skunk Hollow Road
67459
Dakin Cr.
Skunk Ridge Lane
Glen Lane
White Cr.
Craig Road
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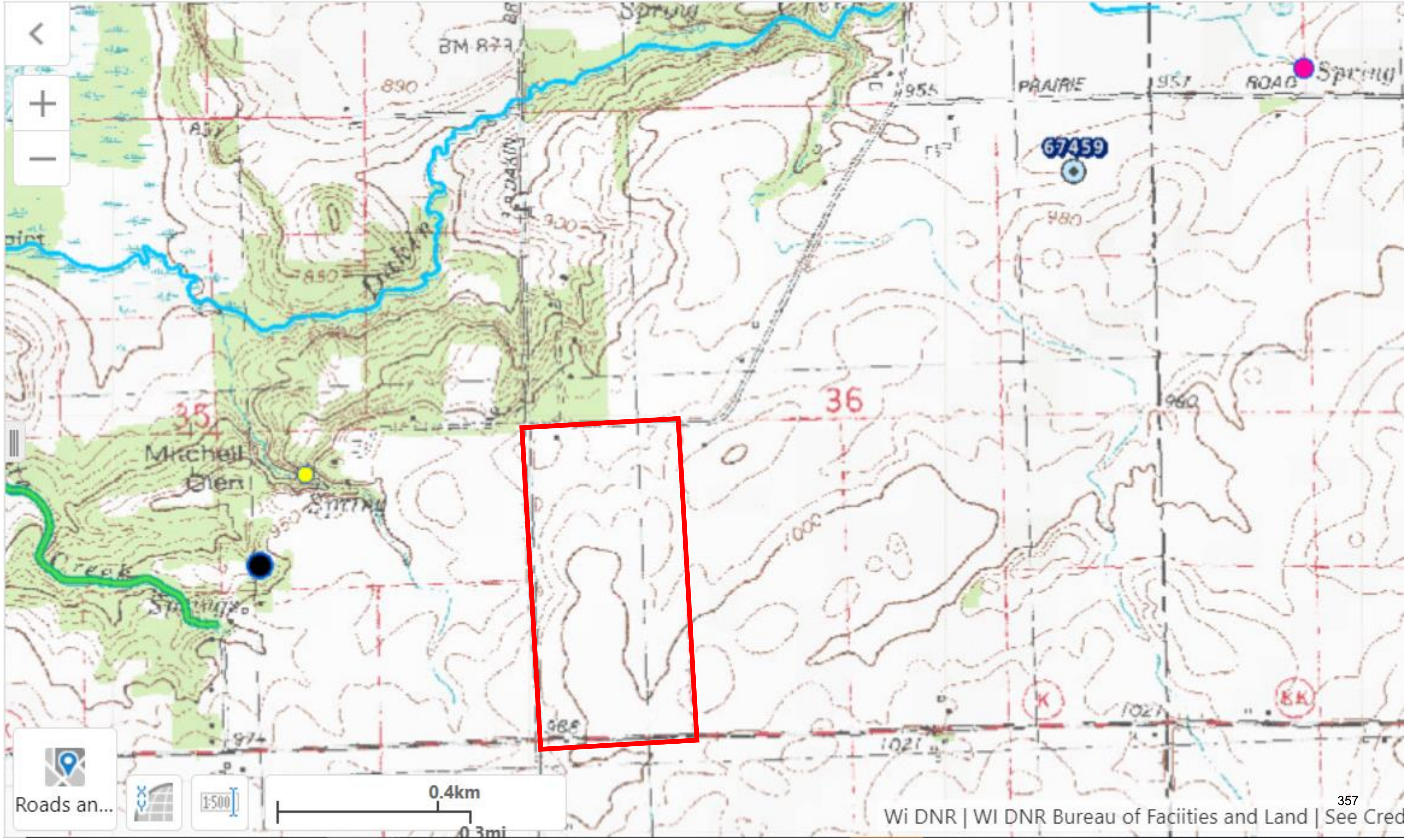

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PRAIRIE
ROAD
Spring
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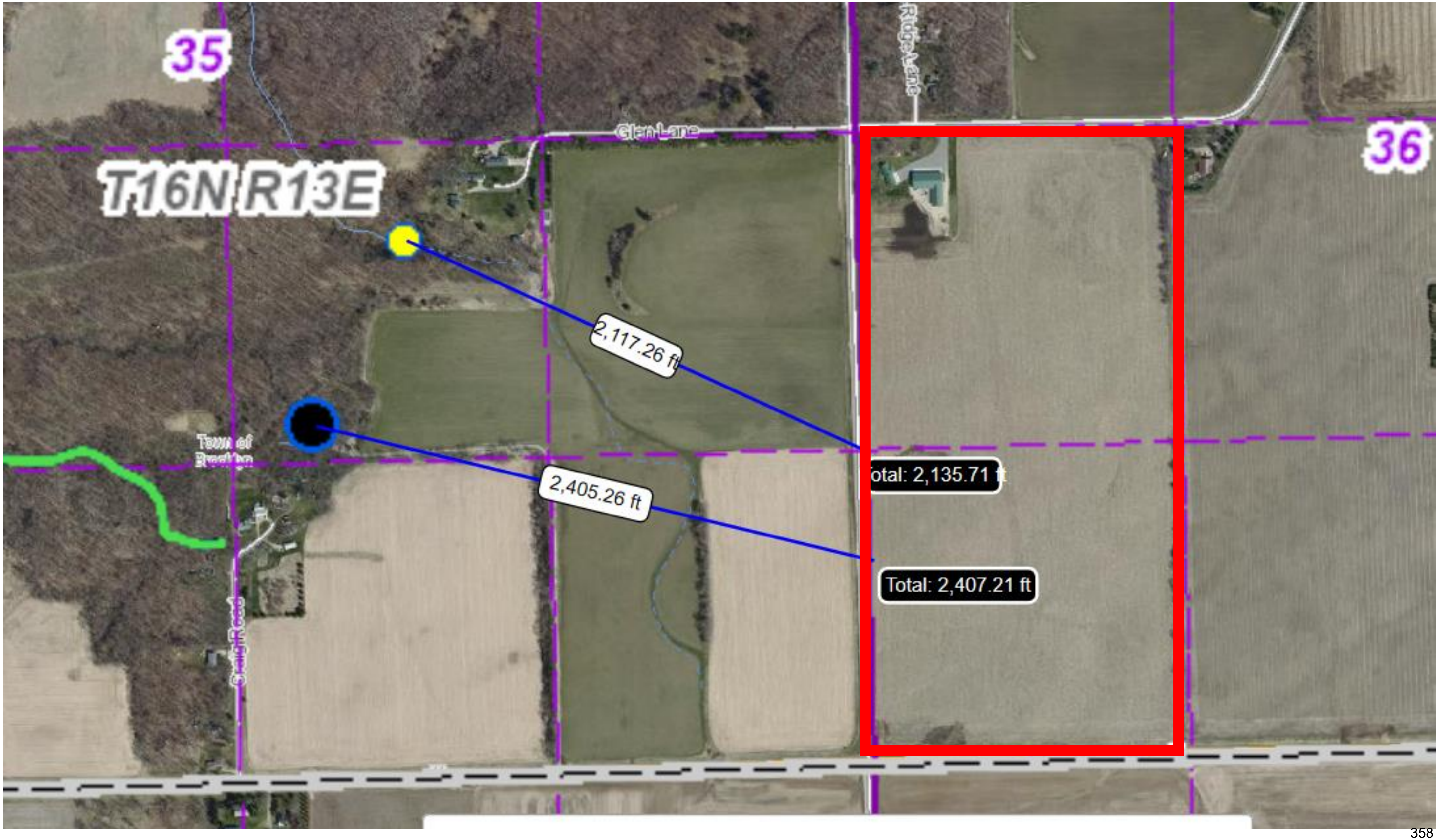
35
36
T16N R13E
Glen Lane
Ridge Lane
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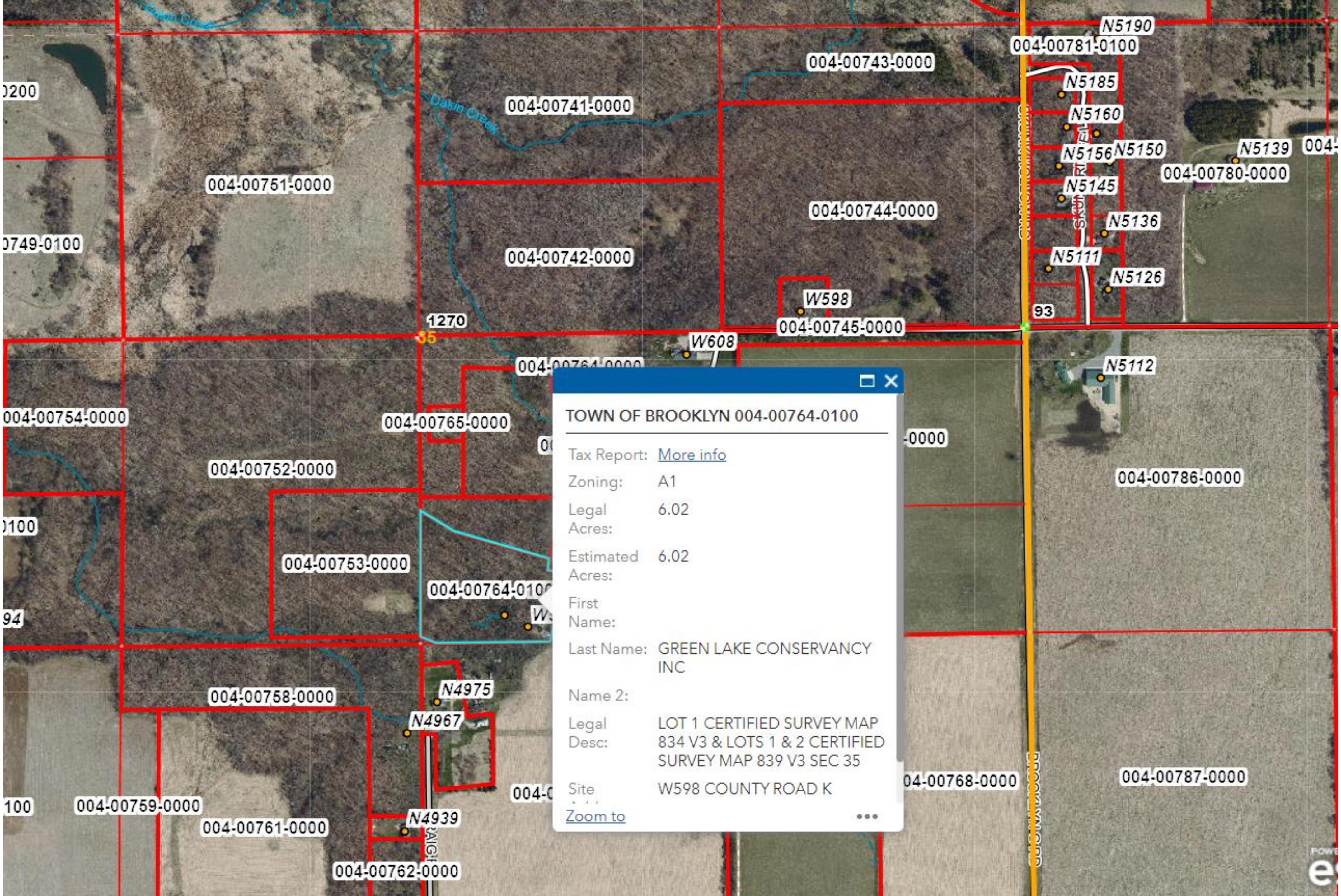
Total: 2,407.21 ft


TOWN OF BROOKLYN 004-00764-0100
Tax Report: More info
Zoning: A1
Legal Acres: 6.02
Estimated Acres: 6.02
First Name:
Last Name: GREEN LAKE CONSERVANCY INC
Name 2:
Legal Desc: LOT 1 CERTIFIED SURVEY MAP 834 V3 & LOTS 1 & 2 CERTIFIED SURVEY MAP 839 V3 SEC 35
Site W598 COUNTY ROAD K
Zoom to
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Dakin Creek
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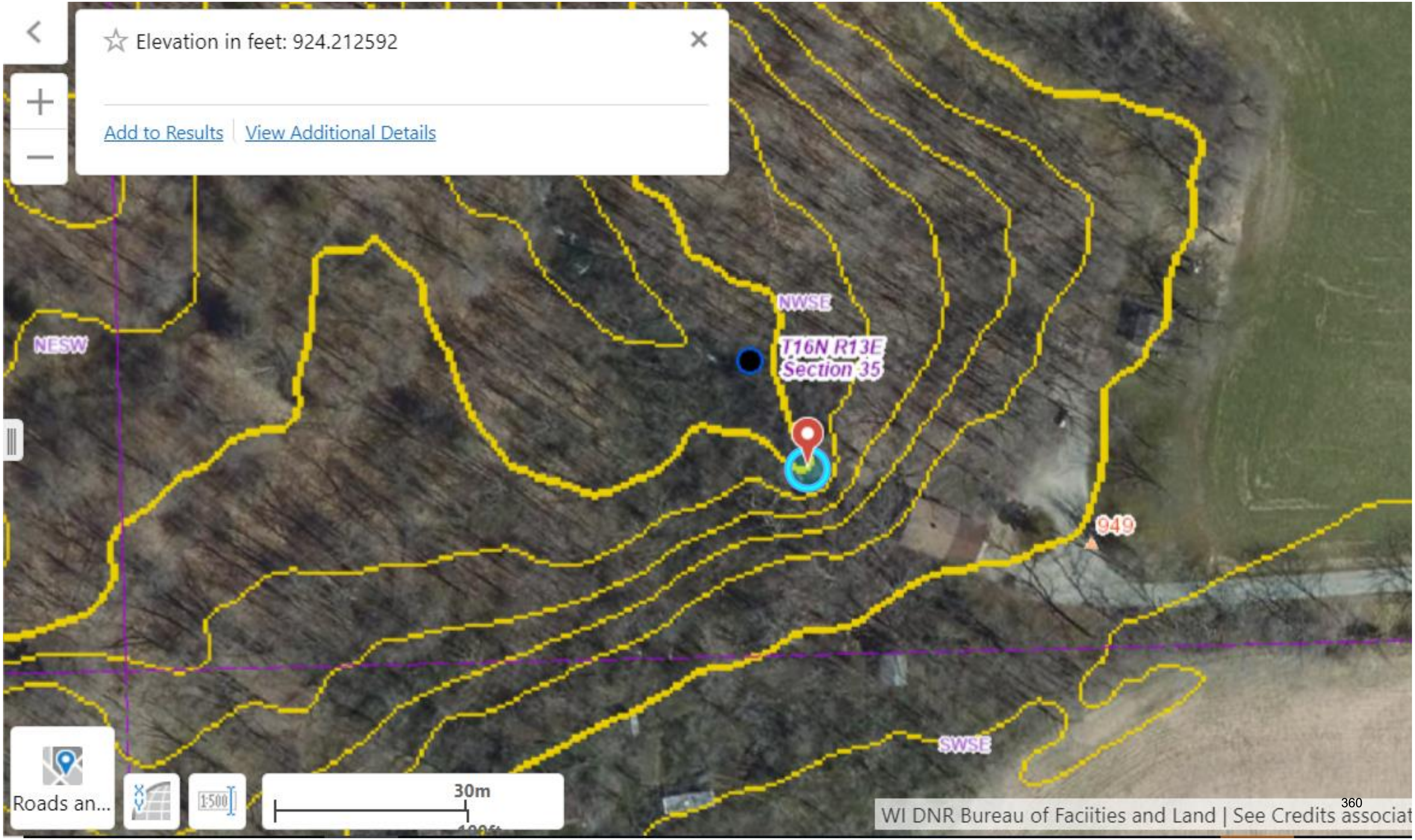
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View Additional Details
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SWSE
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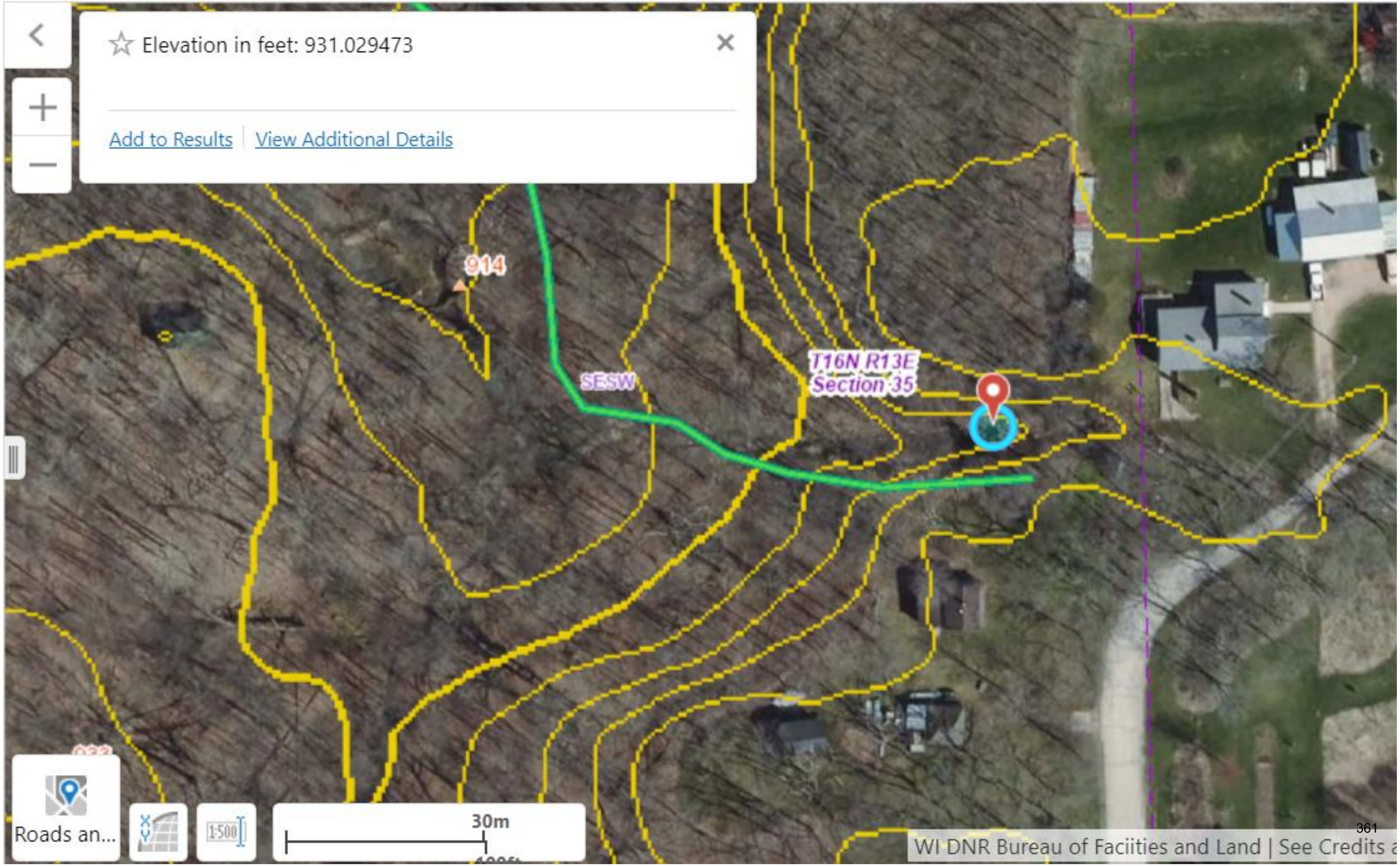
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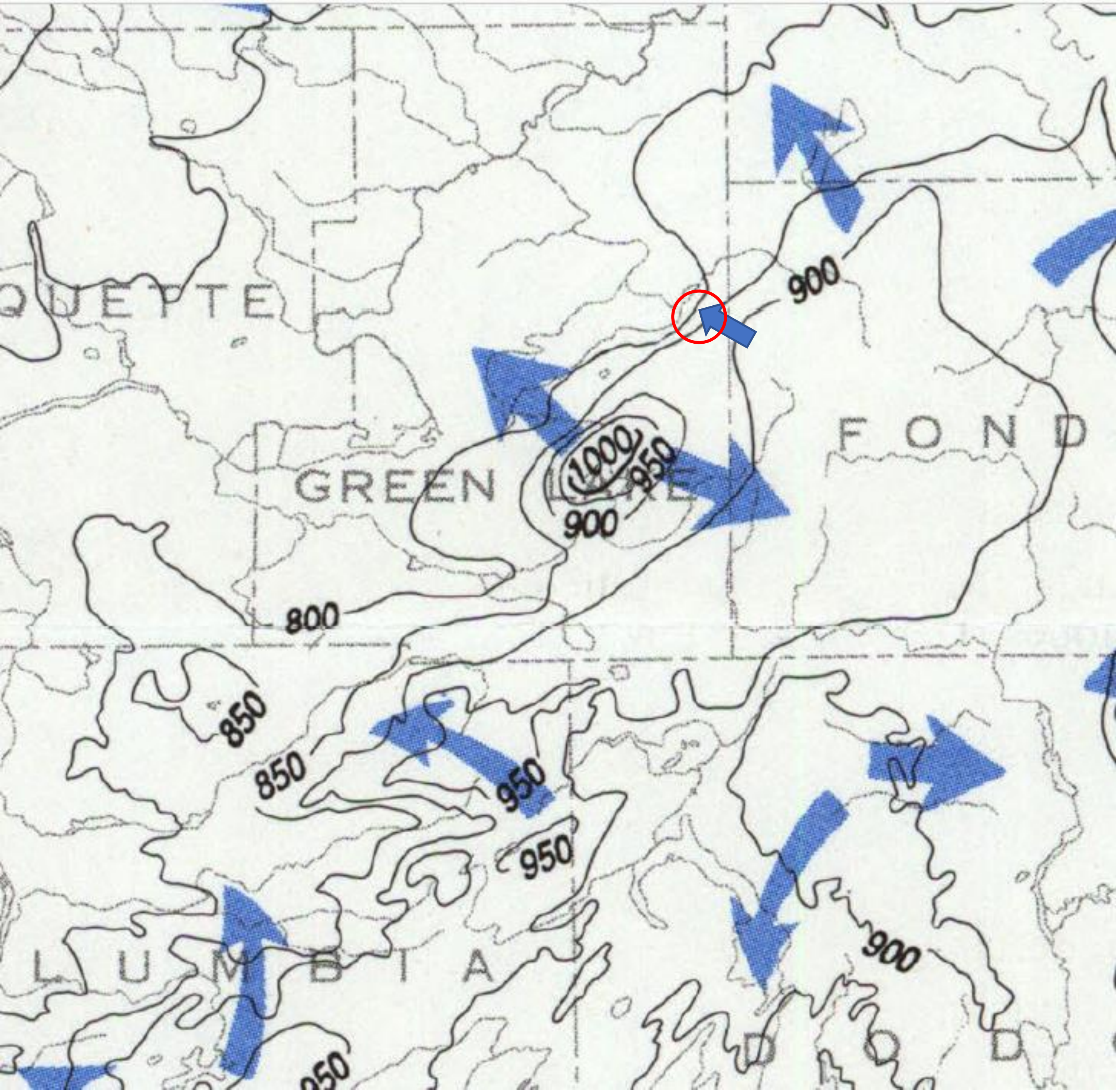


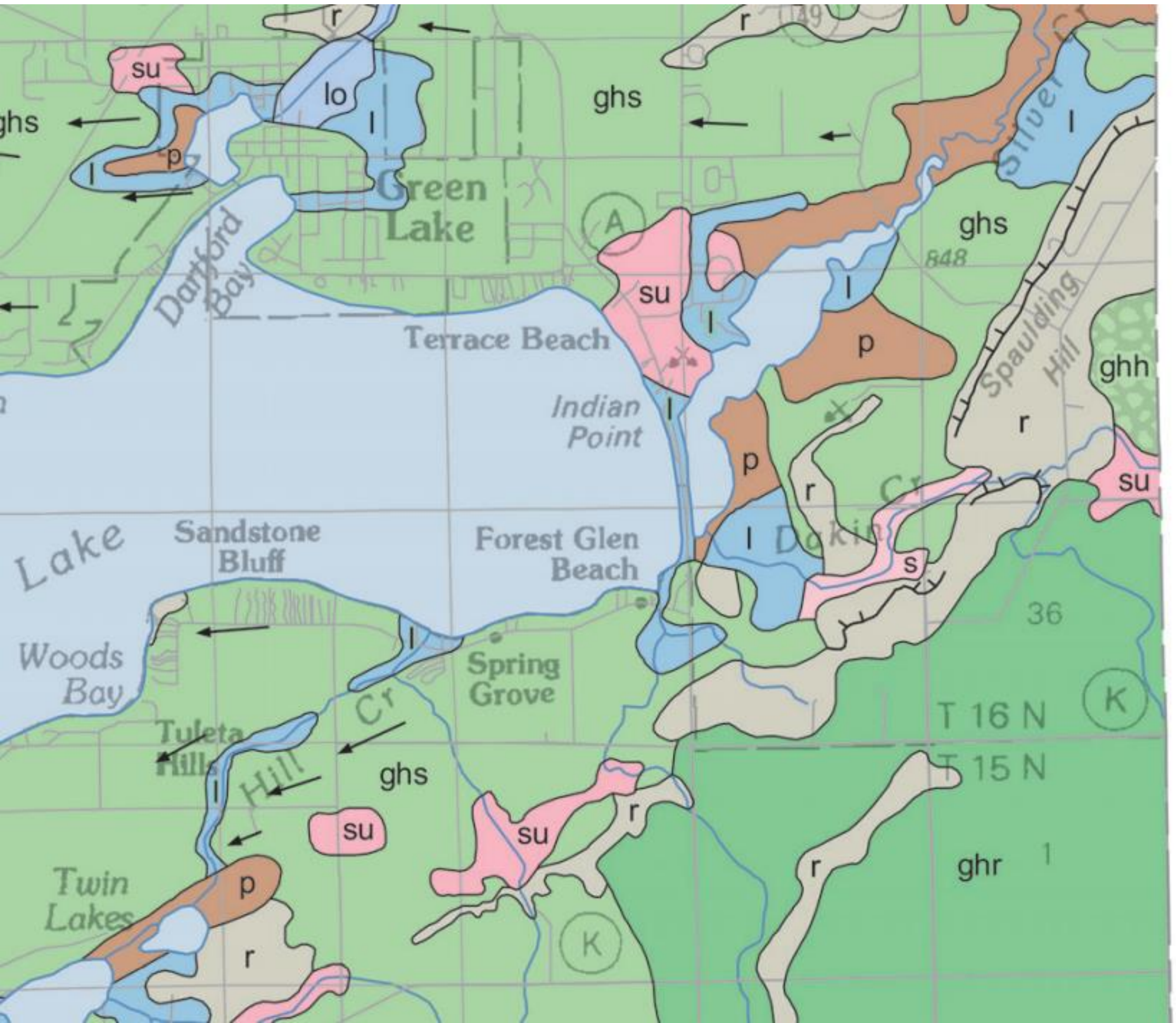
EXPLANATION

— 800 — **Water-table contour** – Shows altitude of water table. Contour interval 50 feet. Contours omitted in areas of steep slopes. Datum is sea level


Generalized horizontal direction of ground-water flow in the shallow aquifer system

This is a composite map, derived from many sources (see inset map). Contours were modified from source maps in some areas. Although the source maps cover a time span of approximately 30 years, they are suitable for preparation of a composite map with a 50-foot contour interval. There are very few places in Wisconsin where the water table has fluctuated more than 20 feet in this time span.

Groundwater flow is from the proposed quarry toward the spring(s).



Explanation

Postglacial deposits

f — **Fill.** Consists of various materials including gravel, sand, silt and clay.

w — **Windblown sand.** Well sorted, generally vegetated. Dunes between 2 and 7 m thick, generally no more than 5 m high. Active blowouts and dunes exist in some places. Deposited immediately following deglaciation. Distribution is obscure in most places and is more widespread than indicated on map.

p, po, pw, ps — **Peat.** Unit **p:** Peat occupying low-lying, flat to low-relief surfaces; thickness varies, but is typically between 1 and 5 m thick. Unit **po:** Peat over silty and clayey lake sediment (or over sandy beach sediment near margins of wetlands) of glacial Lake Oshkosh; usually occurs in areas that are less than 234 m above sea level in elevation (may be beach sediment near margins of wetland). Unit **pw:** Peat over lake sediment of glacial Lake Wisconsin; usually occurs in areas that are between 234 and 296 m above sea level in elevation. Unit **ps:** Peat overlying postglacial or meltwater stream sediment consisting of silty and sandy sediment with some channel sand and silt.

s — **Stream sediment.** Commonly consists of silty and sandy sediment with some channel sand and silt; typically between 1 and 15 m thick. Deposited in flood plains adjacent to post-glacial streams; most of this sediment was probably deposited during the recent past.

Glacial deposits, undifferentiated

l, low, lo, lww, lw — **Lake sediment.** Unit l: Sand, silt, and clay. Unit **low:** Glacial Lake Oshkosh sediment covered with thin patches of windblown sand generally less than 2 m thick. Unit **lo:** Sediment deposited in glacial Lake Oshkosh, usually at elevations below 234 m above sea level; largely silt and clay where deposited in deeper water grading to sand near the shoreline; typically between 1 and 80 m thick; material deposited near the shoreline may include windblown sediment, washed hillslope sediment, and patches of peat that could not be mapped separately. Unit **lww:** Glacial Lake Wisconsin sediment covered with thin patches of windblown sand generally less than 2 m thick. Unit **lw:** Sand, silt, or clay deposited in glacial Lake Wisconsin usually at elevations above 234 m above sea level; largely silty sand where deposited in deeper water grading to sand near the shorelines.

se, sc, sg, sa, su — **Meltwater-stream sediment.** Sand and gravel deposited directly by streams originating from the margin of the Green Bay Lobe; commonly between 1 and 30 m thick. Unit **se:** Eroded meltwater-stream sediment; gullied topography resulting from erosion in postglacial time. Unit **sc:** Collapsed (kettled) meltwater-stream sediment deposited in alluvial fans, deltas, and proglacial river channels. Unit **sg:** Subaqueous morainal bank deposited adjacent to the former margin of the Green Bay Lobe; commonly flat on top. Unit **sa:** Meltwater-stream sediment deposited in an alluvial fan or delta immediately adjacent to a moraine or ice-contact face. Unit **su:** Meltwater-stream sediment deposited in proglacial river channels or in tunnel channels beneath the margin of the Green Bay Lobe.

Holy Hill Formation, Horicon Member

ghh, ghr, ghs — **Till.** Brown to reddish-brown, gravelly, clayey, silty sand deposited by the Green Bay Lobe; generally at least 3 m thick; includes many small to large inclusions of windblown sediment, hillslope sediment, and glacial lake sediment that could not be mapped separately. In some areas, the modern surface reflects the landscape that was present before the last part of the Wisconsin glaciation. Unit **ghh:** Mostly low-relief, nondescript, hummocky topography; includes many areas of enclosed depressions. Unit **ghr:** Generally rolling topography in areas lacking drumlins. Unit **ghs:** Rolling topography that was subglacially molded; contains streamlined landforms including drumlins and flutes; many drumlins in the western part of the study area are composed of stratified sand and gravel rather than till of the Horicon Member.

Bedrock

r — **Bedrock.** In glaciated areas, includes dolomite, sandstone, quartzite, rhyolite, or granite; in the Driftless Area, includes Paleozoic limestone and sandstone. Glacially scoured bedrock is covered by less than 2 m of sediment (sandy till of the Holy Hill Formation or windblown sediment), which is too thin to map.

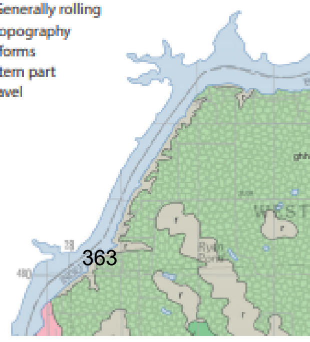
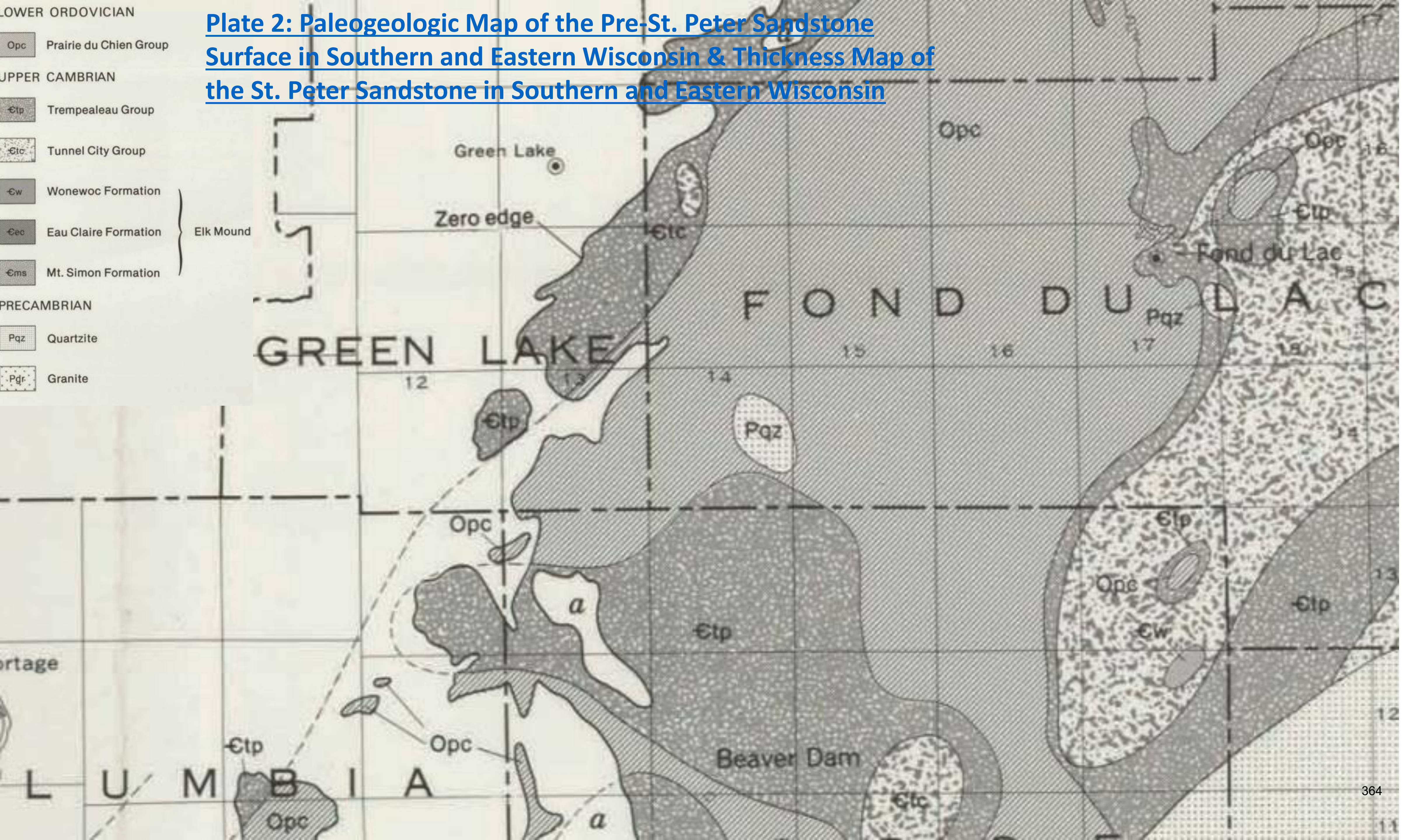
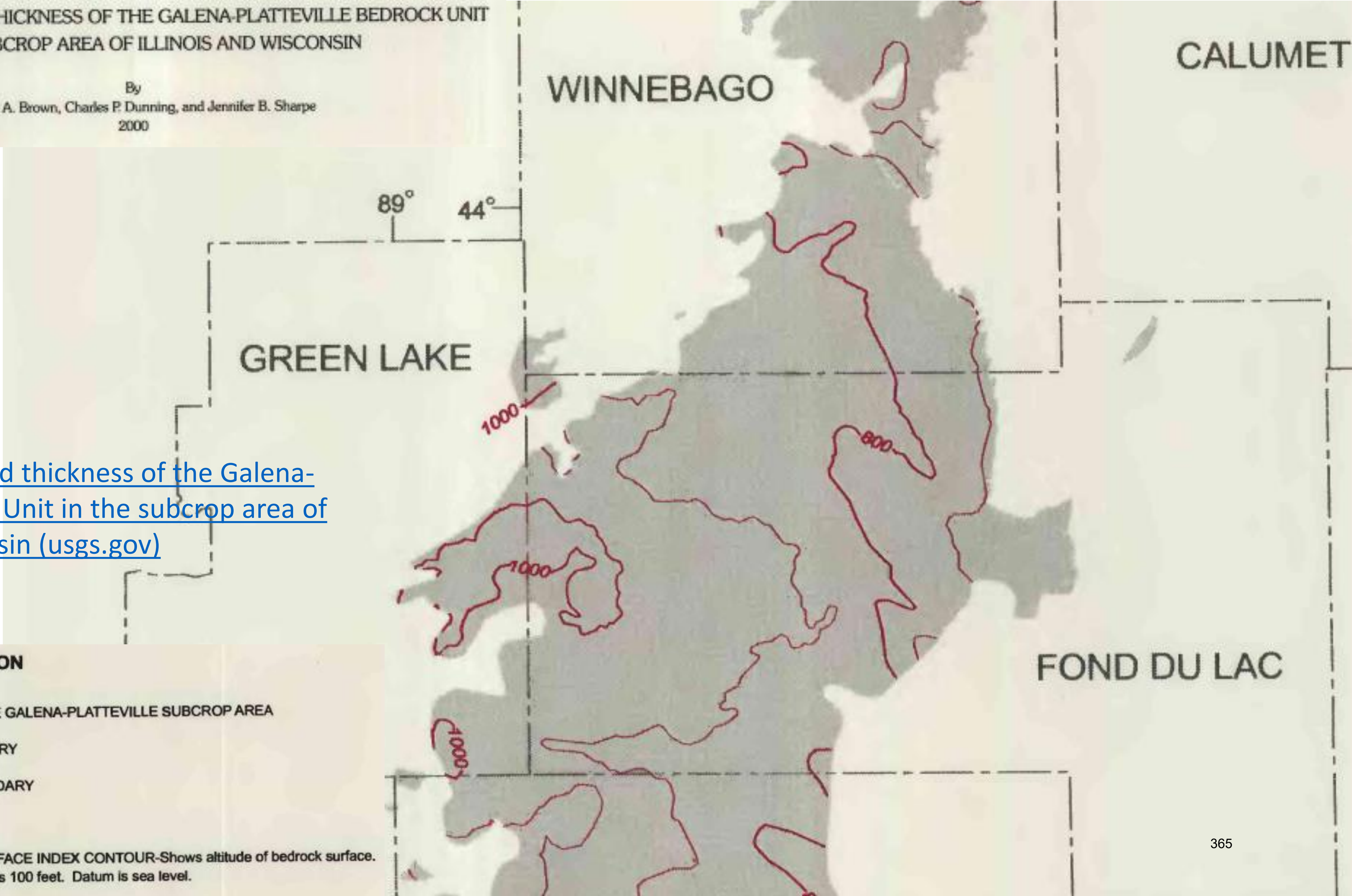


Plate 2: Paleogeologic Map of the Pre-St. Peter Sandstone Surface in Southern and Eastern Wisconsin & Thickness Map of the St. Peter Sandstone in Southern and Eastern Wisconsin



ALTITUDE, DEPTH, AND THICKNESS OF THE GALENA-PLATTEVILLE BEDROCK UNIT IN THE SUBCROP AREA OF ILLINOIS AND WISCONSIN

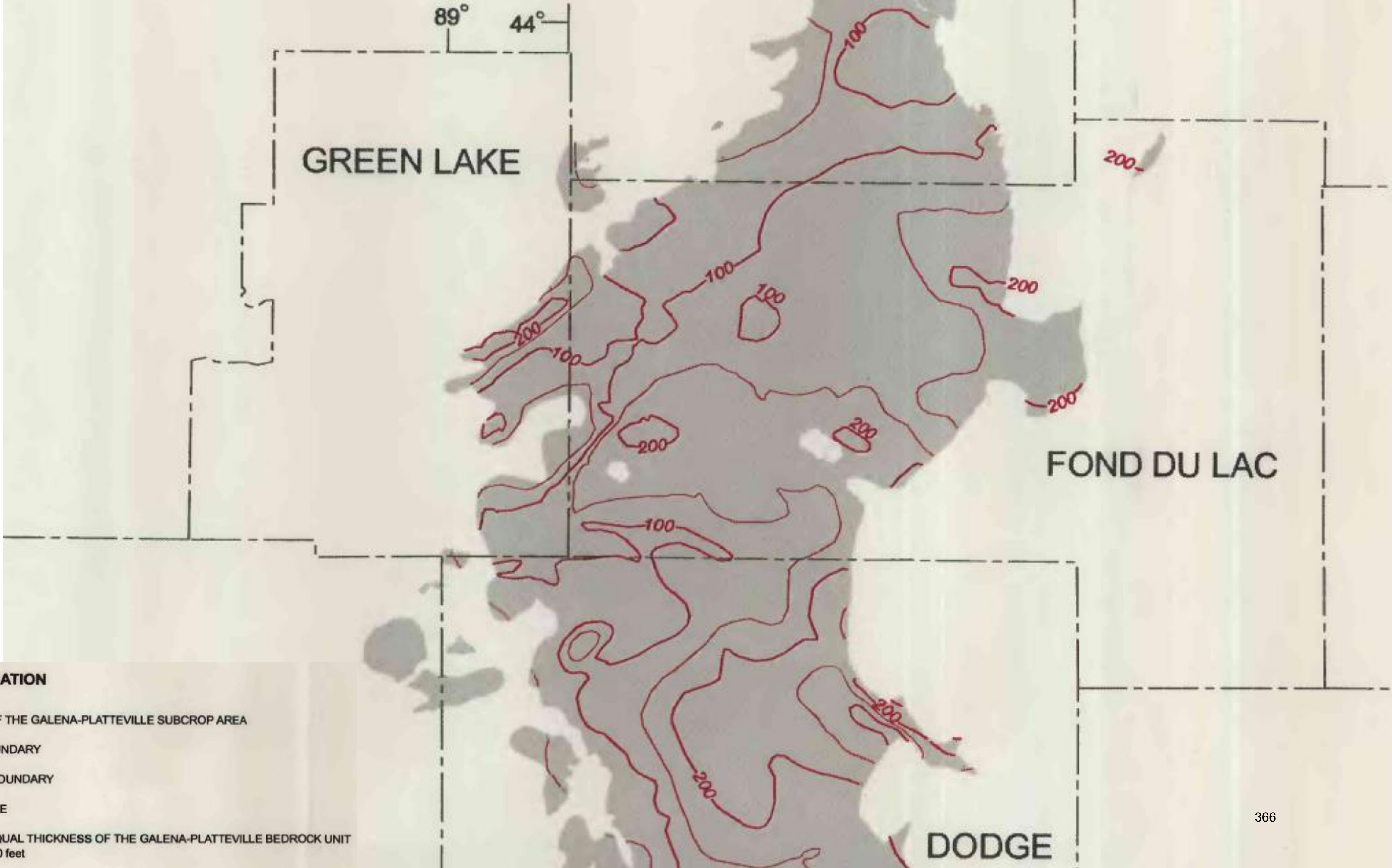
By
Timothy A. Brown, Charles P. Dunning, and Jennifer B. Sharpe
2000



[Altitude, depth, and thickness of the Galena-Platteville Bedrock Unit in the subcrop area of Illinois and Wisconsin (usgs.gov)]

EXPLANATION

- EXTENT OF THE GALENA-PLATTEVILLE SUBCROP AREA
- STATE BOUNDARY
- COUNTY BOUNDARY
- FAULT ZONE
- BEDROCK-SURFACE INDEX CONTOUR-Shows altitude of bedrock surface. Contour interval is 100 feet. Datum is sea level.



EXPLANATION

EXTENT OF THE GALENA-PLATTEVILLE SUBCROP AREA

STATE BOUNDARY

COUNTY BOUNDARY

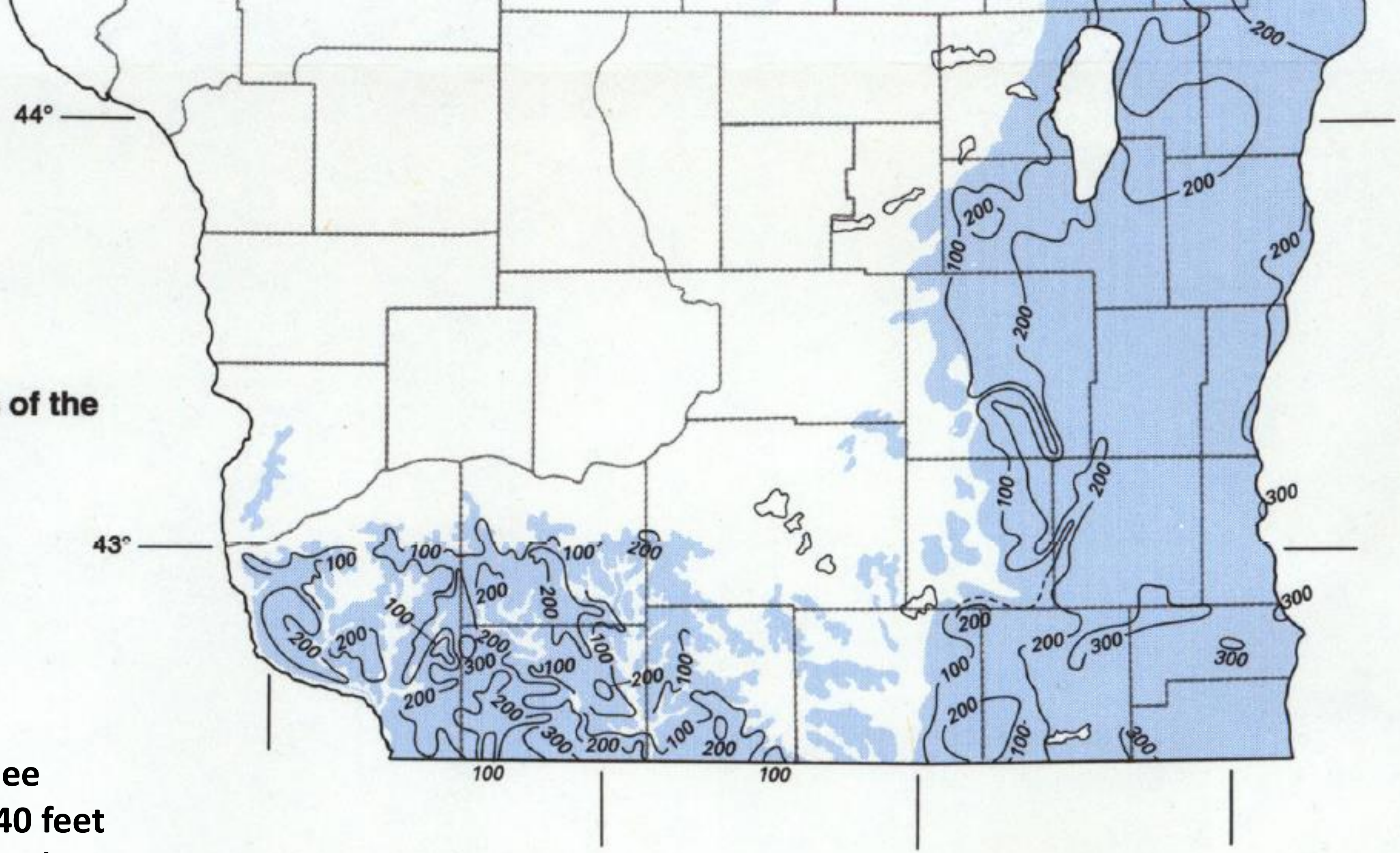
FAULT ZONE

LINE OF EQUAL THICKNESS OF THE GALENA-PLATTEVILLE BEDROCK UNIT
Interval is 50 feet

EXPLANATION

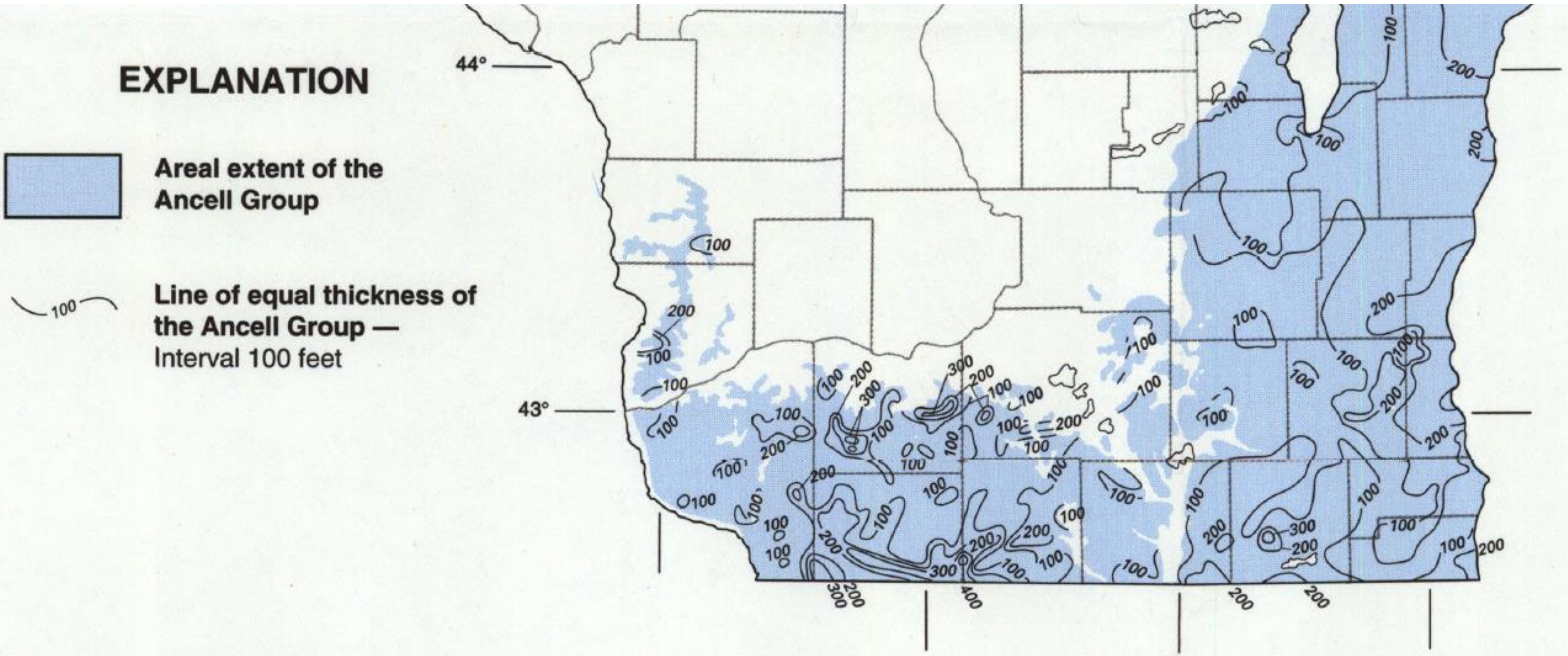
Areal extent of the Sinnipee Group

Line of equal thickness of the Sinnipee Group — Dashed where inferred. Interval 100 feet

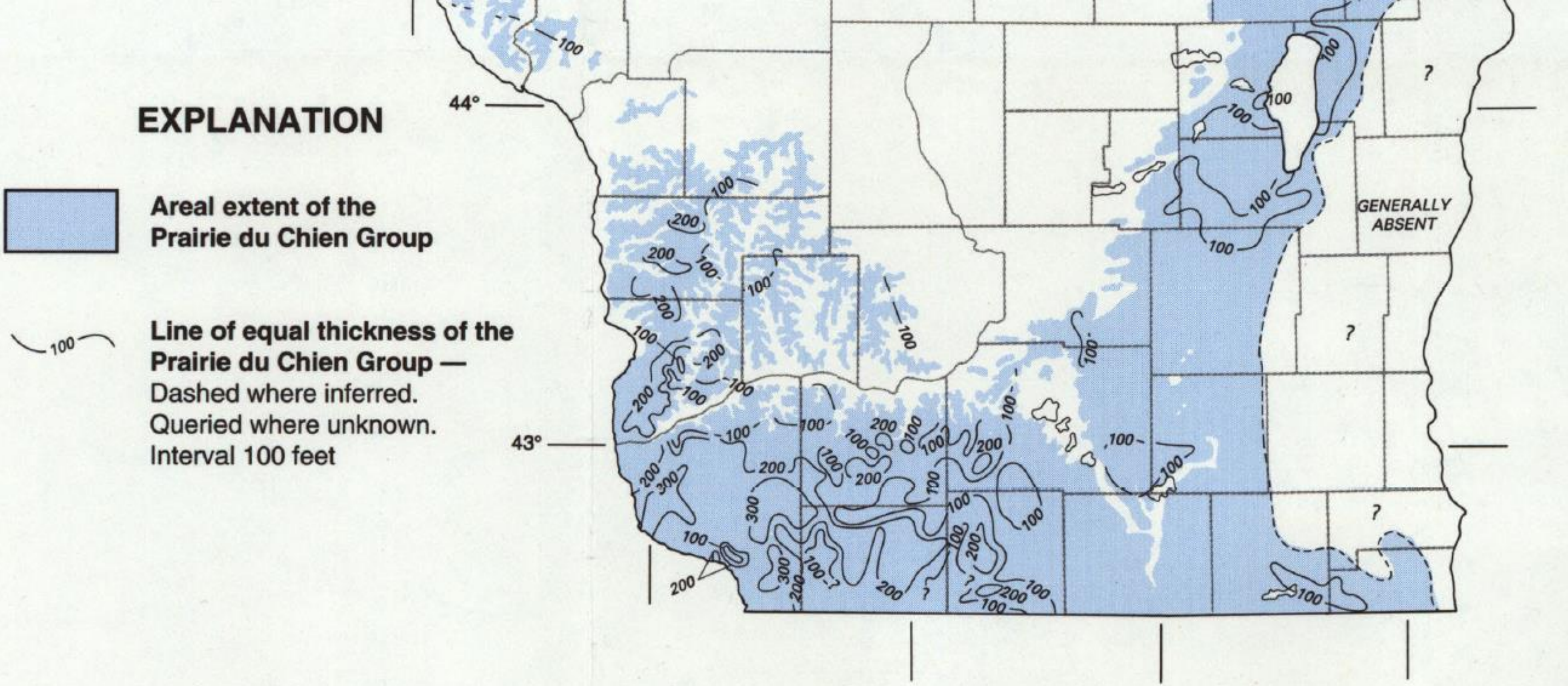


Site is on the edge of the Sinnipee dolomite extent and is only 20-40 feet thick in WCRS in area (see slide 13)

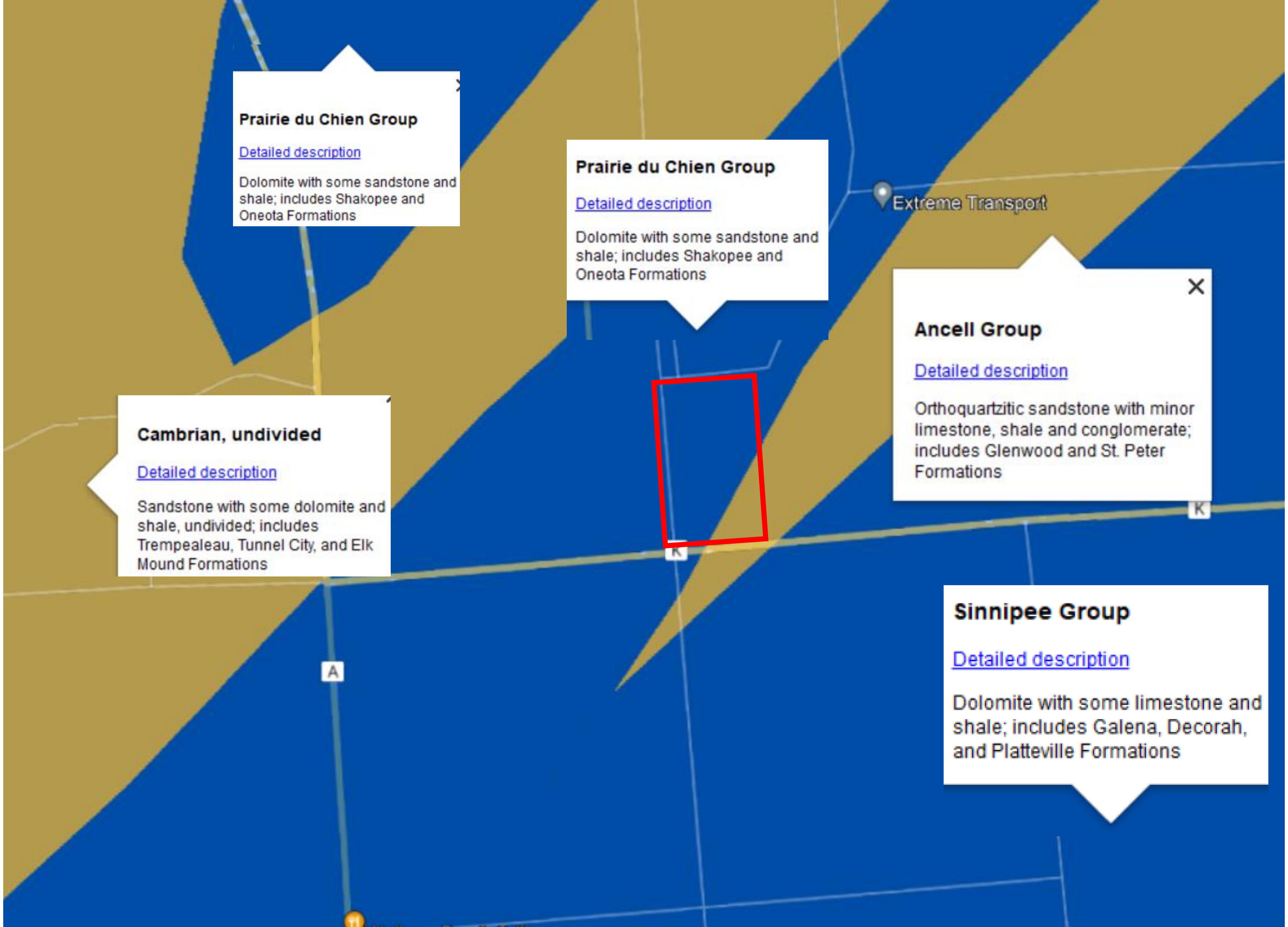
THICKNESS OF THE SINNIPEE GROUP



THICKNESS OF THE ANCELL GROUP



THICKNESS OF THE PRAIRIE DU CHIEN GROUP


Prairie du Chien Group
Detailed description
Dolomite with some sandstone and shale; includes Shakopee and Oneota Formations
Prairie du Chien Group
Detailed description
Dolomite with some sandstone and shale; includes Shakopee and Oneota Formations
Extreme Transport
Ancell Group
Detailed description
Orthoquartzitic sandstone with minor limestone, shale and conglomerate; includes Glenwood and St. Peter Formations
Cambrian, undivided
Detailed description
Sandstone with some dolomite and shale, undivided; includes Trempealeau, Tunnel City, and Elk Mound Formations
Sinnipee Group
Detailed description
Dolomite with some limestone and shale; includes Galena, Decorah, and Platteville Formations
K
K
A

Well Construction Report For WISCONSIN UNIQUE WELL NUMBER SQ446

State of WI - Private Water Systems - DG/2
Department of Natural Resources, Box 7921
Madison, WI 53707
Please type or Print using a black Pen
Please Use Decimals Instead of Fractions.

Form 3300-77A (R 8/00)

Ele 984’

Property Owner	MACHKOVICH, STEVE
Telephone Number	–
Mailing Address	W235 PRAIRIE RD
City	RIPON
State	WI
Zip Code	54971
County of Well Location	Green Lake
County Well Permit No.	W
Well Completion Date	08/20/2004
Well Constructor (Business Name)	DANIEL J STEFFES
License #	6109
Facility ID Number (Public Wells)	
Address	BADGER WELL DRLG
Public Well Plan Approval #	W-24131
City	FOND DU LAC
State	WI
Zip Code	54935
Date of Approval (mm/dd/yyyy)	07/07/2004
Hicap Permanent well #	67459
Common Well #	2
Specific Capacity	2.7 gpm/ft

1. Well Location: [X] Town [ ] City [ ] Village of BROOKLYN
Fire # (if available):
Grid or Street Address or Road Name and Number:
Subdivision Name / Lot # / Block #:
Gov't Lot # or NE 1/4 of NE 1/4 of Section 36 T 16 N; R13 [X] E [ ] W
Latitude Deg. Min. Longitude Deg. Min.
Lat/Long Method: GPS008

2. Well Type: [X] New [ ] Replacement [ ] Reconstruction
of previous unique well # constructed in
Reason for replaced or Reconstructed Well?
[X] Drilled [ ] Driven Point [ ] Jetted [ ] Other:

3. Well serves # of homes and or IRRIGATION (e.g. barn, restaurant, church, school, industry, etc.)
High capacity Well? [X] Yes [ ] No
Property? [X] Yes [ ] No

4. Is the well located upslope or sideslope and not downslope from any contamination source, including those on neighboring properties? [X] Yes [ ] No
Well located within 1,200 feet of a quarry? [ ] Yes [ ] No If yes, distance in feet from quarry:
Well located in floodplain? [ ] Yes [X] No
Distance in Feet from Well to Nearest:
1. Landfill
2. Building Overhang
3. Septic [ ] Holding Tank [ ]
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. Shoreline [ ] Swimming Pool [ ]
9. Downspout/Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain [ ] Cast Iron or Plastic [ ] Other
14. Building Sewer [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
15. Collector or Street Sewer: [ ] Sanitary units in. diam. [ ] Storm [ ] <=6 [ ] >6
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe [ ] Gravity [ ] Pressure [ ] Cast Iron or Plastic [ ] Other
23. Other Manure Storage
24. Ditch
25. Other NR 812 Waste Storage

5. Drillhole Dimensions and Construction Method

Dia (in.)	From (ft.)	To (ft.)
16	0	62
12	62	465

Upper Enlarged Drillhole / Lower Open Bedrock:
[X] 1. Rotary - Mud Circulation [ ]
[ ] 2. Rotary - Air [ ]
[ ] 3. Rotary - Air and Foam [ ]
[ ] 4. Drill-Through Casing Hammer
[ ] 5. Reverse Rotary
[ ] 6. Cable-tool Bit in. dia. [ ]
[ ] 7. Dual Rotary [ ]
[ ] 8. Temp. Outer Casing in. dia. depth (ft)
Removed? [ ] Yes [ ] No If no, why not?

8. Geology

	Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
K-I-	BLACK DIRT	0	3
–YP	HARDPAN STONES SAND	3	34
–L-	LIMESTONE	34	87
–N-	SANDSTONE	87	115
–NL	SANDSTONE LIMESTONE	115	197
–N-	SANDSTONE	197	465

6. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification	From (ft.)	To (ft.)
12	ASTM A53B IPSCO PARAGON 12.750 X .375 EL 21 PLAIN END	0	62

Dia. (in.) Screen type, material & slot size

9. Static Water Level: ft. above ground surface; 38 ft. below ground surface

10. Pump Test: Pumping Level 225 ft. below surface; Pumping at 500 GPM for 1 hours

11. Well is: [X] Above Grade 24 in. [ ] Below Grade
Developed? [X] Yes [ ] No
Disinfected? [X] Yes [ ] No
Capped? [X] Yes [ ] No

7. Grout or Other Sealing Material. Method

Method: TREMIE PIPE PUMPED / Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
NEAT CEMENT GROUT	0	62	45

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? [ ] Yes [ ] No If no, explain:

13. Signature of the Well Constructor or Supervisory Driller: DJS — Date signed 08/20/2004
Signature of Drill Rig Operator (Mandatory unless same as above) — Date signed

Make additional comments on reverse side about geology, additional screens, water quality, etc. Variance issued [ ] Yes [X] No

This well is a mile and a half NE of the spring. The water quality is on the right.

Wisconsin Department of Natural Resources
Laboratory Report

09/24/2012 Lab: 113133790 Sample: IX007160 Page 1 of 2

Laboratory: Wisconsin State Laboratory of Hygiene, 2601 Agriculture Dr, Madison WI 53718
Phone: 800-442-4618 Fax Phone: 608-224-6213
DNR ID 113133790

Sample:

Field #:		Sample #:	IX007160
Collection Start:	09/12/2012 12:00 am	Collection End:	
Collected by:	PATRICK GORSKI	Waterbody/Outfall Id:	
ID #:	SQ446	ID Point #:	
County:	Green Lake	Account #:	PP010
Sample Location:	TOWN OF BROOKLYN (SEC 36 NE:1/4 NE:1/4 T16N R13E)		
Sample Description:	IRRIGATION WELL # SQ446		
Sample Source:	Private (other)	Sample Depth:	
Date Reported:		Sample Status:	PARTIAL
Project No:		Sample Reason:	Investigation

Analyses and Results:

Analysis Method: DIG, ICP, PRIVATE (SW846 3005A) — Analysis Date: 09/17/2012 — Lab Comment:

Code	Description	Result	Units	LOD	Report Limit	LOQ
99404	DIG TOTAL REC SW846 3005A	COMPLETE				

Analysis Method: METALS PANEL, TOTAL REC, ICP (EPA 200.7) — Analysis Date: 09/18/2012 — Lab Comment: NO CHARGE

Code	Description	Result	Units	LOD	Report Limit	LOQ
1104	ALUMINUM,TOTAL RECOVERABLE	16700.	UG/L	3		10
978	ARSENIC TOTAL RECOVERABLE	2310.	UG/L	5		16
1113	CADMIUM TOTAL RECOVERABLE	64.	UG/L	0.5		1.6
918	CALCIUM TOTAL RECOVERABLE	142.	MG/L	0.1		0.3
1118	CHROMIUM TOTAL RECOVERABLE	197.	UG/L	1		3
979	COBALT TOTAL RECOVERABLE	2160.	UG/L	1		3
1119	COPPER TOT REC	9830.	UG/L	2		6
899	HARDNESS TOTAL RECOVERABLE CALCULATION	534.	MG/L	1.4		4.6
980	IRON TOTAL RECOVERABLE	426.	MG/L	0.1		0.3
1114	LEAD TOTAL REC	82.	UG/L	3		10
921	MAGNESIUM TOTAL RECOVERABLE	43.7	MG/L	0.1		0.3
1123	MANGANESE ICP TOTAL RECOVERABLE	1720.	UG/L	1.0		3.0
1074	NICKEL ICP TOTAL RECOVERABLE	4310.	UG/L	1		3

With only 106 hours of pumping the water stripped all the galvanizing off the brand-new center pivot irrigation equipment. This was caused by sulfide s in the Platteville and St Peter being oxidized as acid mine drainage reaction.


Just below red line you can see where the irrigation water had stunted the growth of the soybeans

First Water Quality Test For
WISCONSIN UNIQUE WELL NUMBER AT 573

State of Wisconsin
Department of Natural Resources
Private Water Supply — WS/2
Box 7921
Madison, WI 53707

AUG 17 1988

Property Owner: Ron Wahoske — Telephone Number: (414) 748-6175
Mailing Address: Brooklyn G
City: Ripon — State: Wi — Zip Code: 54971
County: Green Lake — County Well Location Permit No.: W — Well Completion Date: 7-9-88 (M M D D Y Y)

1. Location (Please type or print using a black pen.)
☒ Town ☐ City ☐ Village of Brooklyn — Fire # (if available)
Grid or Street Address or Road Name and Number (if available)
Subdivision Name — Lot # — Block #

Well Constructor (Business Name): Zoellner Central Well Drilling — Registration #: 140
Address: P.O. Box 405
City: Brandon — State: Wi — Zip Code: 53919

2. Mark well location in correct 40-acre parcel of section. (N, E, S, W; marked X in SE quarter)

Gov't Lot # ___ or SW ¼ of SE ¼ of Section 25; T 16 N; R 13 ☒ E ☐ W

3. Well Type: ☒ New ☐ Replacement ☐ Reconstruction/Rehabilitation
of well constructed in 19 ___.
Reason for new, reconstructed, replaced, or rehabilitated well? New Home
☒ Drilled ☐ Driven Point ☐ Jetted ☐ Other

4. Well serves 1 # of homes and/or ___ (ex: barn, restaurant, church, school, industry, etc.)
High Capacity Well? ☐ Yes ☒ No
High Capacity Property? ☐ Yes ☒ No

5. Well Located on Highest Point of Property, Consistent with the General Layout and Surroundings? ☒ Yes No
Well Located in Floodplain? ☐ Yes ☒ No
Distance In Feet From Well To Nearest:
___ 1. Landfill
15' 2. Building Overhang
___ 3. Septic or Holding Tank
___ 4. Sewage Absorption Unit
___ 5. Nonconforming Pit
___ 6. Buried Home Heating Oil Tank
___ 7. Buried Petroleum Tank
___ 8. Shoreline/Swimming Pool
___ 9. Downspout/Yard Hydrant
___ 10. Privy
___ 11. Foundation Drain to Clearwater
___ 12. Foundation Drain to Sewer
___ 13. Building Drain ☐ Cast Iron or Plastic ☐ Other
___ 14. Building Sewer ☐ Gravity ☐ Pressure ☐ Cast Iron or Plastic ☐ Other
___ 15. Collector Sewer
___ 16. Clearwater Sump
___ 17. Wastewater Sump
___ 18. Paved Animal Barn Pen
___ 19. Animal Yard or Shelter
___ 20. Silo — Type
___ 21. Barn Gutter
___ 22. Manure Pipe ☐ Gravity ☐ Pressure ☐ Cast Iron or Plastic ☐ Other
___ 23. Other Manure Storage
24. Other NR 112 Waste Source: Plumbing not Completed

6. Drillhole Dimensions

Dia. (in.)	From (ft.)	To (ft.)
8 3/4	surface	62
6	62	144

Method of constructing upper enlarged drillhole. (If applicable ✓ more than one.)
☒ 1. Rotary — Mud Circulation
☐ 2. Rotary — Air
☐ 3. Rotary — Foam
☐ 4. Reverse Rotary
☐ 5. Cable-tool Bit ___ in. dia.
☐ 6. Temp. Outer Casing ___ in. dia. Removed? ☐ Yes ☐ No If no, explain
☐ 7. Other

9. Geology

Type, Caving/Noncaving, Color, Hardness, Etc.	From (ft.)	To (ft.)
-C- Clay	surface	7
-L- Limerock	7	38
-N- Sandrock	38	144

7. Casing, Liner, Screen

Dia. (in.)	Material, Weight, Specification, Mfg. & Method of Assembly	From (ft.)	To (ft.)
6	New Black Steel 18.97# per ft. 1780 PSI ASTMA 53 Gr. B P.E. Sumotomo	surface	62

Dia. (in.)	screen type and material	From	To

10. Static Water Level
___ ft. above ground level
58 ft. below ground surface

11. Pump Test
Pumping Level 66 ft. below surface
Pumping at 15 GPM for 3 hours

12. Well Is: 12 in. ☒ Above ☐ Below Grade
Developed? ☒ Yes ☐ No
Disinfected? ☒ Yes ☐ No
Capped? ☒ Yes ☐ No

8. Grout or Other Sealing Material
Method: Pressure

Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
Mud + Cuttings	surface	6	

13. Were all unused, noncomplying, or unsafe wells properly filled with sealant? ☐ Yes ☐ No If no, explain: N/A

14. Signature of Well Constructor: Larry J. Hager LJS — Date Signed: 7-11-88
Signature of Drill Rig Operator — Date Signed

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH
See Instructions on Reverse Side

RECEIVED JAN 31 1950 BUREAU SAN. ENG.

1. County: Green Lake — ☒ Town ☐ Village ☐ City: Brooklyn — Check one and give name
2. Location: NE, NW N. E. of Sec. 36 Township 16 north Range 13 E
Name of street and number of premise or Section, Town and Range numbers
3. Owner ☒ or Agent ☐ August Quick
Name of individual, partnership or firm
4. Mail Address: Ripon Route 2
Complete address required
5. From well to nearest: Building 25 ft; sewer 45 ft; drain 50 ft; septic tank 55 ft; dry well or filter bed 78 ft; abandoned well 200 ft.
6. Well is intended to supply water for: Home & Farm

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
8	0	75			
6	75	140			

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind	From (ft.)	To (ft.)
6	Standard Weight steel pipe	0	75

9. GROUT:

Kind	From (ft.)	To (ft.)
Drill cuttings	0	18
comment	18	75

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
clay gravel	0	15
Limestone	15	55
Sand-stone	55	140

11. MISCELLANEOUS DATA:
Yield test: 1 Hrs. at 30 GPM.
Depth from surface to water-level: 52 ft.
Water-level when pumping: 55 ft.
Water sample was sent to the state laboratory at: Oshkosh (City) on Jan. 18 1950

Construction of the well was completed on: Dec. 29 1949
The well is terminated 8 inches ☒ above, below ☐ the permanent ground surface.
Was the well disinfected upon completion? Yes X No ___
Was the well sealed watertight upon completion? Yes X No ___

Signature: R. J. Schafer & Sons — Registered Well Driller
Fremont Wis. — Complete Mail Address

Please do not write in space below

Rec'd JAN 20 1950 No. 00505
Ans'd
Interpretation

	10 ml	10 ml	10 ml	10 ml	10 ml
Gas—24 hrs.	O	O	O	O	O
48 hrs.	O	O	O	O	O

Arsenic data from pump work samples October 2014 – 2021.

		# sample	detects	>10	>20	>50	>100	max		% Detect	% >10	%>20	% >50	% >100
Dane County	13	1139	325	52	35	12	5	737		28.5	4.6	3.1	1.1	0.4
Dodge County	14	534	277	67	44	26	19	1510		51.9	12.5	8.2	4.9	3.6
Door County	15	769	264	15	4	1		96.1		34.3	2.0	0.5	0.1	0.0
Douglas County	16	142	67					8.9		47.2				
Dunn County	17	526	104	13	7	2		95		19.8	2.5	1.3	0.4	
Eau Claire County	18	501	109	7	2			32.1		21.8	1.4	0.4		
Florence County	19	253	121	32	18	5	3	500		47.8	12.6	7.1	2.0	1.2
Fond du Lac County	20	840	355	85	59	38	19	435		42.3	10.1	7.0	4.5	2.3
Forest County	21	71	38	11	3	1		96.6		53.5	15.5	4.2	1.4	
Grant County	22	223	65	7	4	1		72.2		29.1	3.1	1.8	0.4	
Green County	23	433	212	55	33	17	7	474		49.0	12.7	7.6	3.9	1.6
Green Lake County	24	255	108	10	6	2	2	601		42.4	3.9	2.4	0.8	0.8
Iowa County	25	228	77	20	14	6	5	983		33.8	8.8	6.1	2.6	2.2
Iron County	26	35	17	1				14.4		48.6	2.9			
Jackson County	27	292	79	5	2			23.9		27.1	1.7	0.7		
Jefferson County	28	374	180	47	31	14	4	630		48.1	12.6	8.3	3.7	1.1
Juneau County	29	286	35	2	1			25		12.2	0.7	0.3		
Kenosha County	30	655	410	26	9	3	1	460		62.6	4.0	1.4	0.5	0.2
Kewaunee County	31	162	85	12	6	3		74.8		52.5	7.4	3.7	1.9	
La Crosse County	32	587	193	20	7	2		99		32.9	3.4	1.2	0.3	

A RECONNAISSANCE SURVEY OF WELLS IN EASTERN WISCONSIN FOR INDICATIONS OF MISSISSIPPI VALLEY TYPE MINERALIZATION

by

B. A. Brown and R. S. Maass

Open File Report 92-3
31 p.

Winnebago Co.

	Well #	T	R.E.	Sec	Minerals	Geol	Formation	Depth	
	1	2			3		4	5	
1	WI-1	20	17	20	Py	Thwaites	Gal/Pv, PduC.	65-85, 175-195	1
2	WI-9	20	17	21	Py	"	"	110-115	2
3	WI-18	20	17	2	Py	"	Galena/Pv	45-55	3
4	WI-25	20	16	23	"	"	"	128-135	4
5	WI-27	20	17	27	"	"	PduC	237-260	5
6	WI-31	18	16	24	"	"	Platteville	125-150	6
7	WI-48	17	16	15	"	Ostrom	"	55-140	7
8	WI-58	20	17	21	"/Chalco	Thwaites	PduC	190-210	8
9	WI-59	20	17	28	"	"	"	175-230	9
10									10
11									11
12									12
13									13
14									14
15									15
16									16

Note: Trace amounts Pyrite reported in most wells which penetrated Galena/Platteville and Prairie du Chien

Fond du Lac Co.

Well #	T	R.E.	Sec	Minerals	Geologist	Formation	depth
FL-15	15	14	21	Py	Thwaites	PduC	110-170
FL-37	15	17	9	Py	"	Galena/Pville	200-220
FL-41	15	17	15	Py	"	"	190-250
FL-56	15	14	26	"	"	"	185-190
FL-275	16	18	17	"	"	"	~~[illegible]~~-320-325
FL 311	15	17	17	"	Stevrwald	"	25-45, 130-145
FL 332	15	16	19	"	"	"	100-110
FL 334	14	15	3	"	"	"	70-80, 195-205
FL-342	16	14	Ripon	"	Ostrom	"	50-60
FL-343	15	17	22	"	"	"	235-280
FL-347	15	17	16	"	"	"	60-105
FL-351	16	14	21	"	"	Gal/Pville & PduC	5-60 & 130-155
FL 352	14	15	31	"	"	Galena/Pville	55-80
FL 355	16	18	32	"	"	Little from Silurian Thru PduC	
FL-373	14	16	14	"	Warren	Galena/Pville	125-200
FL-369	14	15	36	"	"	"	40-50

Note most wells penetrating Niagara, Maquoketa, Galena/Pville, St Peter and Prairie du Chien report trace to minor pyrite no other sulfides noted.

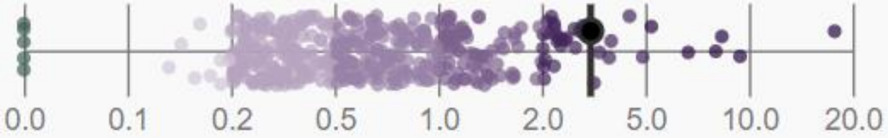
Green Lake County Spring #11

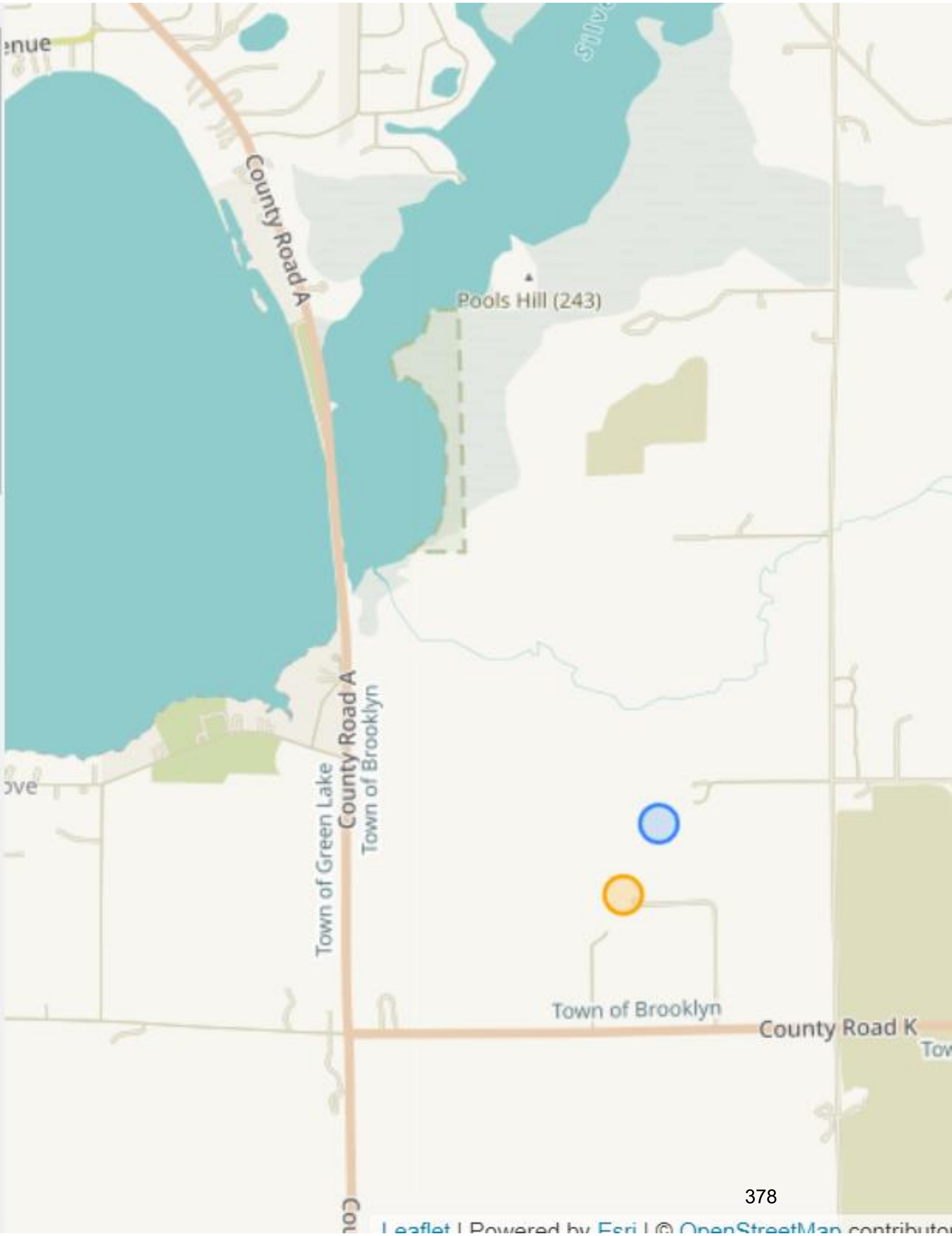
Spring orifice and back wall

Site sketch map

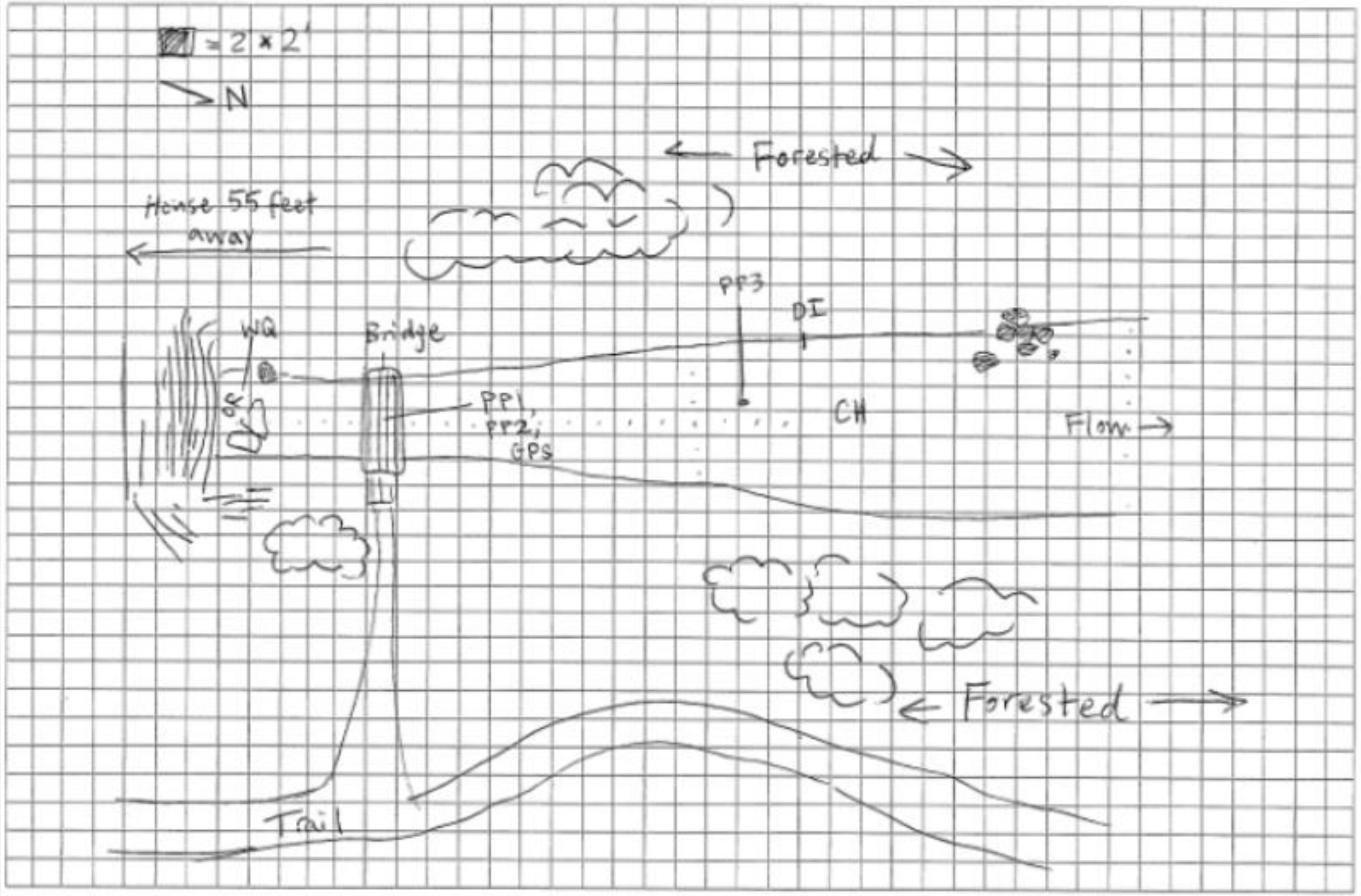
Water quality

Discharge (ft^3/s): 3.414

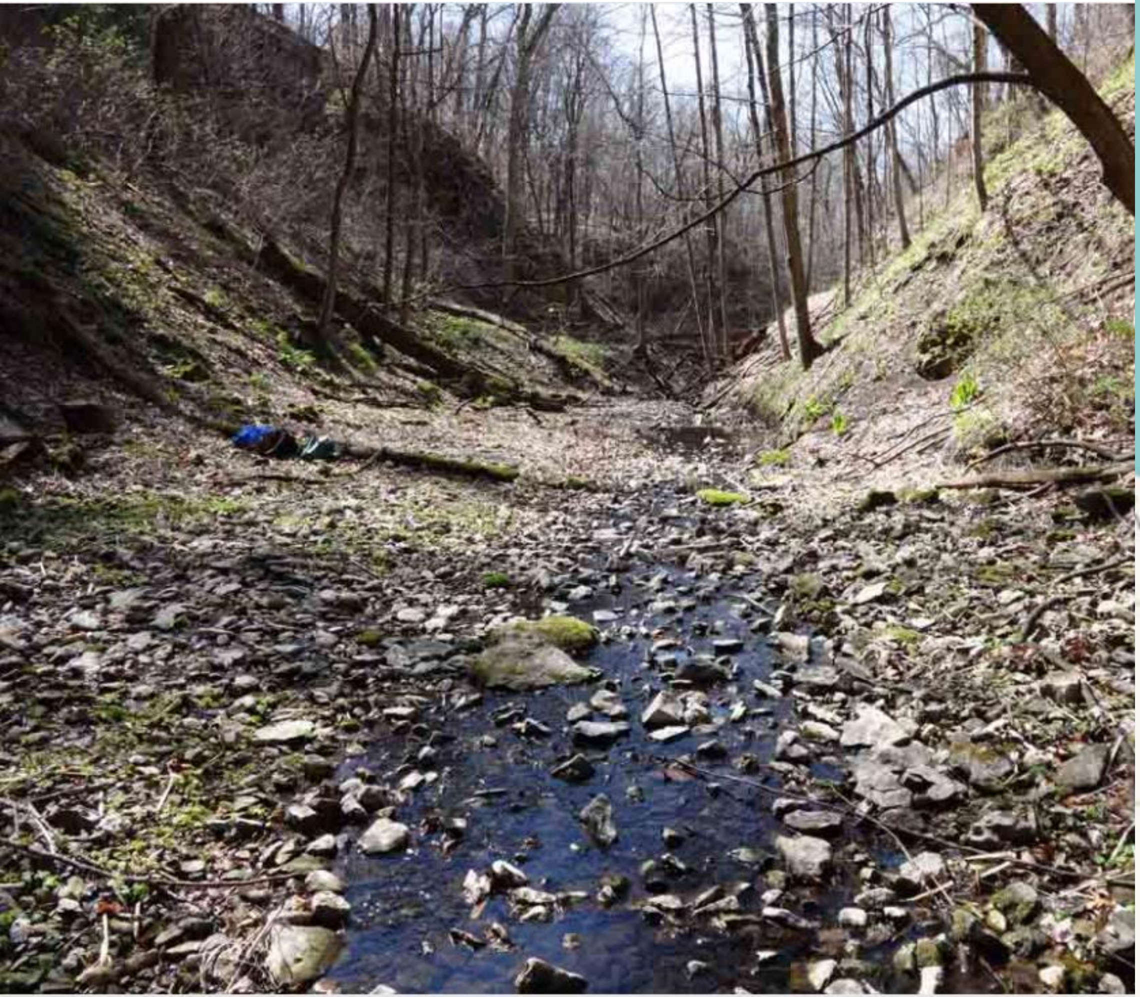


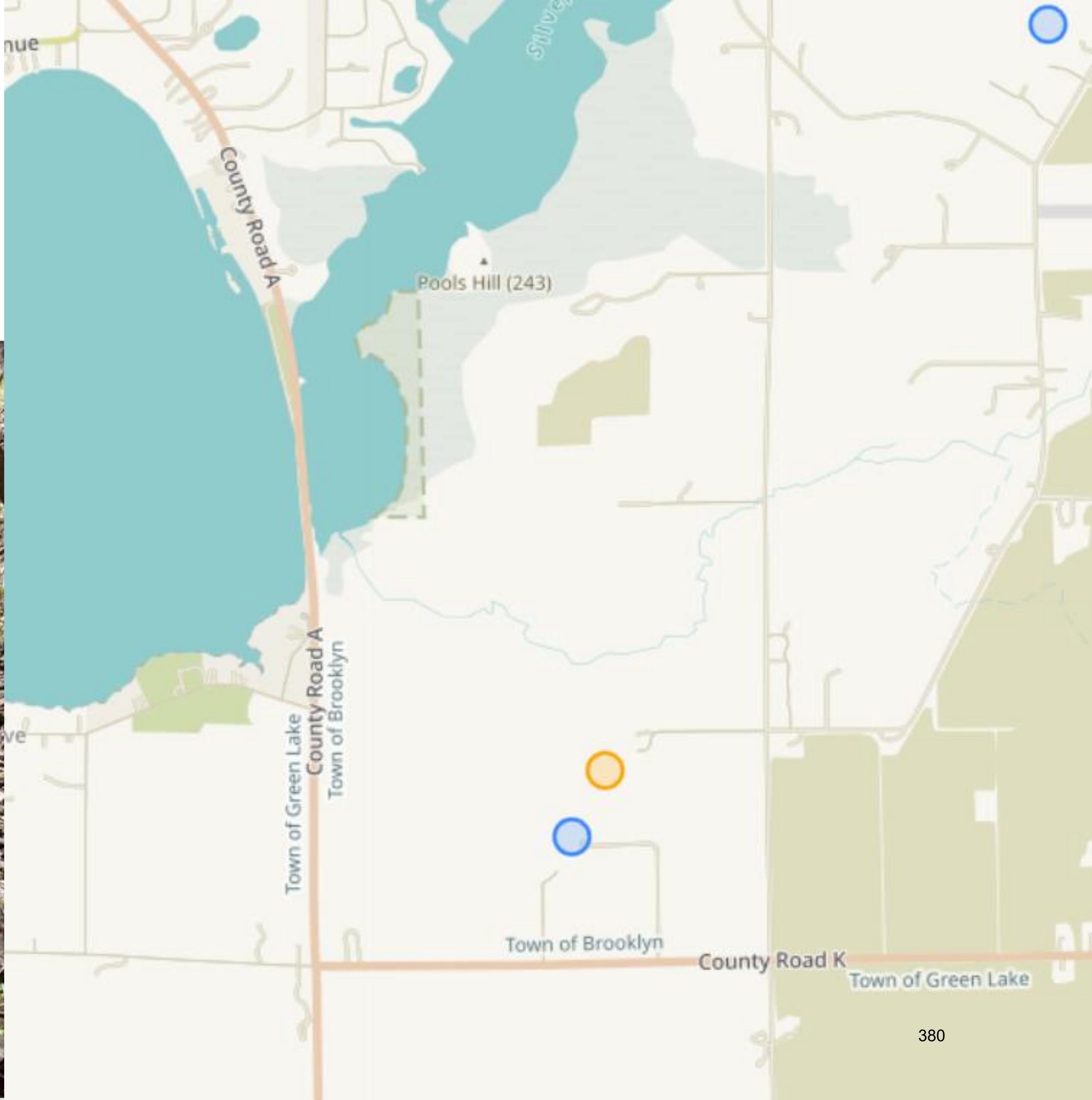


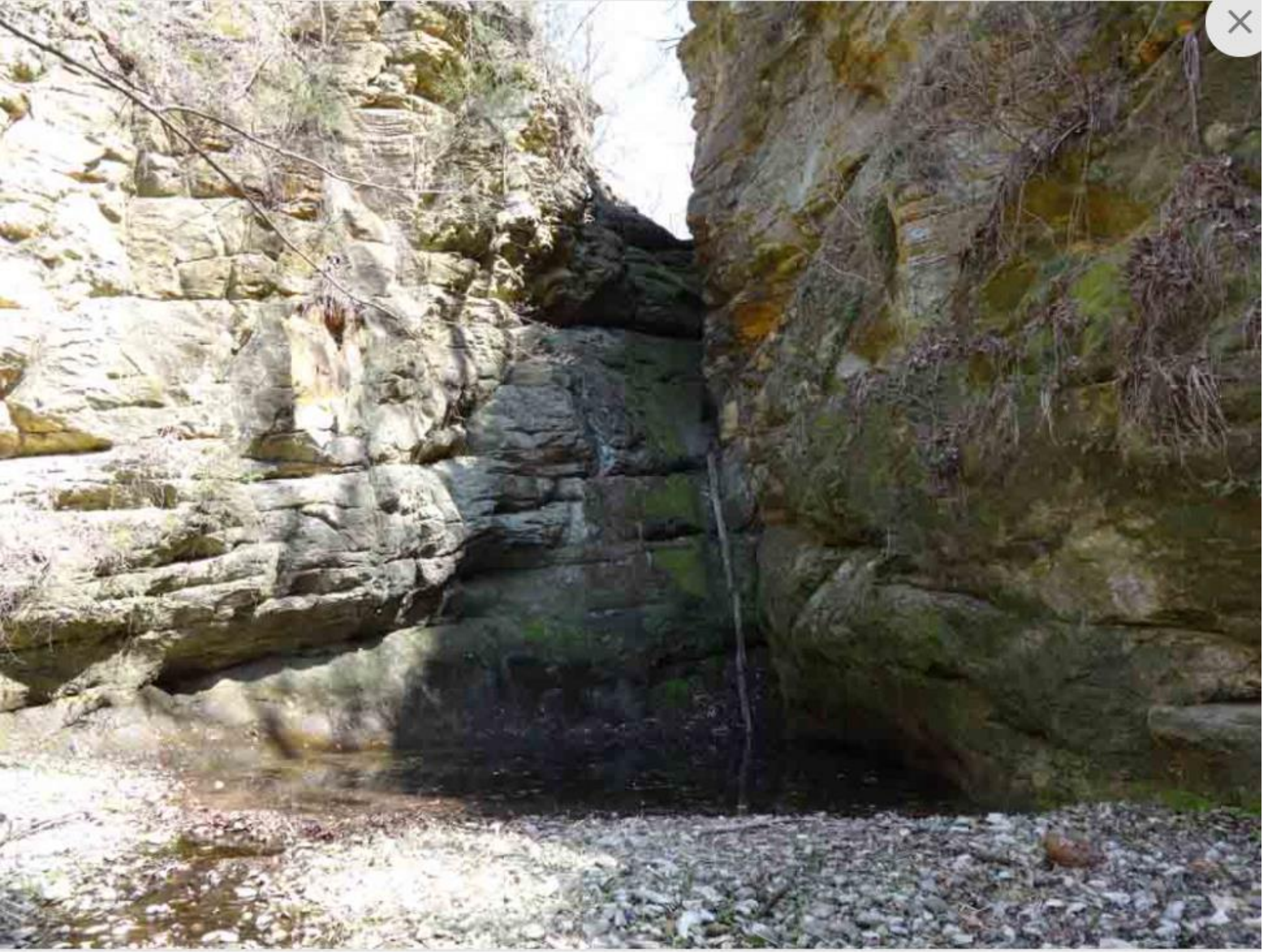
SITE SKETCH MAP   Spring ID: 11   County: Green Lake

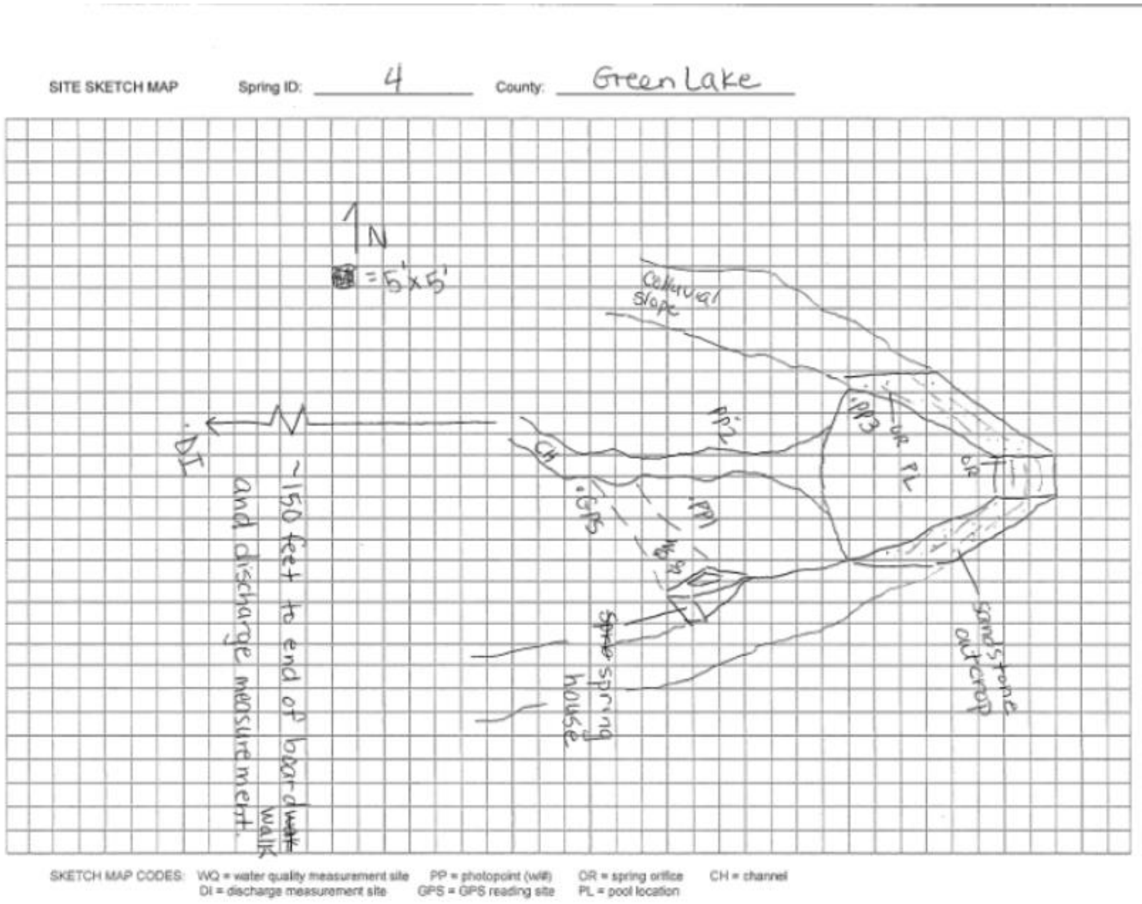


SKETCH MAP CODES: WQ = water quality measurement site   PP = photopoint (w/#)   OR = spring orifice   CH = channel
DI = discharge measurement site   GPS = GPS reading site   PL = pool location




nue
County Road A
Pools Hill (243)
County Road A
Town of Green Lake
Town of Brooklyn
ve
Town of Brooklyn
County Road K
Town of Green Lake





Discharge (ft^3/s): 0.204

Download

RE: Springs, Streamflow and Proposed Mine

Reply | Reply All | Forward | ...

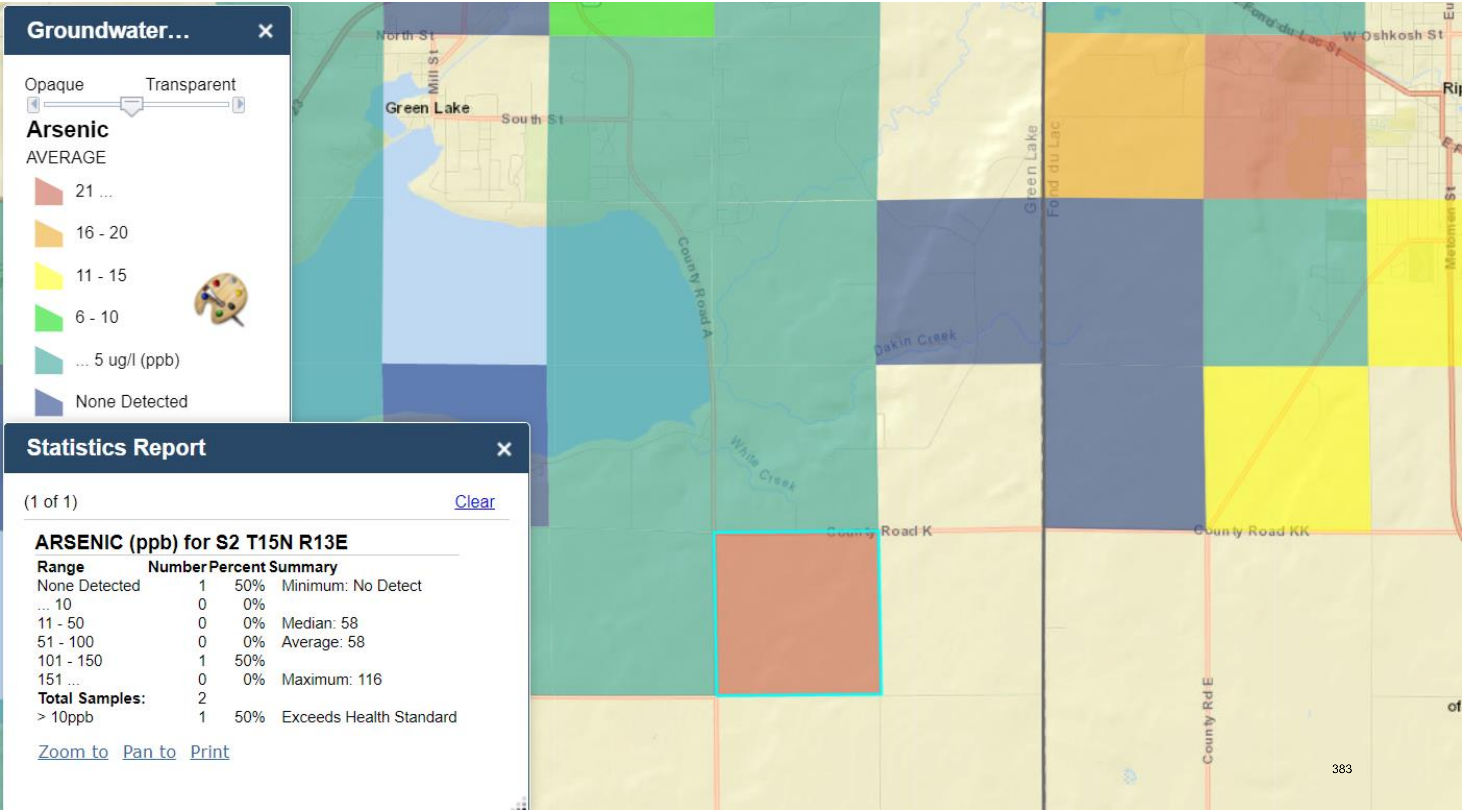
Rosnow, Joseph J - DNR
To Freihoefer, Adam T - DNR
Cc Johnson, Dave M - DNR; Clayton, Nicole L - DNR

Tue 8/2/2022 10:57 AM

I visited all three spring in this area two years ago and two of them are quite unique in their biological, ecological and geological makeup. The headwater spring of White creek (>3 cfs) is the largest spring in the county and quite possibly all of East central Wisconsin. Please let me know what help I can be going forward, I do have the contact information for all three property owners.

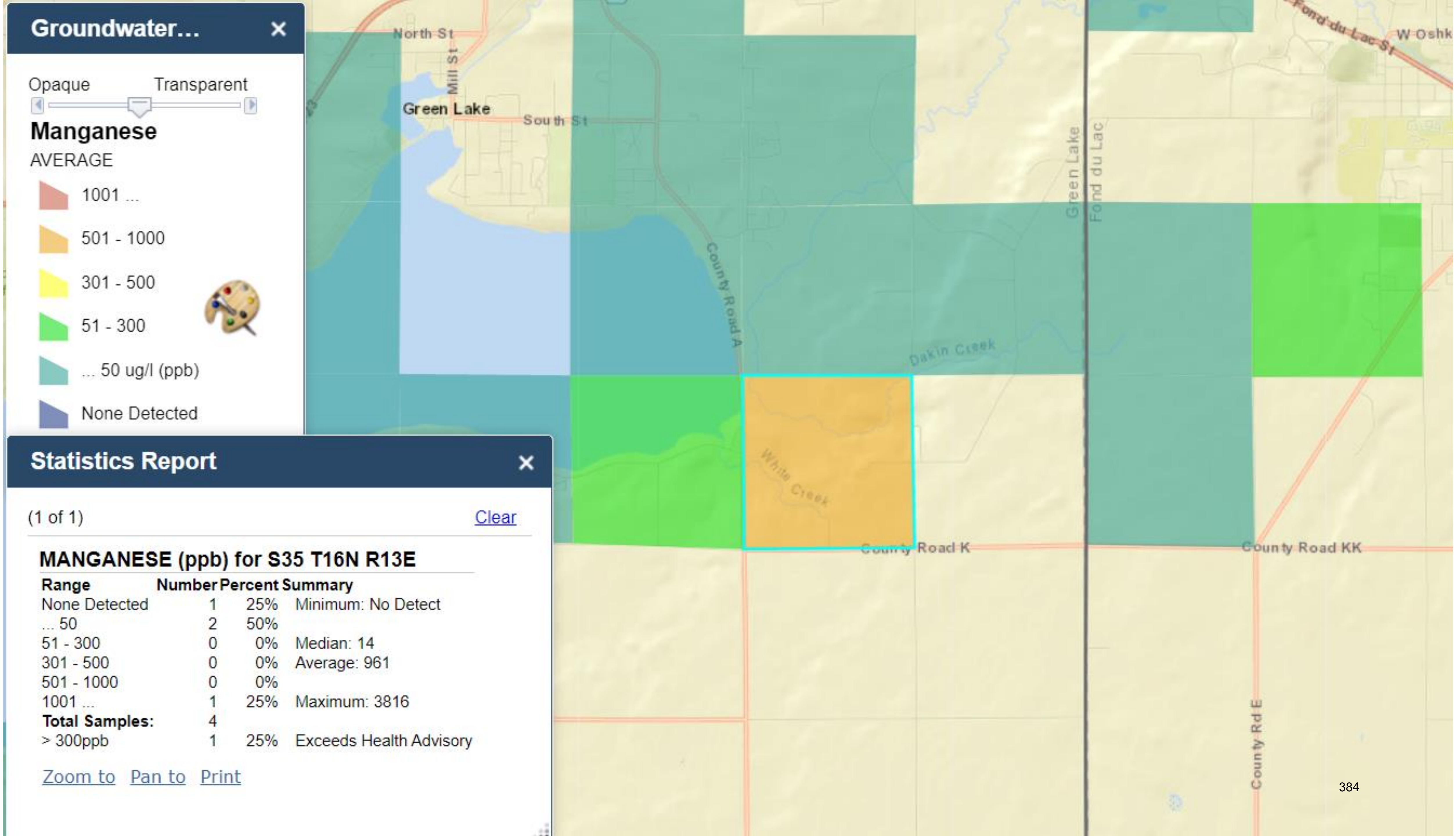
Joe

Joseph J. Rosnow
Water Supply Specialist- Bureau of Environmental Management
Cell Phone: (608) 220-1226
Email: Joseph.Rosnow@Wisconsin.gov



ARSENIC (ppb) for S2 T15N R13E

Range	Number	Percent	Summary
None Detected	1	50%	Minimum: No Detect
... 10	0	0%	
11 - 50	0	0%	Median: 58
51 - 100	0	0%	Average: 58
101 - 150	1	50%	
151 ...	0	0%	Maximum: 116
Total Samples:	2		
> 10ppb	1	50%	Exceeds Health Standard



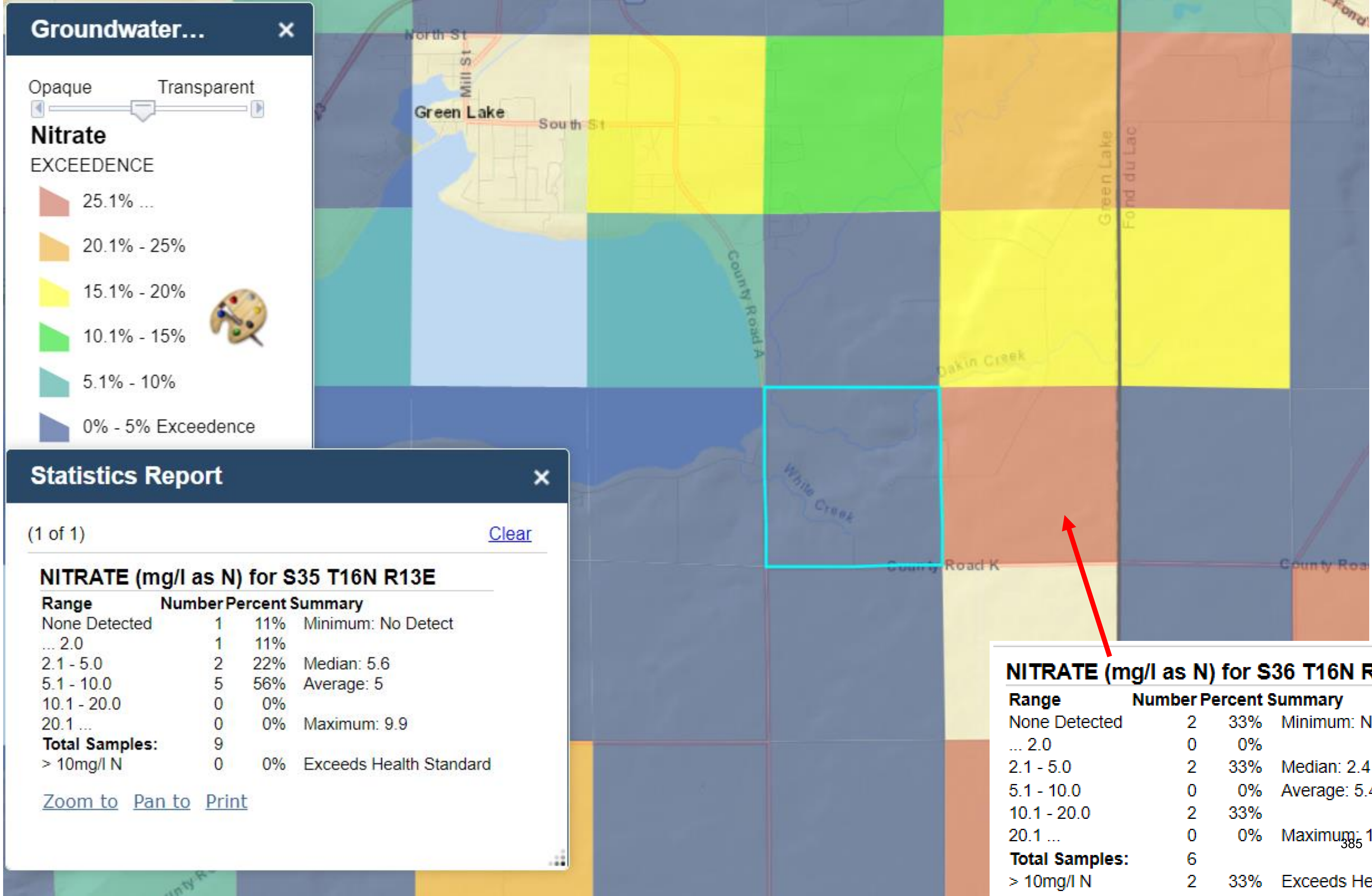
Statistics Report

(1 of 1) Clear

MANGANESE (ppb) for S35 T16N R13E

Range	Number	Percent	Summary
None Detected	1	25%	Minimum: No Detect
... 50	2	50%	
51 - 300	0	0%	Median: 14
301 - 500	0	0%	Average: 961
501 - 1000	0	0%	
1001 ...	1	25%	Maximum: 3816
Total Samples:	4		
> 300ppb	1	25%	Exceeds Health Advisory

Zoom to Pan to Print



NITRATE (mg/l as N) for S35 T16N R13E

Range	Number	Percent	Summary
None Detected	1	11%	Minimum: No Detect
... 2.0	1	11%	
2.1 - 5.0	2	22%	Median: 5.6
5.1 - 10.0	5	56%	Average: 5
10.1 - 20.0	0	0%	
20.1 ...	0	0%	Maximum: 9.9
Total Samples:	9		
> 10mg/l N	0	0%	Exceeds Health Standard

NITRATE (mg/l as N) for S36 T16N R13E

Range	Number	Percent	Summary
None Detected	2	33%	Minimum: No Detect
... 2.0	0	0%	
2.1 - 5.0	2	33%	Median: 2.4
5.1 - 10.0	0	0%	Average: 5.4
10.1 - 20.0	2	33%	
20.1 ...	0	0%	Maximum: 16
Total Samples:	6		
> 10mg/l N	2	33%	Exceeds Health Standard

In reviewing a high capacity well application, the Department will consider on a case-by-case basis whether:

•A proposed high capacity well falls within a groundwater protection area [Wis. Stat. §§ 281.34(4)(a)1. and (5)(b); Wis. Admin. Code § NR 820.30]

•A proposed high capacity well results in > 95% water loss [Wis. Stat. §§ 281.34(4)(a)2. and (5)(c); Wis. Admin. Code § NR 820.32]

•A proposed well's construction degrades safe drinking water, degrades the groundwater resource or impacts public safety [Wis. Admin. Code § NR 812.09(4)]

•A proposed high capacity well, when combined with existing wells, will result in a significant environmental impact to a > 1 cfs spring [Wis. Stat. §§ 281.34(4)(a)3. and (5)(c); Wis. Admin. Code § NR 820.31; *See Lake Beulah*, 2011 WI 54, ¶¶ 39, 44-46, 62-63]

•A proposed high capacity well, when combined with existing wells, will result in a significant adverse environmental impact to a navigable water [Wis. Stat. §§ 281.11, 281.12, 281.34(2); *See Lake Beulah*, 2011 WI 54, ¶¶ 30-34, 39, 44-46, 62-63]

•A proposed high capacity well, when combined with existing wells, impairs a public water system. [Wis. Stat. §§ 281.11, 281.12, 281.34(5)(a); See Lake Beulah, 2011 WI 54, ¶¶ 39, 44-46, 62-63]

If any of these conditions is met in a particular case, the Department may consider adding specific conditions in the high capacity well approval, such as conditions addressing location, construction, pumping capacity, rate of flow, or amount of water that may be withdrawn. [Wis. Stat. §§ 281.11, 281.12, 281.34(2), (5)(a)-(d); Wis. Adm. Code § NR 812.09(4) and ch. NR 820; *Lake Beulah*, 2011 WI 54, ¶¶ 4, 39, 63]. If the Department conditions or denies a well approval, it will provide the applicant with a technical analysis of the scientific evidence it considered when it issued its decision on the application.

A description [PDF] of the Department's high capacity well application review process is available.

1. High Capacity Well Application Received by DNR

2. Potential Environmental Impacts

Does the Proposed High Capacity Well:

- ✓ fall within a Groundwater Protection Area ?
  (Within 1,200 feet to trout stream, outstanding or exceptional resource water body)
- ✓ result in 95% Water Loss?
- ✓ impact groundwater quality?

Do the Proposed High Capacity Well & Existing Wells :

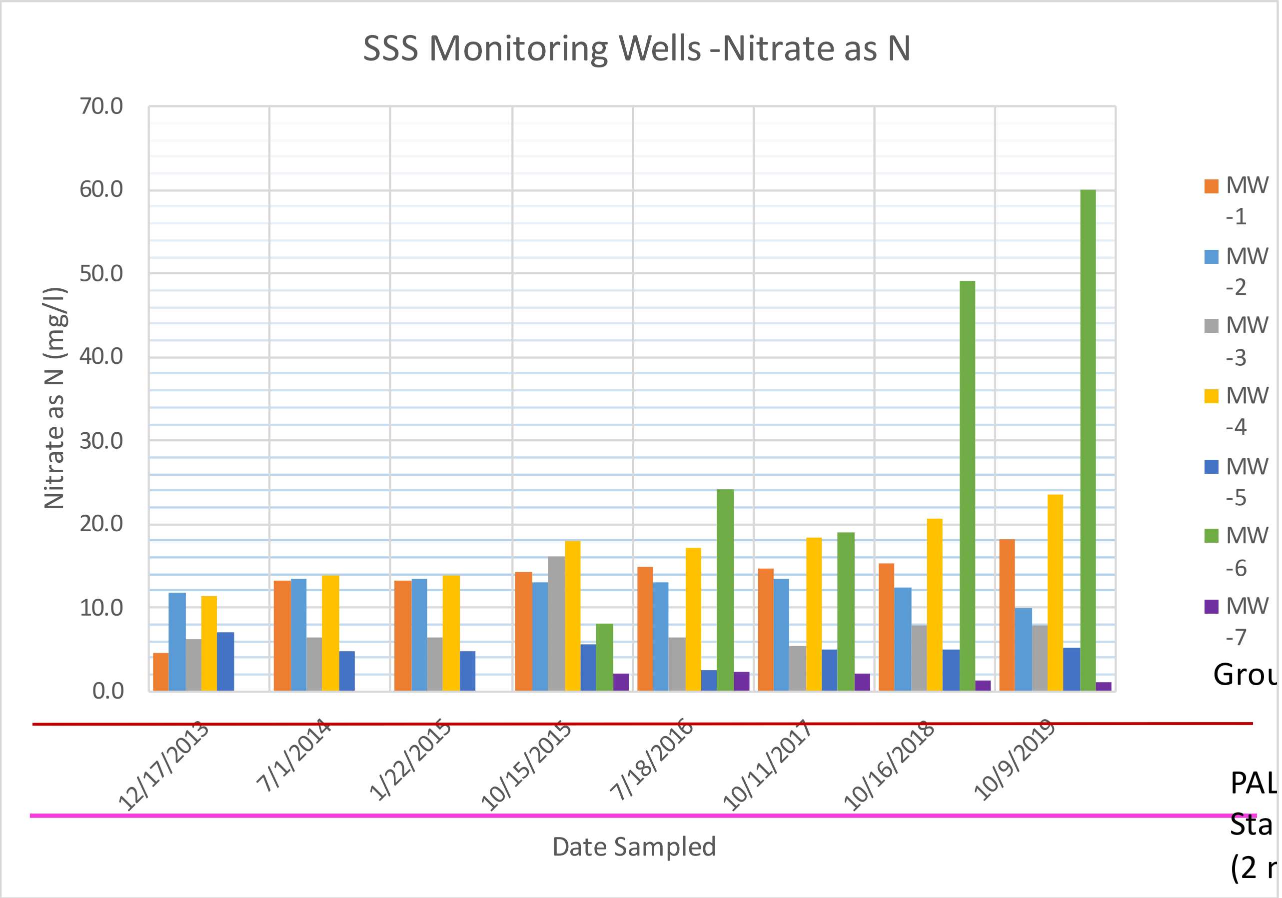
- ✓ impact a spring (> 1 cfs)?
- ✓ impact a navigable lake or stream?
- ✓ impact a municipal well?

Wis. Stat. 281.34, Admin. Code NR 812.09 & ch. NR 820

3. Potential Outcomes

- ✓ Approved as Submitted
- ✓ Approved with Conditions – Technical Support Document Provided to Applicant
- ✓ Denied-Technical Support Document Provided to Applicant

Nitrate is normally present in waters associated with mining as a result of blasting activities using ammonium nitrate or dynamite. [Remove Nitrogen in Mining Effluent Water (911metallurgist.com)]`



The graph on the left is from a Sand mine in western Wisconsin. The nitrate increased due to left over ammonium nitrate used in blasting. There are about 30 private wells downgradient of the site too. Blasting can also result in silt and rust in wells after the shot, as this is a common compliant, we receive.

State of Wisconsin
Department of Natural Resources
Box 450
Madison, Wisconsin 53701

DEC 30 1976

NOTE:
White Copy – Division's Copy
Green Copy – Driller's Copy
Yellow Copy – Owner's Copy

WELL CONSTRUCTOR'S REPORT
Form 3300–15
Rev. 10–75

1. COUNTY: Green Lake
CHECK (✓) ONE: ☒ Town ☐ Village ☐ City — Name: Brooklyn

2. LOCATION: NW, NW ¼ Section SW; Section 34; Township 16N; Range 13E

OR – Grid or Street No. / Street Name: Brooklyn

AND – If available subdivision name, lot & block No.

3. NAME ☒ OWNER ☐ AGENT AT TIME OF DRILLING CHECK (✓) ONE: Elmer Lefke
ADDRESS: Green Lake
POST OFFICE: Green Lake

4. Distance in feet from well to nearest: (Record answer in appropriate block)

Building	Sanitary Bldg. Drain C.I.	Sanitary Bldg. Drain Other	Sanitary Bldg. Sewer C.I.	Sanitary Bldg. Sewer Other	Floor Drain Connected To: C.I. Sewer	Floor Drain Connected To: Other Sewer	Storm Bldg. Drain C.I.	Storm Bldg. Drain Other	Storm Bldg. Sewer C.I.	Storm Bldg. Sewer Other
10										

Street Sewer (San., Storm); Other Sewers (C.I., Other); Foundation Drain Connected to (Sewer, Clearwater Dr., Sewage Sump, Clearwater Sump); Sewage Sump (C.I., Other); Clearwater Sump; Septic Tank: 40; Holding Tank; Sewage Absorption Unit (Seepage Pit; Seepage Bed: 60; Seepage Trench)

Privy; Pet Waste Pit; Pit: Nonconforming Existing (Well, Pump, Tank); Subsurface Pumproom Nonconforming Existing; Barn Gutter; Animal Barn Pen; Animal Yard; Silo With Pit; Glass Lined Storage Facility; Silo w/o Pit; Earthen Silage Storage Trench Or Pit

Temporary Manure Stack; Watertight Liquid Manure Tank; Solid Manure Storage Structure; Subsurface Gasoline or Oil Tank; Waste Pond or Land Disposal Unit (Specify Type); Other (Give Description)

5. Well is intended to supply water for: Home

6. DRILLHOLE

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
16	Surface	48			
6	48	142			

7. CASING, LINER, CURBING AND SCREEN

Dia. (in.)	Material, Weight, Specification & Method of Assembly	From (ft.)	To (ft.)
6	New Black P[illegible] 18.97 - A53 A53M USP	Surface	48

8. GROUT OR OTHER SEALING MATERIAL

Kind	From (ft.)	To (ft.)
Slurry Cement	Surface	48

9. FORMATIONS

Kind	From (ft.)	To (ft.)
Sandy Clay	Surface	15
Limestone	15	100
Sandstone	100	142
Water Bearing		

10. TYPE OF DRILLING MACHINE USED
☐ Cable Tool ☒ Rotary-hammer w/drilling mud & air ☐ Jetting with ☐ Air ☐ Water
☐ Rotary-air w/drilling mud ☐ Rotary-hammer & air
☐ Rotary-w/drilling mud ☐ Reverse Rotary

Well construction completed on Nov 29 1976
Well is terminated 16 inches ☒ above ☐ below final grade
Well disinfected upon completion ☒ Yes ☐ No
Well sealed watertight upon completion ☒ Yes ☐ No

11. MISCELLANEOUS DATA
Yield Test: 8 Hrs. at 10 GPM
Depth from surface to normal water level 26 Ft.
Depth of water level when pumping 28 Ft. Stabilized ☒ Yes ☐ No

Water sample sent to Oshkosh laboratory on Dec 7 1976

Your opinion concerning other pollution hazards, information concerning difficulties encountered, and data relating to nearby wells, screens, seals, method of finishing the well, amount of cement used in grouting, blasting, etc., should be given on reverse side.

Signature: Wallace Clark Registered Well Driller
Complete Mail Address: 5411 [illegible] Rd. Osh. R 3

This is the well on the property.