Baker Soil Services, Inc.
3152 N 100 W
Decatur, IN. 46733
260-701-2143

This report of an onsite soil investigation was requested by: Green Family Farm

Location: Duglay Rd, between McDuffee & Madden Rds, Tract 7
Sec. 7, Eel River Township, Allen County, Indiana

Type of site: New home

Soil Scientist: Joseph W Baker
IRSS # 44

Date: February 10, 2025

This report describes soil conditions observed during an onsite soil investigation conducted on the above date. This report is intended to provide information to the landowner and local health department to be used to determine the suitability of the soil for the installation of an onsite sewage system.

Baker Soil Services and the soil scientist named in this report do not make any assurances, promises, or guarantees regarding the suitability of the soil for installation of an onsite sewage system. The information contained in this report, including any attachments hereto or enclosures herewith, DOES NOT approve or deny a site, provide system specifications, assure that a system can be designed for this site, or imply that any particular system or type of system will function on this site.

In addition to the information contained in this soil report, other factors are considered for use of a site for an onsite septic system, including but not limited to:

- Drainage
- Topography
- Location with respect to construction traffic
- Compaction, stripping, or other site disturbances

The local health department provides system specifications for residential onsite sewage systems. This report will be released to the local health department upon receipt of payment for the preparation of the report.

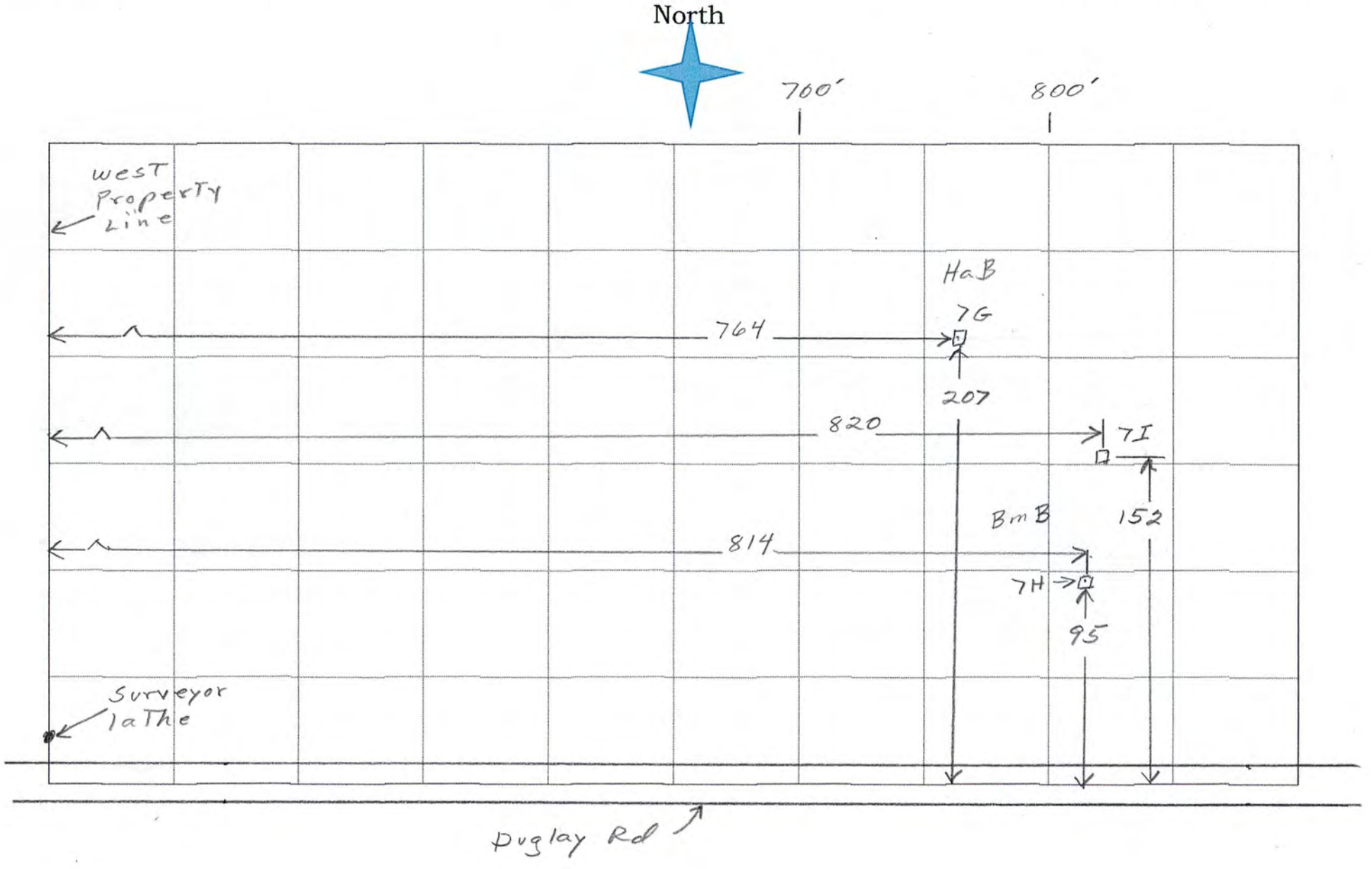
Attached: Map sheet, General site information sheet, Additional soil description sheets(2), Texture analysis sheets (2), iMap photo sheet, Web soil survey sheets Moraine synopsis sheets (6)

This is a preliminary report. Atterberg Limits results are pending. A final report will be issued upon receipt of the Atterberg Limits results.

Baker Soil Services, Inc.

Green Family Farm
Tract 7

HaB – Haskins loam
BmB – Blount SiL/CL



General site information

Soil symbol	HaB	Landscape position	Upland	Limiting layer:	
Land use	Crop	% slope	2.3%	Bedrock	
Vegetation	Corn stalks	Kind of slope	Back slope	Fragipan	
Date	2-10-2025	Shape of slope	Convex	Poor filter	
County	Allen	Direction of slope	East	Compact till	
Map sheet	1	On Moraine?	Yes	Moraine characteristics	
Legal description	Sec. 7		Salamonie Moraine	Dense clay	21
	T 32N R 11E	Site #	Soil pit 7G	Compaction	

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Wetness characteristics:
Depth to seasonal high
water table (inches) < 11
Does it pond water? No
Does it flood? No

Client: Green Family Farm
Tract 7

Depth	Horizon	Texture	Matrix	Mottles	Coating	Grade	Size	Shape	Cons.	Efferv.	P.Mat
0-6	Frozen										
6-11	Ap	Loam 24% C	10YR3/2			1	Tk	Platy	Firm		Glacial Drift
11-21	Bg1	CL 33% C	10YR4/1			1	M	Sbk	Firm		Glacial Drift
21-29	2Bd2	Clay	2.5Y5/4	10YR5/2		0		Massive	V.Firm	NE	Till
29-48	2Cd	CL	10YR4/2		10YR6/1	0		Massive	V.Firm	VE	Till

USDA/SCS soil type this soil most closely represents:
Haskins loam

USDA/SCS Rating for Absorption Fields: Severe
Due to: Seasonal wetness
Moderdately slow permeability
Shallow to limiting layer

Plates in the Ap horizon of Soil pit 7G are 0.75-1.0 inch thick.

Green Family Farm Tract 7

Soil pit 7H: Blount silt loam

Depth	Horizon	Texture	Matrix	Mottles	Coating	Grade	Size	Shape	Cons.	Efferv.	P.Mat
0-3	Frozen										
3-11	Ap	SiL	10YR3/2			1 1	Tn F	Platy Sbk0	Fri		Loess
11-26	2Bt1	Clay 52% C	10YR5/4	10YR5/2	10YR5/2	1	M	Sbk	Firm		Till
26-40	2Cd	CL	10YR4/2		10YR6/1	0		Massive	V.Firm	VE	Till

Plates in the Ap horizon of Soil pit 7H are 0.375-0.5 inch thick

Additional lab testing was run on the 2Bt1 horizon of Soil pit 7H
Cation Exchange Capacity (Sum of Bases): 16.6 meq/100g Cation Exchange Capacity (NH_4 Saturation): 19.13 meq/100g
Atterberg Limits: *Pending*
Pam Thomas ESI-3 Swelling Potential: *Pending*
Muntohar Swelling Potential: *Pending*

Soil pit 7I: Blount clay loam

Depth	Horizon	Texture	Matrix	Mottles	Coating	Grade	Size	Shape	Cons.	Efferv.	P.Mat
0-8	Frozen										
8-11	Ap	CL	10YR3/2			1	Tk	Platy	Firm		Till
11-20	Bt1	Clay 48% C	10YR5/4	10YR5/2	10YR5/2	1	M	Sbk	Firm		Till
20-30	Bss2	Clay	10YR5/4	10YR5/2	10YR5/2	1	C	Wedge	V.Firm		Till
30-48	Cd	CL	10YR4/2		10YR6/1	0		Massive	V.Firm	VE	Till

Plates in the Ap horizon of Soil pit 7I are 0.75-1.0 inch thick.

Additional lab testing was run on the Bt1 horizon of Soil pit 7I
Cation Exchange Capacity (Sum of Bases): 15.0 meq/100g Cation Exchange Capacity (NH_4 Saturation): 17.54 meq/100g
Atterberg Limits: *Pending*
Pam Thomas ESI-3 Swelling Potential: *Pending*
Muntohar Swelling Potential: *Pending*

Grade was shot for this onsite soil investigation by Joseph W Baker with a Bosch laser on 2-7-2025.
The soil downslope of Soil pits 7G, 7H, & 7I is mapped Eel silt loam in the Allen County Soil Survey Manual. Eel is an alluvial soil. No soil pits or soil borings were made to confirm Eel soil. All grade lines shot downslope (East) of Soil pits 7G, 7H, & 7I were found to be concave in shape.

People present during this onsite soil investigation were: Steve Coil, Schrader Real Estate and Auction Company
Eric Ott, Schrader Real Estate and Auction Company (excavator)
Mark Herber, Allen County Dept of Health
Joseph W Baker, Baker Soil Services

Report Number
F25042-0097
Account Number
04517

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3505 Conestoga Dr.
Fort Wayne, IN 46808
260.483.4759
algreatlakes.com

To: BAKER SOIL SERVICES
3152 N 100 W
DECATUR, IN 46733-8384

For: GREEN FAMILY FARM

Farm: TRACT 7
Field: DUGLAY RD

Attn: JOSEPH BAKER

SOIL TEST REPORT

Date Received: 2/11/2025
Date Reported: 2/14/2025

Sample ID	Lab Number	Organic Matter %	Phosphorus		Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Soil pH	Buffer pH	CEC meq/100g	Percent Cation Saturation				
			Bray-1 Equiv ppm-P	Bray P2 ppm-P								% K	% Mg	% Ca	% H	% Na
G7G7	6937															
G7G8	6938															
G7H	6939	1.8	1 *VL*		96 *M*	790 *VH*	1950 *M*		7.1		16.6	1.5	39.7	58.8		
G7I	6940	1.7	1 *VL*		90 *M*	670 *VH*	1750 *M*		6.8		15.0	1.5	37.2	58.3	3.0	

VL = Very Low *L* = Low *M* = Medium *H* = High *VH* = Very High

Sample ID	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts (1:2) mmhos/cm	Nitrate NO_3-N ppm	Ammonium NH_4-N ppm	Bicarb-P P ppm				Comments

Report reviewed and approved by our professional agronomy staff.

Report Number
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To: BAKER SOIL SERVICES
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DECATUR, IN 46733-8384

For: GREEN FAMILY FARM
TRACT 7
TRACT 7
DUGLAY RD

Attn: JOSEPH BAKER

REPORT OF ANALYSIS

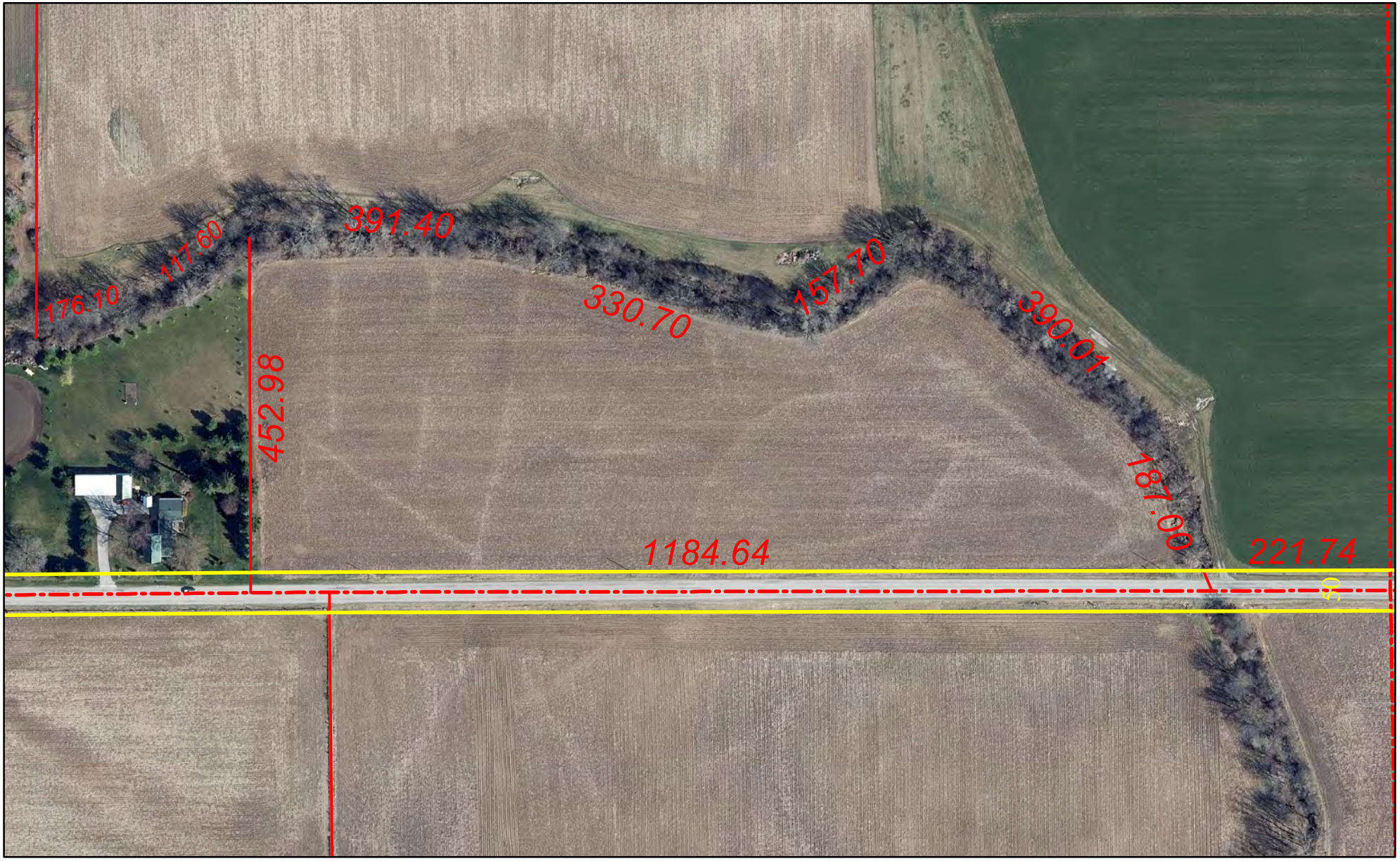
Date Received: 02/11/2025
Date Reported: 02/14/2025

Lab Number	Sample ID	Analysis	Result	Unit	Method
6937	G7G7 Soil pit G 6-10"	Sand	43	%	ISDH Particle Size Analysis
		Silt	33	%	ISDH Particle Size Analysis
		Clay	24	%	ISDH Particle Size Analysis
6938	G7G8 Soil pit G 15-20"	Sand	31	%	ISDH Particle Size Analysis
		Silt	36	%	ISDH Particle Size Analysis
		Clay	33	%	ISDH Particle Size Analysis
6939	G7H Soil pit H 15-20"	Cation Exchange Capacity (NH4-Sat.)	19.13	meq/100g	MSA Part 3 (1996) pp 1220-1221
		Sand	16	%	ISDH Particle Size Analysis
		Silt	32	%	ISDH Particle Size Analysis
		Clay	52	%	ISDH Particle Size Analysis
6940	G7I Soil pit I 14-19"	Cation Exchange Capacity (NH4-Sat.)	17.54	meq/100g	MSA Part 3 (1996) pp 1220-1221
		Sand	18	%	ISDH Particle Size Analysis
		Silt	34	%	ISDH Particle Size Analysis
		Clay	48	%	ISDH Particle Size Analysis

Report reviewed and approved by our professional agronomy staff.

SOILMISC

Duglay Rd, Tracts 5, 6, & 7



North American Datum 1983
State Plane Coordinate System, Indiana East

N

Date: 2/17/2025 1 " = 167 '

Soil Map—Allen County, Indiana
(Duglay Rd)

Map Scale: 1:2,380 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Allen County, Indiana
Survey Area Data: Version 24, Aug 28, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 18, 2022—Jun 21, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BmA	Blount loam, interlobate moraines, 0 to 2 percent slopes	3.4	14.6%
BmB2	Blount loam, interlobate moraines, 1 to 4 percent slopes, eroded	0.1	0.3%
Es	Eel silt loam, 0 to 2 percent slopes, frequently flooded	6.4	28.0%
MrB2	Glynwood silt loam, 2 to 6 percent slopes, eroded	4.8	21.0%
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded	7.2	31.3%
Pe	Pewamo silty clay loam, 0 to 1 percent slopes	1.1	4.9%
Totals for Area of Interest		**23.0**	**100.0%**

On-site Sewage System Functionality in Northeast Indiana soil

Joseph W. Baker, IRSS #44
6-5-23

Description of geology in northeast Indiana

Northeastern Indiana is an area of recessional moraines. A recessional moraine is an area where glacial ice stopped its forward progress and retreated. In Allen County, the Fort Wayne, Wabash, and Salamonie Recessional Moraines are present. The Green Family Farm tracts are on the Salamonie Recessional Moraine.

The source of these moraines is the Erie Lobe of Wisconsin Age of glaciation, which occurred as recently as 13,000 - 22,000 years ago (Fleming, 1996). The material deposited by the Erie lobe is clay and fine silts. The material was deposited by ice melt. As the glacial ice melted, the material that had been incorporated into the ice was deposited as mud flows from the ice.

The landscape of a recessional moraine is gently rolling topography, bisected by drainage swales. Flatter areas within the rolling landscape are often old glacial lakes.

Geological impacts on Soil Absorption Field performance

Properties which are unable to connect to public sanitary sewer systems must utilize an on-site sewage system ('OSS') soil absorption field ('SAF') in order to properly treat and disperse the wastewater which is generated through normal, everyday water usage (toilets, sinks, showers, washing machines, water softeners) in a residence. SAF design in the state of Indiana is predicated on having a sufficient depth of 'suitable' soil, measured from the ground surface down to a limiting layer. A limiting layer is a horizon within the soil profile that will significantly restrict the vertical movement of wastewater. There must be a minimum of twenty inches (20") of suitable soil above a limiting layer, in order for an elevated system to be considered (Indiana State Department of Health, 2014). There must be a minimum of thirty four inches (34") of suitable soil above a limiting layer, in order for a subsurface system to be considered (Indiana State Department of Health, 2014).

The soil in northeast Indiana has been studied over the past 28 years due to SAF's that have been documented to have failed prematurely (sometimes within a matter of months after the system was put into use). Many factors can contribute to SAF failure (hydraulic overload, organic overload, surface compaction, non-functional perimeter drain). However, the frequency and the geographic location of these failures has tied these failures primarily to the soil and the way it was uniquely formed geologically in this region. Site specific troubleshooting of these failed systems has consistently identified unique soil characteristics that were not understood when the state code which governed OSS design (410 IAC 6-8.1, 1990) was written. Study of these failure sites has determined that there are B horizons within the soil profile that have limiting layer characteristics present. Identification, after the fact, of these B horizons with limiting layer characteristics has shown that the systems at these failure sites had significantly less than the minimum required depth to a limiting layer needed for proper long term SAF operation.

In this area of recessional moraines, SAF operation has been documented to be problematic due to the low or very low permeability of the B horizons in these soils. The low or very low rate of permeability is due to three principal factors: high clay content, shrink-swell (or 'expansive') clay, and poorly defined soil structure. These three factors are directly attributable to the unique geology of northeast Indiana and

northwest Ohio. The terms "moraine characteristics" or "anomalous soil characteristics" are used to describe soil conditions of high clay content (with a capacity to shrink and swell), low sand content, and poorly defined soil structure.

For proper wastewater treatment to occur in a SAF, the wastewater must be able to move through the soil in an aerobic, unsaturated fashion. When moisture is added to the soil, the expansive clays swell which prevents or severely restricts further water percolation through the soil. As a SAF is put into use, this wetting of the soil and expansion of the clays will begin to occur. As the clays swell, a saturated, anaerobic condition can develop over time which can lead to effluent surfacing, backup through the system toward the house (interfering with plumbing fixture usage), or saturated flow through the less clayey A horizon, resulting in poorly treated effluent migrating into the perimeter drain.

As stated in Fleming (1996), "*Geologic conditions in many parts of the moraine are not likely to promote satisfactory septic system performance; in fact, they are entirely inimical to it."*

Identifying the problem soils visually during an on-site soil test

When observed in a backhoe pit, well defined soil structure should appear as individual peds, similar to building blocks. When water percolates through the soil, much of the water flows around individual peds, through the soil pore space, not through the peds themselves. Soil structure may take many tens of thousands of years to develop through natural weathering processes. However, with the recent glacial activity occurring only 13,000 years ago, the soil in this area is considered young, which partially explains why it is poorly developed.

When observed in a backhoe pit, a soil exhibiting moraine characteristics will have poorly defined soil structure. The structure may be massive - lacking in any structure at all. The soil may have weak, poorly defined soil structure that parts only with force. Often, moraine soils will exhibit thick wedge structure in clayey subsoil. These wedges are slickensides, referred to by some soil scientists as "pressure faces". Pressure faces (consisting of slickensides {>2"} and stress cutans {<2"}) and very poorly defined soil structure are formed in, and one of the physical manifestations of expansive clay mineralogy within the soil.

The slickensides are 1 to 4 inches thick. They have a thick clay coating on the plate faces.
In moist to wet conditions, the plates are quite prominent. In dry conditions, the plates are less prominent, but soil structure will always break horizontally. This is critical to note, as structure breaking horizontally indicates that the vertical water movement through the profile will be greatly restricted. The wastewater will be forced to move horizontally until it can find a crack or seam to move vertically. This process of moving horizontally in order to find a way to move vertically will slow down the soil's rate at which it can accept wastewater. Soil consistence within a horizon of soil exhibiting moraine characteristics will generally range from very firm to very rigid (as defined by Schoeneberger, et al., 2012). A soil horizon exhibiting moraine characteristics cannot be sliced vertically with a stiff bladed knife. The ability, or inability to slice a soil horizon with a knife is related to the soil horizon's consistence. Soils with very firm or firmer consistence indicates the presence of a limiting layer, per Franzmeier, et al. (2004). In addition, field descriptions of stickiness and plasticity (as described by Schoeneberger, et al., 2012) are also related not only to consistence, but to expansive clay properties as well.

Slickensides were identified at a depth of 20 inches in Soil pit 7I.
Massive clay was identified at a depth of 21 inches in Soil pit 7G.

Moraine characteristics cannot be definitively observed through the use of hand tools (bucket auger or push probe) alone. Backhoe pits are essential to identifying these features in the field. Pits are used to observe an undisturbed soil profile on the backhoe pit wall. Use of backhoe pits to identify slickensides, poorly developed structure and to better quantify the consistence through the vertical knife slice and examination of the soil's stickiness and plasticity are critical additional steps in order to identify the *presence* of these recessional moraine, expansive clay soils.

Identifying and quantifying problem soils through field or laboratory testing

From laboratory analysis, slickensides are known to have expansive clay mineralogy. State mandated Moraine Protocol (Indiana State Department of Health, 2001) requires the use of backhoe pits and laboratory texture analysis (% sand, silt & clay) for on-site soil investigations in counties which have recessional moraines. However, it is now understood that clay content alone will not definitively predict and quantify expansive clays. There are a number of areas in the world which have soils with high clay content. However, some of those soils are also very old and highly weathered. As such, those soils have better soil structure and minerals that have weathered down to non-expansive-type clays.

As referenced in Krenz, et al. (2006), the clay mineralogy of the soil can also affect the SAF performance. As such, additional testing to assess the clay mineralogy is also important. However, direct assessment of the clay mineralogy is expensive, and requires equipment that is typically found only at universities. Other, more common laboratory tests including (but not limited to) Atterberg Limits and Cation Exchange Capacity ('CEC'), will provide more information regarding the soil's characteristics. From the measurable characteristics in these tests, the mineralogy of the soil can be inferred, due to decades of published research (Dakshanamurthy and Raman, 1973; Snethen, et al., 1977; Parker, et al., 1977; Holtz and Kovacs, 1981; Nelson and Miller, 1992; Thomas, et al., 2000; Cerato and Lutenegger, 2002; Yilmaz, 2004; Muntohar, 2006; Seybold and Libhova, 2017). Other states, including North Carolina, Alabama and parts of California use Atterberg Limits test results as part of the process in determining a site's suitability (North Carolina Administrative Code, 2017; Alabama State Board of Health, 2017; Marin County Code, 2016; Humboldt County, 2018).

Other laboratory tests, such as coefficient of linear extensibility ('COLE') (as recommended in Purdue RW-3-W) and COLE $_{rod}$ are direct measurements of a soil's expansive capabilities (Franzmeier and Ross, 1968; Schafer and Singer, 1976; Ross, 1978; Vaught, et al., 2006). According to Krenz, et al. (2006), the Natural Resources Conservation Service ('NRCS') has used the COLE test throughout the state of Indiana. Per Krenz, et al. (2006), NRCS' data indicates that 60 – 100% of the soil in northeast Indiana has high shrink-swell potential, based on COLE data. COLE $_{rod}$ was originally developed using California soils. More recently, COLE $_{rod}$ has been used in Arkansas to research the possibility of identifying expansive clays that are problematic for an OSS (Darnell, et al., 2021).

Soil saturated hydraulic conductivity (K_{sat}) and low water percolation rates in soils are discussed in Hart, et al. (2006) and Soil Survey Staff (2014). From Hart, et al., (2006):

> **"Summary:** Soil hydraulic conductivity must be considered when installing a septic system. In soil with very low hydraulic conductivity, wastewater effluent is unable to move through the soil profile. In soil with very high hydraulic conductivity, the effluent will move through too quickly, and will not be treated properly. Because measuring hydraulic conductivity in the field is complex and time-consuming, there is little data relating ISDH Rule 410 IAC 6-8.1 loading rate data to actual field measurements. The ISDH's current loading rate table for wastewater effluent is based on results from other states and USDA-NRCS estimates of soil hydraulic conductivity.

However, as indicated by Table 1, these loading rates may be high for some soils, so in-field hydraulic conductivity tests are likely to be a better predictor of future septic system performance than the ISDH estimates based on soil morphology. Remember, just because a soil description indicates that a septic system can be installed, does not mean that system will function as designed under the current rule."

Saturated hydraulic conductivity tests are available in a field version, through the use of instruments such as the compact constant head permeameter ('CCHP'). A laboratory version of this test can also be performed, if an undisturbed sample can be collected. In addition to the study of northeast Indiana soil (performed by Hart, et al., 2006), the CCHP has also been used in the state of Virginia (see Thomas et al., 2016) and North Carolina (North Carolina Administrative Code, 2017).

In an effort to better understand the soils in northeast Indiana, recent efforts have been made to analyze these problematic B horizons using all of the above-listed tests (texture analysis, Atterberg Limits, CEC, COLE, COLE $_{rod}$, K $_{sat}$). To date, the testing results have both shown a good correlation between these tests and further supported the physical attributes observed when describing a soil pit.

The documents referenced here were previously examined and discussed by the Indiana Department of Health Northeast Indiana Expansive Clay Committee as part of considering updates to the 8-14-01 ISDH northeast Indiana recessional moraine protocol.

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