



The Mahoning Valley Mushroom Farm North Lima, Ohio AMD Investigation

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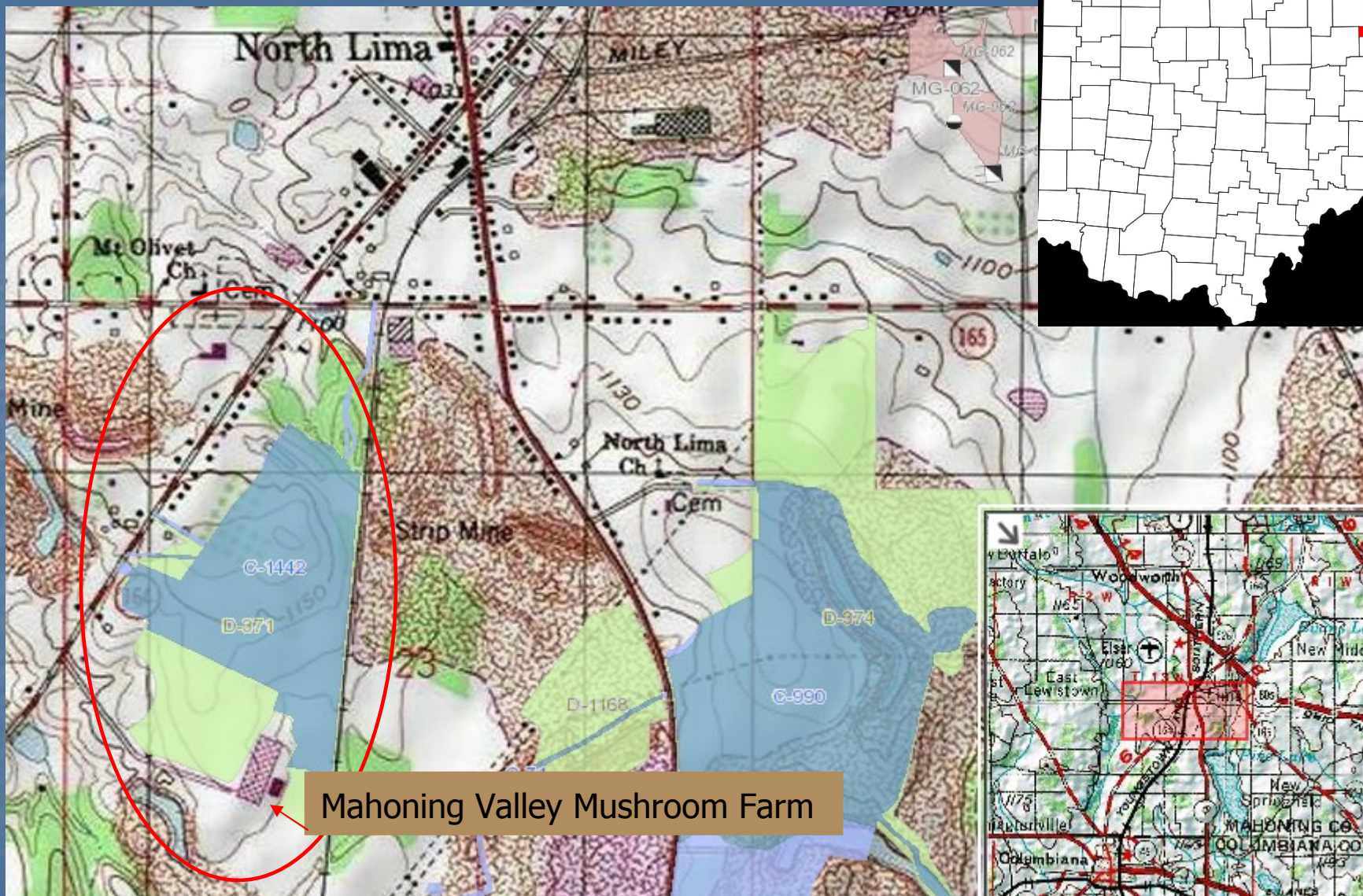
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Date: 3/31/2004  1994

40°56'09.82" N 80°40'07.34" W elev 1102 ft

Eye alt 1568



Mahoning Valley Mushroom Farm

The Problem -



- OSM identified in formal letter to ODNR-MRM in 2007 that Forfeited Permit (D-0371) had generated mine drainage and required action.
- Issue for MRM – Final surety release for this permit occurred in March 1995 – no mine drainage problems assessed at time of release.
- Response – MRM need for thorough evaluation of mine drainage issues at this permit.

2012



400 m

C-71

AMD Issues and problems



Rental house

Pre-existing drainage east of house

Pre-existing AMD seepage west of house



Site Conditions



Laminar AMD flow from basement



Wetland across access road – under SR 164



Laminar AMD flow across drive



Sample Location	pH	Cond	Acidity	Iron	Mang	Alum	Sulfate	Mg	Hard
Discharge at Rental House (SZ-E and SZ-W)	2.94	15,900	2127	490	234	139	6098	713	4001
Downstream from Rental House	4.88	1860	82.7	24	16.5	7.33	733	87.3	679
Downstream on Trib to Mill Creek	5.28	1590	45.3	6.88	11.3	2.28	600	68.9	588

Historical Mining in Area

- C-1442 D&D Mining – Issued May 1981
41.8 acres
 - Repermitted by...
- D-0371 Ferris Coal Co – Issued January 1985
51.4 acres total
- Ferris completed total backfill (Phase I) by 1988 although forfeited bond prior to resoiling (Phase II)

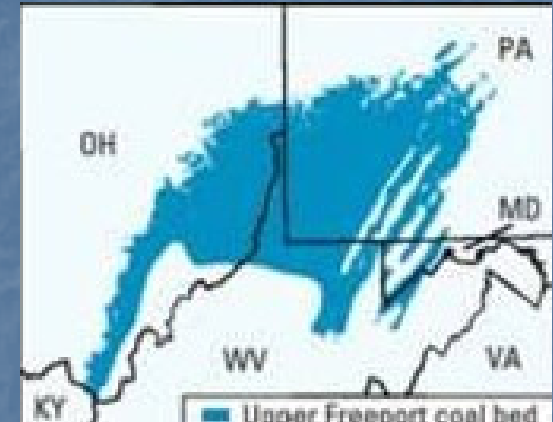


Local Geology

Middle Pennsylvanian, Allegheny Group

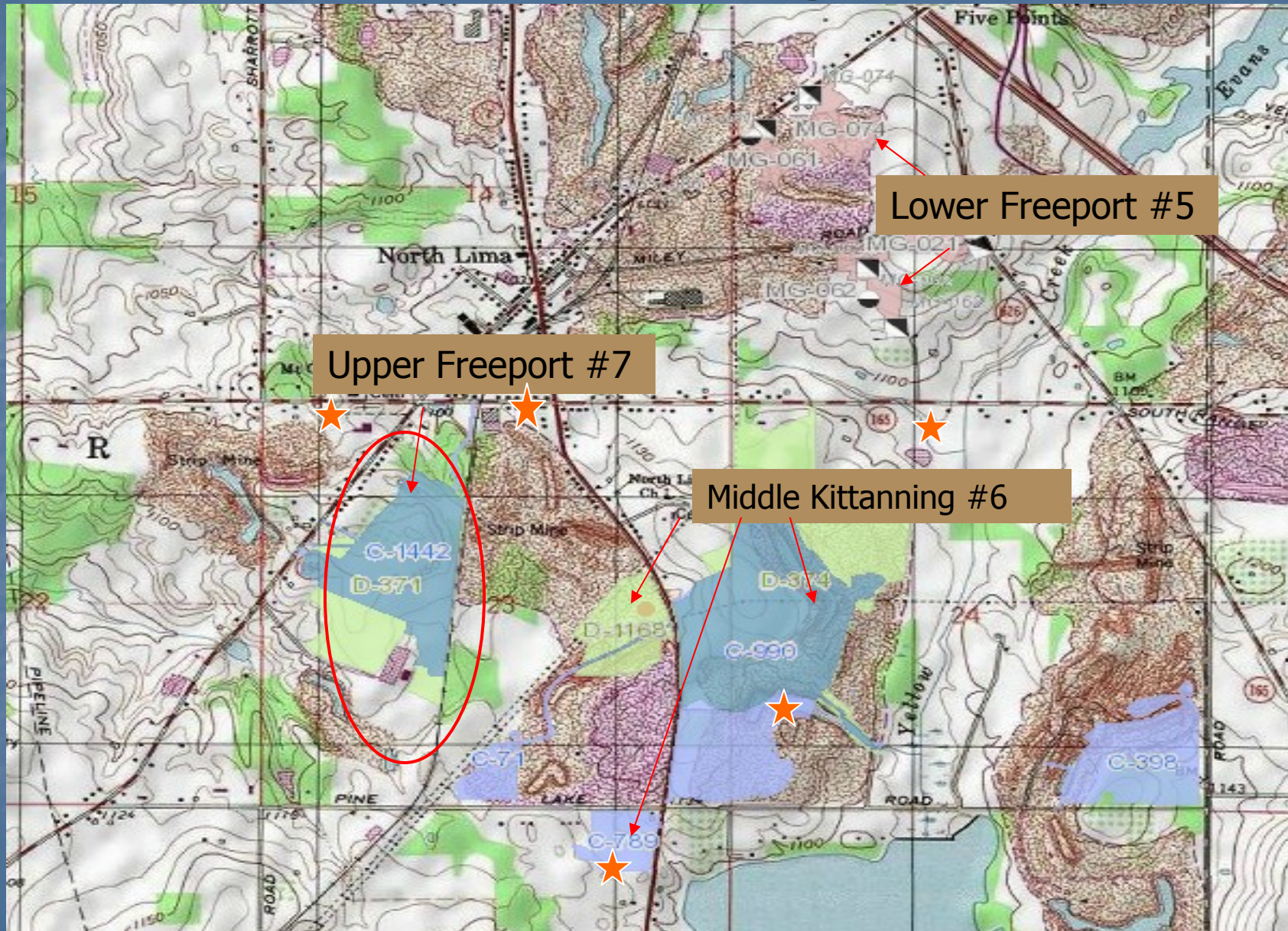
		Upper Freeport cb (No. 7)
☉+	Upper Freeport limestone	
		Bolivar cb
M	Dorr Run shale	
☉+	Lower Freeport limestone	Lower Freeport cb (No. 6a)
M	Washingtonville shale	Middle Kittanning cz (No. 6)
M	Tuscarawas shale	Strasburg cb (No. 5a) ³
M	Columbiana shale ⁴	Lower Kittanning cb (No. 5) ^{3,6}
		Lawrence cb ³
M	Obryan limestone ⁶	Scrubgrass cb ("Clarion") ³

(USGS, 2010)



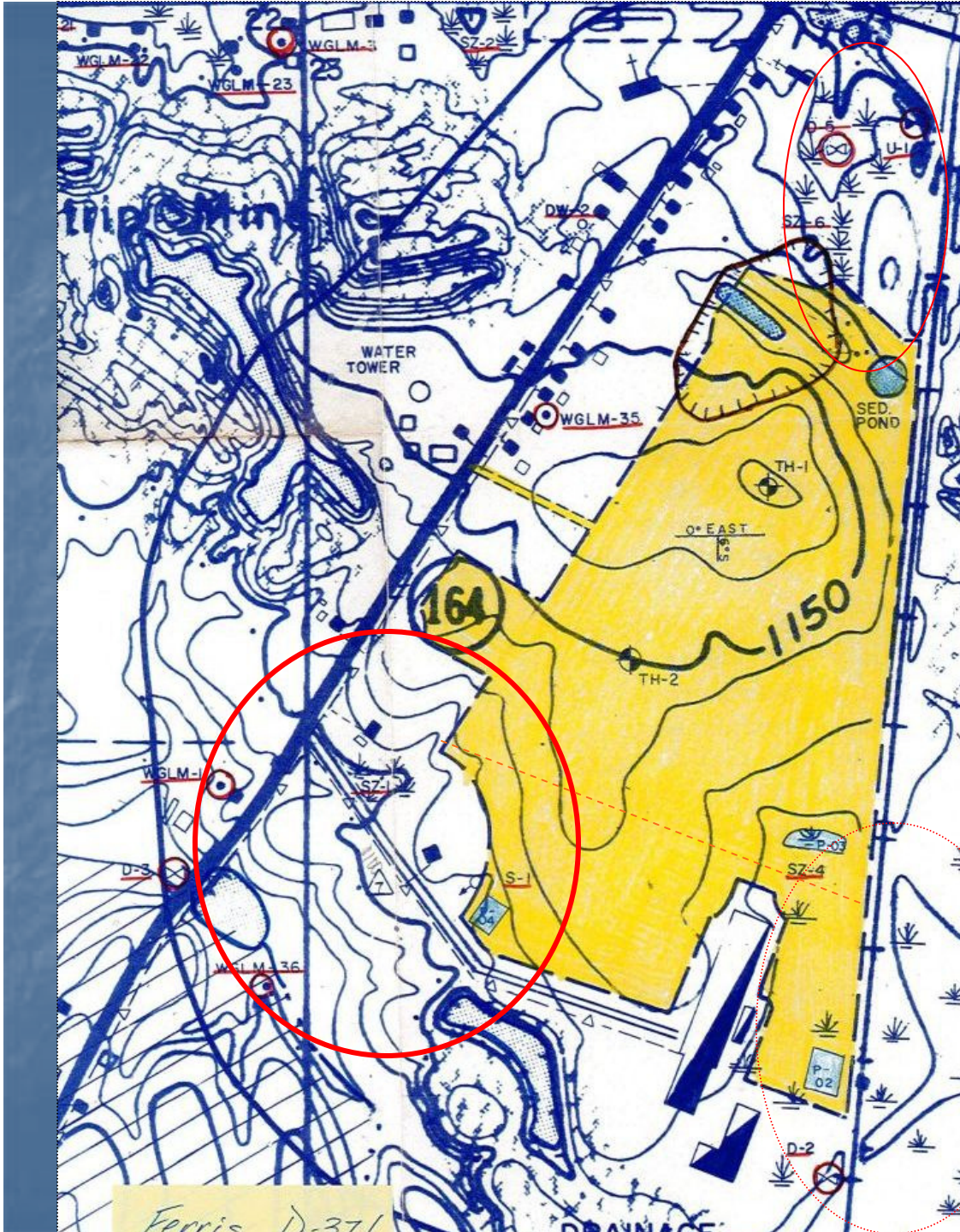
(USGS, 2013)

Extent of Mining in Area



What MRM did know...

- Earlier complaint by rental property – iron-rich water in basement (1990)
- Mid-90's rental home evacuated
- MRM/OSM increased in flows from seeps and house over time
- No other discharges directly from mine site
- Seeps were pre-existing – Pre-law issues



Permit Application- Hydro Map

AML/AMD program investigation



Monitor Wells

Well	Surface Elev	Depth	Bottom Elev	SWL	Lithology	pH
BH-1	1112' msl	13.4 feet	1098' msl	2.0 feet	Silty clay	3.3
BH-2	~1138' msl	34.4 feet	1103' msl	22.0 feet	Silts/sandst	N/A
BH-3	1138' msl	24.5 feet	1113' msl	14.1 feet	Spoil	5.0
BH-4	1154' msl	39.2 feet	1115' msl	38 feet	Spoil	5.4
BH-5	1165' msl	49.0 feet	1116' msl	No Water	Spoil	N/A
BH-6	1165' msl	44.5 feet	1111' msl	43 feet	Spoil	N/A
BH-7	1155' msl	44.0 feet	1111' msl	No Water	Spoil	N/A
BH-8	1156' msl	38.0 feet	1118' msl	33 feet	Brown Sst	N/A
BH-9	1143' msl	33.9 feet	1109' msl	32 feet	Spoil/sst/clay	6.0
BH-10	1127' msl	28.5 feet	1098 msl	13 feet	Spoil/silts/clay	5.6
BH-11	1114' msl	25.5 feet	1099 msl	1 feet	Wet sst/open void	3.8
MW-1	~1125' msl	unknown	unknown	28 feet	Hit void @ 1088'	6.5

What we knew at this time...

- Not much water in backfill spoil Monitor wells
- Artesian flow in MW 1 and 11
- Water quality in mine backfill water net-alkaline mine drainage
- Water quality at Rental house severe acidic- high metals
- Flows dramatic increase since original complaint
- Active mining in #7 coal seam elevation – AMD discharging at lower elevation
- Source of severe mine drainage problem?

Hypothesis:

I hypothesize that there is a detectable geochemical difference between acid mine drainage that results from a surface or deep mine.

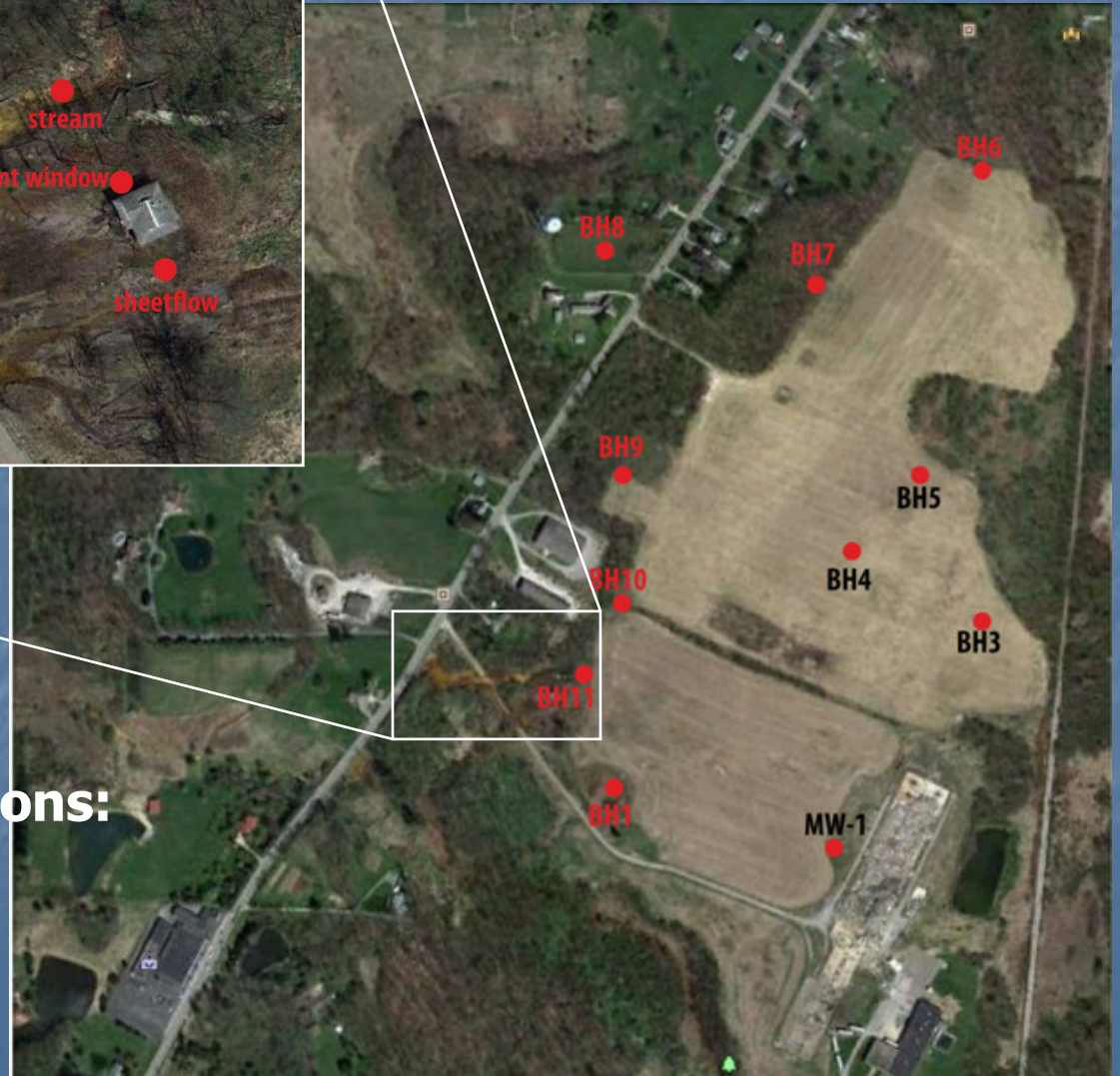
Objectives:

- Establish groundwater flow regime
- Compare water chemistry from surface mine with underground mine
- Identify geochemical signature based on mine type
- Identify reason for AMD seep at surface
- Location of AUM

Surface Water Locations:



The MF Site



Groundwater Locations:

Methods:

Chemical Analyses:

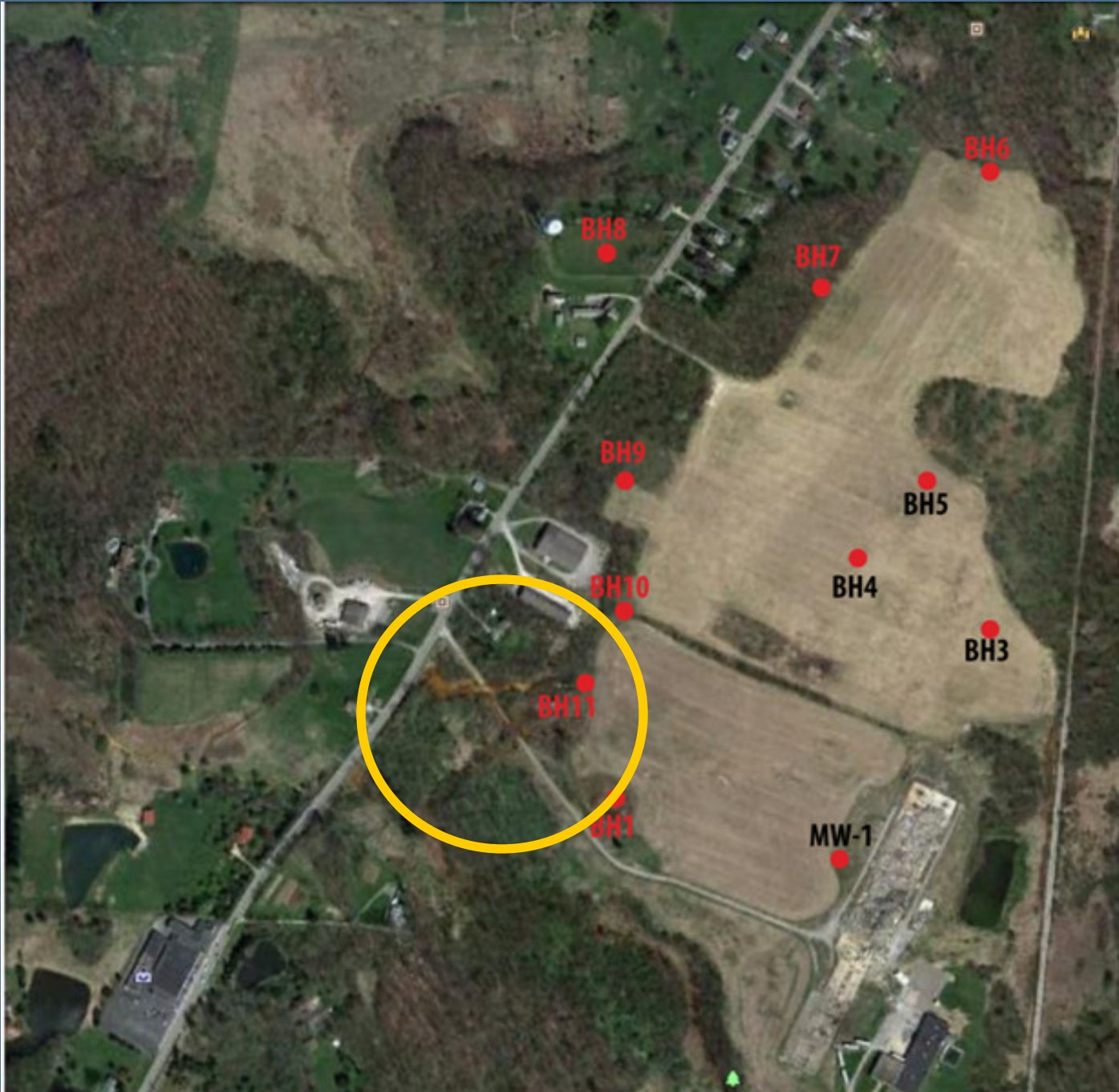
- Spectrophotometry
- Ion chromatography
- Atomic absorption (AA)
- Inductively coupled
- WebPHREEQ

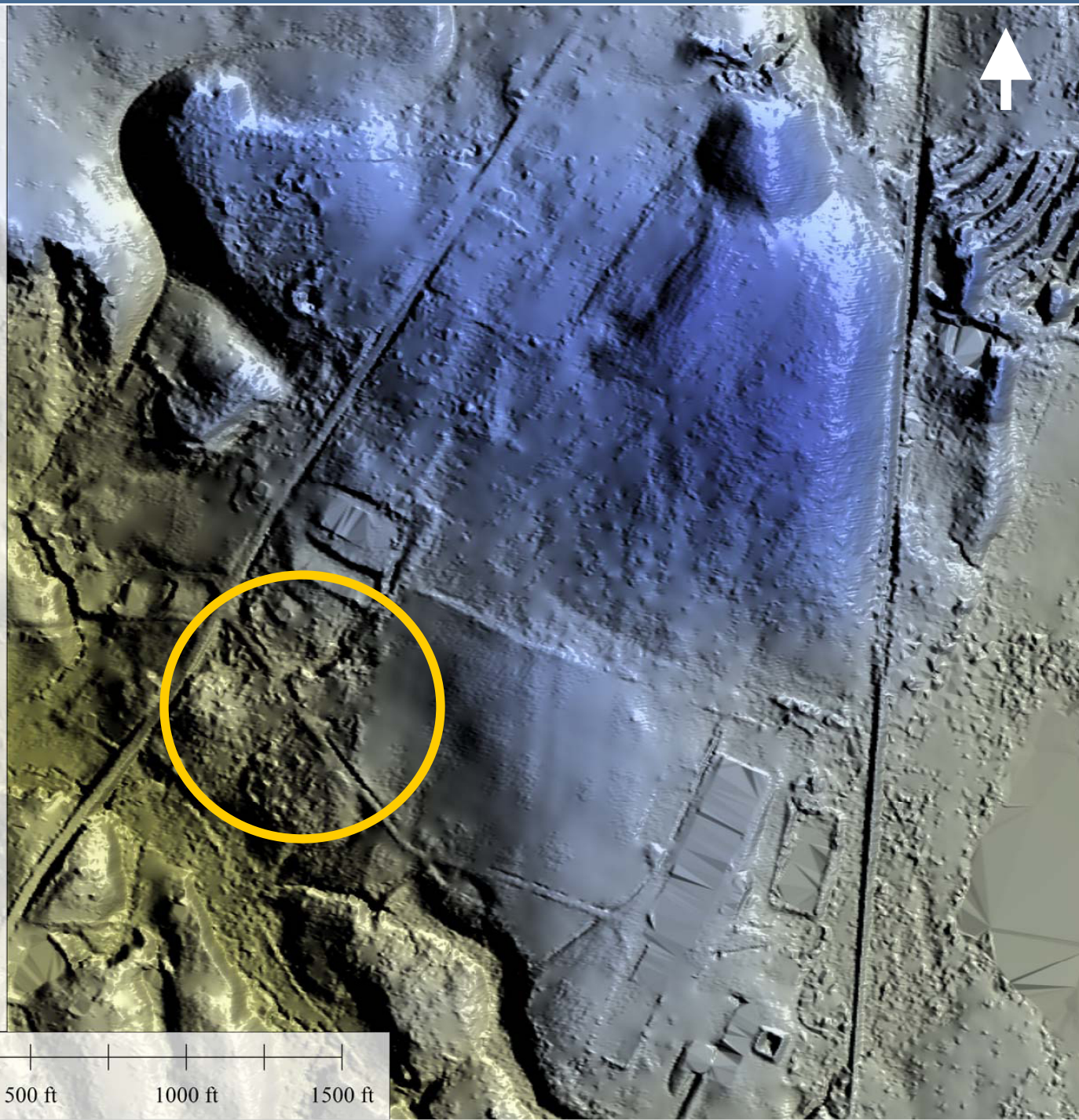
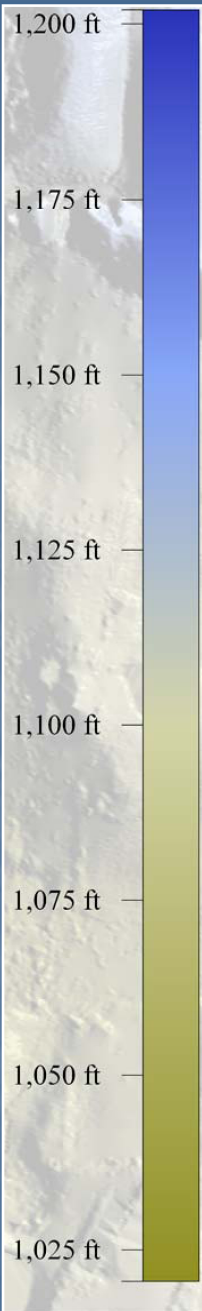
(aqueous geochem modeling)

- Groundwater flow maps
- S_y calculations
- Aerial Photo Analysis

temperature, pH, conductivity, DO

Fe^{2+} , Fe_{tot} , SO_4^{2-} , Mn, Mg, Ca, Na, K, Al, Cl





1 ft pixel resolution LiDAR (ORGRIP)

◆ sampling/well location

↘ GW flow direction

1,175 ft

1,150 ft

1,125 ft

1,100 ft

1,075 ft

1,050 ft

1,025 ft

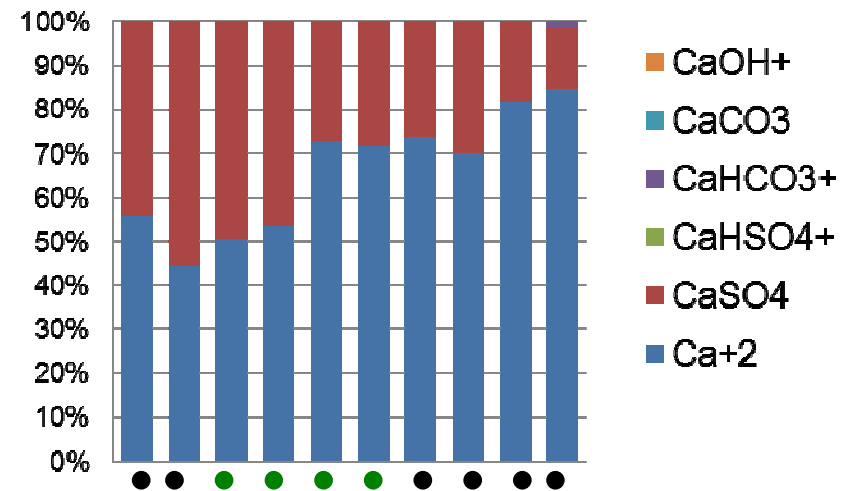
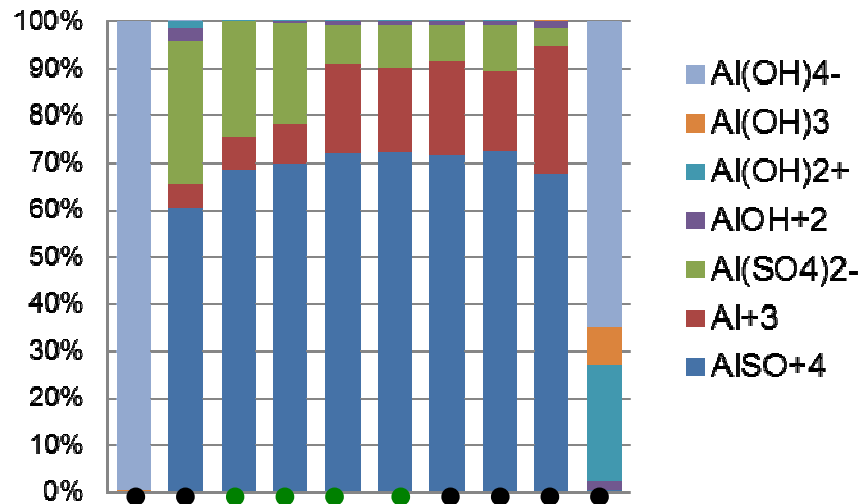
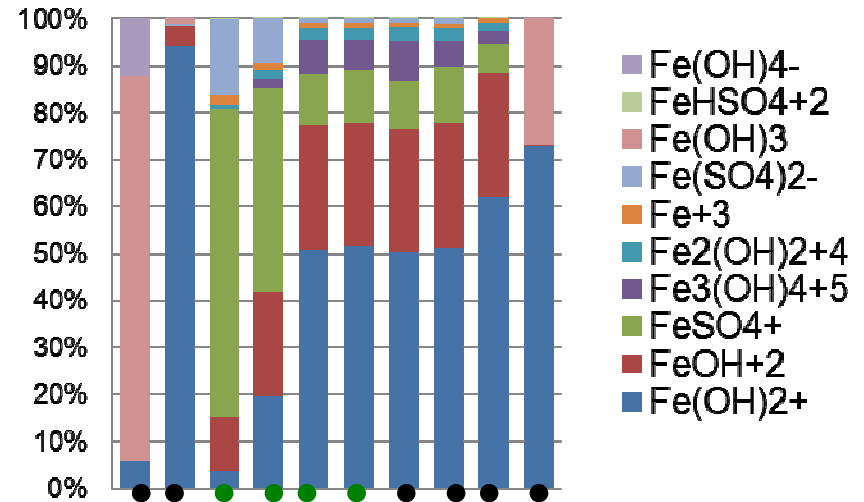
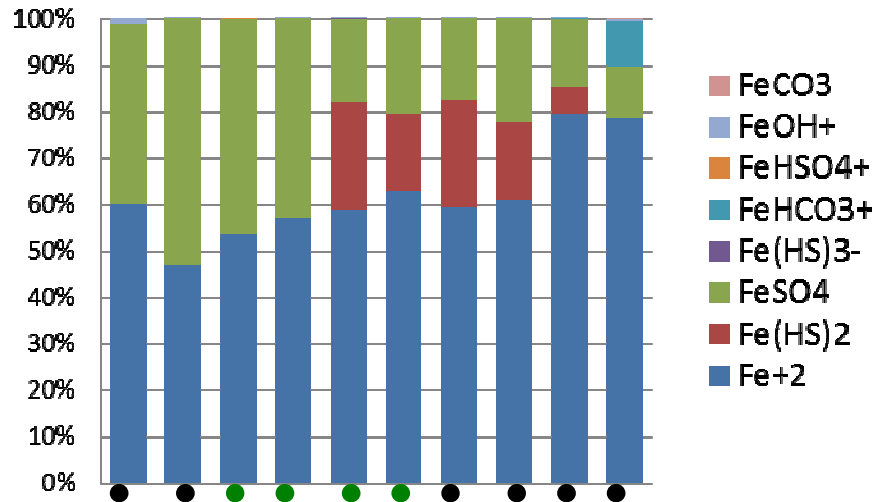
0 ft

500 ft

1000 ft

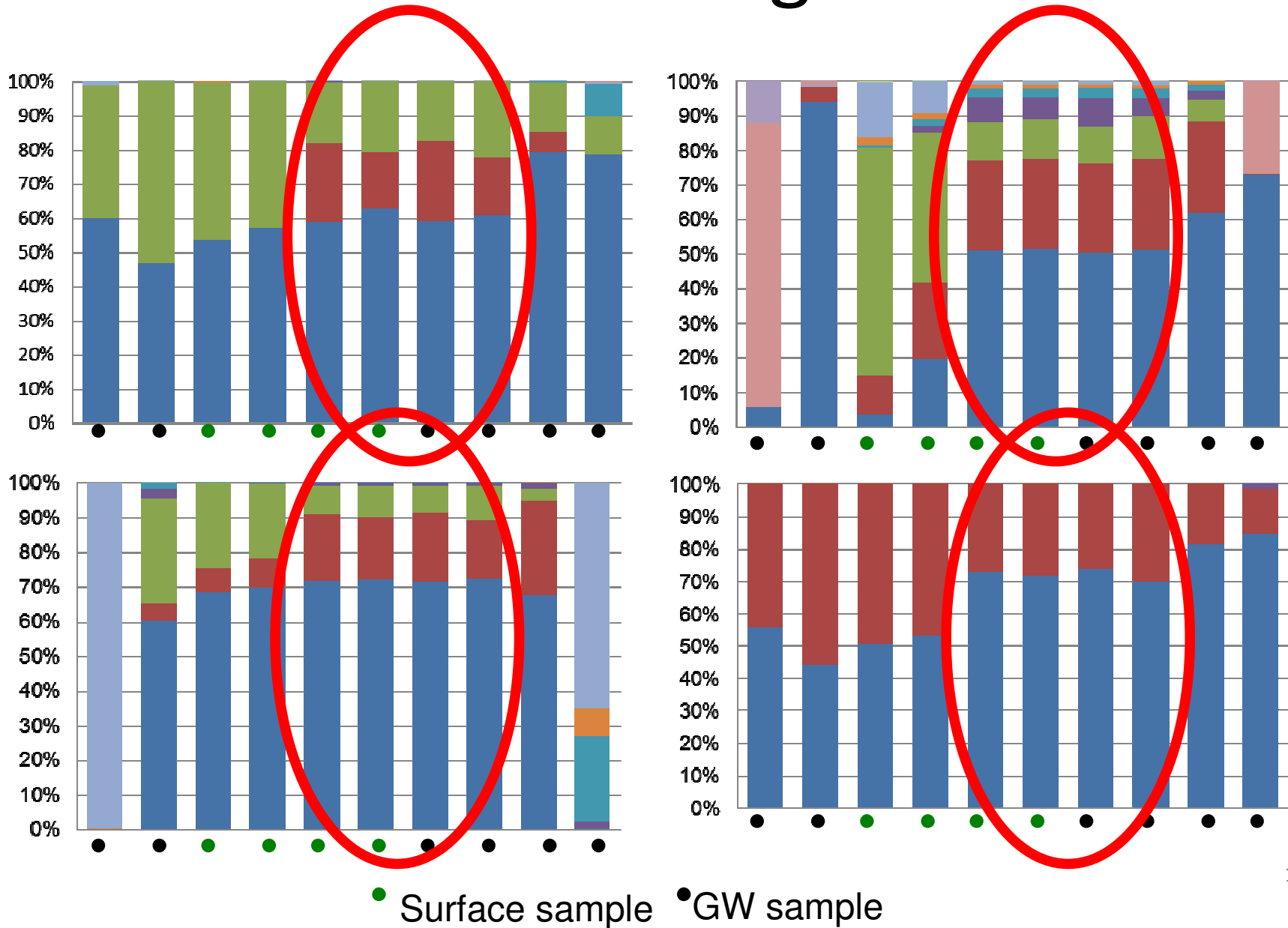
1500 ft

WebPHREEQ Results



● Surface sample ● GW sample

Geochemical Signatures





Artesian Wells!

BH11

elevation=1115 ft.



brown silty sand
to dry ss

saturated brown ss

open void ending
at underclay

TD=1090 ft

BH1

elevation=1112 ft.



brown silty
clay

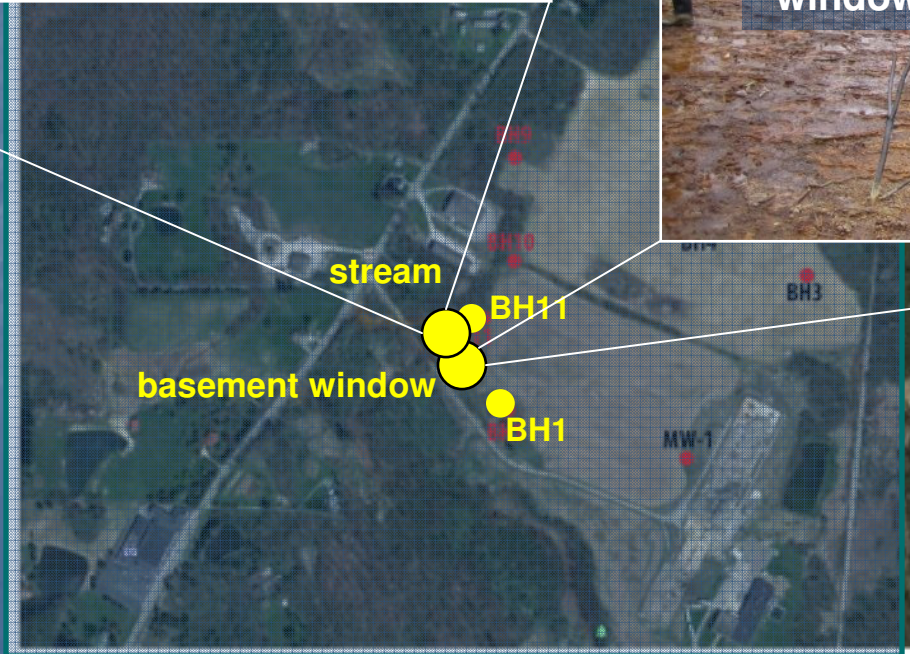
clay

TD=1099 ft

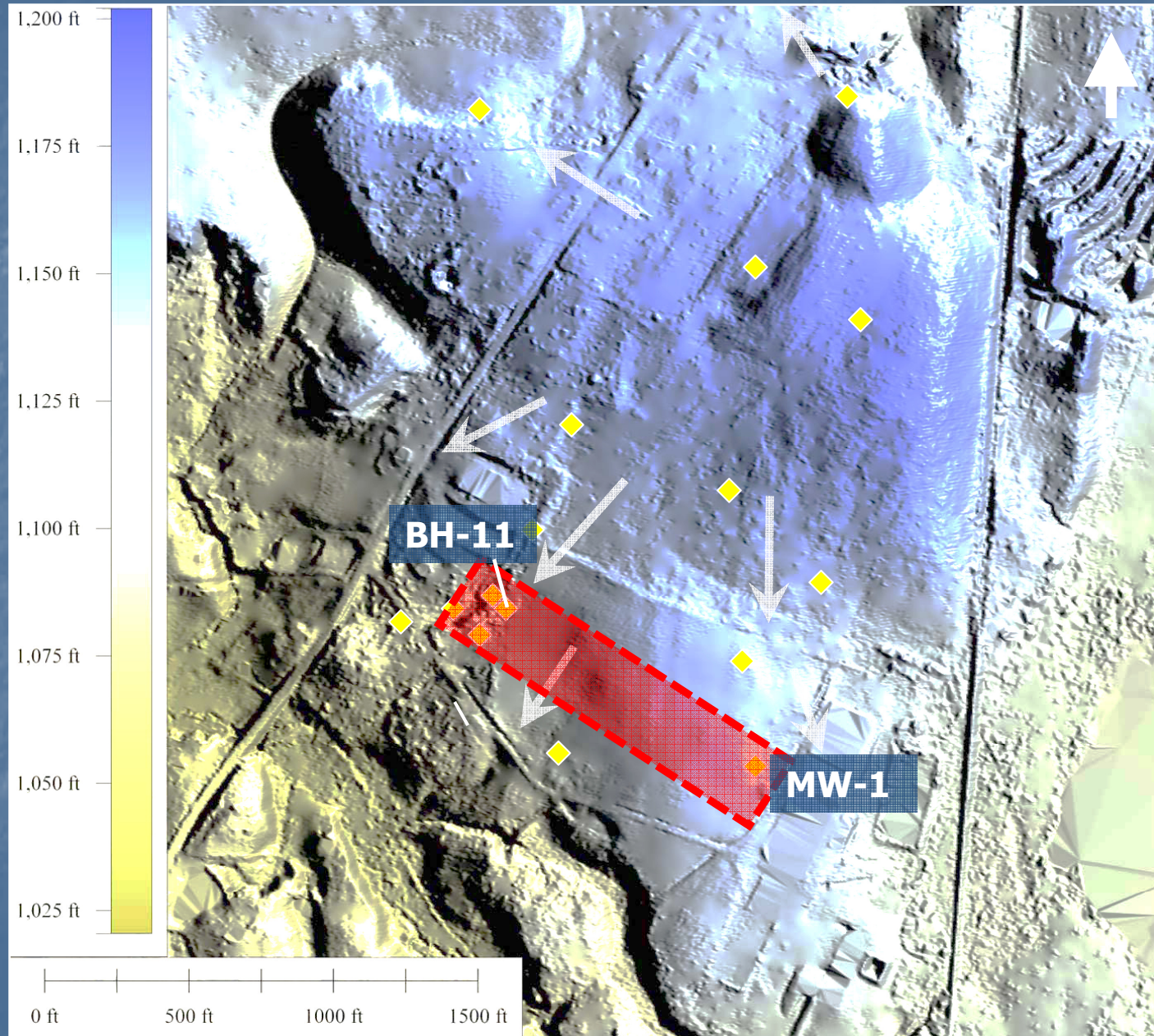
(facing east)



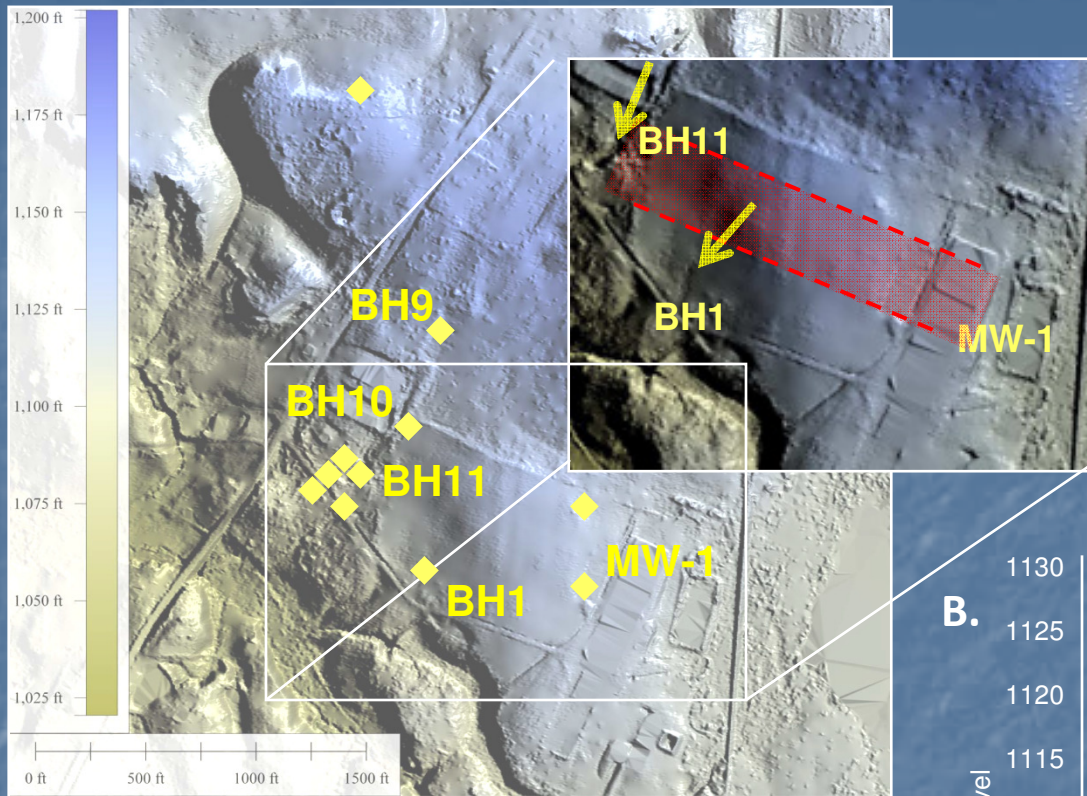
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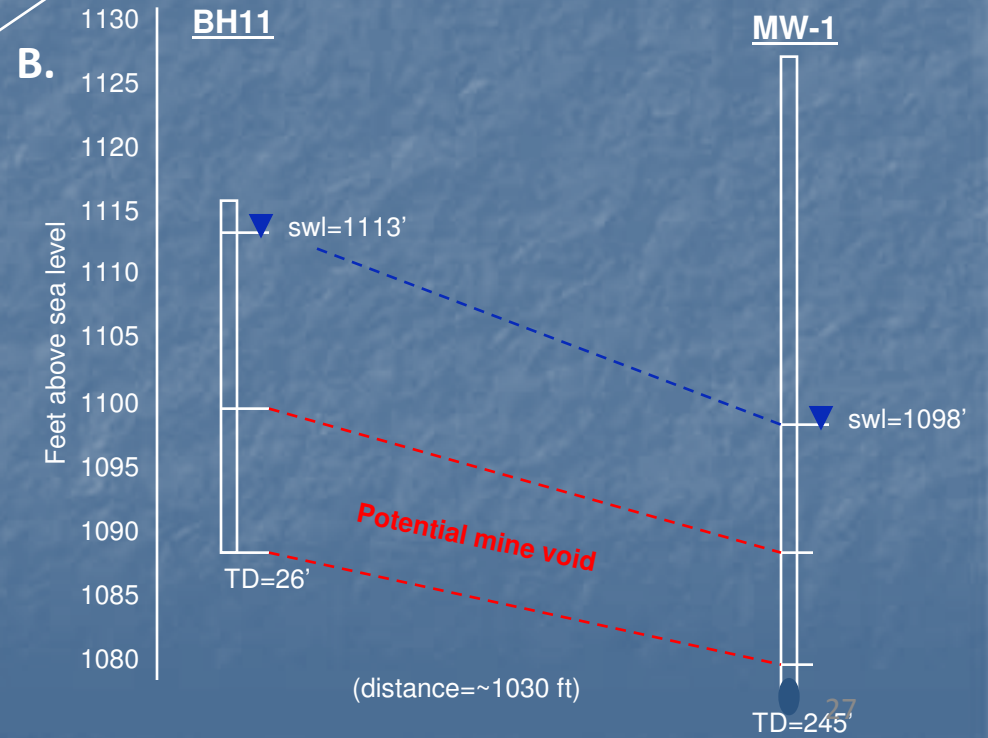
Abandoned Underground Mine



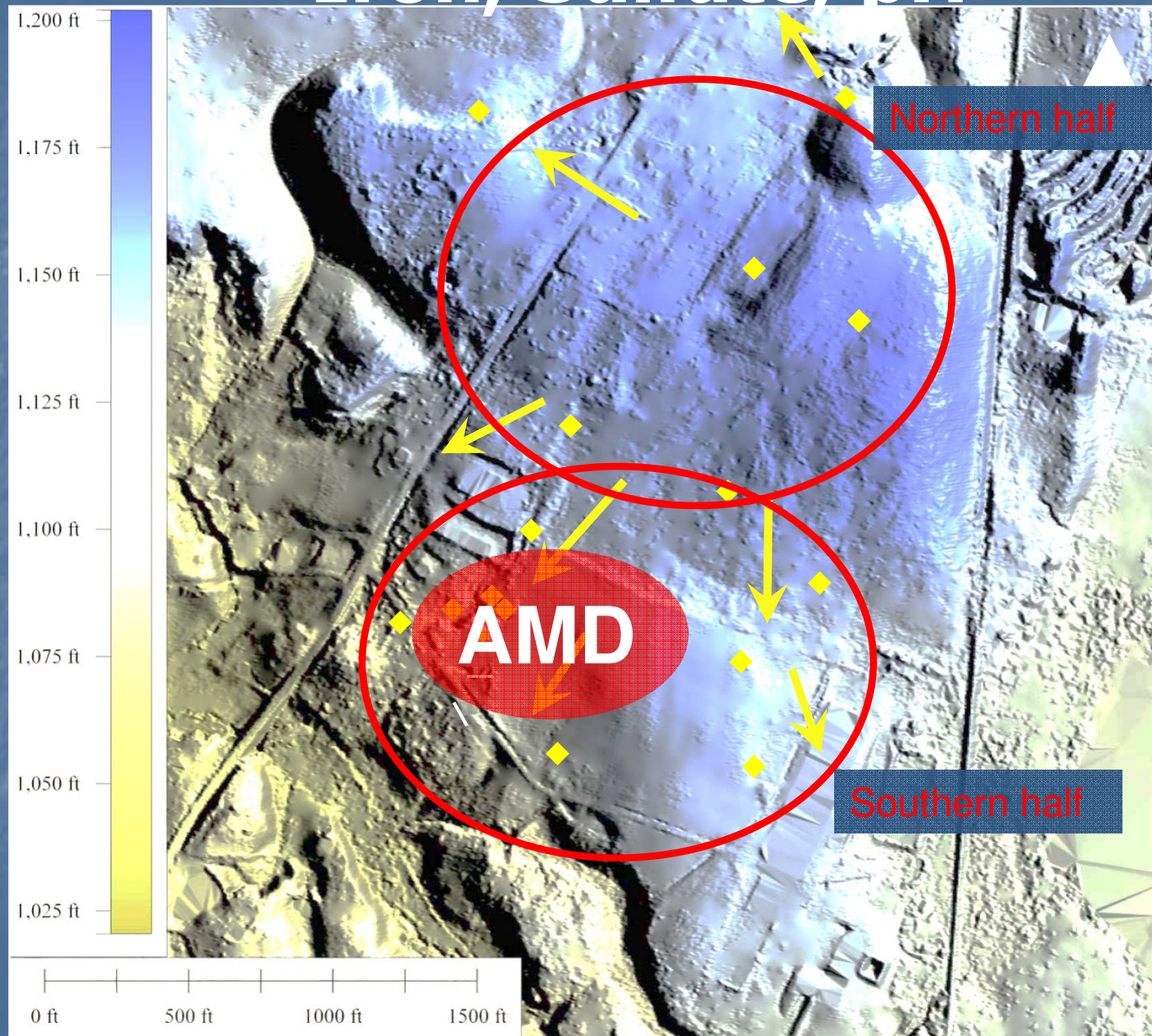
A. Mushroom Farm Site, North Lima, OH



Potential AUM location
GW flow direction



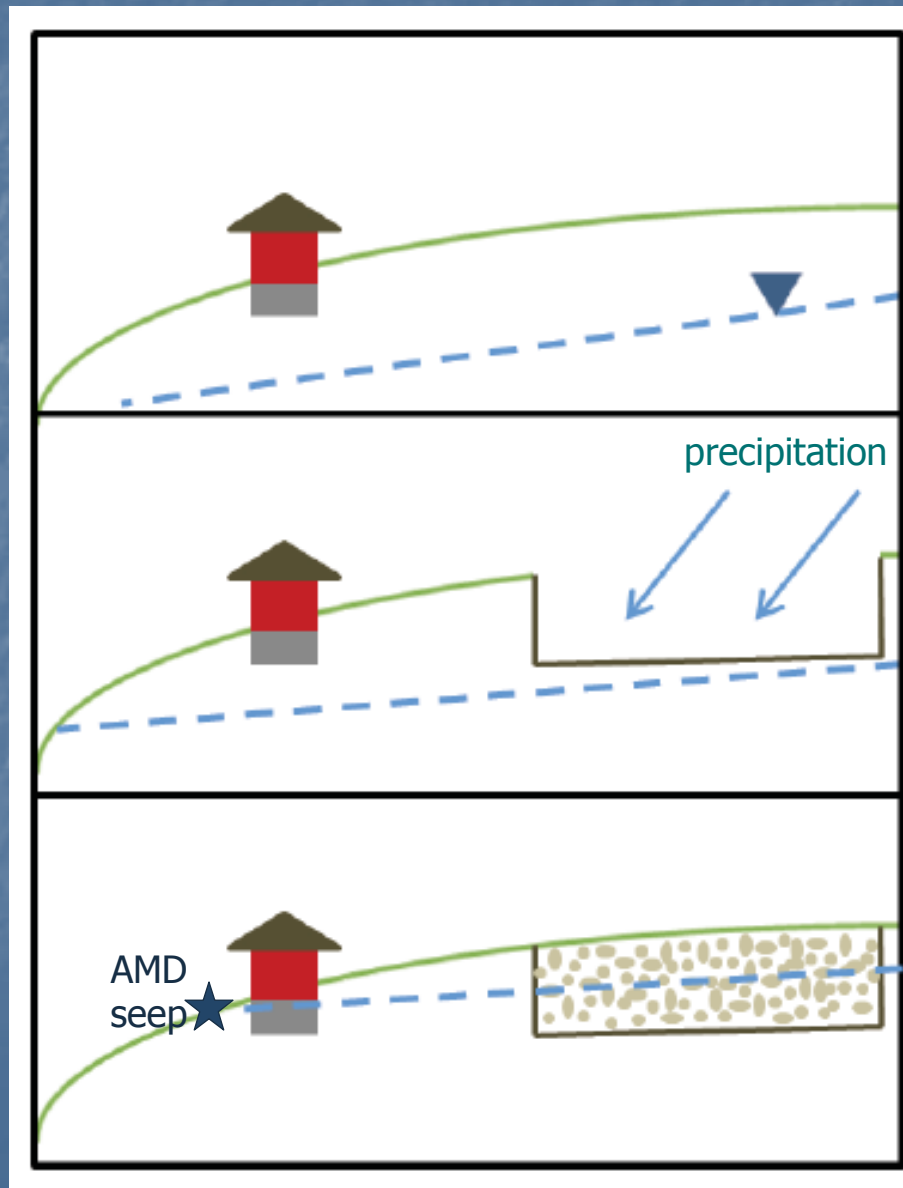
Iron, Sulfate, pH



Aerial Photo Analysis



Change in Infiltration and Permeability



Conclusions

- Radial groundwater flow pattern
- Geochemical signature for AMD coming from the mine void established at BH11, BH1, window, and stream
- AMD discharging around the house = most severe
- Mine void connects BH11 and MW-1, possibly contains some amount of refuse
- AMD discharging is a direct result of change in surface infiltration

**Thank you,
Questions?**

