Protecting Neighbors’ Access to Water

Technical Review Comments on Emma Project Hydrogeologic Assessments

New Mexico Mining and Minerals Division Public Hearing
Silver City, NM August 16, 2022

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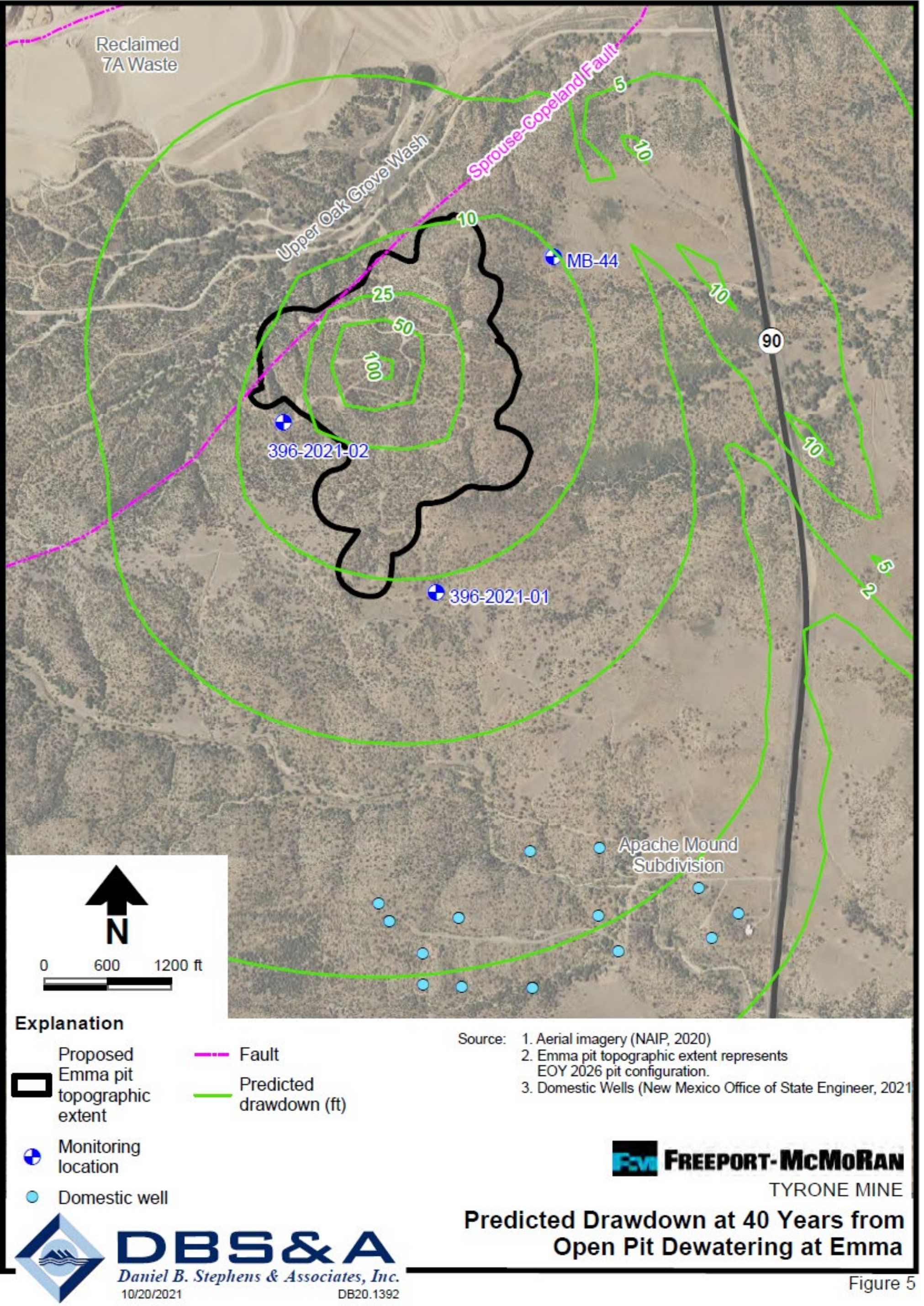
On behalf of

Gila Resources Information Project (GRIP)

Two Drawdown Analyses Reviewed

	Daniel B. Stephens & Associates (DBS&A) 2021 Report	John Shomaker & Associates (JSAI) 2022 Report
Model Type	USGS MODFLOW	USGS MODFLOW (1-layer superposition)
Spatial Domain	136 rows, 123 columns, 9 vertical layers (oriented with structural fabric)	Not Reported (though discretized @ Emma Pit location in cardinal directions)
Simulation Period	103 Years (3 years active mining followed by 100 years of closure)	10 years (beginning with intercept of water table)
Calibration Period	1950 through 2010 (w/ 10-years of observed data from MB-44)	Not Reported
Calilbration Method	Observed vs. simulated contours and hydrograph	Not Reported
Assumed Groundwater Inflow Rate	16 gpm initially, 13.8 gpm at closure, decreasing to 9 gpm (10.2 gpm average)	100 gpm initially at closure, decreasing to 55 gpm (62 gpm average over 10 years)
Pumping/Diversions Incorporated	Emma-Only	Emma Project AND other FMI water rights
Maximum reported Drawdown Result	**2-feet after 40 years @ Closest Domestic Wells**	**10 feet after 10 years @ Closest Domestic Wells**
Summary	More cognizant of the geologic/structural setting and actual pumping period, better discussion of model calibration, but does not incorporate cumulative pumping conditions or assume worst-case inflow	Simpler 1-layer superposition model limited to 10-year pumping period, with more conservative assumptions about inflow and regional water use



Do such differences inspire confidence?

Neither analysis:

1. incorporates adequate baseline data
2. includes domestic water rights in pumping scenarios (even if small), or
3. discusses uncertainty and associated range of plausible scenarios based on that uncertainty.

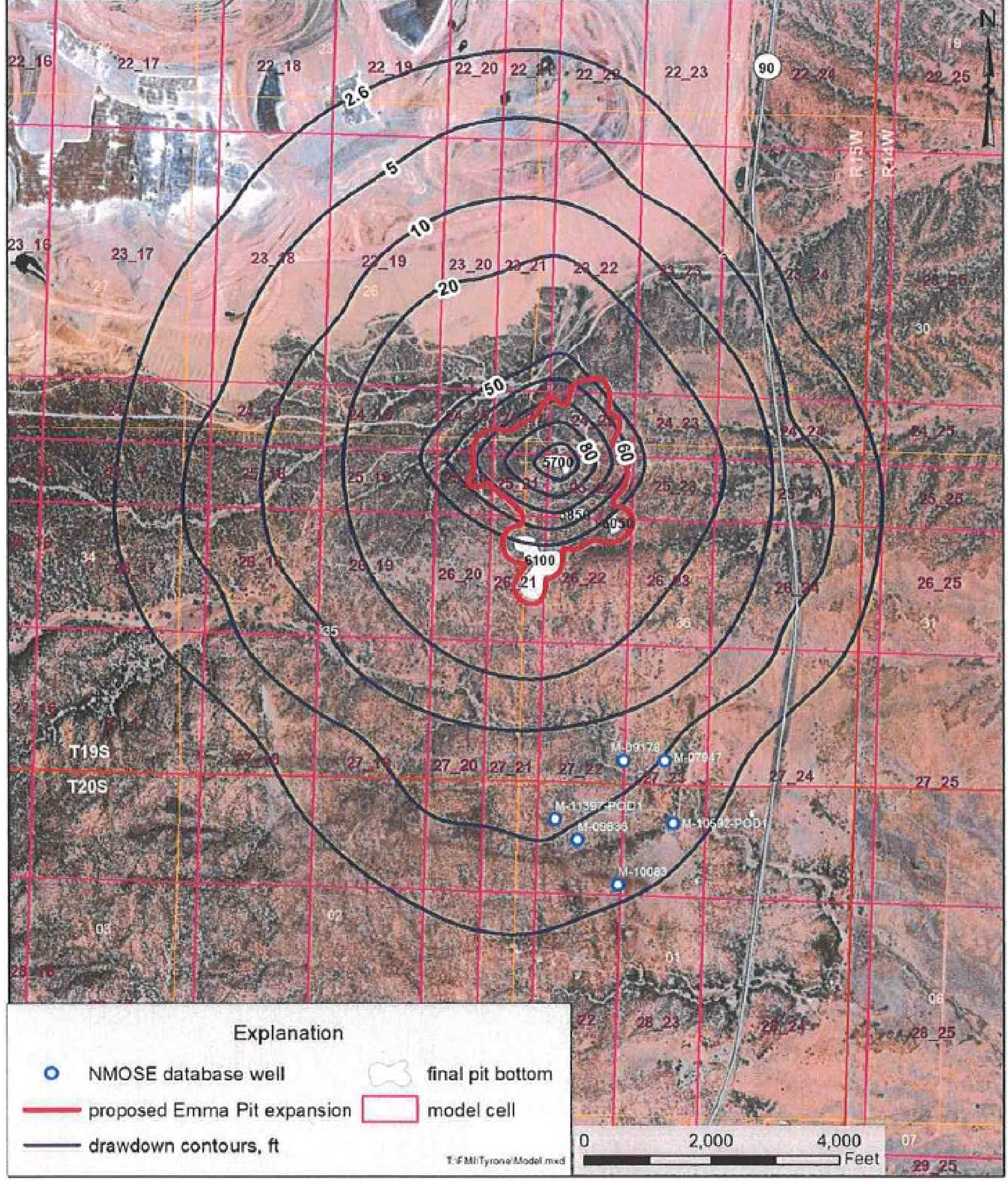


Figure 2. Map showing the model-simulated 10-year drawdown caused by the Emma open pit mine, FMI Tyrone Mining Operations, Grant County, New Mexico.

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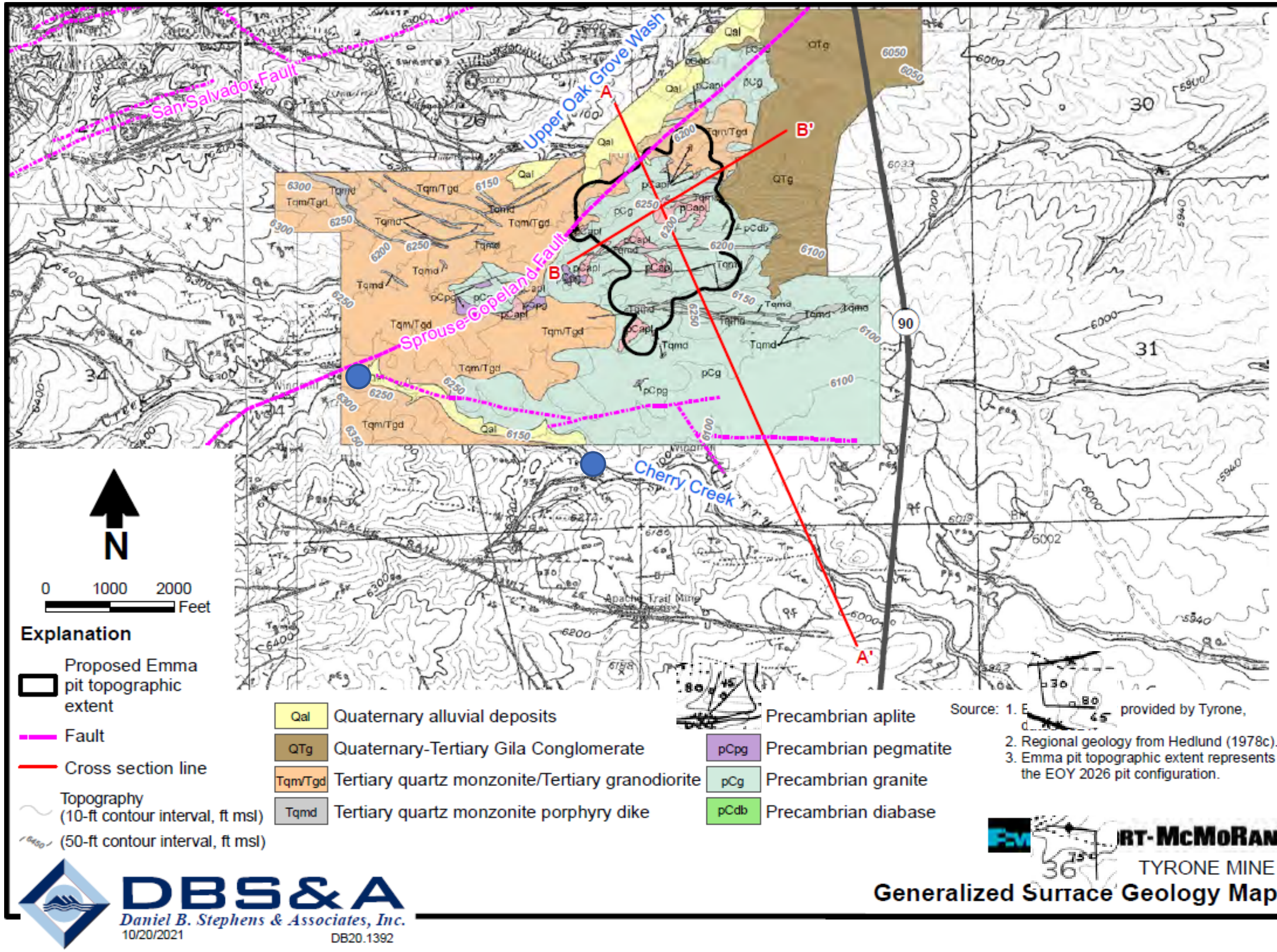
JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS

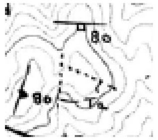
Numerical Models should be based on a complete hydrogeological conceptual model

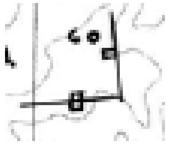
Element		Comment/Concern
Geologic Formations		Based on old/regional mapping south of Emma Pit (Hedlund 1978)
Hydraulic Properties		Very coarse in scale and based only on Emma location
Faults		Updated mapping, but not fully characterized
Groundwater Levels & Trends		Limited data south of Emma, and only one long-term hydrograph at MB-44
Fracture Zones/Orientations		Evidence of intersecting fracture zones
Surface Springs		Two mapped springs along Cherry Creek

A Complex Intrusive Igneous Aquifer

- Highly Heterogeneous
- Faults can impede or facilitate groundwater flow
- Groundwater moves through intersecting fractures and mineralized zones
- Tertiary quartz monzonite dikes are discontinuous in places
- Springs are important indicator of surfacing groundwater
(0.4 miles South of Emma boundary)
- Little is known south of Emma

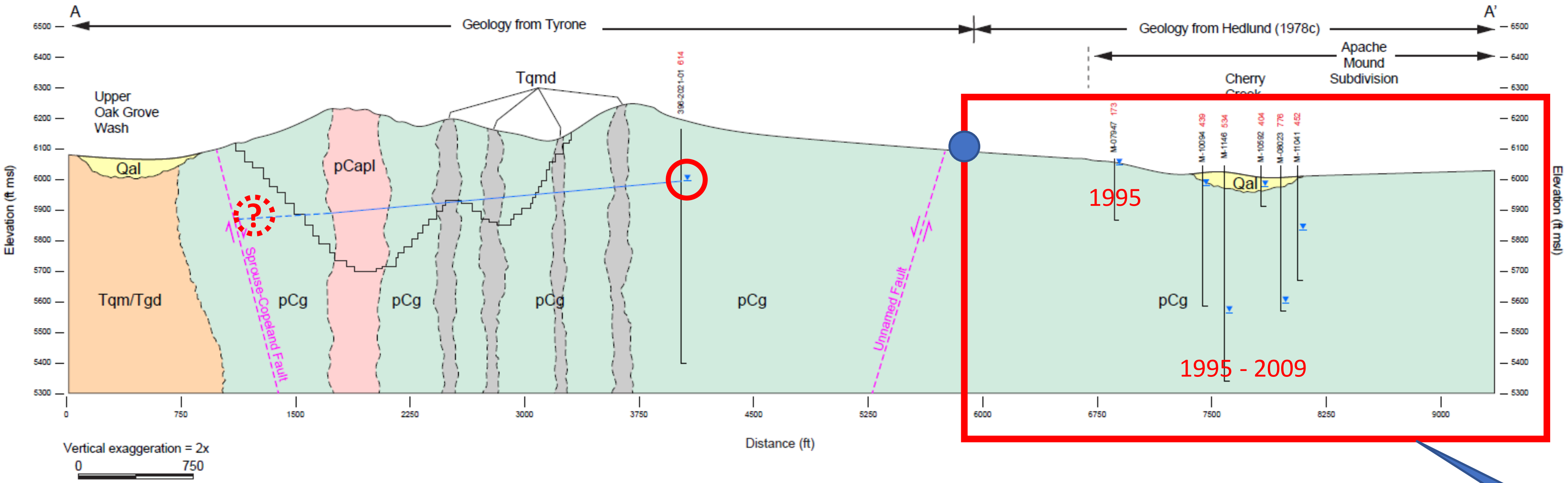






ADDED

Cherry Creek springs



Explanation

Well

Projection Distance

Well ID

Water Level

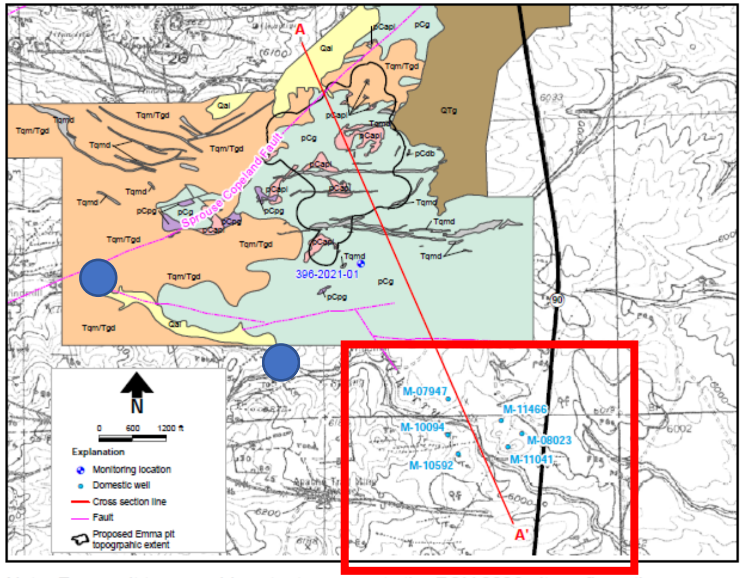
Groundwater elevation contour (dashed where inferred)

Geology

Qal	Quaternary alluvium
QTg	Quaternary-Tertiary Gila Conglomerate
Tqm/Tgd	Tertiary quartz monzonite/Tertiary granodiorite
Tqmd	Tertiary quartz monzonite porphyry dike
pCapl	Precambrian aplite
pCpg	Precambrian pegmatite
pCg	Precambrian granite
pCdb	Precambrian diabase

Source:
1. Emma geology provided by Tyrone, dated 2021.
2. Regional geology from Hedlund (1978c).
3. Domestic wells (New Mexico Office of State Engineer, 2021)

Notes:
1. Cross section does not include some of the thinner dikes intersected by the A to A' line.
2. Hedlund (1978c) geology used for very north end of cross section too (i.e., black and white region shown in plan view map).



Note: Emma pit topographic extent represents the EOY 2026 pit configuration.

Little is known about this area. Groundwater level data is old.

ADDED

Cherry Creek springs

FREEPORT-MCMORAN

TYRONE MINE

Generalized Hydrogeologic Cross Section A-A'

Figure 6

DBS&A

Daniel B. Stephens & Associates, Inc.

10/20/2021 DB20.1392

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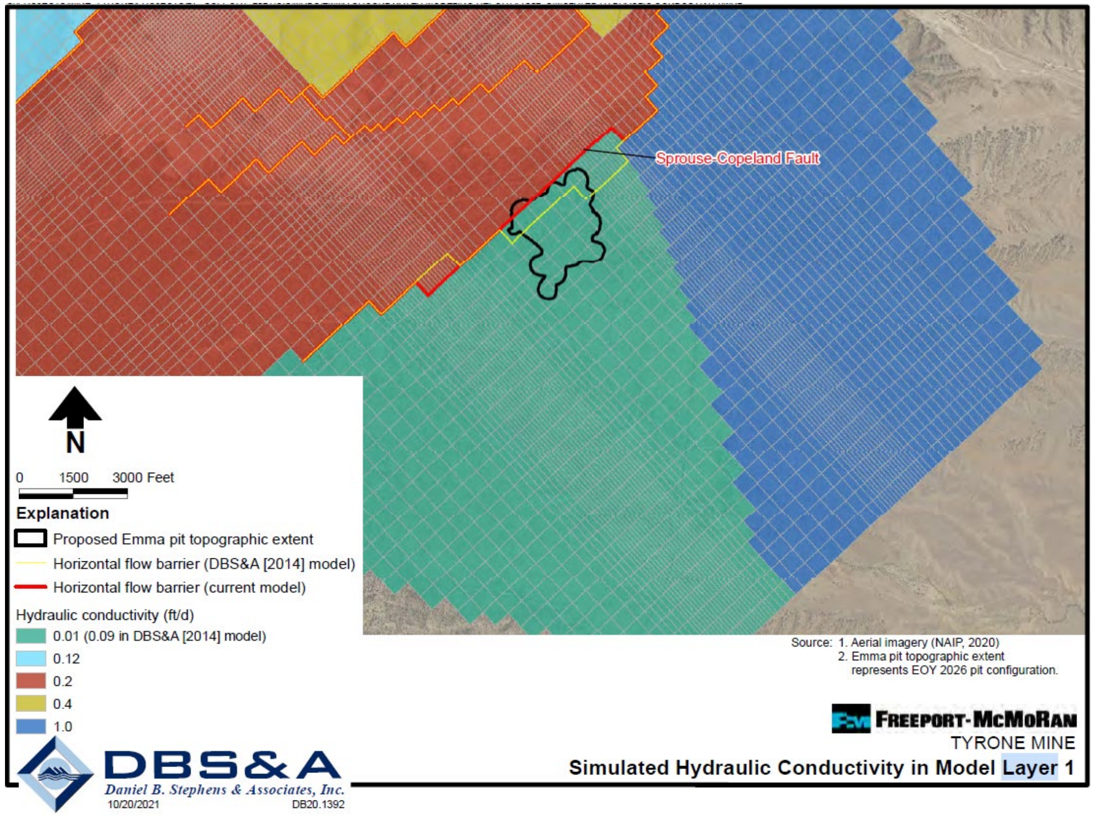
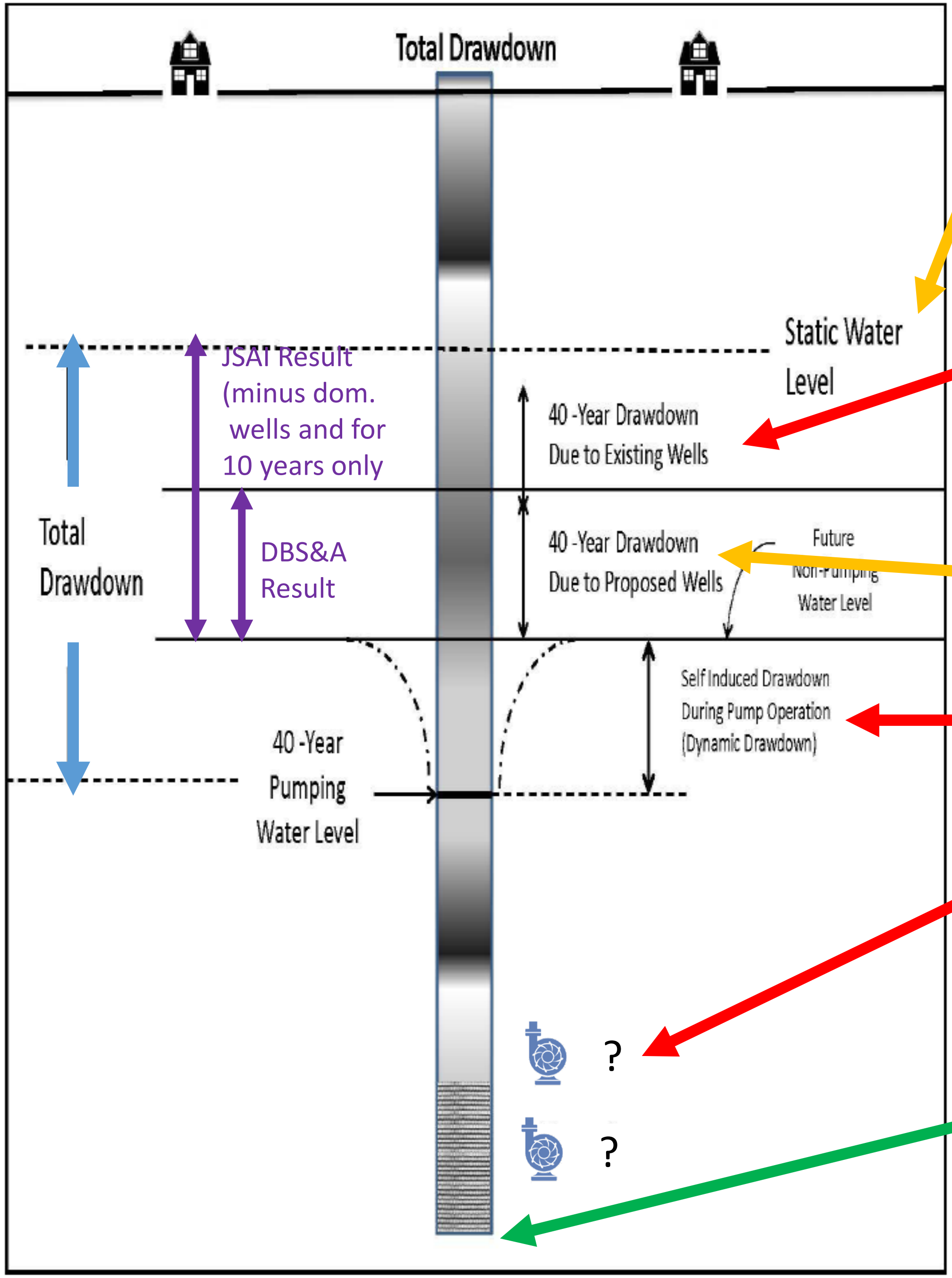
Questionable Model Validation

- Calibration was based on ten-year record of MB-44 only, not extended past 2010
- MB-44 may not be representative of mine site
- Simulated vs observed contours and MB-44 hydrograph reasonably match, but
    - Slightly different direction of flow
    - Small difference in WL elevation
    - **Most importantly, there is a different trend (MB-44 stable, not decreasing)**



Domestic Wells – The Big Black Box

- Information is provided DBS&A and JSAI reports are limited to OSE logs
- Wells have poor yields that rely on very narrow producing zones (both are predominantly in single digits)
- Some evidence groundwater levels have been declining
- Wells likely to have large dynamic drawdowns
- JSAI relies on blanket threshold for Lowest Practical Pumping Level (LPPL) rather than a calculation of total drawdown vs pump setting



Uncertain
(Water level data from OSE logs is up to 100 years old)

Existing domestic water rights not included in the analyses
(existing FMI rights were included in the JSAI report)

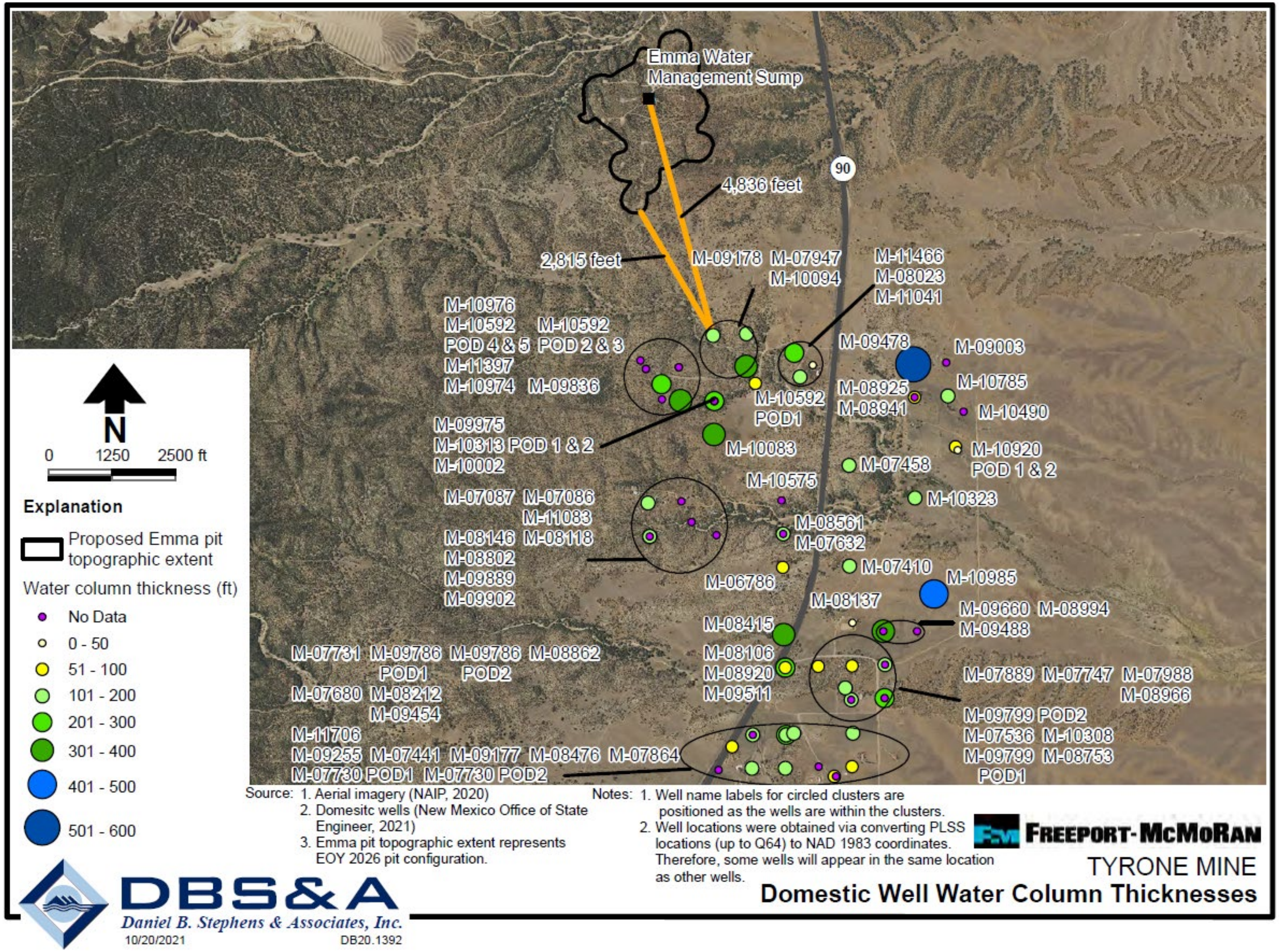
Uncertain
(Issues with model assumptions/validation)

Not included in the analysis

Not included in the analysis
(Locations of well pumps should be considered)

Well depth is the only thing we know for sure from OSE logs

In making an impact determination, it is inappropriate to compare drawdowns to water column thickness



Recommendations

When domestic water rights are at stake, vague assurances and token data collection without a purpose/plan mean little

- A "sentinel well" could work in an alluvial aquifer but may not effectively detect impacts in a fractured hard-rock aquifer controlled more by faults, mineral zones and fractures.
- Implement a **written and enforceable** Groundwater Monitoring and Mitigation Plan, consisting of:
  - Apache Mound Well Subdivision Inventory/Survey
  - Establishment of LPPLs based on actual well construction/operation, inclusive of dynamic drawdowns, and incorporating exercise of all domestic water rights
  - Identification of at least two representative monitoring locations: (1) closest to the Emma Project, and (2) the well within at least 2 miles whose current water level is closest to it's LPPL
  - Establishment of baseline conditions for as long a period as feasible prior to interception of the water table
  - A plan of action to mitigate for any detected impacts (could include well deepening, water trucking, or other measures at FMI's expense)
  - Agency reporting and verification procedures

Questions?

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