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MEMORANDUM

To: Jack Nielson
Owner Sunrise Mining, LLC

DRMS Recd: 9/5/2023

From: David Schiowitz, PG and Brenna Kampf
Water Resource Consultants

Date: January 15, 2021

Re: May Day Mine

Introduction and Purpose

SGM has prepared this memorandum to assist Sunrise Mining, LLC (Sunrise) in obtaining a discharge permit for the May Day Mine through the Colorado Department of Public Health and Environment (CDPHE). Sunrise wishes to pursue a new Individual Permit with the CDPHE that only includes activities proposed on the May Day Mine. The CDPHE has indicated the applicant must show the May Day Mine does not have a hydrogeological connection to the Idaho Mine in order for the CDPHE to issue a discharge permit that does not include outfalls from the Idaho Mine, specifically the Idaho Seep. The purpose of this memorandum is to document the findings of a review of the available documentation on the hydrogeology at the May Day - Idaho Mine Complex and to determine if additional work is warranted to show whether or not the two mines share a hydrogeologic connection.

Overview and Understanding

The May Day Mine and Idaho Mine have a long history of precious metal production at the mouth of La Plata Canyon, Colorado. Mining began in 1903 from the May Day vein and the Idaho Mine did not begin production until 1907. Mining continued until the early 1940's when operations were suspended due to manpower needs of World War II. Since the 1940's mining operations have been limited with operations occurring in the 1960s through the mid-1970's by the Ferris Brothers, and by the Great Guennol Gold Mining Company between 1978 and 1987. In the 1990's Shalako International owned the property and kept all of the permits active but did not complete any significant work. Wildcat Mining Corporation (Wildcat) purchased the Idaho Mine in 2006 and entered into a lease with Fairview Land Corporation, the previous landowner, to operate the May Day Mine. La Plata County Land, LLC purchased the May Day Mine property in 2016. In 2017, Sunrise took over the Division of Reclamation, Mining and Safety (DRMS) permit for the mining complex, which included both mine properties. Sunrise and La Plata County Land, LLC are owned by the same individuals.

The May Day Mine includes five portals; the May Day Nos. 1, 2, 3, and 4, and Chief. The May Day No. 1 and Chief portals are open, but the other portals have been closed or collapsed. The Idaho Mine has two portals, the Idaho Nos. 1 and 2, both of which have collapsed. Reports indicate that there was over 25,000 feet of underground development work on the May Day Mine, including a vertical shaft of 565 feet, an inclined shaft to the same depth, raises and winzes connecting the different levels, four long tunnels, several thousand feet of crosscuts and drifts, and numerous surface cuts and shafts (see Attachments B and C) (Christensen, 2007).

In January 2011, Wildcat submitted an application to convert their existing DRMS permit for the May Day Mine from a Limited Impact Permit to a Regular Mining Operations permit that expanded the permit area and included the Idaho Mill and Mine, the May Day Mine, the access road, and a new proposed base of operations along CR 124. The application was partially approved with conditions in December 2011. DRMS approved an amendment to the May Day - Idaho Mine Complex permit in January 2018 that reduced the proposed mining plan to only include the removal of existing historic ore stockpiles from the May Day Mine property. No onsite mining or milling activities were included. The permit is currently in temporary cessation status while Sunrise pursues permits from the CDPHE and La Plata County.

The facility had a Colorado Discharge Permit System (CDPS) General Permit COR040000 for Stormwater Discharges Associated with Metal Mining Operations under Wildcat. The stormwater permit was approved in June 2017 and effective on October 17, 2006. The permit was terminated on April 1, 2018 at the request of Wildcat. An application for Discharges Associated with Hardrock Mining and/or Milling (discharge permit) was submitted to CDPHE in 2014. The discharge permit was never finalized due to the applicant's concerns with the cost of the required water quality sampling under the permit. Wildcat subsequently withdrew the discharge permit application in February 2018. The discharge permit was submitted under the expanded mining plan proposed by Wildcat. Any new discharge permit application would be submitted under Sunrise for a reduced mining plan.

Method

To determine the feasibility of a hydrogeologic connection between the May Day Mine and the Idaho Mine, SGM relied upon and analyzed the previous work of other professionals as summarized in the reference cited section of this memorandum. Eckel's 1949 Professional Paper provided detailed geologic maps, cross-sections, mine workings and block diagrams which were utilized in this analysis (see Attachment A, B and C). Christensen's 2007 Technical Report, Gonzales' 2011 and 2012 and Hagar's 2011 reports provided pertinent background information on current understandings of the geology, mineralization, structure, hydrogeology, and mining history.

Findings

Geology of the Area

The host rock of the May Day and Idaho mines consists of southward-dipping sedimentary rocks that includes the Permian Cutler Formation through the Jurassic Morrison Formation. The formations generally have low permeability. In addition, the alluvial cover on the surrounding hillsides is thin and the terrain is relatively steep. The La Plata District geologic map is included as Attachment A.

The area is cut from east to west by a series of major faults known as the Mayday-Idaho fault system. The Mayday-Idaho fault system is a series of subparallel, interconnecting, high-angle faults on the southern margin of the La Plata Dome (see Attachment A). These faults likely formed in response to flexure due to structural doming. The faults mostly dip steeply north but some sections also dip to the south, resulting in normal to reverse apparent displacement. Based on work by Gonzales in 2008, slickenlines on the faults indicate nearly dip-slip movement and no evidence was found for substantial horizontal displacement along the fault system. The total apparent vertical-stratigraphic displacement along the fault system is approximately 350 to 500 feet with the May Day splay on the south having 300 to 375 feet of apparent vertical displacement (Eckel, 1949 and Gonzales, 2011). The vertical offset of formations due to faulting creates discontinuous hydrologic blocks that impede the transmission of water as more porous formations run into less permeable formations (Hagar, 2011). These major faults are not heavily mineralized and are often referred to as "barren". It is believed that gouge created during movement acted as an additional barrier to ore-bearing fluids and acts as a barrier to water movement today (Eckel, 1949 and Gonzales, 2011).

Faulting likely caused fracturing of the sedimentary formations, increasing the secondary hydraulic conductivity of the formations locally. These fractures are north-trending, intersect the east-west fault system at high angles, and have been the dominant avenue for mineralized fluids and the formation of ore-bearing veins. Mineralization was mostly confined to the Jurassic Entrada Sandstone, Pony Express Limestone and Junction Creek Sandstone. Mineralization at the May Day and Idaho properties is hosted by epithermal gold-silver telluride veins, stockwork breccia zones, limestone replacement bodies, and disseminated mineralization in porphyritic igneous rocks (Eckel, 1949 and Gonzales, 2011).

Surface Water

Surface water in the area of the mines is derived from precipitation or snow melt. Surface water on the Idaho Mine property generally flows west to the La Plata River. A small drainage that initiates from a pipe approximately 100 feet downhill of the Idaho No. 1 Portal runs to the river and typically has a year-round flow (Idaho Seep).

Surface water from the May Day No. 1, May Day No. 2, and Chief portal areas runs in a general southwesterly direction to Little Deadwood Gulch. Little Deadwood Gulch is an intermittent stream that is tributary to the La Plata River. The gulch runs through the Chief Portal mine area. In 2016, a culvert was installed to carry the Little Deadwood Gulch flows through the Chief Portal area. Prior to this work, the portal entrance would have been located adjacent to and below the creek bed and would have collected some flow from Little Deadwood Gulch. Figure 1 is a site map of the May Day and Idaho Mines and shows the general topography and surface water in the area.

Groundwater

A conceptual model of hydrologic flow in the mines was developed by Hagar (2011). He indicated groundwater flow occurs through porous formations and along fractures and faults. In addition, the underground mine workings act as conduits for groundwater flow.

The steep terrain, limited alluvial cover, and low hydraulic conductivity of the rock formations all help to minimize the amount of snow melt or precipitation that is able enter the groundwater system. Limited recharge does occur through sedimentary outcrops and from stream channels flowing across outcrops (Hagar, 2011). Generally, the Entrada Sandstone and Junction Creek Sandstone have greater hydraulic conductivity than the siltstones, mudstones, and shales of the Morrison Formation, Wanakah Formation, and redbeds of the Chinle (Dolores) and Cutler Formations (R^2, 2017).

Underground flow is limited by offset geologic formations that limit flow from areas of high potential to areas of low potential (Hagar, 2011). It was noted by Hagar that the Entrada Sandstone tends to be the location of recharge for the La Plata River and Little Deadwood Gulch.

Groundwater moves down-gradient, generally following the topography, through the sedimentary formations until encountering a fracture zone (see Figure 2). The water then tends to follow the fractures, which are frequently bounded by impermeable vein deposits and fault gouge. Where the fault runs into a tunnel or adit, water flow will follow the tunnel instead (Hagar, 2011). Groundwater in the mine tunnels will continue to follow the path of least resistance and flow downhill. This may lead the water to flow back to the surface through a portal opening, to water stored behind a blocked portal or tunnel, or down through the tunnels until intercepting the water table. Regionally, groundwater below the water table will continue to flow down-gradient and follow the area topography and structural dip to the south (see Figure 2). However, flow is not uniform over the entire area due to the discontinuous and localized fracture system.

Christensen (2007) reported that the groundwater level below the May Day No. 2 was about 8,871 feet above sea level (asl). Groundwater monitoring wells were installed near the May Day No. 1, May Day No. 2, and Idaho No. 1 portals and in the La Plata River alluvium in 2012 (see Figure 2). Between 2017 and

2019, the average water elevation recorded in the May Day No. 2 monitoring well was 8,791 ft asl. The average water elevation in the Idaho No. 1 monitoring well was 8,739 ft asl and the average elevation of the water level in the La Plata River alluvium well was 8,631 ft asl. While these values show variation, they are generally consistent with the groundwater level determined by Christensen.

Mine Water Flow and Connections

May Day No. 1

Subsurface water in the May Day No. 1 will likely originate in the North Extension Drift near the Chief Portal (see Figure 2), which underlies Little Deadwood Gulch. The creek bed is reportedly 20 feet above the drift. Flows in the creek are greatest in the spring during runoff and also increase with large precipitation events. Fractures in the bedrock above the drift allow surface water to infiltrate and flow into the mine, although the extent has been reduced by the 2016 installation of piping to direct Little Deadwood Gulch through the Chief Portal area. Discharge has been observed at the May Day No. 1 Portal but is not constant. In addition, underground workings are reported to be dry throughout most of the year. The May Day No. 1 adit and mine workings are about 9,300 feet asl. Figure 3 shows a projection of the May Day Mine levels along the May Day vein.

What appears to be a large sinkhole has been observed on aerial photographs. The hole seems to be above the location of a large stope shown on the May Day claim map where the May Day No. 1 adit turns north toward the Chief Portal. If this portion of the adit has caved in, the path of water to the May Day No. 1 Portal could potentially be blocked or slowed. Alternatively, the sinkhole could be an additional path for surface water to infiltrate the mine workings.

May Day No. 2

The May Day No. 2 adit and mine workings are about 8,916 feet asl. Subsurface water in the May Day No. 2 appears to originate from fractures and from the adjacent sandstones and shales with significantly lower hydraulic conductivity. The conceptual groundwater flow paths are illustrated in Figure 2. In addition, water from the May Day No. 1 could travel to the May Day No. 2 through the May Day Mine A and B levels and their connecting shafts (see Figure 3). Observations from previous owners indicate an observed flow of less than 0.5 gallons per minute (gpm) from the May Day No. 2 Portal. The May Day No. 2 is now closed and any water in the adit may be trapped behind the plugged portal. Approximately 850 feet into the May Day No. 2 adit, the Miller Incline Shaft leads down to an east-west crosscut known as the 545 Level due to its approximate elevation of 8,545 feet asl. Water in the May Day No. 2 adit could flow to the 545 Level through the Miller Incline Shaft, although the shaft appears to be caved according to a plan map of the tunnel completed by Eckel (1949) (see Attachment B). The 545 Level is reported by previous owners to be underwater (Nielsen, personal communication, 2020).

Idaho Mine

Subsurface water in the Idaho Nos. 1 and 2 is thought to be associated with recharge through the surface sedimentary formation and water flow along fractures and mine workings. The mapped geologic formation in the vicinity of the Idaho Mine portals is the Entrada Sandstone, one of the more permeable formations in the area. The groundwater travels along the Entrada contact with the Dolores Formation, which is less permeable, until it is intersected by the Idaho Fault. The Idaho Nos. 1 and 2 adits roughly follow the Idaho Fault and associated fracture network. As water flows along the fractures it travels to the Idaho Mine tunnels (Hagar, 2011) (see Figure 5). In addition, the Idaho No. 2 had surface access points that may still be open based on aerial photography observations. These include the Valley View Raise and possibly a hoist marked on the mine claim map (Eckels, 1949). Figure 2 shows the mapped mine workings and general water flow through the mines.

The Idaho No. 1 is located at approximately 8,871 feet asl and the Idaho No. 2 is at approximately 9,000 feet asl. The two are connected through an incline that runs from the Idaho No. 2 adit down to the Idaho No. 1 mine on the northern end of the mine workings within the Valley View vein, also referred to as the Valley View workings. The Valley View workings are believed to be connected to the 545 Level through a 153-foot crosscut and an approximate 600-foot vertical shaft that connects with the May Day No. 4 tunnel with the 545 Level at the bottom (see Figure 4). Figure 4 shows the approximate groundwater level reported by Christensen in relation to the 545 Level, Idaho Nos. 1 and 2, and Valley View workings. Note that the Idaho No. 1 adit elevation is approximately 8,871 feet asl.

The water from the Idaho Seep is likely associated with the Idaho No. 1 adit based on the presence of a pipe that supplies the water and the location and elevation of the Idaho Seep in relation to the Idaho No. 1 Portal. The water in the Idaho Mine that likely feeds the pipe is believed to be sourced from the hillside above the Idaho.

Summary

To summarize, there are three mechanisms at the May Day and Idaho Mine sites for the transport of groundwater:

- **Slow movement of groundwater through the bedrock and faults.** Groundwater in the area generally follows the topography and structural dip of the formations to the south and southwest. Surface water on the May Day property that infiltrates to the water table would, therefore, generally flow to the south and away from the Idaho Mine. Near vertical faulting has juxtaposed sedimentary formations with differing hydraulic conductivities, which further impedes and slows the movement of groundwater. In addition, the presence of fault gouge and the lack of mineralization along the faults at the May Day Mine suggests that the faults do not act as conduits for groundwater. This is supported by the fact that there are no obvious or major surface-discharge springs at or below the May Day No. 1 on the May Day Mine property.
- **Moderate but discontinuous movement of groundwater through fractures.** Gonzales and others report these fracture networks are localized, limited in extent and there is no evidence of a spatial connection between the May Day No 1 and 2 levels with the Idaho mill site. There is evidence of fractures contributing to the infiltration of Little Deadwood Gulch surface flows into the Northwest Extension, which contributes to seasonal discharge at May Day No. 1. Localized fracture networks near and above the Idaho Mine likely contribute to the Idaho seep flows.
- **Faster movement through the mine workings** (adits, drifts, tunnels, stopes, shafts, etc). Based on available mapping for the mines, the May Day and Idaho mines are likely connected through the 545 Level crosscut. Many of the tunnels that make this connection have since caved in there by impeding water connection to the 545 Level. In addition, and importantly, the 545 Level is shown to be more than 300 feet below the water table. Therefore, water movement in the 545 Level would be governed by the regional groundwater flow to the south/southwest rather than to the north and toward the Idaho seep.

Based on this information, SGM does not believe that there is a hydrogeologic connection between the May Day No 1 and No. 2 with the Idaho Seep and, therefore, water quality sample collection at the Idaho Seep is not warranted.

Recommendations

1. Water quality analysis of the anions and cations present in samples from the May Day Mine and the Idaho Seep could help to characterize the source rock geochemistry and possibly differentiate between the two. While substantial water analyses have been performed at the mines, not all of the necessary analytes were previously analyzed to include all anions and cations. Stiff or piper diagrams could be made with the available water quality data to see if there are any apparent differences between water types sampled from the two mines. The collection of additional samples and laboratory analysis may be necessary for a complete comparison.
2. While a tracer study has the potential to show a definitive connection in groundwater flow between the May Day and Idaho mines, SGM does not recommend conducting a tracer study at this site. It is believed that a tracer started at the May Day Mine would not appear at the Idaho Seep. While this result could suggest that the water flow from the May Day does not end up at the Idaho, the results would not be conclusive and do not justify the cost and length of time needed for such a study (likely months or years).
3. As suggested by Hagar in his 2011 report, Sunrise may consider installing a recording flow meter in the May Day No. 1 tunnel and a rain gauge in the immediate vicinity to see if a correlation can be established between precipitation and water flows in the mine. The collection of these data would need to occur for a year or more and would not help with providing documentation to the CDPHE for the current permit application.
4. Meet with DRMS and CDPHE to discuss the findings of this hydrogeologic review and discuss options for permitting operations at the May Day Mine without including water quality analysis of the Idaho Seep.

References

Christensen, Odin D. 2007. May Day – Idaho Mine, La Plata County, Colorado. Technical Report.

Eckel, E.B. 1949. Geology and Ore Deposits of the La Plata District, Colorado, with sections by Williams, J.S., Galbraith, F.W., and others. U.S. Geological Survey Professional Paper 219.

Gonzales, David A. 2010. Letter to George Robinson, dated May 21, 2010.

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Gonzales, David A. 2011b. A Review of Surface and Groundwater Conditions, May Day-Idaho Property, La Plata County. PowerPoint presentation.

Gonzales, David A. 2012. An Evaluation of Selected Mineralized Stockpiles on the May Day-Idaho Property, Southern La Plata mountains, La Plata County, Colorado.

Hagar, Frank. 2011. Conceptual Hydrogeologic Model - May Day Mine – La Plata County, Colorado. Geospatial Analysis, Inc.

Nielsen, Jack. 2020. Personal communication.

R^2, Inc. 2017. Updated Surface and Groundwater Characterization-2017, M-1981-185, May Day Idaho Mine Complex.

Figures:

Figure 1 – Site Map of the May Day and Idaho Mines
Figure 2 – Conceptual Groundwater Site Model
Figure 3 – Plate 26 May Day Vein
Figure 4 – Plate 26 Valley View Vein
Figure 5 – Plate 26 Conceptual Flow on Block Model

Attachments:

Attachment A – Plate 2 from Eckel, 1949
Attachment B – Plate 25 from Eckel, 1949
Attachment C – Plate 26 from Eckel, 1949

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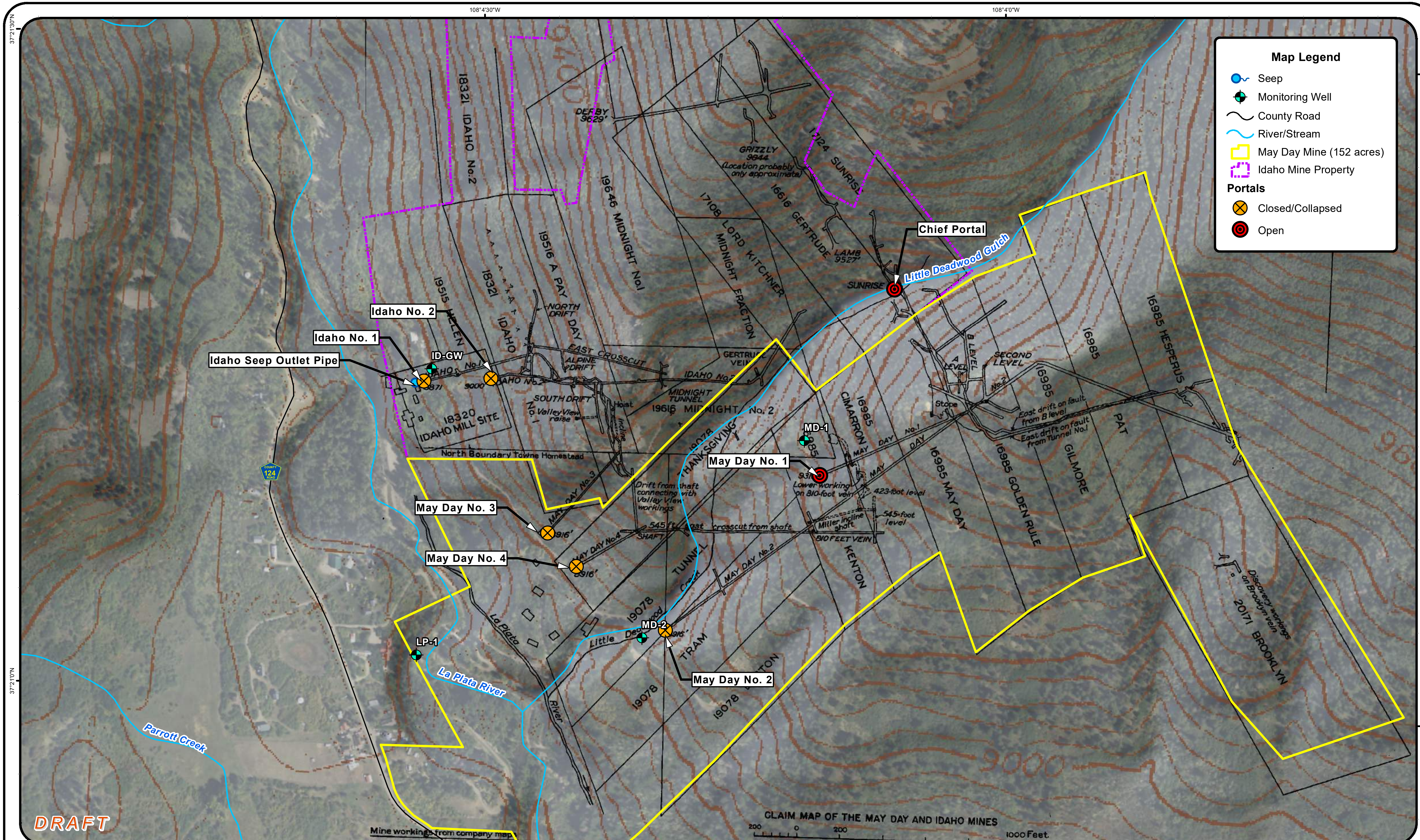

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Figure 1. Site Map
May Day and Idaho Mines
Sunrise Mining, LLC

Date: 1/13/2021	Job No. 2017-460.001 Ph 05	Map by: DSS	Checked by: KCH	Scale: 1:4,800

Data Sources: La Plata County GIS, Eckel 1949, R² 2017, Division of Wildlife, USGS.

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The information displayed above is intended for general planning purposes. Refer to legal documentation/data sources for descriptions/locations.

0 400 800 1,200 Feet

1 inch = 400 feet

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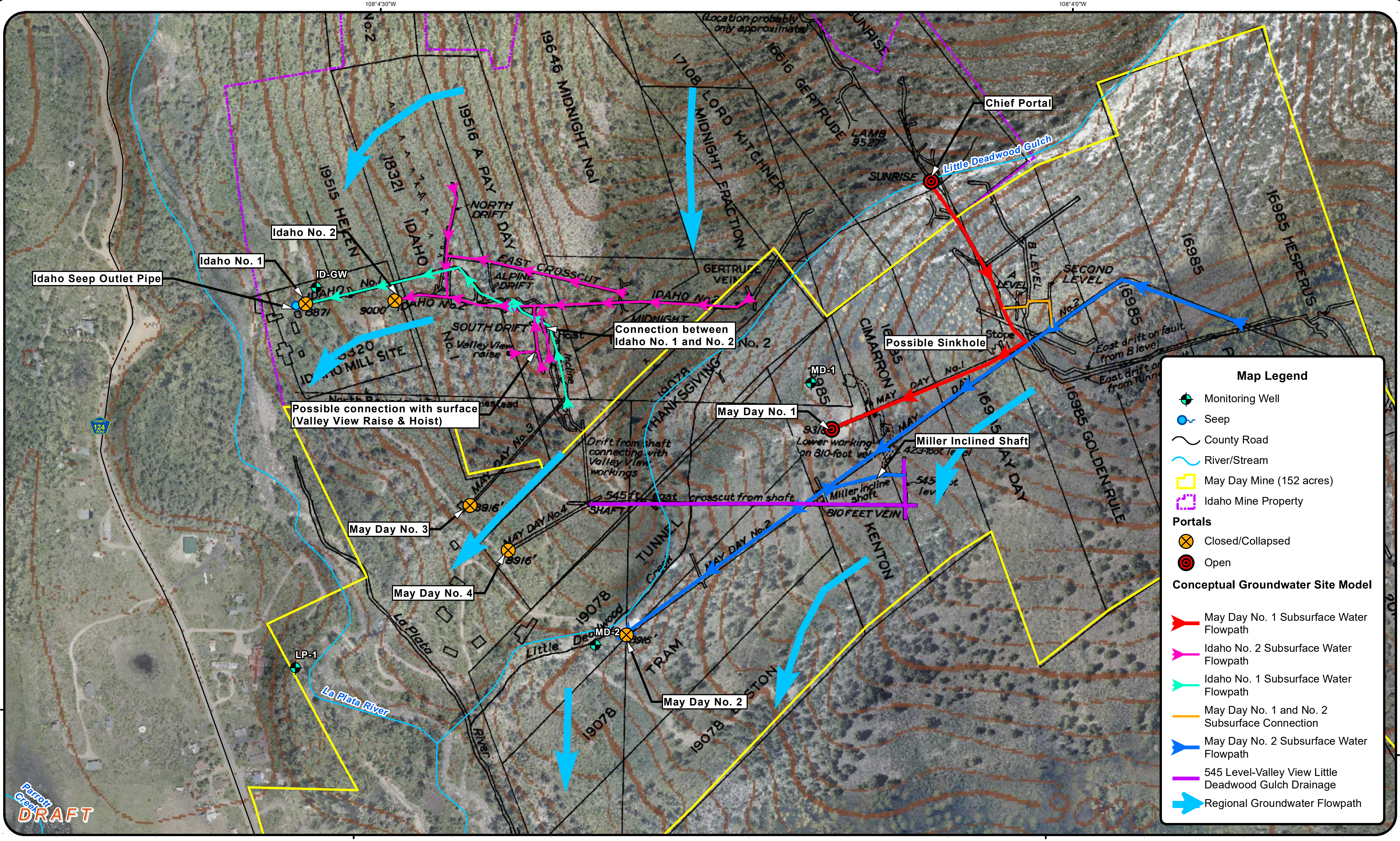

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Figure 2. Conceptual Groundwater Site Model

Sunrise Mining, LLC

Date: 1/14/2021 | Job No. 2017-460.001 Ph 05 | Map by: DSS | Checked by: KCH | Scale: 1:3,600

Data Sources: La Plata County GIS, Eckel 1949, R² 2017, Division of Wildlife, USGS.

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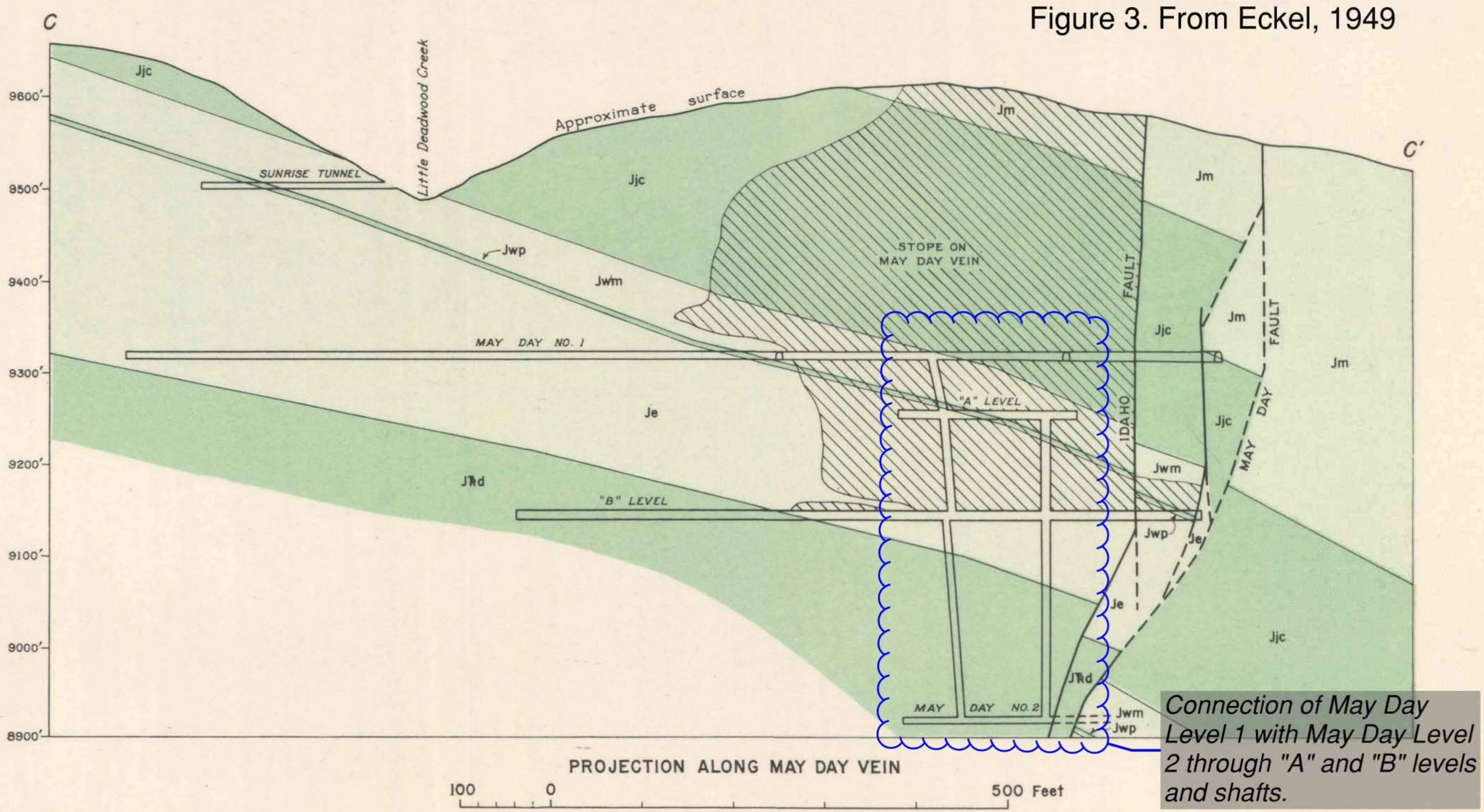
The information displayed above is intended for general planning purposes. Refer to legal documentation/data sources for descriptions/locations.

Figure 3. From Eckel, 1949



Connection of May Day Level 1 with May Day Level 2 through "A" and "B" levels and shafts.

Figure 4. From Eckel, 1949.

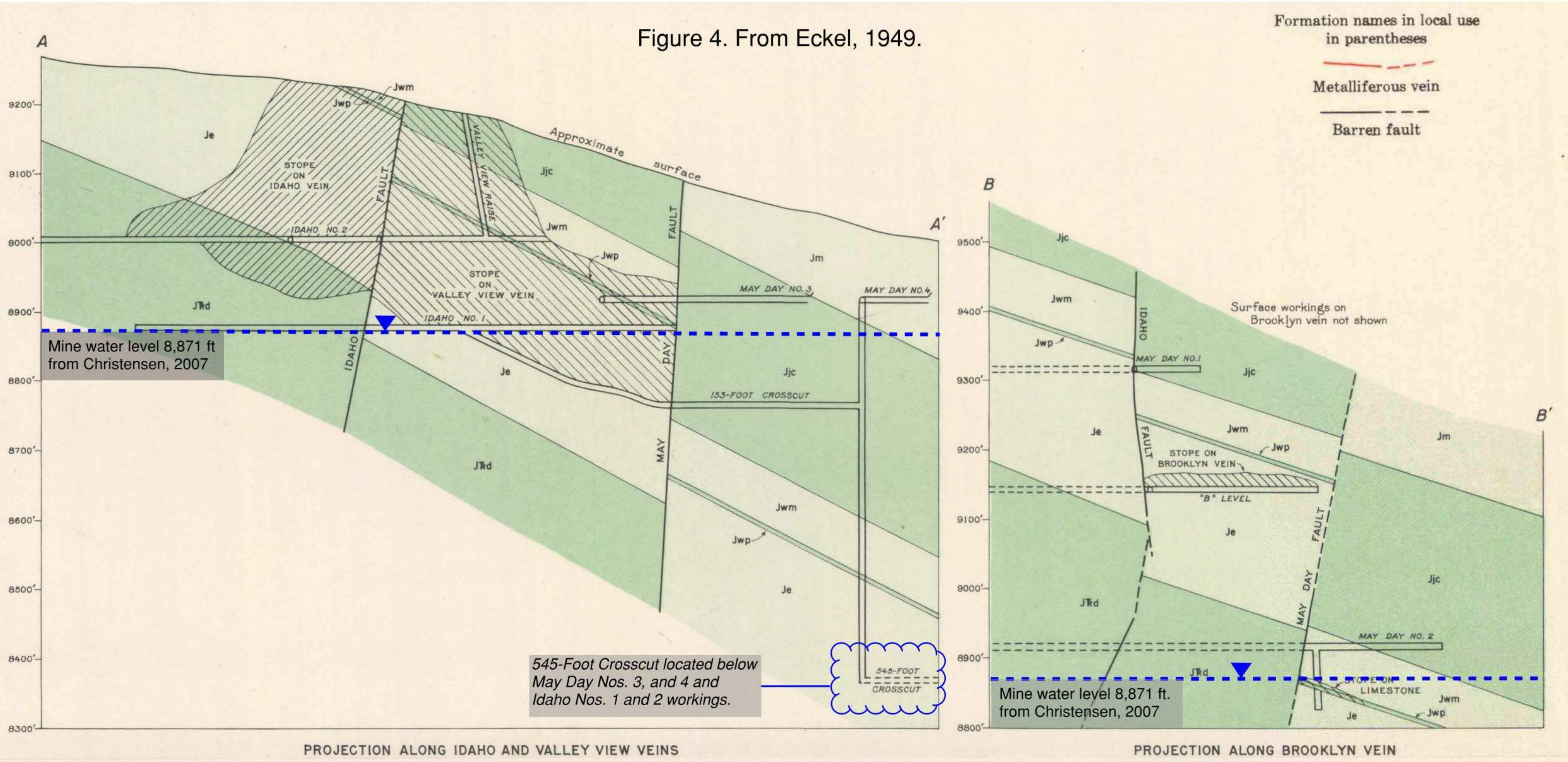
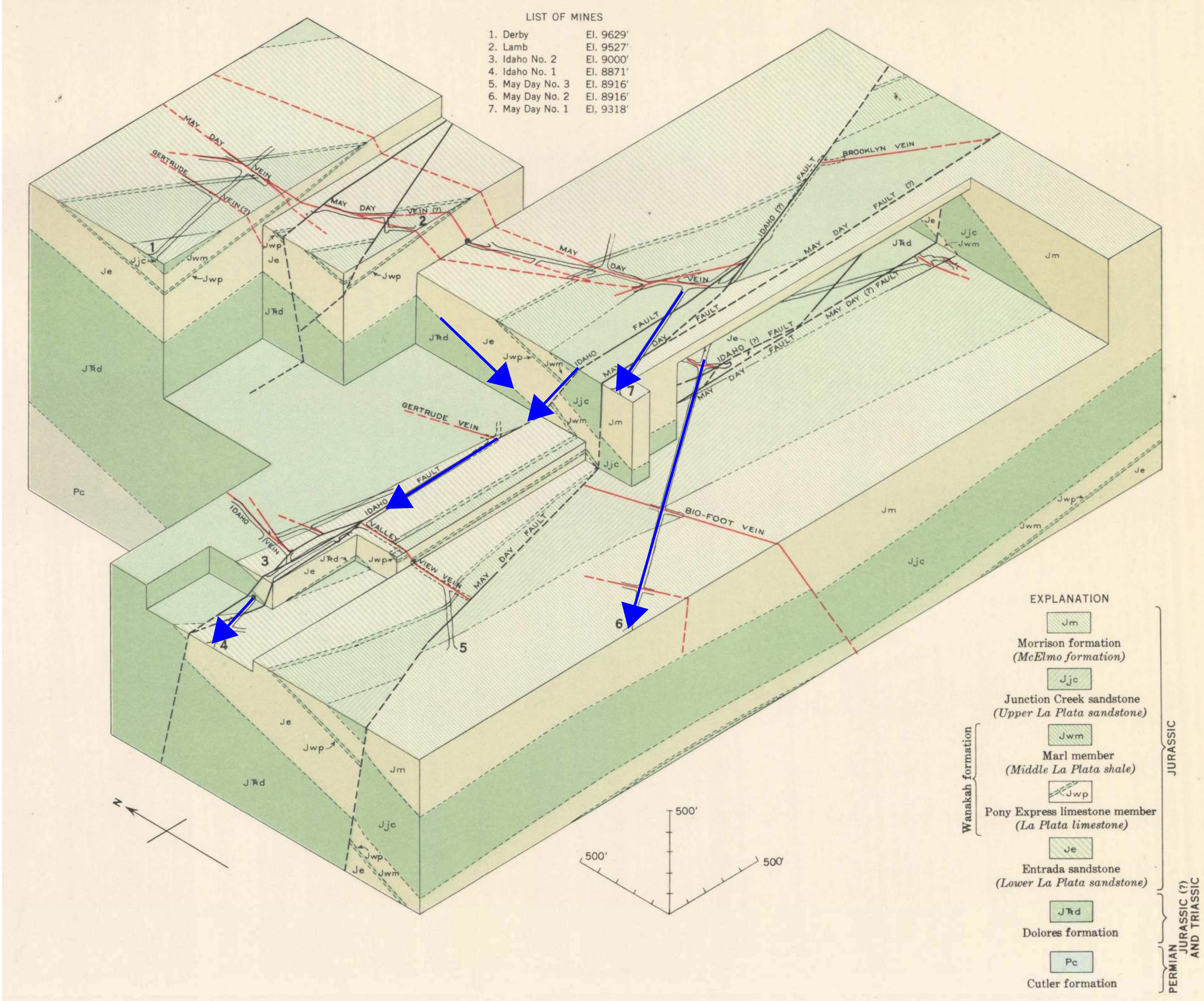
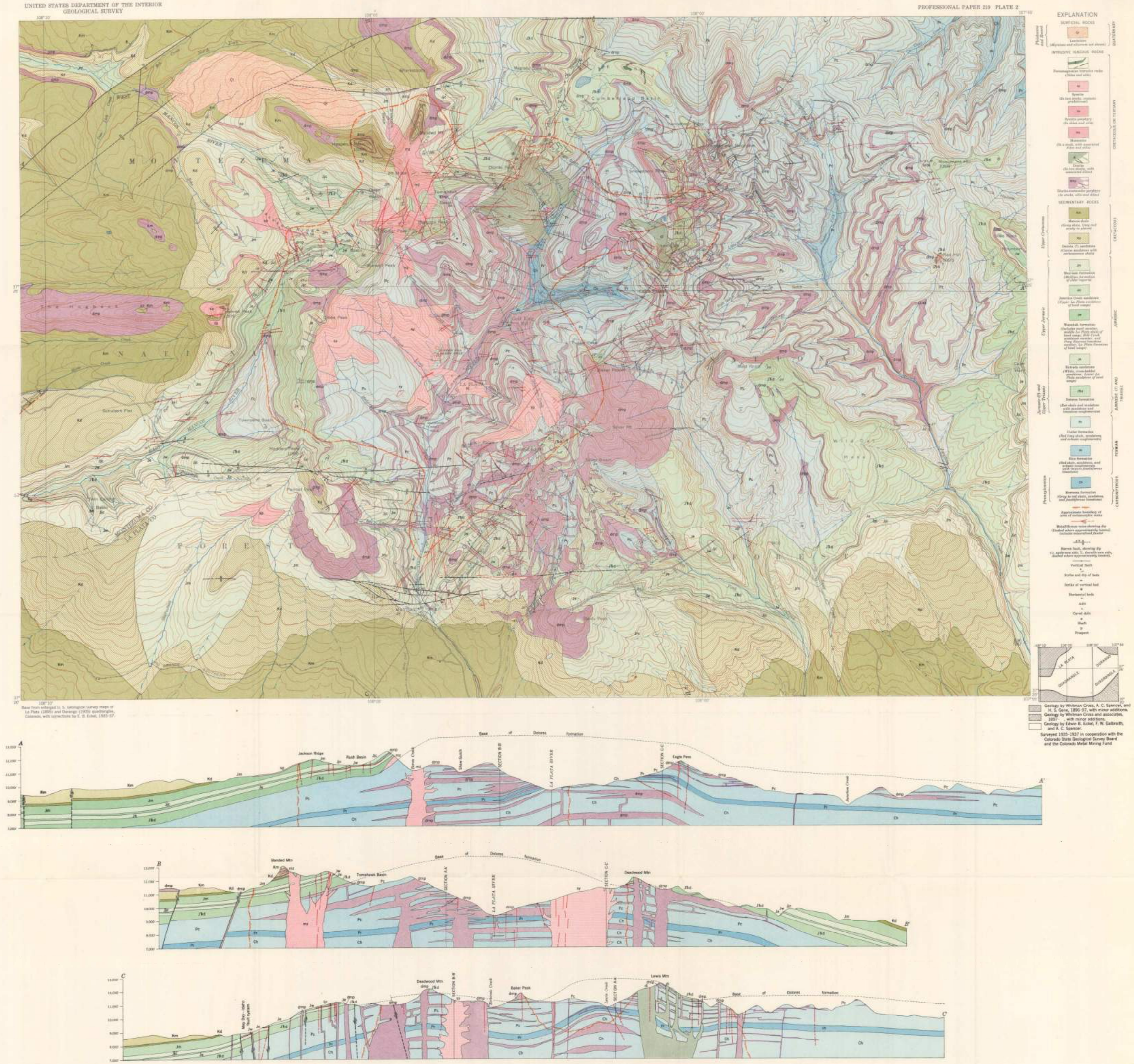


Figure 5. Conceptual Flow on Block Model



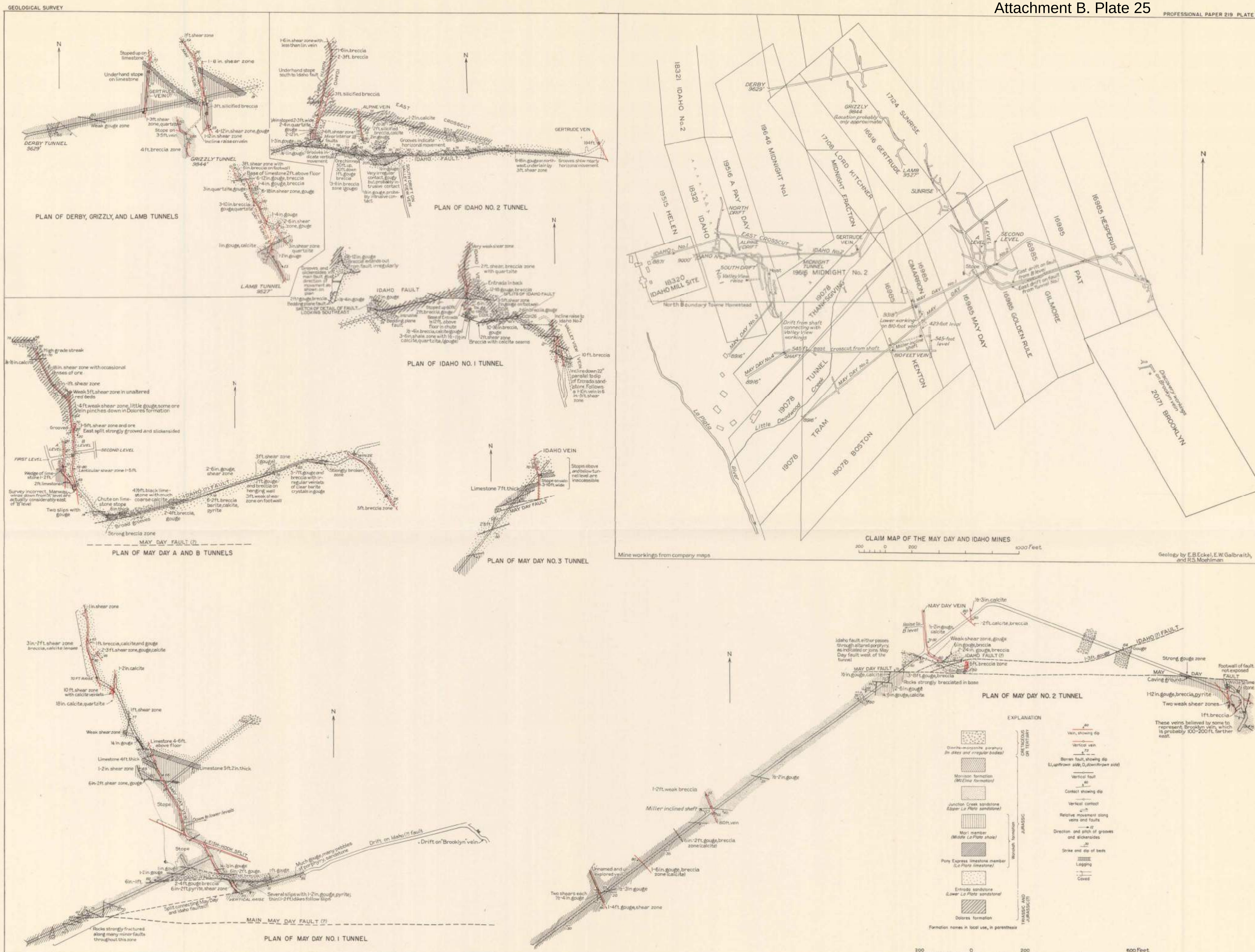
Attachment A. Plate 2



GEOLOGIC MAP AND STRUCTURE SECTIONS OF THE LA PLATA DISTRICT, COLORADO

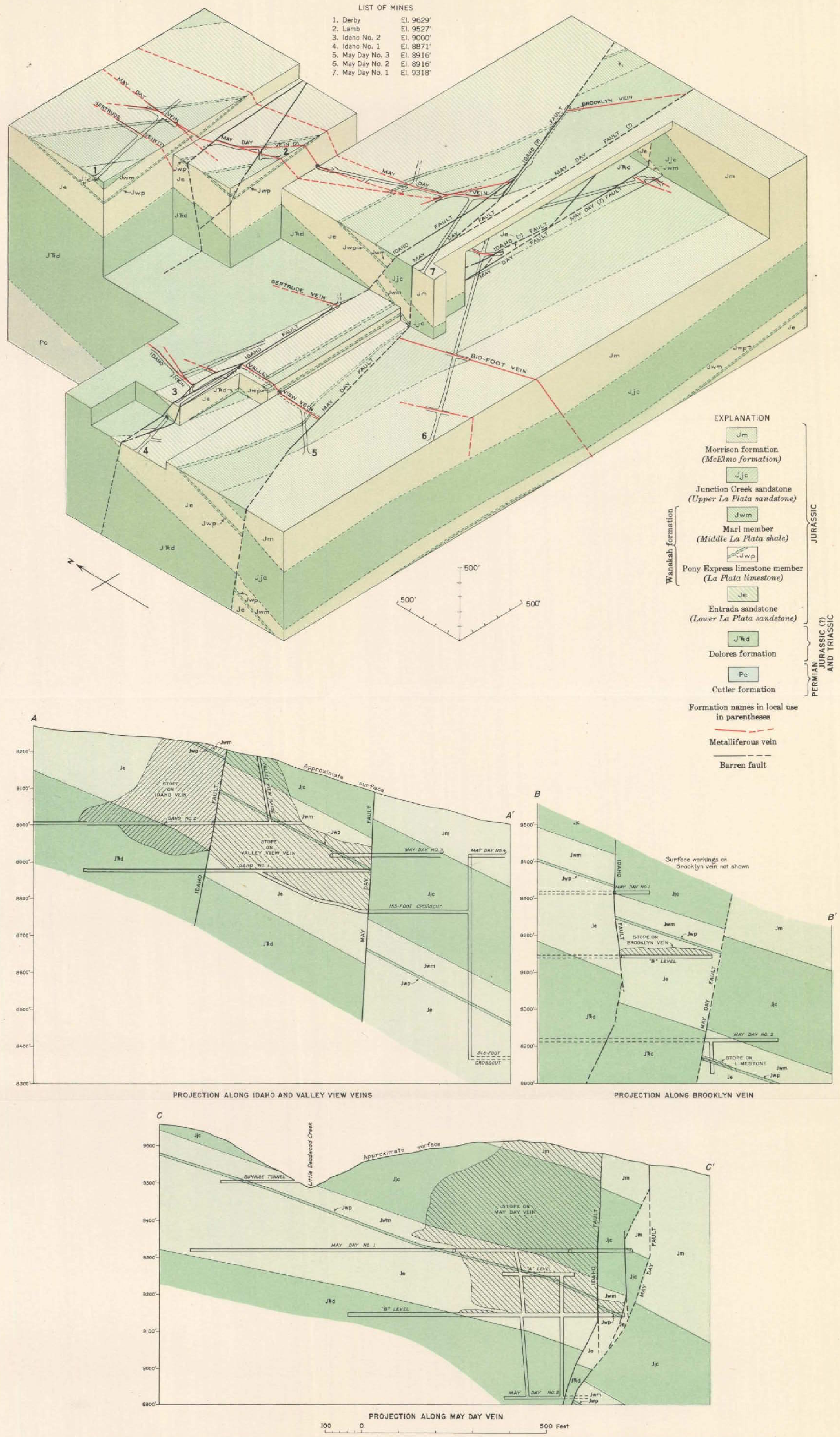
Contour interval 100 feet
Datum is mean sea level

1949



CLAIM MAP AND PLANS OF MAY DAY AND IDAHO MINES, LA PLATA DISTRICT, COLORADO

Attachment C. Plate 26



BLOCK DIAGRAM AND GENERALIZED SECTIONS, SHOWING GEOLOGY AND MINE WORKINGS OF MAY DAY AND IDAHO MINES