

# SGC

## The Mayflower

BPMD Community Advisory Group

May 28, 2020

# Contents

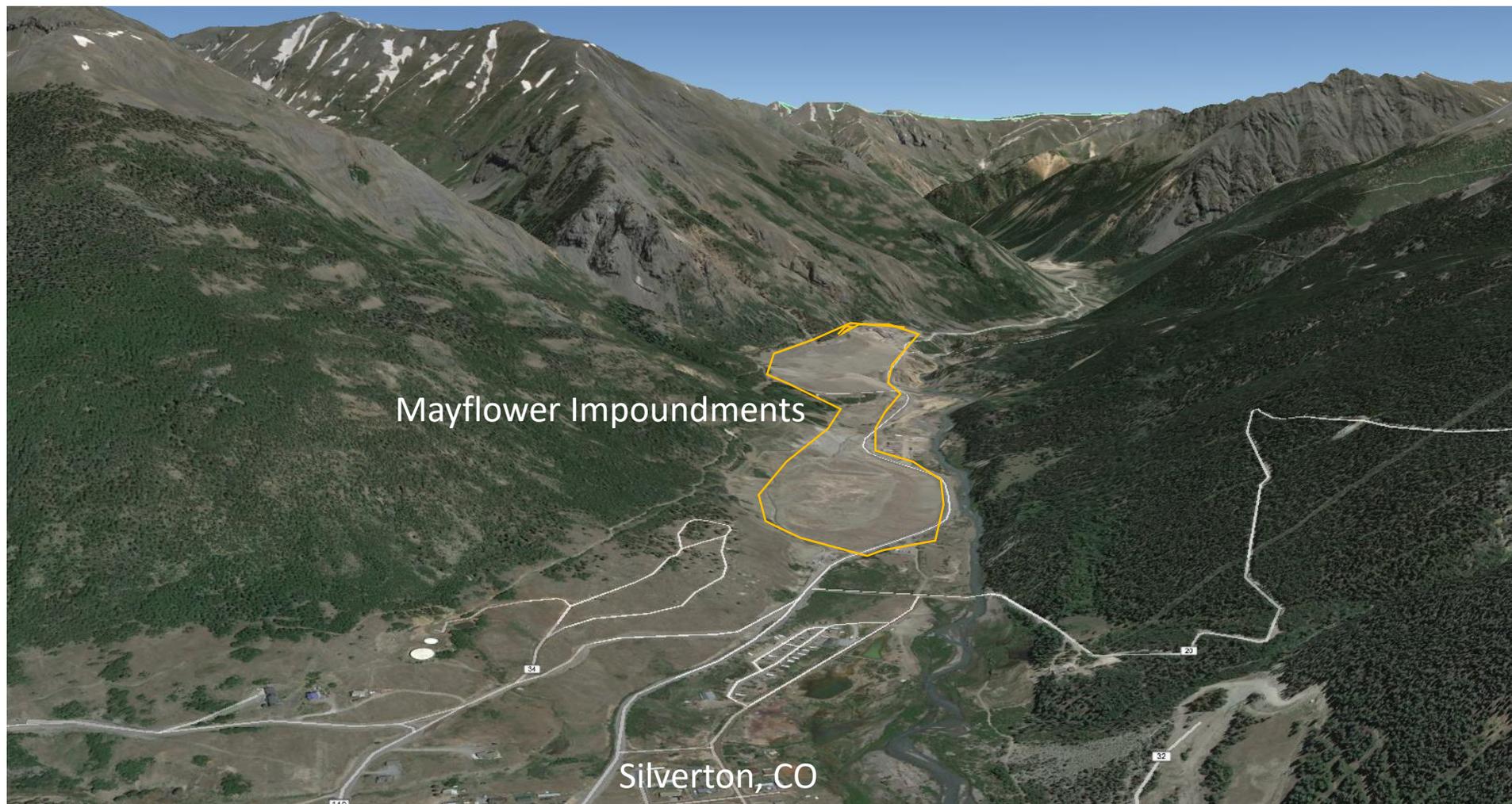
1. Executive Summary and Overview
2. SGC History and Reclamation
3. Mayflower History and Geologic Setting
4. Investigative Work (2015-2019)
5. Expert Review of Data Generated By SGC Work
6. Mayflower as an Ideal Sludge Depository
7. Conclusion

# Executive Summary

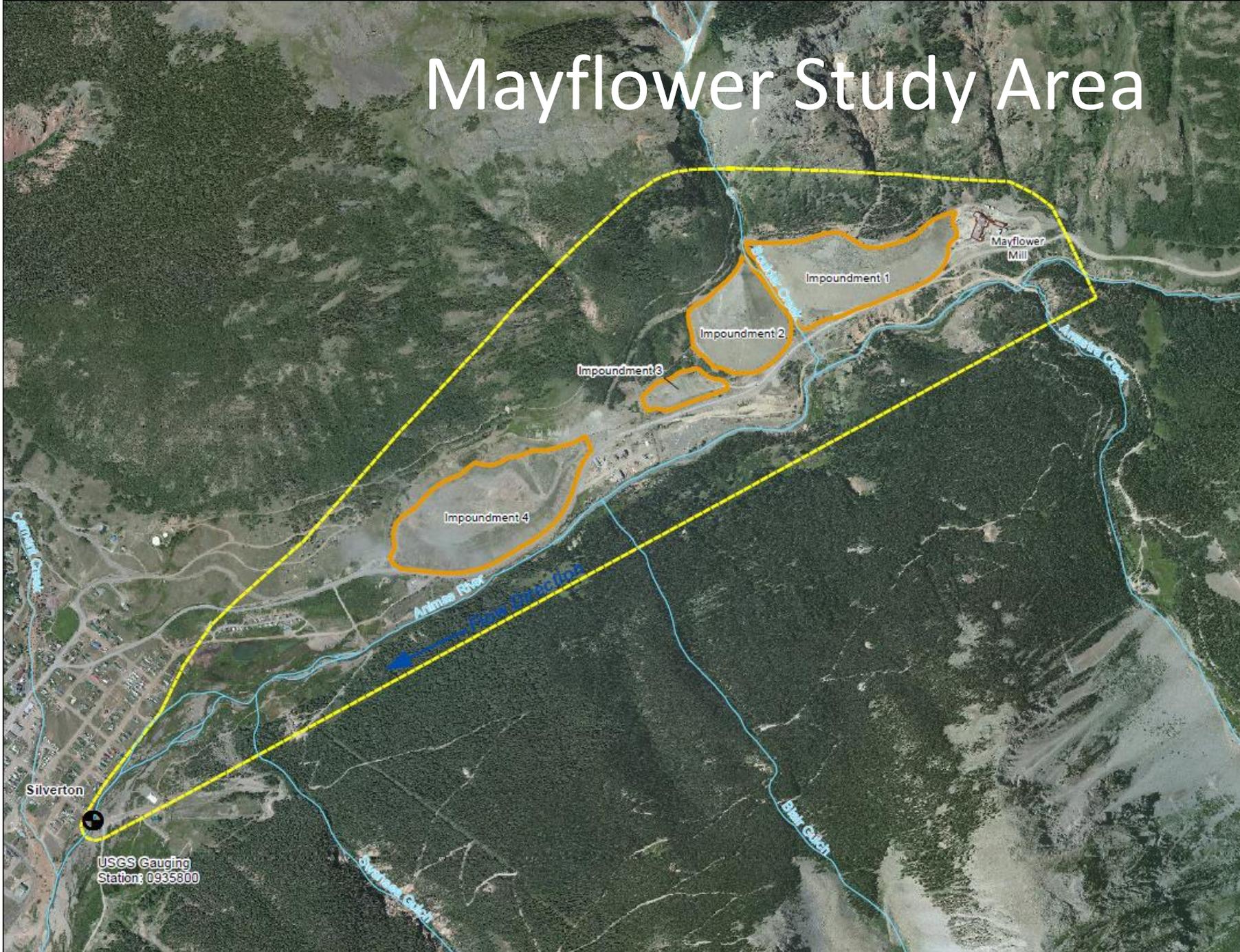
**After 5 years and over \$10 million dollars of intensive studies, there is no evidence that the Mayflower Mill/Impoundments are the source of anything but de minimis metals loading to the Animas River**

- An expert geochemist from Knight Piésold reviewed data obtained during 5 years of extensive Mayflower Investigations and confirmed this conclusion
- Based on these findings, Remedial Investigations should be drawing to a close
- SGC continues to believe Mayflower Impoundment No. 4 would be an ideal repository for the EPA's water treatment plant precipitate

# Map of Mayflower Impoundments and Mill



# Mayflower Study Area



**Legend**

**Rivers and Streams**

- Perennial River or Stream

**Mine Features**

- Mayflower Impoundments
- Study Area (Approximate Boundary)
- Mayflower Mill
- USGS Gauging Station

Basemap: 2011 ESRI World Imagery

0 1,000 2,000  
Feet

**SUNNYSIDE GOLD**  
SILVERTON, CO  
FIGURE 1-2  
**SITE PLAN  
AND  
STUDY AREA**

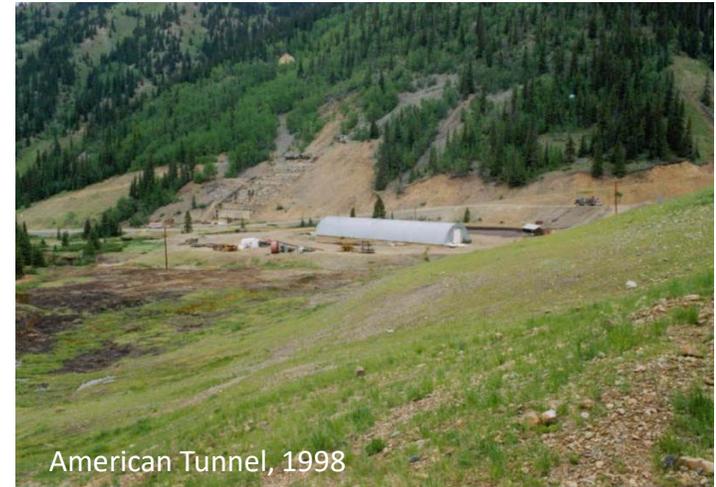
DATE: MARCH 2020  
BY: DKG FOR: NBB

**FORMATION**  
ENVIRONMENTAL

S:\CS\50565-001-Sunnyside-Upper-Animas\042019\AnnualReport\SitePlanStudyArea\_NetPS.mxd

# SGC History

- Sunnyside Gold Corp. (SGC) was established in 1985
- SGC operated Sunnyside Mine from 1986 until 1991
- During operations, SGC used modern mining techniques and adhered to modern environmental regulation
- The mine was closed in accordance with the law, SGC's permits and a State-approved Consent Decree
- SGC's five years of responsible mining and subsequent successful reclamation and remediation both improved water quality in the Animas River



# SGC Reclamation

- SGC has spent more than \$30 million on its successful reclamation and remediation
- The following awards relate to SGC's reclamation work:
  - **1987 Mined Land Reclamation Award for Most Improved Site**, from the Mined Land Reclamation Division, Department of Natural Resources Colorado
  - **1994 Mined Land Reclamation Board Award**, from the Mined Land Reclamation Board, Colorado Mining Association and the Colorado Rock Products Association
  - **2019 Environmental Excellence Award**, from the American Exploration and Mining Association
  - **Lifetime Environmental Achievement Award**, from the National Mining Association, for long-time SGC employee Larry Perino
- SGC has fulfilled all of its regulatory requirements and is in compliance with all of its reclamation obligations
- SGC has completed many reclamation and remediation activities on ground that was never owned or operated by SGC

# SGC Reclamation – Mayflower

- SGC has fully remediated the Mayflower Facilities, including the remediation of historical wastes over which it had no involvement
- Since 2015 SGC has spent 5 years and \$10+ million on investigations at the Mayflower
- SGC aided in the preservation of the historically-important Mayflower Mill
  - The intact Mill was donated to the San Juan County Historical Society, along with \$120,000 and other valuable property
  - Today, the Mayflower Mill is on the National Register of Historic Places and is being operated as a Historical Tour and interpretive center



Mayflower Mill (2013)

# Impoundment 1 Before and After



# Impoundment 2 Before and After



# Impoundment 2 Before and After



# Run-on Ditch Before and After



# Boulder Creek Before and After



# Boulder Creek Before and After



# SGC Demonstrably Improved Water Quality at Mayflower

- SGC only utilized the upper reaches of Impoundment No. 4
  - The entirety of Impoundment No. 4 is above the water table.
- SGC never utilized Impoundment Nos. 1, 2 or 3
- SGC fully reclaimed Impoundment Nos. 1, 2, 3 and 4, as recognized by CDRMS inspections
- SGC's Mayflower Activities Were Federally Permitted
  - SGC's operations and reclamation were conducted pursuant to authority delegated to Colorado by the United States.
  - SGC Operated and reclaimed the impoundments in compliance with its permits

# Mayflower Area History and Ownership

- The Mayflower Study Area has historically been the site of milling, mining-related impoundments, and other uses, commencing around 1892
- SGC acquired the Mayflower Mill and Impoundments in 1985
- SGC donated the Mayflower Mill to the San Juan County Historical Society in 1996 and it was designated a National Historic Landmark in 2000



# Prior to Impoundments

- 1889 – Polar Star Mill constructed at the head of Little Giant Basin. In 1892, the mill was moved to the Boulder Creek area, near site of current Impoundment 3. The Polar Star mill used stamp milling methods
- 1892 through ~1900: Polar Star mill active. Mill buildings are now gone, but the assay building remains
- 1929: Mayflower Mill was constructed and used flotation milling methods. Tailings were discharged to the Animas River until ~1935



# Mayflower Impoundments Construction and Reclamation

## Construction

- 1936 – TP-1 and TP-2 constructed.
  - Impoundments operated until 1975 when there was a breach at TP-1
- 1975 – Temporary tailings impoundment area constructed south of TP-3 on the right bank of the Animas River
  - Operated until construction of TP-3 was completed
- 1976 – TP-3 was constructed
  - Operated until construction of TP-4 was completed
- 1976 – TP-4 constructed

## Reclamation

- 1991/1992 – TP-1 and TP-2 reclaimed
- 1993 – TP-3 reclaimed
- 1989-2006 – TP-4 reclaimed

SGC has fully remediated the Mayflower Facilities, including the remediation of historical wastes over which it had no involvement



# Bonita Peak Area

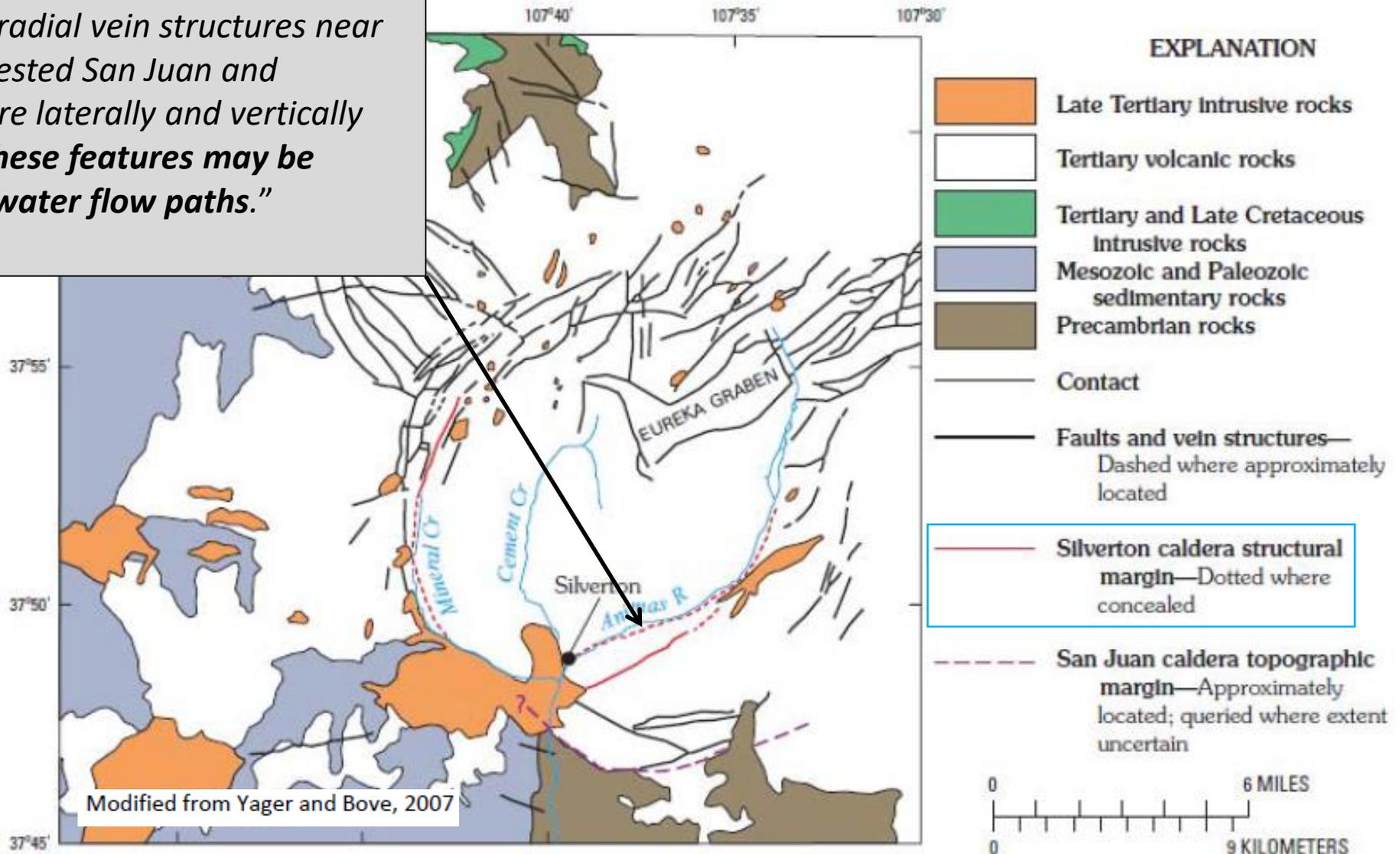
- Geologically, the area has been subject to intense volcanism, mineralization, and glaciation
- Surface water quality is locally poor due to both natural and man-made causes



# Geologic Setting

*“Caldera ring faults and associated veins of the Eureka graben and radial vein structures near the margin of the nested San Juan and Silverton calderas are laterally and vertically continuous. Thus, these features may be important ground-water flow paths.”*

(Yager and Bove, 2007)



# Naturally Mineralized Conditions

- Study Area investigations have shown that acid-generating materials (i.e., pyrite) are abundant in the bedrock in the Mayflower area
- Study Area investigations have shown that water-transmitting mineralized fractures are present in the bedrock in the Mayflower area, and that upward gradients from the bedrock to the alluvial groundwater system, including glacial till, and to the Animas River, exist



# Comprehensive Investigative Approach

- Since 2015, SGC has undertaken extensive investigations of the Mayflower area, voluntarily in 2015 and 2016, and pursuant to an AOC since
- An expert review of the investigations concludes that there is no evidence indicating that the Mayflower Facilities are the sources of anything but negligible metals loading to the Animas River
- SGC's reclamation of the Mayflower Facilities contributed to SGC's success in improving Animas River water quality



# Investigative Work: Comprehensive Sampling

Year	Event	Samples
2015	10	403
2016	8	249
2017	14	476
2018	11	302
2019	5	225
		<b>Total: 1,655</b>

<b>Samples by Media</b>	
Fish tissue (FT)	15
Groundwater (GW)	304
Macroinvertebrate tissue (ITA)	5
Pore water (PW)	79
Sediment (SED)	74
Soil (SO)	467
Surface water (SW)	687
Sediment toxicity (TOX-SED)	8
Water toxicity (TOX-W)	16
<b>Total</b>	<b>1,655</b>

# 2015 Investigative Work

- 10 sampling events, 403 water samples
- Conceptual Site Model (CSM): Characterization of Mayflower Impoundments and Bedrock
- High Density Surface Water Sampling
- Monitoring well Installation – 18 wells - Rotosonic drilling in tails and underlying Alluvium
  - All wells screened below the tails
- Coring in bedrock
- Pressure Transducers installed in wells
- Airborne Geophysical Survey
- Pore water sampling
- Monitoring piezometers



# 2015 Investigative Work

## CSM - Characterization of Mayflower Impoundments

- 17 monitor wells drilled and sampling points established
  - All wells in the impoundments are screened below the tails
- Identify:
  - fill (includes soil over tailings and mine waste around mill)
  - tailings
  - sludge
  - alluvium
- 335 borehole/solid samples submitted for chemical-screening analysis (56 elements)
- Chemical variability determined the appropriate number of samples needed for the full suite of chemical analyses
- Of the 335 screening samples, 101 (including duplicates) were ultimately selected for further analysis



# Results: 2015 Investigative Work

- Impoundment Nos. 1, 2, and 3 are situated on a bedrock bench above the Animas River
- Seven metals of concern in the Study Area: Al, Cd, Cu, Fe, Pb, Mn, Zn
- Synthetic Precipitation Leaching Procedure (SPLP) tests indicate limited percentages of the metals of concern are potentially leachable from the Mayflower Impoundments



**Pore Water Sampling:**  
Target Depth ~ 1 foot below the stream bed



# 2016 Investigative Work

- 8 sampling events, 249 samples
- Baseline aquatic ecological risk assessment
- Pore water sampling (continued)
- Pressure transducers
- Monitoring piezometers



# Results: 2016 Investigative Work

## Baseline Aquatic Ecological Risk Assessment:

- **Proves water quality could support fish, however primary limitation was habitat**
- Ecological risk in the Animas River at the upstream end of the Study Area is similar to that within the Study Area
- No toxicity was observed in 96-hr acute tests performed using juvenile rainbow trout and site water
- No toxicity was observed in chronic sediment toxicity tests for any location downstream of potential sources within the Study Area
- Risks to aquatic-dependent wildlife are low and may be *de minimis*
- **Conclusions are consistent with EPA BERA findings (See Appendix A)**



# Results: 2016 Investigative Work (continued)

- Peak metals concentrations in the Animas River generally occurred prior to peak discharge based on data collected from 2009 to 2016 (SGC collected data in 2015 and 2016)
- During low-flow conditions, increasing metals concentrations in the Animas River were evident
  - In the Seep 6150 area; and
  - Near the downstream end of the Study Area.
- Groundwater in the alluvial aquifer on the right bank of the Animas River had a wide range of metals concentrations and the spatial distribution of key metals remained essentially the same from 2015 to 2016
- Groundwater discharging from bedrock fractures (i.e., concentric and radial faults associated with the Silverton Caldera) appear to be important groundwater flow paths within the bedrock that underlies the Study Area
  - The river within the Study Area likely serves as a low-elevation discharge point for groundwater that is transmitted through the regional bedrock fractures

# 2017 Investigative Work

- 14 sampling events, 476 samples
- Winter low flow sampling
- Rotosonic drilling in and around impoundments
  - 37 borings, 30 wells
  - All wells screened below tails
- Angled core holes drilled
  - 11 angle holes, 5 cored into rock
- Coring in bedrock
- Downhole geophysics
- On-site meteorological station
  - Most comprehensive on-site meteorological station in the area
- Pore water sampling (continued)
- Pressure transducers
- Monitoring piezometers



**Angled Coreholes**

# 2017 Investigative Work

## Winter Low-Flow Sampling



**SGC is the first to sample moving water in winter low-flow conditions in the area with a drone**

# Results: 2017 Investigative Work

- Animas River sampling conducted monthly through the winter indicated peak metals concentrations in March, consistent with the March 2016 data collected by EPA
- Four distinct alluvial groundwater systems are present in the Study Area:
  - Eastern system beneath Mayflower Mill and east half of Impoundment No. 1
  - Central system beneath parts of Impoundment Nos. 2 and 3, including the Boulder Creek valley
  - Western system beneath Impoundment No. 4 and areas to the west
  - Hillside system (discontinuous saturated zones to the north of Impoundments)
- Artesian conditions are present in the alluvial groundwater system west of Impoundment No. 4 and also in the bedrock fracture system to the north of Impoundment No. 4, supporting the concept of upwelling bedrock groundwater



**Pore Water Sampling**

**Legend**

**Monitoring Well, Piezometer and Borehole Locations**

- Monitoring Well **MTMW-##**  
Fully screened in bedrock
- Piezometer

**Rivers and Streams**

- Perennial Stream

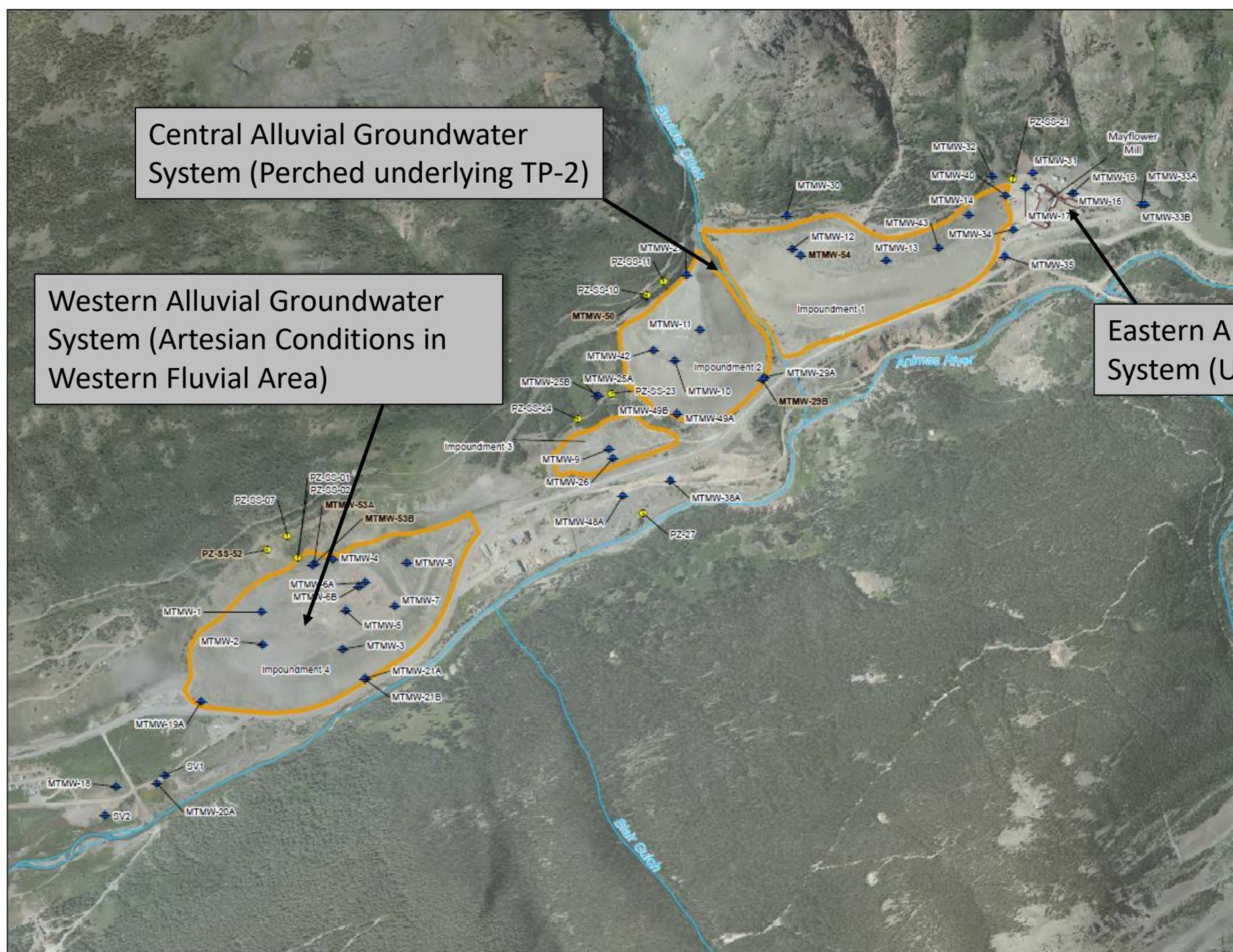
**Mine Features**

- Mayflower Impoundments
- Mayflower Mill

Central Alluvial Groundwater System (Perched underlying TP-2)

Western Alluvial Groundwater System (Artesian Conditions in Western Fluvial Area)

Eastern Alluvial Groundwater System (Upper and Lower)



**SUNNYSIDE GOLD**  
SILVERTON, CO  
FIGURE 2-2

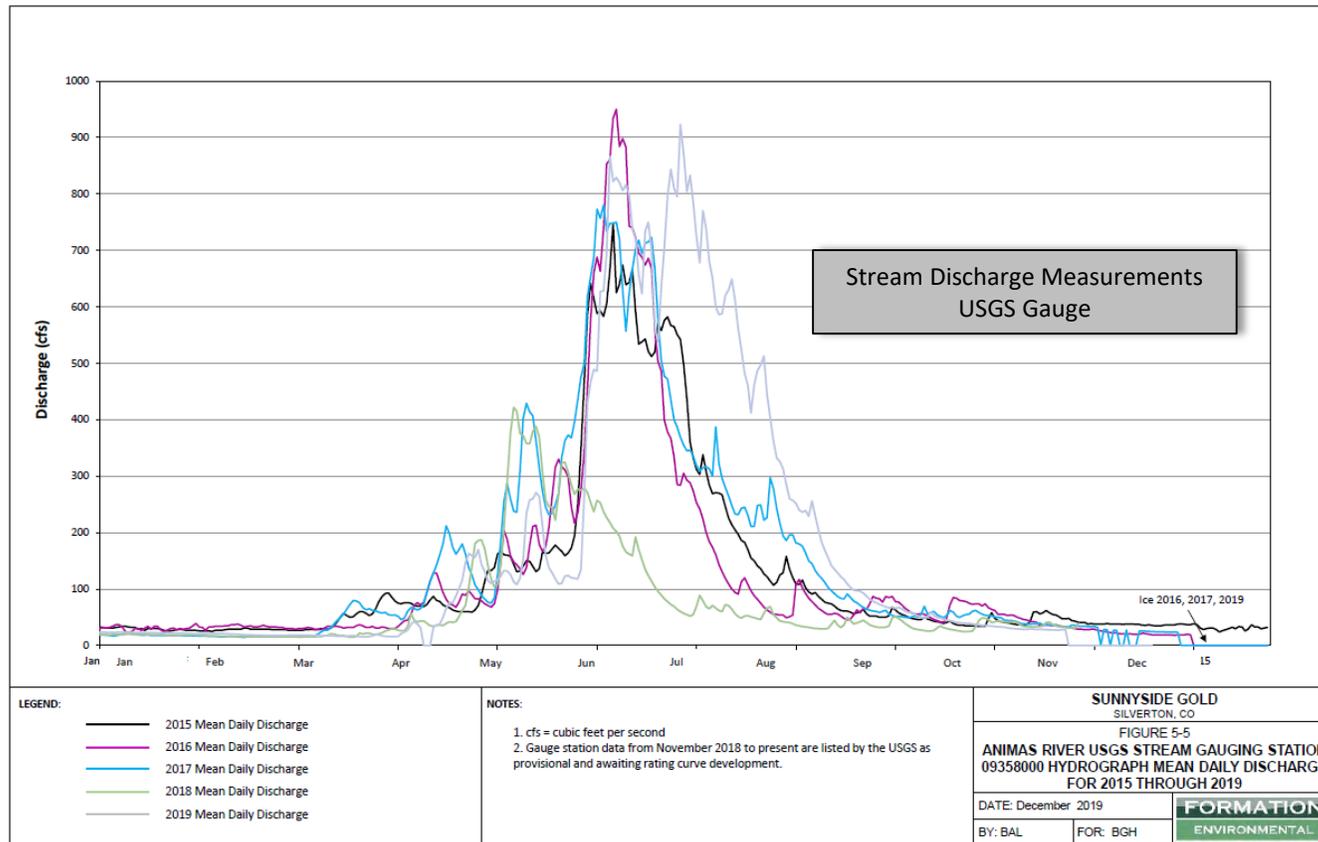
**MONITORING WELL/PIEZOMETER LOCATIONS**

DATE: MAR 09, 2020	<b>FORMATION</b>
BY: DKG	ENVIRONMENTAL
FOR: NBB	

S:\GIS\45065-001-Sunnyside-Upper-Animas\102019\AnnualReport\Borehole\_GW\_Piez\_locations\_NBB.mxd

# 2018 Investigative Work

- 11 sampling events, 302 samples
- Stream discharge measurements
- Monthly sampling of surface water at select stations
- Pressure Transducers
- Monitoring piezometers



# Results: 2018 Investigative Work

- Tritium analyses indicate relatively older groundwater in the Impoundment No. 4 area, further supporting the concept of upwelling bedrock groundwater
- Floodplain tailings just upstream of Seep 6150 exhibit some of the highest total and leachable metals concentrations in the Study Area and are not chemically similar to the Mayflower Impoundment materials



# 2019 Investigative Work

- 5 sampling events, 225 samples
  - Work plan submitted to EPA in June, approved late September, affecting overall number of events and samples
- Trench investigation
  - 6 areas of interest
  - 32 shallow trenches
  - 18 groundwater grab samples
  - 66 soil samples
- Mid-channel sampling – spring, high flow
- High-density pore water sampling – low flow
- Pressure Transducers
- Monitoring piezometers



# 2019 Investigative Work

## Mid-Channel Sampling - Spring High-Flow



- Refined surface water sampling network in 2019
- Targeting mid-channel

# Results: 2019 Investigative Work

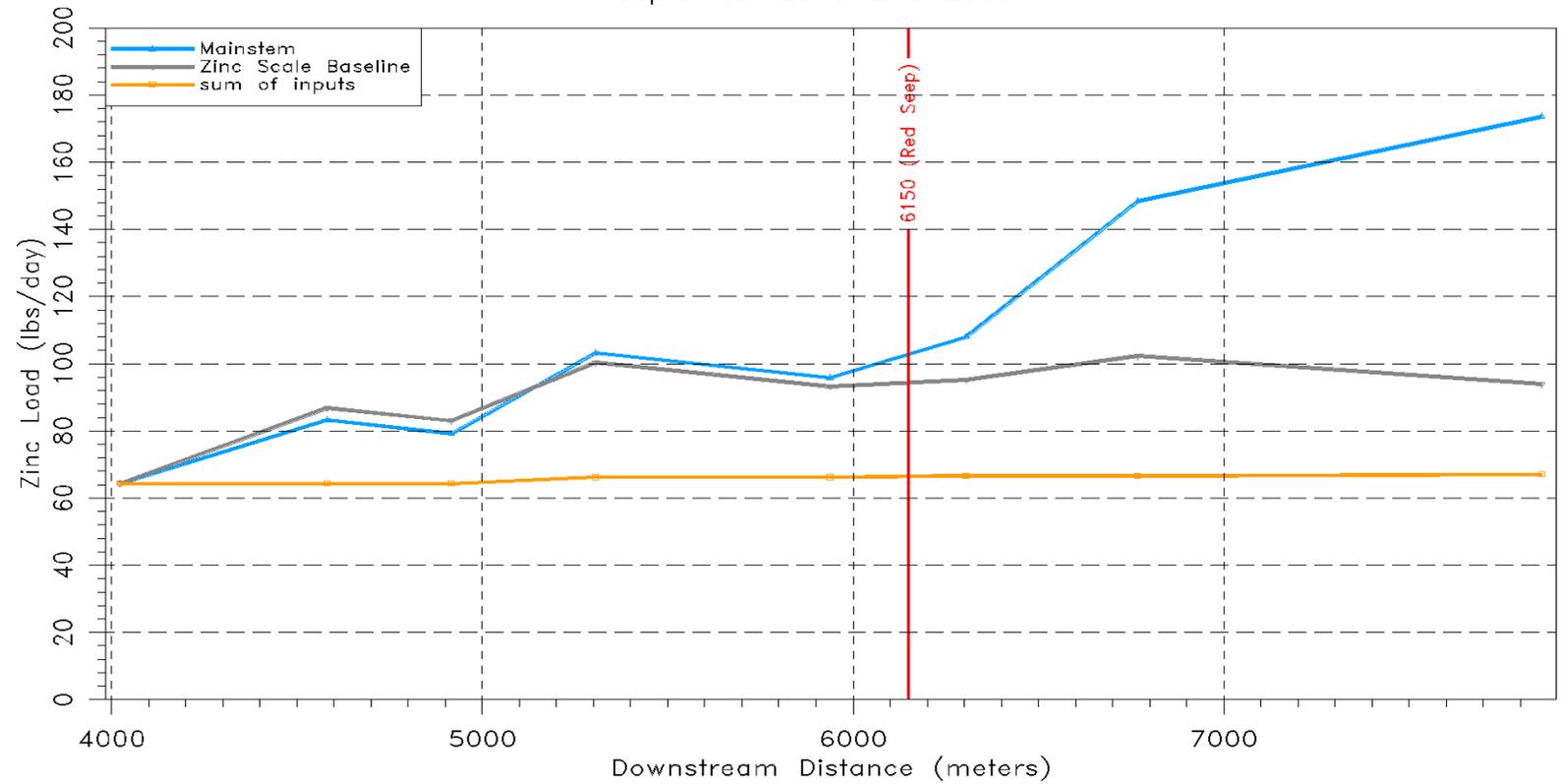
- The concentrations of the metals of interest in the Animas River in the Study Area are, to a large extent, from sources upgradient in the Animas River or from left bank inflows such as Arrastra Creek not influenced by the Mayflower Mill or Impoundments
- Pore water collected from beneath the Animas River channel does not appear to measurably affect surface water concentrations in the River
- The surface water quality in the Study Area is most affected by right bank inflows in the Seep 6150 area and in the vicinity of a slough near the downstream end of the Study Area at right bank inflow station 7690

6150 RBI Seepage



## Comparison Measured and baseline Zinc Load Low Flow 2019

September 2019 Zinc Load



\*CDM Smith, April 2020

7690 RBI



# Results After 5 Years of Study and Comprehensive Sampling

- **There is no evidence indicating that the Mayflower Facilities are the source of anything but negligible metals loading to the Animas River, if any**
  - The concentrations of the metals of interest in the Animas River in the Study Area are, to a large extent, from sources upgradient in the Animas River or from left bank inflows such as Arrastra Creek that are not influenced by the Mayflower Facilities
  - While there is no material impact to the Animas River within the Mayflower Study Area upgradient of Seep 6150, there are impacts downstream of Seep 6150, albeit not from the Mayflower Facilities
  - Impoundment No. 4 is not the source of Seep 6150 metals (geochemically distinct). A comparison of groundwater beneath the tailings with water from 6150 indicate they are not from the same source (*Refer to Appendix A for copper, zinc, lead, cadmium and manganese concentrations*)

# Comparison Groundwater Iron Concentrations

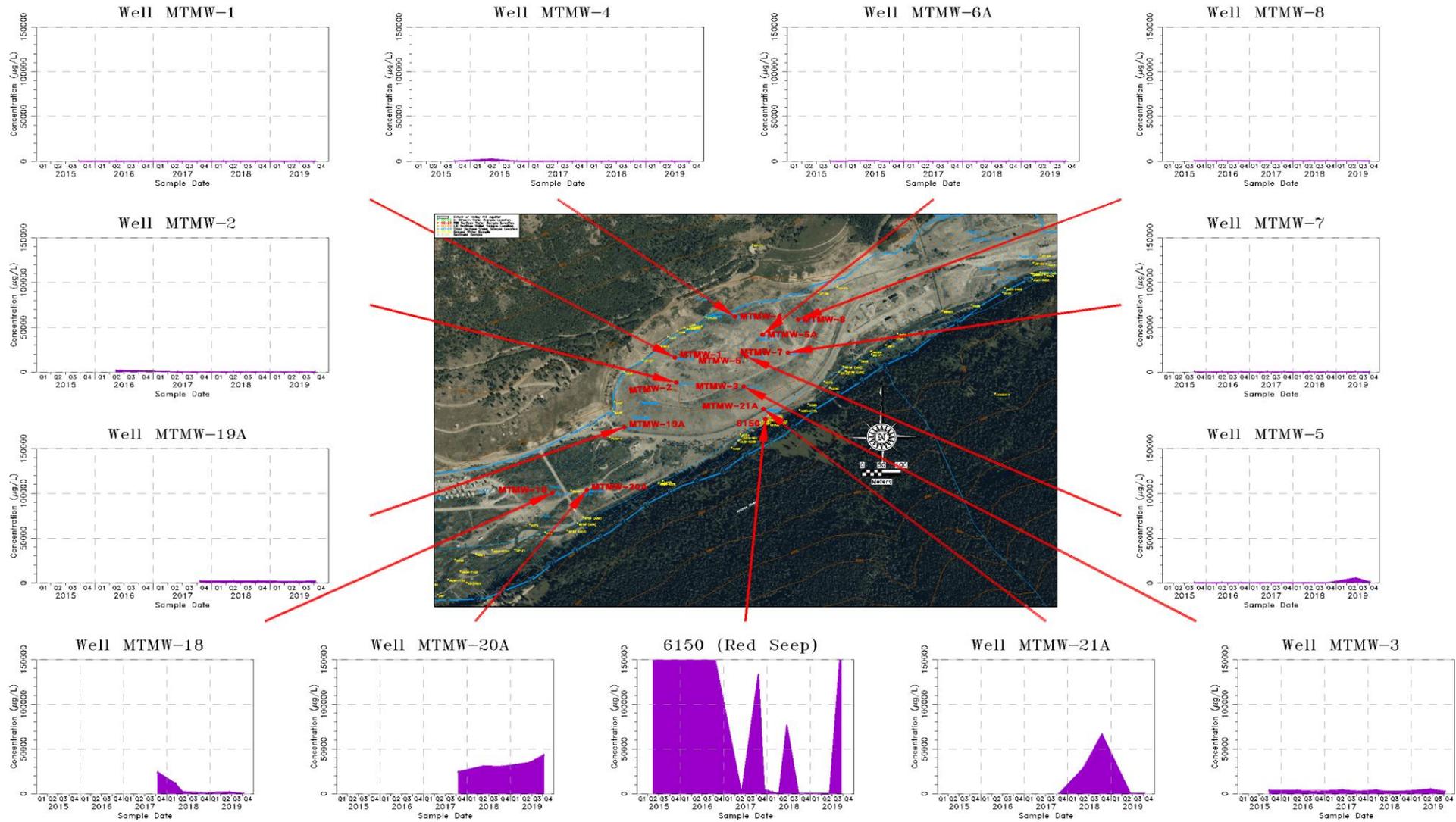


Figure 3.3.1g TP 3&4 Groundwater Dissolved Iron Concentrations

# Knight Piésold Review of Data Relating to Mayflower Area Water Quality

- David Bird, Knight Piésold, geochemist with 30+ years experience in mining geochemistry, reviewed data and materials relating to the Mayflower Mill and the Mayflower Impoundments
  - Reviewed and analyzed extensive and high quality data compiled between 2015 and 2019 as part of SGC's \$10M+ investigations
  - **The Knight Piésold Report is available on SGC's Website:**  
[www.sgcreclamation.com](http://www.sgcreclamation.com)

# Findings: Knight Piésold Review of Data Relating to Mayflower Area Water Quality

- **Groundwater in the Mayflower Mill area is releasing negligible solutes, if any, to the Animas River**

- A seep in the area of Impoundment Nos. 1 and 2 likely originates from a source other than the Mayflower Impoundments
- There is no noteworthy increase in cadmium, copper, or zinc concentrations in the Animas River adjacent to Impoundment No. 3, suggesting negligible right bank discharge of solutes to the Animas River along this reach
- Metals increases in the Animas River along the reach roughly adjacent to Impoundment No. 4 are likely sourced from a seep that does not originate from Impoundment No. 4 or the Mayflower Facilities

# Mayflower Impoundment No. 4

## An Ideal Sludge Repository

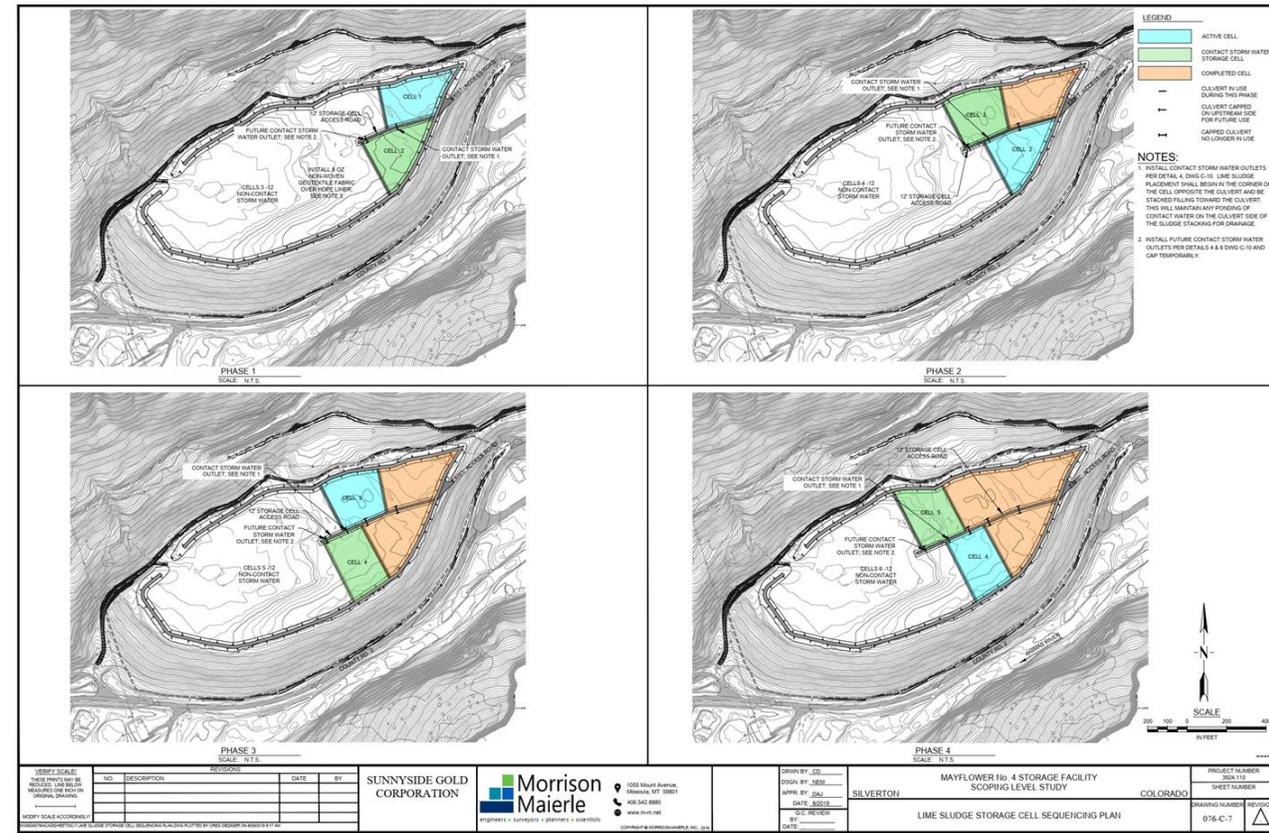
- An expert engineer has called Impoundment No. 4 “*an ideal long-term sludge repository.*”
- The following characteristics contribute to Mayflower Impoundment No. 4 being an ideal repository for water treatment plant precipitate
  - Size
  - Location
  - Topography
  - Prior disturbance and past similar usage
  - No identified hydrological connection to River

# Mayflower Impoundment No. 4

## An Ideal and Available Sludge Repository

- SGC has offered to make Mayflower Impoundment No. 4 available to EPA
- SGC has voluntarily provided EPA with Scoping Level Engineering Drawings for a facility that would provide decades of optimal sludge storage
- EPA has recognized “[a]ll four impoundments would be geotechnically stable for repository placement”

\*U.S. EPA, 2019 Year in Review and Plan for 2020 Bonita Peak Mining District (Apr 2020).



# Conclusion

- **SGC has spent 5 years and over \$10 million dollars on intensive studies which show there is no evidence that the Mayflower Mill/Impoundments are the source of anything but de minimis metals loading to the Animas River**
- **Knight Piésold Review of Data Relating to Mayflower Area Water Quality supports this finding:**
  - “There is no evidence indicating that the Mayflower Facilities are the source of anything but negligible metals loading to the Animas River, if any, and there is no evidence identifying any pathway from the Mayflower Facilities to the Animas River.”
- **Based on these findings, Remedial Investigations should be drawing to a close**
- **SGC continues to believe Mayflower Impoundment No. 4 would be an ideal repository for the EPA’s water treatment plant precipitate**

# APPENDIX A

# EPA Baseline Aquatic Ecological Risk Assessment

- EPA BERA findings
  - “Habitat assessments indicate that some BPMD aquatic habitats will not be able to support all trout life history stages and/or native cutthroat trout due to physical habitat limitations and/or low water temperatures.” TechLaw, Inc, Final Aquatic Baseline Ecological Risk Assessment (Feb. 2019).
  - “Soils and mineralized rock within the BPMD naturally contain high levels of metals and represent non-mining related sources of contamination in local drainages.” TechLaw, Inc, Final Aquatic Baseline Ecological Risk Assessment (Feb. 2019).
  - “The upper Animas River watershed reaches above the Mineral Creek confluence may never have supported healthy and diverse aquatic life communities, even before mining activities started in the 19th century (Church et al., 1999).” TechLaw, Inc, Final Aquatic Baseline Ecological Risk Assessment (Feb. 2019).
  - “While abandoned mines play a significant role in limiting fisheries within the BPMD, it should be noted that portions of the greater Animas River watershed may have never supported aquatic life communities prior to mining due to natural sources of acid rock drainage.” EPA, BPMD Aquatic Baseline Ecological Risk Assessment Fact Sheet (March 2019).

# Comparison Groundwater Copper Concentrations

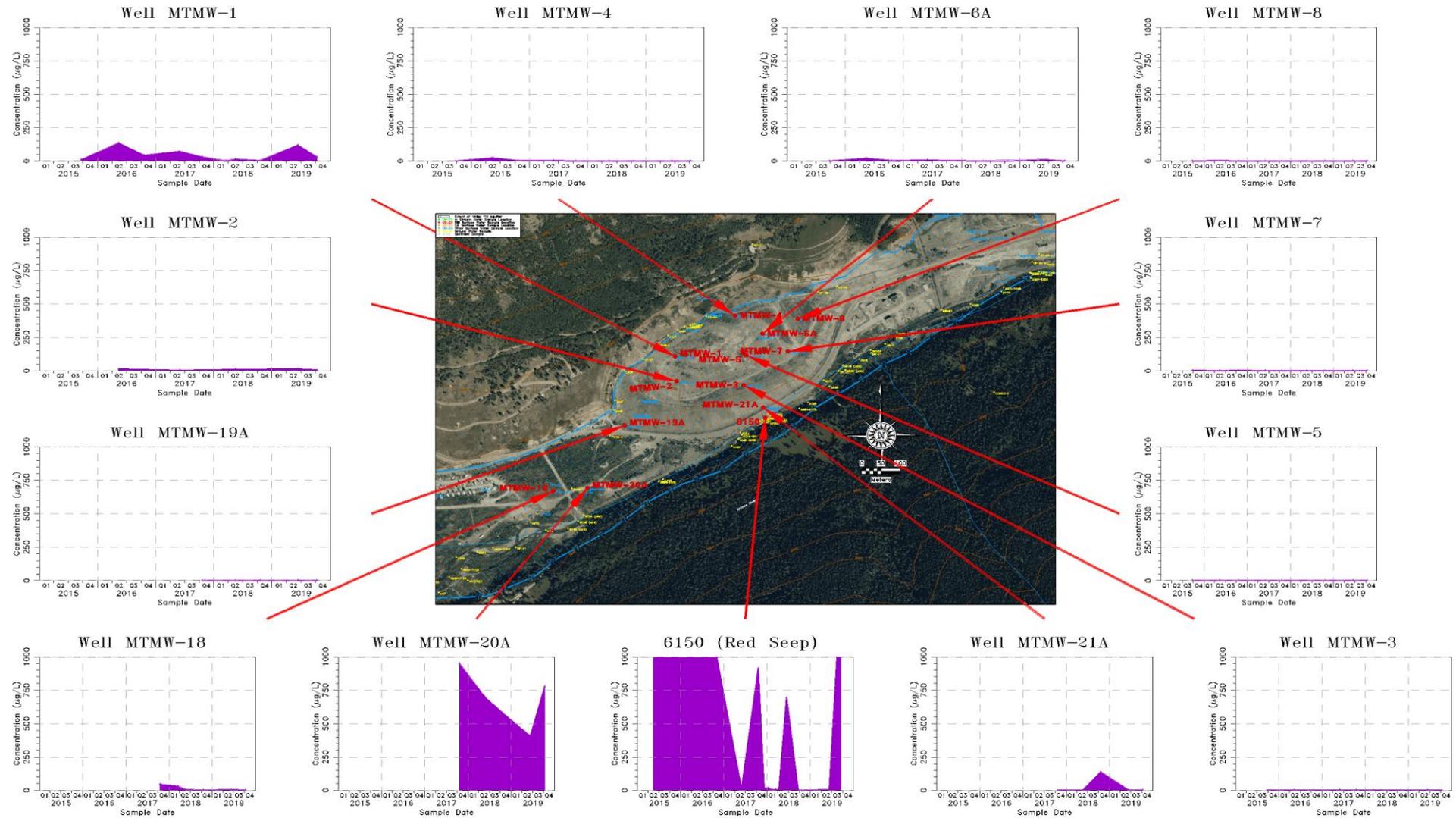


Figure 3.3.1c TP 3&4 Groundwater Dissolved Copper Concentrations

# Comparison Groundwater Zinc Concentrations

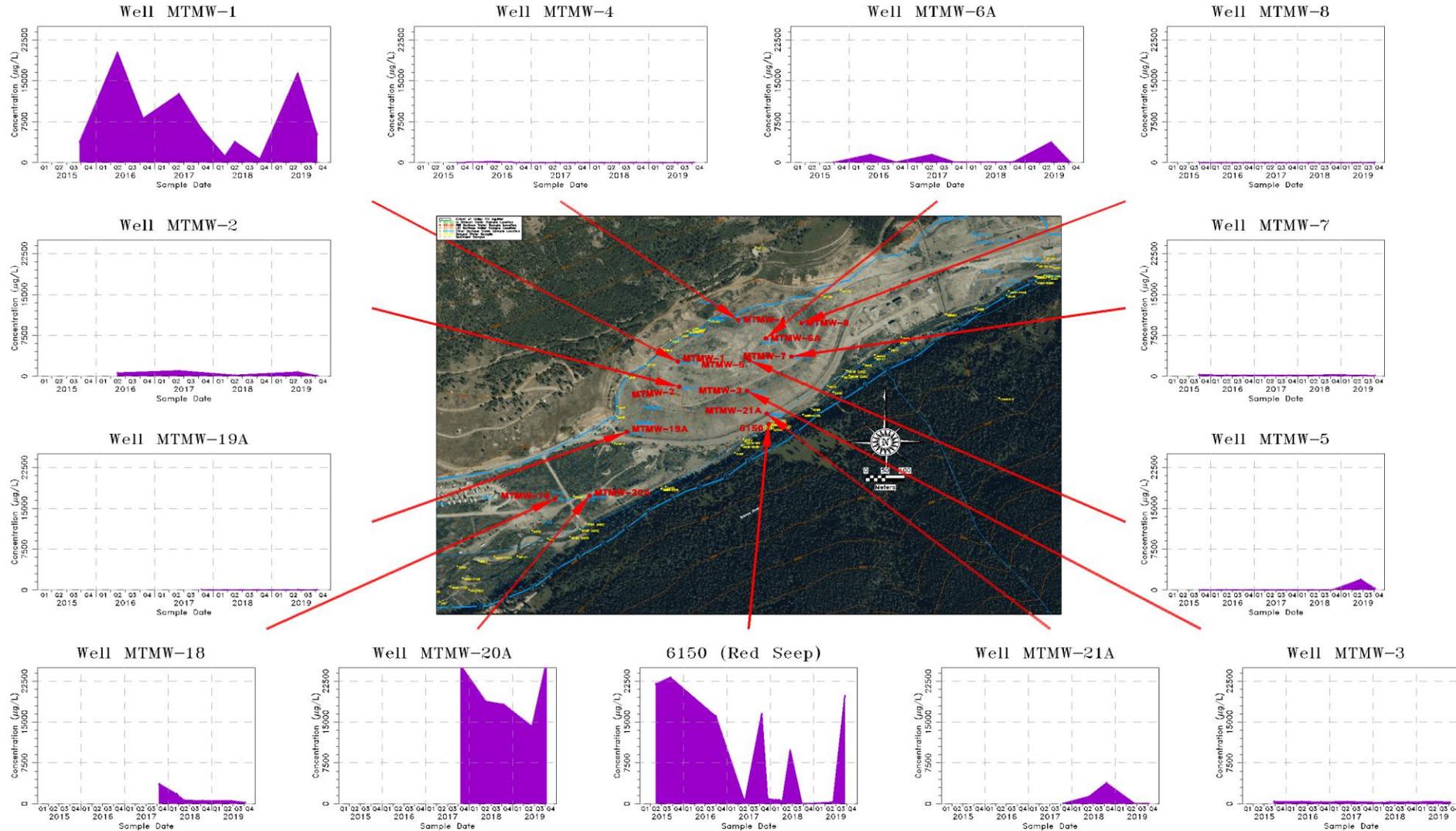


Figure 3.3.1f TP 3&4 Groundwater Dissolved Zinc Concentrations

# Comparison Groundwater Lead Concentrations

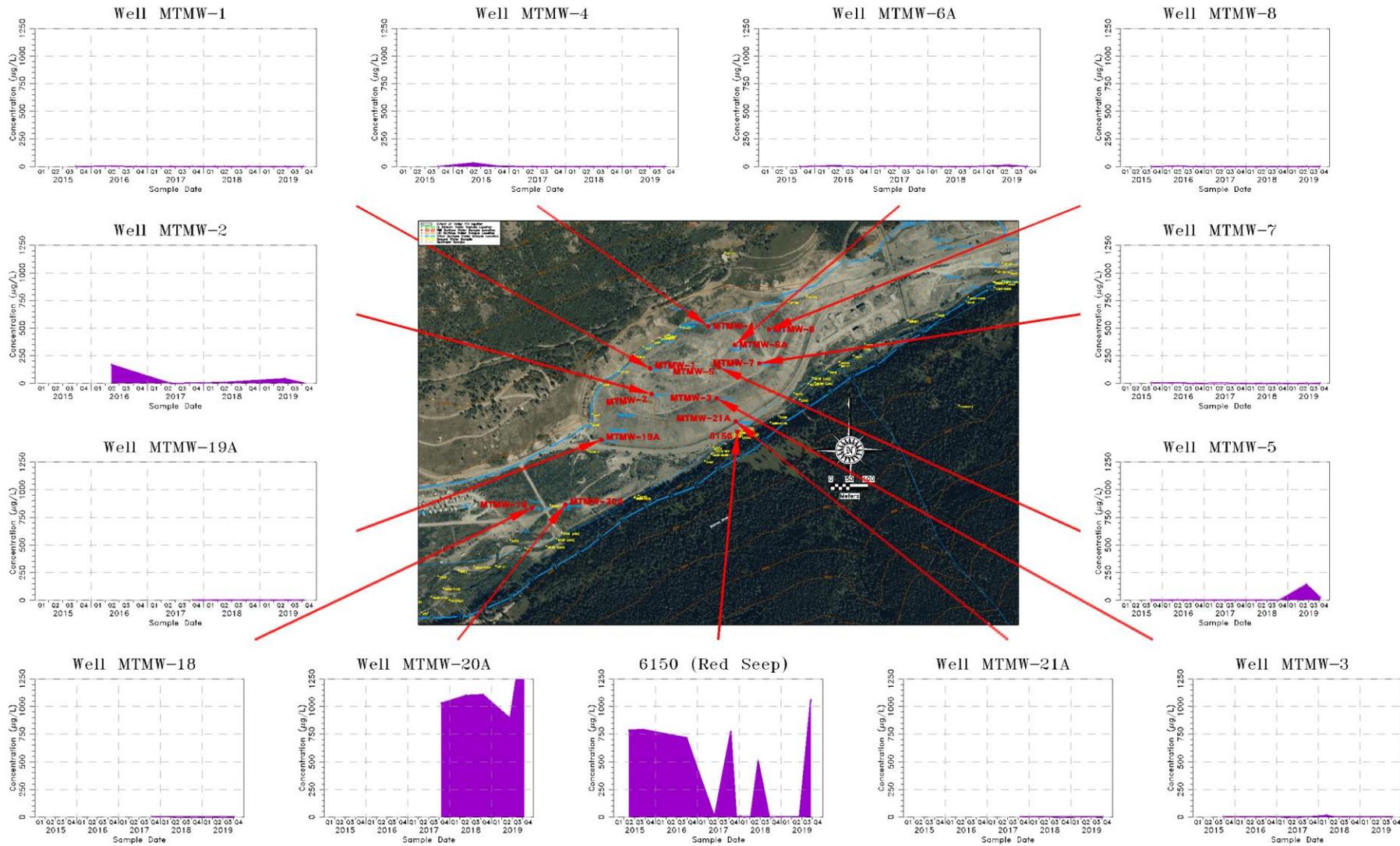


Figure 3.3.1d TP 3&4 Groundwater Dissolved Lead Concentrations



# Comparison Groundwater Manganese Concentrations

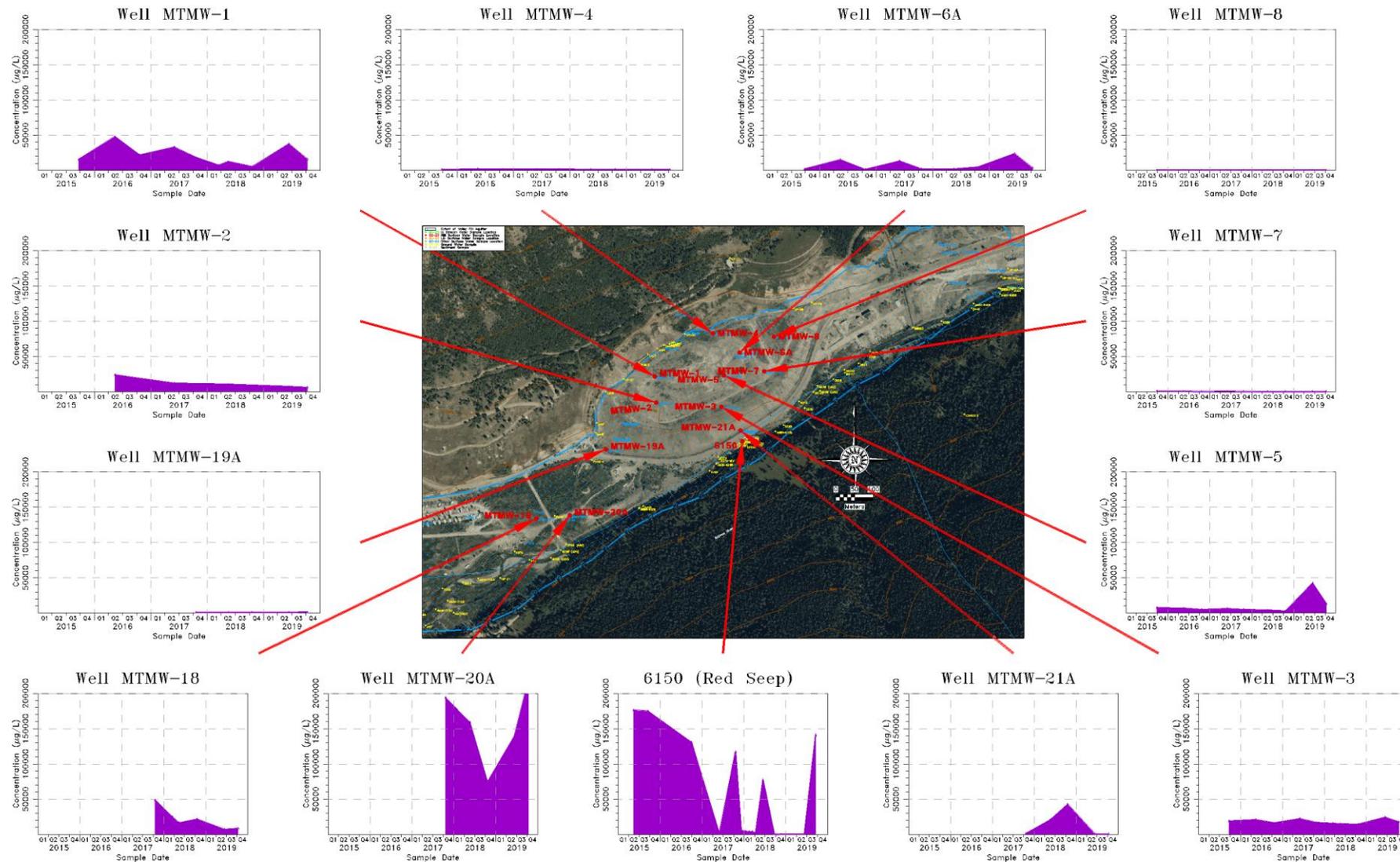


Figure 3.3.1e TP 3&4 Groundwater Dissolved Manganese Concentrations