Saginaw Hill Erosion Control

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December 15, 2015

Fall 2015
NORTHERN ARIZONA UNIVERSITY
CENE 476 Capstone

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1.0 PROJECT UNDERSTANDING

1.1 Purpose

The purpose of this project is to assess erosion that has occurred on the Saginaw Hill Mine tailings repository and to determine what additional measures can be taken to prevent further erosion. The client for this project is the Bureau of Land Management (BLM). The current cap, built in 2009, has eroded at a higher rate than expected [1]. Left unchecked, this could cause tailings to become exposed and migrate into the surrounding environment. Urban development has spread into the area surrounding Saginaw Hill since the mine's closure, and a breach into the tailings cap could cause heavy metals and other contaminants to spread. This project is necessary in order to reduce the risk of contaminant exposure from inhalation or ingestion of tailings particles in the area around Saginaw Hill.

1.2 Background

The Saginaw Hill Mine is a 290-acre area maintained by the BLM [1]. The project site is located roughly 10 miles southwest of Tucson, AZ. The exact location of the site is Township 15 South, Range 12 East, Sections 11 and 12 in Pima County, AZ [2]. Saginaw Hill's location within the Tucson area can be seen in Figure 1.1 below. A topographic rendering of the project site can be seen in Figure 1.2.

Figure 1.1: Saginaw Hill location in state view [5]

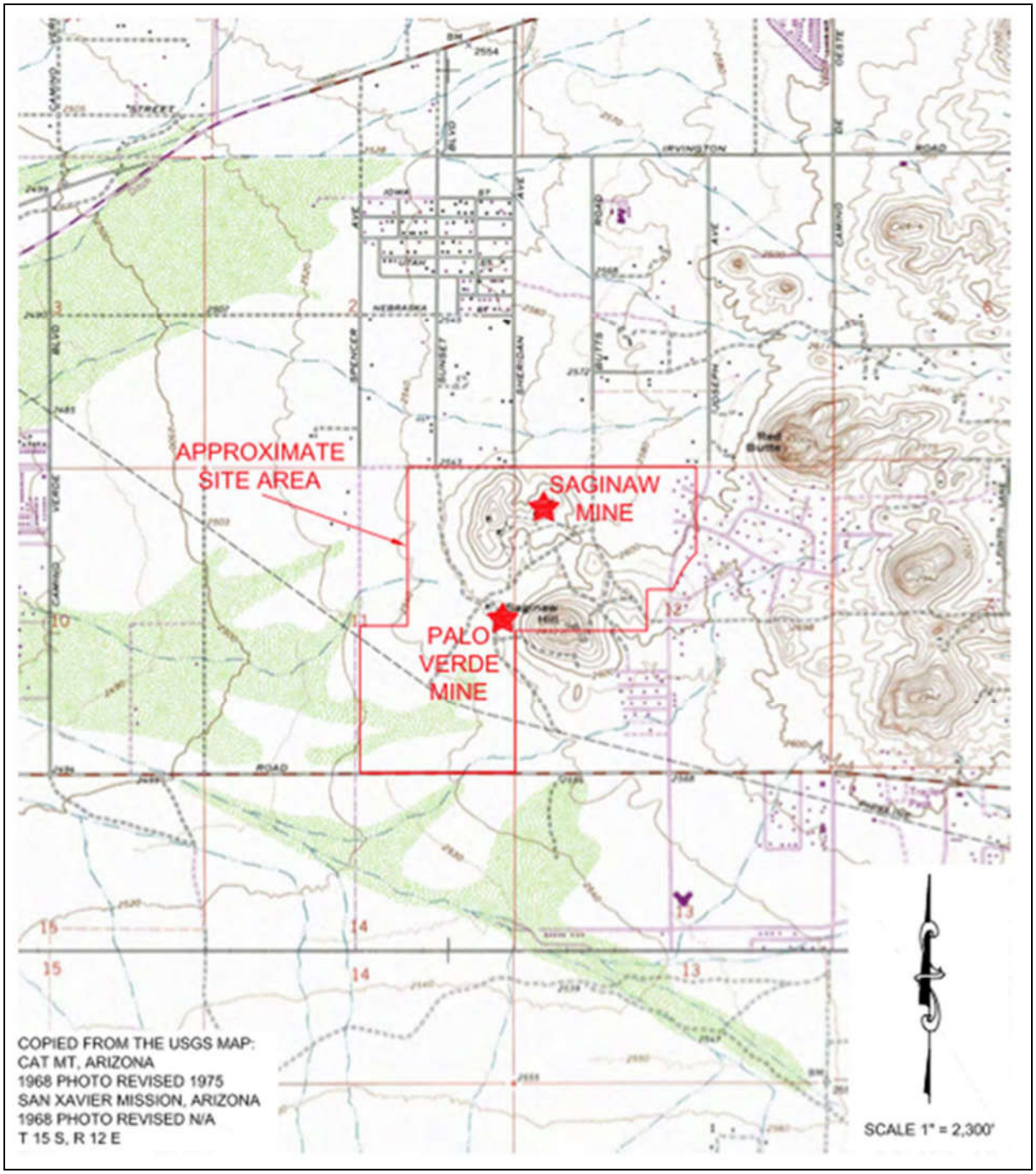

Figure 1.2: Topographic Map with Star indicating Saginaw Hill Mine location [2].

The Saginaw Hill mine was operated from the late 1800's to the mid 1950's. The mine was owned by Saginaw Mining Co. and Tucson Arizona Copper Co. [3]. The mine produced base metal

sulfides, which were used to process valuable metal ores brought in from other locations. The

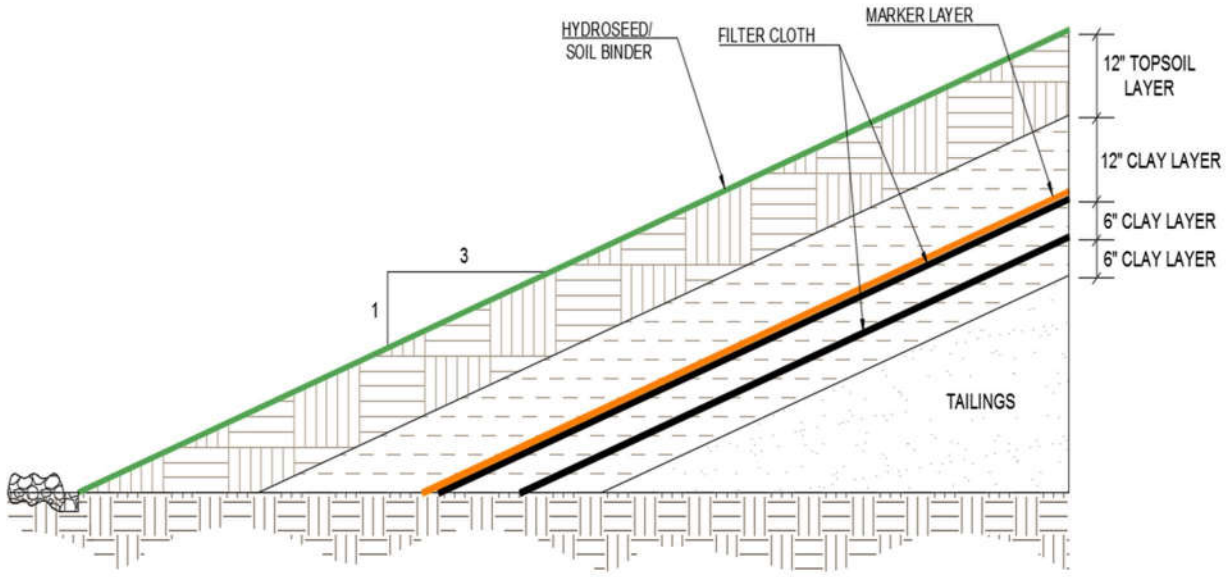

Figure 1.3: Repository Cap Design.

metal sulfides produced at the mine include copper, lead, gold, silver, zinc, and molybdenum [3]. Currently, most of the 540-acre Saginaw Hill area is open to the public except for the contaminated areas located around the mine.

Under the supervision of the BLM, the Saginaw Hill Mine underwent a remediation project in 2009 by Red J Environmental Corporation. The BLM hired Red J to prevent continued contamination from the mine tailings and to monitor the contaminated groundwater surrounding the mine. Red J's scope of work was to consolidate the waste tailings of the mine and sequester them from the surrounding environment. A layered clay and filter cloth repository cap was constructed over the tailings, and is shown in Figure 1.3, to prevent the tailings from migrating. The cap is composed of 3 layers. There is an orange marker layer to indicate where the

Figure 1.4: Revegetation efforts on top of repository cap [2].

bottom of the first clay layer is. Vegetation was planned for the top layer to minimize erosion, a picture of installation is shown in Figure 1.4 [2]. Gravel caps were used to cover the excavated areas. Additionally, Red J constructed drainage channels and stabilized existing washes with multiple layers of soils, aggregate, and fabrics.

Figure 1.5: Vegetation is sparse and erosion is evident on the repository cap [6].

Currently, the Saginaw Hill Mine is being inspected quarterly by Terracon Consultants. Terracon's quarterly reports show there are 13 metals in the groundwater surrounding the area. Figure A.1 in the Appendix shows a map of well site locations surrounding the Saginaw Hill mine. Terracon also inspects the arroyo riprap, gravel cap, repository cap, and diversion channels at the site. The arroyo riprap was deemed acceptable in a recent report, but it was noted that there was an area of bare geo-membrane filter fabric visible. The inspection also noted that the gravel caps were in good condition. However, the report noted that both the repository cap and diversion channels appeared to be damaged by erosion. There was sedimentation in the diversion channels and the repository cap's vegetation layer was missing entirely. Figure 1.5 shows the current condition of the cap. The exposed marker layer and wire-netting geotextile fabric can be seen in Figure 1.6.

Figure 1.6: Exposed marker layer and mesh wire-netting [6].

1.3 Technical Considerations

Design elements at for the site include hydrology, soil, and topographical data collection. Solutions for repairing the existing cap will require evaluation of cap designs in similar environments. Re-vegetation efforts will also be considered using native plants to southeastern

Arizona. Further technical consideration will be given to what maintenance will be necessary after design completion and implementation.

1.4 Potential Challenges

Varying weather conditions could present a challenge for this project. Inclement weather could delay data collection at the site. Additionally, large precipitation storm events could accelerate the damage to the cap. The effects of large storm events could also alter ground slope and geometry at the site. If the storm occurred post design, the design could be inaccurate.

1.5 Stakeholders

Residents in the surrounding area, the BLM, and state authorities who allocate funds for developmental activities are some of the important stakeholders in the process. They are the ones who are directly or indirectly affected by the consequences of the project. The BLM, the client for this project, is interested in containing hazardous substances at the site in order to uphold their mission of "sustaining the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations" [4]. Residents in the surrounding area are stakeholders due to their concerns for personal health and property values. Government authorities have a stake in the project because they are the ones providing funding.

2.0 SCOPE OF SERVICES

The scope of services for this project includes site investigation and erosion control system design. Project management services will also be provided by MARS Consultants. This section also details services that are excluded from the scope of this project.

2.1: Task 1.0 - Site Investigation

2.1.1: Task 1.1 - Topographic Analysis

A detailed land survey will be conducted of the site. Items to be surveyed include cap geometry, channel geometry, and the locations of any damage to the cap. Photographs of the cap and the surrounding area will also be gathered during this time. This data will be used to create a topographic rendering of the site, which will be compared to the topographic data previously collected by Red J to determine what changes in geometry have taken place since the installation of the cap.

2.1.2: Task 1.2 - Soil Analysis

Soil samples from the cap will be collected during the site visit. Geotechnical tests will be performed on the soil samples to determine soil characteristics. Tests will include sieve analysis, shear strength analysis, and compressive strength analysis. The data gathered from these tests will allow the soil's susceptibility to erosion to be determined. Additionally, data will be collected from Arizona's Soil Geologic Survey and previous design reports provided by the BLM.

2.1.3: Task 1.3 - Hydrologic Analysis

The local watershed will be determined using topographic data collected from the site and information available from the United States Geological Survey. The runoff characteristics of the area will also be determined. The flow rate and velocities for various storm events can then be calculated using this information.

2.2: Task 2.0 - Define Regulatory Requirements

Regulatory requirements that pertain to this project will be identified. Additional state and local permitting requirements will also be identified.

2.3: Task 3.0 - Erosion Control System Design

An erosion control system design will be created for the cap. A new cap design will also be provided if determined to be necessary from the site investigation.

2.3.1: Task 3.1 - Identify Problem Areas of Cap

Using the information gathered from the site investigation, the causes of problems with the current cap will be identified.

2.3.2: Task 3.2 - Alternative Solutions

Potential solutions for each problem will be developed. Preliminary plans of each solution will be developed for the sake of analysis.

2.3.3 Task 3.3 - Evaluate Alternative Solutions

The suite of alternative solutions will be evaluated based on the criteria defined by MARS consultants and the BLM. The preferred solution to each problem area will be selected, and a maintenance plan will be developed for the final solution.

2.3.4 Task 3.4 - Cost Estimates

An itemized breakdown of the cost of each solution will be developed and a final cost estimate will be provided. This will include labor, material, and maintenance costs.

2.4: Task 4.0 - Project Management

Project management services provided by MARS Consulting will include scheduling, project review, client meetings, and financial accounting. Scheduling will include deliverable submission dates. Team and clients meetings will be held as needed. Communication with the Technical Advisor, Tyson Parrott of Freeport McMoRan, will occur weekly. Any expenses, including travel, will be recorded. A 50% complete, and final design report will be delivered to the client, including plans of the final design with necessary dimensions and specifications. The results of the geotechnical and hydrological analysis will be reviewed and summarized in the report as justification for the final design. Additionally, a website and a presentation for the final project will be made.

2.5 Exclusions

Investigation of soil below the cap, seismic analysis, groundwater analysis, and contaminant transport analysis are beyond the scope of services provided by MARS Consulting for this project.

Any maintenance plan developed for the final design will not take future environmental changes to the site into account.

3.0 SCHEDULE

Work on the project will begin January 18th, 2016 and will conclude on May 6th. The estimated dates for each task to complete the scope of services are included in Table 3.1. The Geotechnical Lab work and Topographic Rendering can begin at the same time. These tasks can be done in any order, but must all be completed by February 5th. All tasks for watershed modeling can begin on February 8th and may be completed in any order, but must be completed by February 19th. All tasks under Create Website can be completed in order, but must be completed by April 11th. A Gantt chart of the schedule is available in Appendix B B1.

Table 3.1: Schedule for Tasks

Task #	Task Description	Duration in Days	Start Date	End Date
1	Site Visit	2	12/2/15	12/3/15
1.1	Surveying	2	12/2/15	12/3/15
1.2	Collect Soil Samples from Site	1	12/2/15	12/2/15
1.3	Physical Site Analysis	1	12/2/15	12/2/15
2	Identify Problem Area of Cap	25	1/18/16	2/19/16
2.1	Soil Analysis	15	1/25/16	2/12/16
2.1.1	Geotechnical Lab Work	10	1/25/16	2/5/16
2.1.1.1	Sieve Test	1	1/25/16	1/25/16
2.1.1.2	Hydrometer Test	1	1/25/16	1/25/16
2.1.1.3	Shear Strength Test	1	1/25/16	1/25/16
2.1.1.4	Compressive Strength Test	1	1/25/16	1/25/16
2.1.2	Analyze Soil Test Results	5	2/8/16	2/12/16
2.2	Topographic Rendering (CAD Work)	7	1/25/16	2/2/16
2.3	Watershed Modeling	10	2/8/16	2/19/16
2.3.1	Define Channels	3	2/8/16	2/10/16
2.3.2	HEC-RAS HEC-HMS	3	2/8/16	2/10/16
2.3.3	Determine Runoff Flows	3	2/8/16	2/10/16
3	Design Alternatives and Qualifications	15	2/22/16	3/11/16
3.2	Define Criteria	2	2/25/16	2/26/16
3.3	Determine Design Alternatives	5	2/29/16	3/4/16
3.4	Cost Estimates	5	3/7/16	3/11/16
4	Design Work	12	3/21/16	4/5/16
4.1	Create Chosen Design	10	3/21/16	4/1/16
4.2	Draft Design	2	4/4/16	4/5/16
5	Project Management	Ongoing	-	-
5.1	Website	4	4/6/16	4/11/16
5.2	Final Design Report	10	4/12/16	4/25/16
5.3	Final Presentation	10	4/18/16	4/29/16

4.0 STAFFING AND COST OF ENGINEERING SERVICES

Staffing for this project will be provided by MARS Consulting. Personnel will consist of engineers (ENG), a lab technician (LAB), engineering interns (INT), an administrative assistant (AA), and a senior engineer (SENG). A breakdown of the estimated hours required for each task can be seen in Table 4.1 below.

Table 4.1: Hour Estimates for Tasks

Task #	Task Description	Position				
		Senior Engineer	Engineer	Lab Tech	Intern	Admin Assistant
1	**Site Visit**		16	8	8	2
1.1	Surveying		20	10	10	
1.2	Collect Soil Samples from Site		2	1	1	
1.3	Physical Site Analysis		2	1	1	
2	**Identify Problem Area of Cap**	16	32			
2.1	Soil Analysis		16	48		
2.2	Topographic Rendering (CAD Work)	1	2		8	
2.3	Watershed Modeling		28			
3	**Design Alternatives and Qualifications**					
3.2	Define Criteria	8			20	
3.3	Determine Design Alternatives		64			
3.4	Cost Estimates				32	
4	**Design Work**					
4.1	Create Chosen Design	10	160			
4.2	Draft Design	2	2		12	
5	**Project Management**					
5.1	Meetings & Misc.	16	32		10	25
5.2	Website				15	10
5.3	Final Design Report	8	60			5
5.4	Final Presentation		64			5
Total		**61**	**500**	**68**	**117**	**47**

Table 4.2 displays the total costs associated with this project from personnel and travel expenses. The hourly rate for each position include benefits and overhead costs for each position. The site visit costs The total cost estimate for engineering services for this project is $58,110.

Table 4.2: Cost of Engineering Services

1.0 Personnel				
	Classification	Hours	Rate ($/hr)	Cost
	SENG	61	$ 160.00	$ 9,760.00
	ENG	500	$ 75.00	$ 37,500.00
	LAB	68	$ 45.00	$ 3,060.00
	INT	117	$ 35.00	$ 4,095.00
	AA	47	$ 62.00	$ 2,914.00
2.0 Travel				
	Item	Amount	Rate	Cost
	Hotel	3 Rooms	$ 76.00	$ 228.00
	Gas	552 Miles	$ 0.45	$ 220.80
	Meals	22 Meals	$ 15.00	$ 330.00
3.0 Total Cost of Engineering Services				
				$ 58,110.00

5.0 WORKS CITED

[1] Terracon Consultants, Inc, "Second Quarter 2015 Quarterly Groundwater Monitoring and Remedy Inspection," Tuscon, 2015.

[2] Red J. Environmental Corperation, "Saginaw Hill Remedial Action Project," Gilbert, 2009.

[3] J. Duhamel, "Saginaw Hill, Another Old Mine Site In A Tucson Area Neighborhood," 12 March 2014. [Online]. Available: https://arizonadailyindependent.com/2014/03/12/saginaw-hill-another-old-mine-site-in-a-tucson-area-neighborhood/. [Accessed 6 October 2015].

[4] Bureau of Land Management, "Who We Are, What We Do," [Online]. Available: http://www.blm.gov/wo/st/en/info/About_BLM.print.html. [Accessed 1 October 2015].

[5] "Saginaw Hill, Drexel Heights, AZ 85757," Google Maps, 2015. [Online]. [Accessed 30 September 2015].

[6] Terracon Consultants, Inc., "Image," Tuscon, 2015.

Appendix A: Location of Wells

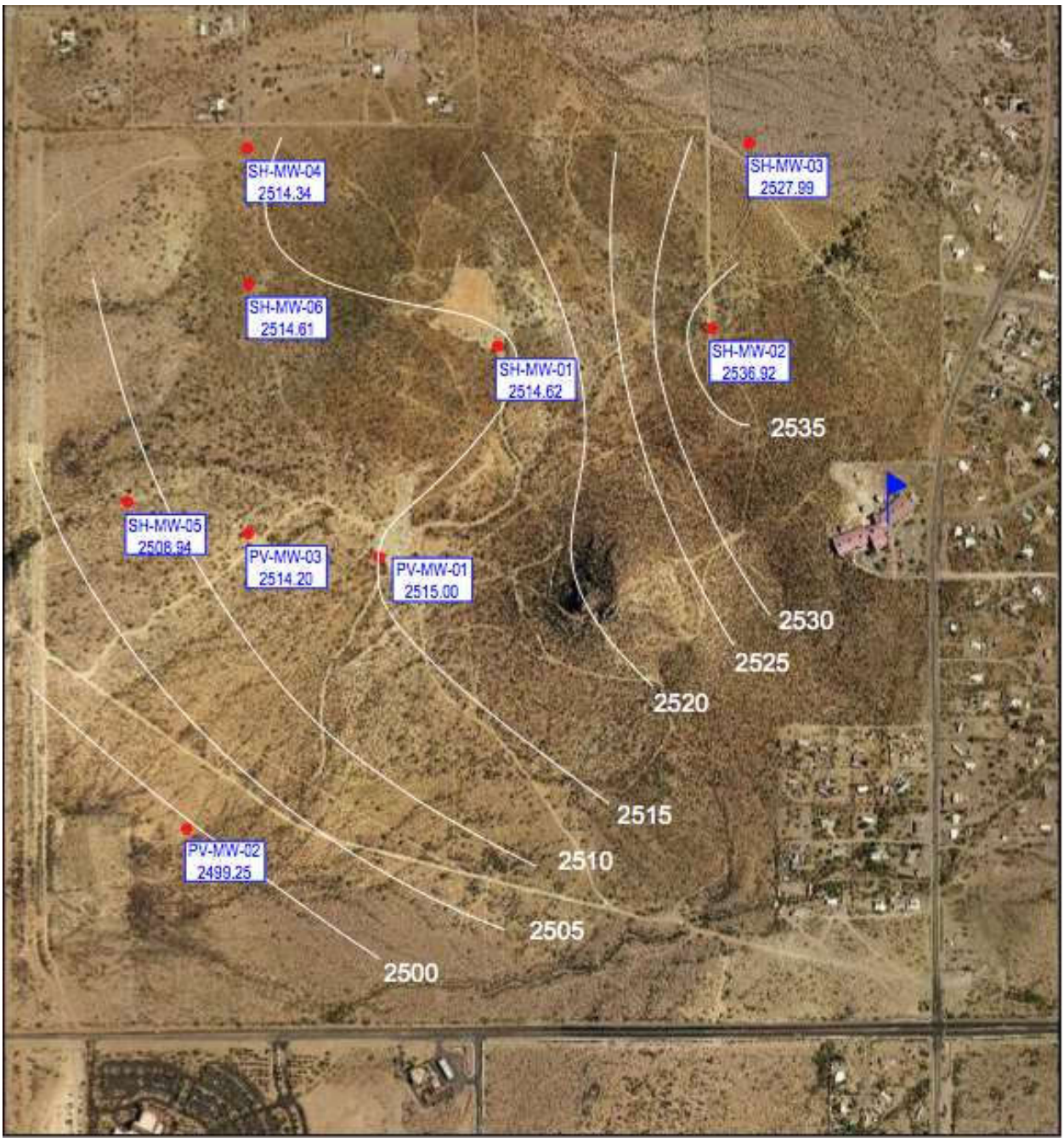

Figure A.1: Map of location of wells surrounding Saginaw Hill mine with groundwater elevation lines [1].

Appendix B: Schedule Gantt Chart