Dust Control Plan (Version 1)

As Required By: Class II Air Quality Control Permit for the Copper World Project

May 2023

Prepared by:

Copper World, Inc.

HUDBAY

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Revision Log

Revision Number	***Revision Lead***	***Purpose of Revision***	***Revision Date***
1	Hudbay	*Supporting Document to the Copper World Project Class II Air Quality Control Permit.*	May 2023

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1.0 INTRODUCTION

As described herein, this Dust Control Plan (Plan) for the Copper World Project (Project) presents methodologies to prevent excessive fugitive emissions from regularly traveled unpaved roads and from open areas and storage piles used or created by the mining operations. Regularly traveled unpaved roadways include processing plant roads as well as the heavy haul truck roads.

The dominant methods of dust control, vehicle speed limits and road treatments, will be implemented on-site and along the unpaved road network to maintain opacity below 20%. Additionally, two control efficiencies are utilized herein for the unpaved road network: 90% and 95%. **Figures 1 through 4** provide the locations where these efficiencies are generally to be applied during operations. Representative operational years (Year 2, Year 8, and Year 14) are shown, including a view of the Plant Site area. This Plan also targets a 90% control efficiency for open areas and storage piles.

For select areas, a 95% control efficiency is applied to regularly traveled roadways using a specific dust control product (see **Appendix A**). Other vendor specific dust control products (dust suppressants) may be used dependent on achieving a 95% control efficiency.

With regard to achieving a 90% control efficiency on unpaved roadways, the Calculation Methodology presented in the Emission Inventory Information, Volume I, U.S. Environmental Protection Agency (EPA), was used.

There are three (3) dust control programs presented herein with regard to roads:

1. Dust Control Program A (generalized dust suppressant approach to achieve a 90% control efficiency)
2. Dust Control Program B (generalized watering approach to achieve a 90% control efficiency)
3. Dust Control Program C (product specific dust suppressant approach to achieve a 95% control efficiency on haul roads)

Dust control on open areas and storage piles is also discussed herein.

With regard to the dust control program using a vendor specific dust suppressant product to achieve 95% control, the planned haul road application areas for the following years are shown: Years 2, 8, and 14. Dust control requirements for the remainder of the operational years will consider these discreet years as well as take into account the actual mine plan.

2.0 FUGITIVE DUST EMISSIONS FROM UNPAVED ROADS

2.1 UNPAVED ROAD NETWORK

The Project has a network of unpaved haul roads for transporting sulfide ore, oxide ore, and waste rock from the open pit mining areas to the primary crushing and/or stockpiling area, heap leach area, and waste rock storage areas, respectively. Additionally, the Project has general roads throughout the facility used by support vehicles.

Site diagrams of the Project area are presented on **Figures 1 through 4**. In general, the road network at the Project includes: (a) haul roads located in the pits, (b) haul roads for transporting ore from the pits to the primary crusher/run of mine stockpiles and heap leach pad, (c) haul roads for transporting waste rock from the pits to the waste rock storage area, and (d) general facility roads around the Project for support vehicles, including the Plant Site.

This Dust Control Plan for the Project's unpaved road network includes the use of chemical dust suppressants or watering. The control efficiency achieved by chemical dust suppressants depends upon the strength of the ground inventory (base), whereas the control efficiency achieved by watering depends upon the amount of water that is used (gallons/yd^2).

As determined by the generalized calculation methodology presented herein, the amount of watering depends on traffic volumes and evaporation rates. The examples used herein only include haul truck traffic. The amount of support vehicle traffic would also be considered when determining the water application intensity needed to control the roads to the stated 90% control efficiency.

The calculation methodology used to estimate traffic volume is presented in **Appendix B**. The road network locations and the average hourly haul truck traffic rates at the stated production, assuming operations of 24 hours per day, are presented below (as examples only):

a) Roadways that will be used to transport ore and waste rock from the mining location inside the Elgin Pit to the exit point of its boundary. These roadways are expected to experience average heavy truck traffic of four (4) vehicles per hour (based on annual VMTs in Year 2 of operations); and

b) Roadways that will be used to transport ore and waste rock from the mining location inside the Rosemont Pit to the exit point of its boundary. These roadways are expected to experience average heavy truck traffic of 15 vehicles per hour (based on annual VMTs in Year 8 of operations).

Note: These roadway segments, and the ensuing roadway watering intensities required to achieve a 90% control efficiency, are for illustration purposes only.

Unlike the generalized road watering calculations, the use of a chemical dust suppressant does not have a direct link to traffic volumes and weather conditions, such as evaporation. However, in reality, the reapplication frequency is influenced by these factors. Although the ground inventory value (base) and reapplication rate can be predetermined (estimated) for a selected control efficiency, the maintenance reapplication rate will be reevaluated during operations based on site specific conditions such as traffic volumes (which affects roadway wear/abrasion). This is applicable to Dust Control Programs A and C. Site specific conditions will also be used to adjust the calculated watering frequency for Dust Control Program B.

2.2 DESCRIPTION OF DUST CONTROL PROGRAMS

Optimal dust control measures depend upon the characteristics of the road network and its use, and upon meteorological considerations. Additionally, dust control measures are continuously evolving with new products becoming available on a regular basis. In order to provide the flexibility to change dust control measures while still achieving the desired control efficiency, this document proposes three (3) dust control programs that either achieve a 90% control of PM_{10} emissions (Dust Control Programs A and B) or 95% control of PM_{10} emissions (Dust Control Program C). Dust Control Programs A and B allow the flexibility to alternate from one dust control program to another or use a separate dust control program for an individual roadway system. The use of Dust Control Program C is location specific. Additional details on the programs are provided in **Section 4.0**.

Note: This Dust Control Plan ensures that at least a 90% control of PM_{10} emissions is achieved on the unpaved road network. The Project is also required to maintain no greater than a 20% opacity for all non-point sources. A 90% control efficiency is considered sufficient to ensure that 20% opacity limit will be met.

2.2.1 Dust Control Program A

Dust Control Program A is a generalized approach that consists of the application of sufficient chemical dust suppressant to achieve a ground inventory of 0.25 gallons/yard^2 with a reapplication frequency of 1-month (where reapplication frequency refers to the time interval between applications used to maintain a specific ground inventory). Note: The 0.25 gallons/yard^2 value was estimated from the chart in **Illustration 4.1** in **Section 4.1**. This estimated value may change due to site conditions.

The term “ground inventory” represents the residual accumulation of a dust suppressant from previous applications. (For a detailed definition of “ground inventory” see page 3-20 of *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures*, EPA-450/2-92-004). Page 3-20 of the EPA document is reproduced in **Appendix C**. Dust suppressants that could be used for this purpose include, among others, lignosulfonates, petroleum resins, asphalt emulsions, and acrylic cement. See **Section 4.1** for further discussion on Dust Control Program A.

2.2.2 Dust Control Program B

Dust Control Program B is a generalized approach that consists of periodic watering in sufficient amounts to achieve 90% control for PM_{10}. Program B would only be applied during days with precipitation of less than 0.01 inches. Example water application intensities necessary to achieve a 90% particulate control efficiency during daylight and nighttime hours are presented in **Tables 2-1 and 2-2**, respectively. The nighttime example assumes that the evaporation rate is half of the daytime rate. Additionally, the examples only use the average annual evaporation rate. Actual calculations would use a more refined set of monthly or seasonal evaporation values, etc.

The selected roadway examples were presented in **Section 2.1**.

See **Section 4.2** for further discussion on Dust Control Program B, including a description of how the application intensities are calculated.

Table 2-1 Average Hourly Watering Requirements During Daylight Hours for Dust Control Program B (Example Only)

Roadway System Category	Traffic Volume (vehicles/hour)	Average Hourly Application Intensity During Daylight Hours Required to Achieve a 90% Control Efficiency for Fugitive Dust Emissions [a]	
		liters/meter^2	gallons/yard^2
From Mining Location to Elgin Pit Boundary (Year 2)	04	0.143	0.031
From Mining Location to Rosemont Pit Boundary (Year 8)	15	0.536	0.118
[a] The model predicts a 90% control efficiency regardless whether the water application intensity is met with a single hourly application, multiple applications during the 1-hour period, or greater application intensities for less frequent applications.			

Table 2-2 Average Hourly Watering Requirements During Nighttime Hours for Dust Control Program B (Example Only)

Roadway System Category	Traffic Volume (vehicles/hour)	Average Hourly Application Intensity During Daylight Hours Required to Achieve a 90% Control Efficiency for Fugitive Dust Emissions [a]	
		liters/meter^2	gallons/yard^2
From Mining Location to Elgin Pit Boundary (Year 2)	04	0.071	0.016
From Mining Location to Rosemont Pit Boundary (Year 8)	15	0.268	0.059
[a] The model predicts a 90% control efficiency regardless whether the water application intensity is met with a single hourly application, multiple applications during the 1-hour period, or greater application intensities for less frequent applications.			

2.2.3 Dust Control Program C

Dust Control Program C consists of the application of a sufficient amount of a specific chemical suppressant to achieve 95% control on haul roads (see **Appendix A**). For haul road applications, the RoadPRO-NT (RPNT) product (or equivalent) is proposed. A target 'base' of material will be achieved through multiple applications (6-10) over an initial 30-45-day period. The targeted 'base' building over this period would be one (1) gallon per 70-90 square feet per application. Reapplication or maintenance applications are targeted at one (1) gallon per 400-750 square feet at an anticipated frequency of every month. **Figures 1 through 3** show where this product would be applied during operations during the respective years. See **Section 4.3** for further discussion on Dust Control Program C.

3.0 PLAN FOR THE CONTROL OF FUGITIVE DUST EMISSIONS FROM OPEN AREAS AND STORAGE PILES

3.1 OPEN AREAS AND STORAGE PILES

Open areas and storage piles include mined areas, overburdened storage areas, as well as waste rock storage areas. Open areas and storage areas which are subject to generating fugitive emissions exclude ore, waste rock, and other similar areas because these areas are characterized by a low silt content and therefore are not dust producing areas. Consequently, dust control measures are not necessary for such areas.

3.2 DESCRIPTION OF DUST CONTROL PLAN

Open areas and storage piles which are in active use and subject to generating fugitive emissions will be controlled by the application of water as required by Title 18, Chapter 2, Article 6 of the A.A.C. and Chapter 17.16, Article III of the P.C.C. Open areas and storage piles which are not actively used will be controlled by applying the methods required by A.A.C. R18-2-604 and R18-2-607 and P.C.C. Sections 17.16.080 and 17.16.110, respectively. This includes the application of sufficient chemical dust suppressant and/or water to develop and maintain a visible crust. Periodic inspections of the open areas will be performed to evaluate the condition of the visible crust and, if necessary, additional chemical dust suppressant and/or water will be applied. Other means which may be applied include use of an adhesive soil stabilizer, paving covering, landscaping, detouring, or other acceptable means. Access to such areas will also be minimized by the construction of berms or other barriers to prevent re-disturbance of the areas.

4.0 DEMONSTRATION THAT THE DUST CONTROL PLAN WILL PROVIDE A 90% OR 95% CONTROL EFFICIENCY

4.1 DUST CONTROL PROGRAM A – 90% CONTROL EFFICIENCY

The control efficiency of a chemical dust suppressant is dependent upon the ground inventory of the dust suppressant and the frequency between applications. A generalized model was developed by the EPA and published in *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures* (see **Appendix C** for an excerpt of the EPA document). The relationship is provided between these parameters and PM_{10} control performance for general dust suppressants. A graph representing this model is presented in **Illustration 4.1**.

The sufficiency of Dust Control Program A to achieve a control efficiency of 90% for PM_{10} is verified by considering **Illustration 4.1**. Using a chemical dust suppressant, a ground inventory of 0.25 gallons/yd^2 (estimate derived from chart) with a 1-month reapplication frequency will provide a control efficiency for PM_{10} of 90%. It should be noted that the model for PM_{10} control efficiency of petroleum-based dust suppressants published in the AP-42, Section 13.2.2 (dated November 2006), agrees with the EPA model used to determine the sufficiency of Dust Control Program A.

The control efficiencies in the above mentioned models are averages and not maximums. Therefore, it can be assumed that using a chemical dust suppressant with a ground inventory of 0.25 gallons/yd^2 could result in control efficiencies higher than 90%. Again, this is a generalized approach and is not product specific.

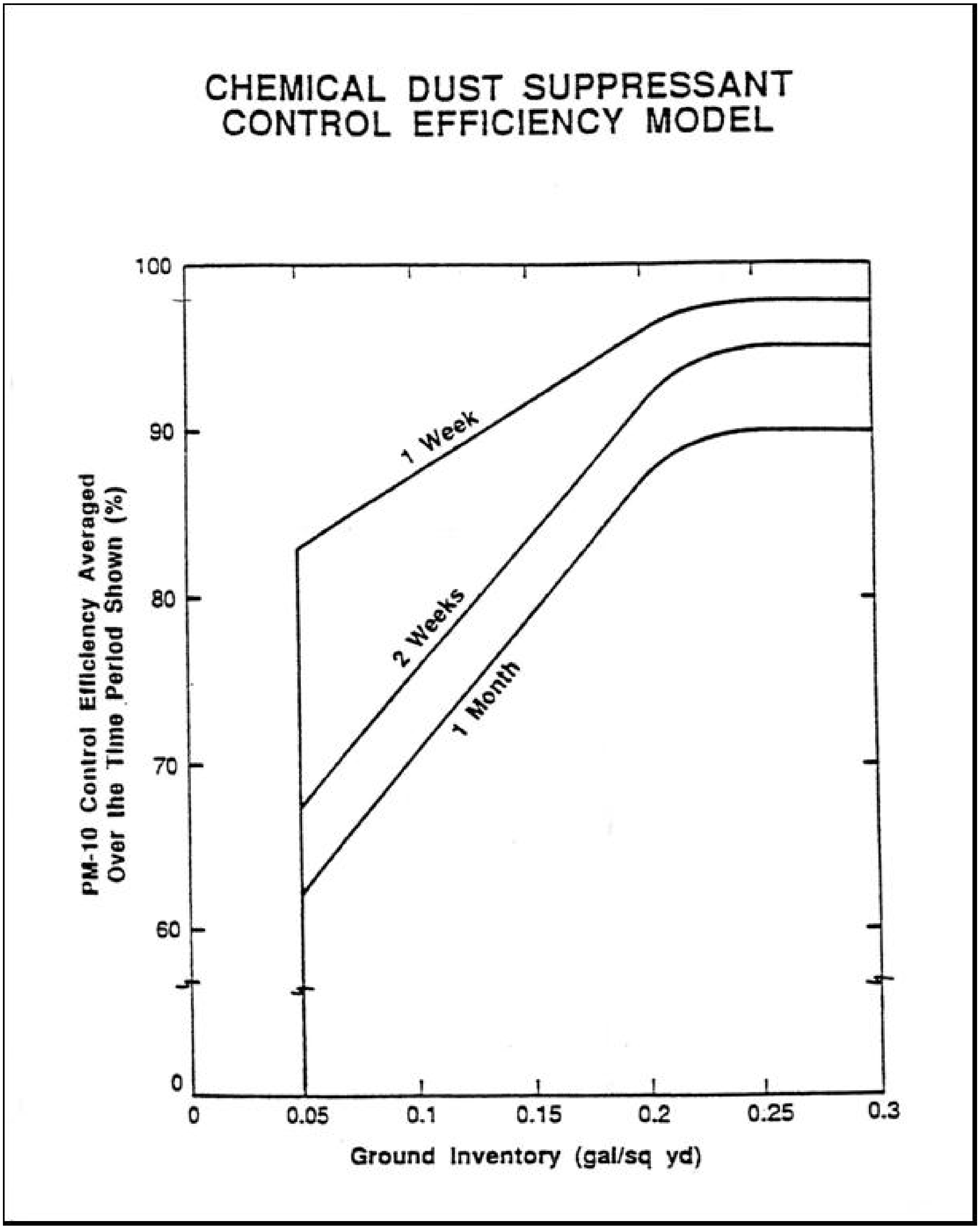


Illustration 4-1 EPA Model for Control Efficiency of PM_{10} when Using Chemical Dust Suppressants.

4.2 DUST CONTROL PROGRAM B – 90% CONTROL EFFICIENCY

The generalized application intensity of water during daylight and nighttime hours required to achieve a 90% control efficiency for each road category is calculated using an empirical model developed by the EPA in the *Control of Open Fugitive Sources*, EPA-U50/3-88-008, September, 1988. An excerpt from this *EPA* document, Page 3-12, is presented in **Appendix D** of this Dust Control Plan. The following equations were derived from this model:

$$i = \frac{0.8 \times p \times d \times t}{(100 - W_c)} \qquad \text{Equation 1}$$

$$p = 0.0049 \times PER \qquad \text{Equation 2}$$

where:

i	=	application intensity (liters/m^2);
p	=	potential average hourly daytime evaporation rate (mm/hr, 0.507 for Tucson, AZ);
d	=	average hourly daytime traffic (vehicles/hr; see Section 2.1);
t	=	time between applications (hours, 1 for hourly applications)
W_c	=	average particulate control efficiency (%, 90 in this case); and
PER	=	mean annual pan evaporation rate (inches/year, example uses 91.2 from the Nogales 6N monitoring station)

As shown by Equation 1, the application intensity is dependent upon the pan evaporation rate. Because the pan evaporation rate differs between daytime and nighttime conditions, as well as meteorological conditions, application intensities will also vary with daylight hours and nighttime hours and with meteorological conditions. The example nighttime hour application intensities calculated herein assumed that the average hourly nighttime pan evaporation rate is equal to 50% of the average hourly daytime pan evaporation rate. Actual pan evaporation rates will be updated to site specific conditions when available.

The application intensity required to achieve a 90% control efficiency is calculated using Equation 1. However, the application intensities are for illustration purposes only due to varying conditions such as evaporation rates and traffic volumes. A summary of example input variables and resulting application intensities during daylight hours and nighttime hours, as derived from the above equation, are presented in **Tables 4.1 and 4.2**, respectively.

The application intensities in **Tables 4.1 and 4.2** are based upon an hourly frequency of application. The Project may reduce the frequency of application by increasing the application intensity. A frequency of once every two hours, for example, would require that the application intensities in **Tables 4.1 and 4.2** to be increased by a factor of 2.

Table 4-1 Summary of Data Used to Verify Dust Control Program B During Daylight Hours (Example Only)

Roadway System Category	Variables				Average Hourly Water Application Intensity (i) [a]	
	Wc (%)	p (mm/h)	d (vehicles/ hour)	t (hours)	liters/ meter^2	gallons/ yard^2
From Mining Location to Elgin Pit Boundary (Year 2)	90	0.447	04	1.0	0.143	0.031
From Mining Location to Rosemont Pit Boundary (Year 8)	90	0.447	15	1.0	0.536	0.118

[a] The model predicts a 90% control efficiency regardless whether the water application intensity is met with a single hourly application, multiple applications during the 1-hour period, or greater application intensities for less frequent applications.

Table 4-2 Summary of Data Used to Verify Dust Control Program B During Daylight Hours (Example Only)

Roadway System Category	Variables				Average Hourly Water Application Intensity (i) [a]	
	Wc (%)	p (mm/h)	d (vehicles/ hour)	t (hours)	liters/ meter^2	gallons/ yard^2
From Mining Location to Elgin Pit Boundary (Year 2)	90	0.223	04	1.0	0.071	0.016
From Mining Location to Rosemont Pit Boundary (Year 8)	90	0.223	15	1.0	0.268	0.059

[a] The model predicts a 90% control efficiency regardless whether the water application intensity is met with a single hourly application, multiple applications during the 1-hour period, or greater application intensities for less frequent applications.

It should be noted that the pan evaporation rates used to calculate the example application intensities in **Tables 4.1 and 4.2** represent annual averages which, when used with Equation 1, will result in an application intensity that is too high for winter months and too low for summer months. Actual application intensities will be determined based on pan evaporation rates representative of the different climatological periods of the year. Additionally, the calculated intensities are based on assumed mine production rates. Lower production rates, resulting in less traffic, would be characterized by lower application intensities. Also, if any type of water adhesion enhancing material, such as a surfactant, is used with Dust Control Plan B, application intensities would be re-evaluated. Additionally, adjustments to the parameters used in the equation, such as evaporation, will be adjusted to site-specific conditions as that information becomes available.

4.3 DUST CONTROL PROGRAM C – 95% CONTROL EFFICIENCY

The control efficiency of a chemical dust suppressant is dependent upon the ground inventory of the dust suppressant and the frequency between applications. The sufficiency of Dust Control Program C to achieve a control efficiency of 95% for PM_{10} is verified by considering the product specific guarantee presented in **Appendix A** of this Dust Control Plan.

Dust Control Program C consists of the application of a sufficient amount of a vendor specific chemical suppressant to achieve 95% control on haul roads. For haul road applications, the RoadPRO-NT (RPNT) product (or equivalent) is proposed (see **Appendix A**). A target 'base' of material will be achieved through multiple applications (6-10) over an initial 30-45-day period. The targeted 'base' building over this period would be one (1) gallon per 70-90 square feet per application. Reapplication or maintenance applications are targeted at one (1) gallon per 400-750 square feet at an anticipated frequency of every month. **Figures 1 through 3** show where this product would be applied during operations.

By building the targeted 'base', the fines are bonded to the large aggregate in the road preventing fugitive dust from forming. Maintenance applications will be required over time to deliver 95% control as the treated surface wears down or is covered up. This application will be evaluated on an ongoing basis to maintain 95% efficiency. Weather, traffic volume, and weak spots in the road that wear down faster are the key factors in determining maintenance application scheduling; wet weather conditions would delay the reapplication, whereas dry conditions or road damage would accelerate the reapplication.

Note: Maintenance applications on the haul roads would also be dependent on road usage and would be adjusted accordingly. For example, haul truck traffic (traffic volume) will be limited in the early years as compared to the latter years. The maintenance application frequency would be modified to accommodate these conditions.

5.0 DEMONSTRATION OF COMPLIANCE WITH THE REQUIREMENTS OF ARTICLE 6 OF THE A.A.C. AND CHAPTER 17.16, ARTICLE III OF THE P.C.C.

Section R18-2-604 of the A.A.C. and Section 17.16.080 of the P.C.C. require, in part, that fugitive dust from open areas be kept to a minimum by good modern practices, such as using an approved dust suppressant.

Section 3.0 of this Plan describes the control measures for wind-blown fugitive dust from open areas and storage piles at the Project. By developing and maintaining a visible crust on the soil in open areas and applicable storage piles, implementing best management practices (e.g., watering), and minimizing access to these areas, this Dust Control Plan complies with the requirements of Article 6 of the A.A.C and Chapter 17.16, Article III of the P.C.C. for the control of fugitive dust emissions from open areas and storage piles.

6.0 PERIODIC REAPPLICATION

6.1 CHEMICAL DUST SUPPRESSANTS

Dust control programs that utilize chemical dust suppressants require periodic application of the chemical dust suppressant in order to replenish the dust suppressant materials that are removed from the road due to the abrasion of the vehicles on the treated road surface.

6.2 ROAD WATERING

The frequency of reapplication of water used in Dust Control Program B will depend upon the operational plans of the Project. The frequency can be hourly, less frequent or more frequent, depending upon the traffic density, meteorological conditions, and operational considerations. The application intensities for water should be treated as annual averages as some days will require a greater water application whereas others will require a lesser water application due to seasonal climatic condition changes. The models introduced in **Section 4.2** predict the same control efficiency independent of whether the water is applied during one pass per hour of the water truck or during multiple passes during the 1-hour period. Additionally, watering will not be required for days when natural precipitation equals or exceeds 0.01 inches on a daily basis or when roads are moist due to recent rain, as the control efficiency during such days is assumed to be 100% by AP-42. Additionally, watering will not be required on roads that are moist from the application of previous control water.

7.0 RECORD KEEPING REQUIREMENTS

7.1 RECORDS OF THE APPLICATION OF CHEMICAL DUST SUPPRESSANTS

Records will be maintained demonstrating the Project’s compliance with the initial chemical dust suppressant ground inventory required by Dust Control Programs A and C by recording the information necessary to demonstrate a 90% or 95% control efficiency.

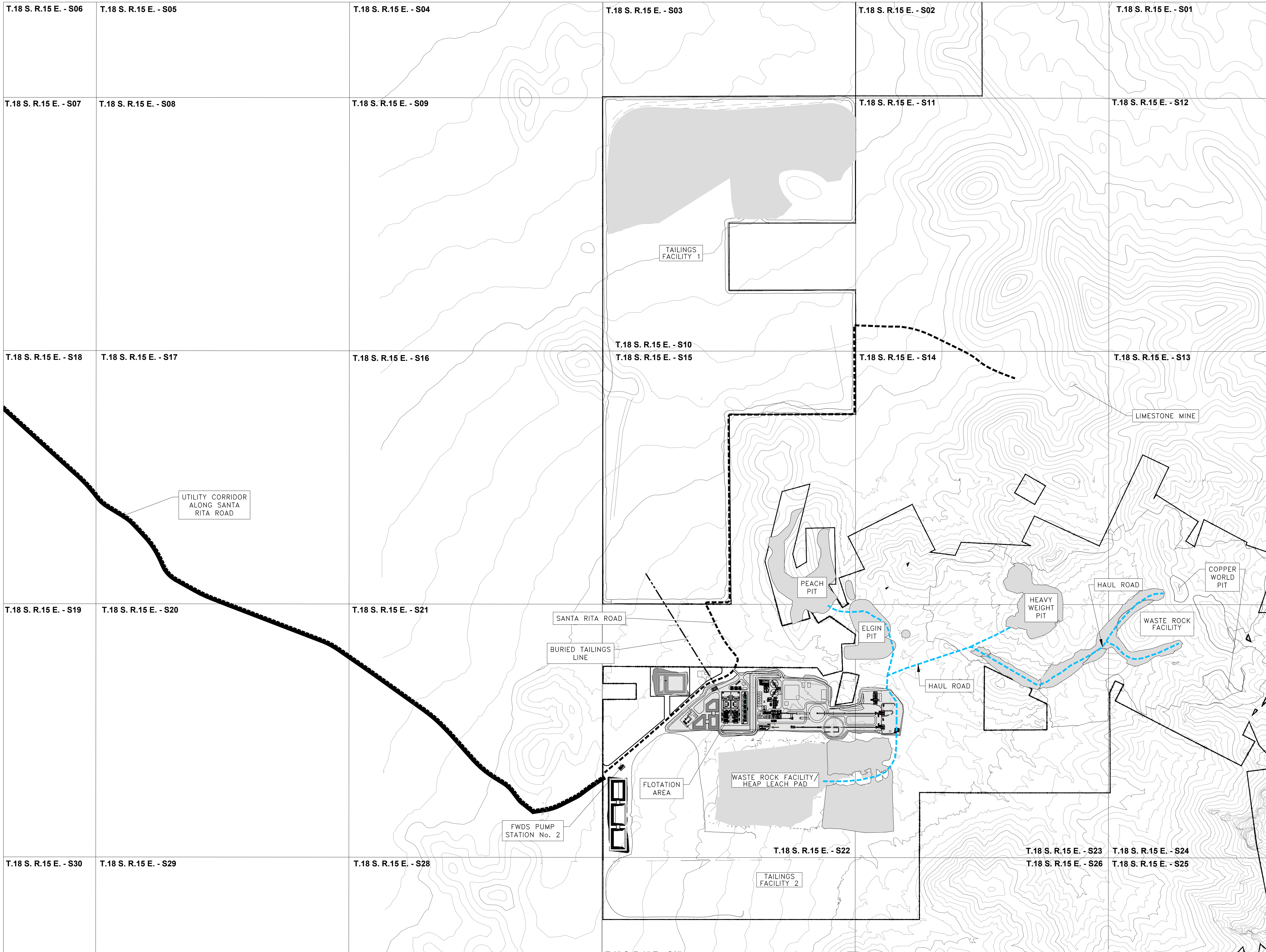
7.2 RECORDS OF REAPPLICATION OF CHEMICAL DUST SUPPRESSANTS

Records will be maintained demonstrating the Project’s compliance with the periodic reapplication of dust suppressants to replace losses as identified in **Section 6.1**. Records will be maintained concurrently with the records described in **Section 7.1**.

7.3 RECORDS OF APPLICATION OF WATER

Records will be maintained demonstrating the Project’s compliance with the watering requirements of Dust Control Program B by recording the information necessary to demonstrate a 90% control efficiency.

FIGURES



LEGEND

- TOWNSHIP LINE
- GENERAL FACILITY FOOTPRINT
- PRIVATE LAND BOUNDARY
- BURIED TAILINGS LINE
- ROAD
- ROAD NETWORK 90% CONTROL EFFECIENCIES

NOTES:

1. FACILITY FOOTPRINT BOUNDARY AND ROADS WILL BE MODIFIED ACCORDING TO THE MINE PLAN.

N

SCALE

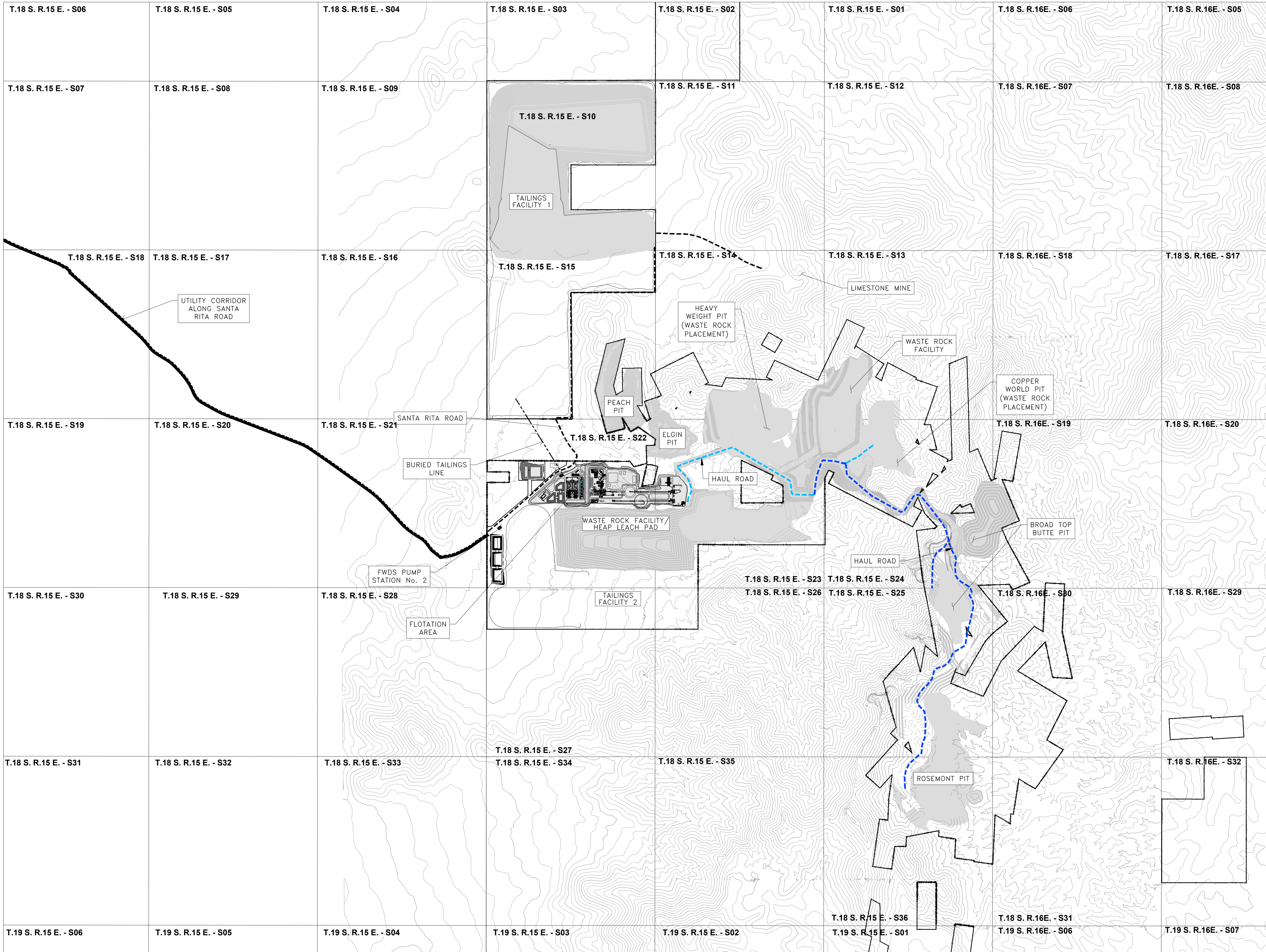
1000' 0 1000' 2000'

CONTOUR INTERVAL = 10'

PROJECT: COPPER WORLD PROJECT	
COUNTY: PIMA	STATE: ARIZONA
	DATE: APRIL 2023

FIGURE NO. 1
YEAR 2 OF OPERATIONS
ROAD NETWORK CONTROL EFFICIENCIES

HUDBAY



LEGEND

TOWNSHIP LINE
GENERAL FACILITY FOOTPRINT
PRIVATE LAND BOUNDARY
BURIED TAILINGS LINE
ROAD
ROAD NETWORK 90% CONTROL EFFECIENCIES
ROAD NETWORK 95% CONTROL EFFECIENCIES

NOTES:

1. FACILITY FOOTPRINT BOUNDARY AND ROADS WILL BE MODIFIED ACCORDING TO THE MINE PLAN.

N

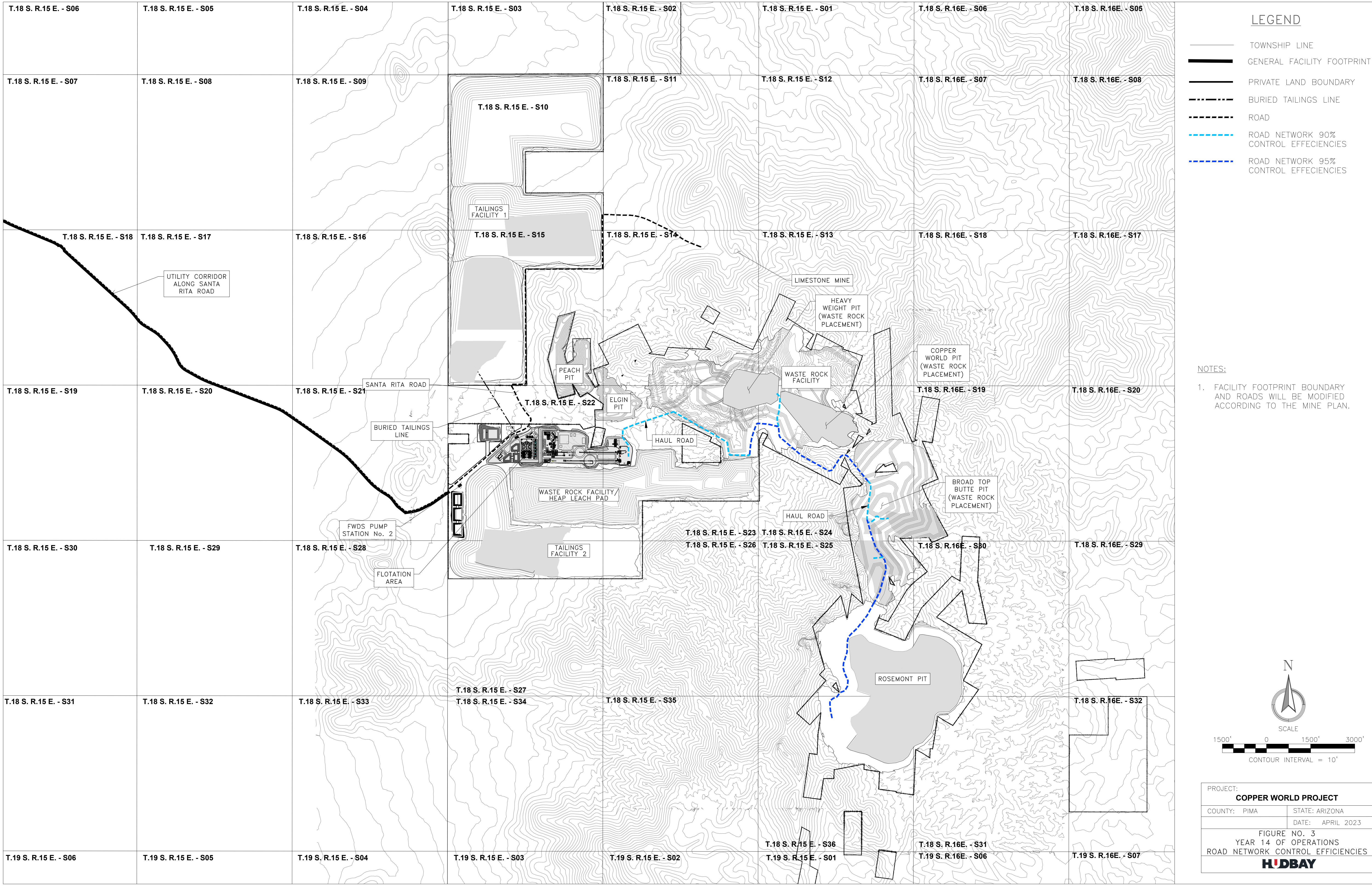
SCALE

1500' 0 1500' 3000'

CONTOUR INTERVAL = 10'

PROJECT: COPPER WORLD PROJECT	
COUNTY: PIMA	STATE: ARIZONA
	DATE: APRIL 2023
FIGURE NO. 2 YEAR 8 OF OPERATIONS ROAD NETWORK CONTROL EFFICIENCIES	

HUDBAY


LEGEND
TOWNSHIP LINE
GENERAL FACILITY FOOTPRINT
PRIVATE LAND BOUNDARY
BURIED TAILINGS LINE
ROAD
ROAD NETWORK 90% CONTROL EFFECIENCIES
ROAD NETWORK 95% CONTROL EFFECIENCIES
NOTES:
1. FACILITY FOOTPRINT BOUNDARY AND ROADS WILL BE MODIFIED ACCORDING TO THE MINE PLAN.
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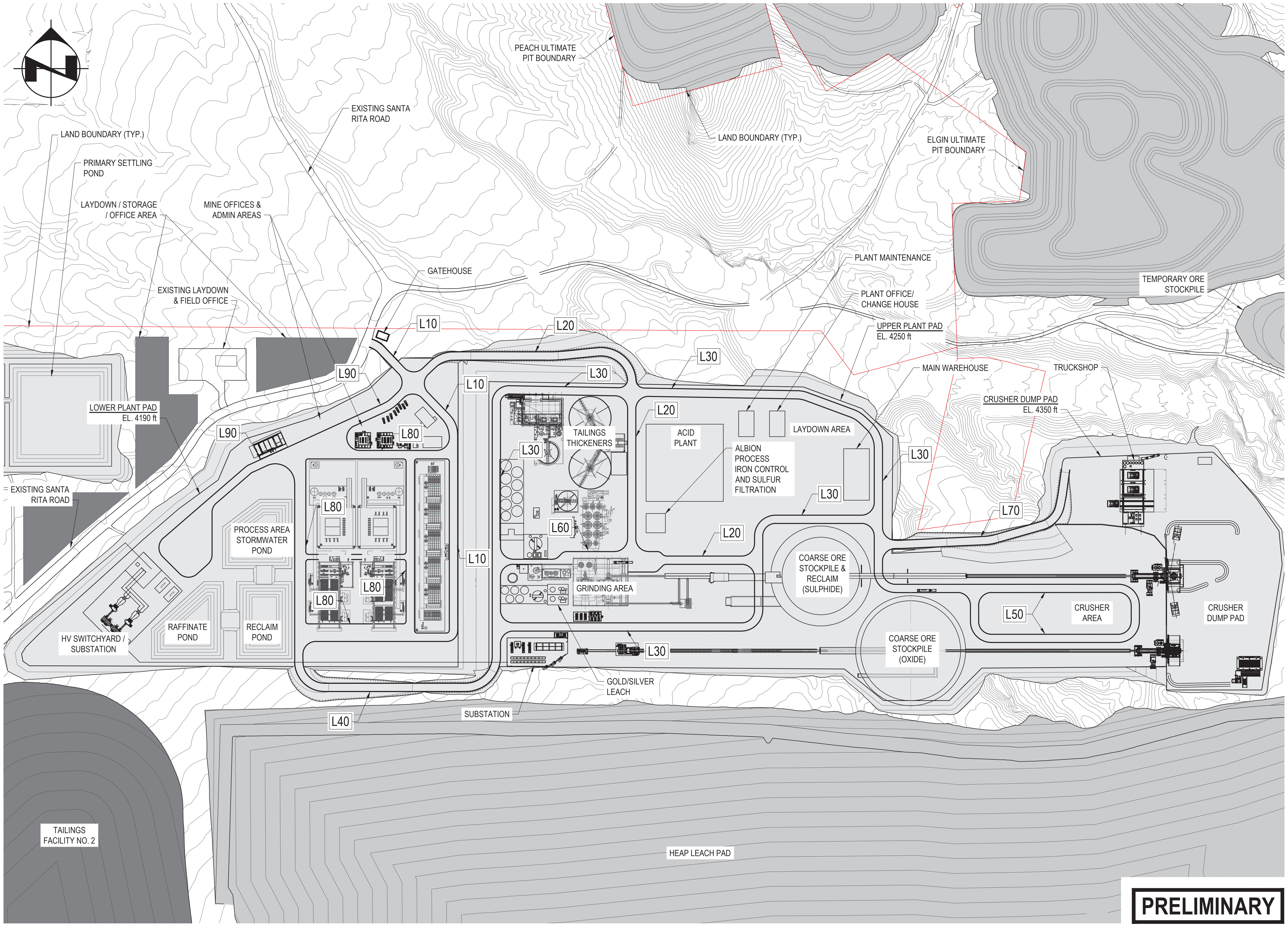
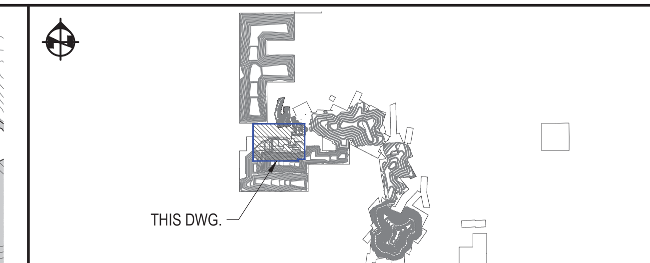
T.18 S. R.15 E. - S05
T.18 S. R.15 E. - S04
T.18 S. R.15 E. - S03
T.18 S. R.15 E. - S02
T.18 S. R.15 E. - S01
T.18 S. R.16E. - S06
T.18 S. R.16E. - S05
T.18 S. R.15 E. - S07
T.18 S. R.15 E. - S08
T.18 S. R.15 E. - S09
T.18 S. R.15 E. - S10
T.18 S. R.15 E. - S11
T.18 S. R.15 E. - S12
T.18 S. R.16E. - S07
T.18 S. R.16E. - S08
TAILINGS FACILITY 1
T.18 S. R.15 E. - S18
T.18 S. R.15 E. - S17
T.18 S. R.15 E. - S16
T.18 S. R.15 E. - S15
T.18 S. R.15 E. - S14
T.18 S. R.15 E. - S13
T.18 S. R.16E. - S18
T.18 S. R.16E. - S17
UTILITY CORRIDOR ALONG SANTA RITA ROAD
LIMESTONE MINE
HEAVY WEIGHT PIT (WASTE ROCK PLACEMENT)
COPPER WORLD PIT (WASTE ROCK PLACEMENT)
PEACH PIT
WASTE ROCK FACILITY
SANTA RITA ROAD
T.18 S. R.15 E. - S19
T.18 S. R.15 E. - S20
T.18 S. R.15 E. - S21
T.18 S. R.15 E. - S22
ELGIN PIT
T.18 S. R.16E. - S19
T.18 S. R.16E. - S20
BURIED TAILINGS LINE
HAUL ROAD
WASTE ROCK FACILITY/ HEAP LEACH PAD
BROAD TOP BUTTE PIT (WASTE ROCK PLACEMENT)
HAUL ROAD
FWDS PUMP STATION No. 2
T.18 S. R.15 E. - S23
T.18 S. R.15 E. - S24
T.18 S. R.15 E. - S30
T.18 S. R.15 E. - S29
T.18 S. R.15 E. - S28
TAILINGS FACILITY 2
T.18 S. R.15 E. - S26
T.18 S. R.15 E. - S25
T.18 S. R.16E. - S30
T.18 S. R.16E. - S29
FLOTATION AREA
ROSEMONT PIT
T.18 S. R.15 E. - S27
T.18 S. R.15 E. - S31
T.18 S. R.15 E. - S32
T.18 S. R.15 E. - S33
T.18 S. R.15 E. - S34
T.18 S. R.15 E. - S35
T.18 S. R.16E. - S32
T.18 S. R.15 E. - S36
T.18 S. R.16E. - S31
T.19 S. R.15 E. - S06
T.19 S. R.15 E. - S05
T.19 S. R.15 E. - S04
T.19 S. R.15 E. - S03
T.19 S. R.15 E. - S02
T.19 S. R.15 E. - S01
T.19 S. R.16E. - S06
T.19 S. R.16E. - S07
N
SCALE
1500' 0 1500' 3000'
CONTOUR INTERVAL = 10'
PROJECT:
COPPER WORLD PROJECT
COUNTY: PIMA
STATE: ARIZONA
DATE: APRIL 2023
FIGURE NO. 3
YEAR 14 OF OPERATIONS
ROAD NETWORK CONTROL EFFICIENCIES
HUDBAY



PRELIMINARY



KEY PLAN

GRAVEL IN-PLANT ROADS

NAME:	DESCRIPTION:	LANES:	LENGTH:
L10	ACCESS ROAD FROM SANTA RITA ROAD TO LOWER PLANT PAD AND ELECTROWINNING & SOLVENT EXTRACTION AREAS	2	1430'
L20	ACCESS ROAD TO UPPER PLANT PAD AND GRINDING AREA	2	2100'
L30	ACCESS ROAD LOOP AROUND GRINDING, TAILINGS, LAYDOWN AND CONCENTRATE AREAS	2	4560'
L40	ACCESS ROAD TO LOWER PLANT AREA AND ELECTROWINNING & SOLVENT EXTRACTION AREAS	2	1110'
L50	ACCESS ROAD LOOP TO LOWER CRUSHER AREA	2	2165'
L60	ACCESS ROAD THROUGH GRINDING AREA	1	535'
L70	ACCESS ROAD TO CRUSHER DUMP PAD AND TRUCKSHOP	2	895'
L80	ACCESS ROAD LOOP AROUND ELECTROWINNING & SOLVENT EXTRACTION AREAS	2	2430'
L90	ACCESS ROAD TO MINE OFFICE AND ADMINISTRATION AREA	2	1130'
		TOTAL:	16355'

NOTES:

1. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
2. ALL ROADS ARE UNPAVED GRAVEL UNLESS OTHERWISE NOTED.

LEGEND:

EXISTING GROUND MAJOR CONTOUR (25')

EXISTING GROUND MINOR CONTOUR (5')

200' 0 200' 400' 600' 800'

SCALE: 1"=200'

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ROSEMONT COPPER WORLD PROJECT

REFERENCES DWG. NO.	TITLE	REFERENCES DWG. NO.	TITLE

NO	BY	CKD	APP	CLIENT	DATE	DESCRIPTION
A	IAC	SM			11FEB22	PRELIMINARY ISSUE
B	IAC	SM			23FEB22	ISSUED FOR STUDY
C	JC	SM			02MAY22	AREAS ADDED

HUDBAY
ROSEMONT COPPER
WORLD COMPANY

ROADS
CIVIL
PLANT SITE
GENERAL ARRANGMENT - SHEET 2

CONTRACTOR DWG. NO. 106075-5200-B-101

DWG. NO. - FIGURE NO. 4

REVISION C

DATE 02MAY2022

APPENDIX A

VENDOR GUARANTEE FOR 95% ROADWAY CONTROL EFFICIENCY

MIDWEST

2/22/2023

Samantha Valentine
Mine Planning ENG
Hudbay Minerals
Rosemont Copper Company
Tucson AZ

Per Rosemont's request, Midwest has put together the following information on roadway dust control programs to achieve 95+% dust control of the treated areas while eliminating the use of water for roadway dust control of these areas. The dramatic emissions "cycling" associated with water-only dust control programs is eliminated, and consistent results are achieved.

Products:
RoadPro-NT (RPNT) is a patented polymeric-infused asphalt emulsion chemistry blended 10:1 with water delivering with proven durability to handle heavier equipment and traffic volumes and would be applied to haul roads. When cured, this product is non-water soluble and will not follow storm drainage. Material cures in 1-3 hours in a typical AZ climate.

SoilSement is a polymer-based program blended 10:1 with water that delivers excellent dust control on light-duty access roads. This product is also non-water soluble when cured and will not follow storm drainage. Material cures in 1-3 hours in typical AZ climate.

Plan:
For both products, establishing a "base" of material through multiple applications (6-10) over the initial 30-45 days is critical. Targeted "base" building over this period would be 1 Gal:70-90 sq ft per application. By building a significant base, the fines are bonded to the larger aggregate in the road preventing fugitive dust from forming. Maintenance applications are required over time to deliver 95+% control as the treated surface wears down or is covered up. Reapplication or maintenance applications are targeted at 1Gal:400-750 sq ft at an anticipated frequency of every month.

These applications will be evaluated on an ongoing basis and employ the Midwest "selective" strategy to maintain 95+% emission control. Weather, traffic volumes, and weak spots in the road that wear down faster are the key factors in determining maintenance application scheduling. For example, wet weather conditions would delay the reapplication. Unusually, dry conditions or road damage would accelerate the reapplication.

Please let me know if you have any questions or comments.

Thanks

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Midwest
Mining Dust Control Solutions

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APPENDIX B

ROADWAY NETWORK TRAFFIC VOLUME CALCULATION METHODOLOGY

ROADWAY SYSTEM TRAFFIC VOLUME CALCULATION METHODOLOGY

The calculation of the road watering application intensity for unpaved roadways is dependent upon traffic volume. For illustration purposes, the roadway system at the Project was divided into two roadway segments based on average hourly traffic rates. Traffic volume estimates for the example roadways were calculated by dividing the anticipated hourly amount of material transferred by the haul trucks on each roadway by the average haul truck load (260 tons) and multiplying this number by 2 to account for the haul trucks returning empty to the mining location. This methodology is shown in the following equation:

$$\text{Traffic Volume}\left(\frac{\text{vehicles}}{\text{hour}}\right) = \left(\text{Material Transferred by Haul Trucks}\left(\frac{\text{tons}}{\text{hour}}\right)\times\frac{\text{1 trip}}{\text{260 tons}}\times\frac{\text{2 passes}}{\text{trip}}\right)$$

The process rates and resulting traffic volume estimates for example roadway systems are listed in the table below. The example traffic volumes in this table are presented for operations associated with Year 2 and Year 8. However, since process rates vary (hourly, daily, and annually), the traffic volumes will be monitored on an on-going basis so that accurate water application intensities are determined and a 90% control efficiency will be met.

Summary of Data Used to Calculate Roadway System Traffic Volume

Roadway System Category	Maximum Daily Process Rate (tons/hour)	Traffic Volume (vehicles/hour)
From Mining Location to Elgin Pit Boundary (Year 2)	520	4
From Mining Location to Rosemont Pit Boundary (Year 8)	1,430	15

APPENDIX C

EXCERPT FROM FUGITIVE DUST BACKGROUND DOCUMENT AND TECHNICAL INFORMATION DOCUMENT FOR BEST AVAILABLE CONTROL MEASURES, EPA-450/2-92-004, SEPTEMBER 1992, PAGES 3-14 to 3-24

3.1.2.2 Water Flushing of Roads--

Street flushers remove surface materials from roads and parking lots using high pressure water sprays. Some systems supplement the cleaning with broom sweeping after flushing. Unlike the two sweeping methods, flushing faces some obvious drawbacks in terms of water usage, potential water pollution, and the frequent need to return to the water source. However, flushing generally tends to be more effective in controlling particulate emissions.

Equations to estimate instantaneous control efficiency values are given in Table 3-1. Note that water flushing and flushing followed by broom sweeping represent the two most effective control methods (on the basis of field emission measurements) given in that table.

In the case of winter sanding, dust generation potential can be reduced if the fine materials left on roadways after pavement drying are cleaned up promptly and without further spreading and resuspension. Prompt cleaning also keeps abrasives from being ground into small particles by road traffic or freeze/thawing. Quick cleanup may not be mandated, however, if a new snowstorm is likely. Cleanup using combination water flushing/broom sweeping is recommended as soon as possible after a storm when above-freezing temperatures keep the flushing water from freezing on the roadway. If the road is already wet, flushing may not be required.

3.2 UNPAVED ROADS

There are numerous control options for unpaved travel surfaces, as shown in Table 3-5. Note that the controls fall into the three general categories of source extent reductions, surface improvements, and surface treatment. Each of these is discussed in greater detail in the following sections.

TABLE 3-5. CONTROL TECHNIQUES FOR UNPAVED TRAVEL SURFACES[a]

Source extent reduction:	Speed reduction
	Traffic reduction
Source improvement:	Paving
	Gravel surface
Surface treatment:	Watering
	Chemical stabilization

[a] Table entries reflect EPA draft guidance on urban fugitive dust control.

3.2.1 Source Extent Reductions

These controls either limit the amount of traffic on a road to reduce the PM-10 emission rate or lower speeds to reduce the emission factor value given by Equation (2-6). Examples could include ride share programs, restriction of roads to certain vehicle types, or strict enforcement of speed limits. In any instance, the control afforded by these measures is readily obtained by the application of the equation.

3.2.2 Surface Improvements

These controls alter the road surface. Unlike surface treatments (discussed below), these improvements are largely "one-shot" control methods; that is, periodic retreatments are not normally required.

The most obvious surface improvement is, of course, paving an unpaved road. This option is expensive and is probably most applicable to high volume (more than a few hundred passes per day) public roads and industrial plant roads that are not subject to very heavy vehicles (e.g., slag pot carriers, haul trucks, etc.) or spillage of material in transport. Control efficiency estimates can be obtained by applying the information of Section 3-1.

Other improvement methods cover the road surface material with another material of lower silt content (e.g., covering a dirt road with gravel or slag, or using a "road carpet" under ballast). Because Equation (2-6) shows a linear relationship between the emission factor and the silt content of the road surface, any reduction in the silt value is accompanied by an equivalent reduction in emissions. This type of improvement is initially much less expensive than paving; however, maintenance (such as grading and spot reapplication of the cover material) may be required.

Finally, vegetative cover has been proposed as a surface improvement for very low traffic volume roads (i.e., access roads to agricultural fields). Even though vehicle related emissions from such a road would be quite low, this method will also reduce wind erosion of the road surface.

3.2.3 Surface Treatments

Surface treatment refers to those control techniques which require periodic reapplications. Treatments fall into the two main categories of (1) wet suppression (i.e., watering, possibly with surfactants or other additives), which keeps the surface wet to control emissions, and (2) chemical stabilization, which attempts to change the physical (and, hence, the emissions) characteristics of the roadway. Necessary reapplication frequencies may range from several minutes for plain water under hot, summertime conditions to several weeks (or months) for chemicals.

Water is usually applied to unpaved roads using a truck with a gravity or pressure feed. This is only a temporary measure, and periodic reapplications are necessary to achieve any substantial level of control efficiency. Some increase in overall control efficiency is afforded by wetting agents which reduce surface tension.

Chemical dust suppressants, on the other hand, have much less frequent reapplication requirements. These suppressants are designed to alter the roadway, such as cementing loose material into a fairly impervious surface (thus simulating a paved surface) or forming a surface which attracts and retains moisture (thus simulating wet suppression).

Chemical dust suppressants are generally applied to the road surface as a water solution of the agent. The degree of control achieved is a direct function of the application intensity (volume of solution per area), dilution ratio, and frequency (number of applications per unit time) of the chemical applied to the surface and also depends on the type and number of vehicles using the road.

3.2.3.1 Watering--

The control efficiency of unpaved road watering depends upon: (a) the amount of water applied per unit area of road surface, (b) the time between reapplications, (c) traffic volume during that period, and (d) prevailing meteorological conditions during the period. All of these factors affect the road surface moisture content. The control efficiency relationship shown in Figure 3-1 is buried in field tests conducted at a coal-fired power plant. Surface moisture grab samples over the daily watering cycle along with the daily traffic flow cycle are needed to determine an average control efficiency using this figure. The low control efficiency for watering of unpaved roads and the need for frequent (almost daily) reapplication preclude the use of watering as possible BACM.

3.2.3.2 Chemical Treatments--

As noted, some chemicals (most notably salts) simulate wet suppression by attracting and retaining moisture on the road surface. These methods are often supplemented by some watering. It is recommended that control efficiency estimates be obtained using Figure 3-1 and enforcement be based on grab sample moisture contents.

The more common chemical dust suppressants form a hard cemented surface. It is this type of suppressant that is considered below.

Besides water, petroleum resins (such as Coherex®) have historically been the products most widely used in industry. However, considerable interest has been shown at both the plant and corporate level in alternative chemical dust suppressants. As a result of this continued interest, several new dust

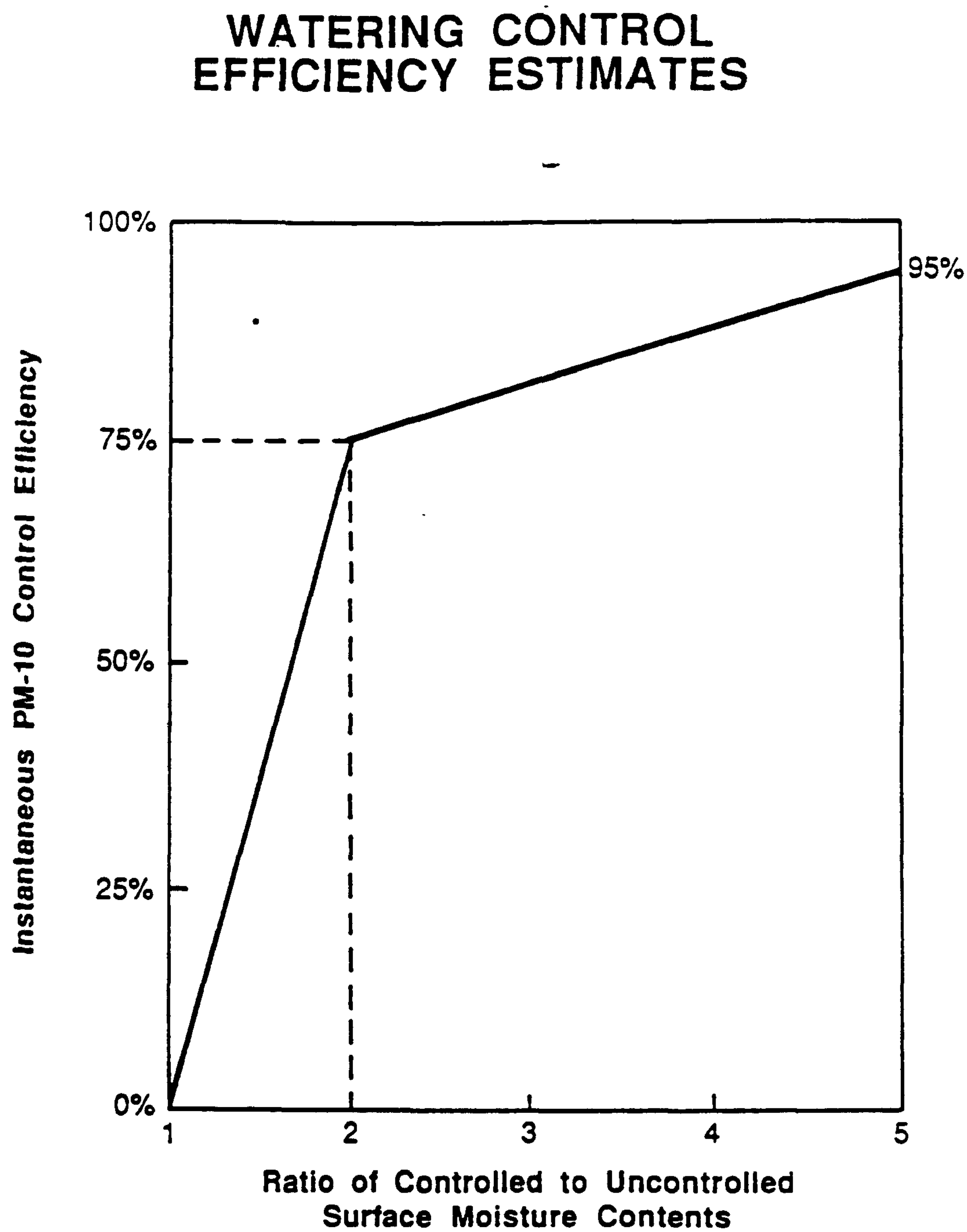

Figure 3-1. Watering Control Effectiveness for Unpaved Travel Surfaces.

suppressants have been introduced. These have included asphalt emulsions, acrylics, and adhesives. In addition, the generic petroleum resin formulations developed at the Mellon Institute with funding from the American Iron and Steel Institute (AISI) have gained considerable attention. These generic suppressants were designed to be produced on-site at iron and steel plants. On-site production of this type of suppressant in quantities commonly used in iron and steel plants has been estimated to reduce chemical costs by approximately 50 percent (Russell and Caruso, 1984).

In an earlier test report, average performance curves were generated for four chemical dust suppressants: (a) a commercially available petroleum resin, (b) a generic petroleum resin for on-site production at an industrial facility, (c) an acrylic cement, and (d) an asphalt emulsion (Muleski and Cowherd, 1987). (Note that at the time of the testing program, these suppressant types accounted for the majority of the market share in the iron and steel industry.) The results of this program were combined with other test results to develop a model to estimate time-averaged PM-10 control performance. This model is illustrated in Figure 3-2. Several items are to be noted:

- The term "ground inventory" is a measure of residual effects from previous applications. Ground inventory is found by adding together the total volume (per unit area) of concentrate (not solution) since the start of the dust control season. An example is provided below.
- Note that no credit for control is assigned until the ground inventory exceeds 0.05 gal/yd^2.
- Because suppressants must be periodically reapplied to unpaved roads, use of the time-average values given in the figure are appropriate. Recommended minimum reapplication frequencies (as well as alternatives) are discussed later in this section.

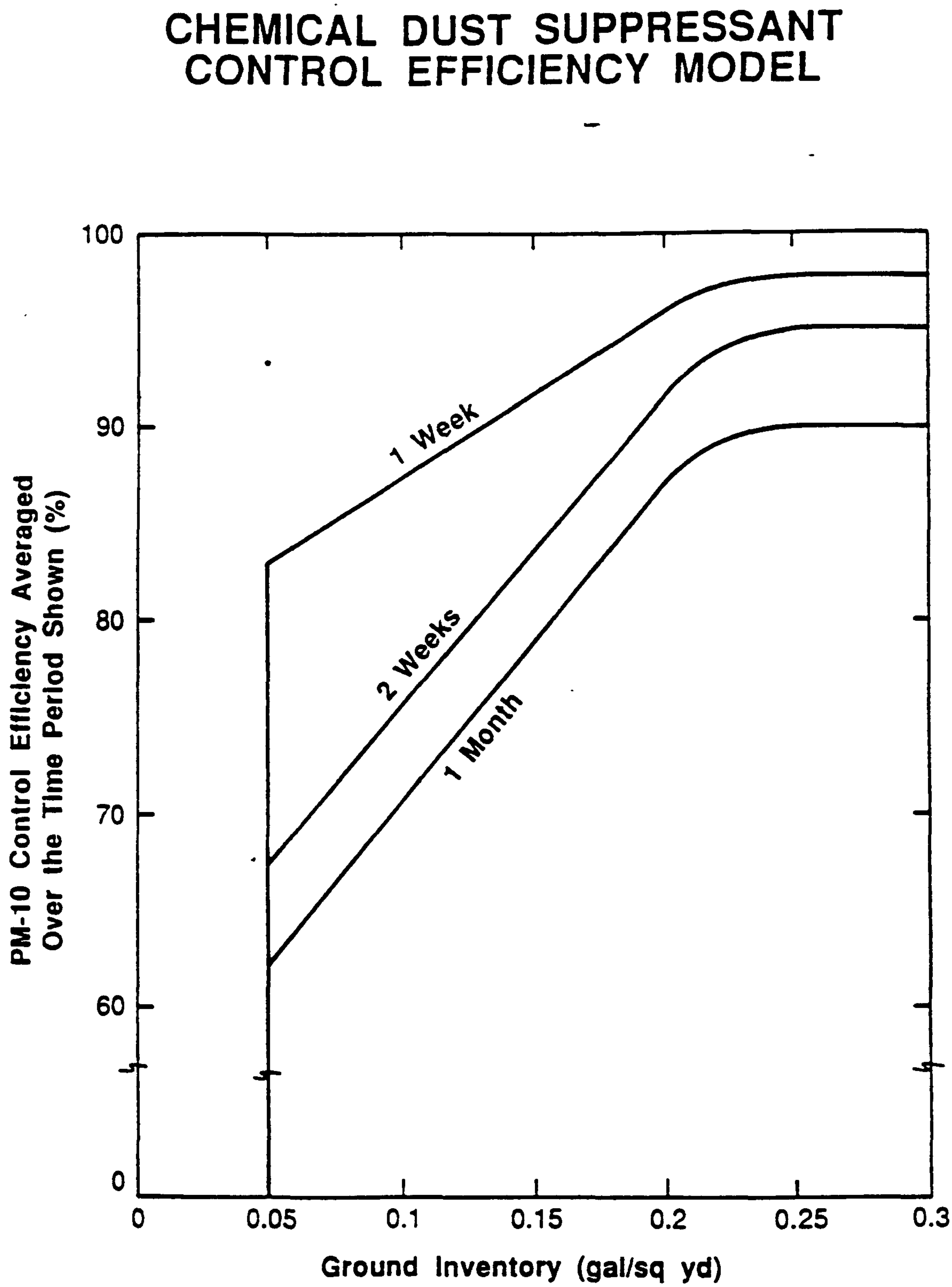

Figure 3-2. Average PM10 control efficiency for chemical suppressants.

- Figure 3-2 represents an average of the four suppressants given above. The basis of the methodology lies in a similar model for petroleum resins only (Muleski and Cowherd, 1987). However, agreement between the control efficiency estimates given by Figure 3-2 and available field measurements is reasonably good.

As an example of the use of Figure 3-2, suppose the Equation (2-6) has been used to estimate a PM-10 emission factor of 2.0 kg/VKT. Further, suppose that starting on May 1, the road is treated with 0.25 gal/yd^2 of a (1 part chemical to 5 parts water) solution on the first of each month until October. In this instance, the following average controlled emission factors are found:

Period	Ground inventory, gal/yd^2	Average control efficiency, percent[a]	Average controlled emission factor, kg/VKT
May	0.042	0	2.0
June	0.083	68	0.64
July	0.12	75	0.50
August	0.17	82	0.36
September	0.21	88	0.24

[a] From Figure 3-1; zero efficiency assigned if ground inventory is less than 0.05 gal/yd^2.

In formulating dust control plans for chemical dust suppressants, additional topics must be considered. These are briefly discussed below.

3.2.3.2.1 Use of Paved Road Controls on Chemically Treated Unpaved Roads--Repeated use of chemical dust suppressants tend, over time, to form fairly impervious surfaces on unpaved roads. The resulting surface may permit the use of paved road cleaning techniques to reduce aggregate loading due to spillage and track-on. A field program conducted tests on surfaces that had been flushed and vacuumed 3 days earlier (Muleski and Cowherd, 1987). (The surfaces themselves had last been chemically treated 70 days before.) Control efficiency values of 90 percent or more (based on the uncontrolled emission factor of the unpaved roads) were found for each particulate size fraction considered.

The use of paved road techniques for "housekeeping" purposes would appear to have the benefits of both high control (referenced to an uncontrolled unpaved road) and potentially relatively low cost (compared to follow-up chemical applications). Generally, it is recommended that these methods not be employed until the ground inventory exceeds approximately 0.2 gal/yd^2 (0.9 L/m^2). Plant personnel should, of course, first examine the use of paved road techniques on chemically-treated surfaces in limited areas prior to implementing a full-scale program.

3.2.3.2.2 Minimum Reapplication Frequency--Because unpaved roads in industry are often used for the movement of materials and are often surrounded by additional unpaved travel areas, spillage and carryout onto the chemically treated road required periodic "housekeeping" activities. In addition, gradual abrasion of the treated surface by traffic will result in loose material on the surface which should be controlled.

It is recommended that at least dilute reapplications be employed every month to control loose surface material unless paved road control techniques are used (as described above). More frequent reapplications would be required if spillage and track-on pose particular problems for a road.

3.2.3.2.3 Weather Considerations--Roads generally have higher moisture contents during cooler periods due to decreased evaporation. Small increases in surface moisture may result in large increases in control efficiency (as referenced to the dry summertime conditions inherent in the AP-42 unpaved road predictive equation). In addition, application of chemical dust suppressants during cooler periods of the year may be inadvisable for traffic safety reasons.

Weather-related application schedules should be considered prior to implementing any control program. Responsible parties and regulatory agency personnel should work closely in making this joint determination.

Compared to the other open dust sources discussed in this manual, there is a wealth of cost information available for chemical dust suppressants on unpaved roads. Note that many salt products are delivered and applied by the same truck. For those products, costs are easily obtained by contacting a local distributor.

3.3 STORAGE PILES

The control techniques applicable to storage piles fall into distinct categories as related to materials handling operations (including traffic around piles) and wind erosion. In both cases, the control can be achieved by: (a) source extent reduction, (b) source improvement related to work practices and transfer equipment (load-in and load-out operations), and (c) surface treatment. These control options are summarized in Table 3-6. The efficiency of these controls ties back to the emission factor relationships presented earlier in this section.

In most cases, good work practices which confine freshly exposed material provide substantial opportunities for emission reduction without the need for investment in a control application program. For example, pile activity, loading and unloading, can be confined to leeward (downwind) side of the pile. This statement also applies to areas around the pile as well as the pile itself. In particular, spillage of material caused by pile load-out and maintenance equipment can add a large

APPENDIX D

EXCERPT FROM CONTROL OF OPEN FUGITIVE DUST SOURCES, EPA-U50/3-88-008, SEPTEMBER 1988 (PAGE 3-12)

3.3.3 Surface Treatments

3.3.3.1 Watering. The control efficiency of unpaved road watering depends upon (a) the amount of water applied per unit area of road surface, (b) the time between reapplications, (c) traffic volume during that period, and (d) prevailing meteorological conditions during the period. While several investigations have estimated or studied watering efficiencies, few have specified all the factors listed above.

An empirical model for the performance of watering as a control technique has been developed.[8] The supporting data base consists of 14 tests performed in four states during five different summer and fall months. The model is:

$$C = 100 - \frac{0.8\ p\ d\ t}{i} \qquad (3\text{-}2)$$

where: C = average control efficiency, percent

P = potential average hourly daytime evaporation rate, mm/h

d = average hourly daytime traffic rate, (h^{-1})

i = application intensity, L/m^2

t = time between applications, h

Estimates of the potential average hourly daytime evaporation rate may be obtained from

$$p = \begin{array}{l} 0.0049 \times \text{(value in Figure 3-2) for annual conditions} \\ 0.0065 \times \text{(value in Figure 3-2) for summer conditions} \end{array}$$

An alternative approach (which is potentially suitable for a regulatory format) is shown as Figure 3-3. This figure is adapted from 11 field tests conducted at a coal-fired power plant. Measured control efficiencies did not correlate well with either time or vehicle passes after application. However, this is believed due to reduced evening evaporation (logistics delayed the start of testing until 3 p.m. and testing continued through the early evening). Surface moisture grab samples were taken throughout the testing period, and not surprisingly, these show a strong correlation with control efficiency.

Figure 3-3 shows that between the average uncontrolled moisture content and a value of twice that, a small increase in moisture content results in a large increase in control efficiency. Beyond this point, control efficiency grows slowly with increased moisture content. Although