FREEPORT-McMoRan

Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Sherry Burt-Kested
Manager, Environmental Services
Telephone: 575-912-5927
Email: sburtkes@fmi.com

February 15, 2017

Certified Mail #70171000000085315217
Return Receipt Requested

Mr. Brad Reid
New Mexico Environment Department (NMED)
Ground Water Quality Bureau
P.O. Box 5469
Santa Fe, New Mexico 87502

Dear Mr. Reid:

Re: Freeport-McMoRan Chino Mines Company –
Discharge Permit 459 Application for the Proposed 9 Waste Rock Stockpile

Pursuant to the New Mexico Environment Department's (NMED) rules at 20.6.7.10.E NMAC, please find enclosed two hard copies and a disc containing an electronic copy of Freeport-McMoRan Chino Mines Company's (Chino) application requesting authorization for the proposed 9 Waste Rock Stockpile. This application consists of the following documents:

- Application fee in the amount of $1,000 (check no.0000888894).
- Attachment 1 - Permitting Requirements Checklist.
- Attachment 2 - Completed NMED Groundwater Discharge Permit Application Form.
- Attachment 3 - Proposed Revised Sampling and Analysis Plan and Supporting Data, February21,2018.
- Attachment 4 - Well Installation In the Reservoir 9 Area, Golder Associates, February 9, 2018.
- Attachment 5 - Summary of North Mine Area Groundwater Evaluation and Results, Golder Associates, February 9, 2018.
- Attachment 6 - 9 Waste Rock Stockpile Closure/Closeout Plan, Golder Associates, March 30, 2017.
- Chino North Mine Area Application Requirements for Discharge Permits at a Copper Mine Facility (aka "Master Document"), October 8, 2015, previously submitted to NMED under separate cover.

The proposed 9 Waste Rock Stockpile (WRS) will be contiguous to Chino's existing mining operations and will be located within the Santa Rita Pit's open pit capture zone and the open pit surface drainage area. The footprint of the WRS will cover approximately 159 acres and will be located over the existing and authorized Reservoir 9 which currently stores impacted storm water.

Following your preliminary review of this application to modify Discharge Permit-459, Chino would appreciate the opportunity to meet with you to provide an overview of the proposed 9 WRS and the supporting information.

Sincerely,

Sherry Burt-Kested
Manager, Environmental Services

SBK:ks
20180215-023
Enclosure

Freeport-McMoRan Chino Mines Company
Proposed 9 Waste Rock Stockpile Application
Attachment 1: Permitting Requirements Checklist
2/15/2018

Rule Citation - NMAC	Rule Description	Chino Submittal/Response
20.6.7.9.B	Application Fee - $1,000	Check enclosed.
	NMED Application Form	Enclosed.
20.6.7.11.A-E	General Application Requirements	See Chino Master Document, dated October 8, 2015
20.6.7.11.F	Notice Requirements	See Completed NMED Application Form for Discharge Permit applications, enclosed.
20.6.7.11.G	Pre-discharge TDS Concentrations in Groundwater	See Chino North Mine Area Master Document, P. 8 and Figure 2A.
20.6.11.J(10)	Proposed Sampling locations	See Proposed Revised Sampling Analysis Plan and Supporting Data memo, enclosed as Attachment 3 to this Application.
20.6.7.11.K 20.6.7.28.K and L	Subsurface Hydrology	See Master Document, P. 23 and Appendix F. See also See *Well Installations in the Reservoir 9 Area*, Golder Associates, February 9, 2018, Attachment 4 to the Application.
20.6.7.11. K	Soil Survey Map	See Chino North Mine Area Master Document, October 8, 2015, P. 23 and Figure 8.
20.6.7.11. M	Flood Zone Map	See Chino North Mine Area Master Document , P. 24 and Figure 10.
20.6.7.11.P	Hydrologic Model	See *Summary of North Mine Area Evaluation and Results*, Golder Associates, February 9, 2018, Attachment 5 to the Application.
20.6.7.11.R Add ref. to Monitoring Well Network rule/SAP	Monitoring Wells	See "Proposed Revised Sampling Analysis Plan and Supporting Data", Attachment 3 to this Application. See also the report "*Well Installation In the Reservoir 9 Area*", Golder Associates, January 8, 2018, Attachment 4 to this Application.
20.6.7.11.T	Closure Plan	See Attachment 6 to this Application, *Closure-Closeout Plan* dated March 31, 2017 for the 9 Stockpile.
20.6.7.21.B	Requirements for Waste Rock Stockpiles: Not applicable.	The 9 Waste Rock Stockpile is designed to be completely inside the OPSDA. This is supported by groundwater monitoring data, and topographic and geologic controls. See the report "*Well Installation In the Reservoir 9 Area*", Golder Associates, February 9, 2018, Attachment 4 to this Application and the *Summary of North Mine Area Groundwater Evaluation and Results*, Golder Associates, February 9, 2018, Attachment 5.

The "Master Document" refers to the "Chino North Mine Area Application Requirements for Discharge Permits at a Copper Mine Facility", dated October 8, 2015.

NEW MEXICO ENVIRONMENT DEPARTMENT
GROUND WATER QUALITY BUREAU

GROUND WATER DISCHARGE PERMIT APPLICATION

Instructions for completing the application are included in the form itself and in the Supplemental Instructions found at the back of the application. You may fill out the application manually, or a Microsoft Word version may be downloaded from www.env.nm.gov (Ground Water Quality) and filled out electronically. Timely processing of this application is contingent upon the technical completeness of the submission. Failure to provide all of the information pursuant to Section 20.6.2.3106 NMAC, following notice of technical deficiency, may result in denial of the application.

Send two complete paper copies AND one electronic copy of this application, with the filing fee to:

Program Manager
Ground Water Pollution Prevention Section
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502

Introduction

Facility Name: Freeport-McMoRan Chino Mines Company - Santa Rita Open Pit, North In-Pit Leach System; the 3A, Northeast, North, and Northwest Waste Rock Stockpiles; and Reservoir 5

GWQB – Date of Receipt
(Department use only)

For Existing Discharge Permits:

DP Number: 459

Expiration Date: December 18, 2022

Type of Discharge (*check one*):

- ☐ Domestic
- ☐ Industrial
- ☐ Agricultural
- ☒ Mining

Type of Application (*check appropriate box*)

- ☐ New – new facility
- ☐ New – existing (unpermitted) facility
- ☐ Renewal only

☒ Modification only
"modification" includes a change in the location of a discharge, and/or increase in the quantity of the discharge, and/or a change in the quality of the discharge.

☐ Renewal and Modification

If this application is to *modify* or *renew and modify* a Discharge Permit, what is the reason for modification of the Discharge Permit? Describe the proposed changes that would result in modification, meaning a change in the location of a discharge, and/or an increase in the quantity of the discharge, and/or a change in the quality of the discharge.

Freeport-McMoRan Chino Mines Company is requesting a modification to DP-459 to construct and operate the proposed 9 Waste Rock Stockpile (9 WRS). The 9 WRS will be located over the existing Reservoir 9 amd will cover approximately 159 acres. The 9 WRS will be buttressed on the east, south and west by hillsides and on the north by an existing haul road. Reservoir 9 will be dewatered and filled in with waste rock. Water in the Rustler Canyon Containment will no longer be routed to the Reservoir 9 area but will be routed to the SX/EW operations. See the attached "Figure 1 - 9 Stockpile Location Map" dated 12/8/2017 for the proposed footprint of the 9 WRS.

Fees Included with Application

All applicants are required to submit a **$100 Application Filing Fee**. An additional fee will be assessed prior to permit issuance. Permit fees are listed in section 20.6.2.3114 NMAC. **Make checks payable to: NMED-Ground Water Quality Bureau**

Application Checklist

The following checklist has been provided to assist in ensuring that the application is complete prior to submission (*check all that apply*):

☒	Part I. Administrative Completeness ☐ $100 Application Filing Fee ☒ A. General Information ☐ B. Public Notice Information ☐ C. Public Notice Preparation
☒	Part II. Technical Completeness ☒ A. Discharge Volume and Description ☒ B. Identification and Physical Description of Facility ☒ C. Flow Metering ☒ D. Ground Water Monitoring ☐ E. Engineering and Surveying (electronic copies) ☐ F. Land Application Area
☒	Part III. Site-Specific Proposals

☒	Part IV. Electronic (PDF) format of Maps and Logs is required (additional paper copies of maps and logs are optional and may be requested by the Department if required for review) ☒ A. Surface Soil Survey and Vadose Zone Geology ☒ B. Location Map ☒ C. Flood Zone Map

Copies of Application

An applicant applying for a Discharge Permit shall submit **two paper copies of the signed application, and an electronic copy of the signed application including all supporting documentation**, to the address listed below.

☒ Two paper copies – completed and signed

☒ Electronic copy in portable document format (PDF) of the signed application and all supporting documentation (designs, maps, logs), on the following media *(choose one)*:

☒ Compact disc (CD)/DVD ☐ Flash drive

Send application and fees to the following address:
Program Manager
Ground Water Pollution Prevention Section
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502

Applicant's Signature

Signature must be that of the person listed as the legally responsible party on this application (Part I, 2a).

I, the applicant, attest under penalty of law to the truth of the information and supporting documentation contained in this application for a Ground Water Discharge Permit.

Signature: _____ Date: _____

Printed Name: _____ Title: _____

Part I. Administrative Completeness

General Information

1. Facility Information

See Supplemental Instructions to determine what constitutes a "facility." The physical address must be provided. If the facility does not have an address, the location can be described by road intersections, mile posts, or landmarks, as appropriate. See Supplemental Instructions for additional information.

Facility Name	Freeport-McMoRan Chino Mines Company - Santa Rita Open Pit, North In-Pit Leach System; Northeast, North, and Northwest Waste Rock Piles; and Reservoir 5
Discharge Permit #	459
Physical Address	99 Santa Rita Mine Road, Vanadium, New Mexico 88023
County	Grant
Type of Facility	Copper mine
Driving Directions	Freeport-McMoRan Chino Mines Company is located approximatley 3 miles northeast of Bayard and 2 miles southeast of Hanover and can be accessed via Highways 152, 180 or 356.

2. Contact Information

a) Applicant Information The applicant is the person or entity (e.g., corporation, partnership, organization, *municipality*, etc.) legally responsible for the discharge and for complying with the terms of the Discharge Permit. If the applicant is an entity, then the name and title of a contact person must be provided. This application must be signed by the applicant or contact person named here.

Applicant Name	Chad D. Fretz			Title	President & General Manager	
Mailing Address	P.O. Box 10					
	City	Bayard	State	NM	Zip	88023
Contact Person	Sandy L. Martin			Title	Executive Secretary	
Contact Information	Office Number	(575) 912-5222		Fax Number	(505) 537-8012	
	Cell Number	(575) 956-5149		E-mail	smartin@fmi.com	

b) Facility Operator/Manager Information Provide the contact information for the facility operator or manager below. If the facility is required to have an operator certified by the State of New Mexico, please include the certification level of the operator named here.

Name	Sherry Burt-Kested			Title	Environmental Manager	
Mailing Address	P.O. Box 10					
	City	Bayard	State	NM	Zip	88023
	Office Number	(575) 912-5927		Fax Number	NA	

Contact Information	Cell Number	(575) 654-0408	E-mail	sburtkes@fmi.com
	Cell Number		E-mail	
Certification Level (if applicable)	NA			

c) Consultant's Information (if applicable) If the consultant is a company or organization, then the name and title of a contact person must be provided here.

Company Name (1)	NA					
Company Contact						
Mailing Address						
	City		State		Zip	
Contact Information	Office Number		Fax Number			
	Cell Number		E-mail			

Company Name (2)	NA					
Company Contact						
Mailing Address						
	City		State		Zip	
Contact Information	Office Number		Fax Number			
	Cell Number		E-mail			

d) Permit Contact Information (if applicable) If someone other than the contacts listed above is a primary contact for this application and/or facility, list here.

Name	Christian Krueger			Title	Sr. Environmental Scientist	
Mailing Address	P.O. Box 10					
	City	Bayard	State	NM	Zip	88023
Contact Information	Office Number	(575) 912-5349	Fax Number	NA		
	Cell Number	(575) 313-6718	E-mail	ckrueger@fmi.com		
Facility Affiliation	Senior Environmental Scientist, responsible for Surface and Groundwater permit compliance, Freeport-McMoRan Chino Mines Company					

3. Ownership and Real Property Agreements [20.6.2.7HH NMAC]

The applicant owns (check as appropriate):

- ☐ The facility
- ☐ All discharge sites
- ☒ Some discharge sites

If someone other than the applicant owns the facility or any of the discharge sites, provide ownership information below. For any portion of the facility where the applicant is not the owner of record, the applicant shall submit a copy of any lease agreement or other agreement which authorizes the use of the real property for the duration of the term of the requested permit (typically five years). Lease prices or other prices may be redacted.

- If more than one person has ownership interest, or a partnership exists, list all persons with an ownership interest.
- If a corporate entity holds an ownership interest, provide the name of the corporate entity and the entity's registered agent as filed with the New Mexico Public Regulation Commission.

Name	Douglas N. Currault 2nd		Title	Secretary	
Mailing Address	333 N. Central Ave				
	City	Phoenix	State	AZ	Zip 85004
Contact Information	Office Number	(602) 366-8093	Fax Number		
	Cell Number		E-mail	dcurraul@fmi.com	
Owns	☒ The facility		☐ A discharge site		
	☐ Attached – lease (or other authorized use) agreement				

Name	Steven I. Tanner		Title	Vice President	
Mailing Address	333 N. Central Ave				
	City	Phoenix	State	AZ	Zip 85004
Contact Information	Office Number	(602) 366-7899	Fax Number		
	Cell Number		E-mail	stanner@fmi.com	
Owns	☒ The facility		☐ A discharge site		
	☐ Attached – lease (or other authorized use) agreement				

4. Public Notice Information

a) Proposed Maximum Daily Discharge Volume: 0 gallons per day
Note: Use the information from Part II.A.2 following its completion.

b) Depth-to-Most-Shallow Ground Water: 0-790 feet
Note: Use the information from Part II.A.2 following its completion.

c) Pre-Discharge Total Dissolved Solids Concentration in Ground Water
[Subsection C of 20.6.2.3106 NMAC]

Provide the concentration of total dissolved solids (TDS) in ground water prior to discharging from the facility. *Note: This information is likely the same as that submitted in the first application for a Discharge Permit for this facility.*

- Pre-discharge TDS concentration in ground water: 320 mg/L (ppm)
  - ☒ Attached – Copy of laboratory analysis report (if available)
- From what source was the sample collected (e.g., upgradient monitoring well, on-site supply well, nearest well within a one-mile radius of the facility)?
  See attached report entitled, "Well Installation In the Reservoir 9 Area, Golder Associates" (February 9, 2018) for pre-discharge TDS concentration at monitoring wells 459-2017-01 and 02. See also the "Chino North Mine Area Application Requirements for Discharge Permits at a Copper Mine Facility", October 8, 2015 (aka "Master Document").

5. Facility Location

In the table below, describe the location for the entire facility by listing the Township, Range, and Section, and/or latitude and longitude for the locations of all components of the processing, treatment, storage, and/or disposal system. See Supplemental Instructions for additional information. [Paragraph (2) and (5) of Subsection C of 20.6.2.3106 NMAC]

Component[1] ID	Township	Range	Section(s)	Latitude	Longitude
Reservoir 9	18 South	12 West	3	32°46'17.6428"	-108°03'58.6502"
Rustler Canyon Containment	18 South	12 West	2	32°46'20.0125"	-108°03'25.5260"
9 Waste Rock Stockpile	18 South	12 West		32°46'17.6428"	-108°03'58.6502"

6. Processing, Treatment, Storage, and Disposal System

Briefly describe how wastewater, sludge, etc. is processed, treated, stored, and/or disposed of at your facility. Include each component listed in the table above.

[1] Components include: septic tanks, impoundments, treatment systems, irrigation sites, leachfields, monitoring wells, mine stockpiles, etc. Additional examples are listed in the Supplemental Instructions. Each component should have a unique ID, for example septic tank-1, monitoring well-3, etc.

Reservoir 9 receives storm waters from the Rustler Canyon Containment System and surface water runoff from the surrounding area. Once the 9 Waste Rock Stockpile has been permitted, storm waters from the Rustler Canyon Containment will be divereted to SX/EW operations and recycled in the process water system.

Stormwater from and through the 9 Waste Rock Stockpile will report the Chino Mines Santa Rita Open Pit, as described in the supporting documents for this Application.

7. Public Notice Preparation [20.6.2.3108 NMAC]

Once NMED has determined that your application is administratively complete, you must complete the applicant's public notice requirements of Section 20.6.2.3108 NMAC. Language for notifications will be mailed to you with an administratively complete determination. Note: Guidance and instructions for completion of applicant's public notice can also be found at the following link: *https://www.env.nm.gov/gwb/NMED-GWQB-PublicNotice.htm*. The information requested below will be used by NMED to approve or reject the proposed public notice newspaper and signage posting locations in accordance with Subsection A of 20.6.2.3108 NMAC. Note: Other requirements of Section 20.6.2.3108 NMAC not listed here, such as certified mailings to nearby landowners, may also apply.

a) Public Notice Posting Locations

Select the type of application you are submitting and provide the requested information. Language to be used in the required notifications will be included in the administratively complete packet.

☐ Renewal Application

1. Following receipt of an administrative completeness determination from NMED, the applicant is required to provide public notice of this application by placing a 2 inch by 3 inch display ad (classified or legal sections are not acceptable) in a newspaper of general circulation in the location of the proposed discharge. Indicate the newspaper in which you intend to place the ad. [Subsection C of 20.6.2.3108 NMAC]

Newspaper: _____

☒ New Application, Modification Application, or Renewal with Modification Application

1. Following receipt of an administrative completeness determination from NMED, the applicant is required to provide public notice of this application by placing a display ad (classified or legal sections are not acceptable) in a newspaper of general circulation in the location of the proposed discharge. Indicate the newspaper in which you intend to place the ad. [Paragraph (4) of Subsection B of 20.6.2.3108 NMAC]

Newspaper: Silver City Daily Press

2. Following receipt of an administrative completeness determination from NMED, the applicant is required to post a sign(s) (2 feet x 3 feet in size) for 30 days in a location conspicuous to the public at or near the facility. One sign must be posted for each 640 contiguous acres or less. NMED may require additional postings for facilities of more than 640 acres or when the discharge site(s) is not located on contiguous properties. Indicate the location(s) where you intend to display the sign(s). [Paragraph (1) of Subsection B of 20.6.2.3108 NMAC]

Note: Conspicuous location means a location where the sign is visible and legible to the public and the public has access (e.g., at facility entrance on public road).

- Is the entire facility (including all components and discharge sites) contained within **less than** 640 acres, and is the acreage contiguous?

  ☐ Yes - Indicate a sign location below.
  ☒ No – Indicate **two** sign locations below.

Sign Location(s): Chino's mine entrance gate and SX/EW entrance gate

3. Following receipt of an administrative completeness determination from NMED, the applicant is required to post an additional notice (a flyer 8.5" X 11" or larger) for 30 days at an off-site location conspicuous to the public (e.g., public library). Indicate the location where you intend to display the flyer. [Paragraph (1) of Subsection B of 20.6.2.3108 NMAC]

Note: The U.S. Postal Service no longer allows the posting of flyers in post offices.

Flyer Location: Bayard Public Library

b) Mailing Instructions

a) The administrative completeness determination letter, including public notice instructions, should be sent to:

☒ Applicant ☐ Consultant

Part II. Technical Completeness

1. Discharge Volume and Description

a. Date of Initial Discharge at the Facility [Subsections A and B of 20.6.2.3106 NMAC]

Date of Initial Discharge: June 15, 2005

b. Determination of Maximum Daily Discharge Volume [Subsection C of 20.6.2.3106 NMAC]

See Supplemental Instructions for more information.

1. **Proposed maximum daily discharge volume:** 0 gallons per day.

(*Note: Use this volume to complete Part I.4.a (Public Notice).*

- Describe the methods and calculations used to determine this volume. Acceptable methods are described in the Supplemental Instructions. If you are relying on metered flows, attach a two-year record of meter readings.

No discharge is associated with the proposed 9 WRS. Rustler Canyon Containment is dewatered in response to storm events only.

- Describe what generates the wastewater, sludge, or other discharges processed and/or disposed of at your facility. Identify all sources (e.g., RV spaces, mobile homes, shower facilities, laundromat, restaurant, backwash systems, septage haulers, contaminated media, etc.). See Supplemental Instructions.

The 9 WRS will generate some impacted stormwater and seepage which will report to the Santa Rita Open Pit.

2. **Identify other wastewater or stormwater discharges at the facility** not described in this application and indicate what other permits apply to them. Examples include discharges from small septic systems covered by Liquid Waste Permits, discharges to surface waters under a NPDES permit, a discharge covered by a separate Discharge Permit, etc. Be sure these other discharge locations are identified on the site map required in item Part II.B.1.

Other Discharges	Permit Number
See the "Chino North Mine Area Application Requirements for Discharge Permits at a Copper Mine Facility", October 8, 2015 (aka "Master Document").	

2. Identification and Physical Description of Facility

[Subsection C of 20.6.2.3106 NMAC]

a. Scaled Map

Provide a clear and legible scaled electronic map of the components of your proposed system and relevant surrounding features, indicating the location of all the following features present at the site:

- overall facility layout
- roads

- treatment units
- lagoons
- tanks
- sumps
- land application fields
- domestic wastewater re-use areas
- pits
- stockpiles
- leachfields
- sludge drying beds
- fences
- buildings
- supply wells
- monitoring wells
- extraction/injection wells
- arroyos
- nearby water bodies such as ponds or canals
- property boundaries
- other permitted discharges
- required setbacks
- north arrow

b. Description of Components

Provide descriptive details of all components of your processing, treatment, storage, and/or disposal system. Include all components listed in the table of Part I.5.

Component	Status[1]	Date of installation or construction (mm/dd/yyyy)	Description (construction material, liner type, irrigation method, capacity, dimensions, area, model number, etc.)
Reservoir 9	existing in use	1988	Water reservoir, unlined, earthen dam, 15,315,017 gallons capacity
Rustler Canyon Containment	existing in use	2010	Impoundment, lined with100-mil HDPE, 1,300,000 gallons capacity
9 Waste Rock Stockpile	proposed	2019	Storage facility for waste rock, approximately 159 acres
Other			See the "Chino North Mine Area Application Requirements for Discharge Permits at a Copper Mine Facility", October 8, 2015 (aka "Master Document").

[1] Status = **proposed**; **existing in use**; **existing not in use**, but proposed for use; **abandoned** without closure, not proposed for use; or **closed**

3. Flow Metering

Describe the facility's flow metering system. See Supplemental Instructions for more information.

Meter ID[1]	Proposed or Existing?	Influent or Effluent?	Location Description	Flow Type[2]	Meter Type[3]	Supporting Documents Attached
20	existing	effluent	Rustler Canyon Containment (RCC)	pumped	closed pipe, mag meter	NA

[1] Meter ID means the numbering or labeling system used to individually identify each meter (e.g., Meter-1, Irrigation Meter-1, etc.).
[2] Flow type - **gravity** flow or pressurized (**pumped**) flow
[3] Meter type - **open channel** such as a weir or flume, or a **closed-pipe** velocity meter such as an electromagnetic meter

4. Discharge Quality

Indicate the expected quality of the discharge (wastewater, leachate, sludge, etc.) that is generated, stored, treated, processed and/or discharged at your facility.

Note: Not all facilities need to characterize influent quality. See Supplemental Instructions for additional guidance.

Contaminants	**Contaminants**	
	Incoming (Influent)	Final (Effluent)
Nitrate as Nitrogen (NO_3-N, mg/L)[1]		
Total Kjeldahl Nitrogen (TKN, mg/L)[1]		
Total Dissolved Solids (TDS, mg/L)[1]		
Chloride (Cl, mg/L)[1]		
Total Suspended Solids (TSS, mg/L)[2]		
Biochemical Oxygen Demand (BOD, mg/L)[2]		
Fecal Coliform Bacteria (CFU/100 mL)[2]		
pH[3]		
Metals (attach list)[3]		
Organic Compounds (attach list)[3]		

1. Include for <u>all</u> domestic systems.
2. Include for domestic systems that use an advanced treatment process.
3. Include for industrial or mining systems if these are contaminants of concern. If metals or organic compounds are present in the discharge, attach a list of influent and effluent concentrations for each metal/organic compound.

5. Ground Water Monitoring

Discharge Permits typically require that ground water samples be collected quarterly from properly constructed monitoring wells located downgradient from discharge locations. The samples must be analyzed for contaminants of concern. For most domestic and agricultural Discharge Permits, the typical contaminants of concern are total Kjeldahl nitrogen (TKN), nitrate-nitrogen (NO_3-N), total dissolved solids (TDS), and chloride (Cl). For most industrial Discharge Permits, typical contaminants of concern are volatile and semi-volatile organic compounds (VOC's), polynuclear aromatic hydrocarbons (PAH's), polychlorinated biphenyls (PCB's), metals, and radionuclides. See Supplemental Instructions for additional information.

a. Depth-to-Most-Shallow Ground Water [Subsection C of 20.6.2.3106 NMAC]

1. Facilities *with* on-site monitoring wells

Provide the depth-to-most-shallow ground water from the most recent ground water levels obtained from monitoring wells at the facility. Depth-to-ground water shall be measured to the nearest 0.01 feet using standard methods and techniques [Subsection B of 20.6.2.3107 NMAC].

Depth-to-ground water is: <u>0.00</u> feet

Note: Use this depth to complete Part I.4.b (Public Notice).

2. **Facilities *without* on-site monitoring wells**

If a facility does not have a monitoring well intersecting most-shallow ground water, provide depth-to-most-shallow ground water for all wells on file located within one mile of the boundary of the facility. This information can be obtained from the Office of the State Engineer (http://www.ose.state.nm.us).

Depth-to-ground water is: NA feet

Note: Use the range of depths from these records to complete Part I.4.b (Public Notice).

☒ Attached – Records from the Office of the State Engineer, including the following:

- location of each well by latitude/longitude and township, range, and section
- use of each well
- depth to ground water in each well
- total depth of each well

b. Ground Water Flow Direction [Subsection C of 20.6.2.3106 NMAC]

1. **Facilities with *three or more* on-site monitoring wells**

Provide ground water flow direction beneath the facility on a ground water elevation contour map. The ground water elevation contour map shall be developed based upon the most recent ground water levels and survey data obtained from on-site monitoring wells.

Flow Direction	Enclosed "Well Installations in the Reservoir 9 Area" (Golder, February 9, 2018)

☒ Included – Ground water contour map from on-site monitoring wells

☒ Included – Monitoring well survey

☐ No survey has been conducted

☒ Survey previously submitted on 12/12/96 (date)

2. **Facilities with *less than three* on-site monitoring wells**

If a facility does not have at least three monitoring wells intersecting most-shallow ground water, provide ground water flow direction based upon either the most recent regional water level data or published hydrogeologic information. Attach the sources of information used to determine ground water flow direction. *Select all that apply.*

☐ Ground water flow direction of the most-shallow ground water beneath the facility based upon the *most recent regional water level data* is _____.
-- Reference: _____ (attach relevant portions)

☐ Attached - Survey data from nearby monitoring wells and a *ground water elevation contour map* indicating the direction of ground water flow.

☐ Ground water flow direction of the most-shallow ground water beneath the facility based upon *published hydrogeologic information* is _____.

-- Reference: _____ (attach relevant portions)

c. Monitoring Well Construction and Identification [Subsection C of 20.6.2.3106 NMAC; Subsection A of 20.6.2.3107 NMAC]

1. **For existing monitoring wells**
   Submit construction logs for all existing, on-site monitoring wells, which indicate the date of installation and well driller.

   ☒ Included - Construction logs for each existing monitoring well.

   ☒ Previously Submitted
   Date 12/12/96

2. **For all monitoring wells -** Identify proposed and existing monitoring well (MW) locations.

MW ID[1]	Proposed or Existing?	Location Description[2] AND Latitude and Longitude	Screen Interval (ft)	Depth to Water
526-96-15	existing	East of Res. 9, -9735.01 and 1477.62	75-105	17.65 ft.
526-96-16	existing	Southeast of RCC, -12575.44 and 6699.79	190-230	88.62 ft.
526-96-17	existing	West of RCC, -9602.08 and 3396.94	518-558	440.13 ft.
526-96-18	existing	South of Res. 9, -12834.29 and 1070.58	409-459	438.13 ft.
459-2017-01	existing	Southeast of Res. 9, 642,576.61 and 2,653,609.51	740-800	755.06 ft.
459-2017-02	existing	Southeast of Res. 9, 642,276.94 and 2,653,473.48	783-863	789.79 ft.

[1] MW ID (Monitoring Well ID) is the numbering or labeling system used to identify a MW (e.g., MW-1, MW-2, etc.).
[2] Example: 60 feet south of the top inside edge of the berm of Wastewater Impoundment-1

d. Past Ground Water Monitoring Results

This item applies only to existing facilities seeking renewal and/or modification of a Discharge Permit that required ground water monitoring. See Supplemental Instructions for additional information.

1. **Attach a graph or table showing all analytical results from ground water monitoring**.

e. Engineering and Surveying

Proposed New Structures or Improvements to Existing Structures

Include electronic plans and specifications for any *proposed* new structures or improvements to existing structures. All final plans and specifications must bear the stamp of a New Mexico licensed Professional Engineer.

- Proposed plans and specifications included (*Select all that apply)*

  ☐ Included for new structure(s)

  ☐ Included for improvements to an existing structure

  ☒ No proposals for new or improved structures

f. Land Application Area Information

For facilities proposing to apply reclaimed or treated wastewater to a land application area, provide calculations showing that nitrogen loading does not exceed 200 lbs/acre/year or that the amount of total nitrogen in the combined application of wastewater and fertilizer does not exceed by more than 25% the amount reasonably expected to be taken up by the crop(s) and removed by harvesting in any 12-month period. Forms to assist in these calculations can be found at: https://www.env.nm.gov/gwb/FORMS/NewMexicoEnvironmentDepartment-GroundWaterQualityBureau-Forms.htm.

☐ Attached – Nitrogen loading calculations

Part III. Additional Proposals and Conditions (if applicable)

In the space provided, propose revisions or additions to the standard Discharge Permit requirements. If you propose any revisions or additions, also provide the rational for your proposal.

NA

Part IV. Maps and Logs to be Attached

1. Surface Soil Survey and Vadose Zone Geology

[Subsection C of 20.6.2.3106 NMAC]

☐ Attached - Most recent regional soil survey map and associated descriptions identifying surface soil type(s).

☒ Attached - Lithologic logs for all existing on-site monitoring wells (if available).

2. Topographic Map [Subsection C of 20.6.2.3106 NMAC]

☒ Attached - Location map with topographic surface contours identifying all of the following features located within a one-mile radius of the facility:

- watercourses
- lakebeds
- sinkholes
- playa lakes
- springs (springs used to provide water for human consumption shall be so denoted)
- wells supplying water for a public water system
- private domestic water wells
- irrigation supply wells
- ditch irrigation systems
- acequias
- irrigation canals
- drains

3. Flood Zone Map [Subsection C of 20.6.2.3106 NMAC]

☐ Attached - Most recent 100-year flood zone map developed by the federal emergency management administration (FEMA) documenting flood potential for the facility.

Describe any engineered measures used for flood protection.

NA

4. Additional Information

Describe any additional relevant information.

Enclosed technical memorandum entitled, "Summary of North Mine Area Groundwater Evaluation and Results" (Golder, February 9, 2018).

Supplemental Instructions

Please note: Discharge Permits are required for a wide range of facilities that process, treat, store and/or dispose of wastewater, sludge, septage, leachate, contaminated soils, mine tailings, industrial waste, mine ore, waste rock, or other similar materials. For the purposes of this application form, the term "discharge" applies to any of these materials whether they are actually discharged or whether they represent only a potential discharge that could occur due to factors such as poor maintenance, improper installation, equipment failure or accidents.

Part I.1 Facility Information and Type of Facility

The "Facility" may be identified as:

- a treatment facility, such as a municipal wastewater treatment plant;
- the source of the discharge, such as a subdivision, or waste rock pile;
- a disposal facility or operation, such as for sludge or septage;
- the discharge location or end user of reclaimed wastewater, such as a golf course or cement plant;
- a storage and/or processing facility with off-site disposal;
- a collection of facilities, such as numerous comfort stations at a state park; or
- a project or operation, such as a construction project or a system to distribute reclaimed wastewater throughout a city.

Examples of a variety of facility types are categorized below. Please note, "Domestic" waste contains human excreta or originates from typical residential plumbing fixtures.

Industrial Waste

- Manufacturing
- Power plant
- Military installation
- Vehicle/equipment wash
- Mortuary
- Hydrocarbon landfarm
- Ground water remediation
- Ethanol plant
- Asphalt plant
- Remediation Systems

Mining Waste

- tailing impoundment
- mine dewatering
- waste rock pile
- smelter slag
- in-situ leach
- leach piles
- pipelines
- collection ponds
- concentrator – other beneficiation

Domestic Waste

- Municipal wastewater treatment plant
- Septage disposal
- Sludge disposal
- Mobile home/RV park
- Campground/park
- School/educational facility
- Restaurant
- Subdivision/apartment complex
- Unincorporated community
- Lodging/resort/spa
- Residential facility
- Commercial/shopping complex
- Laundromat
- Facility using reclaimed domestic wastewater

Agricultural Waste

- Dairy
- Food processing
- Slaughter facility
- Nursery/greenhouse
- Manufacture/processing of agricultural chemicals
- Feedlot
- Livestock truck washout

This listing is only a guide, as there can be crossover between categories. For example, a golf course might use treated industrial wastewater for irrigation. The type of facility in that case is "golf course" and the type of waste is "industrial." A mining operation may need a permit for its restroom and shower facilities. In that case, the type of facility is a "mining operation" and the type of discharge is "domestic waste."

Part I.5: Facility Location

The following are examples of treatment, storage, and disposal components of a wastewater system that should be included in this part.

Treatment Methods

- Septic tank
- Grease interceptor
- Oil/water separator
- Manure separator
- Wetlands
- Lagoon (indicate whether aerated and type of liner)
- Trickling filter
- Activated sludge (extended air, SBR, etc.)
- Sand filter
- Membranes
- Sludge drying bed
- Disinfection (specify type)
  - chlorination

Disposal Methods

- Leachfield
- Infiltration gallery
- Evaporation lagoon (indicate type of liner)
- Evaporation tank
- Impoundment
- Discharge to waters of the US (NPDES permit required)
- Ongoing land application (specify type)
  - subsurface irrigation
  - sprinkler irrigation
  - flood irrigation
  - drip irrigation
  - surface spreading (solids)
  - surface injection (solids)

- UV/ozone
- Water treatment plant
- Injection Wells
- Temporary uses of reclaimed wastewater
- Ongoing use of reclaimed wastewater for:
  - Manufacturing construction or dust control

Storage Methods

- Above/below ground tank
- Storage lagoon (indicate type of liner)
- Holding tank
- Pit toilet
- Stockpile
- Tailing impoundment

Part II.1 Proposed Maximum Daily Discharge Volume

Your Discharge Permit will allow for the treatment, processing and/or discharge of up to a specified volume, generally, a maximum number of gallons per day. The flow at your facility on any given day must not exceed this "maximum discharge volume." It is determined based on the expected contributions from the sources you identified Part II, 1, b, 1.

NMED will carefully review the basis of the maximum discharge volume you propose. Show all your calculations and assumptions.

Animal feeding operations must provide calculations based on the number of animals and water conservation practices in place.

Landfarms, disposal facilities, processing facilities typically identify the expected number of loads to be delivered.

For septic systems and wastewater treatment plants, the maximum discharge volume is also referred to as the "design flow." It includes a peaking or safety factor to guard against back-ups and overflows.

Municipal wastewater treatment facilities should identify the population served, growth assumptions, and expected per capita usage considering any contributing industries.

On-site domestic wastewater treatment facilities should rely on published design flows such as those provided in the NMED Liquid Waste Regulations (20.7.3 NMAC), the Uniform Plumbing Code or the USEPA On-site Wastewater Treatment Systems Manual.

For existing facilities, the maximum discharge volume may be based on a record of measured flows if no changes are anticipated. At least two years of flow data must be submitted, and the highest monthly discharge volume must be multiplied by a peaking factor of 1.5.
NMED will verify that your proposed or existing facility can handle maximum discharge volume you propose.

Be specific in describing all sources. Consider the following examples:

- Municipalities – identify particular industries or specialized facilities contributing wastewater.
- RV Parks – identify showers, dump stations, laundromat, etc.

- Subdivisions – identify homes, apartments, commercial developments, water softener backwash, etc.
- Landfarms or disposal facilities – specify type of materials accepted, e.g., residential septage, car wash grit trap waste, contaminated soils/water, treated municipal sludge, etc.
- Dairies – identify milking parlors, type of washdown used, sources of stormwater runoff, etc.
- Schools – identify cafeteria, gym, showers, etc.
- Truck stops – identify restaurant, showers, car wash, etc.
- Facilities receiving reclaimed wastewater – identify the treatment facility providing the reclaimed wastewater.
- Food processing and industrial facilities – describe the processes which produce the waste stream and chemicals used.
- Mines – identify processes including beneficiation, tailing, waste rock, leach facilities, pipelines, ponds, catchments, booster stations, in-situ leach facilities.

You do not need to include solid wastes, hazardous wastes or discharges being managed under other permits; however, these must be listed under Item C-7 in Part C of the application.

Part II.3: Flow Metering

You must provide a method for measuring the discharge volume (Section 20.6.2.3109.H.1 NMAC). At facilities with treatment or storage lagoons, it is necessary to measure both the volume entering the treatment system as well as the volume ultimately discharged.

If you land apply wastewater to more than one discharge location, you must be able to track the volume to each location.

If your facility is small and relies on gravity to carry wastewater to the treatment and disposal system, it may be acceptable to estimate the wastewater flow. This can be done by metering water usage and deducting the volume of water used for fresh-water irrigation, swimming pools, evaporative cooling, livestock watering or other uses that do not result in wastewater flowing to the treatment system.

Part II.4: Discharge Quality

Untreated wastewater entering a treatment facility (also referred to as “influent”) must be characterized so that the treatment process can be evaluated. It is not necessary to provide influent quality for systems providing minimal treatment prior to discharge or disposal, such as systems relying on crop uptake for treatment (e.g., dairies), septic tank – leachfield systems, storage/processing facilities or evaporative systems. The final quality of the waste or wastewater disposed of or discharged must be characterized for all facilities.

For most agricultural and domestic facilities, the contaminants of concern include nitrate as nitrogen (NO_3-N), total Kjeldahl nitrogen (TKN), total dissolved solids (TDS), and chloride (Cl). For domestic facilities with advanced treatment, additional contaminants include total suspended solids (TSS), biochemical oxygen demand (BOD_5), and fecal coliform bacteria. Contaminants of concern at industrial and mining sites include pH, metals, and organic compounds. List all that apply.

Part II.E: Ground Water Monitoring

The depth to ground water beneath your facility and/or discharge site must be provided. This is true even if your facility or operation is intended to have no discharge. Discharge Permits are required for "no-discharge" lagoons, storage tanks, etc. because of the potential for a discharge to occur due to factors such as improper installation, poor maintenance, equipment failure or accidents.

The best way to determine the depth to water is to measure it in an on-site or nearby monitoring well. If a monitoring well is not available, the measurement may be from a water supply well. If there is a well but it is not possible to access it for a measurement, you could refer to the well log for that well and/or others in the vicinity. Well log information is available on the website of the State Engineer's office:

http://www.ose.state.nm.us/.

Be aware that water levels have dropped in many areas of the state, so more recent well logs in those areas are more reliable.

There may be a significant discrepancy in the depth to water in different wells, even when falling water levels is not a factor. One reason for this is that a water supply well may rely on a deep aquifer rather than water in the "first" or most shallow aquifer. Discharge Permits are intended to protect all ground water, so it is important to report the shallowest depth in the vicinity of your site.

The total dissolved solids (TDS) concentration of the ground water prior to discharge must be provided. As explained for the depth to water, this is true even if your facility or operation is intended to have no discharge. The TDS value provides a general indication of the quality of the ground water that could be affected by your operation.

The best way to obtain a pre-discharge TDS concentration is to sample an on-site or nearby well before your facility begins operating. It is better to sample a shallow rather than a deep well, if possible. It may be that a neighboring facility has existing analytical data for its Discharge Permit. (If so, be sure to obtain data from a non-impacted well.)

If there are no wells in your vicinity or it is not possible to sample them, you may find general TDS concentrations in reports available from sources such as a university, the State Engineer's Office (http://www.ose.state.nm.us/) or the US Geological Survey (http://nm.water.usgs.gov/).
If you are renewing or modifying your Discharge Permit, you may refer to the TDS concentration previously determined if there was a sound basis for it. Monitoring data or other information obtained since the permit was issued, however, may warrant listing a different value.

Part II.E.4: Past Ground Water Monitoring Results

A complete list of ground water standards can be found in Section 20.6.2.3103 NMAC. The standards for contaminants most frequently monitored under Discharge Permits are as follows:

Nitrate-nitrogen (NO_3-N).....10 mg/L
Chloride ..... 250 mg/L
Total dissolved solids (TDS)… 1000 mg/L
Sulfate (SO_4).....600 mg/L
pH ..... between 6 and 9

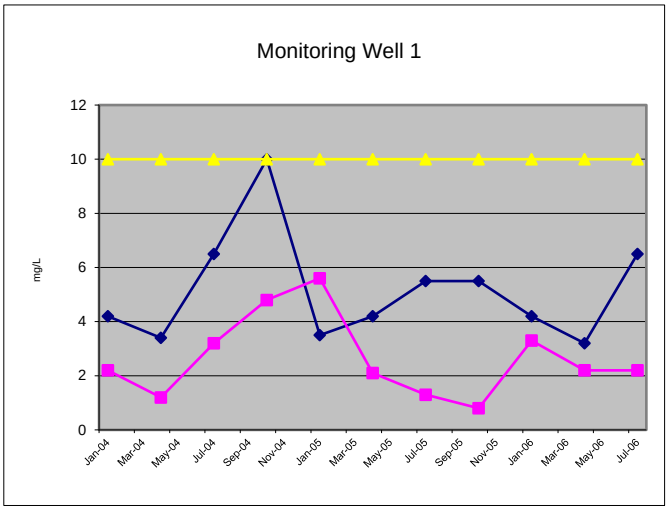
There is no ground water standard for total Kjeldahl nitrogen (TKN). Because TKN converts readily to nitrate as it moves through the vadose zone, however, concentrations approaching or exceeding 10 mg/L are of concern.

Additional parameters typically apply at mining or industrial facilities.

Some ground waters in the state have TDS or chloride concentrations that naturally exceed these standards. In that case, the standard is the naturally occurring level. You must provide documentation of such elevated natural conditions, such as analytical results from a non-impacted well.

An example table and graph follow:

	Monitoring Well 1	
Date	NO3-N	TKN
Jan-04	4.2	2.2
Apr-04	3.4	1.2
Jul-04	6.5	3.2
Oct-04	10	4.8
Jan-05	3.5	5.6
Apr-05	4.2	2.1
Jul-05	5.5	1.3
Oct-05	5.5	0.8
Jan-06	4.2	3.3
Apr-06	3.2	2.2
Jul-06	6.5	2.2



FREEPORT-McMoRan

Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

As part of its application to modify DP-459 to include authorization for the 9 Waste Rock Stockpile, Chino proposes to revise the currently approved December 18, 2017 DP-459 Sampling and Analysis Plan (SAP) to:

- Include the Rustler Canyon containment system and 526-96-16;
- Include monitoring wells 526-96-15, 526-96-17 and 526-96-18, as they are associated with the 9 Stockpile area;
- Propose plug and abandonment of monitoring wells:
  - 459-2006-04
  - 459-98-05
  - 3A-7
  - 493-99-02
  - 526-96-15
- Conduct reduced sampling for Wells 459-96-02 and 459-2002-01.

Figure 1 – "DP-459 Regulated Facilities Sampling Network", February 21, 2018 indicates the revised monitoring well network location for DP-459 and for the 9 Waste Rock Stockpile area.

Reduced Sampling Justification

The following four wells are located within the Santa Rita area of open pit hydrologic containment and therefore are not required to meet the groundwater quality standards. However, these wells do provide information on localized flows and processes.

459-2006-04

The ***Copper Rule 20.6.7.28.H NMAC – Ground water sampling – reduction of sampling analytes states*** "A permittee may also request approval from the department to reduce sampling frequency of an individual analyte if it has not been detected in a particular monitoring well, is consistently below the applicable standard, or is stable and predictable for eight consecutive quarters." Currently this well is sampled quarterly for suites B, C and W. According to the historical data provided below, all analytes in suite C have been below groundwater standards for eight consecutive quarters. In fact, the suite C analytes have been below the standards for the period of record (2009-2017) for this well, except for manganese, which has not exceeded the standard since 2011. As expected, this well does exceed groundwater standards for Total Dissolved Solids (TDS) and Sulfate, since it is located at the toe of a waste rock stockpile. TDS and sulfate have been steady and predictable for eight consecutive quarters. For this latter reason, Chino proposes this well be plugged and abandoned and eliminated from the monitoring well network for DP-459. Wells 459-96-02, 459-96-03, 459-99-01, 459-96-01B and 459-2002-01 are located within the vicinity and demonstrate

that water in this area is flowing to the Santa Rita Open Pit (please see potentiometric maps for this area).

459-96-02

The ***Copper Rule 20.6.7.28.H NMAC – Ground water sampling – reduction of sampling analytes*** states *"A permittee may also request approval from the department to reduce sampling frequency of an individual analyte if it has not been detected in a particular monitoring well, is consistently below the applicable standard, or is stable and predictable for eight consecutive quarters."* Suites A and W are currently sampled quarterly, while suite B is sampled annually. The historical data, provided below, indicate that the analytes in Suites A and B are within standards for the period of record (2006-2017). This well is upgradient of mining activities and provides redundancy with 459-96-03, which is also upgradient of mining activities. Chino proposes to sample annually for suites B and W. Sampling for Suite C would be re-instated if there is a significant increase in Suite B analytes.

459-98-05

This well is currently sampled quarterly for suites B, C and W. As expected, the water quality in this well does not meet groundwater standards. This well is located within the Open Pit Surface Drainage Area and is located at the down-gradient toe of the Northeast Waste Rock Pile. Pursuant to the ***Copper Rule 20.6.7.28.B(2) NMAC,*** which states, *"A permittee shall install monitoring wells around the perimeter and downgradient of each new leach stockpile, waste rock stockpile and tailings impoundment located outside of the open pit surface drainage area",* this well should not be part of the DP-459 monitoring well network for assessing groundwater quality. Chino proposes that this well be plugged and abandoned.

459-2002-01

The ***Copper Rule 20.6.7.28.H NMAC – Ground water sampling – reduction of sampling analytes*** states *"A permittee may also request approval from the department to reduce sampling frequency of an individual analyte if it has not been detected in a particular monitoring well, is consistently below the applicable standard, or is stable and predictable for eight consecutive quarters."* This well is upgradient of mining activities and is located within the Open Pit Surface Drainage Area. Suites A and W are currently monitored quarterly and suite B annually. According to the historical data provided, water quality in this well has been within standards for the period of record provided (2006-2017). Chino proposes to sample annually for suites B and W. Suite C would be sampled for if there is a significant increase in Suite B analytes.

3A-7, 493-99-02 and 526-96-15

These wells are located within the Open Pit Surface Drainage Area and are located beneath approved and proposed waste rock stockpiles. Pursuant to the ***Copper Rule 20.6.7.28.B(2) NMAC,*** which states, *"A permittee shall install monitoring wells around the perimeter and downgradient of each new leach stockpile, waste rock stockpile and tailings impoundment located outside of the open pit surface drainage area",* these wells should not be part of the DP-459 monitoring well network for assessing groundwater quality. Chino proposes that these wells be plugged and abandoned. As noted on Table 2: Monitoring Schedule and Requirements, 3A-7, 493-99-02 and 526-96-15 will be monitored until construction of approved stockpiles prevents wells from being sampled.

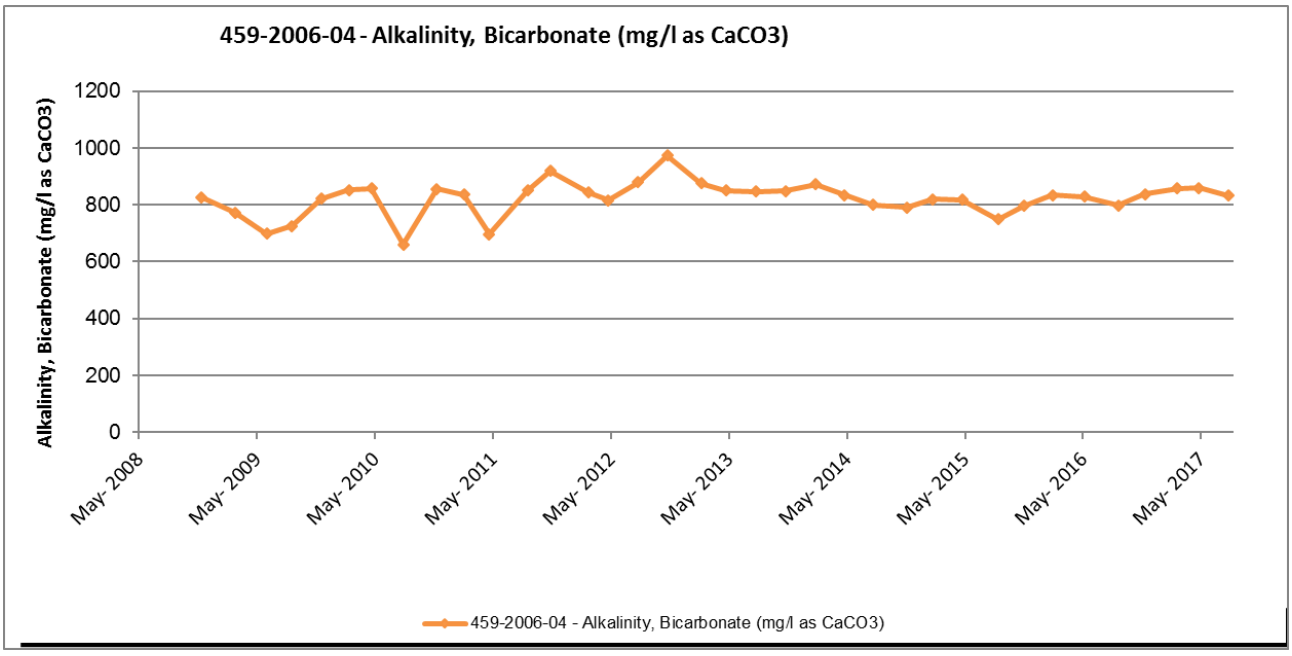
Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

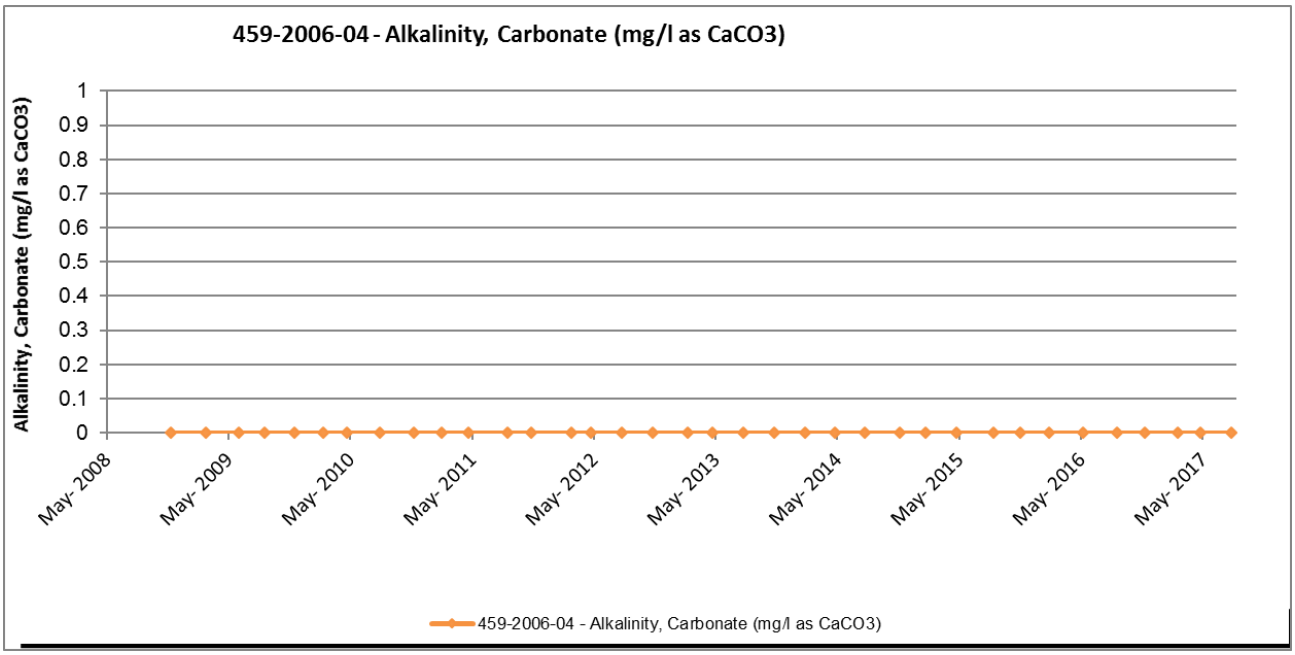
459-2006-04

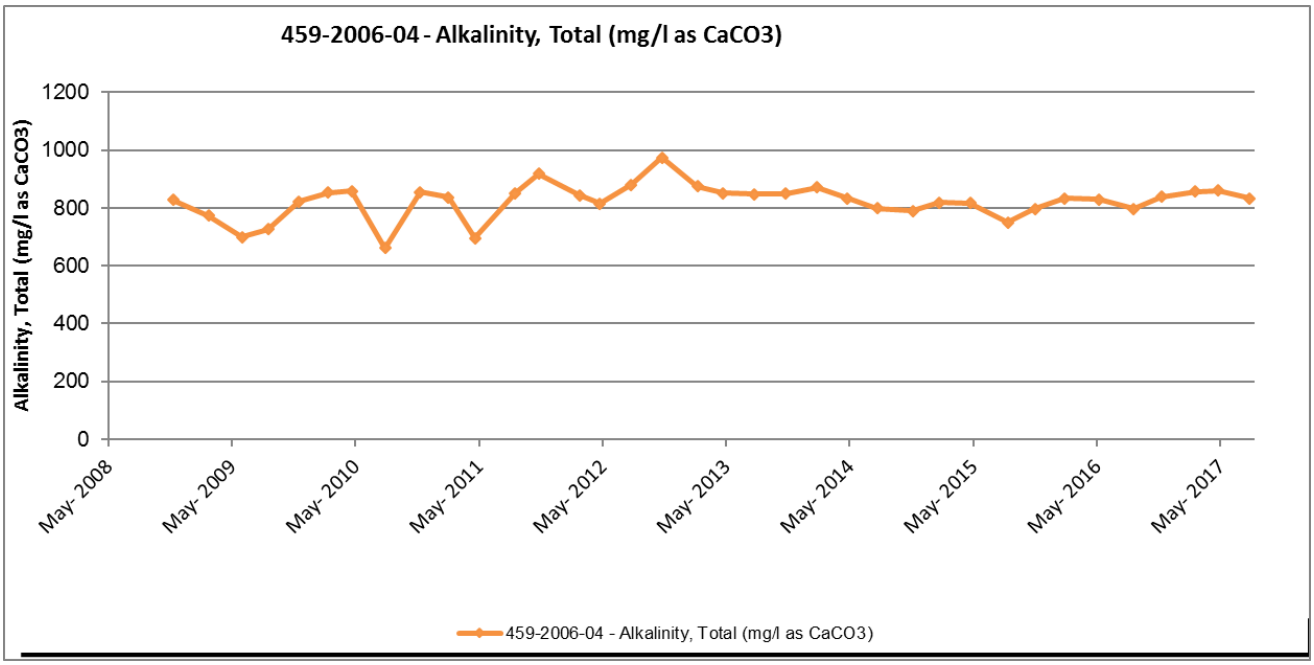
Site Number	Sample Identifier	Sample Date	Al, Diss (mg/L)	Alk, CO3 (mg/L)	Alk, HCO3 (mg/L)	Alk, Tot. (mg/L)	As, Diss (mg/L)	Ca, Diss (mg/L)	Cd, Diss (mg/L)	Co, Diss (mg/L)	Cond, 25C (micromho)	Cr, Diss (mg/L)	Cu, Diss (mg/L)	Fe, Diss (mg/L)	K, Diss (mg/L)	Mg, Diss (mg/L)	Mn, Diss (mg/L)	Na, Diss (mg/L)	Ni, Diss (mg/L)	Pb, Diss (mg/L)	SO4, Tot. (mg/L)	TDS (mg/L)	Zn, Diss (mg/L)
Water Quality Standard			5				0.1		0.01			0.05	1	1			0.2		0.2	0.05	600	1000	10
459-2006-04	320245	11/24/2008	<0.08	<1	827	827	<0.025	695	<0.002	<0.006	NA	<0.006	0.052	<0.06	2.07	234	0.133	35.7	0.042	<0.0075	**2,080**	**3,800**	0.0865
459-2006-04	321052	03/09/2009	<0.08	<1	773	773	0.025	648	<0.002	<0.006	NA	<0.006	0.081	<0.06	2.46	206	**0.21**	35.2	0.057	<0.0075	**1,940**	**3,670**	0.0545
459-2006-04	321669	06/16/2009	<0.08	<1	699	699	0.042	710	<0.002	<0.006	NA	<0.006	0.045	<0.06	2.3	224	0.0662	36.8	0.053	0.0149	**1,990**	**3,680**	0.038
459-2006-04	322494	09/01/2009	<0.08	<1	726	726	<0.025	687	<0.002	<0.006	NA	<0.006	0.072	<0.06	2.02	222	0.118	36	0.058	<0.0075	**1,850**	**3,640**	0.0502
459-2006-04	459-2006-04	12/01/2009	<0.08	<1	821	821	<0.025	658	<0.002	0.0105	NA	<0.006	0.111	<0.06	2.29	222	**0.222**	34.8	0.055	0.0077	**1,980**	**3,720**	0.077
459-2006-04	323137	02/25/2010	<0.081	<1	852	852	<0.025	765	<0.002	<0.0061	NA	<0.0061	0.018	<0.061	1.98	240	0.0525	38.5	0.027	0.0092	**1,880**	**3,800**	0.0407
459-2006-04	323779	05/05/2010	<0.08	<1	858	858	<0.025	724	<0.002	<0.006	NA	<0.006	0.038	<0.06	2.2	237	0.0223	37.7	0.021	<0.0075	**2,000**	**3,730**	0.028
459-2006-04	324698	08/12/2010	<0.08	<1	661	661	<0.025	639	<0.002	<0.006	NA	<0.006	0.03	<0.06	2.19	238	0.0362	37.3	0.029	<0.0075	**1,980**	**3,720**	0.0453
459-2006-04	325421	11/23/2010	<0.08	<1	855	855	0.028	783	<0.002	<0.006	NA	<0.006	0.014	<0.06	2.14	276	**0.213**	37.8	0.091	<0.0075	**2,050**	**4,070**	0.09
459-2006-04	326227	02/15/2011	<0.08	<1	836	836	<0.025	724	<0.002	<0.006	NA	<0.006	0.01	<0.06	2.11	254	0.155	37.1	0.084	<0.0075	**2,090**	**3,050**	0.0905
459-2006-04	326912	05/05/2011	<0.08	<1	696	696	<0.025	648	<0.002	<0.006	NA	<0.006	0.024	<0.06	2.17	263	0.0354	38.8	0.03	<0.0075	**2,080**	**3,680**	0.112
459-2006-04	327727	08/31/2011	<0.08	<1	850	850	<0.025	652	<0.002	<0.006	NA	<0.006	0.018	<0.06	2.15	254	0.0307	36.2	0.036	<0.0075	**1,930**	**3,640**	0.0416
459-2006-04	328410	11/09/2011	<0.08	<1	918	918	<0.025	669	<0.002	<0.006	NA	<0.006	0.014	<0.06	2.2	245	0.0052	37.3	0.015	<0.0075	**1,990**	**3,680**	0.0226
459-2006-04	329208	03/08/2012	<0.08	<1	843	843	<0.025	707	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.21	269	<0.004	39.4	0.032	0.0103	**2,050**	**3,720**	0.0149
459-2006-04	329938	05/07/2012	<0.08	<1	815	815	<0.025	654	<0.002	<0.006	NA	0.0077	<0.01	<0.06	2.19	257	0.0321	38.3	0.018	<0.0075	**1,940**	**3,780**	0.0237
459-2006-04	330790	08/07/2012	<0.08	<1	879	879	0.027	655	0.0035	<0.006	NA	0.0128	0.011	<0.06	2.19	246	0.0241	37.7	0.026	<0.0075	**2,010**	**3,690**	0.0301
459-2006-04	331539	11/06/2012	<0.08	<1	973	973	<0.025	729	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.3	273	0.0078	39.6	0.019	<0.0075	**2,060**	**3,820**	0.0294
459-2006-04	332388	02/19/2013	<0.08	<1	875	875	<0.025	656	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.41	271	0.0277	35.2	0.031	<0.0075	**1,990**	**3,660**	0.0285
459-2006-04	333133	05/06/2013	<0.08	<1	850	850	<0.025	569	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.15	225	0.0387	33.3	0.03	<0.0075	**1,940**	**3,640**	0.0331
459-2006-04	334105	08/07/2013	<0.08	<1	847	847	<0.025	693	<0.002	<0.006	NA	<0.006	0.013	<0.06	2.1	261	0.0495	38.7	0.037	<0.0075	**1,920**	**3,670**	0.042
459-2006-04	334873	11/06/2013	<0.08	<1	849	849	<0.025	752	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.21	240	<0.004	37.6	0.02	<0.0075	**2,010**	**3,730**	0.058
459-2006-04	335764	02/07/2014	<0.08	<1	871	871	<0.025	729	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.32	274	<0.004	40.2	0.017	0.0114	**2,140**	**3,790**	0.0339
459-2006-04	336525	05/08/2014	<0.8	<1	833	833	<0.25	676	<0.02	<0.06	NA	<0.06	<0.1	<0.6	<5	235	<0.04	36.1	<0.1	<0.075	**2,070**	**3,700**	<0.1
459-2006-04	337495	08/04/2014	<0.08	<1	799	799	<0.025	684	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.29	248	0.0234	39	0.028	<0.0075	**1,940**	**3,620**	0.0819
459-2006-04	338278	11/17/2014	<0.08	<1	790	790	<0.025	747	<0.002	<0.006	NA	<0.006	0.395	<0.06	2.34	232	<0.004	38.2	0.01	<0.0075	**1,980**	**3,760**	0.12
459-2006-04	339185	02/04/2015	<0.08	<1	819	819	<0.025	730	<0.002	<0.006	NA	<0.006	0.064	<0.06	2.25	261	0.0048	39.5	0.0152	<0.0075	**2,040**	**3,920**	0.042
459-2006-04	339953	05/06/2015	<0.08	<1	817	817	<0.025	740	<0.002	<0.006	NA	<0.006	0.0463	<0.06	2.38	269	0.0205	40.3	0.0244	<0.0075	**1,910**	**3,940**	0.053
459-2006-04	340977	08/25/2015	<0.08	<1	749	749	<0.025	772	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.42	279	<0.004	42	0.0216	<0.0075	**1,920**	**4,010**	0.033
459-2006-04	341803	11/13/2015	<0.08	<1	796	796	<0.025	762	<0.002	<0.006	NA	<0.006	<0.01	<0.06	2.26	274	<0.004	40.9	0.0121	0.0093	**1,920**	**4,060**	0.074
459-2006-04	342812	02/09/2016	<0.08	<1	833	833	<0.025	759	<0.002	<0.006	NA	<0.006	0.0168	<0.06	2.35	271	0.0051	39.5	0.0197	0.0084	**1,880**	**4,120**	0.083
459-2006-04	343669	05/19/2016	<0.08	<1	829	829	<0.025	794	<0.002	<0.006	NA	<0.006	0.0313	<0.06	2.58	279	0.0215	40.8	0.0354	<0.0075	**1,840**	**3,940**	0.116
459-2006-04	344967	08/31/2016	<0.08	<1	797	797	<0.025	717	<0.002	<0.006	NA	<0.006	0.0119	<0.1	2.42	273	0.0471	39	0.0292	<0.0075	**1,850**	**4,100**	0.052
459-2006-04	345983	11/21/2016	<0.08	<1	838	838	<0.025	795	<0.002	<0.006	NA	<0.006	<0.01	0.119	2.3	275	<0.008	40.1	0.0135	<0.0075	**1,970**	**4,140**	0.086
459-2006-04	347059	03/01/2017	<0.08	<1	857	857	<0.025	795	<0.002	0.0075	NA	0.0093	0.0102	<0.1	2.47	294	<0.008	40.4	0.032	<0.0075	**2,030**	**4,090**	0.093
459-2006-04	348061	05/08/2017	<0.08	<1	859	859	<0.025	783	<0.002	<0.006	NA	<0.006	<0.01	<0.1	2.57	277	<0.008	39.6	0.015	<0.0075	**1,990**	**3,940**	0.049
459-2006-04	349120	08/08/2017	<0.08	<1	832	832	<0.025	754	<0.002	<0.006	NA	<0.006	<0.01	<0.1	2.25	275	<0.008	37.8	0.0216	<0.0075	**2,040**	**4,100**	0.051

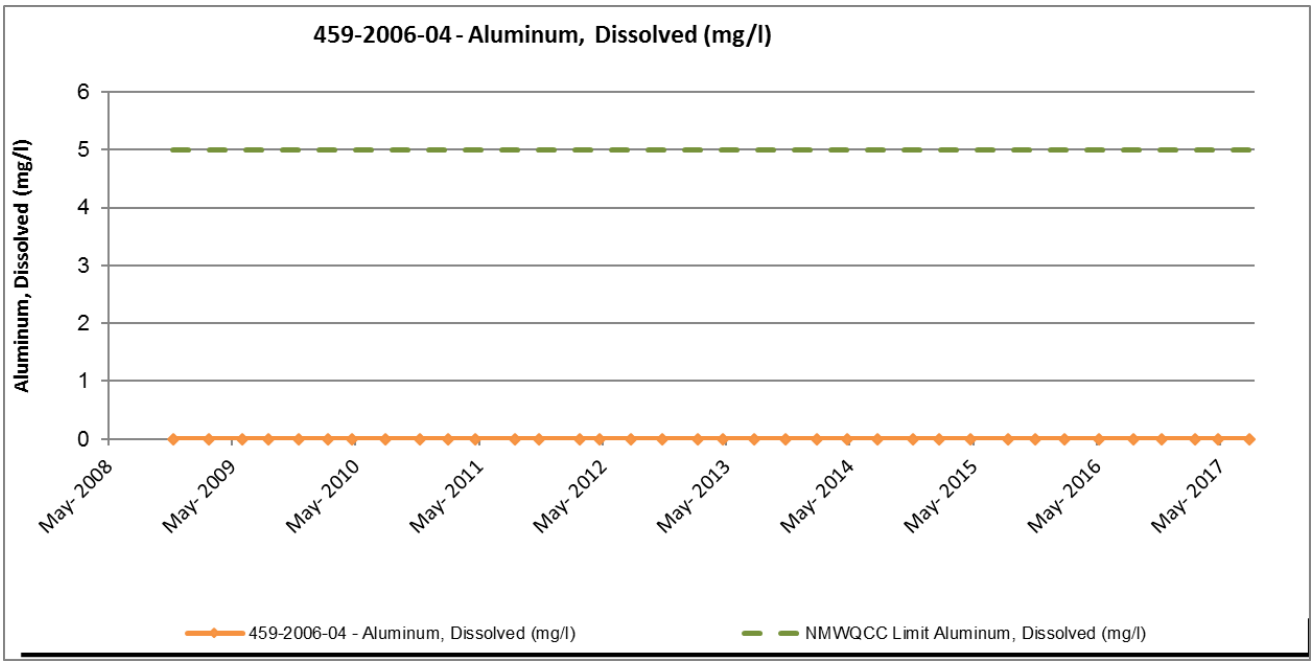
Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

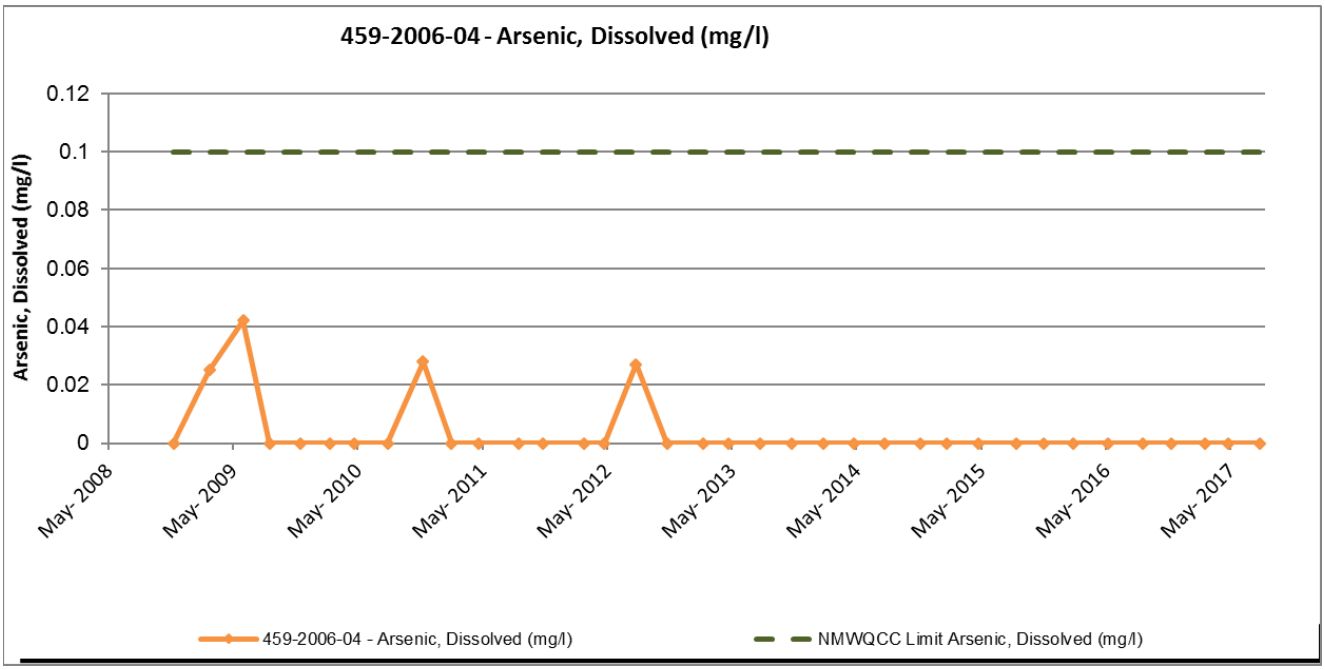
Site Number	Sample Identifier	Sample Date	Comments	Reason for No Sample	Cond, Fld (micromho)	pH, Field (SU)	Cond, 25C (micromho)
Water Quality Standard						6 - 9	
459-2006-04	320245	11/24/2008			3,226	6.48	3,816
459-2006-04	321052	03/09/2009	No DTW - probe hangs up. BGP		3,142	6.4	3,777
459-2006-04	321669	06/16/2009	No DTW - probe hangs up. BGP		2,908	6.14	3,402
459-2006-04	322494	09/01/2009			3,126	6.39	3,673
459-2006-04	459-2006-04	12/01/2009	Probe hangs up - no DTW. BGP		3,072	6.29	3,651
459-2006-04	323137	02/25/2010			3,343	6.37	4,000
459-2006-04	323779	05/05/2010			3,377	6.11	3,898
459-2006-04	324698	08/12/2010			3,232	6.42	3,772
459-2006-04	325421	11/23/2010			3,503	6.59	4,154
459-2006-04	326227	02/15/2011			3,369	6.54	4,031
459-2006-04	326912	05/05/2011			3,120	6.6	3,617
459-2006-04	327727	08/31/2011			3,321	6.64	3,751
459-2006-04	328410	11/09/2011			3,309	6.41	3,845
459-2006-04	329208	03/08/2012			3,162	6.63	3,749
459-2006-04	329938	05/07/2012			3,228	6.53	3,751
459-2006-04	330790	08/07/2012			3,382	6.41	3,820
459-2006-04	331539	11/06/2012			3,372	6.35	3,918
459-2006-04	332388	02/19/2013			3,127	6.42	3,716
459-2006-04	333133	05/06/2013			3,174	6.55	3,781
459-2006-04	334105	08/07/2013			3,225	6.44	3,698
459-2006-04	334873	11/06/2013			3,312	6.36	3,892
459-2006-04	335764	02/07/2014			3,220	6.43	3,879
459-2006-04	336525	05/08/2014			3,328	6.47	3,833
459-2006-04	337495	08/04/2014			3,236	6.48	3,735
459-2006-04	338278	11/17/2014			3,386	6.39	4,006
459-2006-04	339185	02/04/2015			3,500	6.42	4,113
459-2006-04	339953	05/06/2015			3,535	6.35	4,135
459-2006-04	340977	08/25/2015			3,753	6.35	4,285
459-2006-04	341803	11/13/2015			3,878	6.3	4,567
459-2006-04	342812	02/09/2016			3,731	6.72	4,516
459-2006-04	343669	05/19/2016			3,853	6.64	4,477
459-2006-04	344967	08/31/2016			3,805	6.61	4,451
459-2006-04	345983	11/21/2016			3,672	6.41	4,315
459-2006-04	347059	03/01/2017			4,173	6.33	4,904
459-2006-04	348061	05/08/2017			4,076	6.32	4,779
459-2006-04	349120	08/08/2017			4,068	6.14	4,624

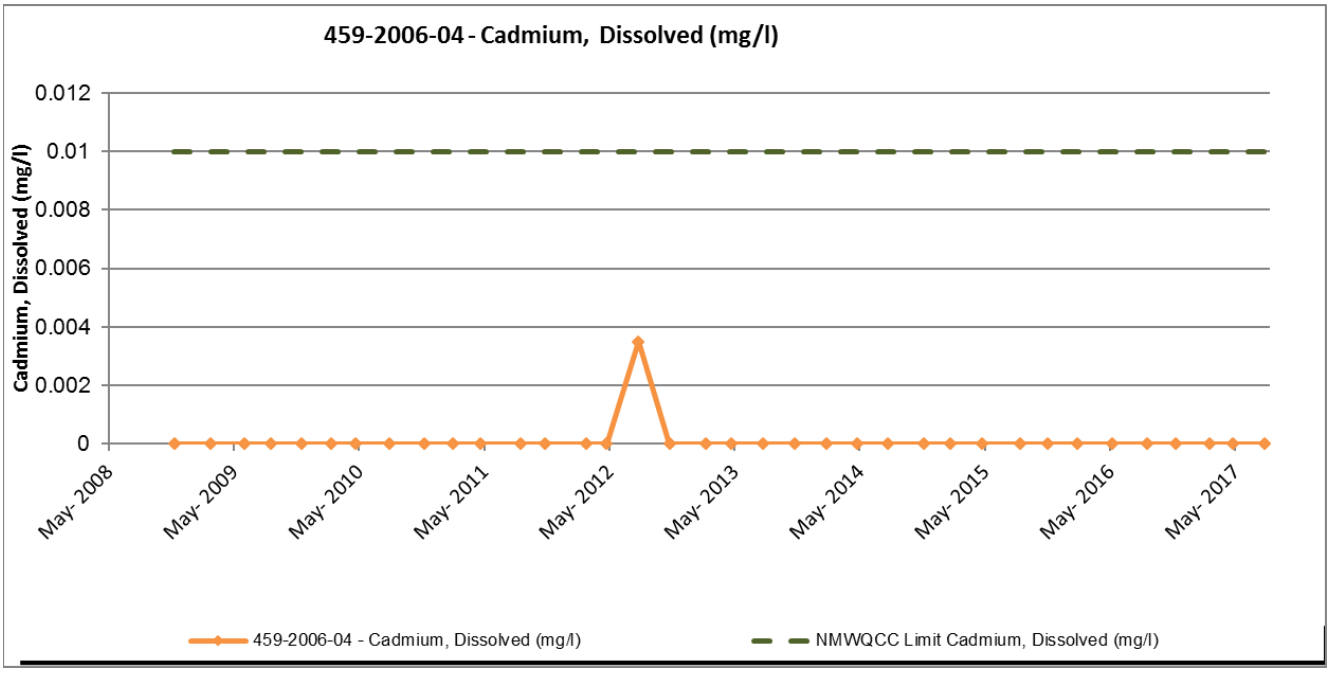

459-2006-04 - Alkalinity, Bicarbonate (mg/l as CaCO3)
Alkalinity, Bicarbonate (mg/l as CaCO3)
1200
1000
800
600
400
200
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Alkalinity, Bicarbonate (mg/l as CaCO3)

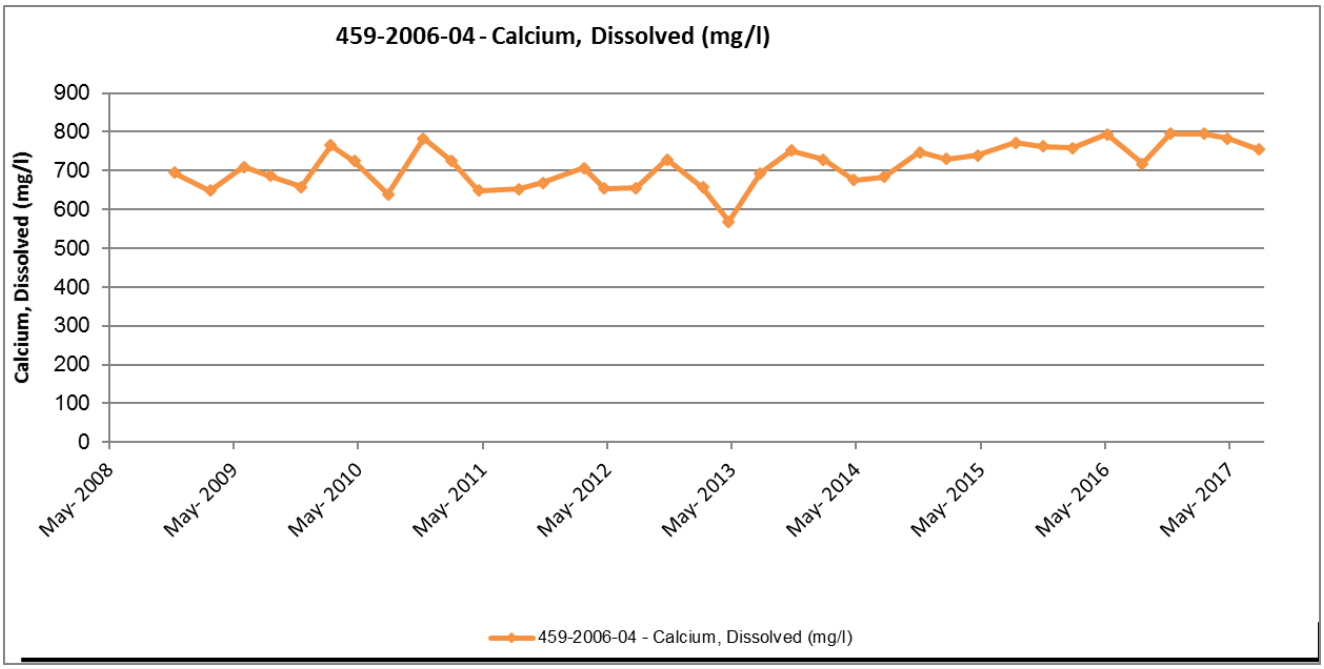

459-2006-04 - Alkalinity, Carbonate (mg/l as CaCO3)
Alkalinity, Carbonate (mg/l as CaCO3)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Alkalinity, Carbonate (mg/l as CaCO3)

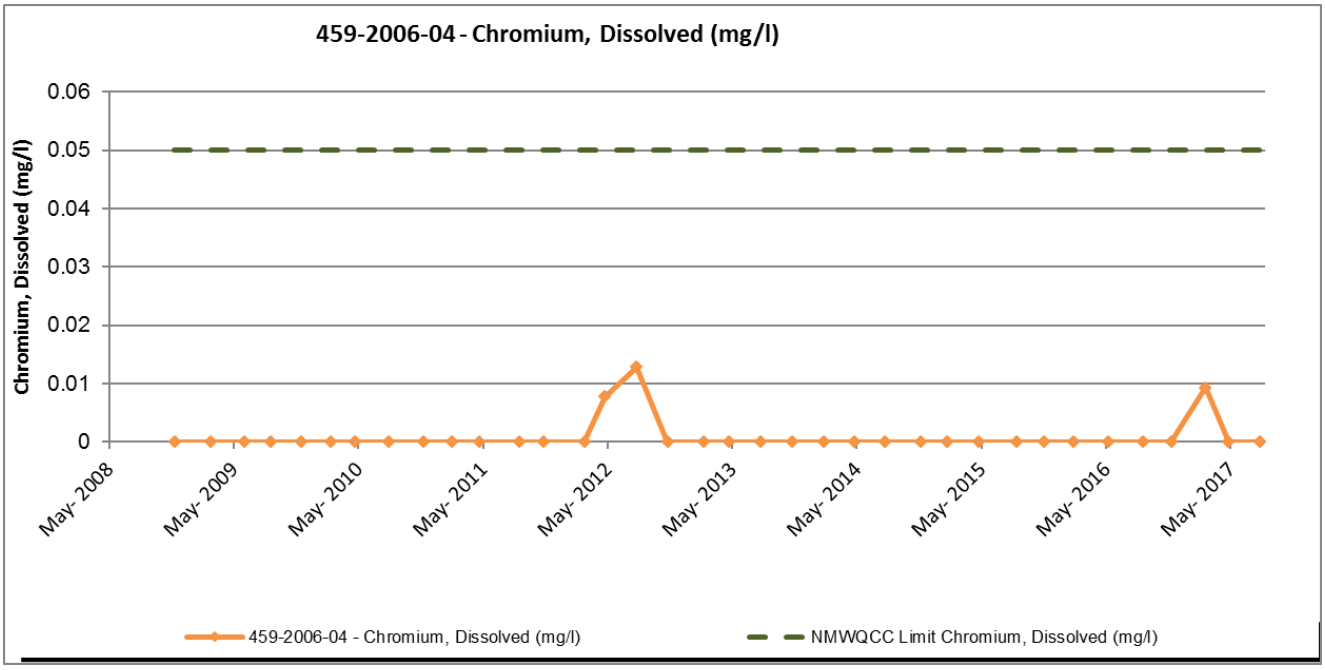

459-2006-04 - Alkalinity, Total (mg/l as CaCO3)
Alkalinity, Total (mg/l as CaCO3)
1200
1000
800
600
400
200
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Alkalinity, Total (mg/l as CaCO3)

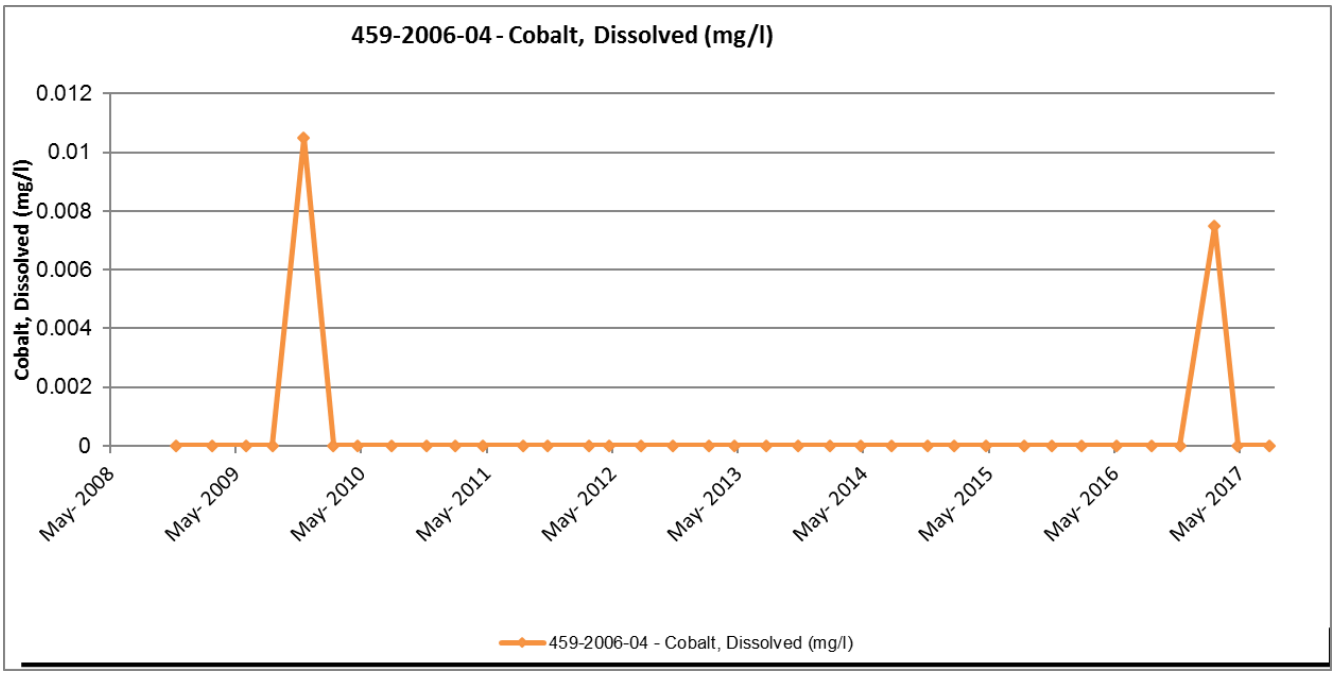

459-2006-04 - Aluminum, Dissolved (mg/l)
Aluminum, Dissolved (mg/l)
6
5
4
3
2
1
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Aluminum, Dissolved (mg/l)
NMWQCC Limit Aluminum, Dissolved (mg/l)

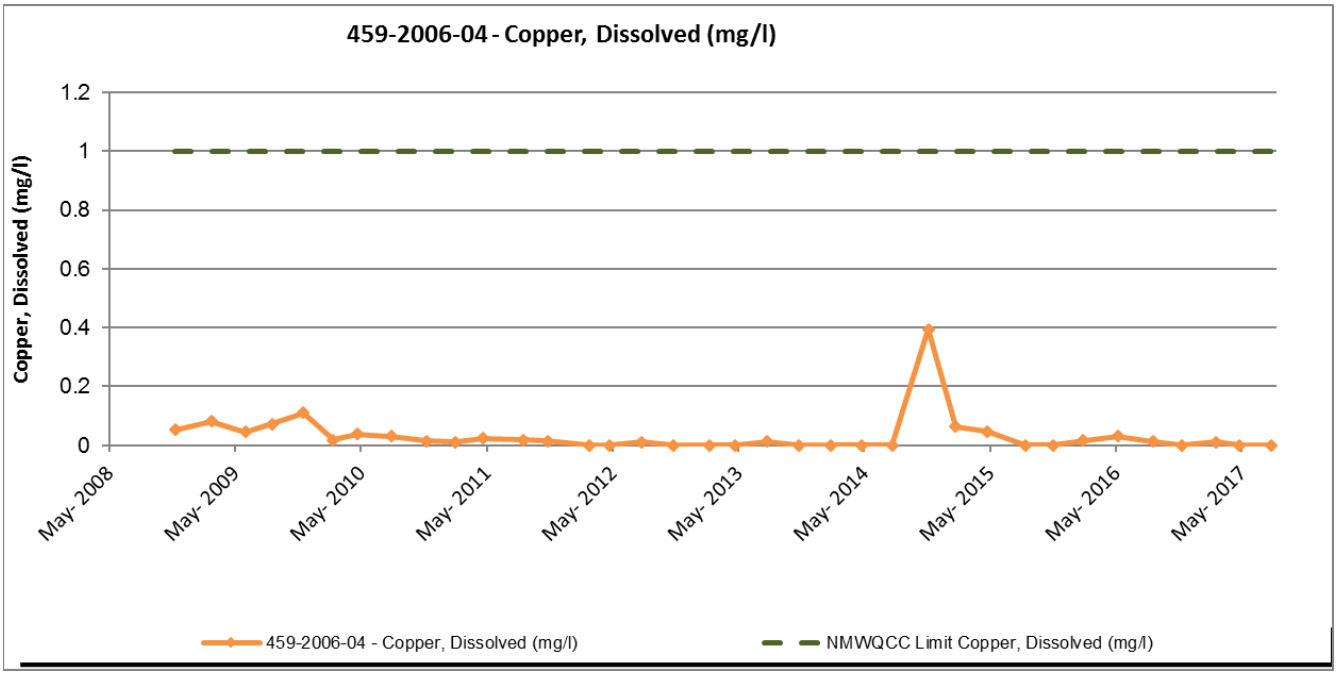

459-2006-04 - Arsenic, Dissolved (mg/l)
Arsenic, Dissolved (mg/l)
0.12
0.1
0.08
0.06
0.04
0.02
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Arsenic, Dissolved (mg/l)
NMWQCC Limit Arsenic, Dissolved (mg/l)

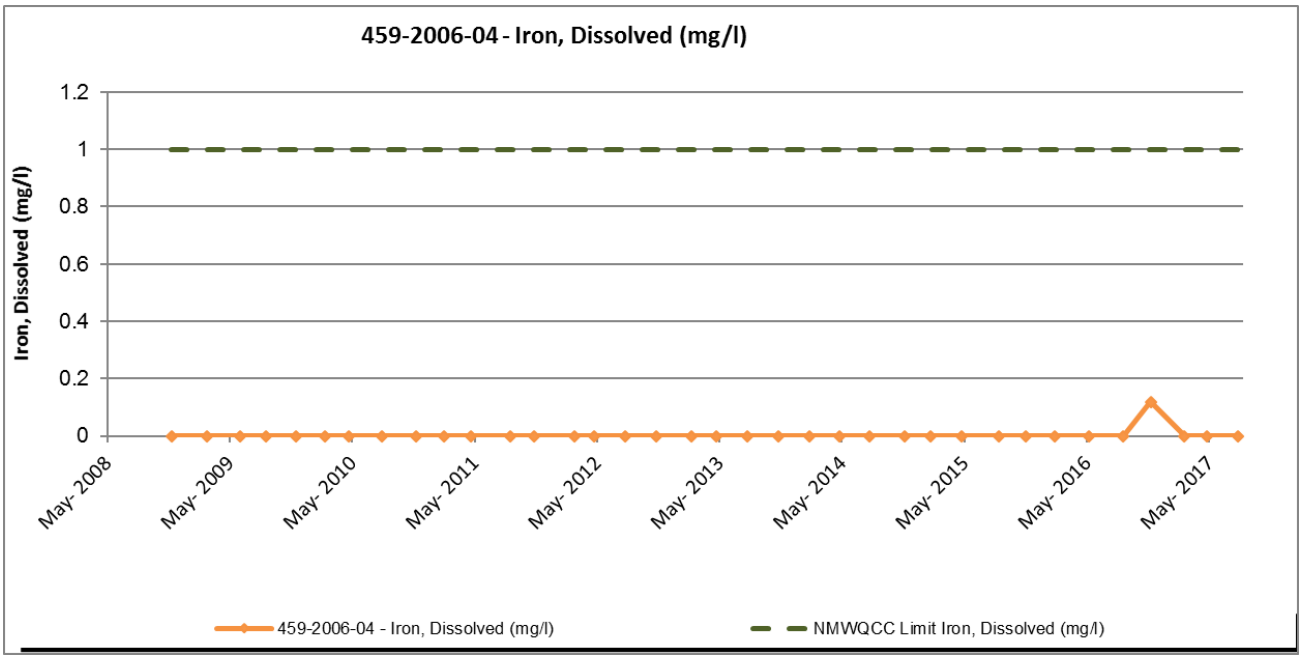

459-2006-04 - Cadmium, Dissolved (mg/l)
Cadmium, Dissolved (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Cadmium, Dissolved (mg/l)
NMWQCC Limit Cadmium, Dissolved (mg/l)

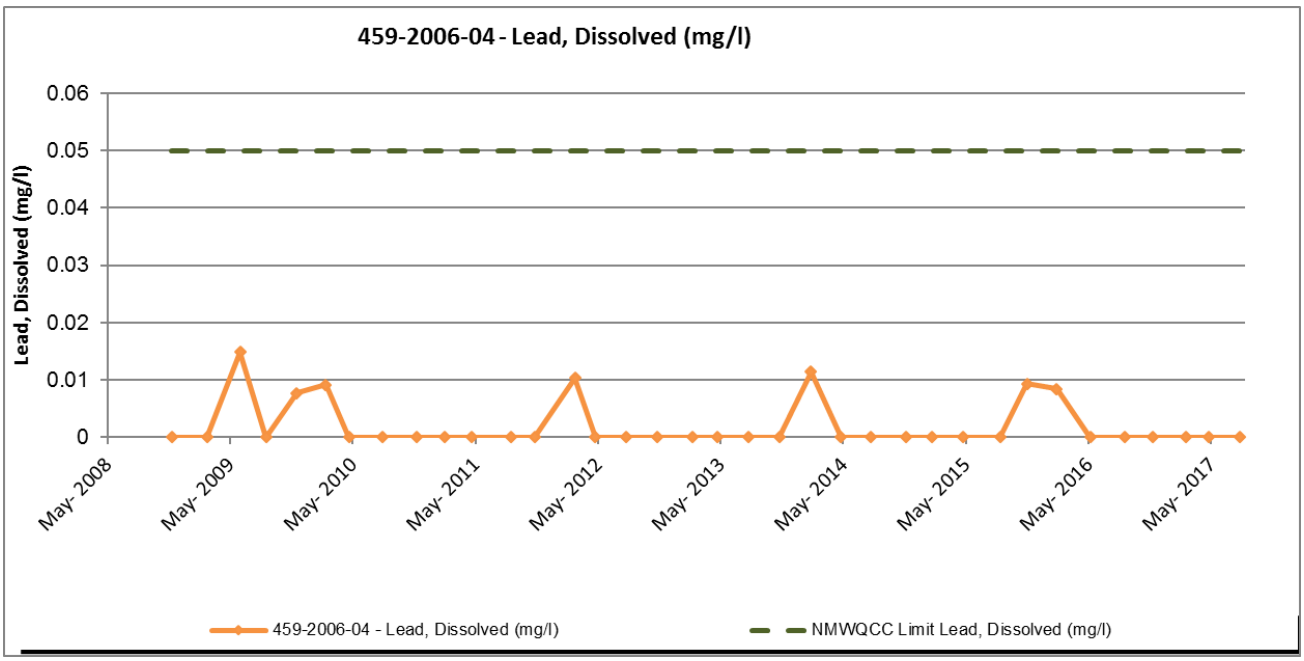

459-2006-04 - Calcium, Dissolved (mg/l)
Calcium, Dissolved (mg/l)
900
800
700
600
500
400
300
200
100
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Calcium, Dissolved (mg/l)

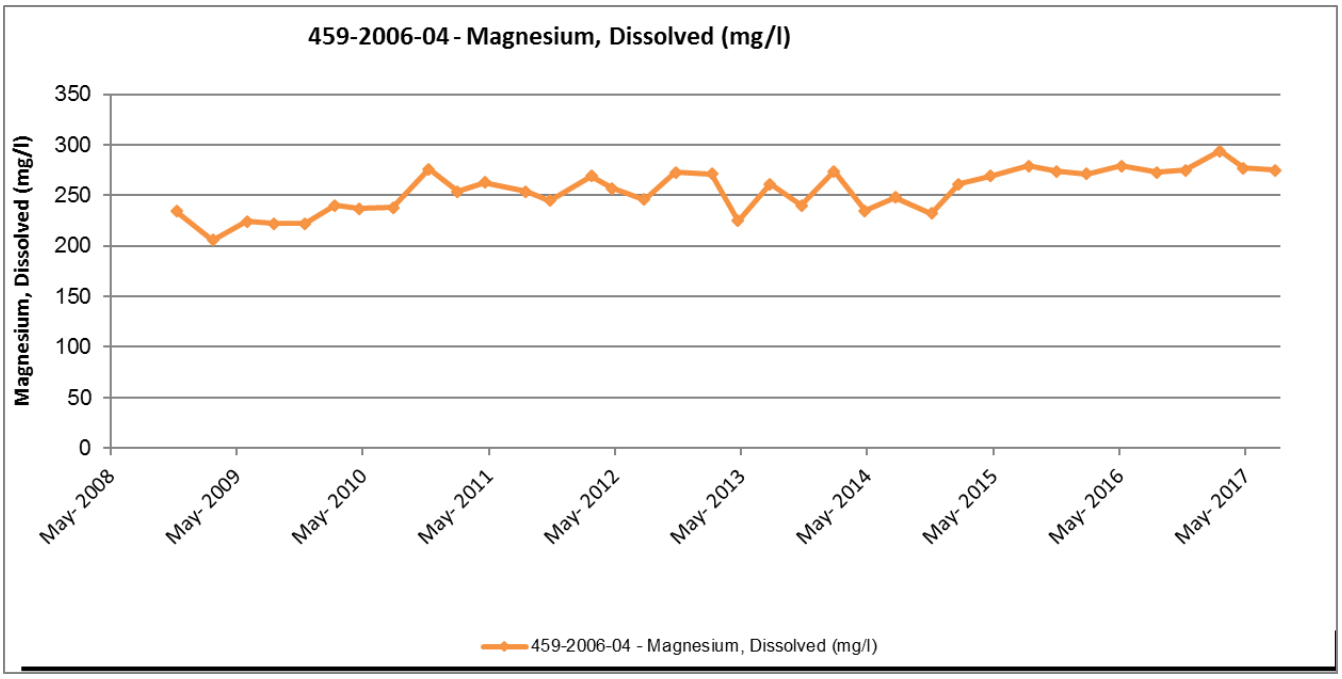

459-2006-04 - Chromium, Dissolved (mg/l)
Chromium, Dissolved (mg/l)
0.06
0.05
0.04
0.03
0.02
0.01
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Chromium, Dissolved (mg/l)
NMWQCC Limit Chromium, Dissolved (mg/l)

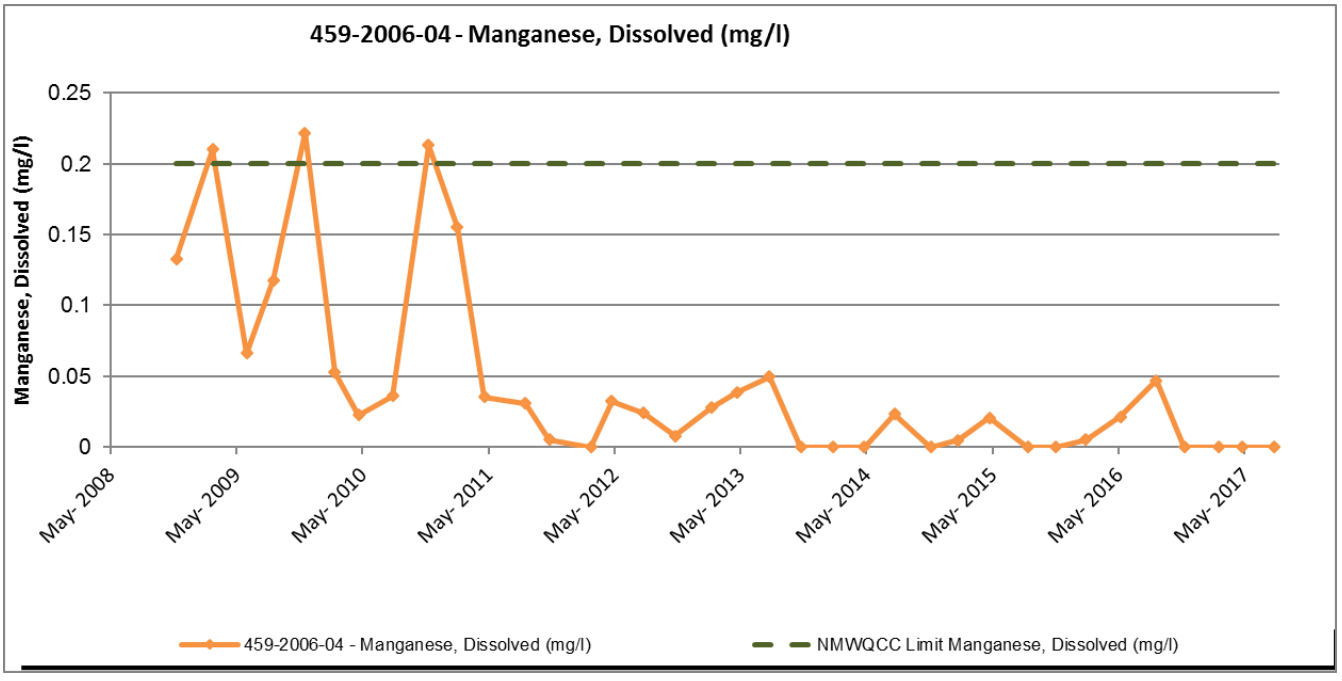

459-2006-04 - Cobalt, Dissolved (mg/l)
Cobalt, Dissolved (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Cobalt, Dissolved (mg/l)

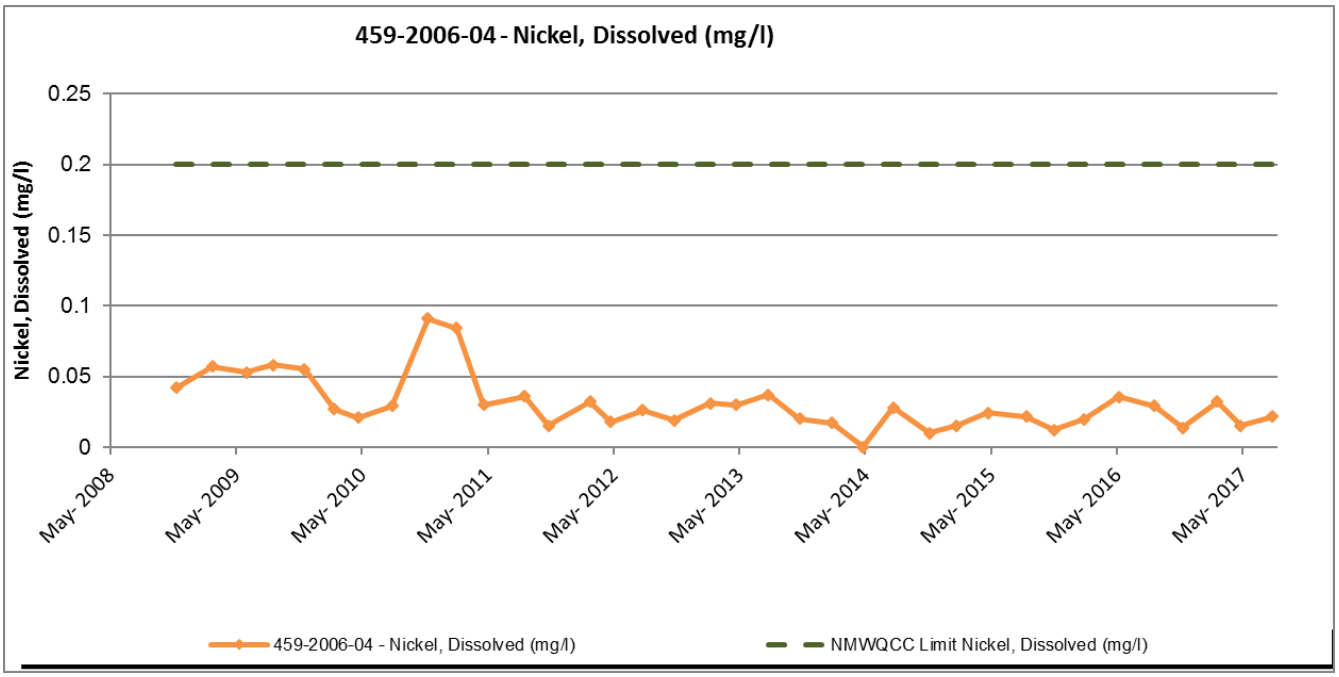

459-2006-04 - Copper, Dissolved (mg/l)
Copper, Dissolved (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Copper, Dissolved (mg/l)
NMWQCC Limit Copper, Dissolved (mg/l)

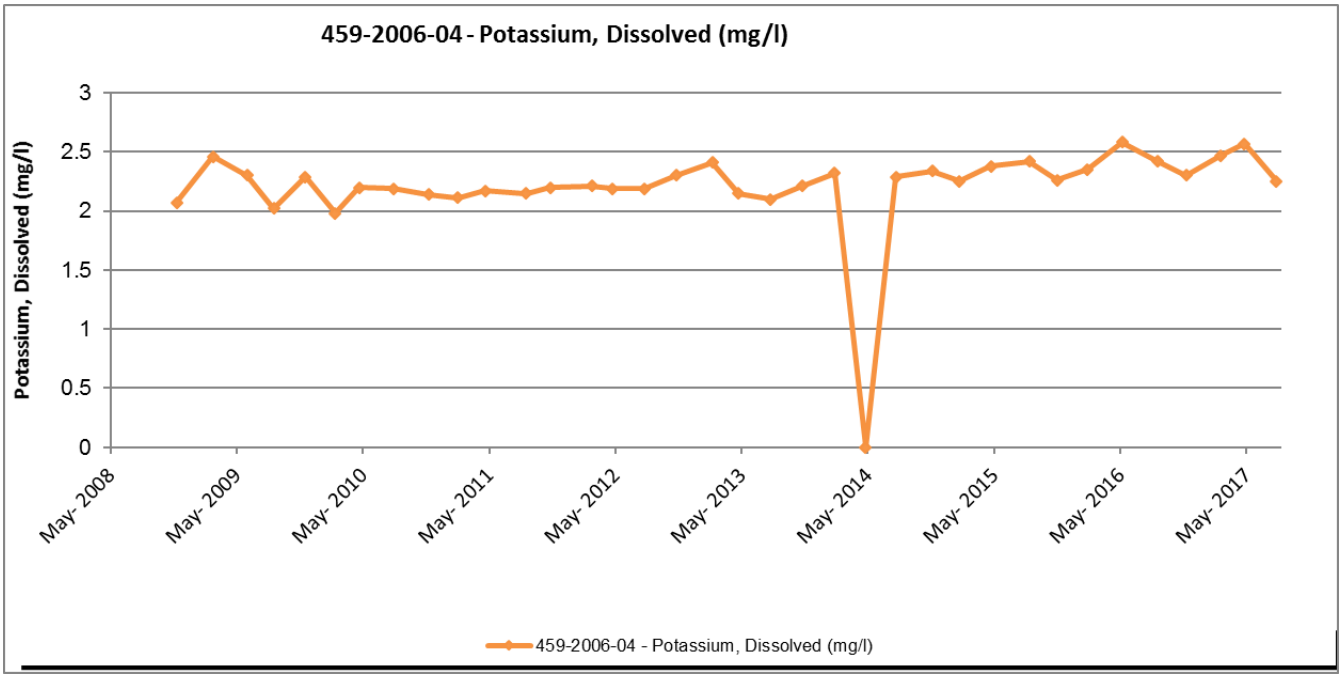

459-2006-04 - Iron, Dissolved (mg/l)
Iron, Dissolved (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Iron, Dissolved (mg/l)
NMWQCC Limit Iron, Dissolved (mg/l)

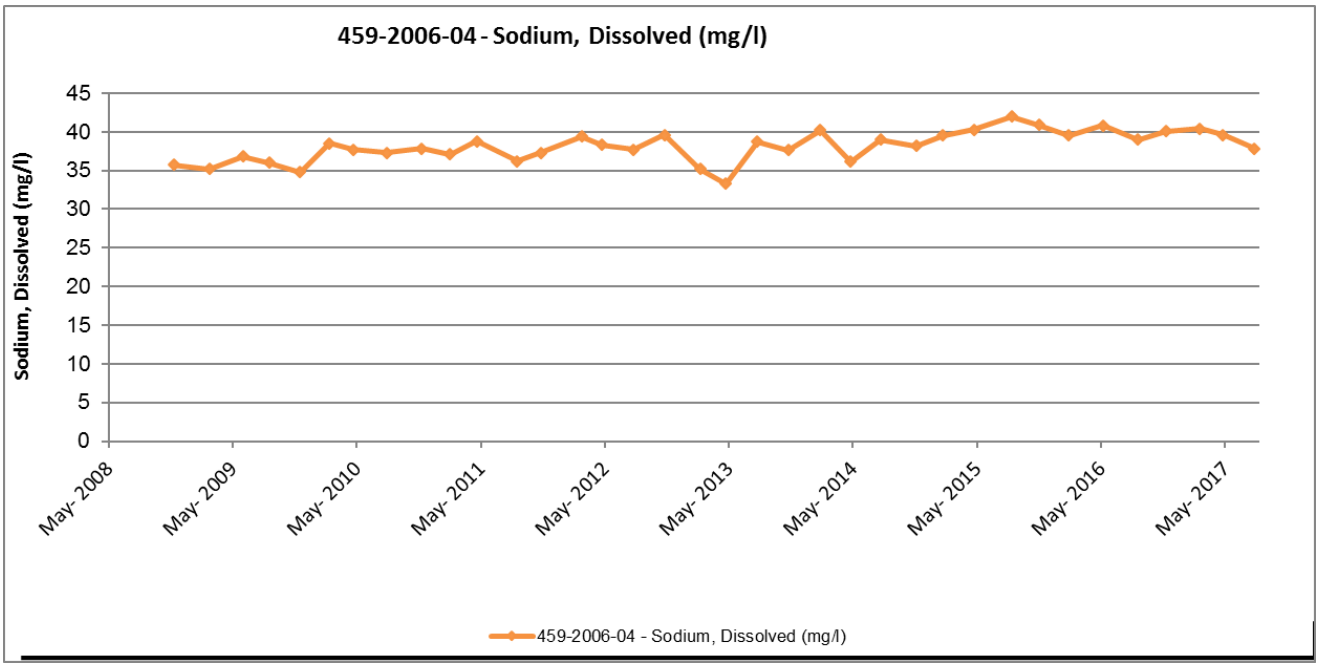

459-2006-04 - Lead, Dissolved (mg/l)
Lead, Dissolved (mg/l)
0.06
0.05
0.04
0.03
0.02
0.01
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Lead, Dissolved (mg/l)
NMWQCC Limit Lead, Dissolved (mg/l)

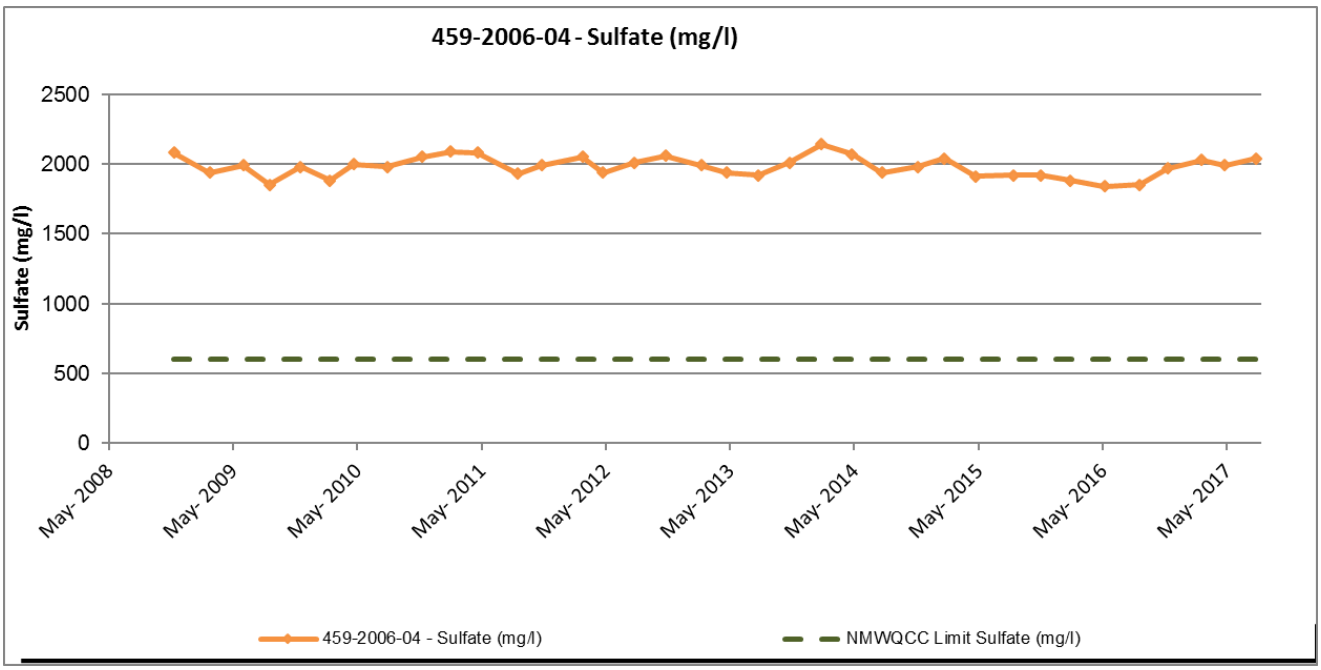

459-2006-04 - Magnesium, Dissolved (mg/l)
Magnesium, Dissolved (mg/l)
350
300
250
200
150
100
50
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Magnesium, Dissolved (mg/l)

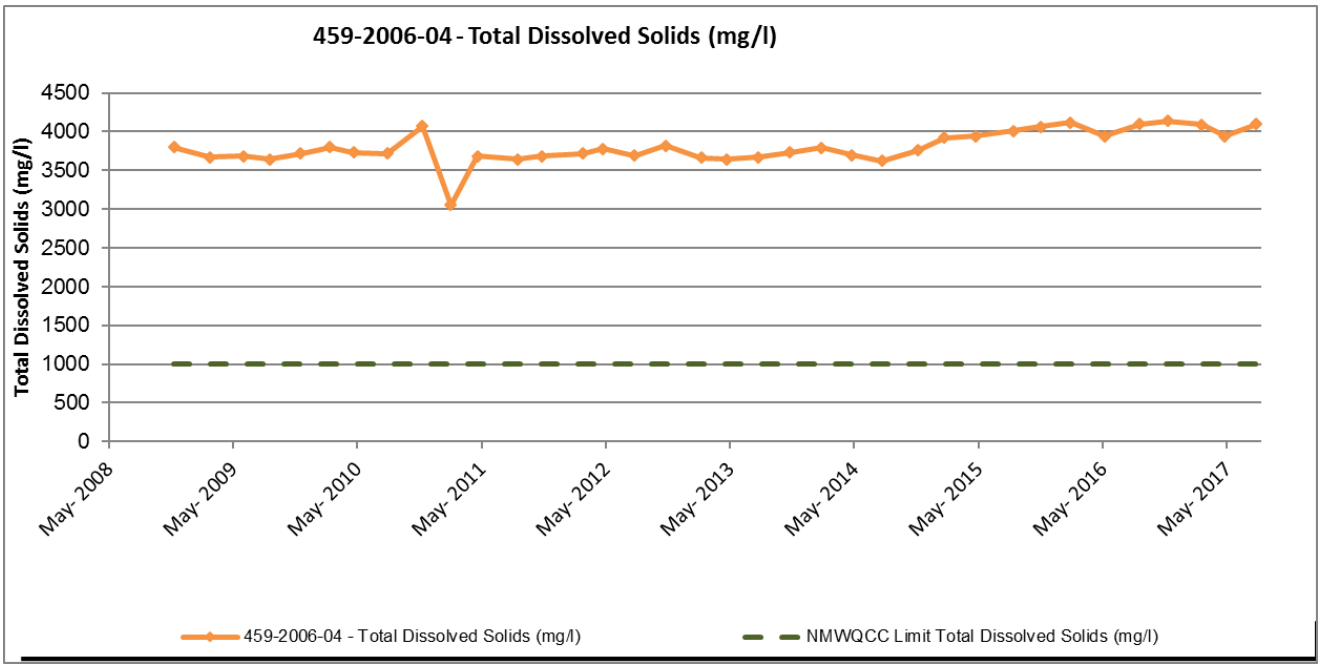

459-2006-04 - Manganese, Dissolved (mg/l)
Manganese, Dissolved (mg/l)
0.25
0.2
0.15
0.1
0.05
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Manganese, Dissolved (mg/l)
NMWQCC Limit Manganese, Dissolved (mg/l)

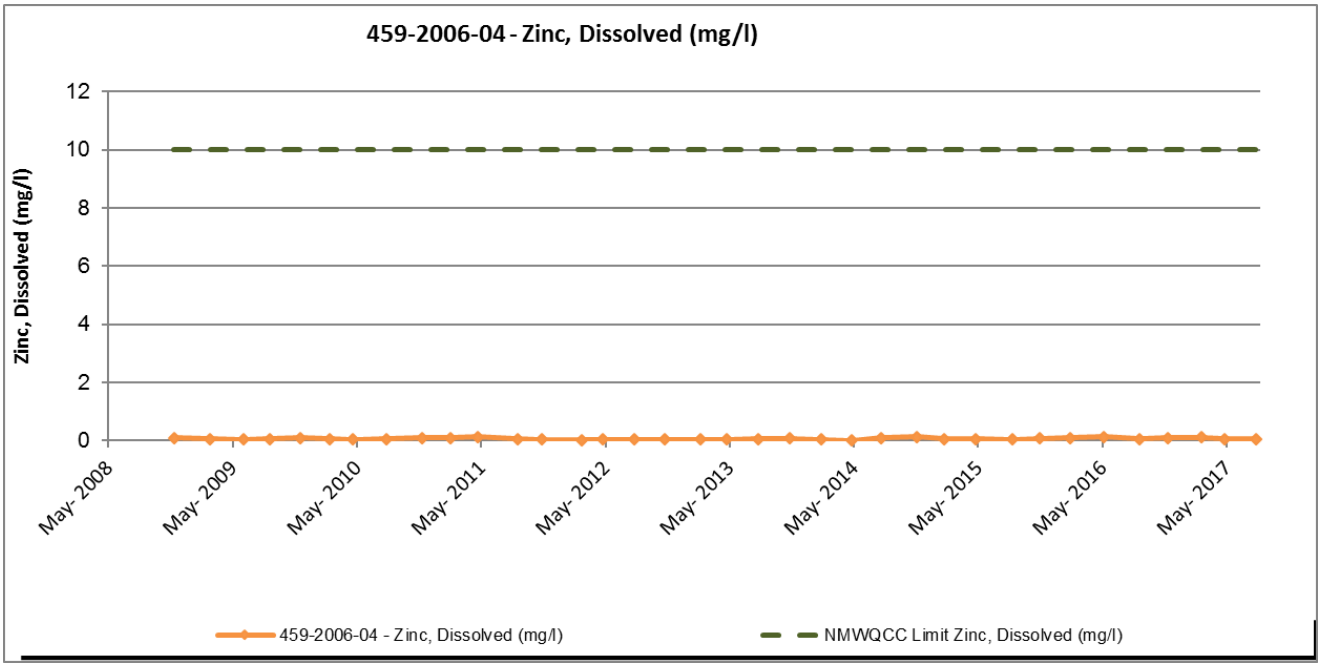

459-2006-04 - Nickel, Dissolved (mg/l)
Nickel, Dissolved (mg/l)
0.25
0.2
0.15
0.1
0.05
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Nickel, Dissolved (mg/l)
NMWQCC Limit Nickel, Dissolved (mg/l)

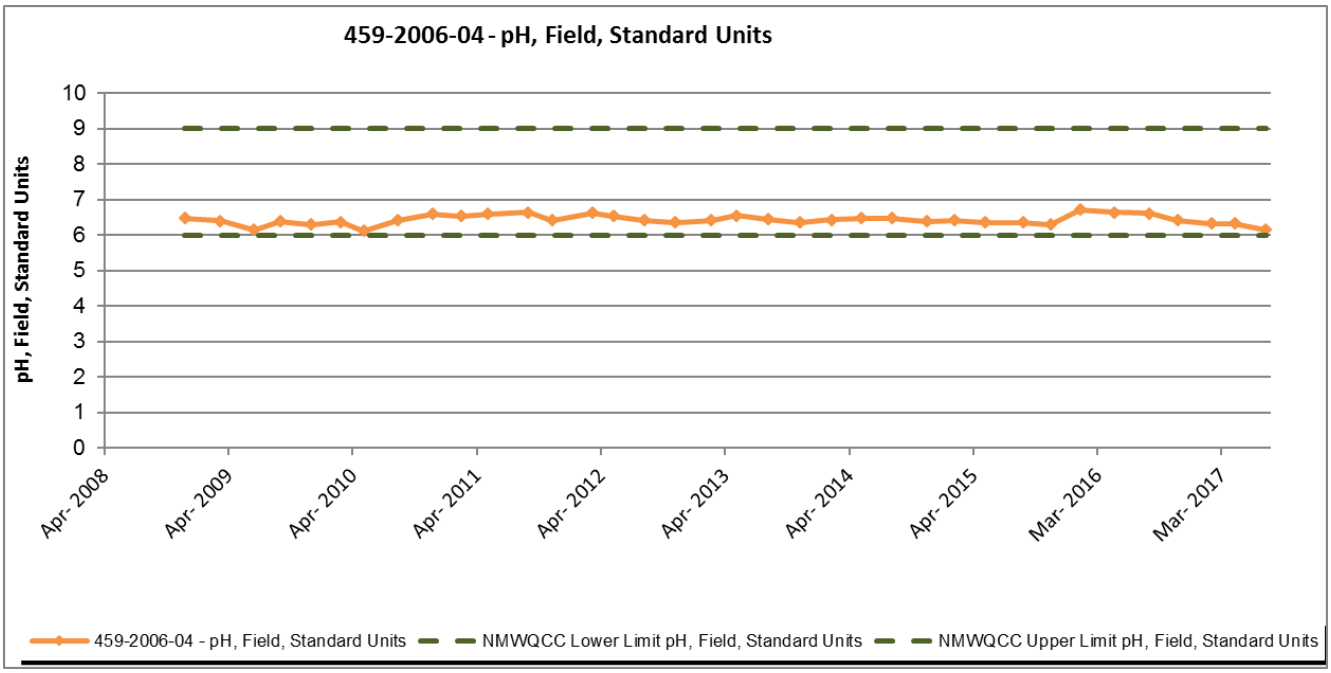

459-2006-04 - Potassium, Dissolved (mg/l)
Potassium, Dissolved (mg/l)
3
2.5
2
1.5
1
0.5
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Potassium, Dissolved (mg/l)

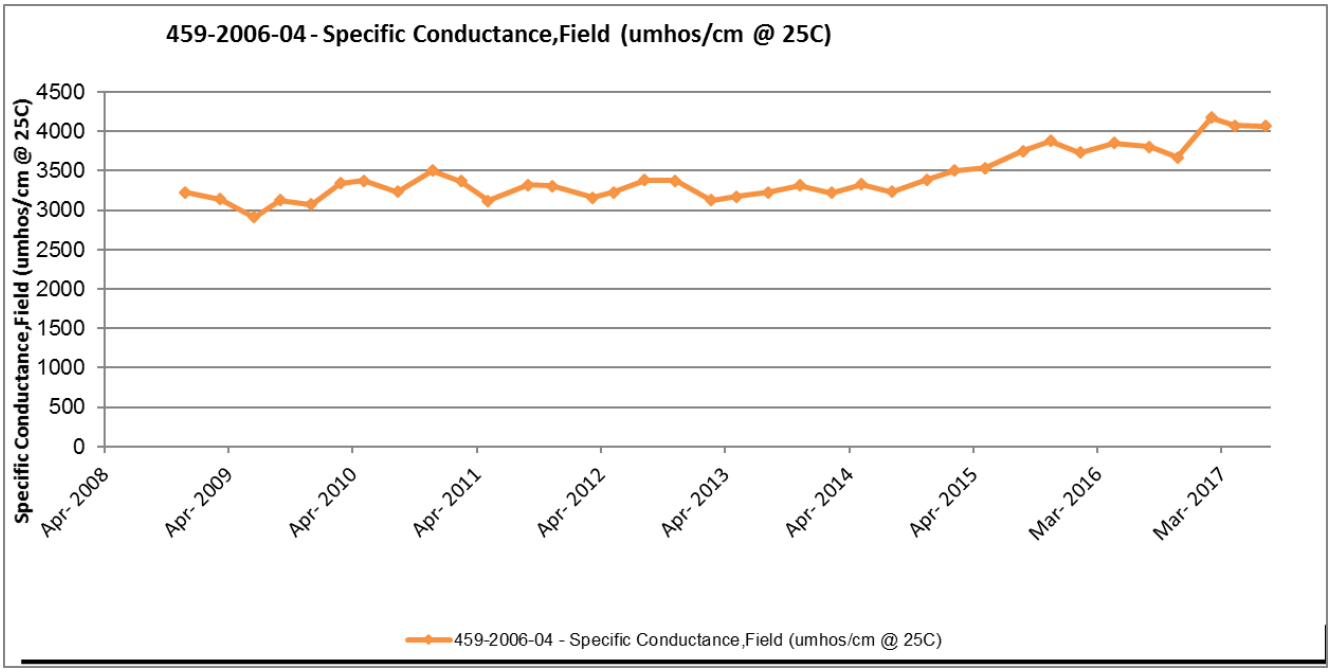

459-2006-04 - Sodium, Dissolved (mg/l)
Sodium, Dissolved (mg/l)
45
40
35
30
25
20
15
10
5
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Sodium, Dissolved (mg/l)


459-2006-04 - Sulfate (mg/l)
Sulfate (mg/l)
2500
2000
1500
1000
500
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Sulfate (mg/l)
NMWQCC Limit Sulfate (mg/l)


459-2006-04 - Total Dissolved Solids (mg/l)
Total Dissolved Solids (mg/l)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Total Dissolved Solids (mg/l)
NMWQCC Limit Total Dissolved Solids (mg/l)


459-2006-04 - Zinc, Dissolved (mg/l)
Zinc, Dissolved (mg/l)
12
10
8
6
4
2
0
May- 2008
May- 2009
May- 2010
May- 2011
May- 2012
May- 2013
May- 2014
May- 2015
May- 2016
May- 2017
459-2006-04 - Zinc, Dissolved (mg/l)
NMWQCC Limit Zinc, Dissolved (mg/l)


459-2006-04 - pH, Field, Standard Units
pH, Field, Standard Units
10
9
8
7
6
5
4
3
2
1
0
Apr-2008
Apr-2009
Apr-2010
Apr-2011
Apr-2012
Apr-2013
Apr-2014
Apr-2015
Mar-2016
Mar-2017
459-2006-04 - pH, Field, Standard Units
NMWQCC Lower Limit pH, Field, Standard Units
NMWQCC Upper Limit pH, Field, Standard Units


459-2006-04 - Specific Conductance,Field (umhos/cm @ 25C)
Specific Conductance,Field (umhos/cm @ 25C)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Apr-2008
Apr-2009
Apr-2010
Apr-2011
Apr-2012
Apr-2013
Apr-2014
Apr-2015
Mar-2016
Mar-2017
459-2006-04 - Specific Conductance,Field (umhos/cm @ 25C)

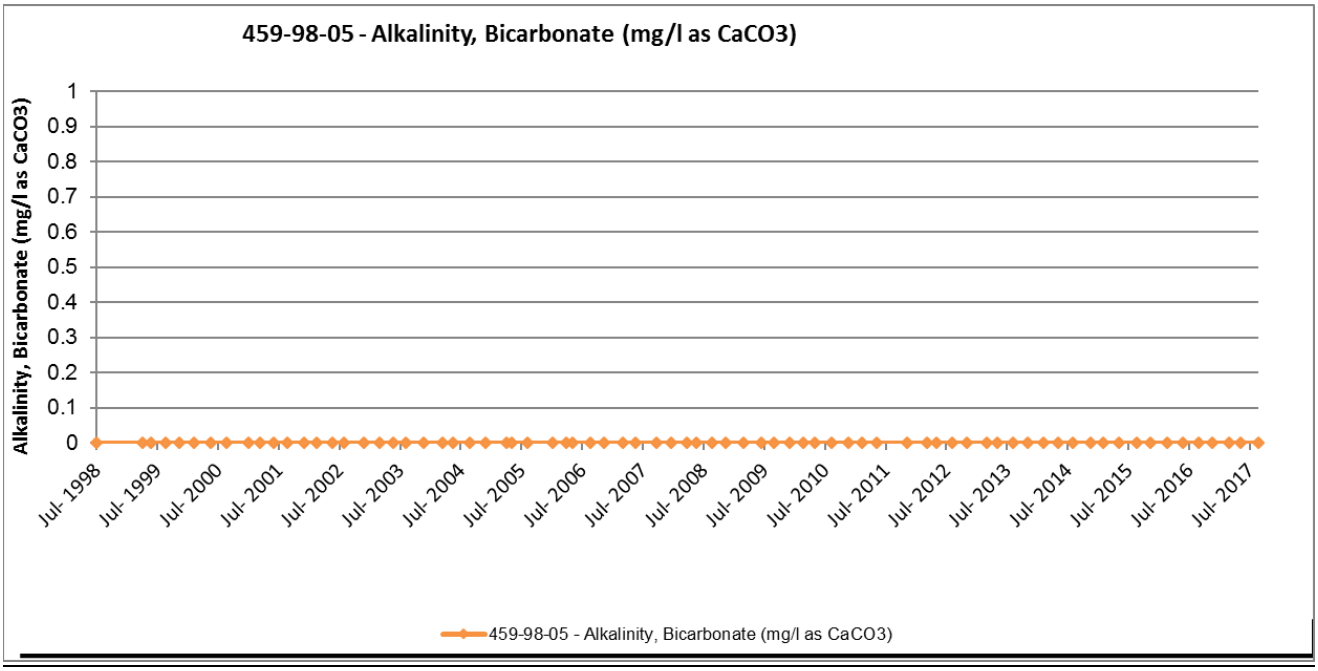
Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

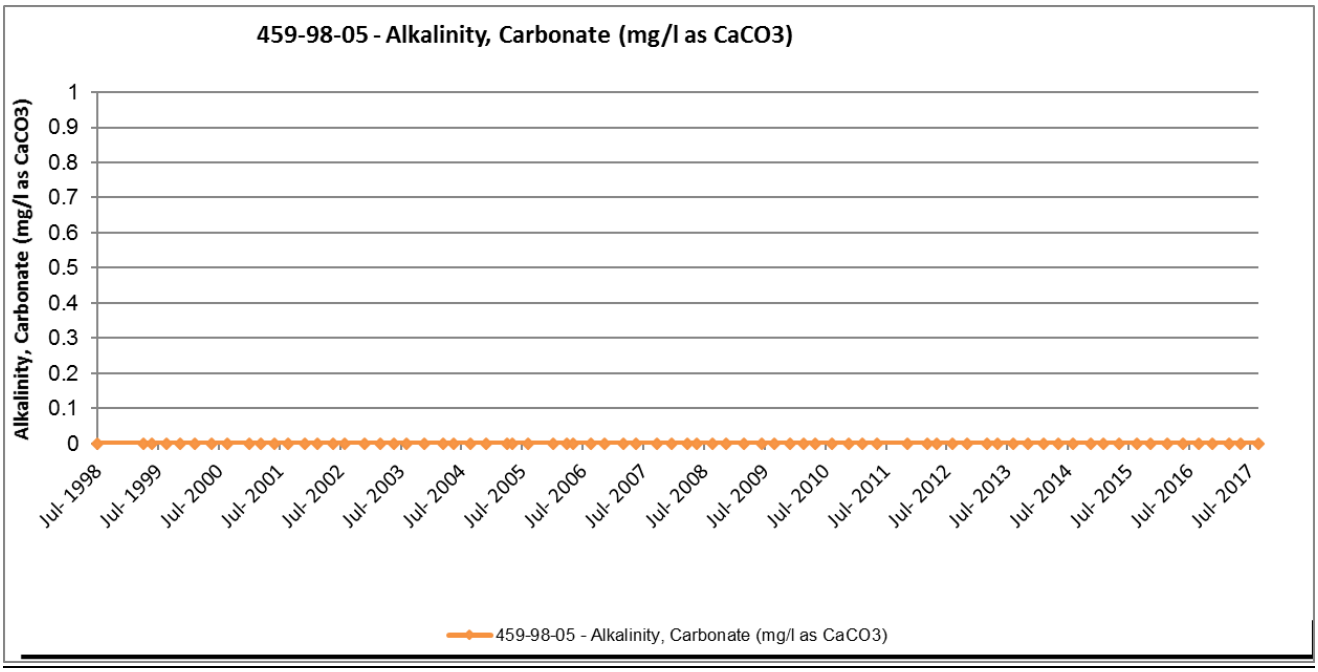
459-98-05

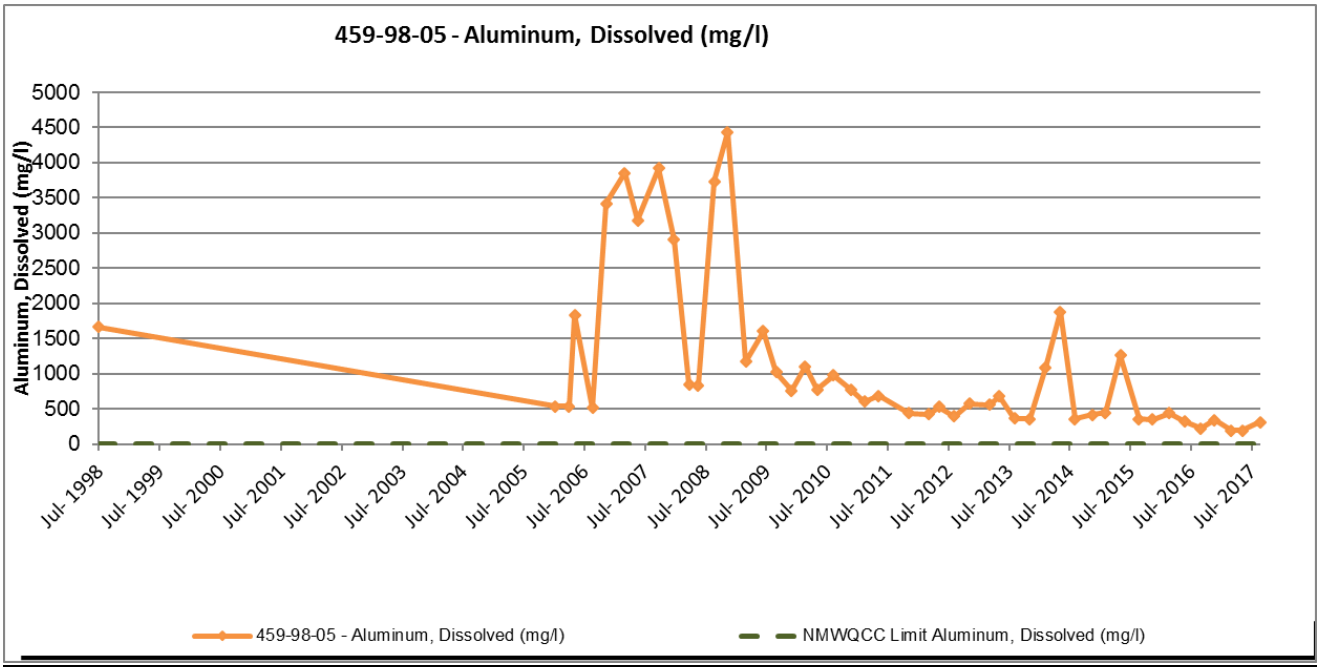
Site Number	Sample Identifier	Sample Date	Al, Diss (mg/L)	Alk, CO3 (mg/L)	Alk, HCO3 (mg/L)	Alk, Tot. (mg/L)	As, Diss (mg/L)	B, Diss (mg/L)	Ca, Diss (mg/L)	Cd, Diss (mg/L)	Co, Diss (mg/L)	Cond, 25C (micromho)	Cr, Diss (mg/L)	Cu, Diss (mg/L)	Fe, Diss (mg/L)	K, Diss (mg/L)	Mg, Diss (mg/L)	Mn, Diss (mg/L)	Na, Diss (mg/L)	Ni, Diss (mg/L)	Pb, Diss (mg/L)	SO4, Tot. (mg/L)	Se, Diss (mg/L)	TDS (mg/L)	Zn, Diss (mg/L)
Water Quality Standard			5				0.1			0.01			0.05	1	1			0.2		0.2	0.05	600	0.05	1000	10
459-98-05	7515	07/08/1998	1,660	<1	<1	NA	<0.4	<0.65	381	0.55	24.1	NA	0.27	734	1,400	<15	2,030	701	18.4	7.26	<0.1	24,300	0.072	43,500	189
459-98-05	8158	04/13/1999	NA	<1	<1	NA	NA	NA	410	0.79	30.8	NA	<0.08	775	1,690	<21	2,540	841	21.3	9.08	<0.77	31,900	NA	47,600	235
459-98-05	8230	06/01/1999	NA	<1	<1	NA	NA	NA	432	0.916	35	NA	<0.05	989	1,900	<17	2,790	918	21.6	10.5	<0.4	83,400	NA	50,000	276
459-98-05	8435	08/30/1999	NA	<1	<1	NA	NA	NA	499	0.789	26.9	NA	0.08	585	1,580	<17	2,190	806	27.3	7.69	<0.4	25,600	NA	32,400	212
459-98-05	8672	11/15/1999	NA	<1	<1	NA	NA	NA	500	0.629	22.8	NA	0.1	511	1,330	<17	2,010	787	41.9	6.64	<0.4	22,500	NA	32,400	193
459-98-05	8872	02/14/2000	NA	<1	<1	NA	NA	NA	450	0.701	24.3	NA	0.103	542	1,440	<8.5	2,100	832	30.7	6.87	<0.2	22,100	NA	33,900	194
459-98-05	9099	05/22/2000	NA	<1	<1	NA	NA	NA	448	0.796	31.4	NA	<0.05	820	1,940	<17	2,750	842	25.9	9.67	<0.4	34,700	NA	51,400	234
459-98-05	9375	08/28/2000	NA	<1	<1	NA	NA	NA	438	0.59	21.1	NA	<0.12	430	1,150	<20	1,870	657	40.5	6.3	0.1	19,500	NA	28,300	170
459-98-05	9671	01/09/2001	NA	<1	<1	NA	NA	NA	461	0.53	24.6	NA	<0.06	518	1,400	<10	2,200	784	32.8	7.24	17	23,600	NA	34,900	193
459-98-05	9957	03/15/2001	NA	<1	<1	<1	NA	NA	443	0.8	31.2	NA	<0.06	756	1,880	<10	2,730	826	25	10.4	<0.05	35,500	NA	54,400	239
459-98-05	25554	06/06/2001	NA	<1	<1	<1	NA	NA	479	1	34.7	NA	<0.3	895	2,240	<50	3,180	917	20.8	10.9	<0.25	38,500	NA	53,200	276
459-98-05	29774	08/30/2001	NA	<1	<1	<1	NA	NA	443	0.88	32.6	NA	0.22	689	1,810	<10	2,740	882	23.5	10.2	0.21	34,600	NA	47,500	240
459-98-05	110029	12/05/2001	NA	<1	<1	<1	NA	NA	393	0.58	19.5	NA	<0.06	359	1,010	<10	1,540	647	31.7	5.4	<0.05	16,000	NA	22,800	159
459-98-05	117919	02/19/2002	NA	<1	<1	<1	NA	NA	482	1.13	39.1	NA	0.54	758	2,180	<10	3,410	1,040	23.1	12.2	0.21	43,100	NA	57,200	319
459-98-05	120592	05/29/2002	NA	<1	<1	<1	NA	NA	502	1.39	42.6	NA	0.66	810	2,540	<10	3,990	1,020	20.1	14.1	<0.05	47,000	NA	68,300	305
459-98-05	212598	08/06/2002	NA	<1	<1	<1	NA	NA	432	0.76	26	NA	<0.06	575	1,600	<10	2,440	845	22.1	8.3	<0.05	26,100	NA	42,100	252
459-98-05	215242	12/04/2002	NA	<1	<1	<1	NA	NA	396	0.523	18.1	NA	0.099	466	628	<5	1,770	801	41.4	5.41	<0.025	14,600	NA	22,000	184
459-98-05	217277	03/06/2003	NA	<1	<1	<1	NA	NA	403	0.938	30.2	NA	0.168	721	1,410	<5	2,690	914	29	9.55	<0.025	31,500	NA	46,600	227
459-98-05	219545	05/28/2003	NA	<1	<1	<1	NA	NA	472	1.03	37.5	NA	0.121	902	2,180	<10	3,530	982	23.7	11.6	<0.05	41,400	NA	60,100	279
459-98-05	221498	08/13/2003	NA	<1	<1	<1	NA	NA	493	1.21	43.5	NA	0.173	1,060	2,390	<10	3,950	1,090	23.7	13.3	<0.05	45,000	NA	66,200	321
459-98-05	222778	11/24/2003	NA	<1	<1	<1	NA	NA	459	1.01	37.8	NA	<0.06	929	2,130	<10	3,570	1,040	26.5	12	<0.5	40,900	NA	58,300	265
459-98-05	225374	03/17/2004	NA	<1	<1	<1	NA	NA	475	1.2	44	NA	0.136	1,270	2,980	<5	4,730	1,320	22.8	14.6	<0.025	47,200	NA	70,500	413
459-98-05	227150	05/19/2004	NA	<1	<1	<1	NA	NA	503	1.25	44.9	NA	0.195	1,050	2,540	<10	4,020	1,090	24.3	14.5	<0.05	50,500	NA	71,400	329
459-98-05	231734	08/30/2004	NA	<1	<1	<1	NA	NA	438	0.53	18.7	NA	<0.3	824	401	<50	1,500	693	<25	5.14	<0.25	15,900	NA	22,200	168
459-98-05	236708	12/01/2004	NA	<1	<1	<1	NA	NA	432	0.772	26.4	NA	<0.12	935	358	<10	2,230	1,280	40	6.93	0.31	17,500	NA	27,000	248
459-98-05	243580	04/04/2005	NA	<1	<1	<1	NA	NA	456	0.67	22.7	NA	<0.3	845	319	<25	1,910	961	31	5.99	<0.25	17,000	NA	23,900	211
459-98-05	248431	05/11/2005	NA	<1	<1	<1	NA	NA	427	0.63	21.5	NA	<0.3	743	205	<25	1,770	913	33	5.92	<0.25	15,400	NA	18,400	195
459-98-05	264961	08/11/2005	NA	<1	<1	<1	NA	NA	461	1.24	41.9	NA	0.42	1,100	1,580	<25	3,580	1,260	<25	11.4	<0.375	39,500	NA	60,700	328
459-98-05	271366	01/12/2006	537	<1	<1	<1	0.25	NA	402	0.545	19	NA	0.042	709	321	<2.5	1,570	841	28.8	5.81	0.086	13,600	NA	19,100	170
459-98-05	274664	04/03/2006	535	<1	<1	<1	<0.5	NA	448	0.64	22.2	NA	0.19	783	338	<10	1,820	1,080	35	2.7	0.33	14,500	NA	21,200	191
459-98-05	281425	05/10/2006	1,830	<1	<1	<1	<1.3	NA	495	0.91	34.1	NA	<0.3	1,040	1,020	<25	2,790	1,180	36	9.4	<0.38	27,800	NA	38,400	280
459-98-05	285032	08/24/2006	514	<1	<1	<1	<0.25	NA	450	0.347	12.8	NA	0.09	638	198	<5	963	435	10.7	3.42	<0.075	9,600	NA	14,300	110
459-98-05	296638	11/15/2006	3,420	<1	<1	<1	<0.25	NA	476	1.06	36	NA	0.875	936	1,780	<5	3,380	949	15.8	10.7	<0.075	36,000	NA	57,700	247
459-98-05	299668	03/06/2007	3,850	<1	<1	<1	<0.25	NA	532	1.31	44.5	NA	0.67	875	2,040	<50	4,580	1,240	<50	12.9	<0.075	50,700	NA	73,100	312
459-98-05	303696	05/24/2007	3,180	<1	<1	<1	<0.25	NA	489	1.24	39	NA	0.75	993	1,690	<5	3,490	1,170	22.9	12.2	1.07	38,400	NA	54,400	263
459-98-05	307514	09/27/2007	3,920	<1	<1	<1	<1.25	NA	457	1.18	38.3	NA	0.415	900	1,870	<25	3,590	988	29.3	11.5	<0.375	46,400	NA	66,000	244
459-98-05	313505	12/26/2007	2,900	<1	<1	<1	<2.5	NA	465	1.11	35	NA	<0.6	829	1,600	<50	3,070	942	<50	10.8	<0.75	37,400	NA	49,000	230
459-98-05	316097	03/26/2008	841	<1	<1	<1	<1.25	NA	438	0.685	25	NA	<0.3	635	618	<25	1,980	916	34.9	6.51	<0.375	14,700	NA	23,000	203
459-98-05	317415	05/21/2008	833	<1	<1	<1	<0.25	NA	434	0.819	27.6	NA	0.261	661	698	<5	2,140	998	35.3	6.28	0.318	19,200	NA	25,000	211
459-98-05	319334	08/26/2008	3,730	<1	<1	<1	<1.25	NA	457	1.1	38.7	NA	0.566	876	1,890	<25	3,530	1,000	<25	10.5	<0.375	41,900	NA	61,000	256
459-98-05	320250	11/13/2008	4,430	<1	<1	<1	<2.5	NA	577	1.17	46.7	NA	<0.6	993	2,430	<50	4,370	1,200	<50	12.6	<0.75	48,500	NA	66,000	329
459-98-05	321053	03/04/2009	1,170	<1	<1	<1	<1.25	NA	416	0.994	36.4	NA	<0.3	1,120	493	<25	2,630	1,390	37.3	9.77	<0.375	25,300	NA	37,500	323
459-98-05	321673	06/15/2009	1,600	<1	<1	<1	<1.25	NA	427	0.874	30.9	NA	<0.3	1,060	430	<25	2,350	1,110	54.3	7.84	<0.375	17,200	NA	37,900	245
459-98-05	322495	09/01/2009	1,020	<1	<1	<1	<1.25	NA	413	0.672	23.7	NA	<0.3	707	484	<25	2,000	849	31.4	10.2	<0.375	14,700	NA	29,300	197
459-98-05	459-98-05	12/02/2009	758	<1	<1	<1	<1.25	NA	430	0.633	21.7	NA	<0.3	662	304	<25	1,740	828	30.8	5.45	<0.375	12,100	NA	23,500	181
459-98-05	323138	02/24/2010	1,100	<1	<1	<1	<0.252	NA	524	0.823	29.7	NA	<0.0606	789	486	<5.05	2,710	1,130	42.7	7.72	<0.0758	18,900	NA	27,500	250
459-98-05	323783	05/05/2010	770	<1	<1	<1	<2.5	NA	424	0.769	32	NA	<0.6	893	315	<50	2,360	1,300	<50	7.23	<0.75	20,700	NA	25,900	277
459-98-05	324699	08/12/2010	972	<1	<1	<1	<0.5	NA	450	0.531	20.5	NA	0.141	677	433	<10	1,670	703	18.6	5.64	<0.15	15,300	NA	24,700	158
459-98-05	325426	11/23/2010	771	<1	<1	<1	<1.25	NA	544	0.659	24.6	NA	<0.3	787	317	<25	1,890	922	35.7	6.15	<0.375	12,000	NA	18,400	193
459-98-05	326228	02/15/2011	604	<1	<1	<1	<1.25	NA	420	0.761	26.9	NA	<0.3	795	238	<25	1,910	1,080	32.6	6.42	<0.375	16,800	NA	25,400	230
459-98-05	326916	05/10/2011	680	<1	<1	<1	<1.25	NA	456	0.917	31.9	NA	<0.3	917	278	<25	2,400	1,280	41.3	7.77	<0.375	25,100	NA	27,600	267
459-98-05	327728	08/31/2011	383	<1	<1	<1	<1.25	NA	340	0.388	14.3	NA	<0.3	484	104	<25	1,150	573	<25	2.59	<0.375	12,300	NA	18,700	123
459-98-05	328411	11/09/2011	434	<1	<1	<1	<2.5	NA	397	0.615	21.6	NA	<0.6	669	176	<50	1,600	848	<50	5.25	<0.75	13,200	NA	21,100	186
459-98-05	329209	03/08/2012	419	<1	<1	<1	<1.25	NA	418	0.571	20.6	NA	<0.3	581	140	<25	1,540	812	29.4	4.66	<0.375	14,300	NA	20,300	177
459-98-05	329939	05/07/2012	523	<1	<1	<1	<1.25	NA	438	0.617	21.3	NA	<0.3	539	330	<25	1,660	818	29.3	5.69	<0.375	14,500	NA	21,500	179
459-98-05	330791	08/07/2012	396	<1	<1	<1	<1.25	NA	423	0.519	17.4	NA	<0.3	569	165	<25	1,320	658	27	4.36	<0.375	12,100	NA	17,700	138
459-98-05	331540	11/06/2012	569	<1	<1	<1	<1.25	NA	453	0.544	19.8	NA	<0.3	587	283	<25	1,580	727	27.6	4.78	<0.375	13,200	NA	18,800	159
459-98-05	332389	03/06/2013	555	<1	<1	<1	<2.5	NA	422	0.542	20.9	NA	<0.6	525	455	<50	1,730	804	<50	5.51	<0.75	16,500	NA	22,100	170
459-98-05	333134	05/06/2013	679	<1	<1	<1	<1.25	NA	402	0.635	22.5	NA	<0.3	524	565	<25	1,750	800	29.8	5.47	<0.375	17,400	NA	25,300	178
459-98-05	334106	08/07/2013	360	<1	<1	<1	<1.25	NA	410	0.342	11.4	NA	<0.3	384	166	<25	930	400	<25	2.83	<0.375	9,330	NA	14,000	84.8
459-98-05	334874	11/06/2013	356	<1	<1	<1	<0.5	NA	438	0.379	14.4	NA	<0.12	442	152	<10	1,100	518	20.8	3.48	<0.15	10,900	NA	14,500	124
459-98-05	335765	02/07/2014	1,090	<1	<1	<1	<1.25	NA	471	0.746	24.7	NA	<0.3	703	796	<25	2,240	774	27.3	7.07	<0.375	23,200	NA	27,800	186
459-98-05	336526	05/08/2014	1,880	<1	<1	<1	<1.25	NA	425	0.851	28.9	NA	<0.3	757	1,250	<25	2,530	853	<25	8.65	<0.375	29,100	NA	40,900	211
459-98-05	337496	08/04/2014	355	<1	<1	<1	<1.25	NA	435	0.224	9.04	NA	<0.3	371	131	<25	758	279	<25	2.37	<0.375	7,840	NA	11,200	67.9
459-98-05	338279	11/17/2014	412	<1	<1	<1	<1.25	NA	436	0.378	14	NA	<0.3	517	130	<25	1,120	483	<25	3.71	<0.375	10,600	NA	14,000	112
459-98-05	339186	02/04/2015	443	<1	<1	<1	<1.25	NA	424	0.512	17.7	NA	<0.3	598	185	<25	1,340	617	<25	4.55	<0.375	15,000	NA	18,000	142
459-98-05	339954	05/06/2015	1,260	<1	<1	<1	<1.25	NA	454	0.656	23.7	NA	<0.3	741	717	<25	2,050	713	25.7	6.36	<0.375	21,400	NA	30,500	175
459-98-05	340978	08/25/2015	356	<1	<1	<1	<1.25	NA	433	0.224	9.15	NA	<0.3	381	82.6	<25	758	283	<25	2.43	<0.375	7,790	NA	11,600	67.8
459-98-05	341804	11/13/2015	347	<1	<1	<1	<1.25	NA	422	0.386	14.1	NA	<0.3	541	100	<25	1,000	412	<25	3.66	<0.375	9,190	NA	13,500	110
459-98-05	342813	02/23/2016	434	<1	<1	<1	<1.25	NA	464	0.654	22.2	NA	<0.3	806	139	<25	1,500	716	26	5.3	<0.375	11,600	NA	18,100	179
459-98-05	343670	05/26/2016	317	<1	<1	<1	<0.25	NA	428	0.354	12.9	NA	<0.06	504	105	<5	1,020	421	25.7	3.21	<0.075	8,840	NA	13,400	97.7
459-98-05	344968	08/31/2016	224	<1	<1	<1	<0.25	NA	403	0.157	6.26	NA	<0.06	275	33.1	<5	591	182	17.2	1.63	<0.075	6,030	NA	8,880	46.5
459-98-05	345984	11/21/2016	339	<1	<1	<1	<0.25	NA	498	0.311	11.3	NA	<0.06	457	71.2	<5	908	345	25.4	2.82	0.252	7,840	NA	11,000	88.6
459-98-05	347060	03/01/2017	191	<1	<1	<1	<0.25	NA	432	0.146	5.93	NA	<0.06	247	33.6	<5	594	189	32.4	1.55	<0.075	5,700	NA	8,130	45.1
459-98-05	348062	05/08/2017	193	<1	<1	<1	<1.25	NA	457	0.146	6.53	NA	<0.3	258	31.4	<25	607	215	36.1	1.66	<0.375	5,900	NA	7,980	51.2
459-98-05	349121	08/22/2017	308	<1	<1	<1	<1.25	NA	450	0.257	11.8	NA	<0.3	454	63.5	<25	925	385	35.7	2.86	<0.375	8,520	NA	12,400	97.8

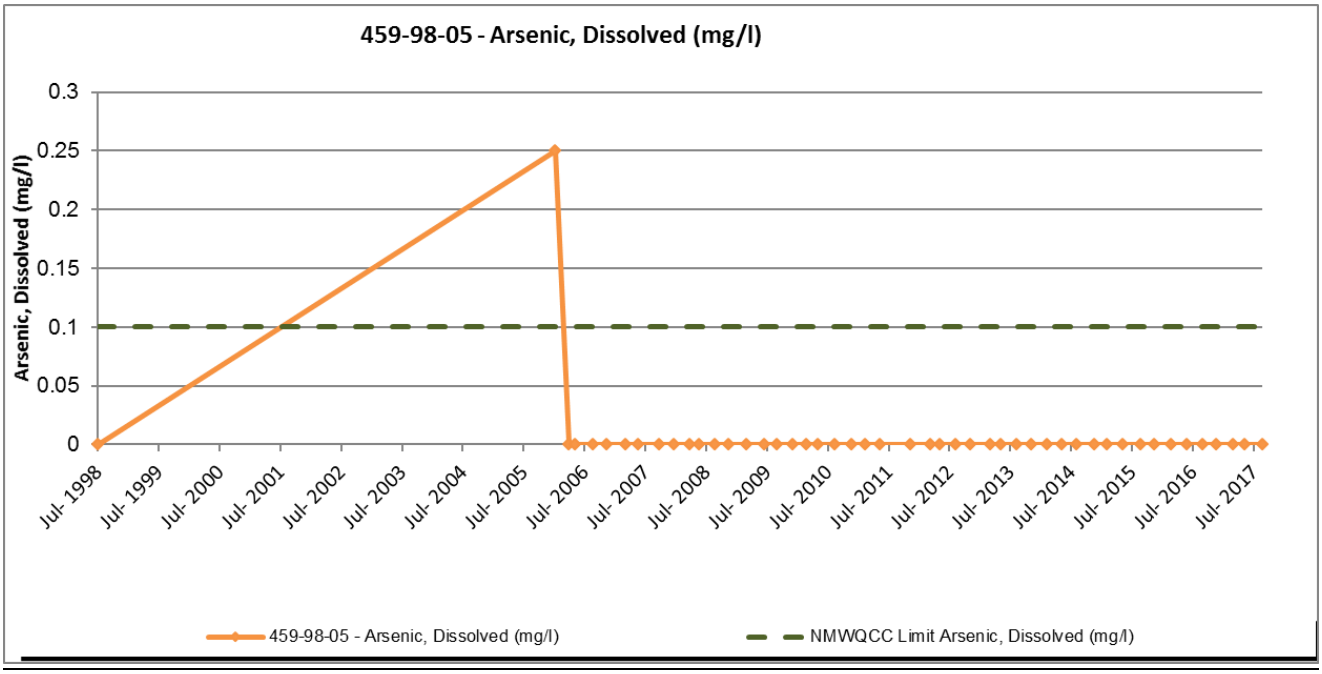
Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

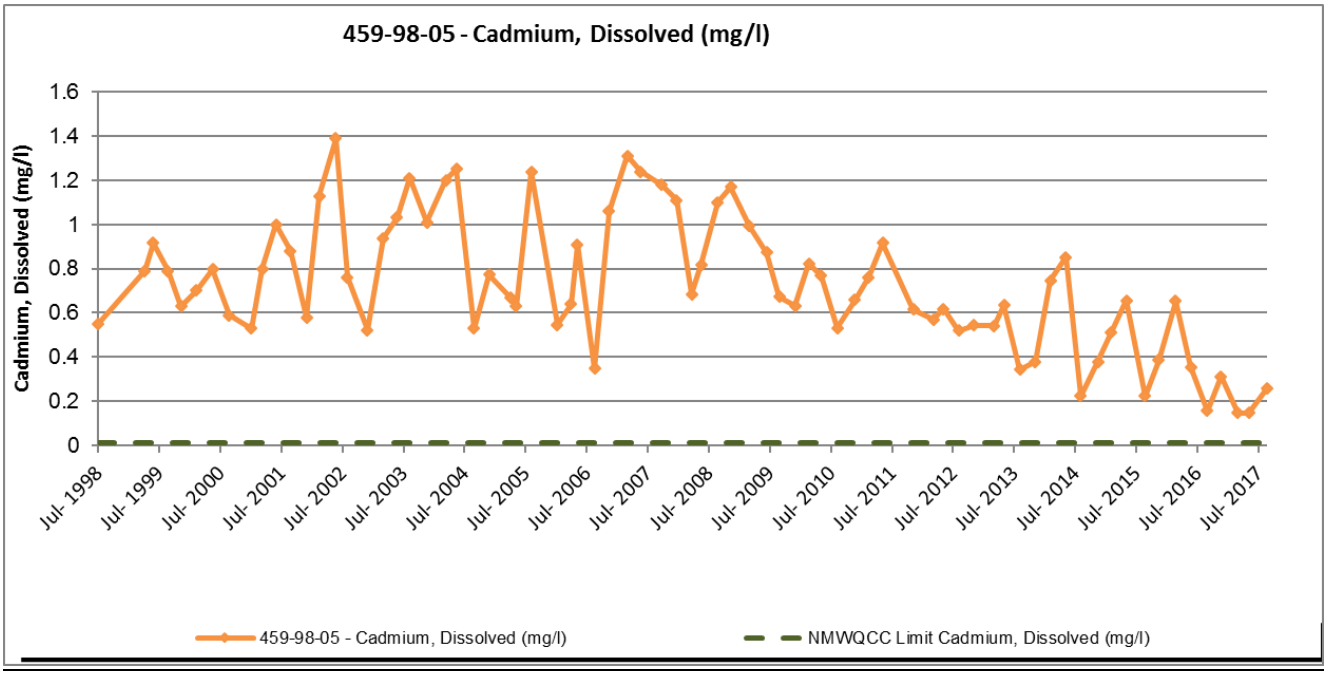
Site Number	Sample Identifier	Sample Date	Cond, Fld (micromho)	Cond, 25C (micromho)	pH, Field (SU)
Water Quality Standard					6 - 9
459-98-05	8158	04/13/1999	17,100	19,313	NA
459-98-05	8230	06/01/1999	18,000	19,489	NA
459-98-05	8435	08/30/1999	15,380	16,721	NA
459-98-05	8672	11/15/1999	13,800	15,756	NA
459-98-05	8872	02/14/2000	14,260	16,389	NA
459-98-05	9099	05/22/2000	18,780	20,807	**3.31**
459-98-05	9375	08/28/2000	13,010	14,662	**3.17**
459-98-05	9671	01/09/2001	14,380	16,784	**2.94**
459-98-05	9957	03/15/2001	18,440	20,872	**3.62**
459-98-05	25554	06/06/2001	20,010	21,710	**3.54**
459-98-05	29774	08/30/2001	19,030	21,493	**2.51**
459-98-05	110029	12/05/2001	10,940	12,601	**2.73**
459-98-05	117919	02/19/2002	21,610	23,741	**2.45**
459-98-05	120592	05/29/2002	24,030	26,345	**2.61**
459-98-05	212598	08/06/2002	16,730	18,419	**2.87**
459-98-05	215242	12/04/2002	10,840	12,458	**2.68**
459-98-05	217277	03/06/2003	18,590	21,179	**2.97**
459-98-05	219545	05/28/2003	21,860	23,522	**3.32**
459-98-05	221498	08/13/2003	22,770	24,911	**3.44**
459-98-05	222778	11/24/2003	20,790	23,481	**3.53**
459-98-05	225374	03/17/2004	26,030	28,300	**3.58**
459-98-05	227150	05/19/2004	24,270	25,234	**3.63**
459-98-05	231734	08/30/2004	11,090	12,445	**2.94**
459-98-05	236708	12/01/2004	12,250	14,079	**3.25**
459-98-05	243580	04/04/2005	12,000	13,211	**2.98**
459-98-05	248431	05/11/2005	11,740	13,146	**3.19**
459-98-05	264961	08/11/2005	2,263	2,518	**2.64**
459-98-05	271366	01/12/2006	1,065	1,246	**3.15**
459-98-05	274664	04/03/2006	11,430	13,136	**3.06**
459-98-05	281425	05/10/2006	17,610	18,718	**3.19**
459-98-05	285032	08/24/2006	8,260	9,410	**3.26**
459-98-05	296638	11/15/2006	21,080	24,173	**2.82**
459-98-05	299668	03/06/2007	25,680	28,694	**2.56**
459-98-05	303696	05/24/2007	21,140	24,137	**2.75**
459-98-05	307514	09/27/2007	23,930	27,027	**2.79**
459-98-05	313505	12/26/2007	20,100	23,409	**2.75**
459-98-05	316097	03/26/2008	11,950	13,794	**3**
459-98-05	317415	05/21/2008	13,310	14,904	**3.12**
459-98-05	319334	08/26/2008	23,160	26,101	**2.76**
459-98-05	320250	11/13/2008	21,740	25,375	**2.73**
459-98-05	321053	03/04/2009	15,930	18,389	**2.72**
459-98-05	321673	06/15/2009	15,590	17,684	**2.73**
459-98-05	322495	09/01/2009	13,640	15,405	**2.91**
459-98-05	459-98-05	12/02/2009	10,960	12,736	**3.18**
459-98-05	323138	02/24/2010	13,310	15,033	**3.32**
459-98-05	323783	05/05/2010	14,610	16,187	**3.13**
459-98-05	324699	08/12/2010	12,300	13,127	**2.97**
459-98-05	325426	11/23/2010	10,310	11,823	**3.11**
459-98-05	326228	02/15/2011	12,540	15,178	**3.09**
459-98-05	326916	05/10/2011	12,760	14,505	**3.28**
459-98-05	327728	08/31/2011	10,170	10,921	**3.28**
459-98-05	328411	11/09/2011	10,520	12,064	**3.24**
459-98-05	329209	03/08/2012	10,080	11,713	**2.81**
459-98-05	329939	05/07/2012	10,790	11,539	**3.39**
459-98-05	330791	08/07/2012	4,549	4,956	**3.4**
459-98-05	331540	11/06/2012	10,450	11,385	**3.29**
459-98-05	332389	03/06/2013	10,930	12,534	**3.59**
459-98-05	333134	05/06/2013	12,520	13,901	**3.54**
459-98-05	334106	08/07/2013	8,110	8,929	**3.37**
459-98-05	334874	11/06/2013	8,100	9,129	**3.18**
459-98-05	335765	02/07/2014	12,590	14,565	**3.32**
459-98-05	336526	05/08/2014	17,050	18,692	**3.51**
459-98-05	337496	08/04/2014	6,930	7,566	**2.9**
459-98-05	338279	11/17/2014	8,180	9,319	**2.98**
459-98-05	339186	02/04/2015	9,780	10,633	**3.07**
459-98-05	339954	05/06/2015	13,510	15,128	**3.13**
459-98-05	340978	08/25/2015	6,740	7,420	**3.05**
459-98-05	341804	11/13/2015	7,740	8,818	**2.9**
459-98-05	342813	02/23/2016	9,400	10,686	**2.98**
459-98-05	343670	05/26/2016	7,660	8,559	**3.23**
459-98-05	344968	08/31/2016	5,480	6,203	**3.29**
459-98-05	345984	11/21/2016	6,199	7,124	**2.42**
459-98-05	347060	03/01/2017	5,764	6,581	**3.16**
459-98-05	348062	05/08/2017	5,740	6,497	**3.12**
459-98-05	349121	08/22/2017	8,250	9,007	**3.72**

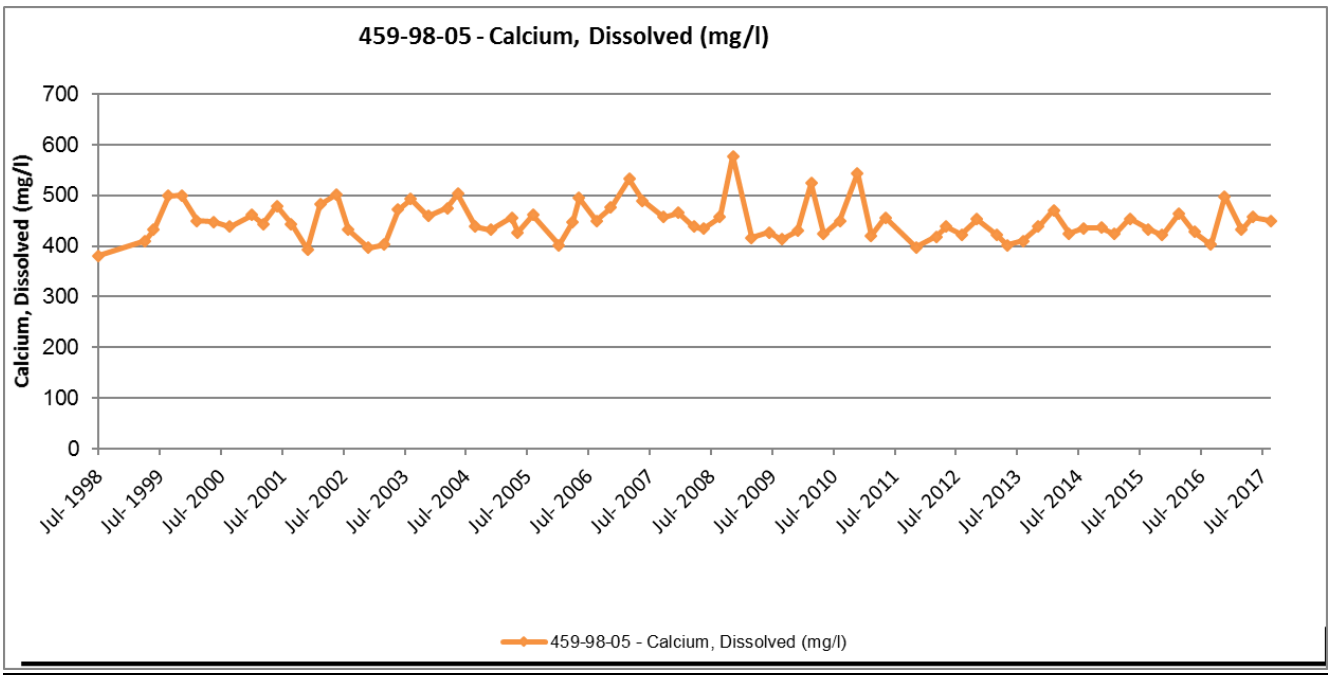

459-98-05 - Alkalinity, Bicarbonate (mg/l as CaCO3)
Alkalinity, Bicarbonate (mg/l as CaCO3)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Alkalinity, Bicarbonate (mg/l as CaCO3)

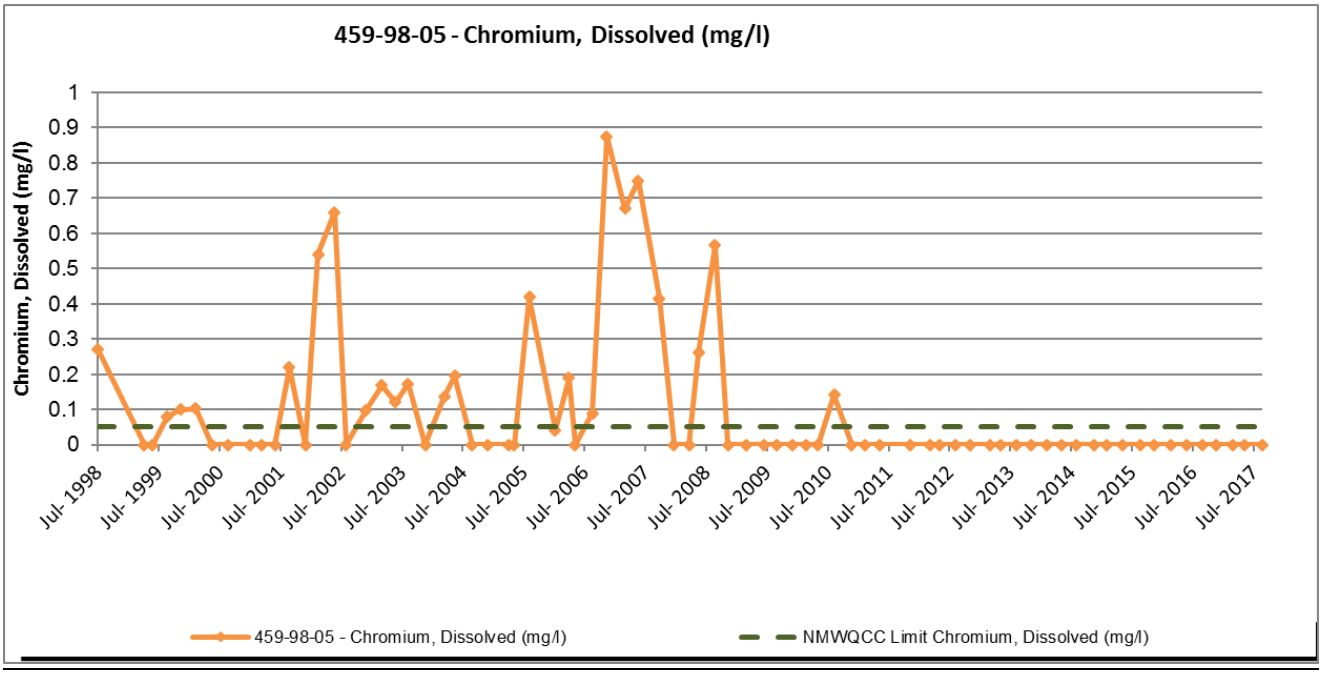

459-98-05 - Alkalinity, Carbonate (mg/l as CaCO3)
Alkalinity, Carbonate (mg/l as CaCO3)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Alkalinity, Carbonate (mg/l as CaCO3)

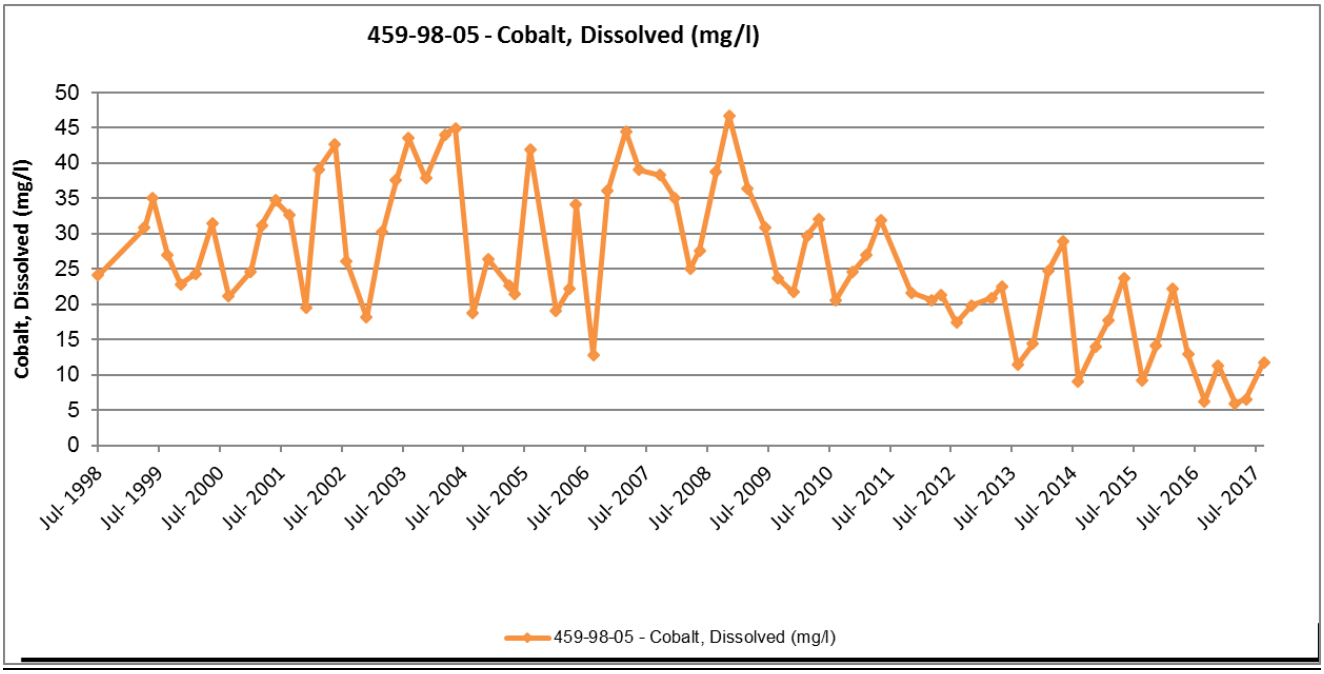

459-98-05 - Aluminum, Dissolved (mg/l)
Aluminum, Dissolved (mg/l)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Aluminum, Dissolved (mg/l)
NMWQCC Limit Aluminum, Dissolved (mg/l)

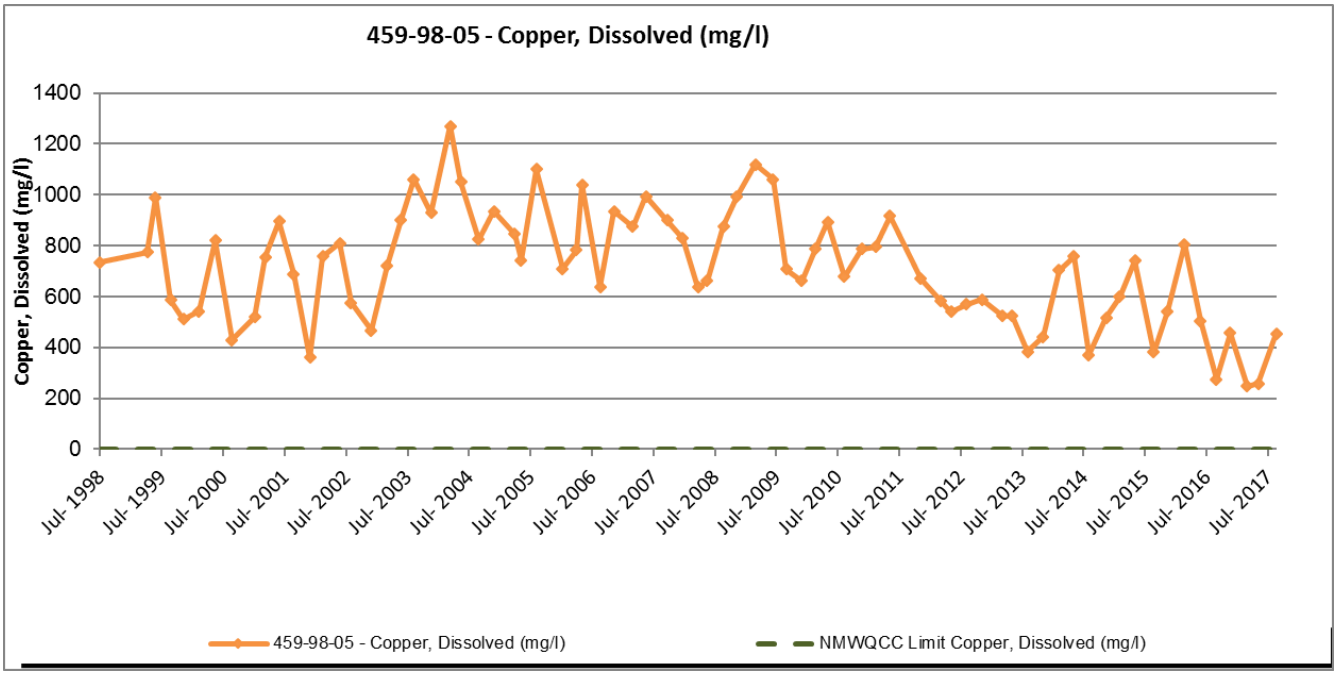

459-98-05 - Arsenic, Dissolved (mg/l)
Arsenic, Dissolved (mg/l)
0.3
0.25
0.2
0.15
0.1
0.05
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Arsenic, Dissolved (mg/l)
NMWQCC Limit Arsenic, Dissolved (mg/l)

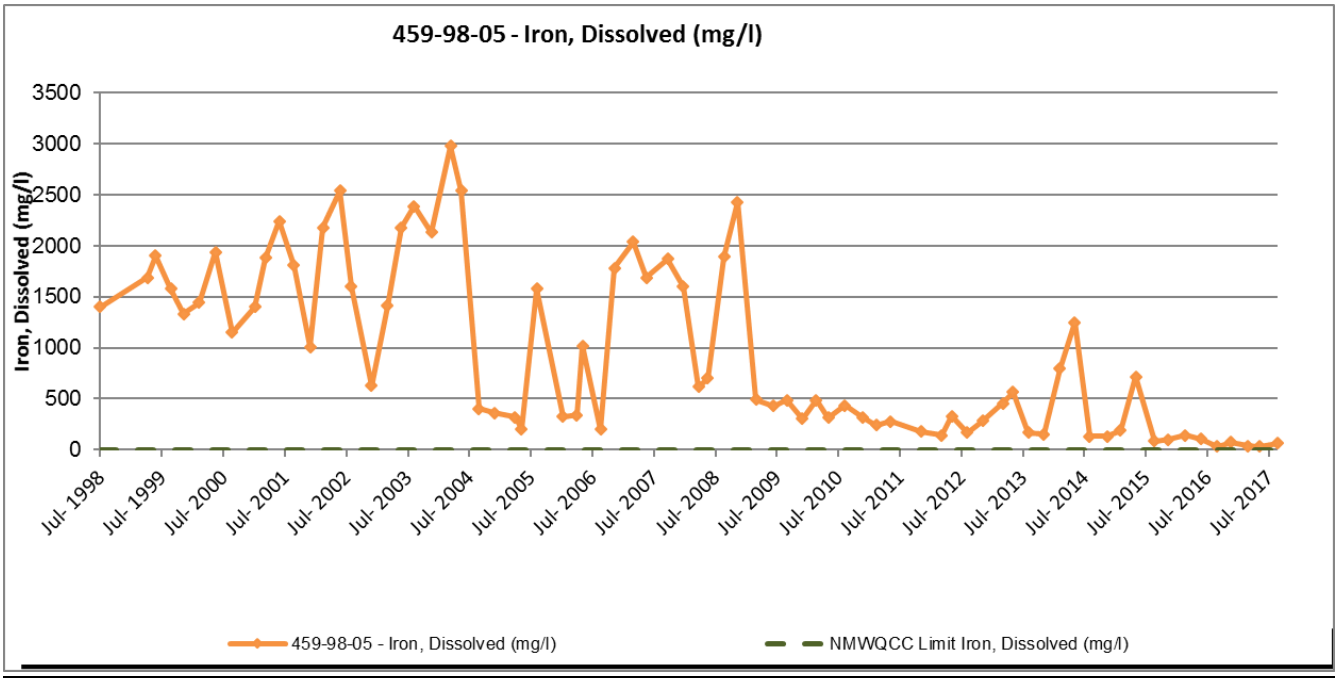

459-98-05 - Cadmium, Dissolved (mg/l)
Cadmium, Dissolved (mg/l)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Cadmium, Dissolved (mg/l)
NMWQCC Limit Cadmium, Dissolved (mg/l)

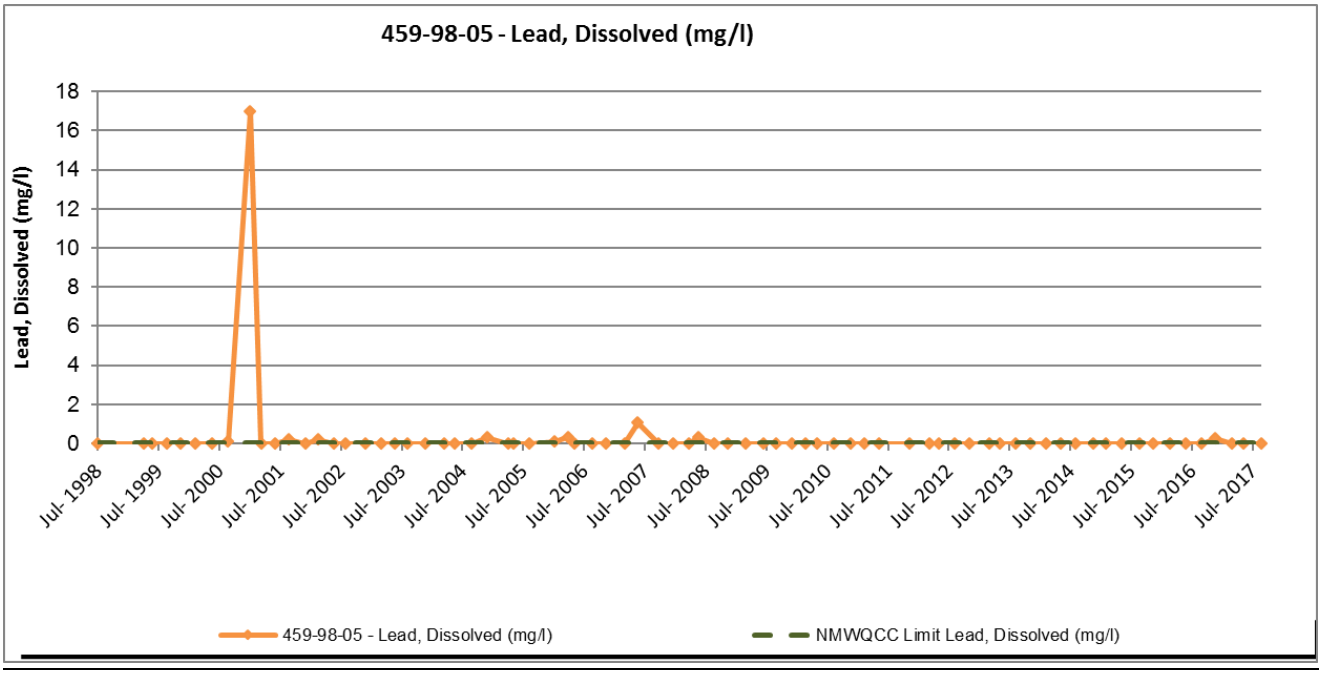

459-98-05 - Calcium, Dissolved (mg/l)
Calcium, Dissolved (mg/l)
700
600
500
400
300
200
100
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Calcium, Dissolved (mg/l)

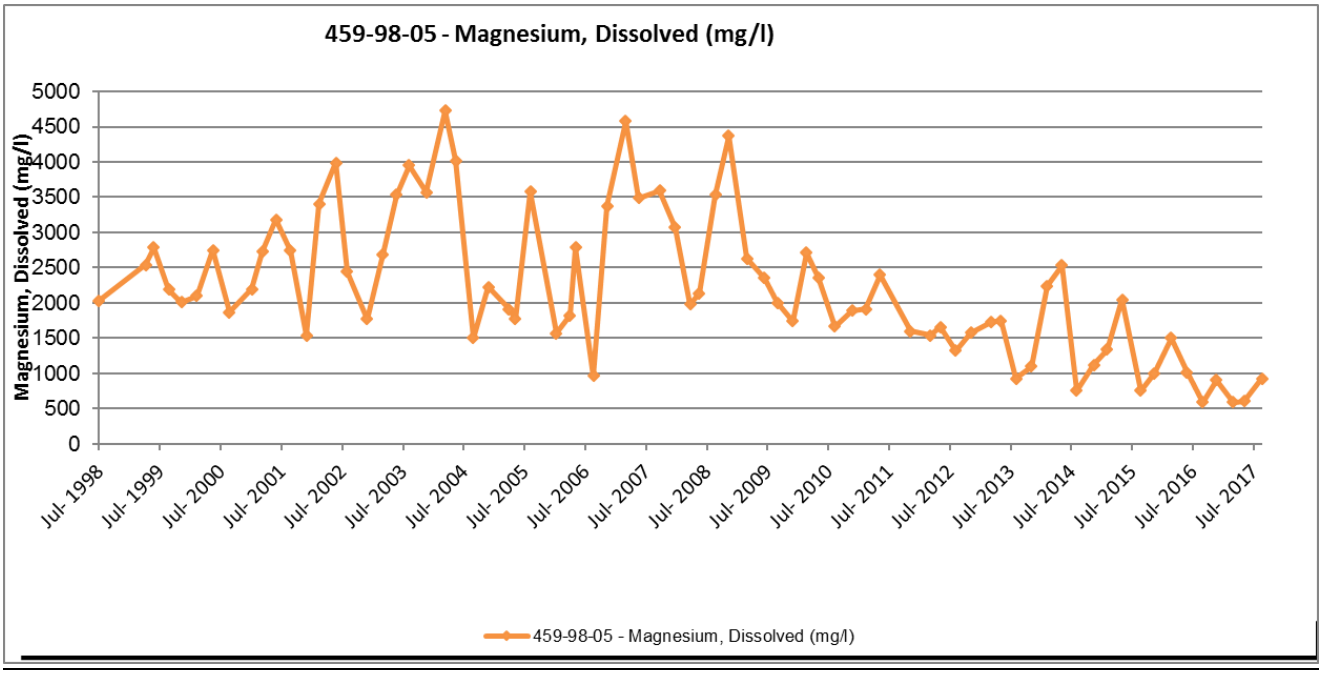

459-98-05 - Chromium, Dissolved (mg/l)
Chromium, Dissolved (mg/l)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Chromium, Dissolved (mg/l)
NMWQCC Limit Chromium, Dissolved (mg/l)

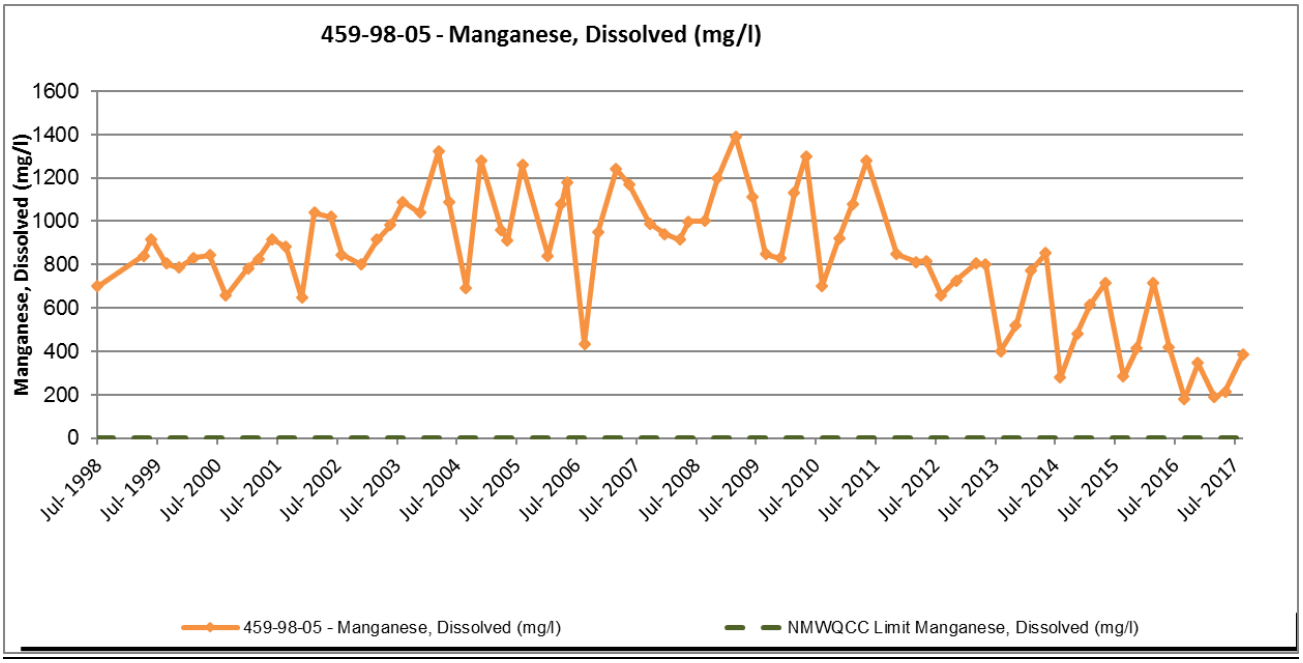

459-98-05 - Cobalt, Dissolved (mg/l)
Cobalt, Dissolved (mg/l)
50
45
40
35
30
25
20
15
10
5
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Cobalt, Dissolved (mg/l)

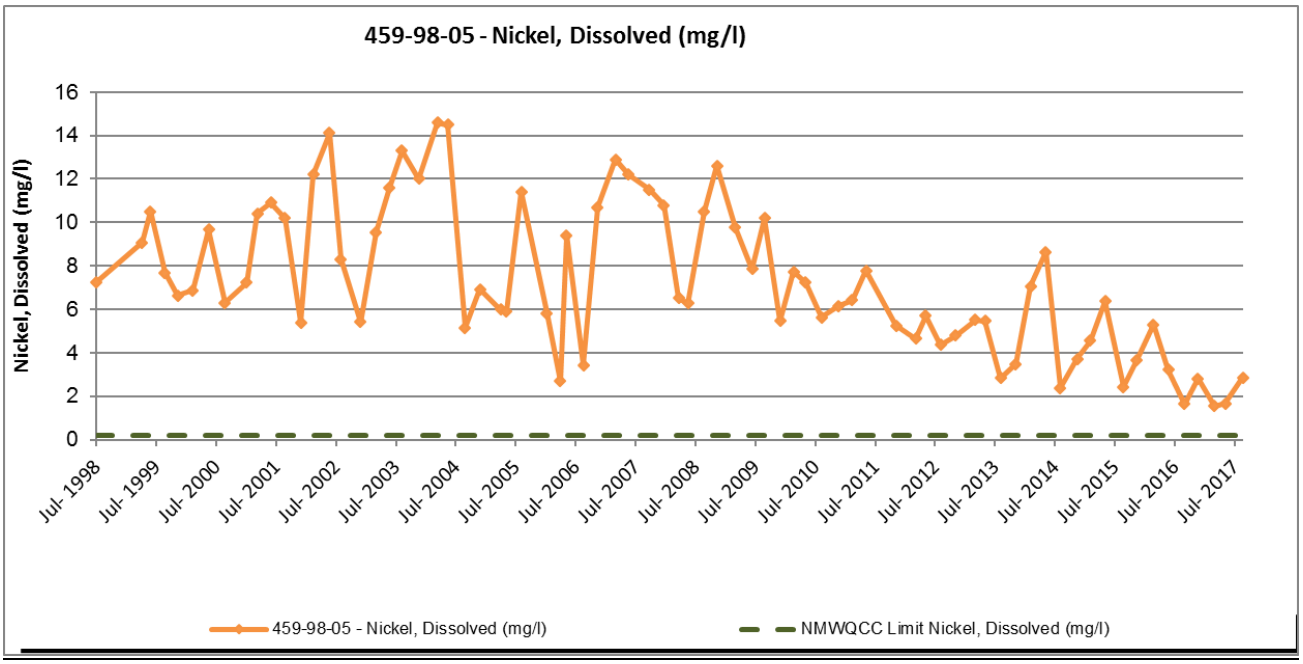

459-98-05 - Copper, Dissolved (mg/l)
Copper, Dissolved (mg/l)
1400
1200
1000
800
600
400
200
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Copper, Dissolved (mg/l)
NMWQCC Limit Copper, Dissolved (mg/l)

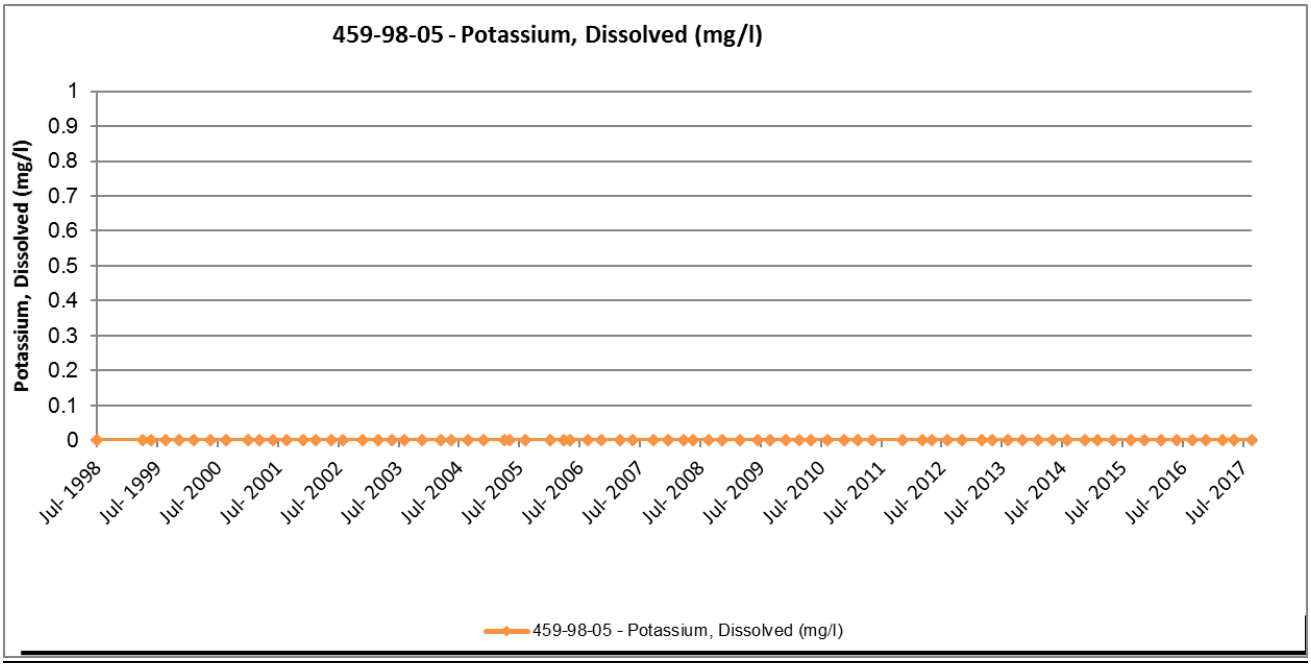

459-98-05 - Iron, Dissolved (mg/l)
Iron, Dissolved (mg/l)
3500
3000
2500
2000
1500
1000
500
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Iron, Dissolved (mg/l)
NMWQCC Limit Iron, Dissolved (mg/l)

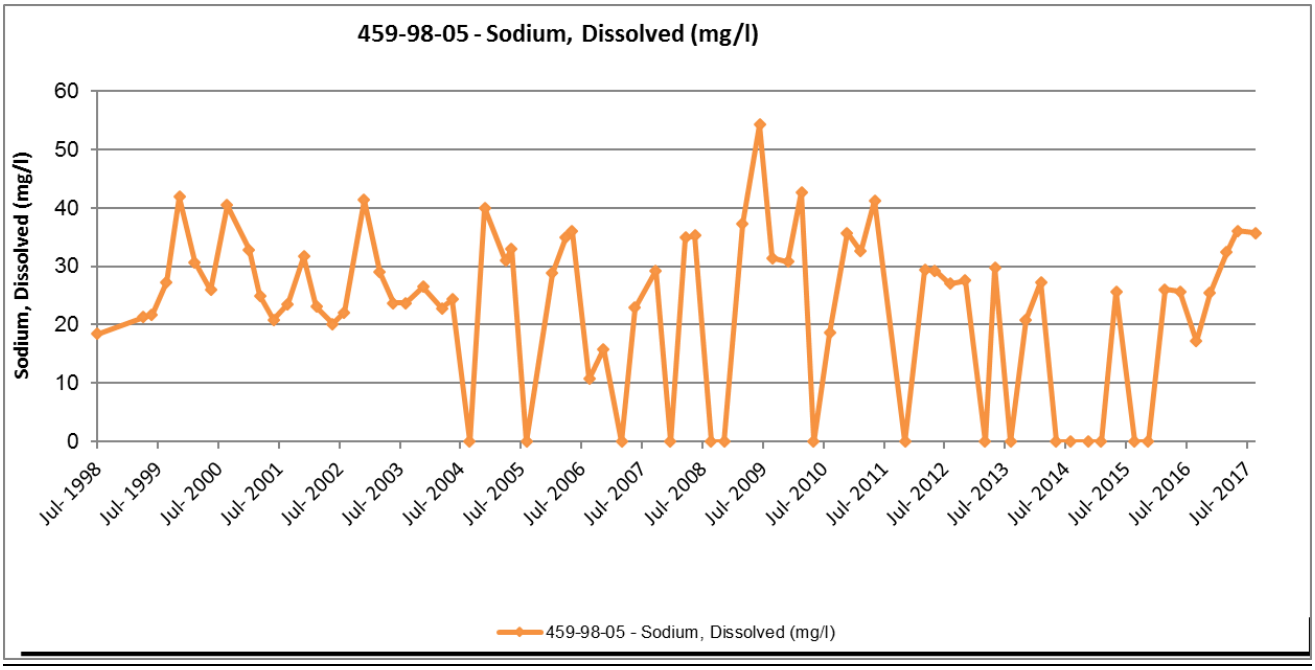

459-98-05 - Lead, Dissolved (mg/l)
Lead, Dissolved (mg/l)
18
16
14
12
10
8
6
4
2
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Lead, Dissolved (mg/l)
NMWQCC Limit Lead, Dissolved (mg/l)

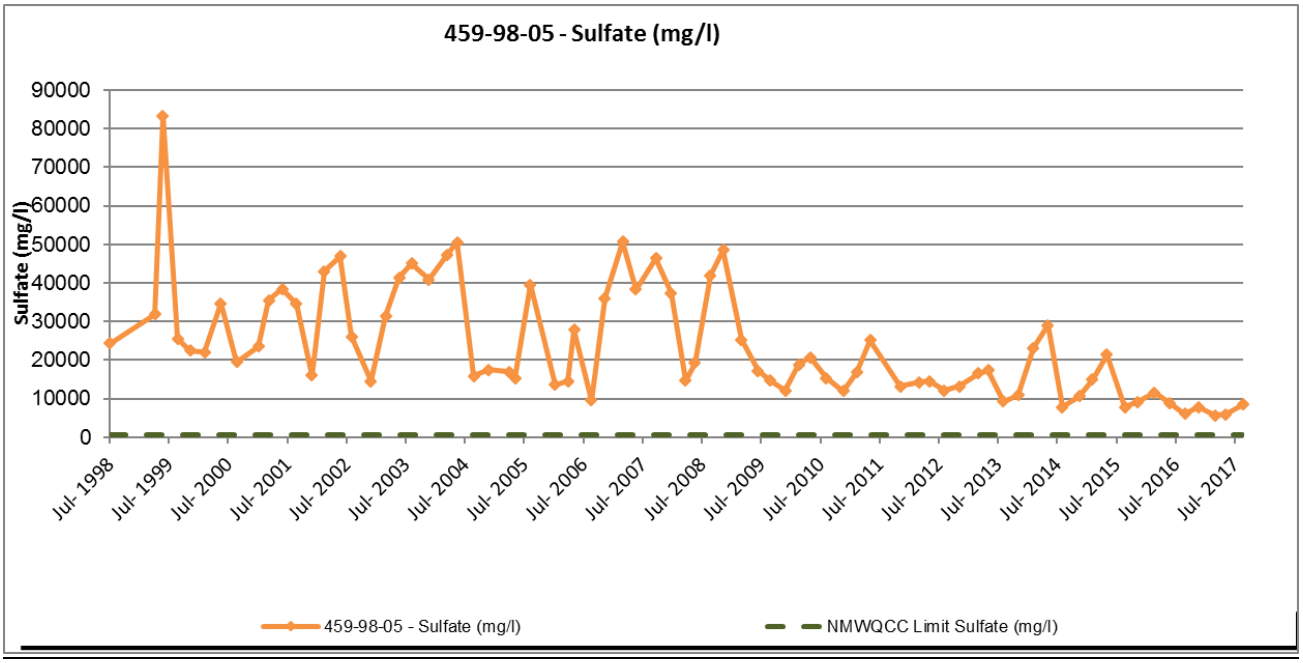

459-98-05 - Magnesium, Dissolved (mg/l)
Magnesium, Dissolved (mg/l)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Magnesium, Dissolved (mg/l)

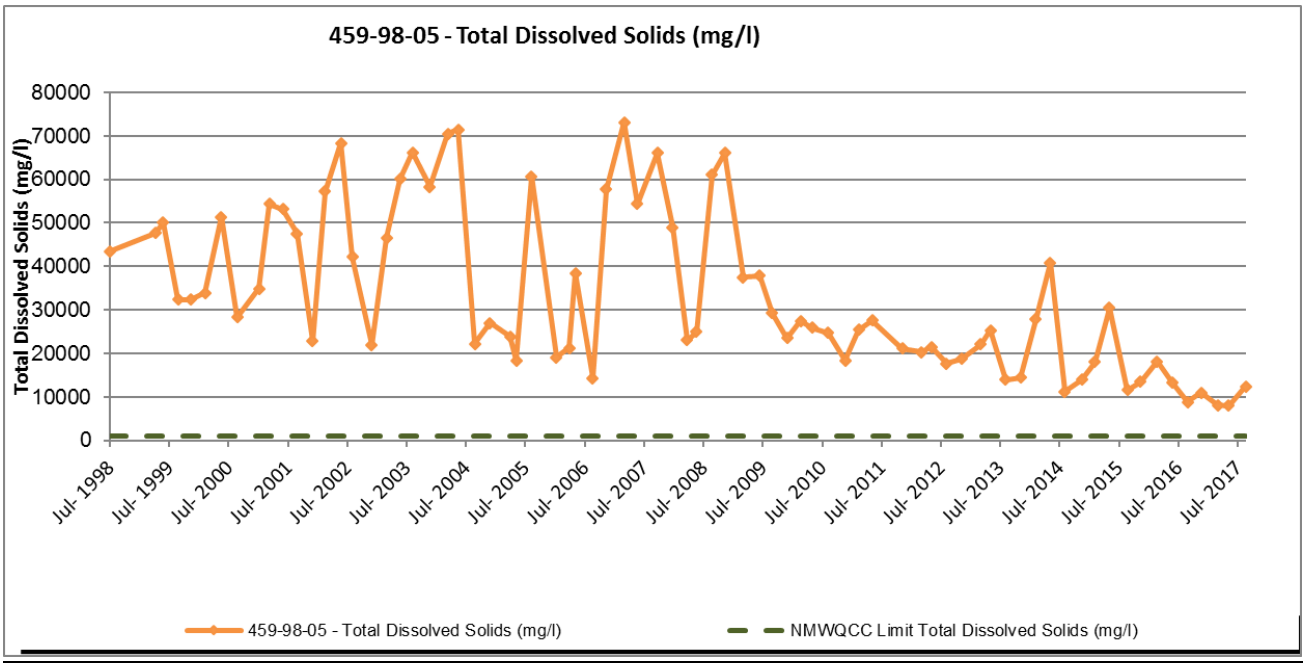

459-98-05 - Manganese, Dissolved (mg/l)
Manganese, Dissolved (mg/l)
1600
1400
1200
1000
800
600
400
200
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Manganese, Dissolved (mg/l)
NMWQCC Limit Manganese, Dissolved (mg/l)

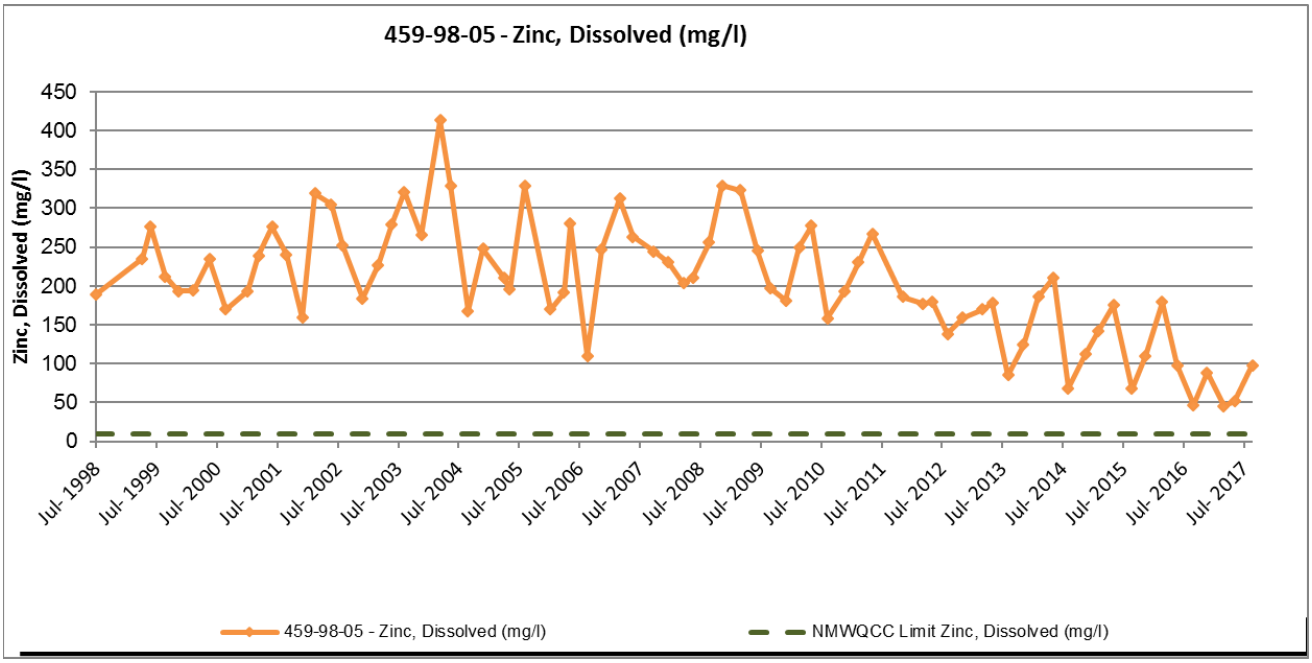

459-98-05 - Nickel, Dissolved (mg/l)
Nickel, Dissolved (mg/l)
16
14
12
10
8
6
4
2
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Nickel, Dissolved (mg/l)
NMWQCC Limit Nickel, Dissolved (mg/l)

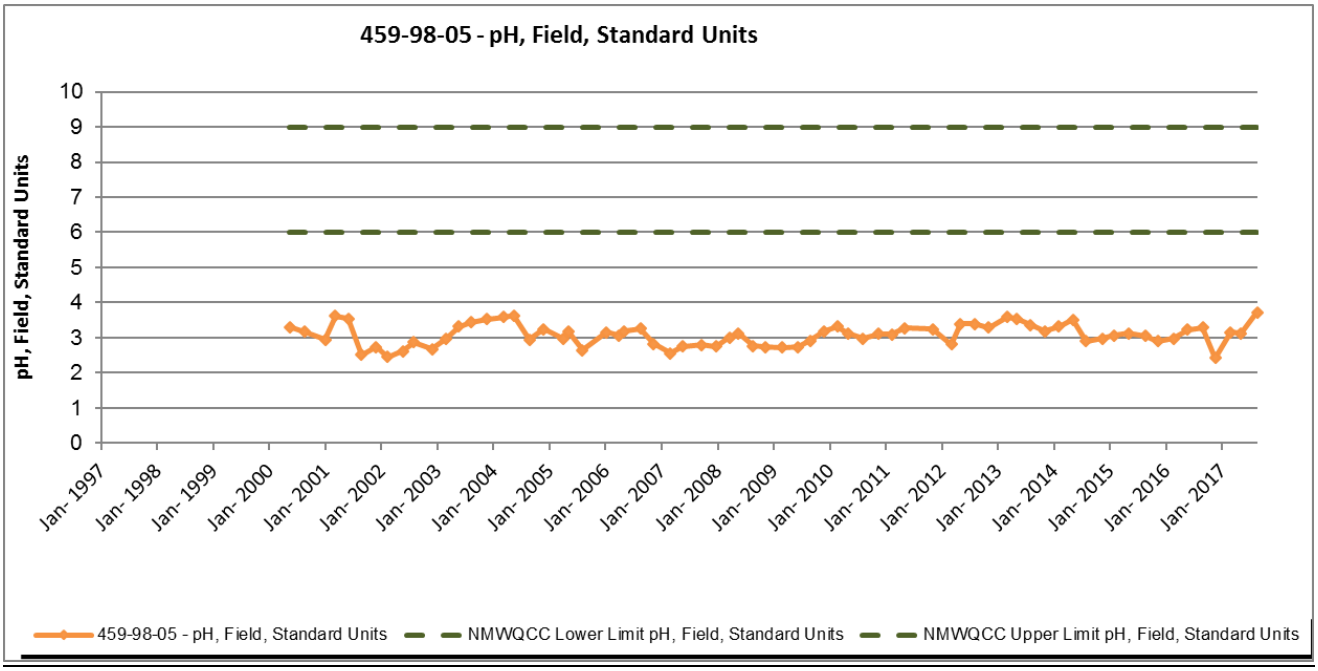

459-98-05 - Potassium, Dissolved (mg/l)
Potassium, Dissolved (mg/l)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Potassium, Dissolved (mg/l)

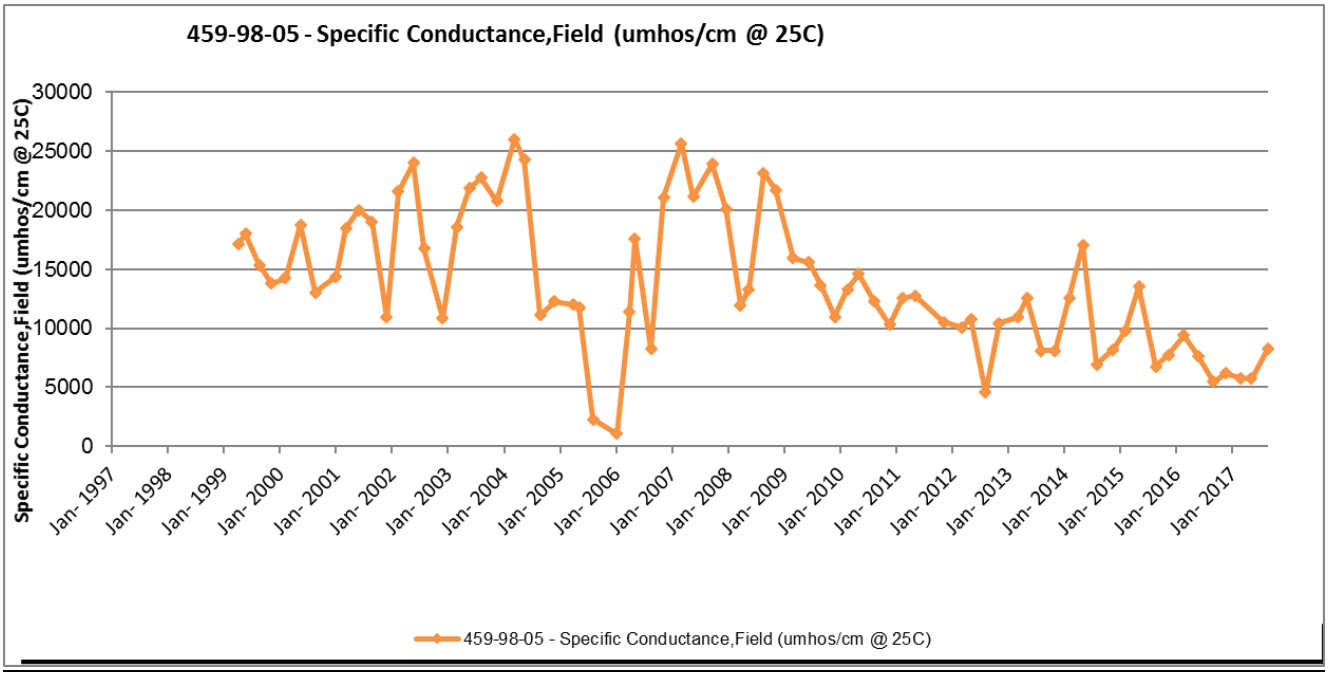

459-98-05 - Sodium, Dissolved (mg/l)
Sodium, Dissolved (mg/l)
60
50
40
30
20
10
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Sodium, Dissolved (mg/l)


459-98-05 - Sulfate (mg/l)
Sulfate (mg/l)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Sulfate (mg/l)
NMWQCC Limit Sulfate (mg/l)


459-98-05 - Total Dissolved Solids (mg/l)
Total Dissolved Solids (mg/l)
80000
70000
60000
50000
40000
30000
20000
10000
0
Jul-1998
Jul-1999
Jul-2000
Jul-2001
Jul-2002
Jul-2003
Jul-2004
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-98-05 - Total Dissolved Solids (mg/l)
NMWQCC Limit Total Dissolved Solids (mg/l)

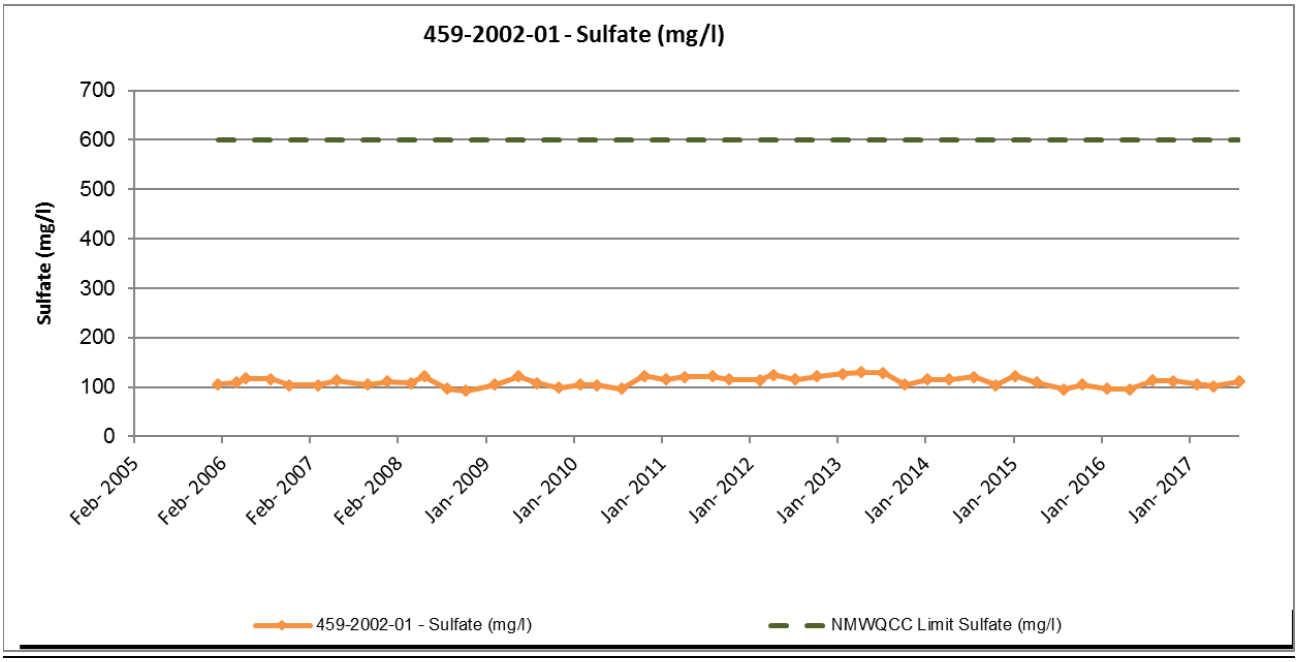

459-98-05 - Zinc, Dissolved (mg/l)
Zinc, Dissolved (mg/l)
450
400
350
300
250
200
150
100
50
0
Jul- 1998
Jul- 1999
Jul- 2000
Jul- 2001
Jul- 2002
Jul- 2003
Jul- 2004
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-98-05 - Zinc, Dissolved (mg/l)
NMWQCC Limit Zinc, Dissolved (mg/l)

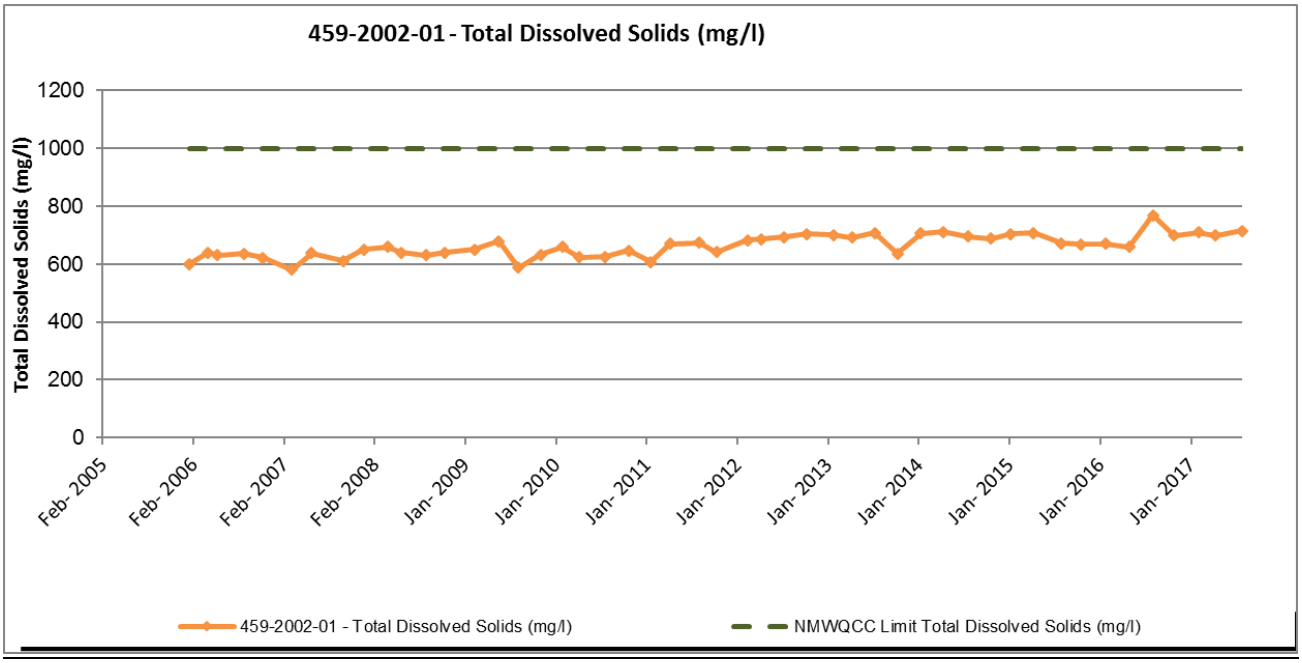

459-98-05 - pH, Field, Standard Units
pH, Field, Standard Units
10
9
8
7
6
5
4
3
2
1
0
Jan- 1997
Jan- 1998
Jan- 1999
Jan- 2000
Jan- 2001
Jan- 2002
Jan- 2003
Jan- 2004
Jan- 2005
Jan- 2006
Jan- 2007
Jan- 2008
Jan- 2009
Jan- 2010
Jan- 2011
Jan- 2012
Jan- 2013
Jan- 2014
Jan- 2015
Jan- 2016
Jan- 2017
459-98-05 - pH, Field, Standard Units
NMWQCC Lower Limit pH, Field, Standard Units
NMWQCC Upper Limit pH, Field, Standard Units

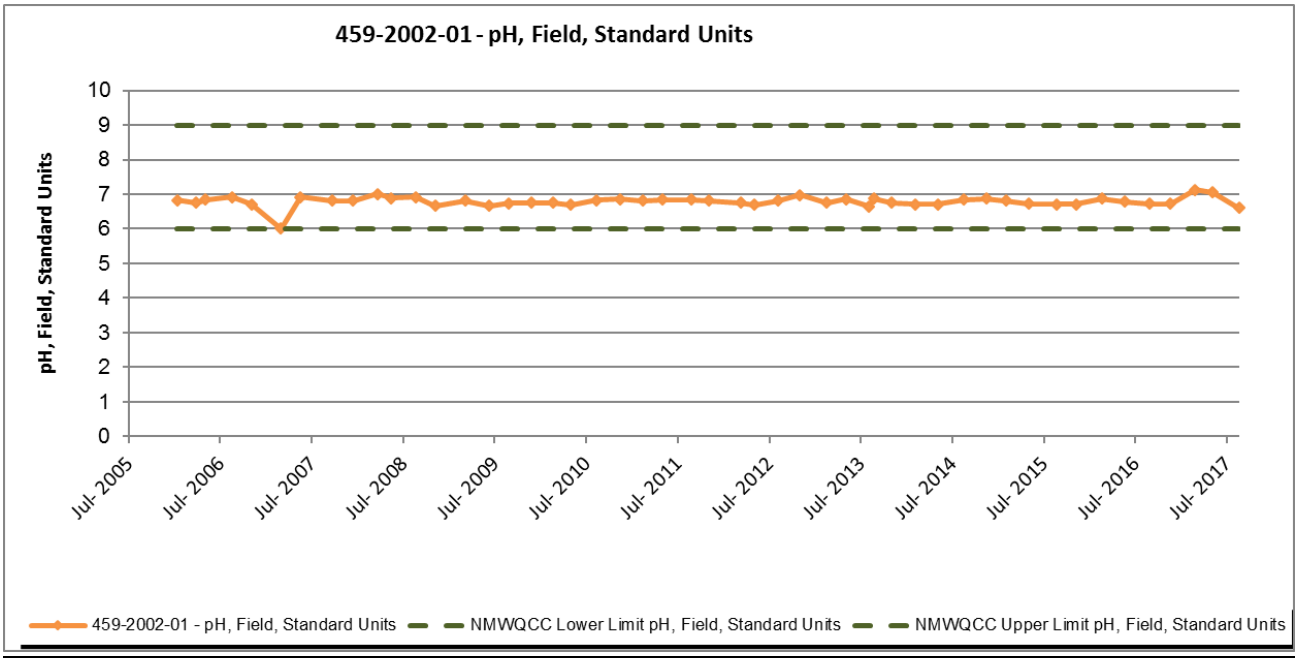

459-98-05 - Specific Conductance,Field (umhos/cm @ 25C)
Specific Conductance,Field (umhos/cm @ 25C)
30000
25000
20000
15000
10000
5000
0
Jan-1997
Jan-1998
Jan-1999
Jan-2000
Jan-2001
Jan-2002
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
459-98-05 - Specific Conductance,Field (umhos/cm @ 25C)

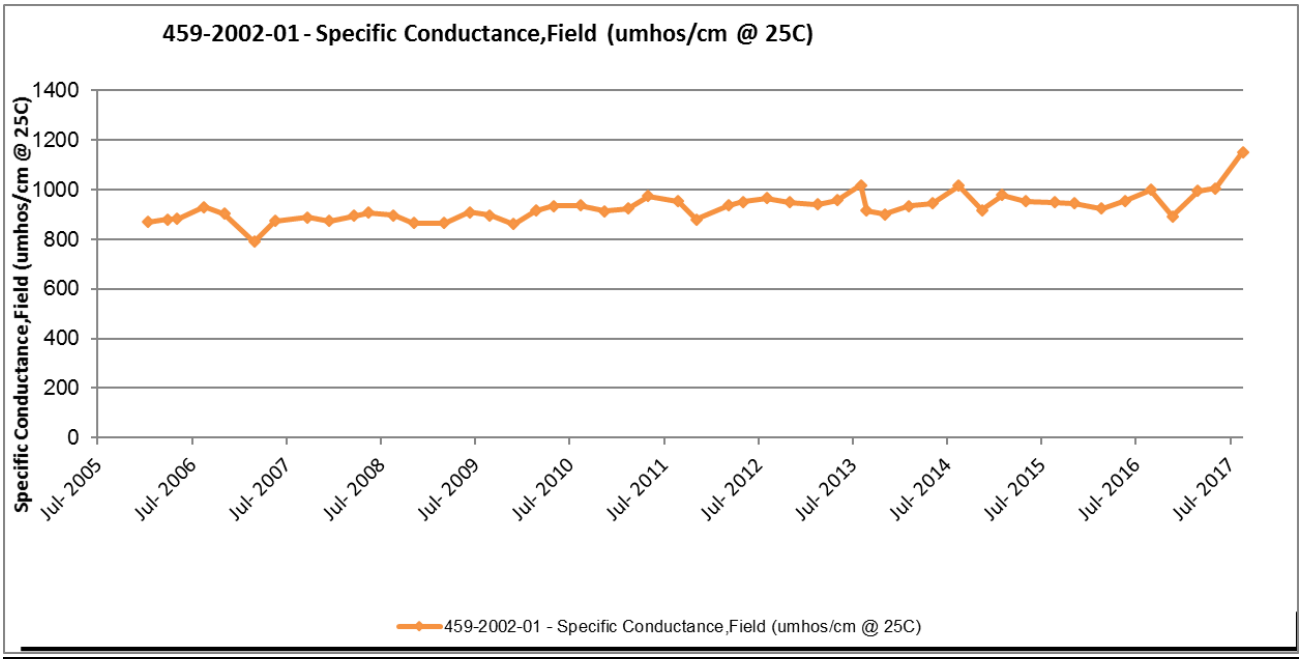
Freeport-McMoRan Chino Mines Company:
DP-459 Proposed Revised Sampling Analysis Plan and Supporting Data

Site Number	Sample Identifier	Sample Date	Cond, Fld (micromho)	pH, Field (SU)	Cond, 25C (micromho)	SO4, Tot. (mg/L)	TDS (mg/L)
Water Quality Standard				6 - 9		600	1000
459-2002-01	271358	01/17/2006	870	6.83	1,020	106	600
459-2002-01	274658	04/03/2006	879	6.75	1,038	109	639
459-2002-01	281417	05/10/2006	882	6.84	1,034	117	631
459-2002-01	285024	08/23/2006	931	6.92	1,075	116	636
459-2002-01	296631	11/08/2006	903	6.71	1,049	104	621
459-2002-01	299664	03/05/2007	790	6	932	104	581
459-2002-01	303690	05/23/2007	873	6.92	1,026	113	637
459-2002-01	307510	09/27/2007	889	6.81	1,042	105	610
459-2002-01	313499	12/19/2007	874	6.82	1,032	111	650
459-2002-01	316093	03/25/2008	895	7	1,042	108	660
459-2002-01	317409	05/20/2008	907	6.89	1,045	121	640
459-2002-01	319330	08/25/2008	897	6.92	1,052	96.8	630
459-2002-01	320241	11/10/2008	865	6.67	1,021	91.7	640
459-2002-01	321048	03/09/2009	866	6.81	1,029	105	650
459-2002-01	321666	06/15/2009	909	6.67	1,047	121	679
459-2002-01	322490	09/01/2009	897	6.74	1,029	108	587
459-2002-01	459-2002-01	12/01/2009	862	6.76	1,017	99	633
459-2002-01	323133	02/25/2010	915	6.75	1,087	105	660
459-2002-01	323776	05/05/2010	935	6.69	1,068	104	624
459-2002-01	324694	08/17/2010	936	6.83	1,066	96.6	625
459-2002-01	325420	11/18/2010	914	6.86	1,048	123	647
459-2002-01	326223	02/16/2011	923	6.82	1,065	115	607
459-2002-01	326909	05/05/2011	975	6.85	1,062	120	670
459-2002-01	327723	08/30/2011	953	6.85	1,054	121	674
459-2002-01	328409	11/08/2011	881	6.81	1,019	115	641
459-2002-01	329207	03/12/2012	936	6.76	1,090	114	683
459-2002-01	329937	05/07/2012	951	6.7	1,086	125	686
459-2002-01	330789	08/07/2012	966	6.81	1,110	115	694
459-2002-01	331538	11/05/2012	948	6.97	1,109	122	704
459-2002-01	332387	02/19/2013	941	6.76	1,123	127	701
459-2002-01	333132	05/06/2013	957	6.86	1,076	130	691
459-2002-01	334104	08/06/2013	1,017	6.65	1,117	129	707
459-2002-01	459-2002-01	08/28/2013	915	6.87	1,068	NA	NA
459-2002-01	334872	11/05/2013	900	6.75	1,055	105	636
459-2002-01	335763	02/07/2014	934	6.71	1,102	115	706
459-2002-01	336524	05/08/2014	945	6.71	1,079	115	711
459-2002-01	337494	08/18/2014	1,016	6.85	1,098	120	695
459-2002-01	338277	11/17/2014	918	6.87	1,098	104	688
459-2002-01	339184	02/04/2015	979	6.82	1,111	123	704
459-2002-01	339952	05/07/2015	954	6.73	1,104	109	708
459-2002-01	340976	08/26/2015	950	6.71	1,046	95.5	671
459-2002-01	341802	11/11/2015	945	6.71	1,093	105	669
459-2002-01	342811	02/22/2016	924	6.88	1,062	96	670
459-2002-01	343668	05/25/2016	956	6.79	1,071	95.1	660
459-2002-01	344966	08/30/2016	999	6.73	1,128	113	769
459-2002-01	345982	11/22/2016	892	6.72	1,046	112	699
459-2002-01	347058	02/28/2017	994	7.12	1,209	106	710
459-2002-01	348060	05/08/2017	1,005	7.05	1,158	102	699
459-2002-01	349119	08/22/2017	1,151	6.6	1,251	111	714


459-2002-01 - Sulfate (mg/l)
Sulfate (mg/l)
700
600
500
400
300
200
100
0
Feb-2005
Feb-2006
Feb-2007
Feb-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
459-2002-01 - Sulfate (mg/l)
NMWQCC Limit Sulfate (mg/l)

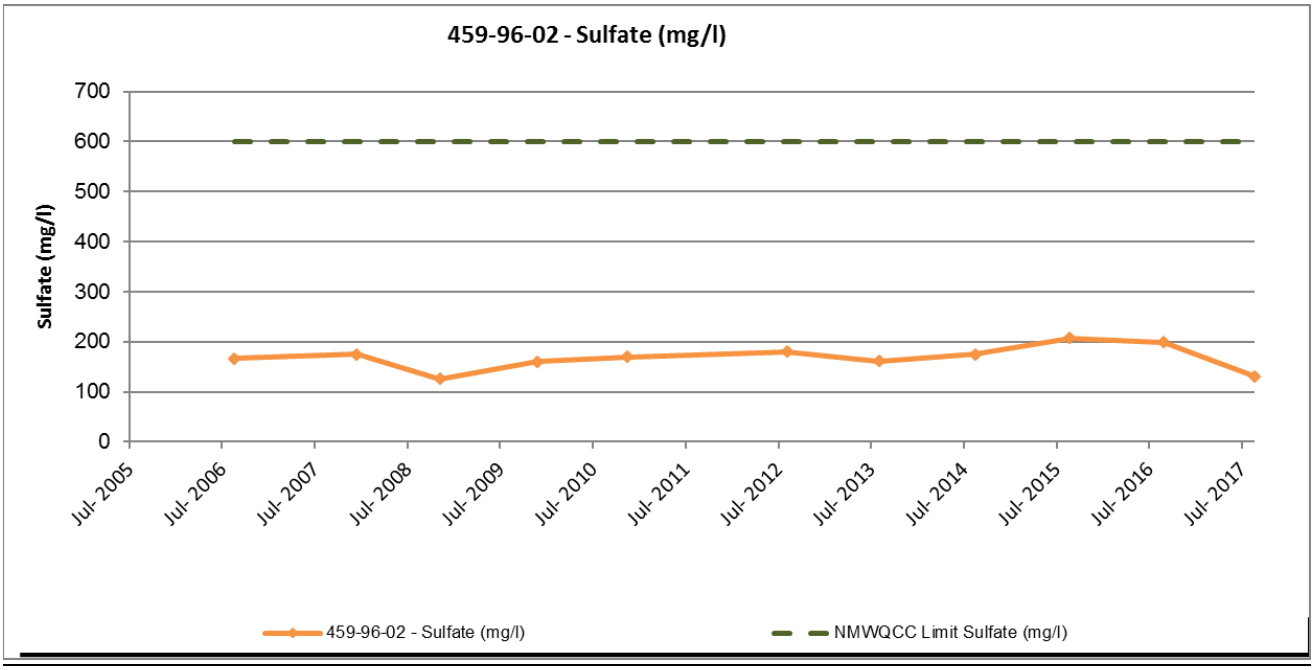

459-2002-01 - Total Dissolved Solids (mg/l)
Total Dissolved Solids (mg/l)
1200
1000
800
600
400
200
0
Feb-2005
Feb-2006
Feb-2007
Feb-2008
Jan-2009
Jan-2010
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
459-2002-01 - Total Dissolved Solids (mg/l)
NMWQCC Limit Total Dissolved Solids (mg/l)

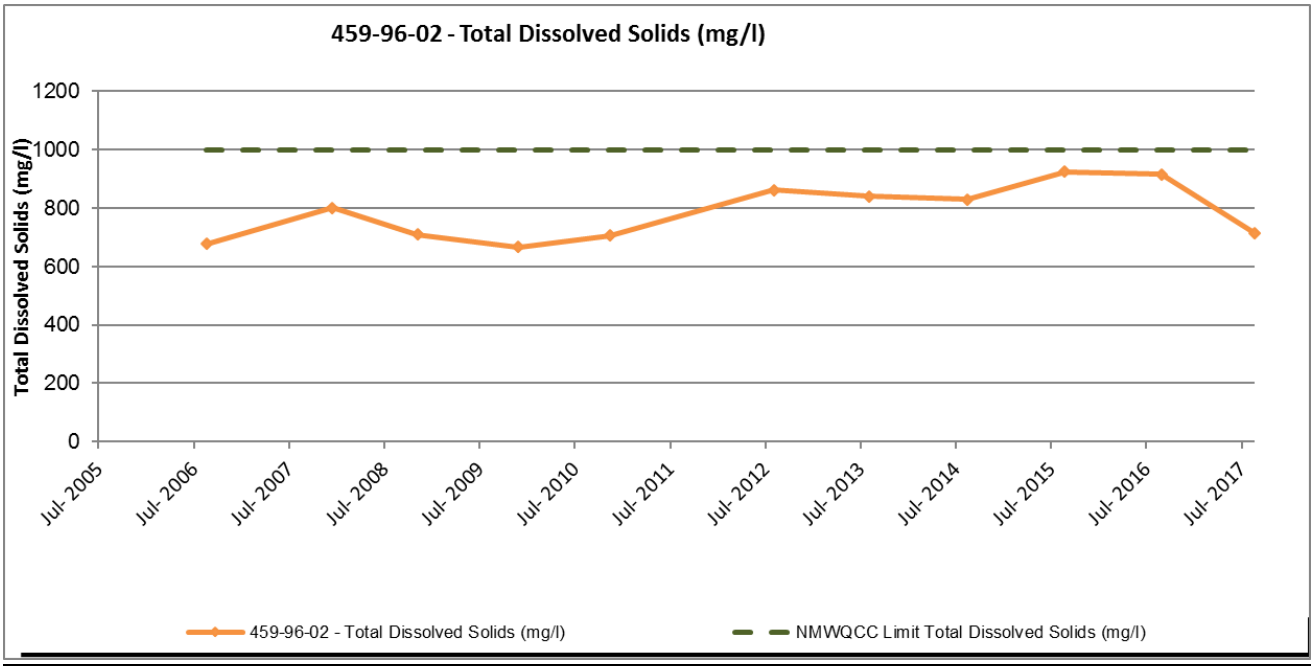

459-2002-01 - pH, Field, Standard Units
pH, Field, Standard Units
10
9
8
7
6
5
4
3
2
1
0
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-2002-01 - pH, Field, Standard Units
NMWQCC Lower Limit pH, Field, Standard Units
NMWQCC Upper Limit pH, Field, Standard Units

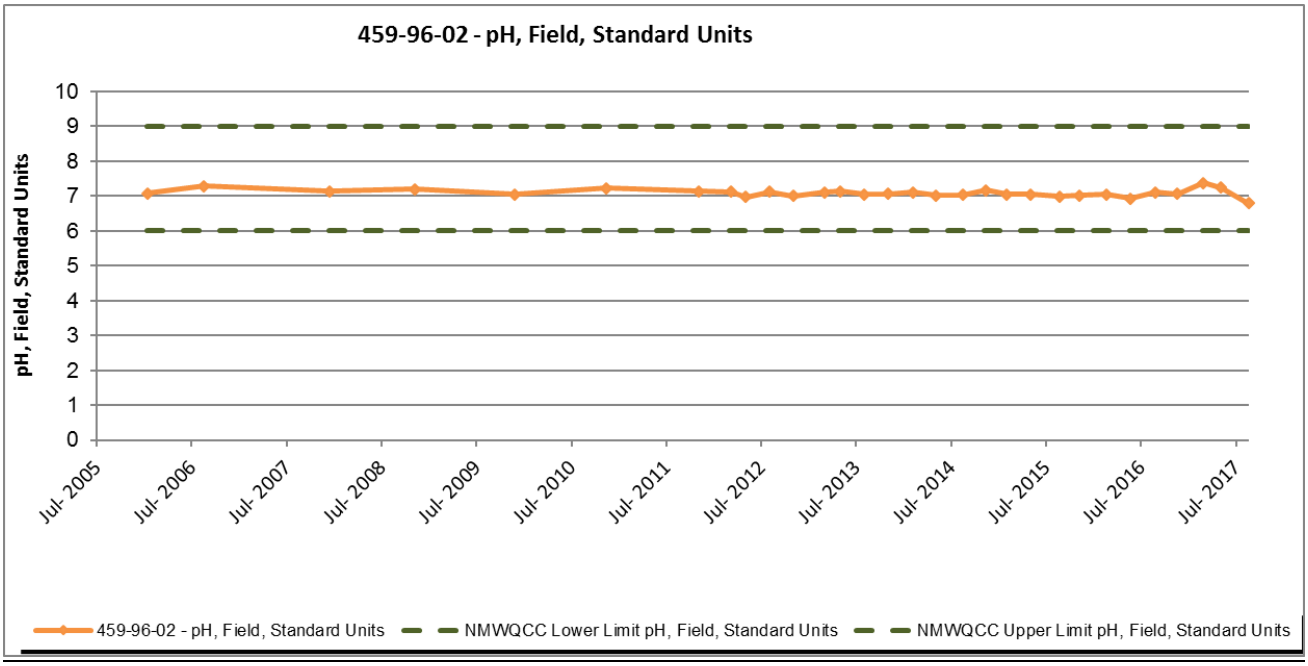

459-2002-01 - Specific Conductance,Field (umhos/cm @ 25C)
Specific Conductance,Field (umhos/cm @ 25C)
1400
1200
1000
800
600
400
200
0
Jul-2005
Jul-2006
Jul-2007
Jul-2008
Jul-2009
Jul-2010
Jul-2011
Jul-2012
Jul-2013
Jul-2014
Jul-2015
Jul-2016
Jul-2017
459-2002-01 - Specific Conductance,Field (umhos/cm @ 25C)

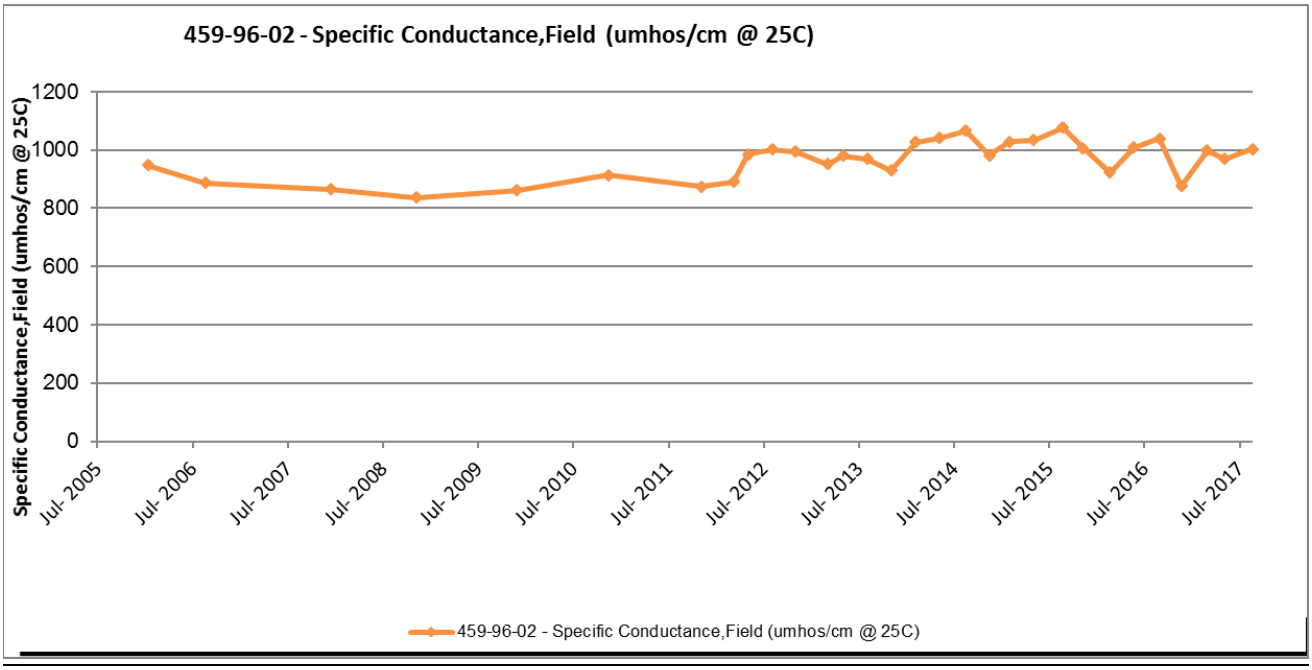
459-96-02

Site Number	Sample Identifier	Sample Date	Comments	Cond, Fld (micromho)	Cond, 25C (micromho)	pH, Field (SU)	SO4, Tot. (mg/L)	TDS (mg/L)
Water Quality Standard						6 - 9	600	1000
459-96-02	271442	01/17/2006		948	1,129	7.08	NA	NA
459-96-02	285029	08/24/2006		886	1,041	7.29	166	678
459-96-02	313514	12/19/2007		865	1,035	7.13	175	800
459-96-02	320247	11/10/2008		836	996	7.2	126	710
459-96-02	459-96-02	12/01/2009		861	1,035	7.05	160	667
459-96-02	325435	11/17/2010		913	1,073	7.22	170	706
459-96-02	328428	11/08/2011		874	1,034	7.13	NA	NA
459-96-02	329219	03/12/2012		889	1,047	7.12	NA	NA
459-96-02	329948	05/07/2012		984	1,146	6.97	NA	NA
459-96-02	330800	08/07/2012		1,001	1,155	7.12	180	862
459-96-02	331550	11/05/2012		993	1,164	7	NA	NA
459-96-02	332401	03/06/2013		950	1,114	7.1	NA	NA
459-96-02	333142	05/06/2013		980	1,144	7.13	NA	NA
459-96-02	334117	08/06/2013		969	1,119	7.04	161	841
459-96-02	334883	11/05/2013		929	1,099	7.06	NA	NA
459-96-02	335778	02/07/2014		1,026	1,208	7.11	NA	NA
459-96-02	336534	05/08/2014		1,041	1,210	7.02	NA	NA
459-96-02	337507	08/18/2014		1,065	1,208	7.03	175	830
459-96-02	338288	11/17/2014		982	1,178	7.17	NA	NA
459-96-02	339199	02/04/2015		1,028	1,189	7.05	NA	NA
459-96-02	339962	05/07/2015		1,034	1,212	7.04	NA	NA
459-96-02	340987	08/26/2015		1,076	1,221	6.99	207	925
459-96-02	341812	11/11/2015		1,007	1,181	7.01	NA	NA
459-96-02	342825	02/22/2016		923	1,089	7.04	NA	NA
459-96-02	343679	05/25/2016	Took a 250 mL preserved with HN03 for a U sample.	1,009	1,160	6.93	NA	NA
459-96-02	344978	08/30/2016		1,039	1,179	7.11	199	915
459-96-02	345993	11/22/2016		875	1,037	7.06	NA	NA
459-96-02	347074	02/28/2017		998	1,200	7.37	NA	NA
459-96-02	348070	05/08/2017		969	1,111	7.24	NA	NA
459-96-02	349132	08/22/2017		1,002	1,139	6.79	131	715


459-96-02 - Sulfate (mg/l)
Sulfate (mg/l)
700
600
500
400
300
200
100
0
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-96-02 - Sulfate (mg/l)
NMWQCC Limit Sulfate (mg/l)


459-96-02 - Total Dissolved Solids (mg/l)
Total Dissolved Solids (mg/l)
1200
1000
800
600
400
200
0
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-96-02 - Total Dissolved Solids (mg/l)
NMWQCC Limit Total Dissolved Solids (mg/l)


459-96-02 - pH, Field, Standard Units
pH, Field, Standard Units
10
9
8
7
6
5
4
3
2
1
0
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-96-02 - pH, Field, Standard Units
NMWQCC Lower Limit pH, Field, Standard Units
NMWQCC Upper Limit pH, Field, Standard Units


459-96-02 - Specific Conductance,Field (umhos/cm @ 25C)
Specific Conductance,Field (umhos/cm @ 25C)
1200
1000
800
600
400
200
0
Jul- 2005
Jul- 2006
Jul- 2007
Jul- 2008
Jul- 2009
Jul- 2010
Jul- 2011
Jul- 2012
Jul- 2013
Jul- 2014
Jul- 2015
Jul- 2016
Jul- 2017
459-96-02 - Specific Conductance,Field (umhos/cm @ 25C)

Freeport-McMoRan
Chino Mines Company
Proposed Revised Sampling and Analysis Plan, 2/21/2018

Table 1: Monitoring and Reporting Summary for Discharge Permit Modification DP-459

Monitoring Report Schedule of Submittal (Section A of 20.6.7.29 NMAC)	
1	January 1 through June 30 (first and second quarter sample periods) - Semi-annual report due by August 31 of each year
2	July 1 through December 31 (third and fourth quarter sample periods) - Semi-annual report and annual reporting requirements due by February 28 of each year

Reporting Summary		
Annual Reporting Frequency	**Number of Sites**	**Description**
1	1	Mine facility ground water elevation contour map
1	1	OPSDA Map
2	NA	Monitoring reports - general requirements (see Subsection B of 20.6.7.29 NMAC)
2	NA	Monitoring reports - analytical requirements (see Subsection C of 20.6.7.29 NMAC)

Sampling Analaytical Suites:

A = Field parameters: Temperature, pH, specific conductance
B = Indicator parameters: Suite A, sulfate, total dissolved solids (TDS)
C = Comprehensive inorganic suite: alk-HCO3, alk-CO3, Ca, Mg, Na, K, F, Cl, Al, As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Se, and Zn
W = Depth to water measurement to the nearest 0.001 foot

Explanation to Abbreviations and Symbols

Type:	Sampling Quarter:	Sampling Analytes Suite C:		
mw: monitoring well	Q1 = Jan. - March	alk-HCO3 = alkalinity-bicarbonate		
Pmw: Proposed monitoring well	Q2 = April - June	alk-CO3 = alkalinity-carbonate		
spg: spring	Q3 = July - Sept.	Ca = calcium	Mg = Magnesium	Na = Sodium
sp: seep	Q4 = Oct. - Dec.	K = Potassium	F = Fluoride	Cl = Chloride
WRP: waste rock stockpile		Al = Aluminum	As = Arsenic	Cd = Cadmium
OPSDA: open pit surface drainage area		Cr = Chromium	Co = Cobalt	Cu = Copper
		Fe = Iron	Pb = Lead	Mn = Manganese
		Ni = Nickel	Se = Selenium	Zn = Zinc

Freeport-McMoRan
Chino Mines Company
Proposed Revised Sampling and Analysis Plan, 2/21/2018

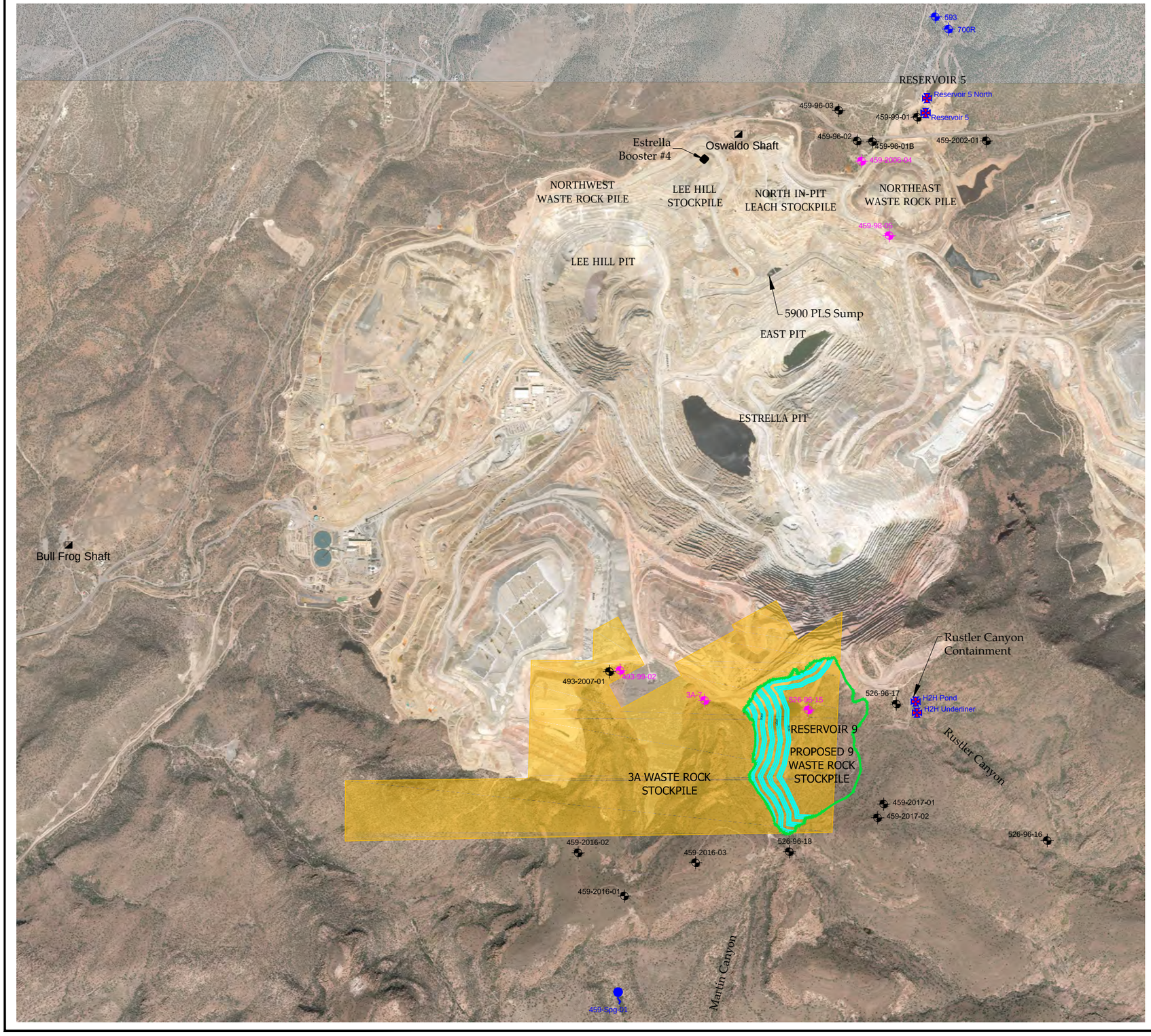
DP-459

Table 2: Monitoring Schedule & Requirements

Area Name	Sampling Location ID	Sampling						Comment
		type	Q1	Q2	Q3	Q4	other	
North WRP (North Waste Rock Pile & In-Pit Leach)	~~459-2006-04~~	~~mw~~	~~BCW~~	~~BCW~~	~~BCW~~	~~BCW~~		Proposed to Plug and Abandon. See Attached Memo
	459-96-01B	mw			BW			
	459-96-02	mw	~~AW~~	~~AW~~	BW	~~AW~~		Upgradient Well. See Attached Memo.
	459-96-03	mw			BW			Upgradient Well.
Northeast WRP (Northeast Stockpile)	~~459-98-05~~	mw	~~BCW~~	~~BCW~~	~~BCW~~	~~BCW~~		Proposed to Plug and Abandon. See Attached Memo.
Reservoir 5	700R	sh & p	BC~~W~~		BC~~W~~			Dust Control Source. See note 2.
	593	sh & p	BC~~W~~		BC~~W~~			Dust Control Source. See note 2.
	459-99-01	mw	BCW	BCW	BCW	BCW		
	459-2002-01	mw	~~AW~~	~~AW~~	BW	~~AW~~		See Attached Memo.
	Res 5 North	sw	BC		BC			
	Reservoir 5 (South)	sw	BC		BC			
~~**Reservoir 9**~~ **9 Waste Rock Stockpile**	459-2017-01	mw	BCW	BCW	BCW	BCW		New well
	459-2017-02	mw	BCW	BCW	BCW	BCW		New well
	526-96-15	mw	BW		BW			Moved from DP-526 SAP. See note 1
	526-96-17	mw			BW			Moved from DP-526 SAP.
	526-96-18	mw	BW		BW			Moved from DP-526 SAP.
Santa Rita Open Pit	Estrella Booster #4	sw	BC		BCD			Part of PLS Collection System. See Attached Memo.
	Oswaldo Shaft	sh & p	BC		BC			Dust Control Source. See note 2.
	Bullfrog Shaft	sh & p	B~~C~~W		B~~C~~W			Dust Control Source
Rustler Canyon	H2H Pond	sw	BC	BC	BC	BC		Currently sampled. Formerly adding to SAP.
	H2H Underliner	sw	BC	BC	BC	BC		
	526-96-16	mw	BW		BW			Moved from DP-526 SAP.
Included in 3A Modification								
3A Stockpile	3A-7	mw	B					See note 1
	493-99-02	mw	B	B	B	B		See note 1
	493-2007-01	mw	B	B	B	B		
	~~493-2004-02~~	~~mw~~	~~B~~	~~B~~	~~B~~	~~B~~		See note 3
	459-2016-01	mw	BCW	BCW	BCW	BCW		
	459-2016-02	mw	BCW	BCW	BCW	BCW		
	459-2016-03	mw	BCW	BCW	BCW	BCW		
	459-SPG-01	sp	B		B			
	Other Observable Seeps (in Martin Canyon)	sp	BC	BC	BC	BC		

Notes:

1. 3A-7, 493-99-02 and 526-96-15 to be monitored until construction of approved Stockpiles prevents wells from being sampled.
2. These wells are production wells; depth to water reading will not provide valid data of actual groundwater levels in the area.
3. Monitor well 493-2004-04 was abandoned on 7/8/17 and was declared abandoned to NMED within the August 2017 Quarterly Monitoring Report fo



N

W E

S

0 1000 2000 3000 ft
SCALE IN FEET

Legend

- Proposed 9 Waste Rock Stockpile Operational Design (Approx. 159 Acres)
- BLM Land
- Groundwater Monitoring Well To Be Plugged and Abandoned
- Groundwater Monitoring Well
- Production Well
- Surface Water Sample Point
- Spring
- Mine Shaft

FREEPORT-McMoRan

CHINO MINES COMPANY

Figure 1

DP-459 Regulated Facilities and Sampling Network

Scale: As Noted	Date: 2-21-2018	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: CBK	

REPORT

WELL INSTALLATIONS IN THE RESERVOIR 9 AREA

Freeport-McMoRan Inc. Chino Mines Company

Submitted To: Freeport-McMoRan
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, NM 88023

Submitted By: Golder Associates Inc.
4730 N. Oracle, Suite 210
Tucson, AZ 85705

February 9, 2018 **1670655**

Golder Associates

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1.0 INTRODUCTION

Golder Associates Inc. (Golder) is pleased to present this Site Investigation Report for the Reservoir 9 area (Figure 1), Chino Mine New Mexico, on behalf of Freeport-McMoRan Chino Mines Company (Chino). Specifically, this report documents installation of two monitoring wells installed to determine groundwater levels and assess existing groundwater quality.

The remainder of this document includes the following:

- **Section 2.0: Groundwater Characterization and Field Investigation** – Describes the field work undertaken for this groundwater characterization investigation.
- **Section 3.0: Recommendations** – Provides recommendations based on the findings.
- **Section 4.0: References** – Provides references cited in the text, tables, and figures.
- **Attachment A:** Contains lithologic logs of the monitoring wells installed during this investigation.

2.0 GROUNDWATER CHARACTERIZATION AND FIELD INVESTIGATION

Based on the results of a geophysical investigation of potential groundwater zones (Golder 2015) and in coordination with Chino and the New Mexico Environment Department (NMED), two monitoring wells were installed to document current groundwater occurrence and elevations and assess the current groundwater quality southeast of a proposed waste rock stockpile in the Reservoir 9 area. Details regarding drilling, well installation, and groundwater sampling are described in the following sections; well logs are provided in Attachment A.

2.1 Field Methods

This section describes drilling methods, monitor well installation, well development and groundwater sampling procedures.

2.1.1 Drilling

Both wells were drilled on the volcanic highlands located approximately 4,000 feet southeast of Reservoir 9 (Figure 1). Drilling and well installation were performed by Yellow Jacket Drilling Services (Yellow Jacket) between March and May 2017. Borings were advanced using a truck-mounted Foremost DR-24HD drill rig. All drilling was performed using air-rotary methods, advancing either a tri-cone gear-bit or percussion hammer. Air (with water injection) was used to lift cuttings to the surface in both borings. A temporary steel surface casing was set in to increase surficial borehole stability and provide a connection for cuttings discharge. Open-hole drilling methods were used to advance boreholes to final depth.

A Golder geologist logged all cuttings and observed the drilling, testing, and installation of the monitoring wells. The lithologic logs and well construction diagrams are provided in Appendix A. Drill cuttings were collected at approximately 10-foot intervals, and archived in chip trays and cloth sacks. Sacks and trays were labeled with borehole number and sample interval (sample ID).

2.1.2 Downhole Video Surveys

Prior to well construction, downhole video surveys were completed by Golder personnel at both well bores. The purpose of the downhole video surveys was to observe and document the occurrence of groundwater, which can be difficult to determine in this low hydraulic conductivity setting. Details of the surveys follow:

- Golder performed the video survey of Well 459-2017-01 on April 7, 2017. Aside from a few drips and wet sidewalls, the well bore was dry down to a depth of approximately 580 feet below ground surface (ft-bgs; i.e., no flow of water was noted). Although the well bore was eventually deepened to 813 ft-bgs), no additional video survey was performed, due to frequent drilling stoppages intended to allow groundwater recharge to the borehole.
- Golder performed the video survey of Well 459-2017-02 on April 26, 2017. No flow of water was noted above the static water level (787 ft-bgs). Details obtained from the video surveys regarding lithology and structural characteristics are presented on the logs in Appendix A.

2.1.3 Rational for Selecting Well Depths and Screened Intervals

From extensive previous drilling experience in this area south of the open pit, determining where groundwater is occurring and what the static water levels are is significantly complicated by the prevailing low hydraulic conductivity of the volcanic rock in this area. In this setting, groundwater is often not airlifted from the borehole sufficiently to confirm when the borehole has been advanced below the water table. This was the reason for having a down-hole camera onsite throughout the drilling project. Further, the drilling rig was periodically left on standby after drilling connections were made, and then airlifted to see if any groundwater had accumulated in the borehole while the rig sat idle (recharge break). Even with the presence of groundwater determined, it can be difficult to identify where exactly it is coming into the borehole. Consequently, longer screened intervals than under normal circumstances were used. The rationale for drilling depths and screened intervals for the wells is as follows:

- **459-2017-01:** Borehole was drilled to a depth in which water was entering the wellbore (approximately 813 ft-bgs), as evidenced by standing water in the borehole. The video survey confirmed that no small-quantity sources (weeps, drips, etc.) were located above approximately 580 ft-bgs, and the recharge breaks mentioned in Section 2.1.2 indicated no infiltration to the borehole above approximately 755 ft-bgs. The screen interval (740-800 ft-bgs) was chosen to provide sufficient screen below the static water level.
- **459-2017-02:** Borehole was drilled to a depth in which water was entering the wellbore (approximately 876 ft-bgs), as evidenced by standing water in the borehole. The video survey confirmed that no small-quantity sources (weeps, drips, etc.) were located above the static water level, approximately 787 ft-bgs. The screen interval (783-863 ft-bgs) was chosen to provide sufficient screen below the static water level.

2.1.4 Monitoring Well Installation

Each borehole was completed as a monitoring well, constructed as follows:

- A 5-inch diameter, flush-thread Schedule 80 polyvinyl chloride (PVC) casing and well screen (slotted casing, 0.010-inch slot) were installed through the desired depth interval. Wells were constructed with 60-80 feet of screened interval. The reason for the relatively long screen intervals was to help capture potential low-production zones (noted from past experience in this area) within the screened interval. A 5- or 10-foot sump and PVC bottom cap were installed below the wellscreens.

  Centralizers were installed on the well string at the top and bottom of the screened interval.
- Gravel pack in the screened interval consisted of 6x9 Colorado silica sand (sand size is generally between the 6- and 9-sized US sieves (approximately 0.13 to 0.09 inches). All gravel pack was installed through a tremmie pipe. Prior to installation of bentonite seals, all wells were surged with a swab (surge block) for approximately 30 minutes to consolidate the gravel pack.
- A plug of hydrated bentonite chips/pellets, 20- to 25-feet thick, was installed above the gravel pack. The interval between the bentonite plug to the surface was backfilled with bentonite slurry (pumped, in lifts with a maximum thickness of 200 feet), and topped off with a cement grout surface seal. Below nominal depths of 200 to 300 feet, all of the bentonite chips/pellets, and pumped bentonite grout were installed through a tremmie pipe. Above those nominal depths, bentonite slurry was discharged directly to the open borehole.

All wells were completed with standard, locking above-ground steel surface completions anchored in concrete. Well constructions were observed by a Golder geologist and conditions encountered during well construction were documented. Following installation, each well location was surveyed to provide coordinates and the surface elevations for water level measurements. Table 1 provides well construction details for each well.

2.1.5 Well Development and Groundwater Sampling

In addition to settling the gravel pack, surging the wells (see previous section) served as pre-development, by drawing fines into the well casing. Final development consisted of removing an additional three well-volumes of water prior to sampling. Final development and sampling was performed using a Pulstar development rig.

During well development, specific conductance, temperature, and pH of the groundwater were measured and recorded using hand-held field instruments. Field equipment was calibrated before, and checked against standards following the sampling event. All samples were collected using a bailer. Groundwater samples were collected in half-gallon plastic bottles provided by Chino.

Following sample collection, Chino personnel divided each groundwater sample into two 500 milliliter (mL) bottles. Chino filtered (0.45 micron filter) and acidifed (HNO_3) one of the 500 mL samples prior to shipment to the laboratory. Purge and sample collection information were recorded on Golder's dedicated groundwater sampling data sheets. Recorded information included sample identification (well ID), time and date of sample collection, and field parameters measured during purge. Sample identification was recorded on each sample bottle using indelible ink.

Samples were shipped directly from the Chino Environmental Office to SVL Laboratories in Kellogg, Idaho via UPS, on May 24, 2017.

2.2 Field Investigation Results

This section presents an overview of the field investigation results. The monitoring wells installed are:

- **Well 459-2017-01** was drilled to a total depth of 813 ft-bgs. The well was screened between 740 and 800 ft-bgs.
- **Well 459-2017-02**, located approximately 300 feet south-southwest of Well 459-2017-01, was drilled to a total depth of 876 ft-bgs. The well was screened between 783 and 863 ft-bgs.

Brief descriptions of the geologic units encountered are presented below. These units were encountered in all three borings.

- **Surface materials** were thin veneers of sand and gravel (colluvium and mixed fill used for drill-pad construction). These soils generally were non-plastic.

- **Basalt and other volcanic rocks** (possibly Caballo Blanco Formation of Elston, 1957, as referenced in United States Geological Survey Professional Paper 555) included baked zones, and appeared reddish-gray to bluish-black. Predominantly aphanitic, grains of varying lithologies, including quartz, milky quartz, feldspar and minor mafic minerals were noted. In general, this rock unit was moderately hard to very hard and slightly weathered. Softer zones were observed (highly weathered to clay), and hematite staining was common.
- **Rhyolite/rhyolite tuff** appeared as a light gray to dark reddish-gray glassy matrix surrounding angular quartz and minor feldspar and mafic (horneblende, biotite) fragments. This rock was moderately hard to hard, unweathered to moderately weathered, and included some clayey horizons.
- **Sugarlump tuff** was encountered in the bottom 3 feet of 459-2017-01. The very light gray tuff was aphanitic, chalky and slightly weathered.

The depths-to-groundwater in the wells and corresponding groundwater elevations during the time of sampling were as follows:

- 459-2017-01: depth-to-groundwater was approximately 755 ft-bgs, which correlates to an elevation of 6,477 feet above mean sea level (ft-amsl) (Table 2).
- 459-2017-02: depth-to-groundwater was approximately 790 ft-bgs, which correlates to an elevation of 6,477 ft-amsl.

The most recently available groundwater elevations for the newly installed wells and averages from the surrounding wells are provided on Figure 1 along with groundwater elevations contours, directions of groundwater flow, and the location of the Open Pit Capture Zone (OPCZ) during mine operations (Golder, 2018). Note also that the proposed footprint of the Reservoir 9 stockpile lies entirely within the OPCZ.

Analyzed constituents included TDS and sulfate (plus field-measurement of pH) in the groundwater samples collected from wells 459-2017-01 and 459-2017-02. Concentrations of these constituents are below New Mexico Water Quality Control Commission (NMWQCC) criteria (Table 2).

Formal hydraulic testing (e.g. pumping tests) were not attempted.

3.0 RECOMMENDATIONS

The hydraulic conductivity of the bedrock in the area southeast of the open pit is notably low, likely to be on the order of 10^{-7} centimeters per second or lower, based on previous investigations and on the observations made during this investigation. As stated above, water is likely delivered to both wells via fractures in the bedrock and, as a result, the groundwater levels described for the wells likely represent static conditions. Golder recommends continued monitoring of depth-to-groundwater in both wells, however, to confirm static conditions. In addition to monitoring of static groundwater levels, the wells should be resampled to confirm the original analytical results.

4.0 REFERENCES

Elston, W.E. 1957. Geology and mineral resources of Dwyer quadrangle, Grant, Luna, and Sierra Counties, New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 38.

Golder. 2018. Summary of North Mine Area Groundwater Evaluation and Results. Technical memorandum to Mr. Christian Krueger, Chino Mines Company. February 9, 2018.

Golder. 2015. Geophysical Investigation of Groundwater and Fracture Flow in the Reservoir 3A and 9 Area. Prepared for Chino Mines Company. September 29, 2015.

United States Geological Survey (USGS). 1967. General Geology of Santa Rita Quadrangle, Grant County, New Mexico, by William R. Jones, Robert M. Nernon, and Samuel L. Moore; Professional Paper 555.

TABLES

Table 1: Well Construction Summary

Well ID	Construction Date[1]	Location (NM West NAD 83)		Elevation (ft-amsl)		Total Depth of Boring (ft-bgs)	Sandpack Interval (ft-bgs)	Screened Interval (ft-bgs)	Screened Formation
		Easting	Northing	Concrete Pad	Top of PVC				
459-2017-01	18-22 Apr 2017	2653609.51	642576.61	7229.76	7232.30	813	733-809	740-800	Rhyolite Tuff
459-2017-02	26 Apr-04 May 2017	2653473.48	642276.94	7264.99	7267.07	876	774-873	783-863	Rhyolite Tuff

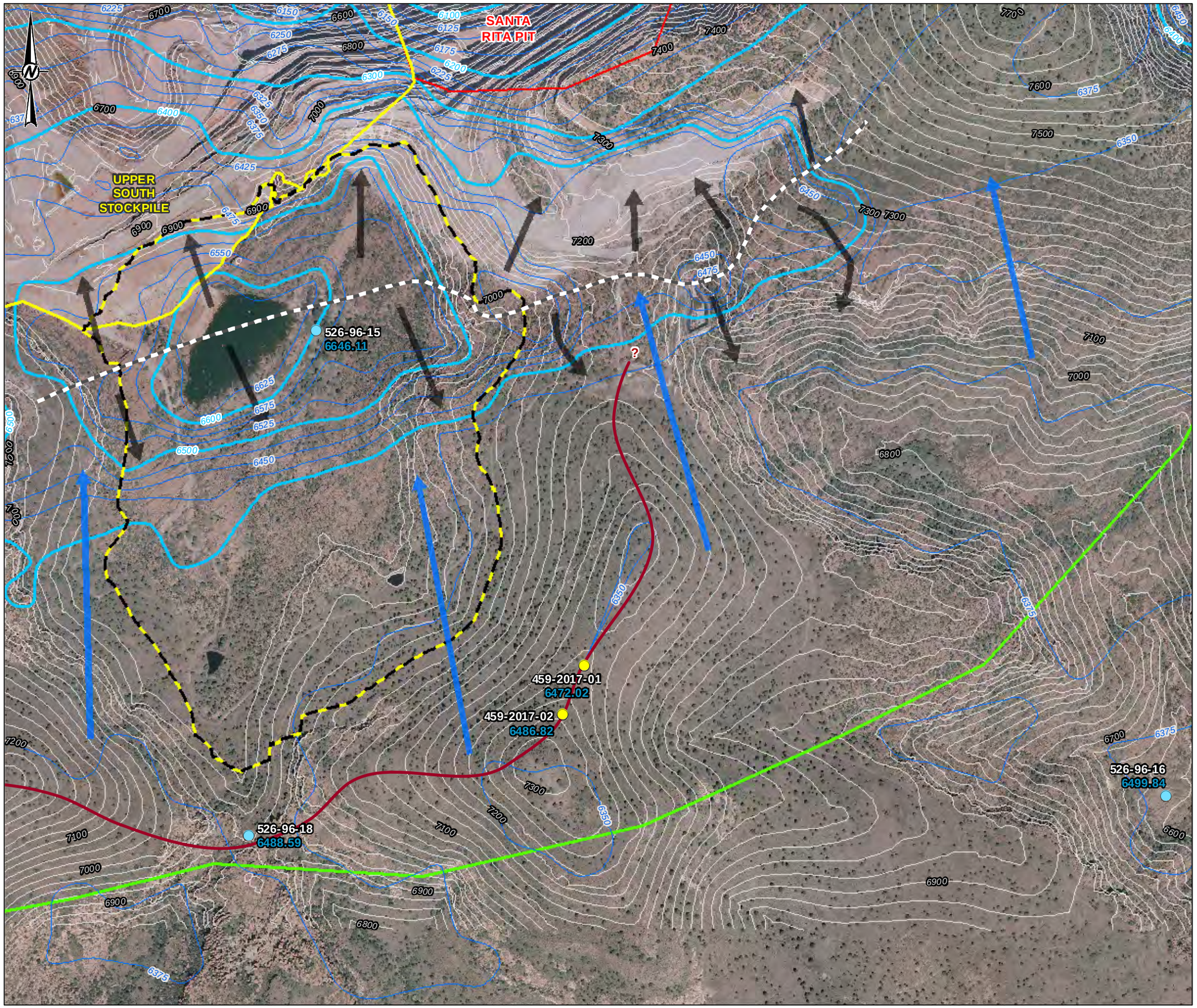
Notes:
1 - suface completion - steel monument and concrete pad - added at later date
ft-amsl = feet above mean sea level
PVC = Polyvinyl chloride
ft-bgs = feet below ground surface

Table 2: Groundwater Quality of New Monitoring Wells

Well ID	Date Sampled	Water Level Information			Field Parameters			TDS	SO_4
		MP Elevation	Depth To Water	GW Elevation	pH	Temp (°C)	Cond (µS)	(milligrams per liter)	
NM GW Standard for Human Health								**NS**	**NS**
Other NM GW Standard for Domestic Water Supply					**6-9**			**1000**	**600**
Other NM GW Standard for Irrigation Use								**NS**	**NS**
459-2017-01	5/21/2017	7232.30	755.06	6477.24	7.30	19.7	511	320	16.5
459-2017-02	5/21/2017	7267.07	789.79	6477.28	7.37	20.3	482	284	15.3

Notes:
TDS = Total dissolved solids
MP = measuring point
µS = microSiemens
NM = New Mexico
GW = groundwater
NS = No Standard
< = If present, the concentration is below the indicated laboratory method detection limit
Shaded values are above the indicated standard.
NA = Not applicable
* Approximately ground surface elevation of spring

FIGURES

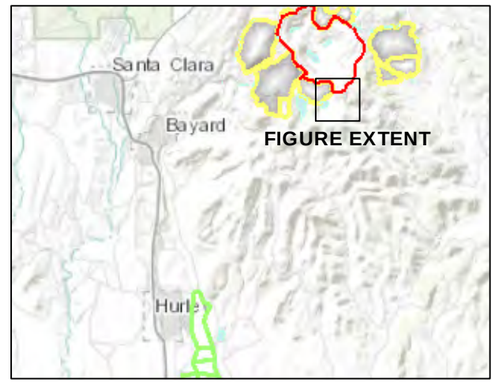


LEG END

- NEW MONITOR WELL
- MONITOR WELL
- SANTA RITA PIT
- STOCKPILES
- REGIONAL GROUNDWATER FLOW DIRECTION
- LOCAL GROUNDWATER FLOW DIRECTION
- PROPOSED RESERVOIR 9 WASTE STOCKPILE
- COMBINED OPERATIONAL OPCZ
- SURFACE CONTOURS (200 FT. INTERVALS)
- LOCAL INFERRED GROUNDWATER DIVIDE
- SURFACE WATER DIVIDE

GROUNDWATER ELEVATION CONTOURS

- 100 FT CONTOUR
- 25 FT CONTOUR



0 600 1,200

1 " = 600 feet

Feet

NOTE(S)

GROUNDWATER LEVEL CONTOURS DERIVED FROM NUMERICAL GROUNDWATER FLOW MODEL (GOLDER, 2016, IN PRESS).
*GROUNDWATER ELEVATIONS FOR 526-96-15 AND 526-96-18 ARE AVERAGED FROM AVAILABLE DATA.
**GROUNDWATER ELEVATIONS FOR 459-2017-01 AND 459-2017-02 ARE MOST RECENTLY AVAILABLE.

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
AERIAL IMAGERY: FLYOVER 2014, CHINO 2014 AERIAL PHOTO.

CLIENT

CHINO MINES COMPANY

PROJECT

SITE INVESTIGATION REPORT FOR THE RESERVOIR 9 AREA

TITLE

WELLS 459-2017-01 AND -02 LOCATION MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2018-02-09
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
1670655	---	2	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

ATTACHMENT A
LOGS OF NEW MONITORING WELLS

CHINO MINES COMPANY
Reservoir 9 area
Well 459-2017-01

NM West NAD 83
EASTING 2653609.508
NORTHING 642576.6098

ELEVATION (FT AMSL)
TOP OF PVC 7232.298
CONCRETE PAD 7229.757

LITHOLOGY	COMMENTS	DRILL RATE 0 FT/HOUR 100	AS-BUILT
SAND and GRAVEL (GP)(0-3'): some silt, clay and cobbles, sub-angular to angular, mixed with FILL (pad construction)	(0 to ~21 ft bgs) 12" borehole diameter, drilled with tri-cone gear bit		Steel monument, 4'x4' concrete pad at surface
BASALT (3'-6') and VOLCANIC AGGLOMERATE (to 25'): aphanitic, sometimes vesicular, moderately to highly weathered (evidenced by clay and Fe-oxide staining), moderately hard. Dark reddish-gray (2.5 YR 4/1)	Began adding water at 21 ft		(0 to ~21 ft') cement + 3% bentonite
RHYOLITE TUFF (Caballo Blanco Formation?)(25' to 134'): aphanitic with quartz and mafic phenocrysts, slightly weathered (Fe-oxide staining), hard. Very dark gray (5 YR 3/1) to reddish-brown (5 YR 2.5/2)	Video survey (VS) performed on 7 Apr VS: vertical frx, dry		
	VS: 45° frx, dry		(+2.6' to 740') 5" Sch 80 PVC blank casing
reddish-gray, 90' sample; very hard at 98'	VS: 60° frx, dry VS: vertical frx, dry		
RHYOLITE TUFF (Caballo Blanco Formation?)(134' to 190'): aphanitic with milky quartz and minor mafic phenocrysts, slightly weathered (Fe-oxide staining), hard. Red (10 R 4/6) to dusky red (10 R 3/4)			(~21' to 710') bentonite slurry
	(21 to 513 ft bgs) 11" borehole diameter, drilled with percussion hammer		
increase in milky quartz from 175' to 190'; very hard at 185'			
RHYOLITE TUFF (Caballo Blanco Formation?)(190'-310'): aphanitic with milky quartz and minor mafic phenocrysts, slightly weathered (Fe-oxide staining), hard. Very dark gray (5 YR 3/1) to dark reddish-brown (5 YR 3/3)			
moderately hard at 207'	VS: coarse-grained		
	VS: borehole wallowed out between 226' and 241'		
increase in Fe-oxide staining from 255' to 290'	VS: borehole walls very rough, with vertical frx (dry) between 241' and 260'		
trace of brown waxy mineral at 275'	VS: smooth borehole walls		
moderately hard at 305'	VS: borehole walls very rough		
KNEELING NUN RHYOLITE TUFF (310'-810'): aphanitic matrix containing shards of glassy and milky quartz, with feldspar and minor mafic minerals, slightly weathered. Reddish-gray (5 YR 5/2)	VS: horizontal frx, dry		
trace of orange-brown waxy mineral at 385'			
	VS: vertical frx, dry VS: smooth borehole walls		
	VS: vertical frx, dry		
	(513' to 813') 10" borehole diameter, drilled with percussion hammer		
	VS: multiple frx, dry		
	Stop video survey at 580'		
moderately hard at 645'			
planar fracture surfaces, veined quartz at 715'			(710' to 733') 3/8-inch bentonite chips (733' to 809') 6x9 Colorado silica sand SWL = 755.06 ft btoc (5/20/2017) (740' to 800') 5" Sch80 PVC Screen 0.010" Slot (800' to 805') 5" Sch80 PVC blank (805' to 805.3') 5" Sch80 PVC bottom cap
SUGARLUMP TUFF (810'-813'): aphanitic, chalky, slightly weathered. Very light gray. Stop drilling at 813 ft bgs. Four feet of slough at time of well construction. All depths are feet below ground surface, unless noted otherwise			

BOREHOLE No.	459-2017-B	TOTAL DEPTH DRILLED	813 FT.	SCALE	AS SHOWN	TITLE	
OSE Reg.	M-10670-POD142	BIT DIAMETER	12", 11", 10"	DATE	8/24/2017	LITHOLOGIC LOG AND WELL CONSTRUCTION DIAGRAM Well 459-2017-01	
LOCATION	Chino Mine	DRILLING FLUID	AIR & WATER	DESIGN	SCW		
CLIENT	Freeport McMoRan	LOGGED BY	SCW	CHECK	MB		
DRILLING CO	YELLOW JACKET	DATE STARTED	3/25/2017	REVIEW	MB	Golder Associates	
DRILLING EQUIPMENT	Foremost DR-24HD	DATE FINISHED	4/22/2017	REV	0 FILE		
DRILLING METHOD	Percussion Hammer	COMMENTS		PROJECT No.	167-0655		

CHINO MINES COMPANY
Reservoir 9 area
Well 459-2017-02

NM West NAD 83
EASTING 2653473.483
NORTHING 642276.9427

ELEVATION (FT AMSL)
TOP OF PVC 7267.071
CONCRETE PAD 7264.993

LITHOLOGY	COMMENTS	DRILL RATE 0 FT/HOUR 100	AS-BUILT
SANDY GRAVEL (GP)(0-2'): sub-angular to angular (run-of-mine FILL)	(0 to ~21 ft bgs) 12" borehole diameter, drilled with tri-cone gear bit		Steel monument, 4'x4' concrete pad at surface
RHYOLITE TUFF (Caballo Blanco Formation?)(2'-134'): aphanitic quartz matrix, occassional small vesicles or solution cavities, slightly weathered (Fe-oxide staining), moderately hard to hard. Dark reddish-brown (5 YR 3/2) to bluish-black (5 PB) to greenish-black (2/5 / 10 Y)	Began adding water at 21'		(0 to ~28') cement + 3% bentonite
small amount of clay, hematite staining at 62 ft moderately weathered (some clay) at 73 ft	Video survey (VS) performed on 26 Apr VS: 60° frx at 58', 91'. 45° frx at 83', 86'. All frx dry		
moderately weathered (clay) at 113 ft	VS: multiple frx between 103' and 117'; all dry		(+2.3' to 783') 5" Sch 80 PVC blank casing
moderately weathered (clay) at 133 ft			(~28' to 750.0') bentonite slurry
RHYOLITE TUFF (Caballo Blanco Formation?)(134'-180'): aphanitic quartz matrix, occassionally scoriaceous, slightly weathered (Fe-oxide staining), moderately hard to hard. Weak red (10 R 4/4) to dusky red (10 R 3/4)			
friable and moderately weathered at 163'; highly weathered (clay) at 173'			
RHYOLITE TUFF (Caballo Blanco Formation?)(180'-381'): aphanitic matrix with sub-round to angular grains of quartz and feldspar, slightly weathered (Fe-oxide staining), moderately hard to hard. Reddish-gray (5 YR 5/2) to reddish-black (10 R 2.5/1) to dusky red (10 R 3/4)	(21' to 876') 10" borehole diameter, drilled with percussion hammer		
	VS: vertical frx, dry		
v. hard at 350'	VS: smooth borehole walls VS: 45° frx, dry		
KNEELING NUN RHYOLITE TUFF (381'-876'): aphanitic matrix containing shards of glassy and milky quartz, with feldspar and minor mafic minerals, slightly weathered. Reddish-gray (5 YR 5/2)	VS: formation change; borehole walls generally smoother below VS: vertical dike at 394', ~2-inch aperture, dry		
	VS: vertical frx, dry		
	VS: vertical frx, dry		
	VS: multiple vertical frx 510' to 530', all dry		
	VS: depositional contact and vertical frx at 524, dry		
	VS: filled vertical frx from 563' to 571', dry		
	VS: filled vertical frx from 626' to 630', dry		
very hard at 648'	VS: vertical frx, dry		
fractures at 785', 788' inferred from drilling action	Stop video survey at 787'		(750.0' to 773.8') 3/8-inch bentonite chips (773.8' to 873.3') 6x9 Colorado silica sand SWL = 789.79 ft btoc (5/21/2017) (783' to 863') 5" Sch80 PVC Screen 0.010" Slot (863' to 873') 5" Sch 80 PVC blank casing (873' to 873.3') 5" Sch80 PVC bottom cap
Stop drilling at 876 ft bgs. Three feet of slough at time of well construction. All depths are feet below ground surface, unless noted otherwise			

BOREHOLE No.	459-2017-C	TOTAL DEPTH DRILLED	876 FT.	SCALE	AS SHOWN
OSE Reg.	M-10670-POD143	BIT DIAMETER	12" tri-cone, 10" perc. hammer	DATE	8/24/2017
LOCATION	Chino Mine	DRILLING FLUID	AIR & WATER	DESIGN	SCW
CLIENT	Freeport McMoRan	LOGGED BY	SCW	CHECK	MB
DRILLING CO	YELLOW JACKET	DATE STARTED	4/22/2017	REVIEW	MB
DRILLING EQUIPMENT	Foremost DR-24HD	DATE FINISHED	4/25/2017	REV 0	FILE
DRILLING METHOD	Percussion Hammer	COMMENTS		PROJECT No.	167-0655

TITLE
LITHOLOGIC LOG AND WELL CONSTRUCTION DIAGRAM
Well 459-2017-02

Golder Associates

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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TECHNICAL MEMORANDUM

DATE February 9, 2018 **Project No.** 1785360

TO Christian Krueger
Freeport McMoRan Chino Mines Company

FROM Mark Birch **EMAIL mbirch@golder.com**

SUMMARY OF NORTH MINE AREA GROUNDWATER EVALUATION AND RESULTS

1.0 INTRODUCTION

This technical memorandum summarizes updates to the groundwater evaluation (model) for the North Mine Area (NMA) as conducted by Golder Associates Inc. (Golder) at the request of Freeport-McMoRan Chino Mines Company (Chino). The NMA groundwater flow model was originally developed in 2005 (Golder 2005[1]) to fulfill the requirements of the New Mexico Environment Department (NMED) as set forth in Condition 92 of Discharge Permit (DP)-1340. The groundwater model was later updated in 2007 as required by Condition 83 of DP-1340 (Golder 2007[2]). Periodic updates to models enable model predictions to be updated and refined because site conditions change over time, new data become available, and the modeling software and computing capacity improves. Golder completed the latest such update in 2015. This technical memorandum summarizes the updates and results from the 2015 modeling as they relate to the proposed placement of a waste rock stockpile in the Reservoir 9 area located south of the Santa Rita pit.

The objectives of the NMA modeling effort to date have been to:

- refine the understanding of the groundwater flow system in the NMA including vertical and horizontal directions and rates of groundwater flow
- estimate current and future groundwater discharges to the open pit
- evaluate the hydrologic conditions beneath the waste rock and leach stockpiles
- estimate the current and future boundaries of the open pit capture zone (OPCZ)
- relate the proposed 9 Waste Rock Stockpile to the OPCZ and to the Area of Open Pit Hydrologic Containment (AOPHC)

For purposes here, the OPCZ is narrowly defined as the area over which groundwater recharged from the surface discharges to the pit, consistent with how Golder has defined it previously[1]. As defined here, the OPCZ is not technically the same concept as the new Copper Rule's definition (NMAC 20.6.7.7B.(5)) of Area of Open Pit Hydrologic Containment (AOPHC). The AOPHC must be established based on a department approved monitoring well network, and by definition, is limited to the area of disturbance authorized by a DP.

The following sections describe the refinements made to the model in 2015, model re-calibration, and an assessment of the model predictability, followed by a comparison of the OPCZ and AOPHC. The final section

[1] Golder, 2005. North Mine Area Groundwater Flow Model: Chino Mine, New Mexico. Report prepared for Chino Mines Company. January 13, 2005.

[2] Golder, 2007. DP-1340 Condition 83 - Hydrologic Study, Final Report. June 28, 2007.

describes the implications of this work with regard to permitting the proposed waste rock stockpile within the Reservoir 9 drainage area.

2.0 NORTH MINE AREA MODEL REFINEMENT

The NMA is located northeast of Hurley as shown on Figure 1. The NMA model area (domain) remains unchanged from the Condition 92 and Condition 83 numerical models, and covers the mountainous region surrounding the Santa Rita pit, the groundwater system beneath the waste rock and leach stockpiles, and Hanover Creek and Lampbright Draw.

The three-dimensional model was constructed using MODFLOW-SURFACT, which is a commercially available version of the widely-used MODFLOW developed by the Unites States Geological Survey. The model grid was refined for the 2015 model re-calibration to provide greater resolution of groundwater flow paths. In the Condition 92 and 83 models, a minimum grid size of 500 feet was used throughout the area of the pit and adjacent drainages. For the 2015 update, the model grid was refined to 100 feet, as shown on Figure 2. Refining the grid, made possible by increasing computing capacity over time, also allows for greater resolution of the surface topography, which is the a driving mechanism for groundwater flow towards local drainages and into the pit. The modeling of the NMA is based upon an extensive set of empirical data from Chino's monitoring well network.

3.0 2015 NORTH MINE AREA MODEL RE-CALIBRATION

A model is "calibrated" by adjusting input parameters, such as hydraulic conductivity (K) of the various hydrostratigraphic (geologic) units, groundwater recharge, and evapotranspiration (ET) to match the observed groundwater levels in monitoring wells as closely as possible. In the 2015 update, two K zones were added to those used in the Condition 92 and 83 models to improve the match (calibration) to wells on the west side of the model area and the area just south of the Santa Rita pit where groundwater levels are abnormally high. These areas of lower K coincide with areas of likely lower K deep intrusive units. The re-calibrated model's K zones and values are presented on Figure 3.

Model recharge zones and rates were also adjusted to match the observed groundwater elevations in the NMA monitoring wells as closely as possible with the model. The re-calibrated model's recharge zones and rates are presented on Figure 4. The stockpiles were simulated with one recharge rate representing the top slope uncovered rate estimated from unsaturated flow modeling for the NMA (Figure 7, Golder 2007[3]).

The groundwater elevations for the re-calibrated model are shown on Figure 5. The groundwater level contours on Figure 5 represent the water table surface calculated by the model that best represents the observed groundwater elevations in the NMA monitoring wells. At some wells, model-calculated groundwater levels are higher or lower than that observed. However, on average, the model-calculated groundwater levels closely match the groundwater levels observed in the total combined set of monitoring wells.

4.0 2015 MODEL PREDICTABILITY ASSESSMENT

Model calibration involves varying the parameters (K, recharge, ET) within ranges that are deemed reasonable based on the available data and published information to match the observed groundwater levels as closely as possible. The model can approximately replicate the observed groundwater level data using differing combinations of K, recharge, and ET. This results in the possibility of developing alternative calibrations that represent the observed groundwater level data equally well.

[3] Golder, 2007. Cover Simulations for Feasibility Study DP-1340, Condition 93 dated June 22, 2007.

A deliberate effort was made to calibrate the model to a different set of input parameters in order to evaluate how sensitive model predictions are to different combinations of model parameter values. The input parameters were adjusted in an attempt to find a combination of parameters that, although still remaining within the ranges allowable based on the available data and published information, would result in higher groundwater inflows to the pit as an alternative for comparison purposes. This effort resulted in the development of an alternative model that was almost as well calibrated to the available groundwater level data.

Once this was done, predictive simulations were run using both models, and the results compared to see how close the predictions are to the various sets of input parameters used in the two models. For this purpose, the extent of the predicted OPCZ's under operational conditions were compared. The model estimated the limits of the OPCZ by placing "particles" of water at the water table, and calculating the flow paths of the water to see if it flows toward and discharges into the pit or flows outward and discharges elsewhere in the model area. The line separating the flow that goes into the pit from the flows discharging elsewhere is the OPCZ boundary.

Figure 6 shows the OPCZs calculated from the recalibrated model and the alternative model. As shown on the figure, the estimated limits of the OPCZ are close. The extent of the OPCZ in the alternative model is slightly farther away from the pit in the West and South Stockpile and Lambright Stockpile areas. The similarity of the predicted OPCZs using the two different models provides confidence in the predicted limits of the OPCZ. Figure 6 also shows a combined OPCZ, which was drawn to represent the closest of the two OPCZs to the pit.

5.0 OPCZ AND AOPHC COMPARISON

Before proceeding to discussing implications with respect to the proposed placement of a waste rock stockpile in the Reservoir 9 drainage area, it is important to understand the differences between the OPCZ and AOPHC as they have been defined, as well as the Open Pit Surface Drainage Area (OPSDA). The regulatory requirements for placing a stockpile under the New Copper Rules depend on whether the proposed stockpile is within the OPSDA or outside of it. To determine the OPSDA, one must also know the OPCZ, or similarly, the AOPHC. The OPSDA is defined by NMAC 20.6.7.7B.(42) as:

> *(42) "Open pit surface drainage area" means the area in which storm water drains into an open pit and cannot feasibly be diverted by gravity outside the pit perimeter, and the underlying ground water is hydrologically contained by pumping or evaporation of water from the open pit.*

The latter part of this definition refers to the AOPHC. The AOPHC is defined by NMAC 20.6.7.7B.(5) as:

> *"Area of open pit hydrologic containment" means, for an open pit that intercepts the water table, the area where ground water drains to the open pit and is removed by evaporation or pumping, and is interior to the department approved monitoring well network installed around the perimeter of an open pit pursuant to Paragraph (4) of Subsection B of 20.6.7.28 NMAC and also limited to the area of disturbance authorized by a discharge permit.*

The OPCZ differs from this definition of the AOPHC in that the OPCZ is not confined to the authorized area of disturbance. The OPCZ could be farther away from the pit in comparison, because it represents the physical area over which groundwater recharge reports to the pit. With regard to the requirement that the AOPHC be based on an approved monitoring well network, the modeling approach used here will satisfy this requirement. This is because the model does not rely on a limited set of monitor wells, but instead, relies on the combined total of the monitoring well data. Any given monitoring well might not represent the actual groundwater level conditions for a number of reasons (e.g. installed in an isolated fault zone or within a perched zone detached from the rest of the groundwater system, etc.). Therefore, a more robust approach is to rely on the preponderance of the available groundwater level data, rather than on a select few datasets.

6.0 IMPLICATIONS REGARDING THE PROPOSED PLACEMENT OF THE RESERVIOR 9 WASTE ROCK STOCKPILE

The modeling effort summarized in this memorandum demonstrates that the proposed footprint of the Reservoir 9 stockpile will be within the OPCZ and the OPSDA. As shown on Figure 7, the OPCZ in the Reservoir 9 area is beyond the surface water divide south of the proposed Reservoir 9 footprint, and beyond the current and proposed area of disturbance. Consequently, the Copper Rules (NMAC 20.6.7.21B.(1) set forth for new waste rock stockpiles within the OPSDA will apply.

The estimated limits of the OPCZ are defensible based on the extensive data and information used to construct the model, and the rigorous modeling approach that was employed. Furthermore, the limits of the OPCZ are conservatively close to the pit, because of a key addition of a low K unit in the 2015 model north of Reservoir 9 and near the rim of the pit. The observed groundwater elevations in this northern area are anomalously high in comparison to groundwater elevations elsewhere around the perimeter of the pit. This indicates that they are perched onto lower K rock or otherwise isolated from the regional groundwater system, and therefore, not representative of the regional groundwater flow system. Placing a low K unit in the model to better match the unrepresentative observed groundwater elevations of the northern area results in a groundwater mound and an apparent shallow groundwater divide (Figure 7) located close to the pit. Groundwater to the north and south of this divide flows to the north and south respectively.

While it might appear that the groundwater south of the local divide will continue flowing south escaping containment by the pit, the particle tracking effort demonstrates that this groundwater reverses course and discharges into the pit. This happens because the regional groundwater system is three dimensional, with frequently greater vertical components of flow compared to horizontal components of flow. As the shallow groundwater flows horizontally south of the divide, it is also flowing vertically downward. As it flows vertically downward, the hydraulic gradient towards the pit becomes greater than the hydraulic gradient to the south. Consequently, the groundwater reverses course in the horizontal sense and discharges into the pit.

7.0 CLOSURE

Golder is pleased to present this technical memorandum summarizing our 2015 modeling effort to Chino. Please contact Mark Birch or Kent Johnejack at (520) 888-8818, if questions arise or if additional information is needed.

Attachments: Figures 1 - 7

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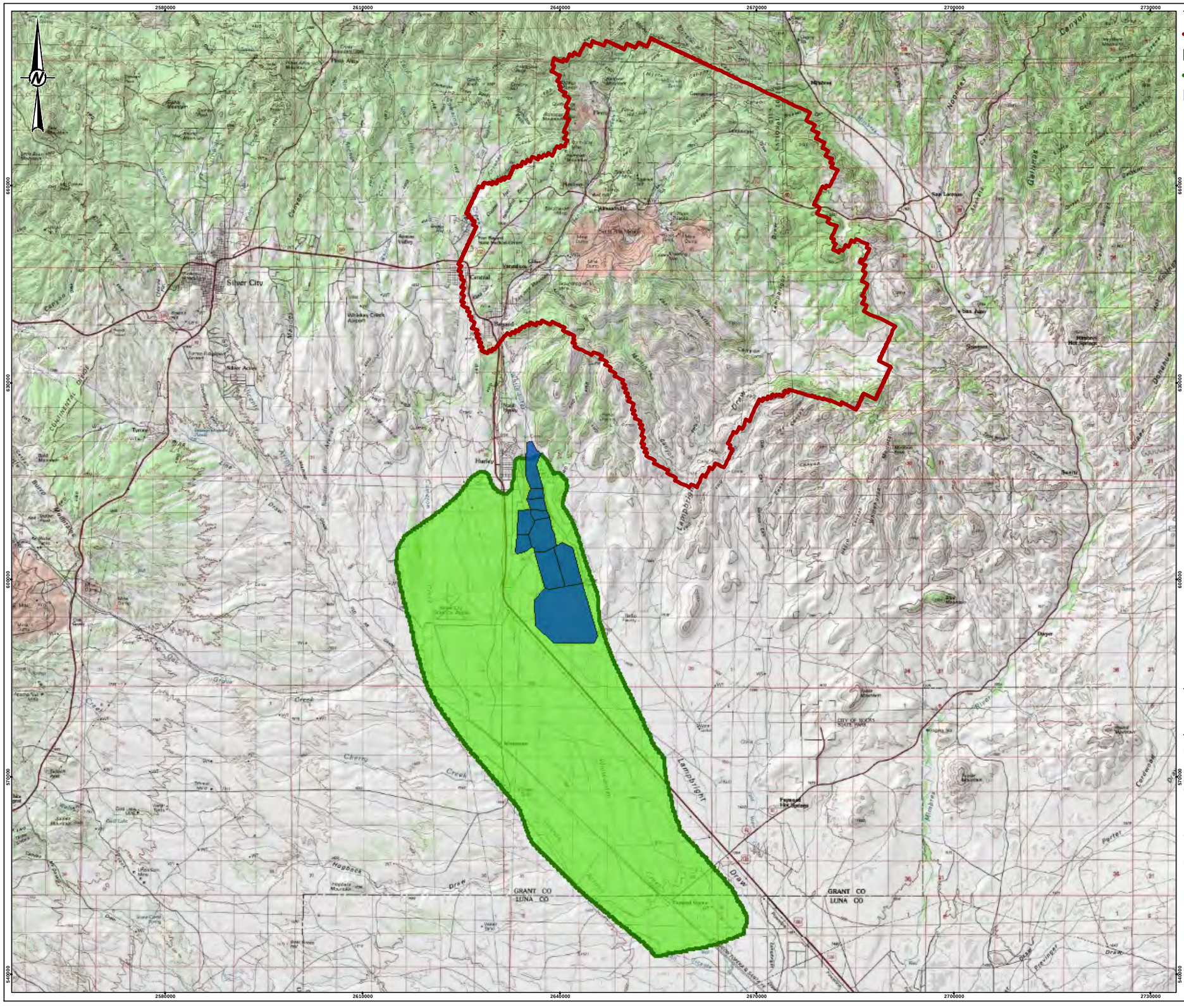
Figures



LEG END

- NMA Model Boundary
- SMA Ponds
- SMA Model Boundary
- SMA Model Domain

0 3 6

1 " = 3 mi MILES

NOTE(S)

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
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CLIENT

FREEPORT MCMORAN CHINO MINES COMPANY

PROJECT

TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

TITLE

LOCATION MAP

CONSULTANT

GOLDER

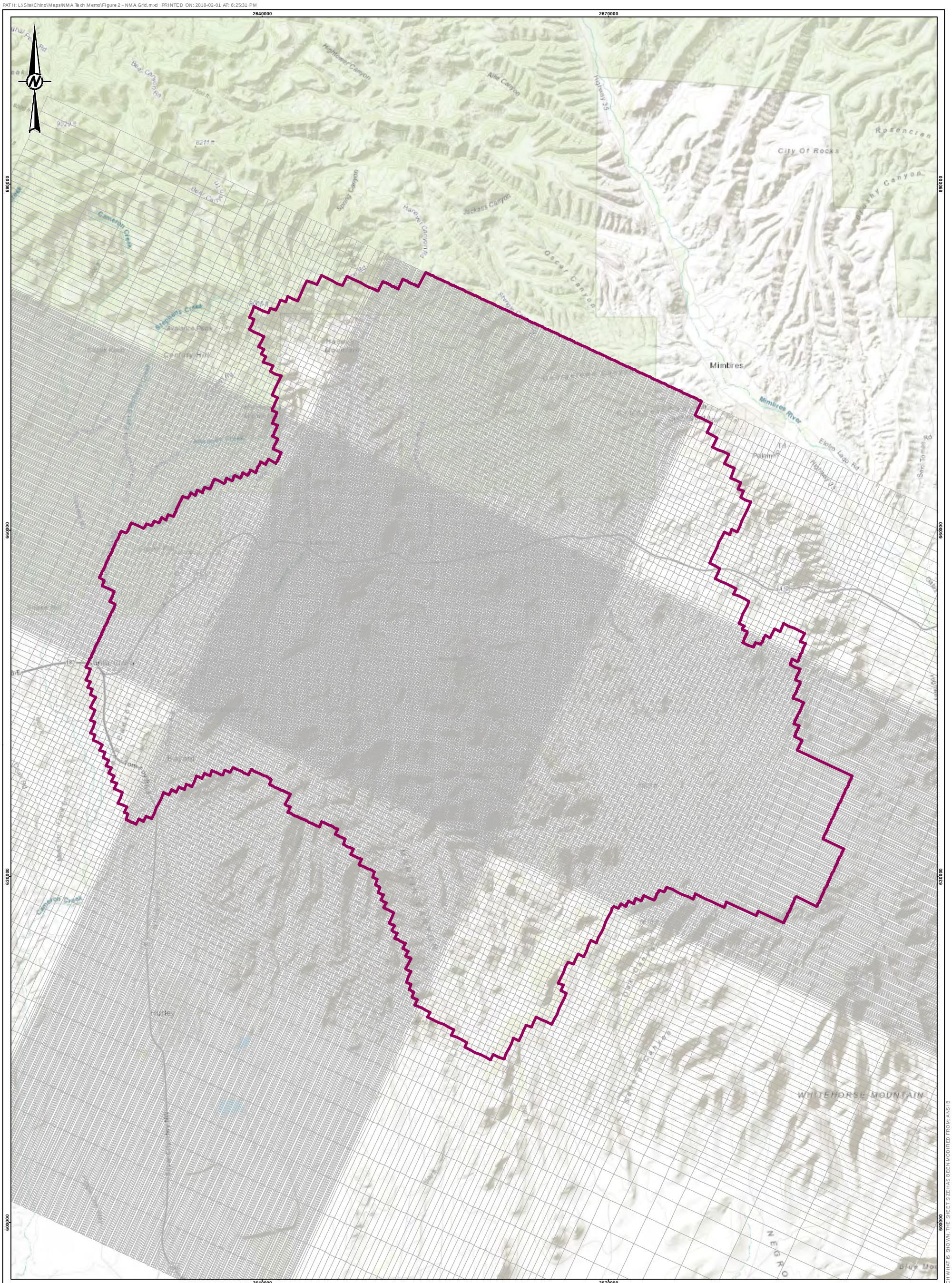
YYYY-MM-DD	2018-01-31
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	1

PATH: U:\GIS\Chino\Figure1 - Location Map.mxd PRINTED ON: 2018-01-31 AT: 10:33:45 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: L:\Site\Chino\Maps\NMA Tech Memo\Figure 2 - NMA Grid.mxd PRINTED ON: 2018-02-01 AT: 6:25:31 PM



LEGEND

- EDGE OF MODEL DOMAIN
- MODEL GRID

NOTE(S)

0 1.5 3
1" = 1.50 mi MILES

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY

PROJECT
TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

CONSULTANT
GOLDER

YYYY-MM-DD	2018-02-01
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

TITLE
2015 RE-CALIBRATED MODEL GRID

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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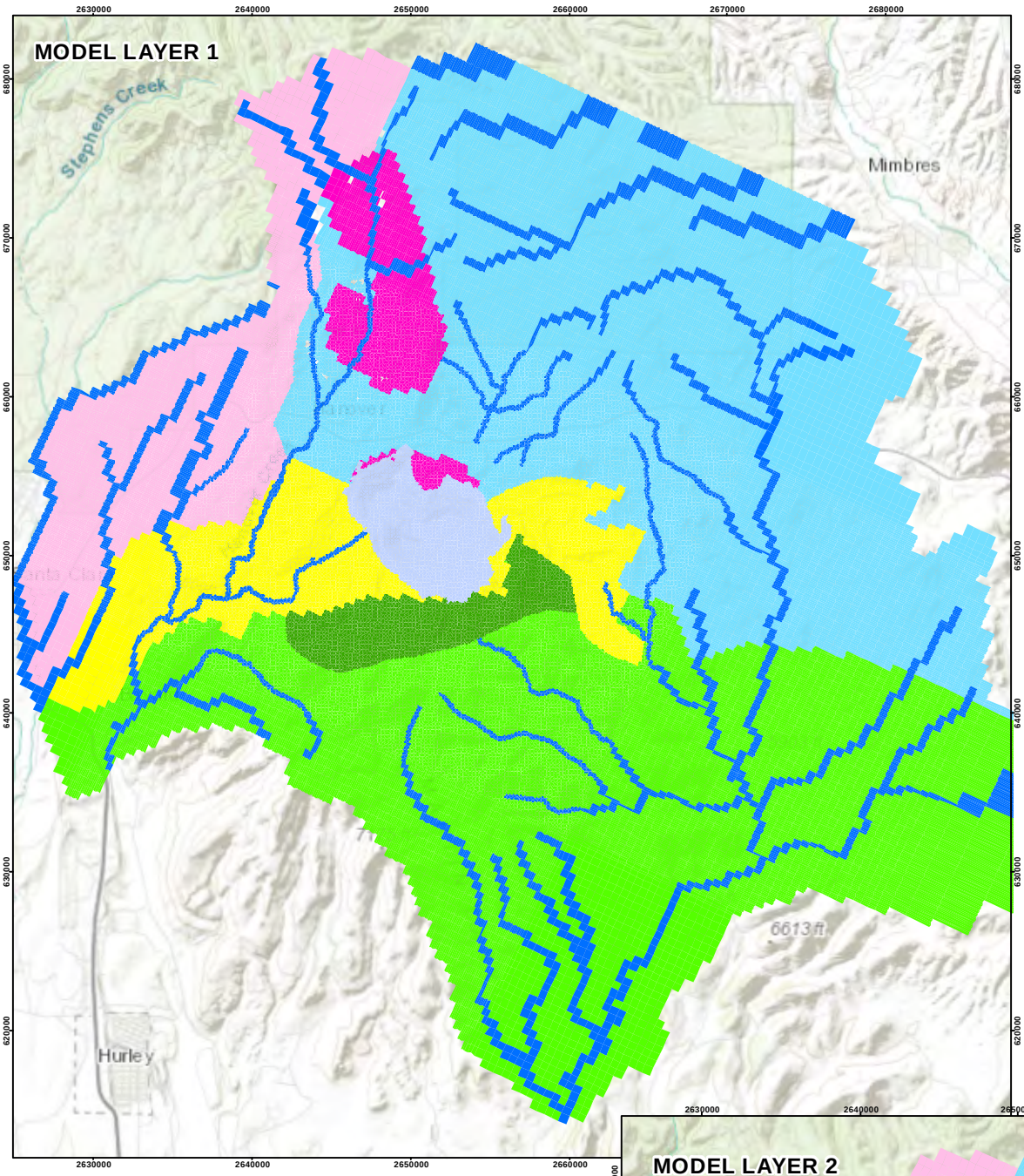
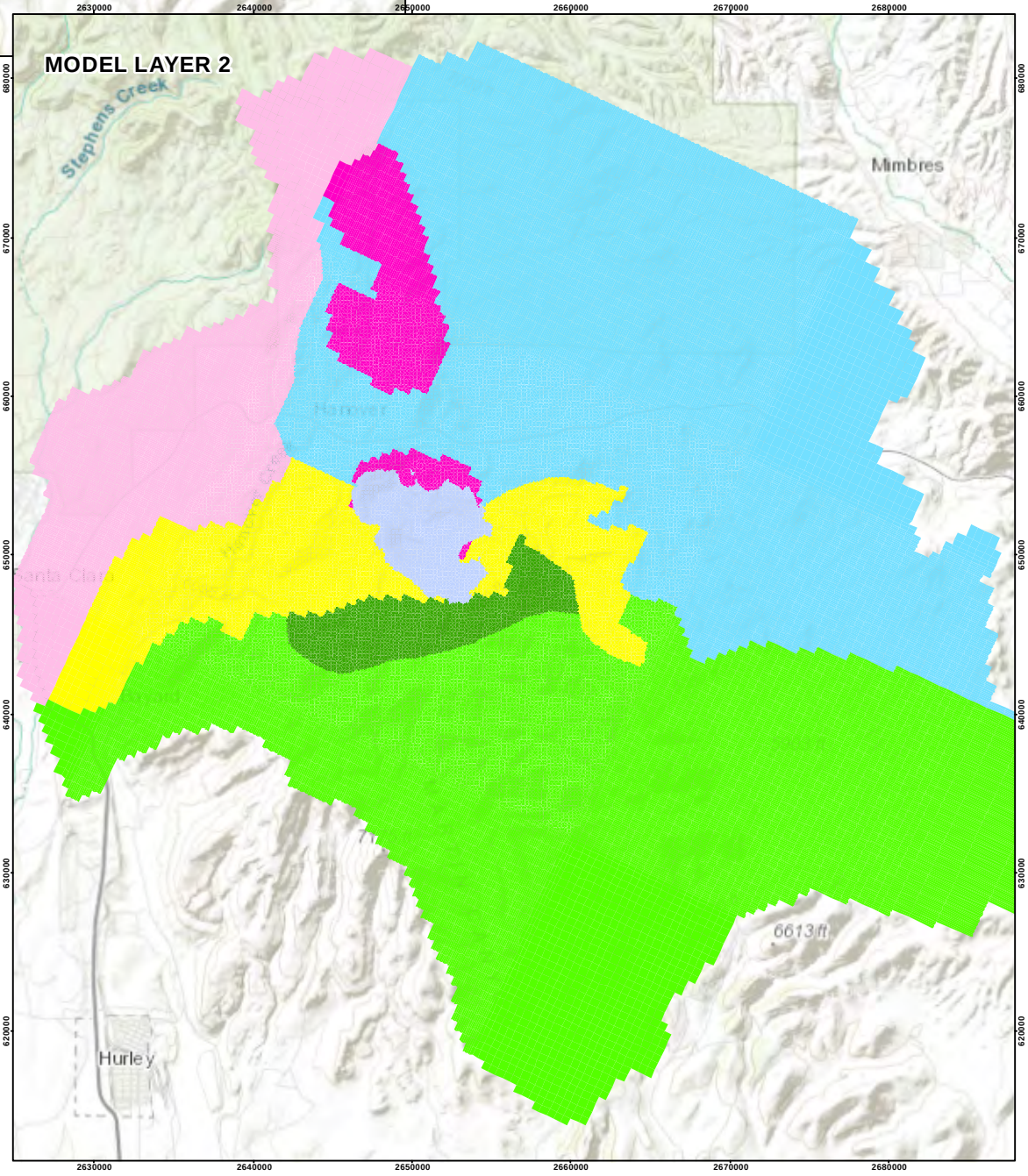




LEGEND

K ZONE (DESCRIPTION, KX, KZ)

- 1 (WASHES, 3 FT/D, 3 FT/D)
- 2 (0.008 FT/D, 0.002 FT/D)
- 4 (0.005 FT/D, 0.001 FT/D)
- 5 (0.003 FT/D, 0.003 FT/D)
- 7 (0.004 FT/D, 0.004 FT/D)
- 10 (PIT, 30 FT/D, 30 FT/D)
- 15 (0.0006 FT/D, 0.0006 FT/D)
- 17 (0.0009 FT/D, 0.0009 FT/D)

0 4

1 " = 2.00 mi MILES

NOTE(S)

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY

CONSULTANT
GOLDER

YYYY-MM-DD	2018-02-08
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

PROJECT
TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

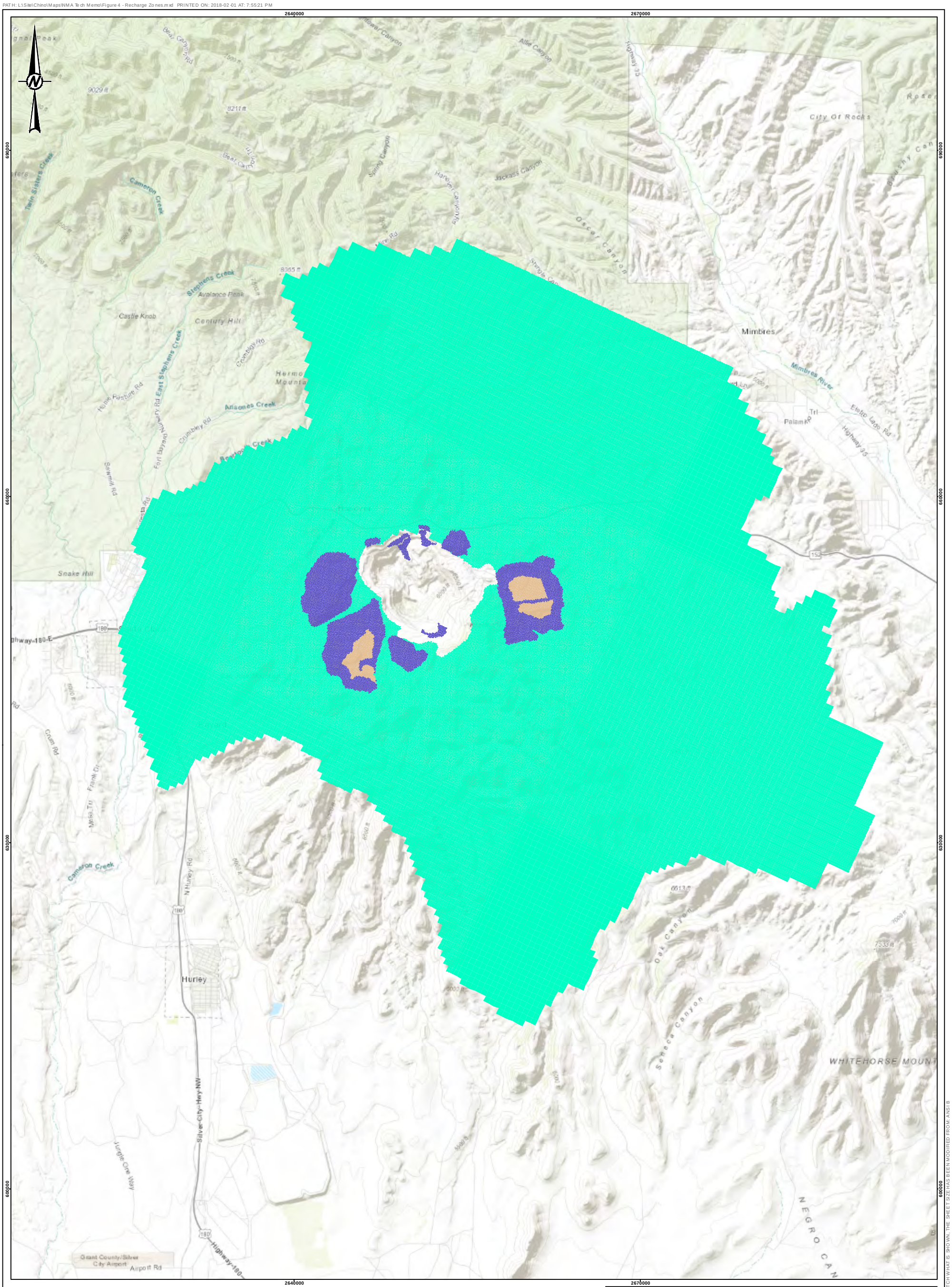
TITLE
2015 RE-CALIBRATED MODEL K ZONES

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in

PATH: L:\Site\Chino\Maps\NMA Tech Memo\Figure 4 - Recharge Zones.mxd PRINTED ON: 2018-02-01 AT: 7:55:21 PM



LEGEND

RECHARGE ZONE, RATE

- 2 (2.04 CM/YR)
- 11 (STOCKPILES, 2.67 CM/YR)
- 17 (LEACHED, 7.68 CM/YR)

NOTE(S)

0 1.5 3

1 " = 1.50 mi MILES

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY

PROJECT
TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

CONSULTANT
GOLDER

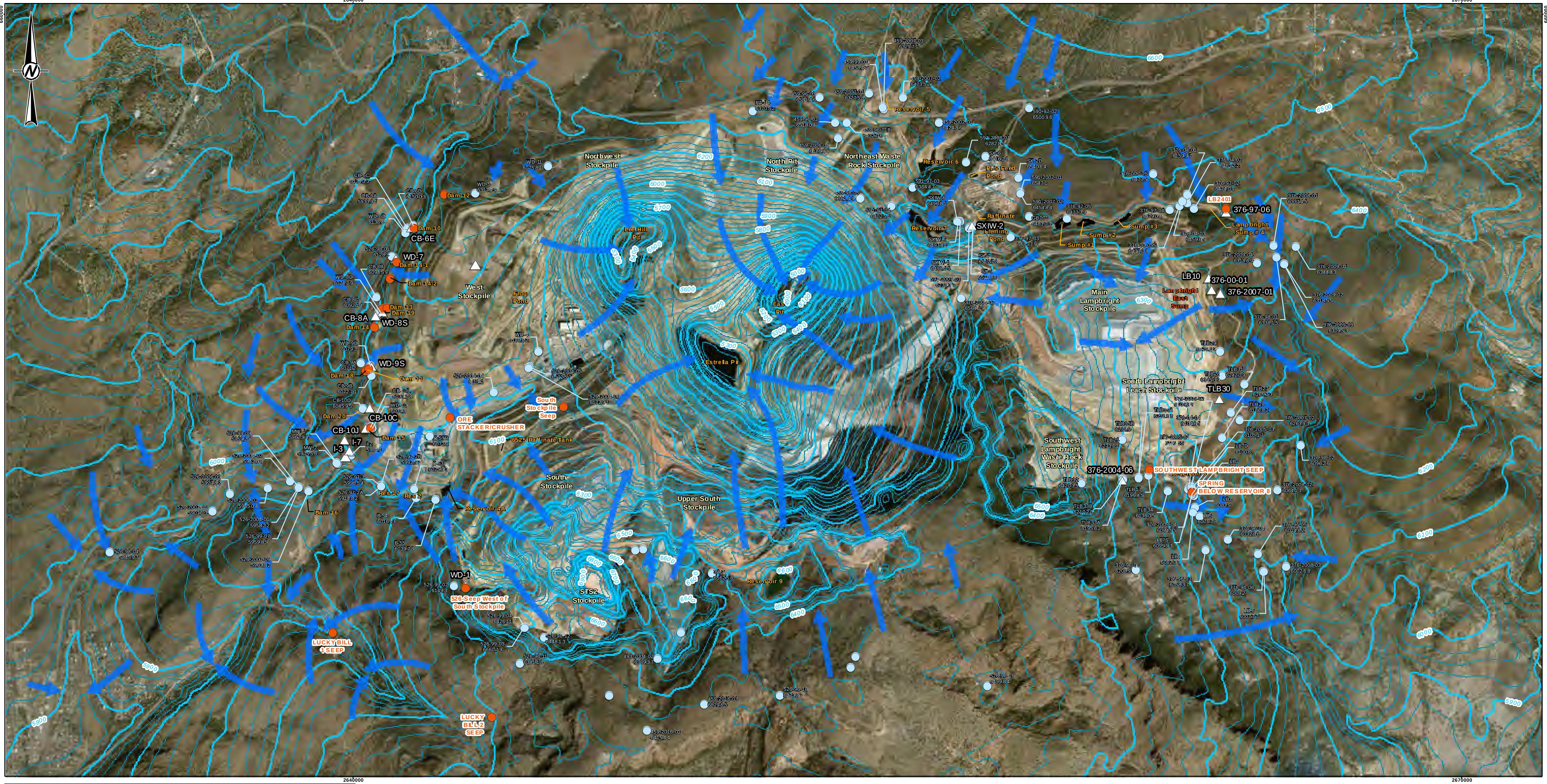
YYYY-MM-DD	2018-02-01
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

TITLE
2015 RE-CALIBRATED MODEL RECHARGE ZONES

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in



LEGEND

SEEP

INTERCEPTOR WELLS

WELL WITH GROUNDWATER

MONITOR WELL

PRODUCTION WELL

INTERCEPTOR WELL

RESERVOIRS

GROUNDWATER FLOW DIRECTION

GROUNDWATER ELEVATION

100 FT CONTOUR

25 FT CONTOUR

0 0.5 1 Miles

1" = 0.5 miles

NOTE(S)

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY

PROJECT
TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

CONSULTANT

GOLDER

YYYY-MM-DD	2018-02-01
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

TITLE
GROUNDWATER CONTOURS

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	5

PATH: L:\Site\Chino\Maps\NMA Tech Memo\Figure 6 - Operational OPCZ.mxd PRINTED ON: 2018-02-08 AT: 3:04:05 PM

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NORTHWEST STOCKPILE

NORTH PIT STOCKPILE

NORTHEAST WASTE ROCK STOCKPILE

WEST STOCKPILE

SANTA RITA PIT

MAIN LAMPBRIGHT STOCKPILE

SOUTH LAMPBRIGHT LEACH STOCKPILE

SOUTHWEST LAMPBRIGHT WASTE ROCK STOCKPILE

SOUTH STOCKPILE

UPPER SOUTH STOCKPILE

STS2 STOCKPILE

LEGEND

- COMBINED OPERATIONAL OPCZ
- ALTERNATIVE MODEL OPERATIONAL OPCZ
- RECALIBRATED MODEL OPERATIONAL OPCZ
- PROPOSED RESERVOIR 9 WASTE STOCKPILE

0 0.4 0.8

1 " = 0.40 mi MILES

NOTE(S)

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER

CLIENT

FREEPORT MCMORAN CHINO MINES COMPANY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-02-08
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

PROJECT

TECHNICAL MEMORANDUM - NORTH MINE AREA GROUNDWATER MODEL

TITLE

2015 RE-CALIBRATED AND ALTERNATIVE MODELS OPERATIONAL OPCZ

PROJECT NO.	CONTROL	REV.	FIGURE
1785360	---	---	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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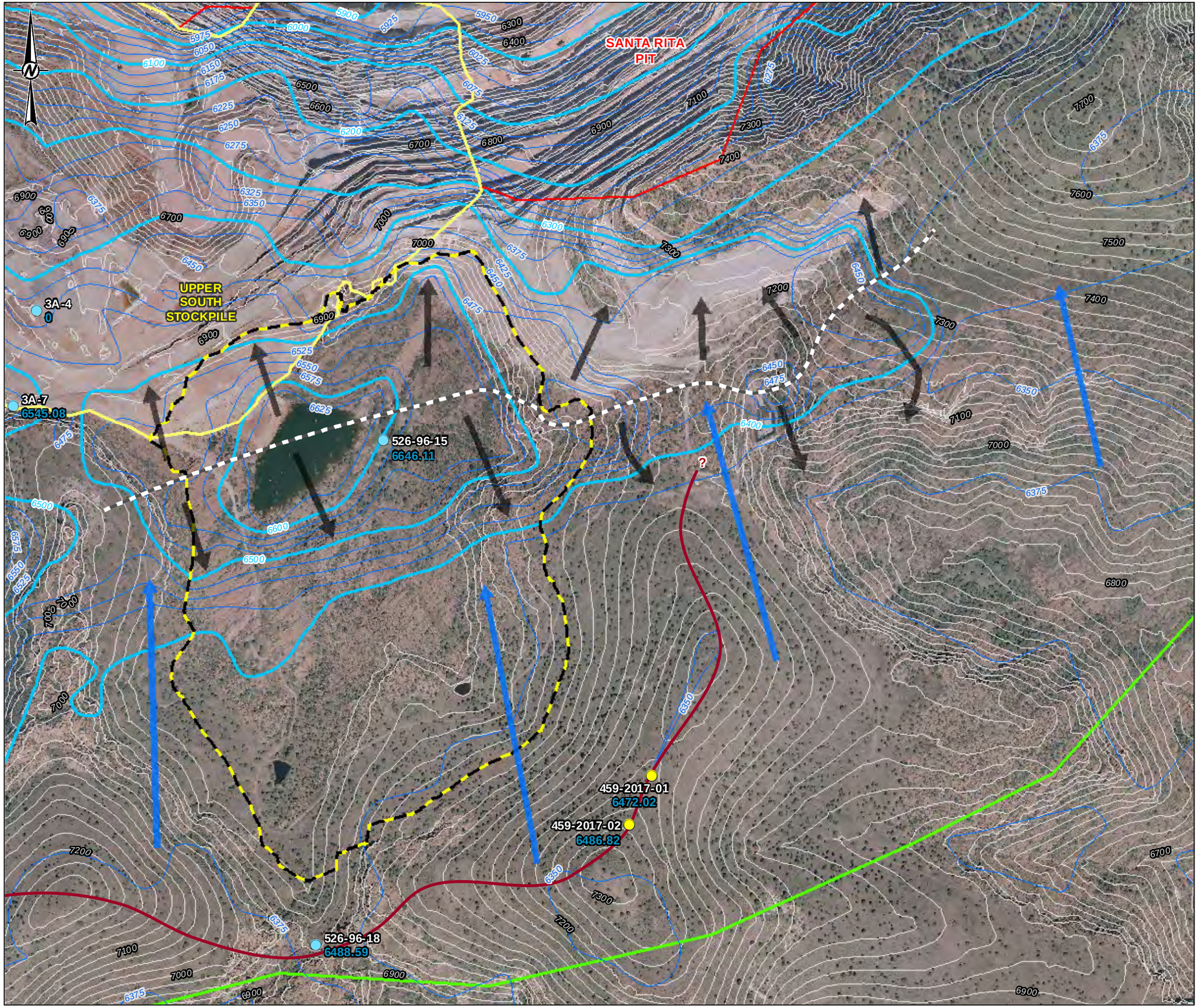

LEGEND

- NEW MONITOR WELL
- MONITOR WELL
- SANTA RITA PIT
- REGIONAL GROUNDWATER FLOW DIRECTION
- LOCAL GROUNDWATER FLOW DIRECTION
- STOCKPILES
- PROPOSED RESERVOIR 9 WASTE STOCKPILE
- COMBINED OPERATIONAL OPCZ
- SURFACE CONTOURS (200 FT. INTERVALS)
- LOCAL INFERRED GROUNDWATER DIVIDE
- SURFACE WATER DIVIDE

GROUNDWATER ELEVATION CONTOURS

- 100 FT CONTOUR
- 25 FT CONTOUR

0 600 1,200

1 " = 600 feet Feet

NOTE(S)

REFERENCE(S)

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP

CLIENT
CHINO MINES COMPANY

PROJECT
NMA MODEL

TITLE
PROPOSED RESERVOIR 9 STOCKPILE

CONSULTANT
GOLDER

YYYY-MM-DD	2018-02-09
DESIGNED	DZF
PREPARED	DZF
REVIEWED	BS
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
1415000	---	---	7

PATH: L:\Sites\Chino\Maps\NMA\Tech Memo\Figure 7 - Proposed Res 9 stockpile.mxd PRINTED ON: 2018-02-09 AT: 14:52 PM

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FREEPORT-McMoRan

Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Thomas L. Shelley
Environmental/Sustainable Development
Telephone: 575-912-5227
e-mail: tshelley@fmi.com

April 5, 2017

Certified Mail #70153010000206574502
Return Receipt Requested

Fernando Martinez
Energy, Minerals and Natural Resources Department
Mining and Minerals Division
Mining Act Reclamation Program
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Dear Mr. Martinez:

Re: Freeport-McMoRan Chino Mines Company – Permit No. GR009RE:
Design Limit Expansion and 9 Waste Rock Stockpile Closure Closeout Plan

Freeport-McMoRan Chino Mines Company (Chino) submits the enclosed application to the Mining and Minerals Division (MMD) to revise the Santa Rita Beneficiation Design Limit (DL) and update the Closure Closeout Plan (CCP) in accordance with 19.10.5 NMMA. As part of this application, a Closure/Closeout Plan (CCP) for the 9WRS is also enclosed.

Chino is proposing to increase the existing DL by approximately 248 acres as illustrated in Figure 1-3 of the CCP. The increase in the DL will allow for the construction of the proposed 9 Waste Rock Stockpile (WRS) and associated infrastructure.

The footprint of the 9WRS is expected to cover approximately 159 acres. Approximately 99 acres will be located beyond the currently approved DL. Chino assumed for the purpose of this application that the portion of 9WRS that occurs beyond the current DL will be subject to Section 19.10.5.508 NMAC. The 9WRS CCP includes the reclamation plans and basis for the Financial Assurance (FA) third party cost estimate, but not the final cost estimate. The earthwork material takeoff was developed by Chino mine under the supervision of Telesto Solutions, Inc. in accordance with standard engineering practice. Supporting data from various references is fully documented in Appendix A of the CCP of this application. Upon approval of this scope of work by State agencies, Chino will submit a FA cost estimate for approval. This will allow Chino to develop a more timely FA cost estimate with a fully vetted scope of work.

A check in the amount of $4,500 is enclosed to process this application.

I certify that I have personally examined and am familiar with the information submitted herein, and based on my inquiry of those individuals responsible for obtaining this

information. I believe the submitted information is true, accurate and complete. Chino looks forward to meeting with you in the near future to facilitate your review of this project.

Sincerely,

Thomas L. Shelley, Manager

TLS: rlm
20170405-001

xc: David Ennis – MMD 7015 3010 0002 0657 4403
Holland Shepherd – MMD 7015 3010 0002 0657 4397
Brad Reid – NMED

FREEPORT-McMoRan

Freeport-McMoRan Inc.
333 North Central Ave
Phoenix AZ 85004

For inquiries, contact us via e-mail: AP@FMI.com<mailto:AP@FMI.com> Self-service website: http://partners.fmi.com

0968

□000 0000197 00000000 006 012 00183 INS: 0 0

NM ENRGY MNRLS & NAT RES DPT
MINING ACT RECLAMATION BUREAU
1220 S SAINT FRANCIS DR
SANTA FE NM 87505-4225

INVOICE NUMBER	INVOICE DATE	PURCHASE ORDER	COMPANY	GROSS AMOUNT	DISCOUNT	NET AMOUNT
11172016DK 9 WASTE ROCK STOCKPILE MM	11/17/16		FREEPORT MINERALS CORPORA	4,500.00	0.00	4,500.00

Check Number	Date	Vendor Number	Name	Total Amount
0000868411	11/23/16	0000101184	NM ENRGY MNRLS & NAT RES DPT	$4,500.00

CH249 v.0.02 01-12-2012

WARNING: THIS DOCUMENT CONTAINS SEVERAL DOCUMENT SECURITY FEATURES

FREEPORT-McMoRan

Freeport-McMoRan Inc.
333 North Central Ave
Phoenix AZ 85004

CHECK NO. 0000868411

64-1278/611 GA

DATE OF CHECK
11/23/16

PAY: FOUR THOUSAND FIVE HUNDRED AND 00/100 DOLLARS

CHECK AMOUNT
$4,500.00

Security features details on back

TO THE ORDER OF NM ENRGY MNRLS & NAT RES DPT
MINING ACT RECLAMATION BUREAU
1220 S SAINT FRANCIS DR
SANTA FE NM 87505-4225

Bank of America, N.A.

Authorized Signature

DO NOT CASH IF THE WORD VOID IS VISIBLE. SEE REVERSE SIDE FOR LIST OF SECURITY FEATURES.

⑈0000868411⑈ ⑆061112788⑆ 329999845⑈

FREEPORT-MCMORAN

FREEPORT-MCMORAN CHINO MINES COMPANY:

APPLICATION TO REVISE

MINING PERMIT GR009RE

FOR

9 WASTE ROCK STOCKPILE

Date: April 5, 2017

Submitted To: **New Mexico Mining and Minerals Division**

Prepared by: **Freeport-McMoRan Chino Mines Company**

FIGURES:

- FIGURE 1-1 – Chino Mine Location Map
- FIGURE 2 – Proposed Design Limit Adjustments
- FIGURE 3 – Proposed Santa Rita Beneficiation Design Limit, Figure 2-4, Revision 8

ATTACHMENTS:

- ATTACHMENT 1: 9 Waste Rock Stockpile Closure/Closeout Plan

APPENDIXS:

- Appendix A: Earthwork Cost Estimate Process Report and Reclamation Design Drawings

APPLICATION REQUEST

Freeport-McMoRan Chino Mines Company (Chino) owns and operates an existing mining operation located in southwestern New Mexico (Figure 1-1). This document constitutes Chino's application to the New Mexico Mining and Mineral Division (MMD) to revise Permit No. GR009RE (Permit) pursuant to 19.10.5 New Mexico Administrative Code (NMAC). Chino is requesting that its mining Permit be revised to:

1.) Expand the Santa Rita Beneficiation Design Limit boundary to include the proposed 9 Waste Rock Stockpile, as indicated in Figure 2 of this application; and
2.) Incorporate into the Permit a closeout plan and proposed financial assurance (FA) for the 9 Waste Rock Stockpile, pursuant to NMAC 19.10.5.506.J and 19.10.12.

The area of the currently approved Santa Rita Beneficiation Design Limit Unit is approximately 6350 acres. The current Santa Rita Unit was approved by MMD on September 17, 2012 as "*Santa Rita Beneficiation Design Limit, Figure 2-4, Rev 6, August 1, 2012*" under Permit Modification 12-1. Chino proposes to expand the approved Santa Rita Design Limit to the south and northeast of Reservoir 9 by 248 acres. This increase will allow for the construction of the proposed 9 Waste Rock Stockpile and associated infrastructure (WRS). Figure 2 delineates the proposed change to the currently approved Santa Rita Beneficiation Design Limit boundary. Chino proposes that Figure 3 of this application, titled "*Santa Rita Beneficiation Design Limit, Figure 2-4, Rev 8, dated 11/16/2016*", replace "Figure 2-4, Rev 6" as the currently approved Santa Rita Beneficiation Design Limit.

The proposed 9 WRS will be contiguous to Chino's existing mining operations. The footprint of the 9 will cover approximately 159 acres and partially lies within the currently approved Santa Rita Beneficiation Design Limit Unit. Approximately 134 acres of the 9WRS will result in new disturbances within Chino's approved mining permit boundary. The 9 WRS is designed to contain approximately 76 million tons of mine waste rock. The stockpile will be placed over Reservoir 9 to an elevation of approximately 7000 ft. The stockpile will be buttressed by hillsides with the exception of the north side which will be buttressed by an existing haul road. The operational design of the 9WRS includes benches that create an approximate overall 3.5V:1H slope to facilitate final closurePursuant to MMD's regulations at 19.10.5.506 A. and B. NMAC, a closeout plan for the 9 WRS is attached (Attachment 1). This application has also been prepared to comply with the New Mexico Environment Department (NMED) Ground Water Quality Bureau's

applicable requirements for closure of copper mine facilities, 20.6.7.33 NMAC. The Closure/Closeout Plan (CCP) describes how the 9 WRS will be reclaimed to achieve a post mining land use of wildlife habitat and to comply with 20.6.7.33 NMAC. Reclamation means the employment during and after a mining operation of measures designed to mitigate the disturbance of affected areas and permit areas and, to the extent practicable, providing for the stabilization of a permit area following closure that will minimize future impacts to the environment from the mining operation and protect air and water resources (19.10.1.7.R.1). The Mining Act requires reclamation to meet certain requirements and to reach a certain point of stability, after which the mining Act Permit is released, and the reclaimed land is not treated any differently than property used for a non-mining purpose.

APPLICANT INFORMATION

19.10.5.502.D NMAC

Applicant Name: Freeport-McMoRan Chino Mines Company

Mailing Address: PO Box 10, Bayard, New Mexico, 88023

Physical Address: 99 Santa Rita Mine Road, Vanadium, NM

Ownership: The Bureau of Land Management owns all property associated with the 9 WRS and supporting infrastructure.

SITE SPECIFIC CHARACTERISTICS

Pursuant to 19.10.5.506.A and 19.10.5.508 NMAC, Chino here describes the relevant site specific characteristics of the area to be covered by the proposed 9 WRS. These site specific characteristics support the proposed CCP and substantiate how the 9 WRS will comply with the applicable portions of 10.10.5.508 NMAC.

The 9 Reservoir is authorized by NMED under Discharge Permit 526 (DP-526) and also occur within permit GR009RE design limit boundary. The proposed 9 WRS is a waste rock stockpile and leaching is not

intended to occur on this facility. Chino is separately submitting an application to NMED to authorize the construction of the 9 WRS and to move the 9WRS from DP-526 to DP- 459.

Geology: Section 3.3.2 of the attached CCP describes the geology underlying the proposed WRS.

Climate: The climate at Chino is warm and dry, with a mean annual precipitation of about 400 mm (16 inches) and a mean annual temperature near 10 C (50 F). Precipitation falls mainly as rain, but snow may occur from November to March.

Surface and Ground Water: This proposal does little to change the existing surface and ground water conditions in this area of the mine. The proposed 9WRS lies within the former upper reaches of the Whitewater Creek watershed. Surface water discharge in this small basin is presently collected in Reservoir 9. No permanent streams are present in the proposed 9 WRS area. Two small ephemeral drainages run roughly from south to north through the valley and terminate in Reservoir 9. Ground water system within the proposed 9 WRS area is in the open pit capture zone. Seepage flows north toward the Santa Rita open pit where it is contained. Additional groundwater information in this area will be supplied under DP-376.

19.10.5.508.A NMAC MOST APPROPRIATE TECHNOLOGY AND BEST MANAGEMENT PRACTICES

Sections 4.0, 5.0, 6.0 and 7.0 in the attached CCP describes the most appropriate technology and best management practices Chino is utilizing during the construction and reclamation of the 9WRS.

19.10.5.508.B(1) NMAC SIGNS, MARKERS, AND SAFEGUARDING

Chino will use existing procedures and practices to safeguard the public from “unauthorized entry into shafts, adits, and tunnels and falls from highwalls or pit edges”. Activities at Chino are regulated, and regularly inspected, by the Mine Safety and Health Administration. Ingress and egress by the public is limited by manned security gates. Perimeter gates are locked except during entry and exit by approved personnel and contractors.

19.10.5.508.B(2) NMAC WILDLIFE PROTECTION

Chino contracted Golder Associates to conduct a pedestrian wildlife survey in July 2016 for the 9WRS area. No special-status (Threatened or Endangered) species of wildlife were observed in the project areas during the survey. The wildlife and vegetation communities in the 9 WRS are typical of the greater region and are non-descript. Golder confirmed that two USNVC alliances were present in the study areas: the alligator juniper-oak woodland alliance and alligator juniper-oak/grama woodland alliance.

The 9 WRS is not expected to markedly change the fauna and flora populations in the area due to the fact that similar habitat is common on undisturbed mine property and in other nearby areas.

19.10.5.508.B(3) NMAC CULTURAL RESOURCES

Chino contracted Dos Rios consultants to conduct an archeology survey in the proposed 9WRS area in September 2016. Five archeological sites were observed in the 9 WRS footprint. Chino is working with the Bureau of Land Management on the observations. Chino will adhere to all applicable New Mexico Cultural Properties Act (CPA 08-6-1 0 through 18-6-17) rules as they relate to project construction on private property. The archeology survey does not indicate a human burial site in the footprint of the 9WRS but in the event one is encountered, work in that area will cease and local law enforcement will be notified by a Chino Mine representative.

19.10.5.508.B(4) NMAC HYDROLOGIC BALANCE

Table 1 describes how Chino will comply with 10.10.5.508.B(4) as applicable.

Table 1

MMD Regulation	Description of Compliance
19.10.5.508.B(4) Hydrologic Balance *Operations shall be planned and conducted to minimize negative impact to the hydrologic balance in both the permit and potentially affected areas.*	Chino will minimize impacts to the hydrologic balance by complying with the applicable portions of 19.10.5.508.(B)(4)(a)-(d).

(a) *Operations shall be designed so that non-point source surface releases of acid or other toxic substances shall be contained within the permit area, and that all other surface flows from the disturbed area are treated to meet all applicable state and federal regulations.*	The 9WRS is located in the OPSDA. Impacted stormwater and possible seepage from the stockpile will be captured in the open pit. An application to modify DP-376 to include the construction of this stockpile has been submitted to NMED for review and approval.
(b) *The disturbed areas shall not contribute suspended solids above background levels, or where applicable the Water Quality Control Commission's standards, to intermittent and perennial streams.*	Not applicable. There are no intermittent or perennial stream in the 9WRS area. Currently, stormwater in the 9 WRS basin flows into the open pit. There will be no change to stormwater flow direction during the construction of the stockpile.
(c) *To provide data to determine background levels for surface water entering the permit area, appropriate monitoring shall be conducted on drainages leading into the permit area.*	Not applicable.
(d) *All diversions of overland flow shall be designed, constructed and maintained to minimize adverse impacts to the hydrologic balance and to assure the safety of the public*	Not applicable.

19.10.5.508.B(5) NMAC STREAM DIVERSIONS

No stream or drainage will be diverted as a result of 9WRS and associated facilities

19.10.5.508.B(6) NMAC IMPOUNDMENTS

Chino is not proposing to construct any impoundments with earthen embankments as part of the 9WRS facility.

NMAC 19.10.5.508.B(7) MINIMIZATION OF MASS MOVEMENT

The operational 9WRS will be constructed to allow for efficient closure of the facility and to ensure that the slope stability requirements listed in the Copper Rules (20.6.7.33.B NMAC) are met. The stockpile is abutted by natural hillside with the exception of the north side which is abutted by an existing haul

road. Section 4.0 (Structural Stability) of the attached CCP provides additional supporting references that the proposed stockpile will meet the slope stability criteria of 20.6.7.33.B NMAC.

NMAC 19.10.5.508.B(8) RIPARIAN AND WETLAND AREAS

Not applicable: No riparian areas, as defined by MMD regulation, 19.10.1.7(R) NMAC, have been identified within or adjacent to perennial or intermittent water bodies at the proposed 9WRS area. Water flow in the area of the proposed 9WRS occurs as a direct result of precipitation events. Likewise, no springs or wetland areas have been identified.

NMAC 19.10.5.508.B(9) ROADS

Not applicable: No new haulage roads are being constructed for the 9WRS.

NMAC.19.10.5.508.B(10) SUBSIDENCE CONTROL

Not applicable: The 9WRS will not have any underground or in situ solution mining activities associated with it.

NMAC 19.10.5.508.B(11) EXPLOSIVES

Not applicable: No blasting is required to build the 9WRS.

NMAC 19.5.508.C SITE STABILIZATION AND SURFACE CONFIGURATION

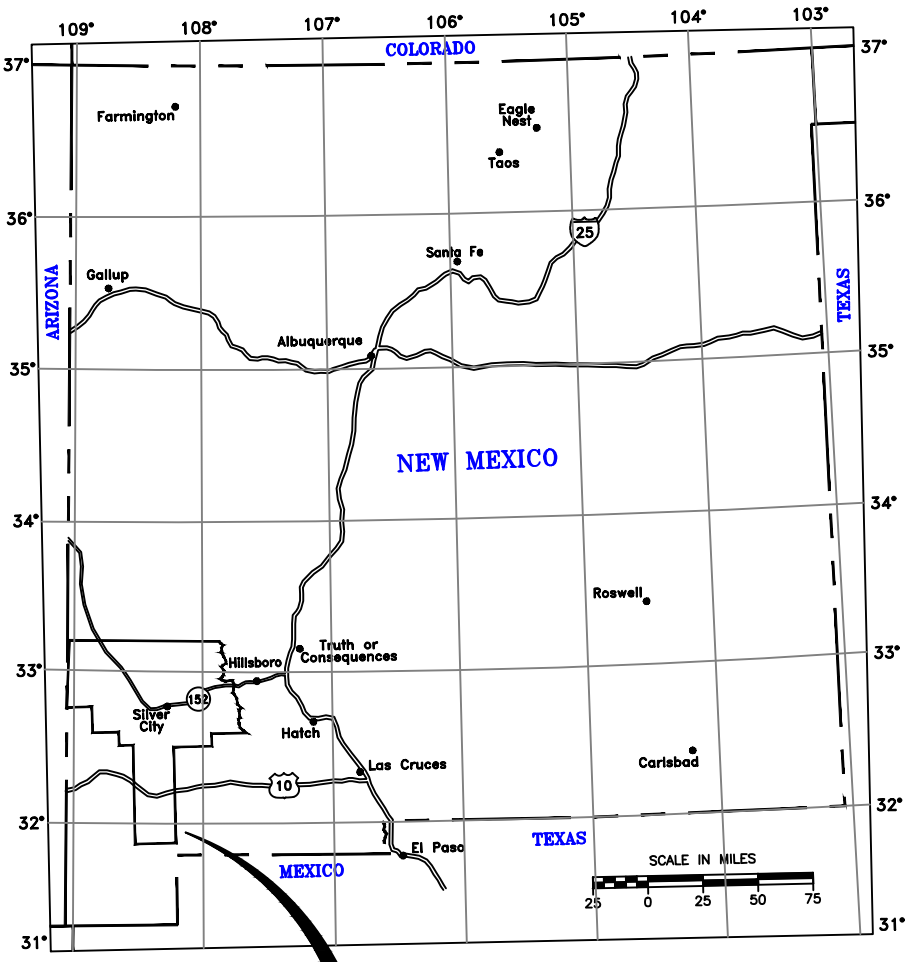
Sections 4.0 and 5.0 of the 9WRS CCP (Attachment 1) describes the surface configuration and measures to stabilize the site.

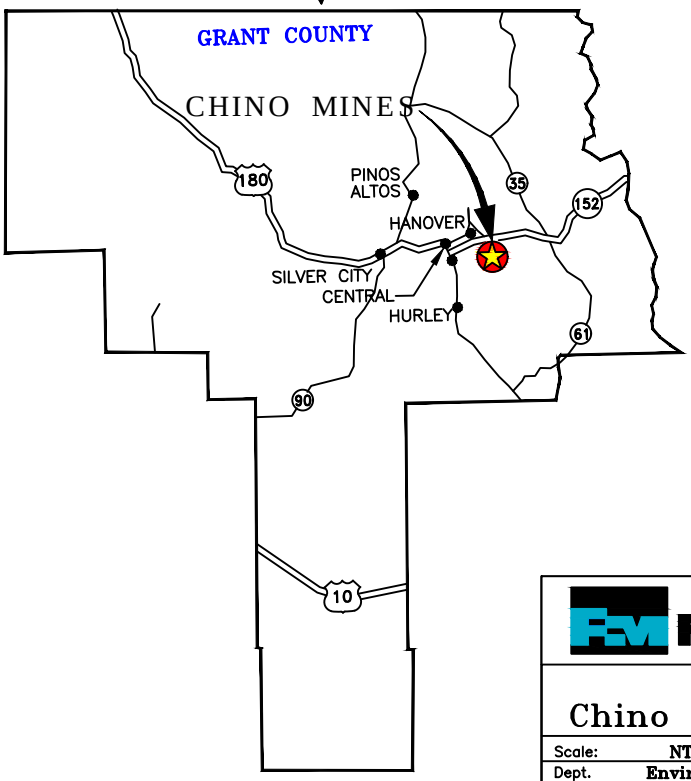
NMAC 19.5.508.D EROSION CONTROL FOR RECLAMATION

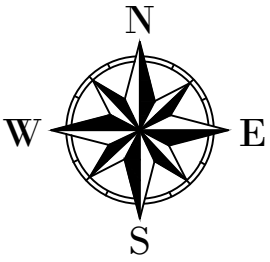
Sections 6.1 of the CCP attached describes the measures to control erosion after reclamation. Reclamation activities will be consistent with current practice although general practices may change in the future. Prior to reclamation of the 9WRS, a CQA/CQC plan will be submitted for department review as part of the final cover design. The plan shall identify a licensed New Mexico professional engineer as the designated CQA officer and include his or her supervision of the CQA plan and shall identify the methods proposed to ensure that the closure construction will be completed in accordance with the design and specifications. BMP's will be utilized during construction and operation of the stockpile to limit sediment transport. Long-term erosion control measures may include the installation of berms, designed channels, and sediment traps, as necessary. Short-term erosion control measures may include, but not limited to: silt fences, hay bales, water bars, and mulching. Final shaping is design to stabilize all disturbed areas. Erosion inspections will be conducted monthly for the first year and thereafter quarterly.

Figure 1

Chino Mine Location Map







FREEPORT-McMoRan

FIGURE 1-1
Chino Mines Co. Location Map

Scale: NTS	Date: 9-7-2016	Notes:	
Dept. Environmental Services			
Drawn By: SMG	Checked By: RLM		

Figure 2

Proposed Design Limit Adjustments

(See Figure 1-3 of the "9 Waste Rock Stockpile , Closure/Closeout Plan" Attached)

Figure 3

Proposed Santa Rita Beneficiation Design Limit, Figure 2-4, Revision 8

NORTH WASTE ROCK PILE

RESERVOIR 5

RESERVOIR 6

NORTHEAST WASTE ROCK PILE

NORTHWEST WASTE ROCK PILE

LEE HILL STOCKPILE

NORTH IN-PIT LEACH STOCKPILE (LEACHED)

SX/EW PLANT

RESERVOIR 7

LEE HILL PIT

WEST STOCKPILE (LEACHED)

EAST PIT

WEST STOCKPILE

MINE MAINTENANCE AND GENERAL OFFICES

SANTA RITA OPEN PIT

ESTRELLA PIT

MAIN LAMPBRIGHT LEACH STOCKPILE (LEACHED)

SOUTH LAMPBRIGHT LEACH STOCKPILE (LEACHED)

IVANHOE CONCENTRATOR

SOUTH STOCKPILE (LEACHED)

UPPER SOUTH STOCKPILE

SOUTHWEST LAMPBRIGHT WASTE ROCK PILE

RESERVOIR 8

STS 2 STOCKPILE

RESERVOIR 9

3A WASTE ROCK STOCKPILE

Legend

- Proposed Chino Mine Design Limit Boundary
- Mine Permit Boundary

DRAFT

FREEPORT-McMoRan

CHINO MINES COMPANY

Proposed Santa Rita Beneficiation Design Limit Figure 2-4 Revision 8

Scale: As Noted	Date: 4/3/2017	Notes:
Dept. Environmental Services		Base Map: 2014 Aerial
Drawn By: SMG	Checked By: RLM	

CLOSURE/CLOSEOUT PLAN

9 WASTE ROCK STOCKPILE CLOSURE/CLOSEOUT PLAN

Freeport-McMoRan
Chino Mines Company
Vanadium, New Mexico

Prepared for: New Mexico Environment Department
Mining Environmental Compliance Section
Ground Water Quality Bureau
Runnells Building
1190 St. Francis Dr.
Santa Fe, NM 87505

and

Mining and Minerals Division
Energy, Minerals, and Natural Resources Department
Wendell Chino Building
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Distribution: 6 Copies – Mining and Minerals Division, w/CD
1 Copy – New Mexico Environment Department, w/CD
4 Copies – Freeport-McMoRan Chino Mines Company, w/CD
2 Copies – Golder Associates Inc., w/CD

March 30, 2017 **1661705**

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List of Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
ABA	acid-base accounting
ac-ft/yr	acre-feet per year
amsl	above mean sea level
AOC	Administrative Order on Consent
APP	Abatement Plan Proposal
bgs	below ground surface
BLM	Bureau of Land Management
CCP	Closure/Closeout Plan
CDQAP	Construction Design Quality Assurance Plan
CFR	Code of Federal Regulations
CGCS	Comprehensive Groundwater Characterization Study
Chino	Chino Mines Company
cm	centimeter
CQAP	Construction Quality Assurance Plan
CQAR	Construction Quality Assurance Report
DBS&A	Daniel B. Stephens and Associates, Inc.
DP	Discharge Permit
DSM	dynamic system model
EOY	end of year
EPA	U.S Environmental Protection Agency
ETS	Evaporative Treatment System
EnviroGroup	EnviroGroup Limited
FS	Feasibility Study
FSIR	Final Site Investigation Report
ft	Feet
Golder	Golder Associates Inc.
Guidelines	Closeout Plan Guidelines
HDPE	high density polyethylene
HDS	high-density sludge
IRA	Interim Remedial Act
IU	investigation unit
M3	M3 Engineering & Technology Corp.
MMD	Mining and Minerals Division
MWWCA	Middle Whitewater Creek Area

List of Acronyms and Abbreviations (Continued)

NMA	North Mine Area
NMED	New Mexico Environment Department
NMMA	New Mexico Mining Act
NMOSE	New Mexico Office of the State Engineer
NMWQA	New Mexico Water Quality Act
NMWQCC	New Mexico Water Quality Control Commission
NSR	New Source Review
O&M	Operation and Maintenance
OPCZ	Open Pit Capture Zone
OPSDA	Open Pit Surface Drainage Area
PMLU	post-mining land use
RCRA	Resource Conservation and Recovery Act
Rules	New Mexico Mining Rules
SCS	Soil Conservation Service
SMA	South Mine Area
SSE	self-sustaining ecosystem
SWQB	Surface Water Quality Bureau
SX/EW	solution extraction-electrowinning
TDS	total dissolved solids
yd^3	cubic yards

1.0 INTRODUCTION

Freeport-McMoRan Chino Mines Company (Chino) operates an open-pit copper mine, concentrator, and solution extraction electrowinning (SX/EW) plant located approximately 10 miles east of Silver City in Grant County, New Mexico (Figure 1-1). Chino is proposing to construct a waste rock stockpile over an area that includes the footprint of Reservoir 9, south of the Santa Rita Open Pit (Figure 1-2). The proposed project is located on lands owned by the BLM.

The construction and location of the 9 Waste Rock Stockpile (9 WRS) is necessary to effectively store mine rock at strategic locations near the open pit and as other stockpiles are filled to capacity. The reclamation plan proposed in this closure/closeout plan (CCP) is intended to meet all state and federal mine reclamation and environmental regulations.

The proposed 9 WRS footprint partially extends beyond the currently approved Mining and Minerals Division (MMD) of the Energy, Minerals, and Natural Resources Department Santa Rita Beneficiation Design Limits (design limits) boundary. Thus, Chino requests that the design limits be expanded to the south to facilitate the construction of the proposed stockpile and associated infrastructure. The proposed 9 WRS will increase the design limits by approximately 248 acres (Figure 1-3). The current mine permit boundary already includes the location of this proposed stockpile and no increase is necessary.

1.1 Purpose of Plan

The purpose of this CCP is to present a reclamation plan consistent with all applicable federal and state regulatory requirements and permit conditions so that a financial assurance cost estimate can be calculated to meet the financial assurance requirements of Part 19.10.12 NMAC. The reclamation plan will demonstrate, where required, that the disturbed area will be reclaimed to a condition that allows for the re-establishment of self-sustaining ecosystem as well to meet the closure requirements of Section 20.6.7.33NMAC.

1.2 Plan Organization

This CCP consists of the following sections:

- **Section 1.0** provides an overview of the CCP for the proposed 9 WRS;
- **Section 2.0** describes the permits associated with the mine;
- **Section 3.0** describes the existing facilities and current environmental setting at the Chino Mine and the proposed 9 WRS area;
- **Section 4.0** describes the proposed 9 WRS configuration;
- **Section 5.0** describes the proposed reclamation plan and associated design criteria and performance objectives for the proposed 9 WRS;
- **Section 6.0** describes the closure and post-closure monitoring plans for the proposed 9 WRS along with contingency plans and reporting schedules;

- **Section 7.0** provides details of the proposed post-mining land use and associated requirements for the proposed 9 WRS;
- **Section 8.0** presents a summary of the material take-offs and factors that will be applied in the capital and operations and maintenance (O&M) cost estimates associated with the proposed reclamation and post-closure monitoring plans presented in Sections 5.0 and 6.0;
- **Section 9.0** presents the proposed reclamation schedule associated with this CCP;
- **Section 10.0** is the signature page for the CCP; and
- **Section 11.0** lists the references used in preparation of this CCP.

The following appendix is also included in the CCP:

- **Appendix A** includes the earthwork cost estimate process report and reclamation design drawings that illustrate the CCP for the proposed 9 WRS.

1.3 Regulatory Authority

In 1993, the New Mexico legislature enacted the New Mexico Mining Act (NMMA) that requires closeout plans to be developed for applicable mines. Rules to implement the requirements of the NMMA were promulgated in 1994. This plan was prepared to comply with applicable regulations and requirements stipulated in the NMMA (NMAC Title 19, Chapter 10, Part 5), New Mexico Water Quality Act (NMWQA), and the New Mexico Water Quality Control Commission (NMWQCC) Regulations (NMAC Title 20, Chapter 6, Parts 2 and 7). In 2013, NMED adopted new rules for the copper mining industry (Copper Mine Rules Section 20.6.7 NMAC), which have been addressed in this CCP.

1.4 Development of CCP Cost Estimates

This CCP provides the engineering basis for the regulatory review of the financial assurance (FA) cost estimate assuming a default scenario, whereby a third party contractor completes the reclamation work. The CCP includes the information required by 19.10.5.506 – 19.10.5.508 NMMA and 20.6.7.33 NMAC, such as topographic maps, key design criteria, design drawings, engineering take off quantities, and reclamation schedule. The CCP is in support of and relies on the knowledge and experience of previous site specific studies, reports, and CCP submittals. With state approval of the CCP basis, the FA current and net present value calculations will be submitted for MMD and NMED approval (19.10.12.1201 NMMA and 20.6.8 NMAC). Outlined in Section 8.0 and detailed in Appendix A is the basis upon which these FA cost estimates will be developed.

2.0 PERMITS AND DISCHARGE PLANS

Chino conducts its mining operations pursuant to numerous state and federal regulations. Table 2-1 lists all state and federal permits, and permit numbers in association with the CCP.

3.0 EXISTING SITE CONDITIONS

The following sections describe the site-specific characteristics of the proposed 9 WRS area.

3.1 Description of the Proposed 9 WRS Area

The proposed 9 WRS is in the North Mine Area (NMA) in an area currently occupied in part by the operational 9 Reservoir (Figure 1-2). The proposed stockpile lies within the open pit surface drainage area (OPSDA). Mine stockpiles, the open pit, and roads are located to the north, east and west of this site. The topography consists of steeply sloping bedrock controlled mountain slopes. Two small ephemeral drainages, former tributaries to Whitewater Creek, run roughly from south to north through the valley and terminate in the 9 Reservoir.

The canyon rock is composed of Tertiary rhyolitic tuff of the Kneeling Nun Formation that is hundreds of feet thick (Figure 3-1). The slopes are vegetated with trees, forbs, grasses and shrubs. The proposed 9 WRS will cover approximately 159 acres at final build out, including approximately 99 acres outside the current design limit boundary, and 60 acres within the current design limit boundary (Figure 1-3). Two groundwater monitoring wells are currently located around the proposed 9 WRS, with one lying within the proposed stockpile footprint (526-96-15). This well will be abandoned as the proposed 9 WRS expands in accordance with Article 72-12 NMSA, all applicable New Mexico Office of the State Engineer (NMOSE) regulations, and the NMED Monitoring Well Construction and Abandonment Guidelines. Chino is currently installing additional ground water monitoring wells (20.6.7.28) within the proposed 9WRS area.

3.2 Past and Current Land Uses

Mining has been the principal land use and economic support for the area since open-pit mining began in 1910. Current land uses in the immediate vicinity of the proposed 9 WRS include mining and wildlife habitat. Additional surrounding land uses outside the mine permit area include private residences, ranching, mining, recreation, and wildlife habitat. Recreation outside the permit area includes camping, picnicking, hunting, off-road vehicle use, hiking, horseback riding, and bicycling.

3.3 Environmental Setting

The following sections present various aspects of the NMA and proposed 9 WRS area, including its topography, geology, climate, hydrology, soils and vegetation, wildlife, and material characteristics. Reservoir 9 is currently located in the approximate site of the proposed stockpile. The reservoir is located in the OPSDA based on monitoring well ground water data, topographic and geologic controls, and past and present surface water flow conditions. At this location surface water flows from south to north, and reservoir seepage continues to flow to the north into the open pit.

3.3.1 Topography

The general topography of the proposed 9 WRS area is depicted on Figure 3-1. Chino operations in the NMA are located near the base of the Cobre Mountains. The proposed 9 WRS area occupies an ephemeral valley that terminates at a mine haul road. The natural ground surface elevation ranges from approximately 6,625 feet above mean sea level (ft amsl) in the vicinity of Reservoir 9 to approximately 7,250 ft amsl along the ridge tops located south and east of the proposed stockpile area. The proposed 9 WRS area is bounded on the north by a haul road, the Upper South Stockpile, and the open pit. To the east, west and south are bedrock ridges composed of outcrops of rhyolitic tuff.

3.3.2 Geology

Chino lies in the transition zone between the Colorado Plateau and the Basin and Range physiographic provinces. The Santa Rita ore deposit that has been mined at Chino lies in the southeastern corner of the Central Mining District (Rose and Baltosser, 1966). Figure 3-1 shows a geological map of the proposed 9 WRS area. The area is underlain mostly by welded rhyolitic tuff associated with the Tertiary Kneeling Nun Formation and other Tertiary basaltic andesite rocks that form the ridges around the area (Jones et al., 1967). The Kneeling Nun Tuff and basaltic andesite volcanic flows are relatively flat lying in this area.

The main geologic units within the proposed 9 WRS area consist of, from youngest to oldest:

- Tertiary Basaltic Andesite Flows (Tba);
- Tertiary Tuff (Tcb), composed of white pumiceous and massive crystal tuffs; and the
- Kneeling Nun Rhyolite (Tk), composed of grayish-red welded rhyolitic crystal tuff.

A northeast trending fault called the Martin Fault has been mapped through the proposed 9 WRS area (Figure 3-1). The Martin Fault is a high angle normal fault that forms a half graben with small to modest displacement downward to the southeast.

3.3.3 Climate

The Chino Mine is located in a semiarid region in southwestern New Mexico, with elevations ranging from about 5,200 to 7,700 ft amsl. The climate at Chino is warm and dry, with mean annual precipitation of about 16 inches (400 mm) and a mean annual temperature near 50˚F (10˚C). Precipitation falls mainly as rain, but snow may occur from November to March. Most of the precipitation in the area falls during July through October in the form of rain during short, intense, thunderstorms. About 60 percent of the precipitation falls during the summer months. Monthly precipitation is generally less than an inch per month from November through June, peaks in July, August, and September with between 2 and 3 inches per month, and generally falls to about 1 inch in October. Annual precipitation averages 17.2 inches at the Santa Rita weather station (elevation of 6,312 ft amsl), which is located about 1,000 feet to the west of the Santa Rita Open Pit.

Evaporative demand in this region is high and annual evaporation far exceeds annual precipitation. Annual potential evaporation measured near the nearby former Reservoir 3A area is estimated at approximately 75 inches per year.

3.3.4 Surface Water Hydrology

The proposed 9 WRS area lies within the former upper reaches of the Whitewater Creek watershed. Surface water discharge in this small basin is now collected in Reservoir 9 to prevent discharge, towards the north, into the Santa Rita Pit. High ridges separate the Whitewater Creek watershed from the Martin Canyon and Rustler Canyon watersheds, which drain towards the south. No permanent streams are present in the proposed 9 WRS area, but two small ephemeral drainages run roughly from south to north through the valley and terminate in Reservoir 9.

3.3.5 Groundwater Hydrology

Groundwater hydrology at the Chino Mine has been analyzed for several decades with the most recent comprehensive report entitled *Chino Mines Company DP-1340 Condition 83 – Hydrologic Study Final Report* submitted in June of 2007. Twice a year, potentiometric maps are submitted to the agency based on groundwater elevation data collected in a monitoring well network system located within the NMA. Conditions are stable and show that the ground water system within the vicinity of the proposed 9 WRS is within the area of hydrologic containment and seepage flows north toward the Santa Rita open pit where it is contained. Under separate application to DP-459, additional groundwater information will be supplied for the area described in this CCP. Groundwater is encountered at an elevation of approximately 6,655 ft amsl in the immediate vicinity of the proposed 9 WRS (at well 526-96-15).

3.3.6 Soils and Vegetation

The soils in the Chino area were mapped by the U.S. Soil Conservation Service (SCS) (Parnham et al. 1983). The SCS map units were composed primarily of complexes of soil series and miscellaneous land areas. The dominant soils in the northern portion of the survey area (Luzena and Muzzler series) are shallow (<50 cm [centimeters]) and fine-textured with moderate to high rock fragment contents. The soils in the uplands are mostly shallow, although moderately deep (50 to 100 cm) and deep (>100 cm) soils occur to a minor extent. The soils in the valley bottoms are generally deep, vary considerably in texture, but tend to be somewhat coarser textured than the upland soils. The proposed 9 WRS area consists of a weakly dissected pediment with moderate to steep rocky slope segments.

The distribution of native vegetation around Chino is locally complex and reflects the combined influences of environmental gradients (soils and climate), disturbance histories (drought, floods, fire, and predation) and management practices. The major structural characteristics of vegetation are controlled primarily by the prevailing environment gradients. The vegetation at Chino was classified using the nomenclature and hierarchical classification of the U. S. National Vegetation Classification (USNVC) system (Grossman et al.,

1998) and mapped at the Alliance level, which represents the sixth tier in a seven-tiered hierarchy. The vegetation alliances in the area surrounding Chino (DBS&A, 2000) are listed in Table 3-1. Golder evaluated terrestrial habitats in the proposed 9 WRS area in 2016 and confirmed that the USNVC alliances present in the area consist of the Alligator Juniper-Oak Woodland Alliance and the Alligator Juniper-Oak/Grama Woodland Alliance.

The Alligator Juniper-Oak Woodland Alliance habitat is characterized by open stands of oaks such as grey oak (*Quercus grisea*) and emory oak (*Q. emoryi*), junipers (alligator [*Juniperus deppeana*] and/or one-seed juniper [*J. monopsperma*]) and piñon pine (*Pinus edulis*), with canopy cover ranging from 10 to 50 percent. This alliance covers roughly 60% of the valley, with the densest woodland primarily on the northwest facing slopes in the southern half of the study area. This alliance is present throughout the proposed 9 WRS area, with the exception of about 15% area covered with reservoir and disturbed area surrounding it. The Alligator Juniper-Oak/Grama Woodland Alliance habitat is also dominated by oaks and alligator juniper, with occasional piñon pine, but with lower tree canopy cover (3 to 8 percent). The understory contains dense grama (Bouteloua spp.) and muhly (Muhlenbergia spp.) grasses. Beargrass is a common member of the shrub component. This alliance covers roughly 25% of the Reservoir 9 valley. This alliance is represented in scattered areas throughout the proposed stockpile site but primarily on the shallower, upper slopes on the south side of the valley.

Trees in the area are predominantly juniper and oak species (Quercus spp.), with occasional piñon pine. Common shrubs observed include banana yucca (*Yucca baccata*), mountain mahogany (*Cercocarpus montanus*), beargrass (*Nolina microcarpa*), Parry's agave (*Agave parryi*) in rocky areas, and Apache plume (*Fallugia paradoxa*). Common grass species observed included Muhlenbergia spp., Harvard's three-awn (*Aristida havardii*), sand dropseed (*Sporobolis cryptandrus*), spike dropseed (*Sporobolis contractus*), hairy grama (*Bouteloua hirsuta*), blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), feather fingergrass (*Chloris virgata*), cane bluestem (*Bothriochloa barbinodis*), and Tufted lovegrass (*Eragrostis pectinacea*).

Herbaceous species observed included golden crown beard (*Verbesina encelioides*), Large petalled wild onion (*Allium macropetallum*), scarlet hedge-nettle (*Stachys coccinea*), southern mountain paintbrush (*Castellija austromonana*), Fendler rockcress (*Arabis fendleri*), Wright's cudweed (*Pseudognaphalium canescens*), canyon morning glory (*Ipomoea barbatisepala*), Carruth's sagewort (*Artemisia carruthii*), Fendler globemallow (*Sphaealcea fendleri*), yellow blanket flower (*Gaillardia pinnatifida*), shepherd's purse (*Capsella bursa-pastoris*), rock fern (*Polystichum* sp.), antelope horns milkweed (*Asclepias asperula*), bahia (*Amauriopsis disecta*), Erigeron spp., and spurge (*Chamaesyce* spp.).

3.3.7 Wildlife

The proposed 9 WRS area is not expected to markedly change wildlife populations in the area because similar habitat occurs extensively on undisturbed mine property and in adjacent nearby areas. Chino contracted Golder to conduct a pedestrian wildlife survey of the proposed 9 WRS area in July 2016. The results of this survey indicated that the vegetated portions of the proposed 9 WRS area provide potential foraging, breeding, and nesting locations for different wildlife species. Twenty-nine wildlife species or their sign were observed during the July 20, 2016 site visit (Table 3-2). Most inhabited the juniper-oak woodland habitat. These included 20 birds, 4 mammals, 1 amphibian and 4 reptiles. Invertebrates were not recorded during the site visit, though several were seen. The most common birds observed were spotted towhees, house wrens, house finches, and western wood-pewees. The most common mammal sighted were rock squirrels. A mule deer was sighted on the northeast side and tracks and pellets were seen throughout the survey area. Southwestern fence lizards and crevice spiny lizards were the most common reptiles seen throughout the area, in both the alligator juniper-oak/grama woodland and juniper-oak woodland alliances. One amphibian species occurred in the area, the canyon tree frog which was sighted on the southwest side of the valley in the juniper-oak woodland habitat.

No State or Federal special-status (threatened or endangered) species of wildlife or plants were observed in the area during the survey. Potential habitat for bats may occur in the form of crevices in the rock outcrops, but no roosts were positively identified. Surveys for Piños Altos flameflower were conducted in representative areas, but none were found.

3.3.8 Material Characteristics

Stockpile and cover borrow source materials found at the Chino Mine have previously been characterized with respect to their chemical composition and physical properties.

Stockpile Materials

On February 17, 2015, Chino submitted an updated material handling plan to NMED as part of the Master Document. Chino continually characterizes mined materials during operations and uses the information to route ore and waste rock to appropriate stockpile storage facilities. The material placed in the 9 WRS will not contain ore-grade copper, but will be mineralized. Waste rock stockpiles in the arid Southwest produce little stockpile seepage relative to leach stockpiles, however, a waste rock stockpile containment plan is proposed under the operating discharge permit (20.6.7.21 NMAC) and shall be performed in accordance with the applicable engineering requirements of Subsection B of 20.6.7.21 NMAC and 20.6.7.17 NMAC.

Chino believes the proposed stockpile is located inside the OPSDA (20.6.7.21.B.2 NMAC) based on site hydrologic studies. Chino is also currently installing additional ground water monitoring wells within the proposed 9WRS area that will provide additional ground water level and water quality data for the area.

Chino under the operating permit and with NMED guidance will establish a monitoring well network and corresponding water quality sampling program. The monitoring well data will be used to demonstrate compliance with applicable rules.

Borrow Materials

Agency approved or conditionally approved borrow material will be used as Reclamation Cover Material (RCM). All RCM are tested in accordance with the approved borrow material handling plans. The RCM is overburden that consists of a heterogeneous mixture of unmineralized and weakly mineralized earthen materials. The suitability of the RCM have been demonstrated as part of the Chino Test Plot program. The fine-earth fraction of the RCM is mostly medium- and moderately coarse-textured with clay contents ranging from about 10 to 20%. The rock fragment content of the RCM ranges from about 35 to 65% by volume. The results from the 2015 vegetation surveys of the stockpile test plots and Rustler Canyon reference area indicate that the unamended, mixed lithology cover material used at the test plots is capable of supporting a diverse self-sustaining ecosystem (Golder, 2015 and 2017). These data demonstrate that the vegetation on the test plots meets or is on a trajectory to meet vegetation success standards. A 3-foot thick cover constructed from the RCM meets the water holding capacity requirements specified by the Copper Mine Rules Section 20.6.7.F (Golder, 2016).

4.0 PROPOSED 9 WRS OPERATIONAL CONFIGURATION

The proposed 9 WRS will be constructed with waste rock mined from the Santa Rita Open Pit. The proposed 9 WRS at final build-out is presented on Figure 1-3. The stockpile is located at the southern periphery of the mine and will cover approximately 159 acres. Other stockpiles and the open pit are adjacent to this location. A process water reservoir (Reservoir 9) is currently located in the northern end of the valley. At final build-out, the top of the stockpile will be at an elevation of approximately 7,000 ft amsl. The stockpile will be constructed by end dumping in lifts approximately 50 feet high. The outslope of the stockpile will be built at angle of repose with between 80 to 100-foot wide benches on each lift, which will result in an overall slope of approximately 3.5H:1V. This operational outslope design will facilitate reclamation at closure, because it allows attainment of the 3H:1V interbench slopes with minimal regrading. The top surface will be nearly level, but will be graded at closure to meet the minimum requirements (Figure 1-3).

5.0 PROPOSED 9 WRS RECLAMATION PLAN

This section presents the reclamation plan and associated design criteria for closure/closeout of the proposed 9 WRS. Reclamation design criteria were developed in consideration of the site-specific conditions that exist at Chino including soil, ecological, operational, and economic constraints. The reclamation design criteria conform to the closure requirements described in Section III of DP-1340, 20.6.7.33 NMAC, and Section 8 of MMD Permit GR009RE. Conceptual level reclamation design drawings for the proposed 9 WRS are presented in Appendix A. Final designs for reclamation of this facility will be prepared and submitted to the agencies as part of the CDQAP.

Performance objectives and design criteria were developed with the intent of meeting the NMWQA, NMWQCC Regulations and NMMA Rules. The reclamation designs were developed to provide sufficient information to calculate the financial assurance cost estimate. A summary of the key design criteria for the 9 WRS are presented in Table 5-1, and are consistent with the requirements specified in Section 20.6.7.33 NMAC. The reclamation performance objectives for the 9 WRS include: establishment of a self-sustaining ecosystem; create a post mining land use of wildlife habitat; and control discharges of water that have the potential to generate leachate and cause an exceedance of applicable standards.

Structural Stability

The operational 9 WRS will be constructed to allow for efficient closure of the facility and to ensure that the Copper Rules (20.6.7.33.B NMAC) slope stability requirements are met. The stockpile is abutted by natural hillsides on all but the north side. On the north side, the stockpile abuts a mine haul road embankment. The overall outslope following reclamation will be approximately 3.5H:1V and up to approximately 250 feet high. Based on a comparison of this configuration to the cross sections of waste and leach stockpiles evaluated in (Golder, 2007b; 2008) it is expected that the proposed stockpile will meet the slope stability criteria of 20.6.7.33.B NMAC.

Stockpile Erosion and Drainage Control

The proposed reclamation design meets the criteria stipulated in permit GR009RE, DP-1340 and Section 20.6.7.33.C NMAC. Erosion and drainage control for the stockpile will be achieved by regrading, construction of stormwater conveyances, and revegetation. Upon reclamation, the 9 WRS top surface will be graded to a minimum final grade of 1% and covered to direct non-impacted stormwater to designated discharge areas. Armored channels, perimeter berms, and hydraulic structures will be designed to control erosion and safely convey stormwater. The stockpile inter-bench outslopes will be graded to at least 3.0H:1V with uninterrupted slope lengths of no greater than 200 feet. Stormwater will be controlled using conventional terrace channels integrated to two downdrains, one on the northwest and the other on the southwest side of the stockpile (Appendix A). Erosion control will be achieved by storm water conveyance channels, stable outslopes, suitable cover material and revegetation.

Run-on from the surrounding terrain will be controlled by perimeter channels located around the 9 WRS (Appendix A). All channels will be designed to accommodate the peak discharge resulting from the 100-year, 24-hour storm event. The perimeter channels will direct surface water flows around the perimeter of the stockpile and ultimately northward toward the open pit.

Temporary erosion control measures may be provided during the construction and early vegetation establishment periods. These measures may include, but are not limited to, berms, mulch, straw bales, silt fences, and minor corrective regrading. All construction will be in compliance with federal and state regulations for temporary storm water control.

Stockpile Cover and Revegetation Specifications

Finish grading of the stockpile subgrade will be performed based on pre-construction surveys. Earth moving equipment such as bulldozers and motor graders will be used to smooth the surfaces and facilitate access for supplemental cover placement and mulching/seeding. Stockpile covers will be placed according to the following criteria:

9 WRS Cover and Grading	
Top Surface Cover Thickness	36 inches
Outslope Cover Thickness	36 inches
Top Surface Grade	1.0 to 5%
Slope (Inter-Bench Slope)	3H:1V max.

The reclamation designs and the associated estimated reclamation quantities presented in Appendix A indicate that the cover requirement for the 9 WRS is approximately 780,208 yd^3. Overburden material that has been stored at the Upper South Stockpile is the primary source of cover material for the 9 WRS.

Revegetation of the covered surfaces will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of Permit GR009RE and applicable modifications. The planned seed mix is discussed in Section 7.0.

6.0 CLOSURE & POST-CLOSURE MONITORING, REPORTING, AND CONTINGENCY PLANS

Closure and post-closure monitoring, reporting, and contingency plans are described in Chino's current operational DP-493, DP-1340, and the MMD Permit. All the closure and post-closure ground water, surface water, seep, spring, and piezometer monitoring data will be reported under the appropriate discharge permit and in accordance with DP-1340 (NMED, 2003). Chino will submit to NMED quarterly reports summarizing reclamation and post-closure activities on or before January 15, April 15, July 15, and October 15 of each year. Two potentiometric maps including data from all active monitoring wells, extraction wells, piezometers, seeps, and springs in the NMA (including the 9 WRS area) will be submitted to NMED in accordance with Section 20.6.7.35 NMAC.

The MMD requires periodic monitoring of revegetation during the responsibility period to evaluate revegetation success. DP-1340 requires the development of post-closure monitoring and contingency plans that are consistent with the terms and conditions of the applicable DP. The following sections summarize the general approach that will used to meet these requirements.

6.1 Erosion and Drainage Control Structures

The reclaimed 9 WRS will be visually inspected for signs of excessive erosion and significant erosion features will be mitigated to prevent future degradation of the site in accordance with Section 20.6.7.35 NMAC and Section 8.N.1 of the MMD Permit. Chino will conduct inspections and submit reports of the reclaimed 9 WRS monthly for the first year following completion of reclamation construction activities, and quarterly thereafter. Additional erosion inspections will also be conducted after a one inch or more rain event. Chino will report evidence of excessive erosion and/or structural failures to the appropriate agencies (MMD, NMED, or NMOSE) in a timely manner. A written report detailing the nature and extent of the problem and a corrective action plan will be developed within 15 days after the problem is identified in accordance with Section 20.6.7.30 NMAC.

As specified in Section 20.6.7.35 NMAC, Chino will routinely inspect and maintain all drainage channels, diversion structures, retention impoundments, and auxiliary erosion control features in accordance with professionally recognized standards, such as the Natural Resources Conservation Service.

6.2 Water Quality Monitoring and Reporting

Monitoring of site water quality will be accomplished through sampling and analysis of water in accordance with Section 20.6.7.35 NMAC. Water quality will be monitored throughout the post-closure period. The monitoring schedule, analytical requirements, location, and construction specifications for the monitoring wells will be determined in consultation with NMED. The analytical results will be reported to the NMED as specified in DP-1340 and Section 20.6.7.28 NMAC.

6.3 Revegetation Success Monitoring

The reclaimed area will be monitored in accordance with 20.6.7.35.C NMAC, DP-1340, and Section 8.N.2 of the MMD Permit after the final grading and the initial establishment of vegetation on the reclaimed land. Chino will conduct semi-quantitative vegetation monitoring during the third year after seeding. Quantitative vegetation monitoring will be performed at the sixth year after planting and for two of the last four years prior to bond release. Revegetation monitoring will include canopy cover, plant diversity, and woody stem density as specified in Section 8.N.2 of the MMD Permit (MMD, 2003a).

6.4 Wildlife Monitoring

Wildlife monitoring will be conducted in accordance to the approved work plan. The approved work plan includes deer pellet counts and bird diversity surveys conducted six years after seeding and two consecutive years prior to bond release. Results of the surveys will not be a condition of, or given consideration with regard to financial assurance release.

6.5 Construction Quality Assurance Plan

Pursuant to Sections 8.D.2.a and 8.E.2.a of the MMD Permit and 20.6.7.34.F and 20.6.7.34.G NMAC Chino will submit a CQAP to the MMD and NMED for approval no less than 180 days prior to regrading of the 9 WRS and placement of any cover material for final closure. The CQAP will be followed by a CQAR to be submitted to the MMD and NMED within 180 days after completion of construction.

7.0 POST-MINING LAND USE DESIGNATION

This section designates the PMLU for the 9 WRS based upon the requirements of the MMD Permit, NMMA Section 69-36-11.6, and Subparts 507.A, 507.B, and 508 of the NMMA Rules (MMD, 1996). PMLUs are specified in Section 3.G. of MMD Permit GR009RE. The approved PMLUs for Chino are wildlife habitat and industrial (MMD, 2003). Wildlife habitat is the primary PMLU for the majority of the Chino mine permit area and is the proposed PMLU for the 9 WRS.

Reclamation of the 9 WRS will result in the development of an early-stage grass/shrub community that will provide a locally important increase in community-level diversity. Some infrastructure may have a post-mining wildlife use such as power poles for raptor perches and main roads for land management. Native vegetation will be established on the reclaimed area resulting in increased erosion protection, direct habitat improvement, and reduced percolation of water into the underlying materials relative to unreclaimed conditions. The proposed reclamation seed mix and seeding rates for the 9 WRS are presented in Table 7-1, and is in accordance with Appendix C of the MMD Permit and applicable modifications. These species have broad ecological amplitudes and will provide structural diversity.

The proposed seed mix was selected to provide early establishment of ground cover, erosion control, and diversity in growth forms. The species selected for the 9 WRS have been successfully used in mine reclamation and range improvement projects in many parts of New Mexico, including the Chino Mine. The primary reclamation seed mix proposed includes cool and warm season grasses, perennial shrubs, and forbs. Depending on availability, alternate species may be substituted for the primary species. The seed mix is designed for application prior to the summer rains. Table 7-2 lists some of the major attributes of the vegetation selected for use at the 9 WRS. The selected vegetation will provide erosion control, promote soil development, and provide forage, seeds, and cover for small mammals and birds. The seed mix includes a number of valuable, nutritious forage and browse species that could be used by wildlife.

7.1 Site-Specific Revegetation Success Guidelines

Section 507.A of the NMMA rules (MMD, 1996) requires that the permit area of an existing mine be reclaimed to a condition that allows the establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding area unless it conflicts with the approved PMLU. Demonstration of the establishment of a self-sustaining ecosystem is made by comparison of the vegetation on the reclaimed areas to vegetation attributes on a reference area and/or technical standards (MMD, 1996).

New disturbances located outside the current design limit will meet the reclamation standards set forth in 19.10.5.507 NMAC and will also comply with the new unit standards set forth in 19.10.5.508.E NMAC. Disturbances located within the current design limit are considered existing mine units and will meet the reclamation standards set forth in 19.10.5.507 NMAC. Site-specific revegetation success guidelines for

each of these areas will follow the established permit conditions for vegetation cover, shrub density, and diversity. The numerical diversity guidelines for the Chino mine are listed in Table 7-3.

8.0 BASIS FOR CAPITAL AND OPERATION AND MAINTENANCE COST ESTIMATES

This section summarizes the material take-offs and factors that will be applied in the capital and O&M cost estimates associated with the 9 WRS reclamation plan. A detailed cost estimate for the purpose of determining the value of the financial assurance performance bond will be prepared following approval of the proposed 9 WRS reclamation plan included in this CCP. The following sections provide the basis upon which these cost estimates will be developed.

8.1 9 WRS Material Take-Offs

The earthworks material takeoff for reclamation of the 9 WRS cost estimate was developed by Chino in accordance with standard engineering practice and is supported with data from various references and is fully documented in Appendix A. The material takeoffs for the major reclamation components are summarized below:

9 WRS Reclamation Quantities[1]		
Item	**Quantity**	**Units**
Earthwork		
Grading	640,954	cubic yards
Bench Grading	14,085	linear feet
Cover Material	780,208	cubic yards
Cover and Revegetate	161	acres
Surface Water Conveyance Channels	21,920	linear feet
Riprap for Conveyance Channels	4,051	cubic yards
Filter/Gravel Below Rip Rap	5,695	cubic yards

Note:

[1] – Quantities developed by Chino

8.2 Basis for Capital Cost Estimates

The earthwork reclamation cost estimate will be based on a template originally created by the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD, 1996). The estimate will include reclamation earthwork and site operations and maintenance costs and will be based on the reclamation designs for the 9 WRS included in Appendix A.

The unit rates that will be used to develop the cost estimate and equipment production factors are provided in Appendix A and are summarized below:

- **Labor Rates:** With the exception of the truck driver rate all labor rates will be developed based on the New Mexico Department of Labor (DOL) Type H (Heavy Engineering) labor rates effective for 2016. These rates include the base, fringe benefit, and apprenticeship contribution rates.
- **Truck Driver Labor Rate:** The base truck driver labor rate is assumed to be 90% of the New Mexico DOL base operator labor rate. Added to the base rate were fringe benefits, apprenticeship contributions, taxes, and Workman's Compensation Insurance.
- **Equipment Rates:** The earth-moving equipment used in the estimate would commonly be available to a contractor. The equipment unit operating costs will be taken from EquipmentWatch Custom Cost Evaluator (Penton Media, Inc., 2016). All costs taken from EquipmentWatch Custom Cost Evaluator are adjusted using the local factor for Las Cruces and overhead is removed from direct costs and included in the indirect cost percentage.
- **Fuel Costs:** The off-road diesel fuel cost will be a vendor quote for delivery of dyed ultra-low sulfur diesel to Silver City, NM.
- **Capital Indirect Costs:** The estimated reclamation costs, at a minimum include contract administration; mobilization; demobilization; engineering redesign; profit and overhead; procurement costs (Section §19.10.12.1205.A NMAC) as well as contingency and project management fee. The percentage rates are supported by using information from similar large scale earthwork projects and State and Federal Reclamation FA cost estimate guidance, Occupational Employment statics, RS Means Contractor Indirect Rates, Margins of Construction, and Business Economics.
- **Equipment Production Factors:** Production factors will be obtained from Caterpillar (2014) for each type of equipment. Productivity curves will also be developed from Caterpillar (2014). See Appendix A for further details.
- **Haul Distances:** Haul distances will be calculated along a preferred route and assumed to originate at the approximate centroid of the source and terminate at the approximate centroid of the reclamation area. A maximum of three segments will be used for each haul route.
- **Borrow Areas:** RCM will be excavated from the Upper South Stockpile.
- **Dozer Push Distances:** Dozer push distances represent the distance from the centroid of the cut block to the centroid of the fill block.
- **Dust Suppression and Site Maintenance:** A full time water truck and a motor grader will be included as part of the fleet during reclamation. The water truck and grader time was set equal to loader time.
- **Revegetation Unit Costs:** The revegetation unit cost will be based on a quote obtained when the cost estimate is being developed. The quote will include: scarifying, discing, rangeland drill seeding, mulching, crimping, and daily per diem.
- **RipRap Production:** The riprap unit cost will be developed based on experience gained producing riprap at the McCain Springs Quarry.
- **Miscellaneous Unit Costs:** Additional miscellaneous unit costs will be taken from several sources including R.S. Means Heavy Construction Cost Data Edition 30 (R.S. Means, 2016). All costs taken from R.S. Means will be adjusted using the location factor for Las Cruces (84.4%).

- **Reclamation:** Reclamation will include: minor top surface grading to achieve a smooth slope following the top surface sloping to the east; pushing down operational stockpile benches to achieve a smooth slope; hauling and grading cover material for the top surfaces; completing surface water channels and benches to collect and convey storm water from the stockpile surfaces; and scarification and revegetation of covered areas.

8.3 Basis of Operation and Maintenance Cost Estimates

Details and supporting documentation for the basis of the O&M cost estimate are provided in Appendix A and summarized below.

The basis for O&M costs related to periodic erosion control and road maintenance are already included in the Chino CCP Update and will not be included as part of the 9 WRS O&M cost estimate. For the 9 WRS, revegetation maintenance will be based on an assumed 2% failure every year for a total of 12 years, starting the year reclamation is completed. Indirect costs are included for long term O&M per MMD (1996) and OSM (2000) guidance and will comprise the same values and factors as the capital indirect costs with exception of contractor profit and overhead. Contractor profit and overhead for long term O&M will be included to account for the long term contract and repetitive annual work. Indirect cost percentages are identical to the percentages presented to MMD and the NMED in meetings with Tyrone on September 20, 2012, and on November 2, 2012.

9.0 CLOSURE SCHEDULE

The proposed reclamation schedule for the 9 WRS summarizes Chino's existing mine plans, near-term mine operation and reclamation commitments and longer-term projections.

The anticipated duration to complete closure of the 9 WRS is approximately 2 years. Under a default scenario, the reclamation would be coordinated with the site-wide reclamation program. Reclamation work will begin within 180 days following of cessation of operations. The most efficient reclamation sequence will be analyzed and developed under the CQAP. However, in preparation of the FA cost estimate the entire site reclamation schedule is developed in total based on the type and area of disturbance as well as the equipment fleet.

10.0 USE OF THIS REPORT

Golder has prepared this CCP for the 9 WRS for the NMED and the MMD of the New Mexico Energy, Minerals and Natural Resources Department. In the compilation of this plan, Golder collaborated with Chino, who prepared the reclamation drawings and basis of the reclamation cost estimate. The 9 WRS CCP has been developed to fulfill the requirements of the following permits and rules:

- Supplemental Discharge Permit for Closure, DP-1340, Chino Mines Company, issued by the NMED on February 24, 2003 (NMED, 2003);
- **Revision 01-1 to Permit GR009RE**, issued by the Director of the MMD of the New Mexico Energy, Minerals and Natural Resources Department on December 18, 2003 (MMD, 2003); and
- Applicable conditions of the **Copper Mine Rules (Section 20.6.7 NMAC)**, respectively.

Respectfully submitted,

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TABLES

Table 2-1: Summary of Chino Closure/Closeout-Related Permits Pertinent to the Proposed 9 WRS

Permit or Requirement	Agency	ID Number	Area Covered
Mining Act Permit	New Mexico Mining & Minerals Division	GR009RE	Chino Mine
Groundwater Discharge Plans	NMED Ground Water Quality Bureau	DP-493, DP-1340	Operational DP for the Reservoir 3A, Reservoir 9, and Highway to Heaven Supplemental DP for Closure
National Pollutant Discharge Elimination System (NPDES)	U.S. EPA (Region 6)	NMR053259 MSGP-2008	Multi-Sector General Storm Water Permit
Water Rights	New Mexico Office of State Engineer	M-3527, M-4425, M-5010 through 5019, M-6724	Chino Mine Areas
Air Quality	U.S. EPA (Region 6)	P066R1 0298M7	Title V Mine-wide Cobre and Chino Mines
Hazardous Waste Generator / Hazardous Materials Inventory	U.S. EPA/New Mexico Department of Public Safety State and County Emergency Response Commission	NMD007396930	Chino Mine
Plan of Operation	Bureau of Land Management	Submitted in 1981 and 1997	All Federal Land

Notes:

SX/EW = Solution extraction/electrowinning
U.S. EPA = United States Environmental Protection Agency
NMED = New Mexico Environment Department
NA = Not applicable

Table 3-1: Vegetation Map Units in the Chino Survey Area

Name	Acreage	Elevation Range (ft amsl)
Mixed-Grama Herbaceous Alliance	6,717	5,200-5,750
Mesquite/Mixed Grama Shrubland Alliance	8,858	5,200-5,800
Fluvial Forest and Shrubland Alliance	1,585	5,200-5,600
Alligator juniper-Oak/Grama Woodland Alliance	10,257	5,800-7,700
Alligator juniper-Oak Woodland Alliance	4,456	5,800-7,400
Mountain mahogany Shrubland Alliance	10,038	5,600-7,600
Ponderosa pine-Oak Forest Alliance	1,552	6,000-7,600
Mine Facilities/Urban	10,122	NA

Notes: NA = Not applicable

Table 3-2. Wildlife Observed During the 2016 Survey of the Proposed 9 WRS Area

Species	Scientific Name
Birds	
Turkey vulture	*Cathartes aura*
Montezuma quail	*Cyrtonyz montezumae*
Mourning dove	*Zenaida macroura*
Black-chinned hummingbird	*Archilochus alexandri*
Norther flicker	*Caloptes auratus*
Cassin's kingbird	*Tyrannus vociferans*
Western kingbird	*Tyrannus verticalis*
Western wood-pewee	*Contopus sordidulus*
Common raven	*Corvus corax*
Western scrub jay	*Aphelocoma californica*
Violet-green swallow	*Tachycineta thalassina*
Juniper titmouse	*Baeolophus ridgwayi*
House wren	*Troglodytes aedon*
Canyon wren	*Catherpes mexicanus*
Rock wren	*Salpinctes obsoletus*
Yellow-rumped warbler	*Setophaga coronata*
Spotted towhee	*Pipilo maculatus*
Black-chinned sparrow	*Spizella atrogularis*
Black-headed grosbeak	*Pheucticus melanocephalus*
House finch	*Carpodacus mexicanus*
Reptiles	
Crevice spiny lizard	*Sceloporus poinsetti*
Southwestern fence lizard	*Sceloporus cowlesi*
Ornate tree lizard	*Urosaurus ornatus*
Whiptail lizard	*Aspidoscilus sp.*
Amphibians	
Canyon tree frog	*Hyla arenicolor*
Mammals	
Rock squirrel	*Spermophilis variegatus*
Chipmunk sp.	*Tamias sp.*
Woodrat	*Neotoma sp.*
Mule deer	*Odocoileus hemionus*

Table 5-1: Summary of Key Design Criteria for Closure of the 9 WRS

Stockpile Regrading:

- Outslope to be graded to an inter-bench slope of 3.0H:1V
- Maximum uninterrupted slope length of 200 feet for outslopes
- Terrace benches will have maximum bench width 50 feet (conceptual designs at 15 feet wide)
- Bench longitudinal slopes at maximum of 5 percent
- Bench cross slopes and channels between 1 and 5 percent
- Top surface graded at a minimum final grade of 1 percent
- Regrading to be done in such a manner that orients surface water conveyances to the exterior perimeter of the stockpile
- Slope channels will be located where possible in natural junctions or drainage chutes, but all channels will contain riprap and energy dissipation structures as appropriate
- Run-on from the surrounding terrain will be controlled by perimeter channels located around the stockpile
- Surface water conveyance channels will be designed to accommodate the peak discharge resulting from the 100-year, 24-hour storm event
- Top surface and outslope to be covered with 36 inches of suitable cover material
- Top surface and outslope to be revegetated in accordance with Appendix C of the MMD Permit and applicable modifications
- A moderate maintenance program will be acceptable until cover vegetation establishes

Haul Roads (all haul roads except those located within PMLU access roads)

- Where located on acid-generating material, surface to be covered with 36 inches of suitable cover material
- Cover surfaces to be revegetated in accordance with Appendix C of the MMD Permit and applicable modifications
- Where located on non-acid-generating material, surface to be ripped and revegetated in accordance with Appendix C of the MMD Permit and applicable modifications
- A moderate maintenance program will be acceptable until cover vegetation establishes

Notes:

MMD = Mining and Minerals Department
PMLU = Post Mining Land Use
OPSDA = Open Pit Surface Drainage Area

Table 7-1: Proposed Interim Seed Mix and Rates for the 9 WRS Site

Species[a]	Life-Form	Duration[b]	Seasonality	Rate[a,c]
Primary				
Blue grama (*Bouteloua gracilis*)	Grass	Per	Warm	0.25
Side-oats grama (*Bouteloua curtipendula*)	Grass	Per	Warm	1.25
Black grama (*Bouteloua eriopoda*)	Grass	Per	Warm	0.10
Green sprangletop (*Leptochloa dubia*)	Grass	Per	Warm	0.15
Plains lovegrass (*Eragrostis intermedia*)	Grass	Per	Intermediate	0.05
Bottlebrush squiretail (*Sitanion hystrix*)	Grass	Per	Cool	1.25
New Mexico needlegrass (*Stipa neomexicana*)	Grass	Per	Cool	1.75
Streambank wheatgrass (*Agropyron dastachyum v. riparium*)	Grass	Per	Cool	1.50
Apache plume (*Fallugia pardoxa*)	Shrub	Per	NA	0.10
Mountain mahogany (*Cercocarpus montanus*)	Shrub	Per	NA	1.00
Winterfat (*Eurotia lanata*)	Shrub	Per	NA	0.60
White prairie clover (*Dalea candida*)	Shrub	Per	NA	0.15
Globe mallow (*Sphaeralcea sp.*)	Forb	Per	NA	0.10
Blue flax (*Linum lewisii*)	Forb	Per	NA	0.15
Total PLS (lb/ac)				**8.40**
Alternate				
Needle-and-thread (*Stipa comata*)	Grass	Per	Cool	ND
Thickspike wheatgrass (*Agropyron dastachyum*)	Grass	Per	Cool	ND
Sand dropseed (*Sporobolus cryptandrus*)	Grass	Per	Intermediate	ND
Tobosa (*Hilaria mutica*)	Grass	Per	Warm	ND
Bush muhly (*Muhlenbergia porteri*)	Grass	Per	Warm	ND
Squawberry (*Rhus trilobata*)	Shrub	Per	NA	ND
Fourwing saltbush (*Atriplex canescens*)	Shrub	Per	NA	ND
Prairie coneflower (*Ratibida columnaris*)	Forb	Per	NA	ND

Notes:

[a] Seed mix and rates are subject to change based on future investigations
[b] Per – Perennial; Ann = Annual
[c] Rate is in pounds of pure live seed per acre; substitutions may change seeding rates
lb/ac = pounds per acre
NA = Not applicable
ND = Not determined
PLS = Pure live seed

Table 7-2: Functions and Attributes of the Primary Plant Species Proposed for the 9 WRS Site

Species	Character[a]	Attributes and Function
Blue grama (*Bouteloua gracilis*)	N,P,W,G	Sod and bunch grass providing ground cover and forage
Side-oats grama (*Bouteloua curtipendula*)	N,P,W,G	Bunch grass providing ground cover and forage
Black grama (*Bouteloua eriopoda*)	N,P,W,G	Bunch grass providing ground cover and forage
Green sprangletop (*Leptochloa dubia*)	N,P,W,G	Erect bunch grass; aggressive short-lived nurse plant with forage value
Plains lovegrass (*Eragrostis intermedia*)	N,P,C,G	Bunch grass providing ground cover and early spring forage
Bottlebrush squiretail (*Sitanion hystrix*)	N,P,C,G	Persistent (moderately palatable) bunch grass providing ground cover
New Mexico needlegrass (*Stipa neomexicana*)	N,P,C,G	Persistent bunch grass providing ground cover and forage
Streambank wheatgrass (*Agropyron dastachyum v. riparium*)	N,P,C,G	Sod-forming grass providing ground cover and forage
Apache plume (*Fallugia pardoxa*)	N,P,S	Mid-height shrub providing browse, cover, and erosion control
Mountain mahogany (*Cercocarpus montanus*)	N,P,S	Mid-height to tall shrub providing browse and cover
Winterfat (*Eurotia lanata*)	N,P,HS	Low shrub providing winter browse
White prairie clover (*Dalea candida*)	N,P,S	Early season legume providing ground cover and forage
Globe mallow (*Sphaeralcea sp.*)	N,P,F	Persistent mid-height forb providing browse
Rubber rabbitbush (*Chrysothamnus nauseosus*)	N,P,S	Mid-height shrub providing cover and erosion control
Blue flax (*Linum lewisii*)	N,P,F	Persistent forb with a pretty blue flower

Notes:

[a] N = Native
I = Introduced
P = Perennial
A/B = Annual or biannual
W = Warm season
C = Cool season
G = Grass
S = Shrub HS = Half shrub
F = Forb

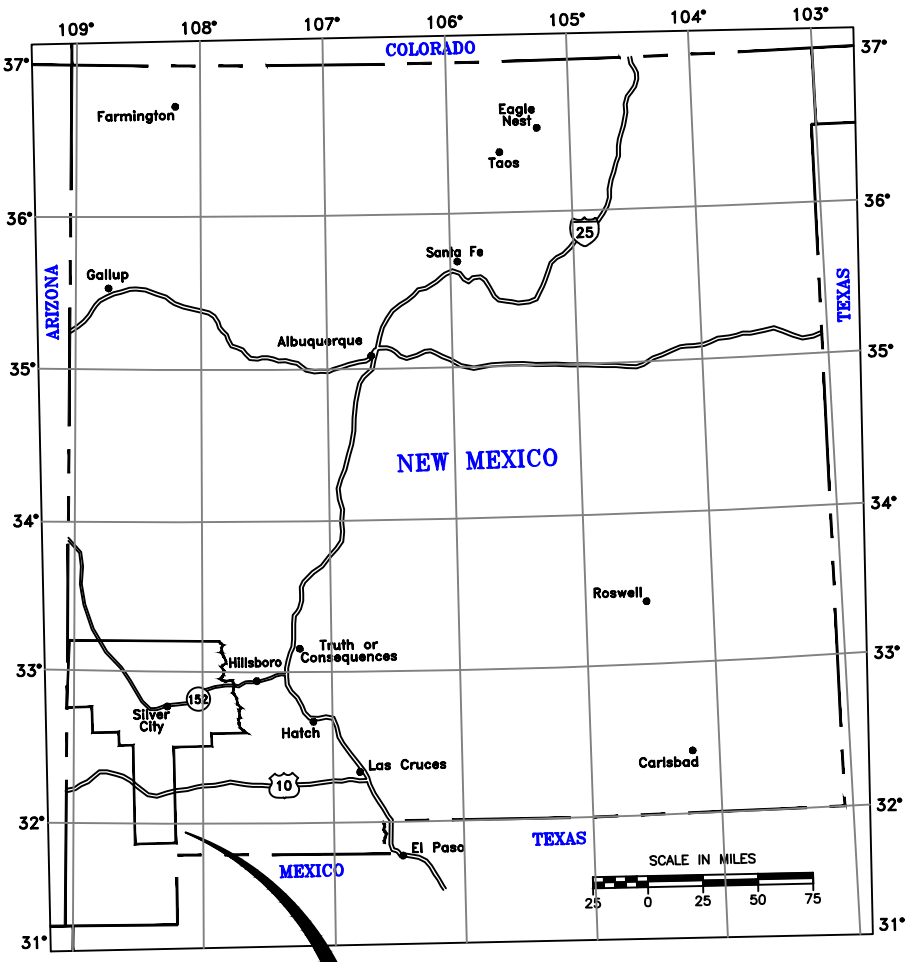
Table 7-3: Proposed Plant Diversity Guidelines for the 9 WRS Site

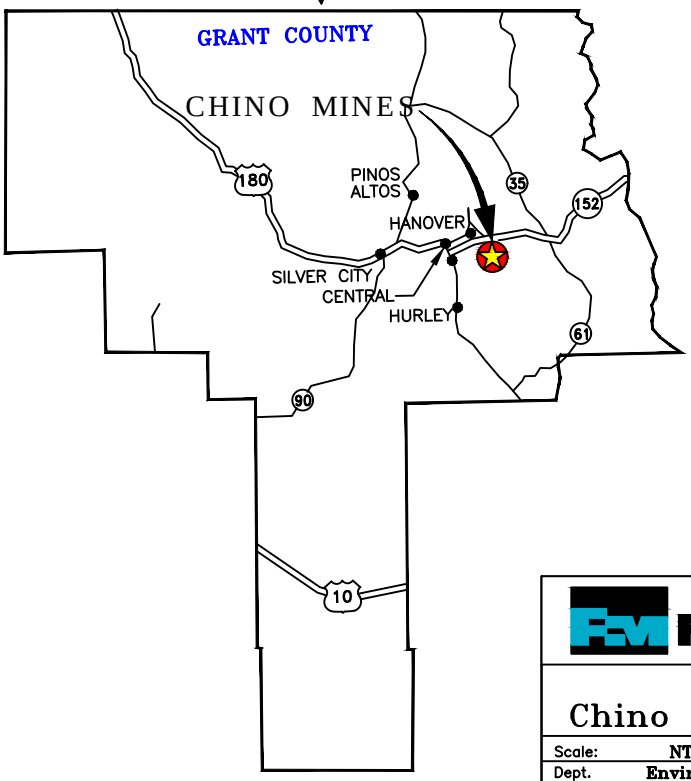
Class	Seasonality	Number	Minimum Occurrence (% cover)
Perennial grass	Warm	3	1
Perennial grass	Cool	1	0.5
Perennial shrub	NA	2	1
Forbs	NA	2	0.1

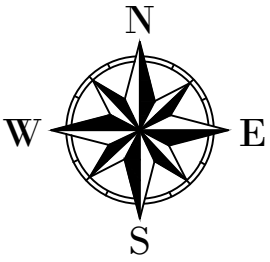
Note:

NA = Not Applicable

FIGURES



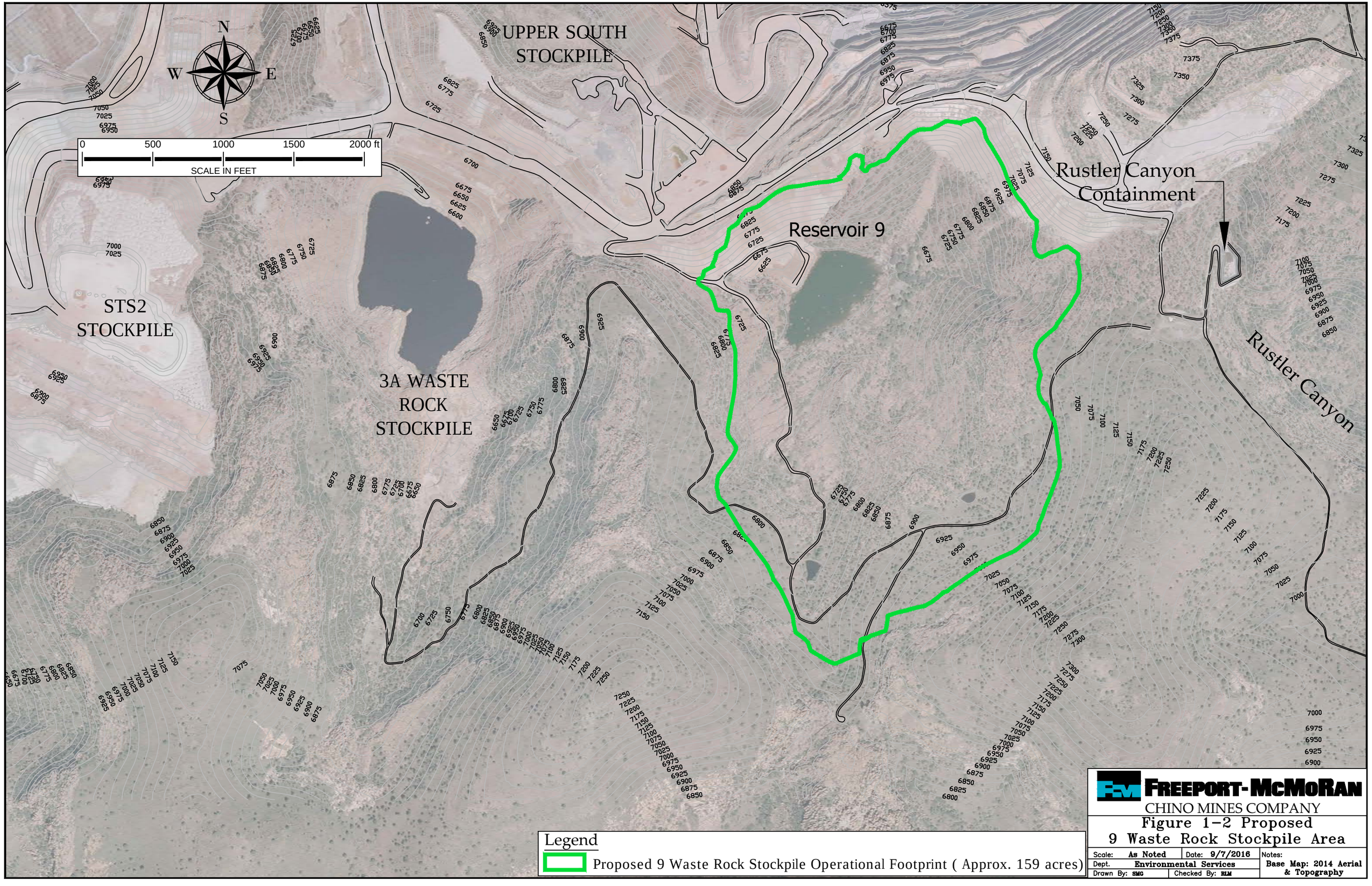




FREEPORT-McMoRan

FIGURE 1-1
Chino Mines Co. Location Map

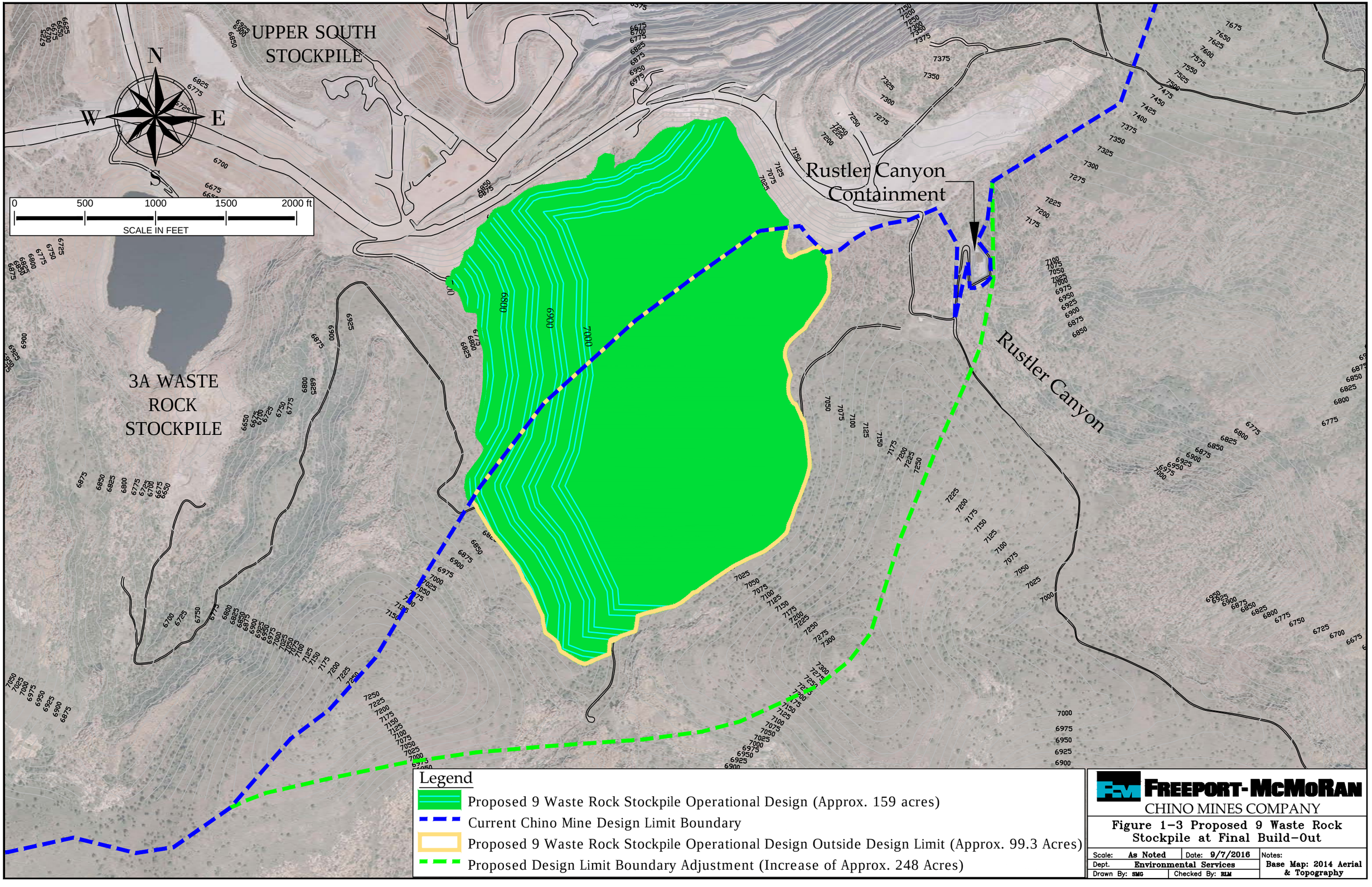
Scale: NTS	Date: 9-7-2016	Notes:	
Dept. Environmental Services			
Drawn By: SMG	Checked By: RLM		



FREEPORT-McMoRan
CHINO MINES COMPANY

Figure 1–2 Proposed 9 Waste Rock Stockpile Area

Scale: As Noted	Date: 9/7/2016	Notes:
Dept. Environmental Services		Base Map: 2014 Aerial & Topography
Drawn By: SMG	Checked By: RLM	


UPPER SOUTH STOCKPILE
3A WASTE ROCK STOCKPILE
Rustler Canyon Containment
Rustler Canyon
N
S
E
W
0
500
1000
1500
2000 ft
SCALE IN FEET
Legend
Proposed 9 Waste Rock Stockpile Operational Design (Approx. 159 acres)
Current Chino Mine Design Limit Boundary
Proposed 9 Waste Rock Stockpile Operational Design Outside Design Limit (Approx. 99.3 Acres)
Proposed Design Limit Boundary Adjustment (Increase of Approx. 248 Acres)
FREEPORT-McMoRan
CHINO MINES COMPANY
Figure 1-3 Proposed 9 Waste Rock Stockpile at Final Build-Out
Scale: As Noted
Date: 9/7/2016
Dept. Environmental Services
Drawn By: SMG
Checked By: RLM
Notes:
Base Map: 2014 Aerial & Topography

UPPER SOUTH STOCKPILE

STS2 STOCKPILE

3A WASTE ROCK STOCKPILE

Reservoir 9

Rustler Canyon Containment

Rustler Canyon

Tba

Tk

Tp

Tcb

Tsq

Ts

Qt

Kep

Kcu

Kcs

7712

7500

7200

7100

7000

6900

6800

6600

6400

7069

7253

7325

7154

7055

Whitewater Creek

N

S

E

W

0 500 1000 1500 2000 ft

SCALE IN FEET

Base Map: Geology of the Santa Rita Quadrangle, New Mexico By Robert M. Hernon, William R. Jones and Samuel L. Moore. 1964

See Figure 2-1b For Geologic Unit Explanation

Legend

Proposed 9 Waste Rock Stockpile Operational Footprint

Proposed Modified Design Limit Boundary

FREEPORT-McMoRan

CHINO MINES COMPANY

Figure 3-1 9 Waste Rock Stockpile Area Surface Geology and Topographic Map

Scale: As Noted	Date: 9/7/2016	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: RLM	

QUATERNARY

Recent

Qal

Younger alluvium
Sand, gravel, and soil. Mapped only where significant geologic relations are hidden

Qt

Hillside rubble and talus

Pleistocene

Qoa

Older alluvium
Gravel and sand cemented with quartz and iron oxides

UNCONFORMITY

Upper Miocene(?) and Pliocene

Tmg

Semiconsolidated gravel deposits in the Mimbres Valley
In part equivalent to Gila Conglomerate

UNCONFORMITY

TERTIARY

Miocene(?)

Tba Tcb

Flows and tuffs
Tba, *basaltic andesite flows.*
Tcb, *white pumiceous and massive crystal tuffs equivalent to the Caballo Blanco Rhyolite Tuff of Elston (1957) intercalated between flows of basaltic andesite south of the Chino mine*

Tbi

Basaltic andesite plugs and dikes
Probable feeders of basaltic andesite flows (Tba)

Tgr

Gravel and boulder deposits
In northwest part of quadrangle

DISCONFORMITY

Tp

Pitchstone, sandstone, and rhyolite tuff
Indurated tuff at top equivalent to Box Canyon Rhyolite Tuff of Elston (1957). Pitchstone at base, locally overlain by sandstone

Tk

Kneeling Nun Rhyolite Tuff[1]
Massive welded and cemented ash flow ranging in composition from quartz latite to rhyolite

Ttn

Rhyolite tuff
Underlies basaltic andesite flows (Tba) *in northern part of quadrangle; resembles Kneeling Nun Rhyolite Tuff*

Tri

Felsitic rhyolite plugs and dike
Relative age not determinable; assumed to be related to extrusion of rhyolite tuffs of Miocene (?) age. Has texture of shallow intrusive

Ts

Sugarlump Tuffs[2]
Thin-bedded pumiceous rhyolite tuffs; brown sandstone containing clinoptilolite locally

Tr Trf

Rubio Peak Formation[3]
Tr, *conglomerates and gravels;*
Trf, *rhyodacite-quartz latite flows*

DISCONFORMITY

Lower Tertiary

Th

Rhyodacite porphyry plug and dikes
Plug underlies Bull Hill; intrudes conglomerate west of Wimsattville (Tw). *Includes quartz latite dikes of Lasky (1936) with sparse phenocrystal quartz*

Tt Tlq

Quartz latite porphyry dikes and plugs
Quartz phenocrysts abundant.
Tt, *Trevorro plug and apophyses;*
Tlq, *all other dikes and plugs of quartz latite porphyry except that of the Turnerville and Republic dike systems* (Ttr) *and those at Copper Flat. Not all of exactly same age*

Tw

Conglomerate west of Wimsattville
Contains fragments of quartz latite porphyry (Ttr). *It is intruded by quartz latite porphyry plug* (Tlq) *south of Oswaldo No. 1 shaft; it is also intruded by plugs and dikes of rhyodacite porphyry* (Tli)

Ttr

Quartz latite porphyry of Turnerville and Republic dike systems
Line pattern indicates southeast facies of Turnerville. Possibly as old as the quartz monzonite porphyry of the Santa Rita stock (Tsq) *or the granodiorite porphyry dikes* (Tg)

Tqm

Quartz monzonite porphyry dikes

Tg

Granodiorite porphyry dikes
May include apophyses of Hanover-Fierro pluton and Santa Rita stock

Relative ages indeterminable: age relations to andesite breccia (TKab) unknown

Thg

Granodiorite porphyry of the Hanover-Fierro pluton and apophyses

Tsq

Quartz monzonite porphyry of the Santa Rita stock and apophyses

Tcf

Quartz latite porphyry at Copper Flat
One complex pluton and two dikes. Relative age uncertain but between hornblende quartz diorite (Klp) *and main epoch of hypogene metallization; that is, before the time of intrusion of the Turnerville and Republic dike systems* (Ttr)

Upper Cretaceous(?) and lower Tertiary

TKg

Orthoclase gabbro
Small plug in North Star Basin

TKm TKd

Diorite and mafic porphyry dikes
TKd, *plagioclase-hornblende diorite porphyry dikes; some are older than the andesite breccia* (TKab).
TKm, *predominantly pyroxene andesite to pyroxene syenite porphyry dikes and a few biotite-plagioclase porphyry dikes. Some are apophyses of orthoclase gabbro plug* (TKg). *Most are younger than the andesite breccia, and one, at least, is older than a granodiorite porphyry dike* (Tg). *Only about 10 percent of dikes in North Star Basin are shown.*

TKab

Andesite breccia
Dark purplish-green indurated volcanic breccia and conglomerate containing blocks and cobbles of older rocks, but mostly of mafic porphyries and dark volcanic rocks. In North Star Basin

CRETACEOUS(?) AND TERTIARY

[1] The Kneeling Nun Rhyolite Tuff was named in a thesis by Elston (1955) for the Kneeling Nun, a prominent landmark near the town of Santa Rita in the Santa Rita quadrangle. The first published mention of the name was by Kuellmer and others (1955), and the first description of the formation was given by Jicha (1954). The formation is a massive partially welded and devitrified ash flow ranging in composition from quartz latite to rhyolite, and in thickness from 200 to 600 feet. It is everywhere conformable with the underlying Sugarlump Tuffs; the upper contact is an erosional one.

[2] The Sugarlump Tuffs was named in a thesis by Elston (1953) for Sugarlump Hill, NE¼ sec. 15, T. 19 S., R. 10 W., in the Dwyer quadrangle, which adjoins the Santa Rita quadrangle to the southeast. The name was first used by Kuellmer and others (1955), and the first published description was given by Jicha (1954). The formation consists of several volcanic and clastic units: well-bedded and massive pyroclastic deposits of latitic or rhyolitic composition, volcanic conglomerates, and sandstones locally replaced by green clinoptilolite. It rests disconformably on the Rubio Peak Formation (Elston, 1957, p. 42) in the Dwyer quadrangle and on early Tertiary and older rocks in the Santa Rita quadrangle. Because it was deposited on an uneven surface, its thickness is quite variable from place to place; the maximum reported thickness is about 1,200 feet, but in the Santa Rita quadrangle the thickness ranges from 50 to about 800 feet. Owing to the lenticularity of the units no section in the Santa Rita quadrangle can be cited as typical.

[3] The Rubio Peak Formation was named in a thesis by Elston (1953) after a prominent butte at secs. 9, 10, 15, 16, T. 19 S., R. 10 W., in the Dwyer quadrangle. The first published description of the formation was given by Hernon and others (1953). The formation consists of andesite and latite flows, conglomerate, welded ash flows, volcanic conglomerate and tuffaceous sandstone. No section can be cited as typical owing to the lenticularity of the flows and other units. The formation was deposited on an irregular surface and is therefore highly variable in thickness. Elston (1957) estimated the maximum thickness in the Dwyer quadrangle to be about 5,000 feet.
On the basis of floral assemblages regarded as most probably of late Miocene or early Pliocene age collected from lake beds overlying rhyolitic tuffs believed to be correlatives of the Kneeling Nun Rhyolite Tuff, and from lake beds within beds believed to be correlatives of the upper part of the Rubio Peak Formation (Jahns and others, 1955; F. J. Kuellmer, written communication, 1960) all three formations described above are tentatively dated as Miocene(?). A major erosional disconformity separates the Rubio Peak Formation and intrusive rocks of early Tertiary age. Flows of basaltic andesite overlying the Kneeling Nun Rhyolite Tuff are older than the Gila Conglomerate of Pliocene and Pleistocene age and parts of the Santa Fe Group of middle(?) Miocene to Pleistocene(?) age.

UNCONFORMITY

Upper Cretaceous(?)

Ksy

Syenodiorite porphyry
Sills and laccoliths

Age with respect to syenodiorite porphyry (Ksy) and andesite breccia (TKab) not shown

Kt

Trachyte porphyry
Sills and small plutons; chilled margins along hornblende quartz diorite (Klp) *and quartz diorite porphyry* (Kep). *Intrudes ancestral Mimbres fault*

Klp

Hornblende quartz diorite
Sills, laccoliths, and few dikes, some in quartz diorite porphyry sills (Kep). *Cut by mafic porphyry dike* (TKm) *north of Hanover Mountain*

Krp

Rhyolite porphyry
Sills. Appears to have blocked the extension of hornblende quartz diorite sill (Klp) *in Groundhog mine. Age relative to quartz diorite porphyry* (Kep) *indeterminable. Cut by granodiorite porphyry* (Tg) *and quartz monzonite porphyry* (Tqm) *dikes. In section C–C' only*

Ka

Augite-hornblende andesite porphyry sills
Near Georgetown. Relative age indeterminable; assumed to have been intruded during time of dominance of the sill form; definitely older than rhyodacite porphyry dikes (Thi) *and younger than Percha Shale*

Kep

Quartz diorite porphyry
Sills and laccoliths

CRETACEOUS(?)

Upper Cretaceous

Kcs Kcsh Kcu

Colorado Formation
Kcs, *sandstone member; alternating beds of sandstone, arkose, and shale. Upper part equivalent to Mesaverde Formation; thin limestone beds in base 100 feet equivalent to Greenhorn Limestone. Chain of circles is a key conglomerate bed.*
Kcsh, *shale member; black shale except for quartzite 20 feet thick in middle part. Equivalent of Graneros Shale.*
Kcu, *Colorado Formation, undivided. 0–1,000 feet thick*

Kb

Beartooth Quartzite
Reddish fine-grained orthoquartzite, minor black shale and conglomerate locally. 50–140 feet thick

UNCONFORMITY

CRETACEOUS

PERMIAN

Lower Permian

Pa

Abo Formation
Red shale, mudstone and limy mudstone, limestone and chert conglomerate. 0–265 feet thick

Magdalena Group

Ps

Syrena Formation
Upper part argillaceous limestone, some shale; lower part limy shale and argillaceous limestone. 170–390 feet thick

Po

Oswaldo Formation
Limestone, some thin shales; sandstone lenses shown by stipple or line of dots where lens is thin. Siliceous shale 20–40 feet thick at base. 330–420 feet thick

PPm

Metasedimentary rocks
Chlorite-actinolite-epidote-garnet-diopside-magnetite alteration, cut by stringers of pyrite

PENNSYLVANIAN

MISSISSIPPIAN

DISCONFORMITY

Lower Mississippian

Ml

Lake Valley Limestone
Limestone and marly limestone. Upper part pure crinoidal limestone, some white chert nodules. 300–400 feet thick

Upper Devonian

Dp

Percha Shale
Box Member of Stevenson (1945), gray shale with calcareous nodules; Ready Pay Member of Stevenson (1945), black fissile shale. 230–315 feet thick

DEVONIAN

DISCONFORMITY

Sf

Fusselman Dolomite
Gray massive cherty dolomite. 100–300 feet thick

SOfm

Fusselman and Montoya Dolomites

Upper Ordovician

Om

Montoya Dolomite
Light-gray dolomite, in part interlayered with dark chert; sandstone 1–16 feet thick at base. 300–350 feet thick

SILURIAN

ORDOVICIAN

DISCONFORMITY

Lower Ordovician

Oe

El Paso Limestone
Light- to medium-gray, thin- to thick-bedded limestone and dolomite. 500–519 feet thick

Upper Cambrian

OCu

Bliss Formation
Dolomitic and shaly limestone, shale, basal conglomerate locally; hematitic and glauconitic sandstone and quartzite. 140–188 feet thick

UNCONFORMITY

pC

Biotite-granite gneiss

PRECAMBRIAN CAMBRIAN

Contact
Dashed where approximately located; short dashed where indefinite; dotted where concealed

Fault, showing direction and amount of dip
Bar and ball on downthrown side. Dashed where approximately located; dotted where concealed; queried where doubtful

Reverse fault
U, *upthrown side*

Strike and dip of beds

Strike and dip of overturned beds

Horizontal beds

Strike of vertical or near vertical foliation

Mine and mill dumps

Landslide

GEOLOGY OF THE SANTA RITA QUADRANGLE NEW MEXICO - GRANT COUNTY GQ-306

DEPARTMENT OF THE INTERIOR UNITED STATES GEOLOGICAL SURVEY

GEOLOGY OF THE SANTA RITA QUADRANGLE, NEW MEXICO

By

Robert M. Hernon, William R. Jones and Samuel L. Moore

1964

FREEPORT-McMoRan

CHINO MINES COMPANY

Figure 3–1B Geologic Unit Explanation

Scale: As Noted	Date: 9/7/2016	Notes:	
Dept. Environmental Services			
Drawn By: SMG	Checked By: RLM		

APPENDIX A

EARTHWORK COST ESTIMATE PROCESS REPORT AND RECLAMATION DESIGN DRAWINGS

9 Waste Rock Stockpile Earthwork Cost Estimate
Process Report

Prepared for

Freeport-McMoRan
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, New Mexico 88023

Prepared by

Freeport-McMoRan
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, New Mexico 88023

March 2017

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1.0 INTRODUCTION

1.1 Purpose & Summary

Freeport-McMoRan Chino Mines Company (Chino) is 9 Waste Rock Stockpile where the 9 Reservoir currently located. The process and associated cost factors that will be used in the earthwork reclamation cost estimate has been prepared by Chinos Mine Company (Chino). The earthwork reclamation process is based on a template originally created by the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD, 1996). The process addresses reclamation earthwork and site operations and maintenance costs.

Reclamation cost estimates are developed by first selecting an appropriate fleet of equipment and associated productivity factors, unit rates, and quantities. Equipment selection is done based on the type of operation and availability. Equipment is optimized based on capacity, productivity, size and shape, and type of operation. The amount of time a reclamation operation takes is based on volume of material, haul distance, change in elevation, and factors called productivity factors. Productivity factors are selected based on the latest Caterpillar equipment publications, and site specific conditions such as slope angle. Unit rates are referenceable current 3rd party rates for labor, equipment, fuel, and materials. Indirect rates are later added to the total direct costs. Conceptual reclamation quantities are based on the mine plan and timing considerations required by financial assurance and established reclamation criteria. The equipment, productivity factors, unit rates, and quantities are put together using the template originally created by MMD to develop the reclamation cost estimate.

1.2 Cost Estimate Assumptions

Assumptions used throughout the cost estimate include:

- **Cost estimate calculations:** Are based on the caterpillar performance handbook and the 1996 MMD cost template. Appendix A.1 provides the calculations that will be used on each calculation sheet of the cost estimate spreadsheet.

- **Labor Rates**: All labor rates are developed based on the New Mexico Department of Labor (DOL) Type H (Heavy Engineering) labor rates effective for 2016. These rates include the base, fringe benefit, and apprenticeship contribution rates. The following FICA, Medicare, Federal un-employment, State un-employment, and Workman's Compensation Insurance are added to the labor rates to obtain the total per hour labor rate.
- **Equipment Rates**: The earth-moving equipment used in the estimate would commonly be available to a contractor. The equipment unit operating costs are taken from EquipmentWatch Custom Cost Evaluator (Penton Media, Inc., 2016). All costs taken from EquipmentWatch Custom Cost Evaluator are adjusted using the local factor for Las Cruces and overhead is removed from direct costs and included in the indirect cost percentage.
- **Fuel Costs**: The off-road diesel fuel cost will be a vendor quote for delivery of dyed ultra-low sulfur diesel to Silver City, NM.
- **Revegetation Unit Costs**: The revegetation unit cost will be a vendor quote including: scarifying, discing, rangeland drill seeding, mulching, crimping, and daily per diem.
- **RipRap Production**: The riprap unit cost will be developed based on experience gained producing riprap at the McCain Springs Quarry.
- **Equipment Production Factors**: Production factors from Caterpillar (2014) for each type of equipment are presented in Table 1. Productivity curves are developed from Caterpillar (2014) and are described in Appendix A.2 and A.3.
- **Haul Distances**: Haul distances are calculated along a preferred route and assumed to originate at the approximate centroid of the source and terminate at the approximate centroid of the reclamation area. A maximum of three segments is typically used for each haul route.
- **Borrow Areas**: The cover source that will be utilized comes from the Upper South Stockpile.
- **Dozer Push Distances**: Dozer push distances represent the distance from the centroid of the cut block to the centroid of the fill block.
- **Dust Suppression and Site Maintenance:** A full time water truck and a motor grader are included as part of the fleet during reclamation. The water truck and grader time are set equal to loader time.
- **Capital Indirect Costs**: Total indirect costs of 22.5% per MMD (1996) and Office of Surface Mining (OSM, 2000) guidance based on total capital reclamation costs for Chino. The indirect costs are comprised of: Mobilization and Demobilization (1.0%), Contingencies (2.0%), Engineering Redesign Fee (2.5%), Contractor Profit and Overhead (15.0%), and Project Management Fee (2.0%). Indirect cost percentages are identical to the percentages presented to MMD and the New Mexico Environment Department (NMED) in meetings with Tyrone on September 20, 2012, and on November 2, 2012 (Table 2).
- **Operations and Maintenance Indirect Costs**: The 9 Reservoir currently has Operations and Maintenance costs (O&M) for Earthwork. No additional Earthwok O&M is recommended for the 9 Stockpile. A total

indirect costs of 17.5% for long term operations and maintenance per MMD (1996) and OSM (2000) guidance and comprise the same values and factors as the capital indirect costs with exception of Contractor Profit and Overhead will be applied for Revegetation Maintenance. Contractor Profit and Overhead for long term operations and maintenance is 10.0%, to account for the long term contract and repetitive annual work. Indirect cost percentages are identical to the percentages presented to MMD and the NMED in meetings with Tyrone on September 20, 2012, and on November 2, 2012 (Table 4).

2.0 RECLAMATION DESIGN

During operations, the 9 Stockpile will be constructed at an overall slope that will result in 3:1 (horizontal:vertical) slope after reclamation benches are cut in. The top surface constructed at a 1% minimum slope, sloping to the southeast and other flat areas will also be constructed at a 1% minimum slope. The conceptual pre-reclamation and reclaimed 9 Stockpile, including details are shown in the Drawings Sheets 1 through 7. The main reclamation activities that will occur include:

- Minor top surface grading to achieve a smooth slope following the minimum 1% top surface sloping to the southeast.
- Minor flat area grading to achieve a smooth slope following the minimum 1% slope.
- Pushing down operational stockpile benches to achieve a smooth slope.
- Hauling and grading cover material for the top surfaces.
- Completing surface water channels and benches to collect and convey storm water from the stockpile surfaces.
- Scarification and revegetation of covered areas.

The major assumptions for this cost estimate would include:

- **Regrading**: Slopes: 200-foot maximum inter-bench slope length, maximum 3H:1V inter-bench slopes, 1% minimum top surface slope. Slopes 1% minimum slope for other flat areas.
- **Outslope Channels and Benches:** 15-foot bench width, 1% to 5% cross-bench slope, <5.0% longitudinal bench slope and 3-feet of cover; channel 6-inches of gravel underlain by 2-feet of cover.
- **Channels:** maximum 2,500 feet in length, maximum 2% longitudinal slope, 3-feet of cover.
- **Downdrains:** 2.5-feet of riprap over 6-inches of filter material underlain by 2-feet of cover.

- **Cover**: 36-inch cover thickness – tops and outslopes. Trucks and loaders with dozer assist perform all cover loading and distribution. The economic optimum number of trucks per loader is used for each haul route.
- **Revegetation Maintenance**: 2% failure every year for a total of 12 years, starting the year reclamation is completed.

3.0 REFERENCES

Caterpillar, Inc. 2011. Caterpillar Performance Handbook, Edition 41. Caterpillar Inc. Peoria, Illinois. January 2011.

Caterpillar, Inc. 2014. Caterpillar Performance Handbook, Edition 44. Caterpillar Inc. Peoria, Illinois. January 2014.

MMD. 1996. [New Mexico Energy, Minerals and Natural Resources, Department, Mining and Minerals Division]. 1996. Closeout Plan Guidelines for Existing Mines, Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Penton Media, Inc. 2016. Equipment Watch Custom Cost Evaluator Version 6.17.13A.

TABLES

Table 1 Equipment Production Factors

Parameter	Value	Comment/Reference
Swell Factor Stockpiles and Tailings[1]	8% Load & haul cover 0% Pushdown	Cover material volumes are calculated based on the reclaimed area and the cover depth. No virgin materials are being regraded as part of reclamation. Thus a swell factor is not applied when regrading material.
Grading (D11T CD, D11T, D9T, 16M, D6T)		
Operator Factor [1]	1.0 Stockpile coarse grading 0.75 Cover & channel fine grading	Due to large job size assume excellent operator (CPH 44, 19-55, excellent) (CPH 44, 19-55, average)
Material Factor	1.2 - Stockpile 1.2 - Cover	CPH 44, 19-55, Loose stockpile
Work Hour	50 min	(CPH 44, 19-55)
Grade Factor – Tops	1.0	(CPH 44, 19-55) 1-5% Slope
Grade Factor - Outslopes[1]	1.6 – 3H:1V Slopes	(CPH 44, 19-55) 1.6 – 3H:1V
Soil Weight	3,300 lb./cy Stockpile 3,000 lb/cy Cover	-
Production Method/ Blade Factor	1.2 – Slot 1 – Channels/Down drains/Benches	(CPH 44, 19-55, slot dozing) No correction applied for channels/ downdrains/benches
Effective Blade Width (feet)	22 D11T CD Universal Blade 14.25 D9T Semi Universal Blade 16 16M 17.5 D6T XL SU	(CPH 44, 19-49) (CPH 44, 19-47) (CPH 44, 11-17) (CPH 44, 19-43)
Speed (miles/hr)	2.5 mph D11T CD and 16M 1.0 mph D9T and D6T	-
Visibility Factor	1.0	(CPH 44, 19-55) Clear
Elevation Factor	1.0	(CPH 44, 30-5)
Transmission Factor	1.0	-
Loader (992K)		
Heaped Bucket Capacity (cy)	16.0	(CPH 44, 23-288, Standard, 3000 lb./yd3)
Loader Cycle Time (load, dump, and maneuver; min)	0.65	(CPH 44, 23-223) Avg 0.6-0.7
Bucket Fill Factor	0.875	(CPH 44, 30-1) Avg 0.85-0.90

Parameter	Value	Comment/Reference
		Loose Material 1" and over
Work Hour (min/hr)	50	(CPH 44, 19-55)
Trucks (CAT 785F)		
Struck Capacity (cy)	71.0	Equipment Watch Specification Sheet
Heaped Capacity(cy)	102.0	(CPH 41, 9-6)
Rolling Resistance (%)	2.5%	(CPH 44, 30-1) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 44, 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 44, 10-20) Avg 1.0-1.2
Work Hour (min/hr)	50	(CPH 44, 19-55)

CPH = Caterpillar Performance Handbook Edition 35, 44(Caterpillar, Inc. 2007, 2014)

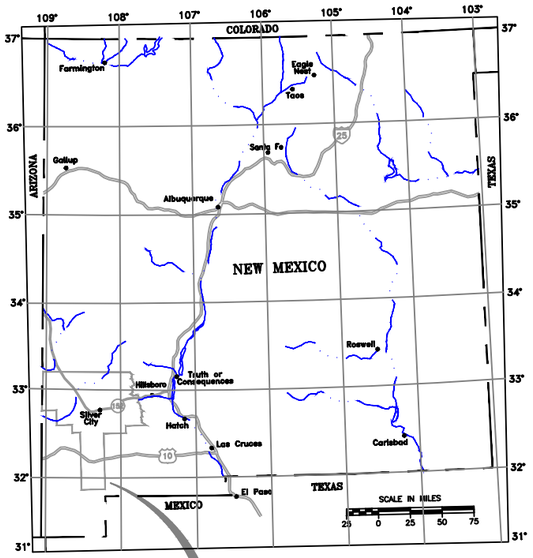
(1) The swell and operator factors used are consistent with factors presented to MMD and NMED in meetings with Tyrone on June 11, 2012, November 2, 2012, and a letter to MMD and NMED from Tyrone dated September 5, 2012.

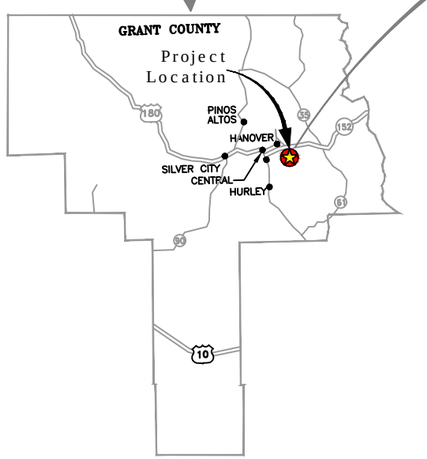
(2) Equipment Watch did not have recent information for Caterpillar 785F performance. The Komatsu HD1500-5 has the same performance specifications as the Caterpillar 785F. Thus, the Equipment Watch costs for the Komatsu HD1500-5 were used as an equivalent for the Caterpillar 785F.

DRAWINGS

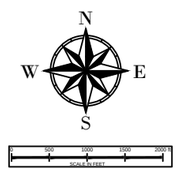
PROPOSED RECLAMATION PLAN FOR THE 9 STOCKPILE

ISSUED FOR FINANCIAL ASSURANCE RECLAMATION COST ESTIMATE





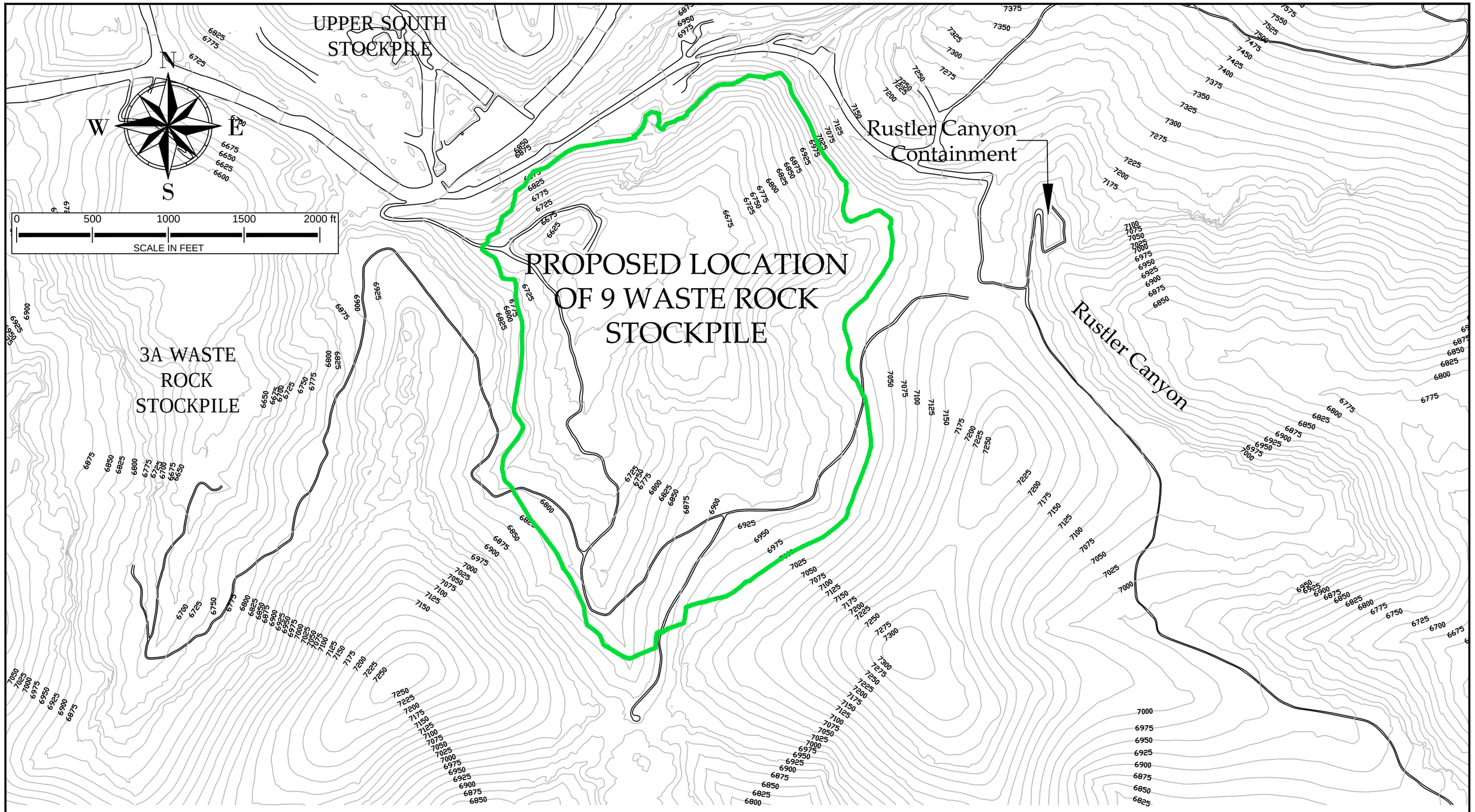
Sheet List Table	
Sheet Number	**Sheet Title**
1	COVER SHEET
2	EXISTING TOPOGRAPHY
3	CONCEPTUAL PRE-RECLAMATION STOCKPILE
4	CONCEPTUAL RECLAIMED STOCKPILE
5	CROSS SECTIONS
6	DETAILS
7	CONCEPTUAL HAUL PATHS



FREEPORT-McMoRan
CHINO MINES COMPANY

Sheet: 1 Cover Sheet

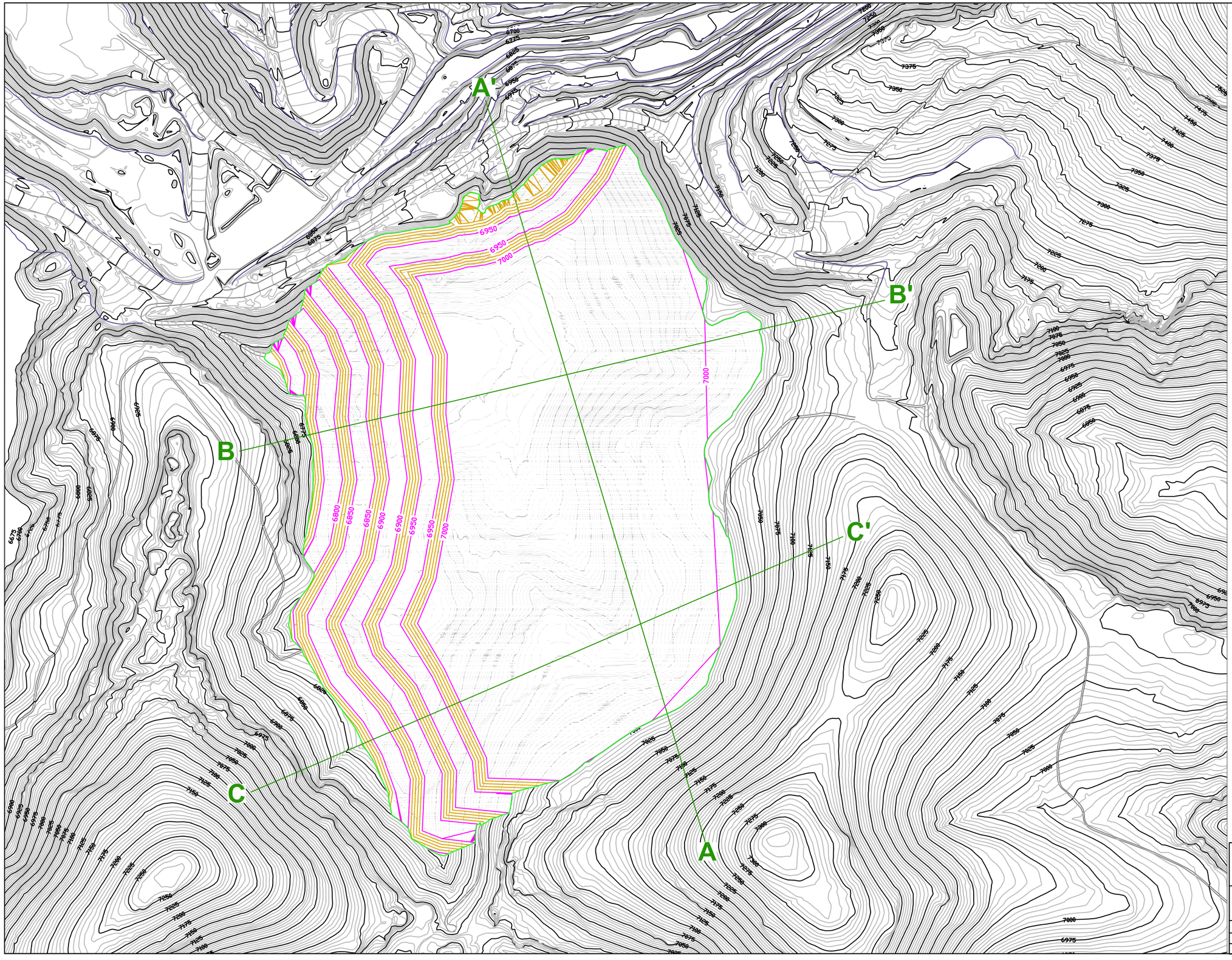
Scale: As Noted	Date: 10/19/2016	Notes:	
Dept. Environmental Services			
Drawn By: SMG	Checked By: RLM		



FREEPORT-McMoRan
CHINO MINES COMPANY

Sheet: 2 Existing Topography

Scale: As Noted	Date: 11/17/2016	Notes:
Dept. Environmental Services		Base Map: 2014 Topography
Drawn By: SMG	Checked By: RLM	



Legend

- 7000 — Major Contours (25ft)
- Minor Contours (5ft)
- 6900 — Operational Major Contours (50ft)
- Operational Minor Contours (10ft)
- Stockpile Boundary
- A — A' Cross-Section Lines
- Roads

NORTH

0 500 Feet

FREEPORT-McMoRan COPPER & GOLD

Sheet 3: Conceptual Pre-Reclamation Stockpile

Scale: As Noted	Date: 10-19-2016	Notes:
Dept. Reclamation		
Drawn By: MJL	Checked By: MJL	

A'

B'

B

C'

C

A

6800

6850

6900

6950

7000

1% Slope

Legend

- Major Contours (25ft)
- Minor Contours (5ft)
- Reclaimed Major Contours (50ft)
- Reclaimed Minor Contours (10ft)
- Stockpile Boundary
- A — A' Cross-Section Lines
- Downdrains
- Outslope Channels
- Surface Channels
- Off-Site Channels
- Roads

NORTH

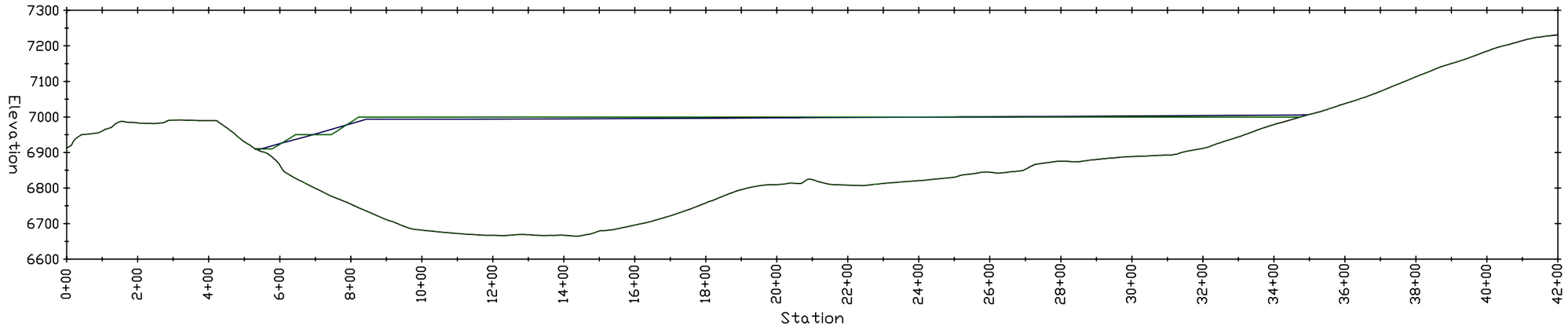
0 500 Feet

FREEPORT-McMoRan COPPER & GOLD

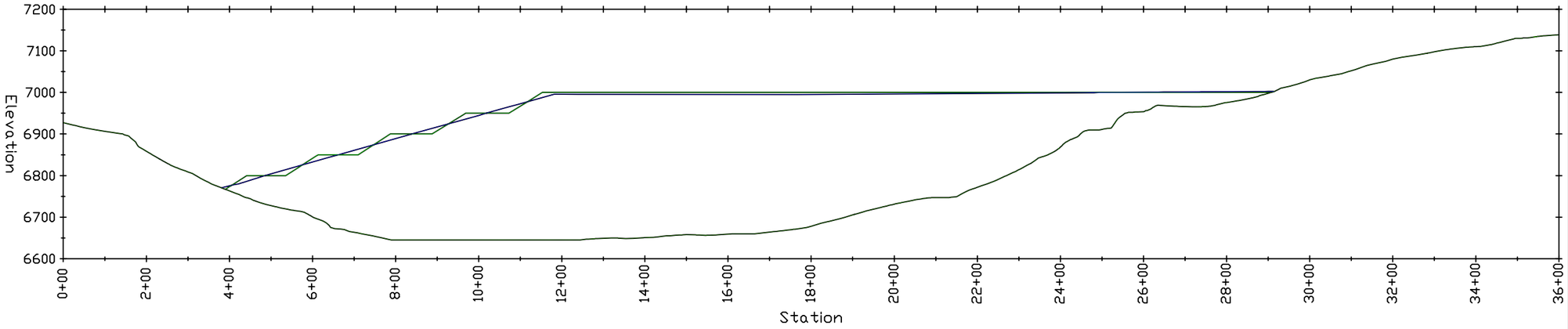
Sheet 4: Conceptual Reclaimed Stockpile

Scale: As Noted	Date: 10-19-2016	Notes:
Dept. Reclamation		
Drawn By: MJL	Checked By: DV	

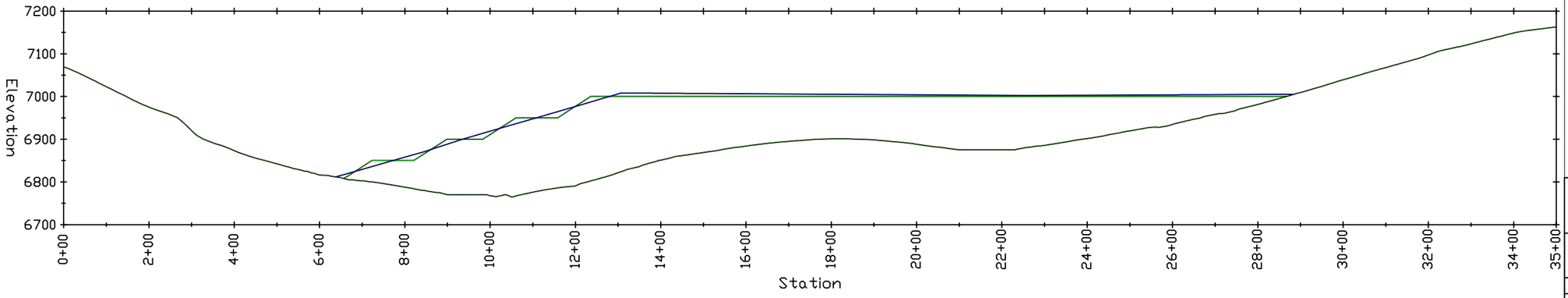
Profile View A-A' (Stations in 200ft)



Profile View B-B' (Stations in 200ft)



Profile View C-C' (Stations in 200ft)



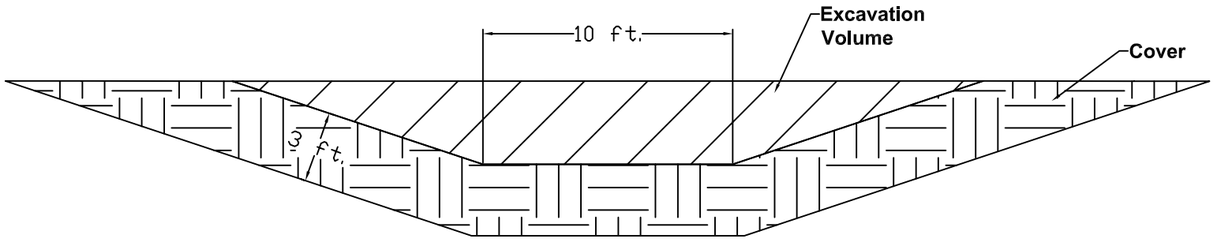
Legend

- Existing Topo
- Operational Stockpile
- Reclaimed Stockpile

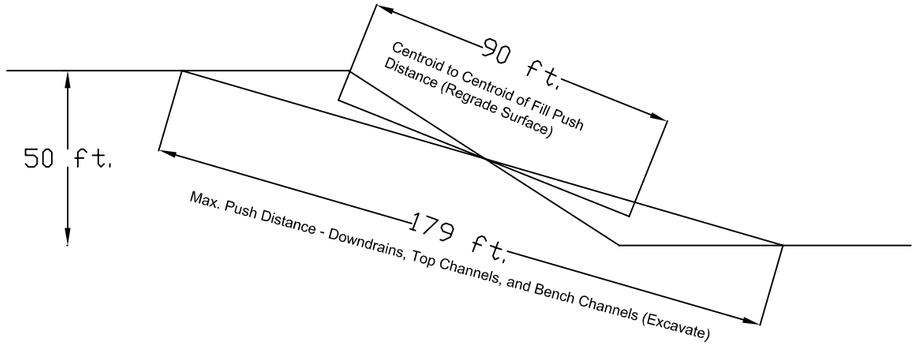
FREEPORT-McMoRan COPPER & GOLD

Sheet 5: Cross Sections

Scale: As Noted	Date: 10-19-2016	Notes:	
Dept. Reclamation			
Drawn By: MJL	Checked By: MJL		

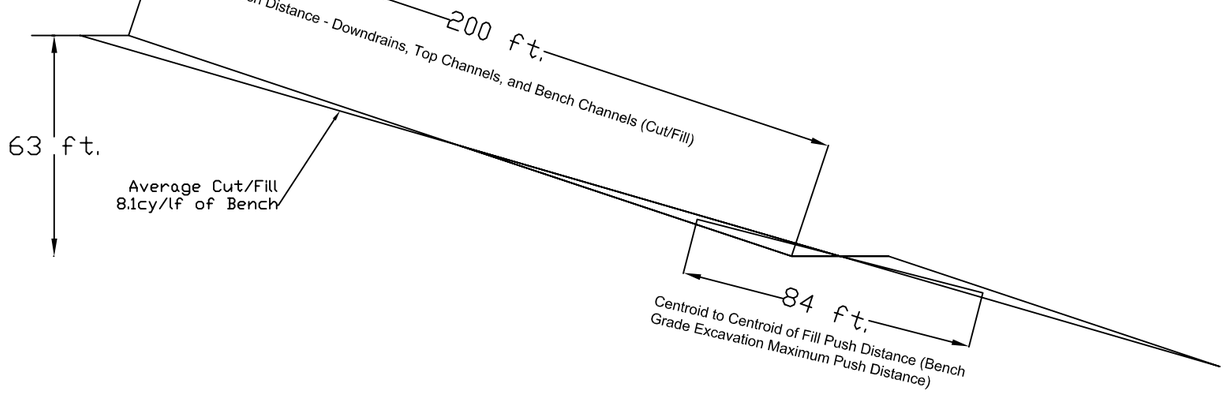


Typical Top Channel (Reclamation Area)

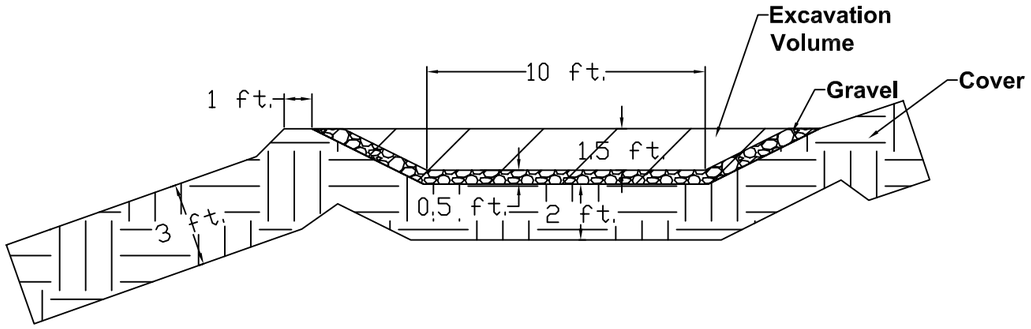


Typical Operational Bench Regrade for 3.5H:1V

Typical Down Chute/ Down Drain Channel



Typical Reclamation Outslope Bench for 3.5H:1V



Outslope Terrace Channel

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Sheet 6: Details

Scale: As Noted	Date: 10-19-2016	Notes:	NTS
Dept. Reclamation			
Drawn By: MJL	Checked By: DV		

UPPER SOUTH STOCKPILE

STS2 STOCKPILE

3A WASTE ROCK STOCKPILE

Rustler Canyon Containment

Rustler Canyon

N

W E

S

0 500 1000 1500 2000 ft

SCALE IN FEET

Legend

- Planned 9 Stockpile Design (Approx. 159 acres)
- Conceptual Haul Route

FREEPORT-McMoRan

CHINO MINES COMPANY

Sheet 7: Conceptual Haul Route

Scale: As Noted	Date: 10/19/2016	Notes:	
Dept. Environmental Services		Base Map: 2014 Aerial & Topography	
Drawn By: SMG	Checked By: RLM		

APPENDIX A
SUPPORTING DOCUMENTATION

APPENDIX A.1

CALCULATION DOCUMENTATION

EQUATIONS USED IN CAPITAL COST SPREADSHEET

Sheet #2 Earthwork:

Bank Volume (bcy) = $Area\ (acre) * Cover\ Depth\ (in) * \frac{43{,}560\left(\frac{ft^2}{acre}\right)}{\left(12\left(\frac{in}{ft}\right)\right)} * \frac{1}{27\left(\frac{ft^3}{cy}\right)}$

Loose or Stockpile Volume (lcy) = Bank or stockpile Volume (cy) * [1 + Swell Factor]

Sheet #3 Grading:

Normal Production (cy/hr) = 159372.008958 * Maximum Push Distance (ft)$^{-0.862481}$
(Caterpillar Performance Handbook Edition 41 D11T CD 1-53)

Productivity (cy/hr) =

$$Normal\ Production\left(\frac{cy}{hr}\right) * Operator * Material * Work\ Hour\left(\frac{min}{hr}\right) * Grade\ Factor * \frac{2{,}300\left(\frac{lbs}{cy}\right)}{SoilWeight\left(\frac{lbs}{cy}\right)} * Prod.Method * Visibility * Elev.* Drive\ Trans.$$

Total Task Time (hr) = $\frac{Loose\ or\ Stockpile\ Volume(cy)}{Productivity\left(\frac{cy}{hr}\right)}$

Grade (Dozing Factor) = -0.02 * Grade (%) + 1
(Curve Fit Cat Handbook Ed 44 19 - 55)

Sheet #4 Loader&Truck:

Total Haul Distance (ft) = ∑ Segment Haul Distance (ft)

Haul Distance Segment (m) = Haul Distance (ft) * 0.3048 (m / ft)

Haul Effective Grade (%) = (Haul Grade (%) + Rolling Resistance (%))(unless < 0 then 0)

Return Effective Grade (%) = (Rolling Resistance (%) - Haul Grade (%))(unless < 0 then 0)

Truck Segment Travel Time Loaded (min/ m) =

-1.6825 * Haul Effective Grade Segment (%)^3 + 0.4592 * Haul Effective Grade Segment (%)^2 * 0.0079* Haul Effective Grade Segment (%) + 0.0009

Truck Segment Travel Time Empty (min/ m) =

-6.2135 * Return Effective Grade Segment (%)^4 + 1.0448 * Return Effective Grade Segment (%)^3 + 0.1016 * Return Effective Grade Segment - 0.0035* Return Effective Grade Segment (%) + 0.0009

(Curve Fit Cat Handbook Ed 41 9 - 42)

Loader (cycles / truck) = $Maximum[\frac{Struck\ Capacity(cy)}{Loader\ Net\ Bucket\ Capacity(cy)}, \frac{Heaped\ Capacity(cy)}{Loader\ Net\ Bucket\ Capacity(cy)}]$

Haul Time (min) = ∑(Segment Travel Time Loaded (min/ m) * Segment Haul Dist (m))

Return Time (min) = ∑(Segment Travel Time Empty (min/ m) * Segment Haul Dist (m))

Loading Time (min) = Loader Cycle Time (min) * Loader (cycles / truck)

Task Time (hr) = $Maximum[\frac{Volume(cy)}{Productivity\left(\frac{cy}{hr}\right)}, Loader\ Task\ Time\ (Hr)]$

Truck Cycle Time (min) =

Haul Time (min) + Return Time (min) + Loading Time (min) + Load / Maneuver Time (min) + Dump Maneuver Time (min)

Productivity (cy / hr) =

$$Work\ Hour\left(\frac{min}{hr}\right) * Loader\left(\frac{cycles}{truck}\right) * Loader\ Net\ Bucket\ Capacity(cy) * \left(\frac{Optimum\ Number\ of\ Trucks}{Truck\ Cycle\ Time(\min)}\right)$$

Net Bucket Capacity (cy) = Heaped Bucket Capacity (cy) * Bucket Fill Factor

Productivity (cy / hr) = $\left(\frac{\text{Net Bucket Capacity(cy)} * \text{Work Hour}\left(\frac{\min}{\text{hr}}\right)}{\text{Loader Cycle Time}(min)}\right)$

Task Time (hr) =$\frac{Volume(cy)}{Productivity\left(\frac{cy}{hr}\right)}$

Sheet #5 Earth Sum:

Direct Cost ($) = [Owning & Operating Cost ($ / hr) + Labor Cost ($ / hr)] * Time Required (hr)
* Number of Units of Equipment

Unit Cost ($ / unit) = $\frac{Direct\ Cost(\$)}{Total\ Production(unit)}$

Earthwork Total Direct Cost ($) = ∑(Total Cost ($))

Sheet #6 Veg:

Direct Cost ($) = Area (acres) * Unit Cost ($ / acre)

Veg Total Direct Cost ($) = ∑(Direct Costs ($))

Sheet #7 Other:

Direct Cost ($) = Quantity (units) * Unit Cost ($ / unit)

Other Total Direct Cost ($) = ∑(Direct Cost ($))

Sheet #1 General:

Subtotal Direct Cost ($) = Earthmoving Total Direct Cost ($)
+ Vegetation Total Direct Cost ($) + Other Total Direct Cost ($)

Subtotal Indirect Costs ($) = $Subtotal\ Direct\ Cost(\$) * \frac{Various\ Indirect\ Costs(\%)}{100}$

Total Cost ($) = Subtotal Direct Cost ($) + Subtotal Indirect Cost ($)

OPTIMIZATION EQUATIONS:

Each Equation for number of trucks (n) from 2 to 25.

Productivity Sheet:

Productivity (cy / hr) =

$$Work\ Hour\left(\frac{min}{hr}\right) * Loader\left(\frac{cycle}{truck}\right) * Loader\ Net\ Bucket\ Cap\ (cy) * \frac{Number\ Of\ Trucks(n)}{Truck\ Cycle\ Time\ (min)}$$

Time Sheet:

Time (hr) = $Maximum[\frac{Volume\ (cy)}{Productivity\left(\frac{cy}{hr}\right)}, Loader\ Task\ Time\ (hr)$

Truck Cost Sheet:

Truck Cost ($) =

Time (hr) * Number of Trucks[n] * (Owning & Operating Cost ($ / hr) + Labor Cost ($ / hr).

Loader Cost Sheet:

Loader Cost for Number of Trucks[n] ($) =

Time (hr) * (Owning & Operating Cost ($ / hr) + Labor Cost ($ / hr))

Total Cost Sheet:

Total Cost Number of Trucks[n] ($) = Truck Cost ($) + Loader Cost ($)

Minimum Cost = Minimum (Total Cost for Number of Trucks[n]($))

Optimum Number of Trucks:

Number of Trucks[n] =

when (Minimum Cost ($) > or = Total Cost for Number of Trucks[n].

then use Number of Trucks[n]; if not, use 0

Optimum Number of Trucks = $\sum_{n=2}^{25} \text{Number of Trucks [n]}$

APPENDIX A.2

EQUIPMENT PRODUCTIVITY CURVE FITS

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar Inc., Peoria, Illinois, U.S.A.

JANUARY 2011

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Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar Inc. nor its dealers warrant that the machines described will perform as estimated.

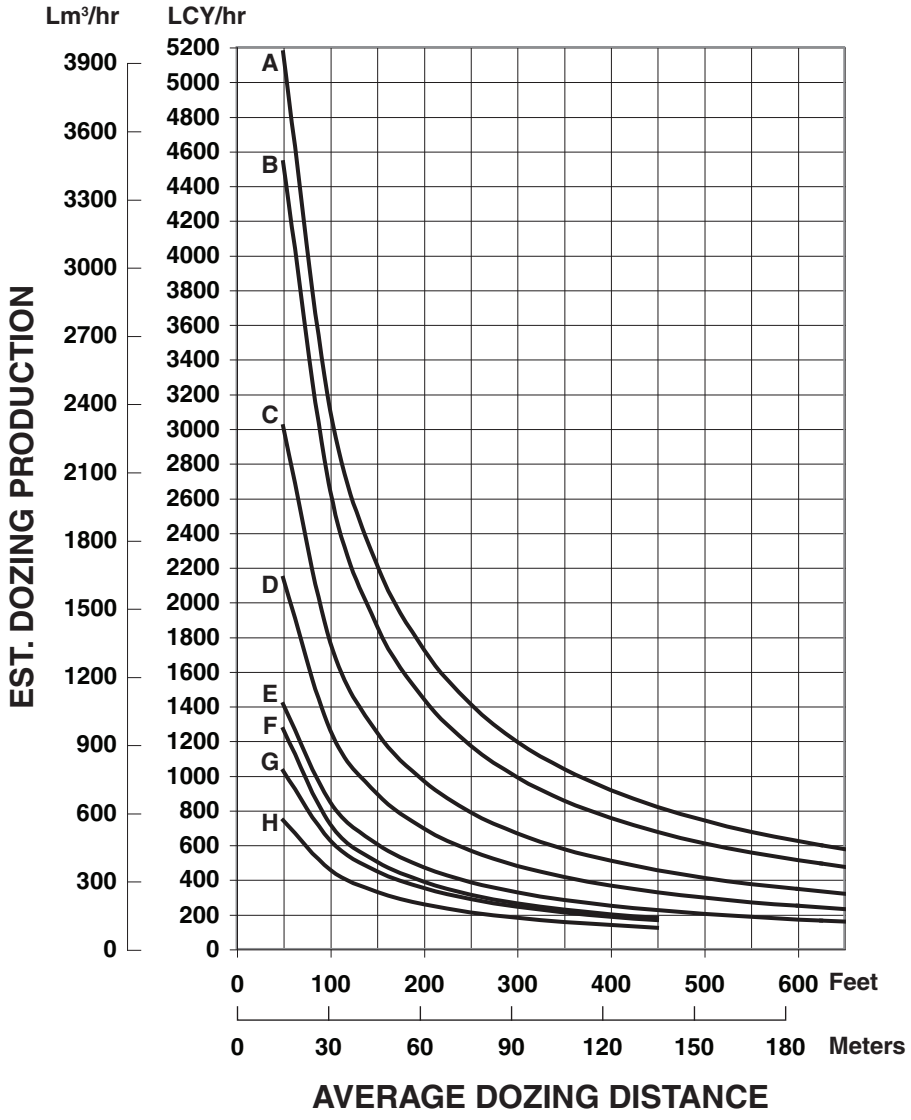
NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

Printed in U.S.A.

SEBD0351-41

ESTIMATED DOZING PRODUCTION ● Universal Blades ● D7G through D11T CD

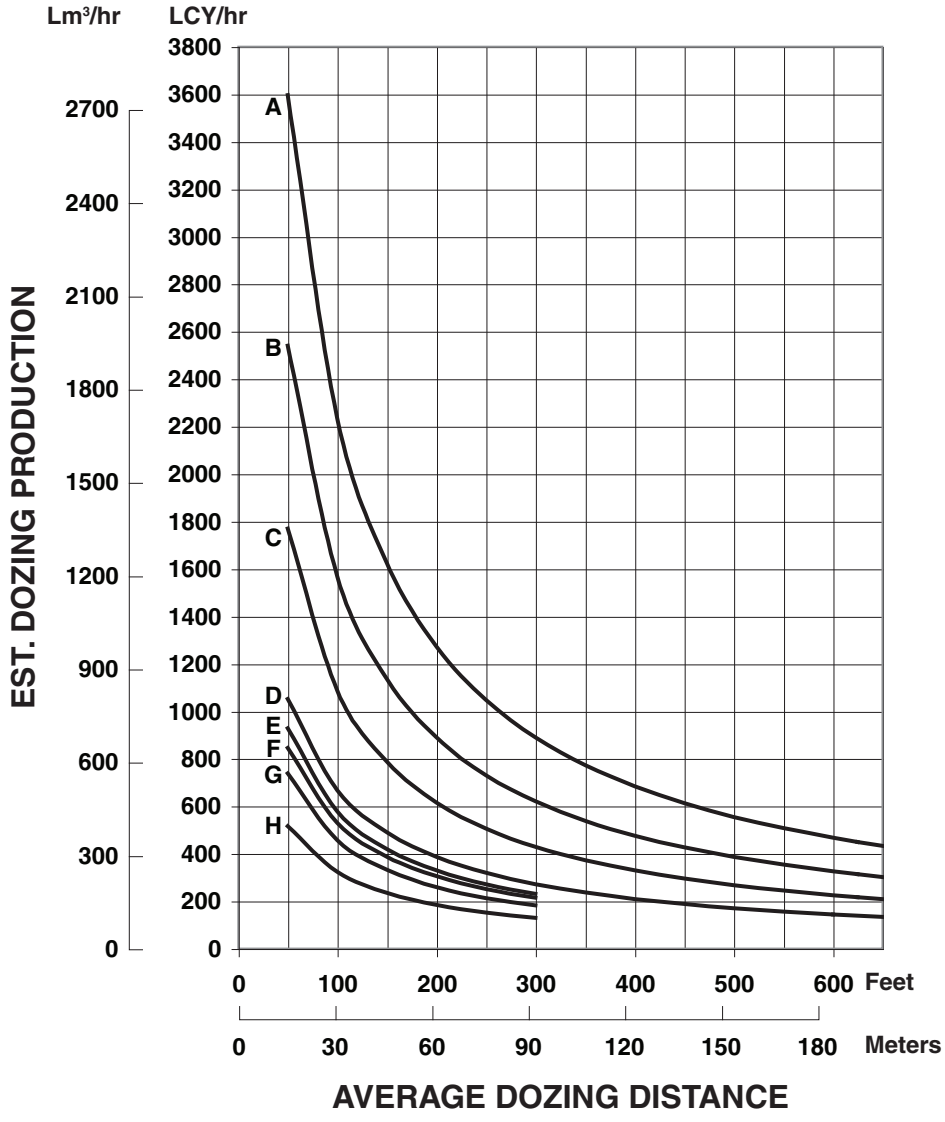


KEY

A — D11T CD
B — D11T
C — D10T
D — D9T
E — D8T
F — D7E
G — D7R Series 2
H — D7G

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● Semi-Universal Blades ● D6N through D11T

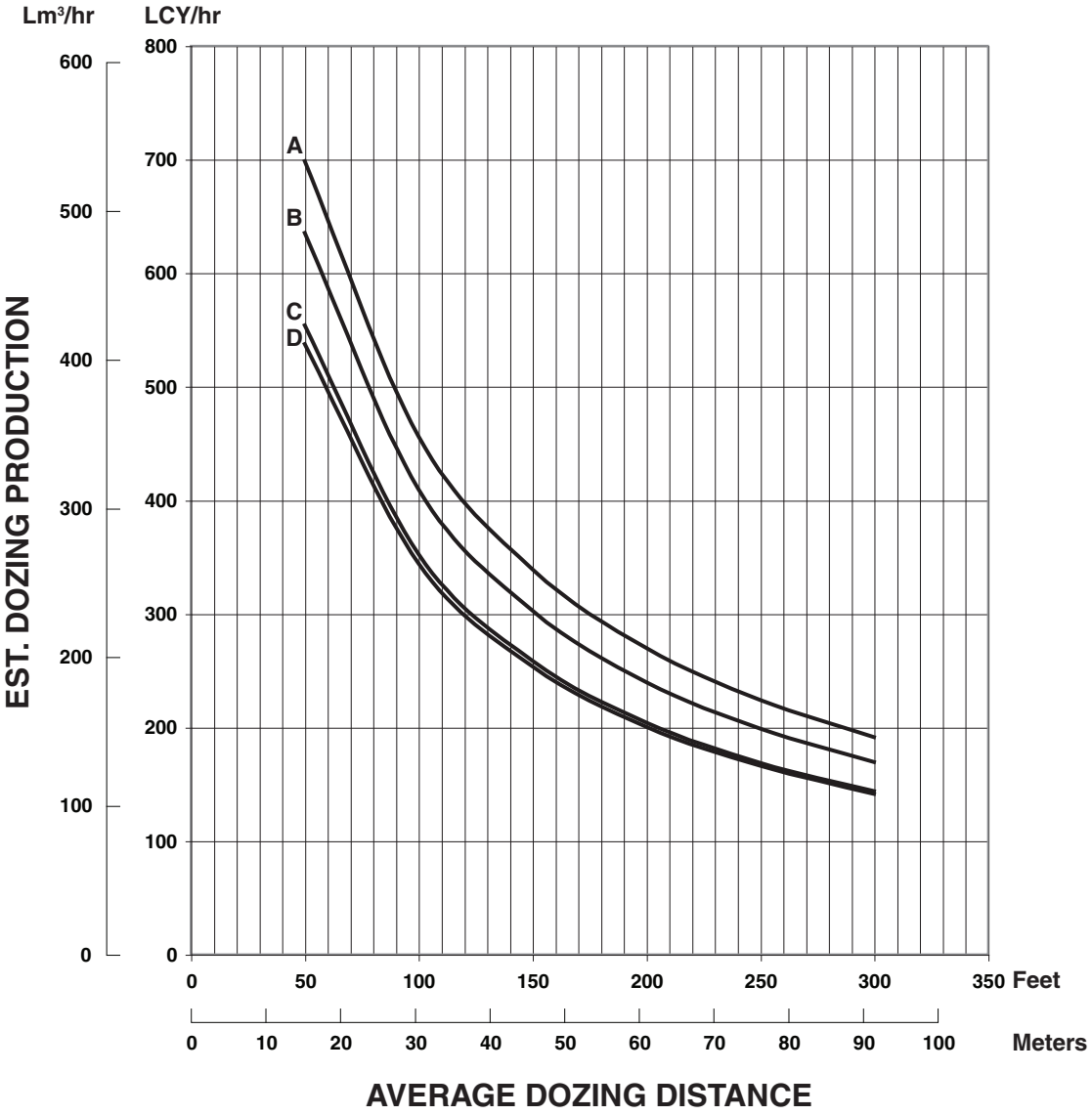


KEY

A — D11T
B — D10T
C — D9T
D — D8T
E — D7E
F — D7R Series 2
G — D6T
H — D6N

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

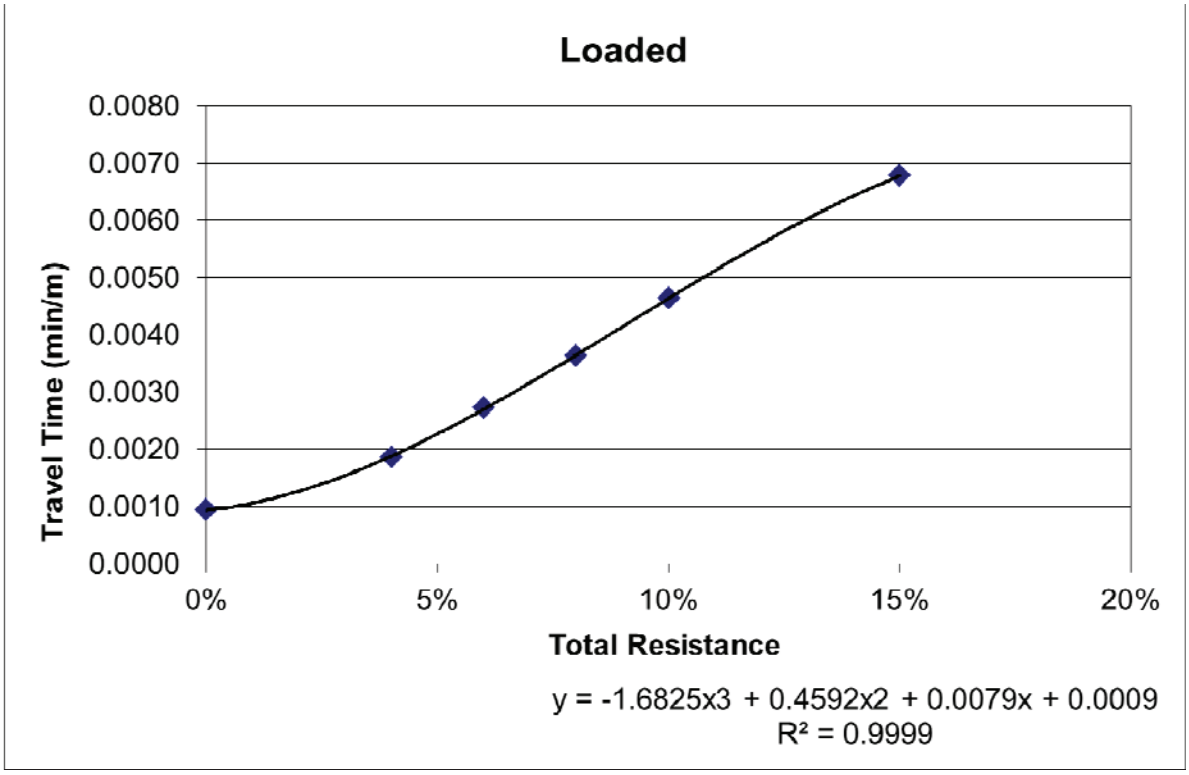
ESTIMATED DOZING PRODUCTION ● Straight Blades ● D6T through D7R Series 2

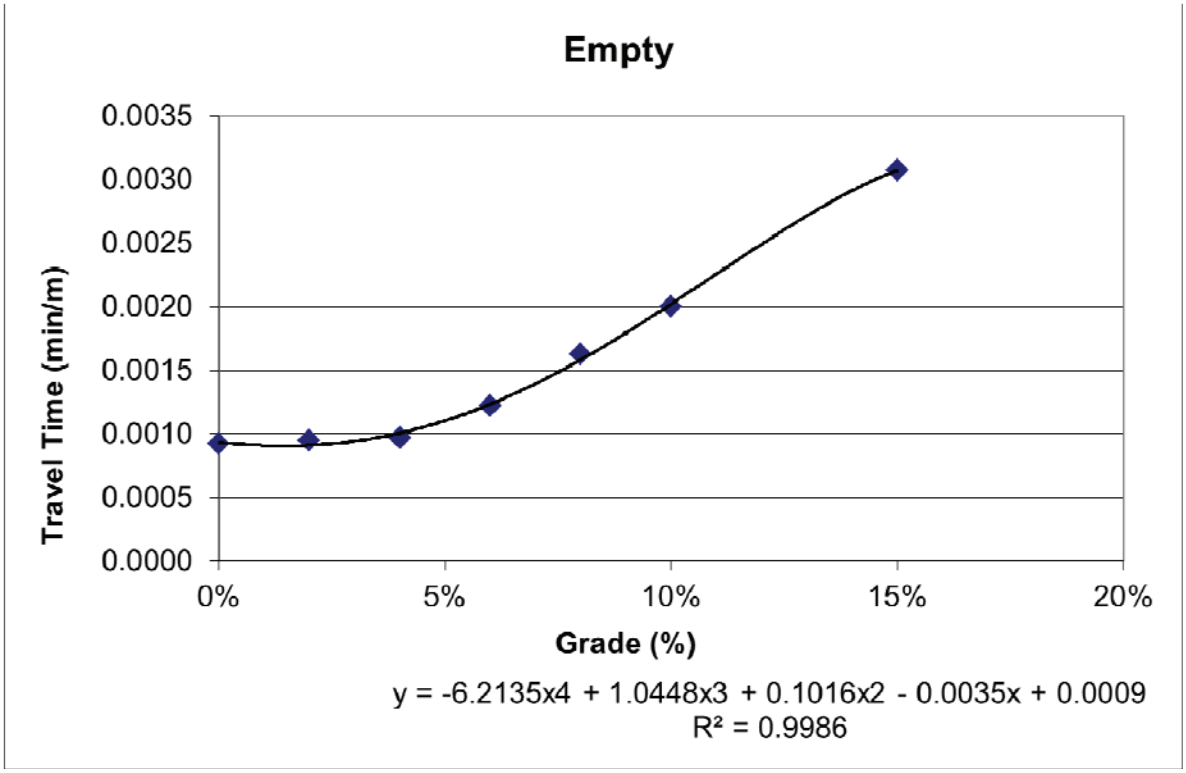


KEY

A — D7E
B — D7R Series 2
C — D6T
D — D7G

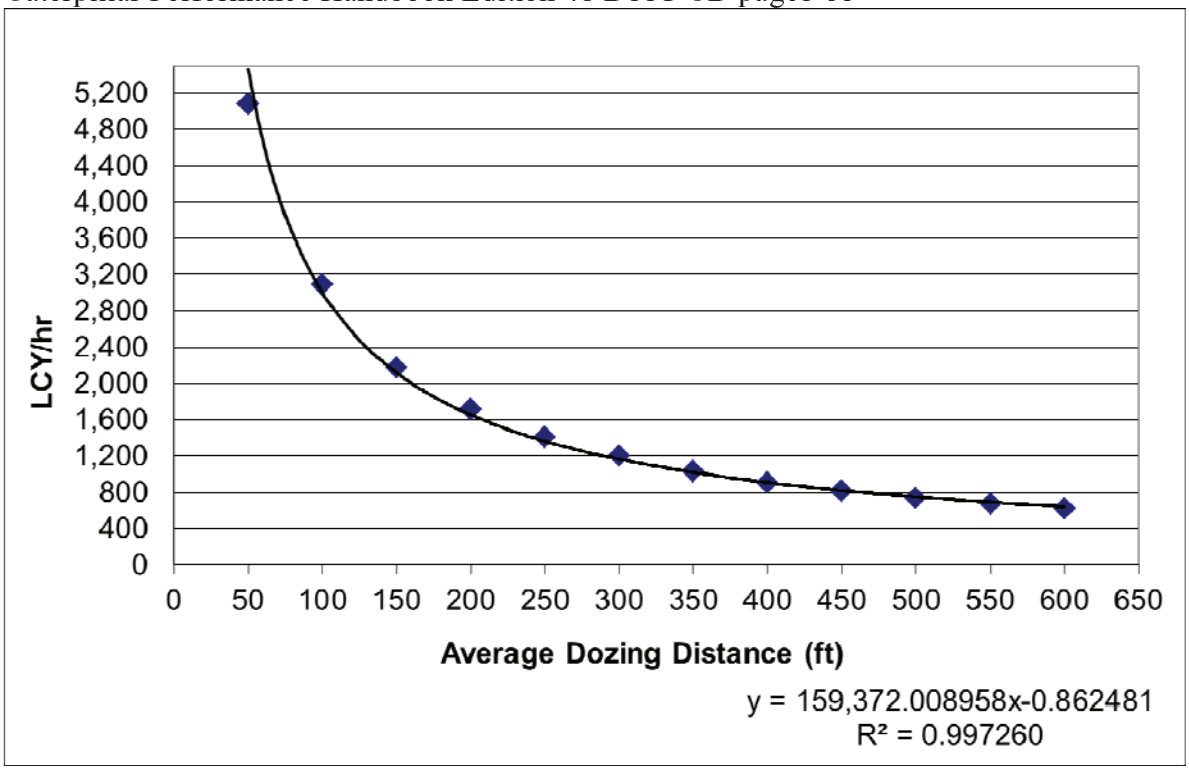
NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.


Loaded
0.0080
0.0070
0.0060
0.0050
0.0040
0.0030
0.0020
0.0010
0.0000
Travel Time (min/m)
0%
5%
10%
15%
20%
Total Resistance
y = -1.6825x3 + 0.4592x2 + 0.0079x + 0.0009
R² = 0.9999


Empty
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Travel Time (min/m)
0%
5%
10%
15%
20%
Grade (%)
y = -6.2135x4 + 1.0448x3 + 0.1016x2 - 0.0035x + 0.0009
R² = 0.9986

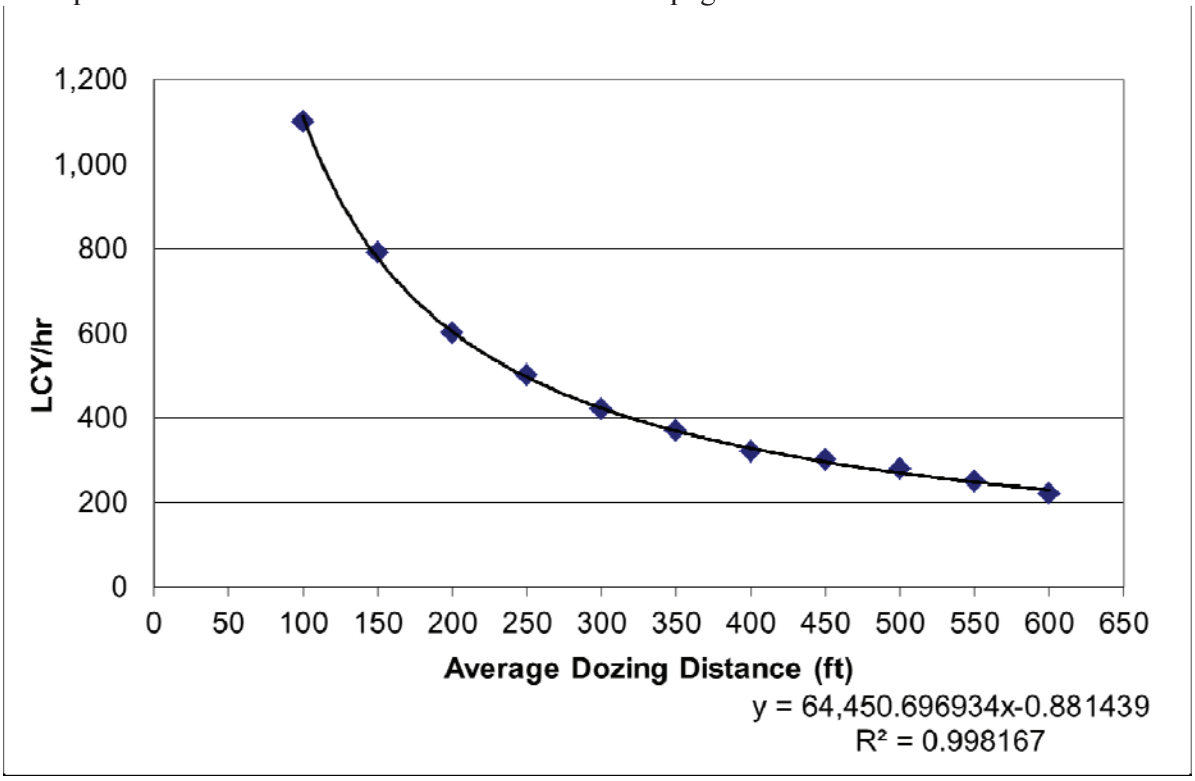
D11T CD

Caterpillar Performance Handbook Edition 41 D11T CD page1-53

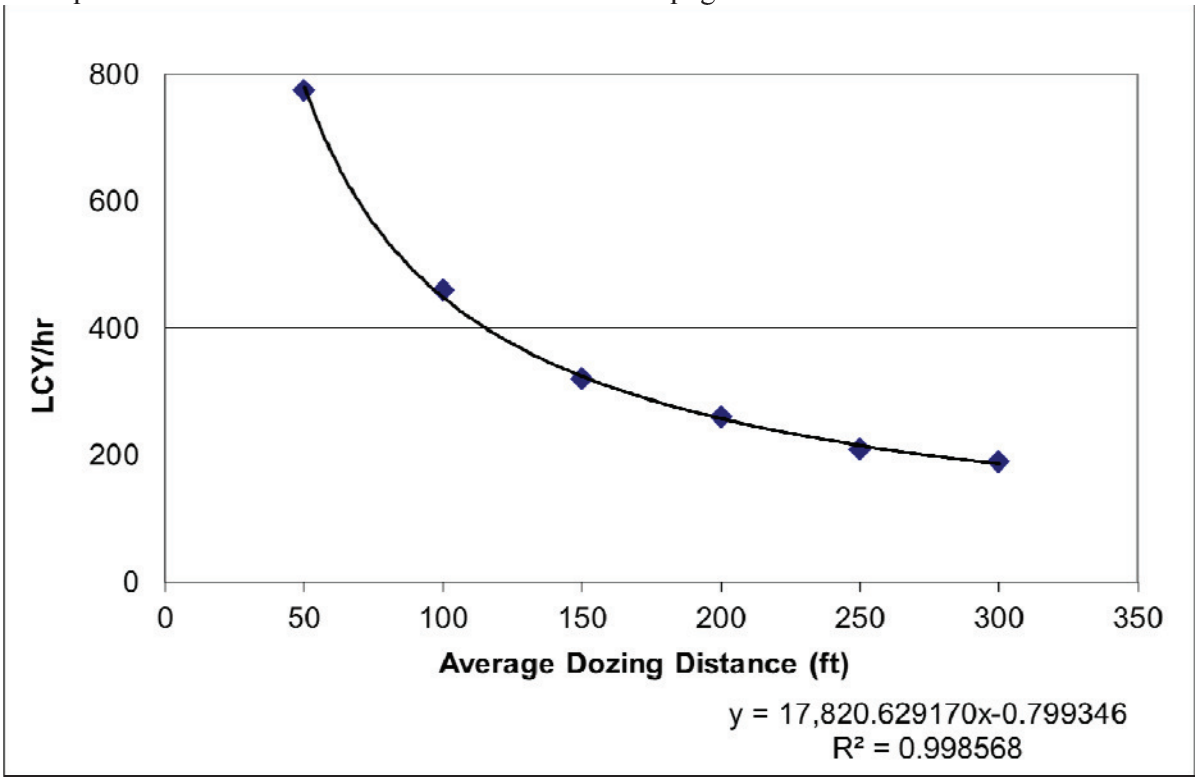


D9T

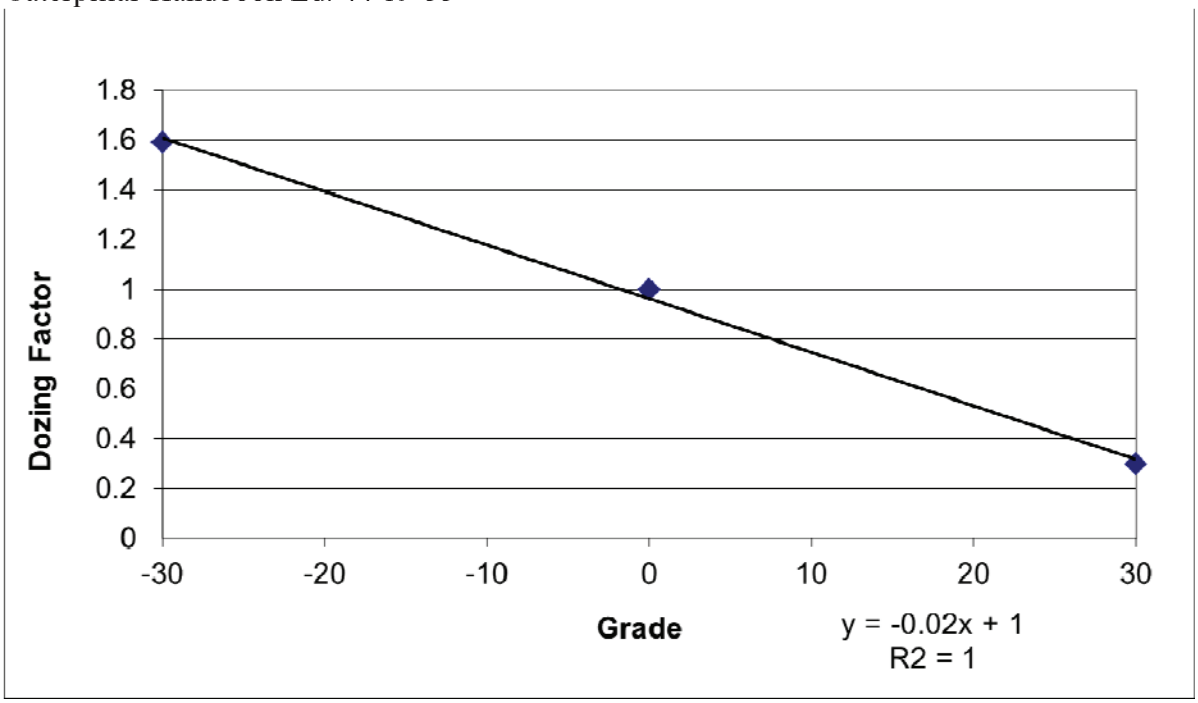
Caterpillar Performance Handbook Edition 41 D9T page1-54



D6T
Caterpillar Performance Handbook Edition 41 D6T page1-55



Dozing Factor
Caterpillar Handbook Ed. 44 19-55



APPENDIX A.3

CATERPILLAR PERFORMANCE HANDBOOK
REFERENCES

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar, Peoria, Illinois, U.S.A.

JANUARY 2014

Please direct any inquiries about the Performance Handbook to the Caterpillar Performance Handbook Coordinator at *Sherman_Ashley_E@cat.com*.

Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar nor its dealers warrant that the machines described will perform as estimated.

NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

Printed in U.S.A.

SEBD0351-44

USE OF BRAKE PERFORMANCE CURVES

The speed that can be maintained when the machine is descending a grade with retarder applied can be determined from the retarder curves in this section when gross machine weight and total effective grade are known.

Select appropriate grade distance chart that covers total downhill haul; don't break haul into individual segments.

To determine brake performance: Read from gross weight down to the percent effective grade. (Effective grade equals actual % grade *minus* 1% for each 10 kg/metric ton (20 lb/U.S. ton) of rolling resistance.) From this weight-effective grade point, read horizontally to the curve with the highest obtainable speed range, then down to maximum descent speed brakes can safely handle without exceeding cooling capacity. When braking, engine RPM should be maintained at the highest possible level without overspeeding. If cooling oil overheats, reduce ground speed to allow transmission to shift to next lower speed range.

Brake Performance Curves are made in compliance with ISO 10268 and applicable to Sea Level and 32° C (90° F) temperature. Contact Factory for Application Specific Performance.

USE OF RIMPULL-SPEED-GRADEABILITY CURVES

For best results, use Caterpillar Fleet Production and Cost Analysis (FPC) to simulate cycle time, fuel burn, and production for Application Specific Performance inquiries. Contact Factory Representative or visit catminer.cat.com/stb for more information.

(See Wheel Tractor Scraper Section)

Total Effective Grade (or Total Resistance) is grade assistance *minus* rolling resistance.

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example —

With a favorable grade of 20% and rolling resistance of 50 kg/metric ton (100 lb/U.S. ton), find Total Effective Grade.

(50 kg/metric ton) = 50 ÷ 10 = 5% Effective Grade
(from Rolling Resistance)
100 lb/ton = 100 ÷ 20 = 5% Effective Grade
20% (grade) – 5% (resistance) =
15% Total Effective Grade

TYPICAL FIXED TIMES FOR HAULING UNITS

Wait time, delays and operator efficiency all impact cycle time. Minimizing truck exchange time can have a significant effect on productivity.

Fixed time for hauling units include:
1. Truck load time (various with loading tool)
2. Truck maneuver in load area (Truck exchange) (Typically 0.6-0.8 min.)
3. Maneuver and dump time at dump point (Typically 1.0-1.2 min.)

Total cycle time is the combination of:
1. The above fixed time
2. Hauling time (Loaded)
3. Return time (Empty)

Example — assume load tool spots hauler with full bucket

		988F	**5130B**
cycle times		.60	.45
First pass	(dump time)	.10 min.	.05 min.
2 passes	(full cycle)	.70	.50
3 passes	"	1.30	.95
4 passes	"	1.90	1.40
5 passes	"	2.50	1.85
6 passes	"	3.10	2.30
7 passes	"	3.70	2.75
8 passes	"	4.30	3.20
9 passes	"	4.90	3.65
10 passes	"	5.40	4.10

NOTE: Other sizes of loading tools will have different cycle times. See Wheel Loader section for **average** cycle times for truck loading.

MODEL	14M		16M		24M	
Base Power — Net	193 kW	**259 hp**	221 kW	**297 hp**	397 kW	**533 hp**
VHP Range — Net	193-204 kW	**259-274 hp**	221-233 kW	**297-312 hp**		—
VHP Plus Range — Net	193-219 kW	**259-294 hp**	221-248 kW	**297-332 hp**		—
Operating Weight*	21 423 kg	**47,229 lb**	27 531 kg	**60,695 lb**	62 726 kg	**138,287 lb**
Engine Model	**C11 ACERT**		**C13 ACERT**		**C18 ACERT**	
Rated Engine RPM	**1800**		**2000**		**1800**	
No. of Cylinders	**6**		**6**		**6**	
Displacement	11.1 L	**677 in³**	12.5 L	**763 in³**	18.1 L	**1104.5 in³**
Max. Torque	1422 N·m	**1049 lb-ft**	1712 N·m	**1263 lb-ft**	2713 N·m	**2001 lb-ft**
No. of Speeds Forward/Reverse	**8/6**		**8/6**		**6/3**	
Top Speed: Forward	50.4 km/h	**31.3 mph**	51.7 km/h	**32.1 mph**	43.4 km/h	**27.0 mph**
Reverse	39.8 km/h	**24.7 mph**	40.8 km/h	**25.3 mph**	41.6 kmh	**25.8 mph**
Std. Tires — Front and Rear	**16R24**		**23.5R25**		**29.5R29**	
Front Axle/Steering:						
Oscillation Angle	**32°**		**32°**		**32°**	
Wheel Lean Angle	**17.1°**		**18.2°**		**18.0°**	
Steering Angle	**47.5°**		**47.5°**		**47.5°**	
Articulation Angle	**20°**		**20°**		**25°**	
Minimum Turning Radius**	7.9 m	**25'11"**	8.9 m	**29'3"**	12.4 m	**40'9"**
No. Circle Support Shoes	**6**		**6**		**6**	
Hydraulics:						
Pump Type	**Variable Piston**		**Variable Piston**		**Variable Piston**	
Max. Pump Flow	280 L/min	**74 gpm**	280 L/min	**74 gpm**	550 L/min	**145 gpm**
Tank Capacity	60 L	**15.9 U.S. gal**	65 L	**17.2 U.S. gal**	135 L	**36 U.S. gal**
Implement Pressure: Max.	24 150 kPa	**3500 psi**	24 150 kPa	**3500 psi**	24 150 kPa	**3500 psi**
Min.	3100 kPa	**450 psi**	3100 kPa	**450 psi**	3100 kPa	**450 psi**
Interior Sound Level/SAE J919	**70 dB(A)**		**72 dB(A)**		**74 dB(A)**	
Electrical:						
System Size	**24V**		**24V**		**24V**	
Std. Battery CCA @ 0° F	**1125**		**1400**		**1500**	
Std. Alternator	**80**		**150**		**150**	
GENERAL DIMENSIONS:						
Height (to top of ROPS)	3535 mm	**139.2"**	3718 mm	**146.4"**	4452 mm	**175.3"**
Overall Length	9349 mm	**368.1"**	9963 mm	**392.2"**	14 194 mm	**558.8"**
With Ripper and Pushplate	10 896 mm	**429"**	11 672 mm	**459.5"**	16 102 mm	**633.9"**
Wheelbase	6559 mm	**258"**	6985 mm	**275"**	10 278 mm	**404.6"**
Blade Base	2840 mm	**111.8"**	3069 mm	**120.8"**	4048 mm	**159.4"**
Overall Width (at top of front tires)	2801 mm	**110.3"**	3096 mm	**121.9"**	4280 mm	**168.5"**
Standard Blade: Length	4267 mm	**14'0"**	4877 mm	**16'0"**	7315 mm	**24'0"**
Height	686 mm	**27"**	787 mm	**31"**	1025 mm	**40"**
Thickness	25 mm	**1"**	25 mm	**1"**	50 mm	**2"**
Lift Above Ground	419 mm	**16.5"**	395 mm	**15.6"**	634 mm	**25"**
Max. Shoulder Reach:***						
Frame Straight — left	2169 mm	**85.4"**	2282 mm	**90"**	3222 mm	**126.9"**
Frame Straight — right	2279 mm	**89.7"**	2587 mm	**101.9"**	3228 mm	**127.1"**
Fuel Tank Capacity	492 L	**130 U.S. gal**	534 L	**141 U.S. gal**	1326 L	**350 U.S. gal**

*__Operating Weight__ — based on standard machine configuration with full fuel tank, coolant, lubricants and operator. 24M includes ripper.
**__Minimum Turning Radius__ — combining the use of articulated frame steering, front wheel steer and unlocked differential.
***Applicable for the standard blade with hydraulic sideshift and tip control. Maximum shoulder reach is obtainable to the right.

MODEL	D6R 6S		D6R 6SU		D6R 6SU XL		D6R 6S LGP	
Gauge	—		1880 mm	**74"**	1880 mm	**74"**	2.23 m	**90"**
Type	**Straight**		**Semi-Universal**		**Semi-Universal**		**Straight**	
Blade Capacities*	3.27 m^3	**4.27 yd^3**	5.35 m^3	**6.99 yd^3**	5.35 m^3	**6.99 yd^3**	5.50 m^3	**7.20 yd^3**
Weight, Shipping** (Dozer)	2599 kg	**5717 lb**	2973 kg	**6540 lb**	2973 kg	**6540 lb**	3054 kg	**6733 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	5.12 m	**16'9"**	5.08 m	**16'8"**	5.33 m	**17'6"**	5.48 m	**18'0"**
Blade Dimensions:								
B Width (including std. end bits)	3.36 m	**11'0"**	3.26 m	**10'8"**	3.26 m	**10'8"**	4.08 m	**13'4"**
C Height	1257 mm	**4'1.5"**	1411 mm	**4'8"**	1411 mm	**4'8"**	1104 mm	**3'7"**
D Max. Digging Depth	473 mm	**18.6"**	453 mm	**1'6"**	453 mm	**1'6"**	658 mm	**2'2"**
E Ground Clearance @ Full Lift	1104 mm	**3'7.5"**	1204 mm	**3'11"**	1204 mm	**3'11"**	1088 mm	**3'7"**
F Manual Tilt	689 mm	**2'3.1"**	—		—		—	
G Max. Pitch Adjustment	**+5.3 to 4.8°**		**+5.6° to –5.2°**		**+5.6° to –5.2°**		**+4.4° to –4.4°**	
H Max. Hydraulic Tilt	764 mm	**2'6.1"**	811 mm	**2'8"**	811 mm	**2'8"**	747 mm	**2'5"**
J Hydraulic Tilt (Manual Brace Centered)	420 mm	**16.5"**	455 mm	**1'6"**	455 mm	**1'6"**	421 mm	**1'5"**
K Push Arm Trunnion Width (to Ball Centers)	—		2.58 m	**8'6"**	2.58 m	**8'6"**	3.42 m	**11'5"**

MODEL	D6T 6A		D6T 6SU		D6T 6A XL		D6T 6SU XL	
Gauge	1880 mm	**74"**	1880 mm	**74"**	1.88 m	**74"**	1.88 m	**74"**
Type	**Angling**		**Semi-Universal**		**Angling**		**Semi-Universal**	
Blade Capacities*	3.64 m^3	**4.75 yd^3**	5.35 m^3	**6.99 yd^3**	3.94 m^3	**5.15 yd^3**	5.35 m^3	**6.99 yd^3**
Weight, Shipping** (Dozer)	3138 kg	**6904 lb**	2973 kg	**6540 lb**	3195 kg	**7044 lb**	2973 kg	**6540 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	5.00 m	**16'5"**	5.08 m	**17'6"**	5.21 m	**17'1"**	5.33 m	**17'6"**
Length (Blade Angled)	5.83 m	**19'2"**	—		6.05 m	**19'10"**	—	
Width (Blade Angled)	3.78 m	**12'5"**	—		3.77 m	**12'5"**	—	
Width (with C-Frame only)	2.93 m	**9'8"**	—		2.99 m	**9'10"**	—	
Blade Dimensions:								
B Width (including std. end bits)	4.16 m	**13'8"**	3.26 m	**10'8"**	4.16 m	**13'8"**	3.26 m	**10'8"**
C Height	1154 mm	**3'10"**	1411 mm	**4'8"**	1154 mm	**3'10"**	1411 mm	**4'8"**
D Max. Digging Depth	506 mm	**1'8"**	453 mm	**1'6"**	511 mm	**1'8"**	453 mm	**1'6"**
E Ground Clearance @ Full Lift	1144 mm	**3'9"**	1204 mm	**3'11"**	1217 mm	**4'0"**	1204 mm	**3'11"**
G Max. Pitch Adjustment	—		**+5.6° to –5.2°**		—		**+5.6° to –5.2°**	
H Max. Hydraulic Tilt	519 mm	**1'8"**	811 mm	**2'8"**	485 mm	**1'4"**	811 mm	**2'8"**
Blade Angle	**25°**		—		**25°**		—	
J Hydraulic Tilt (Manual Brace Centered)	—		455 mm	**1'6"**	—		455 mm	**1'6"**
K Push Arm Trunnion Width (to Ball Centers)	2.58 m	**8'6"**	2.58 m	**8'6"**	2.58 m	**8'6"**	2.58 m	**8'6"**

*Blade capacities as determined by SAE J1265. Tractor and dozer dimensions variations due to SystemOne undercarriage products are negligible. Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.

**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.

MODEL	D9R/D9T			
	9SU		9U	
Type	Semi-U		Universal	
Blade Capacities*	13.5 m^3	**17.7 yd^3**	16.4 m^3	**21.4 yd^3**
Weight, Shipping** (Dozer)	6543 kg	**14,425 lb**	7134 kg	**15,727 lb**
Tractor and Dozer Dimensions:				
A Length (Blade Straight)	6.84 m	**22'5"**	7.18 m	**23'7"**
Blade Dimensions:				
B Width (including std. end bits)	4.35 m	**14'3"**	4.68 m	**15'4"**
C Height	1934 mm	**6'4.1"**	1934 mm	**6'4.1"**
D Max. Digging Depth	606 mm	**1'11.9"**	606 mm	**1'11.9"**
E Ground Clearance @ Full Lift	1422 mm	**4'8"**	1422 mm	**4'8"**
G Max. Pitch Adjustment	**+3.4° to 2.9°**		**+3.4° to 2.9°**	
H Max. Hydraulic Tilt	940 mm	**3'1"**	1014 mm	**3'3.9"**
J Hydraulic Tilt (Manual Brace Centered)	570 mm	**1'10.4"**	616 mm	**2'0.3"**
K Push Arm Trunnion Width (to Ball Centers)	3.17 m	**10'3"**	3.17 m	**10'3"**
Maximum Track Width Permitted	762 mm	**2'6"**	762 mm	**2'6"**
Dual Tilt Option				
G Dual Pitch Adj.	**+4.8° to 5.2°**		**+4.8° to 4.9°**	
H Dual Max. Hyd. Tilt	1139 mm	**3'8.8"**	1231 mm	**4'0.5"**

*Blade capacities as determined by SAE J1265.
Notice that the capacity of the U-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the U-blade. It is intended for **relative comparisons of dozer sizes**, and not for predicting capacities or productivities in actual field conditions.
Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.

MODEL	D11T					
	11SU		11U		11 CD	
Type	Semi-U		Universal		CarryDozer	
Blade Capacities*	27.2 m^3	**35.5 yd^3**	34.4 m^3	**45.0 yd^3**	43.6 m^3	**57.0 yd^3**
Weight, Shipping**						
Standard Dozer	14 813 kg	**32,658 lb**	17 296 kg	**38,131 lb**	24 085 kg	**53,099 lb**
Abrasion Dozer	16 192 kg	**35,698 lb**	18 823 kg	**41,498 lb**	—	
Tractor and Dozer Dimensions:						
A Length	8.38 m	**27'6"**	8.83 m	**28'11"**	8.34 m	**26'8"**
Width	5.60 m	**18'4"**	6.35 m	**20'10"**	6.71 m	**22'0"**
Blade Dimensions:						
B Width (including std. end bits)	5.58 m	**18'4"**	6.35 m	**20'10"**	6.71 m	**22'0"**
C Height	2.77 m	**9'1"**	2.77 m	**9'1"**	2.74 m***	**9'0"*** **
D Max. Digging Depth	766 mm	**2'6.2"**	766 mm	**2'6.2"**	688 mm	**2'3"**
E Ground Clearance @ Full Lift	1533 mm	**5'0.4"**	1533 mm	**5'0.4"**	1850 mm	**6'1"**
G Max. Pitch Adjustment	**+2.1° to 2.2°**		**+2.1° to 2.2°**		—	
H Max. Hydraulic Tilt	1184 mm	**3'10.6"**	1344 mm	**4'4.9"**	1800 mm	**5'11"**
J Hydraulic Tilt (Manual Brace Centered)	886 mm	**2'10.9"**	1006 mm	**3'3.6"**	—	
K Push Arm Trunnion Width (to Ball Centers)	4.18 m	**13'9"**	4.18 m	**13'9"**	4.18 m	**13'9"**
Maximum Track Width Permitted	914 mm	**3'0"**	914 mm	**3'0"**	914 mm	**3'0"**
Dual Tilt Option	**+7.5° to 7.6°**		**+7.5° to 7.6°**			
	or		or			
G Dual Pitch Adjustment	**+0° to 13°**		**+0° to 13°**		**+47.8° to 10.4°**	
H Dual Max. Hyd. Tilt	1706 mm	**5'7.2"**	1938 mm	**6'4.3"**	—	

*Blade capacities as determined by SAE J1265.
Notice that the capacity of the U-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the U-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.
***Blade height with cutting edge at 53°.

All dimensions are approximate.

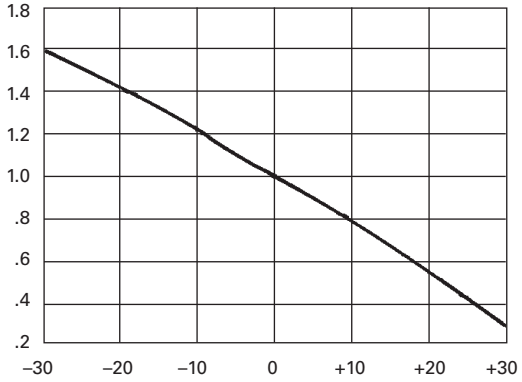
JOB CONDITION CORRECTION FACTORS

	TRACK-TYPE TRACTOR
OPERATOR —	
Excellent	1.00
Average	0.75
Poor	0.60
MATERIAL —	
Loose stockpile	1.20
Hard to cut; frozen —	
with tilt cylinder	0.80
without tilt cylinder	0.70
Hard to drift; "dead" (dry, non-cohesive material) or very sticky material	0.80
Rock, ripped or blasted	0.60-0.80
SLOT DOZING	1.20
SIDE BY SIDE DOZING	1.15-1.25
VISIBILITY —	
Dust, rain, snow, fog or darkness	0.80
JOB EFFICIENCY —	
50 min/hr	0.83
40 min/hr	0.67
BULLDOZER*	
Adjust based on SAE capacity relative to the base blade used in the Estimated Dozing Production graphs.	
GRADES — See following graph.	

***NOTE:** Angling blades and cushion blades are not considered production dozing tools. Depending on job conditions, the A-blade and C-blade will average 50-75% of straight blade production.

% Grade vs. Dozing Factor

(–) Downhill
(+) Uphill



ESTIMATING DOZER PRODUCTION OFF-THE-JOB

Example problem:

Determine average hourly production of a D8T/8SU (with tilt cylinder) moving hard-packed clay an average distance of 45 m (150 feet) down a 15% grade, using a slot dozing technique.

Estimated material weight is 1600 kg/Lm³ (2650 lb/LCY). Operator is average. Job efficiency is estimated at 50 min/hr.

Uncorrected Maximum Production — 458 Lm³/h (600 LCY/hr) (example only)

Applicable Correction Factors:

Hard-packed clay is "hard to cut" material . . .–0.80
Grade correction (from graph) . . . . . .–1.30
Slot dozing . . . . . .–1.20
Average operator . . . . . .–0.75
Job efficiency (50 min/hr) . . . . . .–0.83
Weight correction. . . . . (2300/2650)–0.87

Production = Maximum Production × Correction Factors
= (600 LCY/hr) (0.80) (1.30) (1.20) (0.75) (0.83) (0.87)
= 405.5 LCY/hr

To obtain production in metric units, the same procedure is used substituting maximum uncorrected production in Lm³.

= 458 Lm³/h × Factors
= 309.6 Lm³/h

	Minutes added (+) or Subtracted (–) From Basic Cycle
Machine	
— Material handler	–.05
Materials	
— Mixed	+.02
— Up to 3 mm (1/8 in)	+.02
— 3 mm (1/8 in) to 20 mm (3/4 in)	–.02
— 20 mm (3/4 in) to 150 mm (6 in)	.00
— 150 mm (6 in) and over	+.03 and Up
— Bank or broken	+.04 and Up
Pile	
— Conveyor or Dozer piled 3 m (10 ft) and up	.00
— Conveyor or Dozer piled 3 m (10 ft) or less	+.01
— Dumped by truck	+.02
Miscellaneous	
— Common ownership of trucks and loaders	Up to –.04
— Independently owned trucks	Up to +.04
— Constant operation	Up to –.04
— Inconsistent operation	Up to +.04
— Small target	Up to +.04
— Fragile target	Up to +.05

Using actual job conditions and the above factors, total cycle time can be estimated. Convert total cycle time to cycles per hour.

$$\textit{Cycles per hour at 100\% Efficiency} = \frac{\textit{60 min}}{\textit{Total Cycle Time in Minutes}}$$

Job efficiency is an important factor in machine selection. Efficiency is the actual number of minutes worked during an hour. Job efficiency accounts for bathroom breaks and other work interruptions.

$$\text{Cycles per hour at 50 minutes per hour (83\% efficiency)} = \text{Cycles per hour at 100\% efficiency} \times \frac{\text{50 min actual work time}}{\text{60 min hour}}$$

TRUCK LOADING

Average loader cycle times

914G2-962H	0.45-0.50 min
966H-980H	0.50-0.55 min
988H-990H	0.55-0.60 min
992K-994H	0.60-0.70 min

3. Required Payload Per Cycle

Required payload per cycle is determined by dividing required hourly production by the number of cycles per hour.

4. Bucket Selection

After required payload per cycle has been calculated, the payload should be divided by the loose cubic yard (meter) material weight to determine number of loose cubic yards (meters) required per cycle.

The bulk of material handled does not weigh 1800 kg/m^3 (3000 lb/yd^3), so a reasonable knowledge of material weight is necessary for accurate production estimates. The Tables Section has average weight for certain materials when actual weights are not known.

The percentage of rated capacity a bucket carries in various materials is estimated below. The bucket size required to handle the required volume per cycle is found with the aid of the percentage of rated bucket capacity called "Bucket Fill Factor."

The bucket size needed is determined by dividing loose cubic meters (or yards) required per cycle by the bucket fill factor.

$$\textit{Bucket size} = \frac{\textit{Volume Required/Cycle}}{\textit{Bucket Fill Factor}}$$

BUCKET FILL FACTORS

The following indicates the approximate amounts of material as a percent of rated bucket capacity which will actually be delivered per bucket per cycle. This is known as "Bucket Fill Factor."

Loose Material	Fill factor
Mixed moist aggregates	95-100%
Uniform aggregates up to 3 mm (1/8 in)	95-100
3 mm (1/8 in) to 9 mm (3/8 in)	90-95
12 mm (1/2 in) to 20 mm (3/4 in)	85-90
24 mm (1.0 in) and over	85-90

992K — Standard

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
12.2	**16**	1780	**3000**
11.5	**15**	1890	**3200**
10.7	**14**	2030	**3430**

992K — High Lift

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
12.2	**16**	1560	**2630**
11.5	**15**	1560	**2630**
10.7	**14**	1560	**2630**

993K — Standard

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
15.3	**20**	1780	**3000**
14.5	**19**	1870	**3160**
13.8	**18**	1970	**3330**

993K — High Lift

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
14.5	**19**	1720	**2890**
13.8	**18**	1810	**3060**
13.0	**17**	1920	**3240**

TABLES

SWELL — VOIDS — LOAD FACTORS

SWELL (%)	VOIDS (%)	LOAD FACTOR
5	4.8	0.952
10	9.1	0.909
15	13.0	0.870
20	16.7	0.833
25	20.0	0.800
30	23.1	0.769
35	25.9	0.741
40	28.6	0.714
45	31.0	0.690
50	33.3	0.667
55	35.5	0.645
60	37.5	0.625
65	39.4	0.606
70	41.2	0.588
75	42.9	0.571
80	44.4	0.556
85	45.9	0.541
90	47.4	0.526
95	48.7	0.513
100	50.0	0.500

BUCKET FILL FACTORS

Loose Material	Fill Factor
Mixed Moist Aggregates	95-100%
Uniform Aggregates up to 3 mm (1/8")	95-100
3 mm-9 mm (1/8"-3/8")	90-95
12 mm-20 mm (1/2"-3/4")	85-90
24 mm (1") and over	85-90
Blasted Rock	
Well Blasted	80-95%
Average Blasted	75-90
Poorly Blasted	60-75
Other	
Rock Dirt Mixtures	100-120%
Moist Loam	100-110
Soil, Boulders, Roots	80-100
Cemented Materials	85-95

NOTE: Loader bucket fill factors are affected by bucket penetration, breakout force, rackback angle, bucket profile and ground engaging tools such as bucket teeth or bolt-on replaceable cutting edges.

NOTE: For bucket fill factors for hydraulic excavators, see bucket payloads in the hydraulic excavator section.

TYPICAL ROLLING RESISTANCE FACTORS

Various tire sizes and inflation pressures will greatly reduce or increase the rolling resistance. The values in this table are approximate, particularly for the track and track + tire machines. These values can be used for estimating purposes when specific performance information on particular equipment and given soil conditions is not available. See Mining and Earthmoving Section for more detail.

	ROLLING RESISTANCE, PERCENT*			
	Tires		Track	Track
UNDERFOOTING	Bias	Radial	**	+Tires
A very hard, smooth roadway, concrete, cold asphalt or dirt surface, no penetration or flexing	1.5%*	1.2%	0%	1.0%
A hard, smooth, stabilized surfaced roadway without penetration under load, watered, maintained	2.0%	1.7%	0%	1.2%
A firm, smooth, rolling roadway with dirt or light surfacing, flexing slightly under load or undulating, maintained fairly regularly, watered	3.0%	2.5%	0%	1.8%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 25 mm (1") tire penetration or flexing	4.0%	4.0%	0%	2.4%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 50 mm (2") tire penetration or flexing	5.0%	5.0%	0%	3.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 100 mm (4") tire penetration or flexing	8.0%	8.0%	0%	4.8%
Loose sand or gravel	10.0%	10.0%	2%	7.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 200 mm (8") tire penetration and flexing	14.0%	14.0%	5%	10.0%
Very soft, muddy, rutted roadway, 300 mm (12") tire penetration, no flexing	20.0%	20.0%	8%	15.0%

*Percent of combined machine weight.

**Assumes drag load has been subtracted to give Drawbar Pull for good to moderate conditions. Some resistance added for very soft conditions.

ANGLE OF REPOSE OF VARIOUS MATERIALS

	ANGLE BETWEEN HORIZONTAL AND SLOPE OF HEAPED PILE	
MATERIAL	Ratio	Degrees
Coal, industrial	1.4:1—1.3:1	35-38
Common earth, Dry	2.8:1—1.0:1	20-45
Moist	2.1:1—1.0:1	25-45
Wet	2.1:1—1.7:1	25-30
Gravel, Round to angular	1.7:1—0.9:1	30-50
Sand & clay	2.8:1—1.4:1	20-35
Sand, Dry	2.8:1—1.7:1	20-30
Moist	1.8:1—1.0:1	30-45
Wet	2.8:1—1.0:1	20-45

ALTITUDE DERATION

PERCENT FLYWHEEL HORSEPOWER AVAILABLE AT SPECIFIED ALTITUDES

MODEL	0-760 m (0-2500')	760-1500 m (2500-5000')	1500-2300 m (5000-7500')	2300-3000 m (7500-10,000')	3000-3800 m (10,000-12,500')	3800-4600 m (12,500-15,000')
D3K XL	100	100	100	100	88	85
D3K LGP	100	100	100	100	88	85
D4K XL	100	100	100	100	88	85
D4K LGP	100	100	100	100	88	85
D5K XL	100	100	100	100	88	85
D5K LGP	100	100	100	100	88	85
D5N XL & LGP	100	100	100	100	100	100
D6K XL & LGP	100	100	100	100	N/A	N/A
D6N XL & LGP	100	100	100	100	N/A	N/A
D6N XL & LGP**	100	100	100	100	100	100
D6G	100	100	100	100	94	87
D6G Series 2 XL	100	100	100	94	87	80
D6G Series 2 LGP	100	100	100	94	87	80
D6R	100	100	100	100	92	84
D6R Series 3 (All)	100	100	100	100	92	84
D6T (Tier 4 Interim/Stage IIIB)	100	100	100	100	100	88
D7E	100	100	100	98	95	88
D7G	100*	100*	100*	94	86	80
D7G Series 2	100	100	100	100	100	94
D7R Series 2 (All)	100	100	100	100	100	96
D8R	100	100	100	93	85	77
D8T	100	100	100	100	100	93
D9R	100	100	100	93	85	77
D9T U.S. EPA Tier 4 Final	100	100	100	100	100	100
D9T Tier 3 equivalent NACD Std. Altitude	100	100	100	99	92	83
D9T Tier 3 equivalent NACD High Altitude	100	100	100	100	100	100
D9T EU Stage IIIA equivalent	100	100	100	98	91	80
D9T Tier 2 equivalent	100	100	100	100	99	88
D10T2 Tier 2 equivalent ***	100	100	100	100	100	100
D10T2 Tier 4 Final***	100	100	100	100	100	100
D11T/D11T CD Tier 2 equivalent****	100	100	100	100	100	86
D11T/D11T CD Tier 4 Final****	100	100	100	100	83	67
120H STD	100	100	100	100	100	100
120M	100	100	100	100	95	88
135H STD	100	100	100	100	100	98
12H STD	100	89	83	77	71	65
12M	100	100	100	100	95	88

*Refer to "Captive Vehicle Engine Fuel Specifications" microfiche at your local dealer.
**Information not available at time of printing.
***In forward gears.
****D11T — High altitude arrangement available.

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar Inc., Peoria, Illinois, U.S.A.

JANUARY 2012

Important Notice: The subscription list has been discontinued for the Caterpillar Performance Handbook (PHB). Edition 42 is the final PHB to be distributed via a subscription list. Effective immediately, all Performance Handbooks, including this current edition, can be ordered 24/7 at *https://oos.midlandcorp.com/cat*. Please direct any inquiries about the Performance Handbook to the Caterpillar Performance Handbook Coordinator at *Siegle_Toni_M@cat.com*.

Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar Inc. nor its dealers warrant that the machines described will perform as estimated.

NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

Printed in U.S.A.

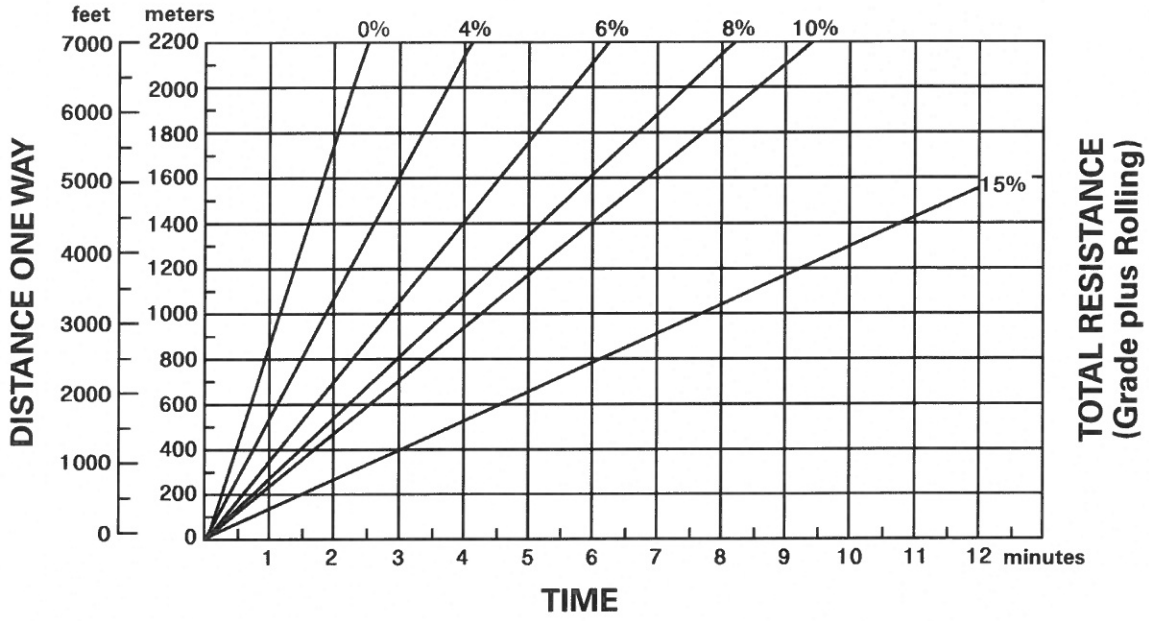
SEBD0351-42



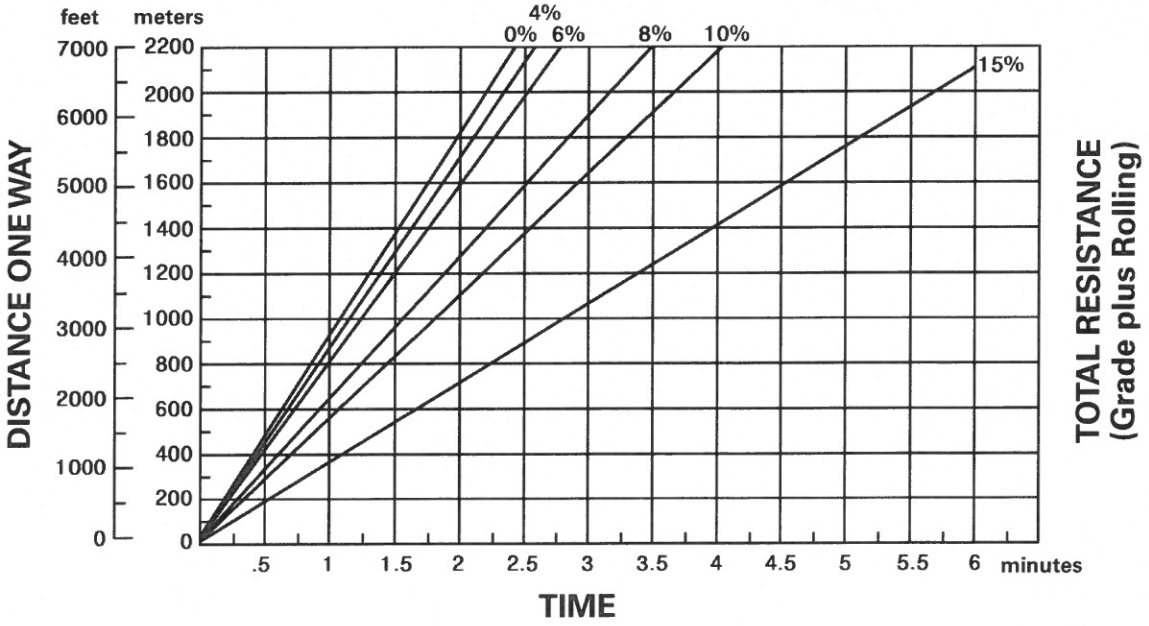
MODEL	785C		785D		789C	
Body Type	Dual Slope		Dual Slope		Dual Slope	
Target Gross Machine Weight §	249 433 kg	**550,000 lb**	249 433 kg	**550,000 lb**	317 460 kg	**700,000 lb**
Basic Machine Weight*	59 385 kg	**130,921 lb**	46 921 kg	**103,443 lb**	67 344 kg	**148,468 lb**
Attachments**	21 677 kg	**47,790 lb**	35 144 kg	**77,479 lb**	29 015 kg	**63,967 lb**
Body Weight without Liners***	22 997 kg	**50,700 lb**	22 997 kg	**50,700 lb**	27 094 kg	**59,732 lb**
Full Liner	8113 kg	**17,886 lb**	8113 kg	**17,886 lb**	9392 kg	**20,706 lb**
Operating Machine Weight	112 172 kg	**247,297 lb**	113 175 kg	**249,508 lb**	132 845 kg	**292,873 lb**
Debris (3% of Operating Machine Weight)	3365 kg	**7419 lb**	3395 kg	**7485 lb**	3985 kg	**8786 lb**
Empty Operating Weight	115 537 kg	**254,716 lb**	116 570 kg	**256,993 lb**	136 830 kg	**301,659 lb**
Target Payload §	133.9 m tons	**147.6 tons**	132.9 m tons	**146.5 tons**	180.7 m tons	**199.2 tons**
Capacity:						
Heaped (2:1) (SAE) Base Body	78 m^3	**102 yd^3**	78 m^3	**102 yd^3**	105 m^3	**137 yd^3**
Heaped (2:1) (SAE) with Std. Sideboards	91 m^3	**119 yd^3**	91 m^3	**119 yd^3**	120 m^3	**157 yd^3**
Distribution Empty:						
Front	**45.0%**		**45.5%**		**45.6%**	
Rear	**55.0%**		**54.5%**		**54.4%**	
Distribution Loaded:						
Front	**33.3%**		**33.3%**		**33.3%**	
Rear	**66.7%**		**66.7%**		**66.7%**	
Engine Model	**3512B EUI**		**3512C HD-EUI**		**3516B EUI**	
Number of Cylinders	**12**		**12**		**16**	
Bore	170 mm	**6.7"**	170 mm	**6.7"**	170 mm	**6.7"**
Stroke	190 mm	**7.5"**	215 mm	**8.46"**	190 mm	**7.5"**
Displacement	51.8 L	**3158 in^3**	58.56 L	**3574 in^3**	69 L	**4210 in^3**
Net Power	979 kW	**1313 hp**	979 kW	**1313 hp**	1335 kW	**1791 hp**
Gross Power	1082 kW	**1450 hp**	1082 kW	**1450 hp**	1417 kW	**1900 hp**
Standard Tires	**33.00R51**		**33.00R51**		**37.00R57**	
Machine Clearance Turning Circle	30.6 m	**100'5"**	33.2 m	**108'11"**	30.2 m	**99'2"**
Fuel Tank Refill Capacity	1893 L	**500 U.S. gal**	1893 L	**500 U.S. gal**	3222 L	**850 U.S. gal**
Top Speed (Loaded)	56.5 km/h	**35.1 mph**	56.5 km/h	**35.1 mph**	57.2 km/h	**35.5 mph**
GENERAL DIMENSIONS (Empty):						
Height to Canopy Rock Guard Rail	5.77 m	**18'11"**	5.68 m	**18'7"**	6.15 m	**20'2"**
Wheelbase	5.18 m	**17'0"**	5.18 m	**17'0"**	5.70 m	**18'8"**
Overall Length (Base Body)	10.62 m	**34'10"**	11.55 m	**37'9"**	12.18 m	**39'11"**
Loading Height (Base Body)	4.97 m	**16'4"**	4.97 m	**16'4"**	5.21 m	**17'1"**
Height at Full Dump	11.21 m	**36'9"**	11.81 m	**38'9"**	11.90 m	**39'1"**
Body Length (Target Length)	7.65 m	**25'1"**	7.65 m	**25'2"**	8.15 m	**26'9"**
Width (Operating)	6.64 m	**21'4"**	7.06 m	**23'2"**	7.67 m	**25'2"**
Width (Shipping)***	3.91 m	**12'10"**	3.91 m	**12'10"**	3.84 m	**12'7"**
Front Tire Tread	4.85 m	**15'11"**	4.85 m	**15'11"**	5.43 m	**17'10"**

*See Weight Definitions and Relations on 9-16. Note: No mandatory or optional attachments or fuel.
**Typical selection of mandatory and optional attachments.
***Data provided is for a representative body and liner package. Several dual slope, flat floor, and mine specific design (MSD) bodies and liner packages are available. All weights, capacities, and dimensions are dependent on the machine configuration (body type, attachments, tires, and optional equipment selected).
§Reference Caterpillar's latest 10/10/20 Payload Policy for information on gross machine operating weight and target payload.
NOTE: Contact Mining Representative to use Caterpillar Weight Configurator for application specific weights.

LOADED



EMPTY



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Engineering Earth's Development, Preserving Earth's Integrity