Surface Water Quality

Introduction

This section discusses the potential impacts to the quality of existing surface water resources in the analysis area. Surface water resources are the same as those listed for “Surface Water Quantity.” The analysis for surface water quality considers the alternatives plus all connected actions, and the analysis area is based on the same considerations as those listed for “Surface Water Quantity.” The analysis area is depicted in figure 64.

Changes from the Draft Environmental Impact Statement

In response to public comment regarding changes in downstream geomorphology and aggradation and scour, an independent qualitative analysis of the geomorphology of Barrel Canyon was performed. The sediment yield analysis is now based on the evaluation of two assessments: the sediment yield model and a new geomorphology analysis (see the “Sediment Yield and Changes in Geomorphology” part of this resource section).

A more robust analysis of predicted stormwater quality runoff from the waste rock facility has been completed. Existing stormwater quality data for the analysis area were updated and used for the analysis. Available existing water quality data for Davidson Canyon and Cienega Creek were presented and applied relative to predicted project stormwater quality (see the “Potential for Acid Rock Drainage,” “Potential for Other Contaminants in Runoff,” and “Potential for Meeting Narrative Surface Water Quality Standards” parts of this resource section).

Additional mitigation measures have been incorporated into the document and assessed for effectiveness at reducing impacts (see the “Mitigation Effectiveness” part of this resource section, as well as appendix B).

Monitoring has been incorporated into the mitigation and monitoring plan (see appendix B) in order to address uncertainty associated with analysis of geomorphological changes and acid rock drainage (see the “Mitigation Effectiveness,” “Monitoring Intended to Assess Potential Geomorphological Impacts,” and “Monitoring Intended to Assess Potential Acid Rock Drainage” parts of this resource section).

Issues, Cause and Effect Relationships of Concern

One significant issue was identified concerning surface water quality.

Issue 3E: Surface Water Quality

Construction and operation of tailings, waste rock, and leach facilities have the potential to result in sediment or other pollutants reaching surface water and degrading water quality, leading to a loss of beneficial uses. If sediment enters streams, turbidity will increase, and State water quality standards could be exceeded. Downstream segments of Davidson Canyon and Cienega Creek are Outstanding Arizona Waters (Tier 3), which are given the highest level of antidegradation protection.
As outstanding resource waters under the ARS, Tier 3 waters must be maintained and protected, with no degradation in water quality allowed.

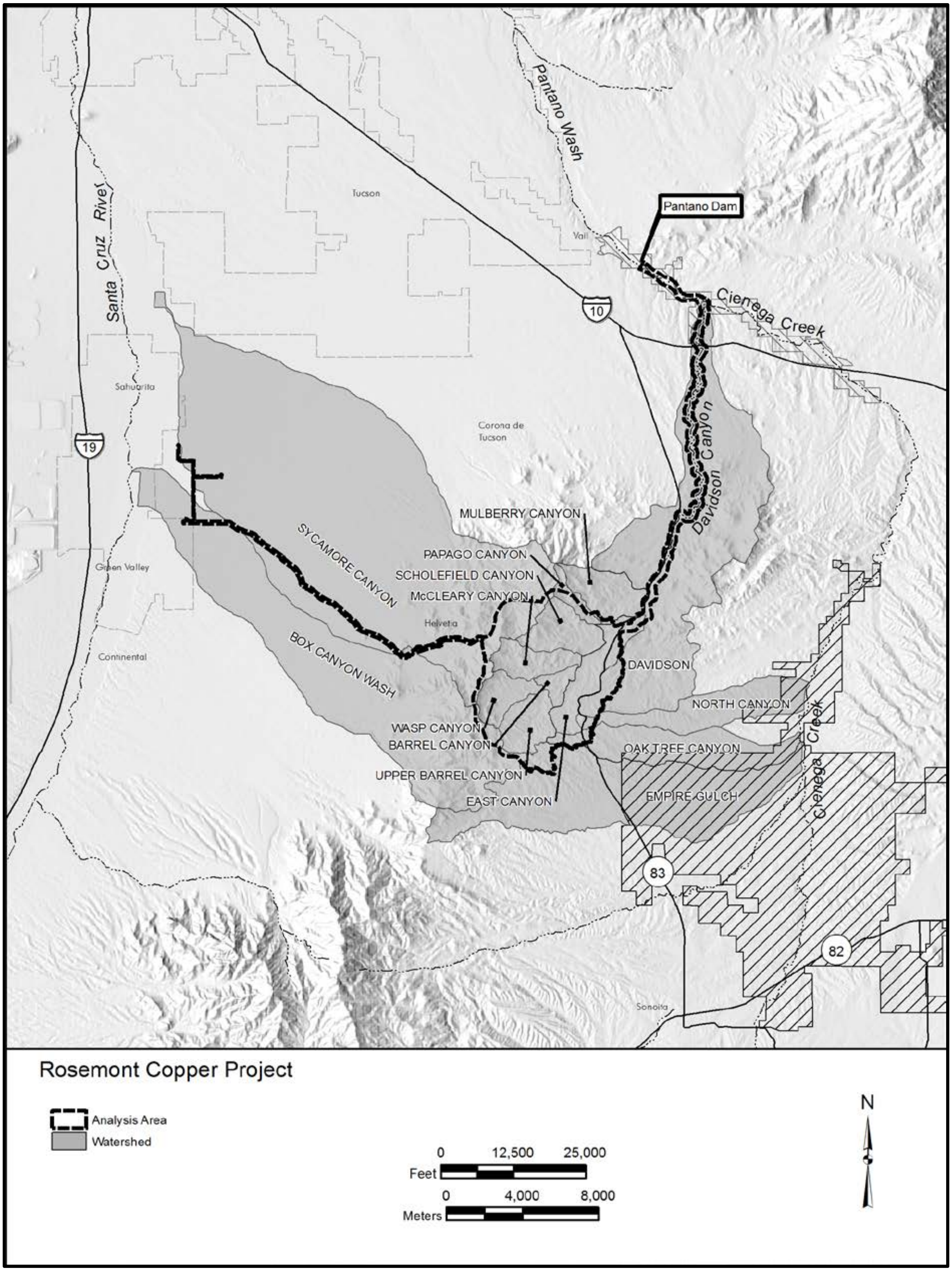

Figure 64. Analysis area for surface water quality

Issue 3E Factors for Alternative Comparison

1. Ability to meet Arizona Surface Water Quality Standards
2. Change in geomorphology and characteristics of downstream channels
3. Acres and locations that may be affected by surface water quality impacts and the duration (in years) of those impacts
4. Acres of potentially jurisdictional WUS impacted

Analysis Methodology, Assumptions, Uncertain and Unknown Information

The methodology for assessing changes in surface water quality consists of four components: (1) the potential for acid rock drainage; (2) expected changes in sediment yield; (3) potential for other contaminants; and (4) dredged or fill material into WUS under the CWA. All analyses presented are based on resource reports prepared by experts in the field.

The potential for acid rock drainage impacts on surface water quality is assessed using geochemical test results from 226 samples collected in the project area. Composite acid base accounting techniques were performed on the various rock types using static testing for preliminary screening; these data were used to characterize the quality of stormwater runoff from the waste rock. Based on the results of static testing, additional kinetic testing (humidity cell tests) and leaching procedures were performed to investigate acid generating potential.

Expected changes in sediment yield (specifically, total suspended solid concentrations) from the project area to the USGS stream gage in Lower Barrel Canyon were modeled using the 1968 Pacific Southwest Inter-Agency Committee method (Pacific Southwest Inter-Agency Committee 1968). The potential for downstream scour or aggradation caused by changes to upstream sediment yield is assessed qualitatively, based on two independent analyses and field observations performed by Golder Associates and WestLand Resources Inc. (Patterson and Annandale 2012; Rosemont Copper Company 2012a). These studies were used in conjunction with the sediment yield modeling to analyze impacts on surface water quality. The Coronado investigated the use of sediment transport models (such as HEC-6) and determined that given the type of system that exists in Barrel Canyon (Patterson and Annandale 2012) and the difficulty of applying sediment transport models to ephemeral systems (Duan et al. 2008; Ruff et al. 1986), running these models would not further inform the decision.

The potential for contaminants other than sediment to enter natural drainage ways is assessed using geochemical test results to predict water quality of stormwater coming into contact with waste rock. To better represent the assorted rock types present at the project area, a weighted average of the test results is used proportionate to the percentage of rock type present. These are then compared with the surface water quality standards specific to the beneficial uses on Barrel Canyon, as well as existing surface water quality data for the project area. Baseline stormwater samples were collected in 2009, 2010, and 2011 from the project area in order to document baseline surface water quality conditions. Available existing water quality data for Davidson Canyon and Cienega Creek have been summarized and are analyzed relative to predicted project stormwater quality.

The fourth component consists of the amount of dredged or fill material within WUS as regulated under Section 404 of the CWA. Washes, wetlands, and stock ponds in the project area, the utility maintenance road, the power line, and the water supply pipeline were surveyed using field methods developed by the USACE (2008a; 2008b). A preliminary jurisdictional waters determination based on the surveys was submitted to the USACE on May 29, 2009, with additional information provided on July 31, 2009, January 5, 2010, and March 1, 2010. The USACE approved the preliminary jurisdictional delineation in November 2010. Two addenda were subsequently submitted to the USACE on March 13 and 15, 2012 (WestLand Resources Inc. 2012a; 2012b). The data, as approved, were used by the Coronado to quantitatively assess direct impacts to surface water quality (i.e., acres of jurisdictional waters impacted). Impacts to riparian habitat/vegetation resulting from the potential reduction in spring flow or stream flow are addressed in the "Seeps, Springs, and Riparian Areas" resource section of this chapter.

The connected actions described in chapter 2 (relocation of electric transmission line; construction and eventual removal of the electrical distribution line, water supply pipeline, and associated features; rerouting of the Arizona National Scenic Trail; and SR 83 highway maintenance and improvements) have all been considered for their potential contribution to direct and indirect impacts. The impacts described include these actions, in addition to the activities associated with each of the action alternatives.

Summary of Effects by Issue Factor by Alternative

Table 97 presents the summary comparison of impacts from each alternative.

Table 97. Summary of effects

Issue Factor	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Issue 3E.1: Ability to meet Arizona Surface Water Quality Standards	Current runoff does not meet Arizona Surface Water Quality Standards for dissolved copper	Runoff from waste rock is predicted to meet Arizona Surface Water Quality Standards for all constituents except selenium; waste rock characterization tests indicate a potential for elevated selenium concentrations in runoff from waste rock	Same as for proposed action	Same as for proposed action	Same as for proposed action	Same as for proposed action
Issue 3E.2: Change in geomorphology and characteristics of downstream channels	No changes from proposed mine. Changing watershed or climatic conditions could alter stream channels.	Sediment load would decrease, but sediment concentrations would remain the same, compared with baseline; analysis indicates that no changes in geomorphology (scour/aggradation) are expected in Barrel Canyon or Davidson Canyon owing to change in sediment load	Same as for proposed action	Same as for proposed action	Same as for proposed action	Same as for proposed action

Issue Factor	No Action	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Issue 3E.3: Acres and locations that may be affected by surface water quality impacts and duration (in years) of those impacts	None	Runoff would affect 2.5 miles of Barrel Canyon (23 acres), and 14 miles of Davidson Canyon (234 acres); potential for effect is greatest during active mine life (20 to 25 years), gradually reducing as reclamation occurs	Same as for proposed action	Same as for proposed action	Same as for proposed action	Same as for proposed action
Issue 3E.4: Acres of potentially jurisdictional WUS impacted	0	48	48.6	42.8	52.6	35.3

Affected Environment

Relevant Laws, Regulations, Policies, and Plans

Table 98 lists the applicable laws, regulations, and policies related to the use, protection, and management of surface water quality that would apply to the development and operation of the project. These laws, regulations, and policies, which will collectively be referred to in the following sections as "regulation(s)," are outlined in more detail in the following sections.

Table 98. Summary of the Federal, State, and local regulatory requirements applicable to the project with respect to surface water resources

Law or Regulation	Regulates
Federal	
CWA – Section 404	Discharge of dredged or fill material into WUS
CWA – Section 303	Surface water quality; implemented by the State of Arizona
Executive Order 11988 – Floodplain Management	Occupancy and modification of floodplains
Executive Order 11990 – Wetlands	Destruction, loss, or degradation of wetlands
FSMs 2520, 2530, and 2880 and FS-881 Technical Guide	Watershed protection and management, water resource management, geological resources, and groundwater management
State	
CWA – Section 401 State Water Quality Certification	Surface water quality; implemented by the State of Arizona
CWA – Section 402 Arizona Pollutant Discharge Elimination System	Surface water quality from point sources, including stormwater; primacy given to State of Arizona

Federal

Clean Water Act (33 United States Code 1251–1376)

The CWA and the Water Quality Act of 1987 form the major Federal legislation governing water quality. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters."

Important sections of the CWA are as follows.

Clean Water Act Section 401

Section 401 (Water Quality Certification) requires an applicant for any Federal permit who proposes an activity that may result in a discharge to WUS to obtain from the appropriate State certification that the discharge will not result in a violation of State surface water quality standards. ARS 49-202(B)–(H) outline the State's water quality certification procedures for any Federal permit or license that involves a discharge to WUS. The ADEQ may certify, deny, or waive water quality certification. No Federal permit or action may be approved if the State denies certification.

Clean Water Act Section 402 / Arizona Pollutant Discharge Elimination System (Arizona Revised Statutes 49-255.01)

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System, a permitting system for the discharge of any pollutant (except for dredged or fill material) into WUS. Since 2002, the ADEQ has had primacy over Section 402 through implementation of the Arizona Pollutant Discharge Elimination System. The Arizona Pollutant Discharge Elimination System program regulates discharge of pollutants into WUS. Historically, the ADEQ has considered virtually all waterways in Arizona, including dry washes, to fall under the jurisdiction of the Arizona Pollutant Discharge Elimination System program and gives special consideration to those that have been designated Outstanding Arizona Waters.

The Arizona Pollutant Discharge Elimination System program regulates point sources of discharge. The most common source regulated is stormwater runoff from construction activities and industrial sites. Coverage under the Arizona Pollutant Discharge Elimination System may be obtained either through issuance of an Individual Permit or a General Permit by the ADEQ (AAC R18-9-C901). There are five general permits that historically have been issued: de minimis discharges, stormwater runoff from construction activities (the construction general permit), stormwater runoff from concentrated animal feeding operations, stormwater runoff from industrial sites (the multisector general permit), and discharge of stormwater from municipal stormwater systems.

A new multisector general permit for stormwater discharges associated with industrial activity/mineral industry was approved by ADEQ on December 20, 2010. Rosemont Copper applied for coverage under the multisector general permit, and coverage was issued by ADEQ on February 7, 2013. This mining multisector general permit specifically applies to stormwater runoff from industrial activities related to metal mining, including tailings, waste rock, haul roads, milling, and ancillary facilities. A key condition for using the general permit is that stormwater runoff may not mix with mine drainage or process water. Stormwater discharges can be covered under the mining multisector general permit if the applicant meets the permit's eligibility criteria and complies with the permit's substantive requirements, including best management practices, stabilization measures, good housekeeping measures, sediment controls, inspection requirements, and record-keeping requirements. Additionally, the mining general permit requires monitoring for several parameters, many of which are hardness dependent, that are specific to copper mining operations.

Multiple surface water permits may be required for this project. Minor temporary discharges, such as pipeline hydrostatic testing or well testing, may be covered as de minimis discharge. Linear construction activities, including road building, utility line construction, and other ground disturbance performed off the mining facility site and greater than 1 acre in size, may require separate coverage under the construction general permit if not covered under the mining multisector general permit.

Clean Water Act Section 404

Section 404 establishes a permit program for the discharge of dredged or fill material into WUS, including wetlands. This permit program is jointly administered by the USACE and EPA. Consultation with the USFWS and State Historic Preservation Officer may also be required before issuance of a permit to ensure compliance with the ESA and National Historic Preservation Act. The immediate regulatory decision regarding which activities fall under Section 404 of the CWA lies with the USACE Los Angeles District, and Section 404 permitting is discretionary on the part of the USACE. In general, there are three methods for obtaining a permit under Section 404: authorization under a nationwide permit, authorization under a regional general permit, and issuance of an individual permit. For all aspects of the proposed project, including road and utility line crossings of WUS, an individual permit would be required. The decision regarding which activities are jurisdictional has been made by the USACE.

Clean Water Act Section 303

The ADEQ has developed surface water quality standards, including narrative limitations, to define water quality goals for Arizona's streams and lakes and provide the basis for controlling discharge of pollutants to surface waters. Beneficial uses for water bodies are identified in State water quality standards (18 AAC Chapter 11, Article 1) and must be achieved and maintained as required under the CWA. Beneficial uses can include support of aquatic life, fish consumption, public water supply, and irrigation. The 303(d) list, as required by Section 303(d) of the CWA, is a list of water bodies that have a designated beneficial use that is impaired by one or more pollutants. Water bodies included on this list are referred to as "impaired waters." The State must take appropriate action to improve impaired water bodies by establishing total maximum daily loads and reducing or eliminating pollutant discharges.

Executive Orders

Executive Order 11988 (May 24, 1977) directs each Federal agency to take action to avoid the long- and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to avoid direct or indirect support of floodplain development whenever there is a practicable alternative.

Executive Order 11990 (May 24, 1977) directs Federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial value of wetlands in carrying out programs that affect land use.

Forest Service Guidance

FSMs that provide guidance for watershed protection and management are discussed in the "Groundwater Quantity" resource section of this chapter.

State

Arizona Water Quality Standards (Title 18 Arizona Administrative Code Chapter 11)

State regulations dictate numeric water quality standards both for surface waters and for groundwater. Numeric surface water quality standards apply to all naturally occurring surface water on nontribal lands within the State, while aquifer water quality standards apply to all groundwater within the State. Numeric surface water quality standards are specific to the use of the water, as well as any special designations for surface waters, and there are varying standards for acute and chronic exposure.

State regulations also identify a narrative water quality standard for surface water. The narrative standards state that surface water shall not contain pollutants in amounts that: (1) settle to form bottom deposits that inhibit the growth of aquatic life; (2) cause objectionable odor; (3) cause off-taste or odor in drinking water; (4) cause off-flavor in aquatic organisms; (5) are toxic to humans, plants, animals, or other organisms; (6) cause growth of algae that inhibit the growth of other aquatic life or impair recreational use; (7) cause a violation of an aquifer water quality standard; or (8) change the color of the surface water. Further, narrative water quality standards state that surface water shall not contain: a pollutant such as oil or grease that floats or causes a film; a discharge of suspended solids that interfere with downstream treatment plants; or solid waste such as refuse, rubbish or trash. The narrative water quality standards also state that a wadeable, perennial stream shall support and maintain organism richness comparable to that of a stream with reference conditions in Arizona.

Existing Conditions

Waters of the United States

Past activities on the Coronado National Forest that have impacted WUS include historic grazing activities, mining, fires, and recreation and off-highway vehicle usage. Current watershed conditions within the analysis area are generally satisfactory, although several subwatersheds have been degraded, as discussed in detail in the "Soils and Revegetation" resource section in this chapter.

Many of the named and unnamed ephemeral drainages on the project area have been determined to be potentially jurisdictional WUS by the USACE. WestLand Resources Inc. (2010a; 2010b) submitted to the USACE a preliminary jurisdictional delineation to map and estimate the total acreage of potentially jurisdictional drainages in the project area and associated utility corridor (figure 65). The preliminary jurisdictional delineation was approved by the USACE on November 1, 2010. Two addenda to the preliminary jurisdictional delineation were subsequently filed with the USACE on March 13 and 15, 2012, for additional areas along the power line and water pipeline (WestLand Resources Inc. 2012a; 2012b). The WestLand Resources Inc. delineation estimates that there is a total of approximately 125 acres of WUS within the areas surveyed by WestLand Resources Inc., which generally correspond to the project area and the utility corridor. The potentially jurisdictional areas include the ephemeral drainages associated with Barrel, Scholefield, Wasp, McCleary, Mulberry, and Papago Canyons, as well as numerous small, unnamed, ephemeral tributary drainages that flow into these canyons. Table 99 provides a list of drainages and the total acreage of potentially jurisdictional WUS within the project area, including the utility corridor.

Table 99. Summary of preliminary jurisdictional waters delineation within project area and utility corridor

Project Component	Area of Analysis (acres)	Potential WUS (acres)	Identified Features
Mine site WestLand Resources Inc. 2010a)	9,136	101.6	154 ephemeral drainages 10 stock tanks 2 concrete dams 7 springs 1 leaking wellhead 1 wetland (Scholefield Spring)
Water line (WestLand Resources Inc. 2010b)	1,158	21.58	95 ephemeral drainages
Addendum to Santa Rita Road utility line (WestLand Resources Inc. 2012a)	38	0.98	5 ephemeral drainages
Addendum to Santa Rita Road utility line (WestLand Resources Inc. 2012b)	49.7	0.801	49 ephemeral drainages

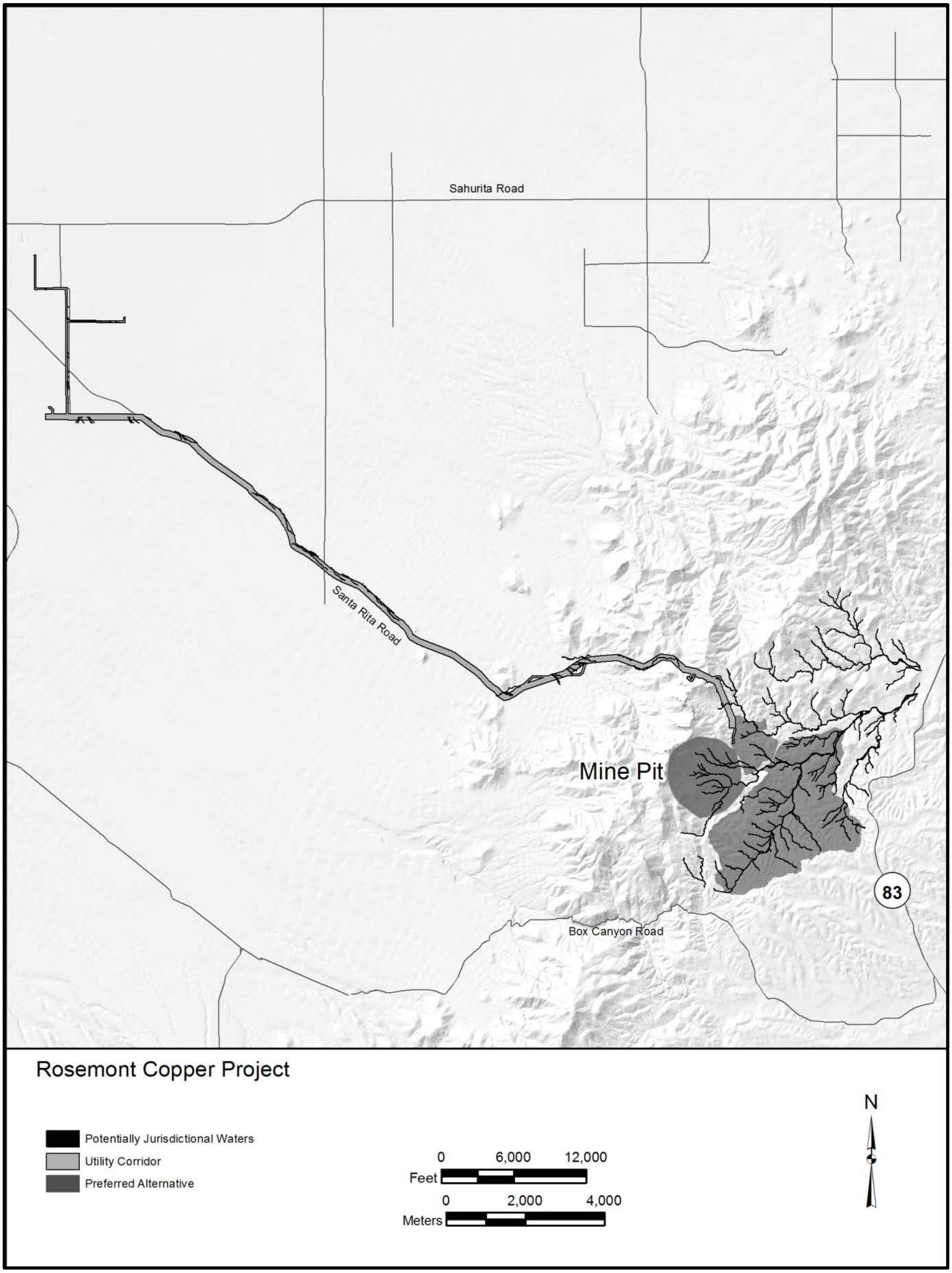

Figure 65. Potentially jurisdictional waters within the project area

Surface Water Quality

Stormwater sampling has been conducted by Rosemont Copper in Barrel Canyon since 2009, and the samples have been analyzed for water quality. In addition, some surface water quality data exist for Davidson Canyon downstream near its confluence with Cienega Creek, as well as within Cienega Creek. None of the drainages within the analysis area have been designated by the ADEQ as impaired or as having other water quality concerns. A portion of Davidson Canyon has been designated an Outstanding Arizona Water by the ADEQ; this is fully analyzed in the “Seeps, Springs, and Riparian Areas” resource section of this chapter.

Six water quality samples were collected from two locations in lower Davidson Canyon by Pima Association of Governments Watershed Planning (2005) between 2002 and 2003. These data were provided in the nomination to classify Davidson Canyon as a Unique Water. Rosemont Copper also collected water samples in lower Davidson Canyon in 2008 and 2010. The sample collected by Rosemont Copper titled “Reach 2 Davidson Canyon” corresponds to the “Davidson 1” location sampled by the Pima Association of Governments. All Davidson Canyon data are summarized below in table 100. Sample locations roughly correspond to two springs presented in the “Seeps, Springs, and Riparian Areas” resource section: Reach 2 Spring (Davidson 1) and Escondido Spring (Davidson 2).

Designated uses in the Outstanding Arizona Water section of Davidson Canyon include Aquatic and Wildlife (ephemeral), Agricultural Livestock Watering, Fish Consumption, Full Body Contact, Partial Body Contact, and Aquatic Wildlife (warm water) (Arizona Department of Environmental Quality 2009). Pima Association of Governments Watershed Planning (2005) found that of the parameters that were tested, none exceeded surface water quality standards and that Davidson Canyon had a lower concentration of total dissolved solids and most major constituents than Cienega Creek.

Rosemont Copper collected two samples in 2008 farther downstream in Lower Cienega Creek (table 101) (Rosemont Copper Company 2012c). This reach of Cienega Creek is an Outstanding Arizona Water, and beneficial uses in this section include Agricultural Livestock Watering, Fish Consumption, Full Body Contact, and Aquatic Wildlife (warm water). The designated uses in this reach are the same as in Davidson Canyon, and surface water quality standards are met for every parameter that has a standard except for pH reading on June 24, 2008. The value is slightly less than the range of values set for the surface water standard for Livestock Watering, which indicates that the water is slightly acidic.

Baseline stormwater quality samples were collected in Barrel Canyon near the compliance point dam at a station referred to as RP2 (in 2009) and PSW5 (in 2010 and 2011) (Rosemont Copper Company 2012c). Sampling results are presented in table 102.

As indicated by the bold numbers in the table, the surface water quality standard for Barrel Canyon beneficial use (Aquatic and Wildlife Ephemeral) is exceeded for dissolved copper. Concentrations of total suspended solids were measured for four of the samples and range from 4,000 to 33,800 milligrams per liter.

Table 100. Summary of Davidson Canyon existing water quality

Parameter	Numeric Surface Water Quality Standard*	6/4/2002 Davidson 1[†] (milligrams per liter (mg/L))	6/4/2002 Davidson 2[†] (mg/L)	8/2/2002 Davidson 1[†] (mg/L)	10/3/2002 Davidson 2[†] (mg/L)	1/3/2003 Davidson 2[†] (mg/L)	5/8/2003 Davidson 1[†] (mg/L)	4/20/2010 Reach 2 Davidson Canyon[‡] (mg/L)	9/24/2010 Reach 2 Davidson Canyon[‡] (mg/L)	10/22/2008 Lower Davidson Canyon[‡] (mg/L)
Alkalinity as Bicarbonate (HCO_3)	No standard	366	354	305	305	415	402	410	324	332
Alkalinity as $CaCO_3$	No standard	300	290	250	250	340	330	–	–	–
Aluminum	No standard	<2.0 D	<2.0 D	<2.0 D	<2.0 D	<2.0 D	<2.0 D	0.23	<0.100	<0.03
Antimony	0.030 – 0.088D 0.640 – 0.747T	–	–	–	–	–	–	<0.00200	<0.0020	0.0012
Arsenic	0.150 – 0.340 D 0.030 – 0.200 T	<0.005 D	<0.005 D	<0.005 D	<0.005 D	<0.005 D	<0.005 D	0.0062	0.00407	0.0028
Barium	98 T	–	–	–	–	–	–	0.348	0.16760	0.158
Beryllium (total)	0.084 – 1.867 T	–	–	–	–	–	–	<0.0005	<0.00050	<0.0001
Bicarbonate (HCO_3)	No standard	–	–	–	–	–	–	500	395	366
Cadmium	0.00147 – 0.03023 D 0.050 – 0.700 T	–	–	–	–	–	–	<0.0020[§]	<0.00200[§]	<0.0001
Calcium	No standard	81 D	93 D	87 D	98 D	96 D	99 D	130	88.6	101
Carbonate (CO_3)	No standard	–	–	–	–	–	–	<20	<20.0	19.2
Chloride	No standard	17	19	15	15	15	15	13	7.14	36.3
Chromium	0.23067 – 1.773 D 75 – 1,400 T	–	–	–	–	–	–	<0.0050	<0.00500	<0.01
Copper	0.02928 – 0.04962 D 0.5 – 1.3 T	–	–	–	–	–	–	0.0030	0.00200	<0.01
Field Conductivity (µS)	No standard	726.6	794.1	723.3	793	791.3	778.3	1,016	606	696
Field pH	No standard	7.93	7.57	7.88	7.45	7.51	7.39	7.8	7.00	7.82
Field Temperature C	No standard	20.4	23.3	28	19.8	17.6	17.8	19.1	22.6	22.0
Fluoride	140	0.48	0.52	0.48	0.48	0.64	0.47	<0.50	0.597	0.8
Hardness as Calcium Carbonate ($CaCO_3$)	No standard	300	290	250	250	340	330	440	–	359
Lab Conductivity (µS)	No standard	740	790	600	780	760	770	910	663	727
Lab pH	No standard	7.6	7.1	7.7	7.3	7.3	7.2	7.8	7.77	8.5
Total Dissolved Solids	No standard	420	390	550	470	520	340	620	462	860
Lead	0.01099 – 0.28085 D 0.015 – 0.1 T	–	–	–	–	–	–	<0.0020	<0.00200	<0.0001

Parameter	Numeric Surface Water Quality Standard*	6/4/2002 Davidson 1† (milligrams per liter (mg/L))	6/4/2002 Davidson 2† (mg/L)	8/2/2002 Davidson 1† (mg/L)	10/3/2002 Davidson 2† (mg/L)	1/3/2003 Davidson 2† (mg/L)	5/8/2003 Davidson 1† (mg/L)	4/20/2010 Reach 2 Davidson Canyon‡ (mg/L)	9/24/2010 Reach 2 Davidson Canyon‡ (mg/L)	10/22/2008 Lower Davidson Canyon‡ (mg/L)
Magnesium	No standard	21 D	23 D	20 D	23 D	24 D	25 D	26	16.5	25.9
Manganese	130.667 T	–	–	–	–	–	–	1.63	0.18130	0.032
Mercury	0.00001 – 0.0024 D 0.010 – 0.280 T	–	–	–	–	–	–	<0.00002§	<0.00020§	<0.0002§
Nickel	0.16804 – 1.513 D 0.511 – 28 T	–	–	–	–	–	–	<0.0050	<0.00500	<0.01
Nitrate as N	3,733	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	–	–	–
Nitrate/Nitrite as N	No standard	–	–	–	–	–	–	0.25	<0.200	0.81
Potassium	No standard	<5.0 D	<5.0 D	<5.0 D	<5.0 D	<5.0 D	<5.0 D	3.7	2.84	3.5
Selenium	0.002 – 4.667 T	–	–	–	–	–	–	<0.0020	<0.00200	**0.0022**
Silicon Dioxide (SiO_2)	No standard	26	25	29	34	31	28	–	–	–
Silver	0.03491 D 4.667 – 8 T	–	–	–	–	–	–	<0.0050	<0.005	<0.01
Sodium	No standard	48 D	45 D	50 D	43 D	49 D	44 D	40	36.1	51.4
Sulfate (SO_4)	No standard	79	100	91	92	90	84	96	52.7	327
Thallium	0.150 – 0.700 D 0.001 – 0.075 T	–	–	–	–	–	–	<0.0005	<0.00050	<0.0001
Uranium	2.8 T	–	–	–	–	–	–	0.0061	0.00596	0.0067
Zinc	0.3793 D 5.106 – 25 T	–	–	–	–	–	–	<0.050	<0.050	<0.01

Notes:
– = The sample was not analyzed for this parameter.
Bold indicates an exceedance of surface water quality standard.
Chromium assumed for purposes of analysis to be Chromium III.
D – Dissolved.
T – Total.
Davidson 1 is located south of I-10 near the unnamed spring at 31° 59′ 00″/ 110° 38′ 46″ (known as Reach 2 Spring in this EIS).
Davidson 2 is located near the confluence with Cienega Creek near the unnamed spring at 32° 00′ 54″/110° 38′ 54″ (known as Escondido Spring in this EIS).
* Applicable surface water standards include Agriculture-Livestock Watering, Fish Consumption, Full Body Contact, Aquatic and Wildlife-Warmwater-Acute, Aquatic and Wildlife-Warmwater-Chronic. Range of standards shown. Hardness for all surface water standards assumed to be 400 mg/L.
† Pima Association of Governments Watershed Planning (2010e).
‡ Rosemont Copper (2012c). Total alkalinity assumed to be measured as HCO_3. Not known whether metal concentrations reflect total or dissolved.
§ Indicates that the detection limit was above the surface water quality standard for at least one use.

Table 101. Summary of Lower Cienega Creek existing water quality

Parameter	Numeric Surface Water Quality Standard*	6/24/08 Lower Cienega Creek (milligrams per liter (mg/L))	10/22/08 Lower Cienega Creek (mg/L)
Alkalinity as Bicarbonate (HCO_3)	No standard	275	278
Aluminum	No standard	<0.03	<0.03
Antimony	0.030 – 0.088D 0.640 – 0.747T	0.0005	<0.0004
Arsenic	0.150 – 0.340 D 0.030 – 0.200 T	0.0035	0.0030
Barium	98 T	0.054	0.060
Beryllium (total)	0.084 – 1.867 T	<0.0001	<0.0001
Bicarbonate (HCO_3)	No standard	323	315
Cadmium	0.00147 – 0.03023 D 0.050 – 0.700 T	<0.0001	<0.0001
Calcium	No standard	186	148
Carbonate (CO_3)	No standard	6	12
Chloride	No standard	12.2	9.9
Chromium	0.23067 – 1.773 D 75 – 1,400 T	<0.01	<0.02
Copper	0.02928 – 0.04962 D 0.5 – 1.3 T	<0.01	<0.02
Field Conductivity (µS)	No standard	1,100	1,092
Field pH	No standard	6.23	6.86
Field Temperature C	No standard	25	22.3
Fluoride	140	0.6	0.6
Hardness as Calcium Carbonate ($CaCO_3$)	No standard	671	537
Lab Conductivity (µS)	No standard	1,400	1,160
Lab pH	No standard	8.3	8.5
Total Dissolved Solids	No standard	1,050	840
Lead	0.01099 – 0.28085 D 0.015 – 0.1 T	<0.0001	<0.0001
Magnesium	No standard	50.1	40.7

Parameter	Numeric Surface Water Quality Standard*	6/24/08 Lower Cienega Creek (milligrams per liter (mg/L))	10/22/08 Lower Cienega Creek (mg/L)
Manganese	130.667 T	0.017	0.09
Mercury	0.00001 – 0.0024 D 0.010 – 0.280 T	<0.0002†	<0.0002†
Nickel	0.16804 – 1.513 D 0.511 – 28 T	<0.01	<0.01
Nitrate/Nitrite as N	No standard	0.03	0.68
Potassium	No standard	4.8	4.5
Selenium	0.002 – 4.667 T	<0.0001	0.0001
Silver	0.03491 D 4.667 – 8 T	–	<0.02
Sodium	No standard	71.5	65.0
Sulfate (SO_4)	No standard	486	365
Thallium	0.150 – 0.700 D 0.001 – 0.075 T	<0.0001	<0.0001
Uranium	2.8 T	0.0074	0.0054
Zinc	0.3793 D 5.106 – 25 T	<0.01	0.01

Source: Rosemont Copper (2012c).

Notes:

– = Sample was not analyzed for this parameter.

D – Dissolved.

T – Total.

* Applicable surface water standards include Agriculture-Livestock Watering, Fish Consumption, Full Body Contact, Aquatic and Wildlife-Warmwater-Acute, Aquatic and Wildlife-Warmwater-Chronic. Range of standards shown.

† Indicates that the detection limit was above the surface water quality standard for at least one use.

Table 102. Results of baseline surface water quality samples in Barrel Canyon

Parameter	Numeric Surface Water Quality Standard* (mg/L)	7/1/2009 RP2 (milligrams per liter (mg/L))	7/21/2009 RP2 (mg/L)	9/4/2009 RP2 (mg/L)	9/6/2009 RP2 (mg/L)	1/22/2010 PSW5 (mg/L)	8/11/2010 PSW5 (mg/L)	7/21/2011 PSW5 (mg/L)	8/3/2011 PSW5 (mg/L)	9/11/2011 PSW5 (mg/L)
Antimony (dissolved)	No standard	<0.0020	<0.025	<0.0200	–	<0.025	<0.0020	<0.00400	<0.0250	<0.0200
Antimony (total)	No standard	<0.200	<0.25	–	<0.25	<0.025	<0.0020	–	<0.0250	–
Arsenic (dissolved)	0.44	0.0100	0.029	<0.10	<0.010	<0.010	<0.010	<0.0200	<0.0100	<0.0100
Arsenic (total)	No standard	<0.300	0.45	–	0.34	0.11	0.037	–	0.263	0.459
Hardness (dissolved)	No standard	94	94	–	75	70	–	–	–	–
Barium (dissolved)	No standard	0.0468	0.062	<0.10	0.032	0.024	0.078	0.064	0.031	0.0413
Barium (total)	No standard	7.49	3.0	–	3.8	0.93	1.2	–	3.72	5.63
Beryllium (dissolved)	No standard	<0.0005	<0.0020	<0.020	<0.0020	<0.0020	<0.0020	<0.00400	<0.00200	<0.00400
Beryllium (total)	No standard	0.0552	0.030	–	0.027	0.0071	0.005	–	0.0262	0.0333
Boron (dissolved)	No standard	<0.10	<0.10	<1.0	<0.10	<0.10	<0.10	<0.200	<0.100	<0.500
Boron (total)	No standard	0.010	<1.0	–	<1.0	<0.10	<0.100	–	<0.100	0.164
Cadmium (dissolved)	0.01612 – 0.02147	<0.0020	<0.0030	<0.030†	<0.0030	<0.0030	<0.0030	<0.00600	<0.00300	<0.00500
Cadmium (total)	No standard	<0.200	0.053	–	0.039	0.011	<0.0030	–	0.0184	0.0398
Chromium (dissolved)	1.427 – 1.817	<0.0050	<0.010	<0.10	<0.010	<0.010	<0.010	<0.0200	<0.0100	<0.0100
Chromium (total)	No standard	<0.500	1.2	–	0.26	0.02	0.031	–	0.223	0.253
Copper (dissolved)	0.01662-0.02194	**0.0497**	**0.032**	<0.10†	**0.022**	**0.038**	0.012	**0.152**	**0.0218**	**0.0252**
Copper (total)	No standard	8.53	29	–	9.1	2.4	0.58	–	7.94	9.88

Parameter	Numeric Surface Water Quality Standard* (mg/L)	7/1/2009 RP2 (milligrams per liter (mg/L))	7/21/2009 RP2 (mg/L)	9/4/2009 RP2 (mg/L)	9/6/2009 RP2 (mg/L)	1/22/2010 PSW5 (mg/L)	8/11/2010 PSW5 (mg/L)	7/21/2011 PSW5 (mg/L)	8/3/2011 PSW5 (mg/L)	9/11/2011 PSW5 (mg/L)
Fluoride	No standard	–	<0.50	–	<0.50	<0.50	<0.50	–	–	–
Lead (dissolved)	0.09224 – 0.12741	<0.0020	<0.010	<0.10‡	<0.010	<0.010	<0.010	0.0748	<0.0100	<0.0100
Lead (total)	No standard	4.64	6.5	–	3.8	0.52	0.2	–	2.52	2.19
Manganese (dissolved)	No standard	0.265	1.3	<0.10	<0.010	<0.010	<0.010	0.0598	0.0151	<0.0200
Manganese (total)	No standard	39.3	29	–	24	5.4	3.3	–	18.5	23.2
Mercury (dissolved)	0.005	<0.0002	–	–	–	<0.0002	<0.0002	<0.000400	<0.000100	<0.000100
Mercury (total)	No standard	<0.0020	–	–	–	<0.0002	0.0004	–	0.0014	0.00176
Nickel (dissolved)	3.075 – 3.996	<0.0050	<0.010	<0.10	<0.010	<0.010	<0.010	<0.0200	<0.0100	<0.0100
Nickel (total)	No standard	<0.500	0.56	–	0.29	19	0.04	–	0.264	0.275
Nitrate-Nitrite (as N)	No standard	–	–	–	1.3	4.6	0.75	–	0.674	0.801
Selenium (dissolved)	No standard	<0.0020	<0.025	<0.0200	<0.025	<0.025	<0.0020	<0.00400	<0.0250	<0.0300
Selenium (total)	0.033	<0.200‡	<0.25†	–	<0.25†	<0.025†	<0.0020	–	<0.0250	–
Silver (dissolved)	0.00174 – 0.00289	<0.0010	<0.0050†	<0.050†	<0.0020†	<0.0050†	<0.0050†	<0.0100†	<0.00500†	<0.0200†
Silver (total)	No standard	<0.100	<0.050	–	<0.0200	<0.0050	<0.0050	–	0.0103	43.8
Thallium (dissolved)	No standard	<0.0005	<0.050	<0.0050	<0.0010	<0.050	<0.0005	<0.00100	<0.0500	<0.0200
Thallium (total)	No standard	<0.0500	<0.50	–	0.0123	<0.050	0.0007	–	<0.0500	<0.0200
Zinc (dissolved)	0.822 – 1.055	<0.050	<0.050	<0.50	<0.050	<0.050	<0.050	<0.100	<0.0500	<0.0300
Zinc (total)	No standard	3.6	17	–	9.9	0.18	0.61	–	6.28	6.33
Total Suspended Solids	No standard	–	–	–	–	4,800	11,000	–	33,800	12,500

Parameter	Numeric Surface Water Quality Standard* (mg/L)	7/1/2009 RP2 (milligrams per liter (mg/L))	7/21/2009 RP2 (mg/L)	9/4/2009 RP2 (mg/L)	9/6/2009 RP2 (mg/L)	1/22/2010 PSW5 (mg/L)	8/11/2010 PSW5 (mg/L)	7/21/2011 PSW5 (mg/L)	8/3/2011 PSW5 (mg/L)	9/11/2011 PSW5 (mg/L)
Total Dissolved Solids	No standard	–	140	–	200	140	120	–	153	356
Specific Conductance at 25°C	No standard	–	210	180	–	180	170	–	229	172

Source: Rosemont Copper (2012c).

Notes:

– = Sample was not analyzed for this parameter.

Bold indicates an exceedance of surface water quality standard.

* Numeric surface water quality standard shown for Aquatic and Wildlife-Ephemeral-Acute use; for standards that vary with hardness, the range shown is based on hardness of 70 to 94 mg/L.

† Indicates that the detection limit was above the surface water quality standard for Aquatic and Wildlife-Ephemeral-Acute.

Environmental Consequences

Direct and Indirect Effects of Each Alternative

No Action Alternative

Under baseline conditions (no action), surface water within the analysis area consists of stock tanks, ephemeral flows that occur as the result of precipitation events, as well as springs or seeps. Under the no action alternative, the Coronado has an ongoing responsibility for managing water resources on NFS lands (see FSMs 2670.12, 2670.32, 2620.5, and 2670.31 (U.S. Forest Service 2005); the 1986 forest plan, as amended (U.S. Forest Service 1986); and the ESA). The no action alternative would not change the Forest Service's responsibility for managing water resources and would result in no further impacts to the quality of surface water resources. Grazing would continue in accordance with the approved forest plan and allotment management plans. Ephemeral washes in the analysis area would continue to flow in response to precipitation, and the sediment yield would continue at the current rate. Climate change would continue over time; anticipated decreases in winter precipitation could decrease the occurrence of ephemeral flows and thus the delivery of sediment downstream. Conversely, the anticipated increase in heavy rains would create higher peak flows with a greater capacity to carry sediment downstream.

Population growth is expected to continue, and recreation within the area is expected to increase. This could result in greater ground disturbance and impacts to surface water quality.

Impacts Common to All Action Alternatives

All of the alternatives, with the exception of the no action alternative, would result in surface water quality impacts to some degree. Direct impacts related to surface water quality that are common to all action alternatives include potential impacts from acid rock drainage, impacts from erosion and sedimentation, and impacts from other contaminants associated with industrial operations. Indirect impacts to surface water quality under each action alternative include potential changes in downstream geomorphology caused by changes in sediment yield. Although disturbed acreage varies slightly for each action alternative, there are no substantial differences in the type or magnitude of impacts on the watershed as a whole. Note, however, that there are several tables included in this section that describe the quantitative differences in impacts among all action alternatives. These tables are included in this section because, for the most part, the quantitative differences in impacts are minor and thus result in the same effects on the resource. These quantitative differences in impacts are not repeated in each action alternative's subsection; rather, the reader is referred back to these tables in this section. The following impacts apply to all action alternatives.

Surface Disturbance of Potentially Jurisdictional Waters of the United States

WUS support riparian areas and provide natural erosion and sediment control across the watershed. They have the capacity to carry or reduce pollutants and nutrients; thus, their loss can indirectly affect surface water quality. Table 103 summarizes the direct impacts on potential WUS and the presence/absence of special aquatic sites for each alternative. Special aquatic sites, as defined in 40 CFR 230.3(q-1), include sanctuaries, refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes. One special aquatic site was identified within the project area and consists of wetlands associated with the Scholefield springs.

Table 103. Summary of impacts under each action alternative on potential WUS and the presence/absence of special aquatic sites

Impact to Potential WUS (acres lost)	Proposed Action	Phased Tailings	Barrel	Barrel Trail	Scholefield-McCleary
Mine operations and pit Direct Indirect Total	42.5 5.5 48	41.8 6.8 48.6	40.0 2.8 42.8	50.0 2.6 52.6	26.2 9.1 35.3
Direct impacts from transmission line	0.25 temporary 0.05 permanent	Same as for proposed action	Same as for proposed action	Same as for proposed action	Same as for proposed action
Direct impacts from water line and utility maintenance road	0.85 temporary* 0.2 permanent	Same as for proposed action	Same as for proposed action	Same as for proposed action	Same as for proposed action
Special aquatic sites (number)	0	0	0	0	1

Source: USACE Section 404(b)(1) Alternatives Analysis (see appendix A).

* These numbers reflect the maximum impacts that would occur from the use of a standard trenching alternative at wash crossings. Though not planned, the use of jack-and-bore technology could reduce impacts to WUS.

Most of the impacts to WUS associated with the mine operations and the pit (i.e., the project area) would be permanent and extend throughout the premining, active mining, final reclamation and closure, and postclosure phases. These impacts include complete excavation of washes in the area of the pit and complete filling of washes in the areas of the plant site, waste rock facility, and tailings facility. Impacts to WUS associated with the utility corridor would primarily be limited to the premining phase and would include temporary excavation for pipeline placement, as well as permanent road crossings. The utility maintenance road, water supply pipeline, and electrical transmission line would be co-located within the same corridor in most places in order to minimize impacts to WUS. In general, impacts from linear features would have a small footprint in washes and would be temporary in nature, occurring only during construction, and would then be revegetated or otherwise stabilized following construction. Unlike the mine operations, linear construction does not tend to concentrate disturbance on a single stream channel like Barrel Canyon, and disturbance would be short lived rather than permanent. Disturbances from the pipeline and transmission line are expected to be relatively small and to be mitigated by best management practices for construction (i.e., structural erosion control techniques such as silt fences and straw bales, along with soil stabilization measures). The water line would be buried underneath potential WUS, and permanent impacts would result from the construction of road crossings and bank stabilization. Power lines would be constructed aboveground with an unpaved associated access road, and no transmission poles would be constructed in washes. The only permanent impact to a wash would occur at culverted road crossings and at no more than three utility poles in the steeper portions of the alignment through the Santa Rita Mountains. Where feasible, the potential WUS would be restored to preconstruction contours following construction of the transmission line and access road. Culverted road crossings would be designed with proper erosion control and energy dissipation measures. Effective detention upstream of culverts would be designed so that they have the positive effect of reducing erosive peak flow and extending flow durations to promote better flow regimes, increase recharge, and generally improve habitat. Implementation of these erosion controls and the stormwater best management practices required under the stormwater pollution prevention plan would further prevent the potential for erosion during and after construction.

All disturbed areas except the utility maintenance road would be hydroseeded with native grasses and completely stabilized following the premining phase.

Sediment Yield and Changes in Geomorphology

Potential indirect effects on surface water quality include changes in downstream sediment yield from the baseline caused by the loss of WUS and riparian areas and changes in downstream geomorphology caused by changes in sediment yield.

WUS and vegetation associated with riparian habitat offer natural erosion control across the landscape. Dredging and filling these streams, along with clearing vegetation in the project area, would directly affect sediment yield generated from the project area. Changes in sediment yield are of concern for several reasons: (1) there would be a loss of soil from the project area; (2) movement of that soil into stream channels can affect water quality by increasing total suspended sediment in surface water flows; and (3) changes in sediment yield can result in geomorphological changes to downstream washes, causing problems with soil scour or aggradation. The impacts to soil loss from the project area are discussed in detail in the “Soils and Revegetation” resource section in this chapter. The impact of the movement of soil from the project area is analyzed in this resource section and is based on sediment modeling performed by Tetra Tech (Zeller 2010a). Impacts to the geomorphology of downstream washes are also discussed in this resource section.

One of the major functions of a stream is to transport sediment. Ephemeral channels such as those found in the project area have a cyclical pattern of infill and erosion. In this pattern, sediment movement usually occurs as pulses associated with flash thunderstorm flows that push large amounts of coarse sediment through the system (Levick et al. 2008). Long-term stream sedimentation behavior is based on the equilibrium between erosion and deposition of sediment delivered to the system. When that delivery system is disrupted or altered, changes to stream aggradation (the rising of the grade of a stream bed) and scour (the erosive removal of sediment from a stream bed) can occur until the system reaches equilibrium once again.

Sediments in ephemeral channels are usually deep, consisting mostly of sand and gravels. While sediment-laden runoff is not desirable, a decrease in sediment production in headwaters could cause narrowing of channels as sediment-starved waters cut into channel deposits left by larger flows. This downcutting can ultimately increase the gradient of the channel and would be likely to result in the formation of discontinuous gullies as gradient adjustments shift farther and farther downstream. Additionally, as channels become narrower and alluvial bed material is removed, out-of-bank flows become reduced, and formerly rich floodplain areas can become hydrologically disconnected. This disrupts water, sediment, and nutrient enrichment of these areas (Levick et al. 2008).

In response to public comment, the Coronado contracted an independent geomorphic assessment of Barrel Canyon to determine the current geomorphic condition of the drainage and qualitatively assess the potential that geomorphic changes could occur with the development of the project (Patterson and Annandale 2012). Based on field observations, Patterson and Annandale (2012) determined that: (1) Barrel Canyon is a sediment-transport limited system; and (2) there are two grade controls between the project area and the confluence of Barrel and Davidson Canyons.

- A sediment-transport limited system means that there is more sediment in the system than the flowing water can transport during normal or even flood-flow conditions; this is common in ephemeral streams due to the flashy nature of flows. Flashy flows emanating from large precipitation events pick up sediment in a pulse of water and then deposit it quickly as flows recede, forming a poorly sorted loose layer in the streambed. The bed materials observed in Barrel Canyon consist of a thick layer of unconsolidated sands, gravels, and cobbles, typical of sediment-transport limited systems. Other evidence of a sediment-transport limited system observed in the field includes angular particles, localized erosion that does not propagate upstream, and deposited materials on top of bedrock and under the SR 83 bridge.

- Grade control in a system limits the extent of any potential change in a system gradient. Two grade control structures occur in Barrel Canyon downstream of the proposed project: one is manmade (the bridge at SR 83), and one is natural (the occurrence of bedrock within the streambed upstream of its confluence with Davidson Canyon).

Patterson and Annandale (2012) concluded that, based on three geophysical variables (sediment availability, channel geometry, and water flow), the proposed mine would not have a significant impact to the geomorphology of Barrel and Davidson Canyons. First, this conclusion is supported by the fact that the availability of loose sediment on the surface of the catchment surrounding Barrel and Davidson Canyons would continue to supply sediment to the streams, regardless of the presence of the project. Thus, the amount of sediment supplied is greater than what the flowing water can carry in the transport-limited nature of the system. With respect to the Outstanding Arizona Waters in lower Davidson Canyon, the area affected by the proposed mine is relatively small (13 percent), compared with the entire catchment upstream of the Outstanding Arizona Waters. Any changes in sediment load would not significantly impact the fluvial geomorphology of the stream system; moreover, the estimated impact of total change in sediment load in lower Davidson Canyon (roughly 4 percent) would be within the normal variation of an ephemeral fluvial system.

Second, the presence of a bedrock grade control structure would prevent streambed degradation, and the sediment transport capacity of flowing water would be maintained, regardless of the presence of the proposed project. In a fluvial system, grade controls limit the extent of erosion both upstream and downstream.

Third, water flow is a factor. Given the spatial variability of storms in this region, precipitation does not often fall evenly over the entire Davidson Canyon watershed. Spatially variable precipitation would result in water flow (and the transport of sediment) from various locations throughout the watershed at different points in time. The nature of storm variability and the nature of the transport-limited system would remain relatively unchanged, regardless of the presence of the mine. Therefore, it is reasonable to expect that the system would not degrade, particularly in the lower reaches of Davidson Canyon near the Outstanding Arizona Waters.

A second independent analysis of geomorphological changes was made by Rosemont Copper (2012a). Field investigations into the channel morphology of Davidson Canyon conducted by Tetra Tech (2010a) indicated that the system currently is either in equilibrium with respect to sediment load or that the sediment supply to the head reaches of the canyon is slightly greater than the transport capacity of the wash. This excess transport capacity would tend to modify, at least to some degree, the tendency for scour that would occur as a result of reductions in sediment yield.

Sediment delivery was modeled to the USGS gaging station in Lower Barrel Canyon Wash, the downstream stormwater control point for postmining conditions for each alternative (Zeller 2010a, 2011). Sediment from the project area would enter stormwater flows through erosion of native soils and waste rock; the tailings area would be protected from erosion by waste rock buttresses. Stormwater management facilities onsite have been designed to maintain total suspended sediment concentrations in stormwater runoff similar to baseline conditions. The prediction of future sediment loads under each alternative uses standard erosion modeling techniques that consider soil, vegetation, and rainfall characteristics but that do not require baseline sediment loads to be known. The lack of samples of baseline sediment load in stormwater in the project area does not affect the analysis. Further, sediment transport modeling (such as HEC-6) was not conducted; the Coronado determined that applying such models to an ephemeral system (Duan et al. 2008; Ruff et al. 1986) would not further inform the analysis. Sediment yield for the baseline condition (no action alternative) and all action alternatives is summarized in table 104.

Table 104. Summary of postmine average annual sediment delivery to the USGS gaging station for each alternative

Condition	Contributing Watershed Area (square miles)	Average Annual Sediment Delivery* (acre-feet)	Sediment Concentration* (parts per million)	Percent Change in Annual Sediment Delivery from Baseline	Percent Change in Sediment Concentration from Baseline
No action	14	16.0	16,407	–	–
Proposed action	6.82	7.84	16,194	−51.3	−1.3%
Phased Tailings	7.06	8.12	16,210	−49.6	−1.2%
Barrel	11.33	10.88	13,686	−32.4	−16.5%
Barrel Trail	8.65	9.95	16,273	−38.2	−0.8%
Scholefield-McCleary	10.35	11.90	16,317	−26.1	−0.5%

Sources: Zeller (2012; 2010a; 2010b).

* Based on sediment delivery to the USGS gaging station in Lower Barrel Canyon.

A comparison of the results of each action alternative with baseline conditions indicates that sediment delivery to the USGS gaging station would be reduced to varying degrees for each alternative. This reduction would primarily be the direct result of the reduction in the contributing watershed area.

Based on Tetra Tech (Zeller 2010a) baseline sediment delivery modeling, the average amount of sediment expected from the types of watersheds found within the project area is 1.15 acre-feet of sediment per year per square mile of watershed. The estimated decrease in sediment yield from disturbed areas upstream of the USGS gaging station ranges from approximately 26 to 51 percent, depending on the action alternative. This decrease in sediment yield would primarily be the result of the changes in the contributing watershed area, which would be caused by capture from mine facilities.

All action alternatives would result in a reduction in sediment yield from the Barrel Canyon watershed. Overall sediment concentrations would not change substantially (approximately 13,600 to 16,300 milligrams per liter) and would remain within the range observed in stormwater samples collected from Barrel Canyon (up to 34,000 milligrams per liter). The redesigned stormwater management for the Barrel Alternative would reduce the sediment concentration more than the other alternatives; with respect to total suspended sediment concentrations, this reduction in sediment yield would be beneficial in maintaining the water quality of ephemeral storm flows. No change in the geomorphology of the channel is expected to occur as a result of this change in sediment yield for any alternatives.

Monitoring Intended to Assess Potential Geomorphological Impacts

In consideration of the uncertainty associated with predicting geomorphological changes, a monitoring components have been incorporated into the mitigation and monitoring plan (see appendix B for full details). The monitoring includes:

- **Sediment transport monitoring.** The movement of sediment between the mine facility and SR 83 would be monitored to identify areas of scour or aggradation that could be caused by changes in sediment load and surface flow.

Location and Duration of Surface Water Quality Impacts

The reach of Barrel Canyon that could be affected is approximately 2.5 miles long, from the USGS gaging station to the confluence with Davidson Canyon. The bridge at SR 83, just downstream of the gaging station, has been identified as a point of concern for potential changes in geomorphology of the channel, scour in particular. This reach of Barrel Canyon represents approximately 23 acres of stream channel that could be impacted by the reduction in sediment load. However, according to Patterson and Annandale (2012), the presence of sediment on bedrock near the bridge indicates the abundant availability of sediment in the system, and the bridge serves as a grade control that limits the erosion capacity of the stream. The reach of Davidson Canyon that could potentially be affected is approximately 14 miles long, from the confluence with Barrel Canyon to the confluence with Cienega Creek. This reach of Davidson Canyon represents approximately 234 acres of stream channel that could be impacted by the reduction in sediment load. The duration of these impacts would be throughout the active mine life, gradually reducing as areas are revegetated and reclaimed. A lesser level of impact would be expected to occur in perpetuity. While some ephemeral stream flow and sediment yield would be expected to return to Barrel and Davidson Canyons postclosure because of the gradual reduction in active stormwater control, the mine pit would always act to capture precipitation, and hydrologic conditions would not be expected to return to premine levels. The analyses conducted indicate that these impacts would not occur downgradient of the natural bedrock control into the lower reaches of Davidson Canyon. The bedrock control is located in Barrel Canyon upstream of its confluence with Davidson Canyon; it is made of erosion-resistant bedrock and would continue to control the stream gradient for an extremely long time (Patterson and Annandale 2012; Rosemont Copper Company 2012a).

Potential for Acid Rock Drainage

Acid rock drainage is a natural process that takes place as mineralized rock surface areas are oxidized when they are exposed to weathering and when the resulting stormwater runoff, or drainage, from the rock becomes acidic. As the drainage becomes more acidic, it has an increased capacity to leach out other elements, particularly metals, from the rock. This can result in polluted runoff, which can impact the quality of surrounding surface water bodies. Acid rock drainage occurs naturally in the environment at a very slow pace, but mining activities accelerate the process by exposing a large amount of rock to weathering in a short amount of time. Additionally, mine-processed rock and fractured waste rock have an increased amount of exposed surface area that can come into contact with water and oxygen.

Alkalinity in mine runoff water primarily comes from dissolved carbonate. When mine water has a pH greater than 4.5, it is said to be alkaline and has the capacity to neutralize acid. However, it is the net alkalinity (alkalinity greater than acidity) or net acidity (acidity greater than alkalinity) of the water that determines whether the mine rock contains enough alkalinity to neutralize the mineral acidity before it is eventually used up and comes to equilibrium (Metesh et al. 1998).

At the Rosemont Copper Mine, the ore is contained primarily within limestone and skarn (metamorphosed limestone) rocks, with minor amounts in quartz monzonite porphyry (igneous), andesite (volcanic), and arkose (sandstone) rocks. Waste rock would also be composed of these same rock types. Geological materials at the project area were characterized using a variety of geochemical analyses; see the "Groundwater Quality and Geochemistry" resource section for a full summary of all tests conducted.

In general, the total sulfide content of host rock at the project area is low, less than 3 percent. Although sulfide mineralization is present at the project area, acid-neutralizing limestone (calcium carbonate) is abundant (Tetra Tech 2010b, 2010c). Additionally, topsoil samples were collected and analyzed for their acid-generating potential (Tetra Tech 2010d). In these static tests, 11 percent of the topsoil samples (2 out of 19) and 5 percent of the rock samples (11 out of 226) indicated the potential for acid generation. Static testing is generally considered a preliminary screening analysis, with more reliable kinetic testing conducted if there are indications that there may be acid-generating potential. Sixteen rock samples were selected for further kinetic testing. When the majority of these materials were subjected to long-term humidity cell testing, the leachate pH remained neutral, and the trends in sulfate, iron, and acidity provided no indication of sulfide oxidation. One rock type, Bolsa Quartzite, was shown to produce net acidity during humidity cell testing as a result of sulfide oxidation.

At the conclusion of the proposed project, final reclamation of the project area would include reclamation and closure of the facilities and final regrading and revegetation of the "Rosemont Ridge" landform. The landform would consist of waste rock from the open pit, a closed heap leach facility (except under the Barrel Alternative), and a closed dry-stack tailings facility; these facilities would all be buttressed and capped with inert or acid-neutralizing waste rock. Direct precipitation and runoff from the landform have the potential to generate acid rock drainage because sulfide minerals, such as those proposed to be mined, have the potential to generate sulfuric acid when exposed to water and air. Based on the overall abundance of potential acid-neutralizing rock types, as defined by geochemical sampling and testing, it is believed that the naturally occurring lime content of the ore-bearing and waste rock material would neutralize any sulfuric acid produced in the processed ore (tailings) or waste rock and that the generation of acid rock drainage is unlikely (Tetra Tech 2010b). Because the tailings and heap leach facilities, as well as any waste rock with potentially acid-generating material, would be buttressed and capped with inert or acid-neutralizing rock, the potential for acid rock drainage is considered low.

Rosemont Copper has calculated predictions of the tonnages of each rock type by year that would be encountered as mining progresses and has calculated the percentage of rock that has been characterized as either non-potentially acid generating or potentially acid generating (Williamson 2012). The percentage of total potentially acid-generating waste mined relative to the total waste mined is predicted for each year beginning in year 1 of active mining and continuing to year 21 of active mining. In any given year, the percent of potentially acid-generating waste mined averages 9 percent a year, with the highest amount, 16 percent, being predicted for year 4 of active mining.

Also calculated was the weighted average net neutralization potential for waste rock by year during active mining. The net neutralization potential is the difference between the acid neutralization potential and the acid-generating potential expressed as tons of calcium carbonate equivalent per kilotons of sample. In accordance with ADEQ (2004) best available demonstrated control technology guidance, if the net neutralization potential is less than −20, it can be considered acid generating; between −20 and +20, the waste has the potential to form acid, and when the net neutralization potential is above +20, the waste can be generally considered non-acid generating. Calculated net neutralizing potential for waste rock mined per year ranges from 75 to more than 500, with a running annual average value of 225 for the projected life of the mine. Thus, the waste rock as a whole can generally be considered non-acid generating.

Encapsulation of rock believed to have acid rock drainage potential and continual testing of waste rock for acid rock drainage potential are design elements of the proposed action and all action alternatives that would mitigate potential acid rock drainage. The waste rock would be managed during mining by monitoring potentially acid-generating and non-acid-generating materials and placing materials in designated areas. Modeling results show that Bolsa Quartzite was the only non-ore rock type that indicated a net capacity to generate acidic drainage (Tetra Tech 2010b, 2010c). Potentially acid-generating waste rock would not be used for construction of the perimeter buttresses, tailings starter buttresses, drains, or channel grading fills but instead would be placed in the interior of waste rock facility and would be encapsulated by the acid-neutralizing and non-acid-generating waste materials (Tetra Tech 2009). Inert or acid-neutralizing waste rock shall be used to build haul roads and buttresses around waste rock and tailings facilities to provide a buffer zone that would isolate potentially acid-generating materials from water infiltration and discharge.

The above design is intended to eliminate or reduce the potential for any acid rock drainage; proper implementation of this design and placement of waste rock and tailings is critical. The methodology for stacking and placing waste rock and tailings was submitted to the ADEQ as part of the aquifer protection permit application (Krizek 2011). The aquifer protection permit was issued to Rosemont Copper on April 3, 2012.

Routine inspections of the waste rock facility would be performed from the time construction begins and would continue quarterly and after every major storm or surface flow event for the term of the ADEQ Aquifer Protection Permit. Inspections would include a visual assessment of the integrity of the waste rock facility and the physical appraisal of design capacity. Additionally, monitoring at the compliance point dam located downgradient of the waste rock facility shall serve as a final control point where water would be temporarily impounded.

The compliance point dam, as detailed in the following section, would be the final sediment pond located at the outlet of Barrel Canyon. The location for the compliance point dam was chosen because it is the downgradient edge of the collective drainages associated with project activities. It is here that final water quality testing for contaminants of concern (as required by the stormwater permit) would be performed prior to release into the natural channel (Tetra Tech 2009).

Because inert or acid-neutralizing waste rock would be used to build buttresses around waste rock and tailings facilities to provide acid buffering, there is little potential for acid rock drainage. Proper implementation of the waste rock stack design and routine inspections of the waste rock facility are components of the ADEQ Aquifer Protection Permit. Modeling and geochemical analysis indicate that acid rock drainage is unlikely to occur. However, if acid rock drainage were to occur, it would be identified early during the planned testing of stormwater under the stormwater permit.

The acid base accounting tests on composite samples (Tetra Tech 2010b), subsequent kinetic testing (Tetra Tech 2010c), assessment of the ability of the waste rock to control acid rock drainage, and implementation of the measures required under the aquifer protection permit indicate that there is a low probability for impacts to surface water quality to occur from acid rock drainage (Tetra Tech 2010c).

In June 2012, further refinements to the Barrel Alternative resulted in removal of the heap leach facility. As a result, some ore that otherwise would have been piled in the lined heap leach facility would be placed in the unlined waste rock facility. The Coronado requested that Rosemont Copper revise the percentages of potentially acid-generating waste rock due to this change, as well as the overall calculation of neutralization potential. Revised calculations indicate minor changes in percentage and timing of placing waste rock but nothing that changes the overall conclusions. For the refined Barrel Alternative without the heap leach facility, in any given year the percentage of potentially acid-generating waste mined that is likely to produce acid drainage averages 10 percent a year, with the highest amount, 16 percent, still being predicted for year 4 of active mining. Similarly, calculated net neutralizing potential for waste rock mined per year still ranges from 75 to more than 500, with a running annual average value of 225 for the projected life of the mine (Rosemont Copper Company 2012b).

Monitoring Intended to Assess Potential Acid Rock Drainage

In consideration of public concerns regarding the uncertainty associated with interpreting the potential for acid rock drainage, three monitoring components have been incorporated into the mitigation and monitoring plan (see appendix B for full details). Two of these are required under the permits that have been issued to Rosemont Copper:

- **Reduction of the potential for acid generation from tailings and waste rock.** Geochemical testing has indicated that there is adequate neutralization capacity in the overall waste rock composition to prevent potential acid generation. However, proper placement of the waste rock is necessary to allow this buffering capacity to be effective. This mitigation involves requirements for the segregation and encapsulation of potentially acid-generating waste rock with rock that has buffering capabilities in order to reduce the risk of potential acid generation. This is required under the aquifer protection permit issued to Rosemont Copper.
- **Detention and testing of stormwater.** This mitigation measure requires detention and testing of stormwater quality from perimeter waste rock buttress areas for water quality testing prior to flowing downstream of the mine site. This would also allow for a reduction in suspended sediment in stormwater flows before flowing downstream. This is required under the stormwater permit issued to Rosemont Copper.

The Coronado has required an additional monitoring measure in order to ascertain that the reactivity of the waste rock pile is fully understood in order to ensure an adequate closure design is implemented.

- **Additional waste rock and tailings characterization.** During operations, additional waste rock characterization tests, above and beyond those required by the aquifer protection permit, would be required to be conducted on waste rock and tailings. This additional analysis includes requirements for humidity cell testing, whole rock chemistry, and mineralogical analysis in addition to the acid-base accounting and leachate testing already being conducted for the aquifer protection permit.

Potential for Other Contaminants in Runoff

Regardless of the acid generation potential of the waste rock, other naturally occurring contaminants could potentially occur in surface water if they were to come into contact with stormwater. The heap leach and dry-stack facilities would not be exposed to surface runoff, nor would the plant site or processing facilities. Precipitation falling on these areas would be fully contained and not released downstream. The waste rock facility would be exposed to surface runoff that leaves the project area and could have the potential to impact surface water quality. Therefore, it is appropriate to analyze the potential water quality resulting from contact between precipitation and the waste rock.

Public comments raised the concern for elevation of nitrogen concentrations in groundwater and surface water due to the residue from the use of ammonium nitrate on site. This potential is analyzed in the "Groundwater Quality and Geochemistry" resource section of chapter 3.

Available waste rock characterization samples suggest that there may be a potential for elevated selenium concentrations in stormwater discharges from the waste rock facility. Table 105 presents the water quality for synthetic precipitate leaching procedure testing conducted on the major waste rock types as well as surface soil samples. Synthetic precipitate leaching procedure testing is designed to simulate the exposure of materials to slightly acidic rainwater and analyze the resulting water quality of any leachate or runoff. The synthetic precipitate leaching procedure water quality data are compared in table 105 with the designated uses for surface water quality standards in Barrel Canyon (Partial Body Contact and Aquatic and Wildlife-Ephemeral). The five named waste rock types in the table represent more than 80 percent of the total rock types that would make up the waste rock facility (Abrigo, Arkose, Concha and Glance, Horquilla, Tertiary Gravel). The synthetic precipitate leaching procedure results indicate that the concentration of selenium observed in leachate from several major waste rock types exceeds the surface water quality standard of 0.033 milligram per liter in Barrel Canyon.

Whether stormwater would actually be exposed to these waste rock types would not be fully known until operations begin. Under the aquifer protection permit, Rosemont Copper has prepared and must comply with a waste rock segregation plan (Krizek 2011). Under the waste rock segregation plan, if waste rock characterization testing that is continually conducted during operations indicates the potential for waste rock to be acid generating, that potentially acid-generating waste rock would be segregated to the interior of the waste rock facility and would not be used to construct the buttresses or used in stormwater conveyance channels. Several of the waste rock types that have exhibited elevated selenium concentrations in synthetic precipitate leaching procedure samples also have been flagged as potentially acid generating; therefore, during operations, they may be segregated in the interior of the waste rock facility and not be in contact with stormwater. Further, once reclamation has been implemented, growth media/salvaged soil will have been placed over most slopes of the waste rock facility, and runoff would contact this soil rather than waste rock. Soil is unlikely to be placed or remain in conveyance channels; in these channels, stormwater would still interact with bare waste rock.

With respect for the potential for stormwater to interact with other contaminants, as required under the stormwater permit, all stormwater from the mine pit and processing facilities would be contained onsite and recycled as process water during the active mining phase. In order to mitigate potential changes in water quality resulting from stormwater encountering waste rock, which would form more and more of the disturbed area over time, a series of stormwater controls such as diversion channels and detention pools designed to handle large 100-year, 24-hour storm events (Tetra Tech 2009) would be constructed to intercept stormwater runoff and route it around the mine facilities.

Table 105. Water quality (in mg/L) for selected waste rock type and applicable designated uses (based on Barrel Canyon)

	Abrigo	Arkose	Concha and Glance	Horquilla	Tertiary Gravel	Surface Soils	Designated Use: Partial Body Contact (milligrams per liter (mg/L))	Designated Use: Aquatic and Wildlife Ephemeral – Acute (mg/L)	Existing Water Quality in Barrel Canyon
Percentage of Total Waste Rock	54%	11%	12%	9%	14%	Not applicable	Not applicable	Not applicable	Not applicable
Aluminum[†]	0.16	0.04	–	–	0.62	0.7	No standard	No standard	Not available
Antimony (total)	–	–	–	–	–	0.00423	0.747	No standard	<0.0020 to <0.25
Arsenic (dissolved)	–	–	–	–	–	Not sampled	No standard	0.44	<0.010 to 0.029
Arsenic (total)	<0.01	<0.01	<0.01	0.02	0.03	0.0513	0.280	No standard	**0.037 to 0.459**
Barium (total)	<0.01	<0.01	0.00	<0.01	0.06	0.01	98	No standard	0.93 to 7.49
Beryllium (total)	–	–	–	–	–	–	1.867	No standard	0.005 to 0.0552
Boron (total)	–	–	–	–	–	Not sampled	186.667	No standard	0.010 to 0.164
Cadmium (total)	–	–	–	–	–	–	0.700	No standard	<0.003 to 0.053
Cadmium (dissolved)	–	–	–	–	–	Not sampled	No standard	0.00706*	<0.003 to <0.006
Calcium	5.68	14.50	8.69	38.40	5.29	10.1	No standard	No standard	Not available
Chloride[†]	0.80	3.46	0.88	36.00	1.18	0.746	No standard	No standard	Not available
Copper (total)[†]	–	0.01	–	–	–	0.01	1.300	No standard	0.012 to 0.152
Copper (dissolved)	–	–	–	–	–	Not sampled	No standard	0.00748*	0.58 to 9.88
Field pH[†]	8.22	7.80	7.42	8.78	7.84	Not sampled	No standard	No standard	Not available
Fluoride[†]	0.23	0.83	0.17	1.46	0.32	0.263	140	No standard	<0.50
Iron[†]	–	–	–	–	0.33	0.4	No standard	No standard	Not available

	Abrigo	Arkose	Concha and Glance	Horquilla	Tertiary Gravel	Surface Soils	Designated Use: Partial Body Contact (milligrams per liter (mg/L))	Designated Use: Aquatic and Wildlife Ephemeral – Acute (mg/L)	Existing Water Quality in Barrel Canyon
Lead (total)	–	–	–	–	**0.02**	**0.0379**	0.015	No standard	**0.2 to 6.5**
Lead (dissolved)	–	–	–	–	–	Not sampled	No standard	0.03595*	<0.002 to 0.0748
Manganese (total)†	–	<0.01	–	–	0.01	0.04	130.667	No standard	3.3 to 39.3
Magnesium	0.89	2.86	0.88	2.24	0.58	1.1	No standard	No standard	Not available
Mercury (total)	–	–	–	–	–	0.03	0.280	No standard	<0.0002 to 0.00176
Molybdenum	0.07	–	–	–	–	0.02	No standard	No standard	Not available
Nickel (total)	–	–	–	–	–	–	28	No standard	<0.5 to 19
Nickel (dissolved)	–	–	–	–	–	Not sampled	No standard	1.502*	<0.005 to <0.10
Nitrate + Nitrite	–	0.03	–	–	–	Not sampled	No standard	No standard	0.674 to 4.6
Nitrite	–	–	–	–	–	Not sampled	233.333	No standard	Not available
Potassium	4.16	6.41	0.83	6.64	2.72	2.5	No standard	No standard	Not available
Selenium (total)	–	**0.06**	–	**0.10**	–	–	4.667	0.033	<0.002 to <0.25
Silicon Dioxide (SiO_2)	–	–	–	–	–	Not sampled	No standard	No standard	Not available
Silver (total)†	–	–	–	–	–	–	4.667	No standard	**<0.005 to 43.8**
Silver (dissolved)	–	–	–	–	–	Not sampled	No standard	0.00041*	<0.002 to <0.05
Sodium	1.50	14.10	5.29	13.70	8.90	8.4	No standard	No standard	Not available
Sulfate (SO_4)†	3.08	27.70	6.34	39.40	3.54	2.76	No standard	No standard	Not available
Thallium (total)	–	–	–	–	–	–	0.075	No standard	0.0007 to 0.0123

	Abrigo	Arkose	Concha and Glance	Horquilla	Tertiary Gravel	Surface Soils	Designated Use: Partial Body Contact (milligrams per liter (mg/L))	Designated Use: Aquatic and Wildlife Ephemeral – Acute (mg/L)	Existing Water Quality in Barrel Canyon
Zinc (total)	–	–	–	–	0.01	0.01	280	No standard	0.18 to 17
Zinc (dissolved)†	–	–	–	–	–	Not sampled	No standard	0.401*	<0.03 to <0.50

Sources: Hudson and Williamson (2011); Levy (2010).

Notes:

Surface soil result reflects the maximum concentration observed from synthetic precipitate leaching procedure testing of three soil samples.

Shading indicates that the constituent is required to be sampled for under the stormwater permit.

Bold indicates an exceedance of the designated surface water quality standards.

– = Not detected.

***** This constituent is subject to surface water quality standards for this designated use based on dissolved concentrations. The ADEQ has developed tables for this constituent, and the standards vary, depending on the designated use and measured hardness of the water taken during the sample (see appendix A (AAC R18-11)). Dissolved standards are based on a calculated hardness of 30 mg/L $CaCO_3$, which is based on a weighted average calcium concentration of 9.9 mg/L and a weighted average magnesium concentration of 1.2 mg/L.

† A secondary drinking water standard maximum contaminant level has been established for these constituents.

Requirements for Control of Selenium under Stormwater Permit

Discharge of stormwater that would exceed the surface water quality standard for selenium in Barrel Canyon is prohibited under Rosemont Copper's stormwater permit. All discharges to WUS, including stormwater discharges from mining operations, require permitting under Section 402 of the CWA. In Arizona, Section 402 is administered by the ADEQ through the Arizona Pollutant Discharge Elimination System program. Rosemont Copper was issued authorization to discharge stormwater under the Arizona Pollutant Discharge Elimination System Mining Multi-Sector General Permit by ADEQ on February 4, 2013. Rosemont Copper is required to maintain coverage under this permit (or other applicable Arizona Pollutant Discharge Elimination System permit), until the site has been released from applicable State or Federal reclamation requirements.

The permit requires Rosemont Copper to select, design, install, and implement control measures (including best management practices), as appropriate, to ensure the discharge meets applicable water quality standards. The permit does not dictate the specific control measures that must be implemented; Rosemont Copper is able to modify control measures as needed, provided that stormwater discharges meet standards.

In order to determine whether water quality standards are met, the permit requires water quality monitoring of stormwater discharges at any outfall locations (i.e., where the facility discharges into a WUS, including dry washes). Analyses must be conducted for pH, hardness, and metals (antimony, arsenic, beryllium, cadmium, copper, iron, lead, mercury, nickel, selenium, silver, zinc), as shown in table 105. If at any time the Rosemont Copper becomes aware, or ADEQ determines, that the facility's discharge causes or contributes to an exceedance of an applicable water quality standard, then Rosemont Copper is required to take corrective action, document the corrective actions, and report the corrective actions to ADEQ.

Potential for Meeting Narrative Surface Water Quality Standards

As described earlier, narrative surface water quality standards have been established by the State of Arizona in addition to numeric standards. With regard to narrative surface water quality standards, water quality described in table 105 is not expected to contain oil or grease; is not expected to be toxic to humans, animals, plants, or other organisms; and is not expected to discolor or create an off-taste or odor. The potential to meet narrative standards for taste and odor can be assessed by comparing surface water quality data in table 105 with the EPA Secondary Drinking Water Standards. The EPA secondary standards are not applicable to surface runoff in any way, but they are useful for assessing impacts to taste and odor and other aesthetic concerns. These nonmandatory standards were established for 15 constituents that could cause offensive taste, odor, color, corrosivity, foaming, or staining in drinking water. These constituents do not present a risk to human health, and the EPA Secondary Drinking Water Standards are not enforceable; rather, they are guidelines for suggested maximum contaminant levels that have been set with the aesthetic quality of water in mind (U.S. Environmental Protection Agency 2012).

Based on the analysis results presented in table 102, current secondary maximum contaminant levels in individual rock types were exceeded for three constituents (aluminum, iron, and pH). Aluminum's secondary maximum contaminant level is set at 0.005 to 0.2 milligrams per liter and is related to color, scaling, and sedimentation. The analysis result for aluminum in the tertiary gravel is 0.62 milligram per liter, which exceeds the upper limits; this waste rock type represents only 14 percent of the total waste rock, and the remaining samples indicate aluminum concentrations below the upper limit. Iron's secondary maximum contaminant level is set at 0.3 milligram per liter and is related to odor, taste, color, corrosivity, staining, scaling, and sedimentation. The analysis result for iron in the tertiary gravel is 0.33 milligram per liter; similar to aluminum, this waste rock type represents only 14 percent of the total waste rock, and the remaining samples indicate iron concentrations below laboratory detection limits. The secondary maximum containment level for pH is set at 6.5 to 8.5 and is related to odor, taste, color, corrosivity, staining, scaling, and sedimentation. The analysis result for pH in the Horquilla rock type is 8.78; this waste rock type represents only 9 percent of the total waste rock, with the remaining samples within pH limits. As the EPA secondary standards are not applicable, these comparisons are for illustrative purposes only, but they indicate that it is unlikely that stormwater runoff would violate narrative surface water quality standards for taste, odor, and color.

Sediment Control Measures

Application to ADEQ for coverage under the General Permit for Stormwater Discharges requires the following: (1) analytical monitoring of stormwater discharges for parameters specific to the copper-mining sector; and (2) development of a stormwater pollution prevention plan to outline best management practices that would be used to minimize the discharge of pollutants in stormwater from the site. The stormwater pollution prevention plan for the project would identify the stormwater outfalls, control measures, monitoring schedule, and analytical parameters that would be monitored as part of the project.

Every action alternative proposes to employ methods during the premining and active mining phases to control sediment loading off the mine site; the methods vary by alternative but generally have the same objectives and effectiveness. For the Barrel Alternative, sediment structures would be installed throughout the mine site to temporarily capture stormwater for the purpose of reducing total suspended solids in stormwater runoff. These basins would be unlined and sized according to the upstream disturbed catchment area. They would be designed out of porous waste rock and serve as temporary structures where stormwater velocities would be slowed to allow for settling sediments before the stormwater seeps through the rock fill and progresses downstream. The sediment structures would be located based on topography, and as the mining operation progresses some structures may be abandoned and others constructed downstream. Additionally, two permanent sediment control structures, one in the Barrel Canyon drainage and one in Trail Creek drainage, would be placed just downstream of the wraparound diversion channels at the toe of the slope.

For the remaining action alternatives, the primary stormwater control feature includes sediment basins located on top of tailings and waste rock benches. For the Phased Tailings and Barrel Trail Alternatives, flow-through underdrains designed to carry stormwater offsite would incorporate starter embankments designed to filter sediment before it enters the drain and protective geotextile liners in the drain to filter out sediment before stormwater is released in the natural channel. The Phased Tailings and Barrel Trail Alternatives would also incorporate a geomembrane covering for the underdrains to prevent comingling of stormwater and tailings seepage.

A small dam, referred to as the compliance point dam, has been designed for temporary impoundment at the lower end of the Barrel Canyon drainage before stormwater is slowly released into the natural drainage. This dam would be built under all alternatives, but for the Barrel Alternative there would be two such dams, one on each drainage, receiving discharge from the waste rock and tailings facilities. This rock dam would be approximately 6 feet tall and has been designed as a porous, flow-through sediment pond with a relatively small capacity of 2 acre-feet. It would be constructed during the premining phase using inert or acid-neutralizing waste rock and would provide the last point of detention in the series of stormwater controls and a point for surface water flows to be monitored and tested; the Arizona Pollutant Discharge Elimination System permitting program has chemical and sediment content monitoring requirements for any stormwater that is discharged offsite.

The compliance point dam would be constructed as an unlined embankment, and normally, the area behind the embankment would be empty. Water would be temporarily impounded behind the dam during storm events and then would be slowly released downstream through the porous rock-fill embankment. The design of the compliance point dam is such that large flows are expected to overtop and occasionally destroy the dam. If the dam were damaged by a storm event, it would be repaired and rebuilt as necessary. Because the compliance point dam would be constructed of inert rock, has a small capacity, would be rebuilt, and is not considered a dam under the jurisdiction of dam safety regulations, any possible effects of the dam's being destroyed are considered insignificant. Depending on reclamation success of the facility slopes, the compliance point dam would be evaluated and removed during the final reclamation and closure phase under the CWA permitting program in place at that time.

Conclusions of Ability to Meet Surface Water Quality Standards

Based on available information, the following conclusions can be drawn from the analysis regarding the ability of surface water quality to meet both numeric and narrative water quality standards:

- Geochemical testing conducted for waste rock characterization indicates that the potential for acid rock drainage to occur is low.
- Existing surface water quality in Barrel Canyon exceeds applicable standards for arsenic, lead, and silver.
- The results of baseline surface water sampling indicate that stormwater runoff from the tailings and waste rock facilities from all action alternatives is not expected to degrade the existing surface water quality in the project area, with the exception of selenium.
- Elevated selenium concentrations have been observed in synthetic precipitate leaching procedure testing from three waste rock types. Predicting the likely selenium concentration in runoff from waste rock is not feasible. Certain waste rock types with acid generation potential would be segregated in the interior of the waste rock facility; these are the same waste rock types that exhibit elevated selenium concentrations and therefore may or may not contact stormwater. Additionally, stormwater would interact primarily with the reclamation soil cover instead of waste rock, although exposure of stormwater to waste rock in conveyance channels would occur.
- Under the stormwater permit, discharge of stormwater containing selenium concentrations above surface water quality standards in Barrel Canyon would be prohibited. Rosemont Copper would be required to implement control measures to reduce selenium concentrations if occurring.
- Permit requirements would also prohibit any discharges that occur to surface waters in Barrel Canyon from causing or contributing to a decrease in the existing water quality of the downstream Outstanding Arizona Waters in Davidson Canyon (AAC R-18-11-101). Potential impacts to the Outstanding Arizona Waters are analyzed in the "Seeps, Springs, and Riparian Areas" resource section of this chapter.
- Because the action alternatives are designed to contain stormwater contacting processing facilities, tailings, or ore onsite and because monitoring protocols would be put in place at the point of compliance, the potential for other contaminants to enter surface water is considered low.

Proposed Action and Action Alternatives

With the exception of the varying amount of impacts associated with each alternative as listed in tables 103 and 104, there are no further impacts solely specific to a particular action alternative.

Cumulative Effects

The analysis area for cumulative effects on surface water quality is identical to that described in the "Surface Water Quantity" resource section, as are the reasonably foreseeable actions that could contribute to a cumulative impact to surface water quality.

The reasonably foreseeable actions discussed in the "Surface Water Quantity" resource section all have not only the potential to change the amount of surface water flows in the analysis area but would represent additional disturbance that could increase erosion in the analysis area, which would impact surface water quality. As a whole, these changes are unlikely to be significant when assessed in the context of the watershed as a whole.

Climate Change

With regard to surface water quality, the climate change feature of concern is the predicted increase in extreme rainstorms and flooding across the desert Southwest. This predicted change in weather patterns could have an effect on the quality of stormwater runoff. An increase in more extreme rainstorms and flooding would create higher volumes of surface flow passing through the ephemeral channels in a shorter period of time. This would increase the potential for erosion and sediment-laden flows. The deposition and aggradation of sediment associated with extreme flooding would affect channel geomorphology and increase the potential for channel downcutting.

Mitigation Effectiveness

Mitigation and Monitoring – Forest Service

- **Growth media salvage and application.** In order to support reclamation activities, soil and other growth media would be salvaged, stored, and applied to the surface of the perimeter waste rock buttress and waste rock and tailings facilities in order to facilitate revegetation.
- **Revegetation of disturbed areas with native species.** Reclamation efforts would include revegetation of native grasses, forbs, shrubs, and trees on areas disturbed by mining and mine related activities. Revegetation would include detection and treatment of invasive weed species.
- **Concurrent placement of perimeter buttress.** Placement of the perimeter buttress allows reclamation activities to take place earlier, concurrent with mine operations.
- **Sediment transport monitoring.** The movement of sediment between the mine facility and SR 83 would be monitored to identify areas of scour or aggradation that could be caused by changes in sediment load and surface flow.
- **Recordation of a restrictive easement on private land parcels in Davidson Canyon to compensate for impacts to WUS and provide other benefits.** Rosemont Copper would record restrictive covenants to preclude real estate development and similar land use activities. Managed grazing, cultural, and some low-impact public use (hiking, bird watching, minor forms of hunting) would be allowed in some locations. These lands total 383 acres and include portions of ephemeral wash, riparian habitat in Davidson Canyon, Barrel Canyon, and Mulberry Canyon, upland buffer habitat adjacent to riparian areas, and three springs.

- **Plant site location and design adjustments to reduce impacts to biological resources.** The entire plant site is sited and designed to reduce its size and overall footprint and to use gravity instead of pumping to move process water where possible.
- **Establishment of the Cienega Creek Watershed Conservation Fund, to be used for future mitigation to in the Cienega Creek watershed.** Rosemont Copper would establish an endowment and provide $2,000,000 of funding. This fund would essentially be established as a resource to help restore the watershed to a functioning ecosystem and as a mechanism to promote adaptive management and allow flexibility in mitigation to achieve desired outcomes in light of future uncertainties.
- **Monitoring to determine impacts from pit dewatering on downstream sites in Barrel and Davidson Canyons.** Monitoring would be conducted of surface water, alluvial groundwater, and deeper groundwater at sites in Barrel and Davidson Canyons. Several locations have already been installed and are being actively monitored, whereas others would require access from landowners.
- **Removal of unneeded facilities during closure.** These facilities include buildings, the plant site, some roads, the perimeter and security fence, power supply line, piping systems, and water supply pipeline. The plant site would be recontoured and revegetated with native vegetation. Building foundations would either be removed or broken up and buried. Reclamation and revegetation of this area would minimize erosion and allow stormwater flow to be returned to the watershed.
- **Hazardous materials containment and management.** In order to reduce potential human health and environmental risks, hazardous materials and substances would be managed and contained within facilities that are designed, constructed, and maintained to meet applicable laws and regulations. These facilities would include leak containment and recovery systems as required and adequate stormwater management and drainage systems to prevent contamination of outside containment areas. An explosives and blasting management procedure would be required to be implemented to ensure that best management practices are applied.
- **Limiting ground-disturbing activities between perimeter fence and security fence.** Any additional soil disturbance between the security fence and perimeter fence would be limited.
- **Additional waste rock and tailings characterization.** During operations, additional waste rock characterization tests, above and beyond those required by the aquifer protection permit, would be required to be conducted on waste rock and tailings. This additional analysis includes requirements for humidity cell testing, whole rock chemistry, and mineralogical analysis in addition to the acid-base accounting and leachate testing already being conducted for the aquifer protection permit.

Mitigation and Monitoring – Other Regulatory and Permitting Agencies

- **Power line and water line locations.** The final location of the power line as considered by the ACC was the shortest route, minimizing soil disturbance.
- **Paving of mine roads.** Paving of certain roads with the mine is required under the air quality permits and would also serve to reduce the potential for erosion of soil from disturbed road areas.

- **Design and location of the heap leach facility to reduce potential impacts to groundwater and surface water quality.** The heap leach facility has been designed and located to reduce the risk of potential contamination of groundwater from seepage. It is designed to collect all possible drainage and solution; it is located on top of a stable rock location; the liner system is designed to meet requirements of the aquifer protection permit; and the facility would be encapsulated by waste rock at closure to protect it from stormwater infiltration.
- **Reduction of the potential for acid generation from tailings and waste rock.** Geochemical testing has indicated that there is adequate neutralization capacity in the overall waste rock composition to prevent potential acid generation. However, proper placement of the waste rock is necessary to allow this buffering capacity to be effective. This mitigation involves requirements for the segregation and encapsulation of potentially acid-generating waste rock with rock that has buffering capabilities in order to reduce the risk of potential acid generation.
- **Equipment and methods to keep potentially contaminated water from being released into the environment.** This mitigation measure requires the use of lined ponds; retention of all contact stormwater for reuse as process water; and the installation of overflow alarms to alert operators of a potential overflow situation. Many of these mitigation components are required under the aquifer protection permit or stormwater permit.
- **Control and recycling of process water.** This mitigation measure would result in an overall reduction in fresh water use and avoidance of potentially contaminated discharges by containing all process water in lined facilities, to be recycled back into the process stream to offset fresh water use.
- **Processing and placement of tailings to reduce water content and overall footprint.** The use of dry-stack tailings instead of traditional slurry tailings would allow for a much smaller footprint for the tailings facility, minimizing soil disturbance.
- **Detention and testing of stormwater.** This mitigation measure requires detention and testing of stormwater quality from perimeter waste rock buttress areas for water quality testing prior to flowing downstream of the mine site. This would also allow for a reduction in suspended sediment in stormwater flows before flowing downstream.
- **Implementation of stormwater pollution prevention plan.** Required under the stormwater permit for the mine, implementation of the stormwater pollution prevention plan would include use of structural sediment controls and best management practices intended to minimize the potential for erosion from the mine site.

Mitigation and Monitoring – Rosemont Copper

- **Elimination of future development of private lands on top of waste rock and tailings.** Disallowing future soil disturbance on top of the reclaimed waste rock and tailings facilities would minimize the potential for future soil disturbance that would reverse reclamation and revegetation efforts.

Conclusion of Mitigation Effectiveness

Many of the above mitigation measures are either design features or permit requirements, and their effectiveness has been analyzed as direct and indirect effects. Several design features would minimize the amount of surface disturbance and therefore would minimize the potential for erosion that would affect surface water quality. Concurrent reclamation and the removal of unneeded facilities during closure would effectively reduce the effects of erosion from the project area through successful revegetation. Limiting ground-disturbing activities between the perimeter fence and the security fence would reduce the potential for impacts to surface water quality from erosion.

Under the Arizona Aquifer Protection Permit program, all permitted facilities must use the best available demonstrated control technology to minimize or eliminate discharges. To do so, a mine has the option of selecting prescriptive control technologies or analyzing site-specific controls. Prescriptive control technologies are generally considered to be the more conservative and protective approach. Rosemont Copper chose to adopt prescriptive best available demonstrated control technologies in their permit application. Permitted facilities include the dry-stack tailings facility (unlined), the process water temporary storage pond (lined), the primary settling basin (lined), the raffinate pond (lined), the heap leach pad (lined), the pregnant leach solution pond (lined), the stormwater pond (lined), the waste rock facility (unlined), and the non-municipal solid waste landfill (lined).

The heap leach facility is further designed to prevent potential discharge of contaminants, for all alternatives except for the Barrel Alternative. The heap leach facility is designed and situated to collect all possible drainage and solution. It is on top of a stable rock location and would be encapsulated by waste rock to protect from stormwater infiltration up to the maximum reasoned storm event. Additional design features are intended to route stormwater around the mine, thus preventing contact with potential contaminants associated with plant site or ore stockpiles, and for detaining stormwater for testing prior to release downstream. These design features would be effective at reducing the potential for impacts to surface water quality at the mine site or downstream.

As a whole, the body of waste rock is expected to have little potential for acid rock drainage, as there are significant quantities of acid-neutralizing rock and relatively little potentially acid-generating waste rock. However, proper placement of these two types of waste rock is necessary to take advantage of the acid neutralization potential. A waste rock segregation plan has been incorporated into the design of the facility and would be informed by continued monitoring and testing of waste rock for acid-generating potential as it is developed from the mine and placed into the waste rock facility. Proper implementation of the waste rock segregation plan would be effective at reducing the potential for impacts to surface water quality.

Hazardous materials would be managed as required under various permits, including MSHA requirements and ADEQ requirements for storage and secondary containment that would be specified in the stormwater pollution prevention plan required under the stormwater permit. Proper management of hazardous materials would be effective at reducing the potential for impacts to surface water quality. In particular, proper blasting management procedures would be effective at reducing nitrogen residue that could accumulate in the forming pit lake or impact downstream surface water.

Mitigation measures and best management practices associated with implementation of the stormwater pollution prevention plan are intended to reduce the potential for surface water quality impacts from improper use, storage, or disposal of petroleum products and other chemicals. Implementation of these best management practices as well as structural erosion controls would also reduce the potential for surface water quality impacts from sediment. As part of the CWA 404 permit requirements, a restrictive covenant would be recorded on 574 acres downstream of the project area in lower Davidson Canyon that would preclude real estate development and restrict grazing. This would effectively mitigate impacts to surface water quality by protecting upland buffer habitat adjacent to washes and restricting land use to low-impact uses such as hiking, bird watching, and managed grazing.

The effectiveness of the Cienega Creek conservation fund would depend on the nature of the projects funded, but in general projects would be expected to be beneficial to surface waters within the area.

In addition to the mitigation measures described above, which would effectively avoid, minimize, reduce, rectify, or compensate for impacts, a suite of monitoring measures is also proposed or required under permits. These measures generally would not be effective as mitigation but rather would provide a means for monitoring potential changes to surface waters within the analysis area.