Significant and Irreversible Environmental Consequences of Groundwater Drawdown from the Proposed Rosemont Mine

October 5, 2017 (Revised November 30, 2017)

EPA's 404(b)(1) Guidelines (Guidelines) are applied in the review of discharges of dredged or fill material into waters of the U.S. (waters) from the proposed Rosemont Copper Mine (Rosemont Mine) in Pima County, Arizona. Following a comprehensive analysis of the impacts on the physical, chemical and biological components of the aquatic environment, EPA has concluded that the Rosemont Mine will result in significant degradation to waters.[1] This document explains the secondary effects of groundwater drawdown from the proposed Rosemont Mine, which causes or contributes to a significant degradation of waters.

Project Description and Environmental Setting

The Rosemont Copper Company proposes to develop the Rosemont Mine within the Cienega Creek watershed in Pima County, Arizona. The mine would occupy approximately 4,750 acres of National Forest Service, Bureau of Land Management and some privately-owned lands, with the primary land holding being Coronado National Forest. The mine is projected to produce over 4.7 billion pounds of copper, 90 million pounds of molybdenum and 54 million pounds of silver over the proposed 25-30 year mine life.

Essential to an evaluation of the environmental effects of the Rosemont Mine is consideration of the geographic scope or landscape setting of the project within the Cienega Creek watershed. The Cienega Creek watershed functions as the lifeblood that sustains a near pristine landscape rich in biodiversity.[2] Several major drainages occur within the project area: Wasp, McCleary, Scholefield, Barrel and Box Canyons, Davidson Canyon, Empire Gulch, Gardner Canyon; and Cienega Creek. The watershed also supports riparian, seeps and springs critical to the survival of many wildlife species.[3]

The upstream tributaries of Cienega Creek, including Davidson and Barrel Canyons, Empire Gulch and its headwaters, provide a wide range of functions critical to aquatic ecosystem health and stability. Empire Gulch, Gardner Canyon, Barrel and Davidson Canyons and Cienega Creek contain intermittent and perennial stream reaches and springs supporting hundreds of acres of

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[1] See, *Environmental Consequences of the Proposed Rosemont Copper Mine: Significant Degradation to Waters of the United States*. Prepared by EPA Region IX dated October 5, 2017 (Revised November 30, 2017). 39 pp.

[2] The Cienega Creek watershed includes waters identified by EPA as Aquatic Resources of National Importance (ARNI) pursuant to §404(q) CWA as well as State of Arizona Outstanding National Resource Waters (ONRW). A portion of the watershed is located within the Cienega Creek Natural Preserve and the Las Cienegas National Conservation Area (LCNCA). Cienega Creek and its tributaries in the LCNCA support approximately 20 linear miles of riparian forest and marshland, which is often flanked by sacaton (*Sporobolus wrightii*) flats or mesquite (*Prosopis velutina*) bosque vegetation communities; additionally, many miles of xeroriparian and shrub communities occur (Bodner and Simms 2008*). Supplemental Information Report Rosemont Copper Project. USDA Forest Service Southwest Region. May 2015 (Rev. June 2015)* (SIR), p. 55.

[3] See the U.S. Fish and Wildlife Service *Amended Final Reinitiated Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona* dated April 28, 2016 (BO).

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high quality riparian and palustrine emergent wetlands.[4] These tributaries provide hydrologic connectivity within the watershed, facilitating the movement of water, sediment, nutrients, wildlife, and plant propagules. The ephemeral and intermittent streams are responsible for a large portion of basin groundwater recharge in this semi-arid region through channel infiltration. These streams contribute to the biogeochemical functions of waters within their watershed by storing, cycling, transforming and transporting elements and compounds, while facilitating the movement of sediment and debris and dissipating energy as part of the natural fluvial adjustment.[5]

Groundwater Drawdown from the Proposed Rosemont Mine

According to the FEIS, the mine pit would be actively pumped or dewatered during active mining creating a hydraulic sink near the mine site and drawdown of the water table near the mine water supply wells due to pumping.[6] The total dewatering loss near the mine site during active mining ranges from 13,000-18,500 acre-feet.[7] There is an estimated annual water loss in perpetuity of 170-370 acre-feet due to the presence of the mine pit lake, which is equivalent to 3 percent of basin recharge.[8] Annual water use of 5,400 acre-feet during the first eight years of mining represents an increase of 6.7 percent in area pumping.[9] Once groundwater begins to be removed from the aquifer by the mine, either by pumping and dewatering during active mining, or through evaporation from the pit lake after closure, groundwater drawdown in the aquifer continues steadily over time, eventually reaching equilibrium. Equilibrium would be reached based on model estimates between 700-7000 years after the closing of the mine.[10]

Analysis used to Assess Impacts from Groundwater Drawdown

To analyze impacts to groundwater quantity from the proposed Rosemont Mine, the U.S. Forest Service (USFS) utilized four numerical groundwater models. These models were used as the basis for conclusions presented in the FEIS and SIR on the impacts from the mine's groundwater drawdown on wetlands, seeps and springs, and streams, including ONRWs, federally listed endangered and threatened species and critical habitat. The USFS determined that the conclusions in the SIR are similar to those in the FEIS and therefore, the analysis disclosed in the FEIS remains valid.[11]

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[4] See United States Forest Service Final Environmental Impact Statement for the Rosemont Copper Project dated December 2013 (FEIS). See letter from Pima County Administrator C.H. Huckelberry to Mr. William James, U.S. Army Corps of Engineers (Corps) and Mr. Kerwin Dewberry, USFS dated September 28, 2017 and another letter to Mr. William James, US Army Corps of Engineers dated November 6, 2017 Re: *New information on the Intermittent Status of Barrel and Davidson Canyons.*

[5] See Levick, L., J. Fonseca, D. Goodrich, M. Hernandez, D. Semmens, J. Stromberg, R. Leidy, M. Scianni, D.P. Guertin, M. Tluczek, and W. Kepner. 2008. *The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest*. U.S. EPA and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116 pp.

[6] FEIS, p. 353

[7] Ibid.

[8] SIR, p. 24.

[9] Ibid., p. 24.

[10] FEIS, p. 503.

[11] SIR, p. 141 and p. 267.

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Measurement factors considered in the groundwater analysis included the:

- Direction and change (feet) of the water table level, including the annual average, range and rate of drawdown, compared with background;
- Extent of impairment to mountain-front recharge;
- Geographic extent in which water resources would be impacted;
- Duration of the effect (years); and
- Potential reduction in subsurface groundwater outflow from Davidson Canyon to Cienega Creek.[12]

Per the USFS, the groundwater modeling used in the FEIS and SIR cannot predict the magnitude or timing of the mine's impacts on distant waters such as Cienega Creek, Davidson Canyon, and Gardner Canyon. The threshold of accuracy for the available models (about 5 feet) renders the analysis of groundwater drawdown on distant surface waters highly uncertain.[13] Therefore, the FEIS and SIR analyses present a range of modeling scenarios as possible outcomes.[14] The USFS chose a single "best-fit" modeling scenario as the best calibrated to real-world conditions and the most likely outcome from the models.[15, 16] This does not change the overall uncertainty of the models and their inability to detect significant impacts that occur from relatively small amounts (*i.e.*, <5 feet) of groundwater drawdown.

Small changes in groundwater levels will have profound adverse effects on surface, and shallow subsurface (*i.e.*, groundwater and hyporheic) flows. The wetted surface area of many aquatic habitats in the arid Southwest during the driest portions of the year (April-early July), including the Cienega Creek watershed, is characterized by shallow surface water depths (*e.g.*, << than a few inches). As such, they are extremely susceptible to drying from small changes in surface depths linked to decreasing groundwater levels. Typically, there is a nonlinear relationship between groundwater-stream interactions such that changes in groundwater levels and stream flow are rarely a simple 1:1 relationship.[17] A consequence is that relatively small drawdown of groundwater levels can result in significant declines in groundwater contributions to stream base flows; one such study by Knox (2006) demonstrated that decreases in groundwater storage of about 3-5% resulted in a decline of stream base flow of 31% and total stream flow of 35%.[18] Significant changes to stream base flow are possible because typically inflow to streams originates from the uppermost portions of the subsidizing aquifer; small declines in the water table can

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[12] SIR, p. 24.

[13] *The conclusion of groundwater experts consulted by the Coronado is that such small drawdowns are beyond the ability of these groundwater models, or any groundwater model, to accurately predict . . ..* SIR, p. 60.

[14] FEIS, p. 290 and SIR, p. 43.

[15] SIR, p. 44.

[16] Following issuance of the FEIS, additional review was conducted and presented in the SIR on the relationship between groundwater levels and flow conditions on Lower Cienega Creek and the predictions on stream flow impacts on Empire Gulch and Cienega Creek. Although significant issues regarding the groundwater models were raised, the USFS found the process undertaken was sufficient to rely upon the groundwater modeling results. The USFS concluded that the models prepared are the most appropriate tools for predicting impacts in the FEIS, if their associated uncertainty is fully disclosed. SIR, pp. 37-42.

[17] Earman and Dettinger, 2011. *Potential impacts of climate change on groundwater resources – a global review. Journal of Water and Climate Change* 24: 213-229).

[18] As presented in Earman and Dettinger 2011.

significantly reduce groundwater contributions that sustain stream flow. [19]

All USFS models predict eventual groundwater drawdown in the assessment area.[20] If we accept the output of the modeling and sensitivity analyses, the probability of occurrence of some level of more than trivial ground- and surface-water drawdown at sensitive waters remains very high. The vulnerability of springs, seeps, stream flows, wetlands and riparian areas in the study area to groundwater drawdown is great; these aquatic habitats are regionally rare, small in area and fragmented, and are currently shrinking in response to the ongoing drought. Projected climate change will also result in further significant groundwater drawdown and the drying of surface waters in the assessment area.[21] Climate change and the high probability of ground and surface water drawdown from the Rosemont Mine combined with the high vulnerability of these aquatic resources to the projected changes means that the environmental risk to aquatic resources and wetlands, and the organisms they support is high.[22]

Secondary Impacts to Waters of the United States

Groundwater drawdown from the Rosemont Mine will cause unacceptable adverse impacts to surface waters, including wetlands of the Cienega Creek watershed.[23] Groundwater drawdown from the mine pit will place stress directly on the regional aquifer. The SIR analysis assumes for many key reaches that there is a complete hydraulic connection between the regional aquifer, the shallow alluvial aquifer, and surface flow in the stream channel.[24] The USFS expects that the stress placed on the regional aquifer by the mine pit will result in drawdown, which will, in turn, result in drawdown in the shallow alluvial aquifer, and reduced stream flows.[25]

Per the FEIS, because of the proposed mine, streams would change from intermittent/perennial flow status to ephemeral flow status as follows: Empire Gulch: 3 miles impacted, Cienega Creek: 20 miles, and Gardner Canyon: 1 mile. Also, Sycamore Canyon north and south, Box Canyon, and Mulberry canyon would be subject to drying effects.[26]

As described in the FEIS and the SIR, the impacts from mine-related groundwater drawdown to Empire Gulch are more certain. Most scenarios indicate that effects will be seen within 50 years of the closure of the mine with one model estimating the time to first impacts to Empire Gulch at

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[19] Earman and Dettinger, 2011.
[20] SIR, p. 24. Four numerical groundwater models were used: three were conducted around the mine site itself and one was conducted around the mine water supply pumping site west of the Santa Rita Mountains.
[21] FEIS, p. 565-566.
[22] Evaluating the gradation and strength of evidence through a risk assessment builds an understanding of the likely environmental outcomes from the proposed project. A risk assessment evaluates various lines of evidence and allows for a balanced consideration and merging of different types of information to make an informed decision on the impacts from the proposed project. Although a risk assessment was recommended by EPA, the USFS chose not to conduct one.
[23] See Guidelines, 40 CFR Part 230 Subparts B-F.
[24] The SIR uses the term "key reaches" as a technique meant to focus the analysis on critical locations, but acknowledges that impacts could occur elsewhere in the system. SIR, p. 67. See letter from Pima County Administrator C. H. Huckelberry to Robert Leidy, EPA dated December 17, 2015 Re: *Rosemont Mine – Surface Water Impacts, Davidson Canyon and Cienega Creek*. See also letter to Colonel D. Peter Helmlinger and Ms. Alexis Straus dated June 6, 2017 Re*: Rosemont Copper Mine, Section 404 Clean Water Act.*
[25] Ibid., p. 76.
[26] FEIS, Table 108.

19 years.[27] An increase in the risk of drying due to groundwater drawdown indicates dry spells would occur with regularity, thereby shifting the stream from perennial to intermittent.[28] The analysis in the FEIS does not imply that impacts from groundwater drawdown occur only at specific modeled time intervals of 50, 150, and 1,000 years, but rather these impacts would develop steadily over time before reaching the levels predicted in the models.[29] By the time this transition occurs, major shifts in riparian vegetation in reaches of Empire Gulch would be expected to be well underway, with complete loss of the hydroriparian corridor and transition to xeroriparian vegetation regardless of climate change stresses. This change in riparian vegetation density and health would be likely to trigger negative feedback loops, resulting in head cuts, erosion, and downstream sedimentation.[30]

Wetlands within Lower Empire Gulch, including the Cieneguita Wetlands, will experience degradation of water quality, contraction of pool volume and surface area impacting aquatic vegetation and obligate plants. Lower Empire Gulch can expect a decrease in pool volume to 67 percent of the original volume from mine drawdown alone.[31] When combined with climate change, pool volumes are projected to decrease to 42-57% of their original volume.[32] The SIR states that pools associated with the Cieneguita wetlands will be reduced anywhere from 25-92% of their original volume.[33] In consideration of climate change, pool volume can reach as low as 8-37% of their original volume.[34] The SIR only analyzed the Cieneguita Wetlands, but Bureau of Land Management has identified more than 30 perennial or seasonal wetlands in the LCNCA, and various impacts to these wetlands are expected.[35]

Riparian – The SIR affirms the conclusions presented in the FEIS for impacts to riparian wetlands. Groundwater drawdown and a decrease in stream flow permanence will cause impacts to riparian vegetation.[36, 37] The high end of the model sensitivity analyses predicts that shift may occur as early as 20 years after mine closure. At this threshold, willows experience canopy dieback, reductions in overall plant density, and reductions in stem density and basal area of young cottonwood and willow.[38]

In evaluating the impact of the Rosemont Mine on riparian habitat, the U.S. Fish and Wildlife Service (FWS) finds that increasing depths to groundwater will eventually result in changes in the species composition of a given site's riparian community (*i.e.,* hydroriparian communities would

[27] FEIS, Table 65.
[28] FEIS, p. 538. One model estimated the time to first modeled impacts for Upper Empire Gulch and Cienega Creek is 19 and 27 years, respectively (Table 65).
[29] FEIS, p. 503.
[30] SIR, p. 131.
[31] SIR, p. 139.
[32] Ibid.
[33] Ibid.
[34] SIR, p. 140.
[35] The USFS stated the groundwater drawdown impacts of stream flow and pools is directly applicable to other wetland areas along the stream channel itself. SIR, p. 67.
[36] Ibid., pp. 131-132.
[37] Based field observation by EPA, a significant portion of these riparian communities are jurisdictional in the areas mapped as hydroriparian and mesoriparian community types. A jurisdictional delineation of all waters potentially impacted by the proposed project was not conducted.
[38] SIR, p. 131.

suffer decreased vigor and extent, eventually transitioning to a xeroriparian community).[39] They note the possibility that groundwater declines resulting from the proposed actions, while seemingly minor, will increase current or future levels of hydrologic variation to the point that present-day riparian communities cannot perpetuate themselves.[40] Noting that the hydrologic modeling in the SIR and Supplemental Biological Assessment does not address future temperatures, rainfall patterns or other factors, they based riparian related effects on endangered/ threatened species and related critical habitat from mine-only drawdown. The FWS states a reasonable assessment is to assume that negative trends in woody riparian habitat observed during the current drought are likely to continue due to climate change.[41] The FWS anticipates appreciable reductions in the representation of cottonwood/willow dominated communities along Cienega Creek and Empire Gulch. Mine drawdown will precipitate an earlier onset and exacerbation of these effects.[42]

Degradation of the riparian vegetation within the Cienega Creek watershed can increase susceptibility to pests and allow for the spread of invasive species. Degradation can create an increase in fuel load and fire risk. Also, degradation of riparian habitat can impact surface flow characteristics like retention and removal of sediment and dissipation of flood flows.[43]

Empire Gulch - Per the FEIS, an estimated 407 acres of hydroriparian habitat may be affected by changes in stormwater or changes in groundwater levels in Empire Gulch.[44] Based on the high estimate of model predictions, groundwater drawdown would cause widespread mortality or transition from hydroriparian to xeroriparian, with cottonwood/willow experiencing the greatest stress. Wetland complexes within the hydroriparian zone would experience drying and widespread mortality of obligate wetland plants and aquatic vegetation.[45]

The FWS supports these conclusions stating Upper Empire Gulch is almost certain to experience major shifts in riparian vegetation due to mine drawdown, regardless of climate changes stresses. They note the 95th percentile analysis predicts the rapid onset of adverse effects (10 years post-mining) followed by a steady progression through drying conditions until total dewatering (zero flow) occurs at 150 years post-mining. The FWS anticipate these effects to result in losses of broadleaf woody riparian species and extirpation of aquatic and emergent vegetation.[46]

Davidson Canyon - Mesoriparian habitat in Davidson Canyon (Reach 2) may experience reduced recruitment, increased mortality rates, and decreased canopy height.[47] Impacts to recently documented hydroriparian habitat in Davidson Canyon, have not been assessed in the FEIS.[48] Forty-nine riparian areas associated with springs will be adversely impacted due to groundwater

[39] U.S. Fish and Wildlife Service Amended Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona dated April 28, 2016 (BO). p. 62.
[40] Ibid.
[41] Ibid., p. 65
[42] Ibid., p. 71.
[43] FEIS, p. 500 and SIR, p. 131.
[44] FEIS, p. 541. Estimates were based on model predictions.
[45] FEIS, p. 542.
[46] BO, p. 69.
[47] FEIS, p. 543.
[48] R.A. Leidy, EPA. Personal Observation April 20, 2016.

drawdown, according to the FEIS.[49]

Cienega Creek - Within Cienega Creek (Reaches 1 through 5) and Gardner Canyon (Reaches 1and 2), high model estimates predict a contraction of the hydroriparian area, with conversion occurring at the transitional margins of the habitat.[50]

Impacts to the biotic community - Project-related groundwater drawdown impacts the biotic community by disrupting breeding, spawning, rearing, and migratory movements, or other critical life history requirements of fish and wildlife resources. Decline in riparian habitat (*e.g.,* reduced plant regeneration, herbaceous and shrub growth, tree survival, foliar cover, woodland width) will adversely affect species such as the threatened yellow-billed cuckoo and its critical habitat.[51] The FWS estimates over the next 150 years; individual stream reaches within the Cienega Creek watershed will experience from 10% - 100% loss of riparian breeding, foraging and prey habitat for the cuckoo.[52] Climate change will exacerbate these effects.[53]

Similarly, there are anticipated adverse effects to the federally endangered southwestern willow flycatcher.[54] Impacts will occur in parts of Empire Gulch and Upper Cienega Creek, because this species relies primarily hydroriparian habitat.[55] The FWS concluded that the effects of groundwater drawdown and related reduced stream flow will likely result in extirpation of breeding pair southwestern willow flycatchers at the Empire Cienega site and will increase the likelihood of extirpation at the locations within the Cienega Creek site.[56]

Pools and Riffles - Pools and riffles would be especially vulnerable to desiccation during the typically driest months of May and June, and during droughts when intermittent pools characterize Cienega Creek embedded within long reaches of a dry streambed. Seemingly small reductions in stream flow caused by mine groundwater drawdown during crucially dry months could cause portions of Cienega Creek to stop flowing.[57] Significant changes to stream base flow are possible because, typically, inflow to streams originates from the topmost portions of the subsidizing aquifer; small declines in the water table can significantly reduce the groundwater contributions that sustain stream flow. Upon review of the new analysis of impacts to refugia pools, the SIR concludes: *Therefore, the contribution to these pools from groundwater is likely the most critical aspect to their continued presence as refugia for threatened and endangered species.*[58]

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[49] The FEIS estimates impacts to 494 acres of Important Riparian Areas. These areas are designated by Pima County for their highest value and function; providing landscape linkages and high biological productivity. FEIS, p. 501 and Table 108, p. 509.
[50] FEIS, p. 542.
[51]BO, p. 232. The FWS notes that while xeroriparian is less sensitive to reduction in surface flow compared to hydroriparian, it can experience reduced vigor, regeneration and survival of young trees. A sustained reduction in surface flow will result in a decline in cuckoo habitat.
[52] Ibid., p. 242.
[53] Ibid., p. 242-243.
[54] Ibid., p. 265. Federal listed as endangered and critical habitat designation.
[55] Ibid., p. 270.
[56] Ibid., p. 281.
[57] DEIS, p. 387 and SIR, p. 63.
[58] SIR, p. 63.

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This conclusion supports the findings in the BO. Water quality typically decreases as the volume of pools and riffles decrease from increases in temperature and dissolved solid concentrations and decreases in dissolved oxygen. These changes can result in increased algal blooms that further reduce the availability of dissolved oxygen.[59] Water quality changes in desiccating pools and riffles can be expected to adversely affect aquatic organism's dependent on these habitats. In the Biological Opinion, the FWS concludes that *the proposed action* [Rosemont Mine] *contributes incremental effects that will, at varying levels, further diminish surface flows, the dimensions of pool habitat, and reduce water quality, resulting in significant degradation of the aquatic ecosystem upon which Gila chub, Gila topminnow, desert pupfish, Huachuca water umbel, Chiricahua leopard frog, and northern Mexican gartersnake depend.*[60] In addition, Pima County concluded that Rosemont Mine would reduce stream flow and groundwater inputs to Cienega Creek and this will reduce the length of pool and riffle habitat.[61]

Desert Springs - Desert springs, often the sole sources of water for wildlife, support wetland ecosystems including rare and endemic species.[62] Human changes to groundwater are one of the greatest threats to long-term sustainability of groundwater dependent ecosystems in arid and semi-arid regions.[63] Following groundwater withdrawal, should a spring continue to flow, the wetlands supported by the outflow would be truncated. The amount of area suitable to support wetland species would be greatly reduced, and the species least tolerant of drying conditions would be extirpated first and eventually replaced by transition upland species.[64] Lowering of the groundwater table during construction and operation will degrade or destroy seventy-six springs.[65] Impacts to Scholefield No. 1 and Fig Tree springs are likely to occur within the active life of the mine because of drawdown in the regional aquifer.[66]

Climate Change

While the USFS maintains the overall conclusions in the FEIS are still valid, they attempted to further evaluate climate change effects by analyzing trends over the past decade and incorporating additional groundwater drawdown due to expected future changes in temperature.[67] The USFS Change did not include change in precipitation claiming the trend analysis indicated that the

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[59] BLM monitored temperature and dissolved oxygen along with stream flow at their locations on Empire Gulch and Cienega Creek and monitoring results showed a relationship between reductions in stream flow, increases in temperature, and decreases in dissolved oxygen. SIR, p. 53. Temperature increases with reductions in stream flow by about 0.36 to 0.77 degrees Celsius (°C) for every 10-gallon-per-minute (gpm) reduction (see appendix C, figures C15 and C17). Dissolved oxygen decreases with reductions in stream flow by about 0.28 parts per million (ppm) for every 10-gpm reduction.

[60] U.S. Fish and Wildlife Service Amended Final Biological and Conference Opinion for the Rosemont Copper Mine, Pima County, Arizona dated April 28, 2016. p. 60.

[61] Powell, B., L. Orchard, J. Fonseca and F. Postillion 2014. *Impacts of the Rosemont Mine on Hydrology and Threatened and Endangered Species of the Cienega Creek Natural Preserve.* Report prepared by Pima County.

[62] Patten, P.T., L. Rouse and J.C. Stromberg. 2007. *Isolated Spring wetlands in the Great basin and Mojave Deserts, USA: Potential Response of Vegetation to groundwater Withdrawal.* Environmental Management DOI 10.1007/s00267-007-9035-9. 16 pp.

[63] Ibid.

[64] Ibid.

[65] FEIS, Table 108, p. 510.

[66] FEIS, Table 60.

[67] SIR, pp. 218-220.

hydrographs analyzed already reflect precipitation conditions similar to those expected in the future. Climate change effects should be additive to current temperature and precipitation.

Evaluating the project impacts considering climate change and drought, the USFS concluded the project would exacerbate the effects of climate change, which would add to cumulative impacts to biological resources. Climate change stressor effects of the project could significantly shorten the time intervals to modeled effects or increase groundwater drawdown and decrease surface water flow.[68]

Groundwater Drawdown is a Regulated Secondary Effect Under § 404 Clean Water Act

Regarding the Rosemont Mine, the Rosemont Copper Company seeks §404 CWA authorization to discharge dredged or fill material into waters associated with the mine pit, tailings, waste rock and ancillary facilities. In addition to the direct impacts, the secondary impacts to waters based on the activities conducted on the "fast land" created by the discharge must be evaluated. Construction of the mine pit requires a §404 CWA permit and the secondary effects of groundwater drawdown from the mine pit is a secondary impact regulated under §404 CWA.

The Guidelines (40 CFR Part 230) support an interpretation of secondary effects to include those surface effects to aquatic resources induced by hydrological modifications associated with the discharge of dredged material authorized.

(1) Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material.[69]

(2) Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S. Activities to be conducted on fast land created by the discharge of dredged or fill material in waters of the United States may have secondary impacts within those waters which should be considered in evaluating the impact of creating those fast lands.[70]

Consideration shall also be given to the potential diversion or obstruction of flow, alterations of bottom contours, or other significant changes in the hydrologic regime.[71]

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[68] SIR, p. 216.

[69] The Corps does not currently dispute that secondary effects on aquatic ecosystems are to be considered as part of the Guidelines factual determination for issuance of a CWA 404 permit. Similarly, the Corps continues to agree that surface water effects because of the operation of facilities associated with the discharge of dredged or fill material are to be considered in the Guidelines analysis and mitigated (*i.e.*, Yazoo Backwater Area, New Madrid Floodway).

[70] Guidelines at 40 CFR 230.11(h) *Determination of secondary effects on the aquatic ecosystem*. These examples are used for instructional purposes regarding secondary effects assessed under the Guidelines. They should not be construed as the only activities that have secondary effects regulated under §404 CWA.

[71] Guidelines at 40 CFR 230.11(b) *Water circulation, fluctuation, and salinity determinations.*

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In addition, the Preamble to the Guidelines states, *"However, in authorizing a discharge which will create fast lands, the permitting authority should consider in addition to the direct effects of the fill itself, the effects on the aquatic environment of any reasonably foreseeable activities to be conducted on that fast land."* The Preamble affirms that the analysis of impacts is not to be limited to consideration of only direct impacts but, to consider the effects from any reasonably foreseeable impact. Regarding the Rosemont Mine, it has been established that there is a hydrologic connection (via groundwater) of surface aquatic resources to a 404- permitted area where groundwater pumping would occur. The activity of groundwater pumping is reasonably foreseeable since the Rosemont Copper Company has stated that such pumping is necessary for construction and/or operation of the mine.[72] The hydrological modification- induced (*e.g,* groundwater drawdown) secondary impacts to aquatic resources would occur because of the §404 permit and associated activities that occur on the permitted area.

To better understand secondary effects, EPA's Office of General Counsel (OGC) issued an Opinion on how "secondary impacts" are defined pursuant to the Guidelines.[73] In the Opinion, OGC states that, *Some impacts that may be caused by the subsequent operation of a project or by associated development may be considered, depending on the directness of the casual connection, the predictability of such impacts, and a general rule of reason.*[74] OGC notes that Congress extended CWA jurisdiction recognizing that effects of pollution move through the aquatic system. Therefore, Congress did not intend to exclude consideration of adverse impacts simply because they were secondary.[75]

In the case of the Rosemont Mine, subsurface drawdown clearly constitutes a significant change in the hydrologic regime affecting surface water. These operational affects are strongly "associated" with the discharge of dredged and fill materials, since they would not occur in the absence of a §404 CWA permit.

§404 CWA permit decisions regulating the secondary effects of groundwater drawdown

Evaluating the secondary effects of groundwater drawdown under §404 CWA is not precedential. The following §404 CWA permit decisions by the Corps of Engineers (and in one case, the Department of the Army) considered hydrological modification- induced secondary impacts to waters within the scope of the Corps' §404 CWA analysis.

Cucumber Gulch - On January 19, 2001, pursuant to the 1992 CWA 404(q) Memorandum of Agreement between the Department of the Army and EPA, EPA requested higher level review of the proposed permit for a commercial/residential/recreational development (Breckenridge Ski Area) in the Cucumber Gulch watershed located in Summit County, Colorado. A primary concern expressed by EPA was the construction of large buildings facilitated only by a new access road

[72] In addition to groundwater pumping, the water lost to evaporation in the mine pit will perpetuate the aquifer drawdown caused by mine pit dewatering. Models estimate equilibrium would not be reached until 700 to 7000 years after mine closure. FEIS, p. 291 and p. 329.
[73] General Counsel Opinions from the Office of General Counsel United States Environmental Protection Act dated January 31. 1980, Through June 7, 1985.
[74] Ibid., p. 128.
[75] Ibid.

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(the regulated 404 discharge), and the subsequent installation of extensive foundation drains will likely intercept groundwater flow supporting rare slope fen wetland complexes down-gradient of the project. [76]

On February 5, 2001, Deputy Assistant Secretary of the Army, Claudia L Tornblom, responded to EPA's request for higher level review, and acknowledged that the Sacramento Corps District would include Special Conditions in the §404 permit. The permit conditions required the applicant submit a plan prior to construction documenting that neither the proposed buildings nor the associated infrastructure would affect the hydrology of the down-gradient wetlands or, if there would be effects, detail how any impacts would be remediated or mitigated.

Dos Pobres/San Juan Copper Mine - In 2004, the Los Angeles Corps District issued a §404 CWA permit to Phelps Dodge authorizing the Dos Pobres/San Juan Copper Mine located in Safford, Graham County, Arizona. The §404 permit authorized direct impacts to 21.4 acres of waters and secondary impacts to 93.2 acres of waters.[77] The mitigation plan included mitigation for secondary impacts from groundwater drawdown to the Gila River, located 8 miles downstream from the project site. Deed restrictions requiring alternative year fallowing of farm land to mitigate for groundwater drawdown was a condition of the §404 permit and thereby, enforceable by the Corps District.

Adam's Rib - In 1992, the Sacramento Corps District considered impacts of groundwater drawdown caused by underground parking with associated subsurface drains for the Adam's Rib Recreation Area project near Eagle, Colorado and the resulting "indirect adverse impacts" (secondary impacts) on nearby wetlands when it evaluated alternatives under the Guidelines. The applicant proposed to place fill in 45.81 acres of wetlands in the development of over 5000 housing units. The Corps determined that without the proposed buildings' subsurface foundation drains, the areas would persist as viable wetlands. Because engineering techniques existed to avoid these impacts, the Corps denied the §404 permit.

Lakebelt Limestone Mines - The Jacksonville Corps District issued §404 CWA permits to several limestone mining companies (2010-2011) in the Miami-Dade County, Florida. Hydrological modeling of the proposed limestone quarry mining expansions indicated that additional mining was expected to result in adverse drainage effects on higher quality wetlands to the west of the expansion area. As a requirement of the issued §404 permits (specific conditions) the mining companies must construct and operate groundwater seepage management facilities that

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[76] For past development projects in or near slope wetlands in montane environments in Colorado, the Sacramento Corps District had acknowledged the potential adverse effects to groundwater hydrology from subsurface structures and drains (*i.e.*, geotechnical studies performed for the Adam's Rib project, near Eagle, Colorado -Review of Technica1 Engineering Documents - Memorandum by Thomas W. Fea and Darrell J. Anderson, U.S. Amy Corps of Engineers, Sacramento District, October 1, 1992) and evaluated less environmentally damaging alternatives prior to a permit decision.

[77] Through groundwater modeling, it was determined that, over time, almost the entire amount of the mine's total pumpage that is lost to evaporation at the mine will be subtracted from the flow of the Gila River. Due to the distance between the mine and the river, the large amount of groundwater flow in the system, and the effects of faults on the flow system, this extraction is expected to be spread over many years. The present calibration of the 2002 model is projecting a peak impact to the Gila River of 34 af/yr at about model year 450.

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eliminate all future adverse secondary wetland drainage impacts associated with permitted mining on high quality Everglades wetlands to the west (adjacent) of the permitted mining area.

Platte West Water Production Facilities - In May 2003, the Omaha Corps District, issued a §404 CWA permit to Omaha, NE's Metropolitan Utilities District for construction of a new well field. Project facilities include two new groundwater well fields, a new water treatment plant, water transmission pipelines and other appurtenant facilities. The two well fields, located west of Omaha in Saunders and Douglas Counties, will provide water to be used by rapidly developing western suburbs. Conditions in the §404 Permit stipulated that up to 30 years of wetland monitoring may be needed for the two well fields and cones of depression in Douglas and Saunders Counties. Monitoring is designed to determine if project operation adversely affects wetlands through the drawdown of the existing groundwater table. Mitigation for impacts to wetlands and streams were conditions of the Corps permit.

Savannah Landfill - The Savannah Corps District pursued compensatory mitigation for wetlands that are now drained and non-jurisdictional due to dredging activities in adjacent upland areas conducted at a solid waste landfill outside of Savannah, GA. In this case, the material excavated from the upland areas was used as cover material for the landfill, the construction of which required a §404 permit. The landfill applicant sought to expand into the excavation area which would require a §404 permit for ancillary activities on the property. The Corps requested compensatory mitigation for the secondary impacts which resulted from the original §404 permit.

Conclusion

The Rosemont Mine will degrade and destroy waters in the Cienega Creek watershed containing regionally rare, largely intact mosaics of some of the highest quality stream and wetland ecosystems in Arizona. The environmental consequences are substantial and unacceptable and contrary to the goals of the CWA. There is no mitigation to prevent the unacceptable adverse secondary effects to these waters from the proposed mine. EPA maintains the secondary impacts associated with this project will cause of contribute to significant degradation of our Nation's waters (40 CFR 230.10(c)).

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