



**MONTGOMERY  
& ASSOCIATES**  
Water Resource Consultants

www.elmontgomery.com

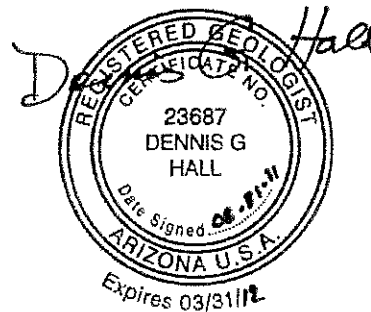
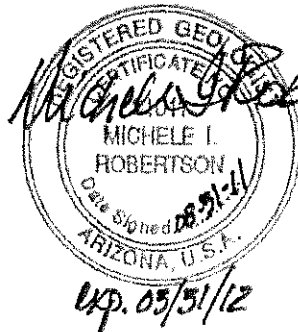
1550 East Prince Road  
Tucson, AZ 85719

TEL 520-881-4912  
FAX 520-881-1609

TUCSON PHOENIX SANTIAGO DE CHILE

**TECHNICAL MEMORANDUM**

**DATE:** August 31, 2011 **PROJECT:** 1362.01  
**TO:** Wayne Costa, TOWN OF FLORENCE  
**FROM:** Michele Robertson and Dennis Hall  
**MONTGOMERY & ASSOCIATES**



**SUBJECT: REVIEW OF CURIS RESOURCES (ARIZONA) INC. APPLICATIONS  
 PZC-32-11-MGPA and PZC-33-11-MGPA FOR GENERAL PLAN  
 AMENDMENTS FOR FLORENCE COPPER PROJECT, FLORENCE,  
 ARIZONA**

**EXECUTIVE SUMMARY**

In accordance with a request from the Town of Florence (TOF), Montgomery & Associates has prepared this technical memorandum summarizing the results of our review of two applications for General Plan Amendments related to the Florence Copper Project (FCP). The FCP is located about 1 to 3 miles northwest from the main part of the Town, within the area designated for potential future development as part of the Merrill Ranch Master Planned Community. The proposed amendments were submitted to TOF on behalf of Curis Resources (Arizona) Inc. The two proposed amendments were reviewed for compatibility with the Environmental Planning and the Water and Wastewater Elements of the TOF 2020-General Plan.

The present approved land use designation for the subject property is Master Planned Community. Amendments proposed by Curis would add a new overlay to the TOF General Plan that, if approved by TOF, would allow implementation of an in-situ copper recovery (ISCR)

project, which would remove leachable copper from the Oxide Zone beneath part of Curis' property. During the life of the ISCR project (projected to be 20 years), hundreds of injection, recovery, and monitor wells would be installed into the Oxide Zone to depths of 400 to 1,600 feet below land surface. The principal permit applications pending for the project include an Underground Injection Control (UIC) Program permit from the U.S. Environmental Protection Agency (EPA) and an Aquifer Protection Permit (APP) from the Arizona Department of Environmental Quality (ADEQ).

Montgomery & Associates reviewed numerous documents provided by TOF and other entities. The principal findings based on our review are summarized below:

- 1) The proposed ISCR project would require modification of the TOF 2020 General Plan to allow delay of implementation of the Master Planned Community proposed for the subject property until after the proposed mining activities are completed.
- 2) The ISCR process would involve generating, storing, transporting, and processing chemical solutions at land surface and circulating leaching solution through the ore body in the subsurface via a network of injection and recovery wells. Surface impacts are anticipated to be minimal and limited to the actual infrastructure elements needed. Surface processes can be monitored directly and problems identified can be mitigated. Subsurface processes are more difficult to monitor and problems, if identified, are more difficult to mitigate.
- 3) Curis predicts that groundwater quality parameters would meet Aquifer Water Quality Standards (AWQS) beneath the subject property following completion of the ISCR operations. However, sulfate and total dissolved solids (TDS) do not have established numeric AWQS or primary maximum contaminant levels (MCLs) for drinking water. Rather, they have secondary MCLs based on aesthetic properties such as taste and odor. The Curis Model projects that little off-site migration of sulfate would occur within 30 years after mining and rinsing operations are completed. Beneath the ISCR area, the Curis Model predicts that sulfate concentrations would remain higher than present concentrations and higher than the secondary MCL (substantially higher in the Oxide Zone and to a lesser degree in the Lower Basin Fill Unit). Impact of residual elevated concentrations of sulfate would need to be evaluated prior to subsequent use of the groundwater resources beneath the subject property.
- 4) As part of the Town's Wastewater Master Plan, Florence proposed to construct the Merrill Ranch Water Reclamation Facility and associated vadose zone recharge wells and groundwater recovery wells; one possible location for this facility is adjacent to the southwestern corner of the Curis property. Although permitting for this facility is on hold due to the current lack of wastewater treatment demand, the proposed ISCR project could impact the recharge and recovery aspects of the proposed plans. For example, production wells operated at locations west of the Curis property could affect post-mining movement of elevated sulfate concentrations from the FCP.

- 5) Reports for the two groundwater flow models prepared for the site were reviewed (the Curis Model and the 1996 Magma Copper Company model). No substantive problems were found that would invalidate results presented in the Curis report. However, some questions still remain about the Curis Model due to insufficient documentation in the report, including model calibration and assumptions about future pumping used in the model. TOF should request that Curis provide additional information regarding the model to confirm that it can be used as a decision-making tool to evaluate groundwater-quality protection measures associated with proposed mining operations.
- 6) The Curis Model does not simulate TOF's planned recharge and recovery operations, and the report does not provide an evaluation of other potential future changes in off-site groundwater pumping or recharge in the vicinity. Once the proximity of TOF's future recharge and recovery operations to the FCP are determined, we recommend simulating these operations using the Curis Model to evaluate: 1) if these changes in groundwater pumping and recharge substantially change hydraulic gradients in the FCP area; and 2) if the FCP mining and post-mining operations pose any concerns to TOF's operations. These recommended model simulations should also evaluate influence of other potential changes in groundwater pumping and recharge in the vicinity of the FCP.
- 7) DEQ and EPA are responsible for issuing permits that provide assurances for protection of the environment. These assurances include control technologies, monitoring, and contingency actions. If the proposed ISCR project would be constructed, operated, maintained, and monitored properly, and if TOF would ensure that future potable groundwater supply and aquifer recharge facilities would be installed outside the FCP site after due diligence evaluations to assess acceptable locations, then we believe that the proposed ISCR project could be implemented in a manner that is consistent with the goals of the TOF General Plan.

## INTRODUCTION

In accordance with a request from the Town of Florence (TOF), Montgomery & Associates has prepared this technical memorandum summarizing the results of our review of two applications for General Plan Amendments related to the Florence Copper Project (FCP). The FCP is located about 1 to 3 miles northwest from the main part of the Town, within the area designated for potential future development as part of the Merrill Ranch Master Planned Community. Locations for the mine site and Master Planned Communities are shown on **Figure 1**. The proposed amendments have TOF designations PZC-32-11-MGPA and PZC-33-11-MGPA and were submitted to TOF on June 2, 2011, by Pew & Lake PLC (Applicant) on behalf of Curis Resources (Arizona) Inc. (Pew & Lake, 2011a and 2011b).

The presently approved land use designation for the subject property is Master Planned Community. Amendments to the TOF General Plan would be required for the TOF to rezone the property to allow Curis to proceed with proposed plans for implementation of an in-situ copper recovery (ISCR) project, which would remove leachable copper from the Oxide Zone beneath the part of Curis' property located in the south half of Section 28 and the north part of Section 33, Township 4 South, Range 9 East (**Figure 2**). A legal description for the property proposed for operations that include ISCR mining (the subject property) is given in **Figure 3**. During the life of the ISCR project, hundreds of injection, recovery, and monitor wells would be installed into the Oxide Zone that ranges from about 400 to 1,600 feet below land surface (bls).

Implementation of the proposed ISCR mining operation would also require permits from federal, state, and local agencies. Curis has submitted applications for this purpose, including: an application to the U.S. Environmental Protection Agency (EPA) for an Underground Injection Control (UIC) Program permit; and an application to the Arizona Department of Environmental Quality (ADEQ) to amend the existing Aquifer Protection Permit (APP) issued for the project.

## SCOPE OF WORK

TOF contracted Montgomery & Associates to review the two proposed amendments for compatibility with the following sections of the TOF General Plan: the Environmental Planning Element; and the Water and Wastewater Element. The scope of work for Montgomery & Associates' contract is limited to review and comment on the potential impact of Curis' proposed General Plan amendments on the elements cited above. However, in accordance with discussions with TOF staff, historical and technical documents were reviewed to provide a basis for evaluating potential impacts of the proposed amendments. These documents described the details of the proposed ISCR project. Montgomery & Associates reviewed numerous documents provided by TOF and additional information obtained from ADEQ, EPA, other publicly-available sources, and Montgomery & Associates' files. Where appropriate, figures prepared by others are included herein for reference; source is given on the figures. A summary of relevant

historical events and processes is provided in this document, together with results of our review, to provide context for the discussion of the General Plan amendments.

## **BACKGROUND**

Curis Resources (Arizona) Inc., is a wholly owned subsidiary of Curis Resources Ltd, a public mineral exploration and development company based in Vancouver, British Columbia, Canada. Curis Resources Ltd is affiliated with Hunter Dickinson Inc (HDI), a private corporation also located in Vancouver. Curis has acquired approximately 1,342 acres of property and/or mineral rights within the Merrill Ranch Master Planned Community within the TOF, Pinal County, Arizona. The Curis holdings include: 1) about 1,182 acres of patented land acquired by HDI in 2009, which was known as the Florence Copper Project; and 2) a lease of mineral rights for 160 acres of State Trust Land under Arizona State Mineral Lease 11-26500 (HDI Curis, 2010a).

FCP is located in Pinal County along the north-side of the Gila River in portions of Sections 26, 27, 28, 33, 34 and 35 of Township 4 South, Range 9 East. The Gila River flows east to west, parallel to the southern boundary of the FCP property. The area targeted for ISCR mining is approximately 212 acres and is located in the S $\frac{1}{2}$  of section 28 and the N $\frac{1}{2}$ N $\frac{1}{2}$  of section 33. In 2007, the TOF annexed property that included the FCP, except for the State Trust Lands (**Figure 1**).

Since the 1960's, the FCP has been the focus of mineral exploration and development. ASARCO conducted much of the initial investigations for the copper deposit. Subsequently, the mineral interests were acquired by Conoco, Inc. In the early 1970's, Conoco installed two underground shafts and over 5,000 feet of drifts to remove a 50,000 ton bulk-ore sample. Metallurgical testing of the recovered material (vat leaching and milling/flotation/concentration) was performed using a small pilot plant built on the property (SRK, 2010). FCP was acquired by Magma Copper Company (Magma) in 1992. BHP Copper acquired Magma in 1996. Both companies conducted extensive geological and metallurgical studies. During the history of investigation of FCP, over 800 coreholes have been drilled to assess the ore resources.

Original plans for mining the ore resources focused on open pit mining and studies were conducted in the early 1990's to evaluate feasibility. Montgomery & Associates conducted hydrogeologic investigations in support of a prefeasibility study for Magma (Montgomery & Associates, 1994). Magma and BHP Copper investigated the feasibility of ISCR. BHP Copper completed the studies of: geology, hydrogeology, metallurgy, and hydrochemistry; the resource estimation; and the environmental permitting activities that had been initiated by Magma. A site characterization report was submitted with the APP application (Magma, 1996; Volume 2 of 5). APP and UIC Permits were issued in 1997 (USEPA, 1997a; ADEQ 1997) and an in-situ pilot test was conducted over a 90-day period from late 1997 to early 1998. BHP initiated, but did not complete, a planned multi-month, field-optimization in-situ recovery test to gather copper-extraction and other technical data for final feasibility; however, the studies that were conducted

indicated that ISCR, followed by solvent extraction – electrowinning (SX-EW) processing, would be the preferred method to develop the FCP (SRK, 2010). Due to economic factors, the commercial mining operation was not implemented. In 2001, BHP Copper sold FCP to a private developer – Merrill Ranch Development. Curis purchased the surface rights and all of the mineral rights of the FCP from Merrill Ranch Properties, LLC in 2009.

### **ISCR PROJECT**

The target for the proposed ISCR mining operation is the Oxide Zone in the basement complex beneath the sedimentary deposits. The Oxide Zone occurs in the depth interval from about 400 to 1,600 feet bls on the subject property. The proposed ISCR project consists of a series of injection and recovery wells that would be used to recover the copper resources. A sulfuric acid-based solution would be injected to dissolve the copper minerals in the Oxide Zone. The copper-laden solution (pregnant leach solution) would be extracted from the formation by the recovery wells. Copper would be recovered from the pregnant leach solution by the SX-EW process. The leach solution would be reconditioned and recycled numerous times, which could result in concentration of dissolved constituents. Key constituents in the concentrated solution include sulfate, total dissolved solids (TDS), metals, and radiochemicals. Observation wells installed around the perimeter of the injection and recovery wells would be monitored to ensure that hydraulic gradients toward the recovery wells are maintained to contain the leach solution. At full scale operation, hundreds of injection, recovery and observation wells would be required by the ISCR project.

Curis proposes that the ISCR process progress from south to north across the FCP site in a series of operational units. Leaching within a unit would proceed until all the economically available copper is removed. Rinsing with native groundwater would follow to remove the residual acidic solution. The current APP and UIC permits require rinsing with groundwater until sulfate concentrations in the mine block are reduced to 750 milligrams per liter (mg/l). Concentrations of groundwater quality parameters are expected to be below applicable Aquifer Water Quality Standards (AWQS) and EPA Primary Maximum Contaminant Levels (MCLs), which are enforceable numeric standards. Sulfate is expected to be the key constituent in groundwater following completion of ISCR operations. Sulfate does not have a numeric AWQS or a primary MCL; sulfate has a secondary MCL of 250 mg/l that is based on aesthetic properties of taste and odor. The Curis Model projects that little off-site migration of sulfate would occur within 30 years after mining and rinsing operations are completed. Beneath the ISCR area, the Curis Model predicts that sulfate concentrations would remain higher than present concentrations and higher than the secondary MCL (substantially higher in the Oxide Zone and to a lesser degree in the Lower Basin Fill Unit). Impact of residual elevated concentrations of sulfate would need to be evaluated prior to subsequent use of the groundwater resources beneath the subject property.

EPA developed a report using data provided by ADEQ regarding technologically enhanced naturally occurring radioactive materials (TENORM) associated with copper mining operations

in Arizona (USEPA, 1999). The report concluded that SX-EW, and other leaching processes, may extract and concentrate soluble radioactive materials, increasing concentrations up to two orders of magnitude over background levels. Geochemical modeling conducted for Curis indicates that the radiochemicals leached and concentrated during ISCR operations would be precipitated in the Oxide Zone as the pH increases early during the post-mining rinsing operations.

Both the APP and UIC permits require an extended period of groundwater monitoring following cessation of operations at FCP. This monitoring would include the key constituents noted above and would be used to evaluate if any constituents pose a threat to groundwater quality.

### **ENVIRONMENTAL PERMITS**

The APP and UIC permits issued in 1997 allowed for in-situ mining operations at the FCP. Major permit conditions included requirements to: demonstrate continuous hydraulic containment of leach fluids; monitor groundwater quality of the Upper Basin Fill Unit, Lower Basin Fill Unit and Oxide Zone at 31 Point of Compliance (POC) wells; and design, construct, operate, and maintain injection wells and surface impoundments to prevent the uncontrolled release of contaminants. An Aquifer Exemption was issued by EPA in conjunction with the 1997 UIC permit for the FCP (USEPA, 1997b). The areal extent of the aquifer exemption is 500 feet beyond the boundary of the planned ISCR area. Within this area, the exempted aquifers include the Oxide Zone, and that portion of the Lower Basin Fill Unit beneath the Middle Fine-Grained Unit or 200 feet above the top of the Oxide Zone, whichever is deeper. The exemption removes protections under the Safe Drinking Water Act for those aquifers within the designated area to allow mining operations to be permitted by EPA.

Curis applied to ADEQ and EPA for transfer of the 1997 APP and the UIC permit. Due to the changes in adjacent land use, EPA revoked the 1997 UIC permit and requested that Curis submit an application for a new permit. The application for re-issuance of the UIC permit and transfer of the Aquifer Exemption is under EPA review. ADEQ reclassified the APP amendment application to a Significant Amendment application which requires more extensive review and opportunity for public comment. The APP amendment application is undergoing review by ADEQ.

### **GROUNDWATER FLOW MODEL**

Montgomery & Associates conducted a review of the report describing the groundwater flow and transport model developed in support of the Curis Resources APP amendment application for planned in-situ leaching at the FCP. The review focused on: evaluating adequacy of the Curis model for determining potential impacts from in-situ mining operations on planned TOF

recharge and recovery operations in the vicinity of the ISCR project. Our review of the modeling report is given in **Attachment A**.

## **TOWN OF FLORENCE 2020 GENERAL PLAN**

The Town of Florence 2020 General Plan was adopted in 2010 and is the product of an extensive public involvement effort (TOF, 2010). The General Plan is intended to provide guidance for decision makers as they consider proposed development and public infrastructure projects. There are twelve elements of the General Plan, each of which includes identified objectives and strategies. In accordance with the scope of work, Montgomery & Associates evaluated the potential impact of the major General Plan amendment applications submitted on behalf of Curis on the Water and Wastewater and Environmental Planning elements of the General Plan.

The Water and Wastewater Element of the General Plan provides for coordination of water and wastewater service demands with proposed land use and growth areas within the community. The element also provides guidance for the planning of a long-term supply of potable water for existing and future development.

The Environmental Planning Element of the General Plan addresses maintenance of healthy air and water quality within the community and sets forth Town policy for the management of natural resources.

### **Curis General Plan Amendments**

Curis submitted two applications for major amendments to the Florence 2020 General Plan:

- 1) Major General Plan Text Amendment Application PZC-32-11-MGPA (HDI Curis, 2011a)
- 2) Major General Plan Amendment Application PZC-33-11-MGPA (HDI Curis, 2011b)

The PZC-32-11-MGPA application requests amendment of the Land Use Element in Chapter 2 of the General Plan. The present TOF proposed future land use plan is shown on **Figure 1**. The applicant proposed creation of a new land use overlay classification that would be added to the five existing overlays described in the General Plan. The new Natural Resource Development and Alternative Energy (NRDAE) overlay is proposed to allow for land uses associated with alternative energy facilities and low impact resource recovery activities. The latter is defined as mineral resources recovery that does not include open pit or strip mining.

The PZC-33-11-MGPA application requests that the NRDAE overlay be applied to a portion of the Curis property that would be used for the ISCR operations. Curis owns 1,182 acres of land south of Hunt Highway. Of this land, the major general plan amendment application addresses only 990 acres. The portion of the property on the north, between Hunt Highway and the State



Trust Land, and a strip of land beneath the power line corridor on the west of the property are not included in this application **Figure 4**. Only 510 acres of the property would be used for ISCR operations with the balance (480 acres) available for other uses. The applicant requests that the NRDAE overlay be applied to the site to allow for development of the copper resources to occur in the immediate future (proposed First Life) and to allow for a return to the land uses similar to those identified in the General Plan in the more distant future (proposed Second Life). The First Life would last for approximately 20 years and comprise development of the ISCR project combined with a mix of recreational, educational, agricultural, and other uses outside of the ISCR area. The Second Life would occur following completion of ISCR mining operations and would be similar to the Merrill Ranch Planned Unit Development (PUD), but would have less dense residential development and more commercial, open space, and recreational areas.

For decades, the FCP property was outside the TOF incorporated boundary, and as a mining property greater than 5 acres was exempt from zoning requirements (Arizona Revised Statutes: § 11-811.C.2). In 2003, TOF annexed the Curis property under a PUD with a mining overlay for the property (HDI Curis, 2011b). In 2007, the Merrill Ranch PUD was amended to remove the industrial use (mining overlay) for the property. In 2009, the property was purchased for the purposes of mining operations. However, the property is presently within an area designated for Master Planned Community Land Use. Curis is proposing a new PUD entitled Florence Copper Project at Merrill Ranch PUD. In conjunction with the change in proposed land use for the Second Life, remaining infrastructural elements of the First Life would need to be mitigated. These elements could include, for example, surface expressions of plugged and abandoned wells, buried liners, pipelines, and trenches.

### **Potential Impacts of ISCR Project on TOF General Plan**

Montgomery & Associates reviewed the proposed amendments for the FCP for consistency with the objectives and strategies under the Water and Wastewater Element of the 2020 General Plan as described below. If both ISCR mining and nearby TOF groundwater facilities are operated simultaneously, TOF and Curis should coordinate plans and activities to ensure that effects of concurrent operations on groundwater conditions are not problematic for either party.

#### **Water and Wastewater Element**

TOF personnel provided information regarding multiple preliminary alternatives for water reclamation facilities. These facilities may include groundwater production wells, vadose zone recharge wells, or both.

**Objective A:** Ensure a renewable, high quality water supply to serve the Planning Area.

Strategy A.1: Evaluate the location for future underground storage of renewable water supplies.

Two potential locations were provided by TOF for the potential future water reclamation facility for Merrill Ranch Master Planned Community. One of these locations has two options to provide for recharge of reclaimed water that would be generated at the proposed Merrill Ranch Water Reclamation Plant (**Figure 5**): one within the Curis property; and one adjacent to the Curis property. The option within the Curis property includes potential installation of vadose zone recharge wells around the boundary of the State Trust Land parcel. The State Trust land is included within the area that Curis proposes for ISCR operations. As a result, TOF is considering other locations for these recharge wells. If the ISCR operations proceed, recharge in this area would not be appropriate and the recharge wells would need to be relocated. Post-mining installation and use of vadose zone recharge wells within the mining area may potentially be acceptable following closure of the ISCR operations, but further hydrogeologic and groundwater quality evaluations would be required at that time prior to proceeding. The option for locating the water reclamation plant adjacent to the Curis property (southwest corner) also includes potential installation of vadose zone recharge wells. Additional potential production wells are shown in this area on **Figure 6**. If the ISCR operations proceed, recharge in this area may be appropriate, as the recharge operations may enhance the hydraulic containment of the ISCR leach solution; however, we recommend further hydrogeologic evaluations be conducted prior to proceeding with this option.

The second potential location provided by TOF is located about 1 mile further west along the north bank of the Gila River. Any recharge or recovery wells that might be associated with this site would share similar, but perhaps substantially reduced, concerns as noted for the potential site on or adjacent to the Curis property.

Strategy A.2: Regularly evaluate the physical availability and quality of groundwater as land is urbanized and adjust water resource portfolio plans accordingly.

TOF plans included a number of locations for production wells throughout the property now owned by Curis. Some of the well locations are within the boundary of the area of the Aquifer Exemption issued by EPA in conjunction with the 1997 UIC permit for the FCP. The exempted aquifers include the Oxide Zone, and that portion of the Lower Basin Fill Unit beneath the Middle Fine Grained Unit or 200 feet above the top of the Oxide Zone, whichever is deeper. The exemption removes protections under the Safe Drinking Water Act for those aquifers within the designated area. Therefore, if the proposed ISCR activities occur on the Curis property, these well locations should be moved off site. In addition, the thickness of basin fill deposits over the ore body in this area is limited, which makes these locations less desirable as a source of long term water supply. While new drinking water supply wells may not be prohibited within the area of the aquifer exemption, ADEQ may impose more stringent requirements for groundwater quality characterization and monitoring prior to and during operation of any water supply well, whether or not future mining operations occur at FCP.

Curis reported that the proposed ISCR operations would use less groundwater than the agricultural operations presently occurring on site. If the on-site agricultural operations would be

suspended or significantly reduced, overall groundwater withdrawals on the property would be reduced.

Strategy A.3: Investigate the use of stormwater retention to prevent flooding, filter water, recharging the aquifer and leveraging of other potable water resources.

TOF personnel expressed concern that the operations proposed by Curis would have a detrimental effect on the natural recharge of stormwater within the project area. Of particular concern was the potential capture of stormwater by the surface impoundments proposed for the site. While the impoundments can be expected to capture precipitation falling directly on the ponds, the impoundment design provides for diversion of stormwater run-on around the ponds. Any stormwater captured in ponds would not be available for potential recharge; however, this stormwater would become available for make-up water and may offset groundwater demand. No facilities are proposed to be located within the 100-year floodplain of the Gila River.

**Objective B:** Promote sustainable practices in the use and reuse of water resources.

An APP application for the Merrill Ranch Water Reclamation Facility was submitted to ADEQ in 2005 to authorize operation of the facility but the application has been placed on hold due to the lack of wastewater treatment demand caused by the downturn in development in the area. The proposed ISCR operations should not adversely affect the location of the proposed facility at the southwest corner of the Curis property. The major impact of the FCP is the need to relocate the series of recharge wells as discussed in Strategy A.1 above.

Strategy B.1: Monitor groundwater quality and manage groundwater supplies to preserve, protect and enhance the quality of delivered water.

TOF is obligated to regularly monitor the public supply wells within its service area and development of the ISCR project would not change that obligation. However, if production wells would be installed within the Aquifer Exemption area, more frequent monitoring may be required. If the APP and UIC permits would be issued, Curis would be required to conduct extensive groundwater monitoring to ensure protection of groundwater quality.

Strategy B.2: Conduct comprehensive assessments to determine adherence to applicable rules and regulations (the EPA's Capacity, Management, Operations, and Maintenance regulations, cross-connection control, pretreatment program, etc.)

This strategy applies to the sewer collection systems and wastewater treatment plants. The proposed ISCR operations at FCP should have no impact on these plans.

### **Environmental Planning Element**

Montgomery & Associates reviewed the proposed amendments for the FCP for consistency with the objectives and strategies under the Environmental Planning Element of the 2020 General Plan as described below.

**Objective A:** Maintain clean air, water and land.

Strategy A.1: Continue to regularly test and evaluate all municipal potable water sources.

The FCP should have no impact on the ability of Florence to continue to maintain compliance with the Safe Drinking Water program. However, if Florence intends to install potable supply wells on the west side of the Curis property (**Figures 5 and 6**), it is suggested that the potential impact of wells in that location be incorporated into the groundwater model of the Curis ISCR impacts.

Strategy A.2: Evaluate the implementation of a wellhead protection program to minimize reductions in the quality of the potable water supply.

The proposed FCP operations should have no impact on TOF development or implementation of a wellhead protection program.

**Objective B:** Protect and enhance valued environmental resources.

Strategy B.1: Provide for the return of water to the Gila River through flow from a dam or through conveyance of tertiary treated wastewater and stormwater runoff.

The proposed FCP operations should have no impact on any plans to construct a dam or to discharge treated wastewater to the Gila River.

Strategy B.2: Protect the Town's water supply through updating and modernizing its wells and conveyance systems.

The proposed FCP operations should have no impact to this strategy.

**Objective C:** Maintain a healthy community by reducing the impacts of natural and man-made environmental hazards.

Strategy C.1: Protect areas where water infiltration, flood control, pollution reduction and other important natural processes are existing or planned.

All Curis surface facilities are located outside the 100-year floodplain of the Gila River. The ISCR operations would be required to apply for and comply with the Arizona Pollutant Discharge Elimination System (AZPDES) General Permit for Stormwater Discharges Associated

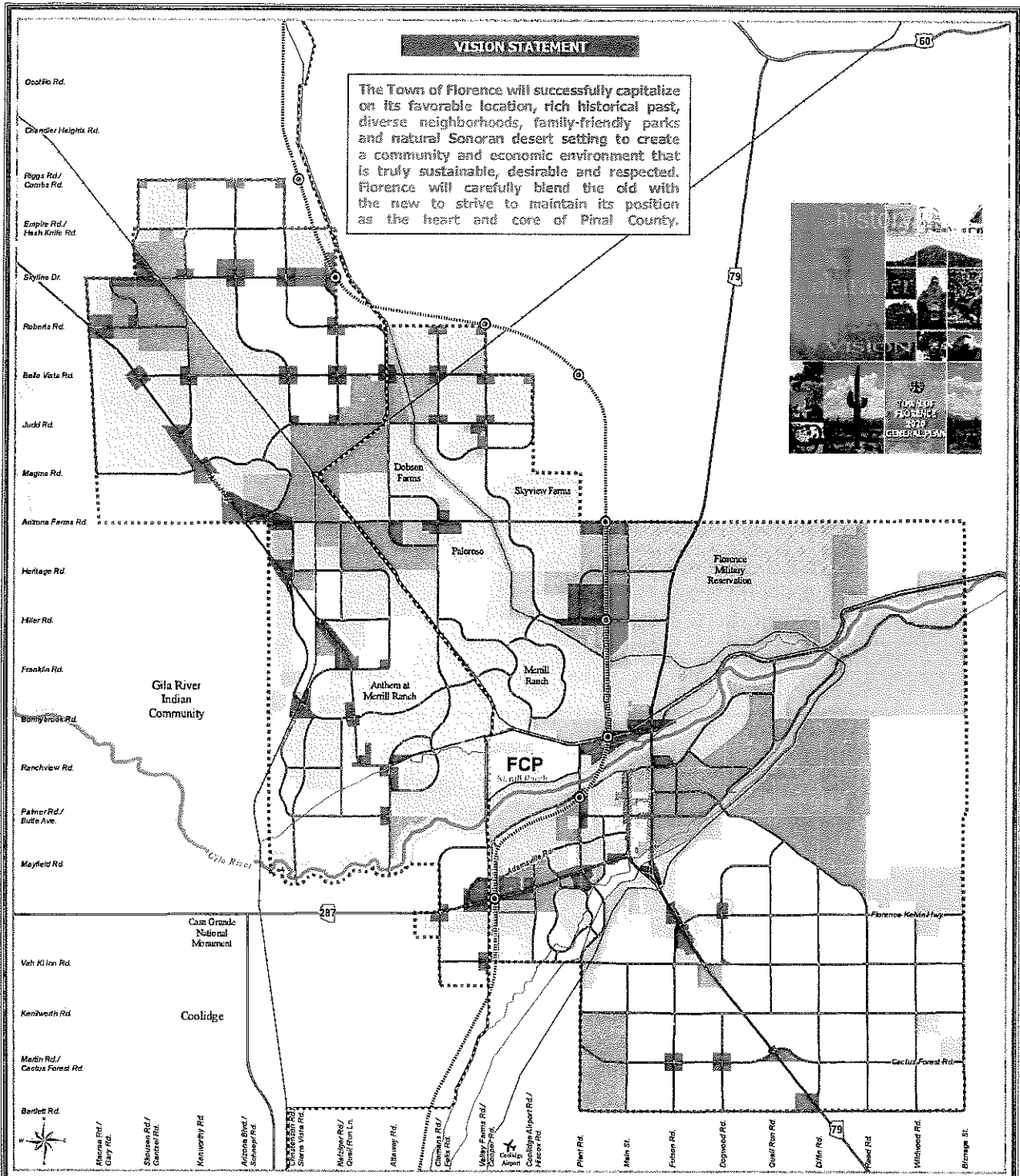
with Industrial Activity – Mineral Industry. According to the APP application, roads, yards, and parking lots would be equipped with stormwater run-on protection and managed as required under the AZPDES General Permit.

Strategy C.2: Approve development proposals only when the protection of water resources has been accomplished in a manner satisfying applicable state and federal requirements.

Curis is required to obtain approval under a number of local, state, and federal permits prior to operation of the ISCR. Both the APP and UIC permits are required to provide protection of water resources.

**REFERENCES**

- Arizona Department of Environmental Quality, 1997. **State of Arizona Aquifer Protection Permit No. P-101704**: January 31, 126 p.
- Montgomery & Associates, 1994, Construction report for wells and piezometers, 2007 summer field program, Phase II area of Green Mountain Project, Fremont County, Wyoming: prepared for Rio Tinto Energy America, Final Report, April 2008, by Montgomery & Associates, Inc.
- Magma Copper Company, 1996. **Magma Florence In-Situ Project Aquifer Protection Permit Application: Five Volumes**: prepared for Magma Copper Company, January 1996.
- HDI Curis, 2010a. **Florence (AZ) Copper Project: Building a Next Generation Copper Producer – Major General Plan Amendment**: prepared by HDICuris, revised May 12, 37 p.
- HDI Curis, 2010b. **Florence Copper Project – Community Presentation**: prepared by HDICuris, June, 29 slides.
- HDI Curis, 2011a. **Florence Copper Project: Application to Amend Aquifer Protection Permit No. 101704 – Volumes 1 through 4**: January.
- HDI Curis, 2011b. **Florence Copper Project: Application to Amend UIC Permit No. AZ396000001 – Volumes 1 and 2**: March.
- HDI Curis, 2011c. **Florence Major General Plan Text Amendment Application – PZC-33-11-MGPA**: submitted to Town of Florence, June 2, 46 p.
- SRK Consulting, 2010. **NI 43-101 Technical Report for the Florence Project, Pinal County, Arizona, USA**: prepared by SRK Consulting, April 20, 130 p.
- Town of Florence, 2010. **Town of Florence 2020 General Plan**. From Town of Florence web site. August 2011.
- U.S. Environmental Protection Agency, 1997a. **Underground Injection Control Program, Area Permit – Class III In-Situ Production of Copper, Permit No. AZ396000001**: issued to BHP Copper, May 1, 102 p.
- U.S. Environmental Protection Agency, 1997b. **Underground Injection Control Aquifer Exemption for EPA Permit #AZ396000001**: May 1, 3 p.



# Town of Florence 2020 General Plan Future Land Use Map \*

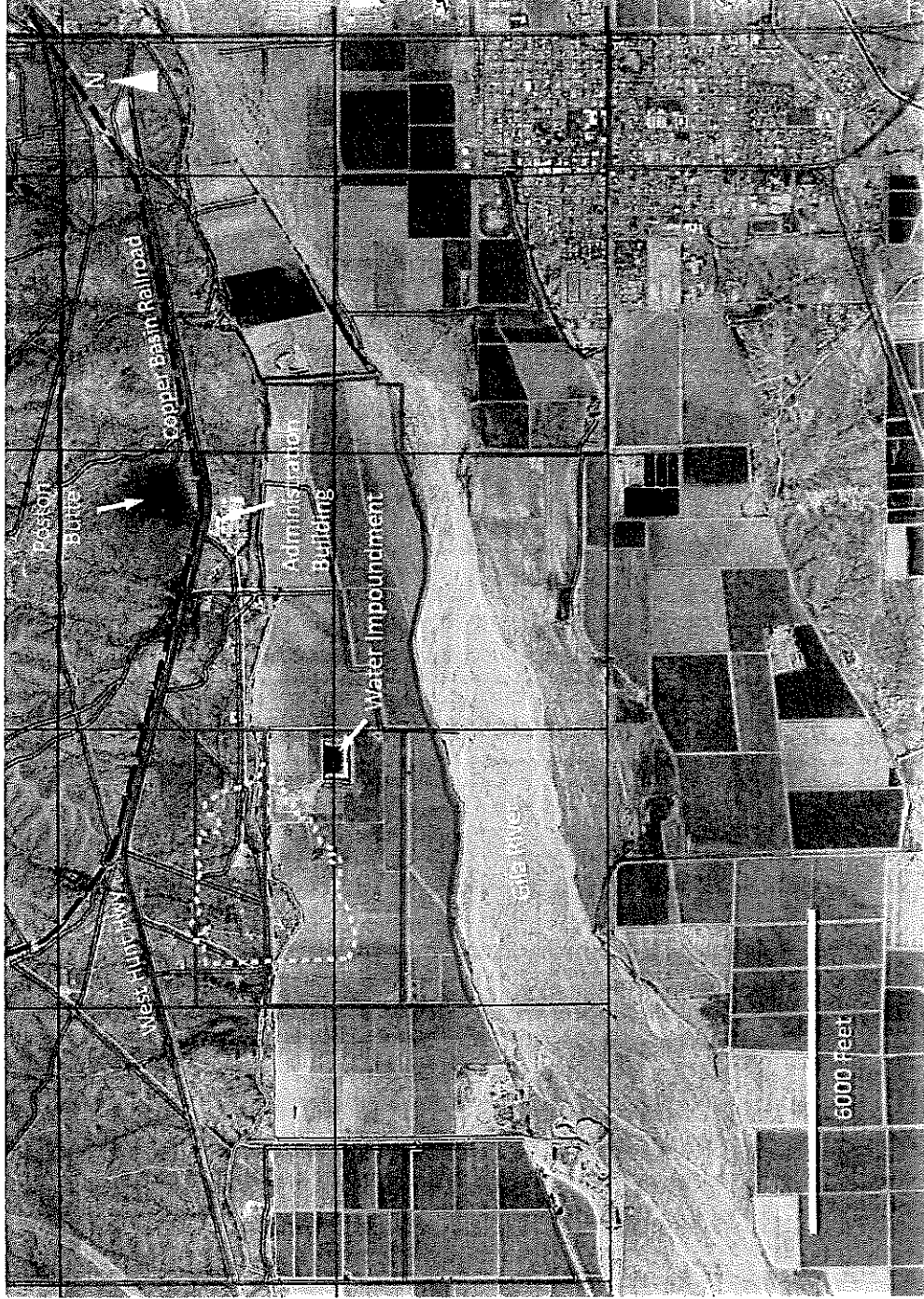
**FIGURE 1. LOCATION MAP**  
(modified from map downloaded from Town of Florence web site)

Legend		Commercial/Office/Industrial		Community/Public		Land Ownership	
Canals	Rural Ranchette Residential (RRR) (0.10-120 DU/AC)	Neighborhood Commercial (NC)	Public/Governmental (P/G)	Bureau of Land Management			
CAP Canal	Low Density Residential (LDR) (1.0-40 DU/AC)	Community Commercial (CC)	Prison (P)	Bureau of Reclamation			
Railroads	Medium Density Residential 1 (MDR1) (4.0-80 DU/AC)	Professional Office (PO)	Military Reservation (MR)	Case Grande National Monument			
Roads	Medium Density Residential 2 (MDR2) (8.0-130 DU/AC)	Employment/Light Industrial (E/LI)	Parks and Recreation (P/R)	Indian Community			
Highways	High Density Residential 1 (HDR1) (12.0-180 DU/AC)	Heavy Industrial (HI)	Open Space (OS)	State Trust Land			
Potential Utility/ Multi-Use Corridor	High Density Residential 2 (HDR2) (16.0-240 DU/AC)						
Conceptual Future Freeway Interchanges		<b>Mixed-Use</b>					
Conceptual Freeway Corridor		Master Planned Community (MPC)					
Conceptual Freeway Corridor with Frontage Road		Downtown Mixed Use (DMU)					
Planning Area		Highway Mixed Use (HMU)					
		Prison/Employment/Light Industrial (P/E/LI)					

\* Amended September 2010 to reflect approved 2010 Major General Plan Amendments.

The land use map is prepared by the Town of Florence Planning Department. The map is a general representation of the future land use plan and is not intended to be used as a legal document. The map is subject to change without notice. The map is not intended to be used as a legal document. The map is subject to change without notice. The map is not intended to be used as a legal document. The map is subject to change without notice.

# Curis Property and Layout



- Curis Resources (Arizona) Inc. Patented Land
- State Mineral Lease
- Outline of deposit @0.05% TCu Cut-off at the depth of 700ft ASL

**FIGURE 2. CURIS BOUNDARY**

Source: HDI Curis, 2010b

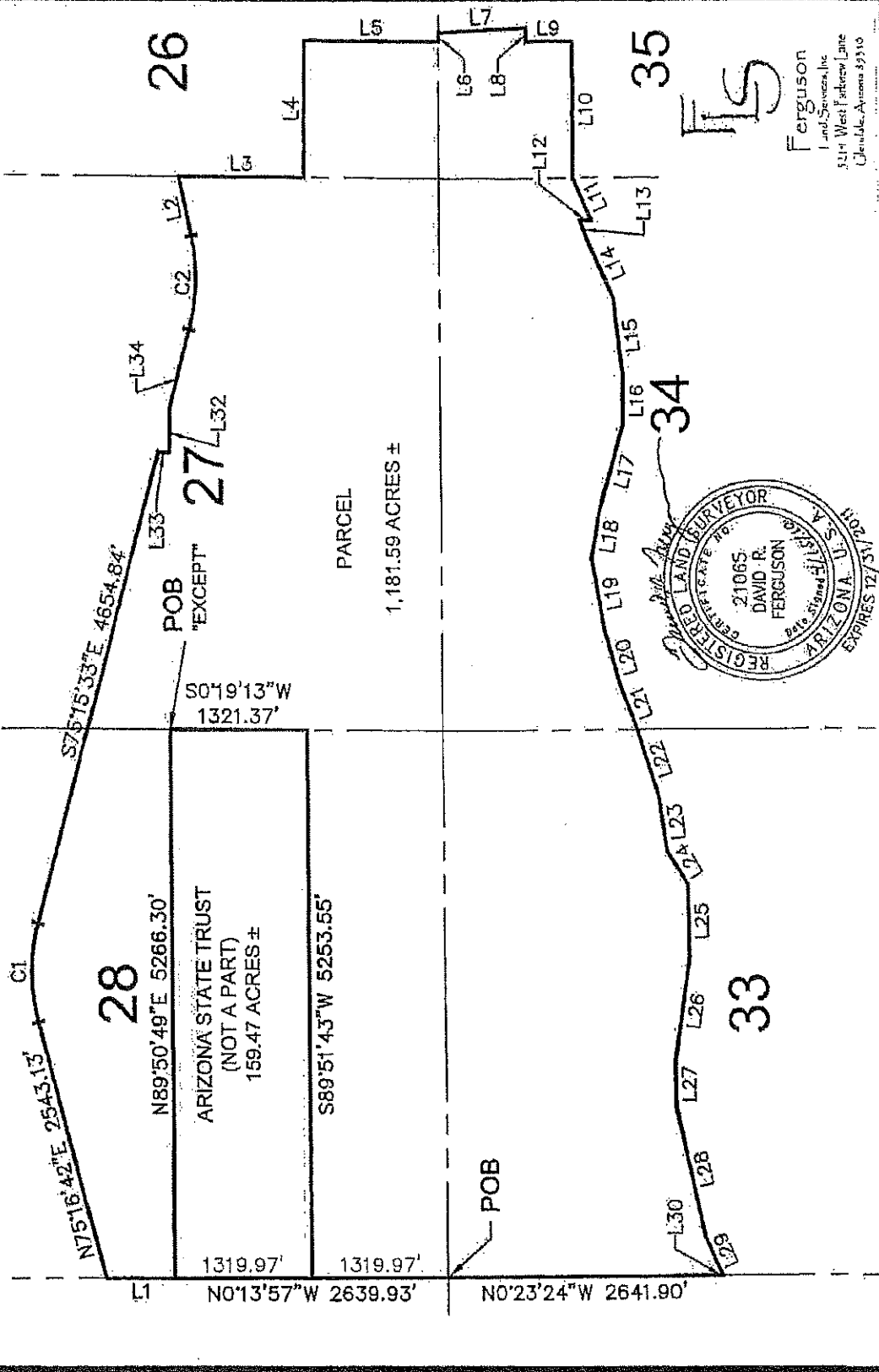


# EXHIBIT "A"

A PARCEL OF LAND LYING WITHIN THE SEC 26, 27, 28, 33, 34 & 35  
TOWNSHIP 4 SOUTH, RANGE 9 EAST OF THE GILA AND  
SALT RIVER MERIDIAN, PINAL COUNTY, ARIZONA



NTS



SHEET 1 OF 2

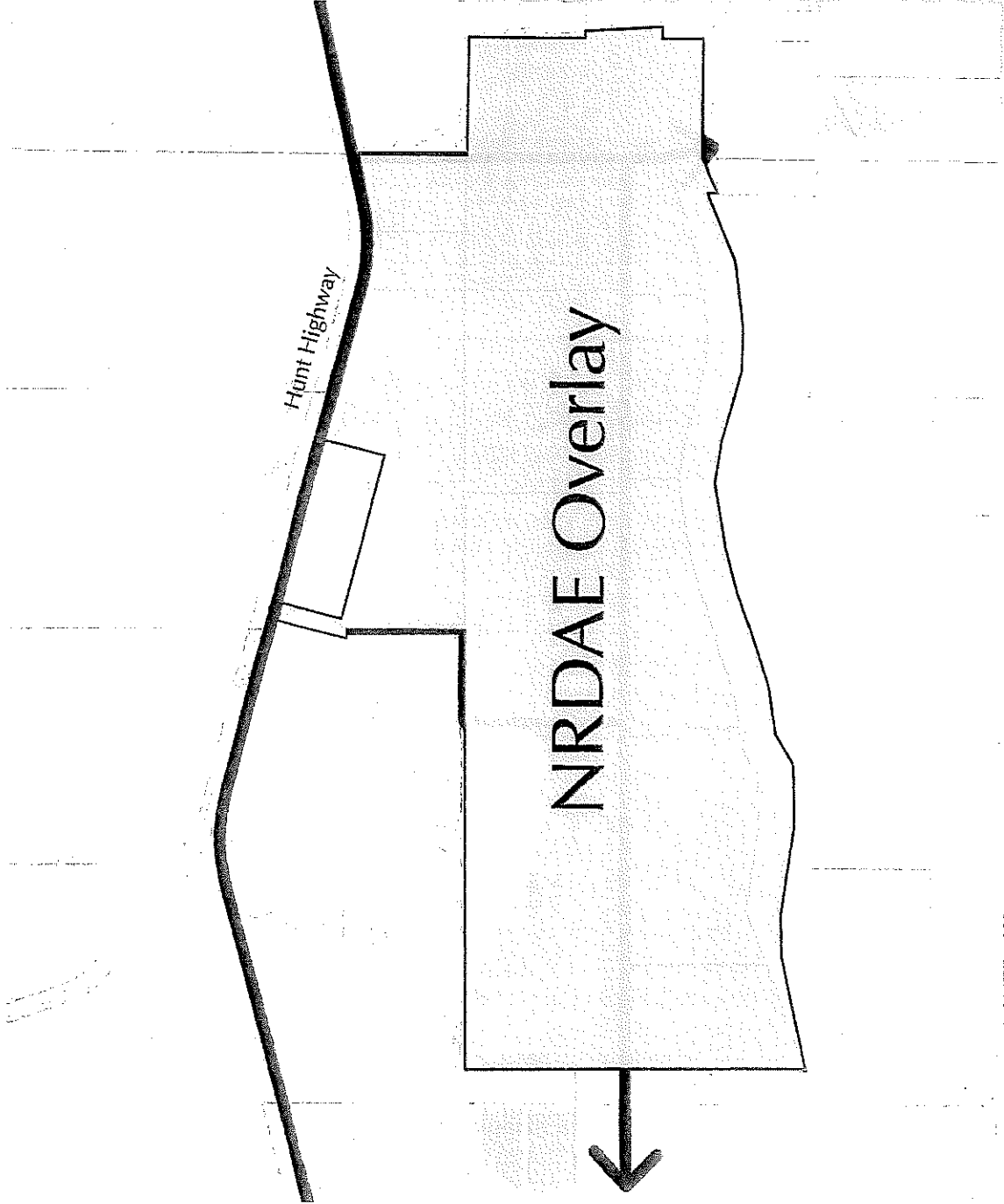
FIGURE 3. LEGAL DESCRIPTION OF CURIS PROPERTY

Source: HDI Curis, 2010a

# FLORENCE COPPER

First Life  
General Plan  
Land Use

Exhibit 3



Source: HDI Curis, 2011c

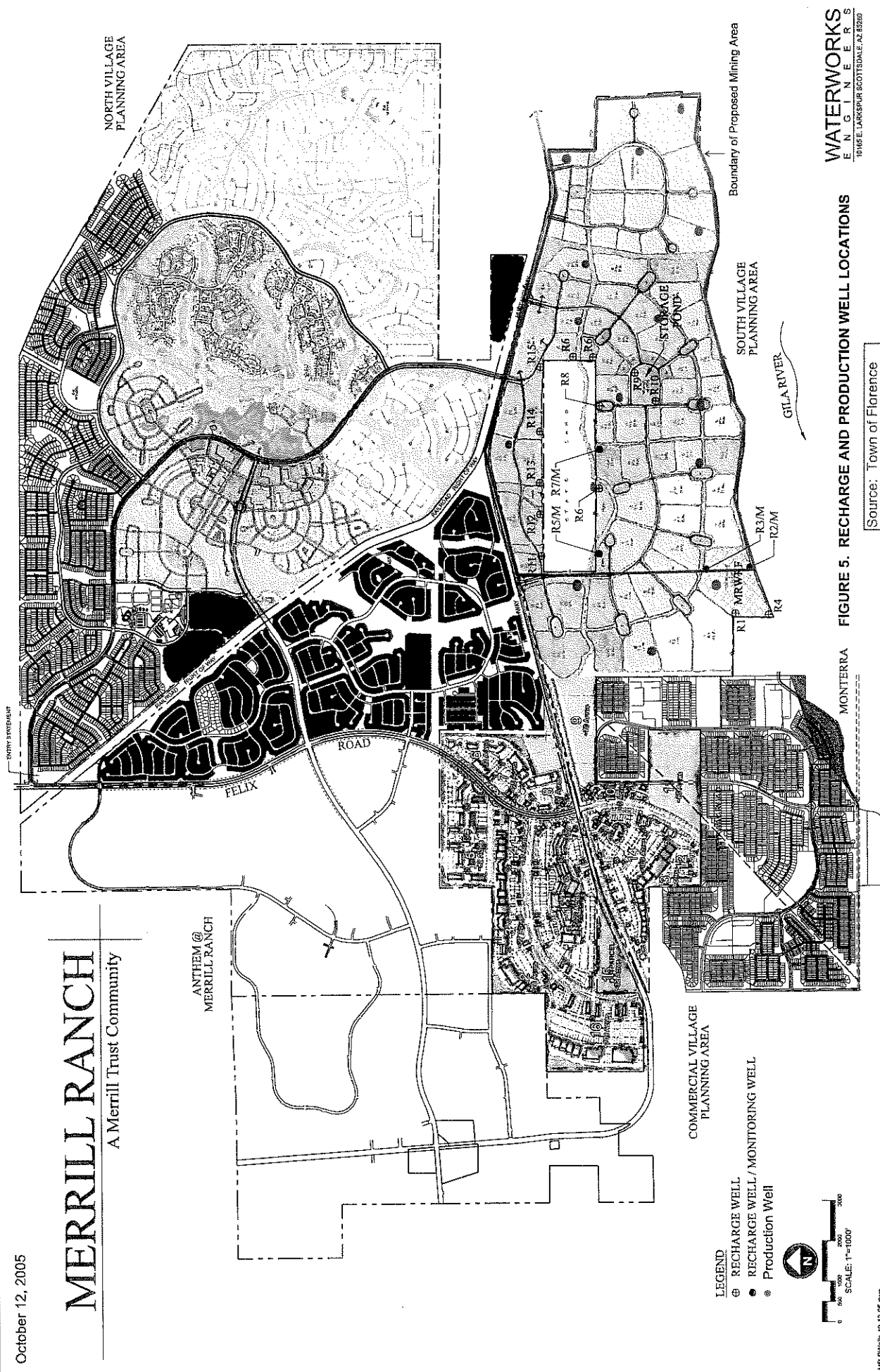
FIGURE 4. NRDAE OVERLAY

October 12, 2005

# MERRILL RANCH

A Merrill Trust Community

ANTHEM @  
MERRILL RANCH



**WATERWORKS**  
E. N. G. J. N. E. E. R. S.  
1016 E. LARKSPUR SCOTSDALE, AZ 85267

FIGURE 5. RECHARGE AND PRODUCTION WELL LOCATIONS

Source: Town of Florence

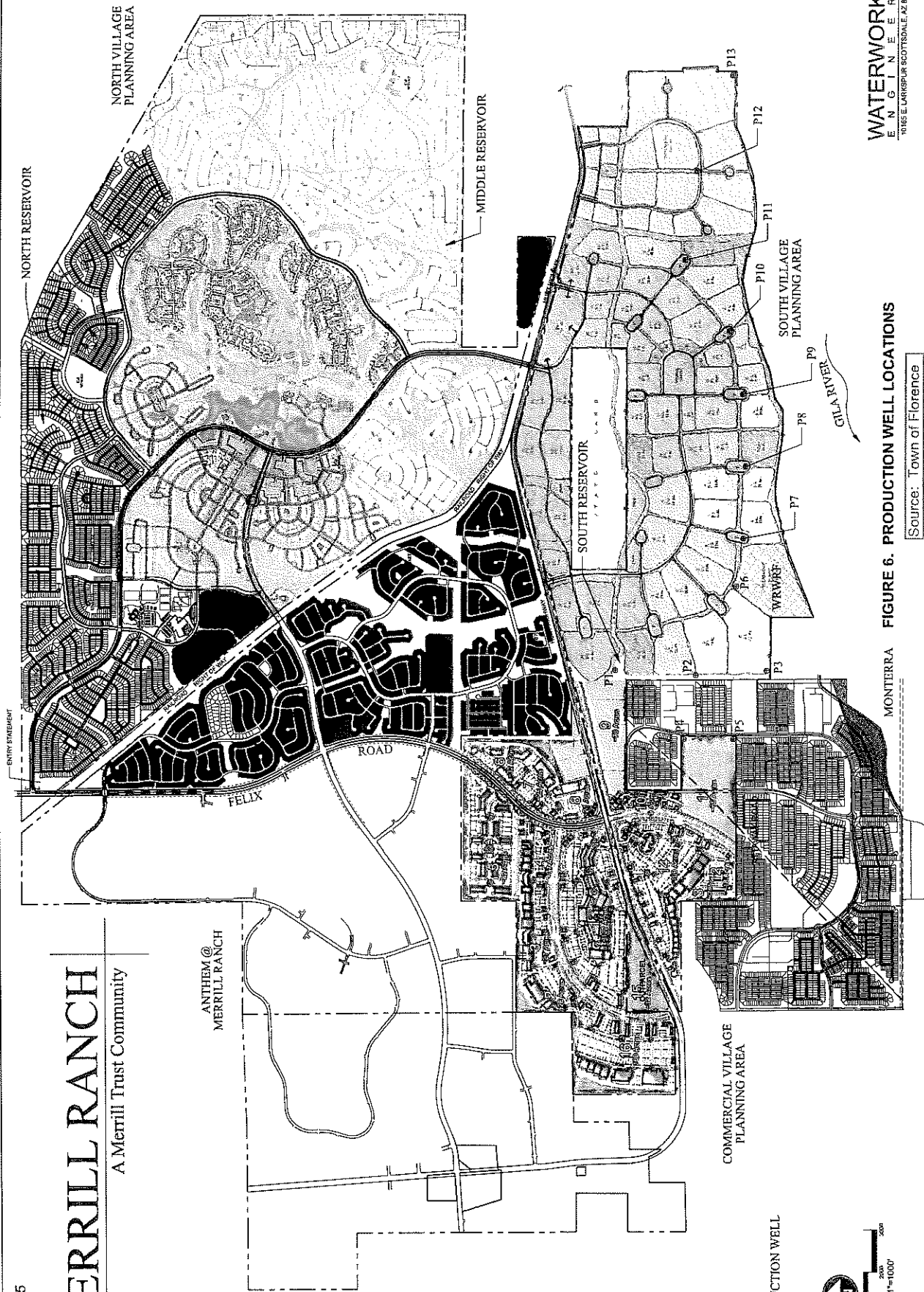
ME-PW11b-001-05.dwg

October 12, 2005

# MERRILL RANCH

A Merrill Trust Community

ANTHEM @  
MERRILL RANCH



**WATERWORKS**  
ENGINEERS  
1195 LARKSPUR SCOTTSDALE, AZ 85268

**FIGURE 6. PRODUCTION WELL LOCATIONS**

Source: Town of Florence

MS-PWRHS-10-12-05.dwg

U.S. Environmental Protection Agency, 1999. **Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona:** presentation prepared by U.S. Environmental Protection Agency, October.



## ATTACHMENT A

Montgomery & Associates conducted a review of the model report, which is Volume 3 of the January 2011 "Application to Amend Aquifer Protection Permit No. 101704" (HDI Curis, 2011a). The report describes the groundwater flow and transport model (designated the Curis Model) developed in support of the Curis Resources Aquifer Protection Permit (APP) amendment application for the proposed in-situ copper recovery (ISCR) operation at the Florence Copper Project (FCP) (HDI Curis, 2011a: Volume 3 of 4). The review focused on evaluating the adequacy of the Curis model for determining potential impacts from in-situ mining operations on planned Town of Florence (TOF) recharge and recovery operations in the vicinity of the FCP. From discussions with TOF, our understanding is the recharge and recovery operations are being considered for a location west from the FCP, rather than on the FCP property as represented in maps made available to Montgomery & Associates. Potential recharge and recovery operations by TOF west of the FCP were not simulated in the Curis Model.

Our review was limited to the model conceptualization, construction, and results presented in the 2011 model report. The 1996 model report prepared for the Magma Copper Company Florence In-Situ Project in support of original APP and Underground Injection Control (UIC) Permit applications (Magma, 1996: Volume 4 of 5) was also reviewed. This model is designated as the Magma Model. Some Curis Model files were made available for our review, but they were not comprehensive and files were only reviewed to clarify questions which arose in the course of evaluating the report. The review did not include: 1) conduct of model simulations presented in the APP Amendment Application to confirm reported results; 2) modification of the model to simulate planned TOF recharge and recovery operations; or 3) a detailed evaluation of the model files to confirm appropriate model code implementation and consistency of model parameters with measured data.

## **BACKGROUND**

The current Curis Model is a modified version of the Magma Model. The Magma model was developed for the 1997 APP and UIC permits for Magma FCP. The Magma model was approved by ADEQ and EPA. The primary differences between the Curis and Magma Models appear to be: 1) the Curis Model layers coincide with the hydrogeologic units in the study area, whereas the Magma Model layers extend laterally across hydrogeologic unit interfaces; and 2) the Curis Model is reported to be calibrated to observed 1984 through 2010 groundwater conditions, whereas the Magma model was only calibrated to 1995 observed conditions.

The 1996 Magma modeling report documents various sensitivity analyses simulated to demonstrate ability of the extraction wells to contain the leach solution. Extraction pumping was simulated at an approximate rate of 9 percent larger than the total injection rate; however, in some of the sensitivity analyses extraction pumping appears to have been simulated at rates of 25 and 35 percent larger than injection rates to achieve containment of leach solution. The 1996 Magma Model projections of leach solution containment were deemed sufficient by the regulatory agencies to support approval of the APP and UIC permits.

## **CURIS MODEL SIMULATIONS**

The Curis Model simulates the following periods: 1984 through 2010 (historical calibration), 2011 through 2032 (predictive mining period), and 2033 through 2062 (predictive post-mining period). The modeling periods are summarized as follows:

- The model starts in transient mode for the 1984 through 2010 historical calibration period and calibration results are presented in the report.

- For the 22-year predictive mining period, injection and extraction pumping were not explicitly simulated in the ore body. Instead, only the excess extraction pumping rate of 1,100 gallons per minute (gpm) was simulated, based on assumed rates of 11,000 gpm for injection and 12,100 gpm for extraction. Therefore, the Curis Model did not directly simulate the proposed injection and extraction operation to assess hydraulic capture of the leach solution during mining. Montgomery & Associates inferred that the amended Curis APP and UIC permit applications rely on the 1996 Magma Model results to demonstrate containment of leaching solutions during the planned 22-year mining operation.
- Simulation of the 30-year predictive post-mining period included particle path and sulfate transport modeling to project potential migration of the “rinse” solution from the ore body after cessation of pumping. Projected groundwater level drawdown due to FCP pumping and extent of post-mining migration of the rinse solution outside of the oxide zone and into the Lower Basin Fill Unit aquifer are relatively small. The post-mining groundwater conditions projected using the Curis Model are consistent with results from the 1996 Magma model. However, further evaluation is recommended once the TOF’s proposed recharge and recovery operation west of the FCP is better defined.

## **CONCLUSIONS AND RECOMMENDATIONS**

The TOF’s future recharge and recovery operations need to be better defined before potential effects of the FCP on these operations can be assessed. Once the proximity of TOF’s future recharge and recovery operations to the FCP are determined, we recommend simulating these operations using the Curis Model to evaluate: 1) if TOF groundwater pumping and recharge substantially change hydraulic gradients in the FCP area; and 2) if the FCP mining and post-mining operations pose any concerns to TOF’s operations.



Our review of the Curis Model report, and the supporting Magma Model report, did not identify substantial problems that would invalidate results presented in the Curis report. The Curis Model appears to be generally consistent with the 1996 Magma Model, which underwent a thorough technical review as part of the original APP and UIC permitting process. The existing APP requires Curis to maintain hydraulic control of leaching solutions during mining, which should be achievable in the FCP hydrogeologic setting given appropriate monitoring and the requirement that Curis will increase extraction rates if necessary to maintain containment.

An evaluation of potential changes in future groundwater conditions which could affect post-mining sulfate movement away from the FCP site was not reported by Curis. No documentation of future pumping is provided in the Curis report. Potential future changes in groundwater pumping by others that could affect hydraulic gradients in the FCP area both during and after mining need to be evaluated. If identified, these changes in groundwater pumping by others, as well as TOF recharge and recovery operations, should be simulated in the model. In order to assess the range of potential effects, we recommend that the additional modeling of TOF recharge and recovery operations include the following range of simulations:

- Conduct simulations with future changes in regional pumping and recharge, such as decreased agricultural pumping or increased recharge from flood events. These model analyses were conducted with the 1996 Magma model during the mining period to evaluate containment, but not for the post-mining period.
- A simulation evaluating the effect of seasonal changes in groundwater pumping, and the resulting change in groundwater movement at the FCP, would be useful to evaluate post-mining sulfate migration. The Curis report describes that direction of groundwater movement changes from northwest to west during the agricultural pumping season. Combined with TOF's potential recharge and extraction operations west from the FCP, seasonal changes in the post-mining flow system may affect post-mining sulfate migration.

- Consistent with the Magma Model, conduct post-mining simulations with a range of transport parameters.

In our review of the Curis report, we did identify some items which, in our opinion, require clarification or further documentation. These items are as follows:

- Documentation of the transient model calibration over the period 1984 through 2010 is not sufficient to fully evaluate adequacy of the model to reproduce observed groundwater conditions over time. Additional transient calibration results, including hydrographs of observed and simulated groundwater levels, should be provided to document that the model is able to reproduce changes in groundwater levels associated with pumping and recharge in the model area. Improved documentation of the ability of the model to reproduce vertical differences in hydraulic head should also be provided.
- A discussion should be provided on how simulations of leach solution containment demonstrated in the 1996 Magma Model are applicable to the current Curis modeling study.
- An illustration should be provided to document projected groundwater levels at end of mining operations for purposes of depicting the hydraulic sink around the leach area.