BEFORE THE ENVIRONMENTAL APPEALS BOARD
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C.

In re:	)	
Florence Copper, Inc.	)	UIC Appeal No. 17-03
UIC Permit No. R9UIC-AZ3-FY11-1	)	

PERMITTEE FLORENCE COPPER, INC.'s RESPONSE TO PETITION FOR REVIEW FILED BY SWVP-GTIS MR, LLC AND THE TOWN OF FLORENCE

ATTACHMENT 4

Southwest Value Partners' Comments on Draft Permit

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April 10, 2015

VIA E-MAIL and U.S. MAIL

U.S. Environmental Protection Agency
Region 9
Drinking Water Protection Section
Mail Code WTR-3-2
75 Hawthorne Street
San Francisco, CA 94105
Attn: Nancy Rumrill

Re: Florence Copper Project
Draft Underground Injection Control Permit R9UIC-AZ3-FY11-1

Ms. Rumrill:

With this letter, Southwest Value Partners (SWVP) is providing its comments on the Draft Underground Injection Control (UIC) Area Permit for the in-situ copper recovery project proposed by Florence Copper Inc. (FCI). As EPA Region 9 knows, SWVP has spent many years challenging ADEQ's Aquifer Protection Permit issued for this same project. Following a 34-day hearing, both the assigned Administrative Law Judge (ALJ) and then the Arizona Water Quality Appeals Board (WQAB) determined that ADEQ's permit (which relied on virtually the same FCI statements on which EPA now relies) was unlawful, arbitrary, based on clearly invalid technical judgments, and unreasonable as a matter of law.

Because of the fatal flaws in the APP, FCI was required to prepare and submit an application for significant amendment and ADEQ must ensure that its substantially revised permit correct all of the shortcomings identified by the ALJ and the WQAB. ADEQ's refusal to heed the concerns we raised during the comment period on its permit caused substantial delay and cost to all parties involved, including to FCI and ADEQ. We implore EPA to avoid repeating the same mistake made by ADEQ.

In most fundamental respects, the proposed UIC permit contains the same flaws that were fatal to the ADEQ permit. We repeatedly have offered to provide EPA with the evidence that led to remand of the ADEQ permit, including key results and reports from the previous ISCR test conducted at this site. Unfortunately, like ADEQ before it, EPA repeatedly has refused to consider that evidence. We do not know if EPA's unwillingness to learn from ADEQ's failure reflects a bias toward the applicant, a too casual review process, or both, but it is unacceptable and benefits no one.

The fact that EPA's draft UIC permit contains many of the same fatal flaws that plagued the ADEQ permit shows that EPAs has not performed a "thorough technical review" of the FCI application that it claims to have performed. Rather, the agency has displayed an astonishing willingness to issue a permit without the most basic due diligence. Should EPA continue to disregard the evidence that was so persuasive in our successful appeal of the ADEQ permit, and ignore the highly relevant comments submitted with this letter, please know that SWVP will pursue all available legal options to challenge this permit. We have great confidence that without significant changes to the draft UIC permit, it (like the ADEQ permit) will not be able to survive the scrutiny of appeal.

In our view, EPA must withdraw the draft permit and start its process over based on the issues identified in these comments and based on lessons learned in the appeal of ADEQ's permit. Regrettably, our experience in this matter to date is that EPA does not intend to address this project appropriately and, if the past is any guide, EPA will act just as ADEQ acted and ignore the substantial permit flaws we have identified. If the EPA elects to ignore our comments, we challenge it to at least provide detailed and considered responses to the comments and questions presented herein, so that our further actions on this matter can be as focused as possible. A simple recitation that the permit reflects EPA's judgments, without convincing analysis and substantial support as to the reasonableness of those judgments, will ensure a contested outcome.

Sincerely,

Ronnie P. Hawks
Russell R. Yurk
Counsel for Southwest Value Partners

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Southwest Value Partners
Comments on
Draft Underground Injection Control Permit R9UIC-AZ3-FY11-1
Issued to Florence Copper, Inc. for the Florence Copper Project
Florence, Arizona

Preface

Southwest Value Partners (SWVP) owns significant amounts of land adjacent to FCI's mine site. This land, like FCI's, is subject to a master development plan approved by the Town and its residents and will be developed for residential and commercial uses. That development will require significant amounts of water for drinking and potable uses. The primary source of that water will be the aquifer into which FCI proposes to inject acid mining solutions. Any escape of mining contaminants from FCI's property would immediately and directly impact current and future uses of land owned by SWVP and the groundwater necessary for those uses.

For the reasons that follow, the Draft Permit is inappropriate and illegal. SWVP's comments are supported by detailed appendices which are considered fully incorporated into, and a part of, the comments. The comments and appendices include numerous references to supporting documents, which are provided electronically on thumb drives submitted with the comments to EPA Region 9 in San Francisco.

The comments were developed based upon a thorough review of numerous additional documents and data that may not be directly cited in the comments, including groundwater models and water quality information. Only by reviewing the entire record available for this site were SWVP and its consultants and experts able to understand the proposed mining process, its potential impacts, and the serious flaws in the Draft Permit. Because EPA Region 9 must conduct a similar review of the record to develop a full understanding of FCI's proposal and its ramifications, hundreds of additional documents not directly cited in the comments are being provided on the accompanying thumb drives. These include all of the reports and data obtained under subpoena from FCI about the BHP pilot test at this same site; the hearing transcripts, briefs, and decisions in the 2013-14 administrative appeal of FCI's state Aquifer Protection Permit; and information obtained through public records requests to ADEQ, EPA, and other agencies.

SWVP retained Lee Wilson, Ph.D., to review and analyze the documents and issues relevant to the Draft Permit. These comments include his analysis and conclusions regarding the Draft Permit and FCI's proposals. Dr. Wilson is a Certified Professional Hydrogeologist with over 40 years of experience. He has performed technical analysis on water resource issues for over 500 projects, been a project director on dozens of environmental management and impact evaluation projects, and served for 17 years as a USEPA mission contractor. His CV is provided in Appendix O.

SWVP also retained Kevin Hebert and Nathan Miller of Southwest Ground-Water Consultants, Inc. to review and analyze the permit record, local hydrogeology, and FCI's groundwater modeling efforts. Their opinions and conclusions are also included in these comments. Their CVs are provided in Appendix O as well.

SWVP joins in the comments filed by the Town of Florence regarding the Draft Permit, and incorporates those comments by reference as if contained herein.

Finally, SWVP submitted to EPA Region 9 a Freedom of Information Act request for documents relevant to the Draft Permit on October 3, 2014.[1] EPA's response to that request was provided in piecemeal fashion over the next six months. Hundreds of documents were received a week or less before the comments were due.[2] This did not allow a reasonable time to review and analyze the responsive documents and incorporate any additional relevant information into these comments before the April 13, 2015 deadline.[3] SWVP requested EPA to extend the deadline because of EPA's delayed and piecemeal production of documents responsive to the FOIA request, but EPA decline to extend the deadline beyond April 13, 2015. Consequently, SWVP reserves the right to supplement these comments as necessary after we have a reasonable opportunity to review the documents only recently produced by EPA.

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1 Letter from Janis Bladine to Nancy Rumrill (October 3, 2014).

2 Only on April 7, 2015, four business days before these comments were due, did SWVP receive notice that the last of the responsive documents were available for review electronically on EPA's FOIA site. *See* Email to Russell Yurk (April 7, 2015).

3 Nor, to SWVP's knowledge, was the general public made aware that these relevant documents were available for review before comments were due.

Comments on UIC Permit No. R9UIC-AZ3-FY11-1

Executive Summary

Critical information has been ignored. The draft UIC permit for FCI is fatally flawed. As explained in Section A of these comments, EPA chose to deliberately ignore data from an identical project at the identical site, the BHP Pilot Test conducted in 1997-1998. These are forensic data that reveal critical issues important to drafting of a proper permit. The data demonstrate: (1) site heterogeneity that has not been properly modeled by FCI; (2) failure of past hydraulic control that is not addressed by EPA's proposed permit conditions; and (3) a need for monitoring far better than EPA proposes to require. EPA's ostrich defense of its position – that lessons learned from a past experiment have no value in regulating a new experiment – is a blatant acknowledgment that the agency has not taken reasonable care in drafting the FCI permit. There simply is no justification for EPA to ignore the world's only source of information about the actual impacts of ISCR copper mining, the BHP Pilot Test, especially given it is from a clone of the project now proposed.

The aquifer exemption is invalid. As demonstrated in Section B, the aquifer exemption granted to FCI by EPA defies logic and it is contrary to law, policy, and facts. A critical fact objection is that EPA granted an exemption of several hundred acres for a project with an intended impact of barely 2 acres. And this exemption covers a far more urbanized area than when first approved in 1997. A critical policy objection is that Region 9 has ignored its own guidance that exemptions be as small as possible, and inside of the Area of Review. A critical legal objection is to EPA's defense of the exemption by arguing that a poor decision made two decades ago is immortal. Continuing to extend the exemption upward into the regional underground source of drinking water is another egregious mistake, one that even ADEQ did not make.

The permit needs a substantial rewrite. As discussed in Section C, the FCI permit must be rewritten to correct the two fatal flaws noted above: failure to make use of lessons learned from the prior project; and failure to reconcile the aquifer exemption with the specific project being permitted. Fixing the latter is easy, and simply requires EPA to follow its own guidance by limiting the exemption to the oxide zone inside the Area of Review and specifically to the area where contamination of the aquifer is necessary for the test to occur. A permit condition should be added to explicitly protect the LBFU regional aquifer, and the Point of Compliance wells should be moved to just outside the exempted aquifer, such as to the wells EPA now considers to be supplemental monitoring wells.

To ensure that problems from the BHP pilot do not occur again, or are effectively monitored if they do occur, various permit conditions must be revised: (1) to address known effects from well inefficiencies; (2) to require proof that all injected acid has been accounted for; (3) to require a rigorous program of aquifer testing; (4) to require FCI to submit models that demonstrably predict known site conditions; (5) to use electrical conductivity in a responsible way to evaluate permit compliance; and (6) to specify a monitoring program with appropriately located wells and effective collection of data.

Additional issues. Our final comments, in Section D, outline numerous changes to the permit that address many permit issues other than the BHP data and the aquifer exemption, and to which EPA must pay attention if a competent permit is to result.

Comments

A. EPA Failed to Exercise Reasonable Care in Drafting the UIC Permit.

EPA has an unquestioned obligation to exercise reasonable care in drafting its permits to ensure the environment is protected. Reasonable care means diligent investigation of claims made in an application, good faith review of public comments, proper attention to the agency's established regulations, policies and practices, and skilled use of relevant data and sound science. Reasonable care requires that EPA demonstrate a high level of professionalism and that the result is a permit with appropriate terms and compliance conditions.

EPA has breached its responsibility to take reasonable care by ignoring these obligations in drafting a UIC permit for the FCI ISCR pilot project mine in Florence, Arizona.

1. The FCI PTF is a clone of the previously conducted BHP Pilot Test.

Nearly 20 years ago the mining company BHP operated a failed ISCR project in a location that is in virtually the same location as the proposed FCI project. The two pilots are virtual clones: the same ore body; the same hydrology; the same basic layout of injection, recovery and observation wells; the same concepts and monitoring relied on for hydraulic control; and the same concepts and monitoring relied on for restoration. Beyond the fact that the project surroundings are vastly different now than when BHP tested the site nearly two decades ago (see comments in Part B, on aquifer exemption), the FCI project differs from its predecessor primarily by being longer in duration, hence a greater volume of acid will be injected, and thus posing a greater risk to the environment.

No competent permit can be written for the FCI pilot without attention being paid to the lessons learned from the BHP pilot. Yet EPA has drafted the FCI permit without taking even the most cursory steps to ensure that problems observed in that pilot are now addressed.

We challenge EPA to explain why the data and scientific insights established by the BHP test are not critical information that any regulator would want in fashioning a permit for FCI's PTF.

2. EPA knows that BHP pilot test data is important, but ignored it.

Table A-1 identifies instances where FCI's application cites results of the BHP pilot as proof to EPA that the ISCR process is safe. However, to support its claims FCI submitted only a short letter report, which interpreted selected data as showing successful hydraulic control during a portion of the test. EPA never asked for additional data to support FCI's representations, and has specifically rejected our offers to provide the data.

We challenge EPA to justify how it can ignore data that are so relevant to the FCI project, that the data caused the ADEQ permit to be voided and remanded for significant amendments.

3. FCI's fight to hide the BHP pilot test data underscores its importance.

SWVP sought and FCI fought disclosure of the BHP data. After FCI refused SWVP's requests for the data, public records requests were made to many agencies, including EPA, none of whom had the information. SWVP then requested the permitting agencies, ADEQ and EPA, to obtain and use the data. The agencies refused.

This forced SWVP to subpoena the information in the State administrative hearing. And even then, FCI would not produce the information - fighting the subpoena, forcing SWVP to respond to a motion to quash, and requiring the ALJ to order FCI to release what turned out to be 47.4 GB of relevant reports and data.

FCI's fight to withhold the BHP information underscores its importance. If there were no important information from the BHP Pilot Test other than the thin letter report already provided to Region 9 and ADEQ, why would have FCI have fought so hard to keep it secret? The answer: because the results from the BHP test are extremely important and relevant to a fair analysis of FCI's proposal, but not favorable to FCI's defense of their assumptions and models. EPA has accepted the FCI assumptions and models in complete ignorance of what the BHP results document as to the reality of the site.

We challenge EPA to explain how it has reached the conclusion that allowing FCI to withhold data is consistent with good practice in writing a permit.

4. EPA has demonstrated a continued disregard for public input.

Appendix E documents repeated requests from SWVP that EPA obtain and make effective use of the entire BHP data set. Until recently, EPA ignored or rejected each request. And in its March production of data, resulting from a Freedom of Information Act (FOIA) request, EPA acknowledged having given the BHP information no consideration.

Indeed, there is nothing in the UIC record to suggest EPA has ever paid meaningful attention to any issue raised by any member of the public with respect to the FCI project. The permit itself provides no provisions that will enable the public to have timely access to the monitoring data generated by the project. SWVP, the Town of Florence, and others will be forced to file FOIA requests, with information obtained long after damage has been done and remediation is either not possible or is unnecessarily difficult.

We challenge EPA to identify any meaningful aspect of the draft UIC permit that reflects public input.

5. Issuing permits without properly reviewing the BHP pilot test data has been shown to be a mistake.

EPA has made the same mistake as ADEQ by ignoring SWVP's requests that it obtain and analyze the full BHP data set. SWVP challenged the aquifer protection permit that ADEQ issued to FCI in part because that agency refused to obtain the BHP data, with the result that the permit gave only superficial consideration to actual site conditions. The data obtained by SWVP through subpoena proved that this omission led to egregious flaws in the permit.

As summarized in Appendix A, ADEQ's disregard for the BHP data was a major consideration in the decision of the ALJ to reject the permit, a decision affirmed by the Arizona Water Quality Appeals Board, and from which FCI did not appeal. EPA's continued disregard for actual data seems certain to doom the UIC permit to the same fate, as it is proof that EPA has not undertaken the required thorough evaluation of the UIC application.

We challenge EPA to explain why it is not arbitrary or technically invalid to ignore a comprehensive adjudicatory proceeding that addressed issues identical to those relevant to the draft UIC permit.

6. EPA ignored conclusive evidence of aquifer heterogeneity.

Every submittal from FCI assumes that in terms of hydrogeology, the ore body is substantially homogeneous at any scale that is relevant to aquifer protection. EPA appears content to accept this assumption. Graphics in Appendix C provide evidence from the BHP test that proves otherwise:

- An interpretive map illustrating the presence of a 'short circuit' in the aquifer
- A map of hydraulic conductivity values demonstrating aquifer heterogeneity
- A map of tracer test results demonstrating aquifer heterogeneity

These attributes of the ore body mean that there will be preferential transport of solutes. This is a site characteristic known to be among the most critical considerations in evaluating aquifer contamination and restoration, and is particularly of concern here given that FCI's pilot project is intended to determine the effects of deliberate pollution by injection of sulfuric acid.

EPA may have signed off on the FCI argument that short circuits will average out over a large project. This argument ignores that the critical locations for acid escape are at the margin of a project, where preferential flow (especially short circuits) can allow acid escape.

We challenge EPA to explain how the permit guarantees the definitive identification of short circuits and preferential flow at the margin of the pilot project; or in the alternative why such preferential flow is irrelevant to hydraulic control.

7. EPA ignored evidence revealing severe problems with FCI's groundwater models.

EPA could easily have used the BHP data to answer this question: *are the models on which FCI relies consistent with the conditions demonstrated by the BHP pilot*? The answer to the question, a resounding NO, should have caused EPA to carefully investigate those models to make sure they were consistent with known site conditions. EPA would have found that none of FCI's models come close to simulating the actual conditions observed during the BHP test, whether flow or solute transport.

The primary reason for this is simple: the FCI models treat the aquifer as an equivalent porous medium (EPM) in which each aquifer layer is entirely homogenous. Minor heterogeneity is limited to modest differences in properties between layers, and the effects of a few faults. The heterogeneity shown in the BHP data is nowhere represented in the FCI models.

BHP itself was confounded by finding that it could not reconcile the results of its flow model with its solute transport model. As a result, the company questioned whether it could continue to use an EPM assumption in modeling the site; see Appendix C. The record shows that EPA has spent a great deal of effort in addressing possible fault-caused heterogeneity in the FCI models, while never asking FCI to incorporate the heterogeneity actually observed at the site by BHP. Nor has EPA asked FCI to defend use of the EPM concept, or to assess use of modeling methods designed specifically for fractured and dual porosity materials.

EPA's blithe acceptance of the FCI model is in direct contrast to agency guidance, which emphasizes that it is important to base predictive tools on observed conditions, and to test them against such conditions. The guidance directs EPA to judge the worth of a model by its ability to match the actual hydrogeologic environment. EPA must explain how it has complied with this guidance.

We challenge EPA to provide any evidence that the FCI models are accurate in predicting the historic effects of the BHP pilot test; and if there is no such evidence, why EPA is confident in the predictive ability of the models.

8. EPA ignored conclusive evidence of failed hydraulic control.

Review of the BHP test data by SWVP experts reveals that the pilot was both a success and a failure. It succeeded in generating data that can be used to evaluate the safety of ISCR mining at this site. But it failed because even when BHP was in nominal compliance with its permit conditions – conditions essentially identical to those now proposed – there were times when BHP failed to contain the injected acid solution and Region 9 was none the wiser. The relevant data showing impermissible acid escape are presented in Appendix A.

Horizontal containment of acid failed during the restoration phase of the project, a phase that FCI neglected to discuss in its representations. The data are consistent with the expectation that short circuits can be important in judging the real-world effects of acid migration at the margin of the project. As discussed in Section B of these comments, this makes it essential that permit terms be written so that short circuits will be identified and their effects determined.

Additionally, vertical loss of copper-bearing acid to the regional aquifer above the ore body was both expected and observed, and is also predicted by the models FCI submitted to EPA. For BHP, vertical excursions were allowed by the permit and of concern only because it might lose potential economic resource. Vertical excursions were not allowed by the ADEQ permit, and will be precluded in the UIC permit once EPA properly limits its aquifer exemption to protect the regional aquifer.

We challenge EPA to explain why it is reasonable for their draft permit to contain terms which are known to have failed at the BHP project.

B. EPA Adopted an Improper and Illegal Aquifer Exemption.

Although Region 9 revoked the existing UIC permit issued to BHP Copper in 1997, at FCI's request it has left in place the aquifer exemption issued in the same year ("1997 Aquifer Exemption"). The 1997 exemption was based upon an application and permit for full commercial operations across the entire ore body. For certain, the surface environment around the mine is now vastly different, and the FCI pilot has a miniscule scope compared to the BHP mine. The logic of the prior exemption no longer applies, if it ever did.

Region 9 should have revoked the 1997 Aquifer Exemption. If Region 9 allows any exemption, it should be limited it to the area actually to be impacted by the pilot project. EPA's failure to do so, and the insistence on leaving the 1997 Aquifer Exemption in place, reflects extraordinarily poor judgment, and is contradicted by the law and by EPA policy.

1. Conditions in 2015 are far different than they were when the exemption was first granted in 1997.

Appendix H documents differences in land use in the area between the mid-1990s and today. It includes maps showing the comparative size of lands controlled by FCI now and by Magma Copper (BHP's predecessor) in 1996. Air photos underlying the maps reveal how extensively land use has changed. The Appendix documents that the 1997 Aquifer Exemption is based on circumstances that no longer exist.

When Magma submitted the application for a UIC permit and aquifer exemption in January 1996, the site was not within an incorporated municipality and the closest residential development downgradient (to the north, northwest, and west) of the prospective mine was approximately 10 miles away. Magma controlled almost 10,000 acres, and the nearest property not owned by a mining interest was nearly three miles downgradient. Thus Magma could state with confidence that the downgradient area adjoining the mine would not be used for public water supply.

Contrasts between the mine site in 1996 and those today could not be more striking:

- the proposed mine is now inside the municipal limits of the Town of Florence;
- the land owned by FCI is now zoned for residential use;
- FCI itself plans for the mine site to be in residential use after it completes mining;
- FCI controls less than 1350 acres, most of which has zoning that prohibits mining, and the rest requires the State of Arizona to approve continued leases;

- existing residential development is only 1 mile downgradient; and
- private lands are less than one-quarter mile downgradient.

Perhaps most important, as shown by the Town of Florence's plan to provide an assured 100-year supply of water, the deep section of LBFU sediments immediately west of the ore body is a prime location for future water supply wells. As Florence and the surrounding areas grow, well fields now relied upon are projected to dry up, which will mandate a shift of pumping ever closer to the site of this PTF project. The fact that planning would locate a well so near the FCI property is not surprising considering that, until recently, plans to mine the ore body by injection of acid had been abandoned.

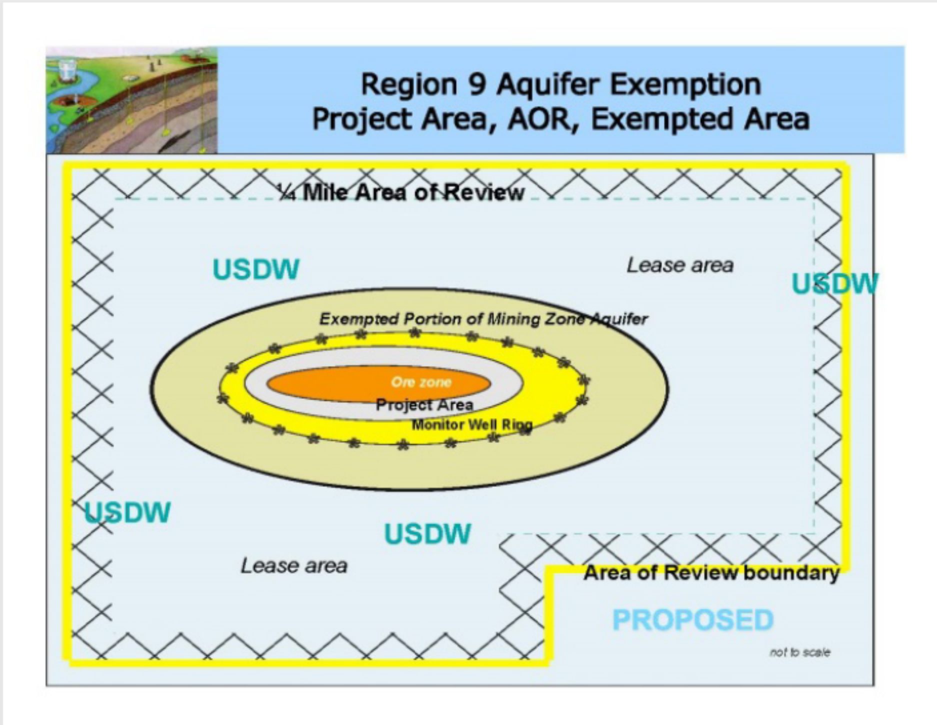
We challenge EPA to explain why it believes the profound changes in circumstances in the area of the FCI project are meaningless to the granting of an aquifer exemption.

2. EPA has regulations and guidance it must follow when exempting aquifers.

40 CFR 146.4 provides a narrow basis for exempting an aquifer from UIC protection. Reduced to the basics, an Underground Source of Drinking Water (USDW) can be exempted if it contains mineral resources expected to be commercially producible, *and* if there are technical reasons the aquifer is not and cannot become a source of potable supply.

Beyond the regulations, EPA Region 9 has published guidance that requires the agency to take all aquifer exemptions very seriously. In particular, when addressing a proposed mining permit, the exempted area is to be kept *as small as possible* while still allowing mineral extraction. Appendix F provides specific references to recent EPA rule-making and permitting decisions that implement this policy. It also cites the source of the figure below. This Region 9 product that has recently been used to show an exemption is appropriate only inside the Area of Review, and not far outside the ring of monitoring wells.

Figure 1. Region 9 Exemption Guidance



We challenge EPA to cite any facts, established policies, or incontrovertible legal basis for its decision to not use the figure above as the basis for defining the aquifer exemption appropriate for the FCI pilot project.

3. There is no basis for exemption of the LBFU.

The Lower Basin Fill Unit (LBFU) is the primary regional aquifer in the area of the FCI project, and immediately overlies the ore body. It was mistakenly included in the exemption of 1997, and is assuredly not eligible for exemption today. As explained more fully in Appendix F, this exemption – indeed any exemption -- of the LBFU violates EPA's regulations and guidance. An exemption is barred because:

- even ADEQ, with all their missteps on the aquifer protection permit, acknowledge that the LBFU is a USDW, that requires protection;
- established plans exist by which the aquifer within the exempted area will be used as a source of drinking water;
- there are no practical obstacles to use of the exempted portion of the LBFU as a public water supply; and

- LBFU contains no commercially developable mineral resources that might justify an exemption.

Of particular interest is that the LFBU at the mine site is not contaminated, yet the Upper Basin Fill Unit or UBFU (the aquifer above the LBFU) *is* contaminated and EPA has chosen to protect the UBFU. Contamination aside, there is no material difference in vulnerability of the two aquifers. The presence of a clay layer between the two units does not act as a barrier that protects the UBFU. This is shown by testimony of an FCI expert at the ALJ hearing, which indicated that an escape of acid from the ore body could reach the LBFU in a few days, and the UBFU in a few weeks. If the UBFU is to be protected, the LBFU must be also.

We challenge EPA to provide even one fact that justifies granting an aquifer exemption to any portion of the LBFU that is in proximity to the FCI project.

4. Region 9 must be consistent in its requirements for the exempted area.

Should EPA for some reason insist on retaining such a large exemption area, then logic requires that the Area of Review must be even larger. EPA must require FCI to close all of the boreholes within the exempted aquifer and area of review, address the problem of the underground mine shafts, and close numerous other wells on and near its property.

We challenge EPA to explain why it believes the Area of Review does not extend to at least the boundary of the exempted area, and why it is not subject to all the highly protective measures normally required in an Area of Review.

5. EPA's defense of the 1997 aquifer exemption is nonsense.

The Statement of Basis for the Draft Permit claims to justify a large exemption area because there are no drinking water wells inside of it today, and existing downgradient drinking water wells are too far from the PTF to be impacted. As a matter of law, this justification is completely wrong; EPA regularly acts to protect aquifers, not just existing wells. We challenge EPA to find any legal authority for its position, or explain why it should ignore its own guidance, illustrated in Figure 1 above.

Region 9 also defends retention of the 1997 exemption on the belief that a decision once made can never be modified or rescinded. There is no legal basis for this position and there is certainly no logic to it. Changing conditions require reevaluation of previous positions and decisions in every phase of environmental regulation. Appendix F includes the relevant legal analysis along with examples where other EPA regions modified an exemption for reasons that include a change in facts and circumstances, inadequate information, or even incorrect information.

C. A Major Rewrite of the FCI Permit is Needed to Fix the Fatal Flaws Noted Above.

EPA's first order of business in drafting an acceptable UIC permit for the FCI pilot project is to rectify the failures discussed above. EPA must investigate, understand, and use the lessons learned from the BHP pilot. And EPA must limit the aquifer exemption to as small an area as necessary. Absent these remedies, we must assume that this weak permit is intended to be the first draft of a weak commercial permit.

1. EPA must understand the nature of what it is permitting.

EPA appears to believe that the small size of the pilot project justifies a lax approach to permitting. This approach is profoundly wrong. The FCI pilot is only the world's second attempt to inject an acid solution into undisturbed bedrock surrounded by a drinking water aquifer. As with any such experiment, rigorous controls and exceptional monitoring are required to ensure that the performance objectives of the project are fully realized. When, as here, it is important that assumptions about project design need to be backed up, very specific permit requirements are appropriate. Beyond determining if copper can be produced in economic amounts (something data so far suggest will not occur), this means conditions that will result in EPA and the public learning in detail what happens to the acid when it invades such a heterogeneous media, and determining which operational requirements work to contain the fluids.

We challenge EPA to explain how a permit that is based on numerous unsubstantiated assumptions, inadequate conditions, and weak compliance requirement will serve to prove up the safety of a commercial project.

2. The aquifer exemption must be revised.

If any aquifer exemption is granted, it must be limited to a small area inside the Area of Review. We anticipate the outer limit of the exemption will fall between the ring of observation wells where possible impacts are acknowledged, and the ring of monitoring wells where FCI represents that contamination will not occur. The top limit of the exemption would be at the top of the oxide zone.

We challenge EPA to provide compelling logic for any exemption that markedly departs from these requirements.

3. A permit condition is needed to protect the LBFU.

A permit requirement will be needed to enforce exclusion of the LBFU from the exempted aquifer. EPA should consider this language from the ADEQ permit: *In-situ solutions shall be injected and contained within the oxide unit.*

We challenge EPA to justify why it cannot adopt a permit condition at least as protective as that adopted by ADEQ.

4. Proper locations should be specified for Points of Compliance.

EPA's decision to place points of compliance years or decades away from a 2-year project is absurd on its face, as evidence by the fact that the identical POC locations were found to be unlawful in the ADEQ permit. EPA needs to specify compliance points closer to the project, and just outside the "as small as possible" aquifer exemption, EPA will have no choice but to specify compliance points closer to the project, within the Area of Review. We suggest that EPA consider using the supplemental water quality monitoring wells as compliance points, with a shift in location inward where appropriate.

To enforce protection of the LBFU, the points of compliance should be at the interface between the regional aquifer and the oxide zone. Methods to determine compliance would include monitoring wells above the injection zone, adding appropriate monitoring ports in the multi-level wells that FCI already proposes, and strapping EC sensors on the outside of operational and observation wells. EPA can look to numerous UIC permits for uranium leaching projects for guidance in this matter.

We challenge EPA to explain any decision that measures compliance outside the Area of Review.

5. The inward gradient condition must be strengthened.

As part of SWVP's successful challenge to the ADEQ permit, our expert Dr. Wilson explained why permit conditions identical to those in the draft UIC permit fail to ensure environmental protection. His interpretations along with other relevant information are presented in Appendix I.

At the hearing, no expert could explain or defend the permit requirement that FCI maintain a 1 foot inward gradient from observation to recovery wells. As Dr. Wilson explained, and as EPA guidance confirms, water level measurements made in pumping (recovery) wells do not measure aquifer water levels, but levels impacted by well inefficiency. In fact, even FCI and ADEQ witnesses agreed that a 1-foot inward gradient requirement was not a reasonable method to ensure containment of contaminants. Given the expectation of relatively low well efficiencies in this project, a much higher inward gradient must be required.

The appropriate permit requirement will set an initial gradient requirement based on actual well efficiency data with a margin of safety, and require this estimate to be updated weekly at first, and at longer timeframes if initial results show stability. EPA also should require gradient control be demonstrated for the entire site (i.e. no spatial averaging; outward gradients from injection wells also considered) on a constant basis. The loss of an appropriate inward gradient at any time should be reported to EPA.

We challenge EPA to defend the 1 foot inward gradient as a conclusive proof of hydraulic control.

6. An acid balance must be required rather than a water balance.

FCI will inject a solution that is entirely acid, and recover a solution which is a mix of native water and spent acid. At BHP the recovered solution far exceeded the injected solution, yet an acid balance showed less than 90% total acid recovery even after years of flushing. A simple mass balance of injected versus recovered fluid volumes, as specified by EPA in the FCI permit, cannot determine whether the all the injected acid has been recovered and thus cannot reliably ensure that hydraulic control has been maintained.

If EPA requires FCI to submit a competent geochemical model (something never done), it should be possible to establish a pH value for recovered water that indicates no acid escape. This pH test should be done daily. Periodically, or at any time the daily test indicates a concern, a more complete acid balance should be required that accounts for estimates of acid consumption and retention in the mine block. The permit also should require a surplus of recovery over injection that is substantially greater than the error potential in the measurement devices (i.e. a 10% excess recovery is not sufficient, if there is a cumulative potential error in metering of 10%). For example, the current permit requirements, when accounting for allowed metering deviance, theoretically allow more fluid to be pumped than is recovered and still meet the definition of hydraulic control. Acid balances should be discrete (i.e. specific to each of the four injection wells).

We challenge EPA to explain how it knows that hydraulic control is guaranteed if FCI pumps more water out than it injects acid in.

7. More rigorous aquifer testing must be required.

Given the known heterogeneity of the aquifer, EPA should require considerably more pre-mining testing than now required in the draft UIC permit. A detailed aquifer testing plan should be required and made available for public comment, so that EPA can be assured that the tests to be conducted are sufficient in number, duration, and use of observation wells. Tracer tests of the type that proved so useful to evaluation of the BHP project are an absolute must, as are porosity logs on all holes.

We challenge EPA to justify its confidence in FCI's investigation of the aquifer, absent tracer tests and an aquifer testing plan.

8. Valid hydrologic modeling must be required.

EPA clearly has not closely investigated FCI's flow model of the site. If it had, it would know the calibration of the model is poor, and that the flow and solute transport models cannot simulate the only actual observations of site conditions, those from the BHP test. Issues with the existing models are documented in Appendices I and P, most notably EPA's own guidance about the importance of models matching observations.

The EPA rigorous aquifer testing described above will provide an initial characterization of the PTF area as to actual heterogeneity in the area of injection and recovery, and probabilities of heterogeneity in areas where escapes could occur. EPA must then determine if an EPM model with real-world heterogeneity is sufficient for assessment of the permit application, or if alternative model types (such as matrix diffusion or other approaches appropriate for fractured aquifers) should be investigated. Only when models have been confirmed against actual site data can EPA rely on the models to predict the fate of injected fluids with and without hydraulic control. Locations of observation wells (and of POC wells) should be established based on the results.

We challenge EPA to defend its acceptance of the FCI flow and transport models without requiring them to be validated against the BHP data.

9. Observation well locations should be more relevant.

Final locations for observation wells should be determined AFTER completion of the aquifer testing and valid modeling discussed above. EPA should ensure that wells are placed so as to assuredly monitor conditions downgradient of the injection zone.

We challenge EPA to defend the existing layout of observation wells, by which no wells are placed in known downgradient locations north and west of the PTF.

10. EC monitoring should be made effective.

The permit is useful in that it requires EC monitoring at observation and recovery wells, but the language is badly written. EC will always decrease away from the mine due to dilution; a lower EC at an observation well than recovery well is not evidence of hydraulic control. For example, if EC is 100,000 at a recovery well, but only 90,000 at an observation well, EPA's permit considers that hydraulic control has been maintained, even if it knows that the native aquifer has an EC of 1,000.

The correct permit condition would initiate investigations and potential changes to project operations at any time any observation wells experiences EC values above levels observed in native groundwater. EC also should be measured and reported for individual depth intervals in observation wells, based on vertical profiling done during the testing phase of the project.

We challenge EPA to defend the permit language regarding the relationship of EC data to hydraulic control.

D. EPA Should Prepare a Competent Permit.

SWVP intends the comments above to demonstrate to EPA that the agency must start over in its drafting of the UIC permit for the FCI pilot. In the process of rewriting the permit, SWVP expects that EPA will play close attention to each and every requirement that is placed on FCI, to ensure that the end result is a well regulated project. Because we want EPA to focus on the egregious flaws identified in Sections A, B, and C, we are not providing an exhaustive review of other permit issues, i.e. those that don't relate to the agency's decision to ignore the BHP data and hold to an invalid aquifer exemption. However, we have identified a small number of other issues that are so problematic that we bring them to EPA's attention in these comments.

1. The permit should set out a consistent schedule.

On page 7 of the permit, the authorization to construct, test, and inject the project is issued up to (i.e. not longer than) 7 years, of which 5 years are post-closure. The Statement of Basis breaks the 2-year operational period into 14 months for construction, testing, and operations, and 9 months for restoration. Even the most cursory reading of the permit application and proposed permit conditions demonstrate that construction and testing of the pilot project will take many months, and even longer if EPA writes a competent permit as outlined above. FCI will do well to *start* injection in 14 months. As written, compliance with the permit schedule assuredly will not occur.

EPA cannot issue a permit that sets a timeframe that on its face is impossible to achieve. Permit duration and phasing must be set out realistically and in detail so that the public can know what is actually proposed. The concept implied by the existing draft, that the schedule has no meaning and/or can simply be modified as the project develops, is unacceptable.

We challenge EPA to provide a flow chart or schedule which sets out the exact timing requirements it is placing on FCI.

2. EPA has not required FCI to submit a detailed restoration plan.

As detailed more fully in Appendix J, the draft permit contains language that could potentially allow FCI to avoid restoration obligations until cessation of its commercial copper production operations. EPA should clarify the permit language to specify that FCI is required to show that restoration of the PTF injection area has been accomplished before commercial operations are permitted.

We challenge EPA to state unequivocally that no commercial permit will be issued until FCI has demonstrated ISRR mining and restoration is safe at this location.

3. EPA should require a competent geochemical model.

EPA cannot reasonably rely on FCI's geochemical model to predict restoration expectations. Model documentation is incomplete and we are confident that EPA was not able to reproduce the results, even if it tried. Key model results (for nitrate and arsenic) are compared to incorrect standards. No explanation for the unexpected elevated nitrate in the pregnant leach solution is presented. No discussion is presented as to changes in porosity and effects of well clogging that can be expected to occur during mine operations. The model has value only in showing FCI's intent to leave behind a large mass of sulfate far in excess of drinking water guidelines, a mass that its own models predict will move into a drinking water aquifer.

The model results are especially problematic for arsenic. Greatly elevated arsenic levels (164 times the drinking water standard) are predicted to occur in the ore body during mining. The rinse water is shown as arsenic free, which is highly doubtful given the widespread occurrence of arsenic in native groundwater of the area. A small number of rinse cycles is shown to make arsenic completely disappear, which is quite contrary to the normal condition in which restoration causes an asymptotic decline in contamination, and to FCI's own studies which predict only a 70% sweep efficiency of its injected fluids. After restoration, pH is predicted to be 7, in contrast to BHP where pH levels below 5 remain almost 20 years after multiple rinse cycles and natural attenuation. Simply stated, the geochemical model has no credibility.

We challenge EPA to demonstrate that it has closely assessed the geochemical model and confirmed that it can be relied upon for predicting ore body chemistry during operations and after restoration.

4. EPA must require FCI to disclose its monitoring data.

As Adrian Brown, FCI's expert, often exclaimed during the ADEQ hearing, effective monitoring must show what happens, when it happens, and where it happens. We know that FCI will gather substantial and meaningful data on a constant basis. Unfortunately, the draft permit allows FCI to keep the vast majority of meaningful data to itself and report mainly meaningless data that will not show what happens, when it happens, and where it happens.

We challenge EPA to demonstrate its intent to ensure that FCI's monitoring data are quickly made available to the public, and the project performance will in be in always transparent.

5. The draft permit terms contain significant errors and inconsistencies.

There are several inconsistencies between the operational requirements and the closure plans as detailed in the draft permit. These must be reconciled before a final permit is issued. Inconsistencies include:

- Numerous references to concepts and facilities that are associated with commercial mining operations and are irrelevant to this PTF.
- References in the permit to stacking are inconsistent with other FCI statements that stacking will not be conducted in this PTF.
- References to recovery well headers during restoration are inconsistent with other statements by FCI that it will use injection wells for recovery during restoration.
- The draft permit contains several references to AWQS instead of to MCLs.
- Monitoring requirements are inconsistent with operational requirements.

6. There is no requirement that FCI delay planned commercial operations until all data from the pilot test is properly reported and analyzed.

This PTF is an experiment intended test the operational parameters of a potential commercial copper ISR operation. The whole point of such an experiment to gather meaningful data to allow not only FCI, but also EPA and the general public, to properly analyze the implications of the ISR operation and ensure that proper safeguards are in place to protect a drinking water aquifer. There is no legitimate reason why the draft permit contains no restriction on FCI's ability to apply for a commercial ISR permit before all data (including post-PTF restoration) is provided to EPA and properly analyzed.

7. EPA must require FCI to disclose its monitoring data.

As Adrian Brown, FCI's expert, often exclaimed during the APP hearing, effective monitoring must show what happens, when it happens, and where it happens. We know that FCI will gather substantial and meaningful data on a constant basis. Unfortunately, the draft permit allows FCI to keep the vast majority of meaningful data to itself and report mainly meaningless data that will not show what happens, when it happens, and where it happens. This failure of the permit is easily remedied.

8. Post-restoration monitoring requirements are inadequate.

As EPA has recognized, insufficient monitoring can lead to "premature conclusions of stability … [and] potentially leading to contamination downgradient or beyond the boundary of the exempted aquifer." Despite this valid concern, EPA has not required FCI to conduct long-term stability monitoring.

Appendix A
The BHP Pilot Test

Region 9's claim of having performed a "thorough" technical review of FCI's application is surprising,[4] given that the agency failed to consider the highly relevant information and reports from BHP Copper Inc.'s 1997-1998 pilot test of In-Situ Recovery (ISR) copper mining at this same site ("BHP Pilot Test"). In the late 1990s, Magma and then BHP Copper proposed a commercial ISR mine at this same site. After obtaining federal and state permits, the BHP Pilot Test was conducted within a few hundred feet of where FCI now proposes to conduct its PTF pilot test. The results of that test are easily the most important information any permit writer would want in fashioning a permit for FCI's PTF. BHP injected into the same ore body and the same hydrogeologic system as FCI, used the same technology[5] and 5-spot well design as FCI,[6] and used an acid solution similar to what FCI proposes to use.

That test generated a huge volume of relevant data on the ISR process and its impacts at this site. After reviewing this data, BHP's staff and consultants, a subsequent owner of the mine, an Arizona State Administrative Law Judge, the Arizona Water Quality Appeals Board, and SWVP's experts all agree that the BHP Pilot Test calls into question many of the key assumptions underlying FCI's application and the Draft Permit. FCI chose to withhold almost all of this data from Region 9. And despite being told repeatedly by SWVP that the data was in FCI's possession, Region 9 never requested it. The failure to do has resulted in a permit that fails to address critical issues and that is premised on assumptions and self-interested assertions by FCI that lack scientific or factual support.

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[4] Statement of Basis, at 2.

[5] FCI Application, Attachment S, NI 43-101 Technical Report, at 18 ("The injection and recovery well design proposed by Curis Arizona is based on experience gained from the BHP pilot test, and is compliant with the Underground Injection Control (UIC) Permit issued to Florence Copper in 1997.").

[6] *Id.*, at 171 ("Curis Arizona plans to use a five-spot well layout pattern, similar to that employed by BHP."); *id.* at 183 ("The planned well spacing was derived from well performance and flow rate observations made during the BHP pilot field test conducted in 1997-1998. The well spacing and planned rates are similar to the values used by BHP during their field pilot test."); FCI Application, Attachment N, at 2 ("The proposed PTF design and operation are closely based on data and observations generated by BHP Copper Inc. (BHP Copper), a previous owner of the FCP site, during its construction and operation of a limited pilot-scale injection and recovery test.").

1. Region 9 Cannot Claim to Have Conducted a Thorough and Reasoned Evaluation of FCI's UIC Application Because it Failed to Review the BHP Pilot Test Data.

FCI is essentially replicating a pilot test conducted over 15 years ago by BHP at this same site. As explained by Dr. Wilson in the state administrative hearing:

> The projects are as identical to one another as you would ever expect to see in pilot projects that are 15 years apart. The only significant difference is the time frame, the length of time of this test that we're now considering. And most important, the permit conditions are virtually identical. In other words, the permit conditions that BHP was required to meet and the permit conditions that [FCI] is required to meet are, for practical purposes, the same permit conditions.[7]

Although Dr. Wilson was speaking about the state-issued Temporary APP, his statements apply even more forcefully to the Draft Permit. Dr. Wilson's review of the BHP Pilot Test data and reports triggered for him a sequence of inquiries, similar to a forensic investigation, such as:

- How did certain phenomena occur during and after the BHP test?
- Were the results allowed by BHP's permit?
- What was wrong with the permit to allow those things to happen?
- What should be done in the current permit to address those issues?
- What data is needed to accurately assess the environmental impacts and safety of FCI's proposed commercial mine?

Region 9 likely would have generated a similar series of questions, had it requested and reviewed the information.

The BHP Pilot Test provides the *only real-world information* on the impacts of ISR mining on groundwater at this site. FCI started with this data in preparing its permit application, and it was the basis for FCI's models, calculations and assumptions. Indeed, FCI has often acknowledged that it has done very little investigation or testing

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[7] OAH Hearing Transcript, March 24 at 51-52.

of its own, relying throughout its permit application on information and reports from Magma and BHP.[8] Thus, the BHP Pilot Test results are critical to FCI's proposal. But FCI cherry-picked the information that it provided to Region 9, just as it did with ADEQ. And both agencies were content to rely on what FCI gave them, despite knowing that other information existed. As a result, Region 9 only got part of the picture before it issued the Draft Permit.

a. Although FCI repeatedly cited to the BHP Pilot Test in its permit application, it provided Region 9 only a single letter report describing limited, purportedly favorable test results.

FCI has repeatedly relied on the BHP Pilot Test to support its claims that the PTF (and later commercial operations) can be safely conducted and that it can control the acid solutions it will be injecting. Table A-1 provides a summary of just some of the places in its application that FCI referenced the BHP Pilot Test as evidence that the ISR process was safe and successful. Yet to support these repeated claims, the only actual data that FCI has submitted to Region 9 is a short letter report with rudimentary hydraulic control information.[9] The letter report itself raises questions about FCI's ability to maintain hydraulic control. But even worse, FCI withheld from EPA a plethora of monitoring data and analytical reports from the BHP Pilot Test, which demonstrated, among other things, that:

- There were vertical and horizontal escapes of acid mining solution.
- BHP encountered unexpected "short circuits" and heterogeniety in the aquifer.
- Reliance on the Equivalent Porous Media concept as a modeling assumption is misplaced.
- In-situ leaching generated unexpected geochemical reactions.

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[8] *See*, *e.g.*, FCI Application, Attach. A, Ex. A-1, at 12 ("No additional hydrologic characterization activities were completed between the conclusion of the BHP Copper pilot test in 1998 and the purchase of the PTF site and surrounding vicinity by Curis Arizona."); *id.* ("No vadose zone characterization activities have been conducted since 1995 when BHP completed site characterization."); *id.*, Attach. I, at 2 ("Given the extensive dataset generated by previous site owners, and the thorough nature of studies conducted previously at the site, Florence Copper does not plan to conduct any additional formation or aquifer testing prior to construction of the proposed PTF.").

[9] FCI Application, Attachment A, Exhibit A-3, Exhibit 14C-1, Letter to Julie Collins, ADEQ Compliance Officer, From Corolla Hoag, BHP Copper, *Report of Results of Hydraulic Control Test* (April 6, 1998).

Had SWVP not obtained these data by subpoena, these critical data and reports would have remained secret.

b. Region 9 knew or should have known that it wasn't getting the whole story about the BHP Pilot Test.

Although FCI provided only one document with actual results from the BHP Pilot Test, Region 9 knew that this was only a fraction of what was available and that the single letter report was not representative of the Pilot Test's results. SWVP repeatedly told Region 9 that there was additional information and reports that FCI had not disclosed and that could provide valuable insight into FCI's proposal.[10]

Despite these notices, there is nothing in the administrative record to indicate that Region 9 requested or reviewed the data. In fact, during the open house in Florence after the Draft Permit was issued, a contractor for EPA indicated that he was not even aware the BHP data even existed. And EPA indicated it had not decided whether to review the BHP data, even though by that time it had already issued the Draft Permit. It is not clear what Region 9 is waiting for.

To its credit, Region 9 did recognize that the single letter report submitted by FCI was thin support for the application:

> Curis states that hydraulic control was demonstrated in the short-term 1997-98 BHP test, but EPA does not have adequate documentation that the 1998 demonstration was acceptable. However, Phase 1 operations will provide additional information on the capability to maintain hydraulic control and allow EPA to evaluate whether not sufficient control has been demonstrated before Phase 2 commercial operations are permitted.[11]

The agency was right to question FCI's blanket assertion that the BHP pilot test demonstrated the feasibility and success of hydraulic control. But waiting for additional information to be developed out of the PTF is not enough when real-world data already exists by which Region 9 could evaluate FCI's proposal.

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[10] A summary of SWVP's notices to Region 9 on this issue is provided in Appendix E.

[11] Letter from David Albright, EPA Region 9 Groundwater Office Manager, to Michael McPhie, FCI President, at 3 (July 20, 2012).

i. Region 9 obligation of due diligence in its permit application review necessitates that it review BHP Pilot Test data.

Federal agencies have a duty to ensure they are basing their decisions on accurate information.[12] And if there is good cause to believe that the information is suspect or exaggerated – as there was in this case – then the agency has a duty to substantiate it.[13] Permitting decisions must be rational, logical, and supportable in light of the information in the record.[14] Here, there is ample evidence casting doubt on the assumptions underlying the Draft Permit in light of the previous BHP Pilot Test. That evidence should have triggered further inquiry by Region 9.

The use of information from previous tests or data from similar sites as a diagnostic tool is a common permitting tool relied upon by regulators.[15] If problems have been encountered at a similar project previously, the permitting agency should take steps to ensure that those problems are addressed in the next permit. This is nothing more than the scientific process at work.

In its guidance on AOR and ZOI calculations, USEPA recognizes that while models, calculations and predictive tools are necessary, it is at least as important to develop and incorporate real-world data based upon observed conditions. Over-reliance on theory and models that are based on ideal conditions not present in the real world are inherently dangerous:

> Because of these simplifying assumptions, analytical solutions describe the response to injection in a very idealized representation of actual aquifer configurations. In other words, the solutions represent what the theoretical response to injection would be if the reservoir were ideal or perfectly uniform. In the real world, aquifers are heterogeneous and anisotropic; they usually vary in thickness; and certainly do not extend to infinity. This is because aquifers are created by complex geologic processes that lead to irregular stratigraphy, interfingering of strata, and pinchouts of both aquifers and aquitards. It is obvious that the worth and

[12] *Van Abbema v. Fornell*, 807 F.2d 633, 642 (7th Cir. 1986) ("The Corps has a duty to ensure the accuracy of information that is important to the decision it is making, at least when obvious errors are brought clearly to its attention.")

[13] *Hammond v. Norton*, 370 F.Supp.2d 226, 251-52 (D.D.C. 2005) ("when the agency has good cause to believe that information is inaccurate or exaggerated, it has a duty to substantiate it.")

[14] *NE Hub Partners, L.P.*, 7 E.A.D. 561 (May 1, 1998).

[15] OAH Hearing Transcript, March 28, 2014 at 38; ALJ Decision at 25, ¶ 98.

applicability of analytical solutions to a particular hydrogeologic environment has to be determined by comparing the deviation between observed response and theoretical response. They have greater worth the more closely the actual hydrogeological environment approaches the idealized configuration.[16]

Furthermore, although models and predictive tools are necessary, accurate input data is essential to the development of reliable calculations and models.[17] Region 9 has previously recognized the important distinction between observed conditions and modeled assumptions at this very site. In a letter to then-BHP Project Manager John Kline, Region 9 expressed a number of concerns in light of the project's heavy reliance "on modeling to project the movement of fluids in fractured media," recognizing the importance of actual observed conditions.[18]

Region 9's legal obligations, coupled with the acknowledged need to test models and assumptions against real world data, mandates that Region 9 review the BHP results and incorporate lessons learned from that test into the Draft Permit. Region 9's failure to do so cannot be justified.

ii. EPA knew well before issuing the Draft Permit that a state administrative review of FCI's proposed mine had resulted in remand of the state permit, in large part due to evidence from the BHP Pilot Test.

This failure is even more egregious because Region 9 knew, or should have known, that significant portions of FCI's state Aquifer Protection Permit (APP), which involved the same basic issues as the Draft Permit, had been remanded to ADEQ for review and revision as a result of the BHP information revealed during the state administrative hearing. After a 34-day administrative hearing encompassing numerous lay and expert witnesses and thousands of pages of exhibits, an independent state Administrative Law Judge (ALJ) recommended that the APP be rescinded and that FCI file a new application to address numerous significant shortcomings. In reaching this

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16 EPA Guidance Document for the Area of Review Requirement, at V-25 (May, 1985).

17 EPA Guidance Document for the Area of Review Requirement, at V-13 ("Obviously, the degree of accuracy in any calculated results will depend on the accuracy of the input data.") and V-15 ("Insufficient basic data require much interpretation, extrapolation, and application of hydrogeologic principles when preparing the requisite hydrogeologic data.")

18 Letter from Gregg Olson, Region 9 Environmental Engineer, to John Kline (June 27, 1996).

conclusion, the ALJ found that "The draft BHP reports are the kind of evidence upon which reasonable persons would rely in serious matters."[19] Among other things, the ALJ found, with respect to the BHP Pilot Test results, that:

- "BHP's draft reports raise serious questions about the appropriateness of the equivalent porous media assumption in FCI's fate and transport model."[20]
- "In light of acknowledged vertical migration of in-situ solution into the LBFU at BHP's pilot project, Appellants established that the Temporary APP does not require meaningful monitoring of possible vertical migration through electric conductivity sensors or a hydrosleeve in the LBFU in the PTF well field or require any contingency action if such migration is identified."[21]
- "Appellants established that during BHP's pilot project, fluid may have migrated horizontally, short circuits were reported, and some data caused BHP to be concerned about the propriety of its equivalent porous media assumption. Appellants established spatial bias in FCI's groundwater flow model in the PTF well field. All of this evidence raises a substantial possibility that despite FCI's maintenance of hydraulic control as defined by the Temporary APP, vertical or horizontal migration of in-situ solution may occur during the two-year term of the PTF."[22]
- "[I]n light of the evidence of vertical and possible horizontal migrations of fluid during BHP's pilot project, ADEQ should have heeded the warning in BADCT § 3.4.4.2 and required meaningful monitoring of potential short circuits in the Temporary APP."[23]

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[19] *Town of Florence v. ADEQ*, No. 12-005-WQAB, Administrative Law Judge Decision, Conclusion of Law 24, at 127 (OAH September 29, 2014) ("ALJ Decision). She also concluded that "BHP's draft reports and the reports' conclusions about hydraulic control and migration of fluid during the 1997-1998 pilot project should be considered to gauge whether the terms that ADEQ approved in the Temporary APP were arbitrary, unreasonable, unlawful, or based upon a technical judgment that was clearly invalid." *Id.*, Conclusion of Law 25, at 128.

[20] *Id.*, Conclusion of Law 26, at 128.

[21] *Id.*, Conclusion of Law 36, at 131.

[22] *Id.*, Conclusion of Law 40, at 132.

[23] *Id.*, Conclusion of Law 41, at 132.

The State's Water Quality Appeals Board accepted the ALJ's decision, remanding the permit to ADEQ for additional review and revisions.[24] But Region 9 chose to ignore the administrative decisions of both the ALJ and the Board. Region 9 cannot claim not to have been aware of these decisions. The agency was well aware of the administrative hearing. The exhibits, daily transcripts, pleadings, and ALJ decision were posted on a public web site, updated almost daily during the hearing. And SWVP informed Region 9 of the hearing and pending decisions more than once before the Draft Permit was issued.[25]

iii. FCI made no effort to amend its application to address the significant impacts of the ALJ's decision on the facts and assumptions underlying the UIC permit application.

Nothing has been found in the record to indicate that FCI ever addressed the state administrative decisions with Region 9. It is evident that FCI made no changes to its application materials after the decisions came out, despite the fact that the application contained numerous incorrect statements and errors as a result of the decisions. FCI's response to the state decisions appears to have been to pretend they never happened.

FCI certified in its UIC application that the information provided was "true, accurate and complete,"[26] but it knew as of September 29, 2014—nearly three months before the Draft Permit was issued, that this was not the case. For instance, FCI knew that the ALJ had ordered ADEQ to reconsider proper placement of the POC wells, but FCI did nothing to indicate that the POC wells listed in its UIC application might no longer be legally used. The willingness of both the permit applicant and the permit writer to ignore this precedential decision is unjustifiable and violates both entities' obligations of due diligence, truthfulness, and public transparency.

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[24] *Town of Florence v. ADEQ*, Case No. 12-005-WQAB, Board Order (November 14, 2014).

[25] Letter from Janis Bladine to Nancy Rumrill (June 20, 2014); Letter from Janis Bladine to Nancy Rumrill (August 1, 2014).

[26] FCI UIC Application, Form OMB No. 2040-0042, Section XIV (August 7, 2014).

c. FCI's fight to keep the BHP Pilot Test secret underscores its importance to Region 9's permit decision.

Although SWVP made numerous public records requests to federal and state administrative agencies, including EPA, ADEQ, the State Land Department, the State Geological Survey, and the State Department of Water Resources, no one had the BHP Pilot Test information. Because neither ADEQ nor Region 9 bothered to obtain the BHP Pilot Test data from FCI, SWVP sought the information itself. It first requested the information through FCI's attorneys, to no avail. This forced SWVP to subpoena the information in the state administrative hearing. And even then, FCI wouldn't produce this information - fighting the subpoena, forcing SWVP to respond to a motion to quash, and requiring the ALJ to order FCI to produce the information.

Despite its heavy reliance on the BHP information in its APP application, similar to its reliance on that information here, FCI argued, in part, that because it had not submitted the BHP data to ADEQ and ADEQ had not considered it, it was irrelevant to ADEQ's permit decision. It also argued that records related to the UIC permit were irrelevant to the APP, even though both permits cover the same site, same aquifer, and same wells. FCI made numerous other unsupported arguments against disclosure of the requested documents.[27] The ALJ had no trouble denying the motion to quash and ordering FCI to produce the documents.

FCI's fight to withhold the BHP results underscores its importance. If there was no important information from the BHP Pilot Test other than the thin letter report already provided to Region 9 and ADEQ, why would have FCI have fought so hard to keep it secret? Because the BHP Pilot Test data is extremely important and relevant to a fair analysis of FCI's proposal, but it is not very favorable to FCI's positions, models and assumptions. EPA Region 9 needs to ask itself why FCI did not volunteer this information from the very start.

In response to SWVP's subpoena, FCI produced 47.4 GB of information, which included individual pilot test well data from 1997 through 2000. It included two extremely relevant draft reports summarizing the data, results, and conclusions of the pilot test; a final report completed and signed by BHP's Project Manager John Kline; results from tracer tests conducted both before and after the pilot test; and volumes of

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[27] FCI, Motion to Quash Subpoena Duces Tecum (November 1, 2013).

data from the individual pilot test wells, including water quality data.[28] In short, the subpoenaed documents reveal much more about the BHP pilot test than FCI disclosed in its permit application.

Region 9 should have reviewed this information before issuing the Draft Permit. The agency knew the information existed and it knew or should have known that the ALJ found the information highly relevant. There is no justification for Region 9's lack of diligence.

d. EPA Region 9 cannot ignore the BHP Pilot Test data.

EPA Region 9 knew it wasn't getting the whole story about the BHP Pilot Test. Despite this knowledge, the agency did not ask FCI to provide the rest of the story – the full data set and the analysis of that data – for its consideration in reviewing FCI's application. Had Region 9 reviewed the BHP Pilot Test data, it would have had a roadmap of the issues that the Draft Permit should have addressed. Instead, the review process was clearly flawed and the Draft Permit was issued on incomplete information, misrepresentations, and faulty assumptions.

When scientists test a hypothesis, they compare their theories to experiment results and real world data. The approach to this permit application should be no different. Region 9 needs to ensure that the Draft Permit is protective and meets UIC requirements; that the PTF will actually contain the injected acid; and that the PTF will generate the data to demonstrate whether this process works in the real world. The only way to do that is to review the BHP Pilot Test results and address the many issues raised by that test in a new permit decision.

2. BHP Was Not Able to Contain Injected Acid Mining Solutions as Intended, Yet Monitoring and Reporting Did Not Alert EPA to Acid Escapes.

Expert review of the BHP Pilot Test data and reports reveals that the pilot was both a success and a failure. It succeeded in generating data that can be used to evaluate the safety of ISR mining at this site. And it succeeded in meeting UIC permit requirements. But while it met permit conditions, BHP failed to contain the injected

[28] All of this information has been provided to Region 9 on the thumb drive accompanying these comments.

acid solution and Region 9 was none the wiser. The BHP Pilot Test information obtained by SWVP shows that:

- Injected acid escaped both vertically and horizontally from the BHP Pilot Test well field;
- These escapes occurred even though BHP complied with its permit terms;
- The hydraulic control permit conditions imposed in the BHP permit were necessary but not sufficient; and, as a result,
- The Draft Permit fails to address serious deficiencies revealed by the BHP Pilot Test.

a. BHP experienced horizontal escapes of acid mining solution.

Injected acid escaped horizontally from the BHP Pilot Test well field. And those escapes occurred even though BHP complied with the hydraulic control monitoring standards in the UIC and APP permits. Under BHP's theory of hydraulic control, which is shared by FCI, acid should never have reached BHP's observation wells, which were placed to detect solution excursions beyond the well field capture zone. By extracting more fluid than it injected, BHP predicted that an inward hydraulic gradient would be created that would contain the injected acid solutions inside the well field.[29]

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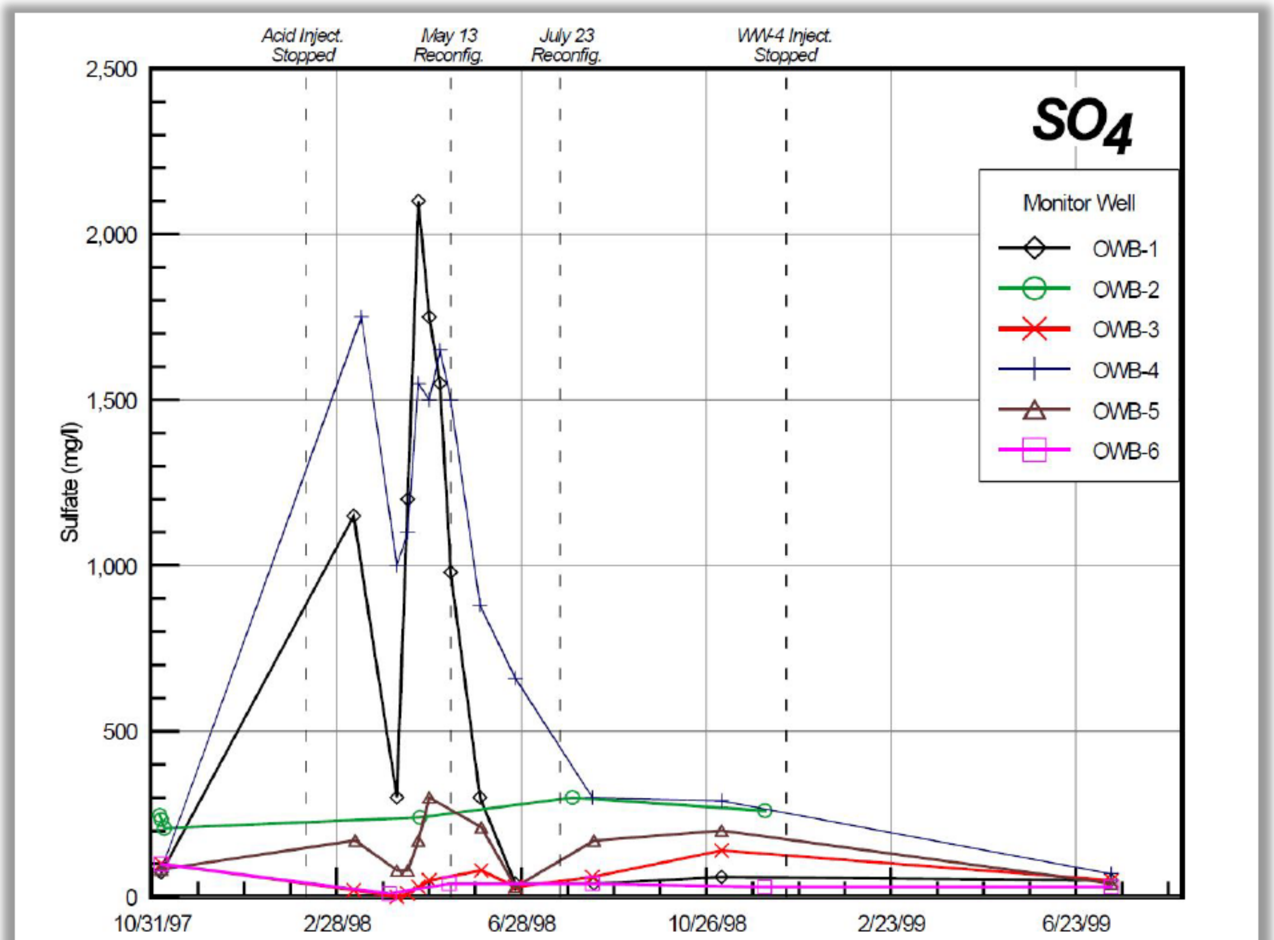
[29] Magma UIC-APP Application, Vol. IV, at 4-2 ("The goal of hydraulic control is to create a region of lower head (water-level elevation) along the perimeter of the mine block being leached. In turn, this configuration ensures that injected lixivants and resultant PLS do not migrate beyond the immediate area under leach (capture zone)."); BHP, *Draft, Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona*, at 10 ("Each of the four injection wells is surrounded by four production wells in a five-spot pattern. Further out, observation wells (OWB wells) have been positioned to monitor lateral solution excursion in the Oxide Unit.").

Figure A-1 – BHP Pilot Test Well Field Diagram[30]

[30] FCI, *Florence Copper Project, First Quarter 2010 Monitoring Report*, Figure 2 (April 28, 2010) (SWVP-013050 - 013069).

Neither EPA nor ADEQ required BHP to monitor for sulfate, pH, or any other water quality parameters at the observation wells. But BHP collected sulfate data from those wells during the rinsing phase of the project for its own purposes. Four wells experienced steady and comparatively low sulfate levels of a few hundred mg/l, indicating that no acid reached the wells. But both OWB-1 on the northeast corner and OWB-4 on the southwest corner of the well field experienced numerous high sulfate concentrations in March and April 1998, during groundwater restoration. In fact, in one sample sulfate exceeded 2,000 mg/l, a value that is ten times background and even higher than the sulfate at the recovery well inside the well field.

Figure A-2: Sulfate Values in Observation Wells During BHP Pilot Test[31]



[31] BHP Copper, Inc., *Florence Porject Field Test Report – Goals, Results, Conclusions (Draft)*, at 99, Fig. 52 (October 15, 1999).

According to Dr. Wilson, the only explanation for these sulfate concentrations is that injected acid solution migrated horizontally to reach the observation wells. And this conclusion is confirmed by the pH data for these same wells, an analysis of which shows results consistent with an escape of acid solution. Review of these results would lead one to believe that injected acid solutions had also migrated beyond the observation wells completely undetected even though all permit conditions were being met.

b. Acid solutions migrated vertically into the LBFU during the BHP Pilot Test.

Injected acid also moved vertically into the LBFU during the BHP Pilot Test. BHP installed electrodes along the wellbore of the five injection wells at three-meter intervals. Changes in electrical resistance were measured before and after injection. Because the injected fluid had smaller resistance than formation water, zones with negative changes in resistance represented the flow paths of injected solution.[32] These flow paths are depicted in red in Figure A-3 below, with "overburden" representing the LBFU.

These measurements show that BHP's acid solution migrated vertically 20 feet into the LBFU. This was predicted by BHP[33] and allowed by BHP permit. And this figure is based on acid migration after only 30 days of injection. Region 9 should anticipate greater impacts to the LBFU from the FCI's more than 400-day PTF. The damage will be even worse from a commercial project where multiple mine blocks will inject millions of gallons of acid over many years.

Although FCI undoubtedly will attempt to dismiss these results as they did in the state administrative hearing, it was confirmed by a final report authored by BHP's project manager at the time, John Kline. Summarizing the results of the BHP Pilot Test in 2001, Kline concluded that upward migration was "definitively" demonstrated,[34]

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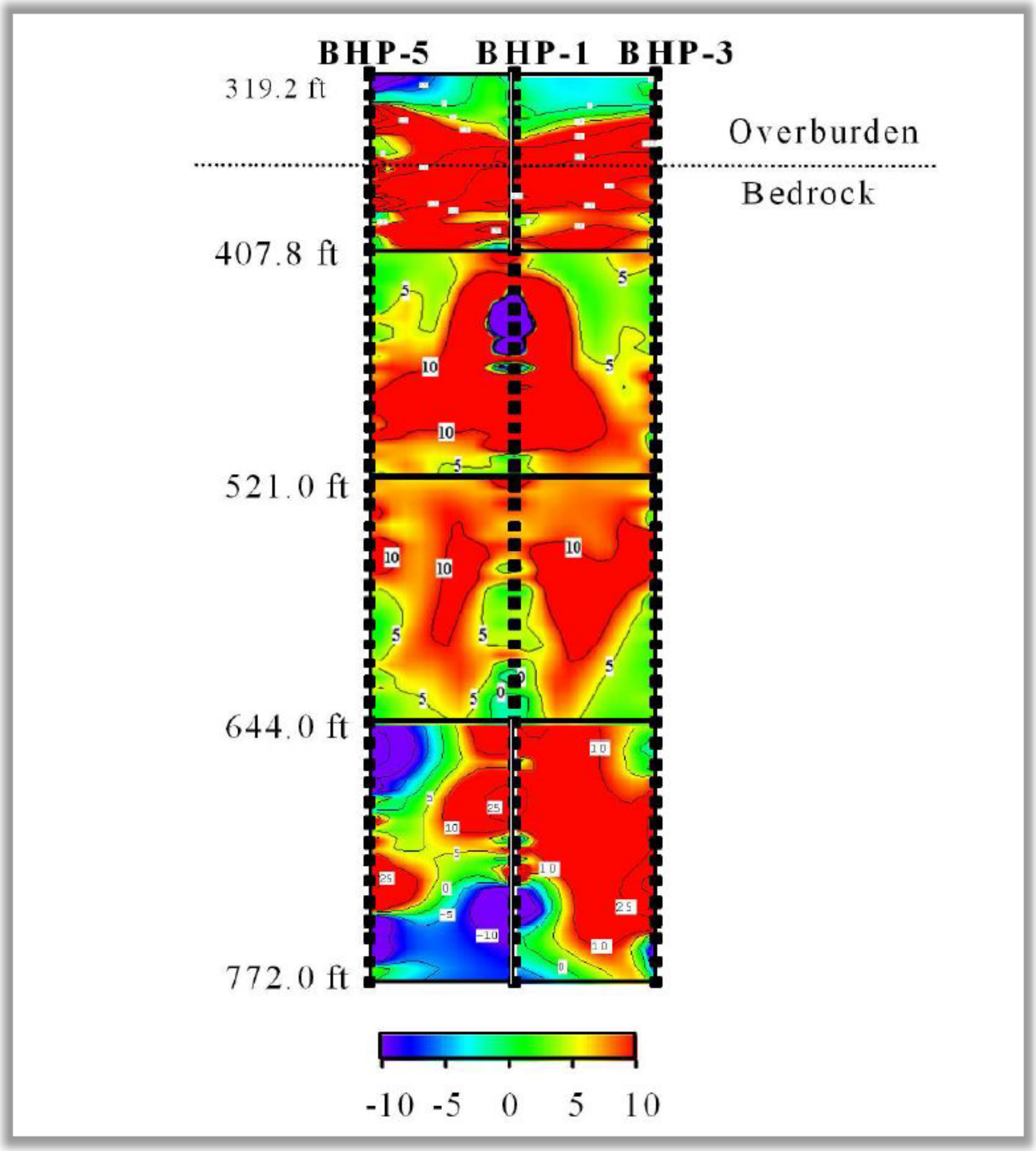
32 BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 45 (October 15, 1999) (SWVP-027215).

33 *Id.* at 45 ("Although the screen of the well is 40 feet below the top of the oxide, the solution has flow vertically into overburden for about 20 feet which is consistent with the numerical simulations.").

34 John Kline, *BHP Billiton Southwestern Copper Florence Project: Well Field Reclamation Test and Well Field Metallurgical Balances*, at 5 (September 12, 2001) (SWVP-022514); May 5 at 37:17-24, 41:5-11.

with migration of acid solution "about 22 feet" into the LBFU.[35] Mr. Kline also testified to this vertical migration during the state administrative hearing.[36]

Figure A-3: Conductivity Difference from Background in mS/m After One Month of Acid Injection During BHP Pilot Test[37]



[35] *Id.* at 2.

[36] OAH Hearing Transcript, Testimony of John Kline, April 2, 2014 at 142-143 ("based upon the way we operated the system, leach solutions most likely went up into that zone").

[37] *Id.*, at 46, Figure 30.

FCI hired an expert to testify regarding the ISR process at the state administrative hearing. His report also confirmed that pressurized acid solution could move vertically into the LBFU and that the 40-foot exclusion zone does not protect against that vertical movement. In fact, his calculations indicated that acid solutions could reach the LBFU in anywhere from five hours to five days.[38] FCI's expert further opined that the 40-foot Oxide Exclusion Zone, on its own, did not protect the LBFU from vertical excursions.[39] This is consistent with FCI's groundwater model, which predicts vertical migration up to 54 feet into the LBFU,[40] and with the BHP Pilot Test results.[41]

3. The BHP Pilot Test Data and Reports Raise Serious Questions about FCI's Models and Assumptions and Show That Critical Changes Need to Be Made in the Draft Permit.

The value of the BHP Pilot Test data is not limited to simply identifying problems. The data also provide insight into the reasons why escapes occurred; why the permit's hydraulic control mechanisms didn't work to contain the injected acid; and what can be done to fix the permit's flaws.

There are three key reasons that BHP's UIC permit failed to prevent and detect escapes of injected acid:

- The acid-water balance measurement does not demonstrate control of injected solutions.
- Measurements of inward hydraulic gradients failed to account for well inefficiencies.
- The permit failed to require any monitoring of vertical migration inside the well field.

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38 OAH Hearing Transcript, Testimony of Lee Wilson, May 6 at 49-53; Expert Testimony of Adrian Brown, P.E., Plate 6-2, *Travel Time for Accidental Release from PTF to POC Wells* (FC001536).

39 OAH Hearing Transcript, Testimony of Lee Wilson, May 6 at 50.

40 Daniel Johnson letter to Nancy Rumrill re *Response to Request for Information Dated July 20, 2012*, at 15 (September 10, 2012).

41 See Appendices A and B for a summary of these results relating to the exclusion zone.

Unfortunately, Region 9 has carried these same fatal flaws into the Draft Permit. Review of the BHP Pilot Test results demonstrates why these mistakes must be fixed in FCI's permit.

a. The acid-water balance measurement does not demonstrate control of injected solutions.

Both the BHP UIC permit and the Draft Permit require the mine operator to recover more fluids than are injected over a 24-hour period. But the operator is measuring two different things. Acidic mining solution is being injected into the aquifer. But a fluid mixture of mining solution, dissolved ore-body minerals, and natural groundwater is being recovered. Any attempt to measure control of the acid mining solution by comparing these volumes will necessarily misrepresent the results and potentially mask escapes of acid solution. This is evidenced by the BHP Pilot Test results. BHP maintained the required differential between injection and recovery, yet a post-test acid balance demonstrated that at least 12% of the injected acid was not recovered.[42]

b. Measurements of inward hydraulic gradients failed to account for well inefficiencies.

Both the BHP and FCI permits require the operator to compare groundwater levels in paired wells and demonstrate an inward hydraulic gradient as evidence of hydraulic control. But the comparison required by the permits is between static water levels at outer, non-pumping observation wells and water levels in an active, pumping inner recovery well. Water levels inside of pumping wells are not representative of the aquifer water levels outside of the well due to well inefficiencies. And neither permit requires adjustments to allow for recovery well inefficiencies. In the BHP Pilot Test, BHP demonstrated the required inward gradient, yet escapes are known to have occurred. Therefore, the permits again are requiring a comparison that misrepresents actual conditions and may hide contaminant escapes.

c. The permit failed to require any monitoring of vertical migration inside the well field.

There was no vertical monitoring inside the well field required in the BHP permit and none is required in the Draft Permit. Instead, both permits rely solely on the

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[42] *See* Appendix C for a more detailed discussion of this issue.

40-foot exclusion zone to maintain vertical containment of acid solutions. There are no monitoring requirements designed to verify that the exclusion zone actually serves its intended purpose or to verify that FCI's EPM assumption is correct. Such monitoring was not required in 1997 because migration of contaminants into the LBFU was acceptable and allowed under the BHP UIC permit. Contaminant migration into the LBFU is neither acceptable nor justifiable today, making reliance upon the exclusion zone and FCI's modeling, with no verification monitoring, inexcusable. And the BHP Pilot Test demonstrated the heterogeneity of the aquifer, which is replete with preferential pathways, faults, and short circuits, and dead zones. FCI's models and assumptions are based on an over-simplified view of the aquifer system that does not match real world data.

4. The BHP Pilot Test provides solutions to the fatal flaws in the Draft Permit.

Thorough analysis of the BHP Pilot Test results provides an understanding of how to address the mistakes that were made and alleviate fatal flaws in the Draft Permit. Had Region 9 reviewed those results, it would have identified at least four critical requirements that should have been included in the Draft Permit.

a. FCI must install more observation wells.

The BHP Pilot Test experience demonstrates the need for two additional observation wells – one due north and another due west of the injection/recovery well field. This is apparent even from the single letter report of limited results provided to Region 9 by FCI.[43] FCI has touted the letter report as demonstrating that "[h]igher water levels and lower electrical conductivities at the observation wells than at the recovery wells were deemed to demonstrate hydraulic control."[44] But a detailed review of the document should have raised serious concerns for Region 9.[45]

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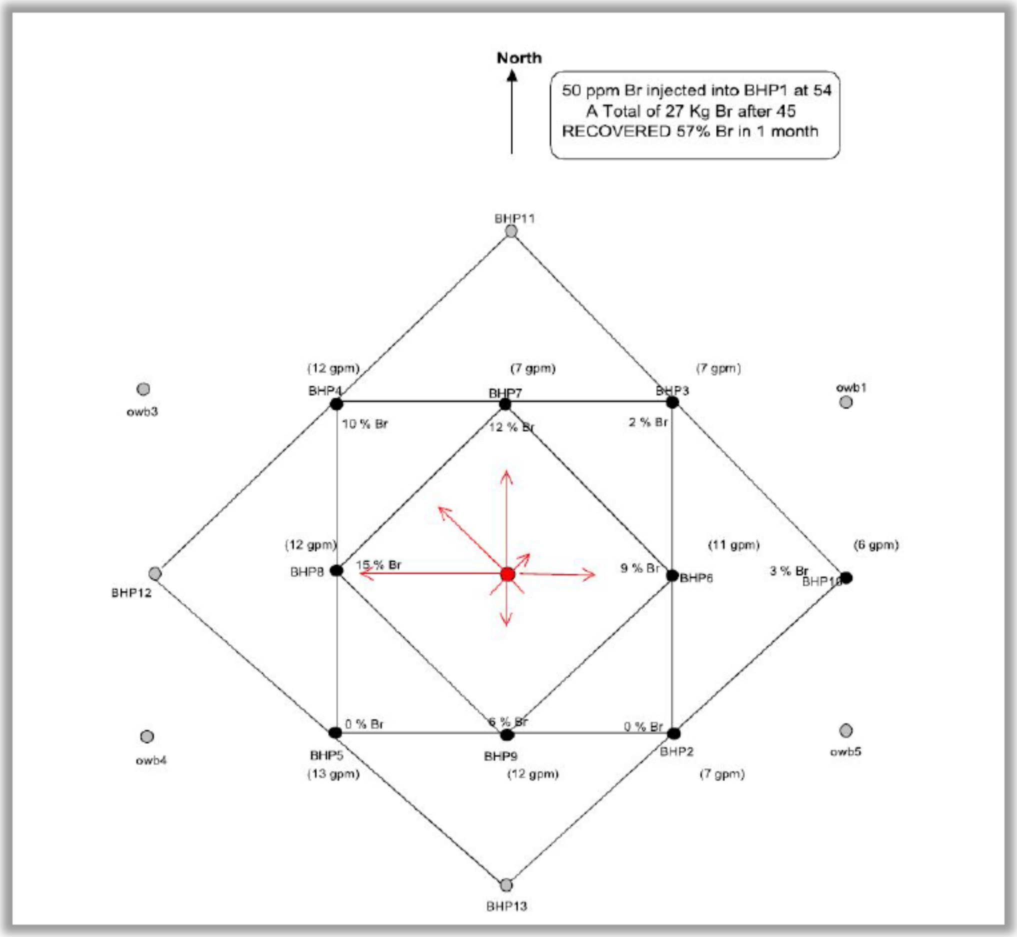
43 BHP, Letter to Ms. Julie Collins, ADEQ (April 6, 1998).

44 FCI, *Temporary APP Application*, Exhibit 10A (Review of Groundwater Sampling Results), § 10A.2.3.

45 A description of the issues raised by the letter report results is provided in Appendix D.

Figure A-4 BHP Bromide Tracer Test Results –
Bromide Percentage Reaching Pumping Wells[46]



BHP also conducted tracer tests before and after the ISR mining test.[47] The results of these tests demonstrate strong groundwater flows due north and due west, in addition to the northwest regional flow. Given the PTF's similar hydrogeology and its proximity to the BHP Pilot Test well field, it is reasonable to expect that strong flows will be observed in the PTF well field to the west, northwest, and north.

The Draft Permit does not require observation wells due north and due west of the well field. This monitoring gap cannot be justified, given the strong evidence of

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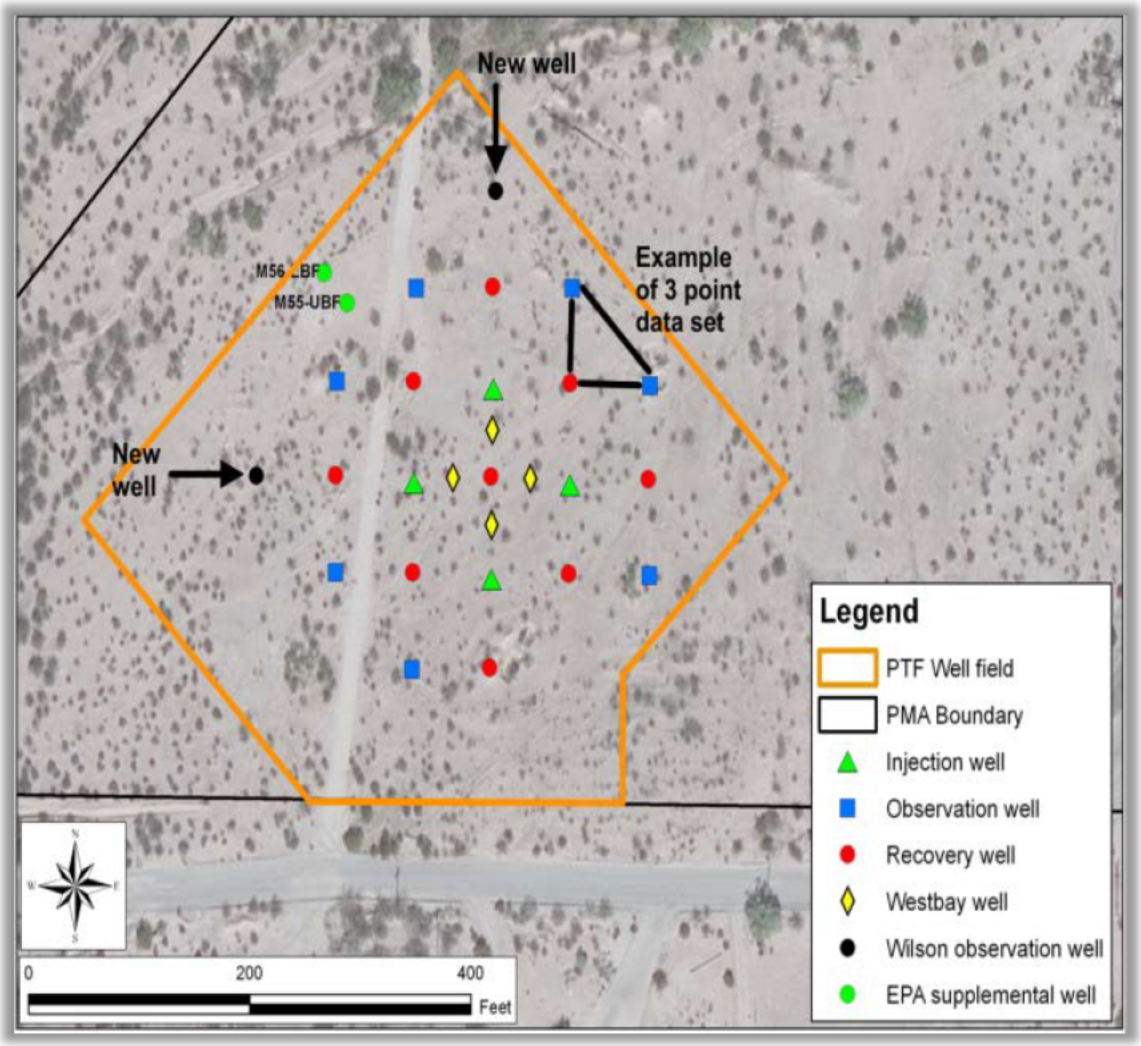
[46] BHP Copper, Inc., *Florence Porject Field Test Report – Goals, Results, Conclusions (Draft)*, at 32, Fig. 17 (October 15, 1999).

[47] BHP, *Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona*, at 15-19, § 6.2.2 (SWVP-022556).

flows in these directions. Consideration of the BHP Pilot Test results mandates that two additional observation wells be installed as depicted by Dr. Wilson in Figure A-5.

Figure A-5: Recommended Location of Additional Observation Wells



b. FCI must monitor and report groundwater conditions at the observation wells in a manner designed to detect excursions.

As part of the PTF's permit monitoring requirements, FCI should be required to conduct daily pH and electrical conductivity monitoring in the observation wells and vertical profiling of water quality in any well that experiences a reduction in pH or an increase in conductivity. This is necessary to reveal the depth at which an acid escape may be occurring – an important component in developing any containment strategy. Although Region 9 has taken a good first step in requiring pH and conductivity monitoring in the observation wells, additional detail needs to be specified in order to get useable data.

Region 9 is requiring electrical conductivity (EC) monitoring, but the Draft Permit does not provide detailed requirements regarding depths.[48] Similarly, there were no specifics in the BHP permit regarding the depths at which EC data was collected. In its letter report touting maintenance of hydraulic control, BHP admitted that the sampling method for the observation wells included the use of a bailer and was different than the method used to collect conductivity readings from the recovery wells.[49] For all that is known, those observation well conductivity readings could have been collected from the upper levels of the aquifer, potentially many hundreds of feet above the depth that injection and recovery were taking place. This would render the data useless. In order to obtain useful data, Region 9 should specify that electrical conductivity monitoring be conducted in the observation wells at intervals that are equivalent to the zones of injection as the injection is taking place.

Also, the standard in the Draft Permit for identifying a problem—lower EC at an observation well than at a recovery well—is pointless. Recovery wells will always have a high EC because they are pumping PLS. If an escape occurs, some dilution of the acid solution will occur as it travels toward an observation well. As a result, the observation well will always have a lower EC than the recovery well, so even if a serious excursion occurs, the permit monitoring requirement will be satisfied. Region 9 should instead require than an alert level be created at the observation wells based on ambient EC conditions. This will provide a touchstone for accurate evaluation of containment.[50]

c. Vertical monitoring of the exclusion zone and LBFU is required within the PTF well field.

The BHP Pilot Test results demonstrate the unremarkable principle that acid solution will move vertically when injected into the aquifer under pressure. But BHP was not required to monitor for vertical migration or report the results. It is "absolutely essential" for Region 9 to require monitoring for vertical flow in the Draft Permit.[51]

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[48] Draft Permit, Part II(E)(c) ("In addition, electrical conductivity measurements in the observation and recovery wells are required to confirm hydraulic control. Conductivity readings in the recovery wells should always exceed readings in the observation wells to confirm hydraulic control.").

[49] BHP, Letter to Ms. Julie Collins, ADEQ (April 6, 1998).

[50] The Draft Permit does require Alert Levels for Specific Conductance at the POC and monitoring wells, but not at the observation wells. *See* Draft Permit, at 23, § II(F)(2)(a).

[51] OAH Hearing Transcript, Testimony of Lee Wilson, March 24 at 162-163.

Vertical migration could be monitored through observation wells drilled into the exclusion zone or with ports or electrodes added to the multilevel Westbay wells that FCI already intends to install.[52] Indeed, this was suggested by Region 9 analysts in 1996, who suggested that BHP install wells in the center of the well field to monitor for vertical excursions.[53] And it is a common requirement at uranium ISR mines for vertical excursion monitoring to be conducted above and sometimes below the uranium ore zone inside the ISR well field.[54] There is no reason to treat this site any differently, as evidenced by the BHP results.

d. The UIC permit must require an acid or sulfate balance.

It is clear from the BHP results that impacts from injected mining solutions were still being demonstrated years after the pilot test ended. It also is clear from the sulfate balance conducted by BHP's project manager that as late as 2001, BHP still had not recovered twelve percent or more of the acid it had injected. To measure whether FCI is truly controlling the injected acid solution, the permit must require FCI to measure what is being injected against what is being removed in the form of an acid or sulfate balance.

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[52] March 24 at 163:2-14. Although the Draft Permit requires annular conductivity sensors in the observation wells, they are to be placed "as close to the MFGU as possible," with monitoring geared more toward well integrity than toward detection of excursions. Draft Permit, at 13, § II(C)(6)c). At most, the monitoring appears intended to alert Region 9 of vertical excursions toward the UBFU. By the time the alert is given at the MFGU, the LBFU—Florence's drinking water supply—will already have been contaminated.

[53] Letter from Gregg Olson, Region 9 Environmental Engineer, to John Kline, BHP, at 4 (June 27, 1996.

[54] *See*, *e.g.*, Powertech (USA) Inc., *Revised Dewey-Burdock Project UIC Permit Application*, at 9-42 (February 2010) ("Monitoring of wells, completed into the aquifers above and below the mining zone, will occur twice a month to check fluid levels and changes in water quality."); Nebraska Department of Environmental Quality, Permit for Underground Injection and Mineral Production Wells, Crow Butte Resources, Permit No. NE0210740, at 15-16 (August 10, 2011) ("Shallow monitoring wells shall be completed in the first continuous and water-bearing sandstone unit overlying the production zone. . . . Shallow monitoring wells shall be installed throughout the mine unit and bi-weekly monitoring . . . initiated prior to installation of any deep monitoring wells or mining wells.")

Table A-1: FCI UIC Application – Citations to BHP Pilot Test

Attachment A, at 4: "This test was conducted **to demonstrate that hydraulic control could be maintained within the portion of the oxide zone, where process solutions were being injected and recovered**. . . . The test successfully demonstrated that hydraulic control could be maintained. The successful completion of the test was reported to ADEQ in a letter, dated April 6, 1998 (BHP Copper, 1998)."
Attachment A, Ex. A-3, at 4: "During the test, lixiviant was injected from November 1, 1997 through February 9, 1998. Injection of lixiviant occurred at a rate of up to 40 gallons per minute (gpm) per well. Because there were more recovery wells than injection wells, the recovery rate per well was typically less than the injection rate per well. The average total lixiviant injection and total PLS recovery rates were approximately 120 and 150 gpm, respectively, which induced a cone of depression around the active well field, creating inward groundwater flow and thereby establishing and maintaining hydraulic control. After injection was discontinued, the injection wells were used to rinse the formation with water in order to facilitate groundwater restoration. . . . Although the hydraulic control test was successfully concluded, BHP Copper deferred constructing a commercial-scale facility due to low copper prices in 1998 and eventually sold the FCP property in December 2001. Hydraulic control was maintained from the time that injection began in 1997 until December 2001 when constituent concentrations in groundwater pumped from the well field were determined to meet closure requirements of UIC Permit No. AZ396000001."
Attachment H, at 4: "Formation testing conducted in 1995 by BHP Copper Inc. (BHP Copper) determined a minimum fracture gradient of approximately 0.71 psi/ft for rock within the oxide zone. To ensure that injection pressures did not induce additional fracturing of the oxide zone, UIC Permit No. AZ396000001 issued to BHP Copper for the FCP in 1997 established a fracture gradient limit of 0.65 psi/ft. The fracture gradient packer testing data are included in Attachment I of this Application. Florence Copper proposes to use the 0.65 psi/ft fracture gradient to determine the maximum injection pressure for each injection interval."
Attachment I, at 2: "In 1997 and 1998, and as required by USEPA in Part II.F.7 of UIC Permit No. AZ396000001, BHP Copper conducted a short-term injection and recovery test **to demonstrate that hydraulic control could be maintained within the injection and recovery zone** while fluids were being injected and recovered during ISCR operations. The successful completion of the test was reported to ADEQ in a letter dated April 6, 1998 (BHP Copper, 1998)."
Attachment N, at 2: "**The proposed PTF design and operation are closely based on data and observations generated by BHP Copper Inc.** (BHP Copper), a previous owner of the FCP site, during its construction and operation of a limited pilot-scale injection and recovery test. The test was conducted at the site from late 1997 to early 1998 for the purpose of demonstrating the feasibility of hydraulic control of injected solutions. **The test successfully demonstrated that hydraulic control could be maintained**."
Attachment N, at 3: "**The groundwater flow model was built using geologic information, formation characteristics, and hydrologic properties of the oxide zone that were measured during**

characterization of the oxide zone by BHP Copper. The model assumes homogeneous and isotropic conditions within the oxide zone, and so cannot be used to predict fluid migration within discrete, unidentified flow paths within the oxide zone."
Attachment N, at 7: "The 1997-1998 test conducted by BHP Copper demonstrated that this proposed well design, pattern, and spacing can be used successfully to induce horizontal well-to-well flow within the oxide zone."
Attachment P, at 6: "In 1997 and 1998, and as required by USEPA in Part II.F.7 of UIC Permit No. AZ396000001, BHP Copper conducted a short-term injection and recovery test to **demonstrate that hydraulic control could be maintained within the injection and recovery zone** while fluids were being injected and recovered during ISCR operations. The successful completion of the test was reported to ADEQ in a letter dated April 6, 1998 (BHP Copper, 1998)."
Attachment S, Form 43-101F1 Technical Report, at 7: "In 1998, BHP conducted a multi-month, field optimization ISCR test to demonstrate hydraulic control, gather copper recovery and other technical data for final feasibility. **The outcome of the study confirmed to regulatory agencies that production wells could be efficiently installed into the mineralized zone, hydraulic control of the injected and process solutions could be maintained and documented, and that the ISCR method was a viable method for copper extraction**."
Attachment S, Form 43-101F1 Technical Report, at 21: "The BHP pilot test demonstrated that hydraulic control could be established and maintained within the FCP mineralized body. The results of their successful demonstration of hydraulic control were submitted to the Arizona Department of Environmental Quality ("ADEQ") in a memo dated April 6, 1998 (BHP, 1998)."
Attachment S, Form 43-101F1 Technical Report, at 29: "The APP required a demonstration of hydraulic control be performed for a period of approximately 90 days prior to commencement of commercial operations. The BHP hydraulic control test was conducted from November 8, 1997 through February 10, 1998. **The goal of the test was to demonstrate that four pairs of pumping and observation wells were adequate to demonstrate a continuous inward hydraulic gradient in the aquifer**. BHP prepared a report on April 6, 1998 documenting the hydraulic control test. This report was submitted to ADEQ and USEPA as a demonstration of compliance with the permit condition."
Attachment S, Form 43-101F1 Technical Report, at 78: "In 1998, BHP conducted a multi-month field optimization ISCR test to gather copper recovery and other technical data for final feasibility. **The outcome of the study confirmed that production wells could be efficiently installed into the mineralized zone, hydraulic control of the injected process solutions could be maintained and documented, and that the ISCR method was still the preferred method.**"
Attachment S, Form 43-101F1 Technical Report, at 164: "The BHP pilot test successfully demonstrated that: The mineralized body had sufficient hydraulic conductivity to support well to well fluid flow; Injected solutions could be recovered in a reliable manner; and Hydraulic control of injected solutions could be maintained."
Attachment S, Form 43-101F1 Technical Report, at 167: "The BHP pilot test demonstrated that hydraulic control could be established and maintained within the FCP mineralized material body. The results of their successful demonstration of hydraulic control were submitted to ADEQ in a memo dated April 6, 1998 (BHP, 1998)."

Attachment S, Form 43-101F1 Technical Report, at 168: "The injection and recovery well design proposed by Curis Arizona is based on experience gained from the BHP pilot test, and is compliant with the Underground Injection Control (UIC) Permit issued to Florence Copper in 1997."

Appendix B:
Summary of BHP Pilot Test Information Regarding Vertical Migration and the Injection Exclusion Zone

BHP was prohibited from injecting acid mining solution into the top 40 feet of the Oxide Zone, the so-called "exclusion zone" requirement intended to prevent vertical migration.[55] Region 9 adopted the same provision in the Draft Permit.[56] But mining solution migrated into the LBFU, despite the 40-foot exclusion zone, during the BHP Pilot Test.

An aquifer is a three-dimensional object that necessarily responds to external influences in a three-dimensional fashion. Because the PTF is an *injection* project, not only a *pumping* project, the pressurized acid solution will move both laterally and vertically (in both directions). Injection under pressure necessarily results in upward flow, and this predictable phenomenon must be overcome to completely control the solution.[57] The question for Region 9 is how much extraction pumping is required to overcome the vertical flow and keep the acid out of the LBFU.

BHP predicted that acid solutions would flow up to 25 feet into the LBFU under pressurized injection, despite the exclusion zone.[58] As BHP described its modeling efforts:

> Figure 23 presents a vertical concentration profile from a cross section between injection wells BHP-6 and BHP-8, and production wells BHP-1, BHP-10, and BHP-12. The wells are placed 40 ft underneath the LBFU and oxide contact zone. The cross section between the two other injection wells has similar concentration contours. It is seen that the injected solution had moved 20 ft to 40 ft into the LBFU at the end of one year. The simulations assume that the hydraulic conductivity in the LBFU does not change. The laboratory test on cores from LBFU showed that the permeability of LBFU

[55] BHP UIC Permit, at 9, § II(C)(4).

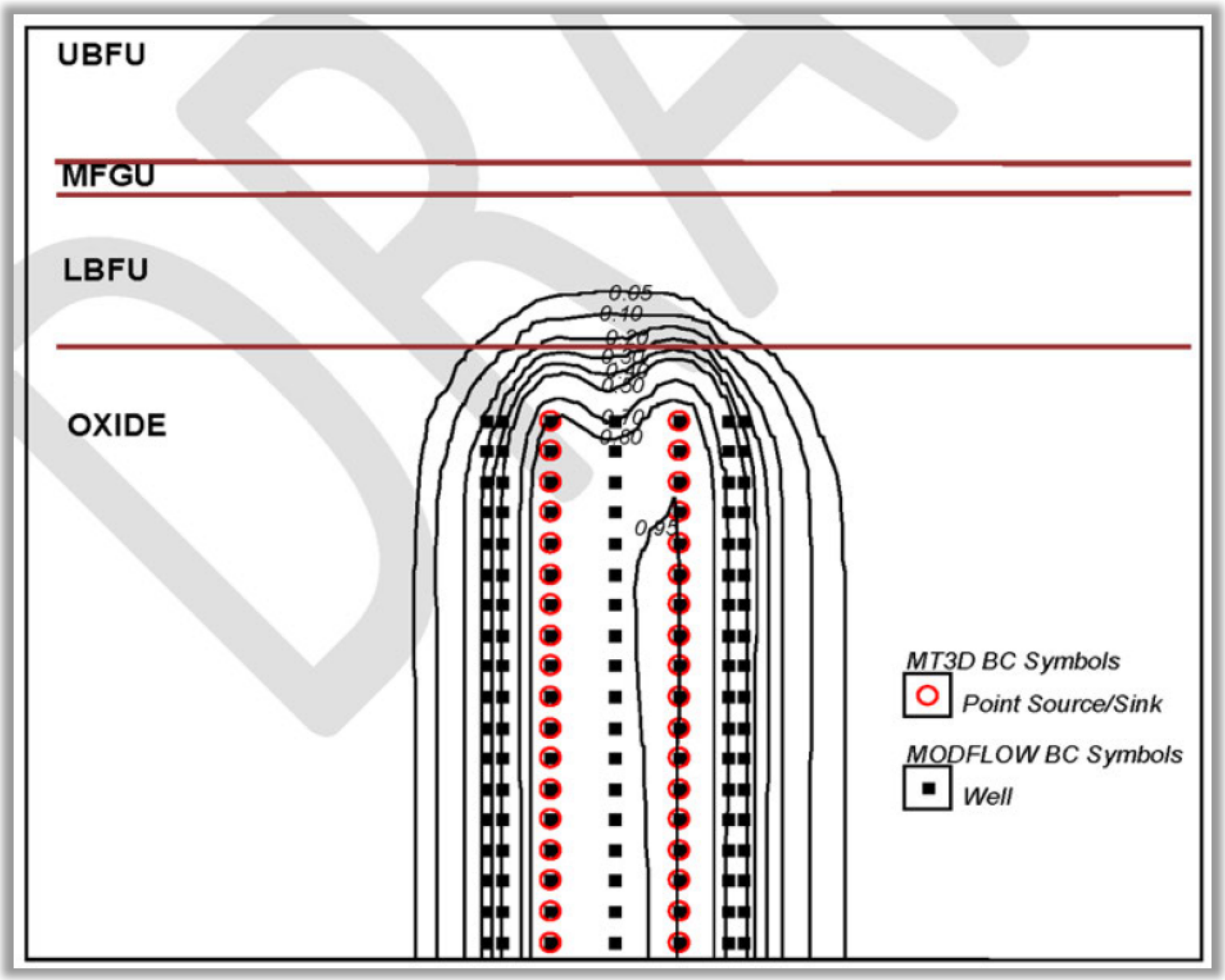
[56] Draft Permit, at 14, § II(C)(7); Statement of Basis, at 6 ("To prevent vertical excursion of injected fluids, the uppermost 40 feet of the oxide zone will be excluded from injection.").

[57] OAH Hearing Transcript, Testimony of Lee Wilson, May 5, 2014 at 91.

[58] *Id.*, Testimony of John Kline, April 2, 2014, at 130 ("The hydrologic model indicated the solution would move upward of 25 feet, but not enter the upper basin fill unit.").

could be reduced 50% during the leaching because of mineral precipitation. The actual vertical excursion could be smaller.[59]

Figure B-1
Figure 23 from Draft BHP Field Test Report. Vertical concentration profile from a cross section between injection wells BHP-6 and BHP-8, and production wells BHP-1, BHP-10, and BHP-12 after one year.
Each layer represents 20 feet.



The BHP UIC permit allowed such vertical flow because the intent of that permit was to protect the UBFU, not the LBFU.[60] And BHP's predictions were confirmed

[59] BHP Copper, Inc., *Florence Project Field Test Report – Goals, Results, Conclusions (Draft)*, at 39 (October 15, 1999)

[60] *See, e.g.*, BHP Copper, Inc., *Florence Project Field Test Report – Goals, Results, Conclusions (Draft)*, at 6 (October 15, 1999) ("The goal of this test program was to install the annular devices during

during the BHP Pilot Test. BHP, using essentially the same process proposed by FCI, confirmed through data that acid would flow upward into the LBFU:

> To monitor the flow paths of solution from injection well to pumping wells, Electric Resistance Tomography (ERT) were used during the injection test. . . . Electrodes are placed in wells along wellbore. By measuring electrical resistance between two electrodes before and after the injection, the changes in electrical resistance of the rock can be calculated by inverse modeling . . . . In this study, electrodes were placed in BHP-1, BHP-2, BHP-3, BHP-4, and BHP-5 at three-meter intervals. The data was collected before the injection of leach solution and after two months of leach. . . . Although the results are qualitative, it is clear that the solution sweep through most of the oxide rocks. Although the screen of the well is 40 feet below the top of the oxide, the solution has flow vertically into overburden for about 20 feet which is consistent with the numerical simulations.[61]

John Kline, the project manager for BHP, concluded in 2001 that "The test results have definitively shown solutions moving through both the ore and LBFU zones."[62] And BHP staff recommended that deeper exclusion zone to limit the loss of mining solution through vertical excursions:

> The calibrated model was used to simulate the solution movement in the leaching test. The results showed that the injected solution will flow vertically into Lower Basin Fill Unit for 20 feet. Although permits allow this, it is not desirable for the leaching purposes. The vertical excursion can be reduced by increase the distance between the top of the screen and the bottom of the LBFU from 40 feet to 60 feet.[63]

Regardless of whether contamination of the LBFU was allowed by BHP's permit in 1997 or whether such latitude was reasonable even at that time, vertical migration

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construction of the wells and to use them as a monitoring device during operations. This design provides monitoring to prevent vertical excursion of leach solutions into the un-permitted upper-basin fill units.").

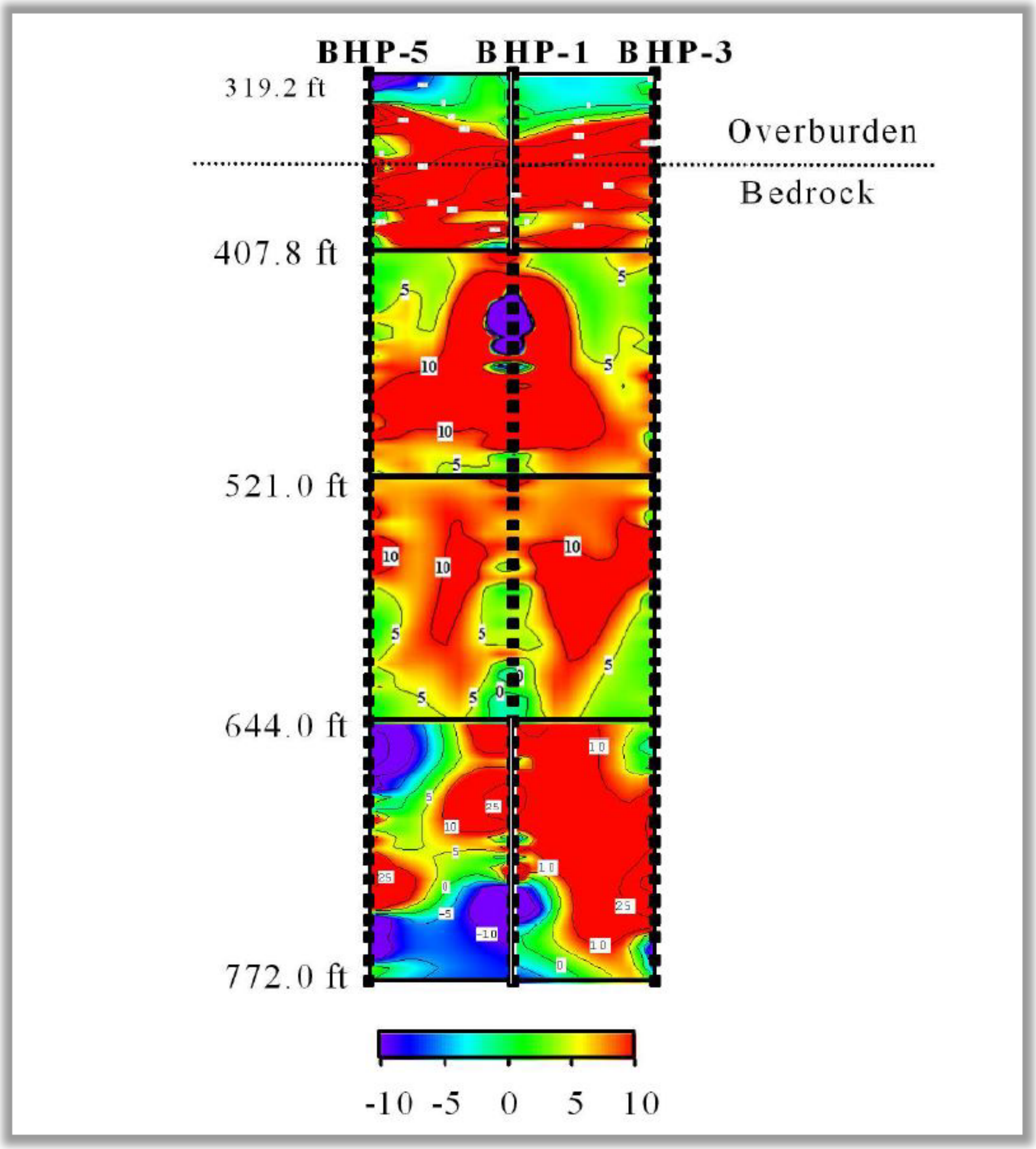
[61] *Id.* at 45.

[62] John Kline, *BHP Billiton Southwestern Copper Florence Project, Well Field Reclamation Test And Well Field Metallurgical Balances*, at 4 (September 12, 2001).

[63] BHP Copper, Inc., *Florence Project Field Test Report – Goals, Results, Conclusions* (*Draft)*, at 47 (October 15, 1999).

into the LBFU is a fatal flaw in 2015, when the LBFU represents the primary drinking water supply for a growing city.

Figure B-2
Figure 23 from Draft BHP Field Test Report. Conductivity Difference from Background in mS/m After One Month of Acid Injection During BHP Pilot Test[64]



[64] BHP Copper, Inc., *Florence Project Field Test Report – Goals, Results, Conclusions (Draft)*, at 46 (October 15, 1999.

Appendix C
BHP Pilot Test Results Demonstrating Extreme Horizontal and Vertical Heterogeneity

A primary reason for the BHP Pilot Test's failure to contain the injected acid is that BHP, like FCI, relied upon the incorrect assumption that the aquifer was homogeneous at the well field scale. Therefore, BHP, like FCI, based its modeling assumptions and calculations on an equivalent porous media (EPM) model that does not reflect real-world conditions.

In all its submittals to Region 9, FCI claimed that prior studies supported the EPM assumption. Notably, FCI's groundwater model was based upon 1996 (pre-BHP Pilot Test) hydrogeologic studies and groundwater modeling. FCI asserted in its UIC application that "No significant additional hydrogeologic characterization activities have been conducted at the proposed PTF well field and surrounding vicinity since the Brown and Caldwell study (1996) was completed."[65] Since it possessed the BHP Pilot Test data at the time this statement was made, FCI clearly knew it was mischaracterizing the information in its possession. The BHP Pilot Test demonstrated the site's extreme heterogeneity, yet FCI chose to ignore the information and to withhold it from Region 9. As a result, the Draft Permit does not adequately address the risks to the LBFU.

As depicted in Figure C-1, SRK developed a map of hydraulic conductivity values obtained through BHP's aquifer testing program, which was relatively comprehensive. There is no indication at all of the homogeneity that FCI's flow model assumes. The map indicates that some parts of the ore body are 100 times as permeable as others. Values are as high as nearly a foot per day, which would allow good flow and provide a pathway for solute transport. The lowest is one-hundredth foot per day (tenth of an inch per day), which won't allow good flow. If a monitoring well were placed in areas of such low conductivity, they would be useless in detecting an acid escape.

Figure C-1. Hydraulic Conductivity Zones Within the Oxide Bedrock in the 5-Spot[66]

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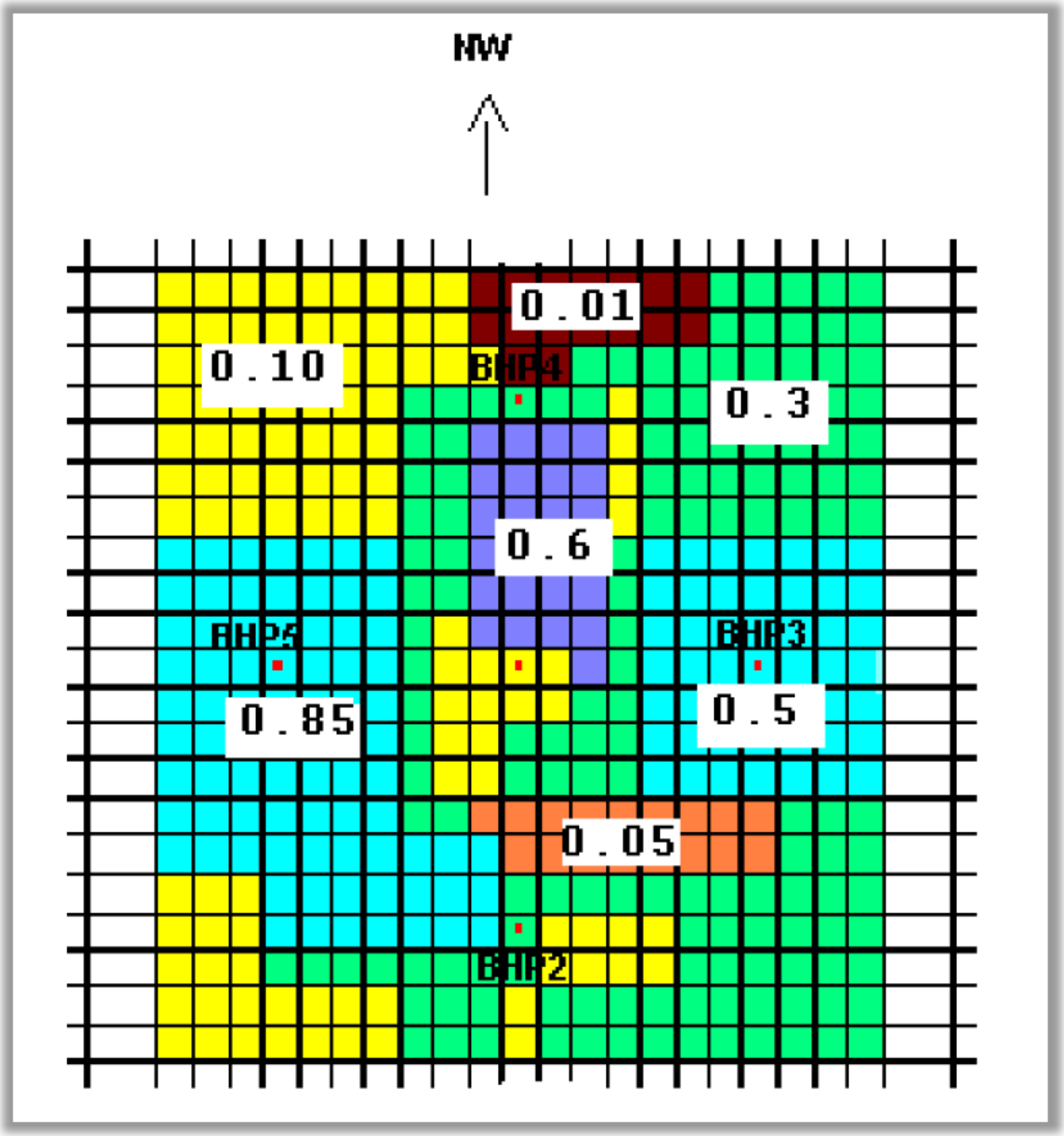
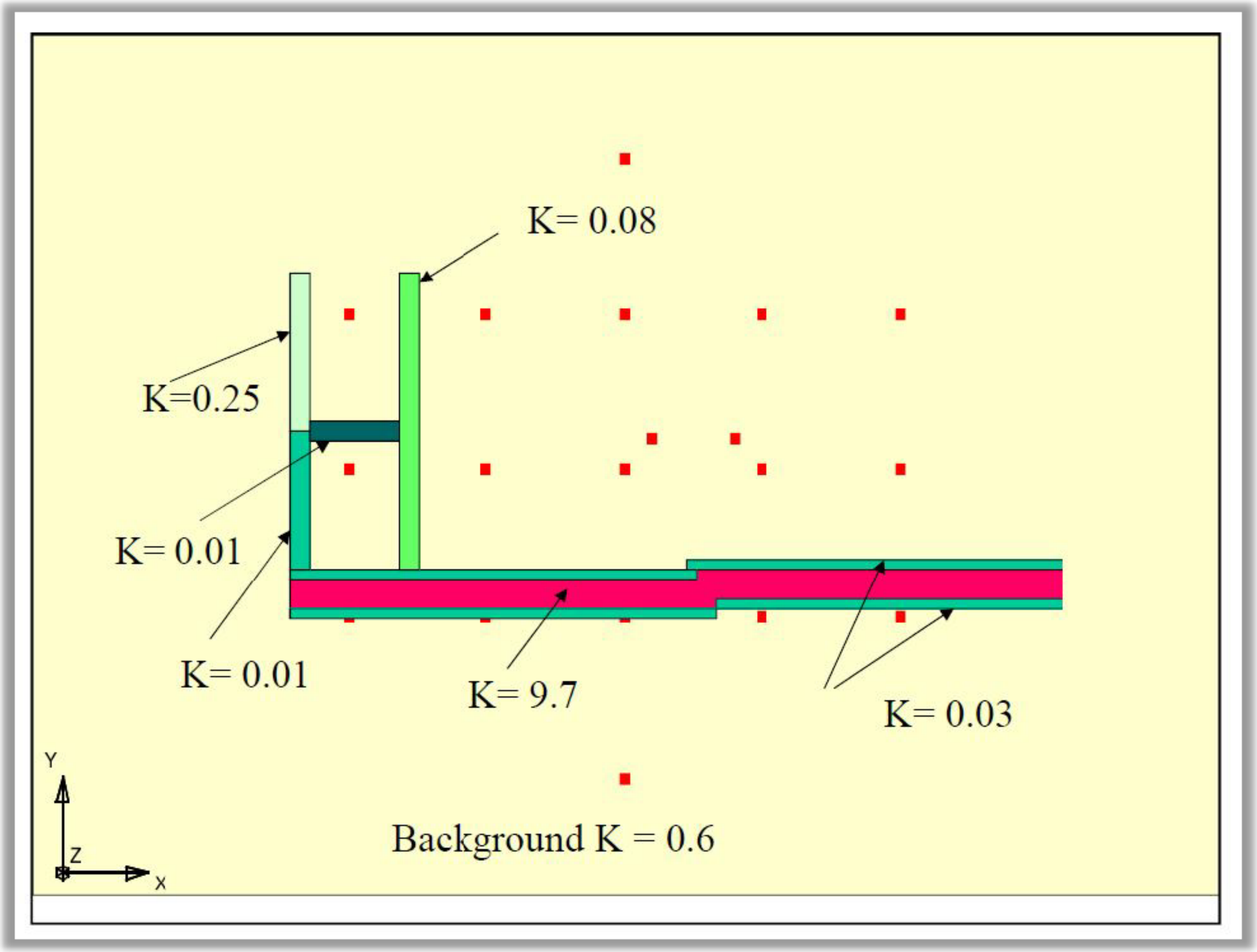
[65] FCI Application, Attachment N, at 4.

[66] SRK Consulting (US), Inc., *Summary of the BHP Copper Florence ISR Field Test and Updated Work*, at 54, Fig. 4-8 (2010).



BHP prepared a map of hydraulic conductivity based on tracer tests done before and after the project, provided in Figure C-2. The red bar at the bottom is a short-circuit–a preferential flow pathway for water to move in an east-west direction near the bottom of the project site. When site geology has short-circuits, acid escapes are possible even when water balance and gradients seem demonstrate hydraulic control.

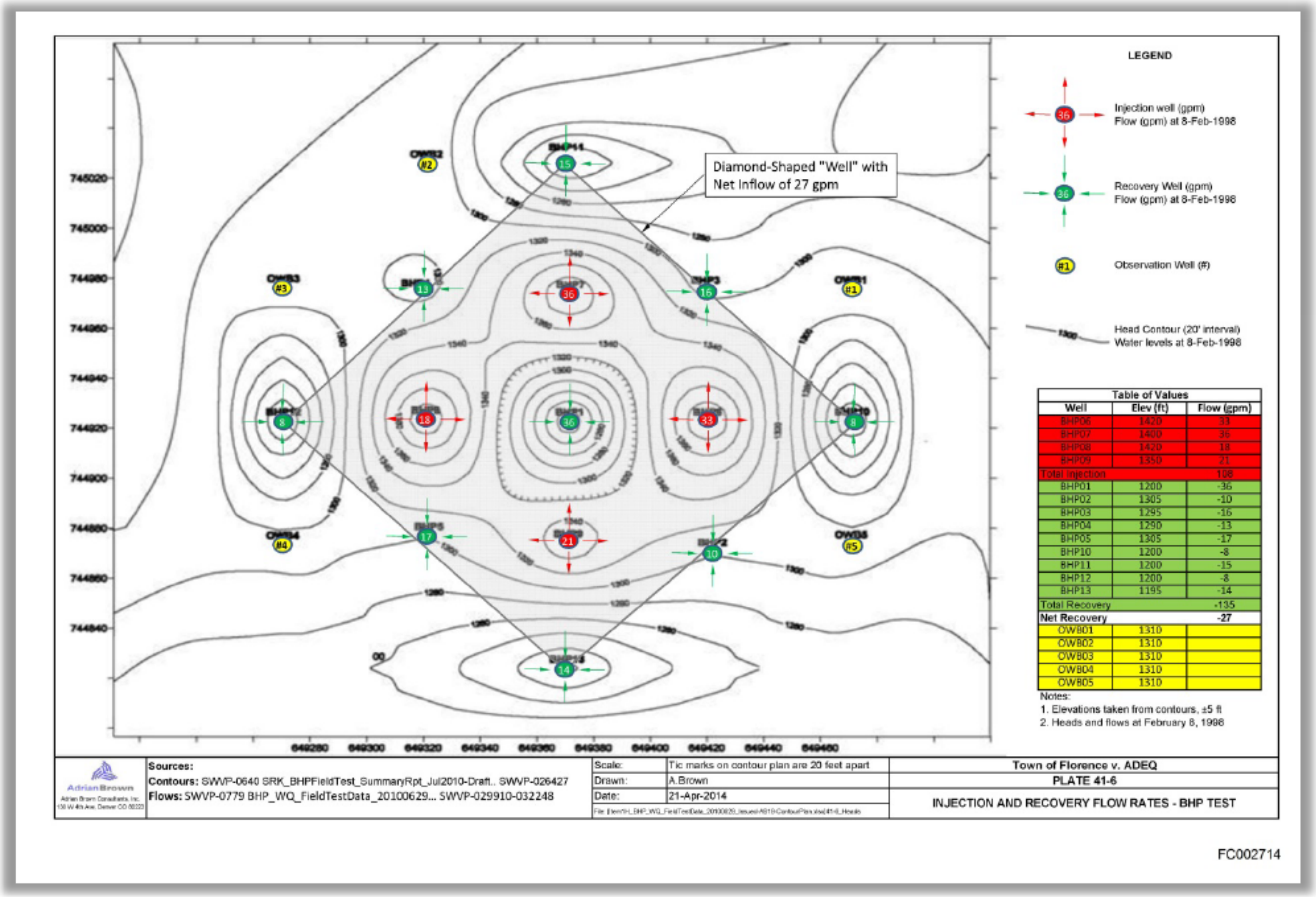
Figure C-2. Calibrated Results of Hydraulic Conductivity.[67]



Finally there is a water table map prepared by FCI's expert, provided in Figure C-3, showing large cones of impression at injection sites, and cones of depression around recovery wells. Well pumping rates were similar among wells, but notice how much smaller the upward cone is on the south side of the area–the area where the tracer tests found a short-circuit. This is an example of a real-world project impact that would never even be hinted at by a model of the type that FCI has prepared and EPA has accepted.

[67] BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 36, Fig. 19 (October 15, 1999)

Figure C-3. Injection and Recovery Flow Rates – BHP Test.[68]



If EPA had requested and reviewed the BHP pilot test data and reports, the agency would have seen that heterogeneity is discussed at length. Especially prominent is the fact that the extreme heterogeneity precluded BHP from building a model that could consistently explain the actual observed data. The extremely heterogeneous conditions experienced during the BHP pilot test that led to failed containment were similarly not accounted for in FCI's assumptions and models underlying its PTF application. If the FCI model cannot reproduce the actual observations made during the BHP test, then Region 9 cannot reasonably rely upon it without much more intensive monitoring and data reporting requirements than are currently in the Draft Permit.

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[68] Adrian Brown Consultants, Inc., Exhibits for Testimony, Plate 41-6 (April 21, 2014).

Appendix D:
Issues Raised by April 6, 1998 BHP Letter Report

Until now, the only results from the BHP Pilot Test that have been disclosed to Region 9 were contained in an April 6, 1998 letter report to ADEQ.[69] FCI has trumpeted this slim document for years as definitive proof that BHP maintained hydraulic control. Attached to the two-page letter was a one-page summary memorandum from Corolla Hoag, electrical conductivity data and tables, and groundwater elevation data from four pairs of observation and recovery wells in the BHP well field. Although this document represents only a small fraction of the relevant data from the BHP Pilot Test, it alone should have raised serious questions for Region 9 about FCI's ability to maintain hydraulic control over its injected acid solution.

A groundwater elevation increase of almost 200 feet occurred in recovery well BHP-5 during the start-up of the pilot test on November 8, 1997. No explanation was provided in the letter report. However, it can be assumed that there was either a malfunction in the pumping mechanisms of the recovery well or that significant mounding may have been occurring between the paired injection well (BHP-9) and the recovery well. FCI has never addressed this data or provided an explanation for the sudden jump in groundwater elevation.

Over a two to three day period (November 8, 1997 to November 10, 1997), hydraulic control was not adequately maintained between recovery and observation well pair BHP-5 and OWB-4 on the west side of BHP's well field. Gradient differential (flow in the wrong direction) was documented during a 12-hour period that was greater than 48 feet at these wells. Also, it appears that from November 8, 1997 to November 18, 1997, hydraulic control was only marginally maintained at this location with a relatively flat groundwater gradient.

Another concern is the methodology for measuring conductivity values in the BHP observation wells appeared to be different than that used for the BHP recovery wells. This likely resulted in data that could not be compared with the certainty necessary to prove hydraulic control. BHP's recovery and observation well sampling method was described as follows:

> The data for electrical conductivity was measured by hand. The samples were taken by two methods. The wells labeled as BHP2, BHP3, BHP4, and

[69] Letter from Ms. Corolla Hoag, BHP, to Ms. Julie Collins, ADEQ (April 6, 1998).

> BHP5 were continuously running pumping wells. … Observation wells OWB1, OWB3, OWB4, and OWB5 did not have pumps in them during the test. These wells were sampled using a sample baler [*sic*] with a small pump attached to guarantee a good sample. The procedure for this sampling was to turn the pump on for five minutes and then let the sample collect for another two minutes before retrieving the baler [*sic*].

This description suggests that samples for electrical conductivity analysis were collected from the observation wells at depths that may have been shallower than for the samples being collected from the recovery wells. If the sample depths were different, a direct comparison of electrical conductivity data from the observation well and recovery well pairs could not have been made, because conductivity results can vary widely at different depths, even from the same well. More importantly, higher electrical conductivity measurements indicative of breakthrough into an observation well and failure of hydraulic control may not even be detected if the sample is being collected well above the zone of injection

Appendix E
Region 9 Had Ample Notice That BHP Pilot Test Information Should Have Been Obtained and Reviewed Before Issuing the Draft Permit.

Even when an agency employs a methodology or analysis with a rational basis, the choice of methodology still must be based upon relevant factors specific to the facility at issue, such as the type of facility and its location. In other words, a rational methodology can still fall short if the agency ignores significant factors that would affect the outcome of the analysis.[70] The BHP Pilot Test data, which Region 9 has ignored, is exactly the type of information that will affect the analysis of FCI's permit application.

An agency has been arbitrary when its action is "unreasoning" and has been taken with "disregard to facts and circumstances."[71] Stated more fully, an agency's decision is likely arbitrary and capricious if the agency "entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise."[72] An agency must review all of the relevant facts and provide a "rational connection between the facts found and the choice made."[73] The BHP Pilot Test data and reports represent relevant facts, perhaps the most important facts available, to the issue of whether a UIC permit should be issued to FCI. Ignoring the information is the definition of arbitrary, capricious, and unreasonable action.

1. EPA Region 9 Should Have Noticed Problems with BHP Pilot Test in 1998.

Region 9 has long known there were potential issues with the BHP Pilot Test, and that knowledge should have triggered concerns and calls for more information from FCI. As discussed in Appendix F, the letter report that BHP submitted to EPA

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[70] *Sierra Club v. Envtl. and Public Protection Cabinet*, 2005 Ky. ENV LEXIS 104, 108-09 (Aug. 9, 2005).

[71] See ADEQ's Amended Closing Memo, at 2 (citing *Maricopa Cnty. Sheriff's Office v. Maricopa Cnty. Emp. Merit System Comm'n*, 211 Ariz. 219, 223, 119 P.3d 1022, 1026 (2005)).

[72] *Southwest Ctr. for Biological Diversity v. U.S. Forest Serv.*, 100 F.3d 1443, 1448 (9th Cir. 1996).

[73] *Burlington Truck* Lines, Inc. v. U.S., 372 U.S. 156, 168 (1962).

Region 9 in April 1998 should have alerted the agency to potential issues with the BHP Pilot Test. Review of the administrative record from the BHP UIC permit would have revealed that letter to Region 9 as early as 2010, when FCI sought to have the UIC permit transferred to its name.

2. SWVP Notified Region 9 of Potential Problems with the BHP Pilot Test Over Two Years Ago.

But even if Region 9 ignored its own files on this site, it was put on notice of the BHP Pilot Test data by SWVP. In September 2012, SWVP asked Region 9 to obtain and review the BHP Pilot Test results. Although FCI touted the BHP Pilot Test as proof that hydraulic control worked, it relied almost exclusively on computer modeling and assumptions to support its application, ignoring data from the BHP Pilot Test that was known to exist. SWVP asked EPA to require that FCI calibrate its models against that data.[74]

This additional BHP Pilot Test data was known to exist because it was cited in letters from a previous property owner expressing concerns over significant inconsistencies between modeling and assumptions underlying the original UIC permit and the BHP Pilot Test results. In December 2005, Brown and Caldwell[75] submitted a letter to the Arizona State Land Department that documented a meeting between Merrill Mining and the Department a week earlier. Citing a 1999 Field Test Report (that FCI did not provide to EPA Region 9), Brown and Caldwell summarized the concerns with the results of the BHP Copper pilot test:

> All of the aforementioned documents were discussed or referenced in our meeting to describe the information that BHP had developed regarding the economic feasibility of the Project. Mr. Ames explained that he had reviewed the key elements of the reports as a professional geologist and that he had doubts that the Project would be feasible. He noted the lack of clean, locally available and inexpensive acid needed for injection; uncertainties regarding the flow and water-rock interactions within the leach zone; remediation uncertainties; and the need for an additional leach test that would involve a significantly larger area than used during the first test. He explained that thus far, no mining company has come forward willing to partner with Merrill and invest the large sums of

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[74] Letter from Ronnie Hawks, Jennings, Haug & Cunningham, to Alexis Strauss, EPA Region 9 Acting Director (September 13, 2012).

[75] Brown and Caldwell is an environmental consulting firm that worked for BHP Copper at this site, stayed on the job when Merrill Mining took over, and continues to work on the site for FCI.

money necessary to conduct another leach test in view of the many uncertainties.[76]

Nearly a year later, Merrill Mining wrote a letter to a potential mining partner regarding the site and the results of the BHP Copper Pilot Test.[77] That letter also summarized significant concerns with the project:

- Merrill noted that "there were major disparities between the results of field tests and the assumptions regarding the copper recovery mechanisms and recovery rates that were used to justify the permits for, and the economic viability of the Florence Copper Project. The disparities led BHP Copper to conclude that the field test results did not justify building a leach facility at Florence . . . ."[78]

- In a Draft Field Test Report prepared by BHP in October 1999 (but withheld by FCI during the permit process), BHP noted substantial disparities between the recovery rates measured during the 1997-98 field test and the data used to justify the project during permitting, concluding that "If the solution chemistry in the production well BHP-1 is, in fact, a result of water-rock reactions, in-situ leaching at Florence may not be possible."[79]

- BHP also concluded in the Draft Field Test Report that much longer leach times might be required to obtain copper at commercially-viable levels, with modeling suggesting leach times of 6 to 8 years. This could, in turn, double the mine life of the project, with the total time between the start of production and closure possibly exceeding 45 years.[80]

- BHP recommended that a new field test be conducted for a much longer duration and employing a multiple-cell test field and expanded water management system. As a precursor to a second field test, BHP recommended an "improved understanding of the geochemical and hydrogeological mechanisms at work before attempting the design of a new field test."[81]

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[76] Jerrell Southall, Brown and Caldwell, Letter to Michael Rice, Arizona State Land Department, at 2 (December 8, 2005).

[77] Letter from Roger Ames, Registered Geologist, Merrill Mining, to Bryan Wilson, President and CEO, Mohave Resources, Inc. (November 21, 2006).

[78] Id. at 1.

[79] Id. at 2 (citing Draft Field Test Report, at 109).

[80] Id. at 2-3.

[81] Id. at 3 (citing Draft Field Test Report, at 102 and 110-111).

SWVP provided this letter to Region 9 in its September 2012 letter, along with a list of BHP Pilot Test reports cited by Merrill. Despite this information, which gave the agency the ability to request specific BHP Pilot Test reports *by name and date*, Region 9 never asked for the reports or data cited in the letters.

3. Region 9 Should Have Been Put on Notice of Problems with the BHP Pilot Test by the State Administrative Hearing in 2014.

In 2013 and early 2014, SWVP obtained voluminous information regarding the BHP pilot test through subpoena in the State administrative hearing. SWVP notified Region 9 in June 2014 that the information was now publicly available and implored the agency to request the full record from the BHP Pilot Test for consideration in making its permitting decision.[82] SWVP repeated the request a few weeks later and provided its legal briefs in the State administrative hearing that further highlighted discrepancies between FCI's application materials and the BHP Pilot Test data.[83] Furthermore, it is clear from information available to SWVP that Region 9 was monitoring developments in that case and would have known of the ALJ's decision in September 2014. Yet it is apparent from the terms of the Draft Permit that Region 9 never reviewed any of this information.

4. Region 9 Has Ignored Its Statutory Obligations to Protect Public Health and the Environment by Ignoring the Existence of Key Data in This Case.

By ignoring the BHP Pilot Test data, Region 9 has ignored its statutory obligations to protect the environment and public health. But even more important, Region 9 has ignored its obligations to the citizens of Arizona and residents of Florence. In representing the public, an agency "is not to be limited to the horizons of the private parties to the proceeding."[84] It is a basic principle of administrative law that an agency charged with representing the public interest must meet a higher standard:

> This role does not permit it to act as an umpire blandly calling balls and strikes for adversaries appearing before it; the right of the public must receive active and affirmative protection at the hands of the Commission.
>
> This court cannot and should not attempt to substitute its judgment for that of the Commission. But we must decide whether the Commission has

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[82] Letter from Janis Bladine, Jennings, Haug & Cunningham, to Nancy Rumrill (June 20, 2014).

[83] Letters from Janis Bladine, Jennings, Haug & Cunningham, to Nancy Rumrill (August 1 and September 18, 2014).

[84] *Michigan Consol. Gas Co. v. Federal Power Comm'n*, 283 F.2d 204, 226 (D.C. Cir. 1969).

correctly discharged its duties, including the proper fulfillment of its planning function in deciding that the "licensing of the project would be in the overall public interest." The Commission must see to it that the record is complete. The Commission has an affirmative duty to inquire into and consider all relevant facts.[85]

In fulfilling its obligations, an agency cannot accept as fact a permit applicant's often self-serving conclusions and assertions as fact, without reasonable investigation and analysis. Especially in an area as important as environmental protection, regulatory agencies must "take the initiative of considering environmental values at every distinctive and comprehensive stage of [the] process."[86] For an agency to do otherwise is to abdicate its obligation to represent the public and "place the burden of analyzing environmental issues upon intervenors"—in this case SWVP, the Town of Florence, and other members of the public.[87] If an agency accepts an applicant's statements without reasonable analysis or investigation and no one from the public steps up to challenge those statements, they could be accepted as true despite relevant and significant evidence to the contrary. The agency cannot foist such responsibility upon third parties, whose resources may be limited.[88] "The danger of this procedure, and one obvious shortcoming, is the potential, if not likelihood, that the applicant's statement will be based upon self-serving assumptions."[89] This is especially true where, as here, the applicant and agency control the information available to the public and the public is given limited time to review the data and prepare a challenge.

Furthermore, a permit applicant should not be allowed to dictate the information upon which an agency decision is based—the agency has an affirmative duty to ascertain all of the relevant facts:

They are not expected merely to call balls and strikes, or to weigh the evidence submitted by the parties and let the scales tip as they will. The agency does not do its duty when it merely decides upon a poor or nonrepresentative record. As the sole representative of the public, which

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[85] *Scenic Hudson Preservation Conference v. Federal Power Comm'n*, 354 F.2d 608, 620 (2nd Cir. 1965); see also *Save Ourselves, Inc. v. Louisiana Envtl. Control Comm'n*, 452 So. 2d 1152, 1157 (La. 1984).

[86] *Calvert Cliffs' Coordinating Comm'n v. United States Atomic Energy Comm'n*, 449 F.2d 1109, 1119 (D.C. Cir. 1971). Although the Calvert Cliffs court was speaking with regard to the National Environmental Policy Act, ADEQ can hardly argue that protection of Arizona's groundwater deserves any less protection.

[87] *Harlem Valley Transp. Ass'n v. Stafford*, 500 F.2d 328, 335 (2nd Cir. 1974).

[88] Id. at 336.

[89] *Greene Cnty. Planning Bd. v. Federal Power Comm'n*, 455 F.2d 412, 420 (2nd Cir. 1972).

is a third party in these proceedings, the agency owes the duty to investigate all the pertinent facts, and to see that they are adduced when the parties have not put them in * * *. The agency must always act upon the record made, and if that is not sufficient, it should see the record is supplemented before it acts. It must always preserve the elements of fair play, but it is not fair play for it to create an injustice, instead of remedying one, by omitting to inform itself and by acting ignorantly when intelligent action is possible * * *.[90]

Nor should a regulated entity complain if an agency requests additional information or conducts further investigation to verify statements in an application—this is a necessary part of doing business in a regulated industry.[91]

5. Having Been Repeatedly Put on Notice of Issues with the BHP Pilot Test, Region 9 Should Not Have Relied Solely and Completely on Information Selected for Inclusion in the UIC Application by FCI.

The duty to actively inquire and investigate is closely related to, but separate from, the agency's duty to reasonably evaluate and verify the information provided in a permit application. Generally speaking, an agency is entitled to rely on the information provided by an applicant.[92] But where information provided by the applicant is challenged and potentially contradictory information is pointed out to the agency, the agency has a duty to undertake an independent investigation to verify the reliability of the information submitted by the applicant.[93] This includes obtaining and reviewing information from other sources or requesting additional information from the applicant.

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[90] *Isbrandtsen Co. v. United States*, 96 F. Supp. 883, 892 (S.D.N.Y.1951) (quoting Senate Subcommittee Hearings on S. 674, S. 675 and S. 918, April 29, 1941, pp. 465–466); See also *In re Kallen*, 455 A.2d 460, 467 (N.J. 1983) (refusal to admit testimony, with knowledge that evidence was lacking, forced a final decision on an incomplete record); *United States v. Kent Bush*, 157 IBLA 359, 392 (IBLA 2002)(separate opinion by Admin. Judge Mullen) (pro se litigant's failure to obtain counsel is no excuse for the agency to have ignored evidence in the record and issues raised by that evidence).

[91] *Railroad Comm'n of Texas v. F.E.R.C.*, 874 F.2d 1338, 1344 (10th Cir. 1989).

[92] *Friends of the Earth v. Hintz*, 800 F.2d 822, 834–35 (9th Cir.1986).

[93] See, e.g., *Van Abbema v. Fornell*, 807 F.2d 633, 642 (7th Cir. 1986) ("The Corps has a duty to ensure the accuracy of information that is important to the decision it is making, at least when obvious errors are brought clearly to its attention."); *Hammond v. Norton*, 370 F. Supp. 2d 226, 251-52 (D.D.C. 2005) ("when the agency has good cause to believe that information is inaccurate or exaggerated, it has a duty to substantiate it").

Nor can an agency ignore relevant information in the record when that information is the basis of public comments and objections. To the extent the information is relevant, the agency must evaluate it and discuss how it impacts the agency's decision. For instance, in *In re Pio Pico Energy Center*,[94] Region 9 issued an air permit to a natural gas power plant. On appeal, the challengers argued that the agency failed to adequately consider emissions data from similar power plants (Panoche and CPV Sentinel) with lower emissions limits in determining Best Available Control Technology (BACT) for the subject permit.[95] The reviewing panel held that the agency dismissed or overlooked this "highly relevant" data from similar operations, which directly conflicted with the agency's conclusions underlying the subject permit terms.[96] The panel explained that:

> The Region had an obligation to investigate and evaluate Panoche and CPV Sentinel, particularly considering the fact that the Region had information about them in the record and was therefore aware of their existence. The Region also had an obligation to explain, as it did with the three test facilities it examined in the Fact Sheet, whether there are differences between the Facility and these two additional facilities, and/or whether source-specific factors exist that justify the selection of an emission limit that is higher than that achieved by, or permitted at, these particular sources.
>
> The Region's failure to adequately consider at the appropriate time what appears to be significant information casts doubt on the BACT analysis. . .. Therefore, the Board concludes that the record does not reflect the exercise of the permit issuer's considered judgment in determining that the emissions limit selected constitutes BACT.[97]

Time and time again, Region 9 has failed to respond to notices that FCI was not presenting the full story in its application. Instead of fulfilling its duty to the public to investigate and determine the facts, Region 9 merely trusted the assertions, predictions, and answers provided by FCI. And when FCI submitted suspect information to the agency, such as the conclusory BHP Pilot Test portion of the permit application, Region 9 accepted it without question or intelligent analysis. Such reliance on suspect and incomplete information is arbitrary, capricious, and unreasonable.

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[94] 16 E.A.D. ___, PSD Appeal Nos. 12-04 through 12-06 (EAB slip op. August 2, 2013).

[95] Id. at 90-91.

[96] Id. at 93-94.

[97] Id. at 97.

Appendix F
The Aquifer Exemption Cannot Be Justified.

Although Region 9 revoked the existing UIC permit issued to BHP Copper in 1997, it left in place the aquifer exemption issued that same year ("1997 Aquifer Exemption"). That exemption was based upon an application and permit for full commercial operations across this entire site. BHP Copper's application and permit have no relationship to FCI's PTF in terms of size, scope, purpose, or impacts to USDWs. Region 9 should have revoked the 1997 Aquifer Exemption and analyzed FCI's application for an exemption in light of FCI's proposal and current conditions in the area. The failure to do so, and the insistence on leaving the 1997 Aquifer Exemption in place, violates the law, EPA guidance, public policy, scientific fact, and good sense because:

- The 1997 Aquifer Exemption includes large portions of the LBFU, which do not quality for an exemption.
- Under existing facts and circumstances, the law at most would allow exemption of the Oxide Zone in the PTF area.
- Region 9 has ignored current USEPA guidance regarding proper analysis of an aquifer exemption application.
- The exemption is requested in the center of a growing city that is almost entirely dependent on the aquifer for drinking water.
- The 1997 Aquifer Exemption is based on facts and circumstances that no longer exist.

1. Even if an Aquifer Exemption Were Allowed, it Must Be Limited to the Oxide Zone in the Immediate PTF Area.

Ignoring the multitude of reasons an aquifer exemption makes no sense in this area (as discussed more below) and assuming an exemption can be justified, the exemption must be limited to the Oxide Zone in the immediate area of the PTF. There is no legal basis for exempting any portion of the LBFU, as Region 9 has done here. Nor is there any basis for an exemption covering hundreds of acres for a PTF well field of only a couple of acres.

a. The LBFU does not meet any of the aquifer exemption criteria.

Even if Region 9 believes an aquifer exemption is somehow justified here, no basis exists for exempting any portion of the LBFU from the SDWA, as was done in the 1997 Aquifer Exemption. The LBFU currently serves as a source of drinking water. Therefore, it does not meet the first exemption criteria.[98] This fact alone renders exemption inappropriate. But the LBFU does not meet any of the other criteria either:

- **The LBFU can and will serve as a source of drinking water in the future**.[99] As discussed in Appendix H, the aquifer in this area, and the LBFU in particular, will continue to serve as an ever-increasingly important source of drinking water in the future. This includes the deep LBFU directly adjacent to FCI's proposed mine area.

- **The LBFU is not mineral producing**.[100] Even ignoring the fact that FCI cannot legally mine any of its privately-held land under the Town's zoning ordinances and land use plans, only the Oxide Zone contains copper in quantities presenting the potential for commercial production. The LBFU consists of alluvial basin-fill sediments that contain no commercially producible copper.

- **The LBFU is not situated at a depth or location that makes drinking water production impractical**.[101] Drinking water production wells are today withdrawing from the LBFU and more wells in this aquifer layer are planned for the future. It is both practical and necessary to withdraw from the LBFU for the Town's growing water needs—other sources are insufficient.

- **The LBFU is not contaminated.**[102] Groundwater quality is excellent in the LBFU. Degradation of this water source from FCI's proposed mining activities should not be allowed.

- **The LBFU is not located over a mining area subject to subsidence or collapse.**[103] FCI has expressly stated that subsidence is not an issue at this site.[104]

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[98] 40 C.F.R. § 146.4(a).

[99] 40 C.F.R. § 146.4(b)

[100] 40 C.F.R. § 146.4(b)(1).

[101] 40 C.F.R. § 146.4(b)(2).

[102] 40 C.F.R. §§ 146.4(b)(3) & (c).

The LBFU meets none of the regulatory criteria for an exemption and EPA has no authority to ignore the criteria. No portion of the LBFU, within the AOR, FCI's PTF well field, or elsewhere should be exempted from the protections of the Safe Drinking Water Act (SDWA).

b. Region 9 cannot explain why it is protecting the UBFU and not the LBFU.

The UBFU and LBFU are identical under the UIC regulations, in that they both are USDWs and neither has commercially-producible mineral resources. But the 1997 Aquifer Exemption left in place by Region 9 allows mining solutions to migrate into the LBFU with impunity, while completely protecting the UBFU from such incursions. There is no basis upon which to distinguish the two zones for purposes of the aquifer exemption criteria, and Region 9 has not even tried to justify the disparate treatment. If the UBFU cannot be exempted and must be protected, so must the LBFU.

c. At most, Region 9 can only justify exempting the Oxide Zone within the AOR.

FCI's PTF well field occupies just 2.2 acres.[105] Yet by leaving the 1997 Aquifer Exemption in place, Region 9 has exempted approximately 212 acres of the aquifer from SDWA requirements. The exempted area covers portions of the aquifer that are over ½ mile or more away from the PTF wells. Even if an aquifer exemption was reasonable in this case for the Oxide Zone, there is no justification under applicable law, science, or logic for the decision to leave the existing broad exemption in place.

Region 9 acknowledges that the lateral area impacted by the PTF wells is much smaller than the 1997 Aquifer Exemption:

> The targeted copper oxide zone and area of review (AOR) for the proposed PTF is a relatively small lateral area well within the boundaries of the existing aquifer exemption. For the PTF, the AOR is a circumscribed area of 500 feet from the PTF well field and the existing aquifer exemption boundary is an additional 500 feet and more beyond the PTF's AOR.[106]

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[103] 40 C.F.R. § 146.4(b)(4).

[104] FCI UIC Application, Attachment A, Exhibit A-3, at 13-14.

[105] Statement of Basis, at 6.

[106] Statement of Basis, at 13.

Region 9 relies upon the areal extent of the AOR to justify the 1997 Aquifer Exemption with regard to evaluation of the aquifer as a source of drinking water. The Statement of Basis for the Draft Permit indicates that there are no current wells within the AOR that will be impacted by the PTF. It further notes that existing downgradient drinking water wells are too far from the PTF to be impacted.[107]

Region 9 then ignores the AOR to find that the entire area covered by the 1997 Aquifer Exemption is not a potential future source of drinking water because the aquifer under those 212-plus acres contains minerals in commercially-producible quantities.[108] Either the AOR is relevant to the determination of an aquifer exemption or it is not. If it is relevant, then Region 9 must limit its evaluation to the AOR because it is purportedly the only area impacted by FCI's PTF.

Unlike the baseless approach used by Region 9 here, USEPA's proposed rule for uranium ISR mines bases the aquifer exemption on the AOR, such that the exemption includes the monitor well ring and a small "buffer zone" beyond to allow for corrective action before an excursion impacts a USDW.[109] This is also the approach used in a recent UIC application for the Dewey Burdock uranium ISR project in South Dakota, where the applicant and EPA Region VIII agreed that the exempted aquifer would include the monitor well ring and a small distance beyond.[110] The distance beyond the monitor well ring included in the exempted area was the area in which contaminants might flow before being detected at the monitor wells. This was calculated to be about 50 feet beyond the monitor well ring.[111]

Draft guidance from EPA Region VIII indicates that the exempted area should be kept as small as possible while still allowing the mineral extraction activities at issue:

> The EPA Region 8 will consider an acceptable location for the aquifer exemption boundary to be a location large enough to allow the mining operation to fully extract the ore and restore the area affected by the flow

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[107] Statement of Basis, at 13-14.

[108] *Id.* at 14-15.

[109] EPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4175 (January 26, 2015) ("The excursion monitoring wells should also be far enough from the aquifer exemption boundary to ensure that any necessary corrective action can be taken before a USDW is adversely impacted.").

[110] Powertech (USA), Inc., UIC Application, Appendix M, Aquifer Exemption Boundary Justification, at M-1 (July 2012).

[111] *Id.* at M-2.

of lixiviant without having the chemical effects of the lixiviant reach beyond the aquifer exemption boundary. Hydrologic modeling should be used to demonstrate that the entire area within the aquifer exemption boundary is required to meet these criteria. *The area within the aquifer exemption boundary should be minimized to protect as much of the aquifer surrounding the mining project as is practically possible, and to minimize the area that will need to be restored upon the completion of mining.*[112]

Furthermore, EPA Region VIII considers the aquifer exemption boundary to be a Point of Compliance so that excursions can be detected at the monitoring well ring and addressed before they reach the aquifer exemption boundary.[113]

It is clear that USEPA generally adheres to the principle that "The scope of coverage of an aquifer exemption request is typically the portion of the USDW affected by the activity."[114] Region 9 has apparently agreed with this approach in the past, although it is not clear why it was not followed here. In a presentation given to stakeholders regarding uranium ISR mining on the Navajo Nation Reservation, Region 9 indicated that the exempted aquifer should include the ore zone, monitor well ring and a buffer area beyond the monitor wells.[115] Following that approach here would result in an Aquifer Exemption of a few acres, not hundreds of acres because most of the exempt aquifer in this case will *not* be affected by the PTF.

Region 9 cannot justify the 1997 Aquifer Exemption unless it requires FCI to include the entire mine site covered by the exemption within the Area of Review. Of course, this makes no sense because the PTF does not impact the hundreds of acres included in the 1997 Aquifer Exemption. Furthermore, a larger AOR will require FCI to close all of the boreholes within the exempted aquifer, address the problem of the underground mine shafts, and close numerous other wells on and near its property. Conversely, Region 9 has provided no justification for not requiring closure of these potential conduits if it intends to leave the 1997 Aquifer Exemption in place.

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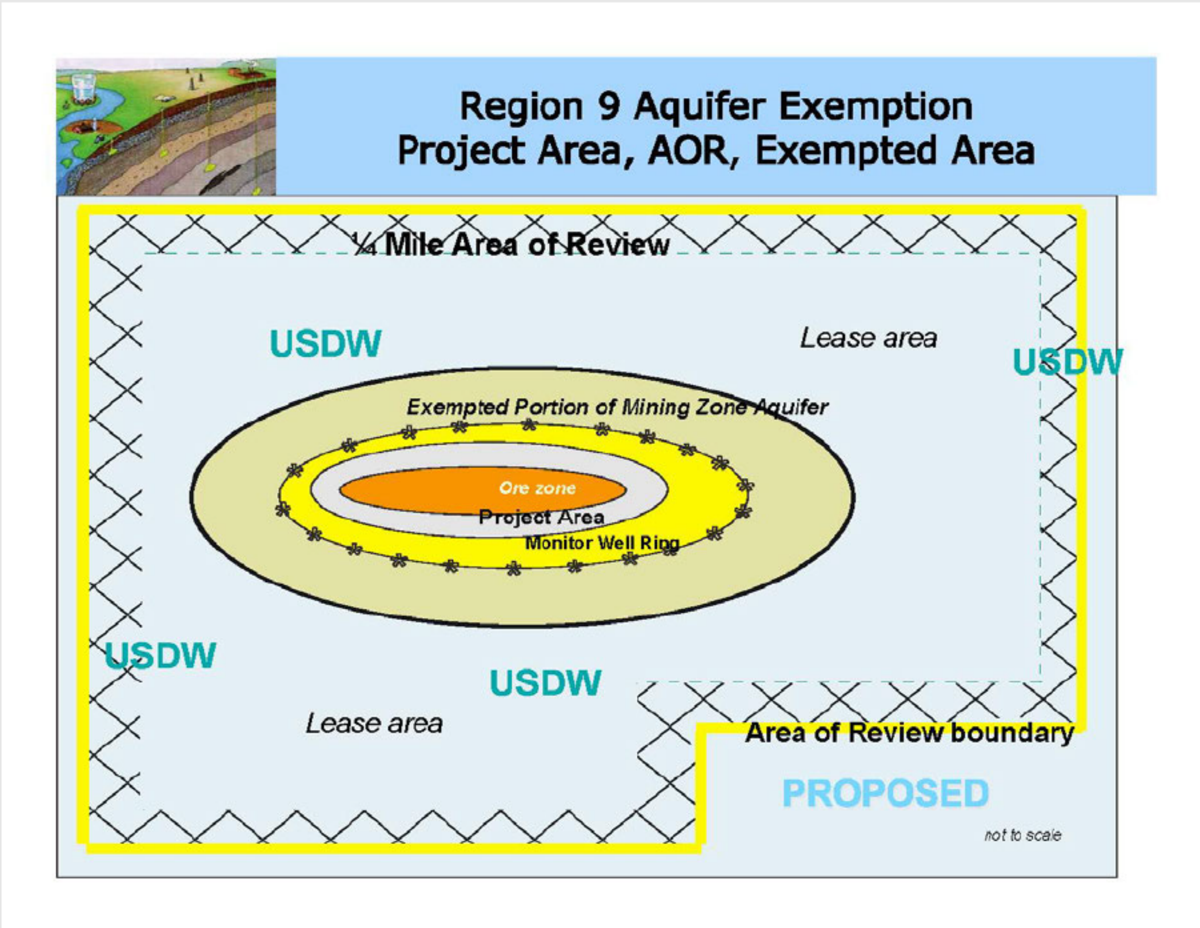
[112] EPA Region VIII, *Draft Discussion of Zone of Influence, Area of Review and Equifer Exemption Boundary for Class III Injection Wells Used for In-Situ Leaching of Uranium*, at 1-2 (June 20, 2008) (emphasis added). Sadly, this draft guidance was drafted by Region 8 staff in conjunction with the applicant and applicant's consultants and no public input, yet it is still more stringent than the Aquifer Exemption allowed by Region 9 here.

[113] *Id.* at 3.

[114] USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4168 (January 26, 2015).

[115] *See* Figure F-1.

Figure F-1. Region 9 Depiction of Proper Aquifer Exemption Area[116]



Region 9 cannot subvert proper analysis of the AOR and aquifer exemption criteria to avoid reevaluation of a 20-year old exemption decision. Region 9 has accepted FCI's assertion that contaminant movement is approximately 40 feet per year, such that AOR is a few hundred feet in diameter. Yet the 1997 Aquifer Exemption extends a half mile or more beyond the PTF well field, sacrificing hundreds of lateral acres of the aquifer to a 2-year pilot project with no assurance that commercial mining will or can occur. There is no logic, scientific support, or legal basis for EPA's position.

[116] Dave Basinger, EPA Region 9 Underground Injection Control Program, Ground Water Office, *EPA Underground Injection Control Permitting of Insitu Leaching*, presented to Uranium Stakeholder Workshop, Gallup, NM (November 2009, modified April 6, 2012).

2. Public Policy, as Expressed by Congress in the SDWA, Favors Drinking Water Uses Over FCI's Mining Scheme.

The driving principal behind Region 9's decision should be protection of the USDW. This requires that Region 9 either deny the aquifer exemption altogether or restrict injection to the Oxide Zone and impose the requirements needed to protect the LBFU. Even ADEQ, despite issuance of a deeply flawed Aquifer Protection Permit, required FCI to contain all mining solutions within the Oxide Zone. Thus, beyond the legal requirements for an aquifer exemption discussed above, there are important practical and public policy reasons for revisiting the aquifer exemption.

a. An aquifer exemption is inappropriate because of current and reasonably foreseeable drinking water uses of the aquifer.

There can be no dispute that the aquifer underlying the PTF is an "aquifer . . . [w]hich supplies any public water system" and is therefore an Underground Source of Drinking Water (USDW) for purposes of this permit.[117] All USDWs are subject to the water quality standards and protections of the SDWA, including the SDWA's prohibition on "underground injection which endangers drinking water sources."[118] Therefore, in order to obtain a Class III UIC permit to inject acid mining solution into the aquifer, FCI must obtain an exemption from SDWA regulation for the aquifer or a portion of the aquifer that would otherwise meet the definition of an USDW before it can inject acid mining solutions into the aquifer.

An aquifer exemption is entirely inappropriate in this case because FCI's injection clearly endangers the Town's drinking water supply. Under the SDWA, underground injection "endangers drinking water sources" if it *may result* in the presence of *any contaminant* in underground water that supplies or can reasonably be expected to supply any public water system and the contamination *may* prevent the public water system from complying with national primary drinking water standards or otherwise adversely affecting public health.[119] In this case, FCI's contaminants will remain in the aquifer after mining is complete, those contaminants will move downgradient toward existing and future drinking water wells, and therefore FCI's proposed injection will result in contamination of groundwater supplying public water systems.

[117] 40 C.F.R. § 146.3.

[118] 42 U.S.C. § 300h(b)(1).

[119] 42 U.S.C. § 300h(d)(2).

Even if this were not the case, EPA Region 9 can exempt all or part of a USDW from SDWA regulation only if the criteria of 40 C.F.R. § 146.4 are met. Regardless of the basis for issuing an aquifer exemption for this site in 1997, today the applicable criteria for an aquifer exemption of the size and scope proposed by EPA Region 9 are not met.

b. The LBFU downgradient of the mine was not a drinking water supply when Region 9 issued the original aquifer exemption.

When Magma Copper Company applied for a UIC permit and aquifer exemption for this site in January 1996, the area north of the Town of Florence and the Gila River was largely unincorporated private and State-owned land—open desert. The closest residential development downgradient of the mine site was approximately 10 miles to the northwest. At that time, Magma controlled much of this area.[120] All of the land three miles or more downgradient (to the north, northwest, and west) of FCI's proposed PTF location—10,000—acres in all, was owned by Magma.[121] ASARCO owned the parcel just west of the proposed mine site and the Arizona State Land department owned a couple of parcels in the area, all vacant land with no existing or proposed groundwater use.

By contrast, FCI owns just 1,182 acres adjacent to the Gila River, leasing another approximately 160 acres from the Arizona State Land Department.[122] And FCI can only legally mine the leased 160 acres. A visual comparison of Magma's land holdings in the 1990s and FCI's today is provided in Figure H-2. This matters because Magma's control of 10,000 acres of empty desert downgradient of its proposed mine was a key consideration in EPA's original aquifer exemption decision. EPA had little or no concern about downgradient drinking water sources because there were no drinking

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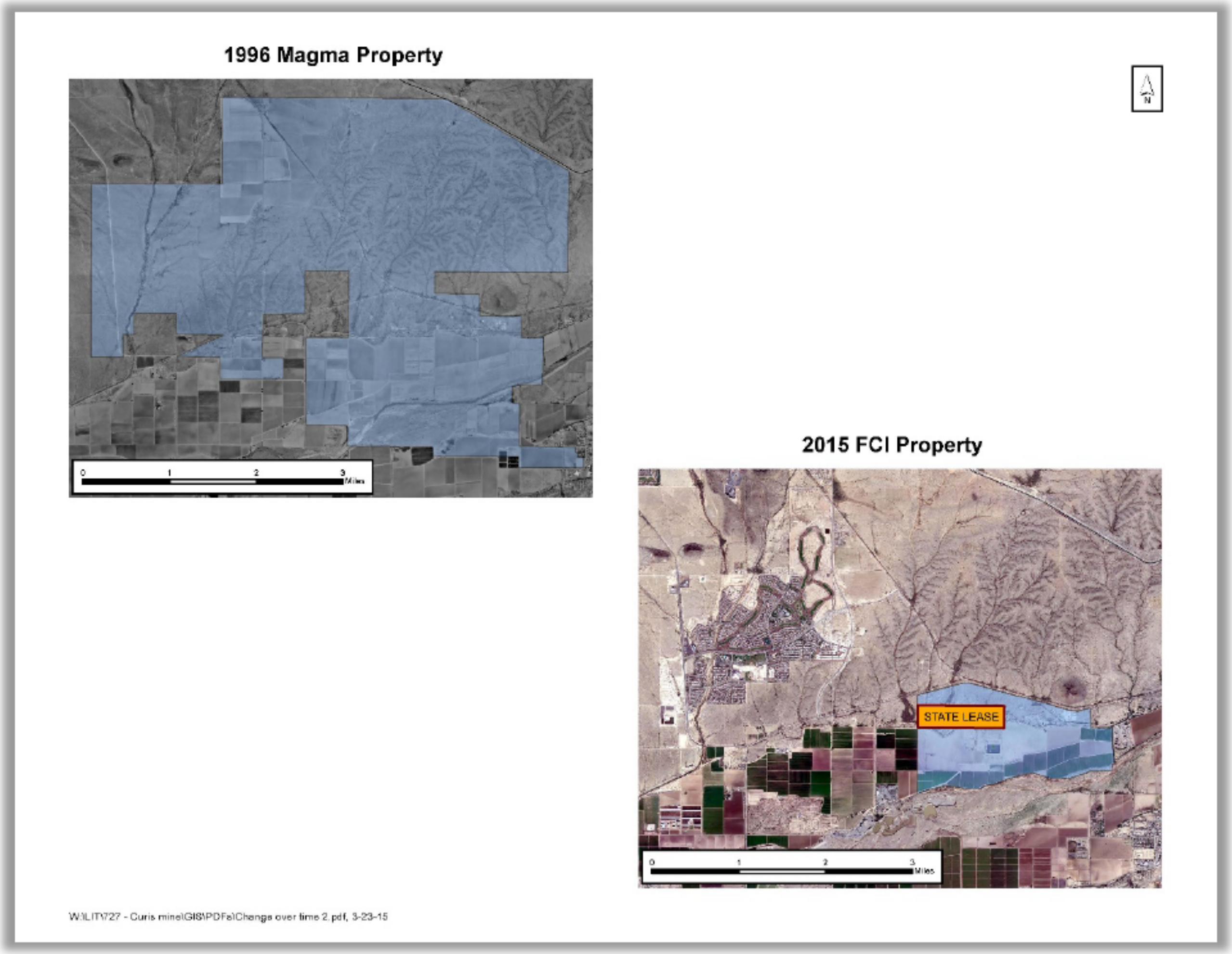
[120] Magma Copper Company, *Underground Injection Control Permit Application, Form 4 and Request for Minor Aquifer Exemption*, Vol. 1, at 2-2 (January 1996) ("Magma controls the uses of the water within the proposed boundary. The mine site and the few homes associated with Magma's drilling and farming operations use imported bottled water and not well water for drinking due to excessive nitrate levels in the water. The area will not be used for drinking water in the future as Magma owns or controls the land.").

[121] *Id.* ("Use of irrigation wells that could potentially interfere with leaching operations will either be closed or relocated to other areas of *Magma's 10,000-acre property*.") (emphasis added); *id.*, Sheet 1.1-1(I), Florence Project Area Map (depicting Magma's then-current landownership) (included separately as SWVP-005903).

[122] FCI Application, Attachment S, M3 Engineering and Technology Corp., *NI 43-101 Technical Report Pre-Feasibility Study*, at 1 (March 28, 2013).

water wells, public or private, downgradient of the mine. Nor could drinking water wells be constructed downgradient during the life of the proposed mine because Magma owned everything downgradient.[123]

Figure F-2. Area Available for Legal Mining in 1996 and 2015.



Today, FCI only owns and controls the land immediately surrounding its proposed mine. FCI's small parcel is now surrounded by a Master Planned Community, with existing homes less than 1.5 miles from the Mine and new residential

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[123] USEPA, *Memorandum re Request to issue a UIC permit and aquifer exemption to BHP Copper* (April 30, 1997) ("There are no drinking water wells, public or private, downgradient from the mine site. Future downgradient wells are also controlled as BHP Copper owns about 2-3 miles of land to the north and west (downgradient) of the site. . . . *Due to the location of the proposed site and the location of the existing wells, even with no controls, impacts to existing drinking water wells would be highly unlikely*.") (emphasis added).

areas that will be located less than 2,000 feet from FCI's proposed production test facility wells. EPA Region 9 recognized the substantial changes in the area when it revoked the UIC permit in August 2010.[124] Given these changes, the agency's refusal to reconsider the aquifer exemption is unreasonable. EPA Region 9 should justify its decision to leave the existing aquifer exemption in place when FCI has no power to prevent private or public drinking water wells from being constructed immediately downgradient of the proposed acid injection wells.

c. FCI proposes to inject acid mining solutions into an aquifer located within municipal boundaries, within a master-planned community, and adjacent to existing and planned residential development.

A previous owner of the mine site decided approximately 10 years ago to develop the land for residential and commercial uses rather than mining. To that end, the landowner had the property rezoned for these proposed uses and obtained the Town's approval of a master development plan. As part of this effort, the mine site and most of the land formerly owned by Magma-BHP was annexed into the Town of Florence.[125]

The mine site now sits nearly dead-center in the Town of Florence and the master-planned community. This was the case in 2009 when FCI's predecessor purchased the mine site, so it was clear that proposed mining operations would be conducted inside city limits, within a residential community, and in an aquifer that served as the primary source of drinking water for that community.

It would be unprecedented to allow ISR acid mining inside a municipal boundary in a portion of the aquifer that is hydrologically connected to the local drinking water supply. Our investigation indicates that existing ISR mines are typically located in remote areas far from drinking water sources and communities. For instance:

- The closest town to the Smith Ranch-Highland uranium ISR mine in Wyoming is over 20 miles away and the area controlled by the mine owner consists of over 40,000 acres.[126]

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[124] USEPA, *Letter to Michael McPhie* (August 5, 2010).

[125] *See* Appendix H for a more detailed discussion of the zoning and land use history of this site.

[126] Cameco, *NRC Source Material License No. SUA-1548 License Renewal Application Technical Report*, at 1-7 and 1-12 (February 2012).

- The Marsland uranium ISR uranium mine in Nebrasksa is four miles from the closest *unincorporated* community, the mine owner controls approximately 7,000 acres in the area, and the mine is located in a county with a total population of less than 10,000.[127]
- The Dewey-Burdock uranium ISR project is located on over 10,500 acres located 13 miles from the nearest town of Edgemont, South Dakota.[128]
- A study by EPA Region VI staff in 2012 examined the location of homes within a ¼ mile of all then-existing Aquifer Exemption area in Texas, which is home to numerous uranium ISR projects. In only one situation were there homes and drinking water wells found within a ¼ mile of an exempted area.[129]

Nor is this a situation like that found in many parts of Arizona, where a town grew up around a pre-existing mine. There has been no commercial mining at this site. If allowed, the mine will be developed inside a pre-existing city. The Town has made the decision, through multiple public elections and town council decisions, to develop this area as a residential community.[130] EPA should not undermine the Town's decisions and its future by permitting acid leach mining inside the Town's limits.

This situation is similar to that found in Goliad, Texas, where a uranium mining company requested an aquifer exemption in close proximity to homes and private wells. Numerous private drinking water wells were located within the AOR and withdrew water from aquifers that were hydrologically connected to the mining zones. In 2011, EPA Region VI rejected the request for an aquifer exemption because it concluded that the applicant had not demonstrated that the aquifer did not currently serve as a source of drinking water because there were wells completed in close proximity to the proposed exemption boundary that were completed in the same geologic zone and that drew water from an aquifer that was hydrologically connected to the exemption area.[131]

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[127] Crow Butte Resources, Inc., *Technical Report, Marsland Expansion Area*, Vol. 1 at 1-2, 2-1 and Table 2.3-1 (May 2012).

[128] Powertech (USA), Inc., Dewey-Burdoch Project License Application, at 1-4 (Feburary 2009).

[129] Ray Leissner, EPA Region VI, Record of Communication to File for the UEC Goliad Co. Aquifer Exemption (April 26, 2012).

[130] *See* Appendix H for a more detailed discussion of the Town's annexation of this property and of FCI's failed attempts to obtain the Town's approval for mining.

[131] Letter from Miguel Flores, Director, Region VI Water Quality Protection Division, to Texas Commission on Environmental Quality (July 1, 2011).

Less than a year later, Region VI again rejected the request for an aquifer exemption, in part because groundwater in the ore-containing zones of the aquifer was connected to drinking water wells in the area. Because groundwater moved through the proposed exempted area on its way to the downgradient drinking water wells, EPA Region VI could not conclude that the proposed exemption area was not a source of drinking water. It also concluded that "based on EPA's experience with other in-situ mining projects, EPA believes there is a high likelihood that, following mining activities, residual waste from mining activities will not remain in the exempted area.[132]

EPA Region VI requested additional groundwater modeling, including a fate and transport model.[133] After additional information was provided by the applicant and hundreds of lateral acres were withdrawn from the aquifer exemption application, EPA Region VI eventually approved a much smaller aquifer exemption area.[134] The decision was based upon data indicating that drinking water wells did not capture groundwater from the smaller exemption area. That exemption area was reduced still further after additional review revealed a lack of groundwater data supporting the exemption in a certain area.[135]

EPA Region 9 should take the same approach here. FCI must demonstrate that wells in the area are not drawing groundwater from the same aquifer into which it is placing contaminants and that its mining contaminants will not move toward those wells once mining is complete. Absent such a showing, the aquifer exemption must be denied.

d. Today, the USDW at this site serves as the primary source of drinking water for the growing Town of Florence and its residents.

Hydrogeologic strata in the area at issue can generally be divided into the Upper Basin Fill Unit (UBFU), Middle Fine Grained Unit (MFGU), Lower Basin Fill Unit (LBFU), Oxide Zone, and Bedrock. The aquifer is saturated into the UBFU, but drinking water wells are not screened in the UBFU due to nitrate contamination, likely from local agriculture. Local drinking water wells are drilled into the LBFU, which supplies high-

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[132] Letter from William Honker, Acting Director, Region VI Water Quality Protection Division, to Texas Commission on Environmental Quality (May 16, 2012).

[133] *Id.*

[134] Letter from William Honker, Director, Region VI Water Quality Protection Division, to Texas Commission on Environmental Quality (December 4, 2012).

[135] Letter from William Honker, Director, Region VI Water Quality Protection Division, to Texas Commission on Environmental Quality (June 17, 2014).

quality groundwater water suitable for drinking water supply. The LBFU is located over and beside the Oxide Zone to be mined by FCI and is hydrologically connected to the Oxide Zone. Water flows through the Oxide Zone and into the LBFU, continuing downgradient to be withdrawn by wells completed in the LBFU. Just downgradient of the PTF well field, the Oxide Zone drops off and the LBFU becomes much deeper, forming an ideal location for future drinking water production wells. Comments by the Town of Florence filed April 13, 2015, including its attached letter from Southwest Ground-Water Consultants describing the Town's water needs and its plans for future water production wells, provide more detail regarding known and foreseeable locations of future water supply wells screened in the LBFU. SWVP hereby incorporates the Town's comments, in their entirety, as if contained herein.

There is no dispute that the aquifer, and particularly the LBFU, is the only feasible source of drinking water for the growing Town of Florence. No other safe and economic sources of water are currently available. The aquifer also is the primary source of drinking water for future residents in a rapidly growing city. People who have chosen to raise families in Florence, couples and individuals who have decided to retire here, and the children and grandchildren of all of these current and future residents deserve a reliable and safe supply of drinking water.

Existing downgradient wells pull from the same portion of the aquifer that has been exempted by Region 9. FCI's short-sighted and profit-motivated mining proposal threatens this vital resource. Contamination of this aquifer would be devastating to the Town and its current residents. An aquifer exemption anywhere in this area for acid leach mining simply makes no sense. Amazingly, Region 9's consultant indicated during the EPA open house on this permit that the exemption was justified *because* the LBFU and Oxide Zone are hydrologically connected. There is no technical or logical basis for such a distorted view of applicable site conditions and legal requirements. Indeed, even though its permit was fatally flawed in numerous ways, even ADEQ recognized that the LBFU must be protected and made it a permit violation for FCI to allow contaminants into the LBFU.[136]

i. **As the Town of Florence grows, drinking water wells will be located directly downgradient of the mine site.**

The location of drinking water wells in relation to the mine site should not be the focus of EPA's exemption analysis—endangerment to the aquifer is the key

[136] Aquifer Protection Permit No. P-106360, at 4 (July 3, 2013) ("The injection of the solutions shall be limited to the Oxide ore body only.").

consideration regardless of well locations. But even if individual well locations were important, the drinking water wells identified to date by FCI do not tell the whole story. As the Town grows, existing wells will be inadequate to supply the drinking water needs of the Town's residents. New wells will be needed and the best location for these new wells is in areas directly downgradient and, in some cases, adjacent to the mine site. A more detailed discussion of plans to develop new wells for future drinking water supplies is provided by the Town of Florence in its April 13, 2015 comments, which are incorporated by this reference.

As Florence grows, the situation will be much like that faced by Region VI in Goliad, Texas. The mine will be close proximity to drinking water wells that are drawing groundwater from the same aquifer into which FCI is injecting acid mining solution. There will be no barrier to prevent the movement of those contaminants into the downgradient wells, especially once mining stops. Under these conditions, the proper decision is to revoke the existing aquifer exemption and deny the permit.

ii. **The aquifer directly beneath FCI's land purportedly will be used for drinking water in the future.**

Even if EPA took the unreasonable position that it should only consider the portion of the aquifer immediately below FCI's property for an exemption, ignoring the interconnectivity with the rest of the aquifer relied upon by local residents, FCI still could not satisfy the aquifer exemption requirements. To be exempted, the aquifer cannot currently serve as a source of drinking water ***AND*** it must not in the future serve as a source of drinking water.[137] But FCI's property will, according to FCI itself, be used for residential and commercial uses once mining is complete. This necessarily means it also could be used as a source of drinking water in the future.

FCI has given multiple presentations to the public and its shareholders in which it touts post-mining reuse of the property. For example, in 2010 FCI touted that after mining the site would be returned to "pre-development or better conditions" and that "the land can be used to support agriculture, residential or community amenities."[138] A

[137] 40 C.F.R. § 146.4. The regulation also allows an exemption if the aquifer is not currently a source of drinking water ***AND*** TDS content is more than 3000 mg/l and less than 10,000 mg/l, and the aquifer is not reasonably expected to supply drinking water in the future. There is no dispute that this second standard does not apply to the high quality water in this aquifer.

[138] Florence Copper Project, *Community Presentation*, at 7 and 21 (Fall/Winter 2010); *see also* Florence Copper Project, *A Discussion with the Town of Florence*, at 2 and 15 (August 2, 2010)

video produced by FCI and still available on the Internet similarly asserts that the site will be available for use as "ballparks, gardens, hiking trails and any other community assets."[139] If this land will be absorbed into the master-planned community after mining, then then water beneath this land will be available for public and private uses. Taking FCI at its word, it is clear that the aquifer beneath FCI's property could serve as a source of drinking water in the future. Therefore, the exemption criteria of 40 C.F.R. § 146.4 cannot be met and no exemption can be given.

Figure F-3. FCI Depiction of Post-Mining Land Use[140]

(“Post operations the land will be used to support agriculture, residential and/or community amenities”).

139 *Curis Resources Ltd. – Changing the Way Copper is Made*, at 2:50+, *available at* https://www.youtube.com/watch?v=a1JtMg6l8Yo&feature=youtu.be (last visited March 3, 2015).

140 Florence Copper Project, *A Discussion with the Town of Florence*, at 16 (August 2, 2010).

e. Region 9 has allowed FCI to mischaracterize the location of USDW in furtherance of an improper aquifer exemption.

FCI has described the closest USDW to the PTF "as well beyond the proposed AOR, which extends 500 feet horizontally beyond the PTF well field area. The PTF well field area and the proposed AOR are located entirely within the previously approved aquifer exemption area."[141] FCI should not have been allowed to define the closest USDW with reference to the 1997 Aquifer Exemption, which covers most of FCI's property.[142] By definition, the 1997 Aquifer Exemption removes the exempted area from SDWA protection so that it is no longer considered a USDW.

Instead, the 1997 Aquifer Exemption should have been revoked and a new analysis conducted because the existing exemption allows acid mining solutions to flow into the LBFU—the Town's drinking water supply—with impunity. This in turn allows FCI to define the closest USDW as being "well beyond" the AOR, when in fact the closest USDW is located within the AOR. EPA Region 9 is using semantics and the unreasonable 1997 Aquifer Exemption to avoid finding that FCI's injection is occurring into and beside a major USDW. Congress did not intend for EPA Region 9 to favor mining interests over the public's drinking water supply by so manipulating the review process.

The closest USDW is in fact directly adjacent to and above the Oxide Zone that FCI plans to mine. The LBFU is in direct contact with the Oxide Zone throughout the PTF well field.[143] Therefore, the closest USDW (the LBFU) is 40 feet from where acid injection begins (the depth of the so-called exclusion zone). Downgradient, the closest USDW (the LBFU) is in places less than 200 feet away from the PTF injection and recovery well field. Under the inadequate provisions of the Draft Permit, FCI's injected acid will flow into the LBFU above and beside the Oxide Zone with impunity. Wherever the acid reaches the LBFU it has reached a USDW because the LFBU is where the Town obtains its drinking water. EPA Region 9 has unreasonably attempted to avoid this fact by leaving the 1997 Aquifer Exemption in place, when the circumstances demand that it be revoked.

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[141] FCI UIC Application, Attach. A, Section 2.1.

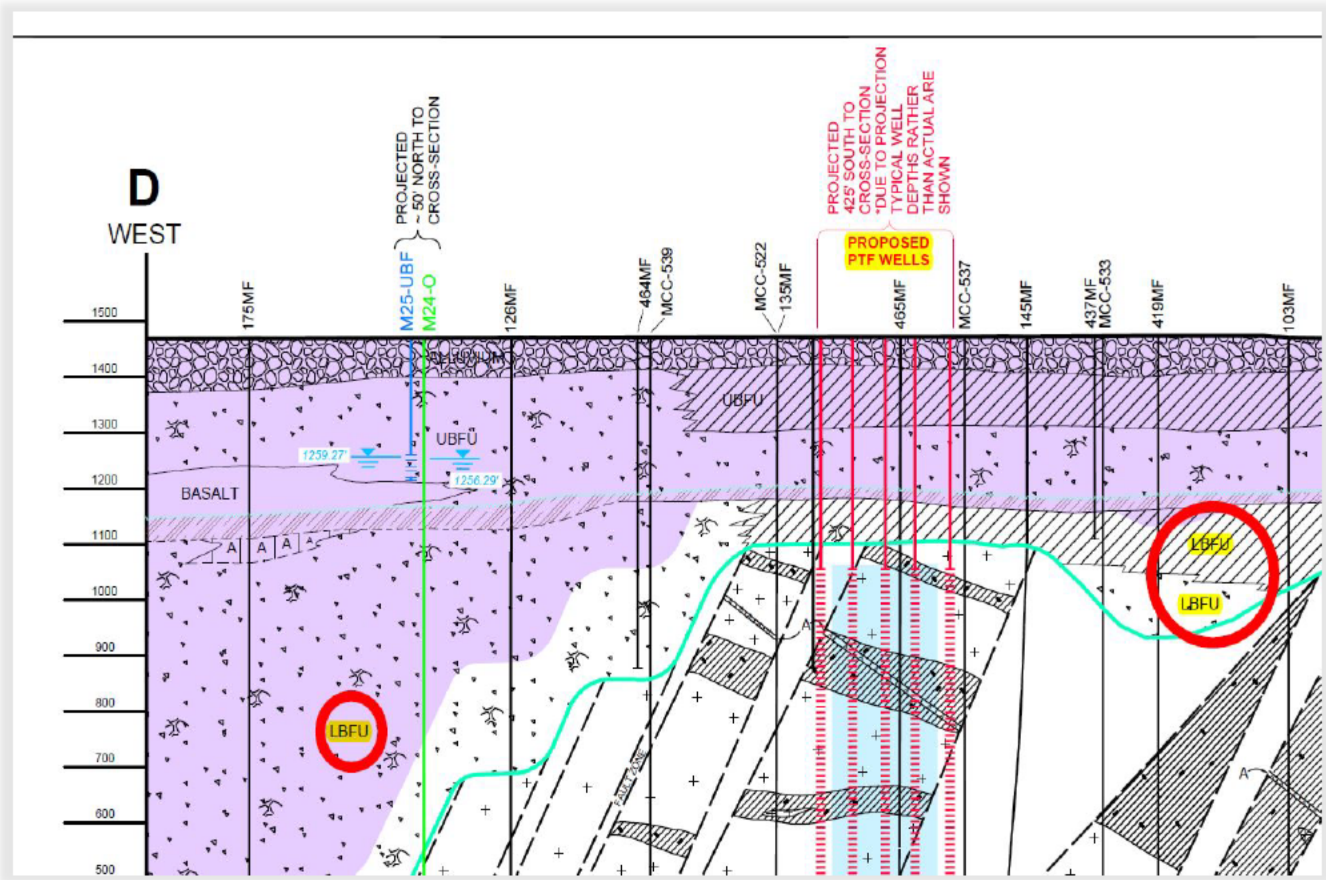
[142] EPA Region 9, *Underground Injection Control Aquifer Exemption for EPA Permit #AZ96000001* (May 1, 1997) ("1997 Aquifer Exemption").

[143] *See* Figure F-4.

3. Region 9's Justifications for the Exemption Lack Legal or Technical Support.

The documents purportedly relied upon by Region 9 to justify the 1997 Aquifer Exemption contain no justification for the exemption. Attachment S to FCI's application does nothing to explain how a 2.2 acre project requires a 212-acre exemption. Nor does it reference or include any documentation from the Magma-BHP Copper application to justify the exemption. The only document relied upon in FCI's application to justify the exemption is its Technical Report Pre-Feasibility Study.[144] But that document addresses full commercial operations, not the PTF. Therefore, no documented basis exists for the proposed aquifer exemption.

Figure F-4. LBFU in Relation to PTF Well Field[145]



144 FCI UIC Application, Exhibit S-2.

145 Detail from FCI UIC Application, Attach. D, Figure D-7.

a. The aquifer exemption is based on facts and circumstances in 1997 that no longer exist.

In considering the aquifer exemption, Region 9 cannot ignore the numerous changes in the area that prompted revocation of BHP's 1997 UIC permit. These changes are addressed in detail elsewhere in these comments. Here, it is enough to list conditions cited by Magma-BHP to justify the exemption that are no longer the case:

- "The mine site and the few homes associated with Magma's drilling and farming operations use imported bottled water and not well water for drinking due to excessive nitrate levels in the water."[146] Today, thousands of residents use groundwater in the area, pumped from the high-quality groundwater found in the LBFU.
- "The area will not be used for drinking water in the future as Magma owns or controls the land."[147] FCI no longer controls most of the 10,000 acres once owned by Magma, and the area is currently and will in the future be used for drinking water.
- Community water systems were all upgradient of the mine in 1997.[148] That is no longer the case.
- Magma sought an area-wide exemption for 2000 to 3000 Class III wells over a 15-year mine life. FCI proposes less than two dozen wells over a 14-month PTF life.
- Magma based its demonstration of commercially producible minerals on confidential documents not available to the public.[149] FCI has based its demonstration solely on the Technical Report Pre-Feasibility Study.

Furthermore, the 1997 Aquifer Exemption was an area-wide exemption for planned commercial operations. No similar proposal is currently before Region 9, and the scale of the PTF is not comparable to BHP's commercial mining plans. Given these differences, Region 9 cannot reasonably assume that the current PTF proposal is justifies continuance of the broad 1997 Aquifer Exemption for full commercial operations. Absent any additional justification from FCI, there can be no basis for approval of the 1997 Aquifer Exemption for the PTF permit.

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[146] Magma Copper Company, *Underground Injection Control Permit Application*, Vol. 1, at 2-2 (January 1996).

[147] *Id.*

[148] *Id.* at 2-4 and 2-5.

[149] *Id.* at 2-1.

b. The exemption appears to be improperly based upon protecting existing wells, instead of protecting the drinking water aquifer.

Underground injection that endangers drinking water sources are prohibited. The SDWA states that "Underground injection endangers drinking water sources if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons."[150] The statute clearly focuses on the impact of underground injection on water in the aquifer.

Courts have interpreted the SDWA broadly to protect aquifers, not just existing wells.[151] To further the intent of the statute, courts have noted that the Act's protections extend not only to current underground sources of drinking water, but also potential future sources and USDWs that are adjacent to an exempted aquifer.[152] Region 9 is not allowed to relax the UIC standards to accommodate mineral production because "the clear and overriding concern" of Congress was to assure the safety of current and future sources of drinking water.[153]

Similarly, the UIC regulations focus on whether "an aquifer or a portion thereof" meets the exemption standards.[154] Nowhere in the SDWA or UIC regulations is the exemption defined by the location of drinking water wells. As USEPA's own guidance document states, the rules does not say that the aquifer must currently supply a public water well or system, but rather that it serves as a drinking water source.[155] The definition of a USDW in 40 C.F.R. § 146.3 "does not mandate that the formation currently be used as a producing water source (*i.e.,* it does not have to have drinking water wells completed into it)."[156]

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[150] 42 U.S.C. § 300h(b)(1)(d)(2).

[151] *Western Nebraska Res. Council v. EPA*, 793 F.2d 194, 195 (8th Cir. 1986); *Phillips Petroleum Co. v. U.S. Environmental Protection Agency*, 803 F.2d 545, 560 (10th Cir. 1986).

[152] *Phillips Petroleum Co.*, 803 F.2d at 560; *Western Nebraska Res. Council*, 793 F.2d at 196.

[153] *Phillips Petroleum Co.*, 803 F.2d at 560.

[154] *See*, *e.g.*, 40 C.F.R. § 146.4.

[155] EPA, *Introduction to UIC Permitting*, at 1-53 (April 2002).

[156] EPA, *Introduction to the Underground Injection Control Program*, at 10 (January 2003).

This distinction seems to have been lost in drafting the permit. Region 9 erroneously focused on drinking water well locations rather than the USDW. For instance, in the Statement of Basis, EPA stated that:

> Under 40 CFR § 146.4(a), an aquifer or portion thereof in the exempted area must not currently serve as a source of drinking water. Information provided in FCI's UIC application indicates that the exempted portion of the aquifer that will be impacted by the PTF does not currently serve as a source of drinking water. To make this determination, EPA first confirmed that there are no drinking water or other producing water wells within the AOR. In addition, EPA reviewed, as described below, whether any existing drinking water wells would produce water from the PTF impacted portion of the existing exempted area over the lifetime of the wells.[157]

Although not explicit in the permit materials, Region 9 appears to believe that the aquifer exemption is justified because existing drinking water wells are located further from the PTF project than water is likely to travel during the life of the PTF wells. Such reasoning has no support in the UIC statutes and regulations. The existence of drinking water wells is irrelevant to determining whether underground injection will impact a drinking water source, as is the wells' locations.

The LBFU cannot be exempted from SDWA groundwater quality standards under 40 C.F.R. § 146.4. But even if an exemption were appropriate, it is the location of the LBFU that determines the lateral extent of the exemption area, not the location of downgradient drinking water wells.

USEPA has long noted that injection into portions of aquifers that are not physically segregated from drinking water sources by impermeable materials—the situation here—"must be done with great care."[158] Generally, USEPA has recognized that injection into such unprotected aquifers is allowed only "if the predominant flow of the aquifer is such that injected fluids will tend to move away from, rather than toward, the protected part of the aquifer."[159] The exact opposite is true here—FCI's contaminants will flow toward the underground supply of drinking water, not away

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[157] Statement of Basis, at 13.

[158] EPA, Office of Drinking Water, *Statement of Basis and Purpose, Underground Injection Control Regulations*, at 16-17 (May 1980).

[159] *Id.*

from it. Although USEPA acknowledges that injection might be allowed in a case such as this one, it should only be allowed if operational conditions sufficient to protect downgradient sources are satisfied.[160] As discussed elsewhere, this permit does not provide such protections.

In effect, Region 9 has determined that an aquifer exemption is permissible because: (1) the aquifer has commercially producible minerals; and (2) the exempted portion of the aquifer has no existing drinking water wells. Given the illegality of mining on FCI's private lands and the impracticality of mining the State Land parcel only, the first basis is dubious at best. The second has no basis in the UIC statutes or regulations and essentially turns the UIC program on its head to favor mineral production over groundwater protection. Such an outcome lacks legal support, devalues the importance of this aquifer, and is illogical given the conditions existing in this area today.

c. The MFGU does nothing to protect drinking water sources threatened by FCI's mining.

Region 9 still seems to be relying, in part, on the existence of the MFGU as a confining layer to justify this permit. For instance, the Draft Permit requires injection formation testing to evaluate subsurface characteristics that include "the confining MFGU within the PTF AOR."[161] The MFGU is irrelevant to the protection of the LBFU as a drinking water source. It is an intermittent layer located *above* the LBFU and below the UBFU. It may provide some protection to the UBFU in some areas, but the Town and its residents do not pull water from the UBFU. Region 9's apparent reliance on the MFGU as a confining layer is completely misplaced.

EPA's approach appears to be a holdover from the circumstances present when the 1997 Aquifer Exemption was issued. At that time, irrigation wells represented the only groundwater use in this area. Those wells pulled from the UBFU only. FCI has continued to characterize the MFGU as a protective layer separating the mining injection zone from irrigation supplies. For instance, the Technical Report Pre-Feasibility Study included with FCI's UIC Application erroneously states that the UBFU is the "principal source of groundwater in the area."[162] This may have been true in 1997

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[160] *Id*.

[161] Draft Permit, at 14.

[162] FCI Application, Attachment S, M3 Engineering and Technology Corp., *NI 43-101 Technical Report Pre-Feasibility Study*, at 90 (March 28, 2013).

but it is not true today. Potable uses of the LBFU are now the principal use of groundwater in the area. The MFGU does nothing to protect the LBFU as a drinking water supply.

d. Region 9's apparent position that the 1997 aquifer exemption cannot be modified or revoked is unreasonable and lacks legal support.

Region 9 has indicated that it believes the 1997 Aquifer Exemption can never be modified or rescinded. There appears to be no legal basis for this position and there is certainly no logic to it. Changing conditions require reevaluation of previous positions and decisions in every phase of environmental regulation. Region 9 is not and cannot be bound forever by historical decisions that may have been based on completely different facts and circumstances, inadequate information, and incorrect information.

There is nothing in the SDWA to support Region 9's position. Rather, the SDWA explicitly states that nothing "shall be construed to alter or affect the duty to assure that underground sources of drinking water will not be endangered by any underground injection."[163] Nor is there anything in the UIC regulations that prohibits Region 9 from altering or revoking the 1997 Aquifer Exemption. In fact, USEPA clearly indicated in promulgating the UIC regulations that changes to aquifer exemptions were expected:

> The Director [of a state UIC program] may exempt aquifers as part of the State program he submits to EPA for approval. Therefore, the designations, by the nature of the process, are subject to public hearing and comment as well as the review and approval of EPA. The Director is free to change the designations or add to them at a later date. Such a change, however, would constitute a major modification of the approved State program and, as a major modification, is subject to public hearing and comment, as well as EPA review and approval.[164]

Furthermore, other sites make clear that aquifer exemptions can be reevaluated and revised to address new issues and concerns. At the Church Rock, New Mexico uranium ISR mine owned by Hydro Resources, Inc., EPA Region VI reopened its 1989 approval of an aquifer exemption for the site, seeking additional information on

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[163] 42 U.S.C. § 300h(b)(3)(C).

[164] USEPA, *Final Rule for Part 146 and Amendments to Part 122*, 45 Fed. Reg. 42472, 42481 (June 24, 1980). Although EPA was here speaking of changes to State-delegated programs, the same would logically apply to programs managed by EPA itself.

drinking water wells in the area.[165] In Goliad, Texas, EPA Region VI revised a recently-issued aquifer exemption to reduce the area covered by the exemption, in response to arguments and data presented by opponents of a proposed uranium ISR mine to be operated by Uranium Energy Corporation.[166]

EPA headquarters also has acknowledged that its standards and record-keeping requirements for aquifer exemptions need to be revised. Ann Codrington, Director of the Drinking Water Protection Division of USEPA's Office of Ground Water and Drinking Water, recently indicated that a key priority for the SDWA permitting program is an evaluation of existing policies for granting aquifer exemptions.[167] Issues being considered are whether baseline monitoring and modeling requirements are needed to determine if an aquifer is a viable USDW and whether water within an aquifer zone could be used for drinking water in the future. The FCI site is a prime example of a site for which such reevaluation is necessary, given the changed conditions in the area that prompted Region 9 to revoke the project's 1997 UIC permit in August 2010 and the paucity of baseline sampling, investigation and modeling that was provided in support of the 1997 permit.

Region 9's approach directly contradicts the SDWA's purpose because it favors mining over protecting drinking water supplies. Its position holds this important regional aquifer hostage to speculative mining proposals that may never be pursued. Already, an aquifer exemption has been in place for nearly 20 years and no commercial mining has ever been conducted. Today, mining is illegal on FCI's private property and there is no proof that commercial mining is viable on the State Land parcel. It is untenable for Region 9 to ignore the drinking water needs of a burgeoning city in reliance on a 20-year old administrative decision that has no justification today.

Region 9's refusal to reconsider the 1997 Aquifer Exemption, when it has openly acknowledged changed conditions requiring revocation of the existing UIC permit, gives the appearance that EPA has pre-determined that FCI's commercial mining project will be allowed. How else to explain leaving in place such a large exemption for such a small PTF facility? If this is truly a stand-alone permit and commercial mining

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[165] Letter from William K. Honker, USEPA Region VI, to New Mexico Environmental Law Center (June 27, 2012).

[166] Letter from William K. Honker to Richard Hyde, Texas Commission on Environmental Quality (June 17, 2014).

[167] Presentation, Ground Water Protection Council Annual Meeting, Houston, Texas (January 2012).

approval truly is dependent upon the results of PTF operations, then no reason exists not to have reevaluated the 1997 Aquifer Exemption in terms of PTF operations alone.

Appendix G:
Public Water Systems Near FCI Mine Site

The LBFU both upgradient and downgradient of FCI's property currently serves as a source of drinking water for residents served by the Town of Florence's system and those served by Johnson Utilities' system.

The Town of Florence currently operates four production wells, all of which are located upgradient of FCI's property. These wells are installed in both the Upper Basin Fill Unit and Lower Basin Fill Unit (LBFU). The nearest well to the FCI property is Johnson Utilities' "Anthem 4" (ADWR No. 55-212512), which is located 1.2 miles directly downgradient of FCI's Pilot Test Facility (PTF). Although not currently active, Anthem 4 was installed to meet future water demands for the expected growth in the area.

Johnson Utilities operates several production wells located either crossgradient or downgradient of FCI's property. Those wells all appear to have been constructed to pump groundwater from the LBFU.

The regional importance of the USDW as a drinking water supply cannot be understated. Surface water supplies in the area are limited and unreliable. In average years, water use in Arizona far exceeds available surface water supplies, more so in dry years, with the shortfall made up by groundwater pumping.[168] Surface water rights to the Gila River, the only significant stream in the Florence area, is already fully allocated under a federal water rights decree, leaving no surface water available for future development.[169] Surface water from the Central Arizona Project, which brings water from the Colorado River to Central Arizona, is prohibitively expensive, in short supply, and is not a dependable future source.

The aquifer, on the other hand, provides ample, good-quality groundwater for drinking water production wells. A review of laboratory analysis of a groundwater sample from Anthem 4, located directly downgradient of FCI's PTF, indicates that water quality in the LBFU in this area is excellent and meets all current drinking water standards.

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[168] *United States v. Super. Ct.*, 697 P.2d 658, 663 (Ariz. 1985).

[169] *See generally*, *In re General Adjudication of all Rights to Use Water in the Gila River System and Source*, 127 P.3d 882 (Ariz. 2006).

The Town of Florence has provided more detail on current and future well locations and water needs in its April 10, 2015 comments, which are incorporated herein by reference.

Appendix H:
Plans for Growth Require Development of New Wells in the LBFU

1. Exploration, Testing, & Permit Issuance

This site has a long history of exploration followed by inactivity and property transfers. Once again, another company has acquired the site and has begun the exploration and testing cycle, seeking agency approvals for a pilot test. Beginning in late 1974, Continental Oil Company (Conoco) conducted an underground copper mining pilot project, drilling hundreds of core holes in an effort to determine the feasibility of open-pit copper mining in the area. Conoco also excavated a series of underground shafts on the State Land parcel. Neither the core holes nor the shafts were properly closed and abandoned. Later in time, Conoco conducted another test, this time an experimental leach agitation process with gold bearing ore. In 1977, Conoco vacated the site.

The site then sat idle for 15 years until Magma Copper Company acquired and began studying the site. As part of their exploration and testing efforts, Magma applied for both underground injection control (UIC) and APP permits. After a public comment period in which less than ten entities or individuals commented on the draft permits, ADEQ and EPA issued the APP and UIC permits for the Florence Copper Project. And by the time of permit issuance, the property had changed hands again, with Broken Hill Proprietary (BHP) becoming the permitee. These permits allowed pilot testing to once again begin. So in late 1997, BHP began a pilot to test the concept of in-situ hydraulic control. This test lasted only 90 days with BHP walking away before completing a final pilot evaluation report. BHP never mined this site, instead completely abandoning the property in the early 2000s.

2. After the Mine Companies Abandoned the Site, a New Owner Requested Annexation & Rezoning by the Town of Florence.

After BHP left the site, Harrison Merrill purchased the property and joined other property owners in petitioning the Town of Florence to be annexed into the Town. Through the adoption of the Pre-Annexation and Development Agreement for Merrill Ranch, any plans and rights for mining on the Merrill Ranch property were effectively terminated, and replaced with plans for residential and commercial development. In late 2003, the Town of Florence passed Ordinance No. 354-03, formally extending the

Town's corporate limits more than 8,000 acres to include the vast majority of the site at issue in this dispute.[170] As part of the change in land use, during 2007, just two years before FCI would buy the property, Mr. Hugh Nowell, Executive Vice President of WHM Merrill Ranch Investments, LLC, signed a consent permitting the Town to rezone the property to Planned Use Development (PUD) status – a land use category that proscribed mining.[171] A Zoning Ordinance was adopted by the Town in 2007 formally modifying the property's zoning to PUD – a zoning category that prohibited mining.[172]

In accordance with the PUD zoning, Town officials, along with property owners and community members, developed the Merrill Ranch Master Plan which established zoning for much of the newly annexed area allowing for homes, schools, open spaces and parks, and commercial uses.[173] Notably, nowhere in this master planned community was mining permitted. This zoning was part of the Town of Florence's General Plan which, in accordance with State law, was put to a vote of the people and approved by the Florence voters. Development to date has followed this plan and residential neighborhoods now flourish within only 1.5 miles of FCI's proposed mine and more homes are planned within less than one-half mile of the mine.

Although the 160-acre State land parcel is not subject to municipal zoning, it is completely encircled by land within the Town of Florence's boundaries and zoned as a master planned community. The land is subject to a State land lease for mining.

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[170] Although the State Land Department supported the Town's efforts, the actual 160-acre State parcel was not annexed into the Town. *See* Town of Florence Ordinance No. 354-03 (Dec. 15, 2003).

[171] Consent to Conditions/Waiver for Diminution of Value (March 21, 2007).

[172] Town of Florence Ordinance No. 460-07 (June 4, 2007) (applicable to the site at issue with the exception of the State land parcel).

[173] *See* Figure H-1, Merrill Ranch Master Plan Planned Unit Development (January 26, 2007) (revised April 4, 2007) and Figure H-2, Merrill Ranch Planned Unit Development Land Use Plan (January 26, 2007).

Figure H-1. Merrill Ranch Master Plan, Planned Unit Development

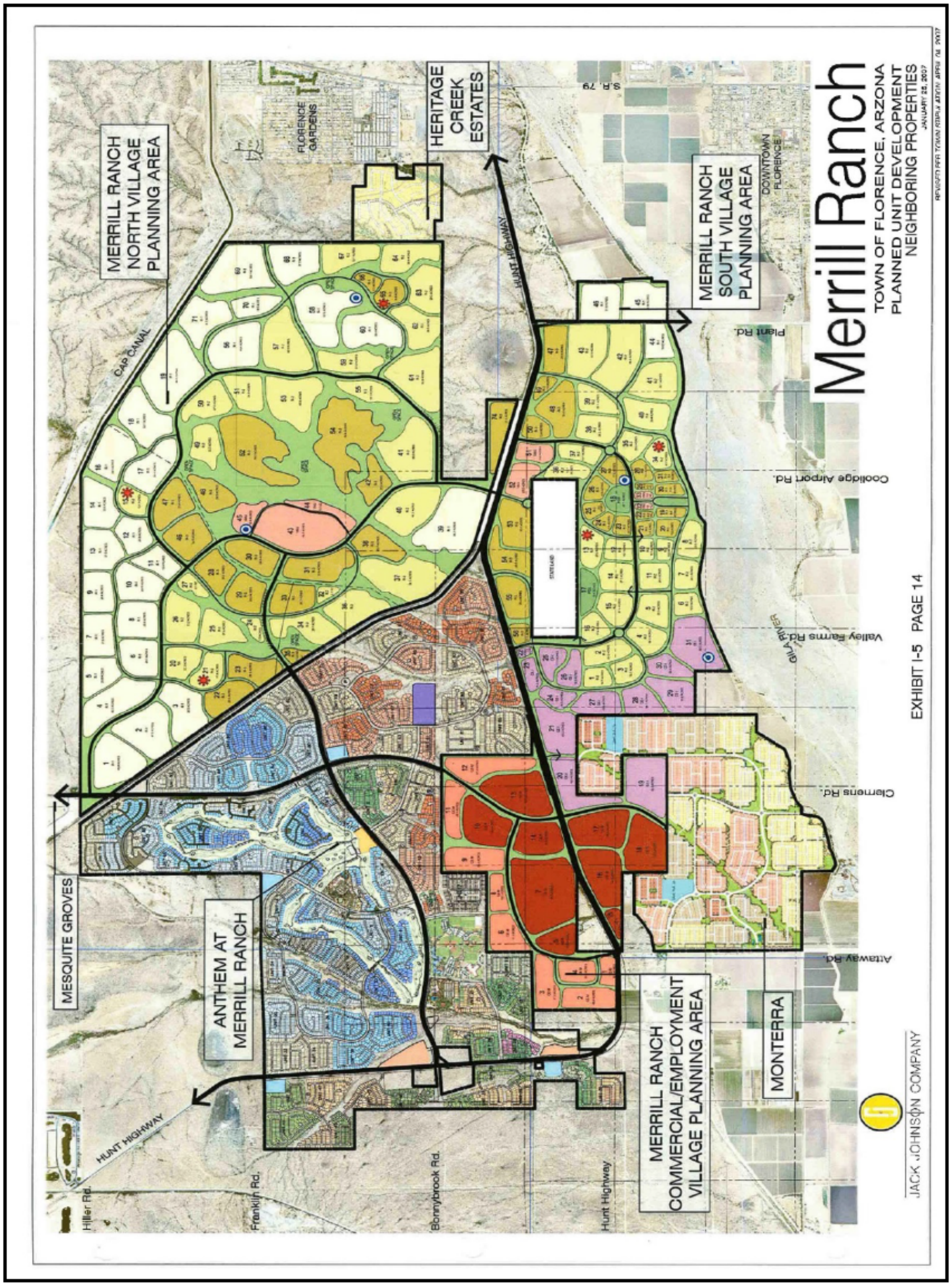
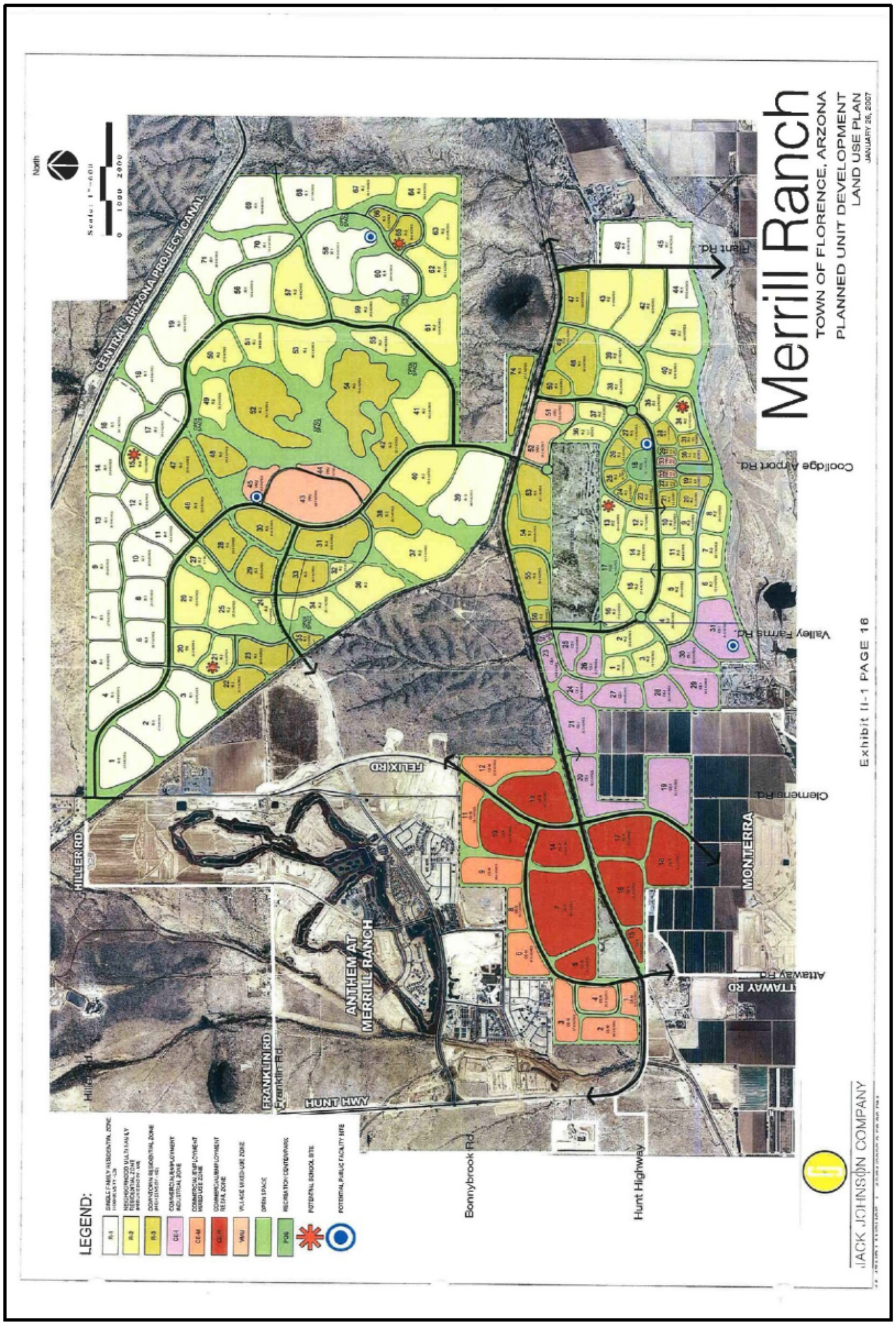


Figure H-2. Merrill Ranch Master Plan, Land Use Plan



3. The Merrill Ranch Master Planned Community Became Reality.

Not only was the mine site annexed and rezoned, but the neighboring area also became part of the Town, was rezoned, and was transformed into a master planned community. Where once there was dirt and scrub brush, now there is a community with retirement and family neighborhoods, pools, a water park, and a golf course. In 2004, five years before FCI came to town, Pulte Homes bought over 3,000 acres of land, more than 2,000 acres of which were from Harrison Merrill. This transaction would later become the Anthem community, the result of more than $400 million dollars invested by Pulte into the community spent in reliance on the Town-approved Merrill Ranch Master Plan. Where to Retire Magazine recently named one of the existing neighborhoods, Sun City Anthem by Del Webb at Merrill Ranch, as one of the top 50 best communities in the nation to retire.[174]

Building permit statistics provide further evidence of this vastly changed area. In 1990 there were only 129 permits issued but that number grew to 556 permits by 2008.[175] Much of the remaining open desert areas have since been annexed into the Town and are slated for continued master plan community development. And with the Town's development came an enormous population boom. According to the Arizona Department of Commerce, the Town's year 1990 population was only 7,321 but grew to 14,466 by the year 2000. And by 2008, the Town of Florence was home to 24,096 people.[176] Taxable sales also greatly increased from $12.3 million in 1990 to $102 million in 2000 and finally to $281.3 million by 2008.[177]

Historic Florence downtown district redevelopment efforts were updated in 2009 and incorporated concepts designed to unite the areas south and north of the Gila River within the vicinity of FCI's proposed mine. The Town's redevelopment plan is centered around three core areas, the Historic Core, the South Gateway, and, closest to FCI's property, the North End.[178] The Town's vision for the North End is to extend the Historic Core, the heart and soul of the Town, while incorporating innovative and

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[174] July/August 2011 edition.

[175] Arizona Department of Commerce, Florence Community Profile, *available at* http://www.azcommerce.com/doclib/commune/florence.pdf.

[176] Arizona Department of Commerce, Florence Community Profile, *available at* http://www.azcommerce.com/doclib/commune/florence.pdf (based upon Revised Census figures).

[177] *Id.*

[178] *See* Figure H-3, Florence Redevelopment Area and Districts Figure, from Town of Florence Downtown Redevelopment Plan Update, Figure 1-1 (Feb. 2009).

sustainable buildings and spaces. According to the Town, "Florence has made a significant investment in land between the Historic Core and the Gila River. This investment becomes the seat of government for the Town and in the future, the County."[179] Part of the Town's vision and plans is to connect the newer northern portion of the town – the Merrill Ranch Master Planned Community – with downtown corridor.[180] FCI's proposed mine interferes with the Town's plans to link the historic downtown redevelopment area with the communities north of the river.

Along with the community's planning efforts, came renewed investments in infrastructure and utilities to support the ongoing and future development. To support the growing and spreading population, Johnson Utilities expanded its operations to serve the population north of the Gila River including Pulte's Anthem community. According to Johnson representatives, the drinking water provider serves approximately 30,000 homes and is only twenty percent built out.[181] The Town of Florence itself also anticipated the need for additional water supplies, especially in the areas north of the Gila River,[182] and began planning to meet those needs. Significantly, the Town's proposed wells are planned to be constructed at the same depth as FCI's wells.[183]

Southwest Value Partners moved into the area in December 2009. Together with a purchase a short time later, SWVP would acquire over 4,000 acres within the Merrill Ranch Master Planned Community. This land houses several existing groundwater wells including a 1,180 foot deep irrigation well just outside FCI's western property border.[184]

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[179] *Id.* at 2-12.

[180] *See Id.*

[181] *See* Figure H-4, Water Production Well Location Map (depicting in **red** the Johnson Service Area).

[182] The Gila River crosses through the Town's current footprint, with the historic downtown district south of the River and FCI's property north of the River.

[183] *See* Figure H-5, Area Wells and Depth to Bedrock Map.

[184] See Figure H-6, Cross-Section of FCI Property Depicting Nearby Well Depths.

Figure H-3. Florence Redevelopment Area and Districts

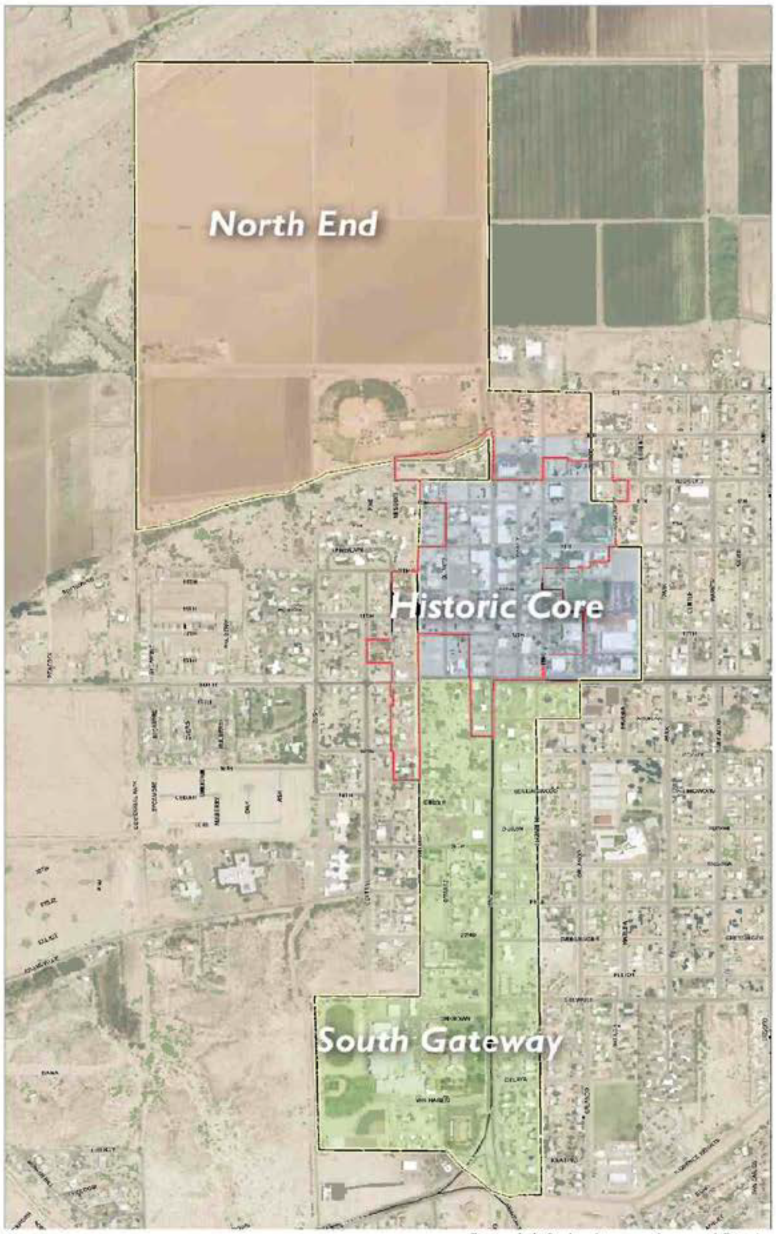
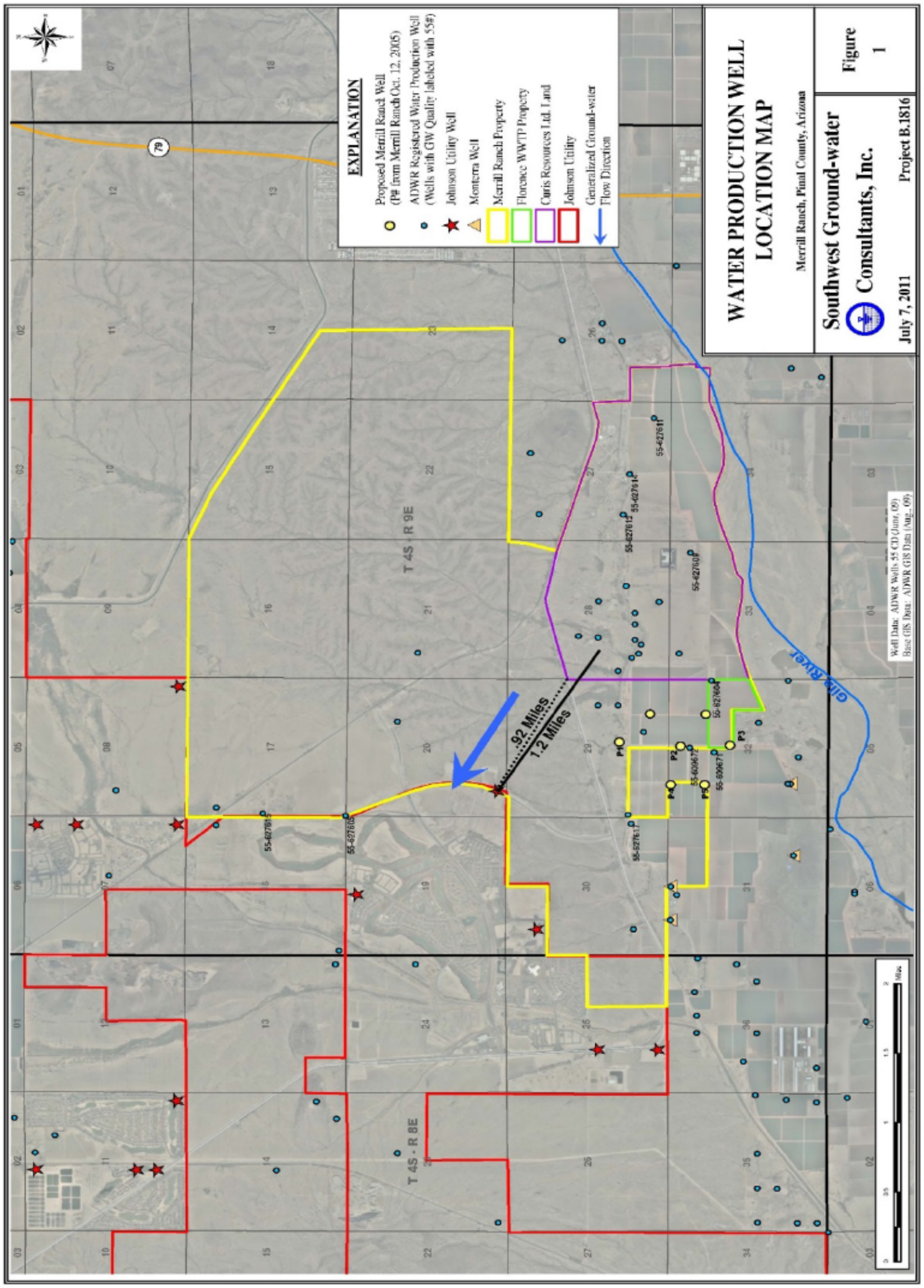


Figure 1-1: Redevelopment Area and Districts

Figure H-4. Water Production Wells



4. The Town of Florence Repeatedly Denied FCI's Attempts to Change the Established Master Plan Land Use.

In December 2009, FCI purchased the property at issue through a "blind" transaction, one that kept its identity and purpose secret. By the time FCI purchased the property, all but the small State Land parcel had already been annexed and incorporated into Florence municipal boundaries, and mining was prohibited and inconsistent with the established zoning, master plan, and general plan.

Because FCI's private land holdings were not zoned for mining, FCI twice requested from the Town of Florence changes in permitted land uses. In the spring of 2010, FCI first formally requested Town approval through a Major General Plan Amendment to allow for mining. After studying the matter, the Town of Florence issued a Planning and Zoning Staff Report on the proposed General Plan Amendment, urging an unfavorable recommendation to the Mayor and Town Council through a scathing 18-page report that outlined the numerous incompatibilities and issues with FCI's application. The item was never heard in the scheduled public hearing because FCI withdrew its application from consideration for the 2010 General Plan Amendment cycle.

FCI's second attempt to convince the Town to allow mining came in the summer of 2011. This time FCI submitted two separate applications for a General Plan Amendment – one to create a new "Natural Resource Overlay" land use category and a second to apply the new category to FCI's property. In response, the Town of Florence Planning and Zoning Commission held two lengthy public hearings. The first hearing, held on September 15, 2011, attracted approximately 300 people and went well into the early morning hours of the following day. The second hearing, on October 6, 2011, was once again filled to capacity with more interested members of the public standing outside in the cold or nearby in overflow rooms. At this hearing, 137 Florence residents submitted comment cards in opposition to the proposed mine. At the conclusion, the Commission did not forward a favorable recommendation to amend the Town's General Plan on either of FCI's two applications to Town Council. Despite FCI's later attempts to withdraw their General Plan Amendment application prior to the scheduled Town Council hearing on November 7, 2011, the Town Council denied their request for withdrawal on their main application and held a hearing on the matter. At this hearing, 124 Florence residents submitted comment cards in opposition to the project, while only 34 Florence residents submitted cards in support. In addition, Johnson Utilities, which provides water to the area also appeared in opposition and voiced many valid environmental concerns. At the conclusion of the hearing, the Florence Town Council unanimously denied FCI's requests by a 7-0 vote. Notably, each council member publicly stated that the proposed mine was contrary to the best interests of Florence residents in the short or long term and that the mine would negatively alter the character of Florence in a dramatic fashion.

This did not, however, end the local community's input and the Town's desire to communicate their message that a mine does not belong in the middle of a master planned residential community. Instead, prompted by the significant public outcry against the Mine, the Town Council passed Resolution No. 1324-11, expressing strong opposition to the Mine and pronouncing as ill-advised a mine along the Gila River in close proximity to populated areas and a vital aquifer.[185] These conclusions were made after the Town, itself a water provider with designated Assured Water Supply status and a Designated Management Agency with Clean Water Act implementation and enforcement authority, considered the health and safety and environmental risks of in-situ mines and the unacceptable economic impacts associated with the legacy of in-situ mining. Further, the Town expressed its view that FCI's Mine was inconsistent with the guiding principles and overall vision of the voter-approved Florence General Plan 2020. This Resolution expressly urges all reviewing agencies to reject any applications which would aid the mine in locating within the Town boundaries of Florence.

The Town's spring 2012 election arrived and FCI's proposed mine was front and center. Voters approved a Mayor and Town Council who ran on a platform opposed to FCI's mining proposals. Election results confirmed what the Town had already repeatedly told FCI – no mining within the Town.

5. Because a Mine is Inconsistent with the Area's Current and Reasonably Foreseeable Future Uses, Nearby Governmental and Quasi-Governmental Entities Formally Oppose FCI's Proposed Mine.

SWVP is not alone in being concerned about the mine's potential environmental impacts and opposing the mine. Pulte, which invested substantial dollars into the Anthem community, Johnson Utilities, residents that call Florence home, and other property owners in the area are all concerned about the impacts of the proposed mine.[186] Another neighbor, the Gila River Indian Community, is so vehemently opposed to a mine in such close proximity to the Community, its residents, and its water that they adopted a resolution formally opposing the mine. Both the Central

[185] Town of Florence Resolution No. 1324-11.

[186] *See* Figure B-7, Area Map Depicting Landowners Opposed to FCI Mine.

Arizona Association of Governments and the Pinal County Partnership also adopted formal Resolutions opposing the FCI mine.

In summary, while the mine property sat idle, the surrounding area has been transformed into a planned use community as envisioned by the Town's staff, elected officials, property owners, and residents. And consistent with the plan, people built homes and communities that rely on the area groundwater for drinking water purposes. This ISR project may not have been controversial in 1997, when the mining company owned all the land surrounding the mine for many miles. But today, private property owners, families, retirees, and other community members own and call that surrounding land home. For these reasons, the mine no longer fits the surrounding area and poses significant risks to current and reasonably foreseeable land and water uses.

Figure H-5. Area Wells and Depth to Bedrock

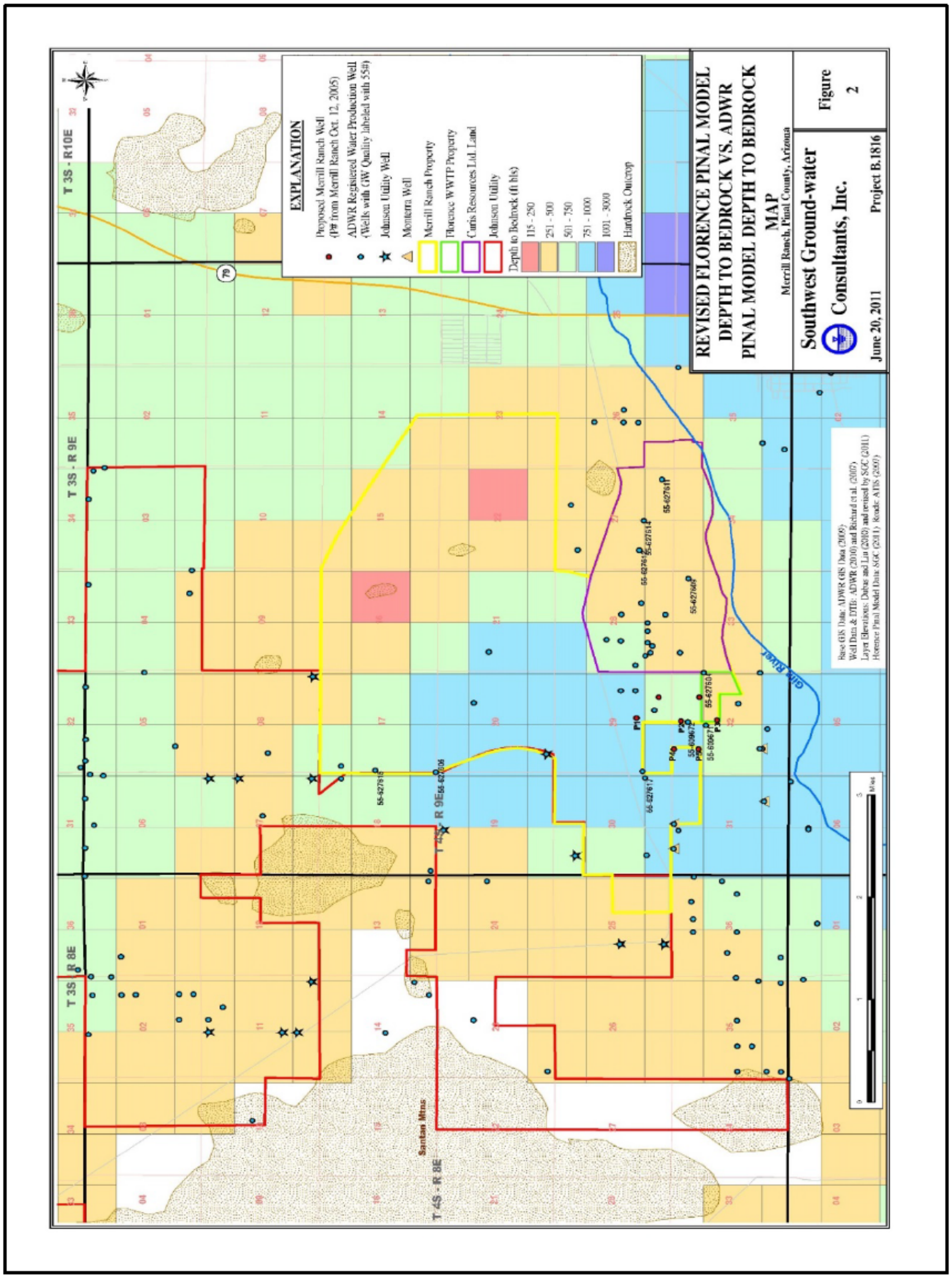


Figure H-6. Cross-Section of FCI Property Depicting Nearby Well Depths

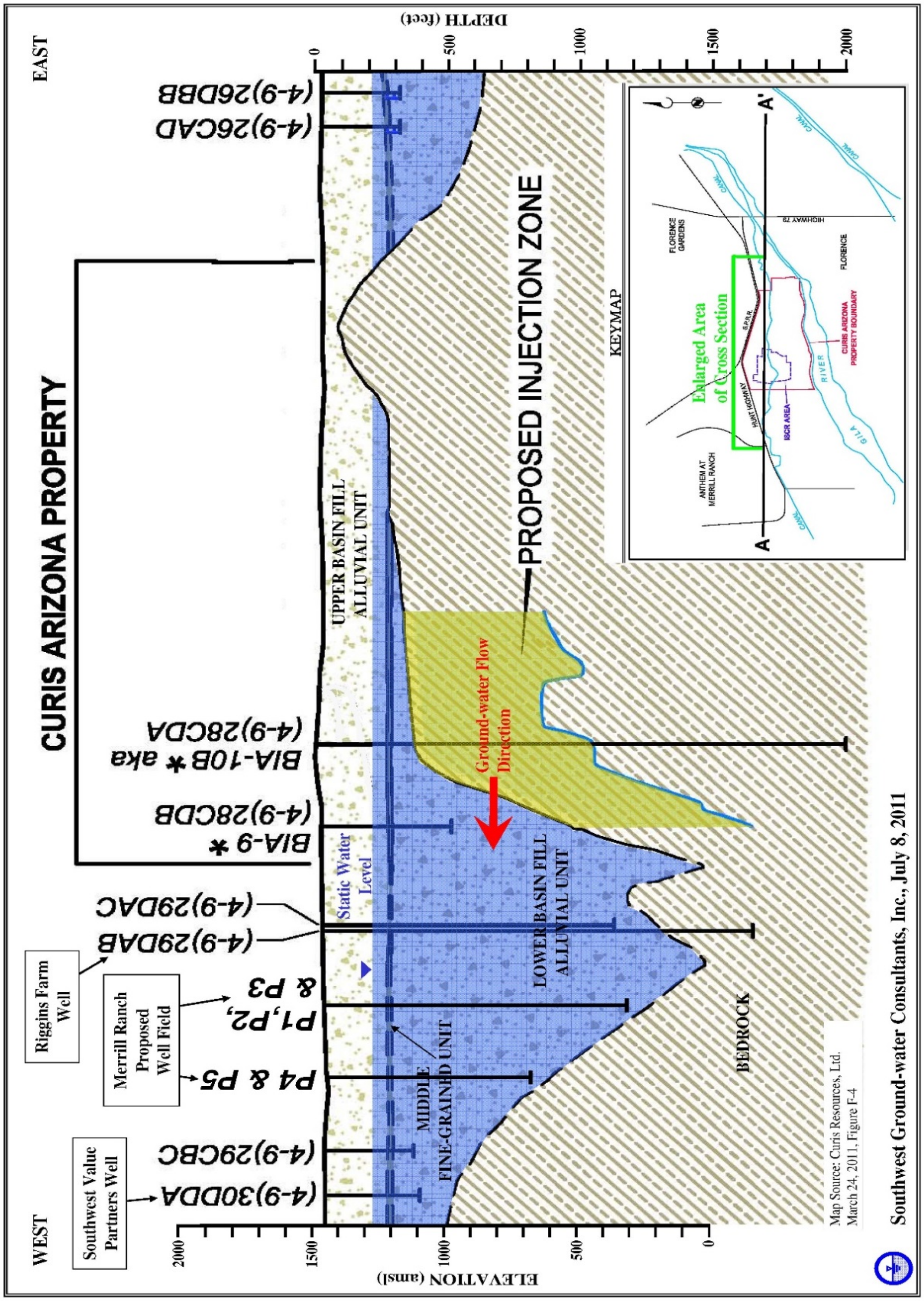
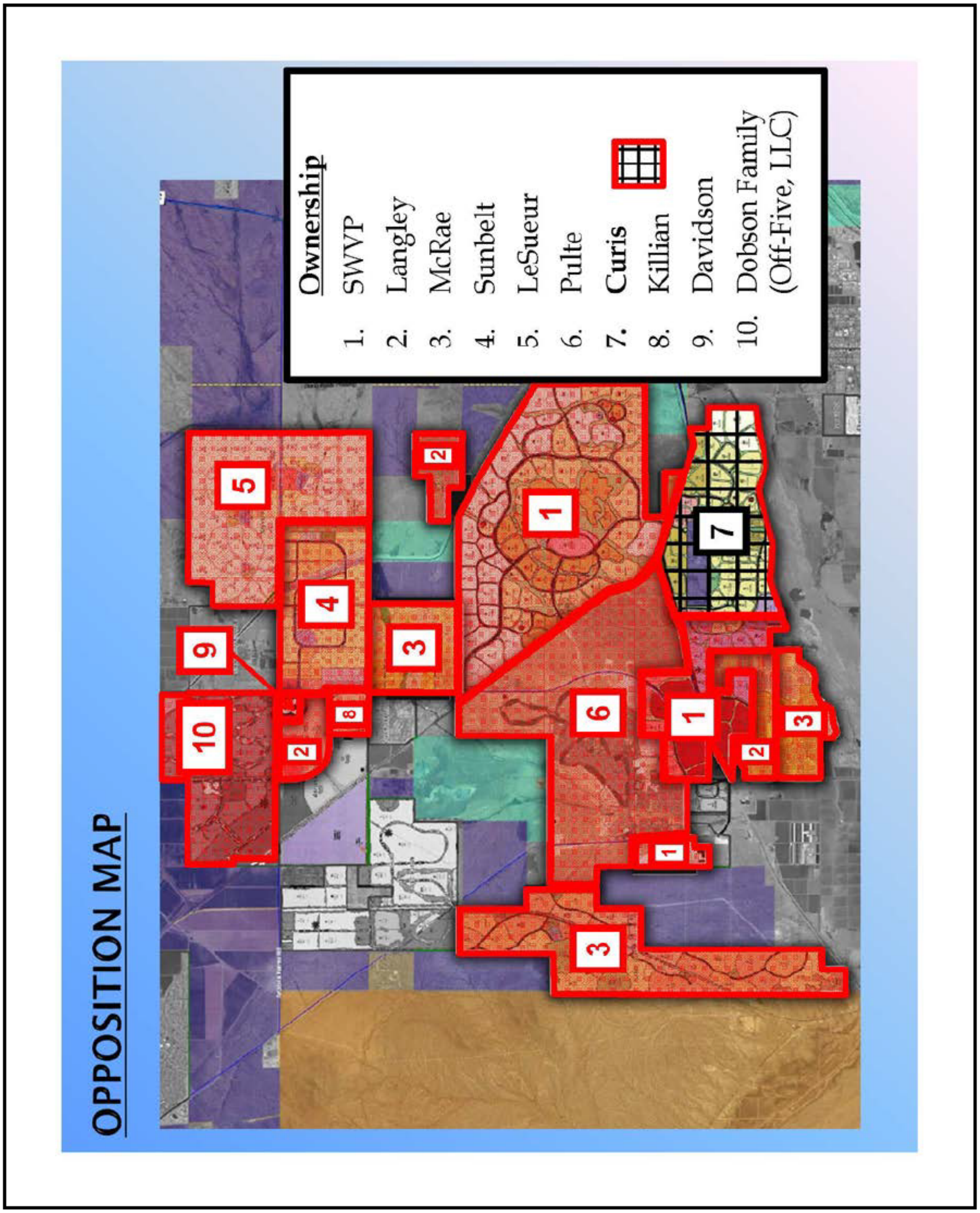


Figure H-7. Area Map Depicting Landowners Opposed to FCI Mine



Appendix I
Monitoring

1. The pre-injection testing requirements are inadequate to determine the site's hydrogeologic conditions.

FCI relies almost exclusively on assumptions and computer models to predict the hydrogeologic implications of its planned in-situ mining operation. As more fully detailed in Appendix C and below in this Appendix, the BHP pilot test data showed that the mining area is heterogenous and contains myriad short circuits. Consequently, it is unreasonable for FCI and EPA to place observation wells evenly around the PTF well field on the simplistic and inaccurate assumption that the hydrogeology will act as an EPM.

Accurate data regarding the implications of FCI's planned in-situ mining operation is critical to ensuring protection of the drinking water aquifer through proper monitoring and operational restrictions. Unfortunately, EPA does not require FCI to conduct adequate pre-injection testing. And the little testing it requires will not produce sufficient data to properly understand the hydrogeology of the area.

To gather accurate data, EPA should mandate a sequential well field development concept. The order in which FCI designs, drills, and tests its various wells is important because they are interdependent. FCI must first design, drill, and test its injection and recovery wells and conduct aquifer tests and tracer tests through those wells to properly determine the hydrogeology of the well site

Only after conducting appropriate aquifer and tracer tests can FCI properly design and drill observation and multi-level wells. An example of the importance of this information is shown by BHP's bromide tracer tests, which demonstrated strong groundwater flows due north and due west, in addition to the northwest regional flow.[187] Figure I-1 below depicts the BHP tracer test results, with longer arrows showing stronger groundwater flow. Despite the near certainty of similar flows in this PTF, the draft permit does not require any observation wells in the direction of this strong groundwater flow, to the north and west of the PTF well field.

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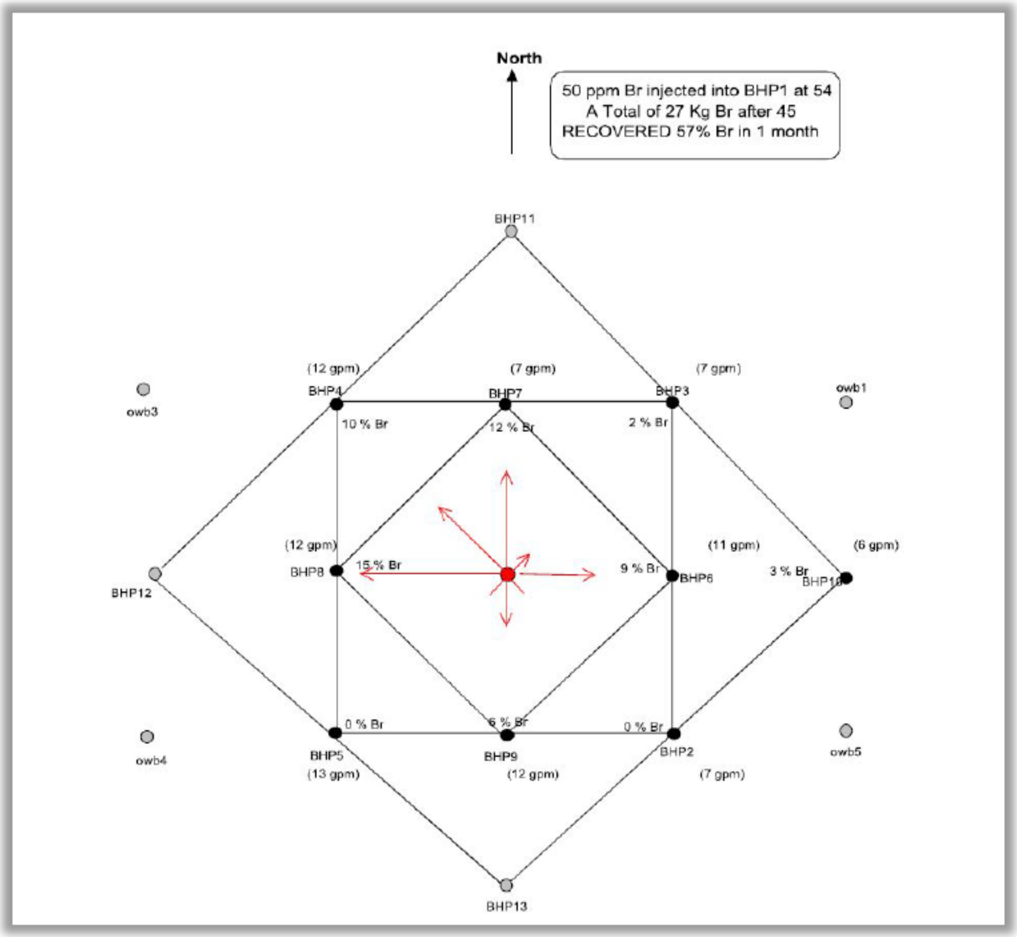
[187] BHP, *Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona*, at 15-19, § 6.2.2 (SWVP-022556).

Figure I-1. BHP Tracer Test Results



Once the observation and multi-level wells are drilled based on actual flow data, those wells must be tested to ensure that the data produced from those wells accurately reflects FCI's operational activities.

Once the testing of FCI's observation and multi-level wells is complete, the data from those tests will guide the design and installation of supplemental monitoring wells. The proper location of all wells should be based on the results of this sequential testing. For example, testing data very well might show that observation wells should not be evenly spaced (as currently designed) or that supplemental monitoring wells should be placed in different locations than those proposed. The key is to place the wells where potential escapes of injected fluid will travel.

2. The draft permit's flawed hydraulic control conditions will fail to ensure containment of injected acid & fail to meet the objective to trigger an alert before contaminants escape.

The draft UIC permit, much like the unlawful APP issued by ADEQ, requires FCI to "ensure that there is no migration of injection fluids, process by-products, or formation fluids beyond the exempted zone …."[188] Regardless of whether the currently-defined exempted zone is lawful, the purpose of the permit is clear – FCI must allow the acid it is injecting into the aquifer to escape beyond the well field.[189]

This purpose was verified by FCI during the APP hearing, where Mark Nicholls testified that FCI's goal is to recover all injected solution at the recovery wells.[190] Indeed, Mr. Nicholls testified that FCI's solution should go beyond the observation wells only if there has been a temporary loss of hydraulic control.[191]

Unfortunately, the UIC incorporates hydraulic control requirements nearly identical to the flawed requirements in the unlawful APP. The draft UIC permit relies on two conditions to ostensibly ensure that contaminants do not leave the well field: (1) an extraction rate at least 110% of the injection rate ("more out than in") on a daily average basis; and (2) a minimum one-foot inward hydraulic gradient between paired observation wells and recovery wells.[192] As more fully described in Appendix A.2.a, the BHP pilot test experienced horizontal escapes of acid solution. The requirements of EPA's draft permit do not address these empirical horizontal escapes. Indeed, even FCI and ADEQ witnesses unequivocally admitted at the APP hearing that these hydraulic control requirements are insufficient to ensure hydraulic control of solution injected into the aquifer.

a. Modified "More Out Than In" Requirement

i. The permit erroneously compares recovery of water rather than acid or sulfate.

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[188] Draft permit at 9 (Section II.B.2).

[189] EPA Statement of Basis at 6 (purpose for the PTF monitoring program is "to ensure that formation water quality is not degraded at and beyond the perimeter of the monitoring well locations and within the overlying basin-fill formations during PTF operation.").

[190] OAH Hearing Transcript, April 18 at 173:10-13, 199:4-22.

[191] OAH Hearing Transcript, April 18 at 200:7-11, 12-22.

[192] Draft permit at 16 (Section II.E.1.a-b).

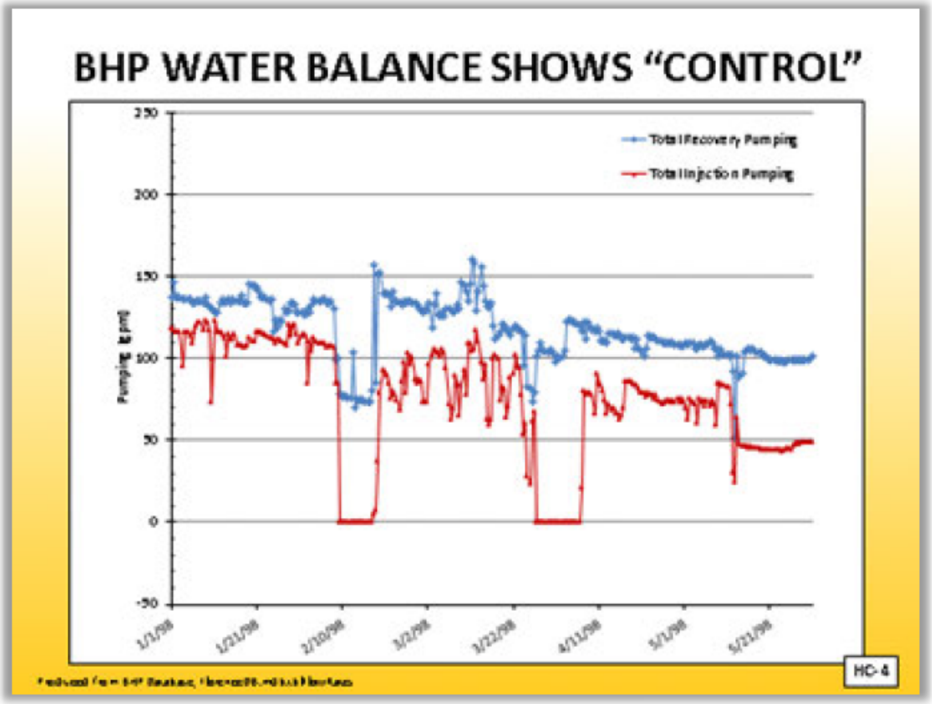
The permit's first hydraulic flaw lies in what it measures – water. But it is not the water that needs to be contained; it's the sulfuric acid that needs to be contained. A comparison of the volume of water injected to volume of water recovered is meaningless to determining whether FCI has controlled the acid it injects into the aquifer.

BHP's UIC permit, like this Draft Permit, required that more water be pumped out than was injected.[193] BHP appears to have fully complied with this requirement. In response to the subpoena, FCI produced a database from the BHP Pilot Test that included injection and recovery volumes during the test.[194] As seen in Figure I-2 below, Dr. Wilson plotted the respective volumes on a graph to visually depict BHP's compliance with the requirement to recover more fluid than was injected. In the graph, the red line depicts injected acid and the blue line shows fluid recovered. Recovery is always higher than injection, indicating that BHP complied with the water balance permit condition. Although in theory this requirement was intended to ensure that no acid escaped, we know that acid solutions did migrate beyond the recovery wells and out of the Oxide Zone. Thus, the requirement that FCI recover more fluids than it injects does nothing to prove that FCI has prevented the migration of acid mining solutions.

[193] BHP UIC Permit # AZ396000001, at 22 ("A loss of hydraulic control occurs when the amount of fluid injected during a 48-hour period exceeds the amount of fluid recovered during the same 48-hour period."); Draft Permit, at 33 ("A loss of hydraulic control is deemed to occur when the amount of fluid recovered during a 48-hour period is less than 110 percent of the amount of fluid injected during the same 48-hour period.").

[194] The approximately 47 GB of BHP Pilot Test data received from FCI in response to SWVP's subpoena is provided on the attached thumb drive in folder "BHP Pilot Test Data Obtained by Subpoena."

Figure I-2. BHP Water Balance Data



The problem is that volume injected is composed solely of sulfuric acid solution, whereas the liquids recovered are composed of both acid solution and native groundwater.[195] The draft permit's simplistic comparison of injection and recovery rates leads to an inaccurate assumption that all *sulfuric acid solution* has been recovered. For example, if FCI injects 1,000 gallons of sulfuric acid solution and recovers 1,100 gallons of combined solution and native groundwater, FCI would be deemed to have satisfied the volume differential permit condition. However, it is not true that the entire 1,000 gallons of sulfuric acid solution was recovered.[196] In essence, the volume differential requirement will mask the fact that FCI may be losing sulfuric acid solution. It is an apples-to-oranges comparison—acid solution in, but water and acid out.[197]

This problem is exacerbated by the fact that recovery wells will necessarily draw water from outside the well field. Indeed, EPA recognized this issue in its February 27, 2013 Request for Information.[198] Simply requiring a greater volume of extraction does not address the issue that a greater volume of water extracted cannot show that FCI

[195] OAH Hearing Transcript, March 24 at 96:13 - 97:2.

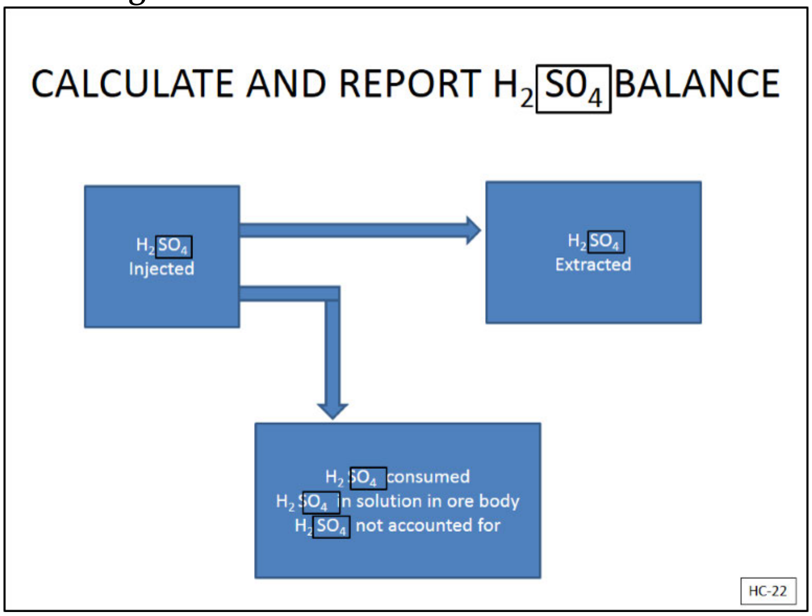
[196] OAH Hearing Transcript, March 24 at 99:3-7.

[197] OAH Hearing Transcript, March 24 at 98:12-16.

[198] See Request for Information dated February 27, 2013.

recaptured the sulfuric acid solution that it intentionally injected into a drinking water aquifer.

Figure I-3. Calculation of Sulfate Balance



Instead, a meaningful permit must require FCI to calculate and report an acid balance or a sulfate balance.[199] As depicted in Figure I-3, all sulfuric acid injected in the aquifer must end up in one of four places: (1) extracted fluids; (2) consumed in chemical reactions in the oxide zone; (3) solution that remains in the ore body; or (4) fluid that has escaped the well field. By requiring FCI to calculate and report an acid or sulfate balance, EPA can determine whether FCI has properly accounted for all of the acid that it injected into the aquifer. A failure by FCI to account for all of the acid that it injected shows that FCI has not maintained hydraulic control.

The BHP pilot test shows significant dilution of the injected acid by native water in the aquifer. Consequently, the amount of acid recovered was far less than injected. Specifically, the recovery rate for sulfuric acid was 88%.[200] Clearly, some of the remaining 12% was lost upwards and outwards from the PTF well field. The rest presumably was left behind, which explains why we still see low pH values more than 15 years after the BHP pilot project.

[199] Either balance calculation will account for the acid injected by FCI into the aquifer.

[200] John Kline, BHP Billiton Southwestern Copper Florence Project: Well Field Reclamation Test and Well Field Metallurgical Balances, at 10 (September 12, 2001); April 2 at 149:15-20, 192:7-15.

Indeed, following a thorough review of the BHP data, Dr. Wilson testified that it was unreasonable for an agency to rely on a simple volume differential comparison without also requiring an acid balance calculation. The real objective of hydraulic control, after all, is to control the acid solution injected into the aquifer. To measure whether FCI can truly control its acid solution, a reasonable permit requires a regular accounting of how much acid is going into the ground and how much is coming out with allowances for some minimal amount of loss.[201] Far from a novel concept, an acid balance was actually completed by Mr. Kline for the BHP Pilot Test and ADEQ staff originally required FCI to calculate and submit an acid balance.[202]

Indeed, FCI will calculate acid balances on a regular basis during the pilot test; it just doesn't plan to report the results.[203] EPA need only require FCI to submit the already calculated acid balances to the agency. Consequently, it is unreasonable for EPA to not require FCI to calculate and submit an acid balance calculation to actually determine whether FCI's operation actually controls its acid solution within the well field as it claims it will.

ii. FCI's method of calculating volume differentials will mask failures of hydraulic control

Besides comparing apples-and-oranges, EPA makes another mistake by allowing FCI to compare *total* volumes of injection and extraction *on a daily average basis*. The permit requires that "the extraction rate shall not fall below 110 percent of the injection rate *on a daily average basis* without prior written approval of a lower percentage from the EPA."[204]

The ostensible purpose of requiring more extraction than injection is to create a cone of depression. This overly simplistic approach has several problems. First, as EPA itself recognized, comparing volumes extracted from recovery wells to volumes of sulfuric acid solution injected into the aquifer is an orange-to-apple comparison.[205] The comparison is false because recovery wells recover aquifer water from outside the mine

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[201] OAH Hearing Transcript, March 24 at 166:11-168:8, 169:5-8..

[202] John Kline, BHP Billiton Southwestern Copper Florence Project: Well Field Reclamation Test and Well Field Metallurgical Balances, at 10-11 (September 12, 2001) (SWVP-022514); March 24 at 168:11-14.

[203] OAH Hearing Transcript, April 16 at 20:16-23:24, 88:23-89:13; April 14 at 30:7-25.

[204] Draft permit at 16 (Section II.E.1.a).

[205] See Request for Information dated Feb. 27, 2013 (Item No. 2).

block in addition to an unknown amount of fluid from within the well field.[206] Consequently, extracting a greater volume at recovery wells cannot ensure that the water drawdown is coming from within the mine block.

Second, by comparing the *total* volume injected to the *total* volume recovered over the *entire well field*, there is no way to ensure that a cone of depression is maintained at all times and throughout the entire well field.[207] For example, if wells in the eastern half of the well field recovered *a greater volume* than was injected, and wells in the western half of the well field recovered *a smaller volume* than was injected, FCI would meet the permit term as long as the total amount recovered over the entire well field was at least 110% of the total amount injected. But, in this scenario, hydraulic control on the western half of the well field *would have failed*. ADEQ's engineer, Jeff Bryan, who reviewed the hydraulic control aspects of the application and permit, admitted that this requirement does not ensure that a cone of depression will be maintained throughout the well field and that it is *unreasonable* to rely on a comparison of the total amount injected to the total amount recovered to establish hydraulic control.[208] The permit's allowance for spatial averaging of extracted and injected volumes over the entire well field does not evidence hydraulic control and is unreasonable.

The hydraulic control terms also fail by time-averaging extracted and injected volumes over a 24-hour period. By allowing daily averaging, FCI can inject more than it recovers during part of the day. During periods of excess injection, hydraulic control would fail, there would be no cone of depression, and pollutants will escape the well field. However, the permit term would be satisfied if a net recovery occurs during the rest of the day such that FCI managed to recover 110% of the volume it injected over the entire day.

Another troubling aspect of the draft permit is that EPA may never know of these losses of hydraulic control because FCI is not deemed to lose hydraulic control until the extraction rate falls below 110 percent of the injection rate over a *48-hour period*.[209] Consequently, FCI could suffer a complete loss of hydraulic control for 47 hours and avoid reporting that loss of control to EPA if it can meet the hydraulic control operational requirements in the 48th hour. Indeed, as with many other terms in the draft permit, a 48-hour period is entirely arbitrary. If the permit requires that FCI's extraction

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[206] *Id*.

[207] OAH Hearing Transcript, April 8 at 157:11-23.

[208] OAH Hearing Transcript, April 8 at 157:24 – 158:6.

[209] Draft permit at 33 (Section II.H.1.b).

rate not fall below 110% of the injection rate on a daily basis, why is hydraulic control not deemed lost until that ratio is unmet for 48 hours? If FCI's extraction rate falls below its injection rate for 12 straight hours, has hydraulic control not been lost? How would EPA even know?

Notably, throughout the entire 34-day hearing on the APP, no witness from ADEQ or FCI could guarantee that the volume differential requirement guarantees a cone of depression or the hydraulic control of contaminants. The permit term's comparison of total well field volumes instead of volumes at individual wells necessarily allows for a loss of hydraulic control in parts of the FCI well field. And the permit term's comparison of total volumes over 24-hour and 48-hour periods necessarily allows for losses of hydraulic control during parts of every day. In both instances, the operational requirements would be met and hydraulic control would be assumed even though hydraulic control had, in reality, been lost. Indeed, as Dr. Wilson testified at the hearing, BHP repeatedly lost control of its acidic solution despite satisfying the volume differential requirement.

Finally, the draft permit's allowance for a 5% error in volume metering will also lead to false demonstrations of hydraulic control. This permit term allow injection well meters to report 5% less volume than FCI is actually injecting and extraction well meters to report 5% more volume than FCI is actually extracting. Although allowance for metering errors is generally reasonable, the minimum volume differential required by EPA is unreasonably low in light of the potential metering errors. When considering the potential for metering errors, the permit does not ensure that FCI's recovery rates will sufficiently exceed its injection rates to ensure hydraulic control. A simple example shows the serious repercussions of the impact of metering errors coupled with the permit's razor thin differential requirements.

The permit states that injection rates will not exceed 240 gpm. If FCI recovers fluid at the allowed 110% of the injection rate, the extraction rate would be 264 gpm. If the injection meter reporting 240 gpm deviates by the allowed 5%, FCI would actually be injecting 252 gpm. At the same time, if the recovery meter reporting 264 gpm deviates by the allowed 5%, FCI would actually be recovering 251 gpm. In that situation, FCI would be reporting full hydraulic control and EPA would be assuming complete hydraulic control. However, all the time, FCI would actually be injecting more volume than it is recovering, thereby *creating an inverse cone of depression*.

These flaws must be corrected before EPA issues a final permit to FCI. Indeed, EPA itself recognized the importance of setting operational requirements intended to increase hydraulic containment.[210] In its June 12, 2013 Request for Information, EPA recognized that modeling assumptions and data from BHP testing necessitated increasing FCI's recovery-to-injection ratio. However, EPA's efforts to ensure hydraulic control are neutralized by the failure to require: (1) an acid or sulfur balance; (2) well-to-well volume comparisons; (3) constant volume differential requirements; (4) and more accurate flow monitors. Without these changes, EPA's permit requirements cannot reasonably ensure hydraulic control.

b. 1-Foot Inward Gradient Is Flawed.

The draft permit also unreasonably relies on maintenance of a minimum one-foot inward hydraulic gradient on a daily average basis to ensure hydraulic control.[211] A loss of hydraulic control is deemed to occur if a flat or outward gradient is observed in any pair of observation and recovery wells over a 48-hour period.[212] As with the volume differential requirements, this term cannot reasonably ensure hydraulic control.

Indeed, BHP did not maintain actual hydraulic control even though it met the UIC permit's requirement of an inward hydraulic gradient between paired observation and recovery wells.[213] In both cases, the requirement is based on a theory that if a cone of depression is created, then injected acid will be contained within the well field. FCI proposed exactly the same requirement in its application.[214] Although BHP's permit did not specify a minimum inward gradient, the addition of a 1-foot requirement now is inconsequential.

Based on BHP Pilot Test database produced by FCI, Dr. Wilson visually depicted the gradient data for BHP-9 and OWB-4, the recovery-observation well pair in the southwest corner of the BHP Pilot Test well field. In Figure I-4 below, the blue line depicts the outside, observation well water level and the red line displays the inside recovery well water level. The observation well's water level is higher than the recovery well's in all cases, indicating there was an inward hydraulic gradient. But as has already been noted, OWB-4 experienced numerous high sulfate concentrations in March and April 1998, indicating horizontal acid escape toward that observation well.

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[210] See Request for Information dated June 12, 2013 (Item No. 6).

[211] Draft permit at 16 (Section II.E.1.b).

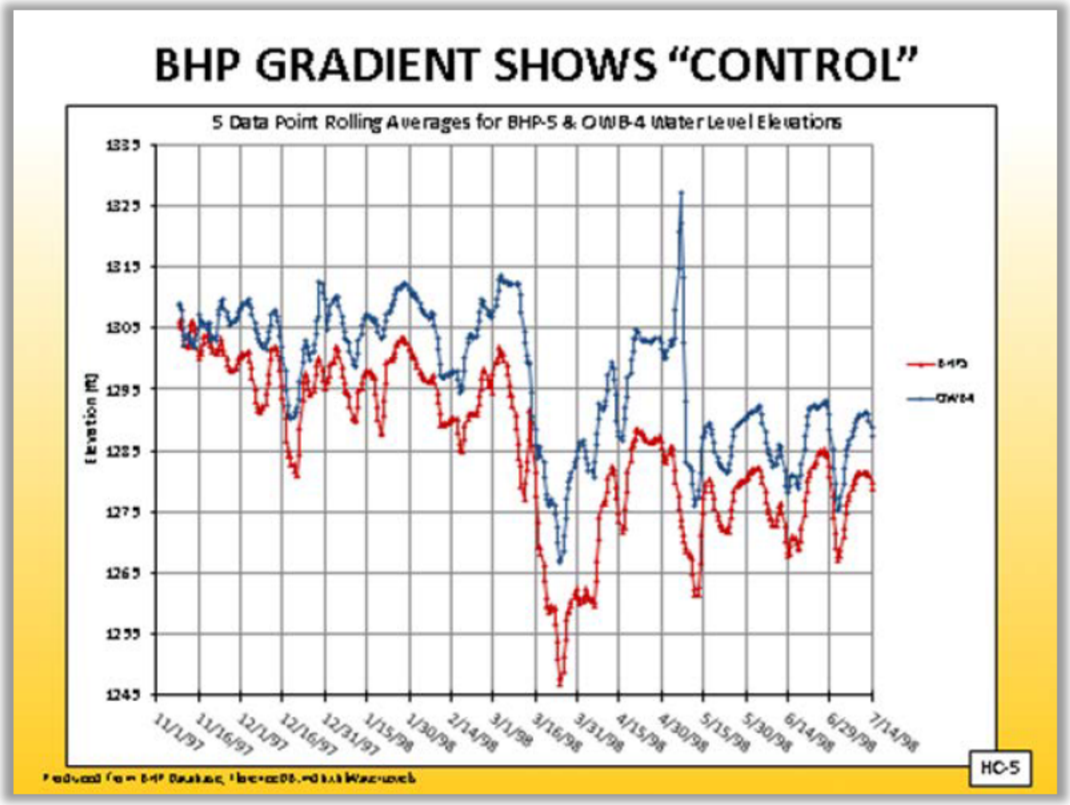
[212] Draft permit at 33 (Section II.H.1.b).

[213] BHP UIC Permit # AZ396000001, at 19, § II(F)(5).

[214] FCI UIC Application, Attachment P, at 6, § P.5.2 ("Hydraulic control will be deemed to exist if the water level in each observation well, located more distant from the PTF well field than the recovery wells, is higher than the water level in its paired recovery well.").

Thus, BHP complied with the water gradient permit condition in its permit during the same period when a known acid escape occurred. This demonstrates that a measured inward gradient is not enough to demonstrate hydraulic control.

Figure I-4. BHP Gradient Data



In the application process, FCI asserted that the recovery of more fluid than is injected, combined with maintenance of an inward hydraulic gradient, would demonstrate hydraulic control.[215] But FCI knew or should have known, based on the BHP data, that successful maintenance of these two parameters does not guarantee hydraulic control. BHP maintained compliance with both requirements in the spring of 1998 and acid escapes still occurred.

First, the permit requires a one-foot inward gradient on a *daily average basis*.[216] Therefore, similar to the flaw in the permit's volume differential requirement, there could be periods during the day where hydraulic control is lost to a flat or outward

[215] FCI Response to EPA Region IX, Appendix 3, *Revised Operations Plan and Related Tables and Figures*, at 3 (July 2, 2013).

[216] Draft Permit, at 27, § II(F)(5); id.

gradient. During the APP hearing, ADEQ engineer Jeff Bryan admitted that temporary periods of a flat or outward gradient would allow FCI solution to escape from the well field.[217] But as long as the *average* for an entire 48-hour period is at least one foot, the permit requirement would be deemed met and EPA would not be notified of the flat or outward gradient.[218]

Second, the differential needs to be greater. Indeed, FCI consultant Mark Nicholls admitted that it would be very difficult and impractical to maintain the well field with a one-foot water level differential between observation and recovery wells and that it *"would be unreasonable"* to try to ensure hydraulic control with a one-foot differential.[219] There is no reason for EPA to include this admittedly unreasonable minimum requirement in the draft UIC permit. Neither ADEQ engineer Jeff Bryan nor Mark Nicholls could provide any rationale for requiring only a one-foot daily differential instead of a greater differential of, for example, two feet or three feet.[220] It is inherently unreasonable to include a measurement standard in a permit that is both unworkable and unreasonable.

Third, the inward gradient unreasonably is based on measurement of water levels in FCI's wells, which are affected by well inefficiencies, instead of water levels in the aquifer. As depicted in Figure I-5 below, well inefficiency occurs because water levels are lower inside a pumping well than the water levels of the actual groundwater aquifer that it is intended to reflect.[221] As reflected in Figure I-6 below, this issue is well understood by EPA and should have been incorporated into the permit requirements.[222]

Although the draft permit condition is intended to ensure a one-foot gradient differential based on the actual aquifer water level, the one-foot differential measurement required by the draft permit is based on a lower water level within the pumping well. The inherent errors in measurement, for which FCI is not required to adjust when submitting data to EPA, could mask the fact that FCI is not maintaining an inward gradient.[223] Indeed, BHP pump test results indicated that wells had a 57%

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[217] OAH Hearing Transcript, April 8 at 175:23 – 176:5.

[218] Draft permit at 33 (Section II.H.1.b).

[219] OAH Hearing Transcript, April 18 at 214:13-18.

[220] OAH Hearing Transcript, April 8 at 173:22 – 174:14; April 18 at 206:5-14.

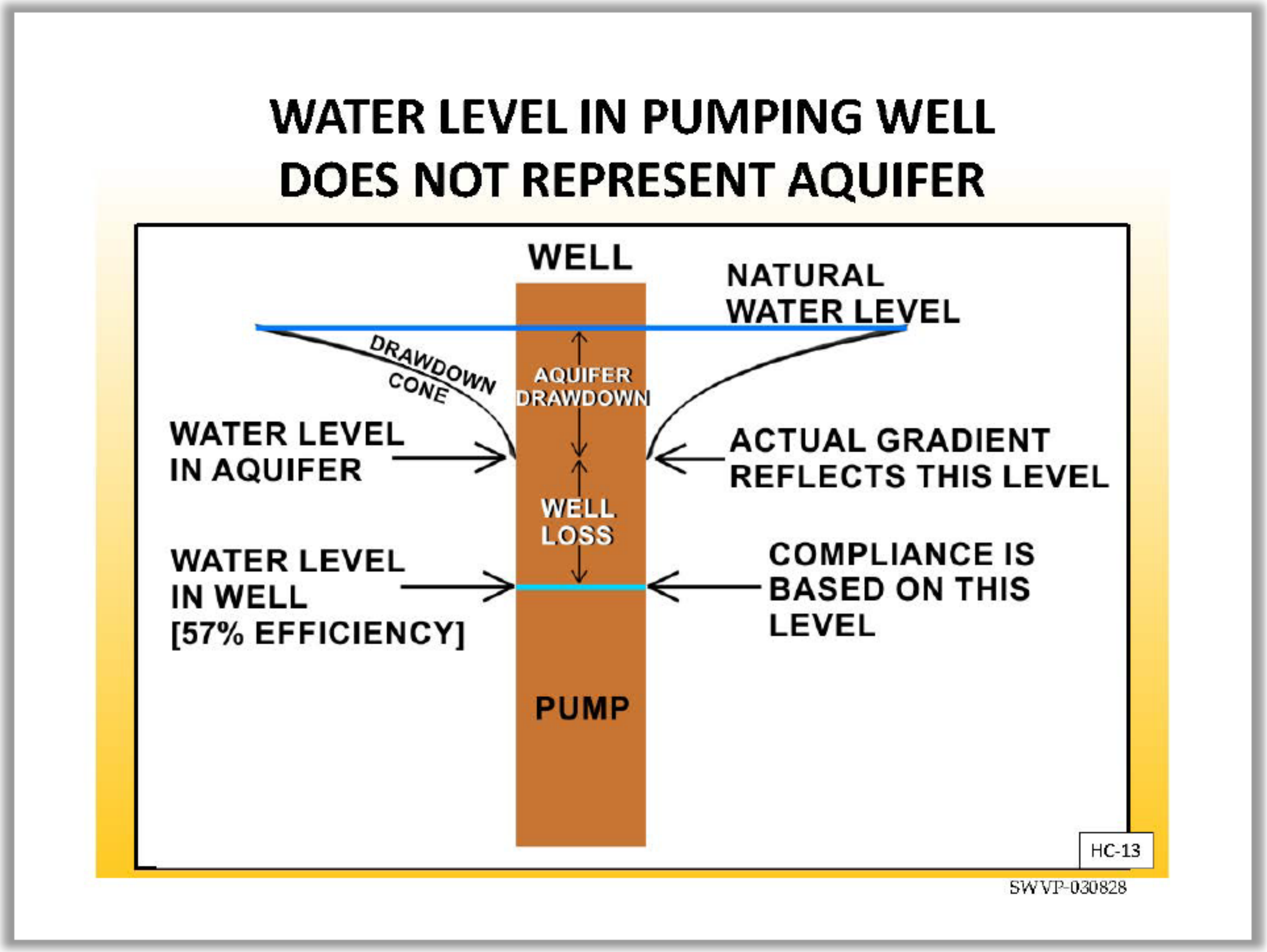
[221] Dr. Wilson OAH Exhibits, at 48.

[222] EPA, A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, at 15 (Jan. 2008).

[223] OAH Hearing Transcript, April 8 at 173:5-21.

efficiency.[224] Jeff Bryan admitted that errors in water levels could be greater than the minimum one-foot differential, which would lead to a false conclusion that FCI had maintained an inward gradient.[225] Consequently, the one-foot inward gradient permit condition can be met by well inefficiency alone, not the actual groundwater aquifer level, and is therefore unreasonable.[226]

Figure I-5. Well Inefficiencies in a Pumping Well



224 Summary of the BHP Copper Florence ISR Field Test and Updated Work (Preliminary Draft) at 47 (Section 4.1.3).

225 OAH Hearing Transcript, April 8 at 173:16-21.

226 March 24 at 115:23-117:5; *see also* Dr. Wilson OAH Exhibits, at 48 (well inefficiency diagram).

Figure I-6. EPA Graphic Explaining the Impact of Well Inefficiencies

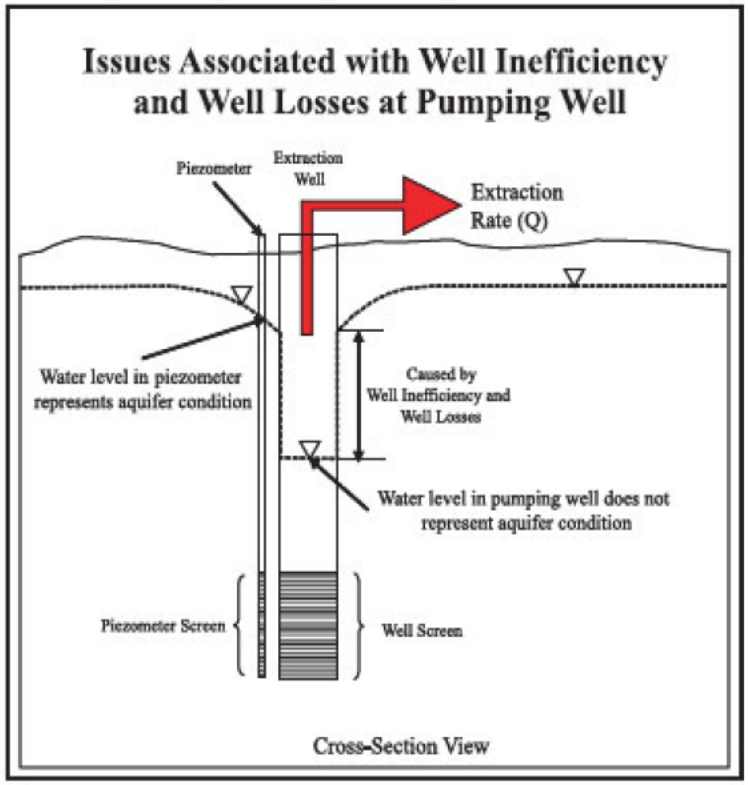


Figure 8. Issues associated with well inefficiency and well losses at pumping well.

Although the draft permit is intended to reasonably ensure the hydraulic control of contaminants and a constant cone of depression, no witness in the 34-day APP hearing could testify that a daily average one-foot differential meets either of those goals. The permit term's generalized comparison of water levels on a daily average basis allows for regular and sustained losses of hydraulic control. As empirically observed in the BHP pilot test, daily average differentials in water levels of more than one foot can occur even though hydraulic control, in reality, had been lost.

c. The permit should require observation wells due north and due west.

As demonstrated by the bromide tracer test conducted after the BHP Pilot Test's leaching phase, two additional observation wells are necessary to monitor FCI's horizontal hydraulic control – one to the North and one to the West of the well field.[227]

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227 OAH Hearing Transcript, March 24 at 126:15-17, 145:3-14; March 24 at 128:22-129:9; Dr. Wilson OAH Exhibits, at 52; *see also* BHP, Hydrogeological Studies for the In-Situ Leach Field Test at Florence,

The tracer test results show higher flows (depicted by longer arrows) in the north to west quadrant, confirming likely flow in the north to west direction,[228] and increasing the possibility for acid to escape.[229] Groundwater modeling agrees with those results, further supporting the need for two additional observation wells.[230]

The draft UIC permit requires observation wells to the northwest, southwest, northeast, and southeast but no observation wells due north and due west of the well field.[231] As explained by Dr. Wilson, "just because the regional groundwater flow direction is northwest, you can't expect the flow is locked into that one direction… [C]learly due north and due west, [there is] a very high percentage chance that flow will be in that direction."[232] EPA should have realized the need for observation wells due north and due west, but failed to require them in the draft permit. In light of the bromide test and modeling results, the permit should include observation wells due north and due west.

FCI erroneously assumes that the recovery well in the middle of the well field would keep injected acid solution from flowing due north and due west.[233] As depicted in Dr. Wilson's Rebuttal Exhibits, at 13, when the PTF injects acid solution under pressure, it creates a net outward or horizontal flow of injected acid.[234] This outward push of injected acid solution creates a risk that acid will not be contained by pumping from the center recovery well, as FCI assumes.[235] Instead of relying on this unproven assumption, the permit should require adequate monitoring to verify that control will be maintained. In that manner, real-world data would replace untested assumptions and EPA will know – instead of simply assume – that hydraulic control is maintained.[236]

Arizona, Q1, at 19 (Fig. 11); BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 43 (October 15, 1999).

[228] OAH Hearing Transcript, March 24 at 132:13-133:7; Dr. Wilson OAH Exhibits, at 52; BHP, Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona, Q1, at 19 (Fig. 11); BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 43 (October 15, 1999).

[229] OAH Hearing Transcript, March 24 at 132:13-133:7; Dr. Wilson OAH Exhibits, at 52; BHP, Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona, Q1, at 19 (Fig. 11); BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 43 (October 15, 1999).

[230] OAH Hearing Transcript, March 24 at 136:3-19; Dr. Wilson OAH Exhibits, at 53.

[231] OAH Hearing Transcript, March 24 at 144:20-145:2; Dr. Wilson OAH Exhibits, at 54; ADEQ-09a at 11,259 (SWVP Comments).

[232] OAH Hearing Transcript, March 24 at 145:24-146:7.

[233] OAH Hearing Transcript, May 5 at 119:4-11.

[234] OAH Hearing Transcript, May 5 at 117:11-20; Dr. Wilson's Rebuttal Exhibits, at 13.

[235] OAH Hearing Transcript, May 5 at 118:15-18.

[236] OAH Hearing Transcript, May 5 at 119:1-15, 121:7-20.

d. Vertical migration

In addition to insufficient monitoring for horizontal migration, the draft permit fails to adequately monitor for vertical migration of injected fluids into the LBFU. EPA identified vertical hydraulic control as an important issue when it required FCI to provide groundwater model simulations in multiple requests for information.[237] Unfortunately, EPA did not review or rely on actual data showing vertical escapes in the BHP pilot test, but instead relied entirely on computer simulations that did not accurately reflect the heterogeneity of the mining area.

The BHP Pilot Test, an in-situ mining experiment of the same design and operated in the same geology and hydrology, produced data showing that vertical movement of injected acid solutions is not only possible but probable. As more fully discussed in Appendix A.2.b, Vertical movement of injected acid solution was both predicted[238] and actually experienced during the BHP Pilot Test.[239]

John Kline, BHP Pilot Test Project Manager, testified that vertical migration into the LBFU was allowed under BHP's permit because they were only trying to protect the UBFU, and that injected acid solution from the BHP Pilot Test did migrate vertically into the LBFU. He agreed that for the PTF, FCI would have to monitor from above or vertically to ensure that injected acid solution wasn't moving into the LBFU.[240]

The BHP Pilot Test also experienced short circuits (localized areas of faster flow).[241] Although the short circuit experienced during the BHP Pilot Test was horizontal in nature, Dr. Wilson explained that short circuits can also occur vertically to create zones of faster vertical flow.[242] The BHP Pilot Test demonstrated that injected acid solution may very well move vertically.

Testimony from FCI witnesses during the APP hearing confirmed that vertical escapes of acid solution likely will contaminate the aquifer. Even FCI's expert witness in the APP hearing, Adrian Brown, admitted that the PTF's injected acid solution could

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[237] See Requests for Information dated January 30, 2012, July 20, 2012, and November 8, 2012.

[238] OAH Hearing Transcript, May 6 at 48:16-49:7: Dr. Wilson OAH Exhibits, at 45 (HC-10); BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 50 (October 15, 1999); BHP, Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona, Q1, at 27 (Fig. 17).

[239] OAH Hearing Transcript, May 6 at 49:8-14; Dr. Wilson's Rebuttal Exhibits, at 31.

[240] OAH Hearing Transcript, April 2 at 198-199.

[241] OAH Hearing Transcript, March 24 at 64:6-65:2, and 69:13-70:6.

[242] OAH Hearing Transcript, May 6 at 62:11-19.

move vertically and that a 40-foot injection exclusion zone does not prevent vertical movement.[243] And FCI's Dan Johnson conceded that if FCI lost hydraulic control then injected acid solution would move vertically into the LBFU.[244]

Considering FCI's own repeated admissions that its current operational plans will cause injected fluids to flow upward into the LBFU, there simply is no excuse for not requiring FCI to monitor for vertical escapes at the LBFU-Oxide Unit interface and report any such escapes to EPA. There are several terms that EPA should include in the permit to address potential vertical escapes:

- FCI should be required to demonstrate the ability to adjust injection pressures to prevent vertical escapes into the LBFU.
- FCI should be required to include at least one conductivity sensor at the interface of the LBFU-Oxide Unit on each well.
- FCI should be required to monitor and report data from ports in their multi-level/WestBay wells at the LBFU-Oxide Unit interface.
- FCI should be required to place a monitoring well at the LBFU-Oxide Unit interface within the PTF well field.

In addition to monitoring for vertical escapes at the LBFU-Oxide Unit interface, EPA should also require monitoring of the LBFU within the PTF well field. FCI already plans to install the necessary infrastructure for doing so. Make no mistake, FCI will be monitoring for vertical migration but will be doing so for its own purposes – not for reporting to the agency. FCI's Dan Johnson admitted that the PTF WestBay (or multi-level) wells could monitor vertical migration at the LBFU-Oxide Unit interface.[245] The WestBay wells will have sensors that can provide the exact data needed. EPA needs only to require as a permit condition that FCI take representative vertical migration samples from the WestBay wells at regular intervals and report that data to the agency. FCI admitted as much during the state hearing.

In official EPA guidance, the agency has previously recognized that horizontal capture demonstrations do not preclude impacted water from being transported vertically,[246] explaining the critical need for proper vertical migration monitoring at the

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[243] OAH Hearing Transcript, May 6 at 49:18-53:19; FC-25 at 39 (exclusion zone not protective) and 134 (Plate 6-2).

[244] OAH Hearing Transcript, April 18 at 47:15-22.

[245] OAH Hearing Transcript, April 16 at 143:19 – 144:7.

[246] EPA, *A Systemic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (Jan. 2008) at 11.

PTF. As discussed earlier, EPA's regulation requires vertical migration water quality monitoring above the injection zone.

3. The Draft Permit's Water Quality Monitoring Program is Flawed.

a. The draft permit's conditions fail to honor EPA's stated purpose and won't provide meaningful data.

In its Statement of Basis, EPA claims that the purpose for the PTF monitoring program is "to ensure that formation water quality is not degraded *at and beyond the perimeter of the monitoring well locations* and *within the overlying basin-fill formations* during PTF operation."[247] The monitor wells are "intended to ensure that PTF area water quality is maintained at the required levels during the five-year post-closure monitoring period."[248] EPA's stated purpose is consistent with the very regulations EPA is tasked with implementing. EPA regulations at 40 C.F.R. § 146.32(e) specify that monitoring wells are to be located "in such a fashion as to detect any excursion of injection fluids, process by-products, or formation fluids outside the mining area or zone."

These claimed purposes are all well and good, but the draft permit does not reasonably reflect these stated goals. In fact, many permit terms are wholly inconsistent with EPA's stated purpose and require substantial revisions.

i. The draft permit's approved aquifer exemption is inconsistent with EPA's stated monitoring purpose.

As discussed in more detail in Appendix F, the enormous 1997 aquifer exemption that Region 9 has left in place for FCI's small PTF unnecessarily removes hundreds of lateral acres of the aquifer from Safe Drinking Water Act protections. As a result, the aquifer far beyond FCI's PTF monitoring wells and the LBFU above and beside the Oxide Zone can be contaminated and degraded with impunity. To satisfy the purported purpose of the Draft Permit (and assuming a UIC permit can otherwise be legally supported and justified), Region 9 should revoke the 1997 aquifer exemption and exempt, at most, only the Oxide Unit within the PTF well field. The overlying and adjacent LBFU should remain a viable USDW in the same pristine condition as it currently exists. The UIC permit's water quality monitoring program should then be

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[247] EPA Statement of Basis at 6 (emphasis added).

[248] EPA Statement of Basis at 6.

tailored to protect the aquifer outside of the revised aquifer exemption and to test the assertion that the PTF's injected acid solution can be contained within the Oxide Unit.

ii. **Representative and meaningful water quality monitoring must be mandated.**

UIC permits, such as the one issued to FCI for its PTF pilot, must contain meaningful water quality monitoring requirements to ensure compliance with the non-endangerment standard. Demonstrating compliance with operational conditions alone (*i.e.*, hydraulic control water level requirements) is not enough to satisfy the regulatory requirements of the EPA's UIC program.

EPA's own regulations mandate protecting USDWs and confirming those efforts with water quality monitoring. An example can be found in 40 C.F.R. §144.12(b), which connects the determination of migrating contaminants into a USDW with water quality monitoring. And requiring both water level data and water quality data to confirm proper containment is not only consistent with EPA's regulations but also with sound scientific principles as recognized in EPA's own guidance. Although the guidance document was written primarily with pump and treat systems (P&T) in mind, the concepts apply equally to capture and analysis of injected solution containment such as presented by the PTF. EPA recognizes, in this document, the need to use "converging lines of evidence" through multiple monitoring techniques to then better understand and more appropriately rely on conclusions about capture or containment of contaminants.[249] Because this is a heterogenous site, the EPA document recognizes that more intensive monitoring may be required in addition to these techniques.[250]

EPA further recognizes that interpreting horizontal and vertical capture from water level maps "is subject to significant uncertainty," a recognition that prompted EPA to recommend "using additional lines of evidence regarding capture to augment the evaluation of flow directions interpreted from water level maps."[251] EPA recognizes that water level analysis alone is not appropriate but that "both hydraulic monitoring and chemical monitoring should usually be components of capture zone evaluations."[252]

[249] EPA, *A Systemic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (Jan. 2008) at 4.

[250] EPA, *A Systemic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (Jan. 2008) at 2.

[251] EPA, *A Systemic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (Jan. 2008) at 9-10.

[252] EPA, *A Systemic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (Jan. 2008) at 26.

And EPA appears to recognize this important principle by including permit conditions mandating water quality sampling at various monitor wells. But without significant strengthening, the permit's water quality monitoring requirements will not be representative and meaningful indicators of whether the USDW remains protected from the PTF's injected acid.

In order to be effective, a permit's water quality monitoring requirements must be representative of the groundwater aquifer's true conditions. EPA regulations at sections 144.54(b) and 144.51(j)(1) recognize the importance of ensuring representative samples for monitoring purposes. As described in 40 C.F.R. §144.54(b), the permit's monitoring requirements must be sufficient to yield data that is representative of the activity. Section 144.51(j)(1) similarly requires that monitoring samples and measurements "shall be representative of the monitored activity," reinforcing the common-sense principle that monitoring requirements should be representative of the activity being monitored.

In order to ensure representative data, the permit must require proper location, depth, number, sampling parameters, and sampling frequency from the monitor wells.

- Number, location, sampling frequency of monitor wells are to be determined after considering a number of factors – including the population relying on the groundwater, area-specific geology and hydrology, etc. – 146.32(h)
- Location - 146.32(e) specifies the proper location of monitoring wells as where necessary to detect excursions beyond the mining area or zone
- Frequency - Injection zone monitoring – water levels and water quality - semi-monthly water quality monitoring is the required minimum per 146.33(b)(4)

Where injection is into a formation with TDS of less than 10,000 mg/l, as is the case for the PTF, both water level and water quality monitoring above the injection zone and outside the mine field are required.[253] Those required monitor wells must be properly located and collect meaningful data. Monitor wells must be located where they will detect excursions of injected fluid, process by-products and formation fluids.[254] As to the frequency of sampling, at a minimum, water quality monitoring must be conducted on a semi-monthly frequency.[255]

[253] 40 C.F.R. 146.32(e).

[254] 40 C.F.R. 146.32(e).

[255] 40 C.F.R. 146.33(b)(4).

iii. **The draft permit's conditions for water quality monitor wells are inadequate.**

(1) <u>All water quality monitor wells – including EPA's supplemental monitor wells and MW-01 – should accurately reflect whether the injected acid is being contained.</u>

EPA's draft permit lacks reasonable water quality monitoring conditions. A review of FCI's application and responses to EPA's requests for information reveal an apparent attempt by FCI to skirt EPA's regulatory requirements for water quality monitoring.

EPA clearly envisioned its supplemental water quality monitor wells to function as compliance wells,[256] in other words, as a resource for meaningful water quality data to confirm containment of the PTF's injected acid and thus, protection of the USDW. Yet FCI rejected EPA's direction to make the supplemental wells into compliance wells, instead minimizing their importance and data use. In their July 2, 2013 Response to EPA, FCI representatives stated that,

> Curis Arizona understands that the purpose of the supplemental monitor wells is to validate modeling performed to predict the performance of the PTF and the extent of the Discharge Impact Area (DIA) following closure. However, at the request of USEPA, Curis Arizona will calculate ALs and AQLs for the supplemental monitor wells using the same procedure specified by the … ADEQ … for calculation of ALs and AQLs for the proposed APP POC wells, and will add the supplemental monitor wells to the quarterly monitoring program. If Curis detects water quality changes in the supplemental monitor wells, Curis will take actions equivalent to those required under APP No. 106360 to validate the water quality change and evaluate and correct the cause of the water quality change.[257]

And again the following year, in response to EPA's multiple requested changes to FCI's Exhibit Q-2 (Closure and Post-Closure Plans – which became Appendix F of the draft permit) regarding monitoring, FCI pushed back on the notion of making the EPA supplemental water quality monitor wells into compliance wells. FCI's response argues that the EPA supplemental water quality monitor wells could not be compliance wells

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[256] *See* EPA Request for Information (June 12, 2013) (Comment 7).

[257] FCI's Response to EPA's RFI (July 2, 2013) at 4.

because they are within the PMA established by the temporary APP. Specifically, FCI stated that

> The text addition requested in item 20.a refers to a sentence which describes the statutory requirements associated with the POC as established for the APP program. By making the requested text addition to this sentence, the sentence will effectively be changed to establish new POC locations within the pollutant management area (PMA) established by APP No. 106360. The APP program requires that the POC be established at the edge of the PMA or beyond depending on site-specific conditions, but not with the PMA. The additional text requested in item 20.a has the effect of establishing the supplemental monitoring wells as POCs at locations that are within the PMA established by APP No. 106360. For this reason the text addition requested in item 20.a was not made to Section 1.4 of Exhibit Q-2.[258]

Yet, what FCI failed to share with EPA is that FCI's argument regarding the PMA was declared unlawful. And under oath during the state administrative appeal hearing, FCI's hydrogeologist Mark Nicholls, testified that he did not expect contaminants to reach the EPA supplemental wells.[259] Thus, using the EPA supplemental wells as compliance wells should not present a problem, and for FCI to claim otherwise is disingenuous at best.

Whatever the EPA supplemental water quality monitor wells are called – compliance wells or operational wells – it is clear that EPA's intent was to require water quality monitor wells just outside the area in which the PTF is supposed to contain its injected acid. And EPA rightly intended this to be the case as it appears to be the agency's way of satisfying the regulatory requirements to properly locate and collect water quality data to ensure that FCI will detect excursions of injected fluid, process by-products, and formation fluids.[260]

Perhaps because of FCI's attempts to downgrade the importance of the EPA supplemental water quality monitor wells, the draft permit is internally inconsistent in its treatment of these wells. Although EPA clearly intended the wells to be water quality monitor wells charged with showing containment of the injected acid, the

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[258] FCI's Response to EPA's RFI (August 7, 2014) at 10 (response to Comment 20).

[259] OAH Hearing Transcript, April 18 at 190:11-17.

[260] *See* 40 C.F.R. § 146.32(e).

permit then fails to carry out that intention. Throughout the permit's Appendix K Exhibit P-1 – an exhibit prepared by FCI and then adopted by EPA – the EPA supplemental water quality monitor wells are referenced as "operational" wells.[261]

Of additional concern is the status and purpose of water quality monitor well MW-01. Even though there is no exclusion of MW-01 from the water quality monitoring well requirements set forth in part II.F. of the draft permit, MW-01 is conspicuously absent from the specific well monitoring tables in FCI's proposed Exhibit P-1 which EPA adopted as its Appendix K to the draft permit.[262] Indeed according to part II.F.1 of the draft permit, EPA considers the POC wells, the seven EPA supplemental monitor wells, *and MW-01* to be water quality monitoring wells for the UIC permit. Also within the body of the draft permit are Tables 1 and 2 (pp. 24-26) which set forth the water quality parameters generally, with specific parameter values often denoted as "TBD." EPA's explanation for the "TBD" notation is explained as "[t]o be determined and approved by the Director for all POC wells, the seven monitoring wells required by EPA *and the MW-01 operational monitoring well* prior to the commencement of injection."[263] EPA's explicit reference to MW-01 within the water quality parameters permit condition demonstrates that the agency intended MW-01 to function as a water quality monitor well for which Levels 1 and 2 parameters would be sampled.

In its August 7, 2014 Response to EPA, FCI indicates its belief that MW-01 should only be an "operational" well, not an EPA supplemental water quality monitor well.[264] Yet FCI describes MW-01's purpose as serving "as an early warning of changing groundwater conditions that might indicate a release during PTF operations prior to arrival of the release at the Point of Compliance (POC)." FCI advocated for only monthly monitoring of pH, sulfate, and TDS at MW-01 with sampling for Level 2 parameters only once prior to start-up and one after rinsing.

EPA intended for MW-01 to be a water quality monitor well like the other monitor wells in the draft permit. Because the draft permit fails to consistently mandate

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[261] Draft Permit Appendix K Exhibit P-1 at 3 ("All samples collected for compliance monitoring at the POC wells and *operational monitoring at the supplemental monitoring wells* will be analyzed using Arizona and USEPA approved methods.")(emphasis added), at 5 ("Florence Copper will begin compliance monitoring at the designated POC and *operational monitoring at the supplemental monitoring wells* once applicable ALs and/or AQLs have been established.") (emphasis added).

[262] Draft Permit Appendix K, Groundwater Quality Alert Levels and Compliance Monitoring, Exhibit P-1, Tables P-3 and P-4.

[263] Draft Permit at 24 and 26 (emphasis added).

[264] FCI Response to EPA RFI (Aug. 7, 2014) at 7 (response to comment 15).

this, the draft permit should be revised to require water quality monitoring from MW-01 just the same as the other water quality monitor wells.

(2) EPA unreasonably relied on the unlawful state POC wells.

Although EPA knew that the ADEQ-mandated POC wells were deemed to be unlawful,[265] EPA nonetheless relied on them by incorporating them into the draft permit's monitoring requirements. Through the permit's incorporation of Figure 11-1, EPA calls POC wells M54-LBF and M54-O "approved new POC well location[s]," even though these two POC wells were declared by the state administrative appeal to be unlawful. In fact, the unlawful POC wells are the only compliance monitor wells required in the draft permit, with the remaining wells referenced as "operational" wells. EPA's reliance on the terms of a permit known by EPA to be declared unlawful evidences is just one of many examples of EPA's dilatory actions in issuing this draft permit.

iv. **Parameters & Measurements**

(1) Electrical conductivity – Although EPA was correct to require EC monitoring, the lack of detail nullifies the monitoring condition

Although requiring electrical conductivity (EC) monitoring[266] is a positive improvement in EPA's draft permit over ADEQ's temporary APP, the permit conditions for EC monitoring lack specifics that are critical to obtaining valid and useful data. So much detail is left out of the permit that the EC requirement risks resulting in non-representative samples. And as mentioned earlier in these comments, EPA regulations require that samples be representative.[267] Several details must be mandated within the permit's EC monitoring condition in order to ensure representative data is obtained.

First, comparisons of daily EC readings of observation wells with paired recovery wells must be depth specific. Because water quality varies vertically within any particular well, it is important that analogous depth samples are obtained in the observation and recovery wells. The importance of depth-specific conductivity

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[265] *See* Electronic mail message from Janis Bladine to EPA's Nancy Rumrill (Sept. 30, 2014).

[266] Draft Permit at II.F.5 ("the Permittee shall monitor electrical conductivity in the observation and recovery wells on a daily basis …")

[267] 40 C.F.R. § 144.51(j)(1).

monitoring was illustrated as recently as late 2011 and early 2012 when FCI reported exceedances at existing point-of-compliance monitoring wells.[268]

Second, because the purpose of EC monitoring is to show whether injected acid has been fully recovered or has escaped past the recovery well, the draft permit condition should be modified to compare observation well EC measurements with background conditions. Comparing background and observation well data would indicate whether conductivity is higher than normal conditions experienced prior to acid injection, thus reflecting if injected acid had escaped past the relevant paired recovery well. Instead, the draft permit requires conductivity level comparisons between observation wells and their paired recovery wells. This is not a proper comparison, as it would almost never indicate a loss of injected acid past the recovery well.

Third, the conductivity sensors required by the draft permit are unreliable. The draft UIC permit states that a conductivity sensor must be strapped to the well screens of recovery, observation, and multi-level sampling wells at regular intervals.[269] According to FCI, this same type of conductivity sensor produced invalid data during the BHP pilot test.

Fourth, in the event the EC measurement indicates a problem, the permit should mandate FCI conduct a sulfate balance with a companion reporting requirement. And such a requirement is more than feasible for this PTF. During sworn testimony, FCI's own expert admitted that FCI could conduct a sulfate balance and that it was feasible to do.[270]

Finally, the permit's reporting requirements as laid out in Appendix E, Operations Plan (Ex. K-2) fail to specify EC data to be reported in the required quarterly monitoring reports,[271] an oversight that must be rectified.

(2) MCL-based limits

Although this standard assists in addressing the arsenic problem created by the State's AWQS, EPA's requirement must be strengthened to prevent future regulatory

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[268] *See* Letters from Daniel Johnson to Katheryn Boland dated September 30, 2011 and January 23, 2012.

[269] Draft Permit at 14 (Section II.C.6.d). See also Statement of Basis at 8.

[270] OAH Hearing Transcript, April 29, at 21:17-22:19; *see also* Appendix I.2.a.i (FCI plans to conduct an acid balance).

[271] Draft Permit Appendix E, Operations Plan at 6.

gaps. As background, EPA should be aware that Arizona has Aquifer Water Quality Standards or AWQS that are based loosely on the federal drinking water standards. Although the federal MCL for arsenic was strengthened to 10 ppb, the state failed to revise its AWQS to match the federal MCL, leaving it at the more lax 50 ppb. As a result, FCI was able to propose to ADEQ that its arsenic limits for monitor wells be based upon the 50 ppb arsenic standard. Thankfully, EPA's MCL-based limit corrects this anomaly by requiring PTF monitor well limits to be set based on federal drinking water standards.[272] Even so there are a number of inconsistencies in the permit that must be corrected to ensure that EPA's MCL-based limit intent is met and to ensure that the state's failure to update future AWQS doesn't result in a regulatory gap that carries over to the PTF permit.

As written the draft permit contains inconsistent permit conditions that would allow FCI to get around setting standards based on MCLs, instead of AWQS. In the draft permit's Appendix K, Groundwater Quality Alert Levels and Compliance Monitoring, based on FCI's proposed Exhibit P-1, AWQS are repeatedly referenced as the basis upon which monitor well alert levels and aquifer quality limits will be set, despite the MCL mandate within the body of the permit. For example, in Section 1.3 of Appendix K, the monitoring program is described as providing "an early detection and prompt response to any condition that might result in an unauthorized discharge to an aquifer or to the vadose zone, *or that might cause a violation of an Aquifer Water Quality Standard (AWQS)* at a Point of Compliance (POC) or supplemental monitoring well, …"[273] Similarly, in the procedure setting forth the new AL calculation procedure, Appendix K repeatedly references AWQS, rather than MCLs.[274] Again in the new AQL procedure, there is repeated reference to AWQS instead of MCLS.[275]

(3) <u>Background levels/condition improvements needed</u>

Although EPA's required baseline sampling *before* injection begins is an improvement on the state-issued permit, additional detail is needed within the permit to generate sufficient background condition data for proper evaluation of the PTF's environmental impacts.

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272 Draft Permit at Part II.F.2.d.

273 Draft Permit Appendix K, Groundwater Quality Alert Levels and Compliance Monitoring at § 1.3, p. 2.

274 Draft Permit Appendix K, Groundwater Quality Alert Levels and Compliance Monitoring at § 1.3.4.1.

275 Draft Permit Appendix K, Groundwater Quality Alert Levels and Compliance Monitoring at § 1.3.4.2.

For proper monitoring and restoration, FCI must accurately determine background conditions and to do so, the permit needs to require additional detail. EPA's recently issued draft uranium ISR regulations provide insight into the importance of properly determining background conditions and the necessary requirements for doing so.

Appendix J
Groundwater Restoration

1. EPA should clarify, improve, and enhance the draft permit's restoration conditions to carry out EPA's intent and to ensure internal consistency.

As was the case with FCI's Aquifer Protection Permit, it is clear that neither FCI nor Region 9 has given much thought to restoration requirements. The attitude seems to be that FCI can easily restore groundwater conditions after mining with a few months of pumping and perhaps some unspecified neutralizing agents. All available evidence supports this assumption, including the BHP Pilot Test results and the experience at ISR mines across the country. Furthermore, the restoration requirements in the Draft Permit are vague and often inconsistent or contradictory, eliminating any certainty as to what FCI actually is required to do. These issues must be addressed to ensure adequate protection and assurances to the people of Florence.

a. Restoration must be completed before review of a commercial permit application begins.

As explained by Region 9's Ms. Nancy Rumrill during a meeting on July 17, 2012, one of EPA's primary intentions behind the UIC permit is to require adequate groundwater restoration to background levels and to require post-closure monitoring to confirm the effectiveness of that restoration. This intent is embodied in the Draft Permit, which states that the intent of post-closure monitoring as being "[t]o ensure that the restoration … accomplished the objective of returning the injection and recovery zone to primary MCLs (or pre-operational background concentration) and thereby providing adequate protection to surrounding USDWs, …"[276] EPA reiterates this intention in its Statement of Basis, stating that "[a]t the end of PTF operations, all constituents of concern in the groundwater must be restored to maximum contaminant levels (MCL) or pre-operational background concentrations if those concentrations exceed the MCLs."[277]

The requirement that FCI demonstrate that restoration can be successfully achieved is a critical aspect of FCI's pilot testing. If FCI cannot restore groundwater

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[276] Draft Permit, Part II(I)(2).

[277] Statement of Basis, at 7.

conditions after 14 months of ISR mining, it certainly will not be able to do so for full commercial operations. And there is no reason for EPA to waste time and resources on a commercial permit before this demonstration has been made. Therefore, FCI's demonstration of successful groundwater restoration must be made *before* Region 9 begins considering any application for commercial mining.

Although this appears to have been Region 9's original intent, the Draft Permit fails to accomplish this intent. The Draft Permit's requirement to restore the groundwater aquifer to MCLs or pre-mining background levels (if already exceeding MCLs) could be interpreted to be contingent on EPA denying a permit request for commercial operations. In Part II(1)(c) of the Draft Permit, closure operations in the injection and recovery zone are required to commence "after copper recovery operations have been completed." In light of FCI's proposed two-phased operations beginning with the PTF pilot and then proceeding with commercial operations, the phrase "after copper recovery operations have been completed" is unclear. The condition could be read to mean that restoration obligations are not triggered until cessation of *commercial* copper production.

This lack of clarity is exacerbated by FCI's proposed Exhibit Q-2, which EPA adopted as Appendix F to the Draft Permit. Here, the trigger for beginning restoration activities is the filing of a permanent cessation notice and submission of a closure plan.[278] Appendix F further states that if the federal and state permits are amended to allow commercial operations, then the wells in the PTF well field will not be closed.[279] Reading these two statements together along with the vague requirements elsewhere leads to the possible interpretation that groundwater restoration is not required unless permit amendments for commercial operations are denied. Because FCI has publicly stated its intention to apply for commercial operating permits while PTF operations are underway, it is possible that the existing vague draft permit restoration conditions could allow FCI to avoid the requirement to restore PTF-impacted groundwater prior to commercial permitting and mining. Region IX should correct the draft permit to clearly require restoration of mining-impacted groundwater at the end of PTF operations, regardless of whether commercial operations move forward.

The PTF is intended to provide information to be used in evaluating the proposed commercial operations' permit request. In response to FCI's request to modify its application, EPA stated that it was "ceasing evaluation of the portions of the original UIC application applicable to Phase 2 full-scale commercial operation until

[278] Draft Permit, Appendix F at 4 (Section 2.1.1).

[279] Draft Permit, Appendix F at 5 (Section 2.1.2).

such time as [FCI] is able to provide sufficient information on the performance of the Phase 1 operations and restoration."[280] If EPA expects to receive data from the PTF's restoration efforts against which it can measure the potential impacts of commercial mining, then EPA must ensure that the draft permit requires FCI to fully restore groundwater to MCLs or background after PTF operations cease and *before* commercial permitting.

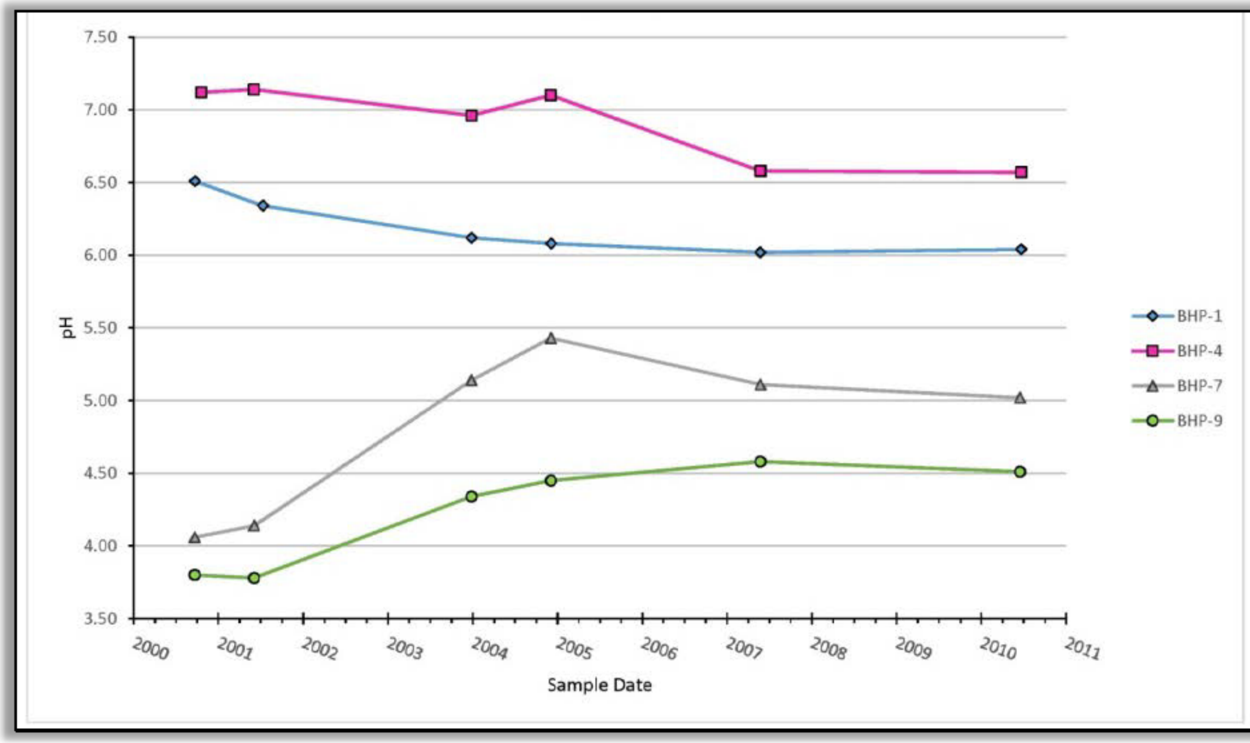
The need for proof of restoration before consideration of a commercial permit is important because there is evidence that FCI's proposed restoration methods may not result in groundwater quality that meets MCLs or background levels. Continuing high pH and sulfate concentrations from the BHP Pilot Test well field show that constituents of the acid injected in 1997-98 remains present to this day. Groundwater samples from the BHP Pilot Test wells were collected and analyzed for Level 2 constituents in September 2000, June 2001, December 2003, May 2007, and June 2010. As depicted in the graph below, two of the recovery wells (BHP-7 and BHP-9) show definite acidity (with values below 7), one of the injection wells (BHP-1) shows definite acidity, and another injection well (BHP-4) shows possible acidity. The lowest pH values were around 4.0, well below ambient conditions and no doubt a remnant from the BHP Pilot Test. And more than 10 years after the BHP Pilot Test, pH at all of these wells still violates the federal secondary MCL.

Sulfate concentrations in the BHP well field show signs of rebound. For instance, BHP-4 had a sulfate concentration of 93mg/L in 2001 and 283 mg/L in 2010. In CH1-R, sulfate was 420 mg/L in 2000, declined slightly through 2004, then began rising again to end at 502 mg/L in 2010. Sulfate also showed a generally increasing trend from 2000 to 2010 in OWB-3 and OWB-4.[281] Furthermore, radiochemicals, which EPA has indicated can be freed up into groundwater during ISR mining, remained above applicable water quality standards in 2010 at 3 BHP Pilot Test wells. These groundwater quality results demonstrate that BHP's restoration efforts were not successful in eliminating threats to drinking water supplies, even though BHP technically met its permit conditions.

[280] EPA Region 9, Request for Information, at 1 (July 20, 2012).

[281] FCI APP Application, Exhibit 10A, BHP Copper Hydraulic Control Test Wells Review of Groundwater Sampling Results, Table 10A-1: Test Field-Field Parameter Results (March 1, 2012).

Figure J-1: pH in BHP Pilot Test Wells[282]



This is not surprising, given that uranium ISR mines across the country have repeatedly failed to meet groundwater restoration permit requirements. Even EPA through its draft uranium ISR rulemaking has recognized the problematic post-uranium mining restoration experience.[283] SWVP previously shared a wealth of reports and information from uranium mines describing the problems encountered with groundwater restoration efforts.[284] This same information is included with these comments and more fully discussed in Appendices M and N for Region 9's consideration in evaluating this draft permit. The known inability to successfully restore groundwater quality at other ISR sites calls into question FCI's assumptions and predictions here, making the PTF restoration results and data all the more important.

b. The restoration process is poorly defined and relies too heavily on sulfate concentrations to define successful restoration.

282 L. Wilson, from data in FCI's APP Application, Exhibit 10A, BHP Copper Hydraulic Control Test Wells Review of Groundwater Sampling Results, Table 10A-1: Test Field-Field Parameter Results (March 1, 2012).

283 USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156 (January 26, 2015)

284 SWVP Letters to EPA dated September 29, 2011 and January 19, 2012.

The UIC regulations authorize EPA to "prescribe aquifer cleanup and monitoring where [it] deems it necessary and feasible to insure adequate protection of USDWs."[285] Groundwater cleanup clearly is necessary in this case. But although Region 9 has included requirements for aquifer restoration after the PTF facility closes, the requirements in the Draft Permit often conflict with requirements in FCI's Closure and Post-Closure Plan.[286] Other requirements are too vague to determine exactly what the Draft Permit requires. But most importantly, the groundwater restoration process relies far too heavily on sulfate concentrations as an indicator of successful restoration. And the restoration monitoring program overall is insufficient to accurately gauge whether FCI has met the required standards.

i. "Restoration" is a misnomer because the groundwater aquifer is not being restored to pre-mining conditions.

The Draft Permit does not require FCI to restore groundwater to pre-operational conditions, unless a contaminant's natural background concentration already exceeded an MCL before mining begins. For contaminants whose natural background concentrations are below an MCL, FCI only has to restore contaminant concentrations to levels below applicable MCLs.[287] This allows FCI to increase contaminant levels during mining and still comply with the permit. EPA may not have authority to enforce original background levels as the restoration standards, but it should make clear to the public that FCI is not being required to return the aquifer to pre-mining conditions.

Nor does compliance with listed MCLs guarantee protection of surrounding USDWs, as EPA seems to assume.[288] Other pollutants in the permit, such as radiochemicals, copper, and sulfate can degrade the aquifer and render it unsuitable for drinking or other potable uses. Yet the Draft Permit contains almost no protection for the aquifer from these pollutants.

Only about 20 contaminants listed in the Draft Permit have federal MCLs. For the others, FCI is required to ensure the contaminants "do not impact USDWs in a way

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[285] 40 C.F.R. § 146.10(a)(4) (subject to implementation in Arizona by EPA under 40 C.F.R. § 147.151).

[286] Draft Permit, Appendix F.

[287] Draft Permit, Section II(I)(1)(a).

[288] Draft Permit, Section II(I)(2) ("To ensure that the restoration . . . accomplished the objective of returning the injection and recovery zone to primary MCLs (or pre-operational background concentrations) *and thereby providing* (*sic*) *adequate protection to surrounding USDWs* . . . .").

that could adversely affect the health of persons."[289] Thus, especially given the focus on existing wells in the Draft Permit (rather than protection of the aquifer generally), FCI will be able to argue that human health is not being affected by even extreme levels of these pollutants because the contaminants have not reached an existing drinking water well, regardless of its impact on the aquifer or a USDW. In other words, the permit seems to allow FCI to pollute the aquifer with impunity, as long as the pollutants are not regulated by a federal MCL and have not reached an existing well. Such a standard does not satisfy the letter or the spirit of the SDWA.

Instead of this vague standard for pollutants without an MCL, the Draft Permit should expressly require FCI to comply with standards that provide more protection for the aquifer and more certainty for future evaluation of FCI's cleanup effort:

- First, FCI should comply with the Treatment Technique Alert Levels for lead and copper, since all drinking water systems must take action if the alert levels are met. FCI's own geochemical model is currently predicting that the alert levels will be exceeded in groundwater after restoration.[290] FCI should not be allowed to pass on the risk of additional treatment costs to water users if its mining process increases lead and copper levels in the aquifer.

- Second, the Draft Permit should expressly require compliance with the Arizona Water Quality Standard for nickel and any radiochemicals for which there is an AWQS that is more stringent than the federal standard.

- Third, the Draft Permit should define an impact to a USDW to include concentrations of any contaminants at Points of Compliance that exceed a federal secondary MCL.

- Finally, the Draft Permit should further require that impacts to a USDW that "that could adversely affect the health of persons" be evaluated at Points of Compliance through fate and transport modeling, a human health assessment, risk analysis, or other reasonable analysis that ties existing and reasonably foreseeable impacts of unregulated contaminants to post-closure aquifer water quality and possible human receptors.

If EPA is intent on issuing a permit to allow ISR mining in the Town of Florence through injection into the Town's main source of drinking water, it should at least draft clear and enforceable standards for cleanup of the aquifer after mining.

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[289] Draft Permit, Section II(I)(1)(b).

[290] Draft Permit, Appendix E, Exhibit K-2, Appendix A.

ii. Contaminant concentrations at well manifolds are not accurate indicators of groundwater conditions in and around the PTF well field.

The Draft Permit requires FCI to monitor contaminant concentrations at well manifolds as an indicator of restoration progress and ultimate success.[291] FCI's permit application appears to indicate that there will be a single manifold distributing acid mining solutions to the four injection wells and a single manifold receiving fluids from the nine recovery wells.[292] It is unclear whether there will be more than the two manifolds due to the lack of detail in FCI's application and the errors and inconsistencies in the text from multiple revisions over the last four years. Nevertheless, it is clear that the Draft Permit requires contaminant monitoring at a collection point receiving recovered fluids from multiple wells, rather than from each individual well head.[293]

It is much more accurate to measure sulfate concentrations at each well head. Accurate measurements are particularly important for a test facility that is purportedly intended to prove that groundwater cleanup is possible. Monitoring at well manifolds will mask variability at individual wells. The mixed fluids from two wells could contain sulfate at concentrations below the indicator standard even though one of the wells actually had sulfate concentrations exceeding the standard. The only way the Draft Permit's current monitoring requirement works is if the aquifer is homogenous, injected solutions move evenly throughout the well field, chemical reactions occur uniformly across the well field, and every well contains similar concentrations of sulfate and other contaminants. But we already know none of those conditions are found at this site. Therefore, the Draft Permit's restoration monitoring requirement is unreasonable and technically invalid.

Reports summarizing the results of the BHP Pilot Test contain repeated statements that the aquifer is extremely heterogeneous and that the EPM assumption BHP relied on in its groundwater modeling does not work. Among other things, BHP's

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[291] Draft Permit, Section II(I)(1)(c). FCI's Closure and Post-Closure Plan refers to monitoring at the "recovery well headers," which are assumed to mean the same thing. *Id.*, Appendix F, Exhibit Q-2, Section 2.1.1(5).

[292] *See generally* FCI Permit Application, Attachment K, including Figure.

[293] The UIC regulations allow manifold monitoring only if the applicant "demonstrates that manifold monitoring is comparable to individual well monitoring." 40 C.F.R. § 146.33(b)(6). FCI has made no such demonstration and the BHP pilot test clearly demonstrates that manifold monitoring is not appropriate in this case.

staff and consultants concluded that the EPM assumption should be re-evaluated,[294] calibration may never be achieved,[295] the model did not fit the data,[296] and the EPM assumption didn't match the actual system geometry.[297] Dr. Wilson has testified that the BHP Pilot Test results are "proof" of a heterogeneous aquifer.[298]

A review of data from the BHP pilot test bears out these conclusions. For instance:

- BHP-4 and BHP-5 were two recovery wells that were just 100 feet apart. If the aquifer were homogeneous, you would expect the two wells to experience similar water level changes during pumping. But water levels during pumping did not match in these two wells at all, indicating a heterogeneous aquifer.[299]

- After the BHP Pilot Test was completed, a bromide tracer test was conducted. The tracer test showed higher flows in the north to west quadrant, confirming likely preferential flows in the north to west direction.[300]

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[294] BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 58 (October 15, 1999) ("Although it has been argued that groundwater flow can be suitably modeled using an assumption of equivalent porous media (cf., Orr, 1998), the discrepancy between modeled and measured porosity suggests that this assumption should be re-evaluated."); Peter Lichtner, *Final Report: Reactive Transport Simulations of the BHP Copper Florence, Arizona In Situ Solution Mining Test Facility*, at 23 (June 26, 1999) ("Both models, however, are based on a volume averaged continuum representation of fractured porous media. Clearly, additional aspects not accounted for in these models are important, such as the presence of fractures resulting in the possibility for fast pathways through the leach zone, and heterogeneities in porosity, permeability, and ore and gangue abundances and their reactive surface areas. To identify such features will be difficult at best. Fracture flow seems to be th eonly explanation for the discrepancy found between observations and predicted arrival times, both of tracers and copper effluent.").

[295] BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 140-41 (October 15, 1999) ("More importantly, as suggested by Dr. Norton, calibration may never be achieved under a conceptual framework of flow and transport through equivalent porous media, instead a hierarchical fracture network approach may be required.").

[296] *Id.* at 142 ("However, flow and transport properties derived from volume-averaged conceptual models (e.g., equivalent porous media) could not be used by reactive transport models to provide an acceptable fit to the data.").

[297] *Id.* at 143 ("Flow and transport models that use volume averaging methods to obtain fluid velocity and flow porosity estimates do not accommodate the type of percolation network geometry that probably exists within the Florence deposit.").

[298] OAH Hearing Transcript, Testimony of Lee Wilson, March 24, 2014 at 41-42.

[299] *Id.* at 15-17.

[300] *Id.* at 128-133; BHP Copper, *Hydrogeological Studies for the In-Situ Leach Field Test at Florence, Arizona (Draft)*, at 19 (Fig. 11) and 16 ("Notice that the percentage of Bromide solution recovered at the

Thus, the BHP pilot test clearly demonstrated that the aquifer behaved in a heterogeneous, non-uniform manner. Under these conditions, sampling at individual wells is the only reasonable means to verify groundwater restoration.

iii. Compliance with the sulfate indicator concentration does not guarantee restoration of the PTF well field.

When sulfate concentrations in the well manifolds are below 750 mg/L, the Draft Permit requires FCI to sample for Level 2 contaminants. Sampling is again to be done at the well manifolds, not individual wells. When all contaminants that have primary MCLs reach concentrations below the MCLs, the sulfate concentration at that point becomes an indicator concentration. FCI must then sample individual wells for sulfate and can discontinue rinsing at any wells where sulfate is below the indicator concentration. After all wells in the PTF well field have reached the sulfate indicator concentration, FCI must discontinue hydraulic control for 30 days and then re-sample each well for sulfate. If all wells are still below the sulfate indicator concentration, EPA considers groundwater restoration to be complete.[301]

Setting the sulfate indicator concentration by measuring at the well manifolds suffers from the same fatal flaw discussed above for measuring sulfate concentrations. Fluids in the well manifolds represent a mixture from several wells, such that variations in contaminant concentrations in individual wells are masked. Sampling for all Level 1 and Level 2 parameters is necessary during the restoration process to accurately determine if cleanup is complete, and it must be done at well heads, not the manifolds.

Although the Draft Permit requires Level 1 and Level 2 sampling at individual wells during PTF operations and after closure, the sampling schedule is too limited to accurately gauge the success of restoration. Level 2 parameters only must be monitored once every six months.[302] FCI has asserted in the State permit proceedings that restoration will be completed in nine months. It is therefore possible that Level 2 sampling would be conducted only once during the restoration process. This is

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pumping wells is not necessarily proportional to the pumping rate or distance from the injection well. A large difference in heterogeneity and communication exist."); BHP Copper, *Florence Project: Field Test Report—Goals, Results, Conclusions (Draft)*, at 31-32 and Fig. 17 (October 15, 1999) ("BHP 8 and BHP 9 are of equal distance from the injection well and had a similar pumping rate of 12 gpm, but they had different results. Fifteen percent of bromide reached BHP 8 and only 6 percent bromide reached BHP 9.").

301 Draft Permit, Part II(I)(1)(c).

302 Draft Permit, Table 3.

insufficient to verify that the aquifer has been restored across the entire PTF well field.[303]

iv. Post-closure monitoring is inadequate to demonstrate the aquifer's long-term stability after mining stops.

The Draft Permit requires quarterly monitoring of Level 1 contaminants for just two years after PTF operations cease and biennial monitoring of Level 2 contaminants for just five years after PTF operations cease.[304] EPA has nowhere explained why it thinks just five years of post-closure monitoring is sufficient. Such limited monitoring, with no option for continued monitoring or other contingencies more than five years after closure, is clearly inadequate to demonstrate that aquifer conditions have permanently stabilized and that the USDW is not endangered.

EPA Region 9 seems to have given little thought to the purpose and needs of the post-closure monitoring period. The point of post-closure monitoring is to demonstrate that the aquifer has stabilized with contaminant levels that are protective of USDWs. As USEPA has already noted and as discussed in more detail elsewhere in these comments, geochemical conditions can continue to change for long periods after ISR mining has ended, requiring long-term monitoring to ensure USDWs are protected.[305] Merely continuing operational monitoring for a few years after mine closure generally is insufficient to prove the aquifer has stabilized.

For commercial uranium ISR mines, USEPA has recommended 30 years of post-closure monitoring to demonstrate aquifer stability.[306] Thirty years of monitoring may not be required for a pilot test on the scale of the proposed PTF. But in fact, no one knows the length of time necessary to demonstrate aquifer stability after the PTF closes. Therefore, Region 9 should follow USEPA's lead with regard to ISR mining and require post-closure mining to continue until FCI can demonstrate aquifer stability "for three consecutive years at a 95 percent confidence interval, measured from the time at which sufficient data to determine statistical significance has been collected, and based on

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[303] *See* USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4187 (January 26, 2015) (requiring monitoring "no less frequently than quarterly").

[304] Draft Permit, Part II(I)(2) and Table 3.

[305] *See*, *e.g.* USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4165 (January 26, 2015).

[306] *Id.* at 4187.

sampling no less frequently than quarterly."[307] Such a standard is clear, enforceable, and protective of USDWs, whereas the Draft Permit's current post-closure requirements are not.

Region 9 can review USEPA's post-closure monitoring proposal for itself, but a few key details warrant mention because they should be included as provisions of FCI's permit:

- EPA should expressly reserve the option to require post-closure sampling for pollutants not currently listed in the Draft Permit, such as constituents of any neutralizing agents that FCI might inject during restoration or additional constituents or geochemical parameters that are necessary to demonstrate aquifer stability through geochemical modeling and calculations.

- The aquifer stability demonstration should be based upon field measurements from the monitoring network and modeling and calculations applying appropriate statistical techniques.

- Post-closure monitoring should continue until FCI demonstrates aquifer stability for three consecutive years at a 95 percent confidence interval, measured from the time at which sufficient data to determine statistical significance has been collected, and based on sampling no less frequently than quarterly.

- Specific, individual wells within the production zone and approved by EPA Region 9—not well manifolds or monitoring wells outside of the well field—should be the points of compliance for assessing aquifer stability and groundwater protection.[308]

These are not random requirements designed to impede mining approval. They are based on USEPA's recognition that post-closure monitoring at ISR mines to date has generally not been conducted long enough to demonstrate aquifer stability, such that rebound of contaminants can go undetected and USDWs can be threatened:

> If insufficient monitoring is conducted, either in duration, frequency, or in the number of wells used to sample the wellfield, it is very possible to reach premature conclusions of stability. In such cases, residual lixiviant or localized areas within the production zone that have not stabilized may cause continued mobilization of uranium and other constituents after

[307] *Id.*

[308] *Id.*

> monitoring is terminated, potentially leading to contamination downgradient or beyond the boundary of the exempted aquifer. . . . To determine whether a trend of increased concentrations is occurring, it is necessary to monitor over long periods of time and use statistical techniques to analyze the data. This is particularly important if the trend in increased concentrations is relatively slow and the natural variability in the well samples is relatively high. These difficulties point to the need for longer post-restoration monitoring periods than historically performed.[309]

Such monitoring becomes even more crucial in light of the fact that FCI's geochemical model has proven completely unreliable. In the early stages of the permit process for this site, FCI was touting its geochemical model as proof that the aquifer could be restored after mining was complete. But facts and testimony developed since then have completely undercut the model's credibility:

- The geochemical model originally submitted to ADEQ and Region 9 was not based on the actual rinse-water source to be used during restoration, so the predicted post-restoration contaminant concentrations were mere guesses, even though FCI easily could have sampled its rinse-water supply well and incorporated the data into the model.[310]

- FCI's own consultants have testified that the original geochemical model, as reported in a document sealed by a registered engineer, did not accurately depict post-restoration pollutant concentrations, although FCI failed to tell either agency the forecast solutions table was incorrect.[311]

- FCI decided to use a different rinse-water source at some point during the ADEQ and EPA permit review, although FCI failed to disclose that information to ADEQ before the APP was issued.[312]

- For the UIC application, FCI has now supplied another version of its forecast solutions table, apparently based on yet another version of its geochemical model, but its own expert characterizes the table as representing contaminant concentrations "that may reasonably be expected" but that actual concentrations

[309] *Id.* at 4176.

[310] OAH Hearing Transcript, Testimony of Dan Johnson, April 15, 2014 at 85-86 and 230.

[311] *Id.*, Testimony of Mark Nicholls, April 21 at 12-20.

[312] *Id.*, April 15, Testimony of Dan Johnson, at 85-86.

"may vary . . . based on natural mineralogical and chemistry variations existing in the formation."[313]

- The forecast solutions table now included in FCI's application depicts arsenic concentrations in make-up water and post-restoration groundwater that are orders of magnitude lower that background levels, despite the fact that FCI's own expert testified that testing conducted in 2014 predicted arsenic levels of 50 to 80 ppb after ISR mining. Such discrepancies call the model's validity into serious question.[314]

With no credible prediction of the length of time needed to restore the aquifer after mining, EPA Region 9 has no basis for predicting that five years of post-closure monitoring is enough. Region 9 should instead require monitoring to continue until FCI has demonstrated aquifer stability as described above. If Region 9 elects not to include the standards advocated above, it should explain why its seemingly random five-year post-closure monitoring period and its vague aquifer restoration standards are sufficient to protect the aquifer.

v. The restoration requirements of the Draft Permit are not consistent with FCI's Closure and Post-Closure Plan.

There are numerous inconsistencies between the language of the Draft Permit and FCI's Closure and Post-Closure Plan that must be reconciled to avoid confusion and future disputes over applicable requirements.

MCLs versus AWQSs

The Draft Permit requires FCI to meet the primary MCLs found in 40 C.F.R. Part 141 or pre-operational background concentrations that exceed the MCLs.[315] FCI's Closure and Post-Closure Plan requires compliance with AWQSs.[316] There are material differences between the two sets of standards. EPA should require FCI to revise the Closure and Post-Closure Plan to mandate compliance with all MCLs and AWQSs, whichever is more stringent.

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[313] FCI Application, Attachment H, Exhibit H-1, at 1.

[314] *See* Appendix K.

[315] Draft Permit, Part II(I)(1)(a).

[316] Draft Permit, Appendix F, Exhibit Q-2, Section 2.1.1(5).

Misrepresentation of hydraulic control requirements

FCI states in the Closure & Post-Closure Plan that the Draft Permit requires hydraulic control to be maintained "in the portion of the oxide zone in which injection has occurred."[317] Would that this was true, but the Draft Permit expressly allows contaminants into the LBFU.

Conflicting sampling requirements

The Closure & Post-Closure Plan states that sampling for Level 2 contaminants will be conducted annually during the restoration and post-closure periods, while the Draft Permit requires semi-annual sampling.

Inconsistent closure objective

FCI states that its closure objective "is to ensure compliance with the requirements of A.R.S. §§ 49-243 B.2 and B.3 by preventing discharges of any pollutant that will cause or contribute to a violation of an Aquifer Water Quality Standard (AWQS) at the applicable POC, or that will further degrade at the applicable POC the quality of any aquifer that at the time of permit issuance violates the AWQS for the pollutant."[318] None of this refers in any way to the Draft Permit's closure standard, which purportedly is "ensure that the restoration . . . accomplished the objective of returning the injection and recovery zone to primary MCLs (or pre-operational background concentrations) and thereby providing (sic) adequate protection to surrounding USDWs . . .".[319]

It is difficult to understand why EPA Region 9 did not require a written closure plan that is consistent with the UIC program and the Draft Permit. In fact, EPA Region 9 asked FCI to amend its closure plan to at least include the EPA-required monitoring wells as points of compliance.[320] FCI refused to do so, arguing that the change would effectively establish new POC locations inside of the state-law-defined Pollution Management Area.[321] That argument is no longer valid (if it ever was) because the ALJ rejected the overly broad Pollution Management Area on appeal and required ADEQ to redefine the PMA according to Arizona law. If that is done correctly, the EPA

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[317] Draft Permit, Appendix F, Exhibit Q-2, Section 2.1.

[318] Draft Permit, Appendix F, Exhibit Q-2, Section 1.4.

[319] Draft Permit, Section II(I)(2).

[320] EPA Region 9, Request for Information, Comment 20(a) (July 11, 2014).

[321] FCI Response to EPA, at 10 (August 7, 2014).

monitoring wells should be located outside of the PMA, eliminating FCI's objection. In any event, EPA Region 9 should not let stand a closure plan that is inconsistent with the Draft Permit just because FCI does not want to spend the time to draft a closure plan specific to the UIC program.

2. Temporary Cessation Should be Prohibited or at a Minimum Better Regulated by More Definite Permit Terms.

Tucked away in Exhibit P-1 (Alert Levels) to Appendix K of the Draft Permit is a section on temporary cessation of mining activities during the PTF period. FCI proposes to give written notice before ceasing operations for 60 days or more, along with "a plan for maintenance of discharge control systems and for monitoring during the period of temporary cessation."[322] FCI proposes to provide a status report *every two years* during temporary cessation. As written, this provision becomes a clever way for FCI to gather limited pilot test data and then shut down to avoid restoration requirements.

First, there is no justification for temporary cessation of a 14-month PTF project. There certainly is no reasonable basis for mothballing a 14-month pilot test for two years or more. FCI will respond that temporary cessation is a common permit term. That is true, for long-term, commercial operations, which this is not. If FCI cannot commit to pilot test operations for just 14 months, it should not be allowed to begin at all. EPA should expressly prohibit temporary cessation in the final permit and require FCI to strike this provision and all other references to temporary cessation in the appendices, exhibits, and any other plans or reports submitted to EPA.

Second, FCI's proposed terms are vague and unreasonable. FCI proposes to submit a plan for "maintenance of discharge control systems" before temporary cessation. The term "discharge control system" is not defined and it appears nowhere else in this permit. This leaves FCI's proposed temporary closure plan completely undefined and subject to whatever interpretation FCI devises. Furthermore, the proposal to submit a status report every two years is ridiculous on its face. It is unbelievable that EPA believes a biennial report, whose contents remain completely undefined in the permit, is sufficient to protect the people of Florence.

This provision is unacceptable. If EPA continues to believe FCI will need to close the PTF before testing is complete, then it should state in the permit that restoration will

[322] Draft Permit, Appendix K, Exhibit P-1, at 5.

begin immediately upon closure. If FCI stops its test seven months in, there will be no benefit to restarting it for the final seven months years later. Instead, FCI should be required to start the restoration process. If FCI wants to conduct additional testing some years later, it can begin anew at that time. This approach is consistent with USEPA's proposal for uranium ISR mines. USEPA has proposed that restoration begin as soon as mining operations go into "standby" mode because failure to maintain a hydraulic gradient during suspended operations will allow migration of pollutants.[323]

In the alternative, EPA should impose specific, detailed requirements designed to protect the aquifer during shutdown. At a minimum, this should include maintenance of all hydraulic controls measures, with full monitoring and reporting. EPA should specifically require continued monitoring for all groundwater quality parameters on a regular basis and implementation of a contingency plan if excursions occur. Such requirements are simple fixes that can be made by reference to existing permit conditions. But to leave this vague provision in place in the final permit is inviting FCI to skirt requirements and standards designed to protect USDWs.

3. The Operations and Closure Plans Contain Numerous Errors and Inconsistencies that Must be Corrected.

Appendices E and Q of the Draft Permit are rife with inconsistencies and unexplained terms and conditions that demonstrate an unsettling lack of diligence and review. These flaws must be corrected to ensure an enforceable and protective permit.

a. Appendix E, Exhibit K-2: PTF Operations Plan

The following issues must be addressed:

i. Page 3 (Injection Pressures)

To avoid confusion later, references to the now-revoked UIC Permit No. AZ396000001 should be revised to refer to the Draft Permit and the injection pressures authorized by the Draft Permit.

ii. Page 3 (Injection Monitoring and Controls)

[323] USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4176 (January 26, 2015).

In this section, FCI states that total flows over 24 hours from injection and recovery wells will be compared and that if "the summed total flow out of the well field exceeds the total flow into the well field . . . hydraulic control is confirmed." This is inconsistent with Draft Permit Section II(E)(1)(a), which requires total recovery to be 110 percent of total injection over 24 hours.

iii. Page 5 (Hydraulic Control)

FCI here states that an inward hydraulic gradient will be monitored by comparing water levels in an inner recovery well and outer observation well. This is inconsistent with Draft Permit Section II(F)(5), which requires FCI to compare each observation well to the closest two recovery wells.

iv. Page 5 (Emergency Response Actions)

If listed conditions occur, this section requires FCI to follow the notification procedures of "the APP." This reference is vague and confusing, because there is an existing, suspended APP in place for the overall site as well as a final Temporary APP that has now been remanded for significant modifications. Because ADEQ and EPA appear unable to coordinate their efforts and provide the public with consistent permit terms across both the UIC and APP permits, this reference should be stricken and the notification requirements should be expressly stated in the UIC permit itself.

v. Page 6 (Emergency Response Actions)

Subparagraph 3 requires injection to stop after a loss of hydraulic control until hydraulic control is established and "recovery wells have operated a sufficiently long period of time to compensate for the amount of fluid that was injected in excess of the amount recovered during the 48-hour period." This is a nonsensical requirement. As discussed in Appendix I, FCI will be extracting a mixture of mining solutions and native groundwater. If FCI injects 1000 gallons in excess of recovery, later extraction of 1000 gallons does not mean all of the acid mining solution was recovered. The 1000 gallons recovered will include some percentage of native groundwater, while an equal percentage of acid solution will remain behind in the aquifer. Better contingency measures are needed to address losses of hydraulic control than this pointless requirement.

vi. Page 6 (Recordkeeping and Reporting)

FCI indicates here that daily operations logs will be retained for only two years and that quarterly reports will be maintained until closure begins. This is inconsistent with the recordkeeping requirements in Section II(G) of the Draft Permit, which require such records to be retained and available for the life of the wells and that records not be destroyed without notice to EPA.

vii. Page 6 (Daily Operations Log)

This section refers to daily water level readings for each "perimeter/recovery well pair." There are no perimeter wells. If the reference should have been to observation wells, then the reference should be to each group consisting of an observation well and two recovery wells.

viii. Page 6 (Quarterly Monitoring Report)

The Operations Plan states that quarterly reports will be submitted within 45 days of the end of each calendar quarter. This is inconsistent with the schedule in Section II(G)(3) of the Draft Permit.

The description of the Quarterly Report's contents in the Draft Permit is inconsistent with the description in the Operations Plan.

This section again refers to "paired perimeter and observation wells." There are no perimeter wells.

There is a reference to flows "in each active production unit" and a reference to a map showing "current operational unit status." These appear to be references to a concept from FCI's commercial mining proposal. They have no place in a permit limited to the PTF.

The list of Quarterly Monitoring Report contents includes "a list of wells and core holes to be abandoned during the next reporting period." The Draft Permit requires all wells and core holes in the AOR to be closed *before* operations begin.

The Operations Plan states that "no solution stacking is proposed during PTF operations."[324] The Draft Permit, however, states that monitoring and advance notification requirements are not applicable to pregnant leach solutions that are re-

[324] Draft Permit, Appendix E, at 6.

injected to increase copper concentrations before delivery to the SX/EW plant.[325] Re-injection to increase copper concentration is the very definition of "stacking." EPA needs to clarify whether stacking will be conducted and, if so, what permit changes are required to address re-injection of pregnant leach solutions.

b. Appendix F, Exhibit Q-2: Closure and Post-Closure Plans

The following issues must be addressed:

i. Section 1.4: Closure Objective

The stated closure objective, compliance with Arizona Water Quality Standards, is inconsistent with the Draft Permit, which requires compliance with MCLs. Improper references to the AWQSs appear throughout the remainder of this Appendix. There are distinct differences in the two standards both in the numeric standards and in the way in which ADEQ has proposed to apply AWQS. Among other things, the AWQS for arsenic is higher than the MCL and ADEQ has proposed to ignore the AWQS for nitrates. Ideally, EPA Region 9 should require FCI to prepare a Closure Plan specific to the UIC permit, rather than incorporating one from the APP permit process. Alternatively, EPA Region 9 require FCI to revise the Closure and Post-Closure Plan to mandate compliance with all MCLs and AWQSs, whichever is more stringent.

In an attempt at consistency between the documents, EPA Region 9 asked FCI to amend its closure plan to at least include the EPA-required monitoring wells as points of compliance.[326] FCI refused to do so, arguing that the change would effectively establish new POC locations inside of the state-law-defined Pollution Management Area.[327] That argument is no longer valid (if it ever was) because the ALJ rejected the overly broad Pollution Management Area on appeal and required ADEQ to redefine the PMA according to Arizona law.[328] If that is done correctly, the EPA monitoring wells should be located outside of the PMA, eliminating FCI's objection. In any event, EPA Region 9 should not let stand a closure plan that is inconsistent with the Draft Permit

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[325] Draft Permit, at 23.

[326] EPA Region 9, Request for Information, Comment 20(a) (July 11, 2014).

[327] FCI Response to EPA, at 10 (August 7, 2014).

[328] *Town of Florence v. ADEQ*, No. 12-005-WQAB, Administrative Law Judge Decision, at 134-141 ("For all of the foregoing reasons, Appellants established that under A.R.S. §§ 49-203, 49-243, and 49-244, the PMA and the location of the POC wells described in the application and permitted by the Temporary APP were arbitrary, unreasonable, and unlawful.").

just because FCI does not want to spend the time to draft a closure plan specific to the UIC program.

ii. Section 2.1: Closure Activities in the PTF Well Field

This section states that the "UIC Permit will require that hydraulic control be maintained in the portion of the oxide zone (IRS) in which injection has occurred." This is not accurate, because the Draft Permit allows acid mining contaminants to flow into the LBFU above and beside the Oxide Zone with impunity. EPA should not be relying on a document prepared for the APP process because the requirements and standards of the Draft Permit are not consistent with those in the APP.

FCI also claims that tanks, piping and equipment will be "thoroughly rinsed" during restoration activities, implying that they can be disposed of or abandoned in place without testing for hazardous substances. Such an assumption, absent any supporting data whatsoever, should not be relied upon to permit disposal or abandonment of these facilities without proper testing.

iii. Section 2.4: Closure Monitoring

Here, FCI states that Level 2 closure monitoring will occur annually. That is inconsistent with the biennial monitoring required in the Draft Permit. The same error is made in Section 2.5 (Post-Closure Monitoring) and Section 3.2 (Post-Closure Monitoring Schedule).

FCI states that monitoring will occur at the Point of Compliance wells for the APP and the supplemental monitoring wells of the Draft Permit. It does not mention monitoring of operational monitoring well MW-01, which the Draft Permit requires. This mistake is repeated later in this Appendix. The text also appears to indicate that monitoring at the EPA monitoring wells will be in accordance with Temporary APP requirements, which is incorrect.

iv. Misrepresentation of hydraulic control requirements

FCI states in the Closure & Post-Closure Plan that the Draft Permit requires hydraulic control to be maintained "in the portion of the oxide zone in which injection has occurred."[329] Would that this were true, but the Draft Permit expressly allows contaminants into the LBFU.

v. Conflicting sampling requirements.

The Closure & Post-Closure Plan states that sampling for Level 2 contaminants will be conducted annually during the restoration and post-closure periods, while the Draft Permit requires semi-annual sampling.

4. Adequate post-restoration rebound monitoring is not required by this draft permit.

The five years of post-closure groundwater monitoring in the Draft Permit is clearly inadequate to gauge the success of restoration or to determine if rebound is occurring. No justification for such a short monitoring period is found in the permit materials. EPA should require a minimum of 30 years of post-closure monitoring.

a. EPA should follow its own proposed rule regarding post-closure monitoring.

In January 2015, EPA proposed new regulations to govern uranium ISR mining.[330] Although uranium ISR mines use different mining solutions than FCI has proposed, the mining techniques, processes, and potential impacts are inarguably similar. Because copper ISR mining can contaminate groundwater with heavy metals, radiochemicals, and other pollutants, similar protections should be imposed on copper ISR mines.

EPA advanced the proposed regulations because:

> . . . [U]ranium ISR operations are very different from conventional uranium mills and the existing standards do not adequately address their unique aspects.
>
> In particular, we believe it is necessary to take a longer view of groundwater protection than has been typical of current ISR industry practices. Although the presence of significant uranium deposits typically

[329] Draft Permit, Appendix F, Exhibit Q-2, Section 2.1.

[330] USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156 (January 26, 2015).

> diminishes groundwater quality, current industry practices for restoration and monitoring of the affected aquifer may not be adequate to prevent either the further degradation of water quality or the more widespread contamination of groundwater that is suitable for human consumption.
>
> Because monitoring after restoration is typically conducted for only a short period, we find it difficult to characterize the probability or magnitude of future contamination problems, or the costs involved in remediating such future contamination. Such costs are not now borne by ISR licensees, nor is there any guarantee that they could be held responsible if contamination were detected by new monitoring implemented years, decades or even longer after the end of site activities . . . It is likely, however, that the costs of such future remediation would far exceed the costs of the more extensive monitoring (in all phases of site activity) that we are proposing today, together with the costs of any additional restoration or prompt corrective action that may be required to address any issues identified as a result of the more extensive monitoring. In this sense, perhaps a generalized future cost of groundwater remediation can be viewed as a proxy for the value of groundwater and its protection.[331]

Similarly, the existing UIC regulations were not designed to address the unique problems posed by copper ISR mining, especially when such mining is proposed in the center of a growing city. And as EPA acknowledges here, a short monitoring period for restoration and rebound is insufficient to detect long-term impacts of copper ISR mining. If contamination is discovered after mining is finished and FCI is dissolved, the citizens of Arizona, not FCI, will pay the costs of cleaning it up or be forced to find alternative supplies. The same reasoning that has led EPA to proposed increased post-closure monitoring at uranium ISR mines requires increased post-closure monitoring in FCI's permit.

b. All available evidence indicates that complete restoration of an in situ leach mine has never been successful.

Despite FCI's repeated assertions that ISR mining is a proven technique, no one has ever demonstrated the ability to fully restore the groundwater aquifer once mining

[331] USEPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4164 (January 26, 2015).

is complete. This likely is why FCI studiously avoids referencing any other ISR mines in support of its proposal.

EPA should be well aware of a 2009 study by the U.S. Geological Survey of groundwater restoration at uranium ISR mines.[332] USGS examined records for Texas's 27 authorized uranium ISR mines, which contained 77 well fields combined. It found that every one of the mines had to request relaxed restoration goals for at least one element "after operators have expended a reasonable degree of effort to restore groundwater . . . following established guidelines."[333] USGS concluded that "Regarding the original question of whether or not groundwater has been restored to baseline in Texas uranium ISR well fields, it was observed that no well field for which final sample results were found in TCEQ records returned every element to baseline."[334]

Furthermore, USGS found that well fields monitored for longer periods of time after closure showed trends of increasing contaminants in groundwater, a trend noted as well at pilot uranium ISR projects in Grover, Colorado, Crown Point, New Mexico, and throughout Wyoming.[335] At the Grover, Colorado pilot test site, uranium and other radioactive constituents, calcium, magnesium, ammonia, total dissolved solids, and other chemicals began increasing—sometimes dramatically—more than six months after mining activities ceased.[336] Regulators and industry experts appear uncertain why this occurs, but it indicates that the effects of in situ mining can not only linger, but actually worsen after restoration activities have stopped.

A comparison of this and related data to claims by the in-situ mining industry highlight the need to carefully evaluate claims regarding the industry's ability to restore groundwater to pre-mining conditions. For example, Powertech Uranium Corporation, which has operated several in-situ mining projects, posted on its web site that "The groundwater restoration, or cleanup of an aquifer impacted by in-situ uranium solution mining has been shown to be technically, physically and economically achievable."[337]

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[332] Susan Hall, U.S. Geological Survey, Presentation to the Uranium 2009 conference in Keystone, Colorado, *Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain* (2009) ("Hall Presentation").

[333] Hall Presentation, at 9 (SWVP-012812).

[334] *Id.* at 21 (SWVP-012824).

[335] *Id.* at 23 (SWVP-012826).

[336] *Id.* at 24 (SWVP-012827).

[337] *See* Powertech Uranium Corp., Groundwater Protection and Restoration During In-Situ Uranium Recovery at the Centennial Project (2011)

But Powertech's assertion is difficult to reconcile with available data. If, by "successful groundwater restoration," one means the successful restoration to baseline conditions as required by a mine's original permits, then no in-situ mine has successfully achieved groundwater restoration.

In fact, Powertech was not able to restore groundwater quality to baseline levels at its own facilities. Another study of Texas in-situ mines demonstrated that five of Powertech's mines had their original groundwater restoration goals amended due to their inability to meet the original restoration goals.[338] For instance, restoration goals for uranium were increased by 1,060% at the Hobson mine, 4,155% at Longoria, 290% at O'Hern, 900% at Pawlik, and 29,900% at the Zamzow mine.[339] Arsenic goals at two of these mines were increased by 181% and 1,438%.[340] Sulfate goals were amended at each of these mines through an increase of 62% to 1,685%.[341] Obviously, "successful restoration" is a relative term.

Similar trends have been noted at uranium ISR mines in other states. Appendix N provides a summary of the problems encountered at several of these mines, as further evidence that mine operators rarely, if ever, restore groundwater as promised.

c. Copper ISR mining presents issues similar to uranium ISR mining that warrant a longer monitoring period.

EPA has acknowledged that "[m]uch remains unknown about the geochemical stability of restored wellfields once [uranium] ISR operations have ceased."[342] But even less is known about copper ISR mining with acid solutions because there has never been a commercial copper ISR mine in the United States. What is clear, however, is that copper ISR mining presents many of the same challenges and uncertainties regarding groundwater restoration that EPA has recognized at uranium ISR mines.

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http://www.powertechuranium.com/s/GroundwaterProtection.asp (visited on February 28, 2011).

[338] Southwest Groundwater Consulting, LLC, *Report on Findings Related to the Restoration of Groundwater at In-Situ Uranium Mines in South Texas* (September 29, 2008).

[339] *Id.*, Attachment E.

[340] *Id.*, Attachment G.

[341] *Id.*, Attachment H.

[342] EPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4165 (January 26, 2015).

EPA has summarized the difficulty of groundwater restoration at uranium ISR mines:

> *The restoration process itself is extremely complex and difficult to control. The fact that significant quantities of uranium and other constituents have been removed from the natural setting may affect flow patterns and create discontinuities that further complicate or retard the restoration process.* Originally, uranium was precipitated from groundwater moving through pore spaces in the host medium, which altered the flow paths on a local level throughout the deposit as the deposition of uranium continued and changed the porosity and permeability of the host medium. Once uranium extraction processes begin, fluids are pumped into the deposit to mobilize the precipitated uranium and remove it; the porosity and permeability of the host rock are also affected. Because the uranium is not initially distributed evenly throughout the deposit (because of the natural variations in the host rock properties), *the extraction process cannot be assumed to remove all of the uranium; in fact, it does not*. The restoration process likewise cannot be assumed to fully restore the porosity and permeability characteristics of the host rock to the exact conditions that existed before the ISR operations began. *These changes in hydrologic properties in the host rock during extraction and restoration processes can have the net effect of altering flow paths within the deposit on a local level. Such largely unavoidable, incomplete restoration efforts may result in pockets of slowly leaching contaminants that may migrate out of the production zone over time.*[343]

Similar circumstances are encountered at this site, albeit with different metals and chemical interactions.

FCI also has indicated it may inject chemical neutralizers during restoration. EPA has recognized the uncertain effectiveness of neutralizers in uranium ISR mining:

> We recognize that it is difficult to reach a definitive conclusion regarding the frequency and extent to which longterm contamination has been or is likely to be a problem at ISR sites, because post-restoration stability monitoring typically occurs for a relatively short timeframe, a few years at most; nevertheless, we believe the available information supports our concerns in this matter. Because the lixiviant used during operations

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[343] EPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4165 (January 26, 2015) (emphasis added).

> oxidizes not just the uranium but the entire production zone, the effect from adding reducing agents to restore the wellfield may just be temporary. If these reducing agents migrate out of the production zone, reoxidation of the uranium in the ''restored'' wellfield may occur. This is especially likely if the natural reducing agents originally present in the production zone (*i.e.,* organic materials and iron sulfide minerals) were sufficiently depleted during ISR operations. To determine if remobilization of constituents precipitated by the restoration process will occur, longer-term monitoring of the site is warranted.[344]

The same is true for the PTF.

Because of the complicated and uncertain nature of the restoration process, EPA has proposed a 30-year monitoring period[345] for uranium ISR mines:

> We are aware of the potential for geochemical conditions in the restored wellfield to alter over time. The ISR process can cause a loss of the chemically reducing potential in the ore zone. Over time, as oxidizing groundwater makes its way into the abandoned wellfield, re-oxidation could occur. Given the slow groundwater travel times in these deposits, it would take even longer time for the degraded water to make its way to water supply wells downgradient of the production zone aquifer and be detected there. *Therefore, when we speak of long-term alteration of the groundwater, we imply timeframes of decades (or longer) rather than a few years*.[346]

EPA should require the same approach here. FCI should be required to demonstrate three consecutive years of aquifer stability through monitoring, then conduct stability monitoring for an additional period of 30 years unless modeling demonstrates long-term aquifer stability such that monitoring can be discontinued.[347]

The small size and short term of the PTF well field does not obviate the need for long-term stability monitoring. The BHP Pilot Test well field continues to experience pH levels and contaminant concentrations that would not be expected had restoration

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[344] *Id.*

[345] *Id.* at 4176.

[346] *Id.* at 4165.

[347] *Id.* at 4176-79.

been successfully achieved and maintained. That test was the same size as the PTF, but restoration remains incomplete 17 years later.

5. Closure of a copper ISR mine is similar to closure of a hazardous waste storage facility and merits the same precautions.

Subtitle C of the Solid Waste Disposal Act (now RCRA) governs the generation, transportation, treatment, storage and disposal of hazardous waste. Regulations promulgated under Subtitle C address issues such as groundwater monitoring around storage and disposal facilities, detection of contaminant releases, corrective actions, and compliance monitoring.[348] Many of these same requirements should be equally applicable to the long-term monitoring and maintenance of a closed ISR mining facility after attempted aquifer restoration. As EPA has noted with regard to uranium ISR mines, "[c]onceptually, at that stage there is similarity between a closed hazardous waste disposal facility and a restored ISR wellfield in the sense that both strive to avoid off-site migration of contaminants."[349]

Among other things, the regulations governing post-closure care of hazardous waste disposal facilities require the operator to:

- Conduct post-closure monitoring for 30 years;[350]
- Maintain and monitor the groundwater monitoring system;[351] and
- Conduct corrective action as necessary to protect human health and the environment, including corrective actions beyond the facility property boundary where necessary.[352]

EPA has found it reasonable to apply the standard RCRA 30-year monitoring period to uranium ISR mines. EPA made this decision based upon the similarities between restoration activities at an ISR well field and an engineered RCRA disposal facility, in that both are designed to contain the potential spread of pollutants. EPA also found that 30 years of monitoring was a reasonable period to detect rebound or upward

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[348] 40 C.F.R. Part 264.

[349] EPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4169 (January 26, 2015).

[350] 40 C.F.R. § 264.117(a)(1).

[351] 40 C.F.R. § 264.310.

[352] 40 C.F.R. §§ 264.100-101.

trends in contaminant concentrations.[353] The 30-year monitoring period can be shortened or extended based upon monitoring data and geochemical modeling.[354] Furthermore, to reduce the monitoring period the operator must demonstrate stability in groundwater contaminant concentrations for three consecutive years. This concept is again derived from RCRA, where three years is the metric of success for groundwater corrective actions. Stability has to be demonstrated at a 95 percent confidence level, another RCRA standard.[355]

It is inconceivable that the people of Florence would receive more protection from Region 9 for a hazardous waste disposal site, where only a *risk* of a release to groundwater exists, than for FCI's mine, which will knowingly and intentionally pollute the aquifer. The Draft Permit, at a minimum, must provide the protection provided a solid and hazardous waste sites, uranium ISR mines, and similar facilities.

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[353] EPA, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings; Proposed Rule*, 80 Fed. Reg. 4156, 4177 (January 26, 2015).

[354] *Id.*

[355] *Id.*

Appendix K:
Arsenic

FCI's predicted ability to eliminate extremely high arsenic concentrations generated during PTF mining is not supported by adequate evidence in the record and appears unrealistic at best. EPA Region 9 should require FCI to "show its work" in support of its geochemical modeling of arsenic concentrations. If FCI cannot adequately support its predictions, then it should be required to explain how it will address the high arsenic concentrations it will produce in the aquifer.

FCI has predicted arsenic concentrations of 1.32 to 1.33 mg/L in the PLS, raffinate, and evaporation pond solution. Given this consistency in predicted process stream concentration, it appears reasonable to assume that similar concentrations will exist in the aquifer itself once PTF mining ends. Thus, while arsenic levels in the aquifer are generally below the federal MCL today, FCI's mining will increase arsenic levels to over 130 times the federal drinking water standard.

Somewhat miraculously, FCI now predicts that after just nine months of restoration efforts, it will be able to reduce arsenic concentrations by well over 2,600 times the level at the start of restoration, to an amazingly low 0.0005 mg/L. Thus, FCI has predicted that it will remove 99.6% of arsenic from post-mining groundwater simply by flushing fresh groundwater through the well field. This is quite the achievement, given that residential reverse osmosis systems have been found to eliminate just 79% of arsenic; commercial RO systems remove 40-99%; ferric sulfate coagulation removes 80-96% of arsenic; alum coagulation removes 23-90%; and iron or manganese oxidation removes 69 to 92% of arsenic.[356]

EPA Region 9 appears to have accepted FCI's bench testing and modeling without question. But there are serious questions about FCI's bench tests, modeling and conclusions that need to be answered before anyone, much less the regulatory agency charged with protecting public health and the environment, accepts them as reasonable and accurate indications of what can be expected during and after PTF operations.

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[356] Christine M. George, et al., *Reverse Osmosis Filter Use and High Arsenic Levels in Private Well Water* (December 2013) (available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3849398/, last visited April 2, 2015); USEPA Office of Water, *Technologies and Costs for Removal of Arsenic from Drinking Water*, EPA 815-R-00-028 (December 2000).

1. EPA Region 9 Must Evaluate the New Bench Test Procedures Utilized by FCI's Consultant.

In October 2012, FCI announced to investors updated metallurgical results on core samples from its property, results that boasted an average copper extraction rate of 61 to 70 percent, higher than FCI's previous modeling. These results were based on what appears to have been a unique series of bench tests developed by FCI's consultants Metcon Laboratories and Dr. Terence McNulty that used a specially-designed laboratory system to allow test solutions to flow horizontally through the drill core. McNulty touted this testing as "more realistic than the vertical column method that has been used in the past. . . ."[357] Similar copper recovery results were reported in January 2013 on additional core samples.[358]

This testing was a key basis for the Pre-Feasibility Study that FCI and EPA Region 9 have relied upon to justify the aquifer exemption.[359] The data generated by the bench tests also was used in FCI's geochemical model, which it used to predict arsenic and other contaminant concentrations after restoration.[360] In fact, use of the new bench test data appears to be the basis for FCI to have revised arsenic concentrations significantly downward in 2014. FCI predicted post-restoration arsenic concentrations of 0.015 mg/L in 2011 and 2012 materials, but reduced that to 0.0005 in 2014 materials.[361] But no reports, summaries, or data from the bench tests have been submitted to EPA Region 9 or ADEQ or otherwise made public.

As a key component of FCI's modeling and predictions of arsenic and other contaminant concentrations, these bench tests must be reasonable and accurate. But this apparently new bench test procedure does not appear to have been peer reviewed

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[357] Deborah Bacal, *Curis Resources says updated metallurgy shows higher copper recovery than prior modeling*, (October 11, 20012).

[358] FCI, *Curis updates metallurgical recovery test work at Florence Copper* (January 8, 2013).

[359] M3 Engineering & Technology Corporation, *NI43-101 Technical Report Pre-Feasibility Study*, § 13.2 (March 28, 2013).

[360] Daniel B. Stephens & Associates, Inc., *Geochemical Evaluation to Forecast Composition of Process Solutions for In-Situ Copper Recovery Pilot Test Facility at Florence Copper, Florence, Arizona*, at 1 through 3 (May 13, 2014) (FCI UIC Application, Attachment H, Exhibit H-1).

[361] Compare, *e.g.*, Schlumberger Water Services, *Technical Memorandum*, *Geochemical Evaluation of Forecast Process Solutions at Florence Copper Project*, Table 3.1 (January 27, 2011) (FCI March 25, 2011 UIC Application, Attachment H, Exhibit H-1) to Daniel B. Stephens & Associates, Inc., *Geochemical Evaluation to Forecast Composition of Process Solutions for In-Situ Copper Recovery Pilot Test Facility at Florence Copper, Florence, Arizona*, Table 3.1 (May 13, 2014) (FCI Final UIC Application, Attachment H, Exhibit H-1).

or evaluated by anyone not on FCI's payroll. FCI has not provided more than short summaries of the technique and the results anywhere in the record. Nor does anything in the record indicate that EPA Region 9 asked any questions about this new technique or requested bench test data used in support of FCI's application models and predictions. Absent any meaningful evaluation of this unique new testing procedure or that data that it produced, EPA Region 9 has no reasonable basis for relying on FCI's geochemical model results. EPA Region 9 has an obligation to the public to ensure that this new test method is reasonably accurate and reliable. It also has an obligation to obtain and review the data used to support FCI's models and predictions, to ensure that those calculations are supported.

2. FCI's Geochemical Model Contradicts Its Own Expert's Recent Testimony.

FCI's predictions are difficult to square with recent testimony from its own consultant. FCI's geochemical model estimates arsenic concentrations in PLS of 1.32 mg/L and just 0.0005 mg/L in post-restoration groundwater. PLS concentrations were based upon analysis of simulated PLS developed during the Metcon bench tests, with results scaled up to match target copper recovery rates. Post-restoration groundwater concentrations were based upon geochemical modeling that incorporated data from those same bench tests.[362]

But less than one year ago (and just one week before the technical memo containing these results was finalized), Dr. McNulty testified that these same bench tests resulted in arsenic concentrations of up to 32,000 μg/L in PLS, with 4 of 24 samples exceeding 1,000 μg/L per liter and the remainder below the bench test detection limit of 1 μg/L but possibly much higher than the arsenic MCL. Even more significantly, Dr. McNulty testified that bench test concentrations of arsenic were averaging 80 μg/L in simulations of post-mining groundwater after rinsing with site water and a neutralizing agent.[363]

FCI's ability to meet the arsenic MCL is also called into question by the testimony of its environmental manager, Dan Johnson. Mr. Johnson testified that the arsenic standard of 0.026 mg/L in the BHP APP "was still low," such that it could not be held to

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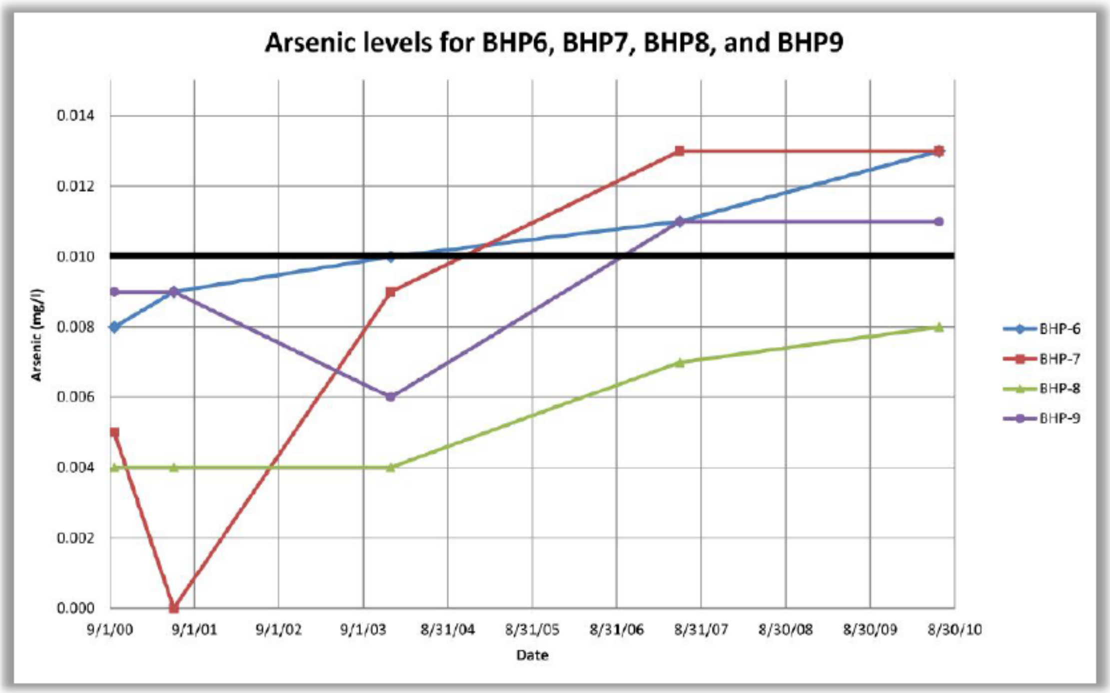
[362] Daniel B. Stephens & Associates, Inc., *Geochemical Evaluation to Forecast Composition of Process Solutions for In-Situ Copper Recovery Pilot Test Facility at Florence Copper, Florence, Arizona*, at 1 and 2 (May 13, 2014) (FCI UIC Application, Attachment H, Exhibit H-1).

[363] Testimony of Dr. Terence P. McNulty, P.E., OAH Hearing, May 6 at 7-20.

that standard at the POC wells. Instead, FCI requested and received permission to monitor arsenic concentrations at its property boundary so that "we would not have any concentration over 10 parts per billion arsenic leaving our property line."[364] As a result, FCI's APP requires an arsenic alert level of 0.026 mg/L at the POC wells, located hundreds of feet beyond the PTF well field, and an enforceable compliance standard of 0.05 mg/L.[365] FCI only has to achieve the arsenic MCL at the property boundary, based on a fate and transport model, not actual monitoring at the property line.[366] If FCI needs natural attenuation to achieve the arsenic MCL at its property line for the state permit, how can it reasonably predict a well field arsenic concentration 20 times below the MCL for the federal permit?

EPA Region 9 should require FCI to publically explain why the geochemical model submitted with FCI's application predicts arsenic concentrations significantly lower than the results testified to by Dr. McNulty and the arsenic standard sought by FCI for the state permit.

Figure K-1. Arsenic Rebound in BHP Test Wells



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364 Testimony of Dan Johnson, OAH Hearing, April 14, 2014 at 85-86.

365 APP No. P-106360, Table 4.1-7 (July 3, 2013). FCI did not propose to change these standards in its recently submitted request for an APP permit amendment.

366 *Id.* Section 2.5.7.

3. EPA Region 9 Needs to Determine Why Arsenic Levels Are Increasing in BHP Pilot Test Wells.

FCI's prediction also does not track with the experience in the BHP Pilot Test wells. In the years since the BHP Pilot Test, arsenic levels in the four BHP injection wells has increased. By August 2010, arsenic concentrations in three of these four wells exceeded the MCL.

These increases began five years or more after the pilot test ended.[367] Under the Draft Permit, a similar scenario in the PTF wells would not be detected during the post-mining monitoring period.[368] EPA can and should require a longer post-mining monitoring period to detect rebounds of arsenic and other contaminants. But EPA should go further and investigate the known rebound of arsenic in BHP Pilot Test wells. Only by understanding why this is occurring can EPA draft a truly protective permit with reasonable requirements for addressing such rebound in the likely event that it will occur again.

Dan Johnson, FCI's environmental manager, testified that the arsenic issue in the BHP wells was due to "remnants of the raffinate that came over from the BHP San Manuel operation," the imported raffinate purportedly containing higher arsenic concentrations.[369] But FCI has repeatedly claimed that restoration of the BHP Pilot Test well field was successful,[370] so concentrations of process streams during mining should not be an excuse for post-restoration exceedances of the arsenic MCL. Nor does Mr. Johnson's testimony explain why BHP initially had well field arsenic concentrations below the MCL but then experienced rebounding concentrations as time went on.

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[367] Dan Johnson, FCI's environmental manager, testified that the arsenic issue in the BHP wells was due to "remnants of the raffinate that came over from the BHP San Manuel operation," the imported raffinate purportedly containing higher arsenic concentrations. OAH Hearing, April 14, 2014 at 84-85. That does not explain why BHP initially had well field arsenic concentrations below the MCL but then experienced rebounding concentrations as time went on.

[368] Draft Permit, Part II(K) ("The duration of this Class III permit shall include the approximate two (2) year PTF operational and closure period and the five (5) year post-closure monitoring period unless terminated under the conditions set forth in Part III, Section B.1 of this permit.").

[369] OAH Hearing, April 14, 2014 at 84-85.

[370] *See*, *e.g.*, FCI UIC Application, Attachment S (NI 43-101 Tech Report), at 201-202 ("BHP began rinsing in 1998 and Merrill Mining continued the rinsing subsequent to their purchase of the project. The rinsing conducted by BHP and Merrill Mining demonstrated that, through a combination of injection and passive inflow of fresh formation water, that the sulfate and other constituent concentrations can be rinsed to levels established in the APP for closure."). Actually, the APP for the BHP site continues to require ongoing monitoring, ADEQ having refused to terminate monitoring and formally close the BHP Pilot Test well field due to ongoing groundwater quality issues.

4. Dealing with Arsenic Contamination Later Is Not Good Enough.

EPA Region 9 may take the position that any issues with arsenic can be addressed through monitoring and contingency actions and that any additional permit requirements are unnecessary. Monitoring and remediation actions to address arsenic contamination after it occurs is not enough. FCI's geochemical model makes no sense because it assumes an unrealistically low arsenic concentration after restoration. And we know that arsenic concentrations actually increased in the BHP Pilot Test wells to levels above the MCL. Obviously, there are issues with arsenic contamination due to ISR mining at this site that need to be further investigated, fully understood and fully addressed *before* mining begins.

It also is no secret that the terms and requirements in the Draft Permit likely will be copied into a later UIC permit for commercial operations, should FCI ever get to that point. The public is well aware that this permit and this pilot test are precedent for the regulatory standards and operational requirements at FCI's commercial mine. The public knows how rarely EPA revisits permit terms once a facility begins operating. FCI is, in fact, counting on the Draft Permit being used as a template for the commercial permit. Therefore, nothing less than robust and thorough permit requirements, based on a full understanding of arsenic generation and remediation in ISR mining at this site, is acceptable.

EPA Region 9 has been put on notice of potential issues with arsenic contamination at this site. Blithe assurances from the agency that arsenic will be addressed later, if it becomes a problem, are unreasonable and technically unsupportable. Furthermore, such assurances would further demonstrate a lack of due diligence and raise additional questions regarding the legitimacy of the public comment process on this permit.

Appendix L:
Sulfate

It is disappointing that neither state nor federal regulators appear concerned about the plume of sulfate that FCI will leave behind once mining is done. No one will be able to drink water contaminated with sulfate at concentrations of 750 mg/L unless it is first treated, an expensive process for which the residents of Florence—not FCI—will be forced to pay. Yet EPA Region 9 appears ready to write off the aquifer with regard to sulfate contamination, despite USEPA's recognition that sulfate contamination is a problem serious enough to warrant a secondary MCL.

Sulfate is a long-term issue for the Town. The Town and other water providers in the area must plan for water supplies 100 years into the future, per Arizona law. The plume will move slowly off of FCI's property and toward drinking water wells, but it will move. Thus, the question for the Town and its residents is not what to do if its wells are contaminated with sulfate, but what to do when that happens. But it should not be their burden to resolve this issue. They deserve more from EPA and the Draft Permit should include protections and requirements designed to keep the cost and burden of dealing with sulfate with FCI, where it belongs.

1. Sulfate Contamination is a Serious and Often Intractable Problem.

Water's smell, taste, and color are affected at 250 mg/L sulfate, one third the level allowed under the Draft Permit. Sulfate in water at levels above 250 mg/L, especially combined with high Total Dissolved Solids, also can cause gastronomic problems in sensitive populations, such as infants, transient populations, and new residents.[371] Based on these considerations, USEPA has set the Secondary Maximum Contaminant Level (SMCL) for sulfate in drinking water at 250 mg/L.[372] In at least one case, the Arizona Department of Health Services has recommended that water from wells

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[371] USEPA, *National Secondary Drinking Water Regulations, Final Rule*, 44 Fed. Reg. 42195, 42201 (July 19, 1979); *Announcement of Regulatory Determinations for Priority Contaminants on the Drinking Water Contaminant Candidate List*, 68 Fed. Reg. 42898, 42905 (July 18, 2003); *Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Sulfate*, EPA 822-R-03-007 (February 2003).

[372] USEPA, *National Secondary Drinking Water Regulations, Final Rule*, 44 Fed. Reg. 42195, 42201 (July 19, 1979).

containing concentrations of sulfate above 250 mg/L but less than 900 mg/L not be used for drinking water or preparing beverages, including infant formula.[373]

Like BHP's 1997 UIC Permit, the Draft Permit uses a sulfate concentration of 750 mg/L as an indicator that the aquifer had been restored to permit standards after PTF operations are complete.[374] This effectively allows FCI to create a plume of sulfate in the groundwater beneath this mine site that will render that water unusable for drinking water purposes. Once hydraulic control stops, that plume will begin to move downgradient. Sulfate dissipates very little as it moves through an aquifer, is persistent in groundwater for decades, is difficult and expensive to remove from drinking water sources, and can interfere with treatment for other contaminants, such as arsenic.

Given that BHP owned all of the property two to three miles downgradient from the mine and that no drinking water wells existed in the area, it may have been acceptable in 1997 to allow creation of a sulfate plume in this aquifer. But it is not acceptable today. Residential development now surrounds the mine area, drinking water wells have been installed downgradient, and more wells will be needed in the foreseeable future. Pulte Del Webb's Anthem Community directly downgradient of the Mine consists of two populations–a retirement community and a family community—that represent sensitive populations recognized by USEPA in the SMCL. Whatever value there may be in mining copper at this site, it does not justify pollution of the area's groundwater with a sulfate plume that will endanger downgradient drinking water supplies for decades to come.

Nevertheless, FCI proposed and EPA Region 9 accepted carrying over the same 750 mg/L sulfate standard into the Draft Permit. Nothing about this proposal makes sense under today's conditions in the Town of Florence. Other mine operators in Arizona, such as at the Sierrita and Bisbee copper mines, are required to provide replacement water supplies when sulfate in groundwater exceeds 250 mg/L.[375] The Town of Florence and its residents deserve no less protection. Permitting FCI to endanger drinking water supplies through the creation of a plume of sulfate is contrary to the purposes of the APP program and the Safe Drinking Water Act. Sulfate should not be a trigger for the measurement of other contaminants in the aquifer, it should be treated as a significant drinking water contaminant that must be reduced below 250 parts per million before rinsing and hydraulic control in a mine block can cease.

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[373] ADHS, *Health Consultation, Walker and Lynx Creek Area* (2001).

[374] Draft Permit, Part II(I)(1).

[375] Clear Creek Associates, *Feasibility Study for Drinking Water Supplies that May Be Affected by Sulfate in the Future, Mitigation Order on Consent Docket No. P-121*-07, prepared for Freeport-McMoran Corp., Copper Queen Branch [Bisbee], at ES-1 (May 28, 2014).

2. The Draft Permit Allows Sulfate Contamination in the LBFU.

EPA Region 9 treats sulfate like an indicator parameter, rather than a groundwater contaminant. If FCI can reduce sulfate concentrations in the PTF well field to 750 mg/L and other contaminants meet required standards, EPA will consider groundwater restoration to be successful.[376] But "successful" restoration will leave behind a plume of sulfate at three times the federal SMCL.

For purposes of demonstrating restoration, FCI will only monitor sulfate at the PTF well field manifolds, which only receive groundwater, in theory, from the Oxide Zone. But monitoring of sulfate in the Oxide Zone does not mean that sulfate will be contained in the Oxide Zone. The Oxide Zone is in direct hydraulic communication with the LBFU, which sits atop and downgradient of the Oxide Zone. Thus, after restoration, sulfate concentrations of up to 750 mg/L will flow out of the Oxide Zone and into the surrounding LBFU.

But the Draft Permit, thanks to the accompanying Aquifer Exemption, allows FCI to directly contaminate the LBFU as well. There is no prohibition on sulfate contamination of the LBFU within the exempted aquifer area, up to the as-yet-undetermined sulfate alert levels at POC and supplemental monitoring wells. So FCI will not have to address sulfate that flows into the LBFU during mining operations as long as it remains below Alert Levels. No one knows what those Alert Levels will be and there will be no opportunity for public review or comment after the ALs are determined by FCI with EPA Region 9 approval. Presumably, EPA expects the public to just trust that the ALs will be protective, despite EPA's overwhelming lack of diligence to date.

3. The Draft Permit Should Set ALs That Are Consistent with the SMCL.

The Draft Permit contains no AQL for sulfate. The public understands that the SMCL for sulfate is guidance that is not legally enforceable. Therefore, EPA Region 9 cannot establish an AQL based on the SMCL or hold FCI liable for a violation of the numerical sulfate secondary standard. But EPA can require ALs that will provide early warning of sulfate contamination at the POC and supplemental monitoring wells and require FCI to address such contamination when it occurs.

[376] Draft Permit, Part II(I)(1).

The Draft Permit should do more than just reserve ALs for sulfate that will be determined later between EPA and FCI without public scrutiny. It should expressly mandate that the sulfate ALs will be set at a reasonable concentration below either the SMCL or existing ambient concentrations at each well, whichever is lower. Consistent with FCI's proposal for setting ALs, the AL should be no higher than 80 percent of the ambient sulfate concentration if ambient conditions exceed the SMCL or 200 mg/L, whichever is lower.[377] This will help assure the public that reasonable ALs will be established, free from pressure by FCI to weaken the protections that the public deserves.

4. The Draft Permit Should Require Sulfate Monitoring for More Than Five Years.

The sulfate problem is exacerbated by the limited monitoring required in the Draft Permit. FCI only has to monitor for sulfate for a total of seven years.[378] The Draft Permit only requires FCI to "ensure that there is no migration of injection fluids, process by-products, or formation fluids beyond the exempted zone" during the 2-year life of the PTF and 5-year post-closure monitoring period.[379] Presumably, after those seven years, migration of contaminants is freely allowed without penalty or consequence to FCI.

But there will be consequences for the Town and its residents. EPA Region 9 has acknowledged that it may take much longer for the contaminant to reach drinking water wells. Apparently, though, EPA expects the Town, its water providers, and its residents to deal with sulfate on their own. The burden and cost of doing so should not be so easily transferred to the public. FCI should be required to monitor for sulfate until it can demonstrate permanent compliance with the SMCL at all properly-located compliance and monitoring points.

5. The Sulfate Requirements Do Not Prevent Adverse Health Effects, as the Draft Permit Otherwise Requires.

The Draft Permit requires FCI to ensure that contaminants without an MCL, like sulfate, "do not impact USDWs in a way that could adversely affect the health of

[377] *See* Draft Permit, Appendix K, Exhibit P-1, Alert Levels, at 4.

[378] Draft Permit, Part II(K) ("The duration of this Class III permit shall include the approximate two (2) year PTF operational and closure period and the five (5) year post-closure monitoring period unless terminated under the conditions set forth in Part III, Section B.1 of this permit.").

[379] Draft Permit, Part I(B)(2).

persons."[380] But EPA Region 9 knows full well that a plume of sulfate with concentrations up to three times the SMCL will adversely impact public health. EPA also knows full well that the plume FCI is leaving behind will travel out of the exempted aquifer and into a USDW relied upon by local residents. Therefore, while EPA pays lip service to public health impacts with this permit requirement, it ignores the very real impacts that an unaddressed plume of sulfate will have on drinking water supplies and public health.

This is just one of many contradictions and inconsistencies in the Draft Permit, but it is a glaring and serious error. Should it choose to do so, EPA Region 9 can address this mistake by incorporating the changes described above. If it ignores those essential revisions in a final permit, EPA will leave in place an internal inconsistency that cannot otherwise be reasonably reconciled. And it will sacrifice the health of local residents to FCI's profit motive and bureaucratic expediency.

[380] Draft Permit, Part II(I)(1)(b).

Appendix M
Radiochemicals

The Draft Permit should, but does not require detailed and reliable monitoring for radiochemicals during PTF operations and specifically address the issue of radiochemical contamination. FCI's mine site is known to contain high levels of radiochemicals. The ISR mining technique—commonly used at uranium mining sites across the country—will mobilize radiochemicals in groundwater. Radiochemicals also will be concentrated in mine process and waste streams, including "stacked" mining solutions that will be re-injected into the aquifer during commercial operations. The potential risks to human health and the environment of such mining in an area zoned for residential and commercial uses should be self-evident. But amazingly, FCI and its predecessors have denied that use of a uranium mining technique at this site could possibly result in radiochemical impacts to groundwater. And the Draft Permit does almost nothing to monitor for radiochemicals or to address the disposition of radiochemicals in FCI's process and waste streams.

Ideally, EPA Region 9 should deny this permit due to the serious risk posed to the Town of Florence's drinking water supply by radiochemicals released into groundwater by FCI's mining process. But at the very least, the final permit for the PTF should ensure that EPA Region 9 and the public fully understand the potential risks, the levels of contaminants generated by FCI's mining, and the options for addressing the radiochemical contamination and waste that FCI will indisputably generate.

1. FCI's ISR Mining Process Is Used Around the World to Mine Naturally Occurring Uranium.

ISR mining is used world-wide to extract uranium. It is indisputable that the injection of alkaline or acid mining solutions into ore bodies will dissolve radiochemicals from soil and rock, mobilizing those radiochemicals in groundwater aquifers. This is exactly what makes ISR mining such a popular technique for uranium mining. The use of this same technique at FCI's site—a site known to contain high levels of radiochemicals—will undeniably mobilize radiochemicals in groundwater and concentrate radiochemicals in mining process and waste streams. The only thing preventing these wastes from contaminating drinking water supplies downstream of the mine is the questionable effectiveness of FCI's hydraulic control system. Even if these systems are completely effective and experience no failures, FCI has nowhere addressed the issue of how it will deal with concentrations of radiochemicals in pregnant leach solutions, raffinates, extracted hydraulic control solutions, or evaporation pond sediments and effluent.

The history of uranium ISR mining does not support FCI's claims that the process is safe and environmentally friendly. The impacts of sulfuric acid ISR mining at European uranium mines on groundwater has been severe and long-lasting. For example, in Straz pod Ralskem, in the Czech Republic, 3.7 million tonnes of sulfuric acid was injected into the uranium ore body. Today, a contaminant plume has spread beyond the mine area to cover approximately 13 square miles and is threatening the drinking water supplies of two towns. In Bulgaria, 2.5 million tonnes of sulfuric acid has been injected at various ISR sites. Approximately ten percent of the surface area of these ISR mines is contaminated with solution spills, possibly preventing the proposed return to use for agriculture. At Haskovo, sulfate concentrations are 1,400 mg/L, free sulfuric acid is 392 mg/L, and pH is 2.2. At Navusen, sulfate concentrations are 13,362 mg/L, and with free sulfuric acid at 5 g/L, the groundwater actually constitutes mine leaching solution.[381]

Experience in Australian uranium ISR mines also should raise concerns about radiochemical impacts at this site. The Beverley and Honeymoon uranium ISR mines use acidic in-situ solution like FCI, instead of the alkaline solutions often used by their U.S. counterparts.[382] Apparently, acidic in-situ solution is preferable for mining because "[f]rom a process perspective, acid leaching has the advantage of achieving a higher extraction of uranium in a shorter period …"[383] Thus, the acid solution that FCI proposes for copper mining is the preferred solution for uranium mining because it acts quickly to mobilize radiochemicals in groundwater.

There are other significant downsides to acid ISR mining, as confirmed by the Australian mines. Groundwater restoration following acid leaching is generally considered to be more difficult to achieve than after alkaline leaching.[384] "Restoration to baseline levels requires an extended treatment period."[385] According to the Australian study, such restoration has only been demonstrated at one pilot site.[386]

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[381] Available at http://www.wise-uranium.org/uISR.html (visited 3-31-15).

[382] *See generally* CSIRO Land and Water, Review of Environmental Impacts of the Acid In-situ Leach Uranium Mining Process (August 2004).

[383] Id. at 9.

[384] Id. at 11.

[385] Id. at 6.

[386] Id. at 9.

Disposal of extracted radiochemical laden materials is also an issue. The two Australian mines use re-injection to dispose of unneeded extracted materials. When Australian officials examined potential alternatives to re-injection, they discussed holding the uranium-laden liquid in surface impoundments and the risks of public and worker radiation exposures. Their discussion is enlightening, especially because FCI has not addressed how it plans to deal with radiochemical materials. According to the study:

> Not re-injecting the waste into the aquifer would require either sophisticated water treatment and/or the installation of much larger evaporation ponds. Both would generate solid wastes to be disposed of in a solid waste repository. When the wastes dried out they would become a possible dust source, which could increase the potential radiation exposure of workers, in particular in relation to dust inhalation, but also from radon inhalation and gamma exposure. Environmental radiation levels at the surface would also increase.[387]

Because FCI plans to use surface impoundments inside a municipality and close to residential areas, it is imperative that the risks of potential worker and public exposure to dust inhalation, radon inhalation and gamma exposure are considered. To date, this issue has been completely ignored by EPA Region 9.

Results at U.S. uranium ISR mines, which use an alkaline rather than acid solution, also demonstrate impacts to groundwater. A detailed discussion of data from these mines is provided in Appendix N.

2. Traditional Copper Mining Is Known to Mobilize Radiochemicals in Groundwater and Concentrate Radiochemicals in Process and Waste Streams.

In Arizona, radiochemicals—primarily uranium and thorium—often are found in or near porphyry copper deposits. USEPA has found that "dump leaching operations and solvent extraction-electrowinning procedures, as well as the practice of recycling raffinate at copper mines, may extract and concentrate soluble radioactive materials," with radiochemical concentration increases of up to two orders of

[387] Id. at 46.

magnitude over background levels.[388] This concentration of radiochemicals in mining process and waste streams is known as TENORM—Technologically Enhanced Naturally Occurring Radioactive Materials.

Uranium is so common in porphyry copper deposits in Arizona that it can be economically feasible to conduct uranium mining alongside copper mining. At least two copper mines in Arizona—the Copper Queen mine in Bisbee and Twin Buttes mine in Sauharita—have operated commercial uranium recovery facilities in conjunction with copper mining. At Twin Buttes, a uranium recovery unit operated from approximately 1980 to 1986, extracting uranium from pregnant leach solutions before the solutions were sent to the solvent extraction plant for copper recovery. In 1997, Cyprus Sierrita Corporation submitted groundwater monitoring data to ADEQ in support of a permit application. That data indicated that gross alpha and gross beta concentrations in groundwater downgradient of the mine processing areas were three to four times higher than background concentrations. Total uranium concentrations were five to thirteen times higher than background.[389]

But even where uranium processing is not commercially feasible, the concentration and mobilization of radiochemicals by copper extraction and beneficiation has the potential to contaminate groundwater, surface water, and soils. USEPA's study of copper mining in Arizona clearly demonstrates that copper mines across the State have contaminated groundwater and surface water with radiochemicals at levels far in excess of background concentrations and often exceeding federal and state drinking water standards:

- At Cyprus Bagdad mine, 64 miles west of Prescott, concentrations of radiochemicals in excess of federal and state standards were found in groundwater and surface water during testing in the early 1990s. As FCI and its predecessors have done, Cyprus Bagdad denied that its mining was to blame for high concentrations of radiochemicals in groundwater, arguing that high background concentrations and the existence of a clay layer beneath channel sediments was the source of the readings. USEPA believed that further investigation was needed to resolve the issue.[390]

- At New Cornelia Mine in Ajo, Freeport McMoran found high concentrations of radiochemicals in monitoring wells sampled in 1997. Nine wells contained

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[388] USEPA, *Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona*, at iii (October 1999).

[389] *Id*. at 26-28.

[390] *Id*. at 33-35.

uranium, radon and other radiochemicals at levels exceeding federal and state standards. Freeport blamed the readings on inaccurate data.[391]

- At BHP's Pinto Valley Mine, which has been the subject of a major remediation effort, high radiochemical levels were found in 1996 data from compliance monitoring wells. All eight of the open pit dewatering wells exceeded one or more radiochemical standards. USEPA concluded that "the data confirm that TENORM is present in the ore at the Pinto Valley mine and that it has leached, in concentrations above federal standards and state guidelines, into the groundwater."[392]

- At Freeport McMoran's Copper Queen mine in Bisbee, a plume of contaminated groundwater extends from the mine tailings area over seven square miles. The plume already has contaminated private wells and threatens production wells in Naco and Bisbee. Freeport McMoran was forced to begin supplying bottled water to some local residents years ago. In 1991 sampling, three of four groundwater samples contained radiochemicals at concentrations exceeding federal and state standards. Subsequent sampling confirmed radiochemical concentrations in violation of water quality standards. Wells within the plume that were screened within the Basin Fill deposits south of the tailings impoundments contained U-238 at concentrations up to 80 times higher than background, U-234 at concentrations up to 30 times higher than background, and alpha concentrations up to 20 times higher than background.[393]

- At Freeport McMoran's Morenci mine, 1995 sampling indicated that gross alpha or gross beta concentrations exceeded drinking water standards in fourteen monitoring wells. Sampling of process and waste streams at the mine indicated that 42 different samples contained radiochemicals at levels exceeding federal or state standards. Gross alpha and gross beta concentrations were sometimes hundreds of times higher than applicable standards, clearly indicating that mining activity was concentrating radiochemicals in process and waste streams, including the raffinate being recycled into the leach circuit.[394]

This brief summary of just a few of Arizona's copper mines clearly indicates that copper mining can and often does concentrate radiochemicals in groundwater and

[391] *Id*. at 43.
[392] *Id*. at 46.
[393] *Id*. at 47-50.
[394] *Id*. at 59-64.

surface water. In many cases across the state, concentrations of radiochemicals are high enough to render water supplies unsuitable for drinking without treatment. But radiochemicals in mining wastes and processes have the potential to impact human health through pathways other than drinking contaminated water. To our knowledge, no studies have been conducted to measure the effect of TENORM on human health and the environment through soil contamination, vapor intrusion or similar migration into residential areas, air contamination from evaporation ponds and wastewater impoundments, air-borne contaminants in dust from tailings and waste piles, and other means.

3. There Has Been Interest in Uranium Mining at this Site Previously.

Consistent with copper mines across the State, radiochemicals are readily found in geologic formations beneath FCI's property. A 2004 report, authored by FCI's current consultants, confirmed that site tests "indicate that leachate from the quartz monzonite and granodiorite is highly enriched in uranium and radium-226, and correspondingly, both display high counts of gross alpha." FCI's consultants concluded that "[i]t is therefore expected that the concentrations of gross alpha would be high and variable in the test wells."[395]

Concentrations of radiochemicals at this site are significant enough that they may have prompted interest in uranium exploration and mining. According to an ADEQ comment during BHP's previous APP process, a records review revealed a Conoco interoffice communication showing "a company named UOCO had approached Conoco about the possibility of leasing the Florence facilities to conduct small-scale uranium vat leaching operations." Also according to ADEQ, the review revealed that "a 5-gallon container marked 'uranium leach liquor' was found in the metallurgical laboratory during the facility inspection." Because of this history, ADEQ told BHP that it needed to provide a detailed closure plan, including complete characterization of sediments and soils, for the site's evaporation ponds.[396] Regardless of whether uranium

[395] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field (April 21, 2004) at 5-4.

[396] BHP Letter to ADEQ (October 9, 1996), Tab 1, Response to ADEQ Comments issued September 30, 1996 at 7. BHP assured ADEQ that they could find no records indicating that Conoco ever used or permitted anyone to use the site for radiochemical testing and explained that upon discovery, the referenced container was empty. *Id.* Given mine owners' constant downplaying of the serious radiochemical issue at this site, BHP's response is not surprising.

mining was ever tested or conducted at the site, this correspondence indicates that there is enough uranium present in soils at the site to generate interest in such mining.

4. BHP Tests Demonstrated the Radiochemicals at this Site Will Leach Into Groundwater During ISR Mining.

USEPA has described BHP testing that demonstrated that ISR mining at this site will leach radiochemicals into groundwater:

> In January of 1996, BHP (Magma) conducted a column leach test to characterize the leachability of the mineralized zone and determine the chemical composition of the resultant PLS. Samples of ore-bearing quartz monzonite and granodiorite were leached for 58 days with 10 liters of sulfuric acid and maintained in a closed system at a pH of 1.5 to 1.7. The PLS was analyzed for common ions, metals and radiochemicals. The TDS and sulfate concentration at the end of the test was 26000 to 37000 mg/L for the quartz monzonite and 18000 to 23000 mg/L for the granodiorite. The gross alpha and beta activities for the quartz monzonite were 8649 and 3683 pCi/L, respectively. Similarly, the gross alpha and beta activities for the granodiorite were 897 and 612 pCi/L, respectively. The Ra-226 concentration of both samples was 33.6 pCi/L for the quartz monzonite and 19.5 pCi/L for the granodiorite. The total uranium, U-234, U-235, U-238 for the quartz monzonite were 4362, 1745, 598, and 1611 pCi/L and for the granodiorite 0.835, 254, 11.6, and 248 pCi/L, respectively (Table 18).[397]

These radiochemical concentrations are up to *five hundred times higher* than drinking water standards. ADEQ also has acknowledged that the possibility of concentrating radiochemicals in the ISR process existed, as confirmed by this test.[398]

Of course, these concentrations do not reflect the impact of proposed groundwater reclamation efforts on radiochemical concentrations after mining is complete. But BHP simulated that effort as well:

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[397] USEPA, *Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona*, at 31 (October 1999).

[398] ADEQ Letter to John Kline, Magma Copper Co., at 15 (December 11, 1996).

> Subsequently, the raffinate from the PLS was recirculated into the leach system for another 19 days. Then the samples were drained and washed with groundwater for another 14 days in an open system. At the end of the wash test, the solution was tested for radiochemicals.[399]

Thus, although the BHP column leach tests showed that radiochemical concentrations could be reduced through rinsing, BHP could not return gross alpha, radium or radon concentrations to background levels. Furthermore, BHP's column leach test appears to have simulated a groundwater rinsing program that was much more extensive than the one proposed by FCI. Finally, nothing in BHP's tests addressed the risks associated with radiochemicals washed out of the aquifer during restoration and deposited in surface retention impoundments.

In September and October 2000 and again in June and July 2001, two to three years after BHP completed its pilot test, Brown and Caldwell sampled groundwater from the pilot test mine block wells. No radiochemical analysis was conducted of the groundwater samples in 2000, but radiochemical concentrations were obtained for samples from 20 wells in 2001. Adjusted gross alpha exceeded water quality standards in 7 of the 20 wells and total radium exceeded standards in 6 of the wells.[400]

As characterized by Radiation Safety Engineering, Inc., the laboratory that analyzed the groundwater samples, water from the pilot test wells showed "significant concentrations" of Ra226 and Ra228 and elevated levels of Ra224. The laboratory concluded that:

> Because of the short half-life of Ra224 (3.6 days), this isotope is rarely identified in the lab, but may appear in drinking water delivered to homeowners if the transit time from the well to the home is short… If any of these sources with observable Ra228 concentration are to be used for drinking water sources, we recommend that they be tested for RA-224 before being put into service.[401]

This warning, from a laboratory specializing in radiochemical analysis, indicates the significance and seriousness of the radiochemical risks at this site.

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[399] Id.

[400] Brown and Caldwell, *Post-Pilot Test Water Quality Screening Report* (September 5, 2001) (SWVP-029183); FCI., Temporary Individual Aquifer Protection Permit Application, Attachment 10, Exhibit 10A (Groundwater Quality Data), Table 10A-6 (Test Field Radiochemical Results) (March 1, 2012).

[401] Radiation Safety Engineering, Inc., Letter to Brown and Caldwell (June 29, 2001).

5. Radiochemicals Have Consistently Exceeded Standards at This Site Since the BHP Pilot Test.

Groundwater sampling conducted since the BHP pilot test reveals high concentrations of radiochemicals in groundwater at the FCI site. This should not be unexpected, given that an ISR technique used at uranium mines across the country is being employed at this site. But instead of recognizing and addressing the problem, FCI and its predecessors have bent over backwards to deny any liability for the contamination. When viewed as a whole, the groundwater data reveals that their denials lack merit and that there is a significant radiochemical issue that EPA Region 9 must address.

In April 2004, nearly *six years* after the BHP pilot test, Merrill Mining asked ADEQ and EPA Region 9 for permission to stop pumping the hydraulic control wells surrounding the pilot project area. That request included a report that noted radiochemical exceedances for December 2003 monitoring well samples – four AWQS exceedances for adjusted alpha and seven exceedances for total radium.[402] These exceedances were as follows:

- BHP-2, a recovery well within the BHP pilot test area, had an adjusted gross alpha activity concentration of 28.0 pCi/L in December 2003, following a June 2001 concentration of 57.0 pCi/L. Both of these concentrations are more than twice the AQWS (15.0 pCi/L). This same well also had total radium concentrations of 10.5 pCI/L in June 2001 and 8.5 pCi/L in December 2003, both in excess of the AWQS (5.0 pCi/L).403 Since 2004, well BHP-2 has continued to demonstrate high radium levels in excess of state standards, with a concentration of 8.9 pCi/L in 2007 and 5.8 in 2010 pCi/L.[404]

[402] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field (April 21, 2004) at 3-3; see also Radiation Safety Engineering Inc., Radiochemical Activity in Water Sampling Results (samples received Dec. 29, 2003 and analysis completed Jan. 13, 2004); Merrill Mining Site Investigation Plan for the Closure of the Florence Copper In-situ Mine Project (Jan. 10, 2007), Appendix A, Summary of Analytical Data for Mine Block Test Wells.

[403] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[404] FCI, Temporary Individual Aquifer Protection Permit Application, Attachment 10, Exhibit 10A (Groundwater Quality Data), Table 10A-6 (Test Field Radiochemical Results) (March 1, 2012).

- In December 2003, CH1-B, a geochemistry cluster well screened at 500 feet bls in the BHP pilot test area,405 had an adjusted gross alpha activity concentration of 33.6 pCi/L, more than twice the AWQS, and total radium of 23.8 pCi/L, nearly five times the AWQS.406 The data also indicates that the uranium concentration in CH1-B (68.4 pCi/L) were more than twice the federal drinking water standard (30 pCi/L).[407]

- CH1-R, part of the same geochemistry cluster well screened at 750 feet bls, contained total radium at a concentration of 5.5 pCi/L in December 2003, in excess of the AWQS. Although the adjusted gross alpha activity concentration in CH1-R was below the AWQS, that is only because adjusted gross alpha does not count the uranium concentration, which was more than four times the federal drinking water standard.[408] [SWGW: Is this a valid point?]

- CH2-R, another geochemistry cluster well screened at 750 feet bls in the BHP pilot test area, had an adjusted gross alpha activity concentration of 20.0 pCi/L in December 2003 and total radium of 10.2 pCi/L. Furthermore, the uranium concentration was three times the federal drinking water standard.[409]

- OWB-4, an observation well inside the BHP pilot test area, had an adjusted gross alpha activity concentration of 22.7 pCi/L and total radium of 5.9 pCi/L in December 2003. This followed concentrations of 34.0 pCi/L and 6.9 pCi/L for gross alpha and total radium respectively.[410] OMB-4 has continued to demonstrate total radium levels higher than the AWQS, with concentrations of 6.6 pCi/L in 2007 and 7.0 pCi/L in 2010.[411]

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[405] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, at 2-1 (April 21, 2004).

[406] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[407] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[408] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[409] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[410] Brown and Caldwell, Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, Table 6 (Test Field Radiochemical Results) (April 21, 2004).

[411] FCI, Temporary Individual Aquifer Protection Permit Application, Attachment 10, Exhibit 10A (Groundwater Quality Data), Table 10A-6 (Test Field Radiochemical Results) (March 1, 2012).

Despite the fact that all of these wells are located at the heart of the BHP pilot test area, Merrill Mining dismissed these results as unrelated to acid leach mining. Merrill claimed that the two cluster wells, CH-1 and CH-2, could not be completely purged, such that the results "may not represent accurate concentrations in the test field."[412] We now know that at least one of these wells has continued to display radiochemical concentrations in excess of applicable standards, indicating that the results cannot be explained away so easily.[413]

Merrill also claimed that the results were indicative of background values, because pH and sulfate levels indicated no impact from ISR mining. Amazingly, no background sampling was conducted when these wells were installed, so there were no baseline of natural conditions for comparison and their conclusions appear to be supposition rather than documented fact.[414] Furthermore, this conclusion is contradicted by background data collected from 20 wells around the mine site in 1995, before ISR operations of any kind began. This data, which includes up to seven rounds of sampling per well during the summer and fall of 1995, indicates that background levels of radiochemicals in groundwater across the 20 wells was well below applicable federal and state levels.[415]

ADEQ's analysis of the 2004 Brown and Caldwell report noted that radionuclides were analyzed for all wells in June 2001 and December 2003 and revealed "numerous exceedances of gross alpha particle activity and total radium above AWQS at various wells."[416] USEPA questioned the radiochemical results in a 2005 email discussing the fact that radiochemical levels in three wells were above the federal maximum contaminant level for uranium and that levels had "actually increased significantly from 2001 to 2003." USEPA indicated that their review revealed nothing "that would explain that this increase is natural." USEPA also questioned why numerous wells were not sampled for uranium in 2003 and whether it would be useful to sample the pilot project observation wells and recovery wells for uranium.[417]

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[412] Brown and Caldwell Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field, at 3-3 (April 21, 2004).

[413] FCI, Temporary Individual Aquifer Protection Permit Application, Attachment 10, Exhibit 10A (Groundwater Quality Data), Table 10A-6 (Test Field Radiochemical Results) (March 1, 2012).

[414] Brown and Caldwell Proposed Cessation of Hydraulic Control at the Florence Project In-Situ Test Field (April 21, 2004) at 3-4 and 5-10.

[415] Magma Copper Company, Site Characterization Report, Table 4.5-4 (Summary of Analytical Results-Radiochemicals) (January 1996).

[416] ADEQ, Letter to Vanguard (August 16, 2004), attached ADEQ Inter-Office Memorandum.

[417] Douglas Liden, Email message regarding Merrill Mining to Barry Rechtorovich, ADEQ (April 6, 2005).

Apparently, Merrill Mining was required to take additional samples because a June 2005 letter report from Brown and Caldwell included radiochemical analysis for samples taken in May from CH1-R, CH1-B, CH2-R, and CH2-B. Adjusted gross alpha and total radium concentrations were below applicable standards for all four wells. Brown and Caldwell concluded that the data confirmed their earlier assessment that "the previously recorded high values were not representative of the water quality at the well's location but were the result of inadequate purging of the permanently mounted down-hole sampling devices." Again, this conclusion—based on a single sample at each well—appears to be undermined by subsequent data for CH1-R that shows total radium and uranium levels in excess of federal and state standards after the 2005 samples were taken. It is unclear why Merrill Mining was not required to resample wells BHP-2 or OWB-4, both of which have continued to demonstrate radiochemical exceedances through 2010.[418] Nevertheless, EPA Region 9 approved closure of the pilot project wells in July 2005.

Additional groundwater exceedances were experienced as recently as December 2011 and January 2012, requiring notification and explanation to both EPA Region 9 and ADEQ. FCI's recent water quality monitoring data from P49-0, a monitoring well perforated in the oxide bedrock zone into which BHP injected acidic solution, demonstrates significant exceedances of alert levels for sulfate, magnesium, and total dissolved solids. Exceedances of the magnitude reported by FCI in wells expressly designated to monitor groundwater conditions resulting from the previous pilot test create doubt as to the effectiveness of BHP's hydraulic control efforts and subsequent restoration efforts.[419]

6. FCI Completely Ignores Radiochemical Concentrations in Process Streams, Waste Streams, and the Impoundment Pond.

[418] FCI, Temporary Individual Aquifer Protection Permit Application, Attachment 10, Exhibit 10A (Groundwater Quality Data), Table 10A-6 (Test Field Radiochemical Results) (March 1, 2012).

[419] FCI, Letter to ADEQ re 5-Day Notification of Alert Level Exceedance for Sulfate (September 30, 2011); FCI, Letter to ADEQ re 5-Day Notification and 3-Day Report of Alert Level Exceedance for Sulfate (January 23, 2012); Jennings, Haug & Cunningham, Letter to ADEQ re January Exceedance Notice (February 16, 2012); Haley & Aldrich, Review of Southwest Groundwater Consultants Technical Memorandum Regarding the December AL Exceedance Observed at POC Well P49-O (March 27, 2012).

Nowhere in its application materials has FCI discussed how it will handle process and waste streams containing elevated levels of radiochemicals. Mobilized uranium, radium and other radiochemicals will be present groundwater extracted from FCI's recovery wells. For example, at ASARCO's Santa Cruz ISR copper project near Casa Grande, Arizona, raffinate and PLS were analyzed for radiochemicals after a pilot ISR test. Gross alpha was 340 times background in the raffinate and over 220 background in the PLS. Total uranium was nearly 500 times background in raffinate and over 300 times background in the PLS. Radium concentrations were similarly well above background.[420] Even allowing in differences in geology and processes, this is clear evidence from an Arizona copper ISR pilot project that radiochemicals will be concentrated in FCI's process and waste streams.

FCI has not indicated whether it will attempt to extract radiochemicals from leach solutions, using an ion exchange column or other means, or if it will simply deposit the radiochemicals in the impoundment pond with the other mining wastes. If radiochemicals are to be extracted, FCI should address how the extracted radioactive materials will be handled, stored, and disposed. If not, FCI should explain the impacts of recirculating and concentrating radiochemicals in the leach solutions. FCI also should explain the risks and impacts of radiochemicals in the impoundment pond wastewater and sediments, as well as how FCI will handle potentially radioactive pond sediments upon termination of mining activities. As the Australian study of uranium ISR mining reported, drying pond sediments and other dry mining waste can become an airborne hazard to workers and residents "in relation to dust inhalation, but also from radon inhalation and gamma exposure."[421]

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[420] USEPA, *Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona*, at 31-32 (October 1999).

[421] CSIRO Land and Water, Review of Environmental Impacts of the Acid In-situ Leach Uranium Mining Process, at 46 (August 2004).

Appendix N
Groundwater Issues At Other In-Situ Mine Operations

In 2009, the United States Geological Survey (USGS) examined groundwater data from 27 ISR uranium mines in Texas, comprised of 77 individual well fields.[422] The purpose of the study was to determine whether groundwater had ever been returned to baseline, pre-mining conditions at any of the 77 well fields. Texas uranium mines use alkaline solutions, which are generally easier to clean up than the acid solutions proposed for use at the Florence site by FCI.

In Texas, 26 chemical constituents are measured before mining to establish baseline conditions in groundwater. Average baseline conditions in the production areas become the goal for remediation and restoration of groundwater after mining ends. The 26 chemicals for which goals are established include:

- 10 chemicals for which USEPA has established Maximum Contaminant Levels (MCL) under the Clean Water Act.
- 5 chemicals for which USEPA has established secondary or recommended standards that are not legally enforceable but that may negatively affect the aesthetic quality of groundwater or have health impacts in sensitive populations.
- 11 chemicals for which there are no established MCL or secondary standards.

Final sample results were available for only 22 of 77 well fields at 13 of the 27 mines studied. Based on those results for the 26 chemicals analyzed, which are summarized in Figure E1, *the USGS concluded that mine operators failed to return post-mining groundwater to baseline conditions at any of the 22 well fields*. More than half of the well fields could not restore groundwater to baseline conditions for selenium and uranium. Sulfate concentrations could not be restored to pre-mining levels in 86% of the well sites. Three-quarters of the well fields could not return groundwater to pre-

[422] United States Geological Survey, *Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain*, Open-File Report 2009-1143 (May 11, 2009).

mining conditions with respect to calcium, magnesium, ammonia, alkalinity, and conductivity. Fluoride, salts and other dissolved solids, sodium, and molybdenum remained above pre-mining levels at a third of the well fields.

Figure N-1, Groundwater Chemistry Data, USGS Report

Table 7: Groundwater Chemistry of Texas In-situ Uranium Production Authorization Areas

(22 PAAs where final analyses are available)

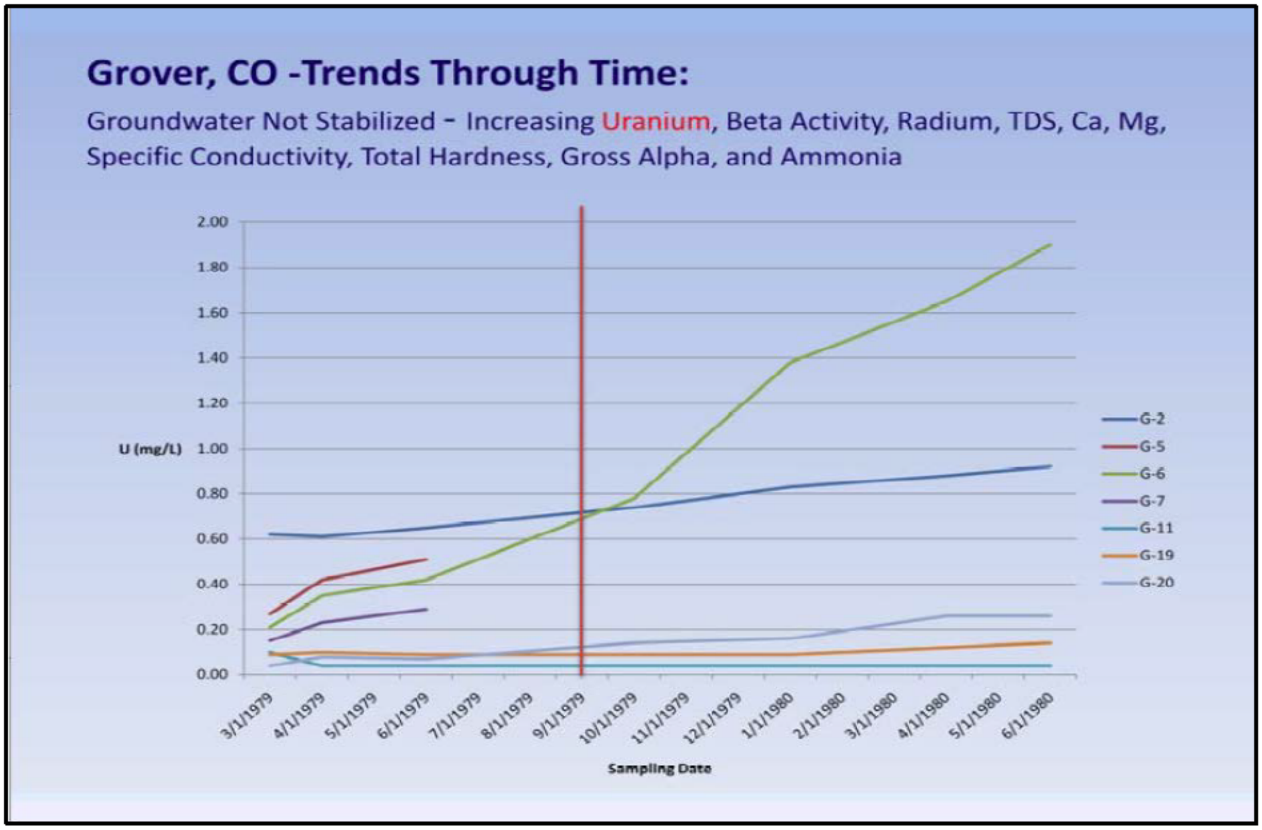
Analyte	USEPA and TCEQ Drinking Water Standards (mg/l)	Baseline Range	Post-Restoration Range	PAAs with Baseline Above MCL or Recommended Standards	PAAs with Post-Restoration Water Above MCL or Recommended Standards	PAAs Where Post-Restoration Analyses Exceed Baseline	PAAs Where Post-Restoration Analyses are Below Baseline
USEPA and TCEQ Primary Maximum Contaminant Levels (MCLs):							
Arsenic	0.01	.004 - 0.23	.002 - .323	77%	55%	18%	82%
Cadmium	0.005	0.0001 - 0.0126	0.0001 - 0.01	45%	23%	27%	73%
Fluoride	4	0.21 - 1.8	0.29 - 1.6	0%	0%	31%	69%
Lead	0.02	0.003 - 1.97	0.001 - 0.05	81%	18%	9%	91%
Mercury	0.002	0.0001 - 0.445	0.0001 - 0.01	9%	0%	22%	64%
Nitrate	10	0.031 - 10.0	0.001 - 2.8	0%	0%	4%	96%
Selenium	0.05	0.001 - 0.049	0.001 - 0.102	18%	4%	54%	45%
Radium (226 & 228 Ra: Pci/l)	5 pci/l	9.36 - 429.8	5.2 - 149	100%	100%	4%	96%
Uranium	0.03	0.025 - 2.0	0.013 - 3.02	95%	86%	68%	32%
TCEQ Secondary Recommended Standards:							
Sulfate	300	15.8 - 250	78 - 3881	0%	18%	86%	14%
Chloride	300	196.9 - 3505	138 - 3326	86%	86%	22%	78%
Total Dissolved Solids	1000	785.7 - 6349	706.3 - 6155	81%	77%	31%	55%
Iron	0.3	0.04 - 5.49	0.01 - 2.7	54%	9%	4%	96%
Manganese	0.05	0.01 - 0.41	0.01 - 0.84	77%	50%	40%	60%
No Established MCL or Secondary Standards							
Calcium	-	4.13 - 241	14.7 - 191			77%	23%
Magnesium	-	0.477 - 125	2.27 - 53			72%	28%
Sodium	-	200 - 2356	169 - 2247			31%	65%
Potassium	-	6.38 - 101	6.1 - 70			14%	86%
Carbonate	-	0.1 - 17.9	0 - 14.6			50%	30%
Bicarbonate	-	160 - 500	160 - 500			66%	25%
Silica	-	16.3 - 76	13.4 - 77.6			19%	81%
Conductivity (umhos/cm)	-	1310 - 11160	1429 - 3697			76%	24%
Alkalinity (as CaCO3)	-	134 - 349	145 - 408			81%	10%
Molybdenum	-	0.01 - 0.2	0.0001 - 3.38			42%	54%
Ammonia-N	-	0.01 - 7.49	0.04 - 120			76%	24%

Baseline and post-restoration data was available for all 22 PAAs with the exception of: Ra, Mo, K, Si, Bicarbonate, Ammonia (21); Conductivity (14); Alkalinity (11) & Carbonate (10)

Due to the inability of mine operators to meet baseline standards, the USGS noted that state regulators had to amend the groundwater restoration goals for at least one chemical for every ISR uranium well field in Texas. The original restoration goals required in the mines' operating permits, goals the mine operators probably assured the public they could meet, had to be relaxed because restoration to those standards proved impossible or infeasible.

Moreover, once restoration activities stopped, groundwater conditions could actually worsen rather than remain stable. Generally for the period at issue, operators of the Texas well fields were required to monitor for only six months after mining ceased and "restoration" of the well fields was completed. Looking outside of Texas, the USGS noted that chemical concentrations in groundwater beneath ISR uranium well fields in Wyoming, Colorado and New Mexico began to increase over time after restoration was complete. For instance, at a Grover, Colorado pilot test site uranium and other radioactive constituents, calcium, magnesium, ammonia, total dissolved solids, and other chemicals began increasing—sometimes dramatically—more than six months after mining activities ceased. Regulators and industry experts appear uncertain why this occurs, but it indicates that the effects of ISR mining can not only linger, but actually worsen after restoration activities have stopped.

Figure N-2: Post-Reclamation Uranium Levels in Groundwater at Grover, Colorado ISR Uranium Mine, USGS Report



Mine operators routinely address their inability to restore groundwater by simply asking for revised standards in their operating permits. For instance, restoration goals for uranium were increased by 1,060% at the Hobson mine, 4,155% at Longoria, 290% at O'Hern, 900% at Pawlik, and 29,900% at the Zamzow mine. Arsenic goals at two of these mines were increased by 181% and 1,438%. Sulfate goals were amended at each of these mines through an increase of 62% to 1,685%.[423] Although the uranium industry touts its success with restoring groundwater after ISR mining, "successful restoration" is obviously a relative term.

1. Summary of Operational History at Crow Butte Uranium In-Situ Mine

Crow Butte Mine is located 5 miles southeast of the City of Crawford, Nebraska. Dawes County's predominant land use is livestock grazing and feed production. Dawes County had a land mass of 1,297 square miles and a population of just over 9,000 in 1998 (6.5 people per square mile). The project site is approximately 2,560 acres.

In September 1984, the Nuclear Regulatory Commission issued an Environmental Assessment for a Research & Development scale operation of an ISR uranium mine at the site. The mine operator projected that it would have to pump and treat 6.27 pore volumes (26.3 million gallons) to completely rinse and restore the aquifer.[424] The NRC stated that the aquifer underlying the project site had been designated for drinking water use by the State of Nebraska and that, if groundwater could not be restored to baseline quality after mining for every contaminant or parameter, at a minimum the drinking water use category would have to be met.[425]

R&D operations began in July 1986. After R&D operations, the NRC approved restoration of the R&D well field in April 1988, but were able to do so only through a finding that groundwater was returned to conditions consistent with pre-mining uses, rather than the original permit standard of a return to groundwater quality consistent with baseline conditions.[426] The mine operator had to pump and treat 19 pore volumes of groundwater to obtain restoration, over 3 times the original estimate.[427]

In October 1987, the mine operator applied for a license to allow commercial scale operations. The license application states "The long term impacts on the groundwater quality should be minimal since restoration of the wellfield will be

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[423] Southwest Groundwater Consulting, LLC, *Report on Findings Related to the Restoration of Groundwater at In-Situ Uranium Mines in South Texas* (September 29, 2008).

[424] NRC, *Environmental Assessment*, at 55 (September 28, 1984).

[425] *Id.*

[426] NRC, *Crow Butte Environmental Assessment*, at 43 (December 12, 1989).

[427] *Id.*

accomplished during operations."[428] In December 1989, the NRC issued an Environmental Assessment and a license for commercial operations. The license stated the "primary goal of restoration shall be to return the groundwater quality, on a mine unit average, to baseline conditions."[429] However, because R&D operations had shown that baseline conditions could not always be met, a secondary goal of "quality consistent with premining use" also was discussed in the EA.[430] The EA projected that it would require only 24 months for remediation of groundwater within individual mining blocks, and 36 months to decommission the site after all mining was completed.[431] This is consistent with NRC regulations, which require groundwater restoration within 24 months, unless otherwise extended by the agency.

Since Crow Butte's license was issued in December 1989, mining operations and groundwater restoration have been completed only at Mine Unit 1. Commercial operation of Mine Unit 1 began in April 1991.[432] Operations ended and Mine Unit 1 was placed into restoration phase in March 1994. Despite the 24-month restoration requirement, groundwater restoration still was not complete four years later, but the mine operator projected that treatment would be completed by April 1998.[433] That deadline was not met either.

Between May 1994 and August 1999, more than 626 million gallons of groundwater from Mine Unit 1 were processed and treated at a cost of over $365,000.[434] Despite this effort, however, nine contaminant parameters still exceeded baseline, pre-mining conditions (arsenic, radium-226, vanadium, calcium, potassium, magnesium, uranium, alkalinity, and bicarbonate).[435] The mine operator requested approval of groundwater restoration at Mine Unit 1 based on a secondary goal of restoration of groundwater to conditions suitable for pre-mining uses—livestock grazing and other agricultural uses.

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[428] Crow Butte License Application, at 7.2(1) (October 10, 1987).

[429] *See* Crow Butte License Amendment 4, at ¶ 10.3(C) (February 28, 2008).

[430] NRC, *Crow Butte Environmental Assessment*, at 41.

[431] NRC, *Crow Butte Environmental Assessment*, Table 3.3.01.

[432] Crow Butte Mine Unit 1 Restoration Report, at 12 (January 10, 2000).

[433] NRC, *Environmental Assessment for Renewal of Source Material License*, at 44 (February 1998).

[434] Crow Butte Resources, *Letter re Response to Request for Additional Information*, at 3 and 13 (August 24, 2001).

[435] Crow Butte Mine Unit 1 Restoration Report, at 35.

In November 1999, the Nebraska Department of Environmental Quality accepted groundwater restoration of Mine Unit 1.[436] In January 2000, the mine operator requested that the NRC approve completion of Mine Unit 1 restoration. At the request of the NRC, the mine operator submitted additional information in support of restoration closure for Mine Unit 1 in August 2001. In March 2002, the NRC denied approval of Mine Unit 1 restoration and ordered the mine operator to immediately restart stabilization groundwater monitoring because sample data "do not demonstrate that the restoration activities in Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment." The accompanying staff report stated that "Staff's analysis indicates that concentrations of ammonium, iron, radium-226, selenium, total dissolved solids, and uranium show strongly increasing concentration trends over the stability monitoring period."[437] The mine operator was eventually able to demonstrate groundwater stabilization and groundwater restoration was approved in March 2003—nine years after restoration began.[438]

Subsequent experience has confirmed the mine operator's inability to restore groundwater at Crow Butte. In January 1996, Mine Unit 2 was placed into restoration. The mine operator failed to restore groundwater to baseline conditions within two years, as originally promised, but in 1998 the mine operator estimated the groundwater restoration would continue for only another two years. That deadline was missed as well. In February 2004, with restoration still incomplete, the mine operator submitted revisions to the Groundwater Restoration Plan for Mine Unit 2.[439] Five years later, with restoration having continued for eleven of the previous thirteen years, the mine operator requested an alternative decommissioning schedule under which restoration is projected to be complete by July 1, 2012—over 16 years after restoration began.[440]

Groundwater restoration at other mine units at Crow Butte have been similarly prolonged:[441]

	Restoration Began	Periods of Inactivity	Projected Completion

[436] Crow Butte Resources, *Letter Response to Request for Additional Information*, at 2.

[437] NRC, *Letter re Denial, Wellfield Unit 1 Ground-Water Restoration Approval* (March 29, 2002).

[438] NRC, *Letter re License Amendment 15* (February 12, 2003).

[439] Mine Unit 2 Groundwater Restoration Plan (February 24, 2004).

[440] Crow Butte Resources, *Letter re Request for Alternate Decommissioning Schedule* (July 24, 2009).

[441] Crow Butte Resources, *Letter re Request for Alternate Decommissioning Schedule* (July 24, 2009).

Mine Unit 3	July 1999	August 2007-May 2009	July 2013
Mine Unit 4	October 2003	August 2007-May 2009	January 2015
Mine Unit 5	August 2007	August 2007-May 2009	July 2016

The mine operator's failure to restore groundwater within the two-year period required in the license and NRC regulations resulted in Notices of Violation from the NRC in September 2009.[442]

Restoration of groundwater quality impacted by mining releases has been similarly ineffective. In March 1996, Well I-196-5, a perimeter monitoring well, failed a mechanical integrity test. Subsequent investigation revealed contaminated groundwater in the upper aquifer as a result of the well failure. Remediation began in April 1996. The operator submitted a letter in April 1998 claiming that the aquifer had been restored and requesting an amendment to its license verifying restoration. The NRC denied the license amendment in May 1999, stating that concentrations of sodium, potassium, bicarbonate, sulfate, fluoride, TDS, alkalinity, arsenic, and uranium exceeded the primary restoration goal.[443] The issue was still open as of April 2000, with restoration continuing. It is not clear from available information if restoration of the upper aquifer was ever completed.

In 2008, the Nebraska Department of Environmental Quality filed a complaint and consent decree against the mine operator for, among other things, construction of injection and recovery wells "in a manner that had the potential to allow the movement of fluid containing contaminants into an underground source of drinking water." The mine also was cited for failing to notify the agency of the violations for nearly two months after it became aware of the problems.[444]

That same year, a geologist who had mapped the surficial geology of the area for the Nebraska Geological Survey concluded that the geologic model used by the mine developers was incorrect and that the potential existed for mining contaminants to flow along fractures and faults in subterranean zones and contaminate downstream drinking

[442] NRC, *NRC Inspection Report and Notice of Violation* (September 24, 2009).

[443] NRC, *Letter re Well I-196-5 Restoration* (May 10, 1999).

[444] Complaint, *State of Nebraska v. Crow Butte Resources, Inc.* (May 23, 2008).

water sources.[445] Just months later in a public meeting discussing issues at Crow Butte, Mike Griffin, an executive with uranium mining company Uranium One, America, admitted that it typically was impossible to restore groundwater after mining, stating that "That usually isn't realistically achievable, because of geochemical changes."[446]

Nebraska requires annual updates to cost estimates for financial assurance purposes. The mine operator's current cost estimate for restoration of groundwater at the ten mining units currently in operation or restoration phases at Crow Butte is $18,046,416.88. That represents more than half of the amount of the mine operator's current financial assurance commitment of over $35 million.[447]

In recent years, there have been a host of permit violations, leaks, spills, and excursions at Crow Butte. This includes violations found during five of 13 inspections between 1999 and 2011; 15 leaks in retention and evaporation pond liners between 2000 and 2011; failed mechanical integrity tests at 10 different wells between 1996 and 2010; 23 horizontal and vertical excursion events in monitoring and perimeter wells, some of which have lasted for years; and failures to conduct required testing, including the failure to conduct mechanical integrity testing on 42 wells in 2008.[448]

2. Summary of Operational History at Irigaray-Christensen Ranch ISR Uranium Mine

In 1977, the Wyoming Mineral Corporation (a subsidiary of Westinghouse Electric Corporation) submitted an Environmental Assessment to the Nuclear Regulatory Commission for full-scale operation of an in-situ leach uranium mine at the 1,000 acre Irigaray project in Johnson County, Wyoming. At the time, the county had a population density of 1.29 people per square mile and employees had to commute to the site from Buffalo, Wyoming, located 43 miles to the northwest. Aside from scattered ranches (the closest of which was 3 miles away), the closest town to the site was Sussex, Wyoming, located 15 miles away with a population of 30. At the time, the mine operator projected a mine life of 10 years.[449]

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[445] Hannan E. LaGarry, Ph.D., *Expert Opinion Regarding ISR Mining in Dawes County, Nebraska* (July 2008).

[446] George Ledbetter, The Chadron News, *NRC takes comments on ISR uranium mining* (September 2, 2008).

[447] Cameco Resources, *Letter re 2011 Surety Estimate* (September 28, 2010).

[448] NRC, *Safety Evaluation Report, License Renewal of the Crow Butte Resources ISR Facility* (December 2012).

[449] Wyoming Mineral Corporation, *Revised Environmental Report* (July 29, 1977).

A license for commercial in-situ leach uranium product was issued in August 1978. The original license permitted operations at an 800 gallon per minute flow rate, using an ammonium bicarbonate injection solution. Due to problems with restoration of aquifer formations mined with ammonia solutions, the mine operator changed to a sodium bicarbonate alkaline injection solution in 1980. Operations at the Irigaray mine ceased in 1982 due to a weak uranium market.[450]

In 1987, Malapai Resources Company (a subsidiary of APS) purchased the Irigaray site and resumed operations. In 1988, permits and licenses were amended to include the Christensen Ranch uranium mining project. Malapai ceased operations at the Irigaray-Christensen Ranch in February 1990 and sold the project to Electricite de France in September 1990. Operations at the site resumed in 1991. The Irigaray-Christensen Ranch project was sold to Cogema in 1993. By 1995, mining at Irigaray has ceased and groundwater restoration had begun, while mining at Christensen Ranch continued with a least one mine unit in restoration phase.[451]

The primary goal of groundwater restoration was to return the quality of groundwater to baseline concentrations, using the best practicable technology and economic reasonableness. A secondary goal was to return the aquifer quality to conditions suitable for pre-mining uses, which were primarily livestock and agricultural uses. An early amendment to the permits and licenses for the Irigaray project raised restoration target values of 4 contaminants (ammonia, bicarbonate, chloride, and uranium) above baseline, pre-mining levels because the mine operator could not restore groundwater to baseline levels for these contaminants. Target restoration values for Christensen Ranch were set as a baseline mean value for each contaminant with permitted ranges of variation, again because "the *exact* average baseline value for a particular constituent will probably not be met at restoration."[452]

Restoration of Mine Units 1 through 3 began in 1990 at the Irigaray project and stabilization of the aquifer was demonstrated by the beginning of 1994. It was originally projected that restoration would require processing of 7 pore volumes of groundwater, but it actually required 16 pore volumes. The mine operator was unable to restore some contaminants in the ore-body aquifer to pre-mining levels, including total dissolved solids and manganese. For total dissolved solids, the mine operator could not even achieve pre-mining class of use standards, but restoration was

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[450] Cogema Mining Inc., *Supplemental Data for Renewal Source Material License SU-1431* (December 1995).

[451] *Id.*

[452] *Id.*

discontinued because continued efforts "would not have provided a reasonable cost benefit ratio." The mine operator also was unable to groundwater quality in the upper aquifer to pre-mining conditions for certain contaminants.[453]

Restoration of Irigaray Mine Units 4 and 5 began in 1992, was discontinued in 1994 and resumed in April 1995. Mine Units 6 through 8 began restoration in April 1995. As of December 1995, the mine operator projected that restoration at all Irigaray mine units would be complete by 1998. The total cost of groundwater restoration for the Irigaray-Christensen Ranch project was projected to be $5,029,754.[454] By 2000, groundwater restoration cost projections had risen to $5.78 million.[455]

Groundwater restoration at the Irigaray project was completed and approved in 2005-06, seven years longer than projected in 1995. The mine operator was able to restore 27 of 29 groundwater contaminants to target levels. Bicarbonate and manganese could not be reduced to pre-mining levels, but did meet state criteria for pre-mining uses of groundwater.[456] Overall, the post-mining mean values for nearly half of the contaminants exceeded pre-mining mean values. Restoration required processing of a minimum of 9.5 pore volumes of groundwater per mine unit and an average of 13.7 pore volumes, or more than twice the original projection.[457]

At Christensen Ranch, mining in Mine Unit 2 began in 1993 and continued through May 1997. Restoration was underway from May 1997 until March 2003, followed by stabilization monitoring until January 2005. Restoration required processing of over 14 pore volumes (over 393 million gallons) of groundwater. Even then, only 24 of 35 contaminants could be reduced to target levels and 4 contaminants (iron, manganese, uranium and radium 226) exceeded target values and federal and state water quality standards. The exceedances were excused by the State of Wyoming because they were deemed consistent with pre-mining uses or because it was believed the contaminants would not migrate beyond the mining area or would naturally attenuate.[458]

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[453] *Id.*

[454] *Id.*

[455] Cogema Mining, Inc., *Annual Update to Financial Surety, License SUA-1341* (August 17, 2000).

[456] Cogema Letter to NRC Requesting Concurrence in Restoration Approval (November 7, 2005).

[457] Gary Janosko, *NRC Review of Cogema Mining, Inc. Irigaray Mine Restoration Report* (September 20, 2006).

[458] Cogema Mining, Inc., *Wellfield Restoration Report Christensen Ranch Project* (March 5, 2008).

At Christensen Ranch Mine Unit 3, restoration required processing of 19.79 pore volumes (over 442 million gallons) of groundwater and required over 8 years to complete. Although restoration was approved by the State of Wyoming, only 27 of 35 contaminants reduced to target levels and 3 contaminants exceeded water quality standards.[459] Other mine units at Christensen Ranch appear to have experienced similar restoration conditions, although detailed data is not available.

It is not clear that restoration at Christensen Ranch has been successful. In June 2010, the NRC issued a finding that contaminant levels in at least one monitoring well were increasing, despite the mine operator's conclusion that the aquifer had been stabilized.[460]

Spills and releases have been common at the Irigaray-Christensen Ranch projects. Between 1987 and 2004, Irigaray reported 177 spills and releases of 50 gallons or more from wells, pipelines, ponds, and process buildings. Christensen Ranch reported 83 releases of 300 gallons or more between 1989 and 2004, with 9 releases exceeded 20,000 gallons. Both projects also had numerous excursions in which contaminants in monitoring wells exceeded permitted standards.[461]

3. Summary of Operational History at Smith Ranch-Highland Uranium In-Situ Mine

The Smith Ranch Mine and Highland Uranium Project are located next to one another and together cover 37,500 acres in Converse County, Wyoming. Both mines have been jointly owned and operated since the 1980s. The mines are located in an area of historical open pit and underground uranium mining. As of 2000, Converse County had a population of 12,052 (3 people per square mile).

The A-Wellfield of the Highland Mine Project is located between two abandoned uranium mines in a remote area of eastern Wyoming. Groundwater flow is toward the flooded open pit of an abandoned uranium mine. Naturally occurring groundwater in the area contains high levels of radium that makes it unsuitable for drinking water or similar uses.[462]

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[459] *Id.*

[460] NRC Letter to Uranium One Americas, Inc. (June 8, 2010).

[461] Tom Hardgrove email to Ron Linton re Lists of Spills and Excursions for COMIN (December 17, 2009).

[462] A-Wellfield Completion Report (January 15, 2004).

From January 1988 until July 1991, the mine operator extracted uranium from the A-Wellfield at the Highland mine site. The Groundwater Restoration Plan for the site stated that the primary restoration goal was to return groundwater to pre-mining conditions, on a mine unit average. If baseline conditions could not be achieved after diligent application of the Best Practicable Technology, a secondary goal of returning groundwater to a quality consistent with re-mining uses was acceptable.[463]p

Groundwater restoration began in July 1991 and continued until October 1998. Stability monitoring for some or all of the regulated contaminants lasted from February 1999 until November 2003. Both the Nuclear Regulatory Commission and the Wyoming Department of Environmental Quality approved closure of the A-Wellfield at Highland in 2003-04, despite the following conditions:

- Concentrations at individual wells exceeded baseline conditions or drinking water quality standards, but closure was granted because the license required average wellfield concentrations to meet listed standards.

- 20 of 35 contaminants were returned to baseline, pre-mining conditions, based on average wellfield concentrations.

- 11 other contaminants were reduced to drinking water standards or below, based on average wellfield concentrations.

- Average wellfield concentrations of iron, selenium, manganese and radium exceeded drinking water standards but met industrial use standards. Based on the mine operator's argument that restoration to pre-mining conditions was infeasible and uneconomical and that the affected aquifer had been unsuitable for drinking water uses before mining, these contaminant levels were permitted to remain.

- Monitored natural attenuation was permitted to reduce certain contaminant concentrations to levels that would not present a threat to downgradient groundwater supplies.[464]

4. Smith Ranch Mine Project

The Nuclear Regulatory Commission issued a commercial license for in-situ leach mining of uranium at the Smith Ranch Mine, east of Highland Mine, in March

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[463] *Id.*

[464] NRC Review of Groundwater Restoration Report (June 29, 2004);

1992. Full-scale operations began in June 1997. By 2000, three wellfields were operable under Wyoming Department of Environmental Quality Permit 603. Each wellfield contained multiple mining units.[465] Together, the Smith Ranch-Highland mines comprise the largest uranium mining operation in the United States.

The mine operator submitted a groundwater restoration plan for Wellfield 1 in October 2001. The plan's goals were described as follows:

> The objective of the reclamation plan is to return the affected surface and groundwater to conditions such that they are suitable for all uses for which they were suitable prior to mining. To achieve this objective, the primary goal of the restoration program is to return the condition and quality of the affected groundwater in a mined area to background (baseline) or better. In the event the primary goal cannot reasonably be achieved, the condition and quality of the affected groundwater will at a minimum be returned to the pre-mining use suitability category (Reference: LQD Rules and Regulations, Chapter XXI, Section 3 (d) (I)).

The mine operator made the following predictions concerning groundwater restoration, based upon data developed during the licensing process and operation of the mine:

- Restoration to primary or secondary goals would require pumping and treatment of 6 core volumes of groundwater.
- Groundwater restoration would take 10 months.
- Stability sampling would require 6 months to a year.[466]

In 2002, the mine operator estimated that restoration costs for Wellfield # 1 would total approximately $750,000. For the four other wellfields operating in 2002, the mine operator estimated that restoration would require from 5 to 14 months at costs ranging from $380,000 to over $1 million per wellfield.[467] Other wellfields were subject to similar conditions under Wyoming Permit 633.

In November 2007, the Wyoming Department of Environmental Quality inspected the mine. In Notices of Violation issued in March 2008, the State cited the mine operator for the following violations of Permit 603:

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[465] NRC Inspection Report and Notice of Violation, at 3 (February 11, 2000).

[466] Wellfield # 1 Restoration Plan (October 18, 2001).

[467] Application to Amend License No. SUA-1548 (February 27, 2002).

- Operation of Wellfield C for 7 to 9 years longer than proposed in the approved Mine Plan.

- Ongoing restoration of groundwater in Wellfield C for 10 years, instead of the 5 years estimated in the amended operating permit.

- Operation of Wellfields D and E for longer than permitted, with continued operation at a time when both wellfields should have been in groundwater restoration phase.

Similar violations were found for other wellfields under Permit 633, with the agency finding that "actual times for uranium production and restoration are, thus far, 2-3 times longer than permit commitments." The agency found that "groundwater restoration is not a high priority" for the mine operator and that due to inadequate restoration infrastructure, it would take at least 20 years to complete groundwater restoration at the site. In addition, the agency noted the existence of 80 reported spills at the mine, numerous retention ponds leaks, well casing failures and excursions, lamenting that, "[u]nfortunately, it appears that such occurrences have become routine."[468]

The agency also found that the mine operator's financial assurance bond was based on calculations that provided for only minimal groundwater pumping and treatment, when much more would be needed, such that the bond was inadequate to cover anticipated restoration costs. Furthermore, the bond calculation included minimal funds for new infrastructure, maintenance, and repair. It also assumed a staff of just 26 people, about half of what was required, and it allowed for salaries at levels that were one-third too low to retain competent staff. The agency estimated that actual reclamation costs for the site approached $150 million, but the mine operator was bonded for a total of only $38, 416,500.[469]

In August 2009, the mine operator requested an extension of the groundwater restoration deadlines for numerous wellfields. Restoration periods were projected to range from 2 to 12 years, with some wellfields not projected to complete restoration until 2025.[470] Based on agency objections, the mine operator submitted a revised restoration schedule that provides for much shorter restoration deadlines, although it appears restoration periods will still far exceed the original projections of 5 to 14

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[468] Notice of Violation (March 10, 2008).

[469] *Id.*

[470] Request for Alternate Schedule for Completion of Decommissioning (August 13, 2009).

months.[471] The estimated cost of restoration increased dramatically from 2002 projections, ranging from over $500,000 to $3.1 million per wellfield.[472]

Recently, the Wyoming Department of Environmental Quality inspected the site and recommended enforcement actions against the mine operator. Among other things, the agency found that abandoned drill holes at the site had not been sufficiently sealed, that the potential existed for communication between aquifers through these drill holes, and that the holes were located close to operating in-situ well fields.[473] FCI's proposed mine site similarly contains hundreds of core holes, many of which can no longer be located and others of which were abandoned decades ago using now-questionable methods to seal the holes.

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[471] Letter submitting revised restoration schedule (May 12, 2011).

[472] Annual Surety Update (June 30, 2010).

[473] Wyoming Department of Environmental Quality, *Letter re April 2011 Inspection Report* (June 13, 2011).

Appendix O:
Expert Resumes

RESUME OF LEE WILSON

EDUCATION AND CERTIFICATION

Ph.D., Geology, Columbia University (1971). Specializations in geomorphology, hydrology, ecology (collectively what is today referred to as "environmental science").

B.A., Geology, Yale University (1964); minor in ecology.

Certified Professional Hydrogeologist #220 (American Institute of Hydrology).

EXPERIENCE AT LEE WILSON AND ASSOCIATES

Since 1973, Dr. Wilson has been President of Lee Wilson and Associates (LWA), a water resource and environmental consulting firm based in Santa Fe, New Mexico. His work generally falls into three categories, each of which is discussed more fully below:

- Technical analysis of water resources for more than 500 projects;
- Author and project director for several dozen environmental management and impact evaluations, including 17 years as an EPA mission contractor;
- Expert testimony on a broad array of water resource and environmental issues in dozens of court and regulatory cases.

Also provided below is information on Dr. Wilsons experience in other areas of resource management while at LWA; and his work as administrator of a successful small business.

WATER RESOURCES

The water resources projects that Lee Wilson has worked on have dealt with issues as follows.

- Water-supply master planning for municipalities and water authorities. Responsible for projecting water demands, design of conservation programs, assessing streamflow supplies on a probabilistic basis, evaluating well field performance, modeling and modeling oversight of well field impacts and reservoir operations, developing strategies for water rights acquisition, investigating water quality problems, designing wellhead protection programs, assessing water-resource regulations, and performing tradeoff analyses of water-supply alternatives based on engineering, economic, environmental and legal considerations.
- Evaluation of water quality impacts and/or clean-up programs for hazardous waste disposal, hydrocarbon leaks and spills, brine pits, coal mining and transport, power plant operations, pipeline construction, salt mining, geothermal development, septic tanks, sewage lagoons, sludge disposal, land application of wastewater, feedlots, dairies, swine breeding facilities, aquaculture, natural saline seeps, watershed development, petrochemical manufacturing, other manufacturing, offshore oil and gas activities, disposal of dredged materials. Note that impacts to soils have been considered in many of these evaluations.
- Assessment of wastewater management alternatives, ranging from conventional treatment and discharge, to recycling alternatives including potable reuse; and evaluation of service area alternatives, especially extension of sewer lines to environmentally sensitive areas.

- Geotechnical/hydrologic components of four dozen dam safety inspections and seismic evaluations (for the Corps of Engineers and state agencies), and numerous other projects involving evaluation of flood hazards, Section 404 permits and/or stormwater management.

There are many specific LWA projects that display Dr. Wilson's ability to tackle complex and or unique issues. These include the following.

- Development of 70,000 acre-feet per year well field and acquisition of more than $200 million in water rights in Canadian River Basin of Texas, through program of test drilling, data interpretation, and well design. Other work for this client -- the Canadian River Municipal Water Authority -- has involved hydrogeology investigations and conceptual design of a successful brine removal well system in the Canadian River Basin of New Mexico; reservoir firm yield and salinity evaluations; and assessment of hydrologic impacts of watershed brush control.
- Project manager and senior hydrologist for the Central Platte River groundwater and surface water modeling program (COHYST).
- Design of New Mexico's statewide program for groundwater quality monitoring, the first such program in the United States.
- Evaluation of numerous groundwater contamination events involving hydrocarbons, solvents, heavy metals, nitrates and other contaminants, for energy companies, major industrial companies, landowners and governments.
- Development of the nation's first set of criteria for use in evaluating full-scale potable recycling of wastewater (for the Hueco Bolson Recharge Project, El Paso Texas, now operational for more than 25 years).
- Design of EPA's prototype Wellhead Protection Program for Indian Lands.
- Development of the nation's first aquifer identification procedures and maps for EPA's Underground Injection Control Program.
- Writing of stream standards for seven Indian tribes in New Mexico.
- Assessment of runoff and contamination risks from Los Alamos National Laboratory, New Mexico, resulting from Cerro Grande wildfire.
- Support to State of Florida with respect to determining minimum stream flow requirements for the endangered Manatee population at Volusia Blue Spring; subsequent work for the past several years has involved peer review of minimum flow designations for rivers, lakes and springs throughout the St. Johns River Basin.
- Preparation of 33 county-level maps of aquifer vulnerability for the New Mexico Underground Storage Tank program (republished on New Mexico Environmental Department web site at http://www.nmenv.state.nm.us/fod/LiquidWaste/aoc.html).
- Performance of hydrologic and regulatory assessments of aquifer management rules for the Edwards Aquifer Authority, Texas; and quantified water-rights values for the Authority.
- Support to design and implementation of extensive studies to assess impacts of water appropriations on Guadalupe River, Texas, including effects on the endangered whooping crane.

- Consultant to Alcoa mining regarding permitting of industrial wells and securing of bond release at Sandow Mine, Texas.
- Active as water rights consultant for more than a dozen communities throughout New Mexico, responsible for oversight of water-rights transfers and compliance with state permit conditions; one example is our oversight of acquisition and transfer of more than $30 million worth of water rights to the Village of Los Lunas; another is support to the City of Las Cruces in preparing a standalone water conservation plan.

ENVIRONMENTAL MANAGEMENT AND IMPACT ASSESSMENT

Dr. Wilson's projects in environmental management and impact assessment include the following, which typically involve evaluations related to all aspects of the environment, including air, water, soils, biota, and human resources.

- LWA was selected in 1984 as level-of-effort NEPA contractor for EPA Region 6; this contract was re-awarded or extended annually for 17 years until our retirement in 2001. Under this contract, Dr. Wilson was the lead participant in over 60 work assignments that included: preparation of state-of-the-art reports on cumulative impacts, EIS post-audits, and NEPA risk assessments; author of a unique Record of Decision that effectively served as a biological opinion under the Endangered Species Act; team leader for EISs on a major lignite mine and power plant, a very large petrochemical plant, oil and gas activities in the Territorial Seas, and dredged materials disposal in the Atchafalaya Delta; team leader for EAs on surface coal mining and confined animal feedlot operations; and responsible for analysis of a Clean Lakes Program project; a generic programmatic agreement for Section 106 of the National Historic Preservation Act; and an investigation of alternatives for beneficial use of dredge spoil in the Laguna Madre, Texas, and statewide in Louisiana and Texas. Note that work under our EPA contract that relates to coastal restoration is identified elsewhere in this resume.
- Prior to the EPA contract LWA prepared numerous impact statements, many of which were of special interest: the first third-party EIS performed in the U.S. (for EPA, on the City of Albuquerque wastewater treatment facilities); the first BLM grazing EIS that was completed without a court challenge (McGregor Range); a 1980 EIS that developed EPA's criteria for potable reuse of wastewater (City of El Paso); and a 1982 wastewater EIS (for EPA on Taos Ski Valley) which has been described as "exactly what CEQ wanted to accomplish when they reformed the EIS process".
- Lee Wilson served Alcoa Corp. as advisor for a controversial EIS prepared by a Third-Party consultant regarding a major coal mine project in Texas. Key issues included groundwater development, effects on endangered species, and the secondary effects of mine-supported energy generation and smelting. The EIS was not challenged.
- Current LWA work on impact issues includes preparation of assessments of arsenic treatment projects for the City of Albuquerque; and evaluation of water resource impacts for a Forest Service EIS being prepared on a major uranium mine, where large quantities of groundwater will be withdrawn for mine depressurization, and where issues of water quality are of importance to the local community; and for a BLM EIS on a copper mine where water issues are paramount.
- Our impact assessments of diverse project types have included: municipal flood control; in-situ copper mining; in-situ potash mining; the eutrophication effects of urban runoff; construction of a natural gas pipeline; the agricultural impacts of wastewater service extensions; the groundwater

impacts (quantity/quality) at a large cooling reservoir constructed in karst terrain; construction/use of a limited access freeway; chemical manufacturing; a pulp and rayon mill; tribal wastewater disposal; trans-national air pollution; and arsenic treatment systems.

- Dr. Wilson also has taught courses on impact analysis. Course sponsors/venues include the Autonomous University of Mexico (Mexico City, 2 courses), FLACAM in Lima, Peru (students from 5 countries), VUB in Brussels, Belgium (students from 20 countries), and the Inter-American Development Bank in Jamaica (students from 10 Caribbean countries).

EXPERT TESTIMONY

Dr. Wilson's experience as an expert witness includes the following.

- Current or recent expert designations and assignments in federal or state courts include: for Datacard and General Electric in a contamination case in California; for El Paso Corporation as a hydrogeology expert in several cases involving ground-water contamination in New York, Florida, New Jersey and New Hampshire; for Taos Pueblo as a water-rights expert in an adjudication case; for several New Mexico municipalities in cases involving protested water rights transfers; for a rock quarry in Texas with respect to well permitting; for acequia associations in the Rio San José Adjudication (New Mexico); for the City of Las Cruces in the Lower Rio Grande adjudication; and more. In the last year he has testified before a Federal Court in Dallas regarding groundwater contamination in Winkler County TX; an arbitration panel in Houston regarding soil and groundwater contamination in McAllen County, TX, and a New Mexico Hearing Officer in Santa Fe, regarding a water rights matter in Dona Ana County, NM.

- An example of testimony regarding groundwater contamination was for Fina and Dominion in a 7-year case involving hydrocarbon releases in McAllen, Texas. The project involved extensive research into local conditions of soil characteristics, groundwater hydrology and contamination, examination of potential sources including pipelines and old gas stations, and background research on diverse issues including mobility of phase-separated gasoline and fingerprinting of natural gas condensate.

- For the State of Florida, Dr. Wilson provided expert testimony in federal court cases regarding interstate water issues, especially relating to competition for streamflows between urban Atlanta, major recreational reservoirs, large-scale irrigation, and the environmental resources of the Apalachicola River floodplain and estuary in Florida.

- Dr. Wilson's past expert work for the State of Nebraska involved two U.S. Supreme Court cases regarding interstate water allocation. The more recent dealt with the Republican River Compact, where issues related to streamflow hydrology, groundwater modeling, Compact accounting, reservoir operations and water-rights administration. Dr. Wilson previously was a lead expert for Nebraska in its interstate litigation on the North Platte Decree; the issues there included protection of environmental flows for the critical habitat of the Whooping Crane; and municipal needs in Wyoming.

- Of past cases, the largest by far was Dr. Wilson's role as chief expert regarding water resource and environmental issues raised in federal litigation brought by a coal slurry pipeline against six railroads ("ETSI case"). This involved extensive research and focused testimony regarding the environmental impacts of coal slurry pipelines, including comparison of impacts to coal transport by unit trains; and regarding the genuineness of railroad protests to permits under the Clean Water

Act, Clean Air Act, Resource Conservation and Recovery Act, Endangered Species Act and other statutes and regulations in South Dakota, Wyoming, Oklahoma, Arkansas, Texas and Louisiana.

- Another well-known expert appearance was as chief technical witness for the City of El Paso in its landmark challenge of a statute barring the interstate transport of groundwater. There, testimony dealt with long-term municipal water supply needs; alternatives ranging from desalting to recycling; surface and groundwater impacts of a 296,000 acre-feet per year diversion; and diverse socio-economic issues related to water use and interstate commerce.
- Other past testimony and/or litigation advice has been provided in hazardous waste disposal, water rights, water rates and water quality cases for clients ranging from major corporations (Johnson and Johnson, Waste Management Inc., Phillips Petroleum, Marathon Oil, OXY Petroleum, Budget Rent-a-Car, ELF-Atochem) to environmental and citizen groups (Sierra Club, La Raza Unida). Dr. Wilson is currently involved in two remediation projects under jurisdiction of the Railroad Commission of Texas, one on behalf of a landowner, one on behalf of an oil and gas producer.

RESOURCE MANAGEMENT

These projects involve specialized aspects of environmental and water resource management.

- LWA's EPA contract included extensive work in restoration of Louisiana's coastal wetlands. Dr. Wilson oversaw preparation of a handbook for managing wetlands impacts of oil and gas development; prepared ecosystem restoration plans and studies (such as a project to divert Mississippi River water to restore Lake Maurapas swamps -- the largest such project so far conceived); evaluated specific projects involving land management, mariculture and barrier islands; and helped write "Coast 2050", the master plan for achieving no net loss of wetlands.
- LWA has undertaken a number of specialized studies aimed at the innovative management of environmental resources. Lee Wilson invented a method by which water supply is quantified and used as the basis of land use density zoning (for Santa Fe County, NM); created a standardized list of subdivision covenants for water conservation; performed the nation's first size-partitioned inventory of fugitive dust, which involved all natural as well as man-related particulate sources in a desert area with numerous tailings piles, copper mines, mills and unpaved roads; prepared the conceptual scope for City of Albuquerque's hazardous waste management master plan; drafted an environmental code for City of Santa Fe, dealing with issues which range from toxic air pollutants to electromagnetic radiation from power lines; and input to design of a project to restore the hydrology of a sacred wetland on Taos Pueblo.

ADMINISTRATION OF A SUCCESSFUL SMALL BUSINESS

Lee Wilson's work as President of LWA has required him to accomplish the following.

- Administer an average of 20 to 30 contracts per year (total annual value averaging > $1,000,000) with government agencies and private companies (almost all repeat clients), to ensure compliance with schedules, budgets and client needs.
- Supervise interdisciplinary research teams of up to 30 members, while performing technical research in a variety of water-resource and environmental disciplines.

- Write most and edit all company reports and make oral presentations of findings to clients, regulatory agencies, and the public.
- Assure quality control so that all work is imaginative, practical, objective and cost-effective.

PRIOR EXPERIENCE, ACCOMPLISHMENTS, HONORS AND PUBLICATIONS

- 1972-1973. Senior Staff Scientist with an environmental consulting firm based in New York City and Dallas, responsible for preparing more than a dozen major EISs and assessments in California, Indiana, New York, North Carolina, Pennsylvania and Texas; projects included large water supply and flood control reservoirs, landfills, coal-fired power plants and land development.
- 1965-1971. miscellaneous short-term assignments, including observer-member of an Australian government team performing an inventory of soil, water and biological resources in the Northern Territory; and lecturer in geology, geomorphology, Pleistocene geology and geophysics at Columbia University, Briarcliff College and Brock University.
- LWA was selected by EPA in its 1994 National Award for Outstanding Achievements as a Small Business Contractor.
- Columbia University Fellowship for advanced study in remote sensing at International Training Center, Delft, Netherlands (1969-70)
- NSF Summer Institute Fellowship in hydrology/hydraulics, Colorado State University (1968).
- Food Fair National Scholar, Yale University, 1960-64
- Member of more than one dozen professional and environmental organizations, including Geological Society of America (Elected Fellow) and National Wildlife Society (Life Member).
- Member of the International Association for Impact Assessment; Chairman of Training and Professional Development Committee (2003-2007; in 2004 received IAIA's award for Outstanding Service.
- For LWA, author of more than 400 technical reports, many distributed widely by government agencies.
- Ten contributions to the Encyclopedia of Earth Sciences series. Scientific articles published in: Groundwater; Water Resources Research; Water Resources Bulletin; American Journal of Science; Bulletin of the International Association of Hydrology; Bulletin of the Geological Society of America; Rev. Geographique Physique et de Geologie Dynamique; EIS Annual Review; Environmental Impact Assessment Review; Journal of Soil and Water Conservation; American Water Works Association Proceedings; Physical Geography.
- Keynote speaker at UNESCO symposium on erosion and sedimentation, Paris, 1977; member of AWRA scientific exchange program with the Peoples Republic of China (1985); member of City of San Antonio delegation to Kumamoto, Japan, water conference (1990); member of EPA/DOE international workshop on EIS methodology (1991); keynote speaker New Mexico Legislature water retreat (2000); member of Advisory Council for the Caroline and William N. Lehrer Distinguished Chair in Water Engineering at Texas A&M University's Biological and Agricultural Engineering Department (2005).

For more information, call Lee Wilson at 505-988-9811, or e-mail: lwa@lwasf.com.

Southwest Ground-water Consultants, Inc.

Kevin D. Hebert, R.G.
Project Manager/Hydrogeologist

Education: B.S., 1983 Geology, University of Louisiana at Lafayette

Registration: Geologist – Arizona (26388)

Years in Profession: 31 **Years with Firm:** 11

Experience: Mr. Hebert is a Registered Geologist with extensive experience managing multidisciplinary environmental projects specializing primarily in characterization studies of complex geologic and hydrogeologic sites. He is Mine Safety and Health Administration (MSHA) certified. His experience includes industrial compliance issues such as Aquifer Protection Permitting (APP), wastewater treatment, landfill closure and permitting. He has also served as Project Manager providing oversight and management for the permitting, installation, and testing of numerous water supply wells in the Phoenix, Pinal, and Tucson Active Management Areas (AMAs). Mr. Hebert has directed and managed the preparation of Spill Prevention Control and Countermeasure (SPCC) plans for sites located in six southwestern states. He has provided oversight and project management for the completion of numerous Phase I Environmental Site Assessments (ESAs) covering a wide range of property types. Mr. Hebert has managed numerous projects at sites containing leaking underground storage tanks (USTs) where his responsibilities included directing site characterization, remediation, and closure. Mr. Hebert also has extensive experience in managing and directing resources to complete due diligence activities, including geologic evaluations at aggregate mine sites relating to multi-site property acquisitions.

Representative Projects: ***Well Design and Installation***

- Water resources and well siting investigation, Lake Pleasant Heights and Saddleback Heights, Peoria, Arizona
- Prepare lithologic logs, review and interpret geophysical logs, provide well design recommendations, and document construction and testing of monitoring and test wells at a surface mine site in central Nevada
- Design, installation, testing and sampling of monitor wells, vapor extraction wells and air sparge wells for many site characterization and remediation projects throughout Arizona
- Managed drilling programs and preparation of pit modeling efforts to estimate quantity and quality of aggregate deposits at mine sites in Arizona, California, Nevada, and Utah
- Managed installation of groundwater and methane monitoring wells at a former municipal landfill site to evaluate potential impacts to subsurface, groundwater and adjacent properties
- Provided oversight and management for several groundwater production wells in the Phoenix, Pinal, and Tucson AMAs. Project activities included preparation of well specifications, well siting and spacing studies, ADWR permit applications, oversight of drilling activities, including geophysical surveys, pump testing, well installation, and quality testing.

Contaminant Investigations

- Conducted and managed numerous Phase I and Phase II ESAs for due diligence for sites with varying complexities in Arizona, California, Texas, Nevada, North Carolina, Utah, and Louisiana
- Completed a Phase I ESA of a 465,000 acre site in Southeast Texas where primary concerns were from extensive oil and gas drilling activities within the site boundaries
- Conducted Phase I and Phase II site investigations at former automobile dealership in San Diego County, CA
- Performed QA/QC and due diligence activities for the completion of Phase I ESAs at 20 surface mining facilities in San Diego County, California
- Directed completion of several ESAs including asbestos surveys for the redevelopment of a downtown city square, Chandler, Arizona
- Managed numerous site characterization and remediation projects for Mobil Oil Corporation at stations containing leaking USTs, Arizona and California
- Provided management and oversight of several site characterization and remedial investigations for leaking UST sites at Texaco facilities in Arizona

- Characterized extent of contamination and identified potentially responsible parties (PRPs) along an abandoned corridor, Winslow, Arizona
- Managed characterization and remediation activities at leaking UST sites managed by the Arizona Department of Environmental Quality's (ADEQ) State Lead Group
- Directed and managed strategies to remediate approximately 40,000 cubic yards of soil contaminated with toxaphene at a former pesticide air strip in Chandler, Arizona. Received a No Further Action (NFA) notification from ADEQ following completion.
- Directed and managed the investigation, characterization, and removal of drums containing hazardous waste at an illegal dump-site, El Mirage, Arizona
- Managed geologic and environmental due diligence activities for multi-site acquisitions of aggregate mine sites and concrete batch plants, Arizona, California, Nevada, and Utah
- Identified and characterized a previously unknown plume of PCE contamination adjacent to a dry cleaning operation in Phoenix, Arizona. Successfully negotiated acquisition of a Prospective Purchaser Agreement (PPA) with ADEQ for the new owner of the facility.

Regulatory Permitting and Compliance

- Expedited Aquifer Protection Permit (APP) review as a consultant to ADEQ, Resolution Copper Mining, LLC, Superior Mine, West Plant Site, Pinal County, Arizona
- Provided technical support to evaluate nitrate alert level exceedances in groundwater samples collected from monitoring wells at the 91st Avenue WWTP, Phoenix, Arizona
- Preparation of AP) application for construction, operation, and maintenance of a clay-lined landfill for disposal of wastes generated by a paper mill in Snowflake, Arizona
- Managed APP activities, which included site characterization, capping, and closure of an 80 acre landfill containing debris generated by a paper mill in Snowflake, Arizona
- Managed an effluent reuse project consisting of storage and seasonal irrigation of 3,100 acres of biomass farmland with 14.5 million gallons per day of effluent discharged from a paper mill in Snowflake, Arizona
- Conducted comprehensive environmental and health & safety audits for several concrete batch plants, pre-cast block plants, asphalt plants, aggregate mining operations, and industrial mineral mines in California, Arizona, Texas, New Mexico, and North Carolina
- Managed activities relating to the design, engineering, construction, operation and maintenance of a 260-acre storage impoundment at a paper mill in Snowflake, Arizona. Obtained dam safety permit from Arizona Department of Water Resources (ADWR)

Expert Witness Testimony and Technical Support for Legal Proceedings

- Provided expert testimony, technical review and consult during and prior to all proceedings of hearing conducted in Maricopa County. Attended hearing providing technical analysis of testimony to support legal team during cross examination of key witnesses. Florence Copper Project, Pinal County, Arizona

Professional Affiliations/Certifications:

- Mine Safety and Health Administration (MSHA) certified
- Arizona Hydrological Society

Southwest Ground-water Consultants, Inc.

Nathan E. Miller
Hydrologist / Groundwater Modeler

Education: B.S., 1997 Hydrology *Magna Cum Laude*, University of Arizona, Tucson

Years in Profession: 17 **Years with Firm:** 16

Experience: Mr. Miller is a hydrologist with expertise in numerical groundwater flow modeling and professional experience performing a variety of tasks including: installation of exploratory borings, monitor wells and production wells; hydrologic field investigations and data analysis; analytical groundwater flow modeling; Geographic Information Systems (GIS) development; relational database development, records reviews, and preparation of hydrogeologic maps and technical reports. His computer skills allow him to take full advantage of available tools, and his skill set is continually adapting to the latest technologies.

Mr. Miller regularly represents clients before the Arizona Department of Water Resources (ADWR) and the Arizona Department of Environmental Quality (ADEQ), and manages the successful completion of permits issued by these agencies. He has conducted numerous assured water supply investigations and prepared applications for Physical Availability Demonstrations (PAD), and Certificates, Analyses, and Designations of Assured Water Supply (CAWS, AAWS, and DAWS). He has completed many well spacing and well impact investigations in support of production well permits. He has also prepared many recharge aquifer impact analyses, applications for Underground Storage Facilities (USF), and provided hydrologic support for applications for Aquifer Protection Permits (APP) with particular expertise in performing analyses to determine the Discharge Impact Area (DIA).

Representative Projects:

Computer Modeling

- Incorporation of proposed groundwater pumping to the ADWR Assured Water Supply Baseline Model in support of applications for Physical Availability Determinations, Analyses and Certificates of Assured Water Supply.
- Modification of USGS Northern Arizona Groundwater Flow Model (NARGFM) to assess stream flow depletion for Environmental Assessment under NEPA, Flagstaff, Arizona.
- Extension of ADWR Assured Water Supply Baseline Model including local recalibration to simulate proposed pumping in the Hassayampa Sub-basin in support of a Designation of Assured Water Supply for the City of Buckeye, Arizona.
- Construction of numerical groundwater flow model of the Hassayampa Sub-basin in support of the USF application for the Tartesso effluent recharge facility, Buckeye, Arizona.
- Modification of ADWR's groundwater flow model of the Salt River Valley to simulate conditions over a 100-year predictive period in support of a Modification of DAWS for the City of Chandler.
- Development and calibration of a numerical (MODFLOW) groundwater flow model of the Harquahala Irrigation Non-expansion Area, including automated parameter estimation (PEST) using pilot points parameterization, regularization, SVD-Assist, and exploration of the Pareto front.
- Development of GIS for the City of Surprise future planning areas, including various hydrogeologic data, and development of a spatial prioritization matrix based on potential production and quality of future wells.
- Construction and calibration of a numerical (MODFLOW) model of the Big Chino Sub-basin, used in support of a Modification of DAWS for the City of Prescott, Arizona.
- Numerical and analytical aquifer modeling for numerous groundwater resource investigations.

Dewatering Projects

- Modeling of aquifer drawdown response to dewatering wells for selection of optimal well spacing and total number of wells for several projects in the Phoenix Metro area.

Assured Water Supply Studies

- Hydrogeologic investigations documenting the groundwater resources available in support of numerous CAWS, AAWS, DAWS, and PAD applications. Submittal of applications for and successful completion of CAWSs for over twenty subdivisions, AAWSs for several master planned communities, DAWSs for two water providers, and PADs for five developments in Arizona.
- Client representation before ADWR as hydrologist in support of numerous Assured Water Supply applications.

Regulatory Permitting and Compliance

- Hydrogeologic studies including Discharge Impact Area (DIA) analysis in support of Aquifer Protection Permits (APPs) for several effluent recharge projects in Arizona.
- Identify source(s) of elevated nitrate and rehabilitation options for a water supply well, Pinal County, Arizona.
- Evaluate the potential cause(s) of alert level exceedances in a monitor well at a recharge facility, Chandler, AZ
- Permitting for Underground Storage Facility (USF), Groundwater Savings Facilities (GSF), Water Storage Permits (WSP), and Aquifer Protection Permits (APP) for recharge projects in Arizona.

Well Design and Installation

- Well construction management, field data collection, and aquifer testing of high capacity production wells and monitor wells in the Phoenix Active Management Area.
- Well design based on review of existing hydrogeologic data and interpretation of lithologic logs, geophysical logs, and zonal water quality of pilot boreholes.
- Preparation of numerous permits to drill and operate wells in Arizona, including analyzing the projected impact to existing registered wells when necessary.

Aquifer Recharge

- Preparation of hydrogeologic studies including area of impact, discharge impact area, and mounding impact analysis models for groundwater recharge projects throughout Arizona.
- Assessment of potential basin recharge capacity for two proposed sites based on field data including analysis of infiltrometer test data and borehole logs.
- Submittal of applications for USF permits for several aquifer recharge sites in Arizona.

Expert Witness Testimony and Technical Support for Legal Proceedings

- Conducted several groundwater flow model runs to support testimony of technical expert during a hearing conducted in Maricopa County. Attended hearing and provided technical analysis of testimony to support legal team during cross examination of other side's witnesses. Florence Copper Project, Pinal County, Arizona.
- Provided technical support for legal proceedings by documenting physical availability of groundwater for a development in the Tucson Active Management Area.
- Served as representative hydrogeologist for a development at a Pinal County Planning and Zoning Commission meeting.

Professional Affiliations/Certifications:

- Arizona Hydrological Society

Appendix P

FCI Groundwater Flow and Transport Model

FCI relies heavily upon a poorly developed groundwater flow and fate and transport model in its UIC permit application. Results of these flawed models were used to develop the AOR and to predict the movement of injected solutions under various scenarios in an attempt to demonstrate the ability to limit aquifer contamination. While Region 9 asked FCI to address several issues pertaining to the flow and transport modeling, the primary shortcomings of the models were not confronted. Additionally, FCI responses to the USEPA were mostly inadequate and in some cases misrepresentative.

FCI developed the Production Test Facility groundwater flow and transport model (PTF Model) initially to support the APP application submitted to ADEQ in January 2011, but later modified it for use in the UIC permit. The PTF model relies on the equivalent porous medium (EPM) assumption, which allows simulation of flow through the network of fractures using commonly used groundwater modeling codes. The PTF model covers a 10.4 by 12 mile area surrounding the PTF site. It has 10 model layers to represent the hydrostratigraphic layers in the area:

- Layers 1 and 2: Upper Basin Fill Unit (UBFU)
- Layer 3: Middle Fine Grained Unit (MFGU)
- Layers 4 and 5: Lower Basin Fill Unit (LBFU)
- Layer 6: Forty foot Exclusion Zone of the Bedrock Oxide Unit
- Layer 7 through 10: Bedrock Oxide Unit

The regional Sidewinder and Party Line fault systems were represented in the model with zones of increased hydraulic conductivity intersecting layers 7 through 10. Outside of the faults, the PTF model assumes that the Bedrock Oxide Unit is isotropic and homogeneous within each layer, with a constant hydraulic conductivity value of 0.57 feet per day for layers 7 and 8, and a constant 0.10 feet per day for layers 9 and 10.

1. FCI Modeling Flaws

a. Conceptual models for simulating flow and transport were not adequately developed.

The character of flow at the scale of the PTF has been poorly defined, and the importance of heterogeneity and anisotropy of fractures throughout the oxide bedrock zone at this scale has not been properly addressed. Analysis of information gained from the BHP pilot test, and additional testing and analysis (e.g. fluorescent dye tracer test at the PTF well field) is needed to refine the conceptual model(s) used to model contaminant flow and transport for the proposed in-site leaching activities.

The BHP pilot test provided an abundance of data to characterize the flow of ground water and the transport of injected fluids from injection wells into the oxide zone. Testing included the following:

- Interference pumping tests: Aquifer tests of twelve of the wells constructed at the BHP test site were conducted.
- Groundwater tracer tests – March to May 1997: Groundwater from the UBFU with relatively high sulfate concentration was injected into one of the BHP test site wells (BHP-1) while four other wells were pumped. Breakthroughs of sulfate were observed in the four pumping wells.
- Acid Leaching test – October 31, 1997 to February 8, 1998: A sulfuric acid solution was injected into four wells and nine wells were pumped.
- Bromide tracer test – May to June 1998: A solution with relatively high bromide concentration was injected into BHP-1 for 45 hours. Eight wells were pumped and the breakthrough of bromide concentrations was monitored over approximately 1 month.

Review of reports and data provided for the BHP tests indicate significant heterogeneity and anisotropy exist within the oxide unit within the BHP test site yet the PTF model assumes this unit is homogeneous within each layer. Analyses of the BHP test data lead to the conclusion that "short-circuits" exist. Failure to analyze the BHP data in developing the conceptual model is a critical flaw in the development of the model.

While analysis of the BHP test data is important for developing the conceptual model for the PTF site, testing and analysis utilizing wells to be constructed at the PTF site is also needed. This will allow characterization of flow and transport specific to the PTF site. Detailed analyses of borehole data including geophysical logs and fracture intensity should be conducted including "well-established geostatistical techniques based on semivariogram analysis" (NRC, 1996) to define a field of values for aquifer hydraulic properties. In a document (Orr, 1996) provided to Region 9 in support of the EPM assumption (see below), detailed recommendations are made for incorporating such a geostatistical analysis into the model. Orr makes reference to broad conclusions of this type of analysis that was done for the then BHP site; however, our review of the materials provided by Region 9 indicates that this analysis was not provided in support of the UIC permit. Furthermore, while it appears that a geostatistical analysis of fracture intensity was conducted, it clearly was not used to develop the groundwater flow and transport model.

The magnitude and correlation of aquifer properties input to a flow model must then be based on observed field data. Characterization of fracture geometry on many scales should be used to guide the groundwater flow model. Aquifer tests and tracer tests similar to those conducted at the BHP test site should be conducted and used to modify, if necessary, the flow and transport model prior to commencement of acid injection at the PTF site. This analysis is critical as flow at this scale is proposed to control the release of contaminants. Furthermore, flow at this scale will continue to be important all around the outer edges of the possible future commercial facility.

b. Use of the EPM assumption is not sufficiently justified.

FCI failed to include sufficient justification of the EPM assumption that is necessary to apply the model codes used for the PTF model. The final UIC application contains one section from a 1996 Brown and Caldwell report (Attachment I, Exhibit I-1) that discusses the EPM assumption. This document suggests that the EPM assumption is supported by the fact that drawdown responses to pumping wells are "wide-spread and general [sic] symmetrical." However, this assessment was based on measurements in wells spaced hundreds to thousands of feet apart. While the examples given may support use of the EPM assumption for modeling groundwater flow at that scale, the same data cannot be used to support use of the EPM assumption for modeling flow and contaminant transport between wells within the proposed PTF site.

The EPA identified the lack of sufficient justification/verification of EPM assumption in its Janurary 30, 2012 Request for Information (RFI) letter. In the March 30, 2012 response letter to USEPA, FCI states that two documents support the EPM approach, Golder (1996) and Orr(1997b). Golder (1996) stated that "simulation of flow with a code such as MODFLOW is appropriate at the scale of the proposed in-situ leaching area". This suggests that the EPM assumption is appropriate for simulating flow through a 3,600 by 3,300 foot area. However, this clearly does not support use of the EPM assumption to model flow at the scale of the PTF site, which is designed to inject and recover acidic solutions within an area of approximately 300 by 300 feet. Flow at this scale will also be important for flow at the extents of a potential commercial facility. Orr (1997b) was referenced, but it appears that only an earlier version of the same document (Orr, 1996) was provided to Region 9. Orr identified that in order for the EPM model to work, the aquifer must be modelled as a "fictitious medium in which smoothly varying spatially averaged values are assigned to each point".

Documentation provided for the BHP tests indicates that the flow and transport model required significant modification in an attempt to calibrate the flow and transport models to the test results. The calibration required incorporation of extreme heterogeneity at the site scale including one or more preferential pathways. BHP consultants questioned the EPM assumption as a result (BHP, 1999). Region 9 should require a detailed evaluation of the BHP test data to show that the data available for the oxide unit support use of the EPM assumption.

Significant advances in modeling flow and transport within fractured rock aquifers have been made since the 1996 studies. Methods have been developed to select the appropriate modeling approach, and to better characterize fracture networks for proper implementation into the selected methodology. Neuman and Vittorio (2005) stated that research "suggests that rarely can one model flow and transport in a fractured rock consistently by treating it as a uniform or mildly nonuniform isotropic continuum." Significant effort has been put towards research on how to implement and justify the use of discrete fracture network (DFN) models to predict contaminant fate and model transport through fractured bedrock. Orr (1996) stated that "since detailed information [pertaining to geometry of fractures] is usually scarce, the discrete fracture approach is essentially impractical. However DFN methods are practical and have been used in many places throughout the world (Parker et al, 2012).

Orr stated that "since detailed information [pertaining to geometry of fractures] is usually scarce, the discrete fracture approach is essentially impractical" and that "available field methods are insufficient to delineate in detail any but relatively extensive features such as major fracture zones." However, a book published in 1996 shows that many characteristics of fractured bedrock networks were already studied in detail by 1996. Field methods were used to document, among other things, "trace length, orientation, spacing, clustering, surface roughness, and aperture" (NRC, 1996). The characterization of fractures has in turn been used to inform the construction and design of complex flow models. Hydraulic testing, hydrophysical flow logging, osmotic transport monitoring cells, and geophysical characterization of in situ fracturing have also been used to characterize fractures represented in a DFN model. Recently developed models that rely on discrete fracture realizations based on observed fracture data have performed relatively well as predictive tools.

c. The transport model was not used to properly assess the recovery of contaminated groundwater.

The potential for secondary porosity to slow the recovery of impacted ground water has not been characterized. Complex patterns of fracture and matrix void space have been observed at many crystalline fractured rock field sites (Ando and Neuman, 2003). BHP test data indicate that residual water quality impacts remain today, 17 years after the testing. Detailed analysis of the BHP test, particularly the geochemical changes following the acid leaching test should be conducted to estimate the time it will take to restore the groundwater quality at the PTF site. This analysis should include a proper assessment of whether dual porosity methods or other modeling techniques to account for matrix diffusion are needed to address the residual water quality impacts to groundwater in the oxide unit.

d. The models have not been sufficiently calibrated for simulating contaminant flow and transport at the PTF site.

The PTF model was calibrated to match groundwater levels throughout the model domain. Statistics of fit to those water levels were used by FCI to attempt to show that the model was sufficiently calibrated. While these assessments are valid for calibrating a regional groundwater flow model, they do not demonstrate sufficient calibration for simulating flow and transport at the PTF site. The groundwater flow model documentation provided by FCI indicates a calibration goal of having the Absolute Residual Mean (ARM) less than 5% of the range of observed values to achieve model errors that "comprise only a small part of the overall model response." If the desired model output is the fate and transport of injected solutions from the PTF mine block, than the overall model response for this model is not an appropriate calibration goal. It would be more appropriate to have model errors in the PTF area that are a small part of the PTF area model response.

FCI's expert witness at the APP hearing provided his own assessment of statistics of fit to groundwater levels using a subset of those used by FCI, selecting only those measurements collected from wells closer to the PTF site. This is an improvement from the statistics presented by FCI in that it focuses the assessment of calibration to the area where the fit is most needed. However, this assessment improperly compared average water levels at each well rather than comparing individual measurements. Using the average in this way artificially reduces the error. Despite this bias, a quick review of the calibration statistics presented by Adrian Brown indicates that the ARM for this subset is 12% of the range, and therefore does not meet the ARM goal presented in the application.

Furthermore, calibration to geochemical changes is needed to significantly reduce the uncertainty of model predictions. Aquifer tests and tracer tests similar to those conducted at the BHP test site should be conducted and the flow and transport model should be calibrated to match the results of the tests.

e. The uncertainty of important model predictions was not sufficiently addressed.

Model scenarios conducted in support of the UIC permit explored only minor variations in a few select parameters of the model, and did not address key uncertainties in input assumptions and parameters. Just as the model development failed to consider heterogeneity and anisotropy within the oxide unit, the uncertainty of these inputs and the impacts of that uncertainty on key model predictions clearly requires investigation.

In summary, the utility of the groundwater flow model as a tool for predicting transport and fate is overstated by Curis. More reliable models of transport through crystalline rock implement an in-depth understanding of aquifer properties (Ando and Neuman, 2003). Sufficient knowledge of the scale of fractures was not demonstrated. The attempt to justify use of an EPM model versus a more complex DFN model was based partially on an antiquated understanding of field methods and modelling techniques. Another major issue is the justification of the use of a single continuum

EPM model for prediction of contaminant transport. The complexity of the model alone (anisotropy, heterogeneity and more discrete features) shows a lack of understanding of the native aquifer conditions. Useful data collected at the field site and analogous sites have not been implemented into the design of the model. Data that could be used to calibrate the model or inform model calibration is not properly incorporated into the model. Sensitivity to variability in physical properties was not addressed. These potential improvements are in addition to the more basic flaws in the model which must be addressed.

2. Consequences of Flaws

Due to flaws that were mentioned above, the utility of the model as a tool for predicting flow is questionable at best. The model capabilities in terms of predicting transport and fate are overstated. Though the regional flow regime may be modeled to a sufficient degree of complexity, transport of contaminants on a local scale is problematic at best. The flawed model is insufficient as a tool to predict fate and transport on the local scale A flawed model whose uncertainty has not been adequately characterized will lead to flawed decisions regarding definition of the AOR and ZOI, placement of monitor wells, and evaluation of the ability to maintain hydraulic control.

3. Summary of Fixes

As described above, there are several revisions that are needed to correct fundamental flaws in the PTF Model. These include:

- Region 9 should require analysis of the BHP field test data including information collected during site aquifer tests, tracer tests, and the acid leaching test to properly develop a conceptual model for flow and transport at the PTF site.
- Borehole data for wells drilled at the PTF site including geophysical logs and fracture intensity data should be analyzed to properly develop a flow and transport model for the PTF site prior to acid injection.

- The use of the EPM assumption requires better justification, including, a demonstration that the BHP test data are consistent with use of the EPM assumption.
- Analysis of the BHP field test data including an assessment of the residual water quality impacts still seen today should be required. This analysis should include justification for not applying dual porosity modeling methods.
- Region 9 should require that the transport model be used to inform the estimates of the number of pore volumes that will be required to sufficiently reduce the contaminants in the aquifer.
- The PTF model needs to be properly calibrated to simulate flow and transport at the scale of the PTF site. This should include reducing model head residual errors in wells local to the PTF site and should include calibrating to aquifer tests and tracer tests conducted at the PTF well field after construction.
- Uncertainty in key model predictions requires further assessement. This should include analysis of the BHP data to characterize uncertainty in heterogeneity and anisotropy at the site scale.

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