Agenda

November 15, 2023

Santa Cruz County Advisory Panel on the South32 Hermosa Project
Tin Shed Theatre, 304 Naugle Avenue, Patagonia, AZ

Timing	Focus	Task/Action	Who
11:30 *30 min*	**Lunch is served**		All
12:00 *5 min*	**Call to Order & Welcome**		Catherine
12:05 *1 min*	**September Minutes** **October Minutes**	Pending	Catherine
12:06 *1 hour* *26 min*	**Presentation: Ramboll**	Presentation, Q & A	Alma Feldpausch Dr. Rosalind Schoof, Ramboll
1:30 *10 min*	**Project Updates** • IROC • Ongoing Permitting and Site Activity • Workforce/Procurement • Traffic/Trac Out • Water/Dewatering Options • Fast-41 Dashboard	Share information, Q & A Note: Generally, up to three of the topics listed will have an update. If there is no new information, there will be no update.	South32
1:40 *10 min*	**Community/Panel** • FOSCR - Ben • PARA - Carolyn • Town of Patagonia Flood and Flow Committee – Carolyn • Other Reports	Share information, Q & A	Panel Members
1:50 *5 min*	**Standing Topics:** • CPBA • Q&A Document	Share information, Q & A	Panel Members, South32
1:55 *4 min*	**January Meeting:** • Location – TBD • Dr. Brad Racette, Manganese	Share information	Catherine
1:59 *1 min*	**Wrap Up**	Final Comments	Catherine
2:00	**End**		All

Meeting Minutes for November 15, 2023
Santa Cruz County Advisory Panel on the South 32 Hermosa Project
The Tin Shed Theater, 309 McKown Avenue, Patagonia, AZ

The meeting was called to order at 12:00 by Catherine.

Attendance:

Meeting Facilitators (Interfuse Associates):
Catherine Tornbom, Joanne Lamb

South32 Hermosa:
Pat Risner, Judy Brown, Brent Musslewhite, Victor Cook, Melanie Lawson, Sandra Moraga, Stephanie Moreno, Garrett Workman (via Zoom)

Panel Members Present:
Maureen DeLaOssa, John Fanning, Gerry Issac, Ruth Ann LeFebvre, Ben Lomeli, Damian Rawoot, Fritz Sawyer, Carolyn Shafer, Guillermo Valencia, Marcelino Varona, Chris Young, Michael Young

Panel Members Absent:
Olivia Ainza-Kramer, Elizabeth Collier, Linda Shore

Consultants/Guests/Visitors:
Ranay Guifarro, Kat Crockett, Mary Tolena, Baily Winston, Stephanie Smith, Jim Babcock, Chris Werkhoven, Ernie Edwards, Skye Leonn

Presenters:
Rosalind Schoof, PhD, Alma Feldpausch, MS, Robinan Gentry, PhD (via Zoom)

1. **Meeting Minutes – Catherine:** The September and October minutes are still under technical review and will be sent out to the Panel members via email for approval.
2. **Community/Panel Updates – Panel Members:**
   - 2.1. **FOSCR – Ben:** We are looking at some planned river cleanups at the beginning of the calendar year. There is so much garbage and trash in there. That's about it.
   - 2.2. **Patagonia Area Resource Alliance (PARA) – Carolyn**: On the Aquifer Protection Permit (APP), which is a legal action by PARA against a state agency to follow state statutes, we have filed an appeal on our reading on the Arizona Pollutant Discharge Elimination System permit. This one was interesting with the state agency renewing a permit, pulling it back, renewing and pulling it back. We expect the next renewal permit to be released any day. The reason we can say that is because ADEQ posts its billable time on public access. We know when they are communicating with EPA, et cetera, and timelines are in there. With the EPA's involvement now, we're going to be very interested to see what they do about Alum Gulch and Harshaw Creek. And on the Forest Service lawsuit, PARA is about to file its answer to the answering briefs from the Forest Service.
   - 2.3. **Town Flood & Flow Committee – Carolyn:** I must correct an error in my report where I said the November 16th meeting has been canceled. That's true. Then I said the next meeting is in December. Wrong. It has been rescheduled for November 30th at 10 a.m. There will be some interesting updates especially with the School Canyon failure project.
3. **Standing Topics:**
   - 3.1. **Community Protection and Benefits Agreement (CPBA) Working Group – Damian**: Our working group had a meeting earlier this month on November 1st. We're happy that a county representative will be joining us, as well as Mayor Andrea Wood of the Town of Patagonia. Dean was working towards trying to get somebody from the City of Nogales to join the effort. In general, we had a more open-ended discussion on how to get the process right. Gerry agreed to work on a new draft of the framework that was shared just a couple days ago. We're all in the process of reviewing and thinking about all the critical elements within it.

     Another topic item in the meeting, and as well as email exchanges of the working group, is getting outside expertise to help us on various elements of the CPBA. One of those being on the topic of environmental justice. We've requested that Dr. Denise Moreno-Ramírez from the University of Arizona College of Public Health speak to us at our December 13 Working Group Meeting. I had a meeting last week with the new director of the Natural Resource Use & Management Clinic at the College of Law, University of Arizona. He was interested in the work that we're doing, There may be a role the law clinic can have to firm up this agreement in a way that it could be moved quicker by the various signatories.

     Marcelino: *I have a question. At our last meeting I recalled that all your work could become irrelevant because South32 goes ahead and starts the project, moves along rapidly, and we fall behind with the good neighbor agreement? Or can the good neighbor agreement be done at any point in time?*

     Damian: There is a timing element, but I think we're going to continue to work. South32 is working through their process as well. Melanie, do you have any thoughts on this?

     Melanie: *The new structure that Gerry helped put together would allow it to be amended throughout the life of the project so that it would be more like a living document that would be updated. That format would allow for new items to be added or adjusted throughout the life of the operation. What we were trying to make clear in the last meeting was that the agreement does not drive our production date. We're not waiting.*

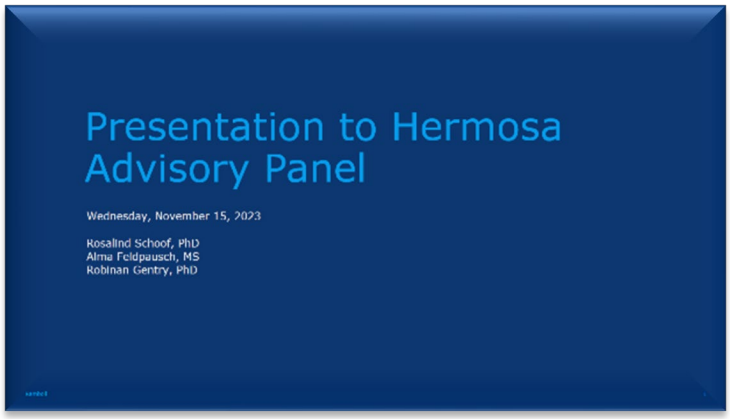
Ruth Ann: *Doesn't some of the monitoring have to happen now so that we know what the baseline is? Or is that even part of the agreement?*

Carolyn: *Based on what Ruth Ann asked, I'd like to plant a seed. Baseline information is very important. And perhaps there could be a separate agreement with South32 to do the baseline agreement we know we want. You hear me say over and over, could we please have a comprehensive groundwater study? So maybe some of that could be done just as a baseline information agreement.*

Ruth Ann: *Food for thought and discussion. Another speaker is, and I don't know her name, Tomas always knows her name, she's out of U of A and she's the groundwater lady. She does all the groundwater studies and has done a lot in Elgin and Sonoita.*

3.2. Q&A Document – Catherine: No update for this month.

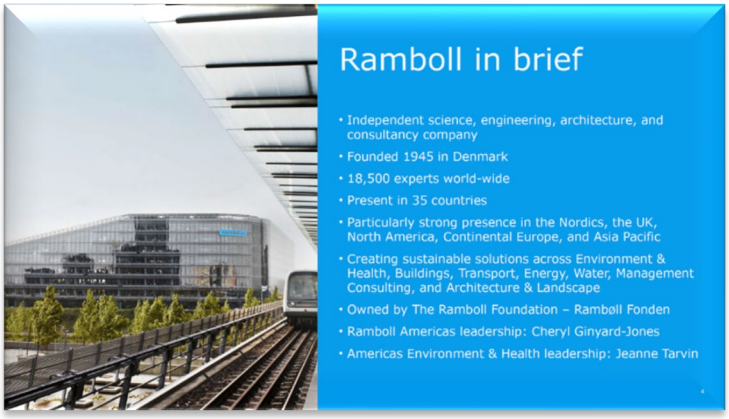
4. Ramboll Presentation – Alma Feldpausch, Dr. Roz Schoof, Dr. Robinan Gentry



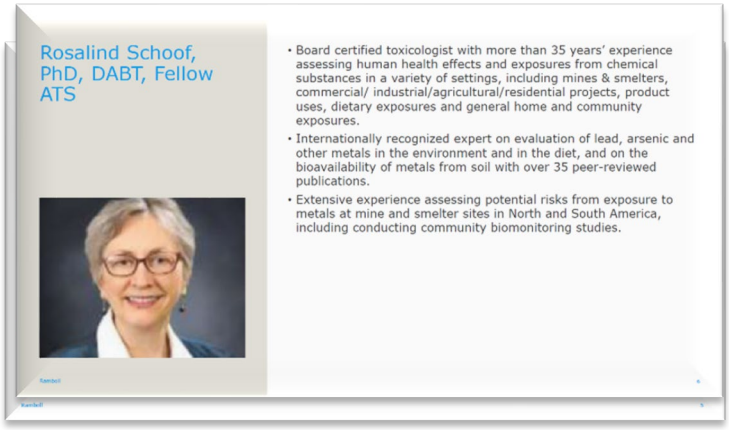
Alma: We have four main themes we'd like to talk about. The first is about who we are and why we're here. Then we will provide background on manganese and its occurrence in the environment and what we know about our background exposures related to manganese. Then we'll transition to Robinan Gentry who is a toxicologist in our Baton Rouge, Louisiana, office and has published quite a lot on manganese. She's going to talk about manganese toxicity and some pharmacokinetic modeling that she's performed. And then from there, we'll talk about what we understand to be our next steps.

Just a little bit of background about Ramboll. Overall, we are a large consultancy company based out of Copenhagen. The Ramboll Group has a lot of different businesses that include architecture and engineering.

The bulk of the practitioners in the United States are focused on environment and health consulting practices. Here in the United States, we're more of a traditional environmental consulting firm with a very large health sciences, air quality, and engineering practice. While our overall leadership is based in Copenhagen, Cheryl Ginyard-Jones and Jeanne Tarvin are our leaders here in the Americas. Roz and I are in our Seattle office, but we do have health sciences practitioners all around the globe. We have a deep bench of people who bring a broad array of experiences from geography and culture to the practice.

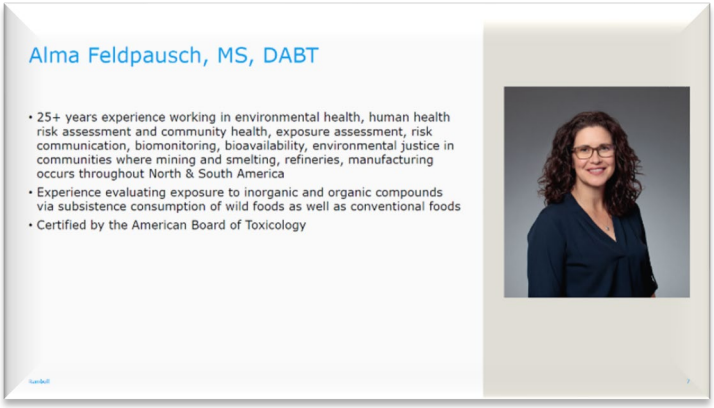


Roz: I'm a board-certified toxicologist. I have been working on mining and smelting sites since the late 1980's. I'm an expert in toxicity and exposures to lead and arsenic. I've dealt with manganese, of course, but not as extensively as lead and arsenic. My research focus has been on the bioavailability of metals in soil. Metals in soil are absorbed into the body in a reduced amount compared to metals dissolved in drinking water. I've published a lot on that topic. I've also been involved in community health studies, including bio-monitoring studies where we've collected blood lead data or urine arsenic data and then compared that with exposure information to figure out what the likely sources of exposure in populations are.

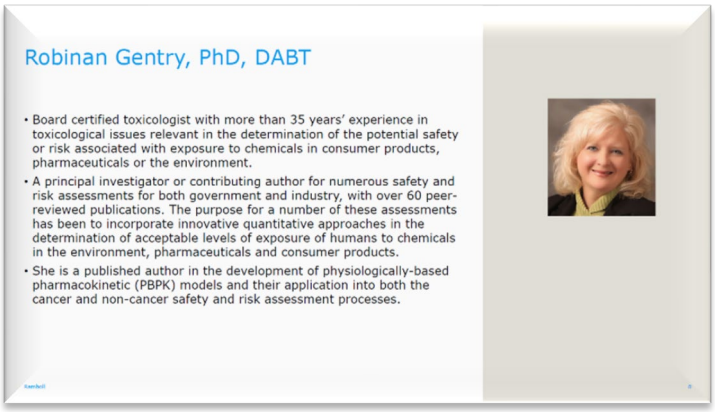


Alma: I'm following in Roz's footsteps, figuratively and literally, up and down the Western Hemisphere checking on mine and smelting sites. I am trying to absorb as much of Roz's expertise in metals toxicity, bioavailability, biomonitoring, and community exposure assessment. I have training in toxicology and am certified by the American Board of Toxicology. I also do a lot of work in environmental justice. That has been taking up more and more of my time in the last couple of years since the current administration has reinvigorated executive orders addressing environmental justice and then adding climate equity onto that.

Robinan: I am a board-certified toxicologist with more than 35 years' experience. My work over the years has been focused on looking at toxicology and the potential safety or risk of chemical exposures in consumer products, pharmaceuticals, and the environment. I've conducted these assessments as a subcontractor with the EPA and OSHA. I've written summary documents and toxicological reviews for the Agency for Toxic Substances and Disease Registry (ATSDR)[1], which is a group within the CDC. Later I'll talk about some models I've been involved with for decades that we've used and applied to look at potential safety of exposure to manganese. I'm a published author on these types of models and their application for both manganese, other metals, and other chemicals that we see people exposed to in the environment.



Alma: A little more specifically about our health sciences team and the background and depth of experience we have with mining sites. As you heard from Roz, she's been working in this area for 30-plus years and has published a lot on metals toxicity and bioavailability. A lot of that has come from working at mine sites throughout the Americas, and especially western United States. These are mines and smelter sites that were in production for hundreds of years, predating our current environmental and public health legislation. You can imagine that a lot of our experience is more on this spectrum of worst-case scenarios where we didn't have a lot of the controls that we have today.



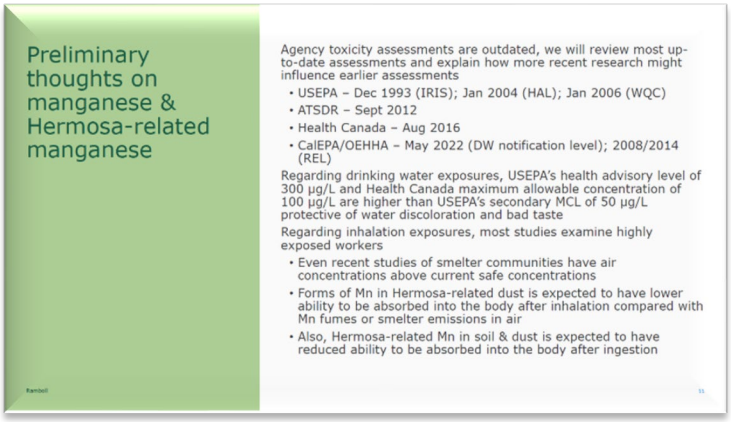
[1] ATSDR is a federal public health agency of the **U.S. Department of Health and Human Services**, based in Atlanta, Georgia. ATSDR protects communities from harmful health effects related to exposure to natural and man-made hazardous substances. They do this by responding to environmental health emergencies; investigating emerging environmental health threats; conducting research on the health impacts of hazardous waste sites; and building capabilities of and providing actionable guidance to state and local health partners. https://www.atsdr.cdc.gov/index.html

We bring a lot of what we've learned from these big mining complex sites to the practice today. We were just at the mine earlier this morning and it was exciting to be somewhere where things are starting out. The mine of today is completely different from anything we've seen. The older mines we work on are struggling to catch up with current technologies for managing liquid and airborne effluents and emissions. Roz, do you want to say anything about our past mining experience? Do you want to talk about Butte?

Roz: I've worked a long time in Montana, especially in Butte and Anaconda. But we've also worked at operating smelters and mines outside the U.S., in Canada, Peru, and Namibia. We have perspectives on contemporary operations, but also what it looks like when these kinds of operations are going on in developing countries that don't have the kind of controls that we apply in the United States. It's important to me personally to see our mineral resources in the United States developed domestically instead of pushing all that onto developing countries where the environmental impacts are going to be much more severe than they would be in a setting like this. I'm not sitting in a community that's having a mine developed, so it's easy for me to say that, right? But that's just something that is in the back of my mind. But nevertheless, we're fully committed to ensuring that communities are protected. And that's the purpose of the work that we do, both with these legacy sites and, in this case, with how a new project is developed.

Alma: Our primary role is to serve as a liaison between South32 and the community on health-related matters. We're quickly getting up to speed on everything. It is South32's intention to work with an academic partner, a group of independent scientists, to work with you and be responsive to questions and concerns, and to provide baseline pre-operational investigation and study. Recognizing that they're quite busy and don't have the in-house expertise specific to this, they brought us on to facilitate the process, and help them identify who within these universities locally have the right expertise. It's not just somebody who knows about manganese and other metals. It's the environmental chemistry, it's the transport, the modeling. There are a lot of pieces to understanding how things move in the environment and how that translates or doesn't translate into potential exposure to people and looking at the broad potential for community or ecological impacts. We're here to help, not to replace, independent experts that you've been looking into. Our role is evolving as we get our feet on the ground.

Roz: I want to emphasize that we're a resource for toxicity of metals generally. Manganese is the issue that you've raised at this point. You may bring to us other questions about other metals too at some point. But one thing about manganese that I think you're fully aware of is that the EPA has not updated their toxicity assessment for manganese in a long, long time. It dates to the 90's. Whenever that happens, we look at other agencies, other countries, to help get updated overviews of toxicity. And part of the issue is that the government agencies can do massive toxicity assessments.



For most of these chemicals, metals in particular, there are thousands and thousands of articles published. And you can't just cherry pick one or the other. You need to do an assessment of what the whole base of literature tells you. It's great when ATSDR does their toxicological profiles. You may have looked at their website. In addition to their big tox profiles, they have a fact sheet on manganese. It's a very useful background, especially for sharing with the general community.

Health Canada has done a more recent update in support of their drinking water regulation[2]. It's a constant process with these metals to keep up with the literature. And it's important to incorporate new thinking and new information into your assessments as you go. We're a resource to help with that.

In terms of drinking water, EPA has a health advisory level of 300 micrograms per liter. Health Canada proposed a somewhat lower level of 100 micrograms per liter. The EPA has a secondary drinking water standard for manganese of 50 micrograms per liter. And secondary MCLs are based not on toxicity but on palatability which is based on discoloration and bad taste in the water that might be associated with manganese.

It turns out people have a distribution of how you taste. So not everybody's going to taste the bad taste at the same level. But 50 is the cutoff EPA recommends. Health Canada did another study and they said 20. But it turns out different manganese compounds may trigger bad taste at different levels. The point is that even lower than these health-based standards, drinking water that has manganese in it may be less pleasant to drink. These are some of the initial top-level thoughts that may be helpful to all of you.

In terms of inhalation exposures, a lot of the studies historically have been of workers who are very highly exposed. There are some recent studies of smelter communities. Those air concentrations were higher than the ones that the EPA is regulating. Even though EPA's health-based values are old, they incorporate uncertainty factors to be protective. For the inhalation, there's a thousand-fold safety factor or uncertainty factor between levels where effects were observed, and the levels EPA says should be our limits. Those are things that we will have to look at more – questions about what form of manganese is going to be in any dust related to the Hermosa mine. Maybe it won't be as well absorbed into the body after inhalation. Maybe it doesn't behave the same way as manganese fumes or smelter emissions. And the same thing for manganese in the soil and dust. It's likely to have a reduced ability to be absorbed after ingestion as compared to manganese in the diet.

Ben: *As I understand, EPA suspended development of manganese regulations back in April of 2019, and we want to know why, and we want to know how anyone processing manganese can proceed without knowing how it should be regulated to protect the public.*

Roz: I don't think that they withdrew any regulations. My understanding is that the IRIS toxicity assessment was put on hold. Is that what you're referring to?

Ben: *No, I understand they suspended developing the regulations.*

Roz: The Integrated Risk Information System (IRIS)[3] is how the EPA does its dose-response assessment for chemicals, and so the reference doses and the reference concentrations that they post on that system are the result of a process they follow that takes years, sometimes a decade, to do. The first document they produce is a pathway for how they're going to proceed to review the new literature and update their values. They don't generally withdraw the existing values while that's going on, but they do also consider other values that have been developed more recently than their own by the ATSDR or by the state of California or other authorities.

And when the EPA posts, they have risk-based screening levels for air, drinking water, and soil that are not regulations. They're guidelines for risk assessors, and that's the level at which you begin to further assess a chemical. In other words, if you're below whatever the risk-based level for manganese might be, say 1,800 parts per million in soil, then don't worry about it. If you're above that, then look more carefully to figure out what kind of risk you might have. It's not a regulation, but it's guidance for risk assessors.

I'm more familiar with what happened recently with uranium. Same kind of thing. EPA developed their plan for uranium, and then they dropped it. They didn't proceed with the assessment. They deferred it.

Alma: It's not uncommon for this to happen because there are competing priorities.

Roz: Like PFAS, for example. There are updates on lead that have the EPA tied up. There's a brand-new IRIS assessment for arsenic that came out. So, they're still generating lots of these documents. It's just which one is their priority gets juggled and gets deferred. Nothing that I know of has been withdrawn. I believe they just stopped the update

Ben: *They stopped the development of the regulation since 2019. I'm wondering if you know when you would expect them to resume developing that regulation?*

Roz: No idea. And again, I don't think it was a regulation. And maybe that's something we can pursue after because if you can show me exactly what you're referring to, I could perhaps help better.

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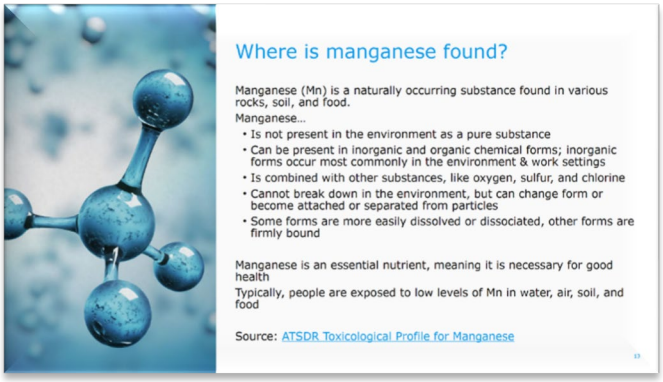
[2] Health Canada: https://www.canada.ca/en/health-canada/programs/consultation-manganese-drinking-water/manganese-drinking-water.html

[3] The IRIS Program (Integrated Risk Information System) is located within EPA's Center for Public Health and Environmental Assessment (CPHEA) in the Office of Research and Development (ORD). The placement of the IRIS Program in ORD is intentional. It ensures that IRIS can develop impartial toxicity information independent of its use by EPA's program and regional offices to set national standards and clean up hazardous sites. https://www.epa.gov/iris

Ruth Ann: *Will you be telling us about how you're going to detect manganese in the water, the air, and the soil here at South32 up at the mine?*

Alma: Looking at concentrations of these different metals in the environment is something that will be addressed in part through South32's long-term environmental monitoring programs. Then you can use that data to answer different questions. If there are concerns about looking at that data and trying to understand how that might result in chemical migration to areas where people could have contact with it, that would be something that we could talk about with the academic partners from University of Arizona, who we're looking at bringing on to help answer some of those public health or environmental health related questions.

Right now, we are trying to help find experts who will answer these difficult questions for you. My understanding is that South32 does this at all their sites. They bring in independent experts rather than their own in-house people to do this so that there is more confidence placed in their results. You can have faith that they are listening to everybody equally and impartially.



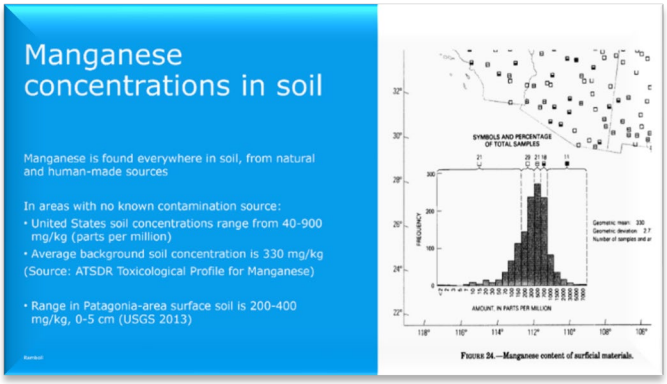
Now we will get into the background on manganese and talk specifically how it's something that's in the earth's crust. It's everywhere. It's ubiquitous. It can be present naturally in inorganic forms where it's bound with other elements.

There are different types of manganese compounds. And because it's present in the earth's crust and in the soil, that means it's also in our stream beds, suspended as particulates in our surface waters and present in our ground waters. It also can be taken up into plants, including plants that we eat. Manganese is something that is taken up into greens, legumes, and some other foods. So, then it becomes part of our diet, as well as our drinking water. And because it's present in the soil, when the wind comes along, it can release manganese and other minerals as windblown dust.

Like other minerals and substances, it doesn't break down or cannot be destroyed, but it can change form in the environment depending on the acidity or basicity of the soil or the water or what other types of compounds it's bound to. Some compounds really hold on to manganese tightly and does not want to let go. In other cases, the bonds are looser, and so the manganese can disassociate and find another partner to hang on to. So, there can be changes over time.

Manganese is important to our bodies. There is an amount of manganese that we really need to have, and then there's an amount where if we have more than what we need, our bodies are good at regulating it. There are instances where if you have too much of it, you overwhelm our body's ability to regulate those essential manganese levels. And then that's when you start seeing adverse health effects related to too much manganese, as opposed to adverse health effects from not enough manganese.

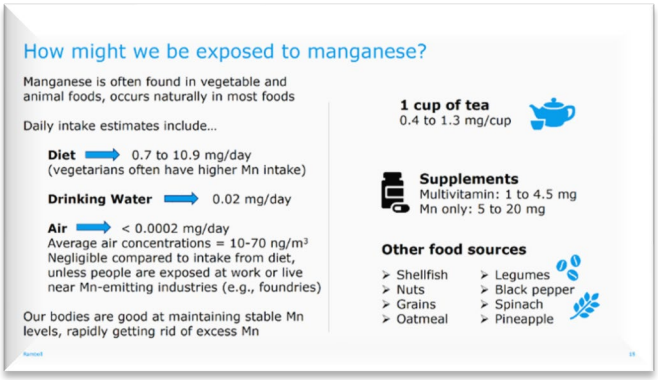
Marcelino: *Can you clarify something for me? Because I'm a little confused with the difference of manganese as an essential nutrient. If it's so vital for the body to exist health-wise, why do we have people in certain communities that are so anti-manganese production within the neighborhood or community?*



Alma: That's a good question. It could be because people aren't aware that manganese, like some other metals associated with different industrial processes, are essential. Cobalt is another one that we encounter at mine sites, and it's essential to our body functioning, and can be used in medicines or supplements, just like manganese can be taken as a supplement for people who are deficient.

But I think there's not a lot of education. It's not like we're all given high-level nutrition classes when going through school that talk to us about every one of these things so that we understand that some of it might be good and too much is not good. Kind of like an aspirin, a little bit can be helpful, especially if you need to thin your blood, but then too much of it can be harmful. But I can't explain why some people have certain ideas about it.

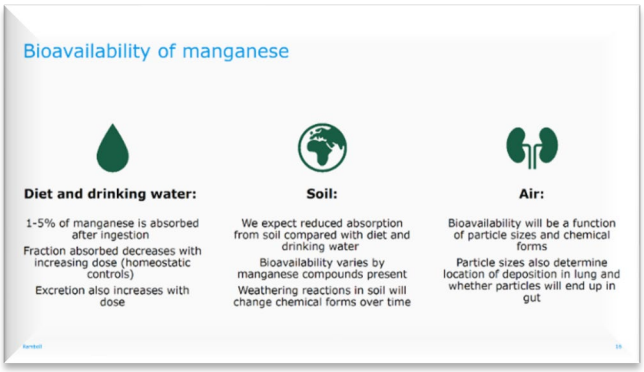
We're in a very mineral-rich historic mining area, with reasonably high levels of manganese. US wide, there's a lot of variability. You can see that our natural soil ranges go from 40 to 900 parts per million. That's a pretty big range. You can see some areas might have a lot of naturally occurring manganese, others not as much. On average, there's about 330 parts per million or milligrams per kilogram. A study by the USGS in 2013 looked at manganese across the country. Specific to this area, they show that a majority of the manganese is in the 200 to 400 parts per million or milligram per kilogram range.



And that's just on the surface soil, which is important. Because that's pretty much what most of us are in contact with most of the time. Because that's what gets blown around by the wind and taken up into our gardens. I mentioned earlier that because manganese is present in the earth's crust and in our soil, it gets taken up into our diet. All this information comes from ATSDR. There's a lot of interesting information about manganese including different specific food types. Manganese gets taken up into grains and tea which sometimes has higher levels of manganese than other foods. There're ranges in supplements and different foods here on the right.

The bulk of our exposure to manganese is through diet. People who are vegetarians will often get more because they're theoretically eating more of those nice leafy green foods. But because of the fiber that comes with it, less of that manganese is absorbed. It just passes right through. About an order of magnitude less manganese comes in through drinking water and there's a negligible amount in the air.

Roz: In terms of bioavailability, manganese is poorly absorbed into the body. So only 1% to 5% of the manganese that you eat in your diet or in your drinking water is going to be absorbed. Alma mentioned, and I think Robinan will come back to, the homeostatic controls. The fraction absorbed decreases as the dose increases. It's how your body regulates how much manganese you get so you're in that optimum level. As the dose increases, you excrete more in the bile and out in the gut. It's well controlled for soil, as I mentioned earlier, the absorption due to the nature of minerals, of manganese in the soil and the interaction of manganese with soil particulates means that the bioavailability can be reduced. There isn't a whole lot of research specifically on manganese in soil. There are tons on arsenic and on lead, and the EPA has default assumptions about the fractional absorption of those metals from soil. They don't have a similar assumption about manganese. It's an area that we know it's reduced, but we don't know really by how much. These weathering reactions over time in the soil will cause the chemical forms of manganese in the soil to change and will also cause interactions between the manganese and the soil particles to change, in some cases to strengthen.

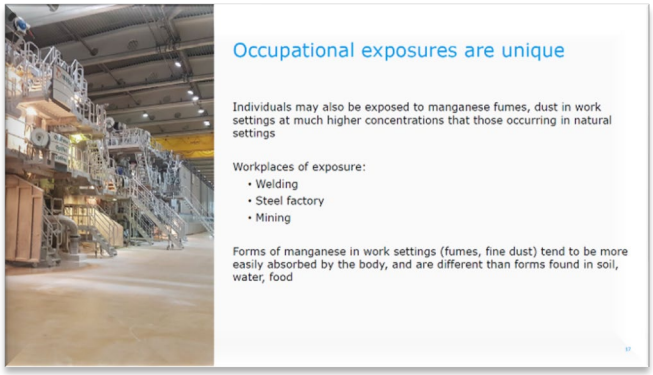


Ben: *Well, you know, it's a heavy metal and it's a trace element. Heavy metals tend to bind themselves to soils, but that's highly dependent on pH.*

Roz: Exactly. It's pH and the nature of the moisture in the soil, whether you've got clay soils, how active are those particles, and because there are interactions on the surface of the various particles. If you have sandy soil, maybe you'll have fewer interactions. Or if you have organic materials present. The nature of the interactions of metal ions within soil is complex, which is why we have tests. We have an in-vitro bioavailability test. We have tests we do in animals that simulate the stomach fluid and measure the relative bioavailability.

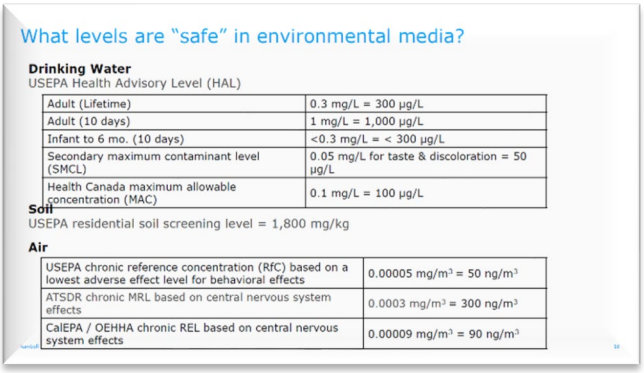
Ben: *If those soils are flushed with water, then the pH of that water is also important.*

Roz: There isn't a lot of information about the absorption of inhaled manganese particles into the systemic circulation, into the blood. Particle sizes are going to determine the location of where those particles are deposited in the lungs. Larger particles are going to be deposited high in the pulmonary system, in the bronchial ciliary respirator, and then you end up swallowing them. They end up being ingested instead of going into the lungs. The very fine particles end up deeper into the lung and have a longer residence time there. It's complicated. The relative impacts of manganese that's ingested versus inhaled, are going to depend on how much is absorbed. In other words, if you inhale less manganese but you absorb a higher fraction, then maybe that dose counts more. And then where does it go once it gets into the stomach versus into the lungs? There may be differences in disposition in the body and that's the pharmacokinetics that Robinan's going to talk about. She's developed models.

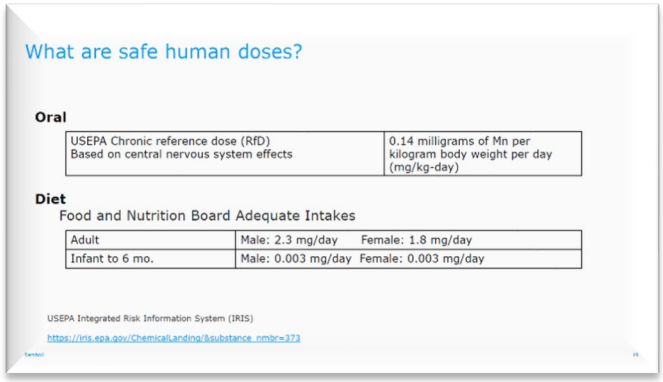


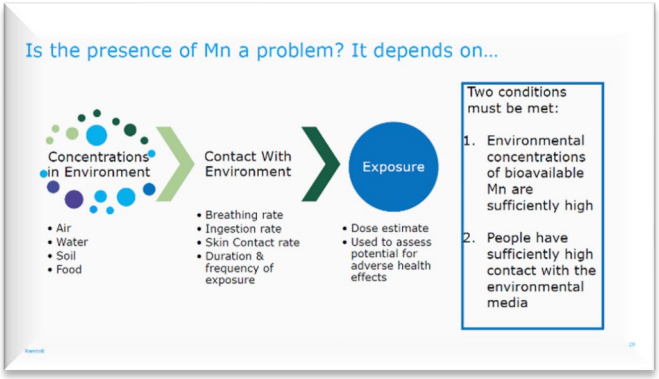
There are a lot of differences between occupational exposures and in general, residential exposures to dust. The nature of metals released from high temperature things like welding or from smelters is going to be different from the nature of materials of dust released from a mining operation. That's another thing that needs to be considered.

This is a summary of some of the drinking water levels.



I wanted to point out that it can be really confusing because we go from milligrams per liter or sometimes micrograms per liter. It's important to make sure you translate properly. The same for air. I've seen publications talk about nanograms per meter cubed, whereas the reference concentrations are in milligrams per meter cubed. I know it's a really basic thing, but all of us can get tripped up on that sometimes when we're trying to do comparisons in our heads. This is also what I mentioned before about safe doses, the reference dose, RfD, is a reference point from which to gauge the potential effects for inhalation. They're stated in terms of the milligrams of manganese per kilogram body weight per day. And again, these are values that are derived with these uncertainty factors, so they don't represent a threshold where there are adverse effects if you're above that, they represent a point at which you need to look more carefully to try to understand risk. And I think there's one for air too.

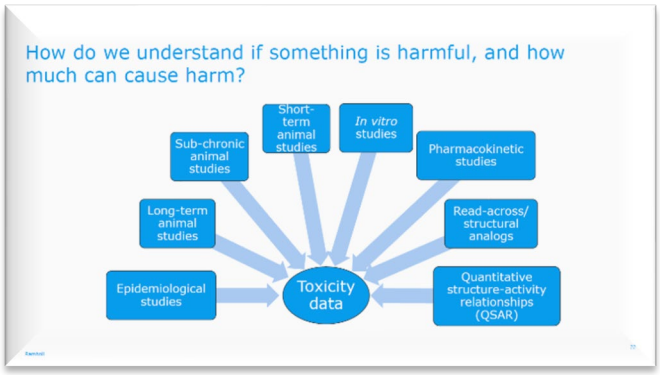




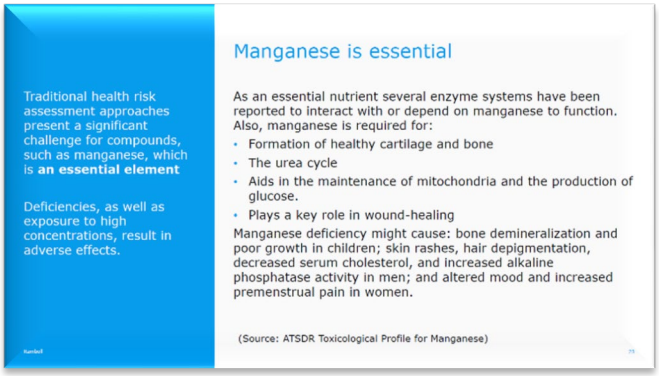
When we do risk assessments, we develop what we call problem formulation to understand the sources, understand transport from the source to where people might be, and transformations that occur along the way.

If we have a complete exposure pathway, then we would get to the point where we start trying to calculate the doses. If you don't have people at the point of the source, then your exposure pathway isn't complete. You don't really have anything to calculate. That's the question - how do things get from one place to another, and how do you accurately estimate the concentrations at the point of exposure? One example is if you have soil in your yard, does that soil get into your house? How much gets tracked in? What are the relative concentrations in indoor dust versus soil? How much soil do you ingest each day versus how much indoor dust do you ingest each day? Those are all highly uncertain things. There are a lot of steps to take from thinking you have a source to try and calculate doses and figure out if you have a risk. We've published papers on that.

Robinan: This slide follows nicely from the question about why EPA has stalled. When we're looking at trying to understand if something is harmful, it's not just focusing on one study. It's looking at all the available evidence from human or epidemiological studies and animal studies. Now we have a growing area of science where we're doing in vitro (dish) studies in the laboratory and trying to simulate biological systems. For each compound that's being studied, it's becoming a bigger group of evidence to look at, to understand if something is harmful and how much can cause harm.



And an even bigger challenge with manganese, as Alma mentioned, is manganese is essential. We need this in our bodies. We have a standing background level of manganese in our body, and it's needed for the formation of healthy cartilage and bone for different cycles in the body. It even plays a role in wound healing. And if we are deficient in manganese, then there are all kinds of health effects we can have from that. The challenge in looking at a compound like this is it's not just how much you're exposed to; it's looking at the context of what is normally in your body. Your body can regulate that. And so how much could you be exposed to before you overwhelm those systems that keep manganese in check in the body? Next slide.



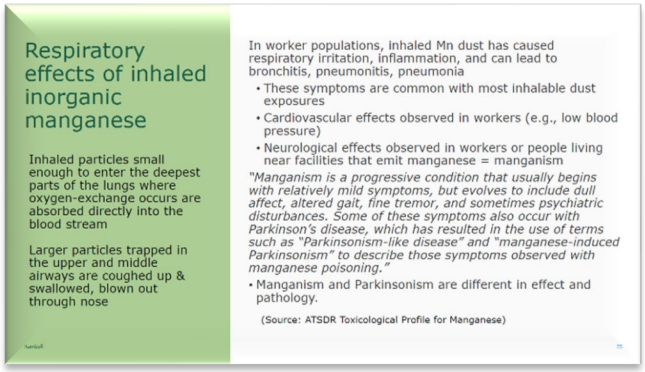
Marcelino: *Does there come a point with the ingestion of manganese that could have an adverse impact on the function of the brain if the level is too high?*

Robinan: That is the main concern in workers who are exposed to very high concentrations. Much, much higher than you're exposed to in the diet or typically in ambient air or drinking water, like Roz has talked about. That has been the focus of looking at those endpoints to help us understand how do we look at those very high levels and how can that inform us on levels where we might begin to see toxicity to the brain. And that's what I'll talk about too. Some of our modeling is focused on trying to look at just that. How much actually gets into the body, and how much could be transported to the target tissue, specifically the brain?

Marcelino: *But you would have to run tests within this area to find out what the definition of a high level of toxicity is? Or is that just a general category throughout the country?*

Robinan: Well, again, I think we're looking at what we've learned from occupational studies. In many of those studies they haven't looked at brain levels in the workers, but they've looked at blood levels and how those correspond to the effects they're seeing in the workers. Many researchers have conducted studies over the years in animals to try and fill the gaps of information that we can't collect in humans.

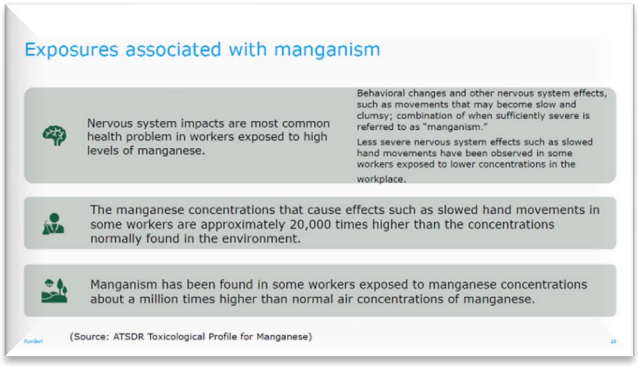
As we've mentioned, too much is not a good thing. We were just talking about how occupational studies provide a lot of data on health outcomes, specifically following inhalation exposure. There are many, many of these studies that have been conducted over multiple decades. We've also had studies conducted to look at those levels that are recommended daily allowances, how much we need in our diet. For workers, we need to understand what the contribution was for their diet, and at what levels they were exceeding those homeostatic mechanisms in the body that can control for that. In general, oral toxicity is generally low. We don't get much absorption, and there are mechanisms that regulate our uptake, so we get what we need. ATSDR and other authoritative bodies have focused on neurological effects trying to use those effects to set levels of exposure where we have plenty of safety built in.



The nervous system is the most common health problem in workers exposed to high levels. But again, it is important to point out that the manganese concentrations that are associated with these effects, such as these workers having slow hand movements or things like that, are ATSDR's estimate, not mine. But we have an authoritative body saying that the concentrations that cause these types of effects are about 20,000 times higher than the concentrations we normally find in the environment. The manganese that's been observed in workers exposed to manganese concentrations is about a million times higher than normal air concentrations of manganese. We have a huge difference between those exposures where we've reported these types of effects and the exposures we experience from what's typically in the environment.

Ben: *You talk about workers and people that are exposed to it on the job. We're concerned about the public, and we've seen videos where the public is affected by manganese dust and the transportation of the mineral.*

Robinan: You've seen studies on the evaluation of the dust from these exposures?



Ben: *We've seen videos, we've seen studies about the public being affected by the dust not just environmental levels, but levels of mining and processing the manganese. Neighbors along the transportation routes, neighbors in the processing plants, neighbors in the mines. These are not workers. These are the public.*

Roz: Are these in the United States or elsewhere?

Ben: *All over the world.*

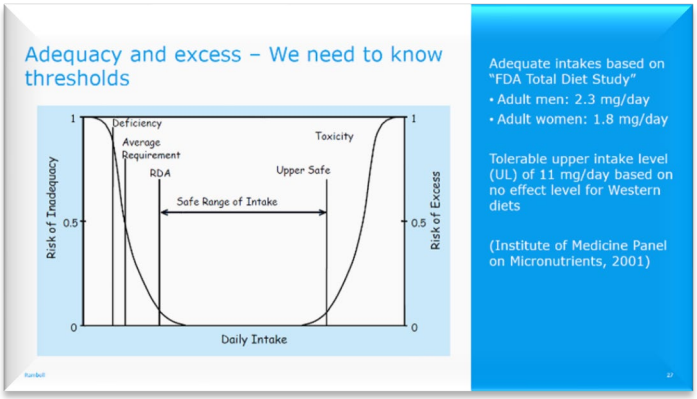
Robinan: An important component of understanding if these are being seen is what are those exposure concentrations? Are there controls in place, or not, to help prevent those exposures? [Note: Robinan was disconnected briefly at this time in the presentation]

Alma: Roz and I have seen big differences between operations in the United States versus other countries that don't have this. Even if they have environmental regulations, they're not always enforced. And that can make a huge difference.

Ben: *We understand this will be the first one in the United States.*

Alma: Well, we have a lot of environmental regulations that are enforced.

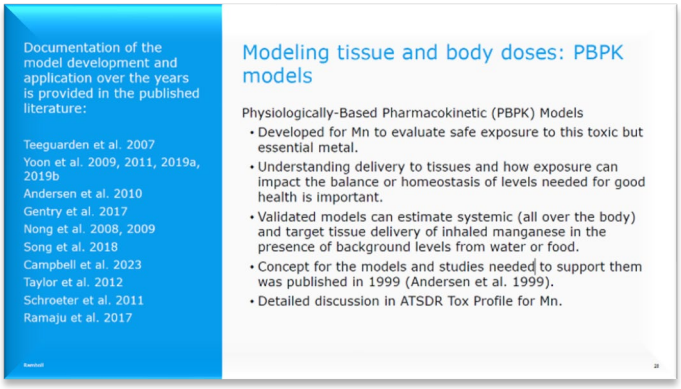
Roz: I emailed one of the EPA's toxicologists in their Region 10 office, to ask the question about the IRIS assessment, because that's who I would go to normally. It's hard to get information from headquarters, but the regional toxicologists are always helpful. He could potentially tell me his perspective, why the EPA dropped that, if he knows, because I looked on the website, and I couldn't see it listed, other than it was suspended. So, like you said, no reason. If you could share with us some of the references you're citing, that would help us assess your comment. [Note: On November 15th (after the meeting), Kris Thayer, who runs the IRIS program provided the following information to Roz by email: "In April 2019 there was an EPA Administrator led adjustment to the prioritization process for IRIS https://www.epa.gov/sites/default/files/2019-04/documents/iris_program_outlook_apr2019.pdf. This document *states "Other assessments that were not identified as priorities for fiscal year 2019 have been suspended but may be restarted as Agency priorities change. These include ammonia, chloroform, ethylbenzene, formaldehyde, manganese, naphthalene, nitrite/nitrate, PAH mixtures, and uranium. Draft assessment materials previously released on the IRIS website will remain accessible for reference on individual chemical pages. Additionally, existing toxicity values found on IRIS will remain available for use.*")



This is what's called a U-shaped dose-response curve. I'm sure you've all heard a toxicologist quote

Paracelsus, or semi-quote Paracelsus, and say the dose makes the poison. If you drink enough water, it's toxic, right? On the right, as the dose goes up, the toxicity potential increases. In this case, because we've got an essential nutrient, the dose goes down and the toxicity goes up. Different kinds of toxicity, but it's the same chemical. This concept of a U-shaped dose-response curve makes it much more complicated to figure out your safe dose. The RDA is the Required Dietary Allowance.

Robinan: You have a happy spot in the middle because you do need a certain amount of manganese. And what we're interested in is both understanding where that curve takes off on the lower end because we don't want to be deficient, and we're interested in this upper end. We can eat as much as 11 milligrams per day as an upper intake and there's- there's no effect from that.

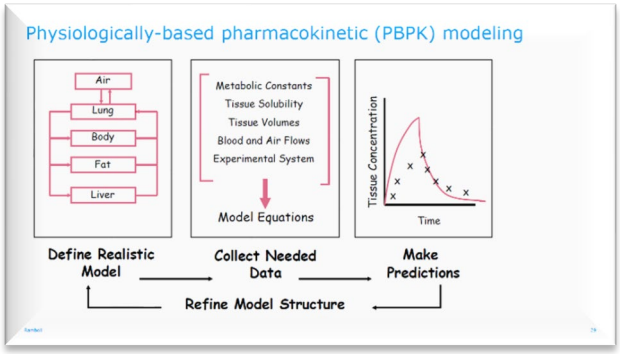


Roz: Also, we can note Robinan, that the safe range can be very different for infants and young children as opposed to for adults. This complicates finding a universally safe level.

Robinan: That's of concern because differences in manganese intake have been observed between infant formula and breast milk, depending on how people feed their young. Infants do require it as well for development. We must be careful about that because some of these systems that regulate manganese in a newborn are still under development.

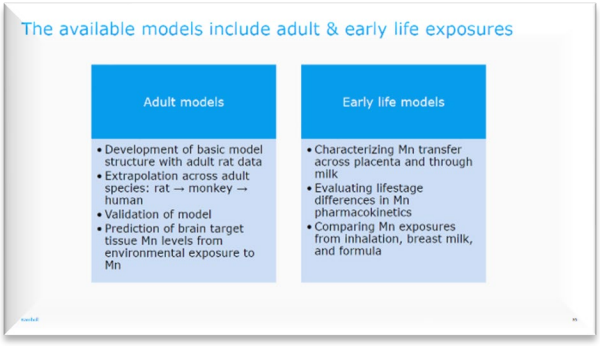
Ben: *Do you have a U-shaped curve for respiratory intake?*

Robinan: What we're most interested in from the respiratory or the inhalation aspect is how much intake would it take to push you up this toxicity side of the U-shaped dose-response curve. Back in the '90s, we developed a concept of developing physiologically based pharmacokinetic models in collaboration with the EPA to develop a concept for these models and as well as the studies that were needed to be conducted to increase the confidence in these models. What they specifically focused on was understanding the delivery of manganese to the tissue and how exposure can impact the balance for the homeostasis of these levels that we've talked about for good health. As you can see from the publications and the initial publication for the concept in 1999, the development of these models and the data to support them have been ongoing for multiple decades.

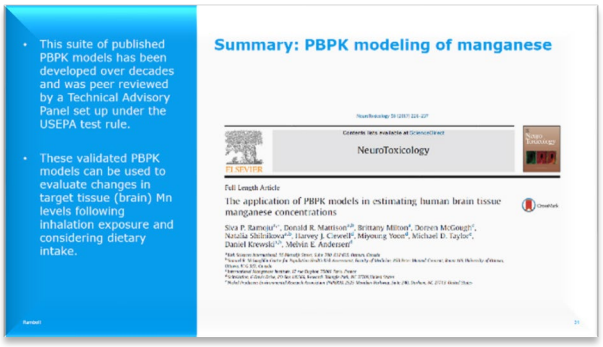


The development of these models is an iterative process. We characterize the full body, the physiology, the movement, then use metabolism uptake of different compounds. We also collect data needed to give us confidence in the model. While we may come up with a concept, data is needed to make sure the models are as accurate as they can be. Then we make predictions against studies for some of these tissue concentrations. And as we do that and we have more data, we will refine the model, so it becomes more and more realistic in the biological situation, and we increase our confidence in the results from the model.

The models for manganese have been under development, as I've said, for multiple decades. And so, they've been expanded over time to address more and more questions that have come up with manganese. They started with the development of a basic model in the rat. We did studies to confirm that, and then there was some extrapolation across species from the rat to the monkey and to the human with expansion of the models. Then we looked at data that we had available in the human and in the animal to validate the model or make sure that what the model was estimating was consistent with what would happen in the body. And then we were able to extend it to predict target tissue levels in the brain from environmental exposure. And after the adult models were complete, we extended that to begin looking at early life issues such as characterizing the transfer across the placenta through the milk, looking at the differences in life stages with the pharmacokinetics, collecting data on what we understood about the development of these processes that keep manganese in homeostasis. And, comparing exposures in the infants from

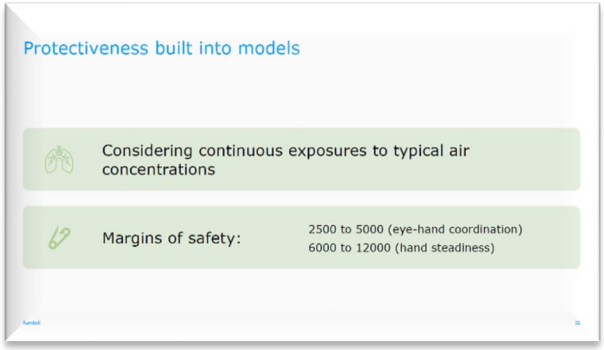


inhalation, breast milk, and formula.



The suite of all these models, as I mentioned, has been developed over multiple decades. As we've developed new pieces of these models and extended these models, they've been peer-reviewed by a technical advisory panel that was set up under an EPA test rule. Those panel meetings and the review of those models involve not only the scientists doing it but also people from the EPA to provide their input. And these validated models can be used to look at changes in target tissue manganese levels following inhalation exposure in combination with what you get from your diet.

Looking at the results from the model and the protectiveness built into models, we are trying to understand what types of margins of safety, or the difference between a level you would get that's normally in the body, and then how much it would take to begin moving you up that side of the U-shaped dose-response curve where you're starting to get accumulation in tissues that could result in toxicity. When we look at those within the model, we're seeing differences between exposures, how much you must get in the tissue, and what the impact of the inhalation would be, we have margins of safety of 2,500 to 5,000 for eye-hand coordination and 6,000 to 12,000 to have any kind of effect on hand steadiness. And that's looking at ambient air concentrations combined with the diet compared to what we've learned about tissue concentrations in those workers where we're seeing those effects.



We have increased confidence in these models. One thing I did that I haven't mentioned is we looked at the model estimates of blood concentration compared to what had been measured in the workers at those inhalation concentrations, and we were able to get verification using that. Based on the results we have increased confidence that these mechanisms that regulate how inhaled manganese is handled in the body control that. Typical concentrations of inhaled manganese are like what you would get in the environment, from soil, from the air, are not expected to lead to accumulation in target tissues. And the accumulation in the target tissues, we see only when you begin to get exposure via inhalation to manganese concentrations that are much, much higher than those historically or currently measured in the United States or Canada. And our conclusions looking at levels in the human models are consistent with what we see in controlled studies in the animals where we can look at the target tissue data.

Carolyn*: Is there any data on how long an exposure before there is this increased amount? Are these studies over one year or say 60 years of a mine life?*

Robinan: Typically, what we've looked at, because the EPA focuses on this, is a continuous lifetime exposure, not just a single exposure or an acute exposure. A lot of this modeling work has been focused on incorporating them into estimating something like what Roz called a reference concentration, which is a lifetime exposure to that level and where you would see that accumulation.

Alma: We are going to wrap up by focusing on the next steps Roz and I and others are going to take. We're going to identify people who we think can help South32 develop a scope of work and engage with these researchers, assuming they're interested and able to help, and provide assurances that not only do they have the expertise, but that they can be responsive and meet expectations that we have of them being able to help.

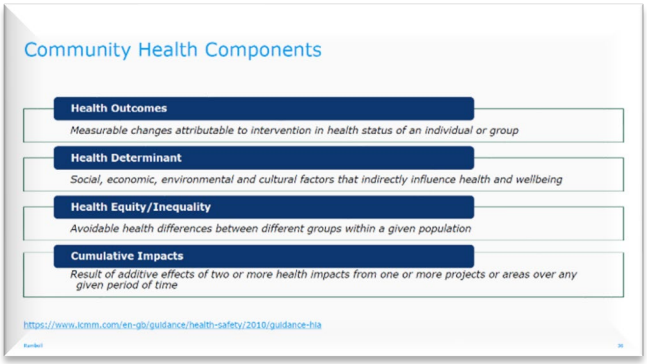
There's a process that's well established, called a Health Impact Assessment (HIA) with different levels of investigation. There are preliminary stages of health investigation that can be done. It's usually an iterative process. As you learn more and identify areas of uncertainty, you can go back and reassess.

It can help you fill in missing pieces of information, but also, ideally, it helps you anticipate where you might see a problem down the road so that you can act before it happens. This is where we're headed, helping South32 come up with a team to start looking into this. It's really important to know that part of this process is scoping out what are the questions that we have and not jumping ahead too far and making assumptions about what you think the problems are because you could be neglecting something that actually should be also brought along through the process and investigated.

You want to be open-minded, especially when we bring these university folks in, to think very broadly about all the potential concerns that we might need to really dig into here.

Another thing to remember is that where you might see exposures occurring elsewhere does not mean this is what's going to happen here. There are a lot of pieces, as Roz talked about, that go into understanding. Is there a source? Is there a complete exposure pathway that translates into an exposure that is high enough to cause an adverse health effect? It's good to not get too far ahead.

This is a high-level overview of the different components of a health impact assessment.



Melanie: *And just to reiterate, the Health Impact Assessment will include five elements that are part of the deposit. We're not just focusing on manganese. We'll look at manganese, lead, zinc, silver, and copper as well.*

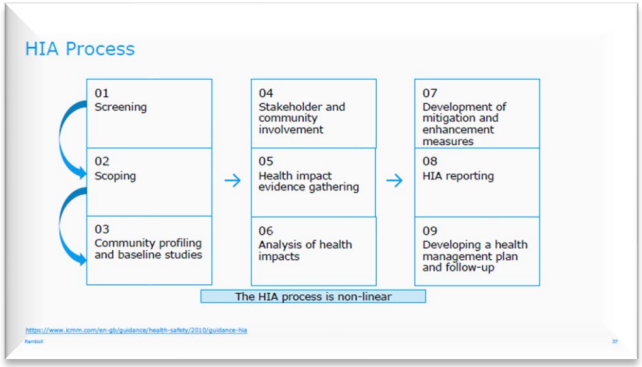
Carolyn: *On the health assessment, do you have a geographic location you're confining that to, or do you want to go countywide?*

Melanie: *That's what we're looking at right now. And also, the location of where the facility is located will also determine where we look as well. Pat will talk about some of that in our update. But looking at the location of that facility will be the big determinant in the scope also of our health assessment.*

Carolyn: *But that's the processing facility. We're right here at where it's going to be mined, and there's potential air movement here as well. So, it's got to be more than just where the processing plant ends up.*

Melanie: *Yes. That will be part of the assessment.*

Alma: This is a high-level view of the components of a Health Impact Assessment (HIA).



Fritz: *So, you guys are still trying to develop a scoping document and then you're still looking at trying to figure out people who might fit on the team?*

Alma: Yes.

Fritz: *There was an article in the Gallup International paper, quoting Pat, I hope I don't get it wrong, starting this health evaluation in town. Do you guys have any idea of a time frame?*

Melanie: *We're trying to finalize the scope before the end of the calendar year. we'll develop the timeline, but as Roz said, we'll depend on the resource identified at the university, their availability, and time commitment to the project. And then we'll be able to build that time frame out. So that's something we could share with the panel once we have identified it a little bit further.*

Fritz: *And I'm assuming for the team, you're going to have medical doctors?*

Melanie: *Yes, internally we have medical doctors within South32 also that advise us on the different parts of the study.*

Fritz: *Okay. Because there was talk about, I think it was in your email, about bringing a guy on from Phoenix?*

Melanie: *Per the panel's request, Catherine did reach out to Dr. Brad Racette, and he's available to present to the panel in January.*

Ruth Ann: *So, you hope at least to get this all, the experts and everybody agreeing, and getting some kind of health assessment ready by the time you start digging in 2025?*

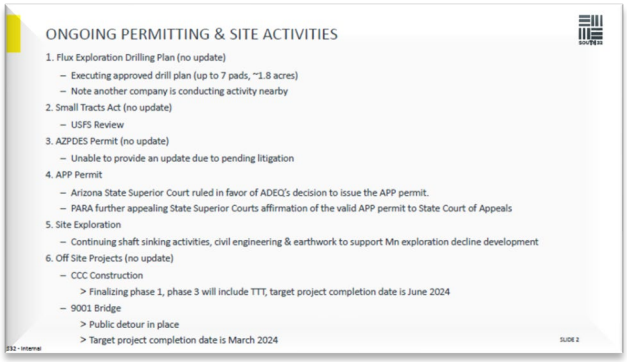
Melanie: *Yes. And then there are different levels within the health assessment. There's the rapid health assessment, and we were discussing that we're maybe a little bit further than that, so maybe a next level more in-depth. Depending on the type of study too, and how in-depth it is, will influence the time as well. I want to make sure Pat has time for his update also. But as we were talking kind of on the walkover, there's probably a lot of follow-up questions from the panel as well. And so, if they're to help keep some order, I can take those questions, or Catherine can, and then we can pass them on to Ramboll. That way there's kind of just a more organized question-and-answer process. We can do that after. And then I imagine this wouldn't be the only time that Ramboll will present to the group, and we can present results and timelines and different things as the-as the process moves forward.*

Catherine: *Melanie, why don't we use the procedure we have in place. Panel members email questions they have to me so that we have a record, and then I'll send them to you.*

5. **Project Updates (Attachment 5) – Pat Risner:** I will provide you with some general updates up front. There are some parts of our update that overlap with what Carolyn shared with you, so I won't rehash any of that. But I also did want to go back to the manganese facility discussion we had a few months ago, recap that a little bit, because it will close out the loop on some of the questions around timing and how it fits with our development.

Ruth Ann: *Just as a side note, how are the electric trucks you're going to be using coming along? Have you had any updates or know when they're going to be ready? The biggest question I get is about those trucks and the dust.*

Pat: I don't know if you've seen it, but Pepsi has a fleet of Tesla Semi electric trucks on the road now. They're still technically in the trial stage. There are many large-scale trials like that going on with different companies for the next two or three more years.



5.1. **Flux Exploration Drilling Plan**: We have started to execute the approved drill plan in Flux Canyon. We just finished the first hole last week and are now starting into the second hole. They're very shallow holes, so it's going quickly. Just a reminder on that one, it's seven pads and about 1.8 acres of disturbance. And we've committed to complete the drilling and the reclamation within 12 months. The other thing I wanted to add is we are seeing some confusion in the community. I think everyone's probably aware that Barksdale is also doing some drilling through the east and south of us, in two different locations.

Fritz: *You said, they're shallow. How shallow are your holes?*

Pat: The first one was about 1,500 – 1,600 feet. They're 1,500 to 2,000 feet at the most. We're testing to make sure that what the geophysics was forecasting is confirmed with drill holes, so it's coming along quickly.

Carolyn: *Is it copper out there, Pat?*

Pat: We're targeting prospects that look like the zinc resource. The old flux mine that was there is like the shallow mining we had in the trench claim where our existing zinc deposit is. So, there's a thought that what sits beneath that is like the zinc deposit that we have.

5.2. **Small Tracts Act:** There was a land acquisition to connect our private land parcels. I don't have an update for you on that. That one's still pending with the Forest Service.

5.3. **AZPDES Permit**: Carolyn talked about the AZPES permit, the discharge permit. We expect to draft the new renewal any day now.

5.4. **APP Permit:** The APP, as Carolyn talked about, has been appealed to the State Court of Appeals.

5.5. **Site Exploration:** The sinking of the two shafts is continuing. These are the two 25-foot diameter, 900-feet deep shafts. One of them is about 135 feet down. The other one's about 50 feet down. We'll start receiving equipment soon to set up the main shaft sinking platform which needs to be about 135 feet down before you can start doing that. We're doing a lot of earthworks to set up the establishment of the decline. We're

accessing the zinc resource with two vertical shafts. Then the manganese resource will be accessed via a decline from the private land. We're doing the earthworks to get the pad set up to start development of that decline early in the new calendar year.

Fritz: *Pat, on the shafts, how wide are they?*

Pat: The finished diameter is 25 feet, 900 feet deep, concrete lined. Two shafts: one for ventilation, one for people, equipment, and hoisting the ore out.

Fritz: *So, when you say equipment, does that include the trucks underground?*

Pat: Yeah.

Fritz: *25' seems small for a truck.*

Pat: We'll be able to hoist all our equipment up and down in that shaft.

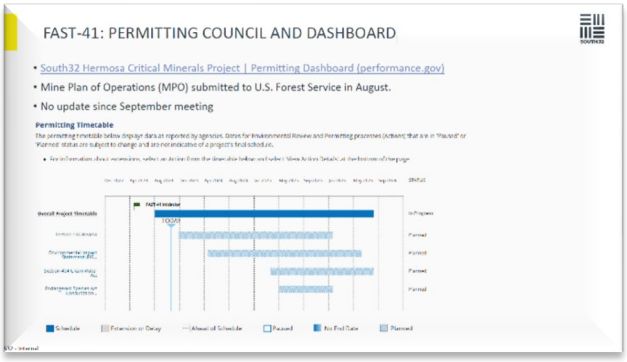
5.6. Off-Site Projects:

5.6.1. CCC Construction: As for the offsite projects, the Cross Creek Connector, we are finalizing phase one. Target completion date on that is still June of next year. So that's coming along.

5.6.2. The 9001 Bridge: And then the 9001 bridge. If any of you have driven through there, you know the public detour is in place. That's coming along. You've seen all the forming activities and starting to pour concrete there. Target completion date is in March of next year.

5.7. FAST-41: There are no updates since September. We submitted the Mine Plan of Operations to initiate the process in August. The next milestone is December 17th when the Forest Service will make a completeness determination. If they find a deficiency, we will need to fix it. Since it doesn't look like we're having a government shutdown, maybe they'll make that date. If it was a government shutdown, that was probably going to be impacted. But, I think we think that's on track for that to be achieved in mid-December.

Carolyn*: Pat is it correct that when they do approve, that under FAST-41, the Mine Plan of Operations then becomes public information?*



Pat: I don't know what the Forest Service will do at that point. I know they would not release it before they get the completeness determination. I don't think FAST-41 has a specific provision as to when it becomes a public document. That's my understanding. But when we get to that point, I think that will be a conversation we'll have with them. But I don't know what their decision will be.

Carolyn: *Well, I'd like to have that conversation with you also and ask that South32 go ahead and release it to the public.*

Pat: I think it's a conversation we would also have to have with the Forest Service as well, but happy to have that discussion. Typically, these documents get made public when the notice of intent goes out before they start the scoping process, which will be April-May timeframe. In NEPA, the upfront public piece is scoping. So, it's coming up with what the alternatives that should be considered might be.

I've got a few slides where I'm going to take you back probably three or four months to review some of the information we provided, and also give you an update on where we're at with the manganese part of the project.

The discussions with customers are advancing. Just to remind you, we will obviously mine the manganese. The production facility that we're still looking to site takes the mined ore that comes from the mine and converts it into a battery-grade product for direct sale to a battery customer. There will be no additional refining processing, there's no smelting involved. It would be for direct sale to an electric vehicle cathode or battery manufacturing facility.

The discussions with potential customers to buy battery-grade manganese from Hermosa have advanced quite a bit. We've now got three memorandums of understanding in place with companies that are planning to build battery manufacturing facilities in the U.S., and we're in discussions with nine others around domestic supply.

In probably the biggest development we had a pilot plant that started producing battery-grade manganese from ore that we've collected from drill holes at the site. That started in July. We're now getting to the point with the pilot plant where it's producing sufficient volumes that we're making available to customers so they can test it, look at specifications of the material. There's a long process for customers to test the material and determine whether it meets their specifications. We are looking at options for how we move this forward.

It's at the end of 2025 when customers start to need small volumes of this material because that's when their initial facilities will come online and they'll start ramping up, and then the volumes ramp up over time. Through 2026 to about 2030 the demand for this ramps up.

The next step is to scale it up to a demonstration-scale facility, which still wouldn't be the full-size commercial facility that would be in early 2026 sometime. As I mentioned in the past, we are working with the Department of Defense. They have funding available to support battery metals projects, but they want projects that are in the two to three-year window, not projects that are five years out because of the need for when these facilities will come online.

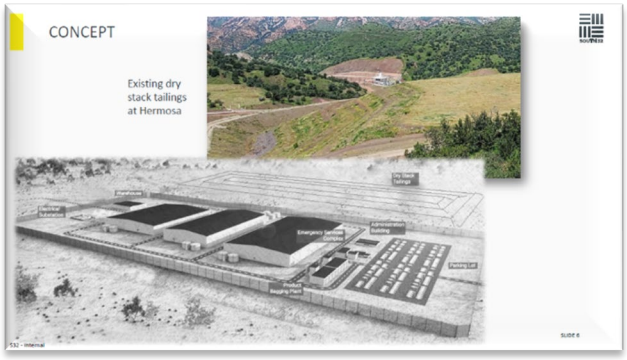
Other than that, starting to construct the decline at sites so we can access the ore body and take a bigger bulk sample underground. Those are the real most recent developments on this front.

Ben: *Before you move on from that slide, I need you to educate me on something kind of dumb, I guess, because I've seen all the samples on slides like this, and the manganese in its ore form is black.*

Pat: Right.

Ben: *But this looks almost like cotton candy or something.*

Pat: It looks a little pink in the photo, but It actually it's a little whiter than that. It kind of looks like laundry detergent. We're taking manganese oxide and converting it into a high-purity manganese sulfate. It looks black in the ore, and then it comes out like this. And that's an important part. The facility we build is not a smelter, it's a completely different process where you're taking that manganese oxide and converting it into a high-purity product that goes into the cathode.



The full commercial facility is still being engineered. We've got a process design. The way in which we process each step of the treatment process is all technology that's out there and used somewhere today. None of that is new or novel. How we're putting it together is the only thing that's new. But because the facility is still being engineered, we've got some conceptual drawings of what it might look like. Obviously, as we continue to progress the technical work, we'll be able to improve these and continue to share more details about what the facility will look like. It's going to take about 120 acres for the initial size of the facility, somewhere between 120 and 250 long-term.

There are two things that I think are important. A lot of the information and videos you see online, are manganese alloy smelters, where they're smelting it into a manganese metal that goes into steel production. About 90% of the manganese in the world right now goes into steel production. That's not what this facility will do. It's just a building with a bunch of tanks in it. We will haul run-of-mine; this means ore that comes right out of the mine, that's about the size of your fist, directly into sealed containers, which will be hauled to this site.

A lot of what you see online, they're hauling manganese concentrates that are going into smelters, and it is fine material which makes it more easily become airborne. We'll be hauling actual ore coming out of the mine that's more this size, the size of your fist, which really can't become airborne like fine particles. Nonetheless, it's in sealed containers. Both the onload and offload at this facility is fully contained and enclosed, and then it goes through a series of treatment steps in these buildings in tanks. We're also working, as we continue to refine the

engineering and do 3D design, where we can give people a view of what the inside of the facility looks like and continue, as it evolves, to share more details. We will have a second or another dry stack tailings facility at this site.

That's a photo of the one that you've probably all seen on site that we built to remediate the historic tailings. That facility will have its own dry stack tailings facility. It will have the clay barrier underneath it, the two layers of geomembrane liner, the underground collection system, all the same things that we have on the tailings facility at site, we will have at this facility as well.

Carolyn: *The dry stack tailings, this will be decades, based on the mine life that I've heard. What's your height on the dry stack tailings anticipated to be over those 60 years?*

Pat*:* It's about the height of a five to six story building.

Ben: *Well, that's my question too, but maybe a little more detail because this is above ground, number one, right?*

Pat: Right.

Ben: *And, what's the concentration of manganese? Because the tailings do not look to scale. You know, it looks rather small.*

Pat: One thing to remember is we're still in a pre-feasibility stage. On the zinc project, we've done a pre-feasibility, a feasibility study, and we're about to finish it and start building. This project's still back in the pre-feasibility stage. There's still a lot of planning and engineering going on. We haven't landed the ultimate size of this facility. We've talked about a targeted manganese sulfate production of 60,000 tons per year. But everything we've talked about is in a range, because we're still working out the size of it. So, that's why we say 120 to 250 acres. It depends on ultimately how large the facility is when we finish the engineering and the planning. So, again, the size of the tailings facility will depend on the production rate for how long we run. All of that's still subject to completion of the pre-feasibility stage.

Ben: *This will not be at a representative scale for the lifetime of the facility.*

Pat: Well, it might be, depending on what the production rate ends up being. We haven't landed that yet until we get to the end of the pre-feasibility study.

Carolyn: *The dry stack tailings that was the remediation that South32 accomplished, which was a good thing for the environment, that required a water treatment plant. Will there be one here?*

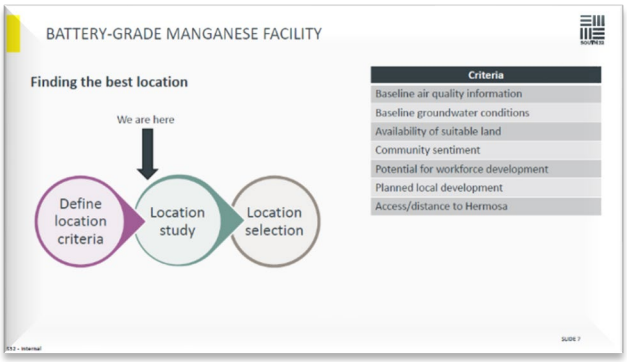
Pat: We haven't contemplated a water treatment plant, but again, we're still in the pre-feasibility study. I think what we wanted to share is there will be a tailings facility that we've applied to the one on site.

Ben: *And you mentioned the liners. That protects the aquifer.*

Pat: Yes.

Ben*: What about the air? Are you going to have some cover over these?*

Pat: The dry stack tailings are compacted to 95% compaction unlike other tailings facilities. The compaction helps quite a bit with dust suppression, and we'll have other measures and engineering controls in place as well. It's an engineered fill not a tailings dam. It gets dewatered, compacted, placed in thin layers, and compacted, much like you compact the base of a road before you lay asphalt. It ends up being an engineered fill structure for all intents and purposes, just like the one on site.



I talked about this in the early days. With respect to the manganese production facility, we're in the location selection portion. There's still a lot of time. I can't give you a date yet of when we would build this facility, because that's yet to be determined as part of the pre-feasibility study. We don't know when we will take the manganese project to full production, because we still are learning and understanding from the customers the rate at which their facilities will come online, and the demand will grow. Right now, we're doing a pilot plant. We'll do a small-scale demonstration plant. But this larger facility that we're still looking to site, we not only do we not know where it's going to be yet, but we don't know the timing of when it will be built yet. It's much further into the future. Nonetheless, we are still working through various alternatives.

I talked about this a little bit last time, and in the Board of Supervisors meeting, when it does come time where we've got a shorter list of potential options of where this facility can go, we talked about one of our criteria: community sentiment. The Panel will be an important part of that, and we will be gauging community sentiment about where it will be located. We've said several times, if there's a strong desire for this to not be in certain locations, then that's an important factor along with these other criteria. There is plenty of time and opportunity for process and input from this group and the broader community once we narrow it down to a smaller set of locations.

Fritz: *So, you're going to have byproducts coming off this too? Because you're not just hauling down manganese, you're hauling down lead and some other stuff, right?*

Pat: We'll have byproducts of zinc and silver with the manganese. No lead. About 80% of what we produce from that deposit will be manganese. Whereas on the other deposit, it's sort of 50/50 zinc, lead, and some silver.

Marcelino: *The last time you talked about that location study, I had asked if you had gotten an outside group or firm to do that location study. And the location selection was going to be done based on the recommendations of that study. The engineer that made a presentation on this location study last meeting indicated that there's no outside group that's doing the study, the engineers are going to make the decision on the location selection. I'm confused now.*

Pat: So, we're using outside resources to generate options to help us find where good sites might be based on the criteria we have.

Marcelino: *But that's not what he said. That's why I'm confused.*

Melanie: *Craig Berry was the one who presented to the Panel, and he was presenting on the Integrated Remote Operation Center.*

Marcelino: *That's what I'm talking about, the remote--*

Pat: That's not what we're talking about here. This is an important point because a lot of people think these two must go together, and they don't.

Marcelino*: Okay.*

Pat: We have vastly different selection criteria. The IROC we want to be in the community because 40% of our workforce will work there. We want to co-locate it with areas where there's job training, workforce development opportunities, where it makes it easy for anyone in the community that wants to work there to show up. That's not the criteria for this facility. Those two processes are running separately, and that process is much more advanced. The IROC is going to be in the Nogales, Rio Rico area somewhere, whereas this facility is likely to be in very different location.

Ruth Ann: *I was asked by somebody in my community, in Sonoita, what is to prevent you from, once you get the manganese, and it's in production, and you're selling it, what is to prevent you from selling it around the world and not in the United States?*

Pat: If you think about something like zinc or lead or copper or most other commodities, you're selling into a global commodity market. You sell some on contracts, and some on spot, and they can go anywhere. The commercial relationships in the battery market are very different, because every cathode or battery manufacturer has a different specification. This is a very high-purity product. It's not a bulk commodity like copper or zinc. We will end up having commercial relationships, long term and short-term contracts, with maybe four or five companies in the United States or in North America. We won't sell on the open market. Part of it is also that we've committed through our work with stakeholders that this is a domestic resource for domestic supply to domestic manufacturing.

Ruth Ann: *I didn't know if it was part of the fast-track agreement that you had to sell in North America or the United States.*

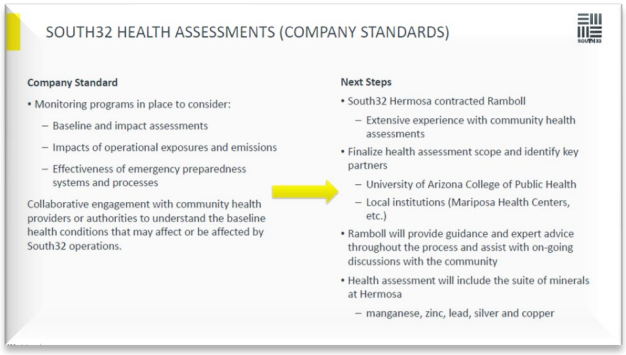
Pat: No, but the reason we're working with the 12 companies we're working with is they all have plans to build facilities in the United States or Canada to serve the US market.

Ben: *That's an important clarification we didn't know.*

Ruth Ann: *I thought it was because the transport cost of going around the world with this stuff would be prohibitive, and that's why you'd stay in the United States.*

Pat: It's not due to the cost. We have a massive market and demand and need emerging in our country. And, as you know, the only manganese deposit that could supply that market domestically. Otherwise, it's coming from China.

This leads to where I want to tie to some of the discussions the team from Ramboll had with you. We have a common set of global health standards in South32 that lay out minimum requirements that apply to any business we have anywhere in the world in just about every category of work - health safety, environment, asset management, engineering. The baseline community health assessment that Ramboll will help us with, as well as the partners that we're looking to bring into it, is a requirement that South32 has, whether local government, local regulations, require things like that or not. We're required to do baseline assessments for our workforce and baseline community health and impact assessments.



Now, that being said, there are a lot of historic operations built in the '60s and '70s that didn't have the ability to do what we have the ability to do today to bring in expertise, to make sure we thoroughly understand both the background air quality, the background dust concentrations, and to Carolyn's point, not just where it's going to be mined, and not just where it's going to be processed, but also the transport routes, and outer lying areas, but also, the baseline health assessment of the baseline health conditions in the community before we ever conduct any activities, be it mining, transport, or producing, battery-grade manganese.

That's why we've brought Ramboll in, because we're getting to the point where we need to do that. We want to bring in expertise to advise us on how to bring in the right partners, and how to design it to be most effective. The reference to the University of Arizona Community health providers is because we understand you need a higher level of expertise, but you also need credible third parties that are external to South32. We've asked Ramboll to come in and help us identify beyond potential resources at the University of Arizona who are the right sort of experts and independent entities that we can bring in to make sure it's credible, make sure it's done properly, in a way in which the community can accept the outcomes.

We do have experts in the company that advise us internally. We obviously want an expert in this part of the world dedicated to help us with the scoping and bringing in the right kinds of partners. And as Melanie said, I think one thing that's key, while we're focused on manganese today, we will look at everything we're going to produce and that includes zinc, lead, and silver.

Carolyn: *Pat, to that point because this is a sticking point that many people have seen. The horrifying reports from a news station about a South32 manganese facility in South Africa. How do you explain what is happening there, but that's not South32's criteria for how it intends to behave everywhere.*

Pat: So, I think we will most likely be the first manganese operation in the world that has done a community health baseline assessment before it started operations. So, most of the other manganese districts in the world, whether it's in the Kalahari, in South Africa, or Northern Australia, or in Gabon and other places, those industries started in the '60s, in the '70s, and did not have the practice of baseline environmental and community health assessments like we can do today.

Obviously, much of that was not done. But I think the biggest difference is, one, you're not looking at mines like what we will do. You're not looking at controls like what we will do. In many cases, what you've seen online aren't even South32 operations in terms of the images. But this is a next generation mine. We can do things from day one that none of those operations in any other part of the world had the opportunity to do.

So when we talk about direct discharge of ore into sealed containers, from the time it's mined to the time it goes into a container on a truck to be transported to that facility, offloaded at the facility, to produce the battery-grade manganese, unload it to go to a customer, not exposed to the environment or to the air at any point in time. We can do that now.

They also didn't have the rigor around baseline assessments, be it environmental for dust, uh, plus the community health side. So, I would say today with the next generation operation, expertise, and technology, we have the ability to build a mine very differently, put controls in that they didn't have the ability to do then, and make sure we understand the condition of the environment and the health of the community before we ever do anything to make sure those controls are effective throughout the life of the mine.

Ruth Ann: *Have you updated in Africa some of those controls?*

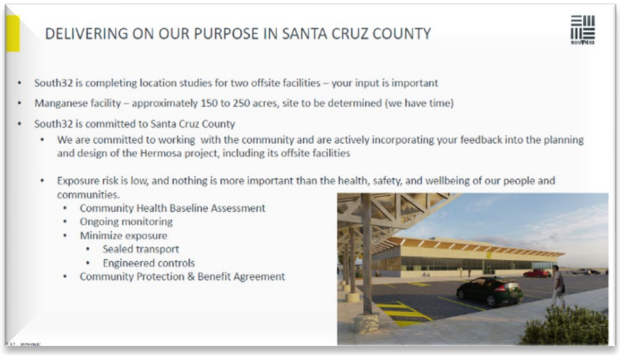
Pat: From both a community and a workforce health exposure limit, we have the most stringent exposure limit in the world, and we apply it everywhere in the world. I think I talked about this a little bit last time. Our occupational exposure limit for workers is 0.05, milligrams per cubic meter. OSHA in the US I think is one. The regulators in Australia are one, the regulators in South Africa are one. That 0.05 applies everywhere, including in South Africa.

And we have controls in place to ensure our workers aren't exposed at levels above that. We've also adopted the most conservative community standard for exposures in the world.

Carolyn: *Will any of your standards address wildlife? Because we are a global biodiversity hotspot with more than 100 endangered Federally threatened species out in the very area you will be operating. How are you addressing that?*

Pat: We do have an environmental standard that talks about biodiversity, it talks about our approach, and that's something I think we can have more conversations about and share that information with you.

To summarize, we are still in the process of locating the two offsite facilities. Community sentiment and input is important. That opportunity for input on the manganese production facility is still coming. We're not to the point yet where we have a range of alternatives to present to the community. I talked about 150 to 250 acres, and we are committed to working with the community and the panel on feedback into the design facility. We need to get the design further along to engage in a meaningful conversation.



Based on what we have available to us from a technology and control standpoint, we do believe the risk exposure is low. I said this a few times, if we can't do things safely, in keeping our people in the community healthy, then that's our first and most important thing that we do every day, and we can't be here if we're not able to do that and demonstrate that. That's why we're going to do the community baseline assessment, the baseline monitoring, and ongoing monitoring. I think it's important to note, while we will do a community health baseline assessment, we will also do periodic assessments for the entire life of the mine. Part of doing the baseline is you've got to have something to compare it to, so you know if there's been any change or not. There will be periodic, ongoing health assessments throughout the life of the mine if it's 30 years, 40 years, 50 years, whatever it is.

I talked about the controls for minimizing exposures, and the discussion earlier about the CPBA is an opportunity to make sure we are held to account and commit to those things to keep the community safe. I know we ran a little long. Any questions about that or anything else?

Marcelino: *When can you make a presentation on the IROC? I want a live presentation so we can get some things straightened out.*

Melanie: *As a follow-up to the presentation that Craig Berry made at our last meeting; I still owe you a summary of the study. He was going to do a summary. But beyond that, until we make a location determination, I don't know that we have anything beyond what Craig Berry presented.*

Pat: I think maybe the next step is we'll get down to probably two options of specific parcels and there's probably an opportunity for some engagement around that**.**

Marcelino: *The IROC is going to be in Santa Cruz County? I don't care where it's at, as long as it's in Santa Cruz County.*

Pat: Yes, absolutely. We've made that commitment. It's going to be somewhere in the I-19 corridor in Nogales or Rio Rico, where the bulk of the population is.

Memo: *What's your timeline on the IROC?*

Pat: Well, we want to decide by the end of the calendar year, so it's coming quickly.

Fritz: *We haven't heard much about your feasibility study, and the funding on the project? Where's that at?*

Pat: The feasibility study is essentially done. What happens when we finish the study phase, the company brings in an external group to independently peer-review the study, to tell us whether we got it all right or wrong, and what we need to fix. That independent review is going on now, and that's going to carry through the end of the year. So, the actual decision on the funding is probably at the end of January, early February now. It's an extended review process.

6. Upcoming Meetings

- December: No meeting.
- January: Dr. Brad Racette with location to be determined.

7. Wrap-Up – Final Comments - Catherine:

7.1 Recommendation for Panel Speaker: Ben has recommended Dr. Frank A. van Hippel to present to the panel in February or March. It was a unanimous vote yes.

7.2 Presentation to Board of Supervisors: Members of the Panel, who are available to attend the upcoming meeting, are encouraged to co-present with Catherine. Memo volunteered.

7.3 Minutes Comment – Ruth Ann: *This is totally unacceptable to have three months' worth of minutes and not have them available. The thing that brought my attention to it was people had asked me questions, and I referred them to the Panel website, and they are not there.*

Catherine: Two months are pending the review process – September and October.

8. Meeting adjourned at 2:27 pm.

5 Attachments:

1 – Town of Patagonia Flood & Flow Committee Update

2 – PARA Update

3 – Ramboll Presentation

4 – Working Group Meeting Summary

5 – South32 Briefing Slides

Town of Patagonia Flood & Flow Committee Update
for the Santa Cruz County Advisory Panel on Hermosa Project
Presented by Panelist Carolyn Shafer as a Flood & Flow Committee Member
January 17, 2024

The Town of Patagonia "Sonoita Creek Flood & Flow Committee" ("F&F") which conducts (currently via Zoom) monthly public meetings the **third Thursday of each month at 10 a.m.**

CURRENT PROJECTS

• Update on School Canyon Failure of CCC Structures (Bob Proctor)

Bill as Patagonia Town Engineer is still working on a letter for site visit for stakeholders S32, Forest Service and others. Ron needs follow-up from Bob for permission from residents of the Mesa HOA to allow the town to clear the diversion debris.

• Patagonia Regional Flood Control Project Feasibility Study (Bill O'Brien)

Bill is waiting on a January/February progress report from the county working through the data and meeting date. Alan will reach out to the consultants ahead of his county BOS meeting. Alan asked Is there cross- sectional data and / or water surface elevations data for Sonoita Creek?

• Watershed Stakeholders USBR/CWMP Grant Notice of Information and funding. (Howard)

Howard has no new information to report however he is working on internal preparations with TAS. He is reaching out to other organizations for anecdotal information. Alan requested to receive a Cienega Creek watershed ground water presentation by Julia Fonseca with slides. The presentation was not recorded but Howard will share the slides from the presentation to all F&F committee members.

• Update on the South32 CCC Flood Plain Use Permit. (Bill)

Bill is working on writing a response to Santa Cruz County.

• Potential Aquifer Management Area (AMA) for Sonoita Creek Watershed (Bob Proctor)

Ben informed about how an AMA for Sonoita Creek watershed spans two groundwater basins; Cienega Creek basin (Sonoita area) and Santa Cruz River basin (starting at Patagonia Lake). Suggests a cooperative with Cienega Creek Partnership who work closely with ranchers to create an AMA. An AMA does not protect surface water, wetlands, streams, and springs. AMA regulates assured water supply vs adequate water supply outside of AMA's. They have the same criteria. AMA's make sure subdivisions of 5 acres or more have enough water, legal ability, the right water quality, but does not address impacts on surface flows. Douglas AMA was successfully established based on voter initiative with criteria to focus on conservation. Goals are now tending to focus on economic development. AZ state legislature would establish a 'Rural' AMA, (RMA) however there are no regulations in rural areas leaving stakeholders like the Farm Bureau -agriculture, ranchers, and land developers to use their political influence to prevent any kind of regulation that considers impacts on groundwater aquifers.

Storm recharge may be a strategy to consider as in the San Pedro River recharge which keeps the river flowing.

- Comprehensive Groundwater Study for Sonoita Creek Watershed status and steps forward (Ben Lomeli)

A comprehensive groundwater study is needed with ground water criteria specific to Sonoita Creek watershed. Criteria would give a local view of local conditions and create a more accurate local model. Mayor Wood, Carolyn, and Ben worked on criteria and requested a study from the Forest Service in the summer of 2020. Forest Service has not address concerns about Patagonia and how it applies to our local conditions. The focus is on water beneath the Patagonia Municipal Watershed. Carolyn will share the history of a series of letters requesting the forest service to fund the study. Ben suggested that the USGS can do a 'electromagnetic fly over' to obtain a precise geology map to better understand the geology that effects an accurate groundwater model. Next letter will include a request for the fly over. Would Alan contact BOS Bracker to update and gain support about letters made by the town of Patagonia? Alan says the county manager might be better for support.

- Harshaw Creek Watershed Restoration Plan – Town position (Ron, Howard)

Howard and Bob discussed reaching out to the Forest Service hydrologists by January 2024. Ben asked what is the goal of the Restoration Plan? The Proper Functioning Condition (PFC) shows Harshaw creek sub watershed is rated poor for aquatic habitat. Rangeland management techniques may be applied to the upper Harshaw creek sub watershed to address and reduce sediment loads and erosion. Forest Service has gaps in data. Carolyn reports the Forest Service has recognizes our official town municipal watershed which identifies six sub watersheds. The worst performing sub watershed was evaluated by the forest service. Harshaw Creek conditions are poor.

The next Committee meeting is scheduled for January 18, 2024.

Patagonia Area Resource Alliance (PARA) ✦ Arizona Mining Reform Coalition ✦ Borderlands Restoration Network ✦ Center for Biological Diversity ✦ Earthworks ✦ Friends of the Santa Cruz River ✦ Friends of Sonoita Creek ✦ Sierra Club (Grand Canyon Chapter) ✦ Tucson Audubon

January 12, 2024

Via Public Comment Form and Email
(heinz.rachel@azdeq.gov)

Arizona Department of Environmental Quality
Water Quality Division
Attn: Rachel Heinz
1110 W. Washington St.
Phoenix, AZ 85007

Re: Comments and Objections to Proposed Renewal of AZPDES Permit (AZ0026387) for South32 Hermosa, Inc.

To Whom It May Concern:

On behalf of the Patagonia Area Resource Alliance (PARA) and the above listed organizations, please accept these comments and objections to the request by South32 Hermosa, Inc. (South32) to "renew"[1] Arizona Pollutant Discharge Elimination System (AZPDES) Permit No. AZ0026387 for the "January Mine Hermosa Project" in Santa Cruz County, Arizona (Draft Permit or Permit).[2]

The issuance of the Draft Permit, as written, violates the Clean Water Act, Arizona law, and is contrary to ADEQ's own statutory duties which require, among other things, that ADEQ "act to protect the environment", promote "the protection and enhancement of the quality of water resources", provide for the "prevention and abatement of all water and air pollution"; and "[e]nsure the preservation and enhancement of natural beauty" in our state. A.R.S. § 49-104(A)(1), (7), (9) and (10).

As ADEQ is aware, PARA commented previously on an older version of this Permit which was initially released for public comment in November 2022 (2022 Draft Permit). A Decision to Issue the 2022 Draft Permit was issued by ADEQ in March 2023, which PARA

[1] PARA recognizes that ADEQ is treating South32's Draft Permit merely as a renewal of Permit No. AZ0026387. However, for the reasons discussed later in these comments, it is PARA's position that the prior AZPDES Permit expired by operation of law and thus, no "renewal" of the Permit is permitted.

[2] ADEQ Public Notice – Renewal of AZPDES Permit AZ0026387 for the January Mine Hermosa Project in Santa Cruz County (November 28, 2023).

subsequently appealed. That Permit was later withdrawn by ADEQ on appeal ostensibly "so it could consider PARA's comments regarding *San Carlos*".[3]

Unfortunately, many of PARA's concerns with the Draft Permit have not been addressed by ADEQ in the current Permit. Indeed, it appears that rather than doing its job to enforce the requirements of the Clean Water Act as required by law, ADEQ has instead spent a great deal of time and effort attempting to explain away or avoid these responsibilities. As discussed below, one need look no further than the Draft Fact Sheet for this Permit to understand this. In any event, as much as ADEQ seeks to avoid the point, it remains true that the Hermosa Project is a "new source" of discharge as defined in the Clean Water Act and regulations at 40 C.F.R. §§ 122.2 and 122.29 and in A.A.C. R18-9-A901(25),[4] and thus it is subject to all new source performance standards and requirements outlined in the Clean Water Act. ADEQ cannot avoid this basic point. In fact, in the revised Draft Permit, ADEQ acknowledges that the Hermosa Project is a "new source" – but it seeks to avoid the consequences of this fact by disingenuously (1) limiting South32's permitted discharges into impaired Alum Gulch to purported "historic" mine sources; and (2) speciously claiming that Outfall 002 is in Lower Harshaw Creek when it is actually located in impaired Upper Harshaw Creek.

While PARA was pleased to see ADEQ's inclusion of Water Quality Based Effluent Limits (WQBELs) in the Draft Permit (which are more stringent than new source performance standards) ADEQ's obligations under the Clean Water Act do not end there.

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[3] *See* ADEQ Motion for Judgment on Notice of Appeal, AZOAH Case No. 23A-D01-DEQ. In *San Carlos Apache Tribe v. State of Arizona, et al.* (No. 1-CA-CV 21-0295, Nov. 15, 2022) (*San Carlos*) the Arizona Court of Appeals rejected ADEQ's conclusion that a new mine shaft was not a "new source" subject to the post-1982 effluent limitations. The Court held that the new mine shaft was a new source and rejected ADEQ's blanket argument regarding 'existing sources' as follows: "[T]he State's argument denying 'that any new buildings, structures, facilities, or installations constructed at a copper mine that began operations before Subpart J was promulgated' is not a new source is inconsistent with the regulatory framework and EPA guidance." *San Carlos* at ¶ 60.

[4] 40 C.F.R. § 122.2 defines "New Source" as follows:

> *New source* means any building, structure, facility, or installation from which there is or may be a "discharge of pollutants," the construction of which commenced:
> (a) After promulgation of standards of performance under section 306 of CWA which are applicable to such source, or
> (b) After proposal of such standards of performance in accordance with section 306 of CWA which are applicable to such source, but only if the standards are promulgated in accordance with section 306 within 120 days of their proposal.

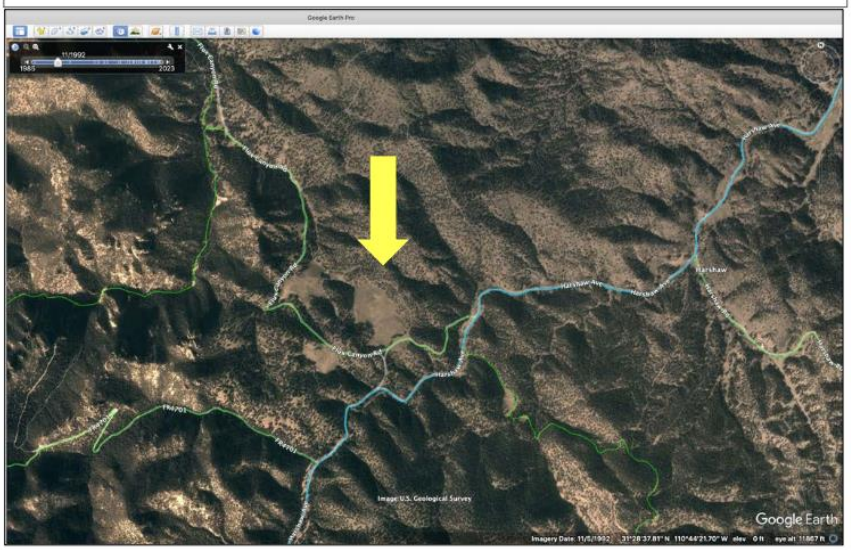
This federal definition of "new source" has been largely adopted into the Arizona Administrative Code implementing the AZPDES Program at R18-9-A901(25).

The Clean Water Act also requires that ADEQ update/finalizes the Total Maximum Daily Load (TMDL) studies for the impaired surface waters of Alum Gulch, Harshaw Creek, and Sonoita Creek, and perform the necessary waste load allocations and related steps associated with these obligations before ADEQ can issue the proposed discharge permit to South32.[5] Additionally, ADEQ must address other failures in the Draft Permit.

I. Historical Overview

ASARCO last operated the "Trench Camp" mine (a small portion of the current mine site) from 1939 to 1957. It was subsequently abandoned for decades. ASARCO was eventually taken to court by ADEQ and the State of Arizona to force the company to invest in cleaning up toxic mine waste drainage leaching from this and other abandoned mines into the surrounding environment and waterways.

The historic "Trench Camp" area only covered about 40 acres and was described in the court testimony by ADEQ as "an inactive underground mine, formerly accessible through the January adit."[6]



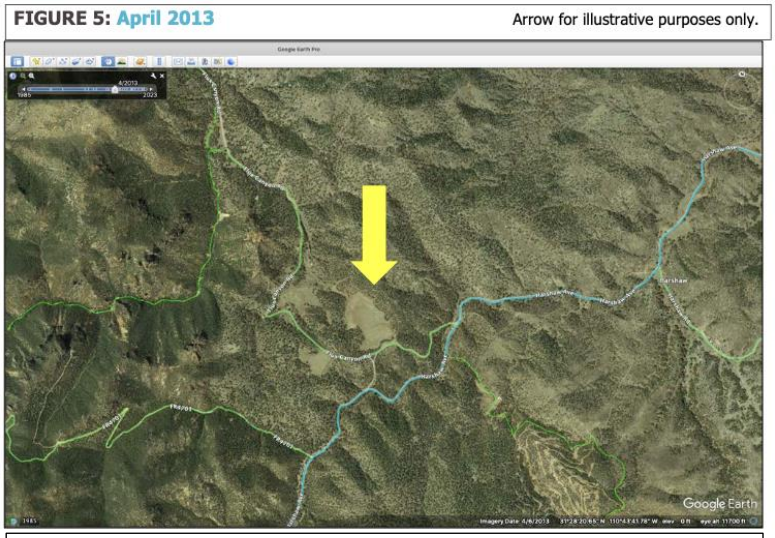
Hermosa Project site, Nov. 1992 (Google Earth)

The history of the now-abandoned mine is described in detail in PARA's letter to the EPA requesting review of this AZPDES Permit from July 2023 (attached here as **Attachment 1** and incorporated here by reference as if stated in full here). *See, e.g.,* images of the long-abandoned, empty site (Figures 1 and 5 from **Attachment 1**) as it appeared in November 1992 and April 2013.

[5] Section 303(d) of the Clean Water Act requires states to identify waters that are impaired by pollution, even after application of pollution controls. For those waters, states must establish a TMDL of pollutants to ensure that water quality standards can be attained. A TMDL is both a quantitative assessment of pollution sources and pollutant reductions needed to restore and protect U.S. waters and a planning process for attaining water quality standards. The TMDL program is a core element of overall efforts to protect and restore water quality to surface waters across the United States and here in Arizona.

[6] Proffer of Direct Testimony of ADEQ Senior Programs Consultant Dennis L. Turner Regarding the Trench Camp Property at 6, *In re ASARCO LLC, et al.*, U.S. Bankruptcy Court, S.D.TX (No. 05-21207).

After acquiring portions of the former Hardshell mining claims and Trench Camp properties from ASARCO LLC and from the ASARCO Multi State Environmental Custodial Trust in 2016, Arizona Minerals, Inc., or AMI (now South32) began making radical changes to the abandoned mining site to facilitate the development of a large-scale industrial mine.



Hermosa Project site, Apr. 2013 (Google Earth)

II. The Hermosa Project Today

In 2018, a new active water treatment plant (WTP1) was constructed for treating seepage and runoff water from the contaminated January Adit mine workings. Additional construction during that time included the development of infrastructure for discharge into Alum Gulch (Outfall 001), the placement of the contaminated tailings and waste rock on a new tailings storage facility (TSF), and the construction of an underdrain collection pond to collect seepage from the TSF. The existing "historic underground works (referred to as the January Adit)"[7] are not integrated with South32 existing mine facilities, but rather are contaminated historic workings simply managed for remediation purposes as a condition of South32's predecessor acquiring the property.

Since its construction in 2018, the remediated TSF has also been used by South32 to hold additional new tailings and related materials associated with its mine activities at the site. As ADEQ itself has stated: "The Trench Camp historic tailings piles (1 through 4) were located in an unlined natural basin in a three pile configuration. Tailings Pile #1 contained tailings and potential acid generating (PAG) waste rock", while the remaining piles contained only tailings. "These tailings piles were moved onto the Trench Camp TSF under the terms of the APP and VRP."[8]

Given South32's then existing and planned exploratory and mine activities at the site, South32 applied for a major expansion of the TSF (to nearly double its size) in 2020. As South32's own materials state: "Placement of exploration decline development rock, PAG construction rock, water treatment solids, sediment from stormwater best

[7] *See* APP P-512235 Amendment Application (August 2020) at 196.
[8] *See* Executive Summary at 1, Aquifer Protection Permit (APP) No. P-512235 (August 2021). *See also* FN7 at 14.

management practices (BMPs), and drill cuttings on the TSF" are one of the activities "required to support the construction of the exploration declines and exploration activities".[9] And as ADEQ has admitted and previously documented:

> Tailings, potentially acid generating (PAG) waste rock and impacted soils beneath the existing tailings piles are to be excavated and placed in the lined Trench Camp TSF as an earthen material. PAG development rock from site surface construction and from a planned exploration decline or shaft, solids from the water treatment plants (WTP1 and WTP2), core cuttings, drill cuttings, and stormwater best management practices (BMPs) solids will also be stored in the lined TSF **as a co-mingled material with the existing tailings and PAG waste rock**. Additionally, the development rock may be placed on the exterior face of the existing tailings and PAG waste rock thereby acting as rock armor, to prevent water and wind erosion prior to closure.[10] [Emphasis added].

An Underdrain Collection Pond (UCP) system was constructed to collect seepage from all old and new materials placed on the TSF. South32 also sought permitting to construct a second water treatment plant (WTP2) and develop other infrastructure to discharge mine water into Harshaw Creek (Outfall 002) from the deep and destructive wells it built to radically dewater the aquifer for mining purposes.

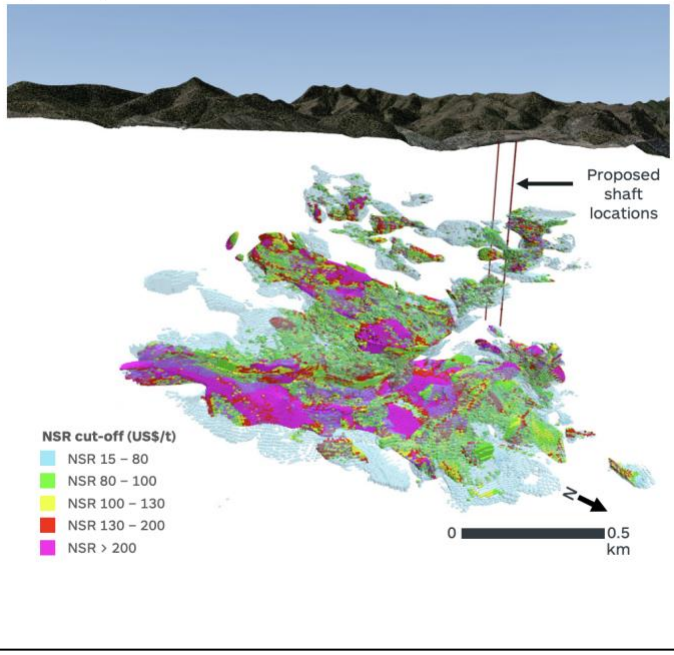
Today, the current Hermosa Project mine site is totally unrecognizable from the historical operations.

Hermosa Project site, Jan. 2023 (Google Earth)

[9] *See* FN7 at 3.

[10] *See* ADEQ's Summary and Response to Public Comments, APP No. 512235, August 4, 2021 at 1.

All of this work is being performed by South32 to facilitate the development of a new large-scale industrial mine. During the life of this Permit, South32 will develop new two new large mine shafts (right) and related infrastructure which in no way resemble the long shuttered historic mining site.



Proposed shaft locations. From South32 Hermosa Project Update Press Release at 5 (Jan. 17, 2022)

South32 describes the Taylor and Clark ore deposits associated with the Hermosa Project as "[o]ne of the largest undeveloped zinc-lead resources in the world, and the largest in America."[11] South32's Graham Kerr stated: "We are designing the Taylor deposit to be our first 'next generation mine', using automation and new technology."[12]

This "next generation mine" will be massive and have no relation to the historic mine that operated at the site many decades ago. Yet, rather than acknowledge that the Hermosa Project is already quite advanced and projected to actually begin mine production during the life of this Permit, ADEQ continues to mislead the public by vaguely describing South32's activities as no more than an exploratory project. *See* Draft Fact Sheet at 4:

> South32 is conducting exploration activities to more fully assess the economic and technical viability of mining the underground polymetallic mineral deposit (primarily targeting zinc, lead, silver and manganese). This will be accomplished largely through advancement of exploration shafts/declines, which will necessitate pumping and treating water from the local aquifer in the vicinity of the shafts/declines to allow for their safe advancement.

South32 explains that "[f]irst production is targeted in FY27 with surface infrastructure, orebody access, initial production and tailings storage expected on patented lands [the site at issue in this Draft Permit] which require state-based

[11] *See* Exhibit AMADEQ-103 at p.6 (Jan. 4, 2022).

[12] *See* South32 Hermosa Project Update Press Release at 1 (Jan. 17, 2022).

approvals."[13] The purpose of these exploration shafts is to develop large and previously untouched polymetallic mineral deposits (including the zinc-lead-silver Taylor sulphide deposit or "Taylor Deposit", and the zinc-manganese-silver deposit or "Clark Deposit").[14]

In December 2023, South32 announced that "initial excavation for the main exploration shaft and the ventilation shaft" began in May 2023, and that "construction pre-sink activities of both shafts remain on track. To date, we have excavated 50 of the planned 115 feet for the main exploration shaft and excavated 115 feet for a ventilation shaft."[15] The total final depths of these shafts is anticipated to be approximately 2,900 feet.

The new project features constructed or proposed by South32 for this "next generation mine" (the TSF and UCP, the two new major wastewater treatment plants, two new massive exploration decline shafts, and deep mine dewatering and depressurization wells) are components of a radically new large-scale mining operation using new technology and techniques. As discussed below, they are substantially independent from existing sources at the site per §122.29(b)(1). In fact, other than the historic tailings which have been commingled in the TSF with new development materials, and the historic January Adit which is unused and only managed for remediation, PARA is unaware of any other historic pre-1982 features of this mine.

In short, it cannot be reasonably denied by ADEQ that the proposed and newly constructed facilities are nothing short of a brand-new mining operation, designed to access deep and untouched ore bodies, using new technology that is simply incomparable to the small-scale historic mining operations of the prior century that ended over 70 years ago.

Hermosa Project site, April 24, 2023 (Private Collection)

[13] *See* FN12 at 4.

[14] https://www.south32.net/what-we-do/our-locations/americas/hermosa

[15] *See* South32 Hermosa Project Operational Update at 1 (Dec. 7, 2023).

III. The Hermosa Project Contains New Sources of Discharge that Must Be Carefully Evaluated Due to the Impaired Nature of the Receiving Waters – and No AZPDES May Issue Until TMDLS and Other Analysis Required by the Clean Water Act are Completed

ADEQ must be aware of South32's rapidly developing activities for a new, full-scale mine that has multiple sources of pollution that could impact nearby surface waters *via* discharge from Outfall 001 or Outfall 002.[16] As a result, as a "new source" (or alternatively, as a new discharger),[17] ADEQ must finalize the needed TMDL studies for these impaired surface waters of Alum Gulch, Harshaw Creek, and Sonoita Creek, and perform the necessary waste load allocations for these discharges to include all sources of discharge as required by the Clean Water Act and its implementing regulations. ADEQ cannot avoid this, no matter how much it twists its obligation under the Clean Water Act. Specifically, 40 C.F.R. § 122.4(i)(1)-(2) (and A.A.C. R18-9-A903(A)(7)) require, in relevant part, that a discharge permit (like the AZPDES at issue here) not be issued:

> (i) To a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards. The owner or operator of a new source or new discharger proposing to discharge into a water segment which does not meet applicable water quality standards or is not expected to meet those standards even after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of CWA, and for which the State or interstate agency has performed a pollutants load allocation for the pollutant to be discharged, must demonstrate, before the close of the public comment period, that:

[16] In fact, perhaps in acknowledgment of this point, ADEQ has (without explanation) changed the name of the current Draft Permit from the "January Mine Hermosa Project Water Treatment Plant" (prior name) to the "January Mine Hermosa Project" (current name), removing the former misleading implication that this AZPDES permit is solely about a water treatment plant. Also, despite the inclusion of "January Mine" in the permit title, the historic and long-abandoned January Adit is not integrated in any way with South32's existing facilities. The January Adit remains contaminated, and it is merely managed by South32 for remediation purposes only as a condition of AMI (South32's predecessor) obtaining the property. *See* ADEQ Public Notice for Renewal of AZPDES Permit (Nov. 8, 2022), and ADEQ Public Notice for Renewal of AZPDES Permit (Nov. 28, 2023).

[17] Even if ADEQ never concedes that the Hermosa Project is a new source or has new sources, the new buildings, structures, facilities and installations constitute "new dischargers" as defined in 40 CFR § 122.2 with multiple sources of pollutants, and a TMDL must still be completed prior to issuance of the proposed AZPDES Permit pursuant to 40 C.F.R. § 122.4(i)(1)-(2).

> (1) There are sufficient remaining pollutant load allocations to allow for the discharge; and
> (2) The existing dischargers into that segment are subject to compliance schedules designed to bring the segment into compliance with applicable water quality standards….

PARA has repeatedly documented to ADEQ (*via* prior comments on this AZPDES Permit, **Attachment 1,** and in filings) that South32's current and planned mine workings, structures, and facilities are "new sources" under 40 C.F.R. §§ 122.22 and 122.29, and R18-9-A901(25), as they involve the construction[18] of new facilities, new structures, and new sources of discharge completely unrelated to the old and long shuttered ASARCO mine site. 40 C.F.R. § 122.29(b), outlines the following criteria for new source determination:

> (b) *Criteria for new source determination*
> (1) Except as otherwise provided in an applicable new source performance standard, a source is a "new source" if it meets the definition of "new source" in § 122.2, and
> (i) It is constructed at a site at which no other source is located; or
> (ii) It totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
> (iii) Its processes are substantially independent of an existing source at the same site. In determining whether these processes are substantially independent, the Director shall consider such factors as the extent to which the new facility is integrated with the existing plant; and the extent to which the new facility is engaged in the same general type of activity as the existing source.

[18] 40 C.F.R. § 122.29(b)(4) makes clear that construction of a new source as defined under § 122.2 has commenced if the owner or operator has:

> (i) Begun, or caused to begin as part of a continuous on-site construction program:
> (A) Any placement, assembly, or installation of facilities or equipment; or
> (B) Significant site preparation work including clearing, excavation or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or
> (ii) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation with a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility engineering, and design studies do not constitute a contractual obligation under the paragraph.

> (2) A source meeting the requirements of paragraphs (b)(1)(i), (ii), or (iii) of this section is a new source only if a new source performance standard is independently applicable to it. If there is no such independently applicable standard, the source is a new discharger. See § 122.2.[19]

In this case, South32's new mine structures and facilities at the Hermosa Project, constructed long after 1982 to further the development of this new mine and reach new untouched deposits, are "new sources" meeting the requirements of §122.29(b)(1)(ii) and (iii) and they are subject to new source performance standards for mines producing copper, lead, zinc, gold, silver, and molybdenum pursuant to 40 C.F.R. § 440.100(a)(1). The new exploration declines and mine shafts, the TSF and UCP and the new WTP2 have (or will) totally replace the process or production equipment that causes the discharge of pollutants as outlined in § 122.29(b)(1)(ii). In addition, South32's processes are undoubtedly "substantially independent of an existing source" at the Hermosa Project mine site under § 122.29(b)(1)(iii). And, as noted above, while it is true that historic seepage from the January Adit is an existing source, it is not "integrated with the existing plant." In fact, there is no existing plant.

Finally, there is no mere "modification" of an existing site under § 122.29(b)(3) since South32 is constructing brand-new buildings, structures, facilities and installations at the Hermosa Project mine site rather than merely altering, replacing, or adding to any existing process or production equipment (there is no existing process or production equipment).

Accordingly, contrary to ADEQ's suggestion, the fact that historic mining has occurred previously at a small portion of the Hermosa Project site does not forever exempt any of its new mine workings, shafts, structures, and facilities from being considered a "new source" under the Clean Water Act (or, alternatively, a new discharger). The only real connection between the new Hermosa Project and the old historic January Adit (managed only for remediation purposes) and the old tailings commingled with new materials (*see* Sec. V(1) below) is that the drainages from these old features are treated in the same wastewater treatment plants. In discussing and promulgating the applicable regulations at 40 C.F.R. § 122.29, the EPA remarked on such a scenario:

> For example, a plant may decide to improve the quality of a product by installing a new purification step into its process, such as a new filter or distillation column. Such a minor change would be integral to the existing

[19] In addition, to be a new source, Section § 122.29 (b)(2) provides, "[a] source meeting the requirements of paragraphs (b)(1)(i), (ii), or (iii) of this section is a new source only if a new source performance standard is independently applicable to it" (emphasis added). Because it is beyond dispute that new source performance standards for mines producing copper, lead, zinc, gold, silver, and molybdenum, codified at 40 C.F.R. Subpart J, are applicable here, *see* 40 C.F.R. § 440.100(a)(1), PARA need not offer any additional argument on this matter here. *See also* Draft Fact Sheet at 15.

> operations and would not require the facility to be reclassified as a new source. However, on the other extreme, if the only connection between the new and old facility is that they are supplied utilities such as steam, electricity, or cooling water from the same source or that their wastewater effluents are treated in the same treatment plant, then the new facility will be a new source.
>
> The legislative history of the CWA indicates that new source requirements were intended to apply where new construction allows flexibility to incorporate new pollution control technology. The fact that a facility can be constructed to utilize an existing waste treatment plant does not address the issue of whether new technology could have been installed. To allow the use of an existing wastewater treatment system, by itself, to preclude the application of new source requirements would frustrate clear statutory intent.

49 Fed. Reg. 38043-38044 (Sept. 26, 1984) [Emphasis added].

Despite all of this, ADEQ continues to assert that because historic mining on a small portion of the site took place many decades ago, every single future activity at or near this site (including exploration and shaft development for the removal of metal ore or minerals at the site) cannot be a "new source" under 33 U.S.C. § 1316 (a)(2) and 40 CFR Part 122.2 (or even a new discharger). This conclusion is both contrary to law and contrary to the facts of the Hermosa Project – a point ADEQ concedes in the Draft Fact Sheet at 11: "ADEQ added the discharge restrictions in Part I.A.1.b. to Outfall 001 to ensure that **no new sources** will be discharged to Alum Gulch (an impaired water) as required by the *San Carlos* decision." (Emphasis added). ADEQ's statement is correct. It is also an admission by ADEQ that everything other than treated mine drainage water from January Adit and drainage from historic portion of the dry stack tailings is a new source.

In fact, the way that ADEQ structured the Draft Permit is a plain concession that the Hermosa Project is a new source. First, nowhere in the Draft Permit does ADEQ deny that the Hermosa Project is a new source. This is in direct contrast to the 2022 Draft Permit (see fact sheet dated March 9, 2023, at 4, where ADEQ stated "ADEQ is considering the discharge from WTP1 and WTP2 to be an existing source rather than a new source"). Second, ADEQ now attempts to limit discharges to Alum Gulch to only what it calls "historic mine sources" (defining "historic" as predating December 3, 1982) thereby disallowing discharges from any other facility at the Project. Fact Sheet at 6. This is a blatant concession that the "rest" of the Hermosa Project is a new source. Otherwise, ADEQ would not have made this distinction in the Draft Permit. Additionally, as discussed in Sec. V(1) below, ADEQ and South32 have both repeatedly documented that the TSF contains (and indeed is permitted to contain) not only historic tailings but new materials (including PAG materials), which are new sources of potential pollutants subject to discharge via Outfall 001 or Outfall 002.

What has become quite clear from the Fact Sheet and Permit is that rather than properly applying the law to the facts of the Hermosa Project site and performing a true new source determination, ADEQ seeks to avoid this obligation entirely – at least for now, leaving its options open to perform (seemingly for the first time) a new source determination at some undefined point in the future after the Arizona Supreme Court issues a decision in *San Carlos Apache Tribe v. State of Arizona, et al.* In its Fact Sheet at page 6, ADEQ rationalizes: "The 2018 permit and 2021 permit modification determined January Mine Hermosa Project to be an existing source in its entirety. If the Arizona Supreme Court vacates the *San Carlos* decision, the permit may be re-evaluated through a permit modification."

ADEQ's suggestion that it can just "kick the can down the road" on the TMDL issue for Alum Gulch, Harshaw Creek, and Sonoita Creek until the Arizona Supreme Court issues a decision in *San Carlos* misconstrues what is actually on appeal in that case. While it is true the Arizona Supreme Court has accepted review of the *San Carlos* decision re: the "new source" issue, the Arizona Supreme Court did **not** accept ADEQ's third issue presented for review. Specifically, the Supreme Court did not accept the following: "Did the Opinion erroneously hold that ADEQ could not renew the [AZPDES] permit until it finalized the TMDL and Resolution complied with 40 C.F.R. § 122.4(i)(1) and (2)?"[20] Accordingly, the Court of Appeals' decision on this issue remains controlling law. ADEQ cannot issue the AZPDES Permit to South 32 until TMDLs for Alum Gulch, Harshaw Creek, and Sonoita Creek are updated/finalized, and waste load allocations are evaluated by South32 and ADEQ under 40 CFR § 122.4(i)(1) and (2) and applicable law.

ADEQ's position to the contrary ignores this aspect of the *San Carlos* decision. Even ADEQ acknowledges the repercussions of the *San Carlos* decision in the Fact Sheet at 5, noting: "In the *San Carlos* decision, the Court held that a mine shaft constructed after 1982 was a 'mine' and a 'new source' as defined in applicable Clean Water Act regulations, and therefore ADEQ could not renew an AZPDES permit authorizing discharges from the 'new source' into an impaired water until the agency first finalized a total maximum daily load (TMDL) for the impaired water." The same is true here.

ADEQ undertakes a tortured analysis to avoid its obligations to prepare the necessary TMDLs and other analysis required by the Clean Water Act. For example, ADEQ denies that there have been or will be any new sources of discharge to Alum Gulch (Outfall 001) under the Permit, as discussed further by PARA in Sec. IV below. Also as discussed in Sec. VI below, ADEQ denies that the discharge to Harshaw Creek (Outfall 002) is actually located in Upper Harshaw Creek which is impaired for multiple elements and listed on ADEQ's 303(d) list, and it denies that Lower Harshaw Creek is also impaired under the Clean Water Act, including from contamination drainage from legacy mines – a point ADEQ is plainly aware of as PARA discusses in Sec. V, and in PARA's Comments

[20] *See* Appellee ADEQ's Petition for Review, Case No. CV-22-0290-PR (Jan. 17, 2023). *See also* Supreme Court Order, Case No. CV-22-0290-PR (Aug. 23, 2023) ("Petition for Review (Appellee ADEQ) = Granted as to issues number one and two only.")

to ADEQ on the Draft 2024 CWA Assessment Comments filed September 11, 2023 (attached here as **Attachment 2** and incorporated here by reference as if stated in full).

Based on the foregoing, ADEQ must conclude that the mine or mine activities to be conducted under the Permit are "new sources" subject to the 1982 effluent limitations imposed by 40 CFR Part 440, Subpart J (or alternatively South32 is a new discharger under 40 CFR Part 122.2). Either way, ADEQ must finalize (or update) its TMDL studies for Alum Gulch, Harshaw Creek, and Sonoita Creek and perform the waste load allocations required by law before it can issue this AZPDES Permit.

IV. A "New Source" Determination is the First Step in the Permit Evaluation Process, Not the Last

The EPA NPDES Permit Writers' Manual[21] lists certain steps for applying effluent guidelines to facilities applying for new or reissued NPDES Permits. One of the first listed tasks for the permit writer, after learning about the discharging facility and identifying relevant effluent guideline categories, is that "the permit writer must determine whether the facility or any part of the facility is a new source." (Manual at 5-27).

5.2.2 Applying Effluent Guidelines through NPDES Permits

Permit writers need to have a detailed knowledge of the industrial facility applying for a new or reissued NPDES permit to identify applicable effluent guidelines and know how to use them to derive TBELs. This section provides a step-by-step procedure for applying effluent guidelines to direct discharges through NPDES permits as shown in Exhibit 5-10.

Exhibit 5-10 Steps for applying effluent guidelines to direct discharges

Step 1.	Learn about the industrial discharger
Step 2.	Identify the applicable effluent guidelines category(ies)
Step 3.	Identify the applicable effluent guidelines subcategory(ies)
Step 4.	Determine whether existing or new source standards apply
Step 5.	Calculate TBELs from the effluent guidelines
Step 6.	Account for overlapping or multiple effluent guidelines requirements
Step 7.	Apply additional regulatory considerations in calculating TBELs
Step 8.	Apply additional effluent guidelines requirements
Step 9.	Document the application of effluent guidelines in the fact sheet

NPDES Permit Writers' Manual (Sept. 2010) at Sec. 5.2.2

The fact that a new source determination comes early in the process is significant, since a new source determination will define how discharge limits and other requirements of the Clean Water Act will be incorporated in the permit. As the Manual explains: "Where a new source is the result of a new installation of process equipment at an existing facility, part of the facility might be subject to existing source standards and other parts of the facility subject to new source standards. Permit writers should identify whether the facility has installed any process equipment after the last issuance of the NPDES permit and

[21] U.S. Environmental Protection Agency, NPDES Permit Writers' Manual (Sept. 2010)

apply the criteria from § 122.29(b) on a case-by-case basis to new construction or new processes…" (Manual at 5-28).

The Manual also cautions:

> It is important to remember that after the effective date of a new source standard, the CWA stipulates that it is unlawful for any owner or operator to operate such a source in violation of those standards. See 33 U.S.C. 1316(e) and 1317(d). EPA's regulations specify that a new source "[must] install and have in operating condition, and [must] *start up* all pollution control equipment" required to meet applicable standards before beginning to discharge. The regulations also indicate that the owner or operator of a new source must meet all applicable standards within the shortest feasible time (not to exceed 90 days). *See* § 122.29(d)(4).

Manual at 5-28.

The only logical conclusion for a permit writer, which would avoid the possibility of unlawful discharge, is for a proper and complete new source determination to be made before a permit is issued or renewed, not after. But ADEQ has chosen to do the opposite here. It intends to issue the AZPDES permit first and postpone a new source analysis until some later time, presumably after the *San Carlos* decision has been issued by the Arizona Supreme Court. The Fact Sheet at 6 states: "The 2018 permit and 2021 permit modification determined January Mine Hermosa Project to be an existing source in its entirety. If the Supreme Court vacates the *San Carlos* decision, the permit may be re-evaluated through a permit modification." However, the Manual is clear that a new source determination should be done upfront for both new and reissued permits, as facilities can change over time. For reasons unknown, ADEQ has simply failed to complete a new source review for this permit renewal.[22]

This is contrary to what the law requires. The vague allusion by ADEQ that it may potentially perform a new source determination sometime in the future, with a seemingly predetermined conclusion, is not lawful. A complete and thorough new source analysis, which properly and honestly applies the law to evaluate all relevant aspects of the current Hermosa Project buildings, structures, facilities, and installations, including their date(s) of construction, must be completed before this Draft Permit is issued.

[22] In fact, it appears that ADEQ has never completed a new source analysis. In response to a public records request filed Dec. 6, 2023 for "[a]ny and all New Source analyses on the January Mine Hermosa Project and its components completed for this permit, as required by law", ADEQ responded stating: "we do not have any new source analyses documents other than the fact sheet itself." Email from ADEQ Records Center, Dec. 13, 2023 at 8:55 AM (Emphasis added).

V. An AZPDES Permit Cannot Issue and Discharge to Outfall 001 Cannot Occur Until Alum Gulch TMDL is Updated and a New TMDL Is Completed for Lead

As noted above, the AZPDES Permit cannot issue until the Alum Gulch TMDL is updated, a new TMDL has been finalized for lead, and the waste load analysis required by 40 C.F.R. § 122.4(i)(1)-(2) and A.A.C. R18-9-A903(A)(7) has been performed.

Amazingly, Alum Gulch was listed as impaired for cadmium, copper, low pH, and zinc over two decades ago and yet ADEQ has failed to bring these surface waters into compliance under the Clean Water Act. ADEQ cannot rely on the fact that there is an existing (and clearly unsuccessful) TMDL for Alum Gulch (Headwaters to Sonoita Creek 2003) which is also over 20 years old.[23] ADEQ acknowledges that it is "required by law to review and update the existing TMDLs every 5 years. At present, every existing TMDL [in Arizona] is more than 5 years old and has not been reviewed or updated."[24]

In short, the Alum Gulch TMDL is significantly outdated in violation of law. It does not reflect current conditions in this surface water system, does not consider or model the current proposed discharge from South32, and there is no evidence that the TMDL and the conditions analyzed in the TMDL have ever been reviewed since it was first issued. ADEQ admits that its TMDL backlog "is hindering ADEQ's ability to restore important sources of water used for drinking, recreation, industry and other activities across the state."[25] This is plainly the case for Alum Gulch.

It is also significant that Alum Gulch is impaired for another contaminant that was not included in the old TMDL. Specifically, Alum Gulch is impaired for lead (added to the 303(d) list in 2022), and the proposed AZPDES Permit renewal here proposes to discharge effluent into Alum Gulch via Outfall 001 that contains certain quantities of lead (*see* Draft Permit at 3, Table 1(a)).[26] But, as discussed above, under 40 C.F.R. § 122.4(i)(1)-(2), no NPDES permit may be issued until the necessary TMDLs and required

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[23] *See* Alum Gulch TMDL, HUC No. 1505031-561A (June 30, 2003).

[24] *See* ADEQ Executive Budget Request (EBR) Fiscal Year 2024 (Sept. 1, 2022) at 109; *see also* A.R.S. § 49-234(J) which states in relevant part: "After a [TMDL] and a TMDL implementation plan have been adopted for a protected surface water, the department shall review the status of the protected surface water at least once every five years to determine if compliance with applicable surface water quality standards has been achieved."

[25] *See* FN24.

[26] *See Friends of Pinto Creek v. U.S. EPA, et al.,* 504 F.3d 1007 (9th Cir. 2007). In *Friends of Pinto Creek*, the 9th Circuit held that issuance of a NPDES permit allowing mining discharges of copper by intervenor Carlota Copper Co. into a waterbody listed on the §303(d) list for copper impairment violated the Clean Water Act.

waste load allocations have been performed. Even ADEQ admits this point in its Fact Sheet at 5: "Under the *San Carlos* decision, discharges from new sources **are prohibited** to Upper and Middle Alum Gulch until the Alum Gulch TMDL is updated to include lead." (Emphasis Added). This is correct. Discharge from Outfall 001 (containing levels of lead) into Alum Gulch (impaired for lead) will, in fact, contribute to a violation of water quality standards. Furthermore, the Draft Permit materials indicate that South32 has not demonstrated compliance with §122.4(1) and (2) (or A.A.C. R18-9-A903(A)(7)). This violates the plain requirements of the Clean Water Act.

Despite ADEQ's best efforts to avoid its obligations, a current and complete TMDL must precede issuance of an AZPDES Permit where the receiving water is impaired as discussed here. ADEQ cannot renew South32's AZPDES Permit until the Alum Gulch TMDL is reviewed and updated in its entirety and a waste load allocation has been performed for this new impairment. Anything less violates the Clean Water Act and Arizona's implementing standards for the NPDES program.

1. The Tailings Storage Facility Contains More Than Just "Historic" Material and Historic Sources

In a clear effort to avoid the TMDL and other requirements discussed above applicable to discharges from Outfall 001 into impaired Alum Gulch, ADEQ includes the following prohibition in the Draft Permit at Part I(A)(1)(b) that ADEQ's own materials demonstrate is untethered from reality: "The only allowable discharges from Outfall 001 are drainage water from historic workings associated with the January Adit, drainage water from historic tailings, and stormwater. See definition of 'historic' in Appendix A, Part B of the Draft Permit. If South32 does seek to add dry stack tailings from a future mill to the existing tailings storage facility, they must notify ADEQ and cease discharge to Alum Gulch." The Draft Fact Sheet (below) contains similar language.

Water from the following sources may be discharged to Upper Alum Gulch per Part I.A.1. of the permit:

- Drainage water from historic workings associated with January Adit
- Drainage water from historic tailings
- Stormwater to which effluent limitation guidelines are not applicable

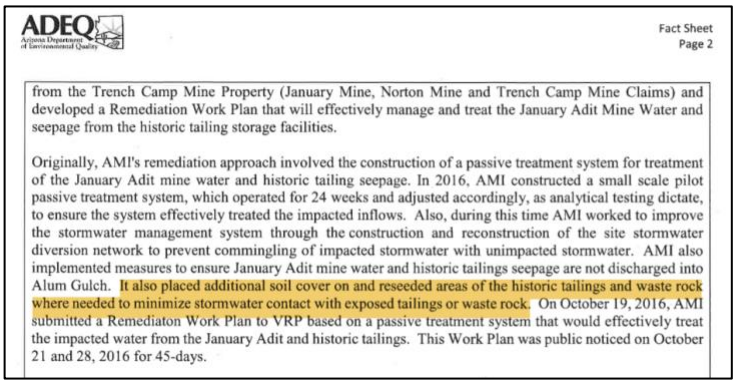
Thus, the only allowable sources of discharge from Outfall 001 to Upper Alum Gulch are treated mine drainage water from historic workings associated with January Adit, drainage from historic dry stack tailings, which predate the effluent limitation guidelines promulgated on December 3, 1982 and are existing sources, whether or not mixed with stormwater. The restrictions on discharges to Upper Alum Gulch ensures that no new sources will be discharged to an impaired water as required by the *San Carlos* decision.

AZPDES Draft Fact Sheet at 6 (Nov. 28, 2018)

ADEQ states that these restrictions are to ensure "that no new sources will be discharged to an impaired water as required by the *San Carlos* decision." (Draft Fact Sheet at 6). [27]

[27] Inexplicably, ADEQ also states: "If 100% reuse is not possible, effluent from WTP1 may be discharged from Outfall 001 to Upper Alum Gulch…" Draft Fact Sheet at 3. Presumably this means that drainage from non-historic sources may be discharged from Outfall 001

The glaringly obvious problem with ADEQ's statement is that it is not true. It does not reflect how the TSF has been used and is currently being used by South32. And it does not reflect how the mine and its mill will operate during the life of this Permit. Indeed, as discussed below, ADEQ's own permit materials reveal that the TSF already contains much more than historic materials, including PAG rock resulting in seepage and drainage that will be discharged into Alum Gulch under the Permit in violation of law. Most recently, this includes development rock and other materials from its ongoing exploration and mine shaft construction activities.[28] ADEQ has also permitted South32 to substantially expand the TSF to accommodate more tailings and materials as their mine progresses over the life of the AZPDES Permit.



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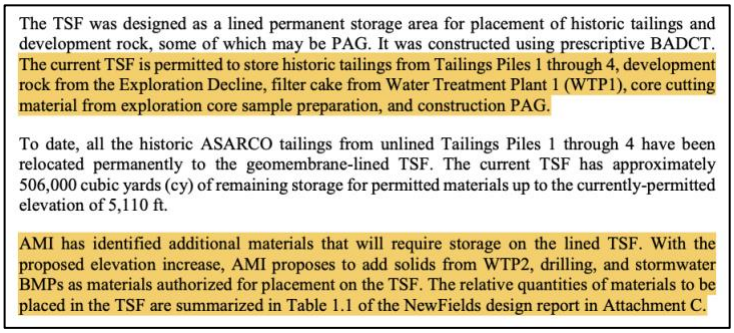
from the Trench Camp Mine Property (January Mine, Norton Mine and Trench Camp Mine Claims) and developed a Remediation Work Plan that will effectively manage and treat the January Adit Mine Water and seepage from the historic tailing storage facilities.

Originally, AMI's remediation approach involved the construction of a passive treatment system for treatment of the January Adit mine water and historic tailing seepage. In 2016, AMI constructed a small scale pilot passive treatment system, which operated for 24 weeks and adjusted accordingly, as analytical testing dictate, to ensure the system effectively treated the impacted inflows. Also, during this time AMI worked to improve the stormwater management system through the construction and reconstruction of the site stormwater diversion network to prevent commingling of impacted stormwater with unimpacted stormwater. AMI also implemented measures to ensure January Adit mine water and historic tailings seepage are not discharged into Alum Gulch. It also placed additional soil cover on and reseeded areas of the historic tailings and waste rock where needed to minimize stormwater contact with exposed tailings or waste rock. On October 19, 2016, AMI submitted a Remediaton Work Plan to VRP based on a passive treatment system that would effectively treat the impacted water from the January Adit and historic tailings. This Work Plan was public noticed on October 21 and 28, 2016 for 45-days.

AZPDES No. AZ0026387 Draft Fact Sheet at 2 (Jan. 2018), emphasis added

ADEQ knows Arizona Minerals, Inc. (now South32) has been placing new, non-historic materials along with historic tailings that present new sources of discharge on the TSF since 2018 when Aquifer Protection Permit (APP) No. P-512235 was issued.

The 2018 Fact Sheet for the initial issuance of this AZPDES Permit (above, left) plainly states that historic tailings materials were commingled with additional materials containing new sources of pollution, such as soil and waste rock since at least 2016, even before the old historic unlined tailings piles were moved and restructured into the current TSF.



The TSF was designed as a lined permanent storage area for placement of historic tailings and development rock, some of which may be PAG. It was constructed using prescriptive BADCT. The current TSF is permitted to store historic tailings from Tailings Piles 1 through 4, development rock from the Exploration Decline, filter cake from Water Treatment Plant 1 (WTP1), core cutting material from exploration core sample preparation, and construction PAG.

To date, all the historic ASARCO tailings from unlined Tailings Piles 1 through 4 have been relocated permanently to the geomembrane-lined TSF. The current TSF has approximately 506,000 cubic yards (cy) of remaining storage for permitted materials up to the currently-permitted elevation of 5,110 ft.

AMI has identified additional materials that will require storage on the lined TSF. With the proposed elevation increase, AMI proposes to add solids from WTP2, drilling, and stormwater BMPs as materials authorized for placement on the TSF. The relative quantities of materials to be placed in the TSF are summarized in Table 1.1 of the NewFields design report in Attachment C.

APP No. P-512235 Amendment Application at 14 (Aug. 18, 2020), emphasis added

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into Alum Gulch, despite ADEQ's statements to the contrary. To reiterate, in addition to drainage from historic and new non-historic and PAG materials from the TSF and UCP, influent into WTP1 (and effluent discharged from Outfall 001 into Alum Gulch) also includes water from other new sources including underground dewatering pumps and operational water services. *See, e.g.* APP P-512235 Amendment Application (August 2020) at 52 (Process Flow Diagram).

[28] *See* South32 Hermosa Project Operational Update (Dec. 7, 2023).

The Fact Sheet for the initial issuance of APP No. P-512235 at 2 (Jan. 2018) for this project further describes the phases in which the old historic unlined tailings piles would be moved, commingled with additional new non-historic materials from multiple sources (including waste rock, native material, and PAG development rock from the exploration decline) into one single new TSF facility, as a component of voluntary remediation and to support the mine. These documents reconfirm that the tailings piles already contained PAG waste rock and native material commingled with historic tailings when developed. This phased TSF construction was completed around 2020.

As noted above, in mid-2020, the APP No. P-512235 was amended to permit the significant expansion of new TSF from 1.7 million cubic yards of material to 2.7 million cubic yards. This size increase was allowed by ADEQ specifically for the addition of new (non-historic) materials on the TSF, including development rock, core cutting material, solids from both WTPs, and new potentially acid-generating (PAG) construction material "as co-mingled material with the existing tailings and PAG waste rock." *See* ADEQ Summary and Response to Comments on APP No. P-512235 (below). All of that material was placed on the TSF.

SUMMARY AND RESPONSE TO PUBLIC COMMENTS

Permit No:	Aquifer Protection Permit (APP) No. 512235, LTF 83040
Facility Name:	Hermosa Project Property
Applicant:	Arizona Minerals Inc. (AMI)
Permit Action:	Proposed Significant Amendment to Arizona Minerals Inc. Aquifer Protection Permit Inventory No. 512235, LTF # 83040
Prepared By:	Arizona Department of Environmental Quality (ADEQ) Groundwater Protection Value Stream 1110 W. Washington Street Phoenix, Arizona 85007
Date:	August 4, 2021

A. INTRODUCTION

Summary

Arizona Minerals Inc. (AMI) has applied for a significant amendment to their Aquifer Protection Permit (APP) number 512235, Licensing Timeframe (LTF) number 83040.

This amendment does not permit mining activity. AMI is conducting exploration activity and remediating existing tailings piles. If AMI adds additional categorical APP discharging facilities, another significant amendment would be required.

The Trench Camp tailings storage facility (TSF) is designed as a lined, dry-stack permanent storage area for the remediation of the existing tailings piles, described above. Placement of the existing tailings piles on the lined permanent containment is part of ADEQ's voluntary remediation program (VRP) in Arizona under the site code 505143-2. Tailings, potentially acid generating (PAG) waste rock and impacted soils beneath the existing tailings piles are to be excavated and placed in the lined Trench Camp TSF as an earthen material. PAG development rock from site surface construction and from a planned exploration decline or shaft, solids from the water treatment plants (WTP1 and WTP2), core cuttings, drill cuttings, and stormwater best management practices (BMPs) solids will also be stored in the lined TSF as a co-mingled material with the existing tailings and PAG waste rock. Additionally, the development rock may be placed on the exterior face of the existing tailings and PAG waste rock thereby acting as rock armor, to prevent water and wind erosion prior to closure.

ADEQ's Summary and Response to Public Comments on APP No. P-512235 at 1 (Aug. 2021) (emphasis added).

South32's placement of non-historic potential PAG-generating material on the TSF and the new sources of pollution related to seepage from these materials is particularly concerning. Once these sulfide and heavy metal-containing materials are brought to the surface, crushed, and exposed to oxygen and water, they will oxidize into sulfuric acid and release the heavy metals. In low pH environments, this sulfuric acid can mobilize additional heavy metals in the environment.[29]

TABLE 1.1 DESIGN CRITERIA (PERMITTED AND NEW MATERIALS)

DESCRIPTION	VALUE	COMMENT
Exploration Decline Development Rock (permitted material)	825,092 tons equating to 488,943 cubic yards expansion potential up to 1,572,906 tons equating to 932,092 cubic yards	The TSF Amended Design is sized to include as much as 932,092 cy of exploration decline development rock, at a placed density of 125pcf. Values provided by AMI.
WTP1 Filter Cake (permitted material)	20,097 cy	Estimated quantity is based on 3,650 cubic yards per year for ~5 years. Includes a 10% contingency increase. Value provided by AMI.
Core Cutting Material (permitted material)	105 cy	Estimated quantity is based on 14 cubic yards per year for ~5 years. Includes a 50% contingency. Value provided by AMI.
Construction PAG rock cut (permitted material)	385,051 cy	Estimated quantity is for construction rock cut (some of which may be PAG) and is based on estimated future construction work. Value provided by AMI.
WTP2 Filter Cake (new material)	14,949 cy	Estimated quantity is based on 4,526 cubic yards per year for ~3 years. Includes a 10% contingency. Value provided by AMI.
Drill Cuttings (new material)	5 cy	Estimated quantity is based on less than 1 cubic yard per year for ~5 years. Value provided by AMI.
Sediment from Stormwater BMPs (new material)	9,000 cy	Estimated quantity is based on 1,800 cubic yards per year for ~5 years. Value provided by AMI.

APP No. P-512235 Amendment Application at 2 (Aug. 18, 2020)

As shown above, the APP Amendment Application submitted in 2020 to ADEQ by South32 also included estimated volumes of new, non-historic materials which have already been permitted for storage on the TSF since 2018, much of which have already been placed on the TSF. Accordingly, it is abundantly clear that ADEQ has long been aware that while the TSF contains historic tailings (that produces historic drainage), the TSF also includes, has long been permitted to include, and does include non-historic tailings materials from a wide variety of mining sources.

[29] *See* AZOAH Hearing Transcript Day 7 (Werkhoven, et al. v. ADEQ, et al, Case No. 21-004 regarding APP Permit No.), Pages 143-147 (Testimony of Dr. Emerman)

It is also noteworthy that drainage from the TSF is collected into one single underdrain collection pond (UCP), where all sources are commingled and then routed for treatment either in WTP1 or in WTP2. ADEQ is completely silent regarding drainage from new, non-historic materials on the TSF to the UCP.

ADEQ's current amnesia on this critical issue is astounding and represents an illogical divergence from the well-known fact that the TSF contains and will continue to be expanded to accommodate a combination of both "historic" and non "historic" materials which are new sources of pollutants.[30] Accordingly, given these new sources of discharge, until ADEQ completes a new TMDL for Alum Gulch that updates the existing outdated TMDL (which now is also impaired for lead) and performs the appropriate waste load allocation/analysis, ADEQ cannot issue the proposed Permit without violating the Clean Water Act.

VI. Harshaw Creek

The entirety of Harshaw Creek ("Headwaters to confluence with Sonoita Creek") is listed as an Arizona Protected Surface Water (PSW) in Arizona in the Arizona Administrative Code, Title 18, Chapter 11, Article 1, Appendix B, with the same designated uses throughout.[31] Yet, as discussed below, ADEQ deliberately segments Harshaw Creek into two different segments, one that ADEQ admits is impaired and listed under its Section 303(d) list (Upper Harshaw), and one that ADEQ denies is impaired in any way (Lower Harshaw), despite evidence to the contrary. As discussed below, ADEQ cannot allow discharge to the impaired waters of Harshaw Creek until it finalizes/updates a TMDL for Harshaw Creek and performs the waste load allocations required by law noted in PARA's comments, above.

1. Upper Harshaw Creek

As discussed above, ADEQ is "required by law to review and update the existing TMDLs every 5 years. At present, every existing TMDL [in Arizona] is more than 5 years old and has not been reviewed or updated."[32] To reiterate, the objective of a TMDL is to determine the loading capacity of the waterbody and to allocate that load among different pollutant sources so that the appropriate control actions can be taken and water quality standards achieved. The TMDL process is important for improving water quality because

[30] Even assuming it were somehow possible to identify and separate many tons of commingled historic and non-historic material in the TSF (which is impossible) this would require forming two TSFs and two UCPs, and permit amendments. And once drainage from the UCP enters WTP1 for treatment, there no indication of how (or even if) ADEQ intends to regulate and enforce any separation between the molecules of historic tailings drainage and molecules of water from non-historic sources.

[31] 18 A.A.C. 11, Page 38

[32] *See* ADEQ Executive Budget Request (EBR) Fiscal Year 2024 (Sept. 1, 2022) at 109.

it serves as a link in the chain between water quality standards and implementation of control actions designed to attain those standards. *See* https://www.epa.gov/tmdl/overview-total-maximum-daily-loads-tmdls

The TMDL report for Upper Harshaw Creek from 2003 (listing impairment from copper and low pH) is over 20 years old.[33] Just like the Alum Gulch TMDL, the Upper Harshaw Creek TMDL also fails to reflect current conditions in this surface water system, does not consider or model the current proposed discharge from South32, and there is no evidence that the TMDL and the conditions analyzed in the TMDL have ever been reviewed since it was first issued. The TMDL must be updated before the Draft Permit is issued.

In a plain attempt to avoid this obligation, ADEQ concludes that Outfall 002 is located in Lower Harshaw Creek and thus, South32's planned discharge from Outfall 002 under the Permit (according to ADEQ) would be to a segment of Harshaw Creek that is not listed on the 303(d) list for impairment. ADEQ is wrong. Its conclusion is not supported by any evidence, it does not comport with ADEQ's original listing for Upper Harshaw Creek, and it is contrary to ADEQ's own data, including the original TMDL itself.

In an effort to validate its after the fact – and convenient – decision to segment Upper and Lower Harshaw Creek (and the impairments associated with these segments), ADEQ (without legal or factual basis) uses new GPS coordinates to redefine the endpoint of Upper Harshaw Creek, putting it in a different location that is conveniently above Outfall 002. Therefore, according to ADEQ, that South32's discharges *via* Outfall 002 are not to surface waters listed as impaired on its 303(d) list. However, these GPS coordinates were not used or referenced in the original 303(d) listing for Harshaw and they were not used or referenced in the 2003 TMDL report. Rather, these coordinates appear to merely have been perfunctorily generated after the fact, and they directly conflict with ADEQ's own description of Upper Harshaw Creek contained in the original 2003 TMDL report. The TMDL indicates that the full length of Upper Harshaw Creek that was listed under Section 303(d) extends beyond these coordinates and it includes Outfall 002. This issue is addressed in PARA's Letter to the EPA dated Oct. 25, 2023, which enclosed PARA White Paper on Harshaw Creek Documenting the Location of South32's Outfall 002 Discharge Location in the Impaired Reach of Upper Harshaw Creek.

PARA will not reiterate the many factual and legal points made in the October 23, 2023, EPA letter and White Paper here, which was shared with ADEQ in November 2023, but instead expressly incorporates the full contents of **Attachment 3** here by reference as if stated in full.[34]

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[33] *See* Harshaw Creek TMDL, HUC No. 155031-561A (June 30, 2003).

[34] *See* Email from Carolyn Shafer to Trevor Baggiore. Subject: "PARA Letter to EPA – AZPDES Renewal Permit" (Nov. 9, 2023 at 11:05 AM).

2. Lower Harshaw Creek

Lower Harshaw Creek is also an impaired surface water, including from acid mine drainage associated with historic mining in the area. Yet, the known impairments in Lower Harshaw Creek are entirely disregarded in the Draft Permit. ADEQ states in the Draft Fact Sheet at 6: "Lower Harshaw Creek is not included on the 303(d) list, i.e., it is not impaired. The Draft 2024 Clean Water Act Assessment does not include Lower Harshaw Creek on the 303(d) list."

ADEQ is aware of, in possession of, and has indeed even collected evidence showing that Lower Harshaw Creek is impaired under the Clean Water Act. Indeed, PARA provided detailed information to ADEQ on this very point in PARA's Comments to ADEQ on Arizona's Draft 2024 Clean Water Act Assessment (July 1, 2017 to June 30, 2022) Integrated 305(b) Assessment and 303(d) Listing Report, dated Sept. 11, 2023, which PARA has attached to these comments as **Attachment 2,** the contents of which are expressly incorporated here by reference as if stated in full. As noted in PARA's comments on ADEQ's Clean Water Act Assessment for 2024, ADEQ cannot continue to ignore evidence on Harshaw's impaired nature and, thereby, dodge its obligations under the Clean Water Act.

The data in ADEQ's Draft 2024 CWA Assessment indicates that ADEQ has either failed to conduct adequate monitoring of Lower Harshaw Creek or it has improperly disregarded or failed to incorporate water quality data readily available to it on Lower Harshaw Creek. For at least the last two CWA Assessment cycles, ADEQ has included only a limited number of samples from Lower Harshaw Creek, testing only for pH with "inconclusive" results. ADEQ cannot avoid placing an impaired water on its impaired water list under Section 303(d) of the Clean Water Act by ignoring information before it or, worse yet, by failing to actually sample or test for impairment in the first place. Further, ADEQ cannot claim, by virtue of this lack of action, that there is no impairment in Lower Harshaw and thereby (through machinations PARA disputes) avoid the TMDL and waste load allocations required by the Clean Water Act before it can grant South32's AZPDES Permit.

It is also noteworthy that other departments within ADEQ have been collaborating with the U.S. Forest Service for some time to address acid mine drainage in the area, including from the historic Lead Queen Mine which drains into Lower Harshaw Creek. Additionally, local volunteer groups including Friends of Sonoita Creek have worked extensively with ADEQ Water Science Division to collect water quality data on water bodies in the Sonoita Creek watershed, including Harshaw Creek. Furthermore, the U.S. Forest Service has been working on a Watershed Restoration Action Plan to address water quality impairment issues from acid rock drainage from legacy mines throughout in the Harshaw Creek Watershed. This fact and all information related to these activities is readily available to ADEQ. ADEQ, however, ignores this information, continuing to suggest that it does not have information to suggest that Lower Harshaw is impaired and should be on the 303(d) list.

In sum, ADEQ must acknowledge the impairments even in what it now conveniently refers to as "Lower Harshaw Creek" and prepare a TMDL for Lower Harshaw Creek before it can issue this proposed AZPDES Permit renewal.

VII. Sonoita Creek

Both Alum Gulch and Harshaw Creek are tributaries to Sonoita Creek. Sonoita Creek has been impaired for zinc since 2004, with no TMDL completed.[35] It is unclear why a TMDL has not yet been completed for Sonoita Creek, and no explanation is given.

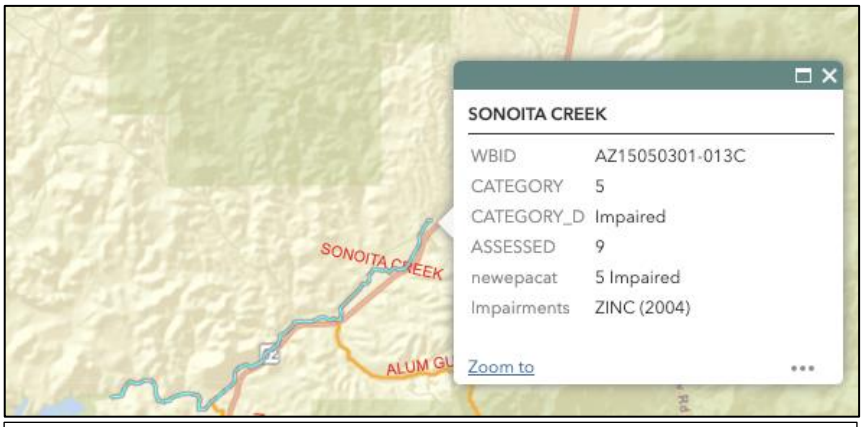

Image from ADEQ Impaired Waters GIS

ADEQ is silent about this impairment in the Draft Permit materials. Instead, ADEQ incudes a 2017 technical memorandum in the Draft Permit materials that defines the Pollutant Management Area (PMA) under Arizona's Aquifer Protection Permit program for South32's APP Permit, suggesting that ADEQ believes that discharges to Alum Gulch will not reach impaired Sonoita Creek. "The technical memorandum estimated the discharge from WTP1 to Upper Alum Gulch would reach a distance of 1.22 miles downstream." Fact Sheet at 9. PARA disputes ADEQ and South32's assertions[36] that discharges via Outfall 001 to Alum Gulch would not reach Sonoita Creek. *See, e.g.,* Lacher & Prucha Report (2021) cited herein.

ADEQ also asserts that: "Harshaw Creek flows to Upper Sonoita Creek (AZ15050301-013A). Upper Sonoita Creek has the same designated uses as Lower Harshaw Creek. Because there is no difference in downstream designated uses, the designated uses of Lower Harshaw Creek are protective of downstream waters." Fact Sheet at 9. But ADEQ's point ignores the fact that Sonoita Creek is impaired for zinc just downstream from where Harshaw enters Sonoita Creek. There is no doubt that South32's discharge to Harshaw Creek will reach Sonoita Creek, which ADEQ appears to concede at least at one point in the Fact Sheet. The fact that discharges from Outfall 002 would reach Sonoita Creek is demonstrated in materials prepared by PARA's own experts, who prepared and presented a fully integrated, calibrated hydrologic model of the Sonoita Creek basin which simulated the complete hydrologic system using extensive sources

[35] *See* ADEQ 2022 303(d) List, Appendix A. *See also* ADEQ Impaired Waters GIS.

[36] *See* Draft Fact Sheet at 9, and Appendix A. *See also* South32 "Groundwater management at our Hermosa project" video.

and datasets, concluding that discharge will reach Sonoita Creek "within several weeks of the initiation of discharge from WTP2". *See* Lacher & Prucha Report (2021) at 24, which is attached to PARA's comments and objections as **Attachment 4**, the contents of which is expressly incorporated here by reference as if stated in full.[37]

The discharges from Outfalls 001 and 002 will include maximum allowable levels of zinc, which will further impair the already-impaired waters of Sonoita Creek. A TMDL must therefore be completed for this zinc impairment and a proper waste load allocation performed before this Permit is issued as discussed above for Alum Gulch and Harshaw Creek. As ADEQ acknowledges in the Fact Sheet at 5, "[u[nder the *San Carlos* decision, discharges from new sources are prohibited" until a TMDL is updated to include a new impairment.

VIII. Because There Have Been Discharges from Outfall 002, this Discharge Data Must Be Considered in the Preparation of South32's AZPDES Permit

The Fact Sheet at 5 states: "Discharge from Outfall 002 occurred on August 30 and 31, 2023; the discharge averaged 0.1255 MGD." Nothing more is provided. However, ADEQ's statement is both outdated and misleading – more discharges have taken place since this time. Copies of Discharge Monitoring Reports (DMRs) obtained via public records request indicate that additional discharges occurred from Outfall 002 in September 2023 (for more days, at higher volumes and longer durations), more in October 2023 (for even more days, at even higher volumes, and even longer durations), and still more in November 2023 (for more days, higher volumes and longer durations). All of this information must be analyzed by ADEQ and considered in the final Permit.[38]

While the Draft Permit requires that DMRs be submitted "by the 28th day of the month following the end of a monitoring period", South32 is still required to document discharge flows on a daily basis. By the time this Draft Permit was released for public comment on November 28, 2023, ADEQ would have at least been in possession of the August and September flow data before issuing the Draft Permit and it should have updated the Draft Permit to consider and accurately reflect the nature of this discharge (pH, hardness, effluent limitations, Assessment Level monitoring, etc.).[39]

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[37] *See* Presentation by Laurel Lacher, PhD, RG and Bob Prucha, PhD, PE on Hydrologic Evaluation of Proposed Hermosa Mine Water Discharge (Jan. 17, 2021). *See also* Presentation by Lacher & Prucha to Town of Patagonia Flood & Flow Committee (June 10, 2021). *See also* South32 Hermosa Project Water Concerns.

[38] These discharges are unlawful because South32's AZPDES permit expired on January 7, 2023. See FN1 above.

[39] Even if the October and November DMRs had not yet received by ADEQ by November 28th, ADEQ could have simply placed a phone call or email to South32 to inquire about

ADEQ made a "routine inspection for compliance with the AZPDES" of the facility on September 28, 2023, *see* Fact Sheet at 10. Outfall 002 reportedly discharged for 24 hours that day. *See* **Attachment 5** (Discharge Flow Records for Outfall 002 from August through November 2023). Information from this inspection, including observed discharge flow rates, new influent monitoring results, should be analyzed and used to develop limits in the Draft Permit. The discharge details also could have been raised at the meeting held between ADEQ and South32 regarding this Draft Permit on November 3, 2023.[40] Astonishingly, this does not appear to have occurred – or if it did, it was not shared with the public and is inexplicably absent from the Draft Permit. Given the enormous public interest in this Permit, the very serious responsibility that ADEQ has to enforce the Clean Water Act and to shape permit terms based upon actual data, ADEQ should have used all available effluent discharge information to calculate permits limits for WTP2 Outfall 002 and it should have shared (and not misled) the public as part of this process in the Fact Sheet. This is not an esoteric point, the Draft Permit contains several provisions, calculations and assumptions which are premised upon the idea that discharge has not occurred from Outfall 002. These must be corrected.

The Draft Fact Sheet at 15 (Sec. VIII, Numeric Water Quality Standards) describes a process for including discharge limits for parameters with reasonable potential (RP) which are known, or expected to be present, in the discharged effluent. However, ADEQ asserts that "RP could not be calculated for potential pollutants that are subject to numeric water quality standards because there is not yet discharge data available."

In fact, the DMRs only report daily flow and pH levels. However, presuming that the escalating trend of discharge levels and volumes as indicated in the August, September, October, and November DMRs have continued through the present date, Outfall 002 has now been discharging for more than a quarter of a year (approx. 135 days as of 01/12/24). *See* **Attachment 5.** This is significant because (under the prior expired AZPDES permit which ADEQ argues is supposedly "administratively continued" which PARA does not concede), this duration would trigger reporting of effluent limitations and monitoring requirements as well as Assessment Levels (ALs).

ADEQ is now in possession of at least four months of discharge data for Outfall 002 (August, September, October, and November). *See* **Attachment 5.** This must be evaluated by ADEQ and used to write the Draft Permit.

The Fact Sheet continues on at 16: "[S]ince limited effluent (discharge) data are available, the Permittee has characterized the influent and treatment processes at WTP1 and WTP2 to show that numeric water quality standards will be met." However, now that

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the status of discharge, since these logs are required to be updated on a daily basis. ADEQ chose only to review the DMRs through August 2023. *See* Fact Sheet at 11.

[40] *See* November 3, 2023 entry: "Meeting with South32" for 1 hour. https://pbill.azdeq.gov/warehouse/webmart/Reports/apcbill.php?license=95353

ADEQ has discharge data from Outfall 002, this must be used, as this data will confirm or undercut South32's assumptions about the influent and treatment processes at WTP2.

Finally, the Draft Fact Sheet at 10, Sec. V (Description of Discharge) states simply: "One pH measurement is available for Outfall 002". As discussed above, this is not true and must be corrected. ADEQ is currently in possession of at least four months' worth of pH discharge data. And, importantly, Discharge Characterization Testing requirements (Table 4, Draft Permit at 8) contains 24 other parameters which are to be measured and reported for characterizing the composition of discharge. The data which is now available from this discharge must be used to write the Draft Permit.

IX. Additional Comments

1. Assessment Level (AL) Monitoring Should Be Done At Least Monthly, Not Quarterly.

The Draft Permit at 5-6 (Tables 2.a. and 2.b.) requires only quarterly monitoring for Assessment Levels (ALs) in 8-hour composite samples. This is insufficient and should instead be done at least monthly. ALs serve an important function, as acknowledged in the Draft Fact Sheet at 17: "ALs serve as triggers, alerting the permitting authority when there is cause for re-evaluation of RP for exceeding a water quality standard, which may result in new permit limitations." In the Draft Permit, these ALs monitor for critical parameters regulated under the Clean Water Act such as antimony, arsenic, barium, beryllium, boron, chromium, cyanide, hardness, iron, nickel, nitrate/nitrite, nitrogen, selenium, silver, and thallium.

Under the Draft Permit, the composite sample will be "formed by combining a series of individual, discrete samples" (Draft Permit Appendix A at 20) which would produce only one single result. This means only one numeric value for each parameter would be produced each quarter –only once every three months.

Table 2.a. Assessment Level Monitoring

Parameter	Assessment Levels (1) (2)		Monitoring Requirements (3) (4)	
	Monthly Average	Daily Maximum	Monitoring Frequency	Sample Type
Antimony	24.6 µg/L	49.3 µg/L	1x/Quarter	8-hr. Composite
Arsenic	30 µg/L	60 µg/L	1x/Quarter	8-hr. Composite

AZPDES Permit Fact Sheet Amendment Application at 13 (Nov. 2023)

It is mathematically impossible to obtain a "Monthly Average" from one single number. Nevertheless, the Draft Permit at 13 states: "If **only one sample** is collected during the reporting period (weekly, monthly, quarterly, annually, etc.) […] In this case, the sample result **is also** the weekly or monthly average.)" A Monthly Average is universally understood to indicate that the results from more than one sample collected during a particular month have been averaged. The arbitrary application of single sample result cannot possibly produce a valid result, and it cannot possibly represent a true

"monthly average." This should be corrected in the Permit and more robust sampling should be required.

While this issue has been raised previously by PARA, ADEQ also appears to have only edited its definition of monthly averages regarding mass limits, concentration limits and mass loading as follows in response: ""If monitoring is required less frequently than monthly, calculate the average monthly mass loading for any month that sampling occurred. Report the highest monthly average within the monitoring period." But this does not resolve the issue. It violates basic laws of mathematics.

This approach is also misleading and it does not address PARA's concerns regarding detection of parameters intended to be targeted by Assessment Level monitoring. These results could mask or conceal high concentrations that otherwise "may trigger evaluation of Reasonable Potential (RP) by ADEQ" (Draft Permit at 5-6). Using at least a monthly sampling frequency for Assessment Levels would obviate this confusion and bias. Because of the large uncertainties associated with the composition of the water from the deep dewatering wells, related mine infrastructure and treatment technologies, more frequent sampling of the Outfall 001 and 002 discharge is required.

In addition to a lack of knowledge about the parameters that will be present and their concentrations in the mine water, potential seasonal variability in mine water chemistry has not been evaluated. Monitoring only one time in a three-month period (quarterly) will not be able to capture seasonal variability or any changes in mine water quality due to pulling water from different parts of the mine.

For the first AZPDES cycle (five years), collecting and analyzing samples on at least a monthly basis, as is the case for effluent limitations and monitoring, will provide a more robust set of data that could be used to understand the temporal and spatial (within the mine) variability in assessment parameter concentrations. Sampling for most of the assessment parameters can use the same bottles as those used for the parameters required for Tables 1(a) and 1(b); however, cyanide and nitrogen would be exceptions and will require separate sample bottles, preservation, and handling.

The use of blasting agents in the underground mine will result in the presence of nitrogen compounds in mine-influenced water. The most common blasting agent is ammonium nitrate-fuel oil (ANFO). The use of ANFO produces highly elevated concentrations of nitrate (nitrate/nitrite as N) and ammonia in mine-influenced water from mines. Therefore, determining nitrate+nitrite (as N) and ammonia is recommended for the Assessment Level parameters (rather than Total Kjeldahl nitrogen).

2. Concentration and Mass Limits Cannot be Reported as Monthly Average and Daily Maximum Based on 1 Monthly Sample

PARA was pleased to see the inclusion of both mass-based and concentration-based limits for the effluent limitations and monitoring requirements of Outfalls 001 and 002 in the Draft Permit at 3-4 (Tables 1.a. and 1.b.), which were not in the prior Permit. However, it is unclear how ADEQ expects to obtain valid data on monthly averages and

daily maximums based on only one 8-hour composite sample which would produce only one single result for each parameter every month. As stated above, it is mathematically impossible to obtain a true monthly average from one single number. This approach is invalid and misleading.

Additionally, considering the reporting terms, ADEQ's definitions of monthly average mass and concentration limits in the Draft Permit Appendix A at 22 are problematic. Monthly Average Mass Limit is defined as: "The highest allowable value that shall be obtained by taking the total mass discharged during a calendar month divided by the number of days in the month the facility was discharging." And Monthly Average Concentration Limit is defined as: "If pollutant monitoring for a monthly average limit occurred over multiple months within a reporting period, calculate the monthly average as above for each monthly sampling that occurred. Report the highest value." These formulas simply cannot produce valid results based on only one monthly sample result.

These definitions, coupled with the reporting requirements, are likely to produce misleading results which could mask or conceal high concentrations or exceedances, which may otherwise trigger certain contingencies. Given that ADEQ added mass-based limits to the Draft Permit with the express intent to "ensure protection of the receiving waters," (Draft Fact Sheet at 12) this must be corrected.

3. Discharge Characterization Testing Should Be Done At Least Monthly

The Draft Permit at 8 (Table 4) contains discharge characterization testing requirements which apply regardless of whether there is discharge from Outfalls 001 and 002. Table 4 requires this monitoring once every six months via one 8-hour composite sample.

However, the section also states: "Samples are to be representative of any seasonal variation in the discharge". This is not possible if samples are only collected twice per year. This would obviously omit data from multiple seasons, and thus, cannot possibly represent from the seasonal variations intended to be captured by ADEQ. Monitoring even quarterly would, at best, capture only one snapshot from each season, which is insufficient and may be anomalous. Monthly testing would provide a more accurate set of data results which can be meaningfully analyzed. This must be corrected in the Draft Permit, and Discharge Characterization Testing monitoring should be done at least monthly.

4. WET (Whole Effluent Toxicity) Monitoring Should Be More Frequent

The Draft Permit at 7 (Table 3) provides that Whole Effluent Toxicity (WET) testing should be done "1x within 6 months of commencing discharge and 1x/year thereafter." Testing is to be done via one 8-hr composite sample. The detection of toxicity levels in these samples above an Action Level are intended to trigger additional, more frequent follow-up testing and certain additional Toxicity Identification Evaluation (TIE) and Toxicity Reduction Evaluation (TRE) Processes. See Draft Permit at 17.

Action Levels are listed as Daily Maximum and Monthly Median – which are both impossible to calculate based on one single annual sample. It is also unclear why daily Maximum Action Levels for Acute Toxicity are listed as "N/A" in Table 3. The primary concern with this section is that annual monitoring may be too infrequent and, if reported in this misleading manner, may never detect acute or chronic toxicity which may be present, and trigger necessary TIE/TRE monitoring and testing requirements to detect and address levels of toxicity in the environment resulting from discharges under this permit.

5. Manganese and Sulfate Must Be Monitored

As ADEQ is likely aware, the EPA maintains a list of 15 contaminants listed on the National Secondary Drinking Water Regulations (NSDWRs), with associated Secondary Maximum Contaminant Levels (SMCLs).[41] Manganese (SMCL 0.05 mg/L) and Sulfate (SMCL 250 mg/L) are both contaminants listed on the NSDWRs. Elevated levels of these contaminants may cause noticeable odors, colors or tastes, may discolor skin and teeth, may be toxic and have damaging health effects on humans, animals and organisms. Elevated levels may also have damaging corrosive effects on pipes and fixtures.

Elevated levels of manganese in water produces black slime or sludge which can result in entire water systems becoming unusable. As the Hermosa Project is a manganese mine, where large amounts of ore containing elevated levels of manganese will be brought to the surface, this concern is particularly relevant.

ADEQ has both the jurisdiction and authority to impose limits for these narrative contaminants. As Arizona's narrative water quality standards at R18-11-108(A) states, in relevant part, that surface waters "shall not contain pollutants in amounts or combinations that […] 2. Cause objectionable odor in the area in which the surface water is located; 3. Cause off-taste or odor in drinking water; 4. Cause off-flavor in aquatic organisms; 5. Are toxic to humans, animals, plants, or other organisms; […] 8. Change the color of the surface water from natural background levels of color."[42]

As raised previously by PARA's experts, South32's water quality consultant Black & Veatch has predicted that WTP2 feed water will contain 32 to 152 mg/L of sulfate, but provides no estimate of the removal to be provided by WTP2. Similarly, Black & Veatch has predicted that WTP2 feed water will contain between 0.48 and 1.02 mg/L of manganese. While some is anticipated to be removed, there are no predictions as to how effective this removal would be relative to the SMCL level of 0.05 mg/L for manganese.

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[41] EPA National Secondary Drinking Water Regulations (NSDWRs).

[42] The National Institutes of Health (NIH) have reported the effects manganese toxicity as a "unique neurotoxicity that progresses from early psychiatric abnormalities to symptoms reminiscent of Parkinson disease". Evans and Masullo. "Manganese Toxicity." [Updated 2023 Jul 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560903.

Several wells in and near the Town of Patagonia already indicate elevated levels of sulfate, some of which exceed the NSDWR standard level of 250 mg/L. As the Town's wells are presently used without treatment except for disinfection, any additional sulfate loading would push these wells above the NSDWR standard levels and begin to impair the quality of existing drinking water. At minimum, ADEQ should specify discharge limits for manganese and sulfate. Preferably, ADEQ should specify discharge limits for all 15 of the EPA's NSDWR contaminants (ask to be included on Discharge Characterization)

6. Ambient Water Temperature Monitoring Requirements Unclear

The Draft Permit at 9 (Part I(E)(3)) states that "The discharge shall not cause an increase in the ambient water temperature of more than 3.0 degrees Celsius." However, it is unclear how ADEQ intends to implement and enforce this provision. There are currently no requirements in the Draft Permit to monitor for ambient water temperature within the waters of Alum Gulch or Harshaw Creek. Moreover, this measurement must be done within the receiving waters. In order for this provision to be clear and meaningful, ADEQ must correct this before issuing the Draft Permit.

7. Dissolved Oxygen Concentration Monitoring Requirements Unclear

The Draft Permit at 9 (Part I(E)(4) states that the discharge "shall not cause the dissolved oxygen concentration in the receiving water to fall below 6mg/L for Alum Gulch (Outfall 001) and shall not fall below 3 mg/L from 3 hours after sunrise to sunset and 1 mg/L from sunset to 3 hours after sunrise for Harshaw Creek (Outfall 002), unless the percent saturation of oxygen remains equal to or greater than 90%."

Again, it is not clear how ADEQ intends to implement and enforce this provision. There are currently no requirements in the Draft Permit to monitor for dissolved oxygen within the waters of Alum Gulch or Harshaw Creek during these particular times of day, and this measurement must be done within the receiving waters. In order for this provision to be clear and meaningful, ADEQ must correct this before issuing the Draft Permit.

8. "Local Storm Event" Is Undefined at p.9, Part I(E)(5)

The Draft Permit at 9 (Part I(E)(5)) states that the discharge from Outfall 001 shall not cause the water of Alum Gulch to exceed 80 mg/L for suspended sediment "except during or within 48 hours after a local storm event."

It is not clear how ADEQ intends to implement and enforce this provision. There are currently no requirements in the Draft Permit to monitor for suspended sediment within the waters of Alum Gulch at any time. This has not been clarified in the Draft Permit materials. In addition, "local storm event" is entirely undefined. In order for this provision to be clear and meaningful, ADEQ must correct this before issuing the Draft Permit.

9. Hardness Data Must Be Updated

PARA has raised concerns about the permit calculations involving hardness ($CaCO_3$) in the prior permit. Tables 1.a. and 1.b. in the Draft Permit include maximum allowable discharge limitations ("Concentration Limits") for the following four metals with hardness-dependent water quality criteria: cadmium, copper, lead, and zinc. The higher the hardness, the less toxic these metals are to aquatic life. Conversely, at low hardness, the metals are the most toxic to aquatic life. Using the measured hardness of the effluent (rather than influent) is a critical step in calculating the relevant Concentration Limits for both Outfalls 001 and 002.

In Table 1.a. (Outfall 001), the Concentration Limits for cadmium, copper, lead and zinc are calculated using a hardness value of 400 mg/L as $CaCO_3$, which is the highest hardness that can be used to calculate standards as noted in Footnote 7. The use of such a high hardness value is based on high hardness levels in the effluent from WTP1. Additionally, the treatment approach for water treatment plant WTP1 in Alum Gulch is briefly described in the Draft Fact Sheet at 4. WTP1 uses ultrafiltration, which typically results in a discharge with low solute concentrations, including calcium and magnesium (the primary components of hardness). Because of the ultrafiltration step, WTP1 effluent will have a substantially lower hardness than the influent. If numeric limits are needed as an example in Table 1.a, using a hardness of 100 mg/L as $CaCO_3$ would be a more appropriate hardness value to use for calculating the Concentration Limits. As an example, the federal chronic aquatic life criterion value for total recoverable zinc at 100 mg/L hardness is 120 μg/L, while the value at 400 mg/L hardness is 388 μg/L.[43]

In Table 1.b. (Outfall 002), the Concentration Limits for cadmium, copper, lead, and zinc were calculated using a hardness of 258 mg/L as $CaCO_3$. As noted in Footnote 7, "Limits listed are based on the lower range of estimated WTP2 influent hardness of 258 mg/L as $CaCO_3$. This number may be adjusted once effluent hardness data becomes available." These values should not be based on the influent hardness, because the relevant monitoring location is the effluent from WTP2. The treatment approach for water treatment plant WTP2 in the Harshaw Creek drainage is briefly described in the Fact Sheet at 4. WTP2 will use an experimental two-step process that includes suspended solids removal and clarification to precipitate metals and separate solids (Step 1) and an ion exchange and electroreduction step to remove selenium (Step 2). The extent to which WTP2 treatment will modify the influent hardness is unknown. However, the measured hardness must be used to calculate the relevant Concentration Limits for Table 1(b) in the final AZPDES permit. Consequently, Footnote 7 in Table 2(b) should be modified to read:

> "The discharge must be tested for hardness at the same time that these metal samples are taken. The maximum allowable discharge limitations

[43] U.S. EPA, 2004. National Recommended Water Quality Criteria, Office of Water, Office of Science and Technology (4304T). https://www.epa.gov/sites/default/files/2015-06/documents/nrwqc-2004.pdf

(Concentration Limits) for cadmium, copper, lead, and zinc shall be calculated using the measured hardness of the effluent sample. Please see the hardness definition in Appendix A, Part B."

In its Response to Comments on the prior Draft Permit, ADEQ stated that influent hardness was used because "effluent monitoring data is not yet available for WTP1 or WTP2." Indeed, ADEQ even committed to the following: "When effluent data is available in subsequent permit renewals, permit limits will be reassessed using the average effluent hardness value."

While effluent hardness values are now provided for WTP1, the Draft Permit does not reflect this for WTP2. Instead, Footnote 7 to Table 1.b. still simply states: "The discharge must be tested for hardness at the same time that these metal samples are taken. Limits listed are based on the lower range of estimated WTP2 influent hardness of 258 mg/L as $CaCO_3$. This number may be adjusted once effluent hardness data becomes available." Given that WTP2 has now been discharging from Outfall 002 for several months even before this Draft Permit was released for comment (as discussed above), effluent monitoring data is now available and actual **effluent** hardness calculations must be considered by ADEQ in the Permit as promised by ADEQ.

10. Total Recoverable and Dissolved Concentrations Must Be Reported

All effluent metals concentrations, with the exception of Chromium VI, are for total recoverable metals (*see, e.g*., Draft Permit, Part II(A)(7)). The draft Permit proposes using metal translators to calculate total recoverable permit limits from dissolved criteria for metals (Fact Sheet at 8). The Fact Sheet at 23 also allows the permittee to perform a translator study to demonstrate what portion of the metal in the effluent will be present in dissolved form in the receiving water. If accepted by ADEQ, the results of the study may be used to modify the effluent limits for the metals studied. The proportion of dissolved metal, which is more bioavailable than particulate metal, can vary substantially depending on many factors that affect the amount of suspended sediment in a sample (*e.g.,* storms, infiltration of eroded soils). Measuring both dissolved and total recoverable metals in effluent samples for one year will provide a site-specific dataset to supplement translator studies conducted by the permittee.

11. Dewatering the Aquifer Is an Ongoing Concern

ADEQ previously stated that 90-100 percent of the inflow to WTP2 will come from South32's extensive planned dewatering activities, including depressurization wells.[44] Similarly, ADEQ explains that AMI's exploration activities "will be accomplished largely though advancement of two exploration shafts, which will necessitate dewatering of the local aquifer in the vicinity of the shafts" and that "WTP2 is designed primarily to treat

[44] *See* 2021 AZPDES Permit Amendment, Statement of Basis at 2.

water from depressurization wells, underground dewatering pumps, and operational water services."[45]

As expressed in prior comments, PARA is gravely concerned with the environmental destruction associated with South32's mine activities, particularly its dewatering activities in this region, which are specifically designed to dewater the aquifer for industrial extractive purposes. As discussed at the beginning of these comments, ADEQ has authority to and must "act to protect the environment", promote "the protection and enhancement of the quality of water resources", provide for the "prevention and abatement of all water and air pollution"; and "[e]nsure the preservation and enhancement of natural beauty" in our state. A.R.S. § 49-204(A)(1), (7), (9) and (10).

Given the importance of the Patagonia Mountains and the existence of immense biodiversity in this region, the depletion of the aquifer will almost certainly harm or even destroy numerous springs and seeps, and other surface water features, at a time when the existence of these critical water resources and the habitat they support are already under pressure from drought and climate change. The groundwater-dependent ecosystems (GDE) are valuable, and the loss of these GDEs should not be lightly brushed aside by ADEQ or South32. While these comments are directed at the ADEQ's potential issuance of a renewed AZPDES Permit to South32 to discharge mine dewatering and depressurization waters to Alum Gulch and Harshaw Creek, it must be acknowledged that the water to be permanently removed from these aquifers is currently an important part of the function and health of this important and biodiverse place.

Conclusion

We appreciate the opportunity to comment on this Draft Permit. ADEQ must address these issues prior to issuance of the renewed Permit, including completing the necessary TMDL studies for Alum Gulch, Sonoita Creek, and Harshaw Creek prior to issuing this renewed Permit. In the interim, South32 must not be permitted – and ADEQ should not allow – discharges from Outfalls 001 and 002 under the old expired permit.[46]

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[45] *See* Draft Fact Sheet at 4.

[46] The initial AZPDES Permit AZ0026387 (issued January 8, 2018) expired on January 7, 2023 (Expired Permit). A.A.C. R18-9-B904(A)(1) provides that an AZPDES permit "expires" after a fixed term of 5-years if the director does "not reissue a permit within the period specified in the permit" "unless it is continued under subsection (C)." The director of ADEQ did not reissue the permit before January 7, 2023. The sole exception in R18-9-B904(C) is not applicable, as it allows for an expired permit to "continue beyond its expiration date" only if 1) an application has been filed at least 180 days before expiration of the existing permit AND the permitted activity is "of a continuing nature", and 2) ADEQ is unable to issue the permit on or before the expiration date of the existing permit. Since the AZPDES was issued in 2018 and through its expiration date, there had been no

Statements of Interests of Commentators

Patagonia Area Resource Alliance is a grassroots organization of volunteer community members committed to protecting and preserving the Patagonia, Arizona area. It is a watchdog organization that monitors the activities of industrial developers such as mining corporations, as well as government agencies, to make sure their actions have long-term, sustainable benefits to our public lands, our watershed, and our regional ecosystem.

Arizona Mining Reform Coalition works in Arizona to improve state and federal laws, rules, and regulations governing hard rock mining to protect communities and the environment. AMRC works to hold mining operations to the highest environmental and social standards to provide for the long term environmental, cultural, and economic health of Arizona.

The **Center for Biological Diversity** is a non-profit public interest organization with an office located in Tucson, Arizona, representing more than 1.7 million members and supporters nationwide dedicated to the conservation and recovery of threatened and endangered species and their habitats. The Center has a long-standing interest in

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discharge under this permit into either Alum Gulch or Harshaw Creek. This is indeed the very *opposite* of continuing nature.

40 C.F.R. § 122.6(d) states, in relevant part: "States authorized to administer the NPDES program may continue either EPA or State-issued permits until the effective date of the new permits, if State law allows. Otherwise, the facility or activity is operating without a permit from the time of expiration of the old permit to the effective date of the State-issued new permit." (Emphasis added).

When the AZPDES Permit renewal was released for public comment in November 2022, and when the Decision to Issue was published in March 9, 2023 (after the Expired Permit had expired) neither draft nor final Fact Sheet said anything about the now-Expired Permit having been extended or administratively continued. If indeed ADEQ intended for the old permit to be administratively continued to cover a gap in permit coverage between January 7, 2023 and March 9, 2023, this would have been acknowledged in at least one of these documents with an explanation. It was not. Discharging for the very first time months after expiration of a permit would not, in any way, qualify a facility for the "continuing nature" exception under R18-9-B904(C). Such a reading of the law is completely nonsensical as it would render the prohibition on discharges without valid permits and the spirit of the Clean Water Act meaningless. Certainly this isn't what ADEQ would attempt to assert here with a straight face. Simply, South32 has been discharging without a permit from August 2023 through at least November 2023, which is a violation of 40 C.F.R. §122.6(d) and the Clean Water Act. South32 should be prohibited from discharging in the absence of a current, effective AZPDES Permit.

projects of ecological significance undertaken in the National Forests of the Southwest, including mining projects.

Tucson Audubon is a 501(c)(3) member-supported community organization established in 1949. The organization promotes the protection and stewardship of southern Arizona's biological diversity through the study and enjoyment of birds and the places they live. Tucson Audubon provides practical ways for people to protect and enhance habitats for birds and other wildlife, and maintains its deep investment in Patagonia through the Paton Center for Hummingbirds along Sonoita Creek, a significant resource at risk due to proposed upstream mining activities.

Friends of Santa Cruz River is a non-profit organization dedicated to ensuring the continued flow of the Santa Cruz River, the life-sustaining quality of its waters, and the protection of the riparian biological community it supports.

Borderlands Restoration Network ("BRN") is a Patagonia-based nonprofit that works to grow a local restorative economy by rebuilding healthy ecosystems, restoring habitat for plants and wildlife, and reconnecting our border communities to the land through shared learning. Our conservation, restoration, and education programs serve the borderlands of Southern Arizona and Northern Sonora, including the protection and restoration of wildlife corridors and surface waters of Sonoita Creek and surrounding watersheds.

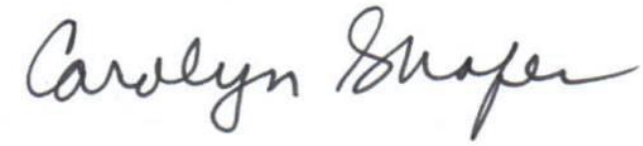
Friends of Sonoita Creek is a non-profit organization dedicated to protecting and restoring the water and natural habitat of the Sonoita Creek Watershed. We inform residents and visitors about its importance to life forms and relationship to the geography through hands on activities, presentations, hikes, and collaboration with kindred organizations.

Earthworks is a nonprofit organization dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions. Earthworks stands for clean air, water and land, healthy communities, and corporate accountability. We work for solutions that protect both the Earth's resources and our communities.

Sierra Club (Grand Canyon Chapter). The Sierra Club is one of the largest and most influential grassroots environmental organizations in the U.S., with more than 3.5 million members and supporters. In addition to protecting every person's right to get outdoors and access the healing power of nature, the Sierra Club works to promote clean energy, safeguard the health of our communities, protect wildlife, and preserve our remaining wild places through grassroots activism, public education, lobbying, and legal action. The Grand Canyon Chapter of the Sierra Club, representing 16,000 members, has a long history of public education and advocacy to protect the lands and waters of Arizona.

Sincerely,

Patagonia Area Resource Alliance



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ATTACHMENT 1

PARA's Request for EPA Review of Pending AZPDES Permit No. AZ0026387 for South32 Hermosa, Inc. in Arizona

(July 7, 2023)

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July 7, 2023

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Re: Request for EPA Review of Pending AZPDES Permit No. AZ0026387 for South32 Hermosa, Inc. in Arizona

Dear Administrator Guzman and Director Torres:

This letter is submitted on behalf of the Patagonia Area Resource Alliance (PARA), a nonprofit community watchdog organization focused on the environmental and economic health and vitality of the Patagonia region of Southern Arizona. In this capacity, PARA has been engaged with the Arizona Department of Environmental Quality (ADEQ) in recent years regarding ADEQ's consideration and issuance of a number of Clean Water Act (CWA) and other permits that PARA contends are not protective of the region's water supply and the health of our community and the environment.

To this end, we write here to request that the EPA exercise its oversight authority of ADEQ to ensure that ADEQ fully complies with its obligations under the CWA. Specifically, we ask that EPA carefully scrutinize the proposed CWA Section 402 discharge permit (AZPDES permit no. AZ0026387) that ADEQ proposes to issue to South32 Hermosa, Inc. (South32) for its mine activities at the Hermosa Project near Patagonia, Arizona ("AZPDES Permit" or "the Permit").

As discussed in greater detail below, ADEQ has inaccurately concluded that the Hermosa Project is a continuation of an "existing mine" under the CWA. However, the Hermosa Project represents an entirely new industrial mine and South32's current and planned mining activities at the Hermosa Project meet the definition of "new source" or "new sources" [40 C.F.R. § 122.2 and 40 C.F.R. § 122.29(b)] under the Clean Water Act and as such, are subject to all new source performance standards and the requirement that ADEQ complete all Total Maximum Daily Load (TMDL) studies for Alum Gulch[1] and Harshaw Creek,[2] and perform the corresponding wasteload allocations[3] for these impaired waters prior to issuing the AZPDES Permit to South32 (if at all).

As you may recall, both PARA and Arizona Representative Raúl Grijalva previously wrote to the EPA raising concerns about this AZPDES Permit.[4]

ADEQ's treatment of South32's AZPDES Permit has a curious procedural posture which PARA will not detail here. In sum, in March of 2023, over PARA's objections, ADEQ issued a decision to renew South32's then expired AZPDES Permit. However, soon after PARA filed an appeal with Arizona's Water Quality Appeals Board challenging, among other things, ADEQ's decision that the Hermosa mine is not a "new source" under the CWA (which effectively stayed the Permit pending review), ADEQ abruptly withdrew its decision on the Permit, suggesting that South32 could simply begin discharging under its prior (now expired) AZPDES permit – for apparently an indefinite period of time.

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[1] Alum Gulch consists of three reaches (WBID Nos. AZ15050301-561A, AZ15050301-561B, and AZ15050301-561C). All three reaches of Alum Gulch are listed on the 303(d) list as impaired for cadmium (1996), copper (1996), pH (1996), and zinc (1996). In 2003, ADEQ completed a TMDL for the first reach of Alum Gulch (AZ15050301-561A), *see* Alum Gulch TMDL and Summary. The second reach of Alum Gulch (AZ15050301-561B) was also recently listed on the 303(d) list as impaired for lead (2022). This 20-year old Alum Gulch TMDL has not been updated, and ADEQ has not completed TMDL on the new lead impairment.

[2] The upper reach of Harshaw Creek (WBID No. AZ15050301-025A) is listed on the 303(d) list as impaired for copper (1992) and pH (1992). In 2003, ADEQ completed a TMDL for the upper reach of Harshaw Creek, *see* Harshaw Creek TMDL and Summary. This 20-year old Harshaw Creek TMDL has not been updated. In addition, ADEQ has not completed a waste load allocation for the discharge from Outfall 002 under the Permit into Harshaw Creek, because ADEQ takes the position that the discharge from Outfall 002 is going into lower Harshaw Creek, which is not on the 303(d) list. However based on ground-level review and familiarity with the location, PARA believes the discharge from Outfall 002 is actually entering into upper Harshaw Creek and thus, a wasteload allocation is required. Additionally, while PARA provided ADEQ with extensive materials indicating that lower Harshaw Creek is also impaired for a number of pollutant, ADEQ has not reviewed lower Harshaw Creek for 303(d) listing to date.

[3] *See* Arizona Administrative Code (AAC) R18-9-A903 (requiring ADEQ to perform a wasteload allocation for a new source or new discharger as part of the AZPDES permitting process if the receiving water is listed as impaired in order to determine that there are "sufficient remaining wasteload allocations to allow for the discharge.").

[4] *See* February 16, 2021 Letter from PARA to EPA (re AZPDES Permit No. AZ0026387). *See also* February 19, 2021 Letter from Rep. Raúl Grijalva requesting review of the permit.

It is our understanding that, as a requisite of Arizona obtaining primacy to administer the CWA's Section 402 (NPDES) discharge permit program, ADEQ is required to send draft and proposed permits and permit materials to EPA for its review.[5] This is also reflected in the Arizona regulations, which require ADEQ to send a copy of the draft permit to EPA.[6] From our review of the public records requested and received in this matter, it is unclear whether ADEQ actually sent a copy of the recent draft AZPDES Permit renewal to EPA for review. Regardless, given that ADEQ's decision to issue the AZPDES Permit was recently withdrawn by ADEQ and thus, is now once again pending, the law requires that ADEQ send the draft Permit to EPA for review.[7]

Because PARA is concerned that any discharge to Alum Gulch and/or Harshaw Creek under the now expired AZPDES Permit or a future AZPDES permit issued by ADEQ will violate the new source performance standards and TMDL requirements of the CWA, we are writing to request that the EPA review AZPDES Permit AZ0026387, including ADEQ's position that the Hermosa Project is an "existing mine" that is not subject to new source standards and related requirements. PARA also suggests EPA independently review any information and analysis used by ADEQ under 40 C.F.R. § 122.29 to determine that South32's Hermosa Project is an "existing mine" and not a "new source" under the Clean Water Act.[8]

The Historic Trench Camp Mine Was Abandoned Long Ago and the New Facilitates and Processes Now being Developed for the Hermosa Project are "New Sources" under the CWA

Historic mining activities occurred intermittently in the Patagonia region since at least the early 1870s. ASARCO last operated the site known as the "Trench Camp" or "January-Norton" mine, which later became part of the Hermosa Project, from approximately 1925 to 1949. *See* **Photo Timeline, Figures 1 & 2 (Attachment A).** However, this mine was closed long ago, and mining activities did not take place at the Hermosa Project mine site

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[5] *See* NPDES MOA between State of Arizona and U.S. EPA Region 9 (2002), Sec. IV(C).

[6] *See* AAC Section R18-9-A908(C)(1) (requirements for sending draft and proposed individual AZPDES permits to EPA for review).

[7] Given the unconventional nature of ADEQ's handling of this AZPDES Permit, it is unclear to PARA whether the AZPDES Permit is currently in draft or proposed form. EPA review is required regardless under these circumstances, per NPDES MOA between State of Arizona and U.S. EPA Region 9 (2002), Sec. IV(C)(1):

> "Unless otherwise waived pursuant to Section IV.D of this AGREEMENT, EPA will review draft AZPDES permits, permit modifications, revocations and reissuances rather than proposed permits. A proposed permit need not be prepared by the DEPARTMENT and transmitted to EPA for review unless the DEPARTMENT proposes to issue a permit which differs from the draft permit reviewed by EPA, EPA has objected to the draft permit, or there is significant public comment."

[8] *See* NPDES MOA between State of Arizona and U.S. EPA Region 9 (2002) at Sec. IV(C)(2).

for over 70 years. This is a commonly understood fact reflected even in South32's own published documents, which note that the Trench Camp mine and mill were "closed permanently" in the late 1960s (Emphasis added).[9] The last several decades of available Google Earth aerial images corroborate this fact, and plainly show a relatively flat piece of vacant land with no mine structures or active mining at the site. *See* **Google Earth Aerial Timeline, Figures 1 through 7 (Attachment B).**

In addition, the Trench Camp property is one of many contaminated sites that were placed into the ASARCO Multi-State Environmental Custodial Trust in 2009, in what was known at the time as "the largest environmental bankruptcy in U.S. history."[10] During this period in time, no mining activity was conducted at the site, and indeed, activities like mining were expressly prohibited under the terms of the Multi-State Environmental Custodial Trust Agreement. *See* Amended Consent Decree and Settlement Agreement Establishing A Custodial Trust For Certain Owned Sites in Alabama, Arizona, Arkansas, Colorado, Illinois, Indiana, New Mexico, Ohio, Oklahoma, Utah, and Washington, Attachment D at Sec. 4.5, *In re ASARCO LLC, et al.* No. 05-21207 (Bankr. S.D.Tex., March 13, 2009). (Except where deemed by the Trustee as reasonably necessary, "[t]he Multi-State Custodial Trust and the Multi-State Custodial Trustee shall not and are not authorized to engage in any trade or business with respect to the Custodial Trust Assets or any proceeds therefrom…"). Emphasis added.

It is also of note that as part of this massive ASARCO case, ADEQ's own expert testified in federal court providing both site visit photographs and a written proffer that the mine was abandoned. He wrote that the area which now includes the Hermosa Project is "an inactive underground mine, formerly accessible through the January Adit". It "consists of an abandoned mill and smelter site", and "one waste rock pile and four tailings piles" which were capped in the early 1990s.[11]

Mr. Turner's site visit photographs from 2007 and 2009 show a long-shuttered historic mining area overgrown with no active mine structures, workings, or activity. *See* **Photo Timeline, Figures 3 & 4 (Attachment A).** Indeed, additional site visit photographs taken by ADEQ in 2017 also demonstrate that the area was still inactive and abandoned at that time as well. *See* **Photo Timeline, Figures 5 through 8 (Attachment A).**

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[9] *See* South32 Mining and History in the Patagonia Mountains presentation by WestLand Resources at p.12

[10] *See* EPA Case Summary: ASARCO 2009 Bankruptcy Settlement and ASARCO Bankruptcy Case Summary: Custodial Trust Settlement Information Sheet. The Trench Camp Mine is one of 18 ASARCO sites for which past and potential future cleanup costs totaling more than $70 million were ordered via the Custodial Trust Settlement Agreement.

[11] *See* Proffer of Direct Testimony of Dennis L. Turner Regarding the Trench Camp Property and Exhibits filed May 13, 2009 at p. 2 and 6 (Documents 11263 and 11263-1), *In re ASARCO LLC, et al.* No. 05-21207 (Bankr. S.D.Tex., March 13, 2009).

When the historic images discussed above are compared against images of South32's Hermosa Project mine site from the last five years, the difference is shocking, as the images plainly demonstrate that an entirely new mine is being constructed at the site. *See* **Google Earth Aerial Timeline, Figures 8 through 11 (Attachment B).** *See* **Photo Timeline, Figure 9 (Attachment A).**

Despite clear and obvious evidence on this point, ADEQ has refused to acknowledge (or even consider *via* a new source performance criteria review under 40 C.F.R. § 122.29(b)) that this new modern industrial mine is an entirely new mine and South32's new mine structures and facilities are "new sources" meeting the requirements of §122.29(b)(1)(ii) and (iii). Crucially, ADEQ has offered little more than a single conclusory rationale to justify its position that the Hermosa Project is the continuation of an "existing mine" and thus, it can never be a new source:

> The mine was first established before promulgation of the 1982 effluent limitation guidelines applicable to ore mining and dressing, 40 CFR Part 440, Subpart J, and accordingly is not a "new source" as defined in 33 U.S.C. § 1316 (a)(2) and 40 CFR Part 122.2. The mine workings and historic tailings at the site date back to the first half of the 20th century. For this reason, ADEQ is considering the discharge from WTP1 and WTP2 to be an existing source rather than a new source or a new discharger under A.A.C. R18-9-A901.24 or R18-9-A901.25.[12]

PARA urges EPA to conduct its own independent review of ADEQ's justification for treating the Hermosa Project as an existing mine vs. a new source under the CWA. ADEQ should be held to a standard of conduct in exercising its primacy under Section 402 which ensures the Clean Water Act is complied with and that our water, our health, and the environment of the Patagonia region is protected. ADEQ is failing to meet this test.

Overview of the New Hermosa Project Mine as a "New Source"

Upon acquiring the former Trench Camp property from the ASARCO Multi-State Environmental Custodial Trust in 2016 (*via* predecessor Arizona Minerals), South32 began performing certain remediation activities at the site as required by ADEQ under the terms of the settlement. They also began exploring and developing a new mine at the site. As demonstrated above, the Trench Camp property and surrounding area today is unrecognizable from the historic operation, and unrecognizable from even 10 years ago.

The Project now includes a new active water treatment plant (WTP1) for treating seepage, runoff and water not only from the historically contaminated January Adit mine workings and from the relocated tailings facility (TSF), but also from future tailings to be placed on the TSF due to South32's mining activities at the Hermosa Project mine site. It also includes infrastructure for discharge into Alum Gulch (Outfall 001) and a new underdrain

[12] AZPDES Permit Draft Fact Sheet (November 2022) at p.5.

collection pond system (UCP) built in approximately 2018 to capture historic and future runoff from the TSF for treatment. The new mine also includes multiple exploratory drilling locations, a planned major expansion of the TSF to accommodate (most immediately) waste rock from the new exploration shafts, current construction of a new second water treatment plant (WTP2) to treat mine water from the mine's newly constructed and deep wells that will be used to dewater the aquifer for its exploratory and future mining purposes. WTP2 will discharge to Harshaw Creek via Outfall 002. And,"[a]ny residual moisture contained in those tailings that reports as runoff or seepage to the lined underdrain collection pond may be treated at WTP1/WTP2 and then contribute to discharge from Outfall 001 or 002." *See* ADEQ Draft Fact Sheet for AZPDES Permit at p.4. Dewatering is anticipated to begin in midyear 2023. Much of the construction for the Hermosa Project mine is anticipated to be complete in CY2025 and production is targeted to begin in FY2027,[13] which is during the life of South32's next AZPDES Permit.

Today, the sole remnant of the prior ASARCO mine workings on the Hermosa Project site that remains is the January Adit (now capped) and its historic tailings that are not meaningfully integrated with South32's current mine facilities, except, as noted above, that seepage from the historic tailings is managed for remediation purposes by South32 as a condition of purchasing this property from the ASARCO Multi-State Environmental Custodial Trust in 2016. *See* Voluntary Remediation Program Work Plan for ASARCO January Adit (Norton Mine), April 2017 at p.4.

The size and scope of the new Hermosa Project cannot reasonably be compared to the long abandoned ASARCO mine.[14] Indeed, South32 describes the (Taylor and Clark) deposits on the Hermosa Project mine as "[o]ne of the largest undeveloped zinc-lead resources in the world, and the largest in America."[15] South32 CEO Graham Kerr stated: "We are designing the Taylor deposit to be our first 'next generation mine', using automation and new technology".[16] ADEQ is also plainly aware of the future plans for the development of a new industrial mine on the Hermosa property as noted in the Fact Sheet:

> AMI is conducting exploration activities to more fully assess the economic and technical viability of mining the underground polymetallic mineral deposit (primarily targeting zinc, lead, silver and manganese). This will be

[13] *See* South32 Hermosa Project Update Press Release on Pre-Feasibility Study (January 17, 2022), attached to Appellant's December 14 Comments to ADEQ on the AZPDES Permit at p. 3, 4 (and throughout).

[14] The only material relationship between the abandoned ASARCO mine and South32's "next generation mine" is the location of the new Hermosa Project itself, which is located, in part, on ASARCO's old permanently-closed and remediated mine site.

[15] *See* South32 Hermosa ADEQ Site Visit Presentation (January 4, 2022) at 6.

[16] *See* South32 Hermosa Project Update Press Release on Pre-Feasibility Study (January 17, 2022) at 1.

> accomplished largely through advancement of two exploration shafts, which will necessitate dewatering of the local aquifer in the vicinity of the shafts to allow for their safe advancement. The VRP and exploration activities will require the continued use of water treatment plant 1 (WTP1) and the construction and use of water treatment plant 2 (WTP2). [Emphasis added].

The Hermosa Project is nothing less than a new industrial mine that has a multitude of "new sources" under 40 C.F.R. § 122.2 and 122.29, and R18-9-A901(25), including new facilities, new structures, and other new sources of discharge that are totally independent from the long abandoned mine workings, and/or which have totally replaced the process and production equipment from the old permanently-closed and remediated mine site. Yet, as noted above, ADEQ continues to dismiss this fundamental point, incredibly concluding without any basis or substantive analysis that because the "mines workings and historic tailings at the site date back to the first half of the 20th century….discharge from WTP1 and WTP2 [are considered by ADEQ] to be an existing source rather than a new source or a new discharger under A.A.C. R18-9-A901.24 or R18-9-A901.25."[17]

In its response to the comments filed by PARA on the Permit, ADEQ doubled down on its "existing mine" theory insisting, "ADEQ maintains that the new source analysis completed during the 2018 permit issuance and 2021 permit modification remains correct under current Arizona law, and there are no changes to the facility which would require reevaluation." ADEQ then went on to conclude (without any substantive analysis and in circular fashion), that "new features, such as the exploration shafts, that are constructed within the existing mine or adjacent area are considered to be part of the existing mine; *i.e.,* new features are not inherently new mines."[18]

ADEQ's expansive use of the phrase "existing mine" to describe a long abandoned and inactive mining area defies the factual record in this case (as documented above) as well as common sense. The definition of a "mine" under Clean Water Act at 40 C.F.R. § 440.132(g) requires the existence of "an active mining area." It is impossible to conclude

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[17] AZPDES Permit Draft Fact Sheet (November 2022) at p.5. *See also* ADEQ Response to Public Comments for Permit No. AZ0026387 – January Mine Hermosa Project (March 8, 2023) at p. 1-2:

> "ADEQ disagrees with the assertion that the January Mine Hermosa Project is a new source. The new source performance standards are applicable to mines which are defined in 40 CFR 440.132(g) as "an active mining area, including all land and property placed under, or above the surface of such land, used in or resulting from the work of extracting metal ore or minerals from their natural deposits by any means or method…" Additionally, the "site" where the mine is located is also defined in 40 CFR 122.2 as including the adjacent area. Therefore, new features, such as exploration shafts, that are constructed within the existing mine or adjacent area are considered to be part of the existing mine; i.e., new features are not inherently new mines. Because the only performance standard applicable is that for a "mine," mine shafts and other features of a mine cannot be new sources under 40 CFR 122.2 and 122.29(b)."

[18] *See* ADEQ Response to Public Comments (March 8, 2023) at p.1-2.

that ASARCO's long abandoned property – a property that was even transferred to and held as part of a Multi-State Custodial Trust – was an "active mining area" when it was acquired by South32's predecessor in interest. And yet, this is exactly what ADEQ concluded.

If ADEQ's patently flawed rationale is allowed to stand, every single future activity (including exploration and shaft development for the removal of metal ore or minerals at the site) will never be a "new source" under the CWA. In ADEQ's view, even if South32's current mine plan is totally unrelated to and not a continuation of the prior abandoned "mine" and even if they will be developing entirely new, previously-untouched deposits, located at depths that could not have been accessed by the long abandoned historic mine. ADEQ's position undermines the very purpose of the Clean Water Act and the purpose of the new source requirements and should be rejected by the EPA.

The Alum Gulch TMDL Must Be Updated and a Wasteload Allocation Should be Performed for Harshaw Creek/Alum Gulch Before the AZPDES Permit is Renewed

Since the Hermosa Project's existing and planned mine workings, structures and facilities are new sources of discharge subject to the 1982 effluent limitation guidelines applicable to ore mining (40 CFR Part 440 Subpart J), ADEQ must also complete a TMDL study for Alum Gulch to consider lead and it must conduct appropriate wasteload allocations for the anticipated discharges to Alum Gulch and Harshaw Creek before it can issue the AZPDES Permit under the Clean Water Act.[19] This approach has been confirmed by the Arizona Court of Appeals in a factually similar, but unrelated appeal, involving ADEQ's issuance of an AZPDES permit for the Resolution Copper Company (Resolution) for discharge to Queen Creek – also an impaired water that lacked a TMDL. *See San Carlos*

[19] After receiving detailed comments from PARA on the AZPDES Permit, ADEQ subsequently rationalized – in an apparent attempt to avoid having to address the new source issue in the instant Permit – that "[i]f the exploration shafts are later determined to be new sources, the treated water from those shafts is discharged from Outfall 002 to Harshaw Creek" (instead of from Outfall 001 into Alum Gulch). *See* Response to Comments on AZPDES Permit at 2 (Emphasis added). ADEQ's rationale is misplaced for several reasons. First, as noted in footnotes 1 and 2, *supra*., both Alum Gulch and upper Harshaw Creek are listed as impaired waters under 303(d) of the CWA, and thus ADEQ must complete a TMDL and appropriate waste load allocations prior to allowing a discharge to either water source. Second, ADEQ's own AZPDES Permit materials (as well as South32's application materials) indicate that dewatering and depressurization wells are permitted to go to **either** WTP1 (and discharged via Outfall 001 to Alum Gulch) or WTP2 (and discharged via Outfall 002 to Harshaw Creek). *See* ADEQ Draft Fact Sheet for AZPDES Permit at p.4. The permit was never amended to state otherwise. Also, new waste rock from mineshaft development (including potentially acid generating waste rock) will be placed on the expanded TSF, and runoff and seepage from TSF is collected in the underdrain collection pond system that drains, in part, to WTP1 for discharge via Outfall 001 to Alum Gulch. This will result in a "new source" of discharge to an already-impaired surface water. Because Alum Gulch is newly listed as impaired for lead, until ADEQ performs a TMDL for Alum Gulch that includes lead, it cannot lawfully permit such a discharge under the current permit.

Apache Tribe v. State of Arizona, et al., Case No. 1 CA-CV 21-0295 (Ariz. Ct. App., Div. 1, Nov. 15, 2022).[20]

In that case, like here, ADEQ took the position that the mineshafts and related facilities being developed by the Resolution Copper mine could not be a "new source" of pollution to Queen Creek since they were being developed at the location of an older, existing mine. However, when ADEQ's rationale was reviewed on appeal it was rejected by the Arizona Court of Appeals. *See id.* In that case, the Court of Appeals stated that if ADEQ's sweeping new source rationale were adopted, it would "render the new source rule under 40 C.F.R. § 122.29 null as applied to new facilities at mining sites", *San Carlos* at 520 P.3d 670 at 679-680, essentially defeating the very purposes of the Clean Water Act. *Id*.

Importantly, the Court of Appeals also held that until ADEQ completed a TMDL and wasteload allocation for impaired Queen Creek, ADEQ could not issue an AZPDES permit to Resolution under the CWA. *See San Carlos v. State* at ¶ 2. The rulings in the *San Carlos* decision are directly applicable here. Until ADEQ completes the needed TMDLs and performs the appropriate wasteload allocations required by law, ADEQ cannot legally issue the AZPDES Permit to South32.

ADEQ's Routine Pattern of Failing to Complete TMDLs

When Arizona secured primacy over the Section 402 NPDES permit program, ADEQ agreed to "[d]evelop and maintain, to the maximum extent possible, the legal authority and the resources required to carry out all aspects of the AZPDES program" and to maintain a "vigorous program of taking timely and appropriate enforcement actions" under the Clean Water Act. *See* NPDES MOA between State of Arizona and U.S. EPA Region 9 (2002), Sec. III(A)(1) and (4).

However, as demonstrated in this instance and others, ADEQ has routinely failed to live up to these requirements. In 2021, the Arizona Auditor General reported that ADEQ, in addition to not adequately protecting Arizona's groundwater aquifers, had failed to "reduced the number of impaired surface waters in the State, limiting its ability to keep these waters safe from pollution."[21] The situation for Alum Gulch and Harshaw Creek is no different. The Upper Harshaw Creek and Alum Gulch TMDLs are now both 20 years old and as noted above, no TMDL has been conducted as a result of Alum Gulch's recent listing on the 303(d) list for lead.

ADEQ even admits that despite being required by law to review and update existing TMDLs every five years, it has failed to do so: "At present, every existing TMDL is more

[20] Opinion at ¶1-¶2. Appellees ADEQ and mining company have filed a Petition for Review with the Arizona Supreme Court, but review has not been accepted or denied to date (Case No. CV-22-0290-PR).

[21] *See* AZ Auditor General Report No. 21-116 (Arizona Department of Environmental Quality – Water Quality Protection Responsibilities), September 28, 2021.

than 5 years old and has not been reviewed and updated."[22] Perhaps in response to this failure, ADEQ requested an appropriation increase of $1.006 million annually to address its TMDL backlog from the Arizona Legislature this year. *See id.* From a review of the final FY2024 Budget it appears that ADEQ did not receive this requested funding.

In conclusion, PARA urges EPA to exercise its authorities under the Clean Water Act to independently evaluate the legal viability of AZPDES Permit No. AZ0026387, including whether the Hermosa Project represents a "new source" (or sources) of pollution subject to the post 1982 new source and TMDL requirements of the CWA.

PARA thanks you in advance for taking the time to review our concerns about the South32 AZPDES Permit. PARA would be grateful if EPA would provide a response to this letter at your earliest opportunity so we can understand how EPA intends to independently review and potentially take action on the AZPDES Permit.

Thank you.

PATAGONIA AREA RESOURCE ALLIANCE

Carolyn Shafer
Mission Coordinator and Board Member

Enclosures

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Ellen Blake, EPA Region IX, NPDES Permits Office (blake.ellen@epa.gov)
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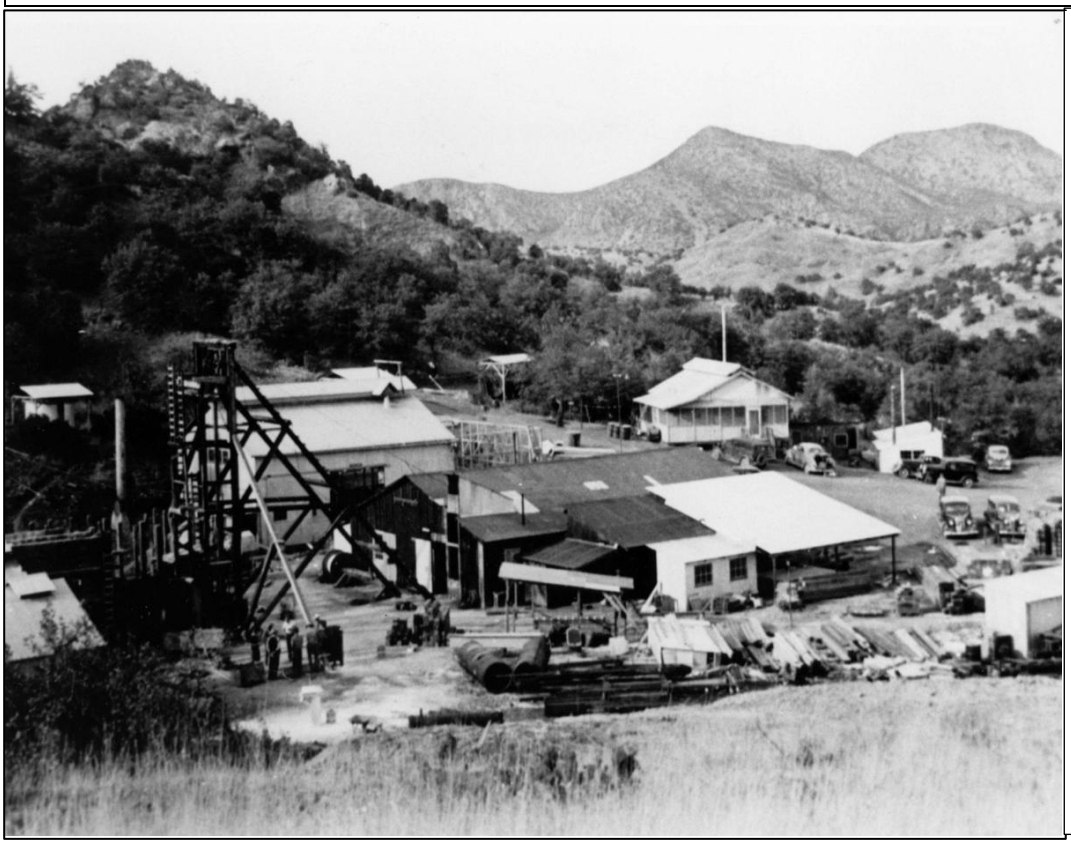
[22] *See* ADEQ Executive Budget Request for FY2024 at 109.

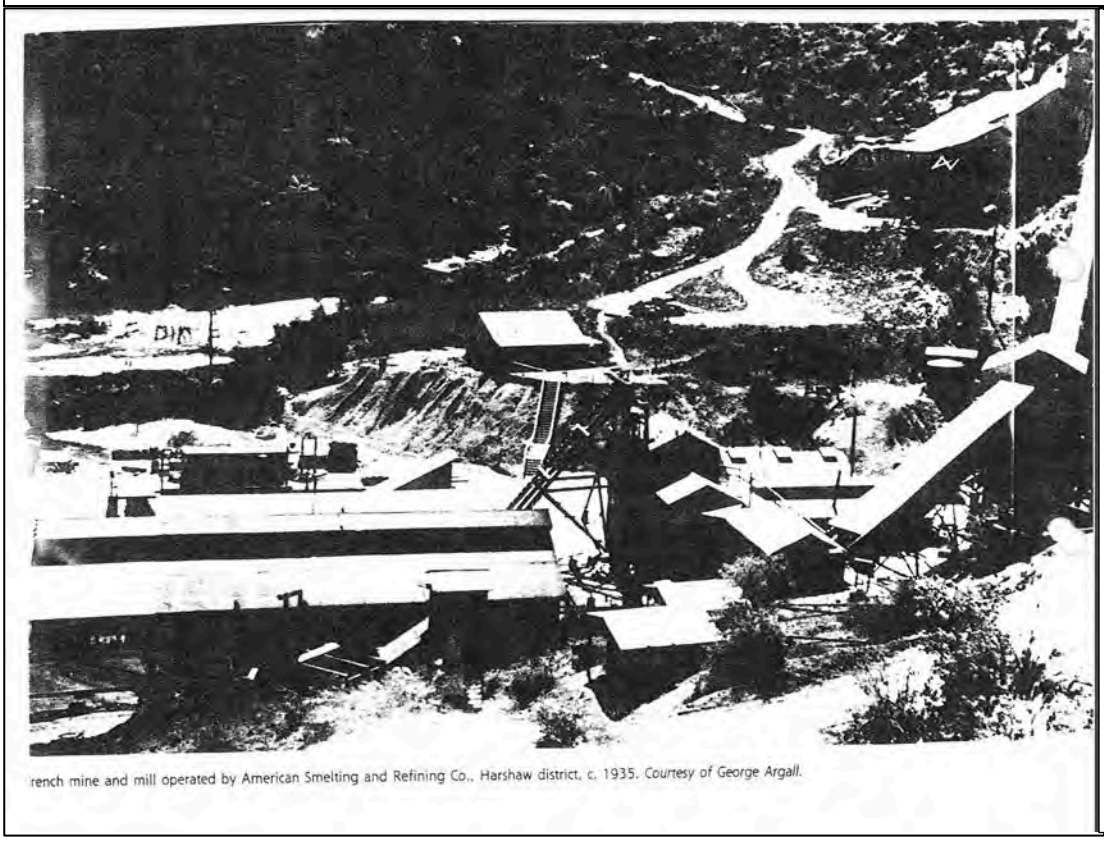
Attachment A

FIGURE 1: Trench Camp Mill, 1930s



https://tucson.com/news/local/mine-tales-trench-mines-history-may-have-begun-with-indian-and-jesuit-miners/article_94be15ff-7dc5-5ca8-808a-73a15a57076d.html

FIGURE 2: Trench Mine & Mill, 1935



rench mine and mill operated by American Smelting and Refining Co., Harshaw district, c. 1935. *Courtesy of George Argall.*

www.docs.azgs.az.gov/OnlineAccessMineFiles/S-Z/TrenchSantacruz140b.pdf

FIGURE 3: 2009. From Exhibit B of Proffer of Direct Testimony of ADEQ Expert Dennis L. Turner in *In re ASARCO LLC, et al.*

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Trench Camp and Passive Treatment System for the January Adit

Trench Camp-site of proposed evaporation pond on tailings pile no. 4 (upper lift of tailings no. 1, site of other proposed evaporation pond, in the background).

View of tailing pile no.4, looking upstream; this pile is the second and lowermost of the two piles proposed for installing the evaporation ponds. Note steep sided nature of this pile, showing the need for additional reinforcement (buttressing) to support additional weight of ponds

FIGURE 4: 2009 From Exhibit B of Proffer of Direct Testimony of ADEQ Expert Dennis L. Turner in *In re ASARCO LLC, et al.*, 2009

Close-up of side slope of tailings pile no. 4 showing the steep-sided nature of the tailings impoundments' slopes

Looking down valley from catchment dam, below tailing pile no. 4. Note that terrain is too steep to accommodate an alternative site for the two evaporation ponds, each about one acre in size.

FIGURE 5: August 2017. ADEQ Site Photo, August 30, 2017 titled "Tailings.jpg" (obtained via Public Records Request)

FIGURE 6: August 2017. ADEQ Site Photo, August 30, 2017 titled "2 Tailings.jpg" (obtained via Public Records Request)

FIGURE 7: August 2017. ADEQ Site Photo, August 30, 2017 titled "2&3 Tailings.jpg" (obtained via Public Records Request)

FIGURE 8: August 2017. ADEQ Site Photo, August 30, 2017 titled "Cap on 2 Tailings Slope.jpg" (obtained via Public Records Request)

FIGURE 9: April 24, 2023 (Private Collection)

Attachment B

GOOGLE EARTH AERIALS - HERMOSA PROJECT PROPERTY

FIGURE 1: November 1992 Arrow for illustrative purposes only.

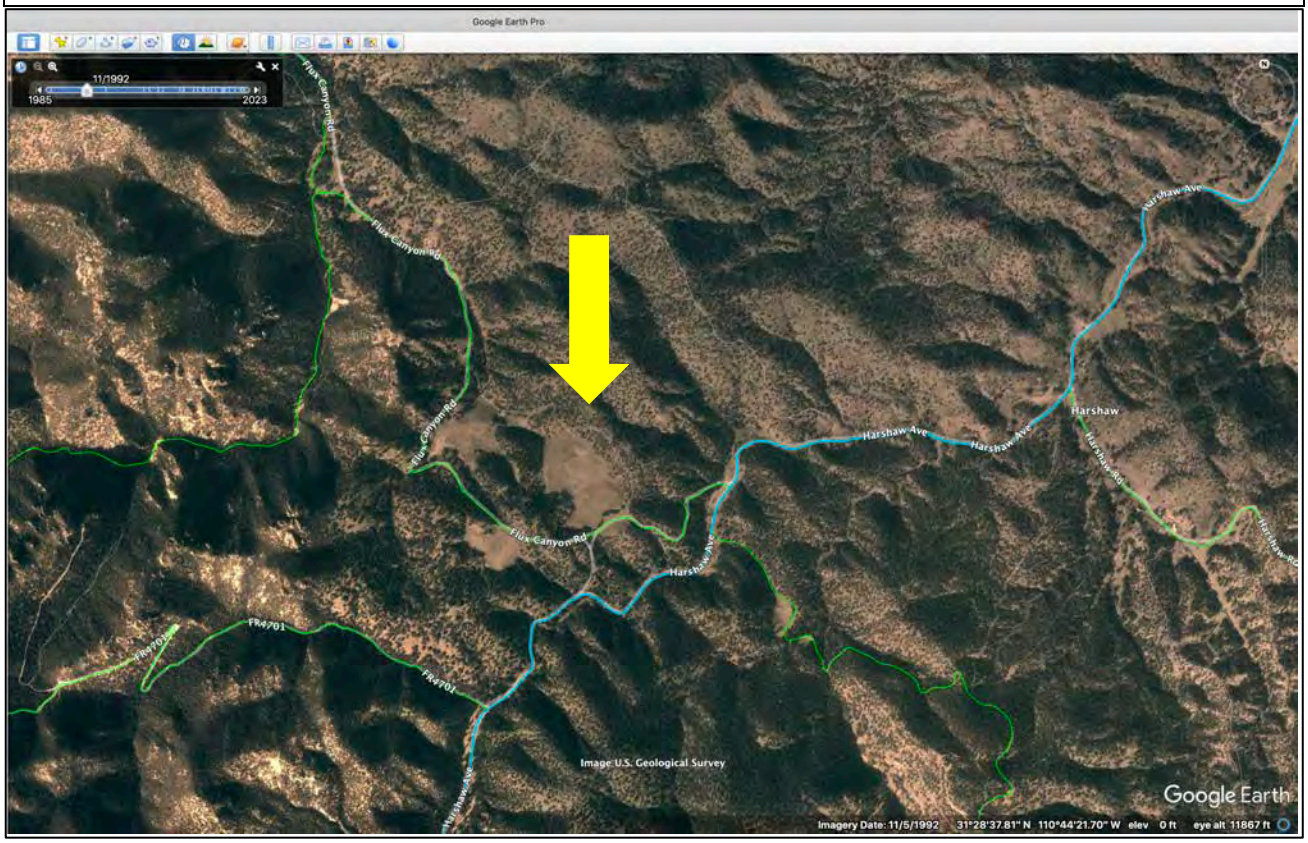


FIGURE 2: June 1996 Arrow for illustrative purposes only.

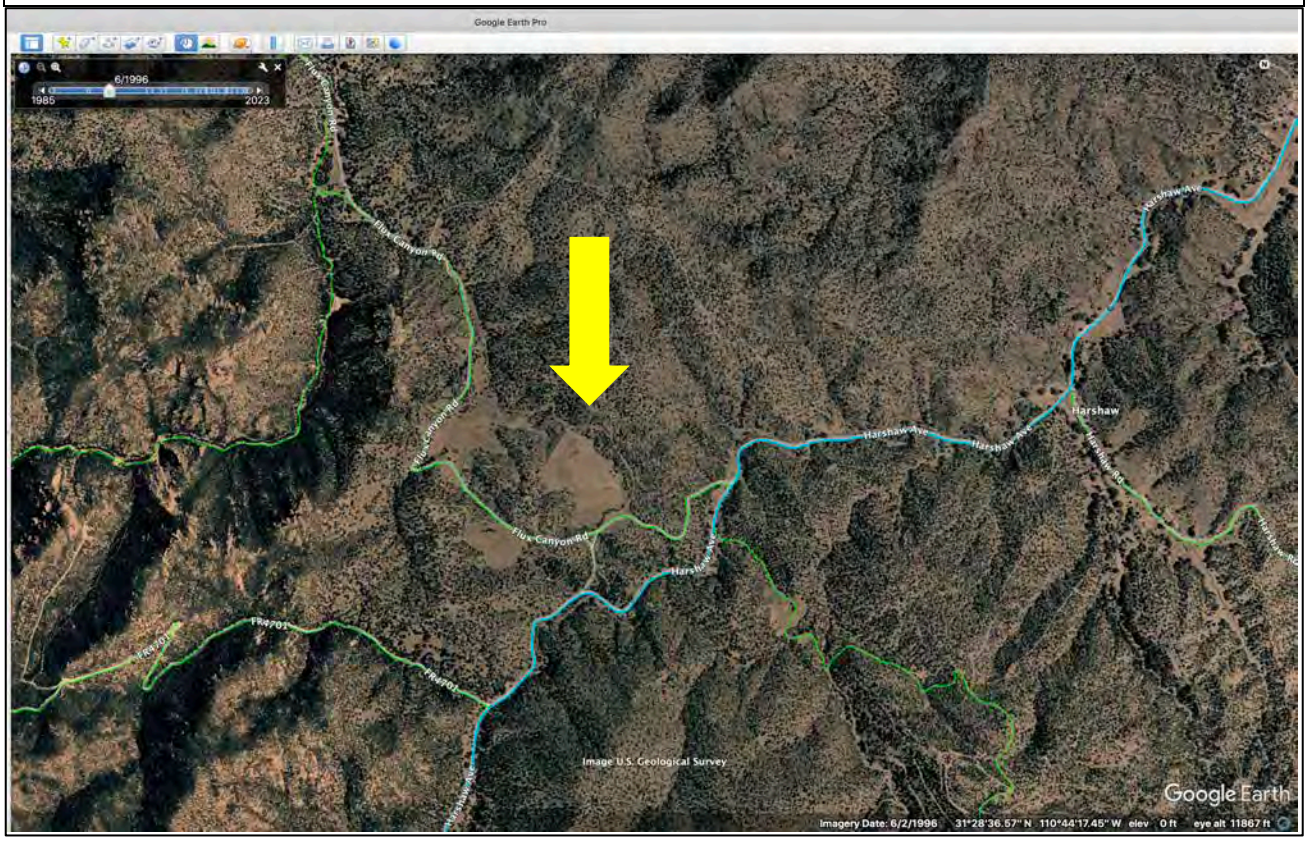


FIGURE 3: September 2004 Arrow for illustrative purposes only.

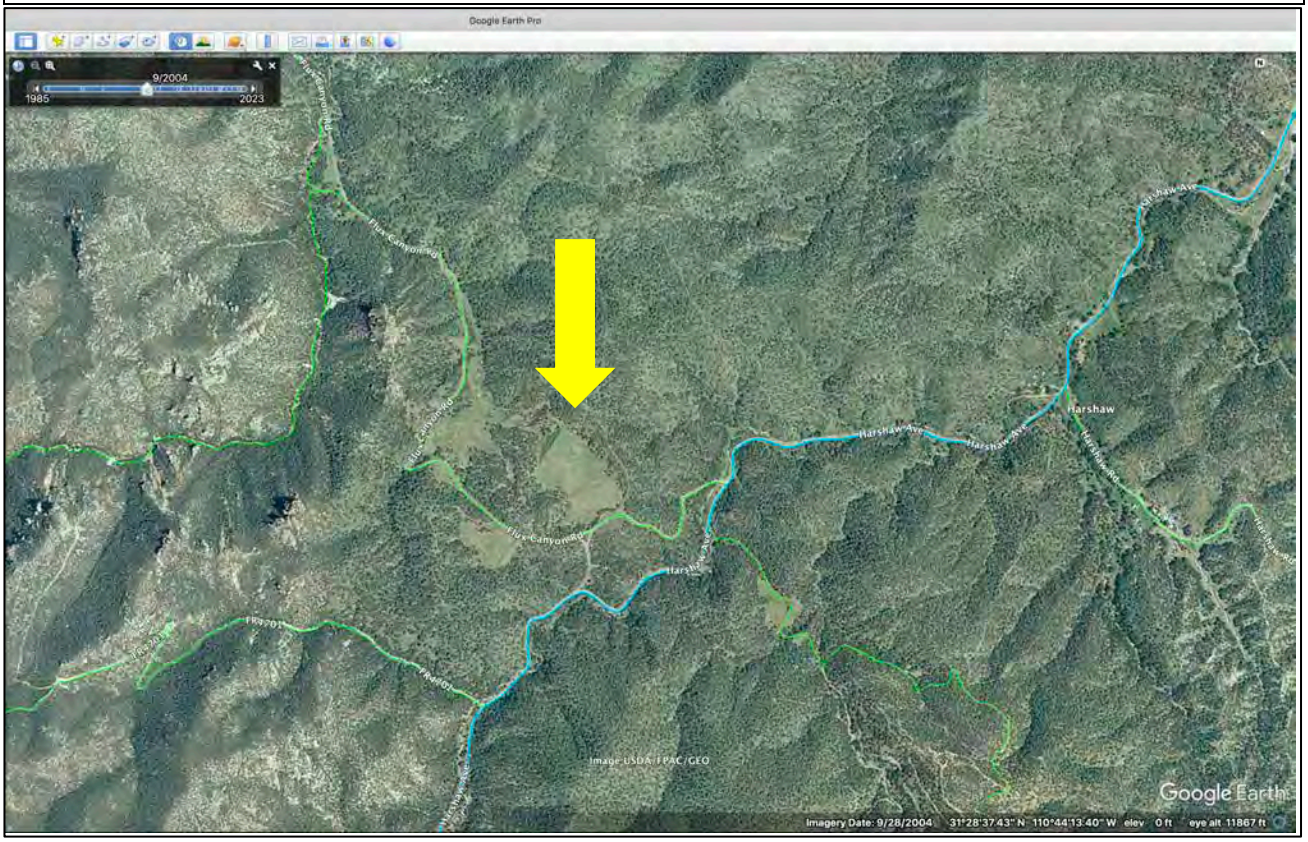


FIGURE 4: June 2006 Arrow for illustrative purposes only.

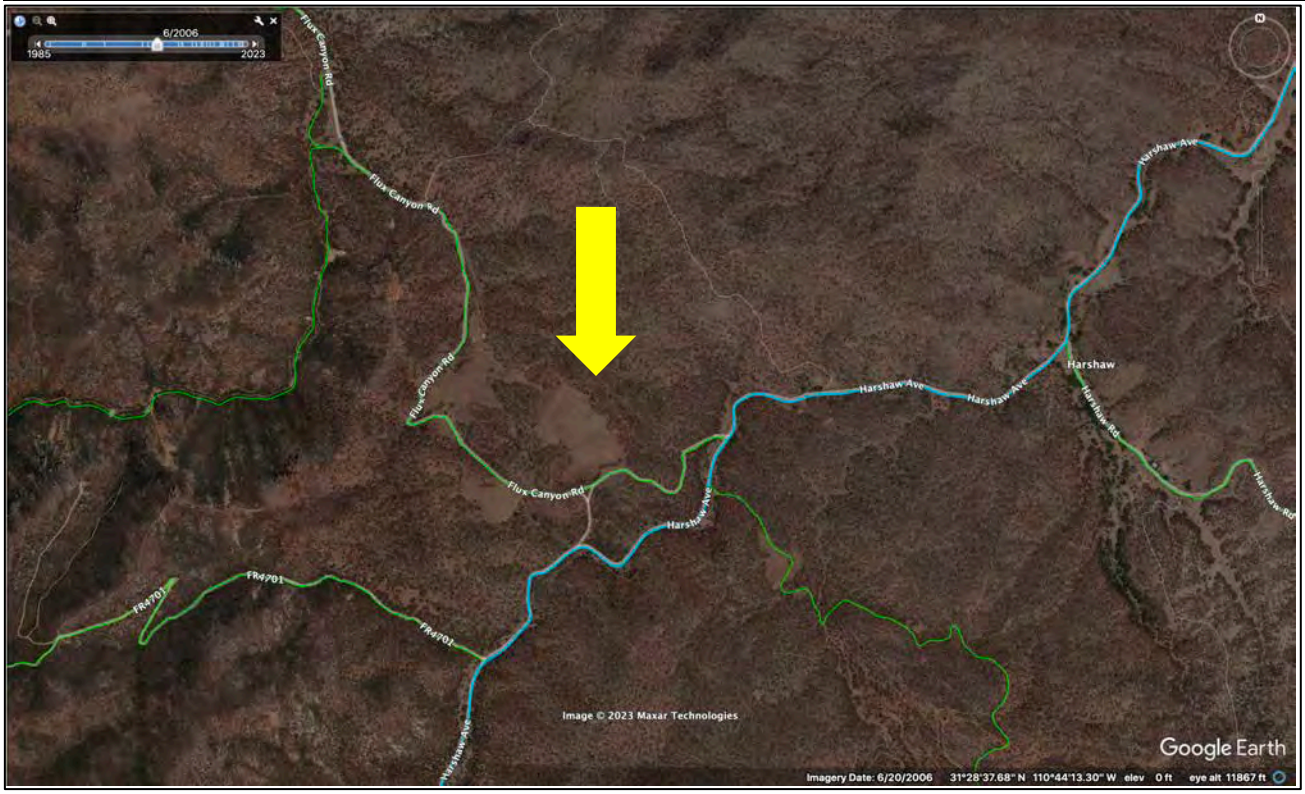


FIGURE 5: April 2013 Arrow for illustrative purposes only.

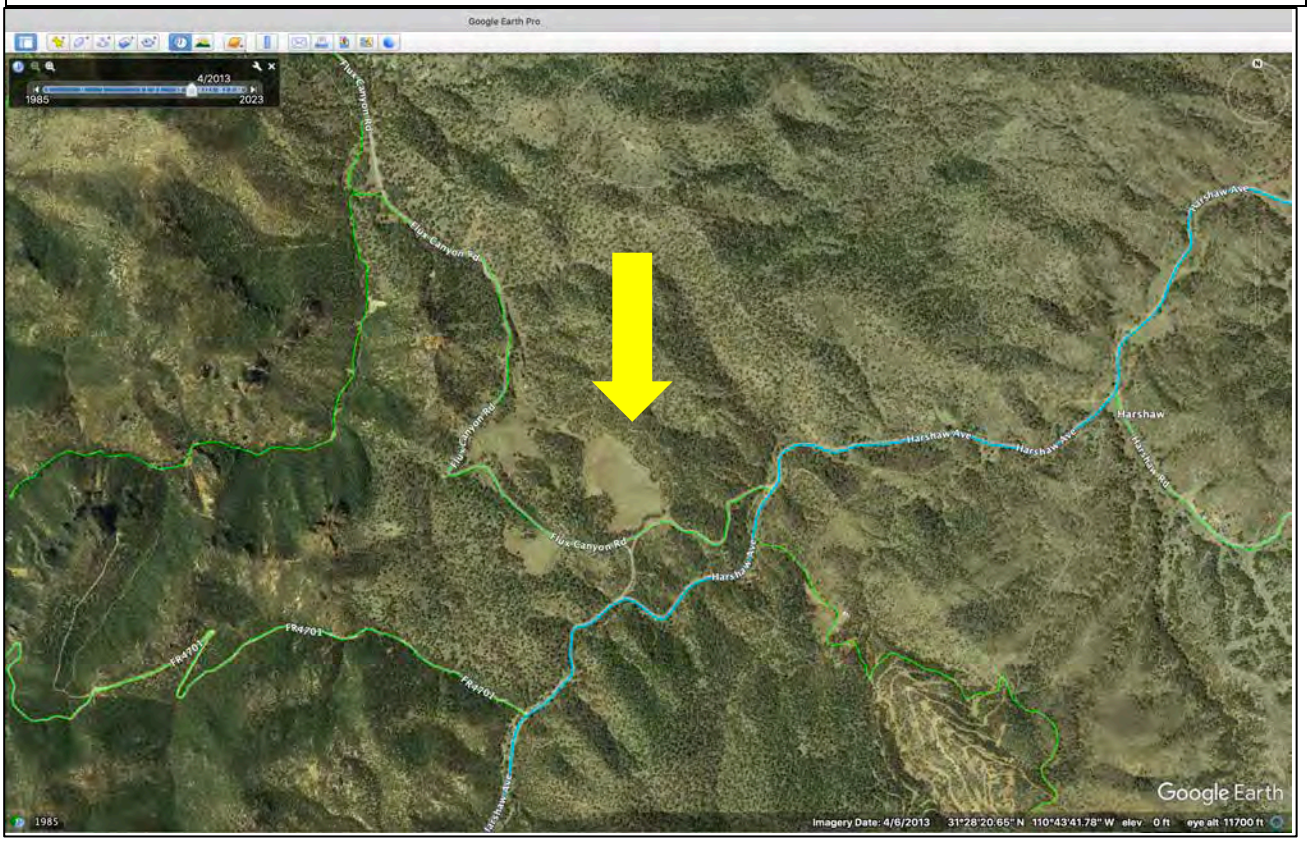


FIGURE 6: January 2015 Arrow for illustrative purposes only.

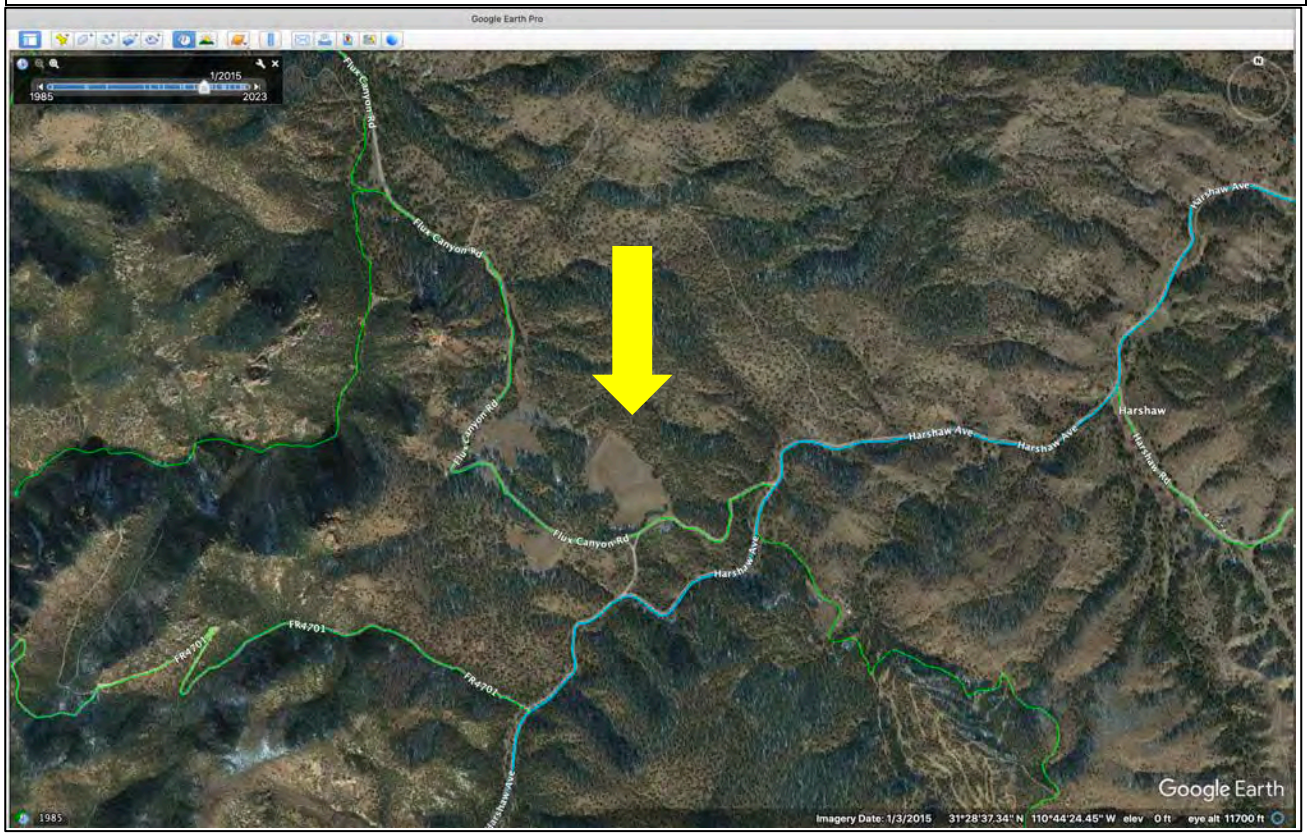


FIGURE 7: May 2017 Arrow for illustrative purposes only.

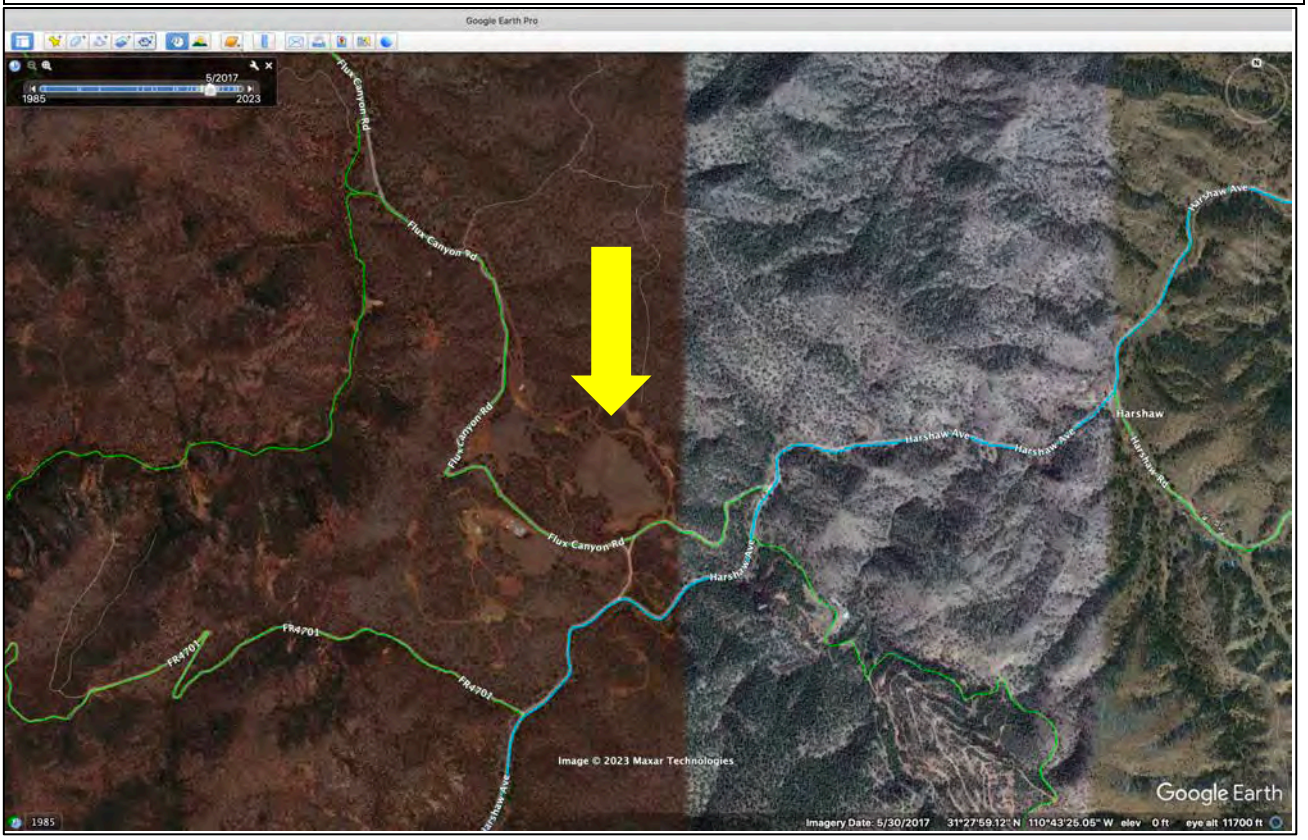


FIGURE 8: September 2018 Arrow for illustrative purposes only.

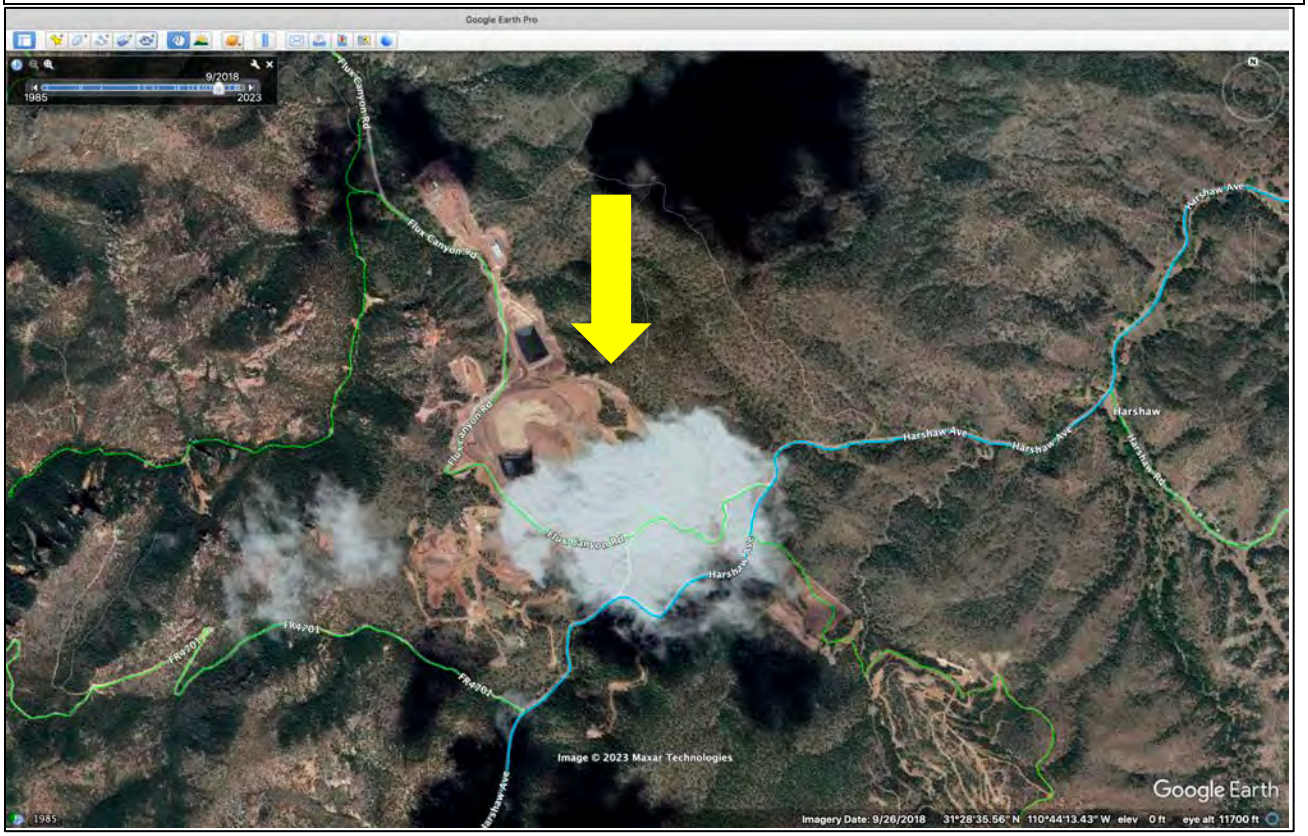


FIGURE 9: May 2019 Arrow for illustrative purposes only.

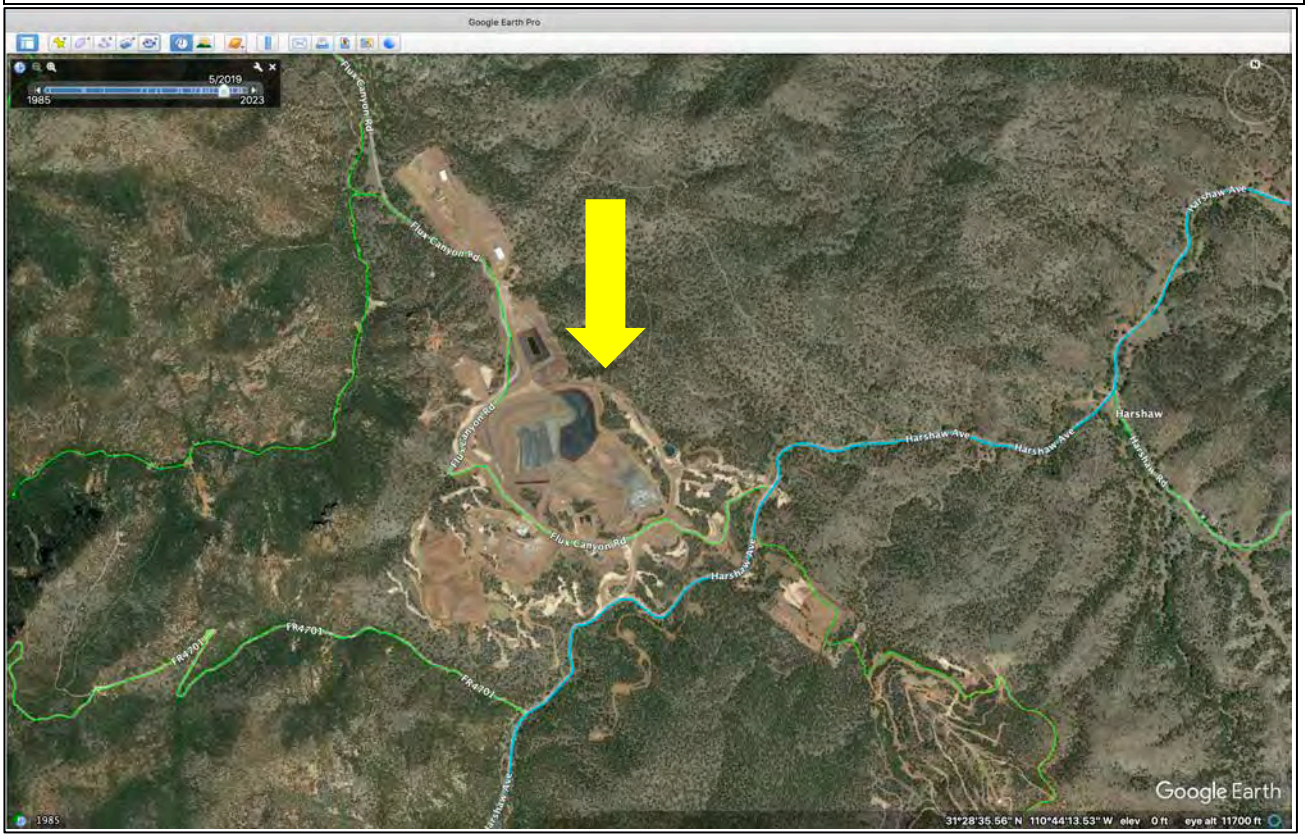


FIGURE 10: January 2020 Arrow for illustrative purposes only.

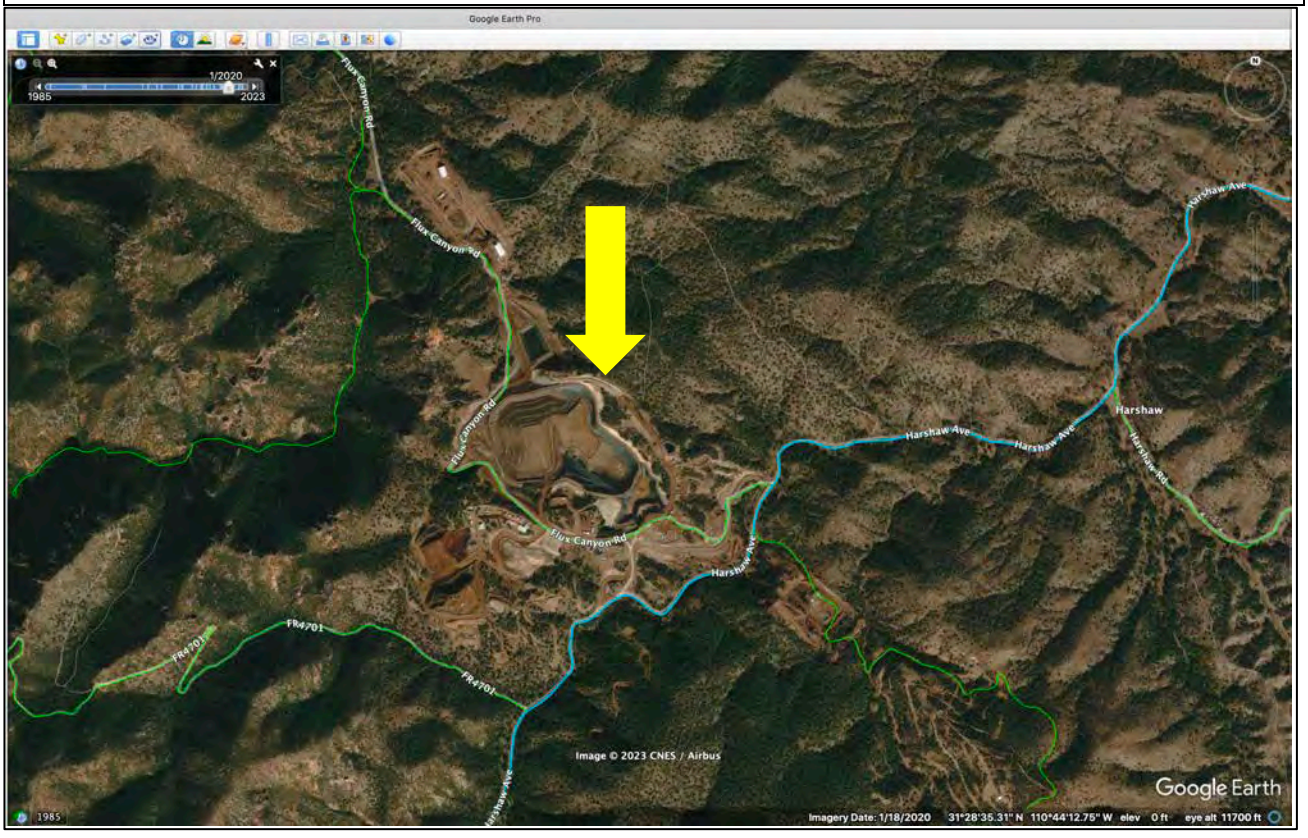
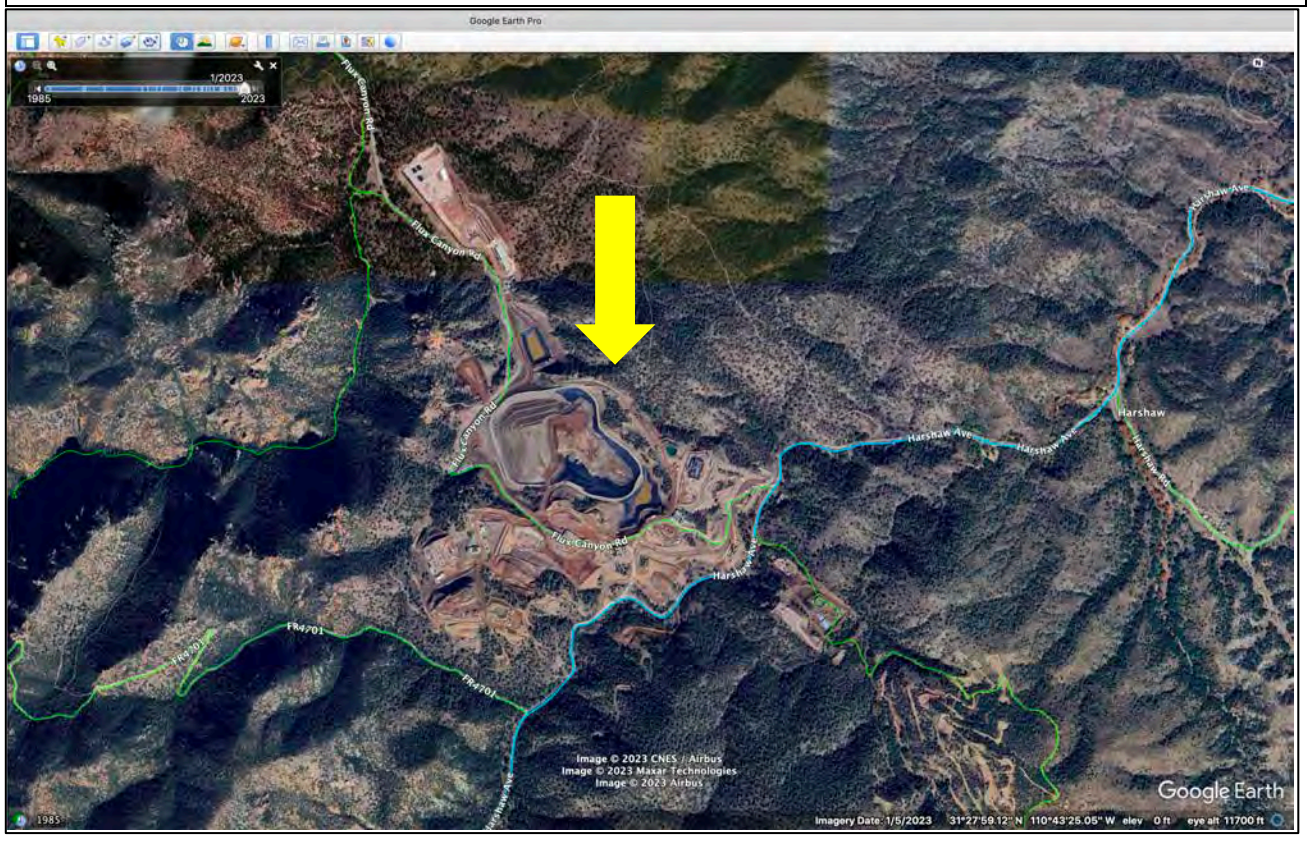


FIGURE 11: January 2023 Arrow for illustrative purposes only.



ATTACHMENT 2

PARA's Comments to ADEQ on Arizona's Draft 2024 Clean Water Act Assessment (July 1, 2017 to June 30, 2022) Integrated 305(b) Assessment and 303(d) Listing Report

(September 11, 2023)

PATAGONIA AREA RESOURCE ALLIANCE
www.PatagoniaAlliance.org
PO Box 1044 * Patagonia, AZ 85624

September 11, 2023

Arizona Department of Environmental Quality
Surface Water Protection
Attn: Jason Jones
1110 W. Washington St.
Phoenix, AZ 85007
Email: jones.jason@azdeq.gov

Re: Comments to ADEQ on Arizona's Draft 2024 Clean Water Act Assessment (July 1, 2017 to June 30, 2022) Integrated 305(b) Assessment and 303(d) Listing Report

To Whom It May Concern:

This letter is submitted on behalf of the Patagonia Area Resource Alliance (PARA), a nonprofit community watchdog organization focused on the environmental and economic health and vitality of the Patagonia region of Southern Arizona.

These comments are provided to the Arizona Department of Environmental Quality (ADEQ) in accordance with the open public comment period on the draft 2024 Clean Water Act Assessment ("Draft 2024 CWA Assessment" or "Assessment") (ending September 11, 2023).[1]

It is our understanding that Draft 2024 CWA Assessment is intended to be a "comprehensive analysis of water quality data associated with Arizona's surface waters to determine whether surface water quality standards are met and designated uses are being supported."[2] Specifically, the Assessment serves three functions: (1) it identifies Arizona waters that need to be protected, maintained or restored by ADEQ; (2) it helps to set priorities, allocate resources, and make decisions about land use activities, discharges to the water, future monitoring, and ADEQ program initiatives, while also fulfilling ADEQ's reporting requirements to EPA; and (3) it provide the public with an important opportunity to learn about and comment on the status of water quality in Arizona.[3] As discussed below, at least in reference to Harshaw Creek, ADEQ's Draft 2024 CWA Assessment falls short of these requirements.

---

[1] https://azdeq.gov/notices/extended-comment-period-begins-draft-2024-clean-water-act-assessment
[2] Draft 2024 CWA Assessment at Chapter 1-1.
[3] *Id.*

ADEQ must revise the Draft 2024 CWA Assessment to incorporate, at minimum, water quality data on Lower Harshaw Creek (WBID 15050301-025B)[4] in the Patagonia Mountains of Santa Cruz County, Arizona which is readily available to ADEQ and, in fact, was produced by ADEQ. Anything less fails to comply with Sections 303(d) and 305(b) of the Clean Water Act.

The EPA published a Memorandum on March 29, 2023, to provide guidance for states to perform integrated reporting under Sections 303(d), 305(b) and 314 of the Clean Water Act. *See* Information Concerning 2024 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions (EPA Guidance Memo). The EPA Guidance Memo, at page 9, provides, in relevant part:

> In developing their CWA 303(d) lists, states, territories, and authorized tribes are required to assemble and evaluate all existing and readily available water quality-related data and information, including for waters for which water quality problems have been reported by local, state, or federal agencies; members of the public; or academic institutions. [citing 40 CFR 130.7(b)(5) in footnote]. These organizations and groups should be actively solicited for research they may be conducting or reporting. [citing 40 CFR 130.7(b)(5)(iii) in footnote]. States, territories, and authorized tribes must use such data and information in developing the CWA 303(d) list unless they provide a rationale not to. [citing 40 CFR 1307(b)(6)(iii) in footnote].

EPA also specifically notes that it will evaluate whether a state, territory, or authorized tribe provides a technical, science-based rationale for its decisions not to use data or information. *See* 2006 Guidance Memo on Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act (cited in the EPA Guidance Memo).

I. The Legal Requirements of Sections 303(d) and 305(b) of Clean Water Act Are Not Met By The Current Draft 2024 CWA Assessment

Section 303(d) of the Clean Water Act requires, in part, that states monitor and assess the water quality of their surface waters, and identify waters that are impaired. To this end, states are required to evaluate existing water quality data to develop a list of impaired waters, so that these waters can be improved and brought into compliance. This is commonly referred to as the "303(d) List".

[4] Lower Harshaw Creek (WBID 15050301-025B) is identified as an 11-mile reach originating at 31º27'43.9"N, 110º43'21.1"W and terminating at its confluence with Sonoita Creek (31º32'35.91", 110º44'45.12"). However, PARA has reason to believe that Upper Harshaw Creek may actually extend *lower* than these provided coordinates ("The bottom portion of the subject reach includes dump number 3 of the Trench Camp Mine and a spring near the downstream end of the subject reach with the only observed constant drainage in the subject basin", Upper Harshaw Creek TMDL at 3).

The data in ADEQ's Draft 2024 CWA Assessment indicates that ADEQ has either failed to conduct adequate monitoring of Lower Harshaw Creek or it has improperly disregarded or failed to incorporate water quality data readily available to it on Lower Harshaw Creek. This is a violation of the requirements of Section 303(d) and must be remedied in order to comply with the law.

Section 305(b) requires states to report to EPA on the overall condition of aquatic resources within their state. ADEQ plainly understands its obligations under this section. *See* Draft 2024 CWA Assessment at Chapter 1-2.

These two requirements have been combined together in the Draft 2024 CWA Assessment, therefore logically, the report must fulfill both requirements. However for reasons discussed herein, ADEQ's failure to adequately describe and analyze the water quality of Lower Harshaw Creek falls short of both legal requirements. This should be remedied by ADEQ.

II. The Draft 2024 CWA Assessment Contains Insufficient Data on Lower Harshaw Creek (WBID 15050301-025B)

ADEQ's Assessment of water samples from Upper Harshaw Creek (WBID 15050301-025A) appear to have been tested for multiple characteristics including Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Fluoride, Lead, Manganese, Mercury, Nickel, pH, Selenium, Silver, Thallium, and Zinc.[5]

In addition to the recent cleanup of acid mine drainage flowing from Lead Queen Mine into Harshaw Creek (discussed below), ADEQ has long been aware that "[m]ining residues are a significant source of pollutants" in Upper Harshaw Creek (*see* Upper Harshaw Creek TMDL at 15). The U.S. Geological Survey (USGS) also concludes that the historic mine sites in the Harshaw watershed –

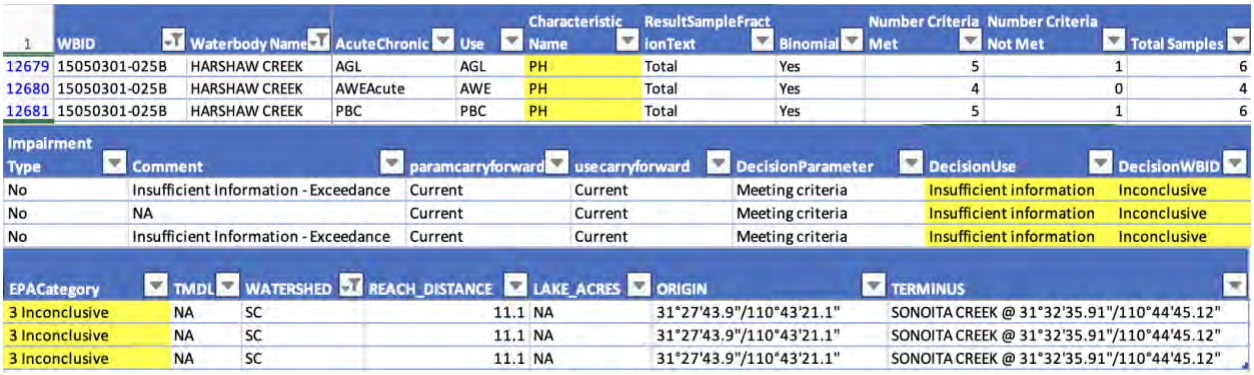
> "typically include numerous adits and shafts, waste rock, and relic tailings dumps, and the larger sites typically have the remains of mills or other ore-handling fixtures, all resting on steep, rocky banks of the stream. These sites release concentrations of metals in the "high metal" (high concentrations) category relative to a large range of mine types compiled from world literature." *Id*. at 16 (internal citations omitted).

In stark contrast, and despite well-known and ongoing water quality impairments as well as pollution and associated remediation in this water body known to ADEQ, Lower Harshaw Creek appears to only have been sampled for pH.[6] It is unclear why Lower Harshaw Creek, which is part of the same body of water as Upper Harshaw Creek (which

[5] *See* Draft 2024 CWA Appendix A – Decisions, lines 12651 through 12678. Data on Upper Harshaw Creek appears to be from only one (1) test sample for each parameter.
[6] *See* Draft 2024 CWA Appendix A – Decisions, lines 12679 through 12681. Data on Lower Harshaw Creek appears to be from 16 (or fewer) samples.

is impaired for multiple elements, and which flows into Lower Harshaw Creek), was not sampled for any of the same characteristics as those sampled in Upper Harshaw.

Of the 16 samples taken in Lower Harshaw Creek (at unknown dates from unknown locations),[7] 12 samples are noted by ADEQ as "Insufficient Information – Exceedance", with the remaining 4 samples noted as "NA" (see excerpted table entries below from Appendix A). Ultimately, ADEQ concludes that Lower Harshaw Creek has "Insufficient information" for decision use and a Category 3 "Inconclusive". *See* Excerpts (below) from Appendix A of Draft CWA Assessment (emphasis added).

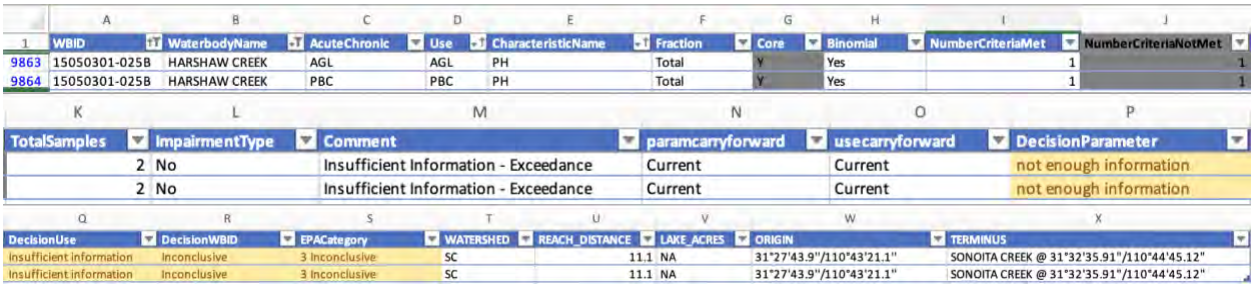


	WBID	Waterbody Name	AcuteChronic	Use	Characteristic Name	ResultSampleFractionText	Binomial	Number Criteria Met	Number Criteria Not Met	Total Samples
12679	15050301-025B	HARSHAW CREEK	AGL	AGL	PH	Total	Yes	5	1	6
12680	15050301-025B	HARSHAW CREEK	AWEAcute	AWE	PH	Total	Yes	4	0	4
12681	15050301-025B	HARSHAW CREEK	PBC	PBC	PH	Total	Yes	5	1	6

Impairment Type	Comment	paramcarryforward	usecarryforward	DecisionParameter	DecisionUse	DecisionWBID
No	Insufficient Information - Exceedance	Current	Current	Meeting criteria	Insufficient information	Inconclusive
No	NA	Current	Current	Meeting criteria	Insufficient information	Inconclusive
No	Insufficient Information - Exceedance	Current	Current	Meeting criteria	Insufficient information	Inconclusive

EPACategory	TMDL	WATERSHED	REACH_DISTANCE	LAKE_ACRES	ORIGIN	TERMINUS
3 Inconclusive	NA	SC	11.1	NA	31°27'43.9"/110°43'21.1"	SONOITA CREEK @ 31°32'35.91"/110°44'45.12"
3 Inconclusive	NA	SC	11.1	NA	31°27'43.9"/110°43'21.1"	SONOITA CREEK @ 31°32'35.91"/110°44'45.12"
3 Inconclusive	NA	SC	11.1	NA	31°27'43.9"/110°43'21.1"	SONOITA CREEK @ 31°32'35.91"/110°44'45.12"

ADEQ's limited and radically insufficient water quality efforts on Lower Harshaw fail to comply with its obligations under the Clean Water Act, particularly given the well-known and ongoing impairments in Upper Harshaw Creek as well as water quality data readily available to ADEQ on Lower Harshaw Creek. Interestingly, the prior (now-finalized) 2022 CWA Assessment also included only a small handful of water quality samples for Lower Harshaw Creek, and ADEQ only tested for pH. For these reasons, ADEQ concluded there was "not enough information" for a decision and was ultimately "Inconclusive." *See* Excerpts (below) from Appendix A of 2022 CWA Assessment (emphasis in original).



	WBID	WaterbodyName	AcuteChronic	Use	CharacteristicName	Fraction	Core	Binomial	NumberCriteriaMet	NumberCriteriaNotMet
9863	15050301-025B	HARSHAW CREEK	AGL	AGL	PH	Total	Y	Yes	1	1
9864	15050301-025B	HARSHAW CREEK	PBC	PBC	PH	Total	Y	Yes	1	1

TotalSamples	ImpairmentType	Comment	paramcarryforward	usecarryforward	DecisionParameter
2	No	Insufficient Information - Exceedance	Current	Current	not enough information
2	No	Insufficient Information - Exceedance	Current	Current	not enough information

DecisionUse	DecisionWBID	EPACategory	WATERSHED	REACH_DISTANCE	LAKE_ACRES	ORIGIN	TERMINUS
Insufficient information	Inconclusive	3 Inconclusive	SC	11.1	NA	31°27'43.9"/110°43'21.1"	SONOITA CREEK @ 31°32'35.91"/110°44'45.12"
Insufficient information	Inconclusive	3 Inconclusive	SC	11.1	NA	31°27'43.9"/110°43'21.1"	SONOITA CREEK @ 31°32'35.91"/110°44'45.12"

While comments on the prior 2022 CWA Assessment are not being proffered here, the point is that between at least these two subsequent CWA Assessments, ADEQ has consistently and without justification gathered and considered virtually no information about Lower Harshaw while, all the while, recognizing and still declining to address what

[7] The Draft 2024 CWA notes that approximately half of the data in the assessment was gathered by ADEQ and half by external entities/data sharing partners (Chapter 2-1).

ADEQ acknowledges is an insufficient amount of information on Lower Harshaw. Given the long history of mining in the area and known contamination associated with this mining, including in Harshaw Creek generally, ADEQ's deliberate indifference to its water quality assessment obligations under Sections 303(d) and 305(b) of Clean Water Act is alarming and should be corrected.

III. ADEQ Is Well Aware of (And Has Been Sampling) Water Quality Issues in Lower Harshaw Creek Due to Contamination From Legacy Mines

ADEQ is well aware of, and has been actively involved in the environmental cleanup and remediation of a long history of contamination in the Harshaw area due to acid mine drainage from the historic Lead Queen Mine, which drains into Lower Harshaw Creek (see Figure 1). Leached metals, including from tailings and waste rock, and acidic stormwater runoff had been carrying metals into Harshaw Creek and severely impacting water quality for some time (see Figure 2).

Figure 2. The adit at Lead Queen Mine, before remediation.

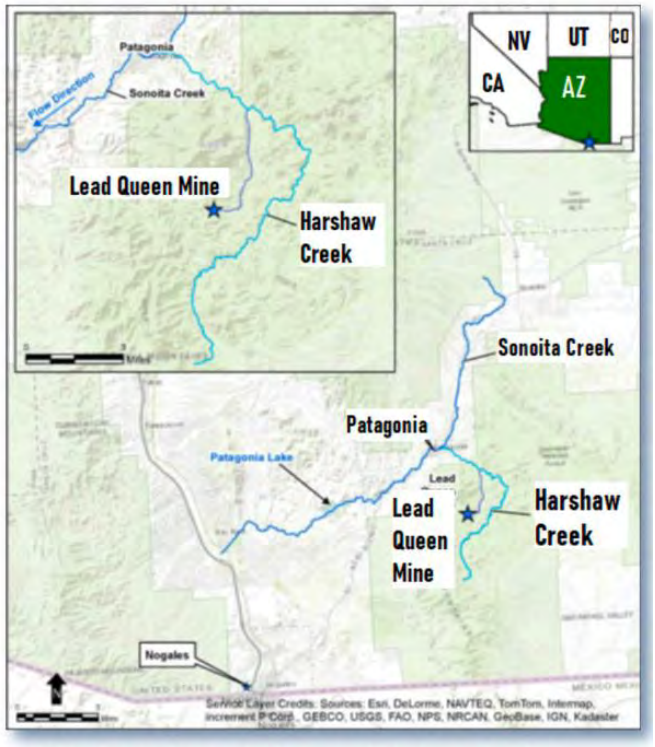


Figure 1. Harshaw Creek is in southern Arizona.

This map is from a recent publication by EPA highlighting the "collaborative effort" between the U.S. Forest Service and ADEQ to address acid mine drainage from the Lead Queen Mine in the Lower Harshaw Creek area[8] (attached here as **Attachment A**). This cleanup of acid mine drainage from the Lead Queen Mine has been ongoing for several years.

[8] *See* "Nonpoint Source Success Story, Arizona", EPA Flyer, September 2022.

The Lead Queen Mine adit was plugged first in 2016, and again in 2019 when the first remedy began to fail and allow further discharge of pollutants into the surface water.[9] ADEQ has reportedly continued to collect and test samples from Harshaw Creek for effectiveness monitoring before and after this work, reportedly testing for lead (total), copper (total and dissolved), zinc (dissolved), and pH[10] (see Table 2).

Table 2. Monitoring results in Harshaw Creek before and after plugging the main adit.

Pollutant[1]	Pre-plug	Post-plug (2020)	WQS	Designated use
Lead (total)	0.021	0.0013	0.015	PBC
Copper (total)	1.4	0.033	0.5	AgL
Copper (dissolved)	1.3	0.027	0.055	AWe
Zinc (dissolved)	4.1	0.082	2.4	AWe
pH	3.69	7.01	6.5–9.0	PBC

[1]Units are in milligrams per liter (except for pH).

Results

Remediation of the Lead Queen Mine improved surface water quality in the Lead Queen Mine tributary, which flows into Harshaw Creek. Data collected post-remediation in 2020 showed no exceedances of surface water quality standards (WQS) (Table 2). ADEQ continues to monitor Harshaw Creek to measure improvements.

In July 2023 (even more recently), the U.S. Forest Service published a Post-Construction Completion Monitoring Report regarding its cleanup work on Lead Queen Mine and ongoing monitoring (attached here as **Attachment B**). The Report indicates that ADEQ has been involved in this ongoing monitoring including surface water sampling in Lower Harshaw Creek.

Indeed, the U.S. Forest Service reported that ADEQ has installed what appears to be an autosampler outside of the Lead Queen Mine adit.[11] The U.S. Forest Service has also reported that ADEQ and U.S. Forest Service are continuing to coordinate on and review sampling efforts.[12]

> It is recommended to monitor the Site for another year. The Forest Service will continue to coordinate with ADEQ staff and review any sampling results for the effectiveness of the remedies. After the monitoring phase is complete, the Forest Service will evaluate road access to the Site.

Based on this information, ADEQ is plainly in possession of (and has indeed directly conducted) more extensive water quality sampling of Lower Harshaw Creek than has been included in the Draft 2024 CWA Assessment. And yet, despite the requirement that "States must consider all readily available data when preparing the Clean Water Act Assessment," 2024 Draft CWA Assessment at Chapter 3-3 (emphasis added), none of this data appears to be included anywhere in the 2024 Draft CWA Assessment for Lower Harshaw Creek.

IV. ADEQ Has Other Water Quality Testing in Lower Harshaw Creek

For many years, volunteers in the Patagonia area have been collecting, testing and reporting water quality data on Harshaw Creek. And since 2021, the Friends of

[9] *See* FN 8.
[10] *See* FN8. Supposedly, as of mid-2022 and using CWA 319 funds, "ADEQ continues to monitor Harshaw Creek to measure improvements."
[11] *See* U.S. Forest Service, Southwestern Regional Office, Coronado National Forest. Lead Queen Mine Remediation – 2023 Post-Construction Completion Monitoring Report (July 23, 2023).
[12] *See* FN 11.

Sonoita Creek has been doing extensive monthly water sampling work across the Sonoita Creek watershed including on Lower Harshaw Creek, **and sending that data to ADEQ Community Science Water Watch Program, Water Science Division**. This work has been done, in part, using equipment provided, calibrated, and audited regularly by the ADEQ Community Science Water Watch Program. It is our understanding that the ADEQ Community Science Water Watch Program reviews this data and submits it to the EPA. It is also our understanding that this testing has consisted of testing for field data, pH, dissolved oxygen, dissolved solids, air and water temperature, and turbidity. Testing for metals is also being done as part of this initiative, and is also being reported to ADEQ.

This data is readily available to ADEQ, given that ADEQ already has it in their possession. Furthermore, ADEQ notes that they submit data to the water quality portal through EPA's Water Quality Exchange "on a daily basis" (*see* Draft 2024 CWA Assessment at Chapter 3-3), and ADEQ uses data from the water quality portal in preparing these CWA Assessments (*id.* at Chapter 3-2). We know that at least some data submitted by Friends of Sonoita Creek has been uploaded to this portal (www.waterqualitydata.us), since queries to this database (shared with PARA) show hundreds of water quality sample data points marked as "Friends of Sonoita Creek" volunteer project between 2021 and 2023.

But for reasons unknown, however, Friends of Sonoita Creek is not listed as one of the organizations involved in collecting data for the Draft 2024 CWA Assessment. *See* Assessment, Chapter 2-2. It is therefore unclear whether any of this testing data was included in the Draft 2024 CWA Assessment, for Lower Harshaw Creek or any other sampled water bodies.

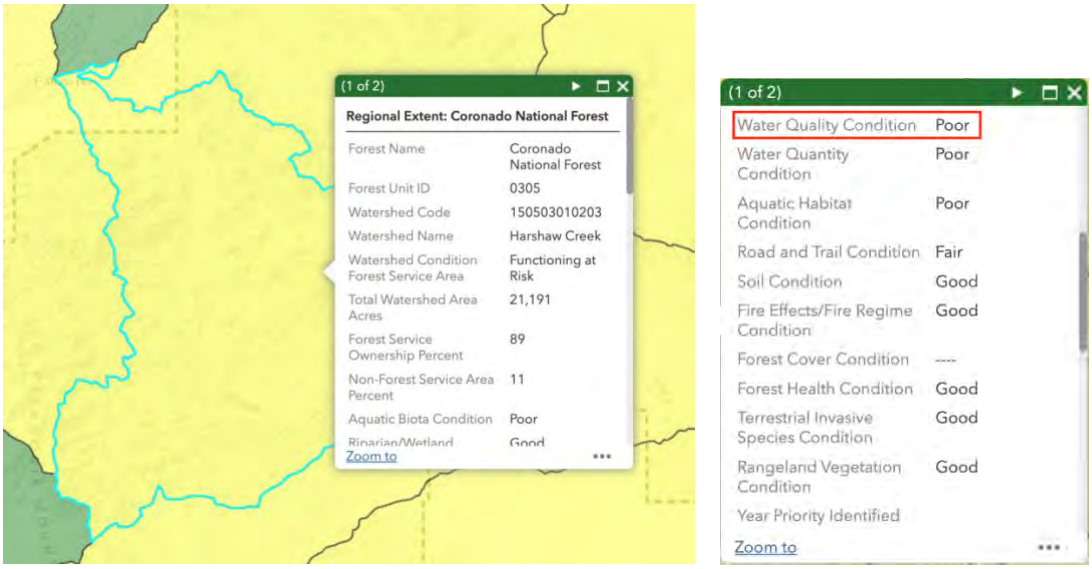
ADEQ should acknowledge all testing/sampling sources and include these data in its combined 303(b) and 305(d) Draft CWA 2024 Clean Water Act Assessment. Moreover, ADEQ should use these data to properly assess and make determinations about potential impairments in Lower Harshaw Creek. Additionally, if ADEQ has determined for some reason not to use these data, the law requires and EPA guidance indicates, ADEQ is required to provide a rationale why these data sources were not included. *See* 40 CFR 1307(b)(6)(iii).

V. The U.S. Forest Service Has Also Documented Water Quality Issues In The Harshaw Creek Watershed

Current U.S. Forest Service data from the Watershed Classification Interactive Map (*see* images on the following page) shows the Harshaw Creek Watershed as having "Poor" overall water quality condition,[13] and that it is in a "Functioning at Risk" watershed condition. It is PARA's understanding that these scores are based, in part, on issues already known as well as hydrological analysis indicating numerous abandoned mine sites throughout the watershed with acid rock drainage issues. It is also PARA's

[13] *See* Watershed Condition Framework – Watershed Classification Interactive Map Viewer (Harshaw Creek Watershed Code No. 150503010203).

understanding that the U.S. Forest Service is working on a Watershed Restoration Action Plan (WRAP) to address these issues within the Harshaw Creek Watershed, including cleaning up and monitoring several additional abandoned mines in the area.



Above: Images from the U.S. Forest Service Watershed Classification Interactive Map Viewer (outline of the Harshaw Creek Watershed and associated watershed condition data).

Given ADEQ's extensive coordination with the U.S. Forest Service on the multi-year cleanup of acid mine drainage at Lead Queen Mine and ongoing monitoring, and work being done by both entities on water quality in the Harshaw Creek Watershed, ADEQ is almost certainly aware of the U.S. Forest Service's work here. As such, water quality data by the U.S. Forest Service in this Watershed that is not already in possession of ADEQ is "readily available" and should have been incorporated in this Draft 2024 CWA Assessment.

VI. Conclusion

Impairment of Lower Harshaw Creek has not been properly assessed under this Draft 2024 CWA Assessment. Indeed the document currently omits almost all known existing data which has a high likelihood of indicating this fact. Given historic contamination from Lead Queen Mine and ongoing monitoring of the area by ADEQ and other entities, it is clear that such data exists. ADEQ therefore should have analyzed and considered this information as part of its Assessment.

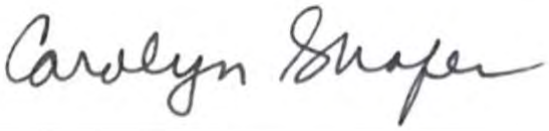
In order to comply with the requirements of Clean Water Act Section 303(d) and 305(b), ADEQ must take this opportunity to amend the Draft 2024 CWA Assessment to more properly incorporate data which is readily available regarding Lower Harshaw Creek. Anything less than this is a fails to meet ADEQ's obligations to report to EPA on the overall condition of the waterbody under Section 305(d) of the Clean Water Act, and

to properly monitor and assess the water quality and identify impaired waters under Section 303(b) of the Clean Water Act.

Thank you for your consideration of our comments.

Thank you.

PATAGONIA AREA RESOURCE ALLIANCE



Carolyn Shafer
Mission Coordinator and Board Member

Enclosures

CC: Tomás Torres, EPA Region 9 Water Division Director (torres.tomas@epa.gov)

Attachment A

NONPOINT SOURCE SUCCESS STORY

Arizona

Federal-State Partnerships Remediate Legacy Mine and Improve Water Quality in Harshaw Creek

Waterbody Improved

Historical mining activities in southern Arizona's Harshaw Creek basin left a legacy of mining waste that produced acid mine drainage. The Arizona Department of Environmental Quality (ADEQ) added a three-mile stretch of Upper Harshaw Creek (HUC 15050301-025A) to its 1996 and 1998 Clean Water Act (CWA) section 303(d) lists for impairments due to copper and acidity. ADEQ completed a total maximum daily load (TMDL) for copper and acidity in 2003. The U.S. Forest Service (USFS) conducted land reclamation and remediation work in the Harshaw Creek area between 2016 and 2019. This work helped to control acid mine drainage in the basin, which resulted in a measurable water quality improvement.

Problem

The Harshaw Creek basin is in southern Arizona's Santa Cruz County in the rolling hills of Sonoita Valley (Figure 1). The closest town is Patagonia, with a population of over 700. Harshaw Creek is a primarily ephemeral stream fed by groundwater during baseflow conditions, with larger flows occurring during storms. The basin is within the Coronado National Forest and is used for recreation and cattle grazing. Many ranches, farms, and vacation homes are located downstream. Designated uses for Upper Harshaw Creek are (1) Aquatic and Wildlife ephemeral (A&We), (2) Partial Body Contact (PBC), and (3) Agricultural Livestock Watering (AgL).

Large-scale mining began in the Harshaw Creek Basin in the mid-1800s and continued for approximately 100 years. The Lead Queen Mine site is on USFS land and is inactive. The underground lead, gold, silver, zinc, and copper mine was discovered in 1897 and was in production between 1898 and 1940. Historic mining activities left behind a variety of waste rock piles, adits, and shafts (Figure 2). Rain falling on the site produced acidic stormwater runoff and leached metals from surrounding mineral-rich rock, tailings, and waste rock. The runoff carried the metals into Harshaw Creek.

ADEQ added a three-mile stretch of Upper Harshaw Creek (HUC 15050301-025A) to its 1996 and 1998 CWA section 303(d) lists as impaired for copper, zinc, and acidity. Monitoring data indicated that the high levels of zinc found were due to natural background conditions and not due to anthropogenic sources. For this reason, ADEQ completed a TMDL for copper and acidity in 2003.

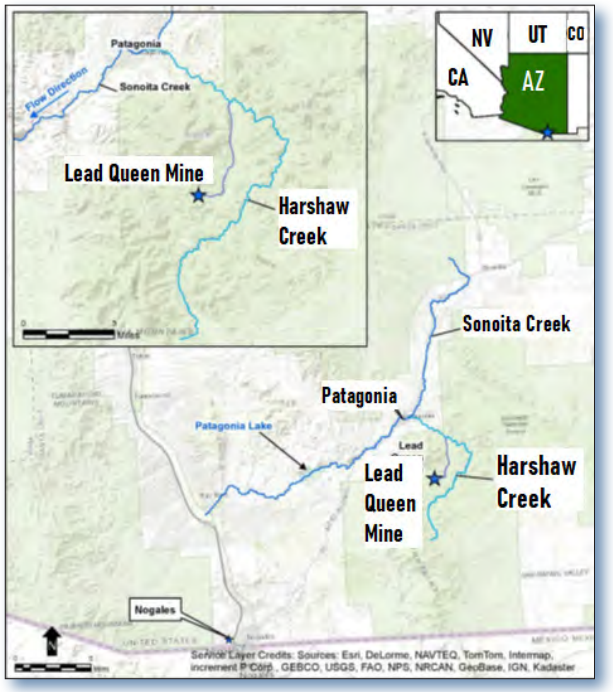


Figure 1. Harshaw Creek is in southern Arizona.

Story Highlights

In 2016, USFS remediated the waste rock piles and addressed several adits and shafts at the site (Table 1). (An adit is a horizontal entrance to an underground mine primarily used for de-watering and extraction of minerals during operations.) The cleanup included the excavation and hauling of waste rock material to a single below-ground consolidation cell, which was covered with 2–4 feet of native soil and revegetated.

Figure 2. The adit at Lead Queen Mine, before remediation.

Entry to the open shafts were closed with bat-friendly gates, while others were sealed using polyurethane foam. A total of 11 zeolite gabion basket structures were installed in the stream channel at various locations downstream of the main adit in order to mitigate stormwater contact. However, the remedy at the main adit began to fail, allowing discharge of pollutants. USFS investigations discovered that the foam plug was intact, but that fractures and faults near the opening were seeping tunnel discharge that was then flowing downstream. USFS built a retention basin to contain and treat the small seep and flow. In 2019, USFS installed a hydraulic plug—a more long-term solution—to cease the discharge. Subsequent site visits confirmed no new seepage coming from the former adit opening.

Table 1. Remediation practices installed at the Lead Queen Mine site.

Practice	Number Installed	Comments
Adit plug	**1**	
Shaft closure	**6**	Mixture of bat-friendly gates and foam
Gabion basket	**11**	Stormwater control and redirection
Re-grade, cover waste rock	**4**	Native soil and revegetated

Table 2. Monitoring results in Harshaw Creek before and after plugging the main adit.

Pollutant[1]	Pre-plug	Post-plug (2020)	WQS	Designated use
Lead (total)	0.021	0.0013	0.015	PBC
Copper (total)	1.4	0.033	0.5	AgL
Copper (dissolved)	1.3	0.027	0.055	AWe
Zinc (dissolved)	4.1	0.082	2.4	AWe
pH	3.69	7.01	6.5–9.0	PBC

[1]Units are in milligrams per liter (except for pH).

Results

Remediation of the Lead Queen Mine improved surface water quality in the Lead Queen Mine tributary, which flows into Harshaw Creek. Data collected post-remediation in 2020 showed no exceedances of surface water quality standards (WQS) (Table 2). ADEQ continues to monitor Harshaw Creek to measure improvements.

Partners and Funding

The project was a collaborative effort between ADEQ and USFS. The subsequent effectiveness monitoring conducted by ADEQ was supported by CWA section 319 funds.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-22-001T
September 2022

For additional information contact:

Natalie Muilenberg
AZ Department of Environmental Quality
602-771-6403 • muilenberg.natalie@azdeq.gov

Attachment B

File Code: 2160 **Date:** July 23, 2023
Route To:

Subject: Lead Queen Mine Remediation - 2023 Post-Construction Completion Monitoring Report

To: Kerwin Dewberry, Forest Supervisor, Coronado National Forest

2023 Post-Construction Completion Monitoring Report

From: Ernesto Maldonado, P.E., Arizona On-Scene Coordinator

Response Authority: CERCLA
Incident Category: Abandoned Mine Clean Up
Category of Removal: Time Critical
Action Memorandum Status: Completed/signed: 02/10/2015
Contract No.: 12837119F0034
Removal Action Start Date: 07/08/2019
Removal Action Completion Date: 09/05/2019

I. SUMMARY

A. Background

The Upper Harshaw Creek watershed is located within the Patagonia Mountains in the NW¼ sec. 33, T22S, R16E, and contains multiple abandoned mines previously known as the Buffalo Group. The Lead Queen Mine (Site) was the most extensively developed property in the group. Discovered in 1897, it ceased operations in 1902. In 1910, the T.E. Munn Mining Co. of San Antonio, Texas, began development at the property again, which resulted in extensive mine workings, including adits, shafts, drifts, crosscuts, and stopes on two levels.

The Site formerly contained multiple mine features and 10,000 cubic yards of waste rock, which were remediated during a cleanup action in 2015. However, the Lead Queen Main Mine adit required additional remediation because the main adit portal was discharging acid mine drainage. In 2016, additional work was performed to prevent and treat acid mine drainage from fractures around the main adit portal which proved ineffective. In 2017, an underground mine assessment was performed to map the inner workings of the main mine adit. In 2019, a hydraulic plug was installed in the main adit to prevent acidic mine drainage from leaking from the main adit portal.

Figures 1 & 2: Adit and rock storage before construction (left) Inside adit before construction (right)

B. Response Actions

In late September 2014, unusually heavy monsoon rains and back-to-back hurricanes in the Patagonia area were followed by the appearance of discolored water in the stream near the Lead Queen Mine. After initial investigations, it was determined that a large amount of precipitation and subsequent saturation of the ground led to the inflow of excessive amounts of rainwater into the mine. The mine workings filled with rainwater, causing the discharge of iron and aluminum-laden acidic water. Downstream of the discharge point, the discolored red-orange acidic water mixed with higher pH runoff to form a white aluminum precipitate and foam that was visible in the stream channel. The red-orange sludge traveled approximately 1 mile downstream, eventually dissipating. The Forest Service, in partnership with the U.S. Geological Survey, investigated the incident and jointly developed an environmental plan for a Time Critical Removal Action at the site.

The Time Critical Removal Action began in 2015. The USFS hired Environmental Cost Management Consultants (ECM) to perform the remediation, which included excavation and hauling of waste rock material, closure of multiple mine features, and the installation of zeolite gabions downstream of the site. Approximately 10,000 cubic yards of waste material was removed from the stream channel and relocated to an onsite consolidation cell and covered with 2-4 feet of native material, then revegetated. Bat-friendly closures were installed at two mine features. Four additional mine features were sealed, including the main mine adit, using polyurethane foam (PUF). In addition, 11 zeolite gabions were installed in the stream channel at various locations downstream of the initial discharge point. The gabions were intended to increase the pH of the stream and reduce heavy metal concentrations in the surface water. Work was completed in November 2015.

In 2016, another unusually heavy monsoon season caused runoff to seep into the mine workings through fractures in the rock surrounding the main adit. This led to the seepage of discolored mine water into the adjacent stream from fractures around the main adit portal. The PUF plug installed the previous year remained intact. The USFS and USGS concluded that further remediation near the immediate area of the Lead Queen Mine main adit portal was required to contain and treat the small amount of flow. In March 2016, a retention basin was constructed with 12-inch limestone in

front of the main adit, and the side drainage from the hillside was diverted around the basin. The width of the temporary access road leading from the staging area to the main adit was reduced to 8 feet, and disturbed areas of the site were reseeded.

Inspection in 2017 showed that water continued to seep from fractures in the rock, evidenced by a large amount of staining on the limestone riprap covering the retention basin. Additionally, a few of the gabions installed in 2015 had rolled downstream due to high-velocity flow during previous monsoon seasons. The USFS determined that an underground mine assessment of the adit and inner workings was necessary to evaluate the hydrology and better understand how water was seeping in and flowing through the mine workings. In August 2017, the USFS hired ECM to remove the PUF closure in the main adit and investigate the inner mine workings.

The investigation began in October 2017. ECM began by removing the limestone retention basin and the PUF plug in the adit portal. Water was pumped from the mine and timbering was placed in unstable areas so workers could safely enter the mine to map underground workings. ECM mapped the length and slope of underground workings as well as surface features to create a diagram of the adits, shafts, stopes, and collapsed areas.

The USFS determined that the best alternative to prevent acidic, heavy metals-laden water from seeping from the mine would be to install a concrete hydraulic plug approximately 85 feet inside the mine. In 2019, a CERCLA Time Critical Removal Action was initiated. Tetra Tech was hired to design and install the hydraulic plug; they mobilized to the site on July 8th, 2019. It was determined that a 10ft thick concrete plug would be sufficient to prevent flow, however a 14ft plug was constructed as an added factor of safety. The contractor began by mixing the loose, muddy material inside the adit with less saturated material from the former retention pond, portal, and from behind gabions #1 and #2. This material was pushed deep into the adit tunnel to act like a small dam, preventing water from seeping into the working area. The contractor then created the back and front bulkheads for the plug 104ft and 90ft inside the adit, respectively. A concrete batch plant was set up on site and the contractor began pumping material for the plug on July 24th. Samples of the concrete were taken throughout the process to check the cure time and strength of the concrete. Final analysis showed a cure rate of 28 days and a strength of 5,000psi.

The contractor re-mobilized to the site on August 26th, 2019, to finish work at the site. The contractor grouted the concrete plug to fill voids left behind from the curing process. The contractor then removed five of the remaining gabions and began backfilling the portal entrance with clean material. The spur road to the site was obliterated and seeded. Work was completed on September 5, 2019.


Figures 3 & 4: Outside adit after construction (left) Stabilized slope after construction (right)

II. 2023 MONITORING INSPECTION

On July 11, 2023, Hailey Stock, Assistant Regional Environmental Engineer, and Ernesto Maldonado, Arizona OSC, visited the former Lead Queen Mine for a monitoring inspection. Access was possible with a high-clearance, 4WD vehicle to the turn-around area on the unnamed access road. The fence and gate around the stabilized area are intact and appear to be effective in keeping out livestock. The slope in this area appears to be stable, with some vegetation growing on the surface and no obvious signs of erosion.


Figures 5 & 6: Views of the gate and inside the stabilized slope area.

What appears to be an autosampler was installed outside of the adit by ADEQ. It had rained the night before, but no surface water was observed originating from the adit or the drainage upstream. The hard rock face outside of the adit also did not appear to be percolating water. Vegetation on the backfilled adit portal appeared to be stable. Numerous insects and birds were observed around the site.


Figures 7 & 8: View of the backfilled adit with autosampler (left) View of the adjacent rock face (right)

The waste repository constructed in 2015 appears to be stable with grasses and shrubs growing on this area.


Figures 9 & 10: Views of the repository

III. RECOMMENDATIONS

It is recommended to monitor the Site for another year. The Forest Service will continue to coordinate with ADEQ staff and review any sampling results for the effectiveness of the remedies. After the monitoring phase is complete, the Forest Service will evaluate road access to the Site.

/s/ Ernesto Maldonado, PE
Arizona Statewide On-Scene Coordinator

cc: Project Mailing List

ATTACHMENT 3

PARA's Follow-Up to Correspondence of July 7, 2023 Requesting EPA Review of Pending AZPDES Permit No. AZ0026387 For South32 Hermosa, Inc. in Arizona*

(October 25, 2023)

*Attachment 3(B) has been removed to avoid duplication with Attachment 2.

PATAGONIA AREA RESOURCE ALLIANCE
www.PatagoniaAlliance.org
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October 25, 2023

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Re: Follow-Up to Correspondence of July 7, 2023 Requesting EPA Review of Pending AZPDES Permit No. AZ0026387 for South32 Hermosa, Inc. in Arizona

Dear Administrator Guzman and Director Torres:

This letter is submitted on behalf of the Patagonia Area Resource Alliance (PARA) as a follow-up to our prior correspondence dated July 7, 2023 in which we requested the EPA to review the pending AZPDES Permit No. AZ0026387 for South32 Hermosa, Inc. in Arizona.

It is our understanding that, since July 2023, the EPA has met with ADEQ on multiple occasions to discuss this pending AZPDES Permit. It is also our understanding that South32 has now reportedly amended its permit application in order to limit which facilities discharge into Alum Gulch (Outfall 001 of the AZPDES Permit) to "eliminate[] the need to further deliberate the new source issues implicated by *San Carlos*."[1] To the extent that changes to the pending AZPDES Permit purport to redirect discharge from Outfall 001 (Alum Gulch) to Outfall 002 (Harshaw Creek), this is still problematic for reasons provided herein.

[1] *See* July 7, 2023 Letter from South32 to ADEQ (proposing certain amendments to AZPDES Permit regarding Outfall 001 into Alum Gulch).

First, we have evidence indicating that Outfall 002 is located in impaired Upper Harshaw Creek. *See attached* White Paper Documenting the Location of South32's Outfall 002 Discharge Location in the Impaired Reach of Upper Harshaw Creek (**Attachment A**). A TMDL was done for Upper Harshaw Creek in 2003, however it has not been updated in the interim two decades.

South32 cannot discharge through Outfall 002 into this impaired water body until an updated TMDL and new implementation plan have been prepared, a new sampling plan has been prepared, and a proper waste load allocation (WLA) is performed as required by the Clean Water Act and applicable law.

Second, *even if* Outfall 002 were located in Lower Harshaw Creek which is not currently on the 303(d) list for impairment, we have evidence to show that Lower Harshaw Creek is indeed impaired, and that ADEQ has long been aware of this fact and yet, despite knowing its impairment status, has failed to take appropriate measures to list this Lower Harshaw Creek on the 303(d) list.[2] ADEQ has been provided with this evidence (and in fact, although some of this impairment evidence was actually produced by ADEQ themselves, it has not been considered in the 305(b) Clean Water Act Assessments). *See attached* Comments on Arizona's Draft 2024 Clean Water Act Assessment (July 1, 2017 to June 30, 2022) Integrated 305(b) Assessment and 303(d) Listing Report filed by PARA with ADEQ on September 11, 2023 (**Attachment B**).

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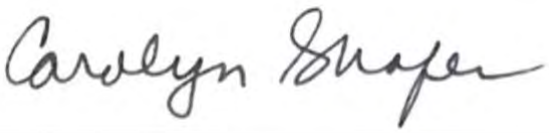
[2] Approximately 10 miles of Harshaw Creek was previously listed on the 303(d) list as being impaired for zinc (see 2002 303(d) List TMDL Priority Ranking and Schedule at p. 3510). While Harshaw Creek was delisted for zinc in 2002 reportedly due to changes in surface water quality standards and because "human-caused exceedances were not observed nor noted during modeling", it was noted that zinc was still on the "list of parameters to be monitored." (2003 TMDL at p. 5) It does not appear that this monitoring is being done in Lower Harshaw Creek.

In 2002 in its Response to Comments on the Draft 303(d) list at p. 3495, the seriousness of the zinc levels detected across 10 miles of Harshaw Creek was described: "At Harshaw Creek was dissolved zinc was up to 11,000 μg/L (almost 30 times the standard). Dissolved zinc exceeded standards in 4 samples out of 4 samples collected (100% of the samples)" (Emphasis added). ADEQ further noted in the 2002 303(d) List TMDL Priority Ranking and Schedule for submission to EPA at p. 3510 that "Although this is an intermittent reach (L4), zinc contamination is significant threat to wildlife (H1) due to the toxic nature of these pollutants and the magnitude and frequency of exceedances as follows: * Dissolved zinc was as high as 860 μg/L (more than twice the aquatic and wildlife standard) and exceeded standards in 4 of 9 samples (about 45%). * A federally listed threatened species, the Mexican spotted owl, occurs in this area and could be further jeopardized by these pollutants if drinking from standing pools after rain events (H4). This is a complex TMDL due to the nature of the pollutants (M5), exceedances are tied to runoff events (M3), natural background issues and intermittent flow (L4). A TMDL is in progress and is expected to be submitted to EPA in 2002 (M6)." (Emphasis added).

Thank you for taking the time to review our concerns about the South32 AZPDES Permit. PARA would be grateful if EPA would provide a response to this letter at your earliest opportunity so that we can understand how EPA intends to review and potentially take action on this AZPDES Permit.

Thank you.

PATAGONIA AREA RESOURCE ALLIANCE



Carolyn Shafer
Mission Coordinator and Board Member

Enclosures

CC: Honorable Congressman Raúl Grijalva
Ellen Blake, EPA Region IX, NPDES Permits Office
(blake.ellen@epa.gov)
Elizabeth Sablad, EPA Region IX, NPDES Permits Office
(sablad.elizabeth@epa.gov)

Attachment A

PARA White Paper (October 17, 2023)
Documenting the Location of South32's Outfall 002 Discharge Location in the Impaired Reach of Upper Harshaw Creek

The South32 Hermosa Project AZPDES Permit No. AZ0026387 contains two points of proposed discharge: Outfall 001 into Alum Gulch[1] and Outfall 002 into Harshaw Creek. Upper Harshaw Creek has also been on the 303(d) impaired water list for pH and copper since at least 1992.

While the Arizona Department of Environmental Quality (ADEQ) did complete a TMDL study for Upper Harshaw Creek, this document is now two decades old and PARA is unable to locate any evidence that this TMDL study or associated implementation plan have ever been reviewed or modified by ADEQ as required by A.R.S. § 49-234(j).[2] Indeed, while an implementation plan was drafted for Alum Gulch TMDL, PARA has never seen (and to date has been unable to locate) any implementation plan for Upper Harshaw Creek. Although there is data available indicating that the waters of Lower Harshaw Creek are also impaired, Lower Harshaw Creek is not presently on the 303(d) impaired waters list.

Recently, ADEQ has asserted (without evidence) that Outfall 002 is located in Lower Harshaw Creek. As a result, ADEQ takes the position that South32's planned discharge from Outfall 002 is to a segment of the Creek that is not listed under 303(d) for impairment. This conclusion is not supported by any evidence, does not comport with ADEQ's original listing for Upper Harshaw Creek, and it is contrary to ADEQ's own data.

In an effort to "validate" its apparent redefinition of Upper and Lower Harshaw Creek, ADEQ has (without basis) used new GPS coordinates to denote the endpoint of Upper Harshaw in a different location that is conveniently above Outfall 002. However, these GPS coordinates were never referenced in the original 303(d) listing or the 2003 TMDL. Rather, these coordinates appear to have been perfunctorily generated after the fact, and they directly conflict with ADEQ's own description of Upper Harshaw Creek contained in the original 2003 TMDL. The TMDL indicates that the full length of listed Upper Harshaw Creek extends beyond these coordinates.

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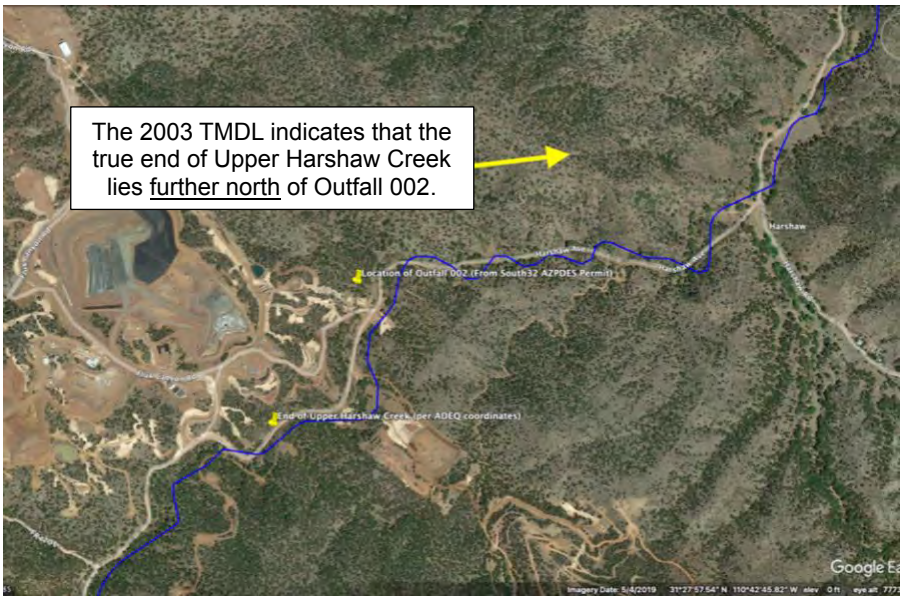
[1] Although not discussed in detail in this paper, Alum Gulch is also on the 303(d) list and a TMDL was completed in 2003 for cadmium, copper, zinc, and pH. Alum Gulch was also recently placed on the 303(d) list as impaired for lead, but a TMDL has not yet been completed for that impairment.

[2] A.R.S. § 49-234(J) provides:

> After a total maximum daily load and a TMDL implementation plan have been adopted for a protected surface water, the department shall review the status of the protected surface water at least once every five years to determine if compliance with applicable surface water quality standards has been achieved. If compliance with applicable surface water quality standards has not been achieved, the department shall evaluate whether modification of the total maximum daily load or TMDL implementation plan is required.

The graphic below provides an overview of the location of Outfall 002 relative to the existing reach of Upper Harshaw Creek.



Based upon a review of the available information, Outfall 002 is plainly located in the impaired segment of Upper Harshaw Creek. Accordingly, South32 cannot discharge through Outfall 002 into this listed impaired water body, until an updated TMDL has been prepared and a proper waste load allocation (WLA) is performed as required by the Clean Water Act and applicable law.

BACKGROUND

In June 2003, ADEQ completed a TMDL study for copper and acidity (pH) impairment on the upper section of Harshaw Creek.[3] Upper Harshaw Creek is impaired for copper and acidity (pH).[4] The EPA approved the Upper Harshaw Creek TMDL in August 2003.[5]

Reviewed here is a comparison of (1) what the 2003 Upper Harshaw Creek TMDL materials indicate as the end of the listed reach; (2) versus coordinates used recently by ADEQ – without rationale – to indicate the end of Upper Harshaw Creek; and (3) the location of Outfall 002.

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[3] *See* TMDL for Upper Harshaw Creek, Sonoita Creek Basin, Santa Cruz River Watershed, Coronado National Forest, near Patagonia, Santa Cruz County, Arizona (WBID No. 15050301-025A), June 30, 2003.

[4] The exact dates of 303(d) listing are inconsistent/unclear. In 1988, the entirety of Harshaw Creek from headwaters to Sonoita Creek appears to have been listed on the 303(d) list for copper and low pH (*see, e.g.,* ADEQ 2008 Nonpoint Source Annual Report at p.73). Current ADEQ GIS eMap Impaired Waters (2002) layer shows upper Harshaw Creek as impaired for copper and pH as of 1992. The Upper Harshaw Creek TMDL (June 30, 2003) (at p.2) itself notes that upper Harshaw Creek was listed for impairments "on the 1996 and 1998 303[d] Lists."

[5] *See* Approval Letter from EPA to ADEQ dated August 7, 2003.

ADEQ's TMDL DESCRIPTION OF THE END OF UPPER HARSHAW CREEK

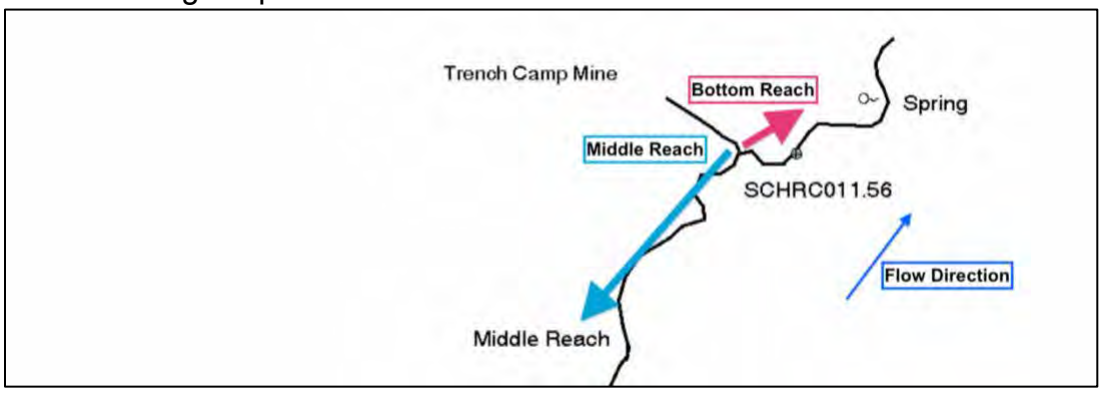
While the 2003 Upper Harshaw Creek TMDL does not contain exact lengths or coordinates for the three sections of Upper Harshaw Creek covered by the TMDL, it does clearly and specifically describe their features. ADEQ described the dividing point between the middle and bottom portions of Upper Harshaw Creek in the TMDL as located near the Trench Camp Mine. The TMDL then specifically describes the bottom portion of Upper Harshaw Creek as including and extending beyond Trench Camp Mine and an unnamed perennial spring. See text excerpt from the 2003 Upper Harshaw Creek TMDL (at p.3, colored annotations added) shown below:

For purposes of this study, upper Harshaw Creek is divided into three sections:

- The headwaters and uppermost tributaries occupied by the Morning Glory Mine adits, shafts and mining residues. The Endless Chain Tributary (unofficial name for purposes of this study) containing the Endless Chain Mine and mill site, and an undisturbed basin.
- The middle portion between the mouth of the Endless Chain tributary and the Trench Camp Mine containing the Augusta Mine, Blue Nose Mine and several other small mines.
- The bottom portion of the subject reach includes dump number 3 of the Trench Camp Mine and a spring near the downstream end of the subject reach with the only observed constant drainage in the subject basin.

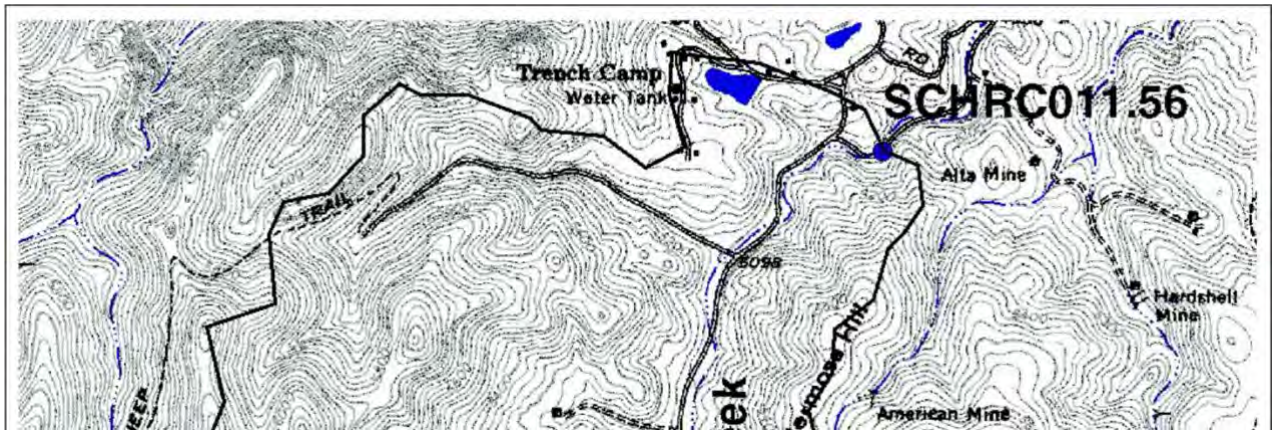
When the 2003 Upper Harshaw Creek TMDL was completed and final notice and determination published in the Arizona Administrative Register, the notice again affirmed that the listed reach includes and **extends past this perennial spring** ("The listed reach of Harshaw Creek runs about 3 ½ miles from its headwaters to a point approximately 50 ft. down-stream from a perennial spring near the Trench Camp Mine site.")[6]

Consistent with the TMDL written description, the map excerpt below (from 2003 Upper Harshaw Creek TMDL at p.18, color annotations added), shows the bottom portion of the listed reach extending past Trench Camp Mine, beyond ADEQ Sample Point No. SCHRC011.56, and ending after the spring. Although the 2003 Upper Harshaw Creek TMDL does not include the exact length of this bottom reach of Upper Harshaw, it extends beyond these tangible points.



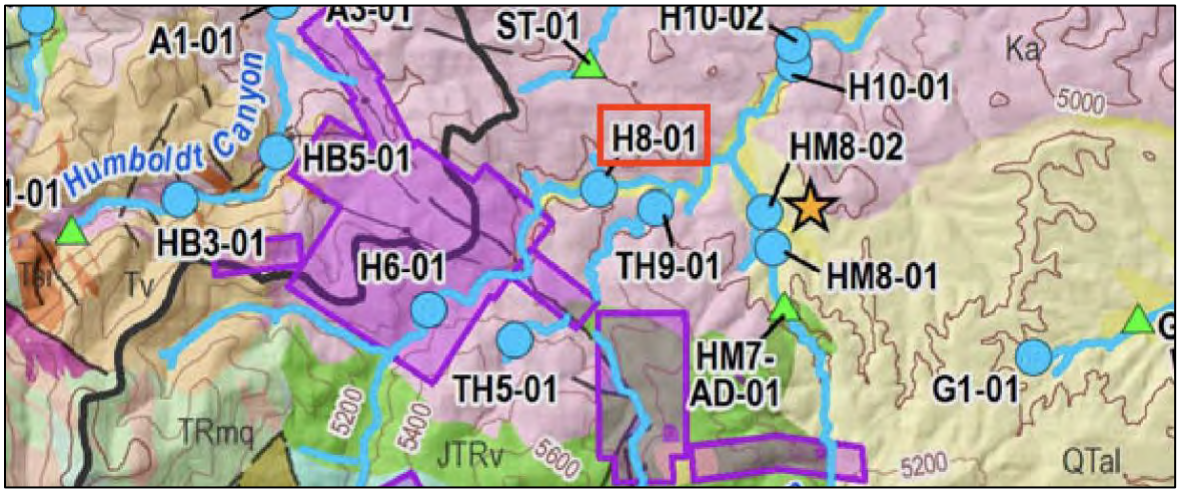
[6] *See* Arizona Department of Environmental Quality Notice of Public Information. Arizona Administrative Register, Vol. 9, Issue 20, p. 1485 (May 16, 2003).

The map excerpt below (from 2003 Upper Harshaw Creek TMDL at p.10) also shows the bottom portion of the listed reach extending past Trench Camp Mine, and beyond ADEQ Sample Point No. SCHRC011.56. Note that this map (based on USGS Quadrangle Map and to scale) does NOT show the spring. Taken together with the description and map above, this demonstrates that the spring (and beyond it, the end of listed Upper Harshaw Creek) lies further north beyond the area.



A spring is a particular locatable point. The USGS defines a spring as "a water body formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water."[7] The spring is the intersection of that water body.

The map excerpt below from the 2022 South32 Seeps and Springs Catalog (excerpt from p.3, red annotation added)[8] correlates with the reach of Upper Harshaw found in the original 2003 TMDL. While there are two springs along Harshaw Creek in this location, data reviewed plainly demonstrates that the spring identified as H8-01 (which lies further north and downstream from the Trench Camp property) is the spring described in the TMDL as the near end point for Upper Harshaw Creek.



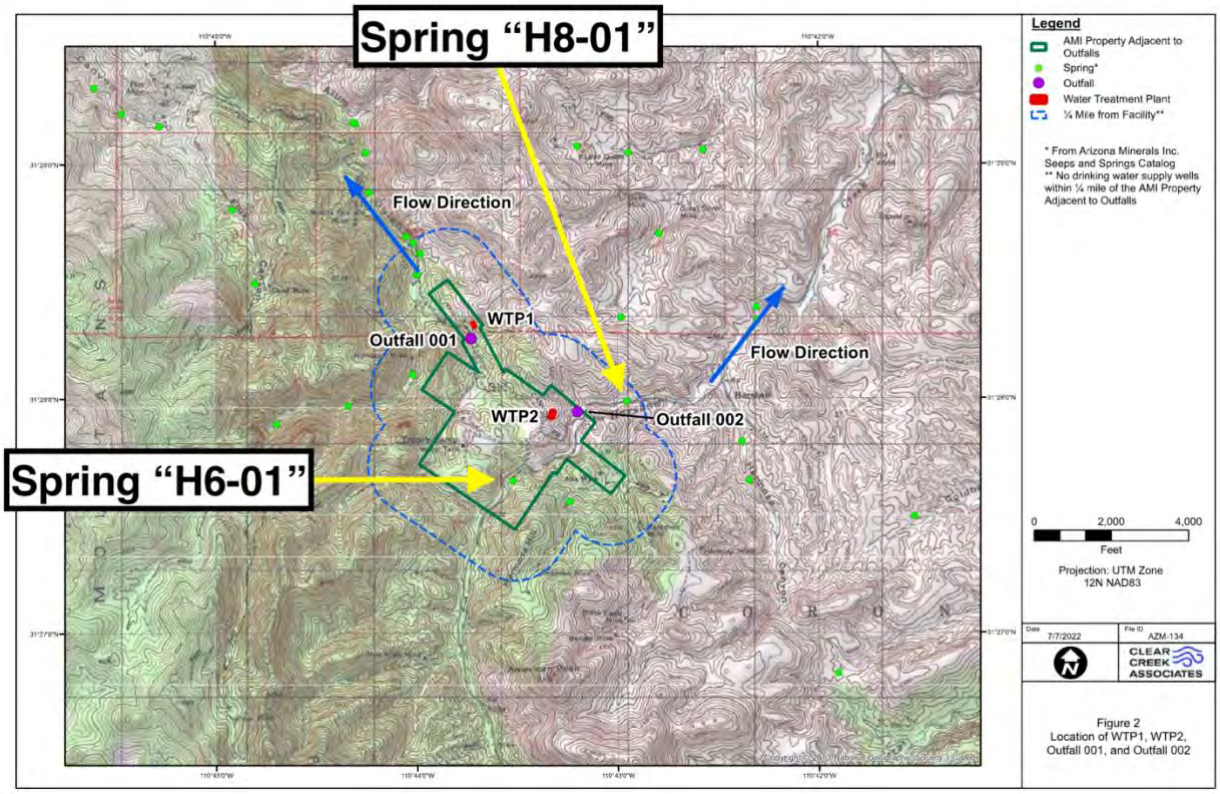
[7] USGS Water Science Glossary (https://www.usgs.gov/special-topics/water-science-school/science/water-science-glossary).

[8] South32 Hermosa Spring And Seep Catalog Version 3.0 (August 2022)

The possibility of the spring at the end of listed Upper Harshaw Creek being H6-01 (the spring located on the Trench Camp property) was reviewed as well. However, as discussed below, all the data and maps in the TMDL and other sources reviewed do not support H6-01 as the referenced spring used by ADEQ in the TMDL and 303(d) listing to denote the end of Upper Harshaw Creek. This point is illustrated in the maps below.

First, H6-01 is located south of sample point SCHRC011.56, which directly conflicts with the TMDL maps and descriptions of the end point spring. While the TMDL correctly documents the presence of more than one spring in this area (which is supported by the map above),[9] only one spring is noted in the TMDL as marking the end of Upper Harshaw Creek. And the TMDL indicates this spring is located much further north than H6-01.

Below - Figure 2 from South32 (formerly Arizona Minerals)'s Application for Reissuance of AZPDES Permit dated July 11, 2022 (annotations added). Outfall 002 is south of (upstream of) H8-01.

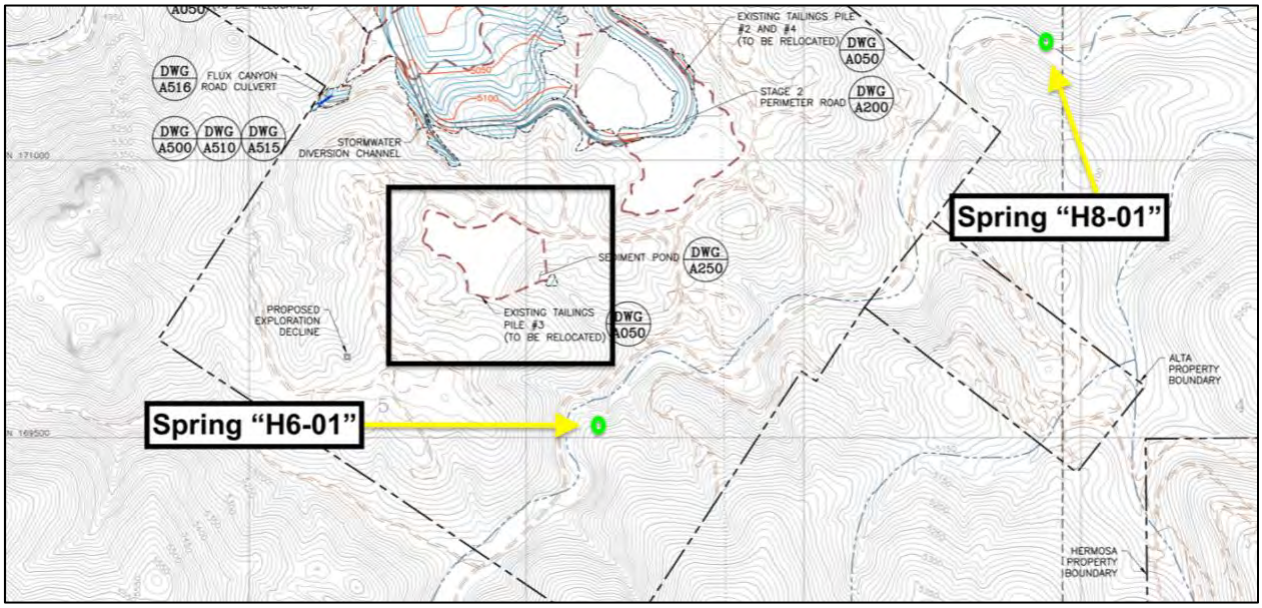


Second, H6-01 is located south of the "fork" branching off to Trench Camp Mine and below dump number 3 (Tailings Pile #3) of the Trench Camp Mine. This conflicts with the location of the spring as shown in the TMDL descriptions and maps, and, if listed Upper Harshaw Creek ended in this location, it would exclude Trench Camp Mine dump number 3 from the bottom reach of listed Upper Harshaw Creek, which directly conflicts with ADEQ's

[9] *See, e.g.:* "During baseflow conditions, flow from the springs was not observed beyond approximately 50 ft. downstream from the springs. Based upon field observations, groundwater (from the springs) is the sole source of flow during baseflow conditions". 2003 Upper Harshaw Creek TMDL at p.3.

own description in the 2003 TMDL. See below (excerpt of Figure 3 from Arizona Minerals, Inc.'s Aquifer Protection Permit Application, Trench Camp Property dated June 5, 2017).

See also below, excerpt of Drawing No. A010 (p. 71) from Tailings and Potentially Acid Generating (PAG) Material Remediation, Placement and Storage Voluntary Remediation Program Design dated April 2017 (annotations and spring identifiers added).



Finally, H6-01 is described in the Seeps and Springs Catalog (at p. 96) as "consists of a relic dam that has silted in along Harshaw Creek" and that "a pipe driven into the bottom of the dam allows for the passage of water". No such description of this spring appears in the 2003 TMDL.

In short, H8-01 is the spring identified in the 2003 TMDL as marking the near bottom reach of impaired Upper Harshaw Creek, which is described by ADEQ as including "dump number 3 of the Trench Camp Mine and a spring near the downstream end of the subject reach" of Upper Harshaw Creek. Thus, there can be no reasonable doubt that Outfall 002

is located within Upper Harshaw Creek, which, as noted above, remains an impaired water listed by ADEQ on the 303(d) list.

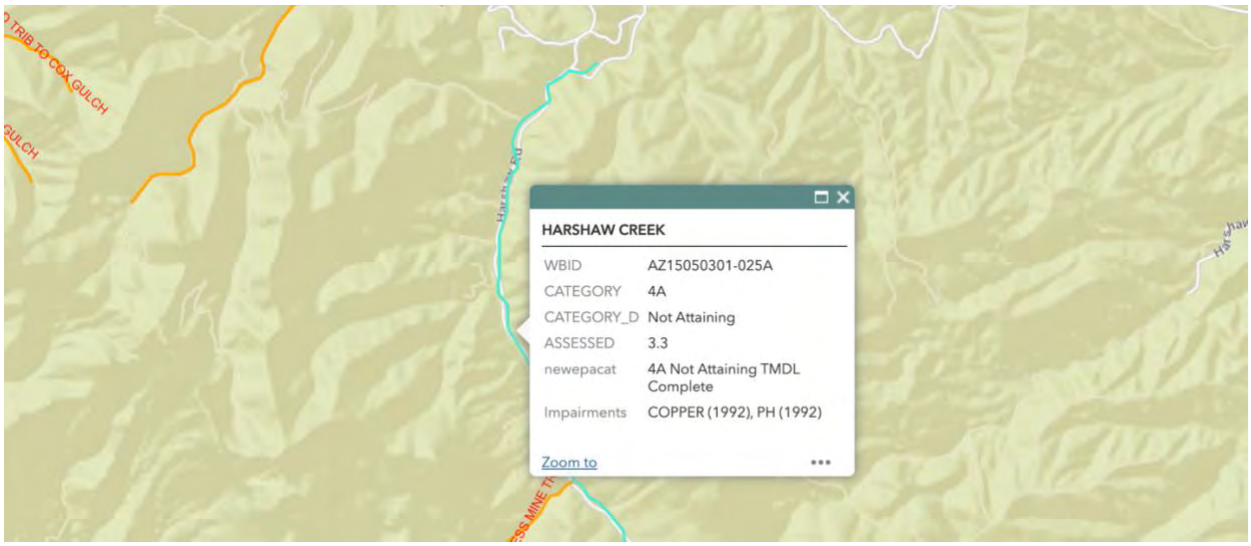
END OF UPPER HARSHAW CREEK (FROM ADEQ)

Recent materials from ADEQ note listed Upper Harshaw Creek (with the "TMDL Complete") extending from headwaters and ostensibly terminating at 31º27'43.9", 110º43'21.1". *See* below, excerpt from ADEQ's 2022 Clean Water Act Assessment, Integrated 305(b) and 303(d) List.

	A	B	P	Q	R	S	T	U	V	W	X
1	WBID	WaterbodyName	DecisionParameter	DecisionUse	DecisionWBI	EPACategory	WATERSHE	REACH_DISTANC	LAKE_ACRES	ORIGIN	TERMINUS
9824	15050301-025A	HARSHAW CREEK	not enough information	Not supporting	Impaired	4A Not Attaining TMDL Complete	SC	3.3	NA	HEADWATERS	31°27'43.9"/110°43'21.1"
9825	15050301-025A	HARSHAW CREEK	not enough information	Not supporting	Impaired	4A Not Attaining TMDL Complete	SC	3.3	NA	HEADWATERS	31°27'43.9"/110°43'21.1"
9826	15050301-025A	HARSHAW CREEK	not enough information	Not supporting	Impaired	4A Not Attaining TMDL Complete	SC	3.3	NA	HEADWATERS	31°27'43.9"/110°43'21.1"
9827	15050301-025A	HARSHAW CREEK	not enough information	Not supporting	Impaired	4A Not Attaining TMDL Complete	SC	3.3	NA	HEADWATERS	31°27'43.9"/110°43'21.1"

PARA has been unable to locate any basis for ADEQ's convenient contraction of the apparent extent of "Upper Harshaw Creek" to just above Outfall 002. These specific coordinates are absent from the text of ADEQ 2003 Upper Harshaw Creek TMDL. They are also absent from all associated TMDL materials obtained and reviewed from that time, and their origins are presently unclear. So far, they only appear in materials dating after the TMDL was completed. In addition, PARA has been unable to locate any information to justify this apparent (*de facto*) "removal" of the bottom extent of Upper Harshaw Creek from the CWA 303(d) list, if this is, in fact, ADEQ's intent.

This point is illustrated when ADEQ's recently-generated end coordinates are plotted on a map (as shown in ADEQ eMap, Impaired Streams 2022 layer, below), they very plainly conflict with what ADEQ's 2003 TMDL describes and identifies as the end of the bottom portion of the impaired reach – marking the end of the impaired reach sooner than the TMDL indicates.



In fact, ADEQ's GPS end coordinates identified as the end of Upper Harshaw Creek (which are not in the TMDL) appear remarkably close (if not the same) spot as the original

sampling point at SCHRC011.56, at the "elbow" shaped dip in Harshaw Creek after the "fork" branching off to Trench Camp Mine. Again, the 2003 TMDL identifies Trench Camp Mine as the dividing location between the middle and bottom portions of listed Upper Harshaw Creek, not the end of listed Upper Harshaw Creek.

In June 2023, a public records request was filed with ADEQ for the GPS coordinates of the perennial spring described in the 2003 TMDL and the ADEQ and USGS sample points. Numbered questions (in purple), and the responses received in August 2023 (in blue) are shown below. ADEQ claims it "could not locate", "does not have" or its system "does not currently house" this data requested.[10]

1. The exact GPS coordinates in latitude & longitude of the beginning and end of the "perennial spring located approximately 50 ft. above the downstream end of the listed reach."2

I could not locate GPS coordinates for the referenced spring.

2. The exact GPS coordinates in latitude & longitude for all of the ADEQ Sample Sites (SCUHR000.56, SCUHR000.38, SCHRC013.63, SCHRC011.56) and USGS sample sites referenced in the 2003 Harshaw Creek TMDL.

We do not have the USGS locations in the ADEQ database, but the requestor may be able to contact the USGS for this information.

SCUHR000.38 latitude and longitudes is 31.43298 and -110.7288.

ADEQ water quality database created in 2017 does not currently house the historic information for SCUHR000.56, SCHRC013.63, SCHRC011.56.

In response to this request, ADEQ could not provide the GPS locations of the perennial spring or the ADEQ or USGS sample points from the 2003 Upper Harshaw Creek TMDL, indicating their recently generated end coordinates are not associated with those locations. Rather, a side-by-side comparison of the materials obtained and reviewed to date demonstrate with certainty that Outfall 002 would discharge to Upper Harshaw Creek. Since Upper Harshaw Creek is impaired for copper and acidity (pH), ADEQ may not allow South32 to discharged to this impaired water until it conducts a new TMDL study to update the two decades old existing TMDL and performs the appropriate waste load allocation for South32's planned discharge.

[10] Email from ADEQ Records Division to acorcoran@milawaz.com, Subject: Re: Public Records Request (CTS#428322) (Wednesday, August 2, 2023 at 9:01 am) relaying responses from Erin Jordan, ADEQ Surface Water Quality Improvement Sectional Manager.

ATTACHMENT 4

"A Technical Review of the Draft AZPDES Permit No. AZ0025387 for Arizona Minerals, Inc January Mine Hermosa Project" by Laurel J. Lacher, PhD, RG of Lacher Hydrological Consulting, and Robert H. Prucha, PhD, PE of Integrated Hydro Systems, LLC

(April 7, 2021)

A Technical Review of the Draft AZPDES Permit No. AZ0025387 for Arizona Minerals, Inc January Mine Hermosa Project

Prepared for Patagonia Area Resource Alliance

by

Laurel J. Lacher, PhD, RG

Lacher Hydrological Consulting

and

Robert H. Prucha, PhD, PE

Integrated Hydro Systems, LLC

April 7, 2021

Overview

Arizona Minerals, Inc. (AMI) has applied to the Arizona Department of Environmental Quality (ADEQ) for a modification to an existing Arizona Pollutant Discharge Elimination System (AZPDES) permit (no. AZ0026387) to discharge treated groundwater and storm runoff from the proposed Hermosa Mine into Harshaw Creek and Alum Gulch, both tributaries to Sonoita Creek (AZ Minerals, Inc., 2020). The original AZPDES permit authorized discharge from an existing treatment plant on the north side of mine property (WTP1) built to treat water prior to discharge to Alum Gulch. This proposed amendment to the AZPDES permit contemplates a second treatment plant AMI plans to build (WTP2) to process discharge slated for Harshaw Creek on the east side of the mine property. The primary source of influent to the WTP2 will be deep groundwater produced during dewatering of mine workings, but it will also include water from core cutting, exploration drilling, stormwater controls, seepage from an underdrain collection pond and January adit, and treated water from WTP1 (AZ Minerals, Inc., 2020). The proposed maximum discharge from WTP2 is 4500 gpm of continuous flow for the first 4 to 5 years of the dewatering period, then diminishing to a smaller maintenance level to maintain the dewatered state of the deep mine workings over the following unspecified number of years (AZ Minerals, Inc., 2020). AMI lists the mine life as 30 years for permitting purposes.

Hydrologic Setting

Figure 1 shows in blue lines ADEQ's Draft Source Water Protection Program streams and lakes in the Patagonia Mountains of Arizona (https://adeq.maps.arcgis.com/apps/webappviewer/index.html?id=e224fc0a96de4bcda4b0e37af3a4daec&showLayers=Counties;Native%20American;Major%20Rivers;SWPP%20-%20Draft%20Surface%20Water%20Protection%20Program%20Streams;SWPP%20-%20Draft%20Surface%20Water%20Protection%20Program%20Lakes). The map in Figure 1 includes an overlay from Figure 2 in AMI's "Application for Amendment to AZPDES Permit AZ0026387 – Water Treatment Plant 2 Hermosa Project" (AZ Minerals, Inc., 2020) to illustrate the locations of the existing WTP1 and Outfall 1 on Alum Gulch and the proposed WTP2 and Outfall 2 on Harshaw Creek. Everything downstream of WTP2 is generally referred to as "lower Harshaw Creek," while the reach above that point is called "upper Harshaw Creek." Harshaw Creek flows northeast from WTP2 and then bends sharply (90 degrees) to the northwest (roughly parallel to Redrock Canyon Creek to the north and Alum Gulch to the southwest) before joining Sonoita Creek within the town limits of Patagonia, Arizona. Redrock Canyon Creek joins Harshaw Creek just above Harshaw Creek's confluence with Sonoita Creek.

From the mouth of Harshaw Creek, Sonoita Creek flows northwest through the Town of Patagonia before taking a sharp bend to the southwest (Figure 2), eventually joining the Santa Cruz River. Less than a mile downstream from the Harshaw Creek confluence, discharge from the Town of Patagonia's wastewater treatment facility (WWTF) discharges to Sonoita Creek resulting in perennial flow there. The light blue line in the inset of Figure 2 shows the only segment of Sonoita Creek identified by the ADEQ as perennial (1600 feet [ft] long). Below this short reach classified as perennial, Sonoita Creek flows downstream through The Nature Conservancy's (TNC's) Patagonia-Sonoita Creek Preserve. As Figure 3 illustrates, TNC established this preserve to protect the verdant riparian area there. TNC's website describes the habitat of the preserve:

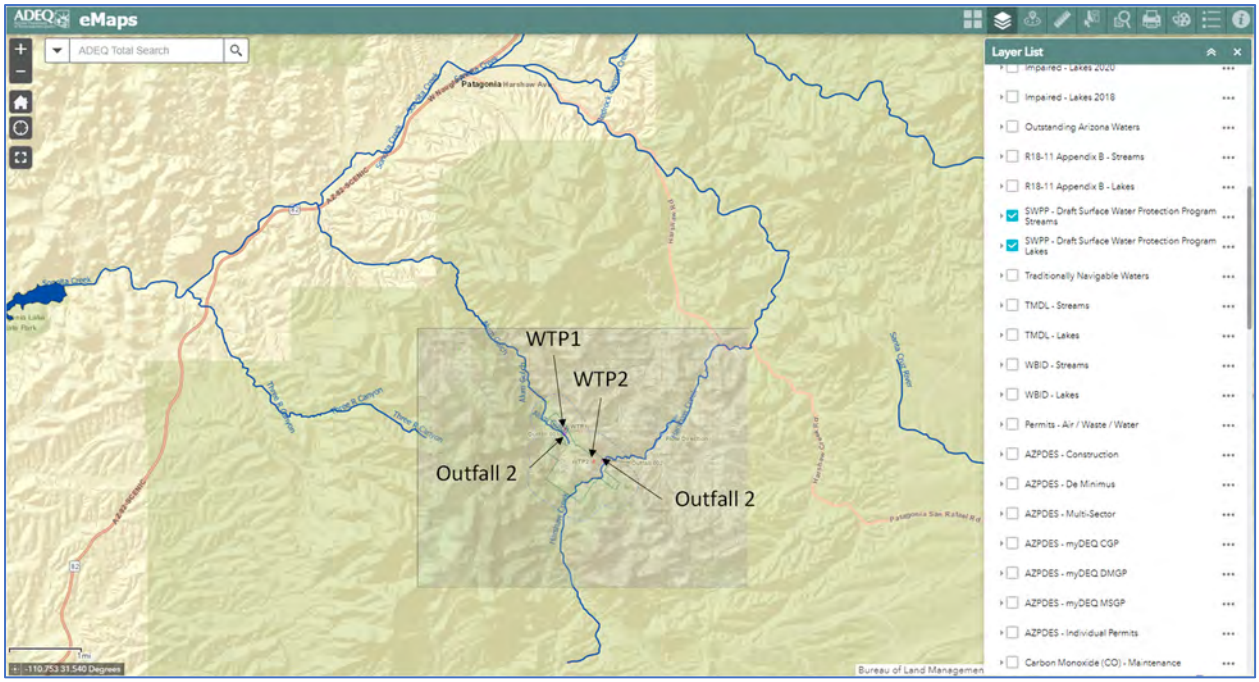


Figure 1. Draft Surface Water Protection Program streams and lakes (blue) in the Patagonia Mountains with map of Hermosa Mine water treatment plants (WTP) 1 and 2 and associated outfalls 1 and 2 (after Figure 2 in AZ Minerals, Inc., 2020).

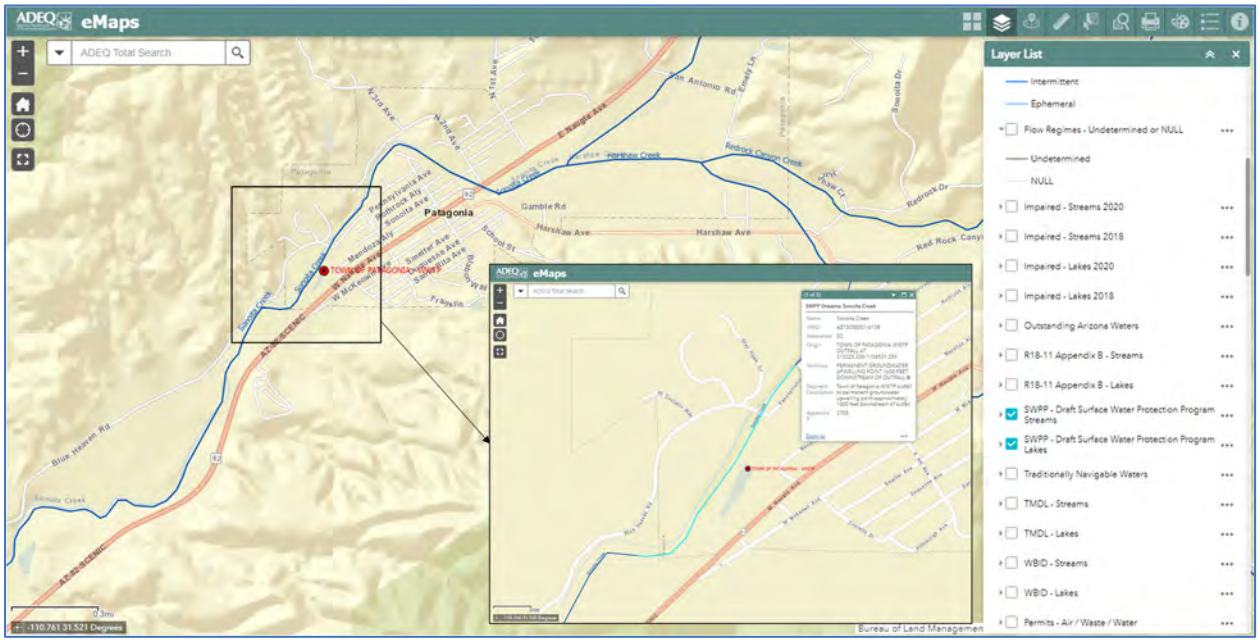


Figure 2. Detailed map of draft protected surface waters, Patagonia WWTF location, and location of the only reach of Sonoita Creek identified by ADEQ as perennial light blue line in inset).

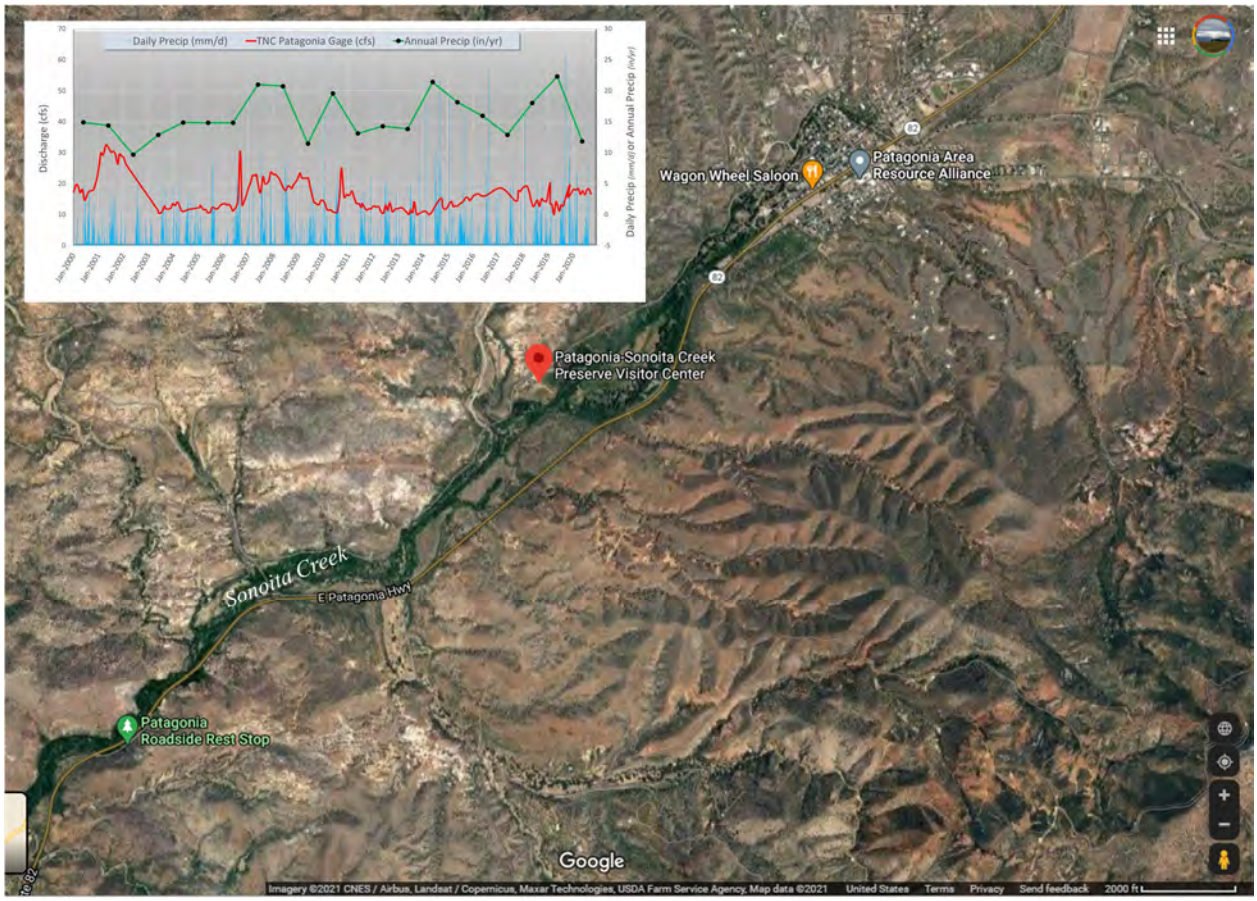


Figure 3. Satellite image of Sonoita Creek flowing through TNC's Patagonia-Sonoita Creek Preserve. Sonoita Creek discharge measured within the preserve by TNC staff is plotted in red on the inset graph for the years 2000 through 2020.

> *This site contains the first two miles of **permanent flow** of **Sonoita Creek** and the floodplains adjacent to the stream. The site contains very high biodiversity values that are primarily focused on the riparian habitats along Sonoita Creek.*
>
> *Here are remnant wetlands, or cienegas, a once-common feature of the Sonoita Creek floodplain and the **most endangered natural community in Arizona**. A significant number of rare and sensitive plant species are found in the Sonoita Creek watershed, including Huachuca water umbel, Santa Cruz striped agave, and the Santa Cruz beehive cactus.*
>
> - *https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/patagonia-sonoita-creek-preserve/*

The Sky Islands Alliance notes that the preserve is, "….actually one of the best bird watching havens in the Southwest. This lush riparian area provides habitat for over 200 species of birds," (https://www.visitskyislands.com/sonoita-creek-state-natural-area/#:~:text=The%20Sonoita%20Creek%20Preserve%20is,over%20200%20species%20of%20birds)

Figure 4 shows the current ADEQ "Flow Regimes" (perennial, intermittent, ephemeral, undetermined, and null) for the Patagonia Mountains in the area south of the Town of Patagonia. Each colored stream in the figure is labeled with its ADEQ Flow Regime classification. Notably, Sonoita Creek through the TNC preserve has no classification ("NULL") and lower Harshaw Creek and Temporal Gulch are "Undetermined."

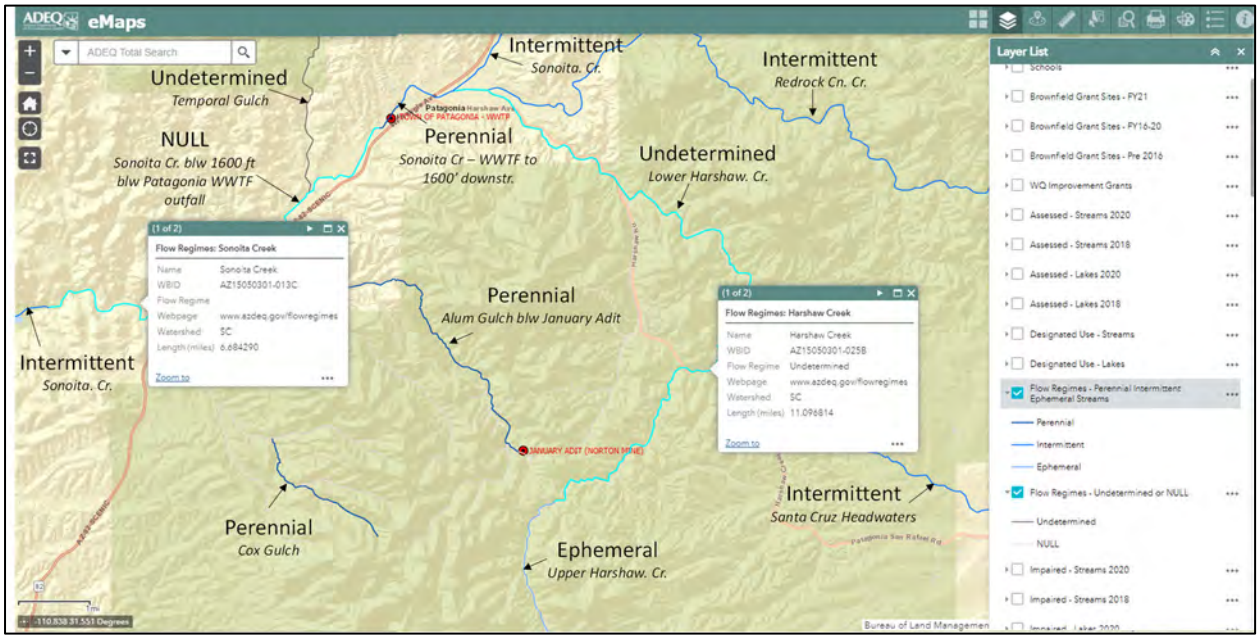


Figure 4. ADEQ flow regime classifications.

The satellite image in Figure 3 and evidence from the TNC preserve provided above suggest that most of the Sonoita Creek reach listed as "NULL" on the ADEQ Flow Regimes map is perennial. ADEQ classifies the flow regime of upper Harshaw Creek as ephemeral, but they have made no determination for lower Harshaw Creek. Inexplicably, ADEQ changed the classification for Harshaw Creek from perennial to ephemeral in 2002, during one of the driest water years on record at that point (ADEQ, 2003a). Several sources cite intermittent and even perennial flow in lower Harshaw Creek, as discussed below.

A 2007 publication funded by the US Bureau of Reclamation examined fish movement through intermittent streams in Arizona. The authors note:

> *Redrock Canyon is a small intermittent stream in southeastern Arizona. It drains the southwest side of the Canelo Hills and is a tributary of Harshaw Creek shortly before it joins Sonoita Creek in the Santa Cruz River basin (Figures 16 and 17**). Harshaw Creek is an intermittent stream*** [emphasis added]*. Sonoita Creek is also intermittent, with a perennial reach in the area of confluence with Redrock Canyon, supported in part by treated sewage return flows from the town of Patagonia.*
>
> - Stefferud & Stefferud, 2007

A 1982 thesis examining acid drainage from abandoned mines in the Patagonia mountains noted that,

> *"Flow was also rarely sighted discharging from the Hardshell tributary and Hermosa Canyon during the winter. At those same times water in* ***Harshaw Creek was usually intermittent*** [emphasis added] *with flow resurfacing directly upstream from site 3* [10 km upstream from Patagonia; downstream of Hermosa mine site].
>
> - Dean, 1982

Floyd Gray, a senior Research Geologist with the USGS Geology, Minerals, Energy, and Geophysics Science Center in Tucson, has conducted research in the Patagonia Mountains for decades. ADEQ relied heavily on his input in the 2003 Harshaw Creek TMDL document (ADEQ, 2003a). According to Dr. Gray, a perennial reach exists in Harshaw Creek about 4 miles upstream from the mouth (below the intersections of Harshaw Rd and Harshaw Creek Rd), and this reach supports minnows and other rare species (Floyd Gray, pers. comm. to A. Maest, 2021). Eddleman (2012) also references this perennial flow as Site 15 in her thesis (Eddleman, 2012) (Figure 5).

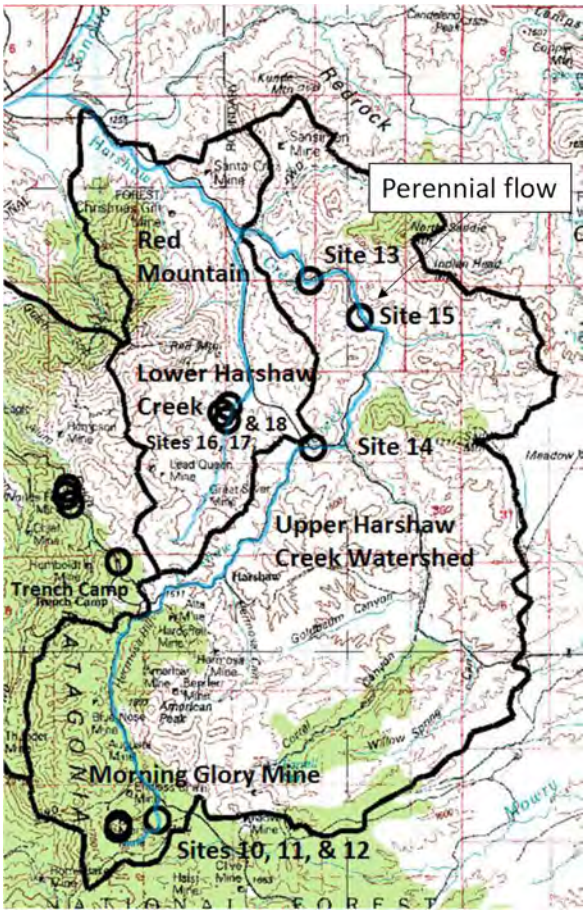


Figure 5. Eddleman (2012) sampling sites with perennial flow observed at Site 15 on lower Harshaw Creek.

The citations and anecdotes from local residents suggest that lower Harshaw Creek may be intermittent and perennial in some reaches others. In further evidence of the uncertain flow regime in Harshaw Creek, AMI applied to the U.S. Army Corps of Engineers (USACOE) for a jurisdictional determination of the flow regime status of Harshaw Creek below the proposed WTP2 (AZ Minerals, Inc., 2020), citing the conflict between the U.S. Geological Survey's National Hydrologic Database listing of Harshaw Creek as

intermittent and the ADEQ's designated use code as Aquatic and Wildlife- ephemeral (A&We). However, the ADEQ's own "Permits in Process" website shows the entire 13.20-mile length of Harshaw Creek as intermittent (Figure 6). Furthermore, ADEQ concluded in its Draft Statement of Basis for the Draft Permit at 2 that "Application of the NWPR [Navigable Waters Protection Rule] Screening Toolkit shows that a portion of Harshaw Creek is "likely a water of the U.S. (WOTUS). Thus, the facility's discharge to Outfall 002 to Harshaw Creek is a point source discharge requiring an AZPDES permit" (ADEQ, 2021b).

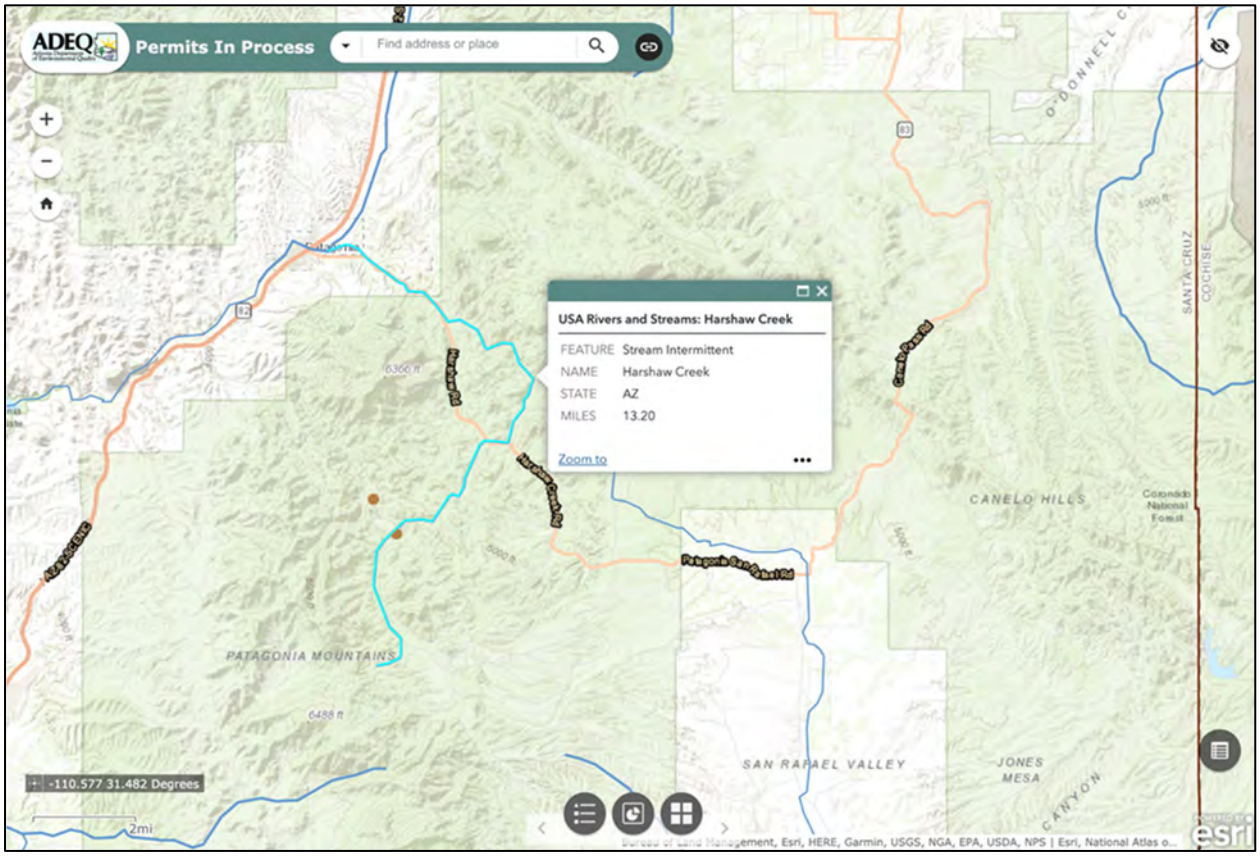


Figure 6. ADEQ Permits In Process map showing Harshaw Creek as intermittent (https://adeq.maps.arcgis.com/apps/webappviewer/index.html?id=13c7ddd647304520aa56b99aef3dce47 accessed April 5, 2021).

Figure 7 shows the National Wetlands Inventory map for lower Harshaw and Redrock Canyon creeks. The blue shaded areas represent Classification Code R4SBA: Riverine, Intermittent, Streambed, Temporary Flooded (see text inset in Figure 7 for more detail). Thus, despite a lack of regulatory consensus on its flow regime as ephemeral or intermittent, lower Harshaw Creek does contain significant riparian habitat. ADEQ's lack of a perennial designation of Sonoita Creek downstream of 1600 ft below the Patagonia WWTF outfall, however, is wholly inconsistent with clear evidence that this reach is perennial and supports one of the mostly highly valued ecosystems in the region.

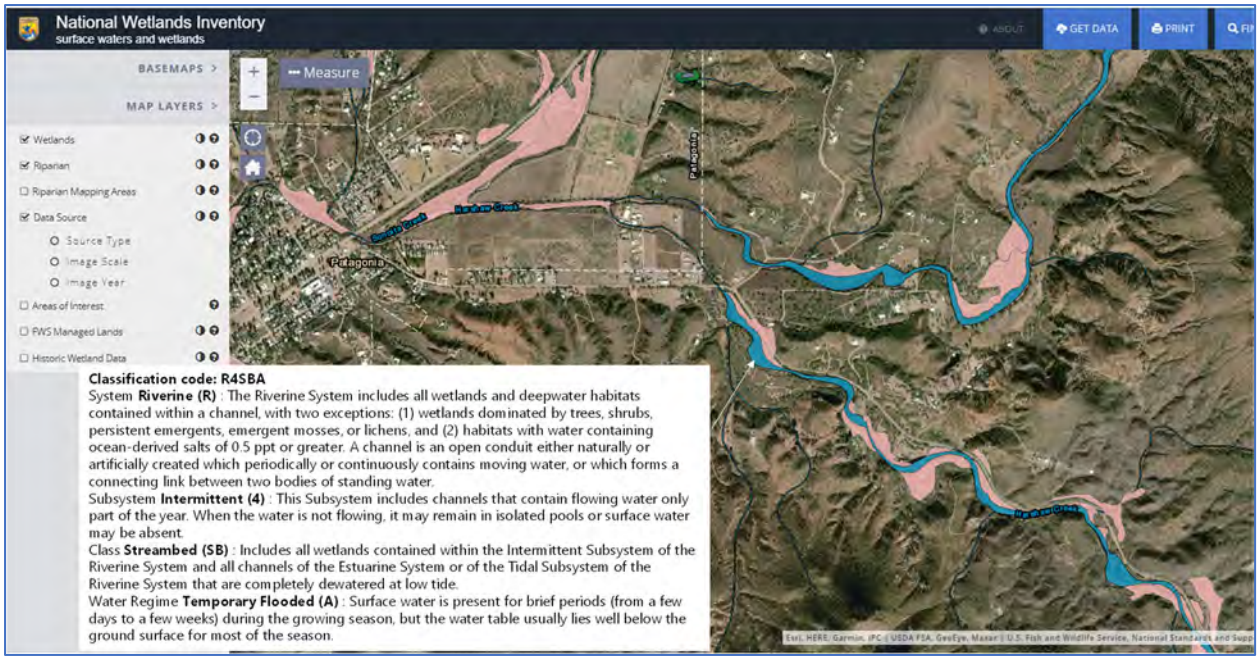


Figure 7. National Wetlands Inventory map of lower Harshaw Creek.

Critical Habitat

The U.S. Fish and Wildlife Service has proposed all of Harshaw Creek and Sonoita Creek below the Town of Patagonia as Critical Habitat for the Threatened yellow-billed cuckoo (Figure 8) (Federal Register 85FR1145811594; https://www.arcgis.com/home/webmap/viewer.html?url=https://services.arcgis.com/QVENGdaPbd4LUkLV/ArcGIS/rest/services/USFWS_Critical_Habitat/FeatureServer&source=sd). Figure 9 shows Critical Habitat designations for jaguar and Mexican spotted owl covering the entire Patagonia/Santa Rita mountain range corridor from Mexico to the Town of Patagonia. Other rare and endangered riparian species such as Chiricahua leopard frog and Northern Mexican garter snake are also found in this area of the Patagonia Mountains (https://ecos.fws.gov/ecp/species/1516 ; https://www.fws.gov/southwest/es/arizona/Documents/Redbook/Northern%20Mexican%20gartersnake%20RB.pdf). The Gila topminnow has also been documented in Sonoita Creek. https://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/GilaTopminnow/gtop94fn.pdf

Protection of the delicate and rare ecosystems below WTP2 is of paramount importance.

Insofar as the presence of a perennial water source in this reach of Harshaw Creek will support a federally listed threatened or endangered (T&E) specie, the ADEQ Director should impose water quality standards (WQS) on the newly created perennial flow in lower Harshaw Creek to protect all species that may utilize or become dependent on this riparian flow.

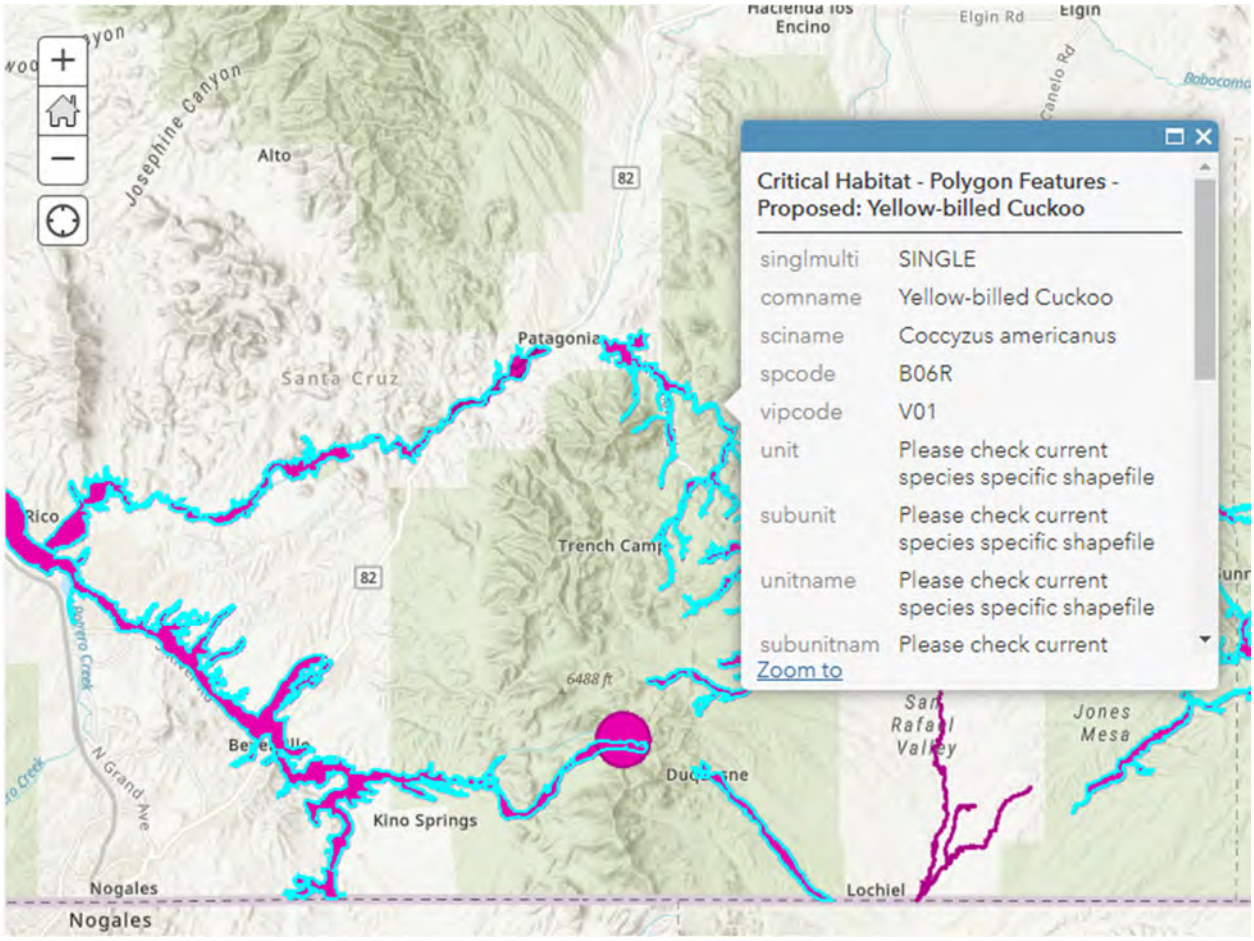


Figure 8. Proposed Critical Habitat (blue) for the Threatened yellow-billed cuckoo.

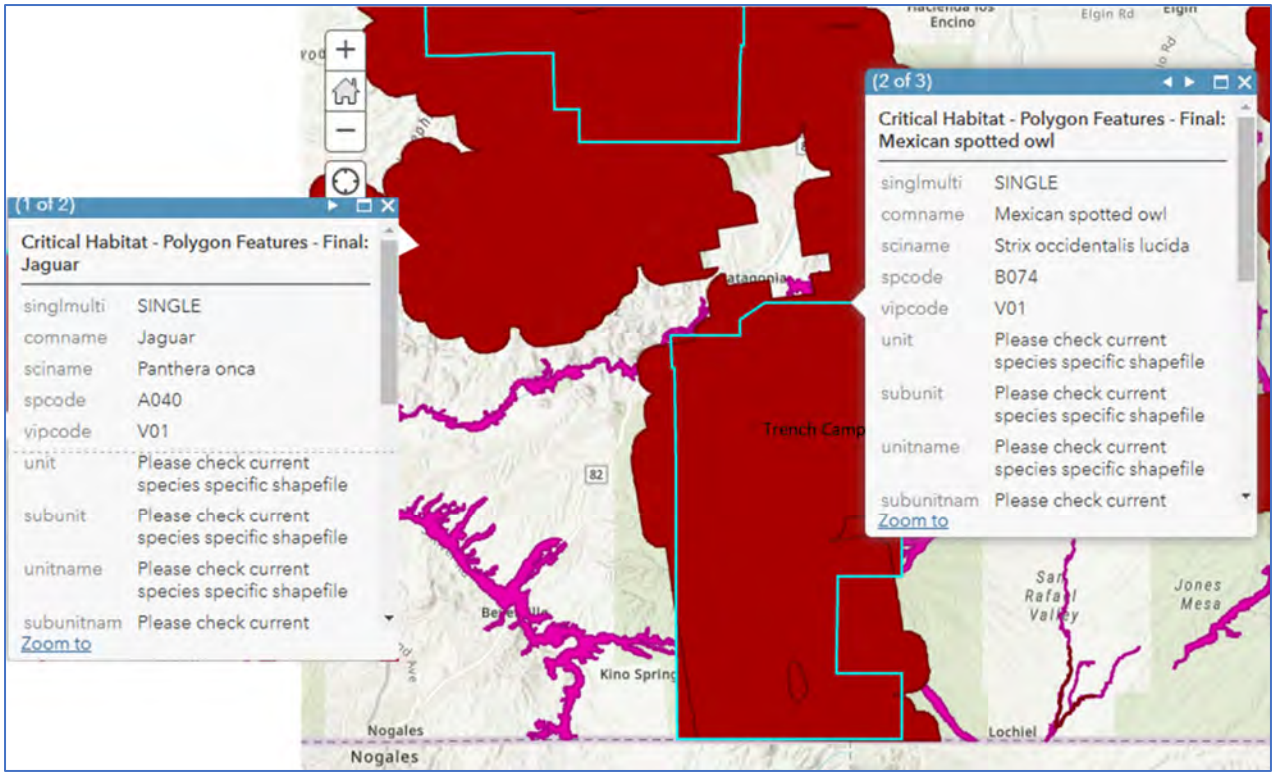


Figure 9. USFWS Critical Habitat for Jaguar and Mexican spotted owl.

Creation of Perennial Effluent-Dependent Water

AMI proposes to discharge up to 4500 gpm (10 cubic-feet per second [cfs]) of treated mine-dewatering "effluent" treated at WTP2 to lower Harshaw Creek continuously for approximately 4 years (AZ Minerals, Inc., 2020), thereby creating a new **perennial effluent-dependent water** (EDW) subject to the rules under AAC R18-11-113- Effluent-Dependent Waters (Arizona Admin. Code, 2019). Accordingly, ADEQ should ensure that the AMI AZPDES permit includes water quality-based standards that are, *at a minimum*, protective of this use.[1] Alternatively, any person may petition the ADEQ Director to classify a surface water as an EDW by providing the following:

1. A map and description of the surface water;
2. Information that demonstrates that the surface water consists of a point source discharge of wastewater; and
3. Information that demonstrates that, without a point source discharge of a wastewater, the receiving water is an ephemeral water. (AAC R18-11-113).

The information provided in this body of comments fulfills these requirements. The Director should designate the stream below WT2 as an EDW or perennial flow and regulate that water, at a minimum, according to the statute for EDWs:

[1] See discussion of application of A&Ww WQS for lower Harshaw Creek on p. 11.

> *The Director shall use the water quality standards that apply to an effluent-dependent water to derive water quality-based effluent limits for a point source discharge of wastewater to an ephemeral water.*
>
> - AAC R18-11-113, Section D.

Once the proposed Hermosa Mine initiates dewatering and WTP2 begins to discharge water to the environment (lower Harshaw Creek), all of lower Harshaw will be a perennial water. Harshaw Creek area has high recreational value today. The U.S. Forest Service lists Harshaw Creek Road as a Scenic Drive (https://www.fs.usda.gov/recarea/coronado/recarea/?recid=25754). Harshaw Creek canyon hosts an Arizona Trail trailhead, historic structures and cemeteries, old mine camps, and open picnic areas shaded by mature oak and sycamore trees. The presence of a perennial stream in this creek will certainly draw more visitors with pets and families eager to play in and picnic near the flowing stream. Accordingly, ADEQ should not issue the Draft Permit as written, but rather should include water quality-based limitations that will be protective of the human health and aquatic and wildlife that will interact with Harshaw Creek below the point of discharge at Outfall 2 and downstream. **A full body contact (FBC) designated use would be most protective of these recreational uses, similar to the perennial reach of Sonoita Creek and Patagonia Lake.**

Protection for Downstream Waters

Arizona's WQS include an "Antidegradation" provision to protect water quality necessary to support existing uses (R18-11-107 Arizona Admin. Code, 2019). Tier 1 projection applies to **EDWs and ephemeral and intermittent** waters. The statute states that, "The Director shall…determine whether there is degradation of water quality in a surface water on a pollutant-by-pollutant basis." It defines Tier 1 protection as follows:

> *The level of water quality necessary to support an existing use shall be maintained and protected. No degradation of existing water quality is permitted in a surface water where the existing water quality does not meet the applicable water quality standards.*
>
> *- AAC R18-11-107, Part B*

Tier 1 protection also mandates that, "a regulated discharge shall not cause a violation of a surface water quality standard or a wasteload allocation in a total maximum daily load [TMDL] approved by EPA (R18-11-107.01, part A.2).

Downstream water bodies from WTP2 include Lower Harshaw Creek and Sonoita Creek. ADEQ has not published a TMDL for either stream, but both streams fall into the categories of EDW, ephemeral, or intermittent covered by Tier 1 protection.

Tier 2 protection under the Arizona WQS Antidegradation provision protects downstream waters that are not listed as impaired and "where existing water quality in a surface water is better than the applicable water quality standard the existing water quality shall be maintained and protected" (R18-11-107C.). Tier 2 antidegradation protection applies to a **perennial water** with existing water quality that is better than applicable water quality standards.

A 2020 assessment by ADEQ listed the perennial Sonoita Creek reach below 1600 ft below the Town of Patagonia's WWTF as "Supporting All Uses." However, the ADEQ provides a disclaimer on its GIS maps

for "Assessed/Impaired Lakes/Streams 2020" indicating that they are in draft form. While this draft map indicates that this reach was delisted for zinc and low dissolved oxygen in 2020 (Figure 10), and so now qualifies for Tier 2 protection, no other documentation of the delisting of Sonoita Creek for its previous impairments in zinc and dissolved oxygen are available. If this reach, in fact, remains "impaired" under Section 304(d) for zinc and dissolved oxygen, then it still qualifies for Tier 1 protection permitting no further degradation.

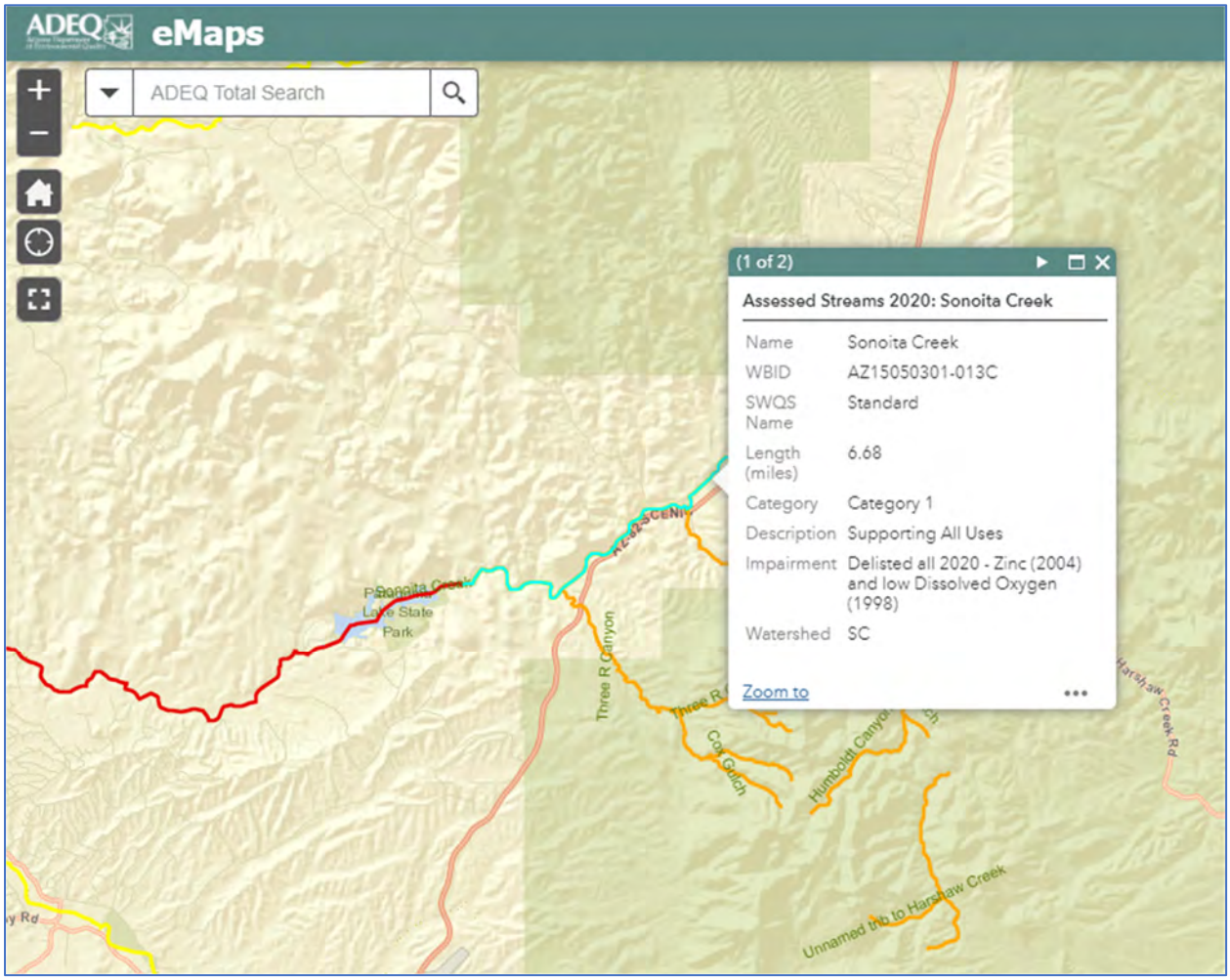


Figure 10. 2020 assessment of Sonoita Creek below 1600 ft below the Patagonia WWTF outfall.

Applicable Water Quality Standards

Table 1 lists the applicable Arizona Designated Uses for Patagonia Lake and all streams below the proposed Hermosa Mine (AAC R18-11 App. A, 2019). Of the stream reaches listed in Table 1, only upper Harshaw Cr (above the proposed WTP2) and Alum Gulch (below WTP1) have published TMDLs (ADEQa, 2003; ADEQb, 2003). The TMDLs prohibit ADEQ from permitting any discharge that exceeds the designated contaminant loading limits (R18-11-107.01, part A.2) for each stream. The TMDLs for upper Harshaw Creek pertain to copper and acidity (low pH), while those for Alum Gulch apply to copper, cadmium, zinc, and acidity.

Without a TMDL, lower Harshaw Creek is protected by the water quality standards associated with the designated use codes shown in Table 1: A&We (Aquatic and Wildlife- ephemeral), PBC (partial body contact), and AgL (agriculture- livestock). Sonoita Creek from the WWTF outfall to 1600 ft downstream is designated as A&Wede (Aquatic and Wildlife – effluent-dependent water), and also has PBC and AgL designated use codes. The perennial reach of Sonoita Creek 1600 ft below the WWTF outfall is governed by A&Ww (Aquatic and Wildlife- warm water), FBC (full-body contact), FC (fish consumption), and AgL. Patagonia Lake has the same designated use codes as the adjacent upstream part of Sonoita Creek except that it also has the AgI (Agriculture – irrigation) designated use code.

However, the evidence of perennial water supporting native aquatic species in lower Harshaw Creek (Floyd Gray, pers. comm.) should trigger a thorough environmental review by ADEQ. The presence of this perennial flow environment would warrant protection under the Arizona designated use code A&Ww (warm water) in the state WQS (Arizona Admin. Code, 2019).

Table 1. ADEQ Water Use Designations for streams and Patagonia Lake below proposed Hermosa Mine.

Stream	Segment	Aquatic & Wildlife	Human Health	Ag	ADEQ Flow Regime
Alum Gulch	Headwaters to 31°28'20"/110°43'51" (abv January Adit)	A&We	PBC	AgL	NULL
Alum Gulch	From 31°28'20"/110°43'51" (January Adit) to 31°29'17"/110°44'25"	A&Ww	FBC, FC	AgL	perennial
Alum Gulch	elow 31°29'17"/110°44'25" to confluence with Sonoita C	A&We	PBC	AgL	perennial
Harshaw Cr	Headwaters to confluence with Sonoita Creek at	A&We	PBC	AgL	Headwaters to 3.25 mi: ephemeral; 3.25 to 10.10 miles: UNDETERMINED
Patagonia Lk	31°29'56"/110°50'49"	A&Ww	FBC, FC	AgI, AgL	Lake
Sonoita Cr	Headwaters to the Town of Patagonia WWTP outfall at 31°32'25"/110°45'31"	A&We	PBC	AgL	intermittent
Sonoita Creek (EDW)	Town of Patagonia WWTP outfall to permanent groundwater upwelling point approximately 1600 feet downstream of outfall	A&Wedw	PBC	AgL	perennial
Sonoita Cr	Below 1600 feet downstream of Town of Patagonia WWTP outfall groundwater upwelling point to confluence with the Santa Cruz River	A&Ww	FBC, FC	AgL	NULL
Definitions:					
AgI	Agriculture- irrigation				
AgL	Agriculture- livestock				
A&Wedw	Aquatic & Wildlife (effluent-dependent water) use by animals, plants , or other organisms for habitation, growth, or propagation				
A&We	Aquatic & Wildlife ephemeral				
A&Ww	Aquatic & Wildlife warm water				
PBC	Partial body contact - not full immersion				
FBC	Full body contact - ingestion likely				
FC	Fish consumption- Harvestable aquatic organisms include, butare not limited to, fish, clams, turtles, crayfish, and frogs.				

Proposed Contaminant Limits

Table 2 lists for each Designated Use code the Arizona WQS limits for the contaminants listed in Table 1.c "Effluent Limitation and Monitoring Requirements" for Outfall 002 (WTP2) in the AZPDES Draft Permit AZ0026387 (ADEQ, 2021a). The last row of the table shows the proposed permit limits from Table 1.c in the Draft AZPDES permit. The proposed permit limits are listed as Monthly Average and Daily Maximum, and apply only to *total* recoverable metals (ADEQ, 2021a). Except in the case of mercury, the applicable water quality standards for A&W (ephemeral, EDW, and warm water) list Chronic and Acute standards for *dissolved* metals rather than total metals. Without a comparable dissolved metals limit for each contaminant, the proposed limits in the Draft AZPDES permit are not

comparable to, nor protective of, water quality standards for the designated uses of downstream waters below WTP2.

Table 3 compares the Chronic Effluent Limitation and Monitoring Requirements for Outfall 1 (WTP1) to the proposed permit limits for the same parameters for Outfall 2 (WTP2). The fourth and seventh columns of the table provide the ratio of WTP2 permit limits to those of WTP1. For copper and cadmium, the proposed allowable concentration limits for the WTP2 discharge are **9.8 and 6.3 times** the WTP1 concentration limits, respectively. Likewise, the draft permit limit for zinc is **2.4 times** higher at WTP2 than WTP1. The Statement of Basis for the draft AZPDES permit (ADEQ, 2021b) states that,

> *…a portion of Harshaw Creek is likely a water of the U.S. (WOTUS). Thus, the facility's discharge from Outfall 002 to Harshaw Creek is a point source discharge requiring an AZPDES permit.*

This same document provides the following description under the subheading "Numeric Water Quality Standards:"

> *Per 40 CFR 122.44(d)(1)(ii), (iii) and (iv), discharge limits must be included in the permit for parameters with "reasonable potential" (RP), that is, those known to be or expected to be present in the effluent at a level that could potentially cause any applicable numeric water quality standard to be exceeded. RP refers to the possibility, based on the statistical calculations using the data submitted, or consideration of other factors to determine whether the discharge may exceed the Water Quality Standards. The procedures used to determine RP are outlined in the Technical Support Document for Water Quality-based Toxics Control (TSD) (EPA/505/2-90-001). In most cases, the highest reported value for a parameter is multiplied by a factor (determined from the variability of the data and number of samples) to determine a "highest estimated value". This value is then compared to the lowest applicable Water Quality Standard for the receiving water. If the value is greater than the standard, RP exists and a* ***water quality-based effluent limitation (WQBEL) is required in the permit for that parameter.*** *RP may also be determined from BPJ based on knowledge of the treatment facilities and other factors. The basis for the RP determination for each parameter with a WQBEL is shown in the table below* [see columns 3 and 5 in Table 3].
>
> *Since this is a new treatment system and effluent (discharge) data are not yet available, RP could not be calculated for other potential pollutants that are subject to numeric water quality standards. Instead of WQBELs, assessment levels (ALs) were established for Trace Substances (Table 2.b in the permit). ALs and relatively frequent monitoring are established for these parameters because they are commonly present in effluents at variable concentrations.*
>
> *As the water treatment plant is not yet constructed, there are no effluent samples from WTP2. The water quality for effluent from WTP2 is characterized by examination of influent to WTP2, the performance of similar treatment plants, and the results of treatability studies for WTP2.*
>
> - ADEQ, 2021b

Table 2. Arizona water quality standards for select contaminants by Designated Use code and proposed contaminant limits for WTP2.

Designated Use	Cadmium (µg/L)			Copper (µg/L)			Lead (µg/L)			Mercury (µg/L)			Susp. Solids (mg/L)	Zinc (µg/L)			pH
		Dissolved[a]			Dissolved			Dissolved			Dissolved				Dissolved		
	Total	Chronic	Acute	Total	Chronic	Acute	Total	Chronic	Acute	Total	Chronic	Acute	Total	Total	Chronic	Acute	
AgI	50			5000			10,000			10			--				4.5-9
AgL	50			500			100						--				6.5-9
A&Wedw		.21-2.0	2.1-34		2.3-29	2.9-50		0.42-10.9	10.8-281		2.4	0.01	--		30-379	30-379	6.5-9
A&We		--	4.9-80		--	5.1-86		--	22.8-592.7	5	2.4	0.01	--		--	284-3599	6.5-9
A&Ww		.21-2.0	2.1-34		2.3-29	2.9-50				280			80		30-379	30-379	6.5-9
PBC	467			1300						280			--				6.5-9
FBC	467			1300									--				6.5-9
FC	6			--			--						--				6.5-9
ADEQ Proposed Limit at WTP2[b]	Monthly Av/Daily Max 50/100			Monthly Av/Daily Max 150/300			Monthly Av/Daily Max 300/600			Monthly Av/Daily Max 1/2			Monthly Av/Daily Max 20/30	Monthly Av/Daily Max 750/1500			6.5-9
a- limits increase with hardness (20 - 400 mg/L)																	
b- all metals are total recoverable																	

Table 3.Draft AZPDES Permit Effluent Limitations and Monitoring Requirements for Outfalls 1 and 2.

Parameter	Maximum Allowable Discharge Limits						Monotoring Requirement	
	Monthly Average (µg/L)		Ratio WTP2:WTP1	Daily Max (µg/L)		Ratio WTP2:WTP1		
	WTP 1 (Alum Gulch)[a]	WTP 2 (Harshaw Cr)[b]		WTP 1 (Alum Gulch)[a]	WTP 2 (Harshaw Cr)[b]		Frequency	Sample Type
Discharge Flow (MGD)	REPORT (4)	REPORT	--	REPORT	REPORT	--	Continuous	Metered
Cadmium	5.1	50	9.8	10.2	100	9.8	1x / quarter	8-hour composite
Copper	24	150	6.3	48.1	300	6.2	1x / quarter	8-hour composite
Hardness (CaCO3)	REPORT [mg/L]	REPORT [mg/L]	--	REPORT [mg/L]	REPORT [mg/L]	--	1x / quarter	8-hour composite
Lead	300	300	1.0	600	600	1.0	1x / quarter	8-hour composite
Mercury	1	1	1.0	2	2	1.0	1x / quarter	8-hour composite
Suspended Solids, Total	20	20	1.0	30	30	1.0	1x / quarter	8-hour composite
Zinc	311	750	2.4	623	1500	2.4	1x / quarter	8-hour composite
pH	Not less than 6.5 standard units (S.U.) nor greater than 9.0 S.U.						1x / week	Discrete
a- Proposed Chronic Effluent Limitations and Monitoring Requirements (discharges of 7 or more consecutive days with <30 days between discharges)								
b- Proposed Effluent Limitations and Monitoring Requirements								

This same language is present in the ADEQ Fact Sheet for the original AZPDES Permit AZ0026387 awarded to AMI for the January Mine Water Treatment Facility (WTP1) in 2018 (ADEQ, 2018), but that document includes the following language that is NOT present in the current Statement of Basis for the WTP2 AZPDES Permit amendment (ADEQ, 2021b):

> *The proposed permit limits were established using a methodology developed by EPA.* ***Long Term Averages (LTA) were calculated for each designated use and the lowest LTA was used to calculate the average monthly limit (AML) and maximum daily limit (MDL) necessary to protect all uses*** *[emphasis added]. This methodology takes into account criteria, effluent variability, and the number of observations taken to determine compliance with the limit and is described in Chapter 5 of the TSD. Limits based on A&W criteria were developed using the "two-value steady state wasteload allocation" described on page 99 of the TSD. When the limit is based on human health criteria, the monthly average was set at the level of the applicable standard and a daily maximum limit was determined as specified in Section 5.4.4 of the TSD.*
>
> *Discharge Limits in Tables 1.a and 1.b were calculated for chronic and acute water quality standards respectively. The frequency and duration of discharges from the WTP will determine which standards are applicable for each monitoring period.*
>
> - ADEQ, 2018

The result of this apparent policy discrepancy is that an already contaminated stream (Alum Gulch) is more protected than a less contaminated one (Harshaw Creek). Despite AMI's and ADEQ's stated intent to meet A&Wedw WQS with WTP2 discharge, the draft AZPDES permit makes no attempt to define water quality-based standards for WTP2 discharge to Harshaw Creek as it did for WTP1 discharge to Alum Gulch.

ADEQ should adjust these limits, including the development of Chronic and Acute limits, for WTP2 (Outfall 2) to be equally protective and relevant to downstream WQS as those for WTP1.

Total Maximum Daily Load (TMDL) Assessments

ADEQ has prepared TMDLs for three streams in the Sonoita Creek basin: 3R Canyon, Alum Gulch, and upper Harshaw Creek. All three of these assessments were published in 2003. While the 2003 TMDL document for Harshaw Creek (ADEQ, 2003a) is clearly titled "Upper Harshaw Creek, Sonoita Creek Basin," a 2007 follow-up assessment (ADEQ, 2007) listed Harshaw Creek "from headwaters to Sonoita Creek" as impaired for copper and pH (Figure 11). Even though the latest ADEQ maps show only upper Harshaw Creek listed as impaired (Figure 12), evidence exists for elevated copper (NextGen Engineering, 2019) (Figure 13) and low pH (Brown, et al., 2020) (Figure 14) in lower Harshaw Creek.

Clearly, ADEQ is aware of the impairment in lower Harshaw Creek and should conduct another TMDL assessment for the entire length of the creek prior to issuing any permit for discharge into Harshaw Creek.

HARSHAW CREEK	USE SUPPORT	OVERALL ASSESSMENT	POLLUTANTS CAUSING IMPAIRMENT	IMPAIRMENT STATUS
From headwaters to Sonoita Creek 15050301 – 025 14.4 miles	A&We – Impaired PBC – Impaired AgL – Impaired	Category 4A Not attaining (impaired)	Copper and pH	TMDL completed in 2003 for copper and pH

MONITORING USED IN THIS ASSESSMENT				
SITE NAMES ID # DATABASE #	AGENCY PURPOSE	SAMPLING PERIOD NUMBER AND TYPES OF SAMPLES		
		Metals	Nutrients – Related	Other
No current data. Site files: 100318, 100319, and 100848				

DATA GAPS AND MONITORING NEEDS			
EXCEEDANCES NEEDING MORE SAMPLES TO ASSESS	MISSING CORE PARAMETERS	MISSING SEASONAL DISTRIBUTION	DETECTION LIMITS NOT LOW ENOUGH
	Insufficient core parameters	Insufficient sampling events	
MONITORING RECOMMENDATIONS		Medium Priority – Need to implement corrective actions at mine sites along Harshaw Creek and its tributaries and then do effectiveness monitoring.	

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Figure 11. ADEQ Watershed assessment results indicating Harshaw Creek impaired condition for copper and pH from headwaters to Sonoita Creek (ADEQ, 2007).

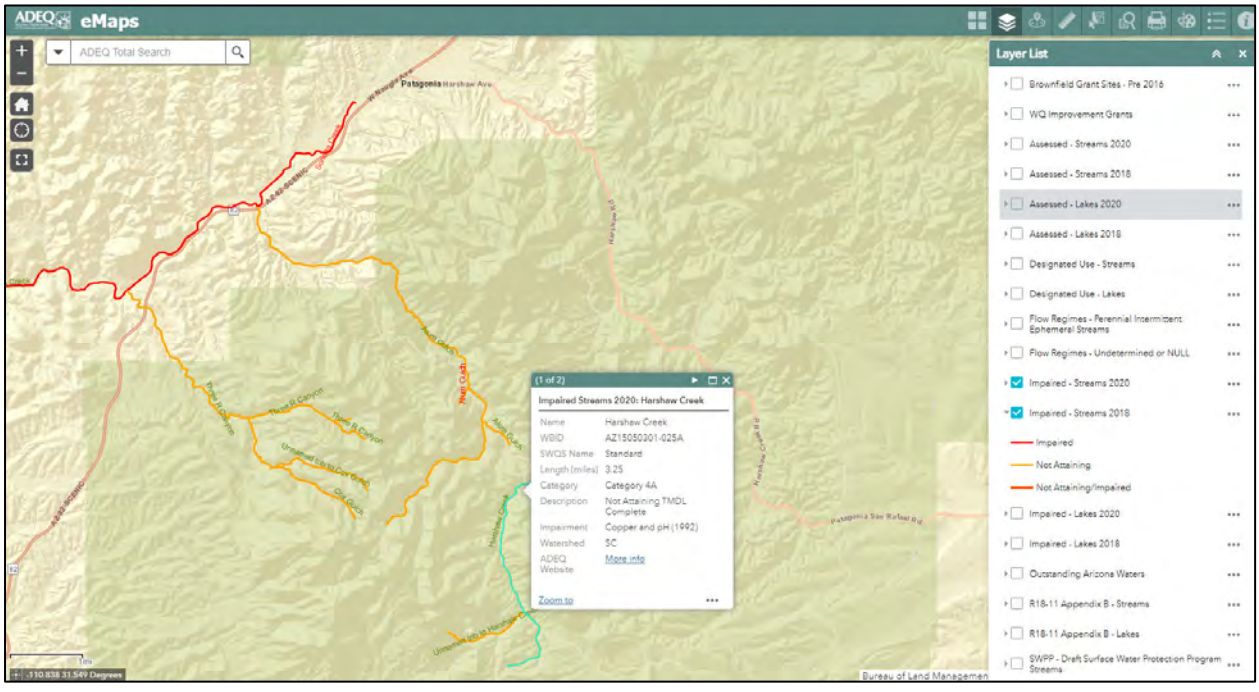

Figure 12. ADEQ Impaired Streams map for 2018 and 2020 showing impairment in upper Harshaw Creek for copper and pH.

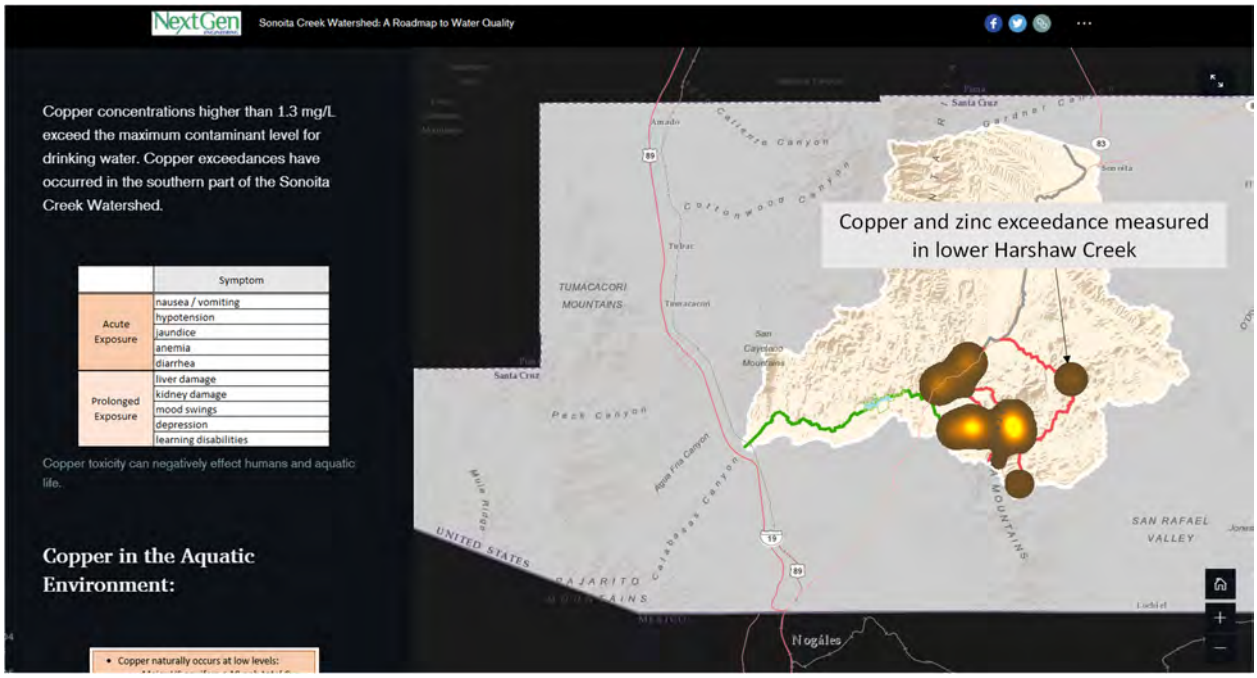

Figure 13. Map of measured WQ exceedances in streams near Hermosa project, including copper and zinc in lower Harshaw Cr. (NextGen Engineering, 2019). https://storymaps.arcgis.com/stories/bca939c4b0c44f8bb939159a28f1515b

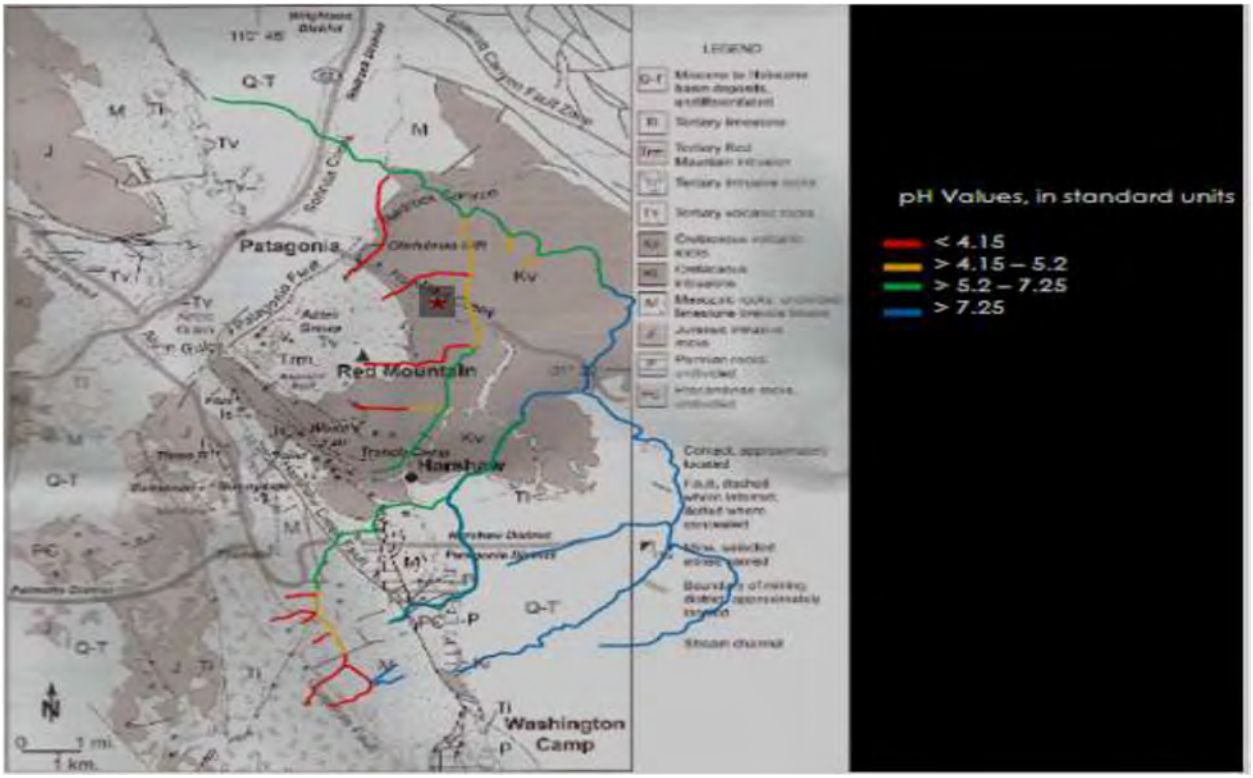

Figure 14. pH values measured in streams near Hermosa Project. Lower Harshaw shows pH values between 5.2 and 7.5 (Brown, et al., 2020).

Hydrologic Connection of WTP2 Discharge to Sonoita Creek

The issue of protecting downstream water bodies is linked to the likelihood that the contaminants discharged at WTP2 will reach downstream water bodies with designated use WQS standards. AMI asserts in its application for amendment to its AZPDES Individual permit (AZ Minerals, Inc., 2020) that all WTP2 discharge water will infiltrate into the subsurface within 9.4 miles, prior to the confluence of Harshaw Creek with Sonoita Creek. This assertion is based on two observations made of natural flow in upper Harshaw Creek over 3 days in October 2018 (ERC, 2020).

Analytical Model

This 9.4-mile distance became the basis for AMI's delineated "Discharge Impact Area (DIA)" and "Pollutant Management Area (PMA)" (Figure 15) downstream of WTP2 (Clear Creek Associates, 2020). The authors of the DIA and PMA delineation study used an analytical (vs. physical) model and note that, "… the analysis does not assess transient events or changes in streambed or aquifer storage over time" (Clear Creek Associates, 2020, p.18).

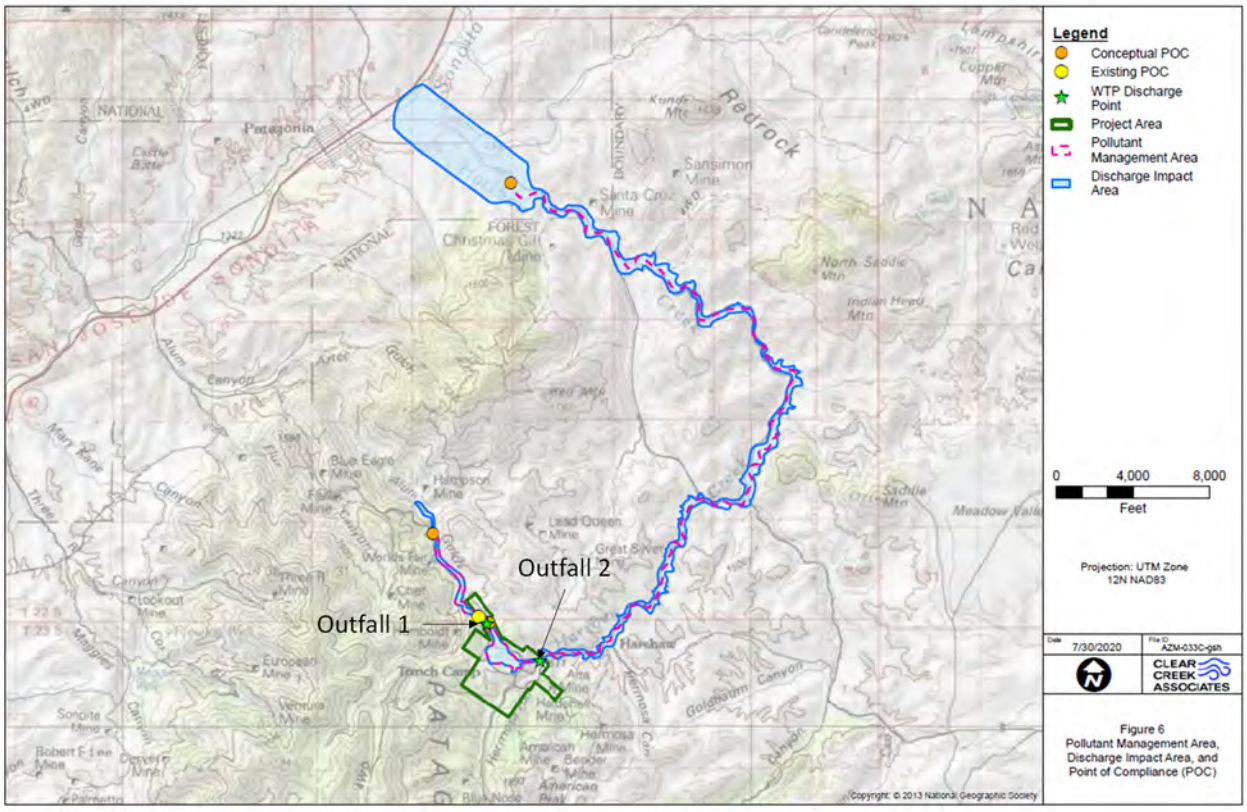

Figure 15. AMI's delineated Discharge Impact Area and Pollutant Management Area for the Hermosa Project (Clear Creek Associates, 2020).

Integrated Hydrologic Model

On November 12, 2020, the Patagonia Area Alliance (PARA) presented a fully integrated hydrologic model of the Sonoita Creek basin at the Town of Patagonia's Flood and Flows Committee meeting (Lacher & Prucha, 2020). The model used the physical modeling tool known as MIKESHE by DHI, Inc. to simulate the complete hydrologic system (weather, snowpack, overland storm runoff, streamflow, infiltration, evapotranspiration, groundwater flow, and pumping). The surface characteristics (soils,

topography, and vegetation) were obtained from published maps and satellite datasets. The subsurface model characteristics were derived from published reports and the review of well logs obtained from the Arizona Department of Water Resources (ADWR) and Hermosa Mine drilling documents. Figure 16 presents a lithologic log developed from ADWR borehole logs and showing considerable clays in some areas of the drainages (Lacher & Prucha, 2020). The authors reviewed more than 30 documents and incorporated all publicly available observation data (groundwater levels, stream discharge, and wet-dry mapping) into their calibration process.

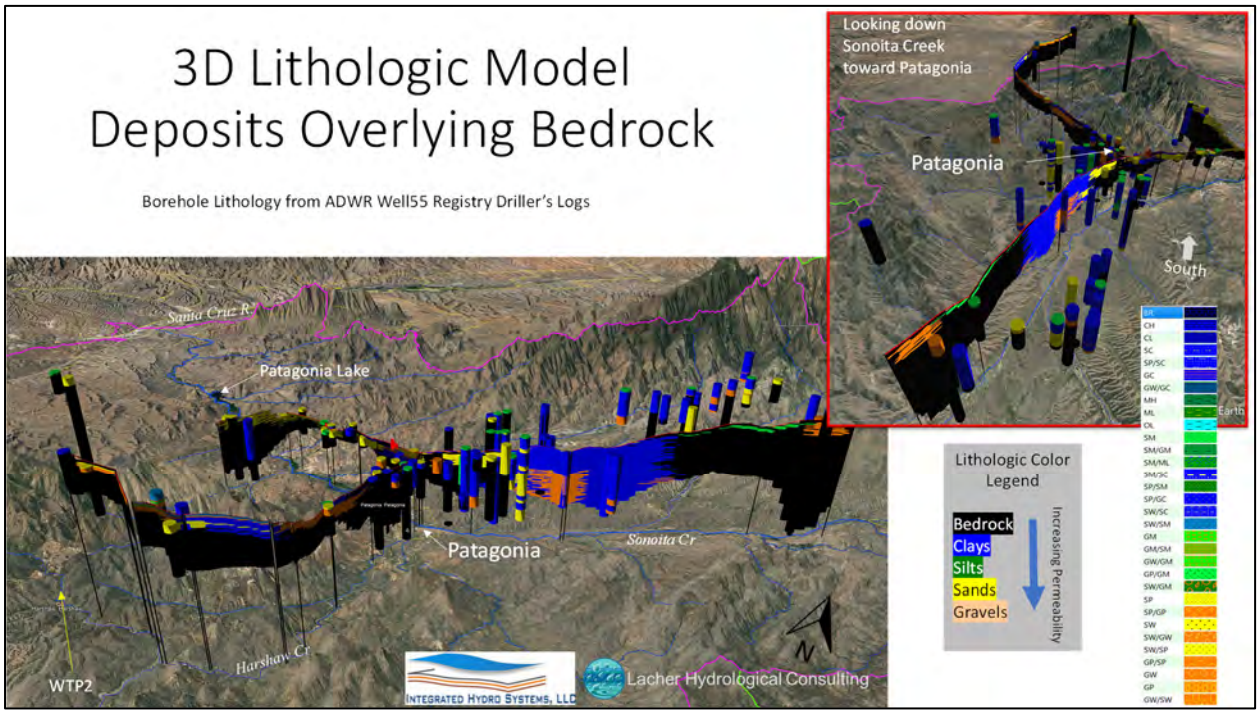

Figure 16. Lithologic model developed from borehole logs along Harshaw and Sonoita creeks (Lacher & Prucha, 2020).

The model used a 500-meter by 500-meter grid and included the entire Sonoita Creek watershed down to the mouth of Sonoita Creek at the Santa Cruz River. The simulation period extended from 2014 to 2020 with an hourly time step.

Figure 17 shows the MIKESHE model domain boundary and the initial head condition and groundwater flow directions in the Sonoita Creek basin derived from groundwater level data from the wells indicated by red triangles. Note the heavy concentration of wells – both municipal and domestic – near the confluence of Harshaw and Sonoita Creeks and the direction of groundwater flow parallel to Harshaw Creek. Schrag-Toso (2020) used isotopes and other water quality parameters to identify various types of groundwater in the Sonoita Creek basin and to derive hydrologic flow paths. Regarding the stream channel sediments along Harshaw Creek, he noted that,

> "*Mountain front recharge and focused mountain block recharge via Harshaw Creek partially recharge the Sonoita Creek alluvial aquifer from which the Town of Patagonia pumps for its municipal water source.*"
>
> - Schrag-Toso, 2020

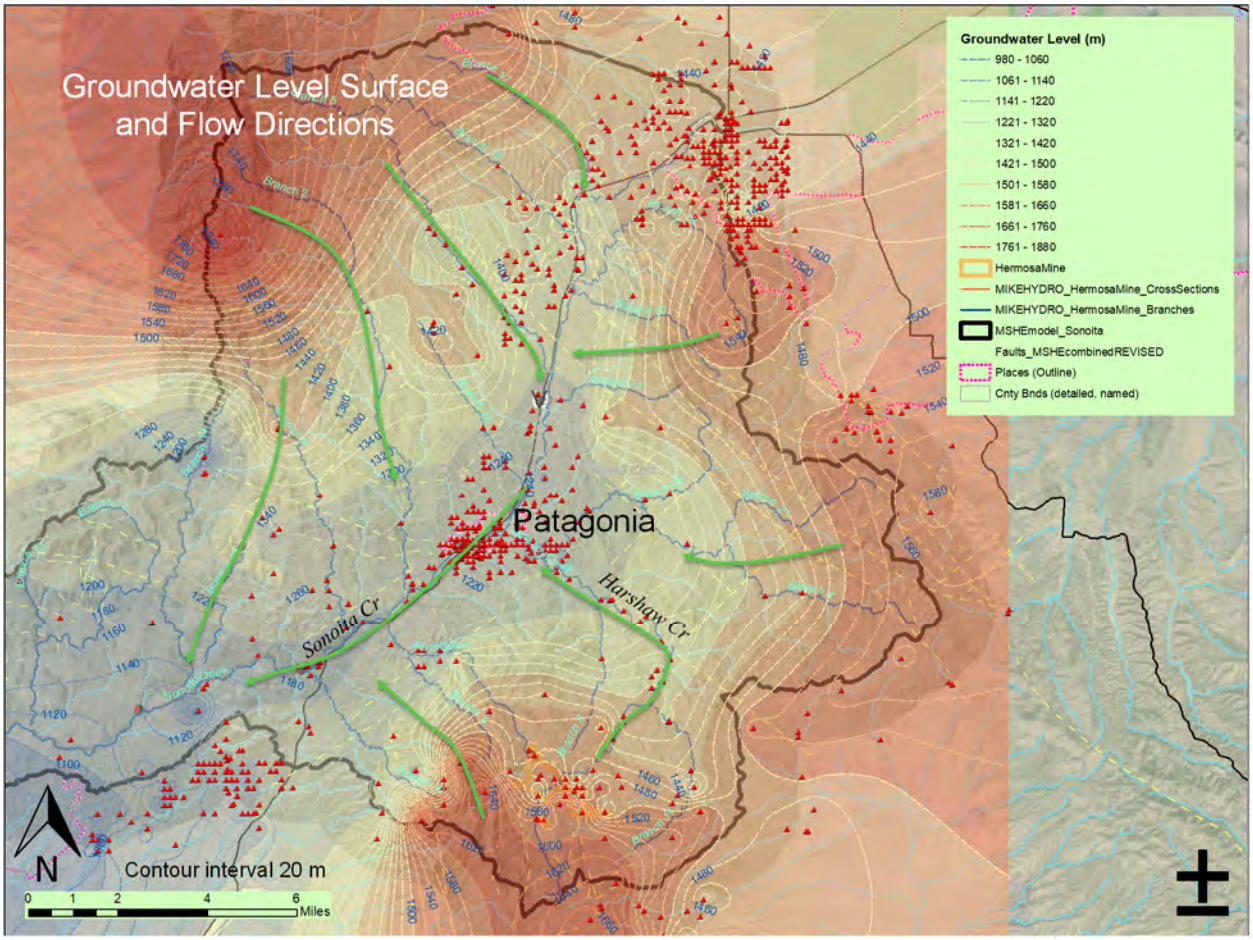

Figure 17. Initial head conditions derived from groundwater level data in wells (red triangles). Green arrows indicate general groundwater flow directions (Lacher & Prucha, 2020).

Figure 18 illustrates depth to groundwater in the Sonoita Creek basin derived from topography and groundwater-level data. The shallow groundwater areas in Harshaw and Sonoita creeks (orange color) generally coincide with shallow bedrock, indicating very little groundwater storage potential before water discharges to the surface as streamflow. As noted in the ADEQ WQS for Sonoita Creek, a natural bedrock high forces groundwater to the surface 1600 ft downstream of the WWTF.

The only streamflow data available for the simulation period were those manually collected by TNC staff at the Patagonia-Sonoita Creek Preserve (P. Leiterman, pers. comm., Oct. 2020). Figure 19 plots simulated (solid line) vs observed (red circles) stream discharge at the TNC preserve over the 2014-2020 simulation period. MIKESHE produced simulated storm runoff not measurable by TNC staff with their wading measurements.

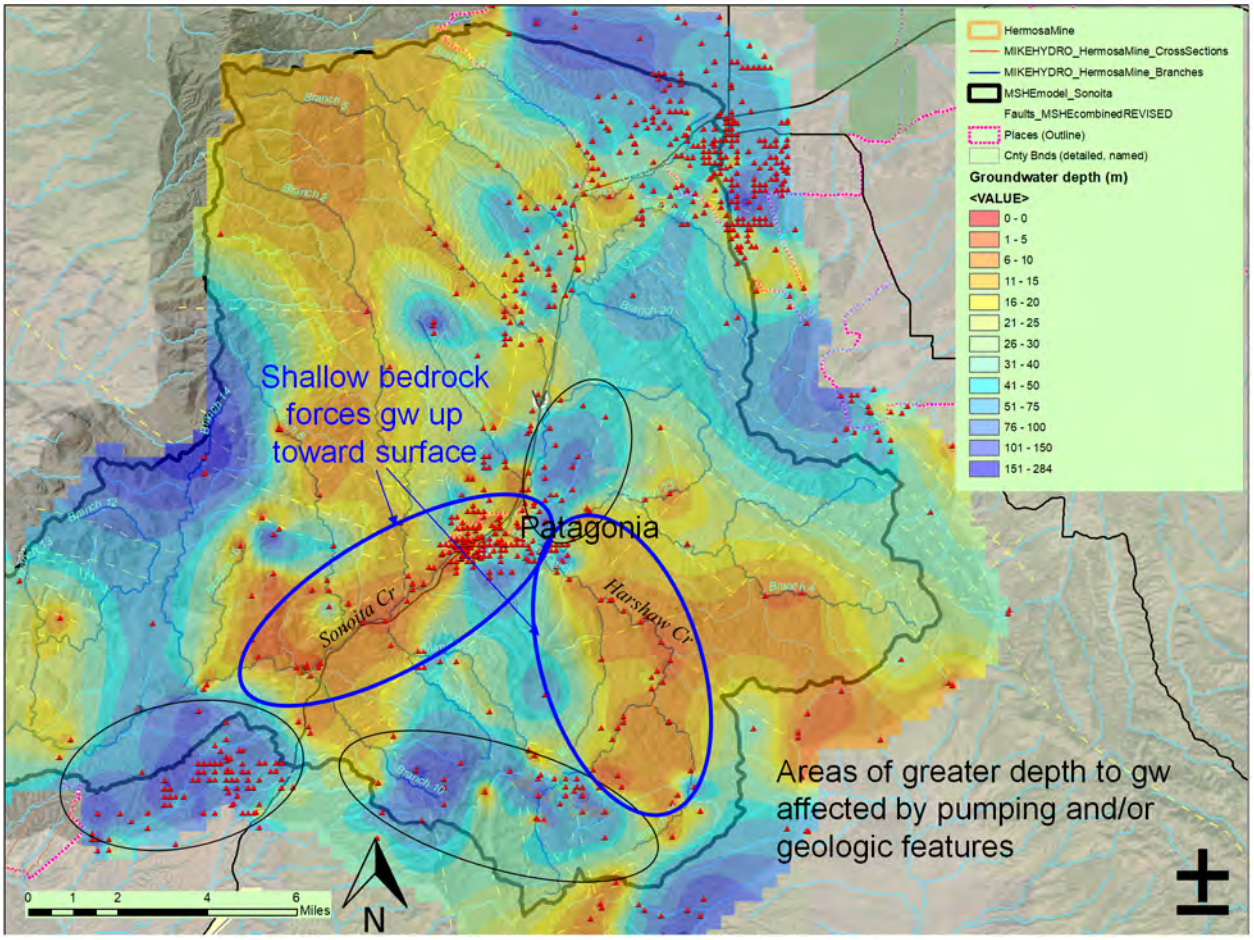

Figure 18. Depth to groundwater map developed from surface topography and groundwater level data. Shallower depths in Harshaw and Sonoita creeks (orange) correspond to areas with shallow bedrock (Lacher & Prucha, 2020).

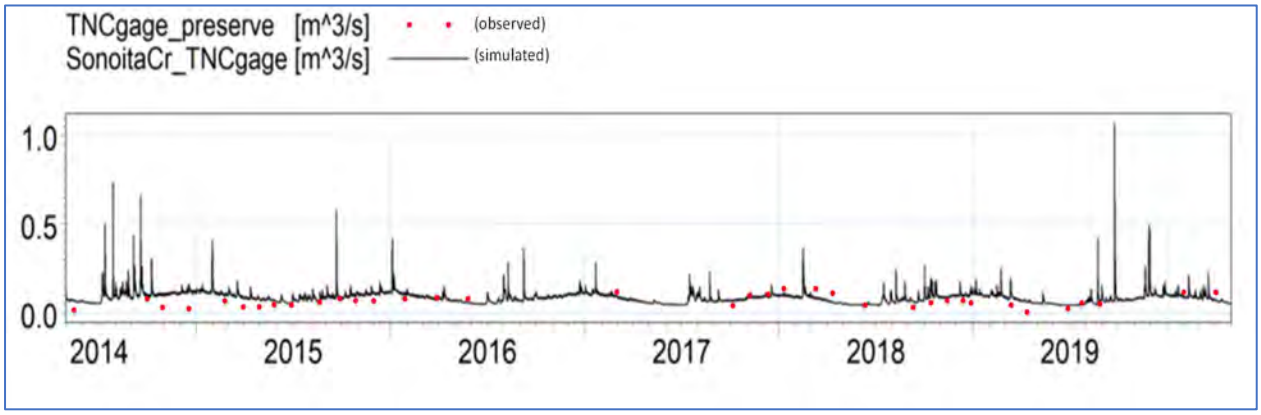

Figure 19. Simulated vs observed stream flow in Sonoita Creek at the TNC Patagonia-Sonoita Creek Preserve.

The Sonoita Creek basin MIKESHE model was developed as a watershed modeling tool, not specifically designed to look at one particular issue. However, the initial use of the model was to simulate 4500

gpm of discharge from the Hermosa Outfall2 location. The highly advanced MIKESHE integrated modeling tool used surface conditions (topography, soils, vegetation) combined with hourly precipitation, temperature, and potential evapotranspiration data to predict storm runoff in the Sonoita Creek watershed. The MIKESHE model then simulated the fate of that runoff plus the additional proposed WTP2 discharge in Harshaw Creek through a sophisticated 3D unsaturated and saturated zone physically based flow model.

Figure 20 illustrates simulated discharge at the TNC Patagonia-Sonoita Creek Preserve under baseline conditions (yellow) and with 4500 gpm of discharge from WTP2 for roughly four years. This graphic shows that after only a little over a month of wetting up the channel and local aquifer system, the added WTP2 discharge is conveyed with virtually no loss (not accounting for evapotranspiration increases over time) from WTP2 through town and down to the TNC preserve. The size of the storm peaks with the additional WTP2 discharge is augmented due to the lack of unsaturated zone storage capacity resulting from shallow groundwater and shallow bedrock in Harshaw Creek; thus storm flows are "rejected" from the groundwater system rather than being able to infiltrate the way they could under baseline conditions. This hydrologic behavior is supported by Schrag-Toso's (2020) assessment that, "….the thin veneer of stream channel sediments appears to be a conduit of groundwater flow, moving groundwater discharged from the fracture system mixed with recent precipitation towards the Sonoita Creek basin."

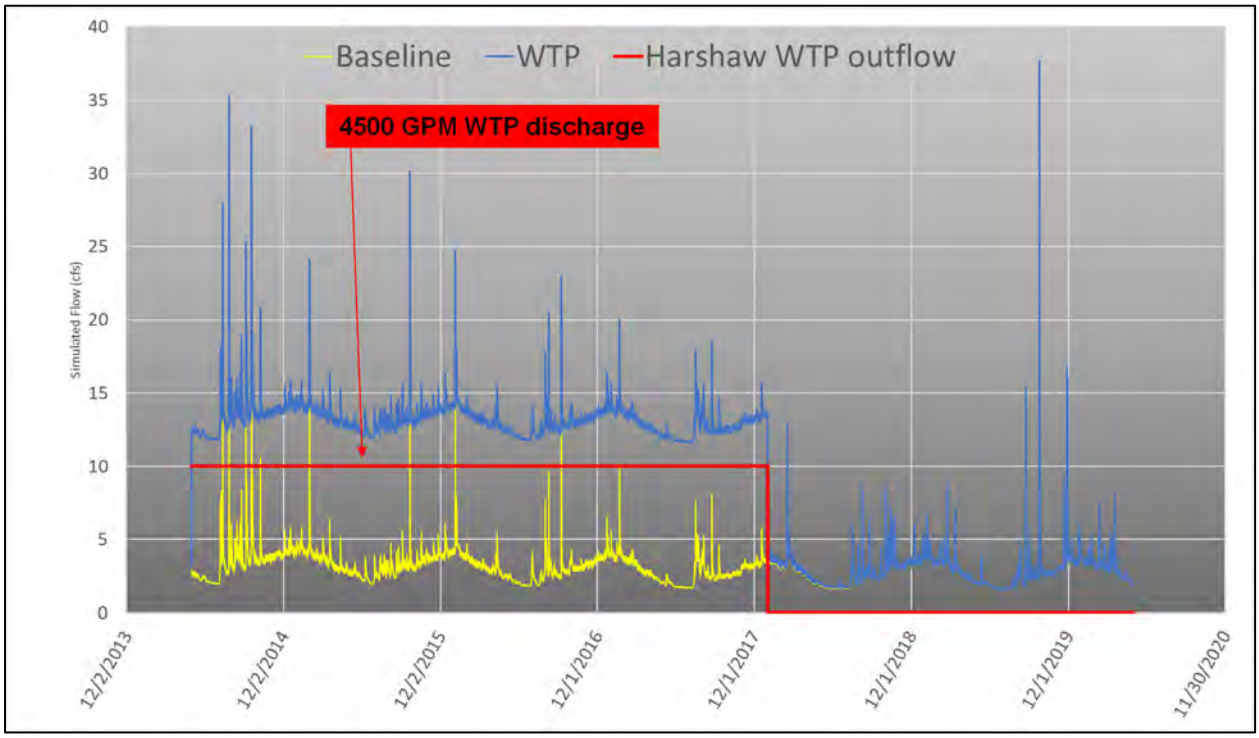

Figure 20. Simulated discharge at the TNC Patagonia-Sonoita Creek Preserve with and without 4 years of 4500 gpm discharge at WTP2.

Pumping Test Data Needed

One test of this simulated response would be the analysis of discharge from the various pumping tests that AMI/South32 has conducted. Figure 21 shows the locations and associated AZPDES permits for 2017 pumping tests in three wells on the Hermosa Project site. Schrag-Toso (2020) documented

pumping-test-related discharge in Harshaw Creek in the winter of 2019-2020. His sample of this flow revealed an isotopic age of at least 1000 years (probably older), indicating a deep source (Schrag-Toso, 2020). **ADEQ should carefully review the details of these and all other pumping tests conducted on the Hermosa Project site with discharge to Harshaw Creek prior to issuance of an AZPDES permit**. In addition, this information may help further calibrate the MIKESHE model and refine its predictions regarding the fate of WTP2 discharge downstream. It is our understanding that Patagonia Area Resource Alliance has requested this information from AMI but AMI has not provided this information.

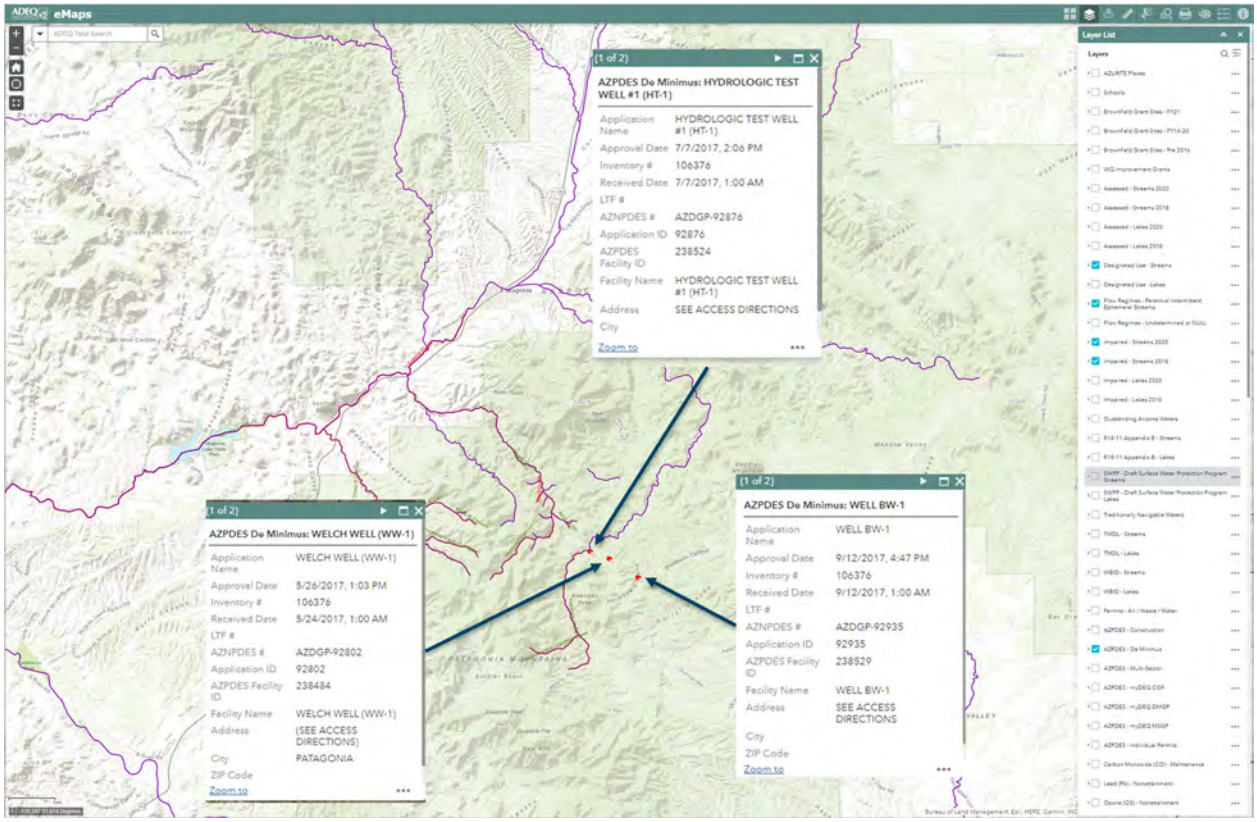

Figure 21. ADEQ map showing locations and AZPDES permits for three pumping tests on Hermosa Project site in 2017.

Cumulative Contaminant Impacts

The Upper Harshaw Creek TMDL assessment acknowledges that:

> *Findings from the USGS investigation suggest that **streambed sediments** are the primary source of pollutant loading (personal comm, Floyd Gray, USGS, 05/31/02). Streambed sediments are not directly addressed by this phase of the TMDL due to a lack of data that can be used to associate sediment concentrations with water column concentrations at various discharges.*
>
> - ADEQ, 2003a

The fact that this major source of contaminants is not addressed in a TMDL is a regulatory failure. Compounding that failure is ADEQ's lack of consideration of the potential for this contaminant source to

affect surface water and groundwater downstream from the TMDL-regulated upper Harshaw Creek reach. In determining appropriate water-quality-based discharge limits for WTP2, ADEQ must assess the risk of contaminant transport from upstream of WTP2 to lower Harshaw Creek and acknowledge the existing natural background levels of high copper, zinc, and acidity already existing in lower Harshaw Creek.

ADEQ must revise its TMDL assessment for Harshaw Creek to include the entire length of both upper and lower reaches and to account for natural background as well as existing legacy mine-related contaminants in stream sediments.

WTP2 Discharge Will Affect Local Wells

Harshaw Creek is a major conduit for both surface water and groundwater to the Sonoita Creek valley. WTP2 discharge will rapidly fill the narrow and shallow alluvium along lower Harshaw Creek, driving waters that would otherwise have recharged through the streambed directly into the Town of Patagonia and the Sonoita Creek aquifer. AMI's determination of the total length of flow for the WTP2 discharge (ERC, 2020 and Clear Creek Associates, 2020) included no consideration for changing saturation levels under Harshaw Creek in the presence of a continuous (perennial) water source. This saturation is likely to keep Harshaw Creek flowing all the way to the perennial EDW reach of Sonoita Creek within several weeks of the initiation of discharge from WTP2 (Lacher & Prucha, 2020). **Thus, all contaminants introduced to this new perennial flow in lower Harshaw – either by storm runoff from upper Harshaw Creek, by WTP2 discharge, or from natural background in Harshaw Creek -- will now be readily conveyed downstream instead of recharging into otherwise available soil pore space.** Large floods that would have discharged from Harshaw Creek to Sonoita Creek without the presence of WTP2 discharge will be augmented by not just the 4500 gpm (10 cubic feet per second) of WTP2 discharge but also by all of the natural runoff that would otherwise have recharged into the sediments below and adjacent to Harshaw Creek. Groundwater that would normally have resided in Harshaw Creek drainage will now flow in response to a larger gradient downstream to Sonoita Creek. From the documents we have reviewed, none of this has been evaluated by ADEQ in its preparation of the draft AZPDES permit.

Any contaminants conveyed by Harshaw Creek surface and groundwater flows will now have more immediate contact with the Sonoita Creek alluvial aquifer which is the primary source of drinking water for Patagonia residents. Well owners along Harshaw Creek will likely experience increased groundwater levels and potentially increased contaminant levels associated with the WTP2 discharge. The potential for WTP2 discharge to impact drinking water wells is unquestionable. AMI's consultant used the Theis equation (Theis, 1935) to calculate a groundwater 30-year travel distance to the northwest of the "anticipated end of surface flow" shown in Figure 15 as 7,227 ft (Clear Creek Associates, 2020). This would put any groundwater recharge from the WTP2 roughly 500 ft above the Sonoita Creek confluence, and well within the range of numerous local wells. However, the MIKESHE model suggests a very different system response, with flows from WTP2 reaching the TNC preserve downstream of the Town of Patagonia within several weeks of the initiation of 4500 gpm flows. Figure 22 illustrates AMI's delineated "Discharge Impact Area" (DIA) overlain on a map of groundwater wells used to define groundwater elevations for the MIKESHE model. This is a subset of all wells in the area. Notably, there are many wells within the entire length of the DIA up Harshaw Creek and south of Outfall 2.

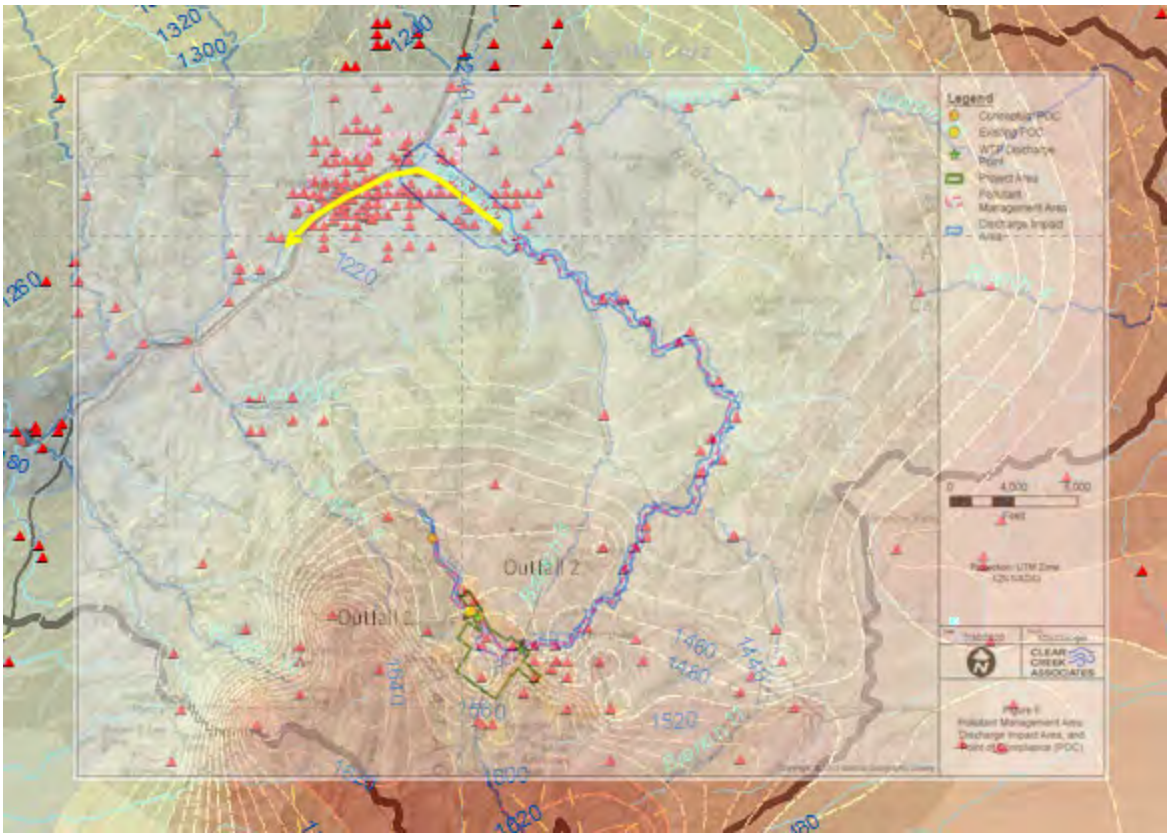

Figure 22. Overlay of AMI's "Discharge Impact Area" (Clear Creek Associates, 2020) on map of groundwater wells (red triangles) and groundwater elevations (Lacher & Prucha, 2020). Yellow arrow shows flow path into and down Sonoita Creek toward the TNC Preserve.

Figure 23 illustrates the conceptual model of flow and contaminant transport down Harshaw Creek to the perennial reach of Sonoita Creek. This graphic highlights the following key issues:

1. Lower Harshaw Creek will convert to fully perennial flow with WTP2 discharge, possibly within several weeks;
2. Multiple sources of contaminants exist in upper and lower Harshaw Creek;
3. WTP2 flows will facilitate transport of these contaminants and those from WTP2 effluent directly to the center of the alluvial aquifer that is the primary drinking water source for residents of the Town of Patagonia.

The complex relationships between groundwater and surface water in this system clearly mandate the use of a **fully integrated hydrologic model**. No other predictive tool will be able to evaluate the rapid feedbacks between the various hydrologic system components and simulate the transport of chemical constituents within the surface and subsurface flows.

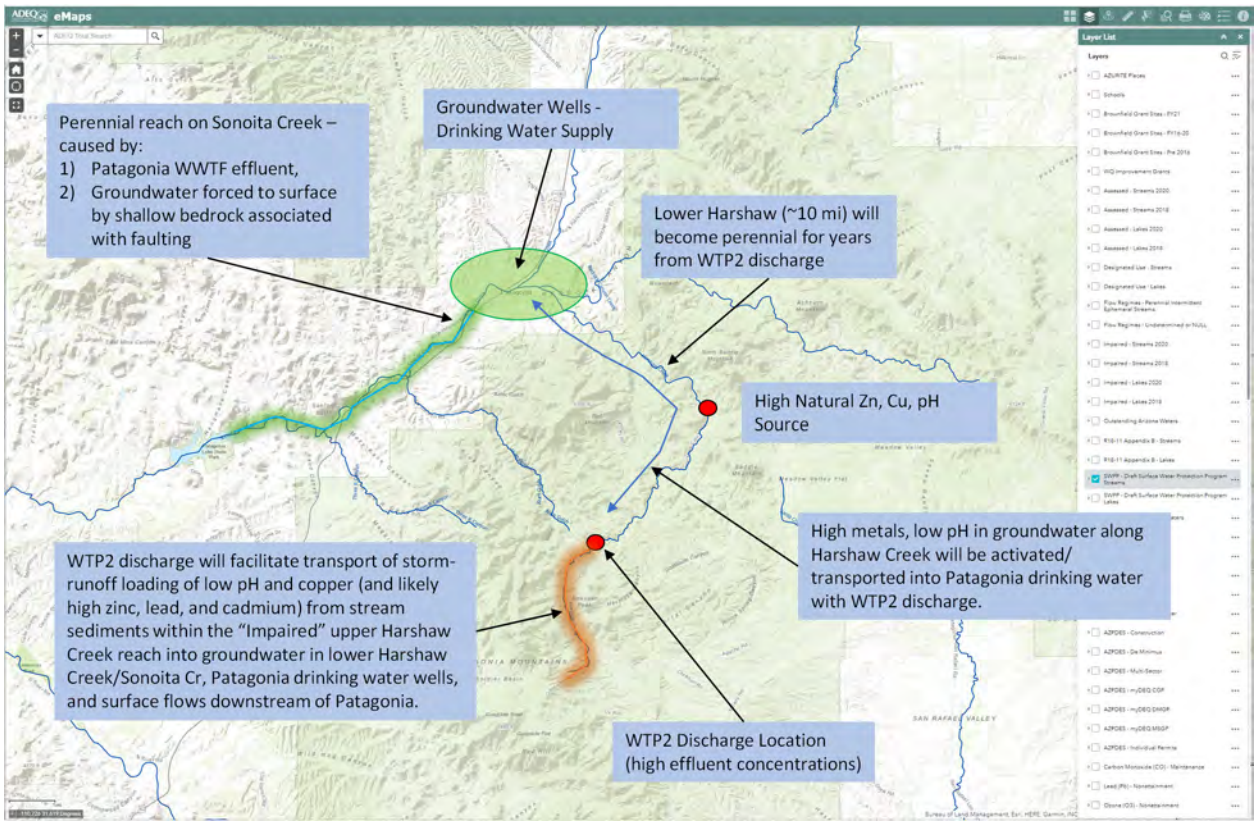

Figure 23. Conceptual model of flow and transport of contaminants along Harshaw Creek and down to perennial reach of Sonoita Creek.

In order to protect ALL downstream water uses, ADEQ must consider drinking water sources in the alluvium of Harshaw and Sonoita Creeks. While these alluvial systems currently have no formal WQS, they are likely WOTUS (ADEQ, 2021b) and the Drinking Water Supply (DWS) Designated Use code should be applied to all upstream contributing waters in this permit to protect the public health. Table 4 compares the Trace Substance Monitoring levels proposed for WTP2 with downstream water body WQS by designated use. The A&Wedw, AgL, and PBC codes currently apply to the first perennial reach of Sonoita Creek and will apply to the new perennial EDW in Harshaw Creek. The DWS Designated Use code should be applied to all waters upgradient of the wells in the alluvial aquifers of Harshaw and Sonoita Creeks, so those standards are presented, as well. The Town of Patagonia has 874 residents, and they operate municipal wells in the shallow alluvium along Sonoita Creek, with very limited treatment capacity. Other individuals also use domestic wells in the alluvium along Harshaw and Sonoita Creeks. The most stringent standards are highlighted in bold in Table 4. Nickel is the only constituent where the proposed monitoring level is lower than the downstream WQS. Many of the A&Wedw standards are specified as "dissolved" rather than "total recoverable" metals. A **transfer study**, as provided for in the Draft AZPDES Permit (ADEQ, 2021a), is necessary to determine the concentration of dissolved constituents in the WTP2 effluent that is required to assess the discharge limits necessary to protect ALL of the downstream water uses. Additional contaminants (eg, cadmium) should be added to the regulated list of contaminants, as required, to protect drinking water and other downstream uses.

Table 4. Proposed Levels for "Trace Substance Monitoring" for Outfall 002 (WTP2) and Arizona WQS by Designated Use.

Parameter	Proposed Assessment Levels (µg/L)	Arizona WQS by Designated Use			
		A&Wedw	AgL	PBC	DWS
Antimony	986	600 D		747 T	**6 T**
Arsenic	246	150 D	200 T	280 T	**10 T**
Beryllium	8.7	5.3 D		1867 T	**4 T**
Chromium, total (5)	1500		1000		**100 T**
Chromium VI (D) (5)	16	**11 D**		2800 T	21 T
Cyanide	16	**9.7 T**	200 T	588 T	200 T
Iron	1640	**1000 D**			
Nickel	**190**	468 H		28000 T	210 T
Nitrogen, TKN, or Nitrate/Nitrite as N	Report (mg/L)	3,733,333			10000/1000
Selenium	3	**2 T**		4667 T	50 T
Silver	16.4	**3.2 H**			35 T
Thallium	109	150 D			**2 T**
NOTES:					
T = total metals					
D = dissolved metals					
H = hardness of 100-399 mg/L					

Significantly More Compliance Monitoring Needed

Because of the large uncertainties surrounding the quality of WTP2 discharge and the complex dynamics of the hydrologic system and multiple important water uses downstream, substantially increased compliance monitoring compared to that currently proposed in the draft AZPDES permit should be required to ensure the health and safety of all downstream water users. Specific monitoring requirements should require AMI to:

1. Install a gaging station with real-time discharge data (publicly available), continuous WQ sampling capability, and a precipitation gauge at the mouth of Harshaw Creek (on the bridge). AMI should pay USGS to install and maintain this gage for (at least) the life of the mine.
2. Publish real-time discharge data (dedicated web portal or via USGS) and WQ results (weekly, at a minimum) from WP2 and WP1.
3. Install RAWS transmitting precipitation/flood-warning gages (at least 2) in the upper Harshaw watershed.
4. Install a permanent, continuously recording streamflow and WQ gaging station between the Patagonia WTTF outfall and the TNC preserve.
5. Install and monitor (with telemetry) several (at least 5) alluvial aquifer wells along Harshaw Creek and Sonoita Creek from WTP2 through town.
6. Report any measured exceedances from the WTP2 outfall within 24 hours and shut down discharge if exceedance persists for more than 24 hours.
7. Report any exceedances of threshold groundwater-level increases (to be determined) in monitoring wells and discontinue discharge at designated trigger level in two or more wells in town.

Summary and Conclusions:

1. The current draft AZPDES permit for WTP2 discharge to Harshaw Creek is wholly insufficient for protecting downstream waters. The technology-based standards currently in Table 1.c of the draft permit must be replaced with water quality-based standards that are protective of ALL downstream water uses, including drinking water.
2. The high recreational and ecological value of Harshaw Creek must be considered in any permit to discharge. The consumption of this water by endangered species and other wildlife plus increased recreational exposure by human visitors as a result of new perennial flow from WTP2 requires a higher level of protection than that offered in the current draft permit.
3. Harshaw Creek currently contains sources of contaminants from legacy mining activities and natural background. This contaminant loading must be assessed in a new TMDL for lower Harshaw Creek to determine the WTP2 discharge limits that will protect all downstream water users, especially those consuming drinking water from the alluvial aquifers that will be impacted by WTP2 discharge.
4. Harshaw Creek will become perennial for several years as a result of WTP2 discharge. The impacts of this perennial flow on existing Critical Habitat must be evaluated through an Environmental Assessment (EA) or Environmental Impact Statement (EIS) process prior to approval of any discharge. Furthermore, the cumulative impacts of creating a perennial flow, and then removing it years later, on species who have grown dependent on that water source must also be evaluated in an EA/EIS process.
5. The hydrologic system requires an integrated hydrologic modeling tool to assess the complex groundwater-surface water dynamics and to evaluate the real risk of contaminant transport from WTP2 and Harshaw Creek to the drinking water wells downstream.
6. The distribution of proposed contaminant limits between Alum Gulch and Harshaw Creek discharges is unjustifiably lopsided, with some loading in Harshaw Creek (WTP2) amounting to nearly 10 times that permitted for Alum Gulch (WTP1). The WTP2 limits should be as protective as those for Alum Gulch, particularly in light of the real risk to downstream drinking water wells in and near the Town of Patagonia.
7. Significantly more frequent and more spatially distributed compliance monitoring will be needed to ensure the health and safety of all downstream water users.

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ATTACHMENT 5

January Mine Water Treatment Plant AZ0026387
AZPDES Discharge Flow Records – Flow Rate and pH
Outfall 002

(August 2023)
(September 2023)
(October 2023)
(November 2023)

APPENDIX B

AZPDES Discharge Flow Record

January Mine Water Treatment Plant - AZ0026387
Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: August **Year:** 2023

DATE	Flow Duration (1) (Total hours per day)	Flow Rate(2) (Total MGD per day)
1	No Discharge (ND)	
2	ND	
3	ND	
4	ND	
5	ND	
6	ND	
7	ND	
8	ND	
9	ND	
10	ND	
11	ND	
12	ND	
13	ND	
14	ND	
15	ND	
16	ND	
17	ND	
18	ND	
19	ND	
20	ND	
21	ND	
22	ND	
23	ND	
24	ND	
25	ND	
26	ND	
27	ND	
28	ND	
29	ND	
30	8 hours	0.098
31	16 hours	~~0.16~~ 0.163

Comment:

footnotes:
(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.
(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

ADEQ Arizona Department of Environmental Quality

APPENDIX B

AZPDES Discharge Flow Record

January Mine Water Treatment Plant - AZ0026387
Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: September **Year:** 2023

DATE	Flow Duration (1) (Total hours per day)	Flow Rate(2) (Total MGD per day)
1	6 hrs	0.0575
2	0 hrs	0
3	0	
4	0	
5	0	
6	0	
7	0	
8	0	
9	0	
10	0	
11	0	
12	0	
13	0	
14	0	
15	0	
16	0	
17	0	
18	0	
19	0	
20	0	
21	0	
22	0	
23	≈ 13.5 hrs.	.1216649
24	≈ 2.5 hrs	.17052001629411
25	24 hrs.	.183953
26	24 hrs.	.190935
27	24 HRS	.181813
28	24 HRS	.142,199
29	24 HRS	.142,700
30	24 HRS	.169000
31	~~24 hours~~ n/a	~~data~~ n/a

Comment:

footnotes:
(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.
(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

ADEQ Arizona Department of Environmental Quality

AZPDES Weekly pH Record

January Mine Water Treatment Plant - AZ0026387

Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: September **Year:** 2023

Week	Date	pH
1	9/1/23	7.2
2	ND	
3	ND	
4	ND	
5	ND	
6	ND	
7	ND	
8	ND	
9	ND	
10	ND	
11	ND	
12	ND	
13	ND	
14	ND	
15	ND	
16	ND	
17	ND	
18	ND	
19	ND	
20	ND	
21	ND	
22	ND	
23	9.23.23	7.1
24	9.24.23	6.9
25	9.25.23	6.9
26	9.26.23	7.0
27	9/27/23	7.1
28	9/28/23	7.2
29	9/29/23	7.2
30	9/30/23	7.2
31		

Comment:

ADEQ Arizona Department of Environmental Quality

APPENDIX B

AZPDES Discharge Flow Record

January Mine Water Treatment Plant - AZ0026387

Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: October **Year:** 2023

DATE	Flow Duration (1) (Total hours per day)	Flow Rate(2) (Total MGD per day)
1	24 hrs	.181116
2	24 hrs	.188873
3	24 hrs	.197467
4	24 hrs	.201288
5	24 hrs.	.228807
6	24 hrs	.209695
7	24 hrs	.203213
8	24 hrs.	.208603
9	20 hrs.	.192339
10	24 hrs.	.214128
11	24 hrs.	.202435
12	24 hrs.	.208856
13	24 hrs.	.212133
14	24 hrs.	.198858
15	24 hrs.	.189749
16	24 hrs.	.212795
17	24 hrs.	.212325
18	24 hrs.	.218345
19	24 hrs.	.216236
20	15 hrs.	.130388
21	24 hrs & JM	0
22	24 hrs & JM	0
23	& JM	0
24	10	.118356
25	24 hrs.	.224536
26	24 hrs.	.222321
27	24 hrs.	.221.013
28	24 hrs.	.202515
29	24 hrs.	.216204
30	24 hrs.	.215358
31	24 hrs	.229361

Comment:

footnotes:
(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.
(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

ADEQ Arizona Department of Environmental Quality

AZPDES Weekly pH Record

January Mine Water Treatment Plant - AZ0026387

Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: October **Year:** 2023

Week	Date	pH
1	~~10/1~~ 10/1/23	7.3
2	10/2/23	7.46
3	10/3/23	7.6
4	10/4/23	7.6
5	10/5/23	7.1
6	10/6/23	7.1
7	10/7/23	7.0
8	10/8/23	~~7.1~~
9	10/9/23	6.4
10	10/10/23	6.9
11	10/11/23	6.9
12	10/12/23	6.82
13	10/13/23	7.16
14	10-14-23	6.94
15	10/15/23	7.17
16	10/16/23	7.26
17	10/17/23	6.8
18	10/18/23	7.14
19	10/19/23	7.0
20	10/20/23	7.57
21	10/21/23	8.2 – ND
22	10/22/23	8.1 – ND
23	10/23/23	7.9 – ND
24	10/24/23	7.5
25	10/25/23	6.8
26	10/26/23	6.8
27	10/27/23	6.8
28	10/28/23	6.7
29	10/29/23	6.8
30	10/30/23	~~6.6~~ 6.1 JM
31	10/31/23	6.8

Comment:

ADEQ Arizona Department of Environmental Quality

APPENDIX B

AZPDES Discharge Flow Record

January Mine Water Treatment Plant - AZ0026387
Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31° 27' 57" N , Longitude 110° 43' 12" W

Month: November **Year:** 2023

DATE	Flow Duration (1) (Total hours per day)	Flow Rate(2) (Total MGD per day)
1	11-1-23 24 hrs	.26816
2	11/2/23 24 hrs	.190334
3	11/3/23 24 hrs	.191744
4	11/4/23 24 hrs	.197,648
5	11-5-23 24 hrs	.190100
6	11-6-23 (24 hrs) 24 hrs	.183,511
7	11-7-23 (20 hrs) 20 hrs	.168,572
8	24 hrs 24 hrs	.195,565
9	24 hrs 24 hrs	1,239,351
10	24 hrs 24 hrs	.195,095
11	24 hrs 24 hrs	.187773
12	22 hrs. 22 hrs	.178878
13	24 hrs	.190 630
14	24	.189',184
15	24	.196,598
16	24	.189,691
17	24hr	.187770
18	24hr	.198364
19	24hr	.180458
20	24	.194409
21	23 hrs	.195,985
22	24 hrs	.195,129
23	24 hrs	.195,034
24	24 hrs	.189,871
25	24 hrs.	DM [redacted] .189,871
26	6 hrs	.54,228
27	Plant Down	
28		
29		
30		
31		

Comment:

footnotes:
(1) Total time of discharge in hours per day. If actual time is not available, use an estimate of flow duration.
(2) Report flow discharged in MGD. If no discharge occurs on any given day, report 'ND' for the flow for that day

ADEQ Arizona Department of Environmental Quality

AZPDES Weekly pH Record

January Mine Water Treatment Plant - AZ0026387

Discharge to Harshaw Creek in the Santa Cruz Basin At:

Outfall No.:002

Location: Latitude 31' 27' 57" N , Longitude 110· 43' 12" W

Month: November **Year:** 2023

Week	Date	pH
1	11-1-23	6.7
2	11/2/23	7.1
3	11/3/23	7.0
4	11/4/23	7.8
5	11-5-23	7.0
6	11-6-23	7.28
7	11-7-23	7.20
8	11-8-23	7.12
9	11-9-23	6.6
10	11.10.23	10.81
11	11.11.23	6.8
12	11.12.23	7.0
13	11.13.23	6.74
14	11.14.23	6.63
15	11-15-23	6.9
16	11-16-23	7.1
17	11-17-23	7.0
18	11.18-23	7.0
19	11-19-23	7.1
20	11-20-23	7.1
21	11/21/2023	7.58
22	11/22/2023	7.62
23	11/23/2023	7.31
24	11/24/2023	7.0
25	11.25	7.0
26	11.26.23	7.5
27	Plant down	Plant Down
28	↓	↓
29		
30		
31		

Comment:

Presentation to Hermosa Advisory Panel

Wednesday, November 15, 2023

Rosalind Schoof, PhD
Alma Feldpausch, MS
Robinan Gentry, PhD

Outline of discussion

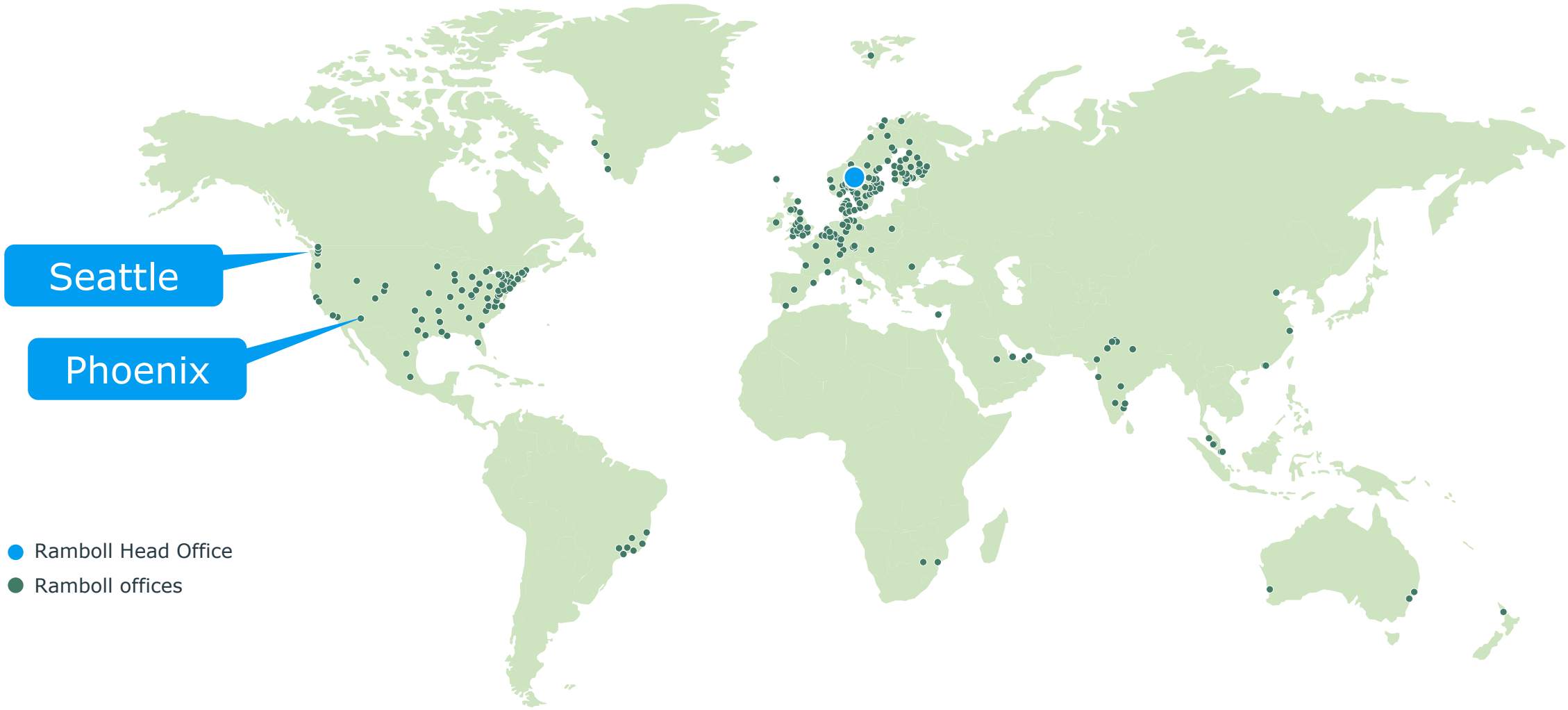
1. Who is Ramboll and what is Ramboll’s role?
2. Manganese – environmental overview
3. Manganese - toxicity primer
4. Next steps

Who is Ramboll & what is Ramboll's role?

Ramboll in brief

- Independent science, engineering, architecture, and consultancy company
- Founded 1945 in Denmark
- 18,500 experts world-wide
- Present in 35 countries
- Particularly strong presence in the Nordics, the UK, North America, Continental Europe, and Asia Pacific
- Creating sustainable solutions across Environment & Health, Buildings, Transport, Energy, Water, Management Consulting, and Architecture & Landscape
- Owned by The Ramboll Foundation – Rambøll Fonden
- Ramboll Americas leadership: Cheryl Ginyard-Jones
- Americas Environment & Health leadership: Jeanne Tarvin

Our global footprint



Rosalind Schoof, PhD, DABT, Fellow ATS

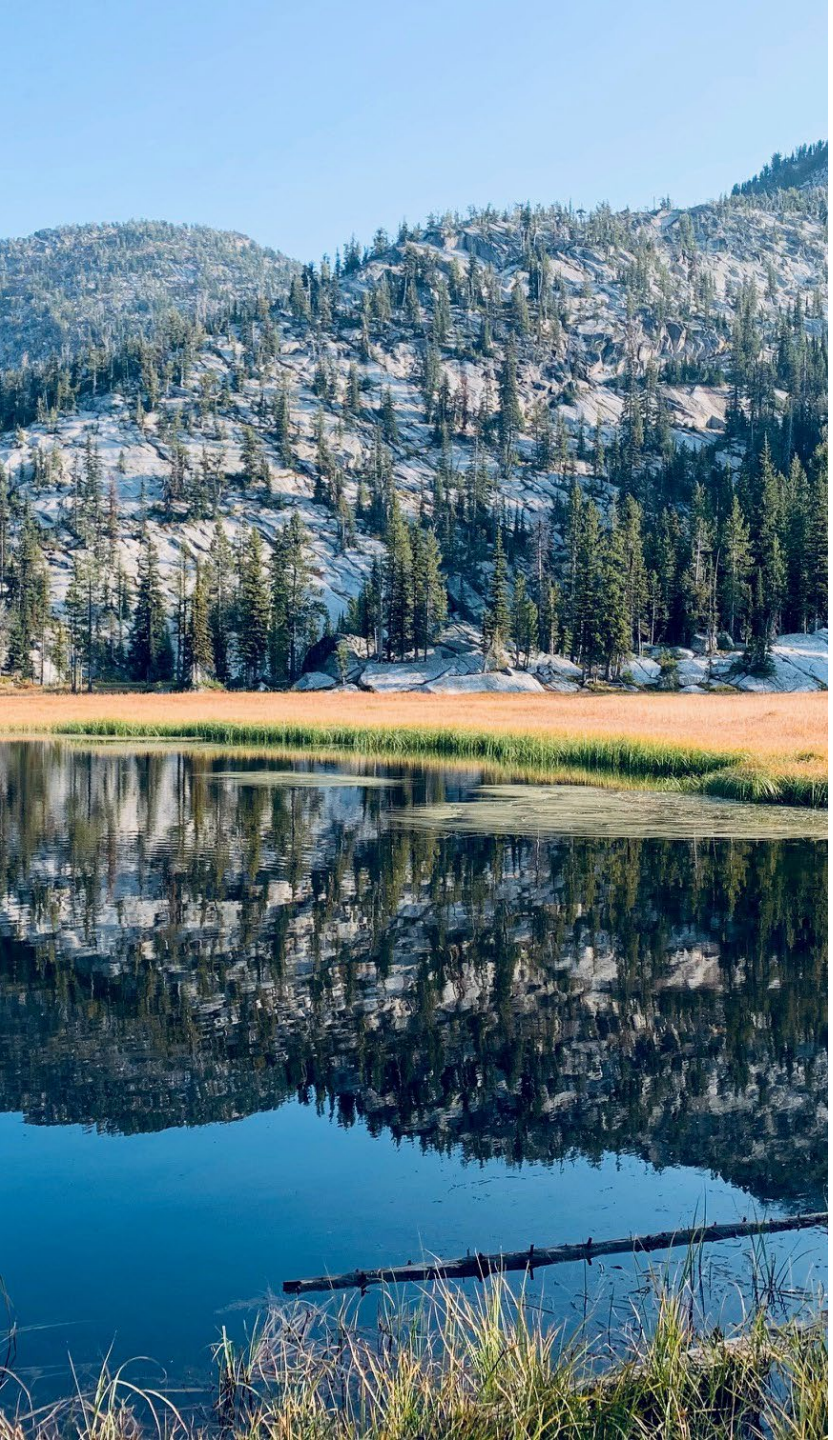
- Board certified toxicologist with more than 35 years' experience assessing human health effects and exposures from chemical substances in a variety of settings, including mines & smelters, commercial/ industrial/agricultural/residential projects, product uses, dietary exposures and general home and community exposures.
- Internationally recognized expert on evaluation of lead, arsenic and other metals in the environment and in the diet, and on the bioavailability of metals from soil with over 35 peer-reviewed publications.
- Extensive experience assessing potential risks from exposure to metals at mine and smelter sites in North and South America, including conducting community biomonitoring studies.

Alma Feldpausch, MS, DABT

- 25+ years experience working in environmental health, human health risk assessment and community health, exposure assessment, risk communication, biomonitoring, bioavailability, environmental justice in communities where mining and smelting, refineries, manufacturing occurs throughout North & South America
- Experience evaluating exposure to inorganic and organic compounds via subsistence consumption of wild foods as well as conventional foods
- Certified by the American Board of Toxicology

Robinan Gentry, PhD, DABT

- Board certified toxicologist with more than 35 years' experience in toxicological issues relevant in the determination of the potential safety or risk associated with exposure to chemicals in consumer products, pharmaceuticals or the environment.
- A principal investigator or contributing author for numerous safety and risk assessments for both government and industry, with over 60 peer-reviewed publications. The purpose for a number of these assessments has been to incorporate innovative quantitative approaches in the determination of acceptable levels of exposure of humans to chemicals in the environment, pharmaceuticals and consumer products.
- She is a published author in the development of physiologically-based pharmacokinetic (PBPK) models and their application into both the cancer and non-cancer safety and risk assessment processes.



Ramboll health sciences & mining/smelting

- Decades of experience studying exposures & health risks, and providing risk communication to mining and smelting communities throughout North and South America, and also experience working on sites in Africa, Australia, SE Asia, Northern Europe
- Health sciences team has published dozens of peer-reviewed studies in collaboration with agency, academic, industry researchers
- Primary focus has been on lead, arsenic, mercury, antimony, cadmium, selenium, manganese, other metals as well as organic chemical compounds in soil, indoor & outdoor dust, air, wild food, drinking water, recreational waters, commercial food, consumer products
- Most studies have been performed in communities with a long history of mining or smelting, predating promulgation of environmental regulations
- Collaborate with multidisciplinary teams consisting of epidemiologists, statisticians, geologists, engineers, environmental chemists, atmospheric scientists, industrial hygienists, analytical & geospatial data analysts

Current role

1. Contracted with South32 in November 2023 to provide on-call technical support related to human health

2. Quickly getting up to speed on mine plans, previous advisory panel engagements

3. Primary role is to serve as liaison between South32 and community on health-related matters

- Help develop relationships with independent scientists/ researchers with expertise in exposure assessment, toxicology, environmental health, community health

- Provide information on manganese and other metals toxicity

- Role will evolve as needs are refined and additional, outside technical support is identified

Preliminary thoughts on manganese & Hermosa-related manganese

Agency toxicity assessments are outdated, we will review most up-to-date assessments and explain how more recent research might influence earlier assessments

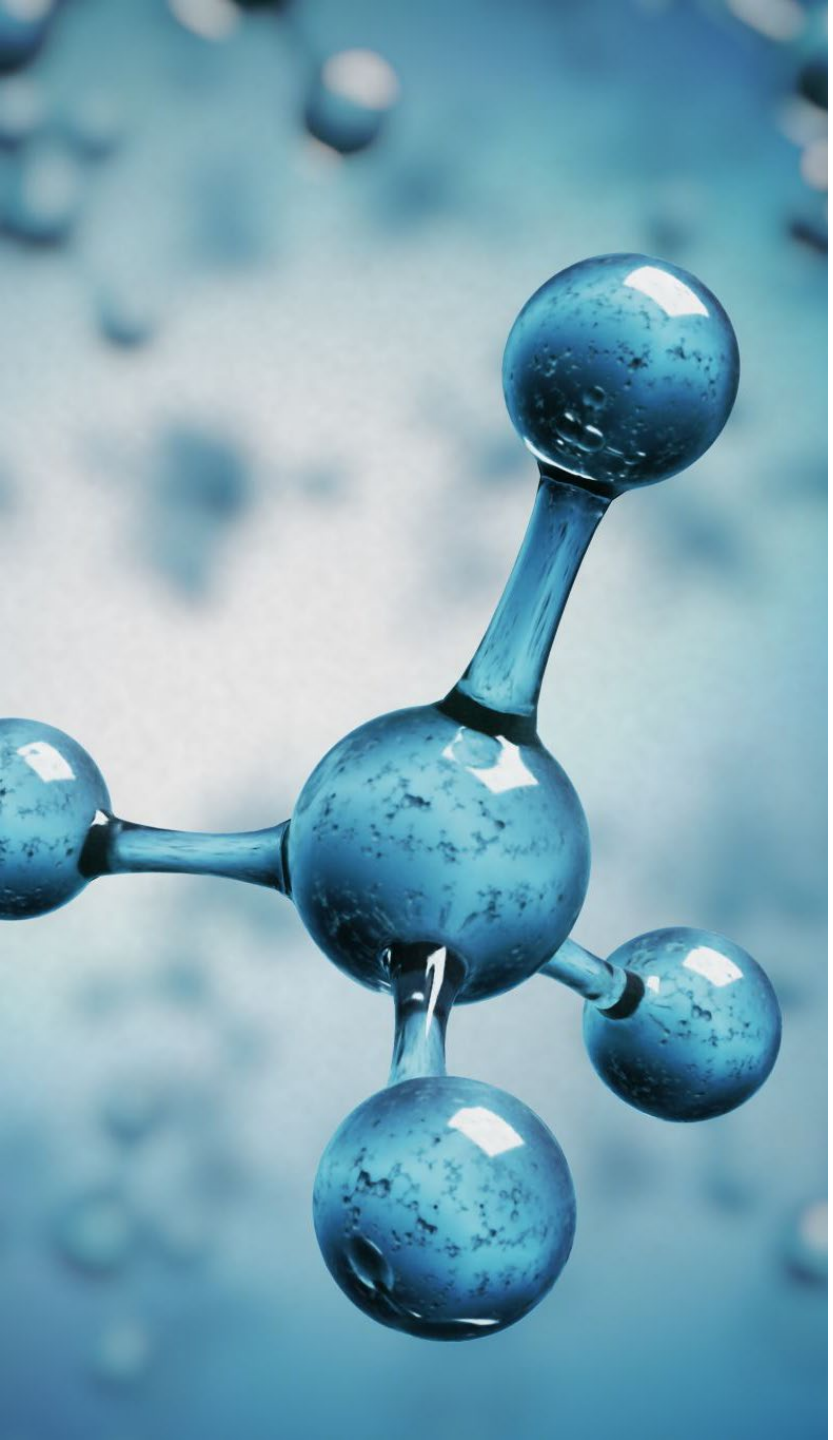
- USEPA – Dec 1993 (IRIS); Jan 2004 (HAL); Jan 2006 (WQC)
- ATSDR – Sept 2012
- Health Canada – Aug 2016
- CalEPA/OEHHA – May 2022 (DW notification level); 2008/2014 (REL)

Regarding drinking water exposures, USEPA's health advisory level of 300 µg/L and Health Canada maximum allowable concentration of 100 µg/L are higher than USEPA's secondary MCL of 50 µg/L protective of water discoloration and bad taste

Regarding inhalation exposures, most studies examine highly exposed workers

- Even recent studies of smelter communities have air concentrations above current safe concentrations
- Forms of Mn in Hermosa-related dust is expected to have lower ability to be absorbed into the body after inhalation compared with Mn fumes or smelter emissions in air
- Also, Hermosa-related Mn in soil & dust is expected to have reduced ability to be absorbed into the body after ingestion

Manganese – environmental overview



Where is manganese found?

Manganese (Mn) is a naturally occurring substance found in various rocks, soil, and food.

Manganese…

- Is not present in the environment as a pure substance
- Can be present in inorganic and organic chemical forms; inorganic forms occur most commonly in the environment & work settings
- Is combined with other substances, like oxygen, sulfur, and chlorine
- Cannot break down in the environment, but can change form or become attached or separated from particles
- Some forms are more easily dissolved or dissociated, other forms are firmly bound

Manganese is an essential nutrient, meaning it is necessary for good health

Typically, people are exposed to low levels of Mn in water, air, soil, and food

Source: ATSDR Toxicological Profile for Manganese

Manganese concentrations in soil

Manganese is found everywhere in soil, from natural and human-made sources

In areas with no known contamination source:

- United States soil concentrations range from 40-900 mg/kg (parts per million)
- Average background soil concentration is 330 mg/kg

(Source: ATSDR Toxicological Profile for Manganese)

- Range in Patagonia-area surface soil is 200-400 mg/kg, 0-5 cm (USGS 2013)

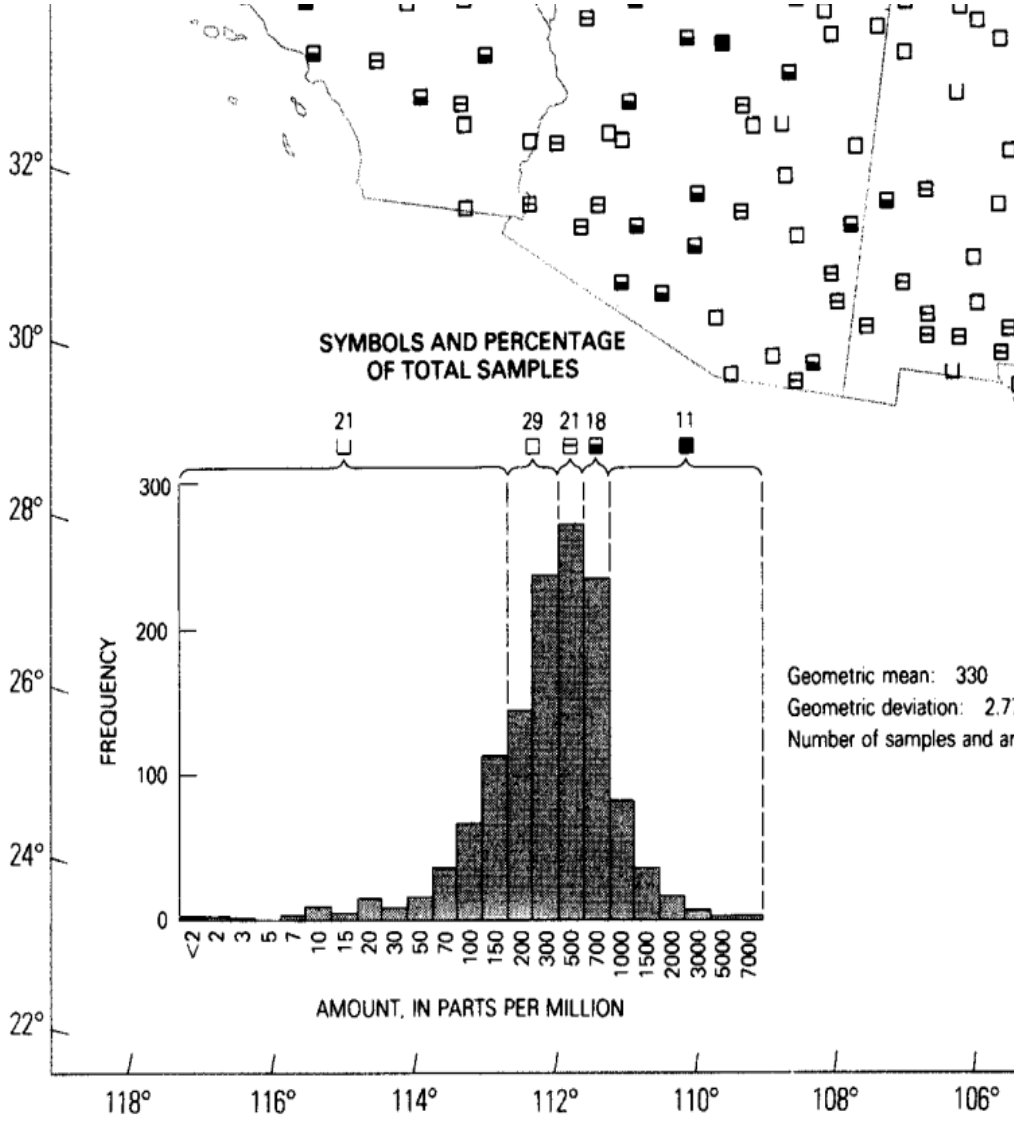


FIGURE 24.—Manganese content of surficial materials.

How might we be exposed to manganese?

Manganese is often found in vegetable and animal foods, occurs naturally in most foods

Daily intake estimates include…

Diet → 0.7 to 10.9 mg/day
(vegetarians often have higher Mn intake)

Drinking Water → 0.02 mg/day

Air → < 0.0002 mg/day
Average air concentrations = 10-70 ng/m^3
Negligible compared to intake from diet, unless people are exposed at work or live near Mn-emitting industries (e.g., foundries)

Our bodies are good at maintaining stable Mn levels, rapidly getting rid of excess Mn

1 cup of tea
0.4 to 1.3 mg/cup

Supplements
Multivitamin: 1 to 4.5 mg
Mn only: 5 to 20 mg

Other food sources

- Shellfish
- Nuts
- Grains
- Oatmeal
- Legumes
- Black pepper
- Spinach
- Pineapple

Bioavailability of manganese

Diet and drinking water:

1-5% of manganese is absorbed after ingestion

Fraction absorbed decreases with increasing dose (homeostatic controls)

Excretion also increases with dose

Soil:

We expect reduced absorption from soil compared with diet and drinking water

Bioavailability varies by manganese compounds present

Weathering reactions in soil will change chemical forms over time

Air:

Bioavailability will be a function of particle sizes and chemical forms

Particle sizes also determine location of deposition in lung and whether particles will end up in gut

Occupational exposures are unique

Individuals may also be exposed to manganese fumes, dust in work settings at much higher concentrations that those occurring in natural settings

Workplaces of exposure:

- Welding
- Steel factory
- Mining

Forms of manganese in work settings (fumes, fine dust) tend to be more easily absorbed by the body, and are different than forms found in soil, water, food

What levels are “safe” in environmental media?

Drinking Water

USEPA Health Advisory Level (HAL)

Adult (Lifetime)	0.3 mg/L = 300 µg/L
Adult (10 days)	1 mg/L = 1,000 µg/L
Infant to 6 mo. (10 days)	<0.3 mg/L = < 300 µg/L
Secondary maximum contaminant level (SMCL)	0.05 mg/L for taste & discoloration = 50 µg/L
Health Canada maximum allowable concentration (MAC)	0.1 mg/L = 100 µg/L

Soil

USEPA residential soil screening level = 1,800 mg/kg

Air

USEPA chronic reference concentration (RfC) based on a lowest adverse effect level for behavioral effects	0.00005 mg/m^3 = 50 ng/m^3
ATSDR chronic MRL based on central nervous system effects	0.0003 mg/m^3 = 300 ng/m^3
CalEPA / OEHHA chronic REL based on central nervous system effects	0.00009 mg/m^3 = 90 ng/m^3

What are safe human doses?

Oral

USEPA Chronic reference dose (RfD) Based on central nervous system effects	0.14 milligrams of Mn per kilogram body weight per day (mg/kg-day)

Diet

Food and Nutrition Board Adequate Intakes

Adult	Male: 2.3 mg/day Female: 1.8 mg/day
Infant to 6 mo.	Male: 0.003 mg/day Female: 0.003 mg/day

USEPA Integrated Risk Information System (IRIS)

https://iris.epa.gov/ChemicalLanding/&substance_nmbr=373

Is the presence of Mn a problem? It depends on…

Concentrations in Environment

- Air
- Water
- Soil
- Food

Contact With Environment

- Breathing rate
- Ingestion rate
- Skin Contact rate
- Duration & frequency of exposure

Exposure

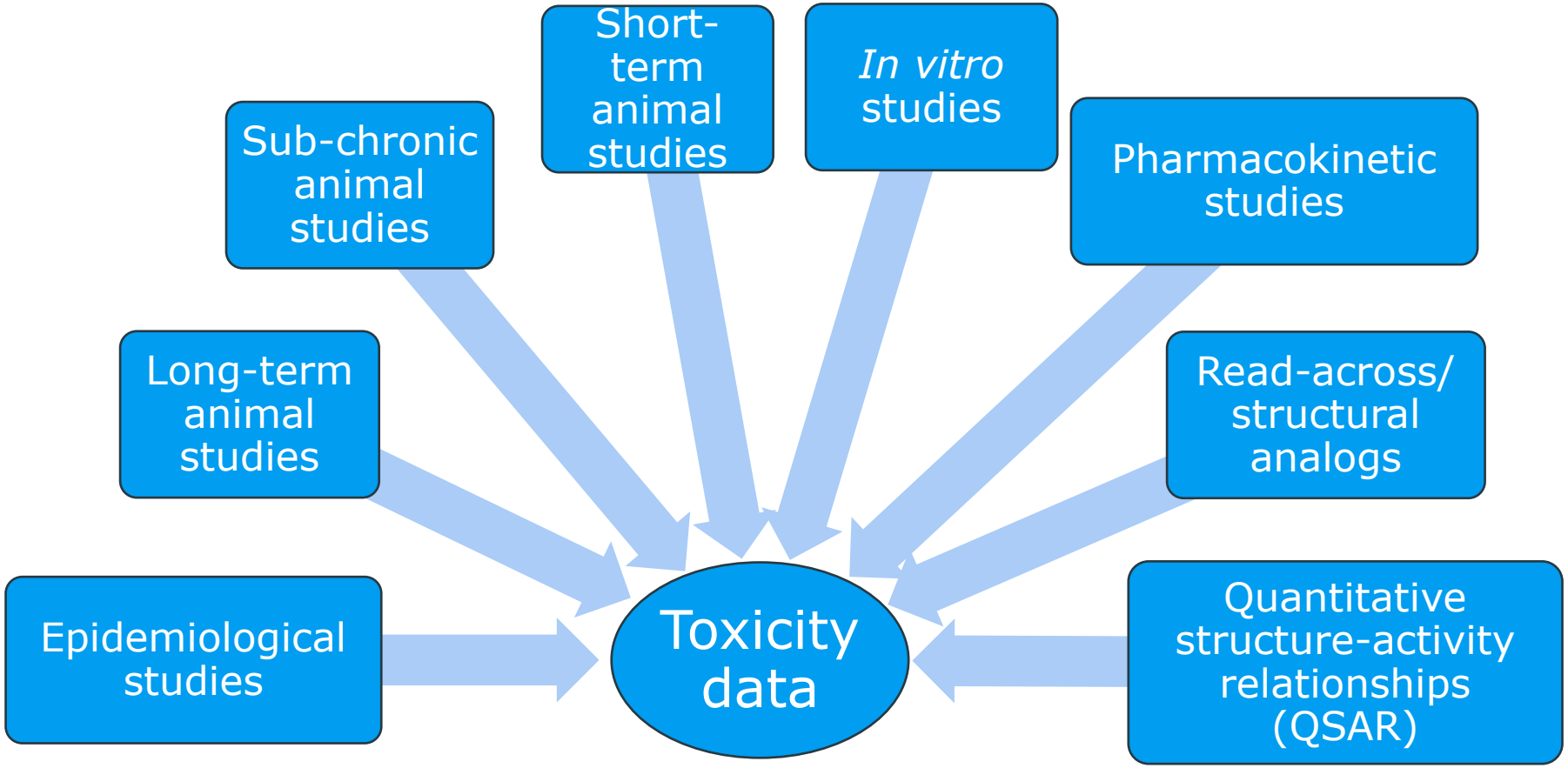
- Dose estimate
- Used to assess potential for adverse health effects

Two conditions must be met:

1. Environmental concentrations of bioavailable Mn are sufficiently high
2. People have sufficiently high contact with the environmental media

Manganese – toxicity primer

How do we understand if something is harmful, and how much can cause harm?



Traditional health risk assessment approaches present a significant challenge for compounds, such as manganese, which is **an essential element**

Deficiencies, as well as exposure to high concentrations, result in adverse effects.

Manganese is essential

As an essential nutrient several enzyme systems have been reported to interact with or depend on manganese to function. Also, manganese is required for:

- Formation of healthy cartilage and bone
- The urea cycle
- Aids in the maintenance of mitochondria and the production of glucose.
- Plays a key role in wound-healing

Manganese deficiency might cause: bone demineralization and poor growth in children; skin rashes, hair depigmentation, decreased serum cholesterol, and increased alkaline phosphatase activity in men; and altered mood and increased premenstrual pain in women.

(Source: ATSDR Toxicological Profile for Manganese)

But, too much is not a good thing

Occupational cohort studies provide data on potential health outcomes following inhalation exposure.

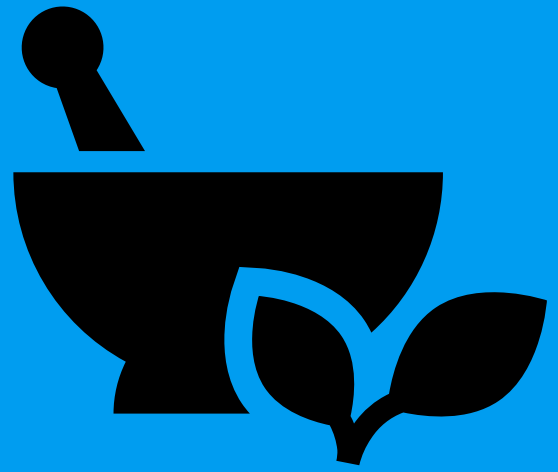
Exposure levels in work settings from inhalation are typically higher than other environmental exposures.

Consequences of Mn exposure above those levels defined as recommended daily amounts.

Using inhalation concentrations to measure dose may not adequately background tissue levels that may result from dietary exposure, as well as what is needed for normal processes.

Reports of adverse health effects in people exposed to high concentrations in food or water are limited

- Information on oral exposures comes mostly from animal studies.
- Generally, oral toxicity is low.



Respiratory effects of inhaled inorganic manganese

Inhaled particles small enough to enter the deepest parts of the lungs where oxygen-exchange occurs are absorbed directly into the blood stream

Larger particles trapped in the upper and middle airways are coughed up & swallowed, blown out through nose

In worker populations, inhaled Mn dust has caused respiratory irritation, inflammation, and can lead to bronchitis, pneumonitis, pneumonia

- These symptoms are common with most inhalable dust exposures
- Cardiovascular effects observed in workers (e.g., low blood pressure)
- Neurological effects observed in workers or people living near facilities that emit manganese = manganism

"Manganism is a progressive condition that usually begins with relatively mild symptoms, but evolves to include dull affect, altered gait, fine tremor, and sometimes psychiatric disturbances. Some of these symptoms also occur with Parkinson's disease, which has resulted in the use of terms such as "Parkinsonism-like disease" and "manganese-induced Parkinsonism" to describe those symptoms observed with manganese poisoning."

- Manganism and Parkinsonism are different in effect and pathology.

(Source: ATSDR Toxicological Profile for Manganese)

Exposures associated with manganism

Nervous system impacts are most common health problem in workers exposed to high levels of manganese.

Behavioral changes and other nervous system effects, such as movements that may become slow and clumsy; combination of when sufficiently severe is referred to as “manganism.”

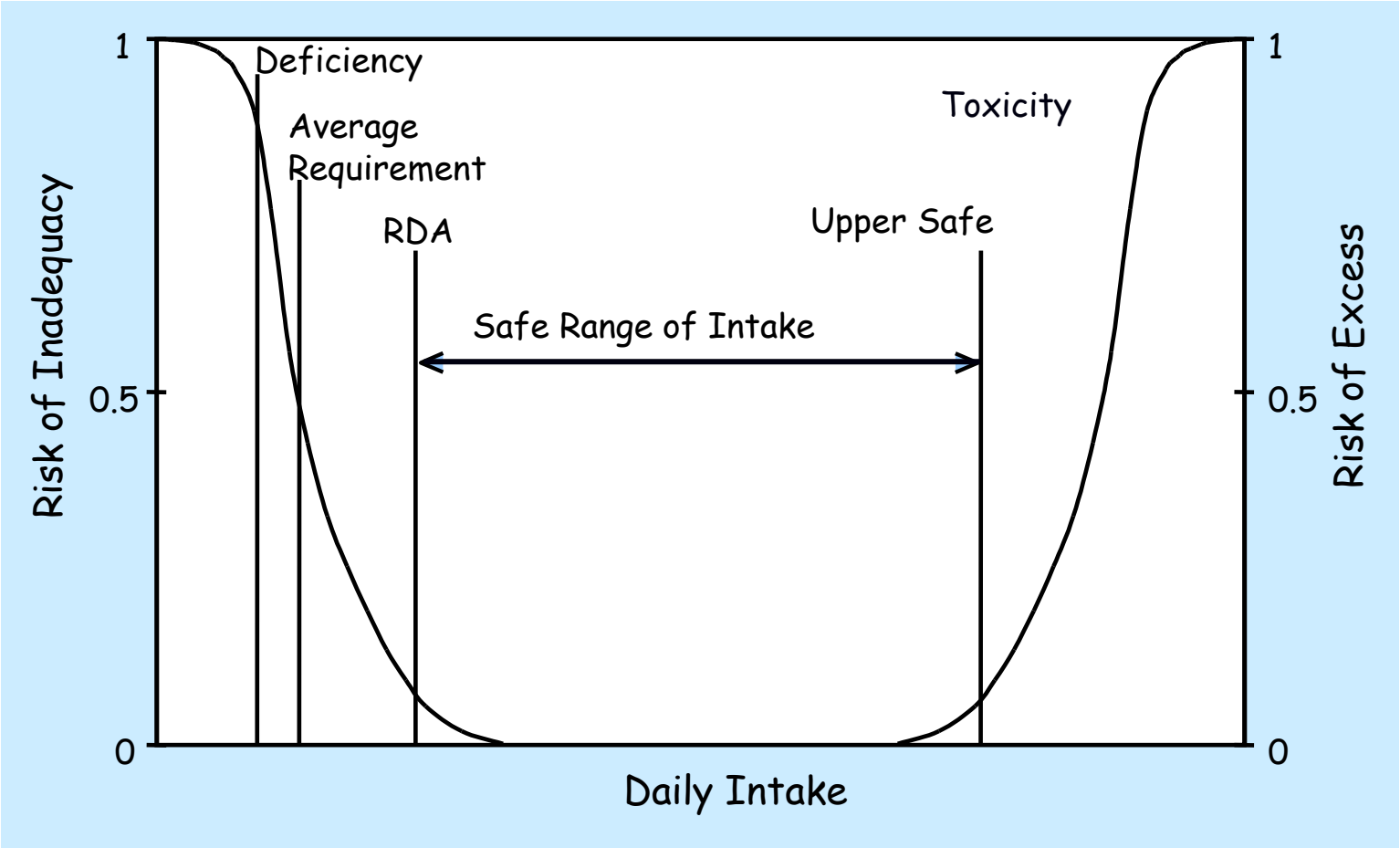
Less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the workplace.

The manganese concentrations that cause effects such as slowed hand movements in some workers are approximately 20,000 times higher than the concentrations normally found in the environment.

Manganism has been found in some workers exposed to manganese concentrations about a million times higher than normal air concentrations of manganese.

(Source: ATSDR Toxicological Profile for Manganese)

Adequacy and excess – We need to know thresholds



Adequate intakes based on "FDA Total Diet Study"

- Adult men: 2.3 mg/day
- Adult women: 1.8 mg/day

Tolerable upper intake level (UL) of 11 mg/day based on no effect level for Western diets

(Institute of Medicine Panel on Micronutrients, 2001)

Documentation of the model development and application over the years is provided in the published literature:

Teeguarden et al. 2007

Yoon et al. 2009, 2011, 2019a, 2019b

Andersen et al. 2010

Gentry et al. 2017

Nong et al. 2008, 2009

Song et al. 2018

Campbell et al. 2023

Taylor et al. 2012

Schroeter et al. 2011

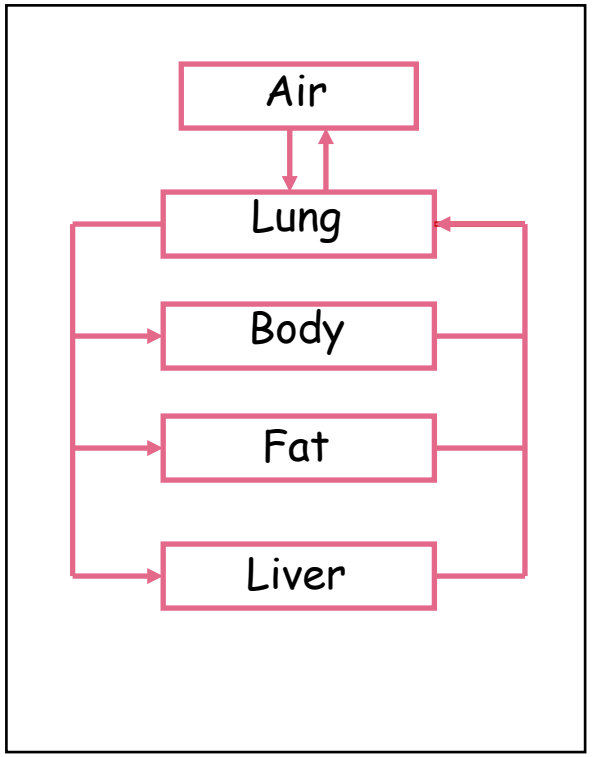
Ramaju et al. 2017

Modeling tissue and body doses: PBPK models

Physiologically-Based Pharmacokinetic (PBPK) Models

- Developed for Mn to evaluate safe exposure to this toxic but essential metal.
- Understanding delivery to tissues and how exposure can impact the balance or homeostasis of levels needed for good health is important.
- Validated models can estimate systemic (all over the body) and target tissue delivery of inhaled manganese in the presence of background levels from water or food.
- Concept for the models and studies needed to support them was published in 1999 (Andersen et al. 1999).
- Detailed discussion in ATSDR Tox Profile for Mn.

Physiologically-based pharmacokinetic (PBPK) modeling



Metabolic Constants

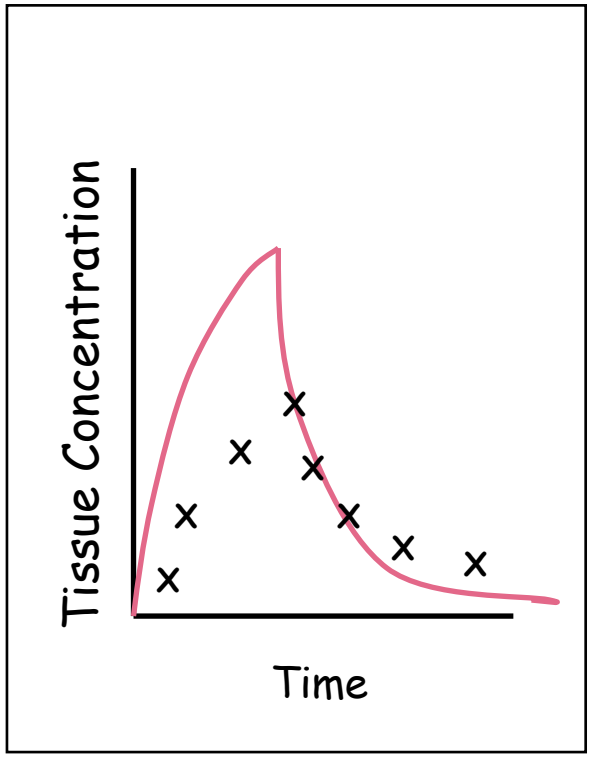
Tissue Solubility

Tissue Volumes

Blood and Air Flows

Experimental System

Model Equations



Define Realistic Model → **Collect Needed Data** → **Make Predictions**

Refine Model Structure

The available models include adult & early life exposures

Adult models

- Development of basic model structure with adult rat data
- Extrapolation across adult species: rat → monkey → human
- Validation of model
- Prediction of brain target tissue Mn levels from environmental exposure to Mn

Early life models

- Characterizing Mn transfer across placenta and through milk
- Evaluating lifestage differences in Mn pharmacokinetics
- Comparing Mn exposures from inhalation, breast milk, and formula

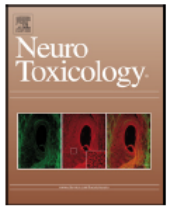
Summary: PBPK modeling of manganese

- This suite of published PBPK models has been developed over decades and was peer reviewed by a Technical Advisory Panel set up under the USEPA test rule.
- These validated PBPK models can be used to evaluate changes in target tissue (brain) Mn levels following inhalation exposure and considering dietary intake.

NeuroToxicology 58 (2017) 226–237

Contents lists available at ScienceDirect

NeuroToxicology



Full Length Article

The application of PBPK models in estimating human brain tissue manganese concentrations

Siva P. Ramoju[a,*], Donald R. Mattison[a,b], Brittany Milton[a], Doreen McGough[c], Natalia Shilnikova[a,b], Harvey J. Clewell[d], Miyoung Yoon[d], Michael D. Taylor[e], Daniel Krewski[a,b], Melvin E. Andersen[d]

[a] Risk Sciences International, 55 Metcalfe Street, Suite 700, K1P 6L5, Ottawa, Canada
[b] Samuel R. McLaughlin Centre for Population Health Risk Assessment, Faculty of Medicine, 850 Peter Morand Crescent, Room 119, University of Ottawa, Ottawa, K1G 3Z7, Canada
[c] International Manganese Institute, 17 rue Duphot, 75001 Paris, France
[d] ScitoVation, 6 Davis Drive, PO Box 110566, Research Triangle Park, NC 27709,United States
[e] Nickel Producers Environmental Research Association (NiPERA), 2525 Meridian Parkway, Suite 240, Durham, NC 27713, United States

Protectiveness built into models

Considering continuous exposures to typical air concentrations

Margins of safety:

2500 to 5000 (eye-hand coordination)

6000 to 12000 (hand steadiness)

PBPK model application in risk assessment (Gentry et al. 2017)

Increased confidence that homeostatic mechanisms regulate how inhaled Mn is handled in the body

- Typical concentrations of inhaled Mn are not expected to lead to accumulation in target tissues.

Accumulation in target tissues

- Predicted only when air Mn concentrations are far higher than those historically or currently measured in the United States or Canada.

Conclusions are consistent with animal data

Next steps

Outreach to external experts

Working with South32 to identify independent experts (team) with relevant expertise

- Need to consider expertise in environmental fate & transport, chemistry, exposure assessment, environmental & public health, toxicology
- Experience in mining helpful
- Effective communication
- Reliability and responsiveness to community

Define objectives for evaluating potential health impacts

- Translate objectives into scope of work
- Guiding development of early planning
- Bring experience performing health studies in historical mining/smelting communities, coordinating with community advisory groups composed of agencies, academics, community leaders, Tribes

Community Health Components

Health Outcomes

Measurable changes attributable to intervention in health status of an individual or group

Health Determinant

Social, economic, environmental and cultural factors that indirectly influence health and wellbeing

Health Equity/Inequality

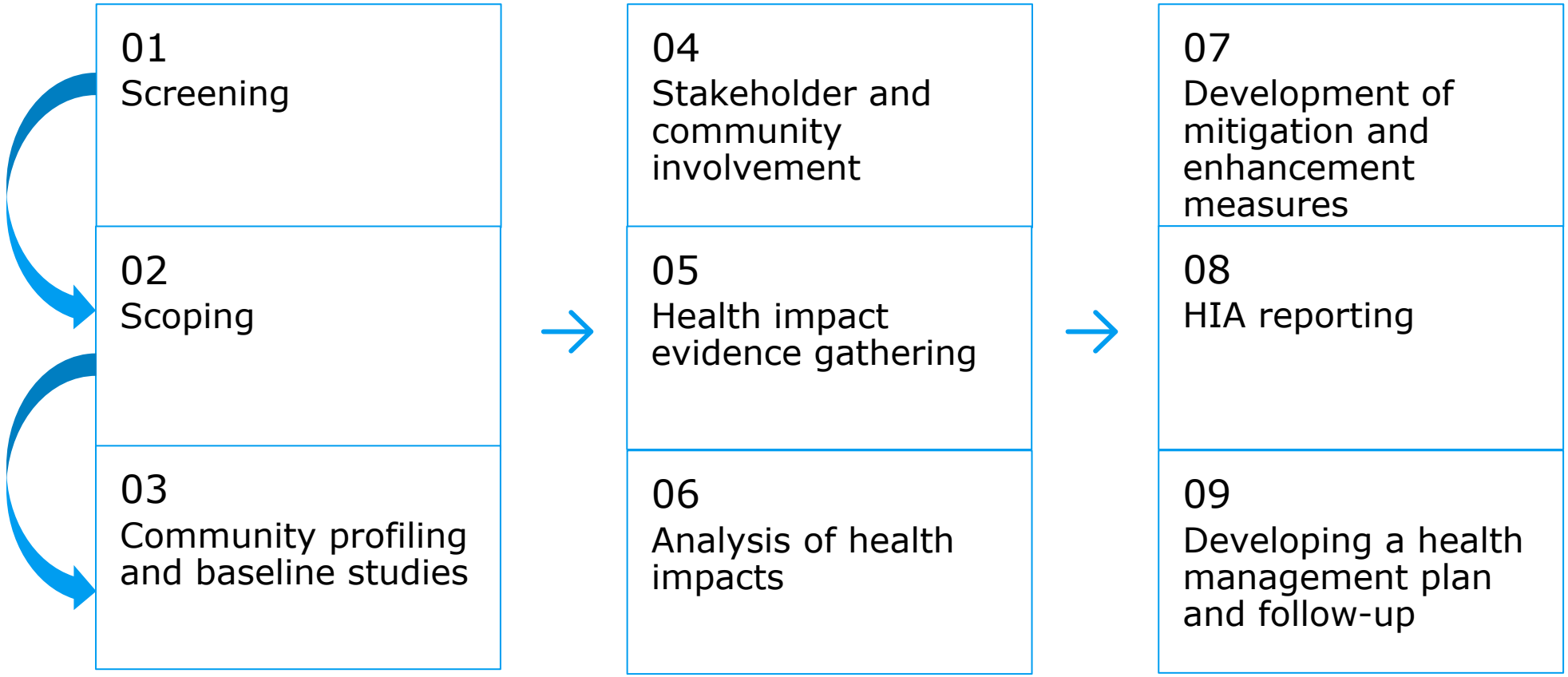
Avoidable health differences between different groups within a given population

Cumulative Impacts

Result of additive effects of two or more health impacts from one or more projects or areas over any given period of time

https://www.icmm.com/en-gb/guidance/health-safety/2010/guidance-hia

HIA Process



The HIA process is non-linear

https://www.icmm.com/en-gb/guidance/health-safety/2010/guidance-hia

Questions?

Thank you for your time today.

RAMBØLL

Bright ideas.
Sustainable change.

CPBA Working Group (WG) Meeting Summary

Santa Cruz County Advisory Panel on the Hermosa Project

November 1, 2023, 11:00 am – 12:30 pm AZ Time via Zoom

Present:

Acorn International
- Ranay Guifarro
- Dr. Chris Anderson
- Dean Slocum

Working Group
- Gerry Isaac
- Ben Lomeli
- Linda Shore

Interfuse Associates
- Catherine Tornbom
- Joanne Lamb

Not Present:
- Carolyn Schafer
- Andrea Wood

Discussion on Process for Developing the CPBA:

- **Document review and timing:**
  - Recognition that we are all learning with this process.
  - The most recent challenge was having too much data all at once and knowing that there will be more coming in December.
  - The WG needs at least two weeks at a minimum to review and make comments on the document.
- **Confirming the Framework:**
  - The main document, which could be called the master agreement, sets out the general principles of what we're trying to accomplish and areas of concern with broad solutions.
  - The appendix would set forth the details of how that's going to be accomplished. Technical items, for example, water monitoring, are laid out in more detail in appendices. Keeping in mind the WG can recommend detail, but the final level of detail will be determined by the signatories to the agreement.
  - The agreement will be made in such a way that it can be modified as new information becomes available. An example is the rapid filtration basins being in the Mine Plan of Operations which could change. This would be the same for the appendices.
  - Appendices Considerations:
    - To what extent is the WG capable of getting into the weeds on technical topics?
    - Concerns about having something so open and generic the signatories will have a hard time negotiating. Consider offering as much specificity as possible to protect our communities. The WG has access to experts to assist in the development of the appendices.
- **CPBA Deadline:** It is unclear what the deadline the WG is managing to. Is aiming for the spring realistic? Getting the signatories determined is a crucial part of this.
- **Environmental Justice (EJ)**: The concept of environmental justice exists to promote a higher level of inquiry into, or standards for, certain environmental risks. If you are an EJ community, the government requires these higher standards of inquiry or protection. From the WG perspective we're trying to define what areas we want to see protected, and we are also trying to define what level of protection we're looking for with respect to each of these areas. If the WG ties itself to EJ, it runs the risk of becoming wrapped up in government bureaucracy and a set of rules that may have unintended consequences.
- **Potential Speaker:** Ben suggested that the WG invite Dr. Denise Moreno-Ramirez, an expert on EJ, from Nogales, and currently at the University of Arizona, to give a presentation on EJ. No action was taken.
- **UA Law Clinic**: Damian, in his role with The Nature Conservancy, will be meeting the new director of the UA Law Clinic. This is an exploratory discussion about opportunities to engage in a variety of issues. Damian will mention the WG to see if the Clinic might be a potential resource for the WG and possibly the signatories.
- **Gerry's Offer:** The WG accepted (with gratitude) Gerry's offer to prepare the next iteration of a conceptual framework to provide more clarity to the structure. At this point it will not include the appendices but will show how the appendices fit into the body of the agreement. The issues pertaining to EJ will be included without using the phrase. The framework draft will be sent out to the working group by November 10th.

Next meetings: November 29 at 9:00 – 10:00 a.m.
December 13 at 11:30 a.m. – 12:30 p.m.

Zoom Link: https://tnc.zoom.us/j/8712196245?pwd=bTBousingieFp0M3h3UnFBaTl2NDd6ZnNnZz09

Presentation to Hermosa Advisory Panel

Wednesday, November 15, 2023

Rosalind Schoof, PhD
Alma Feldpausch, MS
Robinan Gentry, PhD

Outline of discussion

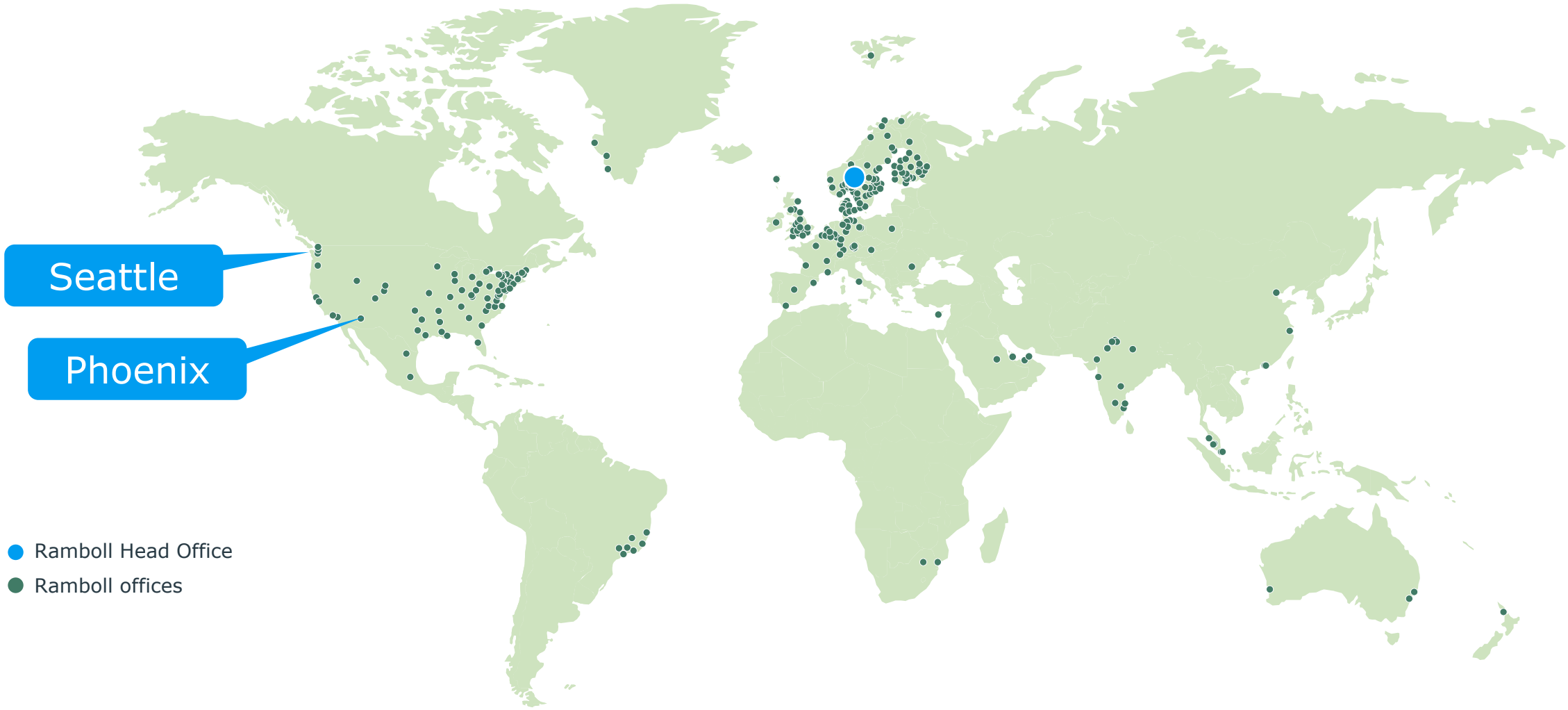
1. Who is Ramboll and what is Ramboll’s role?
2. Manganese – environmental overview
3. Manganese - toxicity primer
4. Next steps

Who is Ramboll & what is Ramboll's role?

Ramboll in brief

- Independent science, engineering, architecture, and consultancy company
- Founded 1945 in Denmark
- 18,500 experts world-wide
- Present in 35 countries
- Particularly strong presence in the Nordics, the UK, North America, Continental Europe, and Asia Pacific
- Creating sustainable solutions across Environment & Health, Buildings, Transport, Energy, Water, Management Consulting, and Architecture & Landscape
- Owned by The Ramboll Foundation – Rambøll Fonden
- Ramboll Americas leadership: Cheryl Ginyard-Jones
- Americas Environment & Health leadership: Jeanne Tarvin

Our global footprint



Rosalind Schoof, PhD, DABT, Fellow ATS

- Board certified toxicologist with more than 35 years' experience assessing human health effects and exposures from chemical substances in a variety of settings, including mines & smelters, commercial/ industrial/agricultural/residential projects, product uses, dietary exposures and general home and community exposures.
- Internationally recognized expert on evaluation of lead, arsenic and other metals in the environment and in the diet, and on the bioavailability of metals from soil with over 35 peer-reviewed publications.
- Extensive experience assessing potential risks from exposure to metals at mine and smelter sites in North and South America, including conducting community biomonitoring studies.

Alma Feldpausch, MS, DABT

- 25+ years experience working in environmental health, human health risk assessment and community health, exposure assessment, risk communication, biomonitoring, bioavailability, environmental justice in communities where mining and smelting, refineries, manufacturing occurs throughout North & South America
- Experience evaluating exposure to inorganic and organic compounds via subsistence consumption of wild foods as well as conventional foods
- Certified by the American Board of Toxicology

Robinan Gentry, PhD, DABT

- Board certified toxicologist with more than 35 years' experience in toxicological issues relevant in the determination of the potential safety or risk associated with exposure to chemicals in consumer products, pharmaceuticals or the environment.
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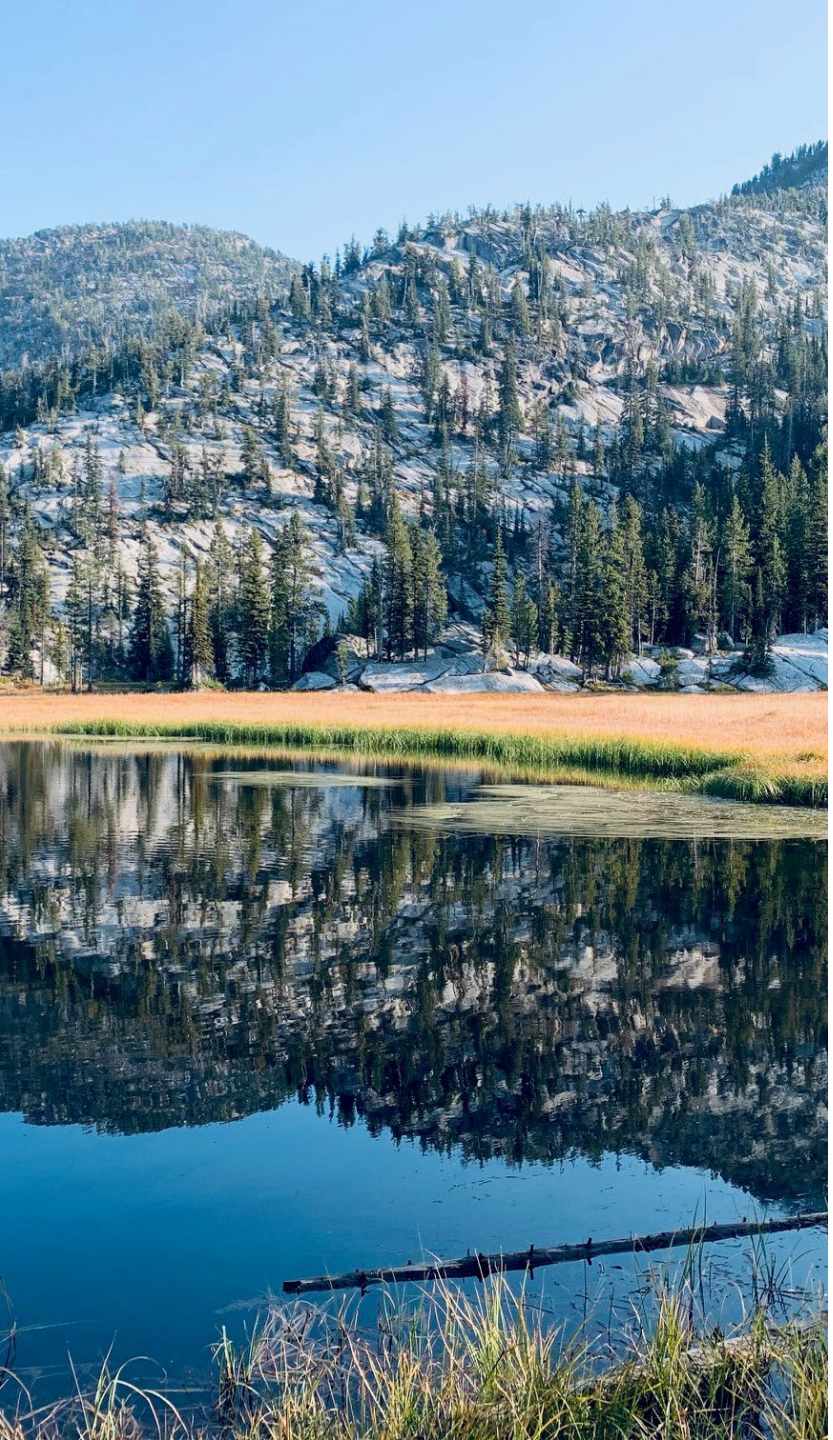

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- Collaborate with multidisciplinary teams consisting of epidemiologists, statisticians, geologists, engineers, environmental chemists, atmospheric scientists, industrial hygienists, analytical & geospatial data analysts

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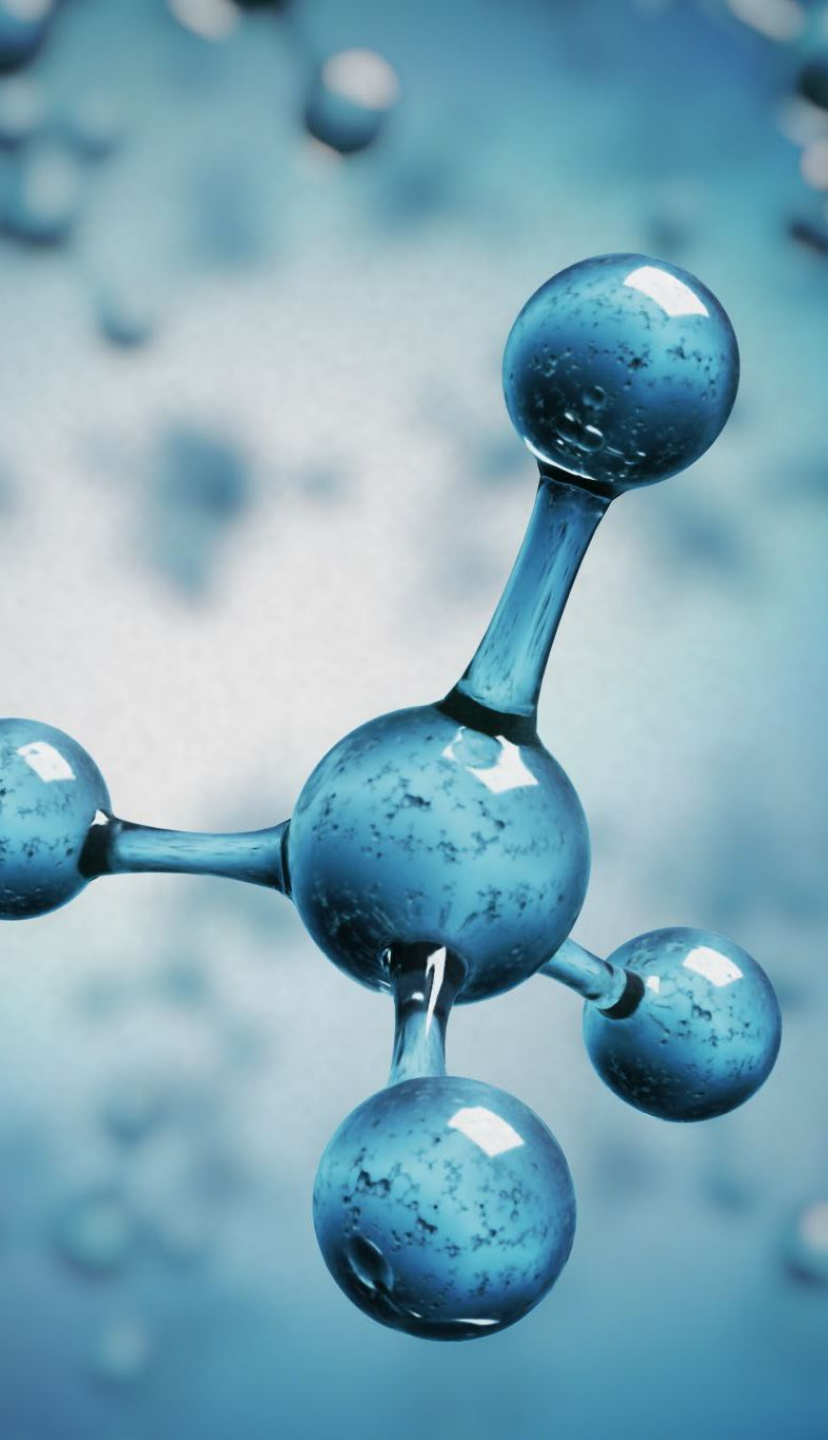
Manganese – environmental overview



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- Is not present in the environment as a pure substance
- Can be present in inorganic and organic chemical forms; inorganic forms occur most commonly in the environment & work settings
- Is combined with other substances, like oxygen, sulfur, and chlorine
- Cannot break down in the environment, but can change form or become attached or separated from particles
- Some forms are more easily dissolved or dissociated, other forms are firmly bound

Manganese is an essential nutrient, meaning it is necessary for good health

Typically, people are exposed to low levels of Mn in water, air, soil, and food

Source: ATSDR Toxicological Profile for Manganese

Manganese concentrations in soil

Manganese is found everywhere in soil, from natural and human-made sources

In areas with no known contamination source:

- United States soil concentrations range from 40-900 mg/kg (parts per million)
- Average background soil concentration is 330 mg/kg

(Source: ATSDR Toxicological Profile for Manganese)

- Range in Patagonia-area surface soil is 200-400 mg/kg, 0-5 cm (USGS 2013)

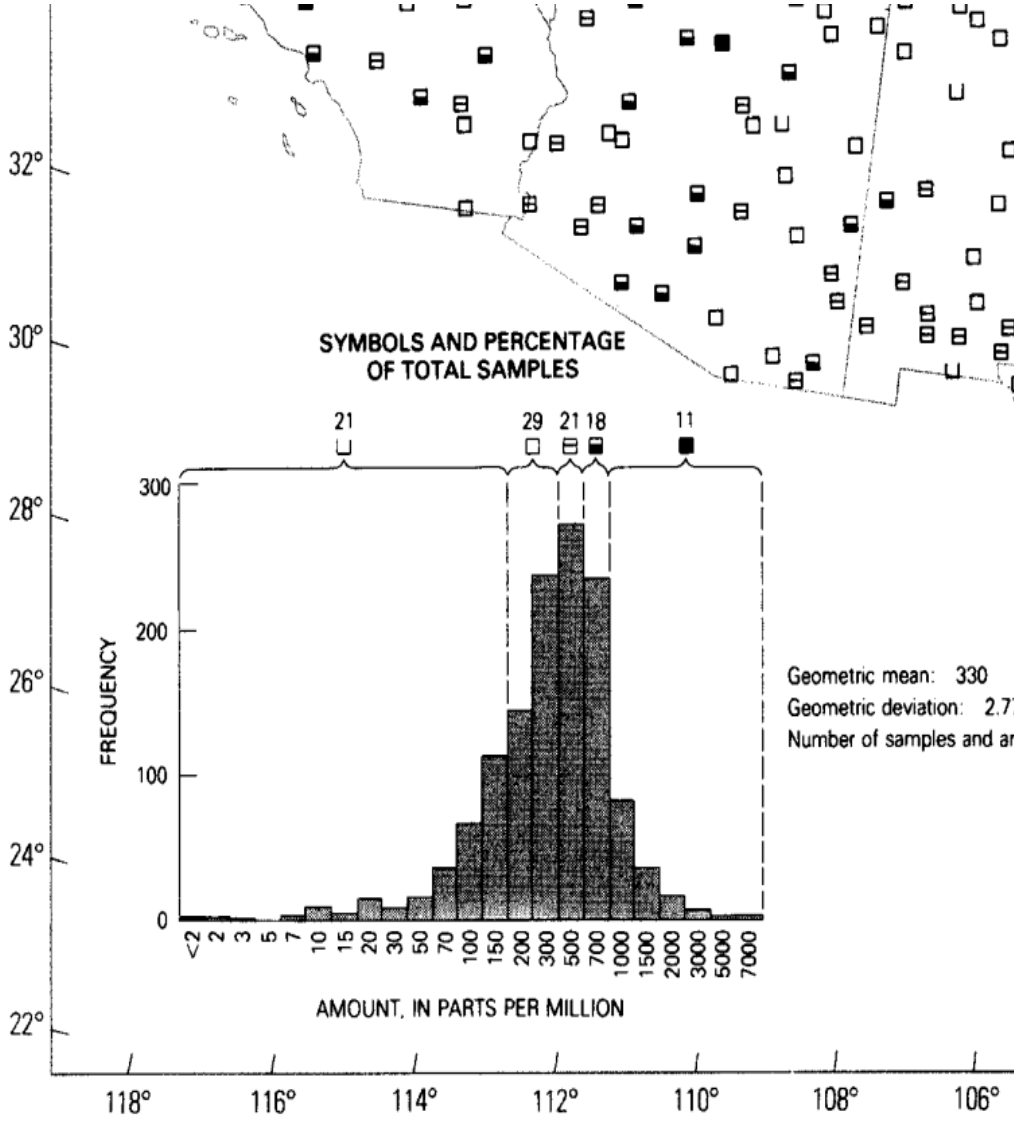


FIGURE 24.—Manganese content of surficial materials.

How might we be exposed to manganese?

Manganese is often found in vegetable and animal foods, occurs naturally in most foods

Daily intake estimates include…

Diet → 0.7 to 10.9 mg/day
(vegetarians often have higher Mn intake)

Drinking Water → 0.02 mg/day

Air → < 0.0002 mg/day
Average air concentrations = 10-70 ng/m^3
Negligible compared to intake from diet, unless people are exposed at work or live near Mn-emitting industries (e.g., foundries)

Our bodies are good at maintaining stable Mn levels, rapidly getting rid of excess Mn

1 cup of tea
0.4 to 1.3 mg/cup

Supplements
Multivitamin: 1 to 4.5 mg
Mn only: 5 to 20 mg

Other food sources

- Shellfish
- Nuts
- Grains
- Oatmeal
- Legumes
- Black pepper
- Spinach
- Pineapple

Bioavailability of manganese

Diet and drinking water:

1-5% of manganese is absorbed after ingestion

Fraction absorbed decreases with increasing dose (homeostatic controls)

Excretion also increases with dose

Soil:

We expect reduced absorption from soil compared with diet and drinking water

Bioavailability varies by manganese compounds present

Weathering reactions in soil will change chemical forms over time

Air:

Bioavailability will be a function of particle sizes and chemical forms

Particle sizes also determine location of deposition in lung and whether particles will end up in gut

Occupational exposures are unique

Individuals may also be exposed to manganese fumes, dust in work settings at much higher concentrations that those occurring in natural settings

Workplaces of exposure:

- Welding
- Steel factory
- Mining

Forms of manganese in work settings (fumes, fine dust) tend to be more easily absorbed by the body, and are different than forms found in soil, water, food

What levels are “safe” in environmental media?

Drinking Water

USEPA Health Advisory Level (HAL)

Adult (Lifetime)	0.3 mg/L = 300 µg/L
Adult (10 days)	1 mg/L = 1,000 µg/L
Infant to 6 mo. (10 days)	<0.3 mg/L = < 300 µg/L
Secondary maximum contaminant level (SMCL)	0.05 mg/L for taste & discoloration = 50 µg/L
Health Canada maximum allowable concentration (MAC)	0.1 mg/L = 100 µg/L

Soil

USEPA residential soil screening level = 1,800 mg/kg

Air

USEPA chronic reference concentration (RfC) based on a lowest adverse effect level for behavioral effects	0.00005 mg/m^3 = 50 ng/m^3
ATSDR chronic MRL based on central nervous system effects	0.0003 mg/m^3 = 300 ng/m^3
CalEPA / OEHHA chronic REL based on central nervous system effects	0.00009 mg/m^3 = 90 ng/m^3

What are safe human doses?

Oral

USEPA Chronic reference dose (RfD) Based on central nervous system effects	0.14 milligrams of Mn per kilogram body weight per day (mg/kg-day)

Diet

Food and Nutrition Board Adequate Intakes

Adult	Male: 2.3 mg/day Female: 1.8 mg/day
Infant to 6 mo.	Male: 0.003 mg/day Female: 0.003 mg/day

USEPA Integrated Risk Information System (IRIS)

https://iris.epa.gov/ChemicalLanding/&substance_nmbr=373

Is the presence of Mn a problem? It depends on…

Concentrations in Environment

- Air
- Water
- Soil
- Food

Contact With Environment

- Breathing rate
- Ingestion rate
- Skin Contact rate
- Duration & frequency of exposure

Exposure

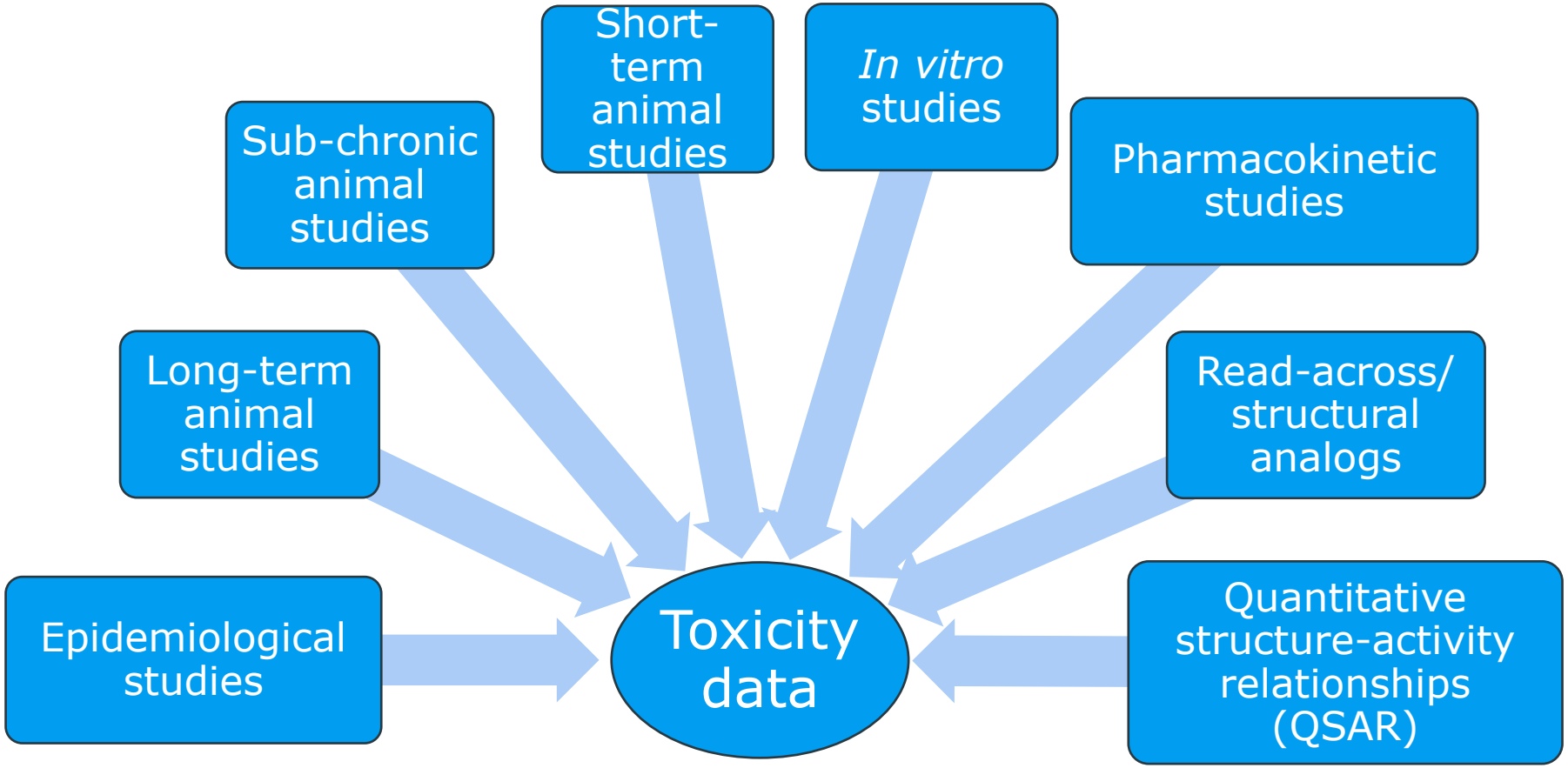
- Dose estimate
- Used to assess potential for adverse health effects

Two conditions must be met:

1. Environmental concentrations of bioavailable Mn are sufficiently high
2. People have sufficiently high contact with the environmental media

Manganese – toxicity primer

How do we understand if something is harmful, and how much can cause harm?



Traditional health risk assessment approaches present a significant challenge for compounds, such as manganese, which is **an essential element**

Deficiencies, as well as exposure to high concentrations, result in adverse effects.

Manganese is essential

As an essential nutrient several enzyme systems have been reported to interact with or depend on manganese to function. Also, manganese is required for:

- Formation of healthy cartilage and bone
- The urea cycle
- Aids in the maintenance of mitochondria and the production of glucose.
- Plays a key role in wound-healing

Manganese deficiency might cause: bone demineralization and poor growth in children; skin rashes, hair depigmentation, decreased serum cholesterol, and increased alkaline phosphatase activity in men; and altered mood and increased premenstrual pain in women.

(Source: ATSDR Toxicological Profile for Manganese)

But, too much is not a good thing

Occupational cohort studies provide data on potential health outcomes following inhalation exposure.

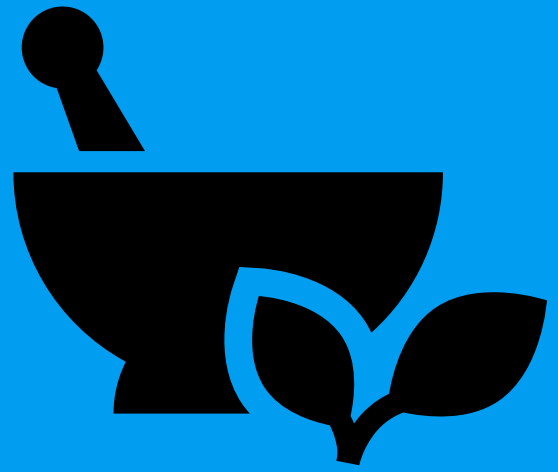
Exposure levels in work settings from inhalation are typically higher than other environmental exposures.

Consequences of Mn exposure above those levels defined as recommended daily amounts.

Using inhalation concentrations to measure dose may not adequately background tissue levels that may result from dietary exposure, as well as what is needed for normal processes.

Reports of adverse health effects in people exposed to high concentrations in food or water are limited

- Information on oral exposures comes mostly from animal studies.
- Generally, oral toxicity is low.



Respiratory effects of inhaled inorganic manganese

Inhaled particles small enough to enter the deepest parts of the lungs where oxygen-exchange occurs are absorbed directly into the blood stream

Larger particles trapped in the upper and middle airways are coughed up & swallowed, blown out through nose

In worker populations, inhaled Mn dust has caused respiratory irritation, inflammation, and can lead to bronchitis, pneumonitis, pneumonia

- These symptoms are common with most inhalable dust exposures
- Cardiovascular effects observed in workers (e.g., low blood pressure)
- Neurological effects observed in workers or people living near facilities that emit manganese = manganism

"Manganism is a progressive condition that usually begins with relatively mild symptoms, but evolves to include dull affect, altered gait, fine tremor, and sometimes psychiatric disturbances. Some of these symptoms also occur with Parkinson's disease, which has resulted in the use of terms such as "Parkinsonism-like disease" and "manganese-induced Parkinsonism" to describe those symptoms observed with manganese poisoning."

- Manganism and Parkinsonism are different in effect and pathology.

(Source: ATSDR Toxicological Profile for Manganese)

Exposures associated with manganism

Nervous system impacts are most common health problem in workers exposed to high levels of manganese.

Behavioral changes and other nervous system effects, such as movements that may become slow and clumsy; combination of when sufficiently severe is referred to as “manganism.”

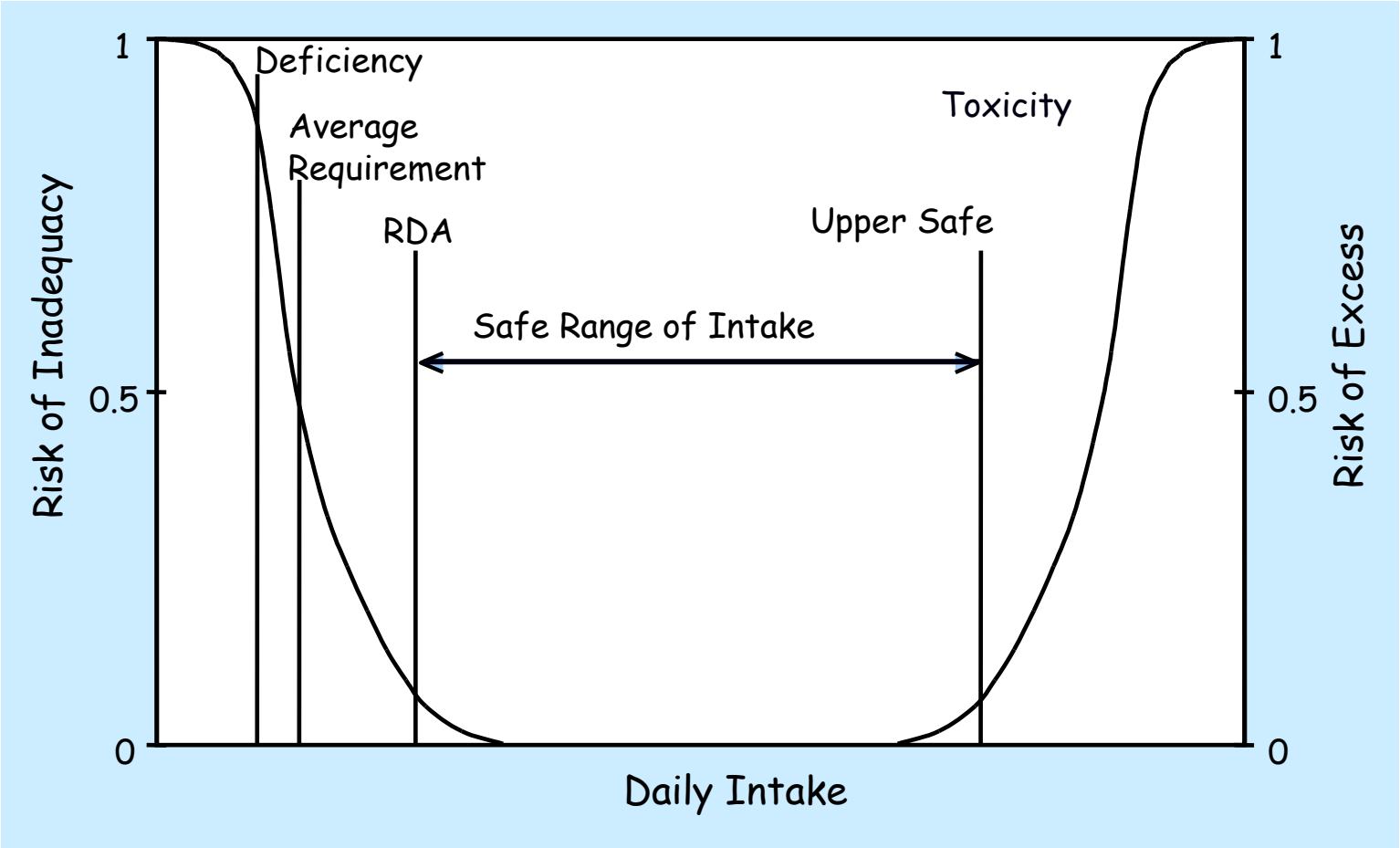
Less severe nervous system effects such as slowed hand movements have been observed in some workers exposed to lower concentrations in the workplace.

The manganese concentrations that cause effects such as slowed hand movements in some workers are approximately 20,000 times higher than the concentrations normally found in the environment.

Manganism has been found in some workers exposed to manganese concentrations about a million times higher than normal air concentrations of manganese.

(Source: ATSDR Toxicological Profile for Manganese)

Adequacy and excess – We need to know thresholds



Adequate intakes based on "FDA Total Diet Study"

- Adult men: 2.3 mg/day
- Adult women: 1.8 mg/day

Tolerable upper intake level (UL) of 11 mg/day based on no effect level for Western diets

(Institute of Medicine Panel on Micronutrients, 2001)

Documentation of the model development and application over the years is provided in the published literature:

Teeguarden et al. 2007

Yoon et al. 2009, 2011, 2019a, 2019b

Andersen et al. 2010

Gentry et al. 2017

Nong et al. 2008, 2009

Song et al. 2018

Campbell et al. 2023

Taylor et al. 2012

Schroeter et al. 2011

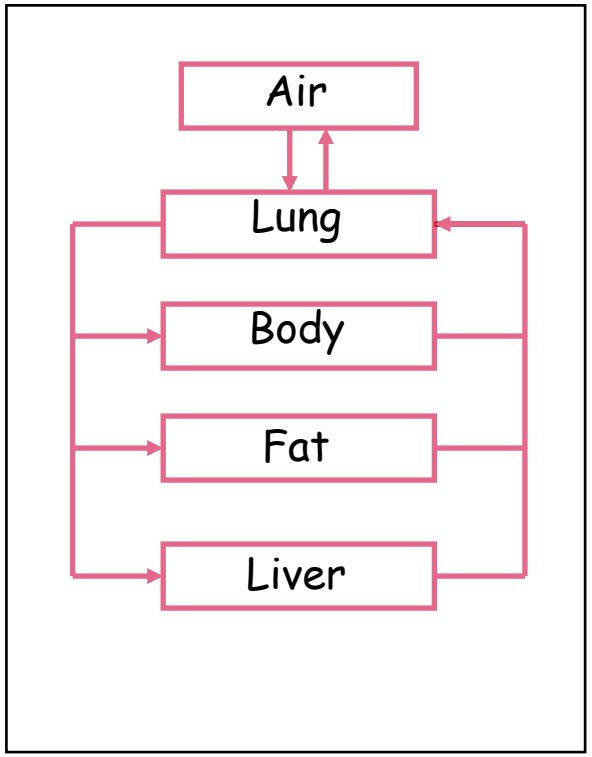
Ramaju et al. 2017

Modeling tissue and body doses: PBPK models

Physiologically-Based Pharmacokinetic (PBPK) Models

- Developed for Mn to evaluate safe exposure to this toxic but essential metal.
- Understanding delivery to tissues and how exposure can impact the balance or homeostasis of levels needed for good health is important.
- Validated models can estimate systemic (all over the body) and target tissue delivery of inhaled manganese in the presence of background levels from water or food.
- Concept for the models and studies needed to support them was published in 1999 (Andersen et al. 1999).
- Detailed discussion in ATSDR Tox Profile for Mn.

Physiologically-based pharmacokinetic (PBPK) modeling



Metabolic Constants

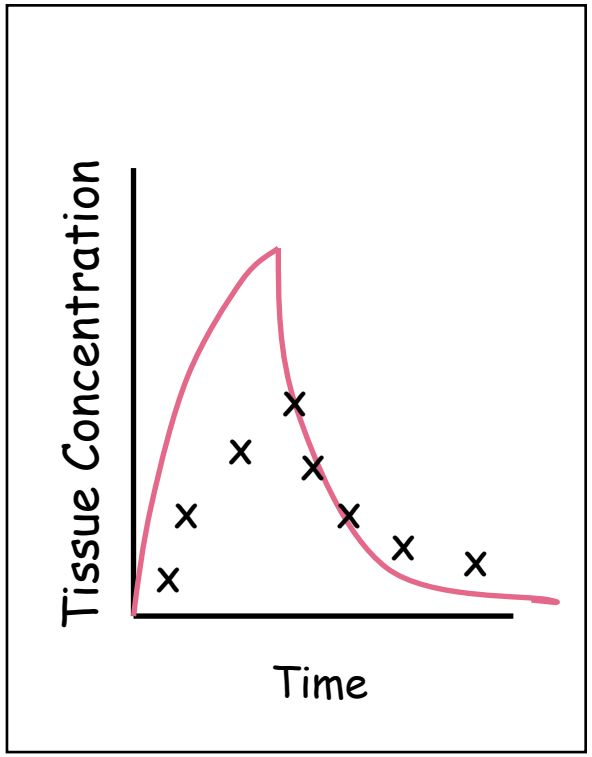
Tissue Solubility

Tissue Volumes

Blood and Air Flows

Experimental System

Model Equations



Define Realistic Model → **Collect Needed Data** → **Make Predictions**

Refine Model Structure

The available models include adult & early life exposures

Adult models

- Development of basic model structure with adult rat data
- Extrapolation across adult species: rat → monkey → human
- Validation of model
- Prediction of brain target tissue Mn levels from environmental exposure to Mn

Early life models

- Characterizing Mn transfer across placenta and through milk
- Evaluating lifestage differences in Mn pharmacokinetics
- Comparing Mn exposures from inhalation, breast milk, and formula

Summary: PBPK modeling of manganese

- This suite of published PBPK models has been developed over decades and was peer reviewed by a Technical Advisory Panel set up under the USEPA test rule.
- These validated PBPK models can be used to evaluate changes in target tissue (brain) Mn levels following inhalation exposure and considering dietary intake.

NeuroToxicology 58 (2017) 226–237

Contents lists available at ScienceDirect

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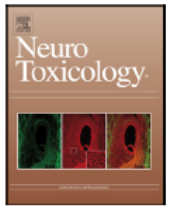

Full Length Article

The application of PBPK models in estimating human brain tissue manganese concentrations

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Protectiveness built into models

Considering continuous exposures to typical air concentrations

Margins of safety:

2500 to 5000 (eye-hand coordination)

6000 to 12000 (hand steadiness)

PBPK model application in risk assessment (Gentry et al. 2017)

Increased confidence that homeostatic mechanisms regulate how inhaled Mn is handled in the body

- Typical concentrations of inhaled Mn are not expected to lead to accumulation in target tissues.

Accumulation in target tissues

- Predicted only when air Mn concentrations are far higher than those historically or currently measured in the United States or Canada.

Conclusions are consistent with animal data

Next steps

Outreach to external experts

Working with South32 to identify independent experts (team) with relevant expertise

- Need to consider expertise in environmental fate & transport, chemistry, exposure assessment, environmental & public health, toxicology
- Experience in mining helpful
- Effective communication
- Reliability and responsiveness to community

Define objectives for evaluating potential health impacts

- Translate objectives into scope of work
- Guiding development of early planning
- Bring experience performing health studies in historical mining/smelting communities, coordinating with community advisory groups composed of agencies, academics, community leaders, Tribes

Community Health Components

Health Outcomes

Measurable changes attributable to intervention in health status of an individual or group

Health Determinant

Social, economic, environmental and cultural factors that indirectly influence health and wellbeing

Health Equity/Inequality

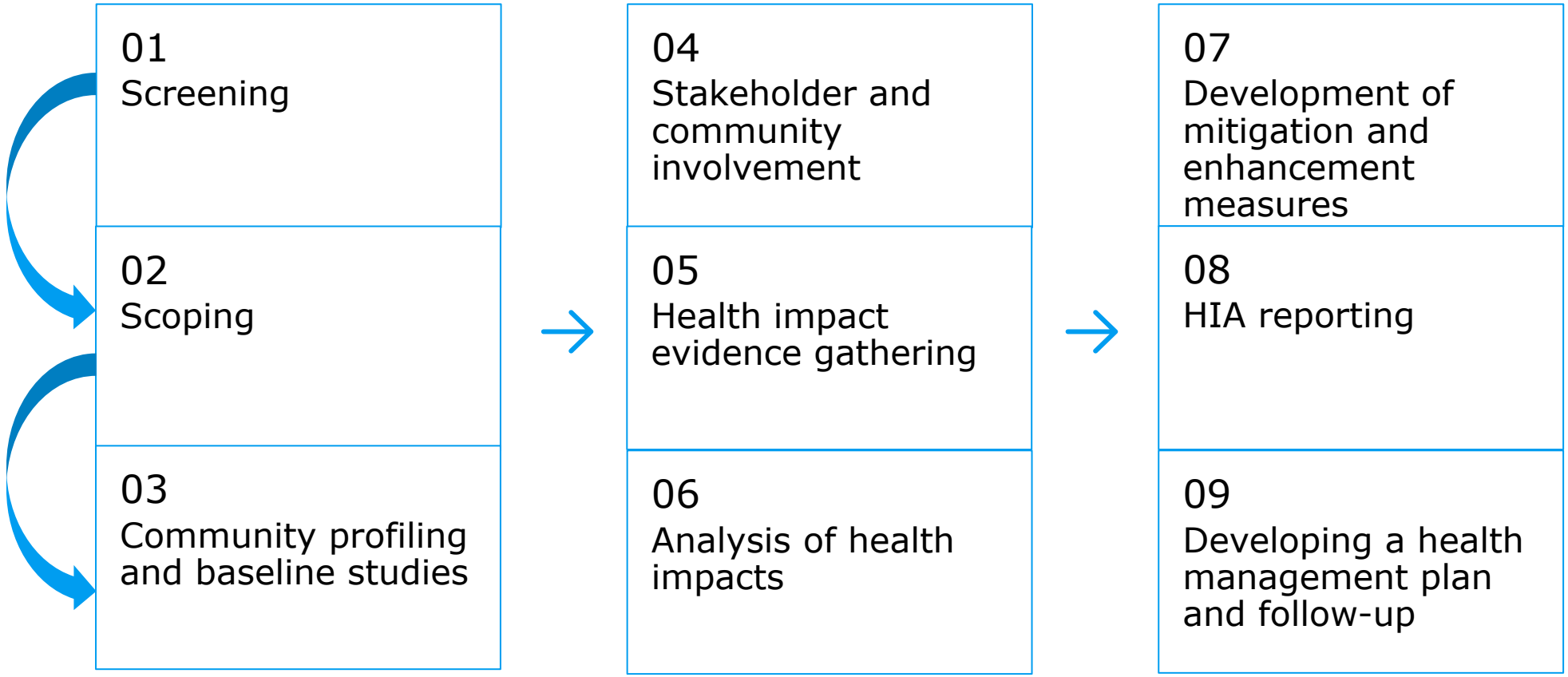
Avoidable health differences between different groups within a given population

Cumulative Impacts

Result of additive effects of two or more health impacts from one or more projects or areas over any given period of time

https://www.icmm.com/en-gb/guidance/health-safety/2010/guidance-hia

HIA Process



The HIA process is non-linear

https://www.icmm.com/en-gb/guidance/health-safety/2010/guidance-hia

Questions?

Thank you for your time today.

RAMBØLL

Bright ideas.
Sustainable change.