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November 5, 2019

Mr. Neil Bosworth, Supervisor
Tonto National Forest

Resolution Copper EIS
PO Box 34468
Phoenix, AZ 85067-4468

RE: Resolution Copper Project and Land Exchange DEIS

Dear Mr. Bosworth,

Earthworks, a national non-profit organization with a focus on mineral policy, submits the following comments specific to alternative mining techniques and tailings facilities. Earthworks sits on the Board of Directors and Steering Committee of the Arizona Mining Reform Coalition, and is also signed on to comments submitted from the Coalition.

Alternative Mining Techniques

Much of the controversy surrounding Resolution Copper's General Plan of Operations regards the subsidence crater at Oak Flat. In the 2017 Draft Alternatives Evaluation Report and its corresponding Appendix C, as well as in the Resolution Copper DEIS, arguments are made to dismiss any and all possible alternative to Resolution Copper's preferred mining method of panel caving. Earthworks believes the general dismissal by the Forest Service of taking a hard look at these alternative mining techniques – which would leave Oak Flat intact for the numerous Native American and social groups who use the area regularly and hold it sacred – runs contrary to the intention of the National Environmental Policy Act, as well as its general role of stewards of the land recognizing a multiple use approach.

Unfortunately, instead of taking this hard look, the Forest Service appears to have simply accepted – via SWCA Environmental Consultants -- a report from Dr. Charles Kliche entitled Technical Memorandum for Alternative Mining Methods. Dr. David Chambers, who like Dr. Kliche is also a physical engineer with 40 years of experience in mining and geotechnical engineering, contributed to the Arizona Mining Reform Coalition's comments on this topic. Had he been the chosen consultant to write about alternative mining techniques for the DEIS through SWCA, his conclusion would be vastly different than Dr. Kliche's in terms of the economic feasibility of other mining techniques. This is an indication that the Forest Service should have consulted multiple independent parties on this topic and compared findings, before simply accepting for the DEIS the conclusion of a single person and a single report, prepared by a for-profit large consultancy that likely has many ties to the mining industry.

It is clear that the Forest Service acknowledges that other mining techniques will vastly reduce or eliminate surface impacts at Oak Flat (Alternatives Evaluation Report, p. 25):

“The Forest Service recognizes and agrees with scoping comments that use of mining techniques other than panel caving could substantially reduce impacts to surface resources, both by reducing or eliminating subsidence and by allowing the potential to backfill tailings underground.”

In all materials, Dr. Kliche and the Forest Service also acknowledge that alternative mining techniques are technically feasible. Cost is cited as the prohibitive factor for any technique other than panel caving – Resolution's preferred method for profit maximization. But the data

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provided in the DEIS and the technical memorandum is open to interpretation, and therefore needs far more detailed analysis in a revised or supplemental DEIS.

Dr. Kliche points to a study outlining underground mining operating costs in Figure 2.3-1, using a spectrum of low, medium, and high. Neither the chart or the report elsewhere specify which factors indicate what constitutes low, medium, or high cost, or how Resolution Copper fits within the spectrum. The difference here is substantial; for block caving, figures vary from \$4.53 to \$20.87. The low range of room and pillar mining (a technique compatible with tailings backfill) is virtually identical to the mid-range of block caving. Without knowing where Resolution Copper stands in the range, it becomes impossible to compare costs if their ranges overlap as they do in this faulted analysis. As another example, the low range of cut and fill mining compared to the high range of block caving is very close – within 10%. The mid-range of mechanized cut and fill is actually lower than the high end of block caving. This analysis must be redone to reflect actual conditions with the Resolution ore deposit, with possible variations in the cost range analysis and methodology supported by sound, thorough research and cited as such. The analysis must also specify these costs in relation to Resolution’s plan of panel caving, whereas chart 2.3-1 refers to block caving. While similar, these are considered different techniques, with different costs. Panel caving at Resolution may indeed be more expensive than block caving, rendering this chart obsolete.

It is also unclear from the materials presented in the analysis in which country these costs refer to. The cost of mining using different techniques varies by country. This analysis should have only used data from the US (or better yet, Arizona data) to reflect costs here, not as what is likely a worldwide aggregate. Beyond this, costs should be unique to Resolution Copper, including the vast expenses possibly associated with dewatering and cooling the deposit, which as pointed out in the Coalition’s comments via Dr. Steven Emerman, could make the entire project economically infeasible as planned.

The Alternatives Evaluation Report indicates that Dr. Kliche was using limited information to form his analysis. Appendix C, page 1 states as much, noting that the objective of the report was to:

“...develop an estimate, based on limited information provided by RCM, of the total tons of potentially mineable material above a cut-off grade of 2% which lies at or above the -2,500 ft level.”

An analysis that the Forest Service is using to guide its decision whether or not to seriously consider alternative mining techniques, thereby protecting Oak Flat, cannot be based on limited information. The Forest Service must therefore perform a new analysis based on all available information unique to the Resolution Copper ore deposit, as well as operating costs specific to panel caving in the United States, and factoring in other costs unique to Resolution Copper, such as dewatering and cooling. This new analysis should use the same ore body modeling that Resolution Copper uses as it advances its own project, not information based on simple drawings of the 1% and 2% copper shells and aggregate ore body grades.

A new, independent analysis should include the most detailed 3-dimensional data and modeling available (which Resolution Copper certainly has) because that is the data that can inform alternative mining techniques. Instead, Dr. Kliche’s report has convinced the Forest Service to entirely dismiss any alternative mining technique from consideration in the DEIS based on simple, generalized assumptions. A legitimate analysis would assess areas of higher ore grade to determine how more targeted mining techniques can access higher grade ore first, then potentially shift to other techniques later, utilizing backfill in all cases to eliminate surface

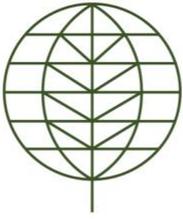
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subsidence. Instead, the DEIS treats all techniques as the only one that would work categorically for the entire deposit, as if all ore is homogenous.

Dr. Kliche refers to “graphical information” provided by Resolution Copper to aid in his analysis, but doesn’t cite that data nor define it further. He refers to some areas of higher quality ore being further away from others, but doesn’t provide the data set he used in his analysis or characterize further. He referenced his “independent assessment of the tonnage of ore within the greater-than-2 percent shell” but doesn’t provide this analysis, instead only showing a chart with all average ore grades above a 1% cutoff being blank. This chart refers to “Resolution data” but there is no explanation of what this data is or how other experts can access it.

Regarding rock quality and ore body characteristics (table 2.3-1 and table 1 in Appendix C), Dr. Kliche has cited general data with an asterisk showing a “match to the characteristics of the Resolution Copper ore deposit” but doesn’t cite the data he used to make these claims. In table 1, he cites information from the US Bureau of Mines from 1964 and 1982, but none of this data is specific to Resolution Copper, and it is woefully outdated. Mining techniques in 2019 and geotechnical engineering is orders of magnitude more sophisticated than it was in 1964, and significantly better than 1982. Footnote 6 indicates data was taken from the Resolution Copper GPO, but there is no actual reference here. Footnotes appear to jump from 5 to 7, so it is unclear what this is referring to.

Cutoff Grades

Both the Alternatives Evaluation Report and the DEIS repeatedly emphasize cutoff grades (COG) for block caving. However, the cutoff grade is based on many highly dynamic factors. Dr. Kliche concludes that 80% of the ore available for milling would not be available for exploitation if any other mining technique were to be employed, because the cutoff grade would make only approximately 20% of the deposit economically viable. But how is it possible to determine this when no analysis has been performed that would evaluate specific COG’s for alternative methods, or a combination of mining techniques? Or, by not including a robust, long term market analysis that may favorably impact COG numbers over the life of the mine.

Cutoff grades present an idea of economic feasibility using today’s copper prices and operating costs, which change over time. The price of copper on November 4th, 2019 was \$2.67 per pound. Had this analysis been written in 2011, when copper was \$4.50 per pound, the COG would be much different, and validate alternative mining techniques more than today, because the company would be equally or more profitable despite using potentially more expensive mining techniques. As the COG shifts, so would the analysis indicating how much ore would be able to be mined profitably.

As the world shifts to renewable energy, we expect a global increase in the price of copper, meaning Resolution Copper is positioned well to enjoy a much more favorable COG moving ahead. On the other hand, we also expect Resolution Copper and industry-tied consultants like Dr. Kliche and SWCA to continue to justify the cheapest-possible mining method regardless of the COG. But until more sophisticated analysis is complete, there will be ambiguity. Dr. Kliche admits this on page 25:

“It cannot easily be known what COG would be required to break even on mining a ton of ore if the cut and-fill technique were hypothetically mandated for the Resolution Copper Project. Given that the per-ton mining costs are as much as seven times greater for cut and fill vs. panel caving, it is not unreasonable to estimate that the COG might increase from 1 percent to 2 or 3 percent.”

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The above indicates that the existing analysis falls short of answering the questions the DEIS is supposed to answer, and is a vague, extrapolative statement. It should be the goal of DEIS to understand the ore body holistically, so that if alternative mining techniques were hypothetically mandated, it would be possible to understand the economics behind them. Unfortunately, Dr. Kliche and therefore the Forest Service, are admitting they are either unwilling to do the proper analysis that would determine a COG for other mining methods or a combination of them, or that the analysis might be too difficult to do. Dr. Kliche apparently had no difficulties ascertaining a COG for block caving, but apparently this is too challenging for any other method.

Dr. Kliche states that mining cost are “as much as” seven times greater than panel caving, even though chart 2.3-1 provides a low end range for cut and fill at \$18.41 versus high end cost for block caving as \$20.87. Again, without presenting costs specific to Resolution Copper, we cannot know where these ranges actually fall. The bias of Dr. Kliche is evident when he makes a statement suggesting costs are seven times higher when his own charts show cost overlaps under different scenarios, yet doesn’t provide a rationale for where on the spectrum these costs may be at Resolution Copper. And again, he uses block caving figures, not panel caving, which may be different in cost.

Table 2 in Appendix C – where Dr. Kliche appears to be basing his statement about a seven-fold increase in cost -- is also flawed, because it uses a cut and fill daily production rate of 1/30th that of the given block cave numbers. Economics determine that the scale of production determines the cost of production by unit. Therefore, this particular chart cannot be relied upon unless it levels the playing field with similar production rates to arrive at a cost estimate, and whether it does this or not is unclear in the materials. This chart is also not specific to Arizona, which enjoys significantly lower tax rates and operating costs than other locations which likely contributed to the data within the chart. Arizona has a major mining presence, meaning materials and labor costs are likely lower than other jurisdictions. It’s also unclear whether table 2 is specific to the US or the world as a whole.

Even if these numbers are accurate as-is, we see room and pillar mining – again a backfill compatible technique – to be only twice the cost of block caving. In our view, even if mining costs were twice that of block caving, the cost of mining technique is not fully representative of the cost of running Resolution Copper as a whole. A complete analysis would look at all costs of running the entire project, and present financial data in that context. It is possible that, as a whole, running Resolution Copper using alternative techniques may only be slightly more expensive than block caving, given all the other administrative and physical costs of running a major mine that have nothing to do with the mining technique.

Finally, Dr. Kliche’s analysis should have included a detailed summary of total extractable ore volumes under every technically feasible mining technique. It is understood generally that panel caving with 70-78 degree cave angles will render about 15% of the total ore within an ore body inaccessible, because the material between the panels will never be mined. How does this 15% compare to other methods? While Dr. Kliche includes tonnage estimates for Resolution Copper block caving using various COG’s, no comparison is given for how much ore might be extracted or not extracted using other techniques.

This is of paramount importance, because if it can be shown that, for example, room and pillar mining can extract 75% of the ore body, versus 85% for block caving, our view is that these numbers are close enough to warrant a mandate for room and pillar mining. And if costs are actually comparable as they could be using Dr. Kliche’s own chart 2.3-1, it could be the case that mining the deposit using room and pillar could only be only slightly less lucrative for the company than panel caving. Again, using the COG approach for analysis is less useful, because what matter most is 1.) how much of the ore body can be mined fully and 2.) what the actual per

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ton cost is using various methods. Unfortunately, Dr. Kliche's analysis does not get us to either conclusion. All we are left with are general industry figures, varying widely and often overlapping, and yet still no idea where costs actually fall with Resolution Copper, and how much of the deposit can be mined using various techniques.

Tailings

As noted thoroughly in the Coalition's comments, the fact that the preferred alternative makes essentially no effort towards water conservation is extremely problematic for us. Arizona – especially southern Arizona – has no luxury to accommodate new, extraordinarily water intensive industries. It will directly compete with existing water users one way or another. We believe all alternatives should have included dry tailings disposal for this reason alone. However, in light of the tailings failures globally, particularly in Brazil and Canada in the last five years, we also remain concerned about catastrophic failures, even with centerline or downstream tailings dams.

The Forest Service and Resolution Copper have the ability to utilize dry tailings, partly because if combined with a backfill-compatible mining technique, ultimate tailings volumes could be less than half that of panel caving.

The Evaluation Report makes clear the benefits of filtered tailings: substantial water savings and the ability to stack high, and also notes the drawbacks of dust and acid generation. It is our view, however, that dust control can be achievable through concurrent reclamation that places a permanent, resilient cover over dry tails as soon as sections are complete. It may not entirely eliminate dust, but if designed properly, has the ability to significantly reduce dust.

Acid generation will eventually be problematic for any tailings impoundment at Resolution Copper designed for dry closure, as are all the alternatives in the DEIS. Arguments are made that using subaqueous tailings deposition would slow acid generation, which is true during the life of the mine, but the life of the mine is only a fraction of the time horizon involving acid generation. Since dry closure will be the reality in any case, it's our view that starting with dry tailings is by far the best option for all alternatives. Roughly 400,000 acre feet of water will be saved during the life of the mine if dry tailings are utilized, and selecting a topographically appropriate site can ensure the minimum amount of surface disturbance and visual impacts.

It is not within the scope of these comments to analyze all methodology that has led to only one alternative including dry tailings (and not the preferred alternative), or to analyze the process that led to site selection for those alternatives. But we believe that in addition to mining technique, the other biggest impact occurs from the type of tailings disposal selected.

Ideally, all tailings would report to a spent open pit, or at least a different type of brownfields site, although we understand that approach can be difficult from an engineering perspective, as well as carry serious risk to groundwater if not done properly. These comments are general; we strongly urge the Forest Service to issue a revised or supplemental DEIS that includes dry tailings in every alternative, and revisits the current rationale for eliminating brownfields sites from ultimate consideration. Perhaps brownfields sites could be partially used? Either way, between using brownfields sites to the maximum extent possible, using alternative engineering techniques to reduce tailings volume by over half via backfilling, and using dry tailings for every alternative, the amount of ultimate surface disturbance from a new tailings impoundment could be eliminated entirely or reduced to a fraction of the current proposed alternative at Skunk Camp. Unfortunately, the Forest Service has dismissed virtually all of these possibilities from further consideration.

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Forest Service's Role as NEPA administrators, not as Arbiters of Mining Economics

The National Environmental Policy Act's intention is to provide a range of alternatives to a proposed action to reduce environmental impacts to the extent practicable. It is not the role of the Forest Service to determine what is "reasonable" in terms of profit margins, which is essentially what it has done in justifying the dismissal of virtually all meaningful alternatives that would vastly reduce impacts, citing cost as the only criteria.

Alternative mining techniques – which have the proven and feasible ability to completely eliminate surface subsidence at Oak Flat – is not considered in any of the alternatives, again citing cost as the reason. Yet this action would allow the Forest Service to dismiss many of the comments associated with vehement public opposition to the mine.

The DEIS in its current form fails NEPA. Even though there are different places considered to place tailings, little effort is made to reduce water consumption and avoid any chance of catastrophic tailings failure, the impacts of which would be so vast as to be barely comprehensible. Surely, a tailings breach of the magnitude of Resolution Copper would be one of the worst environmental disasters in US history. Yet 5 of 6 of the alternatives do not consider filtered tailings. Water consumption is more or less the same for those 5 alternatives, even though it can be reduced dramatically.

The Forest Service is not obligated to approve whatever plan the mining company wishes, based on their prime motive of profit maximization. While we appreciate some of the changes in the DEIS over the GPO, it does not go nearly far enough under the mandates of NEPA to provide a meaningful range of alternatives to minimize impact.

Thank you for your consideration,

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