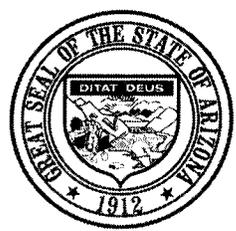


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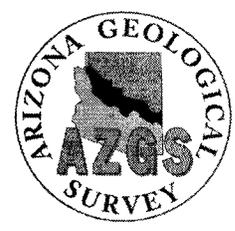
RECEIVED APR 30 2010



Janice K. Brewer
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
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M. Lee Allison, Ph.D., R.G.
Director and State Geologist

April 30, 2010

Teresa Ann Ciapusci
Staff Officer
Ecosystem Management and Planning
Coronado National Forest
300 West Congress, FB42
Tucson, Arizona 85701

Dear Teresa Ann:

The Arizona Geological Survey reviewed the following Rosemont/Augusta documents in regards to the Rosemont copper mine EIS:

- Geotechnical Study Assessment, Tetra Tech, 6/1/2007
- Geotechnical Addendum Volumes 1, Tetra Tech, 2/1/2009
- Geotechnical Addendum Volumes 2, Tetra Tech, 2/1/2009
- Geotechnical Addendum Volumes 3, Tetra Tech, 2/1/2009
- Baseline Geochemical Characterization Tetra Tech, 6/1/2007
- Geologic Hazards Assessment, Tetra Tech, 6/1/2007

We did not find any deficiencies, gaps, or errors in any of the sections that our geologic staff reviewed.

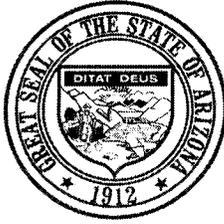
We reviewed "Geology and Seismotectonic Review for the Rosemont Mine Siting Study," Vector, 4/20/2006, and identified possible deficiencies and errors in it. These are described in the attached document. However, our staff found that these concerns may be largely irrelevant as they appear to be addressed in the subsequent "Geologic Hazards Assessment" report of 2007.

Please let me know if you have any questions.

Sincerely,

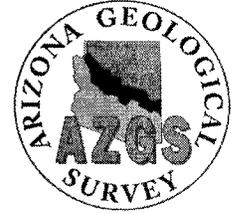
M. Lee Allison
State Geologist and Director

Attachment



Janice K. Brewer
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M. Lee Allison, Ph.D., R.G.
Director and State Geologist

Review of the "Geology and Seismotectonic Review for the Rosemont Mine Siting Study," Vector Colorado LLC, April 20, 2006, 14p.

By the Arizona Geological Survey

Summary

There are a number of analyses, conclusions and determinations made in this report that are not documented or explained, making it difficult to assess the validity of their findings. There are statements made that bring into question the authors technical understanding of the issues they are addressing.

Recommendation

Address the omissions, provide clarification, and resubmit the report for review to determine if the findings have changed or document that they are justified.

Review

Overall

We are concerned that the report provides insufficient documentation for the ground-motion numbers. There is nothing to back up how they calculated the numbers they do provide. The impression is that values were plugged into a spreadsheet of some sort without fully understanding what was being done.

The report implicitly assumes that all the normal faults in the region are known. Because of long-time arid conditions, basin - range contacts that have late Quaternary fault displacements should have been recognized in the extensive geologic mapping published for the region over many decades. Contacts that do not have mapped Quaternary faults in the greater Tucson area can be reasonably inferred to be inactive, or at least not to have moved for hundreds of thousands of years.

Action: The basis for assuming little or no potential for the existence of previously unrecognized basin-bounding faults should be explained.

Specific issues:

1. Re: Section 3.1 Earthquake History of Arizona

The report repeatedly references "recorded" earthquakes between 1852 and the present. However, "recorded" refers to earthquakes recorded by some kind of seismometers, which largely did not exist until the 20th century and did not arrive in

Arizona for many years. We suspect the authors really mean “reported” or “reported and recorded” earthquakes.

This is further borne out by Figure 3.1 which they state shows all the “recorded” earthquakes in Arizona since 1852. The figure appears to show a few hundred events at most, but clearly not the 6,204 events they cite earlier in this section. The figure caption describes it as “Arizona Historic Earthquakes.”

Again, in Section 3.2.1, the report describes 10 historical seismic events “recorded” within 200 km of the Rosemont project, and includes the 1887 M7.4 Sonora Mexico quake that was *not* recorded but was widely reported (see their Table 3.1).

Action: Clarify or correct terminology and implications of “recorded” vs “reported” earthquakes.

2. Re: Maximum Credible Earthquake

This document did not consider the consequences of an earthquake on the nearby Santa Rita fault zone of the size that occurred during a previous, scarp-producing event at ~60-100 ka. This earthquake was estimated by Pearthree and Calvo (1987) to be of magnitude 6.4 to 7.3. Consideration of a repeat event on the Santa Rita fault of this magnitude was not considered. There might be good reasons for not considering such an event, but those are not outlined in the report either.

Reference: Pearthree, P.A., and Calvo, S.S., 1987, The Santa Rita fault zone: Evidence for large magnitude earthquakes with very long recurrence intervals, Basin and Range province of southeastern Arizona: Bulletin of the Seismological Society of America, v. 77, p. 97-116.

Action: Analyze and incorporate the impacts of a MCE on the Santa Rita fault zone.

3. Re: Basis of USGS numbers

The USGS 2002 report (which is not included in the reference section and is referred to a number of inconsistent and casual manners, so we are not sure there is only one report they are discussing) looks like it used only a couple of faults mapped in northwest Arizona. Yet, the Rosemont report lists faults that are supposed to be from the USGS 2002 report. So we are confused.

If the USGS really used all the faults that the Rosemont report (their Table 3.2) lists then the USGS numbers are reasonable. If the USGS only used the couple of mapped faults that they list and relied on background seismicity for the bulk of the state then the USGS numbers are not reliable for this study.

Moreover, we assume the Rosemont report pulls rock site values (compared to soil site values) out of the USGS report but they do not say explicitly. (Note: attenuation equations are developed for specific site conditions - rock and soil and usually the soil category is further broken down) It could be that the USGS values are only for rock, but we cannot tell.

Action: Clarify and document the basis for using the USGS numbers. Provide appropriate and complete references to USGS source materials.

4. Re: Completeness of earthquake catalog

The earthquake catalog they use is the USGS Western US catalog (WUS) which they say is good for the period 1749-2001 (they then supplement for the time later than 2001). We cannot be certain that the record is complete in this region for that time period, even for big earthquakes ($M > 6.5$). We are also not sure that they have a complete modern record (i.e., the last 100 year) of $M > 4$ earthquakes for the areas of Mexico that affect the project.

Action: Document the basis for determining the catalog is complete, and consider the implications for gaps in the record.

5. Re: Fault geometries for attenuation relations

The report fails to describe the fault geometry for both the background and Santa Rita faults, vis-a-vis the study site. They should state the assumptions on fault dip and distance to surface expression of the faults. That is, what numbers for fault distance are they plugging into the attenuation relations?

We found that Table 5.2 on page 18 of the "Geologic Hazards Assessment" report places the closest point on the Santa Rita fault at 11.2 km away from the Rosemont mine site. Table 5.3 gives peak ground accelerations for movement on the Santa Rita fault at 11.2 km away. However, the Santa Rita fault dips westward, at a gently angle according to Johnson and Loy (1992), so the actual distance to an earthquake hypocenter we expect would be at least another 10-15 km away, to the west.

The Santa Rita fault is the largest Quaternary fault in southeastern Arizona, and it is close to the project area. Adequately addressing the seismic hazard for this fault should also address the hazards from smaller faults and those at further distance.

Action: Incorporate the fault geometries for the Santa Rita fault in calculating the attenuation relations.

6. Re: Assumptions for attenuation relations

Did they assume normal faulting for attenuation relations for the Santa Rita and background earthquakes? Do they use rock or soil attenuation equations, and if soil what sort of assumptions did they make on the subsurface velocity profile?

Action: State assumptions explicitly in determining the attenuation relations. Explain the basis for those assumptions and the implications if they are not valid.