Kimberly MacMillan

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Date: Tue, May 3, 2011 at 10:54 PM
Subject: Northern Arizona Proposed Withdrawal Draft EIS comments
To: "NAZproposedwithdrawal@azblm.org" <NAZproposedwithdrawal@azblm.org>

BLM,

Please see attached letter with review comments on the Northern Arizona Proposed Withdrawal Draft EIS.

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Date: May 3, 2011

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BLM, Arizona Strip District
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From: Dr. Abe Springer
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Flagstaff, AZ 86001

Re: Comments on Northern Arizona Proposed Withdrawal Draft EIS

This letter contains my personal comments on the Environmental Impact Statement for the Northern Arizona Proposed Withdrawal. I am a Professor of Hydrogeology at Northern Arizona University (NAU) where I have been studying the aquifers and springs of Northern Arizona and the Grand Canyon region since I arrived in Flagstaff in 1994. Also, I am currently serving as the Director of the School of Earth Sciences and Environmental Sustainability at NAU. These comments do not represent the opinions of NAU, but my own personal observations and interpretations as being a hydrogeologist in Northern Arizona for nearly 20 years. I have supervised numerous student research projects on the groundwater flow of the aquifers which have been published in peer-reviewed literature, have developed numerical groundwater flow models to describe flow through the aquifers, have been involved in numerous management and planning decision processes for the region, and have extensively studied the springs ecosystems and groundwater flow regimes of the Grand Canyon and surrounding regions.

Despite my varied background in ecology, policy, management, and planning, my comments are restricted to my academic specialties in geology and hydrogeology. They address the regional groundwater flow conditions of the Redwall-Muav aquifer. Also, I will demonstrate how the EIS omits important cited literature about the directions and magnitudes of groundwater flow from the South Parcel.

The Supai Formation is a very leaky confining layer, hence the absence of many perched aquifers on top of it. The Supai Formation is not a barrier to downward leakage to the Redwall-Muav aquifer. In fact, if it was a very tight confining layer, there would be significant perched aquifers above it, and the Redwall-Muav aquifer wouldn't receive recharge. Because of the leaky nature of the Supai Formation and the extensive faulting and fracturing within the regional groundwater flow systems, recharge is actually very fast, but episodic. Recharge at sinkholes or along faults or fractures can go from land surface to the Redwall-Muav within hours. A large storm event, which exceeds the capacity of retention basins around or adjacent to mining areas

has the potential for rapid recharge to the deep regional aquifer. The EIS omits a significant discussion of the rapid, episodic nature of focused recharge to the Redwall-Muav aquifer. Therefore, the related analyses and assumptions about contaminant transport are flawed within the EIS. The rapid, episodic, and focused nature of recharge should be included in the EIS analyses.

A significant "Water Resource Issue" is missing from the EIS, as listed in Table 3.1-1. This missing issue is the *Contamination or loss of the Havasupai Nation water supply*. For completeness in the analysis of the EIS, any water supplies which could be contaminated, such as the aquifer at Tusayan or the Colorado River, should be included in the analysis. The omission of the Havasupai Nation water supply is a critical omission. This issue should be specifically listed as a Water Resource Issue and should be analyzed in the EIS. This omission may be due to the fact that the EIS did not include all existing, relevant literature to conduct the analysis of the impacts to the water supply of the Havasupai, as expressed at Havasu Springs.

Discharging into tributaries of the Grand Canyon are the two largest spring complexes in the State of Arizona, the Blue Springs of the Little Colorado River and Havasu Springs. Havasu Springs are the sole source supply of water for the Havasupai Nation. The EIS omits published research which shows the direct connections (in graphical form) of groundwater from the South Parcel to Blue Springs and Havasu Springs (see attached figure). The EIS omits the peer-reviewed publication of Crossey and others, 2009. This manuscript was published in the peer-reviewed journal *GSA Bulletin* on April 24, 2009 and should have been used in the EIS analyses. The attached figure from this manuscript clearly shows the groundwater flow paths from the South Parcel to Havasu Springs.

Crossey, L.J., K.E. Karlstrom, A.E. Springer, D. Newell, D.R. Hilton, T. Fischer. 2009. Degassing of mantle-derived CO_2 and He from springs in the southern Colorado Plateau region– neotectonic connections and implications for groundwater system, *Geological Society of America Bulletin*., 121:1034-1053, doi: 10.1130/B26394.1

The EIS omits another important publication, by Pool and others 2011. Although this was not published until April 2011, it was in draft form in review by December 2009 and could have been used for analysis in the EIS. I served as a member of a technical committee which advised the construction of this model and as a technical reviewer for the published report of the model. The second figure attached to this letter is the regional hydraulic head map from this model, which is more complete and accurate than Figures 3.4-14 and 3.4-15 in the EIS. Figure 3.4-15 is from a study published in 1974 and is very outdated. Figure 3.4-14 deliberately does not show flow arrows continuing from the South Parcel to Havasu Springs or to Blue Springs to give the perception of uncertainty in the directions and magnitude of groundwater flow. The directions and magnitude of flow are clearly shown on the attached figures from Crossey and others 2009 and Pool and others 2011. The authors of the EIS should have had the USGS conduct a flowpath

analysis on the Northern Arizona Regional Groundwater flow model of Pool and others 2011, as is shown with the flow model published in Crossey and others 2009. The flow model of the USGS could be used to calculate travel times and velocities of groundwater.

Pool, D.R., K.W. Blasch, J.B. Callegary, S.A. Leake, and L.F. Graser. 2011. Regional groundwater-flow model of the Redwall-Muav, Coconino, and alluvial basin aquifer systems of northern and central Arizona. U.S. Geological Survey Scientific Investigations Report 2010-5180, 101 p.

For the groundwater flow systems underlying the North and East parcels, regional flow models don't exist. But, both of these regions have well developed karst systems with sinkholes that extend from land surface to the water table. Recharge through these sinkholes is rapid when conditions exist for runoff. Because of the rapid recharge to the aquifers of the regions in the North and East parcels and the lack of scientific tools to predict impacts from mining activities, it would be prudent to apply the precautionary principle and allow no mining till these tools are developed.

For the above stated reasons, the analyses in the EIS are not complete and are flawed. The tools and techniques used in the EIS do not represent the best available science to show the impacts of potential groundwater contamination from the South Parcel on Blue Springs or Havasu Springs. The simple dilution calculations in Chapter 4 of the EIS are not the best available science for conducting an impact analysis. The regional groundwater flow model of the USGS should be used to conduct a particle tracking analysis and potentially a contaminant transport model. The Havasupai rely upon water supplied from springs, not wells, so the water supply, as delivered by springs to the Havasupai, should be tracked and analyzed as a "Water Resource Issue".

Unless these analyses are completed and show no impact to Blue Springs and Havasu Springs, I must recommend that the Alternative B is adopted because the EIS does not rely upon all of the best available science to show the potential impacts of mining activities.

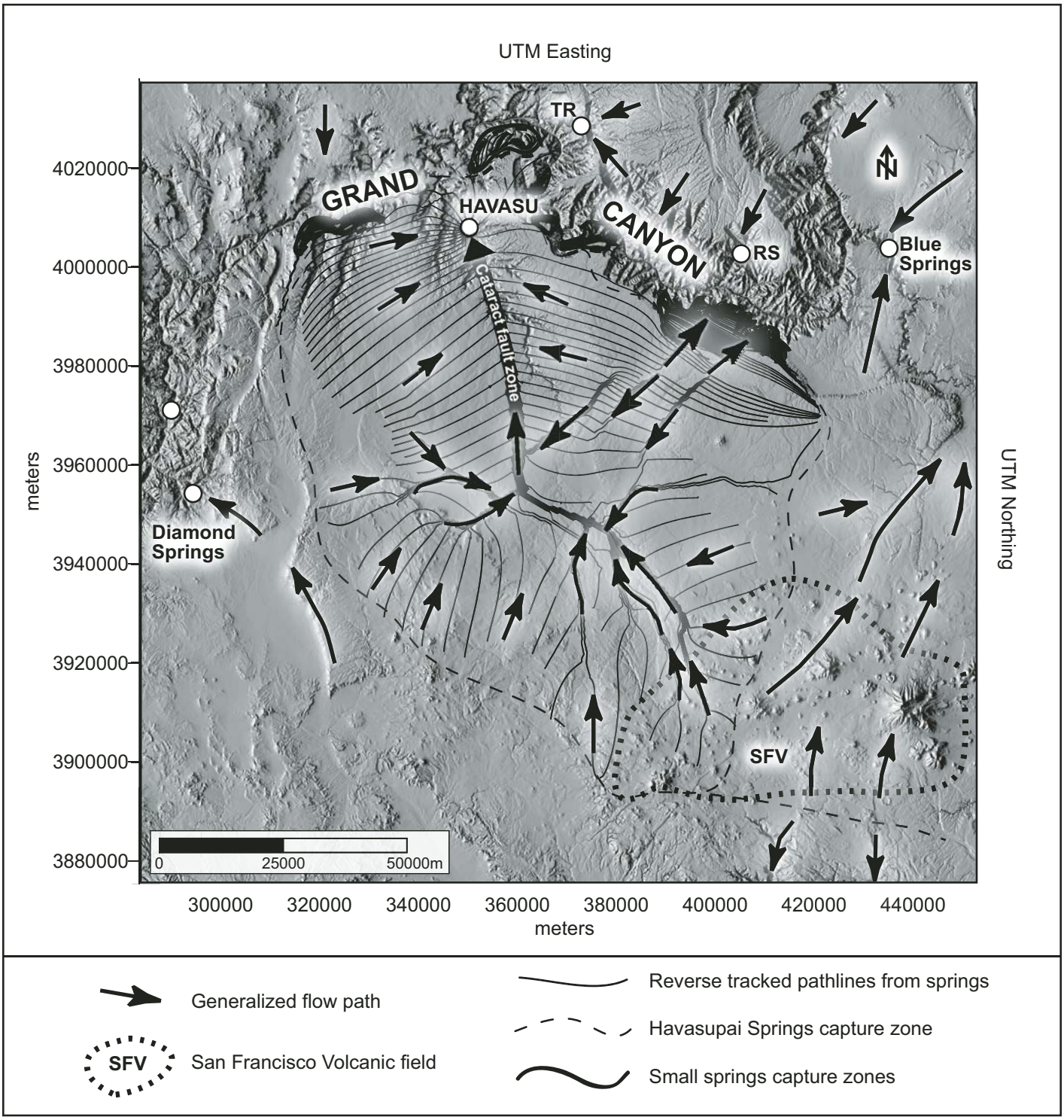

Figure 4. Hydrologic model for Coconino Plateau subbasin (Kessler, 2002) showing San Francisco volcanic field (SFV) recharge area and major high-volume springs: Blue Springs, Diamond Springs, Havasu Springs, RS—Roaring Spring, TR—Trunder River. Fine lines are reverse-tracked particle paths from the model; arrows indicate generalized groundwater flow paths; heavy line shows Cataract fault zone as a fast pathway for groundwater movement.

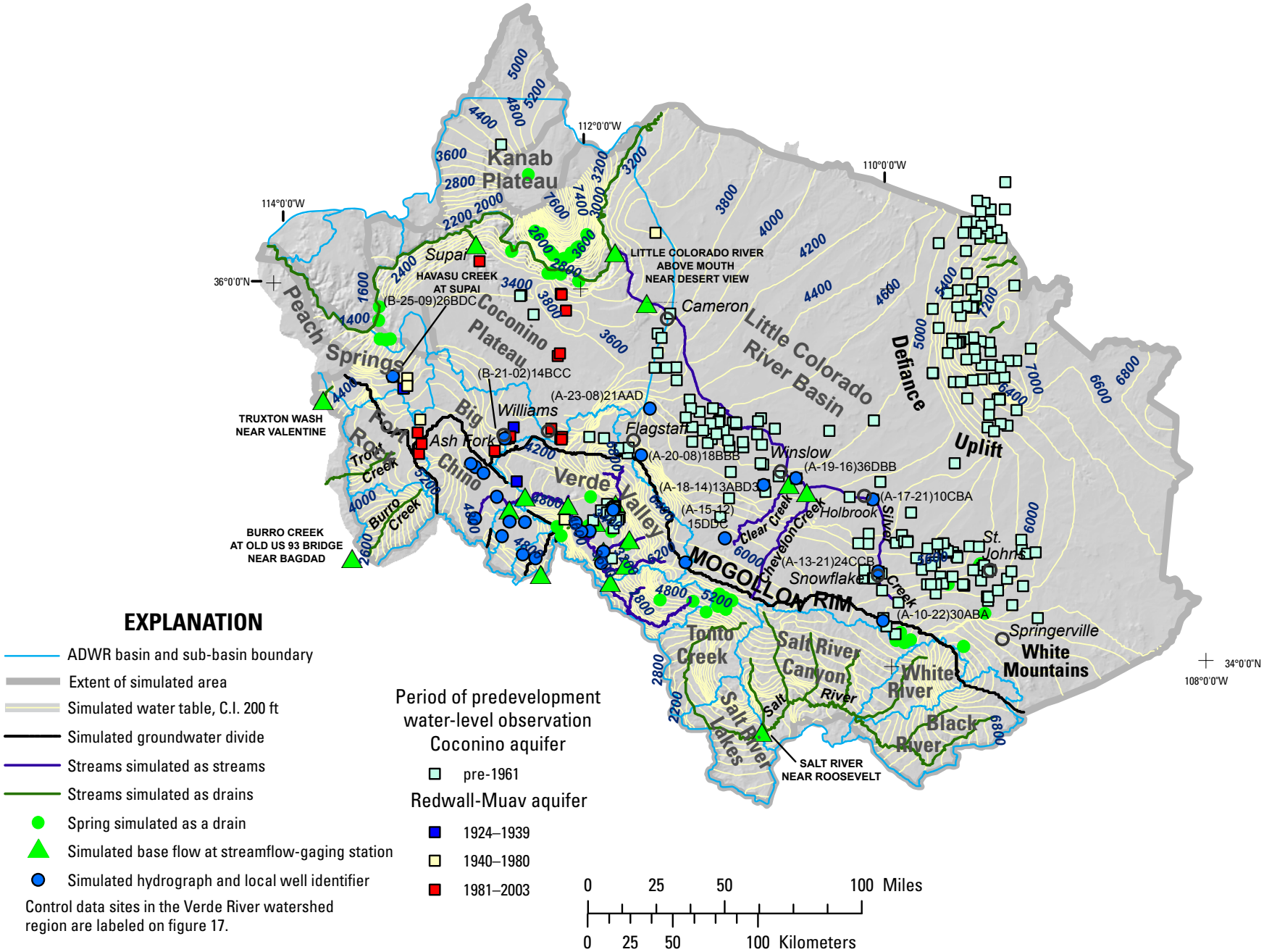

Figure 16. Simulated predevelopment groundwater-flow system, Arizona Department of Water Resources (ADWR) basins and sub-basins, and predevelopment control data sites including wells with water levels and streamflow-gaging stations in the area of the Northern Arizona Regional Groundwater-Flow Model.