RESPONSE TO COMMENTS
BHP Billiton Navajo Coal Company - Navajo Mine
NPDES Permit No. NN0028193

EPA received one set of comments from the San Juan Citizens Alliance, Diné Citizens Against Ruining our Environment (Diné Care) and the Clean Air Task Force. Incorporated by reference was the report titled: *A Preliminary Evaluation of the Potential for Surface Water Quality Impacts From Fly Ash Disposal at the Navajo Mine, New Mexico* D. A. Zimmerman, P.E., SETA, May 20, 2005. EPA has summarized and responded to significant comment below.

COMMENT
We request that the EPA add, at a minimum, water quality based effluent limits for the NPDES permit NN0028193 for Total Dissolved Solids (TDS), sulfate, boron, selenium, arsenic, lead and cadmium to those limits currently proposed in this permit.

RESPONSE:
While EPA does not believe that the mine site is contributing to an increase of pollutant concentrations in the Chaco River downstream of the mine (see response below) EPA notes that no discharge data is available for the above listed pollutants. Therefore, due to concerns raised by the commenter, EPA has added monitoring requirements for those pollutants which may be present that may have the potential cause or contribute to a violation of water quality standards and include arsenic, boron, cadmium, lead, selenium, sulfate and TDS. The permit contains a reopener provision in the permit. If monitoring indicates that the discharge causes, has the reasonable potential to cause, or contributes to excursions above water quality criteria, the permit may be reopened for the imposition of water quality based limits and/or whole effluent toxicity limits.

Although the specific regulation of coal combustion byproducts and their placement in the mine is generally beyond the authority of the NPDES permit, EPA has included additional language in the permit to ensure that the mine is properly managing CCB products to prevent contamination of surface waters. This includes requirements for residue hauling vehicles and areas adjacent to minefills.

COMMENT
Historic reporting shows that TDS, sulfate, boron and selenium are increasing to a statistically significant degree in the Chaco River from points upstream of the Navajo Mine to points downstream to levels causing harm and exceeding water quality standards for at least one toxic trace element, as well as primary and secondary drinking water standards and health advisories for sulfate, TDS and boron. Please see *A Preliminary Evaluation of the Potential for Surface Water Quality Impacts From Fly Ash Disposal at the Navajo Mine, New Mexico* D. A. Zimmerman, P.E., SETA, May 20, 2005, page 23, “Results of Surface Water Quality Analysis, Table 2.

Average selenium levels in the Chaco surface waters have increased from 0.0038 mg/L upstream of the mine to 0.0131 mg/L downstream of the mine, exceeding the chronic aquatic water quality standard established under the Clean Water Act of 0.005 mg/L" (see National Recommended Water Quality Criteria for Priority Toxic Pollutants, EPA Office of Water, 2006).

Average boron levels have increased from 0.219 mg/L upstream of the mine to 2.57 mg/L downstream of the mine. This exceeds the Removal Action Level for boron established by EPA under the Superfund Program of 0.9 mg/L as well as Ten Day and Longerterm Health Advisories for children of 0.9 mg/L and the Lifetime Health Advisory for adults of 0.6 mg/L (see Drinking Water Regulations and Health Advisories, EPA Office of Water, October 1996).

Average sulfate levels have increased from 305 mg/L upstream of the mine to 1118 mg/L downstream of the mine, exceeding the proposed primary DWS of 500 mg/L and secondary DWS of 250 mg/L.

Average TDS levels have increased from 881 mg/L upstream of the mine to 2644 mg/L downstream of the mine, exceeding the secondary DWS of 500 mg/L. Thus TDS levels, an indicator of total pollution in the water, are already above the public welfare drinking water standard upstream of the mine, suggesting clearly that this permit should set stringent TDS limits to keep from making a stressed environment more stressed.

Concentrations of sulfate, TDS and boron monitored by the Navajo Nation EPA in the surface waters of the Bitsui Wash downstream from the Bitsui ash pit in the northeast corner of the Navajo Mine are at harmful levels that are beyond background levels (see *A Preliminary Evaluation of the Potential for Surface Water Quality Impacts From Fly Ash Disposal at the Navajo Mine, New Mexico,* pages 9-15). Levels of these constituents in monitoring wells downgradient of ash in the Bitsui Ash Pit located upstream of this surface water monitoring point have risen clearly to harmful concentrations indicating the ash is the source of the degradation in the Wash. The one well that BHP is calling a background (upgradient) well in this part of the mine, KF-83, is actually downgradient to most of the northern half of Navajo Mine. Not surprisingly, KF-83 also has clearly
increasing levels of sulfate and TDS, given that ash was dumped upgradient to this well.
3 Additional information from the monitoring programs in place at the Navajo Mine and neighboring San Juan Mine indicates there should also be water-quality based effluent limits for arsenic, cadmium and lead set under NPDES permit NN0028193. BHP Minerals uses arsenic in its Navajo Mine permit as a specific indicator parameter of ash contaminant migration, and thus this permit should establish limits for arsenic.

RESPONSE:
EPA does not agree that available data demonstrate that pollutant levels are increasing to a statistically significant degree due to discharges associated with the mine site. In conducting this assessment, EPA evaluated the data presented in *A Preliminary Evaluation of the Potential for Surface Water Quality Impacts From Fly Ash Disposal at the Navajo Mine, New Mexico* by D.A. Zimmerman (hereafter referred to as the Zimmerman report). EPA reviewed effluent discharge data from the mine site; the supporting statistical analysis provided in the Zimmerman report; the physical locations of the upstream and downstream data; and other potential sources contributing an impact to the Chaco River. EPA also reviewed a BNCC commissioned technical review to the Zimmerman Report by Norwest Applied Hydrology (hereafter referred to as the

Norwest report) and relevant components of the permitee's Office of Surface Mining (OSM) Permit Application Package (PAP) for surface mining.

Consideration of effluent discharge data from the mine site

First, EPA evaluated effluent discharge data provided in the Discharge Monitoring Reports required by the existing NPDES permit. As indicated in Section A.1 and A.2 of the permit, monitoring is required daily for all wastewater discharged from each of the permitted outfalls for flow, TSS, iron, and pH. Typically, wastewater generated from runoff events is collected in constructed detention ponds and is recharged, reused or lost to evaporation. Discharges from NPDES regulated outfalls have historically been associated with rainfall events. There have been only five discharge events since the beginning of the last Navajo Mine permit cycle in December 2000. All discharges occurred at Outfall 008. Outfall monitoring demonstrated compliance with permit limits for TSS, iron and pH with the exception of three TSS exceedance in September 2002. No outfall discharge data is available for sulfate, boron, selenium, or the other constituents of concern raised by the commenter. Outfall monitoring demonstrated that relatively little wastewater has been discharged in total during the past permit cycle, on only 5 occasions. Based solely on the volume of runoff generated from active mine areas, coal preparation plant areas, and reclamation areas that has historically been discharged from the mine site related to the annual flow volume of the Chaco River, and the fact that the closest discharge outfall is located a minimum of 3.2 stream kilometers (2.0 miles) from the Chaco River, EPA believes it is unlikely that the discharge from the mine site has the ability to impact the Chaco River.

Criticism of supporting statistical analysis provided in the Zimmerman report

Second, EPA evaluated the statistical basis of the conclusions of the Zimmerman report. Table 2 of the Zimmerman report, "Results of Surface Water Quality Analysis" is a statistical summary of the surface water quality data in the Chaco Basin. Zimmerman compiled data from Navajo Nation Environmental Protection Agency (NNEPA) and United States Geological Survey (USGS) to assess spatial water quality difference between two groups of data labeled "upstream" and "downstream". A temporal monitoring range for each analyte was not explicitly explained.

In respect to surface waters, the Zimmerman report summarizes data for the following water quality analytes; pH, sulfate, TDS, boron, selenium, and arsenic in downstream and upstream groupings. Zimmerman derived downstream and upstream statistics by pooling spatial and temporal data points at each monitoring station and by corresponding them to their appropriate downstream or upstream cluster. Figure 12 (page 26, copied below) illustrates Zimmerman applying this logic towards TDS. TDS data was gathered from USGS stations from 1970-1990. There was no mention of whether NNEPA sampling stations was used in this analysis. Zimmerman notes that collected monitoring points vary year to year for station to station, (e.g., some stations had multiple data points in a given year while others had only a single data value per station). Consequently, to remedy bias that some data points may pose, all data points within their respected year per their respected station. Zimmerman report took blanket averages for all stations and their averaged annual values, irrespective of sample size, and correspond them to upstream and downstream clusters. Based on Table 2 and Figure 12, reported averages of 2644 mg/l and 881 mg/l for downstream and upstream regimes, respectively.

Table 2 (page 25, copied below) presented calculated statistics for analytes of concern. Statistical components included the mean, standard deviation, parametric t-test result at 0.05 significance level ($t_{\alpha=.05}$) and its respective threshold value to reject the null hypothesis (H_o) ($t_{critical}$), t test values' corresponding p-value and a descriptive statistic ratio between downstream and upstream means. Based on utilized statistical tests, Zimmerman assumed that data is normally distributed.

Table 2. Statistical summary of Chaco Basin water quality data.

	Upstream		Downstream		Statistical Parameters				Dn / Up
Analyte	Mean	Sdev	Mean	Sdev	$t_{\alpha=.05}$	$t_{critical}$	p-value	Reject H_o?	Ratio
TDS	881	940	2644	2610	3.78	2.04	.00064	Yes	3.0
pH	7.68	.579	8.21	.587	3.10	1.96	.0021	Yes	3.4
SO_4	305	607	1118	1273	5.94	1.98	<.0001	Yes	3.7
SO_4/TDS	.311	.167	.554	.124	14.6	1.97	<.0001	Yes	1.8
Boron	.219	.132	2.57	3.66	6.95	1.98	< .0001	Yes	11.7
Selenium	.0038	.0046	.0131	.0154	2.54	2.10	.0206	Yes	3.4
Arsenic	.111	.261	.062	.060	3.87	1.96	.00012	Yes	0.56

H_o = null hypothesis: that the means of the upstream and downstream concentrations are the same

Table 2 does not include sample size numbers for gathered upstream and downstream analytes. Sample size numbers were, however, presented in each analytes' probability density function figures, Figures 13-19 in the Zimmerman report. Thus, EPA extracted sample size values by each analyte and its orientation and are presented in the table below:

Table A-EPA Generated addendum to Zimmerman's Figure 2: Sample size number for pooled upstream/downstream designations by each analyte.

n	upstream	downstream	ratio-up: down
TDS	218	32	6.8
pH	725	27	26.9
sulfate	276	91	3.0
sulfate/TDS	271	88	3.1
boron	192	117	1.6
selenium	81	18	4.5
arsenic	355	105	3.4

As seen in Table A, upstream data points predominated data collected downstream at varying ratios. This disparity is physically depicted in Figure 12 by its plotting of pooled upstream and downstream monitoring for TDS. Congruency for downstream and upstream stations layout of TDS to other listed analytes was not mentioned. It is also noted that the report did not specify if a standard collected data time frame window was used. TDS data was extracted from 1970-90; it is uncertain if the other analytes shared the same window. Table A reinforces the sample size disparities between upstream and downstream sample sizes for each analyte. As mentioned, this has confounding statistical ramifications.

Upstream and downstream spatial data

EPA generally agrees that comparing downstream and upstream boundaries to assess water quality is a viable approach. Collected data at designated boundaries was visually illustrated on Figure 11 and 12. However, two issues resonate from the report's assessment of spatial monitoring data; the lack of a clear border between upstream and downstream clusters and its rationale, and the disparity of sample sizes between upstream and downstream data sets per analyte. As mentioned previously, there were no clear justifications behind the separation of the two monitoring regimes. Based on Figure 12, there is an obvious disparity between utilized upstream and upstream monitoring points. The upstream regime for TDS data depicted in Figure 12 illustrates an overwhelmingly large area and pool of monitoring points in respect to downstream regime. The disparity can affect the results of the t-test since the two groups are not approximately balanced.

Temporal data

EPA questions the uniformity of temporal space across all constituents and their respected monitoring stations. The report conveys the uses of 1970-90 USGS TDS data to generate its description statistics for TDS however, it does not explicitly state if the same time frame was applied to the rest of the analytes. Using varying time frames for comparing data sets can confound temporal variability when comparing upstream and downstream statistics and create statistical bias.

Additionally, the inclusion of more current data to generate statistical characteristics was not mentioned. The incorporation of modern data would establish confidence in the claims of upstream and downstream water quality assertions.

Removing bias from mean

EPA concurs with the author that relevant measurements extracted from database searches had variable number of measurements taken annually across all stations. However mitigation from statistical bias by pooling and averaging stations with single or multiple measurements in any given year and/or station was not an appropriate statistical approach. The Zimmerman report ought to have resolved statistical bias by averaging each station's respected year and then aggregate and average a sampling station's annual averages to represent a station's single calculated mean. The report's blanket averaging approach did not mitigate temporal variability. In fact, it confounded both temporal and spatial variability and promoted statistical bias. By recalculating downstream TDS data from Figure 12 and producing one averaged result per station, the mean comes to a value 4738 mg/l with a standard deviation of 3501 mg/l compared to an average value of 2645 mg/l as presented in the Zimmerman report. This averaged station value incorporated yearly averages from 1969-1989. Subsequently, Zimmerman's reported upstream and downstream means may not be proper representations of central tendencies per station.

Verifying Distribution of Data

The report utilized statistical methods that are designated for normally distributed data sets and presented normal probability density function (pdf) fits for each analyte. While the report offers qualitative confirmation of normal distribution by presenting these pdfs, there was no statistical test applied to prove normal distribution for each analyte. Shapiro-Wilcox test would have empirically verified normal or lognormal distribution fits, thus suggest an appropriate statistical method; parametric or nonparametric.

Normal distribution of data would allow parametric approaches such as calculating means, standard deviation, and student t-tests. Non-normal distributions would deem parametric approaches as irrelevant and evoke non-parametric statistics. Non-parametric models do not rely on means and standard deviations as estimated parameters. Consequently, the report's approach to verifying upstream and downstream mean and variance monitoring differences with Student's t-test would not be viable in a non-parametric model. Data would have to be log transformed and non-parametric statistical models would be employed. Interestingly, the reported relatively high standard deviations in Table 2 were an indicator that sample distribution for normality ought to have been examined.

Student t-test

In addition, based on Figure 12's TDS data, EPA noticed that the t-test was done incorrectly. The averages used in the statistical t-test should be discrete values. All 32 TDS results are not discrete because of the temporal correlation within each station with multiple results over time. The degrees of freedom in the test should be from n=9 downstream stations, not n=32 temporally correlated results.

The parametric t-test assumes the data are approximately normally distributed and independent. The variances of the upstream and downstream boundaries need to be tested for equality (using the folded form F statistic) prior to using the t-test. This can determine appropriate t-test to use; pooled t-test (assuming equal variances) versus approximate t-test (assuming unequal variances).

If both upstream and downstream data are normally distributed, the t-test is appropriate to test for equal means. However, if either are not normally distributed or the sample size for one is small (such as $n=9$ downstream samples), a nonparametric test or log-normal transformation may be more appropriate. Suggestions for nonparametric tests include the Wilcoxon Rank Sum, Quantile Test, or the median test.

EPA concludes that the statistical characteristics for upstream and downstream regimes displayed in the Zimmerman report do not conclusively demonstrate a cause and effect relationship. The historical water quality data used to characterize these regimes are highly variable both spatially and temporally and, based on the concerns of the statistical methodology as presented above, EPA does not agree that the Zimmerman report has adequately supported its conclusions.

As an example, Figure 12 presents a map of the downstream TDS concentrations. There are 9 separate sampling locations. Five of the sampling locations have only 1 sample for TDS, while one of the sample locations has 17 samples for TDS. One monitoring site in the downstream area ranged from 720 to 5,600 mg/l of TDS over 5 samples, while the range for the entire data set was from 760 mg/l to 12,000 mg/l. The Zimmerman report summed the total of all data points and divided by the total number of samples, regardless of considerations such as sample location (e.g., middle of the river vs. shallow area prone to higher sediment concentrations) and time of sample (e.g., if the sample was taken during a low flow event when TSS is low or during a rain event when TSS would expected to be high). Given the extreme variability of results, ranging from 760 to 12,000, an average value as presented in the Zimmerman report is of limited utility to compare to another highly variable data set (e.g., the “upstream” data) and is highly dependent on the number of samples taken, the time of the sampling, and the location of the sampling stations.

While EPA recognizes the difficulty in performing statistical analysis on a limited data set, EPA does not conclude that the statistical analysis is sufficient to document that discharges from the mine site is affecting surface waters.

Comparison of spatial upstream and downstream data and other potential sources contributing an impact to the Chaco River

Third, EPA evaluated the physical locations of the upstream and downstream data and potential sources of impacts to the watershed. As noted above, the report defines “upstream” and “downstream” measurement zones as presented in two topographic maps, Figures 11 and 12 (pages 24, 26 respectively). Neither of these maps gives explicit geographical coordinates for the selected sites nor provides scales to assess distances and positions. Unlike Figure 11, Figure 12 does not provide a landmark point of references, i.e. geological formations (Hogback), waterways (San Juan River, Chaco River, and Morgan Lake), industrial operations (Navajo Mines, Four Corners Power Plant, and agricultural project sites), etc. Therefore, EPA has been able to reconstruct only a general description of the report’s presentation of upstream and downstream data.

As indicated, Figures 11&12 are diagrams of the Chaco Basin that have pooled downstream monitoring points. The downstream monitoring area covers roughly 44,000 acres (177 km^2), and is located directly west of the mine site. Estimated area is based on Zimmerman’s aerial topographic map seen in Figure 11 and regenerated on Google Earth Pro (4.2.0205.5730) as seen in Figure A. A toolkit from the program positioned relevant landmarks (i.e. permitted outfalls) to their geographical coordinates and determined approximate distances among interested landmarks, i.e. outfalls, hydrologic features, monitoring stations, industrial operations, etc.

Zimmerman’s downstream boundary consists of Leasing Area I and II of BNCC which comprises Outfalls 001, 002, 004, 006-011 as seen in Figures A and B. Outfalls 006-011 neighbor ephemeral washes at close proximities of 60-760 feet (18-152 m). Services roads for haulage and fords transect and interrupt some washes that tributary to Chaco River.

The downstream area is west of the Arizona Public Service (APS) Four Corner coal-fired power plant and traverses further west across the Hogback mountain formation along the Chaco River. Tailing heap piles from Four Corners lies within the downstream monitoring boundary and neighbors the Chaco River at approximately 1 mile (1.61 km).

The sampling locations of the downstream data are located at distances from the mine site that range from approximately 1 mile to over 10 miles at the furthest location.

Upstream measurement area is defined as “everything South”. Figure 12 portrays the upstream regime which is many times larger than the downstream area. EPA generated Figure C conveys “everything South”, however quantitative boundary assessments were difficult to reproduce. Based on Figures 11 and A, EPA hypothesizes land south of Outfall 010 acted as a demarcation point between downstream and upstream boundaries. EPA could not extract discernable landmarks or cartographic features from Figure 12 to estimate land area or perimeter approximations. However, we crudely estimated 3.17 million acres (12814.7 km^2) and of over 80 miles (128.75 km) lengthwise and widthwise segments of the boundary for a general comparison. Figure D depicts sectioned upstream regime that includes landmark features such as remaining outfalls in Leasing Sites III and IV; Outfalls 013,.016, 017, and 018. No records of discharges from these outfalls exist.

Therefore, the Zimmerman report presents a comparison of 2 data sets, one representing the “downstream” collection that represents an area of approximately 44,000 acres and another representing the “upstream” collection that represents an area of approximately 3.17 million acres. A comparison of the physical location of the sample data set alone demonstrates that there is no expectation that the 2 data sets should exhibit similar characteristics. The presumption that these 2 data sets should demonstrate a similar average concentration is a fundamental flaw of the analysis presented by the commenter. As described below, there are several considerations within a watershed that would support a general increase in dissolved parameters downstream in the watershed.

EPA concludes that the Zimmerman report did not adequately explain upstream and downstream boundaries to determine cause and effect relationships from the mining outfalls to downstream water quality. The lack of sufficient rationale behind upstream and downstream demarcations also neglected to emphasize other potential inputs to the site such as the Four Corners Power Plant, irrigation return flows from NIIP, or natural environmental processes such as rock weathering and dissolution, wind dispersal runoff sources, and evaporation.

Within the watershed, there are several other potential sources that could explain an increase in dissolved constituents in the downstream reaches of a stream as compared to the upper, feeder tributaries. One is the potential inputs from NIIP irrigation water, where, due to evaporation and flushing of dissolved minerals, agricultural return flows may demonstrate an increased concentration in dissolved parameters. EPA also considers Norwest’s hypothesis of environmental processes such as rock weathering and dissolution, wind dispersal runoff sources, and evaporation can modulate background levels of concerned constituents temporally (monsoonal/dry seasons) and spatially, as described in the following section.

Therefore, based on considerations of volume of discharge flow, distance from the discharge points to the receiving water, and geographic distribution of the data sets, EPA does not conclude that pollutant levels are increasing to a statistically significant degree due to discharges associated with the mine site.

The permittee's record indicates there was no discharge to receiving waters from permitted outfalls since NPDES issuance in 1977 with the exception of Outfall 008. Records show that five discharges to receiving waters from Outfall 008, a mine drainage outfall, were due to storm events during the last permit cycle. Outfall discharges occur only when impoundment water levels surpass critical capacity. Constructed risers relieve potential overflow by discharging excess volume to receiving waters. BNCC documents discharge events to EPA in a timely manner. Only one discharge event reveal 3 parameter exceedances from five days of monitoring, 9/10/02-9/14/02. Ensuing discharges after 2002 all have met limit requirements. The nearest distance to the mouth of Chaco River from Outfall 008 is approximately 2.5 miles (4.0 km) along tributaries flowing downstream towards Chaco River.

Background and Pollutant Sources

EPA considers the Norwest report's counter-points against Zimmerman's lack of consideration concerning the varied surface hydrology, flow regimes, and other environmental influences within Chaco watershed. OSM reported that historically San Juan River Basin's "surface water quality is poor with high levels of total suspended solids (TSS) and total dissolved solids (TDS)" and its "water does not meet standards for domestic or livestock use" in the Environmental Assessment. This argument supports their claim that no additional impact will occur for surface water.

EPA also considers Norwest's hypothesis of environmental processes such as rock weathering and dissolution, wind dispersal runoff sources, and evaporation can modulate background levels of concerned constituents temporally (monsoonal/dry seasons) and spatially. Given the semi-arid/arid climate, EPA notes that the Zimmerman report lacks consideration or mention of synoptic evaporation processes that can potentially concentrate constituents downstream and dissolution of soluble constituents upon contact with flowing water downstream from runoff, both agricultural and storm water. The analysis presented in the Zimmerman report did not present natural background conditions or baseline to account for probable net impact from BNCC to surface water quality.

Navajo Nation Environmental Protection compiled data exceeding surface water quality constituents across 35 sites for over 8 years within San Juan Basin under agency sponsored monitoring programs. These sites included upper and middle San Juan River (i.e. Bitsui Wash, Ojo Amarillo Wash, Gallegos Wash, etc) and Chaco Wash (Chaco River, Chinde Wash, Sanostee Wash, etc). NNEPA tallied a total of 274 exceedances at Basin monitoring stations. The top three most frequented contaminants were total residue chlorine (TRC) (n=42), selenium (n=29), dissolved selenium (n=28) and the top three sites with most frequent exceedances were Ojo Amarillo Canyon (n=64), Gallegos Canyon (n=55), and North Chaco River (n=53). Ojo Amarillo and Gallegos stations are located approximately 6 and 18 miles east, respectively, of the mining site and are heavily influenced by NAPI activity and runoff. NNEPA Northern Chaco River monitoring station (06CHACORI01) neighbors Four Corners Power Plant and it mine tailings heap at approximately 6 miles (9.66 km) and 4.25 miles (6.84 km), respectively. The mine tailings heap neighbors Chaco River at approximately 1.0 miles (1.61 km). In addition, adequate baseline data is necessary to assess net impact from industrial activity to natural geological background. Images of mentioned outfall, NNEPA monitoring sites and their comparative distances are provided in Figures E and F. EPA notes that Four Corners Power Plant resides within the downstream boundary and is in close proximity to Chaco River and a downstream NNEPA Chaco River monitoring station.

EPA concludes that overall water quality of San Juan Basin is of poor quality. NNEPA's exceedances monitoring data illustrates a scattering of exceedances across San Juan Basin and throughout time. Given the site complexity and the myriad of other natural- and anthropogenic-occurring inputs, EPA requires convincing data that supports the hypothesis that BNCC discharge is a contributor to water quality degradation. As mentioned previously, BNCC has only discharged from one outfall at five occasions. Consequently, EPA has implemented additional constituent monitoring (arsenic, boron, cadmium, lead, selenium, sulfate, and total dissolved solids) to their permit to address the need for more robust data than what is currently available to characterize BNCC discharge.

Map as presented in page 24 of the Zimmerman report illustrating downstream monitoring points: *Zimmerman, D.A. 2005. "A Preliminary Evaluation of Potential for Surface Water Quality Impacts from Fly Ash Disposal at the Navajo Mine, New Mexico."*

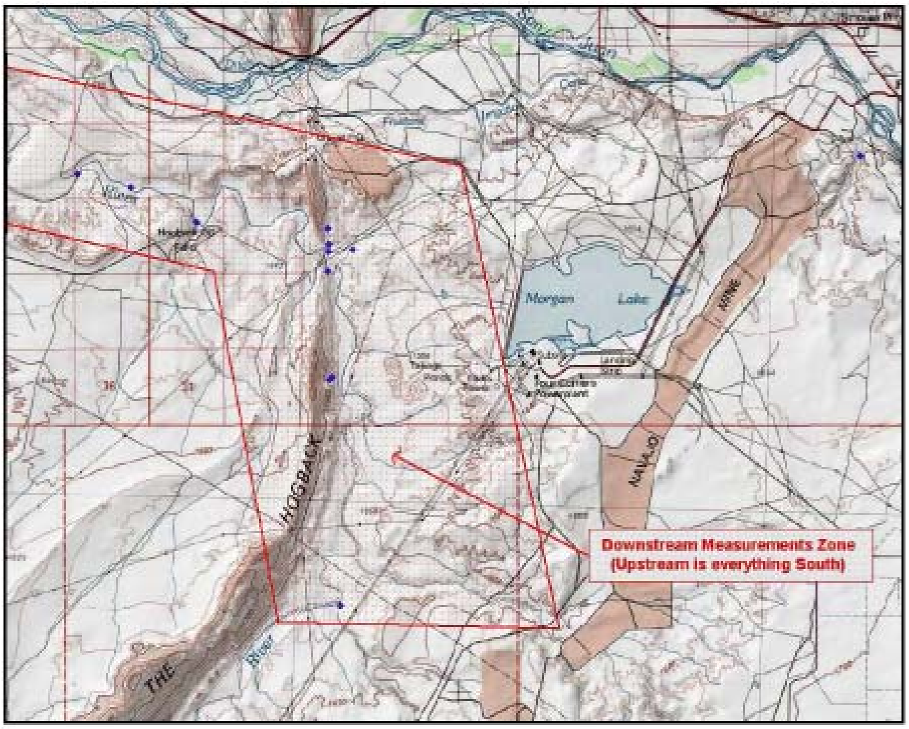

Figure 11. Topographic map showing zone representing "downstream of the mine."

Image as presented in page 26 of the Zimmerman report

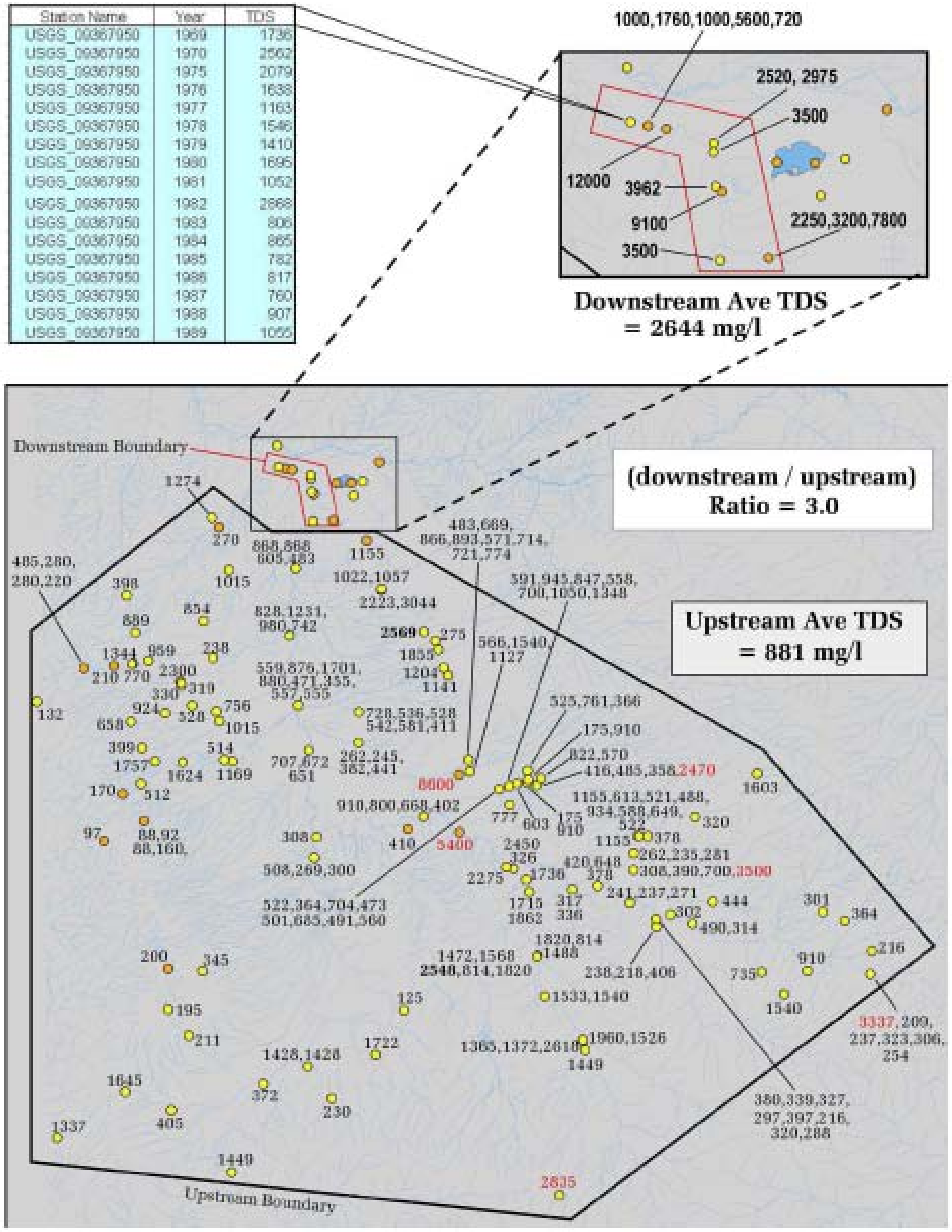

Figure 12. Map of water quality monitoring stations with TDS values plotted. Note that use of average values for USGS station 09367950 biases to the low side, the overall downstream average (see red line and plotted points in Figure 10).

Figure A- Generated BNCC site map comprising all permitted outfalls, Four Corners, and Morgan Lake utilizing Google Earth Pro interface, Google Earth Pro 4.2.0205.5730

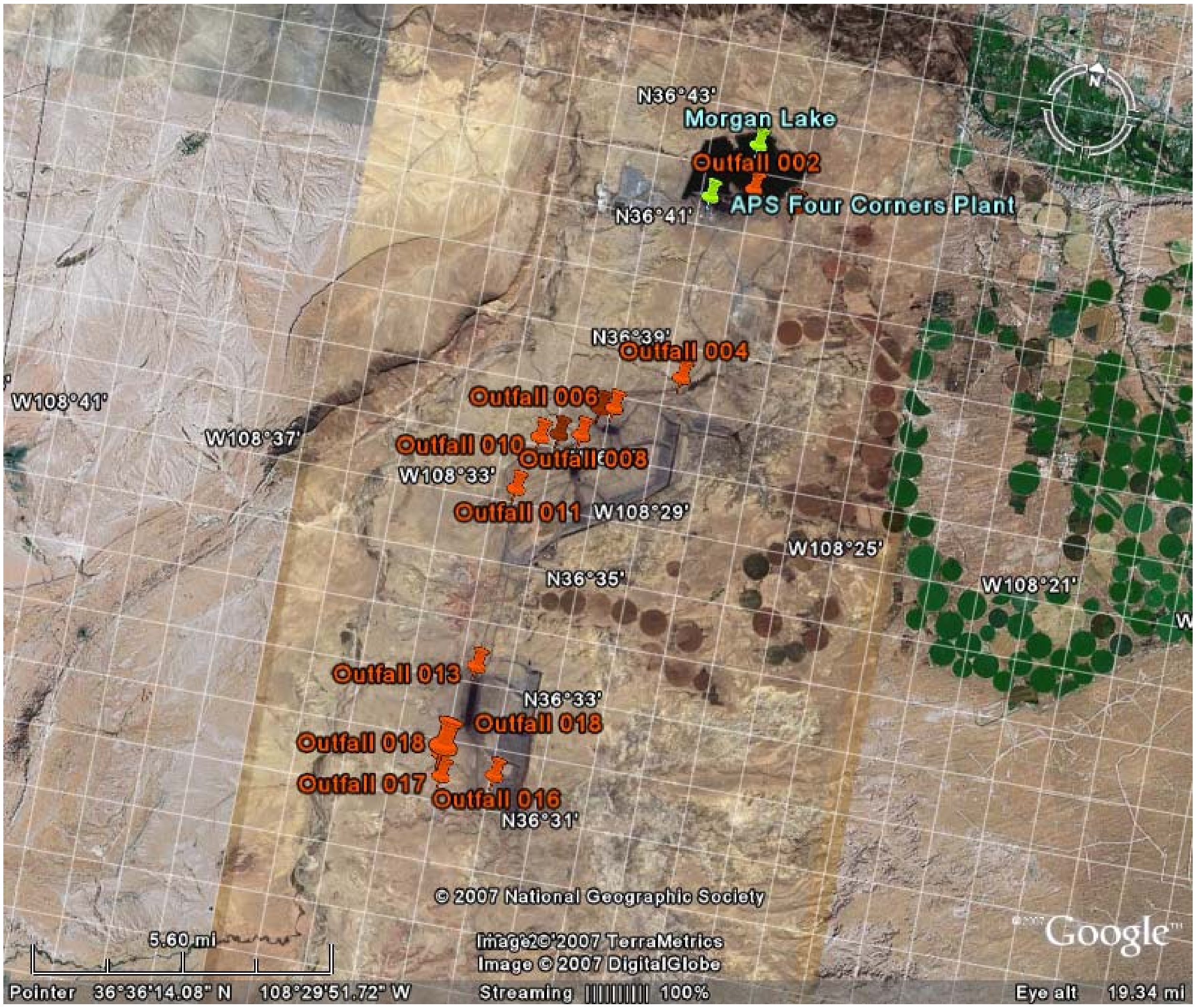

Figure B-Approximated downstream boundary of BNCC based on Figure 12 of Zimmerman generated on Google Earth Pro.

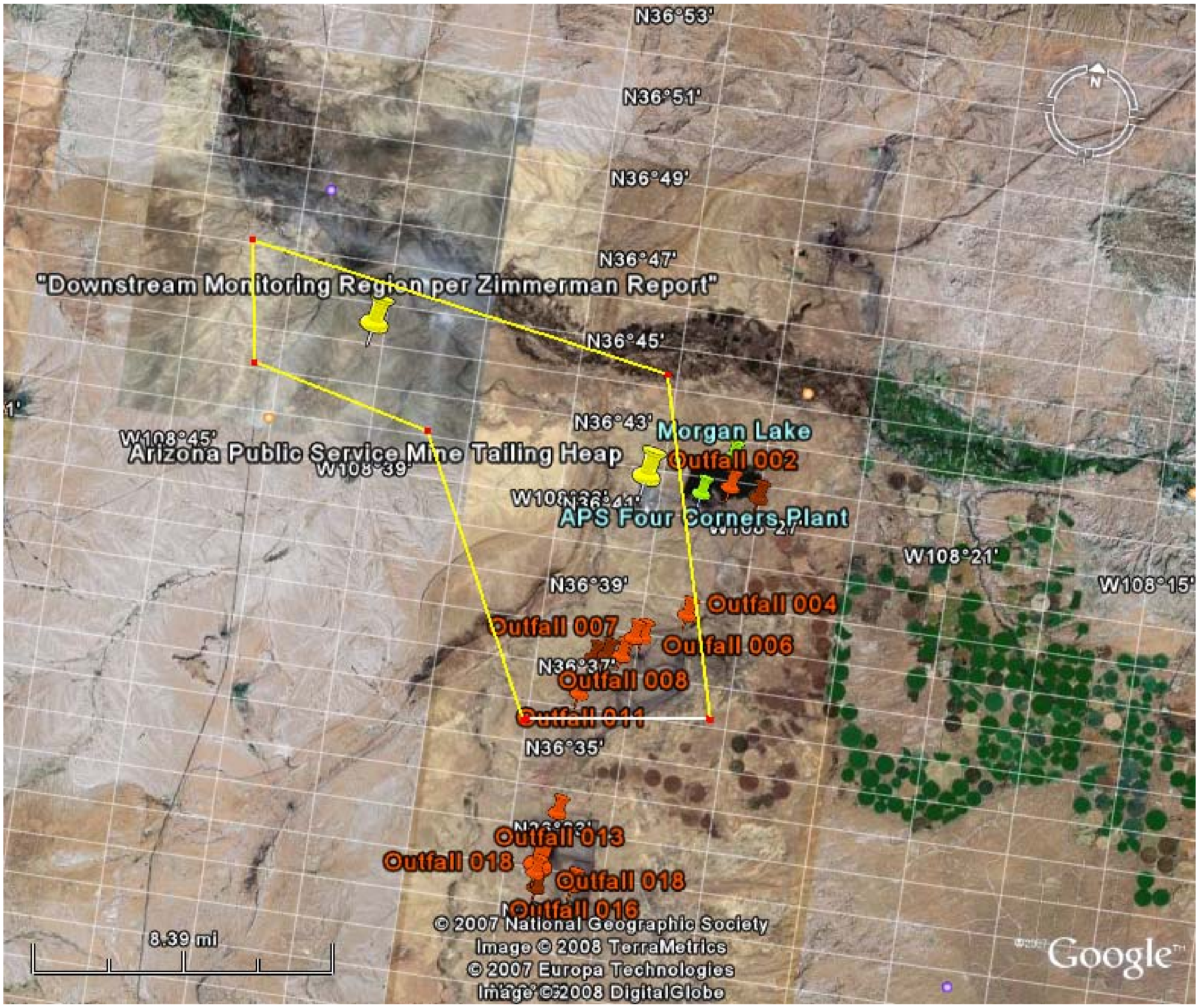

Figure C- Approximated upstream region generated in Google Earth.

Figure D- Zoomed in approximated upstream regime of BNCC and its permitted outfalls. The boundary lies south of Outfall 010.

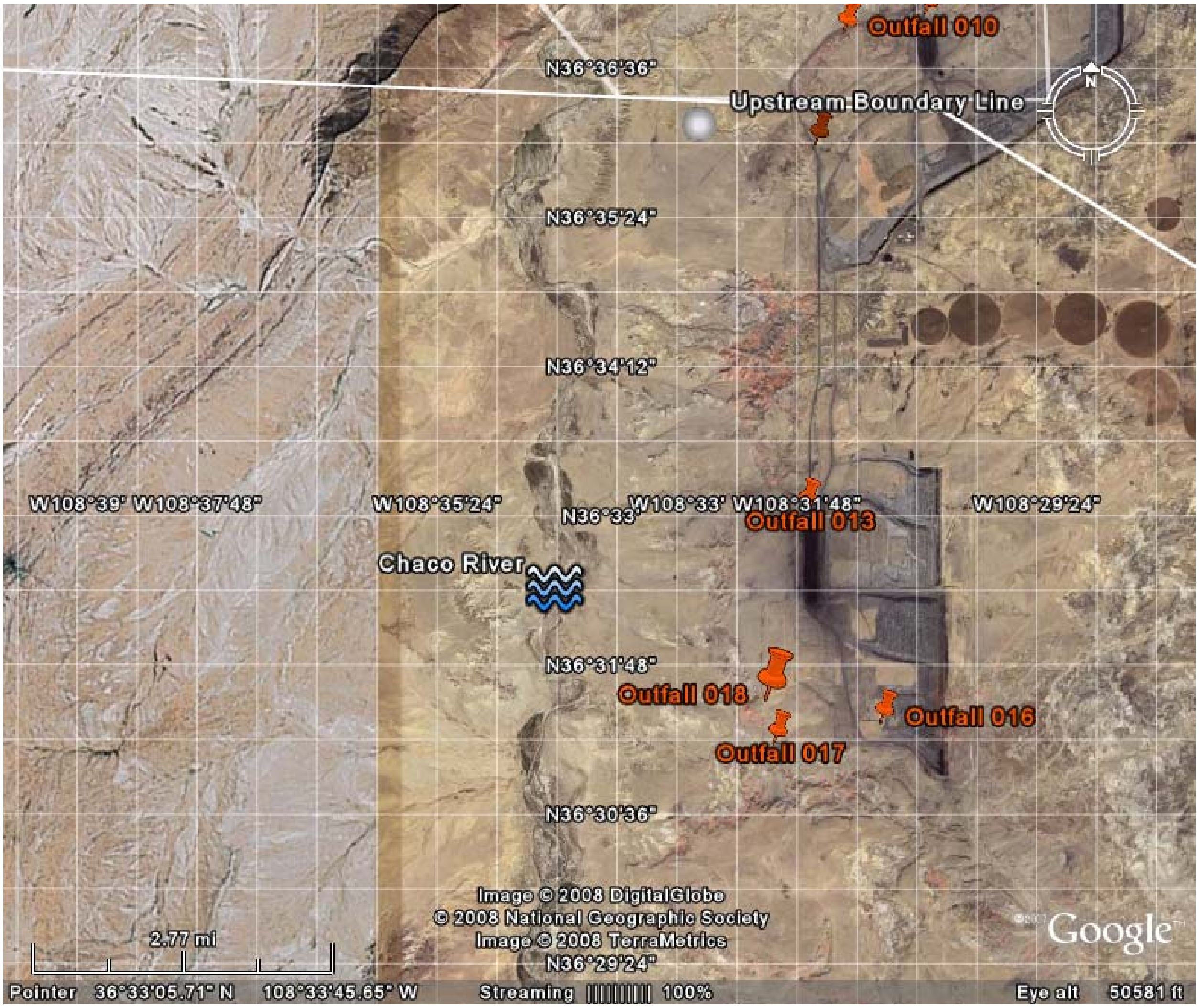

Figure E. Estimated downstream and lower upstream boundaries with geographically positioned outfalls and NNEPA monitoring stations with most exceedances.

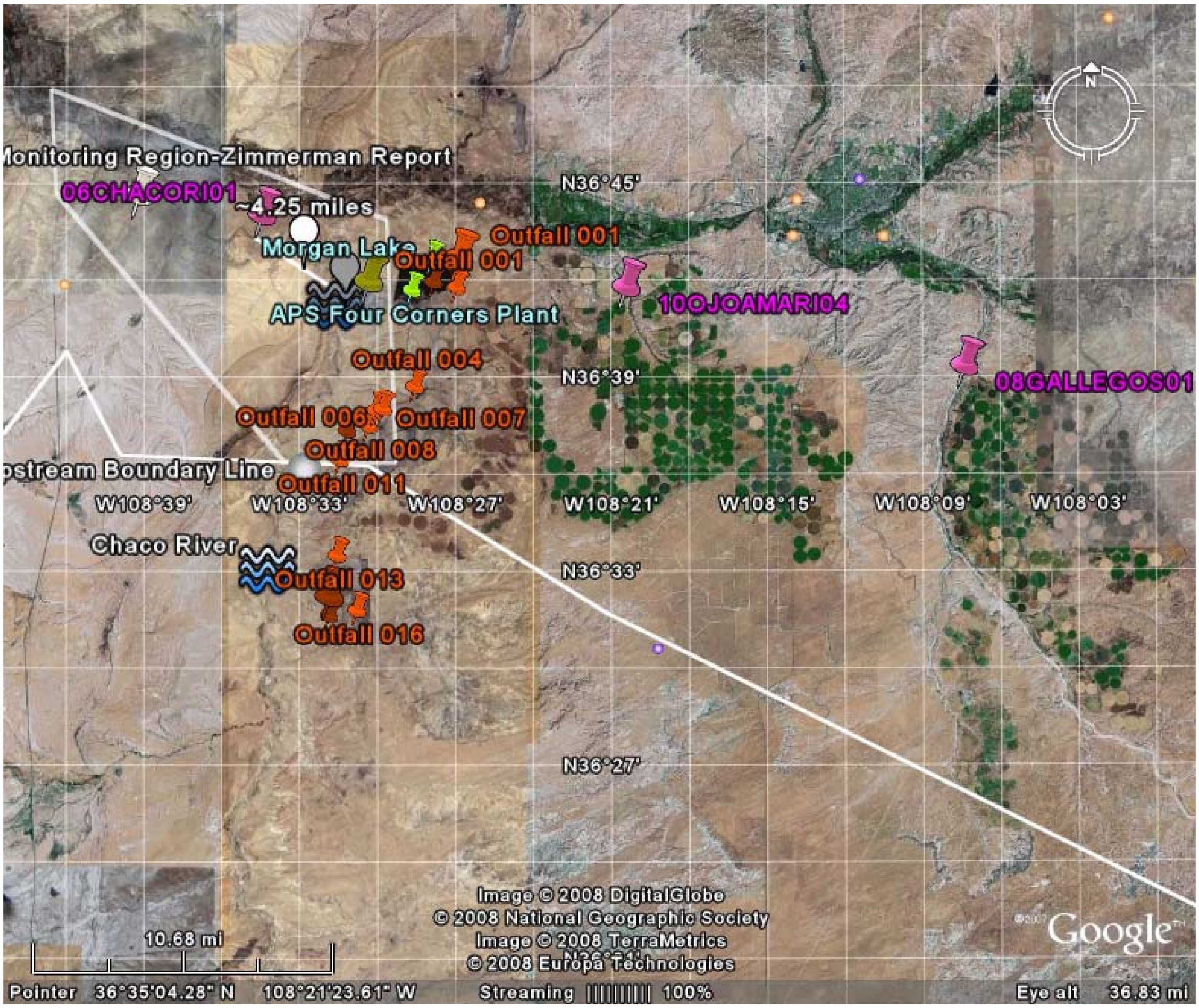

Figure F Positioning of Four Corners Power Plant, Mine Tailings Heaps, and NNEPA's monitoring station, 06CHACORI01 within Zimmerman's downstream boundary.

COMMENT:
High sulfate levels from the coal combustion wastes (CCW) might be keeping the solubility of arsenic low to date at monitoring points, but as sulfate levels wash from the geochemistry in and around ash deposits in the mine, the solubility for arsenic and other trace elements is likely to change.

RESPONSE: As noted above, EPA has included effluent monitoring for arsenic and sulfate in the permit.

COMMENT
The permit should establish limits for cadmium and lead in any surface discharges given that these trace elements, in addition to selenium, are rising to harmful levels in the Shumway Arroyo alluvium as a result of fly ash dumped in significant quantities in close vicinity to the "background" Well D that is part of BHP's neighboring San Juan Mine operation. The same subbituminous coal that is the parent material of the CCW, which is the likely cause for this contamination, is being mined and burned at the Arizona Public Service (APS) Four Corners Power Plant and dumped in the Navajo Pits. Given the low volumes of surface water at most monitoring points around this mine, the permit's limits for trace elements should be equivalent to the CWA's chronic water quality standards to protect the Use Designations in the Chaco River and San Juan River. If no such standards exist for the constituent, limits should be set at levels designed to prevent exceedances of drinking water standards, health advisories, removal action levels, agricultural standards or other standards that protect human health, aquatic life, livestock, crops, flora and fauna against chronic toxicity exposures.

RESPONSE:
EPA has established monitoring requirements in the permit for sulfate, boron, selenium, arsenic, lead and cadmium for each outfall. Should monitoring indicate that the discharge causes, has the reasonable potential to cause, or contributes to excursions above water quality criteria, the permit may be reopened for the imposition of water quality based limits and/or whole effluent toxicity limits. Also, this permit may be modified, in accordance with the requirements set forth at 40 CFR Parts 122.44 and 124.14, to include appropriate conditions or limits to address demonstrated effluent toxicity based on newly available information, or to implement any EPA-approved new Tribal water quality standards. (See Section C "Permit Reopener" of the permit). As the commenter indicated, permit limits will be established based on the most stringent water quality standard necessary to protect the beneficial uses as designated by the Navajo Nation water quality standards.

COMMENT:
There are also rises in mean pH by more than half a unit from upstream to downstream [from 7.68 to 8.21 standard units (s.u.)] in the Chaco River's surface waters. Even though EPA is proposing the 6- 9 s.u. range as a pH limit, NPDES permit NN0028193 should add enhanced monitoring requirements and corrective action trigger levels below 9.0 s.u. to make sure that the rise in pH does not continue to the point of surpassing 9 s.u. before any actions are taken. If the

mean pH over several samplings surpasses 8.5 s.u., the permit should require investigation and actions to prevent further increase as the consequences of a rise in average pH above 9 s.u. could cause substantial harm to life in or dependent on the Chaco River.

RESPONSE:
See above comment regarding the comparison of upstream and downstream data.

The permit establishes an effluent limit for pH such that pH shall be in the range 6.0 to 9.0 at all times. As described in the fact sheet, this is based on the requirements of the Navajo Nation Water Quality Standards and effluent limitations guidelines for the Coal Mining Point Source Category (40 CFR Part 434). This limitation ensures that all discharges will be in compliance with water quality standards and nationally established technology based standards. EPA does not believe there is justification for establishing more stringent limitations for pH at a level of 8.5. The permit already establishes daily monitoring for pH for all discharges, and EPA does not believe that additional monitoring requirements for pH is warranted. Any monitoring demonstrating pH results above 9.0 would be a violation of the terms and conditions of the permit and the permittee may be subject to enforcement.

COMMENT
EPA should appreciate the fact that coal combustion waste is an "industrial solid waste" defined by 40 CFR § 258.2 that has nothing to do with coal mining. Even the US Office of Surface Mining recognizes this and has issued guidance urging mine operations to make sure that the meaning and spirit of other laws are complied with when they dump CCW into coal mines. See *Guidance On Disposal of Coal Combustion Byproducts in the Western United States When OSM Western Region is the Regulatory Authority*, (Office of Surface Mining, Western Region, Approved 2/6/01). The first page of that guidance states: Surface coal mines have been identified and used as disposal sites for CCBs. The Surface Mining Control and Reclamation Act (SMCRA) did not contemplate the disposal of solid wastes in a coal mine, other than wastes generated from coal mining operations.
4 Page 4 of this guidance states,

Objective 2 - CCB disposal operations must conform to applicable State, Tribal, or local solid waste disposal laws and regulations, in addition to the SMCRA regulatory program.

Strategy 2.1 - The permit application should describe the steps that have been taken to comply with applicable Federal, State and Tribal solid waste disposal laws and regulations.

Under 30 CFR § 780.18(b)(9), the permit application must contain a description of the steps to be taken to comply with the requirements of applicable air and water quality laws and regulations and health and safety standards. In our judgment, this guidance is implying that the agency issuing a NPDES permit to a mine in which OSM has oversight control, and which is a major dump site for CCW, will want to ensure that the permit includes more than the most minimal requirements for limits on coal mines that are based solely on what mining operations produce and that have nothing to do with the operations of power plants or the post-combustion solid wastes they produce. Indeed there is long established precedent at the state level in mining regulatory programs for establishing effluent characterization, monitoring and additional limits for constituents beyond the few technology-based limits found in the "Coal Mining Point Source Category BPT, BAT, BCT Limitations and New Source Performance Stands" (40 CFR § 434) when mines are transformed into being dumping grounds for CCW. For example, the Guidance Policy Memorandum for the West Virginia Office of Mining and Reclamation concerning "Disposal and Utilization of Coal Ash on Surface Mining Operations," dated January 3, 1994, states:

Permits, Revisions, and Modifications
The OMR may approve the utilization of coal ash in a beneficial use application as described in an application for a surface mining permit, an NPDES permit, and revisions or modifications to existing permits. . . . .

Coal ash utilization as a beneficial use on surface mining operations will be evaluated by OMR in accordance with plans, design specifications, testing procedures, and monitoring requirements as set forth and submitted on the attached form (MR-36). The attached form will serve as an element to both the surface mining and NPDES permit application or application for a revision or modification of an existing permit.
Water Quality Surface and ground water monitoring stations for the purpose of monitoring coal ash leachates shall be established at appropriate locations so as to satisfy the requirements of both the Surface Mining Act and the NPDES program. Likewise, the analysis of water samples shall include the same chemical parameters for both permits. In the event that discharge points are established at different locations than the designated monitoring stations, analysis of water at the discharge point will include the same chemical parameters as for the monitoring station.

Thus EPA should do more than reissue a bare-bones NPDES permit that lacks any water-quality based effluent limitations for the Navajo Mine, given that it is reportedly the largest CCW mine disposal site in the United States (U.S.) and substantive monitoring data indicates surface waters draining from this mine have become contaminated with well known CCW constituents, particularly when OSM has admitted that SMCRA's requirements were not designed to address CCW disposal in coal mines in the first place.

RESPONSE:
EPA recognizes that there are several authorities with regulatory control over the activities at a coal mine. As the commenter notes, the Office of Surface Mining Reclamation and Enforcement has direct authority over mining operations in accordance with the Surface Mining Control and Reclamation Act (SMCRA). Industrial solid waste handling and disposal may be regulated under the authority of the Resource Conservation and Recovery Act (RCRA).

The Navajo Nation EPA has regulatory jurisdiction over the protection of groundwater on the Navajo Nation. Additionally, the Navajo Nation EPA has the authority under the Clean Water Act to certify that EPA's permitting actions are in compliance with the Tribe's surface water quality standards.

EPA is issuing this NPDES permit under the authority of the Clean Water Act, which regulates the discharge of a pollutant through a point source to a Water of the U.S. Under this authority, EPA must place effluent limitations and conditions in the permit to ensure that the surface water discharge meets water quality standards and meets Best Available Treatment technologies. EPA does not generally have the authority under the Clean Water Act to mandate the type of treatment employed to meet effluent limitations, or to regulate the disposal practices or other conditions on the mine which do not result in the discharge of a pollutant through a point source to a surface water.

EPA at this time does not agree with the assertion that the coal combustion by-product (CCB) backfilling is contributing to surface water quality degradation. As noted in the fact sheet, all surface water runoff permitted by the NPDES permit is contained in detention ponds prior to discharge. The residence time of the settling ponds is sufficient to remove the majority of solids prior to discharge. In fact, the settling ponds are generally large enough to contain most all of the surface runoff from the mine site, resulting in only 5 documented instances of discharge in the life of the permit. There has been no observed nexus between CCB burial areas and surface water quality, such as leachate seepage to the surface from the ponds. According to Office of Surface Mining Decision Document on CCB burial (March, 2001), no significant impact was concluded in the Significant Revision Application NM-003-D-R-03.

At Coal Storage and Coal Preparation designated site (Outfall 002), runoff from the storage and preparation area and ancillary area is contained by impoundment ponds to alleviate flow to neighboring waterways before direct discharge. Mine Drainage designated sites collect runoff in the mine pit, spoil area, and impoundment. Installed risers and pumps at runoff containments mitigate pond overflow for eventual discharge. These risers facilitate in rerouting excess effluent to receiving waters when collected water reaches critical levels. BNCC utilized flocculants, when needed and sedimentation as modes of treatment to meet effluent limits.

Moreover, EPA is not convinced of substantial evidence of a nexus between CCB burial and surface water quality. According to Office of Surface Mining (OSM) Decision Document on CCB burial, OSM concluded no additional impact to water quality supply/values for surface water at disposal areas (Areas I and II) in their Significant Revision Application NM-003-D-R-03. This document was signed and dated in March of 2001.

Listed impacted waterways mentioned in their Environmental Assessment, however, were Chinde, Hosteen, and Barber Washes. The revision application describes Hosteen and Barber Washes as ephemeral waterways and flow in response only to precipitation events. Hosteen and Barber washes were not formally located on any USGS maps or mapping tools, however these washes reside and cross closest to their respected backfilling pits and ramps in Area II. The Assessment described Chinde Wash as an ecologically altered waterway due to return flows agricultural runoff from Navajo Indian Irrigation Project (NIIP) and runs aside Outfall 004. Chinde Wash's altered ephemeral flow regime is considered to be perennial and supports wetland foliage (e.g. salt cedar thickets) east of the mine and its diversion. BNCC constructed the Chinde Diversion to mitigate transecting runoff to potential mining pits, such as the Yazzie Pit, and diverted flow around the Pit to alleviate open pit interaction. A technical review from Norwest Applied Hydrology made the claim that "it is not possible for water from the mine to seep into the Chinde Diversion" and commingle with mining land. Despite NIIP contribution of runoff from agricultural activity occurring in Chinde Wash, EPA notes that NPDES does not regulate agricultural runoff.

EPA agrees with the commenter that the NPDES permit must address all potential sources of pollution that may have an adverse affect on surface receiving waters. Therefore, EPA has placed additional monitoring requirements in the permit to monitor for total dissolved solids (TDS), sulfate, boron, selenium, arsenic, lead and cadmium in the final permit for each outfall in order to substantiate these conclusions.

Although the specific regulation of coal combustion byproducts and their placement in the mine is generally beyond the authority of the NPDES permit, EPA has included additional language in the permit to ensure that the mine is properly managing CCB products to prevent contamination of surface waters. This includes requirements for residue hauling vehicles and areas adjacent to minefills.

Under the Multi-Sector General Permit (MSGP) for Industrial Activities (FRL-6880-5), BNCC mitigated inputs derived by surface storm water by submitting a Storm Water Pollution Prevention Plan (SWPPP) to EPA in 2002. The SWPPP manages storm water runoff over permitted land in conjunction to requirements for Pollution Prevention for Multi-Sector General Storm Water Permits and for Industrial Activities Sector-H.

EPA concurs with the commenters and Zimmerman's report that the backfilling of CCBs in the mine does present a unique circumstance that warrants attention to ensure that water quality is not degraded. EPA recognizes that BNCC documented spillage occurrences from transporting materials in their SWPPP. Thus, EPA is requiring that additional Best Management Practices (BMPs) be incorporated at the mine site to ensure that coal combustion byproducts are properly handled and transported. The BMP provisions EPA has selected to apply to BNCC originate from the BMPs established under Sector O- Steam Electric Generating Facilities of the MSGP, sections 6.O.4.2.10 and 6.O.4.2.12. These BMPs are appropriate to apply to the storage, handling, transportation, and backfilling operations of the CCBs to prevent spillage of materials which may come into contact with surface waters. These BMP requirements relate to Residue Hauling (Section 6.O.4.2.10) and Areas Adjacent to Disposal Ponds or Landfills (Section 6.O.4.2.12).

COMMENT
The EPA should require a competent characterization of the ash and scrubber sludge dumped in the Navajo Mine pits to set water quality based effluent limits for any other pollutants that may pose a harm to the surface waters receiving surface or underground drainages from the Navajo Mine. Given the large volume of coal combustion waste that has already been placed in the Navajo Mine, (approximately 60-70 million tons since the mine began operation), this characterization should include the installation of at least 20-25 pore water monitoring wells directly in the ash in the mine's pits to ascertain concentrations in the leachate being generated in these pits at different depths as
well as the degree of water in the pits throughout a complete hydrologic cycle and, in particular, after precipitation events including storms and snow melts. These wells should sample leachate from at least one pit in each of Navajo Mine areas I, II, III and IV - in addition to the wells in the Bitsui Ash pit. The wells should be sampled at a minimum on a monthly basis for at least one

year to gather sufficient data to establish a credible range of concentrations of constituents in the leachate that should be regulated or at least monitored in NPDES permit NN0028193. These limits should be in addition to the limits for selenium, TDS, sulfate, boron, arsenic, cadmium and lead.

This characterization of pore water could be augmented with ash leach tests given that the monitoring wells may be dry during many of the samplings, but the characterization process should NOT be based primarily on ash leach tests performed in the laboratory as such tests are notoriously poor predictors of what the waste will do in the surface or subterranean mine environment. This characterization and these added limits are necessary to make sure that the use designations stated on page 2 of the permit's October 2000 FACT SHEET are not violated, i.e., primary and secondary human contact, warm water habitat, ephemeral warm water habitat, and livestock and wildlife watering.

Due to changing solubilities for trace metals, driven by evolving concentrations of major ions and oxidation-reduction (redox) conditions, the attenuation of higher pHs to lower levels as ash leachate becomes diluted in the site environment, and the possibility for more stringent emission controls at the Four Corners Power Plant, EPA needs to establish an expanded list of parameters to be monitored in this permit that includes all the trace elements found in the CCW being generated by the Four Corners Power Plant. This list should be based on a bulk analysis of each component of this waste (the scrubber sludge, fly ash, bottom ash and boiler slag) which analyzes for the existence of all of the 17 trace metals commonly found in CCW (see EPA Report to Congress on Wastes From the Combustion of Fossil Fuels, March 1999) in addition to major and minor constituents.
We formally request that the EPA implement as part of this permit a program of at least bimonthly bulk analysis and monitoring within ash pore waters (six times a year) for an expanded suite of parameters. These steps should be continued throughout the five year permit period to establish additional permit limits when the data suggests they are necessary to protect the use designations of surface waters potentially effected by this the permit. This monitoring should include parameters measuring radioactivity and carbon content in leachate from the CCW in-situ (from pore-water 6 monitoring in ash deposits).

RESPONSE:
EPA does not have authority under the NPDES permit to establish groundwater monitoring wells, or to regulate potential contamination of groundwater which may result from the disposal of CCW. (see response provided above)

As indicated previously, EPA has placed additional monitoring in the permit and has placed additional requirements in the permit for Best Management Practices to ensure that placement of CCBs does not result in degradation of surface waters.

Regarding characterization of ash, the Navajo Mine has provided information. EPA does not believe it necessary, within the context of the NPDES permit limitations, to conduct additional characterization studies of the ash.

COMMENT
Groundwater monitoring results also must be regularly examined and reported with the NPDES Discharge Monitoring Reports.

RESPONSE:
The NPDES permit issued under the Section 402 of the Clean Water Act regulates the discharge of a pollutant through a point source to a water of the U.S. The NPDES permit does not regulate groundwater, and EPA does not have authority under the NPDES permit to establish groundwater monitoring wells, or to regulate potential contamination of groundwater which may result from the disposal of CCW.

COMMENT
The EPA needs to expand the NPDES permit to monitor discharges at all washes exiting Navajo Mine, particularly those flowing at elevations below the mining activities. This equates to more monitoring points than just those currently for Outfalls 001 through 018. Monitoring should specifically include the Chinde and Bitsui washes. Valid upstream monitoring points should be established to more effectively monitor impacts resulting from the mining and ash disposal at Navajo mine.

RESPONSE:
The NDPES permit establishes monitoring points at all discharge locations for all washes exiting the Navajo Mine that are associated with active mine areas, coal preparation plant areas, and reclamation areas. Monitoring location Outfall 004 is at the Chinde Wash. There are no outfalls discharging into Bitsui washes and Bitsui is located off BNCC mining area. EPA concluded that outfall locations are established for areas associated with mining activities. EPA does not believe it is necessary to require additional monitoring for areas that are not affected by mining activities.

COMMENT
This needed monitoring program should explicitly require automatic sampling whenever precipitation events occur (i.e., if three storms occur in one month, the operator should sample three times in that month, once after each storm). Given that the mine permit is allowing ash to be left uncovered in pits, open to rampant contact with rain or snow for multiyear periods as standard practice, such sampling is necessary.

RESPONSE: The permit establishes requirements that samples shall be taken at every discharge event, and additionally that sampling be conducted once every 24 hours if the duration of the occurrence is greater than 24 hours. EPA believes that this monitoring frequency is sufficient to adequately characterize every discharge event. EPA does not believe it is necessary to mandate the sampling methodology to the permittee.