Since there are no current uses for the Fruitland formation in or adjacent to the Navajo Tribal Coal Lease and no foreseeable uses other than oil and gas extraction, impacts to the Fruitland formation are not expected to preclude water uses. Additionally, the predicted and observed impacts to the Fruitland Formation do not extend outside of the immediate areas surrounding the mine pits and reclaimed areas and the aquifer is generally not capable of providing a sustainable water supply (NTEC 2013, Part 6 Sect. 41). Therefore for the purpose of this assessment, the impacts to the Fruitland Formation groundwater quantity are considered to be negligible.

5.3.7.4 Pictured Cliffs Sandstone Quantity

The PCS is a marginal water resource due to low permeability, poor water quality, gas production, and low yields. The PCS is also a natural gas reservoir in the San Juan Watershed. Stone et al. (1983) state that the PCS cannot be considered a major aquifer and it is important only because it is the water-bearing horizon immediately underlying the coals in the Fruitland Formation.

Lateral flow through the PCS within Area II is expected to be generally toward the northeast as indicated by the potentiometric surface provided in Figure 15. There could also be a component of flow west toward the PCS outcrop located east of the Chaco River. Groundwater flow rates through the PCS will be very low due to the very low hydraulic conductivity of the PCS. Any discharge along the PCS outcrop to the west of Area II will likely be removed by evapotranspiration. Based on pre-mine observations along the PCS outcrop adjacent to Areas III and IV North, flow rates in the PCS are expected to be insufficient to sustain flow at seeps and into the alluvial aquifer.

It is estimated that a 5 foot drawdown will be present in the PCS at the completion of proposed mining in Area IV North. The layer of shale separating the bottom of the lowest coal seam and the PCS serves to restrict groundwater inflow from the PCS during mining. The thickness of shale layer between the No. 2 coal and the PCS averages about 8.7 feet over the Area IV North mine block but is absent in some places. This variation in the shale thickness has been accounted for in the estimates of drawdown within the PCS. Artesian pressures in the PCS occur in the eastern portion of the Area IV North mine block where the shale thickness separating the coal from the PCS is greater. Accordingly, any drawdown in the PCS is dampened, particularly in these locations where the shale thickness is greater.

The model simulated steady-state post mining potentiometric surface in the PCS is provided in Figure 32. This surface is similar to the pre-mining PCS potentiometric surface in Figure 15, except for the localized increase in the heads in the PCS below the mine backfill within Area IV North. The higher head in the PCS below the mine backfill is due to the higher heads at the base of the mine backfill. Very little change in heads is predicted at locations away from mine backfill, including at the former PCS wells GM-19 and GM-28, located within the lease area at distances of about 3,500 and 3,000 feet from the Area IV North mine pit. This localized increase in heads in the PCS results in an increase in gradients toward the northwest and toward the northeast.

There is one identified livestock watering well completed in the PCS located along the western side of the Chaco River west of Area V which may be influenced by alluvial waters of the Chaco River and it is not known if the well is actively being used. The unit is known to have very low yields in the vicinity of the Navajo Tribal Coal Lease and is generally not capable of providing a sustainable water supply for this use. The primary documented current and historic use of the PCS in the area is for oil and gas extraction, which is not particularly sensitive to water quantity loses within the extraction zones. Therefore impacts to the PCS are not expected to disturb water users. Additionally, the predicted and observed impacts to the PCS do not extend outside of the immediate areas surrounding the mine pits and subsequent reclaimed areas. Therefore for the purpose of this assessment, the impacts to the PCS groundwater quantity are considered to be negligible.

5.3.7.5 **Pictured Cliffs Sandstone Quality**

Comparison of baseline water quality to livestock criteria found that water in the PCS is a very poor source of supply for livestock watering use, specifically because of elevated chloride, sulfate, and TDS concentrations, which are above livestock criteria. However, there is one identified livestock watering well completed in the PCS located along the western side of the Chaco River west of Area V which may be influenced by alluvial waters of the Chaco River. It is uncertain if the well is actively being used. The unit is known to have low yields in the vicinity of the Navajo Tribal Coal Lease and is generally not capable of providing a sustainable water supply for this use. The primary documented current and historic use of the PCS in the area is for oil and gas extraction, which does not have protective use criteria designations, as water quality is not particularly significant for this use. Therefore, impacts to the PCS are not expected to disturb water users. The only non-baseline PCS monitoring well KP-84 did not have sufficient water for sampling during the historic monitoring period from 1990 to 1998. Therefore there will be no comparison of non-baseline PCS quality to baseline conditions.

Direct intermediate-term impacts to the groundwater quality beyond the active mine area are not anticipated to occur during mining and reclamation operations. During active mining, hydraulic gradients and groundwater flow directions in the PCS would be toward the mine pits and backfill areas. Thus, it is expected that there would be little change in the quality of groundwater beyond the limits of the mine pit and mine backfill during mining and reclamation operations. However, over the long term as these gradients reverse post-reclamation increase in TDS and sulfate concentrations in mine spoil backfill may result in increased TDS and sulfate concentrations in the PCS adjacent to mining (Ecosphere Associates Inc. 2011). Additionally, the predicted and observed impacts to the PCS do not extend outside of the immediate areas surrounding the mine pits and subsequent reclaimed areas and are not expected to disturb water users. Therefore for the purpose of this assessment, the impacts to the PCS groundwater quantity are considered to be negligible.

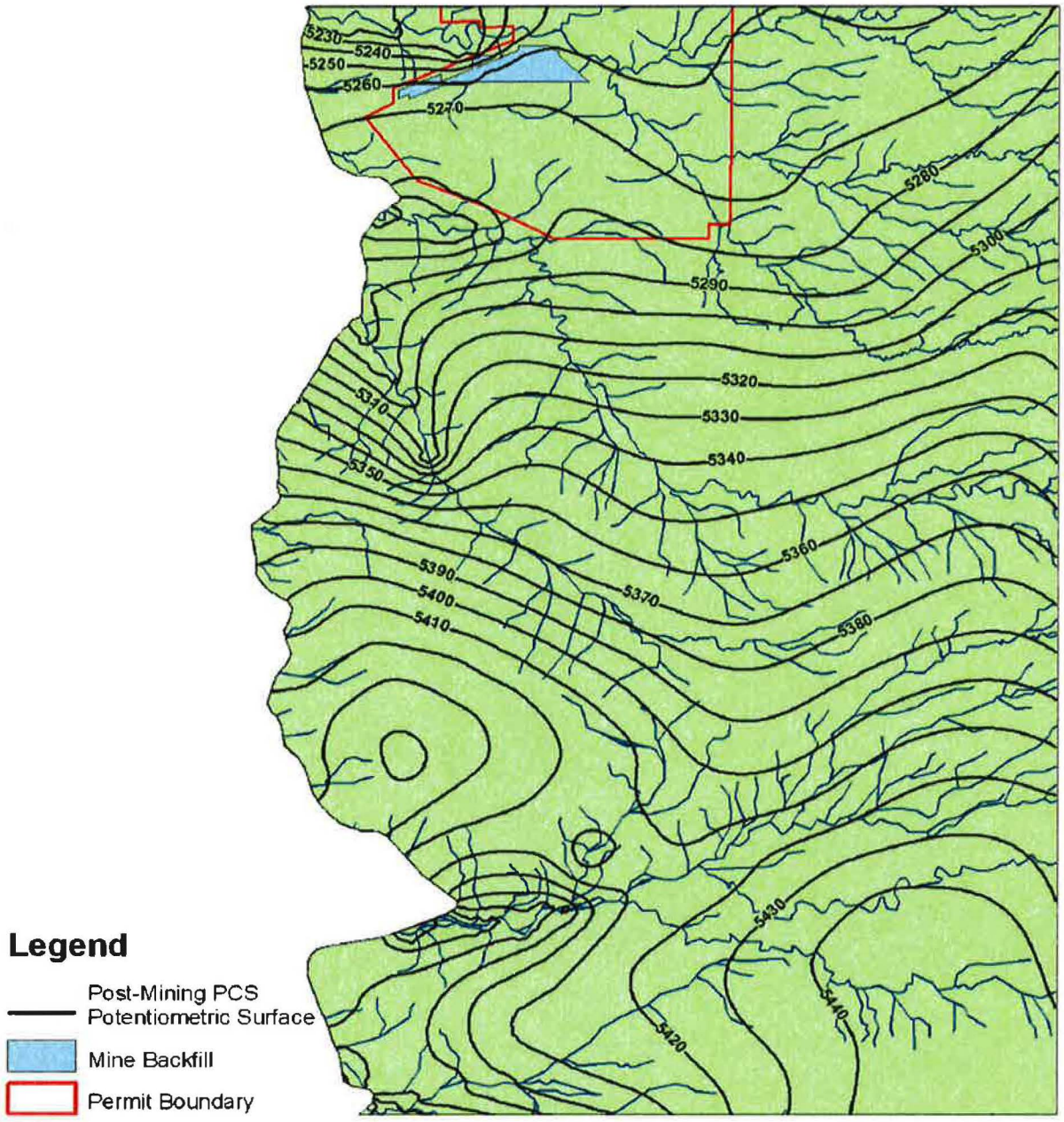

Figure 32: Post-Mining Potentiometric Surface in the PCS Aquifer (NTEC 2013)

6 MATERIAL DAMAGE

Sections 507(b) (11) and 510(b) (3) of SMCRA, and 30 CFR § 780.21 (g) require OSMRE to determine that a mining and reclamation operation has been designed to prevent material damage to the hydrologic balance outside the permit area. "Hydrologic balance" is defined at 30 CFR § 701.5 as, "the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake or reservoir. It encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground and surface water storage."

"Material damage to the hydrologic balance" is not defined in SMCRA or at 30 CFR § 701.5. The intent of not developing a programmatic definition for "material damage to the hydrologic balance" was to provide the Regulatory Authority the ability to develop a definition based on regional environmental and regulatory conditions. Therefore, for the purpose of this CHIA;

> Material damage to the hydrologic balance outside the permit area means any quantifiable permanent adverse impact from surface coal mining and reclamation operations on the quality or quantity of surface water or groundwater that exceeds the identified material damage **limits** and that would preclude any existing or reasonably foreseeable use of surface water or groundwater outside the permit area.

The hydrologic impact assessment presented in Chapter 5 of this document considers available quantity and quality information related to surface water and groundwater resources potentially affected by the Navajo Mine and Pinabete Permit Areas. Chapter 5 contains definitions for impact designation of negligible, minor, moderate, and major (Table 7). Detailed discussion of the monitoring program, impact minimization, and impact designation determinations can be found in Chapter 5. The material damage assessment determines if material damage to the hydrologic balance has occurred, or the has the potential to occur, due to the mining operation.

6.1 Cumulative Impact of NTEC Operations and El Segundo Mine

OSMRE has concluded that surface water quantity and quality cumulative impacts relative to the Chaco River from the El Segundo are negligible. Additionally, the State of New Mexico Mining and Minerals Division has determined that all anticipated mining within the El Segundo Mine has been designed to prevent material damage to the hydrologic regime outside the permit area (NMEMNRD 2008).

6.2 NTEC Operations Impact on NAPI

OSMRE has determined that NTEC operations have negligible impacts on NAPI operations.

6.3 NTEC Operations Impact to Morgan Lake and APS

OSMRE has determined that flow contribution to Morgan Lake from tributaries which traverse the NTEC Navajo Mine and Pinabete Permit area is negligible, and quality impacts associated with these tributaries are also negligible.

NTEC operations are not anticipated to adversely impact the water quantity or quality necessary for power plant operations, and OSMRE has determined that NTEC operations will have a negligible impact on power plant operations.

6.4 Chaco River

OSMRE has determined that impacts of the NTEC mining operation on Chaco River surface water quantity is considered to be negligible. Relative to the Chaco River surface water quality, although the impact designation may be considerable for certain constituents, it does not appear to translate to a

significant impairment of use. OSMRE finds that surface water quality within the Chaco River is generally appropriate for the designated post-mining land use of livestock grazing.

6.5 Historic Mining North of the Navajo Mine Permit

OSMRE finds that changes in alluvial groundwater quantity will not preclude use; therefore, the impact is designated to be negligible. Relative to Fruitland formation and PCS quantity and quality, impact designation is *negligible,* since observed impacts do not extend outside of the immediate areas surrounding the reclaimed areas and the hydrologic units are generally not capable of providing sustainable water supply. OSMRE's assessment has concluded that potential impacts to use from historic CCB disposal are *negligible.*

6.6 Navajo Mine and Pinabete Permit Area

OSMRE has identified both **hydrologic balance thresholds** and **material damage limits** for the Navajo Mine (Table 2).

- A **material damage limit** is a long-term coal mining effect on the hydrologic balance by the mining operation that permanently precludes an existing or reasonably foreseeable designated use outside of the permit boundary, and specifically pertains to the designated post-mining land use within the permit area. Such an effect cannot be effectively mitigated or replaced by the coal operator.
- A **hydrologic balance threshold** constitutes changes to the hydrologic balance caused by the mining operation that are short-term and can be effectively mitigated by reclamation or by water supply replacement, or changes to the hydrologic balance that do NOT preclude existing or reasonably foreseeable uses.

For the purpose of this material damage assessment, short-term impacts are defined as impacts that occur to the hydrologic balance during mining, but are not projected to persist after the reclamation liability period. Long-term impacts are defined as impacts that are projected to persist after the reclamation liability period. The reclamation liability period ends after the permittee has met all of the requirements at 30 CFR 750, including those at 30 CFR 800.13. At a minimum an application for final (Phase III) reclamation liability release would not be considered by the regulatory authority until the reclaimed (back filled, re-graded and top soiled) lands have been revegetated for ten years.

The intent of determining a hydrologic balance **threshold** is to alert NTEC and OSMRE of potential water resource impacts of concern, such that NTEC may take appropriate actions to prevent material damage. The exceedance of a material damage **limit** would result in a finding that material damage to the hydrologic balance outside the permit area had occurred. At the time of final bond release OSMRE must make a determination that material damage to the hydrologic balance outside of the permit area has been prevented. Final bond release shall not be granted until such a determination is made.

The distinction between long-term and short-term impacts is supported in research. Various studies have determined that a number of requirements that must be met by a coal operator in order to achieve final bond release can restore water quality and quantity. Appropriate reclamation has been found to restore the seasonal variation rainfall-runoff watershed processes (Bonta, et al. 1997). Reclaiming diversions and re-vegetation have been shown to considerably improve water quality (Bonta and Dick 2003). Additionally, drastic decreases in suspended sediment concentrations, load rates, and yields have been documented to occur at surface coal mines subsequent to reclamation (J. V. Bonta 2000).

Table 12: Material Damage Limits and Hydrologic Balance Thresholds

Category			Definition
General	Quantity	Limit	irretrievable loss of the water resource to support existing or reasonably foreseeable uses outside of the lease area that cannot be provided by alternate water supplies
		Threshold	long term loss of the water resource that does not preclude the current or potential future use potential of the resource or short term loss of the water resource to support existing uses that can be mitigated by reclamation or by provision of alternate water supplies
	Quality	Limit	long-term changes in water quality outside the lease area that preclude existing or reasonably foreseeable uses that cannot be provided by alternate water supplies
		Threshold	long term changes in water quality that occasionally exceed the water quality observed in the baseline fluctuations but that do not preclude the current or potential future use potential of the resource or short term changes in water quality that consistently exceed the water quality observed in the baseline fluctuations but that do not preclude the current use or can be mitigated by reclamation or by provision of alternate water supplies
Criteria Applied to the Navajo Mine		Limit	**Long-term** (impact remains after final reclamation and bond-release) Impact Designation of **Major** as defined in Table 7, and which **Preclude** Existing or Reasonably Foreseeable **Uses Outside** of the Lease area that **Cannot be Mitigated** by Reclamation or Provision of Alternate Water Supplies
		Threshold	**Long-term** (impact remains after final reclamation and bond-release) Impact Designation of **Moderate or Major** as defined in Table 7 **Outside of the Lease area** that **Does NOT Preclude** Existing or Reasonably Foreseeable **Uses** **OR** **Short-term** (impact occurs only during active mining and reclamation prior to final bond release) Impact Designation of **Major** as defined in Table 7, which **may Preclude** Existing or Reasonably Foreseeable **Uses Outside of the Lease area** that **Can be Mitigated** by Reclamation or Provision of Alternate Water Supplies

A summary of OSMRE's material damage assessment and findings is presented in Table 13 and further discussed below. For clarity in the discussion hydrologic balance **threshold** and material damage **limit** will be bolded, and the impact designations of *negligible, minor, moderate*, and *major* will be italicized.

Table 13: Assessment of Material Damage for the Waters of the Navajo Mine and Pinabete Permit Areas

Water Resource	Assessment Approach	Hydrologic Balance Threshold Reached	Material Damage Limit Reached	Impact Mitigation	Adequate Monitoring Program
Fruitland & PCS Quantity	Evaluation of potentiometric surface contour maps	No	No	Contemporaneous Reclamation	Yes
Alluvial Quantity	Comparison of water levels at individual wells over-time	No	No	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones	Yes
Surface Water Quantity	SEDCAD modeling-assessment of pre- and post-mining impacts; Percent of HUC12 Watersheds controlled with impoundments	**Yes**	No		Yes
Fruitland & PCS Quality	Comparison of baseline water quality to potentially impacted or non-baseline wells, including spoil and CCB wells	No	No	Contemporaneous Reclamation; mixing of overburden/ backfill materials	Yes
Alluvial Quality	Comparison baseline (upstream/pre-mining) water quality to non-baseline (post-mining/downstream) water quality	**Yes**	No	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones	Yes
Surface Water Quality		No	No	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones; Sedimentation Ponds	Yes

6.6.1 Material Damage Assessment

6.6.1.1 Surface Water

Surface water quantity impacts are assessed as a relative percentage of the watershed controlled through the use of sediment impoundments compared to the corresponding Hydrologic Unit Code (HUC) 12 watershed delineation. Hydrologic balance **thresholds** and material damage **limits** have not been reached for any of the assessed HUC 12 watersheds, since all impact designations are *negligible* or *minor.*

When modeled pre-mining peak flows are compared to-post-mining peak flows, the comparison indicates that hydrologic balance **thresholds** and material damage **limits** have not been reached for the Chinde Wash Watershed, Coal Creek-Chaco River Watershed, or Cottonwood Arroyo Watershed.

In the Chinde-Chaco River Watershed a long-term impact designation of *moderate* has been determined for the area outside of the permit boundary. This *moderate* impact designation is due to a reduction in post-mining peak flow. Therefore, the hydrologic balance **threshold** has been reached for this watershed. The material damage **limit** has not been reached since the impact designation has not been determined to be *major* current designated water uses are not expected to be precluded. NTEC and OSMRE are currently discussing modifications to the reclamation plan that may be needed for this area to ensure material damage to the hydrologic balance is prevented outside of the permit area over the long-term.

Relative to Chinde Wash surface water quality, the hydrologic balance **threshold** and material damage **limit** have not been reached, since impacts are not long-term, not determined to be *major*, and will not preclude designated water uses.

6.6.1.2 Alluvium

The material damage assessment for alluvial water quantity confirms that hydrologic balance **thresholds** and material damage **limits** have not been reached, since all impact designations are *negligible*.

It has also been determined that the alluvial water quality hydrologic balance **threshold** has been reached in the Chinde Wash alluvium, since a short-term *major* impact designation has been assigned, which may preclude designated water use. The material damage **limit** has not been reached since impacts are not considered long-term. The alluvial monitoring plan in this area was augmented in 2012-13 to further assess and verify the duration of coal mining impacts in the Chinde Wash alluvium outside the permit area.

Relative to Cottonwood alluvial water quality, the hydrologic balance **thresholds** and material damage **limits** have not been reached since all impact designations are *negligible*.

6.6.1.3 Fruitland Formation and PCS

Relative to Fruitland formation and PCS quantity and quality, hydrologic balance **thresholds** and material damage **limits** have not been reached since impact designation is *negligible* and designated water use is not expected to be precluded. See Section 6.2 Historic Mining North of NTEC Operations for CCB disposal determination.

6.6.2 Conclusion

OSMRE finds that NTEC's Navajo Mine and Pinabete Permit monitoring programs have supplied sufficient information in the approved PAPs for this CHIA and finding. OSMRE finds that the operations of Navajo Mine and proposed Pinabete Permit Area have been designed to minimize impacts within the permit area and to prevent material damage to the hydrologic balance outside of the permit area.