CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

MUD CREEK BASIN
AND
UPPER HUNTINGTON CREEK BASIN

Skyline Mines
C/007/005

White Oak Mines
C/007/001

Carbon, Emery, and Sanpete Counties, Utah

Prepared by

Utah Division of Oil, Gas, and Mining

Latest Revision

August 26, 2003

I. INTRODUCTION

The Skyline and White Oak mines are located in the northern Wasatch Plateau Coal Field, approximately 5 miles southwest of Scofield Reservoir and 25 miles west of the city of Price, Utah. Castle Valley, where the cities of Price and Huntington are located, lies east of the Wasatch Plateau, and farther east is the San Rafael Swell. The Sanpete valley is west of the Wasatch Plateau (Figure 1, Appendix A).

The Skyline leases straddle the drainage divide between upper Huntington Creek and Mud Creek basins. The Carbon - Emery County line lies along this divide. Skyline is mining beneath both basins, but the mine portals are in Eccles Canyon in the Mud Creek basin. Skyline's leases abut the Sanpete County line on the west. The Skyline operation consists of the No. 1, No. 2, and No. 3 Mines. Construction began in 1980. The No. 3 Mine began production in October 1981, the No. 1 in June 1982. A ventilation portal was opened by breakout from the #3 mine into the South Fork of Eccles Creek in 1989. Development of the #2 Mine began in 1992. The current end of coal production from the Skyline mines is projected to cease at the end of March 2004, at which point the mine will be ‘idled’ with a maintenance crew remaining at the mine. Associated with the mines are a conveyor down Eccles Canyon, a loadout at the mouth of Eccles Canyon, and a waste rock disposal site in U.P. Canyon near the town of Scofield.

The mines, loadout, and office area of the White Oak Complex, formerly operated by Lodestar Energy, Inc., are the only other actual mining activity in the area. These were operated by Valley Camp of Utah, Inc. and known as the Belina Complex prior to 1994. The mines are located east of and adjacent to the Skyline mines. Access to the White Oak/Belina mines is through Whisky Canyon, a side canyon to Eccles Canyon, but approximately 22 % or 700 acres of the White Oak/Belina permit area is within Huntington Creek basin. Road construction for the White Oak/Belina Complex began in 1975. The White Oak/Belina #1 Mine operated underground from 1979 through June 1998 and the White Oak/Belina #2 Mine operated underground from 1982 through September 2001. A change in the mining method was introduced at the cessation of underground mining at the White Oak/Belina #2 Mine. Surface mining of the White Oak/Belina #1 and #2 mine portal area was conducted from November 2001 through April 2003. Lodestar Energy, Inc. is currently going through bankruptcy and has ceased operations. The surface mining of the barrier coal accounts for approximately 47 acres of surface disturbance. The White Oak/Belina loadout and mine office are in Pleasant Valley, just downstream of the Skyline loadout.

White Oak began acquiring baseline data in 1994 with the objective of obtaining a permit to mine coal east of Pleasant Valley and beneath Long Canyon, and possibly beneath the Jump Creek and Beaver Creek drainages. Access is planned to be through one or more portals in the vicinity of the disturbed area at the White Oak/Belina loadout. The additional drainages that may be involved in this expanded operation have not been included in this CHIA.

This Cumulative Hydrologic Impact Assessment (CHIA) is a findings document involving an assessment of the cumulative impact of all anticipated coal mining operations on the hydrologic balance within the Cumulative Impact Area (CIA). The CHIA is not a determination if coal-mining operations are each designed to prevent material damage beyond their respective permit boundaries when considered individually. Rather is a determination if there will be material damage resulting from effects that become cumulative outside the individual permit boundaries.

The objectives of a CHIA document are to:

1.	Identify the Cumulative Impact Area (CIA).	(Part II)
2.	Describe the hydrologic system.	(Part III)
3.	Document the baseline conditions of surface and ground water quality and quantity.	(Part IV)
4.	Identify which hydrologic resources are likely to be impacted and determine which parameters are important for predicting future impacts to those hydrologic systems.	(Part V)
5.	Identify relevant standards against which predicted impacts can be compared.	(Part VI)
6.	Estimate probable future impacts of mining activity with respect to the parameters identified in 4.	(Part VII)
7.	Assess probable material damage.	(Part VIII)
8.	Make a statement of findings.	(Part IX)

This CHIA has been prepared by the Utah Division of Oil, Gas, and Mining. It complies with federal and Utah coal regulations as found in 30 CFR 784.14(f) and R645-301-729 respectively. The Belina Mine CHIA by Engineering-Science (1984) and the Huntington Creek Basin CHIA by Simons, Li, and Associates, Inc. (1984), both prepared for the U. S. Office of Surface Mining (OSM), provided much of the information used in this CHIA. The White Oak/Belina (Valley Camp of Utah, 1993) and Skyline (Coastal States, 1993) Mine Reclamation Plans (MRP) have also been used. The Technical Assessment (TA) for the Skyline Mine permit includes information similar to that required for a CHIA, but a complete CHIA was apparently not prepared at the time the original permit was approved in 1980.

II. CUMULATIVE IMPACT AREA (CIA)

The Cumulative Impact Area (CIA) is shown on Figure 2 (Appendix A). This is the area within which the actual and anticipated coal mining activities may interact to affect the surface and ground water. The CIA is determined based on existing mining activities, anticipated mining activities, knowledge of surface and ground water resources, and anticipated impacts of mining on those water resources. Both surface and ground water CIA's have been delineated.

The CIA boundary was last revised in November 2002. The rationale for defining the CIA boundary is explained as follows. The surface water CIA encompasses all of the Mud Creek basin from Scofield Reservoir on the north, to the southern end about 3 miles east of Electric Lake dam. Mud Creek basin includes the ephemeral drainages on the east side of Pleasant Valley, one of which is U.P. Canyon where Skyline's waste rock disposal site is located. White Oak Mine No. 1 and White Oak Mine No. 2 are included within the Mud Creek drainage area. Surface mining methods incorporated in the upper Whisky Creek drainage are included in the Mud Creek drainage. Also included is the Blazon Mine that has been reclaimed, but remains within the UDOGM jurisdiction.

The mountain ridge on the west side of the Mud Creek drainage is also the east side of the Huntington Creek drainage. That ridge, or divide, forms part of the boundary between Carbon and Emery Counties. The north end of the CIA boundary in the Mud Creek drainage is Granger Ridge. Granger Ridge connects the common ridge between Mud Creek & Huntington Creek, to Scofield Reservoir. The north end of the Mud Creek drainage includes the Woods Canyon and Winter Quarters Canyon drainages.

Scofield Reservoir is included in the CIA due to the fact that Skyline Mine discharges flow down Eccles Creek, into Mud Creek, and into Scofield Reservoir. Before March 1999 mine discharges were on the order of 300 to 400 gallons per minute (gpm). From March 1999 through June 2003 Skyline Mine discharges increased incrementally to approximately 11, 900 gpm, of which approximately 1,000 gpm represents the draining of old mine workings from Mine #3. From January through June 2003, total discharge averaged approximately 12,900 gpm (including 1,000 from Mine #3). Of the 12, 900 gpm, approximately 8,700 gpm reported to Eccles Creek and 3,200 gpm reported to Electric Lake Starting in August 2003, another well (JC-3) started pumping approximately an additional 5,100 gpm into Electric Lake which will reduce the discharge into Eccles Creek by the same amount (9,100 gpm to Electric Lake and 3,600 gpm to Eccles Creek, respectively). These flows are expected to decline to about 2,900 gpm in December 2004, but continue for another 5 years. While the pumped flows vary, they are about 10 times the natural flow of Eccles Creek and 3 times the flow of Mud Creek. Normally, Mud Creek is known to contribute 16 % of the annual water budget for the reservoir while at the same time contributing 29% of the nutrient load to the reservoir. This suggests Mud Creek drainage has nutrient-rich soils and increased flows from the mine will increase the nutrient load of the reservoir. Importantly, the increased flows also increase the water volumes to the reservoir and provide considerably more water to the Price River drainage than natural runoff. Other than increased water, it's believed no other hydrologic impacts will be felt downstream of Scofield Reservoir.

The CIA also encompasses all of the Huntington Creek drainage above the mouth of Valentines Gulch. The area immediately below Electric Lake dam, down to North Hughes Canyon, includes the Valentine Fault which runs through Valentines Gulch and continues north into the area of the CIA where mining has occurred. The CIA includes Electric Lake itself, which covers from 100 to 450 acres, depending on water level, and contains 30,000 acre-feet of active annual storage. The lake is a contributor to groundwater in the CIA. The Huntington Creek drainage contains roughly half of the Skyline Mine permit area. The CIA boundary contains all of the Huntington Creek drainage area above Electric Lake dam. Included within this drainage is the area west of the existing mine known as Flat Canyon. Drainages on the west side of Huntington Canyon that are part of the CIA include Bear Canyon, Little Eccles Canyon, Boulger Canyon, Flat Canyon, Swens Canyon, Little Swens Canyon, Brooks Canyon, and Upper Huntington Creek.

The western boundary of the CIA is Gooseberry Fault. This includes the area between the west edge of the Huntington Creek drainage and Gooseberry Creek. The Gooseberry Fault runs north-south through this region and is believed to form a boundary to groundwater flow. The surface hydrology, including springs along the fault escarpment, was extended west to Gooseberry Creek. Similarly, the Pleasant Valley Fault runs north-south along the Mud Creek valley and is believed to form a boundary to groundwater flow. Included between these two fault systems are White Oak Mines No.1 & No. 2, the existing Skyline Mine, the Winter Quarters/North Lease of Skyline Mine, and possible future expansion of Skyline Mine into Flat Canyon. The north end of Huntington Creek drainage joins the north end of the Mud Creek drainage at Granger Ridge to complete the Cumulative Impact Area. The total CIA area is about 54,936 acres with about 28,034 acres in the Mud Creek drainage, about 26,002 acres in the Huntington Creek drainage, and about 900 acres in the Gooseberry Creek drainage.

III. HYDROLOGIC SYSTEM

The CIA is located in both the Mud Creek and upper Huntington Creek basins, headwater basins of the Price and San Rafael Rivers, respectively. The Price River flows generally southeast and passes through the city of Price. Huntington Creek flows generally east. It emerges from the Wasatch Plateau near the town of Huntington and joins with Cottonwood and Ferron Creeks on the east side of Castle Valley to form the San Rafael River. The Price and San Rafael Rivers are tributaries to the Green River, which in turn is tributary to the Colorado River.

Precipitation on the Wasatch Plateau varies from 40 inches at higher elevations to less than 10 inches at lower elevations, 70% to 80% falling as snow from October to April. Precipitation averages 22 to 26 inches per year at the Skyline minesite. Skyline Mine is a weather reporting station. It averages more than 30 inches per year on the higher ridges and in the upper Huntington Creek basin (Coastal, 1993; Simons, Li, and Associates, 1984). Actual and potential evapotranspiration rates are roughly equal (less than 18 inches per year) in the upper elevations of the Wasatch Plateau (Waddell and others, 1983b). Probably less than 5% of the precipitation recharges the ground water system (Price and Arnow, 1979). The Wasatch Plateau is classified as semiarid to subhumid.

Vegetation varies from Sagebrush/Grass and Desert Shrub communities at lower elevations to Spruce/Fir/Aspen and Mountain Meadow communities at higher elevations. Other vegetative communities include Mountain Brush, Pinon-Juniper/Sagebrush, Ponderosa, and Riparian (Simons, Li, and Associates, 1984). These communities are generally used for wildlife habitat and livestock grazing. Even though slopes are steep, vegetation is generally thick and soils with high organic content are well developed, providing an adequate medium for ground water recharge (Coastal, 1993, p. PHC2-5).

Surface Water

Mud Creek basin is an asymmetric watershed. Watersheds on the dominant west flank contain perennial and ephemeral streams that flow eastward to Mud Creek through straight, deeply incised canyons. Small, ephemeral watersheds drain to Mud Creek from the east flank of the basin.

Mud Creek flows north through Pleasant Valley to Scofield Reservoir and normally constitutes around 16% of the annual flow to that reservoir (Valley Camp, 1993, p. 40). Since March 1999 inflows to Skyline Mine were pumped to abandoned underground workings and pumped to Eccles Creek. While there are estimates of the amounts, the actual quantities pumped to Eccles Creek are unknown. Discharges have been recorded since August 16, 2001, and from then through November 1, 2002, have varied from 4,500 gpm to 11,900 gpm, with an average of about 8,000 gpm. The volume of water pumped as of August 1, 2003, has totaled approximately 40,600acre-feet, with approximately 32,700 acre-feet reporting to Eccles Creek, Mud Creek, and Scofield Reservoir and 7,900 acre-feet reporting to Electric Lake. The distribution of water reversed in July 2003, with approximately 8,500 gpm reporting to Electric Lake and approximately 4,000 gpm reporting to Eccles Creek. The increased flow in Eccles Creek has beenapproximately 10 times the average annual amount and increased flow in Mud Creek to about 3 times the average annual amount. Flows are still only about 20% of spring runoff rates. Pumping is expected to decline to about 2,900 gpm in December 2004, but continue at that rate for another 5 years. Normally, Mud Creek contributes 16 % of the annual water budget for Scofield Reservoir while contributing 29% of the nutrient load to the reservoir. Fish Creek supplies approximately 75% of the annual flow into Scofield Reservoir (Waddell and others, 1983b, p. 43) and Pondtown, Lost/Dry Valley, and Miller Canyon Creeks add the rest. The Price River, which is used for irrigation in Castle Valley and provides the municipal water supply for the city of Price, flows from the reservoir.

The upper Huntington Creek basin, approximately 20,000 acres (18,000 acres in the CIA), is drained by both perennial and ephemeral streams. These streams flow into Electric Lake, which is a reservoir owned and operated by Huntington Cleveland Irrigation Company. One of the major water rights holders in that company is Pacificorp (formerly Utah Power and Light Company) who use their water to cool the coal-fired electric generating plant located downstream along Huntington Creek. The discharge of upper Huntington Creek has been regulated by this reservoir since its construction in 1973.

Surface Water Usage

Hansen, Allen, and Luce, Inc. conducted a survey of water rights for Valley Camp of Utah in 1990. The survey covered most of the CIA. One-hundred ninety-four surface water rights were found, 106 for stockwatering, 25 for irrigation, 55 undeclared, and the remaining 8 for other uses. Skyline Mine conducted an updated survey of the water rights in their permit area in 2002, in conjunction with the addition of the Winter Quarters/North Lease. Most perennial and ephemeral streams in the CIA have water rights filed on them.

Ground Water

Ground water is found principally in two configurations within the CIA: numerous small, localized perched systems related to discontinuous sandstone lenses in the Blackhawk Formation, and a continuous regional system in the coal seams and adjacent rocks of the lower Blackhawk Formation and the underlying Star Point Sandstone. A principal factor influencing the distribution and availability of ground water in these systems is the geology.

Geology

Stratigraphy

An offlap (regressive) sequence is exposed in the outcropping Cretaceous rocks within the CIA. Strata exposed in and adjacent to the CIA, shown on the geology map on Figure 3a (Appendix A) and the generalized cross-section on Figures 4 (Appendix A), range in age from Late Cretaceous to Tertiary (Eocene).

The oldest rocks exposed in or adjacent to the CIA are upper members of the Mancos Shale, which crops out in Huntington Canyon below Electric Lake and forms the surface of Castle Valley. The Mesaverde Group overlies the Mancos Shale and consists of the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone and Price River Formation. Overlying the Mesaverde Group are the North Horn and Flagstaff Limestone of the Wasatch Group, deposited in the very late Cretaceous and Tertiary periods. Except for well-developed soils in Pleasant Valley, quaternary sediments are generally limited to narrow, thin alluvium and colluvium deposits along valley bottoms.

The Mancos Shale consists of marine shales interbedded with sandstones and minor amounts of limestone. These shales are good aquicludes, with low horizontal and vertical permeability even near faults. Information discussed later in this CHIA suggests water may flow through some faults more readily than usually observed. The Mancos is a thick, regional aquaclude that hydrologically isolates deeper strata from the coal mining and reclamation operations considered in this CHIA. The Masuk Shale Member at the top of the Mancos grades upward into the Star Point Sandstone, and westward-thinning wedges of marine shale intertongue with and are considered part of the Star Point.

The Star Point Sandstone was deposited in a barrier-beach environment. It consists of three main tongues – from lowest to highest, the Panther, Storrs, and Spring Canyon - that thin eastward and are separated by tongues of marine shale. Bedding in the sandstones is often massive. West of the outcrops, along the Wasatch Plateau escarpment, the sandstone tongues thicken and merge and then grade into the backbarrier, coastal plain, and deltaic deposits of the Blackhawk Formation. Because of the regressive depositional sequence, the lowest Blackhawk coal seam – the Hiawatha or O'Conner - usually lies on or just above the top of the Star Point Sandstone.

Doelling (1972) described the Star Point as almost devoid of shale in the Scofield area. Spieker (1931, p. 25) described the Star Point as uniformly 400 to 500 feet thick in exposures along the Wasatch Plateau escarpment, between Gordon Creek (west of Helper) and Ferron Canyon, but also noted the Star Point is 600 feet thick in central Huntington Canyon and over 1,000 feet thick along Mud Creek. A petroleum exploration well drilled just west of the Skyline Mine (in NE1/4 SE1/4 Sec 16, T. 13 S., R. 6 E) encountered a 1,200-foot thick sequence of Star Point Sandstone that consisted of sandstone layers, with a combined thickness of over 800 feet, inter-bedded with shale.

The Star Point is generally a poor aquifer, due in part to low permeability shale lenses, but water bearing characteristics are greatly enhanced by localized faulting, fracturing, and jointing. The large discharge and low seasonal variability of baseflow to Mud Creek and of springs along the Pleasant Valley fault zone indicate the Star Point has a large storage coefficient and relatively high transmissivity (Wadell and others, 1983b, p. 78).

The Blackhawk Formation consists of approximately 1500 to 1900 feet of lenticular claystones, siltstones, sandstones, and coal seams deposited in backbarrier, coastal plain, and deltaic environments. Claystones contain high percentages of montmorillonite and other swelling clays (Coastal, 1993, p. PHC2-3). The Blackhawk is the main coal bearing formation in the Wasatch Plateau. The important coal seams occur in the lower 350 feet, which is the section that inter-tongues with the Star Point Sandstone. The lower Blackhawk and Star Point Sandstone are usually considered to be one continuous aquifer.

Fluvial channel sandstones are found in the lower Blackhawk but are more frequent toward the top of the formation. These sandstones are local in extent, generally fine grained, and well cemented. They have localized high clay content. The discontinuous character of these channel sandstones and the abundance of clay throughout the Blackhawk Formation produce perched aquifers and favor formation of local flow systems that discharge through numerous seeps and springs.

The Castlegate Sandstone, the basal part of the Price River Formation, is typically massive, resistant to erosion, and white to gray in color. It consists of fluvial pebble conglomerates and fine- to coarse-grained, argillaceous sandstones with some shale. It is carbonaceous in the Book Cliffs, but coal is thin and lignitic. The Castlegate Sandstone is good aquifer material, with seeps and springs common at the Castlegate-Blackhawk contact. The Price River Formation is light-colored, medium-grained and shaley sandstone interbedded with roughly an equal volume of darker, carbonaceous shale or mudstone. There are large point-bar sandstones, and also minor amounts of coal.

The Mesa Verde Group is overlain by the North Horn Formation, which is exposed along the top of the ridge in the western part of the CIA. The North Horn is composed of bentonitic, calcareous, silty shales interbedded with thin limestones and fine-grained sandstones and minor amounts of conglomerate. There are lenticular channel-sandstones throughout, enclosed by the fine-grained shales.

Still farther west and outside the CIA, the Tertiary Flagstaff Limestone is the youngest consolidated rock in the region. Fracturing and dissolution can produce good permeability in this lacustrine limestone, and it is an aquifer where it is thick and extensive enough to receive and store adequate recharge.

Structure

Surface elevations vary from 7600 feet to 10400 feet within the CIA, with the Star Point Sandstone and Blackhawk Formation outcrops forming most of this relief.

The CIA lies on the Clear Creek anticline, primarily on the west flank. Dips on the west flank range from three to six degrees, to the southwest at the south end of the CIA and to the northwest at the north end.

The Pleasant Valley fault zone, one segment of a regional fault zone that extends north-south across the Wasatch Plateau, lies on the axis of the Clear Creek anticline. Total vertical displacement is 800 to 900 feet, down to the east. Intertongued Star Point Sandstone and Mancos Shale crop out west of the fault zone but Blackhawk Formation crops out on the east. Mud Creek flows north along the Pleasant Valley fault zone to Scofield Reservoir, where the fault zone broadens to become the Pleasant Valley Graben. U.P. Canyon, where Skyline's waste rock disposal site is situated, also follows one of the faults of this zone. Strata east of the fault zone but within the CIA are generally flat lying (Figure 3, Appendix A).

Other major faults in the CIA are high-angle, normal, and run north-south to northeast-southwest. Movement is dominantly down to the west. The largest of these faults, with up to 350 feet of displacement, is the O'Connor fault that obliquely transects the White Oak/Belina permit area. The Connelville fault, a zone up to 1000 feet wide and with up to 250 feet cumulative vertical displacement, separates the Skyline and White Oak/Belina mines. Upper Huntington Creek and Electric Lake lie along the Upper Joes Valley fault zone that includes the Diagonal fault, which is paralleled on the east by the Valentine fault. The Joes Valley, Diagonal, Valentine, and smaller unnamed faults do not have significant vertical displacement within the CIA. All of these faults gradually die out to the north and do not extend beyond the northern CIA boundary. The O'Connor and Upper Joes Valley faults continue south outside the CIA. Very small displacement faults, oriented roughly east-west, have been encountered in the White Oak/Belina mine and mapped on the surface at the Skyline mine (Figures 3a and 3b, Appendix A). Four major joint and fracture orientations have been mapped underground and at the surface.

Some of the smaller east-west trending faults have been intruded by magma that solidified to form dikes. A major dike passes through the White Oak/Belina mine operations, extending from Mud Creek to the Connelville fault. Coal has been coked adjacent to this dike and has a slightly increased metal content. There is evidence these dikes affect the movement of ground water in the shallow perched systems (Figures 3a and 3b, Appendix A). The majority of the approximately north-south trending faults located west of the Connelville fault, die out or terminate in the area of an east-west trending fault in Sections 22, 23, 24, Township 13 South, Range 6 East. North of this fault, the majority of the faults and fractures trend approximately east -west. These faults appear to be sub-parallel to the Fish Creek Graben located a few miles north of the Winter Quarters/North Lease area. While mining activities were conducted in Skyline Mine No. 3, the in-situ stresses were measured in the rocks. The results indicated the rocks were in compression in an east-west direction. Similar tests conducted in Skyline Mine No. 2 indicated the rocks were in extension in an east-west direction.

Aquifer Characteristics

In the CIA, the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, Price River Formation, North Horn Formation, and Quaternary deposits all contain potential reservoirs or conduits for ground water. Reservoir lithologies are predominately sandstone. Sandstone reservoirs occur where there is sufficient intergranular porosity and permeability in lenticular fluvial-channel and tabular overbank deposits. Shale, siltstone, and cemented sandstone beds act as aquitards or aquicludes to impede ground-water movement. The Mancos Shale is a regional aquiclude that limits downward flow. Localized aquitards can occur within any of the other, more permeable formations. Ground water in the CIA occurs under both confined and unconfined conditions.

Shallow perched ground water systems provide water to the seeps and springs issuing at the Castlegate Sandstone-Blackhawk Formation contact and from sandstone lenses of the Blackhawk Formation. The Blackhawk sandstone lenses are discontinuous and of local extent. Springs and seeps discharge on the slopes at an elevation considerably above nearby streambeds. The majority of seeps and springs issue from the west dipping strata on west facing slopes, often at a shale-sandstone interface. Flow varies seasonally in response to precipitation and snowmelt. The perched systems may provide some flow directly to alluvial and colluvial fill in canyon bottoms, but they do not provide baseflow to sustain perennial streams.

Recharge percolates from the surface downward until shale is encountered. The water then moves downdip and is channeled into discontinuous but more permeable sandstones creating isolated and/or confined aquifers. Water either continues to move downdip until it is discharged at the surface or resumes vertical flow where more permeable zones are encountered. Discharge from most seeps and springs closely tracks precipitation rates, and recharge probably originates in the small surface depressions or basins in the immediate vicinity. Flow along faults and fractures through the Blackhawk Formation appears minimal due to the sealing ability of the clays, but some recharge gets past the perched systems to reach the deeper regional aquifer. This has been recently supported by geophysical studies and and age-dating of waters encountered along certain faults. The perched and regional systems are separated by unsaturated rock.

A regional ground water system is located in saturated coal and rock of the lower Blackhawk Formation and Star Point Sandstone. Observation wells show the water in this deeper regional system flows beneath the headwater drainages in the CIA and has not shown influence on the seeps and springs of the shallower perched systems. The potentiometric surface follows the topography, with a ground water divide roughly beneath the surface divide, and flow is to the southwest and northeast. Water levels in Skyline's monitoring wells fluctuate seasonally, the changes lagging snowmelt and rainfall events by up to two months. Until August 2001, a long-term decline of water levels in the wells, typically less than 3 feet per year, was attributed to long-term decreases in precipitation and to dewatering of the aquifer by mining (Coastal, 1993, PHC2-4). Since August 2001, the Mine has encountered significant water from a fracture/fault zone (currently known as the Diagonal Fault), and has systematically drawn down the potentiometric head of the Star Point Sandstone.

Natural discharge from the regional system occurs as baseflow into Mud Creek and the lower reaches of its perennial tributaries and into Huntington Creek downstream of Electric Lake. Natural discharge also occurs as seeps and springs at faults and along the outcrop of the impermeable Mancos Shale. The Mancos Shale outcrop delimits the lateral extent of this aquifer. Water is unable to flow downward through the Mancos in any significant amount but will flow laterally through more permeable overlying strata until it discharges at the surface. Little is known of the Blackhawk-Star Point aquifer to the west, but it does not crop out and is considered to extend beneath the Sanpete valley.

Skyline's monitoring well at the waste rock disposal site shows that the regional aquifer continues in Blackhawk-Star Point strata east of Mud Creek. Water supply wells in alluvium along Pleasant Valley produce from a shallow unconfined aquifer interconnected with Mud Creek. The connection between this alluvial aquifer and the regional Blackhawk-Star Point aquifer is not uniform, but areas have been identified where ground water flows through the Pleasant Valley fault from the regional aquifer to the alluvial aquifer and directly to Mud Creek. During periods of low flow, water in Mud Creek comes mainly from seepage from the regional aquifer (Waddell and others, 1983b, p. 34).

Faulting has only local importance in the Blackhawk Formation because clays tend to seal fractures and stop or restrict water movement. On the other hand the clay content of the Star Point Sandstone is low, fractures are not as readily sealed by clay as in the Blackhawk, and secondary permeability created by fracturing increases the mobility of water through the regional system. This is evident in the performance of wells JC-1 and JC-2 located in James Canyon of the Skyline Mine permit area. Both wells were drilled as production wells to relieve water that was entering the Mine. JC-1 is a 14 1/4-inch diameter well with a 60-foot screen-interval that is completed within the Diagonal fault/fractured Star Point Sandstone and currently pumps approximately 4,000 gpm. JC-2 was then drilled to a 20-inch diameter and 60-foot screen anticipating a similar pumping yield. Unfortunately, JC-2 was not completed within a fractured portion of the Star Point Sandstone and through pump tests was determined would only yield approximately 350 gpm. Due to the low yield, JC-2 is not currently being pumped. Both wells were completed approximately 80-feet below the mine workings. The low yield from Well JC-2 required the drilling of Well JC-3 to increase dewatering from the 10-Left area of the mine. Horizontal and vertical hydraulic conductivities in the Star Point Sandstone, as measured by Core Laboratories, Inc. in Dallas, Texas, are on the order of 10^{-2} ft/day. Horizontal hydraulic conductivities in the Blackhawk range from no measurable permeability to 10^{-8} ft/day in the shales and 10^{-9} to 10^{-7} ft/day in the siltstones. Vertical hydraulic conductivities may be greater or smaller but are within one order of magnitude of the corresponding horizontal hydraulic conductivity. Sandstones in the Blackhawk Formation have hydraulic conductivities similar to those of the Star Point Sandstone (Lines, 1985).

Transmissivity of the Blackhawk was determined to be approximately 18 gal/day/ft (2.4 ft^2/day) by a pair of drawdown and recovery tests in a test well near the Skyline portal. No significant difference was noted between the coal zone and sandstone tongue (Vaughn Hansen Associates, 1979, p. 85). Transmissivity of the entire Blackhawk-Star Point aquifer, based on pump tests and core analyses from the Trail Mountain area, probably ranges from 20 to 200 ft^2/day. Storage coefficient probably averages about 10^{-6} for confined conditions and about 0.05 for unconfined (Lines, 1985, p. 15). Canyon Fuel Company (CFC) has a consultant actively creating a numeric hydrologic model of the area using approximately 20-existing monitoring wells located within the permit area. This model will provide localized information regarding the transmissivity of the geologic units in the area. This information should be available in the 4th quarter 2003.

Seeps and Springs

In 1978, 174 seeps and springs were identified on and adjacent to the Skyline permit area, 30% of the sources being seeps. This is roughly one every 40 acres. Higher flows occurred in the springtime. Many seeps and springs dried during the summer and by fall most of the remaining sources flowed less than 2 gpm; only four springs flowed more than 10 gpm. (Coastal, 1993, p. 2-24a and -25a). A survey of the White Oak/Belina mine area in 1978 and 1979 found 94 flowing and 15 dry seeps and springs (Valley Camp, 1993, p. 700-7). In early summer, 8 of the sources had flows greater than 10 gpm, but by autumn most springs were flowing less than 1 gpm and many could not be located (Engineering-Science, 1984, p. 33). Another survey of the White Oak/Belina area in summer of 1990 identified 81 flowing and 43 dry seeps and springs (Valley Camp, 1993, p. 700-7). Anticipating the addition of the Winter Quarters/North Lease tract, another spring and seep survey was conducted in 1993, from which monitoring sites to characterize the area were selected. Monitored springs have exhibited an overall decrease on flow (Coastal, 1993, p, PHC2-6; Valley Camp, 1993,p 700-6). The Skyline and White Oak/Belina surveys probably include duplicate information on many springs because the two permit areas abut.

According to the Seep and Spring survey conducted in the White Oak/Belina area in the summer of 1990, a total of three seeps/springs are affected by the 2001 Surface mining in the area. Seeps/springs S25-13, S25-14, and 30-1 are all located up gradient of the surface mining. Seep/Spring S25-13 is the only site that provided consistent enough flow to be continually monitored. Recorded quarterly flow measurements from site S25-13 range from 0 to 60 gpm, and average <5 gpm. It is anticipated that any flow from the three seeps or springs will still report to Whisky Creek and not be significantly impacted by the surface mining.

Seeps and springs often issue at a shale-sandstone interface. Flow along faults and fractures through the Blackhawk Formation appears minimal due to the sealing ability of the clays.

No seeps or springs have been found at Skyline's waste rock disposal site (Coastal, 1993, p. 2-30a). There has not been a detailed survey for seeps and springs for the portion of the CIA that is not in or adjacent to the two mine permit areas.

Due to the significant inflows encountered in the Skyline Mine since August 2001, increased monitoring of the flows of the seeps and springs within the Skyline permit area has occurred. All the seeps and springs in the Skyline groundwater monitoring program are located within the Blackhawk Formation and have not indicated any draw down or obvious decrease in flow that can be correlated to the mine inflows.

Stream Seepage

Based on flow duration curves, approximately 19% of Huntington Creek streamflow above Electric Lake is attributed to ground water baseflow, but baseflow accounts for nearly 64% of the annual flow in Eccles Creek. This difference is, in part, because the continuous, saturated lower Blackhawk-Star Point aquifer forms approximately 25% of the surface of Eccles Canyon but is not exposed in upper Huntington Canyon. In upper Huntington Canyon ground water comes only from thin, localized, perched aquifers associated with sandstone lenses of the upper Blackhawk Formation (Vaughn Hansen Associates, 1979, p. 63 and 68).

Seepage studies were done in Eccles Creek, South Fork of Eccles Creek, and Huntington Creeks. There is a significant increase of flow in Eccles Creek where the stream crosses onto the Star Point Sandstone outcrop. There is another significant increase at the O'Conner fault where the fault conveys water through fractured Star Point sandstone to the stream. In comparison, the Connelville fault does not add significantly to flow in either the Main or South Fork of Eccles Creek because potential flow paths through the fractured Blackhawk Formation have apparently been sealed by clays.

Changes of streamflow in Huntington Creek can be largely accounted for by inflow from tributaries and hillside springs. Loss of flow just above Electric Lake is attributed to recharge into the alluvium (Vaughn Hansen Associates, 1979, pp. 68 - 80).

Water in Mines

The coal seams that are mined are in the lower Blackhawk Formation, within strata included in the Blackhawk-Star Point aquifer. Saturated conditions have been encountered in the White Oak/Belina mine and Skyline mines along fracture and fault zones and have persisted as mining has progressed downdip. Similar conditions were found in the Utah #2 mine while it operated. Long-term decline of water levels in the Blackhawk-Star Point aquifer in the vicinity of the Skyline Mines, typically less than 3 feet per year, is attributed to both long-term decreases in precipitation and to dewatering of the aquifer by mining (Coastal, 1993, Figures PHC2-4, July 2002 Addendum to the PHC). Ground water flow into the mines can be characterized as: 1) seepage from the coal seams and associated channel sandstones, 2) flow from Blackhawk channel sandstones that have been fractured by faulting and folding, or 3) flow up from the Star Point Sandstone through the Blackhawk by way of faults and fractures.

Discharge from coal seams and channel sandstones average approximately 10 gallons per minute per active mine face, but flow of 200 gallons per minute was encountered at the Connelville fault in the White Oak/Belina mines. Water production typically declines rapidly over a short time. Most flows dry up by the time mining has advanced 500 feet beyond them, but an occasional roof bolt will continue to drip up to 2 gpm for an extended time (Coastal, 1993, p. 2-49). The 200gallon per minute flow from the Connelville fault in the White Oak/Belina mines decreased to 10 to 15 gallons per minute over a four-day period. These observations indicate permeability is localized and recharge to the saturated areas is not extensive. Permeable zones in the Blackhawk sandstones are capable of yielding large quantities of water from storage for a short period of time but are not extensive enough to have sufficient storage or recharge to sustain flows. Seasonal fluctuations of inflow have been observed and are attributed to both seasonal recharge and to subsided areas that intercept surface runoff (Engineering-Science, 1984).

Faulting typically has only local importance in the Blackhawk Formation because the high clay content tends to seal fractures, and movement of water along most faults appears to be effectively blocked or restricted. Of 44 individual fault planes encountered up to 1988 in the Skyline mines, only 5 dripped water from the roof, 4 from where faults intersected sandstone paleochannels. Water discharged up through the floor from the Star Point Sandstone along two other faults (Coastal, 1993,p. 2-24).

Fracturing in the Star Point Sandstone is not as likely to be sealed by clays as in the Blackhawk and as a result secondary permeability created by fracturing tends to increase the mobility of water through the Star Point. Flows of up to 450 gallons per minute were measured from the Pleasant Valley fault zone in the Utah #2 mine. At different times, flow from the Clear Creek mine portal has been reported to be between 100 and 300 gallons per minute (Waddell and others, 1983b; Engineering-Science, 1984). When UDOGM personnel checked this portal in September 1993 water was still flowing at approximately the same rate, however water no longer flows from the portal. Most of this water comes into the mine from the Pleasant Valley fault. Water from Mud Creek is intercepted upstream of the mine and reaches the fault by way of abandoned mine workings and through the Star Point Sandstone (Wadell and others, 1983b). Because of the Pleasant Valley fault zone it is expected that mines east of Mud Creek will typically have larger, more persistent flows than mines on the west side.

North Joes Valley fault has little offset and is not a major structural feature within the CIA. Flow of water from the surface into the mine, through the Blackhawk Formation by way of the North Joes Valley fault zone, would not be anticipated because of the sealing clays in the Blackhawk Formation. In addition, the no mining buffer zone should separate mine workings from main sections of the fault along Huntington Creek and Electric Lake. This will reduce the possibility of reactivation of faults by subsidence and subsequent downward flow along the reactivated faults.

Beginning in March 1999, Skyline Mine encountered a series of major water inflows that are summarized in Table 1. These inflows are the largest ever to occur in underground coalmines in Utah.

TABLE 1 - Water Inflows to Skyline Mine

Inflow Location	Date	Estimated Initial Flow, gpm	Estimated March 2003 Flow, gpm
14-Left HG	03/1999	1,600	300
16-Left HG	12/1999	1,200	300
W. Submains (now referenced as Diagonal Fault	03/2000	1,000	300
10-Left	08/2001	6,500	3,200
E. Submain XC5	10/2001	1,000	370
11-Left HG XC24	02/2002	1,000	900
11-Left HG XC40	02/2002	1,000	1,000
11-Left Setup Rm.	03/2002	1,500	1,300
	Totals	14,800	9,300

These inflows prompted considerable investigations by the mine and outside consultants. They also necessitated a revision to this CHIA in November 2002. All of the inflows were in Mine 2, which proceeded further west than Mine 1 or Mine 3. All inflows are associated with faults and enter the mine through the floor. Based on the investigations of HCI and Petersen (Appendices C, G, and H of July 2002 Addendum to the PHC), it was determined that the water source is the Star Point Sandstone formation located beneath the coal seam. The Star Point Sandstone in the mine area is believed to consist of 14 sandstone layers totaling 743 feet in thickness. Of the five (5) major inflows encountered between March 1999 and October 2001, total inflows have decreased from 11,000 gpm to 4,470 gpm as of June 2003; a 59 percent decrease. As discussed earlier, this formation has a large storage coefficient and relatively high transmissivity. The large network of fracture planes that make up the regional fracture network provide the surface area necessary to drain the water stored in the matrix of the Star Point Sandstone. Based on ^{14}C age dating and Tritium analysis, the water in the Star Point Sandstone is believed to be of ancient origin and represent an isolated groundwater storage volume that is not in direct connection with the surface.

Immediately after the 6,500-gpm inflow, the mine drilled 2 wells into the fault that intercepted the 10-Left inflow location. The intent was to remove groundwater before it entered the mine and thus reduce inflows. Only one well, JC-1, produced appreciable water and is currently pumping at about 4,000 gpm. This pumping was only marginally successful at reducing inflow waters and was estimated to reduce the inflow no more than 800 gpm while the well was pumping 2,200 gpm (HCI).

Due to the significant and sustained inflows that have been encountered in the Skyline Mine from March 1999 and continue through July 2003 numeric hydrologic modeling of the groundwater has been actively conducted. Preliminary results from the modeling attempt to define the outer limit of where the water is being drawn. This is based on the calibration of the model when compared to the drawdown that has been observed in the groundwater wells located in the Upper Huntington drainage basin. The model defines the limits of the aquifer drawdown area by the Gooseberry Fault to the west, the Fish Creek Graben to the north, and the O'Conner Fault to the east. The southern boundary of the drawdown area is still being defined and the additional results are anticipated to be available by October 2003.

Ground- and surface-water monitoring of streams, springs, and seeps conducted by the mine have noted no impacts due to the increased in-mine flows. The springs and seeps respond rapidly to season and to climatic cycles indicating that the springs are fed by discharge from a shallow groundwater system. Appendix A of the Skyline Mine July 2002 Addendum to the PHC graphically outlines the flow of the springs and their response to the Palmer Hydrologic Drought Index (PHDI). Age-dating of numerous springs also support the recharge being fed from a shallow groundwater system.

It is significant to note that all the monitoring wells available for analysis are either completed in the Star Point Sandstone or are in the Blackhawk Formation but are completed through the coal seam. The one exception is well W79-35-1B, which is immediately adjacent to W79-35-1A but is completed within the Blackhawk Formation and above the coal seam. The water level in Well W79-35-1B has remained constant while the water level in Well W79-35-1A (screened below the coal seam) has dropped approximately 300-feet during the dewatering activities in the mine (Figure 3a, 4a, and 5, Appendix A). This lack of communication between the two wells suggests the effectiveness of the Blackhawk Formation in impeding vertical migration of water across the formation.

Beginning in late July 2003 Well JC-3 began pumping water directly from the Skyline mine-workings into Electric Lake at a rate of approximately 5,100 gpm. The Division anticipates the addition of the well will have no adverse affect on the local hydrologic regime. The well represents no net increase in the amount of mine-water being discharged, only a change in the point of discharge. Of the water being routed through underground pumps and discharged into Eccles Creek, the discharge to Eccles Creek is reduced by the amount being pumped to Electric Lake via Well JC-3.

<u>Ground Water Usage</u>

Hansen, Allen, and Luce, Inc. conducted a survey of water rights for the White Oak/Belina mines in 1990. The survey covered most of the area in the CIA. A total of 135 ground water rights were found, 112 on springs and 23 on wells or tunnels. Stockwatering was the declared use on 62 of the water rights, 41 were for other uses, and the remaining 32 were undeclared. The information is summarized in Table 724.100a in the White Oak/Belina MRP and the locations are shown on Map 724.100a. Skyline Mine updated the water rights information in their MRP with the addition of the Winter Quarters/North Lease area in 2002.

Springs and seeps are important to wildlife, though there are no filed rights that declare this as a use.

Both the Skyline and White Oak/Belina mines utilize water from wells in Eccles Canyon that were drilled into fault zones in the Star Point Sandstone. Wells near the Skyline and White Oak/Belina loadouts in Pleasant Valley produce water from both alluvium and Star Point Sandstone. Water from these wells is for domestic, stockwatering, and other uses.

From September 2001 (startup of JC-1 well) through July 2003 approximately 34,300 acre-feet of water has been discharged from the Skyline mine. Of that, approximately 26,400acre-feet has reported to Scofield Reservoir via Eccles and Mud Creeks, and approximately 7,900 acre-feet has reported directly to Electric Lake via Well JC-1. From December 2002 through June 2003 the flow rate has averaged approximately 20..4 cfs to Scofield Reservoir and approximately 8.3 cfs to Electric Lake. Beginning in late July 2003 Well JC-3 began pumping approximately an additional 11 cfs (5,000 gpm) into Electric Lake. This will likely reduce the discharge to Scofield Reservoir by the same 11 cfs. The discharged water is of high quality and has been put to beneficial use in both drainages. The major mine inflows creating the needed discharge are slowly decreasing with time. It has yet to be determined how long these beneficial waters will be encountered. Both Well JC-1 and Well JC-3 and considered mine-dewatering wells and have associated UPDES discharge permits. Currently, no adverse affects have been observed in the existing surface- or groundwater resources being used.

IV. BASELINE CONDITIONS OF SURFACE AND GROUND WATER QUALITY AND QUANTITY.

Surface Water – Baseline Conditions

Surface water is monitored for quantity and quality at various stations operated by the USGS and the coal mine operators. Locations are shown on Figure 5 (Appendix A) and analysis results are found in both the Skyline and White Oak/Belina MRP's, the Mud Creek /Huntington Creek CHIA, and USGS publications. Graphs of selected groundwater wells, springs and streams comparing historic flow to the Palmer Hydrologic Drought Index (PHDI) are provided in PHC Addendum Appendix A of the July 2002 Addendum to the PHC of the Skyline MRP and were last updated with data from the1st quarter (calendar year) 2003 . These graphs illustrate how the springs in the Blackhawk Formation respond rapidly to season and to climatic cycles indicating the springs are fed by discharge from a groundwater system that is in good communication with the surface and annual recharge events. Also, to assist in quantifying any potential effects to Electric Lake, Pacificorp provided the Division with graphs and information illustrating the performance of the lake dating back to 1974. Monitoring has been infrequent or irregular at some stations. With the addition of the Winter Quarters/North Lease tract, additional studies were conducted in Winter Quarters Creek and Woods Creek due to their perennial nature and importance of fishery habitat. The full effects of Electric Lake on the water in Huntington Creek have not been completely determined.

Surface Water Quantity

Average annual yield from the 22,000 acre Mud Creek drainage, as determined from continuous USGS measurements from 1978 to 2001 at station 09310700, is 15.7 cfs (7.3 inches). Discharge rates are summarized in Table 2 Highest discharges result from spring snowmelt (Price and Plantz, 1987). From August 2001 through July 2003, approximately an additional 32,700 acre-feet of mine-water discharge has been added to the Scofield Reservoir. During that time period, flow averaged approximately 19 cfs. With the addition of Well JC-3, the flow rate is anticipated to decrease by at least 10 cfs. Calculations made in October 2002 estimate this flow will continue to drop off to approximately 6.0 cfs by the end of 2004 (Appendix F – July 2002 Addendum to the PHC). This 6.0 cfs represents a 38 percent increase over the average flow observed from 1978 through 2001.

TABLE 2

Discharge of Mud Creek measured near the town of Scofield.

Gaging Station	Date	Average	Maximum	Minimum
USGS 09310700	1978 - 2001 (continuous)	15.7 cfs	389 cfs	1.4 cfs

Eccles, Winterquarters, Boardinghouse, and Finn Creeks are the principal tributaries to Mud Creek. Based on continuous measurements by the USGS from 1980 to 1984 at station 09310600 (Price and Plantz, 1987), average annual yield from the 3,500 acre watershed in Eccles Canyon is 11.7 inches. The maximum-recorded peak flow was 71 cfs in May 1984. Skyline recorded high peak flows in 1983 through 1986. Discharge rates are summarized in Table 3.

TABLE 3

Discharge measured near the mouth of Eccles Creek.

Gaging Station	Date	Average	Maximum	Minimum
USGS 09310600	1980 - 1984 (continuous)	4.70 cfs	71.0 cfs	0.62 cfs
Skyline CS-6	1981 - 2002	6.11 cfs	71.2 cfs	0.54 cfs

Skyline's data indicate water began to be discharged from the #3 mine in 1983, and from 1984 to 1992 discharge averaged 0.50 cfs. Discharge from Skyline Mine #1 began in 1989 and averaged 0.28 cfs from 1989 to 1992. Minimum measured discharges from #1 and #3 were 0.08 cfs and 0.13 cfs and maximums were 0.69 cfs and 1 cfs. In late summer to early autumn when stream flow is naturally low, discharge from the Skyline mines has been estimated to account for as much as 60% to 70% of flow in Eccles Creek.

The additional 19 cfs encountered from August 2001 through July 2003 represents 10-times the normal flow encountered in Eccles Creek. The reduction of mine discharge to approximately 6 cfs will represent twice the normal flow (12 cfs) and 17 percent of the maximum flow. To monitor the impacts of this additional water to the physical characteristics of Eccles and Mud Creek, a study was initiated in the summer of 2002 and will be re-evaluated with additional information collected in the summer of 2003. Field observations indicate the additional water makes the flow at, or just below bank-full capacity of Eccles Creek. However, Eccles Creek appears to be well-armored and able to handle the additional flow. Mud Creek is larger than Eccles Creek and flows are approximately 4-times larger than normally seen, however the flow is not as close to bank-full capacity. Results from the two years of data should be available in the future. The details of the study is outlined in Appendix D of the July 2002 Addendum to the PHC.

Prior to the breakout of the ventilation portal in South Fork of Eccles Creek in 1989, maximum measured flow at station VC-10 was 14.7 cfs. Periods of no-flow were observed in 1981, 1984, 1995, 2001, and 2002 but never during the third or fourth quarter of the calendar year (July-December). Average measured flow from 1978 to 1990 was 1.39 cfs (Table 4).

Construction of the road to the White Oak/Belina Mines in Whisky Canyon began in 1975. Monitoring of Whisky Creek began the same year, so there are no data on conditions prior to disturbance of the drainage. Periods of no-flow have been recorded at least once in each of the four calendar quarters (Table 4). Although not as consistently dry, Whisky Creek was periodically dry from 1982 through 2000.

During average flow conditions Whisky Creek (at VC-5) accounts for approximately 8.1 percent and 2.4 percent of the flow of Eccles Creek and Mud Creek, respectively. Upper Whisky Creek at VC-4 accounts for approximately 15.8 percent of the flow of VC-5, 1.3 percent of Eccles Creek, and 0.4 percent of Mud Creek, respectively. The Surface mining and reconstruction of Upper Whisky Creek impacts the area immediately surrounding site VC-4. Any flow lost due to infiltration into the fill from Surface Mining is anticipated to surface further downstream in Whisky Creek. Although a significant loss in flow at VC-4 would impact flows at VC-5, minimal cumulative impacts would be felt at Eccles Creek and Mud Creek.

The location of sample site VC-4 was moved upstream approximately 280 ft. upstream due to disturbance created by the Surface mining. VC-4 represents undisturbed drainage of Whisky Creek. Although moved upstream, only one small ephemeral draw was eliminated from the drainage basin resulting in an insignificant change in flow.

TABLE 4

Discharges measured at South Fork of Eccles Creek and Whisky Creek

Gaging Station	Date	Average	Maximum	Minimum
South Fork Belina VC-10	1978 - 2002	1.39 cfs	14.7 cfs	0 cfs (2 of 4 quarters)
Whisky Creek Belina VC-5	1976 – 2002	0.38cfs	3.70 cfs	0 cfs (4 of 4 quarters)
Whisky Creek Belina VC-4	1977 – 2002	0.06 cfs	1.0 cfs	0 cfs (4 of 4 quarters)

Boardinghouse and Finn Creeks are not directly affected by current mining, but have been monitored by Valley Camp of Utah and results are summarized in Table 5 (Valley Camp, 1993, p. 700-23). The single reported observation of this stream during a first calendar quarter, in March 1982, found no flow. If coal production were to be increased at the White Oak/Belina mines, one of these two canyons would probably be the site of an additional mine portal and additional mine water discharge.

TABLE 5

Discharges measured at Boardinghouse and Finn Creeks

Gaging Station	Date	Average	Maximum	Minimum
Boardinghouse Belina VC-11	1980 - 2002	1.6 cfs	12.8 cfs	0.02 cfs
Finn Creek Belina VC-12	1980 - 2002	0.47 cfs	4.20 cfs	0 cfs (4 of 4 quarters)

Winter Quarters Creek was monitored by Waddell and others in 1979-1980 and by Skyline in 1981 and 2002. Results are summarized in Table 6.

TABLE 6

Discharges measured at Winter Quarters Creek

Gaging Station	Date	Average	Maximum	Minimum
35*	1979-1980	0.405 cfs	0.51 cfs	0.30 cfs
CS-19	June 2002	0.274 cfs		
CS-20	Nov. 1981	0.07 cfs		
	June 2002	0.818 cfs		

* (Waddell and others, 1982)

Skyline currently monitors upper Huntington Creek where it discharges into Electric Lake, at station UPL-10. Flow is measured periodically when the site is accessible, mainly from May to October. From 1981 to 1993 the average flow during these accessible months was 7.8 cfs (Skyline Mines 1993 Annual Report). Utah Power and Light monitored Huntington Creek above Burnout Creek prior to construction of Electric Lake, and the information is found in the report by Vaughn Hansen Associates (1979). Discharge of upper Huntington Creek is summarized in Table 7.

Average flow of Burnout Creek at station CS-7 from 1981 to 2002 was 1.2 cfs, with minimum and maximum measured flows of 0.01 and 10.7 cfs. None of the other tributaries to Electric Lake are known to be monitored. Flow from Electric Lake, which is not monitored at UPL-3, is regulated for the benefit of downstream users and does not accurately characterize the hydrologic system.

TABLE 7

Discharge of Huntington Creek above Burnout Creek.

Gaging Station	Date	Average	Maximum	Minimum
Utah Power & Light	1971 - 1973	-	>170 cfs	"0.5 cfs
Skyline UPL-10	1981 - 2002	7.7 cfs	79 cfs	0.01 cfs

(Predicted average discharge for Eccles Creek, based on flow duration curves for water years 1976 through 1978, is 5.43 cfs, corresponding to a yield of 13.4 inches. Flow duration curves from Huntington Creek above Burnout Creek for water years 1972 and 1973, before Electric Lake was filled, indicate an average annual discharge of 13 cfs and a yield of 16 inches per year (Vaughn Hansen Associates, 1979). The predictions are based on data from different periods, but the higher predicted yield from the upper Huntington Creek basin in comparison to that from the Eccles watershed may be a consequence of the relative impermeability of the Blackhawk Formation that forms or immediately underlies the surface over most of the upper Huntington Creek basin (Coastal States, 1993, p. 2-42), and the westward dip of the strata.

Burnout and Huntington Creeks drain 8240 acres, 42% of the upper Huntington Creek basin located above the dam, and their combined average discharge has been 6500 acre feet per year (9 cfs). Estimating from the Burnout and Huntington Creek data, discharge from the entire 19,854 acres of the upper Huntington Creek basin located above the dam would be 16,000 acre feet per year (22 cfs). This estimated number is supported by comparing the continuous flow recorded at the mouth of Eccles Creek (Table 3) and using the same flow volume per acre of land for the Upper Huntington basin. Using the same volume per acre number from the Eccles Creek drainage for the 19,854 acres, the average flow for the Upper Huntington basin is 21.2 cfs or 15,350 acre-feet per year. Subtracting a calculated 800 acre-feet of evaporation per year, based on Pacificorp data, the Upper Huntington drainage basin receives an average of approximately 14,500 acre-feet per year.

Electric Lake

Electric Lake, with a storage capacity of 31,500 acre-feet, began filling in 1974. Pacificorp owns approximately 1/3 of the water shares of Electric Lake and uses approximately 12,000 acre-feet of water annually. Since that time Utah Power & Light (UP&L – Pacificorp) has monitored the water within the Upper Huntington drainage basin using primarily imputed flow data, discharge records, lake levels, precipitation, and evaporation. From June 19, 2002, through mid-April 2003 actual flow data was collected from the Upper Huntington basin, with the exception of tributaries located below Boulger Creek which wereestimated to contribute approximately 1 cfs on average. In July 2003, Pacificorp submitted a report to the Division suggesting Electric Lake has been losing a disproportionate amount of water since August 2001, based primarily on the reaction of the lake (Pacificorp – Investigation of Technical Issues related to the Electric Lake and Huntington Creek Controversy June 25, 2003). No number calculation reflecting the calculated volume loss from Electric Lake was provided in the report. The report provides numerous graphs illustrating how the Lake, intuitively appears to be losing water. However, it is hard to have complete confidence in the graphs because the majority of inflow are a 'back-calculation' of data (with the exception of the June 19, 2002, through mid-April 2003 time period). Stage volumes, the leakage of the lake/reservoir, and the effects of the drought all contribute to the response being seen in the lake elevations. Whether the inflows encountered in the Skyline mine are associated with this apparent loss of water, and to what degree, is still being evaluated. The flow monitoring of all the major tributaries above the lake was re-established on June 19, 2003 and will continue until the measuring devices are inundated by Electric Lake. Also, with the significant contributions of water made by wells JC-1 and JC-3 (~1,200 acre-feet/month), the inflow will be closely monitored. This information will provide additional quantitative data to the recent performance of the lake.

As discussed earlier, Skyline Mine encountered considerable groundwater inflows beginning in March 1999. In an attempt to reduce inflows, wells were drilled in James Canyon and groundwater from a fault was pumped into Electric Lake. From September 2001 until September 2002 water was pumped at about 2,200 gpm from Well JC-1. In October 2002 the pumping rate in JC-1 increased to about 4,200 gpm by installing a higher capacity pump. In late July 2003, Well JC-3 began pumping directly from the mine workings at approximately 5,100 gpm, bringing the total discharge to Electric Lake to approximately 9,100 gpm. After that mine operations and drought or non-drought conditions will determine if the pumping continues. Through July 30, 2003, 7,900 acre-feet of water had been pumped into Electric Lake and therefore, the Huntington Creek drainage. The combined discharge of the JC-1 and JC-3 (at ~ 9,100 gpm) is contributing approximately 40.21 acre-feet per day to Electric Lake (~14,680 acre-feet/year).

Mine inflows have also been pumped out of the mine into Eccles Creek. These flows have varied from 4,500 gpm to 10,500 gpm, with an average of about 8,365 gpm through July 2003. . This has increased the normal flows in Eccles Creek to about 10 times normal amounts and increased the normal flows in Mud Creek about 3 times normal amounts.

Due to changes in both economic and mining conditions, mining operations are anticipated to cease by the end of the 1st quarter of 2004. The mine will be in ‘temporary cessation but will maintain a skeleton crew to continue pumping and conduct general maintenance. At that time the water pumped to Eccles Creek is estimated to be no more than 2,900 gpm.

It is anticipated the addition of the Winter Quarters / North Lease area (should it be mined sometime in the future) will have minimal, if any affect on the water quantity being discharged to Eccles/Mud Creek drainage. Based on passed mining in the area, differences in geology from the southern portion of the Skyline Mine permit area, and lack of apparent communication between groundwater wells located in the northern and southern portions of the permit area only occasional short-term in-flow into the mine are anticipated.

Surface Water Quality

Water within the CIA is used for watering livestock and wildlife, mining coal, domestic use, fisheries, and recreation. Downstream, the water is additionally used for irrigation and industrial needs. Land within the CIA is used for wildlife habitat, grazing, recreation, and mining coal. Anticipated post-mining uses are for wildlife habitat, grazing, and recreation.

Scofield Reservoir is classified (latest classification December 7, 2001) by the Utah Division of Water Quality as:

- 1C - protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.
- 2B - protected for secondary contact recreation such as boating, wading, or similar uses.
- 3A - protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain.
- 4 - protected for agricultural uses including irrigation of crops and stock watering.

Scofield Reservoir is:

- A culinary water source.

- One of the top four trout fishing lakes in Utah.
- Has over a one million dollar annual recreational fishing value.
  (E-mail from Louis Berg, Utah Division of Wildlife Resources, to DOGM dated February 4, 2002).

Electric Lake is classified (latest classification December 7, 2001) by the Utah Division of Water Quality as:

2B - protected for secondary contact recreation such as boating, wading, or similar uses.
3A - protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain.
4 - protected for agricultural uses including irrigation of crops and stock watering.

Streams in both basins are classified as:

1C, 3A, and 4.

Furthermore, surface waters located within the outer boundaries of a USDA National Forest, with specific exceptions, are designated by the Utah Division of Water Quality as High Quality Waters - Category 1 and are subject to the state's anti-degradation policy. This anti-degradation policy is that waters shall be maintained at existing high quality and new point source discharges of wastewater, treated or otherwise, are prohibited (Utah Administrative Code, R317-2-3.2 and R317-2-12.1). All of the upper Huntington Creek drainage and most of the headwater drainages of east-flowing tributaries to Mud Creek, including the Skyline mines disturbed area, are within USDA Forest Service boundaries. However, Electric Lake has been reclassified as High Quality Waters – Category 2, which is defined as "…designated surface water segements which are treated as High Quality Waters – Category 1 except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality." Both the effluent and the lake must be sampled for a period of two years for a full suite of metals and nutrients to ensure the mine water is not of a lower quality of water than exists in Electric Lake. During this period, should the water quality of the mine discharge found to be degrading Electric Lake, the discharge could be stopped due to poor water quality. The White Oak/Belina mines, both loadouts, and the waste rock disposal site are outside Forest Service boundaries.

Total Dissolved Solids (TDS)

Water quality in the CIA is considered good, most being of calcium bicarbonate type. TDS levels normally vary between 100 and 400 mg/l in the headwaters regions. Higher TDS levels correspond to low flows. Calcite and aragonite are at or near saturation in the streams flowing into Scofield Reservoir, and precipitation of calcium carbonate in the reservoir is indicated by the water chemistry (Waddell and others, 1983a).

At Well JC-3 (discharging to Electric Lake) TDS is limited to a daily maximum of 255 mg/l with no daily tonnage or flow limitation.

Skyline's monitoring station CS-6 is at the same location as USGS gaging station 09310600, near the mouth of Eccles Canyon. Skyline and USGS measurements of TDS are summarized in Table 8 Skyline measured higher concentrations of TDS between 1981 and 2002 than were measured by the USGS between 1980 and 1984. The USGS analyzed samples more frequently than Skyline. TDS concentrations had been increasing from year to year at this location and others along Eccles Creek below the Skyline mines (Figure 6a, Appendix A). Due to the increased mine inflows and subsequent discharges, Skyline was exceeding their UPDES daily tonnage limit for TDS (7.1 tons/day). However the milligrams per liter values have receded to background levels. In May 2003, the UPDES permit was changed to reflect a maximum of 500 mg/l 30-day average with no associated flow limitation. Should the 500 mg/l 30-day average be exceeded, the 7.1 tons/day limit goes back into effect.

USGS gaging station 09310700, on Mud Creek near the mouth of Winterquarters Canyon and just upstream of the town of Scofield, was operated continuously during water years 1979 through 1984. TDS measurements averaged 315 mg/l with minimum and maximum of 170 and 390 mg/l (Price and Plantz, 1987). Monitoring station VC-1 is approximately 1 mile upstream of 09310700 and just below the White Oak/Belina loadout. At VC-1, average TDS from 1975 to 2002 was 320 mg/l, with a maximum of 730 and a minimum of 156 mg/l.

TABLE 8

Total Dissolved Solids (TDS) in Eccles and Mud Creeks

Gaging Station	Date	Average	Maximum	Minimum
Eccles Creek just above confluence with Mud Creek				
USGS 09310600	1980 - 1984	294 mg/l	492 mg/l	161 mg/l
Skyline CS-6	1981 - 2002	393 mg/l	1282 mg/l	198 mg/l
Mud Creek below White Oak/Belina loadout				
USGS 09310700	1979 - 1984	315 mg/l	390 mg/l	170 mg/l
Belina VC-1	1975 - 2002	320 mg/l	730 mg/l	156 mg/l

There is a shift from calcium toward sulfate and magnesium cations as the water flows toward Scofield Reservoir, probably due to dissolution of evaporites in Mancos Shale tongues exposed in Pleasant Valley (Coastal, 1993, p. 33).

Figures 6 through 8 (Appendix A) show TDS concentrations from 1977 through 2002 from data submitted by Skyline and Valley Camp to UDOGM. Linear regressions of TDS concentration as a function of time were calculated, time providing a rough representation of ongoing coal mining activities such as production, storage, and hauling of coal and discharge of water from the mines. Representative linear regressions are plotted on the figures. Data from the initial period of road construction during 1975 and 1976 were not used in the regression calculations because they are not representative of ongoing mine operations. Road improvement and additional construction were ongoing from 1980 to 1984 but there was not a noticeable change in TDS concentrations during this period. Other specific data omitted from regression calculations are indicated on the figures.

TDS levels in water discharged from Skyline's sediment pond began exceeding the UPDES maximum of 1000 mg/l (753 mg/l annual average) on a regular basis in November 1990. Sulfate concentrations also exceeded the 500 mg/l UPDES limit in most of these high TDS samples. Leaching of sulfate from rock dust in flooded, abandoned areas of the Skyline mines was the source (ERI, 1992). In May 1994 the Utah Division of Water Quality raised the daily limits to 1600 mg/l TDS and 1000 mg/l sulfate on an interim basis through September 1994, with TDS and sulfate levels to meet requirements of the regular UPDES permit at the end of the interim period.

TDS concentrations in lower Eccles Creek are diluted between CS-2 and VC-9 by inflow from South Fork and Whisky Creek and baseflow from the Star Point-Blackhawk aquifer. Further dilution occurs when Eccles Creek flows into Mud Creek, but still TDS concentrations have increased at VC-1 and VC-2 (Figure 7, Appendix A).

TDS concentrations have remained nearly constant at CS-3 and CS-9 above the Skyline mines (Figure 6b, Appendix A). Linear regressions of data from stations CS-11 (Figure 6b, Appendix A) and CS-4 above the Skyline mines and from CS-1 and VC-10 (Figure 6c, Appendix A) in the South Fork of Eccles Creek indicate TDS concentrations have generally increased with time but at a lower rate than in the samples taken downstream of the Skyline mines, CS-1 has actually decreased. These increases may result from airborne dust from the mines and roads. However, coefficients of determination are 20% or less for the regressions of these six data sets (except CS-11, 40%), so at these stations there may be little actual correlation between TDS variations and mining activity.

In Whisky Creek, TDS concentrations have steadily increased at VC-5 below the White Oak/Belina mines from approximately 300 mg/l to close to 1000 mg/l (Figure 6d, Appendix A). The rate of increase is similar to that in lowermost Eccles Creek. Since Whisky Creek accounts for approximately 8% of the flow of the Eccles Creek, this is a minor contribution to the overall balance of the stream. The coefficient of determination of the linear regression is 43%. White Oak/Belina reported 4000 mg/l TDS at VC-5 on June 27, 1986, a singular anomaly possibly caused by road salt getting into the stream (Valley Camp of Utah, 1993). At VC-4 (Figure 6d, Appendix A) above the White Oak/Belina mines, TDS concentrations appear to have remained consistent. TDS values at VC-4 have consistently remained below 200mg/l.

Surface-mining methods should have little impact on the TDS reporting into Eccles Creek. Acid and Toxic-forming testing of the geology in the area was conducted and demonstrated a high neutralizing potential of the sediments and low toxicity. Geologic units containing elevated levels of selenium and metals are to be buried with at least 4 feet of cover and not within the floodplain of Whisky Creek. Currently, due to the economic conditions encountered at the White Oak mine, sampling is not being conducted. Water analysis of Whiskey Creek is unknown, but anticipated to show little change.

TDS in Huntington Creek at UPL-10 above Electric Lake varied from 80 to 442 mg/l and averaged 185.5 mg/l from 1981 to 2002. Figure 8 (Appendix A) shows TDS concentrations for stations upstream of Electric Lake. TDS concentrations appear to have changed little with time

At UPL-3 just below the outlet from Electric Lake, TDS averaged 156.7 mg/l from 1981 to 1991 and ranged from 130 to 210 mg/l (Coastal, 1993, Volume 4). TDS in Huntington Creek at USGS gaging station 09318000 near the town of Huntington was 165 to 345 mg/l between June 1977 and September 1979. TDS in the Price and San Rafael Rivers where they flow into the Green River is 1500 to 4000 mg/l.

Iron and Manganese - Dissolved

From 1979 to 1984, measurements of dissolved iron at USGS gaging station 09310700 in Mud Creek above Scofield ranged from 0.003 to 0.150 mg/l.

Water analyses done for the White Oak/Belina mines have only sporadically included dissolved iron and and only since 1995, included dissolved manganese. The highest value for dissolved iron reported by the White Oak/Belina mines is 6.65 mg/l at VC-13, an abandoned sampling station in Long Canyon. The highest value measured in Whisky Creek below the White Oak/Belina mines at VC-5 was 1.45 mg/l,in October, 1982 . The highest dissolved iron found in Eccles Creek by White Oak/Belina was 0.76 mg/l at VC-6 in August 1980. With the exception of a one-time value of 7.65 mg Iron /l at VC-4 in 1982, VC-4 and VC-5 have had very low dissolved Iron and Manganese values.

Maximum dissolved iron reported by Skyline from surface water between 1980 and 2002 was 0.36 mg/l at CS-2 in Eccles Creek, recorded in 1992. Maximum dissolved manganese was 0.2 mg/l also at CS-2.

Dissolved iron in Huntington Creek at station UPL-10 above Electric Lake varied from 0.03 to 0.16 mg/l and averaged 0.09 mg/l from 1981 to 2002. Dissolved manganese varied from 0.01 to 0.10 mg/l and averaged 0.06 mg/l.

Iron and Manganese - Total

Total iron averaged 2.7 mg/l and total manganese averaged 0.15 mg/l at sites monitored for the White Oak/Belina mines from 1975 through 2002. The highest reported concentration for total iron is 88.5 mg/l, and for total manganese it is 7.15 mg/l. Both samples were from VC-5 on Whisky Creek but were collected at different times. High total iron concentrations have been reported by Skyline at several locations, the highest being 45.10 mg/l at CS-9, above the Skyline mines in the north fork of Eccles Creek. Total manganese concentrations reported by Skyline have ranged from 0.01 to 1.06 mg/l. Price and Plantz (1987) do not report total iron and total manganese concentrations.

Data from CS-6 near the mouth of Eccles Creek show total iron ranged between 0.14 and 24.5 mg/l from 1981 to 2002 and averaged 1.3 mg/l. At monitoring station VC-1 on Mud Creek just below the White Oak/Belina loadout, average total iron from 1977 to 2002 was 1.11 mg/l. The maximum was 7.66 mg/l and the minimum was 0.015 mg/l.

Total iron in Huntington Creek at station UPL-10 above Electric Lake has varied from 0.09 to 0.72 mg/l and averaged 0.34 mg/l from 1981 to 2002. Total manganese varied from 0.019 to 0.07 mg/l and averaged 0.03 mg/l. At UPL-3, just below Electric Lake, total iron averaged 0.2 mg/l from 1981 to 1991 and ranged from 0 to 1 mg/l. Total manganese was below detection limits (Coastal, 1993, Volume 4).

Nickel

The Skyline Mine PHC states (PHCA-27) that nickel concentrations have reached as high as 40 ug/l. This level is greater than the 15 ug/l known to inhibit the reproductive capabilities of Ceriodaphnia dubia, an invertebrate biologic indicator species, but below the chronic and acute criteria, for both aquatic wildlife and human health, in the Standards of Quality for Waters of the State. As the flows increased from 1999 through 2001, there initially were indications of toxicity from high nickel concentrations and high TDS. The significant inflow to the mine from the 10-Left area and changes of how water is handled underground resulted in a decline in TDS and dissolved nickel over time.

The source of this nickel is not identified. Nickel is not typically found in the Wasatch Plateau, neither is it commonly associated with the other atypical metals - copper, lead, and zinc - that are sometimes detected in water and sediment samples from the Eccles and Mud Creek drainages. Monitoring results from ongoing sampling will be checked to see if Nickel values rise in the future. The mine has been working with the Utah Division of Water Quality to track this possible issue.

Other Metals

Trace metals were below U. S. EPA maximum contaminant levels (MCL) in water samples collected from Mud and Eccles Creeks in 1979 through 1980 (Waddell and others, 1983b). Simons, Li, and Associates (1984) found the water at USGS gaging station 09318000, on Huntington Creek near the town of Huntington, met EPA drinking water standards.

Surface water quality data in the Skyline MRP show metal concentrations have generally met Utah Division of Water Quality criteria for class 1C, 2B, 3A, and 4 waters. (Utah Division of Water Quality water quality standards were revised February 16, 1994 and standards are now based on dissolved metal concentrations instead of acid-soluble metal concentrations.) Dissolved selenium in water discharged from the Utah #2 Mine and monitored at VC-3 and VC-3a from 1973 to 1978 frequently exceeded the current Class 1C water quality standard of 0.01 mg/l and exceeded the Class 4 standard of 0.05 mg/l several times (Valley Camp, 1993, Appendix 722.100a).

There are no applicable standards for total metals in water, but what appear to be elevated concentrations of total copper (0.03 mg/l up to 24.5 mg/l) were found between 1981 and 1991 in samples from most of Skyline's sampling stations, including CS-7 and CS-10 in upper Huntington Canyon. High total lead (up to 0.74 mg/l) and total zinc (up to 0.062 mg/l) also were found in several samples (Coastal, 1993, Volume 4). Data from the White Oak/Belina mines contain several analyses with similarly high total lead, copper, and zinc concentrations. The igneous dikes may be the source of these metals.

pH

The range of the average pH of surface water in the Mud Creek and Huntington Creek basins is 7.2 to 8.0 based on measurements at numerous locations. Extremes of 6.0 to 9.2 have been reported. Where both acidity and alkalinity have been determined, alkalinity is typically at least 25 times acidity.

Solids

The estimated annual sediment yield of the Skyline permit area is approximately 0.44 acre-feet per square mile, which would indicate total annual yield to the Price River is 1.25 acre-feet and to the San Rafael River it is 3.07 acre-feet. The majority of this is suspended sediment, with only a small percentage carried as bed load (Coastal, 1993, p. PHC3-2). Using the same estimated yield of 0.44 acre-feet per square mile for the White Oak/Belina permit area, approximate total annual yield to the San Rafael drainage is 0.5 acre-feet and to the Price River drainage is 1.7 acre-feet.

Total suspended solids (TSS) measured at CS-3 and CS-11 in the headwaters of Eccles Creek averages 17 and 49 mg/l. Average TSS is 92mg/l at station CS-6 on Eccles Creek just above the confluence with Mud Creek. The maximum TSS at this location has been 3190 mg/l and the minimum 1.4 mg/l. TSS averages 103 mg/l at VC-9 at the confluence with Mud Creek. The average TSS at VC-5 on Whisky Creek has been 454 mg/l and the minimum 1.0 mg/l.

Annual average TSS at VC-1 on Mud Creek below the White Oak/Belina loadout is 183 mg/l.

Total suspended solids in Huntington Creek at station UPL-10 above Electric Lake have varied from 1 to 41 mg/l, and averaged 5.5 mg/l from 1981 to 2002. Suspended sediment loads reported by the USGS for undisturbed areas of the Huntington Creek drainage are typically less than 100 mg/l at low flow but during high flows can be between 500 mg/l and 1000 mg/l. In lower Huntington Creek, suspended sediment loads in excess of 10,000 mg/l can be expected from thunderstorms, and major floods could produce even higher levels. Construction, mining, and traffic on unpaved roads have produced increases in suspended sediment load in streams but these are minor, temporary conditions that have not been quantified (Simons, Li, and Associates, 1984, p. 2.33).

The naturally reproducing population of cutthroat trout in Eccles Creek was virtually eliminated from Eccles Creek between 1975 and 1983 as road and mine construction increased the sediment load in the stream. Up to 18 inches of fine sediment had accumulated over the natural substrate. Habitat improvement initiated in 1981 resulted in significant recovery of the trout population, 93% of pre-disturbance levels by 1986 (Donaldson and Dalton, Utah Division of Wildlife Resources (DWR)in Appendix Volume A-3, Coastal States, 1993).

Landslides occurred at approximately 1500 locations in the Wasatch Plateau during the 1983-1984 water year due to higher than average precipitation. One of these slides occurred in the North Fork of Eccles Canyon where the creek is normally diverted beneath Skyline's topsoil stockpile. Debris blocked the entry to the diversion, water overtopped the stockpile, and mud and other debris were flushed into Eccles Creek. TSS was measured at up to 9800 mg/l in Eccles Creek by UDOGM personnel. During this same period mud was flowing into Whisky Creek from the unpaved road to the White Oak/Belina mines. TSS levels were not documented in Whisky Creek but the deterioration of water quality from suspended solids was visibly evident to UDOGM personnel who investigated.

In 1987 a tunnel was advanced through an igneous dike in the Skyline #3 Mine. A dark mica mineral, phlogopite, was carried from this tunnel to the sedimentation pond by the mine discharge water. The phlogopite did not settle-out in the pond and was discharged into Eccles Creek, where it was entrapped by algae. The phlogopite and algae, along with bacteria and mold, produced a marked discoloration of stream substrate, described as "slime", as far as the White Oak/Belina loadout on Mud Creek. The fine sediment did not seem to be having any direct effect on the fish in July 1987, but macroinvertebrates were substantially fewer in number and less diverse in Eccles Creek below the mine in comparison to Eccles Creek above the mine, to South Fork, and to Mud Creek. Elevated concentrations of nitrite, nitrate, and phosphate were found in water below the mine and coliform bacteria in the sediment pond were elevated (UDWR, 1987).

The suspended phlogopite problem was solved by rerouting underground drainage around the dike and adding a flocculent to the sedimentation pond, but the slime was still in the streambed in late 1988 when sudsing was observed in Eccles Creek. Further water analyses found a surfactant in addition to continuing high levels of nitrogen and phosphorus. The source of the phlogopite was unrelated to that of these nutrients (see discussion below).

A survey of Eccles Creek in August and October 1989 by the Utah Division of Wildlife Resources (UDWR) found coal fines were accumulating behind beaver dams, particularly in the stretch downstream of the Skyline mines to the confluence with South Fork. Entrapment of the coal in the ponds was causing a loss of trout habitat in upper Eccles Creek, but it was also having a positive effect by preventing migration of the fines downstream to lower Eccles Creek, Mud Creek, and Scofield Reservoir. Fish were almost absent from Eccles Creek at the South Fork confluence, but downstream numbers of fish increased and young fish were evidence of successful spawning. In addition to coal fines, gravel chips from the highway had completely covered the substrate in places (Report dated June 26, 1990 by UDWR in Appendix Volume A-3, Coastal States, 1993).

Studies of macroinvertebrates and sediment in Eccles Creek done for Skyline by Ecosystems Research Institute (ERI, 1992) found mean number of individuals, total number of taxa, and aquatic plant biomass decreased immediately below the mine and then increased downstream. Water below the mine was not acutely toxic, but the effects of chronic toxicity and sediment transport were not determined. The streambed immediately below the Skyline mines was extremely embedded and 0.5 mm to 2 mm diameter particles made up approximately 15% to 25% of the sediment, compared to 5% to 10% in other reaches of the stream.

Winget (1980) noted that sheep and cattle grazing, recreation, unpaved roads, mines, and fires had all contributed to previous degradation and erosion of these watersheds. The results were increased sedimentation and reduction or loss of fish and invertebrate populations. Improved range management along Huntington Creek in the late 1970's allowed some recovery of riparian habitat and bank stability.

Nitrogen and Phosphorus

Wadell (1983a) concluded that Scofield Reservoir may become highly eutrophic unless measures are taken to limit the inflow of nutrients. Winget (1980) attributed nutrient input to Scofield Reservoir to recreation, cattle and sheep grazing, and domestic sources. Wadell's study during the 1979 and 1980 water years found that Mud Creek was providing 16% of the inflow to the reservoir but 22% of the total nitrogen and 24% of the total phosphorus. Wadell attributed elevated nutrient levels in 1979 and 1980 to the clearing of 27 acres of forested land for fire prevention around the Skyline mine portals and roads in 1979.

Fish Creek accounts for 52 % and Mud Creeks accounts for 29 % of the nutrient input to Scofield Reservoir, so Mud Creek contributes a disproportionately high amount of the nutrients. Total phosphorus in particular has been directly correlated with sediment load, and phosphorous loads in Scofield Reservoir have been directly attributed to the erosion and transport of soils during spring runoff. Peaks in nitrate and phosphate during spring runoff have been measured in Mud Creek (Clyde and others, 1981).

Mud Creek drainage has nutrient-rich soils and increased flows from the mine will increase the nutrient load of the reservoir. Importantly, the increased flow due to pumping from the Skyline Mine increases the water in Scofield Reservoir well above the natural runoff, so the impact of the increased nutrient load might be offset by this additional flow, or the total nutrient load might even be diluted.

Inflows to Skyline Mine have been pumped into Eccles Creek since 1983. Since March 1999 inflows to Skyline Mine were pumped to abandoned underground workings and pumped to Eccles Creek. Discharges have been recorded since August 16, 2001, and from then through July 2003, have varied from 4,500 gpm to 10,500 gpm, with an average of about 8,350 gpm. The volume of water pumped as of July 31 2003, is)26,360 acre-feet to Eccles Creek, Mud Creek, and Scofield Reservoir. This has increased the flow in Eccles Creek to about 10 times the average annual amount and increased flow in Mud Creek to about 3 times the average annual amount. Flows are still only about 20% of spring runoff rates. Pumping is expected to decline to about 2,900 gpm in December 2004.

TSS and flow at sample locations C6 on Eccles Creek, VC9 on Mud Creek and VC1 on Mud Creek show the average sediment yield carried by Eccles and Mud Creek prior to 1999 was 2,710 Tons/yr. The average sediment yield carried by Eccles and Mud Creek between 1999 and 2002 has been 2,908 Tons/yr, which is an increase of 7% annually.

Five new monitoring sites were added to Mud Creek and two on Eccles Creek to determine if the significantly increased mine discharge flows are having a negative impact on Mud Creek and Scofield Reservoir. These sites will be monitored for total flow, TDS, TDS, and total phosphorous and for changes to stream morphology.

There is no water quality standard for nitrite, but concentrations in excess of 0.06 mg/l produce mortality in cutthroat trout (UDWR, 1988). Nitrate should not exceed 10 mg/l in Class 1C water, and levels above 4 mg/l are considered an indicator of pollution, usually from sewage. Levels of phosphate in excess of 0.04 mg/l are not toxic to trout but are excessive and promote eutrophication (UDWR, 1988). By state standards for Class 1C, 2A, 3A, and 3B waters, phosphate in excess of 0.05 mg/l is a pollution indicator. The following discussion also refers to MBAS, a detergent or surfactant. The recommended limit for MBAS concentration is 0.2 mg/l (Steve McNeil, Utah Dept. of Health, personal communication in UDOGM, 1988).

At station UPL-10 on Huntington Creek above Electric Lake, total nitrogen averaged 0.38 mg/l from 1981 to 2002, with highs of 1.0 mg/l ammonia and 0.68 mg/l nitrate and lows of 0.01 mg/l for both. Total phosphate averaged 0.42 mg/l with a high of 6 and a low of 0.02 mg/l. At UPL-3 just below Electric Lake, total nitrogen averaged 0.6 mg/l from 1981 to 1991, with highs of 1 mg/l as ammonia and 2 mg/l as nitrate and lows of 0 mg/l for both. Total phosphate averaged 0.2 mg/l with a high of 2 and a low of 0 mg/l (Coastal, 1993).

Data collected by Winget (1980) from 1976 to 1978 indicated that phosphate in Electric Lake was below the minimum concentration needed by aquatic life, and nitrate was just above the limit. These nutrient concentrations reflected the clean nature of the streams feeding the reservoir. Eccles Creek had nitrate concentration adequate for algal growth at most times, but low phosphate.

Discharge weighted average concentrations for nitrogen and phosphorus at Station S-29 in Eccles Canyon (same as USGS gaging station 09310600 and Skyline's station CS-6) during water years 1979-1980 were 11 and 2.2 mg/l. Concentrations of suspended and dissolved nitrogen combined reached 21 mg/l in May1980, and phosphorus reached 4.3 mg/l. These nutrient levels apparently resulted from the clearing of 27 acres of forested land for fire prevention around the Skyline mine portals and roads in 1979 (Wadell, 1983a). In Mud Creek downstream of the confluence with Eccles Creek, at S-36 (near Winterquarters Canyon and USGS gaging station 09310700), discharge weighted average concentrations were 1.3 mg/l nitrogen and 0.1 mg/l phosphorus. The downstream decrease is attributed to the nutrients from Eccles Creek being mostly in suspended form that settles out in the slower flow of Mud Creek. About 50% of the nitrogen and 25% of the phosphorus in Mud Creek in 1980 came from Eccles Creek, but only 20% of the flow. Concentrations of nutrients in Mud Creek peaked at about the same time as those in Eccles Creek. (Waddell and others, 1983a; Waddell and others, 1983b, p. 36).

At Skyline's monitoring station CS-6 on Eccles Creek, between 1981 and 2002, total nitrogen averaged 0.6 mg/l and phosphate averaged 0.14 mg/l. Highs and lows for nitrogen were 2.5 and 0.01 mg/l nitrate and 3.5 and 0.01 mg/l ammonia; for phosphate they were 0.76 and 0.01 mg/l. Data from 1976 to 1979 from several stations along Eccles Creek indicate a high for nitrate of 2.70 mg/l and for phosphate of 0.22 mg/l (Vaughn Hansen Associates, 1979). High, low, and mean nitrate concentrations at VC-1 were 0.38 mg/l, 0.01 mg/l, and 0.07 mg/l between 1975 and 2002, but analyses for nitrates have been infrequent since 1988. Maximum phosphate was 4.55 mg/l in June 1984 and minimum was 0.01 mg/l in September 1987. No phosphate analyses have been done at VC-1 since 1999.

In 1987 a dark mica mineral, phlogopite, was being discharged from Skyline Mine #3 into Eccles Creek by way of the sediment pond (discussed above). The phlogopite was entrapped in algae, which combined with bacteria and fungi to produce a slime on the stream substrate as far as the White Oak/Belina loadout on Mud Creek. The fine sediment did not seem to be having any direct effect on the fish in July 1987, but macroinvertebrates were substantially fewer in number and less diverse in Eccles Creek below the mine in comparison to Eccles Creek above the mine, South Fork, and Mud Creek. Analyses of water samples taken by UDWR (Table 9) found 0.46 mg/l total nitrogen in the stream below the Skyline mines, 0.11 mg/l nitrite (24% of total nitrogen) and 0.34 mg/l nitrate (76% of total nitrogen). Total nitrogen above the mines was 0.29 mg/l, with no nitrite. Phosphate levels in the Skyline sediment pond and Eccles Creek were 0.045 mg/l but no phosphate was detected above the mine. UDWR subsequently found elevated total and fecal coliform bacteria in the sediment pond. Because of the bacteria and nitrites, UDWR suspected the sewage tank was backing up into manhole connections and leaking into the sediment pond. UDWR recommended chlorination of the sediment pond and procedures to avoid recurrence of the suspected sewage backup (UDWR, 1987).

TABLE 9

	Nitrite	Nitrate	Ammonia	Organic Nitrogen	Phosphorus Total	MBAS Detergent
Sampled by UDWR July 1987 (UDWR, 1987)						
Above Skyline Mines	not detected	0.29	**	**	not detected	**
Below Skyline Mines	0.11	0.34	**	**	0.045	**

** Analysis not reported, probably not done

Phlogopite was eliminated from the pond discharge by rerouting flow in the mine and using a flocculent, and UDWR recommendations for reducing pollution from sewage were implemented, but slime persisted in the streambed through the summer of 1988. Random checks by UDWR indicated water quality was acceptable. Fish were abundant and macroinvertebrate populations appeared normal in lower Eccles Creek. In late September foaming was observed in Eccles and Mud Creeks along the same reaches where the slime was found. The slime appeared to be growing and extending deeper into the substrate. UDOGM personnel took samples of Eccles Creek above and below the mines in September 1988, and in October at several locations within the 72 inch bypass, including the discharge of the sedimentation pond (Table 10). Analysis of these samples revealed high nitrite levels persisted. In September, nitrite concentration was 0.64 mg/l in the outfall of the 72-inch culvert, which carries drainage from undisturbed drainages beneath the disturbed area and also receives the discharge from the sedimentation pond. Ammonia and organic nitrogen concentrations were also elevated in comparison to undisturbed drainages (UDOGM, 1988). Samples taken from the pond outfall by UDWR in October 1988 had 14 mg/l nitrate and 0.09 mg/l nitrite (UDWR, 1988). Results of analyses from several different sources during September and October are summarized in Table 10.

Total phosphate was 0.50 mg/l in one sample taken by Skyline from the discharge from the shop (Utah Fuel Company, 1988). Another sample from the shop sump reportedly approached 13 mg/l (Keith Zobell, personal communication, in UDOGM, 1988). Samples taken from the sedimentation pond by UDWR personnel in July and October 1988 had phosphate levels of 0.045 mg/l and 0.06 mg/l (UDWR, 1988). Water analyses also detected a detergent, MBAS, in the sediment pond and the outfall (Table 10)

In addition to the laboratory analyses, Skyline used a field kit to check nitrate levels at various times and locations. On October 5, 1988 nitrate levels were 8 to 9 ppm in Eccles Creek below the mine and 13 ppm in the discharge from the #3 Mine. Other flows into the sediment pond showed no nitrate, indicating the sewage holding tanks were not the source of the nitrate. On October 6, water coming off the longwall section of #3 Mine had 5 ppm nitrate, return water had 3 ppm, and overflow from the emulsion pump had 2 ppm. Water from mined out areas had no nitrate (Utah Fuel Company, 1988).

Trout and invertebrates had not been checked in upper Eccles Creek in mid-September 1988 when lower Eccles Creek was monitored because lower Eccles Creek was supporting healthy populations even with the slime present. However, an intensive sampling of fish and macroinvertebrate populations in early October 1988 revealed that the trout population and biomass in upper Eccles Creek had declined over 90%. Macroinvertebrates were essentially gone in upper Eccles Creek downstream from the sediment pond outfall, but taxa and numbers increased downstream, as did numbers and biomass of fish. High concentrations of nutrients were producing both toxic and eutrophic conditions. Nitrite in the water was a contributing and probably primary cause of mortality of macroinvertebrates in upper Eccles Creek and had forced trout to migrate downstream to where dilution produced a tolerable habitat. Trout spawning had not been successful in 1987 and 1988 in any section of the stream: either the slime precluded successful spawning, the nitrites were fatal to the eggs and fry, or both (UDWR, 1988). Refer to the section Fish and Invertebrates for more information.

TABLE 10

	Nitrite	Nitrate	Ammonia	Organic Nitrogen	Phosphorus Total	MBAS Detergent
Sampled by UDWR July 1988 (UDWR, 1988)						
Sed Pond Effluent	**	**	**	**	0.045	**
Sampled by UDOGM 28 September, 1988						
North Fork	<0.05	1.20	<0.05	<1.00	<0.05	<0.03
Middle Fork	<0.05	0.59	<0.05	<1.00	<0.05	<0.03
South Fork	<0.05	0.21	<0.05	<1.00	<0.05	<0.03
72" Bypass Outfall	0.64	0.38	0.19	1.30	<0.05	0.28
Sampled by UDOGM 03 October, 1988						
Sed Pond at 3'	*	0.26	0.14	*	<0.05	0.75
Sed Pond at 6'	*	0.37	0.14	*	<0.05	0.50
Sed Pond at 9'	*	0.32	0.14	*	<0.05	0.83
Sed Pond at 10.5'	*	0.3	0.16	*	<0.05	*
72" Bypass Outfall	*	0.33	0.25	*	<0.05	*
Pond Spillway in Bypass	*	0.41	0.18	*	<0.05	0.80
Middle and South Fork Confluence in Bypass	*	0.25	*	*	<0.05	0.1
28" Pipe in Bypass	*	*	*	*	<0.05	0.09
Sampled by UDWR October 1988 (UDWR, 1988)						
Sed Pond Effluent	0.09	14.0	**	**	0.06	**
Sampled by Skyline October 1988 (Utah Fuel Company, 1988)						
Eccles Creek	**	**	**	**	0.04	***0.90
Mine #3 Discharge	0.08	2.28	**	**	0.04	***0.87
Sed Pond Discharge	0.04	3.39	**	**	0.06 and 0.04	***1.33
Shop Discharge	0.03	3.18	**	**	0.50 and 0.36	***1.33

* Analysis not done
** Analysis not reported, probably not done
*** Unspecified surfactant, not identified as MBAS

Elevated nitrites were traced to an emulsion oil used in the longwall system in the #3 mine. In a 1:20 dilution that was used, nitrite concentration was 182 mg/l and nitrate was 872 mg/l. As much as 4000 gallons of this emulsion was released each time the longwall unit was moved, which had occurred six times from 1986 to 1988. There were also occasional spills and leaks. The oil was captured and removed from the water by skimming and flocculation before it left the mine, but the nitrogen compounds went into solution in the water and passed through the sediment pond into Eccles Creek. Skyline replaced the emulsion oil with one that contained no nitrites or nitrates. Field kit test results submitted to UDOGM by Skyline in late 1988 indicated nitrate and nitrite levels were dropping in discharges from Mine #3 and the sediment pond (Utah Fuel Company, 1988). Samples taken by UDOGM in December 1988 (Table 11) detected no nitrite or nitrate in discharges from the #3 Mine and the pond, but elevated levels were found in the discharge from the #1 Mine. Field kit results from January to May 1989 showed consistent nitrite and nitrate levels, 0.03 mg/l and 1.07 mg/l respectively, in both the sediment pond and the Mine #3 discharge. In 1989 the longwall unit was moved from Mine #3 to Mine #1. Nitrate and nitrite were within acceptable limits by August 1989 (Table 11).

Sudsing and elevated phosphate turned out to be unrelated to the nitrogen compounds but rather were caused by detergents used for cleaning equipment in the shop and in mop water used to clean the floors. The mop water was being disposed of into floor drains, which empty into the 72 inch bypass culvert by way of the sedimentation pond. The problem has been solved by replacing detergents used in both applications with low sudsing, non-phosphate types and revising procedures so that mop water is now discarded into the sanitary sewer (Utah Fuel Company, 1988).

TABLE 11

	Nitrite				Nitrate			
Sampled by UDOGM	12/14/88	3/29/89	4/18/89	8/31/89	12/14/88	3/29/89	4/18/89	8/31/89
Mine #1 Discharge	0.83	?	*	0.05	5.2	0.034	*	0.075
Mine #3 Discharge	<0.05	0.013	0.14	*	<0.05	0.039	2.0	*
Pond Discharge	<0.05	0.032	0.24	<0.05	<0.05	0.033	1.76	1.48
72" Bypass Outfall	*	*	<0.05	<0.05	*	*	<0.05	1.11

* Analysis not done

Oil and Grease

There is no water quality standard for oil and grease, but the UPDES permit limit for both the White Oak/Belina and Skyline mines is 10 mg/l. A 10 mg/l oil and grease limit does not protect fish and benthic organisms from soluble oils such as those used in longwall hydraulic systems, and UDWR has recommended soluble oils be limited to 1 mg/l (Darrell H. Nish, Acting Director UDWR, letter dated April 17, 1989 to Dianne R. Nielsen, Director UDOGM). For water being discharged to Electric Lake from the JC wells, the limit is 10 mg/l.

Oil and grease in water discharged from Skyline Mine #1 (CS-14) averaged 2.7 mg/l from 1989 to 2002, and 23.4 mg/l was the maximum, in June of 1993. At Mine #3 (CS-12), data from 1983 to 2002 show 1.5 mg/l was the average. The maximum of 12.5 mg/l was recorded in 1987. Discharge from the sediment pond has occasionally exceeded the 10 mg/l limit in the UPDES permit.

The principal source of oil in water discharged from Mine #3 appears to be the longwall unit that was installed in 1986. A water-oil emulsion (5% oil) is used in the longwall hydraulic system to meet MSHA fire protection requirements. As much as 4000 gallons of this emulsion can be released each time the longwall unit is moved. The unit was moved six times between 1986 and October 1988. There are also occasional spills and leaks. Oil is captured and removed from the mine water discharge system by skimming and flocculation before it leaves the mine. Since 1988 an extensive no-spill program has been part of the longwall operations, and if a spill does occur the water and oil emulsion is to be pumped into abandoned sections of the mine rather than being discharged to the surface (Utah Fuel Company, 1988). If there is flocculated oil in the sludge in the sediment pond, it is a potential source of recontamination that will eventually require proper removal and disposal.

Although Well JC-3 discharges water directly from the mine workings, water is being pumped from a portion of the mine that is currently flooded and not accessible. It is not anticipated that any contact with oil & grease, emulsion fluids, or any other contaminants should occur.

Prior to 1985, oil and grease in water discharged from the White Oak/Belina mines was generally less than 0.5 mg/l, with a maximum of 2.2 mg/l. Between September 1985 and June 1989, measurements exceeding 0.5 mg/l increased, with the February 21, 1986 sample exceeding 10 mg/l. Longwall mining equipment is not used in the White Oak/Belina mines. Reasons for the increase in oil and grease in the mine discharge have not been identified.

Temperature

Water temperatures in the streams fluctuate greatly because low flows and turbulence act to quickly equilibrate water temperatures with air temperatures. Winget (1980) found daily fluctuations of 12 to 15 degrees C during warmer months, but fairly constant temperatures of 0 to 2 degrees C during November to March. UDOGM found that the temperature of Eccles Creek increased significantly, 43 degrees to 54 degrees, as it passed through the 72 inch bypass culvert and received the sediment pond discharge (UDOGM, 1988). The maximum allowable change for Class 3A waters is 2 degrees C (3.6 degrees F). The water temperature of the combined discharges of the JC wells is approximately 14°C. Since the temperature of the receiving waters, Electric Lake, varies from 0.5° - 19.7°C at the surface (winter to summer, respectively) of the discharge is satisfactory.

Fish and Invertebrates

James Creek

The Skyline Mine MRP (page 2-71) commits to conducting macroinvertebrate studies and fish studies in James Creek for 2 years beginning in October 2001 and then every three years thereafter. An October 2000 study has already been conducted. Sampling should identify any slow degradation of the creek due to sedimentation. Unfortunately, only one year of baseline data was obtained prior to mining activities. Mt. Nebo Scientific, Inc. collected the data for the first two years, and Dr. Dennis Shiozawa conducted the surveys. The October 17, 2000 and 2001 (2001 Annual Report) reports found James Creek to be in excellent condition despite the large decrease in macroinvertebrate and fish numbers, Table 12 summarizes the sampling.

TABLE 12. Summary of Aquatic Resource Sampling on James Creek in 2000 and 2001.

Date	Macroinvertebrate #/m^2	Biomass (g/m^2)	Total Fish
Fall 2000	378,510*	272	587
Spring 2001**	335,000		
Fall 2001	127,875	256	93

*Used summary data from Fall 2001 report, because Fall 2000 report indicates 34,757/m^2.
** Spring 2001 report not found; used summary data from Fall 2001 report.

The 2001 report provides several explanations for the decrease in macroinvertebrate and fish numbers and cannot directly attribute the decrease to mining activities. The large amount of drilling fluids that spilled into James Canyon was not mentioned or accounted for in this study. However, a subsequent conversation between Susan White of the Division and Dr. Shiozawa indicated that the drilling fluids could have influenced the fish numbers. At the time of the spill the James Canyon wells were permitted under an exploration permit administered by the BLM.

Because of the lack of adequate baseline data and the dramatic decrease in numbers of macros and fish for Fall 2001 these baseline studies should continue. Mitigation will likely be required.

Upper Huntington and Eccles Creeks have naturally reproducing populations of cutthroat trout. Rainbow and brown trout were reported in upper Huntington Creek prior to 1979, but UDWR's work to eliminate these trout species from this fishery has apparently been successful. Rainbow trout have been planted in Scofield Reservoir, and cutthroat trout are recruited from inflowing streams. Speckled dace, mountain suckers, and mottled sculpin are also found in area streams. Macroinvertebrate communities in both drainages have considerable species diversity (Winget, 1980).

Eccles Creek

UDWR ranks Eccles Creek as a valuable trout stream, mainly as a spawning stream for wild cutthroat trout that are eventually harvested in Scofield Reservoir. Data collected in 1971 by the UDWR, prior to coal development, identified Eccles Creek as a somewhat pristine fishery. The stream sustained an estimated resident population of 1272 wild cutthroat trout along 2.5 miles of habitable stream. Adult trout comprised only 4% of this population (Donaldson and Dalton). Although not officially documented by DWR, local sportsmen have reported catching 'some of the largest cutthroat out of Eccles Creek' that they have seen out of any stream on the Wasatch Plateau. This is attributed to the increased flows in Eccles Creek due to the increased mine discharge observed beginning in August 2001.

Benthic invertebrate studies were done by the USGS at three sites on Mud Creek and two in Eccles Canyon in July and September 1979, and July and October 1980. There were consistent downstream and seasonal trends. Diversity decreased downstream in Eccles Canyon, probably because Skyline mine was relocating the stream at the time (Waddell and others, 1983b).

Winget (1980) collected data on invertebrates and sediments in Eccles and Huntington Creeks prior to construction of the Skyline Mines. Skyline studied benthic communities and sediment composition of gravel beds in Eccles Creek from 1979 to 1985. Fishery habitat studies were also done (Coastal, 1993, p. 2-70).

In conjunction with the Skyline study, UDWR conducted fish surveys the first week of August from 1979 to 1986 (Donaldson and Dalton). UDWR found that the fishery began to decline after 1975 in the 1.75 mile stretch of Eccles Creek below the Belina Mines turnoff. Construction of roads and mines caused high sedimentation in the stream, up to 18 inches of fine sediment above the natural substrate. In 1979 the fish population along the entire 2.5 miles of habitable stream was down to 40% of 1971 pre-mining levels, and 18% of the fish were adults compared to 4% in 1971. Construction for the Skyline mines began in 1980. Mitigation started in 1981 but deterioration of the stream continued. By 1983 most of the road through Eccles Canyon was asphalted and disturbed areas were revegetating, but only 27 fish were found in Eccles Creek, a 98% reduction compared to 1971. There were no young-of-year or 1-year juveniles. A reduction of sedimentation was evident by 1985, and by 1986 the cutthroat population had recovered to 93% of the 1971 levels and 1-year juveniles were present (Donaldson and Dalton).

The UDWR conducted fish surveys and macroinvertebrate inventories in 1988 as part of the investigation of the problems with foam and slime in Eccles Creek (discussed above). Fish population had been estimated in 1986 to be 600 fish /mile. In mid September 1988, fish in lower Eccles Creek were abundant and macroinvertebrate populations appeared normal.

However, when Upper Eccles Creek was assessed in October 1988, only 20 fish/mile were found. It was also found that one and two-year old fish were absent from the population. Macroinvertebrate diversity dropped from 6 - 7 families /square foot above the Skyline mines to 1 family present below the mines. Diversity in Mud Creek was 8. Toxicity from nitrites and eutrophication from nitrates and phosphates were the causes of these population losses (UDWR, 1988; UDOGM, 1988).

Studies of macroinvertebrates and sediment in Eccles Creek were done for Skyline by R. W. Baumann (1985) and Ecosystems Research Institute (ERI, 1992). Benthic invertebrates in the stream below the mines indicated stress in the 1984 - 1985 surveys but showed recovery from the conditions that existed in 1981. In 1991, mean number of individuals, total number of taxa, and aquatic plant biomass decreased immediately below the mine and then increased downstream. The zone of impact appeared to extend to the confluence of Eccles Creek with Mud Creek, but at the confluence parameters were similar to those in Mud Creek. It was determined the water below the mine was not acutely toxic, but the effects of chronic toxicity and sediment transport were not determined. The streambed immediately below the mine was extremely embedded and the percentage of sediment 0.5 to 2 mm in size was significantly larger than elsewhere in the streams. Electrical conductivity of the water was highest below the mine and decreased downstream. Sulfate leached from rock dust in flooded, abandoned areas of the mine has been identified as the reason TDS levels in mine water discharges were exceeding UPDES standards.

Upper Huntington Creek

After the spillway gates of Electric Lake were closed in 1973 and the reservoir began to fill, UDWR measured increasing numbers of cutthroat trout in Huntington Creek above the lake. Numbers increased from 104 fish per 0.1 mile in 1974 to 263 fish per 0.1 mile in 1977. Also, smaller fish made up increasing percentages of this population, indicating increased reproduction, resident fish, and increasing recruitment stock for the reservoir (Winget, 1980).

Benthic invertebrate studies were done by the USGS at seven sites in Huntington Creek from 1977 through 1979. Diversity indices had a large variability that was attributed to variations, possibly natural, in water quality and stream environment. Simons, Li, and Associates (1984) concluded several more years data would be required to establish baseline conditions.

Winter Quarters Creek

Winter Quarters Creek was surveyed by UDWR in 1968 and 1971. In 1968, 70 cutthroat trout were found along a 0.1 mile reach, with a maximum size of 14 inches. Winget (1980) does not report the numbers for 1971, but maximum size was 9 inches and the presence of young fish indicated successful spawning. Banks were stable along 70% of the stream. Spawning gravels composed 38-42% of the substrate but low flows limited fish production. Caddisflies, stoneflies, and mayflies were common and water quality was high (Winget, 1980). Additional work will be done in 2003 for further classification of the stream. This information will be collected prior to longwall mining occurs beneath the stream.

Stream Channel Alteration, Alluvial Valley Floor, and Land Use

The Division's March 1984 Technical Analysis written for the Valley Camp Mine (now the White Oak Mine) provides a summation of the history of the alluvial valley floor determination. The Division stated that Whisky Canyon and Pleasant Valley above the Utah No. 2 facilities (White Oak Load Out) were observed by the Office of Surface Mining in August of 1983 to be too narrow for flood irrigation or subirrigation agricultural activities. Also in 1984, it was noted that the pastures are flood irrigated and the grasses on the valley bottom may be subirrigated. In the Valley Camp MRP, Map R645-301-411.100 Premining Land Use Map shows the land use down stream of the Belina Mine Complex. Shown on this map, are two pastures along Mud Creek in Pleasant valley below the Utah No. 2 (White Oak Load Out).

Since August 2001, Skyline Mine has been discharging an average of 8,350 gpm (17.8cfs) into Eccles Creek. These waters flow down Eccles Creek and then to Mud Creek. Mud Creek flows through Pleasant Valley, an alluvial valley floor.

The historical record of flow in Mud Creek is graphed in Figure 2.12.C of the Skyline Mine MRP, as recorded at the USGS station just downstream of the confluence with Winter Quarter's Creek. Ordinarily, high flows of approximately 100 – 150 cfs occur for a short duration during the months of May and June. Flows quickly subside after snow melt back to the baseline flow of approximately 6 – 12 cfs. The highest daily mean flow during the period from 1974 – 2002 was 384 cfs during the month of May 1984. The lowest daily mean flow was 1.6 cfs during January 1980. The mine discharge is constantly contributing additional water to the baseline flow. Mine water discharge will decline over the next two years to approximately 2,900 gpm (5cfs) (Appendix F of the October 2002 Addendum to the Skyline Mine PHC).

Measurements of flows taken on November 26, 2001 (Appendix D, Skyline Mine MRP) recorded 18.4 cfs in Mud creek after the confluence with Eccles Creek and 24.44 cfs after the confluence with Winter Quarters Creek. The gain in flow downstream is attributed to contributions from springs and side streams (2 – 3 cfs) and re-emerging base flow from the alluvium of 3 – 4 cfs (Section 2.12 and Appendix D July 2002 Addendum to the Skyline Mine PHC).

The mine waters being discharged had an average Total Dissolved Solids (TDS) level of 600 mg/L in July of 2000. With continued pumping, the concentration of TDS has decreased to less than 400 mg/L as of March 2002. Above the mine, the average concentration of TDS is 300 mg/L (July 2002 Addendum to the PHC).

Cross sections of the Mud Creek channel were measured at six different stations. The piezometric surface was measured at four of those stations. At Station 7300, in the vicinity of Green Canyon, the groundwater is four feet below the surface. In the area of Station 14480, the groundwater level is eight feet below the surface, reflecting the rolling nature of the land and the incised nature of the stream channel. The ground water rises back up to four feet below the surface at Station 17340. Station 17340 is located at the site of an irrigation diversion, so as a result, the depth to groundwater at a point 400 feet distant from the stream is closer to the surface than that along the stream channel. This is due to irrigation return flow as well as stream channel entrenchment. (Section 2.12 of the Skyline Mine MRP)

Four landowners own Land along Mud Creek. The land is used for grazing. Ray Jensen, Range Specialist for the Bureau of Land Management (BLM) describes the area as sub-irrigated, grazed land with an historical yield of 4000-6000 pounds/acre. The predominant vegetation type is grass. The number of animals grazed on the pastures by each landowner is variable with time.

Canyon Fuel Company has evaluated the value of the pasture ground in terms of the replacement cost for feed. At a consumption rate of 0.5 Tons/mo and a cost of $100/Ton hay, the replacement cost is $50/animal/month. The replacement of feed is not likely, however, since grazing will not be impeded by high flows along Mud Creek and the reduction in available grazing area is limited to stream banks eroded by the high water.

Mud Creek stream channel vegetation was assessed in December 2001 by Dr. Patrick Collins of Mt. Nebo Scientific (Appendix A of Appendix D July 2002 Addendum to the Skyline Mine PHC). A level II investigation was conducted using the methods of the USDA Forest Service. Two reaches were located on Mud Creek. Reach #4 is located just below the confluence of Eccles and Mud Creeks. The riparian community was approximately 91 feet wide and consisted of willows, sedge and rush grasses. Approximately 80% of the banks were vegetated and stable. Downstream, at Reach #5, the width of the riparian community broadened to 120 feet and consisted mostly of willows growing in both riparian and wetland communities. Approximately 60% of the bank was vegetated and stable. (February 27, 2002 EarthFax report in Appendix D of July 2002 Addendum to the PHC). Additional field work observations were conducted in the summers of 2002 and 2003. The results of these observations did not provide any definitive alteration of the riparian or wetland communities.

The gradient of Mud Creek is approximately 0.0091 ft/ft with a sinuosity ratio of 1.6. These figures were derived from aerial photographs (personal communication, November 15, 2002, Rich White, Earth Fax Engineering, with Priscilla Burton of the Division). The channel flattens on approach to Scofield Reservoir with an average gradient of 0.02 to 0.1 ft/ft. Channel subsoils are silty sands and clayey silts, classified by the 1988 Carbon County Soil Survey as Silas and Silas Brycan series. The results of laboratory analysis on the physical properties of the soils in the creek are found in Appendix B of Appendix D of the July 2002 Addendum to the Skyline Mine PHC. Cross sections of the channel describe a channel bed that is 96% cobbles and gravels and side slopes that are 100% sand, silt and clay (Appendix E of Appendix D of the July 2002 Addendum to the Skyline Mine PHC). Low flow terraces are limited in extent and the channel is incised. There is no broad flood plain.

The current stream flows do not approach natural bankfull discharge (Table 5 of Appendix D July 2002 Addendum to the Skyline Mine PHC). The erosional stability of the Mud Creek channel beds and banks was evaluated and found to fall within the allowable velocity using the techniques of evaluation described by the Soil Conservation Service (Table 3 of Appendix D July 2002 Addendum to the Skyline Mine PHC).

A stability evaluation of the channel concluded that well vegetated slopes (grasses and willows) are able to handle the increased flow without erosion (Appendix D of the July 2002 Addendum to the Skyline Mine PHC). There are channel banks of Mud Creek that are not well vegetated and the landowners of these lands should avail themselves of programs that would provide assistance to armor the bank and divert flow to allow the eroding banks an opportunity to reclaim. Canyon Fuel Company is willing to help in this effort, and the Division is facilitating a meeting with the Natural Resources Conservation Service and the landowner for this purpose. The July 2002 Addendum to the Skyline Mine PHC (page PHC A-21) commits to armoring stream channel banks, planting of stream bank stabilizing vegetation or redirection of some flows should monitoring reveal that deterioration of stream chemistry or stream morphology or vegetative community is related to mine water discharge. To help mitigate any potential erosion of the streambanks in Mud Creek, Canyon Fuel Company has provided time and materials to a private landowner owning land on Mud Creek to establish additional armoring along the steeper cutbanks located along the creek.

In conclusion, the potential negative impact to Mud Creek from the increased flows is not the interruption of agricultural activity but the acceleration of instability in the channel banks and increased erosion of the stream channel in reaches of the channel that are not well vegetated. The area impacted would be very small in relation to the acreage being pastured and would be negligible to the total production of the pastures.

Stations along Mud Creek will be monitored four times a year (seasonally) for a period of one year following a reduction in discharge to 350 gpm or less. Sediment loading in Mud Creek will be computed from the TSS and flow data collected. Annual evaluations of the stream will be summarized in a report to be submitted to the Division with the Skyline Mine Annual Report. The monitoring plan will also evaluate the changes in stream morphology and vegetation at the stations over the same time period.

Ground Water - Baseline Conditions

Ground Water Quality - General

With few exceptions ground water is a calcium bicarbonate type. Spring water is generally of better quality than well or mine discharge water. Quality is usually highest in the second quarter of the year when flows are greatest. Samples are rarely taken during the first quarter because of snow cover. Water quality data are available for only one year, four samples from October 1993 to October 1994, from the monitoring well WRDS#1 at Skyline's waste rock disposal site. The WRDS wells have been dry at all other samplings. Locations of seeps and springs sampled for the Skyline and White Oak/Belina mines are shown on Figure 5 (Appendix A). The Division feels these sampling locations adequately characterize the hydrologic regime.

The USGS analyzed water from 140 springs in the Huntington and Cottonwood Creek basins between July 1977 and September 1980. None of the analyses found concentrations over U. S. EPA drinking water standards (Engineering-Science, 1984, p. 2.39). Total dissolved solids content of the ground water from springs and seeps ranges from less than 125 ppm in the Skyline permit area to 4000 ppm at the confluence of the Price and San Rafael Rivers with the Green River.

Ground Water Quality - Castlegate Sandstone

Spring S10-1, the only monitored spring that discharges from the Castlegate or near the Castlegate-Blackhawk contact, has had an average TDS concentration of 99 mg/l and a maximum of only 165 mg/l. This low TDS is attributed to the lack of shale in the Castlegate. The water is low in nutrients and metals. The pH averages 7.3 and alkalinity is typically 25 times acidity. Total and dissolved iron average 0.28 and 0.08 mg/l and total and dissolved manganese average 0.04 and 0.06 mg/l. Springs issuing from the Castlegate Sandstone typically have less than 180 mg/l TDS (Engineering-Science, 1984, p. 27).

Ground Water Quality - Blackhawk and Star Point Formations

Total Dissolved Solids (TDS)

Springs and seeps monitored for the White Oak/Belina mines typically have TDS values in the range of 200 to 300 mg/l. Quarterly average values go from a low of 96 mg/l in the second quarter at S25-13 to a high of 363 mg/l during the fourth quarter at S24-12. The highest TDS reported is 9187 mg/l at S36-19.

Skyline's data show that spring waters from perched aquifers in the Blackhawk Formation typically have TDS levels of 240 mg/l (Coastal, 1993, p. PHC2-6). The highest TDS is 646 mg/l at S13-2 in the north fork of Eccles Creek near the mine. Average TDS at this spring is 347 mg/l. High TDS is also found at S17-2, next to Eccles Creek just above the Skyline loadout and at S24-12 at the head of South Fork.

Water discharged from the White Oak/Belina mines and well water from the Blackhawk-Star Point aquifer had TDS levels of 180 to 480 mg/l in 1979 (Engineering-Science, 1984, Table 1). Average TDS in water discharged from the White Oak/Belina mines from 1981 to 2000 was 674 mg/l, but TDS values as high as 1340 mg/l were measured (Valley Camp, 1993, p. 700-22).

Water discharged from the Skyline mines contained an average of 467 mg/l TDS in 1984, but this had increased to an average of 1273 mg/l in 1991. The average had reduced to 520 mg/l in 2001, and then to 432 mg/l since the significant inflows have been observed. Average sulfate levels went from 150 mg/l in 1984, to 673 mg/l in 1991, and down to 162 in 2001. TDS in the waste rock disposal site monitoring well averaged 552 mg/l in 1992-1993.

Iron and Manganese

Waddell (1982) measured dissolved iron concentrations of 0.720 mg/l at the Clear Creek Mine. At the spring near the mouth of Eccles Canyon, which is the same as Skyline's S17-2, Waddell measured 0.860 mg/l. Skyline's twenty-four measurements of dissolved iron at S17-2 between 1981 and 2002 averaged 0.34 mg/l. Both of these ground water sources issue from faults or fractures in the Star Point Sandstone.

For spring waters from perched aquifers in the Blackhawk Formation, total and dissolved iron average 0.71 and 0.10 mg/l, respectively, and total and dissolved manganese both average 0.02 mg/l.

In water discharged from the Skyline mines, total and dissolved iron averaged 1.4 and 0.09 mg/l, respectively. Total and dissolved manganese levels averaged 0.1 and 0.07 mg/l at the No. 1 mine and 0.07 and 0.08 mg/l at the No. 3 mine. Water from wells is generally similar to mine discharge water (Engineering-Science, 1984, p. 27). At the waste rock disposal site, water from the monitoring well averaged 0.540 mg/l total iron and 0.048 mg/l total manganese in the four samples taken in 1992-1993 (1993 Annual Report).

Water discharged from the White Oak/Belina mines between 1981 and 1989 contained an average total iron concentration of 0.56 mg/l. Total iron exceeded 1.0 mg/l 25 times from 1981 to 1985, with a maximum of 4.60 mg/l, but from 1985 to 1989 levels exceeded 1.0 mg/l only 3 times and the maximum for that period was 2.2 mg/l. From 1989 through 2000, Total iron exceeded 1.0 mg/l/day 6 times with the last exceedence in April 1998 being the highest reported value of 7.27 mg/l. From 1985 through 2000 the 30-day maximum of 70 mg/l Total Iron was exceeded 6 times, with the maximum being 155 mg/l in April 1985 and the last being 108 mg/l in May 1997.

Chloride – Bicarbonate

The following parameters have become significant when characterizing differences between Electric Lake waters and waters being encountered within the Skyline mine:

- The chloride content of Electric Lake waters is nearly four times that of mine inflow waters and chloride cannot be removed, except by dilution, no matter how long the water is in the ground.

- Mine inflow waters contain about 50% greater bicarbonate concentrations than lake waters. Mine inflow waters contain over 3 times the magnesium content of lake water. Electric Lake waters are supersaturated with respect to bicarbonate and magnesium so they cannot acquire more of these constituents.

Other Metals

Dissolved copper has exceeded the 1 hour average criterion for Class 3A waters in the four samples from the monitoring well at Skyline's waste rock disposal site (1993 Annual Report). There are no applicable standards for total metals in water, but what appear to be elevated concentrations of total copper, up to 0.42 mg/l, were found between 1981 and 1991 in the springs sampled by Skyline. Total lead up to 0.05 mg/l and total zinc up to 0.185 mg/l were also found (Coastal, 1993, Volume 4). Data from the White Oak/Belina mines show concentrations of total lead up to 0.17 mg/l and of total zinc up to 0.135 mg/l, however, total copper values are all 0.02 mg/l or lower. Analyses were not done for dissolved copper, lead, and zinc (Valley Camp, 1993, Appendix 722.100a). The igneous dikes in the area may be the source of these metals.

To monitor the addition of mine-water discharge from JC-3 into Electric Lake, trivalent arsenic, cadmium, trivalent chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc will be monitored in both the effluent discharge into the lake and Electric Lake itself for a period of two (2) years. This will provide adequate baseline information to ensure no degradation of Electric Lake is occurring.

pH

The range of average pH of ground water from monitored seeps and springs in the Mud Creek and Huntington Creek basins is 7.1 to 8.0 based on measurements at numerous locations. Extremes of 6.0 to 9.5 have been reported. Where both acidity and alkalinity have been determined, alkalinity is typically at least 25 times acidity (Coastal, 1993, p. PHC2-6).

In water discharged from the Skyline mines the average pH is 7.4 (Coastal, 1993, p. PHC2-7). Water discharged from the White Oak/Belina mines has an average pH of 7.7, with measured high and low of 9.7 and 6.7 (Valley Camp, 1993). The average pH measured at the waste rock disposal site was 6.6 in 1992-1993, ranging from 6.51 to 6.84 (1993 Annual Report). With the addition of Well JC-3, the average pH of water being discharged to Electric Lake will not be significantly different than the Lake values or will will risk be shut off.

Temperature

Temperature variances become a potentially significant parameter when comparing potential sources of water. As outlined in Appendix G of the October 2002 Addendum to the PHC, water encountered in in-mine roof sources have been 8.9 °C, while the temperature of water extracted from Well JC-1 and originating below the mine in the Star Point Sandstone has a temperature range of 13.2 to 15.6 °C. The temperature from JC-1 suggests a source at-depth (geothermal gradient) necessary to produce the temperatures.

Dissolved Oxygen

Although not typically analyzed in groundwater samples, dissolved oxygen has been useful in characterizing differences between water encountered within the mine and Electric Lake water. The dissolved oxygen content of Electric Lake water is over 10 times greater than that of mine inflow waters. While dissolved oxygen can be readily removed from groundwater, it seems unlikely that would occur while moving large volumes of water rapidly through the fractures

Age-dating

To better characterize the origin/residence of waters, significant study of the age of water has been conducted. Using tritium analysis, which functions as an indicator of modern water (in contact with the atmosphere post 1950's), Figure 9 (Appendix A) outlines the relative ages of waters sampled in-mine. Note that the number of tritium units has increased, yet potentially stabilized over time. The presence of tritium currently observed suggests there is some component / percentage of modern water present in the water being discharged from Well JC-1. Tritium unit values (TU) for samples collected in Electric Lake range from 7.76 to 13 TU, and average 9.85 TU. Tritium values for springs located within the permit area (Blackhawk Formation) range from 10.6 to 21.6 TU and average 16.1 TU.

Other age-dating methods used include radiocarbon and environmental tracers (CFC's,He, Ne, N_2, Ar). ^{14}C dating shows the 10-Left inflow waters to be 4,600 years old and JC-1 well waters (in the same fault as 10-Left) to be 6,300 years old. Helium isotope ratios suggest a percentage of the water located in the 10-Left area of the Skyline mine is about 5 years old $\pm$ 3 years. Multiple studies and analysis (Appendix G of October 2002 Addendum to the PHC, Pacificorp report) suggest a component of the water being discharged from the Skyline mine is of modern origin.

The 10-Left and JC-1 are the only areas of the mine where a component of modern water has been observed based on age-dating methods.

Tracer Dye

A tracer dye study was initiated in February 2003 in Electric Lake to help determine whether water from the lake is being discharged from Skyline. In April 2003 an additional 50 pounds of Eocene was placed along the Diagonal fault in the lake and 35 pounds of Fluorescien dye was placed along the Connelsville fault in the lake. To date, preliminary results collected by Canyon Fuel Company indicate no trace of either dye has been encountered in collection packets located at the JC-1 well. However, numerous positive dye signatures have been noted downstream of the dam.

Ground Water Quantity – Baseline Conditions

Flow of springs and seeps issuing from the perched aquifers varies seasonally, indicating local systems. Recharge for most of these springs and seeps probably originates in the small surface depressions or basins in the immediate vicinity. Higher flows occur during spring snowmelt, and flows in the autumn are often lower by an order of magnitude. Some seeps dry completely during the summer. Sustained flows from springs are low; only 4 springs on the Skyline permit area were flowing at 10 gpm or more during the 1978 autumn inventory, and most flowed at 2 gpm or less. Flows are also sensitive to the amount of precipitation during the winter. Springs on the Skyline property were surveyed by OSM contract staff in 1983 following a very wet winter. One unidentified spring was flowing at 300 gallons per minute in late June but by early August it was flowing only 4 gallons per minute. A nearby spring flowed 100 gallons per minute in June and could not be located, apparently because it was dry, in August (Engineering Science, 1984, p. 34). An additional Seep and Spring survey was conducted by the Skyline Mine in the Winter Quarters / North Lease area in 1992 and 1993, which was used in determining the current water monitoring locations. Graphs of selected groundwater wells, springs and streams comparing historic flow to the Palmer Hydrologic Drought Index (PHDI) are provided in PHC Addendum Appendix A of the July 2002 Addendum to the PHC of the Skyline MRP and were last updated with data from the1st quarter (calendar year) 2003. These graphs illustrate how the springs in the Blackhawk Formation respond rapidly to seasonal and to climatic cycles indicating the springs are fed by discharge from a groundwater system that is in good communication with the surface and annual recharge events. Through the 1st quarter of 2003, no obvious changes in flow in the springs, seeps, or elevation in the groundwater wells located in the Blackhawk Formation have been noted due to the significant mine inflows encountered in the Skyline Mine since 2001. This determination is made through the groundwater monitoring sites outlined in the Skyline MRP.

According to the Seep and Spring survey conducted in the White Oak/Belina area in the summer of 1990, a total of three seeps/springs are affected by the 2001 Surface mining in the area. Seeps/springs S25-13, S25-14, and 30-1 are all located up-gradient of the surface mining. Seep/Spring S25-13 is the only site that provided consistent enough flow to be continually monitored. Recorded quarterly flow measurements from site S25-13 range from 0 to 60 gpm, and average <5 gpm. It is anticipated that any flow from the three seeps or springs will still report to Whisky Creek and not be significantly impacted by the surface mining.

The Blackhawk-Star Point aquifer provides baseflow to Mud Creek and the lower reaches of Eccles Creek, but the volume of ground water discharged from the regional Blackhawk-Star Point aquifer has not been quantified. Vaughn Hansen Associates (1979) estimated that 64% of the flow of Eccles Creek was from ground water discharge, with the major portion of this flow entering the stream from the Star Point Sandstone. The Star Point can be presumed to provide baseflow to lower reaches of other Mud Creek tributaries where it is exposed. Low flows of Mud Creek are sustained principally by ground water flowing up from the regional aquifer (Waddell, 1983b). Discharge through fractures such as the O'Connor fault and the Pleasant Valley fault zone has been documented. Some baseflow also probably occurs directly through un-fractured but permeable zones in the Star Point Sandstone. Canyon Fuel Company has been working on numeric hydrologic groundwater model of the area that should be complete by October of 2003. The Star Point Sandstone does not crop out in the headwater drainages of Mud and Huntington Creeks and the regional Blackhawk-Star Point aquifer does not discharge from springs or otherwise contribute to surface flow in these areas.

V. IDENTIFICATION OF HYDROLOGIC RESOURCES

(IDENTIFY HYDROLOGIC RESOURCES THAT ARE LIKELY TO BE AFFECTED AND DETERMINE WHICH PARAMETERS ARE OF IMPORTANCE FOR PREDICTING FUTURE IMPACTS TO THOSE HYDROLOGIC SYSTEMS.)

The Class 3A streams in the CHIA are protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain. The drainages of upper Huntington Creek and Mud Creek have both been identified as habitat for naturally reproducing populations of cutthroat trout. Scofield Reservoir is stocked with rainbow trout but contains cutthroat trout that have reproduced in tributary streams, including Mud, Eccles, Winter Quarters, and possibly Boardinghouse Creeks.

Burnout Creek has been identified as a spawning habitat for the native Yellowstone cutthroat trout population in Electric Lake. Cutthroat trout have been observed in large numbers in James Creek, just south of Burnout Creek, during spawning season. Boulger Creek has been studied as a stream that could be developed into for a spawning, and Skyline has provided funds to the USDA Forest Service for construction of a fish ladder to bypass Boulger Reservoir. Utah Division of Wildlife Resources is concerned about potential loss or alteration of these and other important fish habitats in and around Electric Lake.

Prior to the addition to the North Lease there were 194 surface water rights, 106 for stockwatering, 25 for irrigation, 55 undeclared, and the remaining 8 for other uses. Most perennial and ephemeral streams in the CIA have water rights filed on them. Water rights have been filed on 112 springs and 23 wells or tunnels. Stockwatering was the declared use on 62 of the water rights, 41 were for other uses, and the remaining 32 were undeclared. Springs and seeps are important to wildlife, though there are no filed rights that declare this as a use. Specific water rights information for the North Lease have been updated in October, 2002 (second binder volume 4- Water Rights).

Electric Lake is a reservoir owned and operated by Huntington Cleveland Irrigation Company. Pacificorp owns roughly one-third of the water shares in the company and uses approximately 12,000 acre-feet annually to cool the coal-fired electric generating plant. The Utah Division of Wildlife Resources typically requires minimum flows of 12 cfs in winter and 15 cfs in summer below the lake to maintain a quality aquatic habitat. In 2002 the minimum flow requirement was reduced to 6 cfs because of low storage levels in Electric Lake. To make up the difference, Pacificorp purchased the majority of remaining water shares in the irrigation company to maintain plant operations. The agricultural needs of the Huntington Cleveland area were at a minimum or were not met during the 2003 growing season due to minimal water being delivered. Hydrologic impacts to Electric Lake affect everything from wildlife, to agriculture, to power generation along the Wasatch Front.

Both the Skyline and White Oak/Belina mines utilize water from wells in Eccles Canyon that were drilled into fault zones in the Star Point Sandstone. Wells near the Skyline and White Oak/Belina loadouts in Pleasant Valley produce water from both alluvium and Star Point Sandstone. Water from these wells is for domestic, stockwatering, and other uses.

During the 1979-1980 water year, Mud Creek contributed approximately 16% of the inflow to the Scofield Reservoir. Scofield Reservoir discharges into the Price River, which is used for irrigation in Castle Valley and provides the municipal water supply for the city of Price. Upper Huntington Creek drainage contributes an unknown amount to the total discharge of Huntington Creek, but estimates indicate it could be 25% or more.

Table 13 lists potential impacts to the hydrologic resources, indicates if there is a possibility for cumulative impact outside the permit areas, and identifies analytical parameters or other indicators that need to be monitored to track potential impacts of the permitted mines.

Periods of high suspended solids in the streams are normal as well as periods of high runoff, so fine sediments are flushed from the streambed and clean gravel beds for trout spawning are left. Sediment cleared from the streambed simply moves downstream, and in Mud Creek and upper Huntington Creek basins the sediment eventually accumulates in Electric Lake or Scofield Reservoir. When runoff is low, fine sediments may remain and spawning gravels become unavailable. Fine sediments increase trout egg and fry mortality through suffocation. Invertebrates are also impacted by sedimentation through loss of habitat or mortality. Invertebrate diversity may decrease but resistant or adaptive species will remain. Impacts on invertebrates may reduce the supply of food for the trout. Construction, mining, and other activities produce the same negative impacts by decreasing flow or increasing sedimentation beyond the capacity of the stream to flush itself. Coal fines have the same negative impacts as fine, natural sediments.

Fine sediments, including coal fines, have covered portions of the streambed below the Skyline Mines and have been trapped behind beaver dams in Eccles Creek. Removal of beaver dams has been done in an attempt to increase access from Scofield Reservoir to Eccles Creek for spawning cutthroat trout and to facilitate the flushing of fine sediments from the streambed. Sediment traps along Mud Creek have been suggested by UDWR as a solution that would maintain access to the stream for spawning trout while reducing sedimentation in Scofield Reservoir. The increased flow in Eccles and Mud Creeks, resulting from the pumping from the Skyline Mine, has had a beneficial impact by flushing more fine sediment from these streams.

Temperature increase can reduce dissolved oxygen in a stream. Changes in temperature may directly influence algae growth rates. Winget (1980) found that water temperatures in upper Huntington and Eccles Creeks equilibrated quickly with air temperatures because of the turbulence from rough channels and low flows. However, UDOGM found that the temperature of Eccles Creek increased significantly, 43 degrees to 54 degrees, as it passed through the 72-inch bypass culvert and received the sediment pond discharge (UDOGM, 1988). With the steep gradients and rocky beds of the streams in the CIA, entrainment of oxygen and equilibration with air temperature should be sufficient to eliminate temperature as a factor in habitat quality.

Toxic materials in the water will reduce trout and invertebrate populations through mortality or avoidance. Nitrite concentrations in excess of 0.06 mg/l result in trout mortality. The long term LC_{50} exposure level for trout to nitrate is 1060 mg/l. Phosphorus in excess of 0.04 mg/l is not toxic to trout but does lead to eutrophication. Toxic levels of nitrite and eutrophication from excessive nitrogen and phosphorus were identified by the Utah Division of Wildlife Resources as causes of fish and invertebrate declines in Eccles Creek in 1987 - 1988.

Increased TDS has not been identified as a problem in any of the fisheries. There is no water quality standard for TDS for aquatic wildlife, but 1200 mg/l is the limit for agricultural use. There is a possibility of cumulative effect outside of individual permit boundaries in the Mud Creek drainage. TDS and sulfate exceeded UPDES limits at the Skyline mines because of gypsum contamination in the limestone used for dust control. The discharge returned within UPDES limits after application of contaminated rock dust ceased and continuing flow diluted or flushed residual contamination.

Sediment, total nitrate, phosphorous, and dissolved oxygen have been identified as water quality concerns for Scofield Reservoir. High nitrogen and phosphorus levels lead to increases in algae and aquatic vegetation, which in turn leads to a deterioration of water quality. The reservoir may become eutrophic unless measures are taken to limit nutrient inflow (Waddell and others, 1983a). The increased flow in Eccles and Mud Creeks, resulting from the pumping from the Skyline Mine, may have had a beneficial impact by increasing the inflow of low TDS water into the reservoir; however, the volume of nutrients being added by this flow has not been determined yet.

During the 1979-1980 water year, Mud Creek contributed approximately 16% of the inflow to the reservoir, 18% of the total dissolved solids (TDS), 28% of the total suspended solids (TSS), 18% of the total nitrogen, and 24% of the total phosphorous. During snowmelt, concentrations of nitrogen and phosphorus reached 21 and 4.3 mg/l at the Eccles Canyon gaging station. Most of this was in suspended form, and these unusually high concentrations were probably due to flushing of residual debris from 27 acres of forested land cleared in 1979 for fire protection around the mine portal and road right-of-ways. (Waddell and others, 1983a).

Perched systems have limited storage and recharge capacities, and when they are intercepted by mining operations the resulting in-mine floss decline rapidly. Draining of these perched systems may cause individual springs or seeps to disappear but should have little impact on the hydrologic balance of the area. Flows into the mines that persist for more than 30 days should be considered as possibly intercepting surface water through a natural or subsidence induced fracture system.

Surface-mining methods employed at the White Oak/Belina mine may temporarily disrupt the groundwater and surface flow in the area. It is anticipated seeps and surface flows currently reporting to Whisky Creek will eventually re-surface through the fill or report at the toe of the fill. Any encountered seeps greater than 3 gpm will have a French drain installed to ensure the flow reports to the surface.

Operations at the Skyline Mines are drawing down the potentiometric surface of the regional aquifer, which can induce increased recharge and downward flow through the overlying unsaturated zone. This would have a minimal, probably undetectable effect on perched aquifers or soil moisture because of the generally low hydraulic conductivity of the Blackhawk Formation. However if the area involved were large enough, it could be one process leading to measurable interbasin transfer of water. The cone of depression and resulting effects on the overlying unsaturated strata will diminish with time after mining cease

CHIA--- MUD CREEK AND UPPER HUNTINGTON CREEK BASINS

POTENTIAL HYDROLOGIC IMPACTS	Possible Cumulative Effect Outside Permit Areas	Parameters of Importance and Other Indicators for Predicting Future Impacts
• ***Increased sediment yield from disturbed areas*** **- Alteration or loss of fisheries in streams and reservoirs. Increased rate of sedimentation in reservoirs. Coal spillage from hauling operations and storage. Loss of riparian habitat.**	**YES**	**• Sediments • Fish and Macroinvertebrates**
• ***Flooding or streamflow alteration*** **- increase or decrease in streamflow.**	**YES**	**• Flow • Sediments • Fish and Macroinvertebrates**
• ***Contamination of ground and surface water from acid- or toxic-forming or toxic materials*** **- Contamination of surface water from coal hauling operations and storage. Hydrocarbon contamination from above-ground storage tanks or from the use of hydrocarbons in the permit area. Contamination from road salting. Gypsum used in dust control contaminating mine discharge. Nutrients in mine discharge.**	**YES**	**• Sediments • TDS • pH • Nutrients • Specific cations and anions • Oil and Grease • Fish and Macroinvertebrates**
• ***Subsidence damage to springs and streams*** **- increased sediment load, diminution of flow, physical barrier to fish migration.**	**YES**	**• Flow • Sediments • Fish and Macroinvertebrates**
• ***Alteration or destruction of fisheries and aquatic habitats*** **- loss of flow, loss of access to stream, loss of fish spawning habitat, increased sediment load, acute or chronic toxicity, eutrophication, loss of food supply.**	**YES**	**• Flow • Sediments • Fish and Macroinvertebrates • TDS • pH • Nutrients • Specific cations and anions**
• ***Loss of ground water or surface water availability*** **- water rights, wildlife uses.**	**YES**	**• Flow Age dating Tracer dye Geophysics Groundwater monitoring**
• ***Reduction of flow due to interbasin transport of intercepted water.***	**YES**	**• Flow**

Table 13

VI. MATERIAL DAMAGE CRITERIA - RELEVANT STANDARDS AGAINST WHICH PREDICTED IMPACTS CAN BE COMPARED.

Water within the CIA is used for watering livestock and wildlife, mining coal, domestic use, fisheries, and recreation. Downstream, the water is additionally used for irrigation and domestic and industrial needs. Land within the CIA is used for wildlife habitat, grazing, recreation, and mining coal. Anticipated post-mining uses are for wildlife habitat, grazing, and recreation.

Quality

Water quality standards for the State of Utah are found in R317-2, Utah Administrative Code. The standards are intended to protect the waters against controllable pollution. Waters, and the applicable standards, are grouped into classes based on beneficial use designations.

Scofield Reservoir is classified (latest classification December 7, 2001) by the Utah Division of Water Quality as:

1C - protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.
2B - protected for secondary contact recreation such as boating, wading, or similar uses
3A - protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain.
4 - protected for agricultural uses including irrigation of crops and stock watering.

Scofield Reservoir is: (E-mail from Louis Berg, Utah Division of Wildlife Resources, to DOGM dated February 4, 2002).

- A culinary water source.
- One of the top four trout fishing lakes in Utah.
- Has over a one million dollar annual recreational fishing value.

Electric Lake is classified by the Utah Division of Water Quality as:

2B - protected for secondary contact recreation such as boating, wading, or similar uses
3A - protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain.
4 - protected for agricultural uses including irrigation of crops and stock watering.

Streams in both basins are classified as:

1C, 3A, and 4.

Furthermore, surface waters located within the outer boundaries of a USDA National Forest, with specific exceptions, are designated by the Utah Division of Water Quality as High Quality Waters - Category 1 and are subject to the state's antidegradation policy. This

antidegradation policy is that waters shall be maintained at existing high quality and new point source discharges of wastewater, treated or otherwise, are prohibited (Utah Administrative Code, R317-2-3.2 and R317-2-12.1). All of the upper Huntington Creek drainage and most of the headwater drainages of eastflowing tributaries to Mud Creek, including the Skyline mines disturbed area, are within USDA Forest Service boundaries and are protected by this policy. However, Electric Lake has been reclassified as High Quality Waters – Category 2, which is defined as "…designated surface water segements which are treated as High Quality Waters – Category 1 except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality." Both the effluent and the lake must be sampled for a period of two years for a full suite of metals and nutrients to ensure the mine water is not of a lower quality of water than exists in Electric Lake. During this period, should the water quality of the mine discharge found to be degrading Electric Lake, the discharge could be stopped due to poor water quality. The White Oak/Belina mines, both loadouts, and the waste rock disposal site are outside forest boundaries.

The Utah Department of Environmental Quality, Division of Water Quality can authorize a coal mine to discharge into surface waters under the Utah Pollutant Discharge Elimination System (UPDES). The permits for the mines contain site-specific limitations on total dissolved solids, total suspended solids (or total settleable solids for precipitation events), iron, oil and grease, pH. The Skyline Mines have an additional limitation on sulfate for discharges into Eccles Creek, and a whole suite of metals and nutrients for discharges into Electric Lake.

Water quality standard for nitrate in Class 1C waters is 10 mg/l. Nitrate levels above 4 mg/l are considered an indicator of pollution, usually from sewage, in all waters. For trout, the long term LC_{50} exposure level to nitrate is 1060 mg/l.

There is no water quality standard for nitrite, but concentrations in excess of 0.06 mg/l produce mortality in cutthroat trout (UDWR, 1988).

The water quality standard for Class 3A waters for phosphorus is 0.05 mg/l. Levels in excess of 0.04 mg/l are not toxic to trout but are excessive and promote eutrophication (UDWR, 1988). By state standards for Class 1C, 2A, 3A, and 3B waters, phosphate in excess of 0.05 mg/l is a pollution indicator.

The recommended limit for MBAS, a detergent or surfactant, is 0.2 mg/l (Steve McNeil, Utah Dept. of Health, personal communication in UDOGM, 1988).

There is no water quality standard for oil and grease, but the UPDES permit limit for both the White Oak/Belina and Skyline mines is 10 mg/l. A 10 mg/l oil and grease limit does not protect fish and benthic organisms from soluble oils such as those used in longwall hydraulic systems, and UDWR has recommended soluble oils be limited to 1 mg/l (Darrell H. Nish, Acting Director UDWR, letter dated April 17, 1989 to Dianne R. Nielsen, Director UDOGM).

Increased TDS has not been identified as a problem in any of the fisheries. There is no water quality standard for TDS for aquatic wildlife, but 1200 mg/l is the limit for Class 4, agricultural use.

Physical or chemical indicators alone do not fully evaluate water quality in streams. Macroinvertebrates are excellent indicators of stream quality and can be used to evaluate suitability of a stream to support a trout fishery and other aquatic life. Baseline studies of invertebrates by the USGS (Waddell, 1982) and Winget (1980) and studies done in conjunction with mine operations (Coastal States, 1993; ERI, 1992) provide standards against which actual stream conditions can be evaluated. Cutthroat trout populations are also excellent indicators of stream quality. UDWR surveys of trout populations in Eccles, Winter Quarters, and Huntington Creeks have established baseline conditions.

The maximum temperature for Class 3A waters is 20 degrees C (68 degrees F). The maximum allowable change for Class 3A waters is 2 degrees C (3.6 degrees F).

Sedimentation

Sedimentation of reservoirs and the eventual lose or diminution of their value is inevitable. Waddell and others (1983a and b) examined sedimentation in Scofield Reservoir. A bathymetric survey was done to a) estimate total sediment yield from inflowing streams; and b) to provide detailed bathymetric measurements at selected cross sections to allow more accurate evaluation of future deposition. The rate of sediment accumulation and deposition was estimated by using lead^{210} to determine the relative ages of sediment samples from cores. Increased sedimentation in the reservoirs due to mining in the adjacent drainages might be detectable using such techniques, but direct monitoring of inflowing streams is probably more effective.

Changes in sediment size distribution in streams can be determined by comparison with past studies (Winget, 1980; Coastal States, 1993, Table 2.8-3). Winget identified 15% or more of materials finer than 0.85 mm in diameter as a critical measure of biotic potential, that is whether or not fish eggs and fry and many macroinvertebrates would be suffocated.

Quantity

There are no prescribed standards to assess impacts to water quantity as there are for water quality. It has been determined that the flow regime in the Mud Creek – Upper Huntington Creek impact area may be complicated with preferential fracture-flow and flow along faults. A component also related to quantity is the mixing of water from more than one source. To help assess and evaluate any impacts to the flow regime, the waters need to be characterized with as many unique identifiers as possible. As outlined earlier in this report, they include, but are not limited to the following: significant reduction in historic flows that cannot be attributed to drought conditions; age-dating, solute water analysis, field parameters, tracer-dye, geophysics, hydrologic modeling, and routine surface- and groundwater monitoring all contribute to identifying the origin of waters. The Division will use measurements of flow (both receiving and source), characterizing the water, and impacts to the receiving and source waters in assessing impacts to quantity.

CHIA--- MUD CREEK AND UPPER HUNTINGTON CREEK BASINS

Based on correlations of low flows in several streams in the southern Wasatch Plateau, Wadell (1981 in Wadell and others, 1983b) found that with 5 years of continuous discharge records, monthly flows for August, September, and October could be estimated with a standard deviation of 20%. From measurements in 1979 and 1980 it was calculated that the average ratio of the low flows of Mud and Fish Creeks during October, the low flow month with the least variation, was 0.42.

Wadell and others (1983b, p. 129) approximated the amount of water that would need to be diverted from or to the Mud Creek basin before it could be detected. Assuming 1) a 20% standard deviation, 2) an average flow ratio of 0.42 between Mud Creek and Fish Creek, 3) an average flow of Fish Creek in October of 330 acre-feet/year (5.4 cfs),

$$(\pm 0.20)(330 \text{acrefeet})(0.42) = \pm 28 \text{acrefeet} = \pm 0.45 \text{cfs}.$$

A longterm increase or decrease of flow in Mud Creek of at least 0.45 cfs would be detected 68% of the time by correlating the October flows of Mud and Fish Creeks. The USGS have had stream gaging stations on Eccles, Mud, and Fish Creeks. As of August 2003, Mud Creek and Fish Creek continue to be monitored on a regular basis.

Unfortunately, long term flow data for discharges of Burnout, Boulger, and Huntington Creeks into Electric Lake are are not available. PacifiCorp began monitoring cumulative inflow when the lake was at a historic low beginning in June 2002, and continued through mid-April 2003. . They use a flume located in the lake bottom immediately opposite James Canyon. This flume includes measurements of the James Canyon wells pumped input to the lake and estimates the flows of tributaries below James Canyon to be 1 cfs year-round. This flume was installed in June 2002 and became non-functional in April 2003 due to spring runoff. The flume was recalibrated in June of 2003 and continues to collect flow data.. Pacificorp is installing a second flume further upstream, but still below Boulger Creek to continue to monitor inflows after the flume opposite James Canyon is inundated by rising lake levels. Estimated discharge from the upper Huntington Creek basin is 16,000 acre feet per year (22 cfs) based on the measured discharges of Burnout and Huntington Creeks. This estimated number is supported by comparing the continuous flow recorded at the mouth of Eccles Creek (Table 3) and using the same flow volume per acre of land for the Upper Huntington basin. Using the same volume per acre number from the Eccles Creek drainage for the 19,854 acres, the average flow for the Upper Huntington basin is 21.2 cfs or 15,350 acre-feet per year. Subtracting a calculated 800 acre-feet of evaporation per year, based on Pacificorp data, the Upper Huntington drainage basin receives an average of approximately 14,500 acre-feet per year.

The flow data currently being collected in the upper Huntington drainage will document the necessary flow information necessary to make a quantifiable determination of whether any quantity of water is being lost from the basin. Other crucial information that will be used for relevant standards will be data supplied by Pacificorp when comparing impacts to Electric Lake such as discharge records from the dam, long-term precipitation data, long-term evaporation data, and long-term stage-volume records for the lake.

VII. ESTIMATE OF THE IMPACTS OF MINING ON THE HYDROLOGIC RESOURCES

Quality

Mine discharges of water to both Eccles Creek and Electric Lake are being closely monitored to ensure the mixing of mine water does not create any degradation of the existing hydrologic regime. Water quality standards are outline in Section VI. Any future estimates of impacts will be based on the outlined criteria. Currently, no adverse impacts are being observed, but any possible adverse trends are being documented.

Quantity

Increased Streamflow

Average discharge from the White Oak/Belina #1 Mine between 1981 to 1989 was 0.19 cfs (Table 724.100a). No water had been discharged from the White Oak/Belina #2 Mine as of 1993. Discharge from Pond 004 was sporadic from 1995 through 2000 with no discharges after August 1999. Average discharge flow from 1995 through 1999 was 74 gpm/day. Coal production from both mines has averaged approximately 0.5 million tons per year, so a very rough estimate of water production is 0.4 cfs per million tons of coal mined. Projected maximum coal production from White Oak/Belina #1 and #2 Mines is 2 million tons per year, which would result in an estimated discharge of 0.8 cfs of water.

If both coal-mining operations were to reach maximum production simultaneously, the total projected increase of flow in Mud Creek would be 2.0 cfs. This would also be the increase in Eccles Creek if the White Oak/Belina mines were to discharge all their water from the present portals. But maximizing White Oak/Belina's production to 2 million tons per year would probably require at least one additional portal, either in Boardinghouse or Finns Canyon, and part of the water produced by mining would probably be discharged through that portal. Discharge from Pond 004, which serviced both the White Oak/Belina #1 and #2 Mines, indicated the water anticipated was not encountered during mining. Records indicate only sporadic flows were encountered. Currently, no water is being discharged from the White Oak/Belina Mines.

Skyline's records show discharge was first monitored from the #3 Mine in 1983 and from the #1 Mine in 1989. Up to 1991 the average discharge from Skyline #1 was 0.35 cfs and from the #3 Mine was 0.5 cfs. This is discharged to Eccles Creek by way of the sediment pond. When stream flow is naturally low in late summer to early autumn, discharge from the Skyline mines has been estimated to account for as much as 60% to 70% of flow in Eccles Creek.

Pumping of mine inflow waters from Skyline Mine into Eccles Creek increased the streamflow from normal amounts of approximately 300 gpm to as high as 10,000 gpm in 2002-2003. Eccles Creek is well armored and has shown little or no visual indication of impacts. These same flows continue on to Mud Creek which increases that stream to about 3 times normal amounts. Mud Creek has shown some minor visual indication of streambank erosion. Both streams are being continuously monitored to determine possible impacts. Pumped volumes have dropped to approximately 3,500 gpm with the addition of the JC-3 Well pumping water into Electric Lake. Discharge into Eccles Creek is anticipated to stabalize to approximately 2,900 gpm in 2004. Based the current information and conditions, the estimated impacts due to increased stream flow are minimal and declining.

Mine In-flows

Prior to January 2000 mine discharge from the Skyline was typically below 500 gpm, with additional waters encountered in-mine being used in the operation of the mine. Figure 10 (Appendix A) illustrates the amount of water discharged from the mine and how it has increased with time. As outlined earlier these inflows appear to be originating predominantly from faults and fractured sandstone located below the mine. A dramatic decrease, on the order of 5,000 gpm, is anticipated in the discharge to Eccles Creek. The dramatic decrease is caused by the addition of Well JC-3 that routes mine-water into Electric Lake. Figure 11 (Appendix A) illustrates the cumulative discharge of water from the mine since 1999. As outlined in Table 1, mine-inflows totaling on the order of 9,000 gpm are a concern to the Division for the potential impact to the surface- and groundwater being used in the Mud Creek and Huntington drainages. Per the State regulations, the Division is concerned with the impacts these increased flows will have on the receiving streams/reservoirs and any waters that are being used within the basin to ensure the existing waters are not being diminished. Other than making a determination on impacts to the receiving streams\reservoirs and surface- and groundwater being used in the basin, the Division does not regulate the use or distribution of mine-discharged waters. Current information indicates the water being discharged is not adversely impacting the receiving streams/reservoirs, or diminishing flows within the respective basins.

Wells JC-1 and JC-3 are anticipated to discharge a maximum of approximately 9,000 gpm of mine discharge and groundwater to Electric Lake, providing potentially 1,200 acre-feet of water per month to the reservoir when necessary. Photos 1 through 3 (Appendix B)illustrate the armoring provided by Pacificorp to minimize any impacts to the lake bottom at the point of discharge. The ability to provide quality high quality water at a significant rate to the lake is considered a positive impact on the hydrologic resource of Electric Lake.
Photo 3 – Armoring of channel from discharge pipe to Huntington Creek.

With no apparent adverse impacts to the receiving stream, the increased discharge of mine in-flows to the Mud Creek and Huntington Creek drainages are considered to have a positive impact, providing additional water to the Scofield and Electric Lake reservoirs.

Subsidence

Especially where overburden is minimal or fracturing is extensive, there is potential for the capture of ground water or surface water by subsidence cracks (Engineering-Science, 1984; Valley Camp, 1993, Appendix R645-301-724.600). Subsidence impacts are largely related to extension and expansion of existing fracture systems and upward propagation of new fractures. Because vertical and lateral movement of ground water in the permit area appears to be largely controlled by fracture conduits, readjustment or realignment of the conduit system may potentially produce changes such as increased flow along fractures that are opened and diversion of flow along new fractures. Increased flow rates would potentially reduce residence time and improve water quality. Some of the perched, localized aquifers could be dewatered. Ground water diverted from seeps or springs fed by such systems would most likely emerge nearby at another surface location rather than drain down into the mine. Sealing of subsidence cracks by clays in the Blackhawk is expected to minimize long-term effects of subsidence on the hydrologic systems.

Mines are designed to restrict subsidence to the permit areas. Because the perched aquifers of the Blackhawk Formation are lenticular and localized, there is little potential for the effects from dewatering these aquifers to extend beyond the permit area. Where mining and subsidence occur within the saturated rocks of the regional aquifer there will be a large increase in permeability locally. With time, permeability will decrease as fractures close and the potentiometric surface will establish a new equilibrium. Residual impacts should be restricted to the previously mined area and will probably be negligible. The addition of the Winter Quarters / North Lease area has been a source of concern because portions of Winter Quarters and Woods Creeks are perennial in nature and support aquatic life. However, the combination of extensive overburden, the sealing and pliability of the overlying Blackhawk Formation, and the proposed mining of only one (1) coal seam drastically reduces the potential for any adverse impacts to occur due to subsidence.

VIII. MATERIAL DAMAGE DETERMINATION

Mine In-flows

Most of the water currently being encountered by mining is believed to be generated from the deeper regional Star Point aquifer. This deeper aquifer does not contribute directly to the water budget of the Mud Creek or Upper Huntington Creek basins. However, changes in the potentiometric surface may influence recharge and movement of ground water through the overlying unsaturated zone. Because the potentiometric surface is expected to recover to approximate pre-mining conditions after mining ceases, the overlying unsaturated zone should also be expected to recover to approximate pre-mining conditions.

Information provided by the mine indicates the primary source of the mine in-flows is isolated storage in the Star Point Sandstone located beneath the coal seams. When mining ceases, the ground-water balance should return to pre-mining conditions, with no long-term impacts or material damage. The water being pumped from wells JC-1 and JC-3 to Electric Lake occurs to assist the mining operation and will cease when the mining operation is complete.

Current information suggest no adverse impacts are being observed in Eccles Creek/Mud Creek or Electric Lake due to the increased discharges of water. Monitoring of mine in-flows, groundwater, and surface water within the Mud Creek – Upper Huntington Creek basins is being conducted to adequately identify any future impacts. Information is continually being updated and re-assessed to evaluate any impacts.

Loss of Habitats for Cutthroat Trout and Invertebrates

The critical spawning habitat for Yellowstone cutthroat trout in Burnout Creek is entirely within the Skyline permit area. Upper Huntington Creek and several of its tributaries are within the permit area, with the uppermost reaches of Huntington Creek extending upstream beyond the permit boundary. Large numbers of cutthroat trout have been seen in James Creek during spawning season, but it has not been determined which, if any, of the tributary streams other than Burnout Creek are cutthroat spawning streams. Boulger Creek is being modified to facilitate access by spawning trout.

Subsidence could produce physical barriers or loss of water flow sufficient to block fish from reaching spawning areas. Sedimentation caused by subsidence or other mine related activities could bury gravels used for spawning. These effects would probably be mitigatable by removal of barriers, restoration of flow, or sediment control and no material damage would result. A study done in Burnout Creek indicates that any impacts to the streams would be temporary and minimal.

Cutthroat trout are found in Eccles Creek and other streams of the Mud Creek drainage. This trout population has been heavily decimated by sedimentation, eutrophication, or toxicity several times in the past. These negative impacts generally have been caused by human activity in Eccles Canyon, namely road construction and coal mining. Beaver dams, which are natural traps for fine sediment, have interacted with the additional fine sediments produced by human activities to further reduce trout habitat in Eccles Creek. Trout populations have recovered when the impacting activities have ceased, been modified, or otherwise mitigated, although recovery has not been determined to be 100%.

No material damage to habitats for trout or invertebrates is anticipated and monitoring is ongoing.

Increase or Decrease in Stream-flow

There should be no noticeable change of flow in streams in the Huntington Creek drainage. In Electric Lake however, the JC-1 and JC-3 wells have a potential to provide roughly 46 percent of the total volume of the lake on an annual basis, should pumping continue. With the drought conditions experienced from 1999 thorough 2003 the added water is appreciated downstream. When the current drought conditions reverse and mind discharges continue, excessive flows entering the lower Huntington drainage could potentially become an issue.

The impacts of mine inflows being pumped to Eccles Creek are minimal to that stream. It’s well armored and shows little sign of degradation. The impacts to Mud Creek could be greater, but these are also minimal. As indicated previously, the potential negative impact to Mud Creek from the increased flows is not the interruption of agricultural activity but the acceleration of instability in the channel banks and increased erosion of the stream channel in reaches of the channel that are not well vegetated. The area impacted would be very small in relation to the acreage being pastured and would be negligible to the total production of the pastures. Both streams are being monitored continuously and possible impacts should be detected.

At the cessation of mining, flows in Eccles Creek should return to pre-mining levels. Less flow during low flow periods will be the most noticeable effect. There is no present or foreseen material damage resulting from changes in flow due to present or projected discharge from the mines.

Water Quality

Historically, sulfate and TDS have increased in Eccles and Mud Creeks as a direct result of mining activities. UPDES limits were exceeded for a time at the Skyline sedimentation pond. The suspected source of the problem, gypsum used for dust control, was eliminated and water quality began to recover.

Prior to the 2001 inflows, Whisky Creek contributed approximately 6 percent of the flow in Eccles Creek and 2 percent of Mud Creek, respectively. The combination of limited degradation to water quality and minimal contribution of flow the cumulative impact to water quality within the Mud Creek basin is minimal.

In the late 80's and early 90's excessive nitrogen and phosphorous compounds were introduced into Eccles Creek by mining activities. Sewage was suspected as the source of the contamination at one time, but emulsified oil from longwall hydraulic systems and detergents were determined to be the sources. Fish and invertebrate populations were greatly reduced or eliminated from much of the stream, either because of avoidance or toxicity. Populations recovered after the causes of the contamination were eliminated. The possibility that excessive nitrogen and phosphorous nutrients in inflowing streams could lead to eutrophication of Scofield Reservoir is a concern.

The increased flows in Eccles and Mud Creeks, resulting from the pumping from the Skyline Mine, may have had a beneficial impact by diluting dissolved solids with low-TDS water. The impacts on sedimentation and nutrient loading in Scofield Reservoir have not been fully determined, but in the short term the increased flow has been beneficial in maintaining water above the dead-storage level during the recent four years of drought.

Water quality problems have so far proven to be mitigatble. No material damage to water quality is expected but water quality must be monitored diligently to avoid even short-term problems.

Water quality of water entering Electric Lake will be closely monitored both at the discharge and within the lake to ensure no degradation of water occurs.

Erosion and Sedimentation

Fine sediments in Eccles Creek have increased as a result of road construction and coal mining related activities. Coal fines are a notable addition to the fine sediment load. One impact of the increase in fine sediment has been reduced trout and invertebrate populations because of suffocation of trout eggs and fry, burial of gravel used for trout spawning, and loss of suitable invertebrate habitats.

CHIA--- MUD CREEK AND UPPER HUNTINGTON CREEK BASINS

Fine sediments and runoff associated with the reconstruction of Upper Whisky Creek and surface-mining methods employed at the White Oak/Belina Mine are mitigated with all flows reporting to sedimentation ponds until vegetation standards are achieved. Native stream channel sediments in Upper Whisky Creek were removed and stockpiled for later reconstruction of the channel. Long-term effects to the Mud Creek drainage system should be minimal.

A long-term concern is the loss of water storage capacity in Scofield Reservoir from sedimentation. In the past, sediment traps have been suggested as a means of removing the fine sediments originating in the Eccles Creek drainage. The increased flow in Eccles and Mud Creeks, resulting from the pumping from the Skyline Mine, may have had a beneficial impact by flushing more fine sediment from these streams. The impacts to sedimentation in Scofield Reservoir have not been determined yet.

Sedimentation has not been a problem in the Huntington Creek drainage. To ensure the discharge of the JC wells did not scour the lake bottom and create a suspended solids problem, Pacificorp supplied extensive armoring of the lake bottom at the point where the discharge enters the lake. Photos 1 through 3 illustrate the armoring of the lake bottom and the channel constructed to carry the discharge water from the pipe to the Huntington Creek channel.

Material damage from erosion or sedimentation is not anticipated in either the Mud Creek or Huntington Creek, but monitoring is ongoing.

IX. STATEMENT OF FINDINGS

No evidence of material damage from the actual mining operations has been found. No probability of material damage from actual or anticipated mining operations has been found. The actual and proposed coal mining and reclamation operations have been designed to prevent material damage to the hydrologic balance outside the permit areas.

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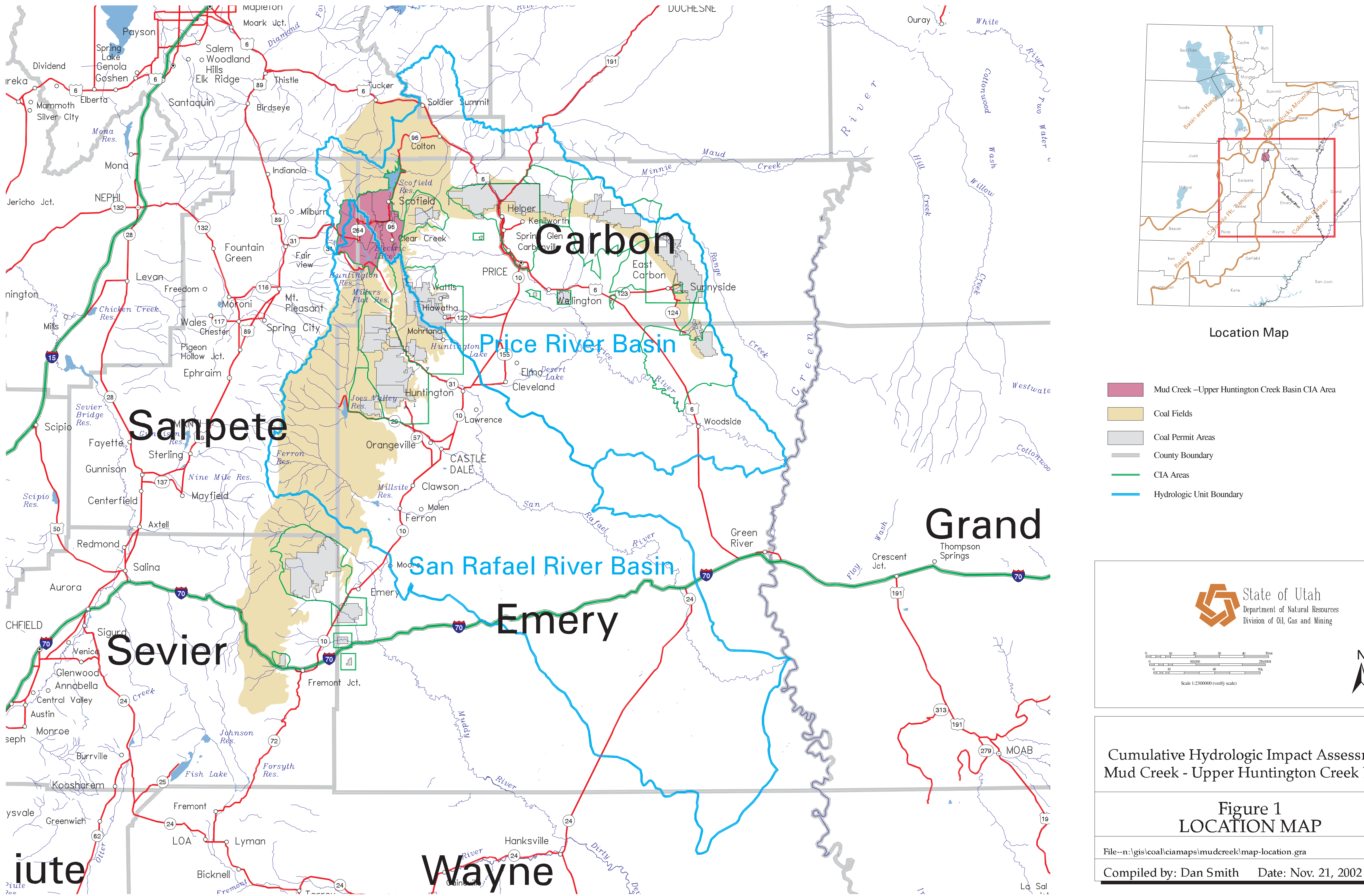
Appendix A



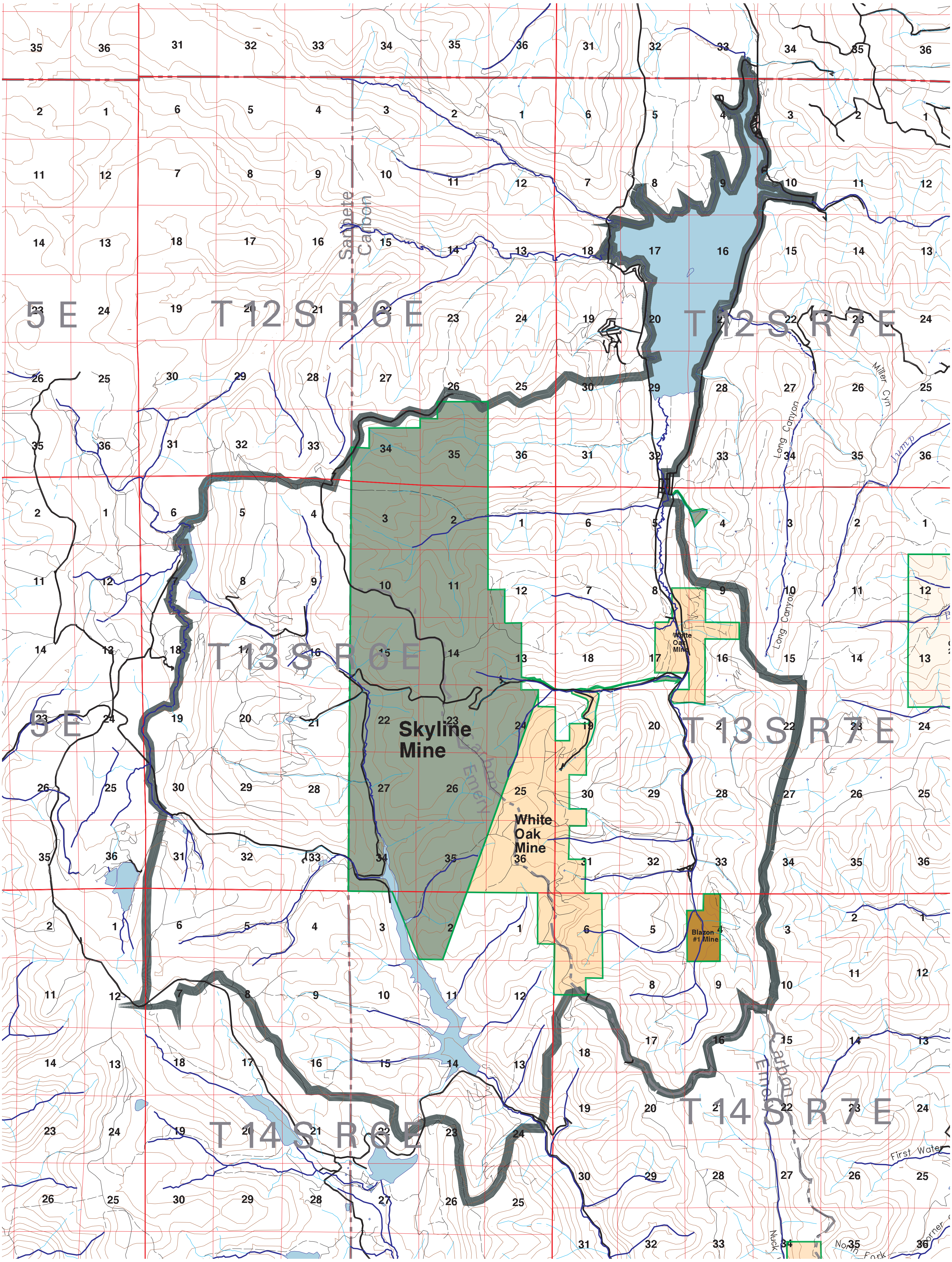
State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 1
LOCATION MAP

File--n:\gis\coal\ciamaps\mudcreek\map-location.gra

Compiled by: Dan Smith Date: Nov. 21, 2002



CIA Area
Intermittent Stream
Perennial Stream
Contours 200ft Interval
Main Road
Graded Dirt Road
Dirt Road

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 2
CUMULATIVE IMPACT AREA (CIA)

File--n:\gis\coal\ciamaps\mudcreek\map-cia.gra

Compiled by: Dan Smith   Date: Nov. 21, 2002

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

N

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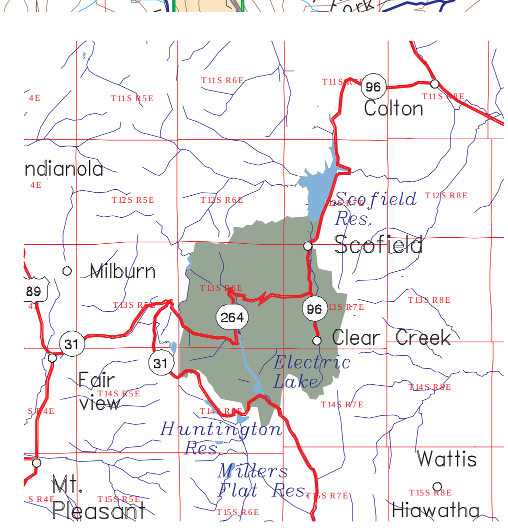
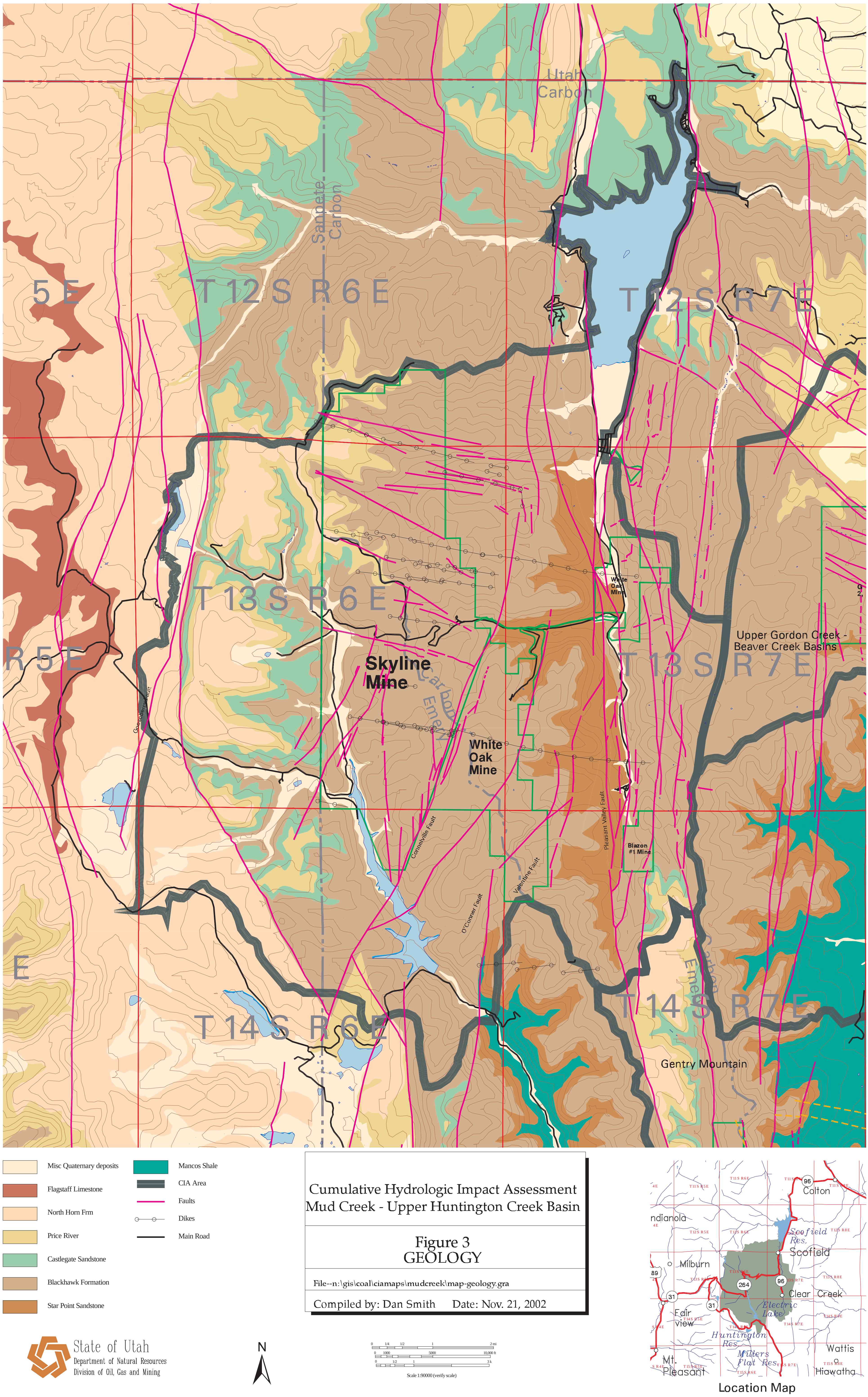


Location Map



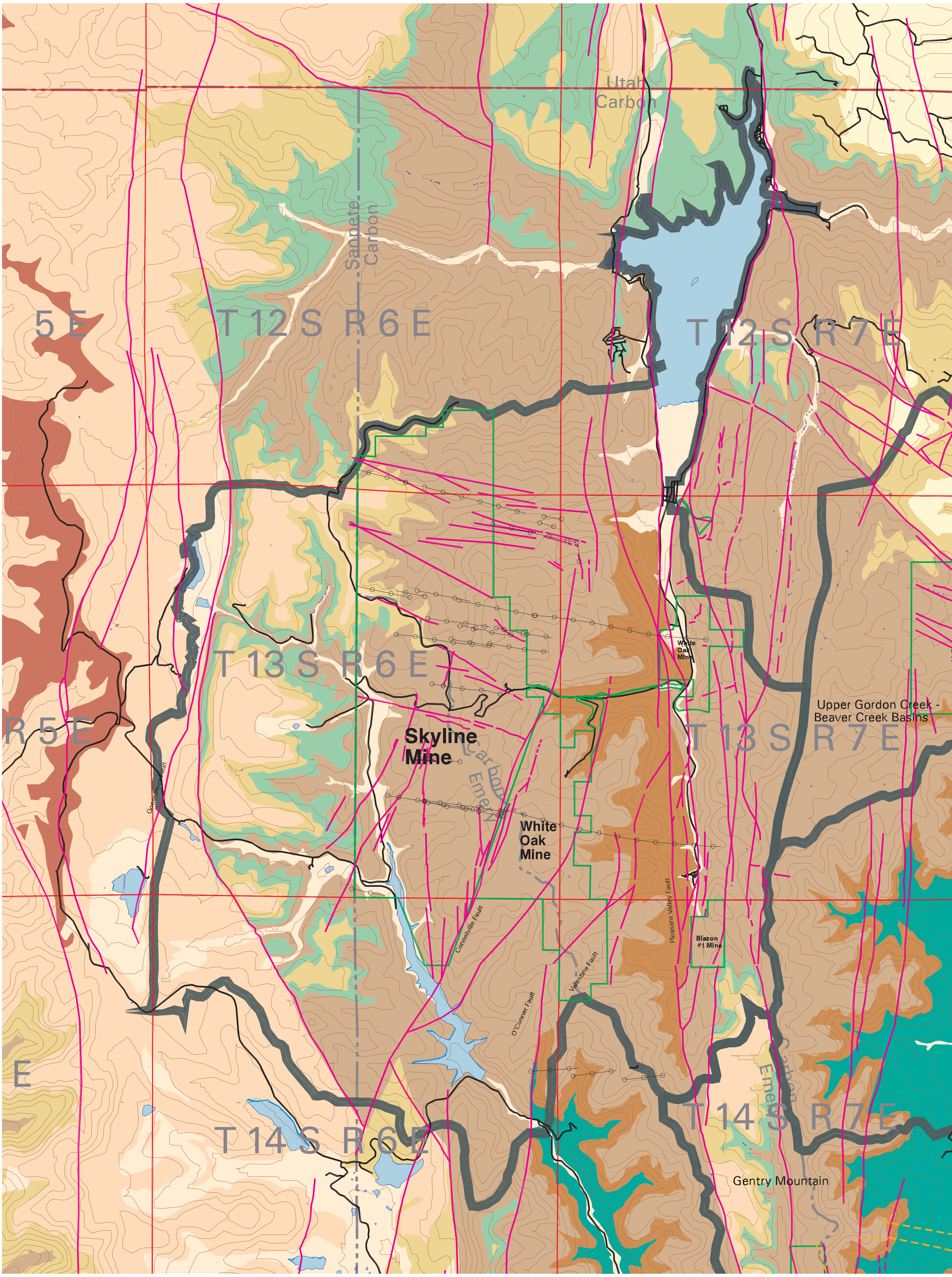
Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 3
GEOLOGY

File--n:\gis\coal\ciamaps\mudcreek\map-geology.gra

Compiled by: Dan Smith   Date: Nov. 21, 2002

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining



- Misc Quaternary deposits
- Flagstaff Limestone
- North Horn Frm
- Price River
- Castlegate Sandstone
- Blackhawk Formation
- Star Point Sandstone
- Mancos Shale
- CIA Area
- Faults
- Dikes
- Main Road

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 3
GEOLOGY

File--n:\gis\coal\ciamaps\mudcreek\map-geology.gra

Compiled by: Dan Smith Date: Nov. 21, 2002

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

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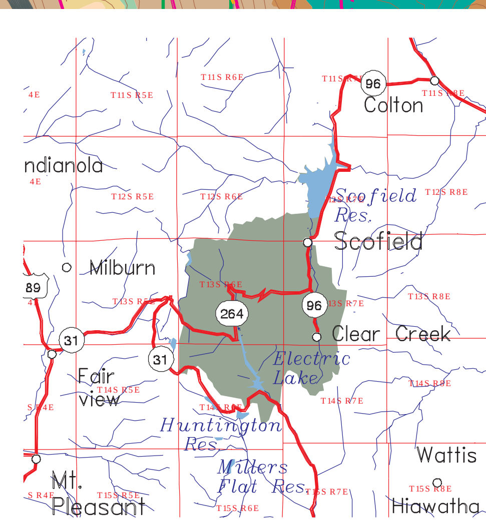
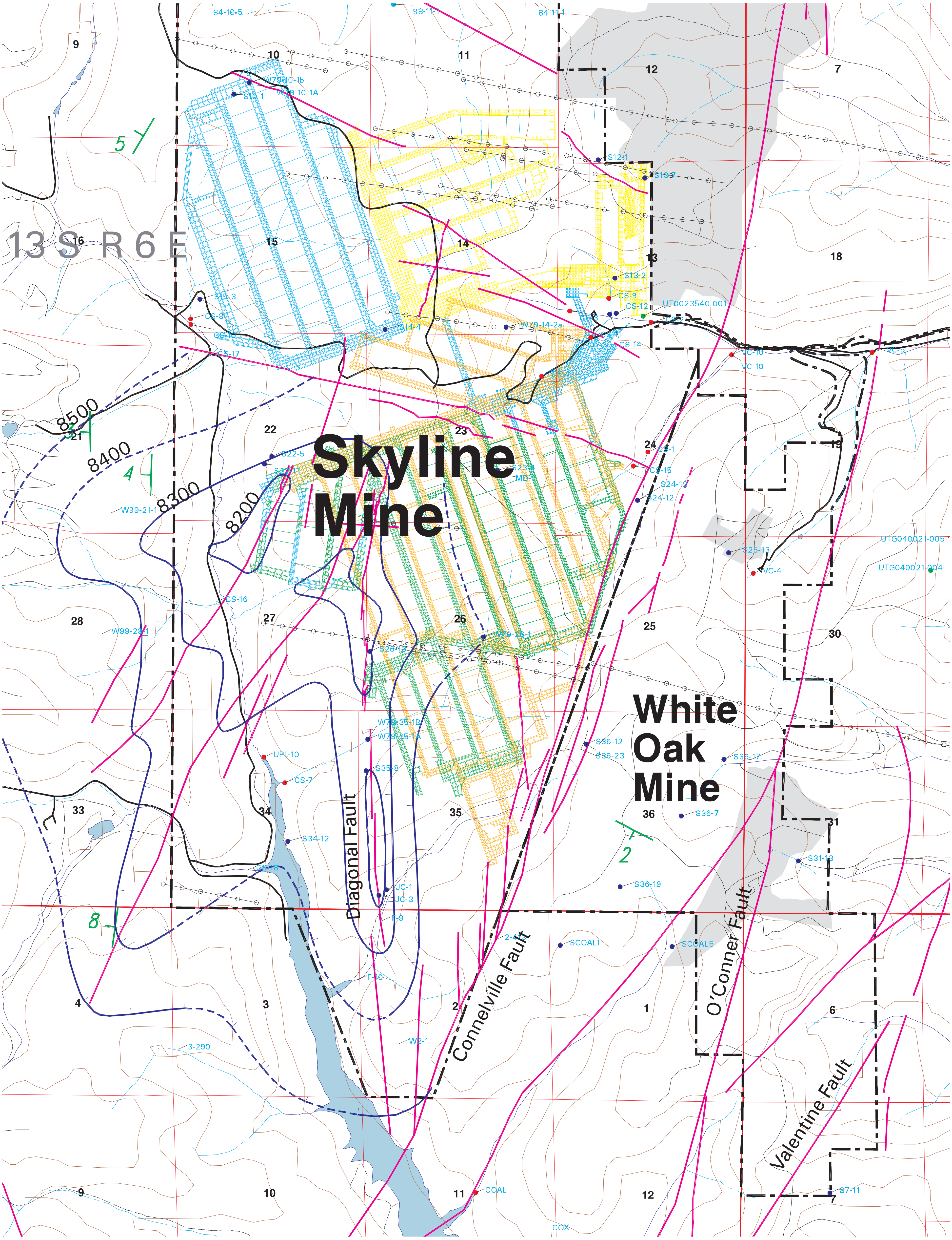


Location Map



Pre-SMCRA, Pre-1977 Mining
Streams
Major Faults
Piezometric Surface Oct 2001
Piezometric Surface Infered Oct 2001
Dikes
Ground Monit.
Surface Water Monit. Site
UPDES Monit. Site

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 3a - Skyline Mine
Mining and Geology

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Compiled by: Dan Smith   Date: August 26, 2003

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

N

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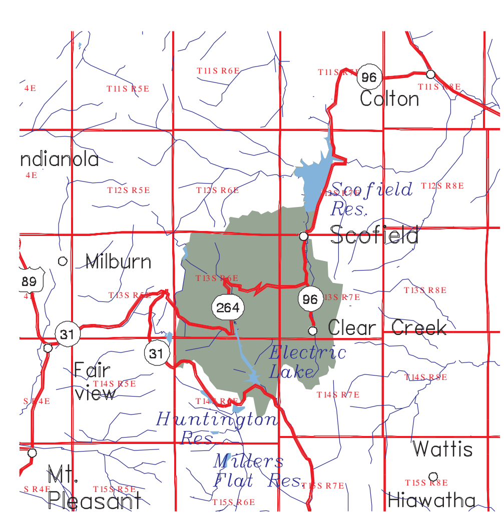
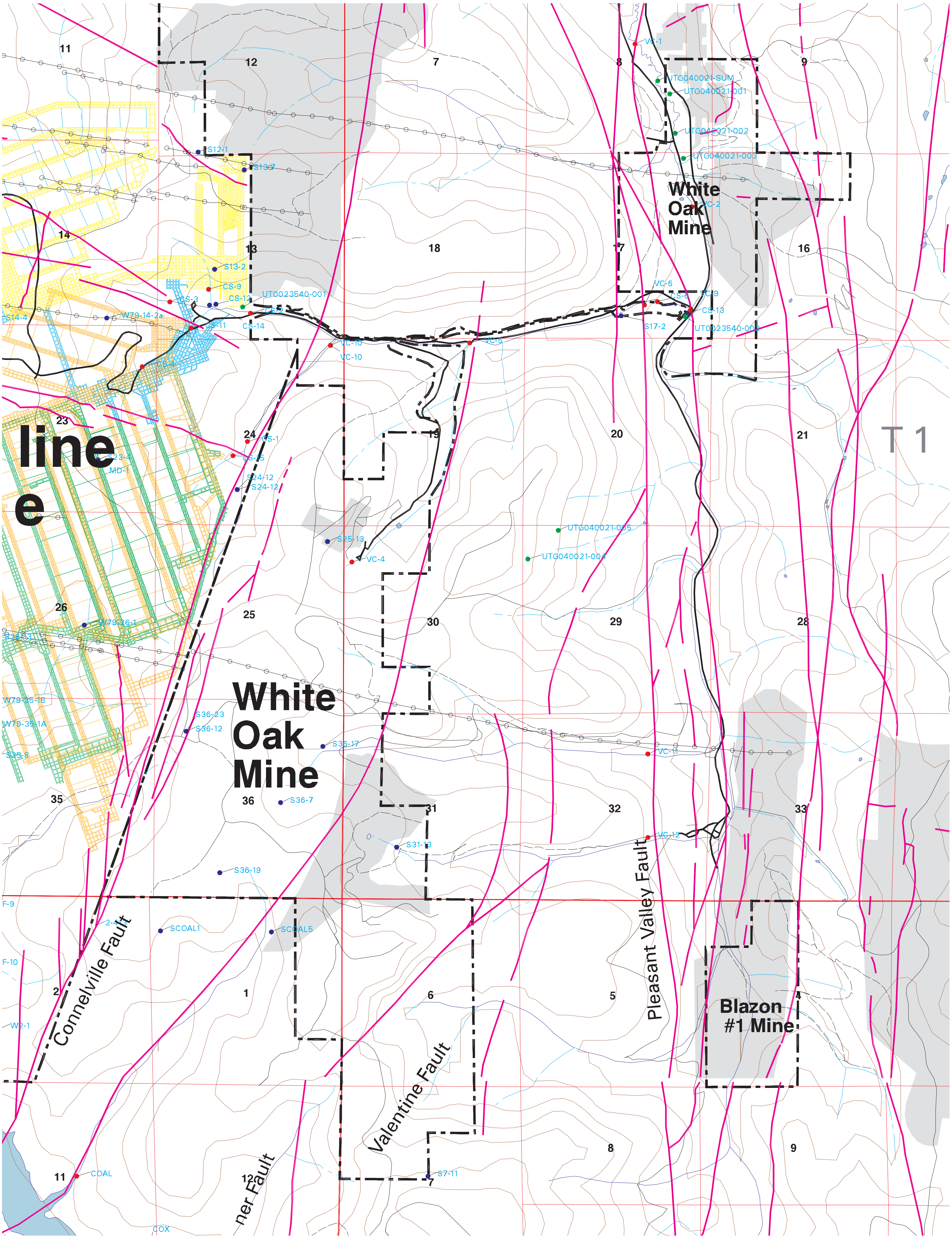


Location Map



(grey)	Pre-SMCRA, Pre-1977 Mining
(line)	Streams
(line)	Major Faults
(line)	Dikes
(dot)	Ground Monit.
(dot)	Surface Water Monit. Site
(dot)	UPDES Monit. Site

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

N

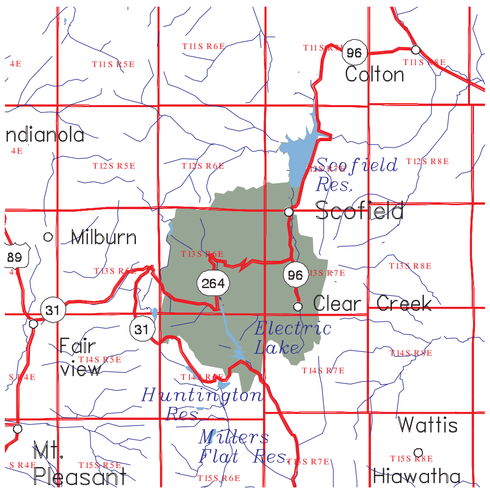
Scale 1:32142 (verify scale)

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

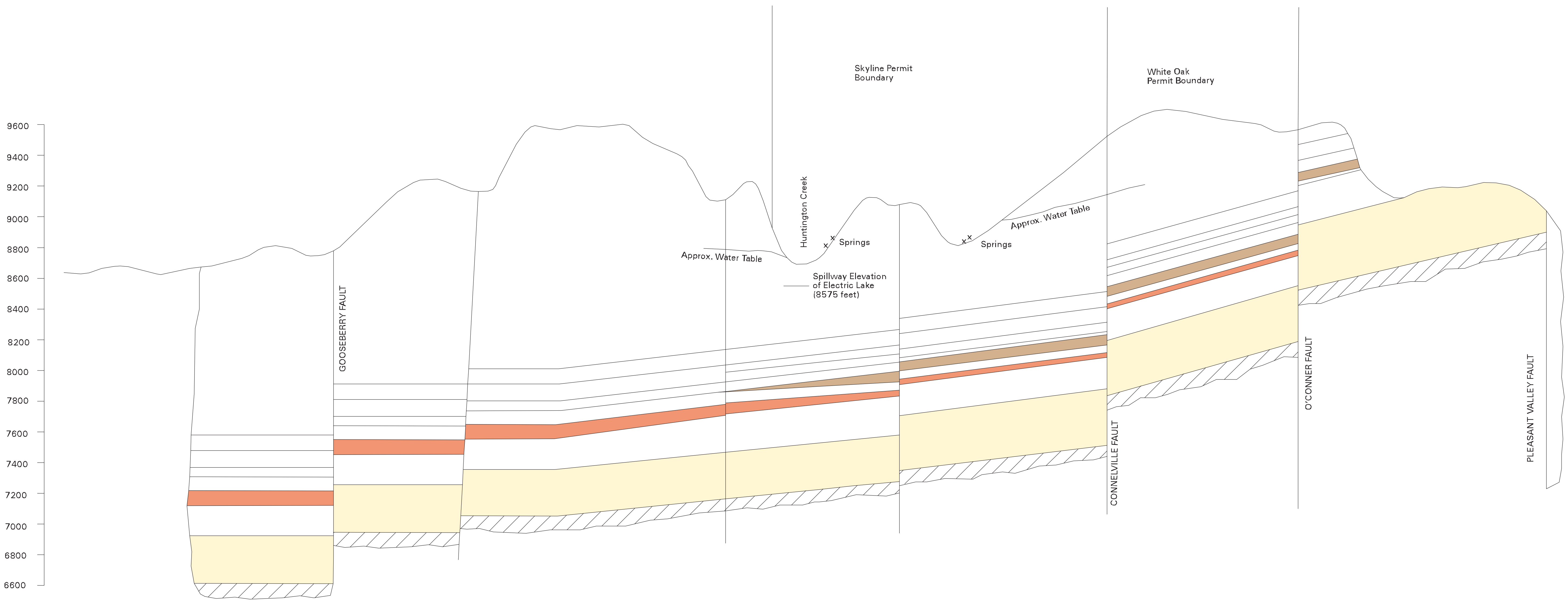
Figure 3b
White Oak and Blazon Mines
Mining and Geology

File--n:\gis\coal\ciamaps\mudcreek\map-mining2.gra

Compiled by: Dan Smith Date: Nov. 21, 2002



Location Map



Hydrogeologic Cross-Section

Storrs Sandstone | Panther Sandstone | Starpoint Sandstone | No Flow Boundary

Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 4
HYDROGEOLOGIC CROSS-SECTION

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Compiled by: Dan Smith Date: Nov. 21, 2002

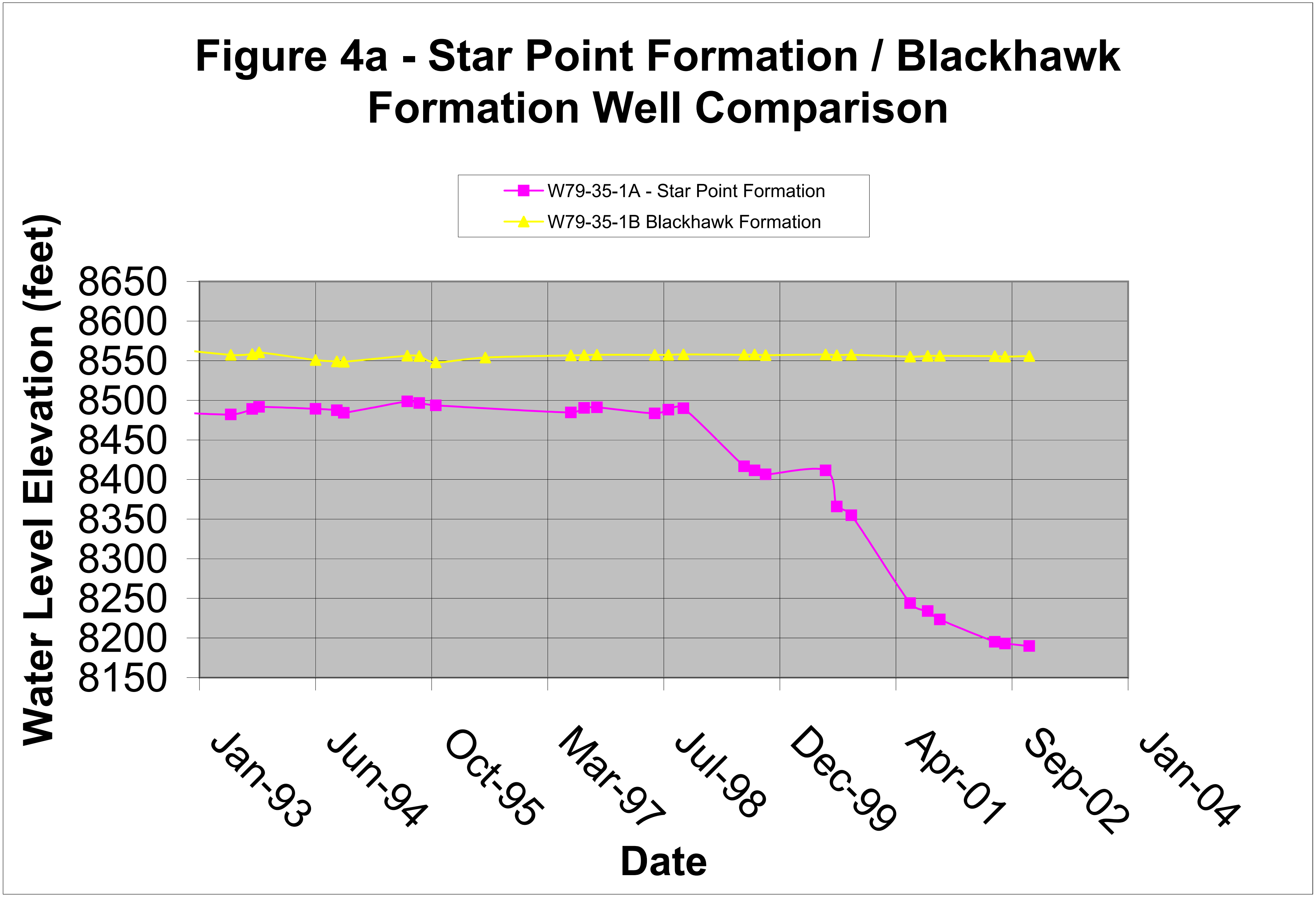
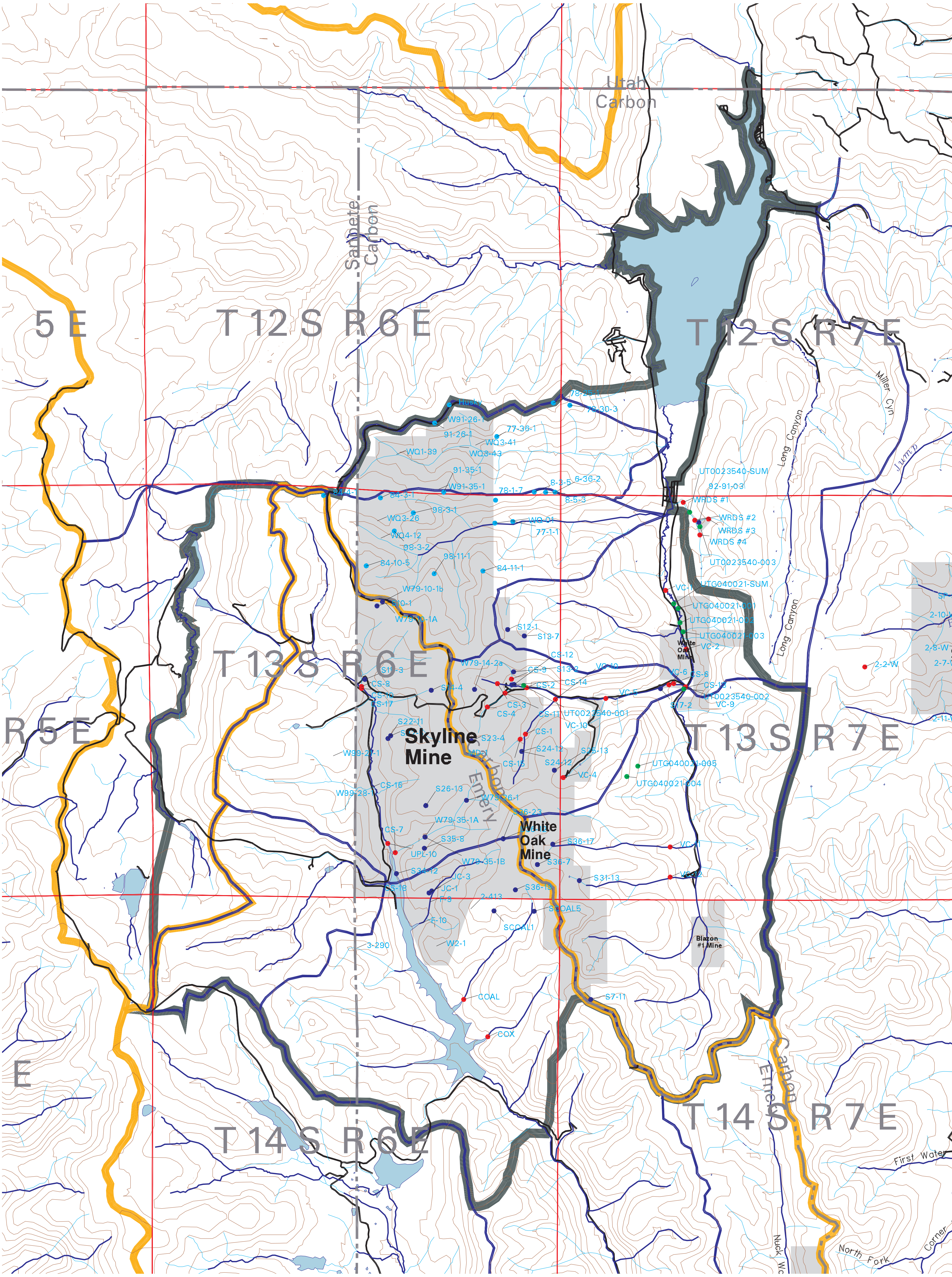


Figure 4a - Star Point Formation / Blackhawk Formation Well Comparison
W79-35-1A - Star Point Formation
W79-35-1B Blackhawk Formation
Water Level Elevation (feet)
8650
8600
8550
8500
8450
8400
8350
8300
8250
8200
8150
Jan-93
Jun-94
Oct-95
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02
Jan-04
Date



- CIA Area
- Intermittent Stream
- Perennial Stream
- Contours 200ft Interval
- Main Road
- Major River Basin
- Hydro Sub-Basin
- Ground Monit.
- Surface Water Monit. Site
- UPDES Monit. Site

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining

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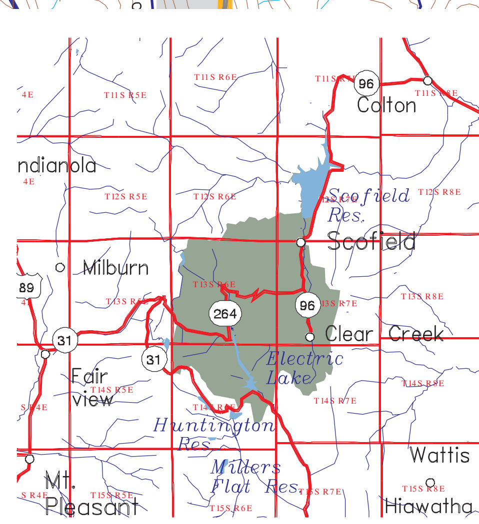
Cumulative Hydrologic Impact Assessment
Mud Creek - Upper Huntington Creek Basin

Figure 5
SURFACE HYDROLOGY

File--n:\gis\coal\ciamaps\mudcreek\map-hydro.gra

Compiled by: Dan Smith Date: Nov. 21, 2002



Location Map

FIGURE 6A
TDS in Lower Eccles Creek
CS-2, VC-6, CS-6, &VC-9 1981-2002

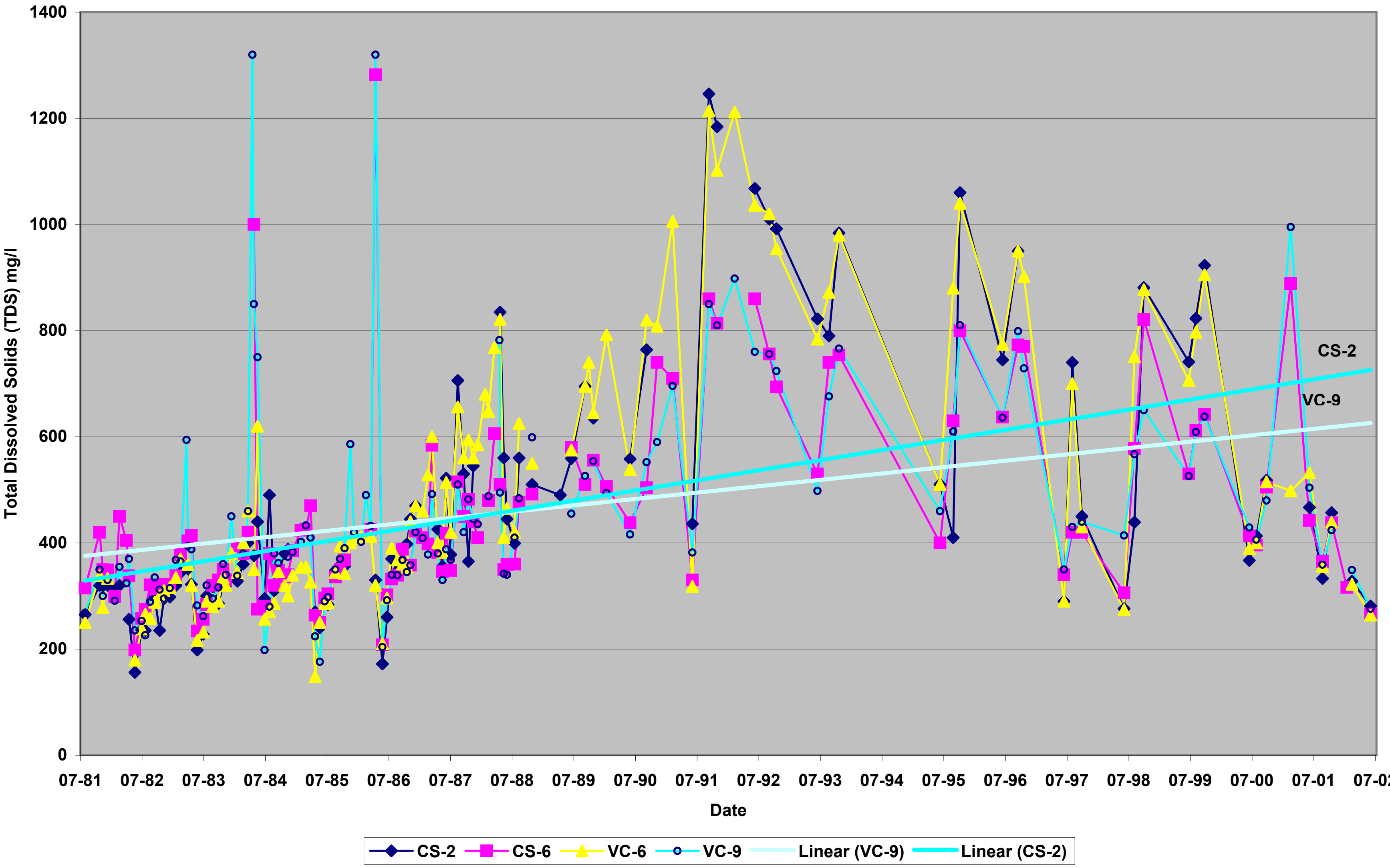


FIGURE 6B
TDS in Upper Eccles Creek
CS-3, CS-4, CS-9, &CS-11 1978-2002

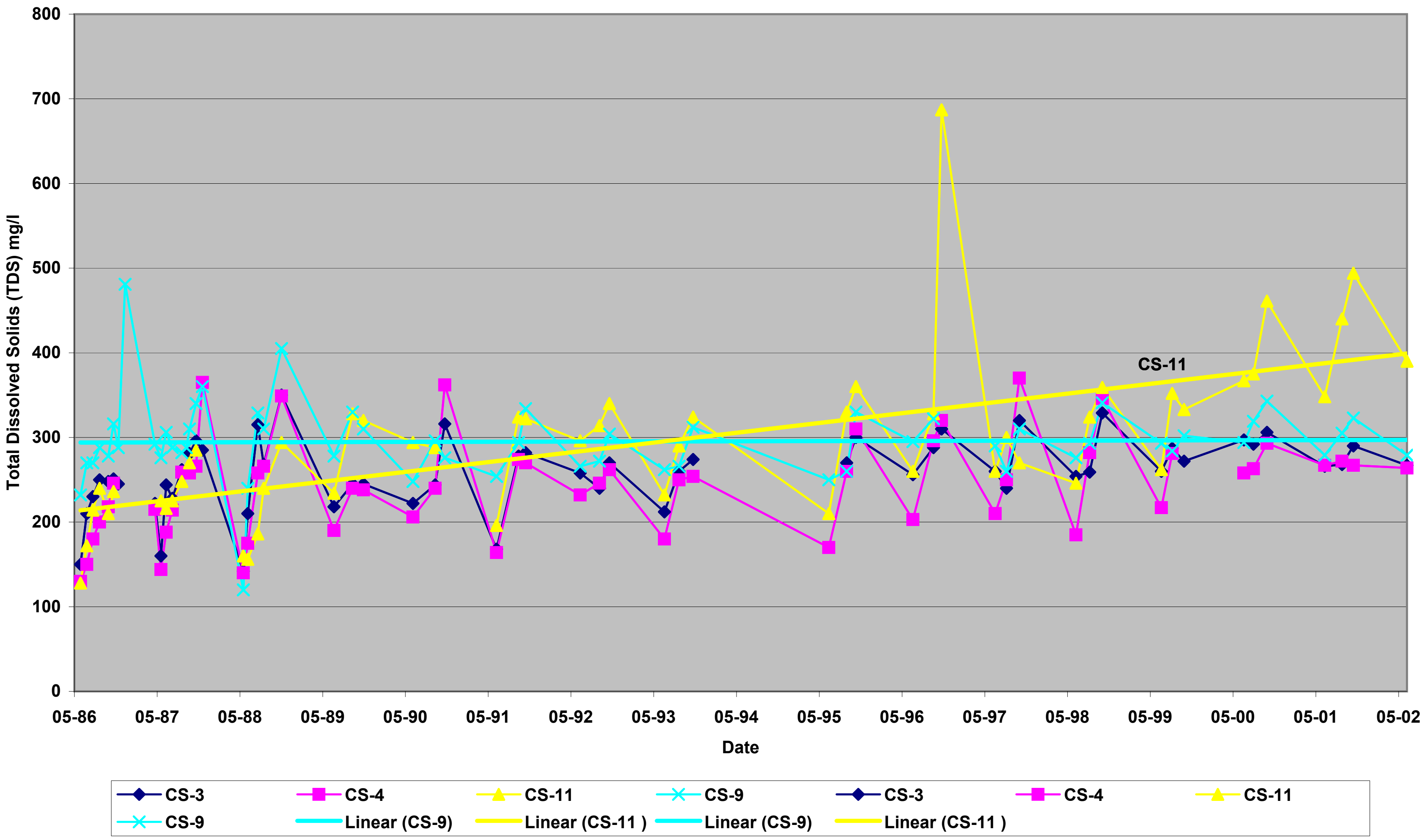


FIGURE 6C

TDS in South Fork of Eccles Creek

CS-1 & VC-10 1978-2002

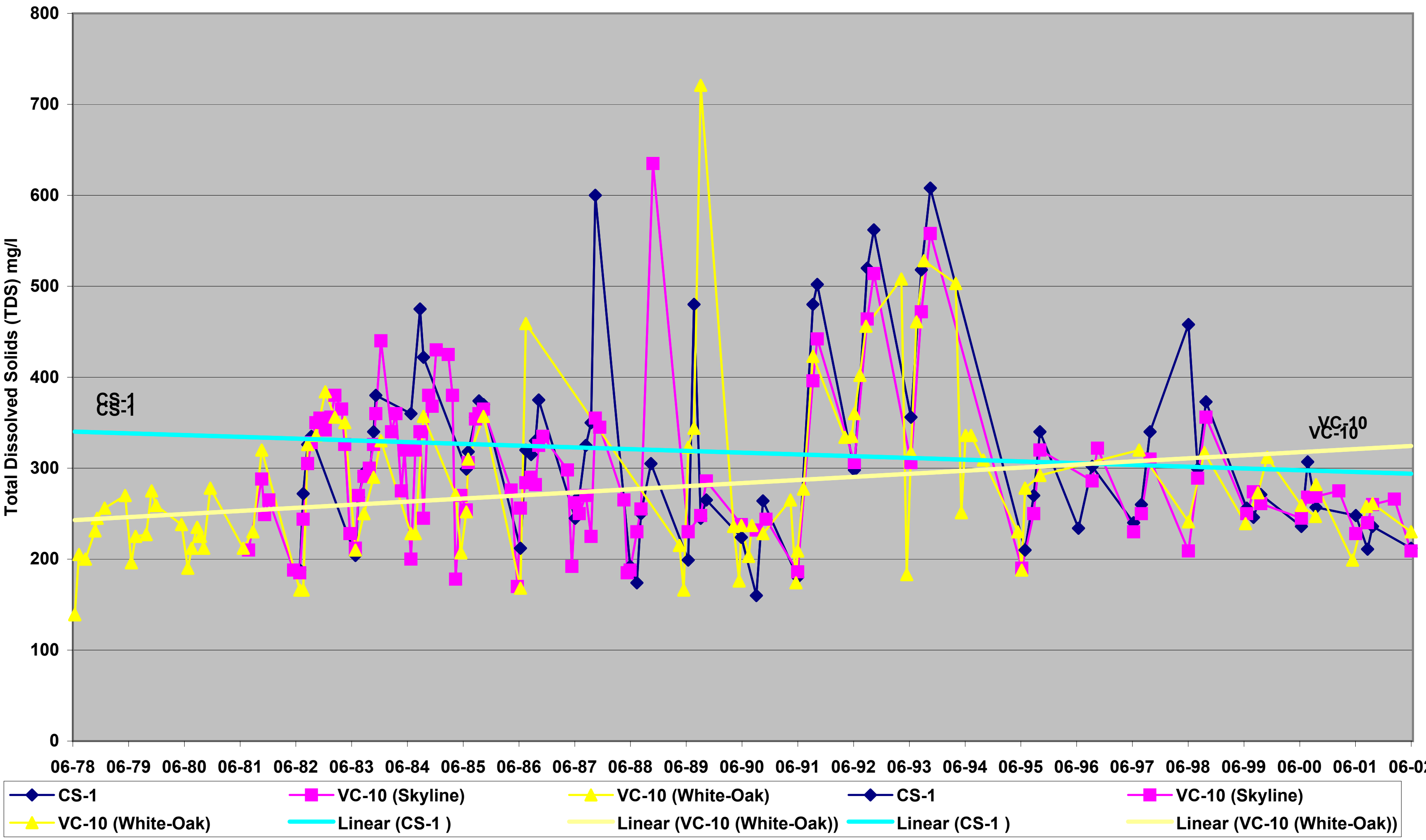
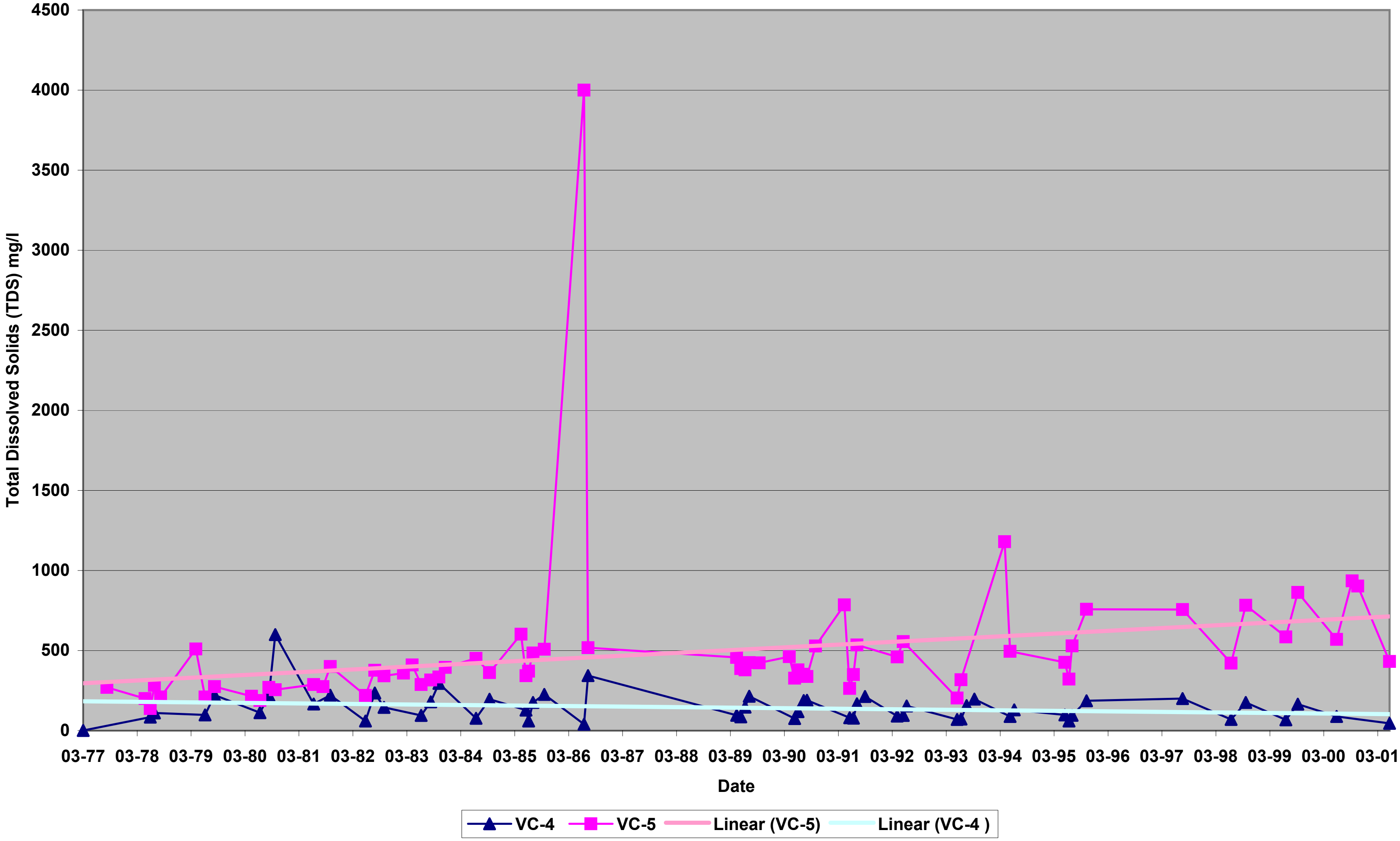


FIGURE 6D
TDS in Whiskey Creek
VC-4 & VC-5 1977-2001



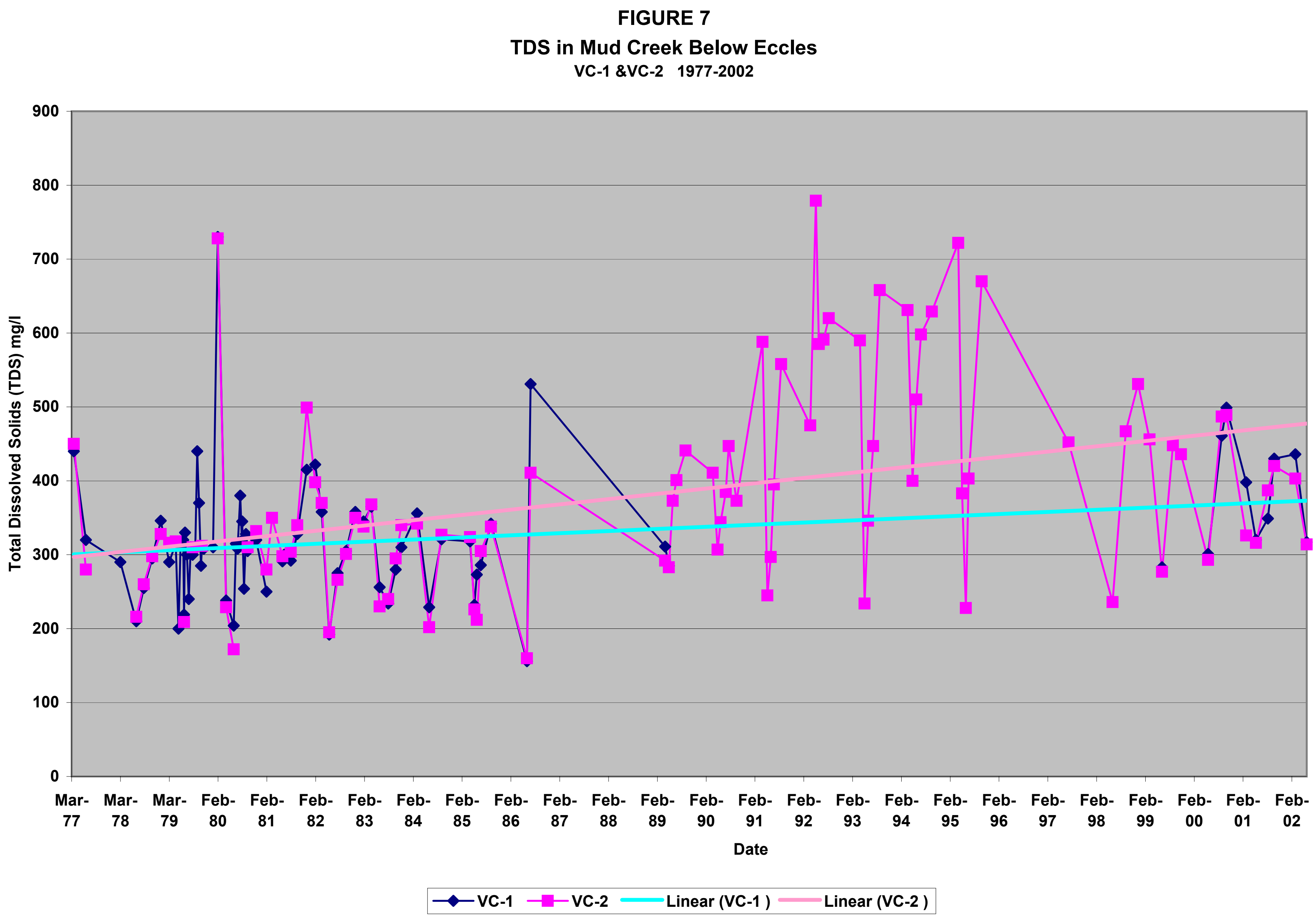
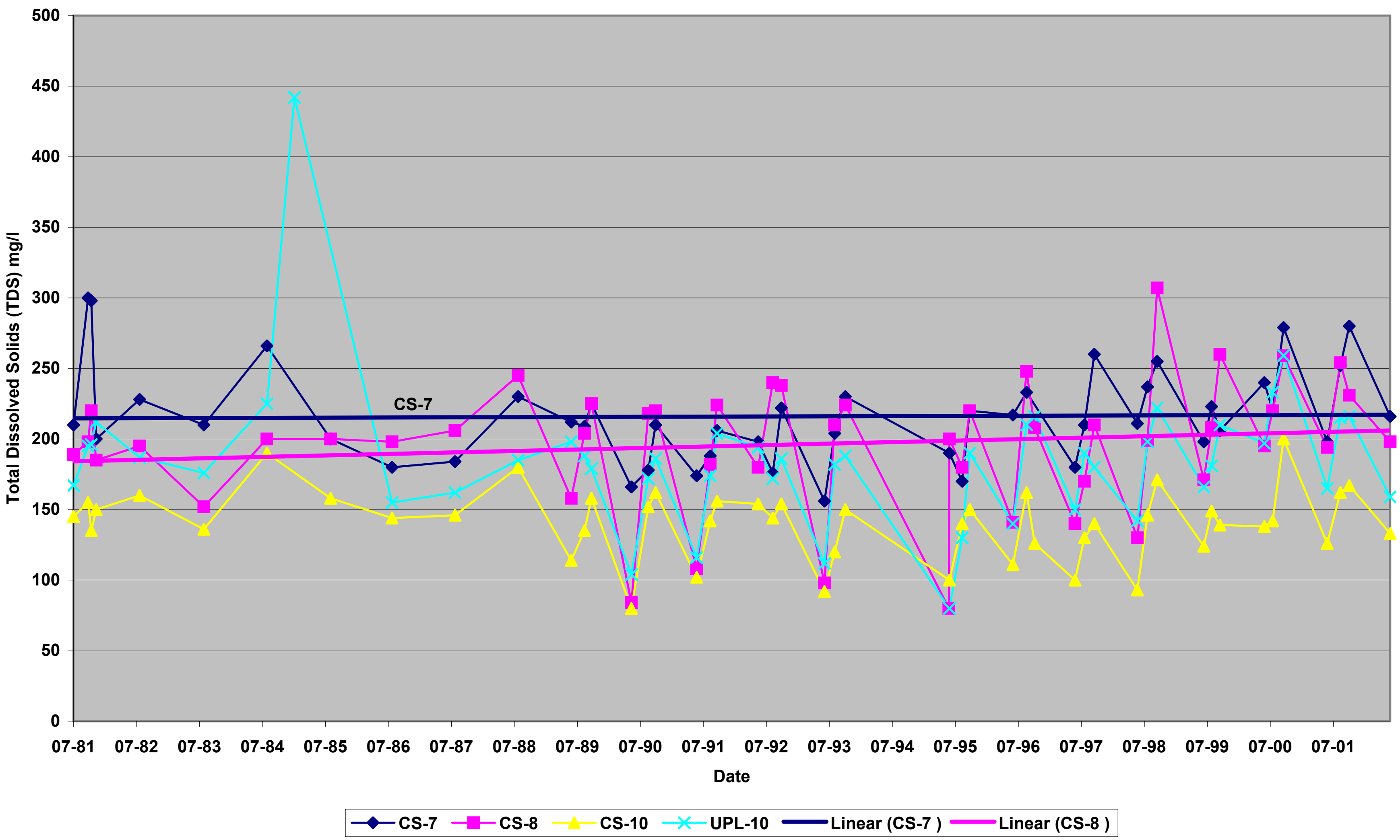


FIGURE 7
TDS in Mud Creek Below Eccles
VC-1 &VC-2 1977-2002
900
800
700
600
500
400
300
200
100
0
Total Dissolved Solids (TDS) mg/l
Mar-77
Mar-78
Mar-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Feb-86
Feb-87
Feb-88
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Date
VC-1
VC-2
Linear (VC-1)
Linear (VC-2)

FIGURE 8
TDS in Upper Huntington Creek
CS-7, CS-8, CS-10 & UPL-10 1981-2002



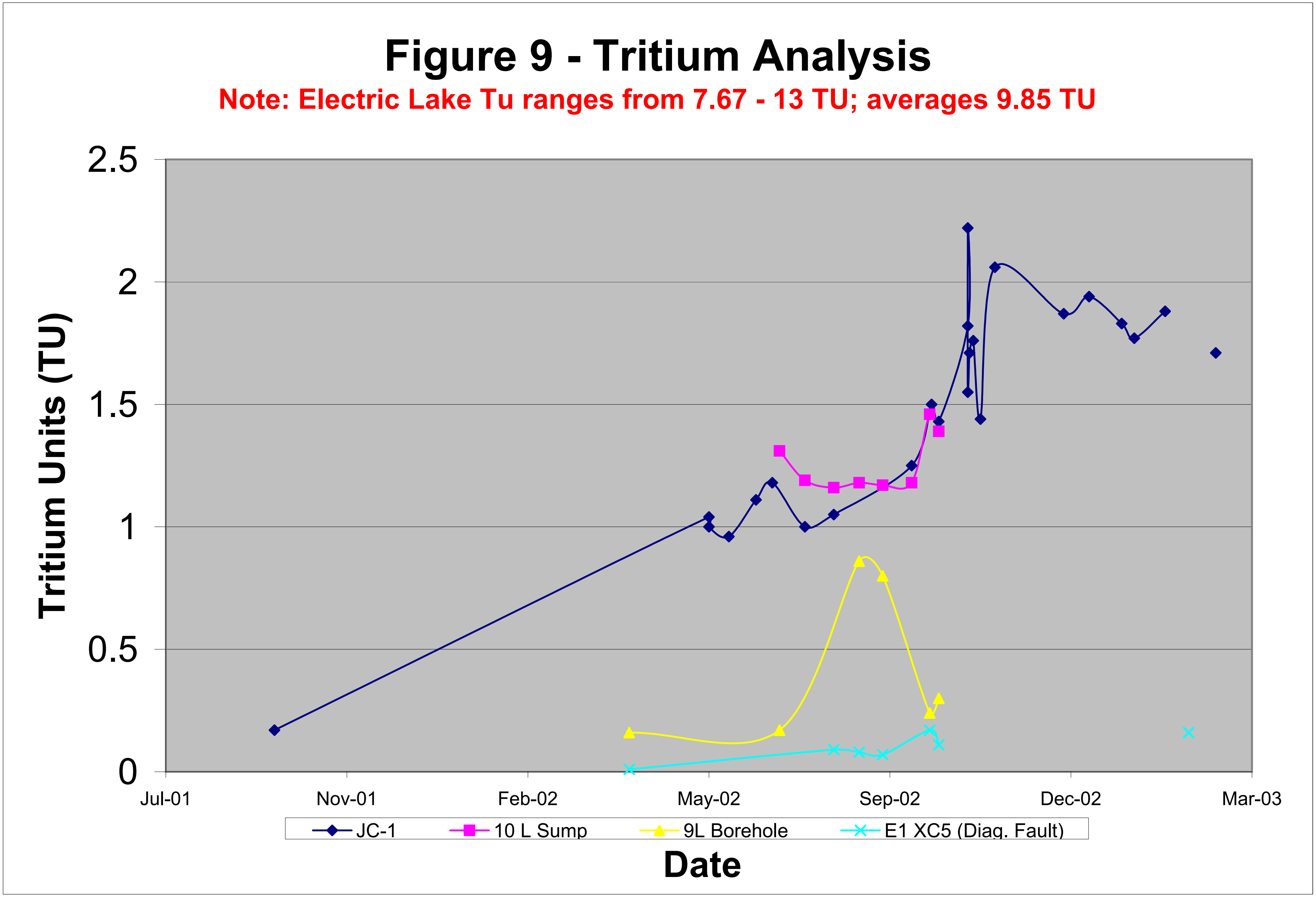
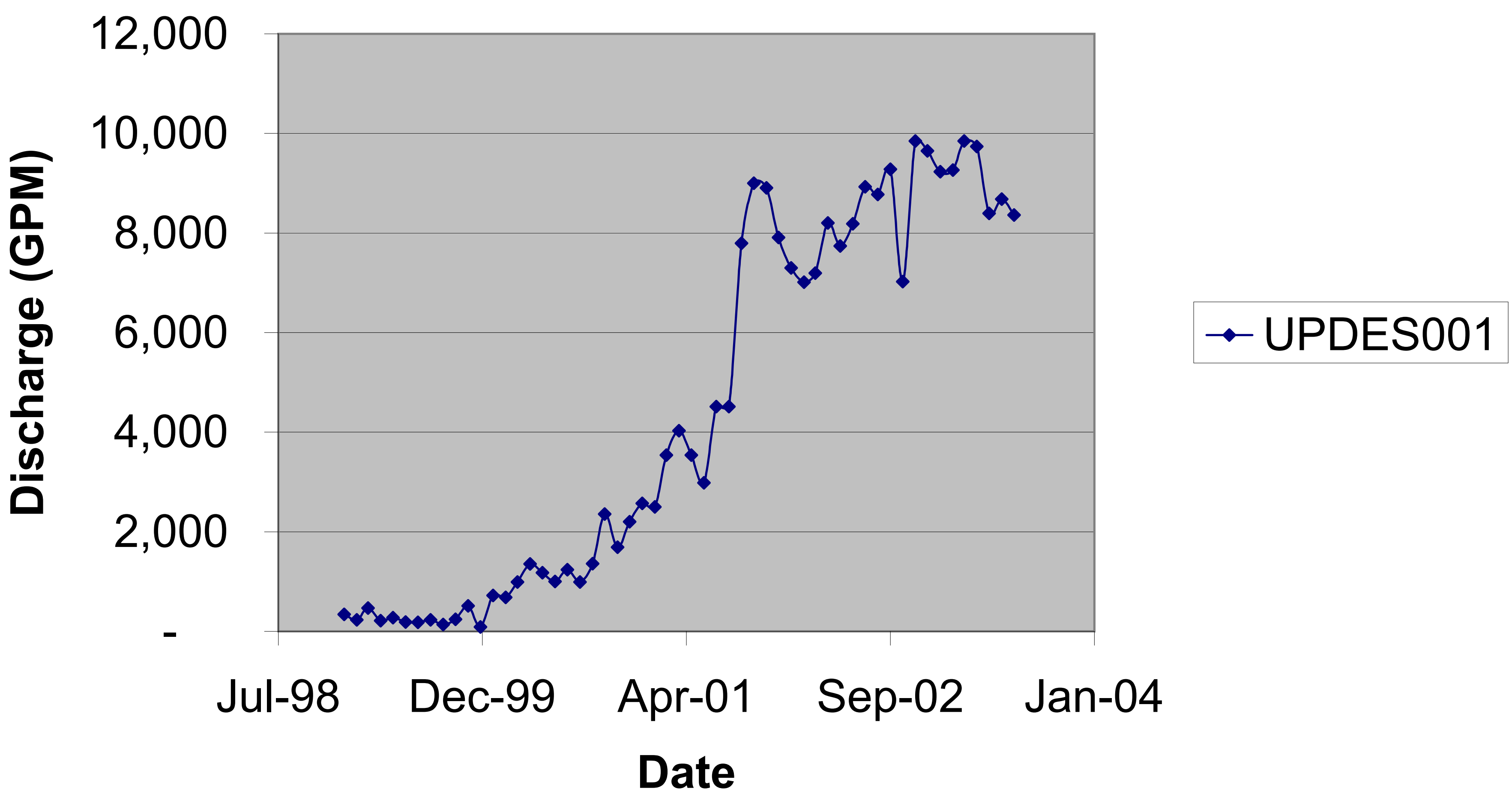


Figure 9 - Tritium Analysis
Note: Electric Lake Tu ranges from 7.67 - 13 TU; averages 9.85 TU
Tritium Units (TU)
2.5
2
1.5
1
0.5
0
Jul-01
Nov-01
Feb-02
May-02
Sep-02
Dec-02
Mar-03
JC-1
10 L Sump
9L Borehole
E1 XC5 (Diag. Fault)
Date

Figure 10 - Skyline Mine Discharge to Eccles Creek



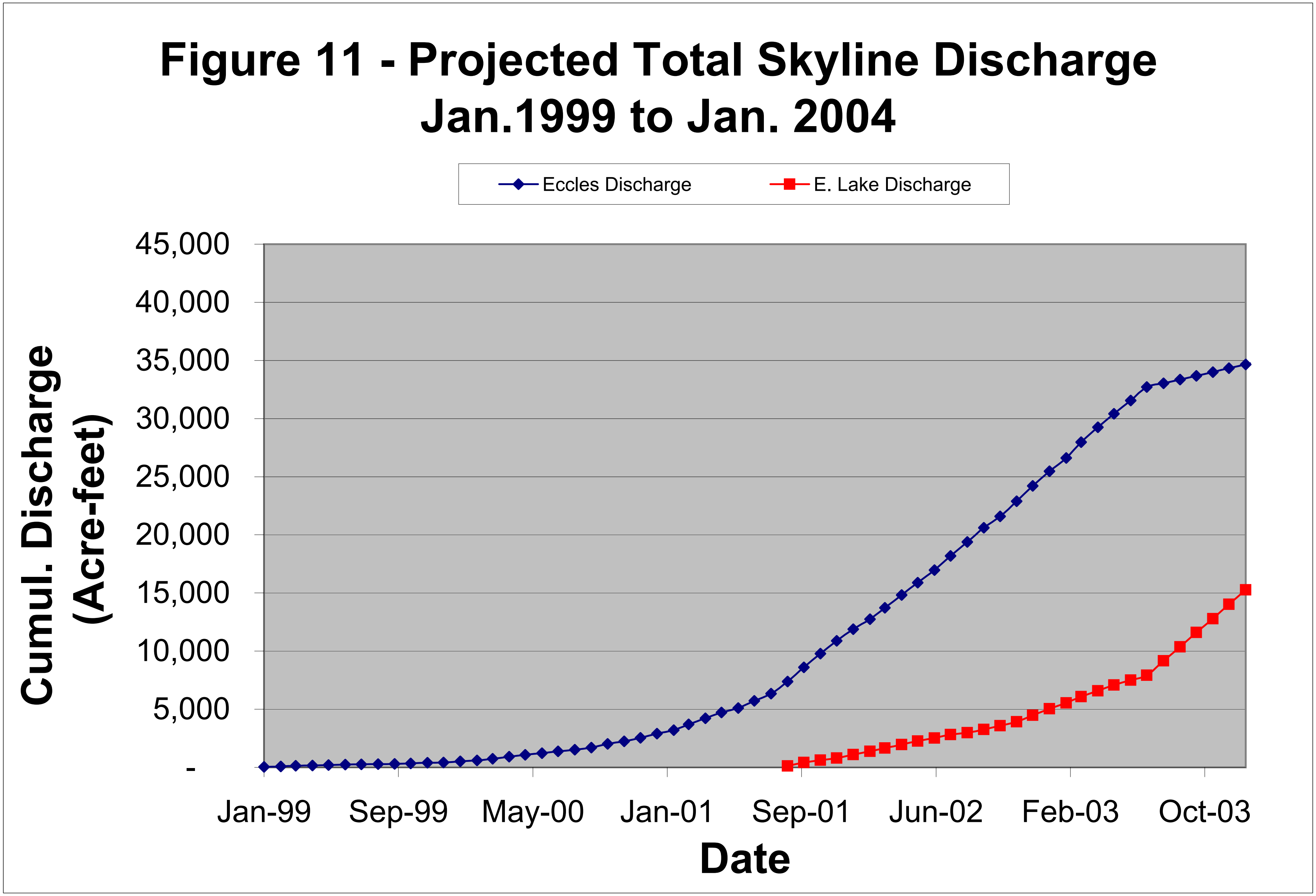


Figure 11 - Projected Total Skyline Discharge
Jan.1999 to Jan. 2004
Eccles Discharge
E. Lake Discharge
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
Cumul. Discharge (Acre-feet)
Jan-99
Sep-99
May-00
Jan-01
Sep-01
Jun-02
Feb-03
Oct-03
Date

Appendix B

Photo 1
Photo 2
Photo 3