Hydrologic Inventory and Baseline Study of the Valley Camp Lease Area, Carbon and Emery Counties, Utah

Prepared for
VALLEY CAMP OF UTAH, INCORPORATED
Clear Creek, Utah

January 1980

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HYDROLOGIC INVENTORY OF THE VALLEY CAMP LEASE AREA AND ADJACENT AREAS, CARBON AND EMERY COUNTIES, UTAH

INTRODUCTION

Recent regulations promulgated by the U.S. Office of Surface Mining Reclamation and Enforcement (OSM) require that environmental resource information be assembled and submitted in areas of surface or underground coal mining prior to renewal of outstanding permits to continue mining operations. Specifically, sections 783.13, 783.15, 783.16, and 783.17 of the OSM regulations (found in volume 44, number 50 of the Federal Register dated Tuesday, March 13, 1979) require that hydrologic information be gathered. In accordance with these regulations, a hydrologic study has been conducted on the 2740 acre coal lease area owned by Valley Camp of Utah, Inc. near the town of Scofield, Utah which is referred to as the Vally Camp lease area (see Figure 1). Coal resources at the site are currently being developed in the Belina mine, although other presently abandoned mines exist within the lease area (i.e. O'Conner and Eagle mines). The purpose of this report is to describe the present hydrologic conditions in the area of concern, the expected impact of future development and continuing mining activities in the Valley Camp lease area on the local and regional hydrologic system, and the methods which have been and will be used to predict and monitor this impact.

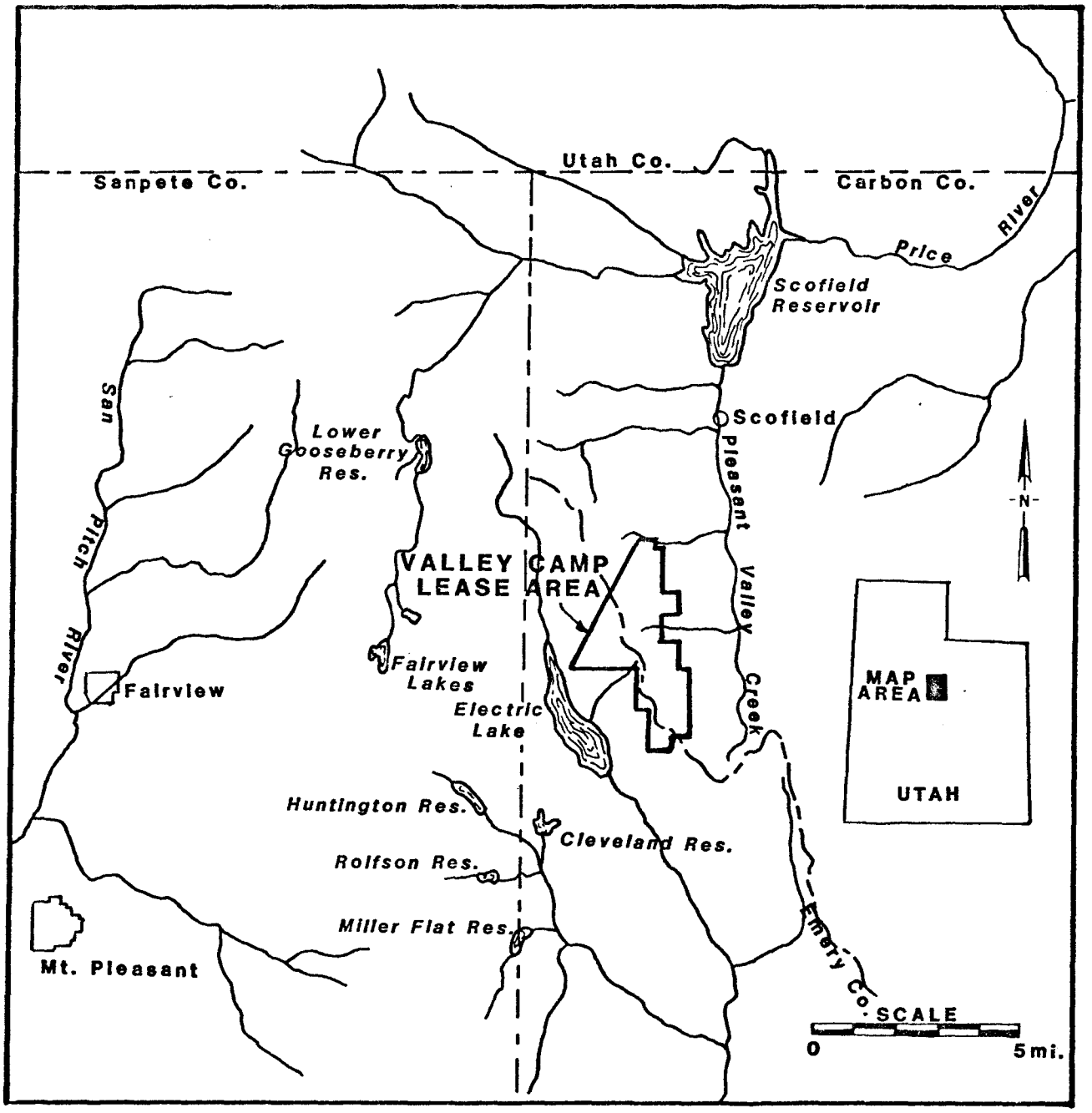


Figure 1. Location of the Valley Camp lease area.

This report has been divided into six sections. The first section describes the overall hydrologic environment, giving a synopsis of the physical variables in the area which have an effect on the hydrologic system. The next section describes the surface water hydrologic system of the lease area and the property adjacent to it along with the associated mining and post-mining monitoring program. The third section takes a similar look at the local and regional ground water system. Current water rights (surface and subsurface) within and surrounding the lease area are then presented, followed by a discussion of the probable impact of mining on the hydrologic system of the lease and adjacent areas (considering both the impacts of Valley Camp mines alone and the cumulative impacts of all mining activity in the area). The final section lists references, including both literature cited in the report and personal contacts made with research organizations and governmental agencies during the study period.

Vaughn Hansen Associates (VHA) of Salt Lake City, Utah has been responsible for the collection and reduction of all hydrologic data. Water quality samples have been analyzed by Ford Chemical Laboratory, Inc. of Salt Lake City, Utah. Methodologies used to collect and analyze the data are described in the appropriate section of the main body of this report.

The majority of the data and information presented in this report were collected and analyzed between the fall of 1975 and December 1979 (inclusive). Where appropriate, individual dates of collection will be noted in the main body of the report.

HYDROLOGIC ENVIRONMENT

Several physical variables have an effect on the hydrologic response of a given area. Among these are geology, soils, climate, and vegetation. Although each of these subjects is covered in a separate report of this application in greater detail, an overview is given here as an aid in understanding the hydrologic system of the Valley Camp lease area and adjacent land. Individual points will be re-emphasized and strengthened, as necessary, in subsequent sections of this report as the data are presented and interpreted.

Geology

The Valley Camp lease area lies in the northern end of the Wasatch Plateau, on the west flank of the Clear Creek Anticline (Doelling, 1972). As such, the dip of the strata is generally towards the west, ranging from about four to eight percent (two to five degrees).

With the exception of local alluvial deposits, all of the units exposed on and immediately adjacent to the Valley Camp lease area are Cretaceous members of the Mesaverde Formation (see Figure 2). The Star Point Sandstone, which extends slightly onto the lease area on the surface in the east canyons, is about 1000 feet thick and nearly devoid of shale (Doelling, 1972). This yellow-gray (salt and pepper) beach sandstone is massive and medium-grained (Spieker, 1931).

Immediately overlying the Star Point Sandstone is the Blackhawk Formation, an interbedded formation of sandstones and shales which is Utah's chief coal

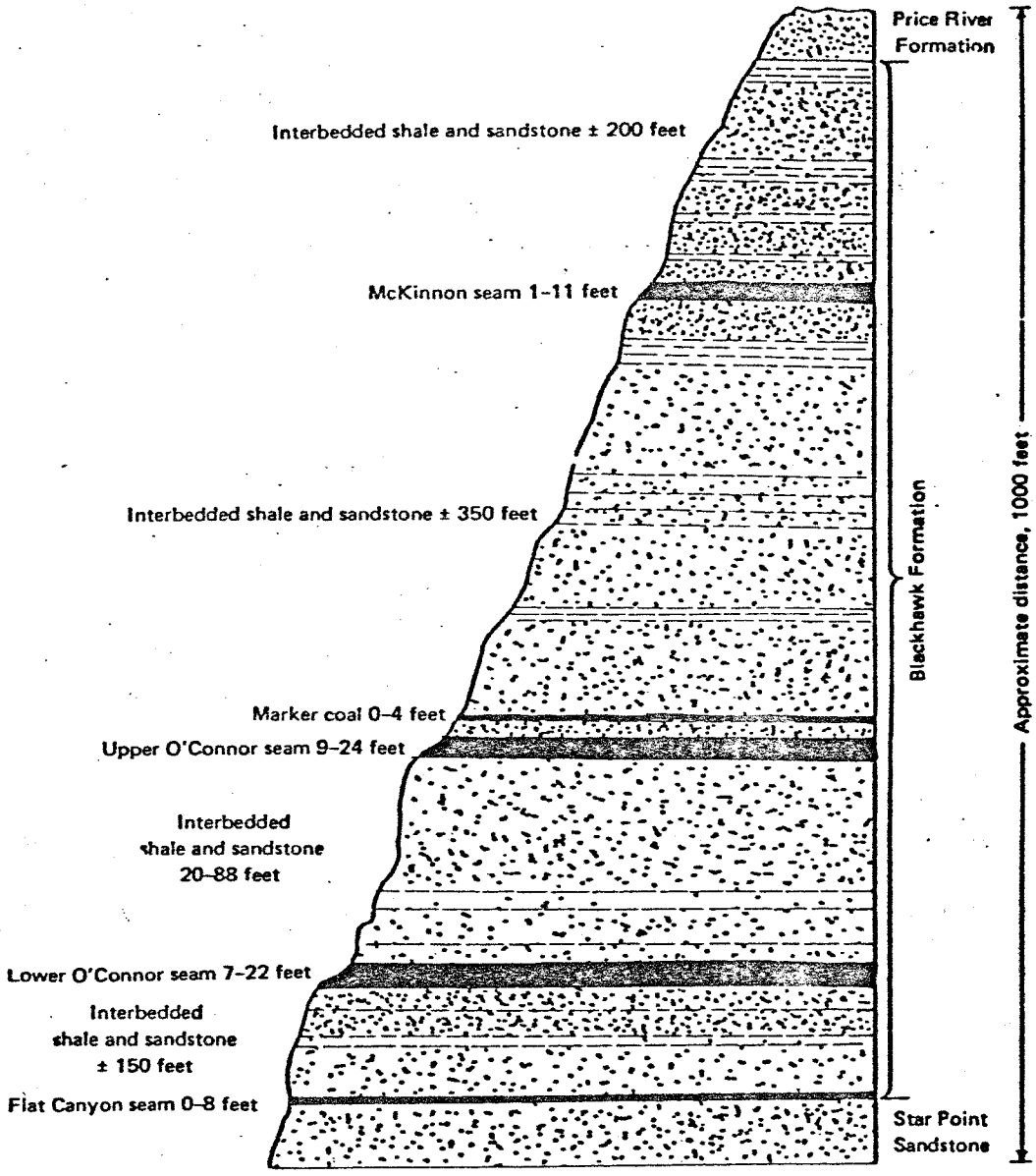


Figure 2. Generalized stratigraphic column near the east boundary of the Valley Camp lease area at the O'Conner mine, Sec. 31, T. 13 S., R. 7 E. (taken from U.S. Geological Survey, 1979).

producer (Stokes, 1964). The sands in this 1000-foot thick member are fine to medium grained and cemented by either calcite or silica with some iron discoloration. They are more irregular than the sandstones of the Star Point, tending to be local in extent and having locally high clay contents (Spieker, 1931; Doelling, 1972). An exception to this is the Aberdeen sandstone, a coarse-grained, light-colored sand with a thickness of 20 to 80 feet, which can be traced throughout the region (Spieker, 1931). The generally discontinuous nature of the Blackhawk sands and their apparent low specific yield (Cordova, 1964) indicate that the water yielding capabilities of the Blackhawk are only locally important.

Spieker (1931) has identified three types of shale in the Blackhawk Formation, all continental in origin---a common clay shale which is soft and granular, a carbonaceous shale, and a smoke-gray shale usually associated with the coal. As was the case with the sandstones, the shales are irregularly bedded (Spieker, 1931). The abundance of shale in the Blackhawk acts as an effective barrier to the downward movement of water within the formation, greatly reducing its overall vertical permeability and the amount of water which percolates through the formation to lower units. Water which reaches the Blackhawk, therefore, percolates downward until it meets a shale layer, which causes horizontal movement to the surface or another "drain" (i.e. sandstone finger) within the formation.

The dominant fault trends in the Valley Camp lease area are northeast-southwest. The faults within the Blackhawk Formation occur basically as

zones (Doelling, 1972) with individual slips usually being clean, sharp displacements with little gouge (Sanders Associates, Inc., no date). Both major faults in the property area are downdropped to the west and tend to die out to the north (U.S. Geological Survey, 1979). The Connelville Fault forms the western boundary of the lease area with a drop which varies from 190 feet at the western central lease boundary to 75 feet near Eccles Canyon (U.S. Geological Survey, 1979). The other major fault in the area, the O'Conner Fault, extends through the center of the lease area and has a drop of about 350 feet (U.S. Geological Survey, 1979). The Pleasant Valley Fault is another major fault which lies east of the lease area.

Other faulting in the area has resulted in only small displacements. It is suspected that these faults have only local hydrologic importance within the Blackhawk Formation because of its high clay content, giving it an ability to seal rapidly. On the other hand, faulting within the Star Point Sandstone likely increases its water yielding capacity due to the creation of secondary porosity (Price and Waddell, 1973).

Soils

No detailed soil survey has been conducted in the lease area by the U.S. Soil Conservation Service. A reconnaissance survey conducted by Rapin (1977), which covers that portion of the lease area within the Manti-LaSal National Forest, indicates that the dominant soils in the area are in loamy skeletal and fine loamy families of Typic and Argic Cryoborolls. As such, they are moderately deep (20 to 40 inches) with thin, dark surface horizons

(high in organic matter), medium-textured (loamy) surface layers, and moderately fine-textured (clay loam) subsoils. Coarse fragment contents tend to be high (35 to 50 percent). A small portion of the area also consists of gravelly and stony colluvial slopes, rock outcrops, and very shallow soils.

As a result physical characteristics, Rapin (1977) indicates that the soils in the lease area are generally moderately stable with a low to moderate inherent erosion hazard. They tend to be well-drained with a moderate to moderately rapid permeability (depending upon whether they were derived primarily from shales or sandstones). Rapin (1977) placed these soils into hydrologic soil group C, which indicates that the infiltration rate is generally slow. It is felt that a more reasonable classification of the soils would be in hydrologic soil group B.

Climate

The continental climate of the lease area is typical of high elevations in the Intermountain Region, with relatively high amounts of precipitation (occurring primarily as snow), low temperatures, and a short growing season (see Figure 3).

Temperature in the area is highly influenced by elevation (Utah Division of Water Resources, 1975). According to Jeppson et al. (1968), January temperatures range from a mean minimum of about 7°F to a mean maximum of

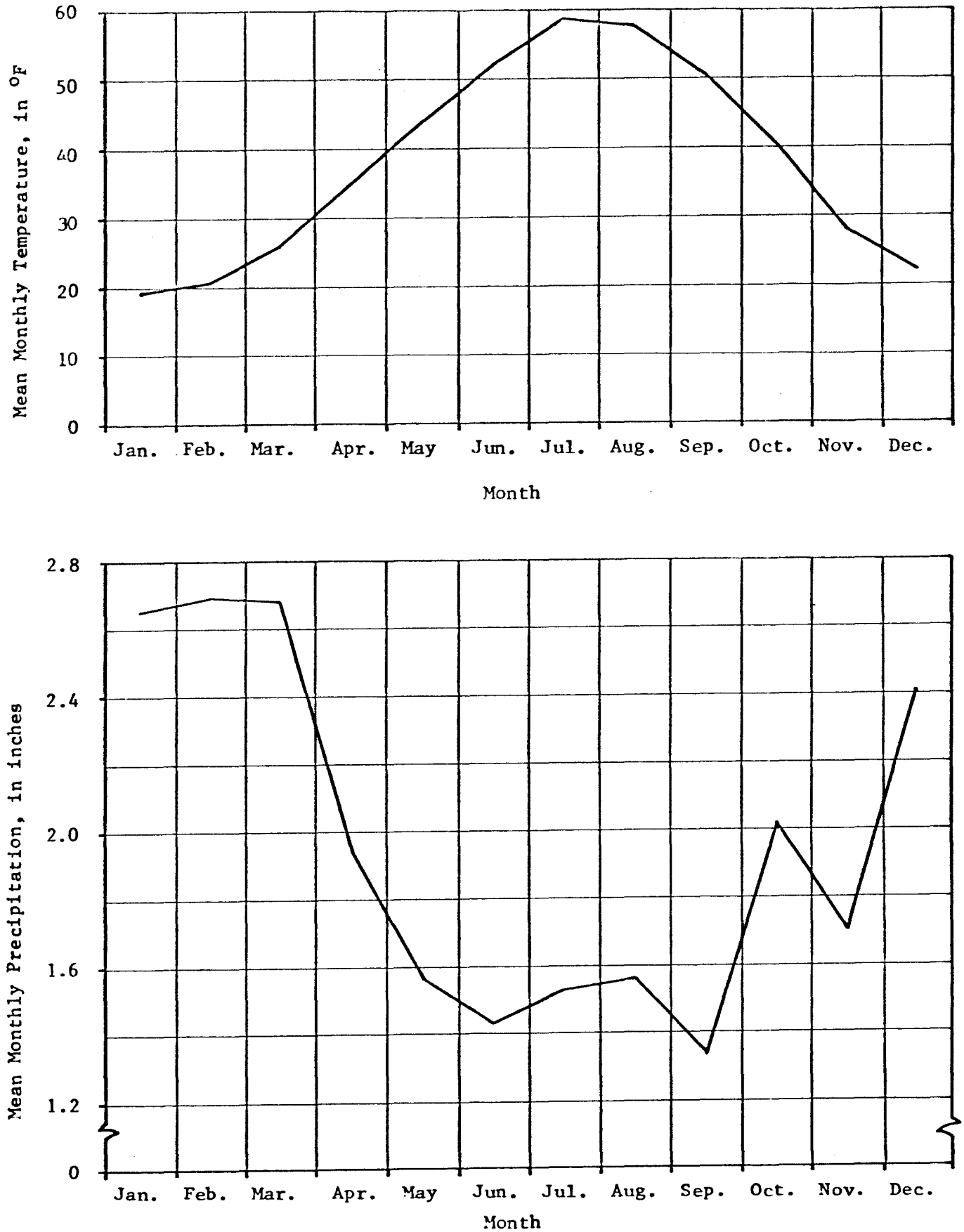


Figure 3. Mean monthly temperature and precipitation at Clear Creek, Utah (taken from Utah Division of Water Resources, 1975).

28°F. July temperatures range from a mean minimum of 40°F to a mean maximum of 77°F. The average frost-free season in the area lasts about 40 days (Jeppson et al., 1968).

Precipitation in the general area is influenced by altitude, topography, and geographic location with respect to the west-to-east storm track (Mundorff, 1972). Jeppson et al. (1968) indicate that the normal annual precipitation in the area is approximately 30 inches. The bulk of this (23 inches or 77 percent) occurs during the months of October through April, primarily as snow. The remaining 23 percent (7 inches) occurs as rainfall during the remaining months of the year.

Jeppson et al. (1968) have determined that annual potential evapotranspiration in the lease area averages about 17 inches. The relatively low evapotranspiration and high precipitation combine to yield excess precipitation, making the area an important source of water for municipal, industrial, and agricultural uses at lower elevations in the respective drainage basins.

Vegetation

Most of the lease area is covered with the conifer-aspen vegetative type, with a small portion of the land being covered with sagebrush and meadow communities (Bentley et al., 1978). Because of the depth of soil, moderate inherent soil fertility (Rapin, 1977), and high precipitation, the area is abundant in species.

Aspen communities occur primarily along the ridges and down the drier slopes to the canyon bottoms. Spruce-fir types are present on north facing slopes where evaporation is low due to the low angle of incidence of the sun's rays and on the west facing slopes where the water supply is more abundant due to the westerly dip of the strata. Sagebrush communities fringe and intermix with the aspen type.

Productivity and percent cover over the area appear to be generally high. This vegetative cover benefits the local hydrologic system, according to Storey et al. (1964), by:

1. Building up and maintaining the organic matter content of the soil, thus developing a more open soil structure which increases infiltration and the moisture storage capacity of the soil as well as protects the surface from the erosive forces of runoff and rainfall impact;
2. Keeping the water spread out over the land, thereby slowing run-off and allowing more time for absorption, resulting in increased infiltration and decreased overland flow (with its attendant erosion and gully formation); and
3. Shading the ground and minimizing wind movement, reducing snow-melt rates and promoting infiltration.

SURFACE WATER HYDROLOGY

Regional Surface Hydrologic System

The Valley Camp lease area is situated in the headwaters of the Price and San Rafael river basins, with the Carbon-Emery county line marking the watershed divide (see Figure 1). Approximately 2020 acres drain on the surface to the east through Eccles Creek, and other smaller tributaries of Pleasant Valley Creek, with water reaching the Price River via Scofield Reservoir (see Figure 4). The drainage from the remaining 720 acres west of the divide flows towards the San Rafael River via Huntington Creek.

Snowmelt is the primary source of water for the perennial streams in the two major basins with summer precipitation usually producing little runoff (U.S. Geological Survey, 1979). Ephemeral streams are also abundant in the Price and San Rafael river basins, existing primarily at lower elevations where evapotranspiration significantly exceeds precipitation.

Water use upstream from Castle Valley (the monoclinal valley containing most of the agricultural land noted in Figure 4) is primarily stock-watering and industrial purposes (coal mining and electrical power generation). Within Castle Valley, agriculture and power production utilize nearly all of the inflowing water (Mundorff, 1972) with minimum flows in the gaged streams and rivers in the two basins occasionally reaching zero. Storage reservoirs are common at higher elevations. Transbasin diversions occur throughout the area.

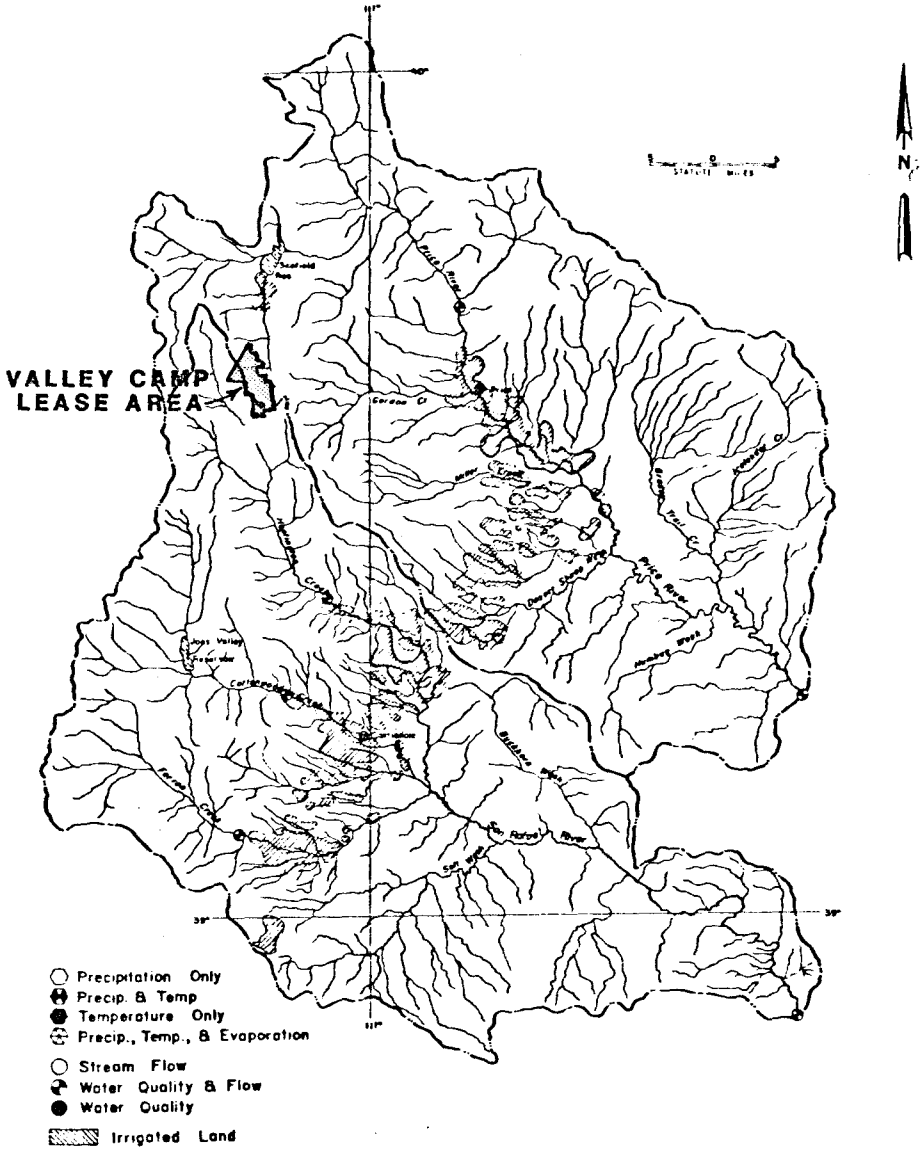


Figure 4. Price and San Rafael river basins (modified from Hyatt et al., 1970).

In general, the chemical quality of water in the headwaters of the Price and San Rafael River Basins is excellent, with these watersheds providing most of the domestic water needs of the people below. However, this quality rapidly deteriorates downstream as the streams cross shale formations (particularly the Mancos Shale in and adjacent to Castle Valley) and receive irrigation return flows from lands situated on Mancos-derived soils (Price and Waddell, 1973). Within the Price River Basin, for example, Mundorff (1972) reports that the Price River and its tributaries generally have a dissolved solids content of less than 400 milligrams per liter above the upper stream gaging station shown in Figure 4. The water in this area is of the calcium bicarbonate type. Between this point and the confluence with Miller Creek, most of the flows originate on or tranverse Mancos shales. Much of the flow is derived from irrigation return flows. The Price River at Wellington, which is near the center of the basin, has an average dissolved solids content of about 1700 milligrams per liter and is of a mixed chemical type (calcium-magnesium-sodium-sulfate). At Woodside, which is about 22 miles upstream from the confluence of the Price River with the Green River, the weighted average dissolved solids content has generally been between 2000 and 4000 milligrams per liter, with the water type being strongly sodium sulfate. Similar deterioration patterns exist in the San Rafael River Basin.

Sediment yield from the upper portions of the two major basins is probably negligible (Mundorff, 1972). According to the U.S. Soil Conservation Service (1975), erosion rates in the Price and San Rafael river basins

vary from 0.1 to 3.0 acre feet per square mile per year. The bulk of the sediment yielded each year at the mouths of the major rivers comes from limited areas covered with highly erodable shales (Mundorff, 1972) and not in the upper elevations characteristic of the lease area.

Drainage Basin Characteristics

The Valley Camp lease area lies in the headwaters of two major watersheds--the Price River and Huntington Creek (tributary of the San Rafael River) basins. The only perennial stream actually located on the lease area is Boardinghouse Creek. This stream along with several ephemeral streams which drain the lease area form dendritic patterns over the area. The landscape of the area varies greatly, with most of the property being covered with conifer and aspen vegetative communities on relatively steep slopes.

Slopes on the lease area vary from greater than 75 percent (37 degrees) near the Carbon-Emery County line to less than 6 percent (3.4 degrees) along the bottom of Long Canyon. The average slope over the area is approximately 28 percent (16 degrees) as determined from a 1:24,000 scale map of the area. Because of the ridgetop location of the property and the variety of channelized flow directions, aspects also vary greatly. However, the Carbon County side of the property does have a dominant aspect to the east (see Plate 1). The topography is rugged, with elevations ranging from about 8700 to 10,044 feet above mean sea level (a range of about 1394 feet).

Because of the climatological conditions of the area (high precipitation and low evapotranspiration resulting in excess water), there are numerous water sources on the lease area. Most of these are undeveloped springs, seeps, and streams, the characteristics of which will be covered in subsequent sections.

Rainfall-runoff relations of the Valley Camp lease area were determined in order to give an index of general surface hydrologic conditions and as a guide in designing future runoff control facilities.

The runoff curve number methods as defined by the U.S. Soil Conservation Service (1972), was used as a basis for this determination. According to the curve number methodology, the algebraic and hydrologic relations between storm rainfall, soil moisture storage, and runoff can be expressed by the equations

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \qquad (1)$$

and

$$CN = \frac{1000}{10+S} \qquad (2)$$

where Q is the direct runoff volume, in inches; P is the storm rainfall depth, in inches; S is a watershed storage factor, in inches, defined originally as the maximum possible difference between P and Q; and CN is a dimensionless expression of S referred to as the curve number.

It is known that runoff curve numbers tend to vary inversely with precipitation depth in forested mountain watersheds (Hawkins, 1973). In later

studies of this phenomenon, Hawkins (1979) concluded that a relatively constant runoff source (i.e. "impervious") area produces this inverse relationship. Because wildland watersheds seldom experience overland flow, this constant source area coincides generally with the area occupied by live (perennial) streams and nearby impervious area (roads, etc.). Hawkins (1979) found that the curve number could be expressed as

$$CN = \frac{100}{1 + P \cdot f(c)/2} \qquad (3)$$

where

$$f(c) = 1 + 2C - (4C^2 + 5C)^{\frac{1}{2}} \qquad (4)$$

and C is the fraction of the total watershed area contained in the source area (i.e. the stream channel and nearby roadbeds). Data were presented by Hawkins (1979) for various watersheds throughout the Rocky Mountain-Intermountain Region as well as values of C determined by an iterative least squares technique. Conditions at two of the watersheds studied by Hawkins (Morris Creek and West Branch of Chicken Creek, located on the Davis County Experimental Watershed near Farmington, Utah) compare favorably with the surface characteristics of the lease area. The relationship between CN and P at these two watersheds is presented in Figure 5. Also shown on this figure for reference purposes is the curve depicting CN which Hawkins (1973) defines as the curve number for a given P below which there is no runoff.

The curve in Figure 5 which describes the West Branch of Chicken Creek is presumably representative of those watersheds within the lease area where road development is extensive and adjacent to the stream channel

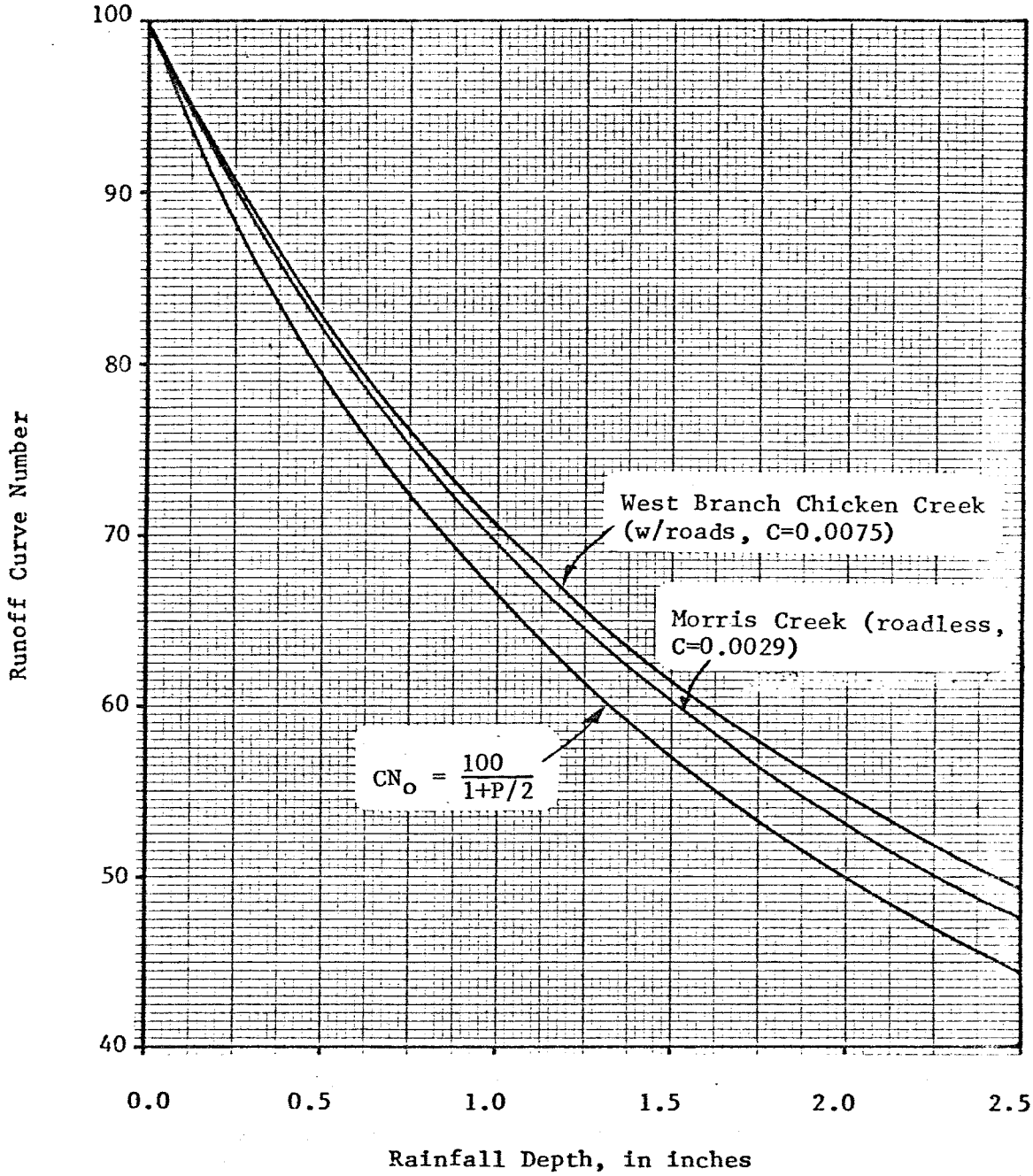


Figure 5. Variation of runoff curve number with rainfall depth at the Davis County Experimental Watershed, Utah.

interception (1.e. Long Canyon, South Fork of Eccles Canyon, etc.). Note that runoff characteristics in a watershed can be described by both curves, depending upon the specific location of concern within the watershed (i.e. Eccles Canyon, as a whole, is described by the upper curve but subbasins, such as the South Fork of Eccles Canyon can be represented by the Morris Creek curve).

Two comments should be made about the information presented in Figure 5. First, the potential for runoff from a rainfall event within the lease area is low. As Hawkins (1979) has indicated and as can be seen in Figure 6, the term C in equation 4 can be thought of as equivalent to the runoff coefficient in the equation Q = CP and tends to be constant for a wildland watershed with a perennial stream (unlike CN). Thus, only a very small portion of the rainfall becomes runoff (between 0.29 and 0.75 percent, depending upon watershed conditions). This indicates that runoff from the lease area occurs almost entirely from snowmelt, not rainfall.

A second comment is that the curves shown in Figure 5 assume that overland flow is non-existent from the majority of the watershed. This is a reasonable assumption for the lease area under most circumstances because of the high infiltration rate relative to storm intensity and the apparent uniform antecedent moisture conditions of the soil surface created by relatively low summer rainfall volumes (see the previous discussion on local climate). Extremes in rainfall intensity and/or

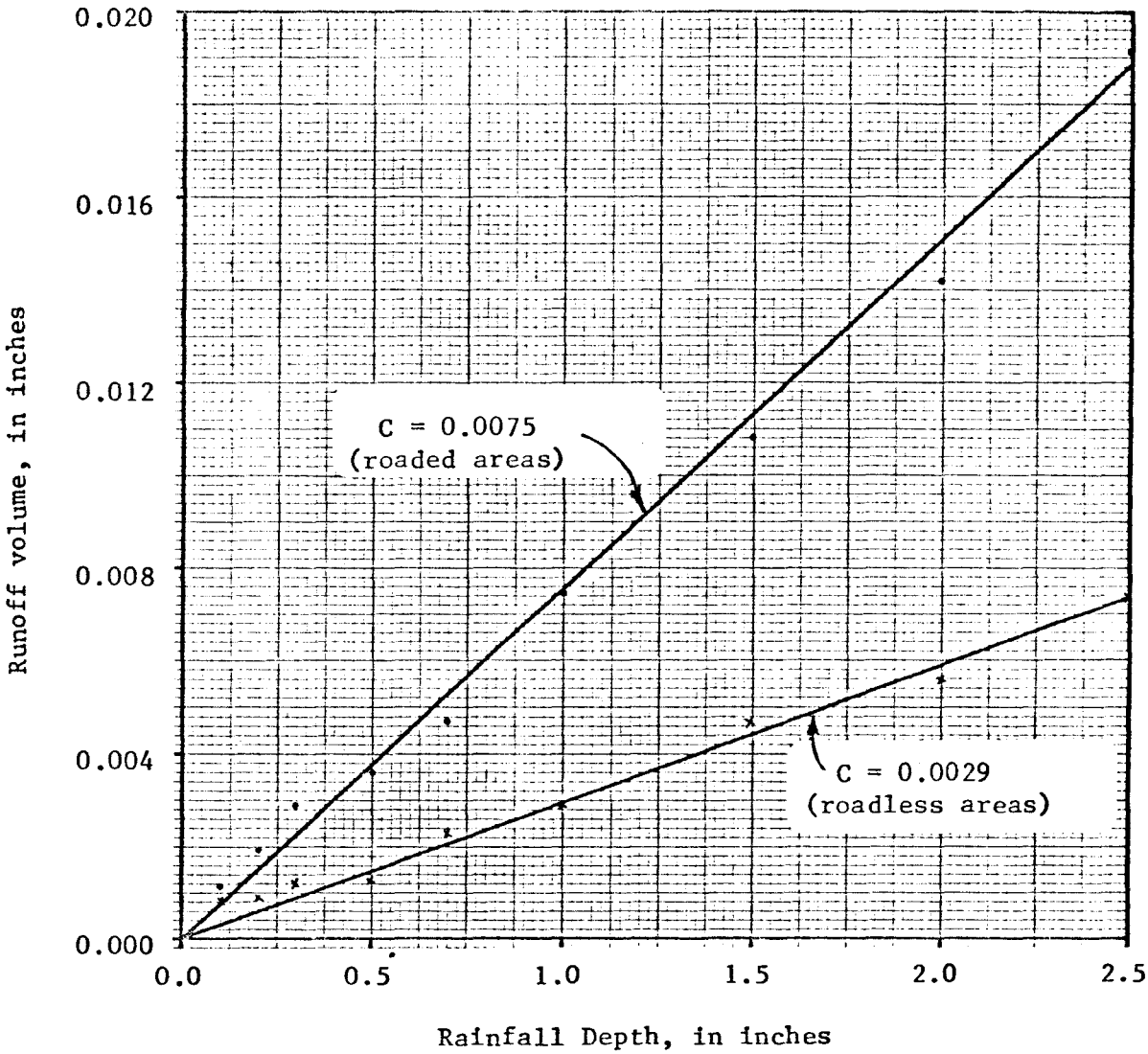


Figure 6. Runoff volumes resulting from a given rainfall depth on the Valley Camp lease area.

soil wetness may cause areas other than the normal source areas to contribute runoff, and thus create departures from the curves shown in Figures 5 and 6. Such conditions are assumed to be rare in the lease area.

Flow Characteristics

Three hydrologic methods were used to determine the average annual water yield from the area, thereby increasing the level of confidence. Grunsky's Formula, which was originally developed by Grunsky (1908) and later reworked by Sellars (1965), states that

$$Q = \alpha P^2 \quad (\text{for } P \leq 1/2\alpha)) \tag{5}$$

and

$$Q = P - 1/(4\alpha) \quad (\text{for } P \geq 1/(2\alpha)) \tag{6}$$

where Q is the long-term average annual runoff, in inches; P is the long-term annual precipitation, in inches; and α is a runoff coefficient, in inches $^{-1}$. A value of 0.015 was assumed for α based on guidelines set forth by Hawkins (1976). Thus, $1/(2\alpha)$ equals 33.3 which is greater than P (30 inches) and equation 5 is used for determining the average annual runoff from the Valley Camp lease area, with a resulting value of 13.5 inches.

A second method used to estimate average annual water yield from the area is often referred to as Ol'deKop's Formula (Sellars, 1965 and Linsley, 1976). According to this method,

$$Q = P - E_o \tanh \frac{P}{E_o} \tag{7}$$

where Q and P are as previously defined; E_o is the potential evapotranspiration; and tanh represents the hyperbolic tangent. As noted in the previous discussion on climate, P and E_o on the lease area are equal to 30 and 17 inches, respectively. Substituting these values into equation 7 results in an average annual water yield of 14.0 inches.

The final method used to determine average annual flows in the lease area was through the derivation of a flow duration curve for Eccles Creek above Pleasant Valley Creek. The flow duration curve, as described by Searcy (1959), combines into one curve the flow characteristics of a stream throughout the range of observed discharges and can be defined as a cumulative frequency curve that shows the percent of time during which specified discharges were equalled or exceeded in a given period. Although it does not show the chronological sequence of these flows, it can be used to determine several hydrologic characteristics of a watershed, including the mean annual flow.

A long-term flow duration curve at the mouth of Eccles Canyon was derived from short-term existing records using the index station method described by Searcy (1959). According to the index station method, flow duration curves are prepared for the period of record at the short-term station and the corresponding period of record at the long-term (index) station. The discharges at selected percent-duration points on the curve of the short-term station are then plotted on logarithmic paper against the discharges for the same percent-duration points from the curve of the long-term station. The relation between discharges at the

two stations for the short concurrent period is assumed to represent the relation for a long period. Following the construction of the long-term flow duration curve for the index station, the flow available a given percent of time at the long-term station can be used to enter the curve of relation (based on the short period of record), in order to obtain the adjusted (to long term) flow available the same percent of time at the short-term station. Instantaneous discharge measurements made during the periodic collection of water quality samples were used for the short-term record on Eccles Creek above Pleasant Valley Creek. These discharges were ranked from high to low to obtain a duration curve. It is assumed that the instantaneous discharge was equal to the mean daily discharge for the day of measurement (see Riggs, 1969). The period of record for these 15 measurments spanned water years 1976 through 1978. Long-term records of monthly flows and flow duration tables for possible index stations were obtained from the U.S. Geological Survey.

The selection of an index (long-term) station was based on comparisons of monthly flow volumes obtained from Utah Power and Light Company for the period covering water years 1972 and 1973 for Huntington Creek above Burnout Canyon and the concurrent period of record of five long-term gaged streams in the general area. The assumption was made that the behavior of Eccles Creek would be similar to that of Huntington Creek and that an index station chosen for Huntington Creek would, therefore, also be valid for Eccles Canyon. Comparisons were made using linear, exponential, logarithmic, and geometric regressions with the standard error of

the estimate selected as the objective function to be minimized. Results of the linear regressions (which proved to be superior) are summarized in Table 1. In this table, S_e is the standard error of the estimate, in acre-feet per month; r^2 is the coefficient of determination; and r is the coefficient of correlation. Based on these results, the White River below Tabbyune Creek near Soldier Summit, Utah (USGS Station No. 09312600 with an 11 year period of record from October 1967 through September 1978) was selected as the index station for Eccles Creek.

Figures 7 and 8 give the flow duration curves for water years 1976 through 1978 of Eccles Creek above Pleasant Valley Creek and the index station (White River below Tabbyune Creek near Soldier Summit, Utah). Note the change of scale on the ordinates of the two figures. The curve of relation

Table 1. Results of linear regression analyses of monthly flows of Huntington Creek above Burnout Canyon and local long-term stream gaging stations for water years 1972 and 1973.

Comparison Station	S_e	r^2	r
White River below Tabbyune Creek near Soldier Summit, Utah	330	0.928	0.963
Beaver Creek near Soldier Summit, Utah	401	0.893	0.945
Huntington Creek near Huntington, Utah	429	0.878	0.937
Minnie Maud Creek near Myton, Utah	447	0.868	0.931
Willow Creek near Castle-Gate, Utah	595	0.765	0.875

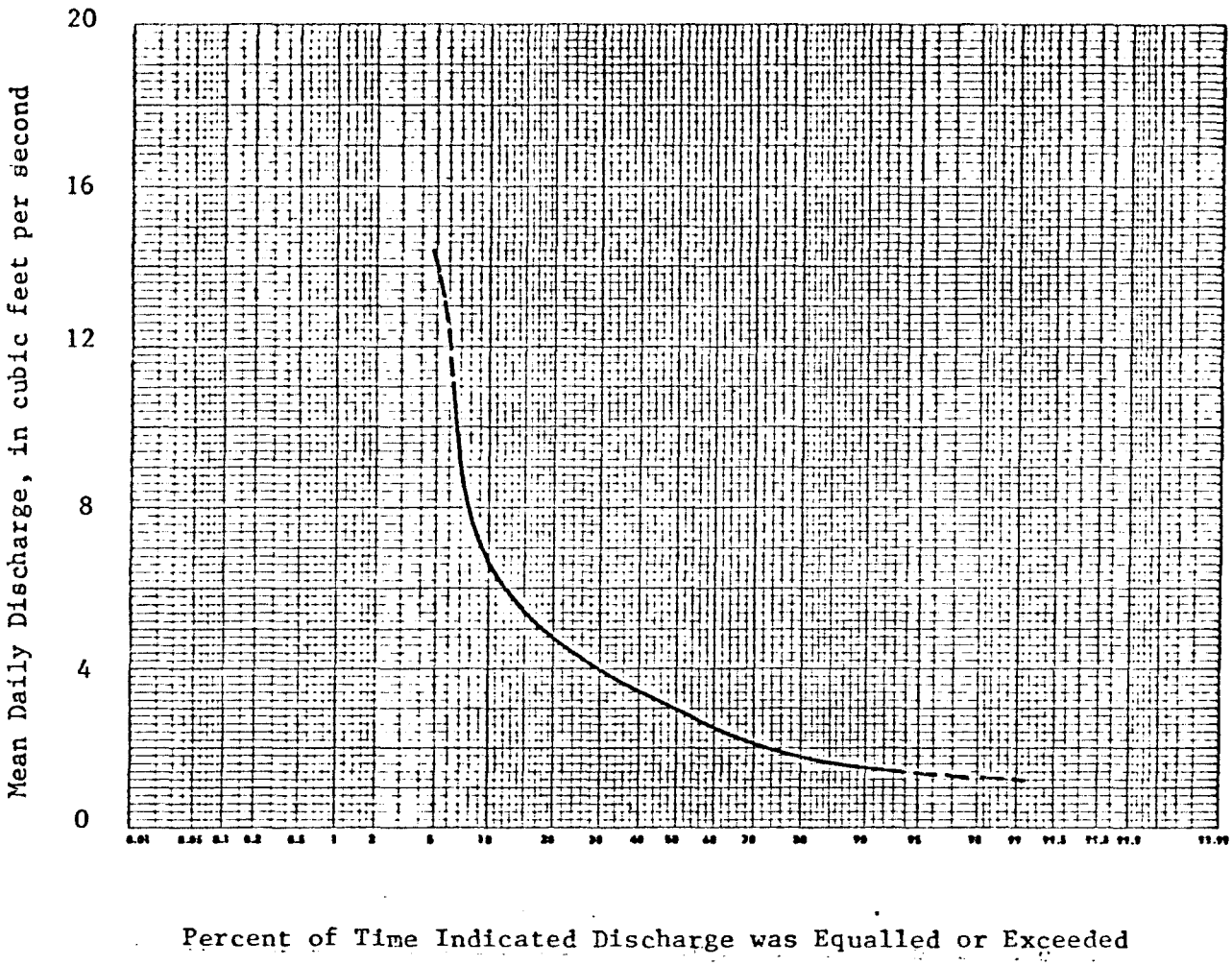


Figure 7. Duration curve of mean daily flows of Eccles Creek above Pleasant Valley Creek for water years 1976 through 1978.

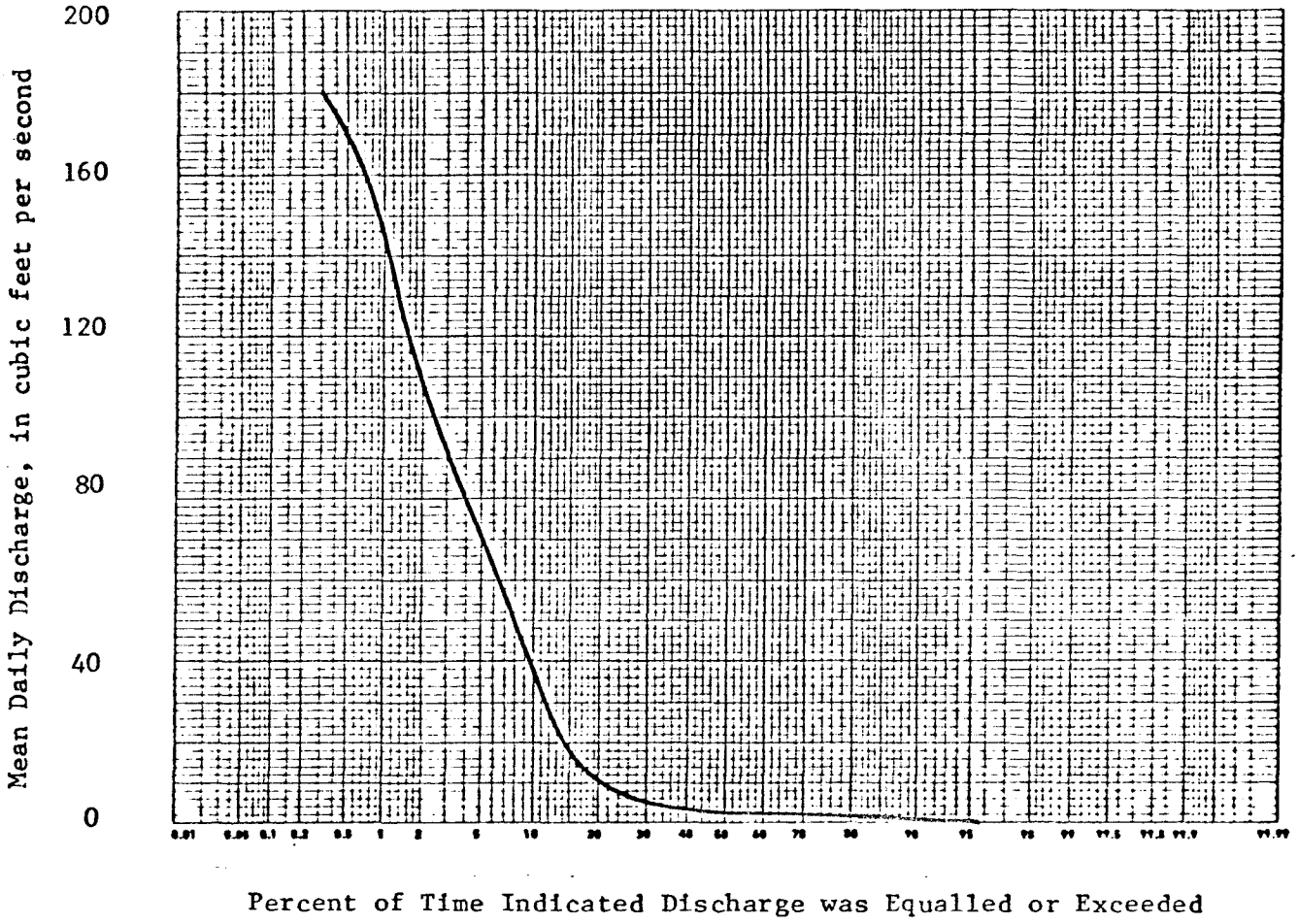


Figure 8. Duration curve of mean daily flows of the White River below Tabbyune Creek near Soldier Summit, Utah for water years 1976 through 1978.

is plotted in Figure 9 using discharge values corresponding to the equal percent duration points of 0.1, 1.0, 5.0, 10.0, 25.0, 50.0, 75.0, 90.0, 95.0, and 99.0. Based on this curve of relation and the long-term flow duration curve of the index station, the long-term flow duration curve of Eccles Creek above Pleasant Valley Canyon developed (Figure 10). The dotted section in the low flow region of the adjusted Eccles Creek flow duration curve is based on instantaneous discharge estimated made by Dr. Robert N. Winget of Brigham Young University in conjunction with biological sample collections at the site during the summer of 1977, a period of severe drought in the western United States (Hughes et al., 1978). The dotted, high flow section of the curve was estimated based on an observation by Searcy (1959) that streams whose high flows come largely from snowmelt tend to have flow duration curves with flat slopes in their upper sections.

Searcy (1959) indicates that the average annual flow of a stream can be found by determining the area under the flow duration curve. This determination is presented in Table 2 for Eccles Creek above Pleasant Valley Creek. The indicated average annual flow of 5.43 cubic feet per second converts to an average annual yield of 13.4 inches over the 3510 acre watershed. This compares favorably with the estimates computed previously by Grunsky's and Ol'deKop's formulas.

In order to determine the seasonal distribution of flows in the lease area, average monthly flows of Huntington Creek above Burnout Canyon

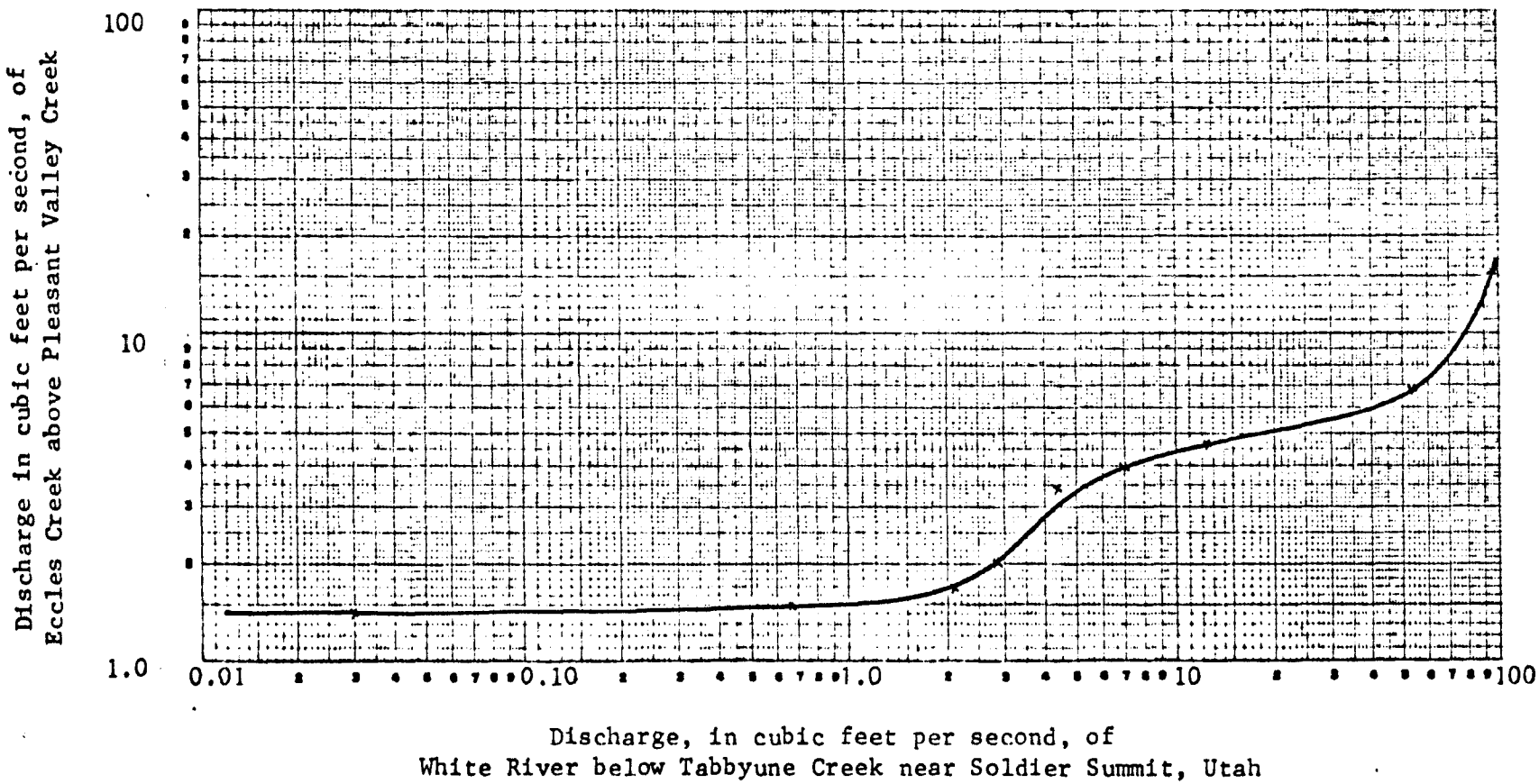


Figure 9. Correlation between Eccles Creek above Pleasant Valley Creek and White River below Tabbyune Creek near Soldier Summit, Utah for water years 1976 through 1978, based on discharges of equal percent duration.

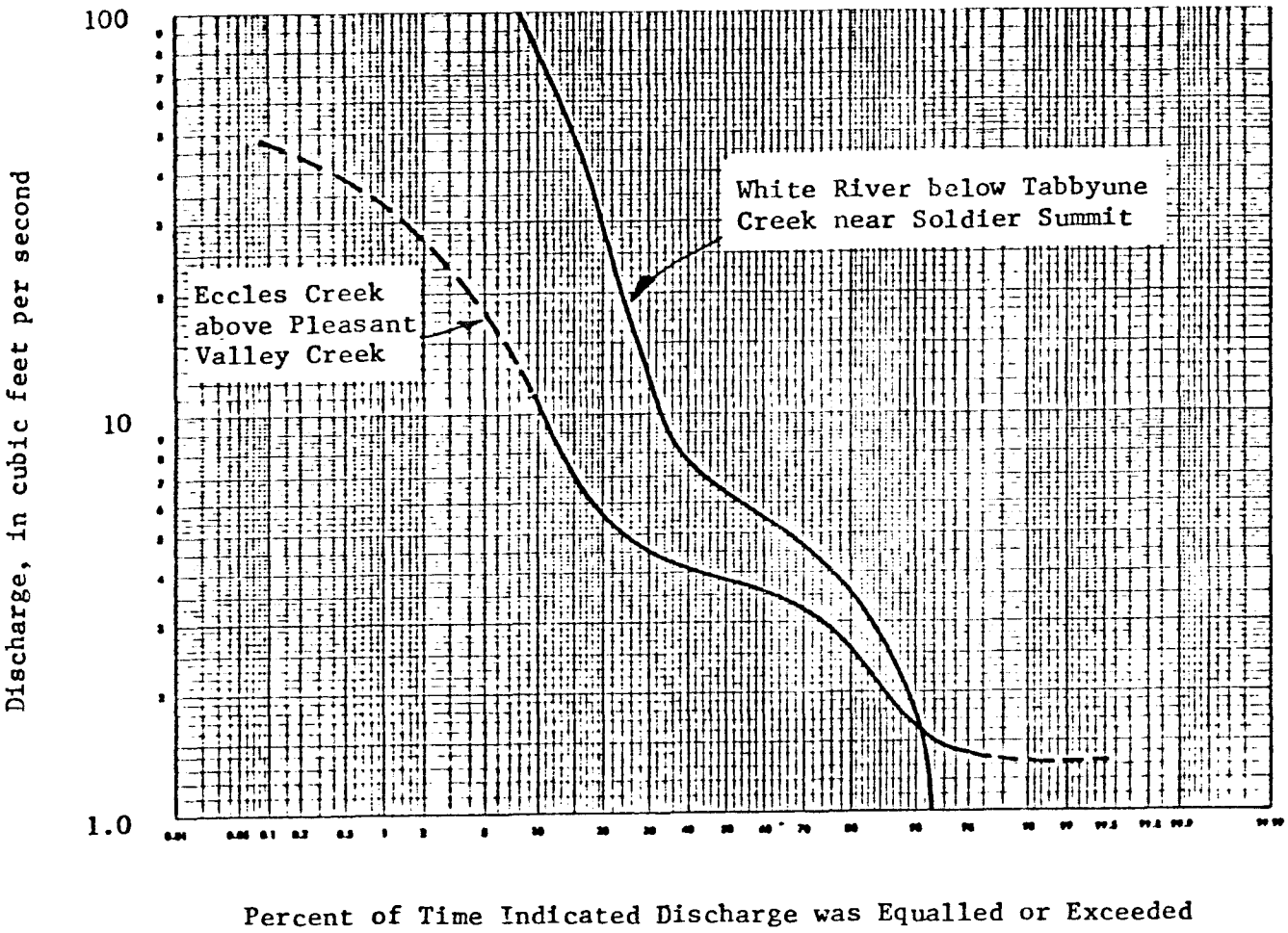


Figure 10. Long-term duration curves of mean daily flows of the White River below Tabbyune Creek near Soldier Summit, Utah and Eccles Creek above Pleasant Valley Creek.

Table 2. Computation of long-term mean discharge of Huntington Creek above Burnout Canyon, based on the adjusted flow duration curve.

Duration Curve Percentages			Discharge (cfs)	
Limits	Interval	Mean of Limits	Q for Mean of Limits	Increment in Interval
0.00 - 0.10	0.10	0.05	209	0.21
0.10 - 0.20	0.10	0.15	195	0.20
0.20 - 1.00	0.80	0.60	168	1.34
1.0 - 3.0	2.0	2.0	128	2.56
3.0 - 5.0	2.0	4.0	92	1.84
5.0 - 9.0	4.0	7.0	59	2.36
9 - 15	6	12	30	1.80
15 - 25	10	20	9.2	0.92
25 - 35	10	30	4.1	0.41
35 - 45	10	40	3.2	0.32
45 - 55	10	50	2.7	0.27
55 - 65	10	60	2.4	0.24
65 - 75	10	70	2.1	0.21
75 - 85	10	80	1.6	0.16
85 - 95	10	90	1.05	0.11
95 - 99	4	97	0.76	0.03
99 - 99.6	0.6	99.3	0.65	<0.01
99.6 - 99.8	0.2	99.7	0.61	<0.01
99.8 - 100.0	0.2	99.9	0.61	<0.01
Total	100.0	-	-	12.84

for water years 1972 and 1973 were computed as a percent of the average annual flow for the same period. These results are plotted in Figure 11. Although the exact percentages will change from year to year, the distribution pattern is expected to remain fairly constant, as evidenced by the flows of gaged streams in the region (see Figure 12). The seasonal distribution shown in the two figures, which is presumably representative of conditions in perennial streams throughout the Valley Camp lease area, is typical of western high elevation, snowmelt streams, where the majority of the flow occurs within a relatively short amount of time in late spring and early summer.

Based on the flow duration curve presented in Figure 10, mean daily flows in Eccles Creek above Pleasant Valley Creek can be expected to range from an occasional low of about 1 cubic foot per second to an occasional high of approximately 50 cubic feet per second.

Estimates of peak flow recurrence intervals in the property area were made based on techniques presented by Fields (1975). According to Fields (1975), the 25- and 50-year recurrence interval flood discharges of Utah streams are related to channel geometry characteristics. Specifically, for the area of the Valley Camp lease, the following relationships were found to apply:

$$q_{25} = 3.7W^{1.57} \tag{5}$$

and

$$q_{50} = 3.9W^{1.58} \tag{6}$$

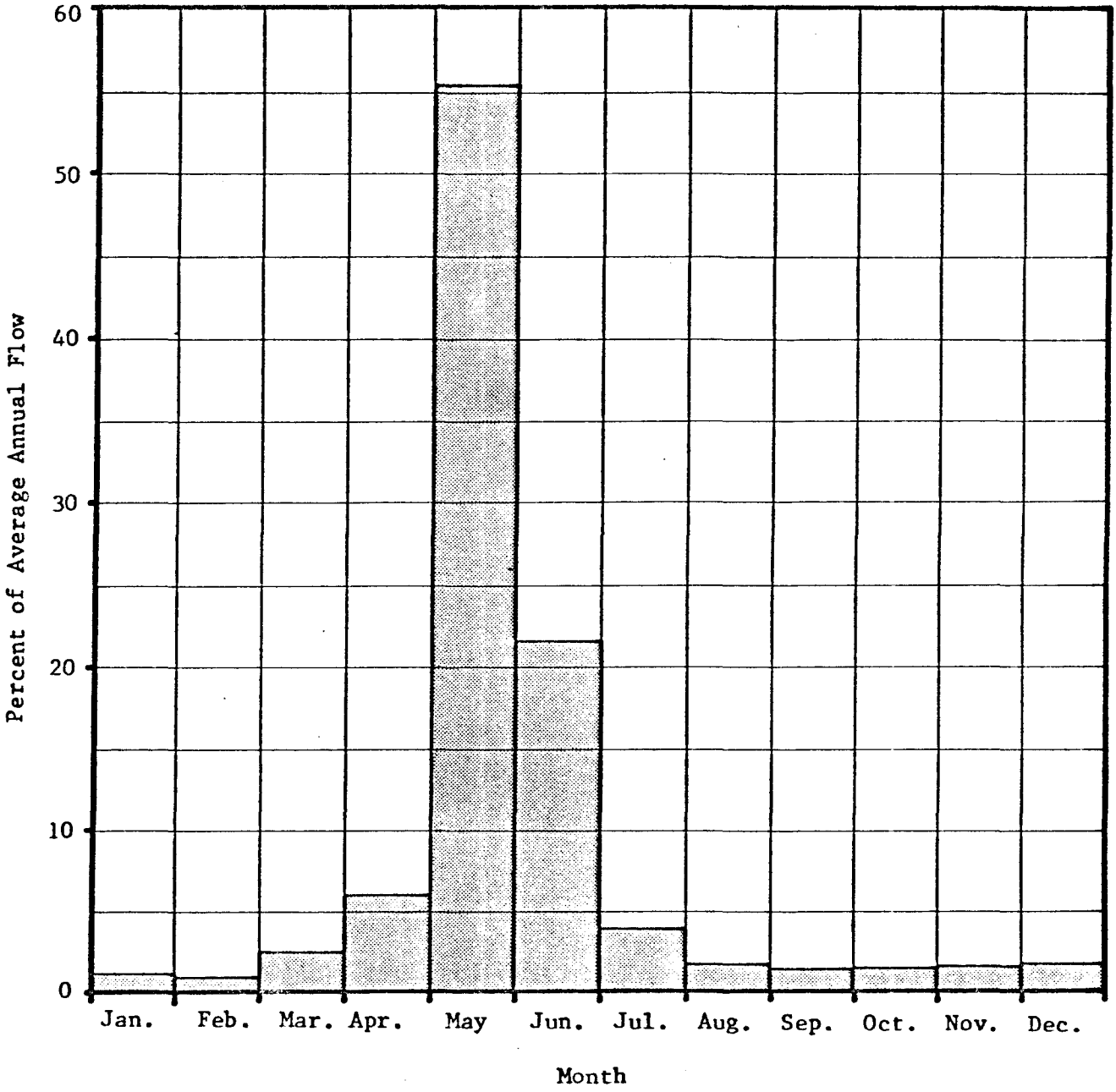


Figure 11. Monthly distribution of flows of Huntington Creek above Burnout Canyon for water years 1972 and 1973.

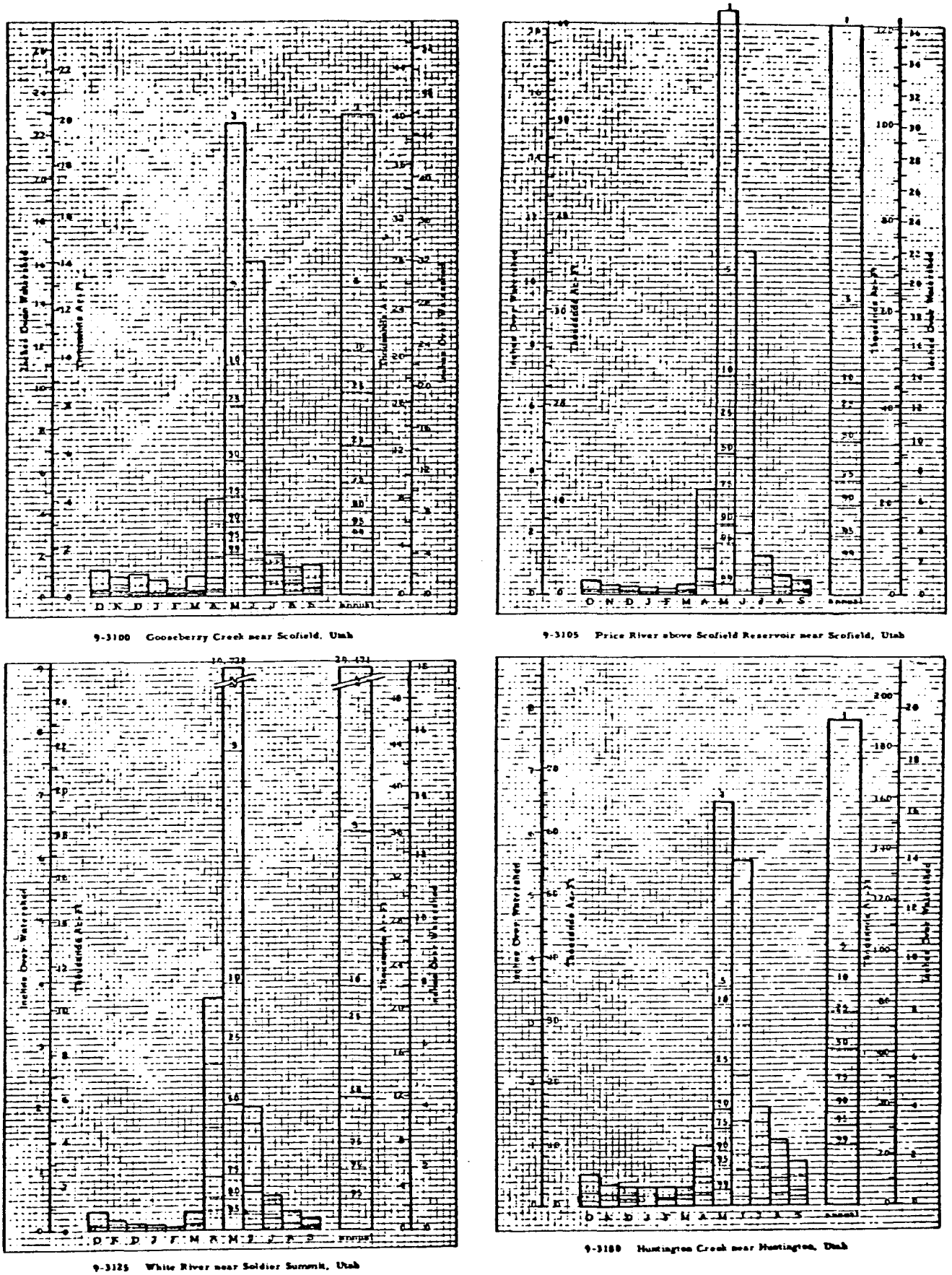


Figure 12. Frequency of occurrence of monthly and annual flows of streams near the Valley Camp lease area (from Jeppson et al., 1968).

where W is the width of the channel bar cross section, in feet, and q_{25} and q_{50} are the 25- and 50-year recurrence interval flood discharges, respectively. The respective standard errors associated with equations 5 and 6 are 28 and 33 percent.

Table 3 presents the resulting flood frequency information. Although the standard errors are relatively high for the prediction equations, the discharge estimates give an idea of the high flows experienced in the streams.

Surface Water Quality

Thirteen sites on and adjacent to the Valley Camp lease area were chosen for the collection of baseline surface water quality data. Stations were located to obtain data from streams above and below the Belina No. 1

Table 3. Flood frequency discharge estimates of selected streams on and adjacent to the Valley Camp lease area.

Stream	Channel Bar Width, in feet	25-Year Peak, in cfs	50-Year Peak, in cfs
South Fork Eccles Creek above Main Fork	2.0	11.0	11.7
Eccles Creek above Pleasant Valley Creek	3.5	26.4	28.2
Finn Creek above Pleasant Valley Creek	0.8	2.6	2.7
Boardinghouse Creek above Pleasant Valley Creek	2.7	17.6	18.7
Slaughterhouse Creek above Pleasant Valley Creek	1.0	3.7	3.9

Mine and the load-out facilities in Pleasant Valley Canyon as well as from other perennial and intermittent streams in both the Huntington Creek and Pleasant Valley Creek basins. All stations were established for the collection of grab samples.

Water quality samples collected by VHA were analyzed according to the schedule shown in Table 4. Some additional constituents, partically dissolved constituents have been analyzed at some of the stations. Analytical methods utilized in the field and in the laboratory are summarized in Attachment A. Field analyses were completed immediately upon sample collection. Samples were preserved for later laboratory analysis according to methods outlined by the American Public Health Association et al. (1976). Attachment B contains the results of chemical analyses of surface water samples collected in the property area during the baseline period.

Seasonal variations in water quality, as indexed by major cations and anions, are depicted in Plate 2. As is to be expected, total dissolved solids concentrations in the area are lowest during the months of April through June when flows are highest and affected by the diluting effect of direct snowmelt. As flows decrease later in the year and the majority of the flow is derived from seepage out of local ground water systems, this dilution effect becomes less pronounced and concentrations tend to increase (Figure 13).

Table 4. Comprehensive water quality analytical schedule.

Field Measurements	Laboratory Measurements
pH	Acidity
Water Temperature	Alkalainity
Air Temperature	Ammonia (NH_3 as N)
Specific Conductance	Bicarbonate
Discharge of Water Level	Calcium
Dissolved Oxygen	Chloride
	Fluoride
	Magnesium
	Potassium
	Sodium
	Sulfate
	Arsenic, Total
	Barium, Total
	Boron, Total
	Cadmium, Total
	Chromium, Total
	Copper, Total
	Iron (Total and Dissolved)
	Lead, Total
	Manganese, Total
	Mercury, Total
	Selenium, Total
	Silver, Total
	Zinc, Total
	Total Suspended Solids
	Total Dissolved Solids
	Nitrate
	Ortho-hosphate
	Phosphate, Total as PO_y
	Phenol
	Oil and Grease

According to Plate 3, surface water in the Valley Camp lease area is of a strong calcium-bicarbonate type, which agrees with the findings of Mundorff (1972). Magnesium concentrations tend to proportionately increase with lower flows, especially at the lower elevations (see the results of Stations VC-6, VC-9, and VC-10). Total dissolved solids concentrations are relatively low throughout the general area, ranging from less than 100 milligrams per liter in the headwaters of the Eccles Creek Basin during the high flow season (Station VC-4) to over 600 milligrams per liter in Pleasant Valley Creek during low flow conditions (Station VC-8).

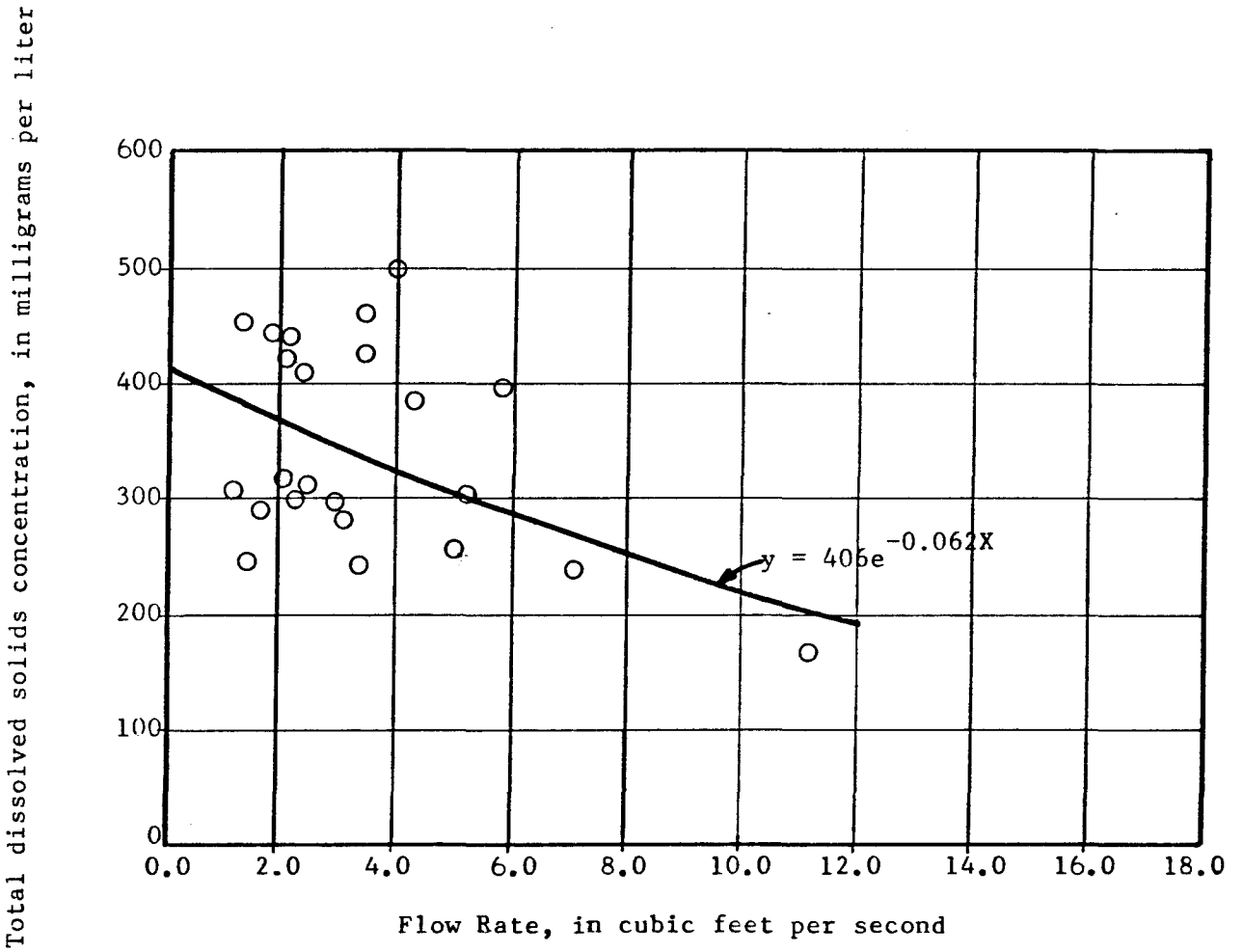


Figure 13. Variation in dissolved solids concentrations with flow rate at Station VC-9.

Suspended solid concentrations in the area tend to increase with an increase in flow rate. As a result, concentrations are higher during the snowmelt run-off period than during that portion of the year when baseflow conditions exist. As an example, the average suspended solids concentration for the period of record during the months of April through June equalled 178 milligrams per liter at VC-9 (6 samples), but during the months of October through December the average concentration dropped to 11.0 milligrams per liter (2 samples).

Hydrogen ion activity (pH) over the Valley Camp lease area tends to be rather constant, varying normally between 7.5 and 8.5. The slightly basic waters in the area result from the high bicarbonate concentrations (American Public Health Association et al., 1975). Although pH values tend to be slightly higher during the spring and summer months (probably due to the increased dissolved carbon dioxide uptake by aquatic organisms during daylight hours), the relatively constant and basic pH indicates that waters in the area are not significantly influenced by pollution (Hem, 1970). The basic condition of the water, together with the low acidity (maximum measured was 32 mg/l as calcium carbonate) and the relatively high alkalinity, indicates that acid drainage problems should not develop as a result of mining in the property area.

Both total and dissolved iron concentrations vary widely over the area, with the source likely being the cementing agents in the Blackhawk

Formation which were previously mentioned. Total iron tends to be somewhat related to flow rate (i.e. higher concentrations exist during the snowmelt runoff period), as might be expected, due to the probable association of iron with sediment, which tends to increase with flow. (See Figure 14). Total iron concentrations also tend to be higher in Eccles Canyon than in Pleasant Valley Creek above Eccles Creek.

Seasonal concentrations of dissolved iron at a given station appear to be much more variable than total iron. As a result, no specific patterns can be detected. About 80 percent of the measured dissolved iron concentrations were less than 30 percent of the concurrent total iron concentration. The difference is greatest during the spring when total iron concentrations are greatest.

Total manganese concentrations measured in the area are low, varying from less than 0.001 to 0.19 milligrams per liter (with the exception of one sample at station VC-5 which had a concentration of 1.53 milligrams per liter). The low manganese concentrations are likely associated with the low acidity (Hem, 1970). No distinct seasonal variations can be discerned.

Table 5 shows the range and mean of concentrations of dissolved solids, suspended solids, acidity, pH, total and dissolved iron, and manganese as measured at each of the thirteen surface water stations.

The Utah Division of Health has classified all water in the Valley Camp lease area as 1C (protected for domestic use with prior treatment by

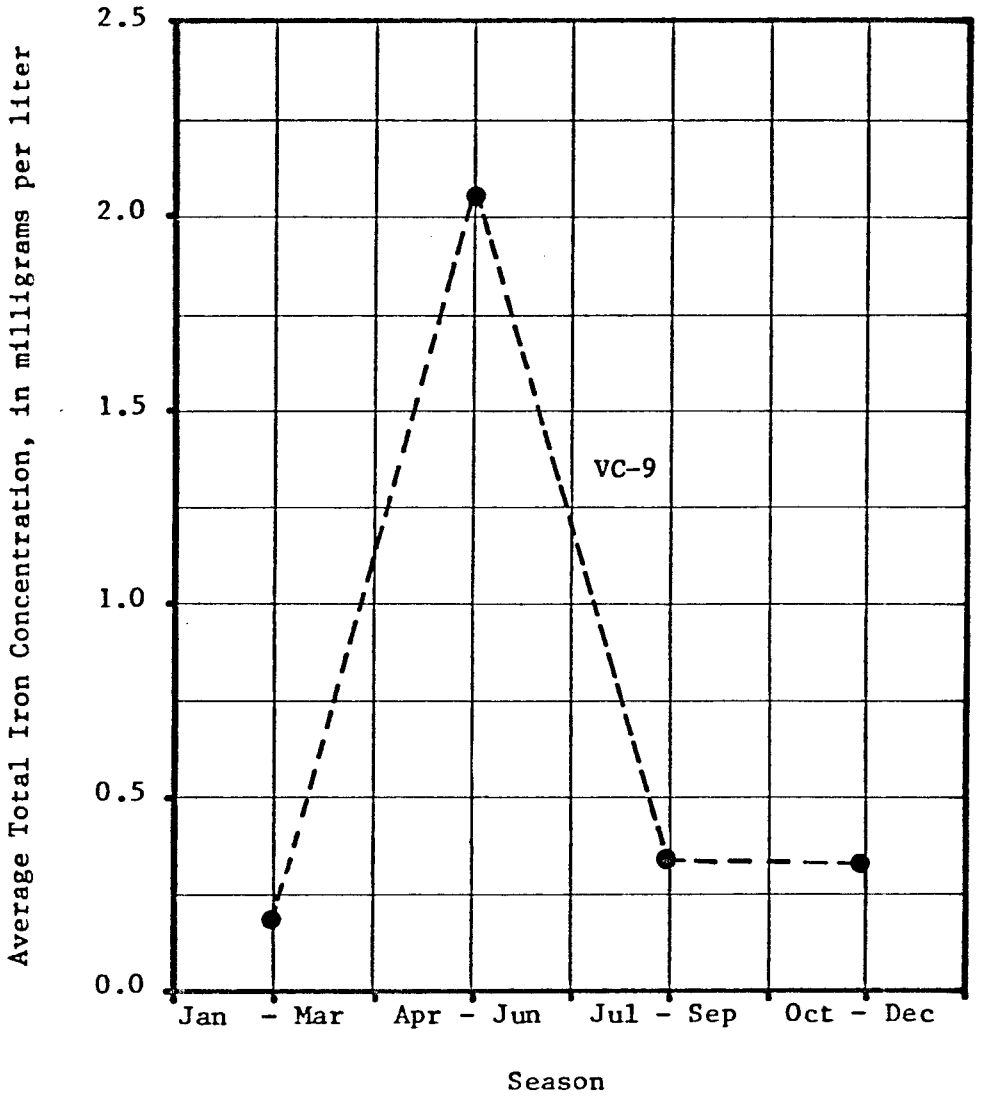


Figure 14. Seasonal variation of average total iron concentrations in Eccles Canyon during the period of record.

Table 5. Results of laboratory analyses of selected water quality parameters

Parameter	TDS			TSS			Acidity			pH			Total Iron			Dissolved Iron			Total Maganese		
Station	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
VC-001	951	200	306	178	1.0	38	32	6	18	8.4	7.0	7.7	1.934	.012	.254	---	---	---	.445	.002	.063
VC-1	550	210	369	111	2	24	14	6	10	8.3	7.1	7.7	3.428	.09	.418	.095	.05	.07	.142	.01	.041
VC-2	510	209	374	84	2.2	21	16	10	12	8.5	7.1	7.8	2.236	.103	.433	.08	.01	.04	.118	.003	.038
VC-4	222	84	129	85	10	49	10	6	8	8.3	7.0	7.8	1.15	.128	.59	---	---	---	.168	.001	.084
VC-5	510	138	274	3910	1	942	10	1.0	5	8.4	7.1	8.0	88.5	.039	11.40	---	---	---	1.532	.013	.226
VC-6	540	160	309	88	2	16	18	2	10	8.4	7.1	7.8	.627	.001	.23	.024	.010	.018	.190	.001	.025
VC-7	520	410	445	---	---	---	---	---	---	8.5	7.6	8.1	.194	.078	.14	---	---	---	.033	.017	.025
VC-8	655	432	541	---	---	---	---	---	---	8.5	7.7	8.0	.305	.093	.20	---	---	---	.102	.068	.085
VC-9	495	162	334	309	10	77	22	10	16	8.45	7.1	7.9	5.84	.040	0.88	.036	.020	.026	.187	.012	.055
VC-10	275	139	227	89	4	16	28	2	16	8.4	7.3	7.8	.540	.045	.25	.050	.020	.032	.074	.004	.023
UPL-3	400	145	184	105	4	10	12	12	12	8.45	7.05	7.6	.418	.067	.18	.02	.03	.04	.109	.001	.037
UPL-10	226	125	172	15	1	6	13	6	9	8.9	7.25	7.9	.62	.144	.36	.114	.060	.087	.040	.004	.020
CS-1	254	190	238	13	4	8	24	12	17	8.4	7.4	7.9	.330	.045	.14	.20	.022	.074	.005	.002	.003
CS-7	240	185	209	9	1	5	16	2	8	9.15	7.2	7.9	.27	.09	.21	.058	.012	.030	.021	.002	.009

standard complete treatment processes), 2B (protected for recreational uses excluding swimming), 3A (protected for coal water aquatic life), and 4 (protected for agricultural uses). The numerical standards which apply to these classifications are given in Table 6.

Station VC-8 on Pleasant Valley Creek above Boardinghouse Creek) had the only measured exceedeances of the coliform standards set by the state. Total and fecal coliform levels at this station exceeded the standard in five of the nine samples taken during 1976 and 1977. Total coliform counts averaged about 20,000 per 100 milliliters (15,000/100 milliliters over the state standard) and fecal coliform counts averaged slightly over the state standard of 2000 per 100 milliliters. These high levels are probably showing an effect of being located a short distance below the town of Clear Creek. Data from the Southeastern Utah Association of Governments (1977) indicate that relatively high coliform levels are also encountered, to a lesser extent, further down Pleasant Valley Creek near Scofield Reservoir.

The state standard for dissolved oxygen was satisfied by all but one sample. On August 3, 1976, the sample collected at station UPL-3 (on Huntington Creek below Electric Lake) measured 0.2 milligrams per liter below the state standard of 6.0 milligrams per liter.

Maximum desirable temperature as set forth by the state standards was exceeded only once. This occurred at Station VC-5 (on Whiskey Canyon Creek above Eccles Creek) on July 12, 1978 when a temperature of 20.5^{o}C was recorded.

Table 6. Utah Division of Health numerical standards for water in the state.

Constituent	CLASSES										
	Domestic Source			Recreation & Aesthetics		Aquatic Wildlife				Agri-culture	Indus-try	Special
	1A	1B	1C	2A	2B	3A	3B	3C	3D	4	5	6
Bacteriological (No./100 ml)												
(30-day Geometric Mean)												
Maximum Total Coliforms	1	50	5,000	1,000	5,000	*	*		*	*		
Maximum Fecal Coliforms	*	*	2,000	200	2,000	*	*		*	*		
Physical												
Total Dissolved Gasses	*	*	*	*	*	(b)	(b)		*	*		
Minimum DO (mg/l) (a)	*	*	5.5	5.5	5.5	6.0	5.5		5.5	*		
Maximum Temperature	*	*	*	*	*	20°C	27°C		*	*		
Maximum Temp. Change	*	*	*	*	*	2°C	4°C		*	*		
pH	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0		
Turbidity increase (c)	*	*	*	10 NTU	10 NTU	10 NTU	10 NTU		15 NTU	*		
Chemical (Maximum mg/l)												
Arsenic, dissolved	.05	.05	.05	*	*	*	*		*	.1		
Barium, dissolved	1	1	1	*	*	*	*		*	*		
Cadmium, dissolved	.010	.010	.010	*	*	.0004(d)	.004(d)		*	.01		
Chromium, dissolved	.05	.05	.05	*	*	.10	.10		.10	.10		
Copper, dissolved	*	*	*	*	*	.01	.01		*	.2		
Cyanide	*	*	*	*	*	.005	.005		*	*		
Iron, dissolved	*	*	*	*	*	1.0	1.0		1.0	*		
Lead, dissolved	.05	.05	.05	*	*	.05	.05		*	.1		
Mercury, total	.002	.002	.002	*	*	.00005	.00005		.00005	*		
Phenol	*	*	*	*	*	.01	.01		*	*		
Selenium, dissolved	.01	.01	.01	*	*	.05	.05		*	.05		
Silver, dissolved	.05	.05	.05	*	*	.01	.01		*	*		
Zinc, dissolved	*	*	*	*	*	.05	.05		*	*		
NH_3 as N (un-ionized)	*	*	*	*	*	.02	.02		*	*		
Chlorine	*	*	*	*	*	.002	.01		*	*		
Fluoride, dissolved (e)	1.4-2.4	1.4-2.4	1.4-2.4	*	*	*	*		*	*		
NO_3 as N	10	10	10									
Boron, dissolved	*	*	*	*	*	*	*		*	.75		
H_2S	*	*	*	*	*	.002	.002		*	*		
TDS (f)	*	*	*	*	*	*	*		*	1200		
Radiological (Maximum pCi/l)												
Gross Alpha	15	15	15	*	*	15(g)	15(g)		15(g)	15(g)		
Radium 226, 228 combined	5	5	5	*	*	*	*		*	*		
Strontium 90	8	8	8	*	*	*	*		*	*		
Tritium	20,000	20,000	20,000	*	*	*	*		*	*		
Pesticides (Maximum ug/l)												
Endrin	.2	.2	.2	*	*	.004	.004		.004	*		
Lindane	4	4	4	*	*	.01	.01		.01	*		
Methoxychlor	100	100	100	*	*	.03	.03		.03	*		
Toxaphene	5	5	5	*	*	.005	.005		.005	*		
2, 4-D	100	100	100	*	*	*	*		*	*		
2, 4, 5-TP	10	10	10	*	*	*	*		*	*		
Pollution Indicators (g)												
Gross Beta (pCi/l)	50	50	50	*	*	50	50		50	50		
BOD (mg/l)	*	*	5	5	5	5	5		5	5		
NO_3 as N (mg/l)				4	4	4	4		*	*		
PO_4 as P (mg/l)(h)	*	*	*	.05	.05	.05	.05		*	*		

STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS (SEE APPENDIX D)

STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS

STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS

* Insufficient evidence to warrant the establishment of numerical standard. Limits assigned on case-by-case basis.

(a) These limits are not applicable to lower water levels in deep impoundments.

(b) Not to exceed 110% of saturation.

(c) For Classes 2A, 2B, 3A, and 3B at background levels of 100 NTUs or greater, a 10% increase limit will be used instead of the numeric values listed. For Class 3D at background levels of 150 NTUs or greater, a 10% increase limit will be used instead of the numeric value listed. Short term variances may be considered on a case-by-case basis.

(d) Limit shall be increased threefold if $CaCO_3$ hardness in water exceeds 150 mg/l.

(e) Maximum concentration varies according to the daily maximum mean air temperature.

Temp. °C	mg/l
12.0 and below	2.4
12.1 to 14.6	2.2
14.7 to 17.6	2.0
17.7 to 21.4	1.8
21.5 to 26.2	1.6
26.3 to 32.5	1.4

(f) Total dissolved solids (TDS) limit may be adjusted on a case-by-case basis.

(g) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(h) PO_4 as P(mg/l) limit for lakes and reservoirs shall be .025.

A sample collected at Station VC-9 (on Eccles Creek above Pleasant Valley Creek) on May 11, 1979 had the only measured exceedances of dissolved copper (0.017 and 0.015 milligrams per liter, exceeding the standard of 0.010 milligrams per liter) and dissolved zinc (0.061 milligrams per liter, exceeding the standard of 0.05 milligrams per liter). A single exceedance of the state standard was detected for cyanide on the South Fork of Eccles Creek at Station CS-1 (0.006 milligrams per liter, exceeding the standard of 0.005 milligrams per liter). Many samples were evaluated for total concentrations of certain trace elements and not dissolved concentrations. Some of these samples revealed relatively high concentrations which may, but do not necessarily, mean that dissolved concentrations exceed state standards. Those elements thus implicated are: silver at Station UPL-10 (Huntington Creek above Electric Lake), iron at Station VC-5, (Whiskey Creek above Eccles Creek), zinc at Stations VC-1 (Pleasant Valley Creek above Scofield) and VC-5, and selenium at Stations VC-1, VC-7 (Boardinghouse Creek), VC-8 (Pleasant Valley Creek above Boardinghouse Creek). All other trace element concentrations measured appear to be in conformance with state maximums.

Exceedance of the state standards for phenol, total phosphate, and un-ionized ammonia were common at most stations. Approximately 18 percent of the phenol analyses listed in Attachment B exceed the state standard of 0.01 mg/l. Most stations had at least one sample with an exceedance. A maximum concentration in the area of 0.25 milligrams per liter was noted at VC-5 (Whiskey Creek above Eccles Creek) on August 23, 1978. The reason for the relative abundance of phenolic compounds in the area is not precisely known. However, the U.S. Environmental Protection Agency (1975) indicates that phenolic compounds may arise from naturally occurring organic sources.

The breakdown of organic residue in the area may be the source of much of the background phenol occurrences.

Nearly 50 percent of the ammonia analyses listed in Attachment B exceed the state standard of 0.02 mg/l. It has not been uncommon to find concentrations of 0.1 to 0.2 milligrams per liter in Eccles and Pleasant Valley canyons. The presence of ammonia in the local streams is probably the result of biological degradation of nitrogenous organic matter.

Approximately 50 percent of the total phosphate samples collected exceeded the state standard of 0.05 milligrams per liter. Although the standard was exceeded at least once at all stations for which total phosphate was measured, most of the high phosphate concentrations were recorded at Stations UPL-3, VC-6 and VC-9. Phosphate concentrations in the area have ranged from less than 0.001 to 2.00 milligrams per liter, averaging normally about 0.11 milligrams per liter. Variations are again large, with no detectable pattern. A portion of the phosphates may well result from the animal wastes resulting from grazing in the area (Hem, 1970). Most of the phosphates entering the streams, however, are probably carried in on sediment and have as their source the phosphorus content of the soils (McElroy et al., 1976).

The concentrations of other constituents sampled at stations throughout the area are generally well below the state standard. In many instances,

trace metal concentrations are consistently below the level of detection of routine laboratory techniques (particularly arsenic, cadmium, mercury, selenium, and silver).

Sediment Yield

Estimates of the average annual sediment yield to be expected from the lease area were made using the PSIAC method (Pacific Southwest Inter-Agency Committee, 1968) and the Universal Soil Loss Equation (U.S. Soil Conservation Service, 1977; Clyde et al., 1978). Tables 7 and 8 contain the parameter estimates and sediment yield computation results of the respective methods. Using a sediment delivery ratio of 25 percent (based on Renfro, 1975), the average annual sediment yield predicted by the Universal Soil Loss Equation is 1.4 tons per acre. This converts to 0.5 acre-foot per square mile if a sediment unit weight of 80 pounds per cubic foot is assumed (see Flaxman, 1975). This compares favorably with the estimate made by the PSIAC method, although it is felt to be somewhat high. Based on guidelines given by Strand (1975) for gravel-bottom streams, it is estimated that approximately 10 percent of the sediment yielded from the property area occurs as bedload. The remaining 90 percent occurs presumably as suspended sediment load.

Assuming that the PSIAC estimate is correct, the lease area yields an average of 1.4 acre-feet per year of sediment to the Price River Basin and 0.5 acre-foot per year of sediment to the San Rafael River Basin. Although no published sediment yield data are available for the upland areas of the two basins, this is undoubtedly only a small portion of

Table 7. Average annual sediment yield estimate of the Valley Camp lease area using the PSIAC method.

Factor	Description	Rating
Surface Geology	Interbedded shales and sandstones, moderately fractured	8
Soils	Medium textured with high percentage of coarse fragments	0
Climate	Precipitation primarily as snow, humid	0
Runoff	Large volume, high peak per unit area	10
Topography	Steep, high relief, no flood plain development	20
Ground Cover	Area completely protected	-10
Land Use	Ordinary road construction, intensive grazing over some areas, no recent logging	0
Upland Erosion	About 25 percent of area characterized by landslide erosion	10
Channel Erosion	Occassionally eroding banks, moderate flow depth	10
	Total	48

Sediment yield (from Figure 15) = 0.4 $AF/mi^2/yr$.

Table 8. Average annual sediment yield estimate of the Valley Camp lease area using the Universal Soil Loss Equation.

Equation: A = RKLSCP

Variable	Meaning	Assigned Value
R	Rainfall factor	26
K	Soil Erodability factor	0.24
L S	Slope length factor (1000 ft) Slope gradient factor (28%)	29
C	Cropping management factor	0.03
P	Erosion control practice factor	1.0
A	Estimated soil loss (tons/acre/year)	5.4

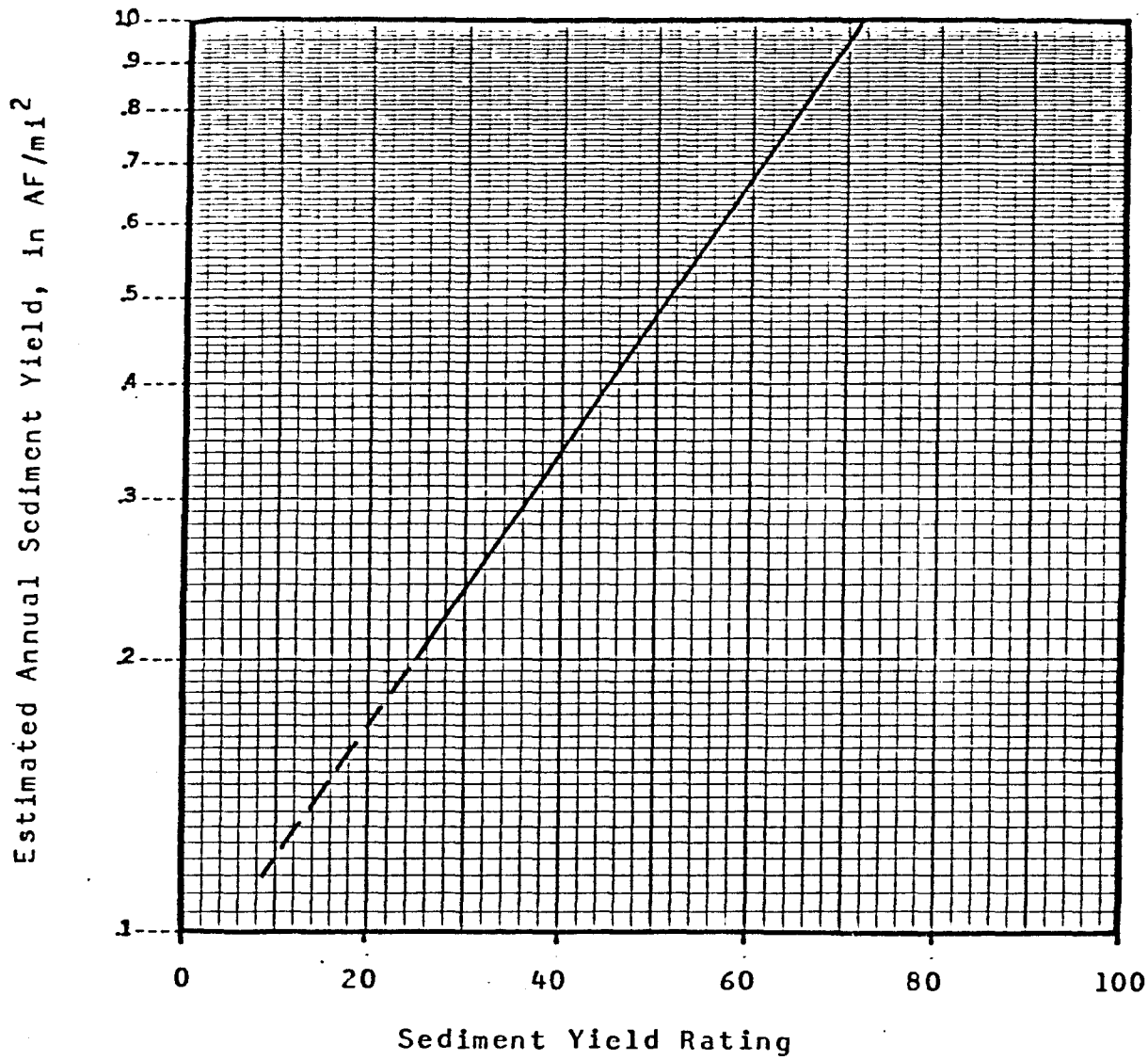


Figure 15. Sediment yield as determined by the PSIAC method (adapted from Shown, 1970).

of the total amount of sediment yielded from the respective basins.

Monitoring Program

To provide an ample and efficient water quality monitoring program, some changes in stations will be made. Stations VC-1, VC-2, VC-4, VC-5, and VC-10 will be maintained to provide continued monitoring of the impact of operations in the Belina No. 1 Mine and the load-out facility in Pleasant Valley Canyon. Stations VC-7 and VC-8 will be replaced by new stations established in Boardinghouse Creek, Finn Creek, and Long Creek (Stations VC-11, VC-12, and VC-13 respectively). These new stations will provide more complete monitoring on the southern portion of the lease. Stations VC-6, CS-7, UPL-3, and UPL-10 will be abandoned since they are located so as to monitor the effects of proposed mining activities by Coastal States Energy Company and not those of Valley Camp. Data from these stations has been included in this report for its benefit in giving an indication of water quality in the area. Station VC-10 will allow adequate monitoring of activities in the South Fork of Eccles Canyon without CS-1, so the latter station will be abandoned. Station VC-9 will be abandoned. Other stations in Eccles Canyon will provide adequate monitoring of Valley Camp activities within the canyon. Construction of a load-out facility of Coastal States Energy Company immediately above VC-9 would greatly reduce the value of the station to Valley Camp. Plate 3 shows the location of all stations that will be monitored.

Samples will be collected from all stations shown in Plate 3 annually and analyzed according to the schedule given in Table 4. These samples will be collected during the month of August each year to allow sufficient time prior to snowfall to collect additional data if the laboratory results show unique, unexpected conditions. Samples will be analyzed according to Attachment A and preserved as previously outlined.

In addition to the annual comprehensive samples, stations in Eccles Canyon (Stations VC-4,VC-5, and VC-10) and on Pleasant Valley Creek (Stations VC-1 and VC-2) will be sampled each spring and fall on a continuing basis according to the abbreviated schedule given in Table 9. Excellent baseline data have been collected on streams surrounding and draining the Valley Camp lease area since January of 1976. Information gained from this data indicates that this sampling frequency will be sufficient. If future data indicate a need, the sampling frequency may be changed and/or parameters may be added to or deleted from this table.

The derivation of Table 9 was based on the need to clarify background conditions and future impacts. Because of the inherently high chemical quality of waters in the Valley Camp lease area, as determined by the baseline study, suspended solids has been included in the abbreviated schedule as the single most important impact indicator. Ammonia, phenol, and phosphate are included because of the

high background concentrations found previously. Total dissolved solids, specific conductance, temperature, and the major cations and anions are included as indexes of major change. Total iron, total manganese, and pH determinations are required by OSM regulations.

As mining develops south of Eccles Canyon, spring and fall samples will be collected also from the stations impacted (i.e. VC-11, VC-12, and/or VC-13) and analyzed according to Table 9 beginning one year prior to any potential underground impact. (These stations are generally inaccessible in the winter.) As will be the case in Eccles Canyon, complete analyses (Table 4) will be run once a year (in August) even after seasonal sampling begins.

Surface water monitoring will continue according to the abbreviated water quality schedule through the mining and reclamation operations. Post-mining data collection will continue on a seasonal basis (spring, summer and fall) at each of the stations until the reclamation effort

Table 9. Abbreviated water quality analytical schedule for monthly samples.

Field Measurements	Laboratory Measurements	
Discharge	Ammonia (NH_3 as N)	Phenol
pH	Bicarbonate	Phosphate, Total as PO_4
Specific Conductance	Calcium	Potassium
Temperature, Air	Chloride	Sodium
Temperature, Water	Iron, Total	Sulfate
	Magnesium	Suspended Solids
	Manganese, Total	Total Dissolved Solids

is deemed successful by the regulatory authority. The August sample will continue to be analyzed according to Table 4 through the post-mining period.

In addition to the above outlined monitoring program, monitoring of all discharges will be conducted in accordance with any NPDES permit in effect. Station VC-001 has been established for this purpose at the Belina No. 1 Mine.

As required, water quality data collected from surface water monitoring stations will be submitted quarterly to the regulatory authority (Utah Division of Oil, Gas, and Mining). Such reports will normally be submitted within 60 to 90 days of the end of each quarter, depending upon the speed of the laboratory analyses.

GROUND WATER HYDROLOGY

Regional Ground Water Hydrologic System

The principle factor controlling the occurrence and availability of ground water in any area is geology. As noted by Price and Waddell (1973), nearly all of the region surrounding the Valley Camp lease area is underlain by rocks of continental and marine origin, consisting predominately of interbedded sandstones and shales. Although some of the sandstones in the region serve as the principle water bearing strata, their ability to yield water for extended periods of time is largely controlled by the existence of the relatively impermeable interbedded shale layers, which prevent the downward movement of a significant amount of water.

According to the U.S. Geological Survey (1979), ground water in the region exists under water table, artesian, and perched conditions. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams and in relatively flat lying sedimentary rocks. Artesian conditions exist at greater depths where a confining layer overlies a more permeable member. However, pressures are generally not sufficient to produce flowing wells. Perched or impeded conditions exist where the confining layer lies beneath the water bearing strata.

Because of the high annual precipitation, the Book Cliffs and the adjacent Wasatch Plateau (where the Valley Camp lease area is located),

act as recharge areas for regional ground water systems (Price and Arnow, 1974). However, only a small portion of the annual precipitation, probably much less than five percent, recharges the ground water supply (Price and Arnow, 1974; U.S. Geological Survey, 1979). Although the depth of water infiltrating through the surface to saturated beds is small (due to the presence of the relatively impermeable shale layers near the surface over much of the area), the total recharge volume is rather significant because of the areal extent of the zone of recharge.

Price and Arnow (1974) indicate that properly constructed wells in the Price and San Rafael river basins would have only limited yields (normally less than 50 gallons per minute). Wells immediately adjacent to the lease area could normally be expected to yield less than 10 gallons per minute. Increased yields could be expected from wells penetrating highly fractured sandstones.

Rocks in the mountainous areas near the lease area generally have low specific yields (0.2 to 0.7 percent) and low hydraulic conductivities (Price and Waddell, 1973). The volume of recoverable water in the area is small, averaging less than 600 acre-feet per square mile in the upper 100 feet of saturated rock (Price and Arnow, 1974).

The quality of ground water in the Price and San Rafael river basins deteriorates with distance downstream much the same as surface water. Dissolved solids contents in ground water range from less than 250

milligrams per liter near the lease area to 3000 milligrams per liter near the confluence of the rivers with the Green River (Price and Waddell, 1973). This increase in dissolved solids concentration is the result of increased contact of water and rock as travel distance increases, with saline shales contributing the major portion of the dissolved constituents.

Characteristics of Seeps and Springs

As an index of ground water hydrologic conditions in the lease area, an inventory was made of existing seeps and springs on and adjacent to the lease area during the months of September and October, 1978, September, 1979 (i.e. the low flow season), and June and July, 1979 (i.e. the high flow season). During this time, the lease area was covered on foot and all seeps and springs found were noted on a map. In addition, an estimate was made of the discharge, a water quality sample was collected, and determinations were made of water temperature and specific conductance. Based on these data, selected samples were chosen which were representative of flow, quality, and geographic variations over the property and sent to the laboratory to be analyzed for calcium, magnesium, potassium, sodium, bicarbonate, chloride, sulfate, and total dissolved solids. Samples collected during September, 1979 were also analyzed for many additional parameters. The results of these analyses can be found in Attachment C.

Results of the field investigation and the chemical analyses are summarized in Plate 4. Also shown in this plate are geologic formations, faults, etc. which may have an influence on the behavior of seeps and springs. Note that a value for total dissolved solids concentration is reported for each spring rather than specific conductance. This transformation was made after establishing a relation between the two parameters for the samples where chemical analyses were completed (see Figure 16). A conversion factor of 0.62 was used.

Because of the large number of springs in the area, some were likely missed during the inventory. However, it is felt that the majority of the springs were sampled and representative conditions were covered.

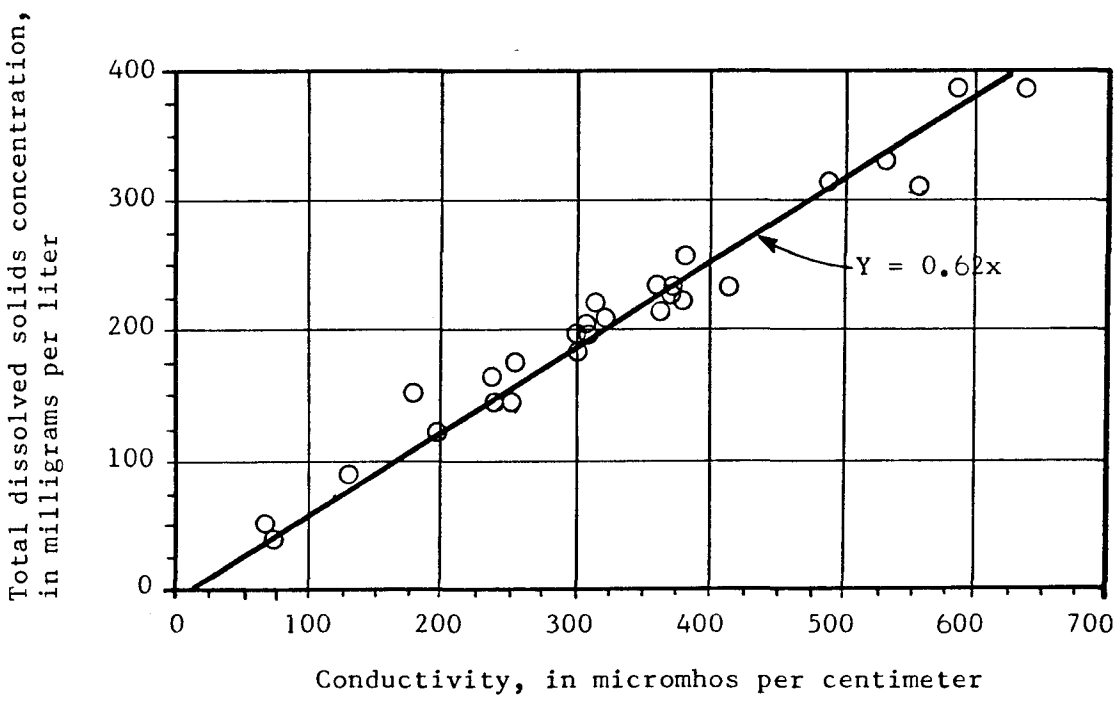


Figure 16. Relation between specific conductance and total dissolved solids concentration for springs in the Valley Camp lease area.

Plate 4 shows the location of 74 seeps and springs located on the lease area as well as 35 seeps and springs adjacent to the lease boundary. Thus, an average of one water source was encountered for every 37 acres in the area, not including the perennial streams. Observations and measurements in the area indicate that the majority of the springs and seeps continue to flow through the low flow period of the year. As a result, the travel distance between water supplies is short for the wildlife and livestock which utilize the area. Therefore, should a frequently used spring dry up as a result of drought, mining impacts, etc., most animals using the water supply would not be greatly affected.

Several observations should be made regarding the occurrence of seeps and springs in the lease area. First, many springs issue near the base of a sandstone lense (where contact is made with a shale member), often a considerable distance (from a few feet to tens of feet) above the adjacent streambed (normally considered the drain in a perennial watershed). This indicates that the shale layers in the Blackhawk Formation act as impeding lenses, carrying at least a portion of the water which percolates through the soil mantle back to the surface where it is eventually discharged into an adjacent stream. Thus, because of the presence of a large amount of shale in the property area, ground water recharge is likely slow.

A second observation deals with the origin of the water issuing from the seeps and springs. Note that a number of springs are located

at relatively high elevations. This, together with the fact that the sandstone lenses in the Blackhawk Formation are very discontinuous (see the previous discussion on geology), implies that much, if not all, of the water found in a given spring originates in the small surface depression or basin immediately adjacent to the spring. Thus, springs are supplied by a bedrock member which is extremely local in extent, as opposed to a larger, more regional system. The same condition presumably applies to springs at lower elevations.

A third observation to be made concerning location is that very few seeps and springs appear to be fault-related. This phenomenon has also been noted elsewhere along the Wasatch Plateau. As noted by the U.S. Geological Survey (1979), the shale layers of the Blackhawk Formation are bentonitic, tending to swell when wet and decompose into an imprevious clay. Apparently, fractures in the Blackhawk Formation seal readily because of the ability of the shale layers to swell and decompose, providing a barrier to water movement.

As a final observation, travertine deposits are often associated with springs in the area. Although this may suggest a deeper seated water source than a localized sandstone, Hem (1970) indicates that this may also result from the high calcium bicarbonate content of the water. This explanation is felt to be reasonable, thereby supporting the hypothesis that faults in the Blackhawk Formation are not ready conveyors of water.

Flows from individual springs were quite small during the summer inventory. Only eight springs were flowing at rates greater than or equal to 10 gallons per minute (25-13 at 25 gallons per minute, 36-3 at 15 gallons per minute, 6-3 at 10 gallons per minute, 25-2 at 22 gallons per minute, 25-5 at 12 gallons per minute, 25-6 at at 10 gallons per minute, 2-2 at 12 gallons per minute, and 25-15 at 30 gallons per minute). Most of the springs in the fall were flowing less than one gallon per minute. Samplings during the summer of 1979 have indicated that flows at a given spring may vary by as much as an order of magnitude during the year, with the higher flows coming near the snowmelt season. This further substantiates the theory that water supplying the springs is generally very local in origin. Water originating from a deeper, more regionalized source would likely have a more constant flow. It also indicates that flows are quite sensitive to the amount of precipitation received during the previous winter.

Almost without exception, the chemical analyses shown on Plate 4 indicate that ground water in the lease area, as indexed by springs, is of a strong calcium bicarbonate type. The data show that three distinctive qualities of spring water can be found in the property area. Springs issuing just east of the lease area in the Starpoint Formation had a higher dissolved solids content, ranging from 217 to 528 milligrams per liter and an average of 327 milligrams per liter during the early summer inventory. These higher concentrations indicate that water surfacing within the Starpoint Formation

has probably traveled further and/or remained underground longer than water surfacing higher up in the Blackhawk Formation.

The few springs issuing adjacent to the South Fork of Eccles Creek had the highest dissolved solids concentrations found on the lease area during the inventory (averaging 276 milligrams per liter during the early summer inventory). These higher concentrations likely result from local conditions which cause prolonged contact of the water with shale layers prior to discharge. Because of the small particle size and, therefore, greater available area of contact in a shale, more dissolved constituents are picked up by the water than would be the case in a more permeable member.

Springs over the remainder of the property area had dissolved solids contents which varied between about 30 and 290 milligrams per liter, averaging approximately 155 milligrams per liter during the early summer inventory. There is a strong tendency for total dissolved solids concentrations to increase as summer progresses and flows diminish. Of the 15 springs sampled both in the early summer and fall, 12 had an increase in dissolved solids. The average change for the 15 stations was an increase of 86 percent.

Seven of the springs shown on Plate 4 were chosen for continued monitoring of water quality and quantity. The selection of representative springs was based on variations in flow, quality, and geographic location as noted in Table 10 and discussed previously (see Plate 3).

Priority was given to high flowing springs, since potential impacts would likely be greatest on these sources. A discussion of the data collected during subsequent samplings will be presented in the section covering ground water quality.

Stream Seepage

Iorns et al. (1965) developed a method of estimating the amount of ground water contributed to streams using flow duration curves. They indicate that the method applies primarily to headwater streams whose flows come largely from snowmelt and are affected little by the activities of man. Thus, the methodology applies to Valley Camp lease area streams.

Table 10. Springs selected for continued monitoring.

Station Number	Reason for Continued Sampling
S7-11	High flow, high TDS content, headwaters of Long Canyon
S24-12	High TDS content, South Fork of Eccles Canyon
S25-13	High flow, low TDS content, near Belina No. 1 Mine
S31-13	Lower elevation, headwaters of Finn Canyon
S36-17	Below O'Connor Mine, headwaters of Boardinghouse Canyon
S36-19	Headwaters of Coal Canyon
S36-23	Headwaters of James Canyon

Note: The letter S in the station number indicates that the source is a spring.

According to this methodology, the average time that flow in a snowmelt-type stream is affected by ground water discharge can be approximated by drawing a line tangent to the steep part of the flow duration curve of the stream and noting the departure point from the lower portion of the curve. The flow represented by the part of the curve below this departure point consists primarily of water discharged from ground water storage. Arithmetic integration between the departure point and the 100 percent duration point is used to determine the ground water discharge rate during baseflow conditions.

The average rate of ground water discharge during the time that streams are controlled by direct runoff (i.e. during the snowmelt season) can be approximated by the flow duration curve discharge that is equalled or exceeded 70 percent of the time. By adding this value to that obtained by integrating the flow duration curve below the departure point, the average annual rate of ground water discharge contributed to the stream is obtained.

An estimate of long-term average annual ground water discharge of Eccles Creek above Pleasant Valley Creek was made using the above outlined methodology and the flow duration curve developed previously (see Figure 7). This stream was chosen because of its proximity to the lease area and the availability of sufficient data for use of this method. The ground water discharge of Eccles Creek is described by Figure 17 and Table 11.

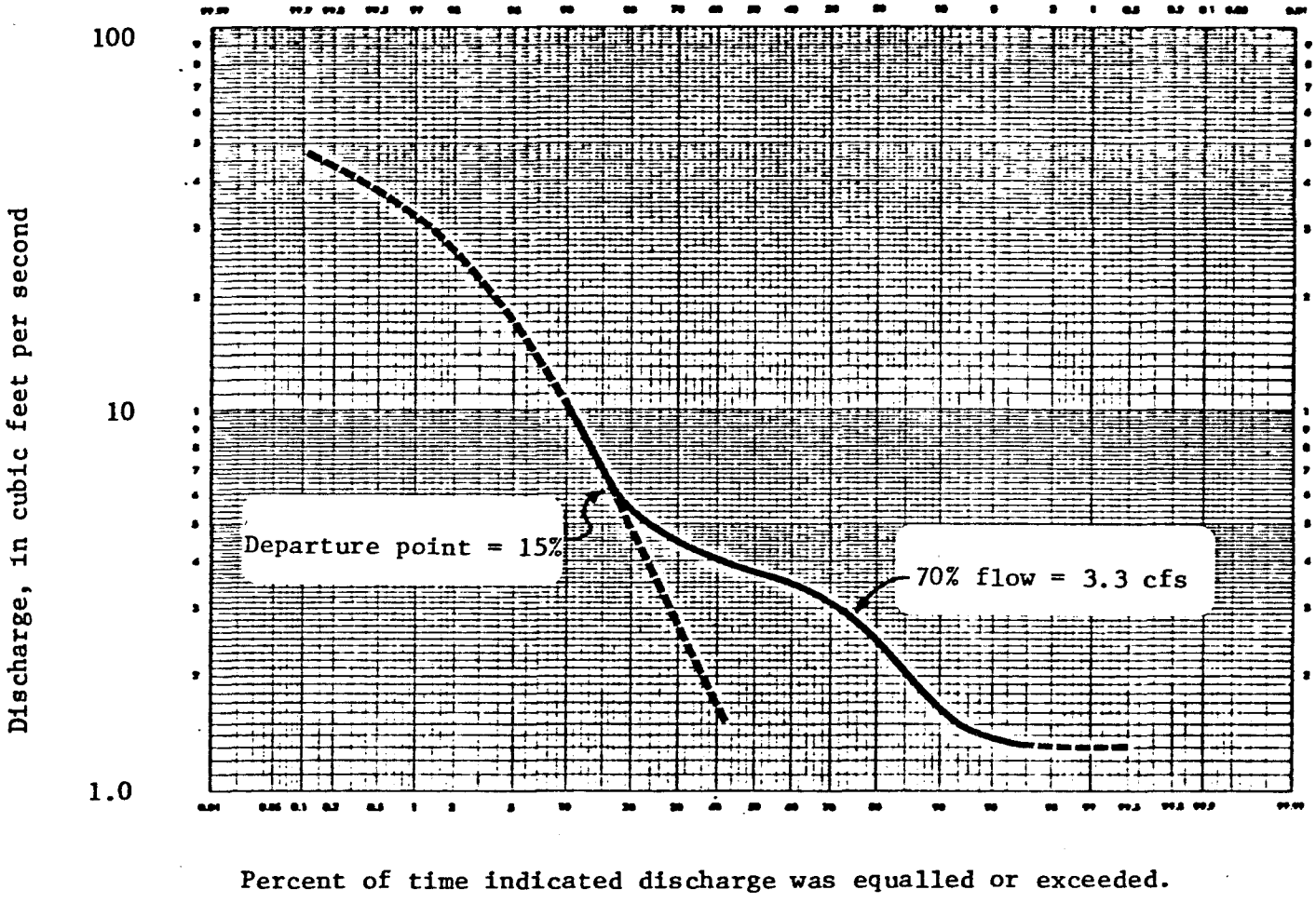


Figure 17. Long-term duration curve of mean daily flows of Eccles Creek above Pleasant Valley Creek showing departure point and 70 percent discharge.

Table 11. Computation of long-term average annual ground water discharge of Eccles Creek above Pleasant Valley Creek.

Duration Curve Percentage			Discharge (cfs)	
Limits	Interval	Mean of Interval	Q for Mean of Limits	Increment in Interval
0-15	15	-	3.3	0.50
15-25	10	20	5.6	0.56
25-35	10	30	4.6	0.46
35-45	10	40	4.1	0.41
45-55	10	50	3.8	0.38
55-65	10	60	3.6	0.36
65-75	10	70	3.3	0.33
75-85	10	80	2.5	0.25
85-95	10	90	1.6	0.16
95-99	4.0	97	1.3	0.05
99-99.6	0.6	99.3	1.3	0.01
99.6-100.0	0.4	99.8	1.3	0.01
Total	100	-	-	3.47

The average annual ground water yield to Eccles Creek above Pleasant Valley Creek (3147 cubic feet per second) represents approximately 64 percent of the total annual flow (5.43 cubic feet per second, see Table 2), or 8.59 inches over the 3510 acre watershed. The principle cause of the high ground water yield in Eccles Canyon is likely the Star Point Sandstone, which is present on the surface over approximately 25 percent of Eccles Canyon. Field observations indicate that this sandstone is nearly full to the upper reaches of the outcrop in Eccles Canyon and yielding water to the creek throughout the canyon (i.e. many seeps and springs can be found along the stream to this point). The Blackhawk Formation which appears on the surface over most of Eccles Canyon yields water essentially only from thin, discontinuous sandstone lenses which are often sandwiched in between shale layers.

In order to better define ground water recharge-discharge conditions on major streams in the area, seepage studies were conducted on the Main Fork of Eccles Creek and the South Fork of Eccles Creek. The Main Fork of Eccles Creek was chosen to assess changes as the water flows across the Star Point Sandstone and major faults. Studies on the South Fork of Eccles Creek were undertaken to assess changes along the Connelville Fault zone in the Blackhawk Formation which the stream generally follows, thereby allowing an estimate to be made of the water conditions which might be encountered in the mine near the fault.

In conducting the seepage studies, at selected points along the stream segments and at points of major tributary inflow, flow rates were determined using either a small, portable Parshall flume (2-inch or 6-inch throat width) or a Marsh-McBirney current memter. Head measurements in the flumes were converted to discharges using tables provided by the U.S. Bureau of Reclamation (1974). Small inflow rates were measured volumetrically or using floats (Buchanan and Somers, 1969) or visually estimated.

In addition to the flow measurements, water quality samples were collected at each seepage study station. These samples were analyzed for the parameters listed in Table 12. All constitutents were analyzed in terms of total concentrations. Attachment D contains the results of the analyses.

Plate 5 summarizes the concentrations of major chemical constituents found at each of the seepage study stations utilizing cation-anion diagrams. Although there is a gradual deterioration in water quality in each of the three streams with distance downstream, no major changes were noticeable. The increased travel time alone may be sufficient to cause the gradual increases in dissolved solids which occurred.

The concentrations of significant parameters were converted to loads to better assess changes in the streams. By subtracting out the loads contributed by measured tributaries, only unmeasured gains or losses in the subject stream are left, thus giving an index of the effect of geologic conditions on a given stream segment.

Table 12. Water quality analytical schedule used for seepage studies

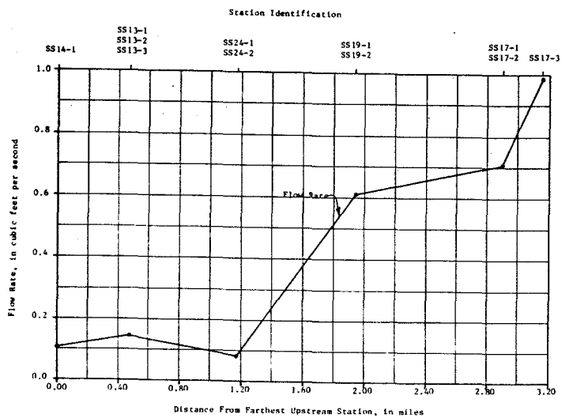
Acidity	Iron
Alkalinity	Lead
Arsenic	Magnesium
Barium	Manganese
Bicarbonate	Mercury
Boron	Potassium
Cadmium	Selenium
Calcium	Silver
Chloride	Sodium
Chromium	Sulfate
Conductivity	Suspended Solids
Copper	Total Dissolved Solids
Fluoride	Zinc

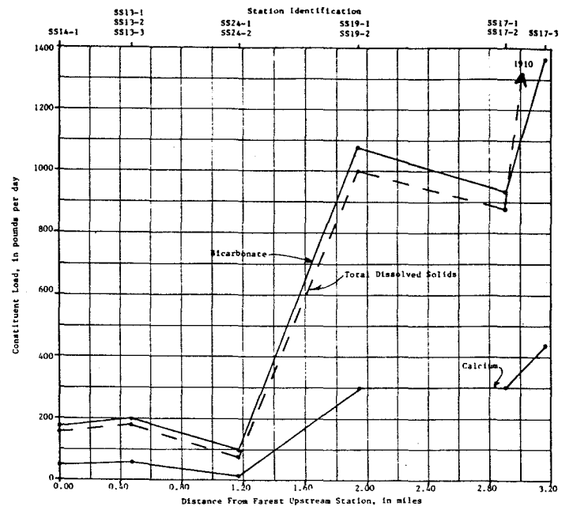
Figure 18 summarizes the changes in flow and constituent loads measured in the Main Fork of Eccles Creek. The data presented in the figure have been corrected for major tributary inflow (i.e. sources where water quality samples were collected). Consequently, the figure shows the conditions which would have existed if all inflow at the measured tributaries had been stopped during the seepage study.

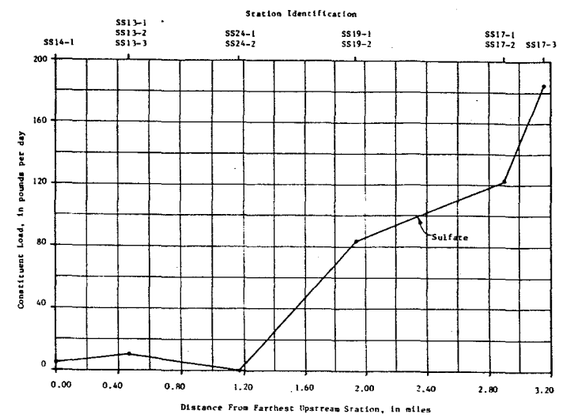
Changes above Station SS24-1, as the stream flows across the Blackhawk Formation, appear to be rather insignificant. The small losses noted may well be the result of water from the stream entering local sandstone lenses in the Blackhawk and following the dip to the west.

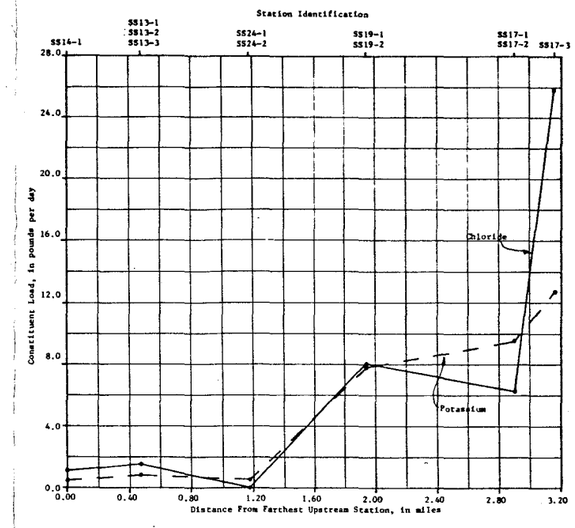
The fact that little change occurs between Stations SS13-1 and SS24-1 indicates that the Connelville Fault zone, which crosses the stream just above the lower station, does not convey a significant amount of water to the surface. This fault has presumably been sealed to flow by the expanding shales.

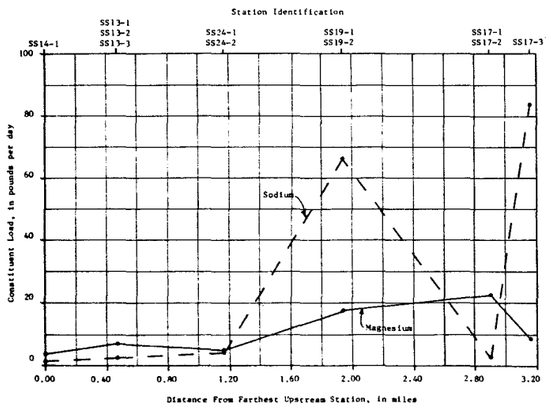
Significant stream changes occur near and below Station SS24-1. As noted in Plate 5, these hydrologic changes are also accompanied by a change in the surface geologic formation (to the Star Point Sandstone) and the existence of two major fault zones which traverse the stream segment (the O'Connor Fault near SS19-1 and the Pleasant Valley Fault near SS17-1).

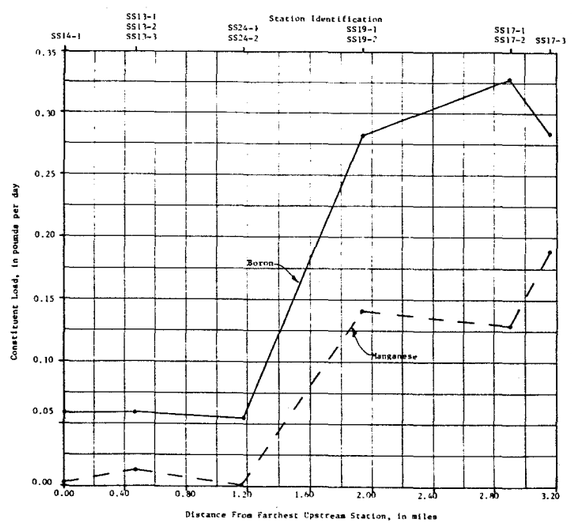


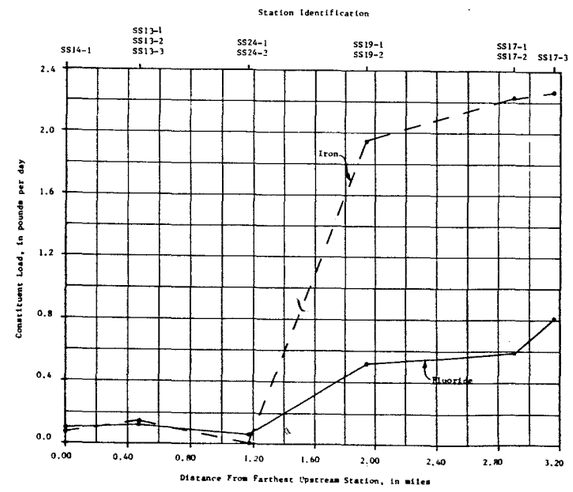












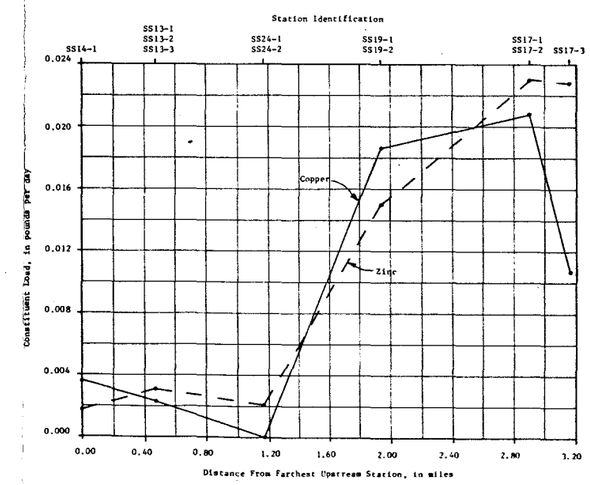


Figure 18. Results of seepage study flows and stream loading calculations for the Main Fork of Eccles Creek. All values have been corrected for tributary inflow.

Based on the number of springs along the stream, it appears that the O'Connor Fault is discharging into Eccles Creek, thus causing the graphical peaks in flow and loads noted in Figure 18 at Station SS-19-1. As a check, the assumption was made that all of the change found at SS19-1 was coming from the O'Connor Fault and adjacent fractures. Table 13 gives the results of calculations to determine the individual concentrations of various parameters which must be present to produce the changes noted in Figure 18, based on the measured flow increase of 0.53 cubic foot per second. Also noted are the results of two water quality analyses: one of seepage from the floor of the O'Connor Mine at the O'Connor Fault (flow equaled one gallon per minute) collected on March 27, 1979 and the second of a spring located on the south side of Eccles Creek near the O'Connor Fault collected on September 10, 1979 and labeled S-1 (flow equaled 15 gallons per minute). The results compare well with the calculations in most cases. The comparison between S-1 and the O'Connor mine also seems to agree with the assumption that the O'Connor Fault is acting as a conveyance structure in the fractured sandstone, thereby discharging into Eccles Creek and causing a major portion of the changes noted by the seepage study. Most constituents sampled at each location are present at higher levels at Station S-1 which may be the result of increased contact time. This would be the case if water was flowing along the fault in a northerly direction. Those cases where lower concentrations occur at Station S-1 (i.e. magnesium and sulfate) may be the result of ion exchange or dissociation.

The Pleasant Valley Fault is present at a Blackhawk-Star Point interface and, as a result, probably serves more as a barrier than a conduit.

Table 13. Computed concentrations of major constituents flowing into Eccles Creek during seepage studies, as compared with water collected along the O'Connor Fault in the O'Connor Mine and a nearby spring.

	Corrected Constituent Load, in pounds per day				Measured Concentration in mg/l	
Parameter	At SS24-1	At SS19-1	Increase	Calculated Inflow Conc., in mg/l	O'Connor Mine	S-1
Bicarbonate	95	1075	980	342.4	241.6	356.2
Calcium	20	300	280	97.8	82.4	110.4
Chloride	0	8.0	8.0	2.8	2.0	4.0
Fluoride	0.06	0.52	0.46	0.16	0.17	-
Iron	0	1.94	1.94	0.68	-	0.97
Magnesium	5	18	13	4.5	25.9	2.9
Manganese	0	0.14	0.14	0.05	-	0.05
Potassium	0.05	7.8	7.3	2.55	2.21	2.58
Sodium	4	66	62	21.7	1.84	15.2
Sulfate	0	84	84	29.4	118	30.0
Total Diss. Solids	75	1000	925	323	335	345

The likelihood of this happening is borne out by the rapid change in loads of most constituents between SS17-1 and SS17-3 and the fact that the computed inflow concentrations required to produce the measured load increase far exceed measured concentrations from the Alpine School District well, located at the mouth of Green Canyon adjacent to the Pleasant Valley Fault. It appears that subsurface water may be flowing beneath Eccles Creek and is being forced to the surface at the Pleasant Valley Fault due to the presence of a barrier created by the impermeable Blackhawk Formation. Much of this is likely deeper water which has not previously mixed with water in the stream above this point.

Figure 19 presents a similar stream loading analysis of the South Fork seepage study results. The data gathered from this stream are much more variable than encountered in the main fork. However, a few general patterns can be seen.

Nearly all constituents measured experienced an increase between the first two stations (SS25-1 and SS24-3). Many seeps and springs appeared on the hillside in this section, accounting presumably for most, if not all, of the increase.

Only a small amount of inflow from seeps (approximately 5 gallons per minute) was noted on the surface between SS24-3 and SS24-4. The remaining 20 gallons per minute of the noted increase likely resulted from diffuse

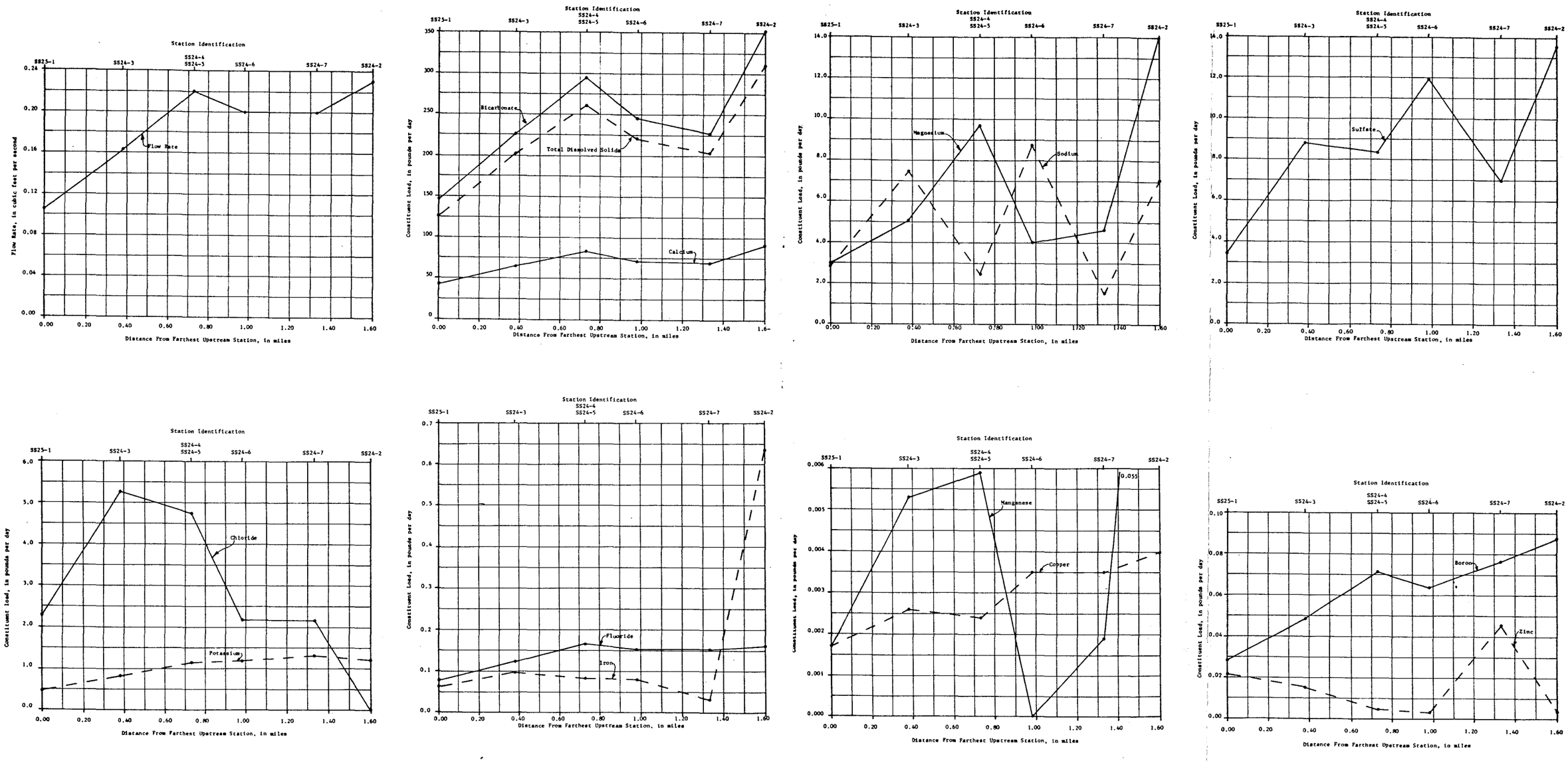


Figure 19. Results of seepage study flows and stream loading calculations for the South Fork of Eccles Creek. All values have been corrected for tributary inflow.

inflow into the stream. Chemically, the segment experienced some exchanging of sodium for calcium and magnesium.

No significant flow changes were noted between SS24-3 and SS24-7. Because of this, it is assumed that the chemical changes noted in Figure 19 resulted almost entirely from ion exchange, dissociation, or precipitation. Small, local changes in flow conditions may have occurred in the stretch also, causing some of the chemical change, but overall alternations in flow were insignificant.

A large beaver pond has been built between SS24-7 and SS24-2. It is reasonable to expect that most changes noted below SS24-7 have resulted either directly from the pond or from springs located in the pond. Some change may have also resulted where the Connelville Fault zone crosses the Star Point Sandstone. The magnitude of this, however, is expected to be small since the Connelville Fault was not shown to be a significant contributor of water to the main fork.

It appears that changes in conditions along the South Fork of Eccles Creek can be largely accounted for by springs which issue in the headwaters area and a large beaver pond at the mouth. The Connelville Fault zone itself apparently has little effect on the stream. This confirms the previous conclusion that the fault is not acting as a conduit but, rather, has likely sealed itself.

Although surface flow conditions throughout the length of the Connelville Fault appear to be uniform, the amount of water encountered in the mines near the fault zone may vary, depending upon whether shale or sandstone is encountered at the fault by the advancing mine face. For example, in approaching the fault from the east, the Belina No. 1 Mine encountered a sandstone lense at the fault in section 24, T. 13 S., R. 6 E. which yielded approximately 200 gallons per minute. Within three or four days the flow decreased to about 10 gallons per minute and has been slowly decreasing since then. If a shale layer had been encountered by the mine at the fault, only a slight increase in the inflow rate to the mine would have been expected (as experienced by the insignificant changes noted in the seepage study). In either case, the increased inflow to the mine probably has as its source water which was stored behind the barrier created by the fault (similar to the condition implied at the Pleasant Valley Fault). Because of the discontinuous nature of the Blackhawk Formation and its apparent slow recharge rate, only an underground area of local extent would be expected to yield water at the fault, thus explaining the relatively rapid decrease in flow at the fault noted in the Belina No. 1 Mine.

Observation Wells

During the summer of 1979, Coastal States Energy Company drilled several coal exploration holes on the Skyline Property (located adjacent to the northwestern border of the Valley Camp lease area). Five of these locations were selected for conversion to ground water observation wells. Deep

observation wells (terminating in the Star Point Formation) with 2-inch casing were installed at each of the five locations. Shallow observation wells (terminating in the Blackhawk Formation, normally above the coal zone) with 2-inch casing were installed at four locations. The casings were perforated throughout the bottom 20 feet, thus providing a measure of the piezometric heads in the respective formations and a determination of whether or not vertical movement was occurring. Since these wells penetrate the same geologic formations that underlie the Valley Camp lease area and because of their proximity to the lease area, information obtained from these wells gives some indication of aquifer and ground water characteristics in the Valley Camp lease area.

Four wells have also been drilled by Valley Camp, one of which reached the ground water table. There are also two open holes, one on and one west of the lease area, which provide additional water table data. Data obtained from these holes and the Valley Camp wells, when supplemented by the data obtained from the Skyline Property mentioned above, give a substantial amount of information about the ground water and aquifer characteristics in and near the lease area.

Ground Water Movement

Peizometric heads were measured during the fall of 1979 in the shallow and deep observation wells, the two open holes and the well near the Belina No. 1 Mine. Data from the shallow wells (see Plate 6) show the ground water flowing in a west to southwest direction over the area west of

the Price and San Rafael drainage basin divide, generally following the dip of underlying formations. The direction of ground water flow in the underlying Star Point Sandstone (as measured in the deep holes) is essentially the same as that measured in the shallow holes.

The ground water table elevation reaches a peak near or slightly to the east of the divide between the Price and San Rafael river basins as shown on Plate 6. Wells on the east of the divide show the water table elevation to be rapidly lowering towards the east with gradients of up to 1600 feet per mile at the head of Whiskey Canyon above W19-1 and 1100 feet per mile at the head of Eccles Canyon above W13-1. Just below W13-1 the gradient drops to about 150 feet per mile, probably the result of fractures associated with the Connelville Fault. Further down Eccles Canyon and in the lower portion of Whiskey Canyon, the gradient is about 300 feet per mile.

An anomalous condition exists between W26-1 and W35-1. While ground water gradients over much of the rest of the property average about 250 feet per mile, the gradient steepens to about 600 feet per mile between the two holes. This anomaly is likely associated with the Valentine Fault zone, which passes through W35-1. During drilling operations, flows in excess of 110 gallons per minute were discharged from W35-1, a higher flow rate than experienced elsewhere on the property. The core confirmed that this hole crossed a hgih angle fault. Apparently, the fracture has connected the sandstone lenses of the Blackhawk Formation with the Star Point Sandstone, thereby significantly increasing the water yield characteristics of the rock at this point and influencing the piezometric head in the area.

At W10-1 (three miles northwest of the lease area) the piezometric head under the coal zone was 35 feet greater than above the coal. At W22-2 (two miles south of W10-1) the underlying piezometric head was 40 feet greater than the overlying head. The area near these two holes is experiencing upward flow from the underlying sandstone. At W14-2 (one mile northwest of the lease area) the piezometric head was five feet less under the coal than above it. Likewise, at W35-1 near Electric Lake, the piezometric head was 15 feet less under the coal.

The water level at W35-1 is 165 feet below the ground surface. However, two springs occur 50 feet up on the hillside adjacent to the observation well and apparently on the fault line. This further substantiates the theory that water issuing from springs on the lease area has a very localized source and indicates that two ground water systems occur in the area. A shallow system is very local in extent and discontinuous, providing water to numerous seeps and springs through thin sandstone layers in the Blackhawk Formation (ranging in thickness from about 1 foot to 60 feet). A deep ground water system is present in the saturated rocks surrounding the coal. This system has little effect on the surface hydrologic regime on the water slopes passing far below the perennial streams, but does surface in the lower reaches of Eccles Canyon.

Deep holes, depth of water, and variability of sandstone layers made it impossible to estimate water yield from the holes during drilling. As already noted, air rigs were discharging over 110 gallons per minute at deeper depths in W35-1. In other locations, flows were usually under five gallons per minute and often zero.

Aquifer Test Results

Drawdown and recovery tests were conducted for Coastal States Energy Company at two different depths in a test well located in Eccles Canyon about 4000 feet north of the Valley Camp lease area. Because of the proximity of the well to the lease area and since the well penetrates geologic formations which extend through the lease area, it is felt that results of aquifer testing are indicative of aquifer characteristics in the lease area. Permission has been granted by Coastal States Energy Company for inclusion of their test results in this report (see Plate 8). Each test consisted of approximately 65 minutes of drawdown testing and an equal period of recovery testing. Water was discharged from the well using a bailer. The data were analyzed over the straight-line portion of the semilog time-drawdown (or time-residual drawdown) curve using the Jacob equation (U.S. Bureau of Reclamation, 1977), which states that

$$T = \frac{2.303\ Q}{4\pi\, \partial s/\partial(\log t)} \qquad (10)$$

where T is the transmissivity, Q is the flow rate from the well during the drawdown test, s is the drawdown, and t is the time since pumping began. In the case of a recovery test, s becomes s' (the residual drawdown or difference between the measured head and the head prior to the start of pumping) and the time term becomes t/t', where t' is time since pumping ceased (U.S. Bureau of Reclamation, 1977). For a particular distance, equation 10 is the equation of a straight-line plot of s versus log t (or s' versus log t/t'). For one log cycle, $\partial \log t$ (or $\partial \log t/t'$) is equal to one. With this in mind, and converting to the gallon-day-foot system of units, equation 10 can be written as

$$T = \frac{264\ Q}{\Delta s} \qquad (11)$$

where T is the transmissivity, in gallons per day per foot; Q is the constant discharge rate, in gallons per minute; and Δs is the drawdown difference per log cycle of time, in feet. The recovery test equation substitutes s' for s.

Tests were run in the open hole at depths of 200 feet (within the coal zone of the Blackhawk Formation, above the Aberdeen Sandstone) and 300 feet (at the bottom of the Blackhawk Formation, below the Aberdeen Sandstone). The data are plotted in Figures 20 and 21. At the 200 foot depth, transmissivities of 21.0 and 16.6 gallons per day per foot were calculated for the drawdown and recovery tests, respectively. Transmissivities of only 16.3 and 17.9 gallons per day per foot were calculated for the respective drawdown and recovery tests at the 300 foot depth.

Two observations can be made regarding the test results. First, the low transmissivities and discharge rates indicate that the Blackhawk Formation is, at best, a poor aquifer. Water is yielded from discontinuous, localized sandstone lenses which prohibit large scale development.

The second observation is that no significant differences exist between the aquifer properties of the coal zone and those of the Aberdeen Sandstone. Thus, the Aberdeen cannot be considered a major water-bearing zone.

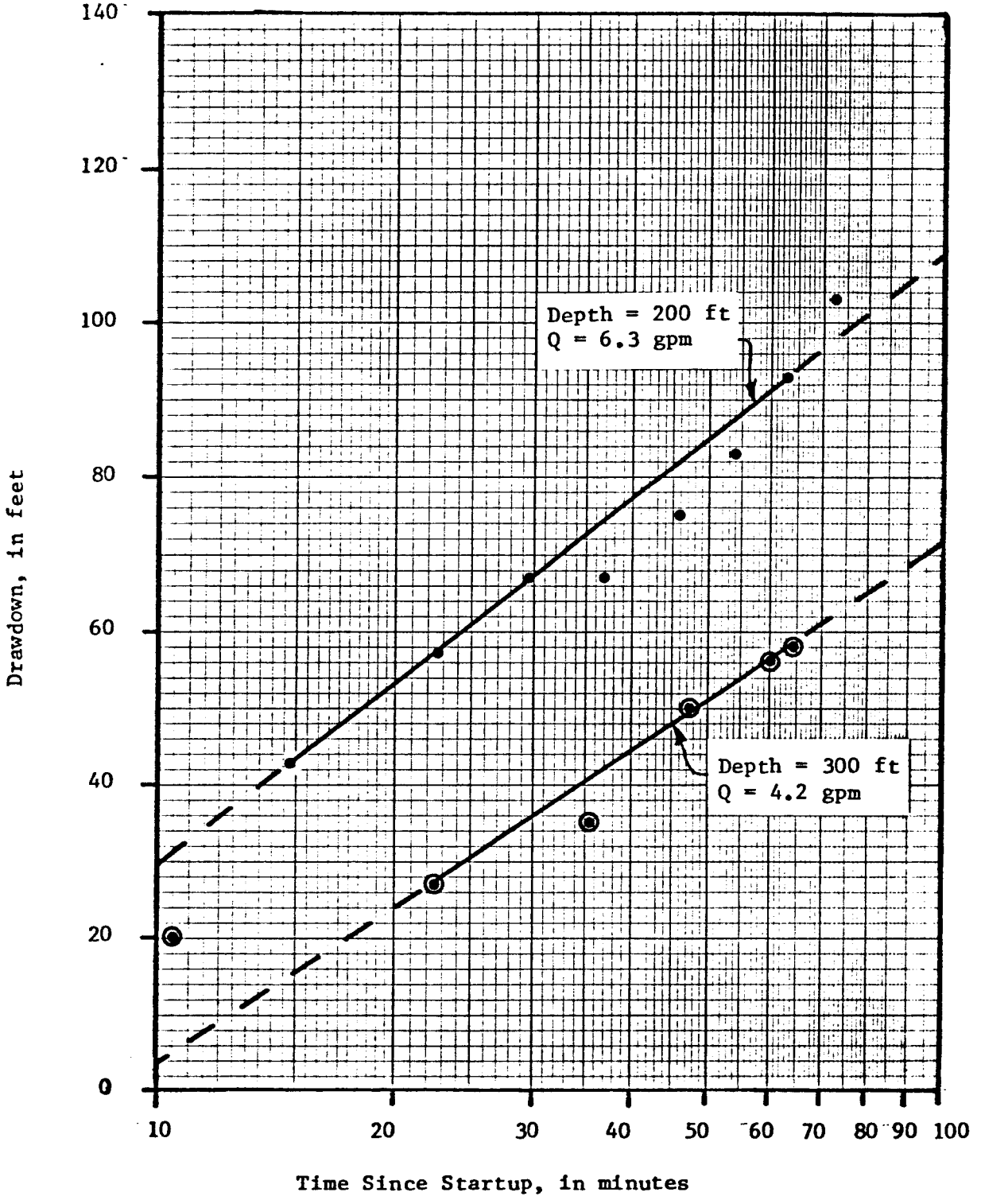


Figure 20. Results of drawdown tests at portal area test well at hole depths of 200 and 300 feet.

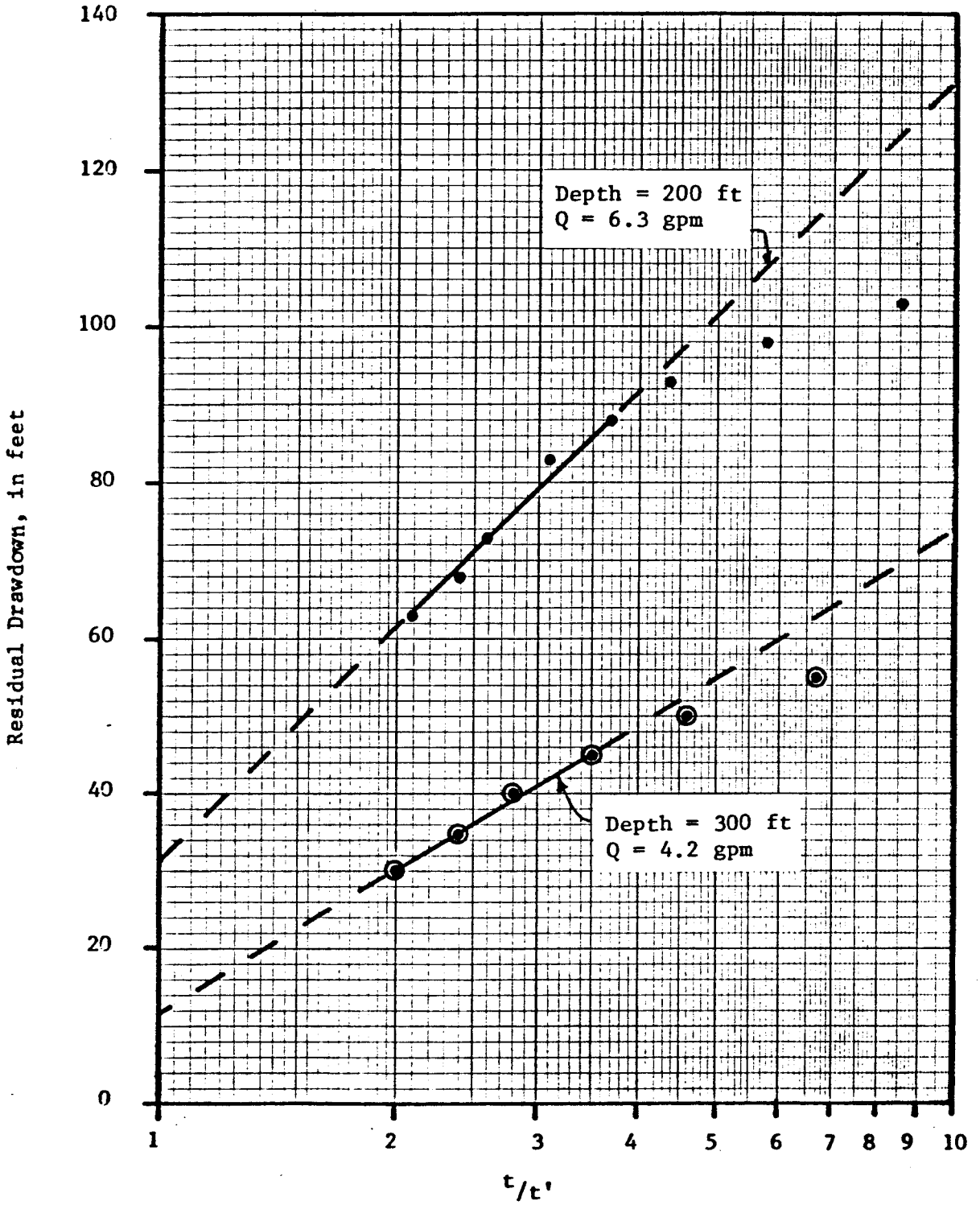


Figure 21. Results of recovery tests at portal area test well at hole depths of 200 and 300 feet.

Continued drilling and aquifer testing at this same site have shown the Star Point Sandstone to be an extremely poor aquifer. A pumping and recovery test was conducted in the late fall of 1979 which indicated that the Star Point Formation was contributing little or no flow. The pumping rate began at 20 gallons per minute and gradually decreased until the flow was only about 6 gallons per minute. The water throughout the test was very turbid which indicates the water was most likely coming from coal zones in the Blackhawk Formation.

A pumping test conducted at W19-1 (near the Belina No. 1 Mine) showed that a limited water supply is available from the Star Point in fractured areas. This well is located near the O'Connor fault. After the first fifteen minutes of pumping, flow had stabilized at 23 gallons per minute. Such rapid stabilization indicates that water is not flowing through porous media, but is reaching the well through underground conduits or fissures. The water yielded from this test was relatively clean. This well is being enlarged so additional test information can be obtained. Information in the area strongly indicated that both the Blackhawk and the Star Point formations are fairly impervious to water flow.

Ground Water Quality

Comprehensive water quality samples were collected during the fall of 1979 from 11 springs (those in Table 10 with the exception of S36-23 and additionally S6-3, S25-5, S35-13, S36-3, and S36-7) shown in Plate

4. Samples were also collected for limited analyses from seepage in the O'Connor and the Belina No. 1 mines, and three wells in the area. Two of the wells were drilled into the Star Point Formation in Eccles Canyon by Coastal States Energy Company (located in SW¼ of Section 13, T. 13 S., R. 6 E. and in the SW¼ Section 17, T. 13 S., R. 7 E.). The third well is operated by the Alpine School District and is completed in the Blackhawk Formation (Section 8, T. 13 S., R. 7 E.).

All samples were collected and preserved as previously outlined. Attachment C and E contain the results of water quality analyses of samples collected from the springs and the wells and mines respectively.

As a measure of the ability of spring water to index the quality of deeper water in the area, the average concentrations of various constituents, as measured at the 11 monitored springs, were compared with the concentrations of those same constituents sampled in the O'Connor and Belina No. 1 mines and the Alpine School District well. These data, which are presented in Tables 14 and 15 and in Figure 22 indicate that the springs are a fair index of deeper water for major cations and anions but are usually lower in trace element concentrations than water from deeper sources. The springs generally have slightly better quality water than the wells or mines thus substantiating the theory that prolonged contact with the underground strata decreases the quality of the water.

Table 14. Results of chemical analyses of water samples collected from various mines and wells.

	O'Connor Well	Alpine Well	Belina No. 1 Mine	Belina No. 1 Mine	Upper Eccles Well (W13-1)	Lower Eccles Well (W17-1)	Whiskey Canyon Well (W19-1)
Date of Sample	March, 1979	March, 1979	March, 1979	October, 1979	November, 1979	November, 1979	December, 1979
Parameter	Concentration, in milligrams per liter						
Arsenic	----	0.004	----	----	----	----	----
Barium	----	0.06	----	----	----	----	----
Bicarbonate	241.56	197.64	258.64	312.32	278.60	329.40	309.88
Cadmium	----	<0.001	----	----	----	----	----
Calcium	82.40	32.00	92.00	69.60	43.20	112.80	75.20
Chloride	2.0	2.0	2.0	<1.0	<1.0	3.0	4.0
Chromium	----	<0.001	----	----	0.005	----	----
Conductivity	510	285	580	370	740	540	500
Fluoride	0.17	0.84	----	0.11	----	0.13	----
Iron	----	0.530	----	----	0.225	2.450	0.465
Lead	----	<0.001	----	----	----	----	----
Magnesium	25.92	9.60	12.00	21.12	30.72	11.52	21.12
Mercury	----	<0.0002	----	----	<0.00005	<0.00005	<0.0002
Nitrate	----	<0.02	----	----	<0.01	<0.01	0.24
Orthophosphate	----	<0.01	----	----	----	----	----
Potassium	2.213	1.289	3.65	0.836	12.50	2.117	1.419
Selenium	----	<0.001	----	----	----	----	----
Silver	----	<0.001	----	----	----	----	----
Sodium	1.84	21.32	25.65	1.75	76.50	3.89	2.51
Sulfate	118	6.0	115	6.0	185	63.0	26.0
TDS	335	182	380	250	480	384	300
pH	7.47	7.39	7.30	7.49	7.35	7.40	7.60

Notes: Conductivity in micromhos per centimeter at 25°C; pH in standard units.

Table 15. Maximum, minimum, and mean concentrations of various ground water constituents.

Parameter	Spring Samples Concentration in mg/l			Well and Mine Samples Concentration in mg/l		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Acidity, as $CaCO_3$	20.0	12.0	15.4	----	----	----
Alkalinity, as $CaCO_3$	240	126	169	----	----	----
Iron, Total	1.20	0.15	0.49	2.45	0.225	1.07
Iron, Dissolved	0.010	0.010	0.010	1.85	0.015	0.93
Manganese, Total	0.005	0.001	0.002	0.114	0.091	0.10
pH	7.4	7.1	7.3	7.49	7.35	7.4
Phenol*	0.004	0.004	0.004	0.01	0.01	0.01
Total Diss. Solids	330	165	255	480	182	335

*of the springs, only S36-3 was tested for phenol.

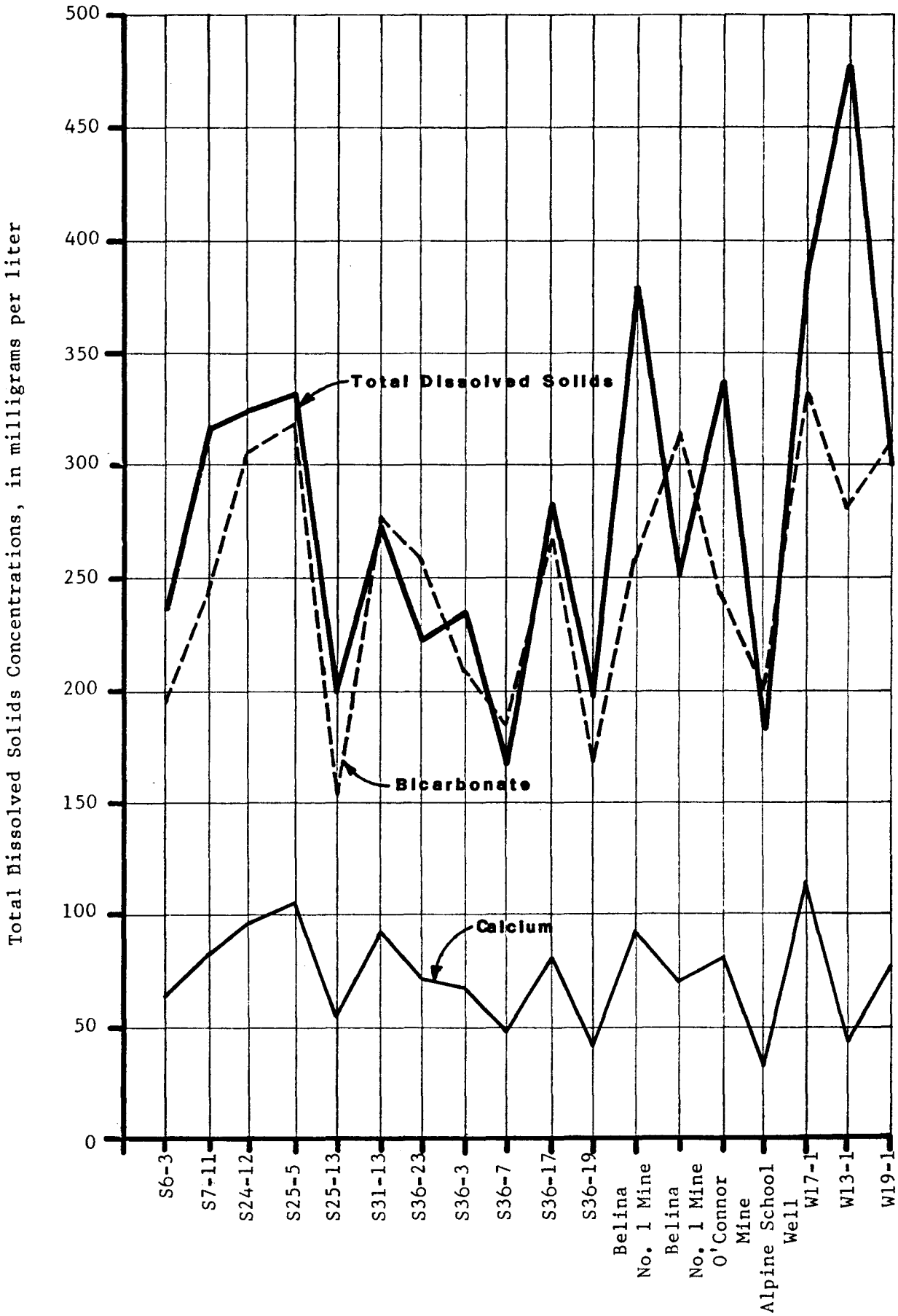


Figure 22. Comparison of water quality data collected from springs, wells, and mines in and near the Valley Camp lease area.

The patterns noted during the initial spring inventory (see Plate 4) did not vary significantly during subsequent measurements. The geographic variations discussed previously remained unchanged as did the strong calcium bicarbonate content of the water.

As noted earlier, there is a tendency for dissolved solids concentrations to increase as the summer progresses and flows diminish. This is probably due to the contribution of water from melting snow which has had only limited soils contact.

Maximum, minimum, and mean concentrations from springs, mines, and wells of various parameters measured on the property are noted in Table 15. Concentrations of these ground waters are generally lower than noted for the same constituents in surface water samples, although the differences do not appear to be very significant. As was noted previously, the high alkalinity, low acidity, and general basic nature of the water indicates that acid drainage problems should not develop as a result of mining on the lease area.

Total phosphate concentrations measured during the baseline period again exceeded the state water quality standards for the uses specified for water in the area.

Samples from each of the Eccles Canyon wells exceeded the state standard of 0.05 milligrams per liter during the baseline period (0.42 mg/l at W13-1 and 0.40 mg/l at W17-1).

Although iron concentrations in the area ground waters are not excessively high, total iron often reaches concentrations above 0.5 milligrams per liter. The state standard for dissolved iron was exceeded once at W17-1 (0.85 milligrams per liter above the state standard of 1.00 milligrams per liter). The natural occurrence of these relatively high concentrations probably results from the iron content of the cementing agents in the Blackhawk Formation, as previously discussed.

As was the case with surface waters in the area, the concentrations of other constituents sampled at stations throughout the area are generally quite low. In many instances, trace metal concentrations were consistently below the detection limit of routine laboratory techniques (especially cadmium, chromium, lead, mercury, selenium, and silver).

Monitoring Program

An ongoing ground water monitoring program will be conducted at each of the ground water stations shown on Plate 3 and listed in Table 10. In addition, data will be collected from the mines and the proposed water supply well being drilled near the Belina No. 1 Mine (W19-1).

As has been shown, the quality of water issuing from springs on the property is somewhat representative of deep water conditions. In addition,

as will be discussed in the water rights section, ground water usage in the area consists almost entirely of springs. Thus, because of the desire to monitor impacts at the site of use, the monitoring of springs in the area takes on added importance.

Although streams in the area may be accessible most of the year, such is not the case with most wells and springs. Thus, water quality data will be collected once each year (during the month of August) from the springs noted on Plate 4 and Table 10, Well W19-1, and seepage in the mines. The collection of an earlier sample may result in the inclusion of a significant amount of snowmelt runoff and a later sample would not normally allow the collection of additional data before snowfall if unique, unexpected conditions are found. Each of the water quality samples will be analyzed as outlined by the comprehensive list contained in Table 4 or an approved abbreviated schedule. The data collected at the springs will give a measure of the impact of mining on the ground water system at its primary point of use. The measurements taken from the mines and the well will give an indication of impacts on the deep ground water system. Water level data will also be collected during August of each year from the well near the Belina No. 1 Mine (W19-1). Significant changes in the source of water in the mines will be noted during the period of operation.

In addition to the above outlined monitoring program, monitoring of discharges will be conducted in accordance with the existing NPDES discharge permits and any others that may be acquired.

As required, ground water quality data collected from the property area will be submitted to the Utah Division of Oil, Gas and Mining. Such reports will normally be submitted within 60 to 90 days after sampling, depending upon the speed of laboratory analyses.

WATER RIGHTS

Surface Water Rights

Tables 16 and 17 list the surface water rights on and adjacent to the Valley Camp lease area which were on record with the Utah Division of Water Rights as of November, 1979. The locations of these water rights can be found on Plate 7.

Surface water rights in the area are primarily for stockwatering and irrigation. Stockwatering rights are almost entirely located directly on the stream. Irrigation rights are centered around the town of Scofield and in Flat Canyon, southwest of the center of the property. Irrigated lands consist almost entirely of pasture. Only stockwatering rights are present on the lease area.

Ground Water Rights

Ground water rights on and adjacent to the Valley Camp lease area, on record with the Utah Division of Water Rights as of November, 1979, are listed in Table 18 and 19 and presented on Plate 8. Again, rights are primarily for stockwatering and irrigation (mainly lawns and gardens). Only a limited number of wells are located in the area.

Also shown on Plate 8 are exchanges of Scofield Reservoir water for ground water in the Pleasant Valley Creek Basin. These are listed in Table 20. All exchanges are wells. Most of the exchanges serve the industrial and domestic needs of mining companies in the area.

Table 16. Surface water rights in the Price River Basin located on and adjacent to the Valley Camp lease area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-345	Tom Nicolaides Leon Nicolaides Mary Stathis Bessie Daraban	Green Canyon Spring Stream	0.75	Irrigation	March 1 to November 30
91-423	Nick Marakis (½ interest)	Winter Quarters Creek	----	Stockwatering	January 1 to December 31
91-431	Nick Marakis (½ interest)	Stream	----	Stockwatering	January 1 to December 31
91-436	Nick Marakis (½ interest)	Stream	----	Stockwatering	January 1 to December 31
91-437	Nick Marakis (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31
91-438	Nick Marakis (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31
91-440	Nick Marakis (½ interest)	Wash with storage	----	Stockwatering	January 1 to December 31
91-441	Nick Marakis (½ interest)	Stream with storage	----	Stockwatering	January 1 to December 31
91-462	John Marakis Estate (½ interest)	Winter Quarters Creek	----	Stockwatering	January 1 to December 31
91-471	John Marakis Estate (½ interest)	Stream	----	Stockwatering	January 1 to December 31
91-476	John Marakis Estate (½ interest)	Stream	----	Stockwatering	January 1 to December 31
91-477	John Marakis Estate (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31
91-478	John Marakis Estate (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-479	John Marakis Estate (½ interest)	Wash with storage	----	Stockwatering	January 1 to December 31
91-480	John Marakis Estate (½ interest)	Stream with storage	----	Stockwatering	January 1 to December 31
91-487	Robert Radakovich	Stream	----	Stockwatering	May 1 to December 15
91-483	Robert Radakovich	Winter Quarters Creek	0.443	Irrigation Stockwatering	March 1 to December 15
91-592	John Marakis Estate (½ interest)	Mud Creek	----	Stockwatering	January 1 to December 31
91-593	Nick Marakis (½ interest)	Mud Creek	----	Stockwatering	January 1 to December 31
91-1008	U.S. Forest Service	Snider Canyon Creek	----	Stockwatering	July 1 to September 30
91-1009	U.S. Forest Service	Tributary to Snider Canyon Cr.	----	Stockwatering	July 1 to September 30
91-1010	U.S. Forest Service	Tributary to Mud Creek	----	Stockwatering	July 1 to September 30
91-1011	U.S. Forest Service	Mud Creek	----	Stockwatering	July 1 to September 30
91-1012	U.S. Forest Service	Mud Creek	----	Stockwatering	July 1 to September 30
91-1013	U.S. Forest Service	Tributary to Mud Creek	----	Stockwatering	July 1 to September 30
91-1014	U.S. Forest Service	Tributary to Mud Creek	----	Stockwatering	July 1 to September 30
91-1015	U.S. Forest Service	Tributary to Mud Creek	----	Stockwatering	July 1 to September 30
91-1016	U.S. Forest Service	Long Canyon Creek	----	Stockwatering	July 1 to September 30
91-1017	U.S. Forest Service	Tributary to Long Canyon Cr.	----	Stockwatering	July 1 to September 30
91-1018	U.S. Forest Service	Tributary to Mud Creek	----	Stockwatering	July 1 to September 30
91-1019	U.S. Forest Service	Tributary to Boardinghouse Canyon Creek	----	Stockwatering	July 1 to September 30

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1020	U.S. Forest Service	Boardinghouse Canyon Creek	----	Stockwatering	July 1 to September 30
91-1021	U.S. Forest Service	Boardinghouse Canyon Creek	----	Stockwatering	July 1 to September 30
91-1022	U.S. Forest Service	S. Fork Eccles Canyon Cr.	----	Stockwatering	July 1 to September 30
91-1023	U.S. Forest Service	Tributary to South Fork Eccles Canyon Creek	----	Stockwatering	July 1 to September 30
91-1024	U.S. Forest Service	Tributary to South Fork Eccles Canyon Creek	----	Stockwatering	July 1 to September 30
91-1025	U.S. Forest Service	Tributary to Eccles Canyon Cr.	----	Stockwatering	July 1 to September 30
91-1026	U.S. Forest Service	Tributary to Eccles Canyon Cr.	----	Stockwatering	July 1 to September 30
91-1027	U.S. Forest Service	Eccles Canyon Creek	----	Stockwatering	July 1 to September 30
91-1028	U.S. Forest Service	Eccles Canyon Creek	----	Stockwatering	July 1 to September 30
91-1029	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1030	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1031	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1032	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1033	U.S. Forest Service	Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1034	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1037	U.S. Forest Service	Tributary to Winter Quarters Canyon Creek	----	Stockwatering	July 1 to September 30
91-1148	Leon & Tom Nicolaides Mary Stathis Bessie Daraban	Green Canyon Stream	----	Stockwatering	January 1 to December 31

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1678	Calvin K. Jacob	Stream	----	Stockwatering	May 1 to November 30
91-2018	Angelo Georgedes	Green Canyon Stream with Storage	----	Stockwatering	May 1 to October 31
91-2019	Angelo Georgedes	Stream with storage	----	Stockwatering	May 1 to October 31
91-2020	Angelo Georgedes	Green Canyon Stream	----	Stockwatering	May 1 to October 31
91-2048	John Jouflas Estate	Pleasant Creek	----	Stockwatering	May 1 to October 31
91-2146	Elrie and Bertha Simonsen	Winter Quarters Creek	----	Stockwatering	June 1 to November 30
91-2548	John Jouflas Estate (2/3 interest)	Pleasant Creek	----	Stockwatering	May 1 to October 31
91-2549	Lee S. Thomas (1/3 interest)	Pleasant Creek	----	Stockwatering	May 1 to October 31
91-2971	Lee S. Thomas (1/3 interest)	Clear Creek	0.106	Irrigation	March 1 to November 30
91-2972	John Jouflas Estate (2/3 interest)	Clear Creek	0.106	Irrigation	March 1 to November 30
91-2973	John Jouflas Estate	Clear Creek	0.381	Irrigation	March 1 to November 30
91-2974	Justus O. Seely	Clear Creek	0.170	Irrigation Stockwatering	March 1 to November 30
91-2977	S. J. Harkness	Clear Creek	0.075	Irrigation	March 1 to November 30
91-2978	Justus O. Seely	Clear Creek	0.683	Irrigation Stockwatering	March 1 to November 30
91-2979	S. J. Harkness	Clear Creek	0.453	Irrigation	March 1 to November 30
91-2980	Helen Miller	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2981	Orson Marsing	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2982	Lillie Pearson	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2983	Thomas Biggs, Jr.	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2984	Waino E. Burton	Clear Creek	0.10	Irrigation	March 1 to November 30

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-2985	Phyllis M Conover	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2986	William & Armeda Sherman	Clear Creek	0.015	Irrigation	March 1 to November 30
91-2987	Leah B. Johnson	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2988	E. D. & Elizabeth Jacobson	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2989	Scofield Town	Clear Creek	0.10	Irrigation	March 1 to November 30
91-2990	Della L. Madsen	Clear Creek	1.166	Irrigation	March 1 to November 30
91-2991	John B. Jones	Clear Creek	4.58	Irrigation	March 1 to November 30
91-3007	Elrie M. & Bertha Simonsen	Winter Quarters Creek	0.63	Irrigation	March 1 to November 30
91-3008	S. J. Harkness	Winter Quarters Creek	0.693	Irrigation	March 1 to November 30
91-3009	Elrie M. & Bertha Simonsen	Winter Quarters Creek	0.68	Irrigation	March 1 to November 30
91-3010	S. J. Harkness	Winter Quarters Creek	0.213	Irrigation	March 1 to November 30
91-3011	S. J. Harkness	Winter Quarters Creek	----	Stockwatering	January 1 to December 31
91-3014	Anton Michelog	Snider Creek	----	Stockwatering	January 1 to December 31
91-3015	Anton Michelog	Mud Creek	----	Stockwatering	January 1 to December 31
91-3040	Tom Nicolaides Leon Nicolaides Mary Stathis Bessie Daraban	Clear Creek	----	Stockwatering	January 1 to December 31
91-3045	Milton A. Oman	Clear Creek	----	Stockwatering	January 1 to December 31
91-3051	John Marakis Estate (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31
91-3052	Mick Marakis (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-3053	Milton A. Oman	Clear Creek	----	Stockwatering	January 1 to December 31
91-3056	Tom Nicolaides Leon Nicolaides Mary Stathis Bessie Daraban	Stream	----	Stockwatering	January 1 to December 31
91-3057	Milton A. Oman	South Fork Eccles Canyon Cr.	----	Stockwatering	January 1 to December 31
91-3059	John Marakis Estate (½ interest)	South Fork Eccles Canyon Cr.	----	Stockwatering	January 1 to December 31
91-3060	Nick Marakis (½ interest)	South Fork Eccles Canyon Cr.	----	Stockwatering	January 1 to December 31
91-3070	John Marakis Estate (½ interest)	Eccles Canyon Creek	----	Stockwatering	January 1 to December 31
91-3071	Nick Marakis (½ interest)	Eccles Canyon Creek	----	Stockwatering	January 1 to December 31
91-3072	Milton A. Oman	Eccles Canyon Creek	----	Stockwatering	January 1 to December 31
91-3074	Milton A. Oman	Eccles Canyon Creek	----	Stockwatering	January 1 to December 31
91-3075	Tom Nicolaides Leon Nicolaides Mary Stathis Bessie Daraban	Eccles Canyon Creek	----	Stockwatering	January 1 to December 31
91-3080	Milton A. Oman	Boardinghouse Canyon Creek	----	Stockwatering	January 1 to December 31
91-3081	Jack Thomas	Boardinghouse Canyon Creek	----	Stockwatering	January 1 to December 31
91-3082	Milton A. Oman	Boardinghouse Canyon Creek	----	Stockwatering	January 1 to December 31
91-3083	Lavern Jensen	Finn Canyon Creek	----	Stockwatering	January 1 to December 31
91-3084	Milton A. Oman	Finn Canyon Creek	----	Stockwatering	January 1 to December 31
91-3086	Anton Michelog	Long Canyon Creek	----	Stockwatering	January 1 to December 31

Table 16. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-3088	Anton Michelog	Tributary to Mud Creek	----	Stockwatering	January 1 to December 31
91-3089	Anton Michelog	Stream	----	Stockwatering	January 1 to December 31
91-3090	Anton Michelog	Stream with storage	----	Stockwatering	January 1 to December 31
91-3440	Calvin K. Jacob	Clear Creek	----	Stockwatering	May 1 to November 30
91-3587	North American Coal Corp.	Boardinghouse Canyon Creek	----	Stockwatering	June 1 to November 30
91-3588	North American Coal Corp.	Finn Canyon Creek	----	Stockwatering	June 1 to November 30
91-3589	North American Coal Corp.	Mud Creek	----	Stockwatering	June 1 to November 30
91-3591	Calvin K. Jacob	Stream	----	Stockwatering	May 1 to November 30
91-3622	Mae Nicolodemas	Clear Creek	0.016	Irrigation	March 1 to November 30
91-3633	D. Euray Allred	Winter Quarters Creek	----	Stockwatering	May 1 to November 30
91-3635	D. Euray Allred	Stream	----	Stockwatering	May 1 to November 30
91-3644	Justus O. Seely	Clear Creek	----	Stockwatering	June 1 to November 30
91-3645	S. J. Harkness	Clear Creek	----	Stockwatering	June 1 to November 30
91-3665	John Marakis Estate	Clear Creek	----	Stockwatering	January 1 to December 31
91-3666	Nick Marakis (½ interest)	Clear Creek	----	Stockwatering	January 1 to December 31
91-3667	Angelo Georgedes	Clear Creek	----	Stockwatering Domestic	January 1 to December 31

Table 17. Surface water rights in the San Rafael River Basin located on and adjacent to the Valley Camp lease area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-1	U.S. Forest Service	Kitchen Fork of Huntington Cr.	----	Stockwatering	July 1 to October 10
93-2	U.S. Forest Service	Kitchen Fork of Huntington Cr.	----	Stockwatering	July 1 to September 30
93-3	U.S. Forest Service	Kitchen Fork of Huntington Cr.	----	Stockwatering	July 1 to September 30
93-4	Crowther Investment Co.	Kitchen Fork of Huntington Cr.	----	Stockwatering	July 1 to September 30
93-6	U.S. Forest Service	N. Fork of Huntington Creek	----	Stockwatering	July 1 to September 30
93-7	John Carlisle Mana H. Conder	Bear Canyon Creek	----	Stockwatering	July 1 to September 30
93-8	U.S. Forest Service	Unnamed fork of Huntington Cr.	----	Stockwatering	July 1 to September 30
93-9	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-10	L.D.S. Church	Swens Canyon Creek	----	Stockwatering	----------
93-11	U.S. Forest Service	Swens Canyon Creek	----	Stockwatering	July 1 to September 30
93-12	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-13	U.S. Forest Service	Burnout Canyon Creek	----	Stockwatering	July 1 to September 30
93-14	U.S. Forest Service	James Canyon Creek	----	Stockwatering	July 1 to September 30
93-16	U.S. Forest Service	James Canyon Creek	----	Stockwatering	July 1 to September 30
93-18	U.S. Forest Service	Flat Canyon Creek	----	Stockwatering	July 1 to September 30
93-19	U.S. Forest Service	Flat Canyon Creek	----	Stockwatering	July 1 to September 30
93-20	U.S. Forest Service	Boulger Creek	----	Stockwatering	July 1 to September 30
93-21	U.S. Forest Service	Boulger Creek	----	Stockwatering	July 1 to September 30
93-32	Lela C. Mower	Jackson Spring #1 Stream	----	Irrigation Stockwatering	----------

Table 17. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-33	Clyde K. Cox	Jackson Spring #1 Stream	----	Irrigation Stockwatering	----------
93-35	Newel B. Cox	Cabin Hollow Stream	----	Irrigation Stockwatering	----------
93-36	Newel B. Cox	Cove Spring Stream	----	Irrigation Stockwatering	----------
93-37	Newel B. Cox	Jackson Spring #1 Stream	----	Irrigation Stockwatering	----------
93-38	Clyde K. Cox	Cabin Hollow Stream	----	Irrigation Stockwatering	----------
93-41	Newel B. Cox	Burns Cox Spring Stream	----	Irrigation Stockwatering	----------
93-48	Stanley Cox	Jackson Hollow Stream	----	Irrigation Stockwatering	----------
93-49	Clyde K. Cox	Jackson Hollow Stream	----	Irrigation Stockwatering	----------
93-51	Stanley Cox	West Fork Jackson Hollow Stream	----	Irrigation Stockwatering	----------
93-57	Clyde K. Cox	Worth Spring Stream	----	Irrigation Stockwatering	----------
93-71	Roscoe C. Cox	Worth Spring Stream	----	Irrigation Stockwatering	----------
93-73	A Ira Cox	Ross Spring Stream	----	Irrigation Stockwatering	----------
93-74	Evan Cox	Ross Spring Stream	----	Irrigation Stockwatering	----------
93-76	Phelps Dodge Corp.	Bear Canyon Creek	----	Stockwatering	July 1 to September 30

Table 17. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-77	Utah Power & Light Co.	Bear Canyon Creek	----	Stockwatering	July 1 to September 30
93-78	U.S. Forest Service	Coal Creek	----	Stockwatering	July 1 to September 30
93-79	U.S. Forest Service	Coal Creek	----	Stockwatering	July 1 to September 30
93-80	Reed Neilson	Huntington Creek	----	Stockwatering	July 1 to September 30
93-81	Bernard Nielsen	Huntington Creek	----	Stockwatering	July 1 to September 30
93-82	Utah Power & Light Co.	Huntington Creek	----	Stockwatering	July 1 to September 30
93-83	U.S. Forest Service	Cox Canyon Creek	----	Stockwatering	July 1 to September 30
93-84	U.S. Forest Service	Valentine Gulch	----	Stockwatering	July 1 to September 30
93-85	U.S. Forest Service	Valentine Gulch	----	Stockwatering	July 1 to September 30
93-86	Kemmerer Coal Company	Valentine Gulch	----	Stockwatering	July 1 to September 30
93-87	Phelps Dodge Corp.	Valentine Gulch	----	Stockwatering	July 1 to September 30
93-92	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-95	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-97	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-99	U.S. Forest Service	Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-100	U.S. Forest Service	Huntington Creek	----	Stockwatering	----------
93-101	U.S. Forest Service	Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-102	U.S. Forest Service	Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-103	U.S. Forest Service	Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-104	U.S. Forest Service	South Fork Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-105	U.S. Forest Service	South Fork Hughes Canyon Creek	----	Stockwatering	July 1 to September 30

Table 17. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-123	U.S. Forest Service	Dipping Canal Creek	----	Stockwatering	July 1 to October 15
93-124	U.S. Forest Service	Dipping Canal Creek	----	Stockwatering	July 1 to September 30
93-125	U.S. Forest Service	Dipping Canal Creek	----	Stockwatering	July 1 to September 30
93-126	U.S. Forest Service	Woodward Canyon Creek	----	Stockwatering	July 1 to September 30
93-127	U.S. Forest Service	South Fork Hughes Canyon Creek	----	Stockwatering	July 1 to September 30
93-263	Kemmerer Coal Company	Coal Creek	----	Stockwatering	July 1 to September 30
93-264	Phelps Dodge Corp.	Coal Creek	----	Stockwatering	July 1 to September 30
93-265	Utah Power and Light Co.	Coal Creek	----	Stockwatering	July 1 to September 30
93-266	U.S. Forest Service	Coal Creek	----	Stockwatering	June 6 to September 25
93-290	Utah Power and Light Co.	Coal Creek	----	Stockwatering	July 1 to September 30
93-338	U.S. Forest Service	Huntington Creek	----	Stockwatering	July 1 to September 30
93-346	L.D.S. Church	Little Swens Canyon Cr.	----	Stockwatering	June 1 to November 30
93-399	Utah Power and Light Co.	Huntington Creek	----	Stockwatering	July 1 to September 30
93-434	William R. Whitehead et al	Kitchen Fork of Huntington Cr.	----	Stockwatering	June 1 to November 30
93-498	Kemmerer Coal Company	Left Fork Huntington Creek	----	Stockwatering	July 1 to September 30
93-543	Morris S. & Betty A. Cook	Coal Creek	----	Stockwatering	July 1 to September 30
93-544	Kemmerer Coal Company	Coal Creek	----	Stockwatering	July 1 to September 30
93-545	Phelps Dodge Corp.	Coal Creek	----	Stockwatering	July 1 to September 30
93-549	Kemmerer Coal Company	Cox Canyon Creek	----	Stockwatering	July 1 to September 30
93-550	Phelps Dodge Corp.	Cox Canyon Creek	----	Stockwatering	July 1 to September 30

Table 17. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-551	Utah Power and Light Co.	Cox Canyon Creek	----	Stockwatering	July 1 to September 30
93-553	Utah Power and Light Co.	James Canyon Creek	----	Stockwatering	July 1 to September 30
93-559	Utah Power and Light Co.	Bear Canyon Creek	----	Stockwatering Irrigation	----------
93-610	Phelps Dodge Corp.	Left Fork Huntington Creek	----	Stockwatering	July 1 to September 30
93-768	W. Chad Cox	Burns Cox Spring Stream	----	Stockwatering Irrigation	----------
93-769	Donald B. Cox	Burns Cox Spring Stream	----	Stockwatering Irrigation	----------
93-772	Donald B. Cox	West Fork Jackson Hollow Stream	----	Stockwatering Irrigation	----------
93-776	Newel B. Cox	Flat Canyon Creek	----	Stockwatering	----------
93-777	Donald B. Cox	Flat Canyon Creek	----	Stockwatering	----------
93-778	A. Ira Cox	Flat Canyon Creek	----	Stockwatering	----------
93-831	Clark-Montana Realty Co.	Bear Canyon Creek	----	Stockwatering	----------
93-832	Kemmerer Coal Company	Bear Canyon Creek	----	Stockwatering	July 1 to September 30

Table 18. Ground water rights in the Price River Basin located on and adjacent to the Valley Camp lease area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-200	Utah Natural Gas Company (½ interest)	Underground water, well	0.134	Domestic Irrigation	January 1 to December 31
91-201	Earl Thomas	Spring with storage	0.068	Stockwatering	April 15 to November 1
91-408	Calvin K. Jacob	Spring	0.011	Stockwatering	May 1 to November 30
91-424	Nick Marakis (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-425	Nick Marakis (½ interest)	Spring	0.022	Stockwatering	January 1 to December 31
91-432	Nick Marakis (½ interest)	Spring	0.011	Stockwatering	January 1 to December 31
91-433	Nick Marakis (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-434	Nick Marakis (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-435	Nick Marakis (½ interest)	Spring	0.011	Stockwatering	January 1 to December 31
91-455	Robert Radakovich	Spring	0.011	Stockwatering	May 1 to December 15
91-463	John Marakis Estate (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-464	John Marakis Estate (½ interest)	Spring	0.022	Stockwatering	January 1 to December 31
91-472	John Marakis Estate (½ interest)	Spring	0.011	Stockwatering	January 1 to December 31

Table 18. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-473	John Marakis Estate (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-474	John Marakis Estate (½ interest)	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-475	John Marakis Estate (½ interest)	Spring	0.011	Stockwatering	January 1 to December 31
91-481	Robert Radakovich	Spring	0.011	Stockwatering	May 1 to December 15
91-1000	U.S. Forest Service	Spring	0.015	Stockwatering	July 1 to September 30
91-1001	U.S. Forest Service	Spring	0.015	Stockwatering	July 1 to September 30
91-1002	U.S. Forest Service	Spring	0.015	Stockwatering	July 1 to September 30
91-1003	U.S. Forest Service	Spring	0.015	Stockwatering	July 1 to September 30
91-1643	Jack Thomas	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-1644	Lee Thomas (1/3 interest)	Spring	----	Stockwatering	May 1 to October 31
91-1679	Calvin K. Jacob	Spring	0.011	Stockwatering Domestic	May 1 to November 30
91-1680	Calvin K. Jacob	Spring	0.011	Stockwatering	May 1 to November 30
91-1681	Calvin K. Jacob	Spring	0.011	Stockwatering	May 1 to November 30
91-1986	Angelo Georgedes	Spring with storage	0.05	Fish Culture	January 1 to December 31
91-2049	John Jouflas Estate (2/3 interest)	Spring	0.011	Stockwatering	May 1 to October 31
91-2144	Elrie and Bertha Simonsen (½ interest)	Simonsen Spring	0.022	Domestic	January 1 to December 31
91-2145	Robert Radakovich (½ interest)	Simonsen Spring	0.022	Domestic	January 1 to December 31

Table 18. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-2669	Della Simonsen	Spring	0.011	Stockwatering	April 1 to November 30
91-2970	Angelo Georgedes	Spring	0.015	Stockwatering	May 1 to October 31
91-2975	Justus O. Seely	Spring	0.011	Irrigation Stockwatering	January 1 to December 31
91-2976	Justus O. Seely	Spring	0.011	Irrigation Stockwatering	January 1 to December 31
91-3012	Angelo Georgedes	Spring	0.015	Irrigation Stockwatering	January 1 to December 31
91-3076	Milton A. Oman	Spring	0.011	Stockwatering	January 1 to December 31
91-3078	Milton A. Oman	Spring	0.011	Stockwatering	January 1 to December 31
91-3087	Anton Michelog	Spring with storage	0.011	Stockwatering	January 1 to December 31
91-3094	Scofield Town	3 Springs	0.033	Municipal	January 1 to December 31
91-3046	Della L. Madsen	Spring	0.011	Stockwatering	April 1 to November 30
91-3460	Mountain Fuel Supply Co. (½ interest)	Underground water, well	0.134	Domestic Irrigation, Misc.	January 1 to December 31
91-3499	Lavern Jensen	Finn Spring	0.011	Stockwatering Domestic	January 1 to December 31
91-3500	Lavern Jensen	Spring	0.011	Stockwatering Domestic	January 1 to December 31
91-3586	North American Coal Corp.	Clear Creek Spring Area	0.50	Stockwatering Domestic Irrigation Industrial	January 1 to December 31
91-3590	North American Coal Corp. (Underground Water)	Clear Creek Mine Tunnel No. 3	0.446	Industrial	January 1 to December 31
91-3595	North American Coal Corp.	O'Connor Mine Tunnel No. 1	0.030	Industrial	January 1 to December 31
91-3596	North American Coal Corp.	O'Connor Mine Tunnel No. 2	0.047	Industrial	January 1 to December 31
91-3668	Angelo Georgedes	Spring	0.015	Stockwatering	May 1 to October 31

Table 19. Ground water rights in the San Rafael River Basin located on and adjacent to the Valley Camp lease area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-5	U.S. Forest Service	North Huntington Spring	0.022	Stockwatering	July 1 to September 30
93-34	Clyde K. Cox	Jackson Spring #2	----	Stockwatering Irrigation	----------
93-39	Newel B. Cox	Cove Spring #2	----	Stockwatering	----------
93-40	W. Chad Cox	Burns Cox Spring	----	Stockwatering	----------
93-43	Newel B. Cox	Cold Spring	----	Stockwatering Irrigation	----------
93-44	Newel B. Cox	Milk House Spring	----	Stockwatering Irrigation	----------
93-45	Newel B. Cox	Spring House Spring	----	Stockwatering Irrigation	----------
93-46	Robert N. Anderson	Unnamed Spring #2	0.20	Irrigation Stockwatering	May 1 to October 15
93-47	Robert N. Anderson	Unnamed Spring #3	0.1337	Irrigation Stockwatering	May 1 to October 15
93-50	Robert N. Anderson	Unnamed Spring #4	0.011	Irrigation Stockwatering	May 1 to October 15
93-52	Stanley Cox	Worth Spring #1	----	Stockwatering	----------
93-53	Stanley Cox	Worth Spring #2	----	Stockwatering	----------
93-54	Clyde K. Cox	Clyde Spring	----	Stockwatering	----------
93-59	Clyde K. Cox	Saw Mill Spring	----	Irrigation Stockwatering	----------
93-60	Roscoe C. Cox	Stan Spring #1	----	Stockwatering	----------
93-61	Roscoe C. Cox	Stan Spring #2	----	Stockwatering	----------
93-62	Stanley Cox	Saw Mill Springs	----	Irrigation Stockwatering	----------

Table 19. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-63	Stanley Cox	Stan Spring #1	----	Irrigation Stockwatering	----------
93-64	Roscoe C. Cox	Stan Spring #1	----	Irrigation Stockwatering	----------
93-65	Doris R. Cox	Stan Spring #2	----	Irrigation Stockwatering	----------
93-66	Donald B. Cox	Stan Spring #2	----	Irrigation Stockwatering	----------
93-67	Newel B. Cox	Mineral Spring #2	----	Irrigation Stockwatering	----------
93-68	Evan Cox	Stan Spring #2	----	Irrigation Stockwatering	----------
93-69	A. Ira Cox	Stan Spring #2	----	Irrigation Stockwatering	----------
93-70	Olea D. Cox	Mineral Spring #2	----	Irrigation Stockwatering	----------
93-71	Roscoe C. Cox	Worth Spring Stream	----	Irrigation Stockwatering	----------
93-72	Evan Cox	Ross Spring #2	----	Stockwatering	----------
93-75	Evan Cox	Ross Spring #3	----	Stockwatering	----------
93-90	L.D.S. Church	Unnamed Spring	0.022	Stockwatering Domestic	June 1 to November 30
93-98	U. S. Forest Service	Sulphur Spring	0.033	Stockwatering	July 1 to September 30
93-114	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-127	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-145	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-153	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-154	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30

Table 19. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-172	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-186	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-187	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-205	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-207	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-232	Osmond & Idena J. Crother	Brooks Canyon Divide Spring	----	Stockwatering	July 1 to September 30
93-279	Crowther Investment Company	Unnamed Spring	0.011	Stockwatering Domestic	June 1 to October 15
93-331	David J. Stone	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-332	R. Phil Shumway	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-333	Richard S. Christensen	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-334	Douglas G. Marriott	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-343	David J. Stone	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-344	R. Phil Shumway	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-345	Richard S. Christensen	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-365	Douglas Marriott	Unnamed Spring	0.02	Stockwatering	June 1 to October 15
93-379	Russel O. Brown	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-380	M. Dover Hunt	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-381	Don Evans	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-391	Eli Clayson	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-402	Clark T. Thorstensen	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15

Table 19. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-404	Russel O. Brown	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-411	M. Dover Hunt	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-429	Don Evans	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-430	Eli Clayton	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-431	Clark T. Thorstensen	Unnamed Spring	0.0222	Stockwatering	June 1 to October 15
93-432	Crowther Investment Company	Brooks Canyon Divide	0.011	Stockwatering	June 1 to October 15
93-433	William R. Whitehead et al	Unnamed Spring	0.011	Stockwatering	June 1 to October 15
93-435	Crowther Investment Company	Unnamed Spring	0.011	Stockwatering	June 1 to October 15
93-449	Crowther Investment Company	Unnamed Spring	0.011	Stockwatering	June 1 to October 15
93-500	St. of Utah State Land Board	North Cleveland Reservoir Spring	----	Stockwatering	July 1 to September 30
93-502	St. of Utah State Land Board	West Cleveland Reservoir Spring	----	Stockwatering	July 1 to September 30
93-763	Robert N. Anderson	Unnamed Spring #8	0.018	Stockwatering	June 15 to October 15
93-770	W. Chad Cox	Spring House Spring	----	Irrigation Stockwatering	----------
93-771	Donald B. Cox	Spring House Spring	----	Irrigation Stockwatering	----------
93-773	Roscoe C. Cox	Ross Spring #1	----	Stockwatering	----------
93-774	A. Ira Cox	Ike Spring #1	----	Stockwatering	----------
93-775	A. Ira Cox	Ike Spring #2	----	Stockwatering	----------
93-838	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-839	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-840	N. M. Jensen Investment Co.	Unnamed Spring	0.022	Stockwatering	June 1 to November 30

Table 19. Continued

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
93-841	N. M. Jensen Investment Co.	Unnamed Spring	0.022	Stockwatering Domestic	June 1 to November 30
93-842	N. M. Jensen Investment Co.	Unnamed Spring	0.22	Stockwatering	June 1 to November 30
93-843	L.D.S. Church	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-844	N. M. Jensen Investment Co.	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-845	N. M. Jensen Investment Co.	Unnamed Spring	0.022	Stockwatering	June 1 to November 30
93-846	N. M. Jensen Investment Co.	Cove Spring	0.022	Stockwatering Domestic	June 1 to November 30

Table 20. Water right exchanges in the Valley Camp lease area.

Water Use Claim No.	Owner	Source	Flow	Purpose of Use	Period of Use
91-452	Robert Radakovich	Well	1.0 A.F.	Stockwatering	March 1 to November 30
91-772	Valley Camp Coal Company	Well	0.446 cfs	Industrial Domestic	January 1 to December 31
91-940	Gooseberry Enterprise Inc.	Springs	66.0 A.F.	Domestic	January 1 to December 31
91-1058	Price River Water Users Assoc.	Well	7.7 A.F.	Industrial Domestic	January 1 to December 31
91-1114	Coastal States Energy Co.	Wells	30.0 A.F.	Industrial Domestic	January 1 to December 31
91-1560	Coastal States Energy Co.	Wells	118.0 A.F.	Industrial Domestic	January 1 to December 31

HYDROLOGIC IMPACT OF MINING ACTIVITIES

Impact on Water Quantity

As has been noted previously in this report, the Valley Camp lease area is covered essentially entirely by the Blackhawk Formation (see Plate 1). This formation consists of interbedded layers of sandstone and shale separated by various mineable and nonmineable coal seams (see Figure 2). The sandstone beds are generally massive while the shale layers are bentonitic, tending to swell when wet and decompose into an impervious clay. Investigations at springs and streams in the property area have indicated that the shale layers prevent downward percolation of water through the Blackhawk at a significant rate. Instead, water which reaches a sandstone finger which is connected to the ground surface rides out on a shale layer, issuing as a spring. Springs tend to receive water from localized rather than regional sources. In addition, because of the ability of the shale material to swell and decompose into an impervious clay, fractures in the Blackhawk Formation do not act as conduits but, rather, barriers to potentially vertically flowing water.

As a result of these observations, it is concluded that mining activities on the Valley Camp lease area will have minimal adverse impacts on the quantity of water in the area. Should subsidence occur, the subsidence cracks will likely seal rapidly, preventing the deep percolation of water and subsequent loss of springs and other water sources. The location of a spring may be changed by a few feet, but no significant loss of

water is anticipated as a result of mining. The sealing of potential cracks will be accelerated where subsidence occurs under live streams. In this case, the silt load carried by the stream would aid the subsurface shales in preventing water loss by providing a surface seal over the subsidence crack.

A relatively insignificant quantity of water will likely be encountered in the mines due to the impermeable nature of the formation and its inability to yield water readily. Hansen (1979) reports that mines in the Wasatch Plateau coal field generally yield less than 10 gallons per minute per active face, with drifts dry approximately 500 feet up-dip from the face. Once a section dries up, leaks reappear only very occasionally in the future. This condition has been observed locally in the O'Connor and Belina No. 1 mines. Apparently, only a zone of saturated sandstone immediately adjacent to the mine is dewatered by the drift.

Should the mines encounter sandstone lenses at the face of a fault, the inflow rate to the mine could change rapidly for a short period of time, as noted in the Belina No. 1 Mine at the Connelville Fault. Under these conditions, inflow rates could exceed 200 gallons per minute for a short period, decreasing rapidly to a more normal rate (10 to 15 gallons per minute).

Most of the water encountered in the mines will be utilized underground for dust suppression, etc. As a result, only those inflows which temporarily exceed storage and mine use requirments should be discharged to

the surface. However, because most of the water will be reused in the mine, the volume of this discharged water will be insignificant. As a result, most of the water which leaves the mine mouth will be indigenous water associated with the coal. Coal from the Valley Camp lease area, tested with ASTM standard procedures, has an equilibrium water content of about eight percent. The moisture content of coal shipped from the lease is about ten percent. This means that of the total moisture of the coal to be shipped only two percent is free water. About one percent of the final moisture content comes from water used in dust suppression, and the other one percent comes from free water in the coal vein.

Thus, the quantity of water present in surface water sources in the area (seeps, springs, and streams) should remain nearly unaffected by mining in the lease area. The water which is removed from the mine mouth, which would normally have traveled to an outlet some distance from the lease area, will represent only a small fraction of the water flowing from the Wasatch Plateau. As a result, the water quantity impacts resulting from mining will be minimal.

Impact on Water Quality

The construction of additional surface facilities utilized in conjunction with Valley Camp mines (yard areas, raods, etc.) will result in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control be provided for all areas of surface disturbance, concentrations should be quickly normalized.

Because mines in the coal fields of the Wasatch Plateau act as interceptor drains, the ground water that is brought to the surface has a lower dissolved solids content than would have existed if the water was to continue its downward movement through shale layers, dissolving increased amounts of salt with distance (Southeastern Utah Association of Governments, 1977; Hansen, 1979). As a result, Valley Camp mines will have a slightly beneficial impact on the chemical quality of water in the region, because the small amount of water which is brought to the surface will dissolve fewer constituents in the stream channel than it would have in the shale formations (particularly the Mancos Shale below the Star Point Sandstone) which it would have encountered (Bently et al., 1978). Although suspended sediment and oil and grease may increase at the mine mouth, these constituents will be removed in keeping with regulatory requirements prior to any potential discharge into adjacent streams.

Because of the high alkalinity and low acidity concentrations in the area (differing normally by one or two orders of magnitude), acid drainage problems should not occur as a result of mining. This is fortified by the fact that coal in the area has a low sulphur content (U.S. Geological Survey, 1979).

Cumulative Impact

The Scofield-Clear Creek area is one of the oldest and most consistent mining areas in the Wasatch Plateau coal field (Doelling, 1972). Mining activities are expected to continue in the area into the 21st century.

As has been noted, the occurrence and quality of water in any region is highly controlled by geology. Because the region surrounding the Valley Camp lease area consists of the same geologic formations, impacts should also be the same. Thus, it is presumed that cumulative mining activities in the Scofield-Clear Creek area will have only slight impact on the areal hydrologic system. Water quantity in the area will remain generally unaffected by mining due to the presence of the relatively impermeable Blackhawk Formation, which likely seals rapidly after subsiding. Regional water quality will be enhanced by mining activities to the extent that water encountered in the mines is discharged.

Alternative Water Supply

OSM Regulations Section 783.17 requires that alternative sources of water supply be identified if mining impacts will result in the contamination, diminuation, or interruption of existing sources. Because no significant hydrologic impacts are expected as a result of mining in the Valley Camp lease area, no alternative water supply needs to be identified.

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ATTACHMENT A

Water Quality Analysis Methods

Table 21. Field methods used for the analysis of water quality samples.

Parameter	Units	Instrument
Flow	cfs	Marsh-McBirney current meter, float measurement, or volumetric measurement
Temperature	^{o}C	Thermometer
pH	units	Beckman Model 1009 pH meter
Conductivity	micromhos/cm @ $25^{o}C$	Hydrolab TC-2 conductivity meter
Diss. Oxygen	mg/l	Hydrolab TDO-2 dissolved oxygen meter

Table 22. Laboratory methods used for the analysis of water quality samples, with standard reference page numbers.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Acidity, as $CaCO_3$	mg/l	Titration	1	273
Alkalinity, as $CaCO_3$	mg/l	Manual or automated electrometric titration to pH 4.5, or automated method	3 5	278 ---
Ammonia, as N	mg/l	Manual distillation (at pH 9.5) followed by nesslerization, titration, electrode, automated phenolate	--- 159 165 168	410 412 --- ---
Arsenic	mg/l	Digestion followed by silver diethyldithiocarbamate, or atomic absorption	--- 9 95	285 283 159
BOD, 5-day	mg/l	Winkler (azide modification) or electrode method	--	543
Barium	mg/l	Digestion followed by atomic absorption or colorimetric	97	152
Bicarbonate	mg/l	Titration	278	--
Boron	mg/l	Colorimetric (Curcumin)	13	287
Cadmium	mg/l	Digestion followed by atomic absorption or colorimetric	101 ---	148 182
Calcium	mg/l	Digestion followed by atomic absorption or titration	103 ---	148 182

Table 22. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Chloride	mg/l	Silver nitrate, mercuric nitrate, or automated clorimetric	--- 29 31	303 304 613
Chromium, VI	mg/l	Extration and atomic absorption, colorimetric	89 105	--- 192
Copper	mg/l	Digestion followed by atomic absorption or colorimetric	108 ---	148 196
Cyanide	mg/l	Distillation followed by silver nitrate titration or pyridine pyrazolone (or barbituric acid) colorimetric	40	361
Fluoride	mg/l	Distillation followed by ion electrode, SPANDS, or automated complexone	--- 65 59 61	389 391 393 164
Gross Alpha Radioactivity	pCi/l	Scintillation counter	--	641
Gross Beta Radioactivity	pCi/l	Scintillation counter	--	642
Iron	mg/l	Digestion followed by atomic absorption or colorimetric	110 ---	148 208
Lead	mg/l	Digestion followed by atomic absorption or colorimetric	112 ---	148 215

Table 22. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
MPN Fecal Coliform	MPN/100 ml	MPN procedure	--	922
MPN Total Coliform	MPN/100 ml	MPN procedure	--	922
Magnesium	mg/l	Digestion followed by atomic absorption or gravimetric	114 ---	148 221
Manganese	mg/l	Digestion followed by atomic absorption or colorimetric	116 ---	148 225
Mercury	mg/l	Flameless atomic absorption	118	156
Nitrate, as N	mg/l	Cadmium reduction, brucine sulfate, automated cadmium or hydrazine reduction	201 197 207	423 427 620
Oil & Grease	mg/l	Liquid extraction with freongravimetric	229	515
Phenol	mg/l	Colorimetric (4-AAP)	241	582
Phosphate, as P	mg/l	Manual or automated ascorbic acid reduction	249 256	481 624
Potassium	mg/l	Digestion followed by atomic absorption, colorimetric or flame photometric	143 --- ---	--- 235 234
Selenium	mg/l	Digestion followed by atomic absorption	145	159
Silver	mg/l	Digestion followed by atomic absorption or colorimetric	146	148

Table 22. Continued.

Parameter	Unit	Method	1974 EPA Methods Page No.	14th Ed. Standard Methods Page No.
Sodium	mg/l	Digestion followed by atomic absorption, flame photometric	147 ---	--- 250
Sulfate	mg/l	Gravimetric, turbidimetric, or automated colorimetric	--- 277, 279	493 496
Suspended Solids	mg/l	Glass fiber filtration, 105°C	268	94
Total Suspended Solids	mg/l	Glass fiber filtration, 180°C	266	92
Total Organic Carbon	mg/l	Combustion - infrared	236	532
Turbidity	NTU	Nephelometric	295	132
Zinc	mg/l	Digestion followed by atomic absorption or colorimetric	155 ---	148 265

ATTACHMENT B

Results of Baseline Surface Water Quality Analyses

Table 23. Results of chemical analyses of surface water quality samples collected at Station VC-001.

Parameter	Units	9-28-77	10-12-77	10-26-77	11-9-77	12-14-77
FIELD MEASURMENTS						
Discharge	cfs	0.007	0.007	0.004	0.003	0.0004
Dissolved Oxygen	mg/l	7.2		8.4	7.5	8.4
pH	units	8.10	8.2	7.8	7.7	7.5
Specific Conductance	umhos/cm @ 25° C					
Temperature, Air	°C	12	10	12	5	6
Temperature, Water	°C	10	6	6	9	1
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	30.0	10.0	20.0	20.0	30.0
Alkalinity, as $CaCO_3$	mg/l	218	226	232	222	214
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	2.5		2.0		1.2
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.207	0.221	0.138	0.141	0.158
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	<2		<2.2		<2
MPN Total Coliform	MPN/100 ml	14		34		2
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l	<1.0		<1.0		2.0
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l	<0.001		<0.001		<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	14.0	15.0	10.0	49.0	6.0
Total Dissolved Solids	mg/l	263	221	254	272	260
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	12-28-77	1-11-78	1-25-78	2-8-78	2-22-78
FIELD MEASURMENTS						
Discharge	cfs	0	0	0	0	0
Dissolved Oxygen	mg/l					
pH	units					
Specific Conductance	umhos/cm @ 25° C					
Temperature, Air	°C					
Temperature, Water	°C					
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l					
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l					
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l					
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l					
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	3-8-78	3-22-78	4-12-78	4-26-78	5-10-78
FIELD MEASURMENTS						
Discharge	cfs	0	0	0	0.15	0.27
Dissolved Oxygen	mg/l				7.1	7.6
pH	units				7.3	7.5
Specific Conductance	umhos/cm @ 25° C					
Temperature, Air	°C				6	15
Temperature, Water	°C				3	7
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l				32.0	18.0
Alkalinity, as $CaCO_3$	mg/l				112	104
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l				16.0	
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l				0.045	0.104
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml				<2	
MPN Total Coliform	MPN/100 ml				12	
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l				15.6	
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l				0.013	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l				178	162
Total Dissolved Solids	mg/l				208	240
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	5-24-78	6-14-78	6-28-78	7-12-78	7-26-78
FIELD MEASURMENTS						
Discharge	cfs	0.18	0.36	0.23	0.06	0.03
Dissolved Oxygen	mg/l	7.2	6.8		6.3	6.7
pH	units	7.6	7.8	7.5	7.6	8.0
Specific Conductance	umhos/cm @ 25° C					
Temperature, Air	°C	8	18	24	21	28
Temperature, Water	°C	11	13	12	13	13
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	14.0	14.0	20.0	14.0	18.0
Alkalinity, as $CaCO_3$	mg/l	336	219	220	218	210
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	<1.0		<1.0		12.0
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.014	0.034	0.086	0.095	0.178
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	<2		<20		<2
MPN Total Coliform	MPN/100 ml	110		330		9
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l	<1.0		<1.0		<1.0
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l	<0.001		<0.001		<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	153	38.0	6.2	41.0	24.0
Total Dissolved Solids	mg/l	246	300	250	274	336
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	8-9-78	8-23-78	9-13-78	9-27-78	10-11-78
FIELD MEASURMENTS						
Discharge	cfs	0.04	0.01	0.02	0.003	0.009
Dissolved Oxygen	mg/l	6.8	6.9	6.9	8.4	7.1
pH	units	7.9	7.9	7.5	8.2	7.7
Specific Conductance	umhos/cm @ 25° C	1460	438			430
Temperature, Air	°C	17	23	15	16	15
Temperature, Water	°C	15	12	10	9.5	7.5
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	16.0	20.0	26.0	22.0	22.0
Alkalinity, as $CaCO_3$	mg/l	216	192	198	200	204
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l		<1.0		1.3	
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.196	0.012	0.019	0.015	0.172
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml		<2		<2	
MPN Total Coliform	MPN/100 ml		33		23	
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l		<1.0		<1.0	
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l		<0.001		<0.001	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l		28.0			
Suspended Solids	mg/l	67.0	7.0	64.0	11.0	71.0
Total Dissolved Solids	mg/l	951	283	270	280	274
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	10-25-78	11-8-78	11-21-78	12-13-78	1-10-79
FIELD MEASURMENTS						
Discharge	cfs	0.01	0	0	0	0
Dissolved Oxygen	mg/l	8.4				
pH	units	7.0				
Specific Conductance	umhos/cm @ 25° C	440				
Temperature, Air	°C	4				
Temperature, Water	°C	5				
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	12.0				
Alkalinity, as $CaCO_3$	mg/l	206				
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	1.7				
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.024				
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	<2				
MPN Total Coliform	MPN/100 ml	110				
Magnesium	mg/l					
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l	<1.0				
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l	<0.001				
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	27.0				
Total Dissolved Solids	mg/l	270				
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	5-9-79	5-24-79	6-13-79	6-27-79	7-11-79
FIELD MEASURMENTS						
Discharge	cfs	0.0005	0.008	0.27	0.37	0.09
Dissolved Oxygen	mg/l	9.4		7.3		
pH	units	7.65	8.2	8.4	7.75	7.7
Specific Conductance	umhos/cm @ 25° C			490	520	4900
Temperature, Air	°C	0	14	20	22	20
Temperature, Water	°C	1	10	13	12	16
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	6.0	12.0	20.0	24.0	18.0
Alkalinity, as $CaCO_3$	mg/l	144	200	248	220	210
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	3.7		2.8		<1.0
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.04	1.934	0.015	0.046	0.065
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	<2.0		<2.0		<2.0
MPN Total Coliform	MPN/100 ml	<2.0		11.0		2.0
Magnesium	mg/l					
Manganese, Total	mg/l	0.012		0.004		0.010
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l	1.0		<1.0		<1.0
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l	<0.001		<0.001		<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	2.0	52.0	5.0	5.0	2.0
Total Dissolved Solids	mg/l	200	314	320	330	300
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc. Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	7-25-79	8-8-79	8-22-79	9-12-79	9-26-79
FIELD MEASURMENTS						
Discharge	cfs	0.36	0.12	0.03	0.21	0.18
Dissolved Oxygen	mg/l		6.0			
pH	units	7.3	7.6	7.8	7.6	7.6
Specific Conductance	umhos/cm @ 25° C	400	430	500	480	450
Temperature, Air	°C	23	24	15		14
Temperature, Water	°C	13	16.5	9		11.5
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	8.0	14.0	13.0	22.0	12.0
Alkalinity, as $CaCO_3$	mg/l	180	272	242	210	214
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l		<1.0		1.5	
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.210	0.09	0.590	0.57	1.290
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml		<2.0		5.0	
MPN Total Coliform	MPN/100 ml		17.0		33.0	
Magnesium	mg/l					
Manganese, Total	mg/l		0.002		0.004	
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l		<1.0		1.4	
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l		<0.001		0.001	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	7.0	3.0	7.0	64.0	67.0
Total Dissolved Solids	mg/l	240	310	300	310	440
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	10-10-79	10-24-79	11-14-79	11-28-79	12-12-79
FIELD MEASURMENTS						
Discharge	cfs	0.22	0.18	0.01	0	0
Dissolved Oxygen	mg/l					
pH	units	7.7	7.3	7.58		
Specific Conductance	umhos/cm @ 25° C	450	390	460		
Temperature, Air	°C			1		
Temperature, Water	°C	6		1		
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l	8.0	12.0	20.0		
Alkalinity, as $CaCO_3$	mg/l	196	204	210		
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	<1.0		<1.0		
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l					
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l					
Chloride	mg/l					
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l					
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.155	0.580	0.440		
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	20.0		<2.0		
MPN Total Coliform	MPN/100 ml	490		110		
Magnesium	mg/l					
Manganese, Total	mg/l	0.021	0.445	0.008		
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l	1.6		0.8		
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l					
Selenium, Total	mg/l	<0.001		<0.001		
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l					
Sulfate	mg/l					
Suspended Solids	mg/l	4.0	12.0	<1.0		
Total Dissolved Solids	mg/l	370	285	308		
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 23. Continued.

Parameter	Units	12-26-79	1-9-79
FIELD MEASURMENTS			
Discharge	cfs	0	0
Dissolved Oxygen	mg/l		
pH	units		
Specific Conductance	umhos/cm @ 25° C		
Temperature, Air	°C		
Temperature, Water	°C		
LABORATORY MEASUREMENTS			
Acidity, as $CaCO_3$	mg/l		
Alkalinity, as $CaCO_3$	mg/l		
Ammonia, NH_3 as N	mg/l		
Arsenic, Total	mg/l		
Arsenic, Dissolved	mg/l		
BOD, 5 Day	mg/l		
Barium, Total	mg/l		
Barium, Dissolved	mg/l		
Bicarbonate	mg/l		
Boron, Total	mg/l		
Boron, Dissolved	mg/l		
Cadmium, Total	mg/l		
Cadmium, Dissolved	mg/l		
Calcium	mg/l		
Chloride	mg/l		
Chromium, Total	mg/l		
Chromium, Dissolved	mg/l		
Copper, Total	mg/l		
Copper, Dissolved	mg/l		
Cyanide	mg/l		
Fluoride	mg/l		
Gross Alpha Radioactivity	pCi/l		
Gross Beta Radioactivity	pCi/l		
Iron, Total	mg/l		
Iron, Dissolved	mg/l		
Lead, Total	mg/l		
Lead, Dissolved	mg/l		
MPN Fecal Coliform	MPN/100 ml		
MPN Total Coliform	MPN/100 ml		
Magnesium	mg/l		
Manganese, Total	mg/l		
Mercury, Total	mg/l		
Nitrate, NO_3 as N	mg/l		
Oil and Grease	mg/l		
Phenol	mg/l		
Phosphate, PO_4 as P	mg/l		
Potassium	mg/l		
Selenium, Total	mg/l		
Selenium, Dissolved	mg/l		
Silver, Total	mg/l		
Silver, Dissolved	mg/l		
Sodium	mg/l		
Sulfate	mg/l		
Suspended Solids	mg/l		
Total Dissolved Solids	mg/l		
Total Organic Carbon	mg/l		
Turbidity	NTU		
Zinc, Total	mg/l		
Zinc, Dissolved	mg/l		

Table 24. Results of chemical analyses of surface water quality samples collected at Station VC-1.

Parameter	Units	8-6-75	12-26-75	1-26-76	3-9-76	4-28-76	6-14-76
FIELD MEASURMENTS							
Discharge	cfs			14.0	8.1	8	15
Dissolved Oxygen	mg/l			10.0	8.4	6.8	7.1
pH	units						
Specific Conductance	umhos/cm @ 25° C	641	730	670	780	700	640
Temperature, Air	°C			-4.0	2.0	10	4
Temperature, Water	°C			0	1.0	6	2
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	218	258	216	278	236	218
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l	<0.01	<0.001	0.007	0.003	0.002	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	<0.01	0.03	0.084	0.065	0.044	0.023
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	264.20	314.76	263	339.1	287.9	265.9
Boron, Total	mg/l	<0.01	<0.01	<0.001	<0.001	0.005	<0.001
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	68.0	77.6	59.2	78.4	72.8	63.2
Chloride	mg/l	6.0	8.0	9.0	8.0	6.0	6.0
Chromium, Total	mg/l	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Copper, Dissolved	mg/l						
Cyanide	mg/l	<0.01	<0.01				
Fluoride	mg/l	0.18	0.23	0.23	0.36	0.25	0.28
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l	0.05	0.095				
Iron, Dissolved	mg/l						
Lead, Total	mg/l	<0.01	<0.001	0.018	0.004	<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	25.55	26.4	28.3	32.16	20.16	20.16
Manganese, Total	mg/l	<0.01	0.01	0.042	0.040	0.050	0.058
Mercury, Total	mg/l	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0002
Nitrate, NO_3 as N	mg/l	0.08	0.04	0.173	0.145	0.140	0.17
Oil and Grease	mg/l			<1.0		<1.0	<1.0
Phenol	mg/l						
Phosphate, PO_4 as P	mg/l	0.05	0.02	0.07	0.155	0.150	0.160
Potassium	mg/l	2.01	2.28	2.87	2.78	2.88	1.63
Selenium, Total	mg/l	<0.01	<0.01	0.055	0.012	0.015	0.019
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l	3.72	5.0	12.1	3.50		19.4
Sulfate	mg/l	49.70	45.0	65.0	46.0	56.0	
Suspended Solids	mg/l						
Total Dissolved Solids	mg/l						
Total Organic Carbon	mg/l			12.0	14.0	12.0	10.0
Turbidity	NTU	1.70	1.4	0.16	2.60	0.60	1.30
Zinc, Total	mg/l	0.05	0.009	0.430	0.032	0.029	0.021
Zinc, Dissolved	mg/l						

Table 24. Continued.

Parameter	Units	8-26-76	9-30-76	10-27-76	11-29-76	12-28-76
FIELD MEASURMENTS						
Discharge	cfs	6	9	4.5	5.5	8
Dissolved Oxygen	mg/l	8.0	9.2	10.4	9.9	9.8
pH	units	8.2	7.2	7.4	7.0	7.8
Specific Conductance	umhos/cm @ 25° C	720	520	760	840	750
Temperature, Air	°C	15	19	0	-4	-5
Temperature, Water	°C	15	9	1.5	1.0	0
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	260	102	294	306	290
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.025	0.012	0.009	0.004	0.007
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	317.2	124.4	358.7	373.3	353.8
Boron, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l	69.0	69.1	52.0	40.0	68.8
Chloride	mg/l	12.0	98.0	4.0	6.0	6.0
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.005	0.009	0.010	0.015	0.003
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.39	0.27	0.12	0.20	0.19
Gross Alpha Radioactivity	pCi/l	<1				<1
Gross Beta Radioactivity	pCi/l	<3				<2
Iron, Total	mg/l	0.310	0.220	0.223	0.275	0.228
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	25.0	19.60	42.0	64.8	31.68
Manganese, Total	mg/l	0.049	0.015	0.016	0.010	0.012
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.18	0.12	0.10	0.08	0.06
Oil and Grease	mg/l	<1.0	4.0	2.6	2.4	<1.0
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.165	0.200	0.160	0.130	0.150
Potassium	mg/l	2.51	2.54	2.51	3.23	2.46
Selenium, Total	mg/l	0.016	0.004	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l	17.0	8.10	12.0	4.7	12.0
Sulfate	mg/l	37.6	33.0	33.8	61.0	39.0
Suspended Solids	mg/l		18.0	21.0	11.0	7.0
Total Dissolved Solids	mg/l	470	350	500	550	510
Total Organic Carbon	mg/l	11.0	12.0	3.0	2.6	3.0
Turbidity	NTU	6.50	5.10	2.40	0.48	2.0
Zinc, Total	mg/l	0.019	0.015	0.025	0.034	0.027
Zinc, Dissolved	mg/l					

Table 24. Continued.

Parameter	Units	3-17-77	6-16-77	6-28-77	8-23-78	10-25-78	12-27-78
FIELD MEASURMENTS							
Discharge	cfs	6	2.4	19	3	4.7	2.9
Dissolved Oxygen	mg/l	10.15	8.8		8.5	11.0	10.4
pH	units	7.5	7.6	7.1	8.3	7.5	7.86
Specific Conductance	umhos/cm @ 25° C	670	450	325	390	540	
Temperature, Air	°C	3	21	20	27	5	-17
Temperature, Water	°C	5	12	16	15	3	0
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	244	262				
Ammonia, NH_3 as N	mg/l	0.15	0.25				
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	0.004	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	0.006	0.056				
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	297.6	319.6	195.2	253.7	295.2	336.7
Boron, Total	mg/l	<0.001	0.017				
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	65.6	68.0	48.8	57.6	74.4	84.0
Chloride	mg/l	4.0	10.0	10.0	10.0	8.0	12.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	0.013	0.015	0.005	0.004	0.015	0.010
Copper, Dissolved	mg/l						
Cyanide	mg/l		<0.01				
Fluoride	mg/l	0.17	0.27	0.14	0.15	0.16	0.16
Gross Alpha Radioactivity	pCi/l		2				
Gross Beta Radioactivity	pCi/l		6				
Iron, Total	mg/l	0.201	0.146	0.099	0.237	0.170	0.139
Iron, Dissolved	mg/l						
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml			<20			
MPN Total Coliform	MPN/100 ml			110			
Magnesium	mg/l	28.32	28.32	11.52	24.5	24.0	26.4
Manganese, Total	mg/l	0.014	0.047	0.049	0.025	0.030	0.053
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.02	0.01	0.20			
Oil and Grease	mg/l	<1.0	<1.0	<1.0	1.3	1.6	1.1
Phenol	mg/l		0.009	0.009	0.008	0.028	0.006
Phosphate, PO_4 as P	mg/l	0.042	0.035				
Potassium	mg/l	2.53	2.30	1.155	2.09	2.450	2.215
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001		
Silver, Dissolved	mg/l						
Sodium	mg/l	5.33	5.66	18.0	4.14	4.00	8.5
Sulfate	mg/l	43.0	22.0	28.0	31.5	38.0	46.0
Suspended Solids	mg/l	13.0	22.0	12.8	2.0	4.0	16.0
Total Dissolved Solids	mg/l	440	320	210	255	295	346
Total Organic Carbon	mg/l	3.0	8.0	18.0			
Turbidity	NTU	1.50	7.50				
Zinc, Total	mg/l	0.018	0.013	0.007	0.010	0.007	0.004
Zinc, Dissolved	mg/l						

Table 24. Continued.

Parameter	Units	2-28-79	4-18-79	6-20-79	8-23-79	10-31-79
FIELD MEASURMENTS						
Discharge	cfs	5.7	12.6	12.3	4.8	2.7
Dissolved Oxygen	mg/l	10.0	10.0	10.0	9.0	9.0
pH	units	7.8	7.72	7.95	8.0	7.9
Specific Conductance	umhos/cm @ 25° C	440	480	375	510	550
Temperature, Air	°C	-7	13	10	11	-1
Temperature, Water	°C	0.2	6.5	4	8.0	7.9
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l			10.0	6.0	14.0
Alkalinity, as $CaCO_3$	mg/l	236	238	190	228	220
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					0.210
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	287.92	292.8	231.8	278.16	286.40
Boron, Total	mg/l					0.050
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l					
Calcium	mg/l	61.6	77.6	56.0	96.0	63.20
Chloride	mg/l	<0.1	14.0	4.0	1.0	8.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001		<0.001
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.003	0.004	0.002	0.007	0.010
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.18	0.16	0.24	0.25	0.17
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.406	3.428	1.080	0.390	0.320
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	0.003	0.004	<0.001	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	24.48	20.16	14.4	4.32	26.88
Manganese, Total	mg/l	0.088	0.142	0.051	0.051	0.049
Mercury, Total	mg/l	<0.0002	<0.0002	0.0003	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.10	0.11	0.24	0.04	<0.01
Oil and Grease	mg/l	1.2	1.4	3.2	<1.0	<1.0
Phenol	mg/l	<0.001	0.008	<0.001	0.108	<0.001
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l	2.001	2.318	1.105	2.203	2.250
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l	10.2	8.83	4.10	9.80	9.60
Sulfate	mg/l	45.0	38.0	18.0	52.0	54.0
Suspended Solids	mg/l	51.0	111	19.0	27.0	27.0
Total Dissolved Solids	mg/l	290	315	219	300	310
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l	0.008	0.012	0.004	0.005	0.006
Zinc, Dissolved	mg/l					

Table 25. Results of chemical analyses of surface water quality samples collected at Station VC-2.

Parameter	Units	8-26-75	12-26-75	1-26-76	3-9-76	4-28-76	6-14-76
FIELD MEASURMENTS							
Discharge	cfs			14.0	8.4	8.0	15.0
Dissolved Oxygen	mg/l			9.9	11.2	6.5	8.0
pH	units	7.80	7.63	7.9	8.3	8.2	8.5
Specific Conductance	umhos/cm @ 25° C						
Temperature, Air	°C						
Temperature, Water	°C						
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l						
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	<0.01	0.06	0.008	0.006	0.009	0.012
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	239.97	295.24	239.1	302.5	263.35	253.7
Boron, Total	mg/l	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	62.40	70.4	51.2	71.2	56.0	58.4
Chloride	mg/l	6.0	8.0	6.0	4.0	6.0	2.0
Chromium, Total	mg/l	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	0.02	<0.01	<0.001	<0.001	<0.001	<0.001
Copper, Dissolved	mg/l						
Cyanide	mg/l	<0.01	<010.				
Fluoride	mg/l	0.14	0.25	0.25	0.34	0.30	0.27
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l	0.13	0.160	0.130	0.210	0.244	0.250
Iron, Dissolved	mg/l	0.01	0.080				
Lead, Total	mg/l	<0.01	<0.001	0.002	0.001	<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	20.16	27.36	27.8	29.76	24.0	23.0
Manganese, Total	mg/l	<0.01	<0.01	0.035	0.024	0.050	0.058
Mercury, Total	mg/l	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001
Nitrate, NO_3 as N	mg/l	0.10	0.04	0.069	0.130	0.155	0.16
Oil and Grease	mg/l			<1.0		<1.0	<1.0
Phenol	mg/l						
Phosphate, PO_4 as P	mg/l	0.07	0.05	0.12	0.120	0.165	0.165
Potassium	mg/l	1.85	2.52	2.10	1.91	1.94	1.42
Selenium, Total	mg/l	<0.01	<0.01	<0.001	<0.001	0.009	0.008
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l	3.52	12.0	19.0	4.87	16.0	6.5
Sulfate	mg/l	41.85	55.0	80.0	56.0	50.0	46.0
Suspended Solids	mg/l						
Total Dissolved Solids	mg/l	374.0	469.0	420.0	467.0	416.0	380.0
Total Organic Carbon	mg/l				8.0	17.0	18.0
Turbidity	NTU	1.50	0.84	0.24	2.30	0.50	1.40
Zinc, Total	mg/l	0.02	0.015	0.013	0.015	0.015	0.005
Zinc, Dissolved	mg/l						

Table 25. Continued.

Parameter	Units	8-27-76	9-30-76	10-27-76	11-29-76	12-28-76
FIELD MEASURMENTS						
Discharge	cfs	5.6	4.0	5.0	4.3	2.0
Dissolved Oxygen	mg/l	8.8	7.3	10.5	10.2	9.3
pH	units	8.2	7.3	7.5	7.1	7.8
Specific Conductance	umhos/cm @ 25° C	660.0	740.0	760.0	780.0	750.0
Temperature, Air	°C	19.0	20.0	2.0	-2.0	0
Temperature, Water	°C	8.2	7.3	7.5	7.1	7.8
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	234.0	262.0	282.0	306.0	278.0
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.010	0.004	0.002	0.004	0.004
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	285.4	319.6	334.0	373.3	339.2
Boron, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l	65.0	76.8	52.0	40.0	77.6
Chloride	mg/l	8.0	8.0	4.0	6.0	4.0
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.006	0.012	0.008	0.002	0.003
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.35	0.25	0.20	0.20	0.18
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.280	0.300	0.310	0.260	0.270
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	24.0	18.60	42.0	64.8	24.9
Manganese, Total	mg/l	0.048	0.017	0.018	0.017	0.012
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.10	0.06	0.05	0.06	0.005
Oil and Grease	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.140	0.165	0.095	0.085	0.110
Potassium	mg/l	2.14	2.27	2.21	3.23	2.09
Selenium, Total	mg/l	0.006	0.004	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l	10.0	18.0	11.0	4.70	10.0
Sulfate	mg/l	40.0	39.0	41.0	61.0	35.0
Suspended Solids	mg/l		8.0	7.0	6.0	4.0
Total Dissolved Solids	mg/l	430.0	480.0	498.0	510.0	489.0
Total Organic Carbon	mg/l	15.0	11.0	9.0	6.0	6.0
Turbidity	NTU	9.90	3.40	2.00	0.54	1.9
Zinc, Total	mg/l	0.006	0.011	0.002	0.005	0.018
Zinc, Dissolved	mg/l					

Table 25. Continued.

Parameter	Units	3-17-77	6-16-77	6-28-78	8-23-78	10-25-78	12-27-78
FIELD MEASURMENTS							
Discharge	cfs	3.5	2.3	16.0	1.5	3.2	5.7
Dissolved Oxygen	mg/l	9.75	7.1		8.6	10.0	11.1
pH	units	7.6	7.6	7.2	8.0	7.2	7.92
Specific Conductance	umhos/cm @ 25° C	690.0	425.0	335.0	395.0		500.0
Temperature, Air	°C	-1.0	21.0	24.0	26.0	3.0	-11.0
Temperature, Water	°C	2.0	13.0	16.0	12.0	3.0	0
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	244.0	240.0				
Ammonia, NH_3 as N	mg/l	0.13	0.13				
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.00o	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	0.005	0.018				
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	297.7	292.8	207.4	270.8	297.6	329.4
Boron, Total	mg/l						
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	68.0	67.2	51.2	57.6	72.0	80.8
Chloride	mg/l	4.0	12.0	10.0	4.0	9.0	6.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	0.002	0.007	0.005	0.006	0.009	0.001
Copper, Dissolved	mg/l						
Cyanide	mg/l		<0.01				
Fluoride	mg/l	0/16	0.20	0.14	0.14	0.16	0.17
Gross Alpha Radioactivity	pCi/l		0				
Gross Beta Radioactivity	pCi/l		0				
Iron, Total	mg/l	0.223	0.137	0.103	0.164	0.188	0.200
Iron, Dissolved	mg/l						
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	26.40	25.92	11.50	26.90	25.90	26.40
Manganese, Total	mg/l	0.017	0.003	0.050	0.026	0.030	0.047
Mercury, Total	mg/l						
Nitrate, NO_3 as N	mg/l	0.03	0.01	0.20			
Oil and Grease	mg/l	<1.0	<1.0	<1.0	1.5	2.0	1.2
Phenol	mg/l		<0.001	0.008	0.002	0.004	0.003
Phosphate, PO_4 as P	mg/l	0.062	0.025				
Potassium	mg/l	2.18	2.28	1.289	1.82	1.80	2.176
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001		
Silver, Dissolved	mg/l						
Sodium	mg/l	8.63	4.78	14.0	3.96	3.90	4.46
Sulfate	mg/l	52.0	28.3	26.0	31.0	39.0	43.0
Suspended Solids	mg/l	8.0	3.0	2.2	6.0	5.0	22.0
Total Dissolved Solids	mg/l	450.0	280.0	216.0	260.0	298.0	328.0
Total Organic Carbon	mg/l	4.0	3.5	19.0			
Turbidity	NTU	1.50	3.50				
Zinc, Total	mg/l	0.017	0.011	0.005	0.012	0.009	0.006
Zinc, Dissolved	mg/l						

Table 25. Continued.

Parameter	Units	2-28-79	4-18-79	6-20-79	8-23-79	10-31-79
FIELD MEASURMENTS						
Discharge	cfs	5.1	12.0	13.6	8.4	5.0
Dissolved Oxygen	mg/l	9.6	9.1	9.5	8.3	10.0
pH	units	7.7	7.73	7.9	8.1	7.3
Specific Conductance	umhos/cm @ 25° C	490.0	490.0	358.0	510.0	550.0
Temperature, Air	°C	-6.0	9.0	14.0	12.0	2.0
Temperature, Water	°C	0.2	6.5	4.7	6.0	1.0
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l			10.0	10.0	16.0
Alkalinity, as $CaCO_3$	mg/l	266.0	238.0	184.0	244.0	228.0
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					0.217
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	324.57	292.8	224.48	297.88	278.16
Boron, Total	mg/l					0.060
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l					
Calcium	mg/l	72.0	80.8	57.6	96.0	65.60
Chloride	mg/l	<0.1	14.0	4.0	2.0	8.0
Chromium, Total	mg/l		<0.001	<0.001		<0.001
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.006	0.002	0.003	0.011	0.012
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.17	0.17	0.16	0.24	0.18
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.519	2.236	1.150	1.210	0.860
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	0.002	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	24.96	19.20	12.96	9.60	29.76
Manganese, Total	mg/l	0.079	0.118	0.053	0.066	0.052
Mercury, Total	mg/l	<0.0002	<0.0002	0.0002	0.0002	0.0002
Nitrate, NO_3 as N	mg/l	0.12	0.20	0.28	<0.01	<0.01
Oil and Grease	mg/l	<1.0	<1.0	5.2	<1.0	<1.0
Phenol	mg/l	<0.001	0.010	<0.001	0.008	<0.001
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l	2.243	2.234	1.048	2.134	2.240
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l	14.0	8.85	2.63	4.92	5.85
Sulfate	mg/l	40.0	41.0	14.8	44.1	60.0
Suspended Solids	mg/l	55.0	54.0	14.0	84.0	40.0
Total Dissolved Solids	mg/l	316.0	318.0	209.0	310.0	320.0
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l	0.005	0.009	0.006	0.004	0.007
Zinc, Dissolved	mg/l					

Table 26. Results of chemical analyses of surface water quality samples collected at Station VC-4.

Parameter	Units	9-30-76	10-27-76	11-29-76	12-28-76	3-17-77	6-16-77
FIELD MEASURMENTS							
Discharge	cfs	0	0	0	0	0	0
Dissolved Oxygen	mg/l						
pH	units						
Specific Conductance	umhos/cm @ 25° C						
Temperature, Air	°C						
Temperature, Water	°C						
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l						
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l						
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l						
Barium, Dissolved	mg/l						
Bicarbonate	mg/l						
Boron, Total	mg/l						
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l						
Cadmium, Dissolved	mg/l						
Calcium	mg/l						
Chloride	mg/l						
Chromium, Total	mg/l						
Chromium, Dissolved	mg/l						
Copper, Total	mg/l						
Copper, Dissolved	mg/l						
Cyanide	mg/l						
Fluoride	mg/l						
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l						
Iron, Dissolved	mg/l						
Lead, Total	mg/l						
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l						
Manganese, Total	mg/l						
Mercury, Total	mg/l						
Nitrate, NO_3 as N	mg/l						
Oil and Grease	mg/l						
Phenol	mg/l						
Phosphate, PO_4 as P	mg/l						
Potassium	mg/l						
Selenium, Total	mg/l						
Selenium, Dissolved	mg/l						
Silver, Total	mg/l						
Silver, Dissolved	mg/l						
Sodium	mg/l						
Sulfate	mg/l						
Suspended Solids	mg/l						
Total Dissolved Solids	mg/l						
Total Organic Carbon	mg/l						
Turbidity	NTU						
Zinc, Total	mg/l						
Zinc, Dissolved	mg/l						

Table 26. Continued.

Parameter	Units	5-10-78	6-14-78	7-12-78	8-23-78	10-25-78	12-27-78
FIELD MEASURMENTS							
Discharge	cfs	0	1.0	0.07	0	0	0
Dissolved Oxygen	mg/l		9.4	7.3			
pH	units		7.0	7.7			
Specific Conductance	umhos/cm @ 25° C		120.0	130.0			
Temperature, Air	°C		20.0	21.0			
Temperature, Water	°C		4.0	14.0			
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l						
Ammonia, NH_3 as N	mg/l		0.10				
Arsenic, Total	mg/l		<0.001	<0.001			
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l						
Barium, Dissolved	mg/l						
Bicarbonate	mg/l		73.2	92.72			
Boron, Total	mg/l						
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l		<0.001				
Cadmium, Dissolved	mg/l						
Calcium	mg/l		23.2	11.2			
Chloride	mg/l		8.0	<1.0			
Chromium, Total	mg/l		<0.001				
Chromium, Dissolved	mg/l						
Copper, Total	mg/l		0.007				
Copper, Dissolved	mg/l						
Cyanide	mg/l						
Fluoride	mg/l		0.08				
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l		0.128	0.215			
Iron, Dissolved	mg/l						
Lead, Total	mg/l		<0.001	<0.001			
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l		1.92	1.92			
Manganese, Total	mg/l		0.013	0.011			
Mercury, Total	mg/l		<0.0002	<0.0002			
Nitrate, NO_3 as N	mg/l						
Oil and Grease	mg/l		0.10				
Phenol	mg/l		<0.001				
Phosphate, PO_4 as P	mg/l						
Potassium	mg/l		0.439	0.618			
Selenium, Total	mg/l		<0.001	<0.001			
Selenium, Dissolved	mg/l						
Silver, Total	mg/l		<0.001	<0.001			
Silver, Dissolved	mg/l						
Sodium	mg/l		5.5	28.0			
Sulfate	mg/l		8.0	24.0			
Suspended Solids	mg/l		85.0	10.0			
Total Dissolved Solids	mg/l		84.0	110.0			
Total Organic Carbon	mg/l		10.0				
Turbidity	NTU						
Zinc, Total	mg/l		0.006	0.018			
Zinc, Dissolved	mg/l						

Table 26. Continued.

Parameter	Units	2-28-79	4-18-79	6-20-79	8-23-79	10-31-79
FIELD MEASURMENTS						
Discharge	cfs	0	0	0.1	0.01	0
Dissolved Oxygen	mg/l			8.1	7.4	
pH	units			8.0	8.3	
Specific Conductance	umhos/cm @ 25° C			112.0	360.0	
Temperature, Air	°C			16	17	
Temperature, Water	°C			7	7.5	
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l			6.0	10.0	
Alkalinity, as $CaCO_3$	mg/l			60.0	202.0	
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l			<0.001	<0.001	
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l			73.20	246.44	
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l			<0.001	<0.001	
Cadmium, Dissolved	mg/l					
Calcium	mg/l			21.60	72.0	
Chloride	mg/l			<1.0	<0.1	
Chromium, Total	mg/l				<0.001	
Chromium, Dissolved	mg/l					
Copper, Total	mg/l			0.007	o.o11	
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l			0.10	0.20	
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l			0.880	1.150	
Iron, Dissolved	mg/l					
Lead, Total	mg/l			<0.001	<0.001	
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l			8.16	4.80	
Manganese, Total	mg/l			<0.001	0.168	
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l			0.12	<0.01	
Oil and Grease	mg/l			1.4	<1.0	
Phenol	mg/l			<0.001	0.004	
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l			0.575	0.733	
Selenium, Total	mg/l			<0.001	<0.001	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l			<0.001	<0.001	
Silver, Dissolved	mg/l					
Sodium	mg/l			0.65	3.50	
Sulfate	mg/l			28.6	10.0	
Suspended Solids	mg/l			64.0	35.0	
Total Dissolved Solids	mg/l					
Total Organic Carbon	mg/l					
Turbidity	NTU					
Zinc, Total	mg/l			0.004	0.055	
Zinc, Dissolved	mg/l					

Table 27. Results of chemical analyses of surface water quality samples collected at Station VC-5.

Parameter	Units	6-14-76	8-2-76	9-30-76	10-27-76	11-29-76	12-28-76
FIELD MEASURMENTS							
Discharge	cfs	0.7	0.1	0	0	0	0
Dissolved Oxygen	mg/l	6.8	8.6				
pH	units	8.4	8.4				
Specific Conductance	umhos/cm @ 25° C	490.0	490.0				
Temperature, Air	°C	8.0	24.0				
Temperature, Water	°C	5.0	10.0				
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	162.0	190.0				
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l						
Arsenic, Dissolved	mg/l		<0.001				
BOD, 5 Day	mg/l						
Barium, Total	mg/l						
Barium, Dissolved	mg/l		0.210				
Bicarbonate	mg/l	197.6	231.8				
Boron, Total	mg/l		0.015				
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l		<0.001				
Cadmium, Dissolved	mg/l						
Calcium	mg/l	48.8	54.0				
Chloride	mg/l	2.0	6.0				
Chromium, Total	mg/l		<0.001				
Chromium, Dissolved	mg/l						
Copper, Total	mg/l		0.130				
Copper, Dissolved	mg/l						
Cyanide	mg/l		<0.01				
Fluoride	mg/l	0.14	0.37				
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l		<1	<3			
Iron, Total	mg/l		0.250				
Iron, Dissolved	mg/l						
Lead, Total	mg/l		<0.001				
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	13.44	17.0				
Manganese, Total	mg/l		0.042				
Mercury, Total	mg/l		0.0002				
Nitrate, NO_3 as N	mg/l		0.10				
Oil and Grease	mg/l		<1.0				
Phenol	mg/l			<0.001			
Phosphate, PO_4 as P	mg/l		0.120				
Potassium	mg/l	1.01	1.10				
Selenium, Total	mg/l		<0.001				
Selenium, Dissolved	mg/l						
Silver, Total	mg/l		<0.001				
Silver, Dissolved	mg/l						
Sodium	mg/l	16.0	2.20				
Sulfate	mg/l	46.0	11.0				
Suspended Solids	mg/l		18.0				
Total Dissolved Solids	mg/l	320.0	320.0				
Total Organic Carbon	mg/l	19.0	8.0				
Turbidity	NTU	20.00	2.50				
Zinc, Total	mg/l		0.039				
Zinc, Dissolved	mg/l						

Table 27. Continued.

Parameter	Units	3-17-77	6-16-77	5-10-78	6-14-78	7-12-78	8-23-78
FIELD MEASURMENTS							
Discharge	cfs	0	0	1.4	1.6	0.3	0.01
Dissolved Oxygen	mg/l			9.9	9.0	8.1	8.2
pH	units			7.5	7.1	8.3	8.4
Specific Conductance	umhos/cm @ 25° C			310.0	250.0	355.0	320.0
Temperature, Air	°C			170	250	27.0	22.0
Temperature, Water	°C			2.5	10.0	20.5	8.0
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l						
Ammonia, NH_3 as N	mg/l					0.12	
Arsenic, Total	mg/l			<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l						
Barium, Dissolved	mg/l						
Bicarbonate	mg/l			50.0	134.2	202.52	219.6
Boron, Total	mg/l						
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l			<0.001	<0.001		
Cadmium, Dissolved	mg/l						
Calcium	mg/l			47.3	38.4	32.5	49.6
Chloride	mg/l			10.0	8.0	2.0	<1.0
Chromium, Total	mg/l				<0.001	<0.001	
Chromium, Dissolved	mg/l						
Copper, Total	mg/l			0.002	0.009		0.006
Copper, Dissolved	mg/l						
Cyanide	mg/l						
Fluoride	mg/l			0.19	0.14		0.12
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l			0.039	1.442	0.098	0.011
Iron, Dissolved	mg/l						
Lead, Total	mg/l			<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l			8.64	5.76	0.80	19.2
Manganese, Total	mg/l			0.015	0.013	0.070	0.011
Mercury, Total	mg/l			<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l				1.12	0.46	
Oil and Grease	mg/l			15.2	<1.0	16.0	12.0
Phenol	mg/l					0.005	0.250
Phosphate, PO_4 as P	mg/l						
Potassium	mg/l			1.364	1.032	1.436	1.481
Selenium, Total	mg/l			<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l			<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l			3.79	7.5	62.0	2.97
Sulfate	mg/l			102.0	10.0	78.0	26.0
Suspended Solids	mg/l			2640.0	869.0	75.0	8.0
Total Dissolved Solids	mg/l			200.0	138.0	283.0	210.0
Total Organic Carbon	mg/l			9.0	23.0		20.1
Turbidity	NTU						
Zinc, Total	mg/l			0.008	0.008	0.014	0.017
Zinc, Dissolved	mg/l						

Table 27. Continued.

Parameter	Units	10-25-78	12-27-78	2-28-79	4-18-79	6-20-79
FIELD MEASURMENTS						
Discharge	cfs	0	0	0	0.3	0.6
Dissolved Oxygen	mg/l	20.1			6.0	
pH	units					
Specific Conductance	umhos/cm @ 25° C					
Temperature, Air	°C					
Temperature, Water	°C					
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					<1.0
Alkalinity, as $CaCO_3$	mg/l				190.0	174.0
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001			0.004	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l				770.0	360.0
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					<0.001
Cadmium, Dissolved	mg/l					
Calcium	mg/l				77.6	56.0
Chloride	mg/l				12.0	0.16
Chromium, Total	mg/l					<0.001
Chromium, Dissolved	mg/l					
Copper, Total	mg/l				0.007	<0.001
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l				0.20	0.16
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l				88.5	0.750
Iron, Dissolved	mg/l					
Lead, Total	mg/l				0.006	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l				11.04	12.48
Manganese, Total	mg/l				1.532	0.063
Mercury, Total	mg/l				<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l				1.09	0.20
Oil and Grease	mg/l				1.8	2.2
Phenol	mg/l				0.008	<0.001
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l				2.532	1.321
Selenium, Total	mg/l				<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l				<0.001	<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l				5.58	2.85
Sulfate	mg/l				191.0	32.5
Suspended Solids	mg/l				39 0.0	18.0
Total Dissolved Solids	mg/l				510.0	210.0
Total Organic Carbon	mg/l				6.0	
Turbidity	NTU					
Zinc, Total	mg/l				0.108	0.015
Zinc, Dissolved	mg/l					

Table 27. Continued.

Parameter	Units	8-23-79	10-31-79
FIELD MEASURMENTS			
Discharge	cfs	0.09	0
Dissolved Oxygen	mg/l	8.8	
pH	units	8.1	
Specific Conductance	umhos/cm @ 25° C	450.0	
Temperature, Air	°C	16.0	
Temperature, Water	°C	5.5	
LABORATORY MEASUREMENTS			
Acidity, as $CaCO_3$	mg/l	10.0	
Alkalinity, as $CaCO_3$	mg/l	198.0	
Ammonia, NH_3 as N	mg/l		
Arsenic, Total	mg/l	<0.001	<0.001
Arsenic, Dissolved	mg/l		
BOD, 5 Day	mg/l		
Barium, Total	mg/l		
Barium, Dissolved	mg/l		
Bicarbonate	mg/l	241.56	
Boron, Total	mg/l		
Boron, Dissolved	mg/l		
Cadmium, Total	mg/l	<0.001	<0.001
Cadmium, Dissolved	mg/l		
Calcium	mg/l	56.0	85.6
Chloride	mg/l	4.0	4.0
Chromium, Total	mg/l	<0.001	
Chromium, Dissolved	mg/l		
Copper, Total	mg/l	<0.001	0.013
Copper, Dissolved	mg/l		
Cyanide	mg/l		
Fluoride	mg/l	0.16	0.22
Gross Alpha Radioactivity	pCi/l		
Gross Beta Radioactivity	pCi/l		
Iron, Total	mg/l	0.750	0.110
Iron, Dissolved	mg/l		
Lead, Total	mg/l	<0.001	<0.001
Lead, Dissolved	mg/l		
MPN Fecal Coliform	MPN/100 ml		
MPN Total Coliform	MPN/100 ml		
Magnesium	mg/l	12.48	6.24
Manganese, Total	mg/l	0.063	0.060
Mercury, Total	mg/l	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	<0.01	
Oil and Grease	mg/l	<1.0	
Phenol	mg/l	0.086	
Phosphate, PO_4 as P	mg/l		
Potassium	mg/l	1.321	1.800
Selenium, Total	mg/l	<0.001	<0.001
Selenium, Dissolved	mg/l		
Silver, Total	mg/l	<0.001	<0.001
Silver, Dissolved	mg/l		
Sodium	mg/l	2.85	4.73
Sulfate	mg/l	44.9	
Suspended Solids	mg/l	1.0	
Total Dissolved Solids	mg/l	275.0	
Total Organic Carbon	mg/l		
Turbidity	NTU		
Zinc, Total	mg/l	0.015	<0.001
Zinc, Dissolved	mg/l		

Table 28. Results of chemical analyses of surface water quality samples collected at station VC-6.

Parameter	Units	6-14-76	8-2-76	9-30-76	10-27-76	11-29-76	12-28-76
FIELD MEASUREMENTS							
Discharge	cfs	3.7	1.7	1	1.7	1	0.6
Dissolved Oxygen	mg/l	6.9	8.4	9.6	10.0	9.5	8.8
pH	units	8.3	8.1	7.6	7.7	7.4	7.6
Specific Conductance	umhos/cm @ 25° C	530	660	830	720	720	700
Temperature, Air	°C	8	24	18	4	-5	-4
Temperature, Water	°C	7	12	9	2	1	2.5
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	188	248	306	278	278	266
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l		0.017	0.040		0.012	0.013
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	229.3	302.5	373.3	339.2	399.2	324.5
Boron, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	56.8	70.0	77.4	84.0	44.8	70.4
Chloride	mg/l	2.5	8.0	12.0	4.0	6.0	2.0
Chromium, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l		0.079	0.006		0.002	0.009
Copper, Dissolved	mg/l						
Cyanide	mg/l						
Fluoride	mg/l	0.27	0.34	0.25	0.19	0.18	0.15
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l		0.364	0.055		0.338	0.380
Iron, Dissolved	mg/l						
Lead, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	18.72	21.0	16.0	15.8	47.0	26.4
Manganese, Total	mg/l		0.190	<0.001		0.011	0.012
Mercury, Total	mg/l		<0.0002	<0.0002		<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l		0.09	0.05		0.12	0.17
Oil and Grease	mg/l			<1.0		<1.0	<1.0
Phenol	mg/l						
Phosphate, PO_4 as P	mg/l		0.220	0.175		0.080	0.078
Potassium	mg/l	1.28	2.34	2.11	1.94	2.75	2.23
Selenium, Total	mg/l		0.005	<0.001		<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l		<0.001	<0.001		<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l	4.18	4.00	37.0	12.0	3.80	6.0
Sulfate	mg/l	38.0	25.3	25.0	21.4	32.6	33.5
Suspended Solids	mg/l			2.0	10.0	9.0	5.0
Total Dissolved Solids	mg/l	350	430	540	470	470	460
Total Organic Carbon	mg/l			2.5	4.0	1.5	10.0
Turbidity	NTU	3.50	13.0	2.00	2.10	0.39	1.9
Zinc, Total	mg/l		0.032	0.028		0.022	0.059
Zinc, Dissolved	mg/l						

Table 28. Continued.

Parameter	Units	3-17-77	6-16-77	5-10-78	6-14-78	7-12-78	8-23-78	10-25-78
FIELD MEASUREMENTS								
Discharge	cfs	0.6	0.3	4.5	8.5	2.1	0.4	0.3
Dissolved Oxygen	mg/l	9.0	7.0	9.0	9.3	8.0	8.6	11.1
pH	units	7.8	7.7	8.0	7.4	8.3	8.1	7.1
Specific Conductance	umhos/cm @ 25° C	630	350	385	260	386	335	440
Temperature, Air	°C	0	18	15	22	21	20	3
Temperature, Water	°C	1	14	4	9	14.5	12.5	0.5
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	244	206					
Ammonia, NH_3 as N	mg/l	0.21	0.18		0.10			
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l							
Barium, Total	mg/l	0.020	0.045					
Barium, Dissolved	mg/l							
Bicarbonate	mg/l	297.7	251.3	238	156.1	222.04	236.7	263.5
Boron, Total	mg/l	0.003	0.014					
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001			<0.001
Cadmium, Dissolved	mg/l							
Calcium	mg/l	73.6	64.0	63.2	45.6	28.0	60.0	65.6
Chloride	mg/l	4.0	6.0	8.0	10.0	2.0	2.0	1.5
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001			<0.001
Chromium, Dissolved	mg/l							
Copper, Total	mg/l	0.010	0.009	0.006	<0.001		0.006	0.005
Copper, Dissolved	mg/l							
Cyanide	mg/l		<0.01					
Fluoride	mg/l	0.16	0.24	0.14	0.13		0.14	0.15
Gross Alpha Radioactivity	pCi/l		0					
Gross Beta Radioactivity	pCi/l		0					
Iron, Total	mg/l	0.609	0.625	0.029	0.161	0.062	<0.001	0.056
Iron, Dissolved	mg/l							
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml							
MPN Total Coliform	MPN/100 ml							
Magnesium	mg/l	18.72	14.40	13.92	6.24	5.28	14.4	20.10
Manganese, Total	mg/l	0.018	<0.001	0.016	0.032	0.010	0.002	0.005
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.15	0.05	1.05	0.49			
Oil and Grease	mg/l	<1.0	<1.0	10.4		5.8	1.0	1.5
Phenol	mg/l		<0.001		0.004		0.010	0.003
Phosphate, PO_4 as P	mg/l	0.055	0.310					
Potassium	mg/l	1.34	1.31	1.176	0.688	1.005	1.178	1.220
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l							
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l							
Sodium	mg/l	6.15	2.19	3.88	7.0	54.0	3.00	3.21
Sulfate	mg/l	28.0	10.8	14.0	14.0	27.0	20.0	19.0
Suspended Solids	mg/l	10.0	3.0	88.0	42.0	8.0	6.0	4.0
Total Dissolved Solids	mg/l	412	230	248	160	228	220	255
Total Organic Carbon	mg/l	6.0	5.0	6.0	28.0		26.0	
Turbidity	NTU	3.50	2.00					
Zinc, Total	mg/l	0.060	0.012	0.009	01004	0.010	0.007	0.008
Zinc, Dissolved	mg/l							

Table 28. Continued.

Parameter	Units	11-8-78	12-27-78	5-11-79	6-20-79	7-20-79	8-23-79
FIELD MEASUREMENTS							
Discharge	cfs	0.5	0.1	1.5	2.4	1.1	0.7
Dissolved Oxygen	mg/l	11.8	11.0	9.3	8.8	7.4	8.8
pH	units	7.4	7.22	8.4	8.4	7.52	8.3
Specific Conductance	umhos/cm @ 25° C	462		390	370	410	410
Temperature, Air	°C	2.0	-2	0	16	24	20
Temperature, Water	°C	0.3	2	0.3	9	12	9.0
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l			12.0	2.0	10.0	12.0
Alkalinity, as $CaCO_3$	mg/l			202	174	194	204
Ammonia, NH_3 as N	mg/l			<0.10	<0.01	<0.01	0.10
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
BOD, 5 Day	mg/l						
Barium, Total	mg/l	<0.001	0.002	0.050	0.060	0.025	0.031
Barium, Dissolved	mg/l			0.02	0.030	0.020	0.020
Bicarbonate	mg/l	283.04	302.56	246.4	212.28	236.68	248.83
Boron, Total	mg/l			0.095	0.050	0.095	0.070
Boron, Dissolved	mg/l			0.090	0.020	0.080	<0.001
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
Calcium	mg/l	72.8	73.6	65.60	62.40	61.60	78.40
Chloride	mg/l	2.0	10.0	6.0	<1.0	4.0	6.0
Chromium, Total	mg/l	<0.001	<0.001	0.005	0.003	0.003	0.006
Chromium, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
Copper, Total	mg/l	0.004	0.127	0.005	0.070	0.008	0.010
Copper, Dissolved	mg/l			0.003	0.001	0.005	0.003
Cyanide	mg/l	<0.01		0.002	<0.001	<0.001	<0.001
Fluoride	mg/l	0.13	0.16	0.11	0.19	0.06	0.21
Gross Alpha Radioactivity	pCi/l				3.1		<2.0
Gross Beta Radioactivity	pCi/l				12.5		3.5
Iron, Total	mg/l	0.091	0.100	0.627	0.300	0.140	0.160
Iron, Dissolved	mg/l			0.024	0.020	0.010	0.015
Lead, Total	mg/l		<0.001	0.001	0.002	0.003	<0.001
Lead, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml				<2.0		63.0
MPN Total Coliform	MPN/100 ml				70.0		790
Magnesium	mg/l	17.28	19.64	13.44	9.60	15.84	4.80
Manganese, Total	mg/l	0.014	0.012	0.007	0.007	0.007	0.004
Mercury, Total	mg/l		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.59	0.74	2.40	0.66	0.05	0.89
Oil and Grease	mg/l		1.6	<1.0	3.0	<1.0	<1.0
Phenol	mg/l		<0.001	0.042	<0.001	0.014	0.008
Phosphate, PO_4 as P	mg/l			0.06	0.018	0.020	0.080
Potassium	mg/l	1.387	1.272	1.151	0.833	1.004	1.118
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
Silver, Total	mg/l	<0.001	<0.001	0.004	0.004	0.002	<0.001
Silver, Dissolved	mg/l			<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	3.33	7.50	2.74	2.41	3.02	3.30
Sulfate	mg/l	23.0	22.0	9.0	24.0	23.0	13.0
Suspended Solids	mg/l	11.0	16.0	22.0	9.0	4.0	20.0
Total Dissolved Solids	mg/l	260	286	260	210	229	231
Total Organic Carbon	mg/l	8.0	19.0	10.0	3.0	8.50	2.80
Turbidity	NTU			4.0	5.0	3.50	3.0
Zinc, Total	mg/l	0.003	0.004	0.015	0.012	0.016	0.008
Zinc, Dissolved	mg/l			0.007	0.008	0.009	0.005

Table 28. Continued.

Parameter	Units	9-26-79	10-31-79	11-30-79
FIELD MEASURMENTS				
Discharge	cfs	0.4	0.3	0.6
Dissolved Oxygen	mg/l	7.2		9.2
pH	units	7.50	7.80	7.3
Specific Conductance	umhos/cm @ 25° C	405.0	505.0	475
Temperature, Air	°C	16.0	-1.0	-5
Temperature, Water	°C	7.5	0.25	0.3
LABORATORY MEASUREMENTS				
Acidity, as $CaCO_3$	mg/l	10.0	18.0	
Alkalinity, as $CaCO_3$	mg/l	196.0	216.0	
Ammonia, NH_3 as N	mg/l	<0.01		<0.01
Arsenic, Total	mg/l	<0.001	<0.001	
Arsenic, Dissolved	mg/l			
BOD, 5 Day	mg/l			
Barium, Total	mg/l	0.036	0.195	
Barium, Dissolved	mg/l			
Bicarbonate	mg/l	239.12	263.52	297.68
Boron, Total	mg/l	0.070	0.060	
Boron, Dissolved	mg/l			
Cadmium, Total	mg/l	<0.001	<0.001	
Cadmium, Dissolved	mg/l			
Calcium	mg/l	60.50	68.80	80.00
Chloride	mg/l	3.0	6.0	4.0
Chromium, Total	mg/l	<0.001	<0.001	
Chromium, Dissolved	mg/l			
Copper, Total	mg/l	0.025	0.010	
Copper, Dissolved	mg/l			
Cyanide	mg/l	<0.001		
Fluoride	mg/l	0.14	0.15	
Gross Alpha Radioactivity	pCi/l			
Gross Beta Radioactivity	pCi/l			
Iron, Total	mg/l	0.020		0.180
Iron, Dissolved	mg/l			
Lead, Total	mg/l	<0.001	<0.001	
Lead, Dissolved	mg/l			
MPN Fecal Coliform	MPN/100 ml			
MPN Total Coliform	MPN/100 ml			
Magnesium	mg/l	12.40	18.72	14.88
Manganese, Total	mg/l	0.020	0.089	0.012
Mercury, Total	mg/l	<0.0002	<0.0002	
Nitrate, NO_3 as N	mg/l	0.20	0.59	
Oil and Grease	mg/l		2.3	
Phenol	mg/l	<0.001	<0.001	0.062
Phosphate, PO_4 as P	mg/l	<0.001		0.080
Potassium	mg/l	0.42	3.00	1.291
Selenium, Total	mg/l	<0.001	<0.001	
Selenium, Dissolved	mg/l			
Silver, Total	mg/l	<0.001	<0.001	
Silver, Dissolved	mg/l			
Sodium	mg/l	5.00	8.10	3.32
Sulfate	mg/l	15.0	40.0	22.0
Suspended Solids	mg/l	1.0	24.0	24.0
Total Dissolved Solids	mg/l	212.0	288.0	277
Total Organic Carbon	mg/l	3.0	10.0	
Turbidity	NTU		3.10	
Zinc, Total	mg/l	0.05	0.005	
Zinc, Dissolved	mg/l			

Table 29. Results of chemical analyses of surface water quality samples collected at station VC-7.

Parameter	Units	1-26-76	4-28-76	8-2-76	10-27-76	11-29-76
FIELD MEASURMENTS						
Discharge	cfs	1.2	2.0	0.3	0.5	1.5
Dissolved Oxygen	mg/l	9.8	9.0	8.2	9.5	9.8
pH	units	8.5	8.2	8.2		7.6
Specific Conductance	umhos/cm @ 25° C	630.0	640.0	660.0		800.0
Temperature, Air	°C	-2.0	12.0	0.3	0.5	1.5
Temperature, Water	°C	2.0	10.0	11.0	4.0	1.0
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	194.0	230.0	242.0		304.0
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001		<0.001		
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.028		0.220		
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	236.6	280.6	295.2		370.9
Boron, Total	mg/l	0.005		<0.001		
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001		<0.001		
Cadmium, Dissolved	mg/l					
Calcium	mg/l	52.0	2-.8	72.0		18.4
Chloride	mg/l					
Chromium, Total	mg/l	<0.001		<0.001		
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	<0.001	0.006			
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.23	0.21	0.39		0.27
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.078		0.194		
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l	0.015		<0.001		
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	36.90	43.6	23.0		42.70
Manganese, Total	mg/l	0.016		0.033		
Mercury, Total	mg/l	<0.0002		<0.0002		
Nitrate, NO_3 as N	mg/l	0.075		0.05		
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.11		0.150		
Potassium	mg/l	2.24	1.67	1.70		2.38
Selenium, Total	mg/l		0.004		0.015	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001		<0.001		
Silver, Dissolved	mg/l					
Sodium	mg/l	2.70	22.0	6.00		52.0
Sulfate	mg/l	69.0	50.0	32.6		35.0
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l	410.0	418.0	430.0		520.0
Total Organic Carbon	mg/l	5.0	19.0	6.0		5.0
Turbidity	NTU	0.19	20.0	2.0		0.48
Zinc, Total	mg/l	0.067		0.008		
Zinc, Dissolved	mg/l					

Table 30. Results of chemical analyses of surface water quality samples collected at station VC-8.

Parameter	Units	1-26-76	4-28-76	6-14-76	8-2-76	9-30-76
FIELD MEASURMENTS						
Discharge	cfs	1.7	3.0	6.4	2.1	1.0
Dissolved Oxygen	mg/l	9.6		8.0	8.8	11.8
pH	units	8.5	8.2	8.2	8.2	
Specific Conductance	umhos/cm @ 25° C	730.0	660.0		770.0	
Temperature, Air	°C	-2.0	12.0	5.0	18.0	19.0
Temperature, Water	°C	2.5	8.0	5.0	11.0	12.0
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	218.0	226.0		268.0	
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	0.006			0.004	
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l		4.8	4.8	3.0	4.5
Barium, Total	mg/l					
Barium, Dissolved	mg/l	0.131			0.450	
Bicarbonate	mg/l	265.9	271.2		326.9	
Boron, Total	mg/l	0.012			0.018	
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l	<0.001			<0.001	
Calcium	mg/l	68.0	60.0		86.0	
Chloride	mg/l	2.0	6.0		10.0	
Chromium, Total	mg/l	<0.001			<0.001	
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l	0.015			0.015	
Cyanide	mg/l					
Fluoride	mg/l	0.25	0.27		0.40	
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.093			0.305	
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l	0.006			<0.001	
MPN Fecal Coliform	MPN/100 ml		230.0	430.0	2300.0	430.0
MPN Total Coliform	MPN/100 ml		4300.0	430.0	4300.0	2300.0
Magnesium	mg/l	26.40	28.3		27.0	
Manganese, Total	mg/l	0.068			0.102	
Mercury, Total	mg/l	<0.0001			<0.0002	
Nitrate, NO_3 as N	mg/l	0.180			0.11	
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.30			0.330	
Potassium	mg/l	1.67	2.57		2.54	
Selenium, Total	mg/l	0.005			0.019	
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l	<0.001			<0.001	
Sodium	mg/l	18.0	9.0		4.20	
Sulfate	mg/l	96.0	56.0		55.0	
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l	476.0	432.0		500.0	
Total Organic Carbon	mg/l					
Turbidity	NTU	0.34	0.52		2.2	
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l	0.046			0.017	

Bill Haynes

Sugar

PTS - Not over 200gp

~~last met~~ 3 or 4 days -

declined to flow

10-15 gpm -

Slowly declining since -

Pump good to 200gpm -

used only 1 pump.

Underground dust suppression.

Entrained in coal

Entrained moisture content of coal by standard ASTM procedure & equilibrium moisture determination at humidity 99% + temp 96°

Equilib moisture = 8% (if this coal is delivered to ASTM standard)

= Ship product 10% ship

Add 2% moisture —

Varies with rank of coal — Bayfield was 2½%

Add about 1% dust + 1% due surface moisture

Table 30. Continued.

Parameter	Units	10-27-76	11-20-76	12-28-76	3-17-77	6-16-77
FIELD MEASURMENTS						
Discharge	cfs	0.9	0.9	1.0	0	29.0
Dissolved Oxygen	mg/l	10.8	8.7	9.6	9.4	8.8
pH	units	7.7	7.7	7.7		
Specific Conductance	umhos/cm @ 25° C	1000.0		980.0		
Temperature, Air	°C	4.0	-4.0	2.0	0	29.0
Temperature, Water	°C	7.0	3.0	5.0	5.0	16.0
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	312.0		306.0		
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l					
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	2.4	3.4	3.5	2.6	1.5
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	380.06		373.3		
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l	90.4		89.6		
Chloride	mg/l	4.0		4.0		
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l					
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.39		0.35		
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l					
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	2300.00	2300.0	2300.0	23000.0	43000.0
MPN Total Coliform	MPN/100 ml	9300.0	93000.0	9300.0	930.0	7500.0
Magnesium	mg/l	32.16		35.04		
Manganese, Total	mg/l					
Mercury, Total	mg/l					
Nitrate, NO_3 as N	mg/l					
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l	2.88		2.90		
Selenium, Total	mg/l					
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l	33.0		28.6		
Sulfate	mg/l	117.0		110.0		
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l	655.0		640.0		
Total Organic Carbon	mg/l					
Turbidity	NTU	2.20		0.75		
Zinc, Total	mg/l					
Zinc, Dissolved	mg/l					

Table 31. Results of chemical analyses of surface water quality samples collected at station VC-9.

Parameter	Units	1-26-76	3-9-76	4-28-76	6-14-76	8-2-76
FIELD MEASUREMENTS						
Discharge	cfs	4.0	1.4	4.3	5.7	2.4
Dissolved Oxygen	mg/l	9.6	9.8	8.1	7.0	8.4
pH	units	7.9	8.3	8.1	8.3	8.3
Specific Conductance	umhos/cm @ 25° C	760	680	595	600	630
Temperature, Air	°C	-4.0	-5.0	12	12	18
Temperature, Water	°C	1.0	2.0	7	6	14
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	202	238	204	208	224
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	0.005	0.002	0.008		
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.151	0.131	0.157		
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	246.4	290.3	248.8	253.7	273.2
Boron, Total	mg/l	0.013	0.010	0.015		
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001	<0.001	<0.001		
Cadmium, Dissolved	mg/l					
Calcium	mg/l	55.2	63.2	50.4	57.6	65.0
Chloride	mg/l	5.0	<0.01	2.0	2.0	8.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001		<0.001
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	<0.001	<0.001	0.008		0.098
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.18	0.50	0.25	0.21	0.43
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.135	0.142	0.228		0.427
Iron, Dissolved	mg/l					
Lead, Total	mg/l	0.013	0.008	<0.001		<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	9.60	26.88	27.3	18.72	23.0
Manganese, Total	mg/l	0.052	0.040	0.049		0.063
Mercury, Total	mg/l	<0.0001	<0.0001	<0.0001		<0.0002
Nitrate, NO_3 as N	mg/l	0.260		0.165		0.15
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.13		0.180		0.140
Potassium	mg/l	1.64	1.24	2.20	1.04	2.02
Selenium, Total	mg/l	0.002	<0.001	<0.001		0.013
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001	<0.001	<0.001		<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l	66.0	12.1	8.0	17.00	5.00
Sulfate	mg/l	117	55.8	50.0	46.0	35.8
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l	495	448	387	395	410
Total Organic Carbon	mg/l	8.0	6.0	19.0	18.0	5.0
Turbidity	NTU	0.20	0.91	0.35	1.10	4.0
Zinc, Total	mg/l	0.017	0.015	0.013		0.016
Zinc, Dissolved	mg/l					

Table 31. Continued.

Parameter	Units	9-30-76	10-27-76	11-29-76	12-28-76
FIELD MEASUREMENTS					
Discharge	cfs	2.1	3.5	2.2	1.8
Dissolved Oxygen	mg/l	8.7	10.6	9.7	9.6
pH	units	7.5	7.6	7.2	7.8
Specific Conductance	umhos/cm @ 25° C	640	690	670	670
Temperature, Air	°C	20	-1	-1	6
Temperature, Water	°C	11	2	1.0	1
LABORATORY MEASUREMENTS					
Acidity, as $CaCO_3$	mg/l				
Alkalinity, as $CaCO_3$	mg/l	230	256	254	254
Ammonia, NH_3 as N	mg/l				
Arsenic, Total	mg/l		<0.001		<0.001
Arsenic, Dissolved	mg/l				
BOD, 5 Day	mg/l				
Barium, Total	mg/l		0.027		0.005
Barium, Dissolved	mg/l				
Bicarbonate	mg/l	280.6	312.3	309.9	309.9
Boron, Total	mg/l		<0.001		<0.001
Boron, Dissolved	mg/l				
Cadmium, Total	mg/l				
Cadmium, Dissolved	mg/l				
Calcium	mg/l	66.9	72.0	24.8	63.2
Chloride	mg/l	8.0	4.0	4.0	4.0
Chromium, Total	mg/l				
Chromium, Dissolved	mg/l				
Copper, Total	mg/l		0.010		0.017
Copper, Dissolved	mg/l				
Cyanide	mg/l				
Fluoride	mg/l	0.20	0.40	0.27	0.24
Gross Alpha Radioactivity	pCi/l				
Gross Beta Radioactivity	pCi/l				
Iron, Total	mg/l		0.333		0.410
Iron, Dissolved	mg/l				
Lead, Total	mg/l		<0.001		<0.001
Lead, Dissolved	mg/l				
MPN Fecal Coliform	MPN/100 ml				
MPN Total Coliform	MPN/100 ml				
Magnesium	mg/l	15.80	21.10	48.90	30.72
Manganese, Total	mg/l		0.063		0.012
Mercury, Total	mg/l		<0.0002		<0.0002
Nitrate, NO_3 as N	mg/l		0.12		0.06
Oil and Grease	mg/l				
Phenol	mg/l				
Phosphate, PO_4 as P	mg/l		0.110		0.170
Potassium	mg/l	1.91	1.97	2.54	2.02
Selenium, Total	mg/l		0.002		<0.001
Selenium, Dissolved	mg/l				
Silver, Total	mg/l				
Silver, Dissolved	mg/l				
Sodium	mg/l	19.0	13.0	14.0	2.80
Sulfate	mg/l	36.0	36.4	40.0	35.0
Suspended Solids	mg/l				
Total Dissolved Solids	mg/l	420	450	438	440
Total Organic Carbon	mg/l	15.0	3.0	4.0	16.0
Turbidity	NTU	2.80	4.30	0.45	2.20
Zinc, Total	mg/l		0.018		0.081
Zinc, Dissolved	mg/l				

Table 31. Continued.

Parameter	Units	3-17-77	6-16-77	5-10-78	6-14-78	7-12-78
FIELD MEASUREMENTS						
Discharge	cfs	3.5	1.7	5.0	11.3	3.4
Dissolved Oxygen	mg/l	9.5	7.8	8.2	8.6	8.0
pH	units	7.8	7.6	7.9	7.3	8.0
Specific Conductance	umhos/cm @ 25° C	640	410	380	290	418
Temperature, Air	°C	0	22	14	25	27
Temperature, Water	°C	2	15	10	11.5	17
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l					
Ammonia, NH_3 as N	mg/l	0.27	0.14		0.10	
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.009	0.063			
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	273.3	275.7	242	163.48	236.68
Boron, Total	mg/l	<0.001	0.025			
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	
Cadmium, Dissolved	mg/l					
Calcium	mg/l	64.0	58.4	67.2	51.2	28.0
Chloride	mg/l	4.0	6.0	8.0	10.0	4.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.015	0.005	0.007	0.004	
Copper, Dissolved	mg/l					
Cyanide	mg/l		<0.01			
Fluoride	mg/l	0.16	0.23	0.16	0.14	
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.092	0.346	0.040	1.887	0.122
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	<0.001	<0.001	0.003	<0.001
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	24.96	26.88	16.32	4.80	7.68
Manganese, Total	mg/l	0.053	0.050	0.012	0.141	0.043
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.05	0.03	0.72	0.36	
Oil and Grease	mg/l	<1.0	<1.0	9.6		1.2
Phenol	mg/l		<0.001		0.003	
Phosphate, PO_4 as P	mg/l	0.038	0.130			
Potassium	mg/l	1.90	1.98	1.676	1.887	1.488
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l	7.10	4.24	4.92	3.49	53.8
Sulfate	mg/l	50.0	28.0	33.0	10.0	26.0
Suspended Solids	mg/l	23.0	14.0	309	247	27.0
Total Dissolved Solids	mg/l					
Total Organic Carbon	mg/l	11.0	4.0	19.0	18.0	
Turbidity	NTU	3.50	2.20			
Zinc, Total	mg/l	0.033	0.014	0.016	0.015	0.013
Zinc, Dissolved	mg/l					

Table 31. Continued.

Parameter	Units	8-23-78	10-25-78	12-27-78	2-28-79	4-18-79
FIELD MEASUREMENTS						
Discharge	cfs	1.5	3.2	1.3	2.1	2.6
Dissolved Oxygen	mg/l	6.8	10.4	12.4	9.7	9.4
pH	units	8.0	7.1	7.91	8.0	7.72
Specific Conductance	umhos/cm @ 25° C	370	470	460	490	470
Temperature, Air	°C	21.5	4	-10	-1	9
Temperature, Water	°C	13.5	4	0.5	2	6
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l				252	232
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l					
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	251.3	280.6	297.7	307.44	283.04
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l		<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l					
Calcium	mg/l	56.8	57.6	73.6	68.8	72.0
Chloride	mg/l	4.0	5.0	6.0	<0.1	8.0
Chromium, Total	mg/l		<0.001	<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.003	0.003	0.003	0.004	0.002
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.15	0.15	0.18	0.17	0.16
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.216	0.241	0.354	0.380	5.840
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	0.002
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	22.1	28.3	24.0	22.56	21.12
Manganese, Total	mg/l	0.038	0.011	0.066	0.076	0.187
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l				0.10	0.40
Oil and Grease	mg/l	2.0	1.3	<1.0	<1.0	3.8
Phenol	mg/l	0.080	0.010	0.004	<0.001	0.004
Phosphate, PO_4 as P	mg/l					
Potassium	mg/l	1.988	1.520	1.995	2.229	1.952
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001			<0.001	<0.001
Silver, Dissolved	mg/l					
Sodium	mg/l	3.14	8.50	3.41	14.30	4.09
Sulfate	mg/l	28.0	40.0	43.0	38.0	40.0
Suspended Solids	mg/l	11.0	12.0	10.0	23.0	217
Total Dissolved Solids	mg/l	240	279	302	311	305
Total Organic Carbon	mg/l	14.0		7.0		
Turbidity	NTU					
Zinc, Total	mg/l	0.014	0.012	0.004	0.005	0.013
Zinc, Dissolved	mg/l					

Table 31. Continued.

Parameter	Units	5-11-79	6-20-79	7-20-79	8-23-79
FIELD MEASUREMENTS					
Discharge	cfs	5.2	7.1	4.9	2.4
Dissolved Oxygen	mg/l	8.3	8.45	8.6	9.1
pH	units	8.45	8.4	7.4	8.0
Specific Conductance	umhos/cm @ 25° C	490	450	480	490
Temperature, Air	°C	5	16	9	13
Temperature, Water	°C	9	4.5	8	5.5
LABORATORY MEASUREMENTS					
Acidity, as $CaCO_3$	mg/l	22.0	10.0	26.0	14.0
Alkalinity, as $CaCO_3$	mg/l	236	216	228	234
Ammonia, NH_3 as N	mg/l	0.20	< 0.01	< 0.01	< 0.05
Arsenic, Total	mg/l	0.002	< 0.001	< 0.001	< 0.001
Arsenic, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
BOD, 5 Day	mg/l		< 1.0		1.6
Barium, Total	mg/l	0.550	0.060	0.053	0.020
Barium, Dissolved	mg/l	0.51	0.045	0.050	0.016
Bicarbonate	mg/l	287.92	263.52	278.16	285.48
Boron, Total	mg/l	0.110	0.063	0.090	0.075
Boron, Dissolved	mg/l	0.105	0.060	0.030	0.060
Cadmium, Total	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	mg/l	70.40	60.80	63.20	96.00
Chloride	mg/l	6.0	2.0	6.0	2.0
Chromium, Total	mg/l	0.014	0.002	0.003	0.005
Chromium, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Copper, Total	mg/l	0.017	0.005	0.005	0.006
Copper, Dissolved	mg/l	0.017	0.002	0.003	< 0.001
Cyanide	mg/l	0.002	0.001	< 0.001	< 0.001
Fluoride	mg/l	0.13	0.14	0.15	0.23
Gross Alpha Radioactivity	pCi/l		3.5		< 2.0
Gross Beta Radioactivity	pCi/l		10.0		3.5
Iron, Total	mg/l	5.780	1.040	0.760	0.190
Iron, Dissolved	mg/l	0.022	0.036	0.010	0.040
Lead, Total	mg/l	0.006	0.005	0.002	< 0.001
Lead, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
MPN Fecal Coliform	MPN/100 ml		8.0		13.0
MPN Total Coliform	MPN/100 ml		79.0		330
Magnesium	mg/l	18.72	11.52	22.08	3.36
Manganese, Total	mg/l	0.043	0.053	0.036	0.004
Mercury, Total	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0001
Nitrate, NO_3 as N	mg/l	1.48	0.33	0.14	0.01
Oil and Grease	mg/l	< 1.0	1.8	< 1.0	< 1.0
Phenol	mg/l	0.022	< 0.001	0.010	< 0.001
Phosphate, PO_4 as P	mg/l	0.24	0.020	< 0.001	
Potassium	mg/l	5.33	1.151	1.786	4.100
Selenium, Total	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Selenium, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Silver, Total	mg/l	0.002	0.003	< 0.001	< 0.001
Silver, Dissolved	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Sodium	mg/l	7.01	12.50	3.36	4.10
Sulfate	mg/l	30.0	14.0	27.0	32.0
Suspended Solids	mg/l	258	24.0	26.0	10.0
Total Dissolved Solids	mg/l	300	240	268	290
Total Organic Carbon	mg/l	5.0	2.0	15.0	4.0
Turbidity	NTU	6.50	10.00	1.00	2.00
Zinc, Total	mg/l	0.061	0.016	0.008	0.013
Zinc, Dissolved	mg/l	0.502	0.012	0.007	0.006

Table 31. Continued.

Parameter	Units	9-26-79	10-31-79	11-30-79
FIELD MEASURMENTS				
Discharge	cfs	3.0	1.7	1.8
Dissolved Oxygen	mg/l	8.0	9.8	10.9
pH	units	7.65	7.70	6.9
Specific Conductance	umhos/cm @ 25° C	510.0	560.0	525
Temperature, Air	°C	6.0	0	-7
Temperature, Water	°C	6.0	2.0	0.3
LABORATORY MEASUREMENTS				
Acidity, as $CaCO_3$	mg/l	15.0	18.0	
Alkalinity, as $CaCO_3$	mg/l	230.0	210.0	
Ammonia, NH_3 as N	mg/l	<0.001		<0.01
Arsenic, Total	mg/l	<0.001	<0.001	
Arsenic, Dissolved	mg/l			
BOD, 5 Day	mg/l			
Barium, Total	mg/l	0.024	0.220	
Barium, Dissolved	mg/l			
Bicarbonate	mg/l	280.60	256.20	292.80
Boron, Total	mg/l	0.050	0.050	
Boron, Dissolved	mg/l			
Cadmium, Total	mg/l	<0.001	<0.001	
Cadmium, Dissolved	mg/l			
Calcium	mg/l	64.20	57.60	74.40
Chloride	mg/l	4.0	2.0	4.0
Chromium, Total	mg/l			
Chromium, Dissolved	mg/l	<0.001	<0.001	
Copper, Total	mg/l	0.019	0.015	
Copper, Dissolved	mg/l			
Cyanide	mg/l	0.001		
Fluoride	mg/l	0.17	0.17	
Gross Alpha Radioactivity	pCi/l			
Gross Beta Radioactivity	pCi/l			
Iron, Total	mg/l	0.340	0.296	0.670
Iron, Dissolved	mg/l			
Lead, Total	mg/l	<0.001	<0.001	
Lead, Dissolved	mg/l			
MPN Fecal Coliform	MPN/100 ml			
MPN Total Coliform	MPN/100 ml			
Magnesium	mg/l	6.20	24.48	22.56
Manganese, Total	mg/l	0.005	0.062	0.095
Mercury, Total	mg/l	<0.0002	<0.0002	
Nitrate, NO_3 as N	mg/l	0.02	<0.01	
Oil and Grease	mg/l		1.2	
Phenol	mg/l	<0.001	<0.001	0.008
Phosphate, PO_4 as P	mg/l	<0.001		0.070
Potassium	mg/l	1.560	2.850	2.112
Selenium, Total	mg/l	<0.001	<0.001	
Selenium, Dissolved	mg/l			
Silver, Total	mg/l	<0.001	<0.001	
Silver, Dissolved	mg/l			
Sodium	mg/l	34.6	7.20	3.41
Sulfate	mg/l	32.0	44.0	40.0
Suspended Solids	mg/l	5.0	24.0	23.5
Total Dissolved Solids	mg/l	286.0	270.0	298
Total Organic Carbon	mg/l	3.0		
Turbidity	NTU	2.6		
Zinc, Total	mg/l	0.048	0.036	
Zinc, Dissolved	mg/l			

Table 32. Results of chemical analyses of surface water quality samples collected at station VC-10.

Parameter	Units	6-14-78	7-12-78	8-23-78	10-25-78	11-8-78	12-27-78
FIELD MEASUREMENTS							
Discharge	cfs	8.5	1	0.2	0.3	0.3	0.2
Dissolved Oxygen	mg/l	9.0	7.4	8.1	11.3	11.4	10.9
pH	units	7.3	8.3	8.0	7.4	7.5	7.65
Specific Conductance	umhos/cm @ 25° C	210	346	305	420	425	395
Temperature, Air	°C	22	21	20	3	2	-2
Temperature, Water	°C	9	16	12	0.5	0.2	2
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l						
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l					0.030	0.026
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	251.28	219.6	241.5	261.08	283.04	290.36
Boron, Total	mg/l						
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l	<0.001			<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	41.6	26.4	52.8	59.2	66.4	18.24
Chloride	mg/l	8.0	<1.0	<0.10	<1.0	2.0	6.0
Chromium, Total	mg/l	0.001			<0.001	<0.001	<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	<0.001		0.002	0.003	0.002	0.003
Copper, Dissolved	mg/l						
Cyanide	mg/l					< 0.01	
Fluoride	mg/l	0.13		0.13	0.14	0.12	0.15
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l	0.519	0.045	0.052	0.086	0.119	0.079
Iron, Dissolved	mg/l						
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001		<0.001
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	7.68	5.76	18.2	20.10	19.2	18.24
Manganese, Total	mg/l	0.022	0.005	0.016	0.004	0.019	0.012
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002		
Nitrate, NO_3 as N	mg/l	0.18				0.12	0.26
Oil and Grease	mg/l	<1.0	<1.0	2.2	<1.0		1.0
Phenol	mg/l	0.002		0.004	0.011		<0.001
Phosphate, PO_4 as P	mg/l						
Potassium	mg/l	0.577	0.914	0.937	0.890	1.027	0.939
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	<0.001	<0.001	<0.001		<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l	2.00	47.0	2.05	3.2	2.24	4.30
Sulfate	mg/l	4.0	15.0	10.0	19.0	12.0	14.0
Suspended Solids	mg/l	89.0	6.0	4.0	4.0	9.0	18.0
Total Dissolved Solids	mg/l	139	205	200	231	245	256
Total Organic Carbon	mg/l	27.0		22.0		11.0	4.0
Turbidity	NTU						
Zinc, Total	mg/l	0.003	0.018	0.015	0.019	0.002	0.003
Zinc, Dissolved	mg/l						

Table 32. Continued.

Parameter	Units	5-11-79	6-20-79	7-18-79	8-23-79
FIELD MEASUREMENTS					
Discharge	cfs	0.9	3.8	1.2	0.6
Dissolved Oxygen	mg/l	9.3	8.7	8.0	8.3
pH	units	8.9	8.18	7.72	8.15
Specific Conductance	umhos/cm @ 25° C	410	340	420	410
Temperature, Air	°C	0	16	24	20
Temperature, Water	°C	2.5	5.5	9	8.0
LABORATORY MEASUREMENTS					
Acidity, as $CaCO_3$	mg/l	6.0	2.0	28.0	12.0
Alkalinity, as $CaCO_3$	mg/l	230	182	220	214
Ammonia, NH_3 as N	mg/l	<0.10	<0.01	<0.01	<0.05
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l	<0.001	<0.001	<0.001	<0.001
BOD, 5 Day	mg/l				
Barium, Total	mg/l	0.040	0.045	0.030	0.040
Barium, Dissolved	mg/l	0.02	0.040	0.020	0.012
Bicarbonate	mg/l	280.6	222.04	268.40	261.08
Boron, Total	mg/l	0.080	0.030	0.090	0,050
Boron, Dissolved	mg/l	0.070	0.015	0.075	0.002
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l	<0.001	<0.001	<0.001	<0.001
Calcium	mg/l	68.0	54.4	64.8	82.4
Chloride	mg/l	6.0	<1.0	2.0	<0.1
Chromium, Total	mg/l	0.003	0.002	0.002	0.004
Chromium, Dissolved	mg/l	<0.001	<0.001	<0.001	0.002
Copper, Total	mg/l	0.003	0.003	0.006	0.004
Copper, Dissolved	mg/l	0.002	<0.001	0.006	0.002
Cyanide	mg/l	<0.001	<0.001	<0.001	<0.001
Fluoride	mg/l	0.11	0.15	0.15	0.20
Gross Alpha Radioactivity	pCi/l		2.5		<2.0
Gross Beta Radioactivity	pCi/l		12.0		4.2
Iron, Total	mg/l	0.350	0.260	0.230	0.250
Iron, Dissolved	mg/l	0.023	0.020	0.050	0.046
Lead, Total	mg/l	0.002	0.002	<0.001	<0.001
Lead, Dissolved	mg/l	<0.001	<0.001	<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml		<2.0		8.0
MPN Total Coliform	MPN/100 ml		70.0		2300
Magnesium	mg/l	13.92	12.48	13.92	3.36
Manganese, Total	mg/l	0.007	0.009	0.022	0.002
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	1.32	0.05	0.10	0.06
Oil and Grease	mg/l	1.6	<1.0	<1.0	<1.0
Phenol	mg/l	0.076	<0.001	0.010	<0.001
Phosphate, PO_4 as P	mg/l	0.06	0.040	0.030	0.090
Potassium	mg/l	1.002	0.691	0.902	0.910
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l	<0.001	<0.001	<0.001	<0.001
Silver, Total	mg/l	<0.001	0.002	0.001	<0.001
Silver, Dissolved	mg/l	<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	6.30	1.71	2.02	2.26
Sulfate	mg/l	5.0	10.0	5.0	10.0
Suspended Solids	mg/l	11.0	7.0	7.0	16.0
Total Dissolved Solids	mg/l	270	196	225	232
Total Organic Carbon	mg/l	8.0	1.0	12.0	3.1
Turbidity	NTU	5.50	6.00	4.20	1.80
Zinc, Total	mg/l	0.011	0.016	0.017	0.010
Zinc, Dissolved	mg/l	0.004	0.004	0.009	0.003

Table 32. Continued.

Parameter	Units	9-26-79	10-31-79
FIELD MEASURMENTS			
Discharge	cfs	16.0	-1.0
Dissolved Oxygen	mg/l	6.8	9.4
pH	units	7.70	7.90
Specific Conductance	umhos/cm @ 25° C	420.0	38.0
Temperature, Air	°C	16.0	-1.0
Temperature, Water	°C	8.5	0
LABORATORY MEASUREMENTS			
Acidity, as $CaCO_3$	mg/l	19.0	24.0
Alkalinity, as $CaCO_3$	mg/l	218.0	222.0
Ammonia, NH_3 as N	mg/l	<0.01	
Arsenic, Total	mg/l	<0.001	<0.01
Arsenic, Dissolved	mg/l		
BOD, 5 Day	mg/l		
Barium, Total	mg/l	0.050	0.214
Barium, Dissolved	mg/l		
Bicarbonate	mg/l	265.96	270.84
Boron, Total	mg/l	0.050	0.030
Boron, Dissolved	mg/l		
Cadmium, Total	mg/l	<0.001	<0.001
Cadmium, Dissolved	mg/l		
Calcium	mg/l	63.85	68.80
Chloride	mg/l	2.0	4.0
Chromium, Total	mg/l	<0.001	<0.001
Chromium, Dissolved	mg/l		
Copper, Total	mg/l	0.015	0.016
Copper, Dissolved	mg/l		
Cyanide	mg/l	<0.001	
Fluoride	mg/l	0.19	0.15
Gross Alpha Radioactivity	pCi/l		
Gross Beta Radioactivity	pCi/l		
Iron, Total	mg/l	0.050	0.030
Iron, Dissolved	mg/l		
Lead, Total	mg/l	<0.001	<0.001
Lead, Dissolved	mg/l		
MPN Fecal Coliform	MPN/100 ml		
MPN Total Coliform	MPN/100 ml		
Magnesium	mg/l	14.10	16.80
Manganese, Total	mg/l	0.036	0.050
Mercury, Total	mg/l	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.03	<0.01
Oil and Grease	mg/l		1.0
Phenol	mg/l	<0.001	<0.001
Phosphate, PO_4 as P	mg/l	0.020	
Potassium	mg/l	0.530	2.800
Selenium, Total	mg/l	<0.001	<0.001
Selenium, Dissolved	mg/l		
Silver, Total	mg/l	<0.001	<0.001
Silver, Dissolved	mg/l		
Sodium	mg/l	4.90	8.50
Sulfate	mg/l	10.0	31.0
Suspended Solids	mg/l	4.0	24.0
Total Dissolved Solids	mg/l	227.0	275.0
Total Organic Carbon	mg/l	1.0	
Turbidity	NTU	4.20	4.40
Zinc, Total	mg/l	0.055	0.022
Zinc, Dissolved	mg/l		

Table 33. Results of chemical analyses of surface water quality samples collected at station CS-1.

Parameter	Units	11-8-78	5-11-79	6-20-79	7-18-79	8-23-79
FIELD MEASUREMENTS						
Discharge	cfs	0.4	0.6	3.6	0.4	0.3
Dissolved Oxygen	mg/l	11.5		8.7	8.4	8.7
pH	units	7.4	8.4	8.4	7.62	7.8
Specific Conductance	umhos/cm @ 25° C	440	410	325	420	420
Temperature, Air	°C		1	16	21	18
Temperature, Water	°C		1	7	7.5	5
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l		14.0	12.0	24.0	16.0
Alkalinity, as $CaCO_3$	mg/l		234	178	210	240
Ammonia, NH_3 as N	mg/l		<0.10	<0.01	<0.01	<0.05
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
BOD, 5 Day	mg/l			<1.0		2.3
Barium, Total	mg/l	0.012	0.010	0.090	0.030	0.020
Barium, Dissolved	mg/l		0.01	0.050	0.020	0.013
Bicarbonate	mg/l	287.92	285.48	217.16	256.20	292.80
Boron, Total	mg/l		0.110	0.059	0.077	0.015
Boron, Dissolved	mg/l		0.105	0.040	0.050	0.010
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Calcium	mg/l	62.4	72.0	55.2	61.6	83.2
Chloride	mg/l	1.0	6.0	2.0	4.0	0.1
Chromium, Total	mg/l	<0.001	0.003	0.003	0.003	0.005
Chromium, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Copper, Total	mg/l	0.005	0.003	0.003	0.008	0.005
Copper, Dissolved	mg/l		0.003	0.003	0.005	0.001
Cyanide	mg/l	<0.01	0.006	0.005	<0.001	<0.001
Fluoride	mg/l	0.13	0.12	0.12	0.16	0.20
Gross Alpha Radioactivity	pCi/l			2.9		<2.0
Gross Beta Radioactivity	pCi/l			9.5		4.0
Iron, Total	mg/l	0.045	0.081	0.330	0.100	0.149
Iron, Dissolved	mg/l		0.022	0.200	0.030	0.045
Lead, Total	mg/l		0.003	0.009	0.001	<0.001
Lead, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml			2.0		4.0
MPN Total Coliform	MPN/100 ml			49.0		700
Magnesium	mg/l	15.84	17.28	11.52	14.64	3.84
Manganese, Total	mg/l	0.003	0.002	0.005	0.005	0.002
Mercury, Total	mg/l		<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.15	1.28	0.18	0.08	0.09
Oil and Grease	mg/l		<1.0	<1.0	<1.0	<1.0
Phenol	mg/l		0.010	0.001	0.024	<0.001
Phosphate, PO_4 as P	mg/l		0.05	0.015	0.020	0.120
Potassium	mg/l	1.022	0.962	0.677	0.909	1.140
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Silver, Total	mg/l	0.001	0.005	0.003	0.001	<0.001
Silver, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	13.68	2.10	1.67	3.11	9.00
Sulfate	mg/l	14.0	10.0	6.0	10.0	6.0
Suspended Solids	mg/l	11.0	4.0	13.0	5.0	6.0
Total Dissolved Solids	mg/l	252	270	190	223	254
Total Organic Carbon	mg/l	4.0	8.00	3.00	10.50	9.00
Turbidity	NTU		0.85	10.00	3.90	2.00
Zinc, Total	mg/l	0.004	0.009	0.017	0.020	0.031
Zinc, Dissolved	mg/l		0.006	0.010	0.018	<0.001

Table 34. Results of chemical analyses of surface water quality samples collected at station CS-7.

Parameter	Units	11-8-78	5-11-79	6-20-79	7-20-79	8-23-79
FIELD MEASUREMENTS						
Discharge	cfs	0.5	1.3	5.5	2.0	0.5
Dissolved Oxygen	mg/l	11.6	9.2	7.4	7.3	7.4
pH	units	7.4	7.8	8.3	9.15	7.2
Specific Conductance	umhos/cm @ 25° C	370	360	290	345	370
Temperature, Air	°C	14	1	16	21	
Temperature, Water	°C	1.5	2	12	13	12.5
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l		16.0	2.0	16.0	4.0
Alkalinity, as $CaCO_3$	mg/l		186	170	190	184
Ammonia, NH_3 as N	mg/l		<0.10	<0.01	<0.01	<0.01
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
BOD, 5 Day	mg/l					
Barium, Total	mg/l	<0.01	0.010	0.040	0.020	0.025
Barium, Dissolved	mg/l		0.010	0.040	<0.001	0.002
Bicarbonate	mg/l	239.12	226.92	207.40	231.81	224.48
Boron, Total	mg/l		0.065	0.046	0.095	<0.005
Boron, Dissolved	mg/l		0.060	0.015	0.090	0.045
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Calcium	mg/l	59.2	65.60	58.40	60.00	73.60
Chloride	mg/l	<0.01	6.0	<1.0	2.0	<0.1
Chromium, Total	mg/l	<0.001	0.006	0.001	0.001	0.004
Chromium, Dissolved	mg/l		<0.001	<0.001	<0.001	0.002
Copper, Total	mg/l	0.001	0.013	0.005	0.004	0.006
Copper, Dissolved	mg/l		0.004	0.005	<0.001	<0.001
Cyanide	mg/l	<0.01	<0.001	<0.001	0.001	<0.001
Fluoride	mg/l	0.09	0.10	0.52	0.14	0.17
Gross Alpha Radioactivity	pCi/l			2.4		<2.0
Gross Beta Radioactivity	pCi/l			12.0		4.0
Iron, Total	mg/l	0.090	0.201	0.270	0.240	0.250
Iron, Dissolved	mg/l		0.012	0.020	0.030	0.058
Lead, Total	mg/l		0.003	0.001	0.015	<0.001
Lead, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml			<2.0		
MPN Total Coliform	MPN/100 ml			170		
Magnesium	mg/l	6.24	9.12	8.64	10.08	2.88
Manganese, Total	mg/l	0.021	0.010	0.007	-0.012	0.002
Mercury, Total	mg/l		<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.78	4.00	0.62	0.71	0.97
Oil and Grease	mg/l		<1.0	<1.0	<1.0	<1.0
Phenol	mg/l		<0.001	<0.001	0.034	0.008
Phosphate, PO_4 as P	mg/l		0.08	0.015	0.020	0.020
Potassium	mg/l	0.090	0.793	0.708	0.759	0.790
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Silver, Total	mg/l	<0.001	0.003	0.003	<0.001	<0.001
Silver, Dissolved	mg/l		<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	15.82	2.07	1.98	2.20	2.80
Sulfate	mg/l	9.0	8.0	14.0	6.0	15.0
Suspended Solids	mg/l	7.0	8.0	9.0	4.0	3.0
Total Dissolved Solids	mg/l	210	240	185	200	210
Total Organic Carbon	mg/l		13.00	1.50	7.00	7.50
Turbidity	NTU		0.85	5.00	5.00	5.00
Zinc, Total	mg/l	0.002	0.013	0.013	0.011	0.015
Zinc, Dissolved	mg/l		0.004	0.010	0.007	0.008

Table 34. Continued.

Parameter	Units	9-25-79
FIELD MEASURMENTS		
Discharge	cfs	0.4
Dissolved Oxygen	mg/l	
pH	units	7.25
Specific Conductance	umhos/cm @ 25° C	370.0
Temperature, Air	°C	15.0
Temperature, Water	°C	9.0
LABORATORY MEASUREMENTS		
Acidity, as $CaCO_3$	mg/l	4.0
Alkalinity, as $CaCO_3$	mg/l	182.0
Ammonia, NH_3 as N	mg/l	<0.01
Arsenic, Total	mg/l	<0.001
Arsenic, Dissolved	mg/l	
BOD, 5 Day	mg/l	
Barium, Total	mg/l	0.028
Barium, Dissolved	mg/l	
Bicarbonate	mg/l	222.00
Boron, Total	mg/l	0.140
Boron, Dissolved	mg/l	
Cadmium, Total	mg/l	<0.001
Cadmium, Dissolved	mg/l	
Calcium	mg/l	75.60
Chloride	mg/l	<0.1
Chromium, Total	mg/l	0.006
Chromium, Dissolved	mg/l	
Copper, Total	mg/l	0.010
Copper, Dissolved	mg/l	
Cyanide	mg/l	0.005
Fluoride	mg/l	0.13
Gross Alpha Radioactivity	pCi/l	
Gross Beta Radioactivity	pCi/l	
Iron, Total	mg/l	0.030
Iron, Dissolved	mg/l	
Lead, Total	mg/l	<0.001
Lead, Dissolved	mg/l	
MPN Fecal Coliform	MPN/100 ml	
MPN Total Coliform	MPN/100 ml	
Magnesium	mg/l	2.14
Manganese, Total	mg/l	0.003
Mercury, Total	mg/l	<0.0002
Nitrate, NO_3 as N	mg/l	0.73
Oil and Grease	mg/l	1.6
Phenol	mg/l	0.003
Phosphate, PO_4 as P	mg/l	0.020
Potassium	mg/l	0.710
Selenium, Total	mg/l	<0.001
Selenium, Dissolved	mg/l	
Silver, Total	mg/l	<0.001
Silver, Dissolved	mg/l	
Sodium	mg/l	2.54
Sulfate	mg/l	18.3
Suspended Solids	mg/l	1.0
Total Dissolved Solids	mg/l	210.0
Total Organic Carbon	mg/l	4.0
Turbidity	NTU	5.30
Zinc, Total	mg/l	0.019
Zinc, Dissolved	mg/l	

Table 35. Results of chemical analyses of surface water quality samples collected at station UPL-3.

Parameter	Units	7-31-74	9-5-74	10-3-74	11-3-74	12-2-74	1-3-75	2-4-75
FIELD MEASUREMENTS								
Discharge	cfs	16	15.3	10		7.65	7.80	7.0
Dissolved Oxygen	mg/l	7.60	7.75	7.15	7.20	8.2	8.45	7.90
pH	units	7.80	7.55	7.60	7.65	7.45	7.22	7.20
Specific Conductance	umhos/cm @ 25° C							
Temperature, Air	°C	21	17	8		12	-5	-4.4
Temperature, Water	°C	6	5	6		4	3	3.5
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	122.0	112.0	144.0	128.0	152.0	140.0	142.0
Ammonia, NH_3 as N	mg/l							
Arsenic, Total	mg/l			0.0000				0.000
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l			3.5				3.1
Barium, Total	mg/l			0.0000				0.0000
Barium, Dissolved	mg/l							
Bicarbonate	mg/l							
Boron, Total	mg/l							
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l			0.0015				0.0012
Cadmium, Dissolved	mg/l							
Calcium	mg/l							
Chloride	mg/l			2.0				1.6
Chromium, Total	mg/l			<0.010				<0.010
Chromium, Dissolved	mg/l							
Copper, Total	mg/l							
Copper, Dissolved	mg/l							
Cyanide	mg/l							
Fluoride	mg/l			0.14				0.13
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l			0.130				0.159
Iron, Dissolved	mg/l							
Lead, Total	mg/l			0.0000				0.0000
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml	<3	<3	<3	<3	<3	<3	<3
MPN Total Coliform	MPN/100 ml	<3	<3	4	<3	<3	<30	<3
Magnesium	mg/l							
Manganese, Total	mg/l			0.062				0.074
Mercury, Total	mg/l			0.0000				0.0000
Nitrate, NO_3 as N	mg/l	1.10	0.85	0.90	0.82	0.65	0.80	0.68
Oil and Grease	mg/l							
Phenol	mg/l			0.0000				0.0000
Phosphate, PO_4 as P	mg/l	0.40	0.27	0.25	0.21	0.155	0.19	0.15
Potassium	mg/l							
Selenium, Total	mg/l			0.0000				0.0000
Selenium, Dissolved	mg/l							
Silver, Total	mg/l			0.0000				0.0000
Silver, Dissolved	mg/l							
Sodium	mg/l							
Sulfate	mg/l			8.0				8.1
Suspended Solids	mg/l	5.0	11.0	13.0	17.8	3.0	5.0	3.0
Total Dissolved Solids	mg/l			168.0				165.0
Total Organic Carbon	mg/l							
Turbidity	NTU	24.0	8.20	3.90	41.0	3.3	4.0	5.40
Zinc, Total	mg/l			0.001				0.017
Zinc, Dissolved	mg/l							

Table 35. Continued

Parameter	Units	3-5-75	4-2-75	5-1-75	6-3-75	7-22-75	10-13-75	11-12-75
FIELD MEASUREMENTS								
Discharge	cfs	7.8	7.6	7				
Dissolved Oxygen	mg/l	7.50	7.2	7.1	7.4		7.2	9.24
pH	units	7.36	7.64	7.18	7.54		7.84	7.56
Specific Conductance	umhos/cm @ 25° C							
Temperature, Air	°C	-14.5	-12.0	2.0	15	23	12	6
Temperature, Water	°C	4.0	3.5	4.0	4.5	3.5	6.5	5
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	168.0	156.0	144	140		98.0	104.0
Ammonia, NH_3 as N	mg/l							
Arsenic, Total	mg/l					0.0000		
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l					4.0		
Barium, Total	mg/l					0.0000		
Barium, Dissolved	mg/l							
Bicarbonate	mg/l							
Boron, Total	mg/l							
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l					0.0023		
Cadmium, Dissolved	mg/l							
Calcium	mg/l							
Chloride	mg/l					4.0		
Chromium, Total	mg/l					<0.010		
Chromium, Dissolved	mg/l							
Copper, Total	mg/l							
Copper, Dissolved	mg/l							
Cyanide	mg/l							
Fluoride	mg/l					0.21		
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l					0.244		
Iron, Dissolved	mg/l							
Lead, Total	mg/l					0.0000		
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml	<3	<3	<3	<3	<3	<3	<3
MPN Total Coliform	MPN/100 ml	73	36	<3	15	<3	29	<3
Magnesium	mg/l							
Manganese, Total	mg/l					0.083		
Mercury, Total	mg/l					0.0000		
Nitrate, NO_3 as N	mg/l	0.40	0.21	0.30	0.26	0.64	0.39	0.33
Oil and Grease	mg/l							
Phenol	mg/l					0.0000		
Phosphate, PO_4 as P	mg/l	0.17	0.16	0.20	0.07		0.99	0.02
Potassium	mg/l							
Selenium, Total	mg/l					0.0000		
Selenium, Dissolved	mg/l							
Silver, Total	mg/l					0.0000		
Silver, Dissolved	mg/l							
Sodium	mg/l							
Sulfate	mg/l					8.7		
Suspended Solids	mg/l	4.5	4.0	5.20	105.0		<1.0	4.6
Total Dissolved Solids	mg/l					145.0		
Total Organic Carbon	mg/l							
Turbidity	NTU	1.60	1.70	2.5	6.2		4.00	1.10
Zinc, Total	mg/l							
Zinc, Dissolved	mg/l							

Table 35. Continued

Parameter	Units	2-5-76	3-3-76	3-31-76	6-15-76	8-3-76	10-1-76	10-28-76
FIELD MEASUREMENTS								
Discharge	cfs		8.4		20	34	37	21
Dissolved Oxygen	mg/l	9.30	9.30		6.8	5.8	6.7	8.5
pH	units	7.16	7.20	7.18	7.4	8.2	7.3	7.6
Specific Conductance	umhos/cm @ 25° C			320	300	320	410	350
Temperature, Air	°C	0	-4		20	13	16	7
Temperature, Water	°C	3	3		7	9	10	7
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	110.0	112.0	122	110	108	124	128
Ammonia, NH_3 as N	mg/l			0.35				
Arsenic, Total	mg/l			<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l							
Barium, Total	mg/l			0.017	0.016	0.018	0.007	0.002
Barium, Dissolved	mg/l							
Bicarbonate	mg/l			148.8	148.8	131.7	151.3	156.1
Boron, Total	mg/l			0.013	0.002	0.005	<0.001	<0.001
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l			<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l							
Calcium	mg/l			40.8	27.2	45.0	36.8	41.6
Chloride	mg/l			0.5	0.50	8.0	10.0	1.8
Chromium, Total	mg/l			<0.001	<0.001	<0.001		
Chromium, Dissolved	mg/l							
Copper, Total	mg/l			<0.001	<0.001	<0.001	<0.001	<0.001
Copper, Dissolved	mg/l							
Cyanide	mg/l							
Fluoride	mg/l			0.14	0.11	0.13	0.17	0.09
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l			0.290	0.210	0.167	0.173	0.210
Iron, Dissolved	mg/l							
Lead, Total	mg/l			<0.001	<0.001	<0.001	<0.001	<0.001
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml	<3	<3					
MPN Total Coliform	MPN/100 ml	<3	20					
Magnesium	mg/l			9.12	5.76	6.0	3.80	8.6
Manganese, Total	mg/l			0.008	0.010	<0.001	<0.001	0.003
Mercury, Total	mg/l			<0.001	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.240	0.290	0.200	0.200	0.40	0.21	0.20
Oil and Grease	mg/l							
Phenol	mg/l							
Phosphate, PO_4 as P	mg/l	0.055	0.057	0.330	0.160	0.130	0.145	0.140
Potassium	mg/l			1.23	0.72	0.89	1.00	0.81
Selenium, Total	mg/l			<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l							
Silver, Total	mg/l			<0.001	<0.001	<0.001		
Silver, Dissolved	mg/l							
Sodium	mg/l			2.48	18.00	1.10	19.0	6.00
Sulfate	mg/l			15.0	9.20	21.0	11.0	25.3
Suspended Solids	mg/l	36.6	4.0					
Total Dissolved Solids	mg/l			210	200	210	270	230
Total Organic Carbon	mg/l							
Turbidity	NTU	0.53	0.70	0.79	0.80	1.20	6.10	1.10
Zinc, Total	mg/l			0.029	0.025	0.019	0.070	0.013
Zinc, Dissolved	mg/l							

Table 35. Continued

Parameter	Units	11-30-76	12-29-76	2-1-77	3-3-77	4-7-77	5-10-77	6-2-77
FIELD MEASUREMENTS								
Discharge	cfs	18	18	12	5	13	5	18
Dissolved Oxygen	mg/l	8.2	8.0	7.9	8.2	7.7	8.4	8.5
pH	units	8.2	7.5	7.4		7.7	7.0	7.3
Specific Conductance	umhos/cm @ 25° C	400	320	350	330	330	370	360
Temperature, Air	°C	-2	6	-3	-6	9	12	24
Temperature, Water	°C	4	3	4	4	5	6	9
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	146	128	130	124	126	146	124
Ammonia, NH_3 as N	mg/l							
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l							
Barium, Total	mg/l	0.004	0.002	0.003	<0.001	<0.001	0.003	0.004
Barium, Dissolved	mg/l							
Bicarbonate	mg/l	178.1	156.2	158.6	153.3	153.7	178.1	151.3
Boron, Total	mg/l	<0.001	<0.001	<0.001	0.005	0.013	0.010	0.011
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l	<0.001	<0.001	<0.001				
Cadmium, Dissolved	mg/l							
Calcium	mg/l	51.2	40.8	45.6	42.4	44.0	34.1	41.6
Chloride	mg/l	4.0	1.5	1.0	<0.01	2.0	<0.01	<0.01
Chromium, Total	mg/l							
Chromium, Dissolved	mg/l							
Copper, Total	mg/l	0.008	0.013	0.007	0.006	0.009	0.004	0.005
Copper, Dissolved	mg/l							
Cyanide	mg/l							
Fluoride	mg/l	0.10	0.09	0.10	0.11	0.18	0.19	0.11
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l	0.117	0.115	0.113	0.090	0.083	0.136	0.124
Iron, Dissolved	mg/l							
Lead, Total	mg/l	<0.001	<0.001	<0.001				
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml							
MPN Total Coliform	MPN/100 ml							
Magnesium	mg/l	10.08	3.29	7.68	9.12	6.72	16.80	13.44
Manganese, Total	mg/l	0.002	0.003	0.004	0.019	0.015	0.085	0.082
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.26	0.22	0.20	0.15	0.10	0.02	0.04
Oil and Grease	mg/l							
Phenol	mg/l							
Phosphate, PO_4 as P	mg/l	0.130	0.180	0.110	0.110	0.092	0.085	0.060
Potassium	mg/l	0.96	0.75	1.00	0.90	1.30	1.04	1.13
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l							
Silver, Total	mg/l							
Silver, Dissolved	mg/l							
Sodium	mg/l	1.5	9.80	1.75	1.63	1.92	3.17	2.33
Sulfate	mg/l	18.0	10.0	20.0	21.0	16.0	20.00	36.9
Suspended Solids	mg/l							
Total Dissolved Solids	mg/l	260	210	230	219.3	220	250	240
Total Organic Carbon	mg/l							
Turbidity	NTU	0.49	0.90	0.50	0.30	14.0	1.50	1.5
Zinc, Total	mg/l	0.009	0.014	0.016	0.018	0.019	0.016	0.013
Zinc, Dissolved	mg/l							

Table 35. Continued

Parameter	Units	7-7-77	8-4-77	9-9-77	10-13-77	11-10-77
FIELD MEASUREMENTS						
Discharge	cfs	18	60	21		22
Dissolved Oxygen	mg/l	9.2	8.4	8.2		9.3
pH	units	8.1	8.2	8.3	7.07	7.6
Specific Conductance	umhos/cm @ 25° C	230	263	230	380	248
Temperature, Air	°C	26	23	25	19	8
Temperature, Water	°C	13	15	17	9	6
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	130	130	128	142	132
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001	<0.001			
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l					
Barium, Total	mg/l	0.003	0.014	0.033	0.021	0.006
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	158.6	158.6	156.2	173.4	161.1
Boron, Total	mg/l	0.009	0.055	0.10	0.15	0.33
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l					
Cadmium, Dissolved	mg/l					
Calcium	mg/l	45.60	46.4	46.4	45.6	47.2
Chloride	mg/l	1.8	<0.01	4.0	<0.01	<0.01
Chromium, Total	mg/l					
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	0.002	0.003	0.004	0.003	0.002
Copper, Dissolved	mg/l					
Cyanide	mg/l					
Fluoride	mg/l	0.13	0.12	0.09	0.08	0.88
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.190	0.092	0.163	0.114	0.044
Iron, Dissolved	mg/l					
Lead, Total	mg/l					
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml					
MPN Total Coliform	MPN/100 ml					
Magnesium	mg/l	6.24	5.76	6.24	12.00	9.12
Manganese, Total	mg/l	0.019	0.005	0.006	0.019	0.004
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.03	0.02	0.03	0.04	0.05
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.050	0.105	0.090	0.086	0.050
Potassium	mg/l	0.90	0.80	1.84	1.02	1.01
Selenium, Total	mg/l	<0.001	<0.001			
Selenium, Dissolved	mg/l					
Silver, Total	mg/l					
Silver, Dissolved	mg/l					
Sodium	mg/l	1.39	9.50	1.81	24.30	1.4
Sulfate	mg/l	9.0	30.0	12.5	74.0	23.0
Suspended Solids	mg/l					
Total Dissolved Solids	mg/l	140	172	150	243	160
Total Organic Carbon	mg/l					
Turbidity	NTU	1.50	0.80	0.36	0.82	15.0
Zinc, Total	mg/l	0.012	0.004	0.011	0.015	0.002
Zinc, Dissolved	mg/l					

Table 35. Continued

Parameter	Units	12-15-77	1-12-78	2-7-78	3-9-78	4-13-78	5-11-78	6-15-78
FIELD MEASUREMENTS								
Discharge	cfs	8.5	9	19	16	14	27	56
Dissolved Oxygen	mg/l	12.8	9.4	9.3	9.8	9.1	8.9	9.5
pH	units	7.6	7.7	8.1	8.0	7.7	7.3	7.5
Specific Conductance	umhos/cm @ 25° C	252	248	272	268	275	230	240
Temperature, Air	°C	3	2	0	5		11	
Temperature, Water	°C	5	3	2.5	11	3.5	4	7.5
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l	142	150	148	146	152	124	124
Ammonia, NH_3 as N	mg/l							
Arsenic, Total	mg/l							< 0.001
Arsenic, Dissolved	mg/l							
BOD, 5 Day	mg/l							
Barium, Total	mg/l	0.013	0.140	0.030	0.070	0.020	0.022	0.040
Barium, Dissolved	mg/l							
Bicarbonate	mg/l	173.2	183	180.5	178.1	185.44	151.28	151.28
Boron, Total	mg/l	0.04	0.12	0.04	0.06	0.05	0.05	0.09
Boron, Dissolved	mg/l							
Cadmium, Total	mg/l							
Cadmium, Dissolved	mg/l							
Calcium	mg/l	47.2	48.0	49.6	48.0	49.6	45.6	40.8
Chloride	mg/l	6.0	2.0	6.0	< 0.01	2.0	6.0	8.0
Chromium, Total	mg/l					< 0.001		< 0.001
Chromium, Dissolved	mg/l							
Copper, Total	mg/l	0.011	0.002	0.006	0.006	0.003	0.002	0.001
Copper, Dissolved	mg/l							
Cyanide	mg/l							
Fluoride	mg/l	0.16	0.10	0.11	0.07	0.11	0.09	0.09
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l	0.270	0.418	0.329	0.331	0.067	0.029	0.123
Iron, Dissolved	mg/l							
Lead, Total	mg/l					< 0.001		< 0.001
Lead, Dissolved	mg/l							
MPN Fecal Coliform	MPN/100 ml							
MPN Total Coliform	MPN/100 ml							
Magnesium	mg/l	9.12	9.60	9.60	9.60	10.08	5.28	7.2
Manganese, Total	mg/l	0.095	0.109	0.081	0.071	0.048	0.047	0.018
Mercury, Total	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Nitrate, NO_3 as N	mg/l	0.07	0.10	0.06	0.11	0.20	0.30	0.57
Oil and Grease	mg/l							
Phenol	mg/l							
Phosphate, PO_4 as P	mg/l	0.030	0.030	0.030	0.032	0.035	0.030	0.026
Potassium	mg/l	0.99	1.36	1.05	2.51	1.328	1.000	0.819
Selenium, Total	mg/l					< 0.001		< 0.001
Selenium, Dissolved	mg/l							
Silver, Total	mg/l							< 0.001
Silver, Dissolved	mg/l							
Sodium	mg/l	2.0	1.0	4.0	4.0	4.13	3.10	8.0
Sulfate	mg/l	12.0	8.0	18.0	22.0	22.0	12.0	16.0
Suspended Solids	mg/l							
Total Dissolved Solids	mg/l	162	166	176	172	180	150	160
Total Organic Carbon	mg/l							
Turbidity	NTU	0.85	1.6	2.20	2.4	2.8	2.20	1.60
Zinc, Total	mg/l	0.046	0.011	0.004	0.014	0.017	0.015	0.003
Zinc, Dissolved	mg/l							

Table 35. Continued

Parameter	Units	7-13-78	8-10-78	9-14-78	10-10-78	11-9-78	12-14-78
FIELD MEASUREMENTS							
Discharge	cfs	67	24	13	28	48	41
Dissolved Oxygen	mg/l	7.7	8.5	7.2	8.4	8.2	10.4
pH	units	7.6	7.3	7.6	7.05	7.65	
Specific Conductance	umhos/cm @ 25° C	230	235	220	230	250	285
Temperature, Air	°C	27	26	12	21	14	1
Temperature, Water	°C	12	7.5	10	11	6.5	4
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	122	118	118	120	142	136
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l		< 0.001	<0.001	<0.001	<0.001	
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	0.019	0.120	0.05	0.037	0.040	
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	148.8	143.9	143.9	146.4	173.24	165.92
Boron, Total	mg/l	0.04	0.04	0.090	0.550	0.090	
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l						
Cadmium, Dissolved	mg/l						
Calcium	mg/l	21.6	44.0	44.0	48.0	47.2	56.0
Chloride	mg/l	2.0	<0.1	4.0	<0.01	2.0	<0.01
Chromium, Total	mg/l			<0.001			
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	0.011	0.001	0.003	0.008	< 0.001	
Copper, Dissolved	mg/l						
Cyanide	mg/l						
Fluoride	mg/l	0.08	0.06	0.08	0.10	0.07	
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l	0.105	0.151	0.093	0.089	0.096	
Iron, Dissolved	mg/l						
Lead, Total	mg/l			<0.001			
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						2
MPN Total Coliform	MPN/100 ml						8
Magnesium	mg/l	3.36	7.2	6.7	5.28	8.16	7.20
Manganese, Total	mg/l	0.019	0.031	0.025	0.018	0.018	
Mercury, Total	mg/l	< 0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Nitrate, NO_3 as N	mg/l	0.39	0.39	0.26	0.10	0.21	
Oil and Grease	mg/l						
Phenol	mg/l						
Phosphate, PO_4 as P	mg/l	0.028	0.030	0.024	0.030	0.025	
Potassium	mg/l	0.889	0.902	0.172	0.914	0.958	0.978
Selenium, Total	mg/l		<0.001		<0.001		
Selenium, Dissolved	mg/l						
Silver, Total	mg/l			<0.001			
Silver, Dissolved	mg/l						
Sodium	mg/l	31.0	2.96	1.59	1.65	4.0	1.79
Sulfate	mg/l	14.0	25.0	15.0	23.0	17.0	38.0
Suspended Solids	mg/l						8.0
Total Dissolved Solids	mg/l	150	155	145	150	165	185
Total Organic Carbon	mg/l						
Turbidity	NTU	1.60	1.2	0.60	0.85	0.46	1.50
Zinc, Total	mg/l	0.011	0.002	0.012	0.003	0.004	
Zinc, Dissolved	mg/l						

Table 35. Continued

Parameter	Units	1-10-79	2-14-79	2-13-79	4-17-79	5-8-79
FIELD MEASUREMENTS						
Discharge	cfs	25.5	18.5	22	34	53.5
Dissolved Oxygen	mg/l	8.8	9.4	10.0	8.1	10.4
pH	units	7.9	7.7	8.45	7.51	8.1
Specific Conductance	umhos/cm @ 25° C	250	290	290	430	270
Temperature, Air	°C	2	0	0	9	1
Temperature, Water	°C	4.5	4	5	3	5.5
LABORATORY MEASUREMENTS						
Acidity, as $CaCO_3$	mg/l					
Alkalinity, as $CaCO_3$	mg/l	138				
Ammonia, NH_3 as N	mg/l					
Arsenic, Total	mg/l	<0.001				
Arsenic, Dissolved	mg/l					
BOD, 5 Day	mg/l	3.5				
Barium, Total	mg/l	0.030				
Barium, Dissolved	mg/l					
Bicarbonate	mg/l	168.36				
Boron, Total	mg/l					
Boron, Dissolved	mg/l					
Cadmium, Total	mg/l	<0.001				
Cadmium, Dissolved	mg/l					
Calcium	mg/l	46.4				
Chloride	mg/l	2.0				
Chromium, Total	mg/l	<0.001				
Chromium, Dissolved	mg/l					
Copper, Total	mg/l	<0.001				
Copper, Dissolved	mg/l					
Cyanide	mg/l	0.005				
Fluoride	mg/l	0.08				
Gross Alpha Radioactivity	pCi/l					
Gross Beta Radioactivity	pCi/l					
Iron, Total	mg/l	0.164				
Iron, Dissolved	mg/l					
Lead, Total	mg/l	<0.001				
Lead, Dissolved	mg/l					
MPN Fecal Coliform	MPN/100 ml	<2	<2	<2	<2.0	<2.0
MPN Total Coliform	MPN/100 ml	8	2	23	33.0	5.0
Magnesium	mg/l	10.56				
Manganese, Total	mg/l	0.035				
Mercury, Total	mg/l	<0.0002				
Nitrate, NO_3 as N	mg/l	0.28	0.17	0.18	0.06	0.10
Oil and Grease	mg/l					
Phenol	mg/l					
Phosphate, PO_4 as P	mg/l	0.040	0.055	0.020	0.04	0.050
Potassium	mg/l	0.861				
Selenium, Total	mg/l	<0.001				
Selenium, Dissolved	mg/l					
Silver, Total	mg/l	<0.001				
Silver, Dissolved	mg/l					
Sodium	mg/l	1.59				
Sulfate	mg/l	19.0				
Suspended Solids	mg/l	1.0	6.0	1.0	1.0	1.0
Total Dissolved Solids	mg/l	164	196	190	280	180
Total Organic Carbon	mg/l					
Turbidity	NTU	1.00	1.50	1.50	3.60	0.45
Zinc, Total	mg/l	0.027				
Zinc, Dissolved	mg/l					

Table 35. Continued

Parameter	Units	6-14-79	7-19-79	8-9-79	8-29-79
FIELD MEASUREMENTS					
Discharge	cfs	88	28	154	22.9
Dissolved Oxygen	mg/l	8.0	8.4	7.8	7.6
pH	units	7.8	7.1	7.0	
Specific Conductance	umhos/cm @ 25° C	260	260	220	270
Temperature, Air	°C	25	19	25	
Temperature, Water	°C	7	9.0	12	7.0
LABORATORY MEASUREMENTS					
Acidity, as $CaCO_3$	mg/l		12.0		
Alkalinity, as $CaCO_3$	mg/l		124		
Ammonia, NH_3 as N	mg/l		<0.01		
Arsenic, Total	mg/l		<0.001		
Arsenic, Dissolved	mg/l		<0.001		
BOD, 5 Day	mg/l				
Barium, Total	mg/l		0.045		
Barium, Dissolved	mg/l		0.040		
Bicarbonate	mg/l		151.28		
Boron, Total	mg/l		0.095		
Boron, Dissolved	mg/l		0.090		
Cadmium, Total	mg/l		<0.001		
Cadmium, Dissolved	mg/l		<0.001		
Calcium	mg/l		40.80		
Chloride	mg/l		<0.1		
Chromium, Total	mg/l		0.002		
Chromium, Dissolved	mg/l		<0.001		
Copper, Total	mg/l		0.009		
Copper, Dissolved	mg/l		0.003		
Cyanide	mg/l		<0.001		
Fluoride	mg/l		0.10		
Gross Alpha Radioactivity	pCi/l				
Gross Beta Radioactivity	pCi/l				
Iron, Total	mg/l		0.130		
Iron, Dissolved	mg/l		0.040		
Lead, Total	mg/l		0.017		
Lead, Dissolved	mg/l		<0.001		
MPN Fecal Coliform	MPN/100 ml	2.0	<2.0		
MPN Total Coliform	MPN/100 ml	17.0		11.0	
Magnesium	mg/l		7.68		
Manganese, Total	mg/l		0.012		
Mercury, Total	mg/l		<0.0002		
Nitrate, NO_3 as N	mg/l	0.78	0.56	0.33	
Oil and Grease	mg/l		<1.0		
Phenol	mg/l		0.194		
Phosphate, PO_4 as P	mg/l	0.060	<0.001	0.020	
Potassium	mg/l		1.072		
Selenium, Total	mg/l		<0.001		
Selenium, Dissolved	mg/l		<0.001		
Silver, Total	mg/l		<0.001		
Silver, Dissolved	mg/l		<0.001		
Sodium	mg/l		2.34		
Sulfate	mg/l		14.0		
Suspended Solids	mg/l	4.0	6.0	8.0	
Total Dissolved Solids	mg/l	170	150	120	
Total Organic Carbon	mg/l		7.00		
Turbidity	NTU	6.50	5.00	10.00	
Zinc, Total	mg/l		0.014		
Zinc, Dissolved	mg/l		0.006		

Table 35. Continued.

Parameter	Units	9-20-79
FIELD MEASURMENTS		
Discharge	cfs	30.0
Dissolved Oxygen	mg/l	8.6
pH	units	7.6
Specific Conductance	umhos/cm @ 25° C	280.0
Temperature, Air	°C	15.0
Temperature, Water	°C	7.7
LABORATORY MEASUREMENTS		
Acidity, as $CaCO_3$	mg/l	12.0
Alkalinity, as $CaCO_3$	mg/l	142.0
Ammonia, NH_3 as N	mg/l	<0.01
Arsenic, Total	mg/l	<0.001
Arsenic, Dissolved	mg/l	
BOD, 5 Day	mg/l	
Barium, Total	mg/l	0.080
Barium, Dissolved	mg/l	
Bicarbonate	mg/l	173.24
Boron, Total	mg/l	<0.001
Boron, Dissolved	mg/l	
Cadmium, Total	mg/l	<0.001
Cadmium, Dissolved	mg/l	
Calcium	mg/l	48.00
Chloride	mg/l	2.0
Chromium, Total	mg/l	0.006
Chromium, Dissolved	mg/l	
Copper, Total	mg/l	0.008
Copper, Dissolved	mg/l	
Cyanide	mg/l	<0.001
Fluoride	mg/l	0.14
Gross Alpha Radioactivity	pCi/l	
Gross Beta Radioactivity	pCi/l	
Iron, Total	mg/l	0.030
Iron, Dissolved	mg/l	
Lead, Total	mg/l	0.001
Lead, Dissolved	mg/l	
MPN Fecal Coliform	MPN/100 ml	<2.0
MPN Total Coliform	MPN/100 ml	<2.0
Magnesium	mg/l	8.90
Manganese, Total	mg/l	0.016
Mercury, Total	mg/l	<0.0002
Nitrate, NO_3 as N	mg/l	0.23
Oil and Grease	mg/l	1.6
Phenol	mg/l	0.110
Phosphate, PO_4 as P	mg/l	0.200
Potassium	mg/l	1.100
Selenium, Total	mg/l	<0.001
Selenium, Dissolved	mg/l	
Silver, Total	mg/l	<0.001
Silver, Dissolved	mg/l	
Sodium	mg/l	12.0
Sulfate	mg/l	35.9
Suspended Solids	mg/l	3.0
Total Dissolved Solids	mg/l	197.0
Total Organic Carbon	mg/l	10.0
Turbidity	NTU	5.00
Zinc, Total	mg/l	0.0006
Zinc, Dissolved	mg/l	

Table 36. Results of chemical analyses of surface water quality samples collected at station UPL-10.

Parameter	Units	6-15-78	7-13-78	8-10-78	9-14-78	10-10-78	11-8-78
FIELD MEASUREMENTS							
Discharge	cfs	34	12.8	3.0	3.5	3.4	1.6
Dissolved Oxygen	mg/l	9.6	8.7	9.0	10.1	8.6	10.8
pH	units	7.5	8.3	7.9	7.6		7.4
Specific Conductance	umhos/cm @ 25° C	193	230	260	285	275	320
Temperature, Air	°C		28	25	13	17	12
Temperature, Water	°C	13	16	17	6	10	4
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l						
Alkalinity, as $CaCO_3$	mg/l	84.0	134	156	168	160	
Ammonia, NH_3 as N	mg/l						
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l						
BOD, 5 Day	mg/l						
Barium, Total	mg/l	0.010	0.010	0.070	<0.01	<0.001	<0.01
Barium, Dissolved	mg/l						
Bicarbonate	mg/l	102.48	163.4	190.3	205	190.32	197.64
Boron, Total	mg/l	0.12	0.05	0.07	0.140	0.045	
Boron, Dissolved	mg/l						
Cadmium, Total	mg/l			<0.001			<0.001
Cadmium, Dissolved	mg/l						
Calcium	mg/l	31.2	42.4	53.6	56.0	53.6	49.6
Chloride	mg/l	14.0	<0.10	<0.10	2.0	0.01	<0.01
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001		<0.001
Chromium, Dissolved	mg/l						
Copper, Total	mg/l	0.005	<0.001	0.003	0.002	<0.001	0.004
Copper, Dissolved	mg/l						
Cyanide	mg/l						<0.01
Fluoride	mg/l	0.08	0.11	0.07	0.11	0.11	0.09
Gross Alpha Radioactivity	pCi/l						
Gross Beta Radioactivity	pCi/l						
Iron, Total	mg/l	0.197	0.245	0.409	0.344	0.310	0.290
Iron, Dissolved	mg/l						
Lead, Total	mg/l	0.004	<0.001	<0.001	<0.001	<0.001	
Lead, Dissolved	mg/l						
MPN Fecal Coliform	MPN/100 ml						
MPN Total Coliform	MPN/100 ml						
Magnesium	mg/l	1.44	5.20	7.2	9.6	8.16	12.0
Manganese, Total	mg/l	0.017	0.004	0.040	0.023	0.030	0.035
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.17	0.20	0.21	0.02	0.21	0.26
Oil and Grease	mg/l						<1.0
Phenol	mg/l						<0.001
Phosphate, PO_4 as P	mg/l	0.045	0.025	0.028	0.075	0.022	
Potassium	mg/l	0.540	0.577	0.691	0.140	0.766	0.290
Selenium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l						
Silver, Total	mg/l	0.004	<0.001	0.170	<0.001	<0.001	<0.001
Silver, Dissolved	mg/l						
Sodium	mg/l	14.0	7.0	3.35	1.00	3.0	2.08
Sulfate	mg/l	14.0	10.0	10.0	10.0	17.0	15.0
Suspended Solids	mg/l			6.0		1.0	15.0
Total Dissolved Solids	mg/l	125	149	170	185	180	165
Total Organic Carbon	mg/l						15.0
Turbidity	NTU	38.0	15.0	2.5	5.5	2.30	
Zinc, Total	mg/l	0.002		0.030	0.003	0.005	<0.001
Zinc, Dissolved	mg/l						

Table 36. Continued

Parameter	Units	12-27-78	1-25-79	3-8-79	4-3-79	5-11-79	6-20-79
FIELD MEASUREMENTS							
Discharge	cfs	4.5	6	6.6	2.6	16.4	25.5
Dissolved Oxygen	mg/l					8.5	8.3
pH	units	7.77	7.25	7.7	7.81	8.2	8.4
Specific Conductance	umhos/cm @ 25° C	285	285		350	194	200
Temperature, Air	°C	-3	-3	2	-1	1	16
Temperature, Water	°C	0	0	0	1	3	12
LABORATORY MEASUREMENTS							
Acidity, as $CaCO_3$	mg/l					6.0	6.0
Alkalinity, as $CaCO_3$	mg/l	154	164	154	152	96.0	112
Ammonia, NH_3 as N	mg/l	<0.10	<0.10		<0.01	<0.10	<0.01
Arsenic, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, Dissolved	mg/l					<0.001	<0.001
BOD, 5 Day	mg/l						
Barium, Total	mg/l	0.004	<0.010			0.020	0.060
Barium, Dissolved	mg/l					0.01	0.040
Bicarbonate	mg/l	187.88	200.08	187.88	185.44	117.12	136.64
Boron, Total	mg/l	0.105	0.180	0.030	0.150	0.085	0.060
Boron, Dissolved	mg/l					0.080	0.040
Cadmium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium, Dissolved	mg/l					<0.001	<0.001
Calcium	mg/l	54.4	56.8	51.20	52.0	35.2	39.20
Chloride	mg/l	6.0	2.0	8.0	2.0	6.0	<1.0
Chromium, Total	mg/l	<0.001	<0.001	<0.001	<0.001	0.005	<0.001
Chromium, Dissolved	mg/l					<0.001	<0.001
Copper, Total	mg/l	0.001	0.004	0.008	<0.001	0.016	0.007
Copper, Dissolved	mg/l					0.005	0.001
Cyanide	mg/l					<0.001	<0.001
Fluoride	mg/l	0.11	0.10			0.06	0.15
Gross Alpha Radioactivity	pCi/l						2.5
Gross Beta Radioactivity	pCi/l						10.0
Iron, Total	mg/l	0.164	0.432	0.144		0.619	0.470
Iron, Dissolved	mg/l					0.072	0.110
Lead, Total	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.004
Lead, Dissolved	mg/l					<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml			<2			<2.0
MPN Total Coliform	MPN/100 ml			170			79.0
Magnesium	mg/l	8.64	7.68	5.76	8.16	4.00	7.68
Manganese, Total	mg/l	0.017	0.027	0.022	0.014	0.022	0.020
Mercury, Total	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.42	0.36	0.74	0.49	1.70	0.15
Oil and Grease	mg/l		3.4			<1.0	<1.0
Phenol	mg/l		<0.001			<0.001	<0.001
Phosphate, PO_4 as P	mg/l	0.04	0.040	0.025	2.00	0.05	0.020
Potassium	mg/l	0.757	0.833	0.760	0.820	0.629	0.571
Selenium, Total	mg/l	<0.001	<0.001		<0.001	<0.001	<0.001
Selenium, Dissolved	mg/l					<0.001	<0.001
Silver, Total	mg/l	<0.001	<0.001		<0.001	0.001	0.004
Silver, Dissolved	mg/l					<0.001	<0.001
Sodium	mg/l	1.95	2.50	6.300	1.76	2.99	1.58
Sulfate	mg/l	10.0	16.0	6.0	14.0	7.0	19.0
Suspended Solids	mg/l	4.0	3.0		1.0	15.0	7.0
Total Dissolved Solids	mg/l	186	185	178	226	130	135
Total Organic Carbon	mg/l	2.0	14.0			6.0	9.00
Turbidity	NTU					4.0	5.00
Zinc, Total	mg/l	0.003	0.004	0.012	0.002	0.031	0.130
Zinc, Dissolved	mg/l					0.010	0.006

Table 36. Continued

Parameter	Units	7-20-79	8-23-79
FIELD MEASUREMENTS			
Discharge	cfs	5.5	1.4
Dissolved Oxygen	mg/l	6.7	7.3
pH	units	8.9	
Specific Conductance	umhos/cm @ 25° C	275	300
Temperature, Air	°C	21	
Temperature, Water	°C	15	15
LABORATORY MEASUREMENTS			
Acidity, as $CaCO_3$	mg/l	10.0	12.0
Alkalinity, as $CaCO_3$	mg/l	152	154
Ammonia, NH_3 as N	mg/l	<0.01	<0.05
Arsenic, Total	mg/l	<0.001	<0.001
Arsenic, Dissolved	mg/l	<0.001	<0.001
BOD, 5 Day	mg/l		
Barium, Total	mg/l	0.030	0.026
Barium, Dissolved	mg/l	0.020	0.013
Bicarbonate	mg/l	185.44	187.88
Boron, Total	mg/l	0.088	0.030
Boron, Dissolved	mg/l	0.080	<0.001
Cadmium, Total	mg/l	<0.001	<0.001
Cadmium, Dissolved	mg/l	<0.001	<0.001
Calcium	mg/l	53.60	58.40
Chloride	mg/l	2.0	<0.1
Chromium, Total	mg/l	0.002	0.009
Chromium, Dissolved	mg/l	<0.001	<0.001
Copper, Total	mg/l	0.007	0.005
Copper, Dissolved	mg/l	<0.001	0.003
Cyanide	mg/l	<0.001	<0.001
Fluoride	mg/l	0.10	0.15
Gross Alpha Radioactivity	pCi/l		<2.0
Gross Beta Radioactivity	pCi/l		8.0
Iron, Total	mg/l	0.620	0.310
Iron, Dissolved	mg/l	0.080	0.114
Lead, Total	mg/l	<0.001	<0.001
Lead, Dissolved	mg/l	<0.001	<0.001
MPN Fecal Coliform	MPN/100 ml		
MPN Total Coliform	MPN/100 ml		
Magnesium	mg/l	5.28	3.84
Manganese, Total	mg/l	0.024	0.004
Mercury, Total	mg/l	<0.0002	<0.0002
Nitrate, NO_3 as N	mg/l	0.24	0.30
Oil and Grease	mg/l	<1.0	<1.0
Phenol	mg/l	0.010	<0.001
Phosphate, PO_4 as P	mg/l	<0.001	0.030
Potassium	mg/l	0.694	0.950
Selenium, Total	mg/l	<0.001	<0.001
Selenium, Dissolved	mg/l	<0.001	<0.001
Silver, Total	mg/l	<0.001	<0.001
Silver, Dissolved	mg/l	<0.001	<0.001
Sodium	mg/l	1.93	1.80
Sulfate	mg/l	6.0	10.9
Suspended Solids	mg/l	7.0	1.0
Total Dissolved Solids	mg/l	164	225
Total Organic Carbon	mg/l	8.00	9.00
Turbidity	NTU	5.00	1.50
Zinc, Total	mg/l	0.009	0.012
Zinc, Dissolved	mg/l	0.006	0.004

Table 36. Continued.

Parameter	Units	9-25-79
FIELD MEASURMENTS		
Discharge	cfs	2.7
Dissolved Oxygen	mg/l	8.3
pH	units	7.7
Specific Conductance	umhos/cm @ 25° C	315.0
Temperature, Air	°C	15.0
Temperature, Water	°C	10.0
LABORATORY MEASUREMENTS		
Acidity, as $CaCO_3$	mg/l	13.0
Alkalinity, as $CaCO_3$	mg/l	158.0
Ammonia, NH_3 as N	mg/l	<0.01
Arsenic, Total	mg/l	<0.001
Arsenic, Dissolved	mg/l	
BOD, 5 Day	mg/l	
Barium, Total	mg/l	0.030
Barium, Dissolved	mg/l	
Bicarbonate	mg/l	192.70
Boron, Total	mg/l	0.030
Boron, Dissolved	mg/l	
Cadmium, Total	mg/l	<0.001
Cadmium, Dissolved	mg/l	
Calcium	mg/l	52.6
Chloride	mg/l	<0.1
Chromium, Total	mg/l	0.010
Chromium, Dissolved	mg/l	
Copper, Total	mg/l	0.008
Copper, Dissolved	mg/l	
Cyanide	mg/l	<0.001
Fluoride	mg/l	0.18
Gross Alpha Radioactivity	pCi/l	
Gross Beta Radioactivity	pCi/l	
Iron, Total	mg/l	0.060
Iron, Dissolved	mg/l	
Lead, Total	mg/l	<0.001
Lead, Dissolved	mg/l	
MPN Fecal Coliform	MPN/100 ml	
MPN Total Coliform	MPN/100 ml	
Magnesium	mg/l	3.90
Manganese, Total	mg/l	0.005
Mercury, Total	mg/l	<0.0002
Nitrate, NO_3 as N	mg/l	0.04
Oil and Grease	mg/l	22.0
Phenol	mg/l	0.005
Phosphate, PO_4 as P	mg/l	0.030
Potassium	mg/l	0.960
Selenium, Total	mg/l	8.00
Selenium, Dissolved	mg/l	
Silver, Total	mg/l	<0.001
Silver, Dissolved	mg/l	
Sodium	mg/l	8.00
Sulfate	mg/l	10.0
Suspended Solids	mg/l	1.0
Total Dissolved Solids	mg/l	182.0
Total Organic Carbon	mg/l	8.50
Turbidity	NTU	2.00
Zinc, Total	mg/l	0.015
Zinc, Dissolved	mg/l	

ATTACHMENT C

Results of Spring Inventory

Water Quality Analyses

Table 37. Results of chemical analyses of water samples collected from selected springs.

Spring	2-2	6-3	6-3	6-12	7-11	7-11	19-10	24-12	24-12	24-6	25-5	25-5	25-13
Date of Discharge	9-06-78	7-17-79	10-01-79	7-17-79	7-17-79	10-01-79	6-26-79	6-25-79	10-03-79	10-26-78	6-25-79	10-03-79	10-26-78
PARAMETER													
Discharge (cfs)	0.027	0.022	<0.001	0.001	0.013	<0.002	0.009	0.007		0.002	0.029		0.007
Temperature, Water	10	5.5	6	6	7	4	7	6		5	4		2.5
Acidity, as $CACO_3$			14.0			14.0							
Alkalinity, as $CaCO_3$			160.00			200.00							
Arsenic			<.001			<.001							
Barium, Total			.020			.010							
Bicarbonate	258.6	158.6	195.20	151.28	134.20	244.00	197.64	353.80	305.00	290.4	212.28	319.64	283.0
Boron, Total			<.001										
Cadmium, Total			<.001			<.001							
Calcium	71.2	46.4	64.00	46.40	35.20	84.00	48.00	78.40	96.80	79.2	58.40	105.60	71.2
Chloride	8.0	<0.1	2.0	<0.1	<0.1	6.0	2.0	<0.1	34.0	.01	<.1	28.0	.01
Chromium, Total			<.001			.002							
Conductivity	395	255	370	240	194	490	320	535	490	352	310	500	430
Copper, Total			.004			.001							
Fluoride			.07			.11							
Iron, Dissolved			.010			.010							
Iron, Total			.640			.660							
Lead			<.001			<.001							
Magnesium	8.1	5.76	14.00	2.88	5.28	19.20	12.48	22.08	5.76	9.60	6.72	2.88	13.44
Manganese, Total			.003			<.001							
Mercury, Total			<.0002			<.0002							
Nitrate, NO_3 as N			.06			26							
Oil and Grease													
Phenol													
Phosphate, PO^4 as P			.110			.060							
Potassium	3.56	0.478	.779	.377	.335	.693	1.275	1.283	1.240	1.257	.338	1.540	0.808
Selenium, Total						.001							
Silver, Total						<.001							
Sodium	2.1	1.43	1.88	1.68	2.30	2.13	3.05	2.33	19.50	2.95	1.50	16.00	1.95
Sulfate	4.0	10.0	55.0	8.0	6.0	80.0	13.0	10.0	14.2	9.0	<3.0	11.1	10.0
Total Dissolved Solids	213	143	238	145	119	316	220	320	323	190	200	330	232
Zinc, Total			.020			.006							
pH	7.35		7.40			7.40			6.90	7.5		7.40	7.5

Table 37. Continued.

Spring	25-13	25-13	25-15	25-17	25-18	25-20	29-1	29-2	30-13	30-15	31-13	31-13	31-13
Date of Discharge	6-26-79	10-01-79	6-26-79	9-06-79	10-26-78	6-25-79	7-25-79	7-17-79	6-26-79	7-18-79	6-17-79	7-17-79	10-04-79
PARAMETER													
Discharge (cfs)	0.056	0.001	0.07	0.004	0.009	0.011	0.004	0.004	0.002	0.004	0.017	0.004	
Temperature, Water	7	11	8	5	4	5	8	7	6	5	5	6	
Acidity, as $CACO_3$		16.0											
Alkalinity, as $CaCO_3$		126.00											
Arsenic		<.001											
Barium, Total		.010											
Bicarbonate	36.60	153.72	41.48	278.1	231.8	36.60	297.68	309.88	336.72	192.76	241.56	258.64	278.16
Boron, Total													
Cadmium, Total		<.001											
Calcium	1.60	56.00	1.60	70.4	62.4	12.80	84.0	74.40	84.80	46.40	62.40	68.00	94.40
Chloride	<.1	<.1	2.0	6.0	.01	<.1	24.0	<0.1	16.0	4.0	2.0	<0.1	20.0
Chromium, Total		<.001											
Conductivity	71	300	176	405	322	69	515	560	640	300	370	420	410
Copper, Total		.003											
Fluoride		.11											
Iron, Dissolved		.010											
Iron, Total		.260											
Lead		<.001											
Magnesium	.48	9.60	.48	11.0	9.60	.96	4.40	25.44	32.64	12.00	14.40	14.40	4.80
Manganese, Total		.001											
Mercury, Total		<.0002											
Nitrate, NO_3 as N		.24											
Oil and Grease													
Phenol													
Phosphate, PO^4 as P		.060											
Potassium	.555	.633	.236	2.95	0.664	.634	1.987	1.643	1.527	0.703	0.999	0.979	1.146
Selenium, Total		.001											
Silver, Total		<.001											
Sodium	10.20	1.15	17.10	4.10	2.10	1.19	7.24	4.13	9.36	4.40	1.41	1.63	4.00
Sulfate	<3.0	53.0	7.6	4.0	14.0	8.5	13.0	49.0	63.0	13.0	17.0	6.0	12.2
Total Dissolved Solids	32.0	199	52.0	219	174	43.0	310	310	380	179	227	233	272
Zinc, Total		.005											
pH		7.40											

Table 37. Continued.

Spring	32-2	35-10	35-13	35-13	36-1	36-3	36-3	36-7	36-7	36-17	36-19	36-19	36-21	36-23
Date of Discharge	7-17-79	6-25-79	6-26-79	10-01-79	6-27-79	6-27-79	10-01-79	6-27-79	10-01-79	10-04-79	7-16-79	10-01-79	7-16-79	7-20-79
PARAMETER														
Discharge	<0.001	0.011	0.013	<0.002	0.009	0.083	<0.001	0.018	0.001			0.001	0.011	0.004
Temperature, Water	9	8	6	7	4	3	3	6	5			6	7	9
Acidity, as $CACO_3$				20.0			18.0		12.0			14.0		
Alkalinity, as $CaCO_3$				240.00			172.00		150.00			134.00		
Arsenic				<.001			<.001		<.001			<.001		
Barium, Total				.030			.030		.020			.010		
Bicarbonate	466.04	207.40	253.76	292.80		80.52	209.84	102.48	183.00	268.40	168.36	163.48	251.32	234.24
Boron, Total							.060							
Cadmium, Total				<.001			<.001		<.001			<.001		
Calcium	75.20	54.40	72.00	84.00		24.80	68.00	34.40	48.00	81.60	40.80	44.00	61.60	64.8
Chloride	28.0	<0.1	2.0	2.0		<.1	2.0	2.0	4.0	18.0	2.0	2.0	2.0	2.0
Chromium, Total				.001			<.001		<.001			<.001		
Conductivity	800	300	360	380	390	128	360	182	250	430	230	300	385	315
Copper, Total				.001			.005		.003			.002		
Fluoride				.13			.08		.11			.09		
Iron, Dissolved				.010			.010		.010			.010		
Iron, Total				.270			.230		1.200			.150		
Lead				<.001			<.001		.003			<.001		
Magnesium	21.12	10.08	4.80	12.00		2.40	12.00	1.92	7.20	5.76	3/36	19.20	10.08	9.12
Manganese, Total				<.001			.003		.005			<.001		
Mercury, Total				<.0002			<.0002		<.0002			<.0002		
Nitrate, NO_3 as N							.77							
Oil and Grease							<1.0							
Phenol							.004							
Phosphate, PO^4 as P				.060			.080		.110			.060		
Potassium	2.013	0.444	.383	.583		.537	.726	.664	.914	1.110	0.349	.521	0.479	0.491
Selenium, Total				<.001			<.001		.001			<.001		
Silver, Total				<.001			<.001		<.001			<.001		
Sodium	75.30	1.62	4.20	2.09		1.32	2.17	1.64	3.00	10.00	13.90	1.33	8.0	1.86
Sulfate	21.0	9.6	4.0	20.0		8.0	45.0	10.3	6.0	10.5	6.0	50.0	6.0	6.0
Total Dissolved Solids	528	184	215	250		81.0	233	150	165	280	155	198	219	206
Zinc, Total				.004			.008		.003			.008		
pH				7.30			7.10		7.20	7.80		7.20		

ATTACHMENT D

Results of Seepage Study

Water Quality Analyses

Table 38. Results of chemical analyses of water samples collected during seepage study.

	SAMPLE SS13-1 9:55	SAMPLE SS13-2 10:15	SAMPLE SS13-3 10:50	SAMPLE SS14-1 9:07	SAMPLE SS17-1 16:10	SAMPLE SS17-2 15:50	SAMPLE SS17-3 16:20	SAMPLE SS19-1 15:00
Acidity as CaCO3 mg/l	12.0	6.0	8.0	15.0	4.0	10.0	12.0	10.0
Alkalinity as CaCO3 mg/l	218.00	208.00	218.00	242.00	208.00	264.00	216.00	250.00
Arsenic as As mg/l	<.001	<.001	<.001	<.001	.001	<.001	<.001	<.001
Barium as Ba mg/l	.020	.020	.030	.020	.050	.060	.040	.050
Bicarbonate as HCO3 mg/l	265.96	253.96	265.96	295.24	253.76	322.08	263.52	305.00
Boron as B mg/l	.090	.075	.070	.100	.080	.060	.060	.080
Cadmium as Cd mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	88.80	72.80	79.20	88.00	77.60	98.40	80.80	84.80
Chloride as Cl mg/l	6.0	2.0	2.0	2.0	2.0	4.0	4.0	2.0
Chromium as Cr mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Copper as Cu mg/l	.005	.003	.006	.006	.005	.005	.003	.005
Fluoride as F mg/l	.19	.16	.14	.17	.15	.16	.15	.15
Iron as Fe (Total) mg/l	.350	.180	.150	.130	.480	.790	.420	.500
Lead as Pb mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Magnesium as Mg mg/l	8.64	9.12	8.16	6.24	7.20	13.92	4.80	7.20
Manganese as Mn mg/l	.031	.018	.011	.004	.030	.063	.034	.037
Mercury as Hg mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Potassium as K mg/l	1.245	1.038	.873	1.001	1.906	2.473	1.973	1.799
Selenium as Se mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Silver as Ag mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Sodium as Na mg/l	5.32	2.85	2.41	2.77	3.21	3.69	11.90	13.50
Sulfate as SO4 mg/l	40.0	14.0	13.0	10.0	26.0	49.0	30.0	21.0
Suspended Solids mg/l	39.0	10.0	9.0	5.0	16.0	8.0	15.0	21.0
Total Dissolved Solids mg/l	282	229	242	262	238	345	321	281
Zinc as Zn mg/l	.005	.004	.003	.003	.005	.003	.004	.004

Table 38. Continued

	SAMPLE SS19-2 14:05	SAMPLE SS24-1 12:10	SAMPLE SS24-2 12:40	SAMPLE SS24-3 8/8/79	SAMPLE SS24-4 8/8/79	SAMPLE SS24-5 8/8/79	SAMPLE SS24-6 8/8/79	SAMPLE SS24-7 8/8/79	SAMPLE SS25-1 8/8/79
Acidity as CaCO3 mg/l	2.0	12.0	10.0	10.0	10.0	10.0	6.0	8.0	6.0
Alkalinity as CaCO3 mg/l	174.00	206.00	234.00	210.00	204.00	246.00	192.00	180.00	210.00
Arsenic as As mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Barium as Ba mg/l	.030	.020	.030	.030	.040	.040	.030	.020	.020
Bicarbonate as HCO3 mg/l	212.28	251.32	285.48	256.20	248.88	300.12	234.24	219.60	256.20
Boron as B mg/l	.070	.090	.070	.055	.060	.070	.060	.070	.050
Cadmium as Cd mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	64.80	68.00	73.60	73.60	69.60	84.80	68.00	66.40	74.40
Chloride as Cl mg/l	8.0	2.0	<.1	6.0	4.0	2.0	2.0	2.0	4.0
Chromium as Cr mg/l	.001	<.001	<.001	<.001	<.001	.001	<.001	<.001	<.001
Conductivity umhos/cm				350	340	390	320	300	350
Copper as Cu mg/l	.006	.004	.003	.003	.002	.001	.003	.003	.003
Fluoride as F mg/l	.16	.15	.13	.14	.14	.14	.14	.14	.14
Iron as Fe (Total) mg/l	.130	.140	.510	.110	.070	.530	.130	.090	.110
Lead as Pb mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Magnesium as Mg mg/l	4.80	9.12	10.56	5.76	8.16	4.80	3.84	4.32	5.28
Manganese as Mn mg/l	.005	.005	.039	.006	.005	.045	.003	.007	.003
Mercury as Hg mg/l	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
Potassium as K mg/l	1.848	1.070	.986	.940	.975	1.059	1.088	1.198	.840
Selenium as Se mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Silver as Ag mg/l	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Sodium as Na mg/l	16.00	5.20	5.90	8.50	2.08	8.00	8.00	2.21	5.00
Sulfate as SO4 mg/l	34.0	13.0	10.0	10.0	7.0	3.0	10.0	6.0	6.0
Suspended Solids mg/l	4.0	7.0	8.0	6.0	5.0	10.0	1.0	2.0	5.0
Total Dissolved Solids mg/l	238	228	249	230	220	258	210	195	222
Zinc as Zn mg/l	.006	.004	.003	.017	.004	.003	.003	.037	.038

ATTACHMENT E

Results of Water Quality Analyses for Samples from Mines and Wells

Table 39. Results of chemical analyses of mine and well water.

Well or Mine		W13-1	W17-1	W19-1	O'Connor Mine	Beline No. 1 Mine (No. 3 South 220)	Beline No. 1 Mine (South Main Entry #1)	Alpine School Well
Date of Sample		11-06-79	11-21-79	12-05-79	3-27-79	3-27-79	10-11-79	3-27-79
Parameter	Units							
FIELD MEASUREMENTS								
Discharge	cfs		90	13				
Dissolved Oxygen	mg/l							
pH	units	7.35	7.4	7.60	7.47	7.49	7.30	7.39
Specific Conductance	umhos/cm @ 25° C	740	540	500	510	370	580	285
Temperature, Air	°C							
Temperature, Water	°C							
LABORATORY MEASUREMENTS								
Acidity, as $CaCO_3$	mg/l							
Alkalinity, as $CaCO_3$	mg/l		270.00	254				
Ammonia, NH_3 as N	mg/l	<.01	<.01	<.01				.004
Arsenic, Total	mg/l							
Arsenic, Dissolved	mg/l		<.001					
Barium, Total	mg/l							.06
Barium, Dissolved	mg/l		.060					
Beryllium, Dissolved	mg/l							
Bicarbonate	mg/l	278.60	329.40	309.88	241.56	312.32	258.64	197.64
Boron, Total	mg/l							
Boron, Dissolved	mg/l							<.001
Cadmium, Total	mg/l							
Cadmium, Dissolved	mg/l	<.001	<.001	<.001				
Calcium	mg/l	43.20	112.80	75.20	82.40	69.60	92.00	32.00
Chloride	mg/l	<1.0	3.0	4.0	2.0	<1.0	2.0	2.0
Chromium, Total	mg/l							<.001
Chromium, Dissolved	mg/l	.005	.001	<.001				
Cobalt, Dissolved	mg/l							
Copper, Total	mg/l							
Copper, Dissolved	mg/l	1.306	.004	.005				
Cyanide	mg/l	<.001	<.001	<.001				
Fluoride	mg/l		.13		.17	.11		.84
Germanium, Dissolved	mg/l							
Gross Alpha Radioactivity	pCi/l							
Gross Beta Radioactivity	pCi/l							
Iron, Total	mg/l	.225	2.450	.465				.530
Iron, Dissolved	mg/l	.015	1.850	.010				
Lead, Total	mg/l							<.001
Lead, Dissolved	mg/l	.011	<.001	<.001				
Magnesium	mg/l	30.72	11.52	21.12	25.92	21.12	12.00	9.60
Manganese, Total	mg/l	.091	.114	.011				
Manganese, Dissolved	mg/l							
Mercury, Total	mg/l	<.00005	<.00005	<.0002				<.0002
Mercury, Dissolved	mg/l							
Nitrate, NO_3 as N	mg/l	<.01	<.01	.24				<.02
Oil and Grease	mg/l							
Phenol	mg/l	<.001	<.001	<.001				
Phosphate, PO_4 as P Ortho	mg/l							<.01
Potassium	mg/l	12.500	2.117	1.419	2.213	.836	3.65	1.289
Selenium, Total	mg/l							<.001
Selenium, Dissolved	mg/l	<.001	<.001	<.001				
Silica, as SiO_2	mg/l							
Silver, Total	mg/l							<.001
Silver, Dissolved	mg/l	<.001	<.001	<.001				
Sodium	mg/l	76.50	3.89	2.51	1.84	1.75	25.65	21.32
Sulfate	mg/l	185	63.0	26.0	118	6.0	115	6.0
Suspended Solids	mg/l		15.0	19.0				
Total Dissolved Solids	mg/l	480	384	300	335	250	380	182
Total Organic Carbon	mg/l							
Turbidity	FTU	50.00	21.00	2.00				
Zinc, Total	mg/l							
Zinc, Dissolved	mg/l	.007	.006	.104				
BOD, 5 day	mg/l		<1.0	<1.0				
COD	mg/l	8.5	4.2	5.6				
MPN Fecal Coliform	MPN/100 ml	<2.0	<2.2	<2.2				<2.2
MPN Total Coliform	MPN/100 ml	490	<2.2	<2.2				<2.2
Phosphate, PO_4 as P Total	mg/l	.420	.400	.120				<.01

Document Information Form

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File Name: White Oak-

To: _____

From:

Person _____

Company _____

Date Received: _____

Explanation: Map- Plate 1. Surface Geology in the Valley Camp Lease area

cc:

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File Name: White Oak

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From:

Person _____

Company _____

Date Received: _____

Explanation: Plate 2. Seasonal Variations in Major chemical Constituents in the lease area

cc:

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Mine Number: C/007/0001

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From:

Person _____

Company _____

Date Received: _____

Explanation: Map - Plate 3. Location of proposed ground and surface water monitoring stations

cc:

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File Name: White Oak

To: _____

From:

Person _____

Company _____

Date Received: _____

Explanation: Map - Plate 4. Identified seeps and springs with available water quality data and geologic information

cc:

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File Name: White Oak

To: _____

From:

Person _____

Company _____

Date Received: _____

Explanation: Map: Plate 5. Seepage study situtations with water Quality and geology Data.

cc:

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File Name: White Oak

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From:

Person _____

Company _____

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Explanation: Map- Plate 6, Ground Water Contours

cc:

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File Name: White Oak

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From:

Person _____

Company _____

Date Received: _____

Explanation: Map - Plate 7. Surface water rights on and adjacent to the Valley Camp lease area

cc:

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File Name: White Oak

To: _____

From:

Person _____

Company _____

Date Received: _____

Explanation: Map - Plate 8. Ground Water rights on and adjacent to the Valley Camp lease area

cc: