PACIFICORP – ENERGY WEST MINING COMPANY
HYDROLOGIC MONITORING PROGRAM
ANNUAL REPORT FOR 2010

MARCH 2011

Submitted to:
United States Department of the Interior Bureau of Land Management
U.S.D.A. - Forest Service: Manti-LaSal National Forest
Utah Division of Oil, Gas and Mining

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I. INTRODUCTION

The 2010 Hydrologic Monitoring Report is hereby submitted in accordance with the U.S. Department of Interior, Office of Surface Mining requirements and the Utah State Division of Oil, Gas and Mining guidelines for hydrologic monitoring in areas of and adjacent to coal mining operations.

This is the thirty-third annual hydrologic report submitted by PacifiCorp since the report entitled "Monitoring of the Water Resources in the Mining Areas of East/Trail Mountain, Emery County, Utah" was submitted to the U. S. Geological Survey and the Utah Division of Oil, Gas and Mining in December 1977. It addresses flow observations and water quality characteristics of the water resources adjacent to PacifiCorp's mining areas in Emery County. (See Figure 1, A & B)

Information was compiled the past year from in-house as well as from state and federal agencies and private sources as follow:

U. S. Geological Survey
U. S. Forest Service
U. S. Department of Commerce, National Weather Service
Utah Division of Oil, Gas and Mining
Utah Division of Environmental Health
Huntington-Cleveland Irrigation Company
Emery Water Conservancy District
Cottonwood Creek Consolidated Irrigation Company

Information from outside agencies will continue to be utilized each year for as long as their data gathering programs continue. As a result, cooperative effort is realized and duplication of effort and expense is substantially reduced.

II. CLIMATIC OBSERVATIONS

In general, runoff and subsequent water supplies are a direct function of the climatic conditions in any given area. Furthermore, the significance of the weather affecting the flow characteristics of the East/Trail Mountain springs cannot be over-emphasized.

Most of the water supply in the Western United States originates in the high mountain ranges as snowfall during winter periods. Snowmelt augmented by spring precipitation produces runoff which is utilized downstream. Fall precipitation influences the soil moisture conditions prior to snowpack accumulation and has a bearing upon runoff the following year.

A. Regional Climatology

From 1982 to 1984 the Western United States, especially Utah, experienced an unprecedented wet cycle of precipitation. The pattern changed in 1985 with conditions returning to slightly above normal. During the 1986 water year, the extremely wet trend returned, and the upper Colorado River Basin experienced above average precipitation. The 1987 weather pattern changed dramatically with near normal valley precipitation and mountain snowfall much below normal. The resulting 1987 runoff was substantially below normal. The drought continued from 1988 through 1992 with runoff amounts much below normal for six consecutive years. The 1993 runoff improved substantially with above average flow conditions occurring in most river basins. In 1994, drought conditions returned throughout much of the West. From 1995 through 1999, water supplies were much improved with above average runoff in Emery County. In 2000, weather conditions changed dramatically and the resulting runoff was much lower than normal. Precipitation was variable during 2001 and runoff values continued below normal though the year. The drought continued into 2002 with much lower precipitation and runoff was near-record low levels for most streams in Emery County. The 2003 water year was nearly as severe as 2002 with flows less than 40%. The extreme dry trend continued through 2004 with precipitation and runoff much below average although 2004 was much improved over the previous 4 years. Finally, in 2005 and 2006 wet conditions returned to the West and resulted in improved water supplies in the Huntington Creek drainage. Most local reservoirs filled to capacity. However, extreme drought returned to the region once again in 2007. Below average precipitation and snowfall coupled with dry and hot conditions in March and April resulted in greatly reduced water supplies which, in turn, severely restricted irrigation water supplies during August and September. However, from 2008 through the 2010 water years, drought conditions eased in the region, filling the reservoirs to capacity, resulting in more abundant water supplies for agriculture and culinary uses.

B. Local Climatology

1. Precipitation

Precipitation amounts recorded for the 2010 water year will be presented for the Castle Dale, Huntington Plant, and East Mountain weather stations. Weather records were incomplete for Electric Lake during 2010 and therefore, are not included with this report. The values for Castle Dale, Huntington and East Mountain are shown in Table 1.

Precipitation in Emery County during 2010 was variable depending on the location. Precipitation at the valley reporting station at Castle Dale was 78% of normal while precipitation at Huntington Plant was only 49%. East Mountain precipitation was 73% of average.

A comparison of precipitation totals for 2009 and 2010 merits consideration in this study. The intent is to develop a correlation between yearly precipitation and spring discharges on East and Trail Mountains. Table 2 is a comparison of the 2009 and 2010 precipitation levels recorded at the three locations.

Tables 3, 4, 5, and 6 indicate monthly precipitation values at Castle Dale, Huntington, Electric Lake (no longer recorded), and East Mountain from the beginning of operation at each site. The tables indicate monthly trends as well as the great fluctuation in yearly totals. Figure 2 shows monthly precipitation at the East Mountain site for the 2010 water year.

The correlation of precipitation levels with spring discharges will be discussed in the East/Trail Mountain Springs section of this report.

2. Temperatures

During the 2010 water year, temperatures were generally normal at Castle Dale and Huntington Plant. Temperatures at the East Mountain station were slightly above normal. Temperatures at Castle Dale were below normal throughout the spring months and slightly above normal during the summer months. For the year, the average temperature was 0.1 degree below normal, whereas in 2009, the temperature was 1.7 degrees above normal.

At Huntington temperatures were generally identical as the Castle Dale data with cooler temperatures during the spring and warmer temperatures during the summer and fall. For the year the average annual temperature was 0.3 degrees below normal compared to 2009 where the temperature was 0.2 degrees above normal.

At the East Mountain station, temperatures were above normal for were all months except December. September recorded the highest departure recording 11.2 degrees above normal. November, March, April, June and July also recorded high departures above normal. All of these months were above normal at by 5 degrees Fahrenheit. For the year, the temperature at East Mountain averaged 5.1 degrees above normal, whereas temperatures were 2.2 degrees above normal in 2009. Temperatures at the Electric Lake station were not recorded. (See Table 7 for temperature data at the 3 stations.)

A comparison of 2009 and 2010 temperatures for the three stations is addressed since temperatures also influence water supplies from year to year. Table 8 depicts the variation and compares 2009 to 2010.

III. DRAINAGE SYSTEMS

The surface drainage system on East Mountain is divided into two major drainages; the southwest portion forms part of the Cottonwood Creek drainage, and the northeast portion contributes to the Huntington Creek drainage. (See Map HM-1) The drainage boundaries, including minor subdivisions to Cottonwood and Huntington creeks, are designated on the accompanying map. The surface drainage system on Trail Mountain is totally contained within the Cottonwood Creek drainage system, with minor subdivisions flowing to Indian and Cottonwood Canyon creeks. (See Plate 7-2) Both Huntington and Cottonwood creeks flow out of the Wasatch Plateau in a southeasterly direction. The creeks merge with Ferron Creek to form the San Rafael River, which is a tributary of the Green River.

A. Huntington Creek Drainage System

Huntington Creek is comprised of many smaller tributary streams that feed the main stream. Deer Creek, Meetinghouse Canyon, Mill Fork Canyon, and Rilda Canyon creeks are the only tributaries to Huntington Creek that emanate from within PacifiCorp's coal mining areas.

1. Huntington Creek

Flow data are recorded on a continuous basis by PacifiCorp at four locations; stations are located on 1) Huntington Creek near PacifiCorp's Huntington Plant, 2)Huntington Plant Diversion, 3) Huntington Creek below Electric Lake about 22 miles upstream from the Huntington Plant, and 4) Electric Lake for elevations and storage. Flow records are maintained by PacifiCorp in order to determine water entitlements and reservoir storage allocation for the various users on the river.

Table 9 shows a summary of actual recorded Huntington Creek flows below Electric Lake and at Huntington Plant, and calculated natural flow at Huntington Plant. The calculated natural flow considers actual flow recorded at the plant, plant diversions, Electric Lake storage change, and lake evaporation. The calculation does not include Left Fork Reservoir regulation since new reservoir monitoring equipment was not operational during part of the year. The average daily discharges for the 2010 water year (October 2009 - September 2010) at the two stations and Electric Lake storage are found in Appendix A.

During the 2010 spring runoff period (April through June) 4941.0 acre feet was stored in Electric Lake which was only 79% of the 2009 stored volume. During spring runoff, the impoundment filled and reached its highest level on June 23, 2010 at an elevation of 8,568.96 feet which is 6.04 feet below spill elevation. Total storage on that date amounted to 27,775 acre feet, which is less than full capacity. The total flow of Huntington Creek at the Huntington Plant was 54,360 acre feet or 78% of average. However, because of plant diversions, lake evaporation and the stored runoff at Electric, adjusted flows of the Huntington Creek at Huntington Plant could increase approximately 25%. A comparison of runoff values for previous years has historically been presented in Table 10. However, because this data is no longer available, Table 10 is discontinued.

During 2010, water quality information on Huntington Creek near the Deer Creek confluence was compiled on a quarterly basis. Locations of water quality sampling stations monitored by PacifiCorp-Energy West Mining Company are listed below (refer to Map HM-1).

a. HCC01 - Above Power Plant Bridge
b. HCC02 - Below Deer Creek Confluence
c. HCC04 - Below Bridge @ Research Farm Bridge+
+ Not listed on map due to scale.

Specific water quality constituents analyzed are shown in Tables 11, 12, and 13. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office. In general, the water shows a gradual increase in concentration of dissolved minerals as the flow proceeds down Huntington Canyon.

2. Deer Creek

Deer Creek is an ephemeral tributary of Huntington Creek and flows from the same canyon in which the Deer Creek Mine is located. PacifiCorp monitors the characteristics of Deer Creek according to the following flow and sampling schedule (see Hydrologic Monitoring Schedule Appendix L).

a. Flow and Sampling Schedule
   (1) Locations:
      (a) Above the Mine - DCR01
      (b) @ Permit Boundary - DCR04
      (c) Below the Mine - DCR06
         (See Map HM-1)
   (2) Flow: Information is collected during the first or second week of each month.
   (3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in March 1988 and will continue through 2011 (i.e. sampling conducted in March, June, September, and December). Field measurements including pH, specific conductivity, and temperature will be performed in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

As stated above, flow information is collected monthly throughout the year with the use of two Parshall flumes. (See Map HM-1 for flume locations.) A hydrograph showing all the data collected for 2010 and 1984-2009 has been generated for each location. (See Appendix B) The hydrographs show that the only flow which occurred in the Deer Creek drainage was the result mine water discharge from Deer Creek Mine. For location DCR01, frozen conditions persisted during the winter months and dry at all other times. Flow at the lower two locations occurred throughout the year as the result of Deer Creek Mine discharge with peak flow occurring in August and September (DCR04 – 3,577 gpm, DCR06 – 3,497 gpm).

c. Quality Information

In accordance with the Hydrologic Monitoring Plan, baseline quality analysis was performed in 2006. Baseline analysis will be repeated once every five (5) years. The results of the historical operational quality analysis are listed in Tables 14 and 15. The minimum, maximum, and mean values are given for a five-year period along with the historical results. Values are in milligrams per liter unless otherwise noted. It is apparent from historical information in the tables that the quality of the Deer Creek runoff degrades slightly from the upper to the lower sampling point. The quality of the lower sampling point is thought to be affected by the Mancos Shale which outcrops above the lower sampling location. Raw data is on file at the Energy West Main Office.

3. Meetinghouse Canyon Creek

Meetinghouse Canyon Creek is an ephemeral tributary of Huntington Creek and is monitored according to the following schedule (see Hydrologic Monitoring Schedule in Appendix L).

a. Flow and Sampling Schedule
   (1) Location: South Fork of Meetinghouse Canyon
       (See Map HM-1)
   (2) Flow: Information is collected during the first or second week of each month.
   (3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed will be those stated in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in March 1984 and will continue through 2011, (i.e. sampling conducted in March, June, September, and December). Field measurements including pH, specific conductivity, and temperature will be performed monthly in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

A hydrograph comparing 2010 and 1984-2009 can be found in Appendix C. For location MHC01 flow did not occur during 2010.

c. Quality Information

In accordance with the Hydrologic Monitoring Plan, baseline quality analysis was performed in 2006. Baseline analysis will be repeated once every five (5) years. Quality sampling was initiated in 1986. When there is flow at location MHC01, Table 16 will list the minimum, maximum, and mean values along with historical results. Raw data is on file at the Energy West Main Office.

4. Mill Fork Canyon

Mill Fork Canyon is a tributary of Huntington Creek and was included in PacifiCorp's monitoring program starting in 1997. Monitoring of Mill Fork is conducted according to the following schedule (see Appendix L). Mill Fork Canyon is ephemeral from its headwaters to the western border of Section 21, Township 16 South, Range 7 East, and intermittent from that point to the confluence of Huntington Creek.

a. Flow and Sampling Schedule

(1) Locations:
  (a) Above Mill Fork Fault – MFU03
  (b) Above Old Mines - MFA1
  (c) Mill Fork Canyon Culvert – MFB2
    (See Map HM-1)

(2) Flow: Information is collected during the first or second week of each month.

(3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in 1997, and will continue through 2011 on a quarterly basis, i.e., March, June, September, and December. Field measurements, including pH, specific conductivity, and temperature will be performed quarterly in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

Flow information is collected monthly throughout the year (See Map HM-1 for locations.) A hydrograph has been generated for each location. (See Appendix D) Locations MFU3, MFA1 and MFB2 flowed during the spring runoff period. For location MFB2 flow occurred during the months of June through October 2010 with a peak flow estimated at 2400 gpm in June.

c. Quality Information

Historical monitoring data collected by Beaver Creek Coal Company - No. 4 Mine and the United States Geological Survey (site No. 76: Open File Report 81-539) has been incorporated in PacifiCorp's hydrologic database. Operational water quality monitoring was conducted during 1997 and 1998 (refer to the Quarterly Hydrologic submittals). Baseline quality analysis was initiated in November 1998 (2002 for MFU03). In accordance with the Hydrologic Monitoring Plan, baseline quality analysis was performed in 2006. Baseline analysis will be repeated once every five (5) years.

Results of the samples collected in 2010 are presented in Tables 17, 18 and 19. It is apparent from the data that the quality of the water degrades slightly from the upper reaches of Mill Fork, i.e., MFU3 to the mouth of the canyon, i.e., MFB2. Water quality has remained relatively consistent from year to year. (See Tables 17, 18 and 19). Raw data is on file at the Energy West Main Office.

5. Rilda Canyon Creek

Rilda Canyon Creek is a tributary of Huntington Creek and is monitored according to the following schedule (see Appendix L). Rilda Canyon Creek is ephemeral from its headwaters to the western border of Section 28, Township 16 South, Range 7 East, and perennial from that point to the confluence of Huntington Creek.

a. Flow and Sampling Schedule

(1) Locations:

(a) Right Fork of Rilda - RCF1*
(b) Left Fork of Rilda - RCLF1**
(c) Left Fork of Rilda - RCLF2**
(d) Rilda Canyon - RCF2*
(e) Rilda Canyon - RCF3
(f) Rilda Canyon - RCW4 (See Map HM-1)

* During mining of the North Rilda leases, an additional site was added in 1999 upstream of RCF1 (adjacent to EM-163) to monitor surface/groundwater relationships. Flow will be measured yearly during base flow conditions.
** Flow and field parameters only.

(2) Flow: Information is collected during the first or second week of each month.

(3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in June 1989 except for RCLF1 and RCLF2, which were initiated in 1990 and 1995, respectively, and will continue through 2011 on a quarterly basis, i.e., March, June, September, and

December. Field measurements, including pH, specific conductivity, temperature, and dissolved oxygen, will be performed at the perennial stream locations, i.e., RCF3 and RCW4, monthly in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

Flow information is collected monthly throughout the year with the use of three Parshall flumes and one V-notch weir. (See Map HM-1 for locations.) A hydrograph has been generated for each flume-weir location. (See Appendix E) Springs utilized by North Emery Water Users Special Services District (NEWUSSD) for culinary purposes are situated between monitoring locations RCF2 and RCF3. Flow above the spring area is ephemeral and below the stream is perennial. For location RCF1 flow occurred only during the months May through August with a peak flow estimated at 2,790 gpm in June. Location RCLF1 and RCLF2 flow only occurred during the months of May and July with a peak flow in June (RCLF1 - 30 gpm and RCLF2 - 30 gpm). For location RCF2 flow occurred only during the months of June and July with a peak flow estimated at 3,118 gpm in June. Below the spring area the stream is perennial and increases in flow from RCF3 to RCW4. During 2010 the peak flow for RCF3 was estimated at 2,903 gpm (June); for RCW4, 3,300 gpm (June). Baseline flow for 2010 at RCF3 and RCW4 was approximately 30 and 91 gpm, respectively. Data suggest that above the NEWUSSD springs the stream loses water to the alluvium and below the spring area the alluvium recharges the stream causing the flow to increase.

c. Quality Information

In accordance with the Hydrologic Monitoring Plan baseline quality analysis was performed in 2006. Thereafter, baseline analysis will be repeated once every five (5) years. Quality sampling was initiated in 1989; results of the samples collected are presented in Tables 20, 21, and 22. It is apparent from the data that the quality of the water degrades from the upper reaches of Rilda Canyon, i.e., RCF1, to the NEWUSSD spring area, and from that point to the mouth of the canyon, i.e., RCW4. Water quality has remained relatively consistent from year to year. (See Tables 20, 21, and 22) Raw data is on file at the Energy West Main Office.

B. Cottonwood Creek Drainage System

The southern portion of East Mountain and the entire Trail Mountain is intersected by Cottonwood Creek and its associated tributaries, including Cottonwood Canyon Creek and Grimes Wash. The Cottonwood Creek drainage is about equal in size to the Huntington drainage, with a total discharge from each of the drainages of about 70,000 acre feet per year. The major cultural feature on Cottonwood Creek is Joe's Valley Reservoir, located about twelve miles west of the town of Orangeville. The 63,000 acre foot reservoir was constructed by the U. S. Bureau of Reclamation and provides storage water for irrigation, industrial, and municipal needs in the Emery County area.

PacifiCorp monitors three of the tributaries of the Cottonwood Creek drainage system, Cottonwood Canyon Creek, Grimes Wash and Indian Creek. (See Maps HM-1 and MFS1851D)

1. Cottonwood Canyon Creek

Based on data collected by PacifiCorp, Cottonwood Canyon Creek is an ephemeral stream from its headwaters to Section 24, Township 17 South, Range 6 East and intermittent from that point to its confluence with Cottonwood Creek. The majority of water moving through Cottonwood Canyon Creek appears to be through the colluvial valley deposits. An extensive hydrogeologic investigation was conducted in Cottonwood Canyon Creek during 1992. Results can be found in Appendix C of the PAP. Four (4) permanent runoff sampling sites have been established along Cottonwood Canyon Creek and sampled as listed below. (See Hydrologic Monitoring Plan in Appendix L).

a. Flow and Sampling Schedule
   - (1) Locations: (See Map HM-1)
     - (a) Above Mine - SW-1
     - (b) Below Mine - SW-2
     - (c) @ USGS Flume - CCC01 (Flow and field parameters only)
     - (d) Above Straight Canyon - SW-3
   - (2) Flow: Information is collected during the first or second week of each month.
   - (3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed will be those stated in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in December 1992 and will continue through 2011, i.e. March, June, September, and December. Field measurements including pH, specific conductivity, and temperature will be performed monthly in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

As stated above, flow information is collected monthly throughout the year. (See Map HM-1 for flume locations.) A hydrograph for 2010 has been generated for each sampling location. (See Appendix F) The hydrographs show the intermittent nature of Cottonwood Canyon Creek. Flow at SW-1, occurred from April through June with a peak of 3.4 gpm in May. Flow at SW-2 occurred from throughout the entire water year with a peak and average base flow estimated at 15.07 gpm (April) and 5.93 gpm (February), respectively. Flow at SW-3 did not occur in 2010. Flows recorded at SW-2 are influenced by discharge from the Cottonwood Mine (TMA001).

c. Quality Information

In accordance with the Hydrologic Monitoring Plan, baseline quality analysis was performed in 2006. Thereafter, baseline analysis will be repeated once every five (5) years. The results of the historical operational quality analysis are listed in Tables 23, 24, and 25. The minimum, maximum, and mean values are given for a five-year period along with the historical results. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office.

The Cottonwood Canyon Creek drainage quality is influenced by the following factors: 1) A relatively high amount of suspended solids during spring runoff from Indian, Roans, Mill, and Marines canyons; 2) Alluvial/colluvial deposit recharge and discharge areas.

2. Grimes Wash

Grimes Wash is an ephemeral tributary of Cottonwood Creek and flows in the same canyon in which the Wilberg/Cottonwood Mine is located. Three permanent runoff sampling sites were established in 1980 and are sampled as listed below (see Hydrologic Monitoring Plan in Appendix L).

a. Flow and Sampling Schedule

(1) Locations: (See Map HM-1)
- (a) Right Fork - GWR01
- (b) Left Fork - GWR02
- (c) Below the Mine - GWR03

(2) Flow: Information is collected during the first or second week of each month.

(3) Water Quality Sampling:

Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed will be those stated in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in March 1988 and will continue through 2011, i.e. March, June, September, and December. Field measurements including pH, specific conductivity, and temperature will be performed in conjunction with quality measurements. Quantity will be monitored monthly.

b. Flow Information

As stated above, flow information is collected monthly throughout the year with the use of two Parshall flumes. (See Map HM-1 for flume locations.) A hydrograph comparing 2010 to the data collected from 1984 through 2009 has been generated for each flume location. (See Appendix G) The Right fork and Left fork monitoring sites remained dry throughout the year. Below the mine (GWR03), flow occurred from April through June with a peak of 0.6 gpm in April. Seeps or dampness at the Below the Mine location was noted throughout most part of the year due to the influence of the springs emanating from the Starpoint Sandstone/Mancos Shale formational contact.

c. Quality Information

In accordance with the Hydrologic Monitoring Plan baseline quality analysis was performed in 2006. Baseline analysis will be repeated once every five (5) years. The results of the 2010 operational quality analysis are listed in Tables 26, 27, and 28. The minimum, maximum, and mean values are given for a five-year period along with the historical results. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office.

The Grimes Wash drainage quality is influenced by two factors: 1) Under normal conditions the Right Fork contributes a relatively high amount of suspended solids during spring runoff due to the fact that it is a south facing canyon dominated by argillaceous sediments; 2) Mancos Shale/Starpoint Sandstone interface seeps and springs elevate the TDS at the Below the Mine location.

3. Indian Creek

Indian Creek is a perennial tributary of the Cottonwood Creek and flows in Upper Joes Valley and merges with Lowry Water near the Joes Valley Reservoir. Four permanent runoff sampling sites were established in 2001 and are sampled as listed below (see Hydrologic Monitoring Plan in Appendix L).

a. Flow and Sampling Schedule
   (1) Locations: (See Map MFS1851D)
      (a) Above Camp Ground - ICA
      (b) Indian Creek Flume - ICF
      (c) Indian Creek Ditch - ICD
      (d) Below Cross-Over Road - ICB
   (2) Flow: Information is collected during base flow only (October)
   (3) Water Quality Sampling:

Water samples will be collected and analyzed during base flow monitoring. Parameters analyzed will be those stated in the DOGM Guidelines for Surface Water Operational Quality. (See Appendix L) The program was initiated in October 2001 and will continue through 2011. Field measurements including pH, specific conductivity, and temperature will be performed in conjunction with quality measurements.

b. Flow Information

As stated above, flow information is collected during base flow only with the use of portable 90^{o} v-notch weir and one permanent Parshall flume. Flow occurred at all four locations with the highest flow (986 gpm) occurring at ICF. (See Map MFS1851D for monitoring locations.)

c. Quality Information

In accordance with the Hydrologic Monitoring Plan baseline quality analysis was performed in 2006. Baseline analysis will be repeated once every five (5) years. The results of the 2009 quality analysis are tabulated in Appendix F. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office.

IV. SPRINGS

A. East Mountain

Between the times where PacifiCorp began monitoring springs on East Mountain and 1986, the number of springs measured increased from less than fifty (50) to nearly eighty (80). PacifiCorp believed that more benefit could be realized by concentrating its monitoring to selective springs in the areas that was undermined within the following five years. (See Map HM-5) A meeting was held on March 25, 1987 with the U. S. Forest Service and the Utah State Division of Oil, Gas and Mining to determine the most effective plan for PacifiCorp's monitoring. A subsequent meeting was held on April 15, 1987 with the State Division of Oil, Gas and Mining to finalize the monitoring plan revisions. In addition to major revisions made in 1987, each year, State and Federal agencies are invited to participate in adjusting the monitoring schedule based on field investigations.

During the meetings it was resolved that the following springs will be monitored. Eight additional springs (denoted with a plus [+] symbol below) were added in 1989 after the annual field verification process jointly conducted by DOGM and PacifiCorp.

*	Burnt Tree Springs		79-40
*	Elk Spring (dev. in 2009)		80-41
*	Sheba Springs		80-43
	Ted's Tub	*	80-44
	79-2	*	80-46
*	79-10		80-47
	79-15	+	80-48
*	79-23		80-50
	79-24		82-51
*	79-26	*	82-52
+	79-28	*	84-56
*	79-29	+	89-60 (Alpine Spring)
	79-32	+	89-61 (developed in 2009)
	79-34	+	89-65
*	79-35	+	89-66
	79-38	+	89-67
		+	89-68

Of these springs, twelve will be monitored on a monthly basis, weather permitting, and have been denoted on the above list with asterisks (*).

Mill Fork Springs:

EM-216	EMPOND
GRANTS SPRING	LITTLE BEAR
JV-9	JV-34
MF-7	MF-10
MF-19B	MF-213
MF-219	MFR-10
MFR-30	RR-5
RR-15	RR-23A
SP1-26	SP1-29
UJV-101	UJV-206

1. Flow and Sampling Schedule

a. Flow

All springs on the preceding lists are measured during the months of July and October. In addition, a minimum of twelve springs are monitored to establish a discharge recession curve (denoted with an * above). Generally, measurements are made on a monthly basis during the months of July through October if weather and reasonable access permit; but when historical data indicate that a spring is short-lived, all efforts are made to measure discharge from that spring at least three times, equally spaced, within its flow period.

b. Quality Samples

All springs listed above are sampled for water quality characteristics during the months of July and October. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Operational Quality. (See Appendix L)

2. Spring Flow

Precipitation decreased only slightly from 2009 to 2010 on East Mountain. Because of the local isolation of rainfall, spring discharge rates responded with the East Mountain - Southern area, Mill Fork and Trail Mountain by generally decreasing slightly in 2010. Drought conditions continued in the region during 2010 water year that reported an average of only 67% of normal over the three monitoring sites. Although December (2009) January, February, and March (2010) were generally well above normal, the rest of the water year experienced an extreme lack of precipitation. These lower precipitation months resulted in lower spring flow discharges impacting stream flows within the Huntington Creek drainage system. Temperature, a critical factor on spring discharge rates, was an overall 5.2 degrees higher (East Mountain Station) in 2010 than the historical averages. However, March through September experienced an average of 6.6 degrees higher than normal temperatures which increased evaporation rates reducing recharge.

Precipitation received at East Mountain weather station and spring discharge rates set an all time low for the 2002 water year and only improved slightly in 2003 and 2004. Table 29, is a tabulation of the flow data collected during the 2010 monitoring season. To record the season variation, all springs measured in July are measured again in October. The seasonal variation is represented in Table 29, under the column heading "Seasonal Net Change." The percentage figures represent the amount of change, either positive or negative. The average change reveals a thirty-six percent (36%) [sixty-seven percent (67%) by volume] decrease from the July to the October measurements for Southern East Mountain and a sixty-two percent (62%) [thirty -six percent (36%) by volume] decrease from the July to the October measurements for the Mill Fork Area. The resulting factor influencing this decrease was the fact that warmer than normal temperatures occurred during spring flow months with little precipitation for recharge.

A twenty-eight year comparison of spring discharge is shown in Table 30. The table includes a year by year comparison of springs identified from each mode of occurrence (Table 31). The springs utilized in the comparison are underlined in Table 31. The flow values for the individual springs represent the July measurements. October measurements were not utilized because winter weather conditions caused some springs to become inaccessible.

Table 30 has been compared to East Mountain climatology to see how closely spring discharge rates follow local annual precipitation. Figure 3 reveals good correlation between spring discharge and precipitation. Along with precipitation, temperature plays a critical role in yearly discharge variations, especially during the early stages of the runoff period. Listed in Table 32 is a comparison of January through June temperature data from surrounding weather stations for the period 1982-2010 versus departure from normal. The comparison is vital in determining mining effects on spring discharge versus general changes in annual precipitation.

Table 32 clearly demonstrates near average temperatures between 1982 and 1984, but starting in 1985 and continuing through 2000 (except for 1991 and 2001) positive departure from normal has been significant. In 2010 the temperatures averaged 0.73 degrees departure from normal. Comparison between spring discharge rate and general changes in annual precipitation patterns correlated well in the past due to relatively normal temperatures experienced during the early runoff period (January through June). Figure 3 not only includes a comparison of spring discharge rate and precipitation as in the past, but also temperature departure due to the critical influence temperature has on peak discharge occurrence.

An additional flow information study was initiated during the summer of 1985. The purpose of the program was to establish flow recession curves for the following springs: (1) Burnt Tree, (2) Elk Springs (developed in 2009), (3) Sheba, (4) 79-10, (5) 79-23, (6) 79-26, (7) 79-29, (8) 79-35, (9) 80-44, (10) 80-46, (11) 82-52, (12) 84-56. The flow information collected during 2010 is shown in Table 33; corresponding spring recession curves comparing 2010 to historical values are located in Appendix H.

3. Quality

To more closely identify springs which are related one with another, water samples were analyzed to determine the percentage of cations and anions in solution. The percentages have been graphically represented as cation-anion diagrams. (See Appendix H) The purpose of the cation-anion diagrams is to identify groups of related springs by water chemistry. To better visualize the concept, the cation-anion diagrams are presented by the geologic formation in which the spring originates. A general pattern for the Flagstaff and Price River formations can be recognized for each year in which the cations/anions were analyzed. A consistent pattern for the North Horn is less obvious due to the complex geology of the formation itself. One aspect the cation-anion diagrams demonstrate is that, even though the quality varies slightly from individual sites as well as from different formations, seasonal variations do not exist.

The quality of the springs sampled in 2010 reveals an excellent correlation with historical averages. A summary of the water quality analysis for a representative group of East Mountain Springs is presented in Table 34. In the table, the mean values for 2010 are compared to the historical results for each respective spring. Raw data is on file at the Energy West Main Office.

B. Rilda Canyon - North Emery Water Users Special Services District (NEWUSSD)

Of concern to PacifiCorp, Energy West is in the proximity with mining activities in Rilda Canyon to the Rilda Canyon Springs. Rilda Canyon Springs currently serve as a culinary water source to the North Emery Water Users Special Services District (NEWUSSD). The NEWUSSD spring system consists of a series of collection lines extending westward up Rilda Canyon and southward up a small side drainage (shown on Map HM-8 in Volume 9 of the PAP). The NEWUSSD spring system is metered at four locations. Meter 1 (Side Canyon Spring) is located at the downstream end of a collection line which enters Rilda Canyon from the South. Meter 2 (Side Canyon Spring plus South Spring) is located near the bottom of the main east-west trending collection line which lies to the south of Rilda Canyon Creek at a point just upstream (west) of the main spring collection box. Meter 2 records combined flows from both the Side Canyon (Meter 1) as well as additional inflows known as South Spring which enter the system below Meter 1. Meter 3 (North Spring) records flows for the east-west central collection line which was constructed through the central portions of the valley near Rilda Canyon Creek. Meter 4 (North Spring) collects data from the north collection line located on the north side of Rilda Canyon Creek. During 1995 flow from the north collection line was combined with the central collection system. As a result Meter 4 was terminated.

1. Spring Flow

Through the cooperative efforts of PacifiCorp and NEWUSSD, flow meters were installed in September 1990 to isolate individual spring areas for quantity and quality (see Map HM-8 in Volume 9 of the PAP). Table 35 lists the individual flow rates for meters 2 and 3 (flow from Meter 1 is included in Meter 2). Accurate data for the first part of 2010 was hampered by operational problems with the diversion valves and meters.

The seasonal variation of the monthly average flow from NEWUSSD's Rilda Canyon Springs is shown in Figure 4. With the installation of flow meters, individual spring contribution to the total flow can be plotted over time.

In early 2009, North Emery Water Users Special Service District and Energy West Mining Company completed a spring development and pipeline project (called the Elk Springs Project). This project involved developing and piping of water from two springs, Elk Spring and Spring 89-61 on top of East Mountain down a ridge in a subsurface trench 7,000 feet, to a cliff face (the Castlegate Sandstone escarpment), behind the cliff face for 2,500 linear feet and a 700-foot elevation drop in a subsurface borehole constructed using directional drilling, and another 15,300 feet in a subsurface trench in a canyon bottom (Meetinghouse Canyon) to the slow-sand water treatment plant in Huntington Canyon operated by NEWUSSD. Total length of the pipeline is 4.7 miles. Total elevation drop of the entire pipeline is about 2,900 feet.

The purpose of this project is to provide NEWUSSD with a long-term dependable source of water supply to the water treatment plant in Huntington Canyon that cannot be interrupted or affected by surface activities in the vicinity of the springs, or possibly by underground coal mining activities that have been common in the area. NEWUSSD and Energy West committed to mitigation work to offset the taking of water from the Elk and 89-61 springs in the form of improvements to 4 other springs nearby on East Mountain. A commitment was also made on the part of NEWUSSD to keep a minimum flow to the surface from Elk and 89-61 springs at all times to preserve the wetlands around those springs. In 2010, work was initiated to fence the parameter of the wetlands of springs 79-1, 80-48, 89-67, and 89-68. This work will be completed during the field season of 2011.

Development of Elk Springs and 89-61 rendered the continued collection of data useless, since the major quantity of waters issuing from these springs is piped to the NEWUSSD treatment plant. No data for these springs will be included with future Hydrology Reports; however, the historical data will remain intact.

2. Quality

Baseline quality sampling of the individual springs was performed in 2006. The minimum, maximum, and mean results of the 2010 spring flow compared to historical quality analysis are listed in Table 36. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office. As stated in Volume 9 of the PAP, differences in the groundwater quality data reflect differences in the groundwater source or the origin of groundwater for the various springs issuing within the Rilda Springs area. The higher sulfate and TDS concentrations from the Meter 2 samples are characteristic of waters associated with the Blackhawk Formation. Waters issuing from the North Spring collection system (Meters 3 and 4) area are of a better quality than waters from the Side Canyon and South Spring collection areas. Water issuing from the North Spring originates primarily from water moving within the alluvial valley sediments and fracture systems of the Starpoint Sandstone and is not derived from the Blackhawk Formation.

C. Trail Mountain

PacifiCorp began monitoring springs on Trail Mountain in 1993. Monitoring prior to 1993 was completed by the previous lease holders. The nine (9) springs listed below are monitored.

T-6 (18-2-1)	T-14 (17-25-1)
T-8 (17-21-1)	T-14A (17-26-5)
T-9 (17-22-1)	T-15 (17-35-1
T-10 (17-26-4)	T-16 (17-35-2)
TM-23 (17-14-4)	

1. Flow and Sampling Schedule

a. Flow

All springs on the preceding list are measured during the months of July through October if weather and reasonable access permit.

b. Quality Samples

All springs listed above are sampled for water quality characteristics during the months of July and October. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Operational Quality. (See Appendix L)

2. Spring Flow

As indicated earlier, precipitation and spring flow rates decreased from 2009 to 2010. Table 37 is a tabulation of the flow data collected during the 2010 monitoring season. The seasonal variation is represented in Table 37 under the column heading "Seasonal Net Change %." The percentage figures represent the amount of change, either positive or negative. The average change reveals a 3.6% increase from July to the October measurements. The only Trail Mountain spring that flowed during the 2010 water year was spring 17-22-1.

A twenty-three year comparison of spring discharge is shown in Table 38. The flow values for the individual springs represent the July measurements. October measurements were not utilized because winter weather conditions caused some springs to become inaccessible.

3. Quality

To more closely identify springs which are related one with another, water samples were analyzed to determine the percentage of cations and anions in solution. The percentages have been graphically represented as cation-anion diagrams. (See Appendix I) The purpose of the cation-anion diagram is to identify groups of related springs by water chemistry. To better visualize the concept, the cation-anion diagrams are presented by the geologic formation in which the spring originates. A general pattern for the geologic formations can be recognized for each year in which the cations/anions were analyzed. A consistent pattern for the North Horn Formation is less obvious due to the complex geology of the formation itself. One aspect the cation-anion diagrams demonstrate is that, even though the quality varies slightly from individual sites as well as from different formations, seasonal variations do not exist.

The quality of the springs sampled in 2010 reveals an excellent correlation with historical averages. A summary of the water quality analysis for springs monitored on Trail Mountain is presented in Table 39. In the table, the mean values for 2010 are compared to the historical results for each respective spring. Raw data is on file at the Energy West Main Office.

V. MINE HYDROLOGY

A. Groundwater and Surface Water Sources in Relation to Mine Workings

The relationship of the Deer Creek, Cottonwood/Wilberg, and Trail Mountain mine workings with the overlying springs is shown in Map HM-5. Beginning in 1979 (Trail Mountain - 1992), PacifiCorp has developed an ambitious spring monitoring program with emphasis to detect changes in the East and Trail Mountain hydrologic regime as a result of mining. The data collected to date reveal no indication of any mine-related effects on spring discharge or surface flow rates. Figure 3 shows a close correlation between spring discharge rates compared to precipitation and temperature.

B. Groundwater Quality and Collection Procedures

PacifiCorp began in-mine quality and quantity measurements in 1977 and has continued monitoring through 2010. With the collection of numerous samples throughout the extent of the mine workings, the quality has remained relatively constant. (Refer to Cation/Anion diagrams in Appendix J). In-mine monitoring was discontinued at Cottonwood and Trail Mountain during 2001 due mine sealing/temporary cessation of operations.

Collection procedures for groundwater quality consist of two grab samples collected and analyzed per quarter at each of the mines which produces measurable quantities of water. Sampling according to this established plan began in the first quarter of 1982. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Operational Quality except when new sites are established. In that case, baseline information will be collected for two (2) years. (See Appendix L)

Long-term monitoring locations have been established at each of the mines which produce measurable quantities of water, i.e., Deer Creek, Cottonwood/Wilberg, and Trail Mountain mines. (See Maps HM-2, HM-3, and Plate 7-3 from previous Annual Reports) As stated earlier, in-mine monitoring at Cottonwood and Trail Mountain during 2001 was discontinued due mine sealing/temporary cessation of operations. Four types of occurrences have been recognized to exist within the current mine workings. (Refer to Figure 5)

1. Structural rolls with overlying fluvial channels,
2. Fault systems (Pleasant Valley and Roans Canyon),
3. Fractures and joints (lineaments),
4. Roof bolt and in-mine drill holes.

A collection device was installed at each long-term monitoring location. Flow and temperatures collected on a quarterly basis from the long-term sites in both mines were fairly consistent. (See appendix J for the Deer Creek In-Mine hydrographs.)

C. Mine Water

1. Deer Creek Mine

a. In-Mine Water Production

The best estimate of in-mine water production was arrived at by combining the following values:

Deer Creek Discharge	695.9 Million Gallons
Estimated Evaporation*	37.8 Million Gallons
Domestic Usage	5.3 Million Gallons
Total Discharge	652.8 Million Gallons

*See 1981 Hydrologic Monitoring Report (revised for two mine fans)

b. In-Mine Quality

Eight samples were collected in the Deer Creek Mine in 2010 (See Map HM-2 in previous reports for locations.) Parameters analyzed in 2010 are those listed in the DOGM Guidelines for Groundwater Baseline or Operational Quality. (See Appendix L)

Table 40 lists the characteristics of the samples collected and compares the mean, minimum, and maximum results of 2010 to the historical values for each location. It is apparent from Table 40 that the average quality of the in-mine water has remained relatively constant. (Refer to Cation/Anion diagrams in Appendix J) Raw data is on file at the Energy West Main Office.

c. Discharge Quantity

Excess water not utilized in the mining operation or for domestic use was either pumped to storage areas or discharged from the mine. The locations of the main sump areas within the mine are shown in Figure 6. The largest volume of water is stored in the western part of Main West, which has not been actively mined for several years.

In-line flow meters are utilized to record the amount of water discharged from the mine, after which it passes through underground sedimentation sumps. Discharge from Deer Creek is either shipped directly to Huntington Power Plant or to the Deer Creek drainage in accordance with stipulations of the Deer Creek UPDES Discharge Permit UT-0023604-002.

The total water discharged from the Deer Creek Mine during 2010 was estimated at 2,132.7 acre feet, or 694.9 million gallons. The recorded flow of 2,132.7 acre feet during 2010 is a 21.9% increase from the corrected 2009 discharge of 1,666.8 acre feet. The average monthly discharges are shown in Figure 7.

A graph displaying the historical discharge rates is included as Figure 8. The volume of water discharged from the mine has increased at a significant rate from 1988 through 1991 due to at least five factors. First, in previous years water discharged was measured with a Stevens Recorder installed in a Parshall flume. It was difficult to maintain calibration of the recorder and, in 1985, in-line flow meters (totalizer and instantaneous flow) were installed, allowing for a more accurate measurement of discharge. Second, mining has progressed into areas largely dominated by sandstone roof. The inflow from those areas is greater per acre of exposed area than areas of mudstone top. Third, mining has progressed into the bottom of the Straight Canyon Syncline, the lowest part of the mine, where a significant amount of water has been intersected. Fourth, mining has intersected the Roans Canyon Fault Graben which has released additional water into the mine workings. Last, prior to 1985, water used in mining was pumped directly from the in-mine sumps. Since that time, all water has been pumped from the mine through the metering system. Mining water is then pumped back into the mine through a high-pressure steel line to the mining faces where it is utilized. Water production decreased significantly in 1992 with the sealing of the 4th South area. The decrease flow recorded during 2002 was related to two factors; 1) replacement of the main discharge flow meter suspect of inaccurate readings (reduction of approximately 50%), and 2) development of a new in-mine sump. Mine discharge rates have remained relatively constant since 2002.

d. Discharge Quality

Monthly water quality samples were collected for 2010. Table 41 compares the minimum, maximum, and mean values from an historical standpoint to 2010. An examination of Table 41 reveals excellent correlation with historical results. Raw data is on file at the Energy West Main Office.

2. Des-Bee-Dove Mine

Production at the Des-Bee-Dove Mine was terminated indefinitely as of February 14, 1987. The portals were sealed and underground hydrologic monitoring was discontinued. The entire mine site has been reclaimed and no longer requires hydrologic monitoring.

3. Wilberg/Cottonwood Mine

The mine fire, which occurred in late 1984, altered normal hydrologic monitoring at the

Wilberg Mine. Normal hydrologic monitoring was reinstated in late 1985 and continued through May 2001. Energy West Mining Company notified the Division of temporary cessation of coal mining operations at the Cottonwood/Wilberg Mine effective May 29, 2001. Coal mining at the Trail Mountain Mine/coal transfer to Cottonwood Tipple ceased as of March 15, 2001. In preparation of temporary cessation, all associated mining equipment including; belt haulage (drives and headrollers), dewatering (pumps and control boxes) and electrical (transformers/rectifiers) were removed from the mine. Verification of equipment removal was conducted on May 4, 2001 with Division of Oil, Gas and Mining (Pete Hess) participating in the review. Bureau of Land Management was notified but was unable to attend. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 28, 2001.

a. In-Mine Water Production

In previous reports, the in-mine water production was arrived at by combining mine discharge, domestic use, and evaporation. Due to the fire, normal coal production and usage were not experienced. Pre-fire coal production resumed during late 1985. A large part of the mine workings have been sealed since the fire. The locations of the sealed areas and sumps are shown on Figure 9. As reported in the 1984 Annual Report, water discharged from the Wilberg Mine complex includes the area designated as the Cottonwood Mine. (See Figure 10) Consistent with previous years, the following table lists the factors involved in estimating in-mine water production.

Wilberg/Cottonwood Discharge

Grimes Wash*	0.0 Million Gallons
TMA	12.4 Million Gallons
Miller Canyon**	0.0 Million Gallons
Estimated Evaporation***	0.0 Million Gallons
Domestic Usage	0.0 Million Gallons
Total Discharge	12.4 Million Gallons

* Discharge Outfall 001 re-located from Grimes Wash to Cottonwood Canyon Creek TMA Portal - July 2001
** Sealed ventilation breakout which intermittently discharges. Site received Phase III bond release on October 4, 2010.
*** See 1981 Hydrologic Monitoring Report.

b. In-Mine Quality

In-mine monitoring was discontinued during 2001 due sealing of the mine. Refer to previous Annual Hydrologic Reports for comparison of samples collected to the historical values.

c. Discharge Quantity

Prior to temporary cessation, water produced in the Wilberg Mine gravity flowed to the northern area of 1st North. At that point it can either be pumped by a vertical turbine located in the Deer Creek Mine which picks up the water and pumps it back to the south and down to the Wilberg Mine main sump or pumped directly to the main sump utilizing submersible pumps. Water produced in the Cottonwood Mine (2nd North area) is transferred to the Wilberg Mine sump. The sump, which functioned as a settling basin, effectively removes settleable solids from the water. A portion of the water was redistributed to various areas of the mine to be utilized in the mining operations. A total of 12.4 million gallons was discharged to Cottonwood Canyon Creek (TMA portal) during 2010. No discharge occurred in 2010 at the Miller Canyon breakouts, which were developed for ventilation purposes but sealed in 1987. (See Figure 11) The portal breakouts at Miller Canyon were reclaimed in 1999 and received Phase III bond release from DOGM in October 2010. Discharge from Cottonwood Mine is monitored in accordance with stipulations of the Wilberg Mine Discharge UPDES Permit UT-0022896.

d. Discharge Quality

Monthly samples were collected from TMA during 2010. Tables 43 compares the minimum, maximum, and mean values from 2010 to the historical values.

4. Trail Mountain Mine

Energy West Mining Company notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 15, 2001. In preparation of temporary cessation, all mining equipment including; production (longwall and continuous miner), belt haulage and electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 2, 2001.

a. In-Mine Water Production

The best estimate of in-mine water production was arrived at by combining the following values:

Trail Mountain Discharge	0.0 Million Gallons
Estimated Evaporation*	0.0 Million Gallons
Domestic Usage	0.0 Million Gallons
Total Discharge	0.0 Million Gallons

* See 1981 Hydrologic Monitoring Report

b. In-Mine Quality

In-mine monitoring was discontinued during 2001 due sealing of the mine. Refer to previous Annual Hydrologic Reports for comparison of samples collected to the historical values.

c. Discharge Quantity

Prior to cessation, water produced in the Trail Mountain Mine either is pumped or gravity flows to a sump located in 4th Left, 5th Left, and 3rd South. (See Figure 12) A portion of the water is redistributed to various areas of the mine to be utilized in the mining operations. Excess water not used in the mining operations is stored in sealed areas of the mine or discharged to Cottonwood Canyon Creek. Historical flows from the Trail Mountain Mine are shown in Figure 13. No water was discharged to Cottonwood Canyon Creek during 2010. (See Figure 14) Discharge from Trail Mountain is monitored in accordance with stipulations of the Trail Mountain Mine UPDES Discharge Permit UTG040003-002.

d. Discharge Quality

No water was discharged to Cottonwood Canyon Creek during 2010.

VI. PIEZOMETRIC GRADIENT INFORMATION

A. Surface

1. Cottonwood Canyon Creek

Eight (8) wells located along the extent of Cottonwood Canyon Creek are monitored monthly. The following table lists the zone isolated with each well.

Well I.D.	Monitoring Zone
CCCW-1A	Alluvial Deposits
CCCW-1S	Starpoint Sandstone
CCCW-2A	Alluvial Deposits
CCCW-3A	Alluvial Deposits
CCCW-3S U	Blackhawk - Fluvial Sandstone
CCCW-3S L	Starpoint Sandstone
EM-31	Lower Blackhawk/Starpoint Sandstone
TM-1B	Starpoint Sandstone
TM-3	Starpoint Sandstone (Straight Canyon)

2. Rilda Canyon

Six (6) wells located in Rilda Canyon are monitored monthly when accessible. The following table lists the zone isolated with each well.

Well I.D.	Monitoring Zone
P-1	Alluvial Deposits
P-4	Alluvial Deposits
P-5	Alluvial Deposits
P-6	Alluvial Deposits
P-7	Alluvial Deposits
EM-47	Lower Blackhawk/Starpoint Sandstone

Information collected during 2010 correlated well with historical information. As a result of mining in the western portion of the Trail Mountain Mine Well TM-3 in Straight Canyon decreased in level due to depressurization of the Star Point Sandstone. As mining proceeded north and the southern portion of the mine was sealed, the aquifer began to recharge (see chart in Appendix F). Hydrographs for the individual wells can be found in Appendix E - Rilda Canyon, Appendix F - Cottonwood Canyon.

B. In-Mine

1. Deer Creek

Four (4) long-term monitoring wells were completed during 1989. (See Map HM-2 for well locations.) Due to changes in the mine layout the last of the remaining wells was destroyed by mining activity during the fourth quarter 2003.

2. Cottonwood Mine

During 1989 four holes were drilled in the Cottonwood Mine. Monitoring of the long-term wells, WCP 1-3, was discontinued in 1992 due to the sealing of the 3rd South area.

VII. WASTE ROCK WELLS

A. Deer Creek Mine - Waste Rock Storage Facility

The Deer Creek Waste Rock Storage Facility is located on the northeast side of State Highway 31 approximately six (6) miles west of Huntington, Utah.

The geology of the Deer Creek Waste Rock Storage Facility is fairly simple and straightforward. The site is located on the southern flanks of Gentry Mountain in the area just south of Wild Horse Ridge. Rocks exposed in the area are marine-derived mudstones in the lower portion of the Masuk member of the Mancos Shale. The Masuk Shale on the bench which adjoins the proposed site on the east and west is covered by a five- to twenty-foot thick layer of terrace gravel of Quaternary age. North-south trending normal faults have disrupted the strata in the region; however, no faults are known to exist within the area of the Deer Creek Waste Rock Storage Facility.

The test wells completed prior to construction identified the existence of a limited quantity of groundwater locally in the Masuk Shale. The water is most likely flowing along fractures in the strata. The rate of water migration has been shown to be extremely slow (<100 feet per year); therefore, the operations to be conducted at the waste rock site should not impact the hydrology of the area. The weathered Masuk Shale present on and near the ground surface will act as an effective barrier to prevent the surface waters from migrating to depths and intersecting groundwater.

The groundwater present in the terrace gravels should not be impacted by the waste rock site because it is located at a higher elevation than the proposed site.

In order to identify the groundwater quality characteristics of the waste rock storage facility one of the test wells completed prior to the construction of the site was developed into a long-term water monitoring well. (See Map HM-1 for location.)

Four samples were collected in 2010. The analysis, along with water depth, is listed in Table 46. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office. It is a well known fact that the Mancos Shale typically contains large quantities of soluble minerals such as gypsum; therefore, any water passing through it will be naturally high in dissolved solids. Samples at the waste rock well verify this condition.

B. Cottonwood/Wilberg Mines - Waste Rock Storage Facility

The Cottonwood/Wilberg Waste Rock Storage Facility is located on the west side of the Wilberg Mine road approximately 1.5 miles south of the Wilberg Mine. The geology of the proposed waste rock site is fairly simple and straightforward. The site is located on the southern flank of East Mountain to the south of Newberry Canyon. Rocks exposed in the area are marine-derived mudstones in the lower portion of the Masuk member of the Mancos Shale. The Masuk Shale on the bench which adjoins the proposed site on the north and east is covered by a five- to twenty-foot thick layer of terrace gravel of Quaternary age. North-south trending normal faults have disrupted the strata in the region; however, no faults are known to exist within the area of the waste rock site.

In order to identify the groundwater quality characteristics of the waste rock storage facility one of the test wells completed prior to the construction of the site was developed into a long-term water monitoring well. (See Map HM-1 for location.)

Four samples were collected in 2010. The analysis, along with water depth, is listed in Table 46. Values are in milligrams per liter unless otherwise noted. Raw data is on file at the Energy West Main Office. It is a well known fact that the Mancos Shale typically contains large quantities of soluble minerals such as gypsum; therefore, any water passing through it will be naturally high in dissolved solids. Samples at the waste rock well verify this condition.

VIII. EFFECTS OF MINING AND SUBSIDENCE ON HYDROLOGY

Since the development of the PacifiCorp mining complex on East and Trail mountains, coal has been extracted causing the partial collapse of the immediate overburden strata and, ultimately, surface subsidence. This occurs in areas of retreat mining in room and pillar sections and in areas of longwall mining. All areas with potential for subsidence are monitored annually. (See annual Subsidence Monitoring reports.)

The springs and surface waters above all areas of mine workings are being monitored closely to measure the effects of mining. No mining-related changes to the springs or surface waters have been identified in the data collected. The water flowing into the mine workings, although temporarily diverted or detained, has not had an impact on the surface waters of East and Trail mountains or the surrounding area.

IX. SUMMARY

PacifiCorp has been conducting a water monitoring program in the area of its underground coal mines in Emery County, Utah in accordance with federal and state regulations. The program has been in existence since 1977, and this is the thirty-third annual report submitted concerning the hydrology.

From 1982 to 1984 the Western United States, especially Utah, experienced an unprecedented wet cycle of precipitation. The pattern changed in 1985 with conditions returning to slightly above normal. During the 1986 water year, the extremely wet trend returned, and the upper Colorado River Basin experienced above average precipitation. The 1987 weather pattern changed dramatically with near normal valley precipitation and mountain snowfall much below normal. The resulting 1987 runoff was substantially below normal. The drought continued from 1988 through 1992 with runoff amounts much below normal for six consecutive years. The 1993 runoff improved substantially with above average flow conditions occurring in most river basins. In 1994, drought conditions returned throughout much of the West. From 1995 through 1999, water supplies were much improved with above average runoff in Emery County. In 2000, weather conditions changed dramatically and the resulting runoff was much lower than normal. Precipitation was variable during 2001 and runoff values continued below normal though the year. The drought continued into

2002 with much lower precipitation and runoff was near-record low levels for most streams in Emery County. The 2003 water year was nearly as severe as 2002 with flows less than 40%. The extreme dry trend continued through 2004 with precipitation and runoff much below average although 2004 was much improved over the previous 4 years. Finally, in 2005 wet conditions returned to the West and resulted in improved water supplies in the Huntington Creek drainage. Water supplies continued to improve and runoff in 2006 was substantially higher than in 2005. Most local reservoirs filled to capacity. However, extreme drought returned to the region once again in 2007. Below average precipitation and snowfall coupled with dry and hot conditions in March and April resulted in greatly reduced water supplies which, in turn, severely restricted irrigation water supplies during August and September. From the 2008 to 2010 water years, drought conditions have eased in the region, filling the reservoirs to capacity, resulting in more abundant water supplies for agriculture and culinary uses.

The data collected in 2010 continued to show the relationship between the variation in surface water quantity and precipitation, but the hydrologic monitoring completed on East and Trail mountains to date has failed to identify any change in the quantity or quality of ground or surface water which can be attributed to mining on the East and Trail Mountain properties.