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#4714

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November 20 2014

Utah Coal Program  
Utah Division of Oil, Gas, and Mining  
1594 West North Temple, Suite 1210  
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Salt Lake City, Utah 84114-5801

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**Subj: Clean Copy Resubmittal for the Cottonwood/Wilberg MRP, PacifiCorp, Cottonwood/Wilberg Mine C/015/0019, Task ID 4714, Emery County, Utah.**

PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company "Energy West" as mine operator, hereby resubmits the clean copies to amended Cottonwood/Wilberg Mine MRP, Volume 1, Part 2, Division Task ID #4714. Energy West mistakenly erred in submitting the text section with inconsistent pagination and also did not remove the SW monitoring sites off Map HM-1B. Please replace the text section and the map from the November 14, 2014 clean copy submittal with the information of this submittal

Energy West is regretful of the mistake but hopeful this submittal clears up any discrepancies. If you have any questions concerning this submittal, please contact Dennis Oakley at 435-687-4825.

Sincerely,

A handwritten signature in blue ink that reads "Kenneth S. Fleck".

Kenneth Fleck  
Geology and Environmental Affairs Manager

Cc: file

Encl

Volume 1, Part 2, pgs 44 - 56  
Appendix A (Monitoring Location Map)

C/015/019 Incoming



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November 14 2014

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PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company "Energy West" as mine operator, hereby submits the clean copies to amended Cottonwood/Wilberg Mine MRP, Volume 1, Part 2, Division Task ID #4714. Please stamp and incorporate into the proper locations in the MRP as outlined in the attached C2 Form.

Because the pagination changed in Volume 1, Part 2, we have included a page of the Table of Contents that shows the corrected page numbers. If you have any questions concerning this submittal, please contact Dennis Oakley at 435-687-4825.

Sincerely,

Kenneth Fleck  
Geology and Environmental Affairs Manager

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Encl C2 Form  
Volume 1, Table of Contents, first page  
Volume 1, Part 2, pgs 44 - 56  
Appendix A (Monitoring Requirements, Monitoring Schedule, Monitoring Location Map, Parameter List)



**Cottonwood/Wilberg Mines**

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HYDROLOGY AND GEOLOGY GENERAL REQUIREMENTS

The Cottonwood/Wilberg Mine area is located in the central portion of the Wasatch Plateau Coal Field in Emery County, Utah (Figure 2-1). Generally, this area is a flat-topped mesa surrounded by heavily vegetated slopes which extend to precipitous cliffs leading to the valley below. The plateau generally has a vertical relief of up to 2,500 feet, rising from Castle Valley below. The following discussion summarizes the structural geology, stratigraphy, hydrology, and economic coal deposits of the region and the Wilberg Mine area.

Hydrologic Monitoring

The Cottonwood/Wilberg Mine is part of the East Mountain property in which PacifiCorp holds coal mining interests. The East Mountain property encompasses multiple adjacent mining operations including; Cottonwood/Wilberg Mine, Deer Creek Mine, and the reclaimed Des Bee Dove Mine (Phase III Bond Released approved August 2014). PacifiCorp has collected comprehensive baseline information on the hydrologic resources of the East Mountain property that consists of ground and surface water investigations, climatological information, baseline cumulative impact area information, and probable hydrologic consequence determination to ensure the protection of the hydrologic balance of the Cottonwood/Wilberg permit area and East Mountain property. This information is found in Volume 9, Volume 9A, and/or Volume 9B.

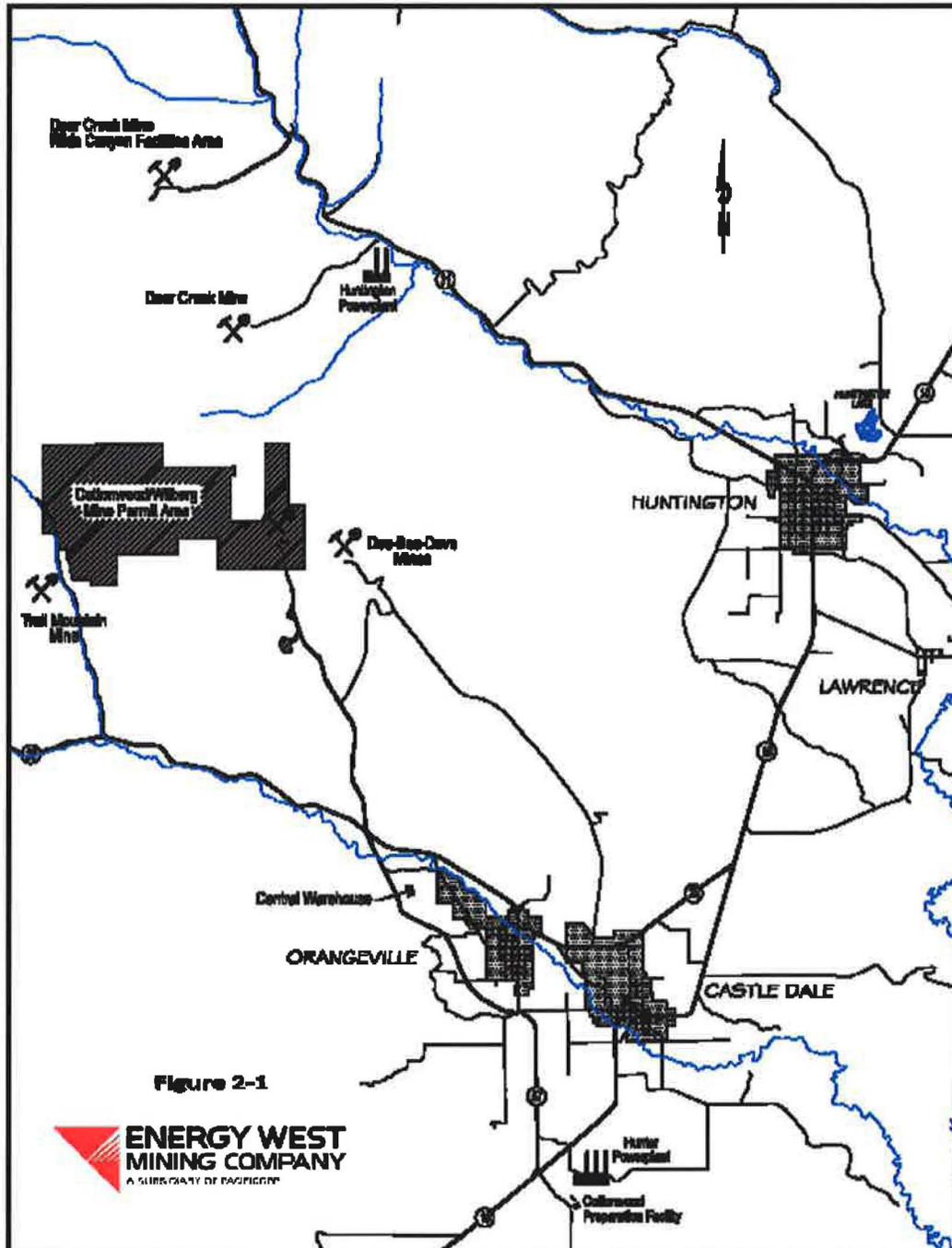
As part of the requirements of the Utah Coal Regulations R645-301-731.221 through R645-301-731.225, a hydrologic monitoring program has been established in cooperation with Utah Division of Oil, Gas, and Mining. The hydrologic monitoring program involves collecting water quality and quantity samples of ground and surface water for specific sites pertinent the Cottonwood/Wilberg Mine permit area. Refer to Part 2, Appendix A for all required ground and surface water monitoring sites, required sampling parameter list, and map showing site locations.

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## Cottonwood/Wilberg Mines

### Data Collection

Utah Power & Light Company has been collecting data regarding the Wilberg Mine area and adjacent properties since 1971. As a result, 118 exploration drill holes have been completed from the surface wherein data were collected regarding the coal seams and enclosing strata (see Map 2-1).



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## Cottonwood/Wilberg Mines

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Nine of these holes were core drilled through the coal zone and all were geophysically logged. Generally, these surface holes are located on about 1/2 to 3/4 mile centers. In addition to these holes, approximately 475 holes have been drilled from within the mines which provide valuable data on as close as 500 foot centers.

The coal seams exposed on outcrop and within the mine workings have been mapped in detail providing data which is valuable in understanding the coal geology.

The interpretations made herein are based on data collected from all of the above sources in addition to the published regional data. All of these data allow the construction of a geologic and hydrologic model which represents the conditions present in the area of the Cottonwood/Wilberg Mine and surrounding areas.

The applicant has made a practice of submitting to the BLM, each year, copies of both lithologic and geophysical logs of all drill holes, surface and underground, which are drilled within federal leases or on fee land. At the time the mine permit was completed, copies of all logs had been submitted to the BLM. This practice will continue throughout the lifetime of the Cottonwood/Wilberg Mine.

### Structure

The geologic structure of the Cottonwood/Wilberg Mine area is fairly simple. The strata are gently down-folded in the area of the Straight Canyon syncline which is present in the northwest portion of the Cottonwood/Wilberg Mine area (see Map 2-2). Dips in the syncline range from two to six degrees with the north limb dipping the steepest.

The Hiawatha Seam generally strikes N60 E and dips one to three degrees in a northwest direction throughout the area of the current Cottonwood/Wilberg Mine workings. However, to the northwest of the Straight Canyon syncline both the Hiawatha and Blind Canyon Seam dip in a southeast direction at three to five degrees. The dip and strike of the coal seams can be better visualized on Map 2-2 which is included herein.

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## Cottonwood/Wilberg Mines

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The strata within the property have been offset by a series of north-south trending fault zones. Generally, these faults are nearly vertical and do not have significant amounts of fault gouge or drag associated with them. One of the major faults present in the region, the Pleasant Valley Fault, has been intersected in the Wilberg Mine (refer to Map 2-2).

The Pleasant Valley Fault consists of two parallel fractures which are about 150 feet apart (see Map 2-2 and cross sections 2-3). Its total displacement, where it was intersected in the Deer Creek Mine to the north is 150 feet with its downthrown side on the east. The displacement diminishes to less than one foot where it was intersected in the Wilberg Mine.

Another north-south trending fault is present to the east of the Pleasant Valley Fault. This fault, the Deer Creek Fault, limits the eastward development of the Wilberg Mine. The displacement of the Deer Creek Fault ranges from 100 to 170 feet with the east block being downthrown.

A fault system has been identified within the Wilberg Mine area which trends in a northeast-southwest direction along the Straight Canyon synclinal axis (see Map 2-2). In the northeast corner of federal lease U-084923, this structure called the Roans Canyon Fault graben, consists of up to six normal faults with displacements up to sixty-five feet.

### Stratigraphy

The rock formations exposed in the Cottonwood/Wilberg Mine area range from Upper Cretaceous to Tertiary in age (see Figure 2-2). These formations in ascending order are the Masuk shale member of the Mancos Shale, Starpoint Sandstone, Blackhawk, Castlegate Sandstone, Price River, North Horn, and Flagstaf Formations. The coal deposits are restricted to the lower portions of the Blackhawk Formation.

The Masuk Shale is the upper member of the Mancos Shale. It consists of light to medium gray marine mudstones. Usually this formation weathers readily forming slopes which are often covered by debris. This formation is generally devoid of water.

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Starpoint Sandstone

Overlying and intertonguing with the Masuk Shale is the Starpoint Sandstone. In this area the Starpoint consists of three or more cliff-forming massive sandstones totaling about 400 feet in thickness. Generally, they are fine to medium-grained and moderately well-sorted. The upper contact of the Starpoint is usually quite abrupt and readily identifiable on the outcrop. Locally, the Starpoint Sandstone exhibits aquifer characteristics.

Blackhawk Formation

The Blackhawk Formation consists of alternating mudstones, siltstones, sandstones and coal. Although coal is generally found throughout the Blackhawk Formation, the economic seams are restricted to the lower 150 feet of the formation. The sandstones contained within the Blackhawk Formation are fluvial and increase in number in the upper portions of the formation. Many of these tabular sandstone channels form local perched water tables. The total thickness of the Blackhawk Formation in the Cottonwood/Wilberg Mine area is about 750 feet.

Castlegate Sandstone

The Castlegate Sandstone generally caps the escarpment which surrounds the mine portal area. The Castlegate consists of about 250 feet of coarse-grained, light-gray, fluvial sandstones, pebble conglomerates, and subordinate zones of mudstones. Although this sandstone is very permeable, it lacks water because of insufficient recharge.

Price River Formation

The Price River Formation overlies the Castlegate Sandstone. The formation is about 500 feet thick and forms slopes which extend upward from the Castlegate escarpment. Fine-grained, poorly sorted, sandstones dominate the Price River Formation but some mudstones are present. The Price River Formation generally lacks water.

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# Cottonwood/Wilberg Mines

Utah Geological and Mineralogical Survey Monograph Series No. 2 1972

**Figure 2-2**

**Stratigraphy of East Mountain  
(Doelling, 1972)**

System	Series	Stratigraphic Unit	Thickness (feet)	Description		
<b>CRETACEOUS</b>	Eocene	Green River Formation	-	Chiefly greenish lacustrine shale and siltstone.		
		Wasatch Group	Colton Formation	300 - 1,500	Varicolored Shale with Sandstone and limestone lenses, thickness to the north.	
	Flagstaff Limestone		200 - 1,500	Dark yellow-gray to cream limestone, evenly bedded with minor amounts of sandstone, shale, and volcanic ash, ledge former.		
	North Horn Formation (Lower Wasatch)		500 - 2,500	Varigated shales with subordinate sandstone, conglomerate and freshwater limestone, thickens to north, slope former.		
	<b>CRETACEOUS</b>	? Maestrichtian	Mesaverde Group	Price River Formation	600 - 1,000	Gray to white gritty sandstone interbedded with subordinate shale and conglomerate, ledge and slope former.
		Campanian		Castlegate Sandstone	150 - 500	White to gray, coarse-grained often conglomeratic sandstone, cliff former, weathers to shades of brown.
			Blackhawk Formation MAJOR COAL BEAMS	700 - 1,000	Yellow to gray, fine- to medium-grained sandstone, interbedded with subordinate gray and carbonaceous shale, several thick coal seams.	
			Star Point Sandstone	90 - 1,000	Yellow-gray massive cliff-forming sandstone, often in several tongues separated by Masuk Shale, thickens westward.	
		Santonian	Mancos Shale	Masuk Shale	300 - 1,300	Yellow to blue-gray sandy shale, slope former, thick in north and central plateau area, thins southward.
		Coniacian		Emery Sandstone COAL (?)	50 - 800	Yellow-gray friable sandstone tongue or tongues, cliff former, may contain coal (?) in south part of plateau if mapping is correct, thickens to west and south. Coal may be present in subsurface to west.
Blue Gate Member				1,500 - 2,400	Pale blue-gray, nodular and irregularly bedded marine mudstone and siltstone with several arenaceous beds, weathers into low rolling hill and badlands, thickens northerly.	
Turonian		Peron Sandstone Member MAJOR COAL BEAMS		50 - 950	Alternating yellow-gray sandstone, sandy shale and gray shale with important coal beds of Emery coal field, resistant cliff former, thickens to south.	
Cenomanian		Tumamuk Shale Member	400 - 650	Blue-gray to black sandy marine slope forming mudstone.		
Albian		Dakota Sandstone MINOR COAL	0 - 80	Variable assemblages of yellow-gray sandstone, conglomerate shale and coal. Beds lenticular and discontinuous.		

Generalized section of rock formations, Wasatch Plateau coal field.

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## North Horn Formation

The North Horn Formation is about 850 to 900 feet thick in the Cottonwood/Wilberg Mine area. Mudstones dominate the rock types present. These mudstones are generally grey to light brown in color. Localized, lenticular sandstone channels are present in this formation throughout.

These sandstone beds are more common near the upper and lower contacts of the formation and many times host localized perched water tables.

### Flagstaff Formation

The youngest formation exposed in the area is the Flagstaff Formation. It consists of white to light-gray, lacustrine limestone. An erosional remnant of 100 to 150 feet of this formation remains forming a cap on the highest plateaus of the area. The formation is fairly well fractured allowing surface water to percolate down to lower strata.

### Economic Coal Occurrences

Three economic coal seams are present on the property which hosts the Cottonwood/Wilberg Mine: the Hiawatha, Cottonwood, and the Blind Canyon Seams. The current workings of the mine are located in the basal or Hiawatha Seam.

### Hiawatha Seam

The Hiawatha Seam is of minable thickness in both the southern and extreme northern portions of the East Mountain property (see Map 2-4). This seam which rests directly on the Starpoint Sandstone ranges in thickness from 16 feet to less than 5 feet. The Hiawatha Seam is not present throughout a major portion of the property. This lack of coal is due to a major distributary river channel which flowed through the coal swamp in an easterly direction.

### Blind Canyon Seam

The second major minable seam on the Cottonwood/Wilberg Mine property is the Blind Canyon Seam. This seam is located from 14 to 140 feet above the Hiawatha Seam (see Map 2-5). The average separation between these seams is 70 to 80 feet but does increase up to 140 feet in the southern portion of the property. The Blind Canyon Seam is of minable thickness through most of the permit area and in part is mined through the Deer Creek Mine (see Map 2-6). This seam ranges in thickness from 16 feet to less than 5 feet. The thickness of the seam thins to less than 5 feet in the southwest portion of the property.

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## Cottonwood/Wilberg Mines

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### Cottonwood Seam

The Cottonwood Seam is located stratigraphically between the Hiawatha and Blind Canyon Seams. This seam is located generally about 70 to 90 feet above the Hiawatha Seam (see Map 2-7) but is found in minable thickness only in the south half of lease U-47978.

feet in the southern limit of minable Blind Canyon Seam.

### Overburden

The coal reserves in the Wilberg Mine area within the Hiawatha Seam are covered by up to 2,300 feet of overburden. Because the topography of these lands displays much relief, the thickness of the overburden is highly variable (see Maps 2-10, 2-11 and cross sections 2-3). The overburden is the greatest in the western and northern portions of the property where the plateau is capped with the Flagstaff Limestone. In these areas the overburden ranges from 2,200 - 2,300 feet. However, the overburden above most of the coal is less than 1,800 feet.

### Chemical Composition

In the development of the Cottonwood/Wilberg Mines and associated surface facilities, some of the strata and alluvium covering the coal seam was excavated to accommodate the facilities. In order to better understand the chemical and physical characteristics of the rock material that was excavated, over 130 samples from both outcrop and core from drill holes were analyzed.

Four drill holes were selected as data points in which core samples were analyzed for their chemical and physical properties (see Figure 2-4). These core drill holes were selected to give the best representation of the same rock sequence which was excavated at the Cottonwood/Wilberg Mine portals and that which will be excavated during the mines life. Two of the holes were drilled from the surface of East Mountain (EM-12C and EM-23C), and two of the holes were drilled from within the Deer Creek and Wilberg Mines (A-25 and B-124).

Samples of rock core were collected from each lithologic unit that was penetrated within the selected drill holes. These samples consisted of a representative section of core averaging 0.3' in length usually taken from the center of each lithologic unit. Samples of rocks which were immediately overlain by minable coal seams were collected at the coal seam contact. The rock

zones sampled and the sample numbers are shown on the core logs for each drill hole (see core logs in Appendix VI.)

In light of the recommendation made by the Office of Surface Mining (OSM) each sample was analyzed for the following:

pH	% Iron
EC (electrical conductivity)	% Zinc
% Calcium	% Sulfate
% Sodium	% Molybdenum
% Magnesium	% Boron
SAR (Sodium Absorption Ratio)	Alkalinity (Equivalent $\text{CaCO}_3$ )

All of the samples of carbonaceous mudstone that were collected were also analyzed for their percent

pyrite/marcasite content. The samples collected from immediately below a minable coal seam were analyzed for their clay content. In addition to these analyses, four or five representative samples of each of the rock types present, sandstone, siltstone, mudstone, interbeds (thinly laminated siltstone and mudstone), carbonaceous mudstone, and coal were tested for their physical properties. These

samples were crushed to a size of -1/4" mesh and the product was screened for its percent sand, silt and clay content.

Front Range Labs, Inc., of Fort Collins, Colorado, was selected to do the analytical work because of their expertise in testing the chemical and physical properties of coal overburden and their ability to perform all of the required analytical work.

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PacifiCorp had previously established an excellent data base regarding the coal quality within the East Mountain property. Since 1979, samples have been collected from within the Deer Creek and Cottonwood/Wilberg Mines on a daily basis. These samples were analyzed by Standard Laboratories, Inc., in Huntington, Utah prior to 1987 and by CT&E, in Huntington, Utah since

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that time. Some of the data reported herein have been gleaned from this work.

The findings of these analyses are separated by formation, rock type and coal seam in Table A and

the individual analysis are found in Appendix VI. For each rock type the mean and standard deviations have been calculated for each of the various chemical and physical parameters. In general, the chemical content within a rock type is moderately consistent as shown by the sandstones and siltstones are variable due to sulfate enrichment by groundwater in some of these rock types and not others.

The sulfur content of the Hiawatha, Cottonwood, and Blind Canyon Seams averages 0.52%, and generally ranges from 0.49% to 0.59%. Of this sulfur content, 79% is in the form of organic sulfur and 16 % is in the form of pyritic including marcasite. The remainder is in the form of sulfate.

Generally, the physical tests which were completed on these samples indicate that all rock types present have the tendency to resist reduction of grain size when excavated and reclaimed and only a minimum of clay-sized particles will be liberated. As may be expected, the coarser-grained rocks, sandstones and siltstones produced much less clay-sized particles when crushed. Generally, the dominant rock type in the area of the Cottonwood/Wilberg Mine is sandstone; therefore, any interpretations made should recognize this fact.

In addition to the aforementioned analyses that were made of the general overburden, the strata immediately above and below the coal seam were analyzed for their potential alkalinity and pyrite/marcasite content and the strata immediately below the coal was analyzed for clay content as well. The results of these tests are as follows:

(NOTE: See Appendix VI for Raw Data.)

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**Table A**  
**Analytical Summary Overburden Analysis**

Lithology	Number of Samples		Chemical Tests											Physical Tests				Crushed Rock Texture	
	Chemical Tests	Physical Tests	Ca Meg/L	Mg Meg/L	Na Meg/L	<sup>1</sup> SAR	Fe ppm	Zn ppm	SO <sub>4</sub> -S ppm	Mo ppm	B ppm	pH (Paste)	E.C. <sup>2</sup> amhos/cm	Sat. %	Pyrite FeS <sub>2</sub> %	Sand %	Silt %		Clay %
<b>Blackhawk Formation:</b>																			
Sandstone:	26	2																	
Mean			4.37	8.18	2.13	1.05	8874	11.47	409.6	.1	.06	8.0	1.55	21.7	-	84.5	11.0	4.5	Sandy Loam
S.D.			3.91	5.13	1.08	0.69	6672	9.7	353.1	0	.06	0.96	0.89	3.36	-	0.71	1.41	2.12	
Siltstone:	24	5																	
Mean			3.06	6.24	2.30	1.69	14512.88	38.26	464.41	.1	0.18	7.88	1.41	20.81	2.3	71.6	17.8	10.6	Sandy Loam
S.D.			2.63	7.23	2.78	3.72	8782.4	21.29	1222.63	0	0.16	1.08	1.72	1.82	0	23.5	16.57	7.7	
Mudstone:	24	4																	
Mean			3.12	3.13	4.70	4.28	11074.13	70.31	233.96	.1	0.28	8.0	1.10	23.99	-	71.5	20.5	8.0	Sandy Loam
S.D.			2.36	2.89	12.76	12.58	5350.17	79.99	275.10	0	0.23	0.31	1.12	4.88	-	13.77	15.2	3.56	
Interbeds:	15	3																	
Mean			4.34	7.98	2.79	1.30	10982.13	21.58	346.95	.1	0.12	8.05	1.58	20.56	-	75.33	17.00	7.67	Loamy Sandy
S.D.			3.13	6.37	1.85	1.36	6584.59	9.97	359.46	0	0.11	0.23	0.92	1.33	-	7.64	9.54	3.06	
Carb- mudstone:	25	3																	
Mean			6.19	6.51	3.7	2.4	9933.76	58.04	438.86	.1	0.42	7.53	1.54	34.76	2.3	73.33	18.00	5.67	Loamy Sandy
S.D.			4.85	8.42	4.85	3.98	6112.12	38.94	378.81	0	0.34	0.85	1.14	9.94	3.29	20.60	16.82	1.53	
Coal (Blind Canyon)	8	0																	
Mean			1.55	1.81	1.68	1.63	2089.38	10.19	103.88	.1	.06	8.0	.36	60.66	0.44				
S.D.			0.59	2.88	1.35	1.27	2557.56	8.82	66.88	0	.05	0.25	.05	18.59	0.06				
Coal (Hiawatha)	2	0																	
Mean			1.52	2.85	1.41	1.58	2532.41	10.82	97.32	.1	0.12	7.95	0.34	60.24	0.51				
S.D.			0.66	3.64	0.95	1.18	2718.02	8.41	72.14	0	0.21	0.24	0.07	16.84	0.06				
Coal (Cottonwood)	1	0																	
Mean			2.50	3.3	0.47	2.21	465	55.0	321.0	.96	0.43	7.40	1.40	21.86	0.49				
S.D.															0.07				
<b>Starpoint Sandstone</b>																			
Sandstone:	11	4																	
Mean			5.14	8.58	3.42	3.57	3798	9.47	1457	.1	0.11	6.76	2.49	30.46	-	90.75	4.75	4.50	Sandy Loam
S.D.			3.89	4.69	2.97	5.18	2965	6.98	2578	0	0.24	1.54	1.20	4.8	-	4.80	3.50	1.91	

1 SAR = Sodium Absorption Ratio  
 2 EC = Electrical Conductivity

NOTE: See Appendix VI for Raw Data

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Cottonwood/Wilberg Mines

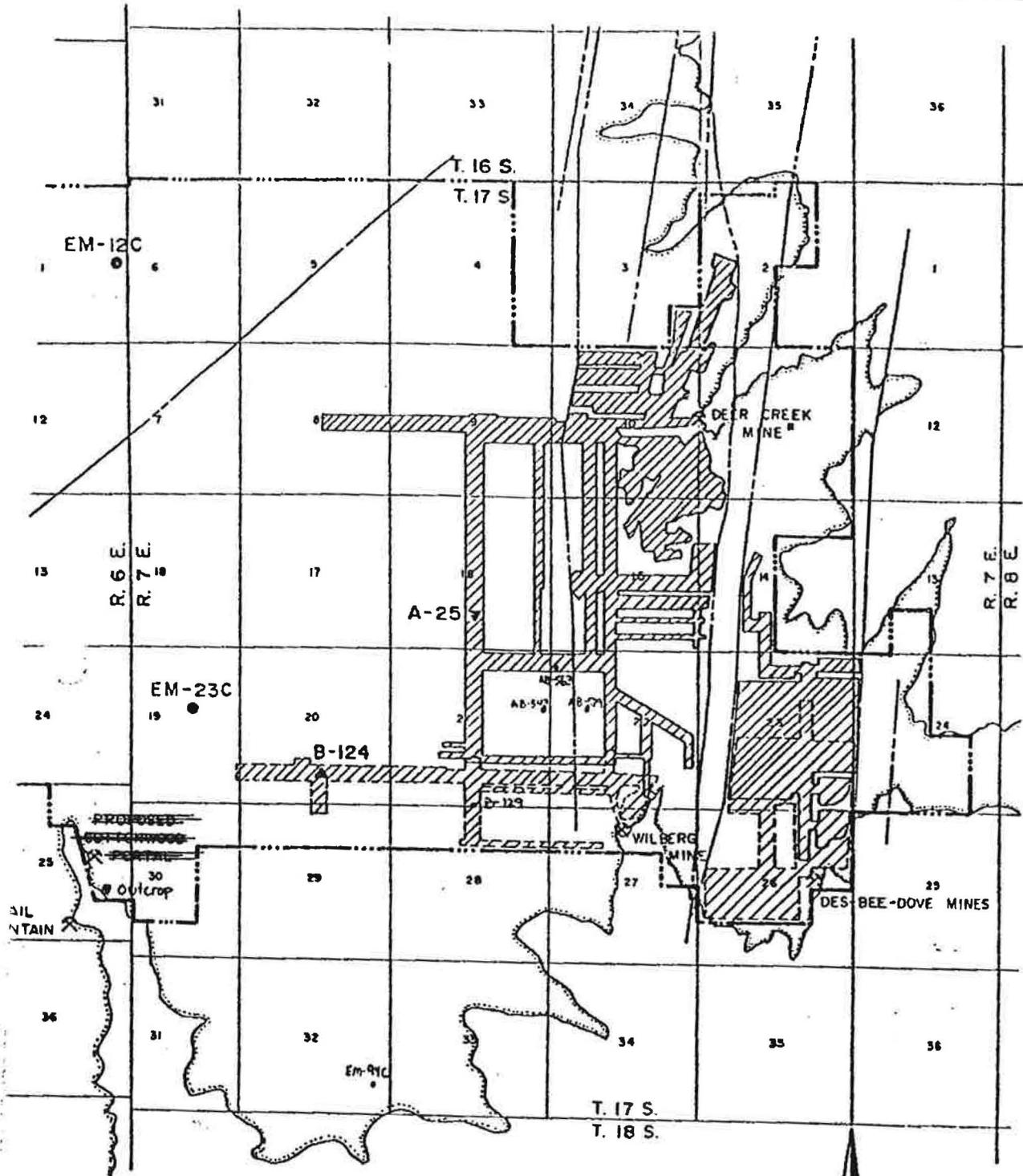


FIGURE 2.4  
DATA LOCATION MAP

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SCALE: 1" = 4400'

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## Cottonwood/Wilberg Mines

Zone Sampled	# Samples	pH	% FeS Pyrite/Marcasite	% Clay	Potential Alkalinity Equivalent (mg/L CaCO <sub>3</sub> )
Hiawatha Seam Roof	3	7.8	3.3	-	281,400
Hiawatha Seam Floor	3	7.5	1.3	5.5	127,300
Cottonwood Seam Roof	2	7.8	0.5	5.2	222,200
Cottonwood Seam Floor	1	8.7	0.4	10.5	70,200
Blind Canyon Seam Roof	2	8.1	0.5	-	252,600
Blind Canyon Seam Floor	3	8.3	1.3	9.0	3,500

The analyses of the overburden samples tested clearly show that no toxic or hazardous materials are present. The material excavated near the portal site is slightly alkaline. Generally, the soils in this region which are derived from the strata tested are alkaline as well. The overburden material which has been excavated will not degrade the quality of the soils in the area or of the groundwater percolating through this material.

The operator commits to sample roof, floor and mid-seam material in active sections annually. A representative sample will be taken in areas mined within a given year. The locations where the samples are taken will be sufficient to include the various lithologies encountered during mining. These locations will be plotted on a map for future reference. The samples will be analyzed for acid- and/or toxic-forming potential in accordance with the Divisions Guidelines for the Management of Topsoil and overburden. The sample location map and laboratory analyses, including raw data, will be submitted to the Division annually.

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# **Cottonwood/Wilberg Mine Water Monitoring Program**

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A**

**For detailed information of the hydrology of the East Mountain CHIA,**

**refer to Volume 9, Hydrologic Section:**

**Cottonwood/Wilberg Mine, Deer Creek Mine**

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**PACIFICORP  
ENERGY WEST  
HYDROLOGIC MONITORING PROGRAM  
WILBERG/COTTONWOOD MINE**

***I. MONITORING LOCATIONS – WILBERG/COTTONWOOD MINE***

**A. Surface Water Hydrology** (for maps refer to Deer Creek, Wilberg/Cottonwood Mine: Volume 9 Map HM-1B)

**1. Cottonwood Creek Drainage System**

a. ***Cottonwood Canyon Creek*** (refer to Deer Creek and Wilberg/Cottonwood Mine: Volume 9 Map HM-1B)

- (1) CCC01 - USGS Flume:  
(Approximately 7800 feet downstream from the outlet culvert for the disturbed area.) 1500 feet North, 200 feet East of the Southwest corner of Section 31, Township 17 South, Range 7 East.

b. ***Grimes Wash*** (refer to Deer Creek and Wilberg/Cottonwood Mine: Volume 9 Map HM-1B)

- (1) GWR01 - Right Fork:  
(Approximately 1500 feet upstream of the inlet culvert for the disturbed area.) 550 feet North, 1500 feet West of the Southwest corner of Section 22, Township 17 South, Range 7 East.
- (2) GWR02 - Left Fork:  
(Approximately 50 feet upstream of the inlet culvert for the disturbed area.) 200 feet South, 2350 feet East of the Northwest corner of Section 27, Township 17 South, Range 7 East.
- (3) GWR03 - Below the mine:  
(Approximately 500 feet downstream of the outlet culvert below the disturbed area.) 1770 feet South, 1820 feet West of the Northeast corner of Section 27, Township 17 South, Range 7 East.

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Appendix A

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2. **Reclamation Monitoring:** Following final reclamation, backfilling and grading monitoring will be conducted at points immediately above and below the reclaimed site.

**B. Groundwater Hydrology**

1. **Piezometric Data**

The Wilber/Cottonwood Mine has been sealed since 2001. There are no accessible in-mine sampling locations.

5. **In-Mine Water Locations**

The Wilber/Cottonwood Mine has been sealed since 2001. There are no accessible in-mine sampling locations.

6. **Waste Rock Wells** (refer to Deer Creek and Wilberg/Cottonwood Mine: Volume 9 Map HM-1B)

- a. Cottonwood

**C. UPDES Monitoring Locations**

- a. ***Wilberg/Cottonwood Mines***

UPDES UT0022896

001- Mine Discharge @ Cottonwood Canyon (TMA)

003- Sediment Pond @ Mine Facilities

005- Sediment Pond Discharge @ Waste Rock Site

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**II. MONITORING SCHEDULE** *(see enclosed monitoring schedules for operational, baseline, and reclamation monitoring)*

**A. Field Measurements**

Field Measurements collected during quality sampling: Listed below are the sites which will be monitored by PacifiCorp - Energy West in accordance with the guidelines established by DOGM; i.e.

- Date and Time
- Flow
- pH
- Temperature
- Conductivity
- Dissolved oxygen (perennial streams only)

**Surface Monitoring**

Surface monitoring locations will be field monitored quarterly for all field parameters, except Indian Creek - monitoring to be conducted during baseflow only.

**1. Cottonwood Canyon Creek**

- a. Cottonwood Canyon Creek
  - (1) CCC01 - USGS Flume
- b. Grimes Wash
  - (1) GWR01
  - (2) GWR02
  - (3) GWR03

**Groundwater Monitoring**

There is only one groundwater monitoring site for the Wilberg/Cottonwood Mine.

- 1. Waste Rock Wells
  - a. Cottonwood

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**UPDES Monitoring**

1. Wilberg/Cottonwood

UPDES sites 001, 003, and 005 will be monitored as specified in the individual permits.

**Reclamation Monitoring**

Surface Water Resources: (see enclosed summary of operational, baseline, and reclamation monitoring schedules)

Surface monitoring locations will be field monitored monthly for flow and all field parameters quarterly until bond release.

Ground Water Resources: (see enclosed summary of operational, baseline, and reclamation monitoring schedules)

Waste Rock Well: will be field monitored for level only on a quarterly basis. Monitoring will be conducted until sealing during final reclamation.

UPDES: Sites will be monitored as specified in the individual permits

**B. Quality Sampling (Laboratory Measurements)**

1. **Surface Water Hydrology:** 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 Quality (see Table 1-Surface Water Quality Parameter List). Quarterly sampling was initiated during March 1988 and will continue throughout the year; i.e., June, September, and December. Baseline analysis was performed in 2011 and will be repeated every five years there-after.

a. **Cottonwood Creek Drainage**

(1) Cottonwood Canyon Creek

(a) CCC01 - USGS Flume

(2) Grimes Wash

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- (a) GWR01
- (b) GWR02
- (c) GWR03

**Reclamation Monitoring - Surface Water Hydrology:** 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 Quality (see Table 1-Surface Water Quality Parameter List). Sampling will be conducted on a quarterly basis until bond release. Baseline analysis will be performed on the 5<sup>th</sup> and 9<sup>th</sup> years following reclamation. In no case will baseline sampling time frame exceed 5 years converting from operational to reclamation monitoring.

**2. Groundwater Hydrology**

- a. **Waste Rock Wells:** One water sample will be collected and analyzed per location quarterly. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table 2-Ground Water Quality Parameter List).

Baseline analysis was performed in 2011 and will be repeated every five years thereafter.

**Reclamation Monitoring - Groundwater Hydrology:**

- a. **Waste Rock Wells:** Waste rock wells will be sealed during final reclamation. One water sample will be collected and analyzed per location quarterly until well sealing. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table 2-Ground Water Quality Parameter List).
- b. **Post Reclamation Monitoring:** PacifiCorp commits to conduct annual surveys to identify new discharge locations within and below sealed portals. If discharge occurs, one water sample will be collected and analyzed per location quarterly. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table

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2-Ground Water Quality Parameter List). Baseline analysis will be performed on the 5<sup>th</sup> and 9<sup>th</sup> year.

**3. UPDES Monitoring Sites**

a. Wilberg/Cottonwood Mines

UPDES sites will be monitored as specified in the individual permits.

***III. ANNUAL REPORTS***

All data collected regarding the hydrology of East/Trail Mountain will be summarized by the applicant in an annual Hydrologic Monitoring Report. Copies of the report will be submitted to the Utah State Division of Oil, Gas and Mining. In addition, any raw data collected will be submitted to the Utah State Division of Oil, Gas and Mining on a quarterly basis.

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**SURFACE HYDROLOGY - RECLAMATION SAMPLING (Table 1)**

<u>Drainage System</u>	<u>Drainage</u>	<u>Location</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
<b>Cottonwood Creek Drainage System*</b>	<b>Cottonwood Canyon Creek</b>	CCC01			Field			Field			Field			Field
	<b>Grimes Wash</b>	GWR01			Operational			Operational			Operational			Operational
		GWR02			Operational			Operational			Operational			Operational
		GWR03			Operational			Operational			Operational			Operational

**GROUNDWATER HYDROLOGY - RECLAMATION SAMPLING (Table 2)**

<u>Groundwater Type</u>		<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
<b>Springs</b>	N/A												
<b>In Mine</b>	N/A												
<b>Wells</b>	<b>Cottonwood Waste Rock Well</b>			Operational			Operational			Operational			Operational
	<i>Cottonwood Waste Rock Well will be sealed during Phase I reclamation. One water sample will be collected and analyzed per location quarterly until well sealing</i>												

**UPDES SAMPLING - (Table 1)**

		<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
<b>Mine Water Discharge**</b>	TMA	As Needed Basis According to UPDES Permit Stipulations											
<b>Sediment Pond Discharge</b>	2 Outfalls	As Needed Basis According to UPDES Permit Stipulations											

**\*\*After Portal Sealing, PacifiCorp Will Monitor Down Dip For Development Of Groundwater Seeps/Springs Until Bond Release**

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**TABLE 2  
GROUND WATER BASELINE, OPERATIONAL, POSTMINING  
WATER QUALITY PARAMETER LIST**

**Field Measurements:**

- \* - Water Level or Flow
- \* - pH
- \* - Specific Conductivity (umhos/cm)
- \* - Temperature

**Laboratory Measurements: (mg/l)**

- \* - Total Dissolved Solids
- \* - Total Hardness (CaCO<sub>3</sub>)
- Acidity (CaCO<sub>3</sub>)
- Aluminum (Al) - Dissolved
- Arsenic (As) - Dissolved
- Boron (B) - Dissolved (Waste Rock Sites Only)
- \* - Carbonate (CO<sub>3</sub><sup>-2</sup>)
- \* - Total Alkalinity/Bicarbonate (CaCO<sub>3</sub>)
- Cadmium (Cd) - Dissolved
- \* - Calcium (Ca) - Dissolved
- \* - Chloride (Cl<sup>-</sup>)
- Copper (Cu) - Dissolved
- \* - Iron (Fe) - Total & Dissolved
- Lead (Pb) - Dissolved
- \* - Magnesium (Mg) - Dissolved
- \* - Manganese (Mn) - Total & Dissolved
- Molybdenum (Mo) - Dissolved
- Nitrogen: Ammonia (NH<sub>3</sub>) - reported as N
- Nitrite (NO<sub>2</sub>) - reported as N
- Nitrate (NO<sub>3</sub><sup>-</sup>) - reported as N
- \* - Potassium (K) - Dissolved
- Ortho Phosphate (PO<sub>4</sub><sup>-3</sup>) reported as P
- Selenium (Se) - Dissolved (Waste Rock Sites Only)
- \* - Sodium (Na) - Dissolved
- \* - Sulfate (SO<sub>4</sub><sup>-2</sup>)
- Zinc (Zn) - Dissolved
- \* - Cation-Anion Balance

\* Operational            - Baseline

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**TABLE 1  
SURFACE WATER (UPDES Monitoring) BASELINE, OPERATIONAL, POSTMINING  
WATER QUALITY PARAMETER LIST**

**Field Measurements:**

*	-	Water Level or Flow
*	-	pH
*	-	Specific Conductivity (umhos/cm)
*	-	Dissolved Oxygen (ppm) (Perennial Streams Only)
*	-	Temperature

**Laboratory Measurements: (mg/l)**

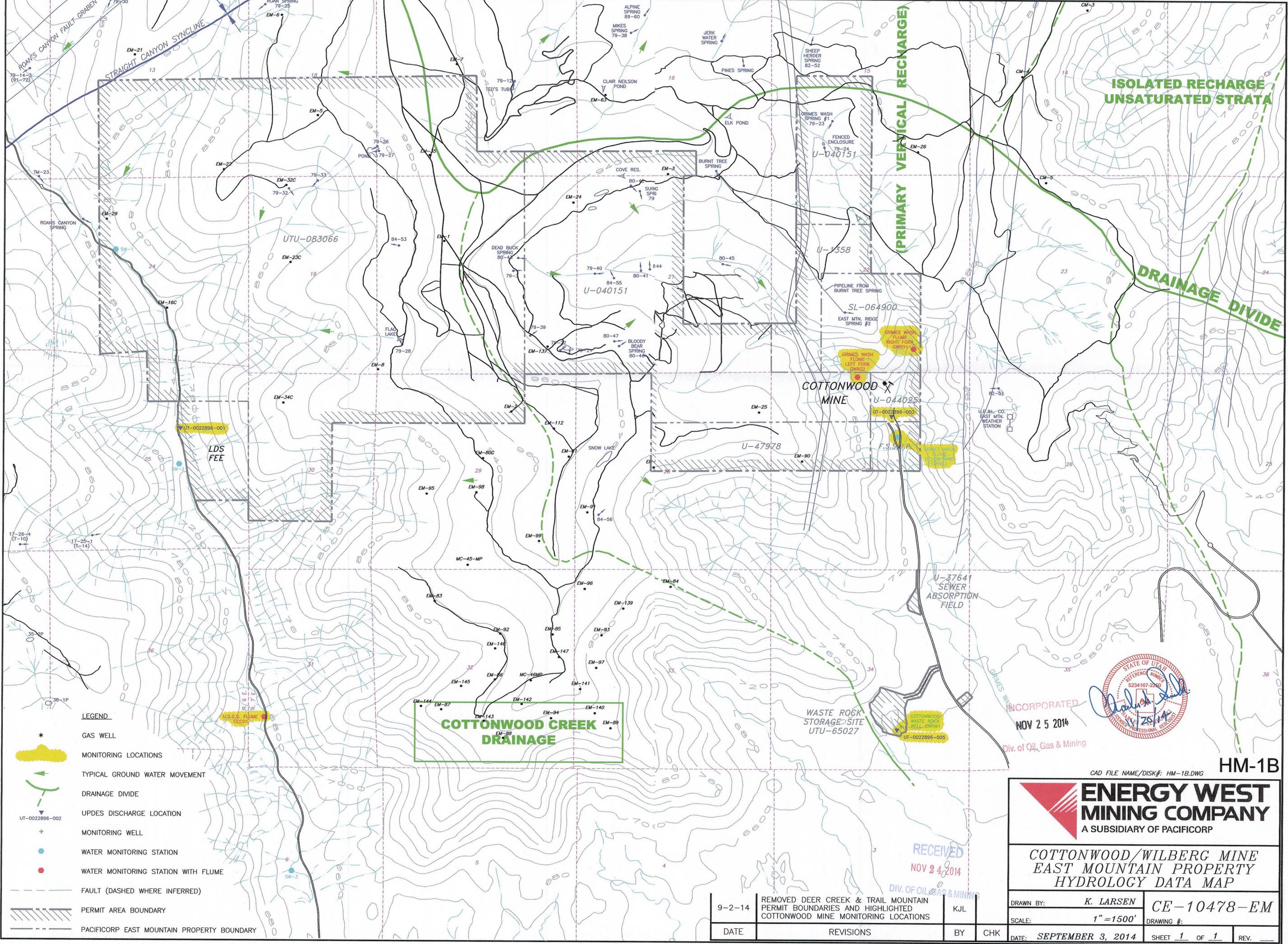
#	*	-	Total Settleable Solids (UPDES Only)
#	*	-	Total Suspended Solids
	*	-	Total Dissolved Solids
	*	-	Total Hardness (CaCO <sub>3</sub> )
		-	Acidity (CaCO <sub>3</sub> )
		-	Aluminum (Al) - Dissolved
		-	Arsenic (As) - Dissolved
		-	Boron (B) - Dissolved (Waste Rock Sites Only)
	*	-	Carbonate (CaCO <sub>3</sub> )
	*	-	Total Alkalinity/Bicarbonate (CaCO <sub>3</sub> )
		-	Cadmium (Cd) - Dissolved
	*	-	Calcium (Ca) - Dissolved
	*	-	Chloride (Cl <sup>-</sup> )
		-	Copper (Cu) - Dissolved
	*	-	Iron (Fe) - Total & Dissolved
		-	Lead (Pb) - Dissolved
	*	-	Magnesium (Mg) - Dissolved
	*	-	Manganese (Mn) - Total & Dissolved
		-	Molybdenum (Mo) - Dissolved
		-	Nitrogen: Ammonia (NH <sub>3</sub> ) - reported as N
		-	Nitrite (NO <sub>2</sub> <sup>-</sup> ) - reported as N
		-	Nitrate (NO <sub>3</sub> <sup>-</sup> ) - reported as N
	*	-	Potassium (K) - Dissolved
	*	-	Oil & Grease (UPDES & Above & Below Mine Sites Only)
		-	Ortho Phosphate (PO <sub>4</sub> <sup>-3</sup> ) - reported as P
		-	Selenium (Se) - Dissolved (Waste Rock Sites Only)
	*	-	Sodium (Na) - Dissolved
	*	-	Sulfate (SO <sub>4</sub> <sup>-2</sup> )
		-	Zinc (Zn) - Dissolved
	*	-	Cation-Anion Balance

# Construction                      \* Operational                      - Baseline

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- LEGEND**
- \* GAS WELL
  - MONITORING LOCATIONS
  - TYPICAL GROUND WATER MOVEMENT
  - DRAINAGE DIVIDE
  - UPDES DISCHARGE LOCATION
  - MONITORING WELL
  - WATER MONITORING STATION
  - WATER MONITORING STATION WITH FLUME
  - FAULT (DASHED WHERE INFERRED)
  - PERMIT AREA BOUNDARY
  - PACIFICORP EAST MOUNTAIN PROPERTY BOUNDARY

**PRIMARY VERTICAL RECHARGE**

**ISOLATED RECHARGE UNSATURATED STRATA**

**DRAINAGE DIVIDE**

**COTTONWOOD CREEK DRAINAGE**

**COTTONWOOD MINE**

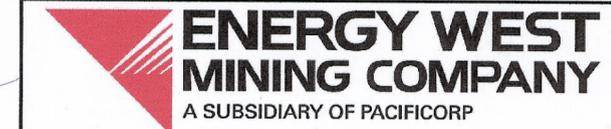
**WASTE ROCK STORAGE SITE UTU-65027**



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**HM-1B**

CAD FILE NAME/DISK#: HM-1B.DWG



**COTTONWOOD/WILBERG MINE  
EAST MOUNTAIN PROPERTY  
HYDROLOGY DATA MAP**

DRAWN BY:	K. LARSEN	CE-10478-EM
SCALE:	1" = 1500'	DRAWING #:
DATE:	SEPTEMBER 3, 2014	SHEET 1 OF 1
REV.		

DATE	REVISIONS	BY	CHK
9-2-14	REMOVED DEER CREEK & TRAIL MOUNTAIN PERMIT BOUNDARIES AND HIGHLIGHTED COTTONWOOD MINE MONITORING LOCATIONS	KJL	

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