PACIFICORP

0071 ONE UTAH CENTER

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File ACT/015/018 #2
Copy PAM

March 23, 1992

Ms. Pamela Grubaugh-Littig
Permit Supervisor
Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: RESPONSE TO INITIAL COMPLETENESS REVIEW COMMENTS, RILDA CANYON LEASE TRACTS, PACIFICORP, DEER CREEK MINE, ACT/015/018, FOLDER #2, EMERY COUNTY, UTAH

AND

PROBABLE HYDROLOGIC CONSEQUENCES (PHC) REVIEW, PACIFICORP, DES BEE DOVE MINE, ACT/015/017, DEER CREEK MINE, ACT/015/018 (INCLUDING THE PROPOSED RILDA CANYON LEASE TRACT), COTTONWOOD/WILBERG MINE, ACT/015/019, FOLDER #2, EMERY COUNTY, UTAH

Dear Ms. Littig:

Transmitted herewith please find two (2) copies of information submitted in response to the above referenced items. One (1) copy is also being hand delivered to the Price office of the Manti LaSal National Forest. The material includes the following and should be used to update Volume 9 - Hydrologic Section of the PAP as described.

REPLACE (revised to new format, R645-301-710 through R645-301-765)

Table of Contents	Pages i-iv
List of Appendices (Appendix dividers are also included)	Page v
Text Section	Pages 1 through 125

REPLACE

Maps HM-1 through HM-8 (updated and certified)

INSERT

Appendix E **Information contained in Appendix E is submitted in response to your letter regarding the probable hydrologic consequence (PHC) review dated February 10, 1992. Included is a detailed hydrologic plan to monitor possible down gradient impacts associated with mining north of the Roans Canyon Fault.**

If the information meets your approval, additional copies will be submitted at your request. Permitting of the drill hole locations in Cottonwood Canyon Creek will be initiated as soon as approval is received.

Please contact Chuck Semborski or myself if you have any concerns or comments.

Sincerely,

Val Payne
Sr. Environmental Engineer

CS/dw
Enclosure

cc: **George Morris (USFS)**
J. Blake Webster
Chuck Semborski
File

PACIFICORP - FUEL RESOURCES
HYDROLOGIC SECTION - VOLUME 9
DEER CREEK ACT/015/018 COTTONWOOD ACT/015/019 DES-BEE-DOVE ACT/015/017

RE: DOGM's review of the Probable Hydrologic Consequence (PHC), memo dated February 6, 1992

Rilda Canyon Lease Area

Division Comments:
In regards to the Rilda Canyon lease area, north of the Graben, the operator has not provided any seasonal baseline (quality and quantity) groundwater data on the aquifers above the coal seam, within the coal seam, and below the coal seam in this lease area. The lease addition cannot be approved until this necessary hydrologic and geologic data is available to the Division.

Response:

The probable hydrologic consequence (PHC) for the East Mountain Property is based on the review of all geologic and hydrologic information. The review included surface exploration holes to delineate hydrologic and geologic conditions; hydrologic analysis of the past and current mine workings; hydrologic research projects (Roans Canyon Fault Crossing, Rilda Canyon Pump Test, and North Horn mudstone swelling indices test); United States Geological Survey technical investigation; and a comprehensive monitoring program. Each aspect listed above was utilized to develop understanding necessary to project the probable impacts to the hydrologic regime.

As stated in Volume 9, pages 7 and 8, two separate groundwater zones have been identified in the East Mountain Property. The first is localized perched water tables in the North Horn Formation, the second a combination of localized perched water tables in the Blackhawk Formation and the Starpoint Sandstone, which exhibit some limited potential as a localized aquifer.

AQUIFERS ABOVE THE BLACKHAWK FORMATION (EAST MOUNTAIN SPRINGS)

The majority of the groundwater which infiltrates the surface (Flagstaff Limestone) flows down vertical fractures which intersect sandstone channel systems in the North Horn Formation. The majority of the groundwater reaching this point intersects the surface in the form of springs in the North Horn Formation (see Figures HF-3 and HF-6, Table HT-1, and pages 6-8 in Volume 9). Very little recharge intersects the Price River Formation and Castlegate Sandstone; consequently, they are not water saturated where intersected in the numerous drill holes penetrating those units. PacifiCorp has drilled a total of one hundred twenty-three (123) surface exploration holes, forty-three (43) of which were completed north

of the Roans Canyon Fault System-Rilda Canyon Lease Area (see attached table). These holes were drilled to delineate coal reserves and to document geologic and hydrologic characteristics of the formations overlying and underlying the coal seams. During surface exploration programs if drilling intersects groundwater, the quantities are reported to the Bureau of Land Management (BLM). Of the forty-three holes drilled north of the fault system-Rilda Canyon lease Area, no significant quantities of groundwater were detected (see attached table). During drilling on East Mountain limited quantities of groundwater-damp zones within sandstone channels are found to exist in the upper and lower portions of the North Horn Formation. As shown in Figure HF-6 and discussed on pages 9-10 of Volume 9, sandstone beds are more common near the upper and lower contacts of the North Horn Formation. It is common to install steel casing in these zones before drilling proceeds to the lower stratigraphic units. When drilling resumes, the cuttings from the lower stratigraphic units are lifted to the surface with compressed air/dry type drilling. This indicates the unsaturated strata-lack of recharge and reveals how effective the mudstone layers at the base of the North Horn Formation are at preventing vertical migration of groundwater. To identify and verify the existence of these bentonitic-plastic type mudstones, PacifiCorp conducted a special drilling program in 1989 to determine the rock strength and lithologic characteristics of the overburden on the East Mountain Property (Volume 9, pages 94-97). Swelling indices for two representative North Horn mudstone samples ranged from twenty-five to forty-five percent of their original volume within a two-hour period (this information was reported in the 1990 Annual Hydrologic Monitoring Report, pages 64-67).

To identify any mining related impacts to the perched aquifer systems above the mine horizon PacifiCorp monitors a significant number of springs which have been or will be undermined within the next five years (see Hydrologic Monitoring Schedule, Volume 9, Appendix A; Volume 9 Map HM-5 and text section pages 96-97). As stated in Volume 9, pages 96-97, a field verification meeting will be held each year with the government agencies involved to determine if changes in the springs monitored are required. Each year in the Annual Hydrologic Monitoring Report spring flow rates are compared to East Mountain Climatology as to how closely spring discharge follows local annual precipitation to verify any mining related impacts.

Data collected by PacifiCorp continue to show the relationship between the variation in groundwater discharge and precipitation. Hydrologic monitoring completed on the East Mountain Property has failed to identify any changes in the quantity or quality of groundwater discharge from the springs which have been undermined. Quality samples are collected from a representative group of springs from the East Mountain Property during the months of July and October. Included in the group are five springs north of the Roans Canyon Fault and four along the fault trace (detailed information concerning quantity and quality as well as a list of springs sampled is reported in the Annual Hydrologic Monitoring reports and Volume 9, Appendix A).

AQUIFERS ABOVE MINING HORIZON (PERCHED AQUIFERS WITHIN THE BLACKHAWK FORMATION)

As stated in Volume 9, pages 108-121, the Blackhawk Formation consists of interbedded layers of sandstone and mudstone separated by various mineable and unmineable coal seams. The sandstone beds/fluvial channel systems are generally massive while the mudstone layers are fine textured and have a tendency to swell when wet and decompose into an impervious clay. Because of the aquiclude formed by mudstone layers in the North Horn Formation, recharge to the Blackhawk Formation is limited, even along major fault systems. Due to the lithologic characteristics of the Blackhawk, both vertical and horizontal migration is constricted.

The interception of groundwater varies and is dependent on several factors. One of the most significant is that when the mine enters virgin country, a significant amount of water is liberated. In virtually all cases the amount of water which flows into the mine exceeds the recharge and, in time, the water inflow decreases in volume. If new areas are not mined, the discharge from the mine will decrease accordingly. As reported in the Annual Hydrologic Monitoring reports, flow rates for individual areas, including fault zones, normally decrease to less than ten percent of the initial flow rate (Volume 9, pages 108-109, cites two examples of the inflow rate reduction).

Long-term monitoring of water producing zones in both Deer Creek and Wilberg/Cottonwood mines has established that, once base flow has been reached, the flow is consistent over time. Monitoring has not indicated any seasonal or yearly variations (see Annual Hydrologic Monitoring reports for in-mine long-term flow information).

As stated in Volume 9, page 109, water discharged from a well or, in this case, underground mines, must be balanced by 1) an increase in recharge to the groundwater system, 2) a decrease in natural discharge from the system, or 3) a decrease of groundwater in storage, or by a combination of all of these. As hydrologic studies have shown and monitoring of intercepted groundwater has verified, recharge into the underground workings is limited even in areas of faults and fractures. Based on the hydrologic characteristics of the Blackhawk and the underlying Starpoint Formation (low porosity and hydrologic conductivities) and data from the surface hydrologic monitoring, decrease in the natural discharge system is considered to be only a minor factor; therefore, groundwater intercepted in the permit area is believed to be from storage. Three main areas/types of groundwater depletion occur within the permit area and are discussed in Volume 9, pages 110-118.

PacifiCorp began in-mine quality monitoring in 1977 (Volume 9, pages 30 and 118). With the collection of numerous samples throughout the extent of the mine workings, quality has remained relatively constant (see Volume 9, maps HM-2 and HM-3, and Annual Hydrologic Monitoring reports). As with the springs, the quality varies from individual sites, but quality from the individual sites remains constant versus time (Volume 9, Figure HF-8, and Annual Hydrologic Monitoring reports for baseline and operational quality from individual locations). The mines in the coal fields of the Wasatch Plateau tend to act as interceptor drains. The groundwater that is brought to the surface has a lower dissolved solids content than would have existed had the water continued its downward movement through shale

layers, dissolving increased amounts of salt with distance (Southeastern Utah Association of Governments, 1977; Vaughn Hansen Associates, Danielson et al, 1981 [Volume 9, page 118]). Volume 9, pages 119-121, also discusses post mining impacts associated with the interception of groundwater.

AQUIFERS BELOW THE LOWEST SEAM - UPPER MEMBER OF THE STARPOINT SANDSTONE FORMATION

As stated in Volume 9, page 8, data collected by PacifiCorp and government agencies indicate two separate isolated aquifer systems on the East Mountain Property; the first is localized perched water tables in the North Horn Formation, the second a combination of localized perched water tables in the Blackhawk Formation and the Starpoint Sandstone which exhibits some limited potential as a localized aquifer. Stratigraphy is the main controlling factor restricting groundwater movement and development of regional and perched aquifer systems within the East Mountain Property (stratigraphy as it relates to groundwater movement is discussed in Volume 9, pages 9-16).

The Starpoint Sandstone overlies and intertongues with the Masuk Shale (Volume 9, pages 15-17). The formation is approximately 150-200 feet in thickness and consists of at least three upward coarsening sandstone units. Mudstone units of the Masuk Shale are present above the lower two sandstone members of the Starpoint Sandstone due to the interfingering nature of the contact between the two units.

The Starpoint Sandstone, which immediately underlies the Hiawatha coal seam, exhibits some characteristics of an aquifer bur experiences little recharge. Studies by the USGS indicate that the Starpoint Sandstone is of low permeability, thus limiting its usefulness as a water producing aquifer. Most of the water discharge from the Starpoint is where it has been intersected by the major canyons in the plateau or where faulting has caused secondary permeability. Drill holes completed in the Deer Creek and Wilberg/Cottonwood mines defined the piezometric gradient in the lower Blackhawk Starpoint System and confirmed the groundwater flow to conform with the topographic relief and structural feature, i.e., regional dip, Straight Canyon Syncline, and regional faulting (see Volume 9, Figure HF-5). This, plus the fact that the Starpoint is only slightly to moderately permeable, allows only limited flow of groundwater through the formation (additional information concerning the characteristics of the Starpoint Sandstone can be found in Volume 9, pages 16-17). As documented in the Annual Hydrologic Monitoring reports, water level in the wells has remained constant even in areas of longwall extraction.

PROPOSED DOWNGRADIENT HYDROLOGIC MONITORING OF THE UPPER MEMBER OF THE STARPOINT SANDSTONE

To delineate any potential impact to the upper member of the Starpoint Sandstone-Spring Canyon Member, PacifiCorp proposes to drill a series of wells downgradient of existing and proposed mine development (see attached map). Studies by PacifiCorp (Roans Canyon Study) and routine exploration drilling on the East Mountain Property have shown that the

individual members of the Starpoint Sandstone are not hydrologically connected. If stratigraphic members of the Starpoint Sandstone below the Spring Canyon Member are penetrated during exploration drilling, water utilized for or intercepted during drilling will be absorbed by the lower units; therefore, the proposed holes will only penetrate the upper fifty feet of the Spring Canyon Member (see attached Figure 2). The location of the drill sites shown on the attached map is based on the regional dip of the top of the Spring Canyon Member of the Starpoint Sandstone Formation and positioned downgradient of the projected workings of the Deer Creek Mine (see attached map for structural information and projected mine workings). Strata north of the Roans Canyon Fault System dip south-southwest at approximately three to four percent. Three possible locations are proposed, two of which will be completed. Access and permitting will determine the most feasible sites to be completed. At each location at least two holes will be completed, one in the colluvial deposits and one in the Spring Canyon Member (see attached Figures 1 and 2). Holes completed in the colluvial deposits will be utilized to compare the well hydrographs to those of Cottonwood Canyon Creek and the Spring Canyon Member. In addition to the proposed holes in Cottonwood Canyon Creek, PacifiCorp proposes to drill two in-mine holes to the Spring Canyon Member from the Blind Canyon Seam north of the Roans Canyon Fault System (see attached map).

If conditions which indicate the hydrologic conditions are different from projected are intercepted during drilling, well completion will be altered to derive a comprehensive hydrologic understanding. Application to drill the monitoring holes will be submitted to the State Engineer for review and approval.

As part of the proposed hydrologic project PacifiCorp will conduct resistivity surveys in Cottonwood Canyon and Rilda Canyon as indicated in the memo dated December 19, 1991, "RE: RESPONSE TO INITIAL COMPLETENESS REVIEW COMMENTS, RILDA CANYON LEASE TRACTS, PACIFICORP ELECTRIC OPERATIONS, DEER CREEK MINE, ACT/015/018, FOLDER #2, EMERY COUNTY, UTAH."

EAST MOUNTAIN SURFACE EXPLORATION DRILL HOLE INFORMATION
DRILL HOLES NORTH OF THE ROANS CANYON FAULT
HYDROLOGIC DATA

DRILL HOLE #	SECTION TOWNSHIP RANGE	YEAR COMPLETED	ELEVATION	TOTAL DEPTH	FORMATIONS PENTERATED	GROUND WATER INFORMATION	STATIC WATER LEVEL
48	19/16/7	1979	9653	1860	North Horn - Starpoint	No Measureable Water Flow	Dry
56	19/16/7	1979	8885	422	Blackhawk	No Measureable Water Flow	315', 77' above Starpoint SS
49	20/16/7	1979	9441	1569	Price River - Starpoint	No Measureable Water Flow	1270'
46	25/16/6	1987	9947	2000	North Horn - Starpoint	No Measureable Water Flow	Dry - lost circulation
44	29/16/7	1978	7860	220	Blackhawk	No Measureable Water Flow	120', 18' below Starpoint SS
45	29/16/7	1979	8080	244	Blackhawk	No Measureable Water Flow	Dry
47	29/16/7	1978	8045	300	Blackhawk	No Measureable Water Flow	Monitoring hole, see attachment
R1	36/16/7	1982	10200	2432	Flagstaff - Starpoint	No Measureable Water Flow	No level reported
R4	36/16/7	1982	10220	2550	Flagstaff - Starpoint	No Measureable Water Flow	No level reported
R3	36/16/7	1982	9747	2055	North Horn - Starpoint	No Measureable Water Flow	Monitoring hole - failed
132	32/16/7	1987	9673	2060	North Horn - Starpoint	No Measureable Water Flow	No level reported
133	32/16/7	1987	9590	2120	North Horn - Starpoint	No Measureable Water Flow	Extremely fractured - no level
135	32/16/7	1987	9537	2020	North Horn - Starpoint	No Measureable Water Flow	Level at 1760' - not stablized
R5	32/16/7	1982	9463	2056	North Horn - Starpoint	No Measureable Water Flow	Monitoring hole - failed, 1983 level = 1635
41	33/16/7	1978	9337	1824	North Horn - Starpoint	No Measureable Water Flow	Dry
42	33/16/7	1978	9294	1860	North Horn - Starpoint	No Measureable Water Flow	Level at 1450' - not stablized
62	33/16/7	1983	9258	1860	Price River - Starpoint	No Measureable Water Flow	Dry
102	33/16/7	1984	8992	1580	Price River - Starpoint	No Measureable Water Flow	Lost circulation - fractured
113	33/16/7	1984	9060	1660	North Horn - Starpoint	No Measureable Water Flow	Dry
43	34/16/7	1979	9130	1760	North Horn - Starpoint	No Measureable Water Flow	1720', 74 below Starpoint SS
12	1/17/6	1977	9936	2415	North Horn - Starpoint	No Measureable Water Flow	Lost circulation - fractured
19	1/17/6	1978	10087	2780	Flagstaff - Starpoint	<2 GPM @ 680'	Level at 2160' - not stablized
27	1/17/6	1979	9686	2170	North Horn - Starpoint	No Measureable Water Flow	Level at 1400' - not stablized
17	6/17/7	1978	9984	2500	Flagstaff - Starpoint	No Measureable Water Flow	Level at 2100' - not stablized
74	6/17/7	1984	9835	2440	Flagstaff - Starpoint	No Measureable Water Flow	Dry - fractured
117	6/17/7	1985	9844	2440	Flagstaff - Starpoint	No Measureable Water Flow	Hole caving - no level
10	5/17/7	1977	9540	2235	North Horn - Starpoint	No Measureable Water Flow	Mud level at 1650'
13	5/17/7	1977	9569	2170	North Horn - Starpoint	No Measureable Water Flow	Dry
15	5/17/7	1977	8987	1650	North Horn - Starpoint	No Measureable Water Flow	Dry
38	5/17/7	1981	9494	2120	North Horn - Starpoint	No Measureable Water Flow	Level at 1640' - not stablized
61	5/17/7	1983	9456	2020	North Horn - Starpoint	No Measureable Water Flow	Dry
72	5/17/7	1985	9528	2040	North Horn - Starpoint	Fracture @ 1300' - 50 GPM	Hole caving - no level
73	5/17/7	1985	9490	2040	North Horn - Starpoint	Minor water @ 260 & 590	Level at 1830' - not stablized
108	5/17/7	1984	9535	2200	North Horn - Starpoint	No Measureable Water Flow	Extremely fractured - no level
14	4/17/7	1977	9301	2040	North Horn - Starpoint	50 GPM @ 100-120(cased)	Level at 1930' - not stablized
60	4/17/7	1983	9313	1960	North Horn - Starpoint	No Measureable Water Flow	Dry
101	4/17/7	1984	9304	1980	North Horn - Starpoint	No Measureable Water Flow	Extremely fractured - no level
114	4/17/7	1984	9109	1680	Price River - Starpoint	No Measureable Water Flow	No level reported
115	4/17/7	1984	9108	1700	Price River - Starpoint	No Measureable Water Flow	No level reported
4	12/17/6	1976	9567	2210	Price River - Starpoint	No Measureable Water Flow	No level reported
20	12/17/6	1978	9439	2265	North Horn - Starpoint	No Measureable Water Flow	Level at 1720' - not stablized
37	7/17/7	1982	9849	2500	Flagstaff - Starpoint	<5 GPM @ 290'	Lost circulation - fractured
78	7/17/7	1984	9750	2450	Flagstaff - Starpoint	10-15 GPM @ 620'	Lost circulation - fractured

COTTONWOOD CANYON CREEK MONITORING WELL DESIGN

(See Figures 1 and 2)

A. Construction Standards

1. Casing

   a. Steel
      (1). At least 18" above ground level (ground surface will slope away from casing)
      (2). Minimum wall thickness
      - 10" surface casing = 0.250"
      - Depth, minimum 18'

   b. Plastic
      (1). Minimum wall thickness
      - 6" riser pipe = 0.316"*
      - 6" slotted = 0.316"*

      * ANSI/ASTM designation "F 480-81, SDR-21"

2. Grouting
   Overburden - unconsolidated, permeable
   Minimum grouting depth - 18 feet to surface
   Minimum non-perforated casing depth - below lowest pumping level

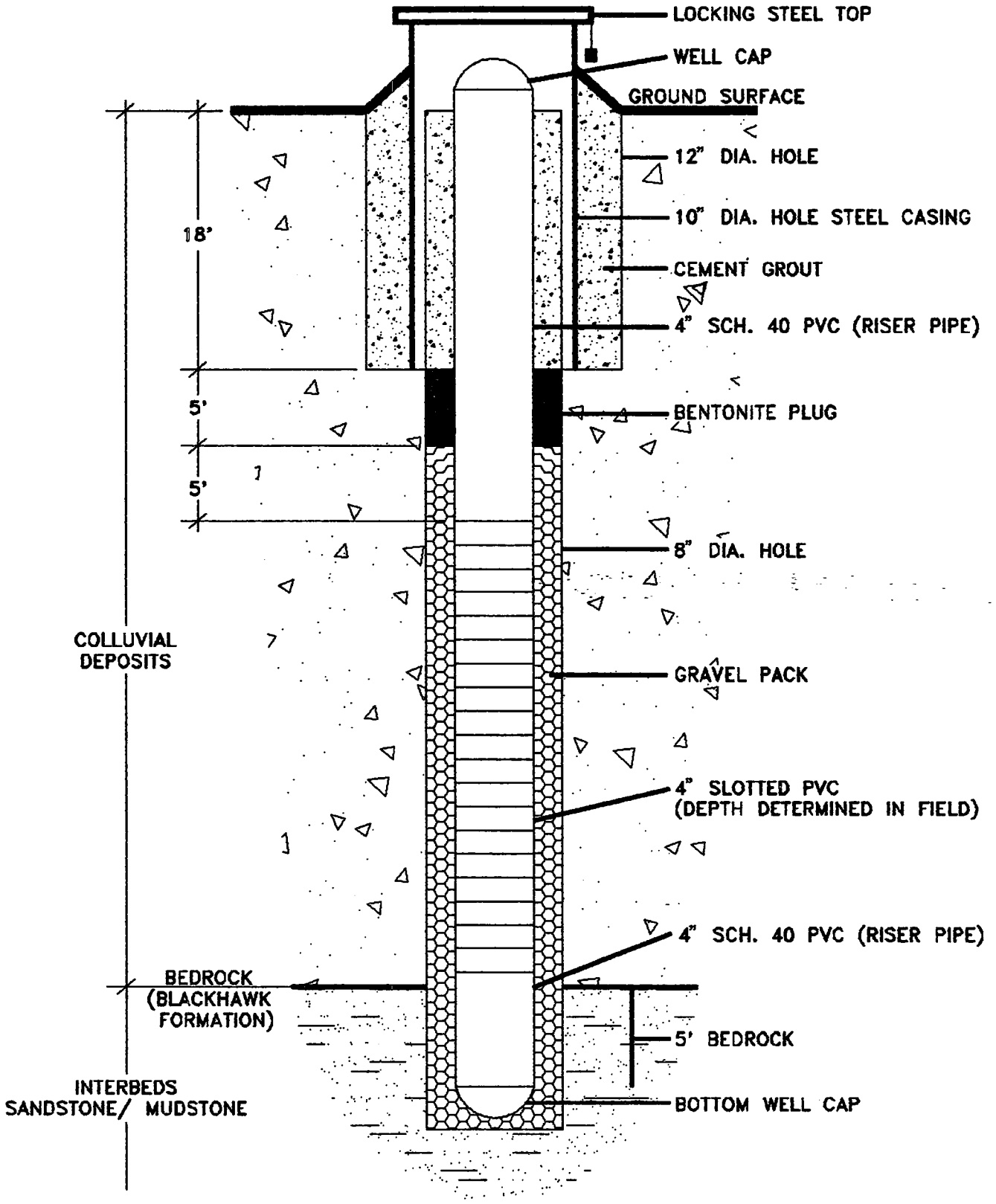
3. Filter material shall consist of clean, well-rounded grains that are smooth and uniform.

B. Dilling method - air rotary

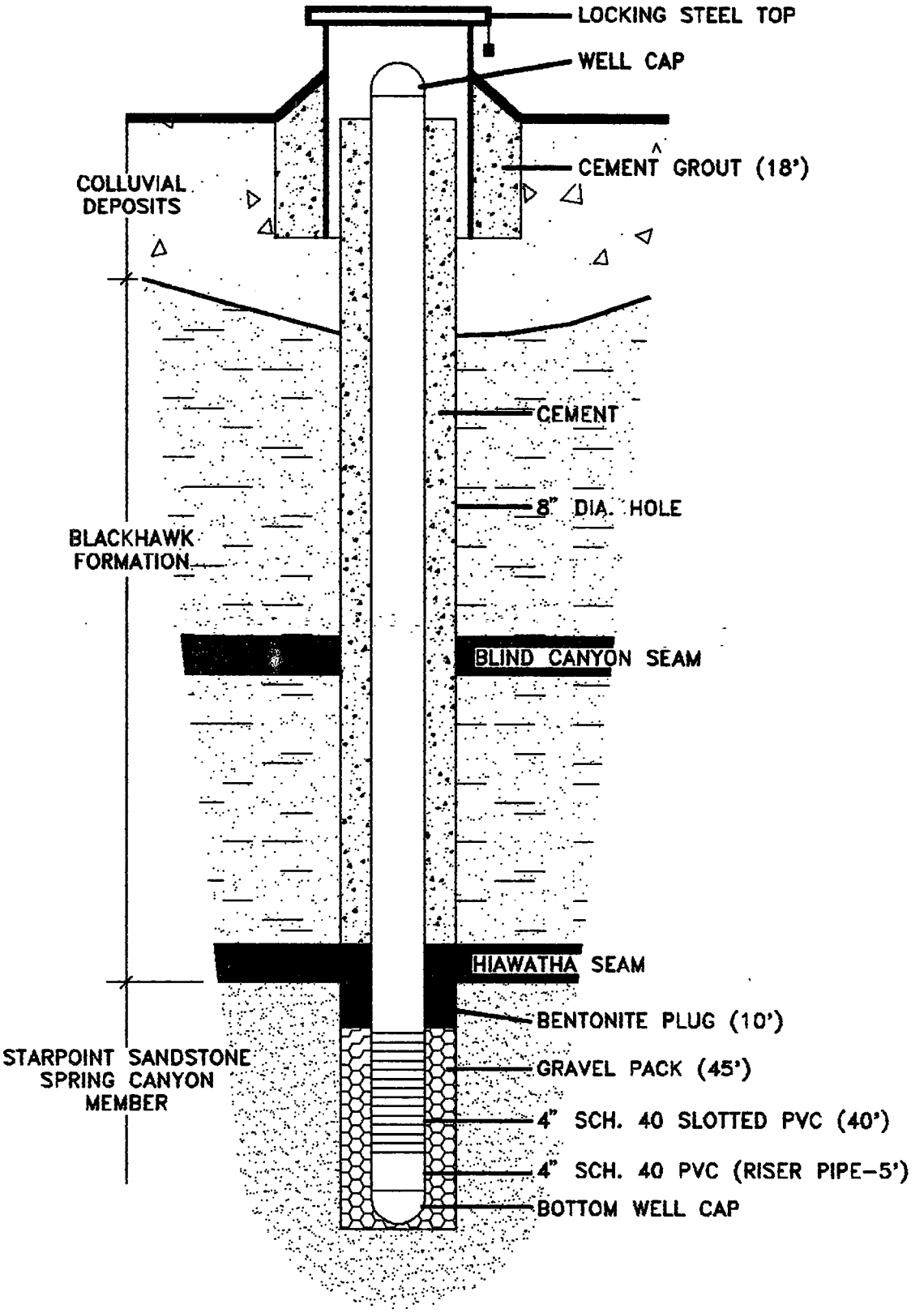
1. Only approved drilling additives will be used.

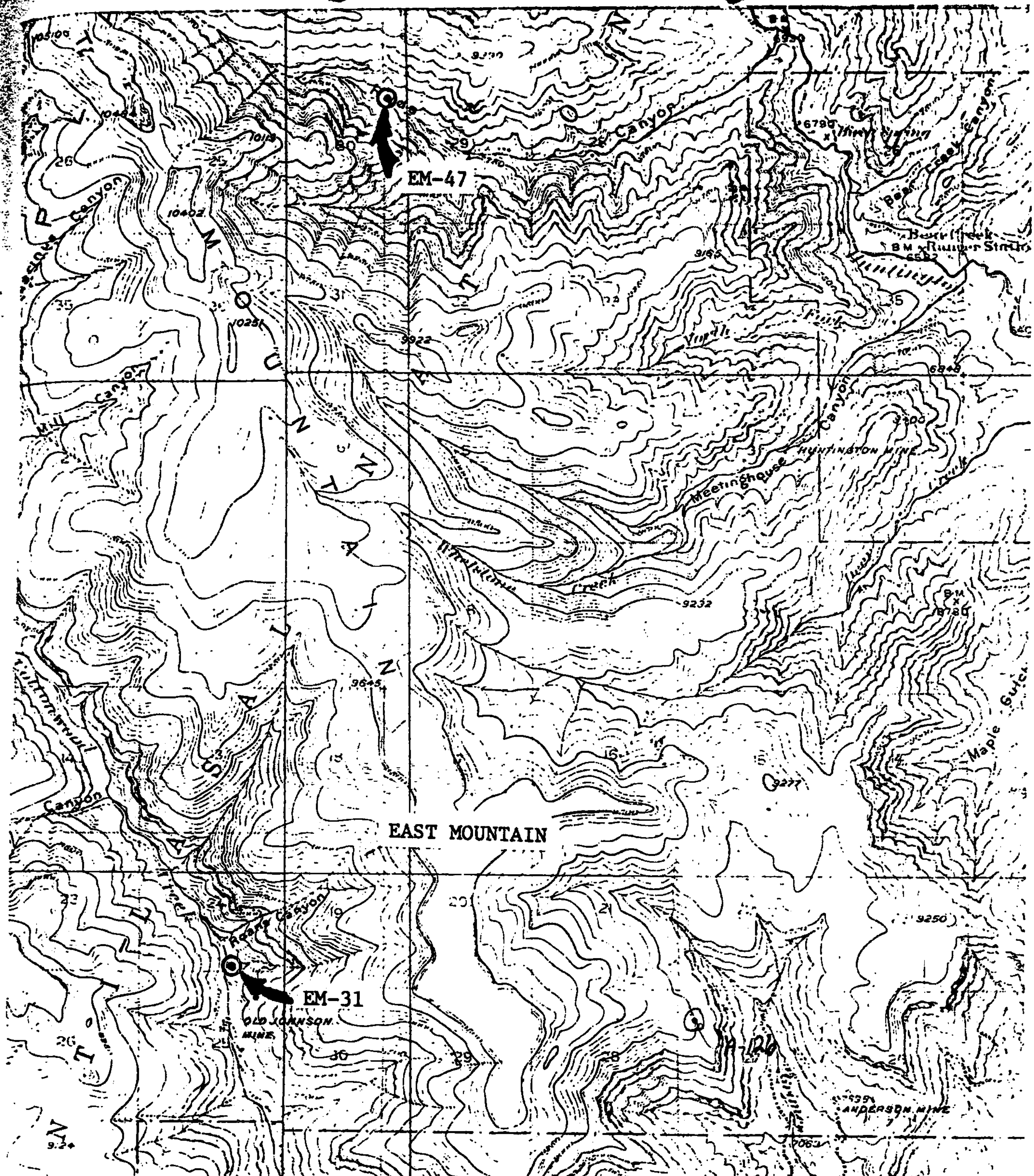
2. Hole will jetted after completion until quality stablizes.

COTTONWOOD CANYON
WELL DESIGN – COLLUVIAL DEPOSITS
FIGURE 1



COTTONWOOD CANYON
WELL DESIGN – STARPOINT/BLACKHAWK CONTACT
FIGURE 2





Drill Hole Water Monitoring Stations

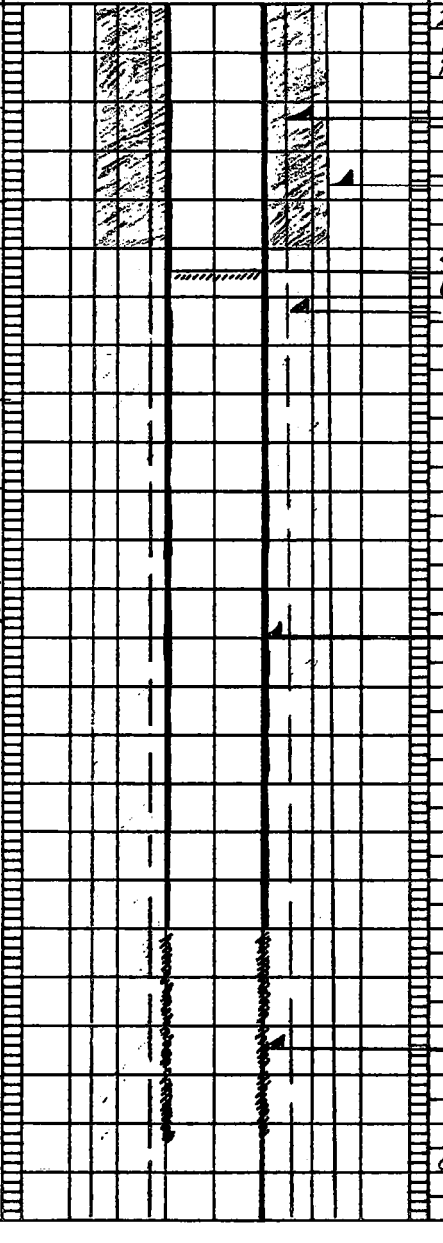
Scale 1" = 1 Mile

PACIFICORP ELECTRIC OPERATIONS
FUEL RESOUCES
MONITORING WELL INSTALLATION LOG

JOB NO. –	PROJECT EAST MOUNTAIN			WELL NO. EM-31		SHEET 1	
HYDROLOGIST FRY	DRILLING METHOD ROTARY - WATER/FOAM			GROUND ELEV. 7415.8		WATER DEPTH	
WEATHER PART CLOUDY	DRILLING CO. STARNER DRILLING			COLLAR ELEV. 7417.8		DATE/TIME 8/26/1978	
TEMP 70's	DRILL RIG 2000	DRILLER STARNER		STARTED 8/26		COMPLETED 8/26	

MATERIALS INVENTORY

WELL CASING 4" I.D. 190 feet	WELL SCREEN 4" I.D. 60 feet	BENTONITE SEAL –			
CASING TYPE STEEL	SCREEN TYPE PERFORATED CASING	INSTALLATION METHOD SEE NOTES			
JOINT TYPE THREADED	SLOT SIZE SEE NOTES	FILTER PACK QTY 50-280			
GROUT QTY 0-50'	CENTRALIZERS –	FILTER PACK TYPE GRAVEL 1/4-3/8"			
GROUT TYPE CEMENT	DRILLING MUD TYPE –	INSTALLATION METHOD –			
LOCATION	NORTHING 361009	EASTING 2088943	TOWNSHIP 17S	RANGE 6E	SECTION 24

ELEV./DEPTH	SOIL/ROCK DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
10	ALLUVIUM		2' RISER - LOCKING COVER INITIAL HOLE DIAMETER 6" REAMED TO 9 3/4"
20			
30	SANDSTONE, LT GRAY FGR.		INITIAL HOLE — 6"
40			FINAL HOLE - 9 3/4
50	INTERBEDS		CEMENT → 0-50'
60	SANDSTONE, LT GRAY M GR.		STATIC WATER LEVEL → 55' (APPROX 45' ABOVE STARPOINT SS) GRAVEL PACK 50'-280' SIZE 1/4-3/8"
70			
80			
90	COAL - HIAWATHA		
100			TOP OF STARPOINT 99.4'
110	SANDSTONE, LT GRAY FGR		
120	STARPOINT SANDSTONE SPRING CANYON MEMBER		
130			STEEL CASING 4" ID 0-190'
140	PRODUCED WATER FROM 100-110 < 10 GPM		
150			
160			
170			
180			
190	MUDSTONE, DK GRAY		
200	MANCOS SHALE		
210			
220			PERFORATED ZONE 190-250' 126 SQ INCHES OF PERFORATION
230	SANDSTONE, LT GRAY MED GRAIN		
270	STARPOINT SANDSTONE PANTHER MEMBER		OPEN CASING
280 TD			

COAL LITHOLOGIC LOG
UTAH POWER & LIGHT COMPANY
DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain DRILL HOLE: EM-31

LOCATION: 155'N, 1680'W, SE 16
COLLAR ELEV.: 7417.8'
HOLE TYPE: WATER MONITORING
PLUG INTERVAL: 0-280'
CORE INTERVAL: —
TOTAL DEPTH: 280'
DATE: August 26, 1978
SCALE: 1" = 10'
GEOLOGIST: Rodger C. Fry

GEOPHYSICAL DATA

LOG	FROM	TO
DENSITY:	46	250
H.R.D.:	10	250
E. LOG:	42	250
GAMMA:	10	250
CALIPER:		
S.P.:	42	250

COAL SUMMARY:

SEAM	THICKNESS	INT.
Blind C	1.8+	81.3
Hiawatha	1.8	0.7
Hiawatha	0.5	3.3
Hiawatha	1.6	0.4
Hiawatha	0.6	2.2
Hiawatha	2.4	0.2
Hiawatha	3.7	

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
+10										
0					+1.8-0 Coal (Exposed at Drill Site) 1.8+ Blind Canyon outcrop					
					0-20 Alluvium Collar					
10										
20					20-40 Sandstone; Light-gray; very fine-grained; Silty					
30				BLACKHAWK FORMATION						
40					40-50 Interbeds: Siltstone; Light-gray; Sandy Carbmudstone; Black; fissile					
50					50-81.3 Sandstone: Light-gray; medium-grained; Moderately sorted;					
60										

COAL LITHOLOGIC LOG

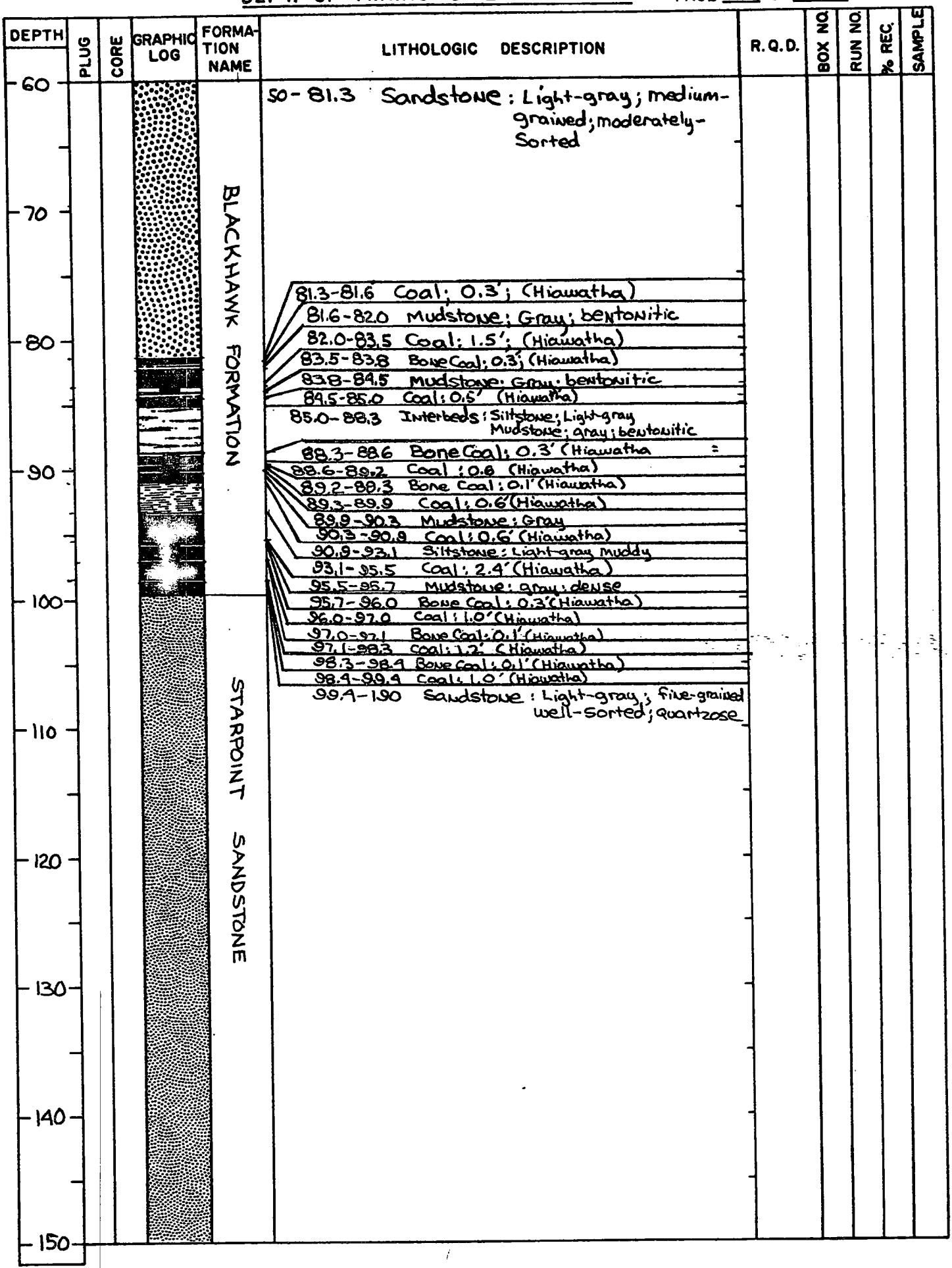
UTAH POWER & LIGHT COMPANY

DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain

DRILL HOLE: EM-31



COAL LITHOLOGIC LOG

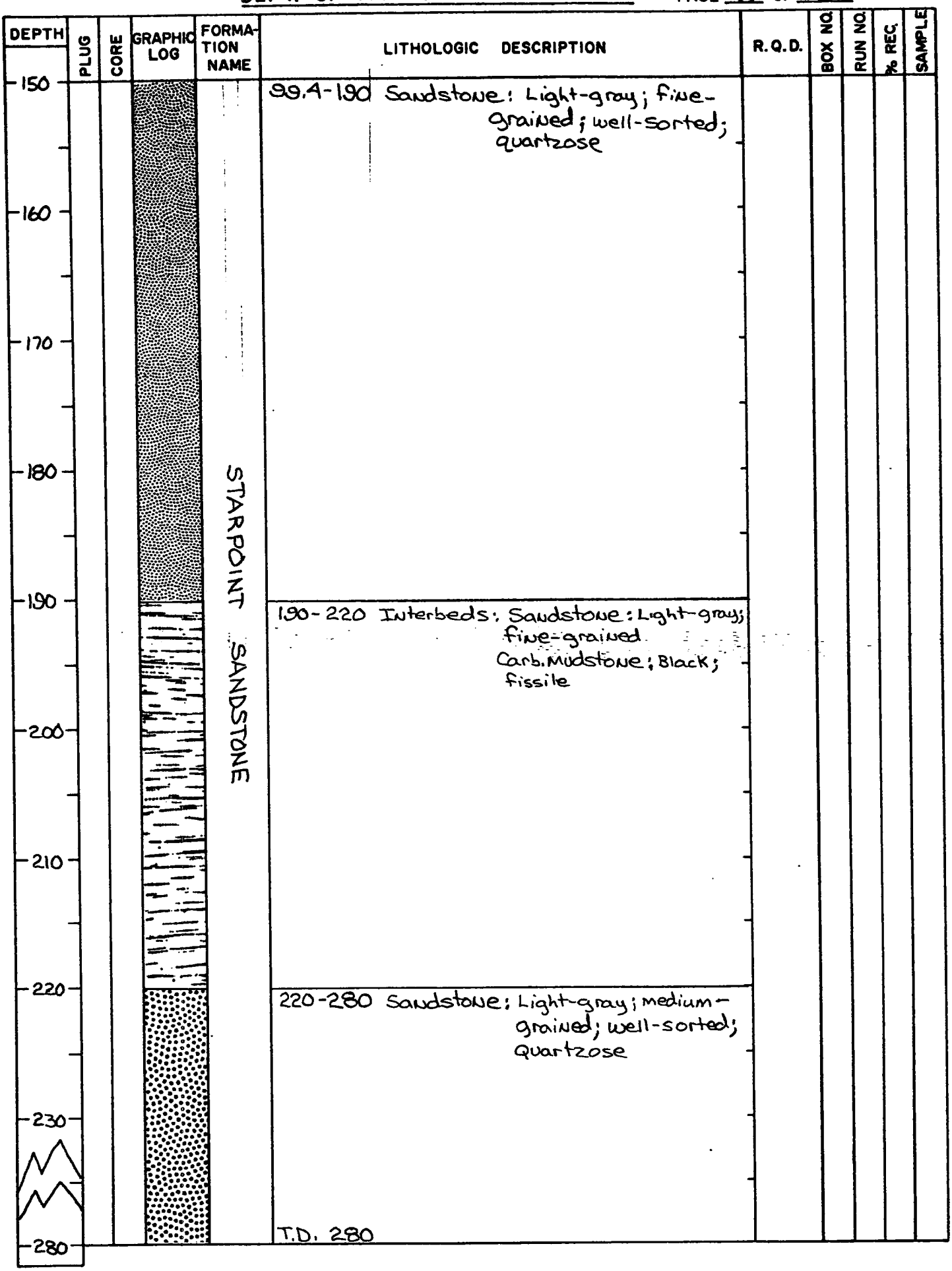
UTAH POWER & LIGHT COMPANY

DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain

DRILL HOLE: EM-31



PACIFICORP ELECTRIC OPERATIONS
FUEL RESOUCES
MONITORING WELL INSTALLATION LOG

JOB NO. –	PROJECT East Mountain		WELL NO. EM-47		SHEET 1 OF
HYDROLOGIST FRY	DRILLING METHOD Rotary - Water/Foam		GROUND ELEV. 8043		WATER DEPTH
WEATHER Partly Cloudy	DRILLING CO. Starner Drilling		COLLAR ELEV. 8045		DATE/TIME 10/8/78
TEMP 60's	DRILL RIG 2000	DRILLER Starner	STARTED 10/8/78		COMPLETED 10/8/78

MATERIALS INVENTORY

WELL CASING 4"	I.D. 210 feet	WELL SCREEN 4"	I.D. 60 feet	BENTONITE SEAL –	
CASING TYPE Steel		SCREEN TYPE Perforated Casing		INSTALLATION METHOD	
JOINT TYPE Treaded		SLOT SIZE See Notes		FILTER PACK QTY 50-300'	
GROUT QTY 17 sacks 0-50'		CENTRALIZERS –		FILTER PACK TYPE Gravel 1/4-3/8"	
GROUT TYPE Cement		DRILLING MUD TYPE –		INSTALLATION METHOD	
LOCATION	NORTHING 391882	EASTING 2094566	TOWNSHIP 16S	RANGE 7E	SECTION 29

ELEV./DEPTH	SOIL/ROCK DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
10	Alluvium		2' Riser - Locking Cover
			Initial Hole Diameter 6"
20			Ream to 9.0" to 300'
30	Sandstone, buff FGR		Cement 0-50'
40			Initial Hole Diameter 6"
50			
60			Final Hole 9"
70			4" Steel Casing - Treaded 0-210'
80	Sandstone, lt gr FGR		
	Coal; Blind Canyon		
90			Gravel Pack 50-300 1/4"-3/8"
100	Interbeds SS/MS		
110			
120	Sandstone lt gray FGR		
	Mudstone, dk gray		
130			
140	Sandstone, lt gray FGR		
	Saturated zone <10 GPM		Static water level after completion 137', stabilized @ 188.6'
150			1.4' above top of Starpoint
160	Interbeds SL/MS		
170			
180	Coal, Hiawatha		
190	Sandstone lt gray FGR		Top of Starpoint Sandstone 190'
200	Starpoint Sandstone		
210	Spring Canyon Member Damp-Saturated		
220	MS 185.1-190.0'		4" Perforated Steel Casing 76 square inches of perforation 210-270'
230			
240			
300	TD 300'		Open Casing

COAL LITHOLOGIC LOG

UTAH POWER & LIGHT COMPANY

DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain DRILL HOLE: EM-47

LOCATION: 640'S; 600'E; NW Cor 29
COLLAR ELEV.: 8045
HOLE TYPE: Plug
PLUG INTERVAL: 0-300'
CORE INTERVAL: -
TOTAL DEPTH: 300'
DATE: October 8, 1978
SCALE: 1" = 10'
GEOLOGIST: R.C. Fry

GEOPHYSICAL DATA

LOG	FROM	TO
DENSITY:	5	250
H.R.D.:	5	225
E. LOG:	5	250
GAMMA:	5	280
CALIPER:		
S.P.:	134	250

COAL SUMMARY:

SEAM	THICKNESS	INT.
Blind C	10.6	85.2
Hiawatha	8.8	

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
0					0-25' Alluvium					
10										
20										
30				Blackhawk Formation	25-70 Sandstone: Buff; fine-grained feldspathic; poorly-sorted					
40										
50										
60										
70										

COAL LITHOLOGIC LOG

UTAH POWER & LIGHT COMPANY

DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain

DRILL HOLE: EM-97

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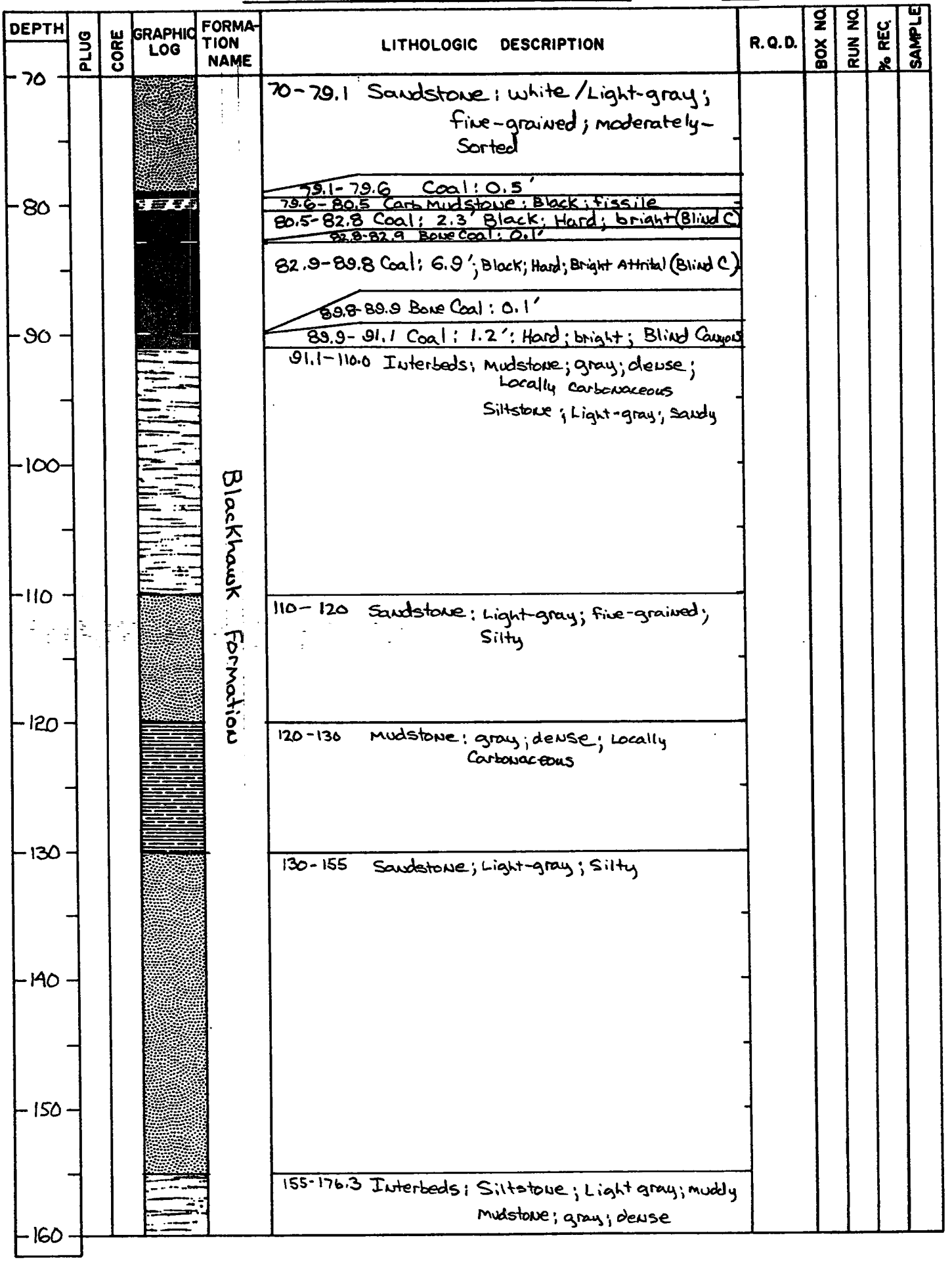

COAL LITHOLOGIC LOG

UTAH POWER & LIGHT COMPANY

DEPT. OF MINING & EXPLORATION

Detailed log

PROJECT: East Mountain

DRILL HOLE: EM-47

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