ADDENDUM 3.3-C

SAMPLED SOIL SERIES DESCRIPTIONS

HILAND SERIES

SOIL MAPPING UNIT: 156 Hiland fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 14-1
TYPICAL PEDON: Hiland silty loam on flat area utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 5 inches; silty loam, non effervescent, very slightly acidic (pH 6.8)

Bt1--5 to 16 inches; loam, non effervescent, slightly acidic (pH 6.5)

Bt2--16 to 31 inches; clay loam; non effervescent, very slightly acidic (pH 6.8)

Bt3--31 to 42 inches; sandy clay loam, non effervescent, very slightly alkaline (pH 7.2)

Btk --42 to 51 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

Ck -- 51 to 60 inches; sandy clay loam, strongly effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 14-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

HILAND SERIES

SOIL MAPPING UNIT: Hiland fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 19-1
TYPICAL PEDON: Hiland loam on northeast facing slope of 3 percent; utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, non effervescent, slightly acidic (pH 6.2)

Bt--3 to 20 inches; silty loam, non effervescent, very slightly acidic (pH 7.1)

Btk--20 to 24 inches; silty loam; strongly effervescent, slightly alkaline (pH 7.6)

C1k--24 to 32 inches; clay, strongly effervescent, moderately alkaline (pH 8.2)

C2k --32 to 44 inches, clay-clay loam, strongly effervescent, moderately alkaline (pH 8.2)

C3k -- 44 to 60 inches; clay loam, strongly effervescent, slightly alkaline (pH 7.9)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 19-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 24 to 44 inches. Marginal selenium and SAR values were found at 44 to 60 inches. Estimated stripping depth is 44 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

KEELINE SERIES

SOIL MAPPING UNIT: 171-1 Keeline, dry complex
SOIL SAMPLE LOCATION: 33-1
TYPICAL PEDON: Keeline sandy loam on east facing midslope of 4 percent utilized as rangeland

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

A--0 to 3 inches; sandy loam, non effervescent; slightly acidic (pH 6.4)

AC--3 to 15 inches; sandy loam, non effervescent; slightly acidic (pH 6.5)

C1--15 to 34 inches; sandy clay loam, non effervescent, neutral (pH 7.0)

C2k—34 to 44 inches; sandy clay loam, non effervescent, very slightly alkaline (pH 7.1)

C2k--44 to 60 inches; sandy clay loam, strongly effervescent, slightly alkaline (pH 7.8)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 33-1 on map included in this report.

RANGE IN CHARACTERISTICS: Free carbonates typically occur throughout the profile, but some pedons may be leached as much as 6 inches. The control section averages fine sandy loam or sandy loam with 5 to 18 percent clay. Rock fragments range from 0 to 15 percent. Some thin strata of coarser material may occur. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 4 mmhos throughout the profile. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING: Keeline soils are on terraces, benches, alluvial fans, fan remnants, ridgetop and hillslope positions. Slopes are 0 to 40 percent. These soils formed in moderately coarse alluvium or eolian deposits derived from calcareous sandstone. Elevations are 3,500 to 6,200 feet. The average annual precipitation is 12 inches with over one-half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 15 inches. The mean annual temperature is about 46 degrees F. but ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 36-1
TYPICAL PEDON: Cushman sandy clay loam on south facing slope of about 3 percent under native grass vegetation

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A-- 0 to 3 inches; sandy clay loam, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

Bt--3 to 12 inches, clay, moist, weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic, common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; very slightly acidic (pH 6.5); clear smooth boundary

Btk--12 to 17 inches, clay, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

Ck--17 to 42 inches, silty clay, strongly effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 36-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal textures (clay to silty clay) were found at 3 to 42 inches. Estimated stripping depth is 42 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash, alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 37-1
TYPICAL PEDON: Cushman loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly acidic (pH 6.2); clear smooth boundary

AB--3 to 7 inches; clay loam, non effervescent, slightly acidic (pH 6.2)

Bt--7 to 15 inches; clay; moist, weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic, common very fine, fine and few medium roots; few faint clay films on faces of peds and lining pores; very slightly acidic (pH 6.7); clear smooth boundary

Btk--15 to 18 inches; clay, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; strongly effervescent, slightly alkaline (pH 7.8); clear smooth boundary

Ck --18 to 28 inches, clay, strongly effervescent, slightly alkaline (pH 7.8)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 37-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for atleast 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal soil texture (clay) was found at 7 to 28 inches. Course fragment percentage was marginal (31 %) at 7-15 inches. Saturation percentage was marginal (80.7) at 15-28 inches. Estimated stripping depth is 28 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash, alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the

annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to130 days depending upon elevation, aspect, and air drainage.

BOWBAC SERIES

Soil Mapping Unit: 157-2 Bowbac fine sandy loam 0 to 6 percent slopes
Soil Sample ID: 80-1
Typical Pedon: Bowbac sandy loam on a northeast facing slope of 1 percent under native vegetation

Taxonomic Class: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A-0 to 3 inches, sandy loam, weak fine and very fine granular structure; soft, very friable, nonsticky nonplastic; many fine and very fine roots; non effervescent, slightly acidic (pH 6.4), abrupt wavy boundary.

BC-3 to 20 inches; sandy loam, non effervescent, very slightly acidic (pH 6.6)

C1-20 to 28 inches; sandy loam, non effervescent, very slightly alkaline (pH 7.1)

C2-28 to 37 inches; sandy loam, strongly effervescent, very slightly alkaline (pH 7.3)

Type Location: Campbell County, Wyoming; refer to waypoint 80-1 on map included in this report.

Range in Characteristics (according to official series description): Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable parameters were found. The estimated stripping depth is 37 inches.

GEOGRAPHIC SETTING (according to official series description): Bowbac soils are on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

SHINGLE SERIES

SOIL MAPPING UNIT: 124-2 Shingle loam, 3 to 30 percent slopes
SOIL SAMPLE LOCATION: 107-1
TYPICAL PEDON: Shingle clay loam on a toeslope of 6 percent in rangeland

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents.

A--0 to 2 inches; clay loam, moderate effervescent, slightly alkaline (pH 7.5)

C--2 to 14 inches; clay loam, strongly effervescent, neutral (pH 7.0)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 107-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft bedrock and paralithic contact ranges from 4 to 20 inches. The mean annual soil temperature is 47 to 53 degrees F. The soils commonly are calcareous throughout, but some pedons are leached to 6 inches The particle size control section averages 20 to 35 percent clay and has more than 15 percent but less than 35 percent fine or coarser sand. The soil is usually dry. The moisture control section is usually moist in April, May and early June. It is dry for 60 consecutive days or more during the 90 day period following the summer solstice. EC is 0 to 2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 14 inches.

GEOGRAPHIC SETTING (according to official series description): The Shingle soils occur on all hillslope positions. Slopes are 0 to 80 percent. These soils formed in colluvium and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone. Elevation is 3,200 to 6,500 feet. The mean annual precipitation is about 10 to 14 inches, most of which falls in April, May, and June. The mean annual temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

KISHONA SERIES

Soil Mapping Unit: 116-2 Kishona fine sandy loam, 0 to 6 percent slopes
Soil Sample ID: 108-1
Typical Pedon: Kishona clay loam in rangeland

Taxonomic Class: Fine loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents

A--0 to 3 inches; clay loam, non effervescent, neutral (pH 7.0)

Bk--3 to 24 inches; silty clay loam, strongly effervescent, slightly alkaline (pH 7.5)

C1--24 to 30 inches; silty clay, strongly effervescent, slightly alkaline (pH 7.8)

C2--30 to 44 inches; silty clay, strongly effervescent, moderately alkaline (pH 8.0)

C3--44 to 46 inches; silty clay loam, strongly effervescent, moderately alkaline (pH 8.0)

Type Location: Campbell County, Wyoming; refer to waypoint 108-1 on map included in this report

Range in Characteristics (according to official series description): Rock fragments ranges from 0 to 15 percent. The mean annual soil temperature ranges from 48 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 190 to 202 days. The depth to carbonates ranges from 0 to 10 inches. Saline phases are recognized. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 90 consecutive days when the soil temperature at a depth of 20 inches is 48 degrees F. or more. The soil is moist for 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 days during that period.

The A horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, loam, silt loam, silty clay loam or clay loam. It is neutral to moderately alkaline.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal texture (silty clay) was found at a depth of 24 to 44 inches. Estimated stripping depth is 24 inches.

Geographic Setting (according to official series description): Kishona soils are on dissected alluvial fans, fan remnants, fan aprons, hills, ridges and terraces. Slopes are typically 0 to 6 percent but range up to 30 percent on dissected slopes. The soils formed in alluvium derived from sandstones and shales. Elevation is 3,500 to 6,700 feet. The average annual precipitation ranges form 10 top 14 inches with over one-half falling in April May and June and less than one inch falling in each month of July, August, September and October. The mean annual air temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

BOWBAC SERIES

SOIL MAPPING UNIT: 157-2 Bowbac fine sandy loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 116-1
TYPICAL PEDON: Bowbac sandy loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; sandy loam, slightly acidic (pH 6.3).

Bt1--3 to 12 inches; sandy clay loam, slightly acidic (pH 6.5).

Bt2--12 to 20 inches; sandy clay loam, very slightly acidic (pH 6.8).

Bk-- 20 to 24 inches; sandy clay loam, slightly alkaline (pH 7.3).

Cr— 24 to 36 inches; sandy clay loam, slightly effervescent, moderately alkaline (pH 8.0).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 116-1 on map included in this report.

RANGE IN CHARACTERISTICS: Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded gravel. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 36 inches.

GEOGRAPHIC SETTING: Bowbac soils are on alluvial fans, terraces, dissected fan remnants, fan piedmonts, hillslopes, pediments, plateaus, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

ULM SERIES

SOIL MAPPING UNIT: 226 Ulm loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 117-1
TYPICAL PEDON: Ulm clay loam-rangeland

TAXONOMIC CLASS: Fine, smectitic, mesic Ustic Haplargids

A-0 to 3 inches, clay loam, moist; strong fine granular structure; slightly hard, friable, sticky and plastic; many fine and few medium roots; slightly acidic (pH 6.1); clear smooth boundary

Bt1-3 to 10 inches, clay loam, moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many prominent clay films on faces of peds; very slightly acidic (pH 6.6); clear wavy boundary.

Btk-21 to 32 inches, clay, moist; moderate medium prismatic parting to strong medium angular blocky structure; very hard, firm, very sticky and very plastic; common fine and few medium roots; common distinct clay films on faces of peds; slightly effervescent; calcium carbonate mostly disseminated with few prominent masses; moderately alkaline (pH 8.1);clear wavy boundary.

Ck1-32 to 40 inches, clay loam, strongly effervescent, moderately alkaline (pH 8.4)

Ck2-42 to 50 inches, sandy clay loam, violently effervescent, moderately alkaline (pH 8.2)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 117-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to calcareous material ranges from 12 to 33 inches. Rock fragments range from 0 to 15 percent channers. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at 10 to 32 inches. Estimated stripping depth is 50 inches.

GEOGRAPHIC SETTING (according to official series description): Ulm soils are on relict alluvial terraces, alluvial fans, fan remnants, plateaus and footslopes and toeslopes of hills. Slopes are 0 to 18 percent. The soils formed in fine and medium textured alluvium derived from interbedded shales and agrillaceous sandstone. Elevations are 3,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature ranges from 46 to 51 degrees F. The frost-free season is 105 to 130 days.

ZIGWEID SERIES

SOIL MAPPING UNIT: 116-3 Zigweid loam, 0 to 6 percent slopes
Soil Sample ID: 123-1
TYPICAL PEDON: Zigweid clay- on a 3 percent southwest facing slope utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplocambids

A--0 to 3 inches; clay, non effervescent; slightly acidic (pH 7.6).

Bw--3 to 14 inches; clay, non effervescent, very slightly acidic (pH 7.3).

BC--14 to 20 inches; clay, strongly effervescent, slightly alkaline (pH 7.8).

C1k--20 to 32 inches; clay, violently effervescent; moderately alkaline (pH 8.2).

C2k--32 to 44 inches; clay, violently effervescent; moderately alkaline (pH 8.3).

C3k—44 to 54 inches; clay, violently effervescent, moderately alkaline (pH 8.2).

C4k—54 to 60 inches; clay, violently effervescent, moderately alkaline (pH 8.1).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 123-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to carbonates ranges from 0 to 8 inches. Depth to the Bk horizon and the base of the cambic horizon ranges from 10 to 22 inches. The particle-size control section and the soil profile are clay loam or loam. Clay ranges from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 50 percent with more than 15 percent but less than 35 percent fine sand or coarser. Rock fragments range from 0 to 15 but are typically less than 5 percent and are mostly soft shale chips. The moisture control section is usually dry in all parts for 90 cumulative days following the summer solstice and for 60 consecutive days during this period. The mean annual soil temperature is 47 to 53 degrees F. The soil temperature at a depth of 20 inches is 41 degrees F. or warmer for 175 to 192 days.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): These soils are on fan aprons, alluvial fans, fan remnants, terraces, fan piedmonts, ridges and hills. In many areas they are dissected. Slopes range from 0 to 20 percent. These soils formed in calcareous, moderately fine textured sediments derived from interbedded shale and soft sandstone. Elevations are 3,500 to 6,600 feet. The mean annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature is about 46 degrees F., and ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

TALUCE SERIES

SOIL MAPPING UNIT: 221-3 Taluce fine sandy loam, 6 to 30 percent slopes
Soil Sample ID: 126-1
TYPICAL PEDON: Taluce sandy loam-on a convex north-facing slope, used as rangeland

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

A- 0 to 2 inches, sandy loam, moist; moderate fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; slightly effervescent, calcium carbonate disseminated; very slightly acidic (pH 6.8); clear smooth boundary.

Ck-2 to 10 inches, sandy loam to sandy clay loam, moist; weak medium platy rock structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; slightly effervescent, calcium carbonate disseminated; slightly alkaline (pH 7.6)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 126-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to bedrock ranges from 6 to 20 inches. Typically, these soils are calcareous throughout, but some pedons are leached to a depth of as much as 4 inches. Rock fragments range from 0 to 15 percent. The particle-size control section has 10 to 18 percent clay. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No marginal or unsuitable parameters were found. Estimated stripping depth is 10 inches.

GEOGRAPHIC SETTING (according to official series description): Taluce soils are on ridges and hills. Slope ranges from 3 to 70 percent. They formed in residuum and slope alluvium derived from sandstone. The mean annual precipitation ranges from 10 to 17 inches with over half of the precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature is 42 to 51 degrees F. Elevation is 3,500 to 6,500 feet. The frost-free season is 100 to 130 days.

FORKWOOD SERIES

SOIL MAPPING UNIT: 144 Forkwood loam, 0 to 6 percent slopes
Soil Sample ID: 127-1
TYPICAL PEDON: Forkwood loam

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; loam, non effervescent; slightly acidic (pH 6.1).

Bt--3 to 20 inches; clay loam, non effervescent, very slightly acidic (pH 6.9).

Btk--20 to 27 inches; clay loam, strongly effervescent; slightly alkaline (pH 7.8).

C1k--27 to 45 inches; clay, violently effervescent; moderately alkaline (pH 8.1).

C2k--45 to 51 inches; clay loam, violently effervescent; moderately alkaline (pH 8.2).

C3k—51 to 60 inches; clay loam, moderate effervescent, moderately alkaline (pH 8.2).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 127-1 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to the base of the argillic horizon is 10 to 33 inches, and depth to continuous horizons of carbonate accumulation is 10 to 33 inches. Rock fragments range from 0 to 15 percent. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature ranges from 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 4 mmhos/cm throughout the profile. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at 27 to 45 inches. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Forkwood soils are on terraces, alluvial fans, fan remnants, hills, ridges and pediments. Slopes are 0 to 15 percent. The soils formed in slopewash alluvium derived from interbedded shales and argillaceous sandstone.

Elevations are 3,500 to 6,000 feet. The average annual precipitation is 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The mean annual air temperature ranges from 43 to 51 degrees F. The estimated frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

BIDMAN SERIES

Soil Mapping Unit: 111-1 Birdman loam 0 to 6 percent slopes
Soil Sample ID: 300
Typical Pedon: Bidman loam-grassland

Taxonomic Class: Fine, smectitic, mesic Ustic Paleargids

A-0 to 4 inches: clay loam, non effervescent; very slightly acidic (pH 6.7)

Bt1-4 to 20 inches: clay, moist; strong medium prismatic structure that parts to strong medium angular blocky; hard, very sticky and very plastic, many prominent clay films on faces of peds, in channels and pores: very slightly acidic (pH 6.8); clear wavy boundary

Bt2-20 to 28 inches: clay, non effervescent; slightly alkaline (pH 7.5)

Btk-28 to 40 inches: clay loam to clay, moist; weak coarse prismatic structure that parts to moderate coarse angular and subangular blocks; extremely hard, very friable; sticky and plastic; few distinct clay films on faces of peds; strongly effervescent; moderately alkaline (pH 8.0): gradual wavy boundary

Ck- 40 to 49 inches: clay loam, moist; massive; hard, very friable, sticky and slightly plastic, violently effervescent, slightly alkaline (pH 7.9)

Type Location: Campbell County, Wyoming; refer to waypoint 300 on map included in this report

Range in Characteristics (according to official series description): Depth to calcareous material ranges from 8 to 26 inches, Depth to the base of the argillic horizon range from 15 to 36 inches. Organic carbon ranges from .6 to 1.5 percent in the surface horizons and decreases uniformly with increasing depth. Cation exchange capacity ranges from 60 t0 90 millequivalents per 100 grams of clay. Rock fragments are typically less than 2 percent but ranges from 0 to 15 percent. This soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is never moist in some or all parts for as long as 60 consecutive days during this same period. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or warmer for 175 to 195 days. The mean summer soil temperature at depth of 20 inches ranges from 59 to 65 degrees F.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal Texture (clay) was found at 4 to 49 inches. Estimated stripping depth is 49 inches.

Geographic Setting (according to official series description): The Bidman soils are on alluvial fans, fan remnants, terraces, ridges and hills. Elevation is 2,600 to 6,000 feet. Slopes range from 0 to 25 percent. These soils formed in thick, calcareous alluvial sediments derived from sedimentary rock. At the type location the mean annual temperature is 47 degrees F., and the mean summer temperature is 66 degrees F. The average annual precipitation is about 12 inches with about half the precipitation in April, May, and June. Precipitation ranges from 10 to 14 inches. The frost-free season is 100 to 130 days.

VONALEE SERIES

Soil Mapping Unit: 235 Vonalee fine sandy loam, 0 to 10 percent slopes
Soil Sample ID: 301
Typical Pedon: Vonalee fine silty clay loam-on north facing hill slope of 6 percent utilized as rangeland.

Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Ustic Haplargids

A-0 to 2 inches, silty clay loam, moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots throughout and common medium throughout; non effervescent: very slightly acidic (pH 6.7) clear smooth boundary

Bt-2 to 15 inches, clay loam to loam, moist, moderate medium subangular blocky structure, soft, very friable, nonsticky and nonplastic; many very fine and fine roots throughout and common medium throughout; strongly effervescent, very slightly alkaline (pH 7.4)

C1-15 to 24 inches, sandy clay loam, moderate to strongly effervescent, moderately alkaline (pH 8.2)

C2-24 to 38 inches, sandy loam, strongly effervescent, slightly alkaline (pH 7.9)

C3-38 to 50 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

C4-50 to 60 inches, sandy clay loam, strongly effervescent, moderately alkaline (pH 8.1)

Type Location: Campbell County, Wyoming; refer to waypoint 301 on map included in this report

Range in Characteristics (according to official series description): Rock fragments are typically less than 5 percent but may range to 15 percent. Depth to continuous carbonate accumulation ranges from 11 to 40 inches, but the soils are typically calcareous above 30 inches. Depth to bedrock is greater than 60 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. It is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The average annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F., or more for 175 to 192 days.

Suitability for Topsoil (according to WDEQ Guideline 1, 1994):

Marginal saturation percentage (83.6) was found at 0 to 2 inches. The estimated stripping depth is 60 inches.

Geographic Setting (according to official series description): Vonalee soils are on ridges, hills, alluvial fans, fan remnants and high terraces. Slopes are 0 to 30 percent. The soils formed in coarse and moderately coarse alluvium or eolian deposits derived largely from calcareous sandstone. Elevations are 3,500 to 6,500 feet. Precipitation ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. The average annual air temperature ranges from 44 to 49 degrees F. The frost-free season is about 105 to 130 days.

HILAND SERIES

SOIL MAPPING UNIT: 158-1 Hiland fine sandy loam, 6 to 15 percent slopes
SOIL SAMPLE LOCATION: 302
TYPICAL PEDON: Hiland sandy loam on northeast facing slope of 3 percent; utilized as rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 3 inches; sandy loam, non effervescent, very slightly acidic (pH 6.8).

BA--3 to 12 inches; sandy loam, non effervescent, slightly acidic (pH 6.3).

Bt--12 to 20 inches; sandy clay loam; non effervescent, very slightly acidic (pH 6.6).

Btk--20 to 30 inches; sandy clay loam, strongly effervescent, very slightly alkaline (pH 7.2).

C1k--30 to 48 inches, clay loam, violently effervescent, moderately alkaline (pH 8.0).

C2k—48 to 60 inches; clay loam, violently effervescent, moderately alkaline (pH 8.3).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 302 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Gravel ranges from 0 to 15 percent in the solum and from 0 to 30 percent in the 2C or Bk horizons. The base of the Bt or Btk ranges from 15 to 35 inches. Depth to continuous carbonate accumulation ranges from 14 to 32 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 52 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos from the surface to the base of the Bt and from 1 to 4 mmhos below the base of the Bt. Bedrock is deeper than 60 inches.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal values were present. Estimated stripping depth is 60 inches.

GEOGRAPHIC SETTING (according to official series description): Hiland soils are on relict surfaces consisting of terraces, fan remnants, pediments, fans, ridges, hills and stabilized dunes. Slopes are 0 to 20 percent. They formed in moderately coarse alluvium and eolian material derived predominantly from sandstone. Elevations are 3,500 to 6,300 feet. The average annual precipitation is about 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature is 43 to 51 degrees F. The frost-free season is 105 to 130 days.

SHINGLE SERIES

SOIL MAPPING UNIT: 124-2 Shingle loam, 3 to 30 percent slopes
SOIL SAMPLE LOCATION: 303
TYPICAL PEDON: Shingle clay loam

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents.

A--0 to 3 inches; clay loam, non effervescent, slightly alkaline (pH 7.6).

AC--3 to 10 inches; clay loam, strongly effervescent, slightly alkaline (pH 7.8).

Cr--10 to 18 inches; silty clay loam; strongly effervescent, slightly alkaline (pH 7.9).

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 303 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft bedrock and paralithic contact ranges from 4 to 20 inches. The mean annual soil temperature is 47 to53 degrees F. The soils commonly are calcareous throughout, but some pedons are leached to 6 inches The particle size control section averages 20 to 35 percent clay and has more than 15 percent but less than 35 percent fine or coarser sand. The soil is usually dry. The moisture control section is usually moist in April, May and early June. It is dry for 60 consecutive days or more during the 90 day period following the summer solstice. EC is 0 to 2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 18 inches.

GEOGRAPHIC SETTING (according to official series description): The Shingle soils occur on all hillslope positions. Slopes are 0 to 80 percent. These soils formed in colluvium and residuum weathered from soft, interbedded sandstone and shale or in alluvium from mudstone. Elevation is 3,200 to 6,500 feet. The mean annual precipitation is about 10 to 14 inches, most of which falls in April, May, and June. The mean annual temperature is about 45 degrees F. but ranges from 43 to 51 degrees F. The frost-free season is about 105 to 130 days.

THEEDLE SERIES

SOIL MAPPING UNIT: 127-2 Theedle loam, 0 to 30 percent slopes
SOIL SAMPLE LOCATION: 304
TYPICAL PEDON: Theedle clay loam- on west facing hill footslope of 6 percent-rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents.

A--0 to 3 inches; clay-clay loam, strongly effervescent, slightly alkaline (pH 7.6)

C--3 to 20 inches; clay loam, violently effervescent, neutral (pH 8.1)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 304 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft, gray, calcareous sandstone or sandy whale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 0 to 3 inches. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): Theedle soils are on rock-controlled fans aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hill slope p[profile but typically are on the lower shoulder, foot slope, and toe slope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

CUSHMAN SERIES

SOIL MAPPING UNIT: 146-2 Cushman loam, 0 to 6 percent slopes
SOIL SAMPLE LOCATION: 305
TYPICAL PEDON: Cushman clay loam- on south facing slope of about 3 percent under native grass vegetation

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplargids

A--0 to 2 inches; clay loam, strongly effervescent,) moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly alkaline (pH 7.5); clear smooth boundary

Btk1--2 to 12 inches; clay loam, moist, moderate medium granular structure; soft, friable, slightly sticky and slightly plastic, common very fine, and fine, and few medium roots; slightly alkaline (pH 7.8); clear smooth boundary

Btk2--12 to 20 inches; clay loam; strongly effervescent, moderately alkaline (pH 8.2)

Bk--20 to 26 inches; clay loam, moist; weak coarse subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic, violently effervescent; calcium carbonated as common prominent irregularly shaped masses and many fine filaments and masses; moderately alkaline (pH 8.2)

Cr --26 to 36 inches, clay loam, strongly effervescent

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 305 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to paralithic contact and bedrock is typically about 28 to 32 inches but ranges from 20 to 40 inches. Depth to continuous horizons of carbonate accumulation is 7 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Depth to the base of the argillic horizon ranges from 10 to 26 inches. Rock fragments range from 0 10 15 percent and are soft shale channers or semirounded sandstone pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for atleast 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0-2 mmhos throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

No unsuitable or marginal parameters were found. Estimated stripping depth is 36 inches.

GEOGRAPHIC SETTING (according to official series description): Cushman soils are on buttes, fan remnant, fan piedmonts, hills and ridges. Slopes range from 0 to 20 percent. The soils formed in moderately fine textured slopewash alluvium and residuum. Surface erosion is common in overgrazed areas, and some thin eolian deposits overlie these soils in some areas. Elevations are 3.500 to 6,000 feet. The mean annual precipitation is 13 inches and ranges from 10 to 14 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September and October. The mean annual temperature is 43 to 51 degrees F. The frost-free season is about 105 to 130 days depending upon elevation, aspect, and air drainage.

THEEDLE SERIES

SOIL MAPPING UNIT: 127-2 Theedle loam, 0 to 3 percent slopes
SOIL SAMPLE LOCATION: 306
TYPICAL PEDON: Theedle clay loam- on west facing hill footslope of 6 percent-rangeland

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents.

A--0 to 2 inches; clay loam, non effervescent, slightly alkaline (pH 7.7)

BCk-- 2 to 20 inches; clay, strongly effervescent, moderately alkaline (pH 8.1)

TYPE LOCATION: Campbell County, Wyoming; refer to waypoint 304 on map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to soft, gray, calcareous sandstone or sandy whale ranges from 20 to 40 inches but is typically less than 32 inches. The soil lacks a cambic horizon, but structural Bw horizons are present in about half the pedons observed. The soil is typically calcareous throughout but may be leached up to 5 inches. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 51 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. The particle size control section averages between 18 and 35 percent clay and is loam, clay loam, or sandy clay loam with more than 15 but less than 35 percent fine or coarser sand. The soil has up to 10 percent rock fragments throughout.

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994):

Marginal texture (clay) was found at a depth of 2 to 20 inches. Estimated stripping depth is 20 inches.

GEOGRAPHIC SETTING (according to official series description): Theedle soils are on rock-controlled fans aprons, fan pediments, and undulating to rolling uplands. They may occupy all components of the hill slope p[profile but typically are on the lower shoulder, foot slope, and toe slope. Slopes range from 0 to 75 percent. The soils formed in medium textured slope alluvium and residuum derived primarily from interbedded sandstone and shale. Elevation is 3,500 to 6,500 feet. The average annual precipitation is 12 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual air temperature ranges from 45 to 51 degrees F. The frost-free season is 105 to 130 days.

ADDENDUM 3.3-D

LABORATORY RESULTS

LABORATORY ANALYTICAL REPORT

Client: Energy Metals Corp
Project: EM Moore Ranch Baseline Soils 432a
Workorder: C07051219

Report Date: 06/28/07
Date Received: 05/24/07

Sample ID	Client Sample ID	Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s.u.	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
		Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-001	WP 116-1	0-3	0.52	33.6	6.3	3.2	1.8	0.13	0.05	0.011	<0.20	55	26	19	SL
C07051219-002	WP 116-1	3-12	0.32	33.1	6.5	2.2	1.1	0.14	0.11	0.009	<0.20	54	21	25	SCL
C07051219-003	WP 116-1	12-20	1.68	43.1	6.8	10	4.9	0.22	0.08	0.005	<0.20	57	19	24	SCL
C07051219-004	WP 116-1	20-24	3.65	48.9	7.3	23	11	0.43	0.10	< 0.005	<0.20	53	19	28	SCL
C07051219-005	WP 116-1	24-36	0.63	51.9	8.0	2.6	3.1	0.31	0.18	< 0.005	<0.20	54	17	29	SCL
C07051219-006	WP 117-1	0-3	0.67	43.5	6.1	3.7	3.1	0.14	0.07	0.011	<0.20	35	35	30	CL
C07051219-007	WP 117-1	3-10	0.42	43.6	6.6	2.3	2.1	0.39	0.26	0.005	<0.20	34	34	32	CL
C07051219-008	WP 117-1	10-21	0.34	69.0	7.1	1.4	1.6	0.95	0.79	< 0.005	0.25	24	33	43	C
C07051219-009	WP 117-1	21-32	0.57	64.5	8.1	1.7	2.2	2.0	1.44	< 0.005	0.34	28	31	41	C
C07051219-010	WP 117-1	32-42	0.52	55.4	8.4	1.2	1.7	2.8	2.37	0.005	0.45	40	28	32	CL
C07051219-011	WP 117-1	42-50	1.04	44.4	8.2	2.3	3.8	4.5	2.64	0.011	0.44	49	19	32	SCL
C07051219-012	WP 123-1	0-3	0.65	45.7	7.6	5.9	2.0	0.12	0.06	0.015	<0.20	38	32	30	CL
C07051219-013	WP 123-1	3-14	0.67	55.0	7.3	4.2	3.1	0.48	0.21	0.016	<0.20	32	30	38	CL
C07051219-014	WP 123-1	14-20	0.67	45.9	7.8	3.6	3.1	0.69	0.38	0.011	<0.20	42	26	32	CL
C07051219-015	WP 123-1	20-32	0.62	53.2	8.2	2.1	3.0	1.6	0.97	0.020	0.22	26	37	37	CL
C07051219-016	WP 123-1	32-44	1.34	49.9	8.3	2.6	5.6	5.2	2.57	0.137	0.37	29	37	34	CL
C07051219-017	WP 123-1	44-54	3.56	56.1	8.2	7.4	19	13	3.57	1.37	1.0	40	29	31	CL
C07051219-018	WP 123-1	44-54								2.31					
C07051219-018	WP 123-1	54-60	7.12	57.1	8.1	26	51	19	3.06	2.06	0.93	32	33	35	CL
C07051219-019	WP 126-1	0-2	0.94	48.6	6.8	9.1	2.0	0.07	0.03	0.005	0.20	69	12	19	SL
C07051219-020	WP 126-1	2-10	0.53	41.8	7.6	4.8	1.1	0.10	0.06	0.011	<0.20	62	18	20	SL - SCL
C07051219-021	WP 127-1	0-3	0.48	49.1	6.1	3.3	1.9	0.07	0.04	0.010	<0.20	47	32	21	L
C07051219-022	WP 127-1	3-20	0.52	54.4	6.9	3.8	2.4	0.15	0.09	0.007	<0.20	44	24	32	CL
C07051219-023	WP 127-1	20-27	0.60	56.9	7.8	4.6	3.5	0.47	0.23	< 0.005	<0.20	31	31	38	CL
C07051219-024	WP 127-1	27-45	0.44	55.7	8.1	1.4	1.5	2.0	1.68	0.014	0.29	20	37	43	C
C07051219-025	WP 127-1	45-51	0.56	54.3	8.2	1.5	1.5	3.6	2.95	0.042	0.78	36	25	39	CL
C07051219-026	WP 127-1	51-60	1.11	50.4	8.2	3.4	3.4	5.7	3.05	0.049	1.0	35	28	37	CL
C07051219-027	WP 300	0-4	0.56	48.0	6.7	3.9	3.0	0.25	0.14	0.010	<0.20	35	31	34	CL
C07051219-028	WP 300	4-20	0.32	74.6	6.8	1.5	1.5	0.83	0.68	0.005	0.23	24	26	50	C
C07051219-029	WP 300	20-28	0.66	68.7	7.5	2.9	3.0	1.9	1.12	< 0.005	0.31	25	31	44	C
C07051219-030	WP 300	28-40	0.77	59.8	8.0	2.4	2.6	3.1	1.94	0.010	0.55	34	26	40	C - CL
C07051219-031	WP 300	40-49	2.61	51.7	7.9	14	14	6.9	1.86	0.037	0.86	38	26	36	CL
C07051219-032	WP 301	0-2	1.68	83.6	6.7	14	5.8	0.22	0.07	0.018	0.29	20	51	29	SICL
C07051219-033	WP 301	2-15	1.04	46.3	7.4	6.9	4.3	0.78	0.33	0.019	0.34	45	28	27	CL - L
C07051219-034	WP 301	15-24	1.09	37.1	8.2	2.1	3.3	6.6	4.04	0.010	0.26	50	24	26	SCL
C07051219-035	WP 301	24-38	0.99	41.6	7.9	2.6	2.8	5.3	3.25	0.007	<0.20	67	14	19	SL
C07051219-036	WP 301	38-50	0.74	39.7	8.1	2.0	1.4	4.7	3.57	< 0.005	<0.20	47	25	28	SCL
C07051219-037	WP 301	50-60	0.42	34.1	8.1	1.0	0.44	3.5	4.11	< 0.005	<0.20	55	20	25	SCL
C07051219-038	WP 302	0-3	0.73	46.4	6.8	6.3	2.3	0.11	0.05	0.009	<0.20	61	23	16	SL
C07051219-039	WP 302	3-12	0.27	37.5	6.3	2.3	1.1	0.09	0.07	0.003	<0.20	62	20	18	SL
C07051219-040	WP 302	12-20	0.26	39.3	6.6	2.0	1.0	0.13	0.11	0.005	<0.20	54	21	25	SCL

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Report Date: 06/28/07
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	Analysis		EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s.u.	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
Sample ID	Client Sample ID	Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-041	WP 302	20-30	0.60	42.5	7.2	4.1	2.4	0.15	0.10	0.005	< 0.20	50	20	30	SCL
C07051219-042	WP 302	30-48	0.41	47.5	8.0	2.2	2.1	0.23	0.14	< 0.005	< 0.20	41	24	35	CL
C07051219-043	WP 302	48-60	0.25	51.1	8.3	0.69	1.8	0.35	0.31	< 0.005	< 0.20	29	34	37	CL
C07051219-044	WP 303	0-3	0.74	55.4	7.6	7.4	1.4	0.11	0.05	0.012	< 0.20	31	37	32	CL
C07051219-045	WP 303	3-10	0.90	62.2	7.8	6.6	2.2	0.23	0.11	0.016	< 0.20	39	30	31	CL
C07051219-046	WP 303	10-18	1.24	57.8	7.9	6.9	4.5	0.63	0.27	0.014	< 0.20	4.0	64	32	SICL
C07051219-047	WP 304	0-3	0.92	57.4	7.6	8.6	1.8	0.09	0.04	0.012	0.26	26	34	40	C - CL
C07051219-048	WP 304	3-20	0.40	59.4	8.1	2.4	1.6	0.23	0.16	0.005	< 0.20	38	27	35	CL
C07051219-049	WP 305	0-2	1.09	48.0	7.5	11	1.8	0.13	0.05	0.010	< 0.20	30	39	31	CL
C07051219-050	WP 305	2-12	0.90	58.4	7.8	7.3	2.0	0.16	0.07	0.015	< 0.20	31	34	36	CL
C07051219-051	WP 305	12-20	0.42	55.5	8.2	2.2	1.8	0.35	0.25	0.007	< 0.20	36	34	30	CL
C07051219-052	WP 305	20-26	0.81	53.8	8.2	3.2	4.0	0.99	0.52	0.003	< 0.20	30	37	33	CL
C07051219-053	WP 306	0-2	0.78	59.6	7.7	7.0	1.8	0.15	0.07	0.003	0.21	29	32	39	CL
C07051219-054	WP 306	2-20	0.84	72.2	8.1	3.4	2.5	2.7	1.55	0.008	< 0.20	24	25	51	C
C07051219-055	WP 14-1	0-5	0.78	45.0	6.8	6.2	2.7	0.11	0.05	0.015	< 0.20	26	53	21	SIL
C07051219-056	WP 14-1	5-16	0.30	50.8	6.5	2.0	1.2	0.12	0.10	0.011	< 0.20	48	28	24	L
C07051219-057	WP 14-1	16-31	0.36	51.5	6.8	2.1	1.5	0.17	0.13	0.003	< 0.20	37	27	36	CL
C07051219-058	WP 14-1	31-42	0.41	41.2	7.2	2.1	1.7	0.23	0.17	< 0.005	< 0.20	49	26	25	SCL
C07051219-059	WP 14-1	42-51	0.36	42.8	8.1	1.9	1.8	0.32	0.24	< 0.005	< 0.20	51	18	31	SCL
C07051219-060	WP 14-1	51-60	0.31	40.4	8.2	1.4	1.7	0.35	0.29	< 0.005	< 0.20	59	19	22	SCL
C07051219-061	WP 19-1	0-3	0.76	42.8	6.2	4.3	2.8	0.12	0.05	0.014	< 0.20	42	37	21	L
C07051219-062	WP 19-1	3-20	0.28	51.9	7.1	0.93	0.66	0.99	1.04	0.007	0.29	26	51	23	SIL
C07051219-063	WP 19-1	20-24	1.53	64.6	7.6	0.11	0.14	0.14	0.39	0.005	0.31	22	53	25	SIL
C07051219-064	WP 19-1	24-32	0.50	59.7	8.2	1.0	1.1	2.8	2.73	0.049	0.50	17	38	45	C
C07051219-065	WP 19-1	32-44	0.79	58.3	8.2	1.5	1.6	4.5	3.59	0.077	1.2	23	37	40	C - CL
C07051219-066	WP 19-1	44-60	5.35	43.6	7.9	27	25	65	12.8	0.224	0.77	44	26	30	CL
C07051219-067	WP 33-1	0-3	0.60	39.4	6.4	3.9	1.6	0.06	0.04	0.011	< 0.20	73	13	14	SL
C07051219-068	WP 33-1	3-15	0.76	34.5	6.5	5.2	2.0	0.03	0.05	0.010	< 0.20	73	12	15	SL
C07051219-069	WP 33-1	15-34	0.32	45.6	7.0	2.5	0.72	0.19	0.08	0.007	< 0.20	63	16	21	SCL
C07051219-070	WP 33-1	34-44	0.82	44.2	7.1	5.6	1.7	0.19	0.10	0.005	< 0.20	59	19	22	SCL
C07051219-071	WP 33-1	44-60	0.98	43.0	7.8	5.5	2.7	0.27	0.13	< 0.005	< 0.20	57	19	24	SCL
C07051219-072	WP 36-1	0-3	0.74	43.3	6.2	4.0	3.3	0.13	0.07	0.011	< 0.20	46	24	30	SCL
C07051219-073	WP 36-1	3-12	0.56	64.6	6.5	2.7	2.5	0.29	0.18	0.010	0.23	34	25	41	C
C07051219-074	WP 36-1	12-17	0.60	63.4	7.8	3.3	3.5	1.1	0.58	0.005	0.21	18	37	45	C
C07051219-075	WP 36-1	17-36	0.72	67.6	8.2	1.7	2.5	2.8	1.91	0.025	0.32	9.0	42	49	SIC
C07051219-076	WP 36-1	36-42	0.79	63.0	8.2	1.4	2.4	3.9	2.66	0.060	0.51	11	43	46	SIC
C07051219-077	WP 37-1	0-3	0.78	43.6	6.2	18	17	0.71	0.17	0.011	< 0.20	52	29	19	L
C07051219-078	WP 37-1	3-7	0.45	39.0	6.2	1.6	2.4	0.47	0.33	0.020	< 0.20	45	22	33	CL
C07051219-079	WP 37-1	7-15	0.79	79.9	6.7	2.5	4.3	1.1	0.61	0.015	0.25	13	36	51	C
C07051219-080	WP 37-1	15-18	1.20	60.7	7.8	3.4	7.0	2.7	1.18	0.007	0.31	12	32	56	C
C07051219-081	WP 37-1	18-26	0.50	60.7	7.8	22	42	6.1	1.08	0.044	0.73	13	30	57	C

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Sample ID	Client Sample ID	Analysis	EC SatPst	Saturation SatPst	pH SatPst	Ca SatPst	Mg SatPst	Na SatPst	SAR	Se-ABDTPA	B-CACL2	Sand	Silt	Clay	Texture
		Units	mmhos/cm	%	s.u.	meq/L	meq/L	meq/L	unitless	mg/kg-dry	mg/kg-dry	%	%	%	
		Depth	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
C07051219-082	WP 80-1	0-3	0.51	40.9	6.4	3.3	1.4	0.19	0.13	0.008	< 0.20	62	22	16	SL
C07051219-083	WP 80-1	3-20	0.52	34.0	6.6	3.6	1.4	0.17	0.11	0.009	< 0.20	64	17	19	SL
C07051219-084	WP 80-1	20-28	0.64	29.1	7.1	5.6	1.8	0.27	0.14	< 0.005	< 0.20	80	9.0	11	SL
C07051219-085	WP 80-1	28-37	0.75	29.5	7.3	6.1	1.7	0.25	0.14	< 0.005	< 0.20	80	9.0	11	SL
C07051219-086	WP 107-1	0-2	0.90	59.7	7.5	6.0	2.5	0.18	0.09	0.015	< 0.20	26	41	33	CL
C07051219-087	WP 107-1	2-14	1.54	58.3	7.0	14	2.8	0.07	0.03	0.025	0.29	33	39	28	CL
C07051219-088	WP 109-1	0-3	1.20	60.0	7.0	11	1.9	0.07	0.03	0.011	< 0.20	21	43	36	CL
C07051219-089	WP 109-1	3-24	0.76	67.1	7.5	5.4	1.9	0.21	0.11	0.007	< 0.20	19	44	37	SICL
C07051219-090	WP 109-1	24-30	0.42	79.9	7.8	2.6	1.9	0.22	0.15	0.010	< 0.20	13	45	42	SIC
C07051219-091	WP 109-1	30-44	0.55	58.7	8.0	2.3	2.8	0.35	0.22	< 0.005	< 0.20	14	45	41	SIC
C07051219-092	WP 109-1	44-50	0.68	61.4	8.0	2.3	3.7	0.83	0.48	0.005	< 0.20	17	46	37	SICL

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	Analysis		Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C07051219-001	WP 136-1	0-3	4.3	2.9
C07051219-002	WP 136-1	3-12	4.1	
C07051219-003	WP 136-1	12-20	3.1	
C07051219-004	WP 136-1	20-24	6.9	
C07051219-005	WP 136-1	24-36	2.8	
C07051219-006	WP 137-1	0-3	2.9	4.4
C07051219-007	WP 137-1	3-10	3.7	
C07051219-008	WP 137-1	10-21	21	
C07051219-009	WP 137-1	21-32	8.9	
C07051219-010	WP 137-1	32-42	4.5	
C07051219-011	WP 137-1	42-50	4.2	
C07051219-012	WP 133-1	0-3	1.6	2.5
C07051219-013	WP 133-1	3-14	4.6	
C07051219-014	WP 133-1	14-20	4.6	
C07051219-015	WP 133-1	20-32	4.0	
C07051219-016	WP 133-1	32-44	3.9	
C07051219-017	WP 133-1	44-54	4.3	
C07051219-018	WP 133-1	44-54		
C07051219-018	WP 133-1	54-60	5.0	
C07051219-019	WP 126-1	0-2	2.2	4.2
C07051219-020	WP 126-1	2-10	3.5	
C07051219-021	WP 127-1	0-3	1.5	3.1
C07051219-022	WP 127-1	3-20	3.3	
C07051219-023	WP 127-1	20-27	6.3	
C07051219-024	WP 127-1	27-45	5.1	
C07051219-025	WP 127-1	45-51	3.5	
C07051219-026	WP 127-1	51-60	3.1	
C07051219-027	WP 300	0-4	1.0	2.9
C07051219-028	WP 300	4-20	8.3	
C07051219-029	WP 300	20-28	5.7	
C07051219-030	WP 300	29-40	4.1	
C07051219-031	WP 300	40-49	2.4	
C07051219-032	WP 301	0-2	1.6	6.8
C07051219-033	WP 301	2-15	1.6	
C07051219-034	WP 301	15-24	< 1.0	
C07051219-035	WP 301	24-38	< 1.0	
C07051219-036	WP 301	39-50	1.1	
C07051219-037	WP 301	50-60	< 1.0	
C07051219-038	WP 302	0-3	< 1.0	3.4
C07051219-039	WP 302	3-12	< 1.0	
C07051219-040	WP 302	12-20	1.8	

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		Analysis	Coarse Frags	Organic Matter
		Units	%	%
Sample ID	Client Sample ID	Depth	Results	Results
C07051213-041	WP 302	20-30	2.6	
C07051213-042	WP 302	30-48	1.7	
C07051213-043	WP 302	48-50	2.4	
C07051213-044	WP 303	0-3	2.1	3.4
C07051213-045	WP 303	3-10	5.2	
C07051213-046	WP 303	10-18	7.7	
C07051213-047	WP 304	0-3	1.8	3.8
C07051213-048	WP 304	3-20	4.9	
C07051213-049	WP 305	0-2	1.7	3.5
C07051213-050	WP 305	2-12	2.0	
C07051213-051	WP 305	12-20	4.7	
C07051213-052	WP 305	20-26	9.0	
C07051213-053	WP 306	0-2	1.4	3.0
C07051213-054	WP 306	2-20	18	
C07051213-055	WP 14-1	0-5	< 1.0	3.5
C07051213-056	WP 14-1	5-16	1.7	
C07051213-057	WP 14-1	15-31	2.6	
C07051213-058	WP 14-1	31-42	2.3	
C07051213-059	WP 14-1	42-51	1.4	
C07051213-060	WP 14-1	51-60	< 1.0	
C07051213-061	WP 19-1	0-3	< 1.0	3.9
C07051213-062	WP 19-1	3-20	10	
C07051213-063	WP 19-1	20-24	18	
C07051213-064	WP 19-1	24-32	4.4	
C07051213-065	WP 19-1	32-44	3.5	
C07051213-066	WP 19-1	44-60	5.7	
C07051213-067	WP 33-1	0-3	< 1.0	2.4
C07051213-068	WP 33-1	3-15	2.4	
C07051213-069	WP 33-1	15-34	1.6	
C07051213-070	WP 33-1	34-44	2.2	
C07051213-071	WP 33-1	44-60	2.7	
C07051213-072	WP 35-1	0-3	1.9	2.9
C07051213-073	WP 35-1	3-12	13	
C07051213-074	WP 35-1	12-17	12	
C07051213-075	WP 35-1	17-36	6.4	
C07051213-076	WP 35-1	36-42	5.1	
C07051213-077	WP 37-1	0-3	< 1.0	2.9
C07051213-078	WP 37-1	3-7	5.6	
C07051213-079	WP 37-1	7-15	31	
C07051213-080	WP 37-1	15-18	24	
C07051213-081	WP 37-1	18-28	14	

ENERGYMETALS
CORPORATION US

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	Analysis	Coarse Frags	Organic Matter
	Units	%	%
Sample ID / Client Sample ID	Depth	Results	Results
C07051219-062 WP 80-1	0-3	1.6	2.5
C07051219-063 WP 80-1	3-20	1.5	
C07051219-064 WP 80-1	20-28	4.1	
C07051219-065 WP 80-1	28-37	2.5	
C07051219-066 WP 107-1	0-2	3.4	2.1
C07051219-067 WP 107-1	2-14	2.6	
C07051219-068 WP 108-1	0-3	2.7	4.1
C07051219-069 WP 108-1	3-24	4.2	
C07051219-090 WP 108-1	24-30	20	
C07051219-091 WP 108-1	30-44	4.1	
C07051219-092 WP 108-1	44-60	3.9	

ADDENDUM 3.3-E

PRIME FARMLAND DESIGNATION

Jamie Eberly
Plant Ecologist
BKS Environmental Associates, Inc.
P.O. Box 3467
Gillette, WY 82717

RE: Prime Farmland for Moore Ranch

Jamie,

I looked over the area for the Energy Metals Moore Ranch Corporation.

There is no prime farmland.

Douglas A. Gasseling

Douglas A. Gasseling, CPAg, CPESC, CCA
Conservation Agronomist
11221 East Highway 30
Cheyenne, WY 82009

3.4 WATER RESOURCES

3.4.1 Water Use

3.4.1.1 Regional Groundwater Use

The license area is located at the southwestern edge of the Northern Great Plains aquifer system, which underlies most of the Dakotas and parts of Montana and Wyoming (USGS 1996). The major aquifers of the Northern Great Plains aquifer system are sandstones of Tertiary and Cretaceous age and carbonate rocks of Paleozoic age. These are overlain by unconsolidated deposits of Quaternary age, some of which are locally highly permeable and underlain by crystalline rocks that yield little water (USGS 1996).

Regional movement of water in the Northern Great Plains aquifer system comes from recharge areas at high altitudes, down the dip of the aquifers and then upward to discharge into shallower aquifers or to the land surface. The regional direction of flow in the deep, confined aquifers follows long flow paths and trends from southwest to northeast. Most of the recharge to the aquifer system is either from precipitation or snowmelt. Much of the discharge from the aquifer system is by upward leakage of water into shallower aquifers where the hydraulic head in the shallower aquifer is less than that of a deeper aquifer (USGS 1996).

The water-bearing units in the Northern Great Plains aquifer system can be divided into six major aquifer systems. From shallowest to deepest, these include:

- Quaternary Aquifers
- Middle Tertiary Aquifers
- Lower Tertiary Aquifers
- Upper Cretaceous Aquifers
- Lower Cretaceous Aquifers
- Paleozoic Aquifers

Table 3.4.1-1 shows these units along with the corresponding geologic formation, general transmissivity and water yields, and general water quality for the Northern Great Plains aquifer systems. Units younger than Lower Tertiary are typically not present within the vicinity of Moore Ranch and therefore are of no significance with respect to groundwater supply. Aquifer systems and geologic formations applicable to the Moore Ranch Project are discussed in greater detail in Section 3.4.3.

Water use estimates for Campbell County for different water use types are presented in Table 3.4.1-2.

Table 3.4.1-1 Northern Great Plains Aquifer Systems and Formations General Characteristics

Aquifer System	Formations	General Transmissivity (gpd/ft).	General Water Yields (gpm)
Quaternary Aquifers	Alluvium, Terrace, and Eolian Deposits	15 to 64,000	Up to 1,000
Middle Tertiary Aquifers	Arikaree Formation	Up to 77,000	Up to 1,000
Lower Tertiary Aquifers	Wasatch and Fort Union Formations	1 to 5,000	1 to 60
Upper Cretaceous Aquifers	Lance and Fox Hills Formations	76 to 2,100	Up to 350 gpm (Lance) and 700 gpm (Fox Hills)
Lower Cretaceous Aquifers	Dakota Sandstone Formation	220-810	Up to 150
Paleozoic Aquifers	Madison Limestone Formation	1,000 to 300,000	Up to 1,000

(HKM et al. 2002).

Table 3.4.1-2 Estimated Water Use in Campbell County, Wyoming

Water Use Type	Withdraws (MGD)
Public Supply	1.88
Domestic GW	0.01
Industrial GW	0.25
Industrial SW	0.15
Irrigated Acres, sprinkler	0.00184
Irrigated Acres, surface flood	0.01096
Irrigated Acres, total	0.01280
Irrigation GW	1.26
Irrigation SW	40.85
Irrigation, total	42.11
Mining GW	56.67
Mining SW	13.29
Mining, total	69.96
Thermoelectric, total	0.41
Total GW, fresh	41.26
Total GW, saline	18.97
Total GW	60.22
Total SW, fresh	54.55
Total SW, saline	0
Total SW	54.55

Source: Hutson et al. 2000
Notes: GW = Groundwater
SW = Surface water
MGD = Million gallons per day

3.4.1.2 Site Area Groundwater Use

The License Area is situated in the southwestern part of the Powder River Basin. The surface unit in the area is Wasatch Formation which is underlain by Fort Union Formation. The Wasatch Formation is further divided into sand layers interbedded with coal and mudstone. The target production zone is referred to as the 70 Sand. The thickness of 70 Sand is normally in the range of 60 to 80 feet and the dip is generally less than one degree toward the northwest. Recharge to the 70 Sand occurs mainly in the outcrop area located southeast of the License Area. The first water bearing formation above the 70 Sand is the 72 Sand (overlying) and first water bearing strata below is represented by the 68 Sand (underlying). Deeper buried 40 and 50 Sands extend areally and are locally considered very significant aquifers (Conoco 1980).

According to the Wyoming State Engineers Office, there are 439 wells located within the 2-mile radius of the License Area boundary as of December, 2005. Most of the groundwater pumped from active wells surveyed within a 2-mile radius of the License Area boundary is used either for stock or CBM production. Groundwater rights within the review area are in Addendum 3.4-A.

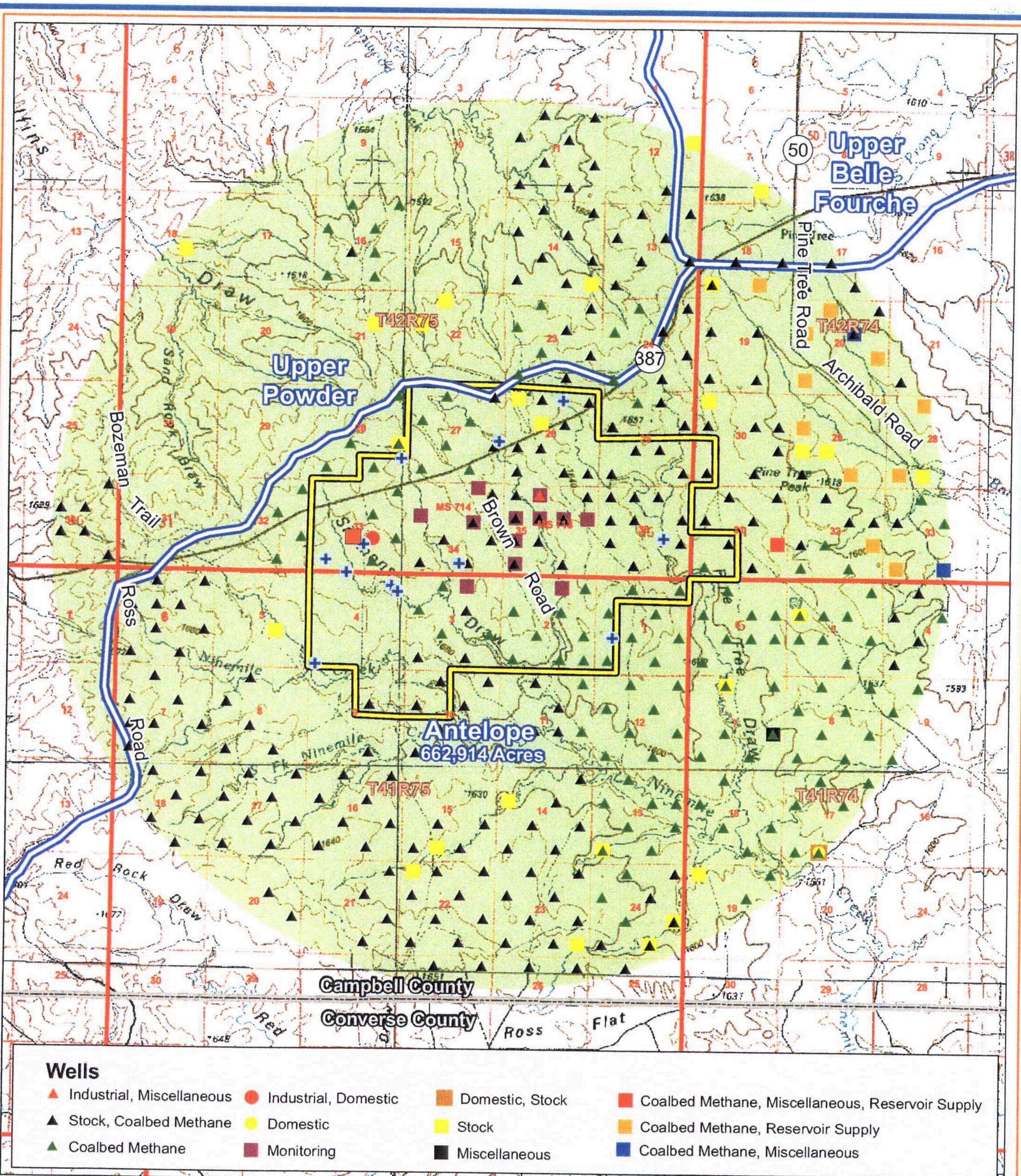
Figure 3.4.1-1 shows the locations of all water wells in the License Area and the 2-mile radius review area. Within this area, there are three domestic water wells ranging from 180 to 440 feet in depth. Licensed yields for these wells vary between 15 and 20 gpm, and static water level ranges between 40 to 85 feet below ground surface (bgs). While these wells are licensed for domestic use, there are no current occupied residences within the License Area and 2-mile radius. Therefore, these wells are not being primarily utilized for human consumption. There are no irrigation wells located within the surveyed 2-mile radius of the License Area boundary. Stock water wells depths range between 2 and 1,200 feet bgs, with static level depth from 4 to 320 feet bgs and yields between 1 and 40 gpm. CBM wells are up to 1,481 feet deep. Water levels from 21 monitoring wells within the License Area boundary range between 70 and 208 feet bgs. Depth of these monitoring wells ranges between 165 to 300 feet bgs (WSEO 2005).

Additionally, there are four stock wells located within the License Area that are older and as a result not licensed through the State Engineers Office. There is also a windmill and a shallow well located in the License Area. However, it is not functional.

In summary, there are three water wells licensed for domestic use and no irrigation groundwater wells within the 2-mile radius review area. Based on population projections, future water use within the 2-mile radius review area would likely be a continuation of present use.

3.4.1.3 Operational Water Use

Based on a bleed of 0.5% to 1.5% which has been successfully applied at other ISR operations, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 99%) of groundwater used in the mining process will be treated and re-injected (Figure 3.1-5). Potential impacts on groundwater quality due to consumptive use outside the license area are expected to be negligible. Impacts from operational water consumption are described in detail in Section 4 of this Environmental Report.



Legend

Moore Ranch Project Area
Unoccupied Residence
Pond
2 Mile Buffer
Fourth Level Watershed Boundary

0 1 2 Miles

Source: Wyoming State Engineers Office

Note: Some wells have multiple uses.

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FIGURE 3.4.1-1
MOORE RANCH PROJECT AREA WATER RESOURCES

Project Number: CO001252.0001.0002

3.4.2 Surface Water

The Moore Ranch License Area, as well as the western, southern, and eastern portions of the 2-mile radius review area (located in Campbell County, Wyoming) are drained by Ninemile Creek, an intermittent stream which flows through the far southern portion of the property in a southeasterly direction, within the Antelope Basin, Hydrologic Unit Code (HUC) 10120101 (US EPA 2007) (Figure 3.4.2-1). Simmons Draw, an intermittent stream, flows through the License Area from the northwest to the southeast and joins with Ninemile Creek just south of the License Area near the Van Gordon Ranch. Another unnamed intermittent stream flows through the center of the License Area from north to south and converges with Ninemile Creek on the south side near the Van Gordon Ranch. Pine Tree Draw is an intermittent stream located in the eastern portion of the License Area, and flows from north to south joining with Ninemile Creek southeast, just upstream from Ninemile Ranch. Pine Tree Draw is composed of three distinct branches within the License Area. The most easterly branch of Pine Tree Draw is fed by Pine Tree Spring, which is located at an elevation of 5,244 feet above mean sea level (amsl). Ninemile Creek joins with Antelope Creek southeast of the License Area in Converse County, WY about 8 miles downstream. Antelope Creek eventually flows easterly through Thunder Basin National Grassland to its confluence with the Cheyenne River in eastern Wyoming (USGS 1977). The Antelope Basin drains a total of 1,036 square miles and is part of the greater Cheyenne River Basin, which is part of the Northeastern Wyoming River Basin area (US EPA 2007 and HKM et al. 2002).

About nine small ponds are located within the License Area (Figure 3.4.1-1). The ponds are located on ephemeral streams including Ninemile Creek, Simmons Draw, an unnamed stream, and Pine Tree Draw. Ponds are used to supply range and pasture animals with drinking water or may be used for holding water discharged from coal bed methane and other oil and gas mining operations.

The northern/northwestern portion of the 2-mile review area drains to the Upper Powder River Basin (HUC 10090202) via Collins Draw and Cottonwood Creek (Figure 3.4.2-1). Collins Draw and Cottonwood Creek flow northward and join with the Dry Powder River in Johnson County, WY northwest of the License Area. The Dry Powder River flows northwesterly to its confluence with the Powder River just north of Sussex, WY. The total drainage area of the Upper Powder Basin is 2,518 square miles (US EPA 2007).

The northeasternmost portion of the 2-mile review area drains to the Belle Fourche River and the Upper Belle Fourche Basin, HUC 10120201, which has a drainage area of 2,934 square miles (Figure 3.4.2-1) (US EPA 2007). In the upper potion of the Belle Fourche River is an intermittent river which eventually joins with the Cheyenne

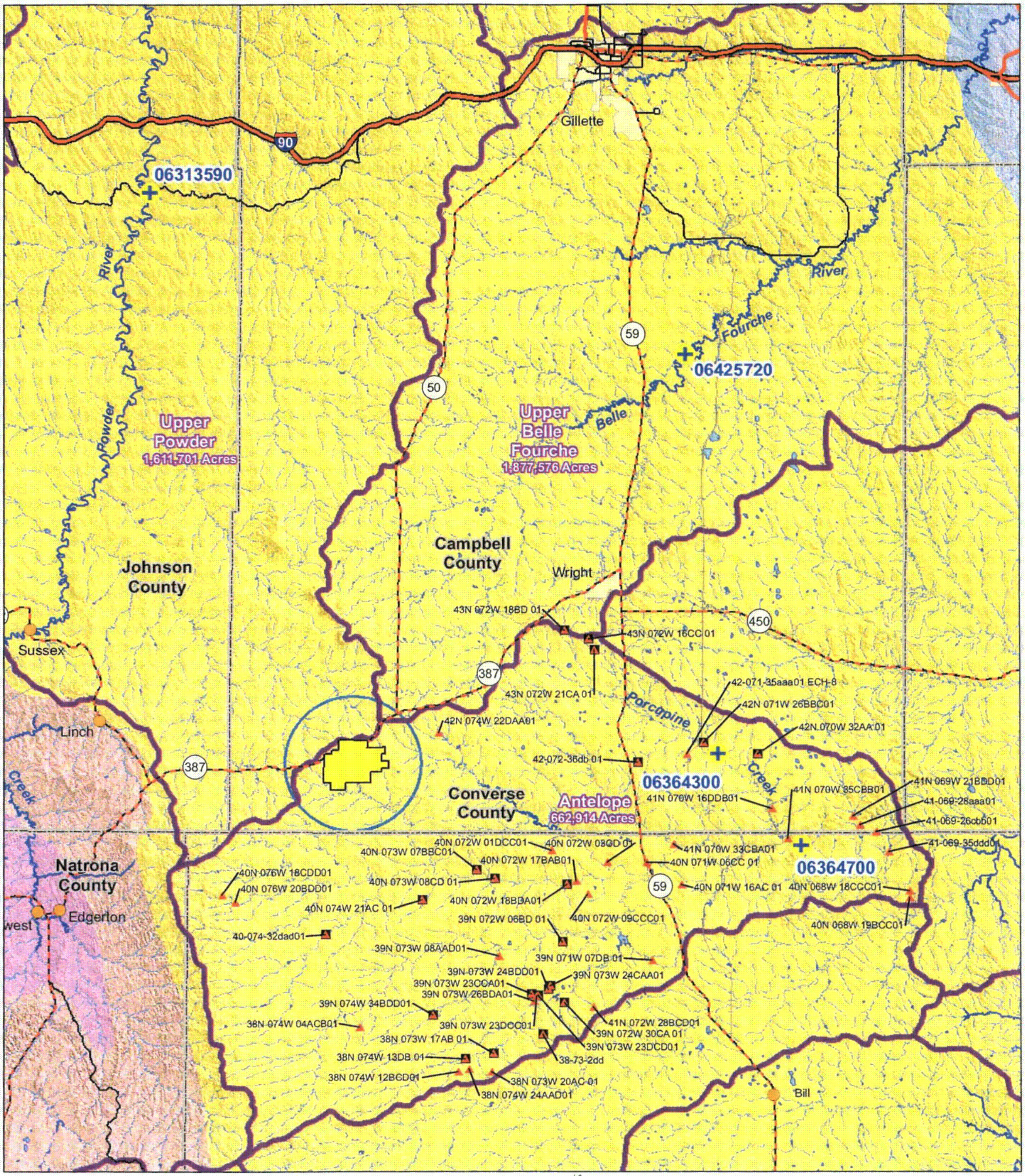
River east of the South Dakota boundary. The Cheyenne River joins the Missouri River in South Dakota.

Elevations near the License Area and its surrounding 2-mile review area are approximately 5,500 feet. Climate in the area is arid, typical of a high desert area, with low annual precipitation (13 inches/year) and high evaporation rates. Hydrographs for streams in the upper portions of the Antelope, Upper Belle Fourche, and Upper Powder River watersheds peak during snowmelt in the late spring/early summer. Summer thunderstorms also influence smaller hydrograph peaks.

3.4.2.1 Surface Water Quantity and Runoff

Surface water data for the Antelope Creek Basin (HUC 10120101) are scarce. No stream flow data are available for drainages located within the License Area or within the 2-mile review area. One U.S. Geological Survey (USGS) stream gage on Antelope Creek near Teckla, WY (USGS 06364700) is located southwest and downstream of the License Area (Figure 3.4.2-1). In the Upper Powder River Basin (HUC 10090202), which receives drainage from the northwest portion of the 2-mile review area, a USGS stream gage (USGS 06313590) is located above Burger Draw near Buffalo, WY. The Upper Belle Fourche River Basin (HUC 10120201), which receives a small portion of the drainage from the northeastern tip of the 2-mile review area, has a USGS stream gage located below Rattlesnake Creek near Piney, WY. Streamflow data from these USGS gage sites were analyzed to describe water quantities that may be influenced from activities within the License Area (USGS 2007).

Available daily mean discharge data for Antelope Creek is limited to September of 1977 through September of 1981. Analysis of daily mean discharge for Antelope Creek near Teckla, WY (USGS 06364700) during this period revealed an average of 9.8 cubic feet per second (cfs) and a median of 0.3 cfs. The maximum daily mean discharge of 2,560 cfs was recorded on May 18, 1978. Analysis of annual instantaneous peak discharge recorded from August 17, 1979 through August 5, 1981 revealed a peak flow of 1,760 cfs measured on August 17, 1979. Average peak flows were 836 cfs, ranging from 70 to 1,760 cfs, and the median peak flow was 836 cfs (USGS 2007) (Figure 3.4.2-2). Flood frequency data analysis was not possible due to the limited record of annual peak instantaneous data.



Legend

- Project Area
- USGS Stream Gage Location
- Fourth Level Sub-watershed Boundary
- County Boundary
- Two Mile Buffer

0 5 10 20 Miles

- USGS Groundwater Well
- USGS Groundwater Monitoring Well

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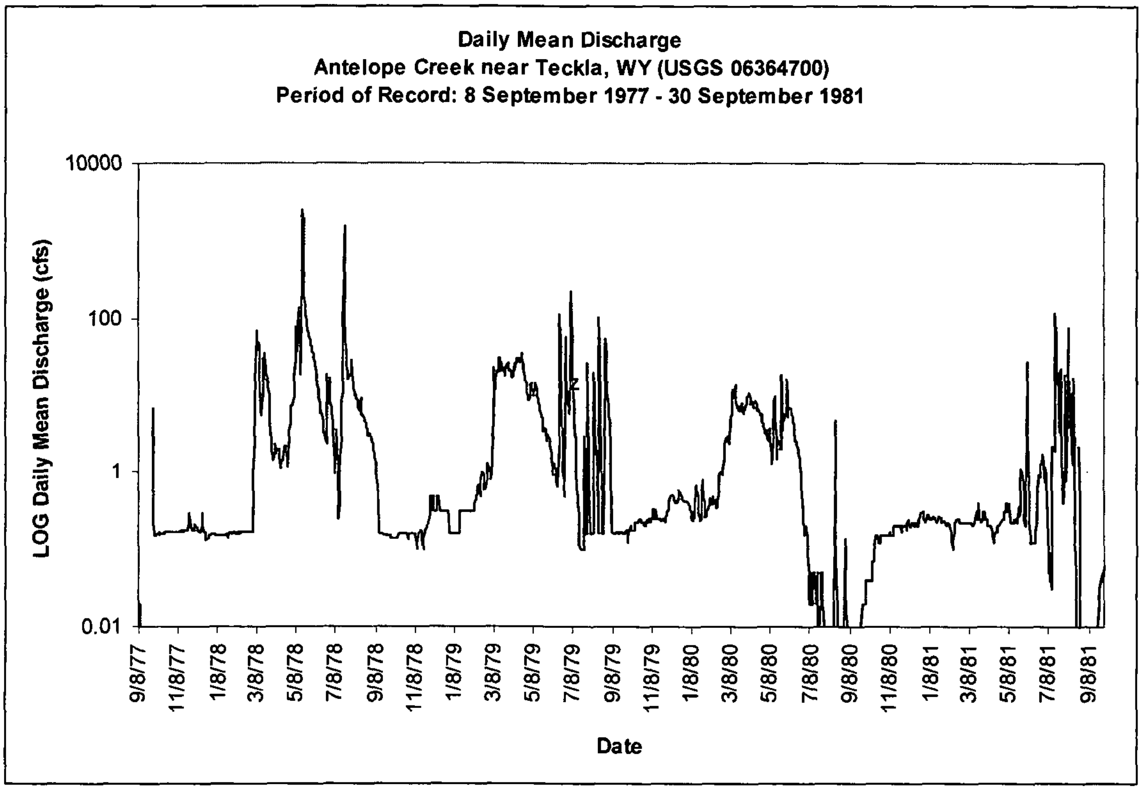
FIGURE 3.4.2-1
MOORE RANCH PROJECT
REGIONAL WATER RESOURCES

Project Number: CO001252.0001.0002

Figure 3.4.2-2 Daily Mean Discharge for Antelope Creek near the Town of Teckla

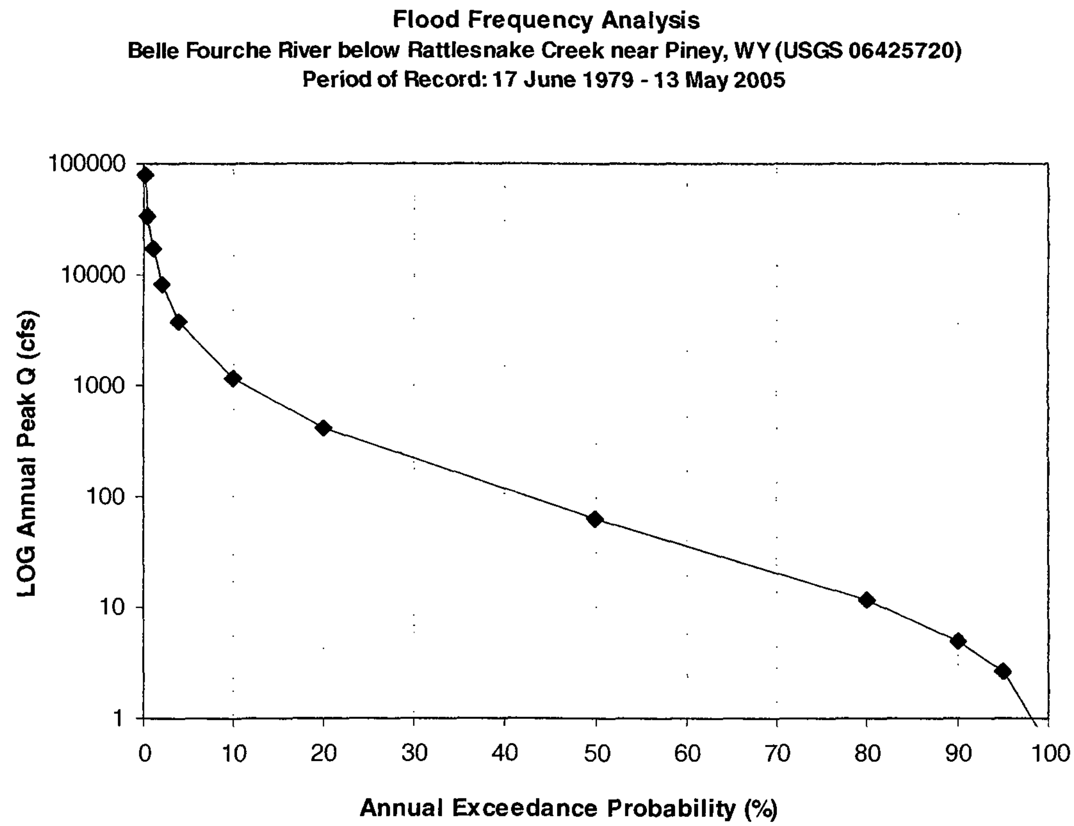


Analysis of daily mean discharge for the Powder River above Burger Draw near Buffalo, WY (USGS 06313590) from June 12, 2003 through June 28, 2007 revealed an average flow of 127 cfs and a median flow of 100 cfs. Daily mean discharge ranged from a minimum of 0.03 cfs to a maximum of 3,050 cfs, which occurred on May 7, 2007. Analysis of annual peak instantaneous discharge for the period of June 18, 2003 to May 12, 2005 revealed an average of 2,360 cfs and a median of 2,200 cfs. Annual instantaneous peaks flows ranged from 1,140 cfs to 3,740 cfs, which was recorded on May 12, 2005 (USGS 2007). Flood frequency data analysis was not possible due to the limited record of annual peak instantaneous data.

Analysis of daily mean discharge for the Belle Fourche River below Rattlesnake Creek near Piney, WY (USGS 06425720) revealed an average flow of 9.0 cfs and a median flow of 0.3 cfs. Daily mean discharge ranged from 0 cfs to 2,740 cfs, which was recorded on December 28, 2003. Analysis of annual instantaneous peak discharge from June 17, 1979 to May 13, 2005 indicated a mean peak flow of 357 cfs and a median peak flow of 36 cfs. Annual instantaneous peak discharges ranged from 4 cfs to 1,300 cfs, which was recorded on June 17, 1979 (USGS 2007).

Flood frequency analysis was performed using the USGS standard method, in which a log-Pearson Type III frequency distribution is fit to the logarithms of the peak flow cumulative distribution. Parameters of the log-Pearson Type III were estimated from the logarithmic peak flows (mean, standard deviation, and coefficient of skewness) with adjustments for low and high outliers, historic peaks and generalized skew (Riggs 1968). Log-Pearson III flood frequency analysis revealed a flood that has the probability of occurring once every 10 years, has a magnitude of about 1,100 cfs. Similarly, a flood that has the probability of occurring once every 100 years has a magnitude of 12,000 cfs (Figure 3.4.2-3).

Figure 3.4.2-3 Flood Frequency Analysis for Belle Fourche River near Piney, Wyoming



Antelope Creek has a drainage area of 980 square miles with an approximate channel length of 62 miles and an average gradient of 0.006 (ft/ft). The elevation at Antelope Creek's headwaters is approximately 6,225 feet above mean sea level (msl), and 4,400 feet at its confluence with the South Cheyenne River. The U.S. Geological Survey has a stream gaging station on Antelope Creek approximately ten miles upstream from its mouth. The drainage area is 959 square miles, at the gage.

Ninemile Creek has a total drainage area of 63 square miles, a channel length of approximately 20 miles, and an average channel gradient of 0.006 (ft/ft). The elevation difference from headwaters to mouth is 610 feet with a maximum basin elevation of approximately 5,500 feet above msl. The channel length within this area is approximately 10.5 miles with an average gradient of 0.007 (ft/ft).

Simmons Draw is a Ninemile Creek tributary flowing southeasterly through the project (Figure 3.4.2-4). Its total drainage area is 8.1 square miles. The channel length is 6.8 miles with an average gradient of 0.007 (ft/ft). Total basin elevation difference is 260 feet with a maximum elevation of approximately 5,475 feet above msl.

Pine Tree Draw, with a drainage area of 8.2 square miles, flows from the north into Ninemile Creek on the eastern edge of the project area (Figure 3.4.2-4). The channel length is approximately 7.6 miles, and the average gradient is 0.009 (ft/ft). The maximum basin elevation approaches 5,470 feet above msl, and the minimum is approximately 5,110 feet.

Simmons Draw has two tributaries which flow in a predominantly southerly direction in the project area. These tributaries are labeled Washes Nos. 1 and 2 on Figure 3.4.2-4. Wash No. 2 is further subdivided into Upper Wash No. 2 and Lower Wash No. 2 based on the channel reach being upstream and downstream of the proposed mining Pit 35N. Wash No. 4, which is tributary to Ninemile Creek, is also further divided into Upper Wash No. 4 and Lower Wash No. 4 at the location of the proposed mill tailings evaporation pond dam.

Wash No. 1 has a drainage area of 1.7 square miles, a channel length of 2.8 miles, and an average channel gradient of 0.014 (ft/ft). The basin elevation difference is approximately 205 feet with a maximum elevation of 5,475 feet above msl.

Upper Wash No. 2 and Lower Wash No. 2 have drainage areas of 1.9 and 0.95 square miles, respectively. Their respective channel lengths are 3.1 and 2.2 miles with average gradients of 0.012 and 0.007 (ft/ft).

The drainage areas of Upper Wash No. 4 and Lower Wash No. 4 are 0.70 and 0.53 square miles respectively. Channel lengths are 0.46 and 1.3 miles with respective gradients of 0.017 and 0.013 (ft/ft).

Wash No. 3 (Figure 3.4.2-4) drains into Pine Tree Draw from the northwest in Section 36 of T42N-R75W. Its drainage area is 1.8 square miles, the channel length and average gradient are 3.2 miles and 0.014 (ft/ft), respectively, and the basin elevation difference is approximately 230 feet. The maximum basin elevation is approximately 5,480 feet above msl.

Drainage basin characteristics for Antelope Creek, Ninemile Creek, and all of the tributaries relevant to the Moore Ranch project area are summarized in Table 3.4.2-1.

Table 3.4.2-1 Drainage Basin Characteristics for the Moore Ranch Project Area

Drainage Basin	Drainage Area (mi²)	Channel Length (mi)	Elevation Differences (ft)	Channel (ft/mi)	Gradient (ft/ft)
Antelope Creek (total)	980	62	1,825	29.4	0.006
Antelope Creek (at USGS gage)	959	52	1,775	34.1	0.006
Ninemile Creek (Total)	63	20	610	30.5	0.006
Ninemile Creek (@ 1-7)	34	10.5	390	37.1	0.007
Pine Tree Draw	8.2	7.6	370	48.9	0.0009
Simmons Draw	8.1	6.8	260	38.2	0.0007
Wash No. 1	1.7	2.8	205	73.2	0.014
Upper Wash No. 2	1.9	3.1	190	61.3	0.012
Lower Wash No. 2	0.95	2.2	80	36.4	0.007
Wash No. 3	1.8	3.2	230	71.9	0.014
Upper Wash No. 4	0.70	0.46	130	90.2	0.017
Lower Wash No. 4	0.53	1.3	90	69.2	0.013

Site Surface Water Runoff

Peak flood estimates for each of the drainage basins within and directly adjacent to the Moore Ranch Project area were previously calculated and presented to the NRC in the Environmental Report for the Sand Rock Mill Project, Docket No. 40-8743 (1980) and subsequent Draft Environmental Statement prepared by the NRC (1982). Those documents were referenced to provide the following runoff estimates. These estimates are considered valid.

In those reports, three techniques were utilized for estimating flood flows and volumes ephemeral basins for different recurrence intervals as described below.

- Lowham (1976) presented a basin characteristics technique whereby peak flow was related to drainage area with consideration of different regions in the state. Lowham's regression equations can be used for basins with drainage areas between 5 and 5,300 square miles. However, using a graphical approach, his technique can be used for basins slightly less than one square mile in area.

- For small basins (approximately 10 square miles and less) Craig and Rankl (1977) developed basin characteristics regression equations which utilize other basin parameters in addition to drainage area to compute peak flows and flood volumes (Craig and Rankl, "Analysis of Runoff from Small Drainages in Wyoming, US Geological Survey, Open-File Report 77-727, 1977).

- Also, for small basins, the U.S. Soil Conservation Service (SCS) has developed a technique to estimate peak flows and flood volumes. These techniques are published in their Engineering Field Manual (1969). The SCS technique utilizes peak rainfall values published by the U.S. Weather Bureau and then takes into consideration soil and vegetation characteristics and basin slope and drainage area to make the flood flow and volume estimates.

The technique presented in Lowham (1976) has since been superseded by Lowham, 1988, and subsequently by Miller, 2003. Therefore, the flood estimates calculated from the techniques in Lowham (1976) are not considered valid and are not presented in this report. The methods used in Craig and Rankl (1977) for analysis for small drainage basins in Wyoming (later published in Craig and Rankl, "Analysis of Runoff from Small Drainages in Wyoming, US Geological Survey, Water Supply Paper 2056, 1978) and the SCS method are considered valid techniques for estimating runoff as described WDEQ-LQD Guideline 8.

Table 3.4.2-2 presents flood flow and volume estimates for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. For comparison purposes, values obtained by utilizing the two techniques described above are tabulated.

Values listed in Table 3.4.2-2 under the SCS method were obtained using curve number 75 and 24-hour duration precipitation values from Miller and others (1973). Table 3.4.2-3 shows precipitation for selected recurrence intervals for different duration periods.

Table 3.4.2-2 Peak Flood Discharge Estimates for 5-, 10-, 25-, 50-, and 100-Year Recurrence Intervals for Drainages within the Moore Ranch Project Boundary

Drainage	Drainage Area (mi^2)	Craig and Rank's Method (CFS)					SCS Method (CFS)				
		5-year	10-year	25-year	50-year	100-year	5-year	10-year	25-year	50-year	100-year
Ninemile Creek	63	4,700	6,900	9,800	14,000	18,000					
Pine Tree Draw	8.2	1,100	1,600	2,200	3,100	3,900					
Simmons Draw	8.1	1,400	2,000	2,600	3,600	4,500					
Wash No. 1	1.7	410	580	770	1,100	1,310	150	250	350	450	550
Upper Wash No. 2	1.9	480	670	890	1,200	1,500	160	260	370	480	580
Lower Wash No. 2	0.95	500	640	770	990	1,200	100	150	240	310	360
Wash No. 3	1.8	400	560	760	1,000	1,300	160	260	360	470	570
Upper Wash No. 4	0.7	260	360	460	610	740	85	140	190	250	300
Lower Wash No. 4	0.53	270	350	440	570	670	70	110	150	210	250

Reference: Conoco, Inc. 1980. Environmental Report for the Sand Rock Mill Project, Campbell County, Wyoming, Docket No. 40-8743. July, 1980.

More recent peak discharge evaluations for similar drainages in the Powder River Basin were conducted to evaluate the performance of reconstructed stream channel reclamation at coal mines (Western Water Consultants, 1995). Rainfall-runoff simulations were based on the SCS triangular hydrograph method to estimate flood discharges for 10 and 100-year events. Flood discharge values calculated for drainage areas in Campbell County of similar size are shown to be relatively similar to 100-year flood discharge values for drainages within the Moore Ranch project area using the SCS method. Table 3.4.2-4 shows a comparison of the Moore Ranch 100-year flood estimates and 100-year flood estimates from similar size drainage basins evaluated in the Western Water Consultants, 1995 report.

Table 3.4.2-3 Precipitation Values For Selected Recurrence Intervals and Durations in the Moore Ranch Project Area (Inches)

Duration	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Duration
5-Min	.25	.35	.42	.52	.59	.66	.83	5-Min
10-Min	.38	.54	.65	.80	.92	1.03	1.29	10-Min
15-Min	.48	.69	.83	1.01	1.16	1.30	1.64	15-Min
30-Min	.67	.95	1.14	1.40	1.61	1.81	2.27	30-Min
1-Hour	.85	1.21	1.45	1.78	2.03	2.29	2.87	1-Hour
2-Hour	.95	1.33	1.59	1.94	2.22	2.49	3.12	2-Hour
3-Hour	1.03	1.44	1.71	2.09	2.38	2.67	3.33	3-Hour
6-Hour	1.25	1.71	2.01	2.44	3.47	3.10	3.86	6-Hour
12-Hour	1.47	2.00	2.35	2.84	3.22	3.60	4.47	12-Hour
24-Hour	1.70	2.29	2.69	3.24	3.67	4.10	5.09	24-Hour

Table 3.4.2-4 Comparison of Moore Ranch Project SCS Method 100-year Flood Estimates with Recent Flood Estimates for Similar Size Drainage Basins in Campbell County

Drainage	Area (Square Miles)	SCS Method 100-year Peak Discharge (cfs)	Drainage	Area (Square Miles)	SCS Method 100-year Peak Discharge (cfs)
Wash No. 1	1.7	550	Russel Draw	1.8	590
Upper Wash No. 2	1.9	580	Russel Draw	1.8	590
Lower Wash No. 2	0.95	360	HA Creek Tributary	1.03	351
Wash No. 3	1.8	570	Russel Draw	1.8	590
Upper Wash No. 4	0.70	300	Lone Tree Prong	0.68	279
Lower Wash No. 4	0.53	250	School Creek	0.49	260

3.4.2.2 Surface Water Quality

No streams within the Antelope Creek Basin are listed on the US EPA Section 303(d) list, which categories impaired surface water bodies. The Upper Powder River Basin is listed on the Section 303(d) list for chloride and selenium from the South Fork of the Powder River to an undetermined distance downstream below Sussex, WY. The Upper Belle Fourche River Basin is listed on the Section 303(d) list for ammonia and total residual chlorine downstream of the Hulett Wastewater Treatment Plant (US EPA 2007).

According to the Wyoming Department of Environmental Quality (WY DEQ), Antelope Creek is classified as a 3B surface water, meaning its designated use is for recreation, other aquatic life, wildlife, agriculture, industry, and scenic value. The North Fork of the Powder River is classified as a 2AB surface water, which means its designated use is for drinking water, game and non-game fisheries, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value. The Upper Belle Fourche River is classified as a 2ABWW surface water, and its associated designated uses are drinking water, game and non-game fisheries, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value (WY DEQ 2001).

Water quality data were available from only one USGS stream gage (06364700) located on Antelope Creek near Teckla, WY from October 3, 1977 through September 7, 2005. Water quality data analyses revealed a mean temperature of 10.4 degrees Celsius (°C) and a range from 0 to 30 °C. Mean dissolved oxygen was 7.8 milligrams/liter (mg/l) and ranged from 2.8 to 11.7 mg/L. Total nitrogen averaged 0.55 mg/L and ranged from 0.21 to 1.8 mg/l. Mean ammonia as nitrogen concentrations were 0.04 mg/L and ranged from 0 to 0.13 mg/l. Nitrite plus nitrate as nitrogen averaged 0.04 mg/L, with a range from 0 to 0.29 mg/l. Average phosphate was 0.03 mg/L and average selenium (water filtered) was 0.56 mg/l (USGS 2007). EMC has conducted surface water quality sampling at 10 monitoring locations at the Moore Ranch site. Sampling was performed on a quarterly basis since last quarter 2006.

Within the Moore Ranch Project Area, surface water samples were collected from 9 sampling locations (all locations are existing stock ponds or areas in drainages where ponding occurs) at upstream and downstream locations from proposed mining areas during late fall of 2006, early spring of 2007, and late spring of 2007. Locations of these sample sites are shown on Figure 3.4.2-4. No surface water was available for sites MRSW-10 and MRSW-11 for sampling during these periods. Water quality data collected from theses surface water sites is summarized in Tables 3.4.2-5 through 3.4.2-13, overall average concentrations are shown in Table 3.4.2-15, and seasonal averages are shown in Table 3.4.2-14. Detection limit values were used for non-detectable results for calculation purposes. (Tables 3.4.2-5 through 3.4.2-15 are at the end of this section).

In general, surface water contained in the ponds at the sampling locations will exhibit typical saline characteristics of coal-bed methane surface discharge (higher values for conductivity, TDS, and bicarbonate) during summer and fall months. Sampling data shows that surface water quality changes during spring months when dilution occurs from snow melt or heavy precipitation events. Significantly higher values for bicarbonate, carbonate, chloride, conductivity, fluoride, TDS, gross alpha, gross beta, nitrogen, arsenic, potassium, magnesium, sodium, occurred during the fall sampling when the surface water contained was largely comprised of CBM discharge. Values for these parameters were typically the lowest during the samples taken in late March, which were taken soon after a large snowmelt event. Samples taken in June, while showing slightly higher concentrations than the March sampling, were also significantly lower than the fall sample due to the influence of spring runoff water contained in the ponds. Another round of surface water samples will be collected in the third quarter of 2007 (late summer) at locations with available water. It is anticipated that water quality from these samples will resemble results from the samples taken in the fall of 2006.

Average water quality during the fall sampling exceeded Wyoming Class I (domestic use) for TDS pH, and iron, and just slightly exceeded Class II (agriculture use) and Class III (livestock use) for pH. Averages for the other sampling periods also exceeded all class of use standards for pH. Overall averages for all sample rounds combined also exceed all class of use standards for pH and the Class I standard for TDS. The data tables also show lead average values for the fall and overall averages above the Class I standard, however these values are inaccurately high due to the use of a detection limit of 0.05 mg/L for the fall of 2006 samples in the calculations. This detection limit in itself exceeds the Class I standard of 0.015 mg/L. Sample results for the next two sample rounds show much lower results below the Class I standard. Also, one value for lead activity at MRSW-1 for the fall of 2006 shows and extremely high anomalous value of 170 pCi/L, and as a result, was believed to be lab error and excluded from the average calculations.

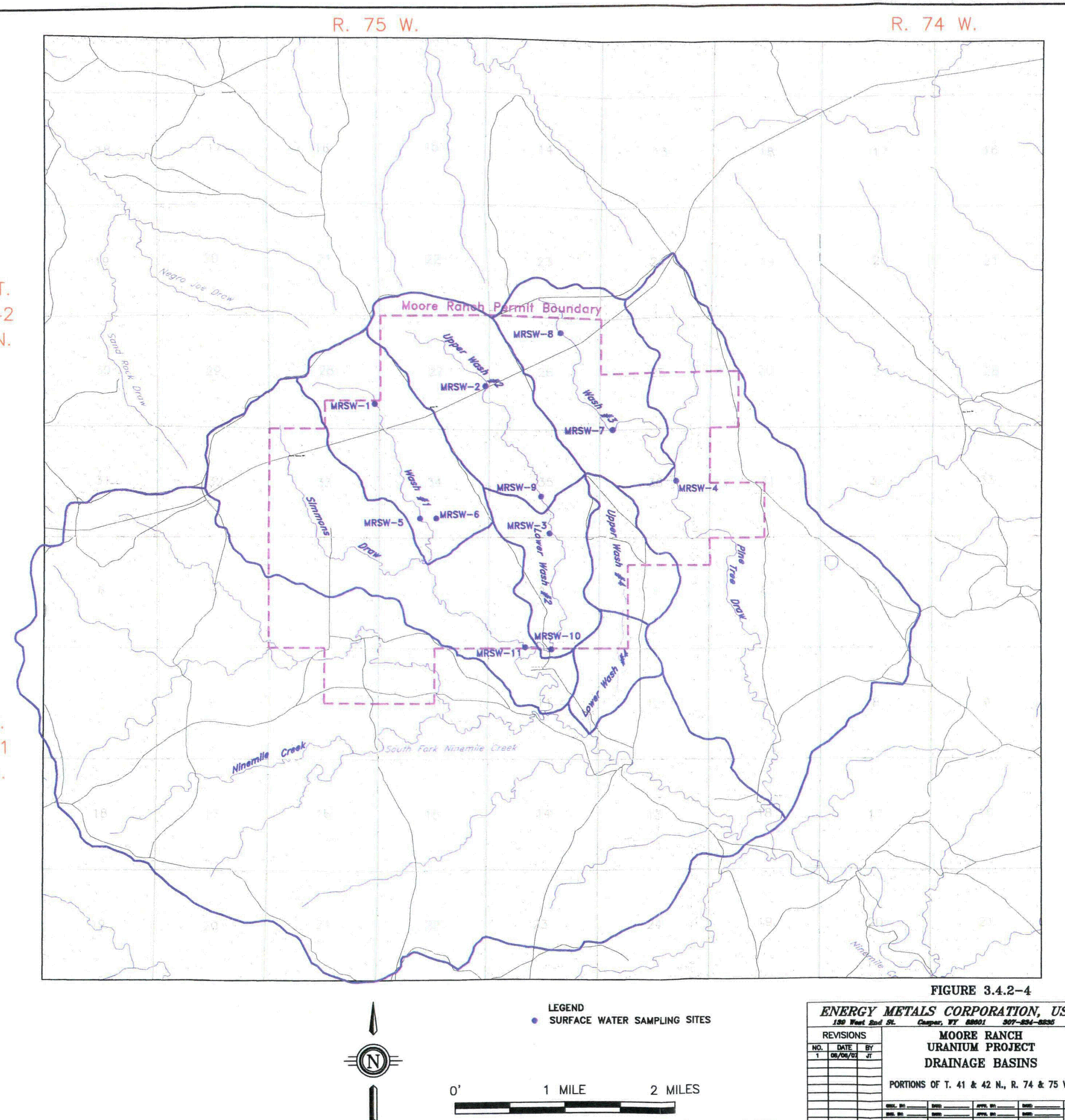


FIGURE 3.4.2-4

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139 West 2nd St. Casper, WY 82601 307-234-8235

REVISIONS		
NO.	DATE	BY
1	08/06/07	JT

MOORE RANCH
URANIUM PROJECT
DRAINAGE BASINS

PORTIONS OF T. 41 & 42 N., R. 74 & 75 W.

Table 3.4.2-5 Water Quality Data from MRSW-1

MRSW-1				
Parameters	**11/3/2006**	**3/23/2007**	**6/15/2007**	**Average**
Bicarbonate as HCO3, mg/L	1140	814	391	782
Carbonate as CO3, mg/L	19	43	50	37
Chloride, mg/L	10	3	3	5
Conductivity, umhos/cm	1940	1260	714	1305
Fluoride, mg/L	0.5	0.7	0.4	0.5
pH, s.u.	8.48	9.06	9.44	8.99
Solids, Total Dissolved TDS @ 180 C, mg/L	1160	772	472	801
Sulfate, mg/L	39	1	2	14
Gross Alpha, pci/L	6.8	1.0		3.9
Gross Beta, pci/L	21.8	10.3		16.05
Lead 210, pci/L	170*	1.0	1.0	57.3
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	<1.0	<1.0
Thorium 230, pci/L	<.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.15	0.08	0.12	0.12
Nitrogen, Nitrate+Nitrite as N, mg/L	0.8	<0.1	<0.1	0.3
Aluminum, mg/L		<0.01	1.1	0.6
Arsenic, mg/L	0.002	0.002	0.006	0.003
Barium, mg/L	0.5	0.5	0.1	0.4
Boron, mg/L	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	43	13	7	21
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, mg/L	0.07	0.07	0.6	0.25
Lead, mg/L	<0.05	<0.001	<0.001	<0.05
Magnesium, mg/L	56	35	14	35
Manganese, mg/L	<0.01	<0.01	<0.01	<0.01
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	17	11	7	12
Selenium, mg/L	<0.001	<0.001	<0.0002	<0.0002
Silica, mg/L	4.7	2.3	8.4	5.1
Sodium, mg/L	355	243	133	244
Uranium, mg/L	0.0052	0.0007	0.0006	0.0022
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.26	0.38	1.31	0.65
Manganese, TOTAL mg/L	0.01	0.02	0.04	0.02
Lead 210, suspended pci/L	<2.0	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<2.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.4	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.4	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003	<0.0003

* Anomalous value considered analytical error.

Table 3.4.2-6 Water Quality Data from MRSW-2

MRSW-2				
Parameters	**10/25/2006**	**3/23/2007**	**6/15/2007**	**Average**
Bicarbonate as HCO3, mg/L	1010	748	532	763
Carbonate as CO3, mg/L	52	22	33	36
Chloride, mg/L	9	3	2	5
Conductivity, umhos/cm	1520	1120	870	1170
Fluoride, mg/L	0.7	0.6	0.4	0.6
pH, s.u.	8.96	8.80	9.13	8.96
Solids, Total Dissolved TDS @ 180 C, mg/L	996	672	520	729
Sulfate, mg/L	1	<1.0	10	4
Gross Alpha, pci/L	3.0	1.5	0	2.25
Gross Beta, pci/L	14.0	9.7	0	11.85
Lead 210, pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	<1.0	<1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.17	<0.05	<0.05	<0.05
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1	<0.1
Aluminum, mg/L		<0.1	0.1	0.1
Arsenic, mg/L	0.002	0.002	0.003	0.002
Barium, mg/L	0.8	0.5	0.1	0.5
Boron, mg/L	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	18	22	11	17
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	0.01	0.05	0.01	0.02
Iron, mg/L	0.07	0.15	0.11	0.11
Lead, mg/L	0.05	0.007	0.001	0.019
Magnesium, mg/L	43	28	20	30
Manganese, mg/L	0.01	0.02	0.01	0.02
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	14	10	7	10
Selenium, mg/L	<0.001	<0.001	<0.002	<0.002
Silica, mg/L	3.8	3.0	0.9	2.6
Sodium, mg/L	349	208	157	238
Uranium, mg/L	0.0003	0.0005	0.0006	0.000467
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	0.01	0.02	0.02	0.015
Iron, TOTAL mg/L	0.07	0.04	0.36	0.157
Manganese, TOTAL mg/L	0.01	0.01	0.02	0.013
Lead 210, TOTAL pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003	<0.0003

Table 3.4.2-7 Water Quality Data from MRSW-3

MRSW-3				
Parameters	**10/25/2006**	**3/22/2007**	**6/14/2007**	**Average**
Bicarbonate as HCO3, mg/L	358	92	33	161
Carbonate as CO3, mg/L	8	9	4	7
Chloride, mg/L	11	2	<1.0	5
Conductivity, umhos/cm	928	544	609	694
Fluoride, mg/L	0.9	0.2	0.4	0.5
pH, s.u.	8.60	9.25	9.45	9.10
Solids, Total Dissolved TDS @ 180 C, mg/L	560	5.5	414	327
Sulfate, mg/L	214	189	254	219
Gross Alpha, pci/L	12.7	7.9		10.3
Gross Beta, pci/L	13.5	9.7		11.6
Lead 210, pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	1.9	1.3
Thorium 230, pci/L	<0.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.09	0.06	0.09	0.08
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1	<0.1
Aluminum, mg/L		<0.1	<0.1	<0.1
Arsenic, mg/L	0.002	0.002	0.003	0.002
Barium, mg/L	0.1	<0.1	<0.1	0.1
Boron, mg/L	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	42	60	48	50
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, mg/L	0.16	<0.03	0.05	0.08
Lead, mg/L	<0.05	<0.001	<0.001	<0.05
Magnesium, mg/L	18	13	18	16
Manganese, mg/L	<0.01	<0.01	<0.01	<0.01
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	8	8	4	7
Selenium, mg/L	<0.001	0.001	<0.001	0.001
Silica, mg/L	2.9	8.3	3.2	4.8
Sodium, mg/L	173	32	46	84
Uranium, mg/L	0.0130	0.0119	0.0043	0.0097
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.33	0.10		0.22
Manganese, TOTAL mg/L	0.01	0.03		0.015
Lead 210, suspended pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.003	<0.003

Table 3.4.2-8 Water Quality Data from MRSW-4

MRSW-4				
Parameters	**10/25/2006**	**3/27/2007**	**6/14/2007**	**Average**
Bicarbonate as HCO3, mg/L	363	156	77	199
Carbonate as CO3, mg/L	24	23	15	21
Chloride, mg/L	23	7	2	11
Conductivity, umhos/cm	1500	792	968	1087
Fluoride, mg/L	0.6	0.5	0.4	0.5
pH, s.u.	9.06	9.41	9.63	9.37
Solids, Total Dissolved TDS @ 180 C, mg/L	984	504	644	711
Sulfate, mg/L	461	230	360	350.3333
Gross Alpha, pci/L	5.6	2.5		4.05
Gross Beta, pci/L	11.9	7.6		9.75
Lead 210, pci/L	<1.0	<1.0	<1.0	1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2	0.2
Radium 228, pci/L	<1.0	<1.0	<1.0	1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.52	0.20	0.09	0.27
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1	0.1
Aluminum, mg/L		<0.1	<0.1	0.1
Arsenic, mg/L	0.006	0.006	0.005	0.006
Barium, mg/L	0.2	0.1	0.1	0.1
Boron, mg/L	<0.1	<0.1	<0.1	0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	24	26	27	26
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01	0.01
Iron, mg/L	0.32	0.03	0.03	0.13
Lead, mg/L	<0.05	<0.001	<0.001	0.050
Magnesium, mg/L	25	18	24	22
Manganese, mg/L	0.02	0.02	0.02	0.02
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	10	8	7	8
Selenium, mg/L	<0.001	<0.001	<0.001	0.001
Silica, mg/L	3.8	12.8	3.7	6.8
Sodium, mg/L	320	114	133	189
Uranium, mg/L	0.0069	0.0034	0.0028	0.0044
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01	0.010
Iron, TOTAL mg/L	0.40	0.07		0.16
Manganese, TOTAL mg/L	0.02	0.12		0.05
Lead 210, suspended pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003	<0.0003

Table 3.4.2-9 Water Quality Data from MRSW-5

MRSW-5				
Parameters	**11/3/2006**	**3/22/2007**	**6/15/2007**	**Average**
Bicarbonate as HCO3, mg/L	1410	924	858	1064
Carbonate as CO3, mg/L	155	24	11	63
Chloride, mg/L	6	7	10	8
Conductivity, umhos/cm	2560	1450	1520	1843
Fluoride, mg/L	1.2	0.5	0.4	0.7
pH, s.u.	9.29	8.66	8.46	8.80
Solids, Total Dissolved TDS @ 180 C, mg/L	1590	890	998	1159
Sulfate, mg/L	9	20	157	62
Gross Alpha, pci/L	11.0	2.4		6.7
Gross Beta, pci/L	32.7	11.0		21.85
Lead 210, pci/L	9.9	<1.0	<1.0	4.0
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	0.2	1.5	2.3	1.3
Radium 228, pci/L	<.1	<1.0	<1.0	<1.0
Thorium 230, pci/L	<.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.27	0.15	0.19	0.20
Nitrogen, Nitrate+Nitrite as N, mg/L	0.9	<0.1	<0.1	0.4
Aluminum, mg/L		<0.1	<0.1	<0.1
Arsenic, mg/L	0.008	0.003	0.004	0.005
Barium, mg/L	0.5	0.5	0.3	0.2
Boron, mg/L	0.1	<0.1	<0.1	0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	9	45	41	32
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, mg/L	0.92	0.05	0.08	0.35
Lead, mg/L	<0.05	<0.001	<0.001	<0.05
Magnesium, mg/L	73	39	50	54
Manganese, mg/L	0.02	<0.01	0.03	0.03
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	22	12	13	16
Selenium, mg/L	<0.001	<0.001	0.004	0.002
Silica, mg/L	9.3	5.2	8.1	7.5
Sodium, mg/L	559	255	230	348
Uranium, mg/L	0.0010	0.0029	0.0027	0.0022
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	0.01	0.01
Iron, TOTAL mg/L	1.11	0.11	0.12	0.45
Manganese, TOTAL mg/L	0.05	0.01	0.06	0.04
Lead 210, suspended pci/L	<2.0	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<2.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.4	<0.2	2.3	0.97
Thorium 230 suspended, pci/L	<0.4	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003	<0.0003

Table 3.4.2-10 Water Quality Data from MRSW-6

MRSW-6			
Parameters	**3/22/2007**	**6/15/2007**	**Average**
Bicarbonate as HCO3, mg/L	351	563	457
Carbonate as CO3, mg/L	7	114	61
Chloride, mg/L	2	3	3
Conductivity, umhos/cm	538	1140	839
Fluoride, mg/L	0.3	0.7	0.5
pH, s.u.	8.52	9.64	9
Solids, Total Dissolved TDS @ 180 C, mg/L	326	754	540
Sulfate, mg/L	10	2	6
Gross Alpha, pci/L	1.1		1.1
Gross Beta, pci/L	6.9		6.9
Lead 210, pci/L	<1.0	<1.0	<1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	1.5	0.9
Radium 228, pci/L	<1.0	<1.0	<1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.13	0.15	0.14
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1
Aluminum, mg/L	0.4	1	0.7
Arsenic, mg/L	0.002	0.006	0.004
Barium, mg/L	0.4	0.2	0.3
Boron, mg/L	<0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005
Calcium, mg/L	26	9	18
Chromium, mg/L	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01
Iron, mg/L	0.21	0.44	0.33
Lead, mg/L	<0.001	0.001	0.001
Magnesium, mg/L	10	15	13
Manganese, mg/L	<0.01	0.02	0.02
Mercury, mg/L	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05
Potassium, mg/L	7	6	7
Selenium, mg/L	<0.001	<0.002	<0.002
Silica, mg/L	9.5	5.6	7.6
Sodium, mg/L	77	232	155
Uranium, mg/L	<0.0003	0.0003	0.0003
Vanadium, mg/L	<0.1	<0.1	<0.1
Zinc, mg/L	0.01	0.01	0.01
Iron, TOTAL mg/L	0.51	0.72	0.62
Manganese, TOTAL mg/L	0.02	0.04	0.03
Lead 210, suspended pci/L	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	0.4	0.3
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003

Table 3.4.2-11 Water Quality Data from MRSW-7

MRSW-7			
Parameters	**10/25/2006**	**6/14/2007**	**Avevrage**
Bicarbonate as HCO3, mg/L	809	520	665
Carbonate as CO3, mg/L	12	22	17
Chloride, mg/L	9	2	6
Conductivity, umhos/cm	1120	837	979
Fluoride, mg/L	0.5	0.5	0.5
pH, s.u.	8.42	8.96	9
Solids, Total Dissolved TDS @ 180 C, mg/L	706	586	646
Sulfate, mg/L	23	3	13
Gross Alpha, pci/L	5.4		5.4
Gross Beta, pci/L	13.1		13.1
Lead 210, pci/L	<1.0	<1.0	<1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	<1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.10	0.08	0.09
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1
Aluminum, mg/L		0.5	0.3
Arsenic, mg/L	0.003	0.004	0.004
Barium, mg/L	0.5	0.3	0.4
Boron, mg/L	<0.1	<1.0	<1.0
Cadmium, mg/L	<0.005	<0.005	<0.005
Calcium, mg/L	27	15	21
Chromium, mg/L	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01
Iron, mg/L	0.70	0.59	0.65
Lead, mg/L	<0.05	<0.001	<0.001
Magnesium, mg/L	18	10	14
Manganese, mg/L	0.02	0.01	0.02
Mercury, mg/L	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05
Potassium, mg/L	10	7	9
Selenium, mg/L	<0.001	<0.001	<0.001
Silica, mg/L	8.4	7.5	8.0
Sodium, mg/L	263	173	218
Uranium, mg/L	0.0006	0.0004	0.0005
Vanadium, mg/L	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.64	0.73	0.69
Manganese, TOTAL mg/L	<0.01	0.04	0.03
Lead 210, suspended pci/L	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2
Uranium suspended, pci/L	0.0007	<0.0003	<0.0003

Table 3.4.2-12 Water Quality Data from MRSW-8

MRSW-8				
Parameters	**10/25/2006**	**3/23/2007**	**6/14/2007**	**Average**
Bicarbonate as HCO3, mg/L	420	458	327	402
Carbonate as CO3, mg/L	1670	44	26	580
Chloride, mg/L	21	2	<1.0	8
Conductivity, umhos/cm	3220	796.0	569.0	1528
Fluoride, mg/L	2.2	0.6	0.4	1.1
pH, s.u.	9.65	9.32	9.23	9.40
Solids, Total Dissolved TDS @ 180 C, mg/L	2190	508	354	1017
Sulfate, mg/L	10	<1.0	14	8
Gross Alpha, pci/L	4.3	2.4		3.35
Gross Beta, pci/L	20.9	10.1		15.5
Lead 210, pci/L	<1.0	<1.0	<1.0	<1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	<1.0	<1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.86	0.09	<0.05	0.33
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1	<0.1
Aluminum, mg/L		0.1	0.2	0.1
Arsenic, mg/L	0.025	0.005	0.004	0.011
Barium, mg/L	0.6	0.1	0.1	0.3
Boron, mg/L	0.1	<0.1	<0.1	0.1
Cadmium, mg/L	<0.005	<0.005	<0.005	<0.005
Calcium, mg/L	6	13	11	10
Chromium, mg/L	<0.05	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, mg/L	0.48	0.09	0.39	0.32
Lead, mg/L	<0.05	<0.001	<0.001	<0.05
Magnesium, mg/L	53	15	11	26
Manganese, mg/L	0.02	<0.01	<0.01	0.01
Mercury, mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05	<0.05
Potassium, mg/L	19	10	7	12
Selenium, mg/L	0.002	0.001	0.001	0.0013
Silica, mg/L	6.1	7.1	3.7	5.6
Sodium, mg/L	842	158	106	369
Uranium, mg/L	0.0040	0.0009	0.001	0.0020
Vanadium, mg/L	<0.1	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.20	0.86	0.063	0.374
Manganese, TOTAL mg/L	<0.01	0.01	0.02	0.01
Lead 210, suspended pci/L	6.3	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2	<0.2
Uranium suspended, pci/L	0.0004	<0.0003	<0.003	<0.003

Table 3.4.2-13 Water Quality Data from MRSW-9

MRSW-9			
Parameters	**3/21/2007**	**6/14/2007**	**Average**
Bicarbonate as HCO3, mg/L	131	67	99
Carbonate as CO3, mg/L	15	12	14
Chloride, mg/L	2.79	<1.0	2
Conductivity, umhos/cm	259	148	204
Fluoride, mg/L	0.2	0.2	0.2
pH, s.u.	9.32	9.16	9
Solids, Total Dissolved TDS @ 180 C, mg/L	148	96	122
Sulfate, mg/L	2	5	4
Gross Alpha, pci/L	1.7		1
Gross Beta, pci/L	3.9		2
Lead 210, pci/L	8.6	<1.0	4.8
Polonium 210, pci/L	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	<0.2	<0.2
Radium 228, pci/L	<1.0	<1.0	<1.0
Thorium 230, pci/L	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	<0.05	<0.05	<0.05
Nitrogen, Nitrate+Nitrite as N, mg/L	<0.1	<0.1	<0.1
Aluminum, mg/L	<0.1	0.3	0.2
Arsenic, mg/L	0.002	0.002	0.002
Barium, mg/L	<0.1	<0.1	<0.1
Boron, mg/L	<0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005
Calcium, mg/L	13	15	14
Chromium, mg/L	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	<0.01	<0.01
Iron, mg/L	0.03	0.19	0.11
Lead, mg/L	<0.001	<0.001	<0.001
Magnesium, mg/L	5	4	5
Manganese, mg/L	<0.01	<0.01	<0.01
Mercury, mg/L	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05
Potassium, mg/L	6	3	5
Selenium, mg/L	<0.001	<0.001	<0.001
Silica, mg/L	6.9	3.4	5.2
Sodium, mg/L	36	8	22
Uranium, mg/L	0.0016	0.0018	0.0017
Vanadium, mg/L	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	<0.01	<0.01
Iron, TOTAL mg/L	0.08	0.19	0.14
Manganese, TOTAL mg/L	<0.01	<0.01	<0.01
Lead 210, suspended pci/L	<1.0	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	<0.2
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2
Uranium suspended, pci/L	<0.0003	<0.0003	<0.0003

Table 3.4.2-14 Water Quality Data - Surface Water - Seasonal Averages

Parameter	Fall	Late-March	Mid-June
Bicarbonate as HCO3, mg/L	787	459	374
Carbonate as CO3, mg/L	277	23	32
Chloride, mg/L	12.7	3.6	2.8
Conductivity, umhos/cm	1827	845	819
Fluoride, mg/L	0.9	0.5	0.4
pH, s.u.	8.92	9.04	9.23
Solids, Total Dissolved TDS @ 180 C, mg/L	1169	478	538
Sulfate, mg/L	108	57	90
Gross Alpha, pci/L	7.0	2.6	
Gross Beta, pci/L	18.3	8.7	
Lead 210, pci/L	2.5	2.0	1.0
Polonium 210, pci/L	<1.0	<1.0	<1.0
Radium 226, pci/L	<0.2	0.4	0.6
Radium 228, pci/L	<1.0	<1.0	1.9
Thorium 230, pci/L	<0.2	<0.2	<0.2
Nitrogen, Ammonia as N, mg/L	0.31	0.10	0.10
Nitrogen, Nitrate+Nitrite as N, mg/L	0.3	<0.1	<0.1
Aluminum, mg/L		0.1	0.4
Arsenic, mg/L	0.007	0.003	0.004
Barium, mg/L	0.5	0.3	0.2
Boron, mg/L	0.1	<0.1	<0.1
Cadmium, mg/L	<0.005	<0.005	<0.005
Calcium, mg/L	24	27	20
Chromium, mg/L	<0.05	<0.05	<0.05
Copper, mg/L	<0.01	0.015	<0.01
Iron, mg/L	0.39	0.08	0.28
Lead, mg/L	<0.05	0.002	0.001
Magnesium, mg/L	41	20	18
Manganese, mg/L	0.02	0.01	0.01
Mercury, mg/L	<0.001	<0.001	<0.001
Molybdenum, mg/L	<0.1	<0.1	<0.1
Nickel, mg/L	<0.05	<0.05	<0.05
Potassium, mg/L	14	9	7
Selenium, mg/L	0.001	0.001	0.002
Silica, mg/L	5.6	6.9	4.9
Sodium, mg/L	409	140	135
Uranium, mg/L	0.004429	0.002775	0.0016111
Vanadium, mg/L	<0.1	<0.1	<0.1
Zinc, mg/L	<0.01	0.01	0.01
Iron, TOTAL mg/L	0.43	0.27	0.50
Manganese, TOTAL mg/L	0.02	0.03	0.03
Lead 210, suspended pci/L	1.8	<1.0	<1.0
Polonium 210 suspended, pci/L	<1.0	<1.0	<1.0
Radium 226 suspended, pci/L	<0.2	<0.2	0.3
Thorium 230 suspended, pci/L	<0.2	<0.2	<0.2
Uranium suspended, pci/L	0.0004	<0.0003	<0.0003

Table 3.4.2-15 Water Quality Data - Surface Water - Average Concentrations

Parameter	Overall Average
Bicarbonate as HCO3, mg/L	523
Carbonate as CO3, mg/L	101
Chloride, mg/L	5.9
Conductivity, umhos/cm	1122
Fluoride, mg/L	0.6
pH, s.u.	9.08
Solids, Total Dissolved TDS @ 180 C, mg/L	702
Sulfate, mg/L	84
Gross Alpha, pci/L	4.6
Gross Beta, pci/L	13.1
Lead 210, pci/L	1.7
Polonium 210, pci/L	<1.0
Radium 226, pci/L	0.4
Radium 228, pci/L	1.0
Thorium 230, pci/L	<0.2
Nitrogen, Ammonia as N, mg/L	0.16
Nitrogen, Nitrate+Nitrite as N, mg/L	0.2
Aluminum, mg/L	0.3
Arsenic, mg/L	0.005
Barium, mg/L	0.3
Boron, mg/L	0.1
Cadmium, mg/L	<0.005
Calcium, mg/L	24
Chromium, mg/L	<0.05
Copper, mg/L	0.01
Iron, mg/L	0.24
Lead, mg/L	0.016
Magnesium, mg/L	26
Manganese, mg/L	0.01
Mercury, mg/L	<0.001
Molybdenum, mg/L	<0.1
Nickel, mg/L	<0.05
Potassium, mg/L	10
Selenium, mg/L	0.001
Silica, mg/L	5.8
Sodium, mg/L	217
Uranium, mg/L	0.0028
Vanadium, mg/L	<0.1
Zinc, mg/L	0.01
Iron, TOTAL mg/L	0.39
Manganese, TOTAL mg/L	0.03
Lead 210, suspended pci/L	1.2
Polonium 210 suspended, pci/L	<1.0
Radium 226 suspended, pci/L	0.2
Thorium 230 suspended, pci/L	<0.2
Uranium suspended, pci/L	<0.0003

3.4.3 Groundwater

This section describes the regional and local groundwater hydrology, including: hydrostratigraphy, groundwater flow patterns, hydraulic gradient and aquifer parameters. The discussion is based on information from investigations performed within the Powder River Basin, data presented in previous applications/reports for the Moore Ranch Site, and the geologic information presented in Section 3.3. Regional and site hydrogeology and baseline water quality conditions are discussed in the following Sections. (For ease of review the figures for this section are contained at the end of the section).

3.4.3.1 Regional Hydrogeology

The Moore Ranch site is located in the southwestern portion of the Powder River Basin, approximately 20 miles east of the north-flowing Powder River and approximately 50 miles north of Casper, Wyoming. Moore Ranch lies within the Northern Great Plains Aquifer System (USGS 1996). The Northern Great Plains Aquifer System contains overlapping aquifers in the Lower Tertiary, Upper and Lower Cretaceous, and Upper and Lower Paleozoic rocks. Figure 3.4.3-1 provides a generalized stratigraphic column of the hydrostratigraphic units of the Northern Great Plains Aquifer System. The Eocene Wasatch Formation, the stratigraphic unit that hosts the uranium mineralization of the Moore Ranch project, crops out over most of the License area (and most of the central portion of the Powder River Basin). The Oligocene White River Formation, which is commonly found in outcrop along the fringes of the Powder River Basin, has been eroded away in the Moore Ranch area. Occasional surficial deposits of the White River Formation are encountered in the vicinity of Pumpkin Buttes (north of the site), but these deposits are not a significant source of groundwater. Furthermore, Rankl and Lowry (1990) state that water from Quaternary alluvium in the Powder River Basin has not been developed extensively because better quality water occurs in the underlying Lower Tertiary and Upper Cretaceous (Wasatch-Fox Hills) sequence and large yields are generally not possible.

The Lower Tertiary aquifers are found within the Wasatch and Fort Union Formations, and the Upper Cretaceous aquifers are found within the Lance Formation and the Fox Hills Sandstone. The Lower Tertiary-Upper Cretaceous aquifer sequence (Wasatch to Fox Hills Sandstone) is about 1,350 feet thick in southeastern Montana and thickens to at least 7,000 feet in Converse County (south of the Moore Ranch Site) (Taylor 1968). The Lewis Shale is a regional aquitard that separates the Upper Cretaceous aquifers from the Lower Cretaceous aquifers.

The Lower Cretaceous aquifers include the Mesa Verde, Frontier and Cloverly Formations. Several regional aquitards are interlayered between these Cretaceous aquifers, including the

Cody, Mowry and Thermopolis Shales. Figure 3.4.3-1 shows the stratigraphic relationship of the Lower Teritiary, Upper and Lower Cretaceous aquifers and the regional aquitards for the western portion of the Powder River Basin.

Historical studies have stated that regional groundwater systems (e.g., the Wasatch, Fort Union, and deeper aquifers) generally flow to the northern portion of the Powder River Basin and discharge via unknown locations in Montana (Lowry & Wilson, 1986, and Rankl & Lowry, 1990). A generalized potentiometric surface map for the Lower Tertiary units of the Northern Great Plains Aquifer system is shown in Figure 3.4.3-2. The hydraulic communication between the aquifer systems has been reported to vary from none to direct. Groundwater flow direction in sediments near outcrop areas generally has been characterized as toward the center of the Powder River Basin.

On a semi-regional scale, ground-water flow occurs to the north-northwest, and the gradient is on the order of 0.004 to 0.006 ft/ft. This ground-water flow direction is consistent with results of numerous studies (Honea, 1974; Morris & Bahr, 1975; NRC, 1978; Rose, 1971). In the vicinity of Moore Ranch, flow in the shallow groundwater system is north to northwesterly, toward the Powder River.

Regional recharge to the Lower Tertiary aquifers in the vicinity of the Moore Ranch Project generally occurs at the formation outcrops along the western and southern edges of the Powder River Basin, associated with the Casper Arch and Laramie Mountain uplifts. Some recharge to the shallower aquifer systems is also derived from localized infiltration of precipitation. As described under the section on geology, sands that contain the uranium mineralization at Moore Ranch (70 Sand) crop out within a mile to the southeast of the License Area. These outcrops are localized recharge zones for the Wasatch aquifers within the Moore Ranch License Area.

For purposes of this application, only hydrogeologic units of Lower Tertiary/Upper Cretaceous age are described with respect to general hydrologic properties and potential for groundwater supply. Units deeper than the Fox Hills Sandstone and beneath the Lewis Shale are generally too deep to economically develop for water supply or have elevated TDS concentration that renders them unusable for consumption. Exceptions to this can be found along the edges of the basin, where Lower Cretaceous and older stratigraphic units are found in outcrop. Near outcrop areas, Lower Cretaceous and Paleozoic units can provide relatively good quality water. In particular, the Mesaverde Formation, Frontier Formation, Madison Limestone and Tensleep Sandstone can produce large quantities of relatively good quality water. However those outcrop locations are tens of miles from the Moore Ranch site. In the vicinity of Moore Ranch, the Lower Cretaceous and Paleozoic rocks are separated from the Wasatch Formation by over 5,000 feet of sediments.

Units younger than Lower Tertiary are typically not present within the vicinity of Moore Ranch and therefore are of no significance with respect to groundwater supply. Hydrologic units of interest within the southwest Powder River Basin are shown on the stratigraphic column in Figure 3.4.3-1 from deepest to shallowest:

- Lewis Shale (Late Cretaceous)
- Fox Hills Sandstone (Late Cretaceous)
- Lance Formation (Late Cretaceous)
- Fort Union Formation (Paleocene)
- Wasatch Formation (Eocene)

Discussion of the regional characteristics for each of these hydrostratigraphic units is provided below.

Lewis Shale

The Lewis Shale underlies the Fox Hills Sandstone and is generally considered the major aquitard between the Upper and Lower Cretaceous aquifer systems in the Powder River Basin. This unit is described by Hodson et al. (1973) as predominately shale with sandy shale zones and lenses of fine-grained sandstone. Thickness of this unit is approximately 450 to 500 feet in the southwest part of the basin. Small quantities of water may be available from the thin sandstone beds within this unit near the margins of the basin. However most of this formation does not yield water (Hodson 1973).

Fox Hills Sandstone

The Fox Hills Sandstone is the basal aquifer unit within the Lower Tertiary/Upper Cretaceous aquifer sequence in the Powder River Basin. The Fox Hills Sandstone consists of fine to medium grained sandstone beds deposited in a marine environment. The Fox Hills Sandstone is described by Weimer (1961) as a lithogenetic unit consisting of a series of individual sands bodies, sometimes several miles wide and hundreds of miles long. The Fox Hills Sandstone has been recognized in the northwestern part of the basin, but is generally poorly developed and unmapped along the western side of the basin (Gill 1966). The Fox Hills Sandstone is approximately 700 feet thick in the west part of the basin (Horn 1955) but is often undifferentiated from the overlying Lance Formation in west and northwest parts of the basin (Hose 1955).

Because of the disconnected nature of the individual sand bodies, hydraulic head data is not sufficient to define a potentiometric surface for a specific horizon within the Fox Hills Sandstone (Rankl 1990). Wells completed in the Fox Hills Sandstone have yields that typically range from 5 to 50 gallons per minute. Locally, this formation can yield over 200 gallons per minute, although lower yields are typically available in the western portion of the basin (Hodson 1973). Flowing artesian conditions (75 gpm) were present in a well in Campbell County, completed at a depth of 2,000 feet.

Lance Formation

Overlying the Fox Hills Sandstone is the Lance Formation. The Lance Formation consists predominately of very fine-to fine-grained lenticular, clayey, calcareous sandstone. Shale, coal and lignite beds are present within the formation, which has a typical thickness of 1,000 to 3,000 feet (Conoco 1982). Wells completed in the Lance Formation generally yield less than 20 gpm and most wells are drilled in outcrop areas for domestic and stock purposes. Because few wells are completed in this formation out toward the center of the basin, potentiometric surface data are limited. It is assumed that the direction of groundwater flow is generally to the north, similar to that of the overlying Fort Union and Wasatch Formations.

Fort Union Formation

The Paleocene Fort Union Formation is stratigraphically between the Lance Formation and the overlying Wasatch Formation, reaching a maximum thickness of approximately 3,500 feet within the Powder River Basin. The Fort Union Formation is described as continental and shallow non-marine deposits of sandstone, carbonaceous shale and coal. Outcrops of the Fort Union Formation encircle most of the basin and the beds dip basinward. This formation is a major source of coal within the Powder River Basin and the United States and is extensively exploited for coal bed methane reserves.

Water is generally produced from sandstone, jointed coal and clinker beds with maximum yields on the order of 150 gpm. Specific capacity determined from wells completed in the Fort Union Formation within the Powder River Basin are generally less than 1 gpm per foot of drawdown (Lowery 1966, and Whitcomb 1964).

The hydraulic gradient of the Fort Union and Wasatch aquifers in the vicinity of Moore Ranch is reported as 0.0014 ft/ft to the north-northwest by Conoco (1982).

Wasatch Formation

The Wasatch Formation is described as an arkosic fine- to coarse-grained sandstone with siltstone, claystone and coals. The Wasatch Formation was deposited as a mixture of alluvial, fluvial and paludal environments. The contact between the Fort Union Formation and the Wasatch Formation is gradational in the vicinity of Moore Ranch and is generally arbitrarily set at the top of the thicker coals or thick sequence of clays and silts (Conoco 1982). The boundary between the two formations was considered by Conoco to be the top of the Roland

Coal. Maximum total thickness of the Wasatch Formation is greater than 1,000 feet (800 to 1,100 feet in the License Area). In the southern portion of the Powder River Basin, the Wasatch Formation generally dips to the northwest at 1.0 to 2½ degrees. The sandstones that contain the uranium mineralization are generally coarse cross-bedded arkosic sand deposited in a high-energy fluvial environment. Individual channel sand units are generally oriented northward.

There are commonly multiple water-bearing sands within the Wasatch Formation. Groundwater within the Wasatch aquifers is typically under confined (artesian) conditions, although locally unconfined conditions exist. Hodson et al (1973) reported that wells completed in the Wasatch typically yield 10 to 50 gpm in the north part of the basin but yields are generally greater in the south part of the basin with yields as high as 500 gpm possible. Specific capacities of wells completed in the Wasatch Formation are usually greater than for wells completed in the underlying aquifers. Specific capacities of 4 to 15 gpm/ft of drawdown were reported by Hodson et al. (1973).

As reported by Rankl and Lowry, most data available to describe aquifers in the Wasatch /Fox Hills sequence are from stock and domestic wells that are generally completed in small intervals of single formations at depths of less than 500 feet. There is large topographic relief in the area and because these wells are completed in sandstone aquifers at differing depths, hydraulic head data are generally not representative of a single continuous stratigraphic horizon and are not sufficient to provide potentiometric surfaces extending over great distances. The overall groundwater flow system in the shallow aquifers in the vicinity of Moore Ranch is toward the Powder River to the north-northwest. However, the aquifer systems are often locally controlled by stratigraphy and topography and attempts to confidently extend potentiometric surface data for any significant distance is difficult.

3.4.3.2 Site Hydrogeology

Groundwater

EMC has been collecting lithologic, water level, water quality, and pump test data as part of its ongoing evaluation of hydrologic conditions at the Moore Ranch Project. In addition to recent data acquisition, historic data collected for Conoco (1982) was used to support this evaluation. Drilling and installation of borings and monitor wells is ongoing in order to provide additional data to further refine the site hydrologic conceptual model. Water level measurements, both historic and recent, provide data to assess potentiometric surface, hydraulic gradients and inferred groundwater flow directions for the aquifers of interest at the Moore Ranch Project, at least on a localized scale. Recently completed pump tests by EMC and Petrotek Engineering Corporation (PEC 2007) as well as the pump tests conducted by

Conoco (1982), were used to evaluate hydrologic properties of the aquifers of interest and to assess hydraulic characteristics of the confining units.

Figure 3.4.3-3 shows the monitor wells (current and historic) that were used in the site hydrologic evaluation. Table 3.4.3-1 (at the end of this section) provides data for those wells to the extent available.

Hydrostratigraphic Units

EMC has adopted the nomenclature used by Conoco (1982) for the hydrostratigraphic units of interest within the Moore Ranch Project. Sands above the Roland Coal are numbered, increasing upward. The 40 and 50 Sands are regionally extensive sands that are considered significant aquifers. The primary Production Zone is identified as the 70 Sand. The 70 Sand is bounded above and below by areally extensive confining units. Overlying the upper confining unit is the 72 Sand. The 72 Sand is considered the overlying aquifer to the Production Zone. The shallowest occurrence of groundwater within the License area occurs within the 72 Sand. Beneath the lower confining unit is the 68 Sand. Although the 68 Sand is considered the underlying aquifer to the Production Zone, it is in communication with the 70 Sand in parts of the License Area. The 68 Sand also appears to coalesce with the underlying 60 Sand in portions of the License Area. Figure 3.4.3-4 depicts the hydrostratigraphic relationship of these units.

A brief description of each hydrostratigraphic unit follows, from shallowest to deepest.

72 Sand (Overlying Aquifer)

The 72 Sand (Overburden above the 70 Sand) consists of a 50- to 250-foot thick sequence of clays, silts, discontinuous sandstones and alluvial sediments. The alluvial sediments are limited to the low-lying areas of surface drainages. A lignite marker bed, designated the "E" coal, is present across the site below the 72 Sand. As previously described, the 72 Sands are discontinuous, and when saturated, generally represent perched water conditions. Figure 3.3-12 is an isopach of the overburden thickness in the vicinity of the ore bodies. The 70 Sand is considered the uppermost continuous water-bearing unit within the License area.

The first potential aquifer overlying the Production Zone is the 72 Sand. The top of the 72 Sand occurs at depths of approximately 30 to 200 ft bgs within the Moore Ranch License

Area. The total thickness of the sand ranges from 5 to 90 feet. This sand is discontinuous across the License area, pinching out to the west-southwest. The 72 Sand is unsaturated over the southern portion of the License Area. In areas that saturated conditions exist within the 72 Sand, this unit is considered the overlying aquifer to the Production Zone aquifer.

Upper Mudstone, E Coal and Lower Mudstone-Upper Confining Unit

Underlying the 72 Sand is a sequence of mudstone, shale and lignite. A persistent, laterally extensive lignite seam was identified by Conoco as the E Coal. The E Coal is located a few feet above the top of the 70 Sand and is a consistent marker bed for the License Area. The units above and below the E Coal were designated by Conoco as the Upper and Lower Mudstone, respectively. The sequence of Upper Mudstone, E Coal and Lower Mudstone are collectively considered the Upper Confining Unit to the Production Zone. Although the E Coal has some intrinsic permeability, its limited thickness (typically 3 feet or less) and limited extent of saturation precludes its use as a source of groundwater supply.

In some instances, saturated conditions have been found to exist in wells completed in shallower sands above areas where the upper portion of the 70 Sand is unsaturated indicating that, at least locally, perched water is present.

70 Sand (Production Zone Aquifer)

The 70 Sand contains uranium mineralization and is the Production Zone at the Moore Ranch Project. The total thickness of the 70 Sand ranges from 40 to 120 feet, but is typically 60 to 80 feet, (Figure 3.3-9). The top of the 70 Sand ranges from approximately 100 to 330 ft bgs within the Moore Ranch License Area. This hydrostratigraphic unit is areally extensive (except to the south where it crops out) and dips to the northwest at less than one degree. The 70 Sand is present in outcrop or under a thin veneer of alluvium and topsoil just south of the License area over large portions of section 11 and 12 of T41N and R75W and Sections 6 and 7 of T41N and R74W. The area of 70 Sand outcrop is a recharge zone for the Production zone aquifer. Water entering the 70 Sand in this recharge area would flow north-northwest across the License Area.

The 70 Sand aquifer occurs generally under unconfined conditions in the MRPA. The 70 Sand aquifer in Wellfields #1 and #3 occurs mostly under unconfined conditions and has adequate hydrostratigraphic confinement between the production sand and/or the overlying/underlying sands. In Wellfield #2, the 70 Sand aquifer occurs under unconfined conditions and for the most part has adequate hydrostratigraphic confinement between the 70 Sand and overlying/underlying sands. However, lack of hydrostratigraphic confinement between the 70 Sand and the underlying 68 Sand occurs in the eastern/northeastern part of Wellfield #2. Additional mine-unit scale testing will provide data necessary to validate the approach for mining and monitoring this section of Wellfield #2. In the south part of the License Area, the 70 Sand is the shallowest occurrence of groundwater (although perched conditions may exist locally in some of the overlying sands and coals). The underlying aquifer to the 70 Sand is the 68 Sand.

Lower Confining Unit

Beneath the 70 Sand is a sequence of clays and silts ranging from 0 to 50 feet thick. The clay/silt sequence is absent in the area of monitor well UMW-2 where the 70 and 68 Sands coalesce.

68 Sand (Underlying Aquifer)

The 68 Sand is present beneath the Lower Confining Unit and in some areas in contact with the 70 Sand. The 68 Sand is typically 40 to 60 feet thick but can reach over 75 feet in thickness (Figure 3.3-8).

Unnamed Shale Unit

The unnamed shale at the base of the 68 Sand has not yet been fully characterized. This unit is generally 5 to 30 feet thick.

60 Sand

The 60 Sand is generally the first sand unit underlying the 68 Sand. In areas where the 70 and 68 Sand coalesce, the 60 Sand may be considered the underlying aquifer to the Production Zone aquifer. The 60 Sand is approximately 100 feet thick and is continuous throughout the area. It is separated from the underlying 50 sand by about 80 feet of shale or mudstone with some interspersed sandstone lenses. Additional borings are being drilled to evaluate the geologic and hydrologic characteristics of this hydrostratigraphic unit.

Potentiometric Surface, Groundwater Flow Direction and Hydraulic Gradient

The EMC hydrologic evaluation of the Moore Ranch Project included measurement of water levels in monitor wells completed in the 70 Sand (Production Zone), the overlying aquifer (72 Sand) and the underlying aquifer (68 Sand) to assess the potentiometric surface, groundwater flow direction and hydraulic gradient of those units. Additional historic water level data were available from the Conoco hydrologic evaluation of the site (1982). Table 3.4.3-2 (at the end of this section) lists water level data recorded for the site monitor wells.

The potentiometric surface for the Production Zone is shown on Figure 3.4.3-5. Water level data used to develop the potentiometric surface map were collected on February 14, 2007. Based on those data, the direction of groundwater flow within the 70 Sand is predominantly to the north, generally consistent with the regional flow system. The horizontal hydraulic gradient calculated from this data is approximately 0.0040 ft/ft (21.1 ft/mile).

Water levels collected from the overlying aquifer (72 Sand) in February 2007 indicate a similar northerly groundwater flow direction as for the 70 Sand aquifer, although the data are sparse (Figure 3.4.3-6). The horizontal hydraulic gradient calculated from the data for the 72 Sand aquifer is approximately 0.0039 ft/ft (20.4 ft/mile).

Figure 3.4.3-7 represents the potentiometric surface for the 68 Sand based on water levels measured in February 2007. Although the general direction of groundwater flow is also to the north, the horizontal hydraulic gradient calculated for the 68 Sand (0.0005 ft/ft [2.6 ft/mi]), is much flatter than for the 70 and 72 Sands.

Vertical hydraulic gradients were determined by measuring water levels in closely grouped wells completed in different hydrostratigraphic units. Figure 3.4.3-8 shows the location of the well groups used for the assessment of vertical hydraulic gradients. Table 3.4.3-3 summarizes the calculated vertical gradients between the 72, 70 and 68 aquifers. The potentiometric surface of the 70 Sand ranges from 50 to 60 feet lower than the potentiometric surface of the overlying 72 Sand at the grouped wells, suggesting that the Overlying aquifer and the Production Zone aquifer are not in hydraulic communication. Vertical hydraulic gradients range from approximately 0.6 to 0.9 ft/ft between the 72 and 70 Sand aquifers and consistently indicate decreasing hydraulic head with depth (downward potential). A downward potential is indicative of an area of recharge, as opposed to an upward potential that is normally indicative of an area of groundwater discharge.

The vertical gradient between the 70 and 68 Sand aquifers is minimal at two of the well groups (MW1 and MW2). There may be hydraulic communication between the aquifers at these locations. This is consistent with earlier observations that the 68 and 70 Sands coalesce in places within the License Area. At the MW4 well group, there is a 5 to 10 foot head difference between the 70 and 68 Sand aquifers (decreasing with depth). In the area of the MW4 well group, the shale unit between the 70 and 68 Sand is 25 to 40 feet thick. The thickness of the shale unit, coupled with the large head difference indicates that the 68 and 70 Sand aquifers are not in direct hydraulic communication at this location. The vertical hydraulic gradient between the 68 and 70 Sand aquifers is variable at the MW3 well group location. Recent data, collected in June and July of 2007, indicate that the potentiometric heads are higher in the 70 Sand aquifer (at well MW3) by 10 to 20 feet. Data collected in February 2007 indicated the potentiometric heads in the 68 Sand aquifer (well UMW3) were higher than the heads in the 70 Sand aquifer by 7 to 10 feet. The water levels in the 70 Sand aquifer remained relatively constant throughout the year but changed by as much as 25 feet in the 68 Sand aquifer at UMW3. The cause for the large fluctuation in water levels in the 68 Sand at well UMW3 is unknown. Well UMW-3 experienced steady drawdown since early February of 2007. Approximately 25 feet of water level decline was observed until mid-August, when the well began to show recovery trend with the water level rising approximately 10 feet. None of the other underlying 68 Sand wells in the project area showed this declining trend and only showed fluctuations of a few feet. Investigation has not revealed the cause of the declining water levels. CBM operations in the area are not likely the cause due to the depth and lower flows of the wells. However, use of a shallow well in the area for CBM drilling water has not been ruled out, but field inspection in the area has not verified this.

Water levels in this well will continue to be closely monitored.

Aquifer Properties

Hydrologic properties for the Wasatch aquifers within the Moore Ranch Project area are estimated from historic and recent pumping tests. Dames & Moore conducted an initial investigation (1978) for Conoco of the hydrologic properties within the Wellfield 1 and Wellfield 22 ore bodies. Conoco performed additional hydrologic evaluation in 1982 to determine the feasibility of in-situ and/or open pit production of those uranium ore bodies.

Historic Pump Tests

A series of aquifer tests were conducted on the Moore Ranch project from 1977 through 1980 to assess hydraulic characteristics of the Production Zone as well as overlying and underlying hydrostratigraphic units. Initial testing was performed by Wyoming Water Resources Research Institute (WWRI). Dames & Moore's assessment of the initial testing was that the results were unsatisfactory because of improperly developed wells, inadequate water level measurements and inappropriate analysis methods (Dames & Moore, 1978). Conoco redeveloped the wells using airlift pumping. Data collected during development of the wells were analyzed by Conoco to determine aquifer characteristics; additional pump tests also were conducted and analyzed by Conoco. A summary of the Conoco tests that were conducted to assess conditions within the ore bodies at Moore Ranch is presented below. Information on the pumping wells and observation wells utilized in the pump tests are provided in Table 3.4.3-1 and the locations of the wells are shown on Figure 3.4.3-9.

- A pumping test was conducted on 8/17/77 at well 885 with wells 886, 887 and 888 as observation wells. These wells are located within the Wellfield 1 orebody. Well 885 was pumped for 1 day (1440 minutes) at a rate of 3.4 gallons per minute (gpm). Observation wells 886, 887 and 888 were located 64, 115 and 50 feet, respectively, from the pumping well. Drawdown in the observation wells at end of test for 886, 887 and 888 were 0.74, 0.76 and 1.94 feet, respectively. All wells are completed within the 70 Sand except for well 887, which is completed in the 68 Sand. The response of well 887 during the pumping test indicates the possibility that there is hydraulic communication between the 70 and 68 Sands in the vicinity of the Wellfield 1 orebody. The Conoco Mine License Application states that the seal between the sands in well 887 was questionable.

- The previously described wells were redeveloped using airlift methods. Recovery following redevelopment was recorded at wells 886 and 887. The effective pumping rate was 2 gpm for 886 and 0.1 gpm for 887 with 0.7 and 12 feet of drawdown, respectively.

- A pumping test was conducted within the Wellfield 2orebody on 6/25/78. Well 1 was pumped at 3.5 gpm for 140 minutes. Observation wells 1805 and 1806, located 36 and 73 feet, respectively from the pumping well, had measured drawdown of 0.71 and 0.54 feet at the end of the test. The pumping well and the observation wells are all completed within the 70 Sand.

- A second pumping test was conducted at Well 1 on 6/25/78 to evaluate hydraulic communication with the 68 Sand within the Wellfield 2 orebody. Well 1 was pumped at 2.5 gpm for 170 minutes. Observation well 1807 is located 111 feet from pumping well and completed within the 68 Sand. Drawdown of 0.37 feet was measured at well 1807 at the conclusion of the pumping test. The test results indicate that there may be hydraulic communication between the 70 and 68 Sand within the Wellfield 2 orebody. However, the Conoco Mine License Application indicates the results are inconclusive based on concerns regarding the integrity of the well completion in 1807.

- Well 1814, located within the Wellfield 3 orebody, was pumped at 19 gpm for 1140 minutes beginning on 12/1/78. A maximum drawdown of 1.87 feet was measured at well 1816, located 55 feet from pumping well. Both the pumping and observation wells are completed within the 70 Sand.

- Well 1823 was pumped for 70 minutes at 1.7 gpm on 5/22/80. Well 1823 is located within the Wellfield 3 orebody and is completed in the 68 Sand. Over 6 feet of drawdown was measured in that well during the test. Water levels were also measured in observation well 1816 during the test. Well 1816 is located 70 feet from 1823 and completed in the 70 Sand. Water levels in well 1816 showed a slight increase during the pumping test, indicating a possible lack of hydraulic communication in that area between the 68 and 70 Sands.

- Well 1814, located in the Wellfield 3 orebody, was pumped at an average rate of 16.8 gpm over 3,100 minutes, beginning on 8/13/80. Maximum drawdown at the pumping well was 32 feet. The maximum drawdown in the well occurred approximately 1170 minutes into test. The pumping rate gradually decreased after that time (from 17.1 gpm to 15.8 gpm) and the water levels showed slight recovery during the latter portion of the test. Water levels were recorded during the test at observation wells 1816, 1815, 1817, and 1823, located 34.5, 89, 228 and 75 feet from the pumping well, respectively. All of the wells are completed in the 70 Sand except for 1823, which is completed in the 68 Sand. Maximum drawdown measured in the 70 Sand observation wells was 2.87 feet (1816), 1.3 feet (1815) and 0.2 ft (1817). Water levels in well 1823 did not show any drawdown, again indicating hydraulic separation between the 68 and 70 Sand in the vicinity of Wellfield 3 orebody.

Results of the tests were variable with the highest transmissivity and hydraulic conductivity values determined for the Wellfield 3 orebody. The results from the aquifer tests are summarized in Table 3.4.3-4. Based on internal review of the data by PEC, representative values are presented in the table along with the range.

Table 3.4.3-4 Summary of Conoco Pump Test Results – 68 and 70 Sand Moore Ranch Project		
	Range of Values	*Representative Value*
34-Orebody		
Transmissivity (T; ft^2/d)	23 to 240	110
Hydraulic Conductivity (k; ft/day)	0.38 to 4.0	1.9
Net Sand Thickness (h; ft)	60	60
Storativity (S)	5.3×10^{-6} to 2.9×10^{-3}	9.8×10^{-4}
Wellfield 2-Orebody		
Transmissivity (T; ft^2/d)	112 to 297	165
Hydraulic Conductivity (k; ft/day)	0.95 to 1.52	1.4 ft/d
Net Sand Thickness (h; ft)	80	80
Storativity (S)	8.0×10^{-5} to 5.2×10^{-4}	2.5×10^{-4}
Wellfield 3-Orebody		
Transmissivity (T; ft^2/d)	374 to 735 ft^2/d	555
Hydraulic Conductivity (k; ft/day)	9.35 to 18.3	13.8
Net Sand Thickness (h; ft)	40	40
Storativity (S)	3.2×10^{-4} to 4.3×10^{-3}	1.4×10^{-3}
Specific Yield	0.01 to 0.058	0.032

Note: The 70 Sand is only partially saturated in the vicinity of the Wellfield 3 ore-body

Additional testing was performed by Conoco in an area to the southeast that was selected as a potential site for evaporation ponds. The purpose of that testing was primarily to assess hydraulic characteristics of the near-surface soils with respect to suitability for pond placement.

Limited data (e.g., laboratory analyses or detailed pump test data) regarding the vertical hydraulic conductivity of the confining units are available for the Moore Ranch Project Area. However, the data from other ISR operations in the Powder River Basin (COGEMA Mining Corporation and Power Resources Inc) appear to be reasonably analogous to Moore Ranch. In this regard, the COGEMA and PRI data indicate the vertical hydraulic conductivity of clays/shales in the Wasatch is on the order of 10^{-7} to 10^{-11} cm/sec (10^{-4} to 10^{-7} ft/d).

2007 Pump Tests

In February 2007, EMC and PEC initiated a pump test designed to accomplish the following objectives:

1. Demonstrate hydraulic communication between the Production Zone (70 Sand) pumping well and the surrounding monitor wells;
2. Assess the hydrologic characteristics of the Production Zone aquifer within the test area;
3. Evaluate the presence or absence of hydrologic boundaries in the Production Zone within the MRPA; and,
4. Demonstrate sufficient confinement between the Production Zone and the Overlying and Underlying Sands for the purposes of ISR mining.

The limited historic data (Conoco) suggested it might be possible to test the entire Moore Ranch Project Area in one test (e.g., by pumping from only one well). For this reason, the pumping well (PW-1) was centrally located between the ore bodies and installed specifically for use as a pumping well. However, based on the results from the first test that indicated greater than anticipated transmissivity and hydraulic conductivity, two additional pump tests were conducted. Table 3.4.3-1 provides basic well information for the pumping wells and observation wells used in the tests. Table 3.4.3-5 summarizes the pump test parameters. The location of pumping wells and observation wells are provided in Figure 3.4.3.10. Details regarding the pump test procedures and results are provided in AppendixA

Table 3.4.3-5 Summary of Moore Ranch 2007 Pump Test Parameters

Test No.	*Pumping Well*	*Duration (minutes)*	*Duration (days)*	*Flow Rate (gpm)*	*Comments*
1	PW-1	14,285	9.9	15.6	20.6' drawdown in PW1; only other response observed was in MW-1 (distance of 109')
2	MW-2	1,465	1.0	26.0	19.4' drawdown in MW-2; response in Well 1805 (70 Sand, distance of 346'); UMW-2 (68 Sand; distance of 10'), 1807 (68 Sand; distance of 252')
3	MW-3	5,535	3.8	14.4	17.8' drawdown in MW-3; no response in any other monitor wells

Transmissivity (T) results from the analysis for the 70 Sand range from 321 to 711 ft^2/d, with an average value of 586 ft^2/d. Based on an average thickness of 80 feet, the average hydraulic conductivity (K) is 7.3 ft/d. Assuming a water viscosity of 1.35 cp (50 degrees F) and a density of 1.0, this equates to a permeability of approximately 2,000 millidarcies (md). The only storativity (S) was obtained from MW-1 at a value of 4.4 x 10^{-3}. Details of the methods of analysis of the pump tests and the results are discussed in Appendix A. Table 3.4.3-6 provides a summary of the aquifer properties estimated from the recent pump test results.

Table 3.4.3-6 Summary of Aquifer Properties Estimated From Recent Pump Test Results	
Pump Test	**Representative Value**
Central Location Between Wellfields 1, 2 and 3 (PW-1 Test)	
Transmissivity (T; ft2/d)	656.5
Hydraulic Conductivity (k; ft/day)	8.87
Net Sand Thickness (h; ft)	77
Storativity (S)	4.39×10^{-3}
Wellfield 1 Test (MW-3)	
Transmissivity (T; ft2/d)	321
Hydraulic Conductivity (k; ft/day)	4.46
Net Sand Thickness (h; ft)	72
Storativity (S)	NA
Wellfield 2 Test (MW-2)	
Transmissivity (T; ft2/d)	711
Hydraulic Conductivity (k; ft/day)	7.33
Net Sand Thickness (h; ft)	97
Storativity (S)	NA

All results are with respect to the Production Zone Aquifer (70 Sand)

No water-level change of significance was observed in the overlying OMW-1 or underlying UMW-1 completions as a result of pumping the PW-1 well completed in the 70 Sand. The UMW-1/OMW-1 wells are located approximately 109 feet from PW-1. No changes of significance were observed in the overlying monitor well during the MW-2 pump test. Well OMW-2 declined slightly during the pumping period, however, the decline continued during recovery. Underlying completions UMW-2 and 1807 (completed in the 68 Sand 252 feet distant) directly responded to pumping, which is expected as the 70 and 68 Sands coalesce in that area.

No significant change in water level was observed in OMW-3 (overlying completion) during the MW-3 pump test. The underlying well (UMW-3) declined steadily during the background monitoring, pumping, and recovery periods (Appendix B, Figure 5-15). The declining trend in UMW-3 continued through July of 2007, but has since shown a recovering trend. As discussed previously, the cause of the decline is not known; however, long-term monitoring data clearly indicate that the decline was not a result of the MW-3 pump test and has not had an impact on water levels in MW-3.

As previously discussed, the potentiometric surface of the overlying 72 Sand is approximately 50 feet higher than the 70 Sand. This difference in potentiometric surfaces supports the testing data that demonstrate isolation between the 72 and 70 Sands.

The difference in potentiometric surface between the 68 and 70 Sand is variable across the site, indicating a downward gradient in some areas and upward gradient in others. There is very little difference in potentiometric heads in the vicinity of MW-2/UMW-2 where coalescing of the 68 and 70 Sands occurs.

The test results demonstrate that:

- The 70 Sand monitor wells located in the near proximity to the pumping well are in communication, indicating that the 70 Sand Production Zone has hydraulic continuity. While communication was not exhibited over the entire area, geologic information clearly shows that the 70 Sand is a contiguous sand body across Moore Ranch Project Area. Additional (mine unit) scale testing required by NRC and WDEQ will demonstrate communication throughout each mine unit between the pumping well(s) and the monitor well ring;

- To adequately stress the 70 Sand, future pump tests may need to incorporate larger-diameter (e.g., 6- or 8-inch) completions to accommodate a 6-inch pump.

- On a regional scale, the 70 Sand has been adequately characterized with respect to hydrogeologic conditions within the test area at the Moore Ranch Project Area;

- Adequate confinement exists between the 70 Sand Production Zone and the overlying 72 Sand throughout the Moore Ranch Project Area;

- Adequate confinement exists between the 70 Sand Production Zone and the underlying 68 Sand throughout the northern and western portions of the Moore Ranch Project Area. Where the 68 and 70 Sands coalesce in the center of Section 35; mining operations will be designed to account for this variation in geology and mine-unit scale testing will demonstrate the validity of the recommended approach(s); and,

- Sufficient testing has been conducted to date at Moore Ranch to proceed with a Class III UIC license application and a NRC license application.

3.4.3.3 Groundwater Quality

Information regarding site water quality is primarily derived from studies conducted by Conoco (1982) and from ongoing exploration and delineation of the Moore Ranch Project by EMC. Conoco began a baseline groundwater monitoring program in 1978 as part of its Mine

License Application for the Sand Rock Project. EMC has initiated a baseline groundwater monitoring program to collect data required for the License to Mine and NRC License Applications for the Moore Ranch Uranium Project.

Regional Water Quality

Water quality within the Powder River Basin ranges from very poor to excellent. Groundwater in the near surface, more permeable aquifers is generally of better quality than groundwater in deeper and less permeable aquifers. However, significant regional aquifers are present at depth that can provide relatively good quality water. In particular, the Mesaverde Formation, Frontier Formation, Madison Limestone and Tensleep Sandstone can produce large quantities of acceptable quality water. But overall, water quality tends to degrade moving into the deeper portions of the Powder River Basin.

Sources of water quality data include the historic USGS WATSTOR data system (now replaced by the National Water Information System), the Wyoming Water Resources Research Institute (WWRI) data system (WRDS) and compilations by various authors including Hodson (1971 and 1974), Larson and Daddow (1984), Crawford (1941), Crawford and Davis (1962) and Wells (1979).

Water quality from the Madison Limestone illustrates the downgradient, basinward increase in TDS levels. Springs from Madison outcrops along the west side of the basin generally yield calcium bicarbonate type water containing less than 500 mg/l TDS. Further into the basin, groundwater within the Madison aquifer becomes progressively more saline with TDS values rapidly exceeding 3,000 mg/l. Groundwater transitions to a sodium sulfate, sodium-chloride water type with distance from recharge areas. TDS concentrations rapidly increase in Western Converse County, possibly related to the structural complexity along the north flank of the Laramie Mountains (Feathers 1981).

Similarly, in the western half of the Powder River Basin, water quality from outcrop areas of the Tensleep Formation is generally below 500 mg/l TDS. Low TDS waters tend to be predominately magnesium to calcium-bicarbonate type. Higher TDS samples generally are associated with higher sodium sulfate or sodium chloride levels. (Feathers 1981)

A study conducted by Lowry et al (1986) that included the Powder River Basin as well as upstream parts of the Belle Fourche and Cheyenne River basins, reported that 84 percent of wells and springs reviewed exceeded the USEPA secondary drinking water standard for TDS

(500 mg/l) and approximately 55 percent of the samples exceeded 1,000 mg/l. The sample set included 693 wells and springs. The average TDS concentration (in mg/l) reported in the study by formation is shown in Table 3.4.3-7.

Table 3.4.3-7 Total Dissolved Concentration by Formation, Powder River Basin (after Lowry et al 1986)

Formation	Average	Min	Max	No of Samples
Alluvium	2,128	106	6,610	38
Wasatch Formation	1,298	227	8,200	191
Fort Union Formation	1,464	209	5,620	257
Fox Hills/Hells Creek Formations	1,100	340	5,450	73
Lance Formation	1,218	251	2,850	31
Tensleep Sandstone*	874	230	6,820	15
Madison Group	1,503	65	3,240	25

* Most of the Tensleep Sandstone samples were collected from springs and near formation outcrop areas

The study noted that the dominant factor affecting TDS concentration within an aquifer is most likely the length of the flow path from recharge to discharge. Wells close to recharge areas generally have the lowest TDS levels and wells farthest from the recharge areas tend to have the highest TDS levels. Only 8 percent of the samples exceeded 3,000 mg/l.

Total dissolved solids levels within the Fox Hills Sandstone are generally higher in the western side of the basin than the eastern side, ranging between 1,000 and 2,000 mg/l. No water type is prevalent. TDS values from the Lance Formation range from about 200 to more than 2,000 mg/l but are typically between 500 and 1,500 mg/l (Hodson 1973).

Water quality for the Fort Union aquifer is described by Hodson (1973) as having TDS values ranging from 200 to more than 3,000 mg/l, but typically is between 500 and 1,500 mg/l. Water type for the Fort Union is predominately sodium bicarbonate to sodium sulfate.

Within the Wasatch, TDS ranges from less than 200 to more than 8,000 mg/l but typically ranges between 500 and 1500 mg/l. Sodium sulfate and sodium bicarbonate are the dominant water types for the Wasatch aquifer system.

The study by Lowry (1986) indicated that manganese levels exceeded the USEPA secondary drinking water standard (SDWS) of 50 µg/l in 43 percent of the 257 samples reviewed. Iron concentrations exceeded the USEPA SDWS (0.3 mg/l) in over 15 percent of the 366 samples reviewed. Selenium levels exceeded USEPA Maximum Contaminant Level (MCL) of 0.05 mg/l, in a small percentage of the wells (2.5 percent). Lead levels exceeded the MCL of 0.015 mg/l in 3.6 percent of the samples. There was no breakdown of the sample groups by formation reported in the study.

Radionuclide data for the Powder River Basin are sparse outside of the uranium mining areas. Feathers and others (1981) reported uranium ranging from 0.5 to over 10,000 µg/l for 96 samples collected from mine monitor wells completed in the Wasatch Formation. Radium-226 samples from the same sample group ranged from 0.2 to 173 pCi/l. Samples from five non-mining locations indicated uranium levels at or below 0.6 µg/l and radium-226 levels at or below 0.8 pCi/l.

Uranium levels from 31 samples from mine monitor wells completed in the Fort Union Formation ranged from 5 to 3,550 µg/l (Feathers 1981). The radium-226 concentration in those same wells ranged from 3.7 to 954 pCi/l. Samples from non-mine wells completed in the Fort Union Formation were generally low in uranium and radium-226 concentration. Samples from Lance and Fox Hills wells were much lower than those completed in the Wasatch and Fort Union mine wells but were similar to the non-mine wells for those formations.

Near Moore Ranch, hydrostratigraphic units deeper than the Fox Hills Sandstone are generally too deep to be economically developed for water supply or have elevated TDS concentrations that renders them unusable for consumption. At Moore Ranch, the Lower Cretaceous and Paleozoic aquifers are separated from the Wasatch aquifer by over 5,000 feet of sediments.

Site Baseline Water Quality

Information regarding site water quality is primarily derived from studies conducted by Conoco (1982) and from ongoing exploration and delineation of the Moore Ranch Project by EMC. Conoco began a baseline groundwater monitoring program in 1978 as part of its Mine License Application for the Sand Rock Project. EMC has initiated a baseline groundwater monitoring program to collect data required for the License to Mine and NRC License Applications for the Moore Ranch Uranium Project

Groundwater Monitoring Network and Parameters

Conoco installed monitor wells within the License Area that were completed in the Production Zone aquifer (70 Sand), the overlying aquifer (72 Sand), the underlying aquifer (68 Sand), the 40-50 Sand, and the Roland Coal. The locations of the Conoco monitor wells that were sampled for water quality are shown on Figure 3.4.3.-11. Table 3.4.3-8 provides construction details for the Conoco monitor wells used in the initial baseline analysis for the area. The parameters included in the Conoco Monitoring Program are listed in Table 3.4.3-9.

Based on the data provided in the Conoco Mine License Application (1982), many of the wells were only sampled once. However, five of the wells, 1, 8-3, 893, 1808 and 1814, were sampled at least four times from November 1978 through April 1980. Two of the wells that were sampled multiple times by Conoco (1808 and 8-3) and one well (885) that was only sampled once, were also included in recent sampling rounds by EMC. The initial monitoring performed by Conoco, and the continuation of monitoring of some of the original wells, provides an extensive baseline record of water quality that supplements the current baseline sampling program.

Conoco also collected groundwater samples from eleven private wells within and near the License Area. These wells were primarily stock wells. The locations of most of those wells are also shown on Figure 3.4.3-11. Several of the private wells are located over two miles outside the License area and are not shown on the figure. The private wells were sampled for the same parameters as the Conoco monitor wells (Table 3.4.3-9). Construction details on the private wells were generally unavailable. Some of these private wells have also been included in the current baseline sampling program.

EMC has installed a monitor well network to evaluate pre-mining baseline conditions within the License area. Four well groups were constructed, each including a completion in the Production Zone aquifer, the overlying aquifer, and the underlying aquifer. In addition to the well groups, four new wells completed in the 70 Sand are included in the baseline water quality monitoring network. Three of the original Conoco wells, 8-3, 1808, and 885, and 4 stock wells were also included in the monitoring program. Monitor wells 8-3 and 1808 are completed across both the 70 and 68 Sands. Monitor well 885 is only completed across the 70 Sand. Table 3.4.3-10 provides a summary of well construction information. The locations of wells included in the current monitoring network are shown on Figure 3.4.3-12. The parameters included in the EMC Monitoring Program are listed in Table 3.4.3-11.

Table 3.4.3-9 Conoco Baseline Water Quality Monitoring Parameters

Major Ions	**Trace Constituents**	**Radionuclides**
Calcium	Aluminum	Radium-226
Magnesium	Ammonia	Uranium
Potassium	Arsenic	Polonium-210
Sodium	Barium	Lead-210
Bicarbonate	Berylium	Thorium-230
Chloride	Boron	
Carbonate	Cadmium	
Sulfate	Chromium	
Nitrate (Total)	Copper	
	Fluoride	
	Iron	
General Water Chemistry	Lead	
Total Dissolved Solids	Manganese	
pH (field and laboratory measured)	Mercury	
Conductivity(field and lab measured)	Molybdenum	
Temperature (field measured)	Nickel	
	Selenium	
	Vanadium	
	Zinc	

This baseline analysis is intended to evaluate the overall quality of groundwater that is moving beneath the License Area under normal pre-mining conditions and does not provide the final basis for establishing restoration criteria for the individual mine units. The mine unit baseline water quality assessment and restoration goals will be provided to the WDEQ with the Mine Unit Plan and reviewed and approved by the EMC Safety and Environmental Review Panel (SERP).

Two rounds of water sampling have been completed in the newly installed monitor well network as of August 2007. Additional sampling events are planned in order to fully assess seasonal and other potential impacts to groundwater quality. However, as described in following sections, with the exception of a few wells, water quality is generally consistent between the two sampling rounds. Also, data collected from the previous baseline monitoring program conducted by Conoco provide additional information to assess temporal variability in water quality. Current data collected from wells included in the previous baseline monitoring by Conoco show relatively consistent results with the previous data showing consistent water quality for the past 25 years. As a result, EMC does not anticipate any significant changes in water quality for the next two sample rounds and believes that sampling data collected to date is representative of site groundwater quality.

Four stock wells located within the License Area were also sampled by EMC to establish pre-mining groundwater quality. Three of the wells (T-1, P'-9, and P'-11) were previously sampled under the Conoco monitoring program (1978-1980). The locations of the four wells are shown on Figure 3.4.3-12. EMC recently replaced the pumps in those wells and was able to gather the following information.

- Stock Well #1 (formerly referred to as T-1). Pump is set 180' below surface in steel casing. Water right associated with this well is License No. 12299. Well may be completed within the 70 Sand based on depth of pump.
- Stock Well #2 (formerly referred to as P'11). Pump is set 260' below surface in steel casing. Well is most likely completed in the 68 sand.
- Stock Well #3 (formerly referred to as P'9). Pump is set 120' below surface in steel casing. Well is most likely completed in the 70 Sand.
- Stock Well #4 (formerly referred to as P'26). Pump is set 141' below surface in steel casing. Total depth of the well is 158 ft. Water right associated with well is License No. 14682. Well is likely completed above the 70 Sand, probably within the 72 sand.

Table 3.4.3-11 EMC Baseline Water Quality Monitoring Parameters

Major Ions	**Trace Constituents**	**Radionuclides**
Calcium	Aluminum (dissolved)	Gross Alpha
Magnesium	Ammonia (as N)	Gross Beta
Potassium (dissolved)	Arsenic (dissolved)	Lead-210 (dissolved and suspended)
Sodium	Barium (dissolved)	Polonium-210 (dissolved and suspended)
Bicarbonate	Beryllium (dissolved)	Radium-226 (dissolved and suspended)
Chloride (dissolved)	Boron	Thorium-230 (dissolved land suspended)
Carbonate	Cadmium (dissolved)	Uranium (dissolved and suspended)
Sulfate	Chromium (dissolved)	
Nitrate + Nitrite (as N)	Copper (dissolved)	
Silica	Fluoride	
	Iron (dissolved and total)	
	Lead (dissolved)	
General Water Chemistry	Manganese (dissolved and total)	
Total Dissolved Solids (@180 F)	Mercury (dissolved)	
pH (field and laboratory measured)	Molybdenum (dissolved)	
Conductivity(field and lab measured)	Nickel (dissolved)	
Temperature (field measured)	Selenium (dissolved)	
	Vanadium	
	Zinc (dissolved)	

Groundwater Quality Sampling Results

Results of the Conoco and EMC baseline monitoring programs are summarized in Tables 3.4.3-12, 3.4.3-13, and 3.4.3-14. Overall water quality determined from the monitoring programs indicates a predominately calcium sulfate to calcium bicarbonate water, although significant differences are apparent between the Production Zone and overlying and underlying aquifers. Figure 3.4.3-13 is a Piper diagram of the average ion concentration for each of the monitor wells included in the EMC baseline sampling program (completed in the 68 through 72 Sands). Groundwater within the Production Zone aquifer is generally a calcium sulfate type. The overlying monitor wells exhibit a generally calcium sulfate type water with the exception of OMW3, which is a calcium bicarbonate type. The underlying monitor wells are more variable, ranging from calcium-to-sodium-sulfate and calcium-to-sodium-bicarbonate. Chloride and carbonate are generally very low in all of the wells.

Figure 3.4.3-14 is a Piper diagram for the average ion concentration for each of the aquifers (including a category for those wells screened in both the 68 and 70 Sands) for the EMC baseline sampling program. Historic data from the wells completed in the 40-50 Sand and the Roland Coal (wells 1822 and 1821 respectively) are also included on the diagram for reference. The water types for these two deeper aquifers show progressively decreasing sulfate and increasing bicarbonate and sodium with depth. The Roland coal sample is clearly a sodium bicarbonate water type. The typical 68 Sand (underlying aquifer) water type appears more like the 40-50 Sand and Roland Coal type water than the 70 (Production zone) and 72 Sands (overlying aquifer). A Stiff diagram of the water quality for the different aquifers shows the transition with depth from a calcium sulfate water to a sodium bicarbonate water (Figure 3.4.3-15)

Three wells that were installed and monitored by Conoco (1982) were included in the current monitoring program. One of the wells, 885, is completed in the Production Zone aquifer and the other two wells are completed across the Production Zone and underlying aquifers. Table 3.4.3-15a compares the analytical results of the those monitor wells from the Conoco and EMC baseline monitoring programs The table shows that two of the monitor wells, 885 and 1808 have shown reasonably consistent water quality since the initial sampling began in 1978. Well 8-3 appears to have anomalous values as described below.

The two wells completed across multiple aquifers, 1808 and 8-3, would be expected to have water quality that falls within the range observed in those two sands. That is the case for well 1808 (Figure 3.4.3-13). However, well 8-3 plots outside of the range observed within either the 68 or 70 sand. The calcium, magnesium and sulfate levels in that well are much higher than the values observed in other monitor wells included in the EMC program. Correspondingly, TDS for 8-3 was over twice as high as for any other Production Zone or underlying monitor well. In addition, the calcium, magnesium and sulfate levels in 8-3 are much higher in the recent sampling events than when the well was first sampled by Conoco in 1979 (Table 3.4.3-15a). Other parameters show relatively good consistency with other wells and historic data A potential cause of these anomalous values for calcium, magnesium, and sulfate could be related to impacts from small mammals falling into the well. This well was covered by a box that contained an old strip chart recorder and float for continuous water level measurement, which protected the well from the weather. However, evidence that small mammals had fallen down the well was observed when the old recording equipment was removed for sampling. Decay of the organic material in the well is a possible cause of the anomalous values detected during monitoring. While several casing volumes were removed during sampling, this well should be flushed by air lifting or increased purging prior to the next sampling round. This anomaly will be evaluated further with additional sampling events. Water quality in the other two wells, 885 and 1808, did not change significantly between the earlier and current sampling events.

Table 3.4.3-15b compares the analytical results from the private wells that have been sampled under both the Conoco and EMC baseline monitoring programs. The list of constituents common to both data sets is not as complete as for the monitor wells listed in Table 3.4.3-15a because not all of the parameters were sampled by Conoco. However, the parameters that were monitored show good consistency over time, an indication of the relatively stable long term aquifer conditions in the area. Future baseline monitoring is anticipated to show a continuation of this long term stability.

Table 3.4.3-16 is a summary of the analytical results for the current EMC baseline monitoring for wells completed in the Production Zone and the overlying and underlying aquifers. Wells that are screened across multiple aquifers or that are of unknown completion intervals are not included in the table. The results are compared to WDEQ Class I Standards and USEPA MCLs.

As shown on the table, over half of the samples exceeded the WDEQ Class I standard for TDS (500 mg/l), with the greatest proportion of exceedences occurring in samples from the Production Zone aquifer. Figure 3.4.3-16 shows the distribution of TDS in the Production Zone and the overlying and underlying aquifers. The range of TDS within wells completed in either the Production Zone or the underlying or overlying aquifers was 266 to 1350 mg/l with an average of 629 mg/l. Well 8-3, which is not included in the table because it is completed across both the Production Zone and the underlying aquifers, had an average TDS value of 2,380 mg/l over the two recent sampling events.

Similarly, almost half of the Production Zone samples exceeded the WDEQ Class I standard for sulfate of 250 mg/l (Figure 3.4.3-17). Sulfate ranged from 79 to 743 mg/l with an average of 301.6 mg/l. The highest sulfate value was found in well 8-3 (1,430 mg/l) which, again, was not included in the table because the well is completed across both the Production Zone and underlying aquifer.

Ammonia, iron, manganese, and selenium were the only trace minerals to exceed standards. The ammonia WDEQ Class I standard of 0.05 mg/l was exceeded at two overlying monitor wells (OMW1 and OMW2). Iron exceeded the WDEQ Class I standard (0.3 mg/l) in one underlying well (UMW4), one overlying monitor well (OMW4), and two Production Zone monitor wells (MW11 and PW-1) and at well 8-3. Iron ranged from below detection to 3.34 mg/l. Manganese exceeded the WDEQ Class I standard(0.05 mg/l) in one Production Zone monitor well (885) and one overlying monitor well (OMW4). The selenium standard (0.5 mg/l for WDEQ Class I and EPA MCL) was exceeded in two wells in the underlying aquifer (UMW2 and UMW4) and two wells in the Production zone aquifer (MW2 and MW7).

The majority of the samples collected from the Production Zone and underlying aquifers exceeded the USEPA MCLs for uranium (0.03 mg/l) and radium 226+228 (5 pCi/l). None of the samples from the overlying monitor wells exceeded the standard for uranium and only one exceeded the radium standard (OMW3). Figure 3.4.3-18 shows the distribution of uranium within the three aquifers. Uranium ranged from below detection (<0.0003) to 0.864 mg/l. Radium 226 distribution is shown in Figure 3.4.3-19. The average uranium concentration for the Production Zone aquifer was 0.16 mg/l, over five times the USEPA MCL. For the 68 Sand aquifer, uranium concentration averaged 0.07 mg/l. Radium 226 ranged from below detection (<0.2) to 306 pCi/l with an average of 59.2 pCi/l. Radium-228 values were much lower, ranging from below detection (<1.0) to 9.5 pCi/l. The combined radium 226+228 concentration in the Production Zone aquifer averaged 96.2 pCi/l, over an order of magnitude greater than the Wyoming Class I Standard or the USEPA MCL.

Underlying wells UMW-1 and UMW-3 had limited water above the J-collar (top of screen liner) available for sampling and the J-collar prevents lowering a pump into the screen. As a result, adequate purging these wells has proven to be difficult and will pose a difficulty in future sampling, which renders the water quality data for these wells questionable and data from wells UMW-4 and UMW-2 are more likely to be representative of water quality in the underlying 68 Sand. EMC will continue sampling efforts in these wells and evaluate any changes in water quality, and water quality of the underlying aquifer will be evaluated extensively during wellfield specific pre-mining baseline hydrologic testing activities.

In summary, general water quality in the shallow Wasatch aquifers within the Moore Ranch License area commonly exceeds WDEQ Class I standards for TDS and SO_4. Radionuclides radium-226 and uranium are elevated above EPA MCLs in the majority of the samples collected from the Production Zone aquifer and the underlying aquifer. The average radium 226-228 concentration in the Production on is an order of magnitude greater than the USEPA MCL. Elevated concentration of these constituents is consistent with the presence of uranium ore-bodies. Current data collected from wells included in the previous baseline monitoring by Conoco show relatively consistent results with the previous data showing consistent water quality for the past 25 years (with the exception of the three anomalous values and potential causes for well 8-3 as previously described). As a result, EMC does not anticipate any significant changes in water quality for the next two sample rounds and believes that sampling data collected to date and presented in this application are representative of site groundwater quality, unless otherwise noted.

Table 3.4.3-1 Monitor Well Data, Moore Ranch Project

Well	Northing	Easting	Township/ Range	Section	TOC Elevation (ft; amsl)	Hole Depth (ft; bgs)	Casing Depth (ft; bgs)	Top Screen (ft; bgs)	Bottom Screen (ft; bgs)	Screen Length (ft; bgs)	Aquifer	Casing I.D. (inches)
PW-1	320,209	1,057,961	T42N R75W	35	5,373.88	280	174	176	246	70	PZ 70 Sand	4.5
MW-1	320,100	1,057,961	T42N R75W	35	5,379.28	280	180	182	250	68	PZ 70 Sand	4.5
MW-2	322,635	1,057,708	T42N R75W	35	5,312.40	200	128	130	195	65	PZ 70 Sand	4.5
MW-3	317,948	1,060,543	T42N R75W	34	5,428.19	320	267	269	317	48	PZ 70 Sand	4.5
MW-4	318,697	1,056,272	T42N R75W	34	5,312.59	280	190	126	164	38	PZ 70 Sand	4.5
MW-5	321,452	1,056,678	T42N R75W	35	5,328.85	280	190	128	198	70	PZ 70 Sand	4.5
MW-6	323,791	1,058,277	T42N R75W	35	5,352.34	280	190	177	257	80	PZ 70 Sand	4.5
MW-7	322,535	1,056,299	T42N R75W	35	5,311.73	280	190	90	177	87	PZ 70 Sand	4.5
MW-8	317,921	1,057,961	T42N R75W	34	5,336.06	280	190	152	205	53	PZ 70 Sand	4.5
MW-9	317,099	1,059,198	T42N R75W	34	5,366.78	280	190	192	252	60	PZ 70 Sand	4.5
MW-10	320,115	1,059,378	T42N R75W	35	5,367.28	280	183	185	250	65	PZ 70 Sand	4.5
MW-11	317,693	1,061,868	T42N R75W	27	5,414.43	340	279	281	331	50	PZ 70 Sand	4.5
OMW-1	320,090	1,057,961	T42N R75W	35	5,379.79	180	146	148	168	20	Overlying 72 Sand	4.5
OMW-2	322,625	1,057,708	T42N R75W	35	5,312.32	100	59	60	78	18	Overlying 72 Sand	4.5
OMW-3	317,938	1,060,543	T42N R75W	34	5,427.72	250	203	205	245	40	Overlying 72 Sand	4.5
OMW-4	318,687	1,056,272	T42N R75W	34	5,312.41	120	74	76	91	15	Overlying 72 Sand	4.5
UMW-1	320,110	1,057,961	T42N R75W	35	5,379.39	340	280	282	312	30	Underlying 68 Sand	4.5
UMW-2	322,645	1,057,708	T42N R75W	35	5,313.07	280	228	230	250	20	Underlying 68 Sand	4.5
UMW-3	317,958	1,060,543	T42N R75W	34	5,426.89	380	351	353	378	25	Underlying 68 Sand	4.5
UMW-4	318,707	1,056,272	T42N R75W	34	5,313.37	300	220	222	252	30	Underlying 68 Sand	4.5
Historic Conoco Wells												
1822	321,574	1,060,356	T42N R75W	35	5,355	740	560	560	600	40	50/40 Sand	NI
887	318,000	1,058,278	T42N R75W	34	5,347	320	290	290	320	30	Underlying 68 Sand	3
1823	320,630	1,056,440	T42N R75W	35	5,345	240	210	210	240	30	Underlying 68 Sand	NI
1807	322,729	1,057,976	T42N R75W	35	5,328	290	250	250	290	40	Underlying 68 Sand	3
1	322,598	1,058,010	T42N R75W	35	5,331	240	200	200	240	40	PZ 70 Sand	5
885	317,898	1,058,399	T42N R75W	34	5,350	240	180	180	240	60	PZ 70 Sand	5
886	317,819	1,058,258	T42N R75W	34	5,349	240	180	180	240	60	PZ 70 Sand	3
888	317,910	1,058,398	T42N R75W	34	5,352	250	180	180	240	60	PZ 70 Sand	3
889	315,219	1,057,936	T42N R75W	34	5,334	260	200	200	260	60	PZ 70 Sand	3

Table 3.4.3-1 Monitor Well Data, Moore Ranch Project

Well	Northing	Easting	Township/ Range	Section	TOC Elevation (ft; amsl)	Hole Depth (ft; bgs)	Casing Depth (ft; bgs)	Top Screen (ft; bgs)	Bottom Screen (ft; bgs)	Screen Length (ft; bgs)	Aquifer	Casing I.D. (inches)
893	317,890	1,058,318	T42N R75W	34	5,348	240	153	153	240	87	PZ 70 Sand	5
1805	322,638	1,058,047	T42N R75W	35	5,331	240	120	120	240	120	PZ 70 Sand	3
1806	322,578	1,057,946	T42N R75W	35	5,324	220	120	120	200	80	PZ 70 Sand	3
1809	325,349	1,058,177	T42N R75W	35	5,356	230	135	135	225	90	PZ 70 Sand	3
1810	320,128	1,057,966	T42N R75W	35	5,378	265	200	200	260	60	PZ 70 Sand	3
1814	320,620	1,056,541	T42N R75W	35	5,345	207	143	143	207	64	PZ 70 Sand	5
1815	320,550	1,056,471	T42N R75W	35	5,348	208	142	142	208	66	PZ 70 Sand	3
1816	320,701	1,056,501	T42N R75W	35	5,343	207	137	138	207	69	PZ 70 Sand	3
1817	320,610	1,056,752	T42N R75W	35	5,350	233	143	143	233	90	PZ 70 Sand	3
22-2	322,809	1,054,603	T41N R75W	2	5,287	165	85	85	165	80	PZ 70 Sand	3
890	317,428	1,060,376	T42N R75W	34	5,410	330	240	240	330	90	70/68 Sand	3
1808	322,427	1,060,516	T42N R75W	35	5,377	275	195	195	275	80	70/68 Sand	5
8-3	318,060	1,054,523	T41N R75W	3	5,308	175	105	105	175	70	70/68 Sand	5
1821	321,534	1,060,275	T42N R75W	35	5,355	1,200	1,120	1,120	1,200	80	Roland Coal	6

Northing and Easting coordinates were converted from historic Conoco survey data to NAD 27 East State Plane Datum, accuracy is unknown.
NI - No information provided

Table [illegible].3-2 Water Level Data, Moore Ranch Project

				7/25/2007		7/17/2007		6/19/2007	
Well	Easting (x)	Northing (y)	TOC Elev	DTW	Elev	DTW	Elev	DTW	Elev
	(ft)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)
MW-1	320,100	1,057,961	5,379.28	193.09	5,186.19	191.40	5,187.88		
MW-10	320,115	1,059,378	5,367.28	185.14	5,182.14	185.20	5,182.08		
MW-11	317,693	1,061,868	5,414.43	242.55	5,171.88	242.60	5,171.83		
MW-2	322,635	1,057,708	5,312.40	124.24	5,188.16	124.30	5,188.10	126.00	5,186.40
MW-3	317,948	1,060,543	5,428.19	250.42	5,177.77	251.00	5,177.19		
MW-4	318,697	1,056,272	5,312.59	116.03	5,196.56	116.00	5,196.59		
MW-5	321,452	1,056,678	5,328.85	135.42	5,193.43	135.50	5,193.35		
MW-6	323,791	1,058,277	5,352.34	168.94	5,183.40	169.00	5,183.34		
MW-7	322,535	1,056,299	5,311.73	118.52	5,193.21	118.20	5,193.53		
MW-8	317,921	1,057,961	5,336.06	167.90	5,168.16	168.00	5,168.06		
MW-9	317,099	1,059,198	5,366.78	184.85	5,181.93	185.00	5,181.78		
PW-1	320,209	1,057,961	5,373.88	196.05	5,177.83	186.20	5,187.68		
OMW-1	320,090	1,057,961	5,379.79	141.24	5,238.55	141.20	5,238.59		
OMW-2	322,625	1,057,708	5,312.32	70.19	5,242.13	71.60	5,240.72		
OMW-3	317,938	1,060,543	5,427.72	188.45	5,239.27	188.50	5,239.22		
OMW-4	318,687	1,056,272	5,312.41	66.44	5,245.97	66.60	5,245.81		
1807	322,697	1,057,962	5,329.23						
UMW-1	320,110	1,057,961	5,379.39	191.22	5,188.17	193.20	5,186.19		
UMW-2	322,645	1,057,708	5,313.07	125.41	5,187.66	125.50	5,187.57		
UMW-3	317,958	1,060,543	5,426.89	267.65	5,159.24	267.00	5,159.89		
UMW-4	318,707	1,056,272	5,313.37	125.72	5,187.65	126.00	5,187.37	126.00	5,187.37
1805	322,670	1,058,062	5,332.50						
885									
1808								165.00	
8-3									

DTW - Depth to Water
Elev. - Water level elevation

Table 3.4.3-2 Water Level Data, Moore Ranch Project

	6/18/2007		6/13/2007		6/12/2007		5/10/2007		5/4/2007	
Well	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**
	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)
MW-1					191.40	5,187.88				
MW-10					185.40	5,181.88				
MW-11					242.40	5,172.03			242.20	5,172.23
MW-2					129.40	5,183.00				
MW-3			255.00	5,173.19	250.60	5,177.59				
MW-4			115.70	5,196.89	116.00	5,196.59				
MW-5					135.60	5,193.25				
MW-6					169.00	5,183.34				
MW-7					118.60	5,193.13				
MW-8										
MW-9					185.00	5,181.78				
PW-1	186.00	5,187.88			186.50	5,187.38				
OMW-1	141.20	5,238.59			141.20	5,238.59				
OMW-2					69.60	5,242.72	75.60	5,236.72	67.40	5,244.92
OMW-3			188.00	5,239.72	188.60	5,239.12				
OMW-4			65.00	5,247.41	66.40	5,246.01				
1807										
UMW-1					193.10	5,186.29	191.40	5,187.99		
UMW-2	135.00	5,178.07			125.60	5,187.47				
UMW-3					259.60	5,167.29				
UMW-4					125.90	5,187.47	125.70	5,187.67		
1805										
885										
1808									153.00	
8-3			59.40							

DTW - Depth to Water
Elev. - Water level elevation

Table [illegible].3-2 Water Level Data, Moore Ranch Project

	5/1/2007		4/30/2007		4/26/2007		2/19/2007		2/14/2007	
Well	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**
	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)
MW-1							192.87	5,186.41	191.33	5,187.95
MW-10							184.93	5,182.35	185.34	5,181.94
MW-11							241.32	5,173.11	242.21	5,172.22
MW-2							123.88	5,188.52	124.27	5,188.13
MW-3							250.18	5,178.01	250.50	5,177.69
MW-4			116.00	5,196.59			115.68	5,196.91	116.05	5,196.54
MW-5							135.23	5,193.62	135.55	5,193.30
MW-6					169.80	5,182.54	168.60	5,183.74	168.95	5,183.39
MW-7					118.90	5,192.83	118.25	5,193.48	118.61	5,193.12
MW-8							149.05	5,187.01	149.40	5,186.66
MW-9	185.00	5,181.78					184.58	5,182.20	184.94	5,181.84
PW-1									186.16	5,187.72
OMW-1					141.00	5,238.79			141.05	5,238.74
OMW-2									67.35	5,244.97
OMW-3					187.10	5,240.62	188.13	5,239.59	188.34	5,239.38
OMW-4					66.40	5,246.01			66.10	5,246.31
1807										
UMW-1									193.58	5,185.81
UMW-2									125.48	5,187.59
UMW-3							243.35	5,183.54	241.67	5,185.22
UMW-4									126.06	5,187.31
1805										
885	164.80									
1808										
8-3	59.40									

DTW - Depth to Water
Elev. - Water level elevation

Table [illegible].3-2 Water Level Data, Moore Ranch Project

	2/9/2007		2/8/2007		12/22/2006		12/15/2006	
Well	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**	**DTW**	**Elev**
	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)	(ft)	(ft amsl)
MW-1	191.95	5,187.33	191.25	5,188.03	192.20	5,187.08		
MW-10	185.21	5,182.07			185.10	5,182.18		
MW-11	242.28	5,172.15			242.10	5,172.33		
MW-2	124.26	5,188.14			124.60	5,187.80		
MW-3	250.55	5,177.64	250.40	5,177.79	250.30	5,177.89		
MW-4	116.10	5,196.49						
MW-5	135.59	5,193.26			135.60	5,193.25		
MW-6	169.02	5,183.32			168.90	5,183.44		
MW-7	118.67	5,193.06						
MW-8	149.44	5,186.62			149.30	5,186.76		
MW-9	184.94	5,181.84			184.40	5,182.38		
PW-1	176.55?	5197.33?	185.86	5,188.02	182.90	5,190.98		
OMW-1	141.09	5,238.70	140.90	5,238.89	193.60	5,186.19		
OMW-2	67.44	5,244.88			66.30	5,246.02		
OMW-3	188.35	5,239.37	188.29	5,239.43	188.10	5,239.62		
OMW-4	66.11	5,246.30						
1807								
UMW-1	193.50	5,185.89	193.52	5,185.87				
UMW-2	125.55	5,187.52			125.60	5,187.47		
UMW-3	239.85	5,187.04	239.35	5,187.54	109.10	5,317.79		
UMW-4	122.18	5,191.19					123.70	5,189.67
1805								
885								
1808								
8-3								

Table 3.4.3-3 Vertical Hydraulic Gradient Calculations, Moore Ranch Project, Wyoming

Well ID	Completion Zone	Ground Surface Elevation	Top of Screen	Bottom of Screen	Midpoint Elevation	Water Level Elevation	Vertical Gradient*	Water Level Elevation	Vertical Gradient*	Water Level Elevation	Vertical Gradient*	Water Level Elevation	Vertical Gradient*	Water Level Elevation	Vertical Gradient*
		(ft amsl)	(ft bgs)	(ft bgs)	(ft amsl)	7/25/2007		7/17/2007		6/12/2007		2/14/2007		2/9/2007	
						(ft amsl)	(ft/ft)	(ft amsl)	(ft/ft)	(ft amsl)	(ft/ft)	(ft amsl)	(ft/ft)	(ft amsl)	(ft/ft)
OMW-1	72 Sand	5,379.70	148	168	5,222	5238.55	-	5238.59	-	5238.59	-	5238.74	-	5238.70	-
MW-1	70 Sand	5,379.00	182	250	5,163	5186.19	0.89	5187.88	0.86	5187.88	0.86	5187.95	0.87	5187.33	0.88
UMW-1	68 Sand	5,378.70	282	312	5,082	5188.17	-0.02	5186.19	0.02	5186.29	0.02	5185.81	0.03	5185.89	0.02
OMW-2	72 Sand	5,312.50	60	78	5,244	5242.13	-	5240.72	-	5242.72	-	5244.97	-	5244.88	-
MW-2	70 Sand	5,312.30	130	195	5,150	5188.16	0.58	5188.10	0.56	5183.00	0.64	5188.13	0.61	5188.14	0.61
UMW-2	68 Sand	5,312.40	230	250	5,072	5187.66	0.01	5187.57	0.01	5187.47	-0.06	5187.59	0.01	5187.52	0.01
OMW-3	72 Sand	5,427.00	205	245	5,202	5239.27	-	5239.22	-	5239.12	-	5239.38	-	5239.37	-
MW-3	70 Sand	5,426.90	269	317	5,134	5177.77	0.90	5177.19	0.91	5177.59	0.90	5177.69	0.91	5177.64	0.91
UMW-3	68 Sand	5,426.50	353	378	5,061	5159.24	0.25	5159.89	0.24	5167.29	0.14	5185.22	-0.10	5187.04	-0.13
OMW-4	72 Sand	5,312.60	76	91	5,229	5245.97	-	5245.81	-	5246.01	-	5246.31	-	5246.30	-
MW-4	70 Sand	5,312.60	126	164	5,168	5196.56	0.80	5196.59	0.80	5196.59	0.80	5196.54	0.81	5196.49	0.81
UMW-4	68 Sand	5,312.70	222	252	5,076	5187.65	0.10	5187.37	0.10	5187.47	0.10	5187.31	0.10	5191.19	0.06

ft amsl - feet above mean sea level
ft bgs - feet below ground surface
* - Positive value indicates a downward hydraulic gradient (heads decrease with depth) and negative value indicates an upward hydraulic gradient (head increase with depth)

Table 3.4.3-6 Summary of Aquifer Properties Estimated From The 2007 Moore Ranch Pump Tests

Pump Test	Representative Value
Central Location Between Wellfields 1, 2 and 3 (PW-1 Test)	
Transmissivity (T; ft2/d)	656.5
Hydraulic Conductivity (k; ft/day)	8.87
Net Sand Thickness (h; ft)	77
Storativity (S)	4.39×10^{-3}
Wellfield 1 Test (MW-3)	
Transmissivity (T; ft2/d)	321
Hydraulic Conductivity (k; ft/day)	4.46
Net Sand Thickness (h; ft)	72
Storativity (S)	NA
Wellfield 2 Test (MW-2)	
Transmissivity (T; ft2/d)	711
Hydraulic Conductivity (k; ft/day)	7.33
Net Sand Thickness (h; ft)	97
Storativity (S)	NA

All results are with respect to the Production Zone Aquifer (70 Sand)

Table 3.4.3-8
Well Completion Data - Conoco Monitoring Program

Well No.	Easting	Northing	Completion Zone	Collar Elevation	Total Depth	Casing Depth	Perforated Interval	Gravel Pack	Drill Bit	Casing Diameter	Type Casing	State Permit No.	DateDrilled
	(ft)	(ft)		(ft amsl)	(ft bgs)	(ft bgs)	(ft bgs)		(in)	(in)			
1	322,598	1,058,010	70 SS	5,331	240	240	200-240	-	6-1/4	5"	PVC	39649	9/17/1977
885	317,898	1,058,399	70 SS	5,350	240	240	180-240	X	9-7/8	5"	PVC	39648	7/22/1977
886	317,819	1,058,258	70 SS	5,349	240	240	180-240	X	8-3/4	3"	PVC	-	7/21/1977
887	318,000	1,058,278	68 SS	5,347	320	320	290-320	X	8-3/4	3"	PVC	-	7/20/1977
888	317,910	1,058,398	70 SS	5,352	250	250	180-240	X	8-3/4	3"	PVC	-	7/21/1977
889	315,219	1,057,936	70 SS	5,334	260	260	200-260	X	8-3/4	3"	PVC	39653	7/29/1977
890	317,428	1,060,376	70-68 SS	5,410	330	330	240-330	X	8-3/4	3"	PVC	39654	7/29/1977
893	317,890	1,058,318	70 SS	5,348	240	240	153-240	X	9-0	5"	Steel	-	11/21/1978
1805	322,638	1,058,047	70 SS	5,331	240	240	120-240	X	8-3/4	3"	PVC	-	7/22/1977
1806	322,578	1,057,946	70 SS	5,324	220	220	120-200	X	8-3/4	3"	PVC	-	7/21/1977
1807	322,729	1,057,976	68 SS	5,328	290	290	250-290	X	8-3/4	3"	PVC	-	7/22/1977
1808	322,427	1,060,516	70-68 SS	5,377	275	275	195.275	X	9-7/8	5"	PVC	39651	7/28/1977
1809	325,349	1,058,177	70 SS	5,356	230	230	135-225	X	8-3/4	3"	PVC	39652	7/28/1977
1810	320,128	1,057,966	70 SS	5,378	265	265	200-260	X	8-3/4	3"	PVC	39650	7/29/1977
1814	320,620	1,056,541	70 SS	5,345	207	207	143-207	-	9-7/8	5"	Steel	-	11/2/1978
1815	320,550	1,056,471	70 SS	5,348	208	208	142-208	X	5-1/8	3"	PVC	-	11/8/1978
1816	320,701	1,056,501	70 SS	5,343	207	207	138-207	X	5-1/8	3"	PVC	-	11/8/1978
1817	320,610	1,056,752	70SS	5,350	233	233	143-233	X	5-1/8	3"	PVC	-	11/8/1978
22-2	322,809	1,054,603	70 SS	5,287	165	165	85-165	X	8-3/4	3"	PVC	39655	8/1/1977
8-3	318,060	1,054,523	70-68 SS	5,308	175	175	105-175	X	9-7/8	5"	PVC	39656	8/1/1977
1821	321,534	1,060,275	Roland Coal	5,355	1200	1200	1120-1200	-	8-3/4	6"	Steel	-	10/22/1979
1822	321,574	1,060,356	50-40 SS	5,355	740	740	560-600, 640-680, 700-720	-	8-3/4	6"	Steel	-	10/26/1979

ft - feet in - inches
ft amsl - feet above mean sea level
ft bgs - feet below ground surface

Table 3.4.3-10
Well Completion Data - EMC Monitoring Program

Well	Easting	Northing	Completion Zone	GS Elevation	Stick-up	TOC Elevation	Pilot TD	Casing Depth	Screen Top	Screen Bottom	Screen Interval
	(ft)	(ft)		(ft amsl)	(ft)	(ft amsl)	(ft bgs)	(ft bgs)	(ft bgs)	(ft bgs)	(ft)
MW-1	320,100	1,057,961	70 SS	5,379.0	0.75	5,378.3	280	180	182	250	68
MW-2	322,635	1,057,708	70 SS	5,312.3	0.95	5,311.4	200	128	130	195	65
MW-3	317,948	1,060,543	70 SS	5,426.9	1.75	5,425.2	320	267	269	317	48
MW-4	318,697	1,056,272	70 SS	5,312.6	0.50	5,312.1	220	124	126	164	38
MW-5	321,452	1,056,678	70 SS	5,328.2	1.20	5,327.0	220	126	128	198	70
MW-6	323,791	1,058,277	70 SS	5,351.9	1.10	5,350.8	280	175	177	257	80
MW-7	322,535	1,056,299	70 SS	5,311.1	0.80	5,310.3	200	88	90	177	87
MW-8	317,921	1,057,961	70 SS	5,335.4	1.50	5,333.9	220	150	152	205	53
MW-9	317,099	1,059,198	70 SS	5,365.9	1.00	5,364.9	280	190	192	252	60
MW-10	320,115	1,059,378	70 SS	5,366.6	1.30	5,365.3	280	183	185	250	65
MW-11	317,693	1,061,868	70 SS	5,413.2	1.50	5,411.7	340	279	281	331	50
PW-1	320,209	1,057,961	70SS	5,373.8	0.50	5,373.3	280	174	176	246	70
OMW-1	320,090	1,057,961	72 SS	5,379.7	0.80	5,378.9	180	146	148	168	20
OMW-2	322,625	1,057,708	72 SS	5,312.5	0.30	5,312.2	100	59	60	78	18
OMW-3	317,938	1,060,543	72 SS	5,427.0	0.80	5,426.2	250	203	205	245	40
OMW-4	318,687	1,056,272	72 SS	5,312.6	0.35	5,312.3	120	74	76	91	15
UMW-1*	320,110	1,057,961	68SS	5,378.7	1.00	5,377.7	340	280	282	312	30
UMW-2	322,645	1,057,708	68SS	5,312.4	1.54	5,310.9	280	228	230	250	20
UMW-3*	317,958	1,060,543	68SS	5,426.5	0.55	5,426.0	380	351	353	378	25
UMW-4	318,707	1,056,272	68SS	5,312.7	1.25	5,311.5	300	220	222	252	30
885	317,898	1,058,399	70 SS	5,350.0	-	-	240	240	180	240	60
1808	322,427	1,060,516	70-68 SS	5,377.0	-	-	275	275	195	275	80
8-3	318,060	1,054,523	70-68 SS	5,308.0	-	-	175	175	105	175	70

ft - feet

ft amsl - feet above mean sea level

ft bgs - feet below ground surface

* The water level in this well was too low for adequate purging prior to sampling.
Analytical samples from this well are considered questionable and are not included in the water quality analysis.

Table 3.4.3-12 Analytical Results - Conoco Baseline Monitoring Program

Well No.	Sample Date	TDS	Conductivity		Temp.	pH		Na	K	Ca	Mg	SO4	Cl	CO3	HCO_3
41N-75W															
22-2	1/3/80	508	725			6.95		13	8	96	23	106	5	0	305
8-3	6/28/79	1,460	1,950	(1,610)	(8)	7.10	(6.85)	8	12	354	58	980	6	0	361
	9/27/79	1,426	1,910	(1,660)	(12)	7.30	(6.50)	9	12	278	96	750	6	0	371
	12/6/79	1,566	1,800	(1,680)	(10)	7.23	(7.75)	8	13	245	120	936	6	0	361
	4/9/80	1,398	2,000	(1,750)	(10)	6.75	(7.1)	10	14	251	115	860	12	0	256
42N-75W															
893	11/30/78	975	1,100		(11.1)	7.1		42	10	180	36	470	2	0	235
	6/27/79	820	1,250	(1,080)	(15)	7.54	(7.25)	47	12	158	35	427	6	0	264
	9/27/79	870	1,250	(1,150)	(13)	7.27	(6.95)	43	11	158	37	408	6	0	278
	10/10/79	914	1,240	(985)	(15)	7.45	(7.70)	45	12	160	34	418	6	0	266
	12/21/79	874	1,150	(1,120)	(11)	7.23	(7.65)	44	12	155	40	410	5	0	266
	4/9/80	842	1,350	(1,150)	(11)	7.31	(7.5)	47	12	159	40	460	10	0	281
885	4/12/78(a)	836	1,113			7.53		31.5	8.1	208	33.5	426	3.3	0	281
886	4/12/78(b)	827	1,299			7.44		46.0	9.5	228	43	75	4.9	0	851
887	4/12/78(c)	1,170	1,490			7.66		54.0	9.1	265	56	459	11	0	375
888	4/12/78(d)	855	1,155			7.97		54.0	8.1	180	30	424	6.4	0	311
889	1/3/80	462	640			6 60		12	8	79	23	198	5	0	134
	4/15/80	395	630	(570)	(11)	7.24	(7.0)	8	8	78	21	192	6	0	146
I	4/12/78(a)	286	504			7.87		8.4	7	80	14	72.5	<2.0	0	228
	11/30/78[b]	364	510		(11.4)	6.7		14.0	7.7	81	15	73	1	0	172
	6/27/79	218	440	(363)	(15)	7.90	(7.75)	13	8	47	14	85	6	0	195
	9/29/79	254	464	(442)	(14)	7.68	(7.20)	15	8	54	14	64	3	0	217
	12/21/79	352	515	(473)	(10)	7.15	(7.40)	14	8	67	16	71	4	0	242
	4/16/80	182	295			7.45	(7.6)	7	7	35	9	46	4	0	127
1805	4/12/78[h]	765	996			8.06		60.0	7.7	143	29	433	6.4	0	178
1806	4/12/78[i]	886	1290			7.25		41.0	9.1	234	46	28	4.9	0	975
1807	4/12/1970[j]	680	1100			7.44		35.0	8.4	187	35	98	<2.0	0	663
1808	6/28/79	573	950	(800)	(15)	7.45	(7.20)	69	9	93	19	303	10	0	161
	9/27/79	570	930	(789)	(14)	7.48	(6.45)	69	9	86	17	300	8	0	171
	12/15/79	608	900	(813)	(9)	7.34	(7.65)	63	8	84	17	280	6	0	159
	4/2/80	684	1,010	(988)	(10)	8.04	(8.2)	77	10	115	24	405	8	0	173
1809	4/15/80	877	1,220	(1,160)	(14)	7.61	(7.5)	59	12	104	34	432	8	0	317
1810	4/15/80	824	1,350	(943)	(13)	7.31	(7.6)	47	12	159	40	460	10	0	281
1814	11/30/78[c]	1,006	1,130		(13.5)	6.5		22.0	8.3	190	38	497	3	0	248
	6/27/79	987	1,440	(1,230)	(13)	7.29	(7.05)	42	12	201	45	461	8	0	307
	9/26/79	1,068	1,480	(1,290)	(13)	7.19	(6.80)	45	14	201	46	490	10	0	305
	12/2/79	1,104	1,380	(1,390)	(10)	7.09	(7.85)	41	12	197	51	508	5	0	285
	4/1/80	1,016	1,370	(1,380)	(10)	7.47	(7.3)	44	13	203	52	562	6	0	305
1821	10/25/79	680	1,020	(620)	(15)	7.93	(7.55)	131	19	78	6	136	12	0	427
1822	10/28/79	468	760	(666)	(13)	7.77	(7.60)	90	7	53	8	166	10	0	183

Notes: Concentration in mg/1 except Conductivity, in mhos/cm @ 25°C; Temperature, in °C; pH, in pH units; U, Pb-210, Po-210, Ra-'226 and Th-230, in pCi/l

( ) Field Measurements

< Concentration less than value.

(a) Additional parameters for this sample are Silica (as S.0) . 10; Alkalinity (as $CaCO_3$) 188; Total Hardness (as $CaCO_3$)

(b) 219; Redox Potential = 196; Nitrite (as N) = *.05; Phogihos (as P) = '.02; and Total Iron . *1.0.

(c) Additional parameters for this sample are Phosphate = 0.04 and Nitrite = [11].01.

(d) Additional parameters for this sample are Phosphate = 0.025 and Nitrite = [11].01.

(e) Additional parameters for this sample are Silica (as 5.0,) = 9.9; Alkalinity (as $CaCO_3$) = 232.5; Total Hardness (as

(f) $CaCO_3$) 560; Redox Potential . 206; Nitrite (as N) = 0.13; Ptosphorus (as P) = *.03 and Total Iron 1.3.

(g) Additional parameters for this sample are Silica (as $S.0_2$) = 19.2; Alkalinity (as $CaCO_3$) = 703; Total Hardness (as $CoCO_3$) =

(h) 640; Redox Potential r. 208; Nitrite (as N) *.05; Phosphorus (as P) = 0.02; and Total Iron 49.

(i) Additional parameters for this sample are Silica (as 5.0_2) . 8.6; Alkalinity (as $CoCO_3$) . 310; Total Hardness (as $CoCO_3$)

(j) 749; Redox Potential . 207; Nitrite (as N) = *.05; Phos4horus (as P) = '[1].02; and Total Iron . 1.0.

Well No.	Al	NH3 as N	As	Ba	Be	B	Cd	Cr	Cu	F	Fe	Pb	Mn
4IN-75W													
22-2	<0.05	0.13	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.003	0.27	1.51	<0.05	0.68
8-3	<0.05	0.11	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.03	1.98	<0.05	0.33
	<0.05	0.81	<0.002	<0.02	<0.005	<1.0	<0.002	0.01	0.004	0.07	2.4	<0.05	0.33
	<0.05	0.47	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.002	0.13	2.65	0.07	0.33
	<0.05	0.11	<0.002	<0.02	<0.005	<1.0	0.006	0.03	0.010	0.09	3.75	0.08	0.32
4IN-75W													
893	0.04	0.15	<0.002	0.07	-	0.1	<0.005	0.01	<0.02	0.1	0.3	0.03	0.03
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.12	4.43	<0.05	0.13
	<0.05	0.13	-	<0.02	-	<1.0	<0.02	<0.01	0.002	0.15	8.7	<0.05	0.17
	<0.05	0.36	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.14	7.3	<0.05	0.15
	<0.05	0.13	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.007	0.13	7.55	<0.05	0.16
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.005	0.03	<0.005	0.10	7.25	0.05	0.16
885	<0.1	<0.1	0.004	0.19	<0.005	0.2	<0.005	<0.01	<0.01	0.1	0.66	-	0.23
886	<0.1	0.18	0.008	1.5	<0.005	0.2	<0.005	<0.01	<0.01	0.4	5.2	-	2.3
887	<0.1	<0.1	<0.002	0.22	<0.005	0.2	<0.005	<0.01	<0.01	0.2	0.18	-	0.34
888	<0.1	0.65	0.019	0.22	<0.005	0.2	<0.005	<0.01	<0.05	0.2	0.18	-	1.5
889	<0.05	0.05	<0.002	<0.02	<0.005	<1.0	<0.005	<0.01	0.003	0.36	<0.05	<0.05	0.21
	<0.05	0.09	<0.005	<0.05	<0.005	<1.0	<0.005	0.02	<0.005	0.34	<0.05	<0.05	0.23
I	<0.1	<0.1	<0.002	0.13	<0.005	0.1	<0.005	<0.01	<0.01	0.1	<0.005	-	0.02
	<0.05	0.01	<0.002	0.06	--	0.1	<0.005	0.01	<0.03	0.1	0.02	0.01	0.01
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.15	<0.05	<0.05	0.004
	<0.05	0.21	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.17	<0.05	<0.05	0.02
	<0.05	0.15	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.003	0.15	<0.05	<0.05	0.02
	<0.05	0.05	<0.002	<0.02	<0.005	<1.0	<0.005	0.02	<0.005	0.15	<0.05	<0.05	<0.01
1805	<0.1	<0.1	0.006	0.15	<0.005	0.2	<0.005	<0.01	<0.01	0.2	0.11	-	0.06
1806	<0.1	0.15	0.029	1.4	<0.005	0.2	<0.005	<0.01	<0.01	0.2	12	-	2.2
1807	<0.1	0.1	0.013	0.67	<0.005	0.2	<0.005	<0.01	<0.01	0.2	1.9	-	1.8
1808	<0.05	0.38	<0.002	<0.02	<0.005	<1.0	<0.002	0.01	<0.002	0.21	0.13	<0.05	0.09
	<0.05	1.02	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.003	0.27	0.21	<0.05	0.13
	<0.05	0.10	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.005	0.23	0.11	<0.05	0.06
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.005	0.02	<0.005	0.20	<0.05	0.07	0.05
1809	<0.05	0.33	0.009	<0.02	<0.005	<1.0	<0.005	0.02	0.019	0.20	2.37	0.07	1.22
1810	<0.05	0.09	<0.002	<0.02	<0.005	<1.0	<0.005	0.02	0.010	0.34	<0.05	<0.05	1.22
1814	<0.05	0.11	<0.002	0.06	--	<1.0	<0.005	0.01	<0.03	0.1	0.4	0.03	0.05
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	<0.002	0.13	5.70	<0.05	0.168
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.02	<0.01	0.003	0.14	11.0	<0.05	0.21
	<0.05	0.14	<0.002	<0.02	<0.005	<1.0	<0.002	<0.01	0.008	0.12	12.1	<0.05	0.20
	<0.05	<0.05	<0.002	<0.02	<0.005	<1.0	<0.005	0.02	0.009	0.09	10.0	0.08	0.21
1821	<0.05	0.80	<0.002	0.06	<0.005	<1.0	0.004	<0.01	<0.002	0.40	<0.05	<0.05	0.05
1822	<0.05	0.07	<0.002	<0.02	<0.005	<1.0	<0.005	<0.01	<0.002	<0.05	<0.05	<0.05	0.02

Notes: Concentration in mg/1 except Conductivity, in mhos/cm @ 25°C; Temperature, in °C; pH, in pH units; U, Pb-210, Po-210, Ra-'226 and Th-230, in pCi/l

( ) Field Measurements

< Concentration less than value.

(a) Additional parameters for this sample are Silica (as S.0) . 10; Alkalinity (as $CaCO_3$) 188; Total Hardness (as $CaCO_3$)

(b) 219; Redox Potential = 196; Nitrite (as N) = *.05; Phogihos (as P) = ˙.02; and Total Iron . *1.0.

(c) Additional parameters for this sample are Phosphate = 0.04 and Nitrite = ¹¹.01.

(d) Additional parameters for this sample are Phosphate = 0.025 and Nitrite =¹¹.01.

(e) Additional parameters for this sample are Silica (as 5.0,) = 9.9; Alkalinity (as $CaCO_3$) = 232.5; Total Hardness (as

(f) $CaCO_3$) 560; Redox Potential . 206; Nitrite (as N) = 0.13; Ptosphorus (as P) = *.03 and Total Iron 1.3.

(g) Additional parameters for this sample are Silica (as $S.0_2$) = 19.2; Alkalinity (as $CaCO_3$) = 703; Total Hardness (as $CoCO_3$) =

(h) 640; Redox Potential r. 208; Nitrite (as N) *.05; Phosphorus (as P) = 0.02; and Total Iron 49.

(i) Additional parameters for this sample are Silica (as 5.0_2) . 8.6; Alkalinity (as $CoCO_3$) . 310; Total Hardness (as $CoCO_3$)

(j) 749; Redox Potential . 207; Nitrite (as N) = *.05; Phos4horus (as P) = ˙¹.02; and Total Iron . 1.0.

Well No.	Hg	Mo	Ni	Ag	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230
4IN-75W												
22-2	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.035					
8-3	<0.001	<0.02	<0.01		<0.002	<0.02	0.047	71 ±4	0±0.6	0.12 ±.03	0.60 ± 0.07	0 ± 0.4
	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	0.021					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.006					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.015					
4IN-75W												
893	<0.0005	<0.01	0.02	-	0.0023	<0.01	0.3	81	-	-	302 ± 20	-
	<0.001	<0.02	<0.01	-	<0.002	<0.02	0.014	58 ± 3	10 ± 0.5	1.5 ± 0.1	126 ± 6	0.3± 0.1
	<0.001	<0.02	<0.01	<0.01	-	<0.02	0.038					
	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	0.025					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.047					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.010					
885	0.00003	0.002	0.02	0.006	<0.005	<0.005	0.03	38			163 ± 20	
886	<0.00002	0.004	0.02	0.006	<0.005	<0.005	0.03	6.8			170 ± 15	
887	<0.00002	0.004	0.03	0.009	<0.005	<0.005	0.02	8.8			1.2 ± 1.2	
888	<0.00002	0.003	0.02	0.006	<0.005	<0.005	0.03	4.1			8.2 ± 3.0	
889	<0.001	<0.05	<0.05	<0.01	<0.002	<0.05	0.077					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.023					
I	<0.00002	<0.002	<0.01	<0.005	0.115	<0.005	0.02	338			69 ± 10	
	<0.0005	<0.01	0.01	-	0.36	<0.01	0.1	399			27.6± 1.7	
	<0.001	<0.02	<0.01	-	0.041	<0.02	0.038	294 ± 15	0±0.2	0.2 ± 0.03	8.0± 7.4	0 ± 0.1
	<0.001	<0.02	<0.01	<0.01	0.093	<0.02	0.051					
	<0.001	<0.05	<0.01	<0.01	0.103	<0.05	0.037					
	<0.001	<0.05	<0.01	<0.01	0.065	<0.05	0.008					
1805	<0.00002	0.002	0.02	<0.005	<0.005	<0.005	0.01	10			6.6 ± 2.3	
1806	<0.00002	<0.005	0.03	0.009	<0.005	<0.005	0.03	12			125 ± 17	
1807	<0.00002	<0.002	0.02	0.006	<0.005	<0.005	0.07	3.4			6.6 ± 2.3	
1808	<0.001	<0.02	<0.01	-	<0.002	<0.02	0.016	71 ± 4	0 ± 0.6	0.12 ± 0.03	0.60 ± 0.07	0 ± 0.4
	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	0.015					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.084					
	<0.001	<0.05	<0.01	-	<0.002	<0.05	<0.005					
1809	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.020					
1810	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.012					
1814	<0.0005	<0.01	0.02	-	0.012	<0.01	0.04	352	-	-	753 ± 45	
	<0.001	<0.02	<0.01	-	<0.002	<0.02	0.035	106 ± 5	0 ± 0.1	0.26 ± 0.05	5.1 ± 0.3	0 ± 0.1
	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	0.087					
	<0.001	<0.05	<0.01	<0.01	<0.002	<0.05	0.099					
	<0.001	<0.05	<0.01	-	<0.002	<0.05	0.017					
1821	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	0.018					
1822	<0.001	<0.02	<0.01	<0.01	<0.002	<0.02	<0.005					

Notes: Concentration in mg/1 except Conductivity, in mhos/cm @ 25°C; Temperature, in °C; pH, in pH units; U, Pb-210, Po-210, Ra-'226 and Th-230, in pCi/l

( ) Field Measurements

< Concentration less than value.

(a) Additional parameters for this sample are Silica (as S.0) . 10; Alkalinity (as $CaCO_3$) 188; Total Hardness (as $CaCO_3$)

(b) 219; Redox Potential = 196; Nitrite (as N) = *.05; Phogihos (as P) = '.02; and Total Iron . *1.0.

(c) Additional parameters for this sample are Phosphate = 0.04 and Nitrite = "11".01.

(d) Additional parameters for this sample are Phosphate = 0.025 and Nitrite = "11".01.

(e) Additional parameters for this sample are Silica (as 5.0,) = 9.9; Alkalinity (as $CaCO_3$) = 232.5; Total Hardness (as

(f) $CaCO_3$) 560; Redox Potential . 206; Nitrite (as N) = 0.13; Ptosphorus (as P) = *.03 and Total Iron 1.3.

(g) Additional parameters for this sample are Silica (as $S.0_2$) = 19.2; Alkalinity (as $CaCO_3$) = 703; Total Hardness (as $CoCO_3$) =

(h) 640; Redox Potential r. 208; Nitrite (as N) *.05; Phosphorus (as P) = 0.02; and Total Iron 49.

(i) Additional parameters for this sample are Silica (as 5.0_2) . 8.6; Alkalinity (as $CoCO_3$) . 310; Total Hardness (as $CoCO_3$)

(j) 749; Redox Potential . 207; Nitrite (as N) = *.05; Phos4horus (as P) = *'.02; and Total Iron . 1.0.

Table 3.4.3.13
Analytical Results-Private Wells Sampled by Conoco 1978-1982

Well Location	Well No.	Date	TDS	Conductivity		Temp.	pH	Na	K	Ca	Mg	S04	Cl	CO3	HCO_3	NO3
41N-74W																
04 NESE	A-1 17304	6/26/79[a]	492	820	(705)	(17)	7.53 (7.15)	39	9	101	15	187	6	0	234	1.7
		12/7/79[b]	606	870	(839)	(7)	7.73 (7.70)	46	9	107	17	215	8	0	278	1.86
04 NESE	A-2 17302	6/26/79[c]	655	1,100	(676)	(17)	7.91 (7.00)	13	9	156	10	179	25	0	312	24
		8/14/79	—	—	(647)	(15)	— (7.45)	—	—	—	—	—	—	—	—	—
		12/7/79	670	1,130	(1,069)	(9)	7.61 (7.70)	9	9	169	27	160	41	0	307	36
17 SWSE	P'-6 9309	6/28/79	831	1,270	(1,083)	(16)	7.66 (7.30)	107	10	128	19	460	12	0	151	0.3
17 SWSE	P'-7 12240	6/28/79	509	940	(795)	(14)	7.58 (7.05)	48	8	100	20	212	16	0	239	0.22
41N-75W																
03 NESW	P'-9	6/20/79	1,024	1,389	(1,163)	(13)	7.32 (6.85)	45	13	201	48	550	7	0	312	1.16
		9/27/79	1,012	1,365	(1,258)	(12)	7.57 (6.95)	42	11	186	46	450	6	0	315	—
		3/26/80	964	1,300	(1,249)	(11)	7.61 (7.30)	42	13	197	47	516	6	0	327	0.44
04 NENW	P'-11	8/16/79	1,048	1,500	(1,308)	(12.5)	7.74 (7.45)	65	12	165	53	548	8	0	283	0.88
42N-74W																
30 NWNW	P'-8 14683	6/28/79	2,339	2,770	(2,466)	(16)	6.95 (6.60)	16	11	512	116	1,270	4	0	366	0.34
42N-75W																
33 SWSE	P'-10	6/20/79	1,566	1,923	(1,608)	(18)	7.71 (7.45)	37	5	375	58	910	12	0	359	0.39
33 SENW	T-1 12299	6/26/79	661	1,100	(924)	(15)	7.49 (7.35)	87	9	106	17	270	10	0	254	1.43
		9/18/79	690	1,060	(896)	(14)	7.69 (6.90)	85	9	106	20	284	7	0	249	3.05
		9/25/79	—	—	(920)	(19)	— (7.05)	—	—	—	—	—	—	—	—	—
36 SENW	P'-36	10/10/79	604	921	(801)	(15)	7.72 (7.30)	15	6	109	43	154	8	0	390	1.07
		12/10/79	693	1,070	(1,042)	(9.5)	7.80 (7.70)	13	5	143	51	251	7	0	398	0.39

All concentrations are in mg/l except Conductivity, in uhos/cm @ 25°C; Temperature, in °C; pH in pH units,
U; Pb-210, Po-210, 'Ra-226 and Th-230 in pCi/l

( ) Denotes field measurements.

Table 3.4.3.13
Analytical Results-Private Wells Sampled by Conoco 1978-1982

Well No.	Al	NH3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe	Pb	Mn
41N-74W													
A-1 17304	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.13	0.011	0.05	0.007
	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.007	0.19	0.050	0.05	0.020
A-2 17302	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.16	0.024	0.05	0.003
	—	—	—	—	—	—	—	—	—	—	—	—	—
	0.05	0.10	0.002	0.02	0.005	1.0	0.056	0.01	0.022	0.22	0.170	0.17	0.020
P'-6 9309	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.08	0.592	0.05	0.072
P'-7 12240	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.14	0.424	0.05	0.078
4IN-75W													
P'-9	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.13	0.069	0.05	0.088
	0.05	—	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.05	0.050	0.05	0.070
	0.05	0.10	0.002	0.02	0.005	1.0	0.005	0.01	0.010	0.12	0.100	0.07	0.080
P'-11	0.05	0.06	0.002	0.02	0.005	1.0	0.008	0.01	0.009	0.14	0.020	0.05	0.020
42N-74W													
P'-8 14683	0.05	0.09	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.31	5.842	0.05	0.856
42N-75W													
P'-10	0.05	0.05	0.002	0.02	0.005	1.0	0.013	0.01	0.002	0.36	0.139	0.05	0.030
T-1 12299	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.17	0.012	0.05	0.016
	0.05	0.05	0.002	0.02	0.005	1.0	0.002	0.01	0.005	0.23	0.120	0.05	0.060
	—	—	—	—	—	—	—	—	—	—	—	—	—
P'-36	0.05	2.81	0.002	0.02	0.005	1.0	0.002	0.01	0.002	0.27	5.600	0.05	0.080
	—	0.14	—	—	—	—	—	—	—	—	—	—	—

All concentrations are in mg/l except Conductivity, in uhos/cm @ 25°C; Temperature, in °C; pH in pH units,
U; Pb-210, Po-210, 'Ra-226 and Th-230 in pCi/l

( ) Denotes field measurements.

Table 3.4.3.13
Analytical Results-Private Wells Sampled by Conoco 1978-1982

Well No.	Hg	Mo	Ni	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230
41N-74W											
A-1 17304	0.001	<0.02	<0.01	<0.002	<0.02	1.80	37±2	0± 0.3	0.03 + 0.1	0.15+ 0.05	0 + 0.1
	0.001	<0.05	<0.01	<0.002	<0.02	1.83	—	—	—	—	—
A-2 17302	0.001	<0.02	<0.01	<0.002	<0.02	0.054	20± 1	0.3± 0.1	0 ± 0.04	0.15 + 0.04	0.4 + 0.1
	—	—	—	—	—	—	—	—	—	—	—
	0.001	<0.05	<0.01	<0.002	<0.05	0.135	—	—	—	—	—
P'-6 9309	0.001	<0.02	<0.01	<0.002	<0.02	0.054	0 ± 2	0+1.0	0+ 0.02	0.35 + 0.05	0.2 + 0.1
P'-7 12240	0.001	<0.02	<0.01	<0.002	<0.02	0.041	6 + 1	0 + 0.05	0 + 0.06	0.74 + 0.07	0.3 + 0.1
41N-75W											
P'-9	0.001	<0.02	<0.01	0.007	<0.02	0.024	32 + 2	1.6 + 0.2	0.4 +.05	2.0 + 0.1	0.2 + 0.1
	0.001	<0.02	<0.01	<0.002	<0.02	0.006	—	—	—	—	—
	0.001	<0.05	<0.01	<0.002	<0.05	0.007	—	—	—	—	—
P'-11	0.001	<0.02	<0.01	<0.002	<0.02	0.05	—	—	—	—	—
42N-74W											
P'-8 14683	0.001	<0.02	<0.01	<0.002	<0.02	0.945	7 ± 1	0 ± 0.5	0.08 ± 0.02	0.75 +0 .07	0 + 0.1
42N-75W											
P'-10	0.001	<0.02	<0.01	<0.002	<0.02	0.078	17+ 1	1.9+ 0.7	0.10 + 0.02	0 + 0.08	0 + 0.1
T-1 12299	0.001	<0.02	<0.01	<0.002	<0.02	0.113	44±2	0 ± 0.4	0.02 ± 0.01	0.41 + 0.06	0.3+ 0.1
	0.001	<0.02	<0.01	<0.002	<0.02	0.07	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
P'-36	0.001	<0.02	<0.01	<0.002	<0.02	0.72	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—

All concentrations are in mg/l except Conductivity, in uhos/cm @ 25°C; Temperature, in °C; pH in pH units,
U; Pb-210, Po-210, 'Ra-226 and Th-230 in pCi/l

( ) Denotes field measurements.

Table 3.4.3-14 Analytical Resu[illegible]C Baseline Monitoring Program

			Major Cations and Anions											General Chemistry		
			Na	K	Ca	Mg	Cl	HCO3	CO3	SO4	NO3+NO2 as N	F	Si	TDS @180 F	Conduct.	pH.
Well ID	Completion Zone	Sample Date	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(umhos/cm)	(s.u.)
MR-UMW-2	68	5/11/2007	50	17	73	6	2	214	3	168	0.4	0.2	8.9	448	674	8.31
MR-UMW-2	68	6/18/2007	50	17	32	1	2	<1	4	133	<0.1	0.3	12.2	266	552	11
MR-UMW-4	68	5/9/2007	76	12	66	8	2	231	<1	212	0.8	0.3	10.7	528	794	7.81
MR-UMW-4	68	6/15/2007	72	10	56	8	5	246	<1	161	0.6	0.3	11.9	448	710	7.96
MR-UMW-4	68	6/19/2007	81	11	41	8	<1	210	<1	144	0.6	0.3	17.3	400	633	8.09
MR-MW-2	70	3/21/2007	18	9	133	30	3	297	<1	226	0.2	0.2	13.2	582	860	7.61
MR-MW-2	70	6/19/2007	24	10	177	38	5	290	<1	450	<0.1	0.2	13.8	906	1220	7.41
MR-MW-3	70	3/22/2007	37	9	109	27	2	265	<1	245	<0.1	0.2	12.8	540	844	7.59
MR-MW-3	70	6/20/2007	37	14	103	26	4	261	<1	249	<0.1	0.2	12.9	562	878	7.73
MR-MW-4	70	4/30/2007	41	15	175	48	3	256	<1	568	1.5	0.1	9.9	968	1335	7.6
MR-MW-4	70	6/13/2007	37	14	194	56	4	256	<1	600	<0.1	0.1	12.1	1090	1450	7.63
MR-MW-6	70	4/26/2007	18	9	91	18	1	244	<1	164	0.8	0.2	11.6	452	705	7.5
MR-MW-6	70	6/12/2007	19	9	94	20	<1	244	<1	170	0.1	0.2	12.4	440	715	7.70
MR-MW-7	70	4/26/2007	26	7	73	15	1	159	<1	187	0.5	0.4	14.2	420	659	7.7
MR-MW-7	70	6/12/2007	24	7	72	16	<1	213	<1	121	0.3	0.2	13.2	352	590	7.76
MR-MW-9	70	5/1/2007	55	11	100	21	2	239	<1	283	0.2	0.2	11.6	650	970	8.1
MR-MW-9	70	6/12/2007	62	12	104	25	1	237	<1	312	0.2	0.2	12.4	638	975	8.10
MR-MW-11	70	5/4/2007	54	10	160	38	2	305	<1.0	460	0.1	0.2	13.2	880	1223	7.13
MR-MW-11	70	6/20/2007	53	11	163	37	2	305	<1	458	<0.1	0.2	14.3	890	1250	7.36
MR-PW-1	70	2/16/2007	22	9	156	37	2	293	<1	363	<0.1	0.1	13.6	754	1066	7.45
MR-PW-1	70	6/18/2007	89	24	38	<1	3	<1	8	169	0.3	0.3	7.6	420	975	11.5
MR-885	70	5/2/2007	40	9	155	34	3	300	<1.0	370	0.3	0.2	12.2	842	1203	7.17
MR-885	70	6/15/2007	37	8	154	35	3	300	<1	407	<0.1	0.2	11.6	802	1150	7.55
MR-1808	68-70	5/3/2007	60.0	7.6	104	19.5	3	179	<1	316	0.1	0.3	6.6	602	976	8.1
MR-1808	68-70	6/19/2007	64	7	97	19	3	178	<1	322	<0.1	0.3	9.4	638	916	7.38
MR-8-3	68-70	5/2/2007	15	12	399	149	<1	370	<1.0	1410	0.2	0.1	12.8	2270	2740	6.93
MR-8-3	68-70	6/13/2007	9	12	408	176	2	359	<1	1430	<0.1	<0.1	12.8	2380	2660	7.13
MR-OMW-1	72	4/27/2007	26	21	88	14	3	191	2	191	<0.2	0.2	11.8	454	713	8.85
MR-OMW-1	72	6/18/2007	30	26	53	9	5	84	4	189	<0.1	0.2	11.7	348	566	8.99
MR-OMW-2	72	5/10/2007	55	10	129	21	4	45	7	466	0.2	0.2	3.4	818	847	9.2
MR-OMW-2	72	6/12/2007	72	12	172	34	6	74	<1	667	0.2	0.2	4.0	1050	1400	8.43
MR-OMW-3	72	4/26/2007	32	15	58	11	2	229	<1	108	0.4	0.2	11.0	348	571	7.97
MR-OMW-3	72	6/14/2007	19	15	59	18	4	239	<1	79	<0.1	0.2	14.2	314	527	8.12
MR-OMW-4	72	4/30/2007	19	16	229	84	4	327	<1	743	3.7	0.2	13.4	1320	1656	7.3
MR-OMW-4	72	6/13/2007	19	20	250	79	3	310	<1	722	<0.1	<0.1	12.8	1350	1700	7.30
Stockwell #1	70?	4/27/2007	53	8	149	33	2	273	<1	404	0.4	0.2	11.0	806	1179	7.5
Stockwell #1	70?	6/13/2007	59	9	149	34	2	273	<1	410	0.2	0.2	11.3	822	1180	7.51
Stockwell #2	68?	4/27/2007	22	10	286	78	8	346	<1	776	0.2	0.2	13.8	1420	1748	7.1
Stockwell #2	68?	6/13/2007	24	10	268	80	9	344	<1	769	<0.1	0.1	14.1	1450	1800	7.34
Stockwell #3	70?	4/27/2007	29	11	456	166	6	388	<1	1500	0.3	0.2	9.2	2470	2980	7.25
Stockwell #3	70?	6/13/2007	30	11	455	168	6	403	<1	1530	<0.1	0.2	9.0	2550	2860	7.32
Stockwell #4	72?	5/9/2007	3	3	64	24	6	232	<1	75	2.5	0.4	9.1	340	524	7.5
Stockwell #4	72?	6/19/2007	4	3	69	25	5	234	<1	79	2.2	0.6	10.1	358	544	7.42

< - indicates sample was below reporting limit
tot. - total dis.-dissolved sus.- suspended

			Trace Metals																
			Al	NH4 as N	As	Ba	B	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	V	Zn
Well ID	Completion Zone	Sample Date	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
MR-UMW-2	68	5/11/2007	<0.1	0.10	0.006	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	0.402	<0.1	<0.01
MR-UMW-2	68	6/18/2007	<0.1	0.21	0.003	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	0.37	<0.1	0.01
MR-UMW-4	68	5/9/2007	<0.1	0.05	0.003	<0.1	<0.1	<0.005	<0.05	0.03	0.31	0.018	0.03	<0.001	<0.1	<0.05	0.052	<0.1	0.01
MR-UMW-4	68	6/15/2007	<0.1	<0.05	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	0.069	<0.1	0.01
MR-UMW-4	68	6/19/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	0.002	0.01	<0.001	<0.1	<0.05	0.060	<0.1	0.01
MR-MW-2	70	3/21/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.03	<0.001	<0.1	<0.05	0.527	<0.1	0.01
MR-MW-2	70	6/19/2007	<0.1	<0.05	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.05	<0.001	<0.1	<0.05	0.004	<0.1	<0.01
MR-MW-3	70	3/22/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-3	70	6/20/2007	<0.1	<0.05	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-4	70	4/30/2007	<0.1	0.13	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.03	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-4	70	6/13/2007	<0.1	0.11	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.04	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-6	70	4/26/2007	<0.1	0.06	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.03	<0.001	<0.1	<0.05	0.006	<0.1	<0.01
MR-MW-6	70	6/12/2007	<0.1	<1.0	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	0.004	<0.1	<0.01
MR-MW-7	70	4/26/2007	<0.1	<0.05	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	0.045	<0.1	<0.01
MR-MW-7	70	6/12/2007	<0.1	<0.05	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	0.119	<0.1	<0.01
MR-MW-9	70	5/1/2007	<0.1	0.20	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-9	70	6/12/2007	<0.1	0.20	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	0.04	<0.001	0.02	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
MR-MW-11	70	5/4/2007	<0.1	0.10	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.47	<0.001	0.03	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-MW-11	70	6/20/2007	<0.1	0.05	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	0.6	<0.0001	0.04	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
MR-PW-1	70	2/16/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.85	<0.001	0.04	<0.001	<0.1	<0.05	<0.001	<0.1	0.02
MR-PW-1	70	6/18/2007	<0.1	2.01	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	0.011	<0.01	<0.001	<0.1	<0.05	0.023	<0.1	<0.01
MR-885	70	5/2/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.15	<0.001	0.05	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-885	70	6/15/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.06	<0.001	<0.1	<0.05	0.002	<0.1	<0.01
MR-1808	68-70	5/3/2007	<0.1	0.06	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.03	<0.001	<0.1	<0.05	0.003	<0.1	<0.01
MR-1808	68-70	6/19/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.06	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
MR-8-3	68-70	5/2/2007	<0.1	1.62	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	3.34	<0.001	0.53	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
MR-8-3	68-70	6/13/2007	<0.1	0.24	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	1.08	<0.001	0.52	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
MR-OMW-1	72	4/27/2007	<0.1	0.53	0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-OMW-1	72	6/18/2007	<0.1	0.59	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-OMW-2	72	5/10/2007	<0.1	0.33	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	0.003	<0.1	<0.01
MR-OMW-2	72	6/12/2007	<0.1	<1.0	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.02	<0.001	<0.1	<0.05	0.003	<0.1	<0.01
MR-OMW-3	72	4/26/2007	<0.1	0.23	0.003	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-OMW-3	72	6/14/2007	<0.1	0.22	0.002	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	<0.01	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-OMW-4	72	4/30/2007	<0.1	0.16	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.41	<0.001	0.22	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
MR-OMW-4	72	6/13/2007	<0.1	0.16	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.17	<0.001	<0.1	<0.05	<0.001	<0.1	0.01
Stockwell #1	70?	4/27/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.06	<0.001	<0.1	<0.05	0.010	<0.1	<0.01
Stockwell #1	70?	6/13/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.05	<0.001	<0.1	<0.05	0.012	<0.1	<0.01
Stockwell #2	68?	4/27/2007	<0.1	0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.03	<0.001	0.24	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
Stockwell #2	68?	6/13/2007	<0.1	0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.58	<0.001	0.25	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
Stockwell #3	70?	4/27/2007	<0.1	0.10	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	4.86	<0.001	0.46	<0.001	<0.1	<0.05	<0.001	<0.1	<0.01
Stockwell #3	70?	6/13/2007	<0.1	0.14	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.24	<0.001	0.46	<0.001	<0.1	<0.05	0.001	<0.1	<0.01
Stockwell #4	72?	5/9/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	0.13	0.004	0.04	<0.001	<0.1	<0.05	0.002	<0.1	<0.01
Stockwell #4	72?	6/19/2007	<0.1	<0.05	<0.001	<0.1	<0.1	<0.005	<0.05	<0.01	<0.03	<0.001	0.06	<0.001	<0.1	<0.05	0.002	<0.1	0.02

< - indicates sample was below reporting limit
tot. - total dis.-dissolved sus.- suspended

							Radionuclides									
			Fe (tot.)	Mn (tot.)	G Alpha	G Beta	Pb-210 (dis.)	Po-210 (dis.)	Ra-226 (dis.)	Ra-228 (dis.)	Th-230 (dis.)	U (dis.)	Pb-210 (sus.)	Po-210 (sus.)	Ra-226 (sus.)	Th-230 (sus.)	U (sus.)
Well ID	Completion Zone	Sample Date	(mg/l)	(mg/l)	(pCi/l)	(pCi/l)	(pCi/l)	(pCi/l)	(pCi/l)	(pCi/l)	(pCi/l)	(mg/l)	(pCi/l)	(pCi/l)	(pCi/l)	(pCi/l)	(mg/l)
MR-UMW-2	68	5/11/2007	<0.03	<0.01	83.3	36.8	<1.0	1.8	1.0	<1.0	<0.2	0.112	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-UMW-2	68	6/18/2007	<0.03	<0.01			<1.0	<1.0	0.6	<1.0	<0.2	0.0188	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-UMW-4	68	5/9/2007	0.04	0.02	53.4	18.4	<1.0	<1.0	1.0	3.3	<0.2	0.0685	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-UMW-4	68	6/15/2007	0.12	0.02			<1.0	<1.0	0.6	<1.0	<0.2	0.0747	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-UMW-4	68	6/19/2007	0.10	0.01			<1.0	<1.0	0.9	<1.0	<0.2	0.0688	<1.0	<1.0	<0.2	0.2	<0.0003
MR-MW-2	70	3/21/2007	<0.03	0.03	1050	327	31	51	138	<1.0	<0.2	0.739	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-2	70	6/19/2007	0.05	0.05			11	2.8	220	3.8	<0.2	0.884	<1.0	3.3	<0.2	<0.2	<0.0003
MR-MW-3	70	3/22/2007	0.13	0.02	370	162	69	34	280	<1.0	<0.2	0.0837	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-3	70	6/20/2007	0.14	0.02			21	7.3	242	5.9	0.6	0.144	41	15	8.1	<0.2	<0.0003
MR-MW-4	70	4/30/2007	2.04	0.03	201	53.8	<1.0	<1.0	45.7	1.7	<0.2	0.130	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-4	70	6/13/2007	0.56	0.04			<1.0	<1.0	42.0	<1.0	<0.2	0.0895	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-6	70	4/26/2007	<0.03	0.03	17.0	13.6	<1.0	<1.0	1.3	<1.0	<0.2	0.0152	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-6	70	6/12/2007	<0.03	0.03			<1.0	<1.0	0.7	<1.0	<0.2	0.0147	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-7	70	4/26/2007	<0.03	0.02	21.2	11.4	<1.0	1.6	1.1	<1.0	<0.2	0.0323	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-7	70	6/12/2007	<0.03	0.02			6.1	<1.0	1.4	<1.0	<0.2	0.0377	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-9	70	5/1/2007	<0.03	0.02	47.1	24.6	<1.0	2.0	2.5	<1.0	<0.2	0.0582	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-9	70	6/12/2007	0.03	0.01			<1.0	<1.0	7.6	<1.0	<0.2	0.0547	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-11	70	5/4/2007	0.68	0.03	156	47.3	<1.0	<1.0	26	3.5	0.9	0.103	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-MW-11	70	6/20/2007	0.89	0.04			<1.0	<1.0	22	<1.0	<0.2	0.104	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-PW-1	70	2/16/2007	1.08	0.04	627	78.9	10	<1.0	82.6	2.1	<0.2	0.188					
MR-PW-1	70	6/18/2007	0.05	<0.01			<1.0	<1.0	<0.2	<1.0	<0.2	0.0053	<1.0	<1.0	0.6	<0.2	<0.0003
MR-885	70	5/2/2007	0.23	0.06	293	147	41	31	309	1.8	<0.2	0.0763	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-885	70	6/15/2007	0.26	0.05			12	12	276	4.3	<0.2	0.110	270	290	9.3	1	<0.003
MR-1808	68-70	5/3/2007	<0.03	0.03	30.9	12.8	<1.0	<1.0	9.1	<1.0	0.4	0.0012	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-1808	68-70	6/19/2007	0.28	0.08			<1.0	<1.0	4.9	<1.0	<0.2	0.0005	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-8-3	68-70	5/2/2007	3.86	0.60	3.6	12.9	<1.0	<1.0	0.8	3.0	<0.2	0.0020	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-8-3	68-70	6/13/2007	3.57	0.53			<1.0	<1.0	1.2	<1.0	<0.2	0.0016	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-1	72	4/27/2007	<0.03	<0.01	3.5	20.4	<1.0	<1.0	0.8	2.8	<0.2	0.0014	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-1	72	6/18/2007	<0.03	<0.01			<1.0	<1.0	<0.2	<1.0	<0.2	0.0008	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-2	72	5/10/2007	0.07	<0.01	9.6	8.6	<1.0	<1.0	1.1	2.5	1.0	0.0027	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-2	72	6/12/2007	0.10	0.02			<1.0	<1.0	1.2	<1.0	<0.2	0.0026	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-3	72	4/26/2007	0.05	<0.01	1.8	13.6	<1.0	<1.0	1.1	9.5	<0.2	0.0014	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-3	72	6/14/2007	<0.03				<1.0	<1.0	0.6	<1	<0.2	0.0024		<1.0	<0.2	<0.2	<0.0003
MR-OMW-4	72	4/30/2007	1.35	0.22	3.5	14.4	<1.0	<1.0	1.8	2.0	<0.2	0.0008	<1.0	<1.0	<0.2	<0.2	<0.0003
MR-OMW-4	72	6/13/2007	1.03	0.18			<1.0	<1.0	2.0	<1.0	<0.2	0.0010	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #1	70?	4/27/2007	<0.03	0.06	68.2	24.0	<1.0	<1.0	0.8	1.6	<0.2	0.0508	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #1	70?	6/13/2007	0.14	0.06			<1.0	<1.0	0.6	<1.0	<0.2	0.0446	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #2	68?	4/27/2007	3.27	0.25	2.0	7.9	<1.0	<1.0	0.9	3.9	<0.2	0.0008	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #2	68?	6/13/2007	3.70	0.25			<1.0	<1.0	0.8	<1.0	<0.2	0.0004	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #3	70?	4/27/2007	9.10	0.46	24.3	16.5	<1.0	<1.0	3.3	3.5	<0.2	0.0077	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #3	70?	6/13/2007	10.0	0.49			<1.0	<1.0	2.8	1.8	<0.2	0.0066	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #4	72?	5/9/2007	2.64	0.19	5.9	5.5	<1.0	<1.0	<0.2	<1.0	0.9	0.0071	<1.0	<1.0	<0.2	<0.2	<0.0003
Stockwell #4	72?	6/19/2007	0.37	0.07			<1.0	<1.0	<0.2	<1.0	<0.2	0.0069	<1.0	<1.0	<0.2	<0.2	<0.0003

< - indicates sample was below reporting limit
tot. - total dis.-dissolved sus.- suspended

Table [illegible]-15a. Comparison of Historic and Current Baseline Monitoring Analytical Results From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	HCO3 (mg/l)	CO3 (mg/l)	SO4 (mg/l)	NO3+ NO2 (mg/l)	F (mg/l)
885	4/12/78	31.5	8.1	208.0	33.5	3.3	281.0	ND	426.0	0.6	0.1
	5/2/2007	40.0	9.0	155.0	34.0	3.0	300.0	ND	370.0	0.3	0.2
	6/15/2007	37.0	8.0	154.0	35.0	3.0	300.0	ND	407.0	ND	0.2
	Average	36.2	8.4	172.3	34.2	3.1	293.7	ND	401.0	0.5	0.2
	Max	40.0	9.0	208.0	35.0	3.3	300.0	ND	426.0	0.6	0.2
	Min	31.5	8.0	154.0	33.5	3.0	281.0	ND	370.0	ND	0.1
1808	6/26/79	69.0	9.0	93.0	19.0	10.0	161.0	ND	303.0	0.3	0.2
	9/27/79	69.0	9.0	86.0	17.0	8.0	171.0	ND	300.0	0.4	0.3
	12/15/79	63.0	8.0	84.0	17.0	6.0	159.0	ND	280.0	0.4	0.2
	4/2/80	77.0	10.0	115.0	24.0	8.0	173.0	ND	405.0	0.2	0.2
	5/3/2007	60.0	7.6	104.0	19.5	3.0	179.0	ND	316.0	0.1	0.3
	6/19/2007	64.0	7.0	97.0	19.0	3.0	178.0	ND	322.0	ND	0.3
	Average	67.0	8.4	96.5	19.3	6.3	170.2	ND	321.0	0.3	0.3
	Max	77.0	10.0	115.0	24.0	10.0	179.0	ND	405.0	0.4	0.3
	Min	60.0	7.0	84.0	17.0	3.0	159.0	ND	280.0	ND	0.2
8-3	6/28/79	8.0	12.0	354.0	58.0	6.0	361.0	ND	980.0	0.6	ND
	9/27/79	9.0	12.0	278.0	96.0	6.0	371.0	ND	750.0	0.5	0.1
	12/6/79	8.0	13.0	245.0	120.0	6.0	361.0	ND	936.0	0.2	0.1
	4/9/80	10.0	14.0	251.0	115.0	12.0	256.0	ND	860.0	0.2	0.1
	5/2/2007	15.0	12.0	399.0	149.0	ND	370.0	ND	1410.0	0.2	0.1
	6/13/2007	9.0	12.0	408.0	176.0	2.0	359.0	ND	1430.0	ND	ND
	Average	9.8	12.5	322.5	119.0	6.4	346.3	ND	1061.0	0.3	0.1
	Max	15.0	14.0	408.0	176.0	12.0	371.0	ND	1430.0	0.6	0.1
	Min	8.0	12.0	245.0	58.0	2.0	256.0	ND	750.0	ND	ND

Historic Monitoring
Current Monitoring

Table [illegible]3-15a. Comparison of Historic and Current Baseline Monitoring Analytical Re[illegible] From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Al (mg/l)	NH4 (mg/l)	As (mg/l)	Ba (mg/l)	B (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Mn (mg/l)
885	4/12/78	ND	ND	0.004	0.19	0.2	ND	ND	0.66		0.23
	5/2/2007	ND	ND	ND	ND	ND	ND	ND	ND	0.15	0.05
	6/15/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06
	Average	ND	ND	0.004	0.19	0.2	ND	ND	0.66	0.15	0.11
	Max	ND	ND	0.004	0.19	0.2	ND	ND	0.66	0.15	0.23
	Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
1808	6/26/79	ND	0.38	ND	ND	ND	ND	ND	0.13	ND	0.09
	9/27/79	ND	1.02	ND	ND	ND	ND	0.003	0.21	ND	0.13
	12/15/79	ND	0.10	ND	ND	ND	ND	0.005	0.11	ND	0.06
	4/2/80	ND	ND	ND	ND	ND	ND	ND	ND	0.07	0.05
	5/3/2007	ND	0.06	ND	ND	ND	ND	ND	ND	ND	0.03
	6/19/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06
	Average	ND	0.5	ND	ND	ND	ND	0.004	0.15	0.07	0.07
	Max	ND	1.02	ND	ND	ND	ND	0.005	0.21	0.07	0.13
	Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03
8-3	6/28/79	ND	0.11	ND	ND	ND	ND	ND	1.96	ND	0.33
	9/27/79	ND	0.81	ND	ND	ND	ND	0.004	2.4	ND	0.33
	12/6/79	ND	0.47	ND	ND	ND	ND	0.002	2.65	0.07	0.33
	4/9/80	ND	0.11	ND	ND	ND	0.006	0.010	3.75	0.08	0.32
	5/2/2007	ND	1.62	ND	ND	ND	ND	ND	ND	3.34	0.53
	6/13/2007	ND	0.24	ND	ND	ND	ND	ND	ND	1.08	0.52
	Average	ND	0.56	ND	ND	ND	0.006	0.005	2.69	1.14	0.39
	Max	ND	1.62	ND	ND	ND	0.006	0.010	3.75	3.34	0.53
	Min	ND	0.11	ND	ND	ND	ND	ND	ND	ND	0.32

Conoco Baseline Monitoring Program

EMC Baseine Monitoring Program

Tabl[illegible]3-15a. Comparison of Historic and Current Baseline Monitoring Analytical Res[illegible] From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Hg (mg/l)	Mo (mg/l)	Ni (mg/l)	Se (mg/l)	V (mg/l)	Zn (mg/l)	TDS@ 180F (mg/l)	Conductivity (umhos/cm)	pH s.u.	Ra-226 (pCi/L)	U (mg/l)
885	4/12/78	0.00003	0.002	0.02	ND	ND	0.03	836	1113	7.53	163	0.056
	5/2/2007	ND	ND	ND	ND	ND	ND	842	1203	7.17	309	0.0763
	6/15/2007	ND	ND	ND	0.002	ND	ND	802	1150	7.55	276	0.110
	Average	0.00003	0.002	0.02	0.002	ND	0.03	827	1155	7.42	292.50	0.08
	Max	0.00003	0.002	0.02	0.002	ND	0.03	842	1203	7.55	309.00	0.11
	Min	ND	ND	ND	ND	ND	ND	802	1113	7.17	276.00	0.06
1808	6/26/79	ND	ND	ND	ND	ND	0.02	573	800	7.20	0.6	-
	9/27/79	ND	ND	ND	ND	ND	0.02	570	789	6.45	-	-
	12/15/79	ND	ND	ND	ND	ND	0.08	608	813	7.65	-	-
	4/2/80	ND	ND	ND	ND	ND	ND	684	986	8.20	-	-
	5/3/2007	ND	ND	ND	0.003	ND	ND	602	976	8.10	9.1	0.0012
	6/19/2007	ND	ND	ND	0.001	ND	ND	638	916	7.38	4.9	0.0005
	Average	ND	ND	ND	0.002	ND	0.04	613	880	7.50	4.87	0.00
	Max	ND	ND	ND	0.003	ND	0.08	684	986	8.20	9.10	0.00
	Min	ND	ND	ND	ND	ND	ND	570	789	6.45	0.60	0.00
8-3	6/28/79	ND	ND	ND	ND	ND	0.05	1460	1610	6.85	0.6	71
	9/27/79	ND	ND	ND	ND	ND	0.02	1426	1660	6.50	-	-
	12/6/79	ND	ND	ND	ND	ND	0.01	1566	1680	7.75	-	-
	4/9/80	ND	ND	ND	ND	ND	-	1398	1750	7.10	-	-
	5/2/2007	ND	ND	ND	ND	ND	ND	2270	2740	6.93	0.8	0.002
	6/13/2007	ND	ND	ND	ND	ND	ND	2380	2660	7.13	1.2	0.0016
	Average	ND	ND	ND	ND	ND	0.02	1750	2017	7.04	0.87	23.67
	Max	ND	ND	ND	ND	ND	0.05	2380	2740	7.75	1.20	71.00
	Min	ND	ND	ND	ND	ND	ND	1398	1610	6.50	0.60	0.00

Conoco Baseline Monitoring Program

EMC Baseine Monitoring Program

Table [illegible]3-15b. Comparison of Historic and Current Baseline Monitoring Analytical Res[illegible] From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	HCO3 (mg/l)	CO3 (mg/l)	SO4 (mg/l)	NO3+ NO2 (mg/l)	F (mg/l)
885	4/12/78	31.5	8.1	208.0	33.5	3.3	281.0	ND	426.0	0.6	0.1
	5/2/2007	40.0	9.0	155.0	34.0	3.0	300.0	ND	370.0	0.3	0.2
	6/15/2007	37.0	8.0	154.0	35.0	3.0	300.0	ND	407.0	ND	0.2
	Average	36.2	8.4	172.3	34.2	3.1	293.7	ND	401.0	0.5	0.2
	Max	40.0	9.0	208.0	35.0	3.3	300.0	ND	426.0	0.6	0.2
	Min	31.5	8.0	154.0	33.5	3.0	281.0	ND	370.0	ND	0.1
1808	6/26/79	69.0	9.0	93.0	19.0	10.0	161.0	ND	303.0	0.3	0.2
	9/27/79	69.0	9.0	86.0	17.0	8.0	171.0	ND	300.0	0.4	0.3
	12/15/79	63.0	8.0	84.0	17.0	6.0	159.0	ND	280.0	0.4	0.2
	4/2/80	77.0	10.0	115.0	24.0	8.0	173.0	ND	405.0	0.2	0.2
	5/3/2007	60.0	7.6	104.0	19.5	3.0	179.0	ND	316.0	0.1	0.3
	6/19/2007	64.0	7.0	97.0	19.0	3.0	178.0	ND	322.0	ND	0.3
	Average	67.0	8.4	96.5	19.3	6.3	170.2	ND	321.0	0.3	0.3
	Max	77.0	10.0	115.0	24.0	10.0	179.0	ND	405.0	0.4	0.3
	Min	60.0	7.0	84.0	17.0	3.0	159.0	ND	280.0	ND	0.2
8-3	6/28/79	8.0	12.0	354.0	58.0	6.0	361.0	ND	980.0	0.6	ND
	9/27/79	9.0	12.0	278.0	96.0	6.0	371.0	ND	750.0	0.5	0.1
	12/6/79	8.0	13.0	245.0	120.0	6.0	361.0	ND	936.0	0.2	0.1
	4/9/80	10.0	14.0	251.0	115.0	12.0	256.0	ND	860.0	0.2	0.1
	5/2/2007	15.0	12.0	399.0	149.0	ND	370.0	ND	1410.0	0.2	0.1
	6/13/2007	9.0	12.0	408.0	176.0	2.0	359.0	ND	1430.0	ND	ND
	Average	9.8	12.5	322.5	119.0	6.4	346.3	ND	1061.0	0.3	0.1
	Max	15.0	14.0	408.0	176.0	12.0	371.0	ND	1430.0	0.6	0.1
	Min	8.0	12.0	245.0	58.0	2.0	256.0	ND	750.0	ND	ND

Historic Monitoring
Current Monitoring

Table 3-15b. Comparison of Historic and Current Baseline Monitoring Analytical Results From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Al (mg/l)	NH4 (mg/l)	As (mg/l)	Ba (mg/l)	B (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Mn (mg/l)
885	4/12/78	ND	ND	0.004	0.19	0.2	ND	ND	0.66		0.23
	5/2/2007	ND	ND	ND	ND	ND	ND	ND	ND	0.15	0.05
	6/15/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06
	Average	ND	ND	0.004	0.19	0.2	ND	ND	0.66	0.15	0.11
	Max	ND	ND	0.004	0.19	0.2	ND	ND	0.66	0.15	0.23
	Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
1808	6/26/79	ND	0.38	ND	ND	ND	ND	ND	0.13	ND	0.09
	9/27/79	ND	1.02	ND	ND	ND	ND	0.003	0.21	ND	0.13
	12/15/79	ND	0.10	ND	ND	ND	ND	0.005	0.11	ND	0.06
	4/2/80	ND	ND	ND	ND	ND	ND	ND	ND	0.07	0.05
	5/3/2007	ND	0.06	ND	ND	ND	ND	ND	ND	ND	0.03
	6/19/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.06
	Average	ND	0.5	ND	ND	ND	ND	0.004	0.15	0.07	0.07
	Max	ND	1.02	ND	ND	ND	ND	0.005	0.21	0.07	0.13
	Min	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03
8-3	6/28/79	ND	0.11	ND	ND	ND	ND	ND	1.96	ND	0.33
	9/27/79	ND	0.81	ND	ND	ND	ND	0.004	2.4	ND	0.33
	12/6/79	ND	0.47	ND	ND	ND	ND	0.002	2.65	0.07	0.33
	4/9/80	ND	0.11	ND	ND	ND	0.006	0.010	3.75	0.08	0.32
	5/2/2007	ND	1.62	ND	ND	ND	ND	ND	ND	3.34	0.53
	6/13/2007	ND	0.24	ND	ND	ND	ND	ND	ND	1.08	0.52
	Average	ND	0.56	ND	ND	ND	0.006	0.005	2.69	1.14	0.39
	Max	ND	1.62	ND	ND	ND	0.006	0.010	3.75	3.34	0.53
	Min	ND	0.11	ND	ND	ND	ND	ND	ND	ND	0.32

Historic Monitoring
Current Monitoring

Table [illegible]-15b. Comparison of Historic and Current Baseline Monitoring Analytical Res[illegible] From Monitor Wells, Moore Ranch Project Area

Well ID	Sample Date	Hg (mg/l)	Mo (mg/l)	Ni (mg/l)	Se (mg/l)	V (mg/l)	Zn (mg/l)	TDS@ 180F (mg/l)	Conductivity (umhos/cm)	pH s.u.	Ra-226 (pCi/L)	U (mg/l)
885	4/12/78	0.00003	0.002	0.02	ND	ND	0.03	836	1113	7.53	163	0.056
	5/2/2007	ND	ND	ND	ND	ND	ND	842	1203	7.17	309	0.0763
	6/15/2007	ND	ND	ND	0.002	ND	ND	802	1150	7.55	276	0.110
	Average	0.00003	0.002	0.02	0.002	ND	0.03	827	1155	7.42	292.50	0.08
	Max	0.00003	0.002	0.02	0.002	ND	0.03	842	1203	7.55	309.00	0.11
	Min	ND	ND	ND	ND	ND	ND	802	1113	7.17	276.00	0.06
1808	6/26/79	ND	ND	ND	ND	ND	0.02	573	800	7.20	0.6	-
	9/27/79	ND	ND	ND	ND	ND	0.02	570	789	6.45	-	-
	12/15/79	ND	ND	ND	ND	ND	0.08	608	813	7.65	-	-
	4/2/80	ND	ND	ND	ND	ND	ND	684	986	8.20	-	-
	5/3/2007	ND	ND	ND	0.003	ND	ND	602	976	8.10	9.1	0.0012
	6/19/2007	ND	ND	ND	0.001	ND	ND	638	916	7.38	4.9	0.0005
	Average	ND	ND	ND	0.002	ND	0.04	613	880	7.50	4.87	0.00
	Max	ND	ND	ND	0.003	ND	0.08	684	986	8.20	9.10	0.00
	Min	ND	ND	ND	ND	ND	ND	570	789	6.45	0.60	0.00
8-3	6/28/79	ND	ND	ND	ND	ND	0.05	1460	1610	6.85	0.6	71
	9/27/79	ND	ND	ND	ND	ND	0.02	1426	1660	6.50	-	-
	12/6/79	ND	ND	ND	ND	ND	0.01	1566	1680	7.75	-	-
	4/9/80	ND	ND	ND	ND	ND	-	1398	1750	7.10	-	-
	5/2/2007	ND	ND	ND	ND	ND	ND	2270	2740	6.93	0.8	0.002
	6/13/2007	ND	ND	ND	ND	ND	ND	2380	2660	7.13	1.2	0.0016
	Average	ND	ND	ND	ND	ND	0.02	1750	2017	7.04	0.87	23.67
	Max	ND	ND	ND	ND	ND	0.05	2380	2740	7.75	1.20	71.00
	Min	ND	ND	ND	ND	ND	ND	1398	1610	6.50	0.60	0.00

Historic Monitoring
Current Monitoring

Table 3.4.3-16 Comparison of Moore Ranch Monitoring Results to Water Quality Standards

	MAJOR CATIONS/ANIONS											
	Na	**K**	**Ca**	**Mg**	**Cl**	**HC03**	**CO3**	**SO4**	**NH4**	**NO2+NO3 (N)**	**F**	**SiO2**
WYO Class I Standard	NA	NA	NA	NA	250	NA	NA	250	0.5	NA[3]	4	NA
EPA MCL	NA	NA	NA	NA	NA[1]	NA	NA	NA[2]	NA	NA[3]	4	NA
All Aquifers (68, 70 and 72)												
Number of Samples	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*
Average	37.8	12.2	115.4	28.4	2.7	227.8	1.5	315.2	0.2	0.4	0.2	11.8
Max	81	26	250	84	6	327	7	743	1	3.7	0.4	17.7
Min	11	4.5	32	1	1	45	0.5	79	0.05	0.025	0.05	3.4
No. Samples> WDEQ Class I	NA	NA	NA	NA	0	NA	NA	**12**	**5**		0	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA
68 Sand Monitor Wells												
Number of Samples	5	5	5	5	5	5	5	5	5	5	5	5
Average	65.8	13.4	53.6	6.2	2.4	225.3	2.0	163.6	0.1	0.5	0.3	12.3
Max	81	17	73	8	5	246	4	212	0.21	0.8	0.3	17.7
Min	50	10	32	1	1	210	1	133	0.05	0.1	0.2	8.9
No. Samples> WDEQ Class I	NA	NA	NA	NA	0	NA	NA	0	**0**	0	0	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA
70 Sand Monitor Wells												
Number of Samples	17*	17*	17*	17*	17*	17*	17*	17*	17*	17*	17*	17*
Average	33.6	9.6	122.9	31.0	2.2	248.1	0.9	312.9	0.1	0.3	0.2	12.4
Max	62.0	15.0	194.0	56.0	5.0	305.0	1.0	600.0	0.5	1.5	0.4	14.3
Min	11.0	4.5	72.0	15.0	1.0	147.0	0.5	121.0	0.1	0.0	0.1	9.9
No. Samples> WDEQ Class I	NA	NA	NA	NA	0	NA	NA	**8**	0	0	0	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA
72 Sand Monitor Wells												
Number of Samples	8	8	8	8	8	8	8	8	8	8	8	8
Average	34.0	16.9	129.8	33.8	3.9	187.4	2.3	395.6	0.4	0.6	0.2	10.3
Max	72.0	26.0	250.0	84.0	6.0	327.0	7.0	743.0	1.0	3.7	0.2	14.2
Min	19.0	10.0	53.0	9.0	2.0	45.0	1.0	79.0	0.2	0.1	0.1	3.4
No. Samples> WDEQ Class I	NA	NA	NA	NA	0	NA	NA	**4**	**3**		0.0	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0	NA

Table 3.4.3-16 Comparison of Moore Ranch Monitoring Results to Water Quality Standards

	TRACE METALS															
	Al	As	Ba	B	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Mo	Ni	Se	V	Zn
WYO Class I Standard	NA	0.050	2	0.75	0.005	0.1	1	0.3	0.015	0.05	0.002	NA	NA	0.05	NA	5
EPA MCL	NA[4]	0.010	2	NA	0.005	0.1	NA[5]	NA[6]	0.015	NA[7]	0.002	NA	NA	0.05	NA	NA[8]
All Aquifers (68, 70 and 72)																
Number of Samples	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*
Average	0.10	0.002	0.10	0.10	0.005	0.05	0.03	0.12	0.002	0.04	0.00	0.10	0.05	0.05	0.10	0.01
Max	0.1	0.0045	0.1	0.1	0.005	0.05	0.1	0.85	0.018	0.22	0.001	0.1	0.05	0.527	0.1	0.02
Min	0.1	0.001	0.1	0.1	0.005	0.05	0.01	0.03	0.001	0.01	0.001	0.1	0.05	0.001	0.1	0.01
No. Samples> WDEQ Class I	NA	0	0	0	0	0	0	**3**	**1**	**3**	0	NA	NA	**7**	NA	0
No. Samples> MCL	0	0	0	NA	0	0	0	NA	0	NA	0	NA	NA	**7**	NA	0
68 Sand Monitor Wells																
Number of Samples	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Average	0.100	0.002	0.100	0.100	0.005	0.050	0.014	0.086	0.005	0.016	0.001	0.100	0.050	0.191	0.100	0.010
Max	0.100	0.005	0.100	0.100	0.005	0.050	0.030	0.310	0.018	0.030	0.001	0.100	0.050	0.402	0.100	0.010
Min	0.100	0.001	0.100	0.100	0.005	0.050	0.010	0.030	0.001	0.010	0.001	0.100	0.050	0.052	0.100	0.010
No. Samples> WDEQ Class I	NA	0	0	0	0	0	0	**1**	**1**	0	0	NA	NA	**5**	NA	0
No. Samples> MCL	0	0	0	NA	0	0	0	NA	0	NA	0	NA	NA	**5**	NA	0
70 Sand Monitor Wells																
Number of Samples	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Average	0.100	0.001	0.100	0.100	0.005	0.050	0.010	0.138	0.002	0.030	0.001	0.100	0.050	0.041	0.100	0.011
Max	0.1	0.002	0.1	0.1	0.005	0.05	0.01	0.85	0.011	0.06	0.001	0.1	0.05	0.527	0.1	0.02
Min	0.1	0.001	0.1	0.1	0.005	0.05	0.01	0.03	0.001	0.01	0.001	0.1	0.05	0.001	0.1	0.01
No. Samples> WDEQ Class I	NA	0	0	0	0	0	0	**1**	0	**1**	0	NA	NA	**2**	NA	0
No. Samples> MCL	0	0	0	NA	0	0	0	NA	0	NA	0	NA	NA	**2**	NA	0
72 Sand Monitor Wells																
Number of Samples	8	8	8	8	8	8	8	8	8	8	8	8				
Average	0.100	0.002	0.100	0.100	0.005	0.050	0.100	0.078	0.001	0.058	0.001	0.100	0.050	0.002	0.100	0.010
Max	0.1	0.003	0.1	0.1	0.005	0.05	0.1	0.41	0.001	0.22	0.001	0.1	0.05	0.003	0.1	0.01
Min	0.1	0.001	0.1	0.1	0.005	0.05	0.1	0.03	0.001	0.01	0.001	0.1	0.05	0.001	0.1	0.01
No. Samples> WDEQ Class I	NA	0	0	0	0	0	0	**1**	0	**2**	0	NA	NA	0	NA	0
No. Samples> MCL	0	0	0	NA	0	0	0	NA	0	NA	0	NA	NA	0	NA	0

Table 3.4.3-16 Comparison of Moore Ranch Monitoring Results to Water Quality Standards

	General Water Quality Parameters			Radionuclides												
	TDS	Conduct.	pH (units)	Gross Alpha	Gross Beta	Pb-210	Po-210	Ra-226	Ra-228	Th-230	U	Pb-210 (sus.)	Po-210 (sus.)	Ra-226 (sus.)	Th-230 (sus.)	U (sus.)
WYO Class I Standard	500	NA	6.5-8.5	15*	NA	NA	NA	5[a]	5[a]	NA	NA	NA	NA	NA	NA	NA
EPA MCL	NA[9]	NA	NA[10]	NA*	NA	NA	NA	5[a]	5[a]	NA	0.03	NA	NA	NA	NA	NA
All Aquifers (68, 70 and 72)																
Number of Samples	31*	31*	31*	15	15	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*	31*
Average	647.1	924.2	7.68	195.83	65.19	7.44	5.48	57.01	2.01	0.26	0.1052	11.30	11.18	0.79	0.23	0.0003
Max	1350.0	1700.0	11.00	1050.00	327.00	69.00	51.00	309.00	9.50	1.00	0.8840	270.00	290.00	9.30	1.00	0.0003
Min	266.0	527.0	3.73	1.80	8.60	1.00	1.00	0.20	1.00	0.20	0.0008	1.00	1.00	0.20	0.20	0.0003
No. Samples> WDEQ Class I	**16**	NA	**4**	11	NA	NA	NA	**15**	**2**	NA	NA	NA	NA	NA	NA	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	**15**	**2**	NA	**19**	NA	NA	NA	NA	NA
68 Sand Monitor Wells																
Number of Samples	5	5	5	2	2	5	5	5	5	5	5	5	5	5	5	5
Average	408.4	672.6	8.634	68.35	27.60	1.00	1.16	0.82	1.46	0.20	0.069	1	1	0.2	0.2	0.0003
Max	528	794	11	83.30	36.80	1.00	1.80	1.00	3.30	0.20	0.112	1	1	0.2	0.2	0.0003
Min	266	552	7.81	53.40	18.40	1.00	1.00	0.60	1.00	0.20	0.019	1	1	0.2	0.2	0.0003
No. Samples> WDEQ Class I	**1**	NA	**1**	**2**	NA	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	0	0	NA	**4**	NA	NA	NA	NA	NA
70 Sand Monitor Wells																
Number of Samples	17*	17*	17*	9	9	17*	17*	17*	17*	17*	17*	17*	17*	17*	17*	17*
Average	653.8	949.6	7.17	309.14	96.18	11.73	8.43	94.34	1.89	0.26	0.1594	18.17	17.96	1.19	0.24	0.0003
Max	1090.0	1450.0	8.10	1050.00	327.00	69.00	51.00	309.00	5.90	0.90	0.8840	270.00	290.00	9.30	1.00	0.0003
Min	352.0	533.0	3.73	8.50	6.80	1.00	1.00	0.20	1.00	0.20	0.0053	1.00	1.00	0.20	0.20	0.0003
No. Samples> WDEQ Class I	**11**	NA	0	9	NA	NA	NA	12	1	NA	NA	NA	NA	NA	NA	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	12	1	NA	**15**	NA	NA	NA	NA	NA
72 Sand Monitor Wells																
Number of Samples	8	8	8	4	4	8	8	8	8	8	8	8	8	8	8	8
Average	750.3	997.5	8.27	4.60	14.25	1.00	1.00	1.10	2.60	0.30	0.0016	1.00	1.00	0.20	0.20	0.0003
Max	1350.0	1700.0	9.20	9.60	20.40	1.00	1.00	2.00	9.50	1.00	0.0027	1.00	1.00	0.20	0.20	0.0003
Min	314.0	527.0	7.30	1.80	8.60	1.00	1.00	0.20	1.00	0.20	0.0008	1.00	1.00	0.20	0.20	0.0003
No. Samples> WDEQ Class I	**4**	NA	**3**	0	NA	NA	NA	0	1	NA	NA	NA	NA	NA	NA	NA
No. Samples> MCL	NA	NA	NA	NA	NA	NA	NA	0	1	NA	0	NA	NA	NA	NA	NA

Table 3.4.3-16 Comparison of Moore Ranch Monitoring Results to Water Quality Standards

*One sample from PW-1 was not consistent with sample results from other wells and one other sample collected from PW-1. The results from that sample analysis were not included in the totals
Samples that were below detection were valued at the detection limit for purposes of calculating the average.
All samples were reported as non-detect for Al, Ba, B, Cd, Cr, Cu, Hg, Mo, Ni and V.

1 - EPA Secondary Drinking Water Standard for chloride is 250.0 mg/l
2 - EPA Secondary Drinking Water Standard for sulfate is 250 mg/l
3 - WDEQ Class I and EPA MCL standards for Nitrate (as N) and Nitrite (as N) are 10 mg/l and 1 mg/l respectively. Only two samples exceeded the lower 1.0 mg/l standard.
4 - EPA Secondary Drinking Water Standard for aluminum is 0.05 to 2.0 mg/l
5 - EPA Secondary Drinking Water Standard for copper is1.0 mg/l
6 - EPA Secondary Drinking Water Standard for iron is 0.3 mg/l
7 - EPA Secondary Drinking Water Standard for manganese is 0.05 mg/l
8 - EPA Secondary Drinking Water Standard for zinc is 5.0 mg/l
9 - EPA Secondary Drinking Water Standard for TDS is 500 mg/l
10 - EPA Secondary Drinking Water Standard for pH is 6.5 to 8.5 s.u.
[a] - Radium standards are for combined Ra226 +228. Only one sample exceeded the standard based soley on the Radium 228 concentration.
All other samples that exceeded the combined standard did so based solely on the Ra226 concentration.

ERA	SYSTEM, SERIES AND OTHER SUBDIVISIONS		STRATIGRAPHIC UNIT	HYDROGEOLOGIC UNIT
Cenozoic	Quaternary		Alluvium	**Not Included As An Aquifer System**
	Tertiary — Pliocene, Miocene	Upper	(Absent in Powder River Basin)	
	Tertiary — Oligocene	Lower	White River Formation	
	Tertiary — Eocene		Wasatch Formation	**Lower Tertiary Aquifers**
	Tertiary — Paleocene		Fort Union Formation	
	Cretaceous		Lance Formation	**Upper Cretaceous Aquifers**
			Fox Hills Sandstone	
		Upper	Lewis Shale	**Confining Unit**
Mesozoic			Mesaverde Formation*	
			Steele Shale	
			Cody Shale	
			Frontier Formation*	
			Mowry Shale	
			Muddy Sandstone*	
			Thermopolis Shale	
		Lower	Inyan Kara Group — Fall River Formation	**Lower Cretaceous Aquifers**
			Inyan Kara Group — Lakota Formation	
			Morrison Formation	**Confining Unit**
	Jurassic		Sundance Formation*	
			Gyspsum Spring Formation	
	Triassic		Chugwater Formation	
	Permian		Goose Egg Formation	
Paleozoic	Pennsylvanian		Tensleep Sandstone / Minnelusa Formation	**Upper Paleozoic Aquifers**
			Amsden Formation	
	Mississippian		Madison Formation	

* Can be a local source of groundwater where permeable

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Figure 3.4.3-1
Regional Hydrostratigraphic Section
Northern Great Plains Aquifer System,
Powder River Basin (after USGS

Project: 312-7	Date: September 2007	
Figure 2.7.2-1.mxd	By: JLM	Checked: KC

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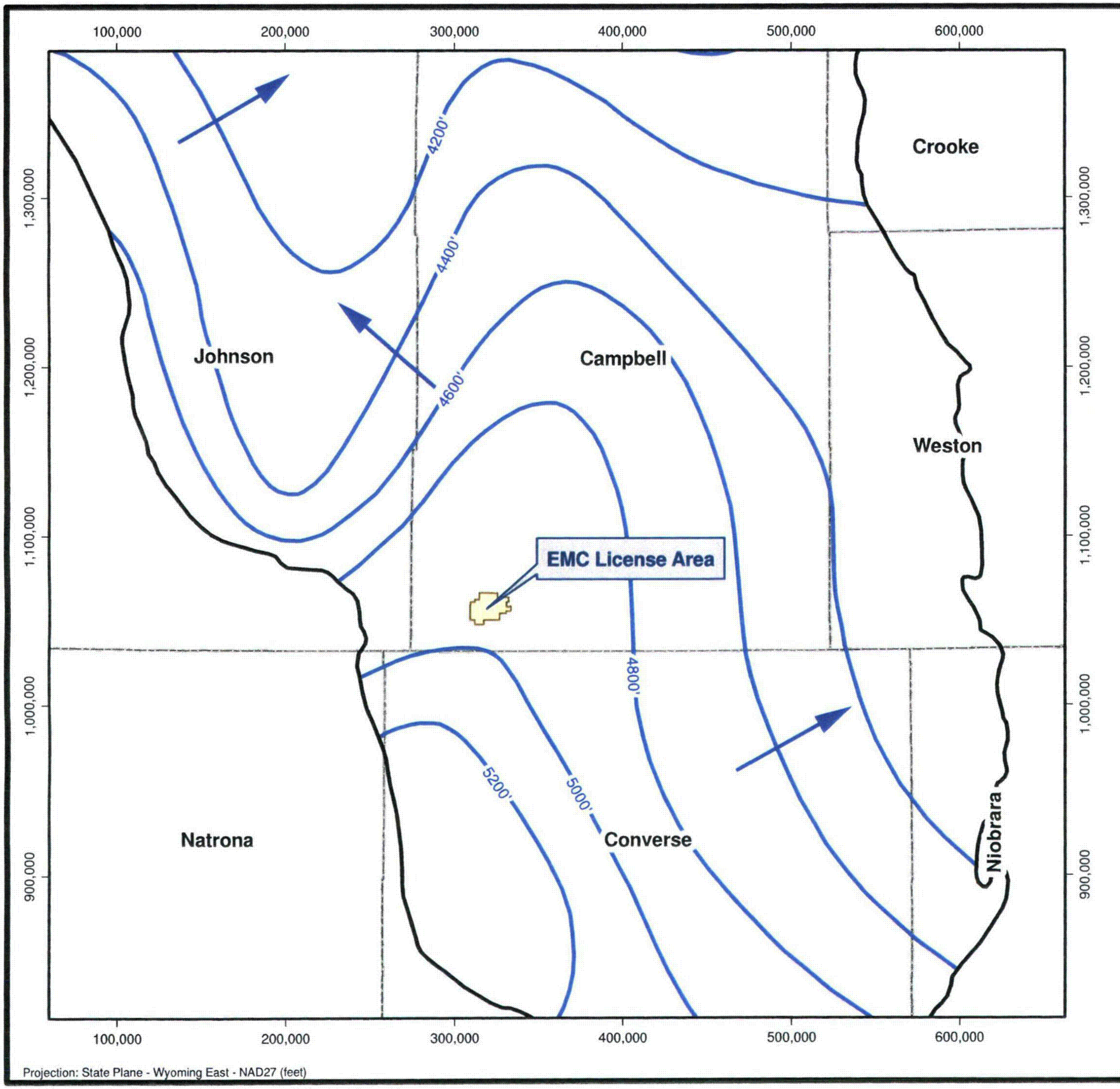

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Figure 3.4.3-2
Potentiometric Surface Lower Tertiary Units, after D. Lobmeyer, 1985

Project: 312-7	Date: September 2007
Figure 2.7.2-2.mxd	By: JLM Checked: KC

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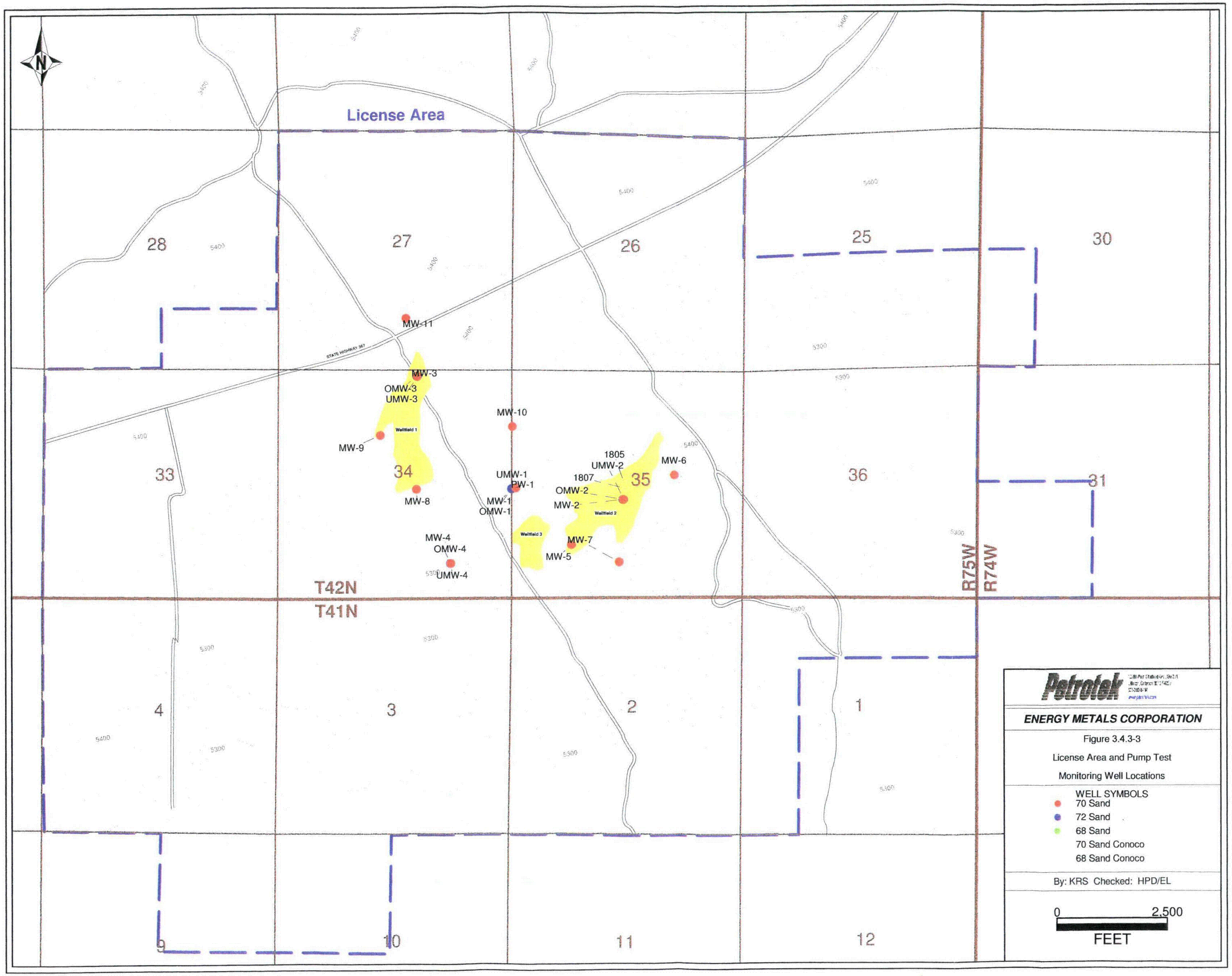

N
License Area
28
27
26
25
30
33
34
35
36
31
4
3
2
1
9
10
11
12
T42N
T41N
R75W
R74W
MW-11
MW-3
OMW-3
UMW-3
MW-9
MW-8
MW-10
UMW-1
PW-1
MW-1
OMW-1
1805
UMW-2
1807
OMW-2
MW-2
MW-6
MW-7
MW-5
MW-4
OMW-4
UMW-4
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Figure 3.4.3-3
License Area and Pump Test
Monitoring Well Locations
WELL SYMBOLS
70 Sand
72 Sand
68 Sand
70 Sand Conoco
68 Sand Conoco
By: KRS Checked: HPD/EL
0
2,500
FEET

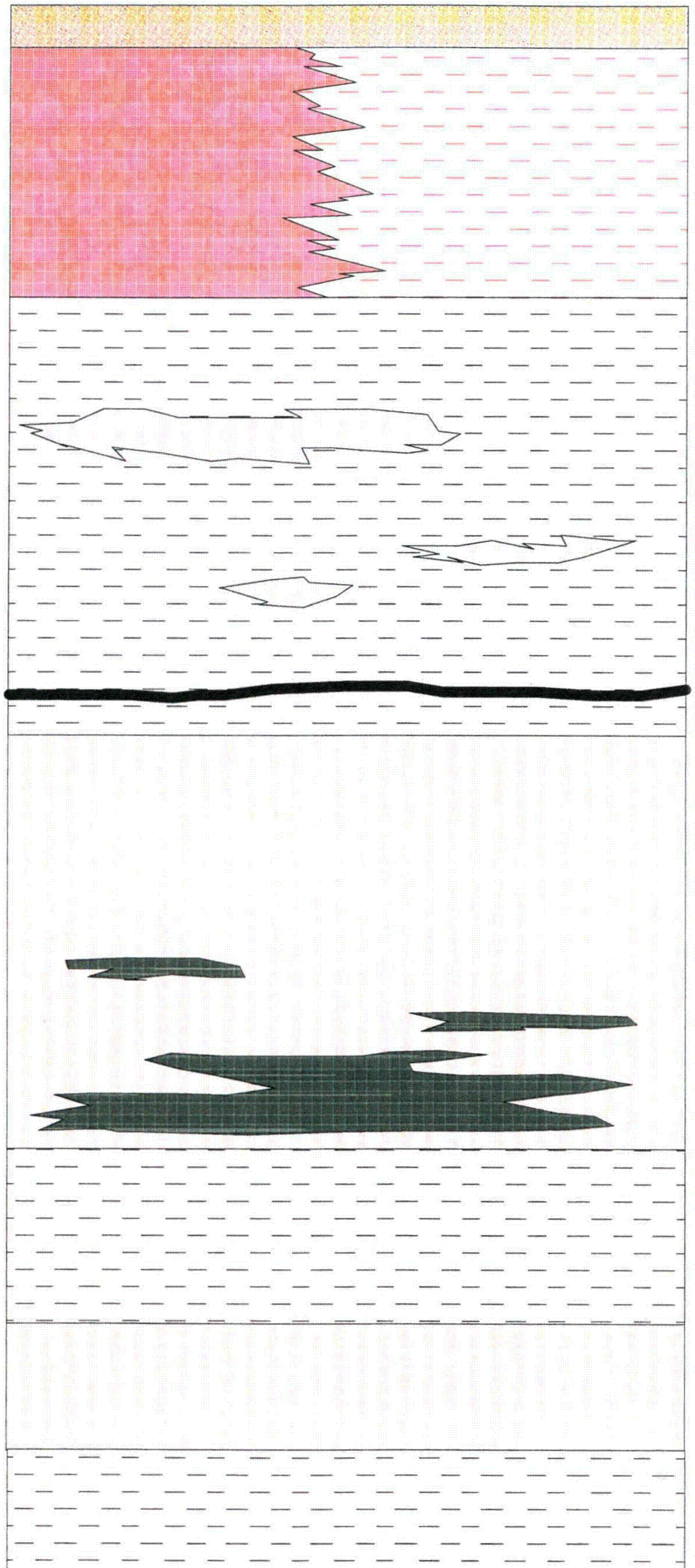

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Figure 3.4.3-4
Moore Ranch Generalized Stratigraphic Section

Project: 312-4-3	Date: September 2007
Dwg: EMC TR Fig 2.7.2-4.SRF	By: KRS Checked: HPD

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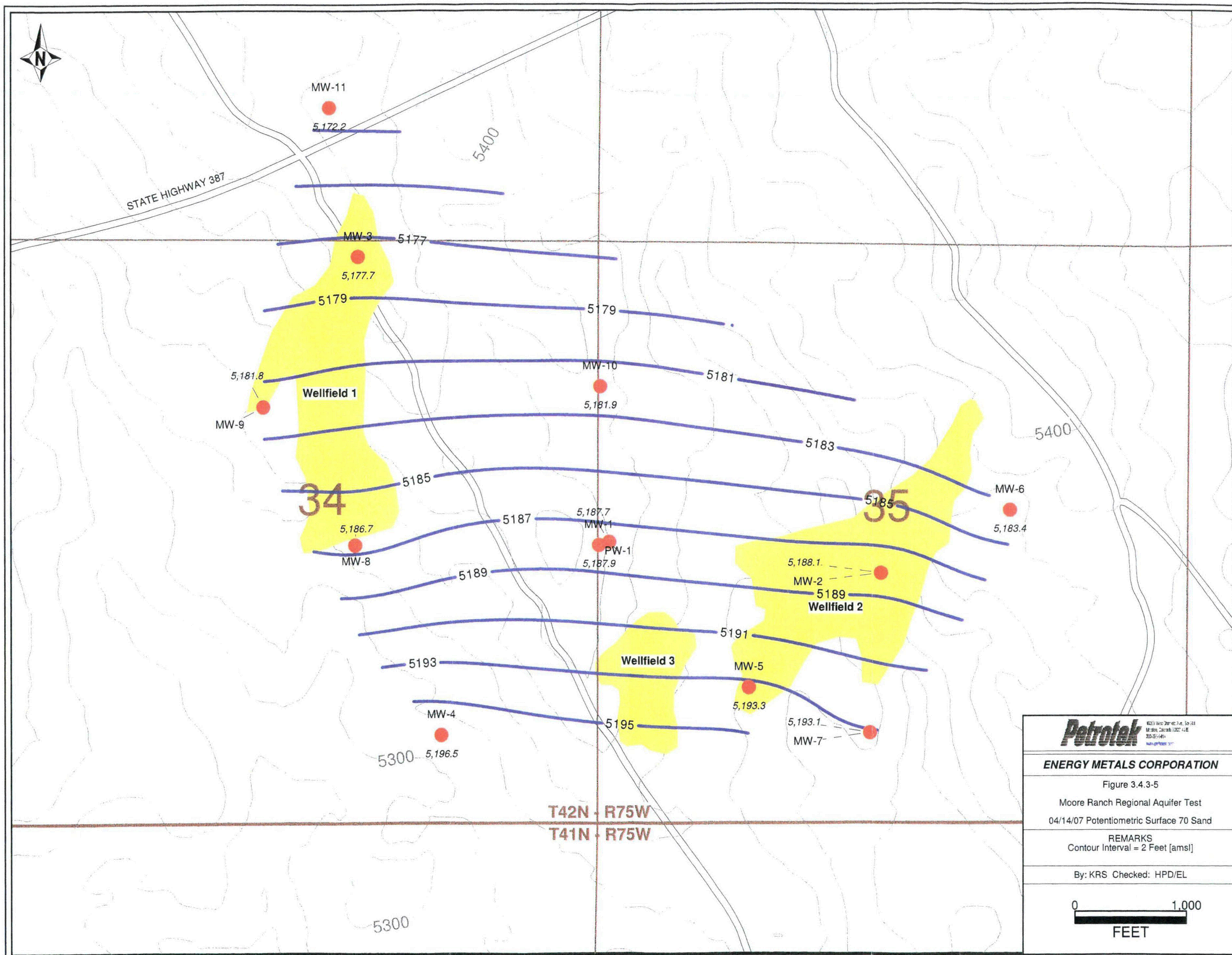

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Figure 3.4.3-5

Moore Ranch Regional Aquifer Test

04/14/07 Potentiometric Surface 70 Sand

REMARKS
Contour Interval = 2 Feet [amsl]

By: KRS Checked: HPD/EL

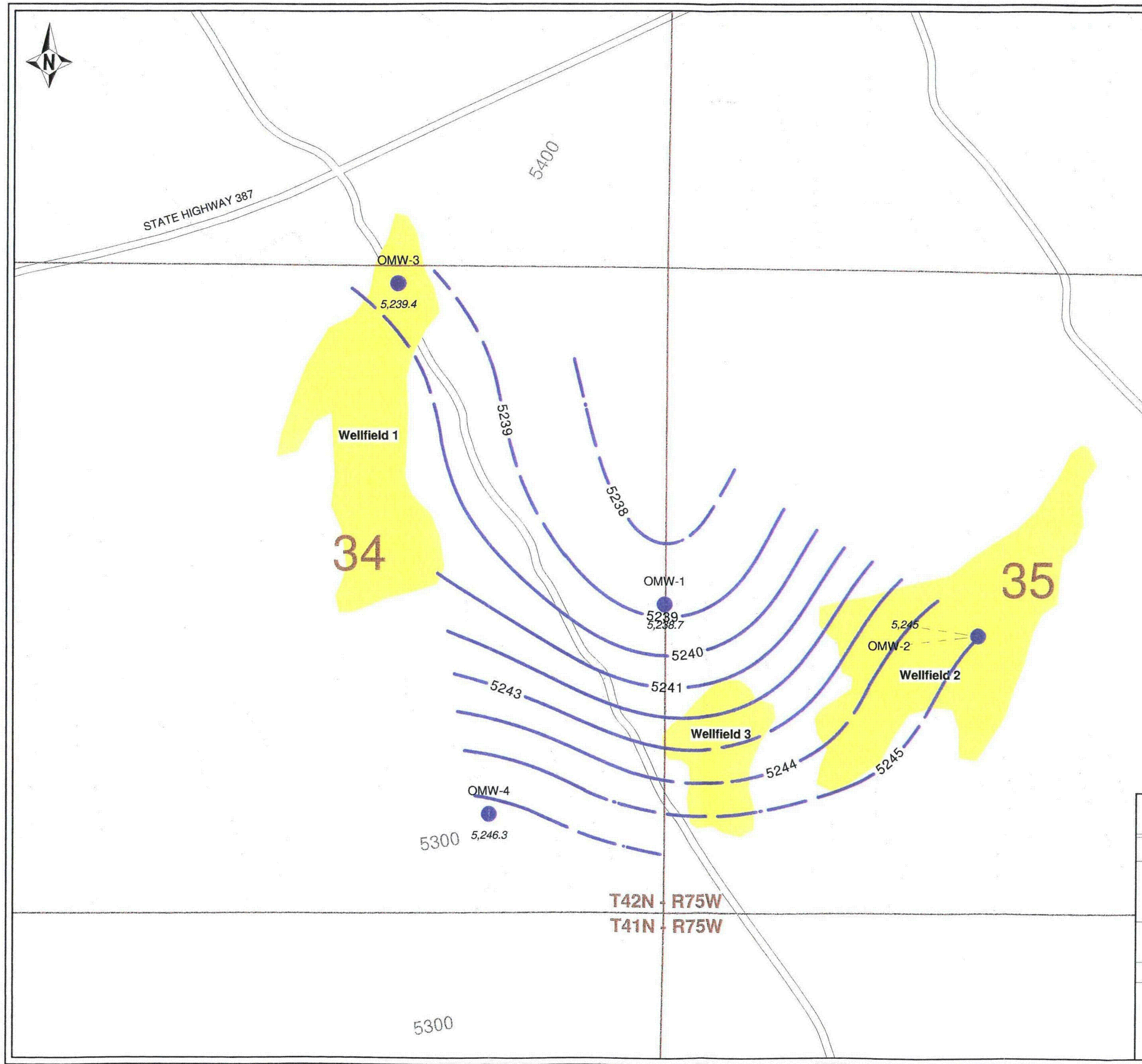

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Figure 3.4.3-6

Moore Ranch Regional Aquifer Test

04/14/07 Potentiometric Surface 72 Sand

REMARKS
Contour Interval = 1 Feet [amsl]

By: KRS Checked: HPD/EL

0 1,000
FEET

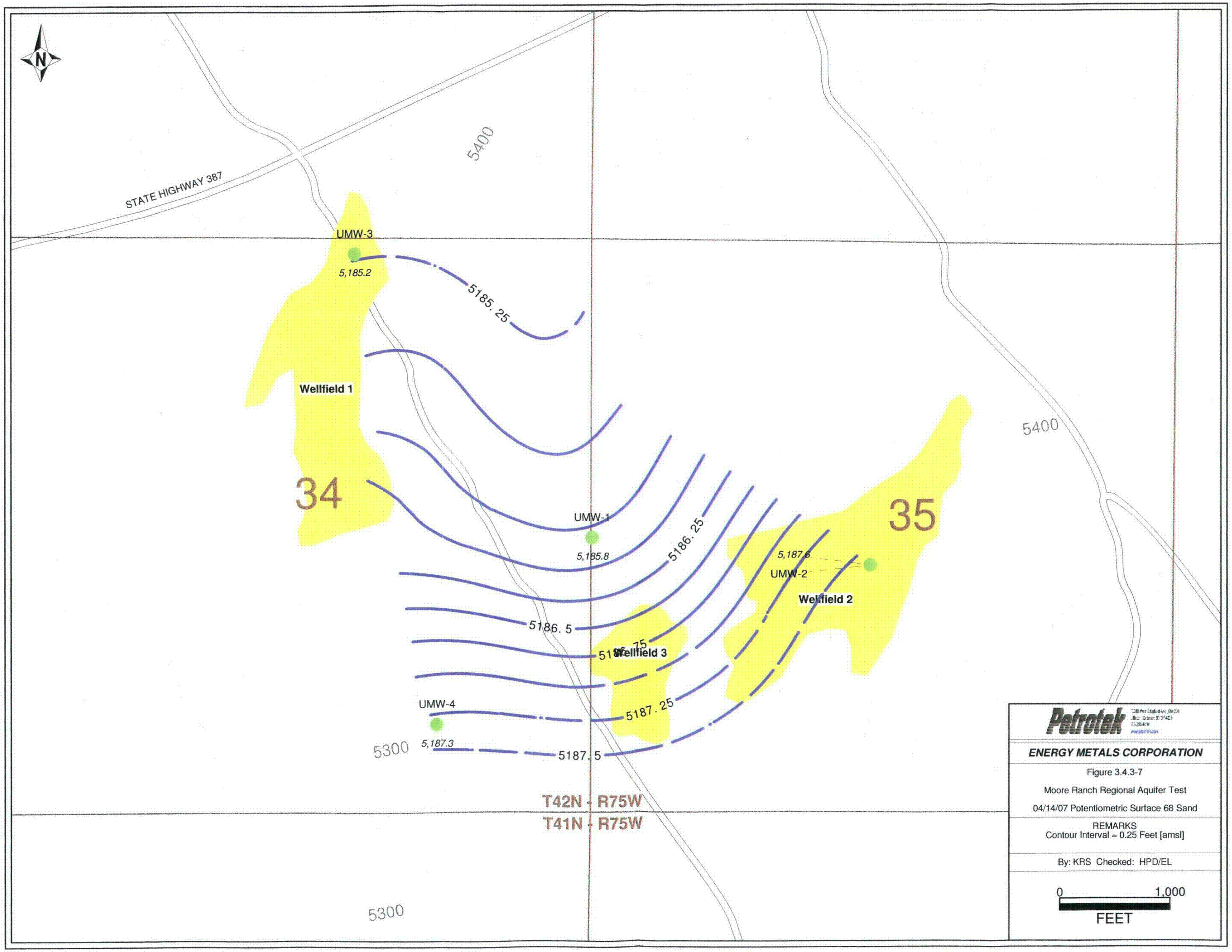

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Figure 3.4.3-7

Moore Ranch Regional Aquifer Test

04/14/07 Potentiometric Surface 68 Sand

REMARKS
Contour Interval = 0.25 Feet [amsl]

By: KRS Checked: HPD/EL

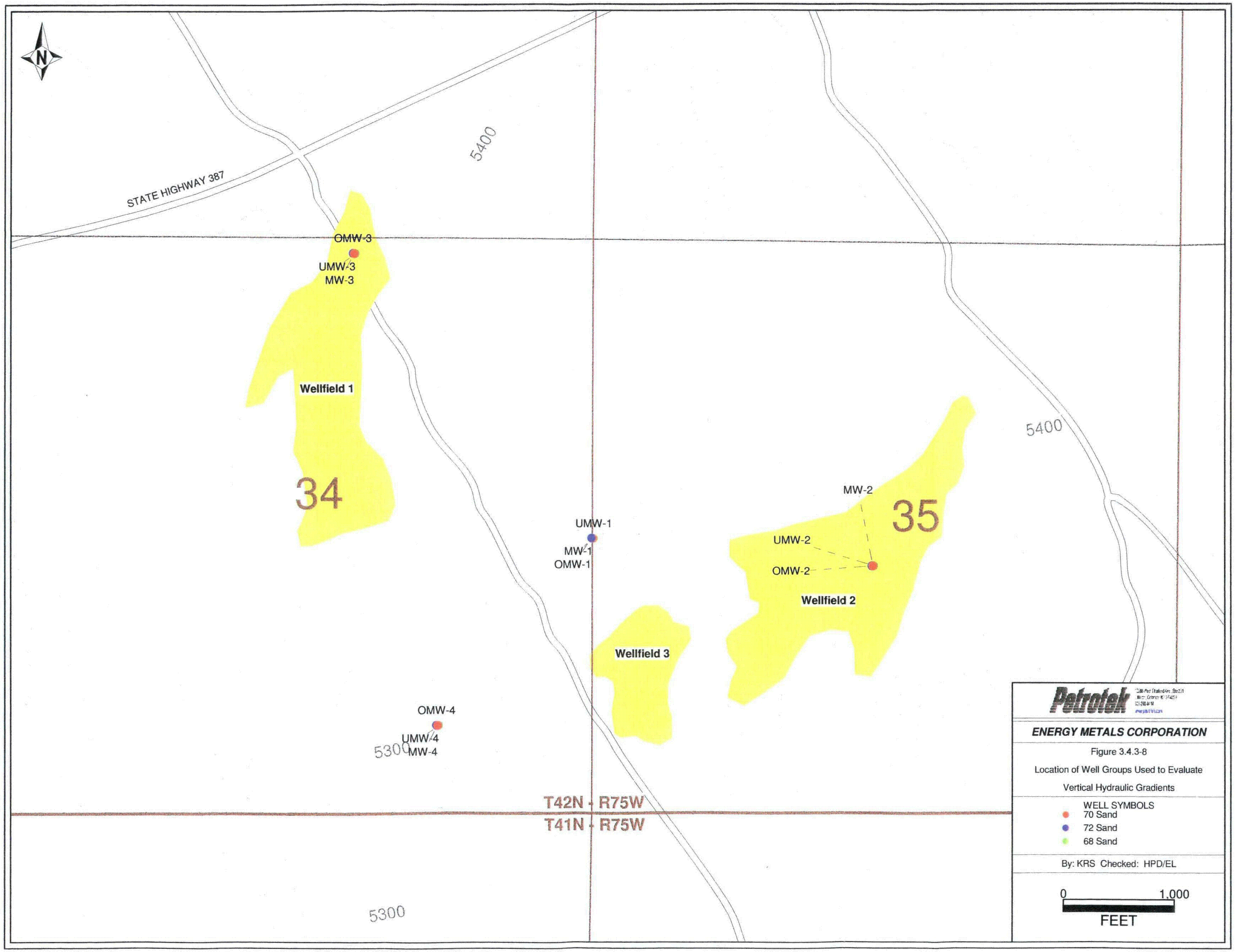
N
STATE HIGHWAY 387
5400
5400
5300
5300
OMW-3
UMW-3
MW-3
Wellfield 1
34
UMW-1
MW-1
OMW-1
MW-2
35
UMW-2
OMW-2
Wellfield 2
Wellfield 3
OMW-4
UMW-4
MW-4
T42N - R75W
T41N - R75W
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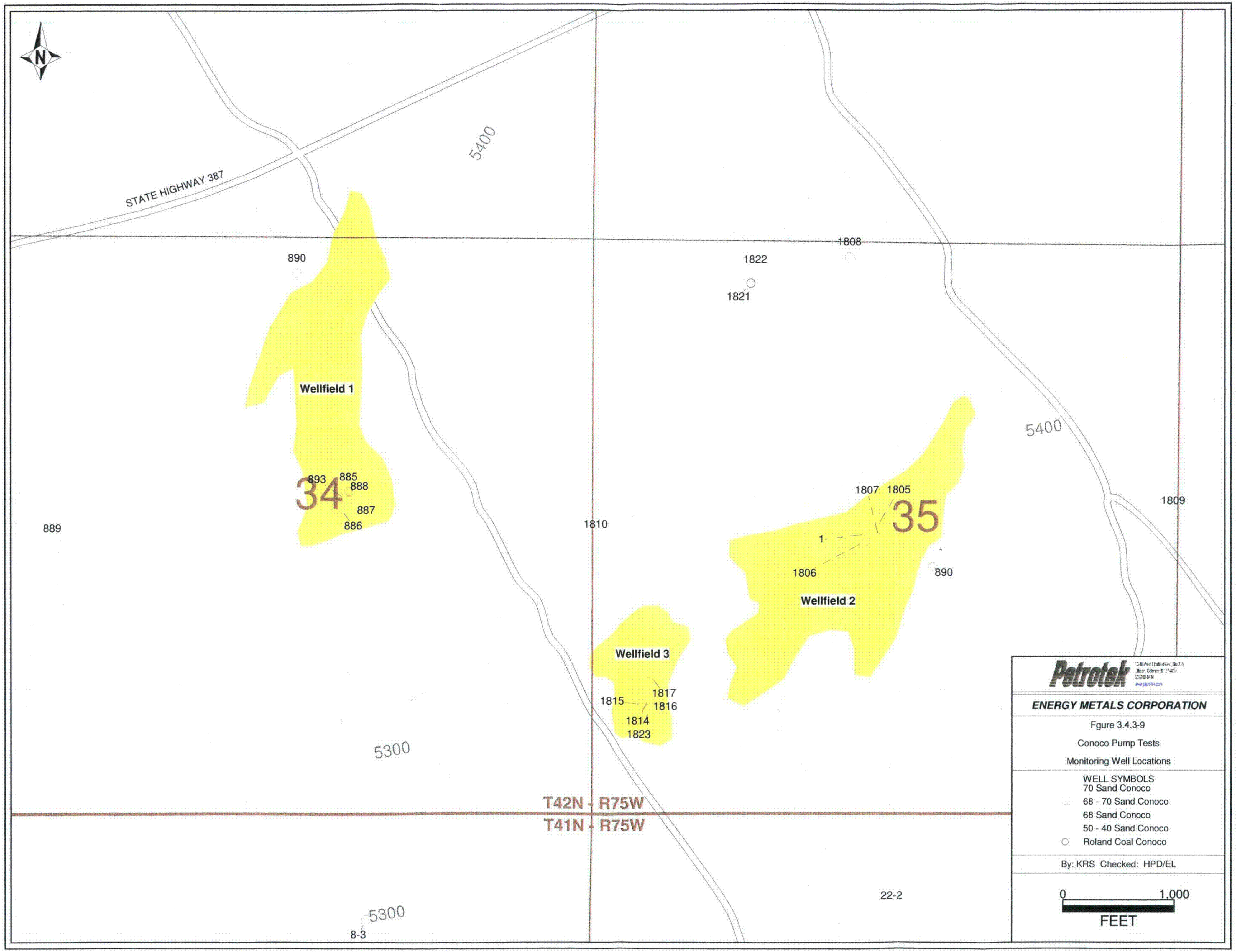
Figure 3.4.3-8
Location of Well Groups Used to Evaluate
Vertical Hydraulic Gradients
WELL SYMBOLS
70 Sand
72 Sand
68 Sand
By: KRS Checked: HPD/EL
0
1,000
FEET



N
STATE HIGHWAY 387
5400
890
1808
1822
1821
Wellfield 1
893
885
888
34
887
886
889
1810
1807
1805
35
1809
5400
1
1806
890
Wellfield 2
Wellfield 3
1815
1817
1816
1814
1823
5300
T42N - R75W
T41N - R75W
5300
8-3
22-2
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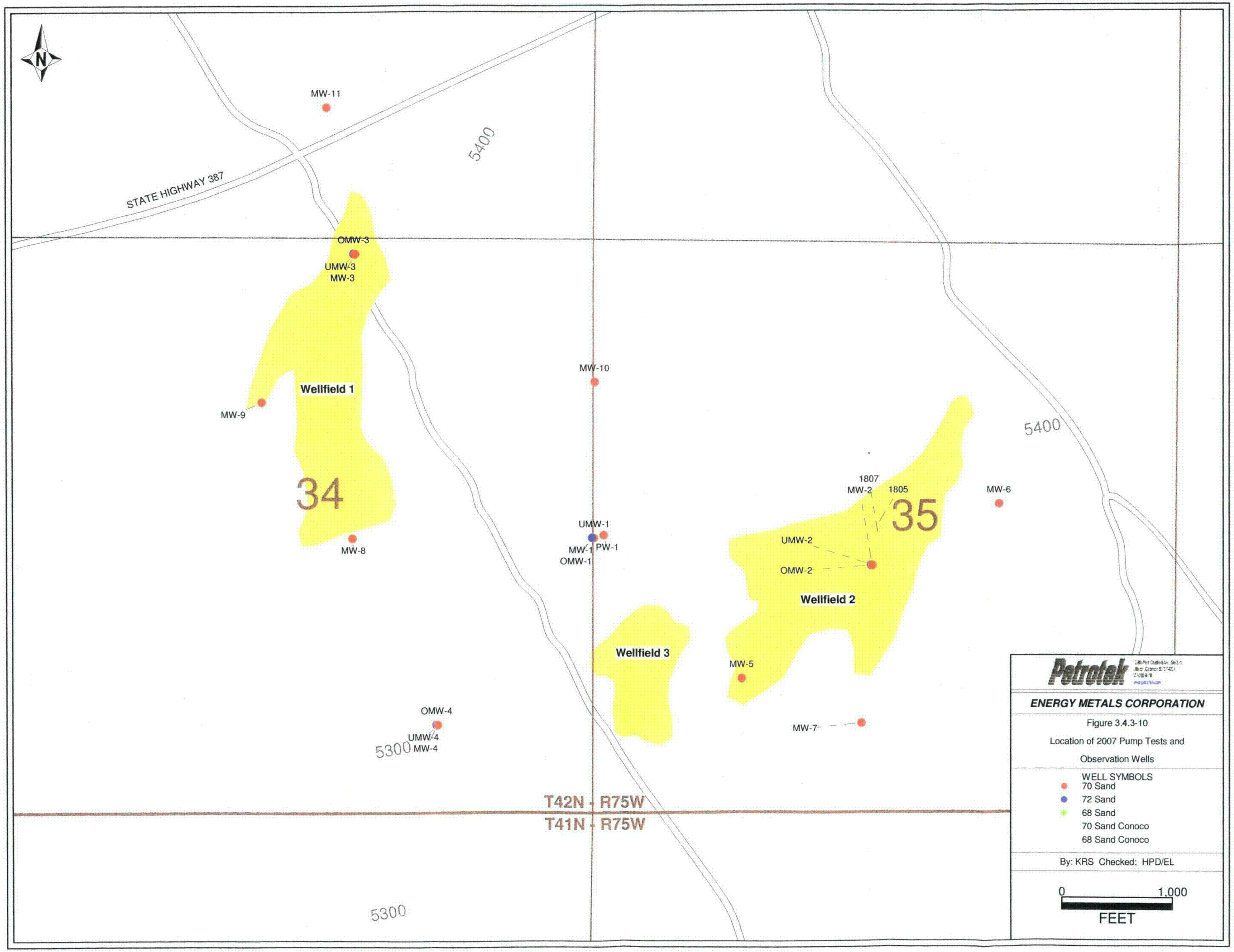
Fgure 3.4.3-9
Conoco Pump Tests
Monitoring Well Locations
WELL SYMBOLS
70 Sand Conoco
68 - 70 Sand Conoco
68 Sand Conoco
50 - 40 Sand Conoco
Roland Coal Conoco
By: KRS Checked: HPD/EL
0
1,000
FEET



N
STATE HIGHWAY 387
MW-11
5400
OMW-3
UMW-3
MW-3
Wellfield 1
MW-9
34
MW-8
MW-10
UMW-1
MW-1
PW-1
OMW-1
Wellfield 3
1807
MW-2
1805
35
MW-6
5400
UMW-2
OMW-2
Wellfield 2
MW-5
MW-7
OMW-4
UMW-4
MW-4
5300
T42N - R75W
T41N - R75W
5300
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Figure 3.4.3-10
Location of 2007 Pump Tests and Observation Wells
WELL SYMBOLS
70 Sand
72 Sand
68 Sand
70 Sand Conoco
68 Sand Conoco
By: KRS Checked: HPD/EL
0
1,000
FEET

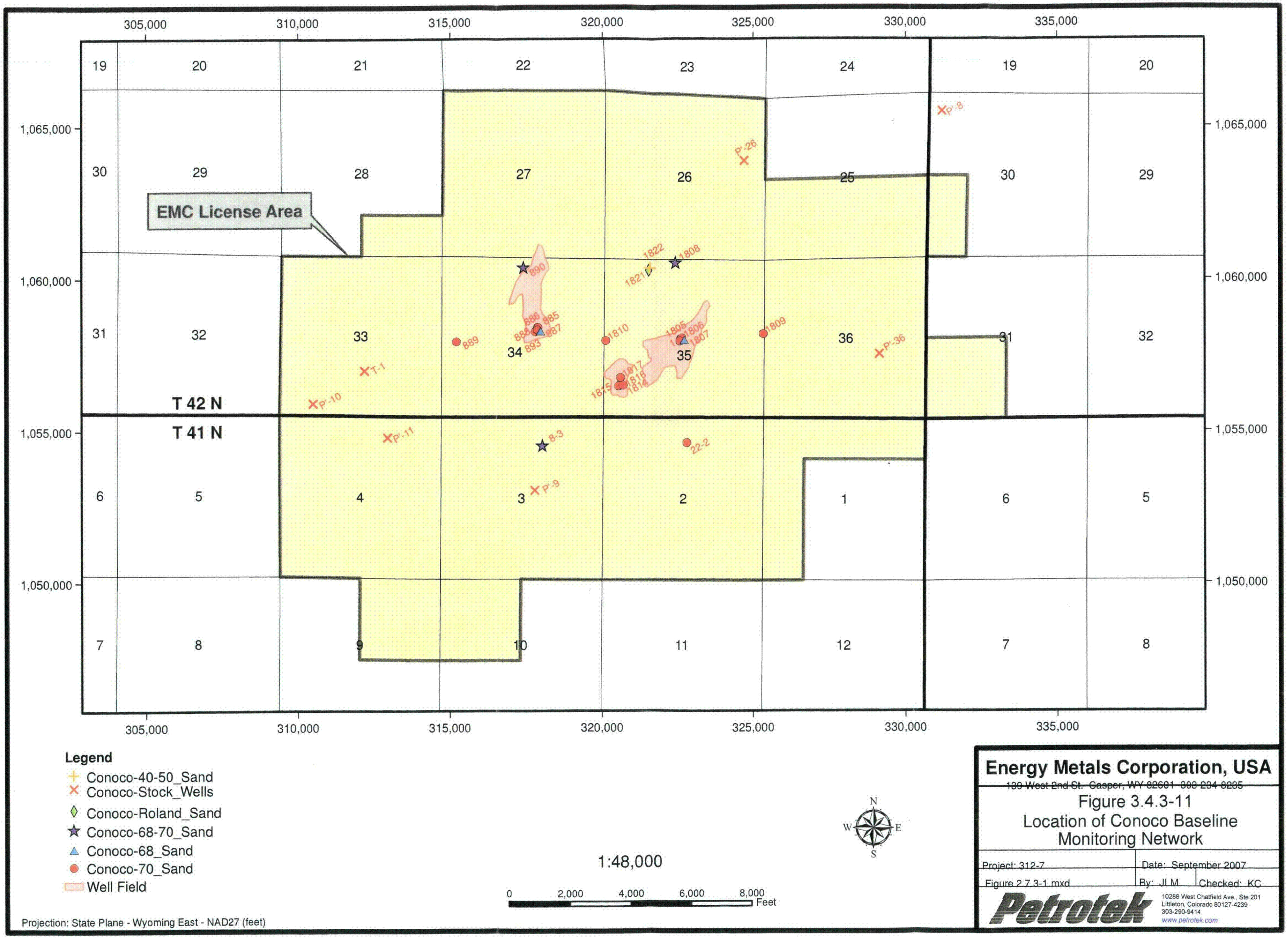
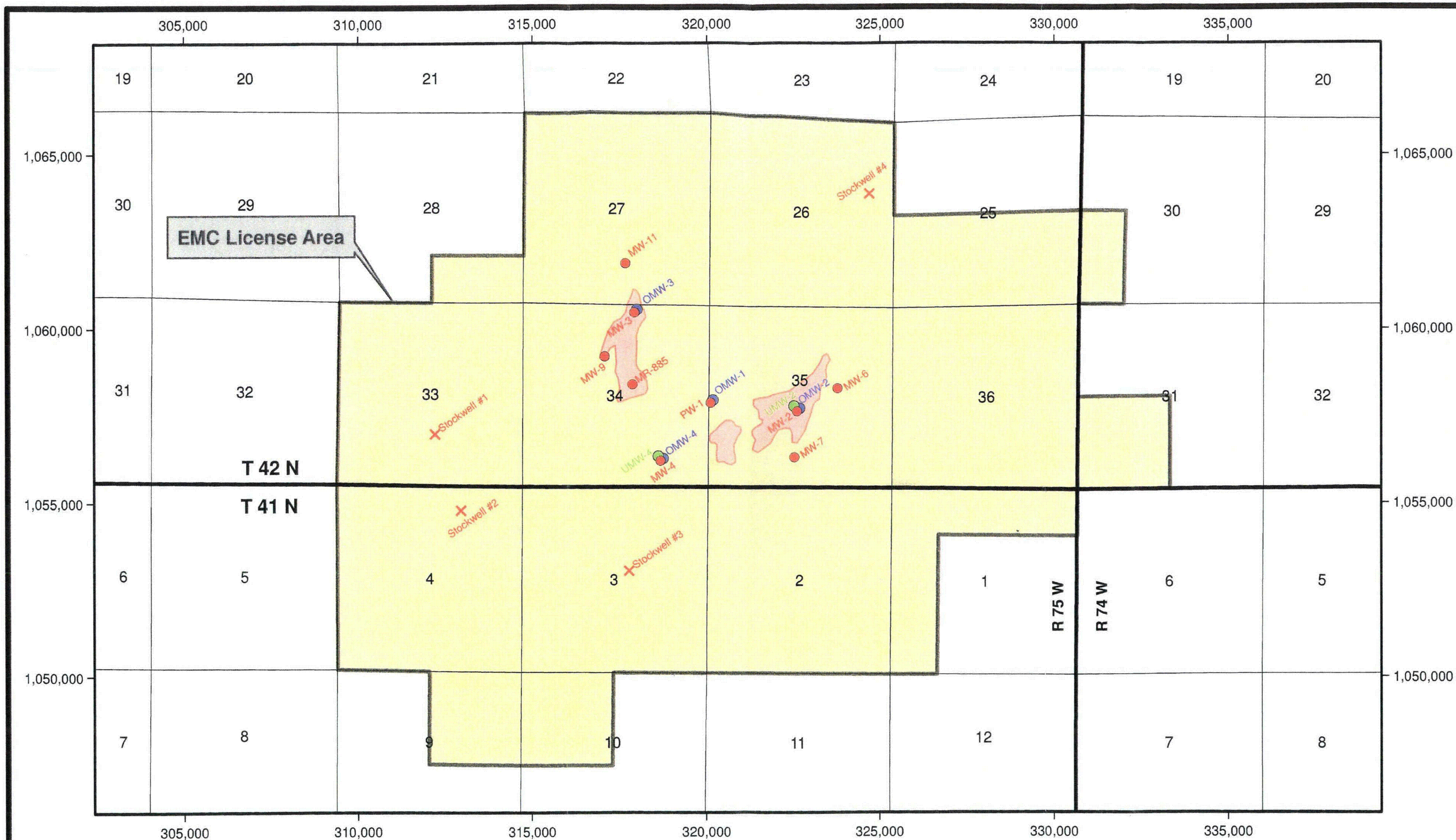


Figure 3.4.3-11
Location of Conoco Baseline Monitoring Network



Legend

- Production Zone (70 Sand)
- Underlying Aquifer (68 Sand)
- Overlying Aquifer (72 Sand)
- Private Well
- Well Field

1:48,000

0 2,000 4,000 6,000 8,000 Feet

Projection: State Plane - Wyoming East - NAD27 (feet)

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Figure 3.4.3-12
Location of EMC Baseline
Monitoring Network

Project: 312-7	Date: September 2007
Figure 2.7.3-2.mxd	By: JLM Checked: KC

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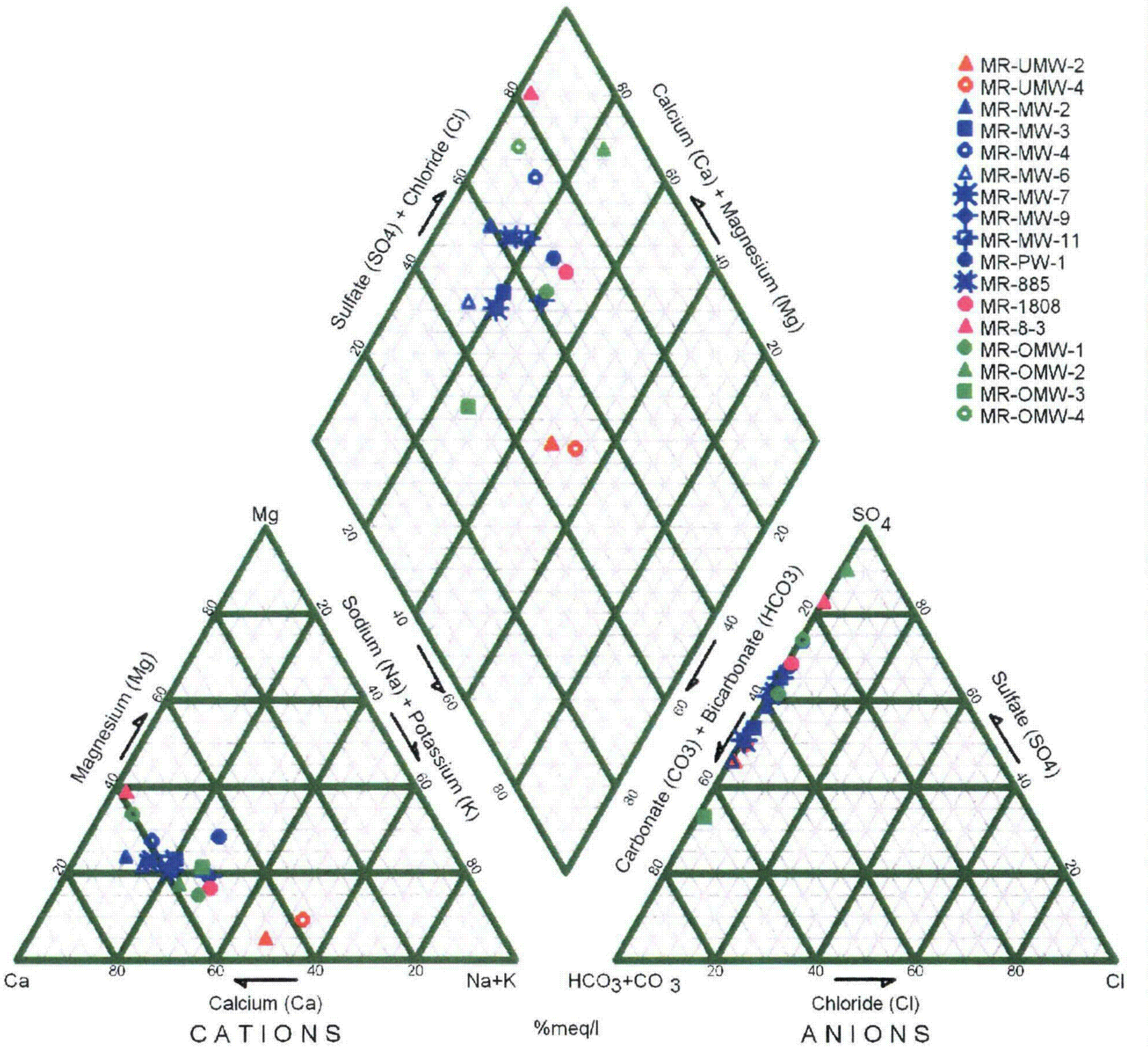

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Figure 3.4.3-13

Piper Diagram - Average Water Quality in Monitor Wells, Moore Ranch

Project: 312-7	Date: September 2007
Figure 2.7.3-3.mxd	By: JLM / Checked: KC

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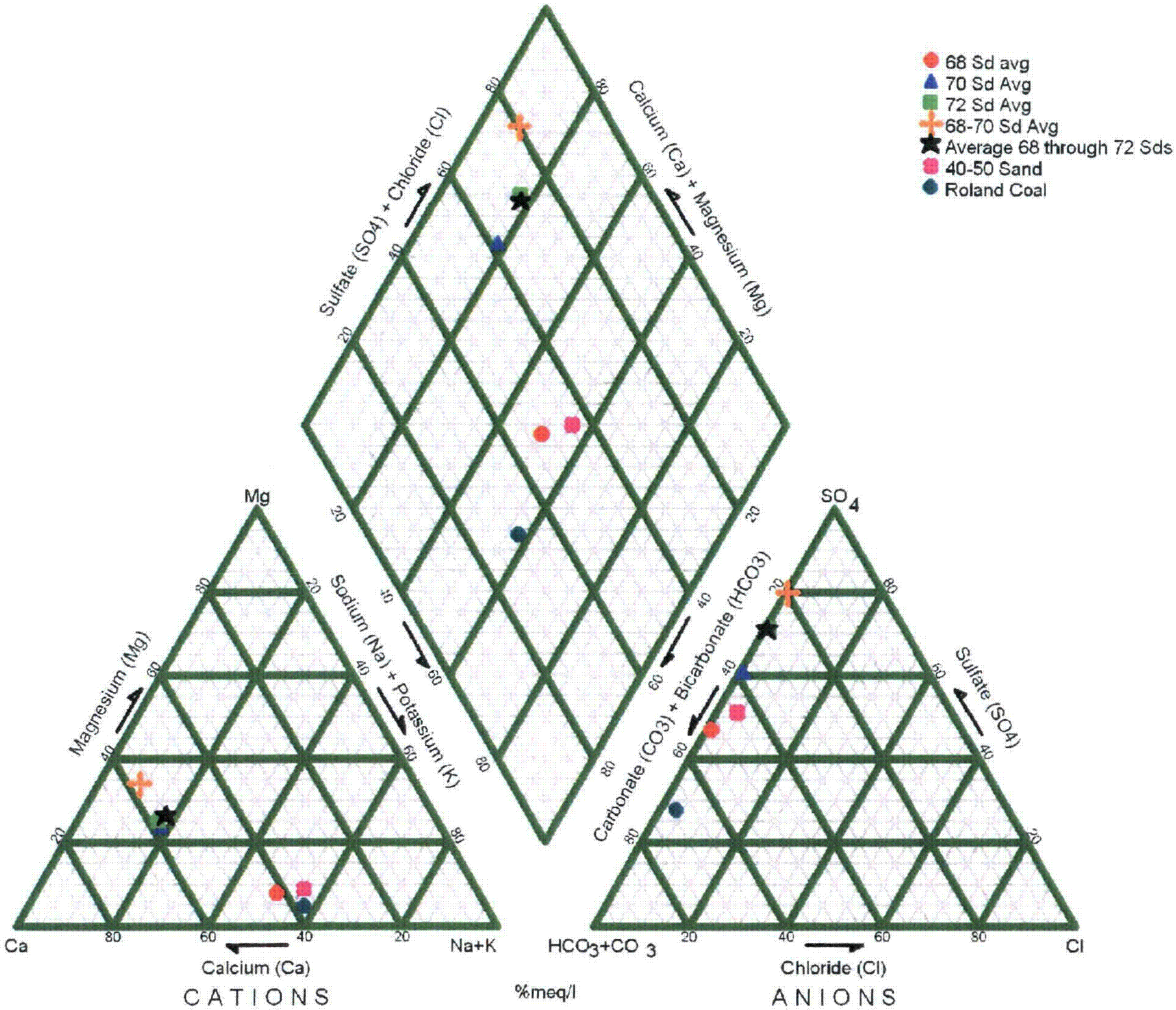

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Figure 3.4.3-14
Piper Diagram - Average Water Quality in Aquifers, Moore Ranch

Project: 312-7	Date: September 2007
Figure 2.7.3-4.mxd	By: JLM / Checked: KC

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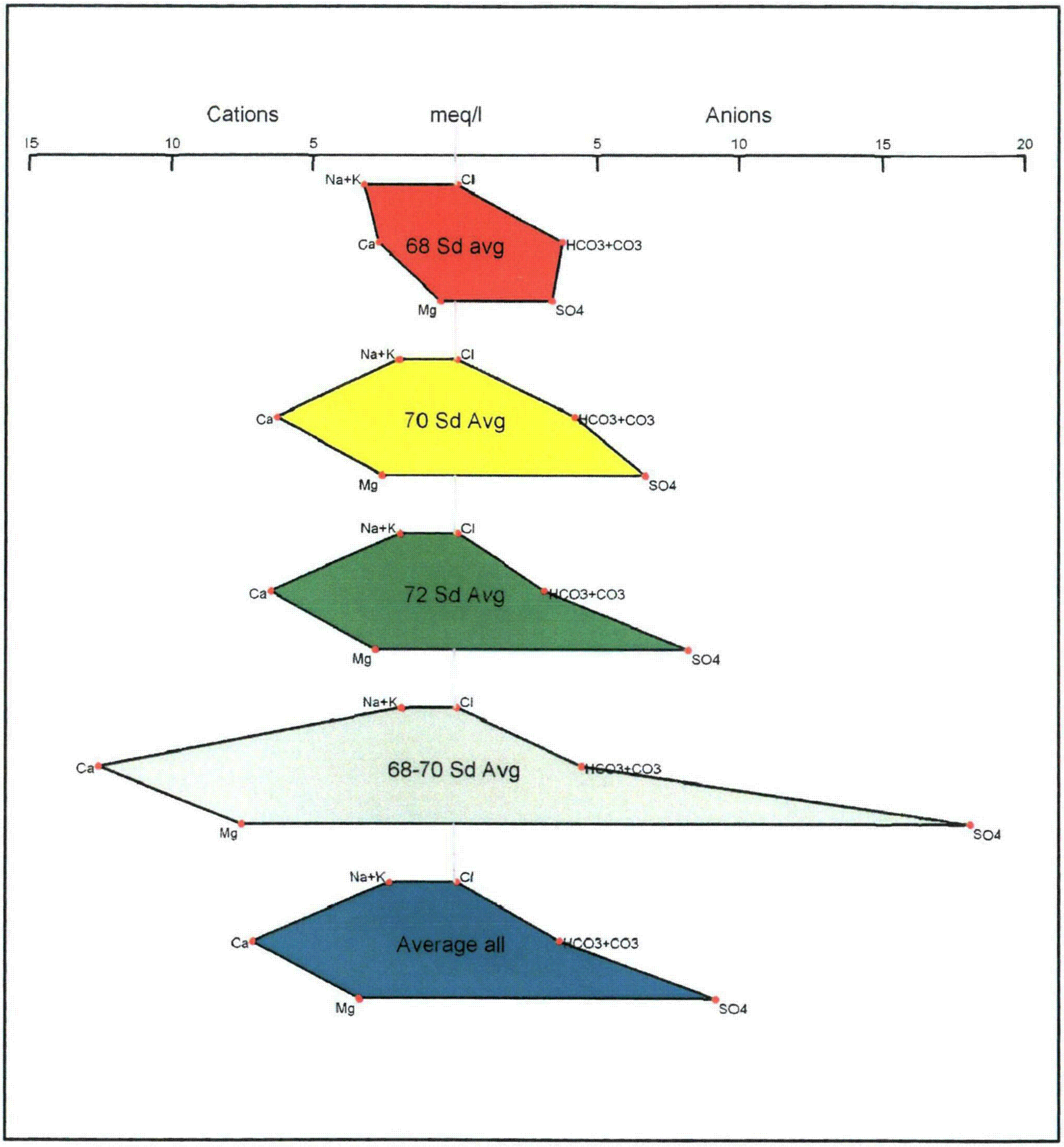

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139 West 2nd St. Casper, WY 82601 303-234-8235

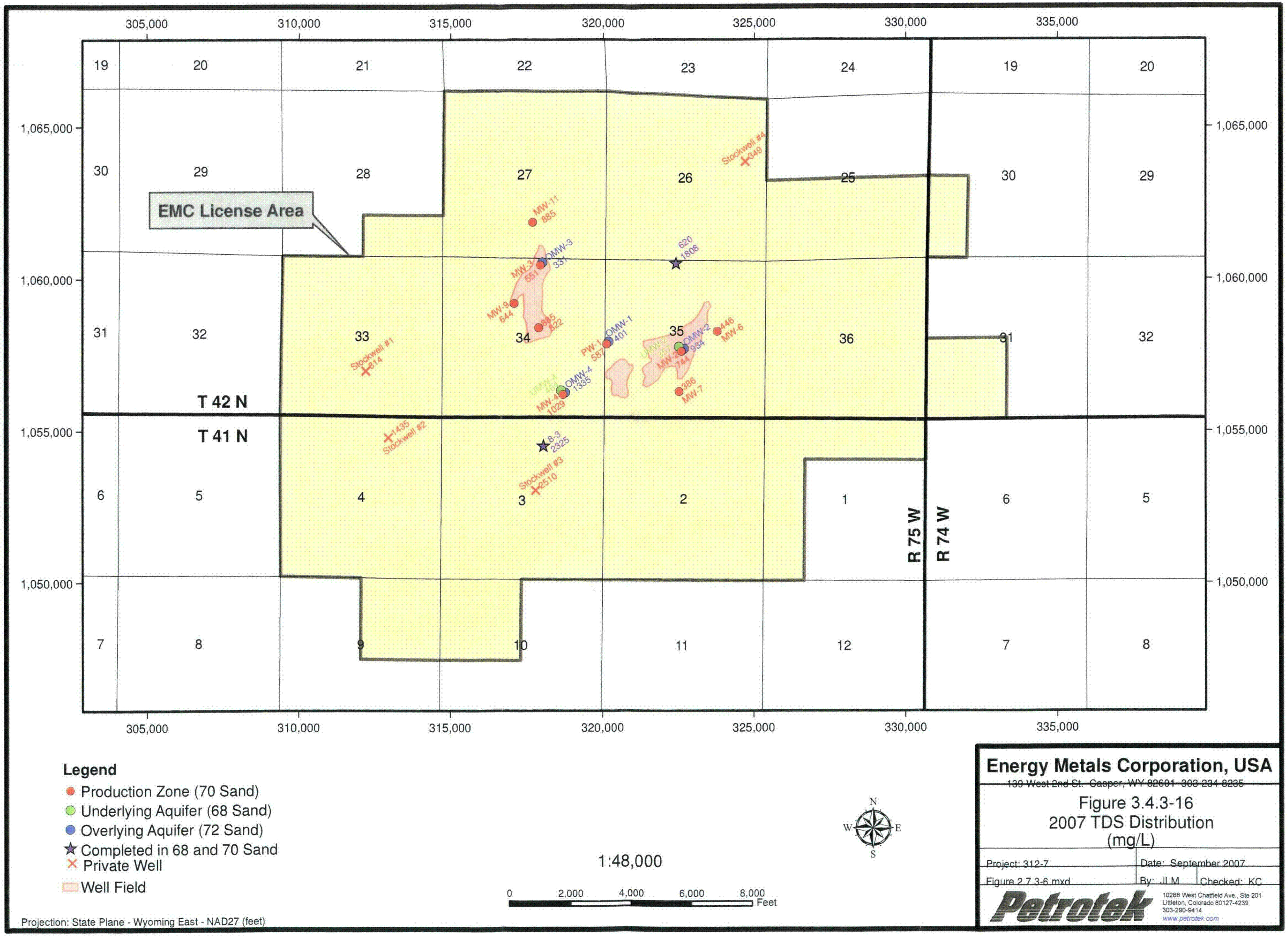
Figure 3.4.3-15

Stiff Diagram-Water Quality in Aquifers Within the Permit Area, Moore Ranch

Project: 312-7	Date: September 2007
Figure 2.7.3-5.mxd	By: JLM / Checked: KC

Petrotek

10288 West Chatfield Ave., Ste 201
Littleton, Colorado 80127-4239
303-290-9414
www.petrotek.com



EMC License Area
T 42 N
T 41 N
R 75 W
R 74 W
Legend
Production Zone (70 Sand)
Underlying Aquifer (68 Sand)
Overlying Aquifer (72 Sand)
Completed in 68 and 70 Sand
Private Well
Well Field
1:48,000
0 2,000 4,000 6,000 8,000 Feet
Projection: State Plane - Wyoming East - NAD27 (feet)
Energy Metals Corporation, USA
Figure 3.4.3-16
2007 TDS Distribution
(mg/L)
Project: 312-7
Date: September 2007
By: JLM
Checked: KC
Petrotek
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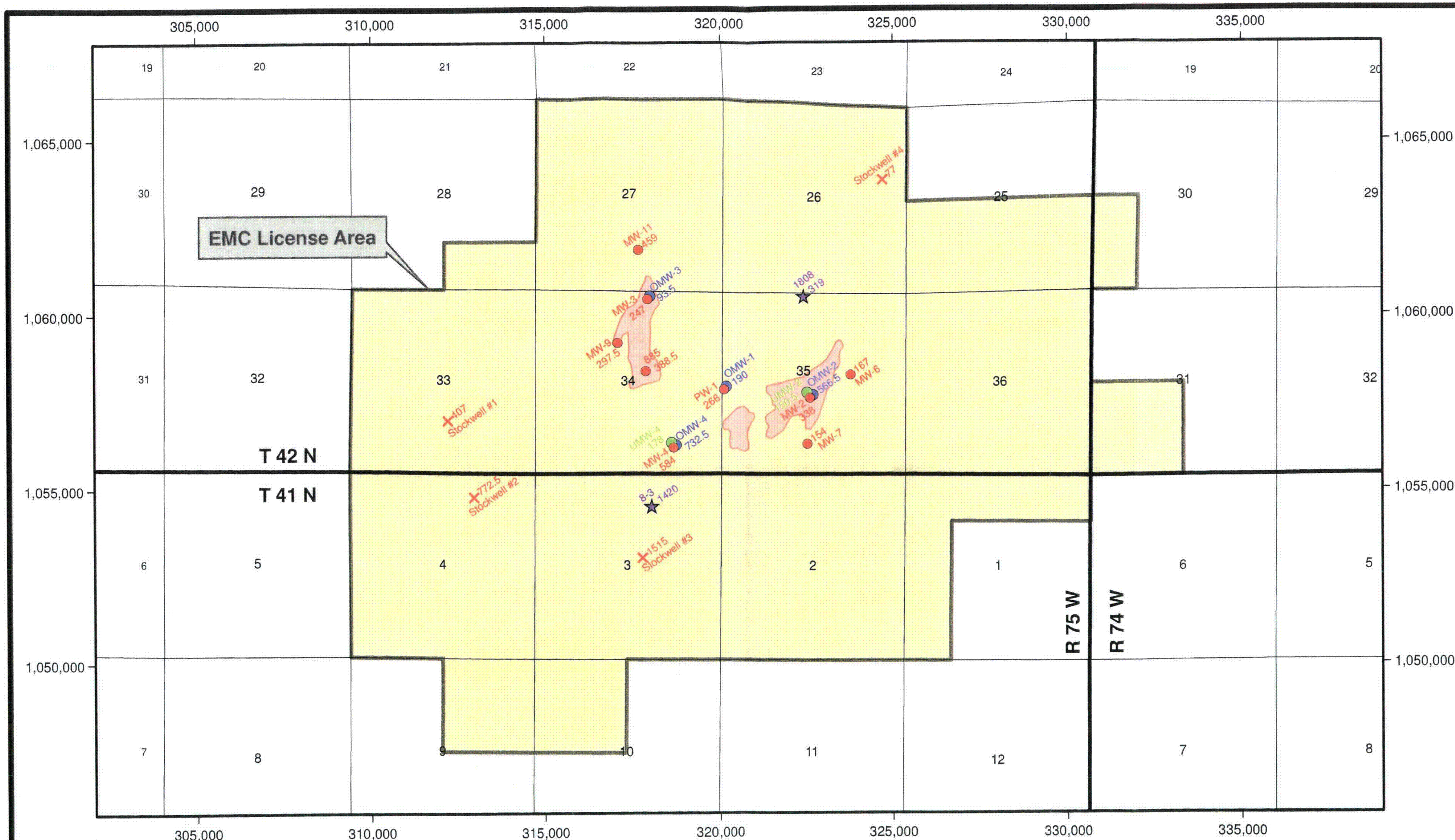
Littleton, Colorado 80127-4239
303-290-9414
www.petrotek.com



Legend

- Production Zone (70 Sand)
- Underlying Aquifer (68 Sand)
- Overlying Aquifer (72 Sand)
- ☆ Completed in 68 and 70 Sand
- × Private Well
- Well Field

Projection: State Plane - Wyoming East - NAD27 (feet)

1:48,000

0 2,000 4,000 6,000 8,000 Feet

Energy Metals Corporation, USA

~~130 West 2nd St. Casper, WY 82601 303-234-8235~~

Figure 3.4.3-17
2007 Sulfate Distribution
(mg/L)

Project: 312-7	Date: September 2007
Figure 2.7.3-7.mxd	By: JLM Checked: KC

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Littleton, Colorado 80127-4239
303-290-9414
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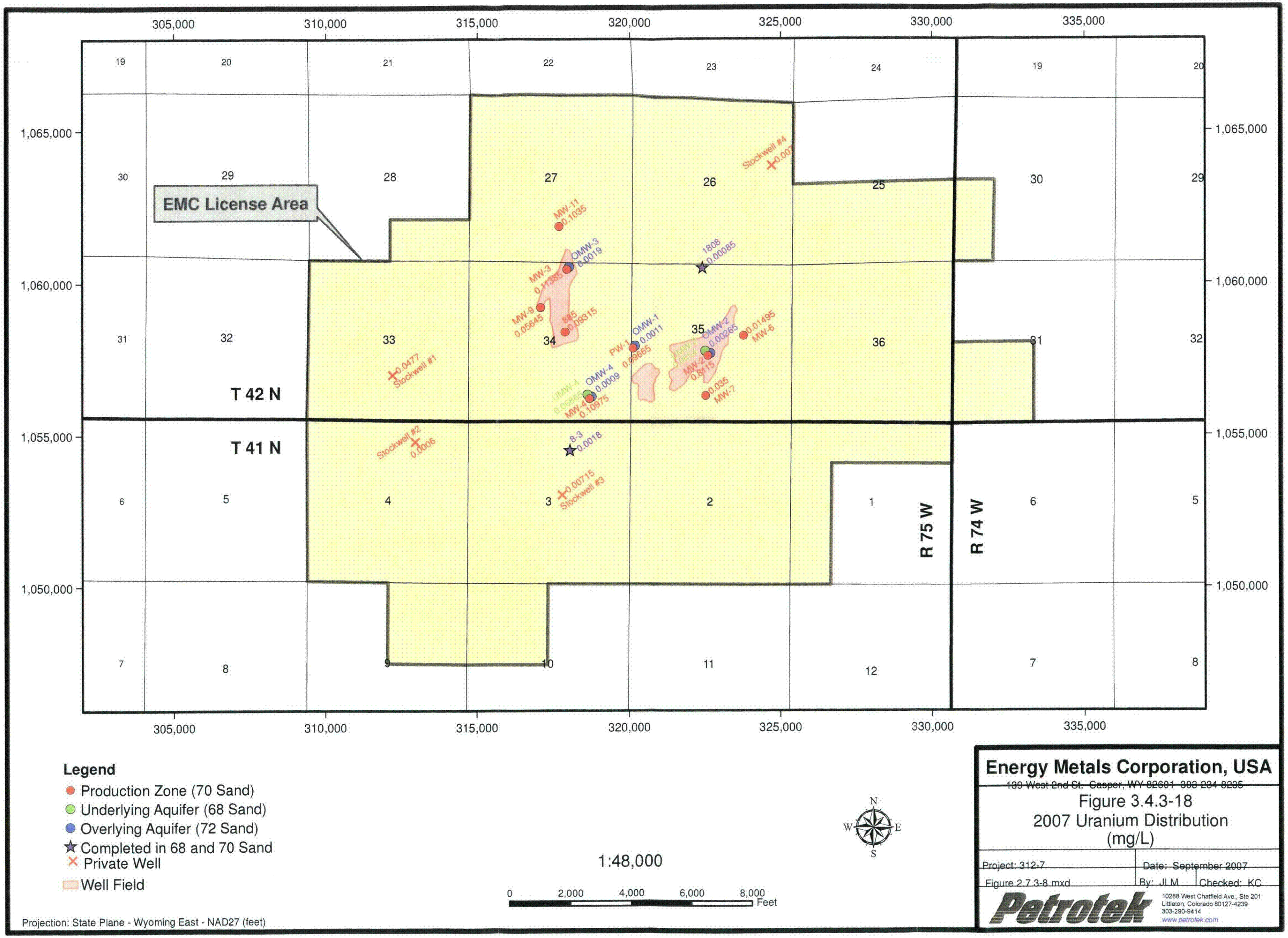

EMC License Area
T 42 N
T 41 N
R 75 W
R 74 W
Legend
Production Zone (70 Sand)
Underlying Aquifer (68 Sand)
Overlying Aquifer (72 Sand)
Completed in 68 and 70 Sand
Private Well
Well Field
1:48,000
0 2,000 4,000 6,000 8,000 Feet
Projection: State Plane - Wyoming East - NAD27 (feet)
Energy Metals Corporation, USA
Figure 3.4.3-18
2007 Uranium Distribution
(mg/L)
Project: 312-7
Date: September 2007
Figure 2.7.3-8.mxd
By: JLM
Checked: KC
Petrotek
10288 West Chatfield Ave., Ste 201
Littleton, Colorado 80127-4239
303-290-9414
www.petrotek.com

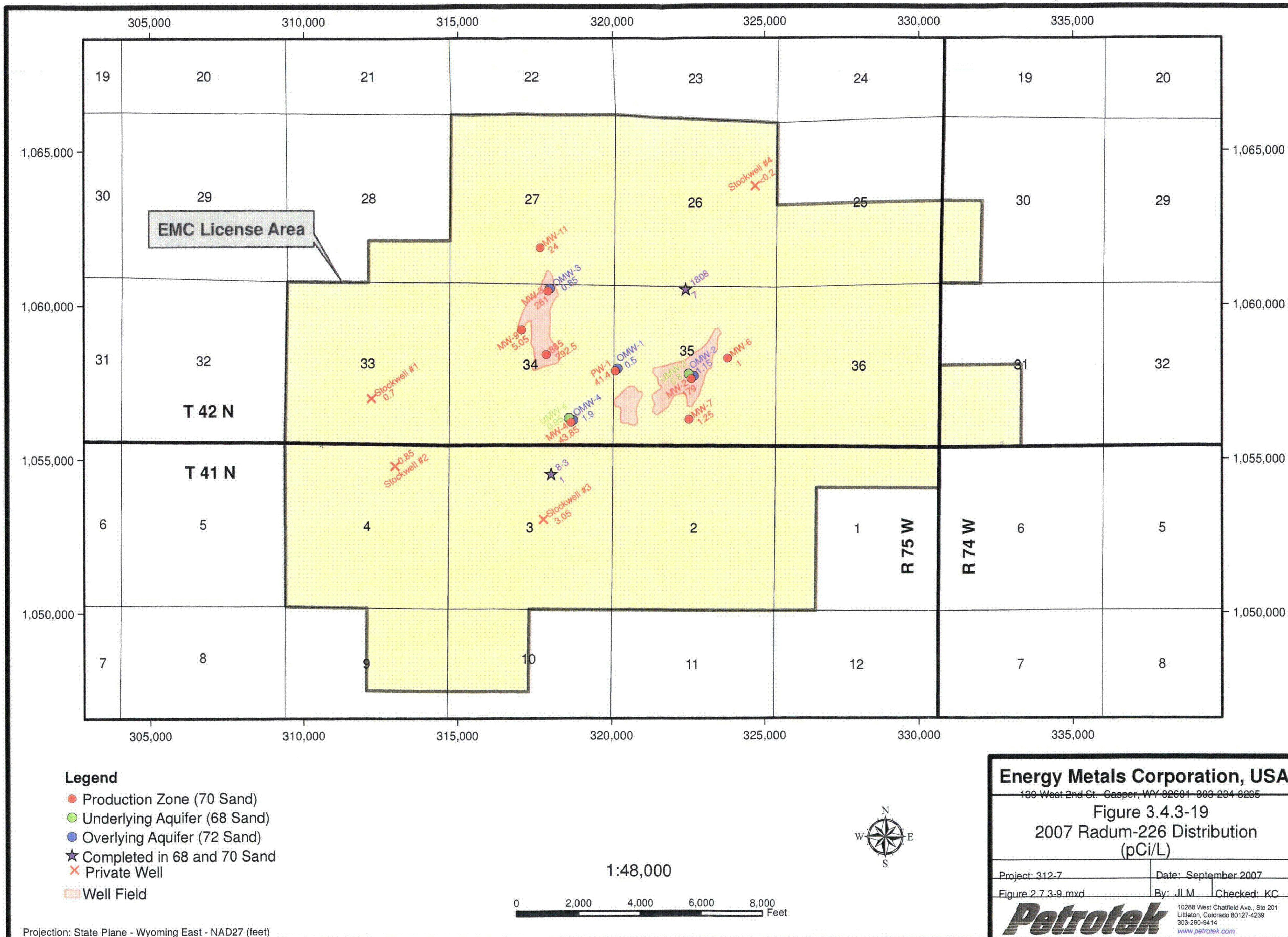

Figure 3.4.3-19
2007 Radum-226 Distribution
(pCi/L)

Addendum 3.4-A

Ground Water Rights within a 2-Mile Radius

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P130611W	43.56295000000	-105.80300000000	DEVON ENERGY PROD. CO., L.P. 2** WY	STATE ARCHIBALD 31S-13	CBM	25	984	600
P139124W	43.60304000000	-105.83870000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 23S-3	CBM	25	1297	937
P139125W	43.59953000000	-105.84370000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 23S-5	CBM	25	1351	890
P139126W	43.59573000000	-105.83840000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 23S-11	CBM	25	1386	1007
P139127W	43.59222000000	-105.84320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 23S-13	CBM	25	1378	1024
P139128W	43.60283000000	-105.81790000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 24S-3	CBM			
P139129W	43.59908000000	-105.82300000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 24S-5	CBM	25	1252	1193
P139130W	43.59556000000	-105.81790000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 24S-11	CBM			
P139131W	43.59178000000	-105.82300000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 24S-13	CBM	25	1289	1179
P139132W	43.58857000000	-105.85820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-3	CBM			
P139133W	43.58482000000	-105.86320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-5	CBM			
P139134W	43.58105000000	-105.85820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-11	CBM			
P139135W	43.57733000000	-105.86320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-13	CBM			
P139273W	43.58480000000	-105.85320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 27S-7	CBM	25	1131	483
P139274W	43.57727000000	-105.85310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 27S-15	CBM			
P139462W	43.55926000000	-105.82800000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-1	CBM			
P139463W	43.55924000000	-105.83810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-3	CBM			
P139464W	43.55555000000	-105.84310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-5	CBM			
P139465W	43.55557000000	-105.83310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-7	CBM			
P139466W	43.55192000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-9	CBM			
P139467W	43.55190000000	-105.83810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-11	CBM			
P139468W	43.54823000000	-105.84310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 2S-13	CBM			
P139469W	43.55920000000	-105.85810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 3S-3	CBM			
P139470W	43.55553000000	-105.86310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 3S-5	CBM			
P139471W	43.55189000000	-105.84810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 3S-9	CBM			
P139472W	43.55187000000	-105.85810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 3S-11	CBM			
P139474W	43.55920000000	-105.86820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 4S-1	CBM			
P139475W	43.57367000000	-105.86820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER CEEEK FEDERAL 33S-1	CBM			
P139476W	43.57006000000	-105.87320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER CEEEK FEDERAL 33S-7	CBM			
P139477W	43.56644000000	-105.86820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER CEEEK FEDERAL 33S-9	CBM			
P139478W	43.56285000000	-105.87320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER CEEEK FEDERAL 33S-15	CBM			
P139479W	43.58856000000	-105.86830000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 29S-1	CBM			
P139480W	43.58108000000	-105.86820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-9	CBM			
P139481W	43.57734000000	-105.87320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-15	CBM			
P148712W	43.52290000000	-105.78770000000	BILL BARRETT CORPORATION	PALM 43-18-4174	CBM	7	821	358
P148713W	43.51193000000	-105.79270000000	BILL BARRETT CORPORATION	PALM 32-19-4174	CBM	22	855	505
P153683W	43.55583000000	-105.78270000000	BILL BARRETT CORPORATION	DIAMOND T 12-5-4174	CBM	18	991	823
P153684W	43.55220000000	-105.77770000000	BILL BARRETT CORPORATION	DIAMOND T 23-5-4174	CBM	17	1037	684
P153685W	43.54855000000	-105.77260000000	BILL BARRETT CORPORATION	DIAMOND T 34-5-4174	CBM	16	1030	980
P153686W	43.55224000000	-105.76760000000	BILL BARRETT CORPORATION	DIAMOND T 43-5-4174	CBM	15	1062	1018
P153687W	43.55935000000	-105.79790000000	BILL BARRETT CORPORATION	DIAMOND T 21-6-4174	CBM	16	986	740
P153688W	43.55575000000	-105.79280000000	BILL BARRETT CORPORATION	DIAMOND T 32-6-4174	CBM	17	982	699
P153689W	43.55214000000	-105.78780000000	BILL BARRETT CORPORATION	DIAMOND T 43-6-4174	CBM	10	1012	762
P153690W	43.53372000000	-105.80290000000	BILL BARRETT CORPORATION	DIAMOND T 14-7-4174	CBM	20	958	6247
P153691W	43.53742000000	-105.79790000000	BILL BARRETT CORPORATION	DIAMOND T 23-7-4174	CBM	20	947	580
P153692W	43.53381000000	-105.79270000000	BILL BARRETT CORPORATION	DIAMOND T 34-7-4174	CBM	19	848	449
P153693W	43.53751000000	-105.78770000000	BILL BARRETT CORPORATION	DIAMOND T 43-7-4174	CBM	22	901	574
P153694W	43.52658000000	-105.78260000000	BILL BARRETT CORPORATION	NINE MILE 12-17-4174	CBM	22	809	587
P153695W	43.51926000000	-105.78270000000	BILL BARRETT CORPORATION	NINE MILE 14-17-4174	CBM			
P153696W	43.52638000000	-105.80290000000	BILL BARRETT CORPORATION	DIAMOND T 12-18-4174	CBM	13	721	486
P153697W	43.53010000000	-105.79780000000	BILL BARRETT CORPORATION	DIAMOND T 21-18-4174	CBM	15	881	503
P153698W	43.52279000000	-105.79780000000	BILL BARRETT CORPORATION	NINE MILE 23-18-4174	CBM	15	852	552
P153699W	43.51921000000	-105.79270000000	BILL BARRETT CORPORATION	NINE MILE 34-18-4174	CBM	22	791	460

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P153700W	43.51560000000	-105.78770000000	BILL BARRETT CORPORATION	NINE MILE 41-19-4174	CBM			
P153927W	43.55565000000	-105.80300000000	BILL BARRETT CORPORATION	DIAMOND T 12-6-4174	CBM	9	999	681
P154591W	43.52996000000	-105.81800000000	BILL BARRETT CORPORATION	MOORE WIRC 21-13-4175	CBM	19	887	578
P154592W	43.53725000000	-105.82810000000	BILL BARRETT CORPORATION	MOORE WIRC 43-11-4175	CBM	18	941	650
P154593W	43.54093000000	-105.82300000000	BILL BARRETT CORPORATION	MOORE WIRC 12-12-4175	CBM	18	994	688
P154594W	43.53359000000	-105.82300000000	BILL BARRETT CORPORATION	MOORE WIRC 14-12-4175	CBM	14	914	589
P154595W	43.52626000000	-105.82300000000	BILL BARRETT CORPORATION	MOORE WIRC 12-13-4175	CBM	18	955	664
P154596W	43.52631000000	-105.81290000000	BILL BARRETT CORPORATION	MOORE WIRC 32-13-4175	CBM	20	859	554
P154747W	43.55586000000	-105.77770000000	BILL BARRETT CORPORATION	DIAMOND T 22-5-4174	CBM	18	1015	679
P155688W	43.54824000000	-105.83310000000	BILL BARRETT CORPORATION	WALKER CREEK 34-2-4175	CBM	17	1011	711
P155689W	43.54826000000	-105.82310000000	BILL BARRETT CORPORATION	WALKER CREEK 14-1-4175	CBM	13	1031	706
P155690W	43.54458000000	-105.82810000000	BILL BARRETT CORPORATION	WALKER CREEK 41-11-4175	CBM	19	1021	745
P155742W	43.55209000000	-105.79280000000	BILL BARRETT CORPORATION	DIAMOND T 33-6-4174	CBM	15	961	709
P155743W	43.55580000000	-105.78780000000	BILL BARRETT CORPORATION	DIAMOND T 42-6-4174	CBM	14	1020	764
P155744W	43.52634000000	-105.80790000000	BILL BARRETT CORPORATION	DIAMOND T 42-13-4175	CBM	12	876	495
P156307W	43.55217000000	-105.78270000000	BILL BARRETT CORPORATION	DIAMOND T 13-5-4174	CBM	17	1019	705
P156308W	43.51560000000	-105.78770000000	BILL BARRETT CORPORATION	NINE MILE 41-19-4174	CBM	19	778	552
P156309W	43.51924000000	-105.77770000000	BILL BARRETT CORPORATION	NINE MILE 24-17-4174	CBM	21	727	445
P156395W	43.55596000000	-105.75260000000	BILL BARRETT CORPORATION	FEDERAL 32-4-4174	CBM	16	858	483
P156399W	43.55589000000	-105.77270000000	BILL BARRETT CORPORATION	FEDERAL 32-5-4174	CBM	15	1042	705
P156400W	43.55959000000	-105.76770000000	BILL BARRETT CORPORATION	FEDERAL 41-5-4174	CBM	20	955	622
P156401W	43.54834000000	-105.80300000000	BILL BARRETT CORPORATION	FEDERAL 14-6-4174	CBM	15	990	734
P156402W	43.55205000000	-105.79790000000	BILL BARRETT CORPORATION	FEDERAL 23-6-4174	CBM	19	967	846
P156403W	43.54474000000	-105.79790000000	BILL BARRETT CORPORATION	FEDERAL 21-7-4174	CBM			
P156404W	43.54482000000	-105.78770000000	BILL BARRETT CORPORATION	FEDERAL 41-7-4174	CBM			
P156405W	43.54120000000	-105.78260000000	BILL BARRETT CORPORATION	FEDERAL 12-8-4174	CBM	16	1000	706
P156406W	43.53389000000	-105.78260000000	BILL BARRETT CORPORATION	FEDERAL 14-8-4174	CBM	11	897	587
P156407W	43.54487000000	-105.77770000000	BILL BARRETT CORPORATION	FEDERAL 21-8-4174	CBM	10	1018	771
P156408W	43.53756000000	-105.77760000000	BILL BARRETT CORPORATION	FEDERAL 23-8-4174	CBM	9	952	598
P156409W	43.54123000000	-105.77260000000	BILL BARRETT CORPORATION	FEDERAL 32-8-4174	CBM	11	1011	668
P156410W	43.53390000000	-105.77260000000	BILL BARRETT CORPORATION	FEDERAL 34-8-4174	CBM	12	841	513
P156411W	43.54491000000	-105.76760000000	BILL BARRETT CORPORATION	FEDERAL 41-8-4174	CBM	11	1062	728
P156412W	43.53758000000	-105.76760000000	BILL BARRETT CORPORATION	FEDERAL 43-8-4174	CBM	10	963	595
P156413W	43.54126000000	-105.76260000000	BILL BARRETT CORPORATION	FEDERAL 12-9-4174	CBM	13	985	704
P156414W	43.53393000000	-105.76260000000	BILL BARRETT CORPORATION	FEDERAL 14-9-4174	CBM	14	909	579
P156415W	43.54494000000	-105.75760000000	BILL BARRETT CORPORATION	FEDERAL 21-9-4174	CBM	13	911	591
P156431W	43.53024000000	-105.77760000000	BILL BARRETT CORPORATION	FEDERAL 21-17-4174	CBM	15	840	525
P156432W	43.52657000000	-105.77270000000	BILL BARRETT CORPORATION	FEDERAL 32-17-4174	CBM	15	827	526
P156433W	43.53024000000	-105.76760000000	BILL BARRETT CORPORATION	FEDERAL 41-17-4174	CBM	14	863	531
P156435W	43.55559000000	-105.82300000000	BILL BARRETT CORPORATION	FEDERAL 12-1-4175	CBM	15	1028	783
P156436W	43.55927000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 21-1-4175	CBM	16	1063	866
P156437W	43.55194000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 23-1-4175	CBM	18	1044	764
P156438W	43.55561000000	-105.81300000000	BILL BARRETT CORPORATION	FEDERAL 32-1-4175	CBM	17	1052	695
P156439W	43.54829000000	-105.81300000000	BILL BARRETT CORPORATION	FEDERAL 34-1-4175	CBM	17	1052	730
P156440W	43.55928000000	-105.80800000000	BILL BARRETT CORPORATION	FEDERAL 41-1-4175	CBM	17	1013	821
P156441W	43.55197000000	-105.80800000000	BILL BARRETT CORPORATION	FEDERAL 43-1-4175	CBM	15	1074	762
P156442W	43.55555000000	-105.84310000000	BILL BARRETT CORPORATION	FEDERAL 12-2-4175	CBM	15	1122	810
P156443W	43.54823000000	-105.84310000000	BILL BARRETT CORPORATION	FEDERAL 14-2-4175	CBM	17	1034	834
P156444W	43.55924000000	-105.83810000000	BILL BARRETT CORPORATION	FEDERAL 21-2-4175	CBM	14	1139	836
P156445W	43.55190000000	-105.83810000000	BILL BARRETT CORPORATION	FEDERAL 23-2-4175	CBM	17	1122	800
P156446W	43.55557000000	-105.83310000000	BILL BARRETT CORPORATION	FEDERAL 32-2-4175	CBM	17	1040	757
P156447W	43.55926000000	-105.82800000000	BILL BARRETT CORPORATION	FEDERAL 41-2-4175	CBM	6	1102	887

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P156448W	43.54461000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 21-12-4175	CBM	15	1018	676
P156449W	43.53729000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 23-12-4175	CBM	18	977	631
P156450W	43.54097000000	-105.81300000000	BILL BARRETT CORPORATION	FEDERAL 32-12-4175	CBM	20	1030	715
P156451W	43.53365000000	-105.81300000000	BILL BARRETT CORPORATION	FEDERAL 34-12-4175	CBM	19	963	679
P156452W	43.54465000000	-105.80800000000	BILL BARRETT CORPORATION	FEDERAL 41-12-4175	CBM	17	1032	811
P156453W	43.53734000000	-105.80790000000	BILL BARRETT CORPORATION	FEDERAL 43-12-4175	CBM	10	995	710
P156454W	43.51893000000	-105.82310000000	BILL BARRETT CORPORATION	FEDERAL 14-13-4175	CBM	23	912	624
P156455W	43.52262000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 23-13-4175	CBM	19	931	642
P156456W	43.51903000000	-105.81290000000	BILL BARRETT CORPORATION	FEDERAL 34-13-4175	CBM	13	903	569
P156457W	43.52269000000	-105.80790000000	BILL BARRETT CORPORATION	FEDERAL 43-13-4175	CBM	7	883	656
P156458W	43.51167000000	-105.82310000000	BILL BARRETT CORPORATION	FEDERAL 12-24-4175	CBM	17	953	521
P156459W	43.51534000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 21-24-4175	CBM	20	903	542
P156460W	43.50809000000	-105.81800000000	BILL BARRETT CORPORATION	FEDERAL 23-24-4175	CBM	4	869	446
P156461W	43.56312000000	-105.78280000000	BILL BARRETT CORPORATION	FEDERAL 14-32-4274	CBM	14	1071	780
P156462W	43.56679000000	-105.77770000000	BILL BARRETT CORPORATION	FEDERAL 23-32-4274	CBM	15	1027	726
P156463W	43.56320000000	-105.77270000000	BILL BARRETT CORPORATION	FEDERAL 34-32-4274	CBM	2	1026	728
P156577W	43.54825000000	-105.82810000000	BILL BARRETT CORPORATION	WALKER CREEK 44-2-4175	CBM	18	1037	737
P156615W	43.57415000000	-105.75750000000	BILL BARRETT CORPORATION	NINEMILE 21-33-4274	CBM			
P156616W	43.57053000000	-105.75260000000	BILL BARRETT CORPORATION	NINEMILE 32-33-4274	CBM			
P158295W	43.58107000000	-105.87830000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-11	CBM			
P158296W	43.60694000000	-105.87400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T-CHAIR) 16S-15	CBM			
P158297W	43.60688000000	-105.88400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T-CHAIR) 16S-13	CBM			
P158298W	43.61420000000	-105.88400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T-CHAIR) 16S-5	CBM			
P158299W	43.61790000000	-105.87910000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T-CHAIR) 16S-3	CBM			
P158300W	43.56293000000	-105.89330000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 32S-15	CBM			
P158301W	43.56651000000	-105.88820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 32S-9	CBM			
P158302W	43.57015000000	-105.89330000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 32S-7	CBM			
P158303W	43.57370000000	-105.88820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 32S-1	CBM			
P158304W	43.57733000000	-105.88320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-13	CBM			
P158667W	43.61428000000	-105.87410000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T CHAIR) 16S-7	CBM			
P158668W	43.61797000000	-105.86920000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T CHAIR) 16S-1	CBM			
P158669W	43.57734000000	-105.87320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-15	CBM	25	1165	705
P158670W	43.58108000000	-105.86820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 28S-9	CBM			
P158671W	43.57733000000	-105.86320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-13	CBM			
P158672W	43.58105000000	-105.85820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-11	CBM	25	1358	910
P158673W	43.58482000000	-105.86320000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-5	CBM			
P158674W	43.58857000000	-105.85820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 27S-3	CBM	25	1365	629
P165993W	43.61061000000	-105.87410000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (T CHAIR) 16S-10	CBM			
P166070W	43.58828000000	-105.81790000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 25S-3	CBM			
37/6/408W	43.59952000000	-105.77260000000	YATES PETROLEUM CORP.	STEVE CS #02	CBM,MIS			
P163654W	43.56329000000	-105.75260000000	YATES PETROLEUM CORP.	BIGHORN CS FEDERAL #13	CBM,MIS			
P167696W	43.56671000000	-105.78780000000	YATES PETROLEUM CORP.	SIOUX CS FEDERAL #01	CBM,MIS,RES			
P158877W	43.57769000000	-105.77270000000	YATES PETROLEUM CORP.	BIGHORN CS FEDERAL #5	CBM,RES	200	974	669
P158878W	43.59947000000	-105.78280000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #2	CBM,RES			
P158879W	43.59589000000	-105.76750000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #3	CBM,RES	200	1031	697
P158880W	43.59219000000	-105.78280000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #5	CBM,RES			
P158881W	43.58860000000	-105.76750000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #8	CBM,RES	200	948	608
P158882W	43.58489000000	-105.78290000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #10	CBM,RES			
P158883W	43.57776000000	-105.76250000000	YATES PETROLEUM CORP.	BIGHORN CS FEDERAL #1	CBM,RES			
P160346W	43.60673000000	-105.79280000000	YATES PETROLEUM CORPORATION	PRATHER CS #4	CBM,RES	200	1179	801
P160347W	43.56686000000	-105.76770000000	YATES PETROLEUM CORPORATION	BIGHORN CS FEDERAL #9	CBM,RES			
P160348W	43.60314000000	-105.77770000000	YATES PETROLEUM CORPORATION	CUSTER CS FEDERAL #1	CBM,RES			

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P161978W	43.58864000000	-105.75750000000	YATES PETROLEUM CORP.	CUSTER CS FEDERAL #13	CBM,RES	200	956	633
P162026W	43.56326000000	-105.76270000000	YATES PETROLEUM CORP.	BIGHORN CS FEDERAL #12	CBM,RES			
P9309W	43.51924000000	-105.77770000000	JOHN W. MOORE	9 MILE 1	DOM	20	273	85
P12240P	43.51924000000	-105.77770000000	JOHN W. MOORE	9 MILE #2	DOM,STO	20	180	40
P12299W	43.56646000000	-105.87320000000	RIO ALGOM MINING CORP.	UM 1575 2 33 42 75	IND,DOM	15	440	60
P60162W	43.57353000000	-105.83810000000	POWER RESOURCES INC	CONOCO 1821	IND,MIS	40	1200	342
P60163W	43.57353000000	-105.83810000000	POWER RESOURCES INC	CONOCO 1822	IND,MIS	45	740	249
P78584W	43.53751000000	-105.78770000000	W. A. MONCRIEF, JR.	LUCKY PINE #7 1	MIS	50	960	200
P161053W	43.53751000000	-105.78770000000	Diamond T LLC	LUCKY PINE #7-1	MIS			
P39648W	43.56912000000	-105.85200000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 43 P	MON	0	240	182
P39649W	43.56998000000	-105.83810000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 34 P	MON	0	240	160
P39650W	43.56998000000	-105.84310000000	POWER RESOURCES INC	MOORE RACNCH PROJEACT D (42 75) 35 O	MON	0	263	208
P39651W	43.57353000000	-105.83810000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 35 OB2	MON	0	275	144
P39652W	43.56996000000	-105.82800000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 35 OB3	MON	0	227	189
P39653W	43.57004000000	-105.86320000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 34 OB4	MON	0	260	164
P39654W	43.57445000000	-105.85120000000	POWER RESOURCES INC	MOORE RANCH PROJECT D (42 75) 34 OB5	MON	0	330	163
P39655W	43.55925000000	-105.83300000000	KERR-MCGEE NUCLEAR CORPORATION	MOORE RANCH PROJECT D(41-75)2-0B6	MON	0	165	99
P39656W	43.55921000000	-105.85310000000	KERR-MCGEE NUCLEAR CORPORATION	MOORE RANCH PROJECT D(41-75)3-OB7	MON	0	175	70
P75097W	43.56912000000	-105.85200000000	POWER RESOURCES INC	MOORE RANCH #886	MON	0	240	186
P75098W	43.56912000000	-105.85200000000	POWER RESOURCES INC	MOORE RANCH #887	MON	0	320	177.2
P75099W	43.56912000000	-105.85200000000	POWER RESOURCES INC	MOORE RANCH #888	MON	0	250	177.3
P75100W	43.56912000000	-105.85200000000	POWER RESOURCES INC	MOORE RANCH #893	MON	0	240	173.19
P75101W	43.56997000000	-105.83300000000	POWER RESOURCES INC	MOORE RANCH #1805	MON	0	240	154.1
P75102W	43.56997000000	-105.83300000000	POWER RESOURCES INC	MOORE RANCH #1806	MON	0	220	146
P75103W	43.56997000000	-105.83300000000	POWER RESOURCES INC	MOORE RANCH #1807	MON	0	290	160.5
P75104W	43.56287000000	-105.84310000000	POWER RESOURCES INC	MOORE RANCH #1814	MON	0	207	157.1
P75105W	43.56287000000	-105.84310000000	POWER RESOURCES INC	MOORE RANCH #1815	MON	0	208	159.6
P75106W	43.56287000000	-105.84310000000	POWER RESOURCES INC	MOORE RANCH #1816	MON	0	207	155.1
P75107W	43.56642000000	-105.84310000000	POWER RESOURCES INC	MOORE RANCH #1817	MON	0	233	162.9
P75108W	43.56287000000	-105.84310000000	POWER RESOURCES INC	MOORE RANCH #1823	MON	0	240	113.1
P14660P	43.58108000000	-105.86820000000	TAYLOR RANCH CO.	TAYLOR #29-1	STO	3	355	150
P14670P	43.55197000000	-105.89320000000	TAYLOR RANCH CO.	TAYLOR #41 1	STO	5	22	5
P14683P	43.58863000000	-105.80280000000	TAYLOR RANCH CO.	TAYLOR #57-1	STO	3	275	175
P17305P	43.54474000000	-105.79790000000	PINE TREE RANCH CO.	PINE TREE #6	STO	20	50	18
P17306P	43.58124000000	-105.78290000000	PINE TREE RANCH CO.	PINE TREE #7	STO	40	150	40
P22296P	43.51506000000	-105.86310000000	OGALALLA ALDN & CATTLE LIMITED PARTN	McNAUGHTIN PASTURE #1	STO	3	125	50
P12244P	43.57777000000	-105.75750000000	JOHN W. & VELMA R. MOORE	FARM #1	STO	20	200	100
P14675P	43.62855000000	-105.80740000000	TAYLOR RANCH CO.	TAYLOR #46-55-1	STO	4	275	195
P14677P	43.62129000000	-105.79280000000	TAYLOR RANCH CO.	TAYLOR #52-1	STO	4	275	180
P14681P	43.58851000000	-105.84310000000	TAYLOR RANCH CO.	TAYLOR #55-1	STO	3	158	80
P14682P	43.58465000000	-105.83810000000	TAYLOR RANCH CO.	TAYLOR #56-1	STO	3	158	80
P14684P	43.60671000000	-105.80270000000	TAYLOR RANCH CO.	TAYLOR #57-58-2	STO	4	350	235
P35330W	43.60640000000	-105.82820000000	TAYLOR RANCH COMPANY LIMITED	TAYLOR BLISS #1	STO	25	500	100
P35746W	43.59963000000	-105.86380000000	BROWN LAND COMPANY	WOODS #1	STO	15	660	320
P37879W	43.58128000000	-105.77780000000	PINE TREE RANCH CO.**CHARLES H. ARCH	PINE TREE #5 1	STO	2	8	4
P50880W	43.59960000000	-105.87380000000	T-CHAIR LIVESTOCK CO.	T-CHAIR LIVESTOCK COMPANY #21-1	STO	25	800	130
P6972W	43.56329000000	-105.75260000000	PINE TREE RANCH CO.	PINE TREE #8	STO	25	210	95
P6973W	43.55583000000	-105.78270000000	PINE TREE RANCH CO.	PINE TREE #9	STO	5	170	60
P63571W	43.60329000000	-105.85900000000	T-CHAIR LIVESTOCK CO.	CCI #8 UPPER	STO	10	421	266
P63572W	43.60329000000	-105.85900000000	T-CHAIR LIVESTOCK CO.	CCI #8 MIDDLE	STO	10	534	259
P63573W	43.60329000000	-105.85900000000	T-CHAIR LIVESTOCK CO.	CCI #8 LOWER	STO	10	722	270
P78123W	43.51893000000	-105.82310000000	INC. W. I. MOORE RANCH CO.	MONA RAE #1	STO	20	200	100

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P78124W	43.51877000000	-105.85810000000	INC. W. I. MOORE RANCH CO.	V B #1	STO	5	100	75
P120979W	43.51550000000	-105.80280000000	W.I. MOORE RANCH COMPANY	Section 19-41-74 Well	STO	8	160	35
P120980W	43.50819000000	-105.80780000000	W.I. MOORE RANCH COMPANY	F C #1 Spring	STO	6	6	0
P120981W	43.50451000000	-105.81290000000	W.I. MOORE RANCH COMPANY	F C #2 Spring	STO	6	4	0
P120982W	43.50451000000	-105.81290000000	W.I. MOORE RANCH COMPANY	F C #3 Spring	STO	1	2	0
P120983W	43.50440000000	-105.82810000000	W.I. MOORE RANCH COMPANY	F C #4 Spring	STO	3	3	0
P120985W	43.52626000000	-105.84320000000	W.I. MOORE RANCH COMPANY	Frankie #1 Well	STO	7	150	30
P81864W	43.61055000000	-105.91400000000	T-CHAIR LAND COMPANY	KILL EM DEAD SMITH WELL #1	STO	25	1200	165
P113642W	43.56656000000	-105.80800000000	WYO BOARD OF LAND COMMISSIONERS** YA	PINE TREE DRAW CS STATE #1	STO,CBM	100	1075	773
P114067W	43.56998000000	-105.84310000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-5	STO,CBM	25	1108	380
P114068W	43.56998000000	-105.83810000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-6	STO,CBM	25	1146	390
P114069W	43.56642000000	-105.83810000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-11	STO,CBM	25	1131	395
P114070W	43.56642000000	-105.84310000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-12	STO,CBM	25	1044	392
P114071W	43.57364000000	-105.81800000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 35S-3	STO,CBM	25	1079	400
P114072W	43.57354000000	-105.82300000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-4	STO,CBM	25	1140	400
P114073W	43.56999000000	-105.82300000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-5	STO,CBM	25	1148	380
P114074W	43.57006000000	-105.81800000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-6	STO,CBM	25	1108	390
P114075W	43.57749000000	-105.80790000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN 25S-16	STO,CBM	25	1081	771
P114076W	43.57711000000	-105.82810000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN 26S-16	STO,CBM	25	1171	390
P114077W	43.57356000000	-105.84810000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 34S-1	STO,CBM	25	1245	696
P114078W	43.56288000000	-105.83300000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 35S-15	STO,CBM	25	1151	750
P114079W	43.57019000000	-105.80790000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-8	STO,CBM	25	1074	390
P114080W	43.56290000000	-105.81800000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-14	STO,CBM	25	1032	390
P114081W	43.58842000000	-105.81290000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN 25S-2	STO,CBM	25	1174	390
P114082W	43.58488000000	-105.80780000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN 25S-8	STO,CBM	25	1129	188
P114083W	43.58106000000	-105.81290000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN 25S-10	STO,CBM	25	1134	390
P114084W	43.57354000000	-105.84310000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-4	STO,CBM	25	1180	400
P114085W	43.56287000000	-105.84310000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER CREEK 35S-13	STO,CBM	25	1107	356
P114086W	43.57373000000	-105.81300000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-2	STO,CBM	25	1052	390
P114087W	43.56644000000	-105.82300000000	WYO BOARD OF LAND COMMISSIONERS** DE	WALKER CREEK ST 36S-12X	STO,CBM	25	1148	1037
P114089W	43.55554000000	-105.85310000000	DEVON ENERGY CORP.** WALKER CREEK LI	WALKER FED 3S-7	STO,CBM	0	0	0
P114102W	43.56912000000	-105.85200000000	DEVON ENERGY CORP.** IBERLIN RANCH P	IBERLIN FED 34S-7	STO,CBM	0	0	0
P114372W	43.58102000000	-105.84810000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 27S-9	STO,CBM	0	0	0
P114374W	43.58828000000	-105.81790000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 25S-3	STO,CBM	0	0	0
P114375W	43.58447000000	-105.82300000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 25S-5	STO,CBM	0	0	0
P114376W	43.58093000000	-105.81800000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 25S-11	STO,CBM	0	0	0
P114377W	43.57715000000	-105.82300000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 25S-13	STO,CBM	0	0	0
P114378W	43.58838000000	-105.83810000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 26S-3	STO,CBM	0	0	0
P114379W	43.58097000000	-105.84310000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 26S-5	STO,CBM	0	0	0
P114380W	43.58091000000	-105.83810000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 26S-11	STO,CBM	0	0	0
P114381W	43.57721000000	-105.84310000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 26S-13	STO,CBM	0	0	0
P114382W	43.58858000000	-105.84810000000	1) DEVON ENERGY CORP 2) MR. MARK IBE	IBERLIN FED 27S-1	STO,CBM	0	0	0
P114387W	43.56997000000	-105.83300000000	1) DEVON ENERGY CORP 2) WALKER CREEK	WALKER CREEK FED 35S-7	STO,CBM	0	0	0
P114391W	43.57350000000	-105.82800000000	1) DEVON ENERGY CORP 2) WALKER CREEK	WALKER CREEK FED 35S-1	STO,CBM	0	0	0
P114397W	43.57026000000	-105.93910000000	1) DEVON ENERGY CORP 2) STATE BOARD	IBERLIN RANCH STATE 36S-6	STO,CBM	25	1430	572
P114398W	43.56663000000	-105.93400000000	1) DEVON ENERGY CORP 2) STATE BOARD	IBERLIN RANCH STATE 36S-10	STO,CBM	25	1384	828
P114399W	43.57030000000	-105.93400000000	1) DEVON ENERGY CORP 2) STATE BOARD	IBERLIN RANCH STATE 36S-7	STO,CBM	25	1399	854
P114400W	43.56660000000	-105.93900000000	1) DEVON ENERGY CORP 2) STATE BOARD	IBERLING RANCH STATE 36S-11	STO,CBM	25	1385	838
P115374W	43.57397000000	-105.92910000000	DEVON ENERGY CORP.** WY STATE BOARD	1 RANCH STATE 36S-1	STO,CBM	25	1481	699
P115377W	43.56297000000	-105.92900000000	DEVON ENERGY CORP.** WY STATE BOARD	1 RANCH STATE 36S-16	STO,CBM	25	1433	1284
38/1/80W	43.53728000000	-105.91850000000	BILL BARRETT CORPORATION	FEDERAL 23-7-4175	STO,CBM			
38/1/81W	43.52250000000	-105.88810000000	BILL BARRETT CORPORATION	FEDERAL 43-17-4175	STO,CBM			

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
38/1/82W	43.50781000000	-105.86830000000	BILL BARRETT CORPORATION	FEDERAL 43-21-4175	STO,CBM			
38/10/79W	43.53364000000	-105.92370000000	BILL BARRETT CORPORATION	FEDERAL 14-7-4175	STO,CBM			
38/10/80W	43.52987000000	-105.88810000000	BILL BARRETT CORPORATION	FEDERAL 41-17-4175	STO,CBM			
38/10/81W	43.51504000000	-105.86810000000	BILL BARRETT CORPORATION	FEDERAL 41-21-4175	STO,CBM			
38/2/80W	43.53357000000	-105.90320000000	BILL BARRETT CORPORATION	FEDERAL 14-8-4175	STO,CBM			
38/2/82W	43.51144000000	-105.86320000000	BILL BARRETT CORPORATION	FEDERAL 12-22-4175	STO,CBM			
38/2/83W	43.50084000000	-105.81790000000	BILL BARRETT CORPORATION	FEDERAL 21-25-4175	STO,CBM			
38/3/80W	43.54461000000	-105.89820000000	BILL BARRETT CORPORATION	FEDERAL 21-8-4175	STO,CBM			
38/3/82W	43.50422000000	-105.86330000000	BILL BARRETT CORPORATION	FEDERAL 14-22-4175	STO,CBM			
38/3/84W	43.50074000000	-105.84830000000	BILL BARRETT CORPORATION	FEDERAL 41-27-4175	STO,CBM			
38/4/80W	43.53725000000	-105.89820000000	BILL BARRETT CORPORATION	FEDERAL 23-8-4175	STO,CBM			
38/4/81W	43.52995000000	-105.91850000000	BILL BARRETT CORPORATION	FEDERAL 21-18-4175	STO,CBM			
38/4/82W	43.51512000000	-105.85810000000	BILL BARRETT CORPORATION	FEDERAL 21-22-4175	STO,CBM			
38/4/83W	43.50819000000	-105.80780000000	BILL BARRETT CORPORATION	FEDERAL 43-24-4175	STO,CBM			
38/5/79W	43.55563000000	-105.92370000000	BILL BARRETT CORPORATION	FEDERAL 12-6-4175	STO,CBM			
38/5/80W	43.53356000000	-105.89310000000	BILL BARRETT CORPORATION	FEDERAL 34-8-4175	STO,CBM			
38/5/81W	43.52261000000	-105.91860000000	BILL BARRETT CORPORATION	FEDERAL 23-18-4175	STO,CBM			
38/5/82W	43.50789000000	-105.85820000000	BILL BARRETT CORPORATION	FEDERAL 23-22-4175	STO,CBM			
38/5/83W	43.50451000000	-105.81290000000	BILL BARRETT CORPORATION	FEDERAL 34-24-4175	STO,CBM			
38/6/79W	43.55929000000	-105.91850000000	BILL BARRETT CORPORATION	FEDERAL 21-6-4175	STO,CBM			
38/6/80W	43.52988000000	-105.89820000000	BILL BARRETT CORPORATION	FEDERAL 21-17-4175	STO,CBM			
38/6/81W	43.51891000000	-105.91350000000	BILL BARRETT CORPORATION	FEDERAL 34-18-4175	STO,CBM			
38/6/82W	43.51157000000	-105.85320000000	BILL BARRETT CORPORATION	FEDERAL 32-22-4175	STO,CBM			
38/7/79W	43.55927000000	-105.90840000000	BILL BARRETT CORPORATION	FEDERAL 41-6-4175	STO,CBM			
38/7/80W	43.52252000000	-105.89830000000	BILL BARRETT CORPORATION	FEDERAL 23-17-4175	STO,CBM			
38/7/81W	43.51153000000	-105.89340000000	BILL BARRETT CORPORATION	FEDERAL 32-20-4175	STO,CBM			
38/7/82W	43.50432000000	-105.85330000000	BILL BARRETT CORPORATION	FEDERAL 34-22-4175	STO,CBM			
38/8/79W	43.55195000000	-105.90830000000	BILL BARRETT CORPORATION	FEDERAL 43-6-4175	STO,CBM			
38/8/80W	43.52619000000	-105.89320000000	BILL BARRETT CORPORATION	FEDERAL 32-17-4175	STO,CBM			
38/8/81W	43.51145000000	-105.87320000000	BILL BARRETT CORPORATION	FEDERAL 32-21-4175	STO,CBM			
38/8/82W	43.51526000000	-105.84820000000	BILL BARRETT CORPORATION	FEDERAL 41-22-4175	STO,CBM			
38/9/79W	43.54097000000	-105.92370000000	BILL BARRETT CORPORATION	FEDERAL 12-7-4175	STO,CBM			
38/9/80W	43.51883000000	-105.89320000000	BILL BARRETT CORPORATION	FEDERAL 34-17-4175	STO,CBM			
38/9/81W	43.50422000000	-105.87340000000	BILL BARRETT CORPORATION	FEDERAL 34-21-4175	STO,CBM			
38/9/82W	43.50800000000	-105.84820000000	BILL BARRETT CORPORATION	FEDERAL 43-22-4175	STO,CBM			
38/9/83W	43.50065000000	-105.85830000000	BILL BARRETT CORPORATION	FEDERAL 21-27-4175	STO,CBM			
P135571W	43.57396000000	-105.78790000000	YATES PETROLEUM CORPORATION	McPARTLIN CS FEE #1	STO,CBM			
P135572W	43.57391000000	-105.79800000000	YATES PETROLEUM CORPORATION	McPARTLIN CS FEE #2	STO,CBM			
P135573W	43.57024000000	-105.80300000000	YATES PETROLEUM CORPORATION	McPARTLIN CS FEE #3	STO,CBM			
P135574W	43.57030000000	-105.79290000000	YATES PETROLEUM CORPORATION	MCPARTLIN CS FEE #4	STO,CBM			
P135873W	43.51872000000	-105.87310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-15	STO,CBM	25	1162	518
P135874W	43.52239000000	-105.86810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-9	STO,CBM	25	1122	486
P135938W	43.57049000000	-105.76760000000	YATES PETROLEUM CORP.	OLSWICK CS FEE #5	STO,CBM			
P135939W	43.57403000000	-105.77770000000	YATES PETROLEUM CORP.	OLSWICK CS FEE #6	STO,CBM			
P135940W	43.56674000000	-105.78280000000	YATES PETROLEUM CORP.	OLSWICK CS FEE #7	STO,CBM			
P135941W	43.57045000000	-105.77270000000	YATES PETROLEUM CORP.	OLSWICK CS FEE #8	STO,CBM			
P136024W	43.61758000000	-105.80760000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 13 S-1	STO,CBM	25	1284	849
P136025W	43.61384000000	-105.81270000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 13 S-7	STO,CBM	25	1313	952
P136026W	43.61029000000	-105.80760000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 13 S-9	STO,CBM	25	1251	902
P136028W	43.61007000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 14 S- 9	STO,CBM	25	1205	755
P136029W	43.61039000000	-105.83870000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 14 S- 11	STO,CBM	25	1203	739
P136030W	43.60686000000	-105.84400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 14 S- 13	STO,CBM	25	1220	500

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P136031W	43.60656000000	-105.83350000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 14S- 15	STO,CBM	25	1182	682
P136032W	43.60275000000	-105.82820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 23 S- 1	STO,CBM	25	1272	343
P136033W	43.59924000000	-105.83330000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 23 S- 7	STO,CBM	25	1280	404
P136034W	43.59544000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 23 S- 9	STO,CBM	25	1346	462
P136035W	43.59193000000	-105.83310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 23 S- 15	STO,CBM	25	1295	775
P136036W	43.60304000000	-105.80770000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 24 S- 1	STO,CBM	25	1200	731
P136037W	43.59932000000	-105.81280000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 24S- 7	STO,CBM	25	1234	734
P136038W	43.59583000000	-105.80770000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 24 S- 9	STO,CBM	25	1185	716.47
P136039W	43.59208000000	-105.81280000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 24 S- 15	STO,CBM	25	1218	874
P136040W	43.58812000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 26S- 1	STO,CBM	25	1255	1073
P136041W	43.58455000000	-105.83310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 26 S- 7	STO,CBM	25	1280	390
P136042W	43.57714000000	-105.83310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 26 S- 15	STO,CBM	25	1260	800
P136043W	43.54089000000	-105.87310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER 9S-7	STO,CBM	25	1050	356
P136044W	43.54456000000	-105.84810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER 10S-1	STO,CBM	25	1086	839
P136045W	43.54454000000	-105.85810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER 10S-3	STO,CBM	25	1076	746
P136046W	43.53724000000	-105.84810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 10S-9	STO,CBM	25	971	625
P136047W	43.53720000000	-105.85810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 10S-11	STO,CBM	25	1032	755
P136048W	43.53349000000	-105.86310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 10S-13	STO,CBM	25	1062	778
P136049W	43.53354000000	-105.85310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 10S-15	STO,CBM	25	1024	700
P136050W	43.52245000000	-105.87810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-11	STO,CBM	25	1162	390
P136051W	43.54087000000	-105.86310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER 10S-5	STO,CBM	25	1131	390
P136052W	43.52979000000	-105.86810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-1	STO,CBM	25	905	264
P136053W	43.52984000000	-105.87810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-3	STO,CBM	25	1044	941
P136054W	43.52617000000	-105.88310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-5	STO,CBM	25	1176	329
P136055W	43.52611000000	-105.87310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-7	STO,CBM	25	1107	562
P136057W	43.51879000000	-105.88310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE WI MOORE 16S-13	STO,CBM	25	1184	503
P136058W	43.54820000000	-105.86310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE (WALKER) 3S-13	STO,CBM	25	1142	300
P136060W	43.53351000000	-105.87310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 9S-15	STO,CBM			
P136061W	43.54089000000	-105.85310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WI MOORE 10S-7	STO,CBM	25	1064	390
P137057W	43.58488000000	-105.78800000000	YATES PETROLEUM CORP.	MCCONNELL CS FEE #1	STO,CBM			
P137058W	43.58490000000	-105.79290000000	YATES PETROLEUM CORP.	McCONNELL CS FEE #2	STO,CBM			
P137059W	43.58123000000	-105.78800000000	YATES PETROLEUM CORP.	McCONNELL CS FEE #3	STO,CBM			
P137060W	43.57758000000	-105.79290000000	YATES PETROLEUM CORP.	McCONNELL CS FEE #4	STO,CBM			
P137785W	43.56663000000	-105.79790000000	DEVON ENERGY PRODUCTION COMPANY, L.P	STATE ARCHIBALD 31S-11	STO,CBM	25	1038	526
P137786W	43.56643000000	-105.84810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 34S-9	STO,CBM	25	1188	390
P137787W	43.56284000000	-105.85310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 34S-15	STO,CBM	25	1146	598
P137788W	43.56282000000	-105.86310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 34S-13	STO,CBM	25	1161	408.92
P137789W	43.56643000000	-105.85810000000	IBERLIN RANCH PARTNERSHIP** DEVON EN	IBERLIN 34S-11	STO,CBM	25	1215	673
P139473W	43.54822000000	-105.85310000000	DEVON ENERGY PRODUCTION COMPANY, L.P	WALKER FEDERAL 3S-15	STO,CBM			
P140449W	43.60319000000	-105.76740000000	YATES PETROLEUM CORP.	STEVE CS FEE #1	STO,CBM			
P140450W	43.59952000000	-105.77260000000	YATES PETROLEUM CORP.	STEVE CS FEE #2	STO,CBM			
P140455W	43.55963000000	-105.75770000000	YATES PETROLEUM CORP.	DIETZ CS FEE #1	STO,CBM			
P140456W	43.55593000000	-105.76270000000	YATES PETROLEUM CORP.	DIETZ CS FEE #2	STO,CBM			
P140457W	43.55228000000	-105.75760000000	YATES PETROLEUM CORP.	DIETZ CS FEE #3	STO,CBM			
P140458W	43.54859000000	-105.76260000000	YATES PETROLEUM CORP.	DIETZ CS FEE #4	STO,CBM			
P144387W	43.59222000000	-105.79290000000	YATES PETROLEUM CORPORATION	OLSWICK CS FEE # 4	STO,CBM			
P145923W	43.61058000000	-105.87900000000	WY STATE BOARD OF LAND COMMISSIONERS	STATE(T CHAIR) 16S-11	STO,CBM			
P149130W	43.57755000000	-105.80290000000	YATES PETROLEUM CORPORATION	CRITTENDON CS FEDERAL #4	STO,CBM			
P150093W	43.58494000000	-105.80280000000	YATES PETROLEUM CORPORATION	CRITTENDON CS FEDERAL # 2	STO,CBM			
P150371W	43.56304000000	-105.79290000000	YATES PETROLEUM CORPORATION	SIOUX CS FEDERAL # 2	STO,CBM	200	1048	811
P150372W	43.59949000000	-105.80270000000	YATES PETROLEUM CORPORATION	CAVALRY CS FEDERAL # 2	STO,CBM			
P150373W	43.59228000000	-105.80280000000	YATES PETROLEUM CORPORATION	CAVALRY CS FEDERAL # 4	STO,CBM			

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P152613W	43.57051000000	-105.76260000000	YATES PETROLEUM CORP.	LOOK CS #1	STO,CBM	200	871	699
P154203W	43.61038000000	-105.78790000000	YATES PETROLEUM CORP.	PRATHER CS #1	STO,CBM	200	1202	851
P154204W	43.61035000000	-105.79780000000	YATES PETROLEUM CORP.	PRATHER CS #2	STO,CBM	200	1239	1002
P154205W	43.60671000000	-105.80270000000	YATES PETROLEUM CORP.	PRATHER CS #3	STO,CBM	200	1185	941
P154207W	43.59947000000	-105.79290000000	YATES PETROLEUM CORP.	OLSWICK CS FEE #2	STO,CBM	200	1038	877
P155673W	43.63224000000	-105.82820000000	DEVON ENERGY PRODUCTION COMPANY, L.P	COSNER 11S-1	STO,CBM	25	1269	500
P155674W	43.63243000000	-105.83900000000	DEVON ENERGY PRODUCTION COMPANY, L.P	COSNER 11S-3	STO,CBM	25	1222	384
P155675W	43.62888000000	-105.84400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	COSNER 11S-5	STO,CBM	25	1192	404
P155676W	43.62479000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 11S-9	STO,CBM	25	1231	583
P155677W	43.62510000000	-105.83880000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 11S-11	STO,CBM	25	1192	534
P155678W	43.62162000000	-105.84390000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 11S-13	STO,CBM	25	1194	708
P155679W	43.62864000000	-105.83360000000	DEVON ENERGY PRODUCTION COMPANY, L.P	COSNER 11S-7	STO,CBM	25	1226	454
P155680W	43.62126000000	-105.83340000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN 11S-15	STO,CBM	25	1232	630
P155710W	43.60681000000	-105.77260000000	WILLIAMS PRODUCTION RMT COMPANY	ANCU NINE MILE LAND 34-17-4274	STO,CBM	17	1120	769
P158876W	43.57762000000	-105.78290000000	YATES PETROLEUM CORP.	BIGHORN CS FEDERAL #4	STO,CBM			
P159666W	43.61405000000	-105.78280000000	WILLIAMS PRODUCTION RMT COMPANY	ANCU 12-17-4274	STO,CBM	13	1195	928
P159667W	43.60675000000	-105.78290000000	WILLIAMS PRODUCTION RMT COMPANY	ANCU 14-17-4274	STO,CBM	13	1093	1027
P159669W	43.61043000000	-105.77770000000	WILLIAMS PRODUCTION RMT COMPANY	ANCU 23-17-4274	STO,CBM	15	1160	1050
P159678W	43.59225000000	-105.76250000000	WILLIAMS PRODUCTION RMT COMPANY	ANCU 14-21-4274	STO,CBM			
P161016W	43.61739000000	-105.82810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 14S-1	STO,CBM	25	1251	835
P161017W	43.60638000000	-105.82300000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 13S-13	STO,CBM	25	1222	1102
P161018W	43.61011000000	-105.81780000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 13S-11	STO,CBM	25	1218	940
P161019W	43.61368000000	-105.82290000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 13S-5	STO,CBM	25	1299	1006
P161020W	43.61741000000	-105.81780000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 13S-3	STO,CBM	25	1271	949
P161021W	43.62116000000	-105.81270000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDERAL 12S-15	STO,CBM	25	1305	930
P161026W	43.61777000000	-105.83870000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDEAL 14S-3	STO,CBM	25	1190	786
P161027W	43.61426000000	-105.84400000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDEAL 14S-5	STO,CBM	25	1260	770
P161028W	43.61390000000	-105.83340000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDEAL 14S-7	STO,CBM	25	1195	804
P161029W	43.58447000000	-105.82300000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDEAL 25S-5	STO,CBM	25	1178	1017
P161030W	43.58858000000	-105.84810000000	DEVON ENERGY PRODUCTION COMPANY, L.P	IBERLIN FEDEAL 27S-1	STO,CBM	25	1231	775
P161649W	43.53725000000	-105.83810000000	BILL BARRETT CORPORATION	WALKER CREEK 23-11-4175	STO,CBM			
P161650W	43.54091000000	-105.83310000000	BILL BARRETT CORPORATION	MOORE WIRC 32-11-4175	STO,CBM			
P161651W	43.54457000000	-105.83810000000	BILL BARRETT CORPORATION	WALKER CREEK 21-11-4175	STO,CBM			
P161652W	43.53725000000	-105.83310000000	BILL BARRETT CORPORATION	MOORE WIRC 33-11-4175	STO,CBM			
P164090W	43.50443000000	-105.82300000000	BILL BARRETT CORPORATION	MOORE WIRC 14-24-4175	STO,CBM			
P164238W	43.55562000000	-105.91850000000	BILL BARRETT CORPORATION	IBERLIN 22-6-4175	STO,CBM			
P164239W	43.55561000000	-105.91340000000	BILL BARRETT CORPORATION	IBERLIN 32-6-4175	STO,CBM			
P164240W	43.54462000000	-105.91850000000	BILL BARRETT CORPORATION	IBERLIN 21-7-4175	STO,CBM			
P164241W	43.54094000000	-105.91340000000	BILL BARRETT CORPORATION	IBERLIN 32-7-4175	STO,CBM			
P164242W	43.53730000000	-105.92370000000	BILL BARRETT CORPORATION	IBERLIN 33-7-4175	STO,CBM			
P164243W	43.54094000000	-105.91340000000	BILL BARRETT CORPORATION	IBERLIN 42-7-4175	STO,CBM			
P164244W	43.53725000000	-105.90830000000	BILL BARRETT CORPORATION	IBERLIN 43-7-4175	STO,CBM			
P164245W	43.54092000000	-105.90320000000	BILL BARRETT CORPORATION	IBERLIN 12-8-4175	STO,CBM			
P166781W	43.50788000000	-105.88840000000	BILL BARRETT CORPORATION	OGALALLA LAND 43-20-4175	STO,CBM			
P166783W	43.50078000000	-105.82810000000	BILL BARRETT CORPORATION	MOORE WIRC 41-26-4175	STO,CBM			
P167682W	43.55196000000	-105.91850000000	BILL BARRETT CORPORATION	IBERLIN 23-6-4175	STO,CBM			
P167683W	43.52255000000	-105.90840000000	BILL BARRETT CORPORATION	IBERLIN 43-18-4175	STO,CBM			
P167684W	43.54830000000	-105.92370000000	BILL BARRETT CORPORATION	IBERLIN 14-6-4175	STO,CBM			
P167685W	43.52625000000	-105.91350000000	BILL BARRETT CORPORATION	IBERLIN 32-18-4175	STO,CBM			
P167686W	43.52990000000	-105.90830000000	BILL BARRETT CORPORATION	IBERLIN 41-18-4175	STO,CBM			
P167687W	43.51886000000	-105.90340000000	BILL BARRETT CORPORATION	IBERLIN 14-17-4175	STO,CBM			
P167688W	43.52621000000	-105.90330000000	BILL BARRETT CORPORATION	IBERLIN 12-17-4175	STO,CBM			

PERMIT	LATITUDE	LONGITUDE	APPLICANT	FACILITY NAME	USES	YIELD	WELL DEPTH	STATIC DEPTH
P167689W	43.54828000000	-105.91340000000	BILL BARRETT CORPORATION	IBERLIN 34-6-4175	STO,CBM			
P167789W	43.51893000000	-105.84320000000	BILL BARRETT CORPORATION	FEDERAL 14-14-4175	STO,CBM			
P167790W	43.52259000000	-105.83820000000	BILL BARRETT CORPORATION	FEDERAL 23-14-4175	STO,CBM			
P167791W	43.52625000000	-105.83310000000	BILL BARRETT CORPORATION	FEDERAL 32-14-4175	STO,CBM			
P167792W	43.51892000000	-105.83310000000	BILL BARRETT CORPORATION	FEDERAL 34-14-4175	STO,CBM			
P167793W	43.52991000000	-105.82810000000	BILL BARRETT CORPORATION	FEDERAL 41-14-4175	STO,CBM			
P167794W	43.52258000000	-105.82810000000	BILL BARRETT CORPORATION	FEDERAL 43-14-4175	STO,CBM			
P167795W	43.51871000000	-105.86310000000	BILL BARRETT CORPORATION	FEDERAL 14-15-4175	STO,CBM			
P167796W	43.52246000000	-105.85810000000	BILL BARRETT CORPORATION	FEDERAL 23-15-4175	STO,CBM			
P167797W	43.51884000000	-105.85320000000	BILL BARRETT CORPORATION	FEDERAL 34-15-4175	STO,CBM			
P167798W	43.52257000000	-105.84820000000	BILL BARRETT CORPORATION	FEDERAL 43-15-4175	STO,CBM			
P167799W	43.51166000000	-105.84320000000	BILL BARRETT CORPORATION	FEDERAL 12-23-4175	STO,CBM			
P167800W	43.50440000000	-105.84320000000	BILL BARRETT CORPORATION	FEDERAL 14-23-4175	STO,CBM			
P167801W	43.51528000000	-105.83820000000	BILL BARRETT CORPORATION	FEDERAL 21-23-4175	STO,CBM			
P167802W	43.50803000000	-105.83820000000	BILL BARRETT CORPORATION	FEDERAL 23-23-4175	STO,CBM			
P167803W	43.51165000000	-105.83310000000	BILL BARRETT CORPORATION	FEDERAL 32-23-4175	STO,CBM			
P167804W	43.50440000000	-105.83310000000	BILL BARRETT CORPORATION	FEDERAL 34-23-4175	STO,CBM			
P167805W	43.51526000000	-105.82810000000	BILL BARRETT CORPORATION	FEDERAL 41-23-4175	STO,CBM			
P167806W	43.50802000000	-105.82810000000	BILL BARRETT CORPORATION	FEDERAL 43-23-4175	STO,CBM			
P167807W	43.51177000000	-105.81290000000	BILL BARRETT CORPORATION	FEDERAL 32-24-4175	STO,CBM			
P167808W	43.51545000000	-105.80780000000	BILL BARRETT CORPORATION	FEDERAL 41-24-4175	STO,CBM			
P167810W	43.50077000000	-105.83820000000	BILL BARRETT CORPORATION	FEDERAL 21-26-4175	STO,CBM			