K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_1-1 Land Use.mxd - 3/21/2012 @ 10:58:36 PM

LEGEND

- Proposed Marsland Satellite Plant Centroid
- Compass Sector Boundary
- Proposed Marsland Expansion Area
- Area of Review
- Nebraska National Forest Boundary

Land Use*

- Cropland
- Drainage/Potential Wetland
- Forest Land
- Rangeland
- Recreational Land

* Land use data were interpreted from aerial image. The delineation of "Drainage/Potential Wetland" type also referenced NHD Flowlines and NWI Wetland Dataset.

N

0 2,250 4,500

Feet

PROJECTION: NAD1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: USDA NAIP IMAGERY 2010

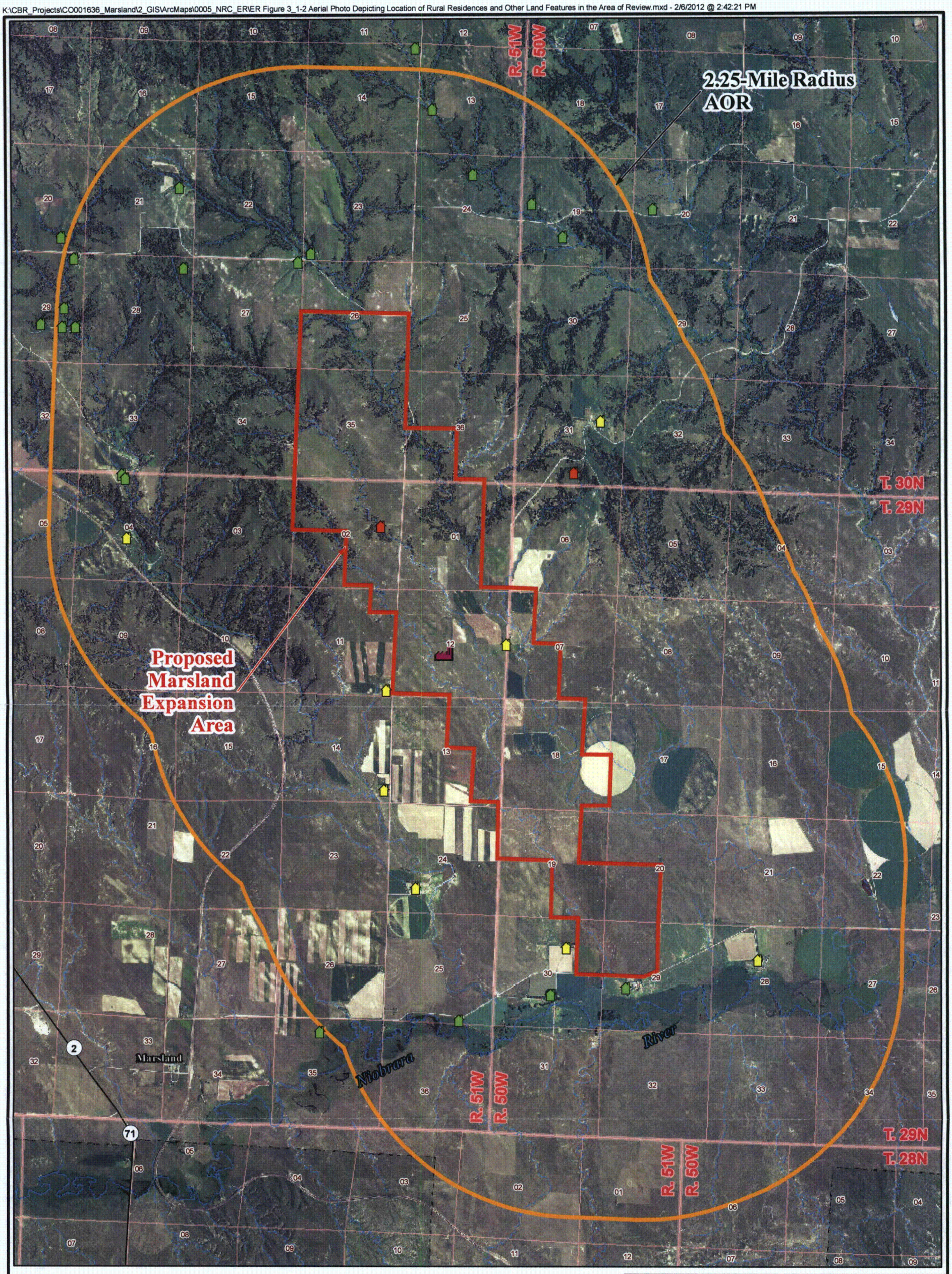
CROW BUTTE RESOURCES, INC.

FIGURE 3.1-1
MARSLAND EXPANSION AREA
LAND USE

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_1-2 Aerial Photo Depicting Location of Rural Residences and Other Land Features in the Area of Review.mxd - 2/6/2012 @ 2:42:21 PM



LEGEND

- Structure
- Satellite Plant
- Occupied Residence
- Unoccupied Residence
- Proposed Marsland Expansion Area
- Area of Review (AOR)
- Intermittent Stream/River
- Perennial Stream/River

N

0 3,000 6,000
Feet

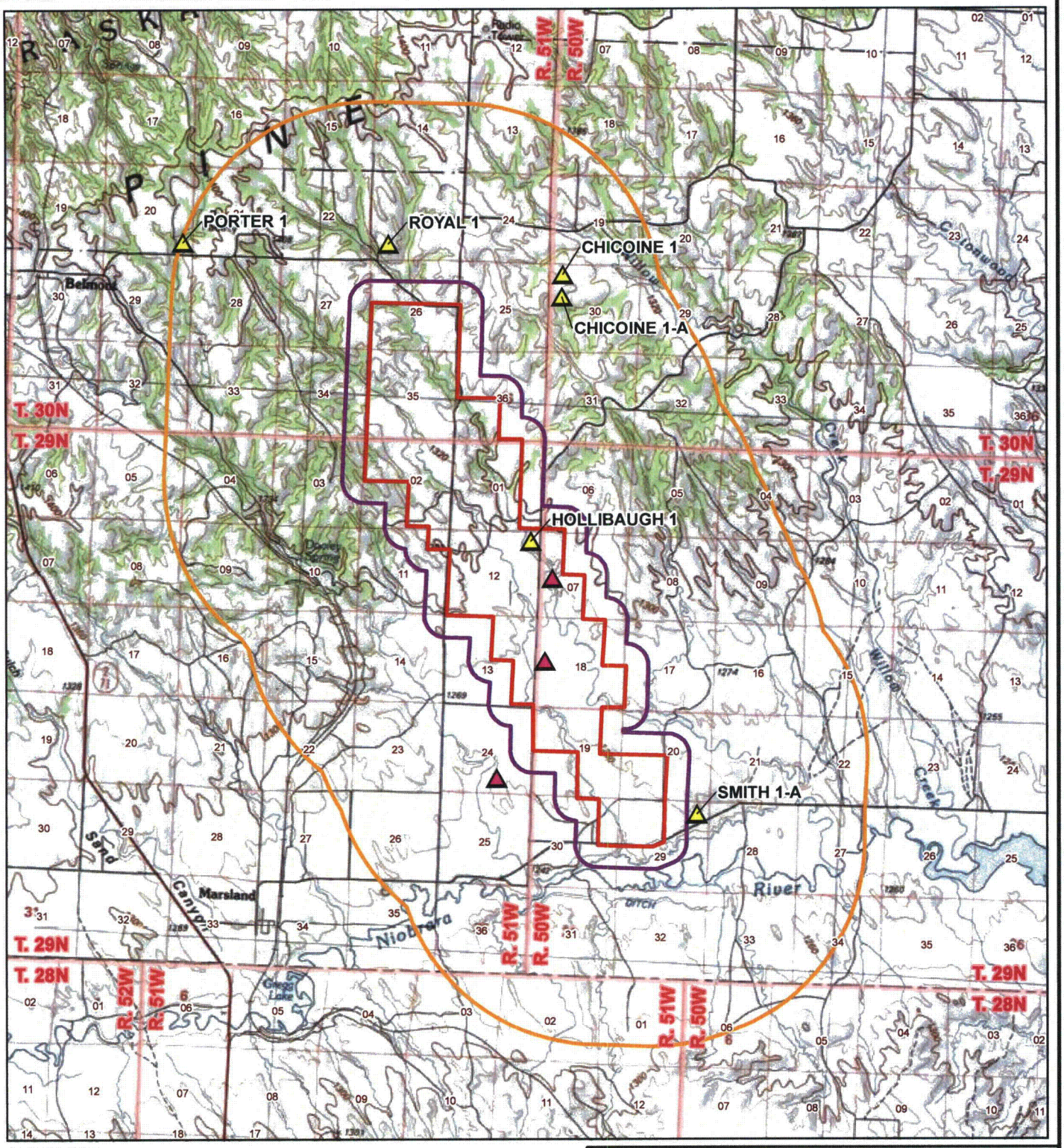
PROJECTION: NAD1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: USDA NAIP IMAGERY 2010

CROW BUTTE RESOURCES, INC.

FIGURE 3.1-2
AERIAL PHOTO DEPICTING LOCATION OF RURAL RESIDENCES AND OTHER LAND FEATURES IN THE AREA OF REVIEW

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: J. CEARLEY

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com



LEGEND

- Sand/Gravel Pit, Inactive
- Dry Hole, Dry and Abandoned
- Proposed Marsland Expansion Area
- ZOEI Boundary (1/4-mile fixed radius)
- AOR Boundary (2-mile fixed radius)

ZOEI = Zone of Endangering Influence
AOR = Area of Review

Sources for Sand/Gravel Pits

1. Dawes County, (http://dawes.assessor.gisworkshop.com/Assessor/index.jsp), Accessed on 08/03/2011, and
2. Burchett, R.R. 1971. Directory of Nebraska Quarries, Pits and Mines. Resource Report Number 5. University of Nebraska Conservation and Survey Division, Lincoln. March.

Sources for Oil/Gas Test Holes

Nebraska Oil and Gas Conservation Commission, (http://www.nogcc.ne.gov/NOGCCPublications.aspx), Accessed on 08/01/2011

N

0 4,000 8,000
Feet

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

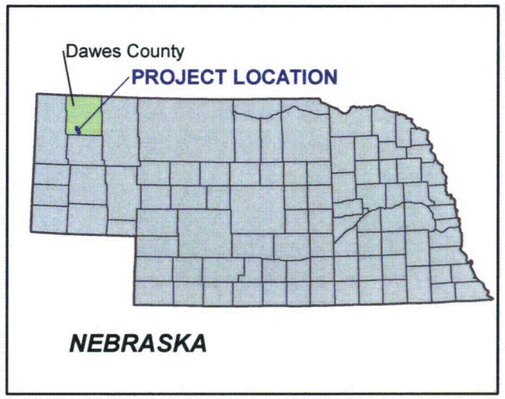
CROW BUTTE RESOURCES, INC.

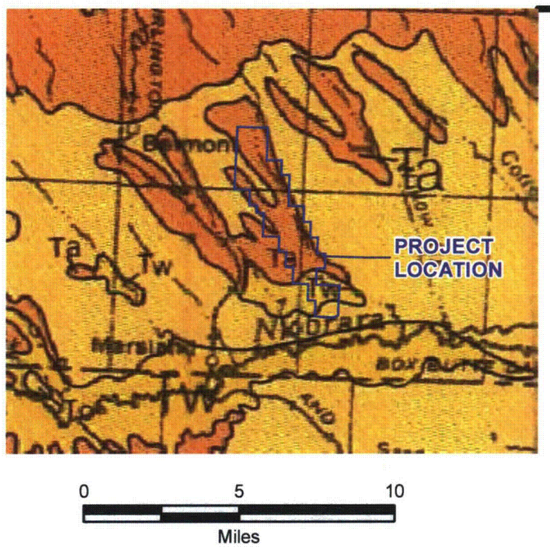
FIGURE 3.1-3
MARSLAND EXPANSION AREA
LOCATIONS OF GRAVEL PITS AND OIL/GAS TEST HOLES

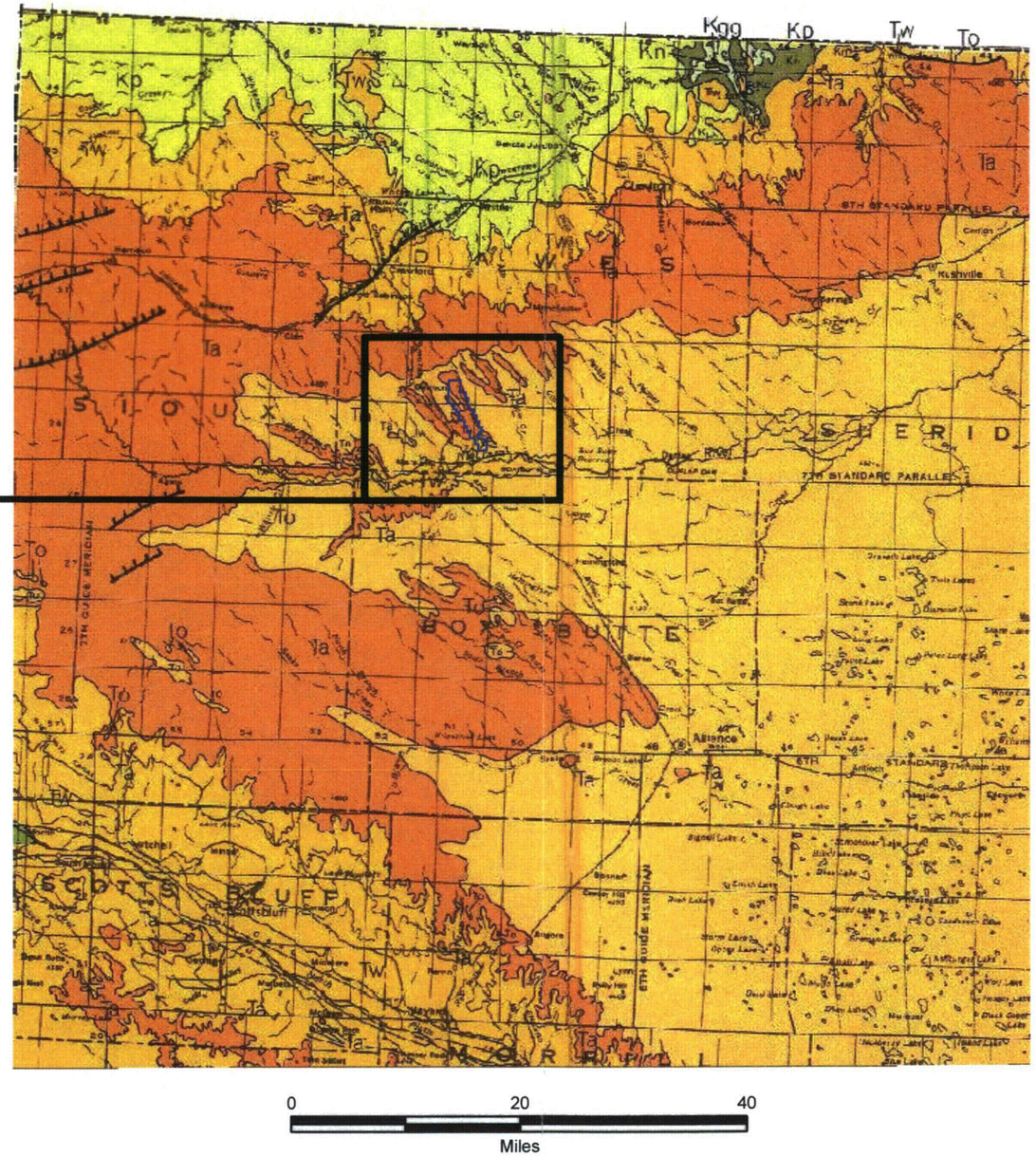
PROJECT: CO001636 MAPPED BY: JC CHECKED BY: J. CEARLEY

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_1-3 Gravel Pits and OG Test Holes.mxd - 3/21/2012 @ 11:15:37 PM







LEGEND

GEOLOGIC PERIOD	SERIES		GROUP OR FORMATION	
TERTIARY	MIOCENE		OGALLALA	To
			ARIKAREE	Ta
	OLIGOCENE		WHITE RIVER	Tw
CRETACEOUS	UPPER CRETACEOUS	MONTANA	Fox Hills	Kf
			Pierre	Kp
		COLORADO	Niobrara	Kn
			Carlile	Kc
			Greenhorn-Graneros	Kgg
	LOWER CRETACEOUS		DAKOTA	Kd
JURASSIC				
PERMIAN	BIG BLUE		CHASE	Pc
			COUNCIL GROVE	Pcg
			ADMIRE	Pa
			WABAUNSEE	Pw
	VIRGIL		SHAWNEE	Ps
			DOUGLAS	Pd
PENNSYLVANIAN	MISSOURI		LANSING	Pl
			KANSAS CITY	Pkc
	DES MOINES		MARMATON	Pm
MISSISSIPPIAN				
DEVONIAN				
SILURIAN				
ORDOVICIAN (Middle & Upper)				
CAMBRIAN & ORDOVICIAN (Lower)				
PRECAMBRIAN				

Source:
Burchett, R.R., 1986, Geologic bedrock map of Nebraska: University of Nebraska Conservation and Survey Division, Geologic Maps and Charts 1, scale 1:1000000.

N

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH FIPS 2601

CROW BUTTE RESOURCES, INC.

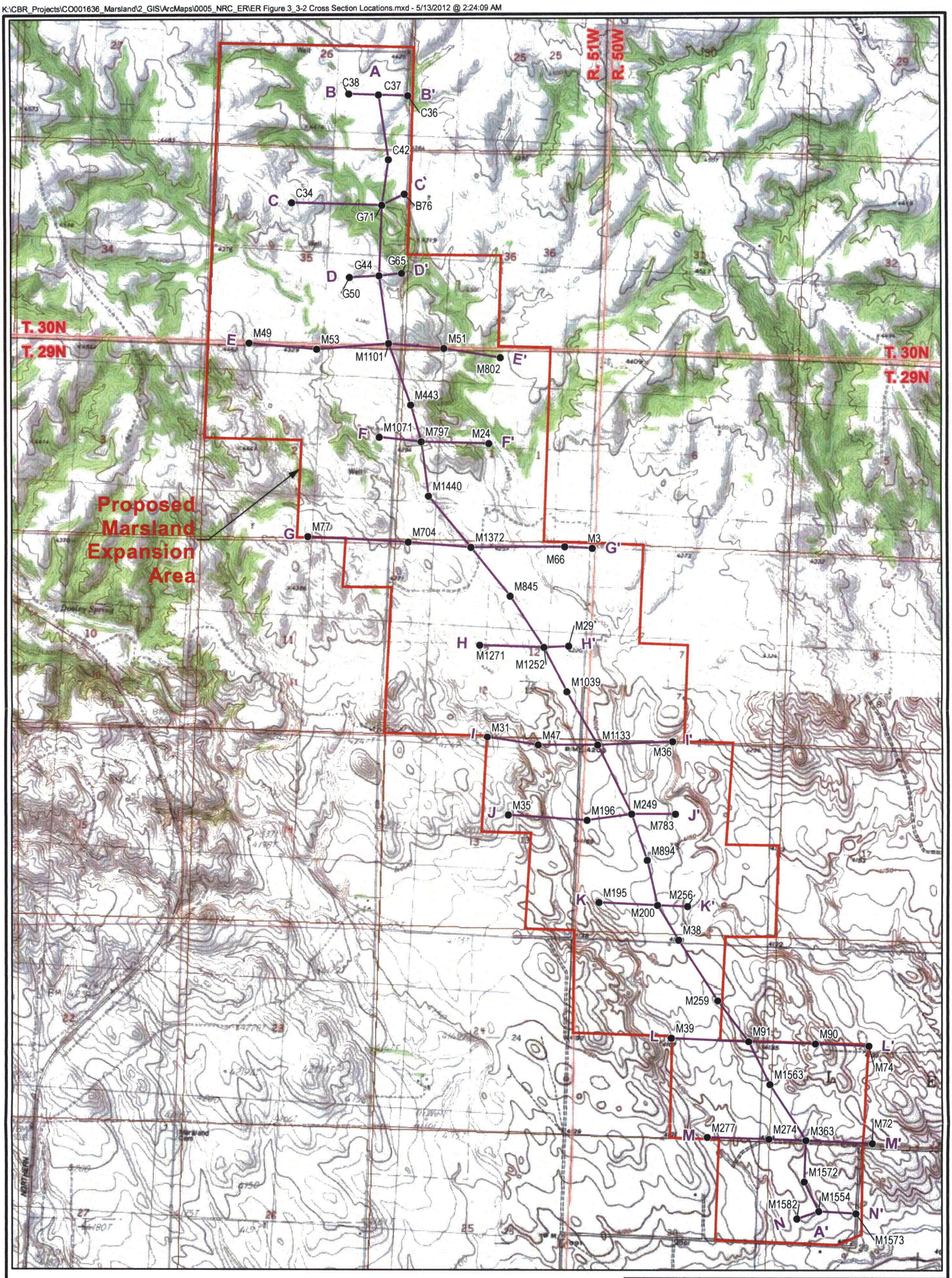
FIGURE 3.3-1
BEDROCK GEOLOGY OF THE MARSLAND EXPANSION AREA

PROJECT: CO001636 | MAPPED BY: JC | CHECKED BY: MS

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-1 Bedrock Geology of the Marsland Expansion Area.mxd - 2/6/2012 @ 3:03:49 PM

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-2 Cross Section Locations.mxd - 5/13/2012 @ 2:24:09 AM



LEGEND

- Borehole
- Cross Section Line
- Proposed Marsland Expansion Area

N

0 1,500 3,000

Feet

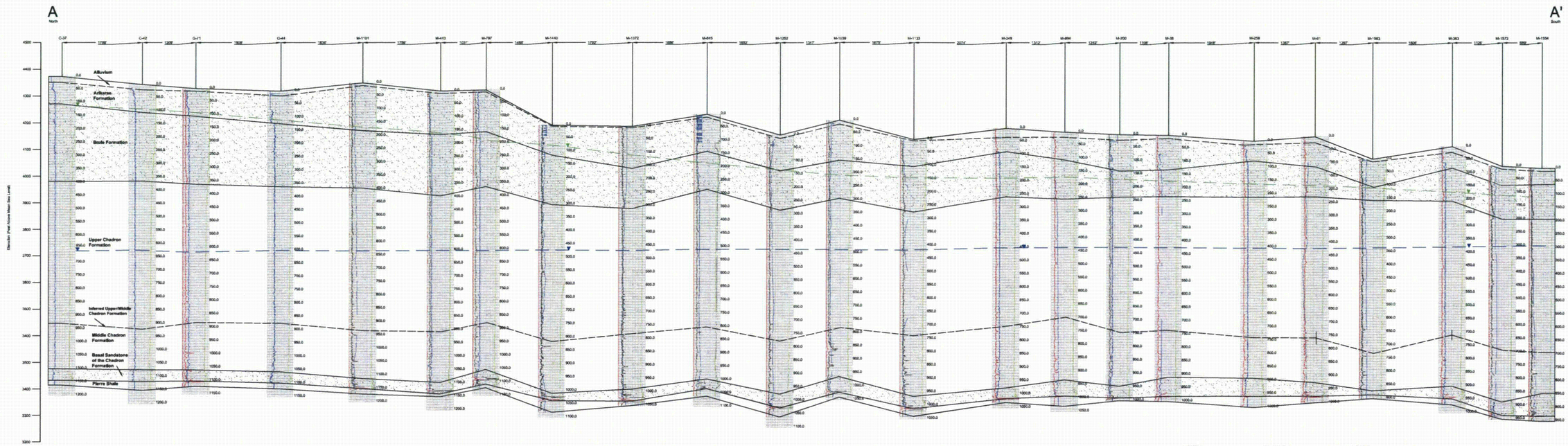
PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-2
MARSLAND CROSS-SECTION MAP SHOWING ARTIFICIAL PENETRATIONS

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com



VERTICAL SCALE
0 50 meters
0 100 200 feet

HORIZONTAL SCALE
0 150 meters
0 300 600 feet

LEGEND
Main Utility Sandstone
Gamma Curve
Neutron or SP Curve
Resistivity Curve
Potentiometric Surface of the Brule Formation
Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

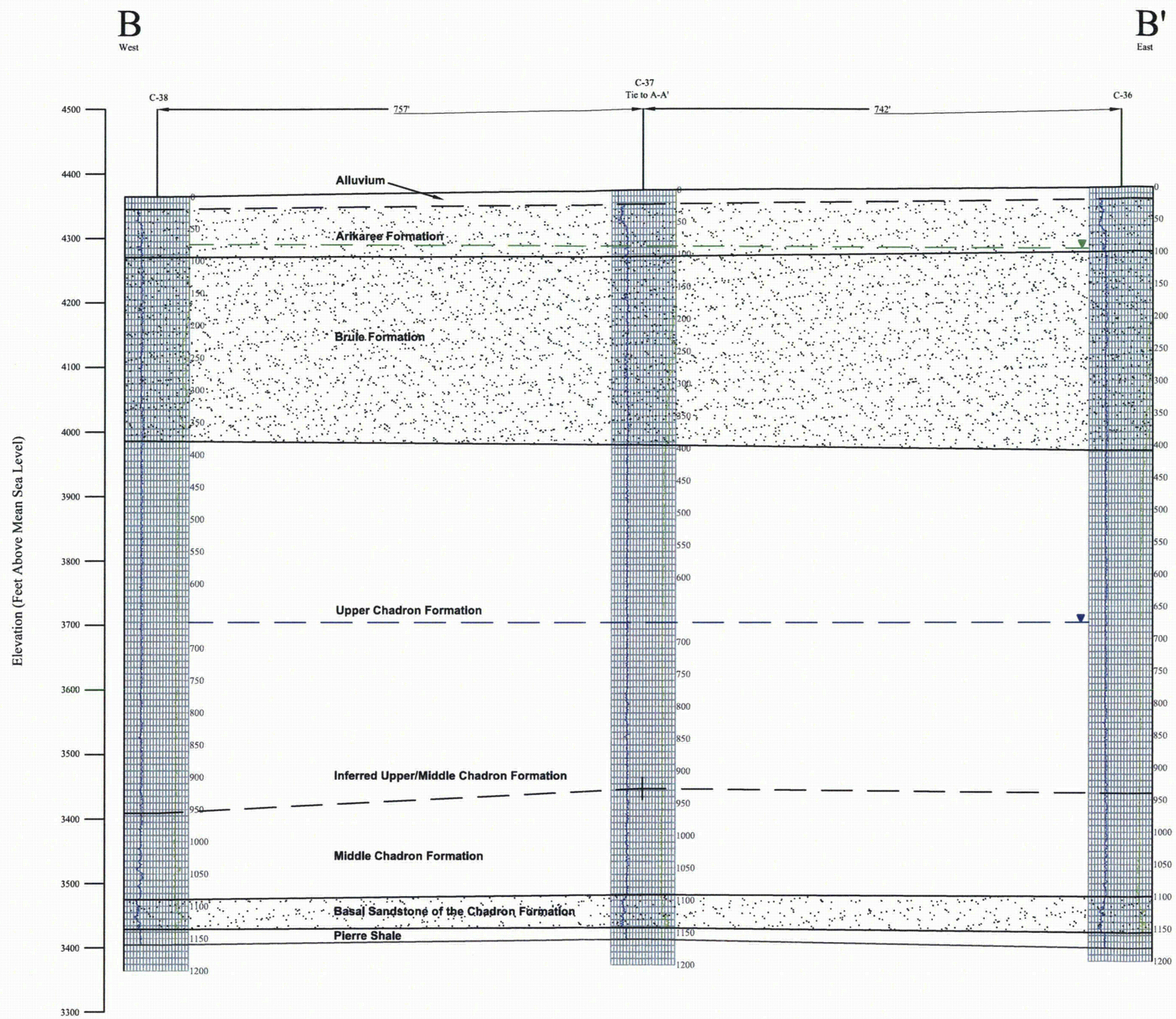
CROW BUTTE RESOURCES, INC.

FIGURE3.3-3a
MARSLAND STRUCTURAL CROSS-SECTION A-A'

PROJECT: CO001638 MAPPED BY: JC CHECKED BY: JA

ARCADIS 680 Pierce Drive, Ste. 100 Parkside Ranch CO 80129 Phone: 303-848-5900 Fax: 303-848-5926 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001638_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3a_A-A'.dwg LAYOUT: Figure 3.3-3a SAVED DATE/TIME: 11/10/2011 1:41 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 50 meters

0 — 100 — 200 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

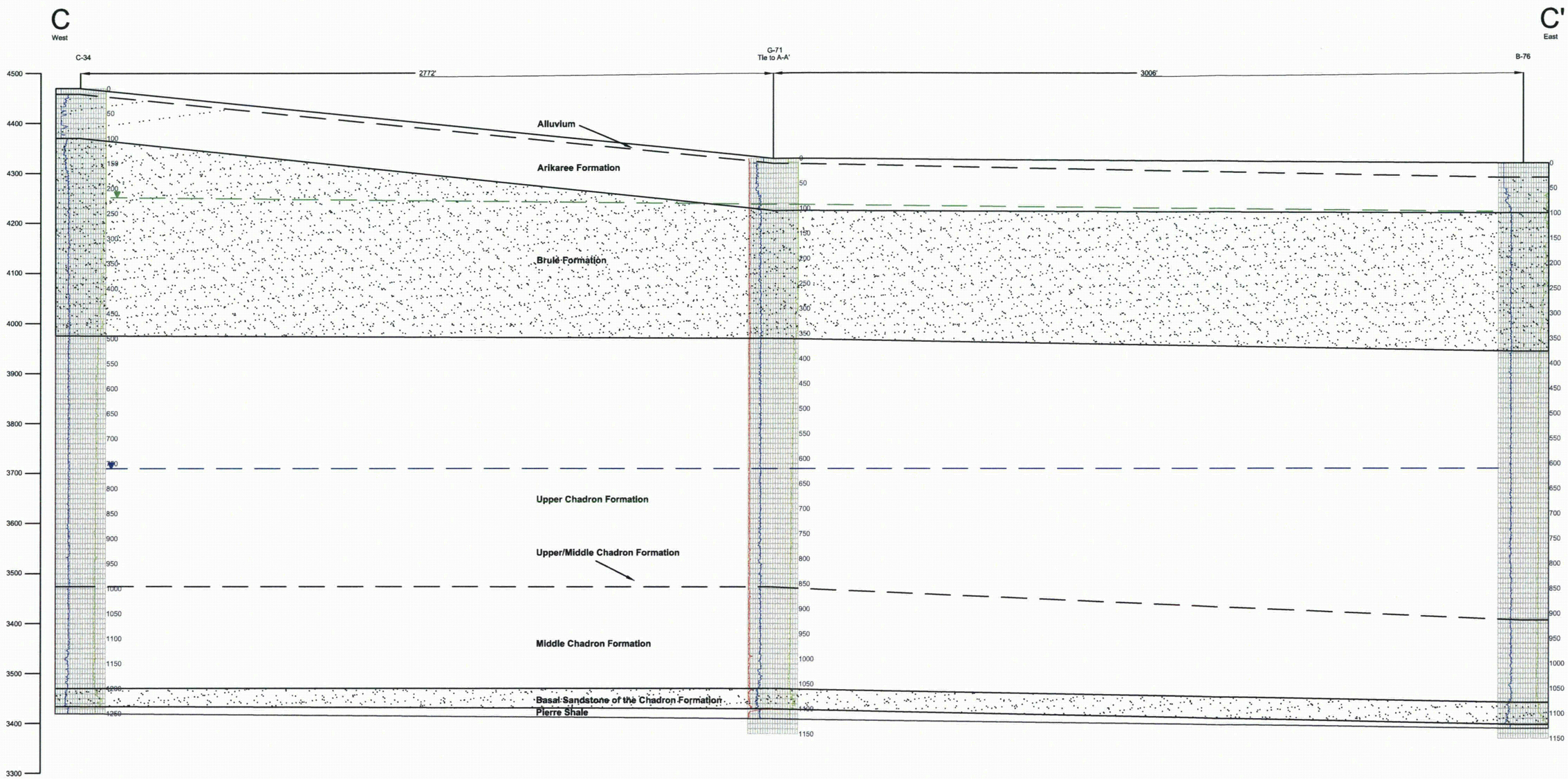
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3b
MARSLAND STRUCTURAL CROSS-SECTION B-B'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3b_B-B'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:45 PM



VERTICAL SCALE
0 — 50 meters
0 — 100 — 200 feet

HORIZONTAL SCALE
0 — 100 meters
0 — 200 — 400 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

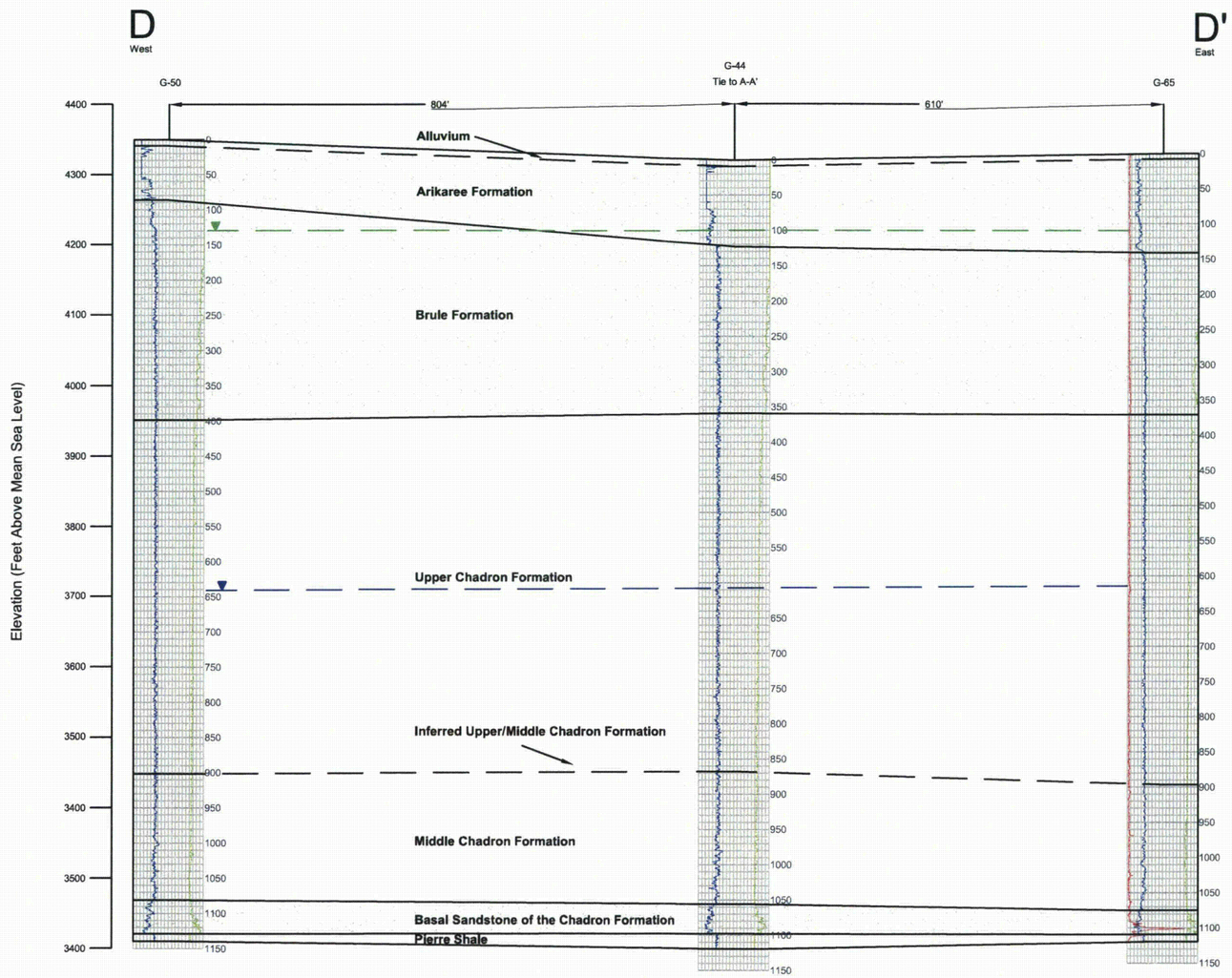
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3c
MARSLAND STRUCTURAL CROSS-SECTION C-C'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3c_C-C'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:47 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 50 meters

0 — 100 — 200 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

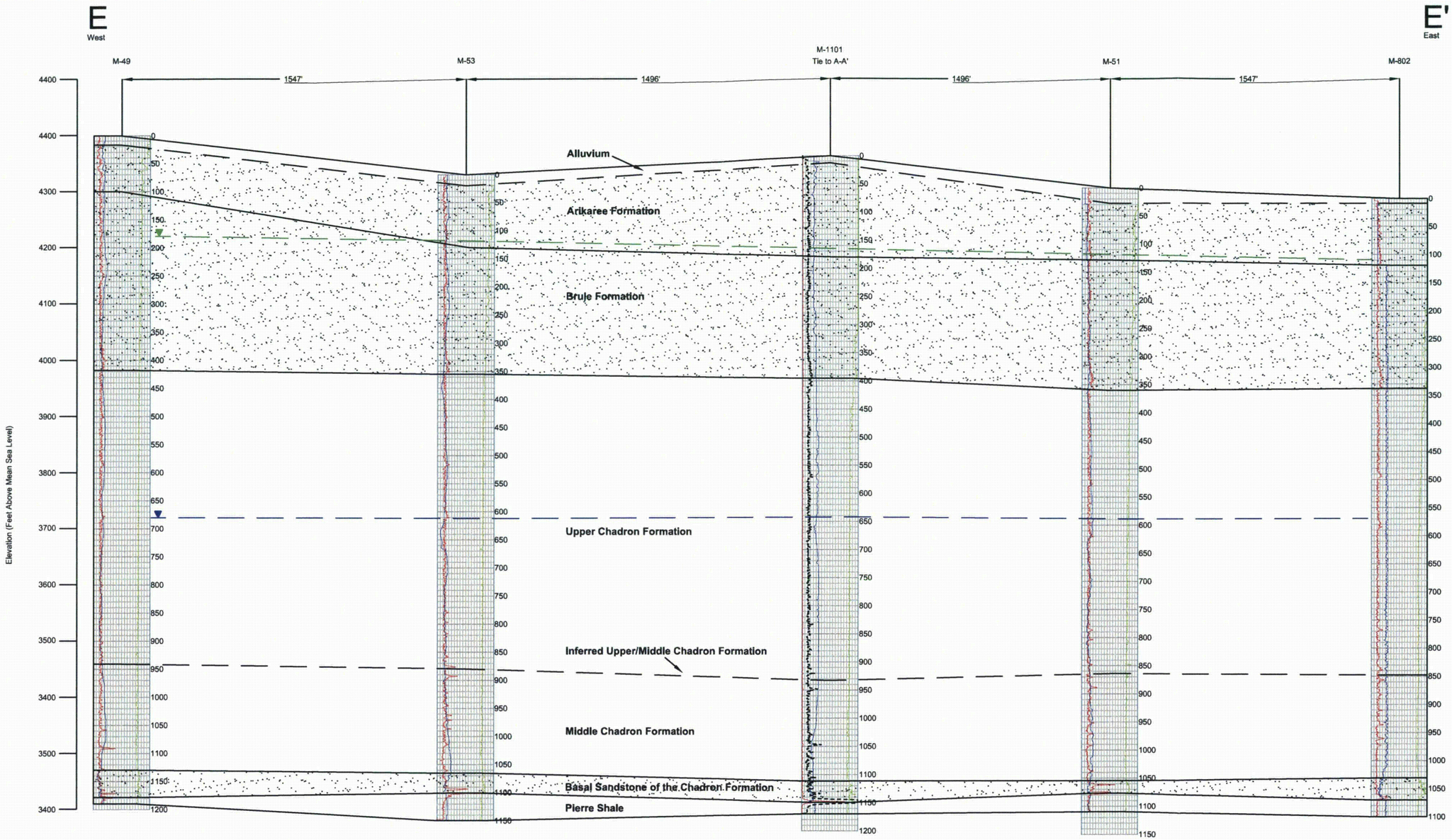
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3d
MARSLAND STRUCTURAL CROSS-SECTION D-D'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3d_D-D'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:49 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 150 meters

0 — 300 — 600 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Sources: Cameco Resources, 2011

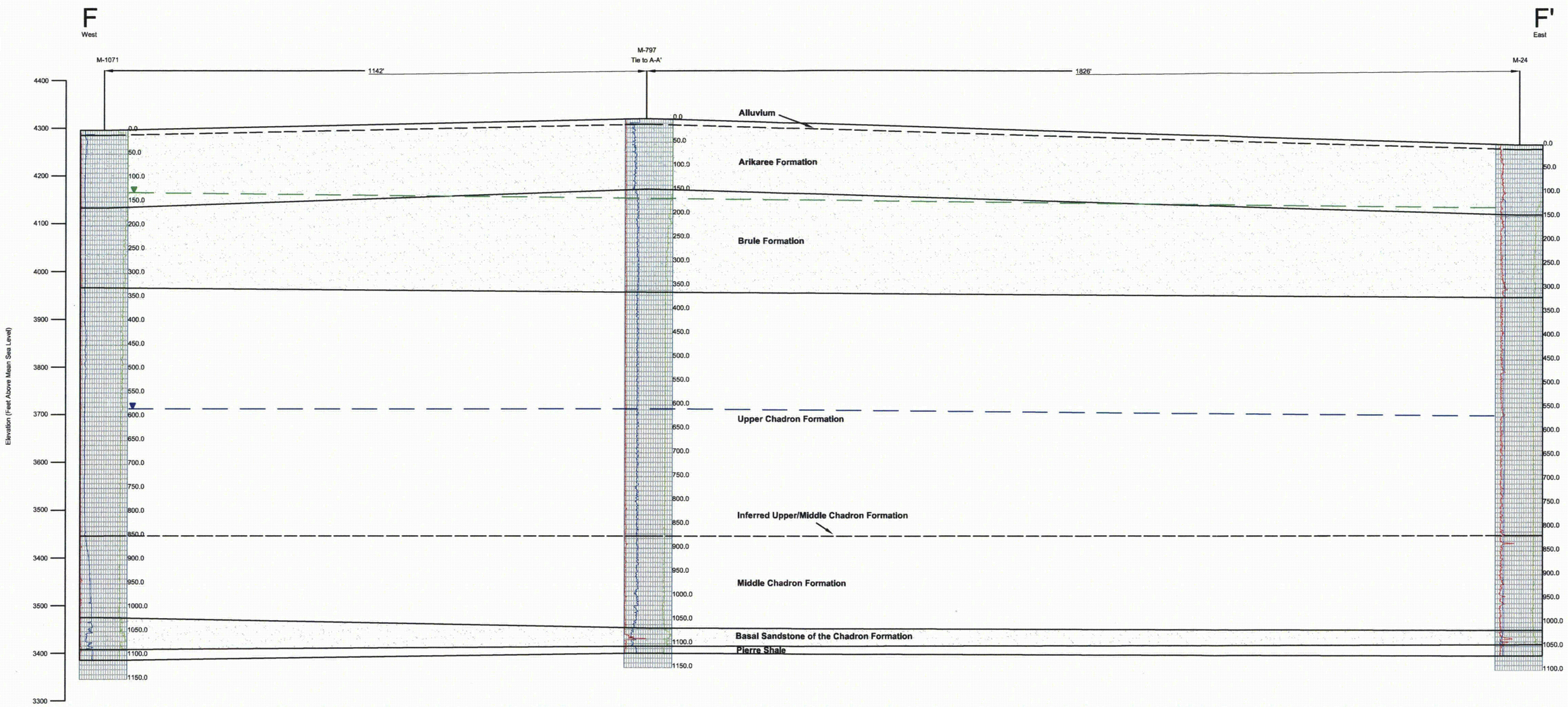
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3e
MARSLAND STRUCTURAL CROSS-SECTION E-E'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3e_E-E'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:51 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 50 meters

0 — 100 — 200 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

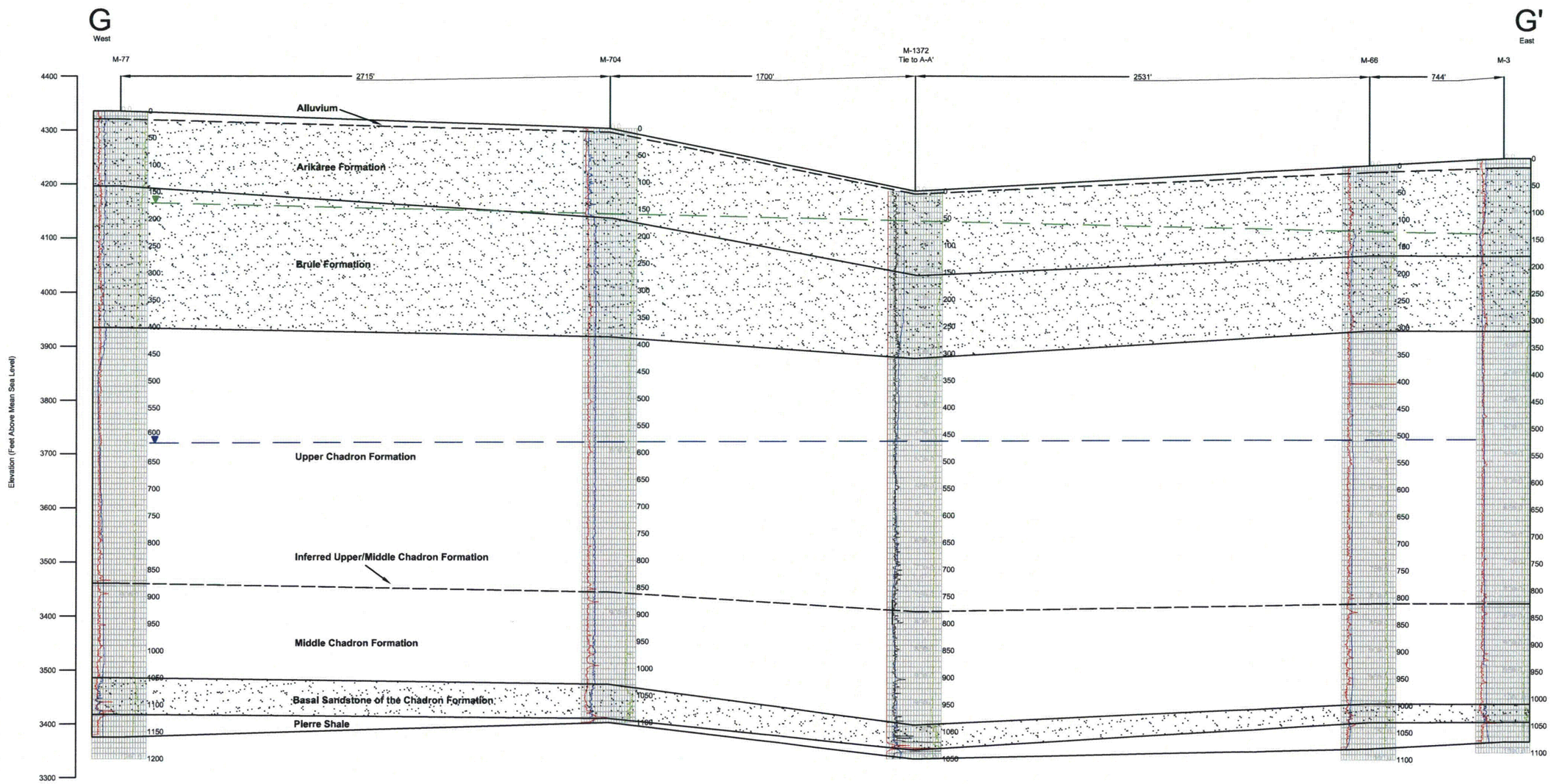
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3f
MARSLAND STRUCTURAL CROSS-SECTION F-F'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 830 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3f_F-F'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:55 PM



VERTICAL SCALE
0 1200 50 meters
0 100 200 feet

HORIZONTAL SCALE
0 150 meters
0 300 600 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

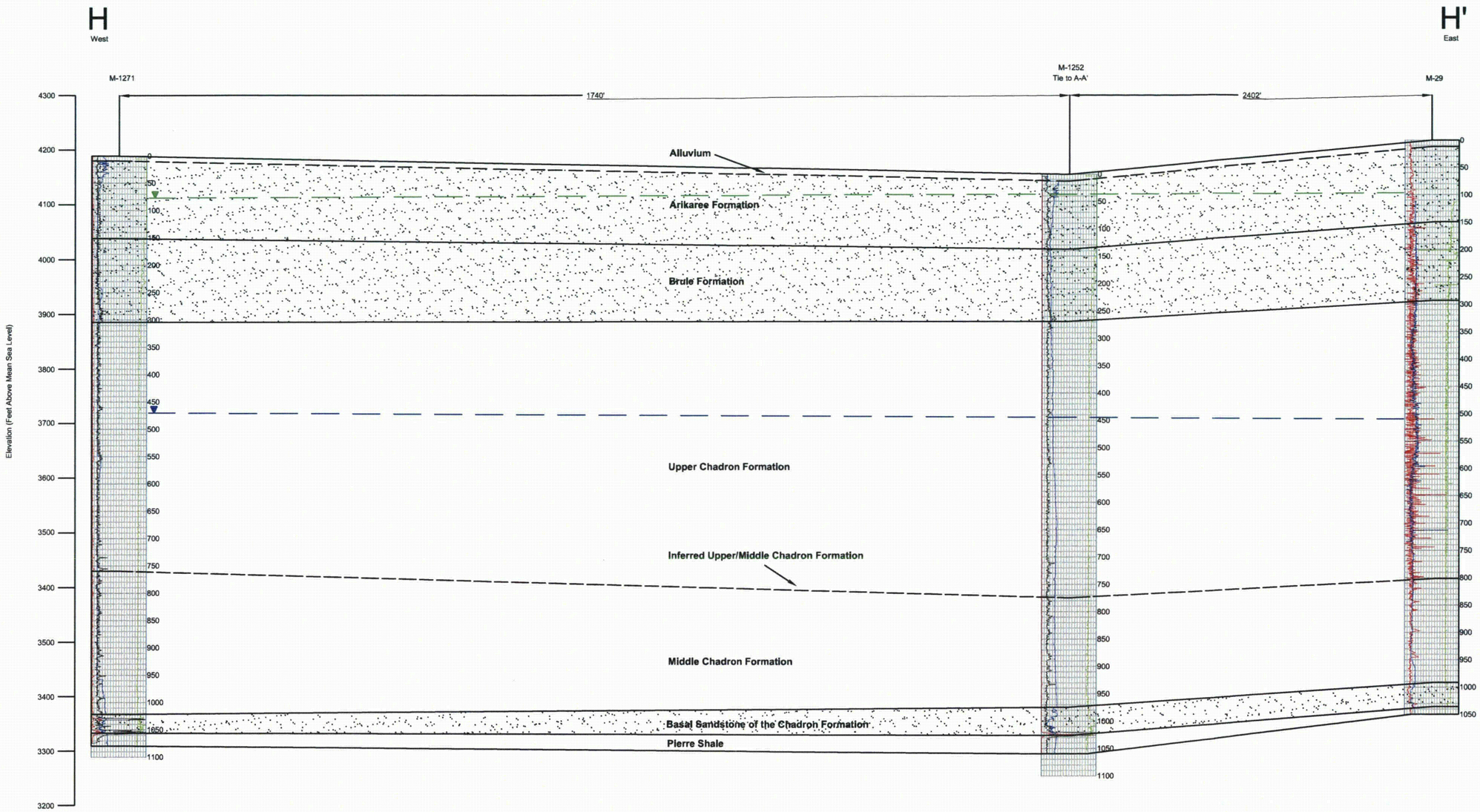
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3g
MARSLAND STRUCTURAL CROSS-SECTION G-G'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3g_G-G'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:57 PM



VERTICAL SCALE
0 — 50 meters
0 — 100 — 200 feet

HORIZONTAL SCALE
0 — 50 meters
0 — 100 — 200 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

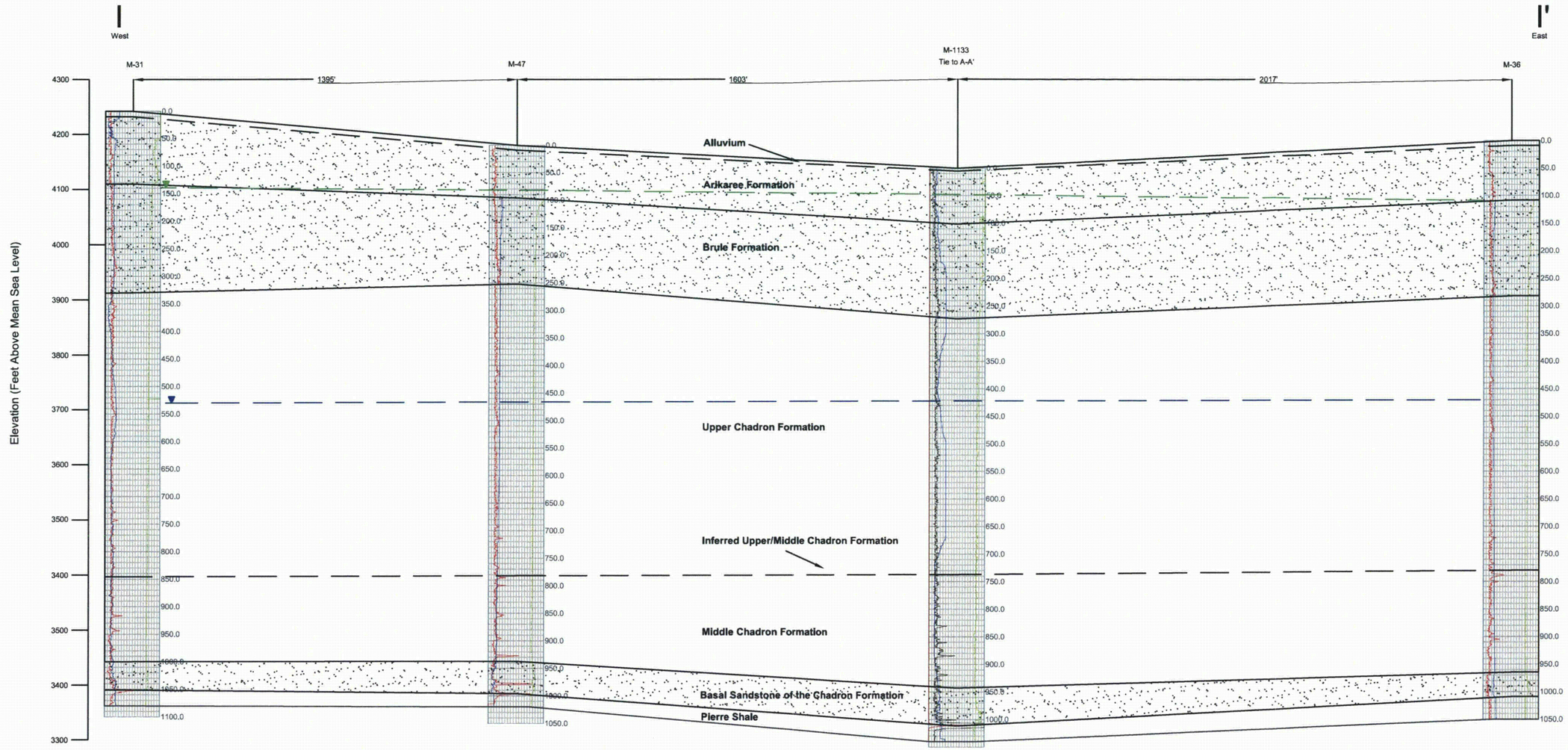
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3h
MARSLAND STRUCTURAL CROSS-SECTION H-H'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3h_H'H'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 1:59 PM



VERTICAL SCALE
0 — 50 meters
0 — 100 — 200 feet

HORIZONTAL SCALE
0 — 100 meters
0 — 200 — 400 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

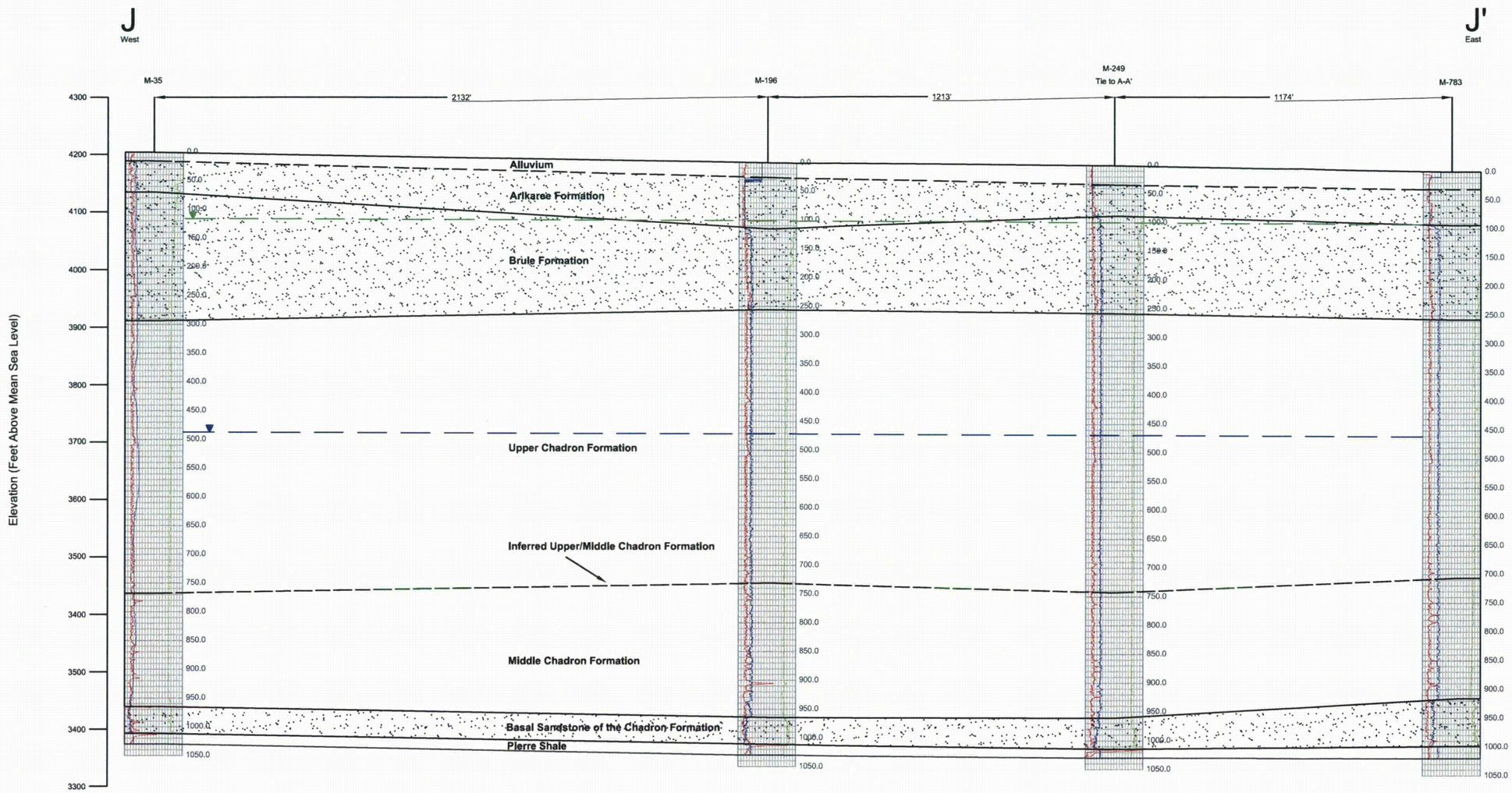
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3i
MARSLAND STRUCTURAL CROSS-SECTION I-I'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\[Figure E.1-3i_I-I'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 2:00 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 100 meters

0 — 200 — 400 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

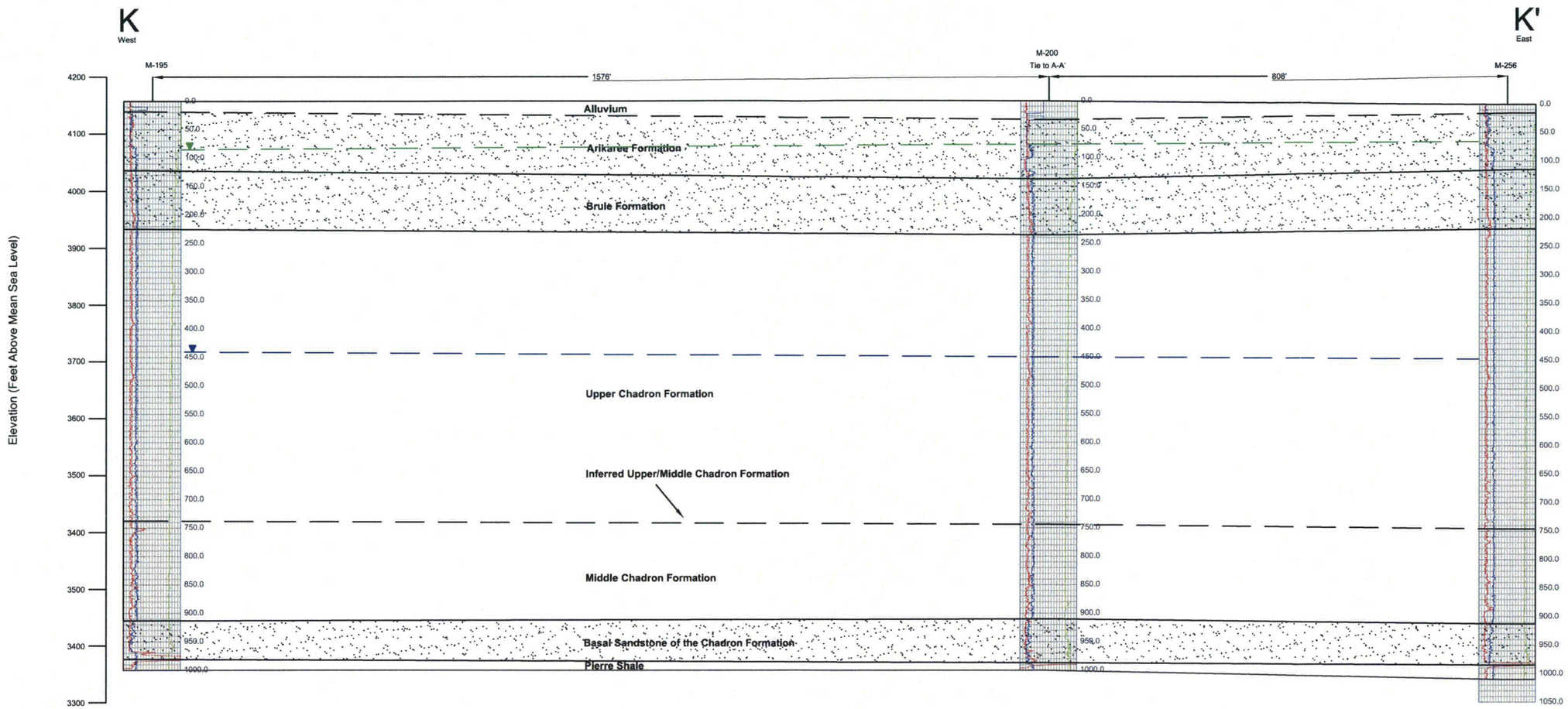
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3j
MARSLAND STRUCTURAL CROSS-SECTION J-J'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3j_J-J'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 2:02 PM



VERTICAL SCALE
0 — 50 meters
0 — 100 — 200 feet

HORIZONTAL SCALE
0 — 50 meters
0 — 100 — 200 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

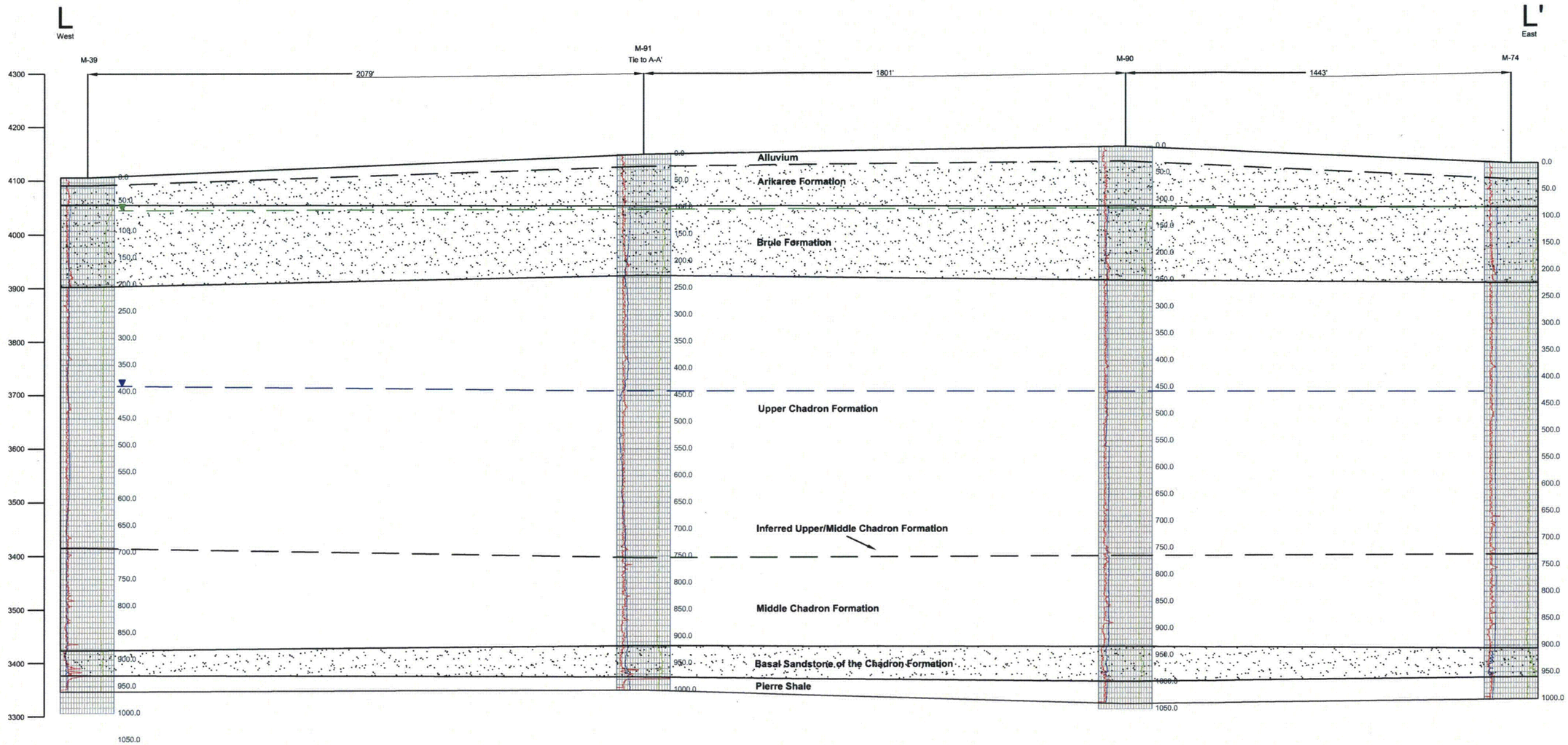
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3k
MARSLAND STRUCTURAL CROSS-SECTION K-K'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3k_K-K'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 2:03 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 100 meters

0 — 200 — 400 feet

Source: Cameco Resources, 2011

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

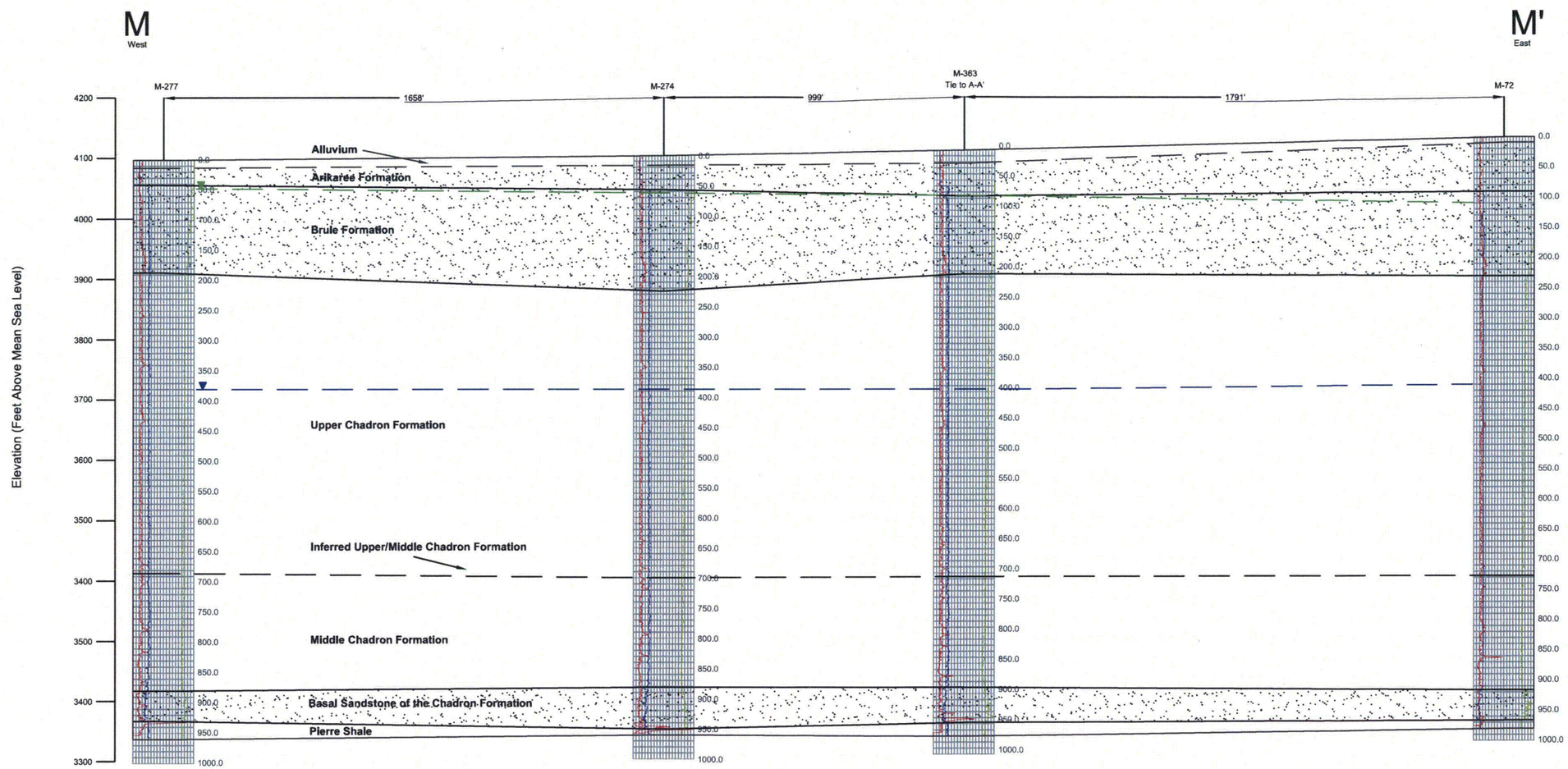
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3I
MARSLAND STRUCTURAL CROSS-SECTION L-L'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3I-L-L'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 2:07 PM



VERTICAL SCALE

0 — 50 meters

0 — 100 — 200 feet

HORIZONTAL SCALE

0 — 100 meters

0 — 200 — 400 feet

LEGEND

- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

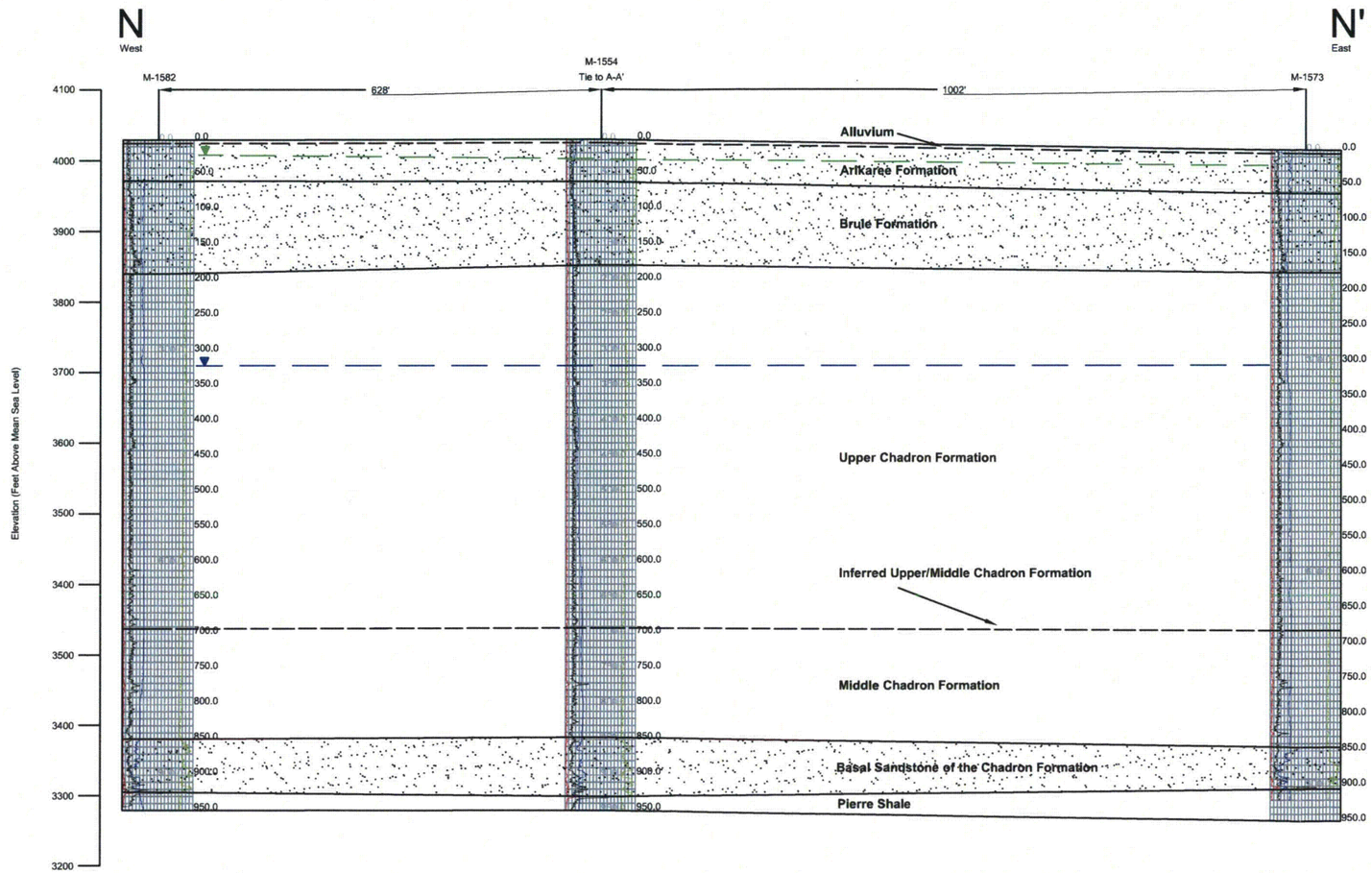
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3m
MARSLAND STRUCTURAL CROSS-SECTION M-M'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3m_M-M'.dwg LAYOUT: ER SAVED DATE/TIME: 11/10/2011 2:08 PM



VERTICAL SCALE
0 — 50 meters
0 — 100 — 200 feet

HORIZONTAL SCALE
0 — 150 meters
0 — 300 — 600 feet

LEGEND
- Main Litholoy Sandstone
- Gamma Curve
- Neutron or SP Curve
- Resistivity Curve
- Potentiometric Surface of the Brule Formation
- Potentiometric Surface of the Basal Sandstone of Chadron Formation

Source: Cameco Resources, 2011

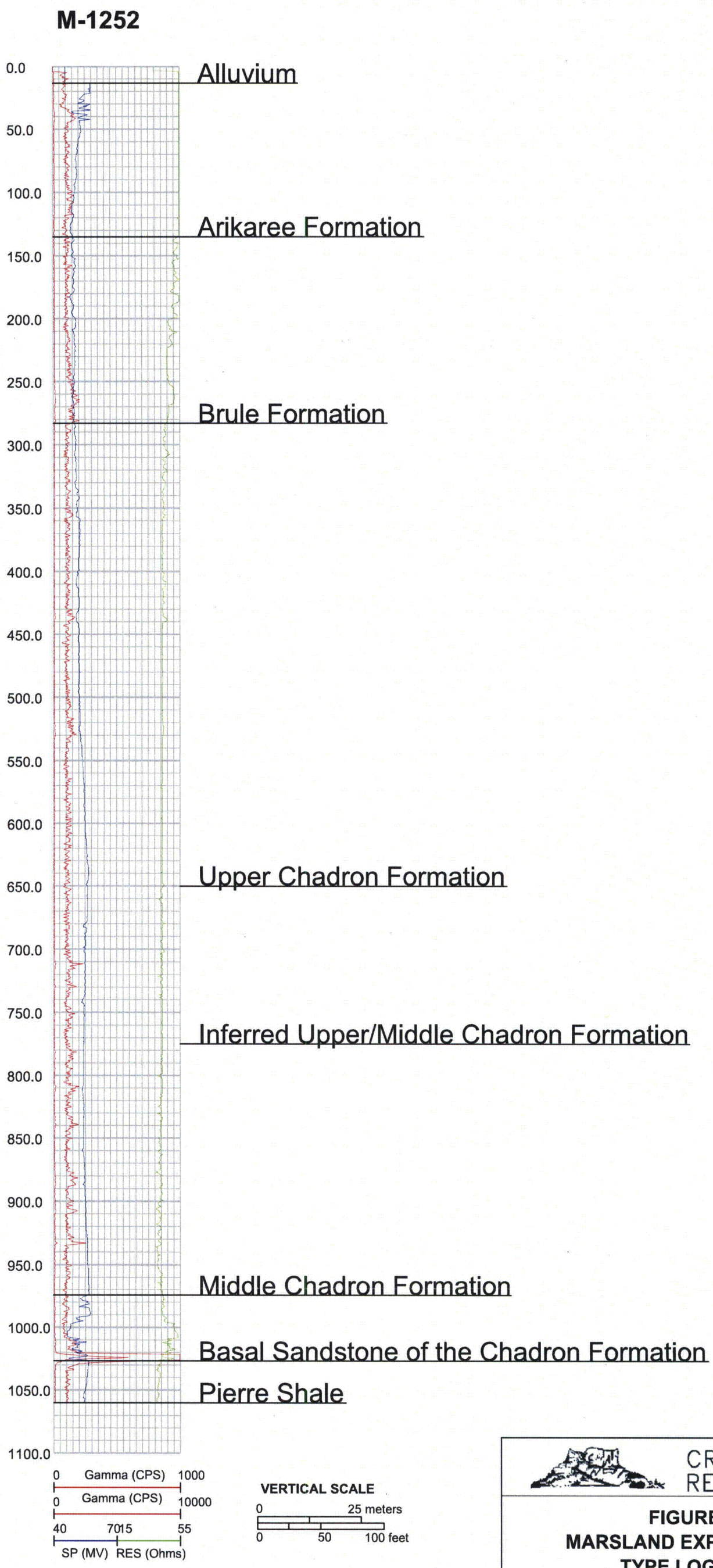
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-3n
MARSLAND STRUCTURAL CROSS-SECTION N-N'

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

PATH: K:\CBR_Projects\CO001636_Marsland\1_ACAD\CrossSections_v2\Figure E.1-3n_N-N'.dwg LAYOUT: ER SAVED DATE/TIME: 2/6/2012 8:37 PM



CROW BUTTE RESOURCES, INC.

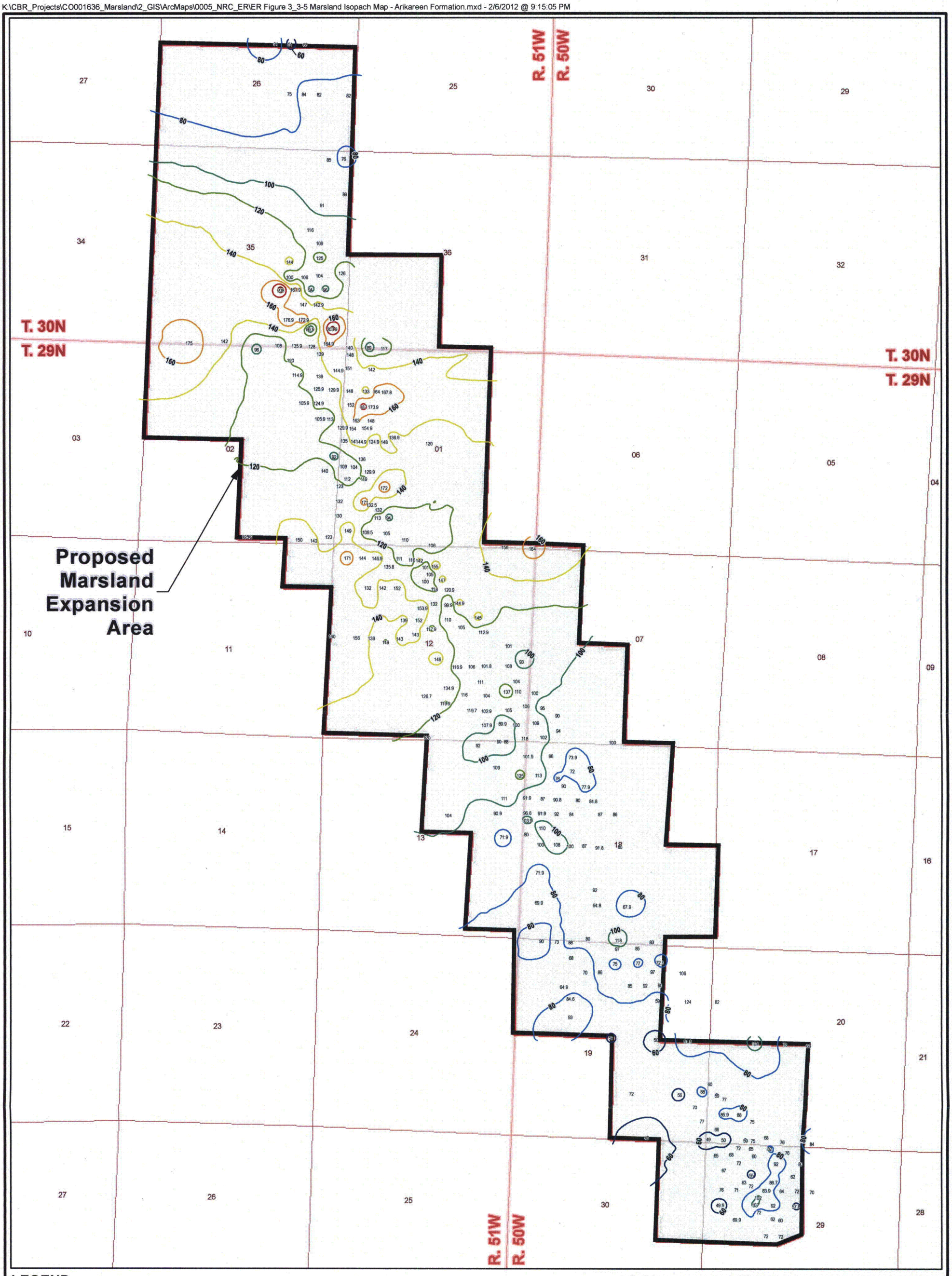
FIGURE 3.3-4
MARSLAND EXPANSION AREA
TYPE LOG (M-1252)

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JA

ARCADIS 630 Plaza Drive, Ste. 100 Highlands Ranch, CO 80129 P: 720-344-3500 F: 720-344-3535 www.arcadis-us.com

Source: Cameco Resources, 2011

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-5 Marsland Isopach Map - Arikareen Formation.mxd - 2/6/2012 @ 9:15:05 PM



LEGEND

Proposed Marsland Expansion Area

72 Unit Thickness Reading (Feet) (label position also stands for borehole location)

Isopach Contour (Feet)

- 60
- 80
- 100
- 120
- 140
- 160
- 180
- 200

N

0 1,250 2,500

Feet

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

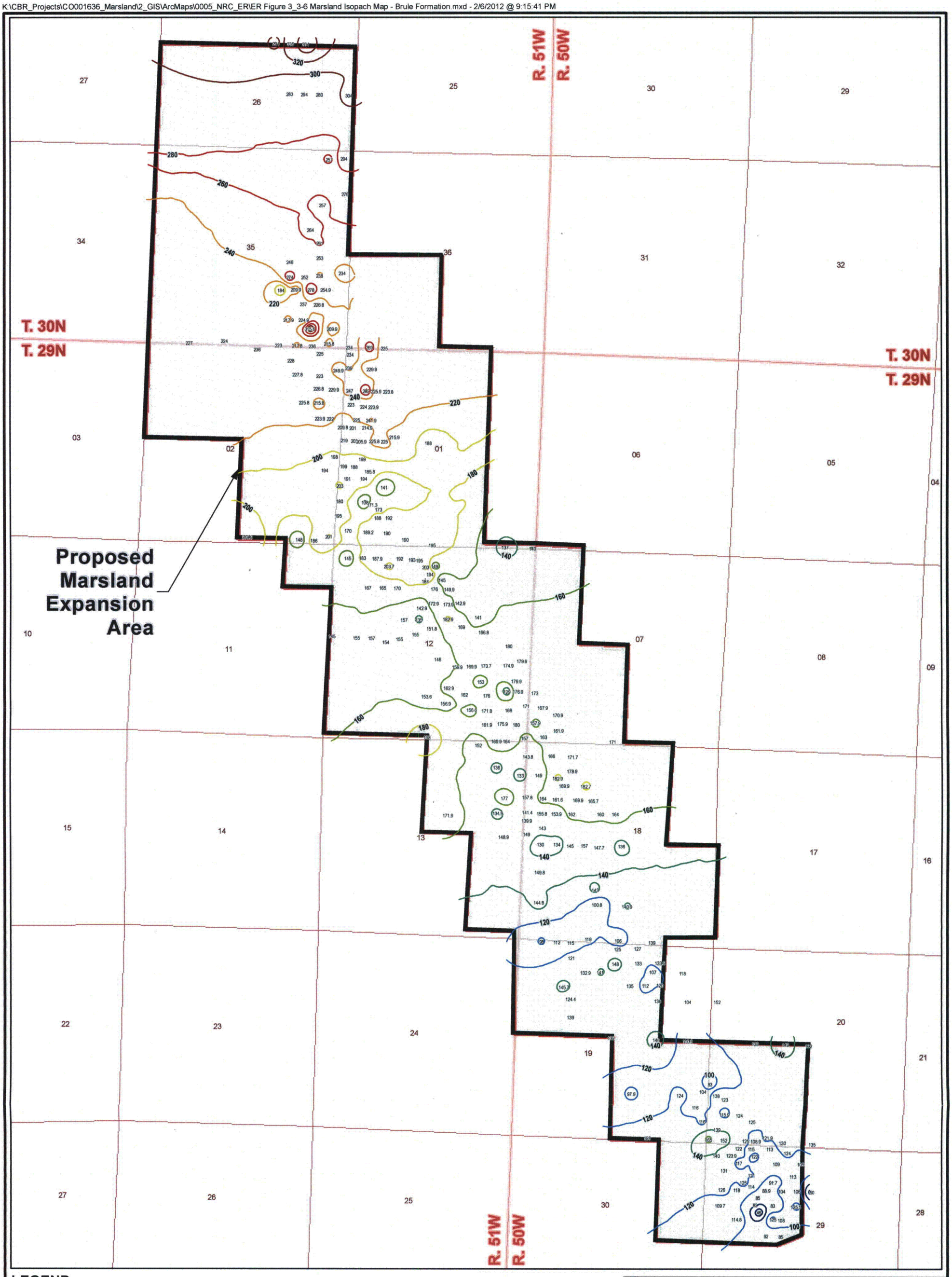
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-5
MARSLAND ISOPACH MAP - ARIKAREE FORMATION

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-6 Marsland Isopach Map - Brule Formation.mxd - 2/6/2012 @ 9:15:41 PM



LEGEND

- Proposed Marsland Expansion Area
- 139 Unit Thickness Reading (Feet) (label position also stands for borehole location)

Isopach Contour (Feet)

- 60 or 80
- 100 or 120
- 140
- 160
- 180 or 200
- 220 or 240
- 260 or 280
- 300 or 320 or 340

N

0 1,250 2,500

Feet

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

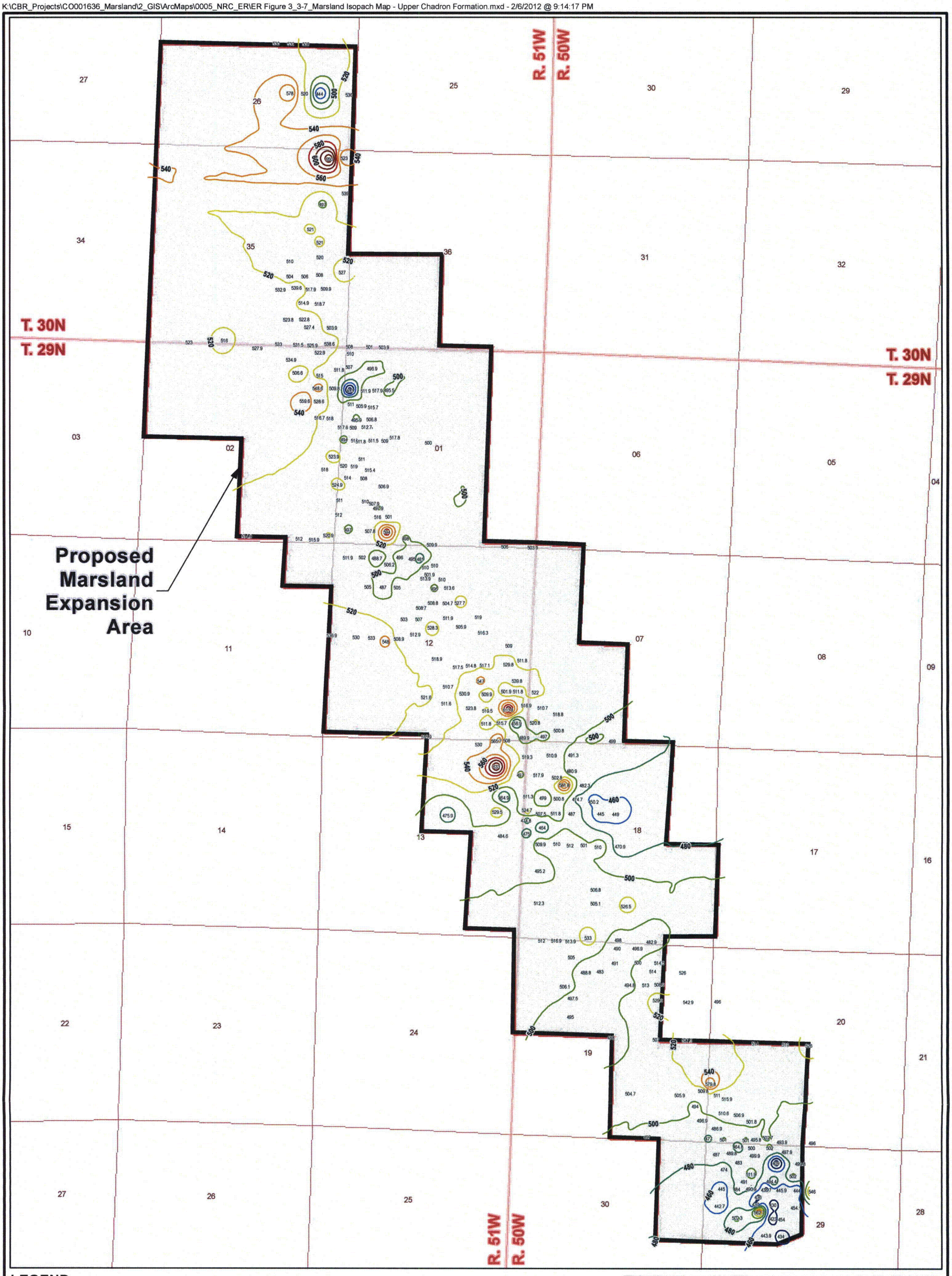
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-6
MARSLAND ISOPACH MAP - BRULE FORMATION

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-7_Marsland Isopach Map - Upper Chadron Formation.mxd - 2/6/2012 @ 9:14:17 PM



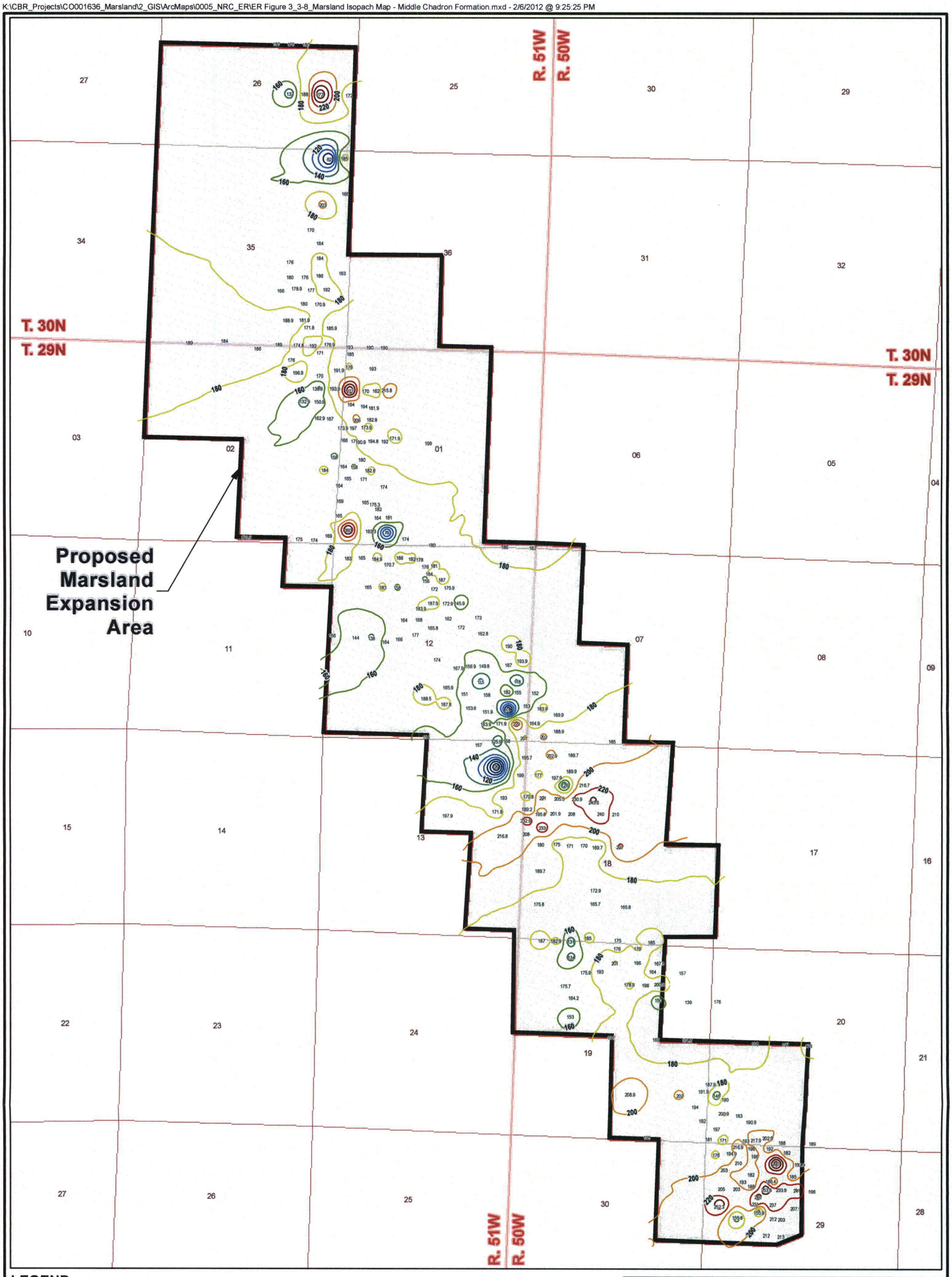
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-7
MARSLAND ISOPACH MAP - UPPER CHADRON FORMATION

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-8_Marsland Isopach Map - Middle Chadron Formation.mxd - 2/6/2012 @ 9:25:25 PM



LEGEND

- Proposed Marsland Expansion Area
- 187 Unit Thickness Reading (Feet) (label position also stands for borehole location)

Isopach Contour (Feet)

- 40 or 60 or 80
- 100 or 120
- 140
- 160
- 180
- 200
- 220
- 240 or 260 or 280

N

0 1,250 2,500

Feet

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

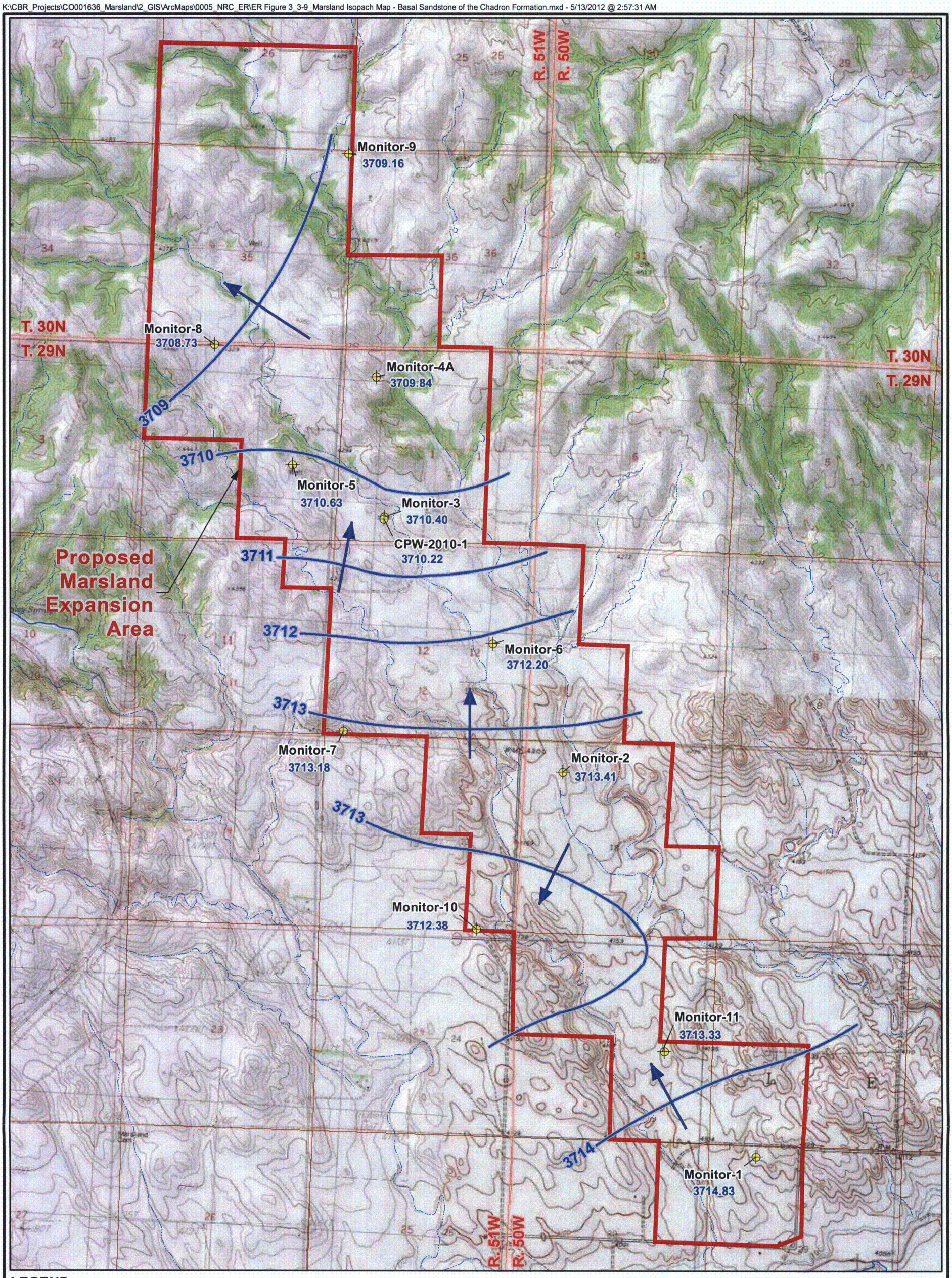
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-8
MARSLAND ISOPACH MAP - MIDDLE CHADRON FORMATION

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-9_Marsland Isopach Map - Basal Sandstone of the Chadron Formation.mxd - 5/13/2012 @ 2:57:31 AM



LEGEND

- Basal Chadron Sandstone Well
- Groundwater Elevation Contour
- Proposed Marsland Expansion Area
- Intermittent Stream/River
- 3714.83 Water Level (feet-above mean sea level)
- Groundwater Flow Direction

N

0 1,250 2,500

Feet

PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

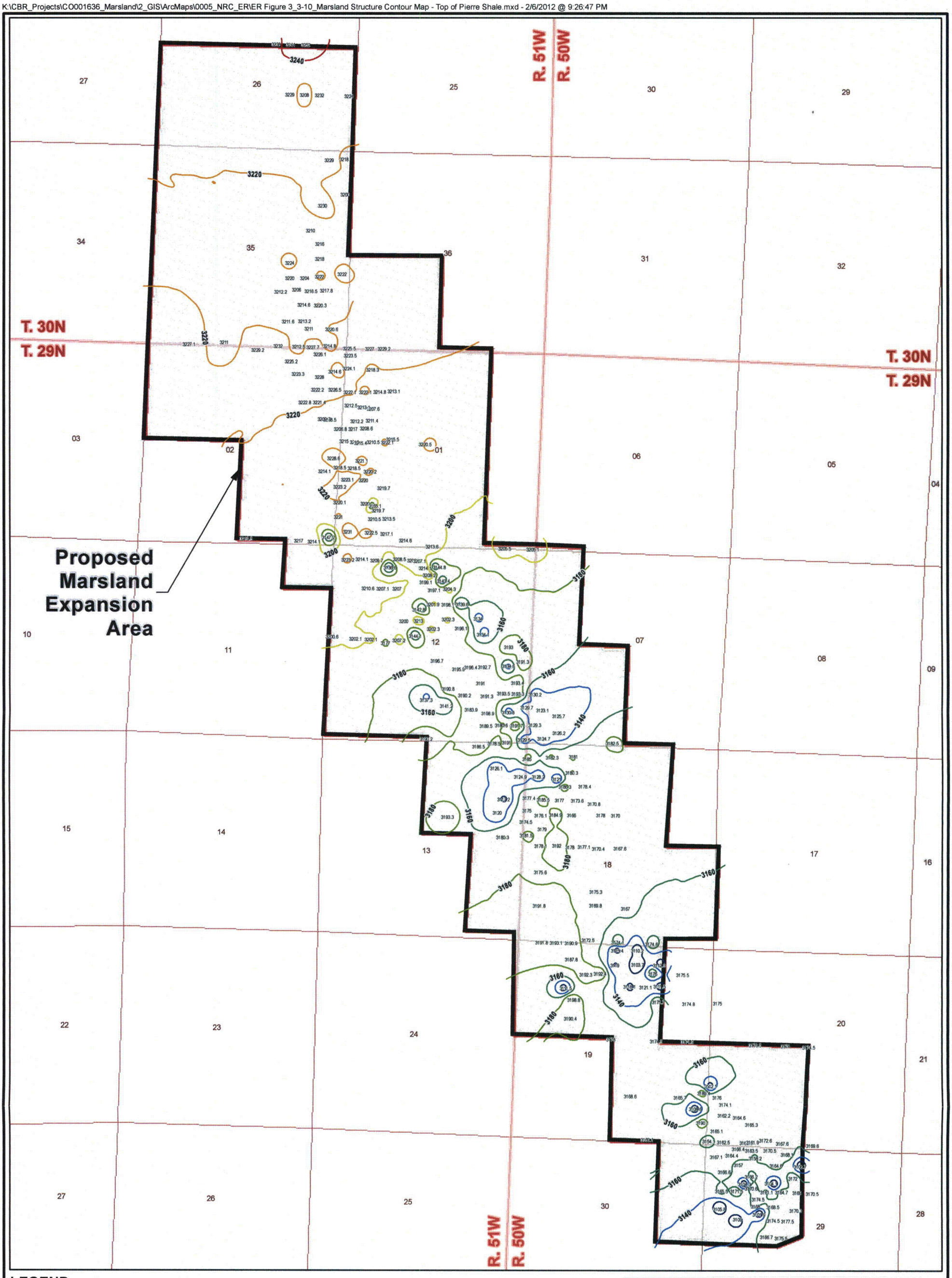
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-9
MARSLAND EXPANSION AREA
POTENTIOMETRIC SURFACE
BASAL CHADRON SANDSTONE (2/22/11)

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-10_Marsland Structure Contour Map - Top of Pierre Shale.mxd - 2/6/2012 @ 9:26:47 PM



LEGEND

Proposed Marsland Expansion Area

3175.6 Groundwater Elevation (FT-AMSL)
(label position also stands for borehole location)

Groundwater Potentiometric Surface (FT-AMSL)

- 3120
- 3140
- 3160
- 3180
- 3200
- 3220
- 3240

FT-AMSL = Feet Above Mean Sea Level

N

0 1,250 2,500
Feet

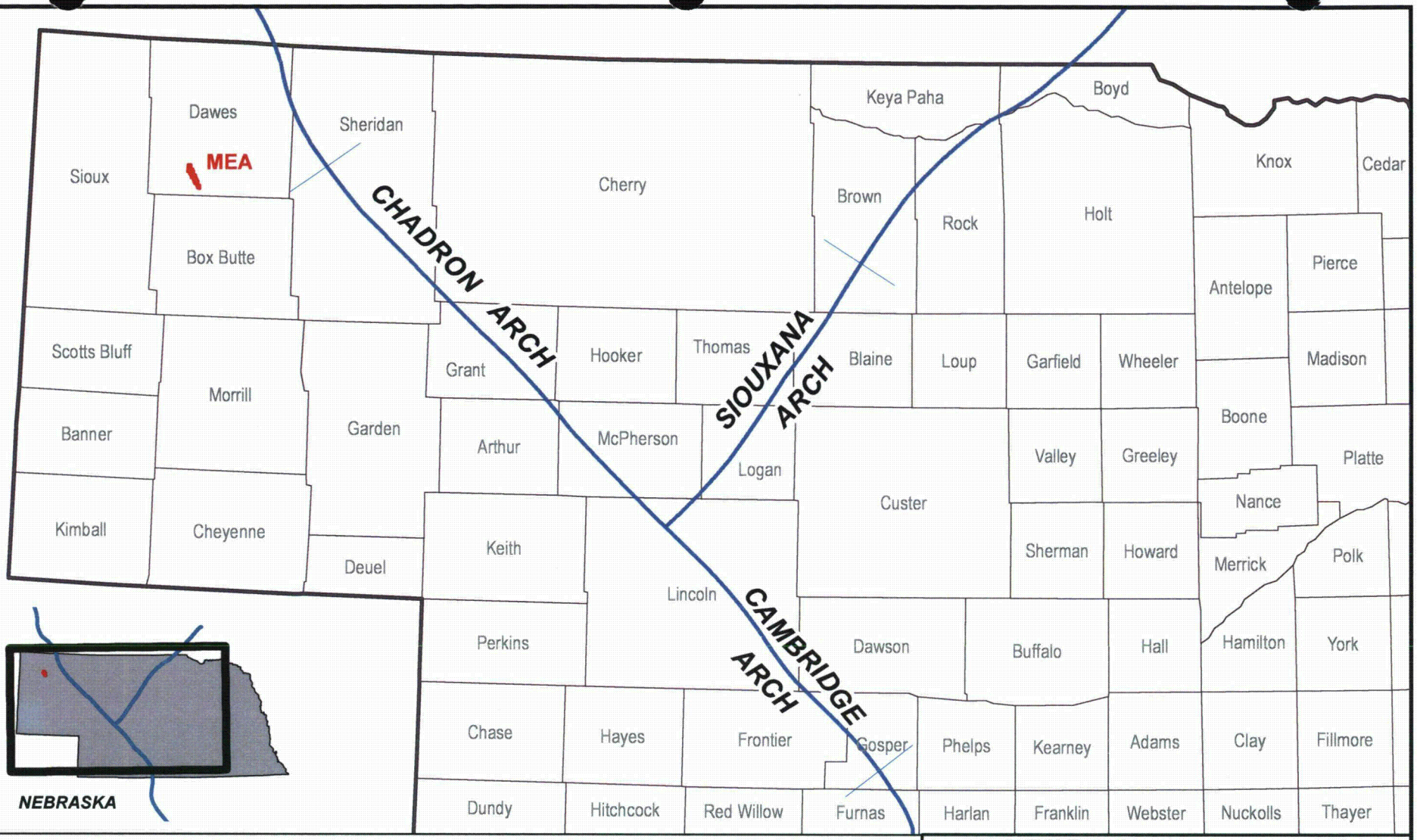
PROJECTION: NAD 1927, STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-10
MARSLAND STRUCTURE MAP - TOP OF PIERRE SHALE

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com



LEGEND

- Proposed Marsland Expansion Area (MEA)
- Nebraska County Boundary
- Nebraska State Boundary

N

0 15 30

Miles

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

SOURCE: STIX, J. 1982

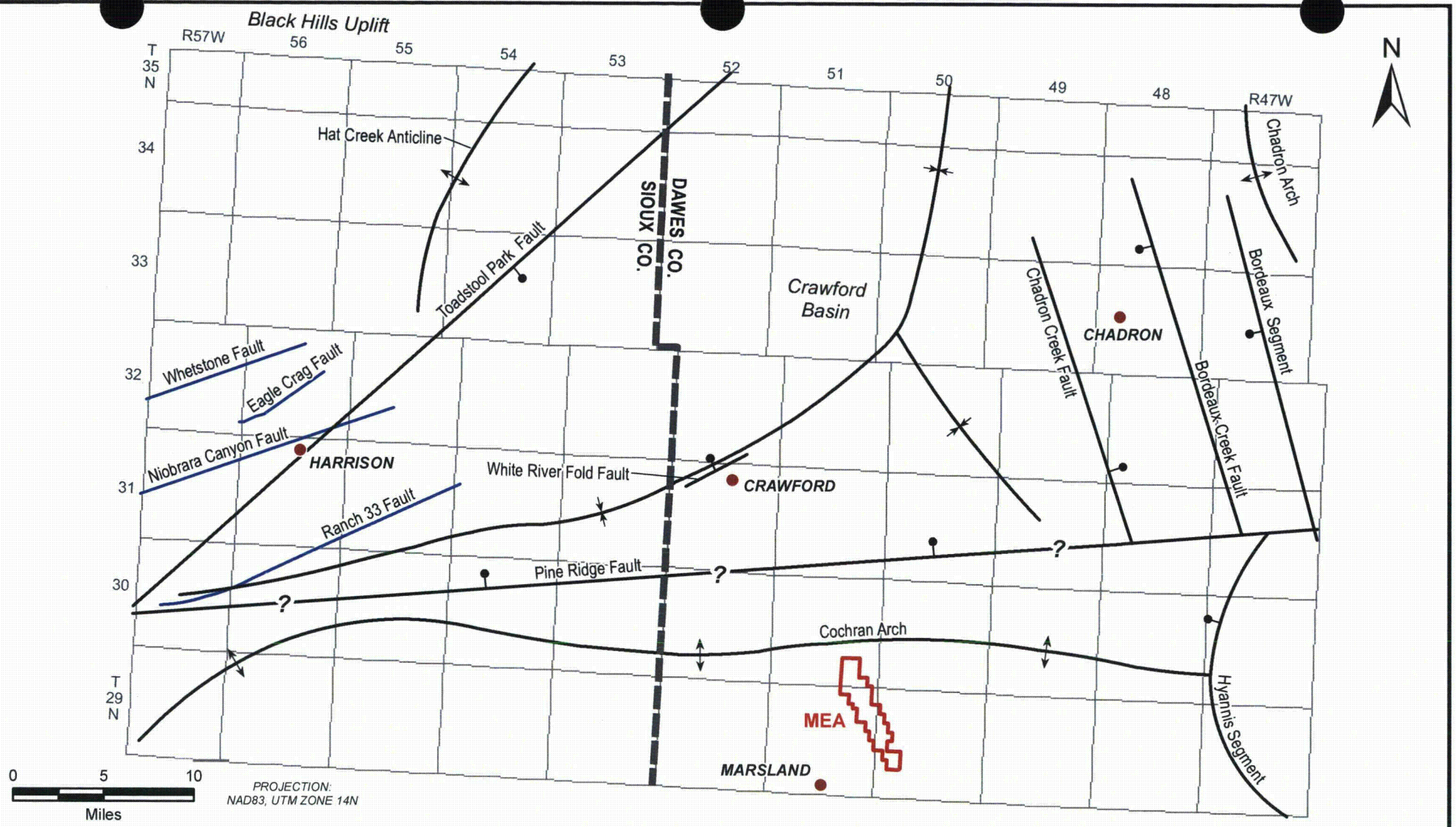
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-11
LOCATION OF CHADRON ARCH AND CAMBRIDGE ARCH IN NEBRASKA

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

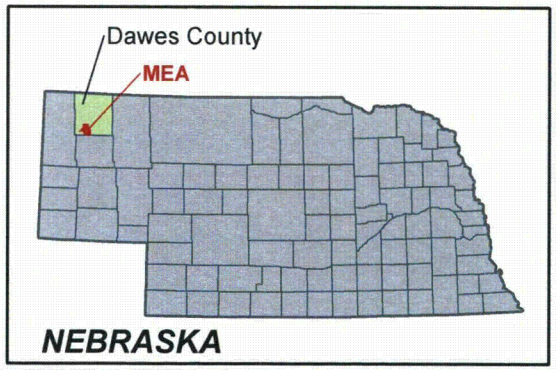
K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-11_Location of Chadron Arch and Cambridge Arch in NE.mxd - 5/15/2012 @ 12:37:54 PM



LEGEND

- City/Town
- Fault (Ball on downthrown side)
- Fault Interpretations by Hunt (1990)
- Anticline
- Syncline
- Proposed Marsland Expansion Area (MEA)

Source:
Modified from DeGraw, 1969;
WFC-White River Fault only (Collings & Knode, 1984)



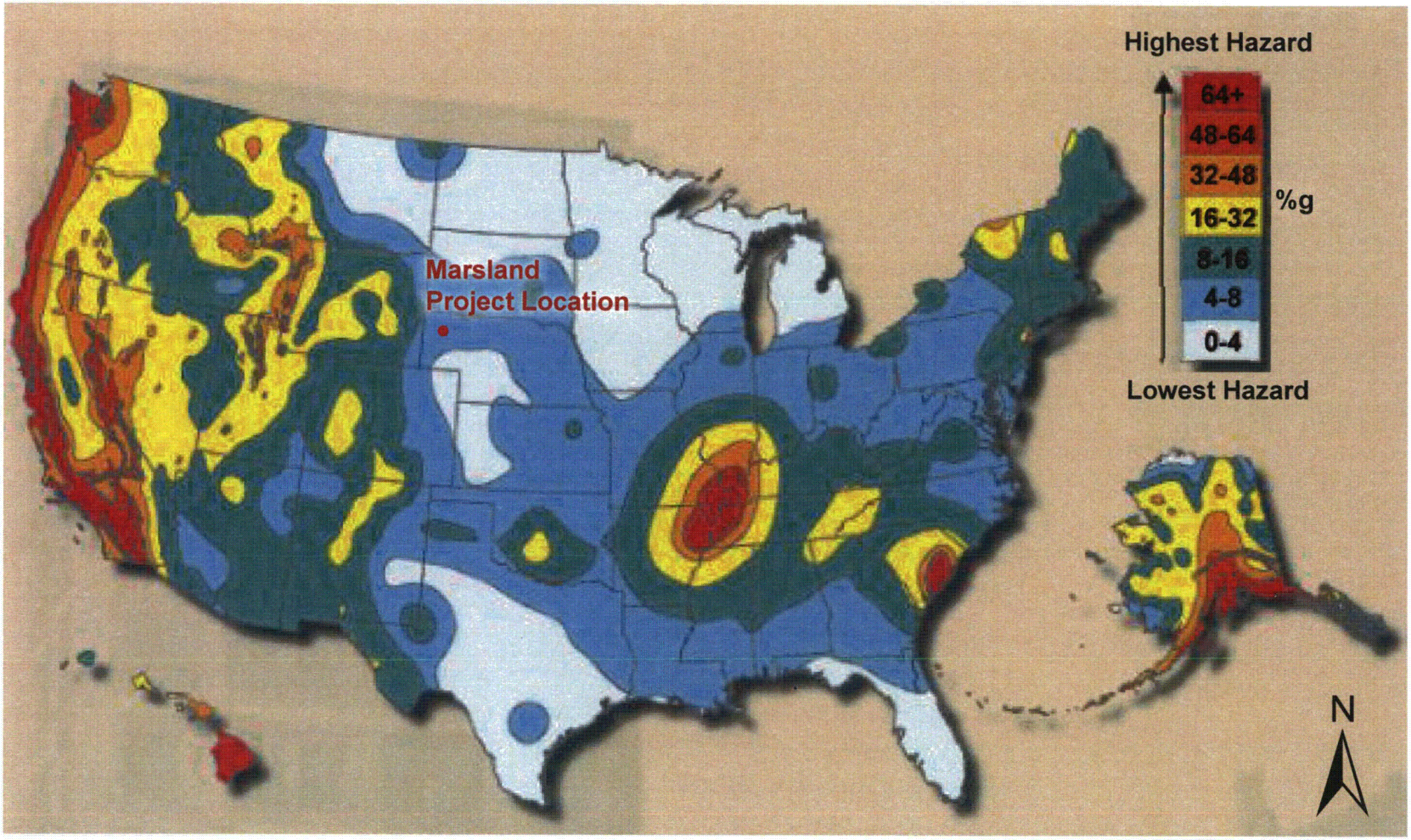
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-12
STRUCTURAL FEATURES MAP OF THE CRAWFORD BASIN

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 3_3-12 Structural Features Map of the Crowford Basin.mxd - 2/6/2012 @ 9:28:33 PM



CROW BUTTE RESOURCES, INC.

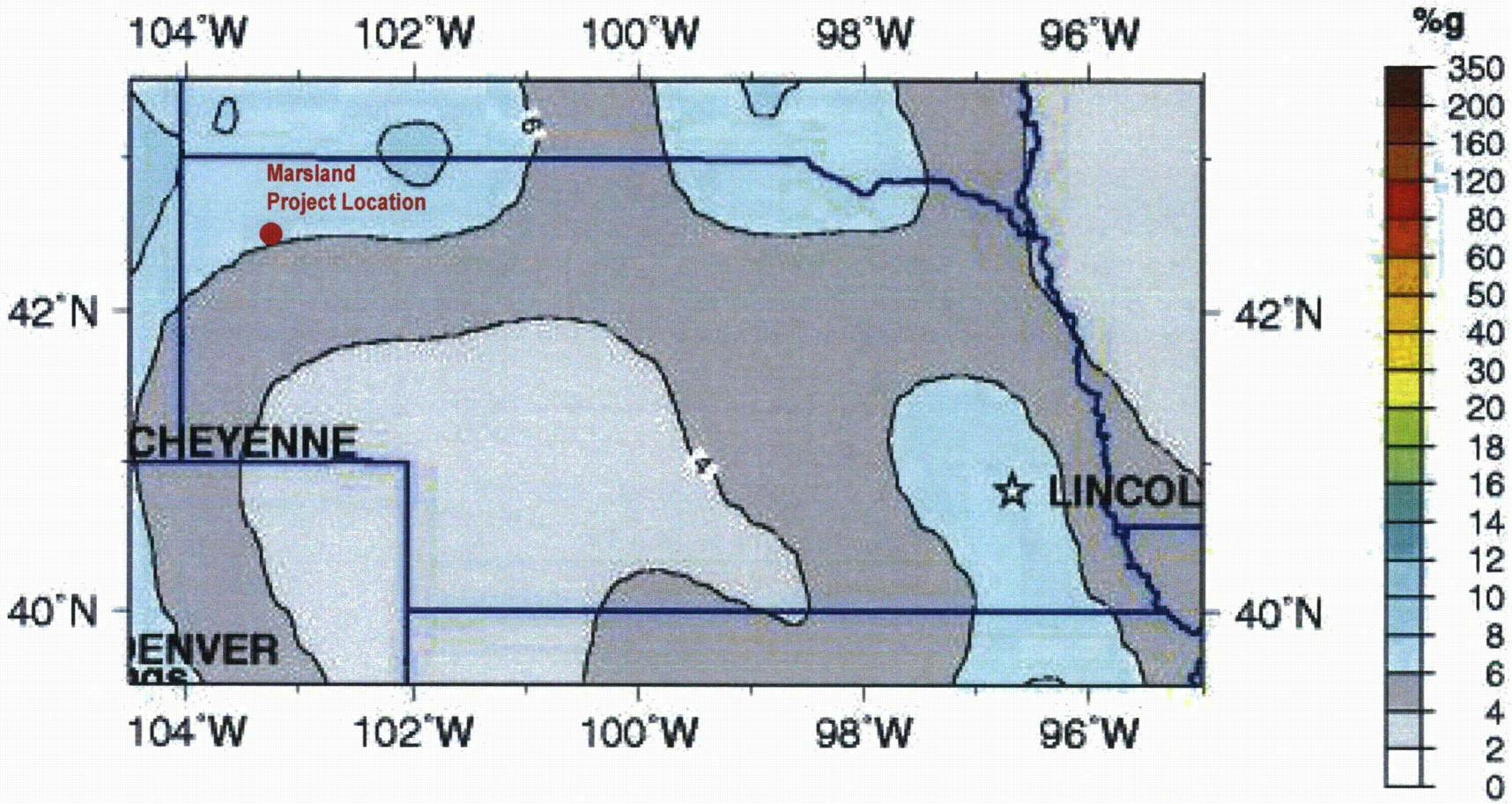
FIGURE 3.3-13
EARTHQUAKE HAZARD RANKING IN THE U.S.

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

SOURCE: SD 2008

K:\CBR_Projects\CO001636_Marsland\3_IMAGES\Illustrator\ER Figure 3_3-13 Earthquake Hazard Ranking in the US.ai @11/03/2011



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
Site: NEHRP B-C boundary
National Seismic Hazard Mapping Project (Peterson, M.D. 2008)

N

CROW BUTTE RESOURCES, INC.

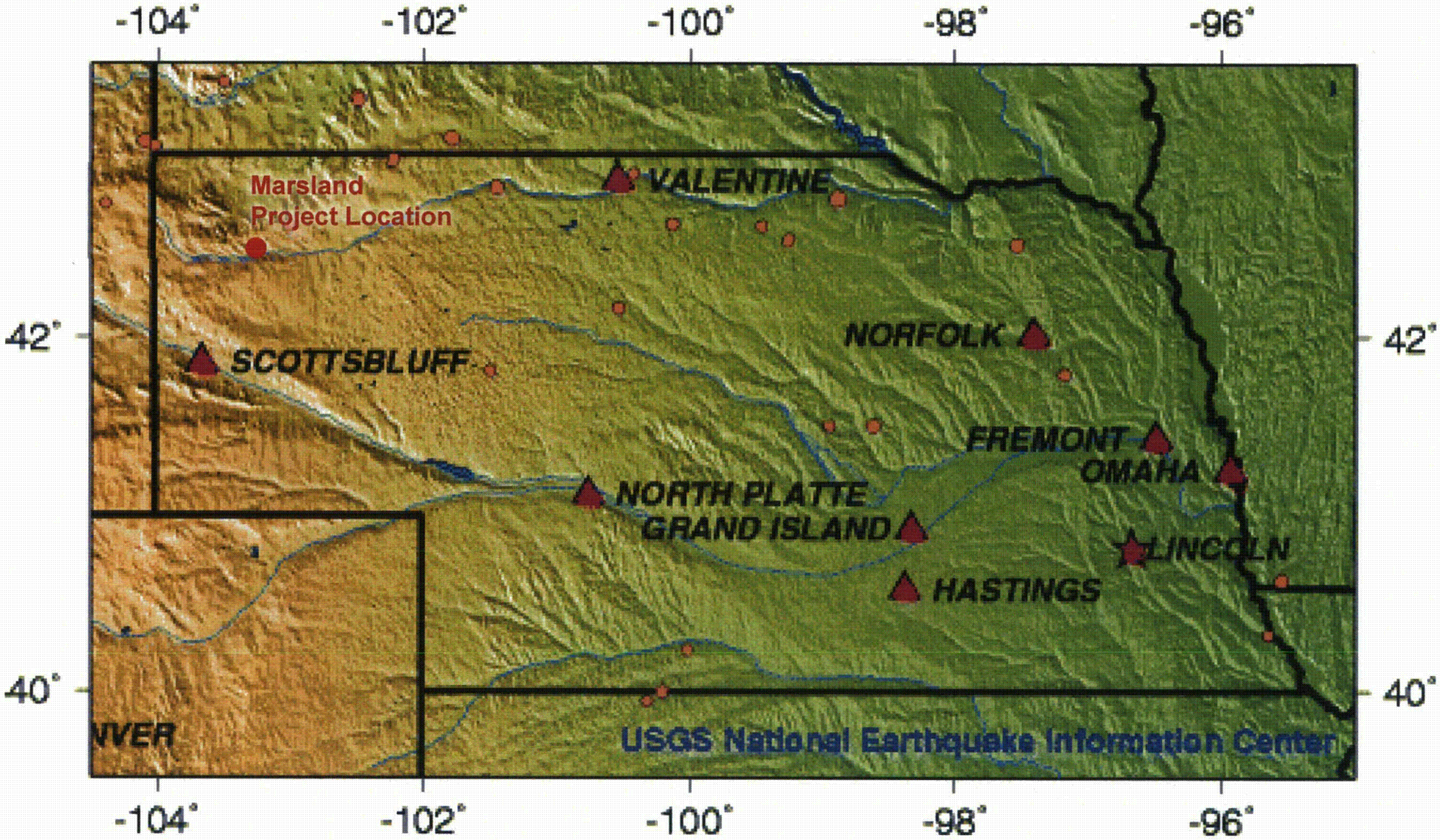
FIGURE 3.3-14
SEISMIC HAZARD MAP
FOR NEBRASKA (2008)

PROJECT: CO0016 6.00001 MAPPED BY: JC CHECKED BY: LW

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

SOURCE: USGS 20009a

KK:\CBR_Projects\CO001636_Marsland\3_IMAGES\Illustrator\ER Figure 3_3-14 Seismic Hazard Map for Nebraska.ai @ 11/03/2011



Depth is in kilometers.
Purple Triangles: Cities
Purple Star: Capital City
Circles: Earthquakes (color represents depth range)
Earthquake locations are from the USGS/NEIC PDE catalog

N

SOURCE: USGS 2009e

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-15
SEISMICITY OF NEBRASKA
1990-2006

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\3_IMAGES\Illustrator\ER Figure 3_3-15 Seismicity of Nebraska 1990-2006.ai @ 11/04/2011