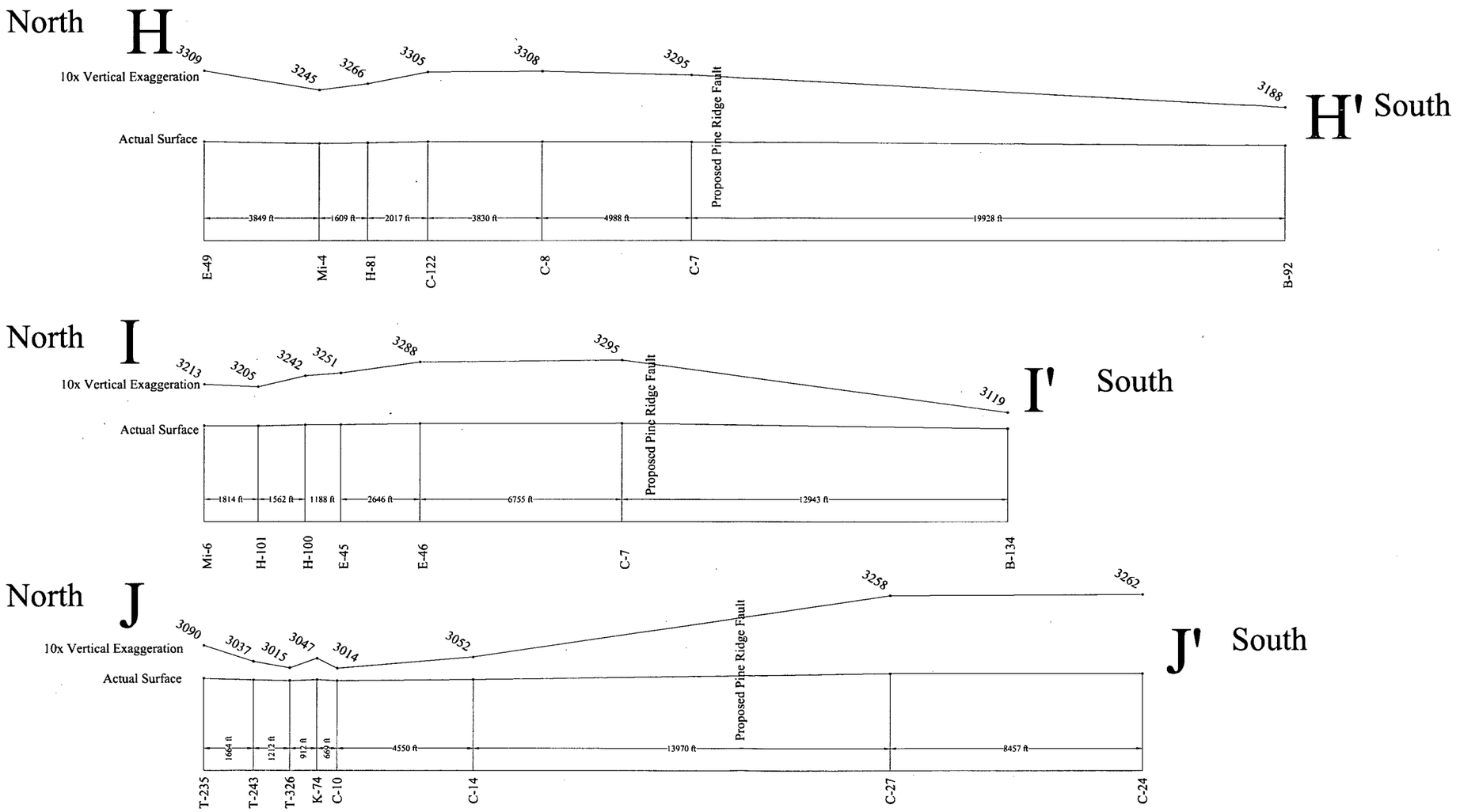


2000 0 2000 4000 6000 8000 Feet

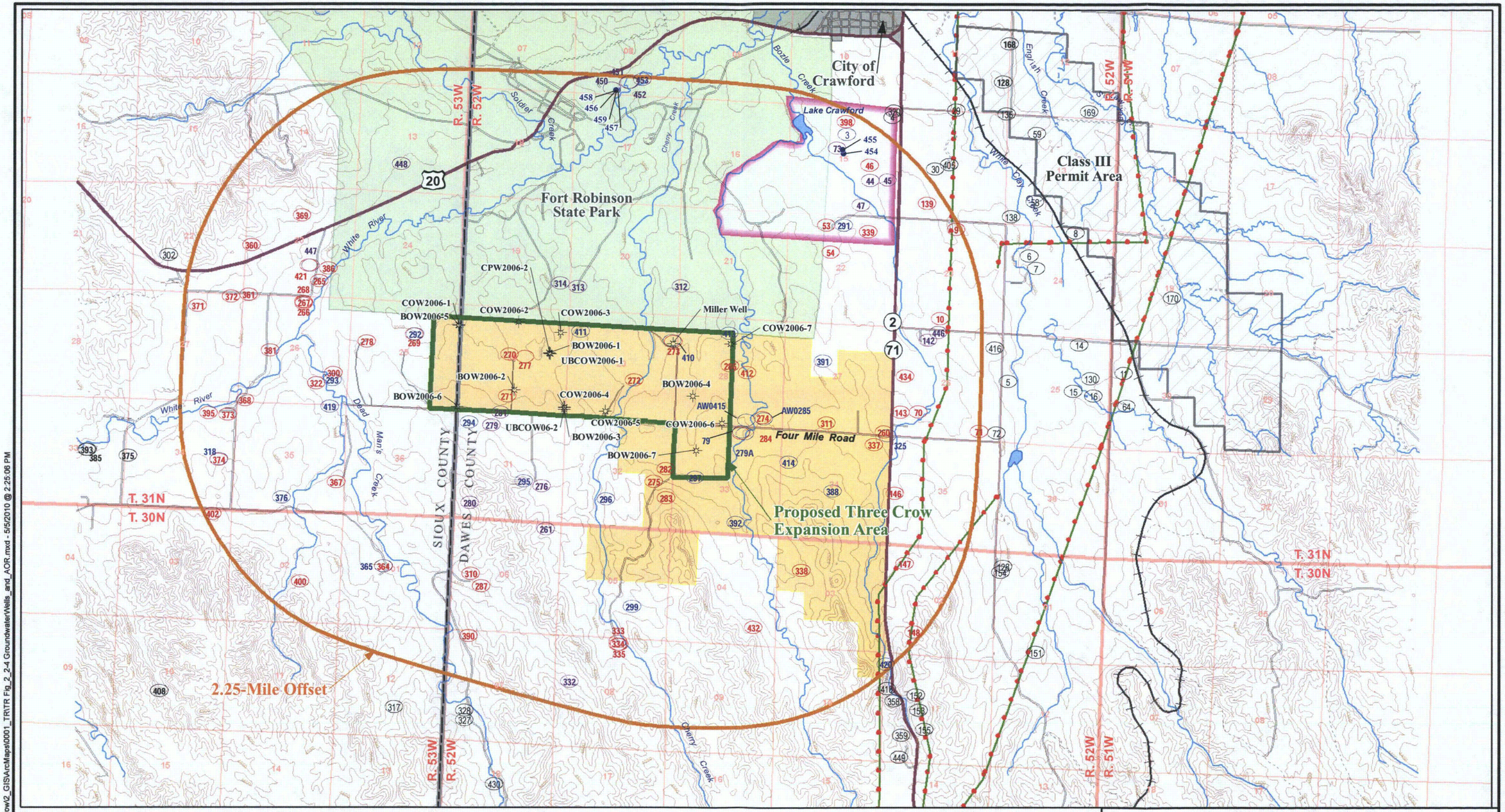
CROW BUTTE RESOURCES, INC.

FIGURE 3.3-15b
THREE CROW STRUCTURAL CROSS-SECTIONS H-H', I-I', AND J-J' (TOP OF PIERRE SHALE)

PROJECT: CO001396 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

PATH: K:\CBR_Projects\CO001396_ThreeCrow\1_ACAD\e-transmittl\hydro-XS.dwg LAYOUT: ER_15b SAVED DATE/TIME: 6/4/2010 5:35 PM



LEGEND

- Monitoring Well
- **Private Wells**
  - (400) Active Surveyed Well
  - (280) Active Unsurveyed Well
  - (376) Abandoned Well
  - (359) Well Located outside of AOR
- Active Public Water Supply Well
- Proposed Three Crow Expansion Area
- 2.25-Mile Area of Review (AOR)
- River/Creek
- Lake
- Class III Permit Area
- Transmission Line
- Highway
- County Boundary
- Elevation Contour (50-Ft Interval)
- Road
- Trail
- Railroad
- Fort Robinson State Park
- Leased Area
- City of Crawford
- City of Crawford's Wellhead Protection Area

0 2,000 4,000
Scale in Feet

N
W E

PROJECTION: NAD_1927_STATEPLANE_NEBRASKA_NORTH_FIPS_2601

ALL ELEVATIONS ARE IN FT-AMSL.

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-1
LOCATION OF GROUNDWATER WELLS IN THE THREE CROW EXPANSION AREA AND 2.25-MILE AREA OF REVIEW

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

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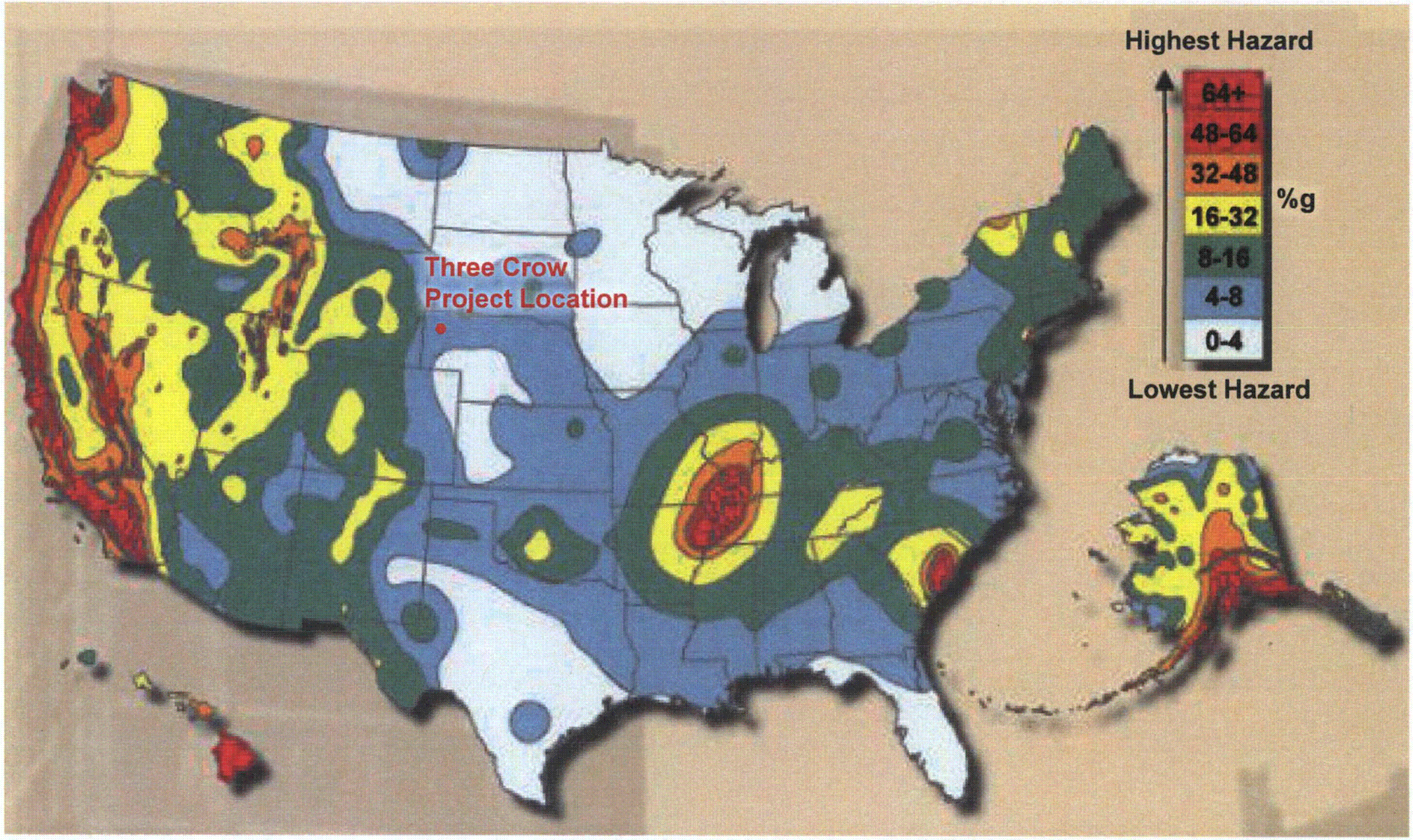
K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TRITR Fig_2_2-4 GroundwaterWells_and_AOR.mxd - 5/5/2010 @ 2:25:06 PM



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W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-16
EARTHQUAKE HAZARD RANKING IN THE U.S.

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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Highlands Ranch, CO 80129
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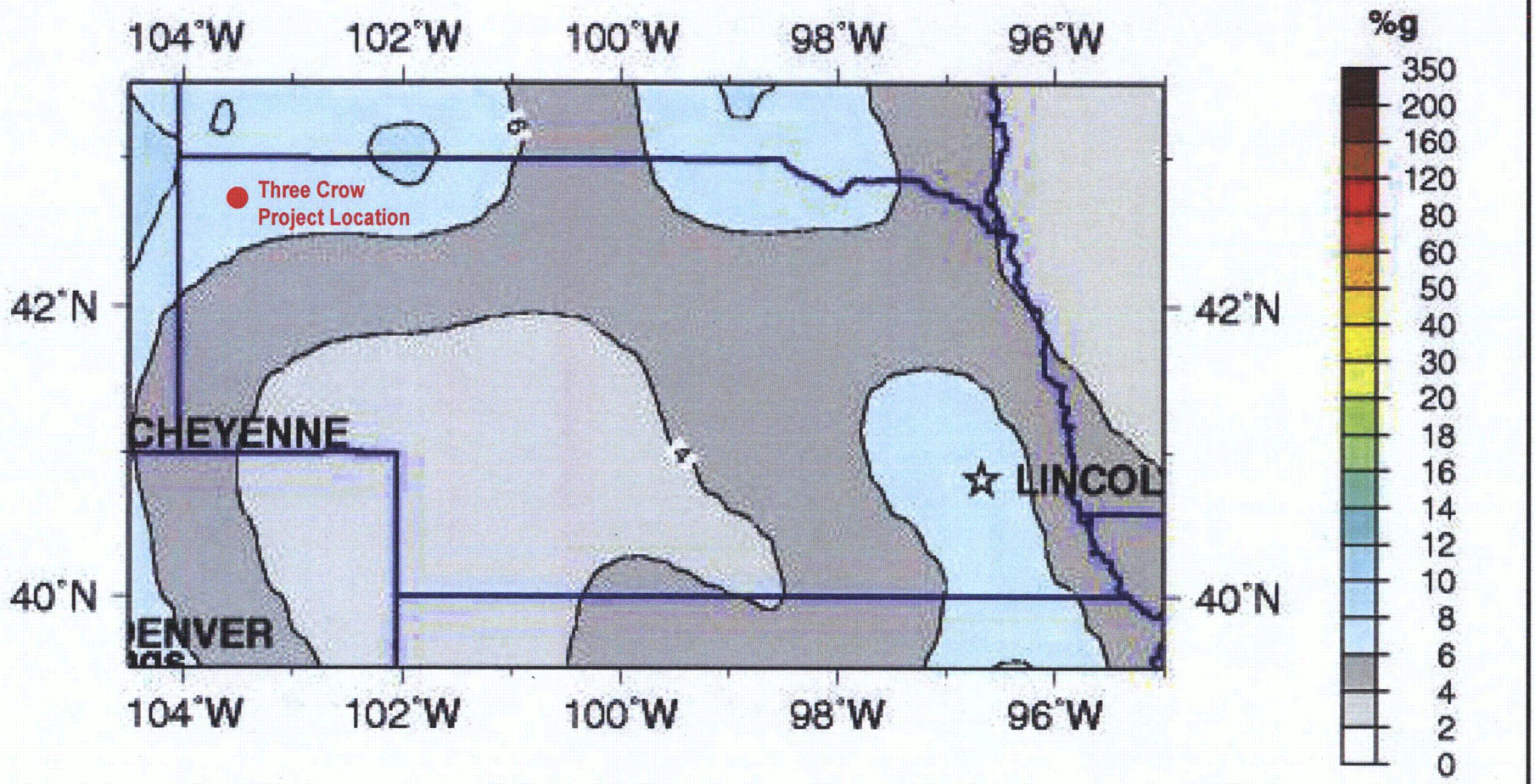
SOURCE: SD 2008

K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_3_3-16 Earthquake Hazard Ranking in the US.ai @ 01/13/2010



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)

SOURCE: USGS 20009a

N
W — E

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-17
SEISMIC HAZARD MAP
FOR NEBRASKA (2008)

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: LW

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Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
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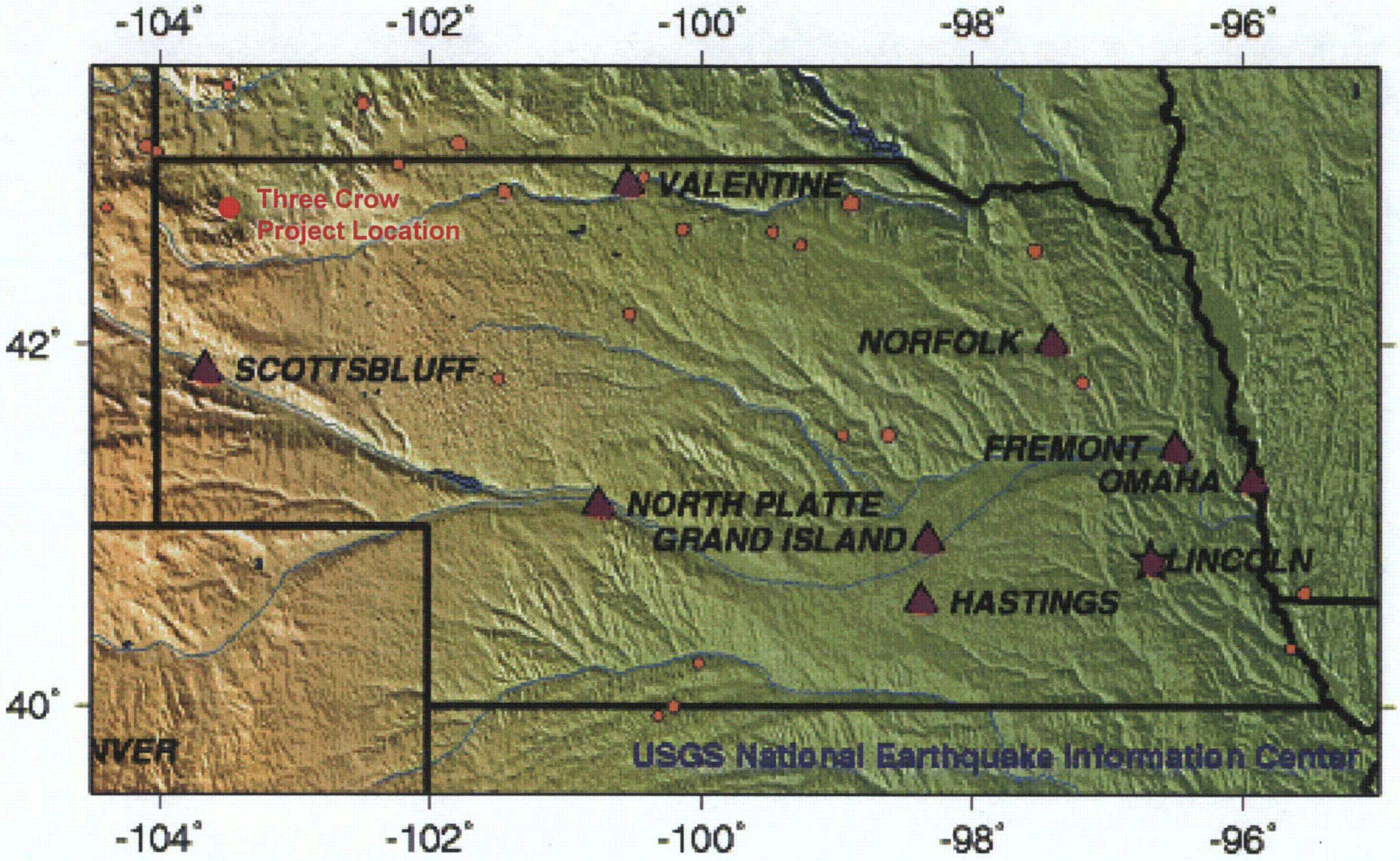
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_3_3-17 Seismic Hazard Map for Nebraska.ai @ 01/08/2010



-151 -71 -33 0

DEPTH

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

SOURCE: USGS 2009e

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-18
SEISMICITY OF NEBRASKA
1990-2006

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: LW

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K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_3_3-18 Seismicity of Nebraska 1990-2006.ai @ 01/13/2010

T. 31N R. 53W | T. 31N R. 52W

19 | 20 | 21

25 | 30 | 29 | 28 | 32 | 33

SIOUX COUNTY | DAWES COUNTY

Cherry Creek | Bozle Creek

Proposed Three Crow Expansion Area

LEGEND: Soils

- 1031, Glenberg fine sandy loam, channeled, frequently flooded
- 1180, Las Animas fine sandy loam, occasionally flooded
- 1356, Bridget silt loam, 1 to 3 percent slopes
- 1357, Bridget silt loam, 3 to 6 percent slopes
- 1363, Bridget very fine sandy loam, 3 to 6 percent slopes
- 1364, Bridget very fine sandy loam, 6 to 9 percent slopes
- 1618, Keith loam, 1 to 3 percent slopes
- 1620, Keith silt loam, 1 to 3 percent slopes
- 1631, Keith silt loam, 3 to 9 percent slopes
- 1742, Rosebud-Canyon loams, 3 to 9 percent slopes
- 1862, Ulysses silt loam, 9 to 20 percent slopes
- 5105, Alliance silt loam, 1 to 3 percent slopes
- 5106, Alliance silt loam, 3 to 9 percent slopes
- 5107, Alliance silt loam, 3 to 9 percent slopes, eroded
- 5118, Busher and tassel loamy very fine sands, 6 to 20 percent slopes
- 5124, Busher loamy very fine sand, 1 to 6 percent slopes, eroded
- 5128, Busher loamy very fine sand, 6 to 9 percent slopes, eroded
- 5129, Busher loamy very fine sand, 9 to 20 percent slopes
- 5200, Oglala loam, 9 to 30 percent slopes
- 5211, Oglala-Canyon loams, 9 to 20 percent slopes
- 5291, Vetal very fine sandy loam, 1 to 3 percent slopes
- 5292, Vetal very fine sandy loam, 3 to 6 percent slopes
- 5947, Duroc very fine sandy loam, 1 to 3 percent slopes
- 5964, Jayem and Vetal loamy very fine sands, 6 to 9 percent slopes
- 6028, Tassel soils, 3 to 30 percent slopes
- 6036, Tassel-Busher-Rock outcrop complex, 6 to 30 percent slopes
- 6109, Sarben loamy very fine sand, 9 to 30 percent slopes
- 9903, Fluvaquents, sandy, frequently flooded

0 500 1,000

Scale in Feet

N | W E

PROJECTION:
NAD_1927_STATE_PLANE_
NEBRASKA_NORTH_FIPS_2601
SOURCE:
AERIAL - NAIP 2006, SIOUX COUNTY & DAWES COUNTY, NEBRASKA;
SOILS - NRCS SOIL MART, NE045, NE165

CROW BUTTE RESOURCES, INC.

FIGURE 3.3-19
THREE CROW EXPANSION AREA
SOILS MAP

PROJECT: CO001396.00001 | MAPPED BY: JC | CHECKED BY: LW

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WYOMING

SOUTH DAKOTA

WH2

WH1

Sioux

Dawes

Sheridan

Cherry

Hat Creek

White River

White Clay Creek

Chadron

Whitney Reservoir

White

Soldier Creek

N

10 0 10 20 30 40 50 Miles

LEGEND

Proposed Three Crow Expansion Area

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-2
WHITE RIVER-HAT CREEK BASIN
(AND SUBBASINS)

PROJECT: CO001396.00003 MAPPED BY: MSH CHECKED BY: JC

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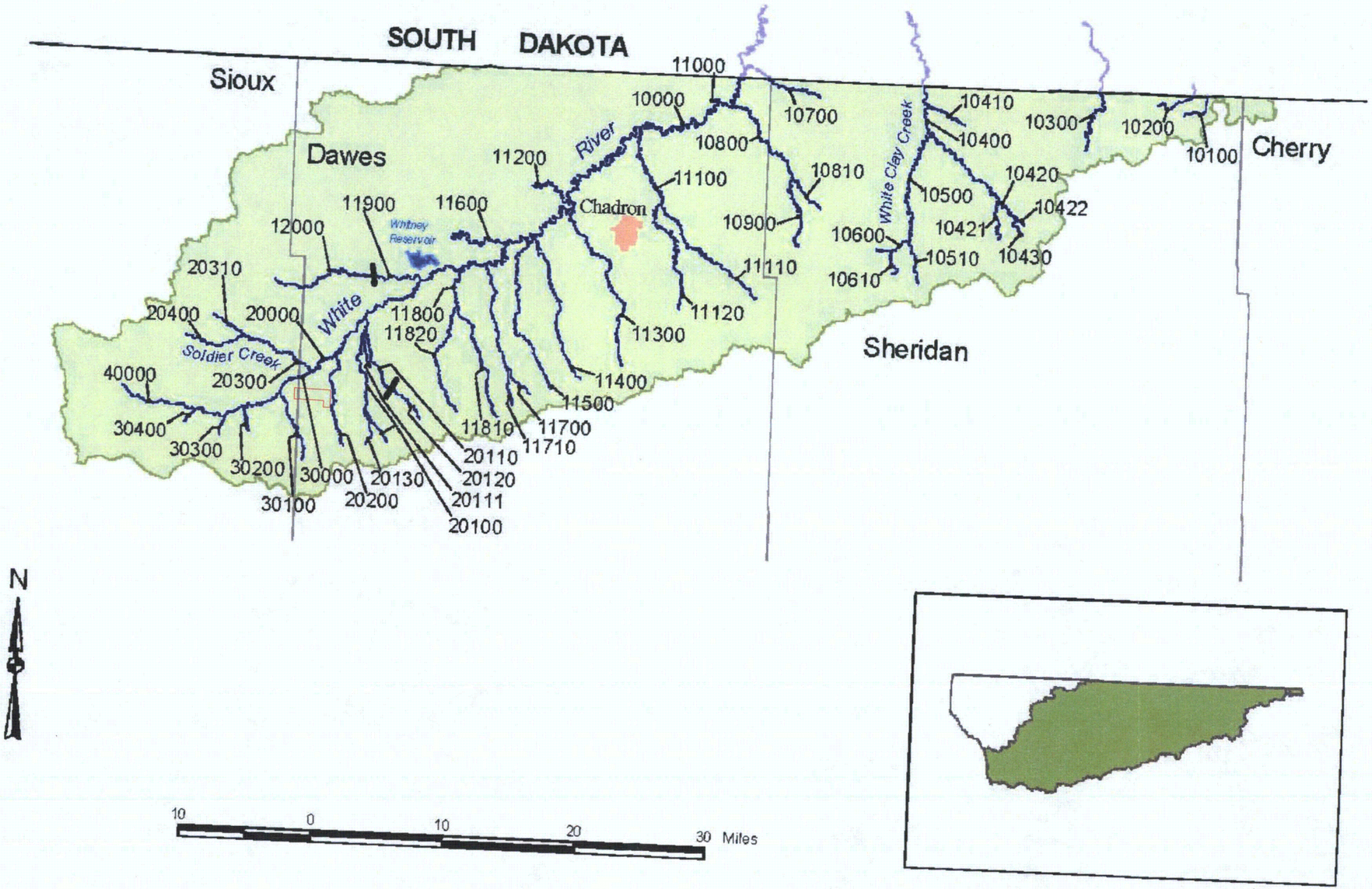
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TR\TR Fig_2_7-1 White River Hat Creek Basin.mxd - 5/24/2010 @ 11:30:50 AM

Subbasin WH1



LEGEND

Proposed Three Crow Expansion Area

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-3
WHITE RIVER-HAT CREEK BASIN
SUBBASINS WH1

PROJECT: CO001396.00003 MAPPED BY: MSH CHECKED BY: JC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
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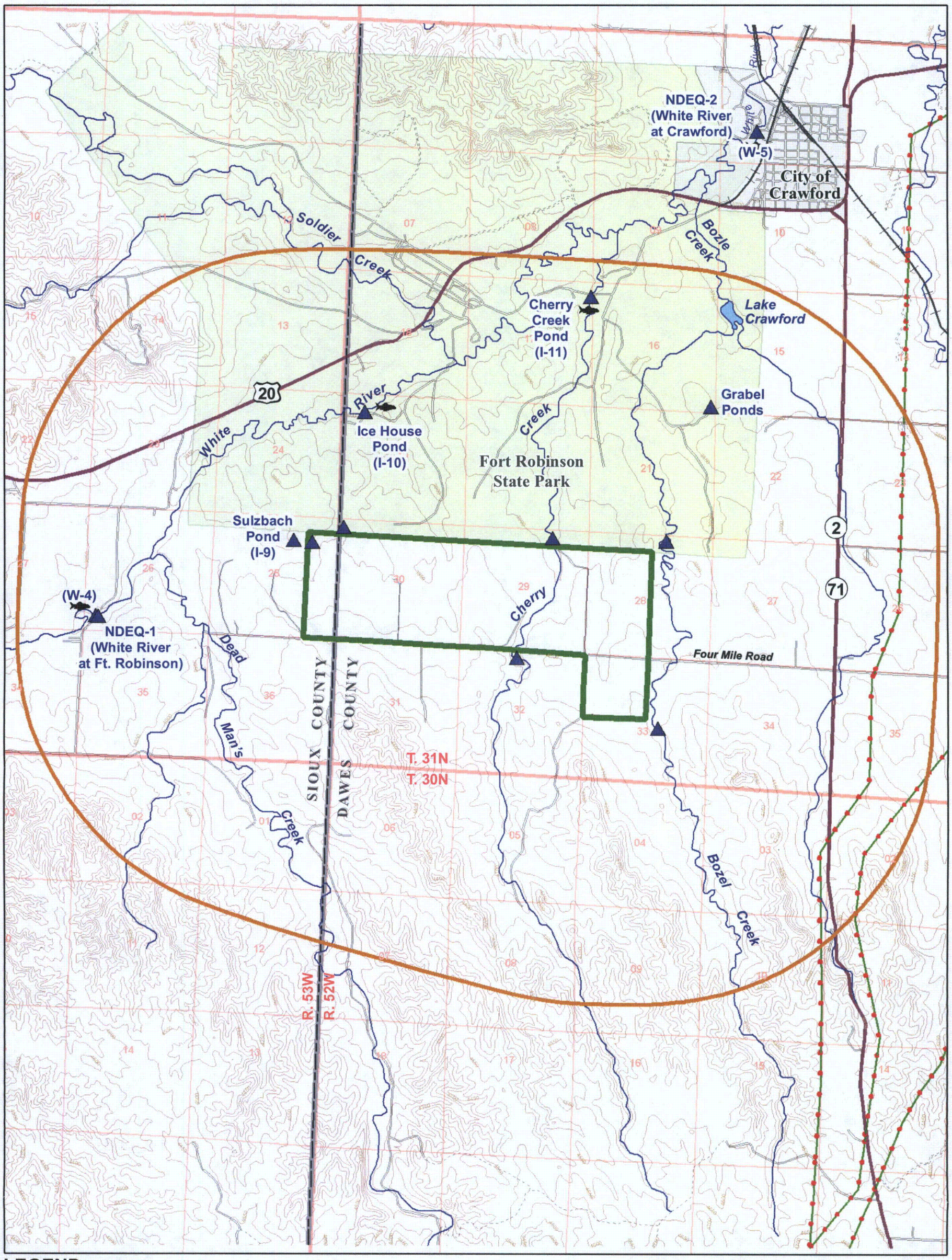
K:\CBR_Projects\CO001396_ThreeCrowW2_GIS\ArcMaps\0001_TRITR Fig_2_7-2_White River_Hat Creek Basin Subbasin WH1.mxd - 5/24/2010 @ 11:27:41 AM



K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TRTR Fig_2_7-3 3Crow Area Surface Water Sampling.mxd - 7/6/2010 @ 11:18:07 AM

LEGEND

- Proposed Three Crow Expansion Area and Class III Permit Boundary
- 2.25-Mile Area of Review (AOR)
- Lake
- River/Creek
- Transmission Line
- County Boundary
- Surface Water Sample Point
- Fish Sampling Location
- Elevation Contour (50-Ft Interval)
- Railroad
- Highway
- Road
- Trail

0 2,000 4,000
Scale in Feet

PROJECTION: NAD_1927_STATE_PLANE_ NEBRASKA_NORTH_FIPS_2601

ALL ELEVATIONS ARE IN FT-AMSL.

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-4
THREE CROW AREA
SURFACE WATER SAMPLING LOCATIONS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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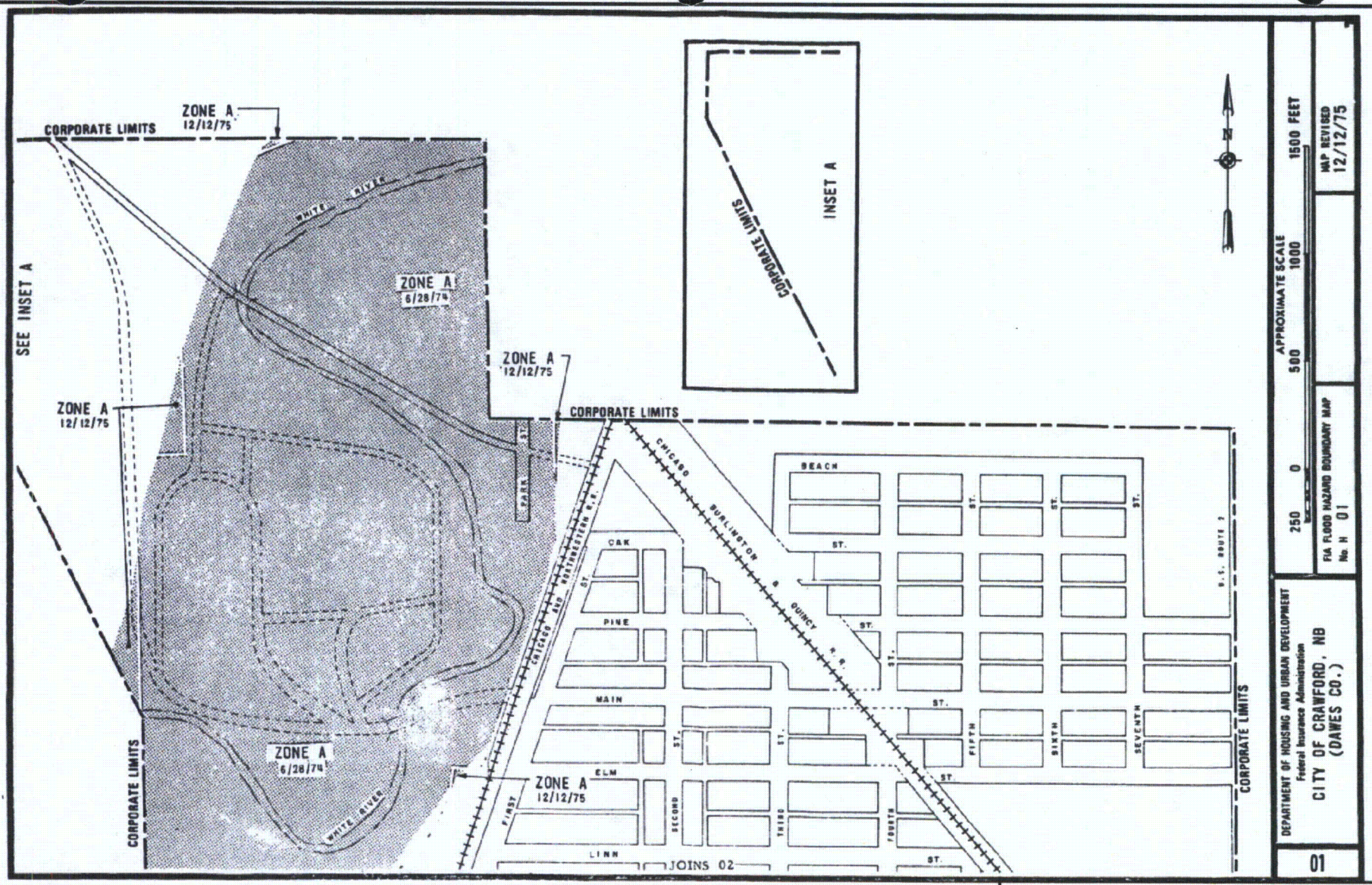

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-5
FEMA FLOOD MAP

PROJECT: CO001396.00002 MAPPED BY: JC CHECKED BY: JEC

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630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
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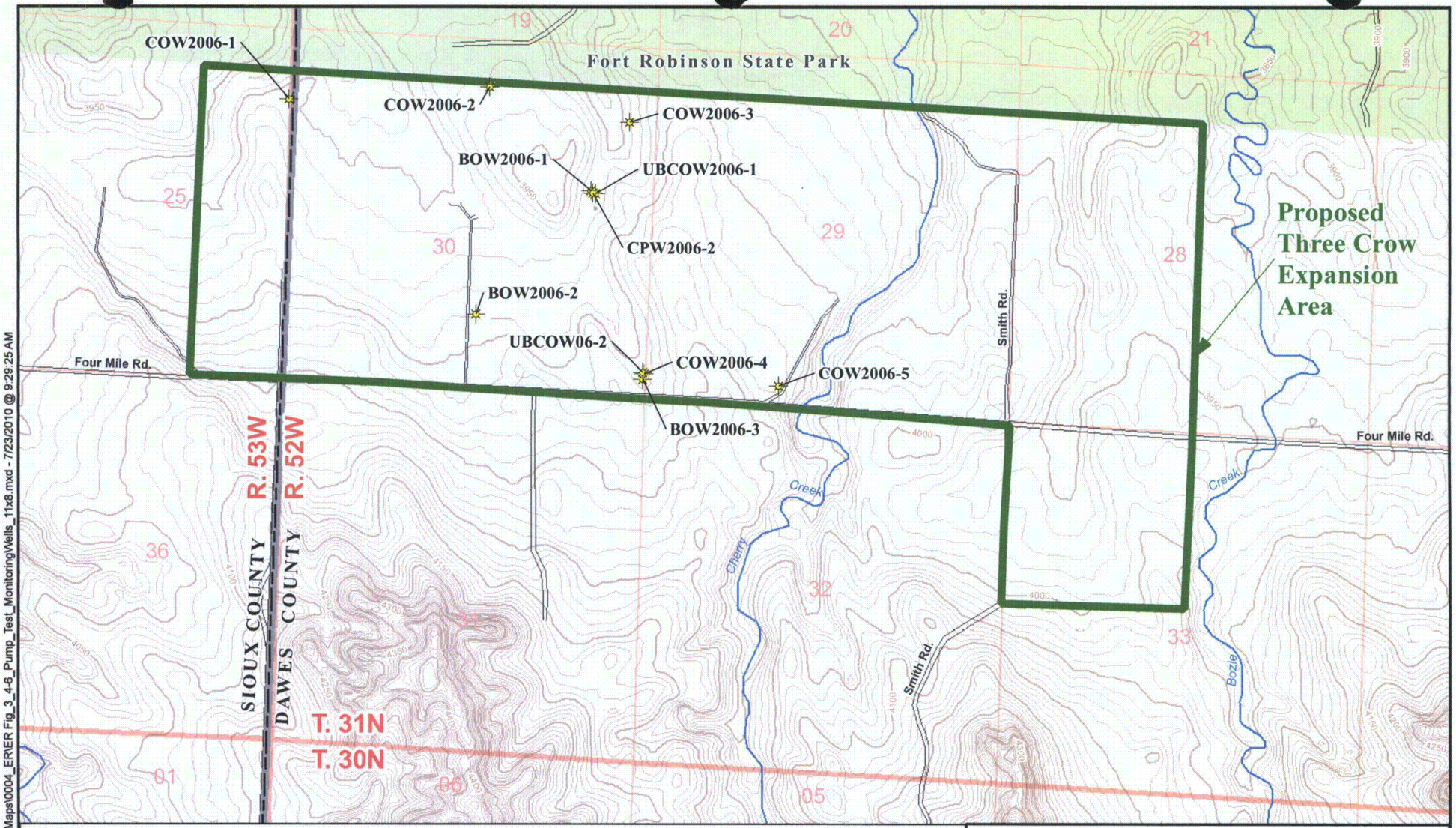

LEGEND

- Monitoring Well
- Proposed Three Crow Expansion Area
- Fort Robinson State Park
- River/Creek
- County Boundary
- Elevation Contour (10-Ft Interval)
- Road

0 1,000 2,000
Scale in Feet

N
W — E

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-6
LOCATION OF THREE CROW
PUMPING TEST MONITORING WELLS

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
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K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0004_ER\ER Fig_3_4-6_Pump_Test_MonitoringWells_11x8.mxd - 7/23/2010 @ 9:29:25 AM

COW2006-1
(3720.4)

COW2006-2
(3717.1)

COW2006-3
(3716.7)

UBCOW2006-1
(3717.7)

CPW2006-2
(3717.3)

UBCOW06-2
(3717.0)

COW2006-4
(3717.0)

COW2006-5
(3716.5)

COW2006-6
(3708.2)

COW2006-7
(3707.6)

3720
3719
3718
3717
3716
3715
3714
3713
3712
3711
3710
3709
3708

19
20
21
22
25
30
29
28
27
36
31
32
33
34

SIOUX COUNTY
DAWES COUNTY

R. 53W
R. 52W

T. 31N
T. 30N

Creek
Cherry
Creek
Bozle

Proposed Three Crow Expansion Area

LEGEND

- Lower Basal Chadron Sandstone Monitoring Well
- Upper Basal Chadron Sandstone Monitoring Well
- (3720.5) Groundwater Elevation (FT-AMSL)
- River/Creek
- County Boundary
- Groundwater Flow Direction
- Proposed Three Crow Expansion Area

Notes:
1. Groundwater elevations are shown for wells screened in the Upper Basal Chadron Sandstone, but were not included in contouring.
2. All elevations are in ft-amsl.

0 1,000 2,000
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-7
THREE CROW EXPANSION AREA
POTENTIOMETRIC SURFACE -
BASAL CHADRON SANDSTONE (01/22/2010)

PROJECT: CO001396.0003 MAPPED BY: JC CHECKED BY: MS

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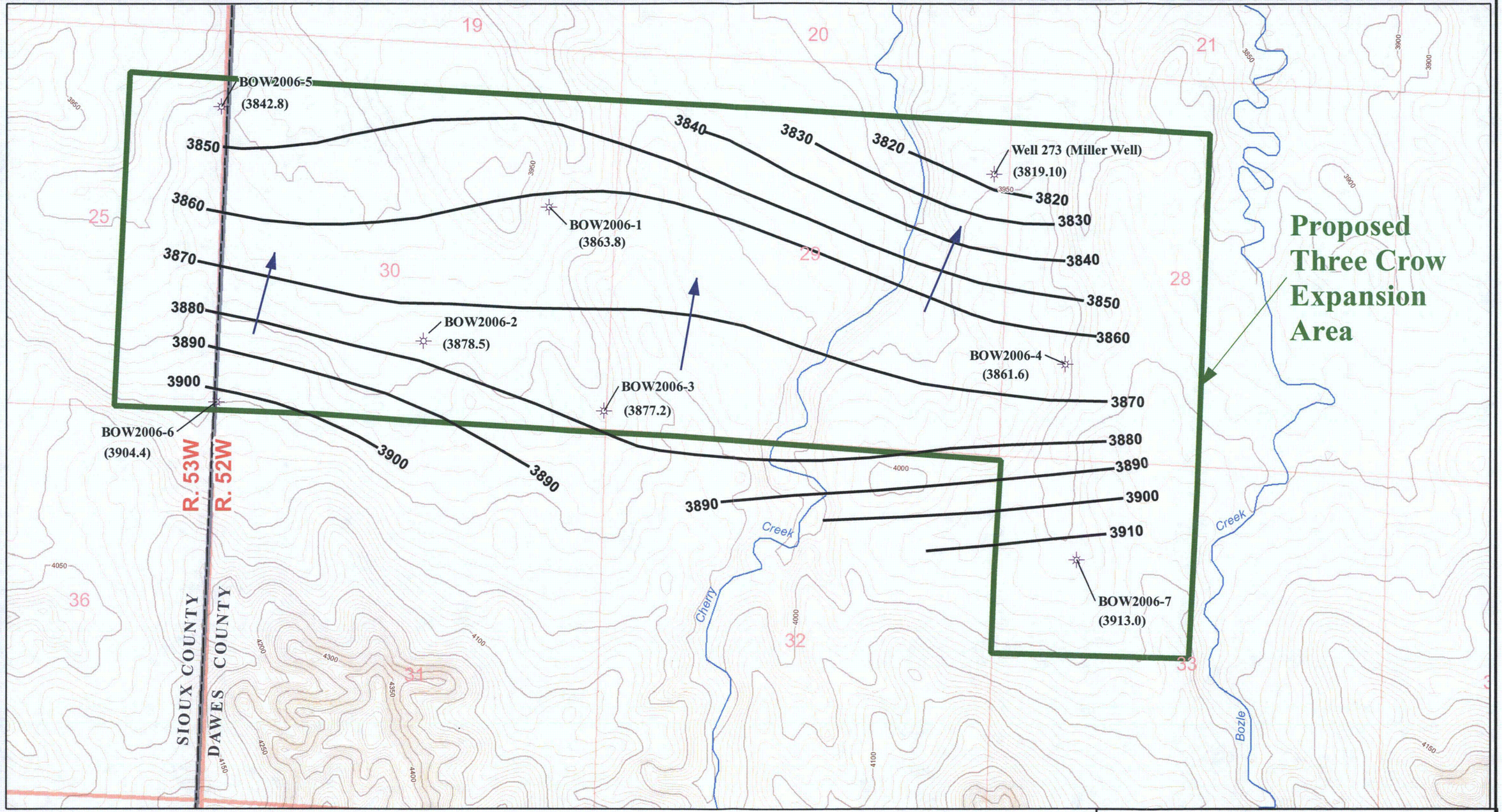
K:\CBR_Project\CO001396_ThreeCrow2_GIS\ArcMaps\0004_ERER Fig_3_4-7 PotentiometricSurface_BasalChadronSandstone.mxd - 7/19/2010 @ 10:16:17 PM



LEGEND

- Brule Formation Monitoring Well
- Groundwater Potentiometric Surface (FT-AMSL)
- (3879) Groundwater Elevation (FT-AMSL)
- Groundwater Flow Direction
- River/Creek
- Elevation Contour (10-Ft Interval)
- County Boundary
- Proposed Three Crow Expansion Area

Notes:
1. Water levels at all well locations were collected on 1/22/2010, with the exception of Well 273 (Miller Well), which was collected on 2/8/10
2. All Elevations are in ft-amsl.

0 750 1,500
Scale in Feet

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

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W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.4-8
THREE CROW EXPANSION AREA WATER LEVEL MAP - BRULE FORMATION (01/22/10 & 02/08/10)

PROJECT: CO001396.00003 | MAPPED BY: JC | CHECKED BY: MS

ARCADIS
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Highlands Ranch, CO 80129
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K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0004_ERIER Fig. 3.4-8 PotentiometricSurface_BruleFm.mxd - 7/19/2010 @ 10:27:45 PM

LEGEND

- Drainage
- Road
- ProposedThree Crow Expansion Area

Habitat Type

- Riverine
- Deciduous Streambank Forest
- Mixed Grass Prairie
- Range Rehabilitation
- Cultivated
- Structure Biotope

0 500 1,000
Scale in Feet

N
W E

PROJECTION:
NAD_1927_STATEPLANE_NEBRASKA_NORTH_FIPS_2601
SOURCE:
AERIAL - NAIP 2006, SIOUX COUNTY & DAWES COUNTY, NEBRASKA;
HABITAT - ARCADIS FIELD SURVEY 2006

CROW BUTTE RESOURCES, INC.

FIGURE 3.5-1
THREE CROW EXPANSION AREA
HABITAT MAP

PROJECT: CO001396.00001 | MAPPED BY: JC | CHECKED BY: LW

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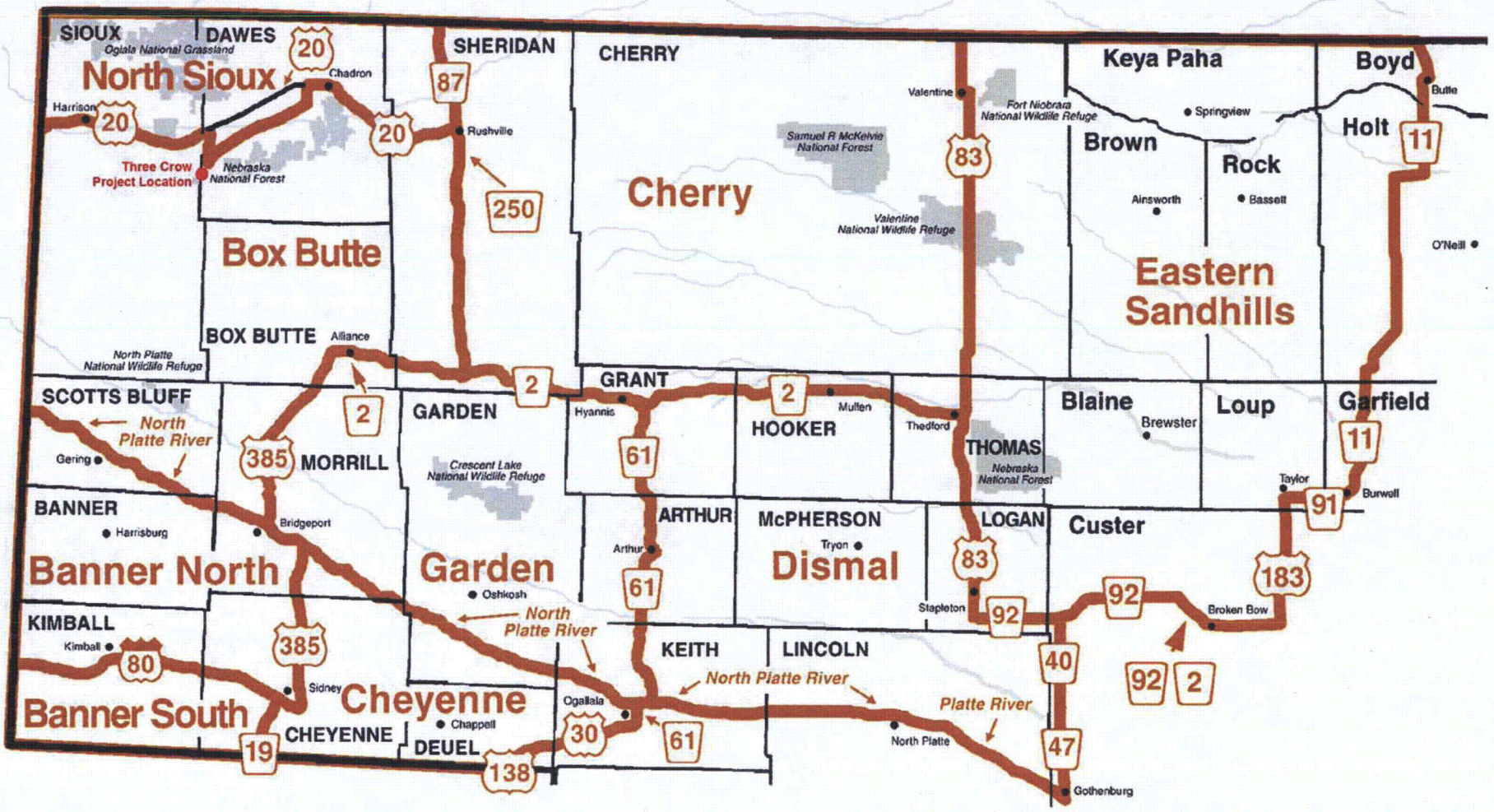
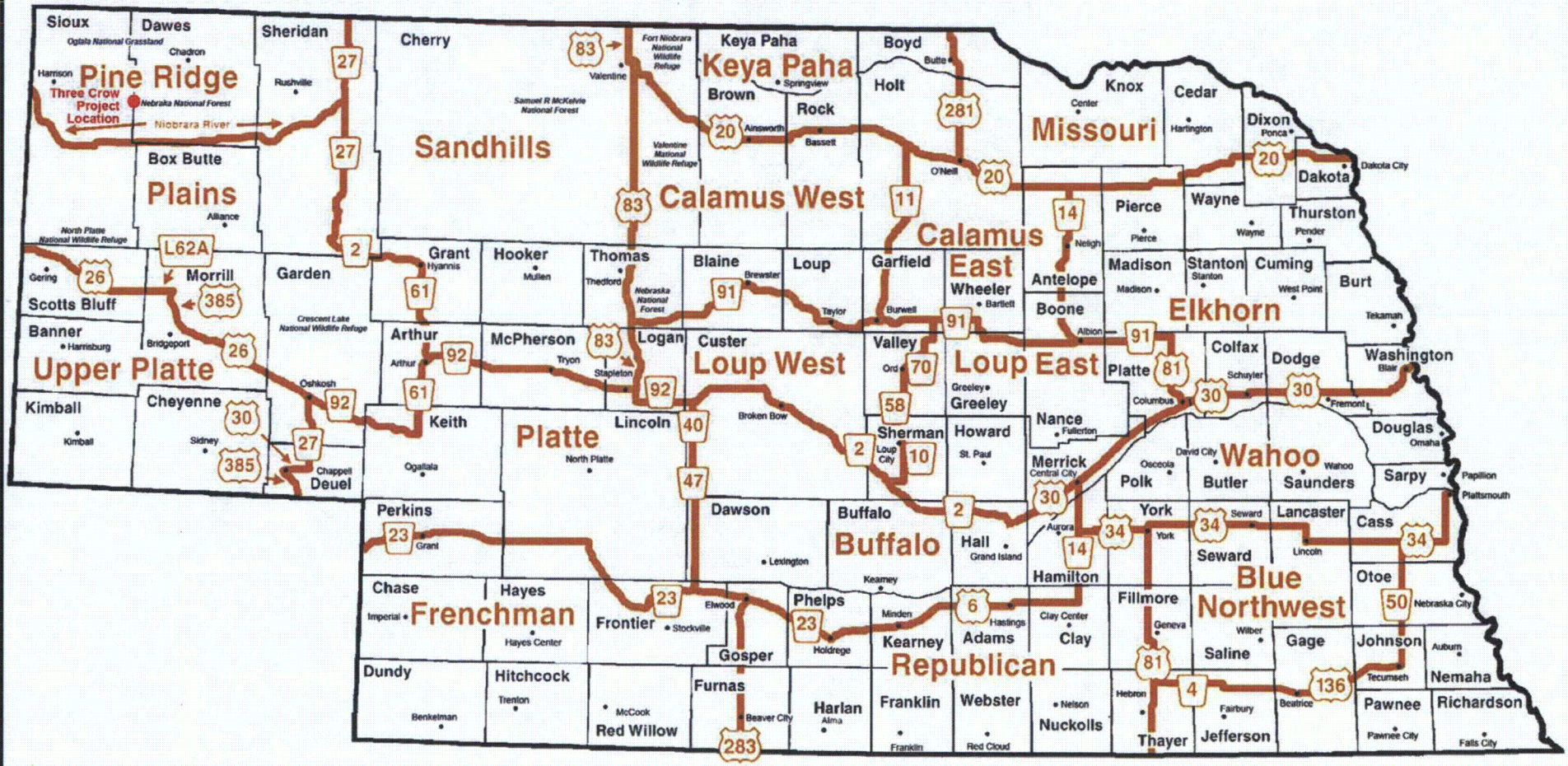
K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TRTR Fig_2_8-1_Habitat.mxd - 5/17/2010 @ 3:27:48 PM


SIOUX
DAWES
Oglala National Grassland
North Sioux
Chadron
Harrison
20
Three Crow Project Location
Nebraska National Forest
Box Butte
BOX BUTTE
Alliance
North Platte National Wildlife Refuge
SHERIDAN
87
Rushville
250
CHERRY
Cherry
Samuel R McKelvie National Forest
Valentine National Wildlife Refuge
Valentine
Fort Niobrara National Wildlife Refuge
83
Keya Paha
Springview
Boyd
Butte
Holt
11
Brown
Rock
Ainsworth
Bassett
O'Neill
Eastern Sandhills
SCOTTS BLUFF
North Platte River
Gering
385
MORRILL
2
GARDEN
Crescent Lake National Wildlife Refuge
GRANT
Hyannis
61
HOOKER
Mullen
Thedford
THOMAS
Nebraska National Forest
Blaine
Brewster
Loup
Garfield
Taylor
Burwell
91
BANNER
Harrisburg
Bridgeport
Banner North
Garden
Oshkosh
ARTHUR
Arthur
McPHERSON
Tryon
Dismal
LOGAN
Stapleton
Custer
Broken Bow
183
92
KIMBALL
Kimball
80
Sidney
Banner South
Cheyenne
Chappell
CHEYENNE
DEUEL
19
138
Ogallala
30
KEITH
LINCOLN
North Platte
Platte River
40
47
Gothenburg
2
N
W
E
SOURCE: NGPC 2010a
CROW BUTTE RESOURCES, INC.
FIGURE 3.5-2
NEBRASKA
PRONGHORN HUNTING UNITS
PROJECT: CO001396.00001
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\CO001396_ThreeCrow\3_IMAGES\Photoshop\ER Fig_3_5-2 NE Pronghorn Hunting Units.psd @ 01/26/2010



N
W — E

SOURCE: NGPC 2010b

CROW BUTTE RESOURCES, INC.

FIGURE 3.5-3
NEBRASKA
DEER HUNTING UNITS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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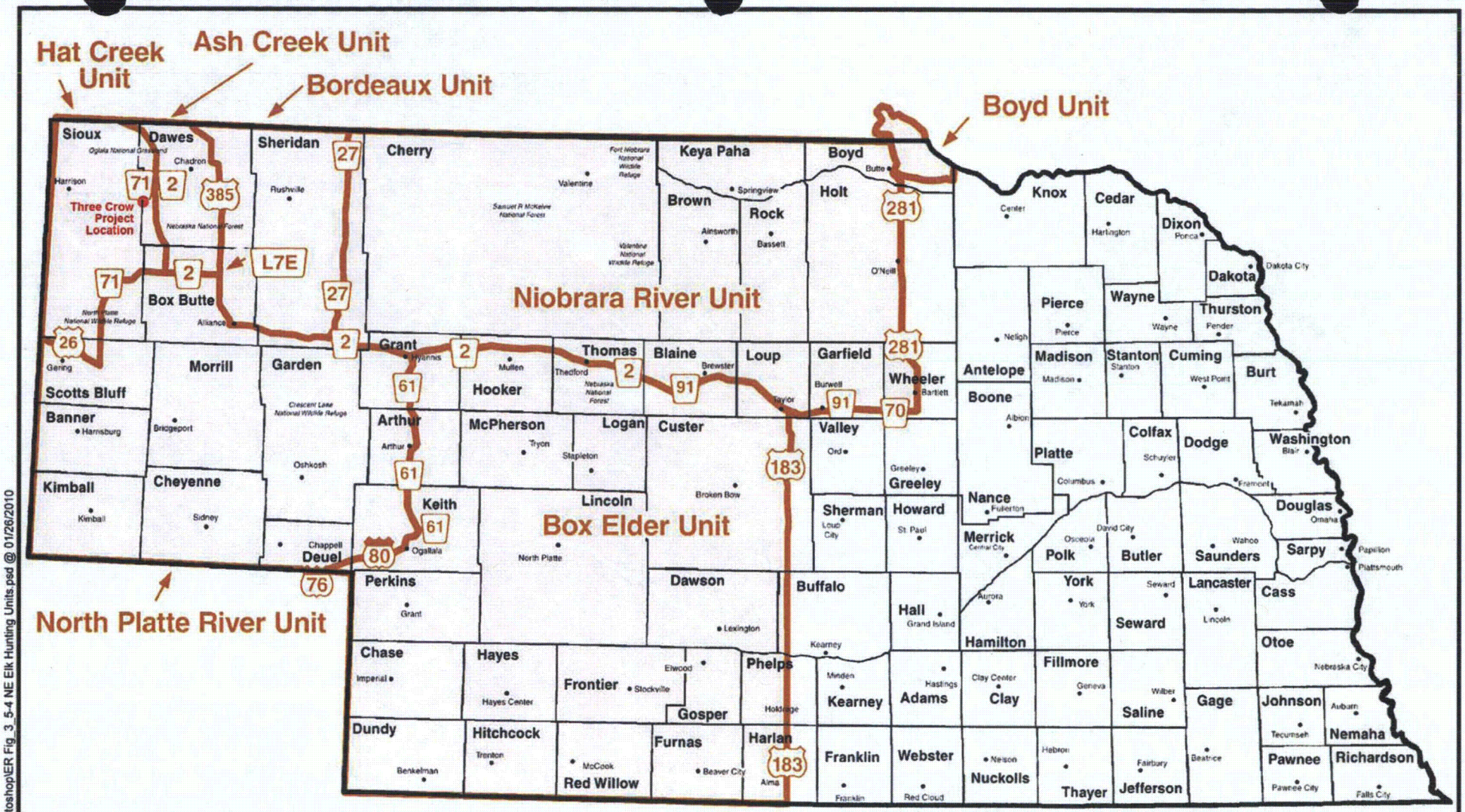
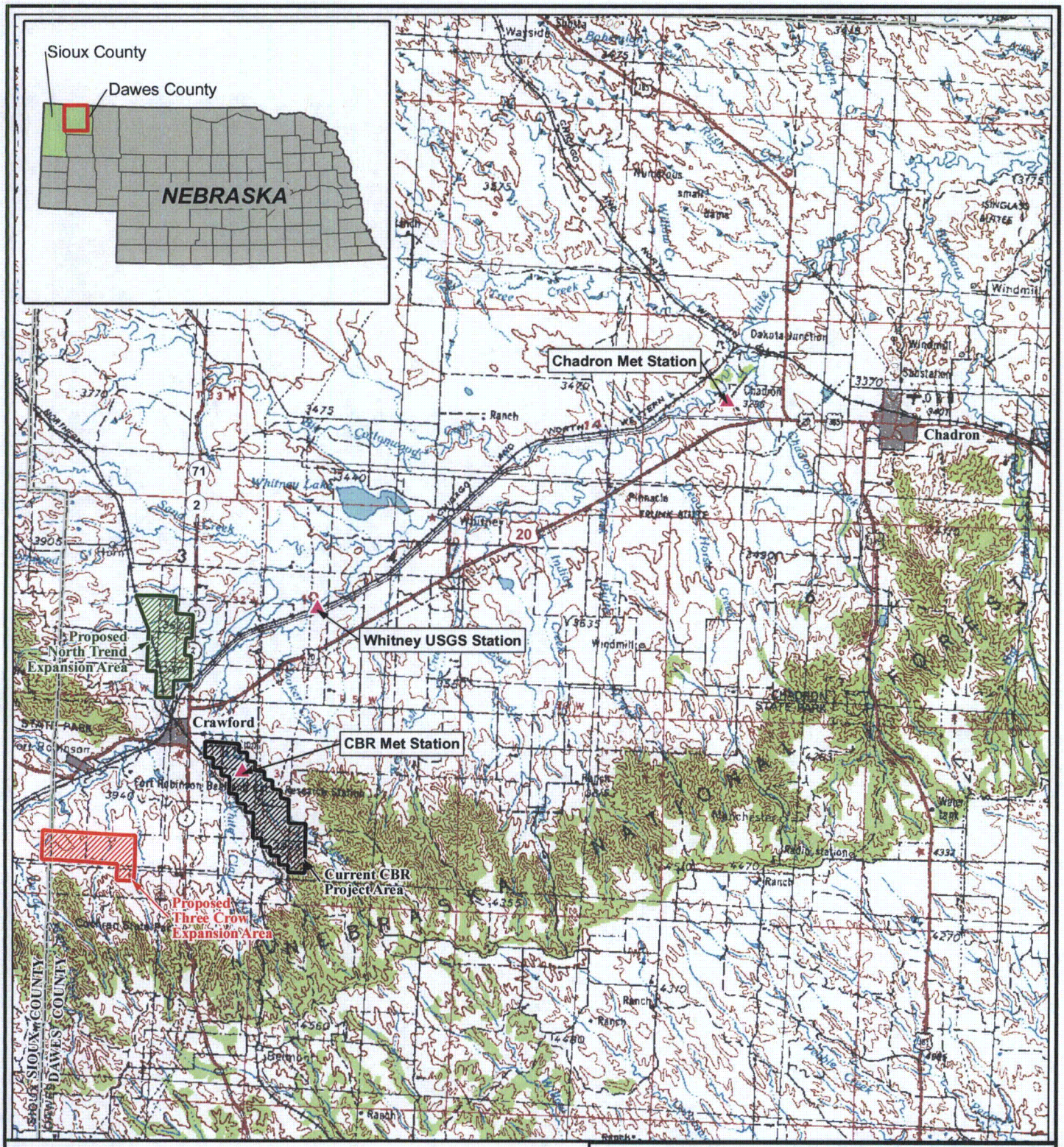
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Photoshop\ER Fig_3_5-3 NE Deer Hunting Units.psd @ 01/26/2010


Hat Creek Unit
Ash Creek Unit
Bordeaux Unit
Boyd Unit
Niobrara River Unit
Box Elder Unit
North Platte River Unit
Three Crow Project Location
L7E
Sioux
Dawes
Sheridan
Cherry
Keya Paha
Boyd
Brown
Rock
Holt
Knox
Cedar
Dixon
Dakota
Pierce
Wayne
Thurston
Box Butte
Grant
Thomas
Blaine
Loup
Garfield
Wheeler
Antelope
Madison
Stanton
Cuming
Burt
Boone
Morrill
Garden
Arthur
McPherson
Logan
Custer
Valley
Greeley
Platte
Colfax
Dodge
Washington
Scotts Bluff
Banner
Kimball
Cheyenne
Deuel
Keith
Lincoln
Sherman
Howard
Nance
Merrick
Polk
Butler
Saunders
Douglas
Sarpy
Perkins
Dawson
Buffalo
Hall
Hamilton
York
Seward
Lancaster
Cass
Otoe
Chase
Hayes
Frontier
Gosper
Phelps
Kearney
Adams
Clay
Fillmore
Saline
Gage
Johnson
Nemaha
Dundy
Hitchcock
Red Willow
Furnas
Harlan
Franklin
Webster
Nuckolls
Thayer
Jefferson
Pawnee
Richardson
N
W
E
SOURCE: NGPC 2010c
CROW BUTTE RESOURCES, INC.
FIGURE 3.5-4
NEBRASKA
ELK HUNTING UNITS
PROJECT: CO001396.00001
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\CO001396_ThreeCrow\3_IMAGES\Photoshop\ER Fig_3_5-4 NE Elk Hunting Units.psd @ 01/26/2010



LEGEND

- Meteorological Station
- Proposed Three Crow Expansion Area
- Proposed North Trend Expansion Area
- Current CBR Project Area
- County Boundary

0 1.5 3
Miles

N
W E

PROJECTION:
NAD_1927_STATE_PLANE_
NEBRASKA_NORTH_FIPS_2601

SOURCE: USGS 1:250K DRG - ALLIANCE (1980), NE

CROW BUTTE RESOURCES, INC.

FIGURE 3.6-1
LOCATION OF
REGIONAL METEOROLOGICAL STATIONS

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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Highlands Ranch, CO 80129
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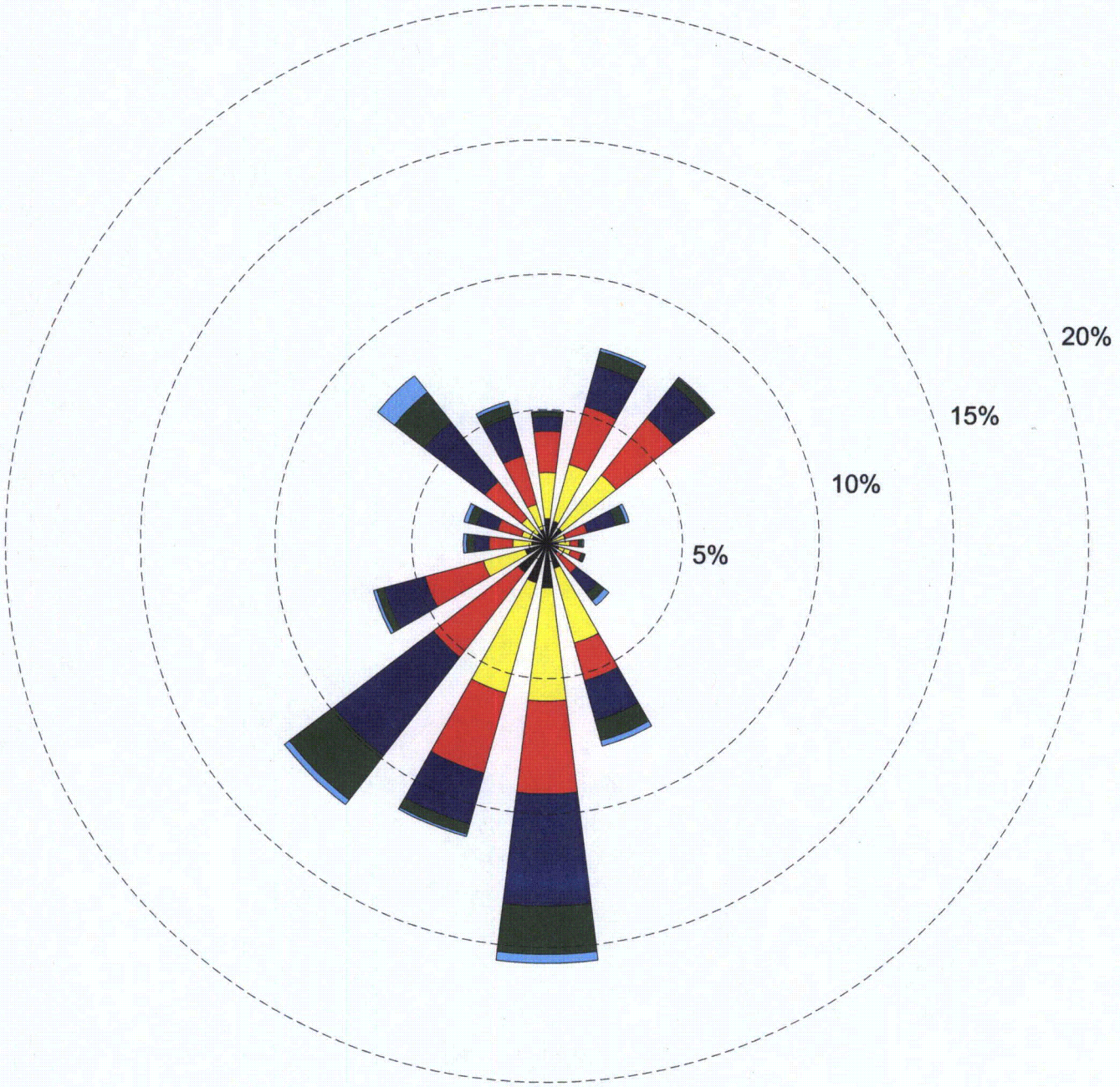
www.arcadis-us.com

K:\CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0001_TR\TR Fig_2_5-1 Regional Met Stations.mxd - 7/19/2010 @ 1:35:22 PM



Wind Speed (knots)

- >21
- 17-21
- 11-16
- 7-10
- 4-6
- 1-3

Average Wind Speed: 8.40 knots
Percent Calm Winds: 0.3 percent
Wind Direction: Blowing from
Data Period: May 1982 - April 1984

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FIGURE 3.6-2
WIND ROSE PLOT
CROW BUTTE

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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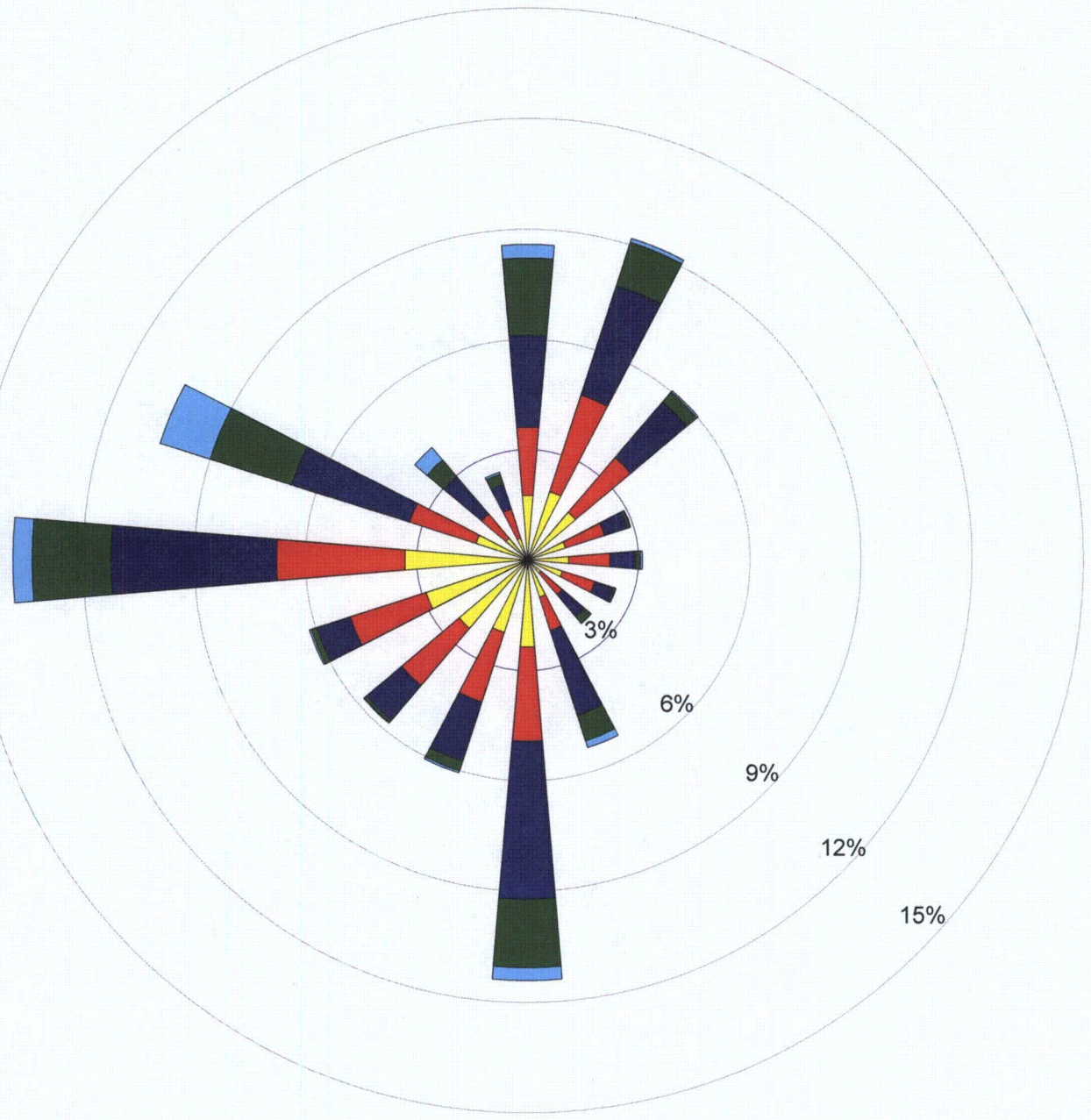
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustration\ER Fig_3_6-2 Wind Rose for Crow Butte.ai @ 05/17/2010



Wind Speed
(knots)

- >21
- 17-21
- 11-16
- 7-10
- 4-6
- 1-3

Average Wind Speed: 11.49 knots
Percent Calm Winds: 0.00 percent
Wind Direction: Blowing from
Data Period: April 1982 - May 1984

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CROW BUTTE RESOURCES, INC.

FIGURE 3.6-3
WIND ROSE PLOT
CHADRON NE - STATION No.24017
1982 - 1984

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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Highlands Ranch, CO 80129
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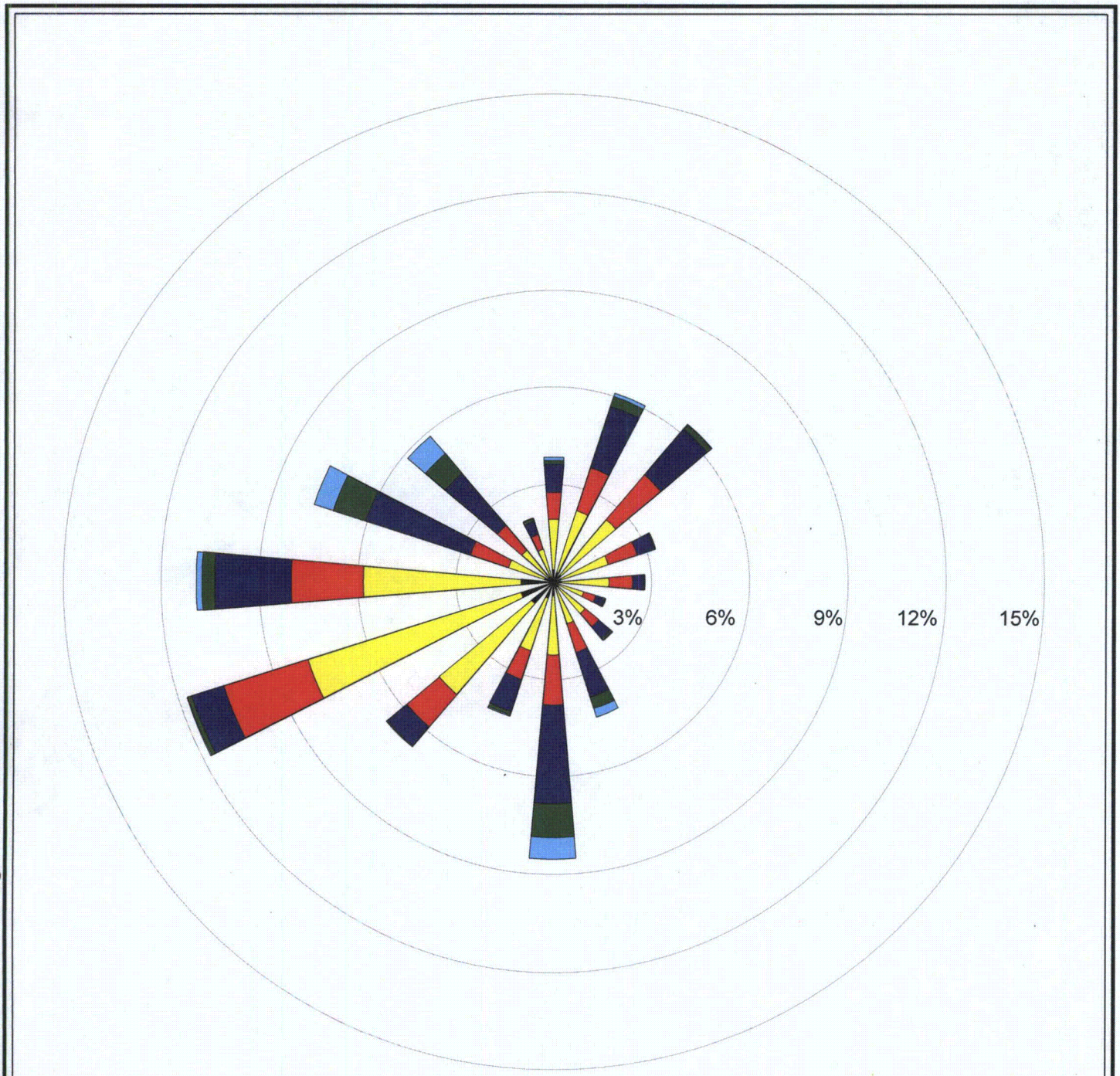
K:\CBR_Projects\CO001396_ThreeCrowI3_IMAGESIllustrationER Fig_3_6-3 Wind Rose for Charon 1982-1984.ai @ 05/18/2010



Wind Speed (knots)

- >21
- 17-21
- 11-16
- 7-10
- 4-6
- 1-3

Average Wind Speed: 8.22 knots
Percent Calm Winds: 11.58 percent
Wind Direction: Blowing from
Data Period: 2000 - 2004, 2005-2009

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FIGURE 3.6-4
WIND ROSE PLOT
CHADRON NE - STATION No.24017
2000 - 2009

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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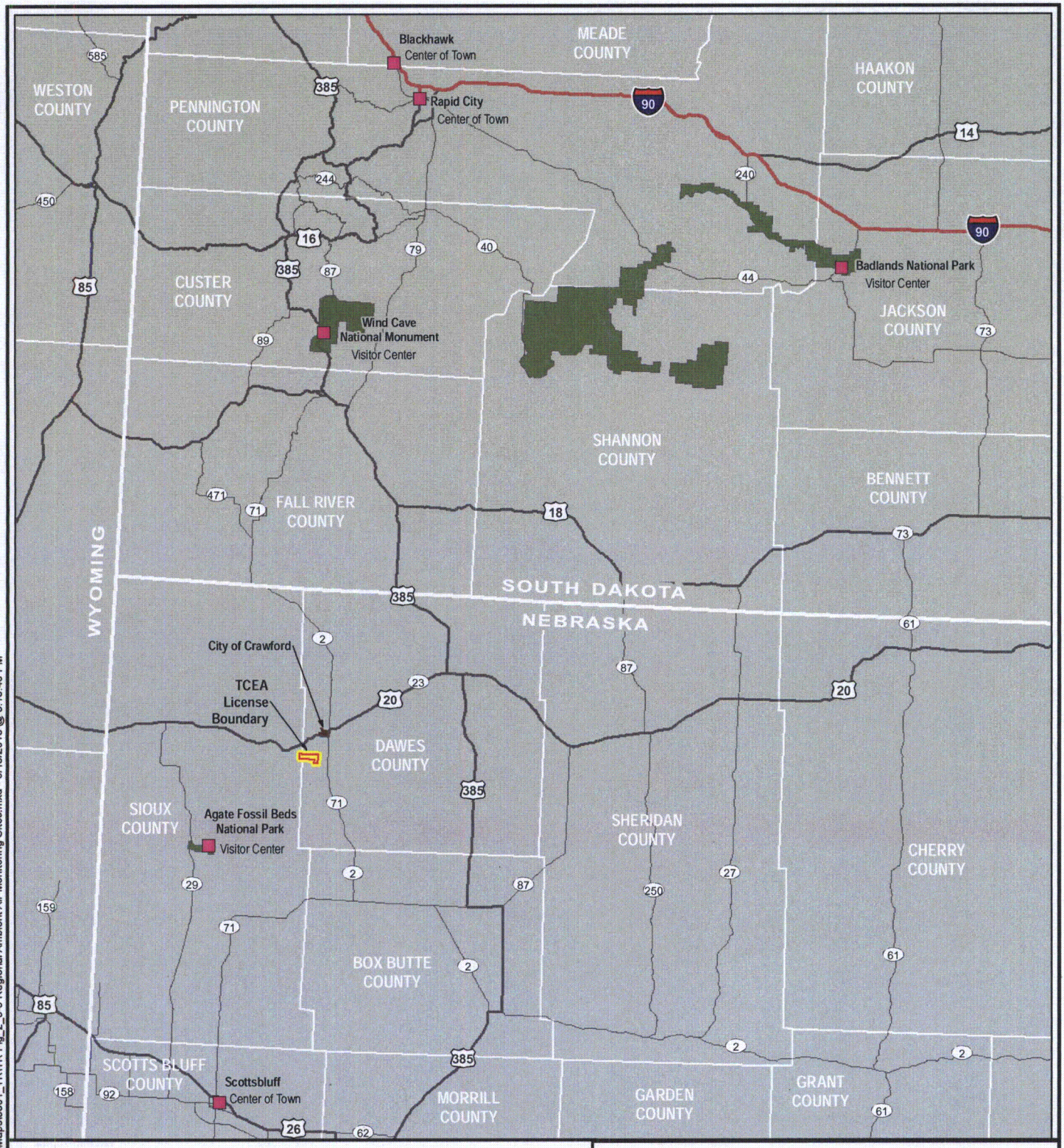
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_3_6-4 Wind Rose for Chadron 2000-2009.ai @ 05/17/2010



LEGEND

- Regional Ambient Air Monitoring Site
- City of Crawford
- National Park/Monument
- Proposed Three Crow Expansion Area (TCEA)
- Interstate Highway
- U.S. Route
- State Highway

0 10 20
Miles

PROJECTION:
NAD 1927 STATE PLANE
NEBRASKA NORTH FIPS 2601

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W E

CROW BUTTE RESOURCES, INC.

FIGURE 3.6-5
LOCATION OF REGIONAL AMBIENT AIR MONITORING SITES

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

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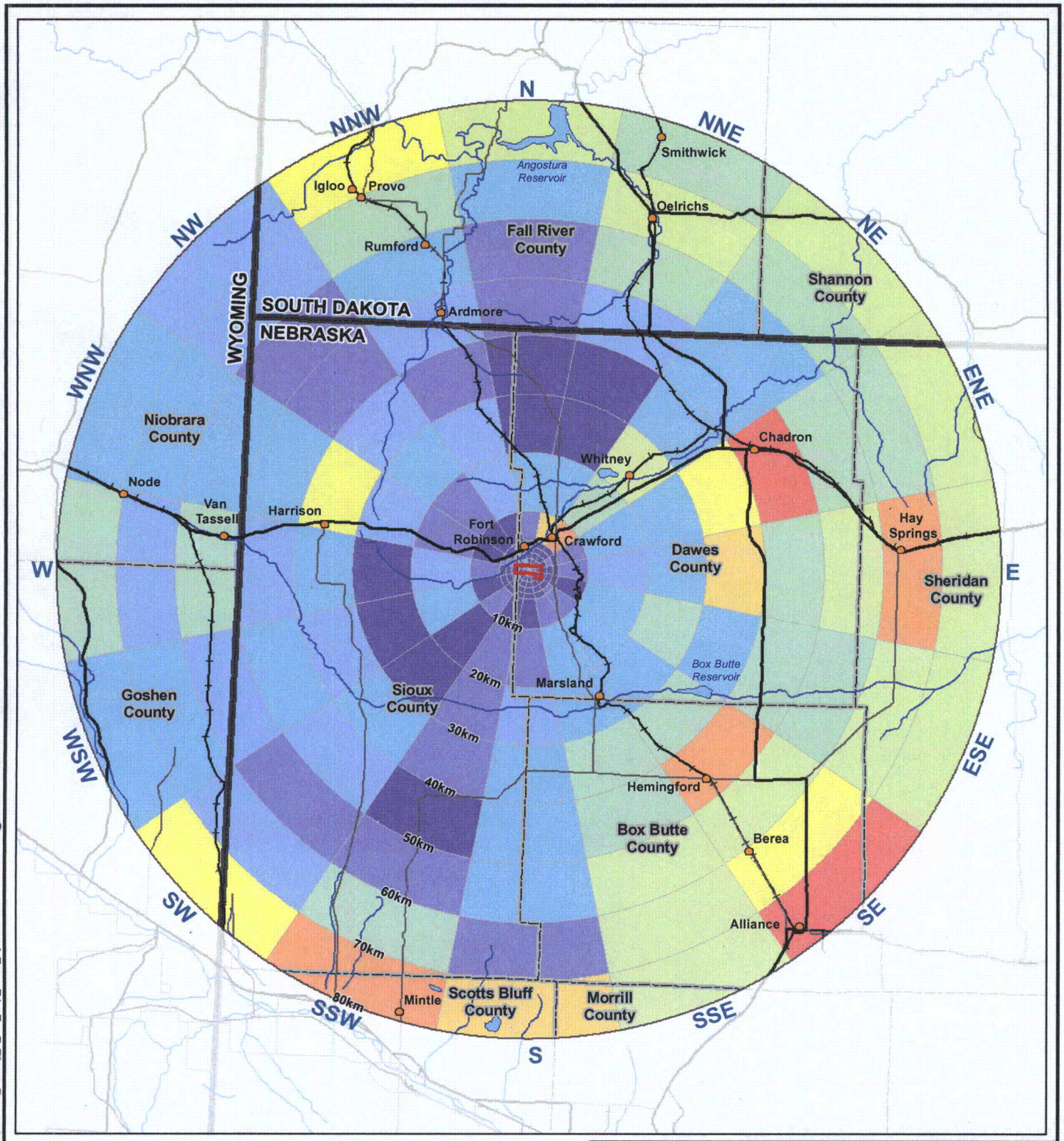

Legend

Proposed Three Crow Expansion Area

Population (Census 2000)

0 - 4	92 - 210
5 - 13	211 - 327
14 - 26	328 - 551
27 - 45	552 - 1,155
46 - 91	1,155 - 9,372

N
W E

0 10 20 30
Kilometers

CROW BUTTE RESOURCES, INC.

FIGURE 3.10-1
SIGNIFICANT POPULATION CENTERS WITHIN AN 80-Km (50 mi) RADIUS OF THE THREE CROW SITE

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: LW

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