Final Report
State Land Wind Feasibility Study

Contract #: 204031

June 28, 2005

Submitted
to

Paul Cartwright
State of Montana
Department of Environmental Quality

By

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1. Table of Contents

2. Summary of results

Work was conducted by Wilde to rank the wind resource for windy regions containing public school trust lands in the state of Montana. The subject sections are managed under the state department of Natural Resources and Conservation (DNRC) to generate income to support schools. It is believed that wind energy generation may be a future source of revenue on these sections of land.

The work was, firstly, to rate the various likely areas of windy school trust land and secondly to select one candidate for further development. The selected section was to be fitted with a 50 meter met tower to gather a full year of wind data at that location.

The ranking placed Judith Gap as the overall best, followed closely by a section in Springdale. Since the Judith Gap site has already been given a fair amount of attention recently, it was determined by Wilde and Paul Cartwright of MTDEQ that Springdale would be considered for installation of a 50 meter tower.

Site biological impact work was conducted prior to installation of the met tower by Wilde, Cartwright and Dr. Al Harmata, a consulting biologist with long term expertise in Montana. The preliminary potential impact index (PII) of the Springdale site was determined to be in the moderate range and it was decided that the 50 meter met tower would be erected on the section in Springdale.

Beginning in May, 2004 and ending May, 2005, a full year of data was collected at the site. The collected data indicated a good resource, with 50 meter wind speed of 17.11 mph with a clear wind direction from the west. The site data predicts capacity factor ranges between 35% and 40% for common contemporary commercial utility scale turbines.

In light of the findings of this report and the work done on the site, the State of Montana DNRC has issued a request for proposals for this site as of this writing and expects responses by July 8th of 2005

3. Criteria developed to rank sites

Criteria factors were developed to quantitatively and qualitatively rank windy state land sites. Once specific factors were chosen, each was assigned range through which a numerical ranking could be accomplished. The resulting matrix of sites is given in Appendix 1.

The selection criteria used to rank sites and the corresponding symbols from the chart are as follows:

- TRS Location - Township, Range and Section
- LL Location - Latitude and Longitude
- WI Wind Intensity (Class 1 to 7)
- WE Wind Estimate Certainty (relative ranking 1-10, based upon number, quality and consistency of data sets, and some private data sets not available to public)
- INT Transmission/Substation Interconnect Potential (relative rankings 1-10, based upon consultants' experience and conversations with utility transmission personnel)
- CS Number Of State Sections within 5 mile radius (includes target section; 1-78.5, 78.5 max)
- TC Available Transmission Capacity (relative rankings 1-10, based upon consultants' experience and conversations with utility transmission personnel)
- SL Proximity To System Load (relative ranking 1-10, based upon consultants experience and conversations with utility transmission personnel)
- SG Proximity To System Generation (relative ranking 1-10, based upon consultants' experience and utility system maps)
- EA Environmental Impacts Avian (relative rankings 1-10, based on consultants' experience including conversations with Department of Interior, Fish and Wildlife and other experts)
- EV Environmental Impacts Visual (relative ranking based upon proximity to residences and thoroughfares and consultants' knowledge of local sentiment toward wind development)
- DA Commercial Development Potential of Area surrounding The State Land Site (relative ranking 1-10, based on development requirements for a commercial type 100 MW wind farm.)
- PR Proximity To Improved Road (all weather road, number of miles 1-10, 10 mile max)

- PT Proximity To Technical Supplies/Facilities/Staff (crane, contractors, Geo Tech) (relative ranking 1-10, based upon 200 mile max)

Following the determination of the criteria, a matrix was developed to quantify the criteria values and identify the top 20 state land wind sites in Montana. Versions of the site matrix were refined in discussions between Wilde and Cartwright.

4. Site locations and rankings

The comprehensive matrix of sites and the respective criteria ranking scores are given in Appendix 1. The sites considered under this work and their respective rankings are listed below.

Ranking	Site Name	TRS	LL
1	Judith Gap	10N15E36	46° 35.39'N, 109° 46.66'W
2	Springdale, MT	1N12E36	45° 47.13'N, 110° 10.84'W
3	Rapelje	2N18E16	45° 55.09'N, 109° 30.29'W
4	Marino (Stanford)	16N10E16	47° 8.49'N, 110° 27.58'W
5	Lindsay (Big Sheep)	18N51E16	47° 19.18'N, 105° 14.14'W
6	Norris	3S1E21	45° 34.03'N, 111° 37.01'W
7	Cut Bank (Ethridge)	32N4W16	48° 31.56'N, 112° 8.43'W
8	Colstrip	1N40E16	45° 49.93'N, 106° 45.80'W
9	Whitehall	1N4W36	45° 47.75'N, 112° 3.10'W
10	Glasgow AFB	32N39E23	48° 31.16'N, 106° 36.88'W
11	Baker	10N58E16	46° 37.21'N, 104° 25.74'W
12	Bowler Flats (Bridger)	7S24E36	45° 10.73'N, 108° 44.02'W
13	Scobey	35N47E21	48° 46.37'N, 105° 34.63'W
14	Duncan Colony (Two Dot)	7N14E20	46° 21.20'N, 109° 59.80'W
15	Blackfeet	No State Sections	48° 31.28'N, 113° 1.71'W
16	Havre Area	33N16E16	48° 36.97'N, 109° 38.75'W
17	Lennep	8N10E34	46° 24.64'N, 110° 27.74'W
18	Martinsdale	9N12E30	46° 31.12'N, 110° 15.26'W
19	Chester	31N7E34	48° 24.24'N, 110° 48.84'W
20	Sweet Grass Hills	35N5E4	48° 49.20'N, 111° 5.32'W

5. Complete Fish and Wildlife Service impact index checklist

Dr. Al Harmata, an experienced Montana wildlife biologist, was contracted to complete the US Fish and Wildlife relative Potential Impact Ranking of the Springdale site.

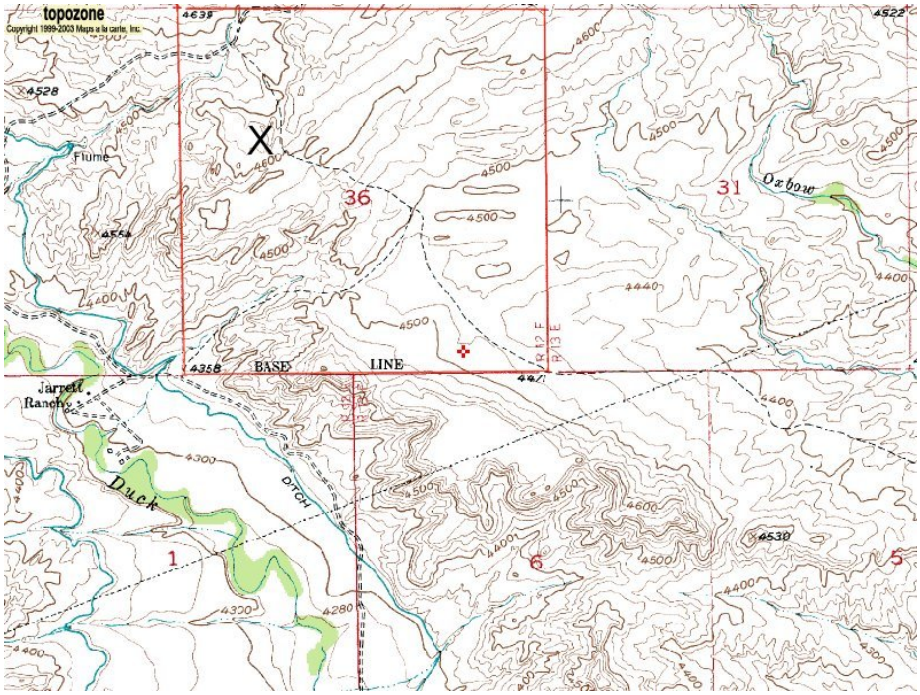
Wilde and Cartwright met with Dr. Harmata at the site for a site walk and detailed inspection of the flora and fauna. The resulting observations were entered onto

the potential impact checklist provided by US Fish and Wildlife for indexing potential wind sites prior to development.

The results of the potential impact report indicated that the Springdale site falls into the “moderate” range. This can be seen in the attached PII report in Appendix 2.

6. Install 50-meter anemometer

Following clearance by DEQ and the biologist a 50-meter meteorological tower was installed at the site at the location depicted by the X in the following site diagram.



The met tower was installed and gathered data from 5/16/2004 through 5/16/2005 and was configured to record one year of 10-minute wind data including wind speed and direction at 10 meters, 25 meters, and 50 meters, also to record temperature.

Monthly data summaries and raw data were submitted to DEQ in electronic format as well as summary data reports showing wind distribution in bin format, wind speed and wind rose.

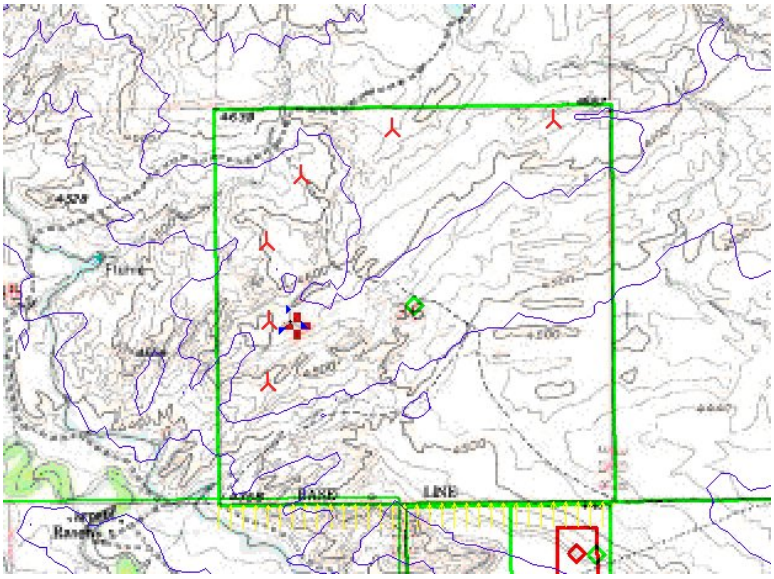
The raw data from the wind anemometer was sent to DEQ at the conclusion of the collection period. This package included 10-minute data for average wind speed and direction for 10 meter, 25 meter, and 50 meter and temperature.

A summary report of the wind data was completed with average wind speed and wind rose and wind speed distribution both for wind speed and direction. This is attached as Appendix 3.

7. Preliminary feasibility study of site

A mock project was set up using GE wind 2.5 MW Turbines for this borderline Class I/II site. The strength and "tuning" of the turbine is indicated by the Class I or II designation, with Class I turbines installed at sites having the higher wind speeds.

The lay out is shown in the following site schematic. The turbines have been sited to mitigate for the prairie dog town located in the eastern half of the section - mid way up.



A preliminary cost estimate for these six turbines (15MW) would be in the $19M range. Energy production is estimated at 45,300 MHW annually for a capacity factor of 37%. At these productions, revenue for school trust fund would be in the range of $75-100K annually.

DNRC has released an RFP for development of this site and expects responses back by the 8th of July, 2005.

8. Appendix 1 – Site Matrix

Task 2 - Twenty Top State Land Sites: Ranking by Selection Criteria

(Value is 1 to 10, low to high; variables with absolute values are converted to a 1 to 10 scale when the Total ranking is calculated.)

Ranking	Site Name	TRS	LL	WI	WE	INT	CS	TC	SL	SG	EA	EV	DA	PR	PT	Total
			Relative weights (1-10)	15	6	6	8	8	5	3	9	7	9	5	4	85
			Weight (%)	17.65%	7.06%	7.06%	9.41%	9.41%	5.88%	3.53%	10.59%	8.24%	10.59%	5.88%	4.71%	
1	Judith Gap	10N15E36	46° 35.39'N, 109° 46.66'W	6	6	6	3.25	10	7	6	7	7	8	1	5	6.89
2	Springdale, MT	1N12E36	45° 47.13'N, 110° 10.84'W	5	5	10	5	10	10	6	6	6	6	1	6	6.70
3	Rapelje	2N18E16	45° 55.09'N, 109° 30.29'W	5	5	5	3	10	5	7	7	9	9	2	4	6.58
4	Marino (Stanford)	16N10E16	47° 8.49'N, 110° 27.58'W	5	5	6	20	10	7	6	5	7	7	1	6	6.50
5	Lindsay (Big Sheep)	18N51E16	47° 19.18'N, 105° 14.14'W	6	5	8	9	7	5	8	5	6	10	3	3	6.41
6	Norris	3S1E21	45° 34.03'N, 111° 37.01'W	7	9	9	30	7	6	7	4	3	4	3	4	6.35
7	Cut Bank (Ethridge)	32N4W16	48° 31.56'N, 112° 8.43'W	5	9	7	4	5	5	4	7	7	9	1	3	6.28
8	Colstrip	1N40E16	45° 49.93'N, 106° 45.80'W	4	2	9	5	9	7	9	4	9	9	3	7	6.28
9	Whitehall	1N4W36	45° 47.75'N, 112° 3.10'W	5	7	8	1	8	7	6	4	5	7	3	6	5.98
10	Glasgow AFB	32N39E23	48° 31.16'N, 106° 36.88'W	5	5	5	78.5	4	6	5	5	6	4	3	3	5.81
11	Baker	10N58E16	46° 37.21'N, 104° 25.74'W	5	4	5	5	6	5	6	4	7	9	3	6	5.67
12	Bowler Flats (Bridger)	7S24E36	45° 10.73'N, 108° 44.02'W	6	4	1	4	9	6	7	6	5	7	6	6	5.67
13	Scobey	35N47E21	48° 46.37'N, 105° 34.63'W	6	2	1	40	3	4	3	6	7	10	3	3	5.65
14	Duncan Colony (Two Dot)	7N14E20	46° 21.20'N, 109° 59.80'W	5	8	5	12	6	5	4	6	5	7	5	4	5.59
15	Blackfeet	No State Sections	48° 31.28'N, 113° 1.71'W	7	9	3	0	3	5	3	8	5	3	1	2	5.49
16	Havre Area	33N16E16	48° 36.97'N, 109° 38.75'W	5	6	4	24	4	7	5	4	2	7	2	5	5.25
17	Lennep	8N10E34	46° 24.64'N, 110° 27.74'W	5	3	5	10	4	4	4	7	4	7	1	4	5.23
18	Martinsdale	9N12E30	46° 31.12'N, 110° 15.26'W	5	5	7	11	4	5	4	6	4	5	2	4	5.20
19	Chester	31N7E34	48° 24.24'N, 110° 48.84'W	5	6	1	9	4	5	4	5	6	7	7	3	4.76
20	Sweet Grass Hills	35N5E4	48° 49.20'N, 111° 5.32''	6	5	2	11	2	4	2	8	5	3	8	3	4.47

KEY for Selection Criteria

TRS	Location - Township, Range and Section
LL	Location - Latitude and Longitude
WI	Wind Intensity (Class 1 to 7)
WE	Wind Estimate Certainty (relative ranking 1-10, based upon number, quality and consistency of data sets, and some private data sets not available to public)
INT	Transmission/Substation Interconnect Potential (relative rankings 1-10, based upon consultants' experience and conversations with utility transmission personnel)
CS	Number Of State Sections within 5 mile radius (includes target section; 1-78.5, 78.5 max)
TC	Available Transmission Capacity (relative rankings 1-10, based upon consultants' experience and conversations with utility transmission personnel)
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EV	Environmental Impacts Visual (relative ranking based upon proximity to residences and thoroughfares and consultants' knowledge of local sentiment toward wind development)
DA	Commercial Development Potential Of Area surrounding The State Land Site (relative ranking 1-10, based on development requirements for a commercial type 100 MW windfarm.)
PR	Proximity To Improved Road (all weather road, number of miles 1-10, 10 mile max)
PT	Proximity To Technical Supplies/Facilities/Staff (crane, contractors, Geo Tech) (relative ranking 1-10, based upon 200 mile max)

9. Appendix 2 – Site impact checklist and Ranking on Potential Impact Index for Springdale site (Dr. Al Harmata)

PHYSICAL ATTRIBUTE CHECKLIST

DATE 22 April 2004

Physical Attribute (max score = 36)				Springdale State Section
Topography	Mountain Aspect*	Side	W	
			E	
			N	
			S	
		Top		
		Foothill	W	
			E	
			N	
			S	✔
	Valley*			✔
	Pass*			
	Gap*			
	Ridge*			
	Bluff*			✔
	Butte*			
Wind* Direction	S			✔
	N			
	E			
	W			✔
	Updrafts*			✔
Migratory* Corridor Potential	Latitudinal (N ↔ S)			✔
	Longitudinal (E ↔ W)			
	Wide Approaches (>30 km)*			✔
	Funnel Effect*	Horizontal		
		Vertical		
Site Size (acres) & Configuration*	<640			✔
	>640 <1000			
	>1000 <1500			
	Turbine Rows not Parallel to Migration			
Infrastructure To Build	Transmission			
	Roads			
	Buildings*	Storage		
		Maintenance		
		Daily Activity		
	Substation			
Increased Activity*				
		Totals		8

Avian Species of Special Concern Checklist
(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

Birds (n = 31) **(max score = 62)**	Springdale		
Occurrence	**B**	**M/W**	**Σ**
Common Loon			
Clark's Grebe			
American White Pelican			
Black-crowned Night-heron			
White faced Ibis			
Trumpeter Swan			
Harlequin Duck			
Northern Goshawk		✔	1
Ferruginous Hawk	✔	✔	2
Peregrine Falcon		✔	1
Columbian Sharp-tailed Grouse			
Yellow Rail			
Black necked Stilt			
Franklin's Gull			
Caspian Tern			
Common Tern			
Forster's Tern			
Black Tern			
Flammulated Owl			
Burrowing Owl	?	?	?
Great Grav Owl			
Boreal Owl			
Black Swift			
Blackbacked Woodpecker			
Alder Flycatcher			
Cassin's Kingbird			
Blue-grav Gnatcatcher			
Dickcissel			
Baird's Sparrow			
Le Conte's Sparrow			
Nelson's Sharp tailed Sparrow			
Subtotals	2	4	6
		Total	6

Bat Species Of Special Concern Checklist
(Complete prior to SPECIES OCCURRENCE & STATUS CHECKLIST)

Bats ($n = 5$) **(max score = 10)**	Springdale		
Occurrence	**B**	**M/W**	**Σ**
Fringed Myotis	✔		1
Northern Long-eared Myotis		✔	1
Spotted Bat	✔	?	2
Townsend's Big-eared Bat	✔		1
Pallid Bat	?		1
Subtotals	4	2	6
Total			6

SPECIES OCCURRENCE & STATUS CHECKLIST

Species (n = 17)
Groups (n = 3)
Max score = 108

		Springdale		
	Occurrence	**B**	**M/W**	**Σ**
Threatened & Endangered	Bald Eagle	✔	✔	2
	Whooping Crane			
	Piping Plover			
	Interior Least Tern			
	Grizzly Bear			
	Gray Wolf		✔	1
	Black-footed Ferret			
	Pallid Sturgeon			
	Woodland Caribou			
	White Sturgeon (Kootenai River)			
	Bull Trout			
Candidate*	Mountain Plover			
	Yellow billed Cuckoo			
	Black-tailed Prairie Dog	✔	✔	2
	Swift Fox			
Special Concern*	Birds (max ∑=62)	2	4	6
	Bats (max ∑=10)	4	2	6
Golden Eagle*		✔	✔	?
Sage Grouse*		?	?	?
Bats*		✔	?	?
	Subtotals	11	12	23
	Total			23

ECOLOGICAL ATTRACTIVENESS CHECKLIST

Ecological Attractor (max score = 17)			Springdale
Migration Route*	Local		
	Continental*	N	✔
		S	
		E	
		W	
Ecological Magnets*	Lotic System		✔
	Lentic System		✔
	Wetlands		✔
	Native Grassland		✔
	Forest		✔
	Food Concentrated		✔
	Energetic Foraging		✔
	Vegetation/ Habitat	Unique	
		Diverse	✔
Significant Ecological Event*			?
Site of Special Conservation Status*[1]*			
Total			10

[1]Value of 2 used if true.

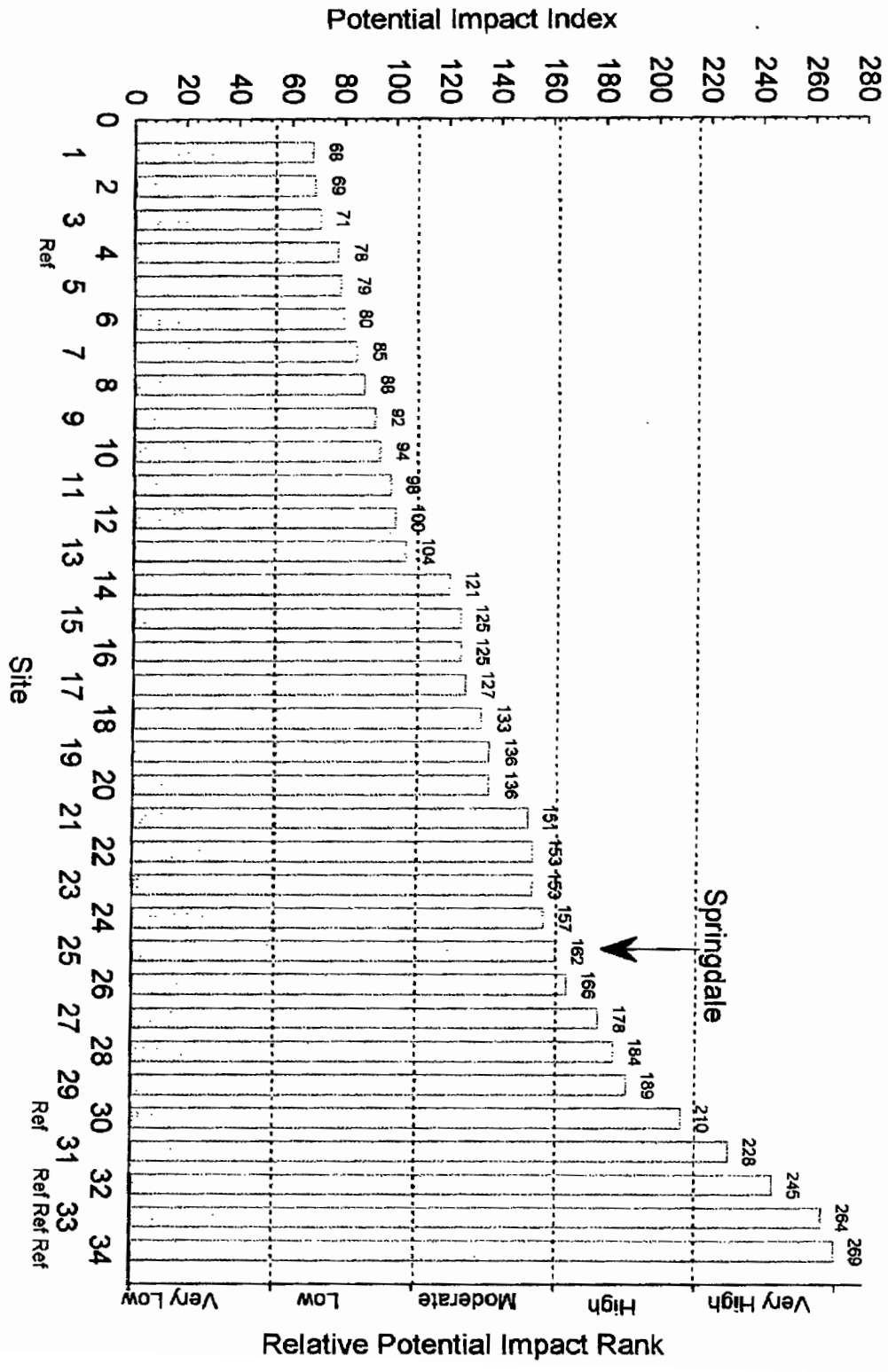
POTENTIAL IMPACT INDEX

	Springdale	
Checklist (p)[1]	Σ	Σ/p
Physical (36 max = 36/161, p = 0.22)	8	36.4
Species Occurrence & Status (108 max, p = .67)	23	34.3
Ecological (17 max, p = 0.11)	10	90.9
Totals		161.6

[1]Proportion of total (161) checklist scores.

SITE SPECIFIC QUESTIONS/COMMENTS

Checklist	Springdale
Physical	
Species Occurrence	Do burrowing owls inhabit the prairie dog town? Do burrowing owls move through the site seasonally?
	Are spotted bats transient and pallid bats breeding in the vicinity (≤7km)? Do other bat species migrate, forage, or breed in the vicinity (≤7km)?
	Are sage grouse transient or breeding on or near (≤7km) the site?
	What is the intensity of use of the prairie dog town by the raptors (spp., #, freq., etc.)?
Ecological	Do birds migrate in numbers and/or by methods or concentrate over the site such that "significant" numbers may be at risk for collision with wind turbines?


Potential Impact Index
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
Site
Ref
1
2
3
4
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80
85
88
92
94
98
100
104
121
125
125
127
133
136
136
151
153
153
157
162
166
178
184
189
210
228
245
264
269
Springdale
Very Low
Low
Moderate
High
Very High
Relative Potential Impact Rank

10. Appendix 3 – Wind Data Summary

Site Information:

Project: New Project

Location:

Elevation: 4604

Sensor Information:

1 NRG #40 Anem. mph
2 NRG #40 Anem. mph
3 NRG #40 Anem. mph
4 NRG #40 Anem. mph
5 No SCM Installed
6 No SCM Installed
7 #200P Wind Vane
8 #200P Wind Vane
9 NRG #110S Temp F
10 No SCM Installed
11 No SCM Installed
12 No SCM Installed

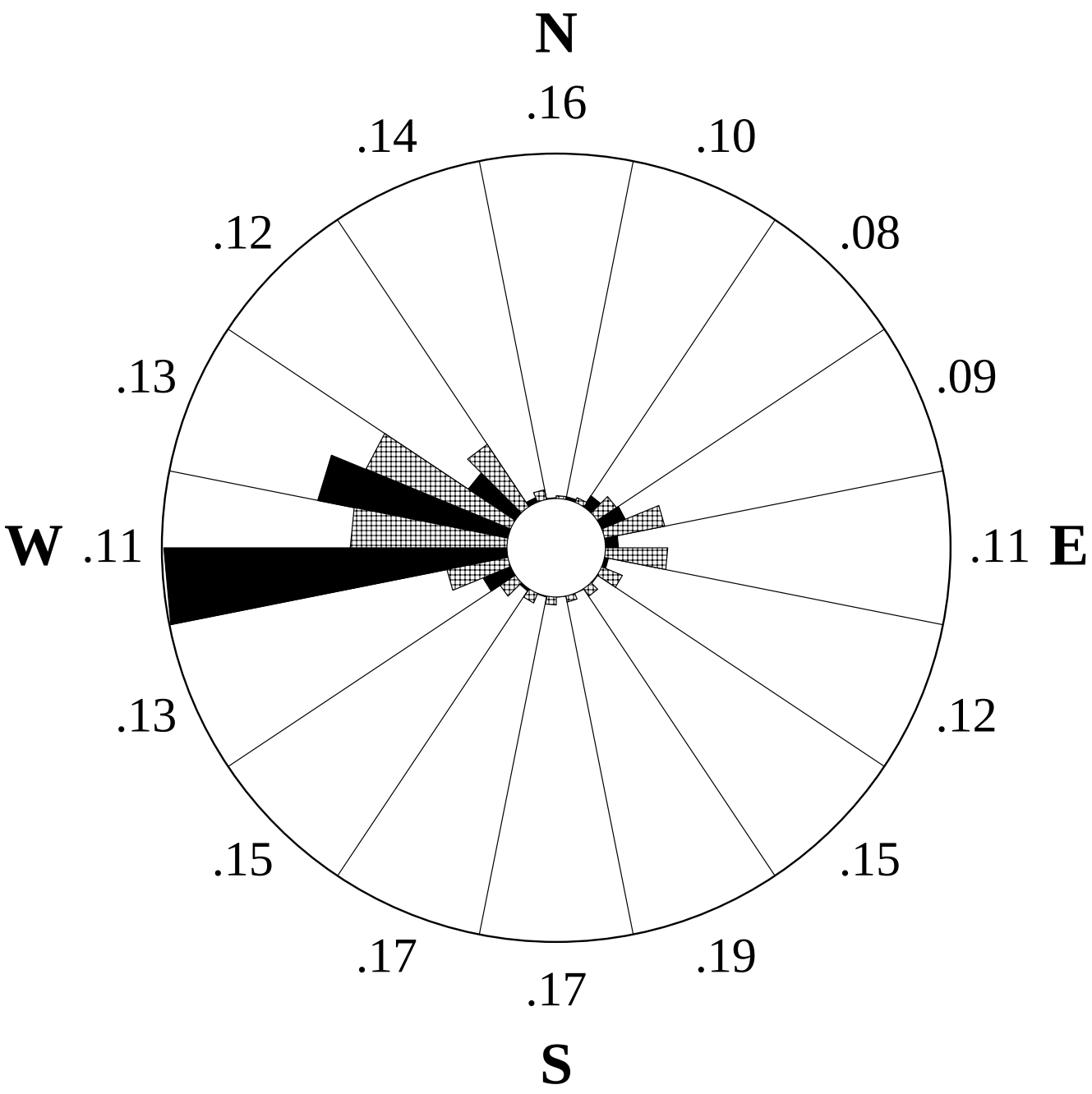
5/16/2004 to 5/16/2005

Summary Report

SITE 0601

Montana DEQ Springdale

Channel	1	2	3	4			7	8	9			
Height	50 M	50 M	25 M	10 M	------	------	50 M	25 M	3 M	------	------	------
Units	mph	mph	mph	mph	-----	-----	deg	deg	F	-----	-----	-----
Intervals with Valid Data	51253	51253	51253	51253			51253	51253	51253			
Average Filtered Data	17.13	16.44	14.94	12.86			289.88	290.15	45.83			
Average for All Data	17.13	16.44	14.94	12.86			289.88	290.15	45.83			
Min Interval Average	0.8	0.8	0.8	0.8					-123.5			
Date of Min Interval	5/16/2004	5/16/2004	5/16/2004	5/20/2004					5/16/2004			
Time of Min Interval	11:10:00 AM	11:10:00 AM	11:10:00 AM	5:30:00 PM					11:10:00 AM			
Max Interval Average	80.6	72.9	65.9	59.9					96.3			
Date of Max Interval	3/11/2005	3/11/2005	3/11/2005	3/11/2005					7/17/2004			
Time of Max Interval	7:20:00 PM	7:20:00 PM	7:20:00 PM	7:50:00 PM					3:20:00 PM			
Average Interval SD	2.07	1.99	2.14	2.22			8.65	9.01	0.12			
Min Sample	0.8	0.8	0.8	0.8					-123.5			
Date of Min Sample	5/20/2004	5/20/2004	5/20/2004	5/20/2004					5/16/2004			
Time of Min Sample	5:20:00 PM	5:20:00 PM	5:20:00 PM	4:00:00 PM					11:10:00 AM			
Max Sample	91.4	82.1	80.3	77.8					97.2			
Date of Max Sample	3/11/2005	3/11/2005	3/11/2005	3/11/2005					7/17/2004			
Time of Max Sample	7:10:00 PM	7:40:00 PM	7:40:00 PM	7:40:00 PM					3:10:00 PM			
Average Interval TI	0.15	0.16	0.17	0.23								
Wind Speed Direction							W	W				



5/16/2004 to 5/16/2005

Wind Rose Ch 1, 7

SITE 0601

Montana DEQ Springdale

Site Information:

Project: New Project

Location:

Elevation: 4604

Anemometer on channel 1:

NRG #40 Anem. mph

Height: 50 M

Serial #: SN:

Vane on channel 7:

#200P Wind Vane

Height: 50 M

Serial #: SN:

Outer Numbers are Average TIs for speeds greater than 10 mph

Inner Circle = 0%

Outer Circle = 50%

Percent of Total Wind Energy

Percent of Total Time

Site Information:

Project: New Project

Location:

Elevation: 4604

Sensor on channel 1:

NRG #40 Anem. mph

Height: 50 M

Serial #: SN:

5/16/2004 to 5/16/2005

Frequency Distribution Ch 1

SITE 0601

Montana DEQ Springdale