EDP Sharp Hills Wind Farm – Visual Effects Assessment
Summary Report – RDI Resource Design Inc – April, 2018

Executive Summary

The EDP Sharp Hills Wind Farm was examined by RDI Resource Design Inc (RDI) for its visual effect on the local farming community within which it would be located. RDI applied a structured objective assessment technique derived from the CEMA Visual Landscape System (VLS) which was developed by RDI. The quantitative approach is common procedure in many countries for assessment of the visual impacts of wind farms, serving both planners and regulators, minimizing preferential subjectivity.

RDI conducted field familiarization of the proposed location of the wind farm and captured panoramic photography from 16 viewpoints, 7 of which were identified by EDP as Visual Representation Locations at which EDP had prepared photo-montages. A further 11 viewpoints were identified by RDI as a desk-top exercise, including the remaining 4 EDP viewpoints. RDI measured the proximity of each of the 83 proposed EDP Vestas V136 wind turbine generators (WTG's) to these viewpoints and to road corridors within the community. RDI produced visual simulations from all 27 viewpoints using the Vestas 3-dimensional model for placement and scale. Two documents containing the photography and simulations were prepared covering all of the viewpoints and are presented as Appendix 2.

RDI found that 24 WTG's would fall within the Foreground Distance Zone around the viewpoints, the zone in the literature found to have the greatest visual vulnerability and impact potential. A similar zone was created along roadways with WTG's nearby, with the finding being that there would be 18 road segments totaling 88km in length from which 64 of the 83 EDP WTG's would be situated within the 1 km foreground distance zone.

The turbine maximum height of 200m with the blade vertical would tower over the low-rolling landscape, structures, and vegetation. This height exceeds the height of the Calgary Tower. When adding consideration of the movement of the blades, the WTG's will cause an unavoidable and continual attraction or distraction, particularly given the proposed density is calculated by RDI to be 1 WTG every 20 hectares (50 acres) over the area of 400km^2 determined and assessed by RDI.

The VLS Rating Form prepared for the wind farm determined that the Existing Landscape Integrity for the area is High, based on Landscape Attraction and Observability, leading to a High Landscape Significance rating, while the wind farm would cause the Integrity to drop to Low or Very Low, meaning that intensive alteration is evident, very or extremely dominant, and of low or very low landscape conformity. The default objective for Landscape Integrity is high, meaning that alteration must be subordinate, well-designed, and have high landscape conformity. The EDP Sharp Hills Wind Farm proposal would be in direct conflict with the recommended Landscape Objective.

RDI concludes that the proposed windfarm would create a continual and inappropriate disruption to the visual quality of the community.

1. Purpose of the Study

RDI Resource Design Inc (RDI) was requested by Gavin Fitch, Q.C. of McLennan Ross LLP of Calgary to provide a Visual Effect Assessment of the proposed EDP windfarm on behalf of their clients the Clearview Group, a concerned group of local farmers and their families. To frame the analysis, RDI determined that it would be useful to answer this question: *to what level or degree would the Sharp Hills Wind Farm be compatible in the existing working agricultural landscape, using standard objective measures of Visual Landscape Assessment?* The credentials of RDI for conducting this assessment as presented in Appendix 1.

The Sharp Hills Wind Farm as proposed would consist of 83 wind turbine generators (WTG's). EDP has selected the Vestas model V136-3.6 MW IEC IIB/IEC IIIA. This model would be the largest WTG ever to be installed in Alberta, with a rotor diameter of 136m, a blade length of 66.7m, a hub height of 132m, and a maximum vertical blade reach of 200m. By way of a familiar scale of reference to compare with the WTG height, the Calgary Tower has a total height of 191m.

2. Study Area

The wind farm would be located on private properties with placement of WTG's along a 26km distance in a north-south direction between Township Roads 310 and 340, and over a 20 km distance east-west between 2 km east of Range Road 42 and 1.4km east of Range Road 60. The area consists of large agricultural farms, two townsites – Sedalia and New Brigden, and is served by an easily accessible network of roads and two highways – Highway 41 and Highway 886 (Figure 1).

RDI placed straight line boundaries closely around the windfarm following roads and townships as indicated by the bold green line in Figure 1. The boundary encompasses $415km^2$. Comparing with familiar cities for scale, this area is 50% of Calgary's area of 825 km^2 and 61% Edmonton's area of $684km^2$. The density of WTGs within this Sharp Hills boundary is 5 every square kilometer (or 1 every 20 hectares which is about 1 every 50 acres).

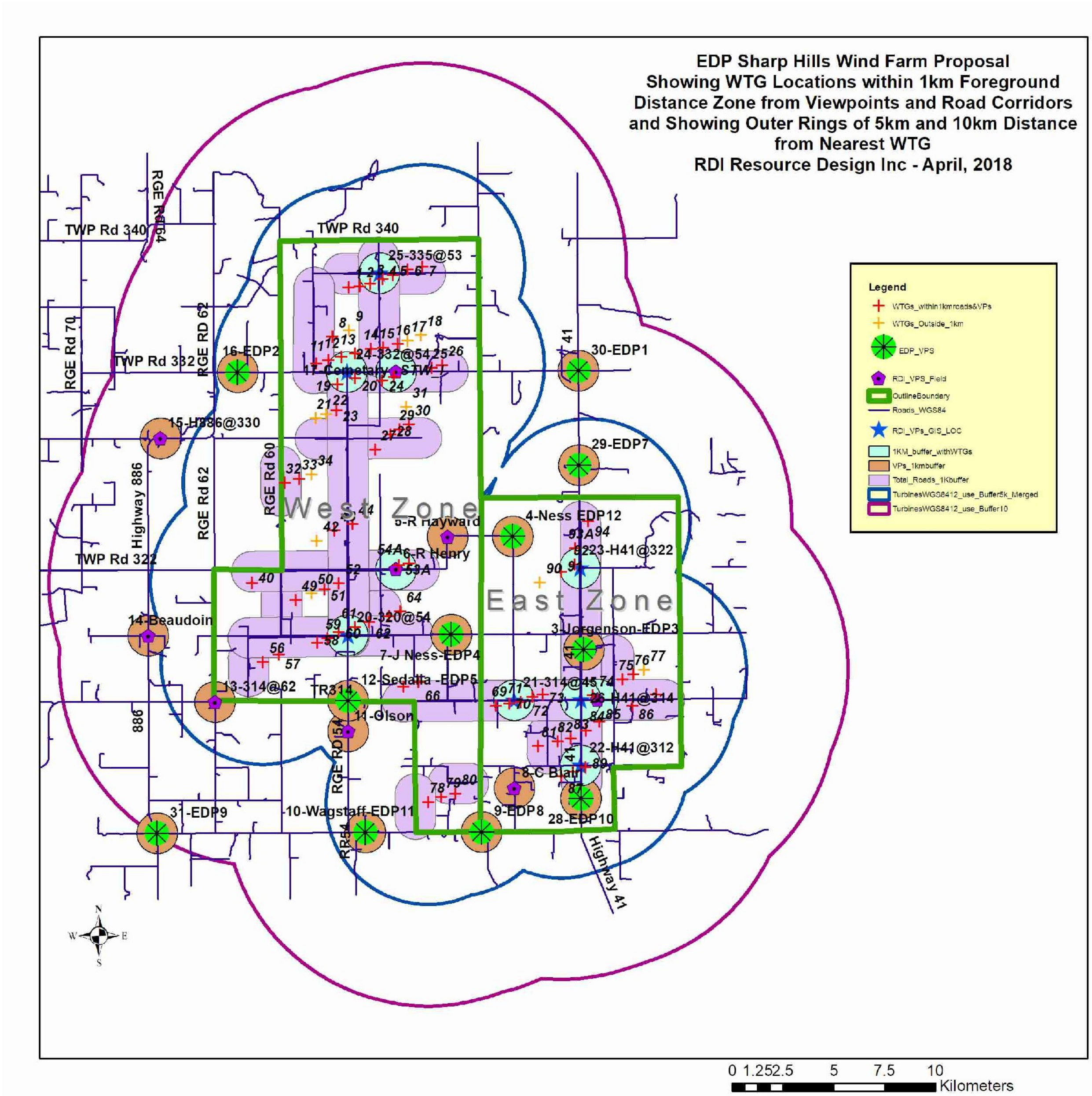

Figure 1. Sharp Hills Wind Farm in relation to Viewpoints and Community Roads

3. Measurement of Visual Landscape

Aesthetics is a set of principles concerned with the nature and appreciation of beauty, especially in art. Pastoral scenes, quite comparable to the Sharp Hills area, have long been the subject of landscape paintings. It is often heard that "*beauty is in the eye of the beholder*", and therefore that aesthetics is not amenable to measurement. However, formal aesthetic qualities of many physical attributes can be easily measured and evaluated using quantitative or classification methods. Such attributes include vertical elements, horizontal elements, form, colour contrast, repetition, texture and pattern, scale, proportion, dominance, cumulative effect, direction, distance and movement, to name some. Metrics relating to "viewing duration" and "number of viewers" also contribute into formula deriving visual sensitivity and ultimately provide input into the determination of Visual Aesthetic Class ratings to differentiate between landforms or visual sensitivity units from one another[1234]. This formal, or expert, approach is commonplace in procedures for measuring visual impacts in Canada, the USA, and in Great Britain[56].

Symbolic aesthetic qualities, such as those contributing to meaning and function, cannot be measured by quantitative methods, and generally rely on soliciting public opinion. However, the formal aesthetic models generally include some generalized estimates, such as "level of concern". RDI did not seek public opinion except those views expressed during the field tour by Sheldon and Kelly Kroker, members of the Clearview Group

The documents referred to in footnotes 1-4 below each have some field inventory procedures by which to record and evaluate a variety of visual sensitivity measures, derive qualitative and/or quantitative visual management objectives by which to differentiate the land base (local, regional, provincial), and establish obligations to achieve those objectives. These are not commonly formalized, or brought into law, until there is review and input by stakeholders and the affected public.

Several procedures using the term "Visual Quality Objective", or "Landscape Integrity" (RDI, 2003 for CEMA) apply qualitative descriptors to evaluate achievement on a continuum, such as ranging from "no perceivable change" to "very intensive alteration, very dominant". The BC approach also assigns numerical limits to the degree or percentage of alteration for each category assigned such as percent alteration of a landform (commonly with regards to timber harvesting).

4. A Brief Survey of Wind Farm Specific Visual Assessment and Planning Literature

RDI located several useful sets of guidelines and research results pertaining to wind farms. These statements and findings are relevant to how the visual assessment of the Sharp Hills Wind Farm proposal can be addressed. These approaches provide as much benefit to regulators as to planners, and can generate public support.

a. **Clean Energy States Alliance, May 2011. A Visual Impact Assessment Process for Wind Energy Projects.** https://www.cesa.org/assets/2011-Files/States-Advancing-Wind-2/CESA-Visual-Impacts-Methodology-May2011.pdf

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[1] Alberta Forestry, Lands and Wildlife. Forest Landscape Management Strategies for Alberta, 1986. https://archive.org/details/forestlandscapem00albe_0

[2] BC. Visual Landscape Inventory Procedures and Standards Manual (1997). https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/vli_procedures__standards_manual97.pdf

[3] RDI, 2003 for CEMA. Visual Landscape System for Planning and Management Aesthetic Resources. http://library.cemaonline.ca/ckan/dataset/c510c9ef-664d-4c5a-be4c-b97eeaf4d137/resource/8a7f288a-f0da-4a01-9c9d-cb021a994895/download/visuallandscapesystemforplanningandmanaging.pdf

[4] Visual Impact Assessment Procedures for – BC. https://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/visual/httoc.htm

“Visual impacts are often among the issues of greatest concern for surrounding property owners and the community. Public acceptance and confidence in wind development are likely to be enhanced when visual issues are clearly and fairly addressed.” p. 2

“It is also important to note that the goal of visual impact assessment is not to predict whether specific individuals will find wind energy projects attractive or not. Instead, the goal is to identify important visual characteristics of the surrounding landscape, especially the features and characteristics that contribute to scenic quality, as the basis for determining how and to what degree a particular project will affect those scenic values. This process can be logical, well articulated, and systematic and can be codified for use by relevant professionals” p. 4

“Studies of public reactions to wind energy projects are useful in providing a broad understanding of general attitudes and also in identifying significant areas of concern. However, in examining a specific project in a particular location, the emphasis should be on evaluating the specific character of the landscape involved, especially the elements that contribute to scenic quality and how the project will affect these scenic resources.” p. 4

“…the assignment of a generic-type score, such as “moderate impact” vs. “high impact,” does not provide meaningful information to the decision maker unless it is clearly explained how the project is seen, in what context, and what the value of the resource is. In contrast, the strength and merits of a written visual analysis rely on a qualified or informed person preparing the evaluation to present his/her arguments in a logical fashion, addressing specific site and project characteristics and effects in a manner that informs the judgment of a reviewing body.” p. 32

b. **Wind Turbine Visibility and Visual Impact Threshold distances in Western Landscapes**.http://visualimpact.anl.gov/windvitd/docs/windvitd.pdf

The document provides findings from 377 observations of five wind facilities in Wyoming and Colorado. Major foci of visual attention up to 19km (12 mi) and likely to be noticed by casual observer >37 km (23mi). Conservative interpretation appropriate radius 48km (30 mi. unlikely to be missed by casual observer up to 32km/20mi, and major source of visual contrast up to 16km/10mi on p. 4. The paper includes a Literature review on p. 8, and a Contrast Matrix on p.9.

c. **Scottish National Heritage, August 2017**. Siting and designing Wind Farms in the Landscape: Guidance Version 3a. https://www.nature.scot/sites/default/files/2017-11/Siting%20and%20designing%20windfarms%20in%20the%20landscape%20-%20version%203a.pdf - Practical guidance for wind farm planners and review agencies.

d. **Argonne National Laboratory, October, 2016. West-Wide Wind Mapping Project.** http://wwmp.anl.gov/report/wwmp-project-report.pdf

The USDI Bureau of Land Management has an on-line mapping program allowing users to both determine, and add, wind energy development exclusions and siting considerations to assist energy planners in 11 Western States, including areas of critical environmental concern, and specific areas with potential conflicts ecological, cultural, recreational, and visual resources.

e. **Viking Energy Partnership. Viking Windfarm Environmental Statement. Chapter 9. Visual Impact.** A comprehensive procedure for addressing visual impact of wind farm development by a proponent. Also addressed in this chapter is an assessment of Cumulative Impact methodology (Section 9.8.2) and Shadow Flicker Effects (Section 9.9). Another related chapter addressed Landscape Character Assessment (Chapter 8) in which the study area is specified to extend for 35km following Scottish national Heritage Guidelines[7].

https://www.vikingenergy.co.uk/assets/files/eia2009/environmental-statement/Chapter-9-Visual-Impact.pdf

f. **British Columbia, 2015. Wind Energy Developments on Forested Landscape – Visual Quality: the public response.** https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/visual-resource-mgmt/research-publications/vrm_vq_wind_energy_publicresponse.pdf

This BC Government publication presents research findings on the public response to wind energy[8], involving 591 participants into the level of public acceptance of wind energy development. In all cases: 1) respondents preferred natural-appearing scenes over developed wind energy scenes, 2) public acceptance increases as viewing distance increases, 3) it decreases as the number of wind turbines increases, and 4) aggregated wind turbines receive lower public acceptance than dispersed turbines.

A challenge with regards to planning and assessment of wind farm developments in Alberta in general is that there appears to be no comprehensive guidelines, nor specific local, regional, or provincial objectives setting out, with advance knowledge and information, areas permitted for greater or lesser intensity of development, or areas restricted from wind farm development. Windfarm proponents in Alberta are relatively unconstrained, as their prime objective, which is to locate the best, continuous wind patterns in proximity to electrical transmission lines and road access, and only on private land. Other land and community values including visual aesthetics, while requiring limited attention, appear to be secondary considerations only.

5. RDI Methodology

RDI has applied standard visual aesthetics metrics pertaining to the size, number, and location of WTG's, and their potential to affect the integrity of the Sharp Hills landscape and the community.

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[7] University of Newcastle (2002) Visual Assessment of Windfarms: Best Practice, Scottish National Heritage (not accessed by RDI).

[8] Wind Energy Developments on Forested Landscape – Visual Quality: the public response, (BC, 2015),

For this assessment, the hard metrics are height of the WTG's / vertical viewing angle (magnitude), viewing distance, repetition, pattern, and blade movement. The proximities and patterns of the proposed WTG's have been simulated and addressed as seen from the viewpoints and along roads to give evidence of the levels of visual vulnerability. These are presented as two separate documents as appendices to this report.

a. Vertical Viewing Angle

The greater the vertical viewing angle there is between the viewer and the viewed object, the greater the apparency, particularly when intervening topography, structures, and vegetation provide little or no screening as is common in the Sharp Hills area. Figure 2 depicts the vertical angle of the 200m maximum height of the WTG and potential 15m vegetation or structures.

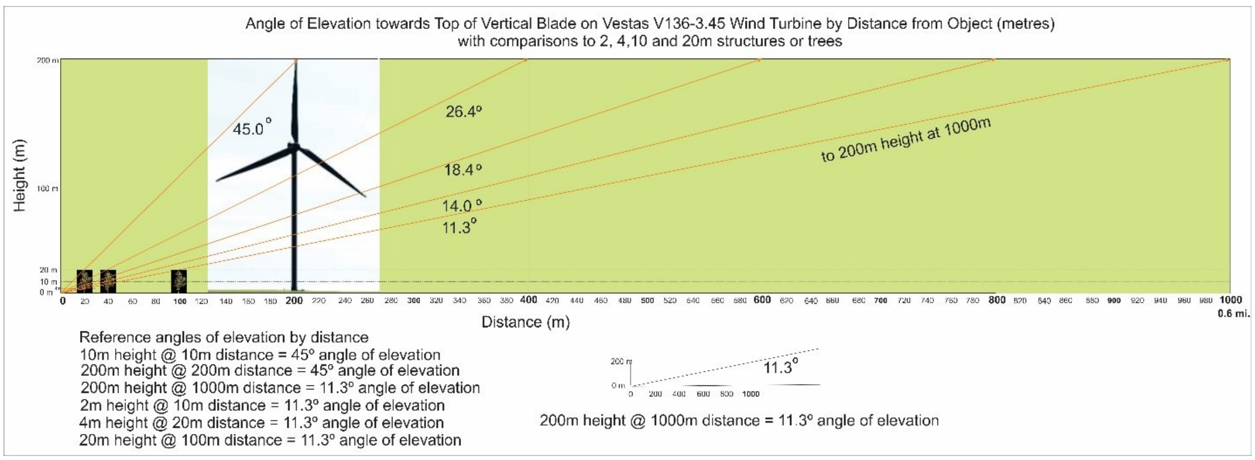

Figure 2. Angle of Elevation to Vestas V136, by Distance from Observer

The vertical angles to the maximum blade tip height of 200m are tracked in Figure 2, relative to similar vertical angles of 16m vegetation or structures, with reference angles shown beneath the diagram. The only existing sizeable existing structures in the area are electrical high tension towers estimated by RDI to be less than 50m in height. Unlike WTG's, the high tension towers are static, without movement. Small oil well pumpjacks do have repetitive movement, but are very dispersed and are very small in the landscape.

Given the mainly open terrain, very limited, low, and patchy nature of tree cover, and generally low farm structures, the tall, rotating WTG's with 68m blades would be distinctly and strongly apparent in the foreground distance zone (under 1 km) and likely apparent from greater distances where situated in the middle ground distance zone (1 km to 8 km).

b. Viewpoints

The EDP Sharp Hills Wind Farm is entirely within the local farming community. The community is serviced by a network of roads and by two highways (41 and 886), providing ease of travel, and frequent, and progressive viewing opportunities towards the WTG's (Figure 1).

A field trip was arranged with the Krokers to examine the landscape and take photographs of existing visual conditions. A concern expressed by the Krokers was that there was an inadequate, and too distant, coverage of viewing opportunities in the materials provided by EDP. Photo-montages of the windfarm were prepared by EDP. RDI was provided with montage sheets for 4 of these viewpoints (EDP 2, 3, 5, and 7). EDP had indicated 11 viewpoints for their assessment, 7 of which were photographed by RDI during the fieldtrip. Each of these viewpoints were photographed with overlapping photography in order to prepare photo-panoramas as provided in the Appendices. The 11 EDP viewpoints in total had an average viewing distance to the nearest WTG of 3735m, and ranged from the closest distance to a WTG at 1370m (EDP 10) to the furthest at 9980m (EDP9).

An additional 9 viewpoints were located by the Krokers, mainly adjacent to farm houses. The average viewing distance to the nearest WTG from these viewpoints is 2713 m, with the closest being 230 m and the furthest at 6470 m. These were each photographed with overlapping photography in order to prepare the photo-panoramas.

During the course of the office evaluation by RDI, 7 more viewpoints were located along the roads which provided more proximate viewing opportunities. These viewpoints had an average viewing distance to the nearest WTG of 410 m, with the closest at 275 m and the furthest at 640m. The justification for providing closer-in views is that abundant opportunities for close-viewing exist along the road network where travel could reasonably be expected to occur. The additional Kroker viewpoints, and those derived by RDI can be considered as relevant as those selected by EDP, and perhaps more so as they either represent actual farm locations, and are more proximate, on average, to the nearest WTG.

RDI tested the foreground proximity of WTG's to the identified viewpoints (those within 1 km). Of the collective 27 viewpoints, 24 had foreground WTG's. Of these, 3 were identified during the Kroker field trip, and 7 were identified during the mapping exercise. There were no EDP viewpoints with foreground WTP's

RDI considers that all roads in the community have high significance due to the expressed level of concern in the community, plus the long-term viewing duration from adjacent farms. The 2 highways have additional significance due to higher user numbers, though as noted below, only Highway 41 has foreground views of WTG's. The desk-top evaluations of the final 7 viewpoints have no RDI photography. Four of these are also EDP viewpoints. Twelve of the 27 viewpoints were within the road buffers containing foreground WTG's – 2 EDP (no foreground WTG's), 3 Kroker (each with at least 1 WTG), and 7 RDI (each with at least 1 WTG). The viewpoints and viewing distances are shown in Table 1 below, and are separated into Parts A and B corresponding the Photography and Simulations documents by the same names in the Appendices. All viewpoints have been simulated and are presented in the Appendix Parts A and B under separate covers.

Table 1. Photography and Simulation Viewpoints

Photography and Simulations Part A		
Viewpoint Name	**Viewpoint Location**	**Distance to Closest WTG**
2-GPS829	GPS829-TR314-Eastof Hwy41	315
3-GPS830-Jorgenson's Bins-EDP3	Hwy 41 near TR 320	2500
4-GPS831-Ness EDP12	EDP12-TR323@RR45	2660
5-GPS832-Randy Hayward	TR323@RR51	2330
6-GPS833-Ralph Henry	TR322, 1227m East of RR53	230
7-GPS834-Jim Ness-EDP4	TR320 east of RR50	2750
8-GPS835-Cory Blair	RR45	2360
9-GPS836-EDP8	TR310@RR50; EDP8	2270
10-GPS837-Wagstaff-EDP11	TR310 @ 736m East of RR54;	3440
11-GPS838-Gene Olson	RR54 @ 2400m South of TR314	3580
Photography and Simulations Part B		
12-GPS839-Sedalia Townsite-EDP5	TR 314 @ RR 54	2750
13-GPS 840	GPS 840-314@62	3075
14-GPS841-Kent&Dawne Beaudoin	TWP RD320-4/RGE HWY 886	5770
15-GPS845	Hwy 886 @ TR 330	6470
16-GPS844-EDP2	EDP2-TR332 east of RR62	3890
17-GPS846-Cemetary	TR332 East of RR53	290
20-320@54	320@54	455
21-314@45	314@45	320
22-H41@312	H41@312	275
23-H41@322	H41@322	300
24-332@54	332@54	520
25-335@53	335@53	360
26-H41@314	H41@314	640
28-EDP10-H41	EDP10-H41	1370
29-EDP7 -HWY41	EDP7 -HWY41	2760
30-EDP1-Hwy41-TR332	EDP1-H41@332-no px	6760
31-EDP9-HWY886-310	EDP9-HWY886@310	9980

As shown in Table 2 below, of the total of 27 viewpoints, 8 are less than 500m from the nearest WTG (no EDP VP's), 2 more are between 500m and 1km, (no EDP VP's), 13 more are between 1km and 5km (7 EDP VP's) , and 4 viewpoints are between 5km and 10km from the nearest WTG (2 EDP VP's). EDP 9 is furthest at just under 10km. Therefore all viewpoints have one or more WTG's 10km or closer.

Table 2. Viewpoint Distances to Nearest Wind Turbine

EDP Viewpoints, by RDI # (11 total)	3, 4, 7, 9, 10, 12, 16, 28, 29, 30, 31	**Average Distance (m)**	3739
		Range: Low (m) - 28-EDP10	1370
		Range: High (m) - 31-EDP9	9980
Number of EDP Viewpoints with Foreground WTGs	0		
Additional Kroker Fieldtrip Viewpoints, by RDI # (9 total)	2, 5, 6, 8, 11, 13, 14, 15, 17	**Average Distance**	2713
		Range: Low (m) - 6-Ralph Henry	230
		Range: High (m) - 15-H886@TR330	6470
Number of Kroker Viewpoints with Foreground WTGs	3		
Additional RDI Selected Viewpoints, by RDI # (7 total)	20, 21, 22, 23, 24, 25, 26,	**Average Distance**	410
		Range: Low (m) - 22-H41@312	275
		Range: High (m) - 26-H41@314	640
Number of RDI Selected Viewpoints with Foreground WTGs	7		

The visibility and visual impact study sponsored by the Bureau of Land Management in the USA[9], found that wind turbines would be a major focus of attention and contrast ranging from 16km to 19km. RDI did not study the exact effect of fall-off of visual apparency at greater distances (e.g. between the Middleground, 1-8 km, and the Background distance zones, greater than 8 km), except where the turbines are revealed in the simulations. The WTG's in the Foreground up to at least the near Middle ground views (1km-5km) easily attract the eye, and would be very hard to ignore as they stand well above the existing cultivated landscape.

c. Community Road Corridors

While fixed viewpoints provide a specific view towards the WTG's, they provide only selected glimpses of the full viewing opportunity easily available from the road network in the community. A fixed

[9] Wind Turbine Visibility and Visual Impact Threshold distances in Western Landscapes http://visualimpact.anl.gov/windvitd/docs/windvitd.pdf

viewpoint might be strongly influenced by intervening farm structures or trees in the foreground, while views may be fully unobstructed one or two hundred metres further along the road past the viewpoint. Roadways provide a continuous and cumulative viewing opportunity along the way. A number of roads provide a viewing sequence in close proximity to WTG's over significant lengths. The longer the length of the road, the greater the potential viewing duration in focal view when approaching and passing. Longer corridor lengths also provide potential viewing of WTG's in the Background Distance Zone (greater than 8 km), and bring them into the Middleground Distance Zone (1km to 8 km) and closer into the Foreground Distance Zone (under 1 km). Repeated exposure to WTG's along roadways create a cumulative effect.

RDI has documented 18 road segments from which 64 of the 83 EDP WTG's as proposed would be situated within the 1 km foreground distance zone. These roads include Highway 41 and Range Road 54 offsetting to Range Road 53 along Township Road 332. The Foreground Distance zone is considered in visual resource management procedures such as the Forest Landscape Management Strategies for Alberta (1988) and the "Visual Landscape Inventory Procedures and Standards Manual" (1997) from BC to be the highest rated distance zone for maximum discernment of detail, texture and contrast, and the most vulnerable to visual impacts arising from human influence.

The road segments with WTG's within the foreground distance zone vary in length from nearly 13 km each (Highway 41 segment, Range Road 54 segment, and Township Road 314 segment), down to 250 m (Range Road 53 north of Township Road 320). RDI added a 1km buffer on each side of these roads to display the foreground distance. The buffered road network containing the foreground WTG's is displayed in purple in Figure 1 above. There are a total of 88km of interconnected community roadways with 1 or more WTG's in the foreground in each segment with an average route distance of 4.9 km. This average road segment distance would contain an average of 5 WTG's within the foreground distance zone. Some WTG's were double counted at crossroads. RDI also tested a 1.5 km distance zone along the same road segments in which all 87 WTG's would be included. By comparison, there are no WTG's located in the foreground along Highway 886, including from Viewpoint 31 – EDP 9.

The roadway segments with WTG's within the 1 km foreground distance zone are shown in Table 3 below.

Table 3. Number of Foreground WTG's by Road Segment

1km Buffered Road Segment Name	Length (km)	Number of Foreground WTG's
H41-buffer	12820	11
TR335-buffer	4027	7
TR332-buffer	6513	10
TR322-buffer	8227	5
TR320-buffer	8141	7
TR314-buffer	12854	10
TR330-buffer	5212	4
RR55-buffer	4208	3
RR60-buffer	1439	2
RR-Westof-H41	905	2
RR42-buffer	1637	2
TR-Westof-RR50	982	2
RR-westof-RR60	862	1
RR60-south-buffer	1207	1
RR53-buffer	4869	7
RR54-buffer	12927	10
RR53south-buffer	251	3
RR52-buffer	1241	1
Total	**88322**	**88**
Average	**4907**	**5**

To summarize, 64 of the 83 WTG's are within the 1km Foreground Distance Zone, and all WTG's are within a 1.5km distance as might be seen from community roads and neigbouring farms. The total of 88 WTG's within the foreground from each segment is greater than the total of WTG's due to double-accounting at intersections. The average number of WTG's within the foreground 1km buffers is 1 per kilometer.

For additional organization, RDI divided those WTG's falling east of RR50 and those west of that line. The division line is shown as a green dashed line in Figure 1. The West Group contains 59 WTG's aligned north-south along Range Road 54, and offsetting a short distance east on Township Road 332 to continue north along RR53. All but one of the 59 WTG's in the West Group would be located within 5 km of this alignment. This 5km distance covers foreground to mid-Middleground Distance Zone. The CEMA document (Fairhurst, 2003) had similarly combined the foreground and mid-Middleground (to 5 km) in what that document termed the front country. The East Group is aligned north-south along Highway 41. All 24 WTG's proposed for this group would be within 3.5 km of Highway 41.

d. Grouping and Pattern Effect

The proposed WTG's have a further organization into rows – creating observable patterns. There would be 11 rows in the West Zone (as shown in Figure 1 above) of 3 WTG's or more, plus 4 rows of 2. The East Zone would have 5 rows of 3 or more WTG's.

The density of WTG's along these two principal north-south corridors, and the organization of the majority of WTG's into WTG strings likely combine to increase visual apparency in the Foreground and Middleground viewing distances.

6. Calculating Sharp Hills Existing Landscape Integrity and the Potential Landscape Integrity Objective

RDI has applied the Visual Landscape System (VLS) approach derived by RDI for CEMA in 2003[10] to rate the various values leading to the calculation of Existing Landscape Integrity for the overall Sharp Hills area. The well-managed agricultural farms and small townsites in Sharp Hills contribute to a very harmonious (High) Existing Landscape Integrity using the terminology of the Visual Landscape System (VLS) While the dominant land-use is agriculture, it nestles in easily with the low rounded hills, small water bodies and more distant escarpments. The broad open views reach the horizons in all directions. The existing transmission line and towers are seen in the distance except at road crossings, causing little visual disruption. Overall Attraction would be classed as Moderate to High, with an over-ride given for slope, as the low-rolling terrain is part of the Attraction. When coupled with opportunities for open, continuous viewing throughout the community (High Observability), the existing Landscape Significance would be rated as High. Given the generally low slope of the terrain, low/uniform land-cover diversity, low/uniform topographic diversity, low/uniform colour contrast, and potential front-lit illumination (sun angle), the visual Risk of future alteration would be at least Moderate. An over-ride would be given to slope class raising the Risk from low to moderate or high if the anticipated alteration in the landscape is very tall (i.e., rising much above the slope).

A default Landscape Integrity Objective is determined as a combination of Risk and Significance in VLS. If the area has Moderate Landscape Risk and High Landscape Significance, the Landscape Integrity Objective default would be Class 2 – High as determined in the matrix on VLS p. 26. The descriptor is the same definition as for Existing Landscape Integrity shown on the Rating Form: minimal alteration evident, subordinate, well-designed, high landscape conformity, 0%-1.5% alteration in landscape. The definition considers agriculture in Sharp Hills to meet all of these criteria except the areal alteration limits (0% to 1.5%) which is not applicable as agriculture is the accepted land-use and is the pervasive land-cover.

The default Landscape Integrity Objective would then be considered in relation to overall planning objectives and integration with the "full range of values, expectations, cost and benefits influencing land and resource management decisions. Trade-offs may need to occur amongst sometimes competing considerations for environmental protection, recreational amenity, resource development requirements

[10] Using terminology and rating form on p. 7 in: RDI, 2003 for CEMA. Visual Landscape System for Planning and Management Aesthetic Resources. http://library.cemaonline.ca/ckan/dataset/c510c9ef-664d-4c5a-be4c-b97eeaf4d137/resource/8a7f288a-f0da-4a01-9c9d-cb021a994895/download/visuallandscapesystemforplanningandmanaging.pdf

and others determined in a Landscape Plan. Landscape Integration incorporates the procedures and outcomes of comprehensive trade-off and consultation”(p. 28). A completed VLS Rating Form follows.

Visual Landscape System
March 2003 Final Draft

Inventory Phase
7

VLS Landscape Unit Rating Form

Rating Viewpoint(s): Sharp Hills- all **Map #(s):** **Photos:** all

Rating Elements
A: Attraction
O: Observability
S: Significance
R: Risk
ELI: Integrity (existing)
OLI: Integrity (objective)

Landscape Unit Label – add values from each Element rating						
LU#	A	O	S	R	ELI	OLI*

*OLI is determined in the Planning Phase

Conducted by: KBF **Date:** April 15/18

Assign appropriate ratings and place in LU label above. Add additional comments on side. Overall ratings in each category may be influenced more strongly by a single factor or few factors. If so, make note of this in the comments at side or on the reverse.

Attraction (A)			
Landform	high attraction; 31-60% slope 5; more than 60% slope 10	moderate attraction; 16-30% slope (3) ←	low attraction; 0-15% slope -5; over-ride
Vegetation	High attraction, interest 5	Moderate attraction (3)	Minor influence: 1; neutral: 0
Water	High attraction, interest 5	Moderate attraction (3)	Minor influence: 1; neutral: 0
Colour	High attraction, interest (5)	Moderate attraction 3	Minor influence: 1; neutral: 0
Adjacent scenery	Enhances LU attraction 5	Moderate influence (3)	Minor influence: 1; neutral: 0
Scarcity (in region)	Rare, unique 5	Distinctive, common (3)	Minor influence: 1; neutral: 0
Land-Use Modification	Harmonious (5)	Neutral; not present 0	Unharmonious -5
Overall Points: 25 **Rating:**	**1 (High) 26 or more**	**(2 (Moderate)) 11-25**	**3 (Low) 10 or less**
Vertical Relief (m):		**Percent Slope (%):**	

For Landscape Attraction Factors above that are neutral or not present, assign a zero (0) rating.

Observability (O)			
Viewing Distance	Foreground/Middle ground < 5km (Front) (10)	Background 5km – 15 km (Back) 3	Seldom Seen FG/MG/BG or >15km (Far Back) -5
Viewing Orientation towards LU	Focal; direct in Line of sight (LOS) (5)	Oblique; Tangential to LOS 3	Peripheral; angled away from LOS 1
Viewing Frequency	Many opportunities (5)	Some 3	Few 1
Viewing Duration	Long (5)	Moderate 3	Glimpse 1
Overall Points: 25 **Rating:**	**(1 (High)) 17 or more**	**2 (Moderate) 8-16**	**3 (Low) 7 or less**

Significance (S)			
Circle Rating In Matrix	Landscape Observability (across)		
Landscape Attraction (down)	1 High	2 Moderate	3 Low
1 High	**1 High Significance**	**1 High Significance**	**2 Mod. Significance**
2 Moderate	**(1 High Significance)**	**2 Mod. Significance**	**3 Low Significance**
3 Low	**2 Mod. Significance**	**3 Low Significance**	**3 Low Significance**

Risk (R)			
Slope Class (Slope: ______%)	Steep 31-60%+ 5; Very steep >60% 10	Moderate 16-30% 5	Gentle 0-15% (-10) ← over-ride
Land-Cover Diversity	Low/uniform (5)	Moderate 3	High 1
Topographic Diversity	Low/uniform (5)	Moderate 3	High 1
Colour Contrast	Low/uniform (5)	Moderate 3	High 1
Illumination	Front/side (5)	Side only 3	Back-light 1
Overall Points: 10 **Rating:**	**1 (High) 19 or more**	**(2 (Moderate)) 7 - 18**	**3 (Low) 6 or less**

Rating:	**Existing Landscape Integrity (ELI)**
1 Very High	No alteration evident, very subordinate, very high landscape conformity, (0%-1.5% alt. in LU)
2 High	Minimal alteration evident, subordinate, well-designed, high landscape conformity (1.6%-7%)
3 Moderate	Moderate alteration evident, dominant, moderate landscape conformity (7.1%-18% alt.)
4 Low	Intensive alteration evident, very dominant, low landscape conformity (18.1%- 30% alt.)
5 Very Low	Very intensive alteration evident, extremely dominant, very low landscape conformity (>30%)

over-ride: agriculture has high conformity

Integrity modifying factors:
Cumulative effect of current alteration in locality/corridor: ☑ High ☐ Moderate ☐ Low ☐ n/a ✓
Perceived ecological integrity in locality/corridor: ☑ High ☐ Moderate ☐ Low ☐ n/a ✓
Locality influence: ☐ Urban ☐ Urban Fringe ☑ Rural, Developed ☐ Rural, Natural ☐ Industrial ✓
☐ Recreational, Developed ☐ Recreational, Natural ☐ Backcountry ☐ Wilderness

Figure 3. Visual Landscape System Rating Form

7. Conclusions and Recommendations

At the commencement of this assessment, RDI determined that it would be useful to answer this question: *to what level or degree would the Sharp Hills Wind Farm be compatible in the existing working agricultural landscape, using standard objective measures of Visual Landscape Assessment?*

The assessment found that the EDP plan would introduce a large number of WTG's within a fairly small area of farms, small townsites, and an easily accessible road network. Of the 27 viewpoints established in total by both EDP and RDI, 15 are closer than 5km to a WTG, and all viewpoints are within 10 km. By comparison, a study conducted for USDI Bureau of Land Management found that wind turbines are a major focus of attention between 16 and 19 km of viewing distance, and likely to be noticed by casual observers at greater than37km (footnote 10, this report).

The existing community road network would bring 64 of the proposed WTG's within 1km of the road network. These are within the Foreground Distance Zone which has the greatest vulnerability according to Visual Resource Management Guidelines and perceptual studies. Further, all 83 WTG's would be located within a 1.5km viewing distance of the community road network.

The average density within the 400km^2 boundary RDI placed around the proposed WTG's would be just under 5 per km^2 which translates to 1 for every 20 hectares or 1 for every 50 acres within the RDI border around the proposed EDP WTG's.

The proposed alignment of the strings of WTG's would further attract attention and diminish visual quality.

The scale of the WTG's, having a maximum height of 200m with the blade vertical, and a blade diameter of 136m, will stand out well-above any objects in the landscape, including farms, trees, and transmission lines in the existing working agricultural landscape, using standard objective measures of Visual Landscape Assessment. The heights of the WTG's compare closely to the height of the Calgary Tower. The steep vertical viewing angle towards the high number of WTG's in the Foreground and Middleground would make screening unlikely, causing very intensive alteration to be evident, high dominance and low landscape conformity. This is the definition of Low or Very Low Landscape Integrity when the VLS Rating Form suggests Sharp Hills should be managed to High Landscape Integrity.

The EDP Windfarm would present a stark and persistent change within the existing cultural landscape, by size, frequency, and proximity. The movement of the turbines blades would inescapably grab the eye in foreground and near-middleground view, unlike stationary transmission towers. The farms and road network offer long duration views dominated by the proposed WTG's. Because of how many WTG's are proposed, they would surround most viewpoints and road corridors, so changing the direction of view would offer little respite.

RDI concludes that the windfarm, as proposed, is incapable of maintaining the High Existing Landscape Integrity as rated using the VLS Rating Form for the local agricultural community, and would result in Low or Very Low Landscape Integrity. The default Objective for Landscape Integrity is indicated by the matrix to warrant the High Integrity Objective, meaning alteration should be subordinate, well-designed, and have high conformity with the landscape.

To then answer the question posed by RDI at the outset, the Sharp Hills Wind Farm will not be compatible in the existing working agricultural landscape, using standard objective measures of Visual Landscape Assessment. A drastic reduction in WTG numbers, or size, and placement at much greater distances from the community may all be necessary to maintain the warranted Landscape Integrity.

Ken B. Fairhurst, PhD, RPF
RDI Resource Design Inc
April 18, 2018

Appendix 1 RDI's Credentials

RDI's credentials for conducting a visual aesthetics assessment of the EDP wind farm proposal are the long-term dedication to, and the practice of, Visual Resource Management by its founder, Ken Fairhurst, PhD., RPF. Ken first became associated with visual landscape issues in Alberta when he conducted the Hidden Creek Visual Impact Assessment consulting project for Alberta Forestry, Lands and Wildlife in 1984 (unpubl. rep., 1984). He later took the full-time position as the Timber Operations Forester in Edmonton with Energy and Natural Resources. During that period, Ken was tasked with the initial development of a Visual Landscape Program in the Province, leading to the eventual completion by his successor and publishing of the "Forest Landscape Management Strategies for Alberta" (1988). Returning to BC in 1985, Ken re-assumed his earlier Regional Landscape Management Specialist position for the Vancouver (Coast) Forest Region for another 11 years after an initial 3 years. Upon once again setting out in his consulting practice in 1996, Ken and RDI later commenced a major undertaking to produce the "Visual Landscape System for Planning and Managing Aesthetic Resources" for CEMA's Sustainable Ecosystems Working Group, Cultural and Historical Resources Subgroup for the Wood Buffalo Region in 2003[11]. The process would have the capability to address top-down and bottom-up planning for all resources in the oil sands region. During this time, Ken also completed a PhD with a doctoral dissertation developing a prediction technique for cumulative visual risk in the landscape along travel corridors. He also taught visual simulation techniques at UBC. RDI's client base has primarily been from industry or government. Projects have included visual impact assessments of several Alberta oil-sands projects (CNRL, Suncor), many dozens of forestry-related projects in BC, as well as visual aesthetics of LNG infrastructure and electricity transmission. A detailed CV is available on-line at www.rdi3d.com.

[11] RDI, 2003 for CEMA. Visual Landscape System for Planning and Management Aesthetic Resources. http://library.cemaonline.ca/ckan/dataset/c510c9ef-664d-4c5a-be4c-b97eeaf4d137/resource/8a7f288a-f0da-4a01-9c9d-cb021a994895/download/visuallandscapesystemforplanningandmanaging.pdf

Appendix 2

Two parallel documents have been prepared presenting panoramic photography, visual simulation, and photo-montages. These are presented in Photography and Visual Simulation Documents Part A and Part B. . RDI also produced several animations to indicated to a greater extent the effect of turbine rotation, including night-time effects with aviation lights turned on.

The photography consisted of overlapping individual 35mm to 42 mm shots using a Nikon D5300 camera with a Nikon 18mm to 105mm lens, set primarily between 38mm and 42mm. The Nikon digital camera frame equates to a standard 35mm camera with a correction factor of 1.5 to become 52mm to 63mm with field of view of 38 to 42 degrees. The individual frames were stitched into full 360 degree panoramas, and then split along the principal roadway in each panorama to provide orientation with cardinal directions (i.e., North / South or East / West).

The proposed EDP WTG's as might be seen from all viewpoints were simulated using Visual Nature Studio (VNS). RDI acquired the Ventas V136 3-dimensional model and inserted it into VNS to provide a realistic and accurate representation of each WTG at correct scale, with maximum heights shown as when the turbine blade is vertical above the nacelle. Viewpoints and WTG's were located in ArcMap and imported into VNS. A 10m grid surface and used to create the surface in VNS. Rendering was set to 360 degrees, based on a composite of individual camera field of view of 40 degrees. The renderings were assigned bare ground attribute due to the absence of vegetative cover information. RDI added small patches of 15 m height tree clumps to provide scale comparisons (vegetation or buildings).

RDI utilized Visual Nature Studio 3-dimensional software to produce 360 degree simulations from each of the viewpoints, split similarly along the roads for ease of comparison and validation. The simulations placed a 3-D model of the Vestas V136 to scale at each WTG point. The Vestas model was shown as having a vertical blade reaching 200m in height, correctly located for distance and terrain. The absence of vegetation cover information was overcome somewhat by the addition of 15m height tree patches to compare with the scale of the WTG's. Camera direction is provided across the length of each simulation. Measurement bars indicate 0 to 180 degrees, and also a 40 degree bar and bounding box (standard 35mm camera frame width).

The wide panoramas tend to diminish the scale of the WTG's. Each single bounding 40 degree box was enlarged to fit a separate report page to allow a full impression of the scale and apparency of the turbines. Viewing distance from a single frame printed image should be 1.5 times the diagonal length of the image (e.g. 11"x8.5" print should have a 21 inch viewing distance).

RDI also prepared day and night photo-montages using WindPro 3.1 from Viewpoint 3 - EDP3 - Jorgenson's Bins. These are provided as inserts on Page 8. The night view shows the aviation lights. Windpro was also used to produce day and night animations with revolving rotors. The animations require a separate viewer and could not be included in this document.