APPENDIX Z
REVISED ACCESS ROAD METHODOLOGY FOR FEIS (MEMORANDUM)

MEMORANDUM

DATE:	February 13, 2014
TO:	David Smith Garry Miller
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FROM:	Linda Erdmann
SUBJECT:	115841 Trans West Express Transmission Project – Revised Access Road Methodology for FEIS

MESSAGE

This memo provides a description of the base data and methodology that will be used to estimate miles of access roads and percentages of these access roads inside and outside the transmission line right-of-way (ROW) by route segment. This data will ultimately be used to approximate the area of ground disturbance associated with new access roads within the Agency Preferred, Applicant Proposed and Alternative Route corridors by route segment in four different types of terrain:

- Terrain Type 1 - Flat
- Terrain Type 2 - Rolling
- Terrain Type 3 - Steep
- Terrain Type 4 - Mountainous

Backbone Access Road Network Methodology

The first step in this process is to identify existing roads in the project area that can be used to access the Agency Preferred, Applicant Proposed and Alternative Route corridors for transmission line construction and maintenance. These public and private roads make up the backbone access road network that includes paved, gravel, and dirt roads.

Google Earth was used to determine the location of existing access roads. Existing paved roads are assumed to require no improvements and therefore no ground disturbance. These roads are categorized as Category 1 Existing Improved Roads. Existing gravel and dirt roads that appear to have wide, well graded or graveled surfaces are assumed to require no improvements and therefore no ground disturbance. These roads are also categorized as Category 1 Existing Improved Roads.

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Existing dirt roads that appear to have narrow, poorly graded surfaces or that appear as two-track paths are assumed to require some level of improvement and therefore ground disturbance. Typical improvements may include widening, realignment, culvert installation, and other necessary improvements to support construction vehicles and equipment. These roads are categorized as either Category 2A Existing Roads *Outside the FEIS Corridor* that Require Improvement or Category 2B Existing Roads *Inside the FEIS Corridor* that Require Improvement. The DEIS corridors were narrowed for the FEIS based on terrain, proximity of other transmission lines, environmental constraints, and land ownership. The net effect on the backbone access road network of narrowing the DEIS corridors to create the FEIS corridors was to slightly increase the length of Category 2A roads (changes captured in the current backbone access road GIS shapefile) and to slightly decrease the amount of Category 2 B roads (did not reduce the average road ratios by terrain type shown in Table 2).

Category 1 Existing Improved Roads and Category 2A Existing Roads Outside the FEIS Corridor that Require Improvement make up the backbone access road network. A GIS shapefile was created for the backbone access road network. The purpose of the backbone access road GIS shapefile is twofold:

1. Identify lengths of Category 1 and Category 2A roads that can be used to access the Agency Preferred, Applicant Proposed and Alternative Route corridors for transmission line construction and maintenance.
2. Identify the starting point for the layout and location of new access roads (Categories 2B, 3, 4, 5, & 6).

New Access Road Methodology for Greenfield Alternatives

A new access road refers to implementing all activities required to establish a travel-way that allows vehicular access from an existing road to the required work location and does not imply construction of a new road with a ditch and a raised shoulder.

A percentage of the length of Category 2B roads described above are considered new access roads and are included in the indicative access road summary by terrain type (Table 2). Due to the nature of improvement requirements, the level of disturbance associated with Category 2B roads is much less than that for a new road. Field verification is required to determine if improvements are needed and if so, what level of improvement. Typically, the type of terrain determines the required level of road improvement (Table 1). Table 1 estimates the percentage of Category 2B roads requiring improvement based on terrain and past experience on other transmission line projects.

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TABLE 1. PERCENTAGE OF CATEGORY 2B ROADS REQUIRING IMPROVEMENT	
Terrain Type	% Road Length Requiring Improvement
Flat	50%
Rolling	60%
Steep	70%
Mountainous	80%

New access roads were identified and mapped along sample segments of the Applicant Proposed Route (June 2010) in order to determine the indicative length of new access roads required for the Agency Preferred, Applicant Proposed and Alternative Routes. This approach provides the information necessary to analyze and compare impacts from construction of the access roads for the alternative routes in the FEIS. The new access roads and backbone access roads described previously will provide the complete road network necessary to construct the TWE Project transmission line.

POWER's construction managers reviewed hard copy USGS 7.5-minute quadrangle topographic maps with the entire length of the Proposed Route shown. Segments along the Proposed Route that represented the different terrain types that would require new access road construction were identified. A total of 18 sample segments were identified which represented flat, rolling, steep and mountainous terrain. Four of the 18 sample segments, 1, 7, 13, and 15, have more than one type of terrain as shown in Table 2.

Once these sample segments were selected, indicative structure spotting based on topographic constraints and spans ranging from 1,200 to 1,400 feet were completed and access roads were hand drawn on the hard copy USGS quad maps using the contours. These maps were then scanned, geo-referenced and the roads digitized into the GIS.

Once in the GIS, the location of the digitized access roads were re-examined by the construction managers to identify any potential digitizing scale errors. For example, if a new access road was located just outside the 250 foot ROW in flat terrain, the location of the road was corrected to be within the ROW as intended. The corrected access roads were labeled by terrain category (Categories 3, 4, 5 & 6) and sample segment number.

The 18 sample segments were analyzed for slope in tenth mile increments, using 6 meter DEMs derived from the TWE Project Towill elevation data. Tenth mile increments were used to obtain 10 data points or values per one mile of sample segment length. This provides a more accurate terrain measurement compared to one data point or value per one mile increment over the total length of the sample segment. This slope analysis provided the minimum, maximum, and average slope and cumulative change in slope for each tenth mile increment, which was then compared to topographic maps for accuracy. In steeper terrain areas, the average slopes were often less than the actual terrain where the flatter sample segments in the mountainous areas had distorted the greater slope values. For example, in Sample Segment 10, all of the average slope values ranked as "steep" or "rolling", although both the topographic map and Google Earth show the areas to be clearly mountainous. In

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addition, the minimum and maximum slopes did not always represent actual terrain. Therefore, it was determined that the cumulative change in slope best represented all terrain types and was used for each tenth mile increment.

The cumulative change in slope for each tenth mile increment over a length of a mile (10 tenth mile increments) is then averaged to calculate the slope value and terrain type per mile of sample segment. This data is then entered into an Excel spreadsheet to compare the percentage change in slope value and terrain type for successive one mile sections of the sample segment. These sections are then grouped by average slope value and dominant terrain type. Therefore, each sample segment can have more than one dominant terrain type.

Miles of sample segments with dominant slopes between 0 to 8 percent are categorized as Flat Terrain; 8 to 15 percent as Rolling Terrain; 15 to 25 percent as Steep Terrain; and over 25 percent as Mountainous Terrain. Roads within these four terrain types are categorized as follows:

- Category 3 Construct Road in Flat Terrain (0 to 8 percent slope)
- Category 4 Construct Road in Rolling Terrain (8 to 15 percent slope)
- Category 5 Construct Road in Steep Terrain (15 to 25 percent slope)
- Category 6 Construct Road in Mountainous Terrain (greater than 25 percent slope)

The miles of transmission line, new access roads, new road within the ROW, and new road outside the ROW were calculated for each sample segment and totaled by terrain type (Table 2). The ratio of line miles to road miles by terrain type were applied to the Agency Preferred, Applicant Proposed and Alternative Routes to estimate the miles of new access roads required by route segment. For example, if Alternative Route segment X from mile 10 to mile 20 is predominantly flat, then using the ratio shown in Table 1 for Category 3 Flat Terrain, which is 1.2, the 10 miles of transmission line for Alternative Route segment X would require approximately 12 miles of new access roads.

Determination of the dominant terrain type along the route segments requires the same GIS slope analysis in tenth mile increments as described above for the sample segments. The cumulative change in slope percentages for each tenth mile increment was mapped according to terrain type: Flat (0 to 8 percent slope), Rolling (8 to 15 percent slope), Steep (15 to 25 percent slope), and Mountainous (greater than 25 percent slope). Demarcation of the dominant terrain along the extent of the route segment required analysis of the slope data as described above. Terrain Sample Maps for the greenfield Sample Segments 1 to 18 were provided in the previous version of this memo (dated March 1, 2011). These sample segments show the cumulative change in slope percentages for each tenth mile increment, miles of terrain type, backbone access network, and indicative structures and access roads.

The ROW data by terrain category was applied to the Agency Preferred, Applicant Proposed and Alternative Routes to estimate the percentage of new roads that would be within the ROW and outside the ROW. In general, roads in flat terrain are most likely to be located within the ROW as compared to those in steep terrain due to topography constraints. So for

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the example given above, approximately 8.76 miles or 73 percent of the new access roads required would be within the ROW and approximately 3.24 miles or 27 percent would be outside the ROW (Table 2).

New Access Road Methodology for Co-Located Alternatives

For route alternatives with existing transmission lines, the TWE Project will be co-located with these existing transmission lines at a 250 foot separation to the maximum extent practicable. This allows for the use of existing access roads along the co-located transmission lines for construction of the TWE Project, decreasing the need for new access roads. Due to the unknown condition of these existing roads for supporting construction traffic, they are considered Category 2B roads as described above.

New access roads in co-located corridors are typically short spur roads that provide access to the work site from the existing access road. The methodology for determining the length of new roads is similar to that described above for the greenfield alternatives. To develop new access road metrics in a co-location setting, 21 new sample segments for different terrain types were selected and new access roads were identified and mapped along these segments of the Applicant Proposed and Agency Preferred Routes (October 2013) in order to determine the indicative length of new access roads required for the routes (Table 3).

As expected, the analysis of the TWE Project in co-location settings resulted in the average access road ratios by terrain type being less than that for greenfield alternatives particularly in flat terrain. Another noticeable difference between the greenfield and co-location settings is that the vast majority of the new access roads in the co-location setting are outside of the 250 ft. right-of-way due to the existing access road being primarily located on the adjacent (existing) transmission line's right-of-way. The new access roads within the new right-of-way are primarily spur roads off of the existing access road network. Maps and GIS files for these sample segments are provided.

Approach

The approach described in the previous memorandum dated March 1, 2011 was used for the DEIS and the modified approach in this memorandum will be used for the FEIS to determine indicative existing access and new access road metrics. These metrics are then used to calculate the disturbance area resulting from improvement of existing access roads and construction of new access roads on a route segment by segment basis.

This approach substantially reduces the time and effort needed to conduct the impact analysis from new access road construction in the FEIS (same approach used in the DEIS) since the detailed process of indicative spotting, locating, and mapping new access roads as done for the sample segments along the Applicant Proposed Route will not be required for the entire length of the Agency Preferred, Applicant Proposed and Alternative Routes.

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Tables 2 and 3 provide the information necessary to analyze and compare impacts from construction of the access roads for the alternative routes in the FEIS. The new access roads and backbone access roads described previously provide the complete road network necessary to construct the TWE Project transmission line.

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TABLE 2. INDICATIVE ACCESS ROAD SUMMARY BY TERRAIN TYPE FOR GREENFIELD ALTERNATIVES

SAMPLE SEGMENT	PROPOSED ROUTE SEGMENT	MILEPOST		LINE LENGTH (MILES)	NEW ACCESS ROAD LENGTH (MILES)*	ROAD IN ROW (MILES)	ROAD OUTSIDE ROW (MILES)	AVERAGE CUMULATIVE CHANGE IN SLOPE (%)	TERRAIN TYPE	RATIOS BY TERRAIN TYPE		ROW BY TERRAIN TYPE			
		BEGIN	END							ACCESS ROAD RATIO	AVERAGE RATIO	TOTAL ACCESS ROADS IN ROW (%)**	AVERAGE ACCESS ROAD IN ROW (%)	TOTAL ACCESS ROADS OUTSIDE ROW (%)**	AVERAGE ACCESS ROAD OUTSIDE ROW (%)
11	U165	10	20	10	10.54	10.0	0.5	2%	Terrain Type 1 Flat	1.05	1.2	95%	73%	5%	27%
12	U255	15	25	10	9.22	9.4	4.4	1%		0.92		68%		32%	
14	N45	0	11	11	12.99	9.7	3.9	3.2%		1.18		71%		29%	
15	N70	3	11	8	10.76	7.7	4.3	2.7%		1.34		64%		36%	
1	W10	9	15	6	6.47	6.2	2.0	5.5%		1.08		76%		24%	
18	N165	4.5	6	1.5	1.58	1.1	0.5	6.5%		1.05		69%		31%	
2	W10	20	31	11	17.33	10.3	8.1	5%		1.58		56%		44%	
3	W25	0	10	10	8.91	8.6	0.3	2%		0.89		97%		3%	
4	W25	20	30	10	11.79	9.2	1.8	7%		1.18		84%		16%	
7	U55	53	60	7	8.75	5.3	5.4	6%		1.25		50%		50%	
5	C60	5	15	10	13.81	9.3	6.1	9%	Terrain Type 2 Rolling	1.38	1.3	60%	64%	40%	36%
6	C85	15	25.2	10.2	12.26	5.8	8.7	10.5%		1.20		40%		60%	
16	N100	0	7.3	7.3	8.63	7.7	0.8	9.5%		1.18		91%		9%	
1	W10	5	9	4	7.76	3.1	5.4	18%	Terrain Type 3 Steep	1.94	1.8	36%	38%	64%	62%
7	U55	50	53	3	7.14	2.3	5.4	16.3%		2.38		30%		70%	
15	N50_S2	30	34.2	4.2	6.23	3.23	3.4	22.5%		1.48		49%		51%	
15	N70	0	3	3	4.67	2.24	2.8	18.2%		1.56		44%		56%	
13	U255	49	56	7	8.91	3.5	7.9	21.1%		1.52		31%		69%	
8	U55	80	90	10	27.12	4.4	24.6	38%	Terrain Type 4 Mountainous	2.74	2.7	15%	18%	85%	82%
9	U70	0	10	10	25.94	3.8	24.8	40.5%		2.59		13%		87%	
10	U70	25	37	12	25.41	6.2	22.7	28%		2.12		21%		79%	
13	U255	45	49	4	15.51	1.5	14.7	28%		3.88		9%		91%	
17	N135	1	3.8	2.8	4.67	1.5	3.2	28.1%		1.67		32%		68%	
18	N165	1	4.5	3.5	10.68	2.1	10.8	27.2%		3.05		16%		84%	

Notes:

*Miles of New Access Road Length includes a percentage of Category 2B Existing Roads Inside Corridor that Require Improvement

**Since the actual section of Category 2B road that would require improvement is not known, the entire length of this road along with the length of new road (Category 3, 4, 5 or 6) is considered.

Terrain Type 1 Flat (0 to 8 percent slope)

Terrain Type 2 Rolling (8 to 15 percent slope)

Terrain Type 3 Steep (15 to 25 percent slope)

Terrain Type 4 Mountainous (greater than 25 percent slope)

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TABLE 3. INDICATIVE ACCESS ROAD SUMMARY BY TERRAIN TYPE FOR CO-LOCATED ALTERNATIVES

SAMPLE SEGMENT	LINE LENGTH (MILES)	NEW ACCESS ROAD LENGTH (MILES)*	ROAD IN ROW (MILES)	ROAD OUTSIDE ROW (MILES)	AVERAGE CUMULATIVE CHANGE IN SLOPE (%)	TERRAIN TYPE	RATIOS BY TERRAIN TYPE		ROW BY TERRAIN TYPE			
							ACCESS ROAD RATIO	AVERAGE RATIO	TOTAL ACCESS ROADS IN ROW (%)**	AVERAGE ACCESS ROAD IN ROW (%)	TOTAL ACCESS ROADS OUTSIDE ROW (%)**	AVERAGE ACCESS ROAD OUTSIDE ROW (%)
2	5	4.78	0.56	7.83	4.8%	Terrain Type 1 Flat	0.96	0.8	7%	10%	93%	90%
4	5	4.42	0.58	7.08	5.8%		0.88		8%		92%	
6	5	4.72	0.57	7.84	7.9%		0.94		7%		93%	
13	5	3.44	0.44	5.69	2.9%		0.69		8%		92%	
14	5	4.00	0.76	5.92	1.1%		0.80		13%		87%	
15	5	3.62	0.92	5.26	3.8%		0.72		18%		82%	
1	5	6.56	1.29	3.92	10.2%	Terrain Type 2 Rolling	1.31	1.1	13%	13%	87%	87%
3	4	5.54	0.59	8.01	11.8%		1.39		7%		93%	
5	5	6.30	0.71	7.60	14.9%		1.26		7%		93%	
7	5	5.98	1.21	7.54	14.6%		1.20		13%		87%	
12	5	2.79	1.02	3.96	10.2%		0.56		25%		75%	
16	5	3.31	0.94	3.18	16.3%	Terrain Type 3 Steep	0.66	1.6	23%	14%	77%	86%
18	5	10.49	2.22	11.94	24.9%		2.10		16%		84%	
19	5	6.87	0.75	8.21	15.6%		1.37		8%		92%	
20	5	8.19	1.10	9.40	16.3%		1.64		11%		89%	
21	5	9.98	1.65	11.77	24.8%		2.00		12%		88%	
8	5	8.84	2.23	7.43	40.9%	Terrain Type 4 Mountainous	2.21	2.4	23%	16%	77%	84%
9	5	8.45	1.96	8.04	33.0%		1.69		20%		80%	
10	5	11.12	1.71	10.21	45.3%		2.22		14%		86%	
11	5	16.38	1.48	18.39	31.4%		3.28		7%		93%	
17	5	12.26	1.97	12.30	25.2%		2.45		14%		86%	

Notes:

*Miles of New Access Road Length includes a percentage of Category 2B Existing Roads Inside Corridor that Require Improvement

**Since the actual section of Category 2B road that would require improvement is not known, the entire length of this road along with the length of new road (Category 3, 4, 5 or 6) is considered.

Terrain Type 1 Flat (0 to 8 percent slope)

Terrain Type 2 Rolling (8 to 15 percent slope)

Terrain Type 3 Steep (15 to 25 percent slope)

Terrain Type 4 Mountainous (greater than 25 percent slope)

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