4.6.3 Analysis and Criteria Scoring of Route Options

The Project Evaluation Criteria were scored by the Project Team on a segment basis using numeric data metrics which were as objective as possible. Criterion scoring by segments can be done where different segments of a route have different characteristics. However, where criteria call for a single numeric score for the whole route, such as "length through stream or wetland", no segment score is appropriate. When segment scoring is appropriate, criteria scores are found for each segment and then, the segment scores for each of the criteria are summed to arrive at an aggregate score for each criterion for the whole route. Length-weighting during segment aggregation is applied to the visual rating and the rating for potential impact on cultural resources, i.e., the two criteria where segment scoring is appropriate, in order to create a summation process for route segments that did not bias the route score on the basis of the number of segments in the potential candidate route. Siting Board precedent has recognized that summing aggregate criteria data for each segment could introduce inappropriate bias for certain criteria if aggregate segment scores are weighted by length in reaching a total route score. For example, if the criteria, "length through stream or wetland", were scored on a segment basis, length-weighting would introduce bias in summing segment scores for the whole route. Length-weighting does not create any bias, however, for the visual and cultural resources ratings since the two qualitative ratings in question are affected by length and should be rated to reflect the impact of length.

Summing data for different criteria into a single score for the whole route is likewise a challenging exercise since each of the criteria may have a different data metric. As a result, simple sums of different criteria data could be like adding "apples" and "oranges" (e.g., adding linear lengths and the number of public facilities). To avoid adding dissimilar criteria, the numeric score for each criterion factor, criterion by criterion, is converted to a common data range, in effect scoring each potential route on a relative scale against the other potential routes for each of the criterion. Here, the common data range is a fraction up to the value of "1", where each route's score on a particular criterion is the ratio of its "raw" score for that criterion, e.g., 53 residences within 100 feet of the ROW, to the highest "raw" score for that criterion among all of the potential routes, e.g., 86 residences. The route with the highest raw score would in the case of each criterion receive a common data range score of "1". Since each of the route alternatives receives a criteria score which is based on the same common data range, the criteria scores can be added together for each route option to obtain a single numerical score for each route alternative which is based on the same numeric "yardstick" as every other route alternative. Ranking each route alternative against the other route alternatives on the basis of this common "yardstick" is then appropriate.

Table 4-4 presents the data collected and analyzed for the Northern Route and Southern Route options. Because both route options include the data associated with the 115-kV improvements along the northern corridor (Segment 3), the Southern Route includes the impacts associated with both corridors.

Table 4-4: Project Evaluation Criteria Metrics

Evaluation Criteria Metrics	Northern Route	Southern Route
Total Length (Miles)	35 miles	57 miles
Railroad Crossings (Number)	2	4
Stream Crossings (Number)	41	61
Length NOT paralleling existing linear facilities	0 feet	0 feet
Length through private easement	0 feet	0 feet
Length of ROW expansion	4.1 miles	5.7 miles
Area of ROW expansion	11.1 acres	15.6 acres
Residences within ROW (Number) [1]	11	12
Residences within 100 feet of edge of ROW (Number)	316	428
Residences within 101 to 300 feet of edge of ROW (Number)	754	1,116
Businesses within ROW (Number)	0	2
Businesses within 100 feet of edge of ROW or centerline (Number)	46	54
Businesses within 101 to 300 feet of edge of ROW (Number)	42	58
Public Facilities within 300 feet of edge of ROW (Number)	2	3
Public Facilities within 301 to 1,200 feet of edge of ROW (Number)	9	18
Length by land use (Commercial/Industrial)	6.8 miles	10.4 miles
Length by land use (Residential)	13.1 miles	18.7 miles
Length by land use (Undeveloped Land)	11.3 miles	23.8 miles
Length by land use (Park/School/Open Space)	3.3 miles	3.9 miles
Visibility (Rating) [2]	50.7	67.5
Length through stream or wetland	6.2 miles	12.8 miles
Length through environmentally sensitive area [3]	7.8 miles	20.5 miles
Potential impact on cultural resources (Rating)[4]	39.2	68.3

Notes:

1. Residences or businesses considered to be located within the ROW does not necessarily mean they would need to be relocated.

2. The visibility rating is a subjective rating and was assigned to portions of the segment based on the length of the line that was considered to have a high (5), medium-high (4), medium (3), medium-low (2), or low (1) impact These ratings were determined by the presence of residences, businesses, and roads within a 1/4-mile of the line and described further below. Portions of the segment where the 345-kV structures would be significantly taller than the existing structures in the corridor were multiplied 1.5 times the visibility rating.

3. Environmentally sensitive areas are locations identified in Massachusetts by the Natural Heritage and Endangered Species Program as Priority Habitats of Protected Species and in Connecticut as the Natural Diversity Database Endangered Species locations.

4. The cultural resources rating is a rating that was assigned to portions of the segment based on the length of the line that was considered to have a High (3), Medium (2), No /Low (1) predicted sensitivity for archaeological resources and described further below.

The first of the three engineering/technical criteria, length, provides insight into the overall length of each of the two route options; approximately 35 miles for the Northern Route and 57 miles for the Southern Route. Both of these distances include the portion of the route in Connecticut but exclude the length of the 115-kV "spurs" off the primary corridor.[3] The lengths of the spurs are approximately 4.2 miles and were not included in the Project evaluation data because they are in common to both routes.

The remaining two engineering/technical criteria, number of railroad crossings and number of stream crossings, provide an indication of the number of potentially difficult crossings associated with the two routes. The number of railroad crossings, 1 and 3 respectively for the Northern and Southern Routes, are not expected to be significantly challenging for construction of the proposed line. The number of stream crossings, 41 and 61 respectively, for the Northern and Southern Routes, indicates that there would be approximately one-third more stream crossings for the Southern Route. Many of these crossings are small, perennial streams that would not require significant technical issues to cross during construction. The largest waterbody crossing is the Connecticut River, which would be crossed in one location along the Northern Route and in two locations along the Southern Route. Larger transmission structures are required at these wider stream crossings but both stream crossings locations already have existing transmission lines over them and are not expected to be significantly challenging from an engineering/technical aspect.

Sixteen human/social criteria were analyzed to provide a general comparison of the following: length not paralleling existing linear facilities (i.e. routes across virgin/new ROW); the types of development along the route, such as residences, businesses, public facilities; the types of land use along the route such as commercial/industrial, residential, undeveloped, or park/school/designated open space; the potential changes to visibility associated with construction of the proposed transmission line; and potential changes to private property (i.e. impacts to private easements and expansion of the ROW.)

Two of the criteria above, length not paralleling existing ROW and length through private easement, resulted in a zero or null value because they were not applicable to the two routes considered for this project. The length through private easement was not applicable because it is used to evaluate portions of a route that would be on virgin/new ROW that is not owned by WMECO or CL&P. However, there would be some locations where the ROW would need to be expanded to accommodate the new transmission line. The primary difference in ROW expansion for the two routes is between the South

[3] The spurs are shown in Figure 4-5 and extend from (i) East Springfield Junction to Fairmont Switching Station; (ii) Cadwell Switching Station to Shawinigan Switching Station and Exit 6 Junction; and (iii) Orchard Junction to Orchard Substation

Agawam Switching Station and Agawam Substation and was analyzed as Segment 2A for the Northern Route and Segment 2B for the Southern Route. The ROW would need to be expanded by approximately 35 feet for about 2,080 linear feet for the Northern Route and would need to be expanded approximately 65 feet for about 2,390 linear feet and 15 feet for about 8,540 linear feet for the Southern Route. The additional ROW for the Southern Route would be required to accommodate two sets of 345-kV structures on this route segment, where the Northern Route would only require one set of 345-kV structures. The estimated amount of ROW expansion for the Northern Route (which includes the portion of the line in CT) is approximately 4.1 miles and 11.1 acres. The estimated amount of ROW expansion for the Southern Route (which includes the portion of the line in CT) is approximately 5.7 miles and 15.6 acres.

For the eight criteria associated with the proximity to residences, businesses and public facilities, the expansion of the ROW was incorporated into the analysis when determining the distances to these facilities. Therefore, the number of residences shown as being within the ROW is 11 for the Northern Route and 12 for the Southern Route and the number of businesses shown as being within the ROW is 0 for the Northern Route and 2 for the Southern Route. The number of facilities within the ROW does not necessarily indicate relocation of these facilities, but would be addressed on a location-specific engineering analysis for safety issues. In general, there would be more impacts to residences and businesses along the Southern Route.

The four criteria associated with land use: commercial/industrial, residential, undeveloped land and park/school/designated open space were evaluated to generally characterize the type of uses of the land immediately adjacent to the route. For this analysis, all land along the route was segregated into one of these four categories. Golf courses were included in the commercial/industrial category and agricultural land use was included in the undeveloped land category. Park/school/municipal land use includes major rivers crossings, land identified as open space and land adjacent to schools and parks. In general, there would be more impacts to these land uses along the Southern Route, because two corridors would be impacted instead of one corridor for the Northern Route as shown in Table 4-8.

A visibility analysis was completed for each route segment based on a desktop evaluation using aerial photography and a GIS database to determine proximity to residences and businesses and location of road crossings. Some field verification of the routes to check visibility was completed, but the analysis was based primarily on a desktop evaluation. A digital terrain analysis was not part of this analysis. A visibility rating was assigned to portions of the segment based on the length of the line that was considered to have a high (5), medium-high (4), medium (3), medium-low (2), or low (1) impact. These

ratings were determined by the presence of residences, businesses, and roads within a 1/4-mile of the line. A home located within 1/4-mile with an unscreened view resulted in a high impact (5), a business with an unscreened view resulted in a medium impact (3), and a road with an unscreened view resulted in a medium-high impact (4). If the proposed line would be built parallel to an existing transmission line, these impacts were all lowered by a value of 2 (i.e., homes received a medium rating, businesses a low rating, and roads a medium-low rating). Thus, for this analysis, all portions of the segment were rated either a 1, 2 or 3 because the proposed line parallels existing transmission lines. Also, to account for portions of the corridor where the proposed 345-kV structures would be significantly taller than the existing structures in the corridor, the visibility ratings were multiplied by 1.5. This was applicable to the entire Northern Route and on the Southern Route from Hampden Junction to Ludlow Substation. The Southern Route between South Agawam Junction and Hampden Junction is proposed to have H-Frame structures that are not significantly taller than the existing 115-kV structures. This approach also recognized that if the Southern Route is used, there would be no 345-kV structures on the northern corridor between Agawam and Ludlow Substations with the 115-kV improvements only, and therefore the 1.5 multiplier was not used. It was assumed the terrain or vegetation would typically block the visibility of the line beyond a quarter of a mile and that 100 feet of trees between the transmission line and residences, businesses or roads would sufficiently block the view of the transmission line such that visibility would be negligible. In cases where two or more features (i.e., residences, roads or businesses) were visible within a 1/4-mile of a segment, the highest rating was assigned. Once a rating was assigned, the lengths of the line considered having a medium, medium-low, or low impacts were multiplied by the rating. These values were then added together to determine the overall visibility rating for a particular segment. The overall rating was then divided by 10,000 to simplify the relevance of the data. In this case, the Northern Route had a visibility rating of 50.7 and the Southern Route had a visibility rating of 67.5. As noted previously, since the Southern Route is impacting two corridors versus one for the Northern Route, it is not surprising that the Southern Route would have more of an impact on visibility.

The final three criteria that are related to environmental/cultural resources impacts are the following: length through streams or wetlands, length through environmentally sensitive areas and potential impacts to cultural resources. The length through streams or wetlands is approximately 6.2 miles for the Northern Route and 12.8 miles for the Southern Route. The length through environmentally sensitive areas is approximately 7.8 miles for the Northern Route and 20.5 miles for the Southern Route. The greater impact for the Southern Route is expected because it would be impacting two corridors.

The potential impacts to cultural resources analysis was similar to the visibility analysis based on information provided by cultural resources subcontractors in Connecticut (Raber Associates) and Massachusetts (UMass Archeological Services). A sensitivity rating was assigned to portions of the segment based on the length of the line that was considered to have a High (3), Medium (2), No /Low (1) predicted sensitivity for archaeological resources. Once a rating was assigned, the lengths of the line considered having a High, Medium, No /Low predicted sensitivity were multiplied by the rating. These values were then added together to determine the overall sensitivity rating for a particular segment. The overall rating was then divided by 10,000 to simplify the relevance of the data; in this case the Northern Route had a sensitivity rating of 39.2 and the Southern Route had a sensitivity rating of 68.3. As noted previously, since the Southern Route is impacting two corridors versus one for the Northern Route, it is expected that the Southern Route would have more of a potential impact on cultural resources.

Tables 4-5 and 4-6 present the unweighted and weighted ratio-scoring respectively, for the Northern and Southern Routes associated with the GSRP. These tables present the integrated Project scoring by including the 345-kV and 115-kV improvements for both route options. To address the issues with potential bias associated with scoring of different criteria, the Project Team utilized a ratio of the lesser result to the greater result for the two route options, assigning a score of one (1) to the greater result. Lower scores are better in this analysis. The weighted table allowed the Project Team to assign higher weights, with a range of 1 to 5, to evaluation criteria that were deemed to be of higher significance than other criteria.

Table 4-5: Unweighted Common Data Range Ratio-Scoring for 345/115-kV Line Routes

Evaluation Criteria Metrics	Northern Route Ratio-Score	Southern Route Ratio-Score
Total Length (Miles)	0.61	1.00
Railroad Crossings (Number)	0.50	1.00
Stream Crossings (Number)	0.67	1.00
Length NOT paralleling existing linear facilities	n/a	n/a
Length through private easement	n/a	n/a
Length of ROW expansion	0.71	1.00
Area of ROW expansion	0.71	1.00
Residences within ROW (Number)	0.92	1.00
Residences within 100 feet of edge of ROW (Number)	0.74	1.00
Residences within 101 to 300 feet of edge of ROW (Number)	0.68	1.00
Businesses within ROW (Number)	0.00	1.00
Businesses within 100 feet of edge of ROW or centerline (Number)	0.85	1.00
Businesses within 101 to 300 feet of edge of ROW (Number)	0.72	1.00
Public Facilities within 300 feet of edge of ROW (Number)	0.67	1.00
Public Facilities within 301 to 1,200 feet of edge of ROW (Number)	0.50	1.00
Length by land use (Commercial/Industrial)	0.66	1.00
Length by land use (Residential)	0.70	1.00
Length by land use (Undeveloped Land)	0.47	1.00
Length by land use (Park/School/Open Space)	0.83	1.00
Visibility (Rating)	0.75	1.00
Length through stream or wetland	0.48	1.00
Length through environmentally sensitive area	0.38	1.00
Cultural resources predictive modeling analysis (Rating)	0.57	1.00
TOTAL	13.12	21.00

Table 4-6: Weighted Common Data Range Ratio-Scoring for 345/115-kV Line Routes

Evaluation Criteria Metrics	Weight	Northern Route Ratio-Score	Southern Route Ratio-Score
Total Length (Miles)	5	3.03	5.00
Railroad Crossings (Number)	2	1.00	2.00
Stream Crossings (Number)	1	0.67	1.00
Length NOT paralleling existing linear facilities	4	n/a	n/a
Length through private easement	4	n/a	n/a
Length of ROW expansion	4	2.83	4.00
Area of ROW expansion	4	2.85	4.00
Residences within ROW (Number)	4	3.67	4.00
Residences within 100 feet of edge of ROW (Number)	3	2.21	3.00
Residences within 101 to 300 feet of edge of ROW (Number)	2	1.35	2.00
Businesses within ROW (Number)	3	0.00	3.00
Businesses within 100 feet of edge of ROW or centerline (Number)	2	1.70	2.00
Businesses within 101 to 300 feet of edge of ROW (Number)	1	0.72	1.00
Public Facilities within 300 feet of edge of ROW (Number)	4	2.67	4.00
Public Facilities within 301 to 1,200 feet of edge of ROW (Number)	3	1.50	3.00
Length by land use (Commercial/Industrial)	1	0.66	1.00
Length by land use (Residential)	4	2.79	4.00
Length by land use (Undeveloped Land)	3	1.42	3.00
Length by land use (Park/School/Open Space)	5	4.17	5.00
Visibility (Rating)	2	1.50	2.00
Length through stream or wetland	3	1.45	3.00
Length through environmentally sensitive area	3	1.14	3.00
Cultural resources predictive modeling analysis (Rating)	2	1.15	2.00
TOTAL		38.48	61.00

Based on the unweighted and weighted evaluation of the criteria scoring, the Northern Route is superior to the Southern Route.

4.6.4 Cost Estimates

Cost estimates for the Northern Route and Southern Route were developed for each Project segment by WMECO. The cost estimates are given in the third and fourth columns (designated 6n North and 6n