ENBRIDGE LINE 5 WISCONSIN SEGMENT RELOCATION PROJECT
22-P-216493

Executive Summaries of:

Construction Assessment: Sediment Discharge Modeling Report
Operations Assessment: Oil Spill Report

Enbridge Line 5 Segment
Relocation Project
Wisconsin

22-P-216493
Executive Summaries of Operations
and Construction Assessments
Final

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Preface

Enbridge has proposed the Line 5 Wisconsin Segment Replacement Project (referred to herein as the L5WSRP, Relocation, or Project) to relocate the existing Line 5 pipeline (Line 5) around the Bad River Reservation ("the Reservation") in northern Wisconsin. RPS Group PLC (RPS) and DNV GL USA, Inc. (DNV) were retained by Enbridge Energy, Limited Partnership (Enbridge) to prepare two documents associated with the L5WSRP: (1) a Construction Assessment, focused on assessing impacts to waterways from sediment discharge associated with construction-related activities; and (2) an Operations Assessment focused on the potential likelihood and consequence of oil spills. The Executive Summary of the Operations Assessment (prepared by RPS and DNV) and the Construction Assessment (prepared by RPS) are provided within.

The Construction Assessment report (the "Sediment Discharge Modeling Report") was prepared by RPS to model sediment releases resulting from pipe installation methods proposed for the L5WSRP. The modeling and results presented herein support a Construction Assessment. Sediment releases were modeled spanning a range of representative locations, environmental conditions, and types and volumes of release. Together, these modeling assessments convey an understanding of the range of potential effects from the Relocation's installation.

The Operations Assessment report (the "Oil Spill Report") was prepared by RPS and DNV to: (i) provide a probability assessment to quantify the likelihood of different release volumes that could occur on each of the routes; (ii) model the hydrocarbon trajectory, fate, and effects from a suite of release scenarios at certain crossing locations; and (iii) to simulate hypothetical releases along each pipeline route being studied to allow for a comparison of receptors. The quantitative analyses in the Oil Spill Report are laid out in a series of Technical Appendices. A total of 13,665 hydrocarbon releases were modeled for the proposed pipeline and route alternatives, spanning a wide range of locations, environmental conditions, seasonality, type and volume of release, and emergency response mitigative measures. Together, the spill probability and consequence assessments convey the overall "risk" associated with the pipeline and allow for comparisons between route alternatives and an understanding of the range of potential effects from the Relocation's operation.

Construction Assessment

KEY POINTS:

Sedimentation Impacts from Pipe Installation Are Low, Localized, and Limited in Time.

For trenched methods at water crossings, the proposed installation activities would be expected to have a lesser magnitude and more brief effect on Total Suspended Solids (TSS) in the water column than storm-related events. As compared to storm-related events that can cause TSS values to exceed hundreds to thousands of mg/L over periods of time that are longer than theses installation periods, trenched crossings would be expected to have TSS concentrations near the installation site in the low hundreds of mg/L, which would decrease below 19 mg/L by approximately 1,000 meters downstream of the crossing and last only ~4-10 hours per construction phase.

Successful horizontal directional drill (HDD) methods will have no sedimentation impacts; however, TSS concentrations resulting from hypothetical inadvertent returns were modeled. TSS concentrations near the HDD release site would be expected to be high (more than 20,000 mg/L), but would decrease to 10-300 mg/L at a point 500-1,000 meters downstream. No modeling scenario (for trenched or HDD crossings) would result in TSS levels exceeding 19 mg/L at farther downstream locations, including any portion of the Reservation.

OVERVIEW OF THE ANALYSIS

RPS used the SSFATE model to assess numerous hypothetical release scenarios during the construction process. SSFATE is a computational sediment dispersion modeling tool that was developed jointly by RPS (previously ASA) and the U.S. Army Corps of Engineers to simulate sediment resuspension and deposition. This model has been used extensively in the United States and internationally to assess the potential impacts of the release of sediments.

- Sediment dispersion modeling of 18 hypothetical release scenarios was performed in SSFATE to assess TSS within the water column from: 1) installation in small-to-medium watercourses for open trench methods; and 2) installation in large watercourses for potential inadvertent returns resulting from a failed HDD under a water crossing. An inadvertent return would involve releases of bentonite drilling fluid, frequently referred to as a “frac out.” This modeling assessed the magnitude and timing of potential water column concentrations of TSS on top of background values (referred to as “in exceedance of”) and the depositional footprint of sediments that may be caused by discharged sediment from installation of the relocated pipeline as it crosses the range of water bodies along the Project alignment.
    - While dry trenching will result in sediment discharge into the water column, the occurrence of an inadvertent return is unlikely (i.e., may never occur), given the planned drilling pressures.
    - The background concentration of TSS within a watercourse can naturally vary greatly (several orders of magnitude) over the course of a year. Storm-related events can cause TSS to exceed hundreds to several thousands of mg/L over periods of time that are longer than planned installation periods.
    - While WDNR holds a water quality standard of 40 mg/L for TSS associated with construction dewatering activities, RPS calculated a more conservative (i.e., more protective) representative threshold of 19 mg/L TSS (based upon the measured relationship between turbidity and TSS within the Bad River) that correlates to the Bad River Band’s water quality standard for turbidity within the exterior boundaries of the Reservation.
    - The downstream extent, duration, and magnitude of elevated TSS concentrations and resulting deposition were assessed for a matrix of 18 scenarios, which captured the variability within watercourse sizes, river flow conditions, and sediment characteristics (i.e., particle or grain sizes). The TSS plumes were expected to be temporary in any given location and would therefore not pose a permanent impact.
- Trenched installations:
    - Crossings in small and medium watercourses were expected to be completed within 20-32 hours, respectively, and would actively release sediment for a total of 4 hours (small) and 10 hours (medium). Associated increases in TSS concentrations would generally follow the same timing of the installation and removal activities, quickly attenuating after the sediment disturbances ceased.

- The sediment loads in the watercourses produced initially larger TSS concentrations near the installation site (up to 132 mg/L) due to the conservatively large assumed amount of sediment that was resuspended and the shallow watercourse depths (1-3 ft deep).
- TSS concentrations predicted downstream of the trenched installations (e.g., 500-1,000 m) were on the order of <1 to 30 mg/L for the small watercourse and <1 to 10 mg/L for the medium watercourse. The levels at 1,000 m distance were consistently below typical background TSS conditions in the water column for the anticipated construction period of June-August. The proposed installation activities would be expected to have a lesser magnitude and more brief effect on TSS in the water column than storm-related events, which would be expected to have a greater and more enduring effects on TSS in the water column than the proposed installation activities.
- By 1,000 m (or 1 km) downstream, the TSS predictions were below the more conservative calculated threshold of 19 mg/L. This threshold exceedance lasted on the order of tens of minutes to hours at any specific location over the course of approximately one day as the TSS was transported downstream.
- TSS concentrations were predicted to be well below a threshold of 19 mg/L for all watercourses represented by the simulated small and medium watercourse scenarios by the time any suspended sediments reached the Reservation boundary.

- HDD installations:
  - No sedimentation will result from a successful HDD.
  - For hypothetical inadvertent returns into a large watercourse:
    - The discharge into the watercourse produced initially large TSS concentrations near the release site (more than 20,000 mg/L) due to the large volume of drilling fluid (bentonite) that was released in a relatively short period of time. The largest concentrations were predicted for the larger release volume (Final Ream Pass) scenario under low river flow conditions, where dilution and dispersion would be the lowest.
    - TSS concentrations predicted at distances 500-1,000 m downstream were on the order of 10-300 mg/L, which is smaller or of similar magnitude to background conditions and those typically caused by storm-related events.
    - By 2,000 m (or 2 km) downstream, TSS predictions for all scenarios were below the more conservative calculated threshold of 19 mg/L. This threshold exceedance lasted on the order of hours at any specific location over the course of one to two days as the TSS was transported downstream.
    - Nearly all of the discharged bentonite eventually settled within the model domain (the Bad River), regardless of river flow rate. The greatest deposition occurred near the release location, as well as toward the center of the river channel. For the Final Ream Pass scenarios with greatest sediment loads, deposition above the thickness thresholds extended slightly further and had greater extent than the Pilot Hole scenarios. The distance and area covered by deposition above 5-10 mm thickness was greatest for the low flow scenario, particularly near the simulated release

location, where deposition at this level extended up to 40 m downstream. While the model predicted very large areas of deposition less than the 0.1 mm reporting threshold, no deposition above that threshold was predicted past 400 m downstream, well upstream of the Reservation boundary.

- Because the Proposed Route crosses the various watercourses at distances between 2.1 km and 23.9 km (1.3 and 14.9 miles) upstream of the Reservation boundary, TSS concentrations were predicted to be below the more conservative calculated threshold of 19 mg/L by the time any suspended sediments from trenching installations (or an inadvertent return on the Bad River) reached the Reservation boundary.

Operations Assessment

KEY POINTS

- Probability of Release is Extremely Remote: The probability of failure (POF) for the Proposed Route is 3.96×10^{-6} failures per mile per year for all release sizes, and 6.34×10^{-8} per mile per year for a Full-bore Rupture (FBR). This is equivalent to the extremely remote probability of a failure occurring somewhere on a given mile of pipe of 1 in 252,000 for any given year and an FBR of 1 in 15,700,000 for any given year. The POF of any size release at the Bad River crossing ranges from 1.25×10^{-7} to 4.59×10^{-7} depending on the route, and at the White River crossing ranges from 2.92×10^{-7} to 8.34×10^{-7} depending on the route. The overall POF for any release at a waterbody crossed by the Relocation is extremely remote, in all cases less than 1 in 6,990,000 in any given year.
- Downstream Movement and Potential for Effects Following a Release are Substantially Reduced by Emergency Response Activities: As modeled, the successful implementation of emergency response mitigation measures following a hypothetical release of oil substantially reduced the downstream progression of oil for even the largest volumes simulated (full bore ruptures of 9,874 bbl on the Bad River and 8,517 bbl on the White River). In these scenarios, between no oil and surface floating oil of a thickness no greater than a patchy and discontinuous dull brown (1-10 µm or microns) or rainbow sheen (0.1-1 µm) were predicted downstream for brief periods of time (less than a few hours). For comparison, a bacterium is 1-10 µm in size, a strand of spider web silk is 3-8 µm, and paper is 70-80 µm thick. Successful containment and collection of released oil would reduce the concentration and duration of exposure to contaminants, which reduced the potential for effects.
- A Route Assessment and Receptor Analysis Comparison, Identified the Proposed Route as Most Favorable: The Proposed Route is considered to be the most favorable route based upon the relatively low number of receptors with the potential for impact following a release, a relatively shorter construction length, and a reduced potential to impact key receptors including the Reservation, wild rice, Lake Superior, and populated areas.

OVERVIEW OF THE ANALYSIS

RPS used a suite of modeling tools to assess numerous hypothetical release scenarios. DNV examined the POF of the proposed routes utilizing its proprietary pipeline probabilistic risk model. OILMAPLand and SIMAP are two separate computational oil spill modeling tools that have been developed by RPS to predict the trajectory, fate, and potential acute effects of released hydrocarbons on land and into water. These models have been used extensively in the United States and internationally to assess the potential impacts of oil spills.

Probability Assessment (Technical Appendix A)

- The probability assessment helps contextualize the likelihood of hypothetical spills along each of the route alternatives. Publicly available failure data, as well as DNV's proprietary probabilistic risk model, were utilized to estimate the Probability of Failure (POF) along the mainline pipe for the Proposed Route, as well as each route alternative (RA-01, RA-02, and RA-03). The POF of pipeline failures that would result in hydrocarbon releases at water crossings that were HDD crossings as well as open cut water crossings were also calculated.
- For all routes, the POF is extremely remote.
  - It is estimated that the POF, considering all commodities transported, for the Proposed Route of the L5WSRP is 3.96×10^{-6} failures per mile per year for all release sizes, and the POF of an FBR is 6.34×10^{-8} per mile per year. This is equivalent to the extremely remote probability of a failure occurring somewhere on a given mile of pipe of 1 in 252,000 for any given year and an FBR of 1 in 15,700,000 for any given year.
  - The POF of any size release at the Bad River crossing ranges from 1.25×10^{-7} to 4.59×10^{-7} depending on the route, and at the White River ranges from 2.92×10^{-7} to 8.34×10^{-7} depending on the route. The POF of any size release at any other water body crossed by the relocation using a shorter HDD is estimated to be lower than those predicted for these crossings. The POF of a release greater than 334 barrels at the Bad River Crossing ranges from 2.14×10^{-8} to 7.85×10^{-8} per year depending on route. The POF of a release greater than 334 barrels at the White River Crossing ranges from 4.99×10^{-8} to 1.43×10^{-7} per year depending on route. The overall POF for any release at a waterbody crossed by the Relocation is extremely remote, in all cases less than 1 in 6,990,000 in any given year.

Hydrocarbon Release Assessments (Technical Appendices B and C)

In Technical Appendices B and C, potential consequences were evaluated by simulating a range of hypothetical release volumes including 334 bbl (recent average release volume, or RARV), 1,911 bbl releases (historical accidental release volume, or HARV), and site-specific FBRs. The HARV was identified based on an analysis of the average release volume since 1985 from all pipelines that carry crude oil on the entire Enbridge Mainline System (PHMSA, 2017). The smaller-volume RARV was identified based on an analysis of release volumes of any reportable size (recorded as >5 gallons or >0.12 bbl) from 2010 to 2019 for all of Enbridge's liquids pipelines and a set of highly conservative assumptions intended to maximize hypothetical release volume. FBR volumes varied by location and route due to location-specific gravitational drain down, with the Existing route having a maximum value of 26,684 bbl, and the Proposed Route having a much smaller maximum value of 13,451 bbl.

Hydrocarbon Trajectory, Fate and Effects Assessment (Technical Appendix B)

- RPS used the SIMAP model to assess the range of downstream movement, behavior, timing, and potential for acute biological effects that may result from a full suite of hypothetical release scenarios where the Proposed Route crosses the Bad River and the White River. In total, a suite of 28 hypothetical release scenarios were evaluated in SIMAP. There was a specific focus on the potential for oil to reach the wild rice habitats in the vicinity of the Kakagon-Bad River Slough Complex and Lake Superior, which are located 22 river miles downstream of the White River crossing of the Proposed Route and 45 river miles downstream from the Bad River crossing.
- Generally, oil was predicted to be transported downstream as a large "slug" of oil that would evaporate quickly (totaling 35-50% of the released volume over the 4-day model simulation) and strand on both shorelines up to their holding capacity, where it would continue to evaporate, degrade, and be subject to Enbridge's Shoreline Cleanup and Assessment Technique (SCAT) program.
- Emergency response mitigation measures would be deployed at pre-identified (but flexible based upon the actual conditions at the time for any real-world event) Control Points on the White River and Bad River that would have the capacity to contain and collect oil.
    - As modeled, the successful implementation of emergency response mitigation measures following a hypothetical release of oil substantially reduced the downstream progression of oil for even the largest volumes simulated (full bore ruptures of 9,874 bbl on the Bad River and 8,517 bbl on the White River). In these scenarios, between no oil and surface floating oil of a thickness no greater than a patchy and discontinuous dull brown (1-10 μm) or rainbow sheen (0.1-1 μm) were predicted for brief periods of time (less than a few hours). For comparison, a bacterium is 1-10 μm in size, a strand of spider web silk is 3-8 μm, and paper is 70-80 μm thick.
    - The amount of oil on the surface of the water was predicted to be reduced to <0.1% of the release volume by the end of the 4-day simulations.
    - This generally prevented slicks from being able to reach the most downstream portions of the Bad River (north of Highway 2). Mitigation activities therefore limited the potential for oil to contact wetlands and wild rice habitats located in these downstream areas. Additionally, because surface oil was removed, downstream surface biological effects were substantially reduced in emergency response mitigated scenarios.
    - In a real-world response, any remaining surface oil sheens would be addressed by the deployment of additional equipment (e.g., set up at Highway 2). This may include additional containment and skimming resources, as well as additional tactics that were not modeled to minimize sheens (e.g., sorbents, pads, X-Tex fabric, pom-poms, etc.) and help capture submerged oil droplets.
- All scenarios (unmitigated and response mitigated) considering the smaller, though still conservatively large, release volumes of 334 bbl and 1,911 bbl at the Proposed Route crossings of the Bad and White Rivers were predicted to prevent whole oil (i.e., the insoluble fraction) from reaching the wild rice areas, Kakagon-Bad River Slough complex, and Lake Superior.
- Highly unrealistic unmitigated scenarios were modeled to illustrate baseline conditions where no response activities were considered or undertaken at all for a 4-day simulation. These artificial results provide hypothetical maximum extents of oil transport and contamination to provide a comparative

basis to assess the benefits of emergency response mitigation measures (e.g., reduced magnitude and extent of contamination, increased timing or prevention of contamination, and reduced potential for effects).

  - For these completely unmitigated scenarios in both the White River and Bad River, oil was predicted to take approximately 2 days, 3 days, or 4 days following a release for oil to reach Lake Superior under high, average, and low (wintertime, ice-covered) river flow conditions, respectively. Following a release, actual response mitigation activation would (as was modeled for the mitigated scenarios) begin at the pre-identified Control Points within 3.1 to 11 hours on the Bad River and 3.8-9.8 hours on the White River, based on Enbridge's maintained cache of available response equipment and tactics and conservative assumptions about the time needed to notify and activate trained responders, transport equipment and personnel and set up an active Control Point with containment and collection.

- Biological effects were assessed in SIMAP using the predicted trajectory and fate of hydrocarbon contamination to use the spatially and time-varying concentrations and duration of exposure to determine acute mortality following a release.
- Most of the surface and shoreline effects were predicted to occur in upstream areas, closer to the release locations, where the surface oil slicks were thickest and more continuous and caused the greatest potentials for shoreline exposure as well. From a risk perspective, following a release of oil, the largest consequences (i.e., greatest predicted magnitude, extent, and potential for biological effects) were associated with the lowest probability (i.e., least likely) spill volume (i.e., FBR releases) during unfavorable environmental conditions, where the spill was unrealistically allowed to continue for four days without any emergency response mitigation measures. Predicted effects were substantially reduced for smaller volume releases (more likely events, while still being unlikely) and when response mitigation was included at pre-arranged locations from Enbridge's emergency response plans (a more likely scenario than a completely unmitigated release). The most likely (and lowest consequence) release volumes (i.e., less than 10 bbl) were not assessed in this study.

Hydrocarbon Route Assessment and HCA Analysis (Technical Appendix C)

- RPS conducted a comparative ranking assessment of pipeline routes based upon high consequence areas (HCAs) and other areas of interest (AOIs) for each route alternative.
- A total of 10,088 hypothetical crude oil releases were simulated in OILMAPLand. This included 5,029 larger, FBR releases under high river flow conditions and 5,029 smaller, RARV releases under low river flow conditions. The hypothetical releases were simulated at 100-meter increments (and at every watercourse crossing) along each pipeline route to assess the overland and downstream movement and behavior of oil. Results of these simulations were used to determine whether specific receptors of concern (HCAs and AOIs) within the Project Area, would potentially be reached by any release. These results allowed for a direct comparison of routes to one another, based upon the numbers of susceptible receptors that have the potential to be impacted following a release and the total length of pipeline that may result in these impacts. The FBR analysis presented a conservative basis for assessing the upper range of susceptible resources (HCAs and AOIs), relevant for routing decisions,

while the RARV analysis presented a lower range of potential impacts, relevant to contextualize more limited transport potential for smaller volume releases under lower river flow conditions.

- The Proposed Route was considered the most favorable route based upon the relatively low number of receptors with the potential for impact following a release, a relatively shorter construction length, and a reduced potential to impact key receptors including the Reservation, wild rice, Lake Superior, and populated areas.
- RA-02 was considered unfavorable because it had the highest-ranking score, which means that relative to the other routes, it had the highest potential to impact the largest number of HCAs and AOIs following a release along the pipeline.
- RA-01 had the lowest overall ranking score. Although the route became less favorable when further consideration and weighting was applied for specific downstream receptors including the Reservation, wild rice areas, and Lake Superior, to which RA-01 is the closest route alternative.
- RA-03 was considered unfavorable because of guaranteed and potential impacts to HCAs and AOIs. While the route alternative is outside of the Bad River watershed, potential impacts move to previously untouched HCAs and AOIs including populated areas, the largest number of wild rice areas outside the Reservation, and numerous State and Federal Lands (e.g., state forest and fishery areas, large portions of the Chequamegon-Nicolet National Forest, and the Saint Croix National Scenic Riverway). RA-03 also has the longest overall length of pipeline, which would 1) increase the likelihood of a release, 2) maximize the potential land surface susceptible to a release, 3) increase the total receptors that may be affected, and 4) maximize the guaranteed effects from construction activities including 86.5 km (53.7 mi or 52.3% of RA-03 total length) within the Chequamegon-Nicolet National Forest, because it would require the longest length of new pipe installation (163.4 km or 101.5 miles).
- RA-03 has the longest overall length among the route alternatives, followed by RA-02, the Proposed Route, and finally RA-01, which would be the shortest

A total of 3,579 additional hypothetical FBR crude oil releases were simulated in OILMAPLand. The hypothetical releases were simulated at 10-meter increments from the banks of the Bad River and White River inland for each route alternative crossing. This high-resolution segment analysis was conducted to determine the total length of pipeline at specific watercourse crossings that would have the potential for FBR releases to enter that crossing directly. The length of the potential impact segment for releases that reached the river at each crossing varied from 90-600 meters (295-1969 ft; sum of left bank and right bank) and was used in the Probability Assessment to determine the likelihood of a release at each watercourse crossing.