The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Clark B. Freise, Assistant Commissioner

Distributed Electronically

May 15, 2017

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Room 1A
Washington, DC 20426

RE: Comments on Study Reports and Study Modification Requests for FERC No. P-1892 (Wilder), P-1855 (Bellows Falls) and P-1904 (Vernon)

Dear Secretary Bose:

The New Hampshire Department of Environmental Services (NHDES or Department) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. NHDES is also responsible for establishing and administering surface water quality standards for New Hampshire.

In accordance with the revised process plan and schedule issued by the Federal Energy Regulatory Commission (FERC) on February 22, 2017[1], NHDES is submitting the following comments and/or requested study modifications regarding study reports filed by TransCanada Hydro Northeast Inc. (now Great River Hydro LLC or GRH) for the following three hydroelectric projects on the Connecticut River:

Wilder Project (FERC No. 1892),
Bellows Falls Project (FERC No. 1855),
Vernon Project (FERC No. 1904).

As indicated at the end of this letter, please note that the Department will likely submit a separate letter supporting comments and study modification requests prepared by the other natural resource agencies, once they are filed with FERC.

<u>Studies 2 & 3- Riverbank Transect and Riverbank Erosion Studies</u>

The objectives of studies 2 and 3 were to:

- Monitor riverbank erosion at selected sites in the impoundments and project-affected riverine sections below Wilder and Bellows Falls dams;
- Determine the location of erosion in project-affected areas and compare these locations with previously compiled erosion maps (e.g., Kleinschmidt, 2011; Simons et al., 1979);
- Characterize the processes of erosion (e.g., piping, slumping, and slips);

[1] The FERC schedule issued on February 22, 2017 requested comments and/or requested study modifications on study reports 2, 3, 6, 9, 10, 14, 15, 17, 18, 19, 21, 22, 23, 24, 25, 27 and 33.

- Ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, and water-level fluctuations related to project operations); and
- Identify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat).

Executive Summary

Comment 1: The Executive Summary should be revised to be consistent with the comments and requested revisions below. As indicated, the Department has concerns with several of the analyses and therefore questions some of the results and conclusions.

Comment 2: The fourth paragraph on page ES-1 states "The unstable banks are comprised of three categories used to characterize bank conditions on over 250 miles of mapped bank: eroding, vegetated eroding, and failing armor." As there is some disagreement over the definition of an unstable bank used in the analyses (see comment 4 below), a sentence should be added to remind the reader that the definition does not include armored banks or banks with notching unless there were other signs of erosion.

5.6.4 Mapping Results

Comment 3: p. 81. To show where the 37% of river bank with notching occurred, the Department requests that a graph similar to Figure 5.6.4-2 be prepared and included in the report showing the percent of bank with notching on unstable and stable banks (as defined in the report).

5.6.5a Spatial Variations in Erosion

Comment 4: This section discusses results of the erosion ratio method which was initially developed by Field Geology Services, LLC to identify potential causes of erosion in the Turners Falls Impoundment, and which is not a widely accepted method (p. 103). Limitations of this approach should be clearly explained in this section and in the Executive Summary. A few examples of what the Department views as limitations, concerns and reasons why some of the results and conclusions are questionable, are provided below.

a. The method only considers banks that were categorized as eroding, vegetated eroding or failing armor It did not include banks that were armored or banks with notching unless other signs of erosion were present. This could skew the results and conclusions regarding the effect of project operation on erosion since notching (the first step in the erosion cycle) was observed along 37% of the river banks (and probably more – see p. 81) and since notching corresponds to the median WSE fluctuation height (see Comment 4.b, and 9 below). It is the Department's opinion that notching and armored banks (which are armored because they were unstable) should be included in the analysis or included in an additional analysis. Inclusion of notched banks would account for banks with a higher potential for erosion and inclusion of armored banks would account for banks which likely experienced significant notching in the past, both of which could be a result, at least in part, of project operation.
b. The method ignores the fact that notching (the first step in the erosion cycle) corresponds to median WSE fluctuation heights along river banks (see Comment 9 below). This by itself suggests that project operation plays an important part of the erosion cycle and why exclusion of all notched banks in the analysis likely skews the results and conclusions.
c. The method is based on data collected for this study and represents a "snapshot" in time. Banks which were not defined as stable for this study (such as banks with notching), might be unstable in the future. This is another reason why the Department believes that all notched banks should be included in the analysis as it would capture banks which are likely to be most prone to further erosion in the future.
d. The method states that to ".. prevent interpreting results potentially skewed by including short lengths of bank, the analysis of erosion ratios was limited to only those 0.5-foot increments that occur along 10% of the banks.." (p. 102). "With such short bank lengths, high erosion ratios might result from a small amount of erosion that could be the result of numerous factors other than WSE fluctuations, including local factors such as flow alteration around islands or bars, tributary confluences, or valley constrictions" (p.102). When this rather arbitrary cutoff of 10% was applied to the results, the study

concludes that “greater magnitudes of WSE fluctuation are not associated with greater levels of erosion” (p. 102). This seems counterintuitive to what one might expect. The Department requests that the data be interpreted without the 10% cutoff since the same argument could be made for any of the other banks.

e. Because not all armored banks were included in the analysis, the study indicates that the erosion ratio for inside river bends is more than for outside bends which is counter to what might be expected (p. 84).
f. The report states that since “the erosion ratio approach for identifying potential causes of erosion has not been widely used, the erosion data was analyzed using a multiple logistic regression...”(p.103). Candidate predictor variables included bank height, median WSE fluctuation, shear stress (at low and high flows averaged across full channel width), presence of armoring or forest vegetation and bend geometry (inside, outside, or straight) (Appendix E, p. E-1). Results and conclusions drawn from the analysis are questionable since the observations are not independent, which is “a violation of one of the usual assumptions of regression”(Appendix E, p. E-2). The Department requests that the study explain how this regression assumption “violation” could impact the results. Results and conclusions are also questionable because they did not include all banks with armor and notching (the first step in the erosion cycle – see Comment 9 below). As previously stated, the Department recommends that the analysis include all banks with notching and armor.
g. The logistic regression included shear stress as a predictor of bank instability (p. 103). Channel average shear stress was derived from Study 4. The channel average shear stress was determined for each model cross section (node) and then interpolated for every foot between nodes (p. 103). Critical shear stress needed to mobilize sediment along the banks was not determined because “Collection of the detailed topographic and particle size data along 250 mi of riverbank needed for usable values for near bank shear stress and critical shear stress were beyond the scope of this study.” The Department requests that the report include more information regarding how channel average shear stress was calculated and how it typically compares to near bank shear stress. The fact that critical shear stress was not calculated for comparison to the average channel shear stress adds another degree of uncertainty with the results and conclusions. The Department notes that Section 6.1 (Flow Velocities and Erosion) includes an analysis of six of the erosion sites where, instead of shear stress, the minimum flow needed to meet a literature based threshold velocity of 2 ft/s to cause sediment entrainment was determined. The Department requests that the areas along the 250 mi of riverbank where the average velocities exceeded the 2 ft/s threshold at the maximum station discharge be described and presented in the report. This information should be available from the modeling conducted to determine the shear stress. In addition the report should include a discussion of how the logistic regression results would be affected if areas with velocities equal to or greater than 2 ft/s were included as a predictor variable instead of average shear stress. Modeled input and output should also be provided.

5.9 Hydraulic and Operations Modeling

Comment 5: An analysis is presented showing modeled velocities in the impoundments for various flows and WSEs (p. 121-123). Results for the impoundment are presented in Table 5.8-1 on p.123 and show that velocities can increase from 36 to 400% in the impoundments when drawdowns are .implemented to accommodate high flows. The Department requests the following:

a. That the report explain why the lower elevations and higher flows shown in Table 5.8-1 were selected and if they represent worse case conditions (i.e., if lower elevations and higher flows were selected, the increase in velocities would be even greater); and
b. that the report and analysis also include calculation and presentation of velocities and velocity differences at stations downstream of the dams.

6.1 Flow Velocities and Erosion

Comment 6: An analysis is presented that compares predicted average velocities from the Study 4 hydraulic model with literature values of velocity thresholds to cause sediment entrainment (2 to 3 ft/s) at three impoundment transects and three riverine transects. The Department requests the following:

a. That the rows labeled "Minimum flow needed for threshold velocity [c]" in Tables 6.1-1 and 6.1-2 be revised to "Minimum flow needed for threshold velocity of 2 ft/s [c]" to clarify that the threshold velocity of 2 ft/s was used;
b. that a discussion be included that compares near bank measured velocity at each transect to the average channel velocities used in the analysis;
c. that a similar analysis be conducted for the rest of the 21 transects analyzed in this study; and
d. that model input and output be provided.

Comment 7: On p. 127, the report states that based on literature a reasonable range of threshold velocities to cause sediment entrainment is 2 to 3 ft/s. Based on a review of the NRCS (2007) reference provided in the report a threshold velocity of 2 ft/s (versus 3 ft/s) seems more reasonable to the Department at this time.

Comment 8: Based on the excerpts below (bullets) it was the Department's understanding that the study would include shear stress analyses at each of the 21 transects to determine if the sediments were likely to be mobilized under normal and high flow operation. A screening level shear stress analysis was conducted and analyzed by logistic regression for much of the study area (see Comments 4f and 4g above) but did not include values for critical shear stress needed to mobilize sediment because "Collection of topographic and particle size data along 250 mi of riverbank needed to for usable values for near bank shear stress and critical shear stress was beyond the scope of this study" (p. 104). The Department requests an explanation as to why information needed to conduct a more complete shear stress analysis (including calculation of the critical shear stress based on site data) was not collected at each of the 21 transect sites.

- On page 5 of the study report, under methods that were employed, the following is stated "Analyze hydraulic modeling data to provide information on flow, velocity, stage (water surface elevation or WSE) and shear stress impacting riverbanks in the study area". In their response to study plan comments dated October 31, 2016, TransCanada stated that "Shear stress analysis (a function of velocity) will be presented in a manner similar to WSE fluctuations. We will further include a statistical analysis of the data using logistic regression as recommended in the Princeton Hydro memo (included in CRWC comment letter)".
- On page 3 of Appendix B in FERC's November 29, 2016 Determination on Requests for Study Modifications and New Studies, FERC states the following : "TransCanada indicates that it will conduct shear-stress and velocity analyses using the one-dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) model in the revised report for studies 2 and 3. TransCanada states that the results of the HEC-RAS modeling and a logistic regression statistical analysis that it proposes will be sufficient to identify the likely causes of erosion at the 21 erosion monitoring sites; therefore, there is no need to sue the River 2D model. " On page 4, FERC states " when TransCanada files its revised study report in January 2017, we will review results, including the HEC-RAS modeling and regression analysis, and as appropriate, consider the need for additional analysis, including use of the River2D model."

Section 6.6 Study Conclusions:

Comment 9: The study concludes the following (p. 164 and 165):

- Erosion within the study area is the result of multiple causal mechanisms working in concert to sustain the cycle of erosion;
- Where erosion occurs and how quickly the cycle of erosion progresses may have more to do with variations in natural bank characteristics throughout the study area rather than on causal forces acting on the banks;
- Bank heights and geomorphic surface and bank composition exert the strongest control on where erosion occurs;

- Tractive forces generated by flood flows are primarily responsible for removal of sediment originating from slides, flows and topples resulting from notches and overhangs forming at the base of the banks;
- While other processes such as waves and seepage forces created by the project related WSE fluctuations may exert some control on the cycle of erosion by potentially contributing to the destabilization of the banks, they cannot be considered as resulting in excessive erosion, that negatively impacts other resources since ultimately the continuation of erosion depends on flood flows that sustain the cycle of erosion.

The Department recognizes that there are multiple factors influencing erosion and high flows are a major factor with regards to removing excessive amounts of bank stabilizing material at the base of an eroding banks. While WSE fluctuations associated with normal plant operations alone may not immediately result in excessive erosion it is the Department's understanding that they do contribute to notching and bank destabilization, and in some cases potential movement of sediment (see last bullet below), which can then lead to excessive erosion especially during high flows. In other words, frequent WSE fluctuations caused by Project operation can significantly impact the erosion cycle by making some banks more prone to excessive erosion, by entraining sediments (i.e., at Bellows Falls and Vernon- see last bullet below) and by potentially increasing the rate and magnitude of erosion (because they are more susceptible). This should be included in the conclusions and Executive Summary and is supported by the following:

- WSEs related to normal project operations under no-spill conditions were found to be consistent with notching and overhangs observed at the bases of 8 of the 21 (38%) of the monitored banks at some point during the two-year monitoring period (p. 138 and 139).
- Approximately 37% (93 miles) of the 250 miles of banks that were studied were observed with notching at the base (p. 81).
- Although the exact elevation of the notching along the 93 miles of banks with notching could not be determined, given that the observations occurred during no spill conditions and recorded all notches/overhangs at the base of the bank – and largely near the water level – it can be assumed that most, if not all, of the mapped notching occurs within the range of elevations associated with normal project WSE fluctuations. (10/31/16 TC Response to Comments[2], comment 12, p. 6 and 7). [Note, the Department requests that this important finding be added to the text (i.e., p. 81 regarding notching) and Executive Summary).
- Notching may have initially triggered instability on the eroding, vegetated eroding, and failing armor banks even where notching was not mapped, but is no longer evident due to the presence of other erosion types that have obscured evidence of notching (p. 81);
- "The dominant erosional mechanism at a given site and the overall susceptibility of the bank material to erosion is dependent on many factors including the height, cohesiveness, and stratification of the sediment" (p. 10). "Banks composed of non-cohesive sediments such as sand and gravel are the most susceptible to erosion..." (p. 10). "The bank sediments at the monitoring sites, representative of the study area as a whole, are nearly ubiquitously comprised of fine-grained and unconsolidated floodplain or glaciogenic sediments that are particularly prone to erosion..." (p. 124).
- "Similar to changes in pore water pressures .... water level fluctuations can also create seepage forces, particularly in finer grained sediments, because of the hydraulic gradient that results between the higher groundwater surface in the bank sediments and the lowered river stage" (p. 12). While direct measurements of seepage forces were not made, even small WSE fluctuations can still contribute to bank instability (p. 138). "The development of only minor pore-water pressures is sufficient to trigger mass failures in fine-grained weakly cohesive soils" (p. 12).
- Table 6.1-2 on p. 129 indicates that the critical threshold velocity of 2 ft/s is exceeded at flows less than the maximum station flow at the Bellow Falls and Vernon projects.

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[2] Letter from TransCanada to FERC dated 10/31/16 regarding "TransCanada Hydro Northeast Inc.'s June 17, 2016 and August 1, 2016 Updated Study Reports – Response to Comments.

Based on the above and the fact that notch height is observed and concluded by GRH to correspond to the height of WSEs associated with normal Project operation, it follows that if the frequency and magnitude of WSEs were reduced, daily changes in seepage forces and the rate and magnitude of notching would be reduced, which in turn would likely reduce the rate and magnitude of excessive erosion when high flows occur. In addition, the magnitude and frequency of high velocity discharges (due to WSE fluctuations) downstream of the dams would also decrease, thereby decreasing the potential and frequency for erosion occurring downstream. For example, according to the final license applications recently filed for each of the three projects, the maximum hydraulic capacity of the turbines at Wilder, Bellows Falls, and Vernon are exceeded approximately 12%, 28% and 22% of the time respectively. It is the Department's understanding that these percentages are based on average daily flows and would be less if they were based on a shorter time interval (such as hourly or sub-hourly) because it would capture sub-daily flow increases due to WSE fluctuations caused by Project operation. Assuming power is generated and daily or sub-daily water surface fluctuations occur any time flows are less than the maximum turbine hydraulic capacity at each project, this suggests that if the projects were operated in a steady pond / run-of-river mode, the annual frequency of daily and sub-daily water surface fluctuations, of changes in bank seepage forces and of changes in velocities downstream of the dams could be significantly reduced by over 72% to 88% (i.e., (263 to 321 days per year) compared to existing Project operation under normal conditions.

Based on the above, the Department requests that the report include a discussion (such as the one above) that describes how operation of the projects in a steady pond / run-of-river mode, which would reduce the frequency and magnitude of daily and sub-daily WSE fluctuations, could potentially benefit efforts to control erosion (including the rate of erosion) along the Connecticut River. This should be included in the body of the report, the conclusions as well as the Executive Summary.

Department Support of Comments and Study Modification Requests of Other Agencies

In addition to the comments and study modification requests described above, the Department also expects to submit a letter of support for comments and study modification requests submitted by the following agencies after they are filed with FERC, since they will also inform the § 401 water quality certification process and help ensure that the Project will comply with New Hampshire surface water quality standards:

- New Hampshire Fish and Game Department (NHFGD);
- U.S. Fish and Wildlife Service (USFWS);
- Vermont Agency of Natural Resources (VANR).

We thank you for the opportunity to comment. Should you have any questions, please do not hesitate to contact me at 603-271-2983.

Sincerely,

Gregg Comstock

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cc. FERC, E-file
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