Comments Wilder Dam FERC1892-026
McIntyre 4/19/2018

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April 19, 2018

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: Wilder Project no. 1892-026; Response by O. Ross McIntyre to Great River Hydro Study Report Meeting March 8, 2018 Wilder Station, Wilder Vermont and Great River Hydro letter of 1/16/2018.

Dear Secretary Bose,

This letter contains my critique of the Supplemental Report Great River Hydro prepared for Erosion Studies 2 and 3 that was presented at the meeting of March 8, 2018.
It also contains my comments concerning statements in Great River Hydro's letter of January 16, 2018 about erosion in response to my critique of its initial report. I refute, herein, evidence that Great River Hydro presented in its letter of January 16, 2018 and at the time of the March 8th meeting that concludes ".....none of the riverbank erosion or road damage along the Connecticut River in the vicinity of the reservoir is caused by the operation of the project, ..."

Background:
Throughout the erosion study reports prepared by TransCanada/Great River Hydro and others, drawings and text are used to illustrate the sequence of erosive events. Material that falls from the river bank forms a bench or berm that constituting a "toe" at the bottom of the river bank. Then, usually during a high water event, the bench or toe material is entrained in rapidly moving water and is carried away. This later process may so weaken or undercut the bank that additional material now collapses to restore the presence of the bench or toe.

The bench or toe may also be restored by other processes not linked to a high water event. The 1979 study of erosion for the U.S. Corps of Engineers along the Connecticut River conducted by Simons, et al, provides examples of forces that contribute to building a berm or bench. [Report on: Connecticut River Streambank Erosion Study, Massachusetts, New Hampshire and Vermont [1979]. Simons, Daryl B Li, Ruh-Ming Alawady, M A Andrew, John W. COLORADO STATE UNIV RESEARCH INST FORT COLLINS [Corporate Author]] These include piping, groundwater, wind waves; boat waves; ice; lack of; or removal of vegetation. A synopsis of this report is included in the Preliminary Application Document (PAD) that was distributed at the

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January 28, 2013 West Lebanon meeting when public input into the relicensing process began. I quote a portion of it below.

"The Wilder impoundment was evaluated in this study, which discussed the various processes that occur along the Connecticut River. The study emphasized two categories of forces that affect the shoreline: (1) those forces that act on or near the surface of the water associated with pool fluctuations; related piping; groundwater; wind waves; boat waves; ice; lack of, or removal of, vegetation;

"The forces that act at or near the surface of the water generally cause the bank to gradually adjust by developing a bench or berm area wide enough to dissipate the forces causing erosion, increasing upper bank stability as the adjustment occurs. The report includes an estimate that the extent of erosion landward would in most cases be limited to an average of about 10 to 15 feet in a large river (such as the Connecticut River). After the bench is formed, growth of aquatic vegetation usually takes place, further increasing the stability and curtailing further significant upper bank erosion."

During that meeting, and subsequently, many observers disagreed with the optimistic opinion of Simons, *et al* in regard to factors that would limit the extent of the erosion. Thirty-five years after the preparation of the above report, new areas of erosion and expansion of old areas had occurred with damage to roads and agricultural land. Aquatic vegetation was largely absent in the bench area presumably because fluctuation in impoundment levels did not permit its establishment, and observers described bank cavities, typical of those seen in piping erosion, consistent with erosion caused by daily cycles of rising and falling water surface elevations (WSE) due to Wilder project operation.

Piping erosion (or seepage erosion, the term used by TransCanda/Great River Hydro) is the type of erosion that one should expect in a setting in which rising water of an impoundment enters a porous bank and then exits it when the impoundment level is lowered. Throughout the performance of three erosion studies by TransCanada/Great River Hydro, the possibility of piping erosion has received little or no mention. The applicant has dismissed its importance believing that the rate of change in impoundment level and the velocities of water exit from saturated riverine soils are insufficient to mobilize and remove material from the bank. **In this regard it is noteworthy that the Simons study attributed 15 to 18% of erosion to pool fluctuations.**

On February 26, 2013 McIntyre, the Town of Lyme and City of Lebanon submitted to FERC a plan for a study of piping erosion during the scoping phase of the license renewal. It called for direct measurement of the amount of water transported into soils during project operation and would have permitted direct calculation of water velocity in and out of soils. Regrettably, this study was not required as a component of the renewal application.

In the absence of feed-back as to why the study was not required by FERC, I conclude that the applicant and FERC were really not interested in obtaining definitive data that could disprove the conclusions that Great River has offered. To

perform studies that could prove that project operation is responsible for any of the erosion seen in the Wilder impoundment is not in the best interest of the company or its investors. The conflict of interest is clear in this matter.

The applicant refuses to consider the possibility that seepage/piping erosion could remove a tiny amount of soil from each foot of the river bank every time a reduction in WSE occurs and that if this goes on every day for 60 years, that a failure in the bank will result. None of the studies TransCanada/Great River performed could have detected this process.

McIntyre contends that this form of erosion has damaged sections of River Road in Lyme. Without ever measuring either the amount or velocity of water entry and exit into Wilder impoundment soils, Great River Hydro believes that the velocity of water exiting from saturated soils at time of drawdown is below the level that could mobilize ANY soil particles. McIntyre and Lyme, have disputed this conclusion and note that TransCanada/Great River Hydro has NEVER measured either the amount or velocity of water exiting the river bank at the time of drawdown or the weight of any soil particles carried in the exiting water.

If we accept the validity of Simons description of events associated with pool fluctuations - piping, wind, wave action, etc, and those resulting from a high water mechanism (high flow events favored as a sole cause by Great River Hydro), we have a cycle of bench formation due to the first, followed by bench removal by the second, followed by bench rebuilding, followed by bench removal, etc. The outcomes described in TransCanada/Great River Hydro's Study number 1 (History of Erosion) are entirely consistent with what such a cycle would produce. McIntyre believes that any erosive activity that increases the amount of material delivered to the bench will accelerate the total erosive process because the increased material delivered to the bench will be carried away by high water events.

Critique of Study 2/3 Supplement:
It should be clear that the latter mechanism of erosion, removal of the bank or berm by entrainment in rapid velocity flow is what the Great River has modeled in the supplemental studies required by FERC, and reported at the March 8th meeting. Great River presented new calculations based upon modeled flow velocity at a selected sample of the 21sites of transect study 3 to support its contention that project operation was not a source of erosive activity. Information on bank and "toe" soil composition was offered, and a formula was developed using mean (or median? both terms were used in the presentation) grain size in the study samples and computed grain weight coupled with empiric data on particle entrainment. **The results indicated that in most of the study sites at project related water flow rates entrainment was not possible. Without entrainment at project-related flow velocities sufficient to carry away material at the toe, erosion in these sites must therefore be due to high water events capable of producing the necessary water velocities required to mobilize the toe. The applicant also offered reasons why the conclusions represented a conservative view of the data.**

Notwithstanding the fact that their study found that project related water velocities were sufficient to entrain material from up to a *quarter* of the sites studied, Great River remained firm in its contention that project operation does not cause significant erosion.

Throughout the three erosion studies conducted by the applicant there has been a troubling lack of statistical input into the study design, conduct, and interpretation. This Supplemental study and report is no exception. I inquired why an average (or median) grain size was used in the calculation of whether entrainment was possible. Although the collected specimens varied considerably in composition it is clear that fine particles, perhaps up to almost half the weight of the total sample, could be susceptible to entrainment but the sample particle at the average weight was too heavy to be entrained. **To conclude that project-induced water velocity changes had not caused an effect under conditions in which a fraction of the sample, in fact, was carried away is a serious error. Were the grain size distribution of bank soils the same distribution found in the toe? If not the same, then the toe was likely comprised of particle sizes large and heavy enough to have escaped entrainment at project related flows while smaller particles had already been lost from the toe.** The size/weight distribution of the particles in each sample should have been determined. The analysis should have presented the fraction, if any, susceptible to entrainment at project related flow velocities. If as little as .01% of the particles in a sample can be mobilized (entrained) by project related flow rates each day for 365 days per year times 60 years we are discussing a lot of material.

The lack of comprehensive information about the particle size distribution is important for another reason. The stability of soil structures is a subject of which I have only a superficial knowledge. However it is clear that in composite structures the removal of the "fines" can have substantial effects on the stability of the remainder. The sorting of soil components by moving water and the major effects that such sorting has on geomorphology is a subject of teaching exercises at highway cuts. In a less dramatic way, but with significant impact, the process that led to such sorting of materials is likely going on at every toe at the bottom of every foot of bank in the Wilder impoundment.

In the Supplementary study as well as in the original study report modeled data was used to determine flow rates at the study sites. In addition, despite each site having WSE measured by pressure transducer gauges, WSE levels were modeled for the sites. Why? I don't trust models for information in turbulent systems. That is why aeronautical engineers put a plane in a wind tunnel before they will fly in it.

In addition, several observers at the time of the March 8th meeting called attention to an outcome of project operation that has not received enough attention. Project operation, in contrast to changes in WSE resulting from seasonal flow in a natural river, produces daily fluctuations sufficient to prevent the establishment of seedling vegetation in the berm area. The lack of rooted plants is likely to increase the susceptibility of the berm to entrainment by even modest high water events.

The erosion ratio used to support Great Rivers contention that project operation does not result in erosion has been the subject of critique by the Connecticut River Conservancy in the analysis by its consultant, Princeton Hydro and by abutter John Mudge. I support their opinions.

Additional Critique of Great River Hydro Comments to McIntyre 1/16/2018:
In the letter of January 16th: Page 5 paragraph 6 Great River comments on erosion events affecting River Road. This paragraph mentions the long history of River Road and notes that flooding events occurred on the road prior to construction of the Wilder Dam. McIntyre notes that the flooding Great River describes was temporary. He is unaware of *any* flood events prior to the construction of the dam that resulted in permanent road closures such as we are now experiencing. The earliest extant map of Lyme in 1808 shows the location of River Road. Though sections of the road were moved when Wilder Dam was built, the remainder of the road stayed in place until the April 2011 event. There is an abundant historic photographic record of the Connecticut River valley in Lyme prior to the construction of Wilder Dam. It shows extensive stretches of riverbank well stabilized by natural and undisturbed vegetation in locations now subject to severe erosion. Removal of the dam would undoubtedly prevent or diminish the loss of agricultural land and damage to Lyme's infrastructure.

Although some who live along River Road attribute its recent erosive failures to the operators incentive to generate increased income by taking advantage of the opportunity to sell into the spot market for electricity, it is also possible that the cumulative small losses of bank material resulting from project operation required 60 years of project operation to become noticeable.

January 16 letter, Page 7, paragraph 3. "Each of these events (as well as additional road failures) is attributable to a significant storm or flood events that occurred on the same day or in the days immediately prior to the road failure." **This statement is wrong** with respect to the failure of River Road south of the East Thetford Bridge. Photographs previously submitted to FERC show this section of the road subsiding more than a year before it had to be closed. There was no specific high water event that caused the subsidence. The process has progressed slowly over more than 36 months and continues to this day.

Also in the same letter: Page 8 paragraph 4: "Lyme's geotechnical consultant, Mike Willis, P.E.,,,, in 2016.... noted that traffic loads and vibration associated with them are very likely the cause of the slump and concluded that the basic problem with the site is the global stability of the soil." **McIntyre points out that slowly progressive piping/seepage erosion of the sort we describe above will produce unstable soil that Willis refers to.** The applicant **has "cherry picked"** an opinion favorable to Great River's viewpoint and fails to mention that another of Lyme's consultants, HTE Northeast, Inc. stated at the time of the 2011failure of River Road, **"The frequent raising and lowering of the water level by downstream dam management (Wilder Dam), over time, is a contributing factor."**

Summary Conclusions:
In summary, I find the methodology that was used in the original and this supplement to Erosion studies 2 and 3 trades simplicity for accuracy and reliability. The calculations used to present the velocity and entrainment data are flawed, biased and incomplete. They do not support the conclusion that project operation causes no erosive damage.

Great River Hydro takes the position that the perpetual easements that its predecessors obtained permit it to maintain the approved reservoir levels. Those who signed the easements must not have anticipated the level of damage that is now apparent. Had they done so they might have refused to sign, or might have stipulated some avenues for recourse. **I believe that the law under which a public resource (the Connecticut River) is made available to private parties for purposes of public good (power generation) was not written with the expectation that roads and fields would be destroyed or carried away down river. True, the signers of easements knew that their signing permitted the water level created by the dam to rise, but the language chosen for the law provides assurance that the government did not expect that projects approved under the law would cause land and infrastructure destruction or disappearance. In light of the damage that is now apparent, it is up to FERC to ascertain whether the amount of public good delivered by Wilder Dam is worth the amount of hardship it delivers to the land and the people of Lyme, a small town of 1716 persons now faced with reopening a road that has already cost the town over $500,000. Downstream from this first failure, a separate erosion site has closed the road for over two years and will cost many hundreds of thousands of dollars to repair. Several additional portions of the road are currently threatened. It is a matter of fairness. This matter, the mitigation of hardship, can be adjudicated by FERC or decided by the courts. I favor mitigation.**

Sincerely Yours

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