Orr&Reno

Douglas L. Patch
dpatch@orr-reno.com
Direct Dial 603.223.9161
Direct Fax 603.223.9061
Admitted in NH and MA

July 24, 2017

Via Hand Delivery and Email
Pamela Monroe, Administrator
New Hampshire Site Evaluation Committee
c/o New Hampshire Public Utilities Commission
21 South Fruit St., Suite 10
Concord, NH 03301-2429

Re: SEC Docket No. 15-04, Application of Public Service Company of New Hampshire d/b/a Eversource Energy for a Certificate of Site And Facility for the Construction of a New 115 kV Transmission Line from Madbury Substation to Portsmouth Substation – Pre-filed Direct Testimony of Joseph J. Famely, Matthew F. Schultz, Stephen H. Jones and Michael F. Dacey on behalf of the Town of Durham and the University of New Hampshire

Dear Ms. Monroe:

Enclosed is the Pre-filed Direct Testimony of Joseph J. Famely, Matthew F. Schultz, Stephen H. Jones and Michael F. Dacey being filed by the Town of Durham and the University of New Hampshire in the above-captioned docket. Copies are being provided electronically to the Site Evaluation Committee and the Service List.

If you have any questions, please do not hesitate to contact me. Thank you for your assistance.

Sincerely,

Douglas L. Patch

DLP/eac
Enclosures

cc (via email): Service List in SEC Docket 15-04 and New Hampshire Department of Environmental Services

1860233_1

THE STATE OF NEW HAMPSHIRE
BEFORE THE
SITE EVALUATION COMMITTEE
DOCKET NO. 2015-04

PRE-FILED DIRECT TESTIMONY OF JOSEPH J. FAMELY, STEPHEN H. JONES, MATTHEW F. SHULTZ, AND MICHAEL F. DACEY ON BEHALF OF THE TOWN OF DURHAM, NEW HAMPSHIRE

July 24, 2017

Qualifications and Purpose of Testimony

Qualifications - Joseph J. Famely

Q. Please state your name and business address.

A. My name is Joseph J. Famely. My business address is 81 Technology Park Dr., East Falmouth, Massachusetts 02536.

Q. Who is your current employer and what position do you hold?

A. My current employer is Woods Hole Group, an environmental and engineering consulting firm. I am a Project Manager and Environmental Scientist in the Applied Ecology and Sustainability group.

Q. Briefly summarize your educational background and work experience.

A. I have been working as an environmental scientist for over 16 years. I received a Bachelor of Arts degree in Environmental Studies and Psychology from Bowdoin College in 2000, and subsequently worked for the environmental firm Menzie-Cura & Associates (later acquired by Exponent) through 2007 specializing in ecological risk assessment. I received a Master of Environmental Management degree from the Yale School of Forestry & Environmental Studies in 2009, with a focus on Urban Ecology and Environmental Design. Since 2009, I have been a Project Manager and Environmental Scientist at Woods Hole Group.

My areas of expertise include ecological risk assessment, coastal planning (both climate change vulnerability/resiliency and dredged material management), and greenhouse gas assessment. My work experience has included ecological risk assessments at state and federal hazardous waste sites in marine, estuarine, and terrestrial environments, expert review of ecological risk assessments, evaluations of toxicity, bioaccumulation, and dilution criteria in support of dredged material management, and analyses of shoreline change in support of regional sediment budget development. Some specific related projects include the development of the ecological risk assessment for the New Bedford Harbor Operable Unit #3 Superfund site, the preparation of sections addressing potential ecological and human health risk in the SEIS for the Designation of

Dredged Material Disposal Site(s) in Eastern Long Island Sound, and the development of a probabilistic ecological risk assessment to evaluate exposure to pesticides in dredged material from the Big Sunflower River Maintenance Project in Mississippi.

A complete list of my past project experience can be found in my *curriculum vitae*, which is included in Attachment A.

<u>Qualifications – Stephen H. Jones</u>

Q. Please state your name and business address.

A. My name is Stephen H. Jones. My business address is Jackson Estuarine Laboratory, University of New Hampshire, 85 Adams Point Road, Durham, New Hampshire 03824.

Q. Who is your current employer and what position do you hold?

A. My current employer is the University of New Hampshire (UNH) and New Hampshire Sea Grant Program. I am a Research Associate at UNH and Associate Director of New Hampshire Sea Grant Program.

Q. Briefly summarize your educational background and work experience.

A. I have been working as an environmental scientist, specializing in microbial ecology and environmental toxicology, for over 34 years. I received a Bachelor of Sciences degree in Soil Science from the University of Maine in 1976, and both a Master of Sciences degree in Soil Science and a PhD in Bacteriology from the University of Wisconsin-Madison in 1980 and 1983, respectively. I subsequently worked as a post-doctoral fellow in the Institute for Comparative & Environmental Toxicology at Cornell University from 1984 to 1986 conducting research on the biodegradation of toxic organic chemicals at low concentrations in surface waters. I then worked as a Research Fellow and Adjunct Professor in the Department of Civil Engineering at Syracuse University from 1986 to 1987 conducting research on strategies to optimize anaerobic digestion of municipal sludge. Since 1987, I have been a resident professor at the Jackson Estuarine Laboratory at UNH, mainly studying a variety of local and regional water pollution and shellfish safety issues. I have been involved as program chair and manager of the Gulfwatch Program since 1991, served as Director of the UNH Center for Marine Biology, and currently as the Associate Director of the NH Sea Grant Program. I have been the Principal Investigator on hundreds of research projects at UNH that have covered a wide scope of environmental and ecosystem issues, and have served on a variety of local to international advisory and steering committees for organizations focused on environmental quality.

A list of my recent project experience can be found in my *curriculum vitae*, which is included in Attachment B.

<u>Qualifications – Matthew F. Shultz</u>

Q. Please state your name and business address.

A. My name is Matthew F. Shultz. My business address is 81 Technology Park Dr., East Falmouth, Massachusetts 02536.

Q. Who is your current employer and what position do you hold?

A. My current employer is Woods Hole Group, an environmental and engineering consulting firm. I am a Senior Coastal Engineer in the Coastal Sciences, Engineering & Planning group.

Q. Briefly summarize your educational background and work experience.

A. I have been working as a coastal engineer for over 13 years. I received my Bachelor of Science Degree in Civil Engineering from Tufts University in 1996 and subsequently a Master of Science Degree in Ocean Engineering from the University of Rhode Island in 2005. I currently am licensed as a Professional Engineer in MA, CT, and LA.

My area of expertise is in the modeling of coastal and estuarine hydrodynamics, waves, and sediment transport processes. My work experience has included regional coastal modeling studies, conducting alternative analyses for flood risk reduction, as well as environmental modeling studies focused on ecological restoration and water quality. Some specific related projects include the modeling of hydrodynamics and constituent transport for the restoration of Stony Brook in Brewster, Massachusetts, three-dimensional water quality modeling of the Eau Gallie River for evaluation of a water treatment facility discharge, and the hydrodynamic characterization and sediment transport evaluation at the former Callahan Mine property in Brooksville, Maine, a United States Environmental Protection Agency (USEPA) superfund site.

A complete list of my past project experience can be found in my *curriculum vitae*, which is included in Attachment C.

Qualifications – Michael F. Dacey

Q. Please state your name and business address.

A. My name is Michael F. Dacey. My business address is 186 Granite Street, Manchester, New Hampshire 03101.

Q. Who is your current employer and what position do you hold?

A. My current employer is GeoInsight, Inc., an environmental consulting and engineering firm with offices in New Hampshire, Maine, Massachusetts, and Connecticut. I am a Senior Consultant and Operations Manager in the Manchester, New Hampshire office.

Q. Briefly summarize your educational background and work experience.

A. I have been employed as a geologist/hydrogeologist and environmental consultant for 31 years and taught secondary math and science for one year. I received a Bachelor of Science Degree in Earth Science from Bridgewater State College in 1980 and a Master of Science Degree in Geology (with a focus on coastal and glacial sedimentary processes) from the University of Rhode Island in 1989. Since 1987, I have worked as an environmental consultant dealing primarily with contaminated site investigations, contaminant fate and transport, and soil and groundwater assessment and remediation. I have also performed pre-dredge surveys and made recommendations on dredge plans using principles of sediment transport in aqueous environments.

Examples of my project experience can be found in my *curriculum vitae*, which is included in Attachment D.

**Q.	What is the purpose of your testimony?**

A.	GeoInsight and Woods Hole Group (GIWHG) were selected by the Town of Durham, New Hampshire (the Town) to assist the Town in evaluating potential environmental impacts associated with the proposed Seacoast Reliability Project (SRP), particularly focused upon the approximately 0.9-mile transmission-line crossing in Little Bay. We were responsible for reviewing available information and providing comments to technical reports prepared by consultants to Eversource Energy (Eversource), the SRP Applicant, and to be available to attend workshops and other meetings pertaining to the project. More specifically, we were tasked with providing the Town an independent interpretation of potential environmental impacts on Little Bay, the associated risks, uncertainties, and how well the Eversource project addresses such risks and uncertainties. Dr. Stephen Jones, Associate Director, New Hampshire Sea Grant Program and Research Associate Professor of Natural Resources at Jackson Estuarine Laboratory, is a resident of Durham and is assisting the GIWHG technical team in matters of toxic impacts potentially resulting from the SRP.

GIWHG previously prepared technical comments that largely pertained to information presented in two reports prepared on behalf of the Applicant: *Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project, Little Bay, New Hampshire*, dated December 14, 2015, and prepared by RPS Group; and *Characterization of Sediment Quality Along Little Bay Crossing*, dated December 1, 2016, and prepared by Normandeau Associates, Inc. (Normandeau). The comments were submitted to the New Hampshire Department of Environmental Services (NHDES) as attachments to a cover letter prepared by Douglas L. Patch, Esq. of Orr and Reno, legal counsel to the Town and UNH, and dated February 28, 2017 (Attachment E.) A copy of this report was provided to the service list in this docket.

In response to our comments and comments presented by Public Counsel and other parties, Eversource's consultants conducted additional investigations, the results of which were primarily presented in two reports: *Revised Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project, Upper Little Bay, New Hampshire*, dated June 27, 2017, and *Supplement to Characterization of Sediment Quality Along Little Bay Crossing*, dated June 30, 2017. We reviewed these documents and other newly submitted documents pertaining to the Little Bay crossing. We also participated in technical sessions that were held on June 7 and July 11, 2017 and have reviewed responses to record requests that were made during those technical sessions.

The purpose of this joint testimony is to present concerns that still remain and must be addressed before it can be concluded that Eversource adequately addressed risks, uncertainties, and impact control measures regarding the Little Bay crossing component of the SRP and that the SRP will have no unreasonable adverse effects on water quality and the natural environment.

Q. What are the primary conclusions of your evaluation?

A. In the aforementioned cover letter prepared by Attorney Patch, our position prior to reviewing new and revised Applicant documents was accurately summarized as follows.

> Based on the preliminary review by our consultants, given the gaps in data as well as limitations of analysis provided so far by the Applicant, it is Durham's position that it cannot assure the residents of Durham that there are no unreasonable adverse ecological effects or that the impact on natural resources will be manageably limited in the Little Bay, and that unreasonable adverse effects in the worst case will not migrate up north towards the mouth of Oyster River or down south beyond the mouth of the Great Bay. Durham has arrived at this preliminary position in part because the Applicant has not provided what Durham's consultants consider to be adequate sensitivity analysis of a set of variables that could impact the plume dispersion, refloatation of sediments and/or of contaminants within or associated with such sediments. The Applicant has done modeling only with very few "snapshot" data points for some variables it has incorporated into its modeling, and has also not incorporated some other variables at all in the modeling. Thus, a consequence of the Applicant's study so far is that it has left unresolved a very large envelope of uncertainty around potential ecological impact from a host of relevant variables. More importantly, it appears that no one, including the Applicant, could put in place adequate control measures during cable installation and/or mitigation measures to control risks because of large uncertainties that still persist.

After reviewing new and revised material submitted by the Applicant, we have concluded that the concerns summarized in Attorney Patch's letter remain. Although some specific concerns previously expressed were addressed through additional data collection, changing installation approach, and refining the SSFATE model, the overarching concerns regarding having adequate protections in place to ensure that adverse ecological impacts will not result from the SRP remain. Specific concerns in support of our position are presented in the paragraphs that follow.

Q. Please describe your assessment of the sediment sampling and compositing performed on behalf of the Applicant.

A. The 2016 Sediment Characterization Report was based upon chemical analyses of 12 sediment cores from the planned cable installation corridor. The 2016 Report characterized composite samples of the top 4 feet of each vibracore. This sample compositing plan was not informed by the specific technologies to be used for cable installation, and therefore, produced a dataset that was limited in its utility for determining potential impacts to biological communities from exposure to contaminants in suspended sediments.

The 2016 Sediment Dispersion Modeling report assumed that 25 percent of sediments are suspended by jet plow operation and that 50 percent of sediments are suspended by hand jetting. Based upon these assumptions, and on the assumption that the upper portion of the sediment column is suspended in the water column (while deeper sediments fluidized in the trench stay in place), we estimated that: (1) the jet plow will suspend approximately the top 0.9 feet of sediment in areas of 3.5 feet burial; (2) the jet plow will suspend approximately the top 2 feet of sediment in areas of 8 feet burial; and (3) hand jetting will suspend approximately the top 1.75 feet of sediment in areas of 3.5 feet burial.

We therefore concluded that: (1) the 2016 sediment sample compositing of the upper 4 feet of each core was not planned from an understanding of the actual impacts of the jetting technologies; (2) the 2016 sediment characterization data was not appropriate for evaluating potential ecological risk from exposure of marine organisms to sediments suspended in the water column by jetting technologies or contaminants that may desorb from suspended sediments and partition to the surface water, especially since the chemical analyses were performed on the bulk sediment samples (inclusive of the heavier sand particles to which contaminants do not typically bind) and did not isolate the fine silt particles, which are more likely to be associated with contaminants and also more likely to remain suspended in the water column; and (3) the Applicant should provide technical data, peer-reviewed literature, and/or industry white papers that will assure the public that it understands the potential impacts of the technologies it is proposing to use in Little Bay and that the sediment compositing is representative of the potential sediment suspension and can reasonably support quantitative evaluations of water quality impacts.

The Applicant responded to these concerns by re-collecting and partially re-analyzing sediment samples for the 2017 Sediment Characterization Report. The 2017 Report characterized composite samples of the top 2 feet of each vibracore. This revised sample compositing plan was not explained in the report other than to say that the change was made “to address reviewer comments.” To date, the Applicant has not produced any technical data, peer-reviewed literature, and/or industry white papers that demonstrate the expected sediment mobilization in Little Bay from the jet plow or hand jetting activities to the proposed (and recently revised) depths. The only information on potential sediment mobilization submitted by the Applicant, which formed the basis for the Sediment Dispersion Modeling assumption of a 10 percent to 35percent suspension (loss) rate, is a 2002 study (developed for an entirely different project) that provides theoretical suspension calculations specific to New York Harbor sediments and a particular piece of equipment (an ITG Jet Plow).

Without technical data, peer-reviewed literature, and/or industry white papers that demonstrate the expected sediment mobilization in Little Bay from the jet plow or hand jetting activities to the proposed (and recently revised) depths, it is not possible to judge the appropriateness of the compositing interval for the 2017 Sediment Characterization Report or to make an informed evaluation of potential ecological risk from exposure to sediments and associated contaminants suspended in the water column.

Q. Please comment on your assessment of the water quality modeling performed on behalf of the Applicant.

A. Despite a direct acknowledgement in the 2016 Sediment Characterization Report that the proposed cable installation methods "will necessarily disturb sediments and suspend them into the water column," there was no analysis (in either the 2016 Sediment Characterization Report or the Ecological Risk Analysis appended to that report) of the potential for contaminants to desorb from sediment particles and become suspended or dissolved in the water column, nor of the potential for exposure of aquatic organisms to these contaminants (whether in dissolved or particulate phase).

The Applicant responded to these concerns in the 2017 Sediment Characterization Report's Ecological Risk Analysis by performing a series of mass balance model calculations based upon the USACE Regional Implementation Manual Tier II Step 1 ("Evaluation for compliance with Water Quality Criteria"). The mass balance model uses maximum sediment concentrations for listed contaminants and conservatively assumes a total (100 percent) release from the sediments to the water column in calculating the dilution factor required to meet water quality criteria. To facilitate direct comparison to the results of the sediment dispersion model, the Applicant rearranged the dilution equation to calculate the maximum total suspended solids (TSS) concentration that should not be exceeded without potentially resulting in an acute water quality violation.

Normally, these calculations would be conservative evaluations of the potential exposure of aquatic organisms to contaminants desorbed from suspended sediments. However, there are uncertainties in the Applicant's water quality evaluation resulting from a number of issues.

First, the sediment concentrations used in the mass balance model calculations are derived from two different datasets – the 2016 0- to 4-foot composites and the 2017 0- to 2-foot composites. Data from the 2017 0- to 2-foot composite samples were available at all twelve (12) sample locations along the SRP cable route in Little Bay for arsenic and pesticides. Data from the 2017 0- to 2-foot composite samples were available at only six (6) of twelve (12) sample locations for lead, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyl (PCBs). The other half of the lead, PAH, and PCB samples, as well as all twelve (12) samples of the other metals (cadmium, chromium, copper, mercury, nickel, zinc), were only measured in the 2016 0-to 4-foot composites. This represents an inconsistency in the water quality model inputs and the mass balance model calculations for some contaminants may be based on composites that misrepresent the suspended sediment horizon.

Second, the assumptions for background concentrations of contaminants in the water (C_{ds} in the mass balance model equation) are not conservative. The study cited as the basis for the metals background concentrations (Donat and Bruland, 1995) is an assessment of metals concentrations in open ocean waters that is not likely representative of the potentially higher concentrations in estuaries such as Little Bay, where land use patterns in the adjacent and tidally-connected watersheds are likely to contribute inorganic contaminants via runoff. The background concentrations of organic contaminants were assumed to be zero, which is highly unlikely given (1) land use patterns in the adjacent and tidally-connected watersheds are likely to contribute organic contaminants such as PAHs via runoff (Hoffman et al., 1984[1]; Menzie et al., 2002[2]); (2) Little Bay has been listed on the New Hampshire 2014 (and Draft 2016) 303(d) List as "Not Supporting" for dioxin and PCBs; and (3) the wide distribution and persistence of organic contaminants in the environment.

Third, the Applicant did not give due consideration, as suggested in prior comments, to the chemistry of the fine sediment particles. All sediment chemical analyses (2016 and 2017) were performed on the bulk samples, which include the heavier sand particles that are not likely to suspend in the water column and do not typically carry contaminants. The fine sediment particles (silts) should have been the focus of sediment chemical analyses to inform water quality modeling (C_s in the mass balance model equation), due to their propensities for contaminant adsorption and water column suspension. The RIM water quality assessment methodology was developed to assess the impacts of bulk sediments falling through the water column, not (fine grained) sediments being preferentially suspended by a jet plow, so this is a conservative, logical, and necessary adjustment to the model input. Since the contaminant concentrations on the fines are likely to be higher than on the bulk samples, there would be a higher likelihood of water quality violations at lower suspended solids concentrations (and thus over a larger area than previously anticipated).

Fourth, because the sensitivity analyses performed with the sediment dispersion model were not comprehensive, it is not possible given current information to adequately bracket the potential for water quality violations due to SRP cable installation. The sediment dispersion model report presents model results from adjusting individual modeling parameters within probable ranges, but it does not quantitatively assess the plume (and deposition) from these runs, nor does it present results examining the sensitivity of adjusting probable combinations of modeling parameters to reflect what could realistically occur during cable installation. Thus, the Applicant has not presented model results for a worst-case scenario and the potential upper bound on suspended sediment concentrations and plume footprint is not currently known. Since the interpretation of the water quality modeling is dependent on the maximum total suspended solids results from the dispersion model, it is possible that contaminants other than copper could exceed acute water quality criteria, and those exceedances could occur over a larger area and over a

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[1] Hoffman, E.J., G.L. Mills, J.S. Latimer, and J.G. Quinn. 1984. Urban runoff as a source of polycyclic aromatic hydrocarbons to coastal waters. Environmental Science & Technology. 18 (8): 580-587.

[2] Menzie, C.A., S.S. Hoeppner, J.J. Cura, J.S. Freshman, and E.N. LaFrey. 2002. Urban and suburban storm water runoff as a source of PAHs to Massachusetts estuarine and coastal environments. Estuaries. 25 (2): 165-176.

longer period of time. This inadequacy in dispersion model sensitivity analysis represents a large uncertainty for the water quality modeling, and highlights a significant obstacle to the design of adequate controls for the protection of aquatic life.

Q. Please comment on your review of the Application for Water Quality Certification and the associated Revised Environmental Monitoring Plan for Little Bay with respect to the State of New Hampshire's Surface Water Quality Standards (Env-Wq 1700).

A. In the 2016 Application for Water Quality Certification and in the 2016 Ecological Risk Analysis, the Applicant was dismissive of pollutant loading analysis and the partitioning of contaminants from suspended sediments to the water column. In response to our comments, the Applicant performed a series of calculations to address potential partitioning of sediment-sorbed contaminants to the water column as a result of sediment suspension, and compared these concentrations to New Hampshire (Marine Acute) Surface Water Quality Standards (Env-Wq 1703.21). As discussed above, this analysis resulted in one potential water quality violation for copper during SRP cable installation activities, and could result in more potential water quality violations if more rigorous sensitivity testing is applied to the sediment dispersion model or if the sediment samples analyzed for contaminants were more representative of the likely suspended fraction in sediments (the silts).

At the same time that these water quality calculations were submitted, the Applicant also submitted a Revised Environmental Monitoring Plan, which established a mixing zone around the construction area that is designed to be permissive of these water quality violations. In reviewing the documentation of the proposed mixing zone and the Water Quality Standards, it is clear that the Applicant has not adequately met the Criteria for Approval of Mixing Zones (Env-Wq 1707.02). This rule states that the department shall not approve a proposed mixing zone unless, among other requirements, it meets the criteria in Env-Wq 1703.03(c)(1). Env-Wq 1703.03(c)(1) states that "all surface waters should be free from substances in kind or quantity that…produce…turbidity that is not naturally occurring and would render the surface water unsuitable for its designated uses." It is counter-intuitive and does not achieve the goals of the New Hampshire Surface Water Quality Standards to allow a mixing zone specifically for abnormal turbidity and related contamination when the rules clearly state that abnormal turbidity is not to be permitted even in mixing zones. It should be incumbent on the Applicant to clearly and unequivocally demonstrate that the proposed mixing zone meets the Criteria for Approval (Env-Wq 1707.02).

Similarly, it should be incumbent on the Applicant to clearly and unequivocally demonstrate that the proposed project is aligned with the Antidegradation rule (Env-Wq 1708).

Q. Please comment on your review of the USACE Regional Implementation Manual and how this guidance applies to the proposed project.

A. In our review of the 2016 Sediment Characterization Report and Ecological Risk Analysis, we stated a concern that the potential for water quality impacts to Little Bay from SRP construction had not been addressed because the Applicant had not thoroughly developed the conceptual site model of potential ecological exposure pathways. We therefore recommended that the Applicant apply the joint USACE/USEPA guidance in the "Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters" (RIM) because it would provide a deliberate and standardized analysis framework upon which to judge the adequacy and completeness of ecological risk analyses for a project that is functionally equivalent to a dredging and dredged material disposal project (because jet plowing and hand jetting disturb and partially suspend sediments in the water column until such time that the suspended particles resettle).

Although the Applicant applied a Tier II evaluation of compliance with State water quality standards using sediment concentrations and a numerical mixing model in the 2017 Ecological Risk Analysis, the RIM (or any other guidance) has not been formally adopted as the ecological risk framework for the proposed action in Little Bay. Thus, the ecological risk analyses for the proposed action still suffer from a lack of transparency as there are no independent standards to provide assurance to the reviewers (or the public) that these analyses have been conducted in an environmentally protective manner.

The following summarizes the current state of the analyses conducted regarding potential impacts to Little Bay in the context of the RIM. Since the proposed action is within waters covered by the Clean Water Act, the "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual" (Inland Testing Manual) also applies. The flowcharts in Figures 3-1, 3-2, and 3-3 of the Inland Testing Manual provide a useful visualization of the steps necessary to make a factual determination of potential impacts to the water column and benthic community from the proposed action.

One of the first steps in a Tier I investigation is the compilation of existing information. This process allows for the identification of the potential for contaminants to be introduced by the dredged material and the evaluation of whether the proposed discharge of sediments may result in contamination, bioaccumulation, or toxicity. Among the various factors, naturally occurring mineral deposits are listed as potential sources of contamination that could be harmful to aquatic biota if mobilized to the water column. Thus, in the Applicant's initial analysis of sediment quality, the argument that high levels of arsenic (exceeding the ER-L) in sediment are due to a naturally occurring deposit does not preclude the sediments from further analysis. Mobilizing sediment (that would otherwise have stayed in place) to the water column as a result of the SRP installation could have an impact on aquatic biota (based upon the available sediment information). Additionally, the identification of contaminants of concern step in Tier I notes that nutrients and microbial contamination (especially near shellfish beds) should not be ignored. The Applicant has only made a preliminary (non-quantitative) assessment of nutrient impacts to aquatic biota, and no assessment of microbial concerns. Considering these issues, the existing information does not provide a sufficient basis for making a factual determination, and therefore, analysis should proceed to Tier II.

Tier II consists of an evaluation of compliance with State water quality standards using a numerical mixing model, and an evaluation of potential benthic impacts using calculations of theoretical bioaccumulation potential. The Applicant's water quality modeling was not sufficiently conservative (for the reasons stated above) to determine if water quality violations may occur outside of the mixing zone. Despite this, the Applicant still calculated potential water quality violations for copper. The copper water quality exceedance was dismissed by the

Applicant based upon the assertion that only a fraction of copper would partition to the water column. However, such arguments are not recognized by the Inland Testing Manual, which requires an elutriate analysis relative to the water quality standard if the numerical model screening fails. Also, there is not enough information to judge whether nonpolar organic compounds in dredged material can bioaccumulate in benthic organisms because, as stated above, the sediment chemistry analyses were performed on bulk samples rather than the silt portion, which is more likely to be associated with contaminants and also more likely to remain suspended in the water column.

Therefore, it is our conclusion that the Applicant needs to provide a set of Tier II analyses that more accurately represent the potential impacts of the proposed action and more diligently follow the Tier II guidelines before a factual determination can be made regarding the potential environmental impacts of the proposed action, and whether Tier III analysis should be required.

Q. Do you have other concerns regarding the Revised Water Monitoring Plan?

A. The Applicant is only proposing to monitor TSS and not critical contaminants (nitrogen, bacteria, metals, toxic organic compounds, in water and in shellfish), the analysis of which is necessary to verify that there are no impacts to aquatic organisms. The monitoring plan does not evaluate impacts to the oyster farms and/or natural oyster beds located within the proposed mixing zone and does not explain how they will mitigate degraded sediment and water quality.

Q. Has the Applicant adequately addressed potential impacts from nitrogen released during cable crossing activities?

A. The Applicant assessment of nitrogen is incomplete because they do not consider nitrogen in sediment pore water. They should modify their assessment by utilizing recent UNH-based peer reviewed papers on the significance of pore water as a source of nitrogen loading to the estuary.

Using nitrogen values from their sediment analysis (total N) and pore water ammonia (NH4); (V.P. Percuoco et al. 2015), we calculated that the amount of N loading to the estuary resulting from hand jetting and jet plowing would be up to 300 times the discharge of total N from the Town Wastewater Treatment Facility (WWTF) in one day. Considering that there will also be N released and mobilization from sediments disturbed by the diver jetting and the old cable removal, these values are an underestimate of the potential N loading that will occur due to this project. There are examples of the USEPA not allowing activities that would contribute much less loading of nitrogen to the estuary than what this project would cause.

Q. Do you have concerns regarding potential arsenic concentrations introduced into the water column during cable crossing activities?

A. The Applicant states or implies that, although arsenic levels in core samples were elevated, they represent background conditions and are naturally occurring; however, the Applicant did not consider that the arsenic in the sediment is generally unavailable to the marine environment whereas the sediments lost to the water column during jetting activities may carry potentially toxic levels of arsenic. ER-L levels were exceeded at seven stations (p. 11). The point made by the Applicant regarding the consistency of arsenic levels with levels reported elsewhere in Great Bay is not relevant because those other studies pertained to sediments that are left in place and not disturbed.

Q. Do you have concerns regarding bacterial contaminants introduced into the water column during cable crossing activities?

A. Yes, *Escherichia coli*, *Salmonella spp*., enterococci, *Giardia lamblia, Cyrptosporidium parvum*, *Clostridium perfringens, Vibrio parahaemolyticus*, *V. cholerae,* and *V. vunificus, and Aeromonas hydrophila* have been documented as being present in sediments, water, and shellfish in the Great Bay-Little Bay area and all can include pathogenic strains. The sediment quality report does not adequately address potential impacts upon oysters and other organisms in the Little Bay environment.

Using a similar approach as used for calculating N loading from the jet plowing and local and literature data for concentrations of fecal coliforms, enterococci, and *Vibrio parahaemolyticus,* we found that the jet plowing would likely cause billions of bacterial cells into the water column and potentially cause bivalve shellfish, like commercial oysters, to be contaminated. Considering the State standards for safe shellfish harvesting (14 fecal coliforms/100 milliliter [ml]) and recreational water use (104 enterococci/100 ml) and national shellfish standards (30 *V. parahaemolyticus*/g oyster), the impact of jet plowing will degrade water quality relative to bacterial contamination. Considering that there will also be release and mobilization of bacterial cells and viruses from sediments disturbed by the diver jetting and the old cable removal, these values are an underestimate of the potential pathogen loading that will occur due to this project. If the Town WWTF discharged the acceptable limit of fecal coliforms (14 FC/100 ml), the number discharged in one day would be seven times lower than the number estimated to be released from sediment disturbance due to the SRP.

Q. Was the hydrodynamic model applied sufficient for characterizing the suspension, dispersion, and deposition of sediments from the cable burial process?

A. Based upon our review of the report entitled *Revised Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project*, *Upper Little Bay*, *NH* submitted by the Applicant and dated June 27, 2017 (the "SRP Modeling Report"), while some of our prior concerns were addressed in the updated modeling, the wind analysis presented does not demonstrate that wind effects are minimal and can be ignored in the hydrodynamic model; and as explained earlier, the sensitivity analysis is still inadequate to reduce the range of uncertainties.

The data presented in Figure 1-19 of the SRP Modeling Report shows there was the occurrence of a wind event with wind speeds in excess of 10 m/s (22 mph) in the months of September to October (the proposed cable burial window) for nine out of the ten years (2007 to 2016) presented. This would indicate a rather substantial wind event is **likely** to occur during the proposed cable installation window, contrary to statements made in the SRP Modeling Report. It's also stated that 88 percent of the winds evaluated are less than 5 m/s (11 mph), but that 12 percent are greater. If these are hourly wind measurements (as indicated by Figure 1-22 in the SRP Modeling Report), that would mean over 175 hours (12 percent of 61 days times 24 hours) have winds greater than 11 mph during the proposed construction window, again indicating the likelihood of wind effects occurring.

The SRP Modeling Report then states the winds from the most significant wind event (out of the ten years evaluated) were directed from 40 to 80 degrees (blowing from the NE to ENE, with peak wind at 50 degrees), and then 310 degrees (blowing from the NW) for another strong wind events. These winds could certainly affect circulation in Little Bay given its north-to-south orientation and measured fetch lengths of 1.8 miles from NE to SW and 2.0 miles from NW to SE (as measured in ArcGIS, Attachment F). These are considerable distances over which sustained winds can produce surface stresses and induce currents.

The analysis presented in Section 1.4.3.2 of the SRP Modeling Report doesn't demonstrate that winds have little effect on current velocities in the shallower portions of Little Bay. The Acoustic Doppler Current Profiler (ADCP) current velocity data shown in Figure 1-24 is for a location in the main deep channel in Little Bay (depth of 17 meters below mean sea level) where winds would have less of an effect on the vertical current profile. Additionally, the ADCP velocity measurements that are closest to the water surface are at a depth of 3.8 meters (12.5 feet) relative to mean sea level (displayed in Figure 1-24 as 13.21 meters above the bottom). The effects of winds at this depth below the surface will be much less than the wind effects in the shallow tidal flats where the water depths range down to 1.2 meters (4 feet) at mean sea level.

It's been suggested by the Applicant, the cable burial being proposed via jet plow will occur over a 5- to 14-hour period and the hand-jetting will occur over a 4-hour period for 18 calendar days (for each cable). Additionally, the modeling conducted shows that resuspension of sediments will continue to occur for up to 3 days after the jet-plow construction activity (and possibly longer if wind effects were evaluated). These installation periods are of sufficient duration for changes in winds (speed and direction) to affect surface water currents and sediment plume movement, especially in the shallow water tidal flats.

Given that the sediment plume from the jet-plow activity is shown to extend to the water surface in the shallow flat areas and that the hand-jetting may be conducted in water depths as small as 1 foot (as stated on Page 58 in the SRP Modeling Report), there is sufficient reason to expect winds can affect sediment dispersion and contribute to additional and prolonged resuspension of sediments. The modeling should evaluate the expected range of wind conditions that will occur during the burial process, and how that affects the sediment plume characteristics and subsequent deposition. This would also help inform whether certain constraints need to be considered during the construction process due to predicted meteorological (wind) and tide (depth) conditions.

Q. Did the SSFATE model and methods applied sufficiently characterize the suspension, dispersion, and deposition of sediments from the cable burial process?

A. Based upon what was presented in the SRP Modeling Report, sensitivity testing was conducted with the SSFATE model to evaluate modeling parameters that can be varied within the range of probable working conditions related to: 1) the jet plow advance rate, 2) the sediment loading to the water column (loss rate) from the jetting process, 3) tidal variations (spring and neap) during the jet-plow burial, as well as 4) the resuspension of sediments after the jet plow burial. These sensitivity tests show the model predicts changes in the sediment plume that would be expected (i.e., there are higher SS concentrations with a higher sediment loss rate); however, the variation in the sediment plume and deposition results were not quantified to fully characterize the range of potential sediment dispersion that may occur as a result of the burial process.

For example, the model simulation conducted where the resuspension of sediments was activated in SSFATE predicts a plume with much greater extent and increased durations of exposure than the "base case." This simulation would also result in increased deposition (both extent and thickness), although these results were not presented. With the shown resuspension of sediments predicted to occur, this option should have been activated for all model simulations that were conducted, and the results quantified in terms of the extent exposed to different SS concentration levels, the duration of exposure, and sediment deposition.

Additionally, based upon the model sensitivity results, model simulations, which represent more of a worst-case scenario, should have been conducted to better understand the potential sediment plume and deposition. There is still much uncertainty based upon the modeling conducted in the sediment plume extent, SS concentrations, duration of exposure, and deposition that will occur with the cable burial, so there is the need to better quantify the upper bounds of the predictions.

For the jet plow simulations, simulations should be conducted for all of the jet plow advance rates as changes in the advance rate are probable (acknowledged by the Applicant). Those model runs should also include the higher 35 percent trench loss rate (this value is unknown and dependent on sediment characteristics, but is at the upper end of what has been documented from past studies[3]), and allow for the resuspension of sediments to occur. For the diver hand jet burial simulations, the option to allow for resuspension of sediments should be activated in the model to better characterize how the plume dissipates after the jetting activity.

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[3] Foreman, J., 2002. Resuspension of sediment by the jet plow during submarine cable installation. Submitted to GenPower, LLC, Needham, MA. Submitted by Engineering Technology Applications, Ltd, Romsey, Great Britain, May 2002.

We also believe expected wind forcing should be included if it cannot be demonstrated that the effects are minimal for neap and spring tide conditions, as noted earlier in this testimony. These additional simulations would help in representing the full range of probable varied combinations of model parameters and better quantify the potential sediment plume and deposition.

In regard to the SSFATE model validation, Section 3.1 of the SRP Modeling Report gives two examples on how the model has been validated in its ability to predict sediment plumes. The first example is of a cutterhead dredging operation conducted in the Elizabeth River in Portsmouth, Virginia. It seems the model assumptions and parameters used for a cutterhead dredge are quite different than the cable burial via jetting being proposed and this is a deep-water application.

The second example is from Upper New York Harbor for a cable burial using jet plow technology from Bayonne, New Jersey to Brooklyn, New York. While it is stated that statistical analyses comparing the observed plume to the model predictions were made, there are no results presented that quantify how the model performed (i.e., range of differences between what was observed and what was predicted). Reference is made to a whitepaper that suggests the model provides for conservative estimates of jet-plow-induced TSS concentrations[4]. However, a figure is included that shows “Field Data” compared to “SSFATE” predictions and the field data shows a 25 to 50 milligrams per liter sediment plume extending close to the water body surface in approximately 12 meters of water, while the SSFATE model showed a plume only extending to approximately 7 meters below the surface. This comparison does not indicate the model is conservative and the predicted plume is significantly different from the field observations. Additionally, it is evident that this again is a deep-water application (more of a coastal environment compared to the estuarine environment of Little Bay with shallow tidal flat areas and depths less than 3 meters) and the sediment characteristics (based upon grain size where sand and muddy sand dominate the sediments in Upper New York Harbor[5]) are very different from those in Little Bay.

While it is acknowledged that it is difficult to characterize sediment plume dynamics in the field and this has not been always required in past applications of the SSFATE model for predicting sediment dispersion due to cable burial activities, the sensitivity model simulations presented in the SRP Modeling Report and model validation examples conducted to date show there is much uncertainty in the sediment plume and deposition that will occur due to proposed installation methods. This gives further justification for a more robust evaluation of potential sediment plume dynamics in Little Bay, so that the potential impacts can be better quantified through

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[4] Whitney, P., and S. Herz, 2013. Submarine cable embedment: integrating suspended sediment modeling and monitoring into the regulatory permit process. ESS Group Coastal Whitepaper, downloaded from http://www.essgroup.com/images/stories/pdfs/Submarine-Cable-Embedment-and-Suspended-Sediment-Modeling.pdf

[5] Nitsche et al., 2007. Regional patterns and local variations of sediment distribution in the Hudson River Estuary, Estuarine and Coastal Science Shelf, 71 (2007) 259-277, Elsevier.

simulation of what can be deemed as a worst-case scenario and, if needed, appropriate remediation measures can be identified.

With the estuarine environment of Little Bay having shallow tidal flat areas dominated by silts and the proposed cable burial methods, further confidence in the sediment plume characteristics and deposition predicted by the SSFATE model could be achieved by conducting a pilot study using proposed construction methods and a field program to characterize the sediment dispersion that actually occurs. This would allow for better quantification of the amount of uncertainty that should be considered when evaluating the results.

Q. Did the results from the 2017 sediment grain-size analysis impact the representativeness of the SSFATE model results?

A. The 2017 grain size data indicates that the sediment contains more silt and less clay than assumed in the original sediment dispersion model, and this could have significant implications for suspended sediment in Little Bay during and after the proposed construction activities. Clays have several properties, including a high surface area and electrostatic attraction, that cause clay particles to flocculate and settle into a relatively cohesive sediment with a relatively low potential for resuspension. Silts do not have these properties and tend to settle into relatively incohesive sediment that has a relatively high potential for resuspension, particularly in areas of high current velocities, such as in this project area.

Several sections of the revised sediment dispersion modeling report suggest that the model is conservative, in part due to clay properties that are no longer expected to be significant (because relatively little clay was present in the samples). Examples include:

- "The SSFATE model predications for resuspended concentrations are highly conservative, however, and the model does not include details about whether the particles were in a floc when they settled/deposited, does not include a cohesive sediment model (electromagnetic attraction of clays)..."
- "Thus most of the fine sediment is likely to be resuspended on subsequent tides and dispersed from the areas initially affected by deposition unless flocculation of the clay particle occurs and they remain in place..."
- "Since the model did not include a cohesive sediment model, a sediment consolidation model, a sediment consolidation model, adjustments for settled flocs (larger diameters), or interactions with the background suspended sediments and bedload, these predictions are an extremely conservative estimate of potential impacts."

Because the sediments are mostly silt, with little clay, some of those assumptions (e.g., floc during settling, electromagnetic attraction of clays) are not expected to be present at significant levels for this project. Therefore, the degree of conservatism suggested by the model has been reduced by the relative absence of clay in the project area. Due to the high percentage of silt, the settled sediment is expected to be relatively incohesive, and the Hjulstrom diagram included in the report suggests that the high tidal velocity in the project area will likely re-suspend the sediment during the high velocity portions of the tidal cycle.

Therefore, to account for this reduced conservatism in the model, and the likely resuspension of the incohesive silty sediment, the resuspension component of the SSFATE model should be run for each of the completed sensitivity analyses, not just the base scenario.

Q. Was the SSFATE model used to evaluate sediment suspension and deposition from the existing cable removal or pre-lay grapnel run?

A. According to information provided by Normandeau during the July 11, 2017 technical session, sediment suspension and deposition associated with the removal of existing cables and during cable clearing procedures (pre-lay grapnel run or PLGR) was not modeled. Appendix D to the SRP Existing Cable Removal Plan states that turbidity levels during cable removal procedures are "expected to be low and ephemeral;" however, no basis for this statement was provided. It is also stated that the PLGR utilizes a 2-inch thick, 1-meter deep blade that will be dragged through the centerline of the proposed cable route. Although the details of this procedure are not provided, disrupting up to 1 meter of sediment would likely cause significant sediment suspension. We consider this to be an omission that should be evaluated individually and in context of total project impacts.

Q. In your opinion will the SRP have an unreasonable adverse effect on water quality and the natural environment of Little Bay?

A. It is our opinion that the Applicant has not adequately demonstrated that the range of possible or even likely conditions under which cable laying will occur will ensure adequate protection of the Little Bay ecosystem. Fundamental issues were identified in February 2017 that still remain to be addressed by the Applicant. These deficiencies have implications throughout the rest of the evaluation that are enumerated in the preceding paragraphs. Of particular significance is the failure to run the SSFATE model using combinations of likely scenarios during the sensitivity analysis. By not evaluating these combinations, the potential worst-case conditions that may be encountered during cable laying activities are still unknown, and uncertainty remains in the sediment dispersion that would occur. In addition, the model did not account for the potential compounding effects of wind-driven currents on sediment transport or show that such effects would be minimal. By not considering these factors, the base case model underestimates the suspended sediment concentrations and the deposition that would occur. These deficiencies carry over to the ecological risk assessment because modeled worst-case scenarios were not considered in evaluating potential ecological risks. In fact, even the results from the sensitivity analyses that were completed were not used to evaluate potential ecological risks. Numerous other deficiencies have been identified in the ecological risk assessment, including issues pertaining to copper, arsenic, nitrogen, and bacteria. These deficiencies lead to an inadequate assessment of potential risks and impacts associated with the project. It is also our opinion that the Applicant has not demonstrated compliance with New Hampshire Surface Water Quality regulations, specifically including the establishment of a mixing zone. The Applicant has not demonstrated that the anticipated conditions meet the criteria for establishing a mixing zone.

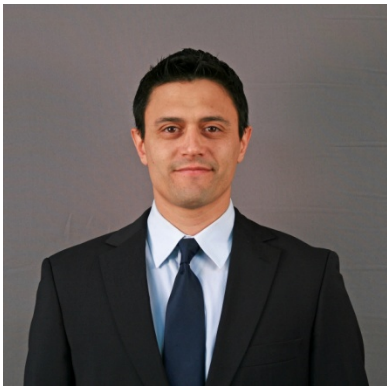
Based upon these factors and the issues presented in the preceding paragraphs, we conclude that the residents of Durham cannot be assured that there will be no unreasonable adverse effects on water quality and the natural environment of Little Bay or that the impact on natural resources will be manageably limited in Little Bay as a result of the SRP as it is currently proposed.

Q. Does this conclude your testimony?

A. Yes, this concludes our testimony at this time, though we reserve the right file supplemental testimony in accordance with the Committee's procedural schedule once we have had a chance to review the NHDES recommendations to the Committee and any other filings made with regard to this project.

ATTACHMENT A

PROJECT EXPERIENCES JOSEPH J. FAMELY



Joseph Famely, M.E.M.

Project Manager/Environmental Scientist

Expertise

Mr. Famely focuses on environmental and sustainability planning with expertise in assessing infrastructure and habitat vulnerabilities to coastal climate change impacts, developing sustainability metrics and greenhouse gas inventories, writing environmental impact statements, and evaluating ecological risk. He has conducted multiple sea level rise and storm surge vulnerability assessments in the New England region, developed customized greenhouse gas assessment tools to help organizations benchmark and track their carbon footprints and prepare sustainability reports, and led strategic land use planning projects. Mr. Famely has conducted numerous aquatic and terrestrial ecological risk assessments at contaminated sites in New England and around the United States, and has applied this significant experience to dredged material management planning efforts in Long Island Sound. As a project manager, he has coordinated multi-discipline teams of architects, engineers and planners in stakeholder engagement processes and developing and assessing design alternatives.

Qualification Summary

- 16 years of experience in environmental assessment and sustainability
- Climate change vulnerability analysis and adaptation planning
- Sustainability planning and greenhouse gas assessment
- Environmental impact statements
- Ecological risk assessment
- Geospatial analysis (ESRI ArcGIS)
- Data visualization and technical writing

Work Experience

2009-Present	Woods Hole Group, Inc. (Project Manager/Environmental Scientist)
2011-2012	Except Integrated Sustainability (Associate)
2009-2012	Anthrocology (Sustainability Consultant)
2008	Yale Urban Design Workshop (Sustainability Fellow)
2006-2007	Exponent (Environmental Scientist)
2000-2006	Menzie-Cura & Associates (Environmental Scientist)

Education

M.E.M., - 2009 Yale School of Forestry & Environmental Studies

B.A., - 2000 Bowdoin College

Certificates of Training

OSHA 40-Hour HAZWOPER

Professional Affiliations

Environmental Business Council of New England, Climate Change and Air Committee

Publications and Presentations

7

Key Projects

Coastal Vulnerability Assessment and Adaptation Prioritization, Trustees of Reservations. Technical Lead – Geospatial Analysis

Prepared vulnerability assessment, based on results of a highly resolved sea level rise and extreme weather model, for all Trustees of Reservations coastal properties. Worked closely with Trustees' staff to develop a coastal vulnerability index for all assets, including infrastructure, habitats, endangered species, natural resource recreational areas, and historical/cultural resources, which will inform prioritization of resilience projects across 30+ properties.

Centredale Manor Restoration Project Superfund Site Trial Support. U.S. Department of Justice. Environmental Scientist

Supported U.S. Department of Justice in defending U.S. Environmental Protection Agency's ecological risk assessments at the Centredale Manor Restoration Project Superfund Site in North Providence, RI. Developed trial materials and coordinated with DOJ lawyers and EPA project managers in preparing the expert witness for trial.

Climate Change and Extreme Weather Vulnerability Assessments for Town of Stonington (CT), ARUP. Technical Lead – Geospatial Analysis

Prepared vulnerability maps, based on results of the U.S. Army Corps of Engineers' North Atlantic Coast Comprehensive Study (NACCS) extreme weather model, for a coastal community in Connecticut with multiple tidally-influenced rivers and embayments. Vulnerability maps were then used to support emergency preparedness and adaptation scoping over various planning horizons – present day, 2030, and 2070.

Ecological Risk Assessment Review and Development of Risk-based Cleanup Goals. MT Environmental Restoration. Project Manager/Environmental Scientist

Conducted a technical review of a Stage II ecological risk characterization for a former printing facility in Massachusetts, and developed recommendations for finalization and submittal. Developed risk-based remedial goals for cadmium in sediment and wetland soil, and oversaw a sediment coring program to determine the vertical and horizontal extents of cleanup.

Climate Change and Extreme Weather Vulnerability Assessment for Great Marsh Communities (MA), National Wildlife Federation. Technical Lead – Geospatial Analysis

Prepared vulnerability maps, based on results of a highly resolved sea level rise and extreme weather model, for six Essex County communities. Vulnerability maps were then used to support emergency preparedness and adaptation planning, with specific emphasis on nature-based adaptation.

Climate Change and Extreme Weather Vulnerability Assessments for Massachusetts Communities, Kleinfelder. Technical Lead – Geospatial Analysis

Prepared vulnerability maps, based on results of a highly resolved sea level rise and extreme weather model, for a number of Massachusetts North Shore and South Shore communities. Vulnerability maps were then used to support emergency preparedness and adaptation scoping over various planning horizons – present day, 2030, and 2070.

MassDOT – FHWA Pilot Project for Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options of the Central Artery, Massachusetts Department of Transportation. Technical Lead – Geospatial Analysis

GIS analyst on a technically advanced, leading-edge pilot project for the Federal Highway Administration evaluating vulnerability to sea level rise and extreme weather events for the Central Artery in Boston, MA using a highly resolved, numerical processes model. Contributed to the development of a geodatabase of infrastructure assets for vulnerability assessment and evaluation of adaptation options. Performed model

Key Projects (continued)

post-processing and QA/QC, and prepared asset vulnerability maps to support vulnerability assessment, emergency response planning, and adaptation planning.

SEIS for the Designation of Dredged Material Disposal Site(s) in Eastern Long Island Sound, Connecticut Department of Transportation. Project Manager

Collaborated with partners at Louis Berger and the University of Connecticut to develop the Supplemental EIS evaluating dredged material disposal site alternatives in Eastern Long Island Sound. Developed analyses of sediment toxicity and bioaccumulation, calculated a dilution criterion for ocean disposal suitability from suspended particulate phase toxicity tests, and authored relevant sections of the SEIS.

Sesuit Harbor Use and Capacity Study. Town of Dennis. Project Manager

Lead a team of engineers, marina development advisors, and landscape architects in the preparation of a master plan for a municipal marina within a harbor on Cape Cod Bay. Analyzed current use and capacity, land and water assets, harbor regulations and by-laws, fee structure, and marina operations and maintenance. Provided the Town with recommendations and cost estimates for land and water improvement design alternatives, and recommendations for changes to administrative and capital processes, to support the safe and efficient operation of the harbor.

Coastal Climate Change Adaptation and Engineering Alternatives. Boston Harbor Association. Technical Lead – Geospatial Analysis

Developed a range of sea level rise and storm surge scenarios using LIDAR data and a customized GIS connectivity analysis to evaluate potential risk to property and critical infrastructure. Supported the development of preparedness plans and engineering adaptations for two sites in Boston – Long/Central Wharves and UMass Boston.

Coastal Climate Change Adaptation and Engineering Alternatives. Battelle. Technical Lead – Geospatial Analysis

Worked with Battelle Ocean Sciences and the University of Southern Maine on assessing the impacts of Climate Change on coastal communities of Groton, Connecticut. Specifically, the regions of Groton Long Point and the infrastructure surrounding the Mystic River were evaluated. The evaluation included the impacts of sea level rise and storm events on potential flooding using LIDAR data and a customized GIS connectivity analysis. For each location, supported the development of conceptual designs for engineering adaptation alternatives. The alternatives ranged from management approaches (e.g., evacuation, flood-proofing of structures, etc.), to soft-engineering options (e.g., beach nourishment, creation of wetlands, etc.), to more significant hard engineering structures (e.g., modular seawalls, revetments, tide gates, hurricane barriers, etc.).

Seagrass Restoration Optimization Strategies in a Changing Climate – Southern New England and New York. The Nature Conservancy. Environmental Scientist

Evaluated the interactive effects of multiple stressors (eutrophication, climate-induced heat stress, sea-level rise-induced light reduction) on the potential success of future seagrass conservation and restoration efforts. Assisted in the development of a database cataloguing relevant characteristics of 170 embayments from Long Island to Cape Cod – including estuarine area and volume, estuarine flushing time, watershed nitrogen loading, sediment physical characteristics, and extent of current or historical seagrass. Contributed to nitrogen loading analyses for twenty selected embayments and ranked overall risk to stressors. The Nature Conservancy uses this tool to prioritize investments in restoration projects, adjoining land preservation, and local changes in policy and planning.

Key Projects (continued)

Ecological Risk Assessment in a Tidally Influenced Freshwater Wetland and Creek. Roux Associates. Environmental Scientist

Conducted a baseline ecological risk assessment for a former metals facility in Connecticut. Planned and led field investigations, managed data analysis, and authored risk characterization report. The analysis included modeling risks to ecological receptors in the wetland and creek from metals and polycyclic aromatic hydrocarbons.

Ecological Risk Assessment in a Riparian Environment. GeoInsight, Inc. Project Manager/Environmental Scientist

Conducted a Stage I and Stage II ecological risk characterization for a former rubber and vinyl tape facility in Massachusetts. Planned and led field investigations, managed data analysis, and authored risk characterization report. The analysis included modeling metals and polycyclic aromatic hydrocarbons in fish and plant tissue from sediment concentrations.

Town of Eastham Conservation Land Inventory and Analysis. Town of Eastham. Project Manager

Conducted an inventory of conservation land in Eastham, including private, municipal, and nonprofit land trust-owned parcels. Reviewed Registry of Deeds documents and relevant Massachusetts conservation law to supplement parcel data with information on the date, method and purpose of protection, the custodian of the protected land, the level of protection, and the existence of wetlands, unrestricted areas, or building envelopes. The work product included a database of conservation land which is hyperlinked to all Registry of Deeds and Town of Eastham documents relevant to the conservation restrictions and readily appended to the Town's GIS system. The analysis included recommendations for increasing the level of protection on conservation lands.

Yale Community Carbon Fund Calculator. Yale Office of Sustainability. Technical Lead – Transportation and Solid Waste

Developed a greenhouse gas emissions model to calculate emissions related to travel, commuting, and events associated with the Yale University community. The calculator is a web-based application which includes integrated explanatory text and a standalone report on methodology. The tool enables members of the community to determine the appropriate quantity of emissions to offset with an online donation to the Yale Community Carbon Fund, which supports carbon mitigation projects for organizations and low-income households in New Haven.

Long Island Sound Dredged Materials Management Planning. U.S. Army Corps of Engineers. Environmental Scientist

Conducted a review of literature on dredge materials management and environmental data for Long Island Sound. Reviewed potential sites throughout the Sound for alternative placement of dredge materials – including beach nourishment via direct placement, upland beneficial use, shoreline confined disposal, and nearshore placement for beach nourishment and shoreline protection. Reviews of alternatives included site visits and desktop review (in an ArcGIS environment) based on spatial analysis of environmental/physical/cultural/infrastructure impacts of project development. Prepared a synthesizing report in support of the Dredged Materials Management Plan for Long Island Sound.

Delaware Estuary Regional Sediment Budget. U.S. Army Corps of Engineers. Technical Lead – Geospatial Analysis

Performed an estuary-wide analysis of historical shoreline change to derive a sediment source term for the fine sediment budget. Using synoptic historical shoreline data and sediment properties data for the wetland coast, calculated the surface area of the estuarine shore lost and gained between the 1880s and 2008, as well as the mass of mineral or organic sediment produced through time. The time-averaged rate of sediment

Key Projects (continued)

production by shore erosion was then used for the sediment budget analysis.

Shoreline Change Analyses for Private Properties on Long Island. Inter-Science Research Associates. Technical Lead – Geospatial Analysis

Conducted numerous quantitative spatial analyses of shoreline and dune movement over time in support of Coastal Erosion Hazard Area evaluations in New York. Analyzed multiple historical aerial photographs to digitize the shoreline and calculate long-term rates of change along transects through the beach and dune. Summarized results and recommended changes in the delineation of resource areas based on review of the data with respect to the New York State Coastal Erosion Management Regulations.

New Bedford Harbor Superfund Site. U.S. Army Corps of Engineers. Environmental Scientist

Data analysis and technical reporting in support of Remedial Investigation and Feasibility Study for New Bedford Harbor Operable Unit #3. Analyzed sediment and tissue chemistry data along with toxicity tests and benthic community data to support management decisions in areas outside the harbor.

Greenhouse Gas Impacts Modeling for a Real Estate Development Environmental Review. Private Client. Project Manager/Technical Lead

Developed a greenhouse gas model to evaluate the impacts of multiple development alternatives for a proposed socially- and environmentally-conscious resort and residential community development's Environmental Impact Statement under the New York State Environmental Quality Review process. Prepared summary tables and text for the EIS submittal as well as a full report documenting the methodology and results.

Neighborhood-Scale Sustainability Master Plan. Greater Dwight Development Corporation. Project Manager/Technical Lead

In collaboration with the Yale Urban Design Workshop, developed a neighborhood-scale sustainability plan for a nonprofit community-based development organization in New Haven, CT. The master plan included spatially-informed sustainability metrics (carbon, water, air pollution, greenspace, social, etc.) and suggested projects for continuous improvement.

Materials Flow Analysis on the Island of O'ahu. Hawaii Community Foundation. Environmental Scientist

Researched and prepared report on material flows in the sectors of imports, exports, and natural resource extraction on the island of O'ahu in Hawaii. Research combined aggregation of available public data with phone and field interviews. The report summarized findings and proposed strategies for the optimization of material flows on an isolated island.

Publications and Presentations

Hoffnagle, B, J Famely, T Wickwire, T O'Shea, V Antil. 2017. Poster Presentation: The Use of a Coastal Vulnerability Assessment to Prioritize Habitat Adaptation Strategies in Response to Future Climate Change. Cape Cod Natural History Conference, Barnstable, MA. March 11, 2017.

Wickwire T.W. and J. Famely. 2016. The Value of GIS and the Ecological Risk Framework for Analyzing Climate Vulnerability of Ecological Assets. ECO: Environmental Coastal and Offshore, October 2016; 18-22.

Bain, A., N. Caruso, J. Famely, R. Herzl, and J. Wu. 2009. Master Plan for Nusajaya / Zone B, Iskandar, Malaysia. Yale School of Architecture Retrospecta 08-09.

Publications and Presentations (continued)

Famely, J. 2008. Adapting Vernacular Architecture for Sustainable and Restorative Environmental Design Elements. Presented Urban Villages, Inc.

Famely, J., E. Gladek, and C. Ziemba. 2008. Material flows on the island of Oahu: Imports, exports, and resource extraction. New Haven: Yale Center for Industrial Ecology.

Von Stackleberg, K., C. Amos, C. Butler, T. Smith, J. Famely, M. McArdle, B. Southworth, and J. Steevens. 2006. Screening Level Ecological Risk Assessments of Some Military Munitions and Obscurant-related Compounds for Selected Threatened and Endangered Species. ERDC-TR-06-11. Engineer Research and Development Center – Construction Engineering Research Laboratory. Champaign, IL.

Famely, J., W.T. Wickwire, and C.A. Menzie. 2005. Assessment and planning approaches in watershed assessment: The embayment eutrophication case study. New England Estuarine Research Society, Spring, 2005 Meeting, Eastham, MA, April 27, 2005.

ATTACHMENT B

PROJECT EXPERIENCES STEPHEN H. JONES

Stephen H. Jones

Research Associate Professor, Department of Natural Resources & the Environment
Associate Director, New Hampshire Sea Grant College Program
Jackson Estuarine Laboratory & Rudman Hall, University of New Hampshire, Durham, NH 03824

EDUCATION

University of Maine-Orono	B.S., Soil Science	1976
University of Wisconsin-Madison	M.S., Soil Science	1980
University of Wisconsin-Madison	Ph.D., Bacteriology	1983

APPOINTMENTS

2006-present	Associate Director, New Hampshire Sea Grant College Program
2008-present	Graduate Microbiology Program Faculty member, Department of Molecular, Cellular and Biomedical Science, University of New Hampshire.
1993-present	Research Associate Professor of Natural Resources and Marine Science, Department of Natural Resources and the Environment, University of New Hampshire.
2002-2006	Director, University of New Hampshire Center for Marine Biology
1989-1992	Research Assistant Professor of Natural Resources and Marine Science, Department of Natural Resources, University of New Hampshire.
1987-1989	Research Assistant Professor, Department of Microbiology, University of New Hampshire.
1986-1987	Research Fellow & Adjunct Professor, Department of Civil Engineering, Syracuse Univ.
18984-86	Research Fellow, Inst. for Comparative & Environmental Toxicology, Cornell University

GENERAL AREA OF INTEREST AND EXPERTISE

My research and scholarly interests are focused on understanding the interactions between bacteria and their environment. I have focused on microbial species and processes that affect human health, and how to model and manage conditions to minimize public health risks. Current interests focus on the ecology of naturally occurring pathogenic *Vibrio* species that can cause human illness to consumers of raw or undercooked shellfish, along with tracking sources of fecal contamination at beaches and shellfish harvest areas. I am also an environmental toxicologist and am interested in the sources and fate of nutrients and toxic metal and organic chemical contaminants in coastal waters.

SYNERGISTIC ACTIVITIES-recent

1. As Associate Director & Assistant Director for Research for the NH Sea Grant Program, I work with researchers from UNH and other NH academic institutions, and support their research through our development and regular competitive programs. I work with other Sea Grant programs to manage regional projects and in program and proposal reviews.
2. International Advisory Committee, International Conference on Molluscan Shellfish Safety. I provide guidance and support for (biannual) meetings and help edit proceedings papers.
3. Co-chair of oral presentation section on Vibrios, National Shellfisheries Association and World Aquaculture Society annual meeting, February 2016, Las Vegas, NV. The focus of this session was to better understand the ecology, epidemiology, harvest management and strategies to prevent human illness associated with pathogenic *Vibrio* species and the consumption of raw shellfish.
4. Executive Leadership Team, NSF-EPSCoR project between Maine and New Hampshire on ‘Safe Shellfish, Safe Beaches”. I worked with the ELT team to manage this large multi-state project.
5. Project Manager and program participant, Gulf of Maine Gulfwatch Program. This international multi-jurisdictional monitoring program focuses on toxic chemicals in blue mussels. I work to seek out funding, manage the annual sampling and analysis logistics, and am typically the lead author on peer-reviewed papers.

6. Piscataqua Region Estuaries Partnership technical advisory committee, former chair.

HONORS AND FELLOWSHIPS

2011-2015	Faculty Fellow in Sustainability Science, University of New Hampshire
2008	Gulf of Maine Distinguished Service Award
2004	Gulf of Maine Visionary Award

PROFESSIONAL AFFILIATIONS

American Society for Microbiology
National Shellfisheries Association
International Association for Food Protection
Interstate Shellfish Sanitation Conference
Northeast Shellfish Sanitation Association

STUDENTS & POSTDOCTORAL SCHOLARS 2011-present

Graduate Students: 7 Undergraduates:20 Postdoctoral Fellow: 1 Post-graduate technicians: 12

TEACHING 2011-present

ENE/CIE 756/856 Environmental Engineering Microbiology, Spring 2015, 2016, 2017

PEER-REVIEWED PUBLICATIONS: 2011-present

Xu F, Gonzalez-Escalona N, Drees KP, Sebra RP, Cooper VS, **Jones SH**, Whistler CA. Accepted manuscript posted online 7 July 2017**.** Parallel evolution of two clades of a major Atlantic endemic *Vibrio parahaemolyticus* pathogen lineage by independent acquisition of related pathogenicity islands. Appl. Environ. Microbiol. doi: 10.1128/AEM.01168-17

Xu F, Gonzalez-Escalona N, Haendiges J, Myers RA, Ferguson J, Stiles T, Hickey E, Moore M, Hickey JM, Schillaci C, Mank L, Derosia-Banick K, Matluk N, Robbins A, Sebra RP, Cooper VS, **Jones SH**, Whistler CA. 2017. Sequence type 631 *Vibrio parahaemolyticus*, an emerging foodborne pathogen in North America. J Clin Microbiol 55:645– 648. https://doi.org/10.1128/JCM.02162-16

Urquhart, E.A., **S.H. Jones**, J.W. Yu, B.M. Schuster, A.L. Marcinkiewicz, C.A. Whistler and V.S. Cooper. 2016. Environmental conditions associated with Elevated *Vibrio parahaemolyticus* concentrations in Great Bay estuary, New Hampshire. PLoS ONE 11(5): e0155018: doi:10.1371/journal.pone.0155018.

Xu, F., S. Ilyas, J. A. Hall, **S. H. Jones**, V. S. Cooper & C. A. Whistler. 2015. Genetic characterization of clinical and environmental *Vibrio parahaemolyticus* from the Northeast USA reveals emerging resident and non-indigenous pathogen lineages. Front. Microbiol. **6**: 272

Whistler, C.W., J. A. Hall, F. Xu, S. Ilyas, P. Siwakoti, **S. H. Jones** and V. S. Cooper. 2015. Use of whole-genome phylogeny and comparisons for development of a multiplex PCR assay to identify sequence type 36 *Vibrio parahaemolyticus*. J. Clin. Microbiol. **53**: 1864-1872.

Taylor M, J Yu, CA Whistler, V Cooper, T Howell and **S Jones** 2014. Treatment time and environmental factors affect the reduction of *Vibrio parahaemolyticus* concentrations in relayed oysters (*Crassostrea virginica*), pp 98-101, In, McLeod et al. (eds). Proceedings of the 9th International Conference on Molluscan Shellfish Safety, Sydney, 17-22 March 2013. ISBN-13: 978-0-646-92993-4.

Jones, S. 2014. Microbial source tracking to identify and manage sources of fecal contamination in shellfish growing waters. Pp. 39-43, In, McLeod et al. (eds). Proceedings of the 9th International Conference on Molluscan Shellfish Safety, Sydney, 17-22 March 2013. ISBN-13: 978-0-646-92993-4.

Ellis, C.E. B.M. Schuster, M. J. Striplin, **S. H. Jones**, C. A. Whistler, and V S. Cooper. 2012. Influence of seasonality on the genetic diversity of *Vibrio parahaemolyticus* in New Hampshire shellfish waters as determined by multi-locus sequence analysis. *Appl. Env. Micro* 78(10):3778-82.

Sunderland, E.M., A. Amirbahman, N.M. Burgess, J. Dalziel, G. Harding, **S.H. Jones**, E. Kamai, M.R. Kargas, X. Shi and C.Y. Chen. 2012. Mercury sources and fate in the Gulf of Maine. Environ. Res. 119: 27-41.

Jones, S.H. 2011. Microbial Pathogens and Biotoxins: State of the Gulf of Maine Report. Gulf of Maine Council on the Marine Environment. http://www.gulfofmaine.org/stateofthegulf. 21 pp.

B.M. Schuster, A. Tyzik, R. Donner, **S.H. Jones**, V.S. Cooper, C.A. Whistler. 2011. Population structure and ecological correlations of an endemic northern temperate population of *Vibrio cholerae* with close relatives to toxigenic isolates. Appl. Envrion. Microbiol. 77: 7568-7575.

RELATED OLDER PUBLICATIONS

Jones, S., C. Krahforst & G. Harding. 2010. Distribution of mercury and trace metals in shellfish and sediments in the Gulf of Maine, pp. 308-315, In, Proceedings of the 7th International Conference on Molluscan Shellfish Safety, Lassus, P. (Ed.) June 14-19, 2009, Nantes, France, Quae Publishing, Versailles, France.

Jones SH. 2009. Microbial Contamination and Shellfish Safety, Ch 1, pp. 3-42, *In* Shellfish Safety and Quality, Shumway, S and G Rodrick (Eds). Woodhead Publishing, Ltd., Cambridge, UK.

Trowbridge PR, SH Jones. 2009. Detecting Water Quality Patterns in New Hampshire's Estuaries Using National Coastal Assessment Probabilistic Monitoring Data. Environmental Monitoring and Assessment 150: 129-142.

Evers, D.C., R. P. Mason, N.C. Kamman, C.Y. Chen, A.L. Bogomolni, D.L. Taylor, C.R. Hammerschmidt, S.H. Jones, N.M. Burgess, K.Munney and K.C. Parsons. 2008. An Integrated Mercury Monitoring Program for Temperate Estuarine and Marine Ecosystems on the North American Atlantic Coast. Ecohealth 5: 426-441.

Jones SH. 2008. Environmental sources of microbial contaminants in shellfish and their public health significance. J. Foodservice 19: 238-244. doi: 10.1111/j.1745-4506.2008.00105.x

Bolster, C.H., J. M. Bromley, and S. H. Jones. 2005. Recovery of Chlorine-Exposed *Escherichia coli* in Estuarine Microcosms. Environ. Sci. Technol. 39: 3083-3089. Hdoi:10.1021/es048643s

Jones, S.H. 2004. Contaminants and Pathogens. pp. 33-41, In: The Tides of Change Across the Gulf. An Environmental Report on the Gulf of Maine and Bay of Fundy. Pesch, G.G. and P.G. Wells (Eds.). Gulf of Maine Council on the Marine Environment, Concord, NH.

Jones, S.H., M. Chase, J. Sowles, P. Hennigar, N. Landry, P.G. Wells, G.C.H. Harding, C. Krahforst and G.L. Brun. 2001. Monitoring for toxic contaminants in *Mytilus edulis* from New Hampshire and the Gulf of Maine. J. Shellfish Res. 20: 1203-1214.

Chase, M. E., S.H. Jones, P. Hennigar, J. Sowles, G.C.H. Harding, K. Freeman, P.G. Wells, C. Krahforst, K. Coombs, R. Crawford, J. Pederson and D. Taylor. 2001. Gulfwatch: Monitoring spatial and temporal patterns of trace metal and organic contaminants in the Gulf of Maine (1991-1997) with the blue mussel, *Mytilus edulis* L. Mar. Poll. Bull. 42: 490-504.

Jones, S.H. 2000. A Technical Characterization of Estuarine and Coastal New Hampshire. The New Hampshire Estuaries Project, Portsmouth, NH.

Weber, J.H., R. Evans, S.H. Jones and M.E. Hines. 1998. Conversion of mercury (II) into mercury (0), monomethylmercury cation, and diemthylmercury in saltmarsh sediment slurries. Chemosphere 36: 1669-1687.

Jones, S.H. and M. Alexander. 1988. Effect of inorganic nutrients on the acclimation period preceding mineralization of organic chemicals in lake water. Appl. Environ. Microbiol. 54:3177-3179.

Jones, S.H. and M. Alexander. 1988. Phosphorus enhancement of mineralization of low concentrations of p-nitrophenol by *Flavobacterium* sp. in lake water. FEMS Microbiol. Lett. 52:121-126.

Wiggins, B.A., S.H. Jones, and M. Alexander. 1987. Explanations for the acclimation period prior to the mineralization of organic chemicals in aquatic environments. Appl. Environ. Microbiol. 53:791-196.

Jones, S.H. and M. Alexander. 1986. Kinetics of mineralization of phenols in lakewater. Appl. Environ. Microbiol. 51:891-897.

Hoover, D.G., G.E. Borgonovi, S.H. Jones, and M. Alexander. 1986. Anomalies in the mineralization of low concentrations of organic compounds in lake water and sewage. Appl. Environ. Microbiol. 51:226-232.

PRESENTATIONS: 2015-17

Application of Robust Microbial Source Tracking Methods for Identifying Bacterial Contamination Sources at Maine's Beaches. **Jones, SH** and D. Rothenheber. 2017. The Beaches Conference: Our Maine and New Hampshire Beaches and Coast. Wells, ME. July 17, 2017.

Ecological Modeling to Identify Seasonal Conditions that Contribute to *Vibrio parahaemolyticus* Concentration Variation in Oysters from a New England Estuary. Hartwick, M, E. Urquhart, C. Whistler, V. Cooper and **SH Jones.** , p. 81, In: Proceedings of the 11th International Conference on Molluscan Shellfish Safety in Galway, Ireland, May 14-18, 2017.

Identification of a conserved pathogenicity island architecture in prevalent *Vibrio parahaemolyticus* clinical strains from North America and its application for pathogen enumeration in oysters. Feng, X, N. Gonzalez-Escalona , K. Hartman, V. Cooper, **SH Jones,** C. Whistler, p. 102, In: Proceedings of the 11th International Conference on Molluscan Shellfish Safety in Galway, Ireland, May 14-18, 2017.

Vibrio parahaemolyticus Population and Microbial Community Dynamics Related to Post-Harvest Oyster Relay Success. **Jones, SH**, M. Taylor, M. Hall, A. Marcinkiewicz, T. Howell, V. Cooper, C. Whistler, p. 103, In: Proceedings of the 11th International Conference on Molluscan Shellfish Safety in Galway, Ireland, May 14-18, 2017.

Pathogenic Vibrios in New England Shellfish: Pathogenic Strain Detection & Population Dynamics, Environmental & Predictive Modeling, and Best Management Practices. **Jones, SH**, C. Whistler, M. Hartwick. Northeast Shellfish Sanitation Conference, Northeast Vibrio Workshop. April 13, 2017. Freeport, ME.

Pathogenic Vibrios in New England Shellfish: Pathogenic Strain Detection & Population Dynamics, Environmental & Predictive Modeling, and Best Management Practices. **Jones, SH**, C. Whistler, M. Hartwick. University of New Hampshire School of Marine Science and Ocean Engineering Seminar. April 5, 2017.

New Hampshire Oyster Re-Submergence for Reduction of Vibrio parahaemolyticus Levels-2016. Jones, SH and C. Nash. Annual NH Shellfish Growers Meeting. NH Shellfish Program. March 17, 2017. Portsmouth, NH.

Applying Surveillance and Seasonal Trend Analysis to Identify Conditions that Influence *V. parahaemolyticus* Concentrations in New England Shellfish. Hartwick, M and **SH Jones**. 2017. Northeast Aquaculture Conference and Exposition/Milford Seminar, Providence, RI. January 12-13, 2017.

Shellfish and Coastal Water Contamination from Bird Feces. **Jones, SH** and D. Rothenheber. 2017. Northeast Aquaculture Conference and Exposition/Milford Seminar, Providence, RI. January 12-13, 2017.

Assessing Opportunities for Aquaculture in Shellfish Growing Areas Adjacent to Wastewater Treatment Plant Outfalls: Determination of Viral Reduction Performance, Impacts on Shellfish Safety and Informing Harvest Managers. **Jones, SH**, T. Howell, L. Howell, K. Calci, G. Goblick, K. DeRosia-Bannick, T.

Getchis. 2017. Northeast Aquaculture Conference and Exposition/Milford Seminar, Providence, RI. January 12-13, 2017.

Microbial Source Tracking in Maine Coastal Communities. **Jones, SH**, D. Rothenheber and M. Sims. 2016. INVITED presentation to the Maine DEP Watershed Managers annual roundtable, Augusta, Maine. November 9, 2016.

Vibrio parahaemolyticus Population Dynamics Within an Estuarine Microbial Community. Hartwick, M. and **S. Jones**. Poster presented at the 16th International Symposium on Microbial Ecology, Montreal, Quebec. August 21-26, 2016.

Fecal Contamination Sources in Storm Water from a MS4 Regulated Town. Rotheheber, D. and **S. Jones**. Poster presented at the 116th General Meeting of the American Society for Microbiology annual meeting, Boston, MA. June 16-20, 2016.

Bacterial Pollution and Sources: A Look at York, Maine Beaches. **S. Jones**, D. Rothenheber. INVITED co-presentation and discussion at the Northeast Estuarine Research Society annual meeting with Steve Burns, Town Manager of York, Maine. April 14, 2016.

Comparative Genomic Analysis of Environmental Strains of *Vibrio parahaemolyticus*. J.Lemaire, S.Richards, M.Hartwick, F.Xu, **S. Jones**. 25h Annual COLSA Undergraduate Research Conference. April 23, 2016.

Empirical Modeling of *Vibrio parahaemolyticus* Presence and Concentration in New Hampshire Shellfish. **S. Jones**, E. Urquhart, M. Hartwick, V. Cooper, C. Whistler. **Co-chair** at Vibrio session of the World Aquaculture Society/National Shellfisheries Association annual meeting, Las Vegas, NV. February 23, 2016.

Know Thy Enemy: How Analysis of the Northeastern Pathogenic Population of *Vibrio parahaemolyticus* Can Improve Pathogen Identification and Risk Assessment. C. Whistler, F. Xu, A. Marcinkiewicz, J. Hall, K. Drees, M. Halee, V. Cooper, **S. Jones**. World Aquaculture Society/National Shellfisheries Association annual meeting, Las Vegas, NV. February 23, 2016.

Jones S, Urquhart E, Hartwick M, Whistler C, Cooper V. 2016. Empirical Modeling of *Vibrio parahaemolyticus* Presence and Concentration in New Hampshire Shellfish, p. 21. *In* Blogoslawski WJ, Milke L, editors. 2016. 36th Milford Aquaculture Seminar. US Dept of Commerce, Northeast Fish Sci Cent Ref Doc. 16-06; 52 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/publications/ 2015

Downeast Drainage - Examining and Communicating the Dynamics of Bacteria Pollution Events in the Gulf of Maine. S. Smith, B. McGreavy, S. Roy, B. Gerard, K. Cole, D. Rothenheber, **S. Jones**, D. Brady, C. Petersen. Poster presentation at the American Geophysical Union meeting, San Francisco, CA, December 12-16, 2015.

The Ecology of *Vibrio parahaemolyticus* in the Northeast US. INVITED plenary presentation at the Northeast Vibrio Forecasting Workshop, Sheldon CT, November 17, 2015.

Sources and Fate: The impacts of storm drains & cast seaweed on beach water quality-York Maine. D. Rothenheber, **S. Jones**. INVITED presentation to the Maine Watershed Bureau annual roundtable, Augusta, Maine. November, 2015.

The Role of Plankton in *Vibrio parahaemolyticus* Ecology in a New England Estuary. M. Hartwick, E. Urquhart, V. Cooper, **S. Jones**. Poster presented at the115th General Meeting of the American Society for Microbiology annual meeting, New Orleans, LA. May 30-June 2, 2015.

Phylogenetic and Comparative Genomic Analysis of Resident Pathogenic *Vibrio parahaemolyticus* Strains from the Atlantic of the United States. Feng Xu, **Steve Jones**, Vaughn Cooper & Cheryl Whistler. 2015. Poster presented at the 115th General Meeting of the American Society for Microbiology annual meeting, New Orleans, LA. May 30-June 2, 2015.

Long-term Trends Within *Vibrio* Spp. Populations in New England. **S. Jones**, E. Urquhart, F. Xu, A. Marcinkiewicz, M. Hartwick, V. Cooper & C. Whistler. INVITED Seminar to the MA Dept. of Public Health and MA Division of Marine Fisheries. May, 2015.

Long-term Trends and Emergence of Pathogenic Strains Within *Vibrio Spp.* Populations in New England. **S. Jones**, F. Xu, A. Marcinkiewicz, M. Hartwick, E. Urquhart, V. Cooper, C. Whistler. INVITED presentation at the Northeast Food and Drug Officials Assn. annual meeting, Burlington, VT. May 8, 2015.

Optimized Separation of Estuarine Plankton to Determine Associations with Vibrio Species. E. Schulz, E.Deyett, M. Hartwick, E. Urquhart, **S. Jones**. 24th Annual COLSA Undergraduate Research Conference. April 25, 2015.

Vibrio ecology and population dynamics in the Great Bay Estuary. Meghan Hartwick and **S. Jones**. Presentation at the SMSOE 1st Annual Graduate Student Research Symposium, April 13, 2015.

Characterizing the Utility of Plankton in *Vibrio parahaemolyticus* Surveillance. M. Hartwick, J. Lemaire, E. Urquhart, V.S. Cooper**, S. Jones**. Poster presentation at the Maine Sustainability & Water Conference 2015. Tuesday, March 31, 2015 Augusta Civic Center, Augusta, Maine.

Modeling Variation in Pathogenic Bacteria Concentrations in Coastal and Estuarine Waters. Erin Urqhuart, Kelly Cole, Damian Brady, Vaughn Cooper, **Steve Jones**, Meghan Hartwick, Jacqueline LEMAIRE. INVITED Oral presentation at the Maine Sustainability & Water Conference 2015. Tuesday, March 31, 2015 Augusta Civic Center, Augusta, Maine.

Long-term Trends of Pathogenic *Vibrio Spp.* Populations in New England, U.S. **Steve Jones**, Erin Urquhart, Meghan Hartwick, Michael Taylor, Vaughn Cooper & Cheryl Whistler. INVITED Oral Presentation at the 10th International Conference on Molluscan Shellfish Safety in Puerto Varas, Chile, March 18, 2015.

Use of Environmental Determinants to Model the Risk of Pathogenic *Vibrio* Bacteria in Great Bay Estuary, NH. Urquhart, E., Hartwick, M., **Jones, S**., Whistler, C., Cooper, V. New England Association of Environmental Biologists (NEAEB) & NH Water and Watershed Conference. March 20, 2015. Bartlett, NH.

Long-term Trends of Pathogenic *Vibrio Spp.* Populations in New Hampshire Oysters. **Steve Jones**, Erin Urquhart, Meghan Hartwick, Michael Taylor, Vaughn Cooper & Cheryl Whistler. INVITED Oral presentation in Vibrio Session at the Northeast Aquaculture Conference and Exposition in Portland, ME. January 15, 2015.

Characterization of clinical and environmental *Vibrio parahaemolyticus* from New England reveals emerging resident and invasive pathogen lineages. Feng Xu, **S.H. Jones** and others. Oral presentation in Vibrio Session at the Northeast Aquaculture Conference and Exposition in Portland, ME. January 15, 2015.

MANUSCRIPT REVIEWS: 2015-present

Journal of Shellfish Research, Applied and Environmental Microbiology, Journal of Marine Biology and Oceanography, PLoS One, Marine Pollution Bulletin

FUNDED PROJECTS: (through 2016-17)

2016-18. *Assessing Opportunities for Aquaculture in Shellfish Growing Areas Adjacent to Wastewater Treatment Plant Outfall: Determination of Viral Deactivation Performance, Impacts on Shellfish Safety and Informing Harvest Management*: NOAA/Sea Grant Aquaculture Research Program. $449,583.

2015-16: *Monitoring Activities to Support the National Coastal Condition Program in New Hampshire*: US EPA/NH Dept. of Environmental Services. $65,000.

2010-18: *Estuarine Monitoring Activities that Support the NH Estuaries Project in 2016*. Piscataqua Regional Estuaries Partnership/US EPA.$45,000-65,000/y.

2016-19*: Ecosystem Factors Affecting Vibrio parahaemolyticus Populations and Potential Impacts on Shellfish Safety*. : UNH Agric. Exptl. Station/USDA. $45,000.

2013-16: *Effects of Environmental Conditions on Detection and Populations of Pathogenic Vibrios in Oysters Grown in the Northeast US*: UNH Agric. Exptl. Station/USDA. $39,000.

2014-*16:* *Strengthening the scientific basis for decision-making: Advancing sustainability science and knowledge-action capacities in coupled coastal ecosystems*: National Science Foundation/EPSCoR Program. $3,000,000.

2017-18: *Cocheco & Bellamy River Sonde Deployment and Studies*: Cities of Dover & Rochester, NH. $65,912.

2016-17: *Cocheco River Sonde and Dover WWTF Impact Study*: Cities of Dover, Portsmouth & Rochester, NH. $25,485.

2014-18*: Vibrio Analysis of Oyster Farms and Re-Submergence Study*: NH Dept. of Environmental Services. $9,990-12,299/y.

ATTACHMENT C

PROJECT EXPERIENCES MATTHEW F. SHULTZ

Matthew F. Shultz, M.S., B.S., P.E.

Senior Coastal Engineer

Expertise

Modeling of coastal and estuarine hydrodynamics, waves, and sediment transport processes and in the evaluation of structural and non-structural shoreline protection alternatives. Project management of large-scale coastal modeling studies, the development of models for assessment of coastal hazards and adaptation measures, as well as large-scale marsh restoration and the assessment of hydraulic structures. Extensive experience in programming languages and in developing software to present, analyze, and solve engineering and scientific problems. Experience in areas of marine structure design, waterfront construction, and construction project management.

Qualification Summary

- More than fifteen years of diverse professional experience in the fields of coastal, civil and software engineering
- Experienced with modeling coastal hydrodynamics, sediment and particulate transport, coastal wave dynamics, and tidal hydraulics
- Strong programming skills and knowledgeable in software design and advanced concepts
- Numerical model experience with CMS, MIKE21, EFDC, DELFT3D, HEC-RAS, ADCIRC, SWAN, RMA, STWAVE, SBEACH, CSHORE GENESIS, DYNLET, CORMIX, and ACES
- Programming experience with MATLAB, FORTRAN, C++, JAVA, VBScript, JavaScript, HTML, XML, XSL
- Database experience: Oracle, SQL Server, SQL Anywhere, MS Access

Work Experience

2016-present	Senior Coastal Engineer, Woods Hole Group
2010-2016	Senior Coastal Engineer/PM, Dewberry
2005-2010	Coastal Engineer, Woods Hole Group
2004	Graduate Assistant, University of Rhode Island
1998-2004	Senior Consultant, WinMill Software
1997-1998	Field Engineer, Modern Continental Construction

Education

M.S., Ocean Engineering – 2005
University of Rhode Island
B.S., Civil Engineering – 1996
Tufts University

Licenses and Registrations

- P.E., Professional Engineer, Connecticut License PEN.0030884
- P.E., Professional Engineer, Louisiana License PE.0036650
- P.E., Professional Engineer, Massachusetts License 47832

Professional Affiliations

Member, American Shore & Beach Preservation Association (ASBPA)

Member, Coasts, Oceans, Ports, and Rivers Institute (COPRI)

Member, American Society of Civil Engineers (ASCE)

Publications and Presentations

11

Key Projects

Coastal Processes Evaluation for Plum Island, Newburyport, MA. – Lead Coastal Engineer
In support of a NFWF Grant for Community Risk Reduction through Comprehensive Coastal Resiliency Enhancement for Great Marsh Upper North Shore, MA, Woods Hole Group conducted a coastal processes analysis to assist with the understanding of existing conditions and causes for shoreline retreat and erosion along Plum Island. Wave and sediment transport models were developed to characterize sediment transport trends in average annual and extreme storm wave conditions. The coastal study will give further insight into erosion hotspots that have historically occurred along the barrier island, the influence of jetty structures/nearshore features near the inlet to the Merrimack River, and potential mitigation solutions.

Design and Permitting of Nearshore Borrow Site and Sand Bypass System at Scusset Beach, Sandwich, MA. – Senior Coastal Engineer
Conducted an analysis of coastal processes to characterize existing wave environment and sediment transport trends at Scusset Beach State Reservation. Wave and sediment transport models were then used to evaluate different sand source alternatives including offshore/nearshore borrow sites along with beach profile adjustment and mining of sand dunes. An alternatives analysis was conducted to refine the borrow site location and dimensions, and to also gauge potential impacts of sand bypassing on adjacent infrastructure and natural resources. Engineering design and permit level plans of the recommended alternative were developed to support the Town of Sandwich in the permit process for sand placement at Town Neck Beach. Work was conducted with funding from the office of Massachusetts Coastal Zone Management's (CZM) Coastal Community Resilience Grant Program.

Chapoquoit Beach Restoration, Falmouth, MA - Senior Coastal Engineer
Planning and design project to restore critically eroded Chapoquoit Beach using sand dredged from the Cape Cod Canal by the US Army Corps of Engineers. Updated coastal processes analysis for the West Falmouth shoreline in Buzzards Bay to develop a sediment budget in support of the beach restoration study. Sediment transport analysis assisted in determining rate of infilling occurring at the inlet to West Falmouth Harbor and maintenance dredging requirements. Work was conducted under funding from the office of Massachusetts Coastal Zone Management's (CZM) Coastal Community Resilience Grant Program.

Hudson River Project: Resist, Delay, Store, Discharge NEPA EIS, Hudson County, NJ. -Lead Coastal Engineer
Feasibility Study and EIS for a $230-million comprehensive urban water strategy conceived to protect the Hoboken waterfront, as well as parts of Weehawken and Jersey City. Known as Resist, Delay, Store, Discharge, the project incorporates hard and nature-based infrastructure measures to address surge protection, coastal defense, and systemic drainage issues. Responsible for developing a MIKE21 coastal hydrodynamic model that was integrated with a MIKE URBAN stormwater model using MIKE FLOOD. Work also involved preliminary design of flood protection concepts through wave runup and overtopping analysis, overland wave modeling using a 1-D wave transformation model, computing dynamic wave loading and forces, and evaluating landward hazards to developments and built infrastructure.

Oakwood Beach Flood Attenuation Feasibility Study, Staten Island, NY - Lead Coastal Engineer
Integrated water resources study evaluating the feasibility of coastal storm damage reduction, storm water drainage and BMPs with added nature-based-infrastructure to increase ecological restoration opportunities for a community impacted by Hurricane Sandy. Responsible for the development and evaluation of alternatives to USACE's proposed revetment including the assessment of design waves and water levels to be used in wave runup and overtopping assessments. Conducted technical oversight and QAQC for 2-D hydrodynamic model used to evaluate newly proposed channels and revetment alignment combined with flow-control structures under tidal and extreme storm conditions. Working with regional offices consulted with NY DEC, USACE, The Nature Conservancy, NYC and other stakeholders to help ensure combined needs were properly assessed and incorporated into the project.

Key Projects (continued)

Coastal A Zone Maps, Massachusetts - Senior Coastal Engineer
Served as technical advisor and provided quality assurance and control for the development of new Coastal A Zone Maps for the Commonwealth of Massachusetts. Developed the technical review process and administered quality reviews for new and revised mapping of the Limit of Moderate Wave Action (LiMWA) to advise community officials of hazards due to waves and where Massachusetts State Building Code requirements and other regulations would apply. Coastal A Zone maps were developed for over 1,100 miles in eight coastal counties in Massachusetts keeping with the new FEMA guidance for delineating wave hazards.

FEMA Risk MAP Production & Technical Services (PTS), Federal Emergency Management Agency, Nationwide - Senior Coastal Engineer and Project Manager
Led several countywide coastal updates in FEMA Regions II and III. Projects included task management of terrain processing, field reconnaissance, coastal hydrodynamics and wave modeling, erosion analyses, hazard risk assessment, mitigation, outreach, and floodplain mapping. Provided technical oversight for storm surge modeling and coastal hazard assessments. Also provided direction and input on coastal appeal resolution, as well as the development of new coastal guidelines and procedures for FEMA's coastal flood studies.

Levee Analysis and Mapping Pilot Studies, FEMA Region VI – Lead Coastal Engineer
Served as lead engineer and subject matter expert for new Levee Analysis and Mapping Procedures being implemented by FEMA HQ and Region VI for assessing non-accredited levees. Led working group in the development of new procedures for non-accredited levees subject to coastal flooding. Work involved developing consensus among multiple agencies including representative FEMA regions and the USACE. Conducted pilot studies in LA (Plaquemines and Lafourche Parishes) and TX (Freeport Levee System) to apply and evaluate new methodologies in assessing coastal risk in areas protected by non-accredited levees. Work involved levee breach assessments and the integration of 1-D to 2-D coastal hydraulic models to define the hazards within the polder.

Coastal Hazard Assessment for Lake Erie, FEMA Region V – Senior Coastal Engineer
Provided technical oversight and input on the 2-D coupled surge and wave model setup including the historical storm characterization, mesh development, and model validation. Assisted in the development of a Coastal Modeling and Analysis framework for the implementation of new methodologies and guidelines for the assessment of coastal hazards in the Great Lakes. Integrated modules to assess response-based (multi-event) erosion and wave runup using CSHORE-1D model and extreme statistical distributions. Using joint probability distributions, evaluated five combinations of waves and water levels for the assessment of hazards at the 1% and 0.2% annual return frequencies

NY-NJ Storm Surge Study, FEMA Region II - Senior Coastal Engineer
Served as lead engineer for storm surge model development tasks including ADCIRC and SWAN mesh development, model validation, and the QAQC of over 175 storm surge model simulations. Validation was conducted through hindcasts of both tropical and extratropical storms and the verification of simulated maximum surge and wave conditions. Storms were developed using the Joint Probability Method-Optimum Sampling and modeling was conducted on a high-performance computing environment. Provided technical oversight and review of computed storm surge return frequencies developed for coastal hazard assessments.

Big Bend FL Storm Surge Study, FEMA Region IV - Senior Coastal Engineer
Storm surge study encompassing Taylor, Dixie, and Levy Counties in Florida. Provided technical oversight and input for storm selection, the statistical methods (JPM) developed for study area, and model validation. Conducted detailed reviews of the seamless bathymetry/terrain surface developed for mesh generation and of the ADCIRC and SWAN modeling meshes to ensure features were adequately represented.

Key Projects (continued)

Climate Change Adaptation Strategies for Coastal Community, East Boston, MA – Coastal Engineer
Managed development of coastal engineering alternatives to protect coastal community against varying levels of projected sea level rise combined with extreme coastal storm events. Investigated retrofitting techniques, including floodproofing and other adaptation strategies, for an urban community to address impacts of climate change. Drafted design concepts and estimated projected costs for alternatives to assist in a scenario-based risk assessment. Participated in outreach activities to inform community of potential impacts, coastal engineering alternatives, and other community-specific adaptation strategies

Numerical Modeling of Hydrodynamics and Constituent Transport for Stony Brook Wetlands Restoration Feasibility Study, Brewster, MA – Coastal Engineer
The project consisted of implementation of a field data collection program, development and calibration of a two-dimensional numerical circulation model using the Environmental Fluid Dynamics Code (EFDC), and the application of the calibrated model to conduct an alternatives analysis aimed at restoring tidal flow to the Stony Brook estuarine system. The hydrodynamics and salinity model was utilized to simulate existing conditions, as well as alternatives involving the replacement of two culvert structures which convey tidal flow under the Route 6A roadway to the upstream/landward portion of the marsh. The potential benefit and impacts of the each proposed restoration alternative were evaluated including upland flooding, sediment transport/scour of the channel bed or adjacent roadway, effects on drainage/infrastructure, and any effects on migratory anadromous fish. The alternatives were simulated under typical tidal, low-flow, and storm conditions to fully assess their performance and to make a recommendation on how to best achieve restoration with minimal impacts.

Coastal Structure Design for Fisheries and Marina Facilities, KSA - Lead Coastal Engineer
Evaluation and design of revetment and composite breakwater structures for fishing port developments in the Eastern Province. Conducted nearshore wave transformation modeling using STWAVE to arrive at design wave conditions. Computed wave runup, overtopping, and transmission for design scenarios and determined static and dynamic loading for composite rubble-mound/vertical wall structure.

Flood Plain Analysis for Cameron Parish, LA – Coastal Engineer
Reviewed Flood Insurance Rate Maps (FIRMs) and Base Flood Elevations (BFEs) established by the Federal Emergency Management Agency (FEMA) for coastal parish. Gathered LIDAR topographic data for the parish communities and performed comparison with elevation data used within the two-dimensional model to establish the flood zone boundaries. Developed wind field for Hurricane Ike using data from various sources for input into an ADCIRC model. Performed hindcast of Hurricane Ike using a two-dimensional ADCIRC model in order to compare simulated storm surge levels with data recorded locally within the parish, during the storm.

Numerical Modeling of Hydrodynamics for Proposed Arabian Canal, Dubai, UAE, Limitless – Coastal Engineer
In order to evaluate the conceptual design of a proposed canal in Dubai, two separate hydrodynamic models (1-D and 2-D) were developed. The models were used for a preliminary analysis of the flushing characteristics of the proposed 75-kilometer canal which would be connected to the Arabian Gulf. A one-dimensional analytical model and a two-dimensional numerical model of the canal were developed. The analytical model provided preliminary results that were used to determine whether certain design concepts warranted more detailed analysis, and to guide the development of the numerical model. Sensitivity analyses were then conducted to assist in developing components of the canal design, including the locations, size, and operation of tide gates, channel dimensions, and potential marina developments. The components of the canal design were varied within the models, water flushing/refreshment periods were computed, and areas having potential water quality issues were identified. Recommendations were made in order to achieve the water quality objectives while also preserving the design objectives for the development.

Key Projects (continued)

Evaluation of Shoreline Protection at Beach Facility, Bristol, RI. - Lead Coastal Engineer
Responsible for conducting field investigation of existing shoreline protection measures at neighborhood association beach facility in order to propose alternatives for remediating erosion incurred at the site. Analyzed average annual and extreme storm conditions in conducting desktop study to evaluate alternatives to replace or repair the existing degraded seawall structure at the beach facility. Evaluation of alternatives included an assessment of overall effectiveness, structural lifetime, construction feasibility, as well as estimates of permitting, engineering, and construction costs. Developed recommendations for the neighborhood association to effectively control erosion at the site, to retain the upland facility, and to provide safe access to the recreational resource.

Hydrodynamic Characterization and Sediment Transport Evaluation at the Former Callahan Mine Property, Brooksville, ME – Coastal Engineer
The Goose Pond estuary is a site of environmental concern and is classified as a Superfund site on the National Priorities List by the Environmental Protection Agency (EPA). The site is the former location of a zinc/copper open-pit mine where mining operations were conducted adjacent to and beneath the tidal estuary. Supported the Maine Department of Transportation (DOT) for an evaluation of contaminant transport and fate at the former Callahan Mine site connected to the Penobscot River in Brooksville, ME. Characterized the hydrodynamics and transport processes within the flooded former mine property influenced by the tides of Penobscot Bay. The project consists of a field data collection program, and the development of a three-dimensional hydrodynamic and sediment transport model to evaluate overall circulation patterns and transport within Goose Pond. Processed measured water level, salinity, and current speed/direction data to characterize baseline conditions at the site and to calibrate the model. Applied numerical model to simulate significant precipitation and storm surge events to assess the potential for sediment mobility under extreme conditions.

Evaluation of Shoreline Restoration at Nantasket Beach, Hull, MA. – Coastal Engineer
Responsible for developing wave and sediment transport models to simulate existing conditions and conduct an alternative analysis in support of a comprehensive coastal processes study to address ongoing coastal erosion at Nantasket Beach. Quantified site-specific wave conditions using measured wind and wave data, and the STWAVE numerical wave transformation model. Simulated transport processes along the barrier beach using a state-of-the-art sediment transport model to evaluate the performance of the existing seawall, as well as structural and non-structural shore protection measures under various environmental conditions. Assessed the performance and lifetime of the selected shore protection measures to provide guidance on potential long-term solutions for the area.

Numerical Modeling of Reverse Osmosis Water Treatment Facility Discharge Dilution, Melbourne, FL, Reiss Environmental – Coastal Engineer
Developed a three-dimensional model of the Eau Gallie River using the Environmental Fluid Dynamics Code (EFDC) to simulate the hydrodynamics and particulate transport within the estuarine system. The modeling effort was for the continued evaluation of the City of Melbourne's reverse osmosis concentrate discharge into the Eau Gallie River. Application of EFDC model involved the development of a curvilinear-orthogonal grid defining the geometry of the system, as well as defining conditions at both upstream and downstream boundaries of the Eau Gallie River, the atmospheric conditions, and the concentrate discharge into the model domain. Existing conditions were simulated and the model was calibrated and verified using collected field data. The model was then applied to simulate DEP specified design flow conditions (7Q10) to characterize the concentrate dilution and the extent of mixing zones for the parameters of interest.

Key Projects (continued)

Hydraulic Modeling and Scour Assessment for WM. T Morrissey Boulevard Bridge at Pattens Cove, Dorchester, MA – Project Manager/Coastal Engineer
The potential for scour was assessed for the Morrissey Boulevard Bridge crossing at Pattens Cove for both 100-year and 500-year storms. The DYNLET1 numerical model was employed to evaluate the hydraulic characteristics of the tidal waterway. The model was driven and calibrated using field data collected at the site. The tidal current velocities and water elevations obtained from the storm simulations were used to compute the maximum scour potential for the open-bottom box culvert. The scour analysis, performed following FHWA and USACE methodologies, assisted in determining the single-digit code under Item 113 of the *FHWA Recording and Coding Guide for Structure Inventory and Appraisal of the Nation's Bridges* for the Morrissey Boulevard/Pattens Cove bridge crossing. Recommendations of scour countermeasures were made for the site to offer protection from future extreme storm events.

Flood Plain Analysis for Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR), Falmouth, MA – Project Manager/Coastal Engineer
Conducted flood plain analysis to support a FEMA LOMR application to revise the base flood elevations and flood zone map for coastal properties fronting Vineyard Sound in Falmouth, MA. The 100-year return period wave height and storm surge levels were established and wave transformation and wave runup modeling were completed utilizing the FEMA Coastal Hazard Analysis Modeling Program (CHAMP) and US Army Corps of Engineers methodologies. The potential for erosion was estimated and flood zone delineations were made based on the model results.

Mixing Zone Evaluation in Lake Michigan, Indiana Dept. of Environmental Management - Coastal Engineer
Conducted study to support the review of a permit renewal application for a discharge into Lake Michigan. The study included a literature review on Lake Michigan currents to help characterize receiving waters in the vicinity of the discharge. Observations of currents in Lake Michigan were also made over a 45-day period using two Acoustic Doppler Current Profiler (ADCP) systems in order to better determine the discharge site-specific ambient conditions. The current data were processed and an attempt was made to correlate the currents with wind observations obtained from nearby locations in order to model long-term conditions. This data was then analyzed to define the appropriate ambient water input conditions to use in modeling the discharge's dilution and mixing zone.

Numerical modeling of a ship-to-shore causeway in waves, N. Kingstown, MA, University of Rhode Island/Vibtech Inc. - Coastal Engineer
Developed numerical model to analyze the motion of an articulated ship-to-shore causeway system in nearshore areas. The vertical motions of the floating structure were evaluated for sea state 3 conditions. The model was developed using potential flow theory to solve the equations of motion. The work involved conducting a wave simulation from a wave spectrum to construct the time history of the structure's response. Results from the model were compared with those obtained from experimental data. A study was then completed to analyze the sensitivity of the system's dynamics to the variation of critical parameters.

Material testing and transport for casting basin at Fort Point Channel, Boston, MA, Modern Continental Construction - Engineer
Managed the environmental testing, transport, and disposal of over 500,000 cubic yards of dredge and excavate material taken from and around Fort Point Channel. Portions of the channel were dredged for the construction of a series of cofferdam cells used to close off a casting basin (dry dock) at the waterfront. Material was also excavated to form the casting basin used to construct concrete tunnel sections. The material was transported to a temporary storage location for sorting and testing. Material was then transported to various locations throughout the Northeast following DEP regulations.

Key Projects (continued)

Construction management at Fort Point Channel Crossing, Boston, MA, Modern Continental Construction - Engineer
Oversaw areas of construction related to the fabrication of concrete tunnel tube sections for the Fort Point Channel Crossing Central Artery/Tunnel project. Managed implementation of a multi-media groundwater filter system. Monitored and managed operation of technical systems, including groundwater control, construction noise control, and geotechnical instrumentation. Also worked with subcontractors in obtaining project approval and in reviewing and procuring necessary submittals.

Publications and Presentations

Shultz, M.F., L. Xu, R. Parab. and S. McCormick. 2015. "Incorporating a Blend of Solutions for Flood Mitigation in Hurricane Sandy Recovery", Coastal Structures and Solutions to Coastal Disasters Joint Conference, September 9-11, Boston, MA.

Shultz, M.F. and T. Graupensperger. 2014. "Conceptual Nature-Based and Gray Infrastructure for Flood Resiliency at Oakwood Beach, NY After Hurricane Sandy" Restore America's Estuaries 7th National Summit on Coastal and Estuarine Restoration, November 1-6, National Harbor, MD.

Shultz, M.F. 2014. "Hurricane Isabel – A Look Back and to the Future." American Shore & Beach Preservation Association National Conference, October 15-17, Virginia Beach, VA.

Shultz, M.F. 2013. "Post-Hurricane Sandy Advisory Base Flood Elevations" 2013 NJ Society of Professional Land Surveyors General Membership Meeting, January 8, Toms River, NJ.

Shultz, M.F. 2012. "FEMA Region III Coastal Hazard Analyses and FIRM Updates" 2012 MD Association of Floodplain and Stormwater Managers Annual Conference, October 25, Linthicum Heights, MD.

Shultz, M.F, 2012. "Coastal Hazard Analyses within Delaware Bay and River" Delaware River Basin Commission Flood Advisory Committee September 2012 Meeting, Trenton, NJ.

Shultz, M.F., A. Farhadzadeh, and V. D. Nimmala. 2011. "Inundation due to Levee Wave Overtopping - An Integrated Modeling approach ." 2011American Shore & Beach Preservation Association Fall Conference, October 19-21, New Orleans, LA.

Douglas, E., P. Kirshen, C. Watson, J. Wiggin, M. Shultz, and M. Paolisso. 2010. "Coastal Flooding and Environmental Justice: Identifying Vulnerable Communities and Feasible Adaptation Strategies for the Boston Metro Area." 2010 EWRI Congress, May 16-20, Providence, RI.

Hamilton, B. and M.F. Shultz. 2010. "Salt Marsh and Anadromous Fish Run Restoration at Stony Brook, Brewster, MA." Restore America's Estuaries Annual Conference, November 13-17, Galveston, TX.

Shultz, M.F. and K.F. Bosma. 2007. "3-D Hydrodynamic and Water Quality Modeling to Assess the Impacts of a Reverse Osmosis Water Treatment Discharge." 2007 American Shore & Beach Preservation Association Fall Conference, October 21-24, Galveston, TX.

Shultz, M.F. 2005. "Simulation of a Ship-to-Shore Causeway System in Waves." Master's Thesis, University of Rhode Island, Kingston, RI.

ATTACHMENT D

PROJECT EXPERIENCES MICHAEL F. DACEY

MICHAEL F. DACEY, P.G., L.S.P.

Senior Consultant / Senior Hydrogeologist

Mr. Dacey is primarily responsible for developing and implementing assessment, remediation, compliance and geothermal energy projects. He provides clients with technical expertise in geology and hydrogeology, contaminant fate and transport, evaluation and selection of remediation alternatives, pertinent State and federal regulations, air discharge evaluation and permitting, and geothermal well and well field design. Mr. Dacey has directed over 250 assessment and remediation projects. In his capacity as a Licensed Site Professional (LSP), Mr. Dacey has provided regulatory oversight on over 100 Massachusetts based projects. He has also been a key regional account manager for several major petroleum and industrial national customers. Mr. Dacey manages GeoInsight's regional office located in Manchester, New Hampshire.

Education:

M.S. Geology
University of Rhode Island, 1989
B.S. Earth Science
Bridgewater State College, 1980

Years of Experience:

32 years

Areas of Expertise:

Remedial Investigation/Conceptual Remedial Design, RCRA Corrective Action, Litigation Support, State and Federal Regulatory Compliance/ Negotiation, RETA Investigations/AST Secondary Containment Evaluations

Professional Registrations:

Massachusetts Licensed Site Professional
Professional Geologist: NH

REMEDIAL INVESTIGATION; COMMERCIAL/ INDUSTRIAL FACILITY, MANCHESTER , NEW HAMPSHIRE; 1999-2009; Project Manager.

Completed remedial investigation on multiple potentially responsible party (PRP) site to delineate co-mingled chlorinated solvent (dissolved and separate phase) and heavy fuel oil (separate phase) impacts on former mill property. Designed and implemented remediation plan utilizing soil excavation and chemical oxidation, which met objectives for sale of property. Evaluated and monitored for vapor intrusion and designed/implemented sub-slab vapor abatement system. Provided litigation support during mediation of multiple PRP lawsuits and adherence to administrative consent order.

SITE INVESTIGATION; WASTE DISPOSAL FACILITY, NEW HAMPSHIRE; 1999-Present; Project Manager.

Conducted preliminary and comprehensive site investigations to delineate the nature and extent of chlorinated solvents disposed of in commercial septage lagoons. Evaluated remedial alternatives, including monitored natural attenuation and source containment/removal. Identified poetential sensitive receptors and lead negotiations with State agency for final remedy.

PHASE I ENVIURONMENTAL SITE INVESTIGATIONS AT 16 BULK PETROLEUM STORAGE FACILITIES; 2005 AND 2010; SPRAGUE ENERGY; NEW ENGLAND AND NEW YORK TERMINALS; Account/Project Manager.

Completed Phase I Environmental Site Assessments in accordance with ASTM 1527 guidelines at 16 bulk petroleum storage facilities. Complied with required aspects of the ASTM standard and specific bank requirements. Evaluated Recognized Environmental Concerns and provided conclusions and recommendations on potential environmental risks and for additional investigation, as necessary.

CHLORINATED SOLVENT INVESTIGATION AT BALL BEARING MANUFACTURING FACILITY; LACONIA, NEW HAMPSHIRE; 1999-Present; Project Manager.

Developed work scope and completed Site Investigation that included shallow and deep soil borings and monitoring well installations; smoke and dye testing to evaluate discharge points for a subsurface drainage system; and aquifer characterization testing. The Site Investigation concluded that some or all of the chlorinated solvent impact was from an upgradient facility. Geologic setting consisted of thick glaciofluvial depositional sequence of sand and gravel. Assisted client counsel in negotiations with the New Hampshire Department of Environmental Services (NHDES) and upgradient property owner.

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) INVESTIGATIONS; NEW HAMPSHIRE; 2016-Present; Senior-in-Charge

Developed strategies and implemented work plans to assist a manufacturer and an industrial property owner to identify potential PFAS impacts at their perspective facilities. Followed NHDES guidelines to minimize the potential for PFAS cross-contamination.

GEOTHERMAL ENERGY FEASIBILITY STUDY; TWO MULTI-UNIT RESIDENTIAL STRUCTUES; ARCHITECT; SHARON AND NEWINGTON CONNECTICUT; 2011- Senior Technical Advisor.

Provided engineering consulting services to an architectural firm to evaluate the feasibility of utilizing geothermal heating/cooling at two multi-unit residential facilities in Sharon and Newington, Connecticut. Researched several ground-coupled heat exchange options and prepared specifications for a closed-loop pilot well at both locations. Interpreted results of 48-hour pilot tests and provided recommendations for well and well-filed design.

RCRA FACILITY INVESTIGATION AND ENVIRONMENTAL INDICATOR DETERMINATION; FORMER HAZARDOUS WASTE STORAGE FACILITY; NATICK, MASSACHUSETTS; 1999 -2008; Project Manager.

Senior project manager for Environmental Indicator Determination (EID) and Resource Conservation and Recovery Act (RCRA) Facility Investigation project involving chlorinated and non-chlorinated volatile organic compounds. On behalf of facility owner, prepared an EID report and a scope of work for a final RCRA Facility Investigation (RFI SOW) and negotiated final RFI SOW with the United States Environmental Protection Agency (USEPA) and completed final RFI.

SITE INVESTIGATIONS; IRVING OIL TERMINALS; REVERE, MASSACHUSETTS AND NEWINGTON, NEW HAMPSHIRE; 1998; Project Manager.

Developed and implemented investigation strategy to adequately characterize soil and ground water conditions prior to Irving Oil's purchase of the properties. Used results to evaluate cleanup requirements in accordance with Massachusetts Contingency Plan (MCP) and NHDES regulations. Advised Irving Oil of costs associated with soil and ground water issues.

CHLORINATED VOLATILE ORGANIC COMPOUND REMEDIAL INVESTIGATION AND DESIGN; MACHINE TOOL SHOP, MASSACHUSETTS; 1996-Present; Project Manager.

Developed investigation strategy, including passive soil gas survey and multi-level wells, to identify point sources and extent of dissolved- and liquid-phase chlorinated solvents in the overburden and bedrock aquifers within a Zone II Wellhead Protection Area. Conducted *in situ* chemical oxidation pilot study and incorporated results into Remedial Implementation Plan. Worked directly with PRP counsel to address regulatory mandates, defense to downgradient property owner claims, and estimate total project costs. Provided technical support and LSP services that lead to successful sale of property.

REMEDIATION SYSTEM AND LSP OVERSIGHT, HYDROCARBON-IMPACTED OVERBURDEN AND BEDROCK AQUIFERS; TIER 1A PUBLIC INVOLVEMENT SITE, MASSACHUSETTS; 1996-2007; Project Manager and LSP.

Phase II investigation involving multi-level overburden and bedrock wells and aquifer characterization testing utilizing remote transducers and fracture lineament study. Completed design and installation of multi-well air sparge and vent system with bedrock hydraulic control. Operated remediation system under Phase V of the MCP. Conducted presentations to public involvement group at critical site milestones and negotiated with town agencies. Conducted expanded investigation to define and delineate impacts of MTBE to bedrock and overburden residential supply wells.

SYSTEM DESIGN AND GROUND WATER RECLASSIFICATION; GASOLINE RETAIL FACILITY, MASSACHUSETTS; 1996-1999; Project Manager.
Developed conceptual design and approved final design for 18-point air sparge system. Coordinated and provided oversight for complete system installation during facility upgrade. Devised strategy to implement Grants of Environmental Restrictions to change ground water classification from GW-1 to GW-2/GW-3. Coordinated extension of public water supply to impacted residential and commercial properties.

PHASE I, II, AND III INVESTIGATIONS; METALS RECYCLING FACILITY, MASSACHUSETTS; 1996-1998; LSP.
Provided LSP oversight and regulatory direction during completion of Phase I through Phase III investigations. Approved two Release Abatement Measures (RAMs) and one Immediate Response Action (IRA) to address polychlorinated biphenyl (PCB) oil, lead, and polycyclic aromatic hydrocarbon (PAH) impacts in surface soil.

SITE INVESTIGATIONS; UTILITY COMPANY, MASSACHUSETTS; 1996-1997; LSP.
Provided LSP oversight during preliminary and comprehensive site investigations at two sites. Devised closure strategy for multiple releases using Method 3 risk assessment at one site and provided senior and LSP review during installation and operation of a biosparge system at the other site to address a naphtha release.

POLYCHLORINATED BIPHENYL AUDIT; UTILITY COMPANY, FITCHBURG, MASSACHUSETTS; 1996; Project Manager.
Completed audit of PCB management and handling practices and provided recommendations pertaining to TSCA compliance.

POLYCHLORINATED BIPHENYL INVESTIGATION AND REMEDIATION; UTILITY COMPANY, SOMERSWORTH, NEW HAMPSHIRE; 2015-2016; Senior-in-Charge.
Conducted TSCA-compliant investigation to delineate PCB-impacted concrete in a large utility company fleet warehouse. Prepared Self Implementing Cleanup Plan and met final clean-up objectives for closure without property restrictions.

POLYCHLORINATED BIPHENYL INVESTIGATION AND REMEDIATION; MARINA, PORTSMOUTH, NEW HAMPSHIRE; 2016; Senior-in-Charge.
Conducted TSCA-compliant investigation to delineate PCB-impacted soil at an active marina. Prepared modifications to an existing Self Implementing Cleanup Plan and conducted initial phase of excavation and sampling activities for closure with property restrictions. Included City and State conservation and wetland permit applications.

SITE INVESTIGATION/NAPL RECOVERY; BULK FUEL TERMINAL; NEWINGTON, NEW HAMPSHIRE; 1994-Present; Project Manager.
Provided rapid response services to mitigate petroleum breakout along coastline. Designed and installed interceptor trench with hydraulic control to remove non-aqueous phase liquid (NAPL). Maintained long-term hydraulic control system in tidally influenced area and conducted a soil vapor extraction (SVE) pilot study. Conducted all necessary monitoring and reporting in accordance with

National Pollutant Discharge Elimination System and Groundwater Management Permit requirements.

HYDROGEOLOGIC INVESTIGATION/HYDROCARBON RECOVERY; MOBIL OIL BULK STORAGE FACILITY;PORTSMOUTH, NEW HAMPSHIRE; 1994-1997; Project Manager.
Developed investigation strategy to identify multiple point sources for dissolved- and liquid-phase hydrocarbons in the aquifer. Directed pilot test studies and the design of a large-scale SVE/air sparge (AS) system and dissolved- and liquid-phase recovery systems. Operated and maintained SVE/AS system. Provided consulting support during property sale and facility dismantling.

REMEDIAL INVESTIGATION/SYSTEM DESIGN; EXXON GASOLINE RETAIL FACILITY, GREENLAND, NEW HAMPSHIRE; 1994-1996; Project Manager.
Devised investigation strategy to track a release of approximately 6,000 gallons of petroleum from an underground storage tank (UST). Involved with the design of a remediation system to contain and remove liquid- and dissolved-phase petroleum. Maintained system for five years.

SITE INVESTIGATION; MOBIL OIL BULK TERMINAL; SOUTH PORTLAND, MAINE; 1994; Project Manager.
Developed and implemented site investigation strategy to characterize soil and ground water impacts at the terminal. Results were used to develop remedial strategies for multiple point source areas.

HYDROGEOLOGIC INVESTIGATION; RAYTHEON DEFENSE MUNITIONS PLANT, MASSACHUSETTS; 1990-1996; Project Manager.
Assimilated geologic, hydrogeologic, and chemical data collected from 18 multi-level monitoring wells and provided interpretations on chlorinated solvent distribution. Provided regulatory guidance on MCP requirements. Also provided interpretations used for contribution resolution with the US Army Corp of Engineers.

IN SITU AND ABOVEGROUND SOIL VAPOR EXTRACTION SYSTEMS; GASOLINE RETAIL AND BULK STORAGE FACILITIES, NEW HAMPSHIRE AND MASSACHUSETTS; 1989-Present; Project Manager.
Designed and implemented *in situ* SVE systems to remove adsorbed hydrocarbons from the unsaturated zone. Obtained regulatory permits required to activate the system. Also installed several systems into aboveground treatment cells for on-site remediation. Soil subsequently declassified and disposed of as clean fill.

IN SITU AIR SPARGE SYSTEMS; GASOLINE RETAIL FACILITIES, NEW HAMPSHIRE; 1989-1995; Project Manager.
Provided conceptual design and implemented the first prototype ground water AS system in New England for removal of dissolved- and adsorbed-phase hydrocarbons in the aquifer. Completed subsequent conceptual designs and installation oversight for four AS systems.

PETROLEUM RETAIL FACILITIES; MASSACHUSETTS; 1987-Present; Project Manager and LSP.
Involved in work at numerous retail petroleum facilities throughout New England. Responsibilities included directing monitoring well placement and installation, sampling, residential drinking water and air sampling, oversight of treatment system design and installation, and treatment system operation and maintenance. Responsibilities included regional account management for several major petroleum retailers. Provided expertise in all phases of the MCP, including investigations, remediation, risk assessment, and site closure.

REMEDIATION SYSTEM, HYDROCARBON IMPACTED OVERBURDEN AND BEDROCK AQUIFERSRESIDENTIAL SUPPLY WELLS; EXXON GASOLINE RETAIL FACILITY, HAMPSTEAD, NEW HAMPSHIRE; 1987-1995; Project Manager..
Project managed petroleum release site impacting twenty-one residential and commercial supply wells. Evaluated dissolved-hydrocarbon plume migration pathways along 0.5 mile plume through primary and secondary bedrock fractures. Forty-two point-of-entry (POE) granular activated carbon units installed, maintained, and routinely sampled on the 21 residential supply wells. Resolved numerous technical issues relating to chemical fouling and erroneous laboratory analytical results. Mr. Dacey's knowledge of contaminant fate and transport in fractured bedrock aided the identification of potential high-risk receptors and the design of a remediation system with four recovery wells. Assisted client counsel with expert testimony during litigation with homeowners and facility operator.

SPECIAL TRAINING:

OSHA 40-Hour Safety Training
OSHA 8-Hour Annual Refresher Training
OSHA 8-Hour Supervisor Training
Natural Attenuation of Chlorinated Solvents in Groundwater, ITRC, Amherst, MA, 1998
Beyond TPH, Understanding and Using the New VPH/EPH Approach, DEP/LSPA, Marlborough, MA, 1997
Environmental Risk Characterization, LSPA/ DEP, 1996
Remediation Waste and Remedial Wastewater Management, LSPA/DEP, 1996
Management of Manufactured Gas Plant Sites, EPRI/GRI, Chicago, Il, 1995
Applications in Ground Water Pollution & Hydrology (NGWA), Princeton, NJ, 1993
Advanced Groundwater Topics, UNH, Nashua, NH, 1995

PROFESSIONAL AFFILIATIONS:

National Ground Water Association
Association of Massachusetts Licensed Site Professionals
Geologic Society of New Hampshire

PUBLICATIONS AND PRESENTATIONS:

Dacey, M.F., "Transition from Initial Response Phase to Remedial Action Phase, Case Study: Campton Site," NHDES Consultant's Day, 1995.

Dacey, M.F., "Environmental Site Assessments," GTI, Portsmouth, 1992.

Dacey, M.F. and Kresge, M.W., "An evaluation of *in situ* groundwater aeration," Proceedings of The Ninth Annual HAZMAT Management Conference: June 12-14, 1991, Atlantic City, NJ, p. 1015-1027, 1991.

Dacey, M.F., "Physical Stratigraphy and hydrography of the Misquamicut-Winnapaug microtidal barrier/lagoon complex: Westerly, Rhode Island," Master's Thesis, Department of Geology, University of Rhode Island, Kingston, RI, p. 152, 1989.

Boothroyd, J.C., Dacey, M.F., and Rosenberg, M.J., "Geological aspects of shoreline management: A summary for southern Rhode Island," v. 1M: Tech. Rept. No. 6-SRG, Dept. of Geology, University of Rhode Island, Kingston, RI, 20 p., 1986.

Boothroyd, J.C., Rosenberg, M.J., and Dacey, M.F., “A geological survey of Quonochontaug, Winnapaug, and Maschaug Ponds, Westerly, Rhode Island,” Tech. Rept., Earth Surface Research Inc., Kingston, RI, 17 p., l985.

Dacey, M.F. and Boothroyd, J.C., “Late Quaternary Stratigraphy of the Misquamicut-Winnapaug Barrier Lagoon System,” Geological Society of America, Abstract Program, Northeast Section, v. 19, n. 1, 1987.

Boothroyd, J.C., Rosenberg, M.J., and Dacey, M.F., “Resent Sedimentary History of Flood-Tidal Deltas in Microtidal Lagoons of Rhode Island,” Geological Society of America, Abstract Program, v. 18, m. 7, 1986.

ATTACHMENT E

COMMENTS FILED WITH NHDES

Orr&Reno

Douglas L. Patch
dpatch@orr-reno.com
Direct Dial 603.223.9161
Direct Fax 603.223.9061
Admitted in NH and MA

February 28, 2017

Via Hand Delivery and Email
Dori Wiggin, Administrator
Water Division
New Hampshire Department of Environmental Services
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095

Re: SEC Docket No. 15-04, Application of Public Service Company of New Hampshire d/b/a Eversource Energy for a Certificate of Site And Facility for the Construction of a New 115 kV Transmission Line from Madbury Substation to Portsmouth Substation – Comments to Department of Environmental Services

Dear Ms. Wiggin:

This is a follow up to the meeting which we had with you and Gregg Comstock earlier this month. Enclosed are the comments of the Town of Durham regarding the above-captioned matter and more specifically with regard to the portion of this Project that would impact on Little Bay. These comments represent preliminary concerns raised by consultants hired by the Town of Durham with regard to prefiled testimony and reports that have been filed by the Applicant in this matter with the Site Evaluation Committee concerning the impact on Little Bay.

As you will see in the attached documents there are a number of specific concerns with the analyses that have been done by the Applicant to date. Based on the preliminary review by our consultants, given the gaps in data as well as limitations of analysis provided so far by the Applicant, it is Durham's position that it cannot assure the residents of Durham that there are no unreasonable adverse ecological effects or that the impact on natural resources will be manageably limited in the Little Bay, and that unreasonable adverse effects in the worst case will not migrate up north towards the mouth of Oyster River or down south beyond the mouth of the Great Bay. Durham has arrived at this preliminary position in part because the Applicant has not provided what Durham's consultants consider to be adequate sensitivity analysis of a set of variables that could impact the plume dispersion, refloatation of sediments and/or of contaminants within or associated with such sediments. The Applicant has done modeling only with very few "snapshot" data points for some variables it has incorporated into its modeling, and has also not incorporated some other variables at all in the modeling. Thus, a consequence of the Applicant's study so far is that it has left unresolved a very large envelope of uncertainty around potential ecological impact from a host of relevant variables. More importantly, it appears that no one, including the Applicant, could put in place adequate control measures during cable installation and/or mitigation measures to control risks because of large uncertainties that still persist. It is Durham's position that such uncertainties need to be reduced by the Applicant through further suggested data collection, analysis and sensitivity analysis of driving variables. Only thereafter can anyone design adequate controls and mitigation measures. In summary, from Durham's viewpoint, there is insufficient evidence and analysis to assess potential unreasonable adverse ecological impacts, and Durham therefore lacks confidence that adequate controls/mitigation measures could be designed without first reducing the envelope of uncertainties.

The Town of Durham is submitting these comments to you, making them available to the Applicant and the service list in this docket, and making them available to the public in the interest of full disclosure. These comments are being provided in light of the role that your Department plays as a permitting authority in this process, which includes reviewing proposals, identifying issues of concern and submitting recommended draft permit terms and conditions to the Site Evaluation Committee pursuant to RSA 162-H:7 and 7-a, Admin. Rule Site 301.12, and consistent with orders issued by the SEC in this docket.

Durham reserves its right to change its position on any of these issues as it works its way through the Site Evaluation Committee process.

If you have any questions, please do not hesitate to contact me. Thank you for considering these comments.

Sincerely,

Douglas L. Patch

DLP/eac

Enclosures

cc (via email): Service List in SEC Docket 2015-04; Gregg Comstock, Water Division

On behalf of the Town of Durham (the Town), GeoInsight is the project director for a consulting team consisting of geologists and hydrogeologists from GeoInsight and ecological risk assessors and engineers from Woods Hole Group (WHG, as a team: GIWHG). The team's primary objective is to review application documents presented to the New Hampshire Site Evaluation Committee (SEC) for the Seacoast Reliability Project (SRP), prepared on behalf of Public Service Company of New Hampshire d/b/a Eversource (the Applicant), and advise the Town regarding the adequacy and scientific validity of such documents in demonstrating that potential environmental and ecological risks associated with SRP were adequately and accurately assessed.

This document presents a summary of GeoInsight's preliminary comments and opinions regarding the SRP, and specifically regarding the potential environmental and ecological risk associated with the suspension and deposition of sediments resulting from cable laying activities in Little Bay. This document focuses on the sedimentological aspects of the available data; however, it also considers the broader ecological ramifications presented in documents prepared by WHG.

This preliminary evaluation is primarily based upon a review of the following SEC documents and associated references:

1. Pre-Filed Direct Testimony J. Jiottis
    a. Attachment Jiottis
2. Pre-Filed Direct Testimony A. Pembroke
3. Pre-Filed Direct Testimony A. Godfrey
    a. Attachment Godfrey
4. Appendix 1 USGS Project Overview Map
5. Appendix 2 SRP Environmental Maps
6. Appendix 3 Existing Conditions Maps
7. Appendix 7 SRP Natural Resource Existing Conditions Report
8. Appendix 13 Joint NHDES USACE Wetlands Permit Application
9. Appendix 14 NH DES Section 401 Water Quality Certification Request
10. Appendix 34 Natural Resource Impact Assessment
11. Appendix 35 Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH
12. Pre-filed Testimony of Marc Dodeman as substitution for Anthony Godfrey
13. Characterization of Sediment Quality Along Little Bay Crossing, Durham to Newington, NH (December 1, 2016)

Based upon GeoInsight's review of the report titled *Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH,* (Sediment Dispersion Report), references provided in the Sediment Dispersion Report, and associated SEC documents listed above, it is our opinion that the Sediment Dispersion Report does not adequately represent potential sediment dispersion and associated deposition related to the proposed cable-laying activities.

The report states that wind currents were not considered because of the small surface area (i.e. fetch) at the location of the crossing. However, while fetch can be a limiting factor for wave height and corresponding depth of impact in the water column, the 0.9-mile long crossing and 2-mile north-south length of Little Bay is sufficient fetch to generate wind-driven currents, particularly during periods of sustained winds from a consistent direction. Wind-driven currents can enhance or mute tidal current velocities, so a persistent wind from the southeast or southwest across the approximately 2.7-mile north-south length of Little Bay during an ebb tide would increase the velocity of northward flowing currents, which, in turn, potentially increases bottom shear stress, thus increasing sediment transport and possible entrainment into the water column.

Wind driven currents have the largest potential impact to current velocities and bottom shear stress in shallow intertidal mudflat and upper slope areas. The Sediment Dispersion Report states that hand jetting (and silt curtains) will be used on 296 feet of the western mudflat area, indicating that the remaining approximately 1,700 feet of the western mudflat will be subject to jet plowing, presumably without silt curtains. Using the stated jet plow advance rate of 328 feet per hour, 1,700 feet of the western mud flat would be traversed in 5.2 hours. The model assumes that it takes 7 hours to proceed from high slack, when jet plowing is proposed to begin and when the approximate depth of water over the mudflats would be 8 to 9 feet, through the ebb cycle to the subsequent flood cycle; therefore, work would proceed across the western mudflat for 4 to 5 hours in ebbing conditions and in progressively decreasing water depths. Therefore, the later segments of jet plowing across the western mud flats would be most subject to potential impacts from wind currents that could both disperse suspended sediments and potentially entrain bottom sediments.

The Sediment Dispersion Report assumes that 25% of the material in the jet plow cross-sectional area will likely be suspended during the jet plowing process, but also acknowledges that redeposited sediments will be re-suspended during subsequent tidal cycles. The sediment dispersion model does not consider the fate of re-suspended sediments. However, sediment re-suspension, particularly in the deeper part of the channel where tidal velocities are high and previously cohesive fine-grained sediments have been liquefied by jet plowing, may be particularly significant. Based upon a review of vibracore logs from the 2014 and 2016 coring programs, channel stratigraphy generally consists of a thin veneer (<2 feet thick) of fine- to medium-grained sand overlying silt and clay. The silt and clays are of glaciomarine origin and are characteristically dense, stiff, moderately to highly cohesive, and plastic. These characteristics present three potential concerns pertaining to jet plowing the channel crossing:

1. The inability of jet plow to penetrate dense silts and clays to target depths without increasing jetting pressures, which may result in additional sediment suspension, the effects of which were not modeled.
2. The inability of jet plow to penetrate to the target depths or to the regulatory-required depth and defaulting to the use of concrete mats. The use of concrete mats in the channel environment and their potential impacts to the benthic environment and sedimentation patterns was not considered by the applicant.

3. By liquefying stiff, cohesive silts and clays during the jetting process the deposit's cohesiveness and bulk density are significantly reduced, and these properties are directly related to its shear strength. Cohesive silts and clays have higher shear strengths than unconsolidated silts and clays, which is why cohesive silts and clays can exist in high-energy channel environments while unconsolidated, liquefied silts and clays will be eroded and entrained into the water column. This physical change potentially makes liquefied silts and clays occupying the cross-sectional area of the cable trench available for re-suspension during multiple tidal cycles until trench sediments are in equilibrium with the channel flow regime.

   The fate of the re-suspended sediments and the degree, geographic spread, and duration to which turbidity in the water column will be increased was not addressed by the applicant.

Another concern regarding the 2014 and 2016 vibracore program and associated sediment sampling, that has a potential bearing on sediment dispersion during jet plowing, is that the amount of flocculation (i.e., the "clumping" and deposition of clay minerals) assumed by the model does not consider actual variations in grain size or mineralogy. The degree of flocculation is important because incorrectly high flocculation assumptions can under-estimate the amount of suspended sediment.

The assumed flocculation in the model was based upon approximated volumes of clays in the samples, but the fine-grain size fraction of the samples was not differentiated between silts and clays using testing methods (e.g., pipette or hydrometer analysis). The estimations provided in the Sediment Dispersion Report are based upon methods that use cutoff criteria for grain sizes that are different from the suspended sediment model. For example, the classification from Flemming (2000) used in the report specifies 2 micrometers (μm) as the silt/clay boundary, but SSFATE considers clay to be up to 7 μm (more than three times the particle size used in the Flemming classification). Therefore, using diagrams from Flemming (2000) to estimate grain size fractions for the SSFATE model can be inaccurate. The visual approximations used in the report also suggest the assumed percentage of clay may be too high because grain size analysis of comparable units in Great Bay indicated more silt and less clay (Trainer, 1997) than assumed in the report.

The mineralogy of the sediment is also important in evaluating flocculation because not all clay minerals flocculate in the same degree. Some clay minerals (e.g., smectites) are expected to readily flocculate, while other clay minerals (e.g., illiltes and kaolinites) are not expected to flocculate and may remain suspended in the water column. The Sediment Dispersion Report uses a simplified flocculation assumption that is not supported with data regarding actual grain sizes or mineralogy of the fine-grained sediment at the study site.

Ecological aspects of the Sediment Quality Report are addressed in a separate preliminary report by Woods Hole Group, but because the Sediment Quality Report relies upon data presented in the Sediment Dispersion Report, the Sediment Quality Report cannot adequately address issues pertaining to sediment quality.

Some specific concerns about the Sediment Quality Report are as presented as follows.

The Sediment Quality Report states that "Each sediment sample was tested for the parameters shown on Table 1 which were taken from the recommended testing limits outlined in the Regional Implementation Manual (RIM; U.S. EPA and U.S. Army corps of Engineers 2004), a document that delineates how estuarine and marine sediments being proposed for dredging and aquatic disposal should be tested for contaminants." The RIM includes pesticides in the list of chemicals of concern, but pesticides were not analyzed in the samples collected from Little Bay. This is a particular concern for sediments that were deposited prior to 1980 (Partnership, 2013), before compounds such as DDT were banned or became highly regulated. Presumably, these buried sediments will be suspended during hand jetting and jet plowing activities; therefore, potential ecological impacts from pesticides should be evaluated, as specified in the RIM.

The 2016 vibracore program was completed to collect the samples so that sediment quality could be evaluated. However, as with the 2014 vibracore program, channel cores failed to penetrate to the target trench depth of 8 feet, which raises the concern previously described that jet plowing may not attain target depths, and that the potential response (i.e. higher jetting pressure, concrete mats in the channel) to not attaining target depths are not adequately addressed in the Sediment Dispersion Report or the Sediment Quality Report.

In conclusion, based on the three testimonies of the GIWHG team, and given the gaps in data and the narrowly focused data interpretation provided so far by Eversource, it is GeoInsight's opinion that:

- As of now, the identified data gaps do not allow the Town of Durham to conclude that there are no significant environmental risks; and,
- Based upon the Applicant documents presented to date, there are significant data and evaluation deficiencies that preclude the Applicant from designing adequate control measures or mitigation measures to mitigate potential risks associated with the proposed cable crossing in Little Bay. Such uncertainties need to be reduced through further suggested data collection and analysis; only thereafter can adequate controls and mitigation measures be designed and implemented.

This document provides Woods Hole Group's preliminary evaluation and analysis of the Seacoast Reliability Project (SRP), proposed by the Public Service Company of New Hampshire d/b/a Eversource (the Applicant) and submitted for approval to the New Hampshire Site Evaluation Committee (SEC). The evaluation focuses on the modeling conducted to assess impacts related to the proposed burial of transmission cables in Little Bay. The evaluation relates to unresolved concerns with the methods applied and underlying assumptions used to assess the sediment dispersion and associated impacts that would occur with the proposed cable burial activities, specifically with the use of a jet plow and hand jetting.

The preliminary evaluation is based on a review of the following SEC documents and associated references:

1. Pre-Filed Direct Testimony J. Jiottis
    a. Attachment Jiottis
2. Pre-Filed Direct Testimony A. Pembroke
3. Pre-Filed Direct Testimony A. Godfrey
    a. Attachment Godfrey
4. Appendix 7 SRP Natural Resource Existing Conditions Report
5. Appendix 14 NH DES Section 401 Water Quality Certification Request
6. Appendix 34 Natural Resource Impact Assessment
7. Appendix 35 Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH
8. Pre-filed Testimony of Marc Dodeman as substitution for Anthony Godfrey
9. Characterization of Sediment Quality Along Little Bay Crossing, Durham to Newington, NH (December 1, 2016)

In my opinion, there is an overarching concern with the modeling conducted to assess the sediment dispersion, transport, and deposition that would occur as a result proposed cable installation within Little Bay, NH. Many assumptions were made with regard to the environmental conditions at the time of the burial and the sediment release that would occur as a result of the cable burial process. Specifically, assumptions were made in the hydrodynamic and sediment transport modeling conducted for the cable burial process in Little Bay with regards to the following:

1. degree of water mixing in Great Bay (the model assumes that the Great Bay estuary is well-mixed),
2. discharge values used for river inflow,
3. effect of winds (with or without gusts) on currents in Little Bay,
4. water depth for variable tidal conditions during each of the three cable installations,
5. current velocity for variable tidal conditions during each of the three cable installations,
6. sediment characteristics for sediment layers that were not sampled,
7. degree of sediment flocculation for different sediment mineralogy (further discussed in GeoInsight comments),
8. volume of sediment released from a jet plow,
9. height of sediment release and vertical distribution above the seafloor,
10. jet plow advance rate,
11. water flow rate at exit nozzles of the jet plow,
12. water pressure at exit nozzles of the jet plow, and
13. resuspension of sediments after initial deposition.

No sensitivity analyses were conducted to assess these assumptions, and the impact of varying these parameters on the model results of plume formation and sediment deposition. Thus, the modeled plume results shown in the report using the assumed parameters may not be representative of what occurs in this dynamic estuarine environment. Conducting a sensitivity analysis of the above parameters would provide a better understanding of the range of sediment plume and deposition variations that may occur during the cable installation.

While some of the assumptions related to the jet plow installation method are based on past studies, they are not founded based on analyses conducted for Little Bay and/or the Great Bay Estuarine system. The validity of these underlying assumptions could be evaluated by validating the results produced by the SSFATE model used to simulate the sediment dispersion. The validation would be done using actual turbidity and plume measurements made during previous installations or a demonstration project in similar sediments, using the same jet-plow method. No evidence has been provided that the SSFATE model results have been validated.

Because of the assumptions used and lack of sensitivity testing conducted combined with the lack of SSFATE model validation in a similar environment, the accuracy of the sediment plume and deposition results presented for cable burial process is not known and the uncertainty cannot be quantified. The model results are therefore inadequate for evaluating the potential impacts to resources within Little Bay and the larger Great Bay Estuary.

Based on what was presented in SEC Appendix 35 - "Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH", there are shortcomings in the application of the BELLAMY hydrodynamic model that should be addressed to fully understand the sediment dispersion that would occur as a result of the burial process.

Specifically, with regards to the selection of the hydrodynamic model, there is no justification made or data shown to support the use of a two-dimensional (2-D), depth-averaged model for the Great Bay estuarine system rather than a three-dimensional (3-D) model. A 2-D model is appropriate for estuarine systems that are well mixed (i.e. little vertical stratification), while a 3-D model should be applied for estuaries that have vertical salinity gradients in order to capture density-driven circulation patterns (due to combined fresh water and tidal inflow). In past studies where the BELLAMY model was used, it is stated the estuary is well mixed and references are made to a field data collection program conducted in the late 1970s[1]. However, a review of the data from this study at Adams Point in the upper estuary shows vertical variability in current velocities of up to 20 cm/sec. In addition, any observations made regarding the characteristics of the estuary are specific to the measurement period of this study (summer of 1975) which is a typical dry season with relatively little river inflow. Because the cable burial installation process will release sediments in the bottom layers of the water column, characterizing the vertical profile of current velocities is important to how the sediment will be dispersed both vertically and laterally within the estuary. There is no data shown to indicate whether the upper portion of the Great Bay estuary is well mixed during the season when the installation will occur to preclude the use of a three-dimensional hydrodynamic model.

For rivers feeding into the Great Bay estuary, average freshwater discharge values were applied as constant inputs to the model simulations. There is no comparison given, however, as to how these average values compare with the time period over which the cable burial is expected to occur. It has been noted elsewhere in the permit application that the installation is proposed for the fall season when historically there is an increase in precipitation (based on a review of discharge data from USGS gauge 01073500 at Lamprey

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[1] Swenson, E., Brown, W.S., Trask, R., 1977. Great Bay Estuarine Field Program 1975 Data Report Part 1: currents and sea levels. UNH Sea Grant Technical Report # UNH-SG-157, University of New Hampshire, New Hampshire, USA, 109 pp.

River near Newmarket, NH). There is no analysis or discussion of how a significant precipitation event occurring prior to or during installation may affect the river flow contributions and how that could increase stratification in the upper estuary and change the hydrodynamics where the cable will be installed. A range of river discharge values which are representative of the period when the cables are to be installed should be applied in the model.

It was stated in the pre-filed testimony of Ann E. Pembroke that a spring tidal cycle was used in the model simulations. The sediment dispersion model report shows example model currents (Figures 2-2 and 2-3) which appear to be from September 2nd of 2014 which is representative of a neap tidal cycle. There is no documentation of the start date and time of the predicted tides used in the 13-hour model simulations of the jet plow or the 10-day and 20-day simulations of the hand jetting. The type of spring tide level simulated (for jet plowing) and the window of time simulated (for hand jetting) is important as it will directly affect the tidal currents and dispersion of sediments. Additionally, it has been documented that the three cables will be installed via jet plow subsequently over a 3- to 4-week period. Hand jetting for the west and east shallow sections will follow for subsequent periods of 10 and 20 days per cable. The three subsequent cable installations will, therefore, be completed at different tidal cycles (including spring and neap). Installing the three cables subsequently at different tidal cycles will result in different plume dynamics and deposition patterns for each cable installation, however no modeling was done to assess these differences.

A statement is made in the sediment dispersion model report that "*No wind forcing was applied to be consistent with previous studies, which showed the wind effect is short term and minimal, particularly since the modeling focused on steady state conditions.*"
In reviewing the previous studies cited (Bilgili et al., 2005; McLaughlin et al., 2003; Swanson et al., 2015)[2,3,4] there are no comparisons made to establish that wind effects are minimal and do not impact currents within the estuarine system. The modeling and simulations being conducted for the SRP cable burial are of a dynamic varying tidal condition and the construction activity being proposed via jet plow occurs over a 13-hour period and hand-jetting will occur over a 4-hour period. These installation periods are of sufficient duration for changes in wind patterns (speed and direction) to affect surface water currents and sediment plume movement, especially in the shallow water tidal flats where the model results of the sediment plume show suspended sediments reach nearly to the water surface. Additionally, the resuspension of sediments will continue to occur for hours after

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[2] Bilgili A., Proehl J. P., Lynch D. R., Smith K., Swif, M. R., 2005. Estuary-Ocean Exchange and Tidal Mixing in a Gulf of Maine Estuary: A Lagrangian Modeling Study, Estuarine, Coastal and Shelf Science Volume 65, No. 4, 607-624 pp. doi:10.1016/j.ecss.2005.06.027

3 McLaughlin JM, Bilgili A, Lynch DR (2003) Dynamical Simulation of the Great Bay Estuarine System Tides with Special Emphasis on N2 and S2 Tidal Components, Estuarine, Coastal and Shelf Science, Volume 57, No. 1-2, pp. 283-296.

4 Swanson, C., A. Bilgili and D. Lynch, 2015. Long Term Simulations of Wastewater Treatment Facility Discharges into the Great Bay Estuarine System (New Hampshire). Water Quality, Exposure and Health, Volume 7, Issue 1, pp. 67-77.

the construction activity. SEC Appendix 14 – Application for Water Quality Certification pg.10 acknowledges the contribution of wind-induced currents and how it can affect the resuspension of sediments in the tidal flat areas. Given the duration of proposed construction activity, the potential resuspension, and the measured fetch length of Little Bay from north-to-south being approximately 2.7 miles (a sufficient distance over which winds can be sustained to produce surface stresses and induce currents), the modeling should include the expected range of wind conditions that will occur during the burial process.

Based on what was presented SEC Appendix 35 - "Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH", the methods applied and assumptions made in the SSFATE model are not sufficient for characterization of the potential sediment dispersion that may occur as a result of the cable burial process.

With regard to the sediment characteristics, the April 2014 sediment cores in the deeper channel (LB-6-A, LB-7-B, LB-8-B) did not penetrate to the proposed trench depth of 8 feet. An assumption was thus made as to the sediment characteristics below the core penetration depth and what would be released during the jetting process. It has been documented in the December 2016 Characterization of Sediment Quality report that the 2016 sediment cores in the channel did not hit target recoveries due to the "density of the underlying clay layer". It was not specified what the assumed sediment characteristics were for this this dense clay under-layer in the SSFATE model simulations. Conservative higher fine fractions should be used for the clay layer that could not be penetrated to examine the maximum potential for sediment suspension and dispersion that may occur due to jetting.

The reference cited for the sediment release fraction from jet plow activity (Foreman, 2002)[5] states 10 to 35% of the trench volume is entrained in the water column and is based on sediment characteristics from New York Harbor. A 25% sediment release fraction was used in the SSFATE model for the cable burial in Little Bay, although it does not appear an analysis was conducted to justify the sediment release fraction based on sediment characteristics within Little Bay. The reference cited also states "*The analysis performed assumes that there is no variation in soil properties with trench depth.*" and "*If the sediment is more consolidated, it will require a greater volume of water to fluidize it leading to a larger amount of sediment being resuspended*". As shown in the 2014 and 2016 sediment core data acquired by the Applicant, there are variations in the sediment layers with depth in Little Bay and evidence of stiff and/or consolidated clays. Additionally, as the stiff clay layers found (and those found to be impenetrable) in the core samples are encountered, an increase in the jet water flow rate is likely required, which will result in an increased amount of sediment released to the water column. A higher sediment release

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[5] Foreman, J., 2002. Resuspension of sediment by the jet plow during submarine cable installation. Submitted to GenPower, LLC, Needham, MA. Submitted by Engineering Technology Applications, Ltd, Romsey, Great Britain, May, 2002

fraction should be evaluated to assess a worst-case scenario and the sensitivity on the sediment plume and deposition.

With regard to the sediment being released by the jet-plow burial activity, no information is given as to the vertical distribution of the sediment released to the water column that was specified in the SSFATE model to represent the sediment source. The vertical distribution of sediment above the trench will vary based on the sediment characteristics and ambient currents. It is not clear how the vertical distribution of the sediment release was determined, how it was specified in the model, and if it was varied along the cable route. The model sensitivity to the vertical release distribution should also be evaluated.

The jet-plow advance rate for the cable burial process was specified as a constant rate of 100 m/hr in the SSFATE model. While a constant advance rate may be desirable, it has been documented there are stiff layers of sediment that may require adjustment of the jetting pressure, the Applicant is proposing to adjust the cable burial depth from 3.5 to 8 feet when moving from the western shallow flats to the deeper portion of the channel within Little Bay, and there are potential unknown obstacles along the route. In addition, if water quality criteria are exceeded while operating, adjustments to the jetting process may be required. Any potential delay incurred during the burial operation (i.e. due to equipment failure/adjustments, obstructions, exceedance of water quality criteria, etc.) was not taken into account. If there is a delay in the cable burial process, the suspended sediment plume, dispersion, and deposition patterns all will be affected due to the varying tidal currents and flow reversals with flood and ebb tides. The model and resulting plume dynamics should be evaluated for unforeseen changes and potential varying of the plow advance rate.

It is stated in the sediment dispersion model report that one cable route was simulated, however, the combined deposition results for all three cable routes are presented. It is not specified how the combined deposition results for all three cable routes were determined and if an assumption was made that the initial bed composition and post-installation deposition would be the same for all three cable runs. As sediments are disturbed by the first cable installation, any deposited sediments within the subsequent cable routes are subject to being remobilized by the jetting process. It is likely that these disturbed and deposited unconsolidated sediments would be the higher fine fractions that are more likely mobilized and would tend to generate larger plume sizes. The subsequent cable installations should be modeled explicitly to give a better characterization of the expected plume and deposition.

In the sediment dispersion model report, a number of technical reports are referenced that demonstrate successful application of the SSFATE model to dredging. However, it has not been shown how the SSFATE model performs in its simulations of cable and pipeline burial operations via jet plow and hand jetting. As there are past submarine cable burial studies of this type where suspended solid concentrations have been monitored during installation, the SSFATE model results can be validated to show its capability in simulating the jetting burial process. This would help test some of the underlying assumptions made in the model's application for Little Bay, if the validation was performed for a similar estuarine environment having similar sediment characteristics. The model validation would provide some level of confidence in the predicted sediment plume and deposition and allow for quantification of the amount of uncertainty that should be taken into account when evaluating the results. Without any documentation of how the SSFATE model has been validated in similar settings for studies of this type, there is little assurance the model results are reasonable in predicting the sediment plume characteristics and resulting deposition that would occur with the cable burial process.

There is a discussion of the stability of deposited sediments in the sediment dispersion model report and it was determined that most of the fine deposited sediments would be mobilized and re-suspended on subsequent tides. There is no analysis or modeling performed, however, to assess the increased suspended sediment concentrations, duration of exposure, and ultimately where these sediments would likely be distributed after the initial deposition. Re-suspension of unconsolidated fine-grained material disrupted by jet plow activity is expected to occur where tidal velocities are high and where newly deposited sediments will not be in equilibrium with the channel flow regime. Until an equilibrium is reached, the disrupted fine-grained material will be continually entrained into the water column, transported and deposited on subsequent tidal cycles. This would lead to increased suspended sediment concentrations, an extended period of exposure, and a larger area of deposition than what was shown in the model results presented by the Applicant, which could pose additional potential impacts. The re-suspended sediments would be transported to areas of natural deposition within the estuarine system and likely south into Great Bay proper, which has shallow depths and lower current velocities. Additionally, the jetting process for the three submarine cable installations will result in a depression or scar on the seabed as a result of the jetting process. The potential impacts of sediment dispersion cannot be fully assessed unless an analysis is conducted to characterize the resuspension that would occur, the ultimate fate of those sediments, and to estimate how long the scars will take to recover under ambient conditions.

Additional concerns relate to the proposed cable installation methods and whether an alternate approach using a mechanical plow was considered for the Little Bay cable crossing. There is no information given or analysis shown to justify why the use of a mechanical/shear plow was not considered to minimize potential impacts. Based on a review of past studies[6,7], a mechanical plow has been proposed for shallow burial depths (less than 7 feet) and the sediment release fraction used for a mechanical plow is 2-15%, which would pose reduced impacts than a jet plow which has been suggested to have a sediment release fraction of 10-35%. A 42-inch (3.5-foot) burial depth is already planned

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[6] HDR, 2014. Lake Champlain Water Quality Modeling Report, New England Clean Power Link, December, 2014.

[7] HDR, 2014. Application for Construction of the Rockaway Delivery Lateral Project Appendix G - Hydrodynamic and Sediment Transport Analyses for Rockaway Delivery Lateral Project, January, 2014.

for the western tidal flats and in Welsh Cove. It was stated by the Applicant in a January 12th, 2017 public meeting presenting the Sediment Quality Report, that the required burial depth is 42 inches, and that the Applicant was targeting additional burial to 96 inches (8 feet) in the deeper channel voluntarily. If there is no requirement to bury the cable to a depth of 8 feet (i.e. 42" burial across the entire project area), the use of a mechanical plow could be considered. If the Applicant can show that a mechanical plow is not a feasible approach for the entire cable burial route, a mechanical plow, or zero to little jetting, should be considered to minimize impacts in the shallow tidal flat areas where the sediments properties support this method. The pocket penetrometer test results from the April 2014 sediment boring logs for the western flats (LB1 through LB-5) show sediment shear strengths in the top 48-inches of sediment are less than 14 kPa, the maximum shear strength allowable for use of a mechanical/shear plow based on a shear plow analysis completed for cable burial in Lake Champlain (ETA, 2010)[8]. This data suggests the alternative of using a mechanical plow (zero/reduced jetting) for the cable burial process in Little Bay was not adequately addressed. Additionally, the applicant has not addressed the comparative impacts of the proposed deeper burial and what are the differences in water quality impacts from a 42-inch burial compared to a 96-inch burial.

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[8] Engineering Technology Applications, 2010. Southern Lake Champlain Plough Feasibility, Issue 2, October, 2010.

This document, prepared by Joseph Famely, provides Woods Hole Group's preliminary evaluation and analysis of the Seacoast Reliability Project (SRP), proposed by the Public Service Company of New Hampshire d/b/a Eversource (the Applicant) and submitted for approval to the New Hampshire Site Evaluation Committee (SEC). The evaluation focuses on potential ecological impacts related to the proposed burial of transmission cables in Little Bay, and is based on a review of the following SEC documents:

1. Pre-Filed Direct Testimony J Jiottis
    a. Attachment Jiottis
2. Pre-Filed Direct Testimony A Pembroke
3. Pre-Filed Direct Testimony A Godfrey
    a. Attachment Godfrey
4. Appendix 1 USGS Project Overview Map
5. Appendix 2 SRP Environmental Maps
6. Appendix 3 Existing Conditions Maps
7. Appendix 7 SRP Natural Resource Existing Conditions Report
8. Appendix 13 Joint NHDES USACE Wetlands Permit Application
9. Appendix 14 NH DES Section 401 Water Quality Certification Request
10. Appendix 34 Natural Resource Impact Assessment
11. Appendix 35 Modeling Sediment Dispersion from Cable Burial for SRP Little Bay, NH
12. Appendix 37 Rare, Threatened and Endangered Species and Exemplary Natural Communities Report – Partially Confidential
13. Appendix 38 Essential Fish Habitat (EFH) Assessment
14. Pre-filed Testimony of Marc Dodeman, as substitution for Anthony Godfrey
15. Characterization of Sediment Quality Along Little Bay Crossing, Durham to Newington, NH

In reviewing these documents, I noted significant deficiencies in the Applicant's submittal due to various data gaps and analysis gaps which are described in the body of this evaluation. It is my opinion that these gaps resulted from the Applicant dismissing potential impacts or exposure pathways as insignificant without providing sufficient analyses to support these conclusions. The impact of these deficiencies is that the Applicant's SEC documentation does not contain sufficient information upon which to judge whether the SRP, specifically the burial of transmission cable under Little Bay, will have an unreasonable adverse effect on water quality or the natural environment.

Failure to follow an established risk assessment framework

The "*Characterization of Sediment Quality Along Little Bay Crossing*" report (Sediment Quality Report) relies entirely on "Appendix A: Ecological Risk Analysis" for the assessment of potential ecological risk from SRP installation activities in Little Bay. Appendix A purports to be an ecological risk assessment but fails to identify the ecological risk assessment guidance under which the analyses were conducted. By failing to identify and follow an established risk assessment framework, and instead borrowing some of the steps and procedures from the formalized and deliberate process of ecological risk assessment, the Sediment Quality Report's Ecological Risk Analysis misses important potential contaminants and exposure pathways for the proposed work in Little Bay. These deficiencies and gaps in both data and analysis result in a document that does not address the potential ecological impacts of disturbing and mobilizing sediments as proposed for the SRP.

There are well established standards of practice for conducting ecological risk assessments provided by the State of New Hampshire, the United States Environmental Protection Agency, the United States Army Corps of Engineers, the International Navigation Association, the Tri-Services Commission, and the National Forest Service (among others). Had the Applicant followed any one of these established risk assessment frameworks, the analyses would have produced a complete and representative assessment of potential ecological risks from cable burial (and associated) activities. The most critical (but not the only) elements, currently deficient in SRP documentation, that the Applicant would have been required to consider in adhering to an established risk assessment framework are:

- Development of the Site Conceptual Model would have required the Applicant to consider and address the ramifications of jet plowing and hand jetting activities in terms of mobilizing potential contaminants into the water column;
- Detailed consideration of the operational effects of jet plows and hand jets (i.e. the portion of sediments in the trench that are fluidized in place vs. the portion of sediments that are mobilized to the water column) would have formed the basis for the recommended sediment compositing plan;
- An understanding of the potential current and historical contaminants affecting Little Bay would have highlighted the importance of investigating parameters such as pesticides, herbicides, nitrogen, and bacteria;
- Integrated consideration of the aforementioned elements would have highlighted the importance of a robust investigation of the fine organic sediment fractions because of their propensity for contaminant adsorption and their vulnerability to water column suspension.

By not identifying the regulatory framework for the risk assessment (or standard guidance and associated technical updates), the Sediment Quality Report does not provide a sound basis upon which to judge whether the data and assessment are sufficient to justify conclusions regarding potential ecological risk.

As an ecological risk assessment professional, I recommend that the Sediment Quality Report and supporting analyses unambiguously follow the standards of practice for ecological risk assessment provided by any one of the many state or federal agencies. This would provide the reviewer with a standard "checklist" of whether the analysis has been conducted in an environmentally protective manner; clearly define the regulatory program under which the risk assessment is being performed; and assure the general public that the assessment has been done under some well-reviewed and universally accepted standards.

It is my opinion that, of all the available ecological risk assessment frameworks, the most applicable to the SRP is the USACE Regional Implementation Manual (RIM) and associated USACE technical publications for assessing the environmental impacts of dredged material management sites. Because the proposed cable installation techniques (jet plowing and hand jetting) disturb and partially suspend sediments in the water column until such time that the suspended particles resettle, it is functionally equivalent to a dredging and dredged material disposal project. This approach would place the analysis within a well-recognized standard of practice. If the analysis followed the requirements of the Tiered process in the RIM, it would provide a deliberate and standardized analysis that two federal agencies (USACE and USEPA) have reviewed and consider environmentally protective. This approach would also provide any reviewers of the documents a regulatory context and standardized format against which to assess the adequacy of the work. Finally, it would provide the general public with some assurance that the methods employed have been accepted by the engineering and scientific community as protective for this type of project.

Had the Applicant followed the RIM guidelines, the currently available data would not have been satisfactory for a Tier I evaluation. Current sediment chemistry data are not appropriate for Tier I evaluation because the 4-foot composite samples are not representative of the potential disturbance and mobilization of sediment to the water column (see below discussion of sediment compositing plan) or the post-construction benthic exposure zone. Additionally, the SRP analyses omitted pesticides, a standard group of contaminants recommended in Tier I RIM evaluations "based on their toxicity, their persistence in the environment, their ability to bioaccumulate and their widespread and consistent occurrence in New England estuarine, marine and freshwater sediments and organisms."[1] Further, because the proposed cable burial method will mobilize sediments to the water column, RIM would require a Tier II evaluation of compliance with state water quality standards using sediment concentrations and a numerical mixing model, as well as an evaluation of potential bioaccumulation for non-polar organic contaminants. If these numerical evaluations indicated potential risk, the RIM would then require a standard elutriate toxicity test. If Tier II analyses were inconclusive, further analysis would be required (such as water column and sediment toxicity tests, sediment bioaccumulation tests, long term bioassays and bioaccumulation tests, and risk modeling).

Neglect of water column exposure and potential impacts

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[1] U.S. EPA New England and U.S. Army Corps of Engineers, New England District. 2004. Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters.

The "*Modeling Sediment Dispersion from Cable Burial for SRP*" report (Sediment Dispersion Modeling report) assumes that 25% of sediments are suspended by jet plow operation (the assumption for hand jetting is 50%). The literature cited in the Sediment Dispersion Modeling Report suggests that jet plow sediment suspension rates can vary between 10% and 35%.[2] Despite a direct acknowledgement in the Sediment Quality Report that the proposed cable installation methods "will necessarily disturb sediments and suspend them into the water column", there is no analysis (nor discussion in the conceptual site model) of the potential for contaminants to desorb from sediment particles and become suspended or dissolved in water column, nor of the potential for exposure of aquatic organisms to these contaminants (whether in dissolved or particulate phase).

The State of New Hampshire has established surface water quality standards (New Hampshire Code of Administrative Rules, Chapter Env-Wq 1700), which include criteria not only for the parameters assessed in the SRP Application for Water Quality Certification (Benthic Deposits [1703.08] and Turbidity [1703.11]) but also for bacteria, nutrients, metals, semi-volatile organic compounds (including PAHs), pesticides, and PCBs. Although the Applicant measured some of these contaminants in sediments (see also critique of sediment compositing plan), no modeling of potential water column concentrations was performed. The SRP Application for Water Quality Certification incorrectly assumed that no pollutant loading analysis was necessary because "the project proposes no increase in impervious surfaces and thus no changes in pollutant loading," ignoring the fact that the installation will mobilize historically buried sediments (to which pollutants could be adsorbed, suspended as particulates, and subsequently dissolved) to the water column.

The direct result of this gap in analysis is that, apart from turbidity and benthic deposits, there is no information available upon which to judge whether or not the proposed SRP activities in Little Bay could constitute a water quality violation.

In addition, Little Bay and surrounding waterbodies (Adams Point and Great Bay) are on New Hampshire's 2012 §303(d)[3] Clean Water Act list of water quality limited segments. The parameters upon which these impairment listings are based include:

- Light Attenuation Coefficient
- pH
- Dissolved Oxygen
- Nitrogen (Total)
- *Enterococcus*

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[2] Foreman, J., 2002. Resuspension of sediment by the jet plow during submarine cable installation. Submitted to GenPower, LLC, Needham, MA. Submitted by Engineering Technology Applications, Ltd, Romsey, Great Britain, May, 2002.

[3] http://www.des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/a08-303d-list.pdf

- Fecal Coliform
- Polychlorinated biphenyls
- Dioxin (including 2,3,7,8-TCDD)
- Mercury

Because these waterbodies are currently being regulated on these parameters, the Applicant should demonstrate that SRP installation activities will not cause further impairment from construction-related sediment suspension.

Sediment compositing plan was based on inadequate information

The Sediment Quality Report was based on chemical analyses of 12 sediment cores from the planned cable installation corridor. The sampling plan called for the characterization of the top 4 feet of each vibracore in areas where the planned cable burial depth is 3.5 ft., and separate characterization of the upper (top 4 feet) and lower segments of each vibracore in areas where the planned cable burial depth is 8 ft. (unless physical stratification was observed and subsampling was required, which did not occur).

This sample compositing plan was not informed by the specific technologies to be used for cable installation, and therefore produced a dataset that is limited in its utility for determining potential impacts to biological communities from exposure to contaminants in suspended and resettled sediments. The Sediment Dispersion Modeling report assumes that 25% of sediments are suspended by jet plow operation, and that 50% of sediments are suspended by hand jetting. Based on a review of available literature[4] and consultation with an engineer with expertise in submarine cable projects[5], it is reasonable to assume that the portion of the sediment column that is suspended in the water column is the upper portion, and that deeper sediments fluidized in the trench stay in place. Thus, based on the assumptions used in the SRP model, it is reasonable to assume that the jet plow will suspend approximately the top 0.9 ft. of sediment in areas of 3.5 ft. burial, and will suspend approximately the top 2 ft. of sediment in areas of 8 ft. burial. Similarly, based on the assumptions used in the SRP model, it is reasonable to assume that hand jetting will suspend approximately the top 1.75 ft. of sediment in areas of 3.5 ft burial. The post-construction biologically active layer is potentially a mixture of the resettled sediments and adjacent surficial sediments which have sloughed in to the trench. Sediment sample compositing should be informed by the jetting suspension rates and the expected remnant surficial sediments in order to realistically quantify potential exposure and risk. Further consideration should be given to the fraction of those suspended sediments that remain suspended in the water column and subsequently may make contaminants available in the water column. The specific consideration of the fine silt and clay particles suspended by jetting is of

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[4] Foreman, J., 2002. Resuspension of sediment by the jet plow during submarine cable installation. Submitted to GenPower, LLC, Needham, MA. Submitted by Engineering Technology Applications, Ltd, Romsey, Great Britain, May, 2002.

[5] Personal communication, Payson Whitney, ESS Group. February 15, 2017.

particular importance because higher levels of contamination are typically associated with these fine organic fractions. For these reasons, the 4-foot composites analyzed for the Sediment Quality Report are inappropriate for characterizing ecological risk and not grounded in the physical and technological processes of the jetting installation processes.

Further, the Sediment Quality Report's compositing plan yielded sediment data that is not comparable to either the National Coastal Condition Assessment (NCCA) data or the ecological sediment benchmarks referenced in the Sediment Quality Report. The standard operating procedures for the National Coastal Condition Assessment specify the use of Young-modified Van Veen Grab (or similar) samplers which collect surficial (7 cm) sediment samples[6] for chemical and other analyses. The comparisons made between NCCA data and SRP cores are inappropriate because the sampling and compositing methods were different. Therefore, the conclusion that sediment conditions in the planned cable installation corridor are consistent with NCCA sediment conditions for Little Bay (classified as "good") is not valid. Similarly, the ecological sediment benchmarks used as an "initial screening level review" in the Sediment Quality Report – the Effects Range Low (ER-L) and Effects Range Median (ER-M)[7] – were developed from sediment toxicity test data using benthic organisms that inhabit the top 6 to 12 inches of sediment. It is therefore inappropriate to compare a 4-foot composite sample to these benchmarks unless the cable installation process homogeneously mixed all sediments within the trench, and that completely homogeneous mixture was representative of the post-construction biologically active layer. Since all accounts of the jetting process presented by the Applicant and in the literature suggest that jet plows are designed to minimize sediment disturbance and suspension, comparison of a 4-foot composite sample to the ER-L or ER-M is not valid. Therefore, there is not sufficient information upon which to base a judgment of whether post-construction sediment passes the Applicant's proposed "initial screening level review".

Finally, it is likely that the compositing plan resulted in physical averaging over the 4-foot horizon. Therefore, any signal from legacy contamination associated with a particular (historical) sediment layer would have been lost due to mixing with other (cleaner) layers.

For these reasons, the conclusion that the sediments in the planned cable installation corridor do not pose a potential risk to ecological receptors is predicated on a faulty and misinformed sample compositing scheme and non-compatible comparisons.

Incomplete list of constituents of potential concern

The Sediment Quality Report lists the constituents of potential concern for sediments as the parameters required by the USACE Regional Implementation Manual (RIM), plus a selection of

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[6] USEPA. 2014. National Coastal Condition Assessment: Field Operations Manual. EPA-841-R-14-007. U.S. Environmental Protection Agency, Washington, DC.

[7] Long E.R., L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration. Seattle, Washington. 1990

other contaminants (total petroleum hydrocarbons, dioxins/furans, perfluoro compounds) in response to regional concerns. The list of contaminants analyzed by the Applicant is incomplete for two reasons: the list excludes some contaminants required by the RIM, and it excludes some other contaminants that are of particular concern for Little Bay. These omissions represent data gaps in the SRP evaluation that inhibit the complete assessment of potential ecological risks from exposure to reworked and suspended sediments due to SRP cable burial activities.

First, the Applicant omitted the following contaminants – which are listed as the required contaminants in the RIM[8] – from its list of parameters analyzed in Little Bay sediment cores:

- Aldrin
- cis- and trans-Chlordane
- cis- and trans-Nonachlor
- Oxychlordane
- 4,4'-DDT, DDE, DDD
- Dieldrin
- alpha- and beta-Endosulfan
- Endrin
- Heptachlor
- Heptachlor epoxide
- Hexachlorobenzene
- Lindane
- Methoxychlor
- Toxaphene

The omission of these pesticides, which are routinely required for analysis under the RIM, is a major data gap because it ignores a significant class of contaminants that falls under regulatory jurisdiction. These contaminants were included in the RIM framework "based on their toxicity, their persistence in the environment, their ability to bioaccumulate and their widespread and consistent occurrence in New England estuarine, marine and freshwater sediments and organisms"[9]. The disturbance and potential mobilization of legacy pesticides, both within the biologically active benthic zone and to the water column, is a potentially significant exposure pathway that should have been addressed.

Second, the Applicant omitted the following contaminants – which could occur and potentially impact benthic and aquatic organisms, if released – from its list of parameters analyzed in Little Bay sediment cores:

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[8] U.S. EPA New England and U.S. Army Corps of Engineers, New England District. 2004. Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters.

[9] U.S. EPA New England and U.S. Army Corps of Engineers, New England District. 2004. Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters.

- Herbicides, because they have potentially been introduced historically to Little Bay via stormwater runoff
- Nitrogen, because it is listed as a source of impairment for Little Bay, Adams Point, and Great Bay in New Hampshire's 2012 §303(d)[10] Clean Water Act list of water quality limited segments. Additionally, recent studies[11] demonstrated that resuspension of sediments leads to a release of nitrogen to the water column in concentrations that suggest desorption from resuspended particles. Quantification of this release is critical given the §303(d) listing and current efforts to limit nitrogen input to Little Bay.
- *Enterococcus* bacteria, because it is listed as a source of impairment for Little Bay, Adams Point, and Great Bay in New Hampshire's 2012 §303(d)[12] Clean Water Act list of water quality limited segments.
- Pathogens (e.g. *Clostridium perfringens* and *Vibrio*), because of potential impacts to shellfishing and oyster aquaculture if mobilized from sediments under certain enabling conditions.
- Fecal coliform, because it is listed as a source of impairment for Little Bay, Adams Point, and Great Bay in New Hampshire's 2012 §303(d)[13] Clean Water Act list of water quality limited segments.

Due to these data gaps, it impossible to make a wholly informed judgment as to the potential for ecological risk from SRP activities in Little Bay.

Potential Impacts to Oysters

The Natural Resource Impact Assessment concludes that there will be no impact from suspended sediments to oysters in natural and restored beds or in aquaculture because exposure to suspended sediments would be too low to elicit any effects, and because sedimentation in the vicinity of the oyster beds and aquaculture areas would be ≤0.5 mm. These conclusions were based on the findings in Wilber and Clarke (2001)[14]. The Applicant should re-examine potential impacts to oysters considering both the model sensitivity analysis (recommended by

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[10] http://www.des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/a08-303d-list.pdf

[11] Percuoco, VP, LH Kalnejais, and LV Officer. 2015. Nutrient release from the sediments of the Great Bay Estuary, NH. USA. Estuarine, Coastal and Shelf Science. 161:76-87.

[12] http://www.des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/a08-303d-list.pdf

[13] http://www.des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/a08-303d-list.pdf

[14] Wilber, D. H. and D. G. Clarke. 2001. Biological Effects of Suspended Sediments: A Review of Suspended Sediment Impacts on Fish and Shellfish with a Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management 21: 855-875.

M. Shultz, Woods Hole Group) and in light of more recent literature review[15] by the same authors. The assessment of potential impacts due to excess turbidity and sedimentation should focus especially on sensitive life stages.

Additionally, the mobilization of sediments to the water column could expose oysters to various chemical and bacterial constituents which could have adverse effects on sensitive life stages or on commercially viable stocks. These potential impacts need to be reviewed in order to ensure the ecological health of oyster (and other shellfish) populations/stocks as well as to safeguard against potential public health issues.

Assessment of Life-cycle Impacts of the Cable Burial Incomplete

The Sediment Dispersion Modeling report and the derivative impact assessment documents focus on the potential impacts of SRP construction in Little Bay. Based on the various critiques of these assessments presented in this preliminary analysis and in the preliminary analyses of M. Schultz (Woods Hole Group) and M. Dacey (GeoInsight), it is my opinion that cable installation impacts have not been sufficiently addressed by the Applicant because there are significant gaps in data and analyses in the Applicant's evaluation of cable installation impacts. In addition, the other components of the project that are lacking in quantitative impact analysis are:

- Removal of sections of existing out of service cables from Little Bay prior to SRP construction
- Excavation of SRP cables from Little Bay during project service life for repair and maintenance
- Removal of SRP cables from Little Bay at their end of service life

The assessment of the cumulative life cycle impacts of the SRP cable burial in Little Bay is incomplete because it ignores these activities which "will necessarily disturb sediments and suspend them into the water column". The Applicant should discuss the methods, timing, and spatial extent of these activities, and quantitatively assess their impacts because the SRP impact assessments are inadequate in their absence.

Water Quality Monitoring Plan is Inadequate

The water quality monitoring plan (the Monitoring Plan) presented in the Little Bay Environmental Monitoring Plan (Appendix D of SRP "*Application for Water Quality Certification*") is inadequate because it is predicated on unsubstantiated assumptions, is too permissive in its definition of what conditions constitute a water quality violation, and does not

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[15] Wilber, D. H., and D. G. Clarke. 2010. "Dredging activities and the potential impacts of sediment resuspension and sedimentation on oyster reefs." Proceedings of the Western Dredging Association Thirtieth Technical Conference, San Juan, Puerto Rico. Vol. 6169.

provide a framework for real-time adaptive management of water quality during construction activities.

The Applicant proposes to implement a mixing zone because the construction activities are expected to cause exceedances of the water quality criterion for turbidity (increases greater than 10 NTU above background). The Monitoring Plan asserts that the proposed mixing zone "complies with all Minimum Criteria established in Env-Wq 1707.02" but does not present evidence to substantiate this claim. Although some of this information may be presented in various other parts of the SRP application, the relevant information should be summarized (at minimum) in the Application for Water Quality Certification to substantiate the claim that the proposed mixing zone:

a) Meets the criteria in Env-Wq 1703.03(c)(1);
b) Does not interfere with biological communities or populations of indigenous species;
c) Does not result in the accumulation of pollutants in the sediments or biota;
d) Allows a zone of passage for swimming and drifting organisms;
e) Does not interfere with existing and designated uses of the surface water;
f) Does not impinge upon spawning grounds and/or nursery areas of any indigenous aquatic species;
g) Does not result in the mortality of any plants, animals, humans, or aquatic life within the mixing zone;
h) Does not exceed the chronic toxicity value of 1.0 TUc at the mixing zone boundary; and
i) Does not result in an overlap with another mixing zone.

The Monitoring Plan lists the following procedures for the determination of compliance with the turbidity criterion based on field monitoring of turbidity 1,000 ft. up-current and 1,000 ft. down-current of the construction activity:

- The three water column measurements collected at each impact and each reference station will be averaged for each hour
- Average values at an impact station will be compared to the range of reference station averages for that hour
- If average turbidity at any impact station exceeds the highest reference station value by <10 NTUs at a given time, the difference between values will be considered to be insignificant
- If average turbidity at any impact station exceeds the highest reference station value by more than 10 NTUs for that particular hour, but does not exceed the highest reference station value the following hour, then the exceedance is considered to be insignificant
- If average turbidity at any impact station exceeds the highest reference station value by more than 10 NTUs for two consecutive hours, then further evaluation will be required

These procedures for the determination of compliance with the turbidity criterion are too permissive in their design and are not grounded in an understanding of the potential impacts of SRP construction or the regulations. The Monitoring Plan proposes that turbidity will be measured at the near-surface, mid-depth, and near-bottom. It is reasonable to monitor these three strata in the water column because many factors (including temperature, salinity, currents, sediment particle size) can influence where suspended sediments migrate in the water column after initial entrainment. What is unreasonable, however, is that the Applicant intends to average these three measurements for comparison to similar water column averages from the reference stations. Averaging both dilutes the signal in the impact area and ignores the very different assemblages of organisms that may be exposed to the turbidity plume during construction. In addition, the Applicant proposes that the determination of significance should be based solely on the duration of exceedance – an exceedance lasting less than 2 hours is judged to be insignificant. This determination is not appropriate because Env-Wq 1708.09 does not allow for a determination of significance based on duration. The State regulations regarding the determination of significance assert that an activity is significant if it is "projected to use 20% or more of the remaining assimilative capacity for a water quality parameter". Thus, the Applicant should base the determination of significance on an assessment of assimilative capacity for Little Bay.

The Applicant's Monitoring Plan allows for further permissiveness in the determination of significance because turbidity exceedances of more than 10 NTU above background for more than 2 hours are not automatically judged to be significant, but rather will be passed along to the regulatory agencies for comparison to the range of available historical data (for Fall months) from the CICEET buoy[16] in Great Bay. Judgment of the significance of water quality criterion exceedances should not be based on post-hoc data analysis by regulatory agencies. These determinations are regulated under the New Hampshire Surface Water Quality Regulations (Env-Wq 1700), promulgated by the New Hampshire Department of Environmental Services, and the Applicant should present an analysis of remaining assimilative capacity rather than proposing alternative methods for these determinations.

Finally, the Monitoring Plan asserts that it is not feasible to stop and re-start jet plow operations without risking additional sediment disturbance, and therefore the results of the water quality monitoring for the first installation will inform adjustments to subsequent installations. This argument is flawed because it is entirely within the contractor's control to adjust the water pressure and rate of advancement of the jet plow during installation[17]. Thus, the Monitoring Plan should be modified such that it allows for real-time adaptive management of the jet plow operation in response to ongoing turbidity monitoring. Instead of a turbidity criterion exceedance triggering further post-hoc comparisons, any exceedance should trigger real-time management measures to reduce turbidity in addition to post-hoc analysis to inform subsequent installation parameters.

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[16] The "CICEET buoy" referenced in the Applicant's Monitoring Plan is now managed by the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS). Another useful source of regional turbidity data is the Great Bay National Estuarine Research Reserve (GBNERR) buoy in Great Bay, which is referenced in the Natural Resource Existing Conditions Report but omitted from the Monitoring Plan.

[17] Personal communication, Payson Whitney, ESS Group. February 15, 2017.

The Applicant should revise and expand the proposed water quality monitoring plan in order to ensure that all anticipated impacts from the project are documented and evaluated against the appropriate criteria. The plan should expand the duration of pre- and post-disturbance monitoring. Because of the high variability in ambient turbidity presented by the Applicant, it is important to know what the conditions are more than just one hour before commencing construction. Because the sediment plume can remain suspended in the water column, and this suspension may be influenced by environmental conditions, it is important to confirm the model's prediction that the plume dissipates two hours after termination of construction by extending post-disturbance monitoring until downstream turbidity is not significantly different from upstream (reference) turbidity. Most importantly, turbidity should not be the only parameter monitored during construction. In order to effectively detect and manage potential impacts, the Applicant should design the monitoring plan to account for all parameters under the jurisdiction of the State of New Hampshire surface water quality standards (New Hampshire Code of Administrative Rules, Chapter Env-Wq 1700) as well as the parameters listed as limiting factors on New Hampshire's 2012 §303(d) listings for Little Bay and adjoining segments.

Lack of Electromagnetic Field Monitoring Plan

The Natural Resource Impact Assessment acknowledges that little is known about how benthic invertebrates respond to electromagnetic fields (EMFs), citing a BOEMRE (prepared by Normandeau) study[18] on EMFs from submarine power cables. This BOEMRE study recommends monitoring EMF once the cable is powered in order to verify the modeled level of exposure and determine if any impacts have occurred, however an EMF monitoring plan is not included in any monitoring plans reviewed in the SEC application. The Applicant should follow its own consultant's published recommendations regarding monitoring the effectiveness of EMF mitigation measures, and design an EMF monitoring plan for the SRP accordingly.

Turbidity and TSS Data Used to Establish Ambient Range Should be Thoroughly Vetted

The SRP "*Natural Resource Existing Conditions Report*" (Existing Conditions Report) presents very large ranges for turbidity and total suspended solids (TSS) in the vicinity of the SRP planned cable installation corridor. These measurements need to be thoroughly vetted in order to develop an accurate and representative understanding of ambient water quality conditions in immediate and adjacent waterbodies, especially for the time of year of planned SRP construction (late Fall and early Winter). Although these turbidity and TSS measurements do not directly frame the threshold upon which to judge a water quality violation (the Environmental Monitoring Plan sets up turbidity monitoring up-current and down-current of the construction area), their accuracy is nonetheless important because Applicant has proposed a contingency for judging exceedance significance based on historical turbidity data.

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[18] Normandeau, Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

The Existing Conditions Report presents turbidity data for Great Bay over four years (2009-2013) from the months April – December, omitting data from January – March. Although mean turbidity is generally low, maximum values can exceed the mean by two orders of magnitude. These data are not representative of the expected conditions during SRP construction because they include Spring and Summer data, when no construction activity will take place. Further, factors such as precipitation, wind, waves, currents and ice scour can affect turbidity, but the Applicant does not present an analysis correlating turbidity to any of these factors. Therefore, given the data presented by the Applicant, it would be impossible for a regulatory agency to judge the significance of a water quality exceedance in the short window of time between individual cable burials.

The Existing Conditions Report also presents TSS data for Adams Point (Table 3.4-8), indicating that TSS was statistically higher during 2001-2008 than during 1974-1981. The standard deviations of these datasets were very high. Additionally, it has been reported[19] that Winter (January – March) TSS data from Adams Point collected between approximately 2003 and 2014 are biased high due to the method of sampling. For these years, when the floating docks at Jackson Estuarine Lab were removed to prevent ice damage, TSS samples were collected via wading instead of by boat (in the channel). Investigators comparatively demonstrated that these nearshore data are not comparable to channel data (historically taken at end of pier or by boat) because wading samplers could not avoid the back eddies and shallow water resuspension. Therefore, some of the data presented in Table 3.4-8 are likely biased high and should not be relied upon to establish the ambient conditions for Little Bay without further investigation.

The Applicant should address this variability in greater detail and present an expected possible range of turbidity (or TSS) levels for the period of SRP construction in order to best anticipate potential impacts of additional suspended solids from construction. Also, the applicant should more thoroughly explain other factors affecting background turbidity levels (precipitation, wind, waves, currents, ice scour).

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[19] Personal communication, Dr. Stephen Jones, UNH. February 15, 2017.

ATTACHMENT F

ARCGIS MEASUREMENTS

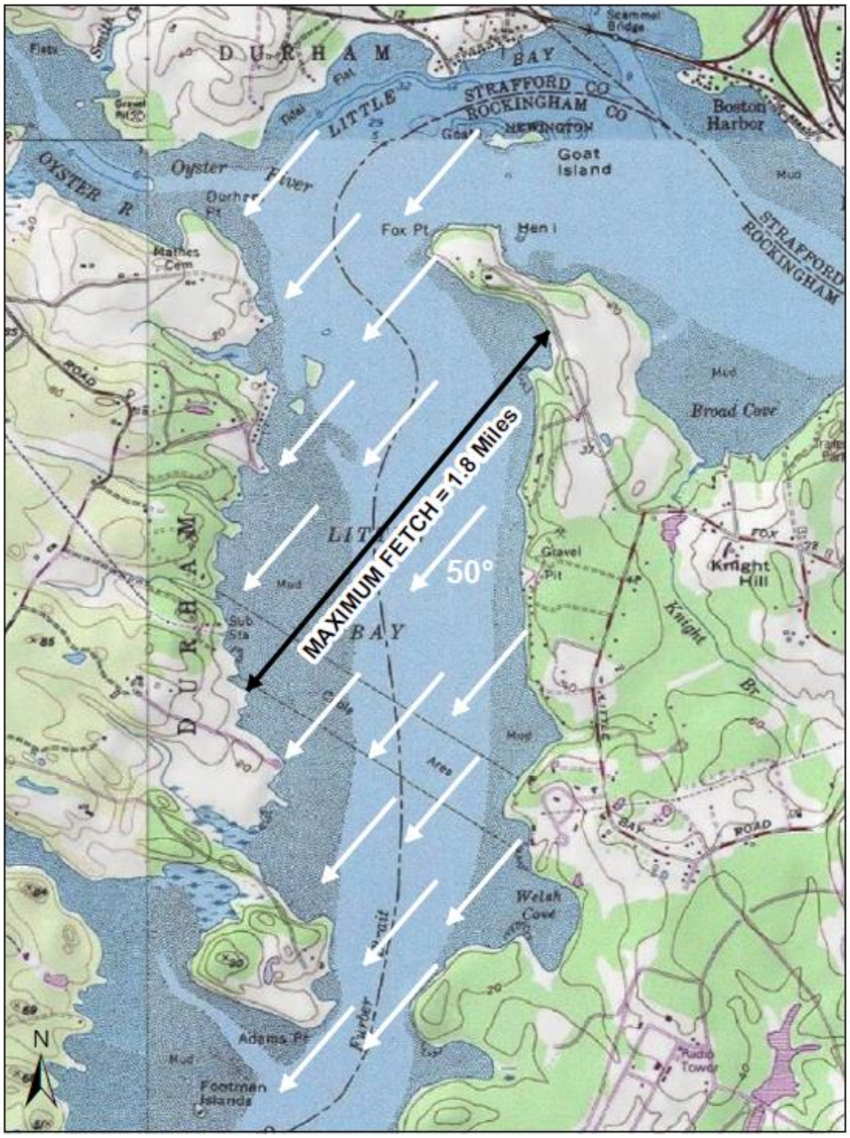

Figure 1. Wind fetch in Little Bay for wind direction of 50 degrees (clockwise from true North)

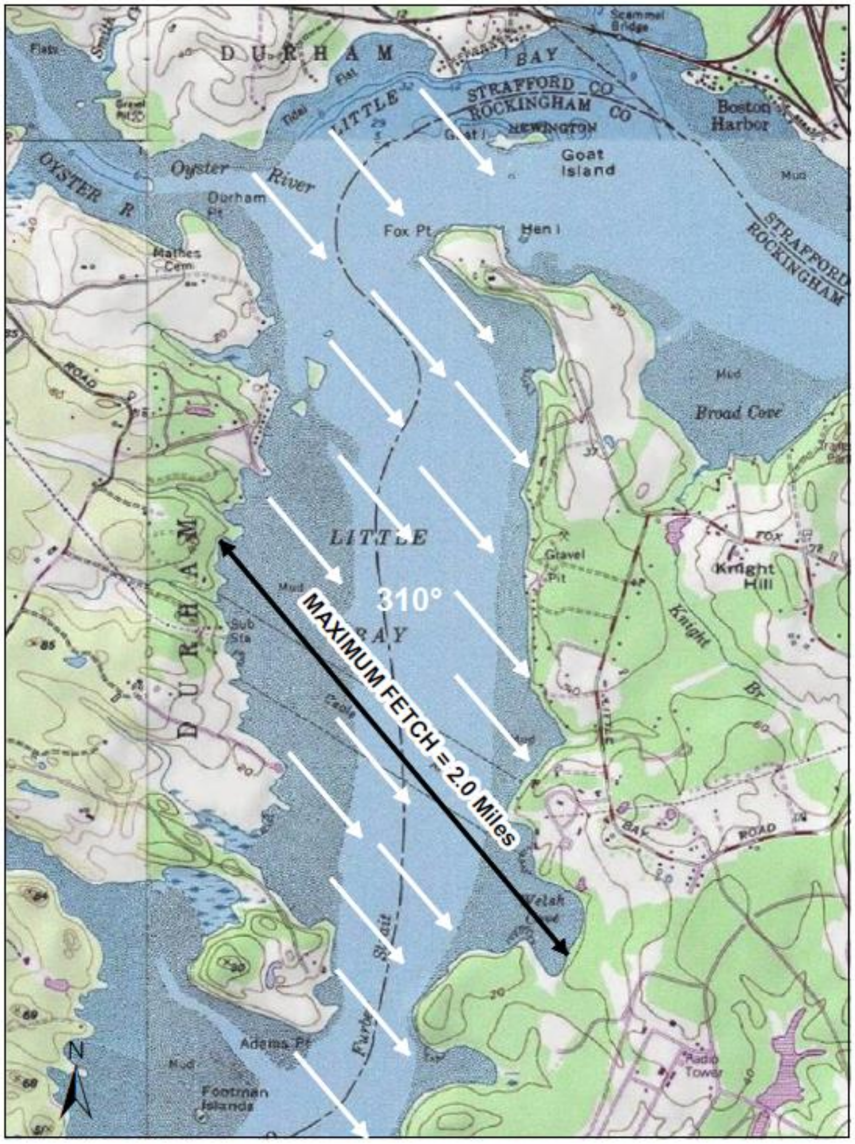

Figure 2. Wind fetch in Little Bay for wind direction of 310 degrees (clockwise from true North)