FERC Proposed Study Plan Meeting

May 14, 2013 (afternoon) and May 15, 2013

Northfield Mountain Pumped Storage Project (FERC No. 2485)

Turners Falls Hydroelectric Project (FERC No. 1889)

Agenda

May 14: 1 pm to 4 pm

- Water Quality Monitoring Study (3.2.1)
- Hydraulic Study of TF Impoundment, Bypass Reach and below Cabot (3.2.2)
- Evaluate the Impact of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation (3.8.1)
- *Watershed Wide Stormwater Model (4.2.1)*
- *Climate Change and Continued Project Operations (4.2.2)*

May 15: 9 am to 4 pm

- *Feasibility of Closed or Partially Closed Loop System (4.7.1)*
- *Creation of a Decommissioning Fund (4.7.2)*
- 2011 Full River Reconnaissance Study (3.1.1)
- Northfield Mountain (NM)/Turners Falls (TF) Operations Impact on Sediment Transport (3.1.2)
- *Study of Shoreline Erosion caused by NM Operations (4.1.1)*
- *Study the Impact of Operations of the NM Project and TF Dam on Sedimentation and Sediment Transport in the CT River (4.1.2)*

Water Quality Monitoring Study

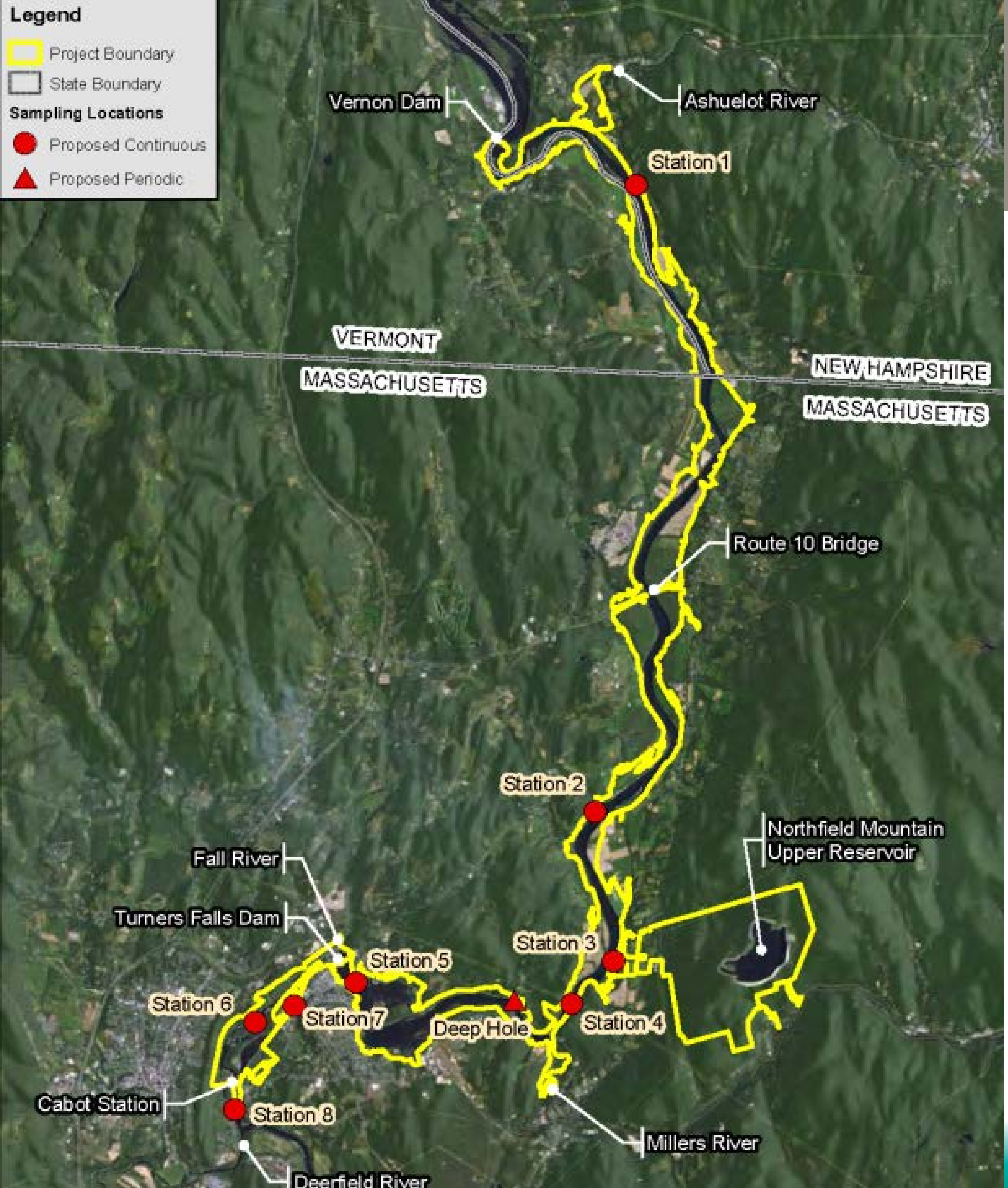
Task 1: Develop Water Quality Sampling Plan

- Once FERC issues its Study Plan Determination letter, the water quality sampling plan will be sent to MADEP for review and comment.
- Sampling plan will include quality assurance procedures.

Task 2: Continuous Dissolved Oxygen (DO) and Temperature Monitoring

- Continuous (15 min) in-situ DO/temp monitoring from Apr 1 to Nov 15 at 8 locations (map attached).
- DO/temp monitoring in impounded waters will be suspended from a surface buoy and deployed to 25% of the depth.
- In bypass reach, canal and below Cabot, DO/temp monitoring equipment will be installed mid-channel, mid-depth.
- Spot measurements of DO/temp taken during deployment, bi-weekly visits and upon retrieval of equipment.

8 Continuous DO and temp monitoring locations (Stations 1-8)



Stations 2-4


Legend
Continuous Monitoring Location
Station 2
Northfield Mountain Upper Reservoir
Northfield Mountain Tunnel
Station 3
Northfield Tailrace
Station 4
Millers River Confluence

Stations 5-8

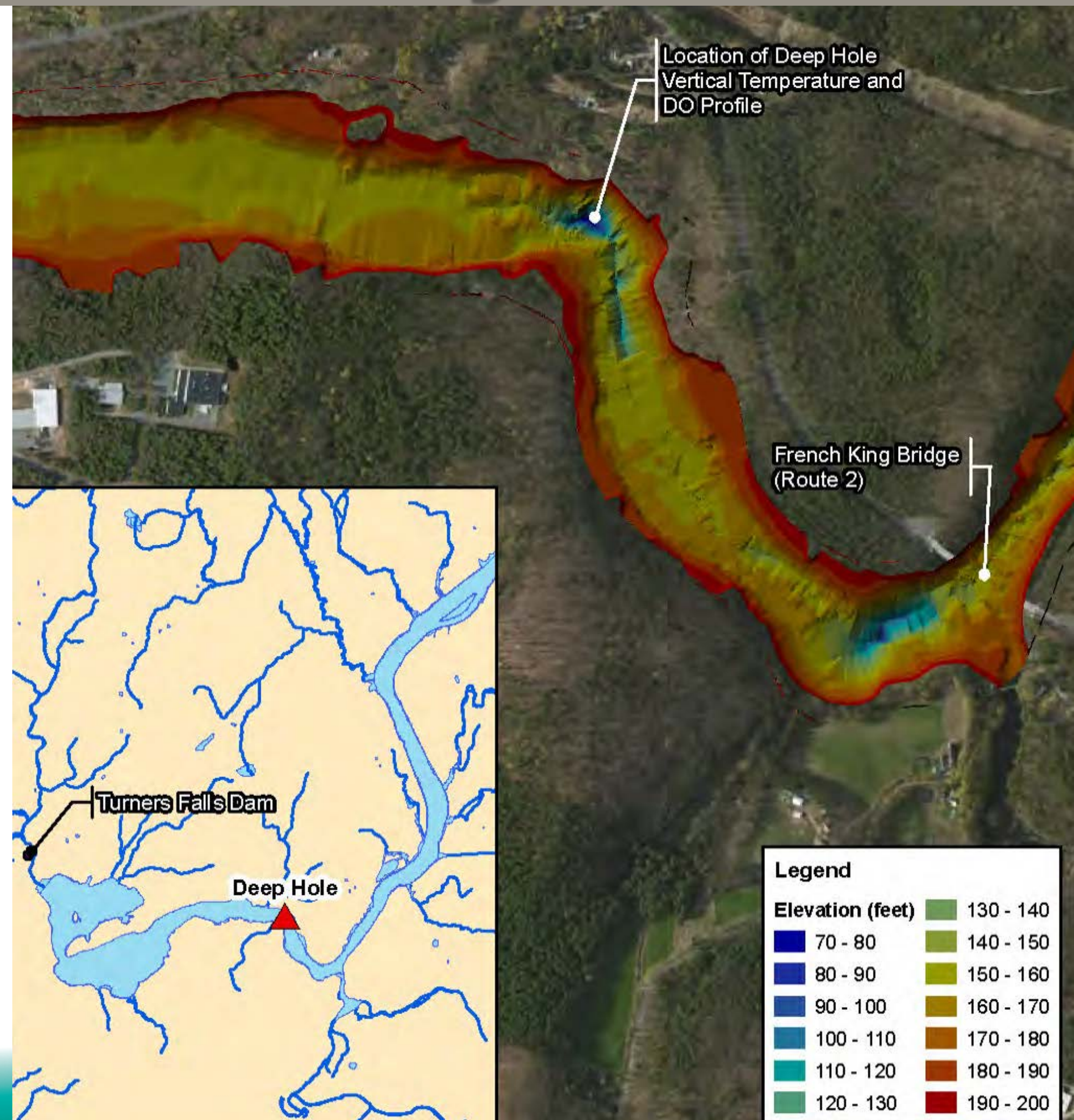

Legend
Continuous Monitoring Location
Fall River Confluence
Turners Falls Dam
Station 5
Bypass Reach
Station No. 1
Station 7
Station 6
Power Canal
Cabot Station
Station 8
Deerfield River Confluence

Water Quality Monitoring Study

Task 3: DO/Temperature Profiles

- Vertical profiles of DO/temperature in deep hole in TF Impoundment.
- Measurements taken in 1.0 meter increments.
- Collected bi-weekly from early April 2014 through mid Nov 2014 (approximately 16 profiles).

Task 4: Report

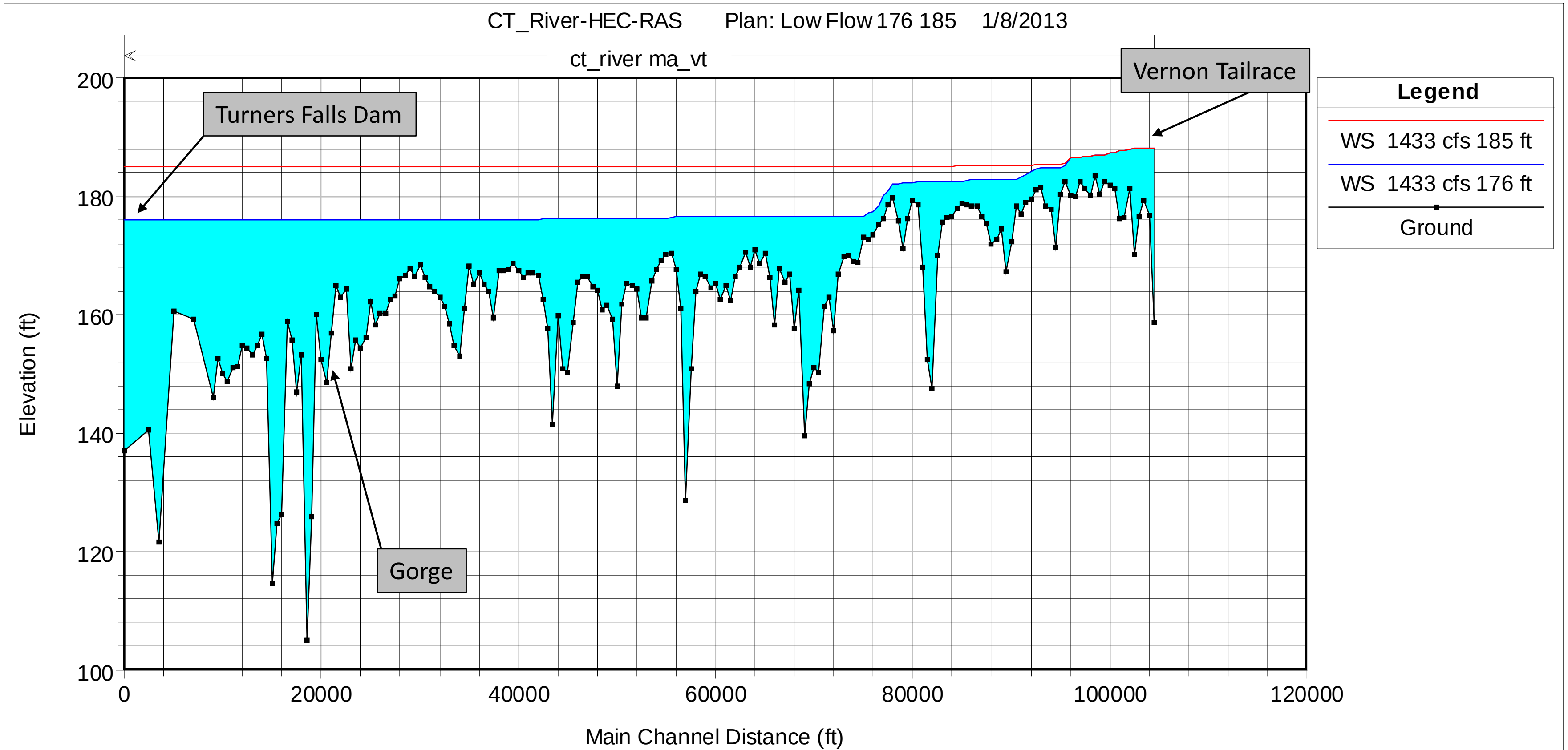


Hydraulic Study of TF Imp, Bypass Reach & below Cabot Station

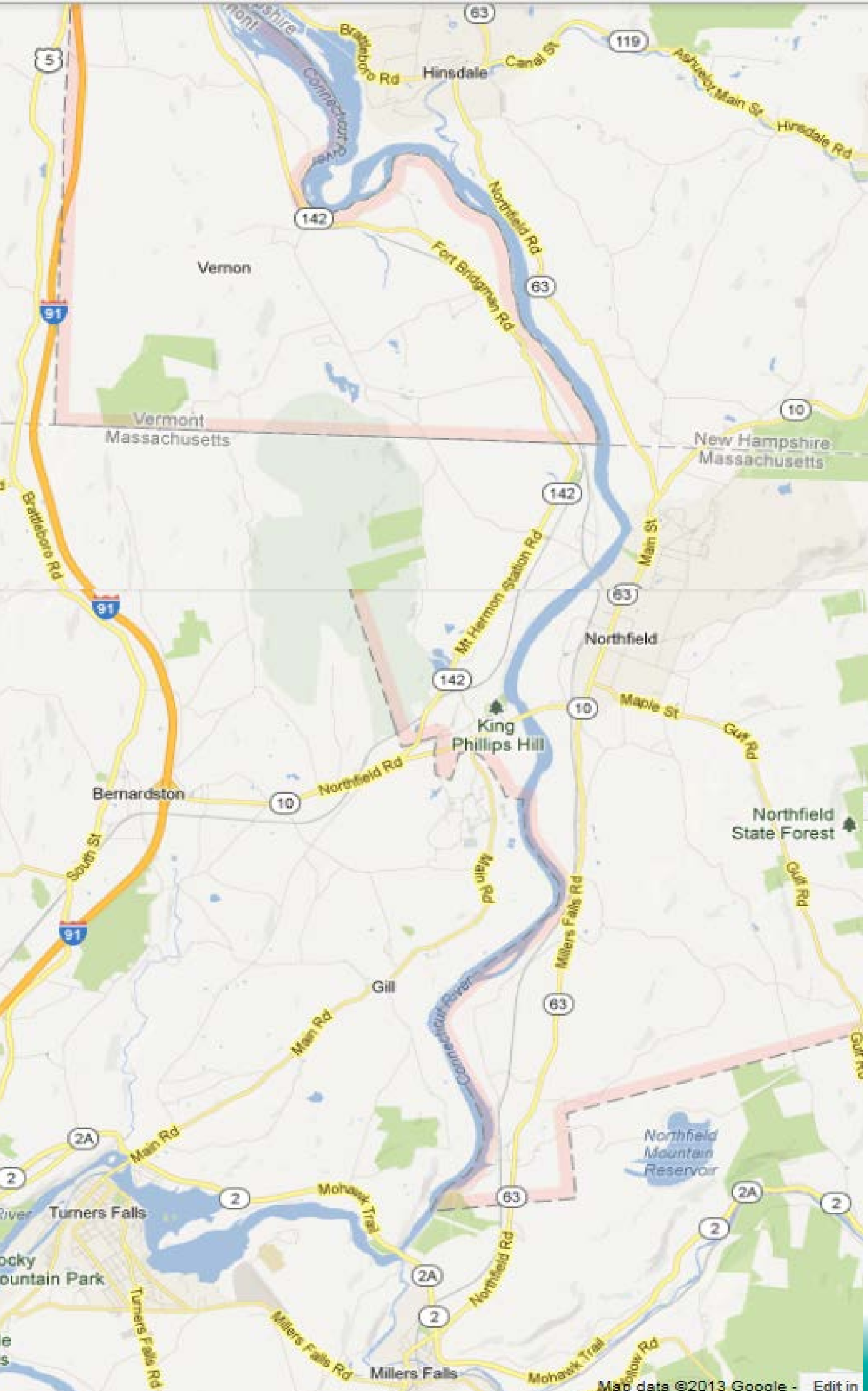
FirstLight Power Resources
GDF SUEZ

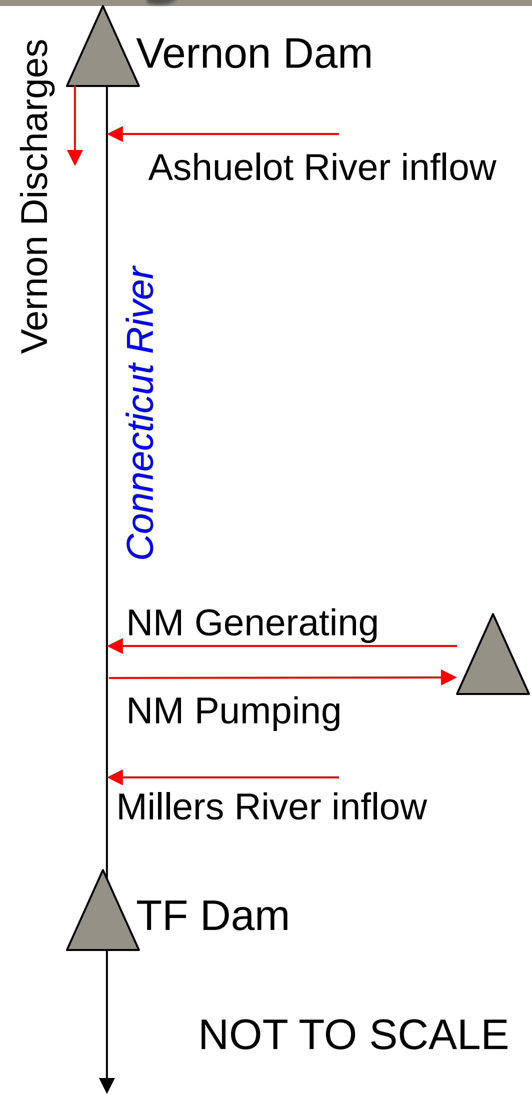
Task 1: Update TF Impoundment HEC-RAS Model (TF Impoundment)

- Existing HEC-RAS model updated to include time varying flow: tributary inflow at Ashuelot and Millers Rivers (USGS gages), Vernon discharges (estimated by TransCanada) and Northfield pump or gen operations (convert MW to cfs). All of the above is recorded on FL log sheets.



TF Impoundment Layout



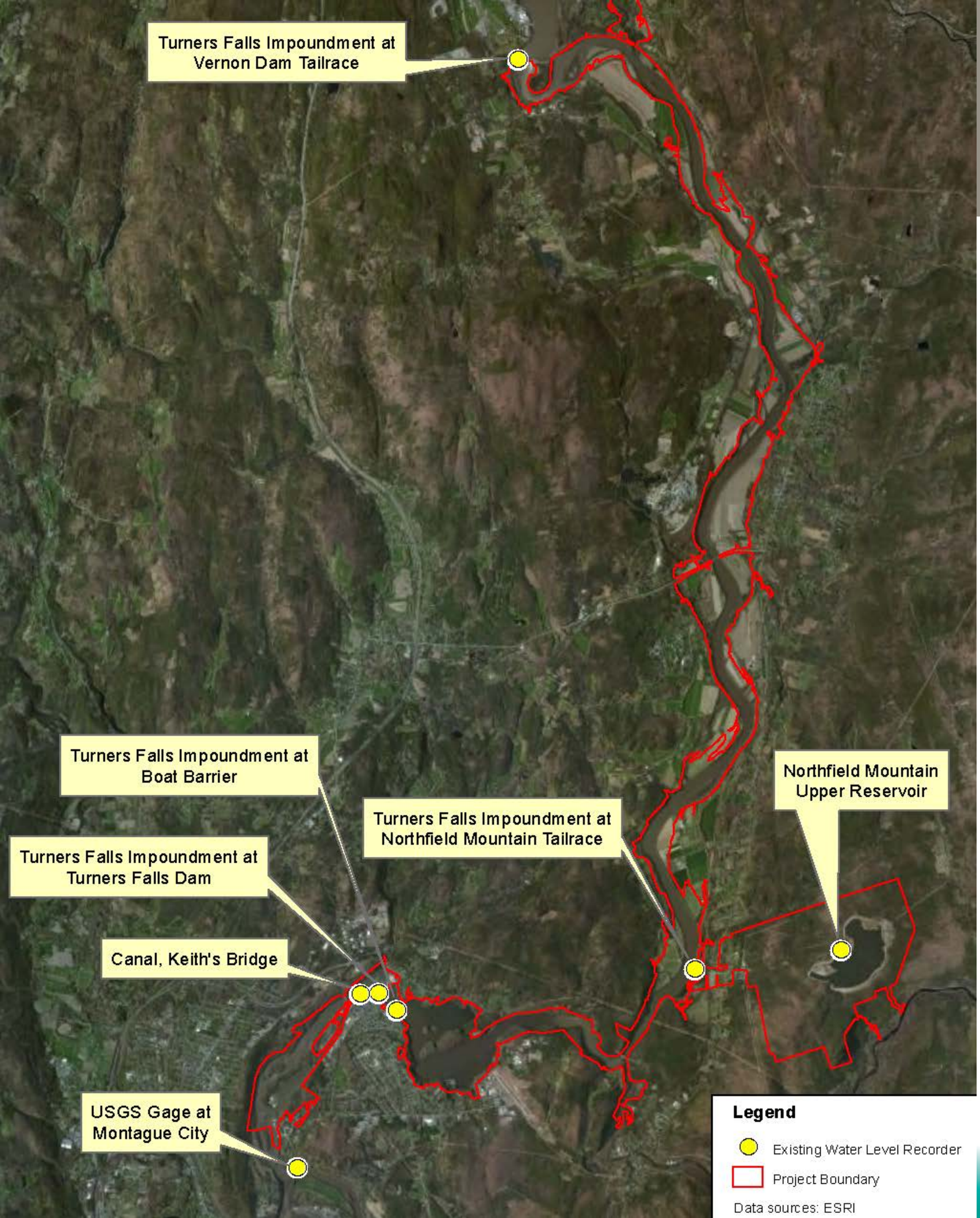


Hydraulic Study of TF Imp, Bypass Reach & below Cabot Station

Task 2: Model Calibration (TF Impoundment)

- Calibrate hydraulic model to measured water surface elevations (WSEL).
- WSELs are measured hourly at 4 locations in impoundment:
  - Vernon Tailrace, Northfield Tailrace, Boat Barrier and TF Dam.
  - In 2012, WSEL measured near VT/NH/MA border and Route 10 Bridge.
- For calibration, HEC-RAS model will operate as steady-state (constant flow) with no NM pump/gen such that flow conditions throughout the length of the impoundment are relatively steady for several hours.
- Ideal if Vernon discharges remain constant over travel time period (less than 10 hrs if flow < 20,000 cfs).
- Calibration will consist of adjusting Mannings n values to match observed WSEL.

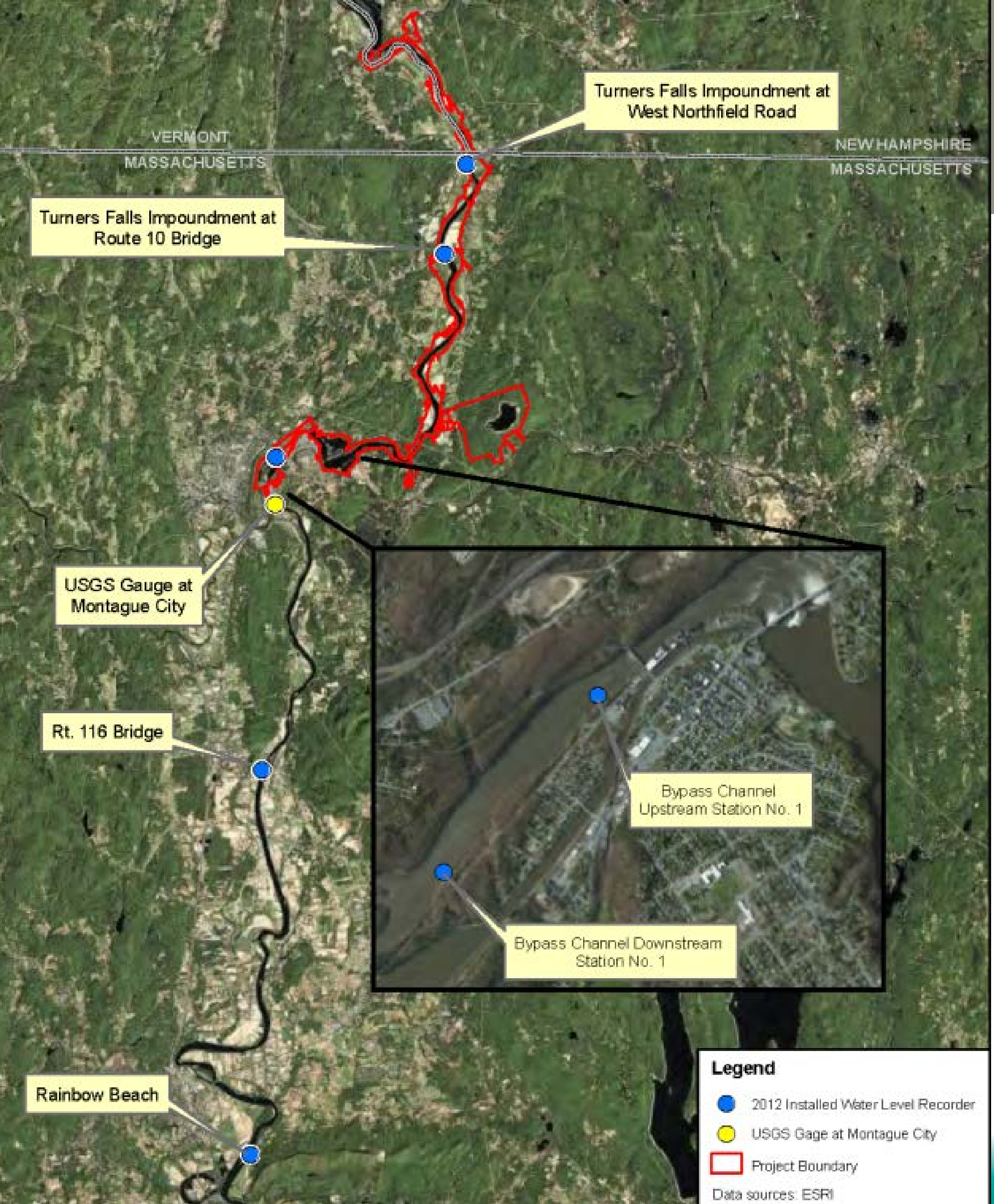
Existing Water Level Recording Gages



2012 Water Level Recorders

2 in TF Impoundment

2 below Cabot Station



Hydraulic Study of TF Imp, Bypass Reach & below Cabot Station

Task 3: Unsteady Flow Model (TF Impoundment)

- Once calibrated, operate model as unsteady (hourly varying flow).
- Time varying flow will be simulated to determine changes in the WSELs at select locations.
- Sensitivity analyses will be conducted to determine influence on water level fluctuations such as:
  - Constant inflow from Ashuelot and Millers River, no NM gen/pump, only time varying discharges from Vernon
  - Constant inflow from Ashuelot, Millers, and Vernon, only time varying NM gen/pump
  - Other combinations TBD

Task 4: Contact FEMA and obtain FIS Hydraulic Model (TF Dam to Holyoke Dam)

- Obtain FEMA hydraulic model and convert to HEC-RAS.

Hydraulic Study of TF Imp, Bypass Reach & below Cabot Station

Task 5: Development of HEC-RAS Model and Calibration (below Cabot)

- Develop HEC-RAS model and match FEMA 100-year flood profile.
- Calibration will consist of adjusting Mannings n values to match observed WSEL at Rte. 116 and Rainbow Beach under steady flow conditions.
- Include any new transects from IFIM study into model.

Task 6: Unsteady Flow Model (below Cabot)

- Once calibrated, operate model as unsteady (hourly varying flow).
- Time varying flow will be simulated to determine changes in the WSELs at select locations.
- Sensitivity analyses will be conducted to determine influence on water level fluctuations such as:
  - Constant inflow from Deerfield River, constant headpond elevation at Holyoke Dam, only time varying discharges from Cabot.
  - Constant discharge from Cabot, constant headpond elevation at Holyoke Dam, only time varying discharges from Deerfield River.
  - Other combinations TBD.

Task 7: Report

Evaluate Impact of Current & Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation

Task 1: Modify Model

- Obtain TNC HEC-ResSim Operations Model.
- Update to reflect hourly time step for period 1960-2003.
- Other modifications: properly simulate fish ladder flows, attraction flows, bypass flow and use of upper and lower (TF Impoundment) reservoir storage.

Task 2: Calibration

- Calibrate model to flow (flow duration and hydrographs) and generation based on observed flow/generation.

Task 3: Establish Baseline Model

- Once calibrated, model will be updated to reflect today's equipment and operating conditions.
- Model output (flow, generation) will be used as a basis of comparison to alternative operating conditions (termed production runs).

Evaluate Impact of Current & Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation

Task 4: Production Runs

- A production run is considered a change made to the baseline model.
- Alternative modes of operation can be simulated and results (flow, generation) can be compared to the baseline model. Changes could include:
  - Limitations on TF Impoundment water level fluctuations
  - A minimum flow regime in the bypass
  - Timing and magnitude of hydropower releases
  - Limitations on maximum discharge capacity of hydropower releases

Task 5: Use of Model Output for other Uses

- Output from the model – specifically flows – will be used to inform other studies.
- Flow data will be used in habitat time series analyses.

Task 6: Report

Study Not Proposed

Watershed Wide Stormwater Model

Summary

- Proponent seeks a stormwater model using LiDAR of the entire CT River Watershed.

Rationale for Not Conducting Study

- There is no nexus between stormwater runoff in the entire CT River Watershed and Project Operations.
- The Proponent estimated the proposed study cost as over $2,000,0000.
- The study would not inform PME measures.
- Two other studies- hydraulic model and operations model address many of the Proponent’s study objectives.

Study Not Proposed

Climate Change and Continued Project Operations

Summary

- Proponents want to predict temperature increases in impoundments over next 30-50 years due to climate change and how climate change may impact high flow events.

Rationale for Not Conducting Study

- The study would not inform the development of license conditions or PME measures.
- The proponents have not established that the proposed study methodology is consistent with generally accepted scientific practice.

Study Not Proposed

Feasibility of Converting the NMF Project to a Closed-Loop or Partially Closed Loop System

Summary

- Proponents are seeking a feasibility study to evaluate developing a closed or partial loop system.
- Proponents suggest that a useful study could be accomplished at low cost with “some engineering and design work”.

Rationale for Not Conducting Study

- The level of effort and cost to conduct a feasibility study would be extremely high and proponents have not shown that mitigation measures for existing Project impacts will not be sufficient.
- FERC recently stated that while the Federal Power Act authorizes it to require modifications to an applicant’s proposal, FERC does not believe it has the authority to require a license applicant to construct and operate an entirely different project from the one it has proposed.

Study Not Proposed

Decommissioning Fund

Summary

- Proponents are seeking the licensee to develop a decommissioning fund.
- Proponents allege there are thousands of abandoned dams in New England waterways and state that the dams are at risk from age and storm events.

Rationale for Not Conducting Study

- FERC has consistently denied requests for establishing decommissioning funds in new licenses.
- Abandoned dams are very different from FERC licensed dams. FERC-licensed dams are subject to rigorous dam safety requirements.

2013 Full River Reconnaissance Study

Task 1: Document Existing Riverbank Features and Characteristics

- Document existing riverbank features and characteristics (see table below) over entire length of TF Impoundment.
- Document shoreline using geo-referenced video photography.
- Conduct ground-based observations along top of riverbank at specific areas of interest.

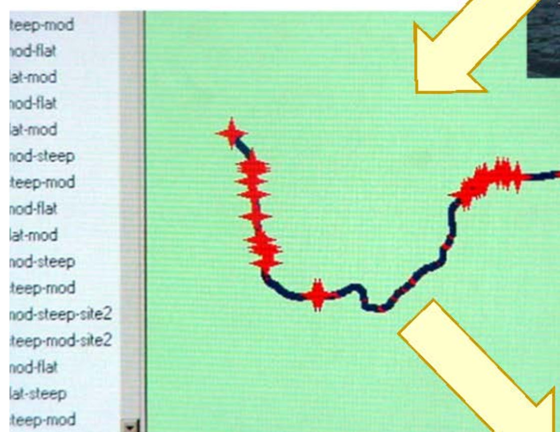
Upper Riverbank Slope	Overhanging	Vertical	Steep (>2:1)	Moderate (4-2:1)	Flat (<4:1)	
Lower Riverbank Slope	Vertical	Steep (>2:1)	Moderate (4-2:1)	Flat (<4:1)		
Upper Riverbank Sediment	Silt/Sand	Gravel	Cobbles	Boulders	Rock	Clay
Lower Riverbank Sediment	Silt/Sand	Gravel	Cobbles	Boulders	Rock	Clay
Upper Riverbank Height	Low (<8 ft.)	Medium (8-12 ft.)	High (>12 ft.)			
Degree Upper Riverbank Vegetation	Heavily Vegetated	Moderately Vegetated	Sparsely Vegetated	None to Very Sparse		
Mass Wasting	Little/None	Some	Extensive			
Erosion Type	None	Overhanging Bank	Undercut Toe	Notching	Slide	
Lower Riverbank Vegetation	None	Heavy	Moderate	Sparse		

2013 Full River Reconnaissance Study

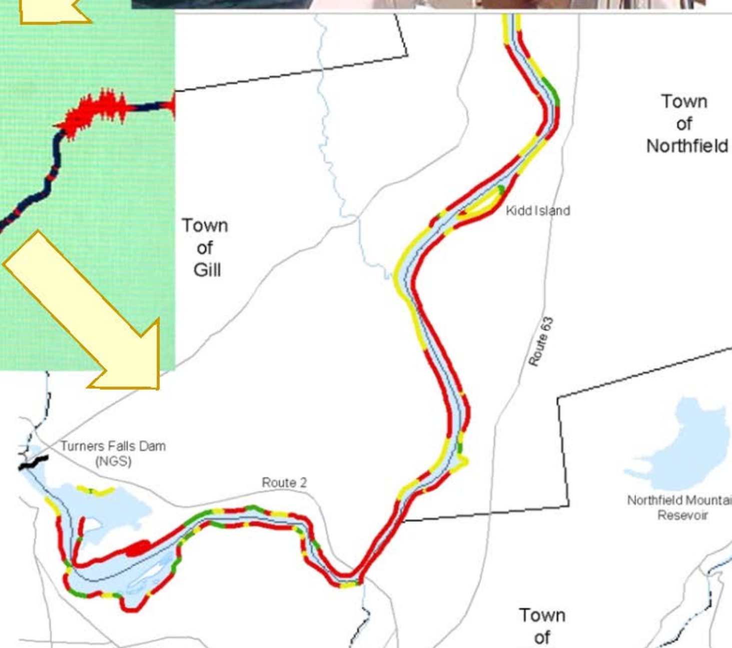
Task 2: Spatially Define Riverbank Feature and Transitions

- Study conducted during leaf-off by boat and foot.
- GPS, data and laser range finder used for data collection.

1. Geo-referenced Video Data Collection
2. Download Video Data into a Mediamapper Software, to be Exported to GIS



3. Import Data from Mediamapper to GIS (ArcView). Develop Composite Maps



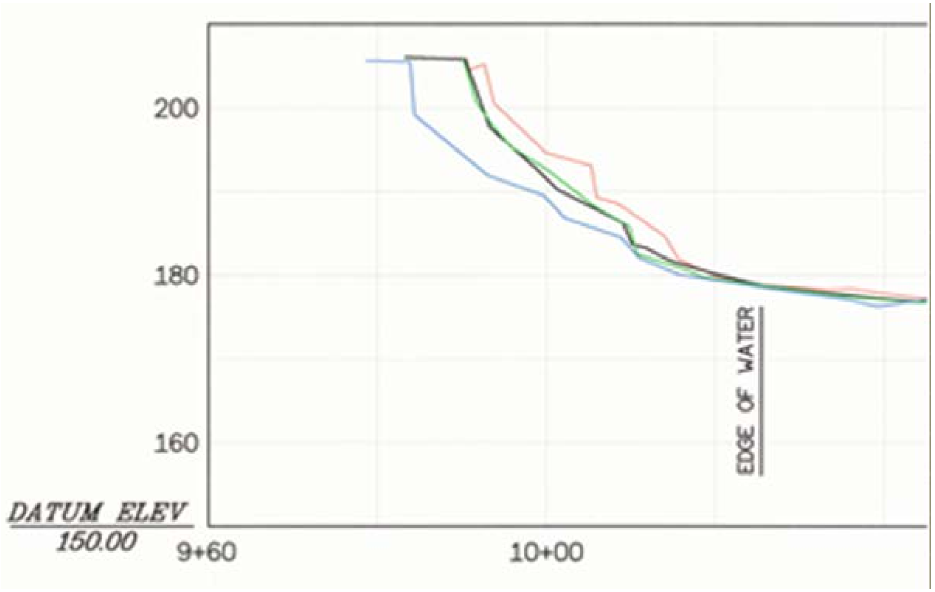
2013 Full River Reconnaissance Study

Task 3. Develop Maps, Summary Statistics, Evaluation of Conditions, and Analyze Changes in Condition since Implementation of ECP and from 2008 FRR

- Develop maps showing longitudinal extent and distribution along impoundment.
- Calculate summary statistics quantifying the lengths of features and characteristics.
- Plot cross-sections (both old and new cross-sections).
- Compare the 2013 FRR with previous FRRs using the summary statistics and mapping.
- Discuss areas of erosion adjacent to previously stabilized banks.
- Map land use practices.

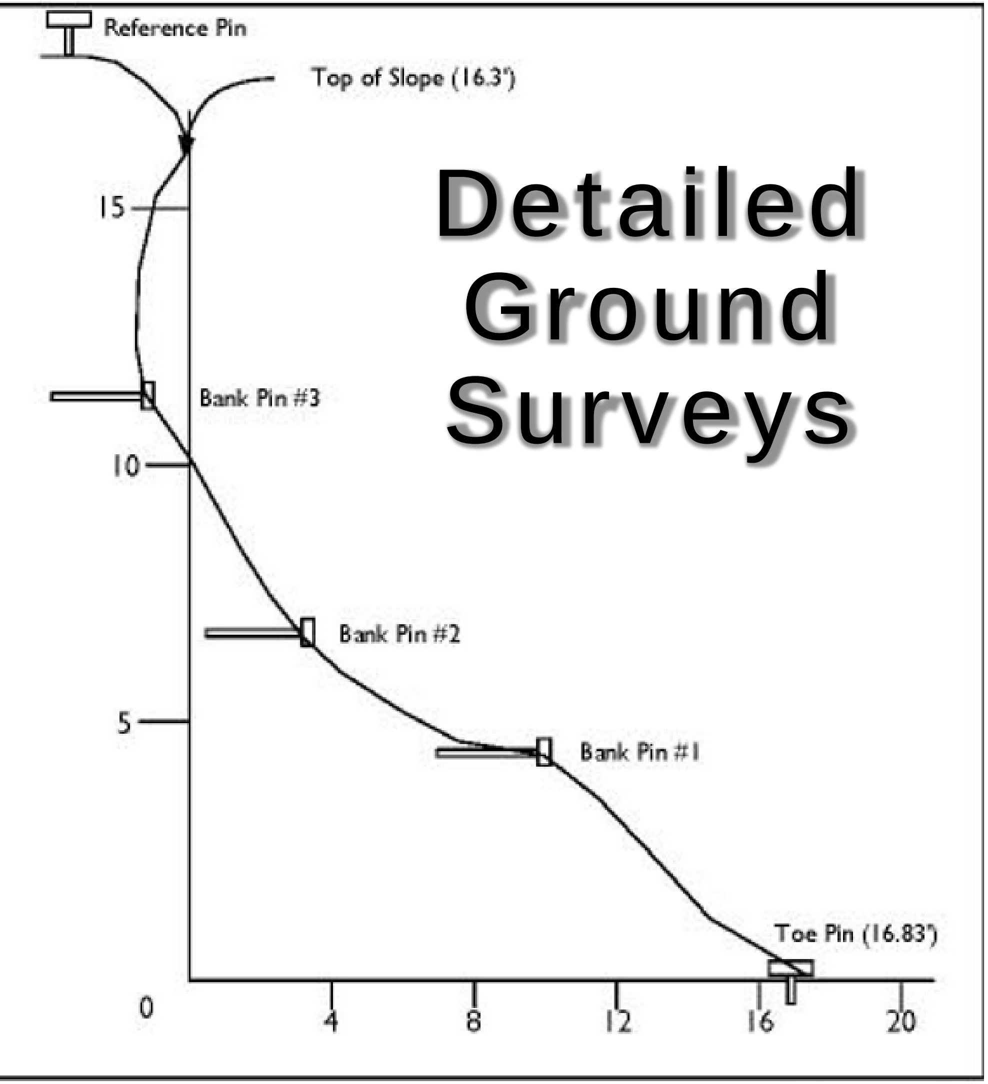
Task 4. Develop Final Report and Mapping

2013 Full River Reconnaissance Study



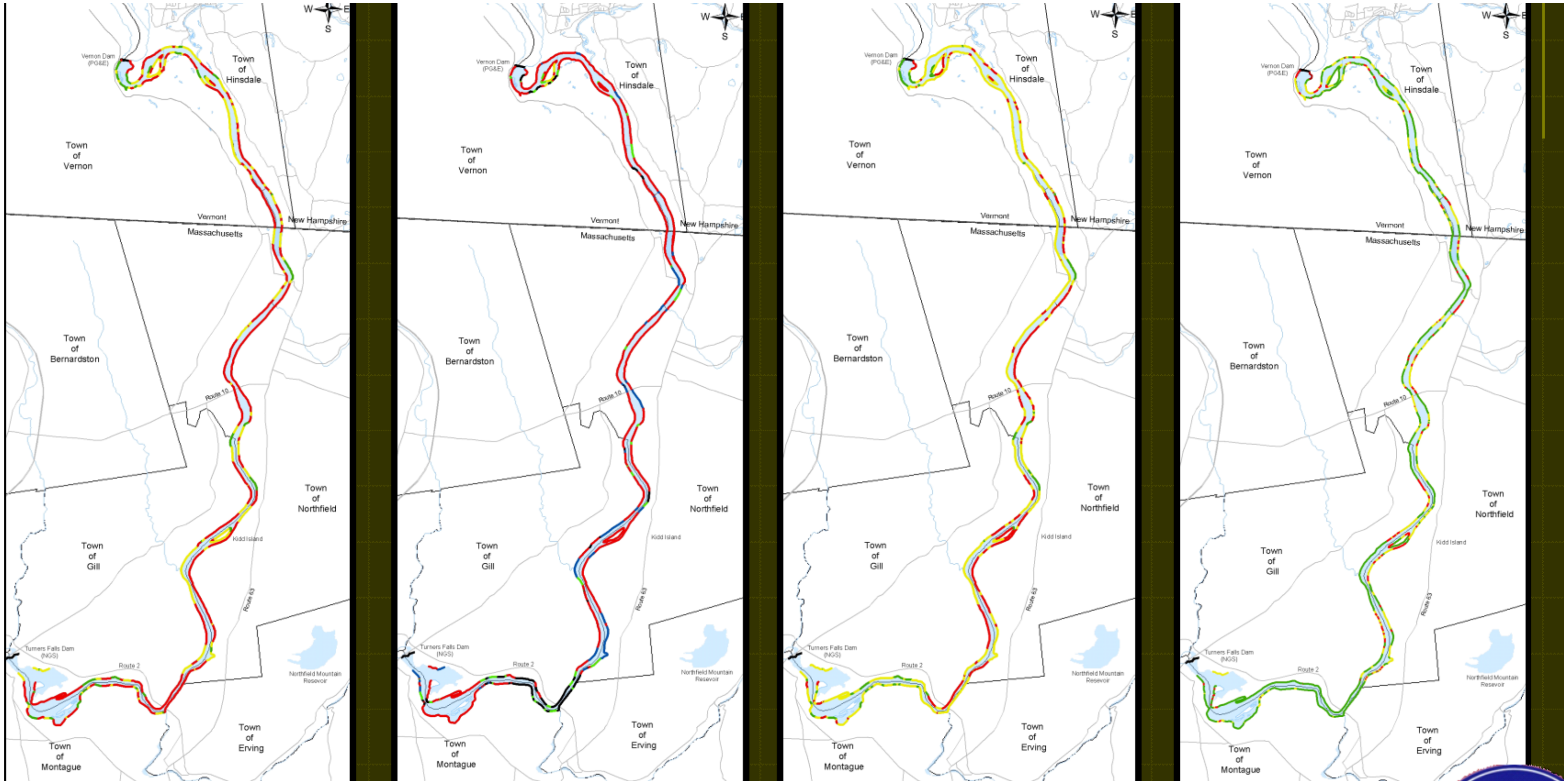
Cross Section Data

2013 Full River Reconnaissance Study



Detailed Ground Surveys

2013 Full River Reconnaissance Study

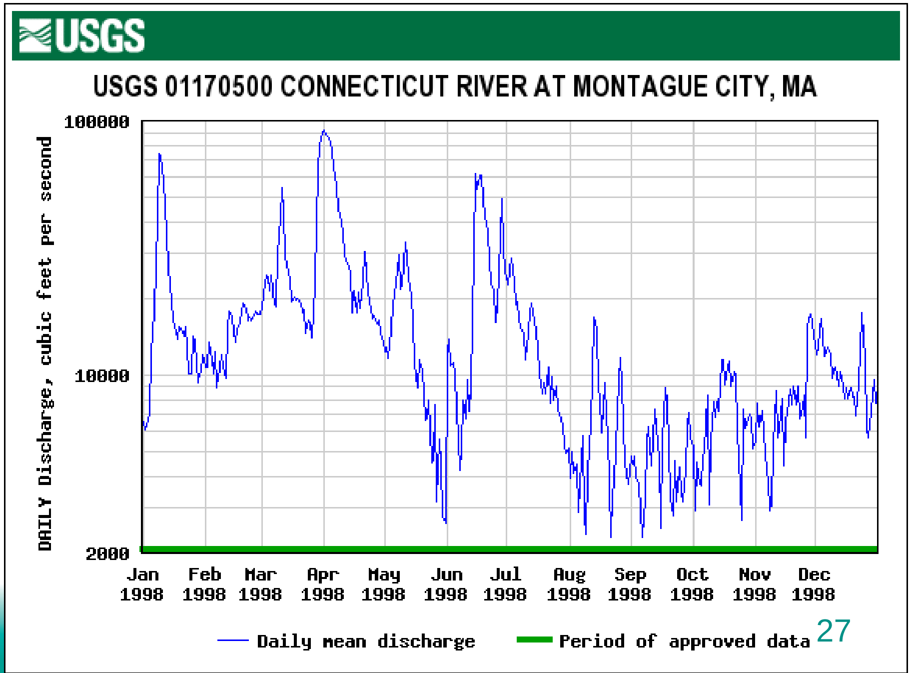


height material slope vegetation

NM/TF Operations Impact on Sediment Transport

Task 1: Data Gathering and Background Mapping

- Hydraulic data (flow, water level) from FirstLight and TransCanada
- Previous studies (Corps of Engineers, Field, Simons & Associates, New England Environmental)
- USGS flow data
- Aerial Photographs
- Cross-section surveys
- Sediment sampling & suspended sediment sampling

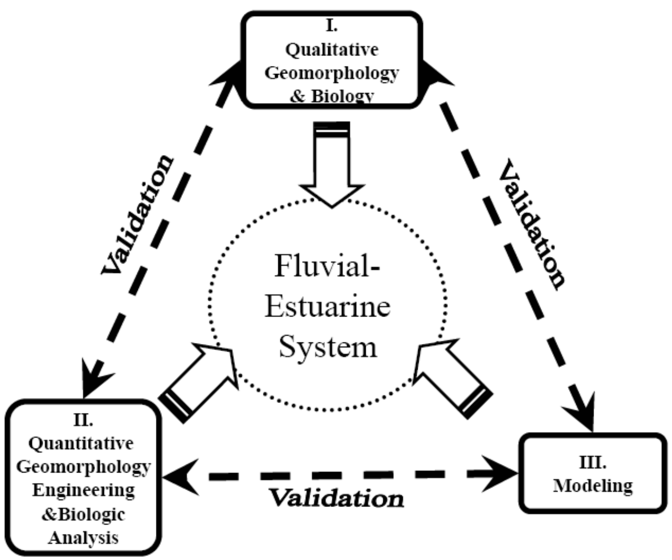


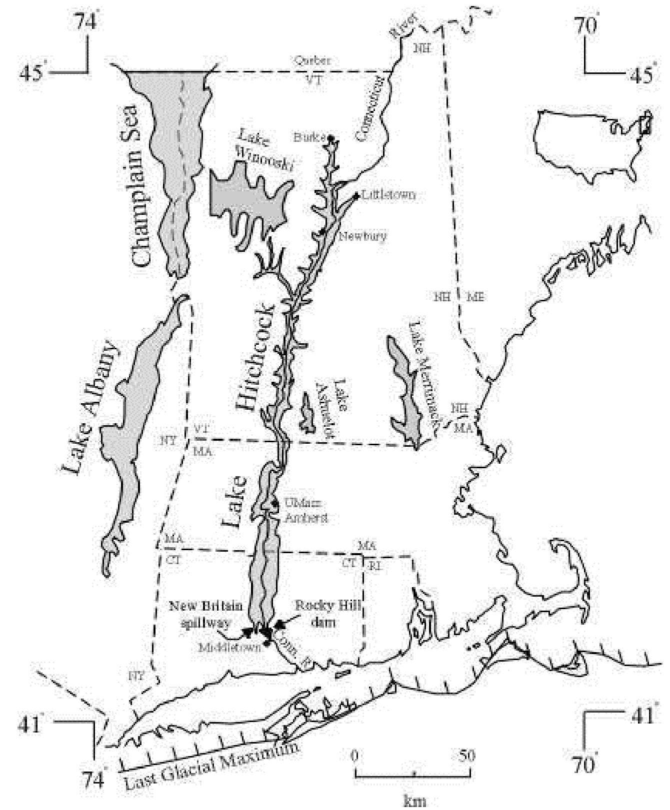
NM/TF Operations Impact on Sediment Transport

FirstLight Power Resources
GDF SUEZ

Task 2: Geomorphic Understanding of Connecticut River

- Apply geomorphic principles from scientific literature to the Connecticut River considering geomorphic history
- Geomorphic classification
- Comparison with other reaches and river systems



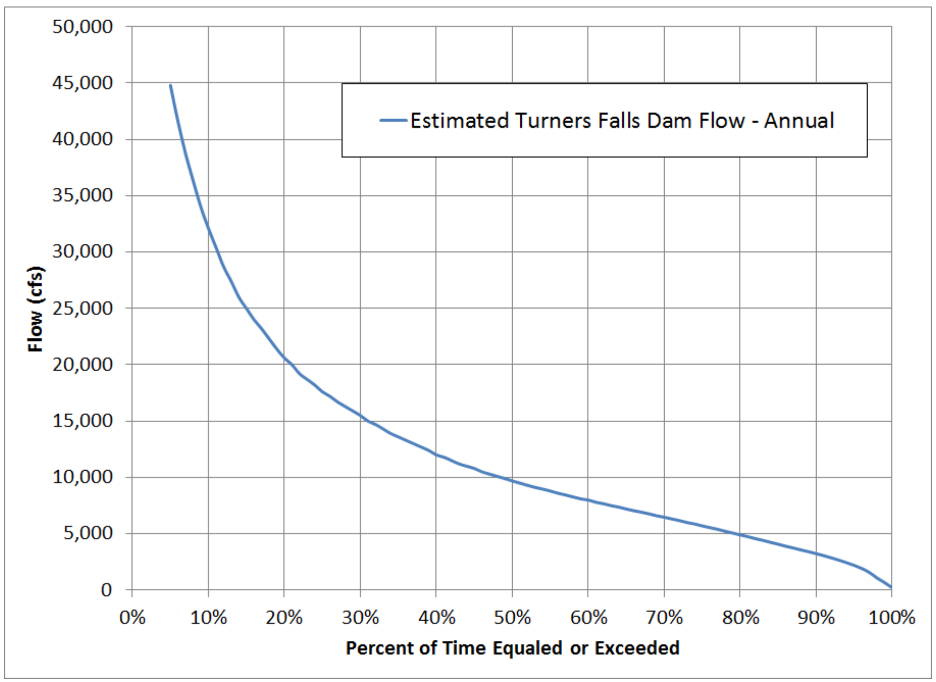


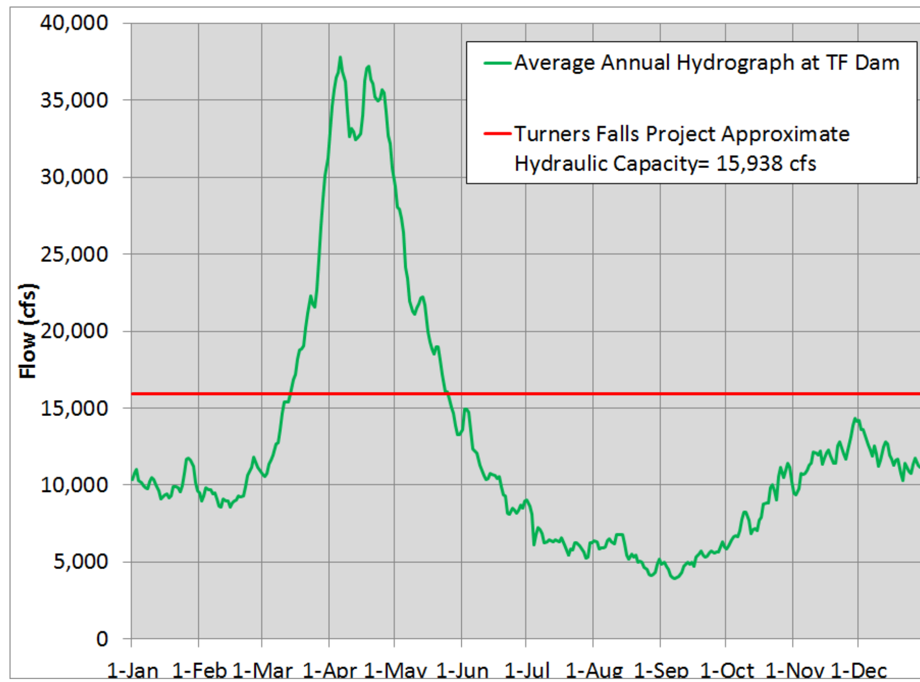
Schumm (1977, The Fluvial System):
Frequently environmentalists, river engineers, and others involved in navigation and flood control consider that a river should be unchanging in shape, dimensions and pattern. This would be very convenient. However, an alluvial river generally is changing its position as a consequence of hydraulic forces acting on its bed and banks.

NM/TF Operations Impact on Sediment Transport

Task 3: Evaluation of Water Elevation and Flow Data

- Hydrographs
- Water level fluctuation analysis
- Flow & water level duration analysis
- Flow-frequency analysis

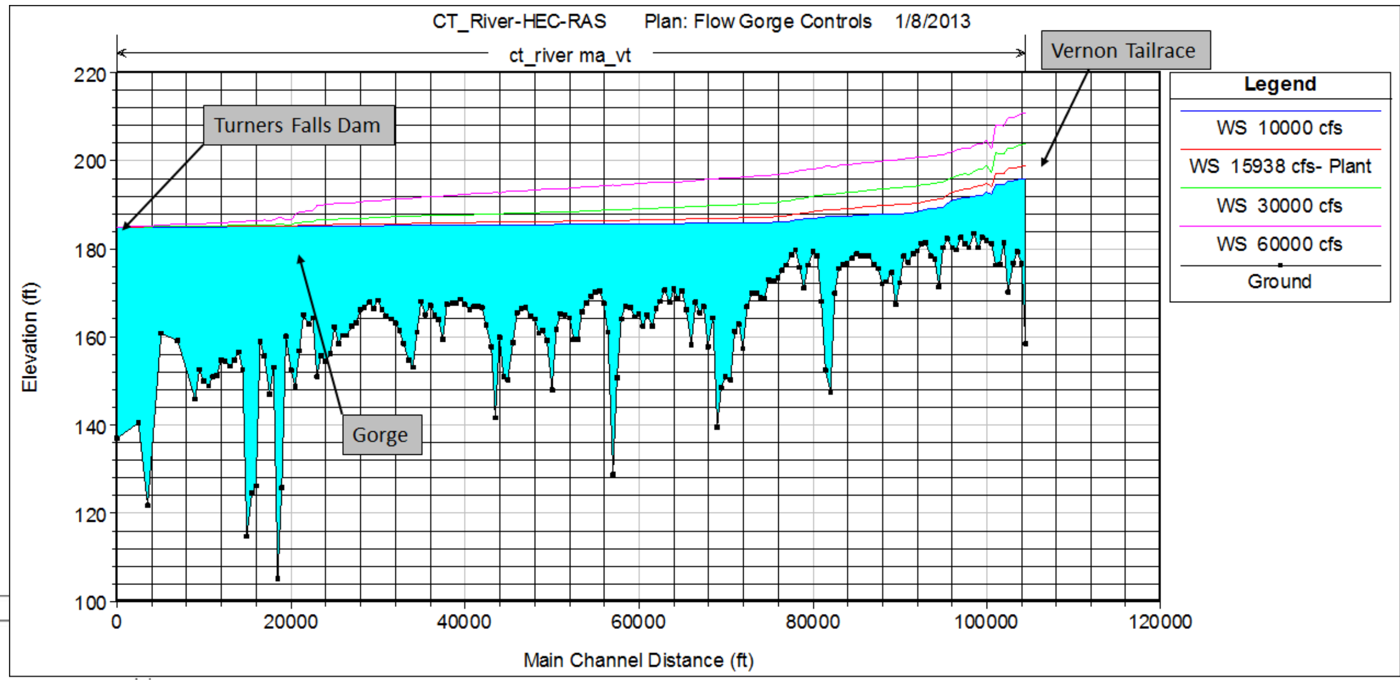




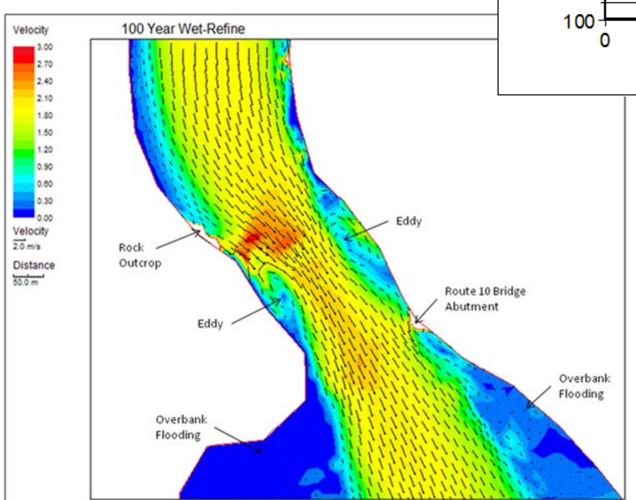
NM/TF Operations Impact on Sediment Transport

Task 4: Hydraulic Model of TF Impoundment

- HEC-RAS:



- RIVER2D:



NM/TF Operations Impact on Sediment Transport

Task 5: Map and Describe Active or Recent Bank Erosion

- Assessment Team: fluvial geomorphologist, geotechnical engineer, and environmental scientist.
- Map start/end of erosion sites.
- Document bank erosion that have been locus of prior stabilization projects (learn what has, and has not, worked in the past).
- Within active or recent bank erosion sites conduct the following:
  - Establish fixed transects.
  - Map land use practices.
  - Document any “sensitive receptors” such as bank-nesting birds.
- At each transect, analyze soils including: classification, structure, parent materials, texture, hydric regime, position on landscape, chemistry, and susceptibility to slope failure.

NM/TF Operations Impact on Sediment Transport

Task 6: Causes of Erosion

- At each transect and erosion documented, fluvial geomorphologist and geotechnical engineer will collectively evaluate causes of bank erosion. Team will make determination if erosion is caused by a) hydropower operations, b) other causes, or c) a combination of hydropower operations and other causes.
- Erosion sources: flood events, boat waves, water level fluctuations, seepage and piping, ice and debris, land management practices.

NM/TF Operations Impact on Sediment Transport

Task 7: Identify Bank Stabilization Projects

- Identify stabilization projects where a causal relationship between hydropower operations and erosion is determined.

NM/TF Operations Impact on Sediment Transport

Task 8: Upper Reservoir Drawdown Sediment Transport

- Sediment Management Plan calls for:
  - Continuous measuring of suspended sediment concentrations at Rte. 10 Bridge and at Northfield Mountain Project.
  - Annual Bathymetry of Upper Reservoir.
  - Final report due at FERC on 12/1/2015.
  - FL will evaluate options to minimize releases of accumulated sediment in Upper Reservoir after study is complete.

NM/TF Operations Impact on Sediment Transport

Task 9: TF Power Canal Sediment Transport

- Evaluate potential for sediment re-suspension on sturgeon habitat due to opening emergency spillway gates. Two other studies being conducted to address this issue.

NM/TF Operations Impact on Sediment Transport

Task 10: Report

- Executive Summary
- Introduction
- Geomorphology of the Connecticut River
- Evaluation of Water Level and Flow Data
- Evaluation of Boat Wakes
- Hydraulic Modeling
- Soil Mapping
- Field Study and Mapping
- Erosion Processes
- Causes of Erosion Attributable to FirstLight’s Hydropower Operations
- Identify Bank Stabilization Project Attributable to FirstLight’s Hydropower Operations
- Upper Reservoir *Sediment Management Plan* (completed until December 2015)

Study Not Proposed

Study of Shoreline Erosion caused by NM Operations

Summary

- Among many objectives, the study seeks to conduct a historical analysis of soil loss, erosion, nutrient loading, topography compared to today.

Rationale for Not Conducting Study

- Conducting the historical analysis would not inform potential PME measures or license conditions.
- FERC uses current conditions as baseline conditions; not pre-raising of the dam or historic conditions.
- Most of the study objectives are being addressed in Study Nos. 3.3.1 and 3.3.2.

Study Not Proposed

Study the Impact of Operations of the NM Project and TF Dam on Sedimentation and Sediment Transport in the CT River

Summary

- Among many objectives, the study seeks to a) install a suspended sediment monitoring site below the NM tailrace and b) conduct a comparison of TF Impoundment bathymetric surveys between 1913 and today.

Rationale for Not Conducting Study

- Conducting the historical comparison of bathymetry would not inform potential PME measures or license conditions.
- FERC uses current conditions as baseline conditions; not pre-raising of the dam or historic conditions.
- Most of the study objectives are being addressed in Study Nos. 3.3.1, 3.3.2, 3.2.2, 3.3.13, 3.3.14, 3.3.17, 3.4.1, 3.5.1, 3.6.6.