

**TRANSCANADA HYDRO NORTHEAST INC.**

**ILP Study 29  
Northeastern Bulrush Survey**

***Study Report***

***CLASSIFICATION - PUBLIC***

**In support of Federal Energy Regulatory Commission Relicensing of:**

Wilder Hydroelectric Project (FERC Project No. 1892-026)  
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)  
Vernon Hydroelectric Project (FERC Project No. 1904-073)

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**June 17, 2016**

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## EXECUTIVE SUMMARY

This report presents the results of TransCanada's 2014 ILP Study 29 Northeast Bulrush Survey. The northeastern bulrush (*Scirpus ancistrochaetus*) is a federally-listed endangered species that is known to occur at one location along the Connecticut River in the Bellows Falls project area.

Surveys for northeastern bulrush were performed in 2014 to determine the presence and extent of populations and potential habitat within the Wilder, Bellows Falls, and Vernon project-affected areas. Survey sites were chosen using aerial photographic interpretation, ecological occurrence records for the known population, and personal communication with biologists that have performed previous site surveys. Eight sites were chosen for field surveys. These sites appeared to possess habitat characteristics appropriate for northeastern bulrush: ponds, shallow marshes, and beaver flowages with seasonally variable water levels and open canopies. Field surveys to the eight selected sites further narrowed the potential list to four sites. The field visits concluded that the unsuitable habitat types were either hydrologically dominated by the river, densely vegetated, or subject to repeated anthropogenic disturbance such as haying, planting, and excavation. None of these conditions is typical habitat for northeastern bulrush. Four sites were determined to possess potential habitat for northeastern bulrush. Two of these sites (including the known location) are located in the Bellows Falls impoundment, and two are in the Vernon impoundment. These sites were intensively surveyed by canoe and/or foot for bulrush populations.

No individuals of northeastern bulrush were located during field surveys, including at the location where the species has been previously found. High water levels were observed at several sites due to beaver dams which control water levels within the majority of the habitat areas, and which may have inhibited the growth or establishment of the species. Northeastern bulrush is also known not to flower every year, which confounds identification of populations within a given year.

Suitable habitat is reliant on seasonal or occasional inundation that exposes substrate to colonization by northeastern bulrush, but is also limited in duration and frequency to allow for establishment and growth of the population. Sites that are subject to periodic inundation throughout the year, especially during the growing season (April-October) may not provide suitable habitat conditions.

Analysis of output from the Hydraulic Model (Study 4) indicates that two of the four sites with suitable habitat are located beyond the geographic extent of modeled data (e.g., beaver dams located in backwater areas well away from the mainstem) and could not be accurately analyzed using modeled mainstem water surface elevation (WSE) data. The presence of the beaver dams indicate that normal project operations would not affect these sites, as the purpose of the beaver dams would be to retain ponded water that would otherwise be drained or flowing. The dams would not persist if they were routinely inundated by project operations. However, it is possible that seasonal high water or occasional flood events could

inundate or occasionally breach the beaver dams and help to create or maintain suitable habitat conditions at these sites. The two other study sites are located close enough to the mainstem for analysis of modeled data and results indicate that seasonal high flows (and occasional project operations) may support the conditions necessary to create or maintain suitable habitat conditions at these sites.

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### List of Abbreviations

CRWC	Connecticut River Watershed Council
FERC	Federal Energy Regulatory Commission
FWS	U.S. Department of the Interior – Fish and Wildlife Service
ILP	Integrated Licensing Process
NHDES	New Hampshire Department of Environmental Services
NHNHD	New Hampshire Natural Heritage Bureau
RSP	Revised Study Plan
RTK	Real Time Kinematic Unit
TransCanada	TransCanada Hydro Northeast Inc.
USR	Updated Study Report
VANR	Vermont Agency of Natural Resources
VDFW	Vermont Department of Fish and Wildlife
WSE	Water surface elevation

## 1.0 INTRODUCTION

This report presents the results of the 2014 northeastern bulrush (*Scirpus ancistrochaetus*) study (ILP Study 29) conducted in support of Federal Energy Regulatory Commission (FERC) relicensing of the TransCanada Hydro Northeast Inc. (TransCanada) Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855), and Vernon Hydroelectric Project (FERC No. 1904). TransCanada has initiated the Integrated Licensing Process (ILP) for these projects in order to renew their operating licenses beyond the current expiration date of April 30, 2019 for each project.

Operations of the Wilder, Bellows Falls, and Vernon projects have the potential to affect northeastern bulrush habitats. The species is listed as Federally Endangered, as well as endangered in both Vermont and New Hampshire. Northeastern bulrush is found in small bodies of shallow water such as ponds, beaver flowages, and wetland depressions characterized by seasonally variable hydrologic regimes (FWS, 1993). Northeastern bulrush appears adapted to seasonal hydrologic regimes that allow it to compete with other species that would otherwise dominate in areas of more consistent hydrology (U.S. Fish and Wildlife Service 1993, Royte and Lortie, 2000).

In their study requests, US Fish and Wildlife Service (FWS), New Hampshire Department of Environmental Services (NHDES), New Hampshire Natural Heritage Bureau (NHNHB), Vermont Agency of Natural Resources (VANR), Connecticut River Watershed Council (CRWC), and the Town of Rockingham, Vermont, specifically requested a survey for northeastern bulrush. The Revised Study Plan (RSP) for Study 29 was approved without modification in FERC's September 13, 2013 Study Plan Determination.

Northeastern bulrush is a perennial species in the sedge family (Cyperaceae). This species is phenotypically similar to several common species, such as woolly bulrush (*Scirpus cyperinus*), dark-green bulrush (*Scirpus atrovirens*), and Georgia bulrush (*Scirpus georgianus*). The most reliable diagnostic feature of the northeastern bulrush is the presence of bristles with recurved barbs on the achenes (fruit). These bristles are approximately 1-1.5x the length of the achene. Other similar species either have much longer bristles (as in *S. cyperinus*), or lack teeth or barbs on the bristles (as in *S. atrovirens* and *S. georgianus*). Other features that aid in identification include green-brown lower leaf sheaths, wrinkled achenes, and a pendulous inflorescence (Magee and Ahles, 2007; Haines, 2011; New England Wildflower Society, 2014). A combination of these features allows for a positive identification of northeastern bulrush.

Habitat requirements for northeastern bulrush are variable, and can range from inundated pond margins to emergent wetlands with a subsurface water table. The common characteristics of northeastern bulrush habitat in the northern part of its range are an open canopy and an intermittently variable water table. It is hypothesized that receding water caused by seasonal variation or the removal of an impoundment (beaver dam or structure) exposes bare substrate that the

northeastern bulrush requires for flowering and germination. Without intermittently exposed substrate, the bulrush appears to be outcompeted by other species adapted to more consistent water levels. Drastic changes in hydrology, such as prolonged inundation or drought, have also been shown to adversely impact the species. (FWS, 2008, 1993; Royte and Lortie, 2000)

## **2.0 STUDY GOALS AND OBJECTIVES**

The goal of this study was to survey a known population of northeastern bulrush and search for undocumented populations that may be located within the Wilder, Bellows Falls, and Vernon project-affected areas, as well as to assess the potential effects of project operations on bulrush populations or suitable habitat. Northeastern bulrush was classified as a Federally Endangered species in 1991. In New Hampshire, it is considered Endangered (Rank S1) with nine known occurrences in the state according to the FWS (2008). None of the recorded populations occur along the Connecticut River (Royte and Lortie, 2000).

Vermont also considers northeastern bulrush Endangered (Rank S2/S3), with 22 known locations within the state. One population occurs near the Connecticut River in the Town of Rockingham, Vermont within the Bellows Falls Project. This population was first documented in 1960 and last observed in 1999. Surveys for this population were conducted in 2003, 2005, 2010, 2011, and 2012, but were not successful in relocating the population (Vermont Natural Heritage Inventory, 2014). The inability of these surveys to relocate this known population could be due to several factors, including the inconsistent flowering of the species, the large size of the site, or inaccessible site conditions that prevented thorough field searches. The species is only presumed locally extirpated by the respective state agencies and therefore is assumed to be potentially present for this and future surveys.

The primary objectives of this study were to:

- document the presence, absence, and status of the previously documented population of northeastern bulrush in the study area;
- survey for additional locations of populations of northeastern bulrush in suitable habitats;
- estimate the elevation of identified populations of northeastern bulrush to daily operational flows and impoundment levels to assess the potential influence of project operations on those populations; and
- assess effects on populations from non-flow-related project operations within the project boundaries (e.g., recreation, agricultural leases).



### 3.0 STUDY AREA

The study area included the shorelines and terrestrial project lands of the Wilder, Bellows Falls, and Vernon impoundments and riverine reaches downstream of each dam (Figure 3.1). All field surveys conducted for this study were restricted to TransCanada’s fee-owned project lands, flowage easement lands that may be hydrologically connected to the Connecticut River, and/or lands that were publicly accessible by boat or by foot and within 200 feet of the river’s edge.

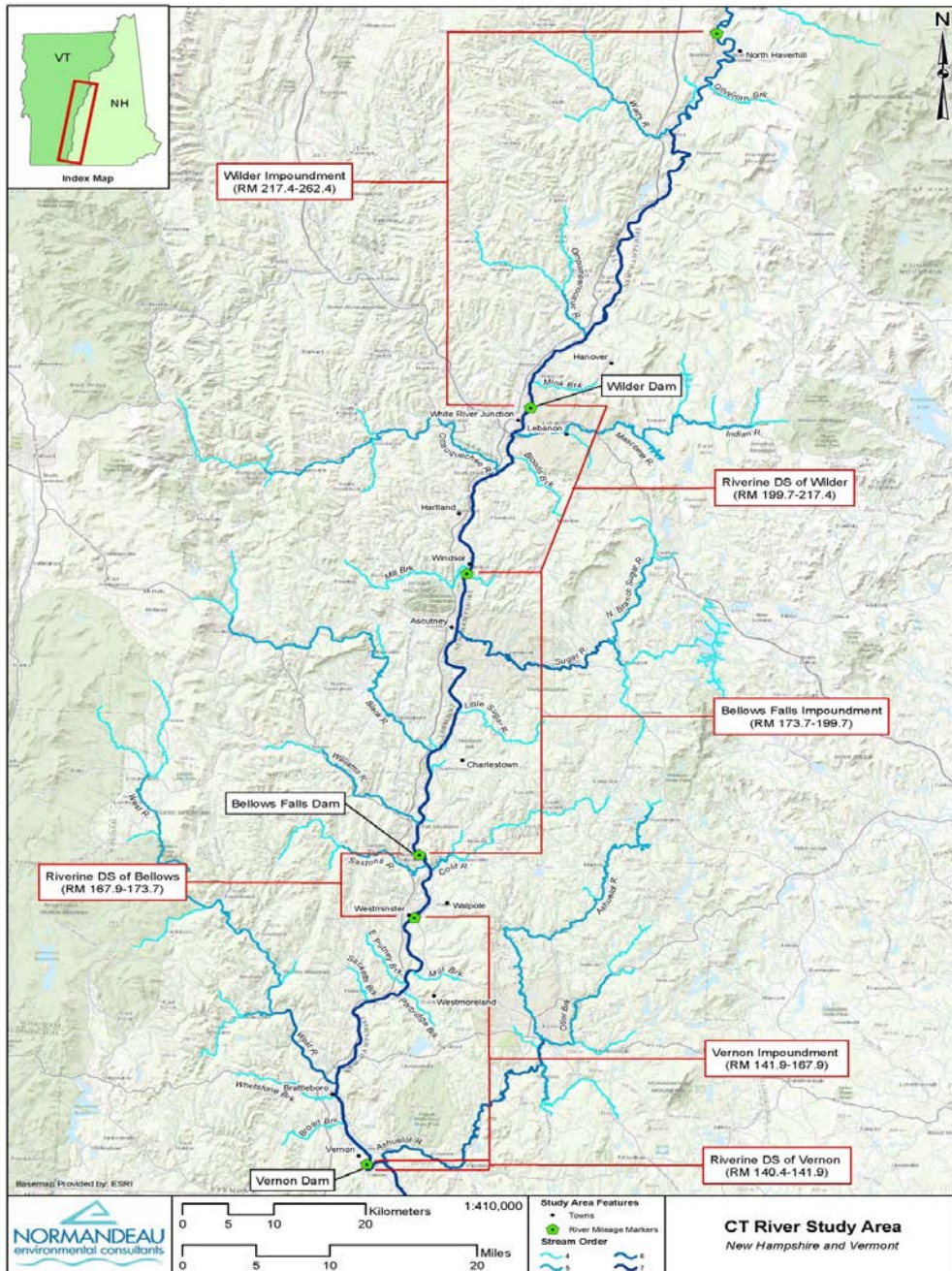


Figure 3.1. General study area.

## **4.0 METHODS**

### **4.1 Habitat Suitability Assessment**

A desktop analysis of existing data was conducted to identify potentially suitable habitat for northeastern bulrush within the study area. Additionally, site information collected for previous surveys, including other rare, threatened and endangered plant species surveys, was considered in determining suitable habitat.

Suitable habitat for northeastern bulrush consists of a variety of habitat types, including wet meadows, beaver flowages, and shallow waterbodies. Common characteristics of the habitats in which northeastern bulrush has been found are intermittently variable (e.g. seasonally or due to beaver activity) water levels and an open canopy that allows for full sun exposure.

Data used for the preliminary desktop analysis included the aquatic and terrestrial habitat maps for the study area (Study 7 – Aquatic Habitat Mapping Study and Study 27 – Floodplain, Wetland, Littoral, and Riparian Habitats Study), site-specific high resolution stereo true-color aerial photography, other publicly available aerial photos, and personal communication with other staff biologists that were familiar with the projects. Further preliminary research included requesting records from New Hampshire Natural Heritage Bureau and the Vermont Natural Heritage Inventory regarding historical and recent locations of northeastern bulrush in Vermont and New Hampshire. Robert Popp, botanist for the Vermont Department of Fish and Wildlife (VDFW), was also contacted for information regarding the known occurrence of northeastern bulrush in Rockingham, Vermont. Mr. Popp located the last recorded observance of this species at the site in 1999.

Potentially suitable habitat areas were identified through the presence of wetland depressions, beaver flowages, and shallow ponds based on interpretation of aerial photography. Preferred sites supported diverse palustrine (freshwater) emergent wetlands with seasonal or intermittently variable water levels. Hydrology was surmised by comparing the field observations and aerial photography from multiple years to get a sense of the variation in water levels over time.

### **4.2 Identification of Survey Sites**

Eight sites were chosen for the field survey for northeastern bulrush. These sites appeared to be ponds, wet depressions, or open water within small wetlands. Several of these sites were also identified as providing suitable habitat for the species because they appeared to have beaver dams and flowages. These flowages can provide suitable habitat for species that depend on open substrate through natural cycles of colonization, ponding, and abandonment that are observed in areas of beaver activity. When the flowages are abandoned due to a depletion of food sources or predation, the dams fail and substrate is exposed for colonization (Naiman et al., 1988). Sites that did not provide fluctuating water levels or support similar vegetation classes were deemed not suitable to provide possible habitat for the bulrush. Dense herbaceous vegetation, such as stands of broad-leaved cattail

(*Typha latifolia*), or invasive reed canary grass (*Phalaris arundinacea*), were also determined to be unsuitable habitat for the target species.

### 4.3 Field Surveys

Surveys for northeastern bulrush were performed on August 22, August 25, and September 9, 2014 to coincide with the fruiting period for the species. The presence of achenes on potential individuals aids identification and allows the surveyors to quickly differentiate similar species (see Section 1.1). When a potential individual of northeastern bulrush or a similar species was encountered, it was identified using both *Flora Novae-Angliae* (Haines, 2011) and *Flora of the Northeast* (Magee and Ahles, 2007). Characteristics of the specimens being investigated were therefore evaluated according to different dichotomous keys, thus allowing for increased accuracy of identification. The location was also recorded with a TGPS unit capable of sub-meter accuracy. Detailed state data sheets were available for field use for any surveyed populations according to New Hampshire Natural Heritage Bureau or Vermont Natural Heritage Inventory criteria.

Field surveys were performed by foot and/or by canoe within the field sites. Additionally, several sites were only accessible by canoe, although once entered, hiking was often possible to examine potential bulrush communities. The survey effort involved steering the canoe along the margin of the deep water portions of the sites (when present) until suitable habitat was encountered and the survey was continued on foot. Binoculars were also used to scan large emergent zones or distant areas of difficult access, followed by close examination for accurate identification. The surveys focused on any areas within the chosen wetland sites that currently have an open canopy and support a variety of wetland sedges and grasses.

## 5.0 RESULTS AND DISCUSSION

### 5.1 Desktop Habitat Assessment

Eight sites were chosen for initial investigation within the study area based on the presence of ponds, shallow marshes, and beaver flowages. All sites were located on land which is fee-owned by TransCanada, to which TransCanada owns the flowage rights, or that was accessible by boat. One site was located in the Wilder impoundment, in the Town of Bradford, VT. Three were located in the Bellows Falls impoundment - two in Charlestown, NH, and one in Rockingham, VT. Four sites were located in the Vernon impoundment - two in Brattleboro, VT, one in Hinsdale, NH, and one in Vernon, VT (Figure 5.1).

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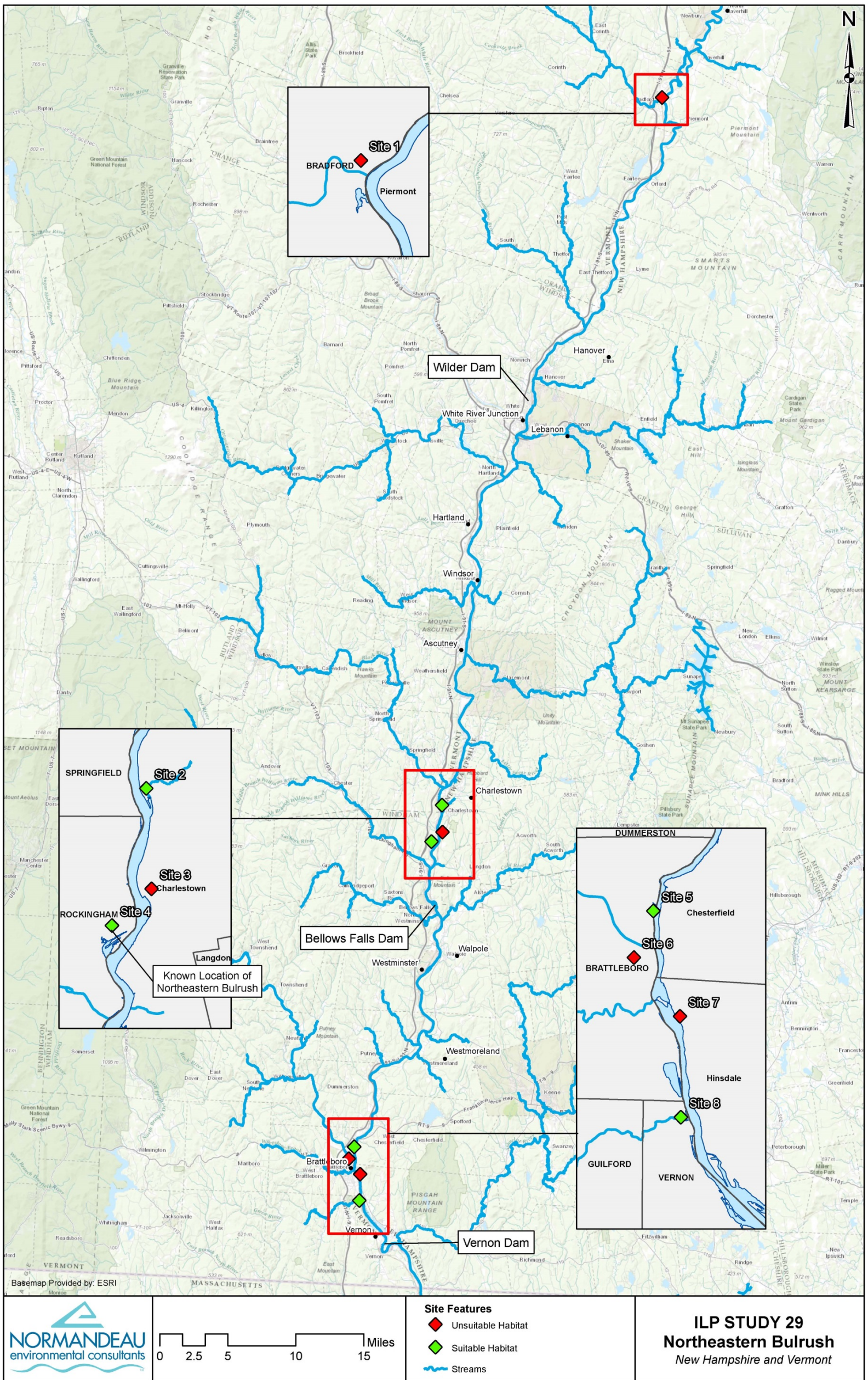


Figure 5.1. Initial survey locations for northeastern bulrush.

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## 5.2 Field Surveys

The initial eight survey sites were narrowed to four sites that had greater potential for northeastern bulrush after performing field checks of habitat suitability (Table 5.1). Sites that were determined to be directly subject to riverine hydrology (i.e. not separated by a berm, beaver dam, or structure) or were densely vegetated were rejected as suitable habitat for the species because the substrate was not exposed for a period of time great enough for colonization by northeastern bulrush. Survey sites that were rejected included Site 29-01 which supported a monotypic stand of common cattail, Site 29-07 which lacked a substantial herbaceous community due to steep banks, and Site 29-06 which was determined to be dominated by riverine hydrology. A fourth location, Site 29-03, is comprised of a series of shallow depressions within active corn fields. These depressions appear to experience seasonal inundation, although they support dense herbaceous vegetation throughout their depth and therefore lack ecological space for species dependent on exposed substrate like northeastern bulrush. All of these sites were still subjected to a field survey, although the survey was less intensive than for those sites determined to have a higher potential to support northeastern bulrush.

A discussion of the four sites with the greatest habitat potential follows. The sites are illustrated in Figures 5.2 through 5.6. Site GPS coordinates are included in [Appendix A](#) of the privileged version of this report.

Table 5.1. Field survey site selection and assessment.

Site ID	Town, State	Location	Survey Date	Potentially Suitable Habitat	Rationale
29-01	Bradford, VT	Wilder impoundment	08/25/2014	No	Dense cattails, not impounded – riverine hydrology
29-02	Charlestown, NH	Bellows Falls impoundment	08/25/2014	Yes	Series of beaver impoundments, open canopy
29-03	Charlestown, NH	Bellows Falls impoundment	09/09/2014	No	Dense herbaceous vegetation, anthropogenic disturbance (agriculture)
29-04	Rockingham, VT	Bellows Falls impoundment	09/09/2014	Yes	Known NE bulrush record, beaver impoundments
29-05	Brattleboro, VT	Vernon impoundment	08/22/2014	Yes	Small beaver impoundment, some herbaceous vegetation
29-06	Brattleboro, VT	Vernon impoundment	08/22/2014	No	Dominated by riverine hydrology
29-07	Hinsdale, NH	Vernon	08/22/2014	No	Steep banks do not support large herbaceous community, canopy cover, not impounded – riverine hydrology
29-08	Vernon, VT	Vernon	08/22/2014	Yes	Small variable aged beaver impoundments, diverse herbaceous community



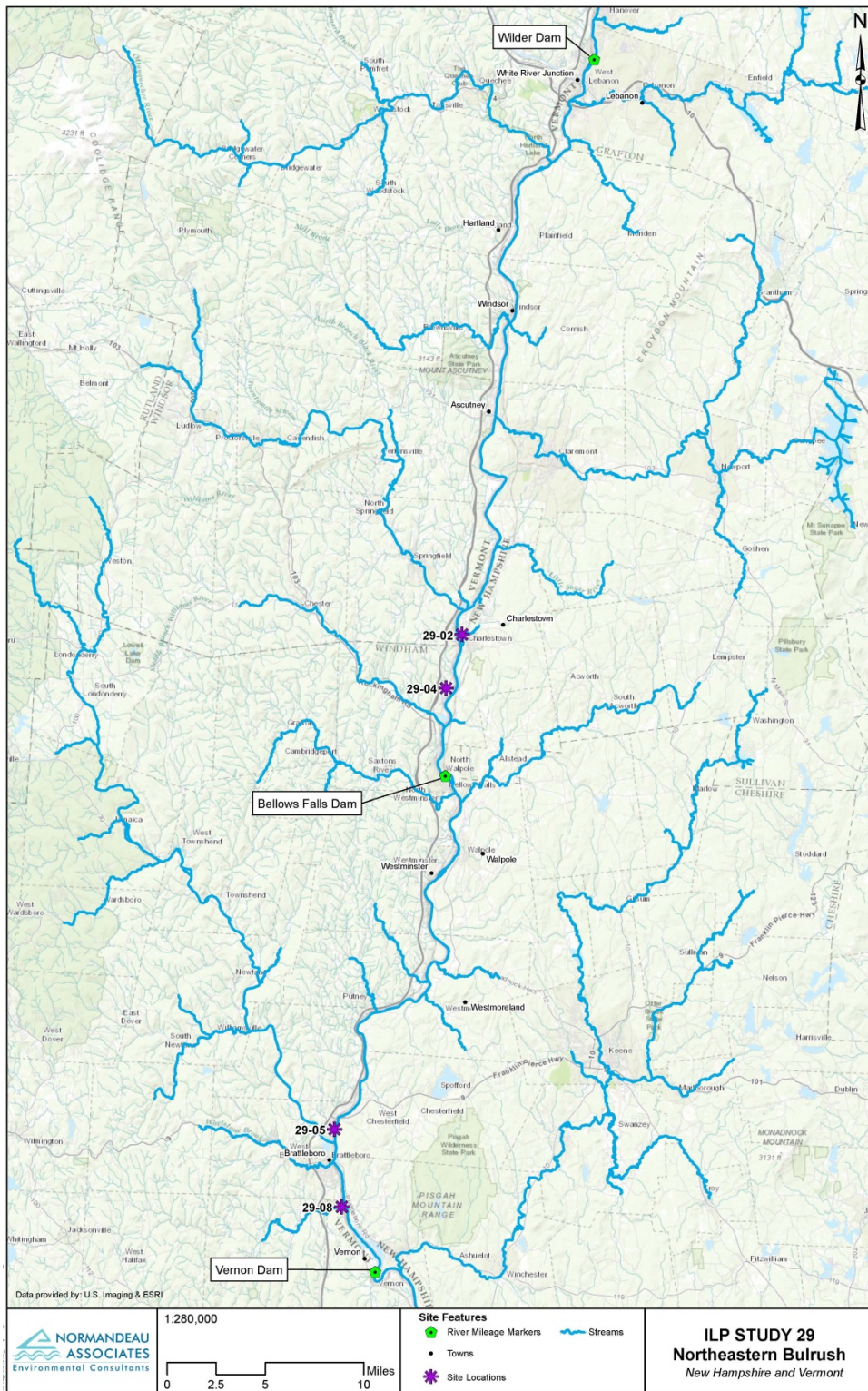


Figure 5.2. Sites with suitable habitat for northeastern bulrush (public version).

### Site 29-02: Bellows Falls Project

Site 29-02 (Figure 5.3) is located in the Bellows Falls impoundment in Charlestown, New Hampshire. The site is characterized by a series of small beaver impoundments along a perennial stream. Upon entering the site, it was determined to have high potential for northeastern bulrush habitat due to its hydrology driven by the beaver dams and a high degree of structural diversity in the herbaceous layer, ranging from submerged aquatic species such as bullhead pond-lily (*Nuphar variegata*) to species associated with mesic sites (e.g. *Solidago rugosa*). A canoe was used to access the interior of the site, and vegetation communities were investigated on foot.



Figure 5.3. Site 29-02 interior.

The vegetation community is comprised of many species associated with northeastern bulrush occurrences in the northern portion of its range (FWS, 1993). Dominant species within the site include rice cut grass (*Leersia oryzoides*), reed canary grass (an invasive species), pickerelweed (*Pontederia cordata*), woolly bulrush, soft rush (*Juncus effusus*), bur-reed (*Sparganium* sp.), and swamp yellow-loosestrife (*Lysimachia terrestris*). Large stands of plants phenotypically similar to northeastern bulrush were investigated, but all were conclusively determined to be common species, such as woolly bulrush or dark-green bulrush.

The beaver dams appear to be stable, and 1 to 2 feet above the upper operational level of the Bellows Falls project as observed by the observed high water mark on the downstream (free-flowing) side of the beaver dams. This estimation was performed by observing visual clues as to the typical maximum water surface elevation, such as wrack lines, scour, wrested vegetation, and changes in plant

community. These observations were based on direct field observations although not supported by direct elevation measurement at the time of field surveys. The vegetation density within these beaver impoundments exceeds 90% where water depth allows for emergent vegetation. This observed vegetation density provides little ecological space available for newly established northeastern bulrush individuals, resulting in minimal suitable habitat. The opening of bare substrate in these communities by such forces as muskrat and beaver activity, artificial impoundment, or atypically large storm events is needed to allow for a greater extent of northeastern bulrush habitat.

#### Site 29-04: Bellows Falls Project

Site 29-04 (Figure 5.4) is located in the Bellows Falls impoundment in Rockingham, Vermont, and is the location of the northeastern bulrush population previously described by R. Popp and last observed in 1999. Access to the site is by canoe, with portaging necessary over several large beaver dams. The largest of these dams is approximately 7 feet above the upper operational level of the Bellows Falls project as estimated by the observed high water mark along the downstream shore as an abrupt community change horizontally along the downstream shore. The site is a backwater area of the Connecticut River, and fed by small, unnamed tributaries. The wetland is bordered on the east, north, and west by actively hayed fields.



Figure 5.4. Site 29-04 interior.

The majority of the interior of the site was inundated at the time of the survey, with large submerged aquatic beds throughout. Additionally, the margins of the northern and southernmost pools contained dense stands of broad-leaved cattail to

the exclusion of most other species. Areas dominated by common cattail were not surveyed further for northeastern bulrush as this was determined to be unsuitable habitat. The margins of the large central pool and the eastern portion of the southern pool exhibited high species diversity along a gentle gradient; both areas have high potential for northeastern bulrush habitat. These areas were searched extensively where accessible. Dominant species observed within areas of potential habitat include woolly bulrush, tussock sedge (*Carex stricta*), soft rush, soft-stemmed bulrush (*Schoenoplectus tabernaemontani*), rice cut grass, three-way sedge (*Dulichium arundinaceum*), dark-green bulrush, swamp yellow-loosestrife, and reed canary grass.

Directions over land to the previously identified group of northeastern bulrush located on this site are included on the ecological occurrence report provided by the VDFW. These directions were closely followed, although the water level observed at the site in 2014 was much higher than when the directions were initially written. The high water level was also evident in the adjacent hayed fields. These fields have been managed previously, but it now appears as if enlarged beaver dams have expanded flooded areas, impacting these fields and preventing further mowing.

#### Site 29-05: Vernon Project

Site 29-05 (Figure 5.5) is a small beaver impoundment located in the Vernon impoundment in Brattleboro, Vermont. The pool is separated from the Connecticut River by a small beaver dam, approximately a foot above daily project operational flow levels as estimated by the observed high water mark along the downstream shore. This estimation was based on observations along the main channel of the river of a well-defined scour line and water staining on the shore. The majority of the site is forested, which limits the potential for northeastern bulrush habitat. The southern margins of the deep water portions of the pool exhibit large herbaceous communities and an open canopy that may provide suitable habitat for the species. This area was surveyed on foot.



Figure 5.5. Site 29-05 interior.

The vegetation community in the area of greatest potential habitat is comprised of a variety of herbaceous species typical of other similar habitats. Dominant species included rice cut grass, woolly bulrush, bur-reed, reed canary grass, three-way sedge, marsh fern (*Thelypteris palustris* var. *pubescens*), sensitive fern (*Onoclea sensibilis*), ditch-stonecrop (*Penthorum sedoides*), and false water-pepper smartweed (*Persicaria hydropiperoides*). The only *Scirpus* species observed was conclusively identified as woolly bulrush.

The intact beaver dam appeared stable. It was estimated to be only slightly higher than the typical project impoundment water surface elevation, and may be overtopped by the main river channel on occasion. This conclusion is based on the water level at the time of field survey, which was near the upper level of the dam which may limit the potential for the site to support northeastern bulrush. The generally closed canopy over emergent vegetation also reduces the area available to the bulrush. Site 29-05 is only marginally suitable for northeastern bulrush. Removal or abandonment of the beaver dam would allow for project operational fluctuations in water surface elevation that could clear some of the currently vegetated substrate and provide ecological space for a viable northeastern bulrush population to establish itself if the area becomes impounded again.

#### Site 29-08: Vernon Project

Site 29-08 (Figure 5.6) is a series of ponds located near the outlet of a perennial stream in the Vernon impoundment, in Vernon, Vermont. The ponds are caused by both beaver dams and anthropogenic sources, including old excavations and a railroad embankment. A large area of the site is dominated by a monotypic stand

of common cattail which provides little habitat for other herbaceous species; however, the margins of several ponds are very diverse and provide potentially suitable habitat for northeastern bulrush.



Figure 5.6. Site 29-08 interior.

The vegetation structure and community types varies widely throughout the site, ranging from submerged aquatic species such as bullhead pond-lily, water-milfoil (*Myriophyllum* sp.), and pondweeds (*Potamogeton* spp.), to well established stands of speckled alder (*Alnus incana* ssp. *rugosa*). Dominant species in areas of greatest potential habitat include woolly bulrush, dark-green bulrush, soft rush, pickerelweed, common cattail, spotted touch-me-not (*Impatiens capensis*), and a variety of sedges (*Carex* spp.).

Multiple low beaver dams impounded small areas of water at this site, resulting in many small (less than 200 sq. ft.) pools that may provide potential northeastern bulrush habitat. Based on the presence of established woody vegetation, the ages of the dams were estimated to range from less than one year to more than five years. The variable age of the dams implies that they can be breached on occasion or abandoned, leading to variable water levels in the resultant pools. This cycle of impoundment and abandonment by beavers may provide ideal habitat for northeastern bulrush in some portions of this site.

### 5.3 Field Survey Results

No individuals or populations of northeastern bulrush were located during the 2014 survey effort. This includes negative findings from the site (Site 29-04) in which northeastern bulrush has had been observed in 1999.

Four survey sites were determined to lack suitable northeastern bulrush habitat because they supported a monotypic stand of common cattail (Site 29-01), lacked a substantial herbaceous community due to steep banks (Site 29-07), or were dominated by riverine hydrology (Site 29-06). In addition Site 29-03 is a series of shallow depressions within active corn fields. These depressions appear to experience seasonal inundation, although they support dense herbaceous vegetation throughout their depth and therefore lack ecological space for species dependent on exposed substrate like northeastern bulrush.

The four remaining sites possessed high potential for northeastern bulrush in at least portions of each site but no individuals of the species were observed. Several reasons may account for the negative findings, including lack of propagules, prolonged site inundation, lack of fruiting individuals, or invasive species. Propagule availability may be limited due to the species' rarity in the region.

In addition, the water levels at all four sites appeared to be controlled by beaver dams, which may lead to prolonged high water levels within the sites and thus a suppression, reduction, or elimination of the species from the sites. This high water level was observed at the known bulrush location (Site 29-04) and is cited by R. Popp as a possible contributing reason for the decline of northeastern bulrush at the site. The previous documentation from the site is not detailed enough to determine if the primary beaver dam has increased in size since the species was last observed. Because northeastern bulrush may not fruit every year, the likelihood of detection during field surveys is reduced. Phenotypically, the individuals of northeastern bulrush look very similar to species common to all of the survey sites, primarily woolgrass and dark-green bulrush. Lastly, invasive species such as the reed canary grass observed at Site 29-02 may be impacting native species through competition, thus reducing native biodiversity in the wetlands.

## **6.0 ASSESSMENT OF PROJECT EFFECTS**

The common characteristics of northeastern bulrush habitat in the northern part of its range are an open canopy and an intermittently variable water table. It is hypothesized that receding water caused by seasonal variation or the removal of an impoundment (beaver dam or structure) exposes bare substrate that northeastern bulrush requires for flowering and germination. Without intermittently exposed substrate, the bulrush appears to be outcompeted by other species adapted to more consistent water levels.

### **6.1 Effects of Project-Related Water Level Fluctuation on Habitat**

Suitable habitat is reliant on periodic inundation with sufficient duration, seasonality, and frequency that exposes substrate to colonization by northeastern bulrush, discourages competition, and allows for establishment and growth of the population. As discussed in Section 5, initial assessment based on visual observations in 2014 suggested that there were no project effects on the four sites having potential northeastern bulrush habitat, due to the elevation and position of

the beaver impoundments which appeared to control water levels at the study sites, and appeared to be above the projects’ operational water surface elevation range. In 2015, the four study sites with the appearance of suitable habitat were revisited and habitat range elevation data was collected using a Real Time Kinematic (RTK)-GPS during the course of other field studies in order to provide more definitive habitat elevation data for use in modeling. The RTK “reference elevation” is defined as the elevation of RTK data taken on the beaver dams assumed to limit influence of the river on the site’s habitat behind the beaver dams. It should be noted that the RTK-measured beaver dam heights in 2015 may have differed from those observed in 2014 due to differences in timing and magnitude of seasonal water levels between the two years which could lead to an increase in the height of dams in response to high seasonal flows.

Hydraulic Model (Study 4) cross sections were identified at, or nearest to, the study sites. Model cross sections and rating curves at those locations were analyzed to determine if the beaver dam reference elevation fell within the modeled range of normal project operations WSEs at each study site in order to screen each site for potential project effects. Since the model cross sections only represent mainstem WSE, an accurate calculated WSE of two study sites (Sites 29-02, 29-04) located well off the mainstem could not be determined. For the two remaining study sites (Sites 29-05, 29-08), the reference elevation was determined by the hydraulic model to be inundated under the very upper portion of the range of the Vernon impoundment WSE under normal project operations (Table 6.1).

Table 6.1. Hydraulic model screening of project effects on habitat reference elevation<sup>1</sup> measured in 2015.

Site ID#	Location	Project Area	Model Node #	Model Max. WSE (ft) <sup>a</sup> NAVD88	Habitat Reference Elev. (ft) NAVD88	Habitat Inundation under Normal Project Operations Based on Hydraulic Model Output
29-05	Brattleboro, VT	Vernon	200	219.8	219.4	Reference beaver dam elevation inundated at all project-related flows when Vernon dam WSE >= 219.4 ft
29-08	Vernon, VT	Vernon	112	219.6	219.0	Reference beaver dam elevation inundated at all project-related flows when Vernon dam WSE >= 219.0 ft

a. Hydraulic model maximum WSE elevation at the site under normal project operations.

<sup>1</sup> All WSE values are reported in the North American Vertical Datum of 1988 (NAVD 88).



Output from the Operations Model was used to further analyze the timing, frequency, and duration of water level fluctuations at Sites 29-05 and 29-08. Weekly minimum, maximum, and mean WSEs for all five modeled annual hydrologies combined (including high flows and high WSEs above normal project operations) were plotted along with the reference habitat elevations (beaver dam height measured in 2015 with an RTK) for each site. Figures 6.1 to 6.2 present the modeled WSE data.

Site 29-05 had mean weekly WSEs higher than the reference elevation only during spring (mid-March to mid-May) and weekly mean WSE did not exceed the reference elevation throughout the rest of the year although the site was inundated (spikes above reference elevation, Figure 6.1) in at least one modeled hydrology, at least once in most weeks of the year. These results agree with field observations (Section 5.2) which indicate only marginal suitable habitat. Due to the presence of beaver dams largely responsible for maintaining a sustained inundated condition and the data suggesting only spring runoff conditions or high water events periodically over topping the beaver dam reference elevation, it is unlikely that inundation under normal project operations is responsible for the hydrologic influence controlling the vegetation community and the absence of northeastern bulrush at Site 29-05.

Similarly, Site 29-08 had mean weekly WSEs higher than the reference elevation in spring and slightly higher than the reference elevation periodically throughout the rest of the year (Figure 6.2). The beaver dams at this site appeared to be variable in age (Section 5.2) indicating that that they are frequently breached or abandoned, leading to variable water levels in the resultant pools. This cycle of impoundment and abandonment by beavers may provide ideal hydrology for northeastern bulrush in some portions of this site, although the species was not observed during field surveys. Due to the presence of beaver dams largely responsible for maintaining a sustained inundated condition, it is unlikely that inundation under normal project operations is responsible for the hydrologic influence controlling the vegetation community and the absence of northeastern bulrush at Site 29-05. It is possible that occasional overtopping of the beaver dam, based on the reference elevation and mainstem WSE's, whether due to high water or when the impoundment is at its upper operating range, may actually encourage periodic dam failure or abandonment and thus provide valuable colonization opportunity.

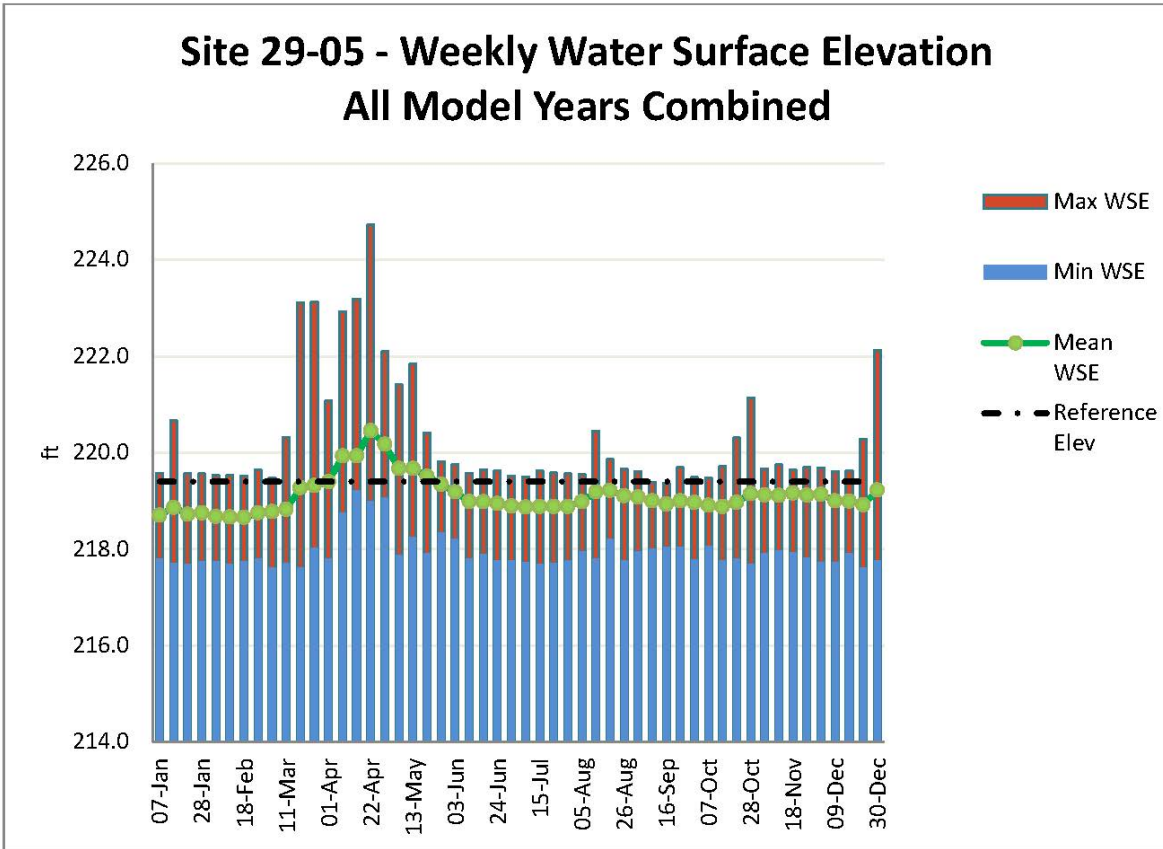


Figure 6.1. Site 29-05 weekly water surface elevation – all modeled hydrologies.

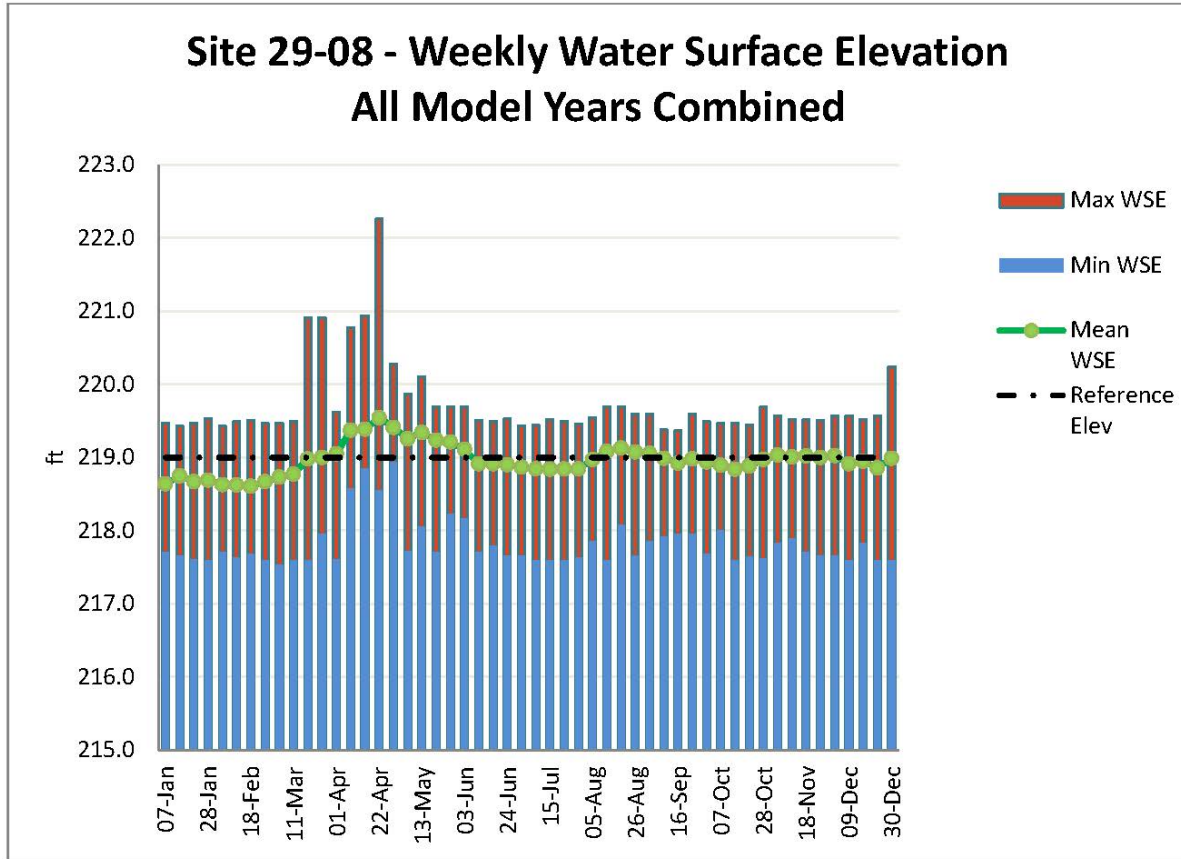


Figure 6.2. Site 29-08 weekly water surface elevation – all modeled hydrologies.

## 6.2 Non-Flow Related Project Effects on Habitat

Non-flow related project effects such as project recreation areas or leasing of project land for agricultural activity on TransCanada lands could also affect populations if located in proximity to those activities. Two of the four sites with suitable habitat (Site 29-02 and Site 29-04 which has supported northeastern bulrush in the past) are located adjacent to agricultural operations within the FERC project boundary. Direct agricultural impacts (e.g., runoff) may occur but were beyond the scope of this study to evaluate. Site 29-08 with suitable habitat is located within the FERC project boundary near a road and non-TransCanada owned car top boat launch. Road runoff could have an adverse effect on habitat, but it is unlikely that boating or the occasional camping that may occur there (recreational facility assessment from Study 30, Louis Berger Group and Normandeau Associates, Inc., 2016) would cause adverse effects on northeastern bulrush habitat. The fourth site (Site 29-05), while within the FERC project boundary, did not appear to have such associated activities.

### 6.3 Study Conclusions

All four sites with suitable habitat are occupied by beavers and their dams which control water levels in the wetlands behind the dams. Beavers are extremely unlikely to build dams in locations or at heights that are inundated on a continual or frequent (e.g., daily/weekly) basis as a result of normal project operations, particularly during the growing season, as they would rapidly build the dams higher in response to an increase in WSE. In addition, the water level behind the beaver dams at all four sites may produce prolonged high water levels within the sites, resulting in temporary or permanent suppression, reduction, or elimination of the species from the sites, that is unrelated to project operations.

For the two sites where the backwater WSE that could not be ascertained from mainstem modeled WSE data, it is likely that creation or maintenance of suitable habitat by occasional inundation that exposes substrate to colonization by northeastern bulrush can only occur through non-project related seasonal or flood-related high flows. For the two sites located within the range of normal project operations, these operations do not appear to adversely impact the overall potential for suitable habitat (geographically and vegetatively limited at both sites), and may allow for establishment and growth of the population in portions of the sites.

Although northeastern bulrush was not found during the 2014 field surveys, it had only been recorded previously at one site (Site 29-04); however, it was beyond the scope of this study to determine if the previously recorded population has been extirpated or has simply eluded detection due to the size of the site and/or the biology of the species.

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# **APPENDIX A**

**Field Survey Site Coordinates**

**Privileged Information**

**(Not included in public version of this report)**