**TRANSCANADA HYDRO NORTHEAST INC.**

# ILP Study 19
# American Eel Downstream Passage Assessment

## *Study Report*

**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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**May 16, 2016**

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# EXECUTIVE SUMMARY

The goal of this study was to assess whether operations at the Wilder, Bellows Falls, and Vernon Projects affect the safe and timely passage of adult silver phase American Eels (*Anguilla rostrata*) emigrating out of the Connecticut River. The objectives of this study were to quantify the movement rates, timing, and relative proportion of silver eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, downstream passage facilities, and spillways; and to assess the instantaneous and latent mortality and injury of silver eels passed through each different turbine type at each project.

The study was conducted in the fall of 2015. Eels used in this study were procured from a source in Newfoundland, Canada and underwent pathology testing prior to importation. As a result of delays in fish collection and testing, the field portion of the study was delayed from August/September to late October.

## *Route Selection and Residency*

This study was carried out between October 27, 2015 and January 22, 2016. The radio-tagged eels were released in five groups from October 27 – November 5, 2015. A total of 170 silver American Eels were radio-tagged and released. Each project received 50 radio-tagged eels released in their impoundment (approximately 3 miles upstream of project). Due to two separate spill events occurring at Bellows Falls during the study an additional 20 eels were released into the Bellows Falls power canal. All releases were conducted in the afternoon and evening (13:40 - 20:05 hr). Eel length ranged from 363 to 1,025 mm with an average of 795 mm.

Travel time from release site to study area for eels released at Wilder ranged from 1 hour, 39 minutes to 8 days, 2 hours, 31 minutes (median = 1d, 1h, 6m). Residency time within the project's study area after first detection ranged from 2 minutes to 1 day, 15 hours, 36 minutes (median = 13m). Most eels that passed Wilder did so via the turbine intakes. Turbine Units 1 and 2 passed 71.1% (N=32). Unit 3 passed 22.2% (N=10) and the trash/ice sluice passed 6.7% (N=3). Five of the 50 released eels (10%) did not pass the project.

The travel time from release site to study area for eels released into the Bellows Falls impoundment ranged from 41 minutes to 46 days, 15 hours, 44 minutes (median = 1d, 2h, 50m). Residency time ranged from 4 minutes to 3 days, 21 hours, 37 minutes (median = 38m). Eels released at the power canal had very short travel times ranging from 4 minutes to 1 day, 23 hours, 43 minutes (median = 1h, 10m). Residency time ranged from less than 1 minute to 10 days, 5 hours, 34 minutes (median = <1m). The travel time from passage at Wilder to first detection at Bellows Falls for the 28 Wilder-released eels that arrived at Bellows Falls ranged from 2 days, 50 minutes to 20 days, 15 hours, 34 minutes (median = 3d, 7h). Residency in the Bellows Falls study area ranged from 7 minutes to 1 day, 14 hours, 59 minutes (median = 36 m). Most eels that passed Bellows Falls did so via the turbine intakes which passed 81.7% (N=76) of all fish. The trash/ice sluice passed 12.9% (N=12) and the spillway passed 5.4% (N=5) although four of those passed during leakage flows only and the fifth eel passed late in the season during spill (December 21). Five of the 98 total fish arriving at Bellows Falls (5.1%) did not pass the project.

The travel time from release site to study area for eels released at Vernon ranged from 26 minutes to 9 days, 9 hours, 57 minutes (median = 1d, 6h, 32m). Residency time ranged from 6 minutes to 19 days, 3 hours, 37 minutes (median = 47m). Of the 28 Wilder eels to pass Bellows Falls, 24 were also detected within the Vernon study area. Travel time from passage through the Bellows Falls project to Vernon ranged from 3 days, 3 hours, 50 minutes to 7 days, 15 hours, 56 minutes (median = 5d, 8h, 40m). Forty-four eels originating at Bellows Falls also passed at Vernon. The travel time ranged from 17 hours, 9 minutes to 50 days, 23 hours, 50 minutes for impoundment released eels and from 1 day, 3 hours, 57 minutes to 20 days, 39 minutes for canal released eels (median = 3 d, 6h, 58m).

Of the 112 eels that passed Vernon, most passed Vernon via the turbine intakes. Turbine Units 5-8 passed 42.93% (N=48). Units 9 and 10 passed 27.7% (N=31). The fish pipe passed 18.8% (N=21). Turbine Units 1-4 passed 6.3% (N=7). The trash/ice sluice passed 2.7% (N=3). The fish tube and the fishway each passed one eel. Six eels (5.1%) did not pass the project.

Overall, of the 170 eels released, 154 (90.5%) emigrated past their intended project, mostly at higher generation flows. Sixteen (9.5%) did not emigrate downstream to their intended project; of those, seven were identified in the forebay of the intended project or through manual monitoring within the study area and nine were never detected following release. With median residency times less than one hour at each project it can be concluded that the ability to locate downstream routes of passage through the projects does not hinder the timing of silver American Eel emigration.

### *Turbine Survival*

Direct relative turbine survival and injury (at 1 hour and 48 h) for silver American Eel were estimated in passage through Unit 2 at both the Wilder and Bellows Falls projects and Units 4, 8, and 9 at the Vernon project using the HI-Z tag fish recapture methodology. Units were selected to represent the variety of turbine types found at all three projects. Fish tagging, release, and recapture techniques were similar to those used for adult fish in previous studies at other projects. Fifty eels were used for each treatment condition along with 40 controls. Treatment eels were released through Kaplan turbines at Wilder Unit 2 and Vernon Unit 8, and Francis turbines at Wilder Unit 3, Bellows Falls Unit 2, and Vernon Units 4 and 9. Two treatment conditions (discharges) were tested at Vernon Unit 8 one treatment condition was tested at each of the other units. Wilder Unit 3 test were curtailed due to poor recovery results and further investigation indicated a passage into the tailrace was blocked by the grating which serves to diffuse flow into the fish ladder. Discharge from Unit 3 serves as attraction water for the fish ladder. No results or further analysis is presented for Wilder Unit 3 in this report.

Recapture rates for the treatment eels ranged from 93.8% to 100%. All but one control eel was recaptured. The estimated immediate (1 h) survivals were 80.0% (Wilder Unit 2), 100.0% (Bellows Falls Unit 2), 97.8% (Vernon Unit 4), 89.6% (Vernon Unit 8 at 1,000 cfs), 78.0% (Vernon Unit 8 at 1,700 cfs), and 97.9% (Vernon Unit 9). For all Vernon units combined, the estimated immediate (1 h) survival was 91.1%.The estimated 48 h survival values ranged from 62.0% (Wilder Unit 2) to 98% (Bellows Falls Unit 2) and for Vernon: 93.5% (Vernon Unit 4), 87.5% (Vernon Unit 8 at 1,000 cfs), , 74.0% (Vernon Unit 8 at 1,700 cfs), and 97.9% (Vernon Unit 9).

For all Vernon units combined, the estimated 48 h survival was 88.0%. Following the study plan, survival estimates were also calculated with only recaptured fish. The estimated 48 h survival values ranged from 66.0% (Wilder Unit 2) to 98.0% (Bellows Falls Unit 2) and from 91.3% to 100% at the different Vernon units. The estimated 48 h survival for all Vernon units was 92.8%.

All recaptured treatment fish were examined for injuries. The number of treatment fish that had visible injuries ranged from 4 (8.7%) for Vernon Unit 9 to 20 (42.6%) for Wilder Unit 2. One fish (2.2%) at Vernon Unit 8 (1,000 cfs) and 1 (2.3%) at Vernon Unit 8 (1,700 cfs). Two fish displayed only loss of equilibrium (LOE) both for Vernon Unit 8. Two (5.3%) control fish had visible injuries and none displayed LOE. Fish free of visible injuries, having less than 20% scale loss per side and free of loss of equilibrium were designated with a malady-free status. Malady-free estimate rates were adjusted by any maladies incurred by control fish. The malady-free estimates for recaptured fish ranged from 60.6% at Wilder Unit 2 to 96.4% at Vernon Unit 9, to 90.8% at Bellows Falls Unit 2. The malady free estimate for recaptured fish at all Vernon units combined was 78.2%.

The results of this survival study show that eels passing through Francis turbines fare better than through Kaplan (propeller type) turbines. Based on the results of this study, eels passing the Kaplan units at Wilder will incur considerable injury and mortality while those passing the Francis units at Bellows Falls should incur little injury and mortality. The larger Francis units (9 and 10) at Vernon should provide safe passage to most eels. The smaller Francis units (1-4) should also provide relatively high survival but would inflict some bruising. The Kaplan units 5-8 appear to provide better passage conditions at the lower discharge tested than at the higher discharge rate.

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## List of Abbreviations

| | |
|---|---|
| CI | Confidence Interval |
| CRWC | Connecticut River Watershed Council |
| FERC | Federal Energy Regulatory Commission |
| FirstLight | FirstLight Power Resources |
| FWS | U.S. Department of the Interior – Fish and Wildlife Service |
| NHDES | New Hampshire Department of Environmental Services |
| NHFGD | New Hampshire Fish and Game Department |
| RSP | Revised Study Plan |
| SE | Standard Error |
| TransCanada | TransCanada Hydro Northeast Inc. |
| TU | Trout Unlimited |
| USR | Updated Study Report |
| VANR | Vermont Agency of Natural Resources |
| VDEC | Vermont Department of Environmental Conservation |
| VFWD | Vermont Fish and Wildlife Department |

# 1.0 INTRODUCTION

This study report presents the findings of the 2015 assessment of American Eel Downstream Passage (ILP Study 19) conducted in support of Federal Energy Regulatory Commission (FERC) relicensing efforts by TransCanada Hydro Northeast Inc. (TransCanada) for the Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855), and the Vernon Hydroelectric Project (FERC No. 1904).

Adult, or silver phase American Eels (*Anguilla rostrata*) emigrate during the mid-summer through late fall; a time of year when river flows are generally within the operating capacities of the Wilder, Bellows Falls, and Vernon projects except during high water events. Therefore, eels would likely pass the projects through the turbines, open fish passage facilities or spill gates (if open). Because silver eels are known to be present upstream of the Vernon and Bellows Falls projects, and potentially in the Wilder project, it is necessary to understand how they move downstream through the projects and to assess what level of injury or mortality caused by passage during emigration may occur. In their study requests, U.S. Department of the Interior-Fish and Wildlife Service (FWS), New Hampshire Department of Environmental Services (NHDES), New Hampshire Fish and Game Department (NHFGD), Vermont Agency of Natural Resources (VANR), Trout Unlimited (TU) and Connecticut River Watershed Council (CRWC) identified these issues and requested a field study to identify project effects on emigrating silver phase American Eels.

The Revised Study Plan (RSP) was approved without modification (except to delay the study until 2015) in FERC’s February 21, 2014 Study Plan Determination.

# 2.0 STUDY GOALS AND OBJECTIVES

TransCanada conducted this study in the fall of 2015 to assess whether Wilder, Bellows Falls or Vernon project operations affect the safe and timely passage of emigrating silver phase American Eels. The specific objectives of this study were to:

- quantify the movement rates, timing, and relative proportion of silver eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, downstream passage facilities, and spillways; and

- assess instantaneous and latent mortality and injury of silver eels passed through each turbine type. This study was designed to estimate the direct (1 and 48 h) survival and malady-free rates (eels without visible injuries and no loss of equilibrium) of adult American eels passing the Wilder, Bellows Falls, and Vernon projects using the HI-Z Turb’N (HI-Z) tag (Heisey *et al.,* 1992) recapture technique. Survival and malady-free estimates were to be within ± 10%, 90% of the time. Survival and malady-free estimates were to be obtained near the settings the units are operating at most of the time to evaluate typical conditions.

# 3.0 STUDY AREA

The study areas associated with assessing American Eel movement rates and passage through the dams encompassed the Wilder, Bellows Falls, and Vernon Project forebays, tailraces, turbines, downstream fish bypass routes, and spillways as shown in Figures 3.1 – 3.3.

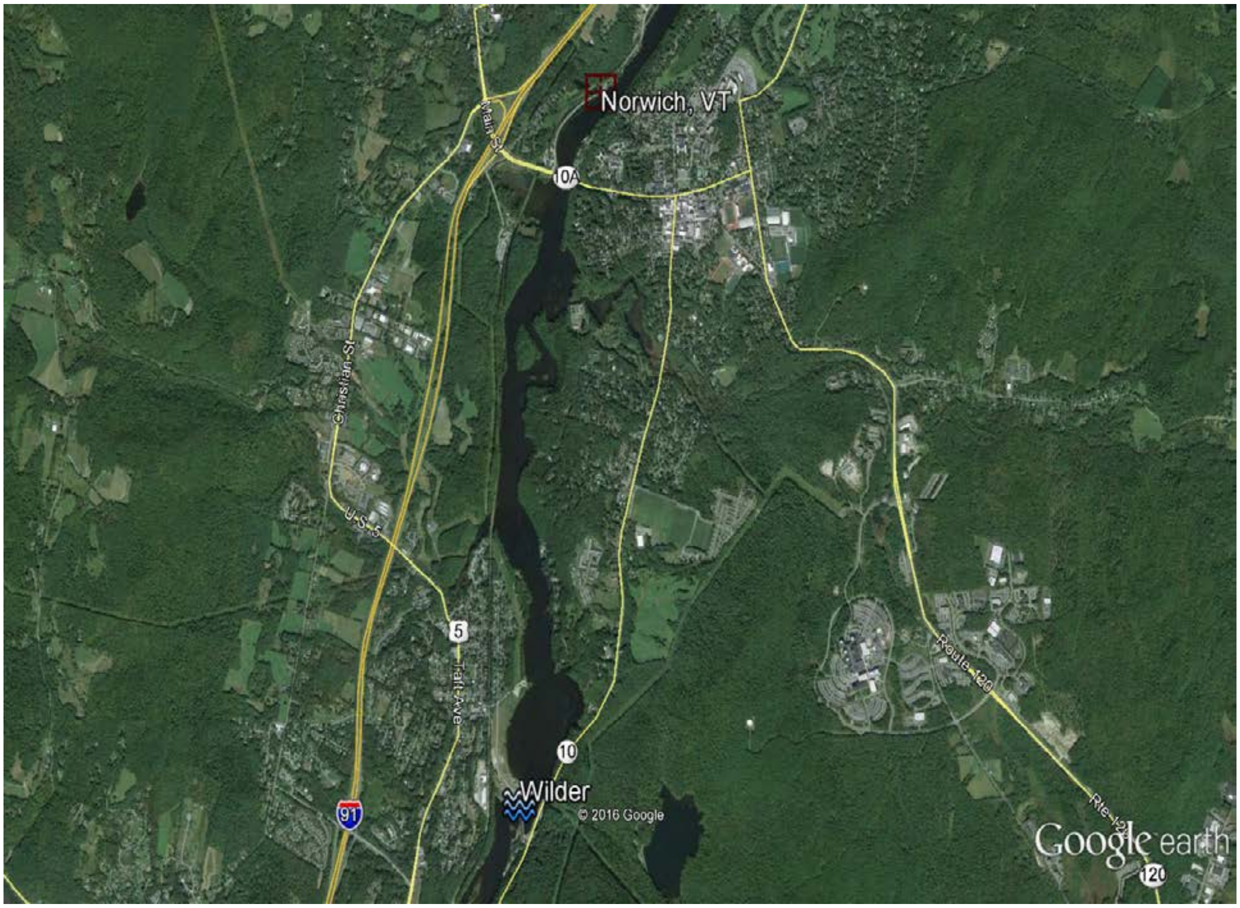



Figure 3.1. Wilder study area.

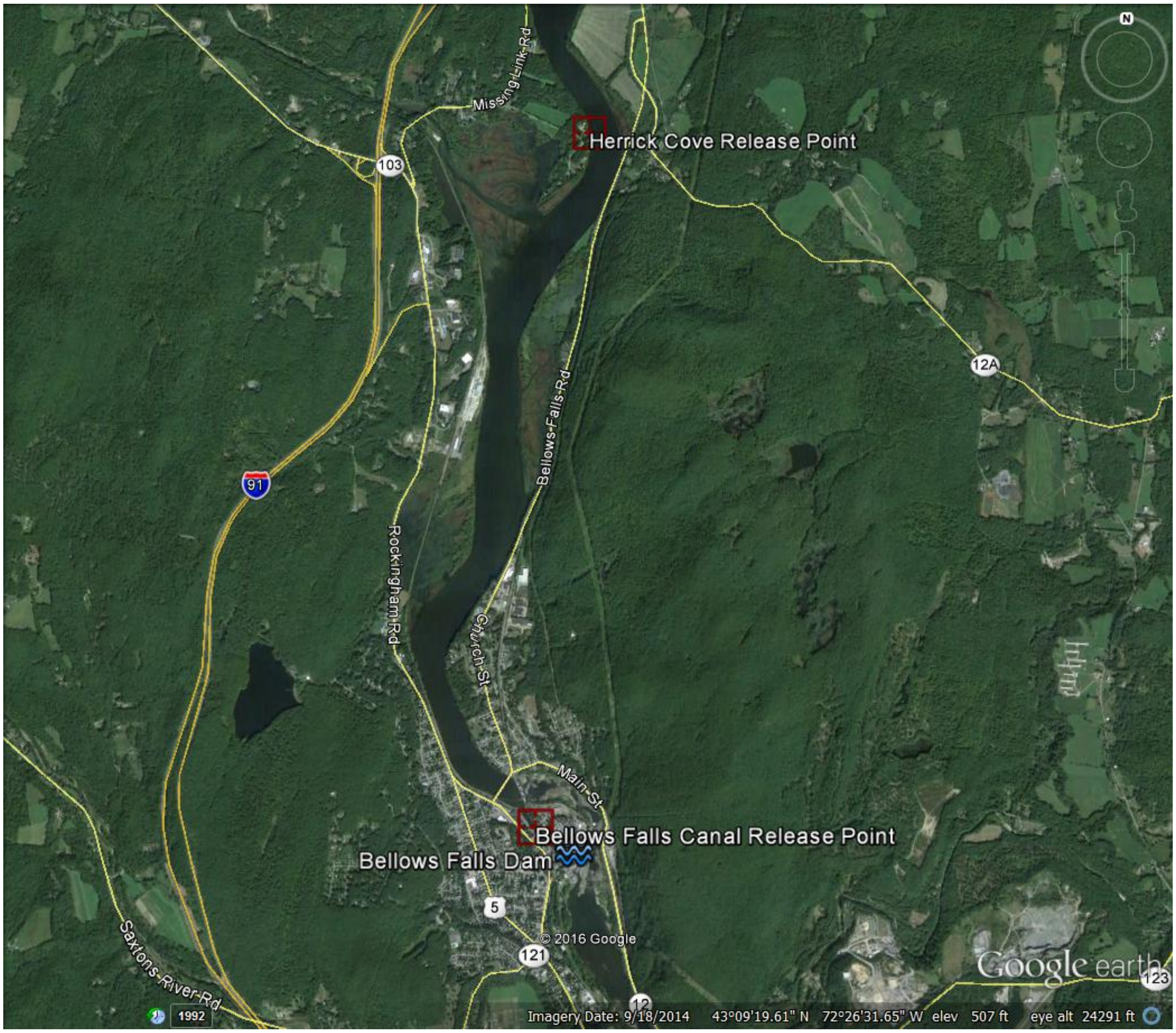



Figure 3.2. Bellows Falls study area.

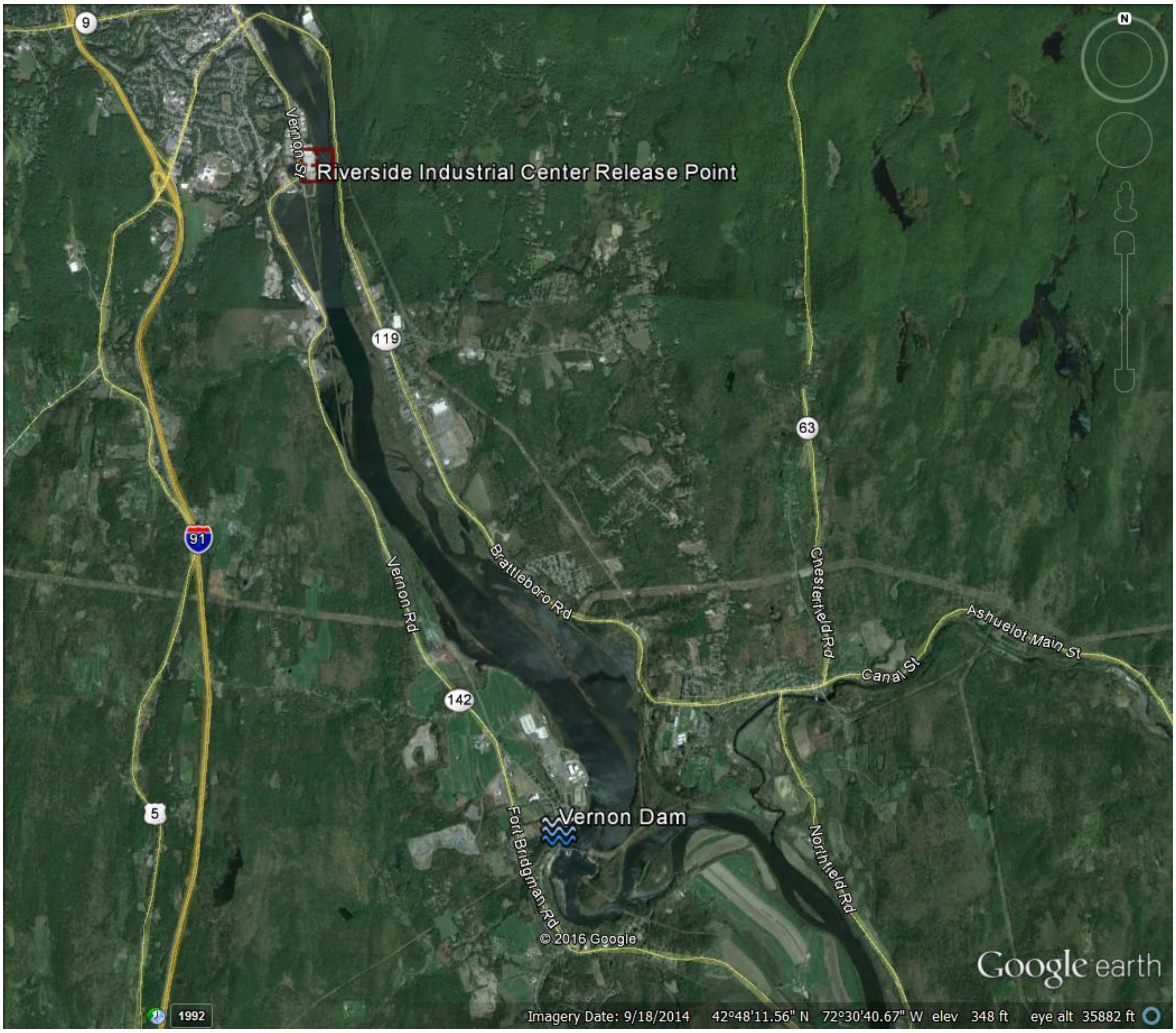



Figure 3.3. Vernon study area.

# 4.0 METHODS

Silver American Eel downstream passage was assessed by radio-tagging and systematically monitoring fish movements and passage through each of the routes through the projects. Downstream turbine passage survival and injury was assessed by using HI-Z mark/recapture methodology used on adult eels at other power stations (Normandeau, 2010; 2011a; and 2011b).

## 4.1 Source of Eels

The RSP anticipated collection of eels at either the Turners Falls or Holyoke bypass samplers as suggested by the resource agencies, or from out-of–basin if needed to meet the sample size requirements. However, on February 5, 2015, Normandeau staff on behalf of TransCanada notified NHFGD and Vermont Fish and Wildlife Department (VFWD) via email of concerns over collection of the needed number of in-basin eels as specified in the RSP. The only reliable source to collect numbers of silver-phase American Eels in the Connecticut River Basin is the Holyoke Canal Bypass Sampler. Due to the large number of silver-phase American Eels needed to fulfill the requirements of relicensing studies for the TransCanada projects as well as FirstLight projects (Turners Falls, Northfield Mountain), and Conte Lab research, it was determined that no in-basin source would be sufficient. As a result, TransCanada and FirstLight proposed to import eels from out-of-basin sources and submit a sample for fish disease assessment prior to release into the Connecticut River. This issue was discussed in more detail at a working group consultation conference call on February 10, 2015 and comments and recommendations were provided by VFWD and NHFGD on March 25, 2015 and April 9, 2015, respectively.

TransCanada and FirstLight consultants jointly prepared and submitted to NHFGD, VFWD, and Massachusetts Department of Fish and Wildlife (MDFW) a "Plan for Implementation of Adult American Eels to the Connecticut River Basin in 2015" (Normandeau and Kleinschmidt, 2015) which proposed to procure eels from a source in Newfoundland, Canada likely to collect sufficient numbers, and proposed a series of pathogens tests and testing protocols. NHFGD and VFWD provided comments on the plan and additional recommendations on June 4, 2015, and Normandeau provided additional information in response on July 16, 2015 (to NHFGD) and July 17, 2015 (to VFWD). Kleinschmidt had similar interaction and communications with MDFW. All related documents and communications were included in Appendix C of the Updated Study Report (USR) filed on September 14, 2015.

All pathology tests conducted as part of eel importation had acceptable results and both states issued import permits after review of the pathology test reports (Appendix A). However, due to the need to import eels and the timing of their receipt, the study included a variance from the RSP in that route selection was delayed until late October rather than the expected start of the study in late August. Once pathology reports were received, fish were flown then trucked within 24 hours to the sites, where they received one or more days of onsite acclimation prior to the start of tagging and release. It does not appear that this delay compromised the study or study results in any meaningful way.

## 4.2 Route Selection and Residency Methodology

Proportional route selection, travel time, and forebay residency time for adult eel downstream passage was assessed by radio-tagging and systematically monitoring tagged eel movement and passage through each of the three projects. Radio-tags were surgically implanted into each specimen. Sigma Eight Inc. model TXPSC-1-450 tags were used for this study. Each tag is approximately 8.24 g in air, 62 mm in length, and 10 mm in height with a 12-inch whip antenna that will propagate a signal. The tags used were calibrated for a 2.0-second burst rate and had a life expectancy of 361 days. For this study three frequencies were used. Each release contained a proportionate number of tags in frequencies 150.340 MHz, 150.360 MHz, and 150.380 MHz. Each transmitter contained a unique pulse code to allow for individual fish identification.

Each of the three projects received 50 eels in five release groups of 10 eels each. Each group release occurred on the same day at all three projects (October 27, 29, and 31, November 3 and 5). All eels were released approximately 3 miles upstream of their respective project. In accordance with the RSP, since spill occurred at Bellows Falls during the study, an additional 20 eels were released under two groups directly into the Bellows Falls power canal on October 29 and 31. Including these eels, a total of 170 eels were used.

Adult eels were selected for tagging by dip netting an eel from the holding tank (see Section 4.4 for details on holding procedures) to a tagging container filled with an anesthetic bath. After an appropriate exposure to the anesthetic the specimen was placed into a restraint for surgical implantation of the radio-tag. An approximate 15-mm incision was made with a scalpel approximately 3-5 inches forward of the vent. Following an appropriate incision the sterilized radio-tag was inserted and a cannula was used to fix the antenna into place through the abdomen wall. Following the insertion of the radio-tag and antenna the incision site was then sutured. Once all sutures were completed the eel was placed into holding for 2-3 hours for recovery.

### 4.2.1 Wilder

Remote telemetry monitoring occurred at the Wilder forebay, fishway exit, trash/ice sluice, turbines, tailrace, and spillway (Figure 4.2-1). Radio receivers capable of monitoring multiple radio channels simultaneously at each location were coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites monitored while minimizing overlap between the sites. Fifty radio-tagged eels were released approximately 3 miles upstream of the project.

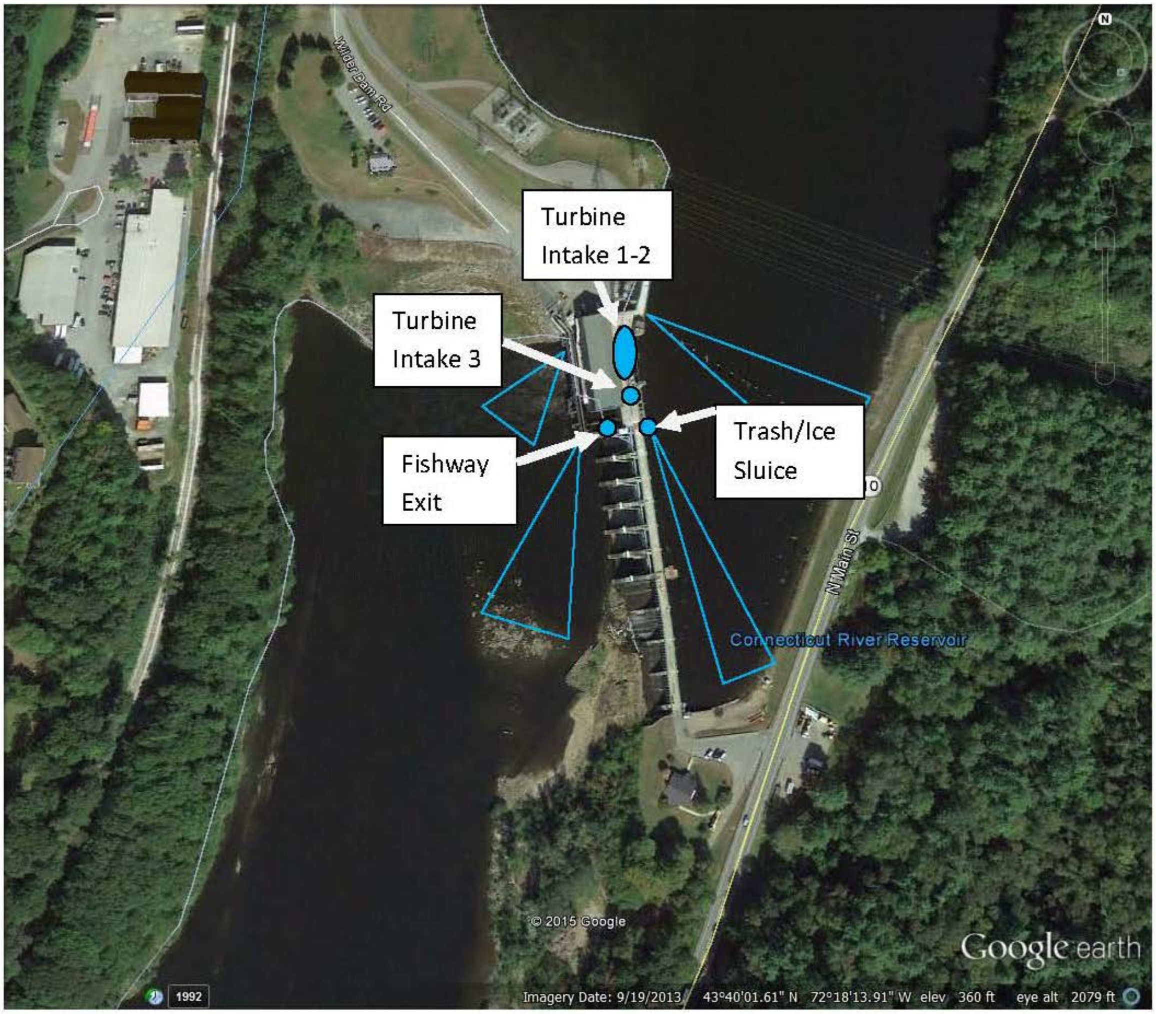



Figure 4.2-1. Wilder telemetry layout and passage routes.

### 4.2.2 Bellows Falls

Remote telemetry monitoring occurred at the Bellows Falls power canal entrance, station forebay, turbines, fishway and tailrace, and the spillway dam and bypassed reach (Figures 4.2-2 and 4.2-3). Radio receivers capable of monitoring multiple radio channels simultaneously at each location were coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites monitored while minimizing overlap between the sites. Seventy radio-tagged eels were released upstream of Bellows Falls. Twenty of these were released directly into the Bellows Falls Power Canal under spill conditions.

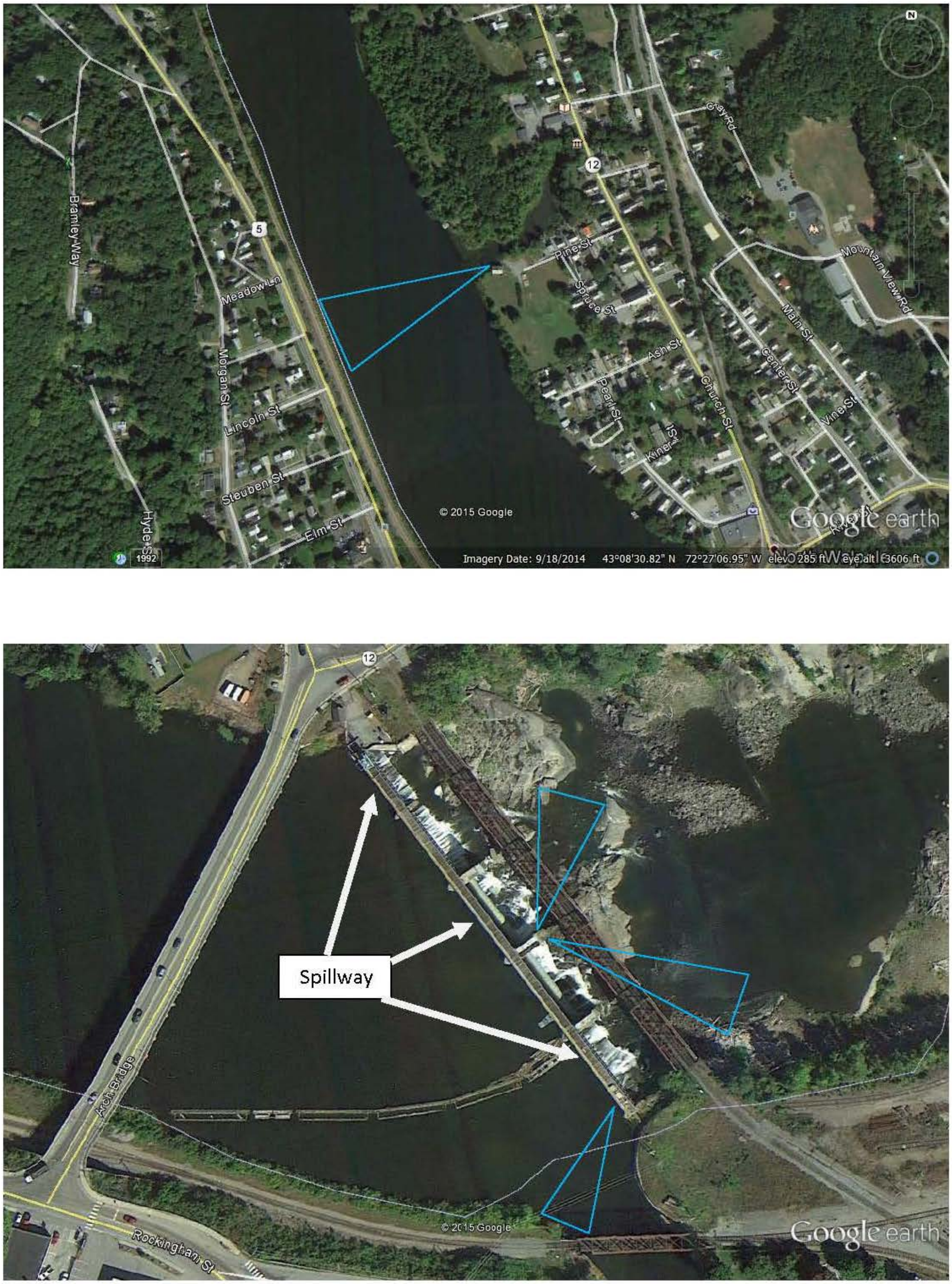



Figure 4.2-2. Bellows Falls power canal (top) and spillway dam (bottom) telemetry layout and passage routes.

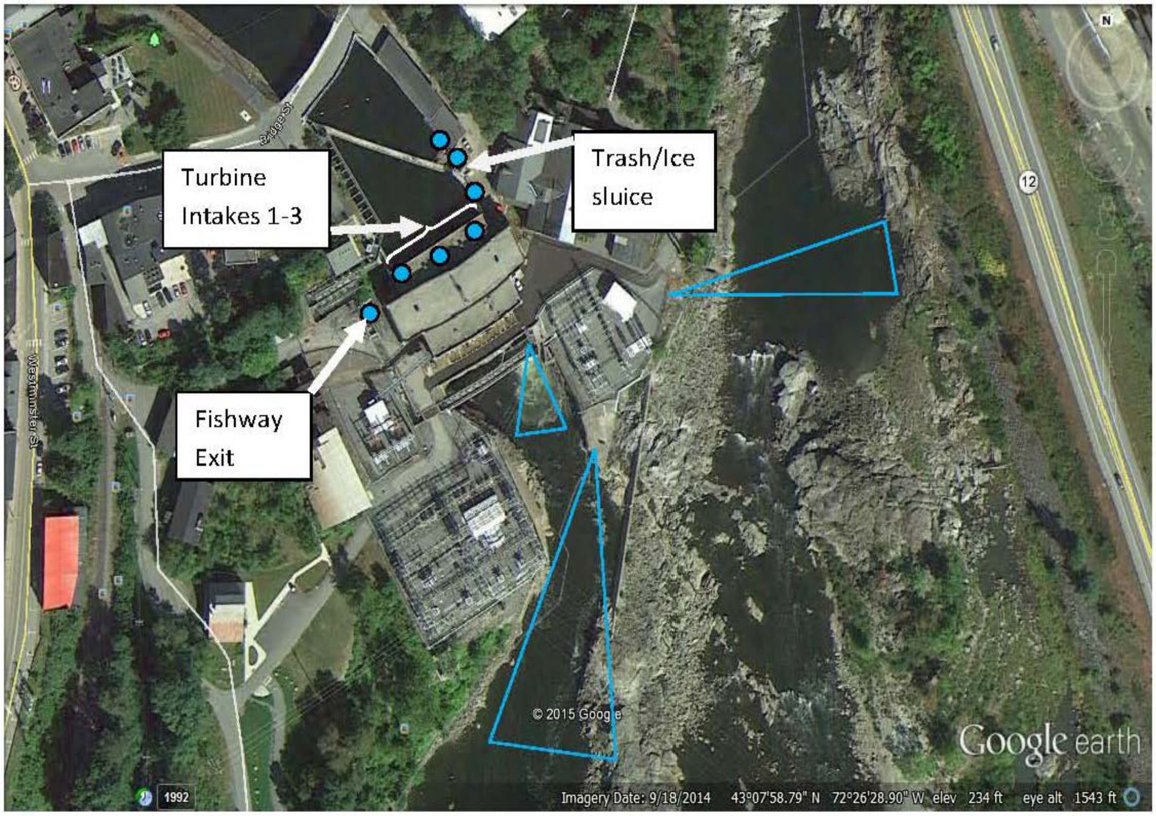



Figure 4.2-3. Bellows Falls powerhouse telemetry layout and passage routes.

### 4.2.3 Vernon

Remote telemetry monitoring occurred at the Vernon forebay, log boom and diversion boom, fish pipe, fish tube, turbines, tailrace, and spillway (Figures 4.2-4 and 4.2-5). Radio receivers capable of monitoring multiple radio channels simultaneously at each location were coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites monitored while minimizing overlap between the sites.


Figure 4.2-4. Vernon upstream telemetry layout and passage routes.

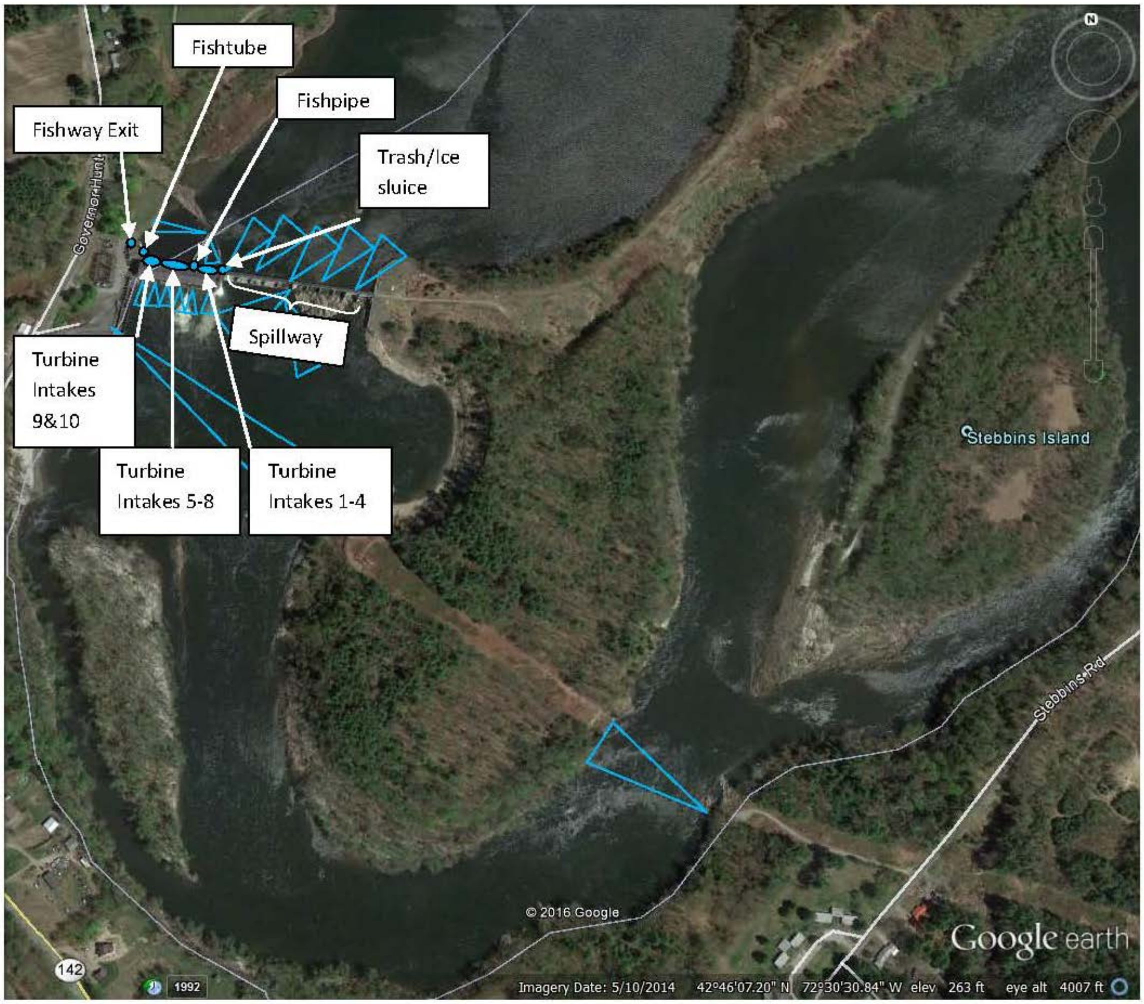



Figure 4.2-5. Vernon dam telemetry layout and passage routes.

## 4.3 Turbine Survival (HI-Z Tag) Methodology

### 4.3.1 Procedures

Adult American Eels were released into the intakes of designated Francis (Wilder Unit 3, Bellows Falls Unit 2, Vernon Units 4 and 9) and Kaplan (Wilder Unit 2, Vernon Unit 8) Units. After passage, live and dead eels were captured and the condition of each was examined. At the end of the 48 h holding period, all alive and uninjured eels were released to the river. Survival and malady-free rates were estimated for each passage location with the exception of Wilder Unit 3 where the study was suspended due to low recapture rates (see Section 4.4.1). Descriptions of the observed injuries were recorded to help assess the probable causal mechanisms for injury/mortality (see Section 5.2 Tables 5.2.1-1 through 5.2.1-2, and 5.2.1-6).

The operational and physical parameters measured during the release of treatment adult eels through the designated units and control eels into the tailrace are presented in Tables 4.3.1-1 and 4.3.1-2.

Table 4.3.1-1. Characteristics of turbines tested.

| Project / Unit # | Turbine Type | Max discharge (cfs) | Discharge (cfs) at best efficiency | Best turbine efficiency | No. blades / buckets | RPM | Head (ft) | Runner diameter (ft) |
|---|---|---|---|---|---|---|---|---|
| Wilder Unit 2 | Kaplan, adjustable blade, single runner | 6,000 | 2,500-3,000 | 12–14 MW | 5 blades | 112.5 | 49 | 15 |
| Wilder Unit 3 | Vertical Francis, single runner | 700 | 700-740 | 2.4-2.8 MW | 14 buckets | 212 | 58 | 6 |
| Bellows Falls Unit 2 | Vertical Francis, single runner | 3,670 | 3,000-3,300 | 13-15 MW | 15 buckets | 85.7 | 57 | 14.5 |
| Vernon Unit 4 | Vertical Francis, single runner | 1,465 | 1,000-1,400 | 2.3-2.5 MW | 13 buckets | 133.3 | 35 | 5.208 |
| Vernon Unit 8 | Vertical Kaplan, axial flow | 1,800 | 1,330-1,460 | 3.5-3.8 MW | 5 blades | 144 | 32 | 10.171 |
| Vernon Unit 9 | Vertical Francis, single runner | 2,035 | 1,500-1,600 | 3.5-3.9 MW | 12 buckets | 75 | 34 | 9.167 |

Table 4.3.1-2. Daily average of project parameters during turbine survival testing.

| Date | Average Project Discharge (KCFS)[a] | Average Turbine Discharge (KCFS) | Average Discharge through tested Unit (KCFS) | Forebay Elevation (ft) | Tailrace Elevation (ft) | Gross Head (ft) |
|---|---|---|---|---|---|---|
| **Vernon Unit 8 (test A)** | | | | | | |
| 26-Oct | 3.483 | 2.931 | 1.236 | 219.67 | 182.65 | 37.02 |
| **Vernon Unit 9** | | | | | | |
| 27-Oct | 2.629 | 2.093 | 1.308 | 219.66 | 182.45 | 37.22 |
| **Vernon Unit 4** | | | | | | |
| 28-Oct | 2.373 | 1.597 | 0.992 | 219.79 | 182.07 | 37.72 |
| **Vernon Unit 8 (test B)** | | | | | | |
| 3-Nov | 7.506 | 6.843 | 1.681 | 219.56 | 184.05 | 35.51 |
| **Bellows Falls Unit 2** | | | | | | |
| 30-Oct | 9.348 | 9.331 | 3.229 | 290.38 | 229.80 | 60.58 |
| **Wilder Unit 2** | | | | | | |
| 1-Nov | 5.495 | 5.468 | 4.748 | 383.15 | 329.75 | 53.40 |

a. Total discharge only during the time of fish releases.

### 4.3.2 Sample Size Calculations

Prior to initiating the study, the sample size requirement had been determined to fulfill the primary objective of obtaining survival estimates and malady-free rates within a pre-specified precision (ε) level. The sample size is a function of the recapture rate ($P_A$), expected passage survival ($\hat{\tau}$) or mortality ($1-\hat{\tau}$), survival of control eels (S), and the desired precision (ε) at a given probability of significance ($\alpha$). In general, sample size requirements decrease with an increase in control eels surviving, being malady-free and recapture rates (Mathur *et al*. 1996, 2000). Only precision and the probability of significance level can be strictly controlled by an investigator. Results of other turbine direct survival studies on adult eels (Normandeau 2010; 2011a; 2011b) indicate a sample size of approximately 60 (50 treatment and 10 control) eels should be sufficient to attain survival estimates within ± 10%, 90% of the time, for the selected operating condition of the selected turbine at each project. This number assumes close to 100% control survival, a recapture rate of 95%, and expected passage survival and malady-free rates of greater than 85% for a specific study.

Fifty treatment eels were released within the Unit 2 intake and 10 control eels were released into the tailrace for each of the Wilder and Bellows Falls studies. At Vernon, a total of 194 treatment eels were released within the turbine intakes (48 at Unit 4; 48 at Unit 8 at 1,000 cfs; 50 at Unit 8 at 1,700 cfs; and 48 at Unit 9) along with 19 control eels released into the tailrace (Tables 4.3.2-1 and 4.3.2-2).

Table 4.3.2-1. Required sample sizes for treatment and control fish releases for various combinations of control survival (S), recapture probability (PA), and turbine related mortality (1- $\hat{\tau}$) to obtain a precision (ε) of ≤±0.10 at 1-α =0.90.

| Control Survival (S)[a] | Recapture Rate ($P_A$) | Turbine Mortality (1- $\hat{\tau}$) | Number of Fish |
|---|---|---|---|
| 1.00 | 0.99 | 0.05 | 18 |
| | | 0.10 | 29 |
| | | 0.15 | 39 |
| | | 0.25 | 55 |
| | 0.95 | 0.05 | 39 |
| | | 0.10 | 49 |
| | | 0.15 | 57 |
| | | 0.25 | 70 |
| | 0.90 | 0.05 | 69 |
| | | 0.10 | 76 |
| | | 0.15 | 82 |
| | | 0.25 | 90 |
| 0.95 | 0.99 | 0.05 | 45 |
| | | 0.10 | 54 |
| | | 0.15 | 107 |
| | | 0.25 | 111 |

a. Table values also applicable for malady free estimates.

Table 4.3.2-2. Schedule of released adult eels, October-November 2015. Combined controls released into the tailrace downstream of the three stations.

| Lot No. | Date | Water Temp (°C) | Vernon | | | | Bellows Falls | Wilder | | Combined Controls | Actual Treatment Release[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unit 4 | Unit 8 @ 1000 cfs | Unit 8 @ 1700 cfs | Unit 9 | Unit 2 | Unit 2 | Unit 3[a] | | |
| 1E | 10/26 | 8.4 | | 48 | | | | | | | 50 |
| 2E | 10/27 | 8.0 | | | | 48 | | | | 10 | 50 |
| 3E | 10/28 | 8.3 | 48 | | | | | | | 9 | 50 |
| 4E | 10/30 | 7.7 | | | | | 50 | | | 10 | 53 |
| 5E | 10/30 | 7.7 | | | | | | | 10 | | 10 |
| 6E | 11/01 | 7.5 | | | | | | 50 | | 10 | 50 |
| 7E | 11/03 | 9.1 | | | 50 | | | | | | 50 |
| **Total** | | | **48** | **48** | **50** | **48** | **50** | **50** | **10** | **39** | **313** |

a. Wilder Unit 3 eels not used in analysis.

### 4.3.3 Tagging and Release

Procedures for handling, tagging, release, and recapture of eels were similar for treatment and control groups. Eels were randomly selected from the holding tanks (see Section 4.4 for details on holding) located on the intake deck using dip nets and transported in pails or tubs to the tagging site.

In order to bring large adult eels to the surface for rapid recapture, three to six HI-Z balloon tags were attached with a small cable tie through the musculature at two or three locations along the eel's back via a curved cannula needle. Radio-tags were attached in combination with one of the HI-Z tags to aid in tracking released eels. Specially designed eel restraint devices developed and built by Normandeau aided in tagging treatment and control eels (Figures 4.3.3-1 and 4.3.3-2).

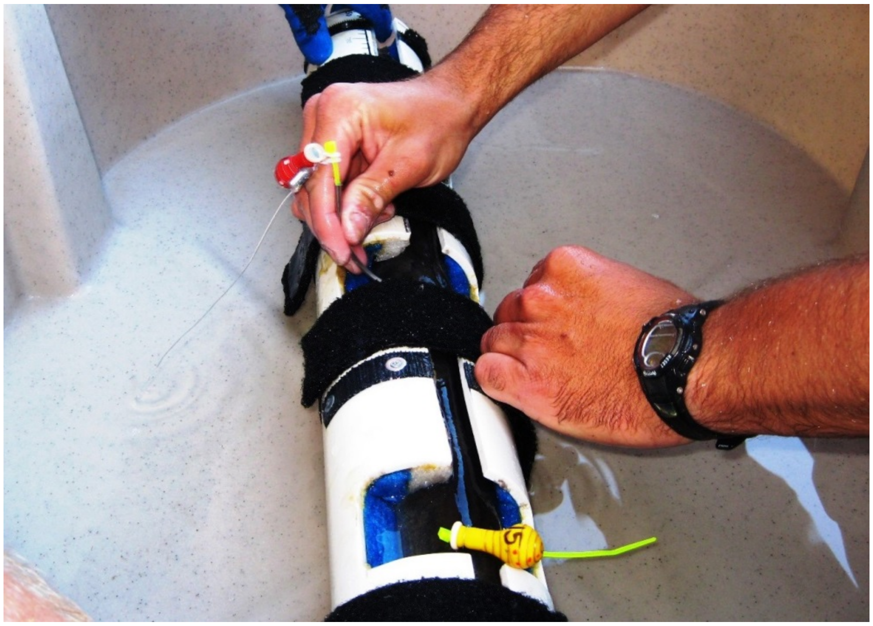


Figure 4.3.3-1: Cannula used to attach HI-Z tags and radio-tags to adult American Eels.

Figure 4.3.3-2. Restraining device used to aid in HI-Z tagging with eel ready for release through the induction system.

Eels were individually marked and identified with small numbered Floy tags. The tubular Floy tags were inserted into musculature near the anterior region of the dorsal fin. Just prior to release, the HI-Z tags were activated by injecting a small amount of water into each HI-Z tag, which causes the tags to inflate in approximately 2 to 4 minutes. Tags were activated while the eel was still in the restraining device (Figure 4.3.3-3).

Figure 4.3.3-3: Injecting catalyst into a HI-Z tag attached to an adult American Eel.

All treatment eels were released through an induction apparatus. The induction apparatus was connected to 4-inch diameter hoses which allowed the eels to pass freely to the desired release points for treatment eels at each project. The release hose was lowered behind the trash racks to below the ceiling of the intake to ensure the eels passed through the turbine. The induction system and each release hose had a continuous supply of river water supplied by a 3-inch trash pump to ensure eels were transported quickly to the desired release point. Control eels were released through an identical induction apparatus attached to a 4-inch diameter flexible hose approximately 50 feet long that released eels into the tailrace (Figures 4.3.3-4 – 4.3.3-8).

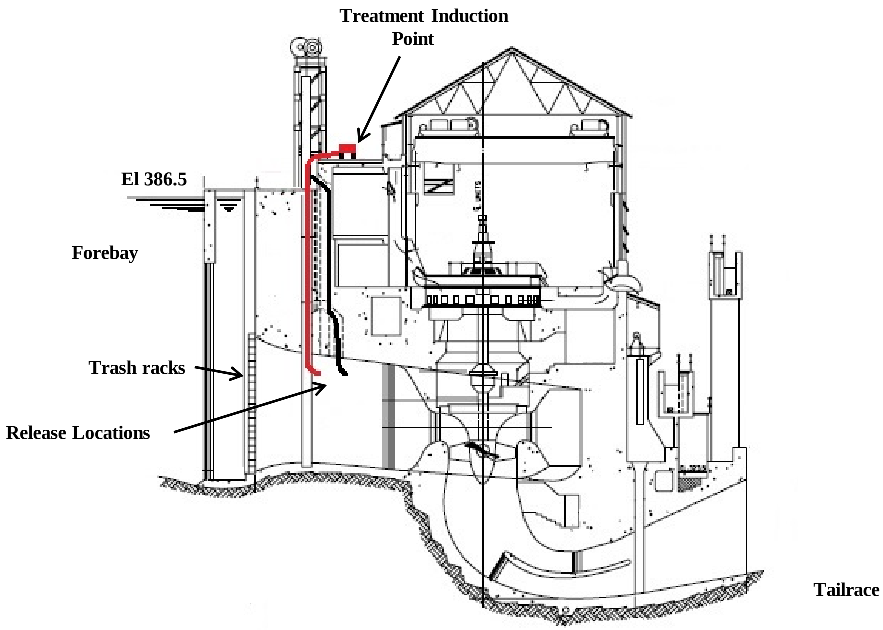



Figure 4.3.3-4: Schematic of Wilder Unit 2 showing approximate location of the treatment induction system and the terminus of the release hose (red line) and the release hose deployment configuration through a vent pipe for Unit 3 (black line).

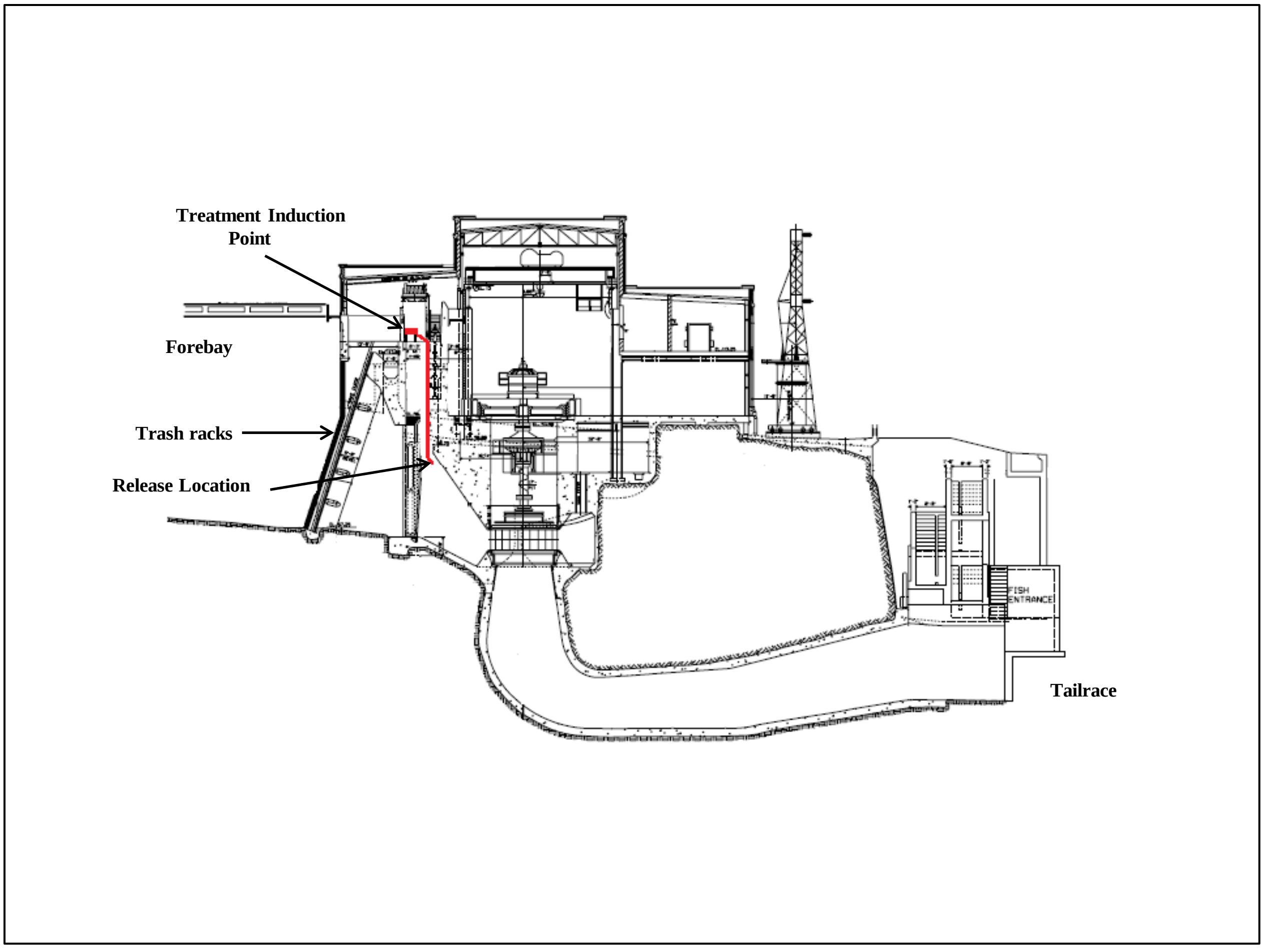



Figure 4.3.3-5: Schematic of Bellows Falls Unit 2 showing approximate location of the treatment induction system and the terminus of the release hose (red line).

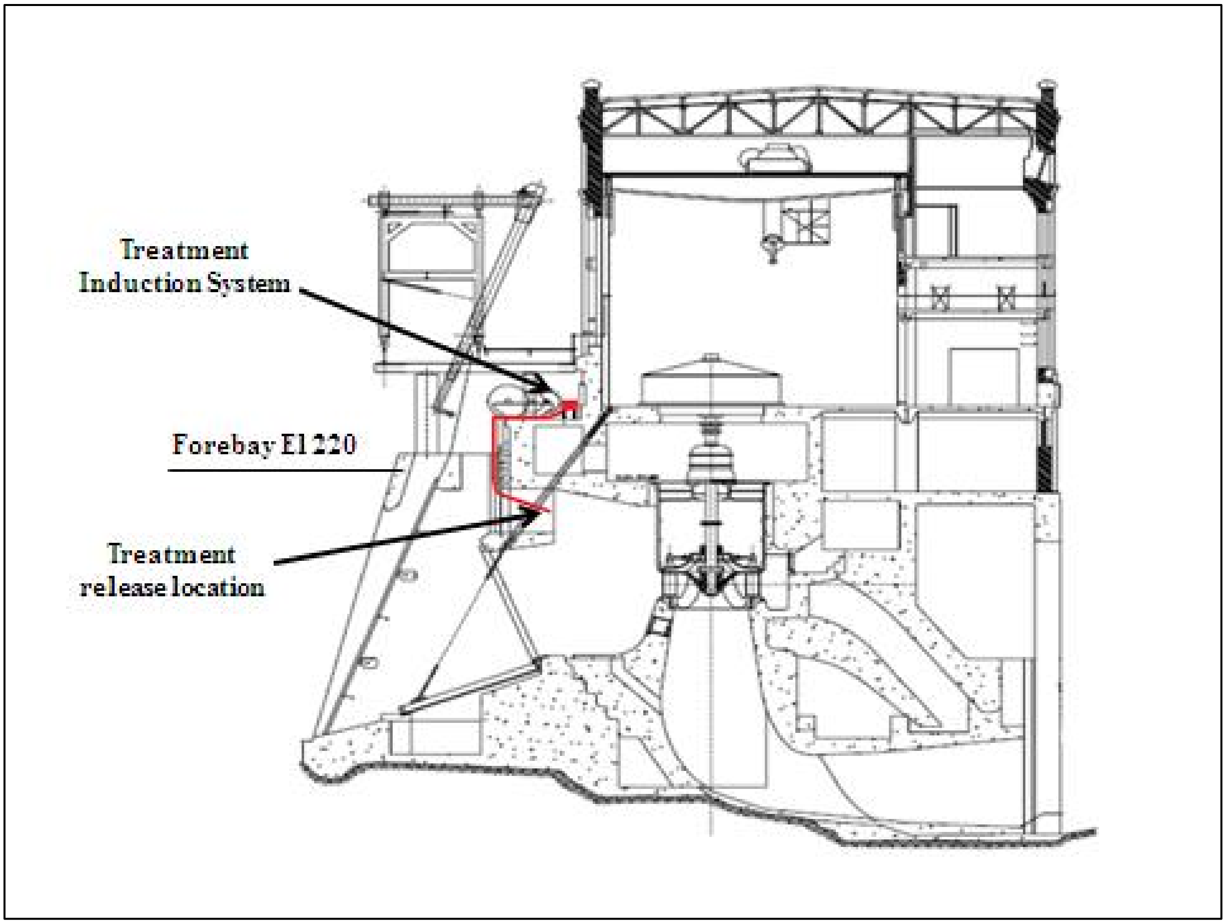



Figure 4.3.3-6: Schematic of Vernon Unit 4 showing approximate locations of the treatment induction system and the terminus of the release hose (red line).

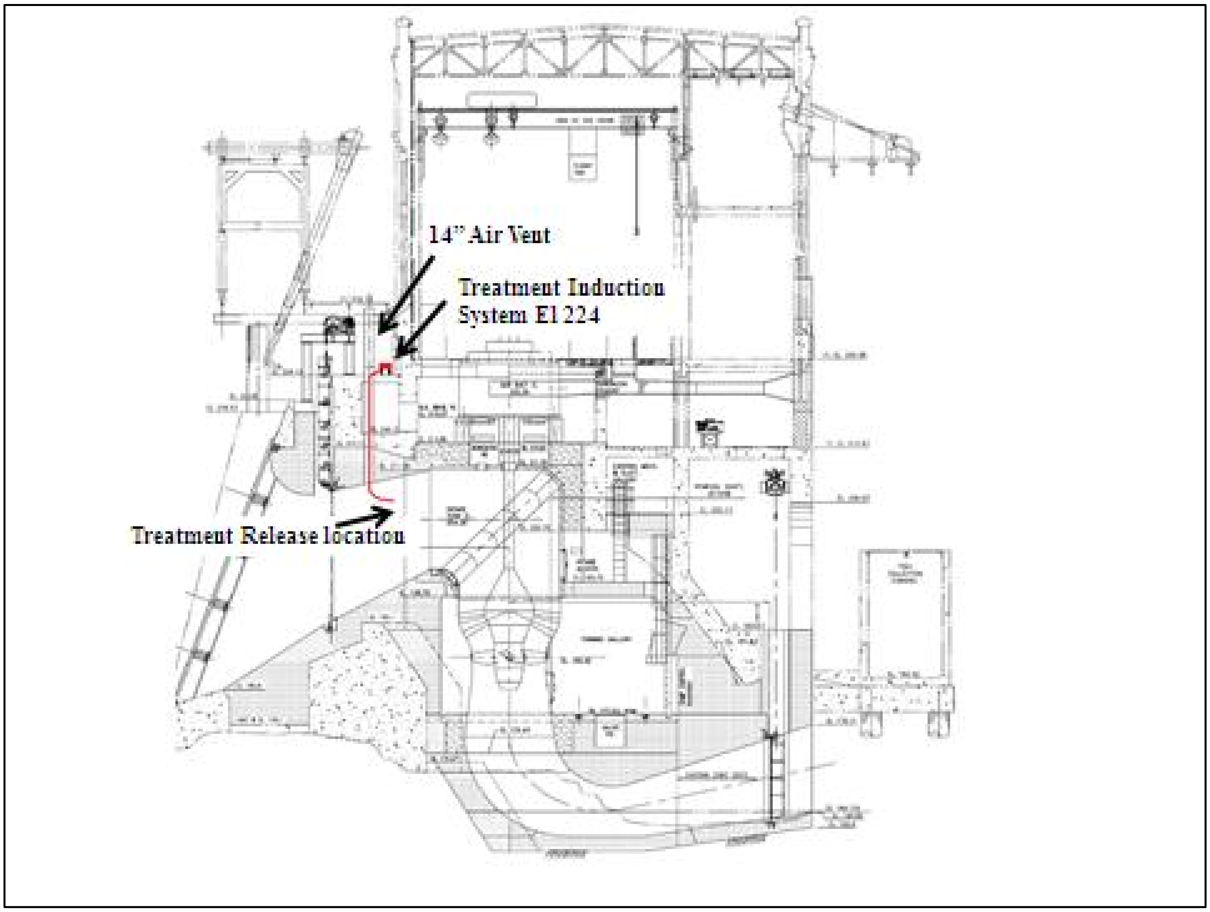



Figure 4.3.3-7: Schematic of Vernon Unit 8 showing approximate locations of the treatment induction system and the terminus of the release hose (red line).

Figure 4.3.3-8: Control induction system and release hose used to release HI-Z tagged adult American Eels.

### 4.3.4 Adult Eel Recapture Methods

After release (either as treatment or control), the eels were tracked and then retrieved when buoyed to the surface downstream of the projects by one of three recapture boat crews. Boat crews were notified of the radio-tag frequency of each eel upon its release. Radio signals were received on a loop antenna coupled to an Advanced Telemetry System receiver. The radio signal transmission (48 or 49 MHz) enabled the boat crews to follow the movement of each eel after passage and position the boats downstream for retrieval when eels were buoyed to the surface. Recaptured eels were placed into an on-board holding facility, and all tags were removed with the exception of the Floy tag. Each eel was immediately examined for maladies consisting of visible injuries and loss of equilibrium, and assigned appropriate condition codes. Tagging and data recording personnel were notified via a two-way radio system of each eel's recapture time and condition (Figure 4.3.4-1 and Table 4.3.4-1).

Recaptured eels were transported to shore and held in 900-gal holding tanks to monitor delayed effects of tagging and turbine passage. The eels were held for 48 h based on the protocol established for HI-Z tag assessment (Heisey *et al.* 1992) and laboratory studies conducted to assess shear effects on fish (Neitzel *et al.* 2000). Tanks were continuously supplied with ambient river water by two redundant pump systems connected to different electrical circuits. Water levels in the tanks were maintained at a minimum of 20 inches below the top of the tanks and the tanks were covered with netting or tarps to prevent eel escapement or predation. Eels that were alive at 48 h and free of major injuries were released into the river (Figure 4.3.4-2).

Figure 4.3.4-1. Boat crew retrieving a HI-Z tagged adult eel. HI-Z tagged eel with balloons inflated can be seen in front of the boat.

Figure 4.3.4-2. Delayed assessment tanks used to monitor the 48h period following recapture of HI-Z tagged adult eels.

Table 4.3.4-1. Condition codes assigned to fish and dislodged HI-Z tags for fish passage survival studies.

| Status Codes | Description |
|---|---|
| * | Turbine/passage-related malady |
| 4 | Damaged gill(s): hemorrhaged, torn or inverted |
| 5 | Major scale loss, >20% |
| 6 | Severed body or nearly severed |
| 7 | Decapitated or nearly decapitated |
| 8 | Damaged eye: hemorrhaged, bulged, ruptured or missing, blown pupil |
| 9 | Damaged operculum: torn, bent, inverted, bruised, abraded |
| A | No visible marks on fish |
| B | Flesh tear at tag site(s) |
| C | Minor scale loss, <20% |
| E | Laceration(s): tear(s) on body or head (not severed) |
| F | Torn isthmus |
| G | Hemorrhaged, bruised head or body |
| H | Loss of Equilibrium (LOE) |
| J | Major |
| K | Failed to enter system |
| L | Fish likely preyed on (telemetry, circumstances relative to recapture) |
| M | Minor |
| P | Predator marks |
| Q | Other information |
| S | Special describe as needed |
| R | Removed from sample |
| T | Trapped in the rocks/recovered from shore |
| V | Fins displaced, or hemorrhaged (ripped, torn, or pulled) from origin |
| W | Abrasion / Scrape |

| Status Codes | Description |
|---|---|
| **Survival Codes** | |
| 1 | Recovered alive |
| 2 | Recovered dead |
| 3 | Unrecovered – tag & pin only |
| 4 | Unrecovered – no information or brief radio telemetry signal |
| 5 | Unrecovered – trackable radio telemetry signal or other information |
| **Dissection Codes** | |
| 1 | Shear |
| 2 | Mechanical |
| 3 | Pressure |
| 4 | Undetermined |
| 5 | Mechanical/Shear |
| 6 | Mechanical/Pressure |
| 7 | Shear/Pressure |
| B | Swim bladder ruptured or expanded |
| D | Kidneys damaged (hemorrhaged) |
| E | Broken bones obvious |
| F | Hemorrhaged internally |
| J | Major |
| L | Organ displacement |
| M | Minor |
| N | Heart damage, rupture, hemorrhaged |
| O | Liver damage, rupture, hemorrhaged |
| R | Necropsied, no obvious injuries |
| S | Necropsied, internal injuries |
| T | Tagging/Release |
| U | Undetermined |
| W | Head removed; i.e., otolith |

### 4.3.5 Classification of Recaptured Adult Eels

As in previous investigations, (Mathur *et al*. 1996 and 2000; Normandeau 2010 and 2011a and b; Normandeau and Skalski 1998 and 2005; North/South Consultants Inc. and Normandeau Associates, Inc. 2007, 2009; Normandeau. 2010, 2011a, 2011b) the immediate post-passage status of an individual recaptured eel and recovery of inflated tags dislodged from eel were designated as alive, dead, or unknown. The following criteria were used to make these designations: (1) alive—recaptured alive and remaining so for 1 h; (2) alive—eel did not surface but radio signals indicated movement patterns (an un-recaptured eel was also classified as alive if no HI-Z tags were recaptured, and based on telemetry information the eel appeared to have moved into underwater structures that prevented the HI-Z tags from buoying it to the surface); (3) dead—recaptured dead or dead within 1 h of release; (4) dead—only inflated dislodged tag(s) were recovered, and telemetric tracking or the manner in which inflated tags surfaced was not indicative of a live eel; and (5) unknown—no eels or dislodged tags were recaptured, or radio signals were received only briefly, and the subsequent status could not be ascertained.

Per the RSP eels and tags falling into criteria 4 and 5 above were to be censored from the data set.

Mortalities of recaptured eels occurring after 1 h were assigned 48 h post-passage effects although eels were observed at approximately 12 h intervals during the 48 h delayed holding period. Dead eels were examined for maladies, and those that died without obvious injuries were necropsied to determine the probable cause of death. Additionally, all specimens alive at 48 h were closely examined for injury. An initial examination of the eels when captured allowed detection of some injuries, such as bleeding and minor bruising that may not be evident after 48 h due to natural healing processes (Figure 4.3.5-1).

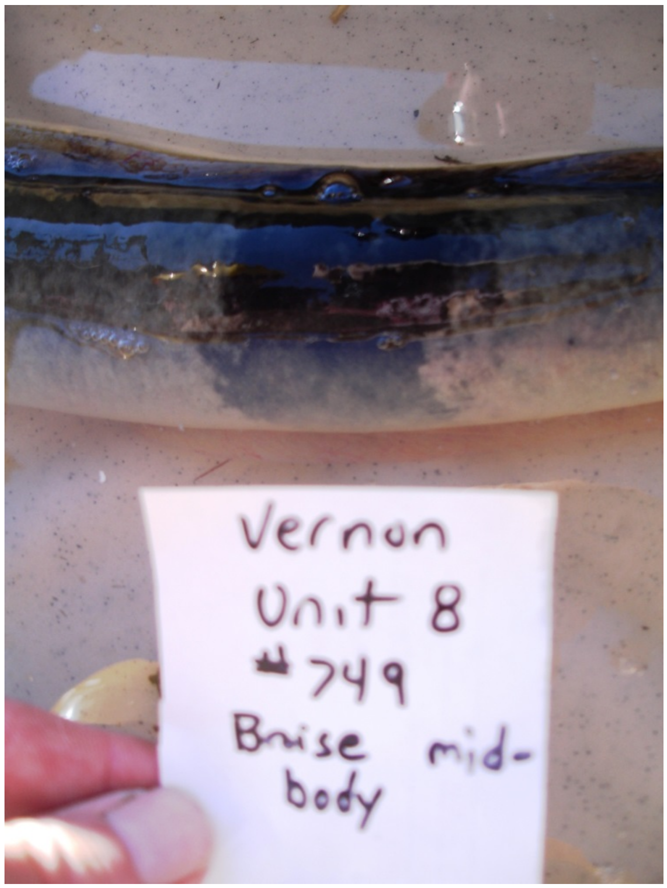



Figure 4.3.5-1. Eel with minor bruising after passing through Vernon Unit 8.

### 4.3.6 Assessment of Injuries

All recaptured eels, dead or alive, were examined for the type and extent of external injuries. Dead eels were also necropsied and examined for internal injuries when there were no apparent external injuries. Injuries were categorized by type, extent, and area of body. Eels without visible injuries that were not actively swimming or swimming erratically at recapture were classified as having "loss of equilibrium". This condition has been noted in most past HI-Z tag direct survival/injury studies and often disappears within 10 to 15 minutes after recapture if the eels are not injured. Visible injuries and loss of equilibrium (LOE) were categorized as minor or major. The criteria for this determination were based primarily on field staff's previous field observations (Tables 4.3.4-1 and 4.3.6-1).

A malady classification was established to include eels with visible injuries, and or LOE. Eels without maladies were designated "malady-free". The malady-free metric is established to provide a standard way to depict a specific passage route's effects on the condition of entrained eels (Normandeau and Skalski, 2005). The malady-free metric is based solely on eels physically recaptured and examined. Additionally, the malady-free metric in concert with site-specific hydraulic and physical data may provide insight into what passage conditions and locations provide safer eels passage.

Table 4.3.6-1. Guidelines for major and minor injury classifications for fish passage survival studies using the HI-Z Tags.

| |
|---|
| A fish with only Loss of Equilibrium (LOE) is classified as major if the fish dies within 1 hour. If it survives or dies beyond 1 hour it is classified as minor. |
| A fish with no visible external or internal maladies is classified as a passage related major injury if the fish dies within 1 hour. If it dies beyond 1 hour it is classified as a non-passage related minor injury. |
| Any minor injury that leads to death within 1 hour is classified as a major injury. If it lives or dies after 1 hour it remains a minor injury. |
| Hemorrhaged eye: minor if less than 50%. Major if 50% or more |
| Deformed pupil(s) are a: major injury. |
| Bulged eye: major unless one eye is only slightly bulged. Minor if slight. |
| Bruises are size-dependent. Major if 10% or more of fish body per side. Otherwise minor. |
| Inverted or bleeding gills or gill arches is major |
| Operculum tear at dorsal insertion is: major if it is 5 % of the fish or greater. Otherwise minor. |
| Operculum folded under or torn off is a major injury |
| Scale loss: major if 20% or more of fish per side. Otherwise minor |
| Scraping (damage to epidermis): major if 10% or more per side of fish. Otherwise minor. |
| Cuts and lacerations are generally classified as major injuries. Small flaps of skin or skinned up snouts are: minor. |
| Internal hemorrhage or rupture of kidney, heart or other internal organs that results in death at 1 to 48 hours is a major injury. |
| Multiple injuries: use the worst injury |

### 4.3.7 Survival and Malady-Free Estimation

In order to obtain the survival estimate comparable to other HI-Z tag direct survival studies and to follow the guidelines of the RSP, survival estimates were calculated for all eels (including classification 4 and 5 see Section 4.3.5) and also with only recaptured eels. All controls were combined from the three projects for the survival and injury analysis, the typical procedure unless there are differences in survival rates for control fish released at different locations for a given study.

The release and recapture data were analyzed by a likelihood ratio test to determine whether recapture probabilities were similar for dead ($P_D$) and alive ($P_A$) fish (Mathur *et al*. 1996). The statistic tested the null hypothesis of the simplified model (Ho: $P_A$=$P_D$) versus the alternative generalized model (Ha: $P_A \neq P_D$). The simplified model has three parameters (P, S, τ) with three minimum sufficient statistics ($a_c$, $a_T$, $d_T$) while the alternative generalized model (recapture probabilities of alive and dead fish are unequal) has four parameters ($P_A$, $P_D$, S, τ) and four minimum sufficient statistics ($a_c$, $a_T$, $d_{c,}$ $d_T$). If homogeneity ($P > 0.05$) was revealed by the chi-square test, turbine passage survival can be estimated by the simplified model with increased precision. Appendix B also provides the definition of terms, derivation of likelihood estimates, and assumptions of the likelihood model. The maximum likelihood estimators associated with the model are:

$$\hat{\tau} = \frac{a_T R_C}{R_T a_C}$$

$$\hat{S} = \frac{R_T d_C a_C - R_C d_T a_C}{R_C d_C a_T - R_C d_T a_C}$$

$$\hat{P}_A = \frac{d_C a_T - d_T a_C}{R_T d_C - R_C d_T}$$

$$\hat{P}_D = \frac{d_C a_T - d_T a_C}{R_C a_T - R_T a_C}$$

The variance (Var) and standard error (SE) of the estimated passage mortality ($1-\hat{\tau}$) or survival ($\hat{\tau}$) are:

$$Var(1-\hat{\tau}) = Var(\hat{\tau}) = \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_{A)}}{R_T} + \frac{(1-SP_A)\tau}{R_C}\right]$$

$$SE(1-\hat{\tau}) = SE(\hat{\tau}) = \sqrt{Var(1-\hat{\tau})}\ .$$

Separate survival probabilities (1 and 48 h) and malady-free rates and their associated standard errors were estimated using the likelihood model given in Mathur *et al*. (1996) and Normandeau Associates Inc. and Skalski 1998 (Appendix B). The formulas follow:

Direct Survival, 1 and 48 h

Where:

$$\hat{\tau}_i = \frac{a_{Ti} R_c}{R_{Ti} a_c},$$

$R_{Ti}$ = Number of eels released for the ith treatment condition (i = 1,..., 9);

$a_{Ti}$ = Number of eels alive for the ith treatment condition (i = 1,...,9);

$R_c$ = Number of control eels released;

$a_c$ = Number of control eels alive;

Malady-Free (MF) Eels

Where:

$$MF_i = \frac{c_{Ti} R_c}{R_{Ti} c_c},$$

$C_{Ti}$ = Total number of eels without maladies for treatment i (i = 1,...,9);

$R_{Ti}$ = Number of eels recovered that were examined for maladies for treatment i

(i = 1,...,9);

$C_c$ = Number of control eels recovered without maladies;

$R_c$ = Number of control eels recovered that were examined for maladies.

Eels that were still alive at 48 h but had injuries that would eventually lead to death or prevent them from migrating to the ocean (e.g., tail severed, multiple backbone fractures) were considered functionally dead when calculating the 48 h survival estimates (Figure 4.3.7-1).

Figure 4.3.7-1. American Eel considered functionally dead. Eel was alive at 48 hours, but had a completely severed tail.

### 4.3.8 Assignment of Probable Sources of Injury

Limited controlled experiments (Neitzel *et al.,* 2000; Pacific Northwest National Laboratory *et al.,* 2001) to replicate and correlate each injury type/characteristic to a specific causative mechanism provide some indication of the cause of observed injuries in the field. However, these experiments were conducted primarily on salmonids and not eels. Some injury symptoms can be manifested by two different sources that may lessen the probability of accurate delineation of a cause and effect relationship (Eicher Associates, 1987). Only probable causal mechanisms of injury were assigned for this study.

Some injuries (e.g., sliced bodies) may be assigned to a specific causative source with greater certainty (Normandeau Associates *et al*., 1995). Injuries likely to be associated with direct contact with turbine runner blades or structural components are classified as mechanical and include: bruise, laceration, and severance of the eel's body (Figure 4.3.8-1) (Dadswell *et al*., 1986; Eicher Associates, 1987; Normandeau, 2010; 2011a; 2011b). Passage through gaps between the runner blades and the hub or at the blade tips may result in pinched bodies (Normandeau Associates *et al*., 1995). Contact with the turbine structural components may result in bruising. Injuries likely to be attributed to shear forces for salmonids are decapitation, torn or flared opercula, and hemorrhaged eyes (Dadswell *et al*., 1986). However, shear induced injuries in eels are not well documented. The probable pressure-related effects are manifested as hemorrhaged internal organs;

and emboli in fins. Pressure related forces can also cause bulging and hemorrhaged eyes. Statistical analyses are provided in Appendix B; daily tag-recapture data in Appendix C; and daily injury data in Appendix D.


Figure 4.3.8-1. American Eel with severed body after passing through Vernon Unit 8 (1,000 cfs).

## 4.4 Methods Specific to Each Project

### 4.4.1 Wilder

Eels were transported in a tank by truck from a holding tank at Vernon and delivered to a holding tank with a capacity of approximately 900 gal. The tank was located upstream on the head works of the Wilder facility to hold the eels prior to testing. An additional similarly sized tank was located adjacent to this tank to hold the eels after testing runs. Only eels in good physical condition were used for this study. A continual supply of ambient river water was supplied to each tank and all eels were held for a minimum of 12-24 h prior to tagging which allowed eels time to recover from transport and handling stress.

Treatment eels were released through Kaplan Unit 2 and Francis Unit 3 (minimum flow unit) approximately 5 ft below the ceiling of the turbine intake. Unit 2 eels were released through a head gate slot and Unit 3 through a vent pipe (Figure 4.3.3-4). Testing at Unit 3 was curtailed after the release of 10 eels when it was determined that most of the discharge from this unit was directed into the fishway and the features within the fishway prevented the recapture of seven of the ten eels. After consultation with TransCanada personnel, it was deemed that the present egress pattern at Unit 3 would not permit the determination of reliable survival/injury estimates. The aquatics working group was notified of this study plan variance on November 13, 2015. The 50 treatment eels released to Unit 2 ranged in length from 710 to 1,005 mm, with an average of 821 mm. The 39 combined control eels released at Wilder, Bellows Falls, and Vernon ranged in length from 660 to 880 mm, with an average of 798 mm (Figure 4.4.1-1).

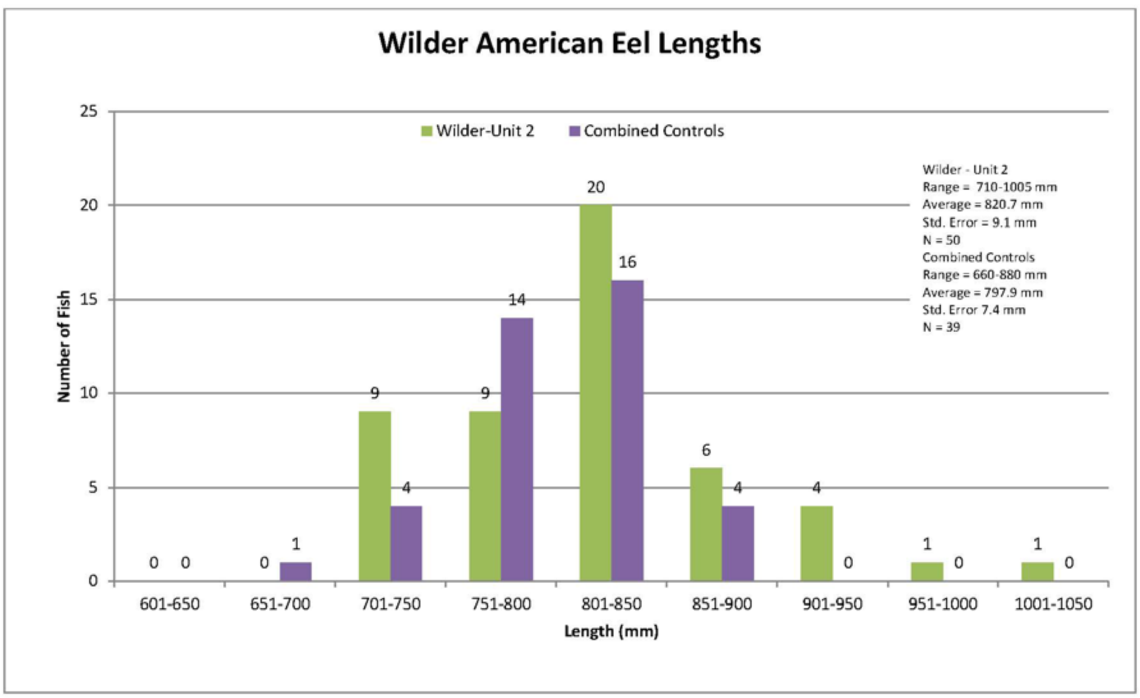



Figure 4.4.1-1. Length frequency for HI-Z tagged adult American Eels released at Wilder Station. Combined controls released at the three projects.

#### 4.4.2 Bellows Falls

Eels were transported in a 100-gal tank by truck from Vernon and delivered to Bellows Falls the day of the test. The eels were taken directly from the transport truck to the tagging site throughout the day as needed. The transport/holding tank was supplied with aeration. A holding tank with a capacity of approximately 900 gal was located on the downstream side of the power house to hold the eels for the 48h delayed assessment period. This tank was continuously supplied with ambient river water. The 50 treatment eels released ranged in length from 680 to 995 mm, with an average of 816 mm (Figure 4.4.2-1).

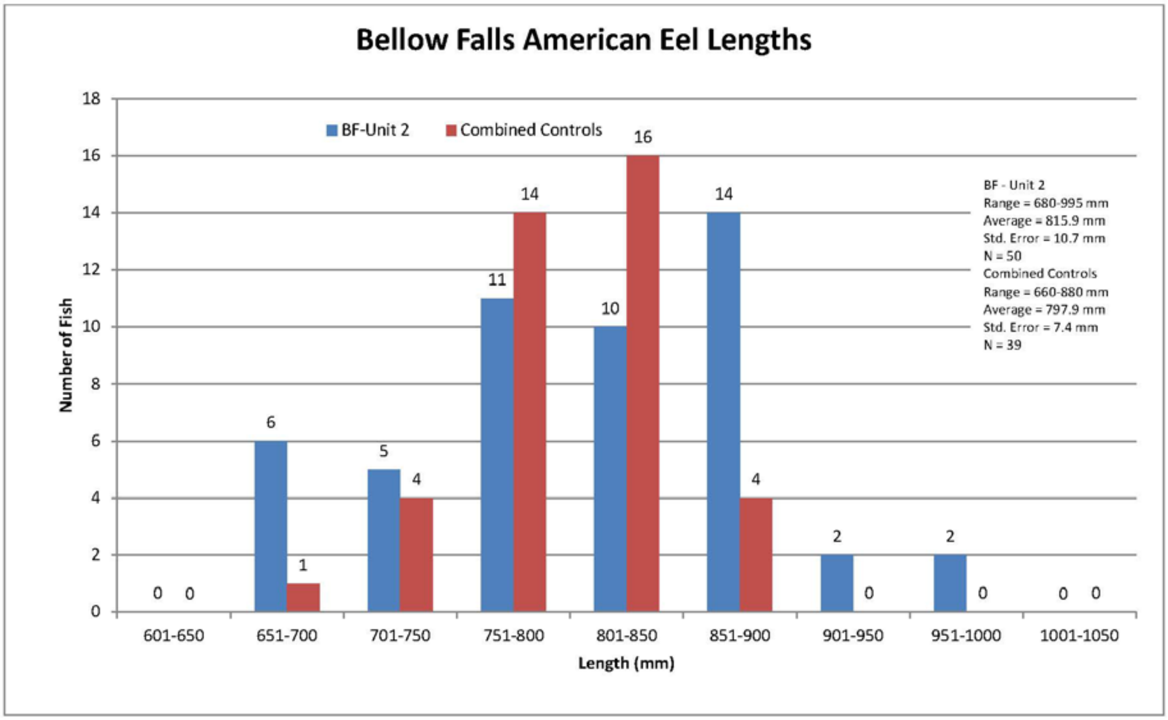



Figure 4.4.2-1. Length frequency for HI-Z tagged adult American Eels released at Bellows Falls Station. Combined controls released at the three projects.

#### 4.4.3 Vernon

Eels were stocked in two approximately 900 gal holding tanks at Vernon. Details on the source of the eels and method of transport are described in Section 4.1. The eels tested at Wilder and Bellow Falls were subsequently removed from these two tanks at Vernon. The tanks were located upstream near the head works of the facility to hold the eels prior to testing. Two additional tanks were located on the tailrace deck to hold eels for the 48h delayed assessment after turbine passage. A continual supply of ambient river water was supplied to each tank and all eels were held for a minimum of 12-24 h prior to tagging.

The 48 h treatment eels released through Unit 4 ranged in length from 700 to 960 mm, with an average of 818 mm. At Unit 8 discharging 1,000 cfs, 48 treatment eels were released and ranged in length from 680 to 1,040 mm with an average of

813 mm. At Unit 8 discharging 1,700 cfs, 50 treatment eels were released and ranged in length from 700 to 950 mm with an average of 795 mm. The 48 treatment eels released through Unit 9 ranged in length from 650 to 930 mm, with an average of 796 mm (Figure 4.4.3-1).

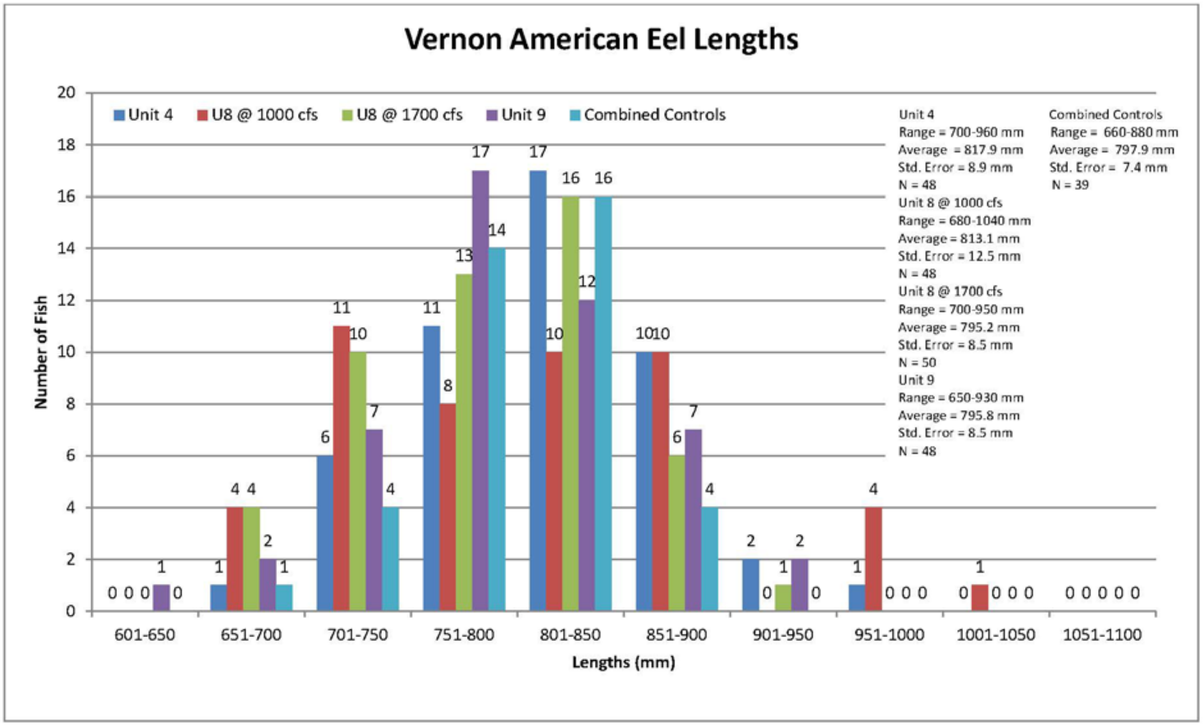



Figure 4.4.3-1. Length frequency for HI-Z tagged adult American Eels released at Vernon Station. Combined controls released at the three projects.

# 5.0 RESULTS AND DISCUSSION

## 5.1 Route Selection and Residency

A total of 170 silver eels were surgically implanted with radio-tags and released upstream of Wilder, Bellows Falls, and Vernon dams on five occasions during a ten-day period between October 27 and November 5, 2015 (Table 5.1-1). Fish were tagged and released in groups of ten and released approximately three miles upstream of each project (0.4 miles upstream of Ledyard Free Bridge in Norwich, VT; Herricks Cove Park, Rockingham, VT; Depot Street Bridge in Bellows Falls, VT; and Riverside industrial complex, Brattleboro, VT).

Table 5.1-1. Summary of eel tagging and releases, fall 2015.

| | Release Groups | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | October 27 | | October 29 | | October 31 | | November 3 | | November 5 | |
| | Tag Freq. | No. | Tag Freq. | No. | Tag Freq. | No. | Tag Freq. | No. | Tag Freq. | No. |
| **Vernon** | 150.340 | 3 | 150.340 | 4 | 150.340 | 3 | 150.340 | 4 | 150.340 | 3 |
| | 150.360 | 4 | 150.360 | 3 | 150.360 | 3 | 150.360 | 3 | 150.360 | 3 |
| | 150.380 | 3 | 150.380 | 3 | 150.380 | 4 | 150.380 | 3 | 150.380 | 4 |
| **Bellows Falls** | 150.340 | 4 | 150.340 | 3 | 150.340 | 4 | 150.340 | 4 | 150.340 | 3 |
| | 150.360 | 3 | 150.360 | 4 | 150.360 | 3 | 150.360 | 2 | 150.360 | 4 |
| | 150.380 | 3 | 150.380 | 3 | 150.380 | 3 | 150.380 | 4 | 150.380 | 3 |
| **Wilder** | 150.340 | 3 | 150.340 | 3 | 150.340 | 3 | 150.340 | 4 | 150.340 | 4 |
| | 150.360 | 3 | 150.360 | 3 | 150.360 | 4 | 150.360 | 3 | 150.360 | 3 |
| | 150.380 | 4 | 150.380 | 4 | 150.380 | 3 | 150.380 | 3 | 150.380 | 3 |
| **TOTAL** | | **30** | | **30** | | **30** | | **30** | | **30** |
| **Bellows Falls Power Canal** | | | 150.340 | 3 | 150.340 | 3 | | | | |
| | | | 150.360 | 3 | 150.360 | 3 | | | | |
| | | | 150.380 | 4 | 150.380 | 4 | | | | |
| **TOTAL** | | | | **10** | | **10** | | | | |
| **N=170** | | | | | | | | | | |

### 5.1.1 Wilder

Fifty radio-tagged eels were released in the Wilder impoundment. Of these, 45 passed through the Wilder project. Three of the five remaining eels moved to the Wilder forebay. Only one eel was never detected again past release. The dominate route of passage was Wilder Units 1 and 2 where 32 eels (71.1% of all passed) used these routes. Ten eels (22.2%) used Unit 3 for downstream passage. Three eels (6.7%) used the trash/ice sluice for passage (Table 5.1.1-1). The sluice had been opened seasonally on November 3, two days prior to passage by the three eels that used that route.

Table 5.1.1-1. Eel passage routes at Wilder, 2015.

| Passage Route | No. | % of all passed | % of all released |
|---|---|---|---|
| Turbine Units 1-2 | 32 | 71.1% | 64.0% |
| Turbine Unit 3 | 10 | 22.2% | 20.0% |
| Trash/ice sluice | 3 | 6.7% | 6.0% |
| **Total Passed** | **45** | **100.0%** | **90.0%** |
| Did not pass | 5 | | 10.0% |
| **Total Released** | **50** | | **100.0%** |

Travel time of each tagged fish from the release site to downstream sites was calculated as the time interval between release time and first detection at the Wilder monitoring sites. Residency in the vicinity of Wilder was calculated from first detection and last detection within the immediate Wilder monitoring zone.

Fish with a single detection at the station were assigned a residency time of ≤ 1 minute. Following release, travel time from the release point to initial detection at Wilder ranged from 1 hour, 39 minutes to 8 days, 2 hours, 31 minutes (median = 1d, 47m). Residency ranged from 2 minutes to 1 day, 15 hours, 58 minutes (median = 13m) (Table 5.1.1-2).

Table 5.1.1-2. Eel travel and residency times, Wilder, 2015.

| Release Group | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| W1 | Min | 00:02:21 | | Min | 00:00:05 |
| | Max | 04:01:22 | | Max | 00:07:31 |
| | Average | 01:10:21 | | Average | 00:01:13 |
| | Median | 01:00:09 | | Median | 00:00:19 |
| W2 | Min | 00:02:32 | | Min | 00:00:06 |
| | Max | 08:02:31 | | Max | 00:19:57 |
| | Average | 01:10:05 | | Average | 00:05:23 |
| | Median | 00:14:45 | | Median | 00:00:14 |
| W3 | Min | 00:01:39 | | Min | 00:00:07 |
| | Max | 01:01:36 | | Max | 00:20:14 |
| | Average | 00:11:15 | | Average | 00:05:41 |
| | Median | 00:03:33 | | Median | 00:00:13 |
| W4 | Min | 00:04:05 | | Min | 00:00:02 |
| | Max | 03:06:26 | | Max | 00:06:04 |
| | Average | 02:06:17 | | Average | 00:01:03 |
| | Median | 03:02:15 | | Median | 00:00:09 |
| W5 | Min | 00:03:06 | | Min | 00:00:03 |
| | Max | 07:10:47 | | Max | 01:15:36 |
| | Average | 01:20:47 | | Average | 00:05:48 |
| | Median | 01:01:28 | | Median | 00:00:07 |
| **All Wilder Fish Combined** | | | | | |
| | Min | 00:01:39 | | Min | 00:00:02 |
| | Max | 08:02:31 | | Max | 01:15:36 |
| | Average | 01:11:36 | | Average | 00:03:58 |
| | Median | 01:01:06 | | Median | 00:00:13 |

Water temperatures during passage over the course of the study ranged from 8.99°C to 10.26°C. Of the 45 passage eels 48.9% (N=22) passed Wilder dam at temperatures between 9.8°C and 10.2°C (Figure 5.1.1-1). The flow at Wilder varied during eel passage. Eels passed Wilder from approximate minimum flow (746 cfs) up to 9,834 cfs. However, 57.7% (N=26) eels passed at flows between 9,000 and 10,000 cfs (Figure 5.1.1-2). The most common time of passage occurred during the 20:00 h (N=11) and the 21:00 h (N=11). This was followed closely by the 19:00 h (N=9). Reviewing all passages hourly 68.9% (N=31) of fish passed through the Wilder project between 19:00 and 21:00 h (Figure 5.1.1-3).

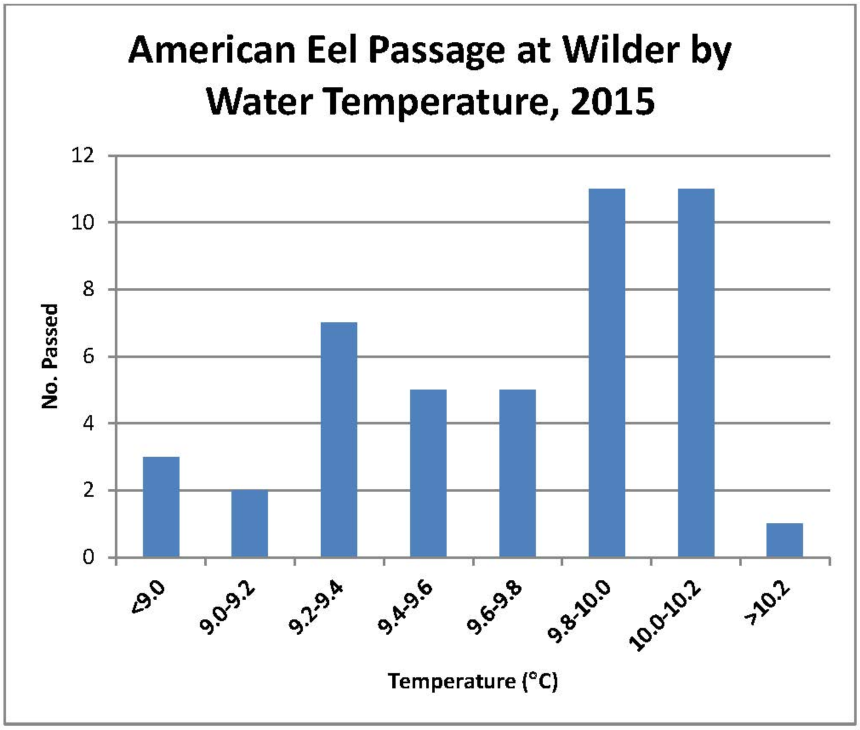



Figure 5.1.1-1. American Eel passage at Wilder by water temperature, 2015.

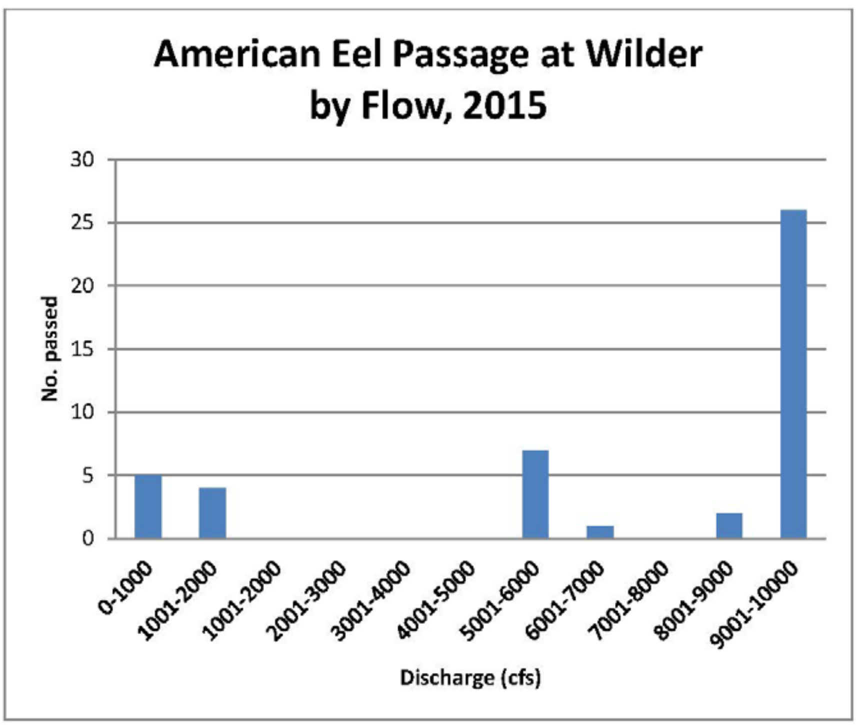



Figure 5.1.1-2. American Eel passage at Wilder by project discharge flow, 2015.

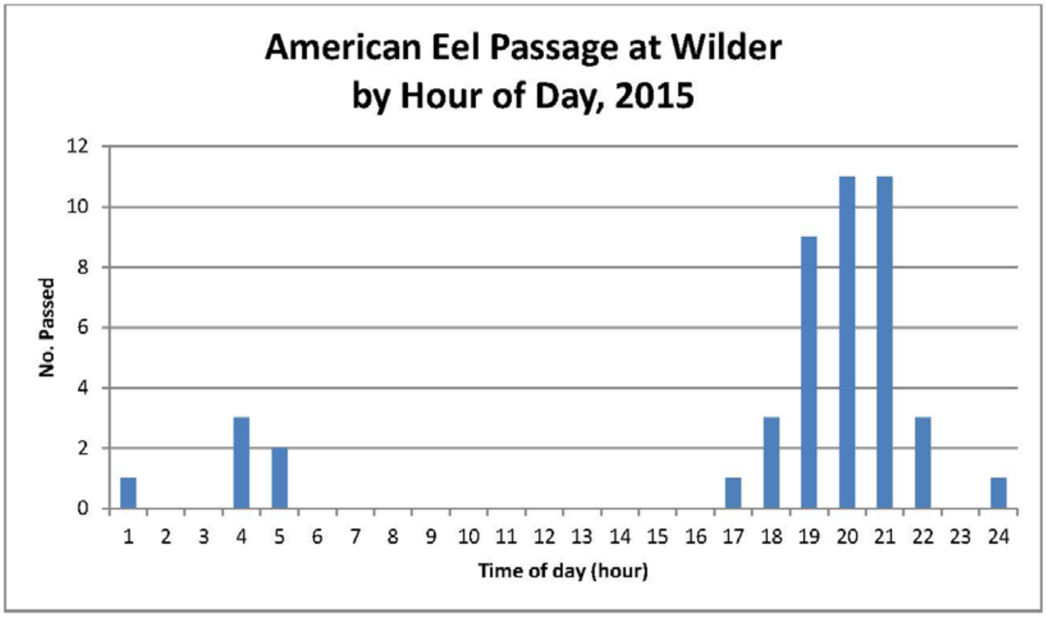



Figure 5.1.1-3. American Eel passage at Wilder by hour of day, 2015.

The proportion of flow through each passage route was calculated by dividing the passage route flow at the time of passage by the total discharge from the project at that time. The prominent route of passage was through Units 1 and 2 (71.1%). Flow through those units during the time of eel passage ranged from almost 0 to 9,018 cfs. The average proportional flow through Units 1 and 2 during the time of eel passage was 99.8% of total project discharge. Flow through Unit 3 ranged from 696 to 747 cfs. The average proportional flow through Unit 3 during the time of eel passage was 10.2%. Flow through the Wilder trash/ice sluice during the time of eel passage ranged from 410 to 694 cfs and the average proportional flow during the time of eel passage was 7.2% (Table 5.1.1-3).

Table 5.1.1-3. Flow range and proportion of flow by route at Wilder, 2015.

| | **Units 1-2** | **Unit 3** | **Trash / Ice Sluice** |
|---|---|---|---|
| Number passed by route | 32 | 10 | 3 |
| Percent passed by route | 71.1% | 22.2% | 6.7% |
| Flows by route of passage (cfs) | 0 – 9,018 | 696 -747 | 410 - 694 |
| Flow proportions by route of passage (total project discharge cfs) | 1% - 91.7% | 7.6% - 93.2% | 7.1% - 54.9% |
| Average proportional flow | 99.9% | 10.2% | 7.2% |

Based on analysis of telemetry data and detections at radio receivers, six (13.3%) of the successfully passed (N=45) eels released in the Wilder impoundment exhibited some wandering or potential searching behavior within the trash/ice sluice and the forebay boat barrier prior to passage (example shown in Figure 5.1.1-4). These eels made more than one attempt at entering and exiting the forebay before locating a passage route. The remaining 39 eels (86.7%) passed without the wandering type of movement patterns that may signify searching. Appendix E includes maps for all successfully passed eels. It should be noted that approach paths are generalized based on detection through the receiver detection zone only, and not necessarily exact location of approach path (e.g., river right, left, or center.

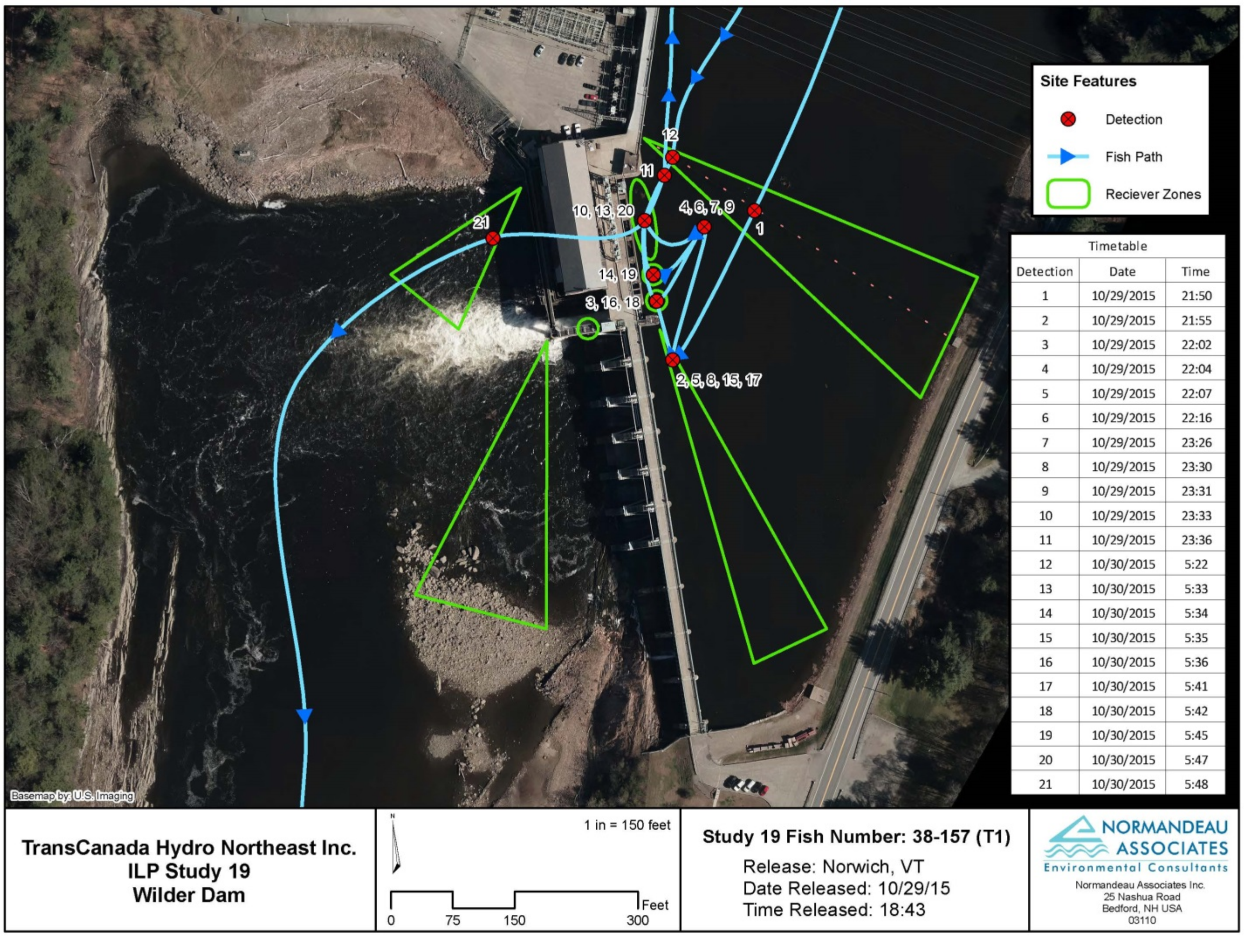



Figure 5.1.1-4. Example map showing eel wandering pattern prior to passage at Wilder, 2015.

### 5.1.2 Bellows Falls

Fifty radio-tagged adult eels were released into the Bellows Falls impoundment. Of these, 90% (N=45) passed through the Bellows Falls project. Of the five eels that never passed the project, three were still detected within the study area, however, passage was unconfirmed. One eel was detected during a manual track flight, and one was never detected after its release. Of the 45 available eels 82.2% (N=37) emigrated through Bellows Falls turbine Units 1 - 3. Five used the trash/ice sluice (11.1%) and 3 (6.6%) were detected going through the Bellows Falls spillway into the bypassed reach. Two of the three eels that used the spillway did not pass during a spill event and it is suspected that leakage at the dam may be sufficient for emigrating eels to navigate. No eels used the fishway as an emigration route.

Twenty radio-tagged eels were released into the Bellows Falls power canal during spill events. Two groups of ten eels were released during the 2nd release and the 3rd release. All of these eels emigrated downstream through the Bellows Falls project. Ninety five percent (N=19) of eels released into the power canal passed via turbine Units 1 – 3 and one eel (5%) used the trash/ice sluice.

An additional 28 fish emigrated from Wilder into the Bellows Falls study area. Of these, 20 (71.4%) used the turbines. Six (21.4%) used the trash/ice sluice and two (7.1%) used the spillway during leakage flows rather than active spill. Analysis of overall eel passage (N=93) through the project indicated that 76 (81.7%) fish emigrated using the turbines. Twelve (12.9%) eels used the trash/ice sluice and 5 (5.4%) used the spillway. The trash/ice sluice was opened seasonally on November 2, and 10 of the 12 fish passed via that route when it was operating. There may have been enough leakage flow (not registered in flow monitoring data) to allow passage prior to that date. Table 5.1.2-1 summarizes passage routes for all eels within the Bellows Falls study area.

Table 5.1.2-1. Passage routes for all eels approaching the Bellows Falls project (from Wilder and Bellows Falls release groups), 2015.

| Passage Route | No. | % of all passed | % of all released |
|---|---|---|---|
| **Bellows Falls Impoundment and Canal Released Fish** | | | |
| Turbine Units 1-3 | 56 | 86.2% | 80.0% |
| Trash/ice sluice | 3 | 4.6% | 4.3% |
| Dam spillway | 6 | 9.2% | 8.6% |
| Total Passed | **65** | **100.0%** | **100.0%** |
| Did not pass | 5 | | 7.1% |
| **Total Released** | **70** | | **100.0%** |
| **Combined Wilder and Bellows Falls Released Fish** | | | |
| Turbine Units 1-3 | 76 | 81.7% | 77.6% |
| Trash/ice sluice | 12 | 12.9% | 12.2% |
| Dam spillway | 5 | 5.4% | 5.1% |
| **Total Passed** | **93** | **100.0%** | **94.9%** |
| Did not pass | 5 | | 5.1% |
| **Total Released** | **98** | | **100.0%** |

Travel time of each tagged fish from the release site to the project was calculated as the time interval between release time and first detection at the Bellows Falls monitoring sites. Residency time in the vicinity of Bellows Falls was calculated as the time interval from first detection and last detection within the immediate Bellows Falls monitoring zones (Tables 5.1.2-2 through 5.1.2-4). Fish with a single detection were assigned a residency time of ≤ 1 minute.

Following release into the impoundment, travel times from the Bellows Falls release point at Herricks Cove, VT to initial detection at Bellows Falls ranged from 41 minutes to 36 days, 3 hours, 13 minutes (median = 1d, 2h, 50m). Residency time ranged from 4 minutes to 46 days, 15 hours, 44 minutes (median = 38 m) (Table 5.1.2-2).

Table 5.1.2-2. Eel travel and residency times at Bellows Falls, 2015.

| **Release Group** | **Travel Time (dd:hh:mm)** | | | **Residency (dd:hh:mm)** | |
|---|---|---|---|---|---|
| BF1 | Min | 00:00:41 | | Min | 00:00:23 |
| | Max | 05:07:36 | | Max | 01:07:59 |
| | Average | 01:20:57 | | Average | 00:08:05 |
| | Median | 01:13:42 | | Median | 00:01:01 |
| BF2 | Min | 00:02:06 | | Min | 00:00:05 |
| | Max | 10:04:14 | | Max | 00:22:35 |
| | Average | 01:07:57 | | Average | 00:02:41 |
| | Median | 00:03:52 | | Median | 00:00:28 |
| BF3 | Min | 00:01:57 | | Min | 00:00:22 |
| | Max | 09:07:01 | | Max | 00:18:42 |
| | Average | 01:23:49 | | Average | 00:02:33 |
| | Median | 00:18:01 | | Median | 00:00:31 |
| BF4 | Min | 00:03:44 | | Min | 00:00:04 |
| | Max | 17:23:22 | | Max | 15:15:44 |
| | Average | 03:09:42 | | Average | 05:03:57 |
| | Median | 02:06:57 | | Median | 00:00:54 |
| BF5 | Min | 00:03:24 | | Min | 00:00:24 |
| | Max | 36:03:13 | | Max | 12:19:36 |
| | Average | 6:06:25 | | Average | 01:14:20 |
| | Median | 1:05:22 | | Median | 00:01:22 |
| **All Impoundment Released Fish Combined** | | | | | |
| | Min | 00:00:41 | | Min | 00:00:04 |
| | Max | 36:03:13 | | Max | 46:15:44 |
| | Average | 02:07:08 | | Average | 28:20:03 |
| | Median | 01:02:50 | | Median | 00:00:38 |

For eels released into the power canal, travel times ranged from 4 minutes to 1 day, 23 hours, 40 minutes (median = 1h, 10m). Residency for canal released eels ranged from virtually zero in most cases to 10 days, 5 hours, 34 minutes (median = 0m) (Table 5.1.2-3). For eels arriving from Wilder, travel times from initial release above Wilder to detection in the Bellows Falls study area ranged from 2 days, 50 minutes to 20 days, 15 hours, 34 minutes (median = 3d, 7h). Residency within the Bellows Falls study area for Wilder eels ranged from 7 minutes to 1 day, 14 hours, 59 minutes (median = 36m) (Table 5.1.2-4).

Table 5.1.2-3. Canal released eel travel and residency times at Bellows Falls, 2015.

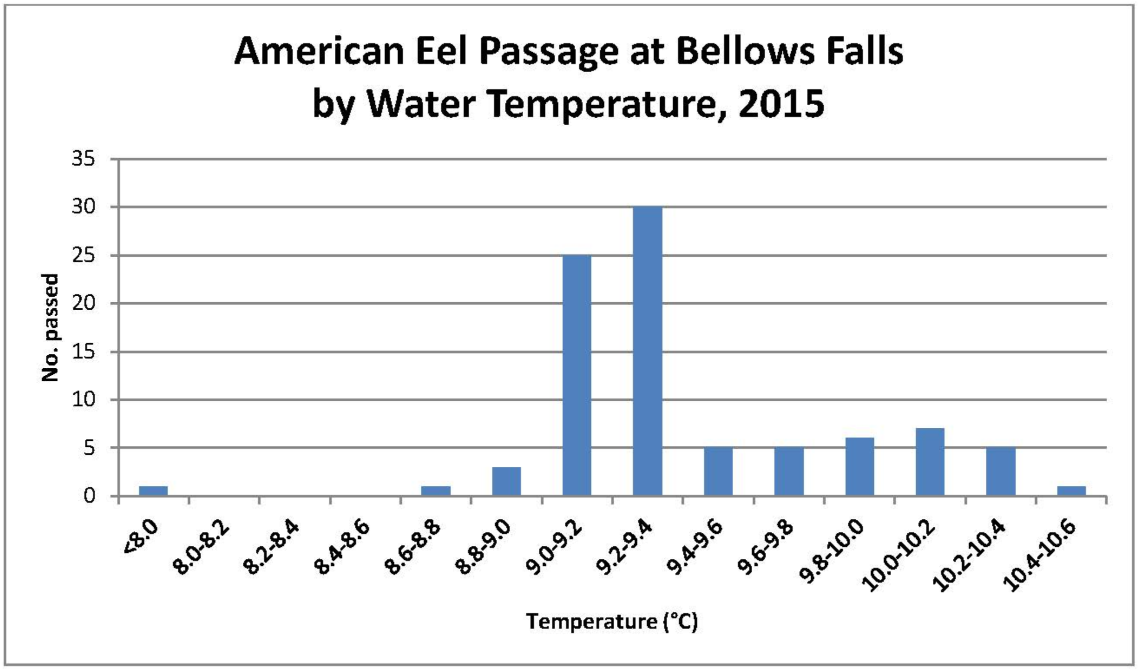
| Release Group | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| BFC2 (canal) | Min | 00:00:08 | | Min | 00:00:00 |
| | Max | 00:02:59 | | Max | 00:22:49 |
| | Average | 00:01:16 | | Average | 00:02:40 |
| | Median | 00:01:03 | | Median | 00:00:00 |
| BFC3 (canal) | Min | 00:00:04 | | Min | 00:00:00 |
| | Max | 01:23:40 | | Max | 10:05:34 |
| | Average | 00:09:16 | | Average | 01:18:41 |
| | Median | 00:01:44 | | Median | 00:00:00 |
| **All Canal Released Fish Combined** | | | | | |
| | Min | 00:00:04 | | Min | 00:00:00 |
| | Max | 01:23:40 | | Max | 10:05:34 |
| | Average | 00:05:29 | | Average | 00:23:44 |
| | Median | 00:01:10 | | Median | 00:00:00 |

Table 5.1.2-4. Wilder released eel travel and residency times at Bellows Falls, 2015.

| | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| | Min | 02:00:50 | | Min | 00:00:07 |
| | Max | 20:15:34 | | Max | 01:14:59 |
| | Average | 04:14:58 | | Average | 00:03:22 |
| | Median | 03:07:00 | | Median | 00:00:36 |

Water temperatures during passage over the course of the study ranged from 7.8°C to 10.4°C. Of the 93 passage eels, temperature data was available for 89 and of those 59.1% (N=55) passed at temperatures between 9.0 and 9.4°C (Figure 5.1.2-1). Bellows Falls station discharge varied during eel passage. Eels passed Bellows Falls from approximate minimum flow (1,446 cfs) up to 15,088 cfs (i.e., during spill). Overall, 55.9% (N=52) eels passed at flows between 10,001 and 12,000 cfs

(Figure 5.1.2-2). The most common time of passage occurred during the 19:00 h (N=15) and the 21:00 h (N=15). Reviewing all passages hourly, nearly 71% (N=66) of fish passed through the project between 19:00 and 23:00 h (Figure 5.1.2-3).




Note: Temperature data was not available for passage of 4 fish.

Figure 5.1.2-1. American Eel passage at Bellows Falls by water temperature, 2015.

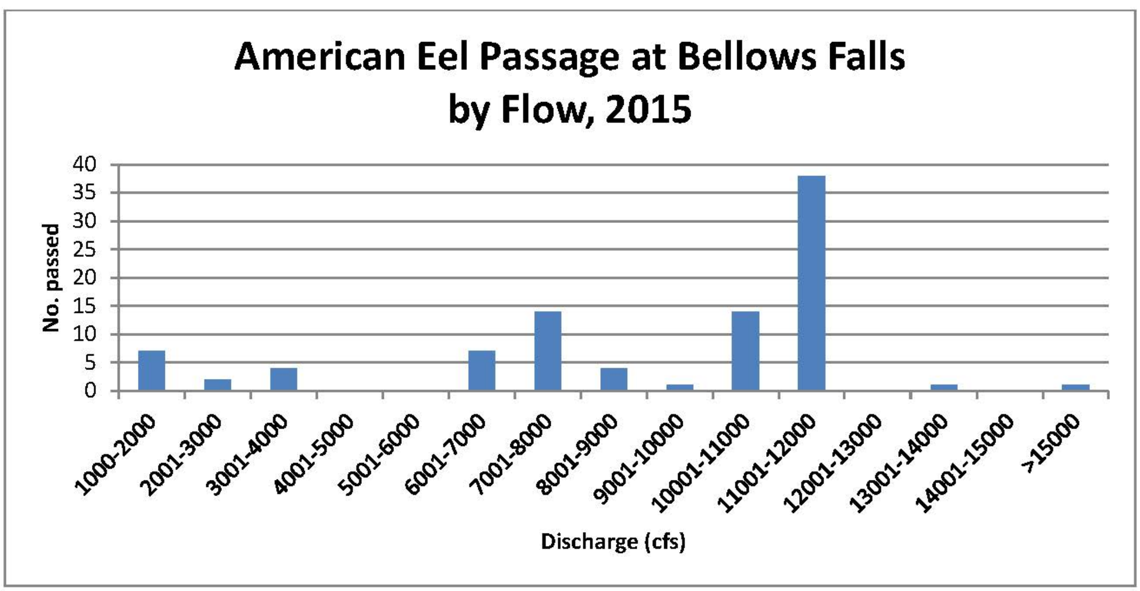



Figure 5.1.2-2. American Eel passage at Bellows Falls by project discharge flow, 2015.

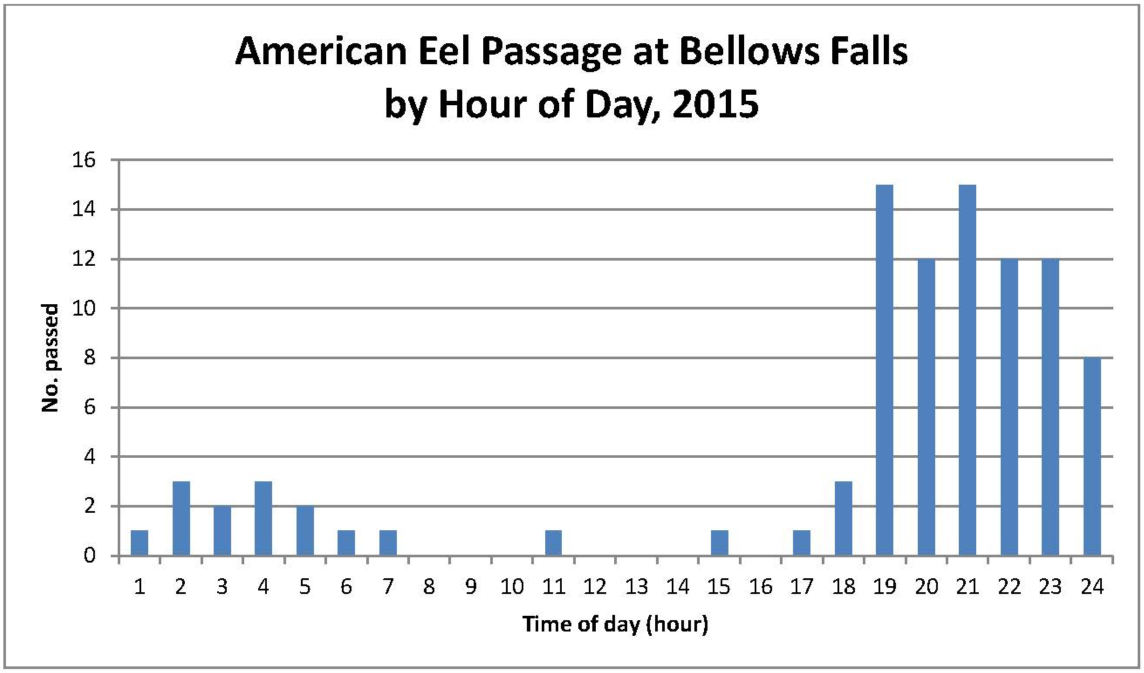



Figure 5.1.2-3. American Eel passage at Bellows Falls by hour of day, 2015.

The proportion of flow through each passage route was calculated by dividing the passage route flow at the time of passage by the total discharge from the project at that time. The prominent route of passage was through turbine Units 1-3 (81.7%). Flow through those units during the time of eel passage ranged from 1,380 to 11,185 cfs. The average proportional flow through the units during the time of eel passage was 97.5%. Flows through the trash/ice sluice during the time of eel passage ranged from 0 to 166 cfs and the average proportional flow was 1.4%. Flow through the spillway during the time of eel passage ranged from approximately 125 cfs (leakage flow) to 2,594 cfs, including leakage (Table 5.1.2-5). Only one eel passed via the spillway during active spill from the dam.

Table 5.1.2-5. Flow range and proportion of flow by route at Bellows Falls, 2015.

| | Units 1-3 | Trash / Ice Sluice | Spillway |
|---|---|---|---|
| Number passed by route | 76 | 12 | 5 |
| Percent passed by route | 81.7% | 12.9% | 5.4% |
| Flows by route of passage (cfs) | 1,380 - 11,185 | 0 - 166 | Leakage – 2,594 |
| Flow proportions by route of passage (total project discharge cfs) | 86.5% - 98.7% | 0% -10.0% | 1.1% - 26.8% |
| Average proportional flow | 97.5% | 1.4% | 10.1% |

Based on analysis of telemetry data and detections at radio receivers, five of the 65 successfully passed eels (7.7%) exhibited some wandering or potential searching behavior prior to passage and the remaining successfully passed eels (92.3%) did not exhibit such behavior. One eel (1.5%) made only two apparent attempts at locating a downstream passage route within the project forebay. Additional searching behavior was found from the TransCanada boat house located on Pine Street (North Walpole, NH) to the mouth of the Bellows Falls Power Canal. Four eels (6.2%) displayed wandering or searching behavior when within that area, and entered and exited the area more than once in an attempt to locate an emigration route. Three of these located a passage route within the Bellows Fall forebay (example shown in Figure 5.1.2-4). The remaining eel located a passage route within the spillway at the dam (Figure 5.1.2-5). Appendix E includes maps for all successfully passed eels. It should be noted that approach paths are generalized based on detection through the receiver detection zone only, and not necessarily exact location of approach path (e.g., river right, left, or center.

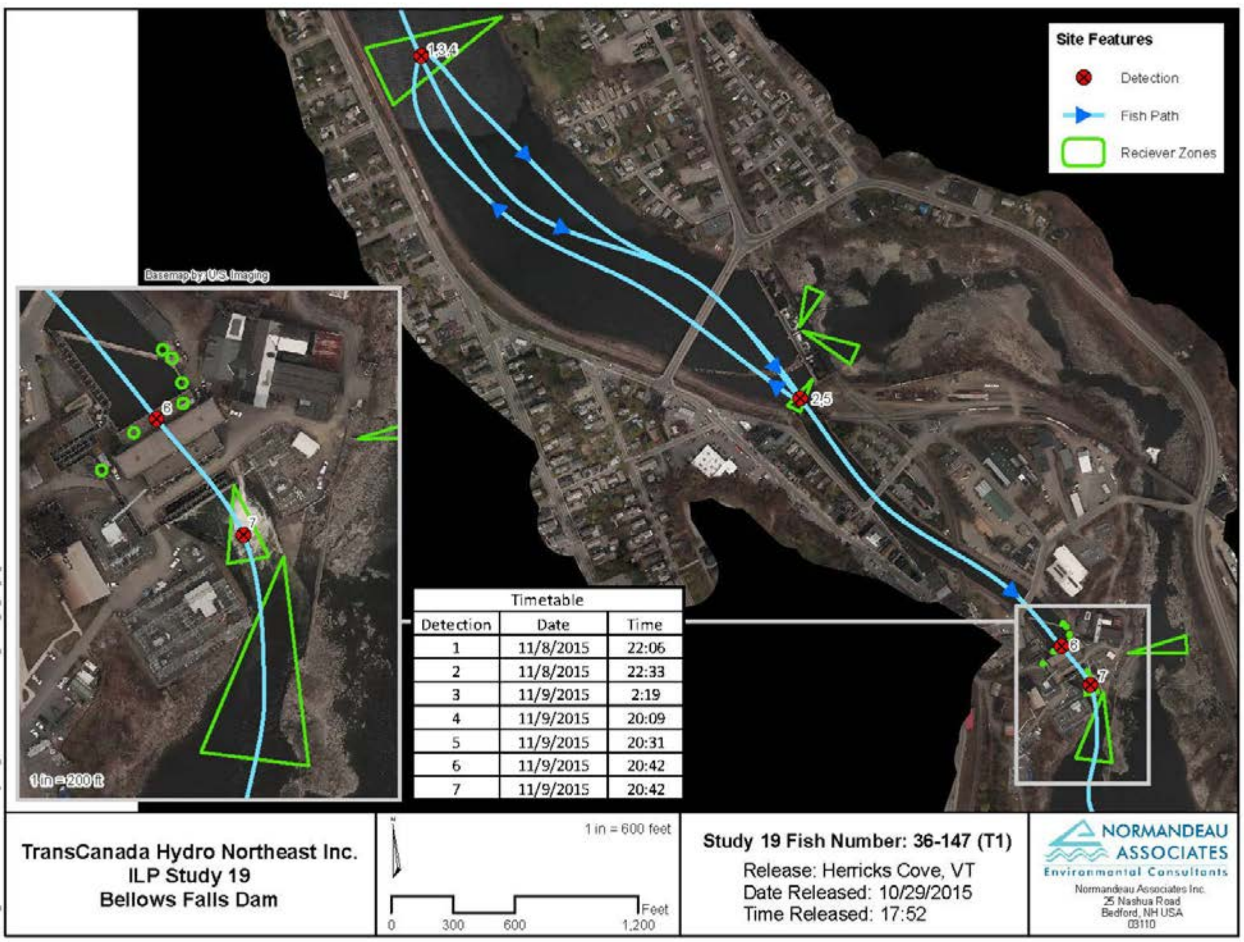



Figure 5.1.2-4. Example map showing eel wandering pattern prior to passage at Bellows Falls, 2015.

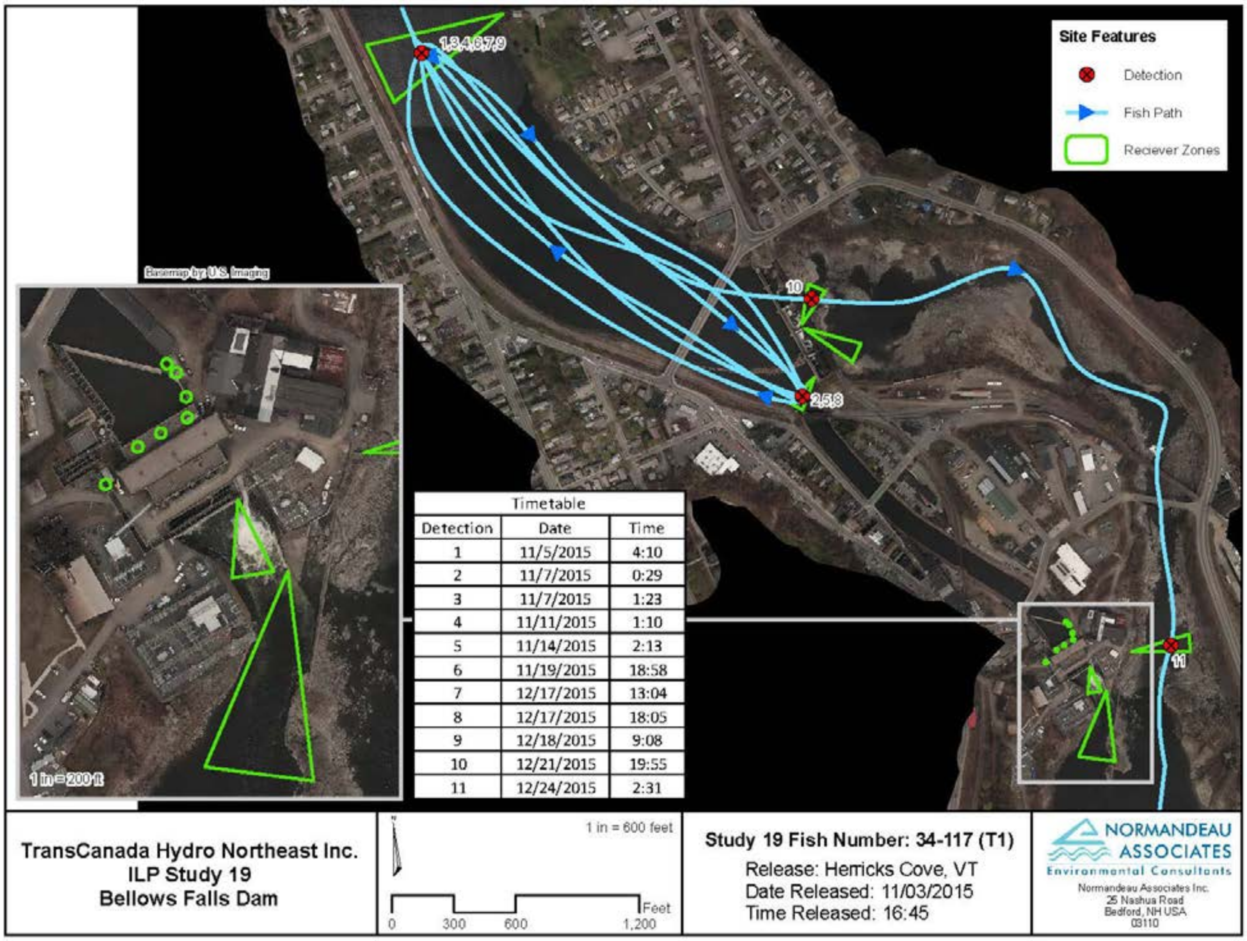



Figure 5.1.2-5. Example map showing eel wandering pattern prior to passage via the spillway at Bellow Falls, 2015.

### 5.1.3 Vernon

Fifty radio-tagged adult eels were released into the Vernon impoundment. Of these, 88% (N=44) passed through the Vernon project. Six eels never passed the project and of these, one was detected within the study area, however, passage was unconfirmed. Of the 44 available eels 52.3% (N=23) emigrated through Vernon turbine Units 5 - 8. Eleven used Units 9 and 10 (25%). Four used the fish pipe (9.1%). Three (6.8%) used Units 1 - 4. One (2.3%) eel was detected at each of the fish tube, trash/ice sluice, and fishway.

Of the 70 radio-tagged eels released into the Bellows Falls impoundment and power canal, 65 emigrated downstream through the Bellows Falls project. Of these, 44 were detected in the Vernon study area and passed the Vernon project. Twenty (45.4%) of the Bellows Falls eels passed through Vernon Units 5 - 8. Thirteen (29.5%) used Units 9 and 10. Nine (20.4%) eels used the fish pipe and two eels used Units 1 - 4.

Of the 28 eels released above Wilder and detected in the Bellows Falls study area, 24 (85.7%) were detected in the Vernon study area. Eight (33.3%) used the Vernon fish pipe. Seven (29.1%) used Units 9 and 10. Five (20.8%) used Units 5 - 8. Two (8.3%) were detected at the trash/ice sluice and 2 (8.3%) were detected at Units 1 - 4. Analysis of overall eel passage (N=112) through the Vernon project indicated that 48 (42.9%) fish emigrated via Units 5 - 8. Thirty one (27.7%) eels used Units 9 and 10. Twenty one (18.8%) eels emigrated through the fish pipe. Seven eels emigrated via Units 1 - 4 (6.3%). Three eels used the trash/ice sluice (2.7%) and the fish tube and fishway exit each passed a single radio-tagged eel (0.9% each) Table 5.1.3-1 summarizes passage routes for all eels within the Vernon study area.

Table 5.3.1-1. Eel passage routes at Vernon for all eels detected at the Vernon project (released for Wilder, Bellows Falls, and Vernon), 2015.

| Passage Route | No. | % of all passed | % of all released |
|---|---|---|---|
| **Vernon Released Fish** | | | |
| Turbine intake 5-8 | 23 | 52.3% | 46.0% |
| Turbine intake 9-10 | 11 | 25.0% | 22.0% |
| Fish pipe | 4 | 9.1% | 8.0% |
| Turbine intake 1-4 | 3 | 6.8% | 6.0% |
| Trash/Ice sluice | 1 | 2.3% | 2.0% |
| Fish tube | 1 | 2.3% | 2.0% |
| Fishway | 1 | 2.3% | 2.0% |
| Attraction flow pipe | 0 | 0.0% | 0.0% |
| **Total Passed** | **44** | **100.0%** | **88.0%** |
| Did not pass | 6 | | 12.0% |
| **Total Released** | **50** | | **100.0%** |
| **Combined Wilder, Bellows Falls, and Vernon Released Fish** | | | |
| Turbine intake 5-8 | 48 | 42.9% | 40.7% |
| Turbine intake 9-10 | 31 | 27.7% | 26.3% |
| Fish pipe | 21 | 18.8% | 17.8% |
| Turbine intake 1-4 | 7 | 6.3% | 5.9% |
| Trash/Ice sluice | 3 | 2.7% | 2.5% |
| Fish tube | 1 | 0.9% | 0.8% |
| Fishway | 1 | 0.9% | 0.8% |
| Attraction flow pipe | 0 | 0.0% | 0.0% |
| **Total Passed** | **112** | **100.0%** | **94.9%** |
| Did not pass | 6 | | 5.1% |
| **Total Released** | **118** | | **100.0%** |

Travel time of each tagged fish from the release site to downstream sites was calculated as the time interval between release time and subsequent detection at the Vernon project monitoring sites. Residency time in the vicinity of project was calculated as the time interval between release time and subsequent detection within the immediate Vernon project monitoring zones. Fish with a single detection were assigned a residency time of ≤ 1 minute.

Following release, emigration times from the Vernon release point at Riverside industrial complex in Brattleboro, VT to initial detection at Vernon ranged from 26 minutes to 9 days, 9 hours, 57 minutes (median = 1d, 6h, 32m). Eel residency time ranged from 6 minutes to 19 days, 3 hours, 37 minutes (median = 47m), (Table 5.1.3-2).

Table 5.1.3-2. Eel travel and residency times at Vernon, 2015.

| Release Group | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| V1 | Min | 00:03:51 | | Min | 00:00:29 |

| Release Group | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| | Max | 06:07:11 | | Max | 19:03:37 |
| | Average | 02:07:16 | | Average | 02:05:37 |
| | Median | 01:22:59 | | Median | 00:00:45 |
| V2 | Min | 00:04:57 | | Min | 00:00:30 |
| | Max | 01:09:06 | | Max | 00:02:51 |
| | Average | 00:09:13 | | Average | 00:00:50 |
| | Median | 00:06:15 | | Median | 00:00:38 |
| V3 | Min | 00:07:03 | | Min | 00:00:26 |
| | Max | 06:07:37 | | Max | 01:23:53 |
| | Average | 01:21:37 | | Average | 00:07:33 |
| | Median | 00:13:40 | | Median | 00:00:44 |
| V4 | Min | 00:06:08 | | Min | 00:00:45 |
| | Max | 09:09:57 | | Max | 04:01:17 |
| | Average | 04:14:48 | | Average | 01:13:15 |
| | Median | 04:06:05 | | Median | 00:18:55 |
| V5 | Min | 00:00:26 | | Min | 00:00:06 |
| | Max | 08:04:16 | | Max | 04:07:40 |
| | Average | 02:11:00 | | Average | 00:12:31 |
| | Median | 02:08:00 | | Median | 00:01:01 |
| **All Impoundment Released Fish Combined** | | | | | |
| | Min | 00:00:26 | | Min | 00:00:06 |
| | Max | 09:09:57 | | Max | 19:03:37 |
| | Average | 02:06:08 | | Average | 00:22:55 |
| | Median | 01:06:32 | | Median | 00:00:47 |

For eels arriving from Bellows Falls, travel times from initial release above Bellows Falls to detection in the Vernon study area ranged from 17 hours, 9 minutes to 50 days, 23 hours, 50 minutes (median = 6d, 8h, 49m). For canal released fish, travel to Vernon ranged from 1 day, 3 hours, 57 minutes to 20 days, 39 minutes (median = 3d, 6h, 58m). Residency for Bellows Falls eels in the Vernon study area ranged from 15 minutes to 34 days, 19 hours, 44 minutes (median = 1h, 5m) for Bellows Falls impoundment released fish and from 43 minutes to 1 day, 21 hours, 28 minutes (median = 1 h, 2 m) for canal released fish (Table 5.1.3-3).

For eels arriving from Wilder, travel times from initial release above Wilder to detection in the Vernon study area ranged from 3 days, 3 hours, 50 minutes to 7 days, 15 hours, 56 minutes (median = 5d, 8h, 40m). Residency for Wilder eels in the Vernon study area ranged from 33 minutes to 1 day, 20 hours, 34 minutes (median = 2h, 2m) (Table 5.1.3-4).

Table 5.1.3-3. Bellows Falls impoundment and canal released eel travel and residency times at Vernon, 2015.

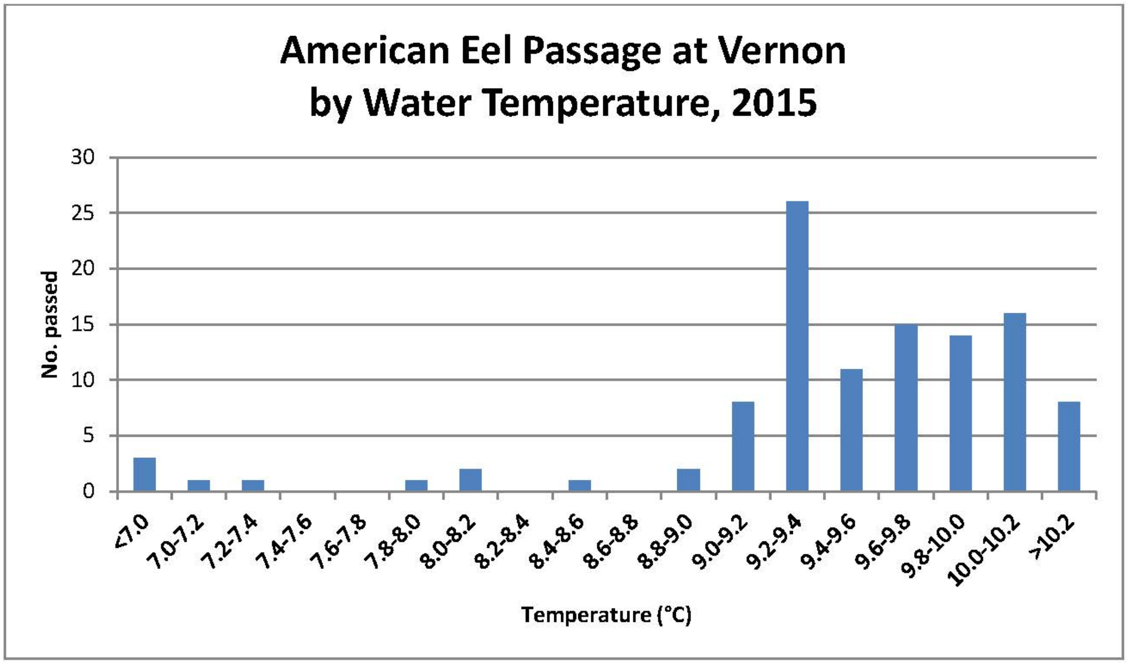
| | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| Impoundment Fish | Min | 00:17:09 | | Min | 00:00:15 |
| | Max | 50:23:50 | | Max | 34:19:44 |
| | Average | 10:04:42 | | Average | 01:05:50 |
| | Median | 06:08:49 | | Median | 00:01:05 |
| Canal Fish | Min | 01:03:57 | | Min | 00:00:43 |
| | Max | 20:00:39 | | Max | 01:21:28 |
| | Average | 05:15:00 | | Average | 00:07:56 |
| | Median | 03:06:58 | | Median | 00:01:02 |

Table 5.1.3-4. Wilder released eel travel and residency times at Vernon, 2015.

| | Travel Time (dd:hh:mm) | | | Residency (dd:hh:mm) | |
|---|---|---|---|---|---|
| Impoundment Fish | Min | 03:03:50 | | Min | 00:00:33 |
| | Max | 07:15:56 | | Max | 01:20:34 |
| | Average | 05:12:27 | | Average | 00:10:07 |
| | Median | 05:08:40 | | Median | 00:02:02 |

Water temperatures during passage over the course of the study ranged from 7.3°C to 10.2°C. Of the 112 passage eels, temperature data was available for 109 and of those, virtually all (N=98, 82.6%) passed at 9.0°C or higher (Figure 5.1.3-1).

Station discharge at Vernon varied during eel passage. Eels passed from flows of 1, 810 cfs up to 28,541 cfs. However, 29.5% (N=33) eels passed at flows between 8,000 and 9,000 cfs, and another 32.1% (N=36) passed at flows between 9,000 and 14,000 cfs (Figure 5.1.3-2). Seventy-six (67.9%) of fish passed the project between 19:00 and 24:00 h (Figure 5.1.3-3).




Note: Temperature data was not available for passage of 3 fish.

Figure 5.1.3-1. American Eel passage at Vernon by water temperature, 2015.

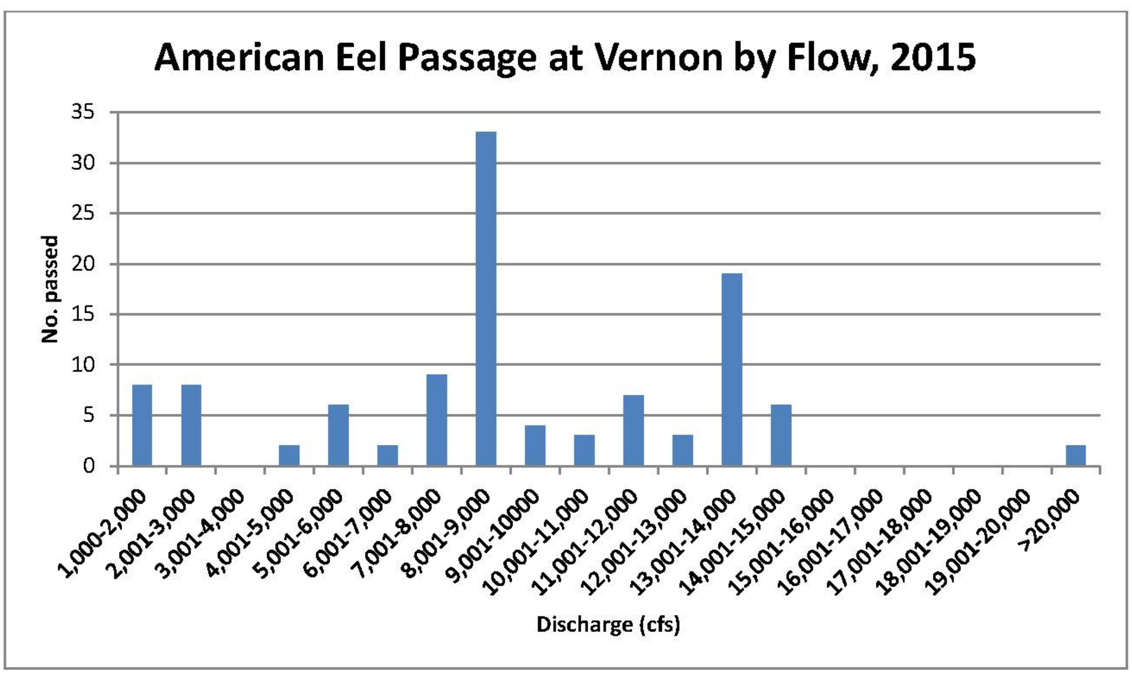



Figure 5.1.3-2. American Eel passage at Vernon by project discharge flow, 2015.

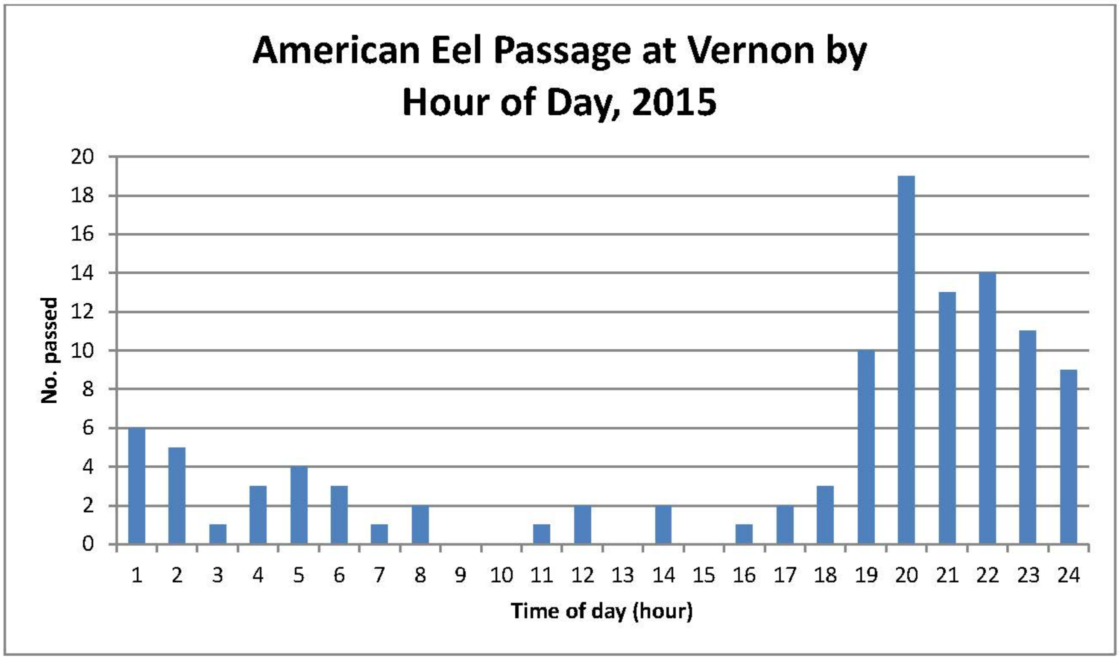



Figure 5.1.3-3. American Eel passage at Vernon by hour of day, 2015.

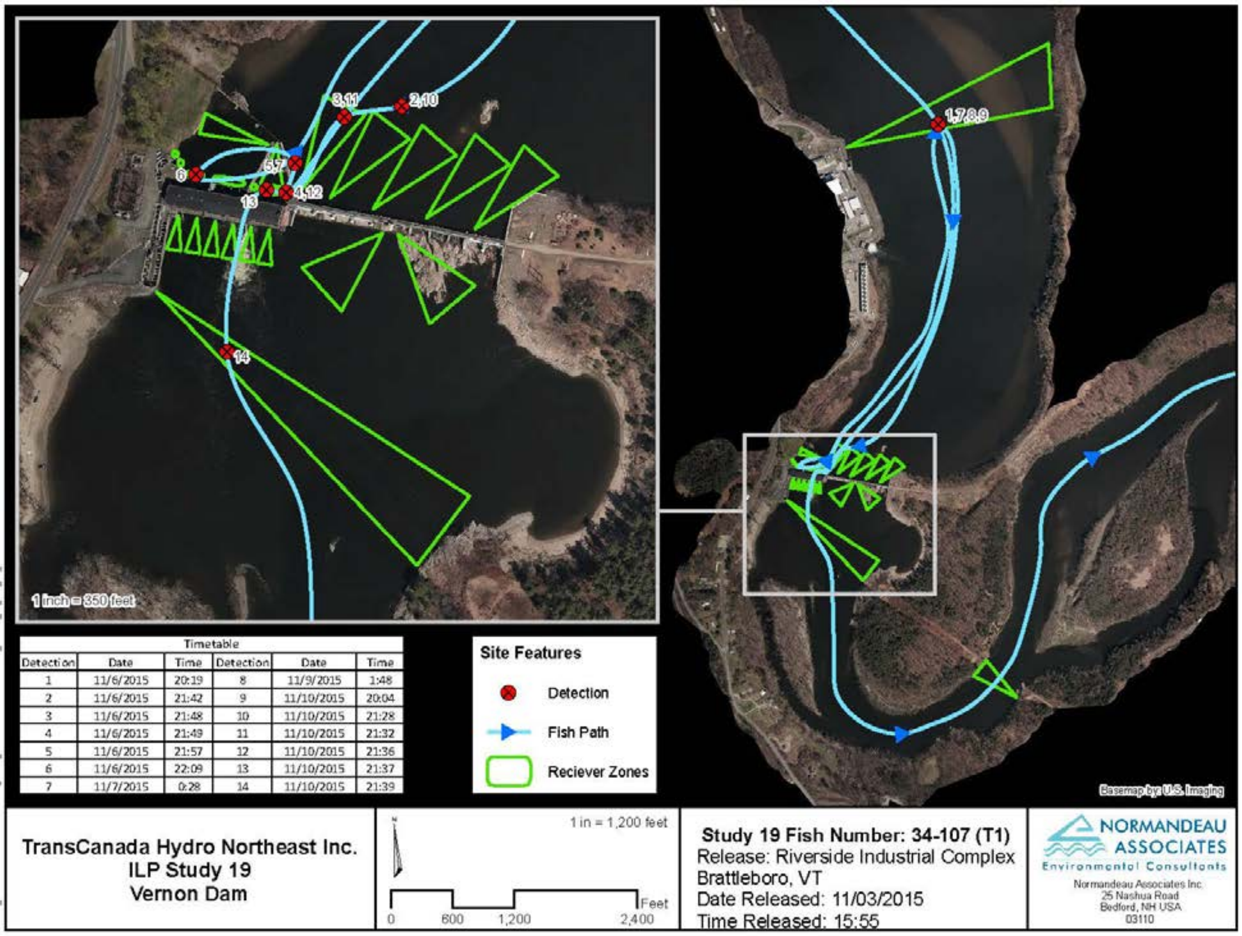
The proportion of flow through each passage route was calculated by dividing the passage route flow at the time of passage by the total discharge from the project at that time. The prominent route of passage was through Units 5 - 8 (42.8%). Flow through those units during the time of eel passage ranged from 0 to 7,042 cfs. The average proportion of flow through those units during the time of eel passage was 58.6%. Units 9 and 10 accounted for 27.7% of total passage. Flow through those units during the time of eel passage was approximately 1,280 to 3,326 cfs. The average proportion of flow through this route was 36.5%. The fish pipe passed 18.8% of all eels and the flow was constant at approximately 350 cfs. The average proportion of flow through this route was 5.9%. Units 1 – 4 passed 6.2% of all eels at flows ranging from 0 to 4,252 cfs. The average proportion of flow through this route was 19.3% (Table 5.1.3-5). The trash/ice sluice passed 2.7% of all eels but flows there were considered to be leakage flows since TransCanada flow monitors did not register any flow during the time of eel passage, although flow was observed. Therefore, actual flows and proportional flows through the trash/ice sluice could not be calculated.

Table 5.1.3-5. Flow range and proportion of flow by route at Vernon, 2015.

| Route | Number passed by route | Percent passed by route | Flows by route of passage (cfs) | Flow Proportions by route of passage (cfs) | Average proportional flow |
|---|---|---|---|---|---|
| Fish tube | 1 | 0.9% | 40 | 2.0% | 2.0% |
| Fish pipe | 21 | 18.8% | 345-350 | 1.2% - 18.7% | 5.9% |
| Fishway | 1 | 0.9% | 65 | 1.1% | 1.1% |
| Trash/Ice Sluice | 3 | 2.7% | Unknown[a] | Unknown[a] | Unknown[a] |
| Units 1-4 | 7 | 6.3% | 0 - 4,253 | 0% - 31.5% | 19.3% |
| Units 5-8 | 48 | 42.9% | 0 -7,042 | 0% - 77.7% | 58.6% |
| Units 9-10 | 31 | 27.7% | 1,280 -3,326 | 11.8% - 80.5% | 36.5% |

a. Flows are unknown through the trash/ice sluice, but likely to be minimal relative to other passage flows.

Based on analysis of telemetry data and detections at radio receivers, seven of the 112 successfully passed eels (6.3%) exhibited some wandering or potential searching behavior prior to passage in the areas of the intakes for Units 5-8 and the trash/ice sluice. All seven of these entered and exited the study area more than once (example shown in Figure 5.1.3-4). The remaining 105 successfully passed eels (93.8%) passed without the wandering type of movement patterns that may signify searching. Appendix E includes maps for all successfully passed eels. It should be noted that approach paths are generalized based on detection through the receiver detection zone only, and not necessarily exact location of approach path (e.g., river right, left, or center.




| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/6/2015 | 20:19 | 8 | 11/9/2015 | 1:48 |
| 2 | 11/6/2015 | 21:42 | 9 | 11/10/2015 | 20:04 |
| 3 | 11/6/2015 | 21:48 | 10 | 11/10/2015 | 21:28 |
| 4 | 11/6/2015 | 21:49 | 11 | 11/10/2015 | 21:32 |
| 5 | 11/6/2015 | 21:57 | 12 | 11/10/2015 | 21:36 |
| 6 | 11/6/2015 | 22:09 | 13 | 11/10/2015 | 21:37 |
| 7 | 11/7/2015 | 0:28 | 14 | 11/10/2015 | 21:39 |

Figure 5.1.3-4. Example map showing eel wandering pattern prior to passage at Vernon, 2015.

## 5.2 Turbine Survival

### 5.2.1 Recapture Rates

The HI-Z tag recapture technique performed satisfactorily with high recapture rates (physical retrieval of live and dead eels), with the exception of Wilder Unit 3. Details are provided in Table 5.2.1-1 and Appendix C for the three projects.

As discussed in Section 4.4.1 eels were released at Wilder Unit 3 on October 30. In the initial test group, ten eels were released into the unit and three emerged in the tailrace, resulting in the loss of seven eels as well as the seven radio tags they were carrying (radio tags were used on more than one fish during this study, averaging about 10 fish per tag and loss of many radio tags could have impacted the ability to continue the evaluation). With the 70% loss of fish, the Unit 3 study was suspended and the working group was notified via email of this study plan variance.

Eels were released on November 1, 2015 through Unit 2 at Wilder. Of the 50 treatment eels released, 40 (80.0%) were recaptured alive and seven (14.0%) were retrieved dead. Only inflated HI-Z tags were retrieved on 3 (6.0%) treatment eels. The eels with only the HI-Z tags recaptured were assigned a dead status. The recapture rate for the combined controls was 97.4%. This rate was also used for Bellows Falls, and Vernon.

At Bellows Falls eels were released through Unit 2 on October 30, 2015 with a high recapture rate of 100% for both treatment and control eels.

Eels were released on four days at Vernon: through Unit 4 on October 28, through Unit 8 (discharging 1,000 cfs) on October 26, Unit 8 (discharging 1,700 cfs) on November 3, and through Unit 9 on October 27. Control eels were released on October 27 and 28. Recapture rate was high at 93.8% (Unit 4), 95.8% (Unit 8 at 1,000 cfs), 88.0% (Unit 8 at 1,700 cfs), and 95.8% (Unit 9). Inflated, dislodged HI-Z tags were retrieved on one Unit 4 eel, two at Unit 8 at 1,000cfs, and four at Unit 8 at 1,700 cfs. Released eels with only the HI-Z tags recovered were assigned a dead status.

Table 5.2.1-1. Tag-recapture data and estimated 1 h and 48 h survival for adult eels.

| | Vernon Unit 4 | | Vernon Unit 8 @ 1,000 cfs | | Vernon Unit 8 @ 1,700 cfs | | Vernon Unit 9 | | Vernon Units Combined | | Bellows Falls Unit 2 | | Wilder Unit 2 | | Combined Controls [c] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No. Released[a]** | **48** | **%** | **48** | **%** | **50** | **%** | **48** | **%** | **194** | **%** | **50** | **%** | **50** | **%** | **39** | **%** |
| **No. Alive** | 45 | 94 | 43 | 90 | 39 | 78 | 46 | 96 | 173 | 89 | 50 | 100 | 40 | 80 | 38 | 97 |
| **No. Recaptured Dead** | 0 | | 3 | 6 | 5 | 10 | 0 | | 8 | 4 | 0 | | 7 | 14 | 0 | |
| **No. Assigned Alive[b]** | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | 3 |
| **No. Assigned Dead** | 1 | 2 | 2 | 4 | 6 | 12 | 1 | 2 | 10 | 5 | 0 | | 3 | 6 | 0 | |
| Tags Only | 1 | | 2 | | 4 | | 0 | | 7 | | 0 | | 3 | | 0 | |
| Stationary Signal | 0 | | 0 | | 2 | | 1 | | 3 | | 0 | | 0 | | 0 | |
| **No. Unknown** | 2 | 4 | 0 | | 0 | | 1 | 2 | 3 | 2 | 0 | | 0 | | 0 | |
| **Survival 1 h (%)** | 97.8% | | 89.6% | | 78.0% | | 97.9% | | 91.1% | | 100.0% | | 80.0% | | | |
| **Std Error (%)** | 2.2% | | 4.4% | | 5.9% | | 2.1% | | 2.1% | | N/A | | 5.7% | | | |
| **No. Held** | 45 | | 43 | | 39 | | 46 | | 173 | | 50 | | 40 | | 38 | |
| Died in Holding | 2 | | 1 | | 2 | | 0 | | 5 | | 1 | | 9 | | 0 | |
| Alive 48 h | 43 | | 42 | | 37 | | 46 | | 168 | | 49 | | 31 | | 38 | |
| **Survival at 48 h (%)** | 93.5% | | 87.5% | | 74.0% | | 97.9% | | 88.0% | | 98.0% | | 62.0% | | | |
| **Std Error (%)** | 3.6% | | 4.8% | | 6.2% | | 2.1% | | 2.4% | | 2.0% | | 6.9% | | | |
| **90% CI (%)** | 6.0% | | 7.8% | | 10.2% | | 3.5% | | 3.8% | | 3.2% | | 11.3% | | | |

a. Analytical sample; some eels were removed from analysis due to unrecoverable conditions (i.e. trapped in tailrace).

b. Eels assigned alive status based on telemetry and visual observation.

c. Combined controls released into the tailrace downstream of the three stations.

### 5.2.2 Recapture Times

Recapture times (the time interval between eel release and subsequent recapture) for the eels released through Wilder Unit 2 ranged from 1 to 16 minutes and averaged 3.3 minutes. Almost all the eels were recaptured within eight minutes; however one eel was recaptured 16 minutes after being released. This eel was alive, and had no injuries attributable to turbine passage (Figure 5.2.2-1). The average time for the combined control recapture at Wilder, Bellows Falls, and Vernon was 21.1 minutes. This recapture time was also used for Bellows Falls and Vernon.

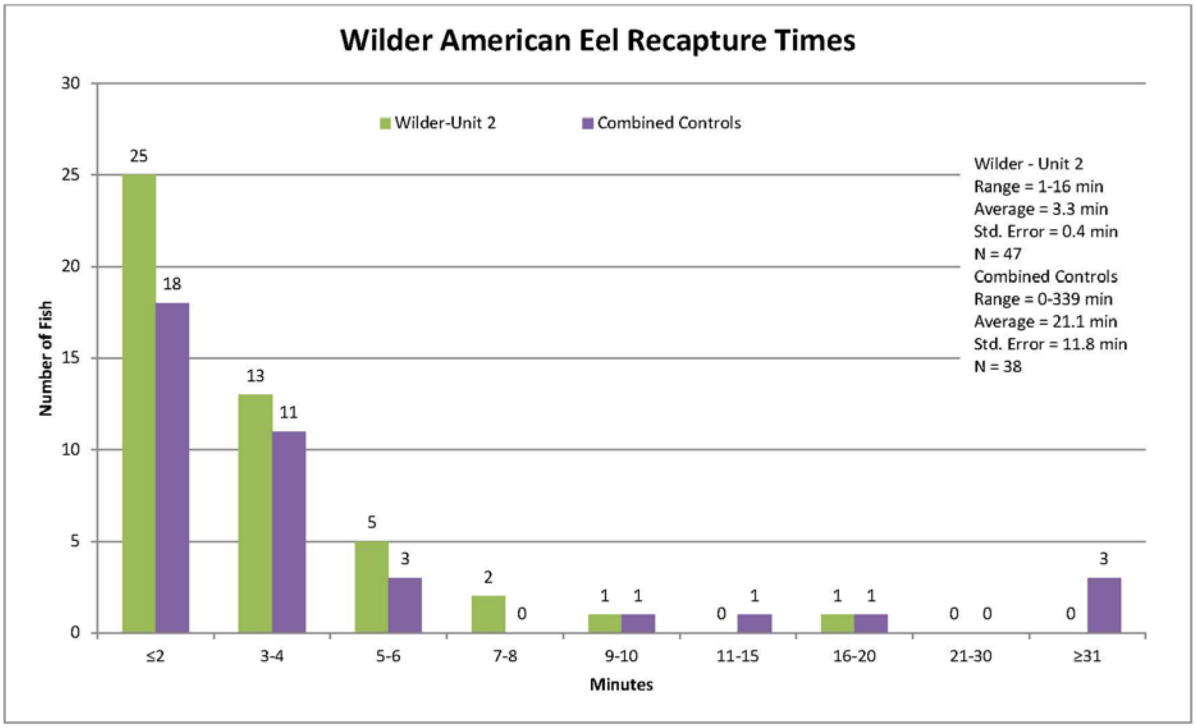



Figure 5.2.2-1. Recapture times for HI-Z tagged adult American Eels released at Wilder Station. Combined controls released at the three projects.

At Bellows Falls, recapture times (the time interval between eel release and subsequent recapture) for the eels released through Unit 2 ranged from 1 to 73 minutes and averaged 9.3 minutes. All but five of the eels were recaptured within fifteen minutes; however, three eels were recaptured more than 30 minutes after being released. Many of the eels that took longer to recapture surfaced along the downstream face of the power house and had to be captured with a drop net from shore by the downstream fish passage exit flume (Figure 5.2.2-2).

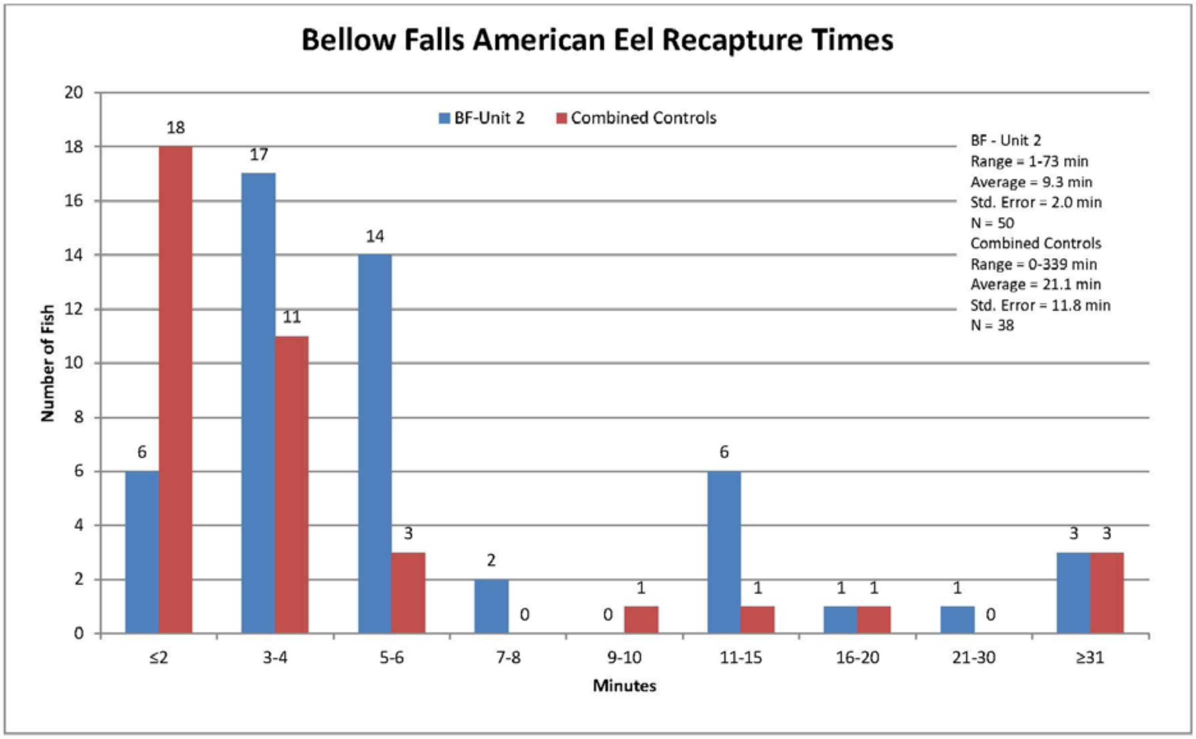



Figure 5.2.2-2: Recapture times for HI-Z tagged adult American Eels released at Bellows Falls Station. Combined controls released at the three projects.

At Vernon, recapture times (the time interval between eel release and subsequent recapture) for the eels released through Unit 4 ranged from 2 to 325 minutes and averaged 14.9 minutes. All but three of the eels were recaptured within 25 minutes; however, three eels had recapture times >30 minutes. One of these three was recaptured alive 325 minutes after release and had no injuries attributable to turbine passage (Figure 5.2.2-3).

Recapture times for eels released through Vernon Unit 8 discharging at 1,000 and 1,700 cfs ranged from 1 to 255 minutes, and 2 to 126 minutes, respectively. Average recapture times were 10.6 minutes for Unit 8 eels released at 1,000 cfs and 11.5 minutes for Unit 8 eels released at 1,700 cfs. All but two of the eels were recaptured within 30 minutes of release at 1,000 cfs. Only three of 50 eels were recaptured after 30 minutes of release at 1,700 cfs.

At Vernon Unit 9, eel recapture times ranged from 1 to 237 minutes and averaged 24.6 minutes. All but seven eels were recaptured within 15 minutes with recapture times >59 minutes. All seven of these eels were recaptured alive and had no injuries attributable to turbine passage. Most of the long recapture times were for eels that appeared to hold up for extended periods in underwater structures before the HI-Z tags could buoy them to the surface. There were also indications that some of these eels were able to dislodge some of their tags by spinning while in crevices in boulders.

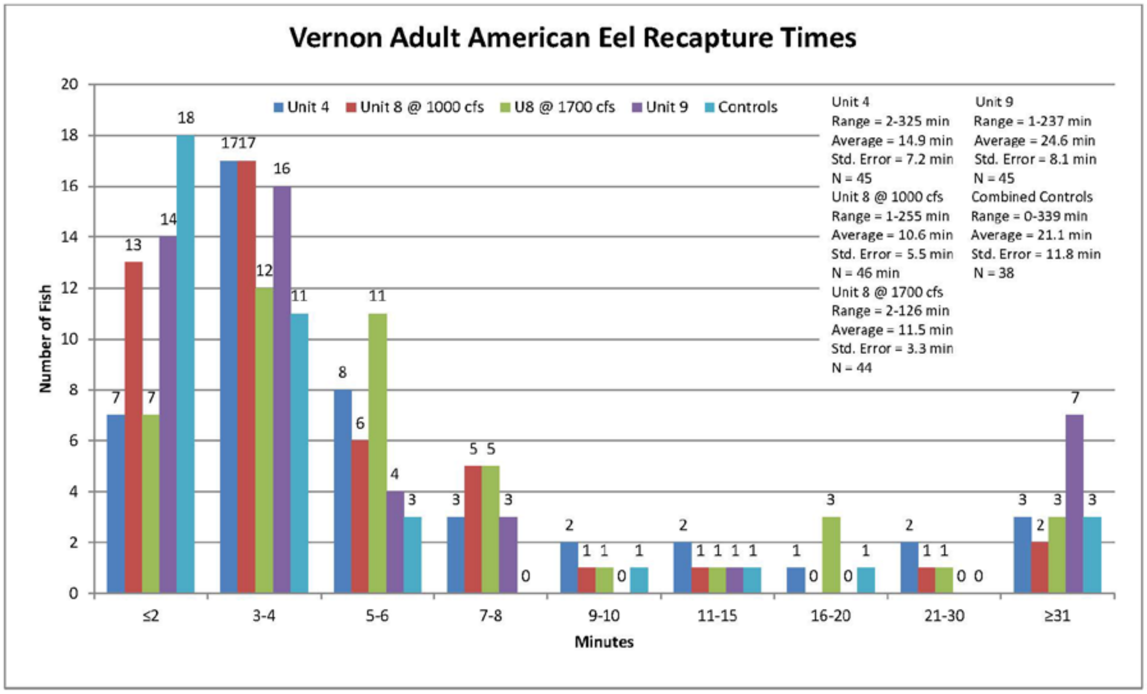



Figure 5.2.2-3. Recapture times for HI-Z tagged adult American Eels released at Vernon Station. Combined controls released at the three projects.

### 5.2.3 Survival Estimates

#### *All Fish*

Survival estimates for all fish are provided in Table 5.2.1-1 above for each of the three projects.

At Wilder the 1 h direct survival was 80%. Survival at 48 h was 62.0%. The 48 h survival estimate was adjusted downward by one eel that was alive at 48 h but classified as functionally dead (severely injured). The precision of the 48 h survival estimates for the Unit 2 eels was within ± 11.3%, 90% of the time. The target precision of ≤ ± 10.0%, 90% of the time for the Unit 2 survival estimate was not attained primarily because of the relatively low survival estimate.

At Bellows Falls the 1 h direct survival was 100.0%. Survival at 48 h was 98.0%. The precision of the 48 h survival estimates for the Unit 2 eels was within ± 3.2%, 90% of the time.

At Vernon the 1 h direct survival was 97.8% (Unit 4), 89.6% (Unit 8 at 1,000 cfs), 78.0% (Unit 8 at 1,700 cfs), and 97.9% (Unit 9). Survival at 48 h was 93.5%, 87.5%, 74.0%, and 97.9% for the Unit 4, Unit 8 at 1,000 cfs, Unit 8 at 1,700 cfs, and Unit 9 releases, respectively. These survival estimates excluded three eels still alive at 48 h that were considered functionally dead (severely injured). The precisions of the 48 h survival estimates for Unit 4, Unit 8 at 1,000 cfs, and Unit 9 releases were all within ± 7.8%, 90% of the time, and the precision for Unit 8 at 1,700 cfs was ±10.2%, 90% of the time. The 1 and 48 h direct survival estimates for the combined Vernon units were 91.1% and 88.0%, respectively. The precision of the 1 and 48 h survival estimates were both within ± 3.8%, 90% of the time.

### Only Recaptured Fish

Following the RSP, survival estimates were also calculated with only recaptured eels (Table 5.2.3-1). At Wilder the estimated immediate (1 h) survival was 85.1% and the 48 h survival estimate was 66.0% (CI ±11.4%). Since all eels at Bellows Falls were recaptured, the estimated 1 h (100%) and 48 h (98.0%) survival estimates were the same as those reported above.

At Vernon the estimated immediate (1 h) survival was 100.0% (Unit 4), 93.5% (Unit 8 at 1,000cfs), 88.6% (Unit 8 at 1,700 cfs), and 100.0% (Unit 9). Survival at 48 h was 95.6%, 91.3%, 84.1%, and 100% for the Unit 4, Unit 8 at 1,000 cfs, Unit 8 at 1,700 cfs, and Unit 9 releases, respectively. These estimates were also adjusted for functionally dead eels. The precision of the survival estimates (1 and 48 h) for the Unit 4, Unit 8 at 1,000 cfs, Unit 8 at 1,700 cfs, and Unit 9 releases were all within ± 9.1%, 90% of the time. For all Vernon units combined, 1 and 48 h direct survival was 95.6% and 92.8%, respectively. The precision of the 1 and 48 h survival estimates were both within ± 3.2%, 90% of the time.

Table 5.2.3-1. Tag-recapture data and estimated 1 h and 48 h survival for only recaptured adult eels, October-November 2015.

| | Vernon Unit 4 | | Vernon Unit 8 @ 1000 cfs | | Vernon Unit 8 @ 1700 cfs | | Vernon Unit 9 | | Vernon Units Combined | | Bellows Falls Unit 2 | | Wilder Unit 2 | | Combined Controls [b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No. Released [a]** | **48** | **%** | **48** | **%** | **50** | **%** | **48** | **%** | **194** | **%** | **50** | **%** | **50** | **%** | **39** | **%** |
| **No. Recaptured** | 45 | 94 | 46 | 96 | 44 | 88 | 46 | 96 | 181 | 93 | 50 | 100 | 47 | 94 | 38 | 97 |
| No. Alive | 45 | 94 | 43 | 90 | 39 | 78 | 46 | 96 | 173 | 89 | 50 | 100 | 40 | 80 | 38 | 97 |
| No. Dead | 0 | 0 | 3 | 6 | 5 | 10 | 0 | 0 | 8 | 4 | 0 | 0 | 7 | 14 | 0 | 0 |
| **Survival 1 h (%)** | 100.0% | | 93.5% | | 88.6% | | 100.0% | | 95.6% | | 100.0% | | 85.1% | | | |
| **Std Error (%)** | N/A | | 3.6% | | 4.8% | | N/A | | 1.5% | | N/A | | 5.2% | | | |
| **No. Held** | 45 | | 43 | | 39 | | 46 | | 173 | | 50 | | 40 | | 38 | |
| Died in Holding | 2 | | 1 | | 2 | | 0 | | 5 | | 1 | | 9 | | 0 | |
| Alive 48 h | 43 | | 42 | | 37 | | 46 | | 168 | | 49 | | 31 | | 38 | |
| **Survival at 48 h (%)** | 95.6% | | 91.3% | | 84.1% | | 100.0% | | 92.8% | | 98.0% | | 66.0% | | | |
| **Std Error (%)** | 3.1% | | 4.2% | | 5.5% | | N/A | | 1.9% | | 2.0% | | 6.9% | | | |
| **90% CI (%)** | 5.1% | | 6.8% | | 9.1% | | N/A | | 3.2% | | 3.3% | | 11.4% | | | |

a. Analytical sample; some fish were removed from analysis due to unrecoverable conditions i.e. trapped in tailrace.

b. Combined controls released into the tailrace downstream of the three stations.

### 5.2.4 Injury Rate, Types, and Probable Source

Tables 5.2.4-1, 5.2.4-2 and 5.2.4-3 below, and Appendix D provide details on injury rates, types, and probable sources for the three projects.

At Wilder the injury rate for eels released into Unit 2 was 42.6%; 20 of the 47 recaptured eels had passage related visible injuries. The dominant injuries for eels passing through Unit 2 were severed bodies or decapitations (12.8%) and internal hemorrhaging/broken bones (17.0%). These injuries were likely mechanically inflicted by the blades and other components within the turbine. Other common injuries included gill damage (8.5%), hemorrhaged eye(s) (6.4%), scrapes or bruises on head or body (12.8%), and cuts or lacerations (2.1%). Almost all the injuries, 19 of 20 (40.4% of recaptured eels) were attributed to mechanical forces, and one (2.1%) was attributed to shear forces. The cause of the two control eel injuries was undetermined and considered minor. No eels displayed only loss of equilibrium upon recapture. Seventeen of the injuries (36.2%) were classified as major and three (6.4%) were considered minor.

At Bellows Falls seven of the 50 Unit 2 treatment eels (14.0%) and 2 of the 10 control eels (20.0%) had passage related visible injuries. The dominant injury (8.0%) for treatment eels was scrapes and/or bruises to the head and/or body. Gill damage accounted for 4.0% of injuries and fin damage was also 4.0%. No eels displayed only loss of equilibrium upon recapture. Of the injuries to control fish, one (2.6%) had bruising to the head and one (2.6%) had anal fin damage. Mechanical forces accounted for five (10.0%) of the eel injuries and shear forces were responsible for two (4.0%). The cause of the control eel injuries was undetermined. Only three (6%) of the treatment eels had an injury considered major. All other injuries (treatment and control) were classified as minor.

At Vernon sixteen of the 45 recaptured Unit 4 eels (35.6%) had passage related injuries. The dominant injuries through Unit 4 were scrapes or bruises to the head/body (28.9%). Gill damage (8.9%), internal injuries (6.7%), cuts or lacerations (2.2%), and damage to the fins (4.4%) accounted for the remaining passage related visible injuries through Unit 4. None of the Unit 4 eels were severed.

Of the 46 recaptured eels through Vernon Unit 8 discharging at 1,000 cfs, thirteen (28.3%) had visible injuries. Scrapes and bruises accounted for 10.9%, fin damage for 8.7%, decapitation or severed body for 6.5% and internal damage for 2.2% of the remaining passage related visible injuries.

Vernon Unit 8 discharging at 1,700 cfs treatment eels had an injury rate of 27.3% (12 of 44 eels had visible injuries). Decapitation and/or severed body accounted for 11.4% of injuries; gill damage (6.8%); scrapes or bruises to the head/body (4.5%); hemorrhaged eyes (2.3%); internal damage (4.5%) and cuts or lacerations (2.3%).

Vernon Unit 9 treatment eels had an injury rate of 8.7% (4 of 46 recaptured eels). Most of the injuries were scrapes or bruises to the head/body (6.5%) with fin damage (2.2%) accounting for the remaining passage related injuries. None of the recaptured eels were severed passing Unit 9. There were no visible injuries on any of the 19 control eels released into the Vernon tailrace.

The probable cause of all 16 of the Unit 4 visibly injured eels was mechanical forces. Seven injuries were considered minor and nine major. The probable cause for 13 of 14 visibly injured eels from Unit 8 at 1,000 cfs was mechanical forces with 10 considered minor and four major. The cause of one visibly injured eel could not be determined. Of the 13 visibly injured eels from Unit 8 at 1,700 cfs, the probable cause was mechanical forces for 10 eels, shear forces for two eels, and undetermined for one eel. Three injuries were considered minor and ten major. All four of the Unit 9 treatment eels had injuries attributed to mechanical forces and all were considered minor.

Overall, 45 of 181 (24.9%) of the recaptured treatment eels had visible injuries. The dominant injury (12.7%) for eels passing the Vernon project was scrapes and bruises to the head or body. These injuries were likely mechanically inflicted by the blades and other components within the turbine.

***Malady-Free Estimates (MFE)***

Malady-free (MF) estimates (i.e., eels free of passage-related maladies) are presented in Table 5.2.4-4 and MF rates are based only on recaptured eels and are adjusted for controls. The MF estimate for Wilder Unit 2 released eels was 60.6% with a 90% CI of 13.1%. The target precision for the MF estimate of ± 10.0%, 90% of the time was not attained. The MF estimate for Bellows Falls Unit 2 released eels was 90.8%, with a 90% CI of 10.3%.

At Vernon the MF estimate for Unit 4 released eels was 68.1%, with a 90% CI of 13.1%. The MF estimate for Unit 8 at 1,000 cfs released eels was 73.4%, with a 90% CI of 12.6%. The MF estimate for the Unit 8 at 1,700 cfs released eels was 74.4%, with a CI of 12.8%. The MF estimate for the Unit 9 released eels was 96.4%, with a CI of 9.4%. Overall, the pooled MF estimate for all releases at Vernon was 78.2%, 90% CI of 7.5%.

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Table 5.2.4-1. Summary of visible injury types and injury rates observed on recaptured adult eels, October-November 2015.

| No. Released | No. Examined | | Passage Related Visibly Injured | | Injury Type[a] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Loss of Equilibrium only | | Gill Damage | | Hemorrhaged eye(s) | | Scrape or Bruised Head/body | | Broken Backbone Internal Hemorrhaging | | Decapitated Severed Body | | Cut or Laceration | | Fin(s) Damage | |
| | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % | No | % |
| **Vernon Unit 4** | | | | | | | | | | | | | | | | | | | | |
| 48 | 45 | 93.8 | 16 | 35.6 | 0 | 0 | 4 | 8.9 | 0 | 0 | 13 | 28.9 | 3 | 6.7 | 0 | 0 | 1 | 2.2 | 2 | 4.4 |
| **Vernon Unit 8 @ 1000 cfs** | | | | | | | | | | | | | | | | | | | | |
| 48 | 46 | 95.8 | 13 | 28.3 | 1 | 2.2 | 0 | 0 | 0 | 0 | 5 | 10.9 | 1 | 2.2 | 3 | 6.5 | 0 | 0 | 4 | 8.7 |
| **Vernon Unit 8 @ 1700 cfs** | | | | | | | | | | | | | | | | | | | | |
| 50 | 44 | 88.0 | 12 | 27.3 | 1 | 2.3 | 3 | 6.8 | 1 | 2.3 | 2 | 4.5 | 2 | 4.5 | 5 | 11.4 | 1 | 2.3 | 0 | 0 |
| **Vernon Unit 9** | | | | | | | | | | | | | | | | | | | | |
| 48 | 46 | 95.8 | 4 | 8.7 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6.5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.2 |
| **Vernon Units Combined** | | | | | | | | | | | | | | | | | | | | |
| 194 | 181 | 93.3 | 45 | 24.9 | 2 | 1.1 | 7 | 3.9 | 1 | 0.6 | 23 | 12.7 | 6 | 3.3 | 8 | 4.4 | 2 | 1.1 | 7 | 3.9 |
| **Bellows Falls Unit 2** | | | | | | | | | | | | | | | | | | | | |
| 50 | 50 | 100 | 7 | 14.0 | 0 | 0 | 2 | 4.0 | 0 | 0 | 4 | 8.0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4.0 |
| **Wilder Unit 2** | | | | | | | | | | | | | | | | | | | | |
| 50 | 47 | 94.0 | 20 | 42.6 | 0 | 0 | 4 | 8.5 | 3 | 6.4 | 6 | 12.8 | 8 | 17.0 | 6 | 12.8 | 1 | 2.1 | 0 | 0 |
| **Combined Controls (released into the tailrace downstream of the three stations).** | | | | | | | | | | | | | | | | | | | | |
| 39 | 38 | 97.4 | 2 | 5.3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.6 |

a. Some fish had multiple injury types.

Table 5.2.4-2. Incidence of maladies, including injury, and temporary loss of equilibrium observed on released adult eels, October-November 2015.

| Date | Test Lot | Fish ID | Alive / Dead | | Maladies | Passage Malady [a] | Photo | Malady Severity | Probable Cause |
|---|---|---|---|---|---|---|---|---|---|
| **Vernon Unit 4** | | | | | | | | | |
| 10/28/15 | 3E | 967 | alive | | Bleeding from gills | Yes | No | Major | Mechanical |
| 10/28/15 | 3E | 964 | alive | | Bruise on right side of head | Yes | No | Minor | Mechanical |
| 10/28/15 | 3E | 959 | alive | | Bruised on right side of body | Yes | No | Minor | Mechanical |
| 10/28/15 | 3E | 954 | alive | | Part of caudal fin missing | Yes | No | Minor | Mechanical |
| 10/28/15 | 3E | 841 | alive | | Bleeding from behind pectoral fins; part of caudal fin missing | Yes | No | Major | Mechanical |
| 10/28/15 | 3E | 839 | alive | | Bleeding right side behind head | Yes | No | Major | Mechanical |
| 10/28/15 | 3E | 833 | alive | | Small cut in front of right pectoral fin; bruise on head; bleeding from gills; scrape on right side | Yes | No | Major | Mechanical |
| 10/28/15 | 3E | 826 | dead | 24h | Heart ruptured; bruising on right side of body; internal hemorrhaging | Yes | Yes | Major | Mechanical |
| 10/28/15 | 3E | 969 | dead | 24h | Necropsied, no obvious injuries | No | Yes | Major | Undetermined |
| 10/28/15 | 3E | 822 | alive | | Bleeding from gills; bruise on lower mandible | Yes | Yes | Major | Mechanical |
| 10/28/15 | 3E | 823 | alive | | Bruised on left side mid-body | Yes | No | Minor | Mechanical |
| 10/28/15 | 3E | 828 | alive | | Bruise on left side mid-body | Yes | Yes | Minor | Mechanical |
| 10/28/15 | 3E | 829 | alive | | Scrape on snout; broken backbone | Yes | Yes | Major | Mechanical |
| 10/28/15 | 3E | 847 | alive | | Bruised on head and jaw both sides | Yes | Yes | Minor | Mechanical |
| 10/28/15 | 3E | 951 | alive | | Bleeding from left gill; bruise on left side just behind pectoral fin | Yes | No | Major | Mechanical |
| 10/28/15 | 3E | 952 | alive | | Bruise on left side mid-body | Yes | Yes | Minor | Mechanical |
| 10/28/15 | 3E | 960 | alive | | Broken backbone | Yes | Yes | Major | Mechanical |
| **Vernon Unit 8** | | | | | | | | | |
| 10/26/15 | 1E | 732 | alive | | Laceration and scrape on caudal fin | Yes | No | Minor | Mechanical |
| 10/26/15 | 1E | 720 | alive | | Hemorrhaged anal fin | Yes | No | Minor | Mechanical |
| 10/26/15 | 1E | 722 | alive | | LOE | Yes | No | Minor | Undetermined |
| 10/26/15 | 1E | 730 | alive | | Laceration on anal fin; part of caudal fin missing | Yes | No | Minor | Mechanical |
| 10/26/15 | 1E | 738 | alive | | Hemorrhaged caudal fin | Yes | No | Minor | Mechanical |
| 10/26/15 | 1E | 702 | dead | 1h | Severed body; Hemorrhaged internally | Yes | Yes | Major | Mechanical |
| 10/26/15 | 1E | 731 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 10/26/15 | 1E | 739 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 10/26/15 | 1E | 723 | dead | 24h | Crushed left side of face, broken lower mandible; broken backbone; Internal hemorrhaging | Yes | No | Major | Mechanical |
| 10/26/15 | 1E | 704 | alive | | Bruised and scraped on the mouth | Yes | Yes | Minor | Mechanical |
| 10/26/15 | 1E | 705 | alive | | Scrapes on both sides of head | Yes | No | Minor | Mechanical |

| Date | Test Lot | Fish ID | Alive / Dead | | Maladies | Passage Malady [a] | Photo | Malady Severity | Probable Cause |
|---|---|---|---|---|---|---|---|---|---|
| 10/26/15 | 1E | 710 | alive | | Bruised mid-body both sides | Yes | Yes | Minor | Mechanical |
| 10/26/15 | 1E | 714 | alive | | Bruising both sides of body near tail; scrape on tip of tail | Yes | Yes | Minor | Mechanical |
| 10/26/15 | 1E | 749 | alive | | Bruised mid-body both sides | Yes | Yes | Minor | Mechanical |
| **Vernon Unit 8 1700 cfs** | | | | | | | | | |
| 11/3/15 | 7E | 150 | alive | | Laceration on body | Yes | No | Minor | Mechanical |
| 11/3/15 | 7E | 112 | alive | | Bleeding from gills; hemorrhaged right eye | Yes | No | Major | Shear |
| 11/3/15 | 7E | 143 | alive | | LOE | Yes | No | Minor | Undetermined |
| 11/3/15 | 7E | 125 | alive | | Bruise on left side of body | Yes | No | Minor | Mechanical |
| 11/3/15 | 7E | 111 | alive | | Bleeding from gills | Yes | No | Major | Shear |
| 11/3/15 | 7E | 107 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 118 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 126 | dead | 1h | Decapitated | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 145 | dead | 24h | Some blood coming out of gills, and mouth, crushed top of skull | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 105 | alive | | External bruising on left side front third of fish, dorsally | Yes | No | Major | Mechanical |
| 11/3/15 | 7E | 106 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 123 | dead | 48h | Broken backbone and internal hemorrhaging | Yes | Yes | Major | Mechanical |
| 11/3/15 | 7E | 135 | dead | 1h | Severed body | Yes | No | Major | Mechanical |
| **Vernon Unit 9** | | | | | | | | | |
| 10/27/15 | 2E | 805 | alive | | Small part of caudal fin missing | Yes | No | Minor | Mechanical |
| 10/27/15 | 2E | 767 | alive | | Bruised left side front of body | Yes | Yes | Minor | Mechanical |
| 10/27/15 | 2E | 769 | alive | | Bruised right side mid-body | Yes | Yes | Minor | Mechanical |
| 10/27/15 | 2E | 772 | alive | | Bruised on right and left sides body | Yes | Yes | Minor | Mechanical |
| **Bellows Falls Unit 2** | | | | | | | | | |
| 10/30/15 | 4e | 6 | alive | | Bruise on head | Yes | No | Minor | Mechanical |
| 10/30/15 | 4e | 27 | alive | | Bleeding from gills | Yes | No | Major | Shear |
| 10/30/15 | 4e | 38 | alive | | Hemorrhaged anal fin | Yes | No | Minor | Mechanical |
| 10/30/15 | 4e | 46 | alive | | Bruise on lower mandible; part of caudal fin missing | Yes | No | Minor | Mechanical |
| 10/30/15 | 4e | 49 | alive | | Bleeding from gills | Yes | No | Major | Shear |
| 10/30/15 | 4e | 18 | alive | | Bruise on head | Yes | No | Minor | Mechanical |
| 10/30/15 | 4e | 26 | dead | 24h | Bruised lower jaw and head | Yes | Yes | Major | Mechanical |

| Date | Test Lot | Fish ID | Alive / Dead | | Maladies | Passage Malady [a] | Photo | Malady Severity | Probable Cause |
|---|---|---|---|---|---|---|---|---|---|
| **Wilder Unit 2** | | | | | | | | | |
| 11/1/15 | 6E | 117 | alive | | Hemorrhage on head | Yes | No | Minor | Mechanical |
| 11/1/15 | 6E | 106 | alive | | Minor bruising lower mandible | Yes | No | Minor | Mechanical |
| 11/1/15 | 6E | 93 | alive | | Hemorrhaging from left gills | Yes | No | Major | Shear |
| 11/1/15 | 6E | 90 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 91 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 110 | dead | 1h | Decapitated | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 116 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 123 | dead | 1h | Severed body | Yes | No | Major | Mechanical |
| 11/1/15 | 6E | 125 | dead | 1h | Laceration on body; gills protruding; broken back bone | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 129 | dead | 1h | Severed body | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 86 | dead | 24h | Hemorrhaged left eye; bruise just behind pectoral fins | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 121 | dead | 24h | Massive gill bleeding, Crushed head | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 122 | dead | 24h | Broken back bone | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 83 | alive | | Hemorrhage on skin, middle third of body both sides | Yes | No | Minor | Mechanical |
| 11/1/15 | 6E | 84 | dead | 48h | Bleeding from gills; bruise on head; hemorrhaged left eye | Yes | Yes | Major | Mechanical |
| 11/1/15 | 6E | 89 | dead | 48h | Broken backbone | Yes | No | Major | Mechanical |
| 11/1/15 | 6E | 96 | dead | 48h | Hemorrhaged right eye; broken backbone | Yes | No | Major | Mechanical |
| 11/1/15 | 6E | 104 | dead | 48h | Broken backbone behind vent | Yes | No | Major | Mechanical |
| 11/1/15 | 6E | 108 | dead | 48h | Bruising behind vent both sides, swollen rib area, rigid and hard | Yes | No | Major | Mechanical |
| 11/1/15 | 6E | 113 | dead | 48h | Broken backbone | Yes | No | Major | Mechanical |
| **Combined Controls (released into the tailrace downstream of the three stations).** | | | | | | | | | |
| 10/30/15 | 4e | 56 | alive | | Minor scrape on anal fin | Yes | No | Minor | Undetermined |
| 10/30/15 | 4e | 63 | alive | | Bruise on head | Yes | No | Minor | Undetermined |

a. Maladies include both visible injuries and LOE attributed to turbine passage.

Table 5.2.4-3. Probable sources and severity of maladies observed on recaptured adult eels, October-November 2015.

| No. of Fish Examined | Total With Maladies[a] | | Probable Cause | | | | | | Severity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mechanical | | Shear | | Undeter-mined | | Minor | | Major | |
| | No | % | No | % | No | % | No | % | No | % | No | % |
| **Vernon Unit 4** | | | | | | | | | | | | |
| 45 | 16 | 35.6 | 16 | 3.56 | 0 | 0 | 0 | 0 | 7 | 15.6 | 9 | 20.0 |
| **Vernon Unit 8 @ 1000 cfs** | | | | | | | | | | | | |
| 46 | 14 | 30.4 | 13 | 28.3 | 0 | 0 | 1 | 2.2 | 10 | 21.7 | 4 | 8.7 |
| **Vernon Unit 8 @ 1700 cfs** | | | | | | | | | | | | |
| 44 | 13 | 29.5 | 10 | 22.7 | 2 | 4.5 | 1 | 2.3 | 3 | 6.8 | 10 | 22.7 |
| **Vernon Unit 9** | | | | | | | | | | | | |
| 46 | 4 | 8.7 | 4 | 8.7 | 0 | 0 | 0 | 0 | 4 | 8.7 | 0 | 0 |
| **Vernon Units Combined** | | | | | | | | | | | | |
| 181 | 47 | 26.0 | 43 | 23.8 | 2 | 1.1 | 2 | 1.1 | 24 | 13.3 | 23 | 12.7 |
| **Bellows Falls Unit 2** | | | | | | | | | | | | |
| 50 | 7 | 14.0 | 5 | 10.0 | 2 | 4.0 | 0 | 0 | 4 | 8.0 | 3 | 6.0 |
| **Wilder Unit 2** | | | | | | | | | | | | |
| 47 | 20 | 42.6 | 19 | 40.4 | 1 | 2.1 | 0 | 0 | 3 | 6.4 | 17 | 36.2 |
| **Combined Controls (released into the tailrace downstream of the three stations)** | | | | | | | | | | | | |
| 38 | 2 | 5.3 | 0 | 0 | 0 | 0 | 2 | 5.3 | 2 | 5.3 | 0 | 0 |

a. Maladies include both visible injuries and LOE attributed to turbine passage.

Table 5.2.4-4. Summary malady data and malady-free estimates for recaptured adult eels, October-November 2015.

| | Vernon Unit 4 | | Vernon Unit 8 @ 1000 cfs | | Vernon Unit 8 @ 1700 cfs | | Vernon Unit 9 | | Vernon Units Combined | | Bellows Falls Unit 2 | | Wilder Unit 2 | | Combined Controls [a] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number released** | **48** | **%** | **48** | **%** | **50** | **%** | **48** | **%** | **194** | **%** | **50** | **%** | **50** | **%** | **39** | **%** |
| **Number examined for maladies** | 45 | 93.8 | 46 | 95.8 | 44 | 88.0 | 46 | 95.8 | 181 | 93.3 | 50 | 100 | 47 | 94.0 | 38 | 97.4 |
| **Number with passage related maladies** | 16 | 35.6 | 14 | 30.4 | 13 | 29.5 | 4 | 8.7 | 47 | 26.0 | 7 | 14.0 | 20 | 42.6 | 2 | 5.3 |
| Visible injuries | 16 | 35.6 | 13 | 28.3 | 12 | 27.3 | 4 | 8.7 | 45 | 24.9 | 7 | 14.0 | 20 | 42.6 | 2 | 5.3 |
| Loss of equilibrium only | 0 | 0 | 1 | 2.2 | 1 | 2.3 | 0 | 0 | 2 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Number without passage related maladies** | 29 | 64.4 | 32 | 69.6 | 31 | 70.5 | 42 | 91.3 | 134 | 74.0 | 43 | 86.0 | 27 | 57.4 | 36 | 94.7 |
| Number without passage related maladies that died | 1 | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Malady-free rate (%)** | 68.1% | | 73.4% | | 74.4% | | 96.4% | | 78.2% | | 90.8% | | 60.6% | | | |
| **Std Error (%)** | 8.0% | | 7.7% | | 7.8% | | 5.7% | | 4.6% | | 6.2% | | 8.0% | | | |
| **90% CI (%)** | 13.1% | | 12.6% | | 12.8% | | 9.4% | | 7.5% | | 10.3% | | 13.1% | | | |

a. Combined controls released into the tailrace downstream of the three stations.

### 5.2.5 Survival Comparison with Other Projects

The direct survival and injury estimates for the present study at Vernon, Bellows Falls, and Wilder indicate that the eels fared better passing through the larger and slower speed Francis turbines than the Kaplan (propeller type) turbines. Higher survival through these Kaplan turbines is consistent with other direct survival/injury studies conducted on eels at four propeller type turbines on the Rhine and Rhone Rivers in France and on the St. Lawrence River in New York (Normandeau, 2010, 2011a, 2011b; Normandeau and Skalski, 1998), (Table 5.2.5-1). There are no as yet published studies conducted on adult eel passage through Francis units although FirstLight conducted a study in 2015 as part of the Turners Falls project relicensing, at the time of this report that data has not been published.

The turbine passage survival (48h) at four large (240-262.6 in diameter) propeller turbines in other studies (Table 5.2.5-1) ranged from 73.5-93.0%. These turbines had rotation rates close to 95 rpm. The most significant factor that affected survival for these units was the number of blades, with lower survival rates of 78.6 and 73.5% for five and six-bladed units versus 93.0 and 92.4% for four-bladed units.

The propeller turbines tested at Wilder and Vernon were smaller than units tested at other projects (189 and 122 in, respectively), had slightly higher runner speed (112.5 and 144 rpm, respectively), and had five blades. The survival at these smaller and slightly faster units was lower (62.0%) at the Wilder turbine, within the range (74.0%) at Vernon Unit 8 at 1,700 cfs, and higher (87.5%) at Vernon Unit 8 at 1,000 cfs than obtained at the other propeller turbines tested in other studies.

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Table 5.2.5-1. Comparison of direct survival and injury of adult eels passed through Vernon, Bellows Falls, and Wilder stations with comparison to other projects and studies.

| Station | Turbine Type | Unit Tested | No. of Blades/ Buckets | Runner Speed (rpm) | Runner Diameter (in) | 48 h Survival (%) | 48 h Std Error (%) | Visibly Injured (%) | Injuries Classified Major (%) | Dominant Injury |
|---|---|---|---|---|---|---|---|---|---|---|
| Vernon | Francis | 4 | 13 | 133.3 | 62.5 | 93.5 | 3.6 | 35.6 | 20.0 | bruises on body/ head |
| Vernon | Francis | 9 | 12 | 75 | 110 | 97.9 | 2.1 | 8.7 | 0.0 | bruises on body/ head |
| Vernon @ 1,000 cfs | Kaplan | 8 | 5 | 144 | 122 | 87.5 | 4.8 | 28.3 | 8.7 | bruises on body/ head |
| Vernon @ 1,700 cfs | Kaplan | 8 | 5 | 144 | 122 | 74.0 | 6.2 | 27.3 | 22.7 | severed body |
| Bellows Falls | Francis | 2 | 15 | 85.7 | 174 | 98.0 | 2.0 | 14.0 | 6.0 | bruises on body/ head |
| Wilder | Kaplan | 2 | 5 | 112.5 | 180 | 62.0 | 6.9 | 42.6 | 36.2 | severed or bruised body |
| **Other Projects** | | | | | | | | | | |
| Beaucaire, France[a] | Bulb | n/a | 4 | 94.0 | 245.7 | 93.0 | 1.5 | 6.5 | 6.5 | bruised head/body |
| Fessenheim, France[a] | Kaplan | n/a | 4 | 88.2 | 262.6 | 92.4 | 2.2 | 11.5 | 6.7 | severed or nearly severed body |
| Ottmarsheim, France[a] | Kaplan | n/a | 5 | 93.8 | 246.0 | 78.6 | 2.3 | 26.5 | 20.7 | head/ body severed or nearly severed |
| Robert Moses [b], NY | Propeller | n/a | 6 | 99.2 | 240.0 | 73.5 | 3.4 | 36.7 | 24.1 or higher | severed body |

a. European Eel.

b. 48 hour survival, little mortality beyond 24 hour.

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# 6.0 STUDY CONCLUSIONS

## 6.1 Route Selection and Residency

### 6.1.1 Wilder

The dominate route of passage at Wilder was through turbine Units 1 and 2 (71.1%) which also had the greatest proportion of flow during times of passage (average proportion 99.8%). Only three eels used the trash/ice sluice (6.7%), the existing downstream passage structure, once it was opened on November 3. The proportion of eels using the trash/ice sluice when it was open in relation to all eels that passed through all routes when it was open was 15.8%. Most eels passed the project at full generation flows, during evening hours, and at water temperatures 9.8°C or higher. Residency time in the Wilder forebay ranged from 2 minutes to 1 day, 15 hours, 36 minutes (median = 13 minutes). With median residency time being short, and the small proportion of eels exhibiting searching behavior (13.3%) prior to passage, it can be concluded that the ability to locate downstream routes of passage through the project does not hinder the timing of the emigration.

### 6.1.2 Bellows Falls

The dominate route of passage at Bellows Falls was through turbine Units 1 through 3 (81.71%) which also had the greatest proportion of flow during times of passage (average proportion 97.9%). Twelve eels used the trash/ice sluice and two of those passed via that route prior to its opening on November 2 (perhaps at leakage flows). It is possible that there was enough leakage flow to allow passage for those eels. The proportion of eels that passed while the trash/ice sluice was open to those that passed via the turbines was 21.3%. Five eels (5.4%) passed via the spillway with four of those passing during only leakage flow from the dam. Most eels passed the project at full generation flows, during evening and nighttime hours, and at water temperatures from 9.0 – 9.42°C. Residency time in the Bellows Falls study area for all fish combined ranged from less than 1 minute to 46 days, 15 hours, 44 minutes (median ranged from less than 1 minute for fish released in the canal, 38m for fish released in the impoundment, and 36m for Wilder fish). With median residency times being short and the small proportion of eels exhibiting searching behavior (5.3%) prior to passage, it can be concluded the ability to locate downstream routes of passage through the project does not hinder the timing of the emigration.

Due to the Bellows Falls project spilling at the dam during two of the five releases an additional two release groups of 10 radio-tagged eels each were released directly into the power canal. It was noted that regardless of generation occurring at the time of the releases canal eels were not committed to moving downstream immediately. Five of the 20 eels were first detected (25%) at the mouth of the power canal. All eels released in the power canal did pass through the project, however not all eels passed on the same day as they were released, and one did not pass for over 10 days.

### 6.1.3 Vernon

The dominate route of passage at Vernon was through turbine Units 5 through 8 (42.9%) which also had the greatest proportion of flow (average proportion of flow 58.5%). Twenty-one eels (18.8%) used the fish pipe, the existing downstream passage structure which was in operation throughout the study period. Three eels (2.7% of all passed eels) used the trash/ice sluice when it was in its normal closed position with no calculated flow passing through this route. However, based on the Vernon impoundment elevation there was water passing over the top of the gate. TransCanada flow monitors did not register any flow during the times of passage, although flow was observed.

Most eels passed the project at 50-75% of full generation flows, during evening and nighttime hours, and at water temperatures from 9.2 – 10.2°C. Residency time in the Vernon forebay ranged from 6 minutes to 34 days, 19 hours and 44 minutes (median = 47m for Vernon released fish; 1h, 5m for Bellows Falls fish; and 2h, 2m for Wilder fish). With median residency time less than two hours for all eels passing Vernon, and the small proportion of eels exhibiting searching behavior (5.9%) prior to passage, it can be concluded the ability to locate downstream routes of passage through the Vernon project does not hinder the timing of the emigration.

### 6.1.4 Overall Passage through the Projects

Of the 170 eels released, 154 (90.5%) emigrated past their intended project on average within 24 hours of their release above, or first detection at the project. Maps of movement and passage for each passed fish are provided in Sixteen (9.5%) eels did not emigrate downstream to their intended project; of these, seven were identified in the forebay or through manual monitoring within the study area. Of the sixteen, five eels from the Wilder releases, five from the Bellows Falls releases, and six from the Vernon releases never passed their intended project. Seven of those 16 eels were detected after release; however nine were never detected following release. The final fate of these fish is unknown. It is possible that they moved into tributaries and did not migrate; their tags became dislodged; they died and settled on the river bottom; or they were preyed upon by other fish or birds.

From analysis of telemetry data it is apparent that some eels exhibited potential route searching behavior prior to passage. Searching behavior can be defined as wandering movements in the vicinity of passage routes in an attempt to locate an available route. The vast majority of eels in this study exhibited minimal wandering behavior.

## 6.2 Turbine Survival

### 6.2.1 Wilder

The direct survival estimate of 62.2% for eels passing through Kaplan Unit 2 was lower at this unit than any of the other units tested at Bellows Falls and Vernon. Injury rate (42.6%) for the recaptured eels was also the highest observed and 36.2% of the injuries were classified as major. These injuries were primarily bruised or severed bodies. Similar survival and injury results would be expected for the untested Kaplan Unit 1 at Wilder.

Although the Francis turbine (Unit 3) wasn't able to be tested due to the configuration of the discharge that feeds into the fish ladder from below via an energy dissipation chamber separated from the ladder by a grate. Its characteristics are similar to the Francis turbine tested at Vernon Unit 4. The small Francis turbine at Wilder has 14 buckets, a runner speed of 212 rpm, and a runner diameter of 72 inches. The turbine at Vernon Unit 4 has 13 buckets, a runner speed of 133.3 rpm, and a runner diameter of 62.5 inches. The 48 h survival of eels passed through this turbine was 93.5%. Based on these results, eels passing through Wilder Unit 3 could have a similar survival rate.

### 6.2.2 Bellows Falls

The 48h direct survival of 98.0% for eels passing Francis Unit 2 at Bellows Falls was the highest obtained at any of the turbines tested. The injury rate of 14.0% was the second lowest observed and only 6.0% of the examined eels had injuries considered major. Injuries were primarily bruises to the body. Because all the Bellows Falls units are similar, eels should incur little mortality and injury passing the Bellows Falls turbines.

### 6.2.3 Vernon

The 48h direct survival was highest, 97.9%, for eels passed through the larger Francis turbine Unit 9 at Vernon. This unit also had the lowest injury rate, 8.7%, of any of the turbines tested. Additionally none of the injuries (bruises on head and body, fin damage) were classified as major. The smaller Francis Unit 4 also had relatively high 48h survival of 93.5%; however, 36.5% were injured, primarily bruises to head and body, and 20% of the eels had major injuries.

The Kaplan Unit 8 had a higher 48h survival (87.5%) at the lower discharge tested (1,000 cfs) than at the higher discharge (1,700 cfs) where the survival was 74.0%. Injury rates were similar, 28.3 and 27.3% respectively, for the two discharge rates. Although injury rates were similar, the lower discharge inflicted fewer major injuries (8.7%) than the higher discharge (22.7%). Additionally, more fish were severed at the higher discharge. Based on these direct survival and injury results emigrating eels should incur high survival and few injuries passing the two larger Francis Units 9 and 10. Turbine passage should also be relatively high for eels passing the smaller Francis Units 1-4. Kaplan Units 5-8 effects on eel passage survival and severity of injuries appears to be partially dependent upon discharge rates with better passage conditions at lower discharges.

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# APPENDIX A

## Pathology Test Results

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Specimen: EEL BODY x60 Rec: 23-SEP-15
Submitted By: THREADER Sample ID: SAMPLE #1 NFLD

HISTORY: A mixture of 60 adult and juvenile American eels were submitted for gross pathology and parasitology examination. This group was Lot 1: from fisher Wally Cunard, Northern Penisula of Newfoundland. These eels were collected between Sept. 6 -12, picked up and shipped for diagnostics on Sept. 12

In addition to the gross examination, each eel was sampled for general bacteriology using a kidney swab, and eel tissues were grouped into 5 fish pools, each containing gill, spleen, heart and kidney tissues for virus isolation on 5 cell lines.

GROSS FINDINGS: (60 eels were examined)
All eels showed normal morphology, no lesions noted either externally or internally. All swim bladders were removed and opened and no parasite were noted in any of the 60 bladders.

GROSS PARASITOLOGY: No parasite, including Anguillacoides crassus, were found.

BACTERIOLOGY: All kidney samples were negative by both Aeromonas salmonicida and Yersinia ruckeri.

VIROLOGY: Virus isolation on 5 cel lines (CHSE,EPC,ASK,EK1,FHM) was negative.

MORPHOLOGIC DIAGNOSIS:
Normal eel morphology, no infectious disease of concern identified.

COMMENTS - Virology results for both groups of eels (120 in total) are reported in the lab number U23122-2015, all were negative for viruses. The bacteriology and parasitology results are split between the two submission, U23122-2015 and U23226-2015.

David Groman MSc., PhD. Fish Pathologist
Signed and dated 19-OCT-15

Please consult your veterinarian for interpretation of results.

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Specimen: EEL BODY x60 Rec: 24-SEP-15
Submitted By: THREADER Sample ID: SAMPLE #2 NFLD

HISTORY: A mixture of 60 adult and juvenile American eels were submitted for gross pathology and parasitology examination. These are Lot 2: collected by Dean Cuttler, who fished for them between Sept 9 -15, picked up September 19 at Bay St. George, and set for diagnostic testing at the AVC.

In addition to the gross examination each eel was sampled for general bacteriology using a kidney swab, and eel tissues were grouped into 5 fish pools, each containing gill, spleen, heart and kidney tissues for virus isolation on 5 cell lines.

GROSS FINDINGS: (60 eels were examined)
All eels showed normal morphology, no lesions noted either externally or internally. All swim bladders were removed and opened and no parasite were noted in any of the 60 bladders.

GROSS PARASITOLOGY: No parasite, including Anguillacoides crassus, were found.

BACTERIOLOGY: All kidney samples were negative by both Aeromonas salmonicida and Yersinia ruckeri.

VIROLOGY: Virus isolation on 5 cell lines (CHSE,EPC,ASK,EK1,FHM) was negative.

MORPHOLOGIC DIAGNOSIS:
Normal eel morphology, no infectious disease of concern identified.

COMMENTS - Virology results for both groups of eels (120 in total) are reported in the lab number U23122-2015, all were negative for viruses. The bacteriology and parasitology results are split between the two submission, U23122-2015 and U23226-2015.

David Groman MSc., PhD. Fish Pathologist
Signed and dated 19-OCT-15

Please consult your veterinarian for interpretation of results.

# APPENDIX B

## Turbine Survival Statistical Analysis

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**DERIVATION OF PRECISION, SAMPLE SIZE, AND MAXIMUM LIKELIHOOD PARAMETERS**

The statistical description below is excerpted from Normandeau Associates and Skalski (2000). For the sake of brevity, references within the text have been removed. However, interested readers can look up these citations in the report prepared by Normandeau Associates and Skalski (2000).

The estimation for the likelihood model parameters and sample size requirements discussed in the text are given herein. Additionally, the results of statistical analyses for evaluating homogeneity in recapture and survival probabilities, and in testing hypotheses of equality in parameter estimates under the simplified ($H_O$:$P_A$=$P_D$) versus the most generalized model ($H_A$:$P_A \neq P_D$) are given.

The following terms are defined for the equations and likelihood functions which follow:

| | | |
|---|---|---|
| $R_C$ | = | Number of control fish released |
| $R_T$ | = | Number of treatment fish released |
| R | = | $R_C$=$R_T$ |
| n | = | Number of replicate estimates $\hat{\tau}_i$ ($i$=1,…,n) |
| $a_C$ | = | Number of control fish recaptured alive |
| $d_C$ | = | Number of control fish recaptured dead |
| $a_T$ | = | Number of treatment fish recaptured alive |
| $d_T$ | = | Number of treatment fish recaptured dead |
| S | = | Probability fish survive from the release point of the controls to recapture |
| $P_A$ | = | Probability an alive fish is recaptured |
| $P_D$ | = | Probability a dead fish is recaptured |
| $\tau$ | = | Probability a treatment fish survives to the point of the control releases (*i.e.*, passage survival) |
| 1-$\tau$ | = | Passage-related mortality. |

The precision of the estimate was defined as:

$$P(-\varepsilon < \hat{\tau} - \tau < \varepsilon) = 1 - \alpha$$

or equivalently

$$P(-\varepsilon <| \hat{\tau} - \tau |< \varepsilon) = 1 - \alpha$$

where the absolute errors in estimation, *i.e.*, $|\hat{\tau} - \tau|$, is <$\varepsilon$ (1-$\alpha$) 100% of the time, $\hat{\tau}$ is the estimated passage survival, and $\varepsilon$ is the half-width of a (1-$\alpha$) 100% confidence interval for $\hat{\tau}$ or 1-$\hat{\tau}$. A precision of ±10%, 95% of the time is expressed as P($|\hat{\tau} - \tau|$<0.10)=0.95.

Using the above precision definition and assuming normality of $\hat{\tau} - \tau$, the required total sample size (R) is as follows:

$$P\left( \frac{-\varepsilon}{\sqrt{Var(\hat{\tau})}} < Z < \frac{\varepsilon}{\sqrt{Var(\hat{\tau})}} \right) = 1 - \alpha$$

$$P\left( Z < \frac{-\varepsilon}{\sqrt{Var(\hat{\tau})}} \right) = \alpha / 2$$

$$\Phi\left( \frac{-\varepsilon}{\sqrt{Var(\hat{\tau})}} \right) = \alpha / 2$$

$$\frac{-\varepsilon}{\sqrt{Var(\hat{\tau})}} = Z_{\alpha/2}$$

$$Var(\hat{\tau}) = \frac{\varepsilon^2}{Z^2_{1-\frac{\alpha}{2}}}$$

$$\frac{\tau}{SP_A}\left[ \frac{(1 - S\tau P_A)}{R_T} + \frac{(1 - SP_A)\tau}{R_C} \right] = \frac{\varepsilon^2}{Z^2_{1-\frac{\alpha}{2}}} \ .$$

where Z is a standard normal deviate satisfying the relationship $P(Z>Z_{1-\alpha/2})=\alpha/2$, and $\Phi$ is the cumulative distribution function for a standard normal deviate.

If data can be pooled across trials and letting $R_C=R_T=R$, the sample size for each release is

$$R = \frac{\tau}{SP_A}\left[ 1 + \tau - 2S\tau P_A \right]\frac{Z^2_{1-\alpha/2}}{\varepsilon^2} \ .$$

By rearranging, this equation can be solved to predetermine the anticipated precision given the available number of fish for a study. In most previous investigations (Normandeau Associates and Skalski 2000) this equation has been used to calculate sample sizes because of homogeneity between trials; in the present investigation sample size was predetermined using this equation.

If data cannot be pooled across trials the precision is based on

$$\sum_{i=1}^{n}(1 - \hat{\tau}_i)/n = 1 - \sum_{i=1}^{n}\hat{\tau}_i/n = 1 - \bar{\hat{\tau}} \ .$$

Precision is defined as

$$P(|\bar{\hat{\tau}} - \bar{\tau}| < \varepsilon) = 1 - \alpha$$

$$P(-\varepsilon < \bar{\hat{\tau}} - \bar{\tau} | < \varepsilon) = 1 - \alpha$$

$$P\left( \frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}} < t_{n-1} < \frac{\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}} \right) = 1 - \alpha$$

$$P\left(t_{n-1} < \frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}}\right) = \alpha / 2$$

$$\Phi\left(\frac{-\varepsilon}{Var(\bar{\hat{\tau}})}\right) = \alpha / 2$$

$$\frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}} = t_{\alpha/2,n-1}$$

$$Var(\bar{\hat{\tau}}) = \frac{\varepsilon^2}{t^2_{1-\alpha/2,n-1}}$$

$$\frac{\sigma^2_\tau + \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_A)}{R_T} + \frac{(1-SP_A)\tau}{R_C}\right]}{n} = \frac{\varepsilon^2}{t^2_{1-\alpha/2,n-1}}$$

where $\sigma_\tau^2$=natural variation in passage-related mortality.

Now letting $R_T=R_C$

$$\frac{\sigma^2_\tau + \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_A)}{R} + \frac{(1-SP_A)\tau}{R}\right]}{n} = \frac{\varepsilon^2}{t^2_{1-\alpha/2,n-1}}$$

which must be iteratively solved for n given R. Or R given n where

$$R = \frac{\frac{\tau}{SP_A}\left[(1-S\tau P_A) + (1-SP_A)\tau\right]}{\left[\frac{n\varepsilon^2}{t^2_{1-\alpha/2,n-1}} - \sigma^2_\tau\right]}$$

$$R = \frac{\frac{\tau(1+\tau)}{SP_A}}{\left[\frac{n\varepsilon^2}{t^2_{1-\alpha/2,n-1}} - \sigma^2_\tau\right]}$$

$$R = \frac{\tau(1+\tau)}{SP_A}\left[\frac{t^2_{1-\alpha/2,n-1}}{n\varepsilon^2 - \sigma^2_\tau t^2_{1-\alpha/2,n-1}}\right].$$

The joint likelihood for the passage-related mortality is:

$$L\,(S,\ \tau,\ P_A,\ P_D \mid R_C,\ R_T,\ a_C,\ a_T,\ d_C,\ d_T) =$$

$$\binom{R_C}{a_c d_C}(SP_A)^{a_C}((1-S)P_D)^{d_C}(1-SP_A-(1-S)P_D)^{R_C-a_C-d_C}$$

$$\times\binom{R_T}{a_T d_T}(S\tau P_A)^{a_T}((1-S\tau)P_D)^{d_T}(1-S\tau P_A-(1-S\tau)P_D)^{R_T-a_T-d_T}\ .$$

The likelihood model is based on the following assumptions: (1) fate of each fish is independent, (2) the control and treatment fish come from the same population of inference and share that same survival probability, (3) all alive fish have the same probability, $P_A$, of recapture, (4) all dead fish have the same probability, $P_D$, of recapture, and (5) passage survival ($\tau$) and survival (S) to the recapture point are conditionally independent. The likelihood model has four parameters ($P_A$, $P_D$, S, $\tau$) and four minimum sufficient statistics ($a_C$, $d_C$, $a_T$, $d_T$).

Because any two treatment releases were made concurrently with a single shared control group we used the likelihood model which took into account dependencies within the study design (Normandeau Associates *et al.* 1995). For any two treatment groups (denoted $T_1$ and $T_2$), the likelihood model is as follows:

$$L(S,\tau_1,\tau_2,P_A,P_D \mid R_C,R_{T_1},R_{T_2},a_C,d_c,a_{T_1},d_{T_1},a_{T_2},d_{T_2}) =$$

$$\binom{R_C}{a_c d_C}(SP_A)^{a_C}((1-S)P_D)^{d_C}(1-SP_A-(1-S)P_D)^{R_C-a_C-d_C}$$

$$\times\binom{R_{T_1}}{a_{T_1} d_{T_1}}(S\tau_1 P_A)^{a_{T_1}}((1-S\tau_1)P_D)^{d_{T_1}}(1-S\tau_1 P_A-(1-S\tau_1)P_D)^{R_{T_1}-a_{T_1}-d_{T_1}}$$

$$\times\binom{R_{T_2}}{a_{T_2} d_{T_2}}(S\tau_2 P_A)^{a_{T_2}}((1-S\tau_2)P_D)^{d_{T_2}}(1-S\tau_2 P_A-(1-S\tau_2)P_D)^{R_{T_2}-a_{T_2}-d_{T_2}}\ .$$

This likelihood model has the same assumptions as stated in Normandeau Associates and Skalski (2000) but has five estimable parameters (S, $\tau_1$, $\tau_2$, $P_A$, and $P_D$). The survival rate for treatment $T_1$ is estimated by $\tau_1$ and for treatment $T_2$, by $\tau_2$. A likelihood ratio test with 1 degree of freedom was used to test for equality in survival rates between treatments $\tau_1$ and $\tau_2$ based on the hypothesis $H_O$: $\tau_1 = \tau_2$ versus $H_a$: $\tau_1 \neq \tau_2$.

Likelihood models are based on the following assumptions: (a) the fate of each fish is independent; (b) the control and treatment fish come from the same population of inference and share the same natural survival probability, S; (c) all alive fish have the same probability, $P_A$, of recapture; (d) all dead fish have the same probability, $P_D$, of recapture; and (e) passage survival ($\tau$) and natural survival (S) to the recapture point are conditionally independent.

The estimators associated with the likelihood model are:

$$\hat{\tau} = \frac{a_T R_C}{R_T a_C}$$

$$\hat{S} = \frac{R_T d_C a_C - R_C d_T a_C}{R_C d_C a_T - R_C d_T a_C}$$

$$\hat{P}_A = \frac{d_C a_T - d_T a_C}{R_T d_C - R_C d_T}$$

$$\hat{P}_D = \frac{d_C a_T - d_T a_C}{R_C a_T - R_T a_C} \ .$$

The variance (Var) and standard error (SE) of the estimated passage mortality ($1 - \hat{\tau}$) or survival ($\hat{\tau}$) are:

$$Var(1-\hat{\tau}) = Var(\hat{\tau}) = \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_{A)}}{R_T} + \frac{(1-SP_A)\tau}{R_C}\right]$$

$$SE(1-\hat{\tau}) = SE(\hat{\tau}) = \sqrt{Var(1-\hat{\tau})} \ .$$

**DERIVATION OF VARIANCE FOR WEIGHTED AVERAGE SURVIVAL ESTIMATE**

The variance of a weighted average is estimated by the formula

$$\hat{\bar{\theta}}_W = \frac{\sum_{i=1}^{n} W_i \hat{\theta}_i}{\sum_{i=1}^{n} W_i}$$

with

$$\text{Var}\left(\hat{\bar{\theta}}_W\right) = \frac{\sum_{i=1}^{n} W_i \left(\hat{\theta}_i - \hat{\bar{\theta}}_W\right)^2}{(n-1)\sum_{i=1}^{n} W_i}$$

where $\hat{\bar{\theta}}_W$ = the weighted average,

$\hat{\theta}_i$ = the parameter estimate for the *i*th replicate,

$W_i$ = weight.

**One hour survival estimates for Adult American Eel passed through Unit 4 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 4): 48 released, 45 alive, 1 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9770 | (0.0161) | Recovery probability |
| Tau = | 0.9783 | (0.0215) | Unit 4 survival |
| 1-Tau = | 0.0217 | (0.0215) | Unit 4 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -14.340047

Variance-Covariance matrix for estimated probabilities:
0.00026 0.00000
0.00000 0.00046

Profile likelihood intervals:

| | Unit 4 survival | Unit 4 mortality |
|---|---|---|
| 90 percent: | (0.9230, 0.9977) | (0.0023, 0.0770) |
| 95 percent: | (0.9078, 0.9987) | (0.0013, 0.0922) |
| 99 percent: | (0.8739, 0.9997) | (0.0003, 0.1261) |

Likelihood ratio statistic for equality of recovery probabilities: 2.417010

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult Eel passed through Unit 4 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit4): 48 released, 43 alive, 3 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9770 | (0.0161) | Recovery probability |
| Tau = | 0.9348 | (0.0364) | Unit 4 survival |
| 1-Tau = | 0.0652 | (0.0364) | Unit 4 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -20.612418

Variance-Covariance matrix for estimated probabilities:
0.00026 0.00000
0.00000 0.00133

Profile likelihood intervals:

| | Unit 4 survival | Unit 4 mortality |
|---|---|---|
| 90 percent: | (0.8579, 0.9784) | (0.0216, 0.1421) |
| 95 percent: | (0.8395, 0.9834) | (0.0166, 0.1605) |
| 99 percent: | (0.8004, 0.9906) | (0.0094, 0.1996) |

Likelihood ratio statistic for equality of recovery probabilities: 2.417010

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 8 (1000 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 8-1000 cfs): 48 released, 43 alive, 5 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.8958 | (0.0441) | Unit 8 (1000 cfs) survival |
| 1-Tau = | 0.1042 | (0.0441) | Unit 8 (1000 cfs) mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -16.038854

Variance-Covariance matrix for estimated probabilities:
0.00194

Profile likelihood intervals:

| | Unit 8-1000 cfs survival | Unit 8-1000 cfs mortality |
|---|---|---|
| 90 percent: | (0.8740, 1.0000) | (0.0000, 0.1260) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eel passed through Unit 8 (1000 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 8-1000 cfs): 48 released, 42 alive, 6 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.8750 | (0.0477) | Unit 8 (1000 cfs) survival |
| 1-Tau = | 0.1250 | (0.0477) | Unit 8 (1000 cfs) mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -18.084968

Variance-Covariance matrix for estimated probabilities:
0.00228

Profile likelihood intervals:

| | Unit 8-1000 cfs survival | Unit 8-1000 cfs mortality |
|---|---|---|
| 90 percent: | (0.8521, 1.0000) | (0.0000, 0.1479) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 8 (1700 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 8-1700 cfs): 50 released, 39 alive, 11 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.7800 | (0.0586) | Unit 8 (1700 cfs) survival |
| 1-Tau = | 0.2200 | (0.0586) | Unit 8 (1700 cfs) mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -26.345398

Variance-Covariance matrix for estimated probabilities:
0.00343

Profile likelihood intervals:

| | Unit 8-1700 cfs survival | Unit 8-1700 cfs mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty- eight hour survival estimates for Adult American Eel passed through Unit 8 (1700 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 39, released, 39 alive, 0 dead**
**Treatment (Unit 8-1700 cfs): 50 released, 37 alive, 13 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.7400 | (0.0620) | Unit 8 (1700 cfs) survival |
| 1-Tau = | 0.2600 | (0.0620) | Unit 8 (1700 cfs) mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -28.652846

Variance-Covariance matrix for estimated probabilities:
0.00385

Profile likelihood intervals:

| | Unit 8-1700 cfs survival | Unit 8-1700 cfs mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 9 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 9): 48 released, 46 alive, 1 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9885 | (0.0114) | Recovery probability |
| Tau = | 0.9787 | (0.0210) | Unit 9 survival |
| 1-Tau = | 0.0213 | (0.0210) | Unit 9 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -10.299572

Variance-Covariance matrix for estimated probabilities:
0.00013 -0.00000
-0.00000 0.00044

Profile likelihood intervals:

| | Unit 9 survival | Unit 9 mortality |
|---|---|---|
| 90 percent: | (0.9246, 0.9977) | (0.0023, 0.0754) |
| 95 percent: | (0.9096, 0.9988) | (0.0012, 0.0904) |
| 99 percent: | (0.8765, 0.9997) | (0.0003, 0.1235) |

Likelihood ratio statistic for equality of recovery probabilities: 1.198855

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult Eel passed through Unit 9 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 9): 48 released, 46 alive, 1 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9885 | (0.0114) | Recovery probability |
| Tau = | 0.9787 | (0.0210) | Unit 9 survival |
| 1-Tau = | 0.0213 | (0.0210) | Unit 9 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -10.299572

Variance-Covariance matrix for estimated probabilities:
0.00013 -0.00000
-0.00000 0.00044

Profile likelihood intervals:

| | Unit9 survival | Unit 9 mortality |
|---|---|---|
| 90 percent: | (0.9246, 0.9977) | (0.0023, 0.0754) |
| 95 percent: | (0.9096, 0.9988) | (0.0012, 0.0904) |
| 99 percent: | (0.8765, 0.9997) | (0.0003, 0.1235) |

Likelihood ratio statistic for equality of recovery probabilities: 1.198855

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eels passed through combined Unit 4, Unit 8 (1000 cfs), Unit 8 (1700 cfs) and Unit 9 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment: 194 released, 173 alive, 17 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9828 | (0.0085) | Recovery probability |
| Tau = | 0.9105 | (0.0207) | Vernon Station survival |
| 1-Tau = | 0.0895 | (0.0207) | Vernon Station mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -77.474944

Variance-Covariance matrix for estimated probabilities:
0.00007 -0.00000
-0.00000 0.00043

Profile likelihood intervals:

| | Vernon Station survival | Vernon Station mortality |
|---|---|---|
| 90 percent: | (0.8726, 0.9407) | (0.0593, 0.1274) |
| 95 percent: | (0.8645, 0.9456) | (0.0544, 0.1355) |
| 99 percent: | (0.8478, 0.9544) | (0.0456, 0.1522) |

Likelihood ratio statistic for equality of recovery probabilities: 1.479423

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eels passed through combined Unit 4, Unit 8 (1000 cfs), Unit 8 (1700 cfs) and Unit 9 and combining all controls for Vernon Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment: 194 released, 168 alive, 23 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 0.9871 | (0.0074) | Recovery probability |
| Tau = | 0.8796 | (0.0235) | Vernon Station survival |
| 1-Tau = | 0.1204 | (0.0235) | Vernon Station mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -86.279791

Variance-Covariance matrix for estimated probabilities:
0.00005  0.00000
0.00000  0.00055

Profile likelihood intervals:

| | Vernon Station survival | Vernon Station mortality |
|---|---|---|
| 90 percent: | (0.8373, 0.9147) | (0.0853, 0.1627) |
| 95 percent: | (0.8285, 0.9206) | (0.0794, 0.1715) |
| 99 percent: | (0.8104, 0.9314) | (0.0686, 0.1896) |

Likelihood ratio statistic for equality of recovery probabilities:   1.106921

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10:  2.706
For significance level 0.05:  3.841
For significance level 0.01:  6.635

**Forty-eight hour survival estimates on Adult American Eels passed through Unit 2 and combining all controls at Bellows Falls, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 2): 50 released, 31 alive, 19 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9800 | (0.0198) | Unit 2 survival |
| 1-Tau = | 0.0200 | (0.0198) | Unit 2 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -4.901956

Variance-Covariance matrix for estimated probabilities:
0.00039

Profile likelihood intervals:

| | Unit 2 survival | Unit 2 mortality |
|---|---|---|
| 90 percent: | (0.9708, 1.0000) | (0.0000, 0.0292) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates on Adult American Eels passed through Unit 2 and combing all controls at Wilder Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 2): 50 released, 40 alive, 10 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.8000 | (0.0566) | Unit 2 survival |
| 1-Tau = | 0.2000 | (0.0566) | Unit 2 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -25.020121

Variance-Covariance matrix for estimated probabilities:
0.00320

Profile likelihood intervals:

| | Unit 2 survival | Unit 2 mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American eels passed through Unit 2 and combing all controls at Wilder Station, October-November 2015.**
**Control: 39 released, 39 alive, 0 dead**
**Treatment (Unit 2): 50 released, 31 alive, 19 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.6200 | (0.0686) | Unit 2 survival |
| 1-Tau = | 0.3800 | (0.0686) | Unit 2 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -33.203206

Variance-Covariance matrix for estimated probabilities:
0.00471

Profile likelihood intervals:

| | Unit 2 survival | Unit 2 mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eel passed through Unit 4 combining all controls, at Vernon Station, October-November 2015.**
**Control: 38 examined, 36 without maladies, 2 with maladies**
**Treatment (Unit 4): 45 examined, 29 without maladies, 16 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.6802 | (0.0797) | Unit 4 Malady-Free Estimate |
| 1-Tau = | 0.3198 | (0.0797) | Unit 4 Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -37.122111

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00094
-0.00094 0.00635

Profile likelihood intervals:

| | Unit 4 Malady-Free CI | Unit 4 Malady CI |
|---|---|---|
| 90 percent: | (0.5483, 0.8121) | (0.1879, 0.4517) |
| 95 percent: | (0.5231, 0.8388) | (0.1612, 0.4769) |
| 99 percent: | (0.4743, 0.8948) | (0.1052, 0.5257) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eel passed through Unit8 (1000 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 examined, 36 without maladies, 2 with maladies**
**Treatment (Unit 8-1000 cfs): 46 examined, 32 without maladies, 14 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.7343 | (0.0769) | Unit 8-1000 cfs Malady-Free Estimate |
| 1-Tau = | 0.2657 | (0.0769) | Unit 8-1000 cfs Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -36.102451

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00102
-0.00102 0.00592

Profile likelihood intervals:

| | Unit 8-1000 cfs Malady-Free CI | Unit 8-1000 cfs Malady CI |
|---|---|---|
| 90 percent: | (0.6055, 0.8622) | (0.1378, 0.3945) |
| 95 percent: | (0.5805, 0.8886) | (0.1114, 0.4195) |
| 99 percent: | (0.5316, 0.9451) | (0.0549, 0.4684) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eel passed through Unit 8 (1700 cfs) and combining all controls at Vernon Station, October-November 2015.**
**Control: 38 examined, 36 without maladies, 2 with maladies**
**Treatment (Unit 8-1700 cfs): 44 examined, 31 without maladies 13 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 0.9880 | (0.0120) | Recovery probability |
| Tau = | 0.7437 | (0.0780) | Unit 8-1700 cfs Malady-Free Estimate |
| 1-Tau = | 0.2563 | (0.0780) | Unit 8-1700 cfs Malady Estimate |

Log-likelihood: -39.954489

Variance-Covariance matrix for estimated probabilities:
0.00131 0.00000 -0.00103
0.00000 0.00014 -0.00000
-0.00103 -0.00000 0.00608

Profile likelihood intervals:

| | Unit 8-1700 cfs Malady-Free CI | Unit 8-1700 cfs Malady CI |
|---|---|---|
| 90 percent: | (0.6126, 0.8729) | (0.1271, 0.3874) |
| 95 percent: | (0.5870, 0.8995) | (0.1005, 0.4130) |
| 99 percent: | (0.5370, 0.9565) | (0.0435, 0.4630) |

Likelihood ratio statistic for equality of recovery probabilities: 0.294649

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eel passed through Unit 9 and combining all controls at Vernon Project, October-November 2015.**
**Control: 38 examined, 36 without maladies, 2 maladies**
**Treatment (Unit 9): 46 examined, 42 without maladies, 4 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9638 | (0.0573) | Unit 9 Malady-Free Estimate |
| 1-Tau = | 0.0362 | (0.0573) | Unit 9 Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -21.425501

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00133
-0.00133 0.00328

Profile likelihood intervals:

| | Unit 9 Malady-Free CI | Unit 9 Malady CI |
|---|---|---|
| 90 percent: | (0.8648, 1.0000) | (0.0000, 0.1352) |
| 95 percent: | (0.8437, 1.0000) | (0.0000, 0.1563) |
| 99 percent: | (0.8001, 1.0000) | (0.0000, 0.1999) |

Likelihood ratio statistic for equality of recovery probabilities: -0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate on Adult American Eel passed through combined Unit 4, Unit 8 (1000 cfs), Unit 8 (1700 cfs), and Unit 9 and combining all controls at Vernon Station, October-November 2015.**
**Control: 39 examined, 38 without maladies, 2 with maladies**
**Treatment: 181 examined, 134 without maladies, 47 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.7815 | (0.0456) | Vernon Station Malady-Free Estimate |
| 1-Tau = | 0.2185 | (0.0456) | Vernon Station Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -111.495790

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00108
-0.00108 0.00208

Profile likelihood intervals:

| | Vernon Station Malady-Free CI | Vernon Station Malady CI |
|---|---|---|
| 90 percent: | (0.7121, 0.8714) | (0.1286, 0.2879) |
| 95 percent: | (0.6994, 0.8937) | (0.1063, 0.3006) |
| 99 percent: | (0.6747, 0.9443) | (0.0557, 0.3253) |

Likelihood ratio statistic for equality of recovery probabilities: -0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eel passed through Unit 2 and combining all controls at Bellows Falls, October-November 2015.**
**Control: 38 examined, 36 without maladies, 2 with maladies**
**Treatment (Unit 2): 50 examined, 43 without maladies, 7 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9078 | (0.0624) | Unit 2 Malady-Free Estimate |
| 1-Tau = | 0.0922 | (0.0624) | Unit 2 Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -28.083472

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00126
-0.00126 0.00389

Profile likelihood intervals:

| | Unit 2 Malady-Free CI | Unit 2 Malady CI |
|---|---|---|
| 90 percent: | (0.8011, 1.0000) | (0.0000, 0.1989) |
| 95 percent: | (0.7792, 1.0000) | (0.0000, 0.2208) |
| 99 percent: | (0.7348, 1.0000) | (0.0000, 0.2652) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Malady-Free estimate for Adult American Eels passed through Unit 2 and combining all controls at Wilder Station, October-November 2015.**
**Control: 38 examined, 36 without maladies, 2 with maladies**
**Treatment (Unit 2): 47 examined, 27 without maladies, 20 with maladies**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 0.9474 | (0.0362) | Control group survival |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.6064 | (0.0796) | Unit 2 Malady-Free Estimate |
| 1-Tau = | 0.3936 | (0.0796) | Unit 2 Malady Estimate |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -39.889994

Variance-Covariance matrix for estimated probabilities:
0.00131 -0.00084
-0.00084 0.00633

Profile likelihood intervals:

| | Unit 2 Malady-Free CI | Unit 2 Malady CI |
|---|---|---|
| 90 percent: | (0.4769, 0.7389) | (0.2611, 0.5231) |
| 95 percent: | (0.4527, 0.7654) | (0.2346, 0.5473) |
| 99 percent: | (0.4065, 0.8201) | (0.1799, 0.5935) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 4 and Unit 9 at Vernon Project for <u>only recaptured eels</u> and combining all controls, October-November 2015.**
**Controls: 38 recaptured, 38 alive, 0 dead**
**Treatment Unit 4: 45 recaptured, 45 alive, 0 dead**
**Treatment Unit 9: 46 recaptured, 46 alive, 0 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S1 = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| S2 = | 1.0 | N/A | Unit 4 Turbine survival* |
| S3 = | 1.0 | N/A | Unit 9 Turbine survival* |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: 0.0000

Tau = 1.0000 (0.0000) Unit 4 Turbine/Control ratio
Tau = 1.0000 (0.0000) Unit 9 Turbine/Control ratio

Z statistic for the equality of equal turbine survivals: 0.0000

Compare with quantiles of the normal distribution:

| | 1-tailed | 2-tailed |
|---|---|---|
| For significance level 0.10: | 1.2816 | 1.6449 |
| For significance level 0.05: | 1.6449 | 1.9600 |
| For significance level 0.01: | 2.3263 | 2.5758 |

Confidence intervals:

| | Unit 4 Survival | Unit 9 Survival |
|---|---|---|
| 90 percent: | (1.0000, 1.0000) | (1.0000, 1.0000) |
| 95 percent: | (0.9999, 1.0001) | (1.0000, 1.0000) |
| 99 percent: | (0.9999, 1.0001) | (0.9999, 1.0001) |

Likelihood ratio statistic for equality of recovery probabilities: 0.0000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eel passed through Unit 4 for only recaptured eels and combining all controls at Vernon Station, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment (Unit 4): 45 recaptured, 43 alive, 2 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9556 | (0.0307) | Unit 4 survival |
| 1-Tau = | 0.0444 | (0.0307) | Unit 4 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -8.181913

Variance-Covariance matrix for estimated probabilities:
0.00094

Profile likelihood intervals:

| | Unit 4 survival | Unit 4 mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 8 (1000 cfs) and Unit 8 (1700 cfs) for only recaptured eels and combining all controls at Vernon Station, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment (Unit 8-1000 cfs): 46 recaptured, 43 alive, 3 dead**
**Treatment (Unit 8-1700 cfs): 44 recaptured 39 alive, 5 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S1 = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| S2 = | 0.9348 | (0.0364) | Unit 8-1000 cfs Turbine survival |
| S3 = | 0.8864 | (0.0478) | Unit 8-1700 cfs Turbine survival |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -26.6683

Tau = 0.9348 (0.0364) Unit 8 (1000 cfs) Unit 8-1000 cfs survival/Control ratio
Tau = 0.8864 (0.0478) Unit 8 (1700 cfs) Unit 8-1700 cfs survival/Control ratio

Z statistic for the equality of equal turbine survivals: 0.8054

Compare with quantiles of the normal distribution:

| | 1-tailed | 2-tailed |
|---|---|---|
| For significance level 0.10: | 1.2816 | 1.6449 |
| For significance level 0.05: | 1.6449 | 1.9600 |
| For significance level 0.01: | 2.3263 | 2.5758 |

Confidence intervals:

| | Unit 8-1000 cfs | Unit 8-1700 cfs |
|---|---|---|
| 90 percent: | (0.8749, 0.9947) | (0.8077, 0.9651) |
| 95 percent: | (0.8634, 1.0061) | (0.7926, 0.9801) |
| 99 percent: | (0.8410, 1.0285) | (0.7632, 1.0096) |

Likelihood ratio statistic for equality of recovery probabilities: 0.0000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eel passed through Unit 8 (1000 cfs) for <u>only recaptured eels</u> and combining all controls at Vernon Station, October-November 2015.**
**Control 38 recaptured, 38 alive, 0 dead**
**Treatment (Unit 8-1000 cfs): 46 recaptured, 42 alive, 4 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9130 | (0.0415) | Unit 8-1000 cfs survival |
| 1-Tau = | 0.0870 | (0.0415) | Unit 8-1000 cfs mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -13.590203

Variance-Covariance matrix for estimated probabilities:
0.00173

Profile likelihood intervals:

| | Unit 8-1000 cfs survival | Unit 8-1000 cfs mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimate for Adult American Eels passed through Unit 8 (1700 cfs) for only recaptured eels and combining all controls at Vernon Station, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment (Unit 8-1700 cfs): 44 recaptured, 37 alive, 7 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.8409 | (0.0551) | Unit 8-1700 cfs survival |
| 1-Tau = | 0.1591 | (0.0551) | Unit 8-1700 cfs mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -19.279010

Variance-Covariance matrix for estimated probabilities:
0.00304

Profile likelihood intervals:

| | Unit 8-1700 cfs survival | Unit 8-1700 cfs mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eel passed through Unit 4, Unit 8 (1000 cfs), Unit 8 (1700 cfs), and Unit 9 for <u>only recaptured eels</u> and combining all controls at Vernon Station, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment: 181 recaptured, 173, alive, 8 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9558 | (0.0153) | Vernon Station survival |
| 1-Tau = | 0.0442 | (0.0153) | Vernon Station mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -32.772984

Variance-Covariance matrix for estimated probabilities:
0.00023

Profile likelihood intervals:

| | Vernon Station survival | Vernon Station mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eels passed through Unit 4, Unit 8(1000 cfs), Unit 8 (1700 cfs), and Unit 9 for only recaptured eels and all controls at Vernon Station, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment: 181 recaptured, 168 alive, 13 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9282 | (0.0192) | Vernon Station survival |
| 1-Tau = | 0.0718 | (0.0192) | Vernon Station mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -46.757672

Variance-Covariance matrix for estimated probabilities:
0.00037

Profile likelihood intervals:

| | Vernon Station survival | Vernon Station mortality |
|---|---|---|
| 90 percent: | (0.9091, 1.0000) | (0.0000, 0.0909) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**One hour survival estimates for Adult American Eels passed through Bellows Falls Unit 2 and Wilder Unit 2 for <u>only recaptured eels</u> and combining all controls, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment BF: 50 recaptured, 50, 0 dead**
**Treatment Wilder: 47 recaptured, 40 alive, 7 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S1 = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| S2 = | 1.0 | N/A | Bellows Falls Unit 2 survival* |
| S3 = | 0.8511 | (0.0519) | Wilder Unit 2 survival |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -19.7804

Tau = 1.0000 (0.0000) Bellows Falls Unit 2/Control ratio
Tau = 0.8511 (0.0519) Wilder Unit 2/Control ratio

Z statistic for the equality of equal turbine survivals: 2.8679

Compare with quantiles of the normal distribution:

| | 1-tailed | 2-tailed |
|---|---|---|
| For significance level 0.10: | 1.2816 | 1.6449 |
| For significance level 0.05: | 1.6449 | 1.9600 |
| For significance level 0.01: | 2.3263 | 2.5758 |

Confidence intervals:

| | BF Unit 2 | Wilder Unit 2 |
|---|---|---|
| 90 percent: | (1.0000, 1.0000) | (0.7656, 0.9365) |
| 95 percent: | (0.9999, 1.0001) | (0.7493, 0.9529) |
| 99 percent: | (0.9999, 1.0001) | (0.7173, 0.9848) |

Likelihood ratio statistic for equality of recovery probabilities: 0.0000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eels passed through Unit 2 at Bellows Falls for only recaptured eels and all combining all controls, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment (BF Unit 2): 50 recaptured, 49 alive, 1 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.9800 | (0.0198) | Bellows Falls Unit 2 survival |
| 1-Tau = | 0.0200 | (0.0198) | Bellows Falls Unit 2 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -4.901956

Variance-Covariance matrix for estimated probabilities:
0.00039

Profile likelihood intervals:

| | BF Unit 2 survival | BF Unit 2 mortality |
|---|---|---|
| 90 percent: | (0.9708, 1.0000) | (0.0000, 0.0292) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

**Forty-eight hour survival estimates for Adult American Eels passed through Unit 2 at Wilder Station for only recaptured eels and combining all controls, October-November 2015.**
**Control: 38 recaptured, 38 alive, 0 dead**
**Treatment (Wilder Unit 2): 47 recaptured, 31 alive, 16 dead**

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

| | estim. | std.err. | |
|---|---|---|---|
| S = | 1.0 | N/A | Control group survival* |
| Pa = Pd | 1.0 | N/A | Recovery probability* |
| Tau = | 0.6596 | (0.0691) | Wilder Unit 2 survival |
| 1-Tau = | 0.3404 | (0.0691) | Wilder Unit 2 mortality |

* Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

Log-likelihood: -30.141914

Variance-Covariance matrix for estimated probabilities:
0.00478

Profile likelihood intervals:

| | Wilder Unit 2 survival | Wilder Unit 2 mortality |
|---|---|---|
| 90 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 95 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |
| 99 percent: | (0.0000, 1.0000) | (0.0000, 1.0000) |

Likelihood ratio statistic for equality of recovery probabilities: 0.000000

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

# APPENDIX C

## Daily Turbine Survival Recapture Data

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**Daily data for recaptured adult eels passed through Units 4, 8 (2 releases) and 9 at Vernon Station, Bellows Falls Unit 2 and Wilder Unit 2, October-November 2015. Combined controls released into the tailrace downstream of the three stations.**

| | Vernon Station | | | | Bellows Falls | Wilder | |
|---|---|---|---|---|---|---|---|
| | Unit 8-1000cfs | Unit 9 | Unit 4 | Unit 8-1700cfs | Unit 2 | Unit 2 | |
| | 10/26 | 10/27 | 10/28 | 11/3 | 10/30 | 11/1 | Totals |
| | | | **Treatment** | | | | |
| Number released | 48 | 48 | 48 | 50 | 50 | 50 | **294** |
| Number alive | 43 | 46 | 45 | 39 | 50 | 40 | **263** |
| Number recovered dead | 3 | 0 | 0 | 5 | 0 | 7 | **15** |
| Assigned dead | 2 | 1 | 1 | 6 | 0 | 3 | **13** |
| Dislodged tags | 2 | 0 | 1 | 4 | 0 | 3 | **10** |
| Stationary radio signals | 0 | 1 | 0 | 2 | 0 | 0 | **3** |
| Undetermined | 0 | 1 | 2 | 0 | 0 | 0 | **3** |
| Held and Alive 1 h | 43 | 46 | 45 | 39 | 50 | 40 | **263** |
| Alive 24 h | 42 | 46 | 43 | 38 | 49 | 37 | **255** |
| Alive 48 h | 42 | 46 | 43 | 37 | 49 | 31 | **248** |
| | | | **Controls** | | | | |
| Number released | | 10 | 9 | | 10 | 10 | **39** |
| Number alive | | 10 | 9 | | 10 | 9 | **38** |
| No. Assigned Alive* | | 0 | 0 | | 0 | 1 | **1** |
| Number recovered dead | | 0 | 0 | | 0 | 0 | **0** |
| Assigned dead | | 0 | 0 | | 0 | 0 | **0** |
| Dislodged tags | | 0 | 0 | | 0 | 0 | **0** |
| Stationary radio signals | | 0 | 0 | | 0 | 0 | **0** |
| Undetermined | | 0 | 0 | | 0 | 0 | **0** |
| Held and Alive 1 h | | 10 | 9 | | 10 | 9 | **38** |
| Alive 24 h | | 10 | 9 | | 10 | 9 | **38** |
| Alive 48 h | | 10 | 9 | | 10 | 9 | **38** |

* Eel assigned alive status based on telemetry and visual observation.

# APPENDIX D

## Daily Turbine Survival Injury Data

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**Daily malady data for recaptured adult eels passed through Units 4, 8 (2 releases) and 9 at Vernon Station, Bellows Falls Unit 2 and Wilder Unit 2, October-November 2015. Combined controls released into the tailrace downstream of the three stations.**

| | Vernon Station | | | | Bellows Falls | Wilder | |
|---|---|---|---|---|---|---|---|
| | Unit 8-1000cfs | Unit 9 | Unit 4 | Unit 8-1700cfs | Unit 2 | Unit 2 | |
| | 10/26 | 10/27 | 10/28 | 11/3 | 10/30 | 11/1 | Totals |
| **Treatment** | | | | | | | |
| Number released | 48 | 48 | 48 | 50 | 50 | 50 | **294** |
| Number examined | 46 | 46 | 45 | 44 | 50 | 47 | **278** |
| Passage related maladies | 14 | 4 | 16 | 13 | 7 | 20 | **74** |
| Visible injuries | 13 | 4 | 16 | 12 | 7 | 20 | **72** |
| Loss of equilibrium only | 1 | 0 | 0 | 1 | 0 | 0 | **2** |
| Without maladies (passage related) | 32 | 42 | 29 | 31 | 43 | 27 | **204** |
| With non-passage maladies | 0 | 0 | 1 | 0 | 0 | 0 | **1** |
| **Controls** | | | | | | | |
| Number released | | 10 | 9 | | 10 | 10 | **39** |
| Number examined | | 10 | 9 | | 10 | 9 | **38** |
| Passage related maladies | | 0 | 0 | | 2 | 0 | **2** |
| Visible injuries | | 0 | 0 | | 2 | 0 | **2** |
| Loss of equilibrium only | | 0 | 0 | | 0 | 0 | **0** |
| Without maladies | | 10 | 9 | | 8 | 9 | **36** |
| Without maladies that died | | 0 | 0 | | 0 | 0 | **0** |

# APPENDIX E

## 2D Maps of Eel Movement and Passage

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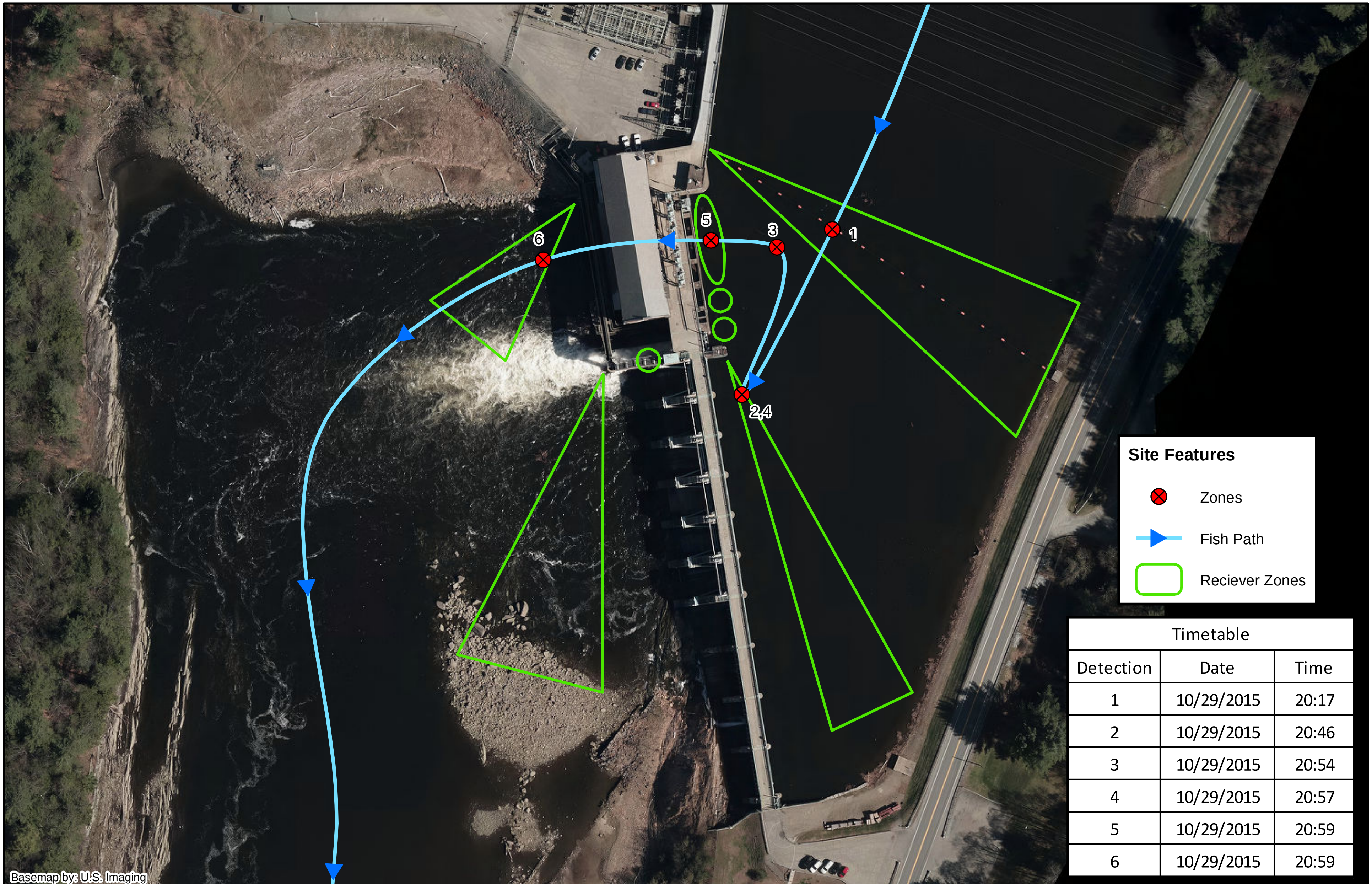


Timetable

| Detection | Date | Time |
|---|---|---|
| 1 | 10/29/2015 | 20:17 |
| 2 | 10/29/2015 | 20:46 |
| 3 | 10/29/2015 | 20:54 |
| 4 | 10/29/2015 | 20:57 |
| 5 | 10/29/2015 | 20:59 |
| 6 | 10/29/2015 | 20:59 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-121 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:15

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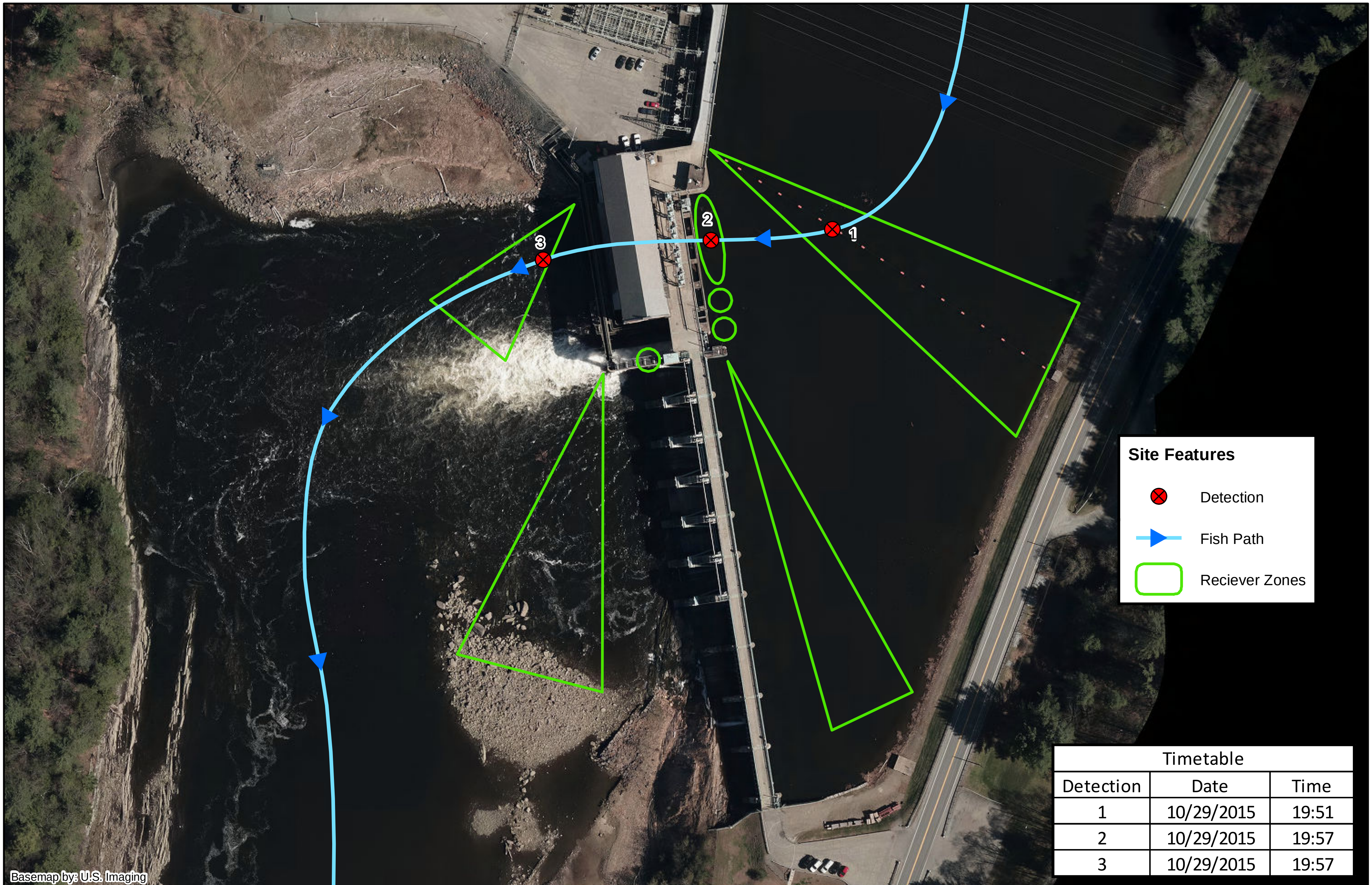


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 19:51 |
| 2 | 10/29/2015 | 19:57 |
| 3 | 10/29/2015 | 19:57 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-122 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 20:05

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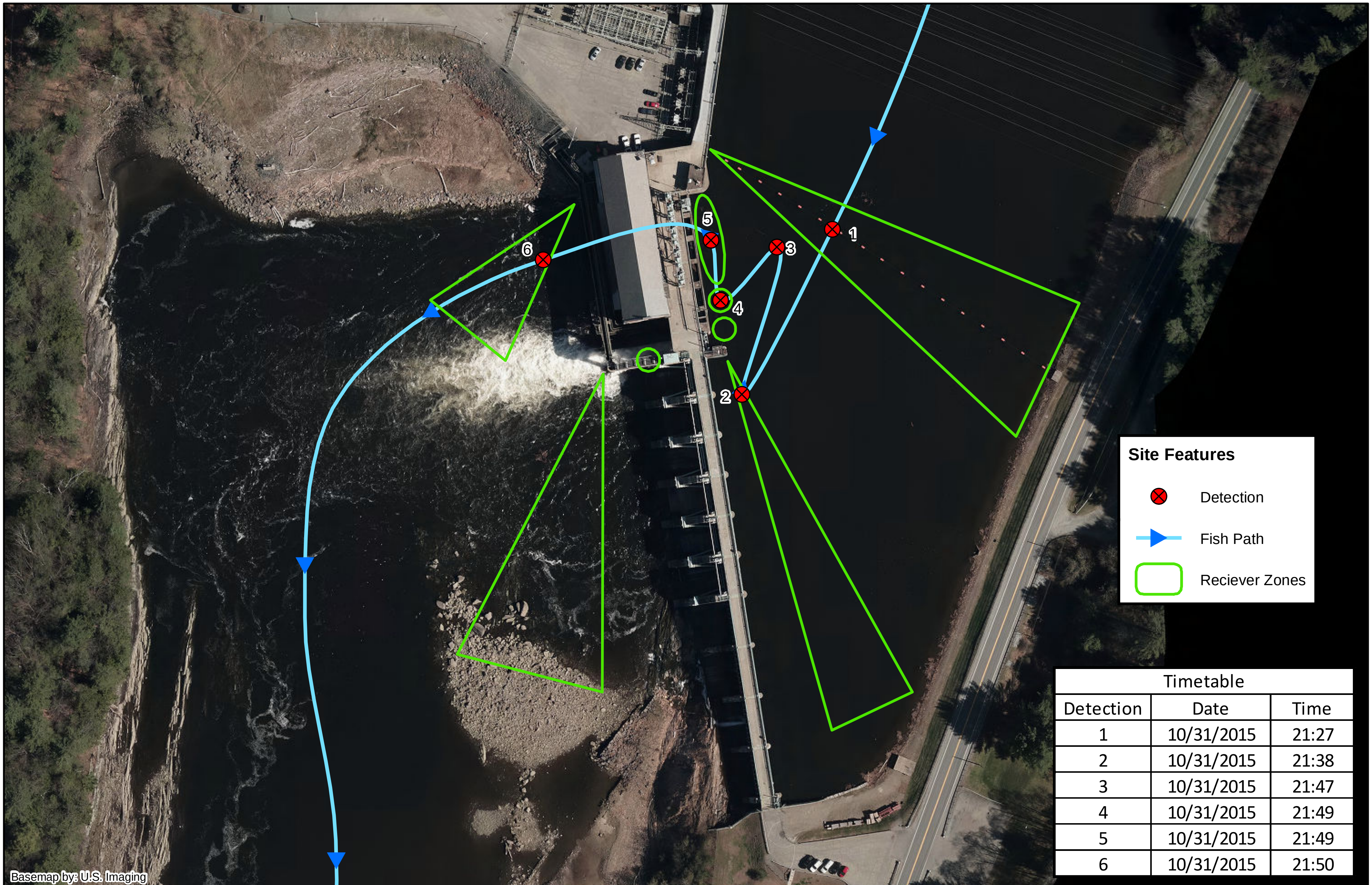


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 21:27 |
| 2 | 10/31/2015 | 21:38 |
| 3 | 10/31/2015 | 21:47 |
| 4 | 10/31/2015 | 21:49 |
| 5 | 10/31/2015 | 21:49 |
| 6 | 10/31/2015 | 21:50 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-123 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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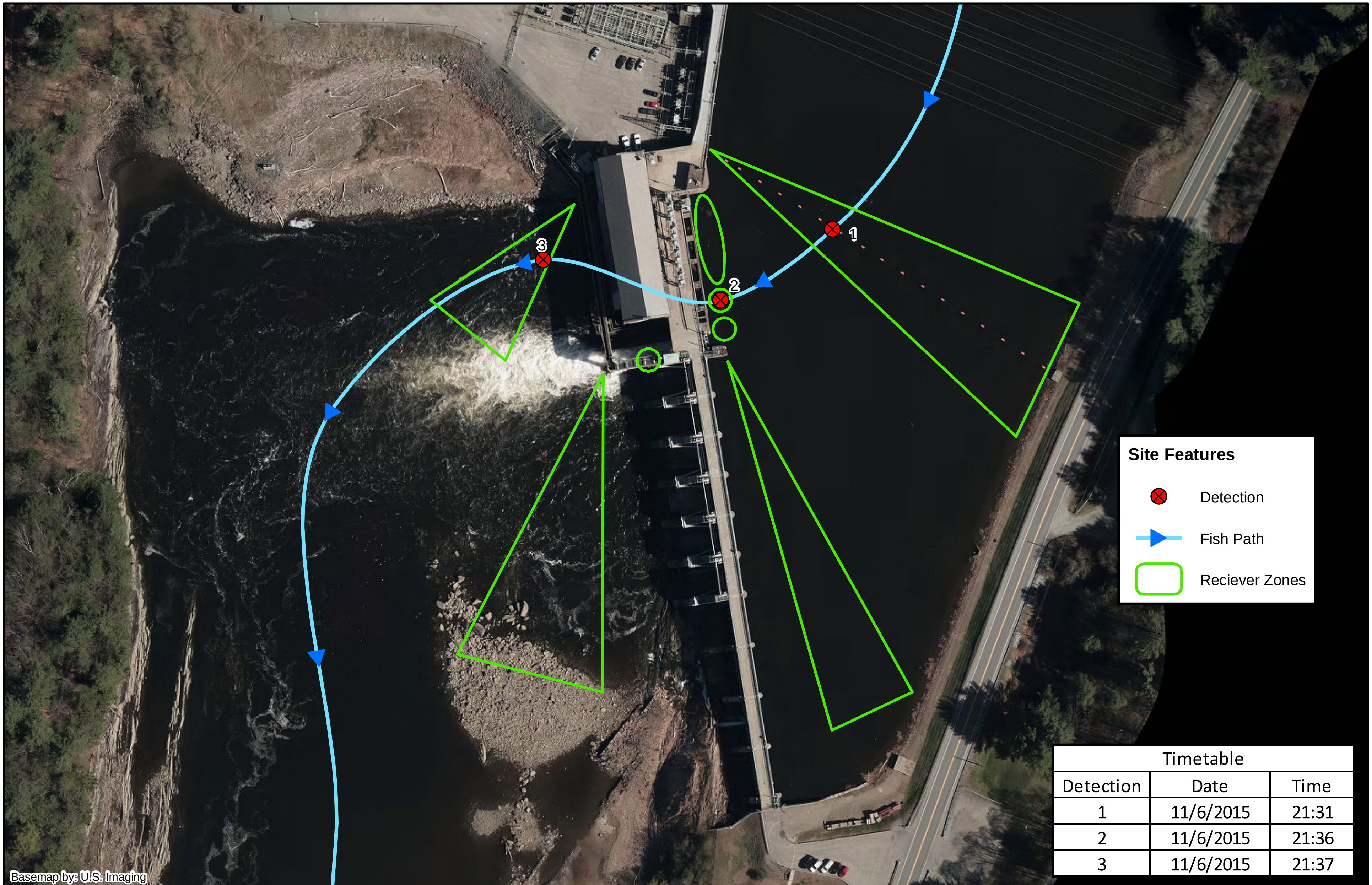


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 21:31 |
| 2 | 11/6/2015 | 21:36 |
| 3 | 11/6/2015 | 21:37 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-127 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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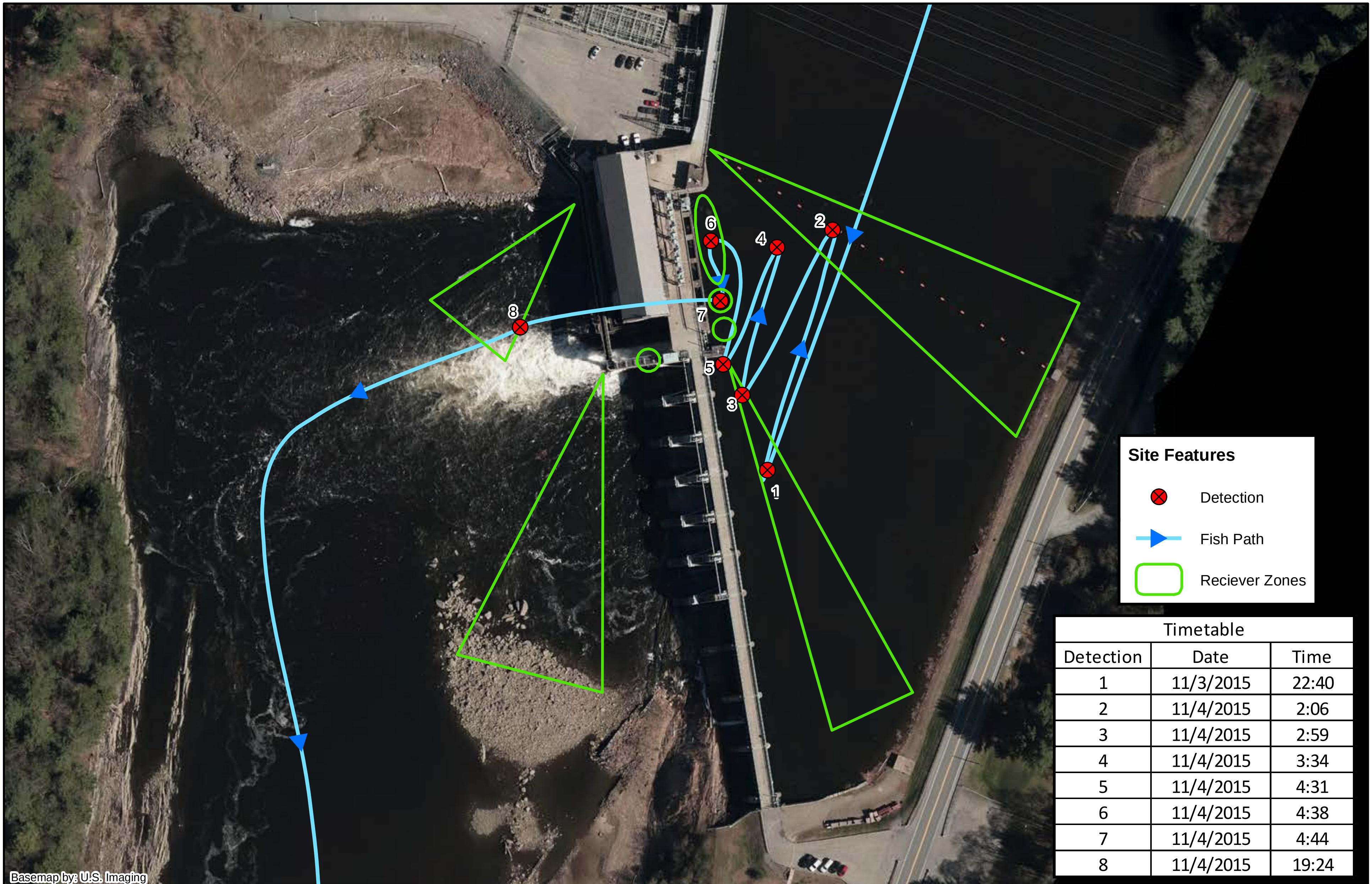


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 22:40 |
| 2 | 11/4/2015 | 2:06 |
| 3 | 11/4/2015 | 2:59 |
| 4 | 11/4/2015 | 3:34 |
| 5 | 11/4/2015 | 4:31 |
| 6 | 11/4/2015 | 4:38 |
| 7 | 11/4/2015 | 4:44 |
| 8 | 11/4/2015 | 19:24 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-128 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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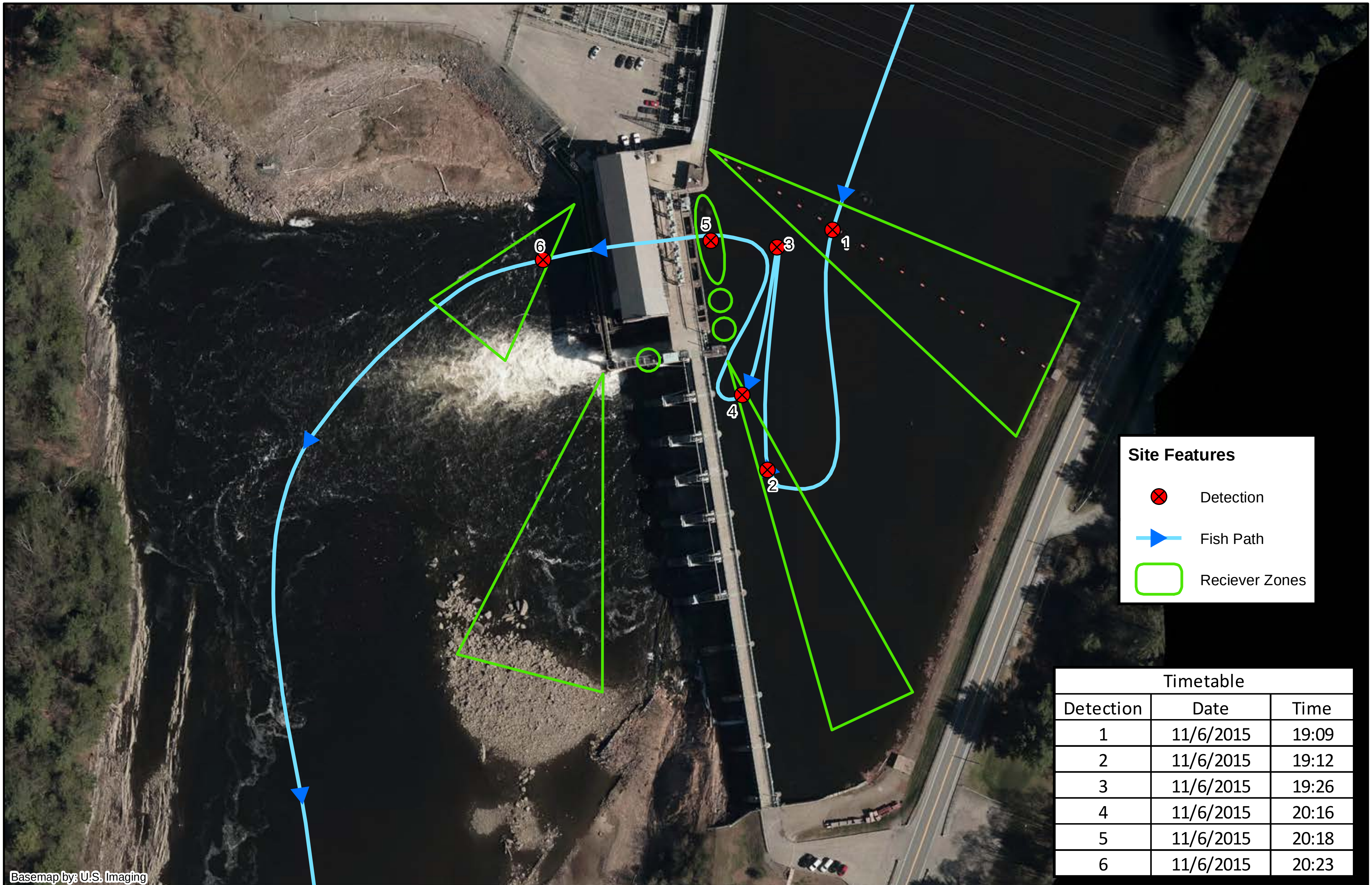


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:09 |
| 2 | 11/6/2015 | 19:12 |
| 3 | 11/6/2015 | 19:26 |
| 4 | 11/6/2015 | 20:16 |
| 5 | 11/6/2015 | 20:18 |
| 6 | 11/6/2015 | 20:23 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-129 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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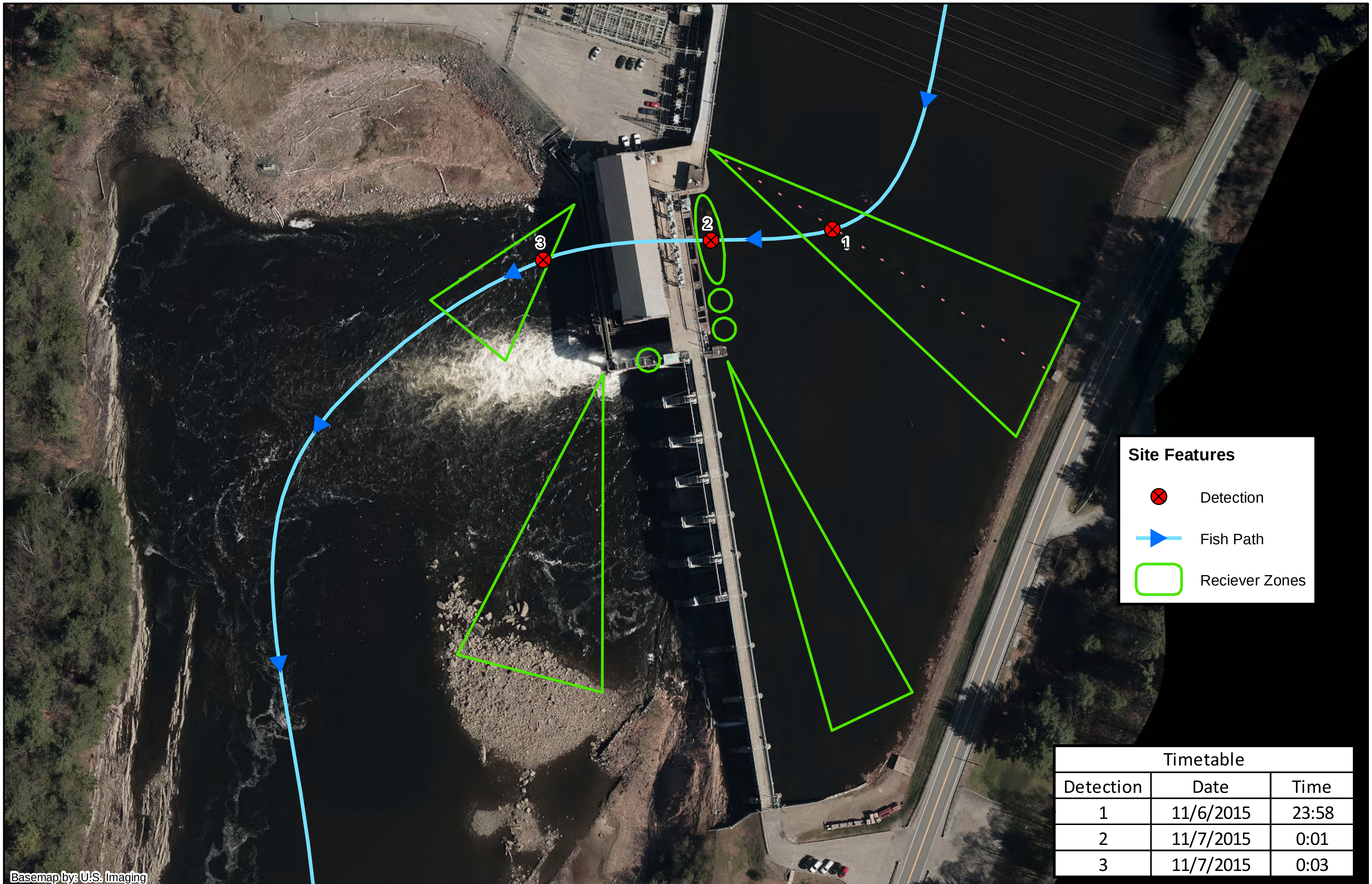


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 23:58 |
| 2 | 11/7/2015 | 0:01 |
| 3 | 11/7/2015 | 0:03 |

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**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-130 (A1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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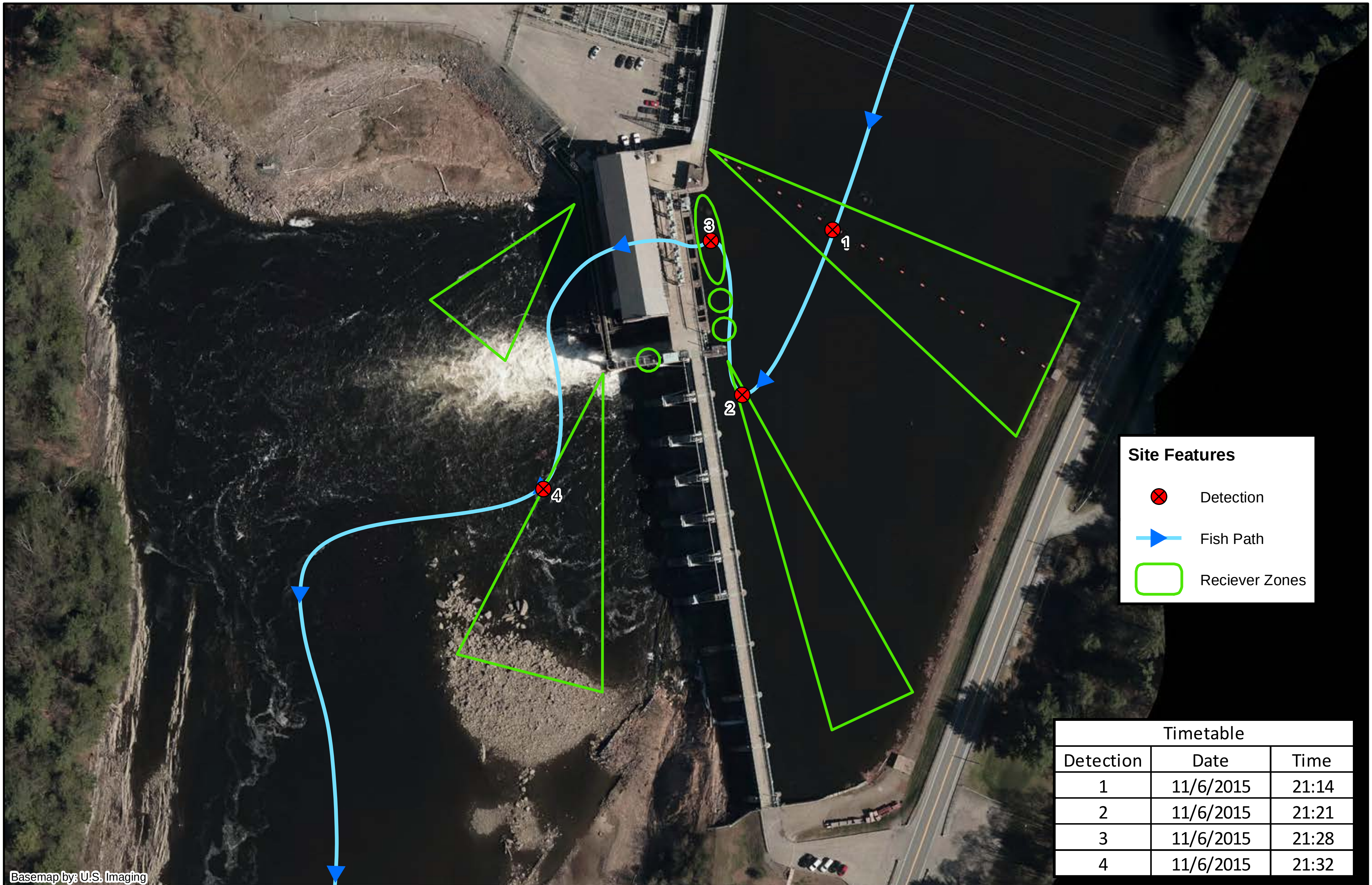


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 21:14 |
| 2 | 11/6/2015 | 21:21 |
| 3 | 11/6/2015 | 21:28 |
| 4 | 11/6/2015 | 21:32 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-151 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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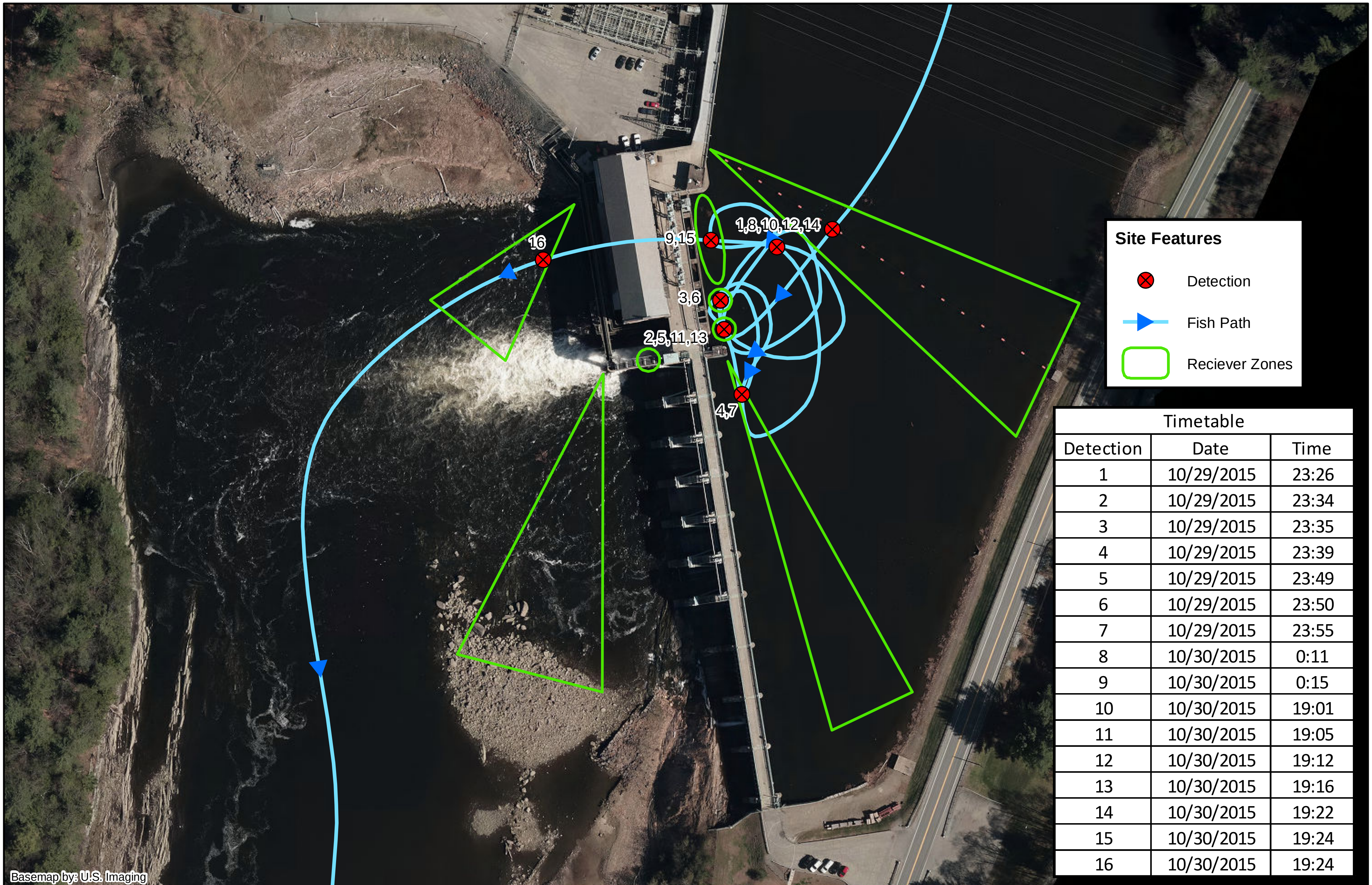


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 23:26 |
| 2 | 10/29/2015 | 23:34 |
| 3 | 10/29/2015 | 23:35 |
| 4 | 10/29/2015 | 23:39 |
| 5 | 10/29/2015 | 23:49 |
| 6 | 10/29/2015 | 23:50 |
| 7 | 10/29/2015 | 23:55 |
| 8 | 10/30/2015 | 0:11 |
| 9 | 10/30/2015 | 0:15 |
| 10 | 10/30/2015 | 19:01 |
| 11 | 10/30/2015 | 19:05 |
| 12 | 10/30/2015 | 19:12 |
| 13 | 10/30/2015 | 19:16 |
| 14 | 10/30/2015 | 19:22 |
| 15 | 10/30/2015 | 19:24 |
| 16 | 10/30/2015 | 19:24 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-152 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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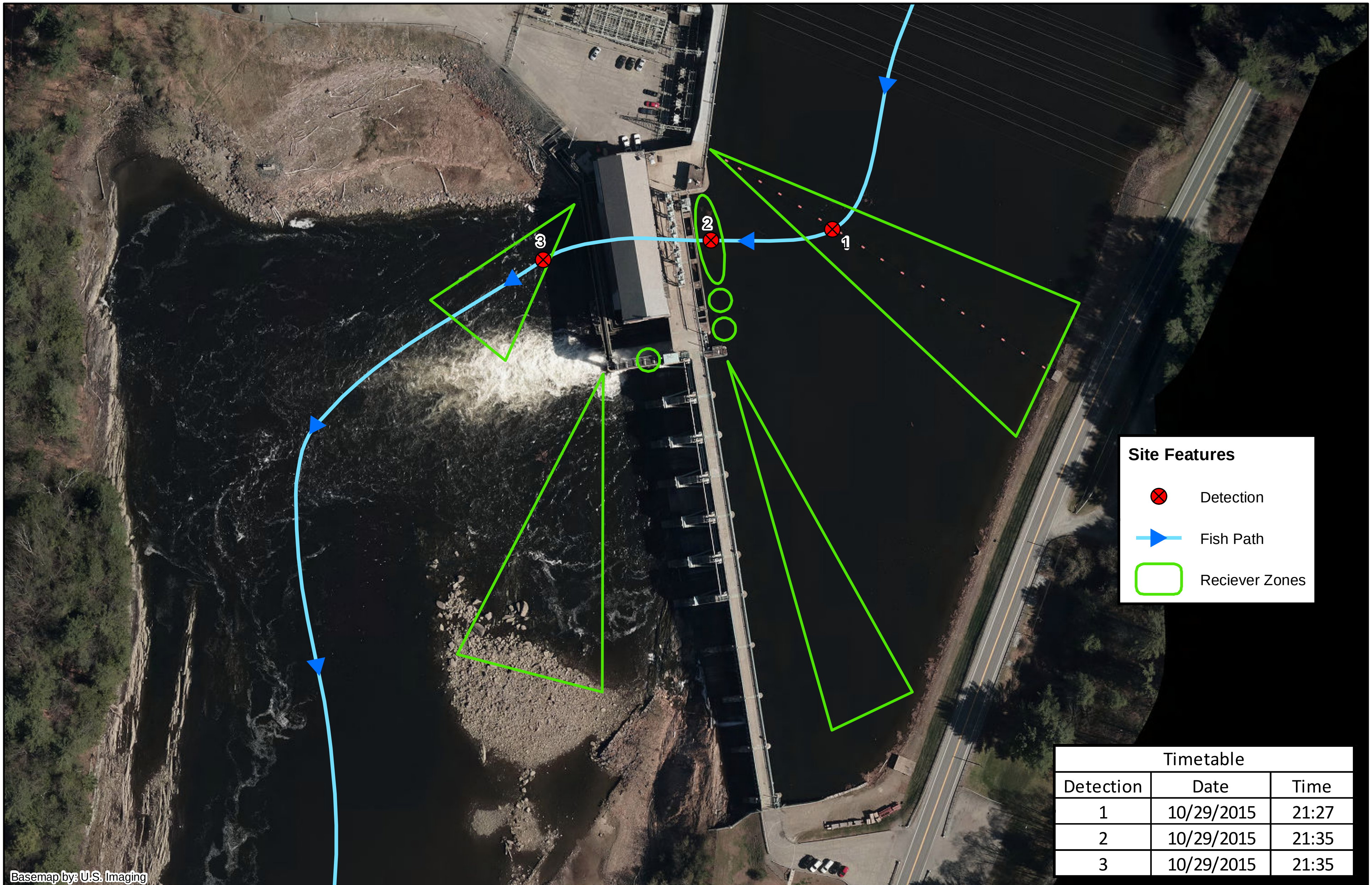


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:27 |
| 2 | 10/29/2015 | 21:35 |
| 3 | 10/29/2015 | 21:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

**Study 19 Fish Number: 34-153 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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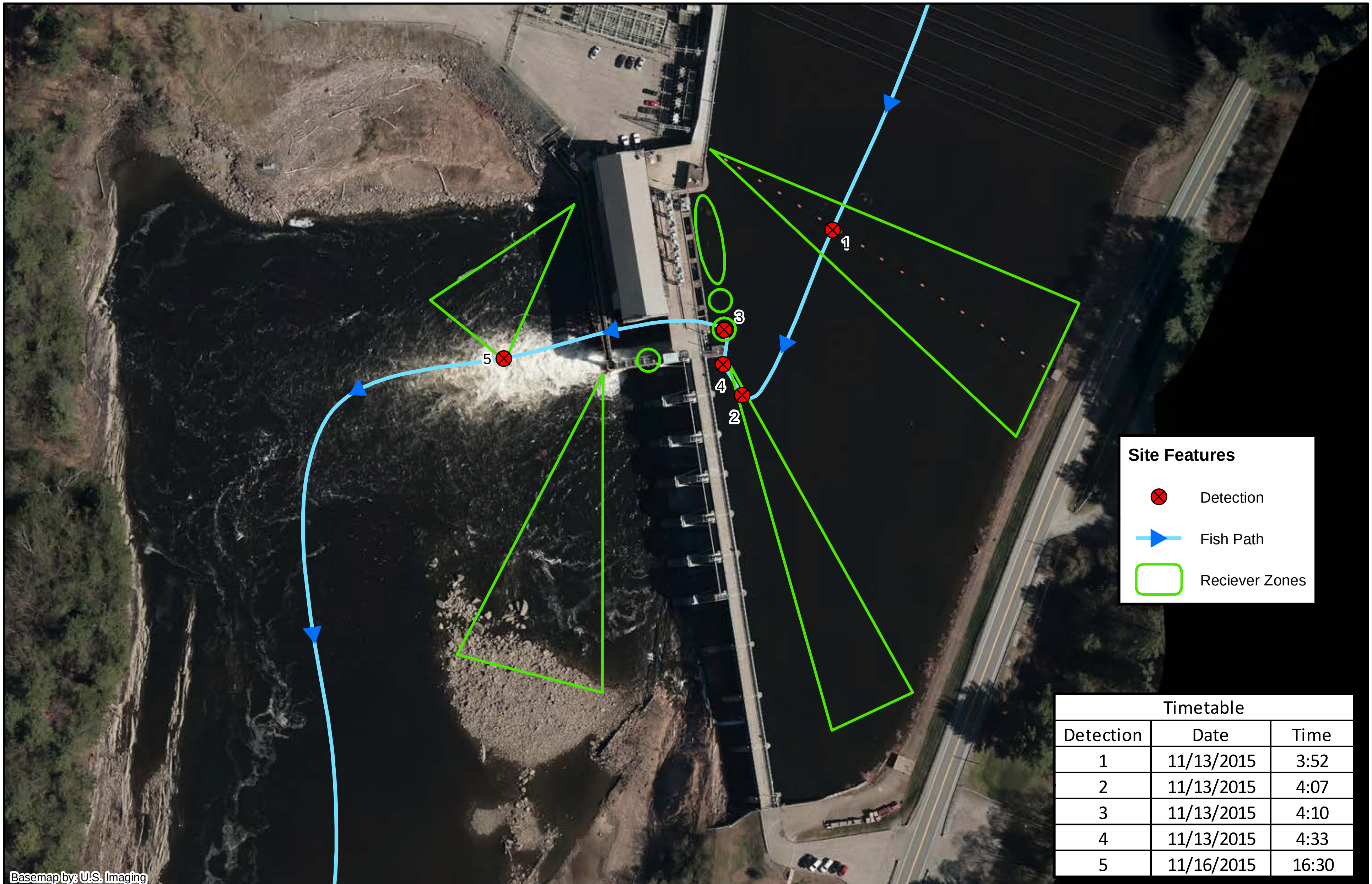


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/13/2015 | 3:52 |
| 2 | 11/13/2015 | 4:07 |
| 3 | 11/13/2015 | 4:10 |
| 4 | 11/13/2015 | 4:33 |
| 5 | 11/16/2015 | 16:30 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-154 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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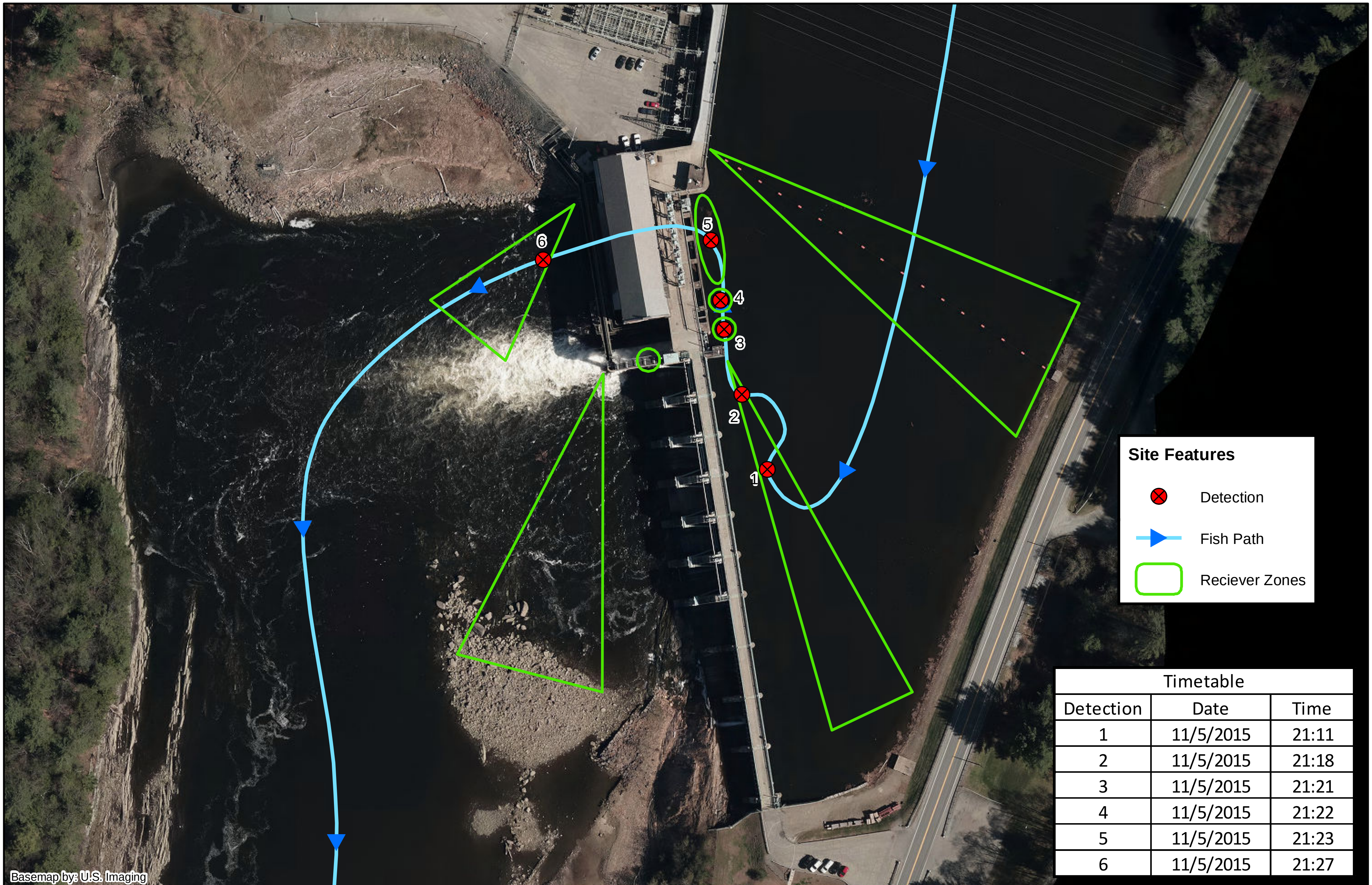


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 21:11 |
| 2 | 11/5/2015 | 21:18 |
| 3 | 11/5/2015 | 21:21 |
| 4 | 11/5/2015 | 21:22 |
| 5 | 11/5/2015 | 21:23 |
| 6 | 11/5/2015 | 21:27 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-155 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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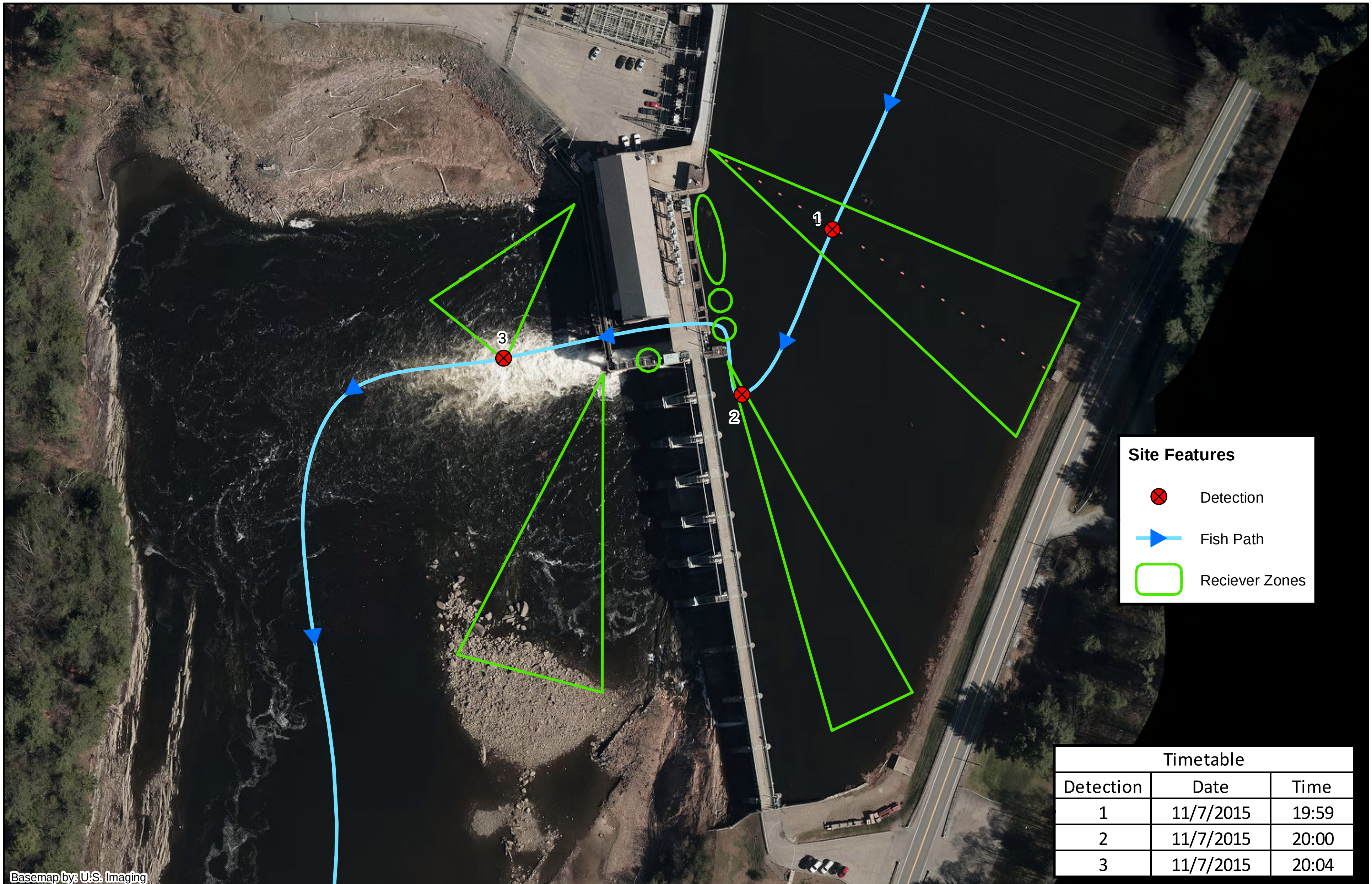


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 19:59 |
| 2 | 11/7/2015 | 20:00 |
| 3 | 11/7/2015 | 20:04 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-156 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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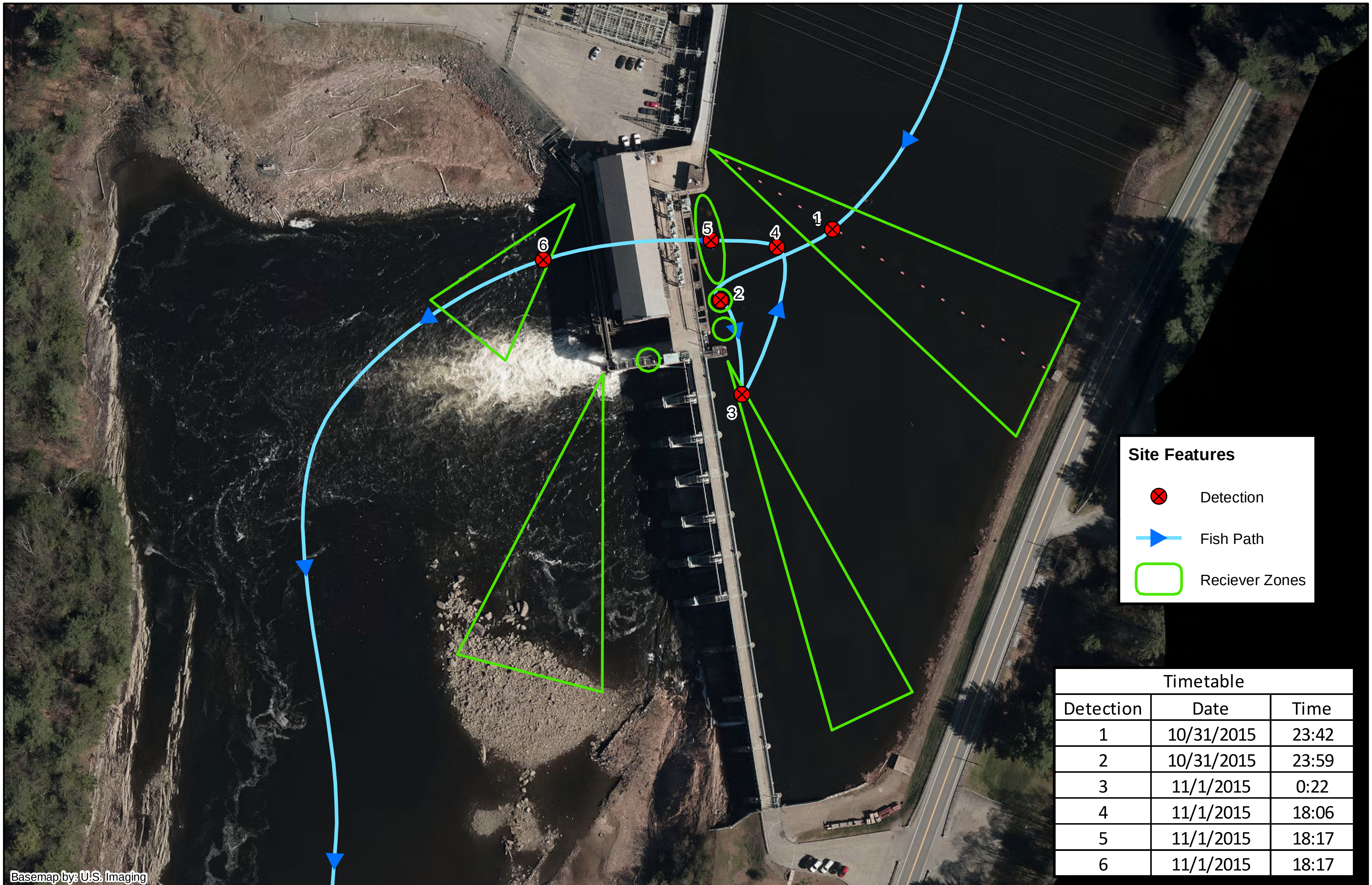


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 23:42 |
| 2 | 10/31/2015 | 23:59 |
| 3 | 11/1/2015 | 0:22 |
| 4 | 11/1/2015 | 18:06 |
| 5 | 11/1/2015 | 18:17 |
| 6 | 11/1/2015 | 18:17 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-181 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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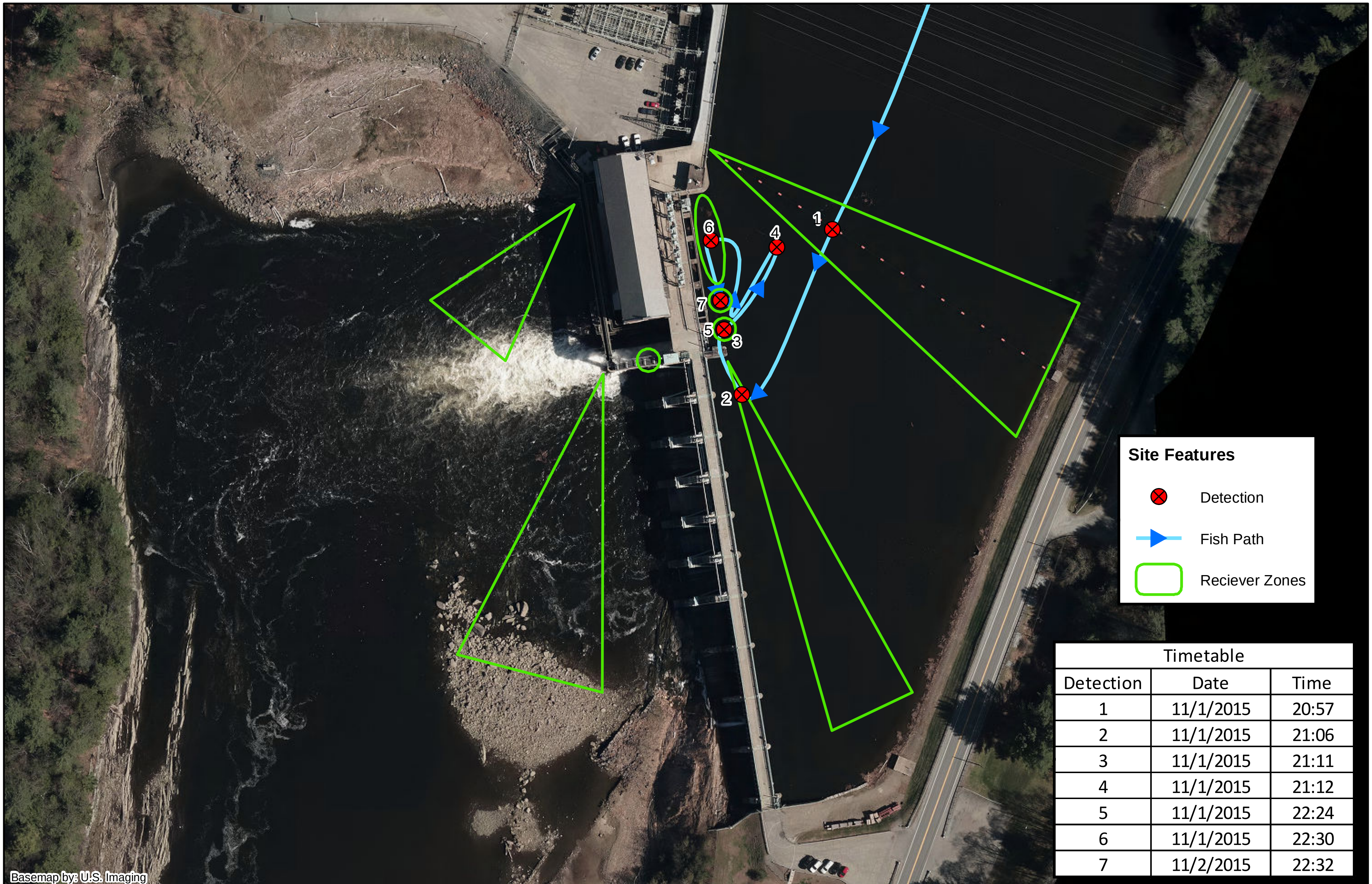


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 20:57 |
| 2 | 11/1/2015 | 21:06 |
| 3 | 11/1/2015 | 21:11 |
| 4 | 11/1/2015 | 21:12 |
| 5 | 11/1/2015 | 22:24 |
| 6 | 11/1/2015 | 22:30 |
| 7 | 11/2/2015 | 22:32 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-182 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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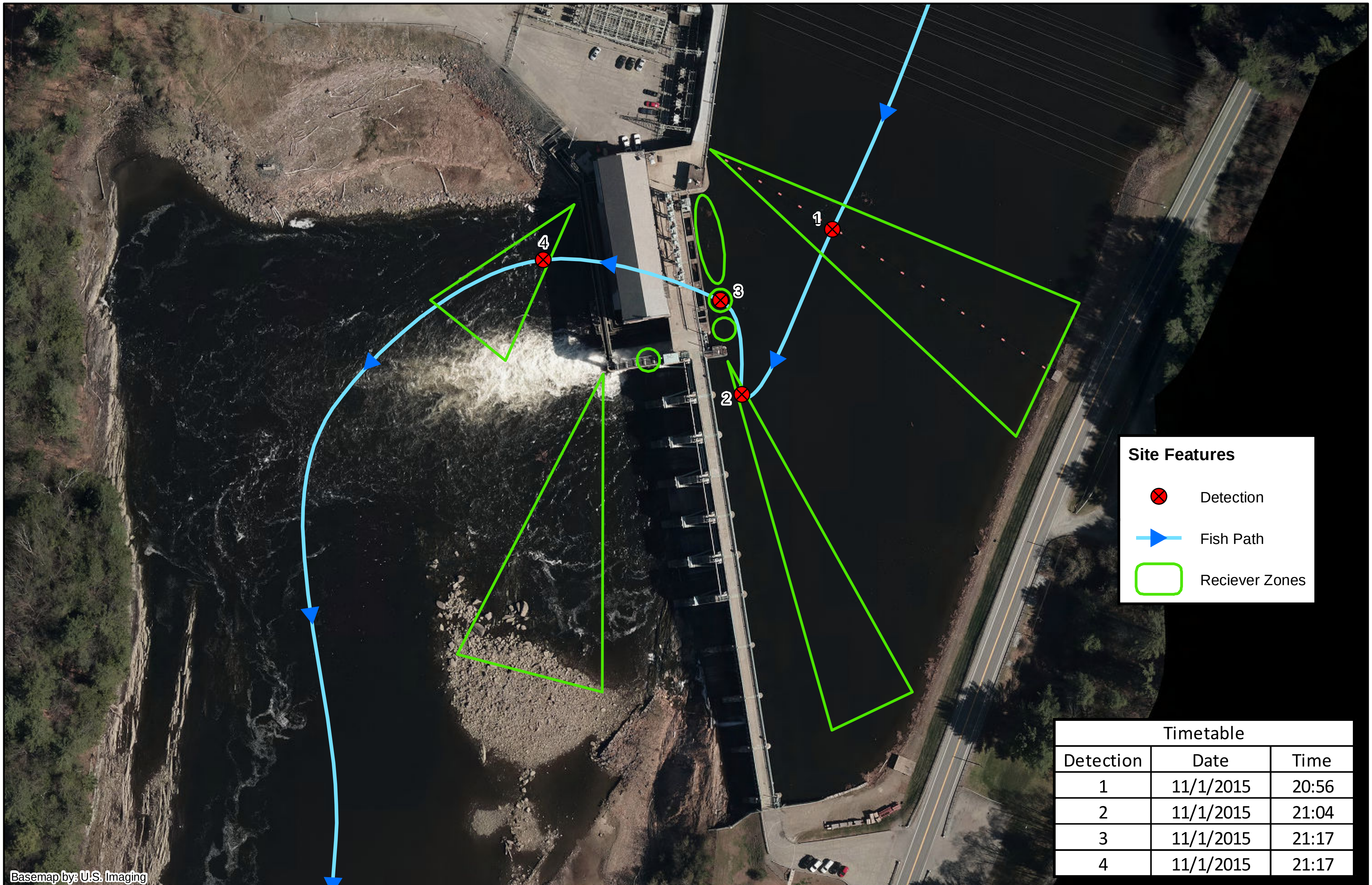


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 20:56 |
| 2 | 11/1/2015 | 21:04 |
| 3 | 11/1/2015 | 21:17 |
| 4 | 11/1/2015 | 21:17 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-183 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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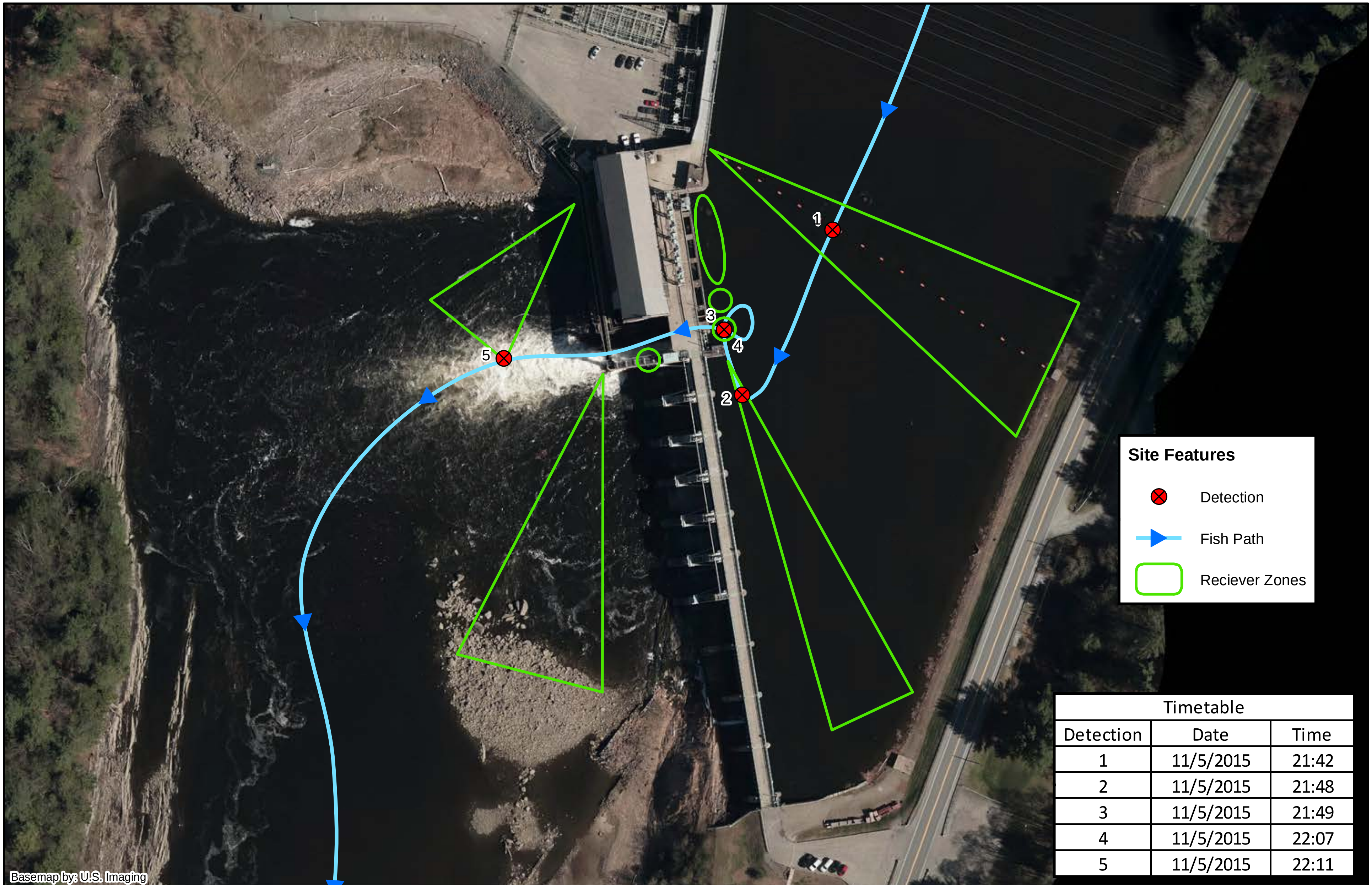


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 21:42 |
| 2 | 11/5/2015 | 21:48 |
| 3 | 11/5/2015 | 21:49 |
| 4 | 11/5/2015 | 22:07 |
| 5 | 11/5/2015 | 22:11 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 34-57 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05


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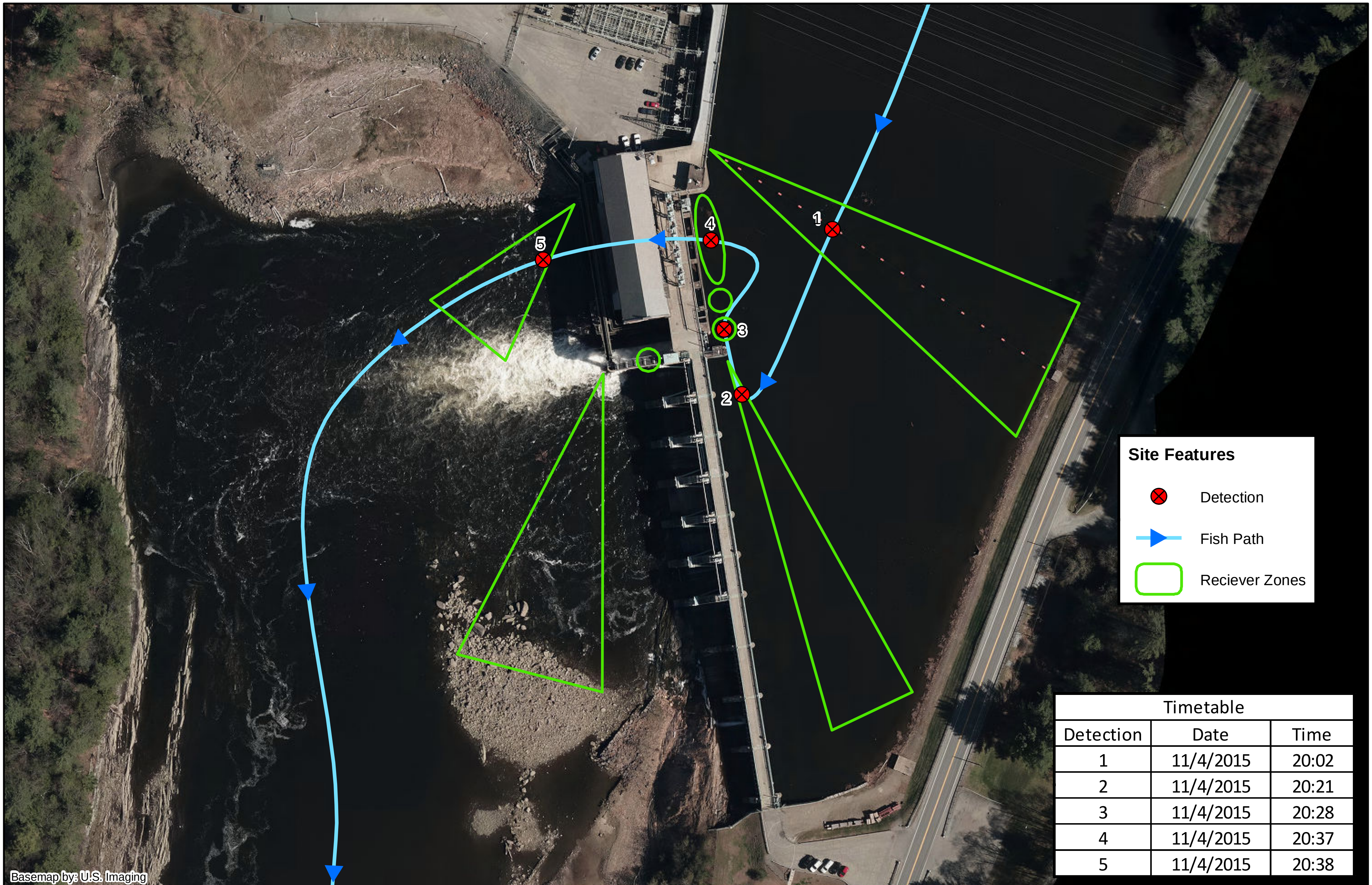


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 20:02 |
| 2 | 11/4/2015 | 20:21 |
| 3 | 11/4/2015 | 20:28 |
| 4 | 11/4/2015 | 20:37 |
| 5 | 11/4/2015 | 20:38 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-121 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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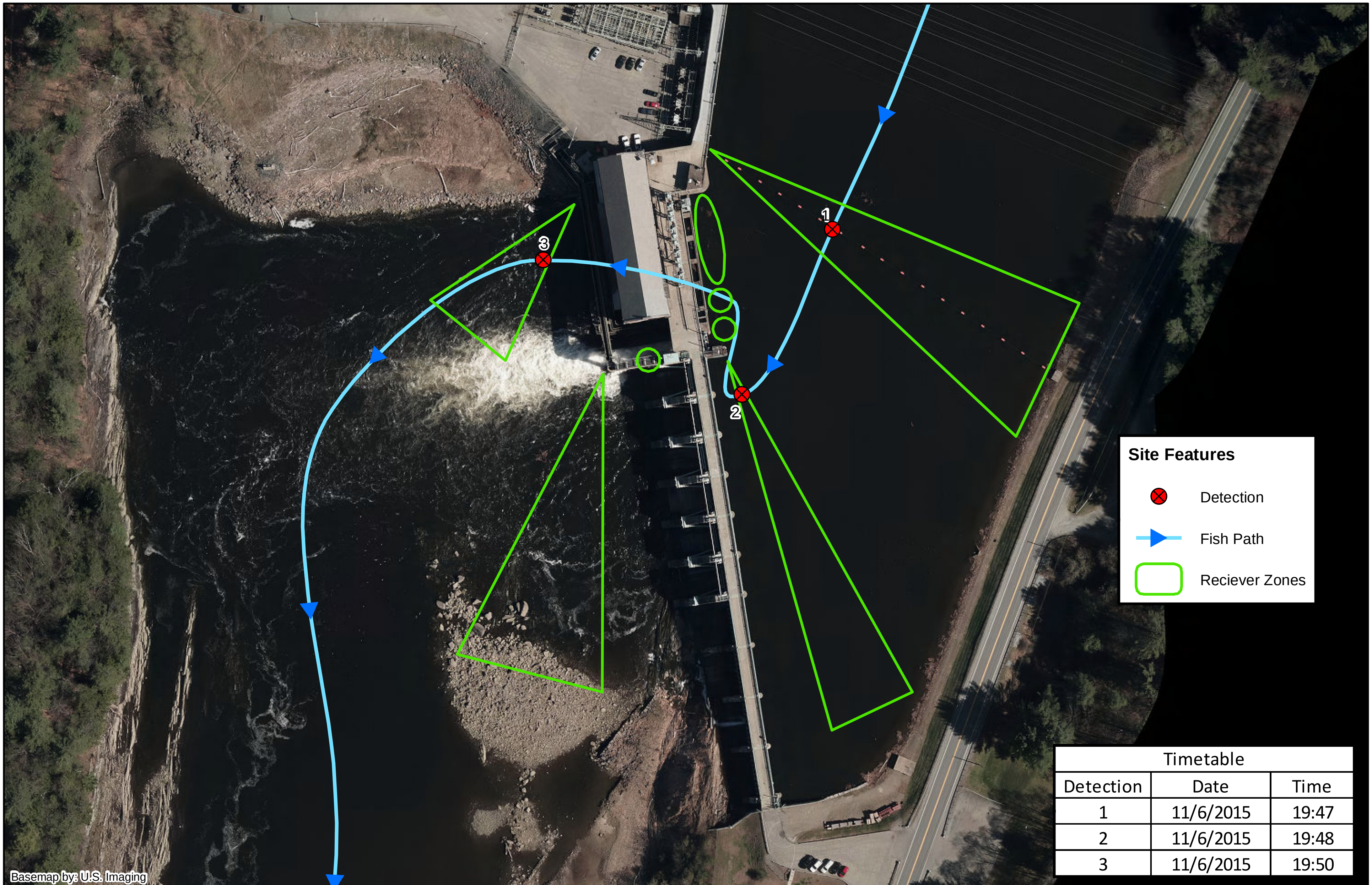


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:47 |
| 2 | 11/6/2015 | 19:48 |
| 3 | 11/6/2015 | 19:50 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-122 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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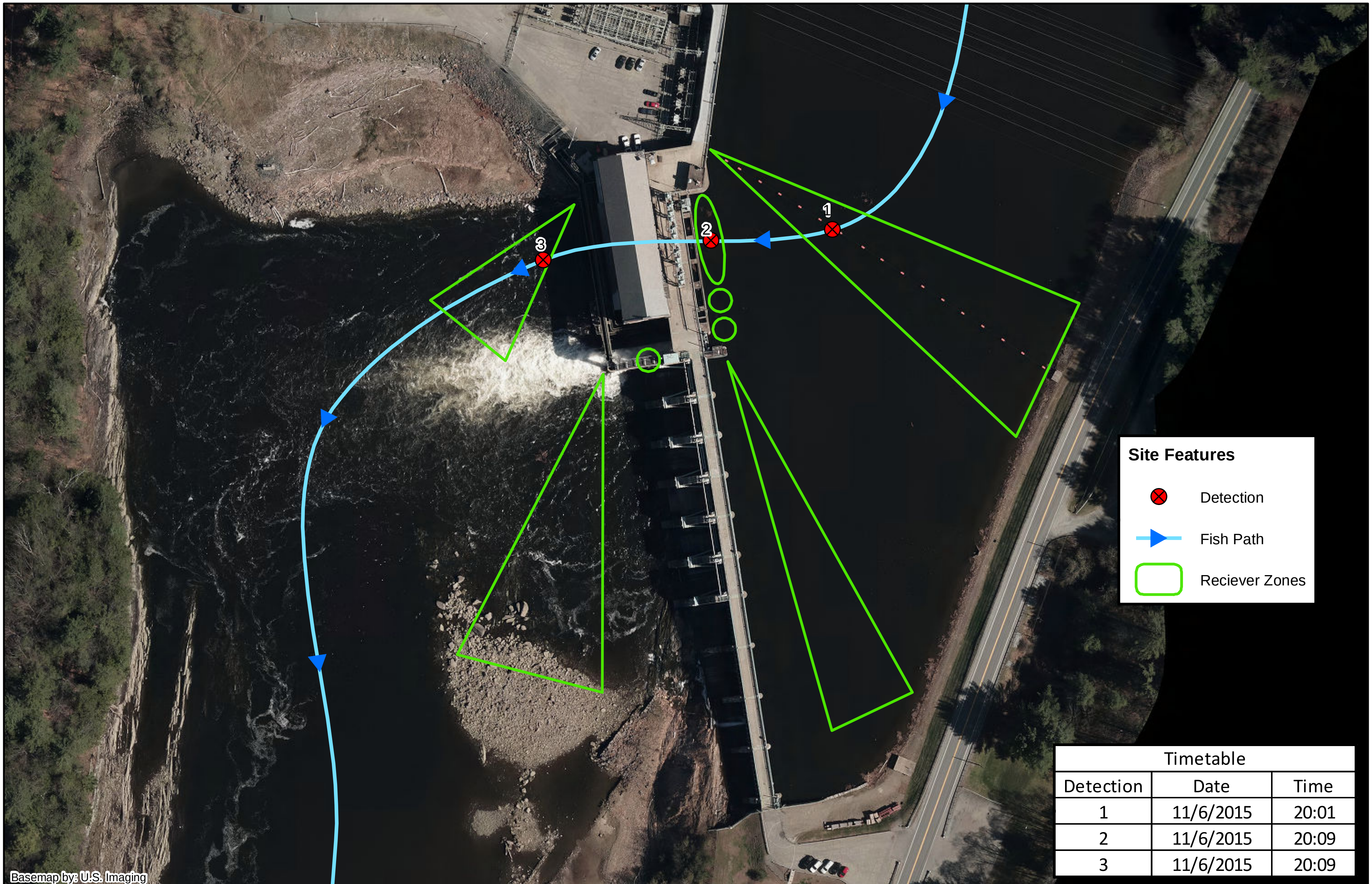


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 20:01 |
| 2 | 11/6/2015 | 20:09 |
| 3 | 11/6/2015 | 20:09 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-123 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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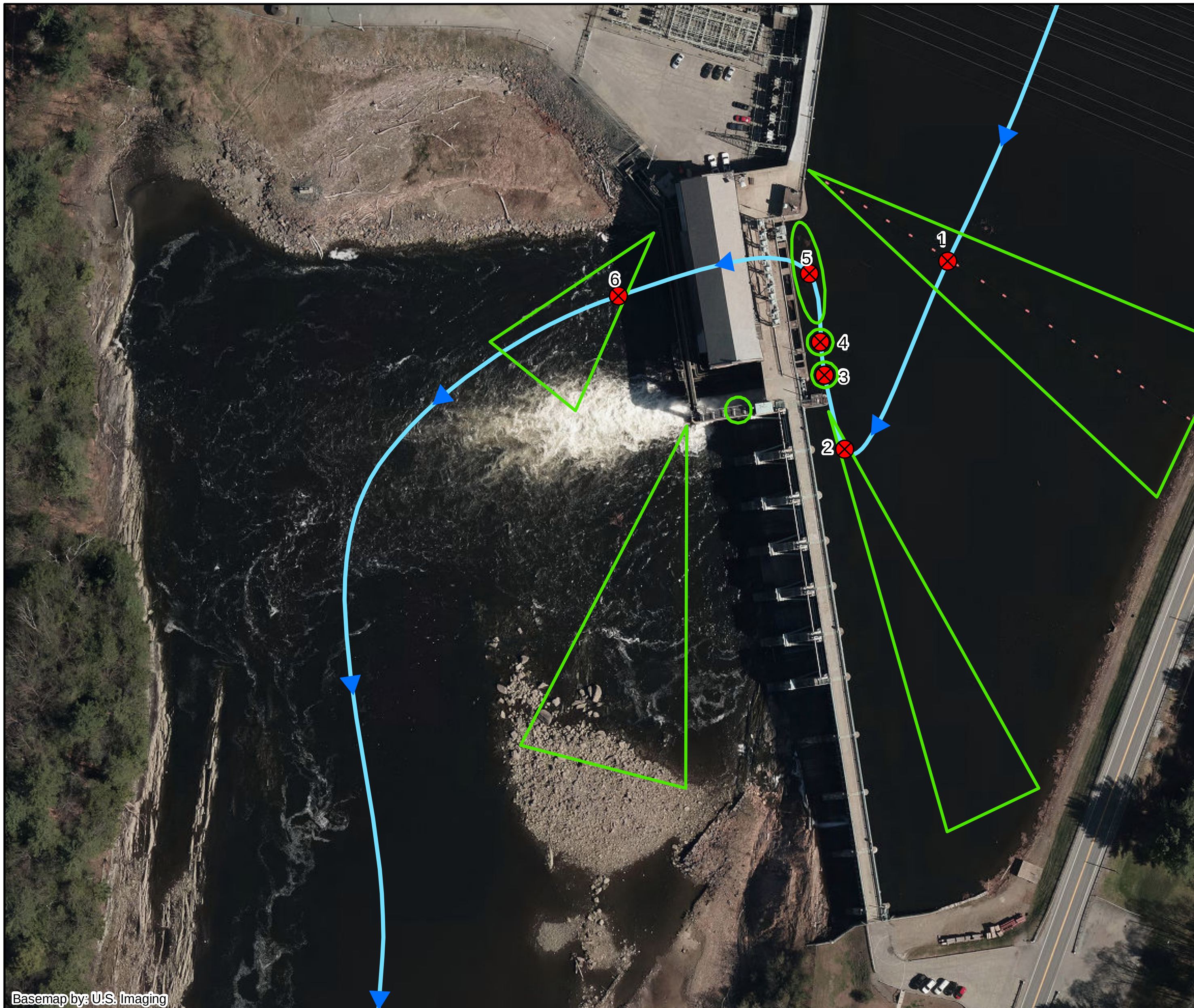


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 19:39 |
| 2 | 10/28/2015 | 19:49 |
| 3 | 10/28/2015 | 19:51 |
| 4 | 10/28/2015 | 19:54 |
| 5 | 10/28/2015 | 19:55 |
| 6 | 10/28/2015 | 19:55 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-124 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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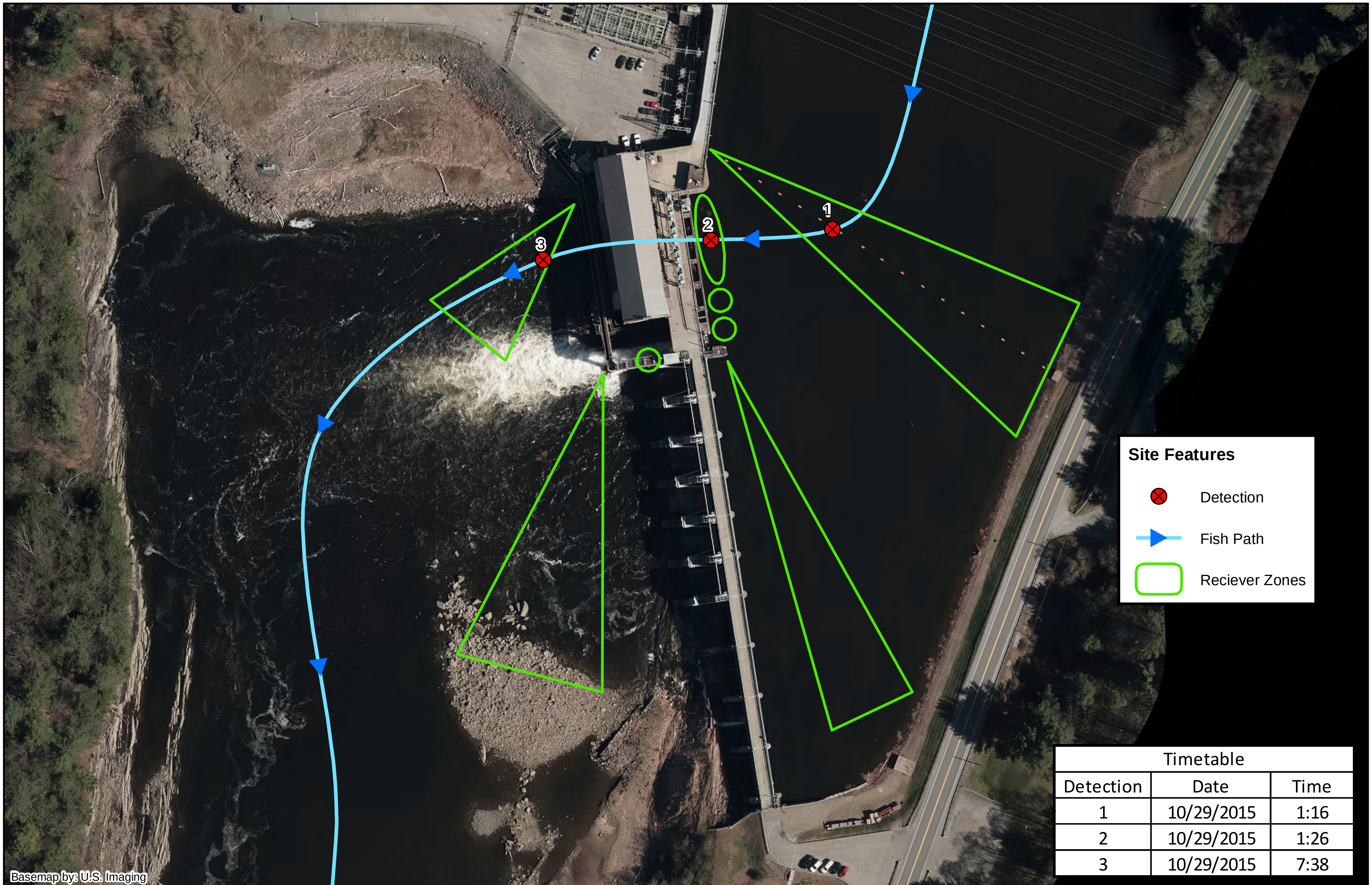


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 1:16 |
| 2 | 10/29/2015 | 1:26 |
| 3 | 10/29/2015 | 7:38 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-125 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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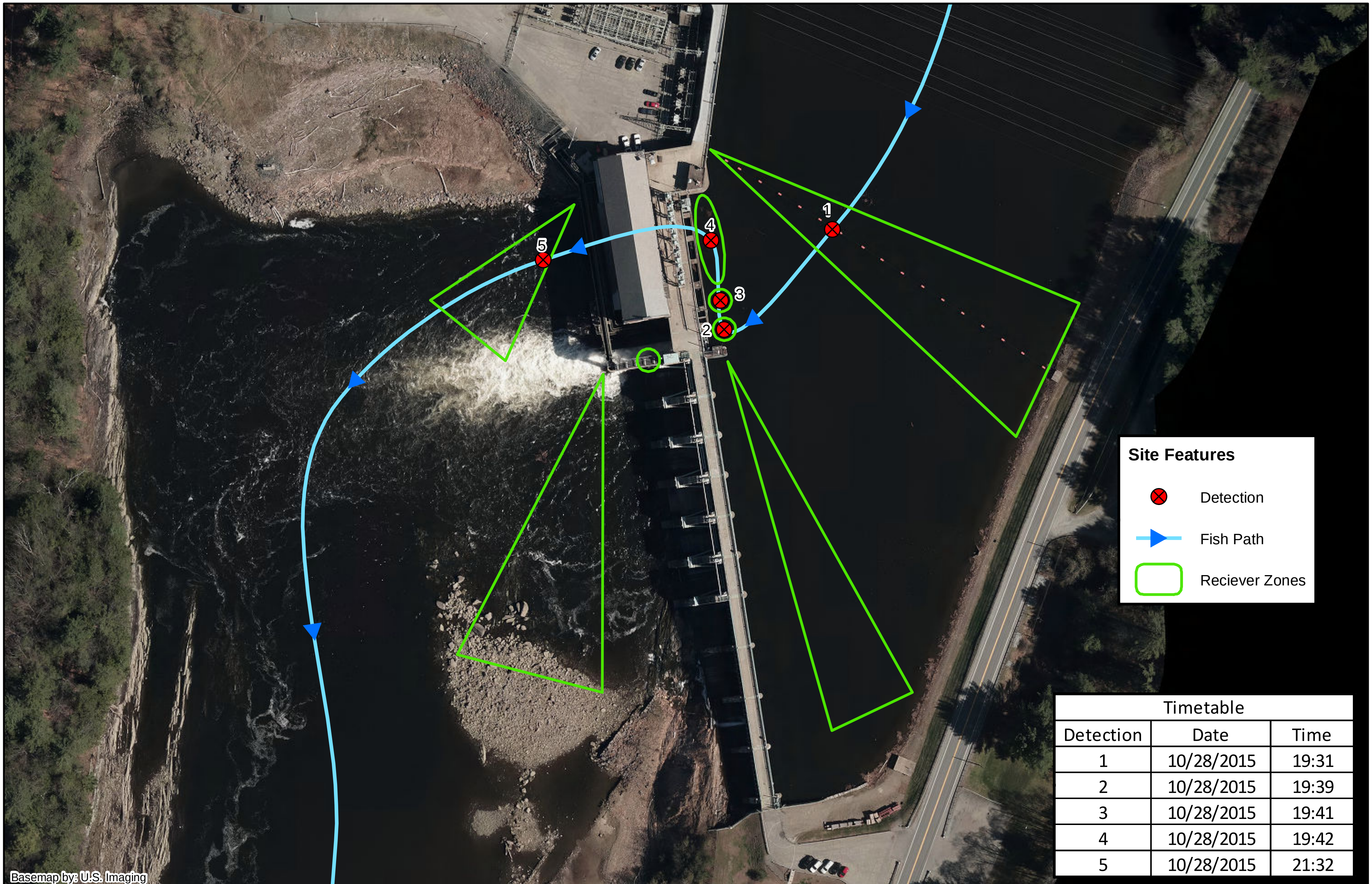


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 19:31 |
| 2 | 10/28/2015 | 19:39 |
| 3 | 10/28/2015 | 19:41 |
| 4 | 10/28/2015 | 19:42 |
| 5 | 10/28/2015 | 21:32 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-126 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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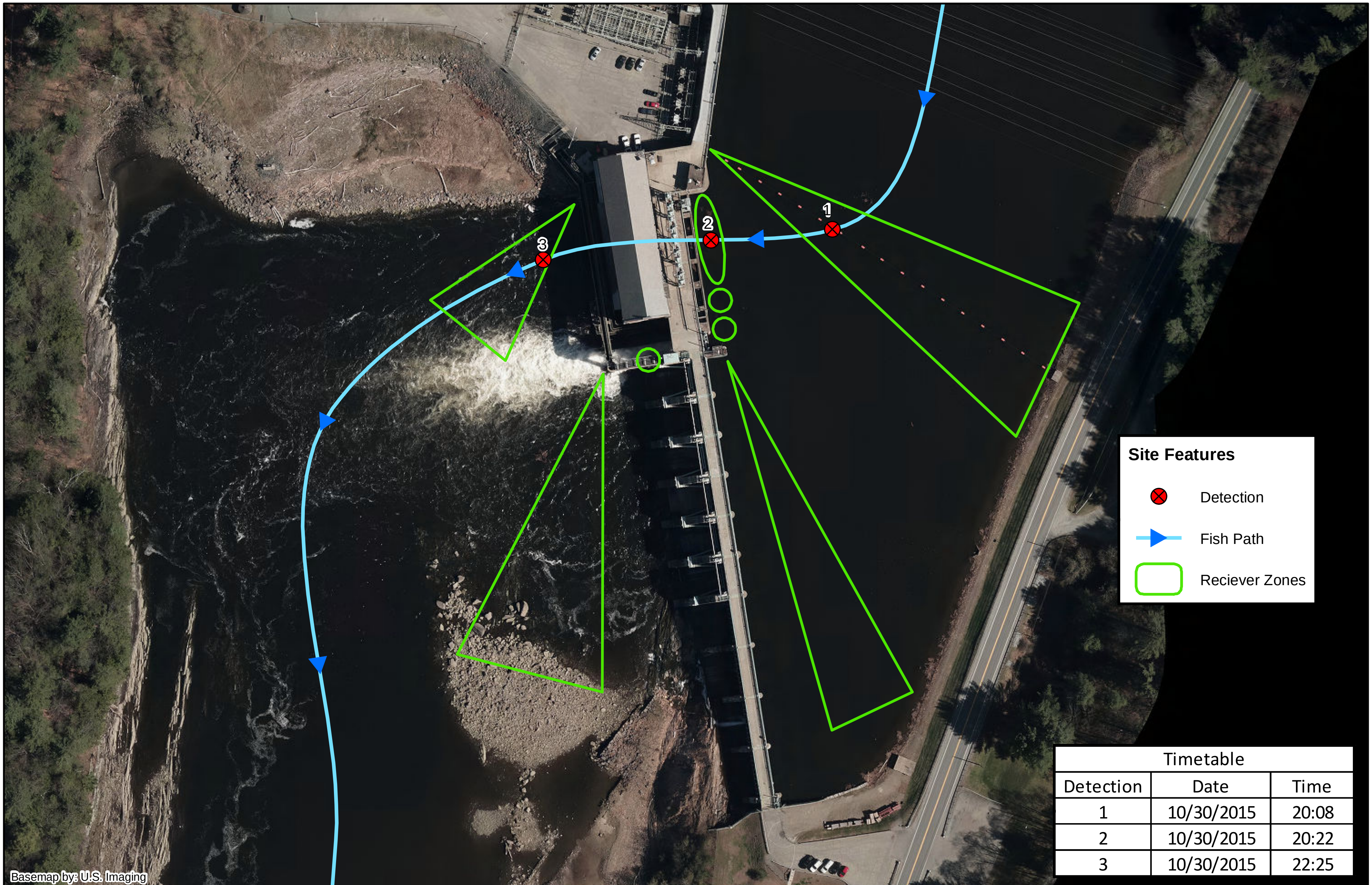


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 20:08 |
| 2 | 10/30/2015 | 20:22 |
| 3 | 10/30/2015 | 22:25 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-154 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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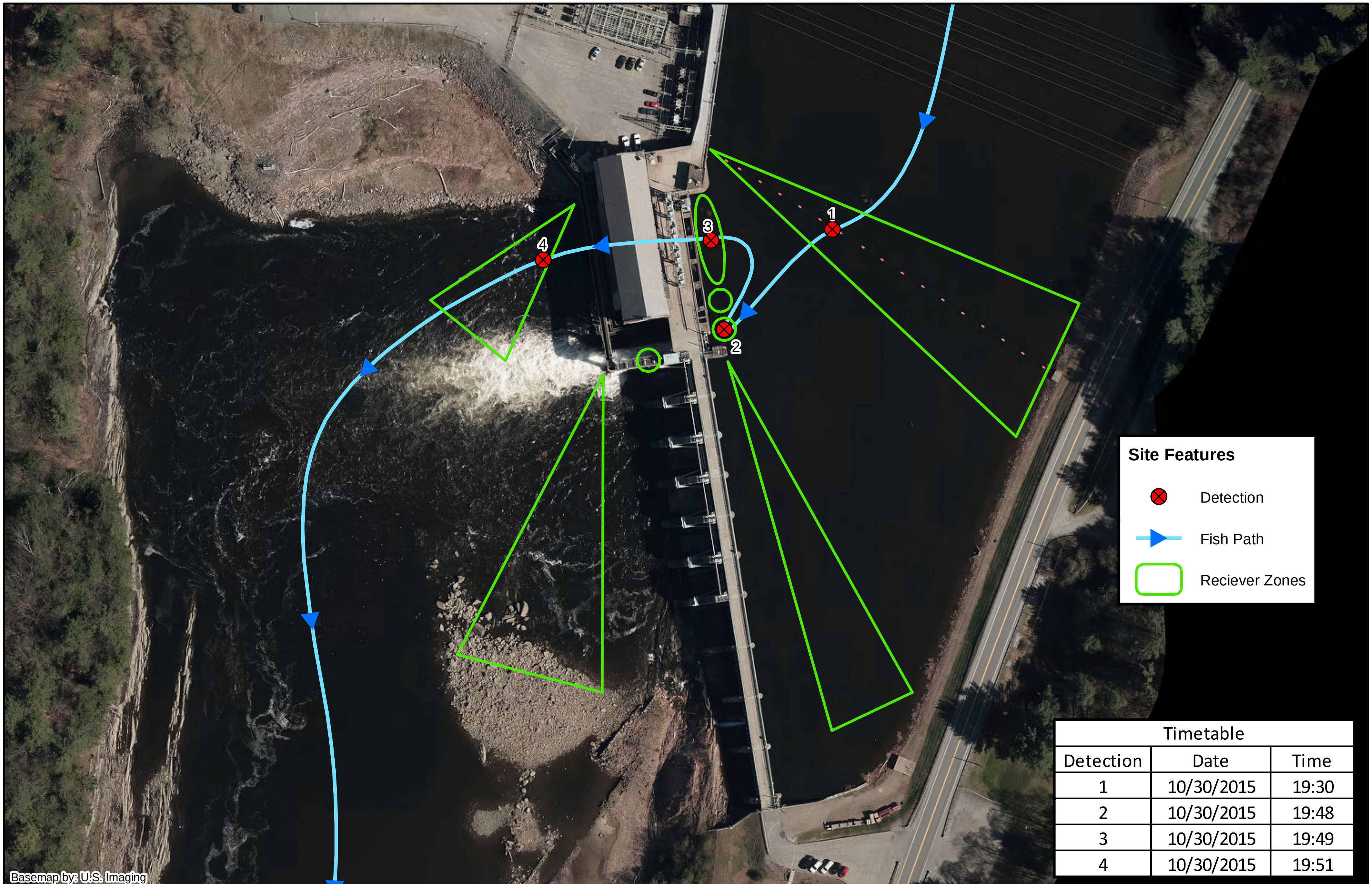


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 19:30 |
| 2 | 10/30/2015 | 19:48 |
| 3 | 10/30/2015 | 19:49 |
| 4 | 10/30/2015 | 19:51 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-155 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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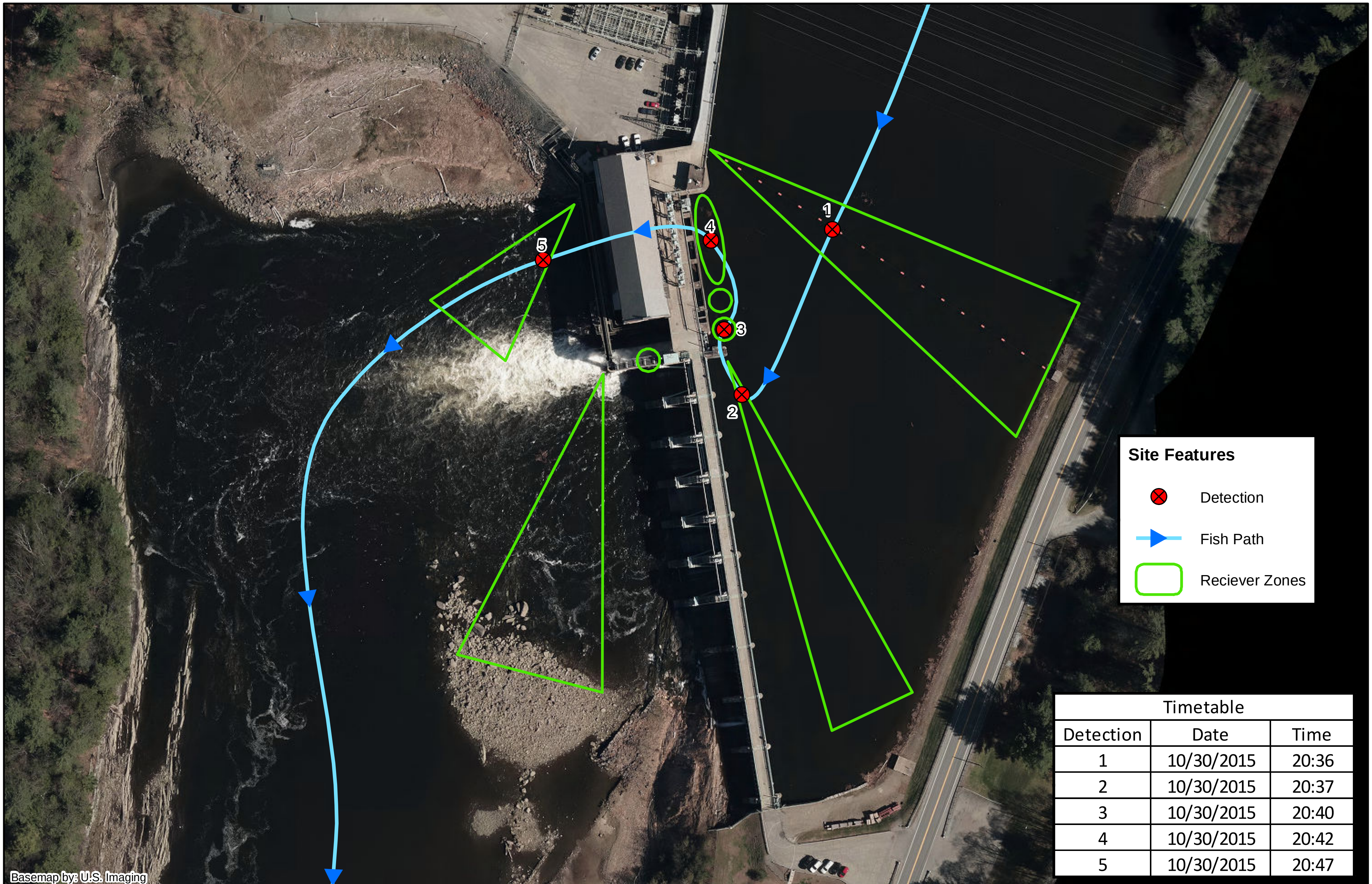


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 20:36 |
| 2 | 10/30/2015 | 20:37 |
| 3 | 10/30/2015 | 20:40 |
| 4 | 10/30/2015 | 20:42 |
| 5 | 10/30/2015 | 20:47 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-156 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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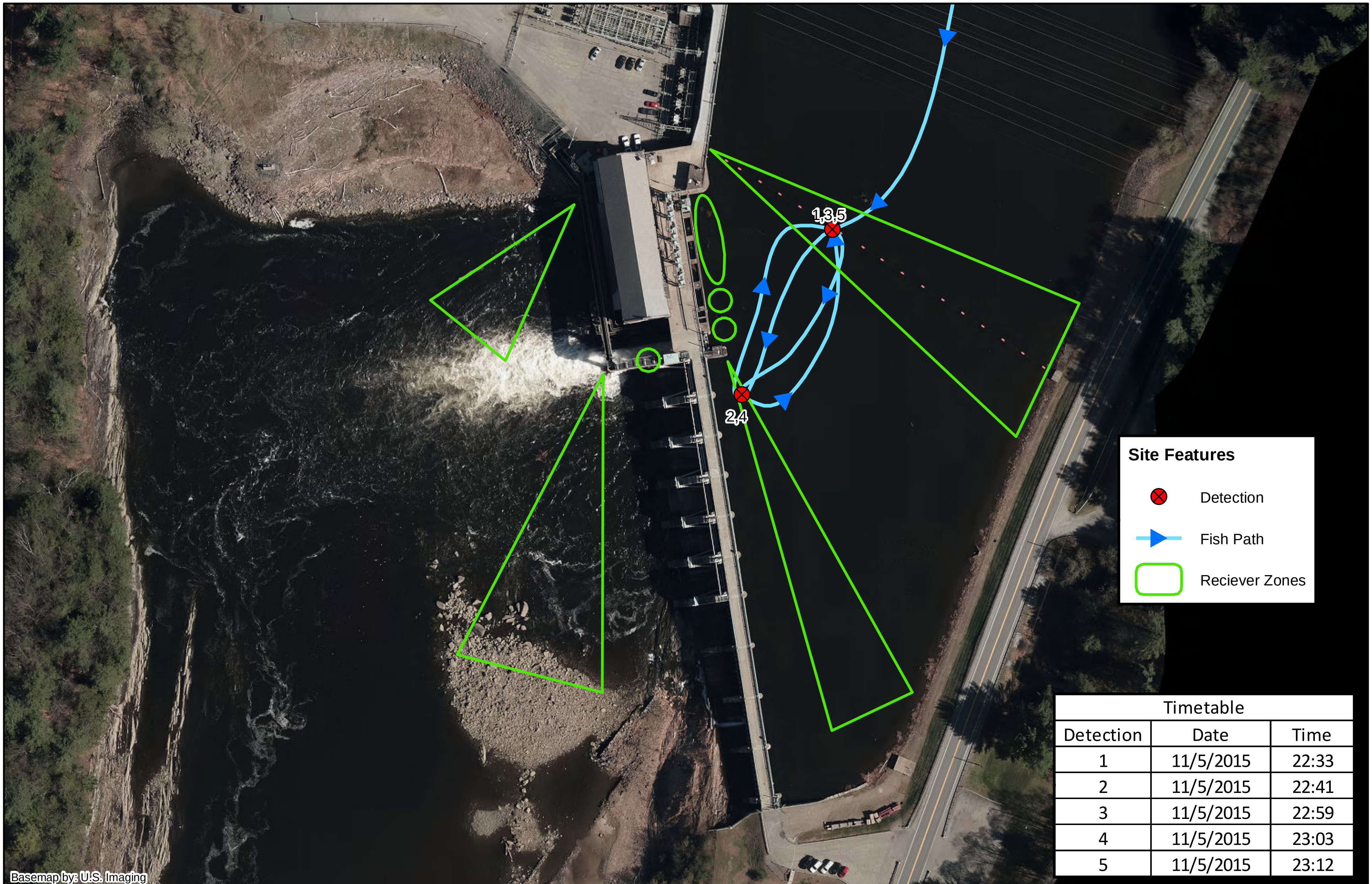


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 22:33 |
| 2 | 11/5/2015 | 22:41 |
| 3 | 11/5/2015 | 22:59 |
| 4 | 11/5/2015 | 23:03 |
| 5 | 11/5/2015 | 23:12 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-157 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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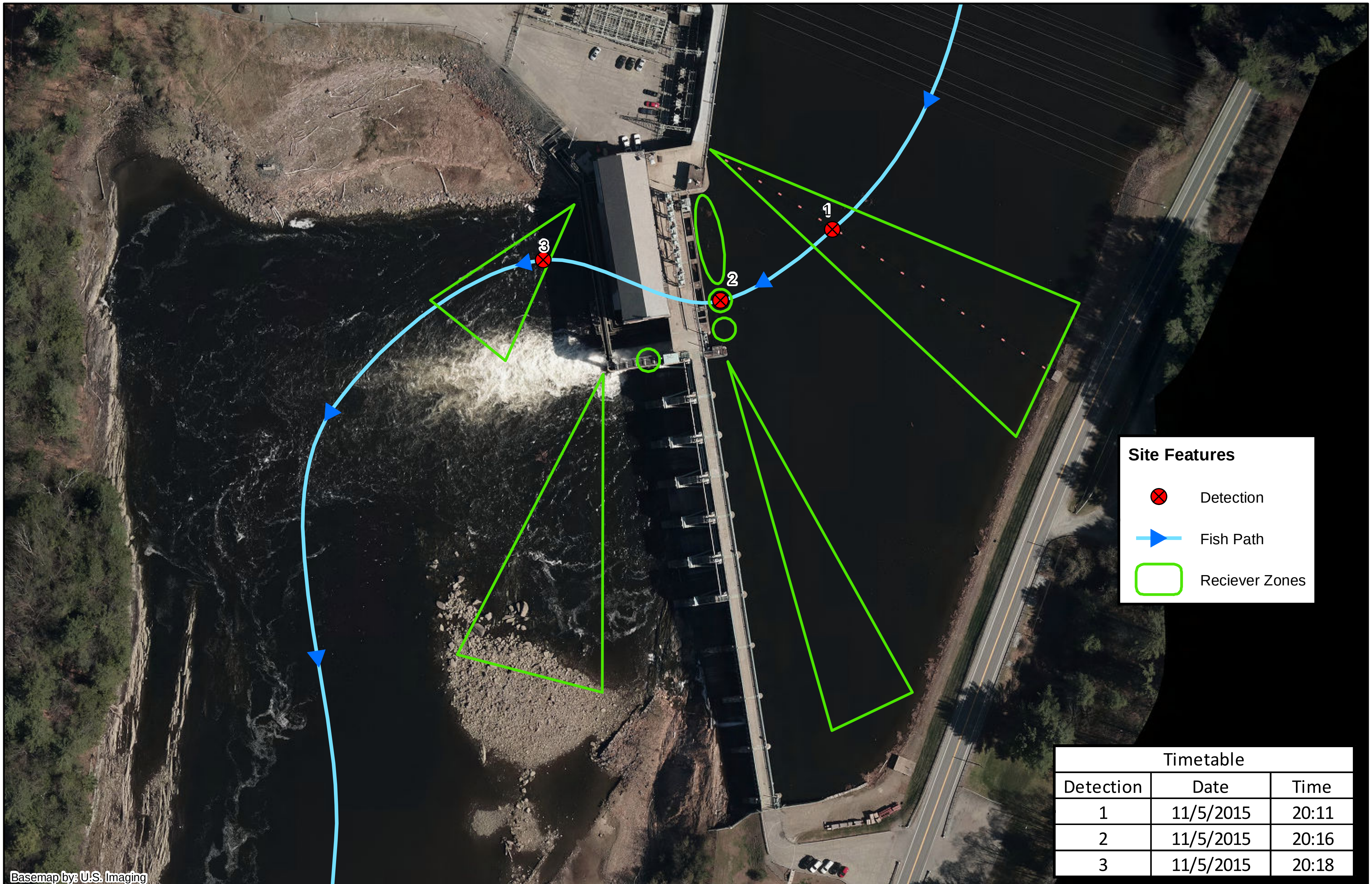


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
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| 2 | 11/5/2015 | 20:16 |
| 3 | 11/5/2015 | 20:18 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-158 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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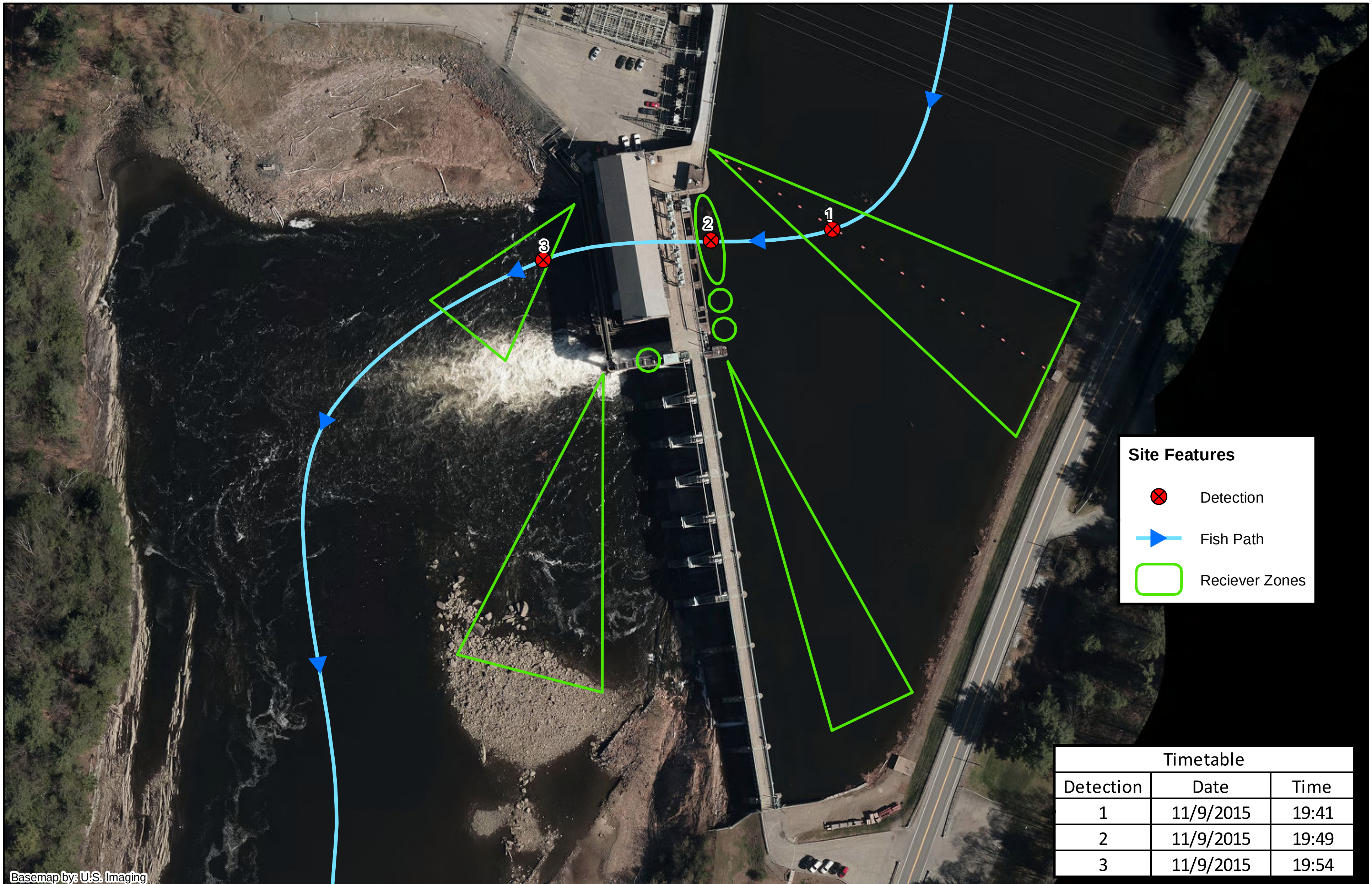


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 19:41 |
| 2 | 11/9/2015 | 19:49 |
| 3 | 11/9/2015 | 19:54 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-160 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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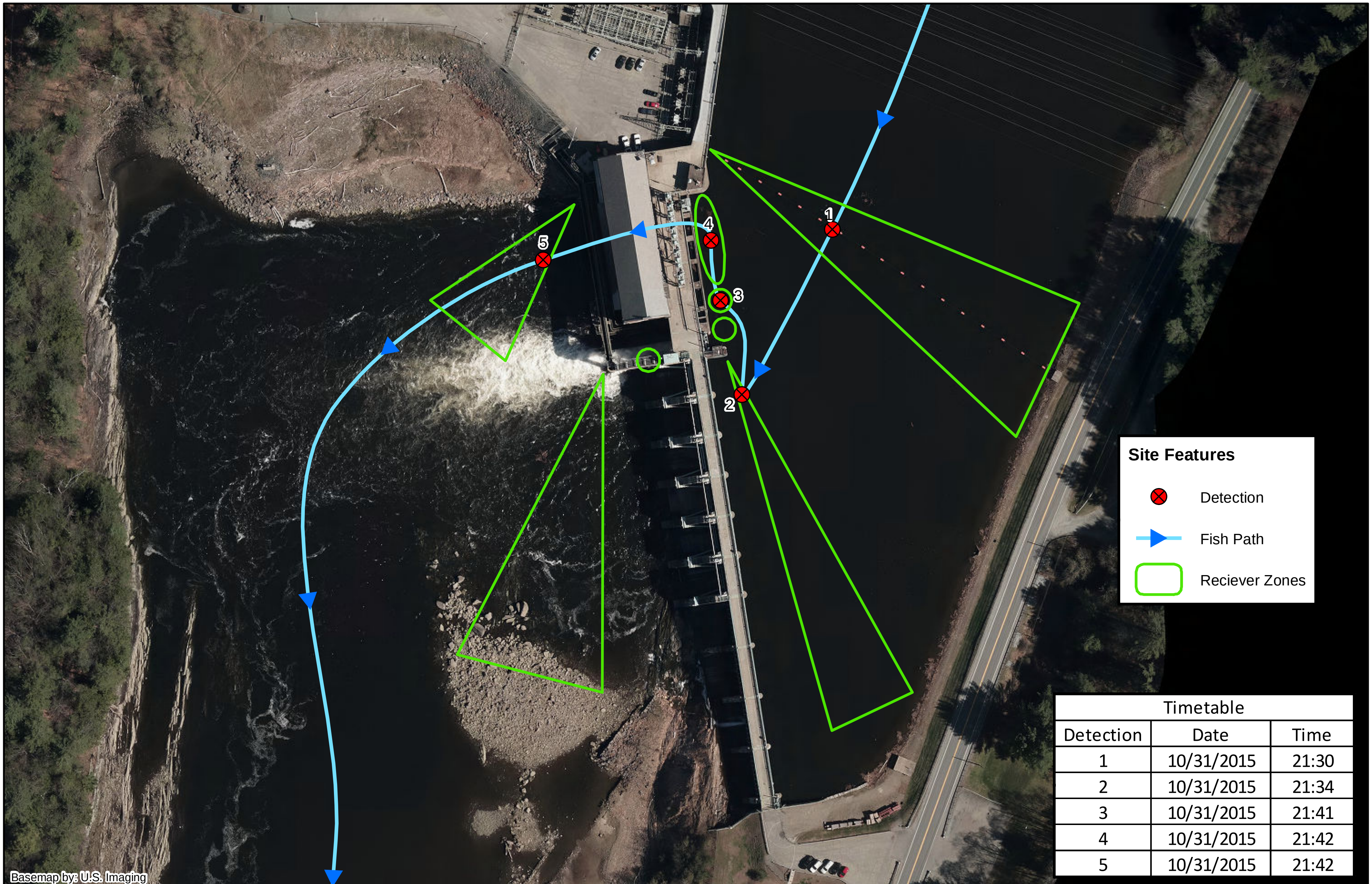


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 21:30 |
| 2 | 10/31/2015 | 21:34 |
| 3 | 10/31/2015 | 21:41 |
| 4 | 10/31/2015 | 21:42 |
| 5 | 10/31/2015 | 21:42 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-184 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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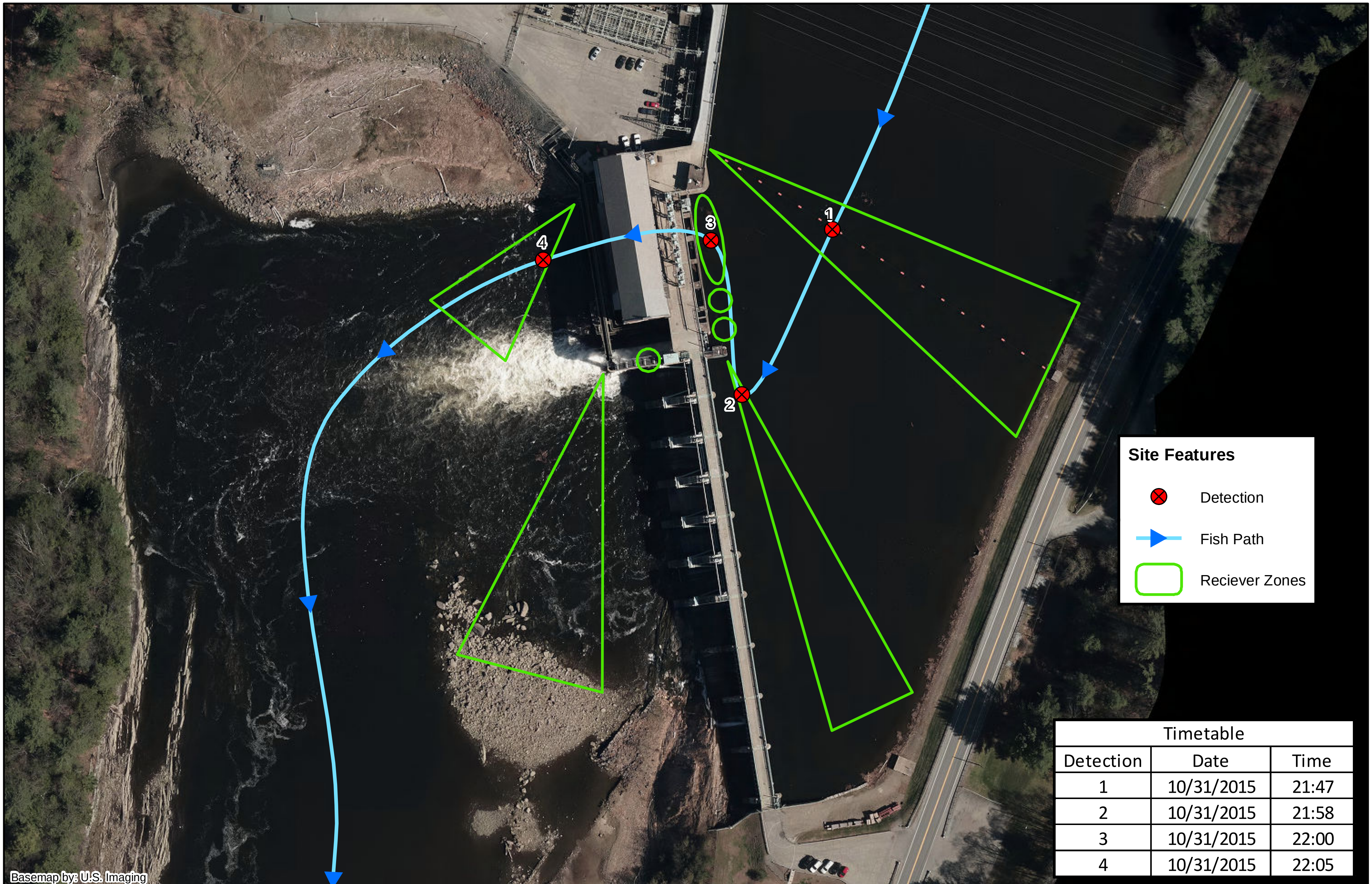


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 21:47 |
| 2 | 10/31/2015 | 21:58 |
| 3 | 10/31/2015 | 22:00 |
| 4 | 10/31/2015 | 22:05 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 36-187 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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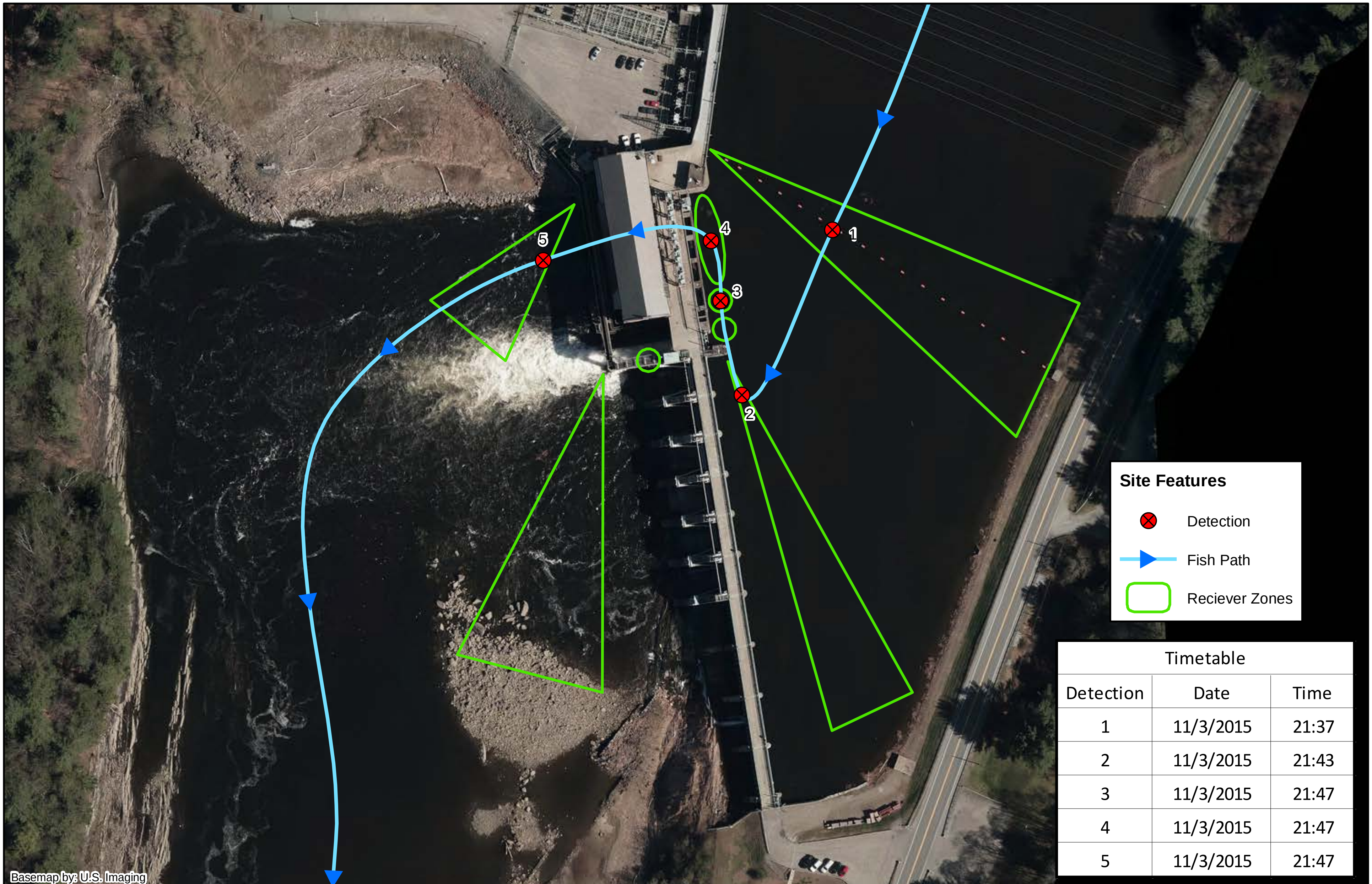


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 21:37 |
| 2 | 11/3/2015 | 21:43 |
| 3 | 11/3/2015 | 21:47 |
| 4 | 11/3/2015 | 21:47 |
| 5 | 11/3/2015 | 21:47 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-124 (T1)**

Release: Norwich, VT
Date Released: 11/3/2015
Time Released: 17:32


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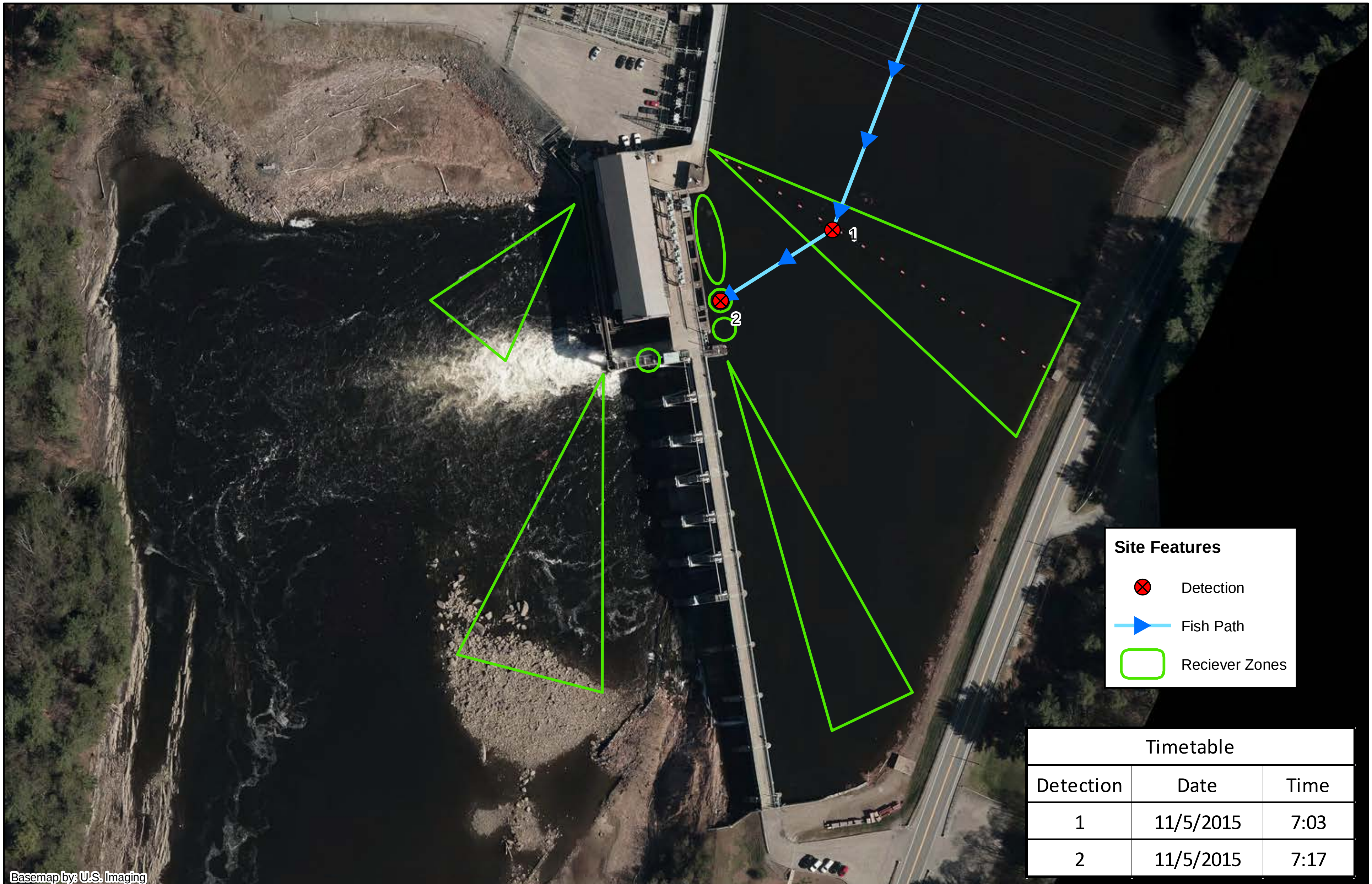


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 7:03 |
| 2 | 11/5/2015 | 7:17 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-125 (T1)**

Release: Norwich, VT
Date Released: 11/3/2015
Time Released: 17:32

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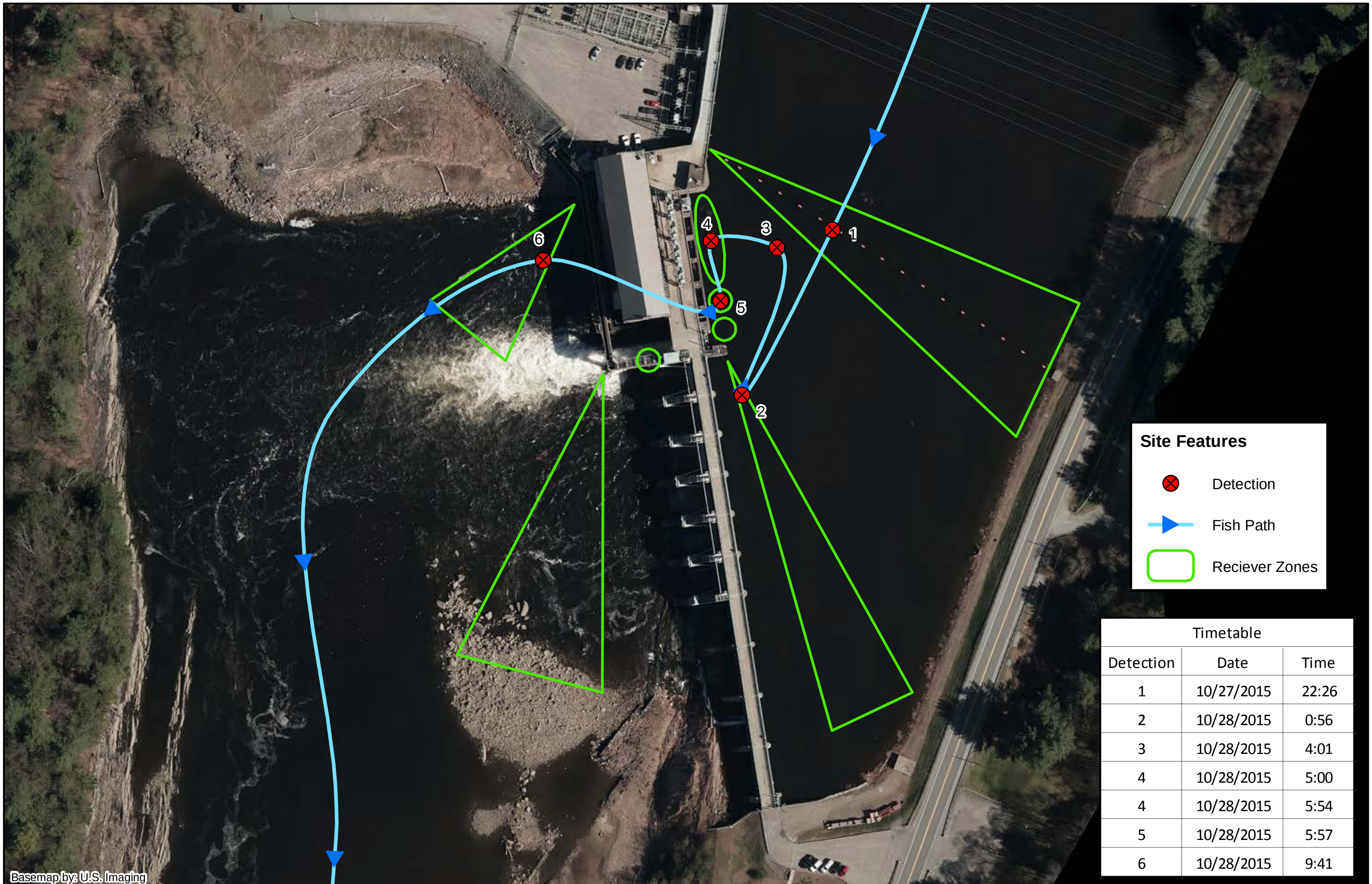


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/27/2015 | 22:26 |
| 2 | 10/28/2015 | 0:56 |
| 3 | 10/28/2015 | 4:01 |
| 4 | 10/28/2015 | 5:00 |
| 4 | 10/28/2015 | 5:54 |
| 5 | 10/28/2015 | 5:57 |
| 6 | 10/28/2015 | 9:41 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-127 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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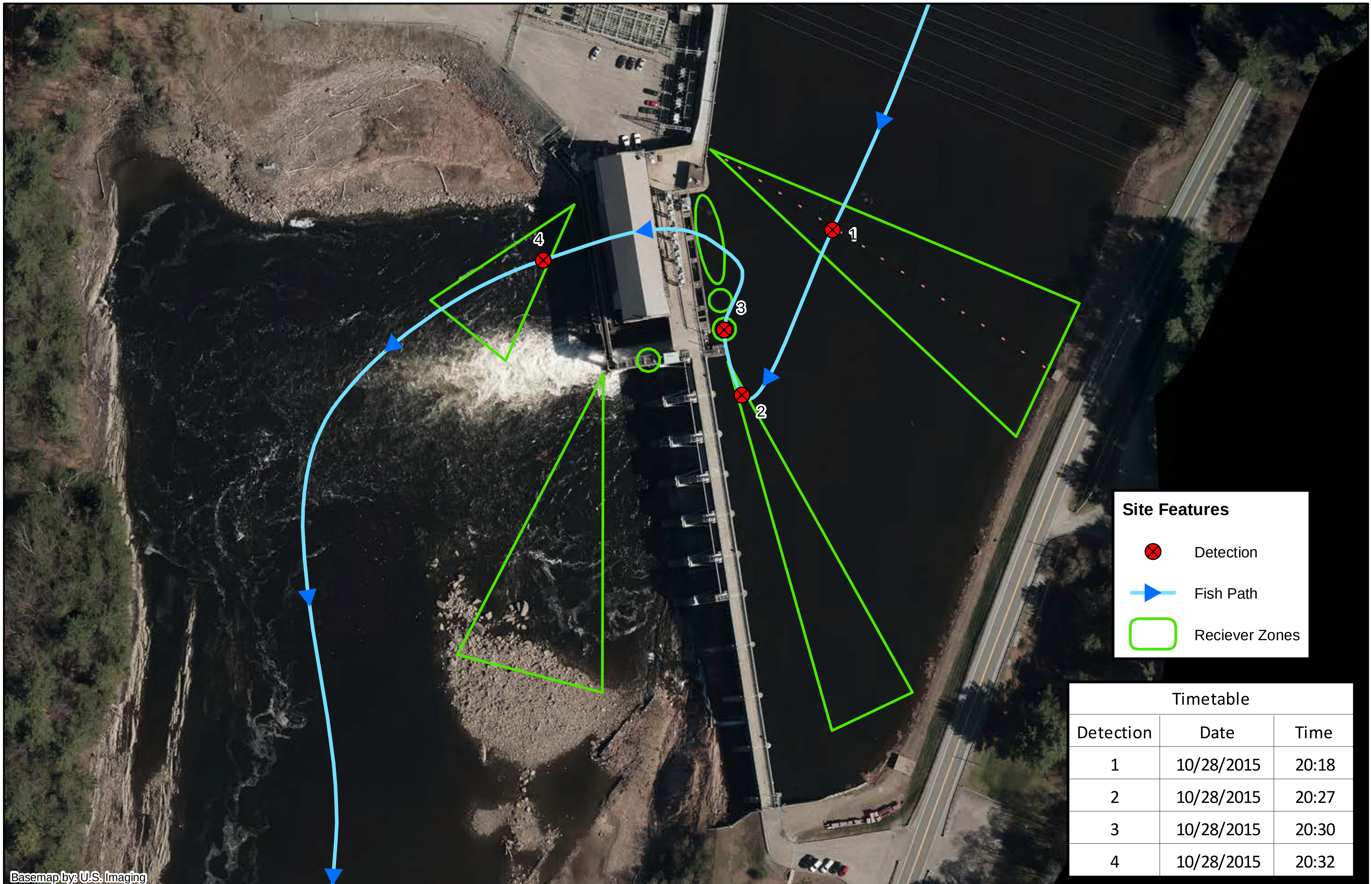


| Timetable | | |
|---|---|---|
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| 1 | 10/28/2015 | 20:18 |
| 2 | 10/28/2015 | 20:27 |
| 3 | 10/28/2015 | 20:30 |
| 4 | 10/28/2015 | 20:32 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-128 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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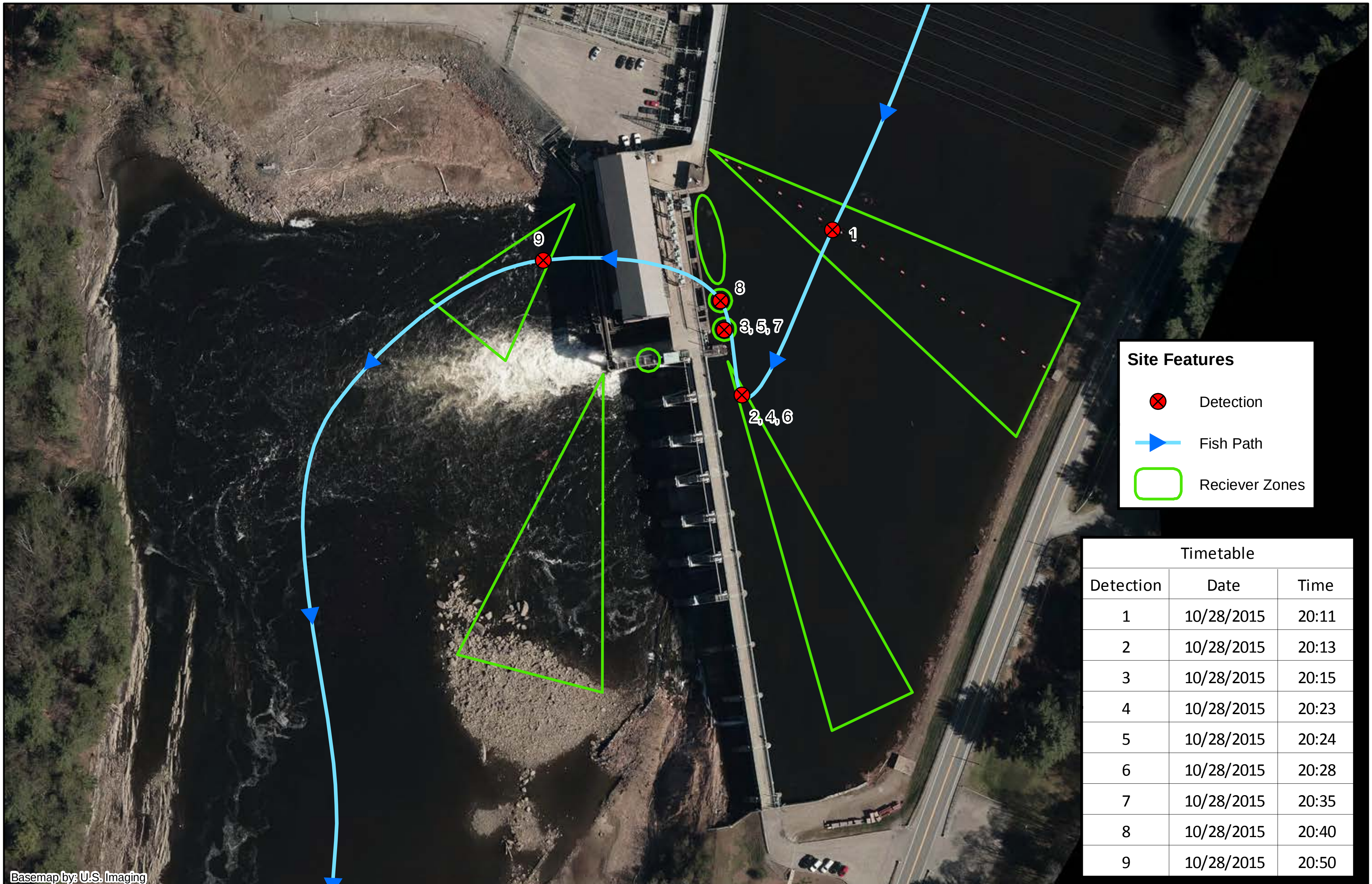


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 20:11 |
| 2 | 10/28/2015 | 20:13 |
| 3 | 10/28/2015 | 20:15 |
| 4 | 10/28/2015 | 20:23 |
| 5 | 10/28/2015 | 20:24 |
| 6 | 10/28/2015 | 20:28 |
| 7 | 10/28/2015 | 20:35 |
| 8 | 10/28/2015 | 20:40 |
| 9 | 10/28/2015 | 20:50 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-129 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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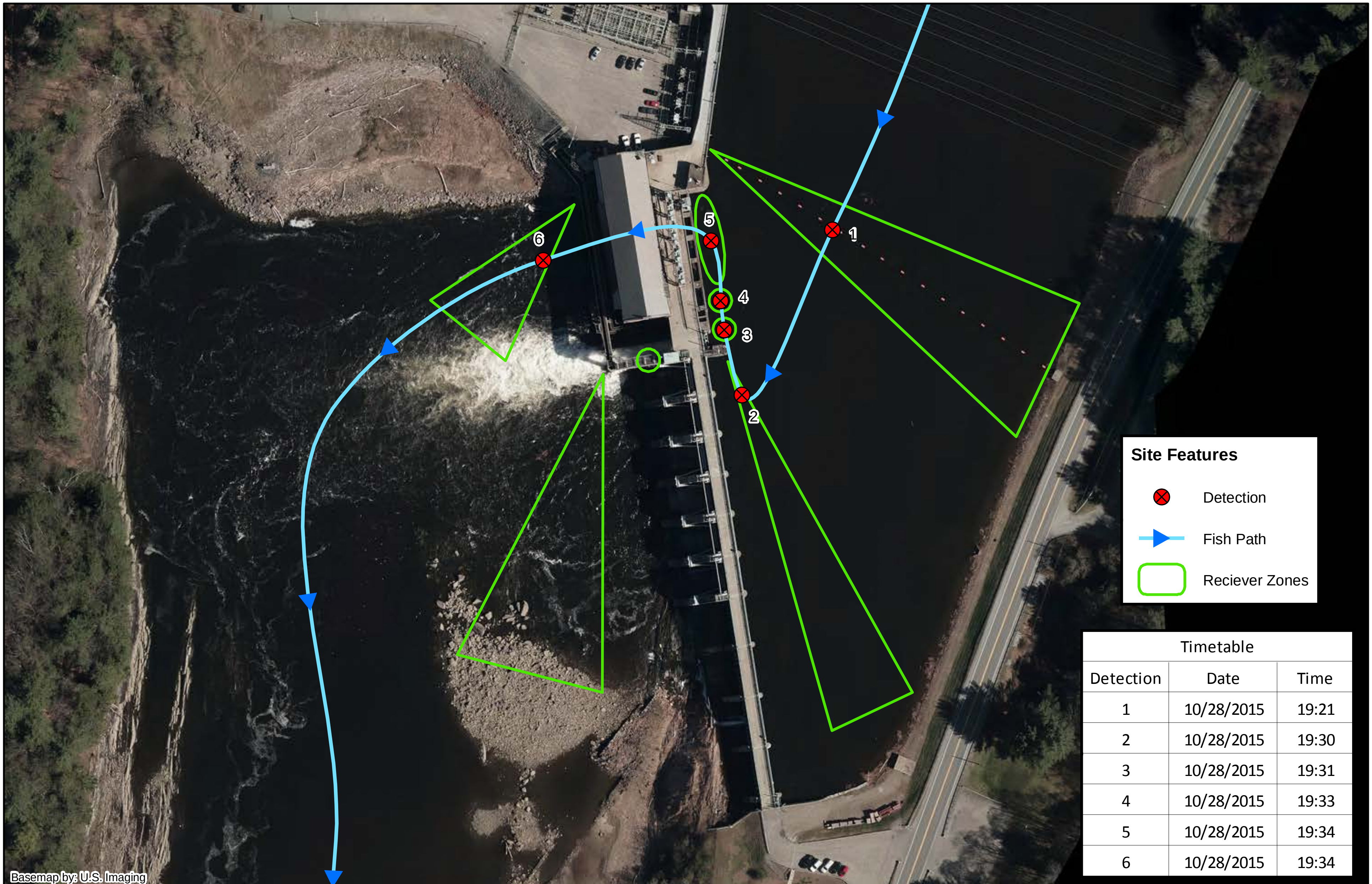


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 19:21 |
| 2 | 10/28/2015 | 19:30 |
| 3 | 10/28/2015 | 19:31 |
| 4 | 10/28/2015 | 19:33 |
| 5 | 10/28/2015 | 19:34 |
| 6 | 10/28/2015 | 19:34 |

G:\Projects\GIS_Projects_2016\TransCanada\S_19\MXD\Wilder\TC_Wilder_38_130_T1_033016.mxd

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

N

0 75 150 300 Feet

**Study 19 Fish Number: 38-130 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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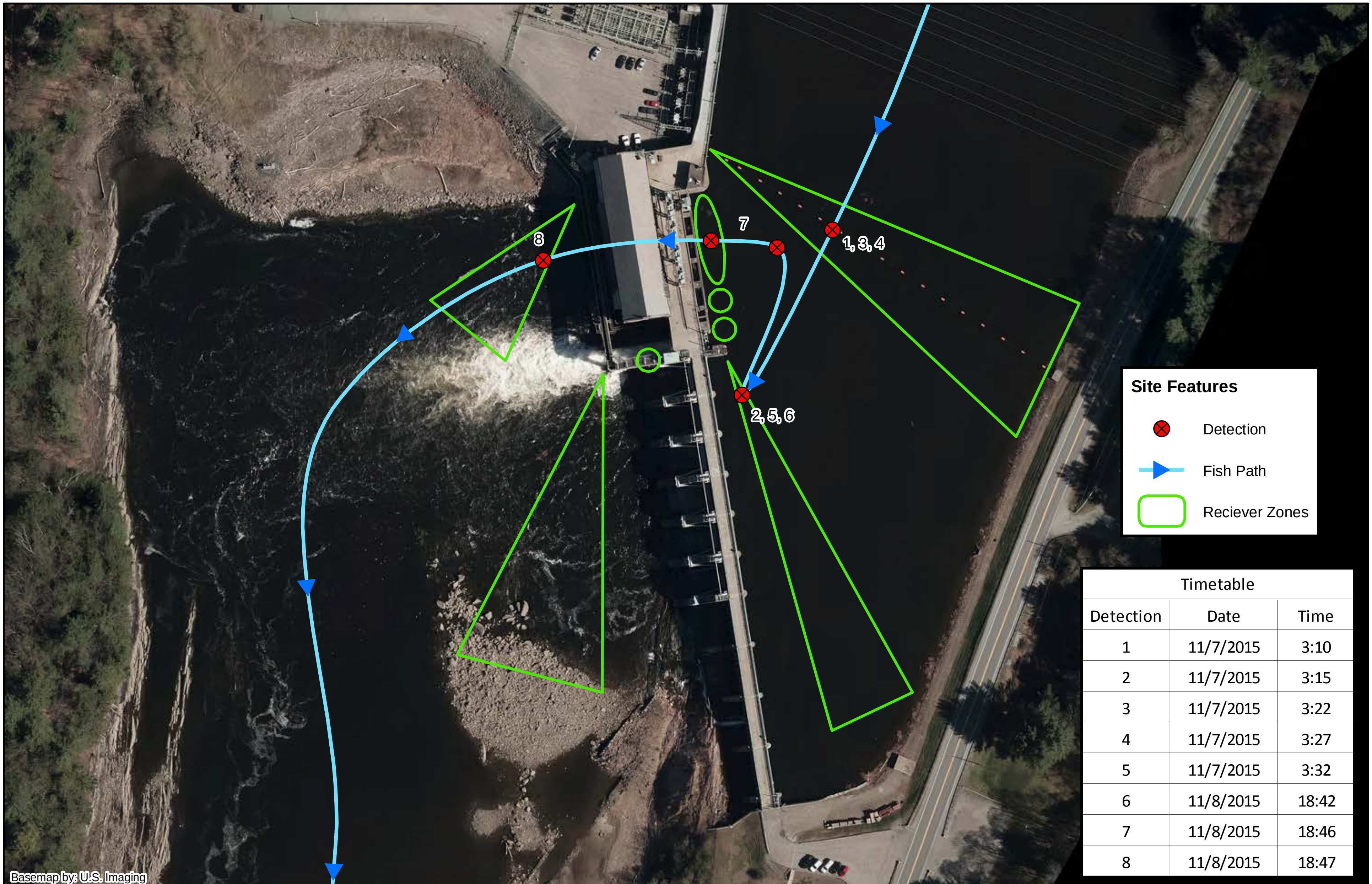


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 3:10 |
| 2 | 11/7/2015 | 3:15 |
| 3 | 11/7/2015 | 3:22 |
| 4 | 11/7/2015 | 3:27 |
| 5 | 11/7/2015 | 3:32 |
| 6 | 11/8/2015 | 18:42 |
| 7 | 11/8/2015 | 18:46 |
| 8 | 11/8/2015 | 18:47 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-151 (T1)**

Release: Norwich, VT
Date Released: 11/5/2015
Time Released: 17:05

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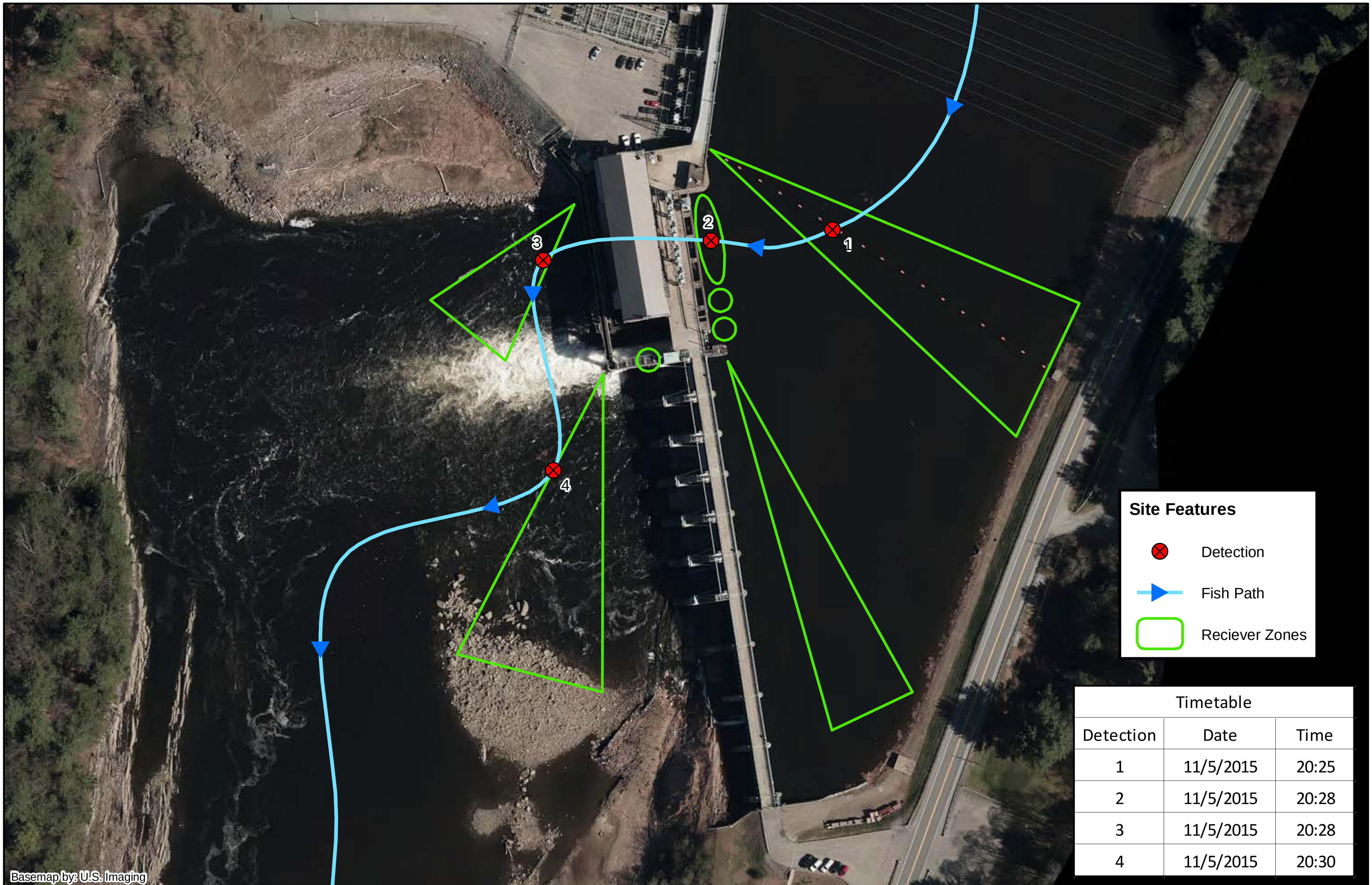


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 20:25 |
| 2 | 11/5/2015 | 20:28 |
| 3 | 11/5/2015 | 20:28 |
| 4 | 11/5/2015 | 20:30 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-152 (T1)**

Release: Norwich, VT
Date Released: 11/5/2015
Time Released: 17:05

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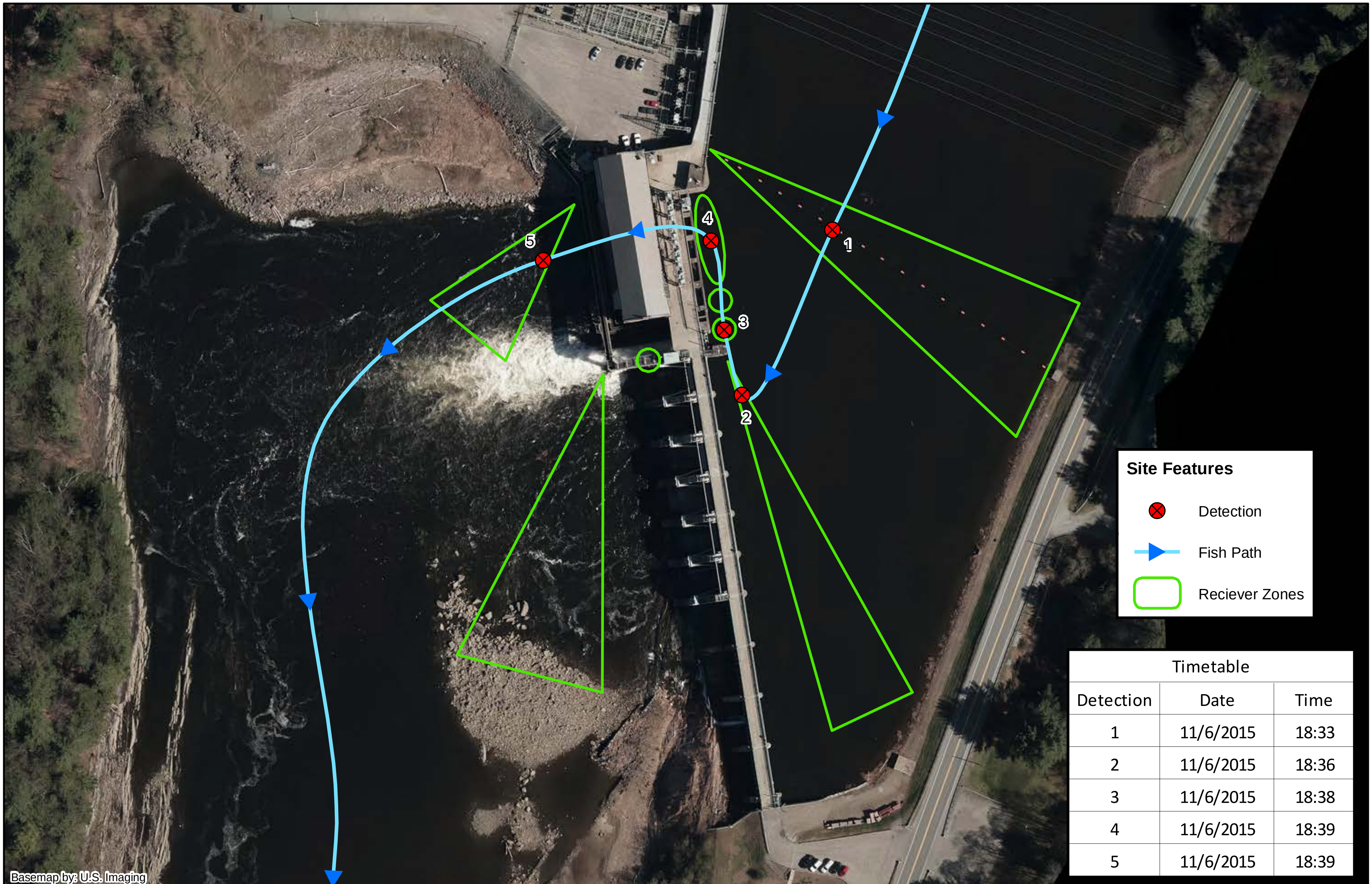


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 18:33 |
| 2 | 11/6/2015 | 18:36 |
| 3 | 11/6/2015 | 18:38 |
| 4 | 11/6/2015 | 18:39 |
| 5 | 11/6/2015 | 18:39 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-153 (T1)**

Release: Norwich, VT
Date Released: 11/5/2015
Time Released: 17:05

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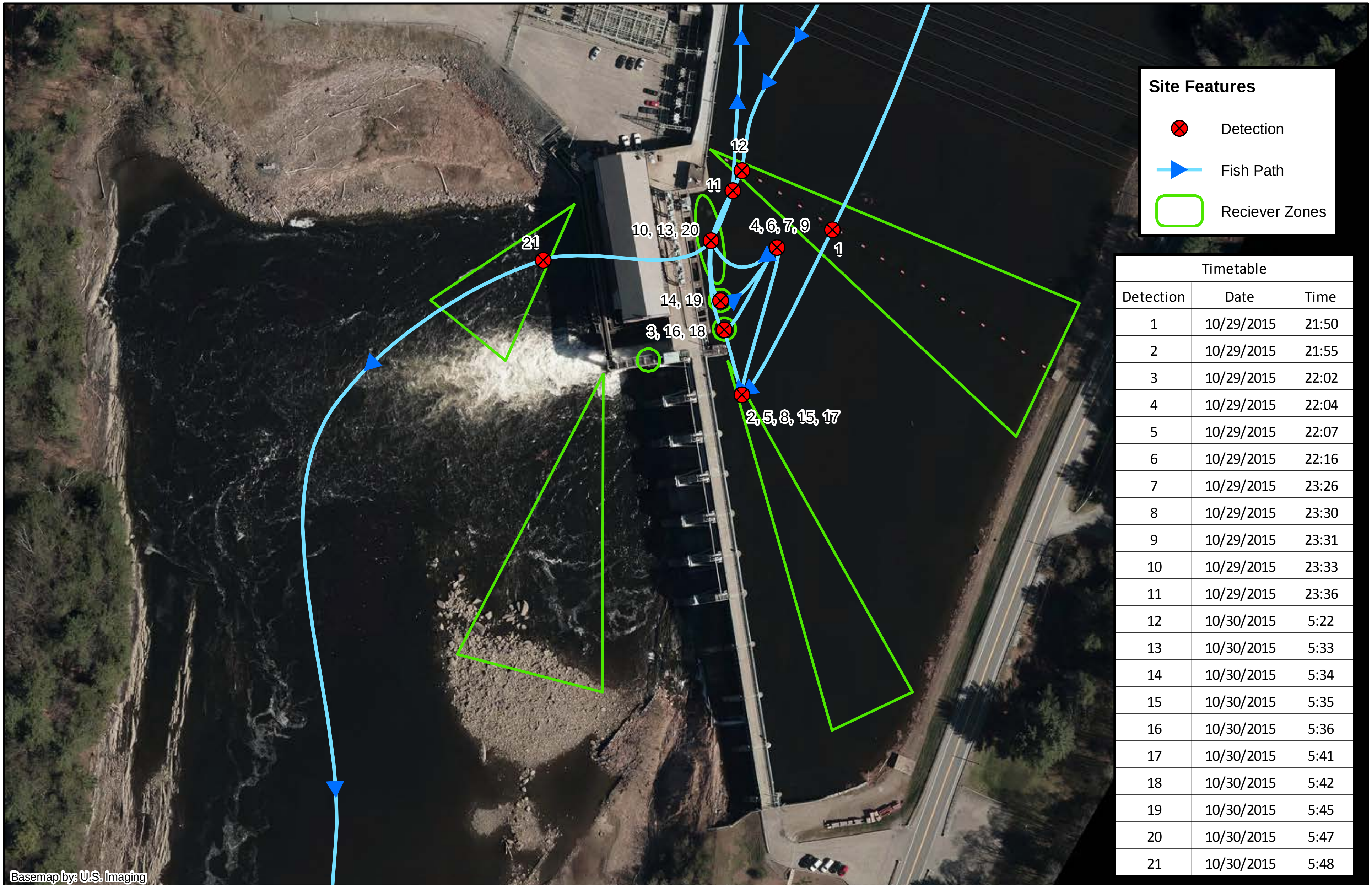


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:50 |
| 2 | 10/29/2015 | 21:55 |
| 3 | 10/29/2015 | 22:02 |
| 4 | 10/29/2015 | 22:04 |
| 5 | 10/29/2015 | 22:07 |
| 6 | 10/29/2015 | 22:16 |
| 7 | 10/29/2015 | 23:26 |
| 8 | 10/29/2015 | 23:30 |
| 9 | 10/29/2015 | 23:31 |
| 10 | 10/29/2015 | 23:33 |
| 11 | 10/29/2015 | 23:36 |
| 12 | 10/30/2015 | 5:22 |
| 13 | 10/30/2015 | 5:33 |
| 14 | 10/30/2015 | 5:34 |
| 15 | 10/30/2015 | 5:35 |
| 16 | 10/30/2015 | 5:36 |
| 17 | 10/30/2015 | 5:41 |
| 18 | 10/30/2015 | 5:42 |
| 19 | 10/30/2015 | 5:45 |
| 20 | 10/30/2015 | 5:47 |
| 21 | 10/30/2015 | 5:48 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-157 (T1)**

Release: Norwich, VT
Date Released: 10/29/15
Time Released: 18:43

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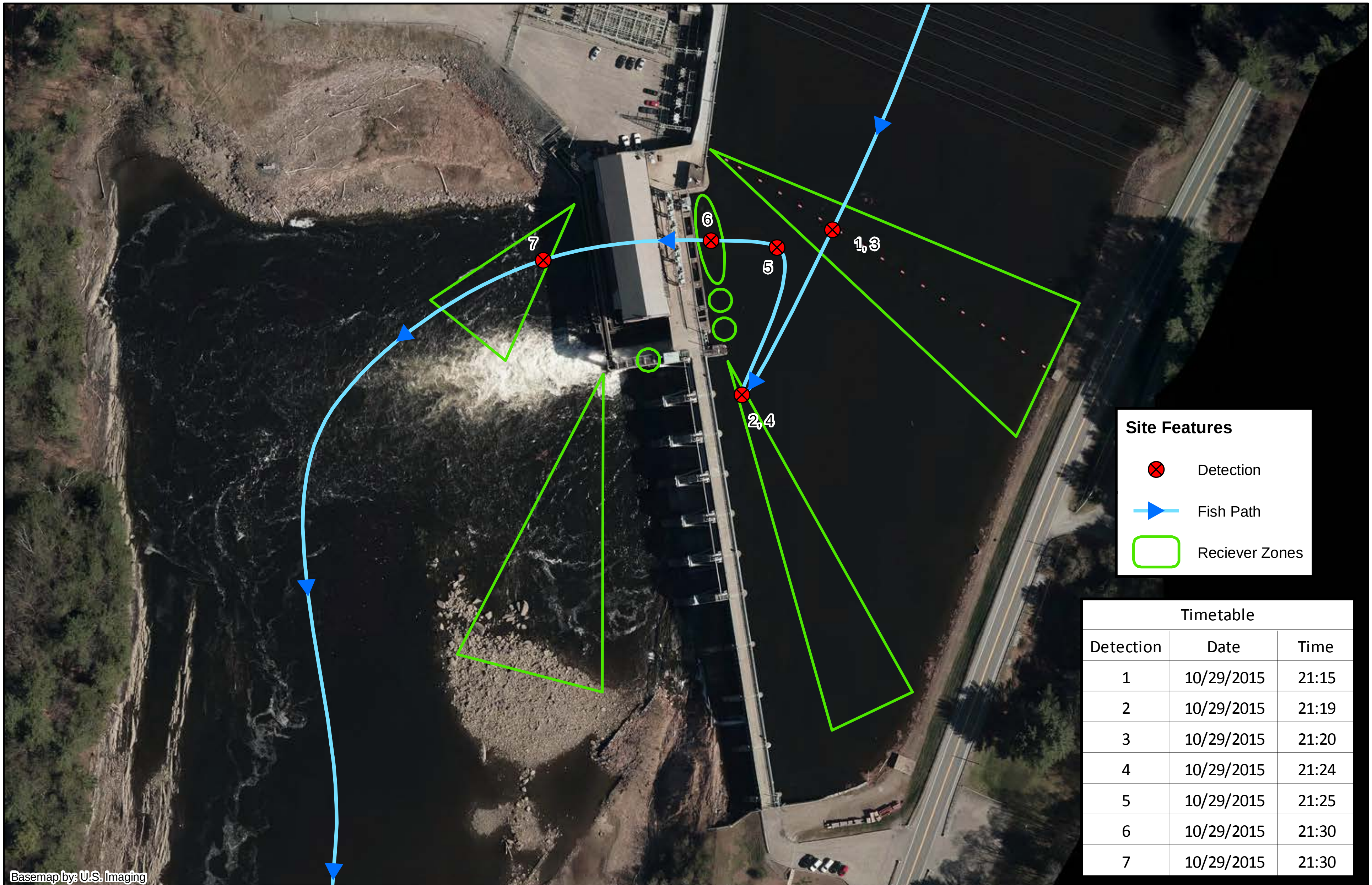


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:15 |
| 2 | 10/29/2015 | 21:19 |
| 3 | 10/29/2015 | 21:20 |
| 4 | 10/29/2015 | 21:24 |
| 5 | 10/29/2015 | 21:25 |
| 6 | 10/29/2015 | 21:30 |
| 7 | 10/29/2015 | 21:30 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-158 (T1)**

Release: Norwich, VT
Date Released: 10/29/15
Time Released: 18:43

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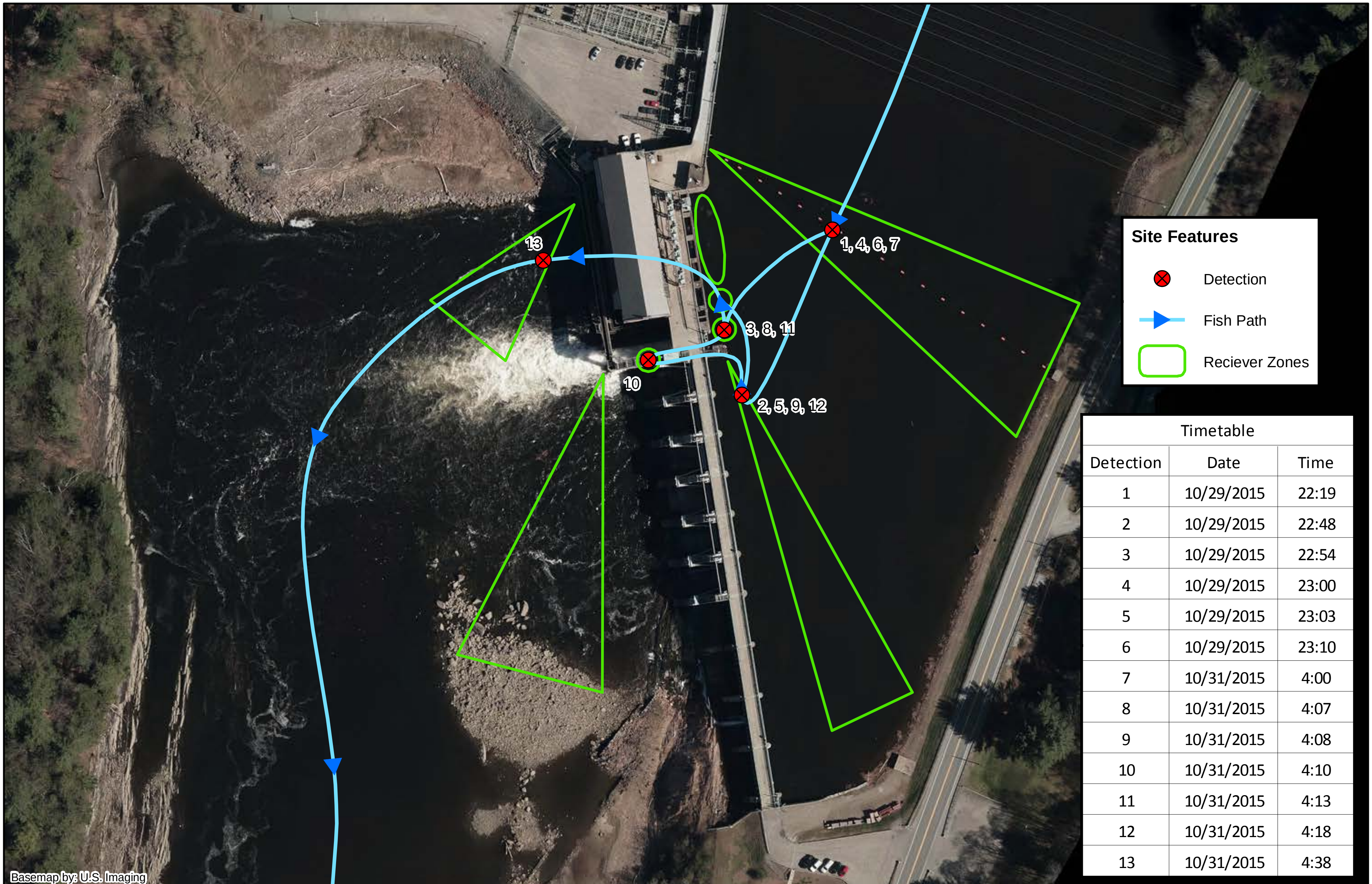


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 22:19 |
| 2 | 10/29/2015 | 22:48 |
| 3 | 10/29/2015 | 22:54 |
| 4 | 10/29/2015 | 23:00 |
| 5 | 10/29/2015 | 23:03 |
| 6 | 10/29/2015 | 23:10 |
| 7 | 10/31/2015 | 4:00 |
| 8 | 10/31/2015 | 4:07 |
| 9 | 10/31/2015 | 4:08 |
| 10 | 10/31/2015 | 4:10 |
| 11 | 10/31/2015 | 4:13 |
| 12 | 10/31/2015 | 4:18 |
| 13 | 10/31/2015 | 4:38 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-159 (T1)**

Release: Norwich, VT
Date Released: 10/29/15
Time Released: 18:43

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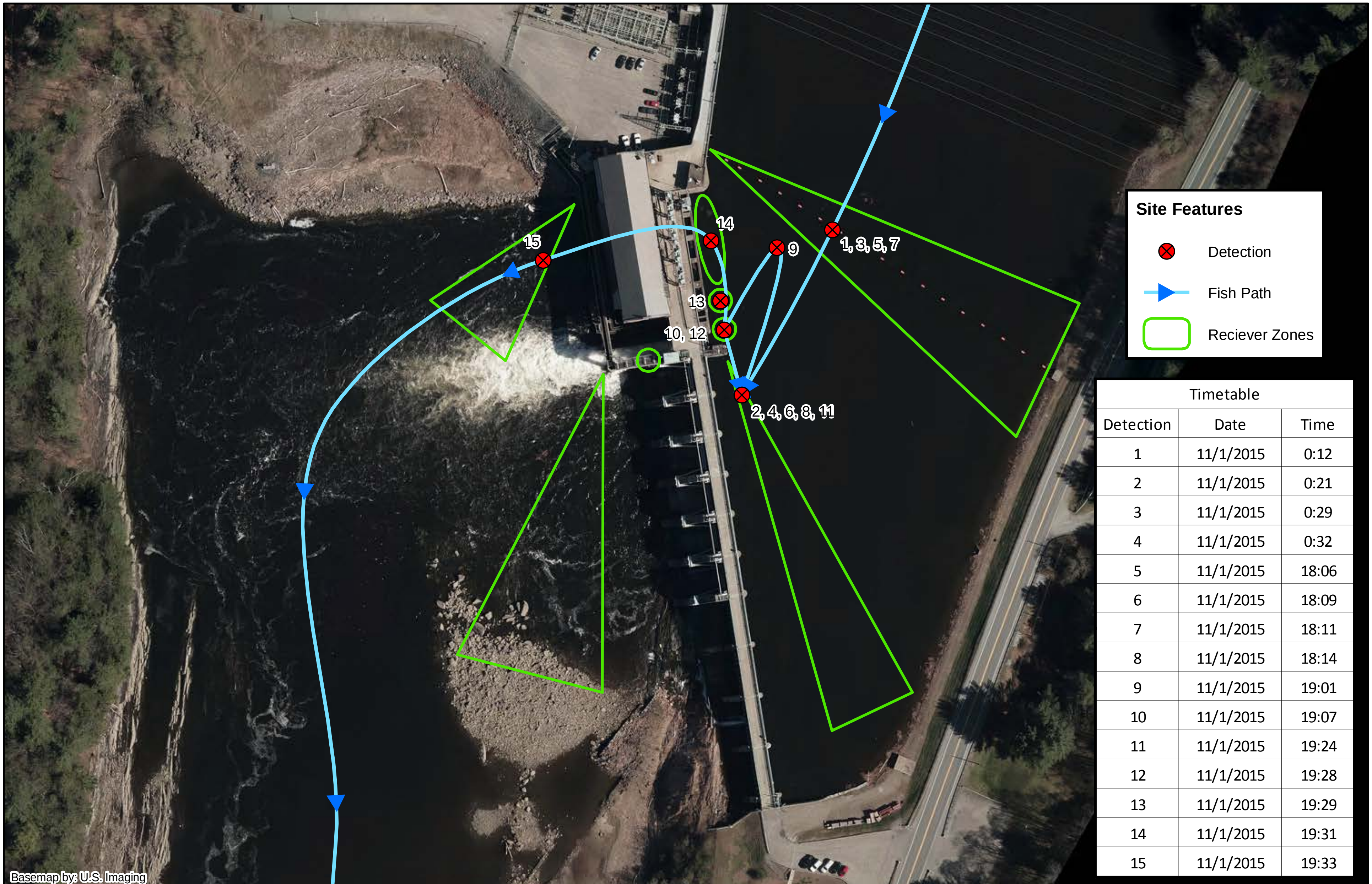


Timetable

| Detection | Date | Time |
|---|---|---|
| 1 | 11/1/2015 | 0:12 |
| 2 | 11/1/2015 | 0:21 |
| 3 | 11/1/2015 | 0:29 |
| 4 | 11/1/2015 | 0:32 |
| 5 | 11/1/2015 | 18:06 |
| 6 | 11/1/2015 | 18:09 |
| 7 | 11/1/2015 | 18:11 |
| 8 | 11/1/2015 | 18:14 |
| 9 | 11/1/2015 | 19:01 |
| 10 | 11/1/2015 | 19:07 |
| 11 | 11/1/2015 | 19:24 |
| 12 | 11/1/2015 | 19:28 |
| 13 | 11/1/2015 | 19:29 |
| 14 | 11/1/2015 | 19:31 |
| 15 | 11/1/2015 | 19:33 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-160 (T1)**

Release: Norwich, VT
Date Released: 10/29/15
Time Released: 18:43


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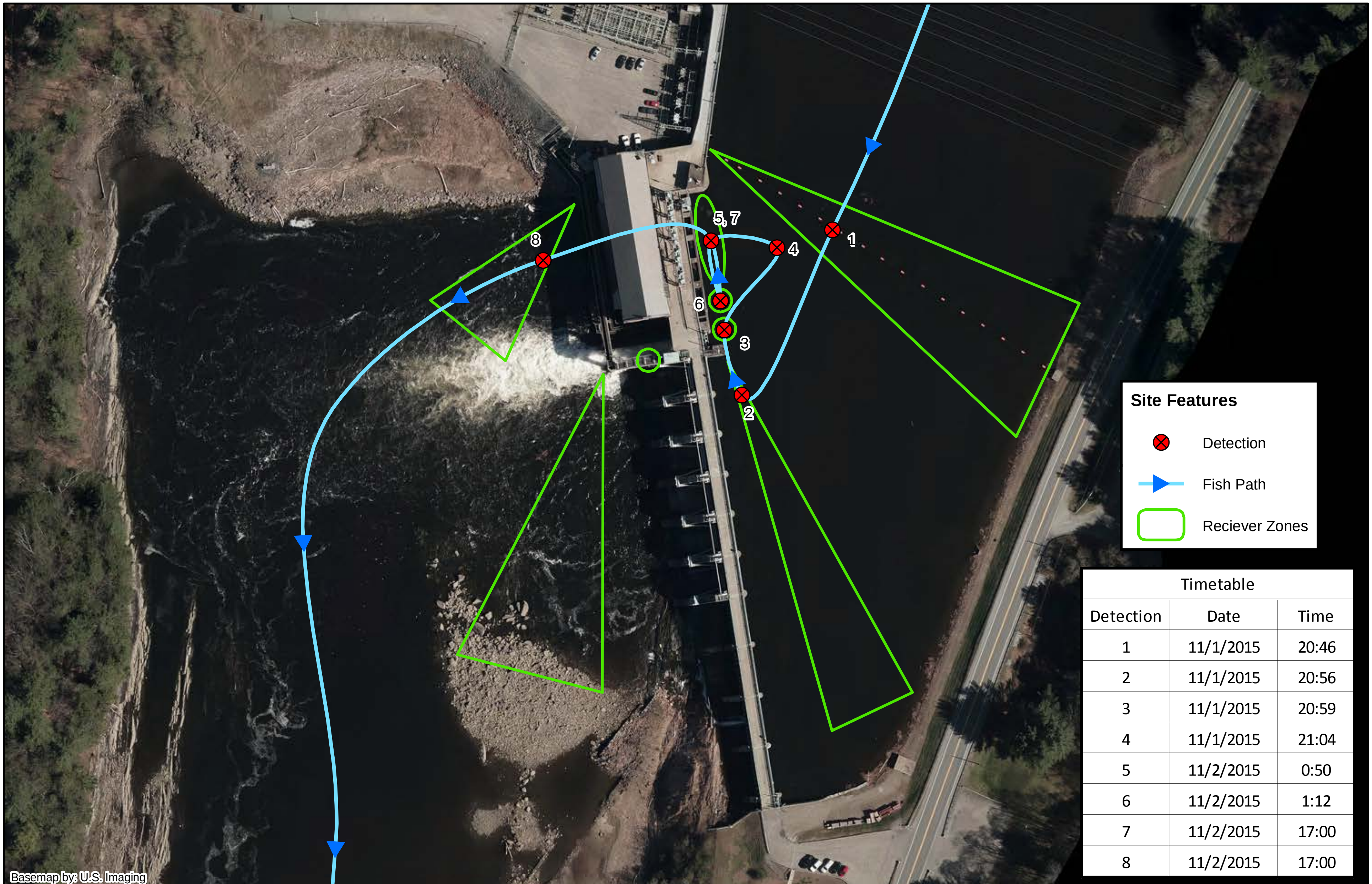


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 20:46 |
| 2 | 11/1/2015 | 20:56 |
| 3 | 11/1/2015 | 20:59 |
| 4 | 11/1/2015 | 21:04 |
| 5 | 11/2/2015 | 0:50 |
| 6 | 11/2/2015 | 1:12 |
| 7 | 11/2/2015 | 17:00 |
| 8 | 11/2/2015 | 17:00 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-188 (T1)**

Release: Norwich, VT
Date Released: 10/31/15
Time Released: 19:21

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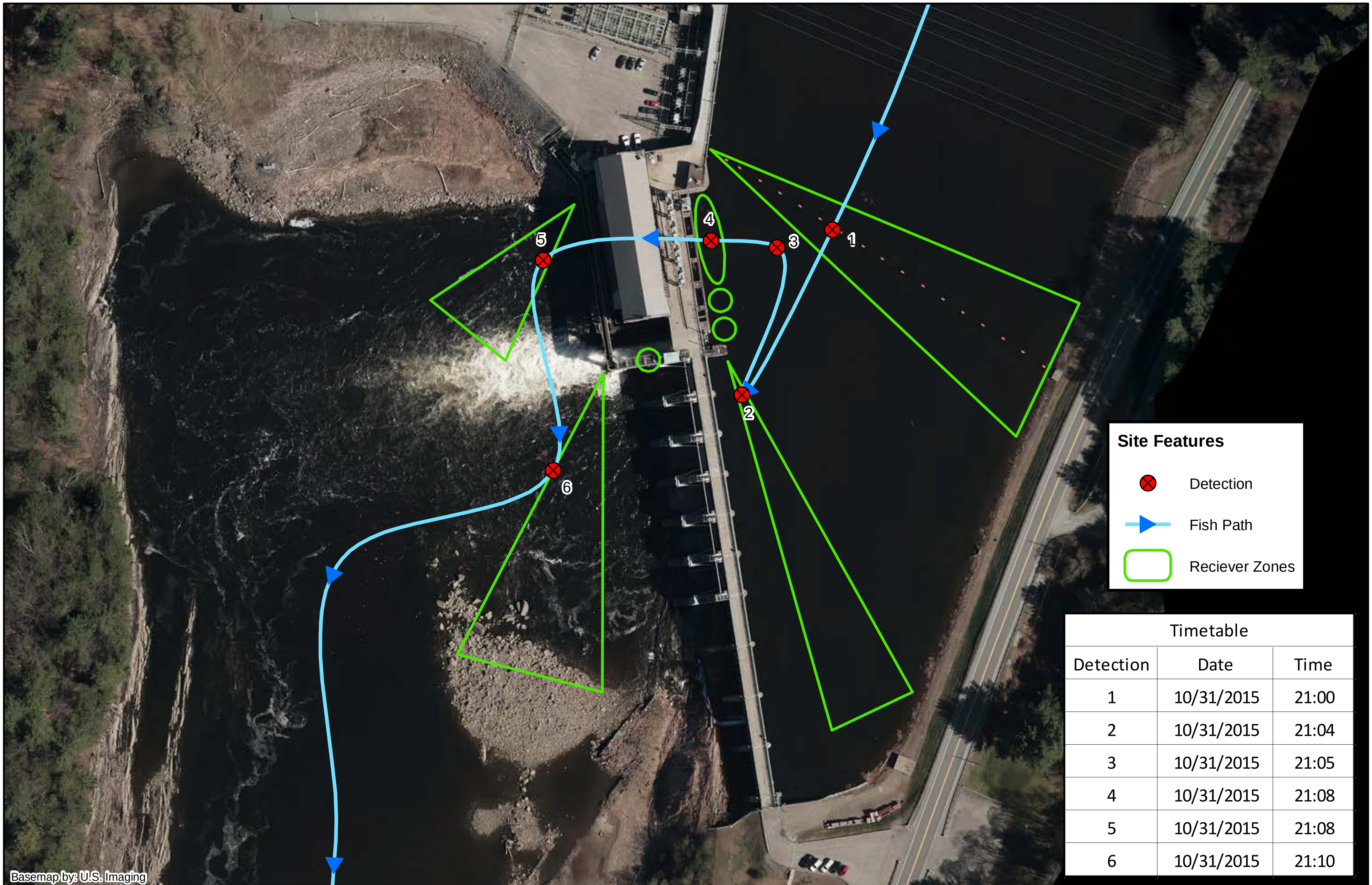


Timetable

| Detection | Date | Time |
|---|---|---|
| 1 | 10/31/2015 | 21:00 |
| 2 | 10/31/2015 | 21:04 |
| 3 | 10/31/2015 | 21:05 |
| 4 | 10/31/2015 | 21:08 |
| 5 | 10/31/2015 | 21:08 |
| 6 | 10/31/2015 | 21:10 |

G:\Projects\GIS_Projects_2016\TransCanada\S_19\MXD\Wilder\REV1\TC_Wilder_38_189_T1_050516.mxd

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**


**Study 19 Fish Number: 38-189 (T1)**

Release: Norwich, VT
Date Released: 10/31/15
Time Released: 19:21

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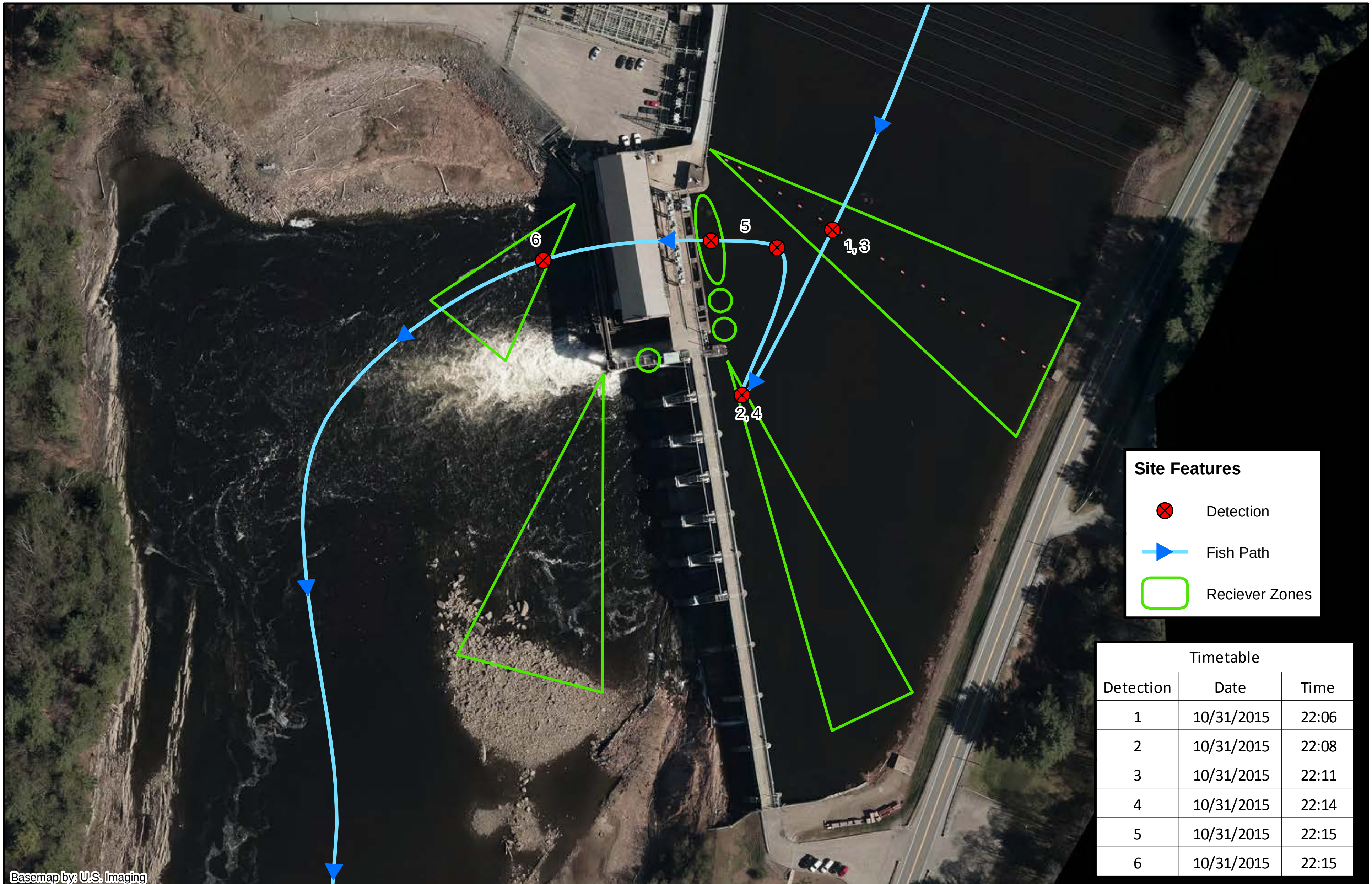


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 22:06 |
| 2 | 10/31/2015 | 22:08 |
| 3 | 10/31/2015 | 22:11 |
| 4 | 10/31/2015 | 22:14 |
| 5 | 10/31/2015 | 22:15 |
| 6 | 10/31/2015 | 22:15 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-190 (T1)**

Release: Norwich, VT
Date Released: 10/31/15
Time Released: 19:21

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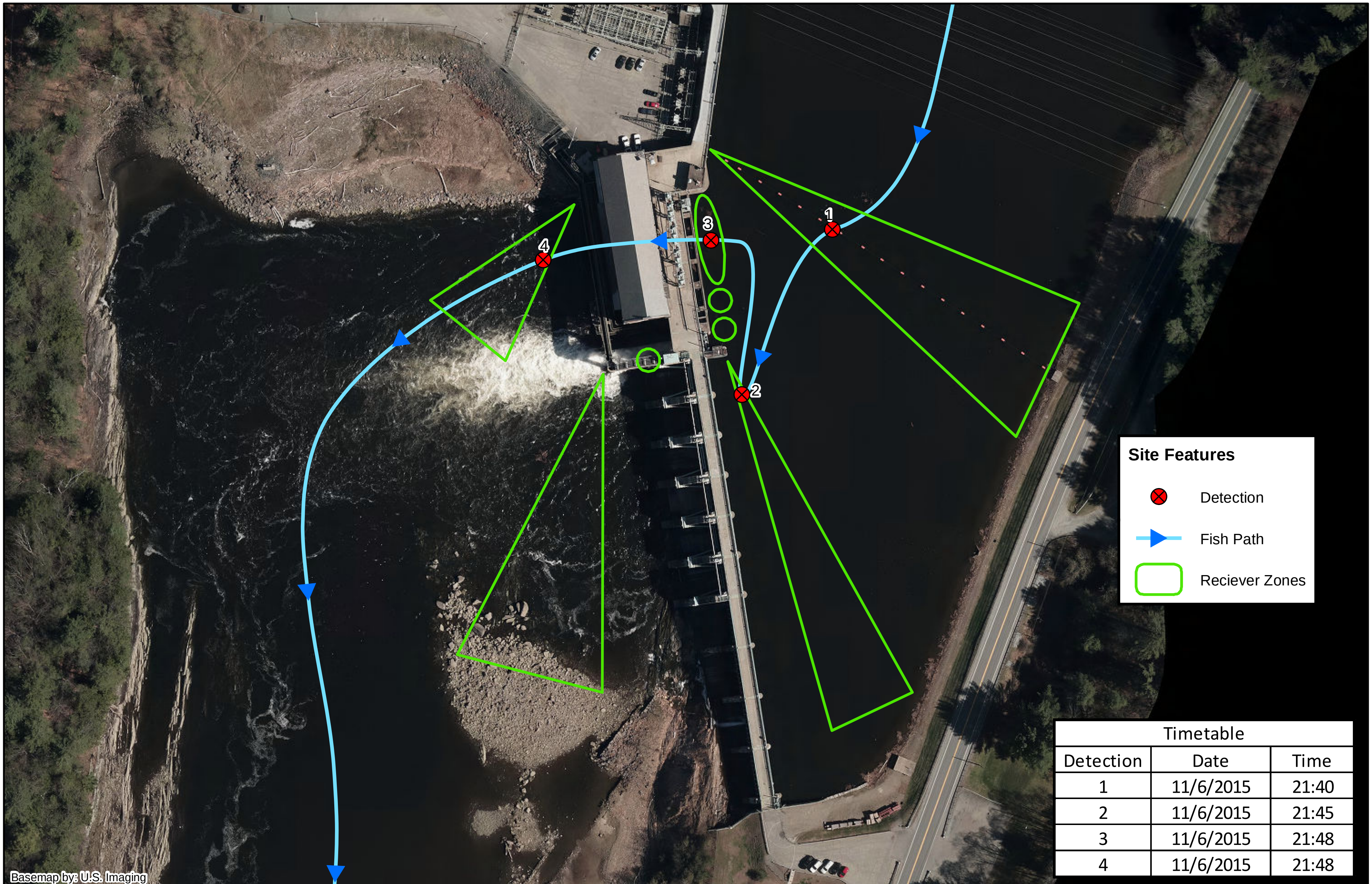


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 21:40 |
| 2 | 11/6/2015 | 21:45 |
| 3 | 11/6/2015 | 21:48 |
| 4 | 11/6/2015 | 21:48 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Wilder Dam**

N

1 in = 150 feet

0 75 150 300 Feet

**Study 19 Fish Number: 38-58 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32


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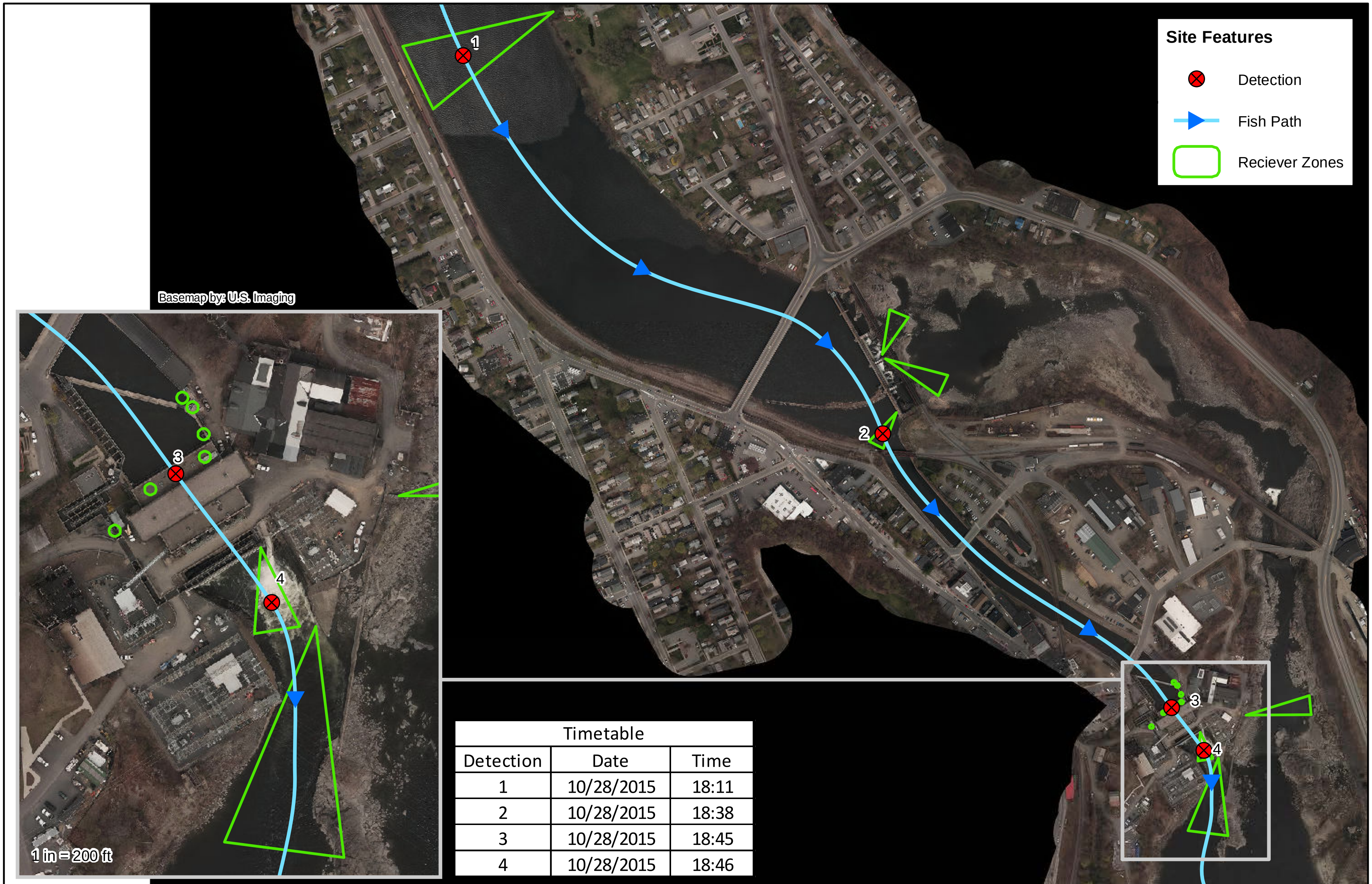


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 18:11 |
| 2 | 10/28/2015 | 18:38 |
| 3 | 10/28/2015 | 18:45 |
| 4 | 10/28/2015 | 18:46 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-111 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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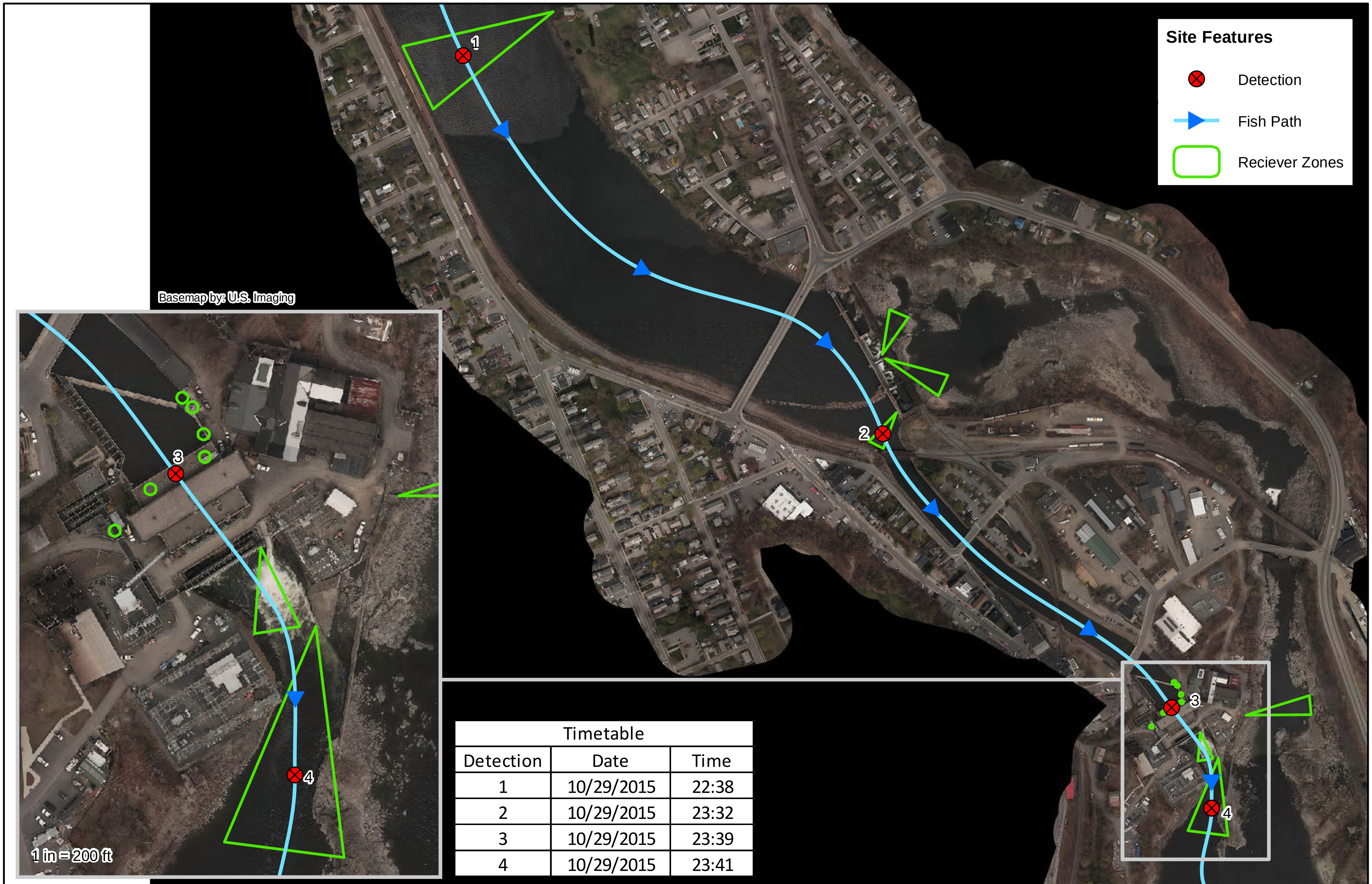


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 22:38 |
| 2 | 10/29/2015 | 23:32 |
| 3 | 10/29/2015 | 23:39 |
| 4 | 10/29/2015 | 23:41 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-112 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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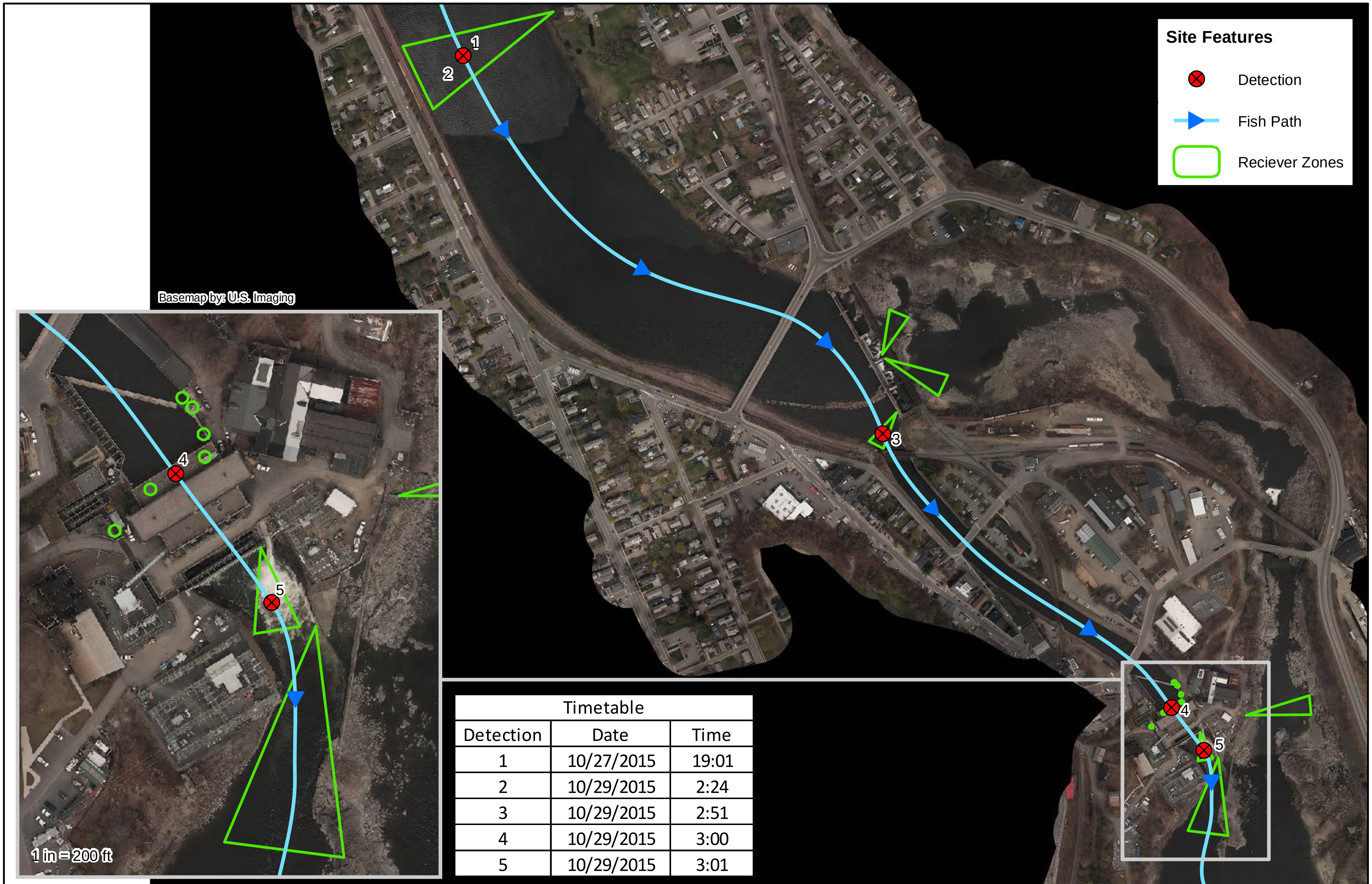


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/27/2015 | 19:01 |
| 2 | 10/29/2015 | 2:24 |
| 3 | 10/29/2015 | 2:51 |
| 4 | 10/29/2015 | 3:00 |
| 5 | 10/29/2015 | 3:01 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-114 (A1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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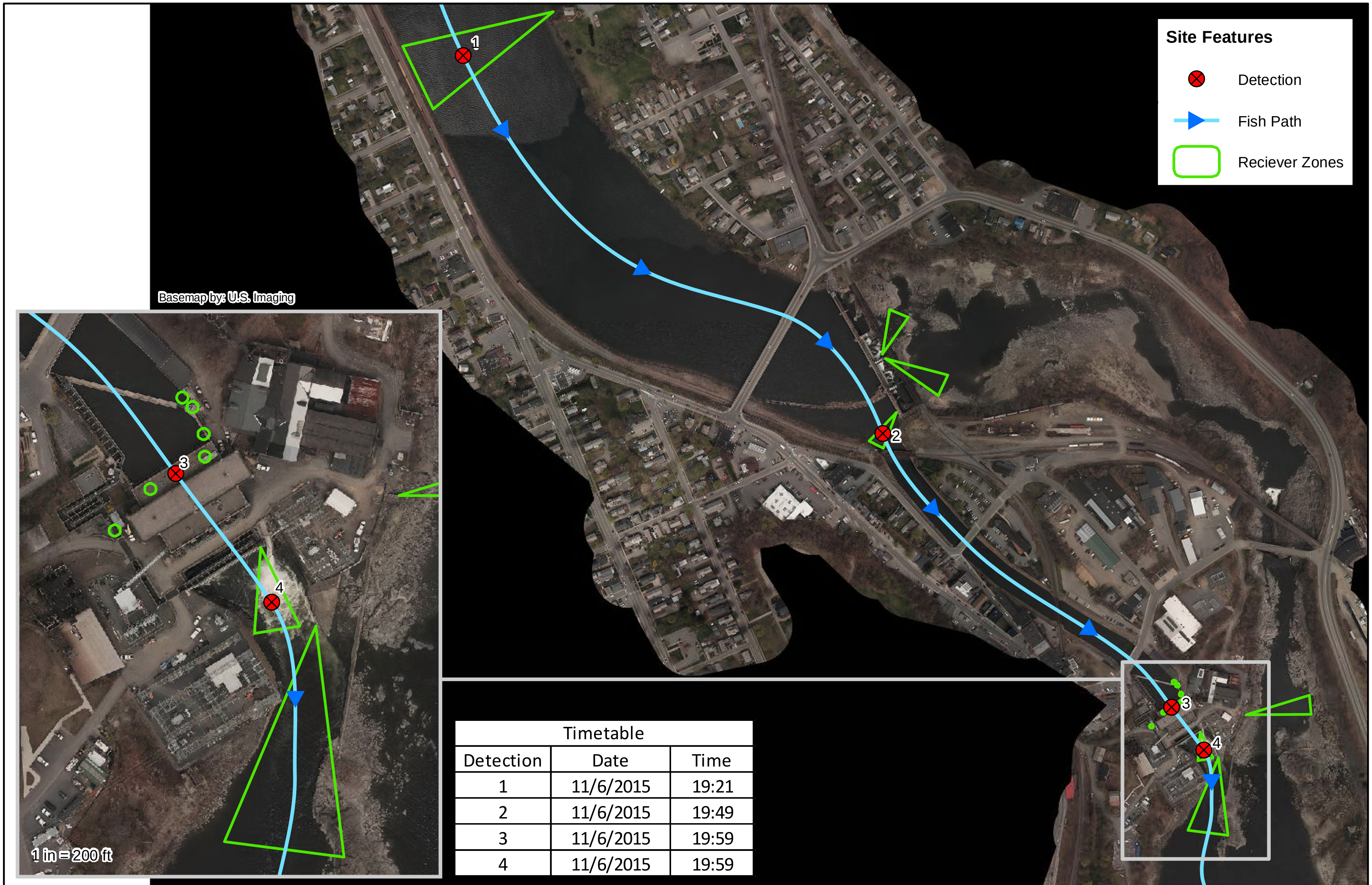


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:21 |
| 2 | 11/6/2015 | 19:49 |
| 3 | 11/6/2015 | 19:59 |
| 4 | 11/6/2015 | 19:59 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-115 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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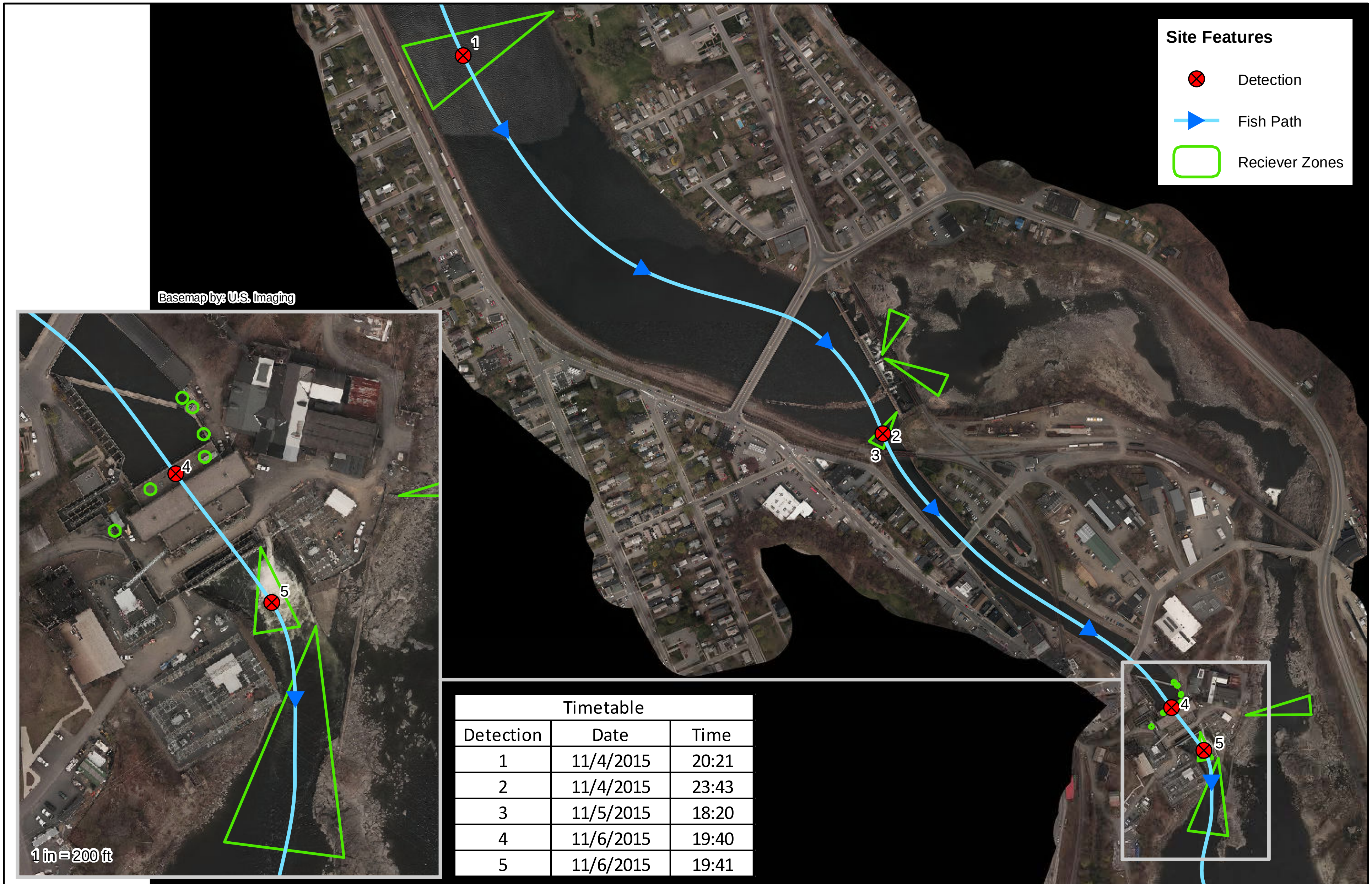


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 20:21 |
| 2 | 11/4/2015 | 23:43 |
| 3 | 11/5/2015 | 18:20 |
| 4 | 11/6/2015 | 19:40 |
| 5 | 11/6/2015 | 19:41 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-116 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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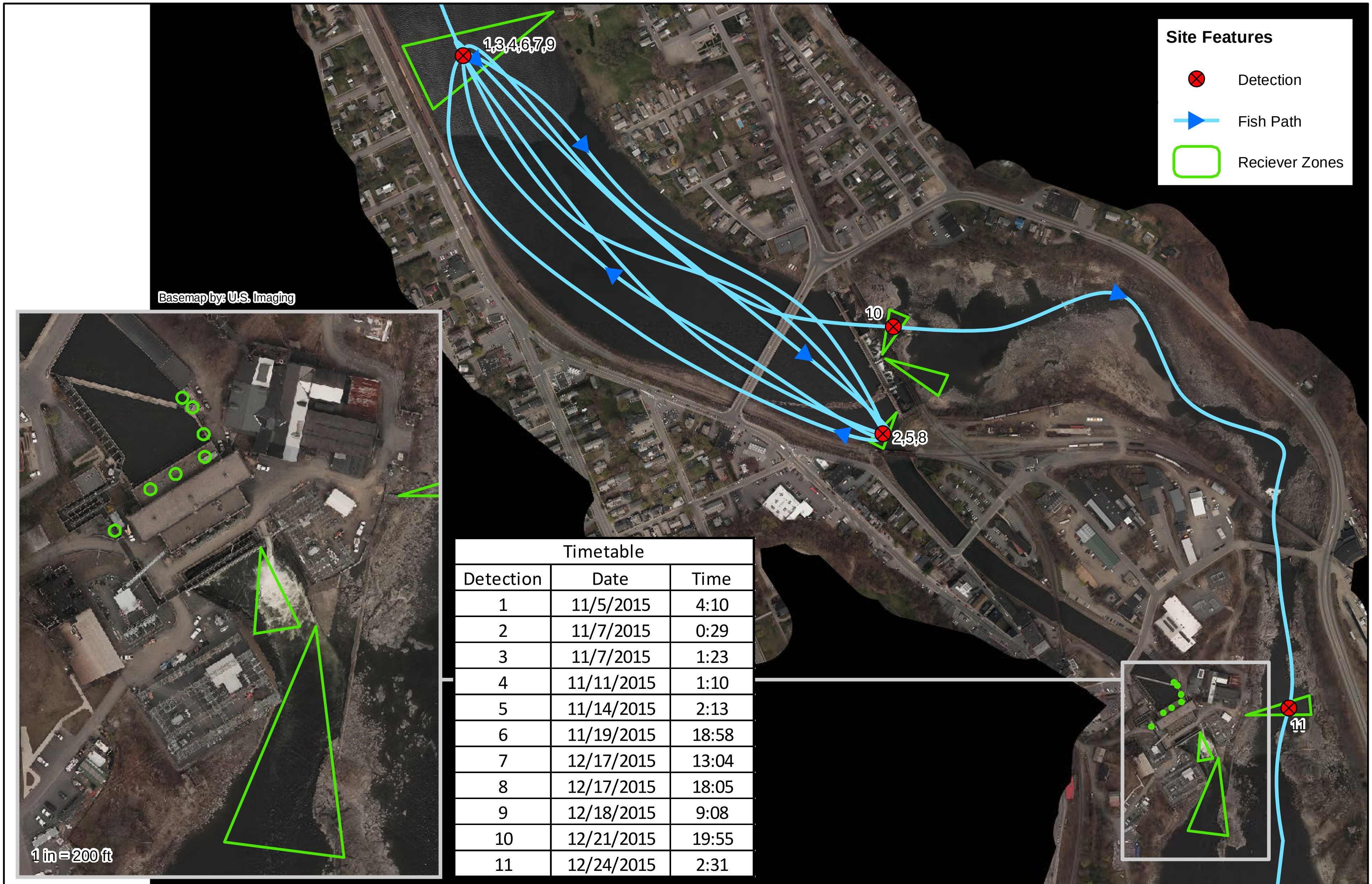


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 4:10 |
| 2 | 11/7/2015 | 0:29 |
| 3 | 11/7/2015 | 1:23 |
| 4 | 11/11/2015 | 1:10 |
| 5 | 11/14/2015 | 2:13 |
| 6 | 11/19/2015 | 18:58 |
| 7 | 12/17/2015 | 13:04 |
| 8 | 12/17/2015 | 18:05 |
| 9 | 12/18/2015 | 9:08 |
| 10 | 12/21/2015 | 19:55 |
| 11 | 12/24/2015 | 2:31 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-117 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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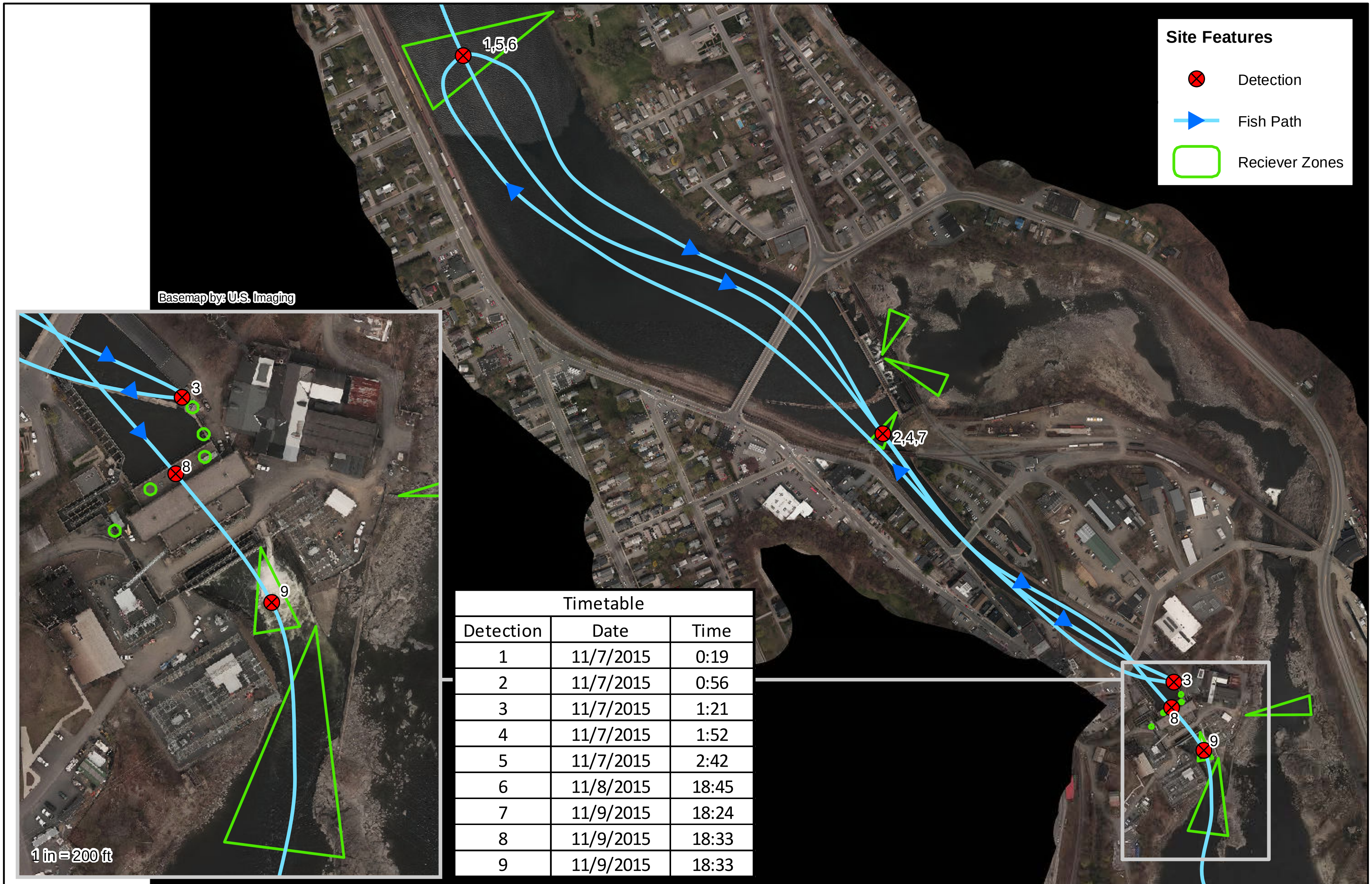


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 0:19 |
| 2 | 11/7/2015 | 0:56 |
| 3 | 11/7/2015 | 1:21 |
| 4 | 11/7/2015 | 1:52 |
| 5 | 11/7/2015 | 2:42 |
| 6 | 11/8/2015 | 18:45 |
| 7 | 11/9/2015 | 18:24 |
| 8 | 11/9/2015 | 18:33 |
| 9 | 11/9/2015 | 18:33 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-118 (T1)**

Release: Bellows Falls, VT
Date Released: 11/03/2015
Time Released: 16:45

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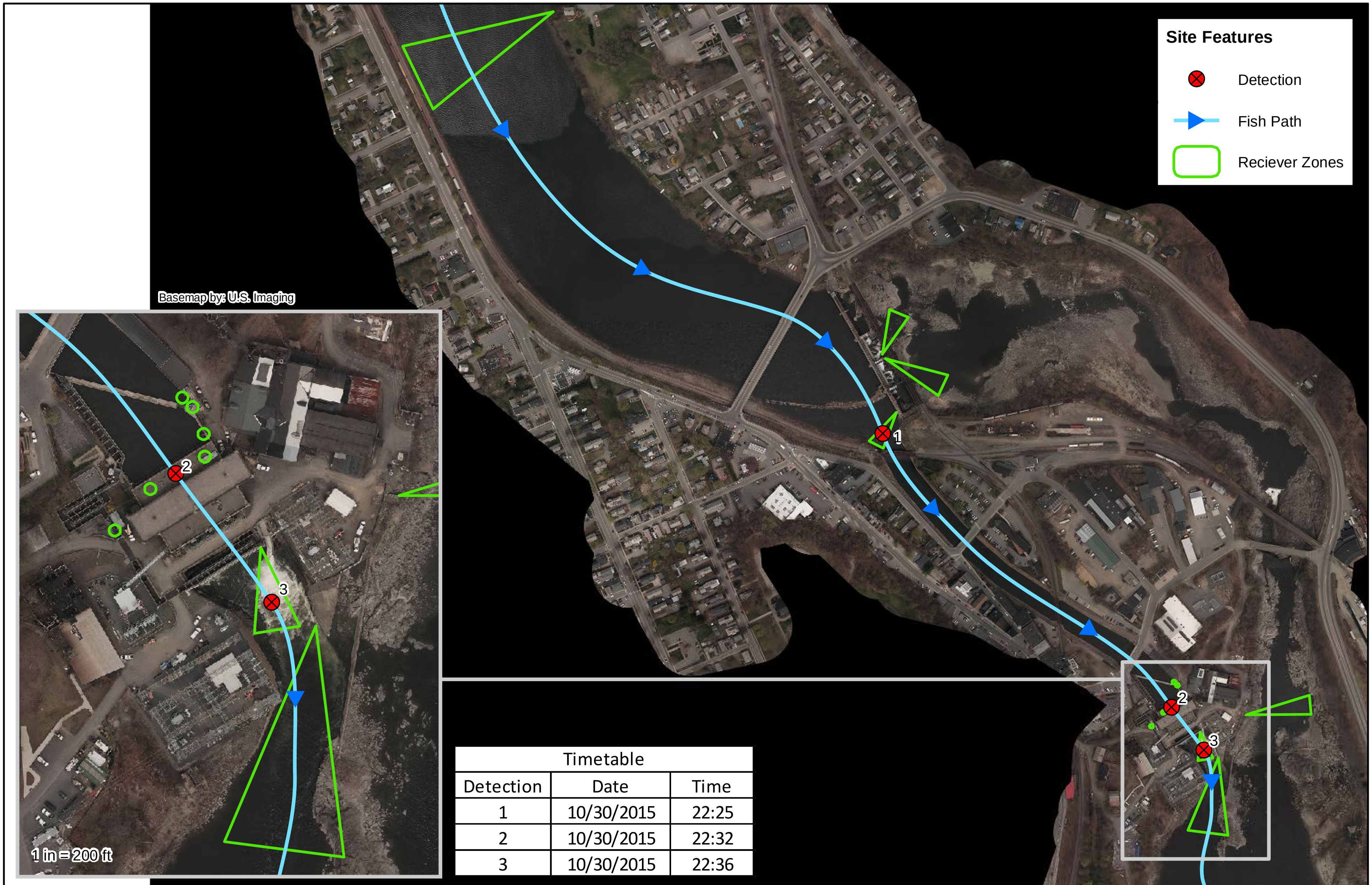


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 22:25 |
| 2 | 10/30/2015 | 22:32 |
| 3 | 10/30/2015 | 22:36 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N
1 in = 600 feet
0 300 600 1,200 Feet

**Study 19 Fish Number: 34-121 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05


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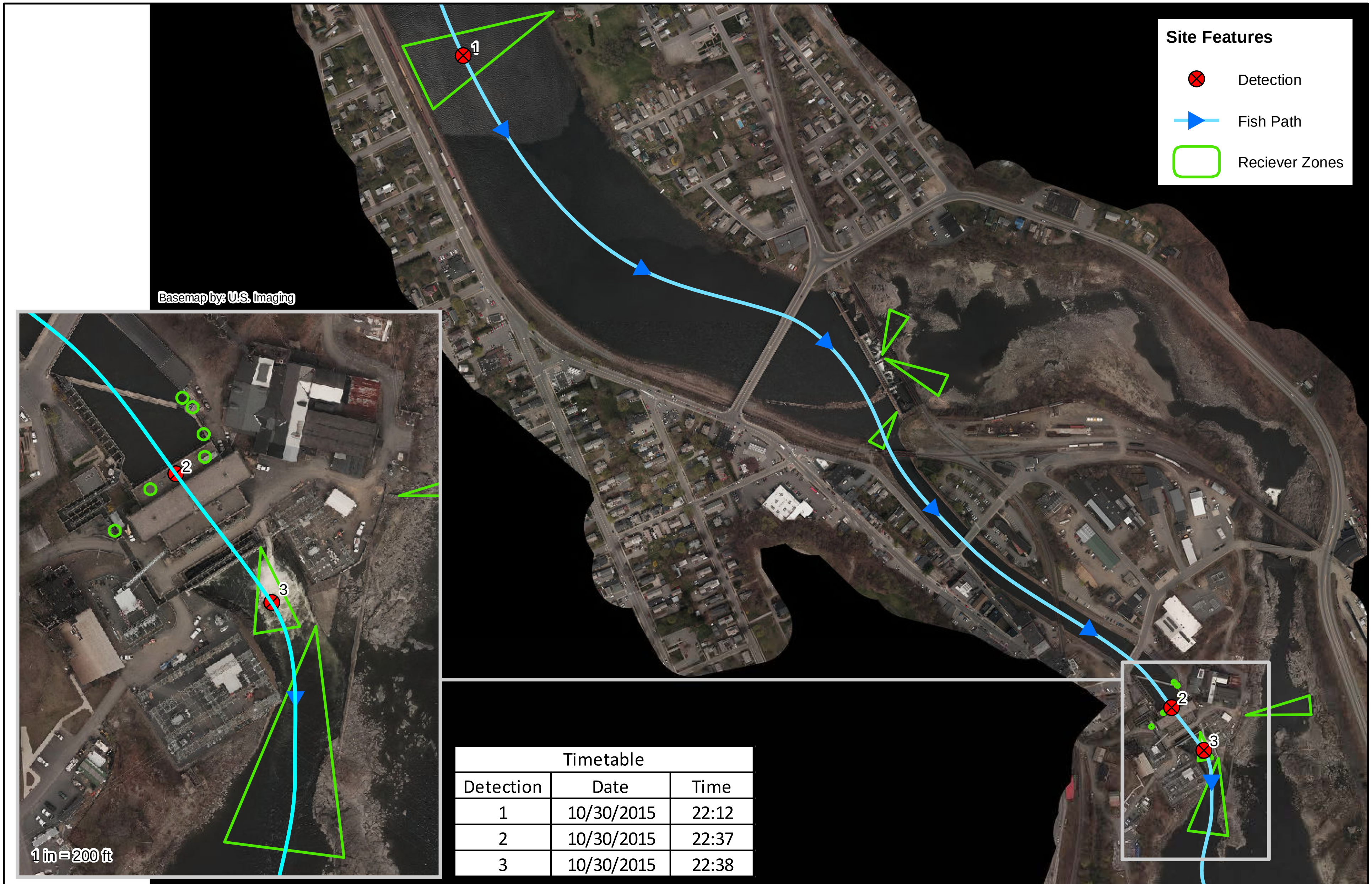


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 22:12 |
| 2 | 10/30/2015 | 22:37 |
| 3 | 10/30/2015 | 22:38 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 34-122 (A1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05

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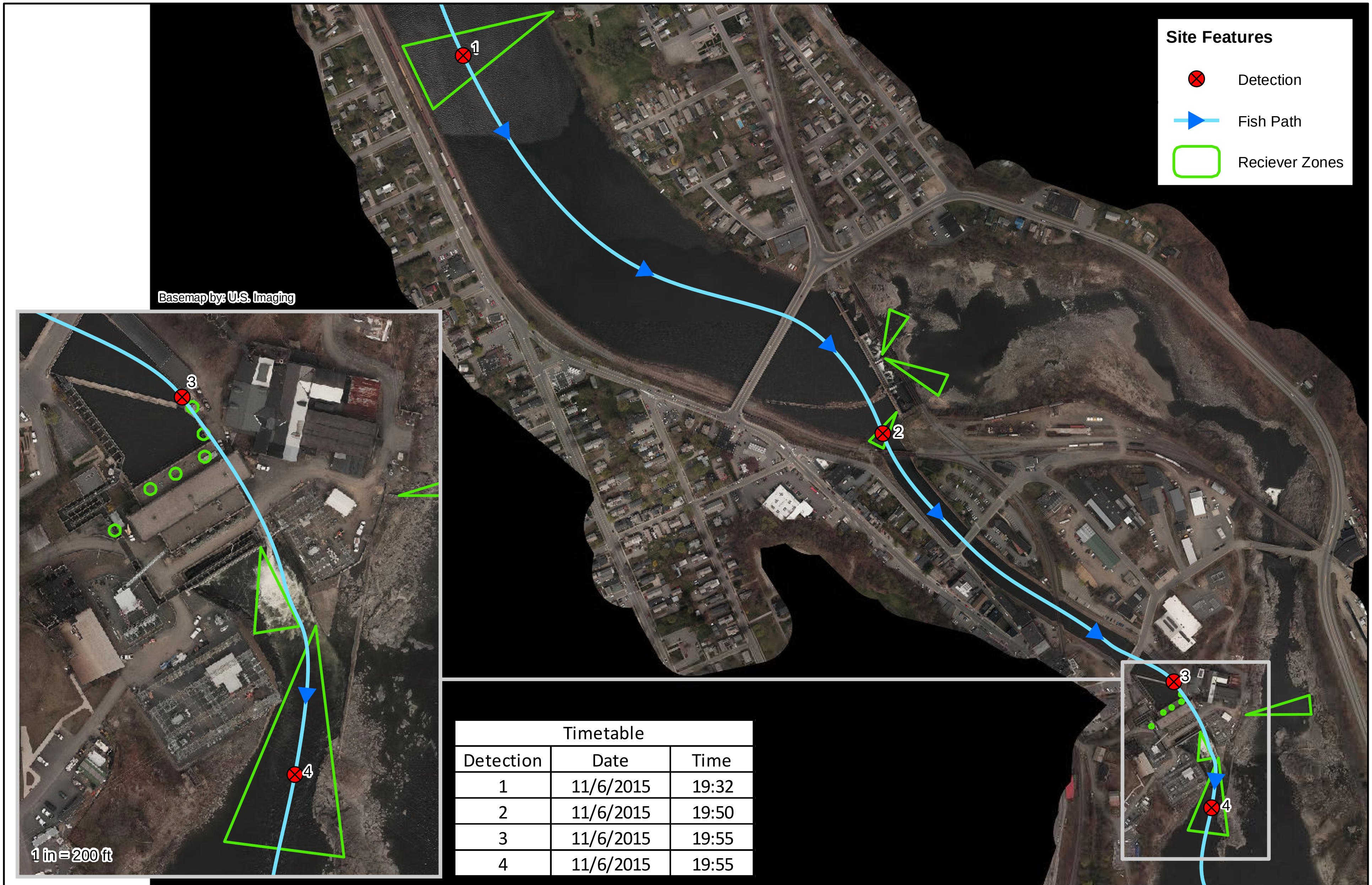


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:32 |
| 2 | 11/6/2015 | 19:50 |
| 3 | 11/6/2015 | 19:55 |
| 4 | 11/6/2015 | 19:55 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-128 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32


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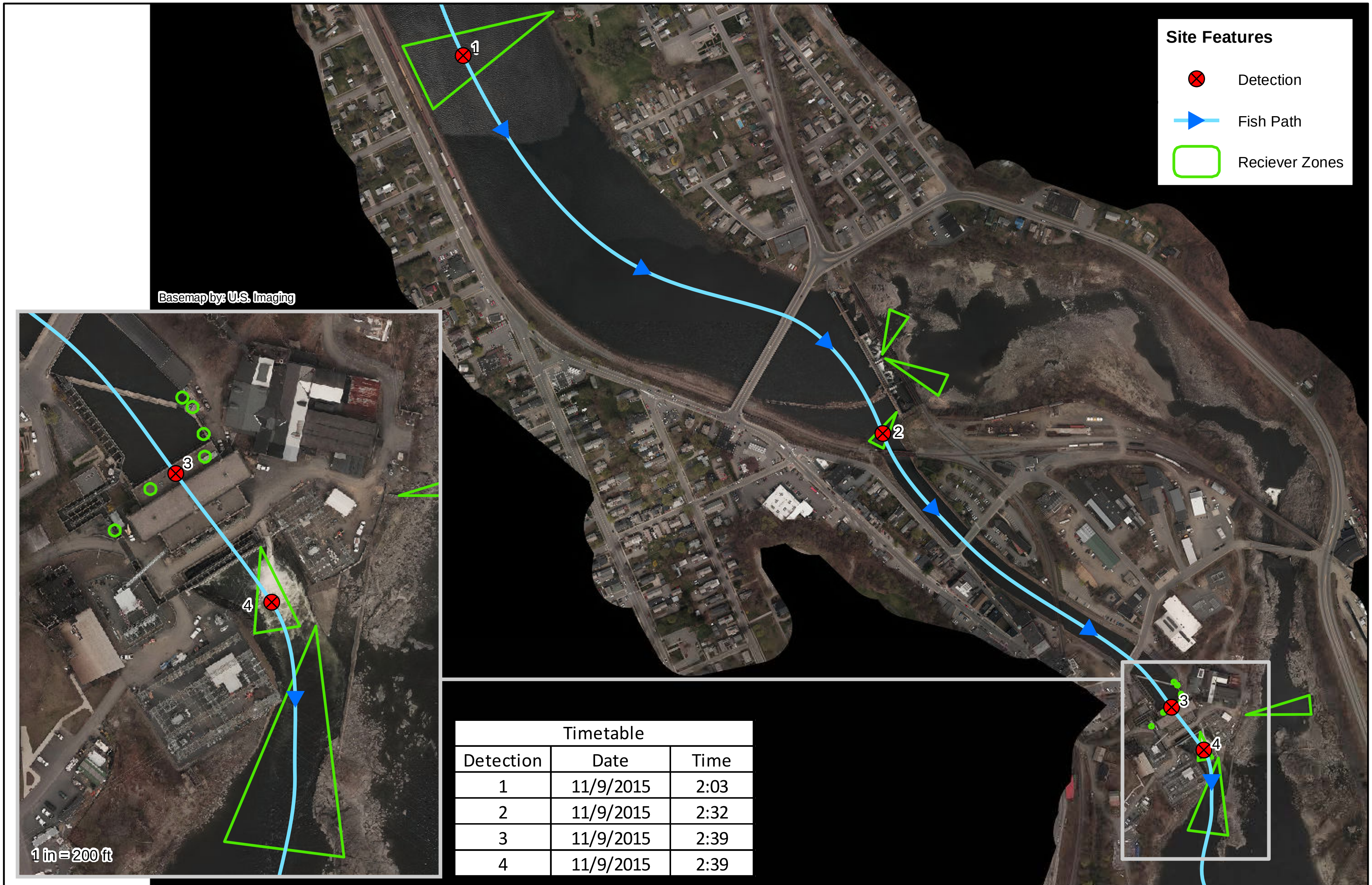


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 2:03 |
| 2 | 11/9/2015 | 2:32 |
| 3 | 11/9/2015 | 2:39 |
| 4 | 11/9/2015 | 2:39 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-129 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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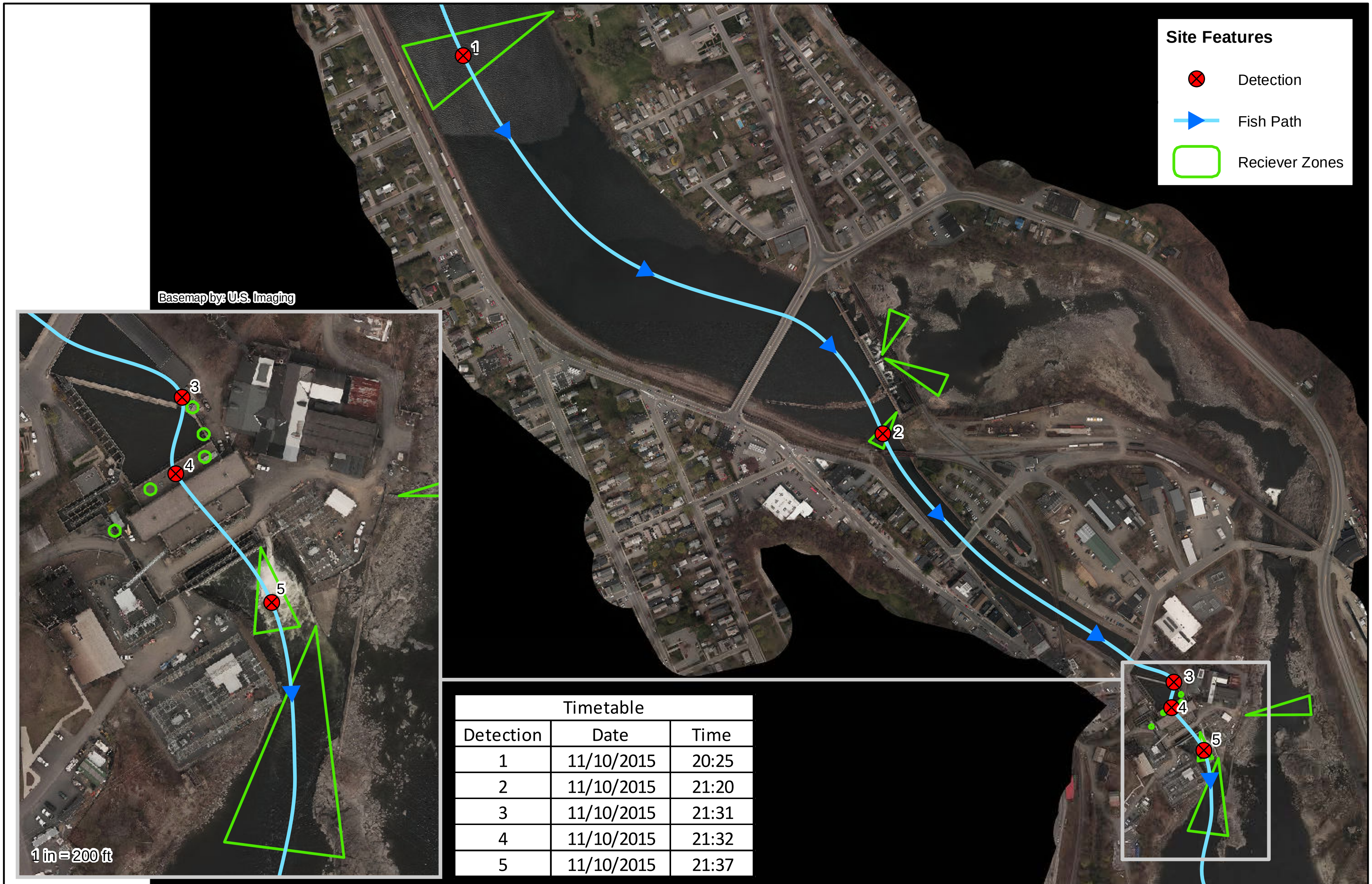


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 20:25 |
| 2 | 11/10/2015 | 21:20 |
| 3 | 11/10/2015 | 21:31 |
| 4 | 11/10/2015 | 21:32 |
| 5 | 11/10/2015 | 21:37 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-130 (A1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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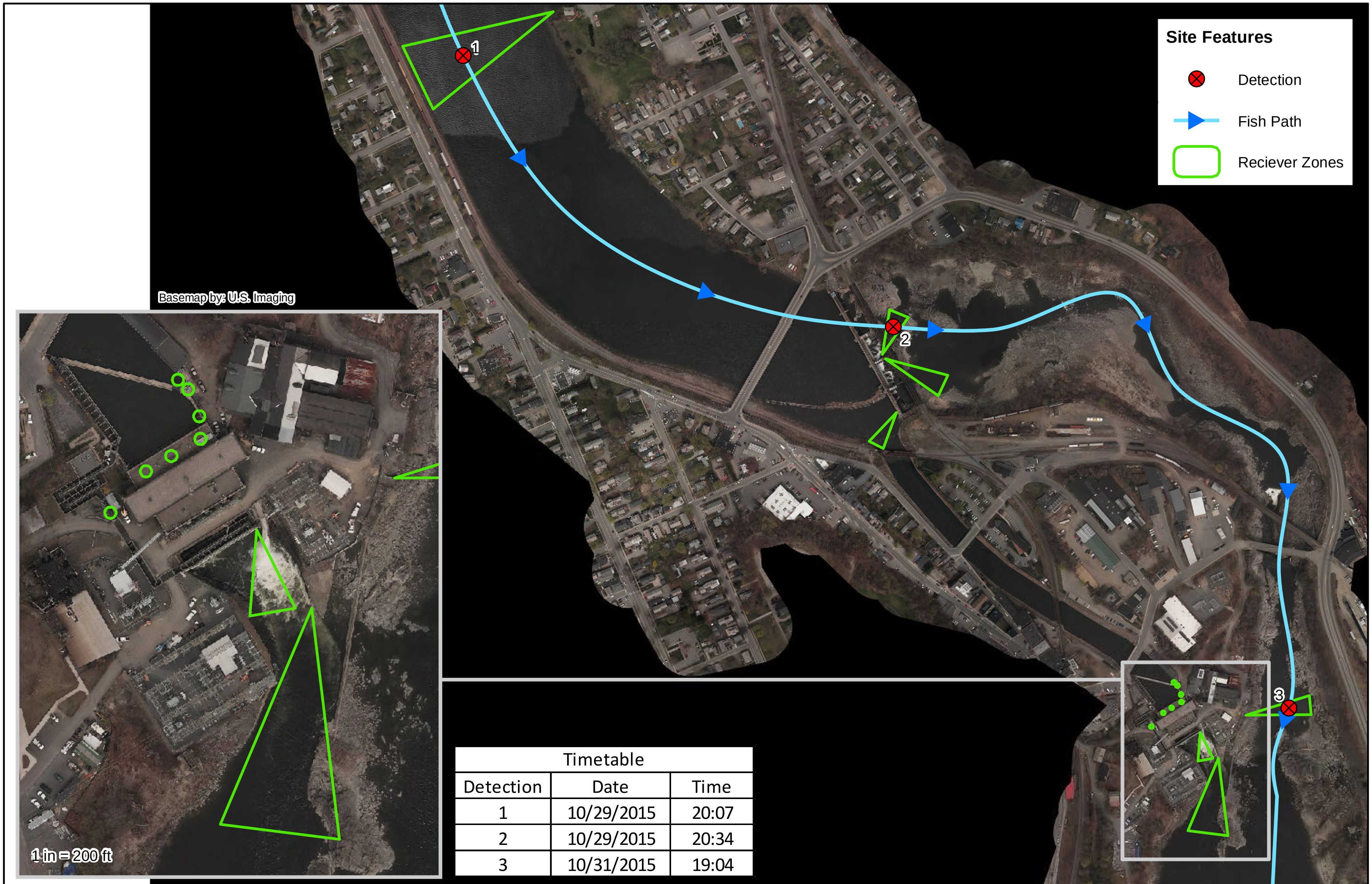


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 20:07 |
| 2 | 10/29/2015 | 20:34 |
| 3 | 10/31/2015 | 19:04 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-141 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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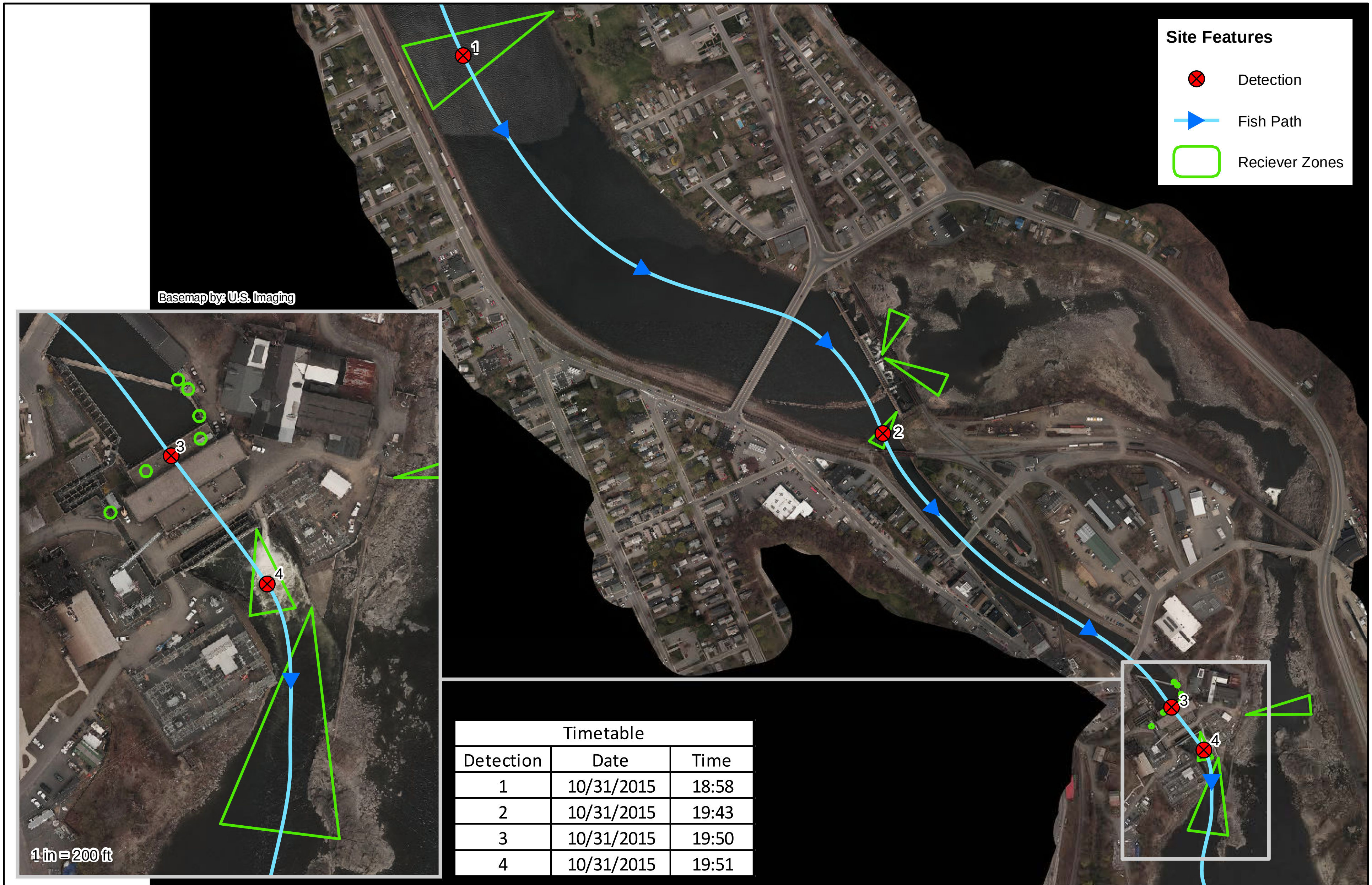


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 18:58 |
| 2 | 10/31/2015 | 19:43 |
| 3 | 10/31/2015 | 19:50 |
| 4 | 10/31/2015 | 19:51 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-142 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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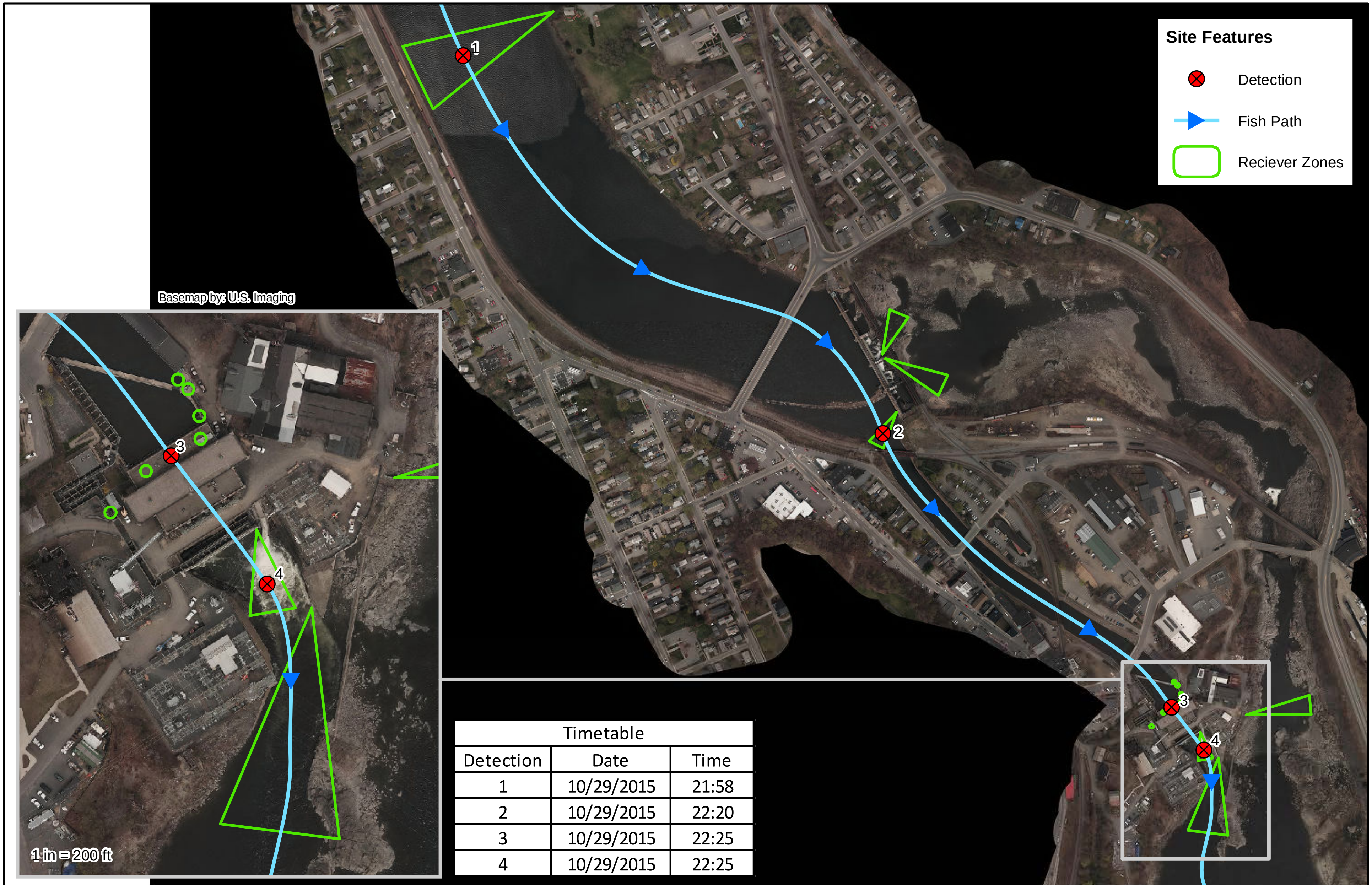


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:58 |
| 2 | 10/29/2015 | 22:20 |
| 3 | 10/29/2015 | 22:25 |
| 4 | 10/29/2015 | 22:25 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-143 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52


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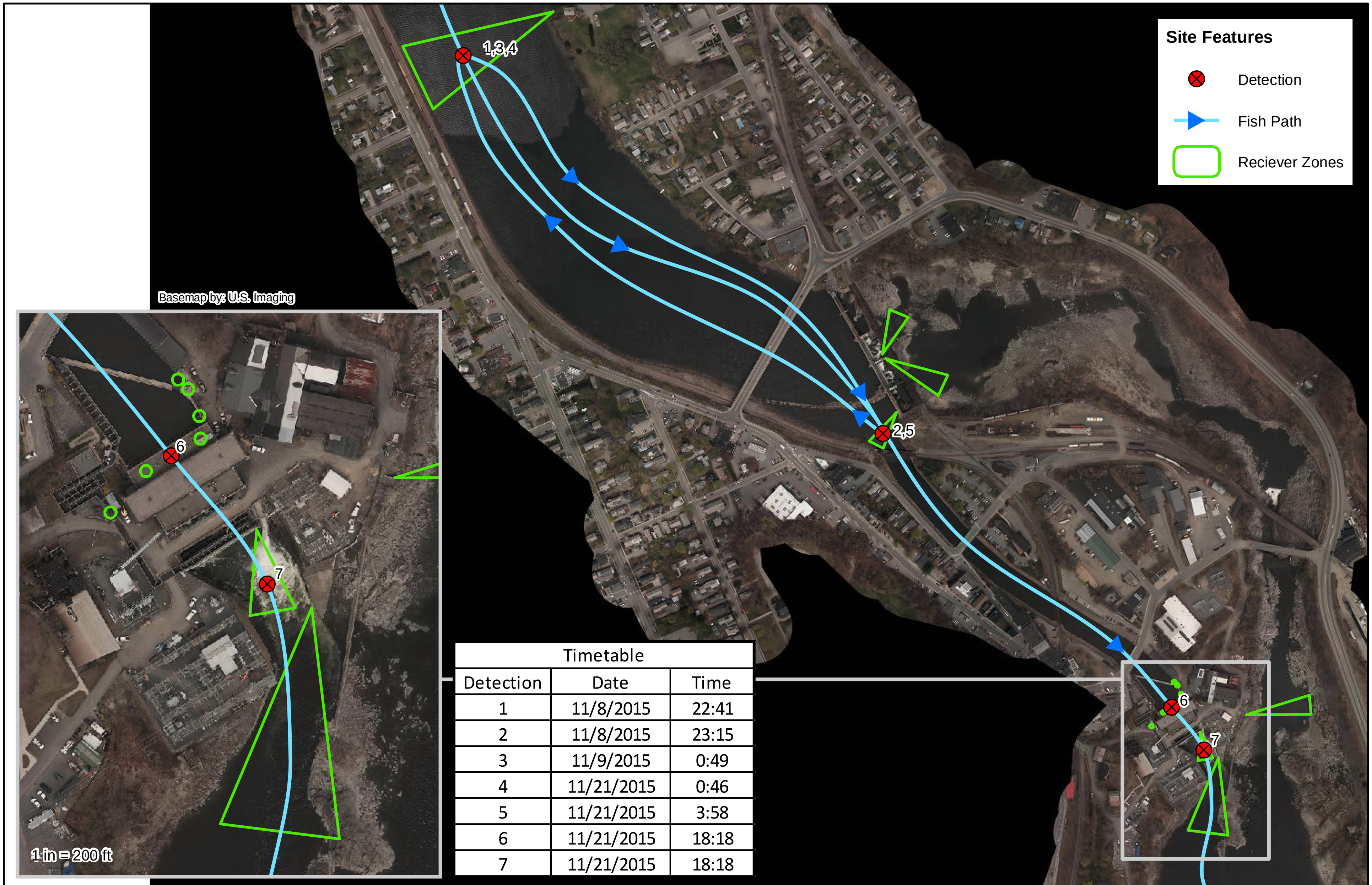


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 22:41 |
| 2 | 11/8/2015 | 23:15 |
| 3 | 11/9/2015 | 0:49 |
| 4 | 11/21/2015 | 0:46 |
| 5 | 11/21/2015 | 3:58 |
| 6 | 11/21/2015 | 18:18 |
| 7 | 11/21/2015 | 18:18 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-148 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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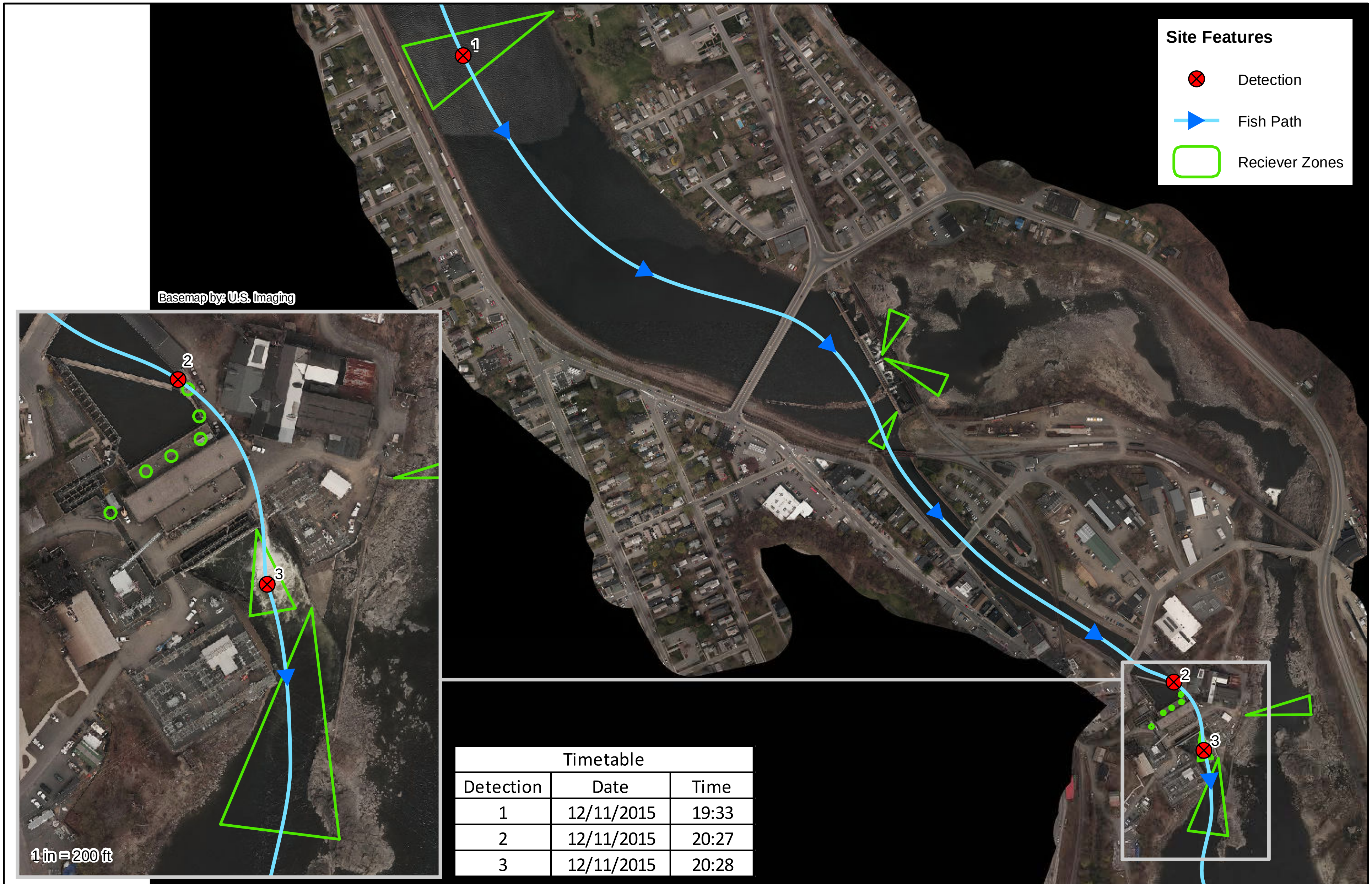


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 12/11/2015 | 19:33 |
| 2 | 12/11/2015 | 20:27 |
| 3 | 12/11/2015 | 20:28 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-149 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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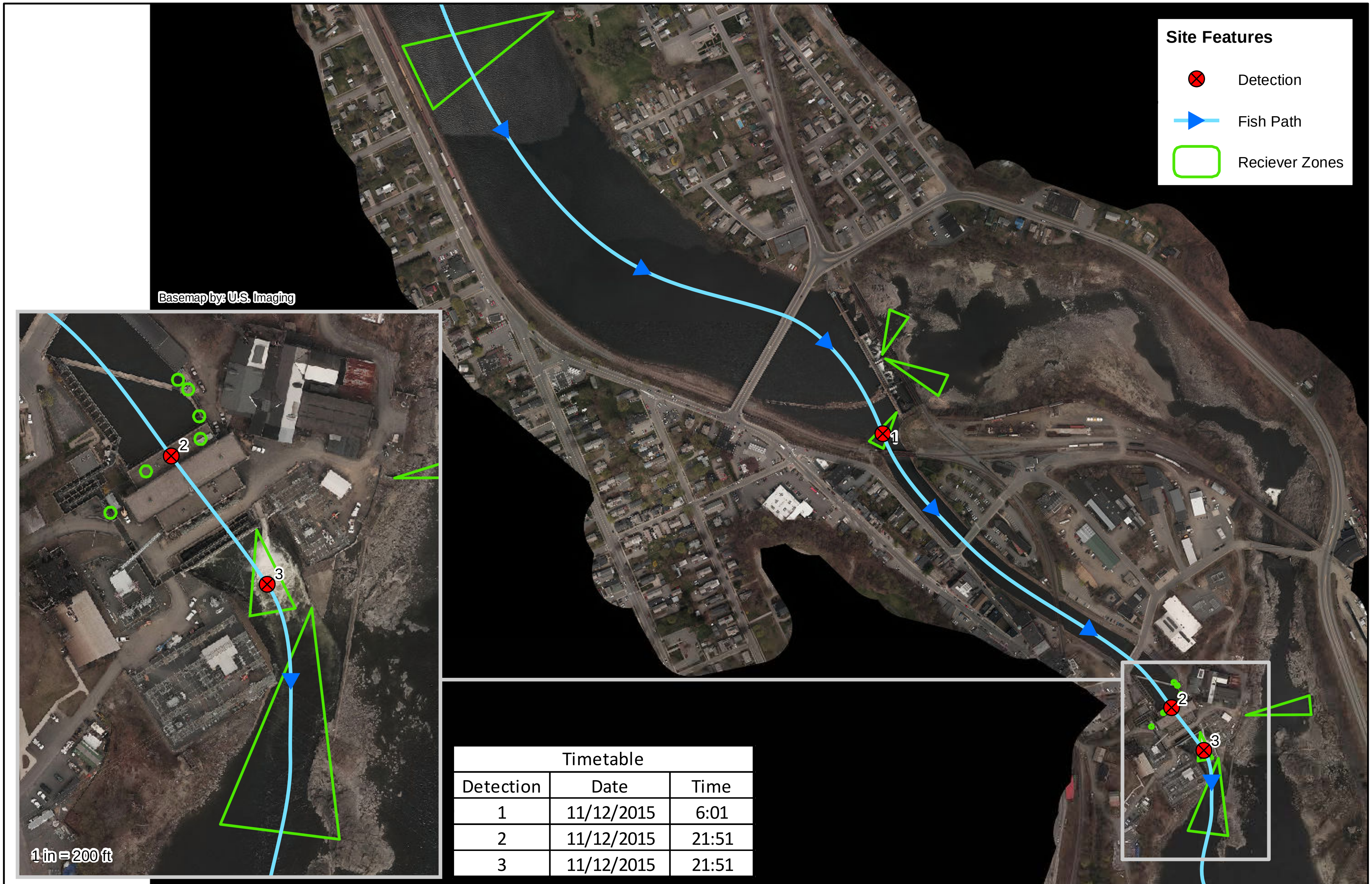


| Detection | Date | Time |
|---|---|---|
| 1 | 11/12/2015 | 6:01 |
| 2 | 11/12/2015 | 21:51 |
| 3 | 11/12/2015 | 21:51 |

Timetable

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N
1 in = 600 feet
0 300 600 1,200 Feet

**Study 19 Fish Number: 34-150 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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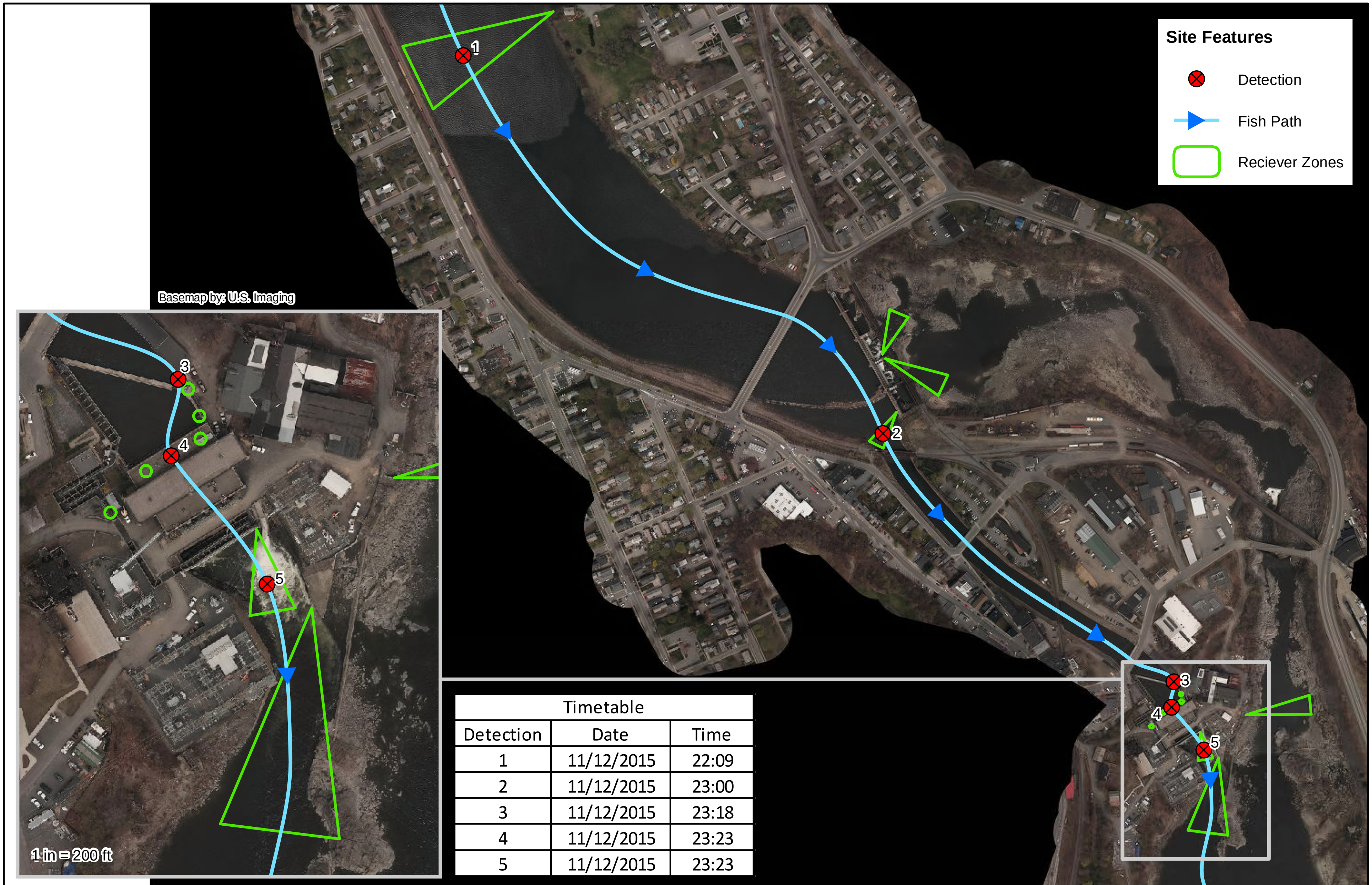


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/12/2015 | 22:09 |
| 2 | 11/12/2015 | 23:00 |
| 3 | 11/12/2015 | 23:18 |
| 4 | 11/12/2015 | 23:23 |
| 5 | 11/12/2015 | 23:23 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-151 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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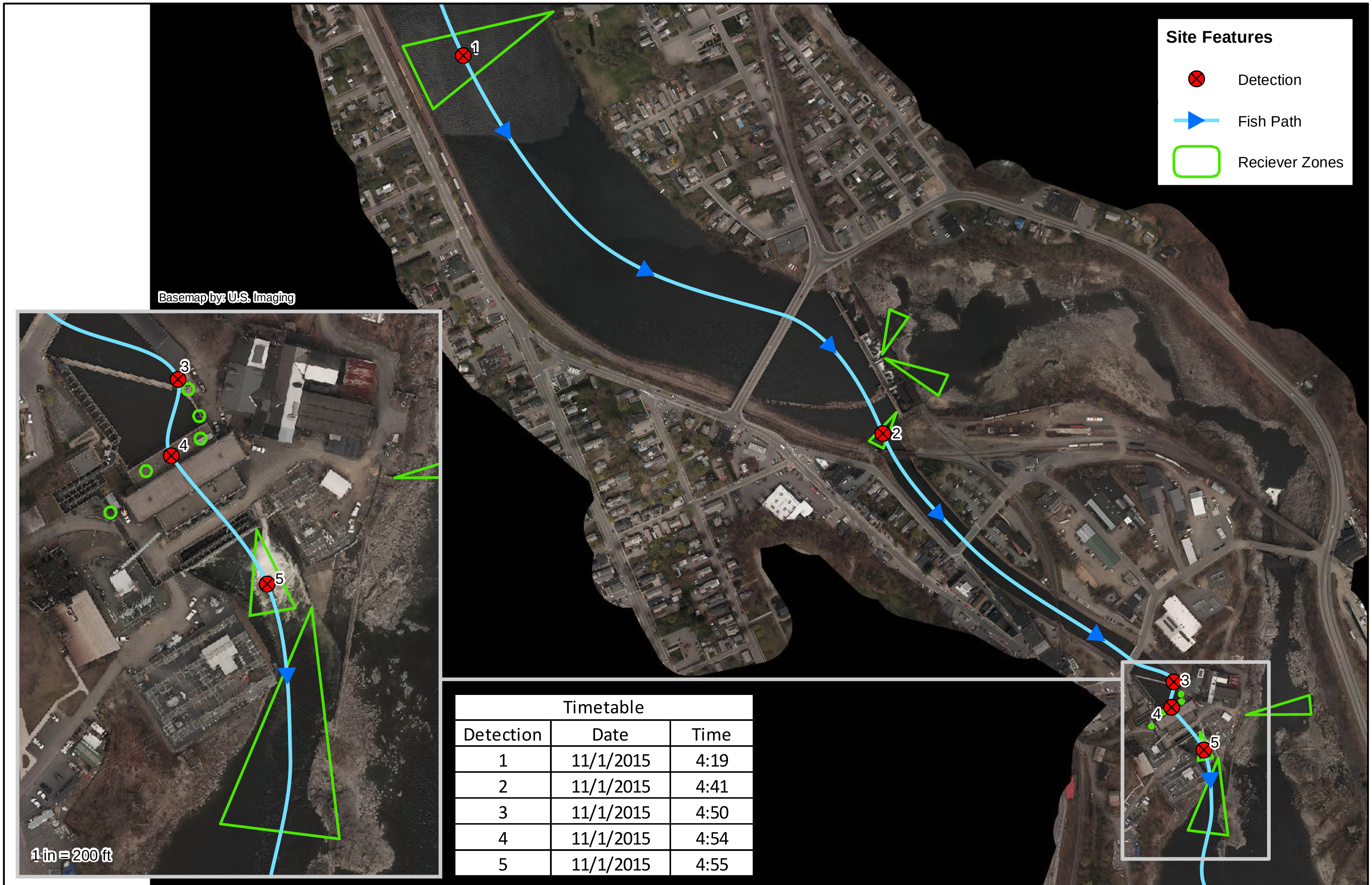


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 4:19 |
| 2 | 11/1/2015 | 4:41 |
| 3 | 11/1/2015 | 4:50 |
| 4 | 11/1/2015 | 4:54 |
| 5 | 11/1/2015 | 4:55 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-152 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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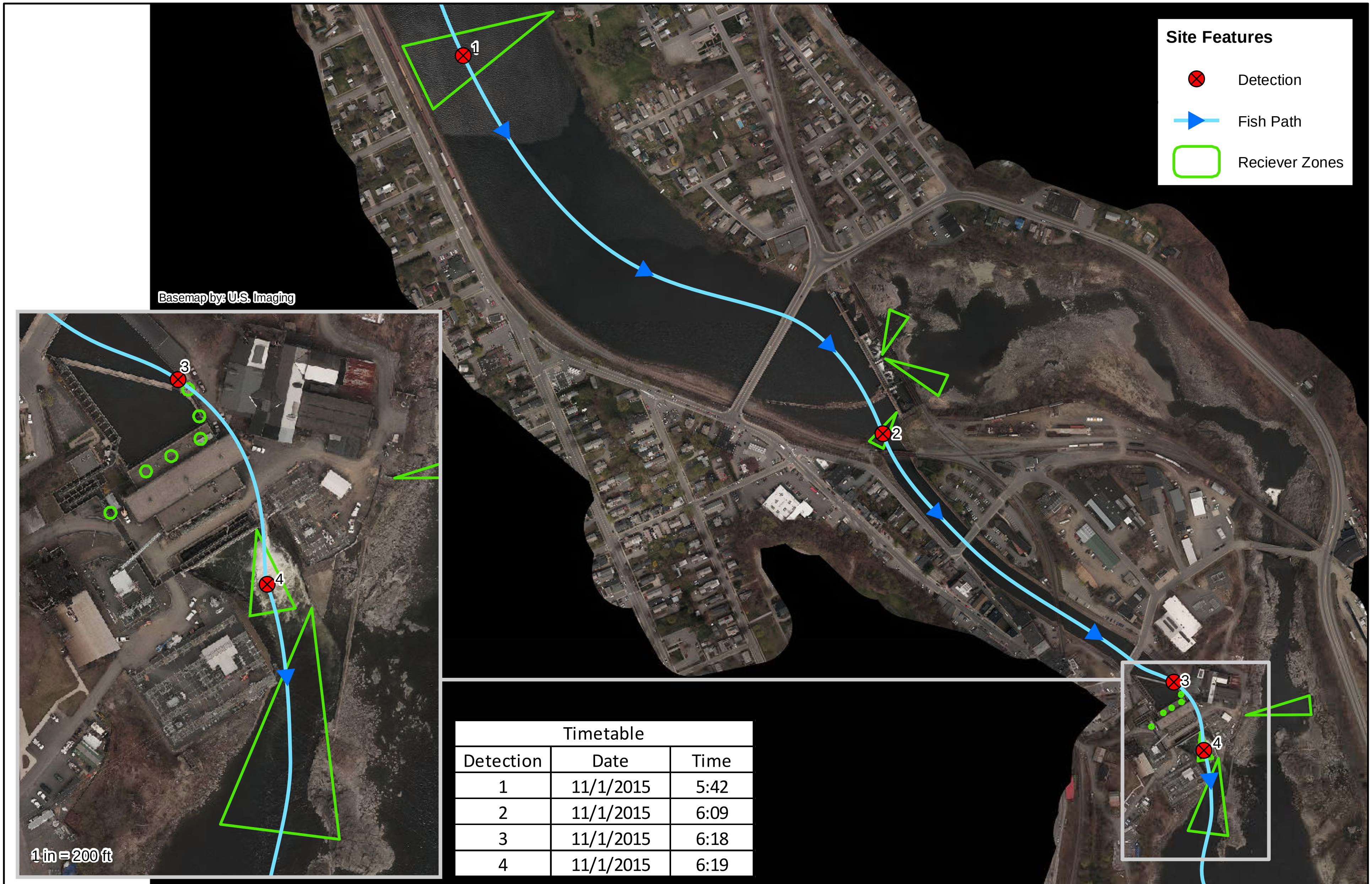


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 5:42 |
| 2 | 11/1/2015 | 6:09 |
| 3 | 11/1/2015 | 6:18 |
| 4 | 11/1/2015 | 6:19 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-153 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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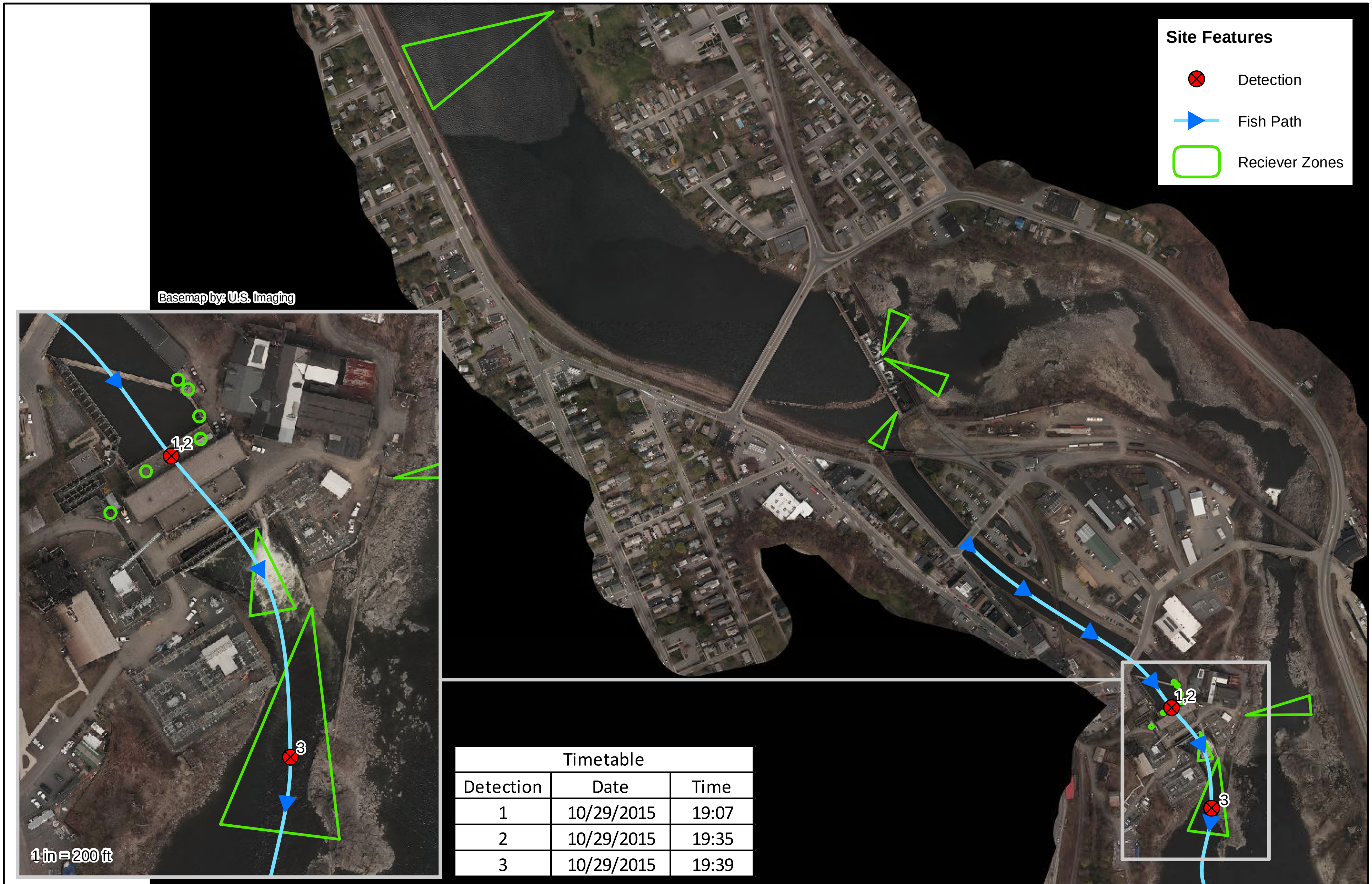


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 19:07 |
| 2 | 10/29/2015 | 19:35 |
| 3 | 10/29/2015 | 19:39 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-51 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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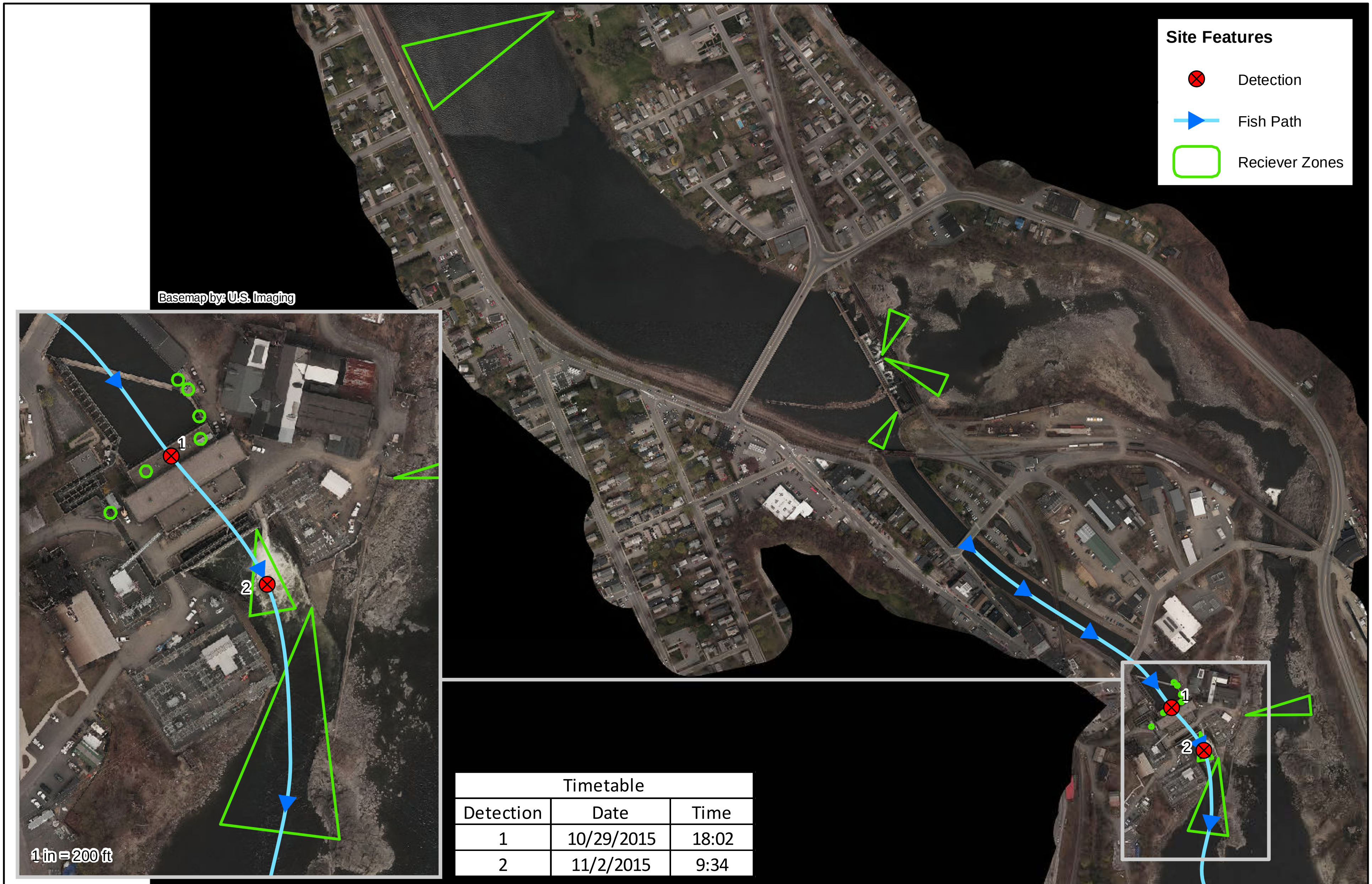


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:02 |
| 2 | 11/2/2015 | 9:34 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-52 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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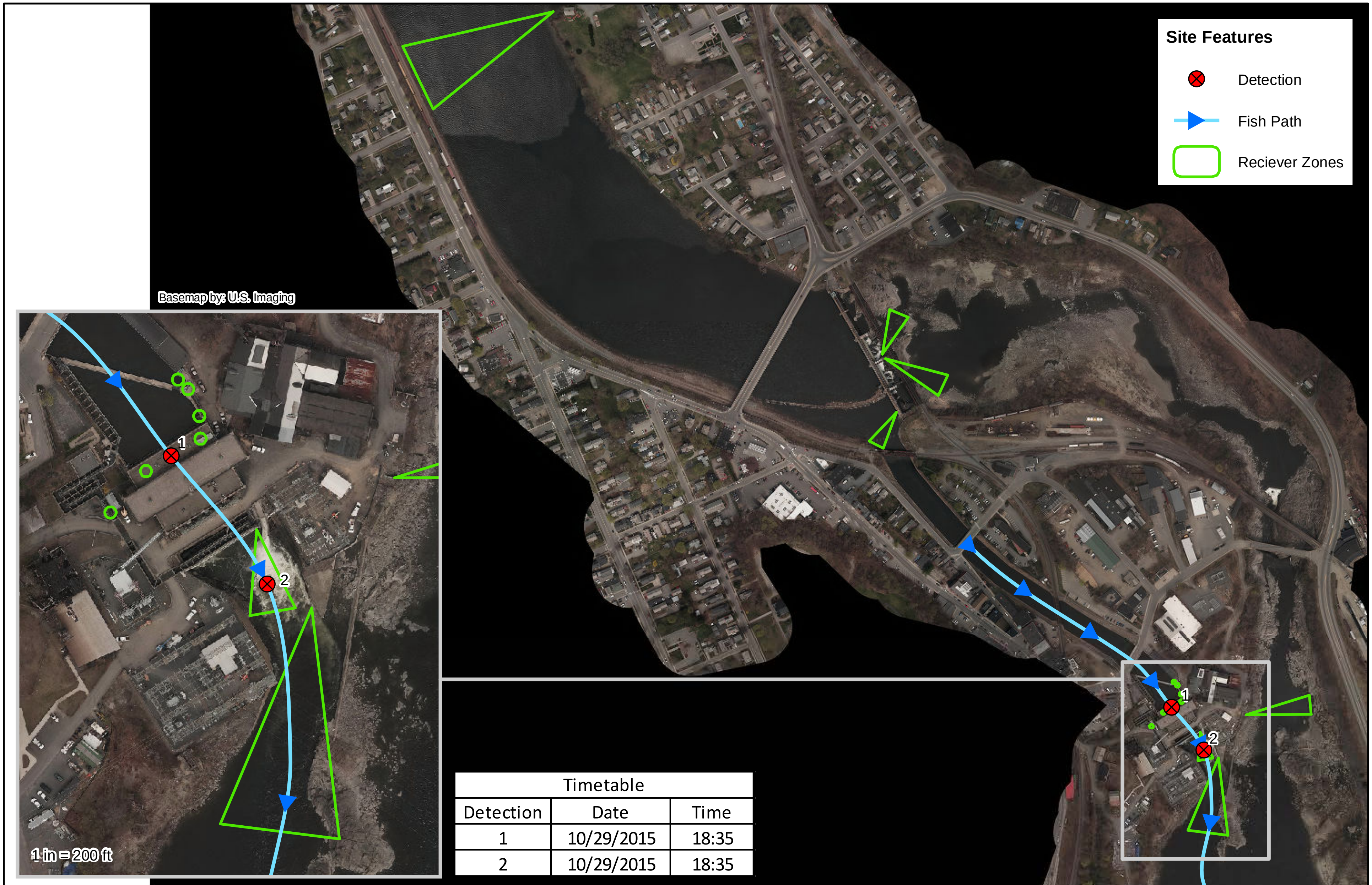


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:35 |
| 2 | 10/29/2015 | 18:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-53 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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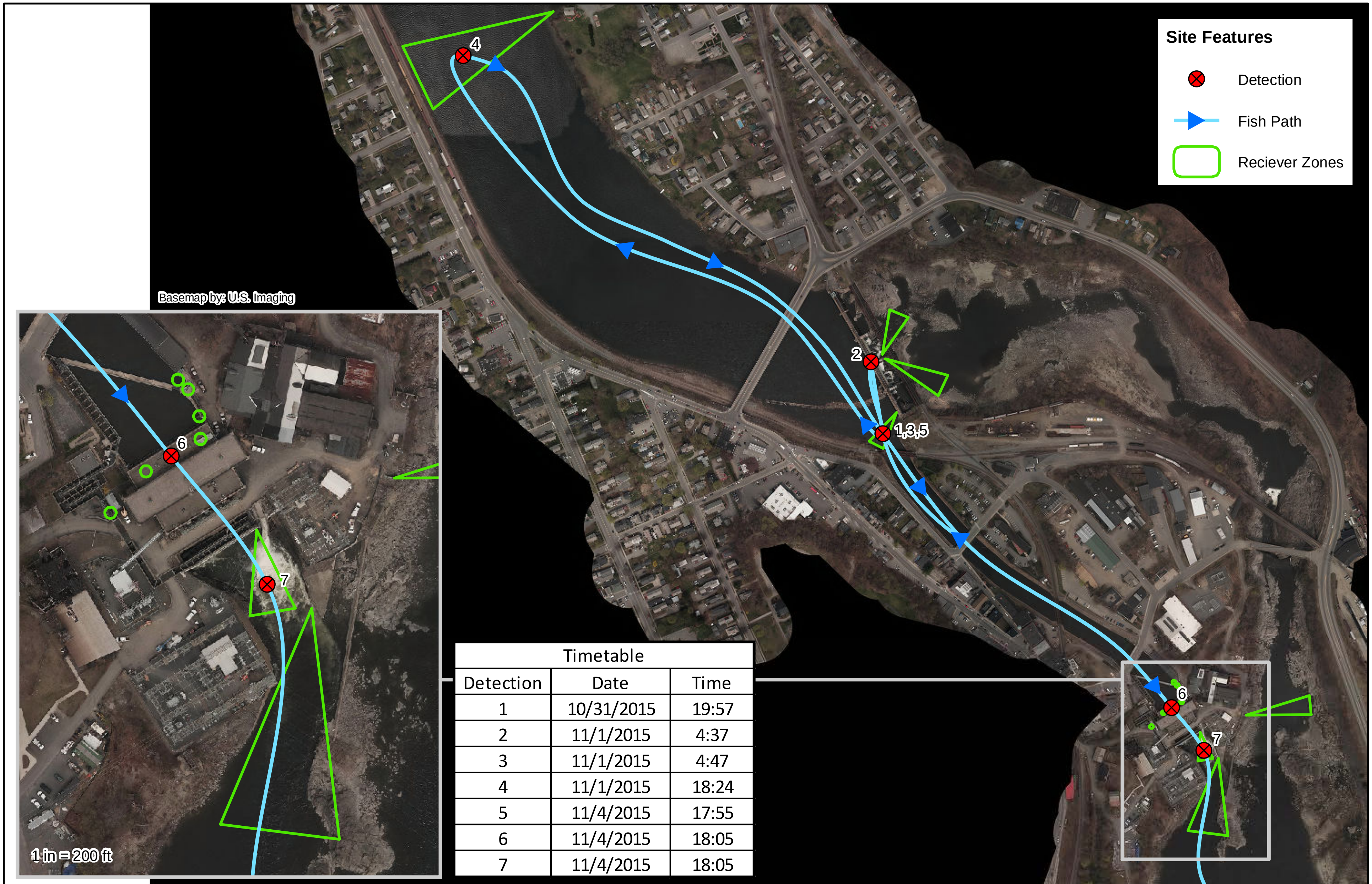


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 19:57 |
| 2 | 11/1/2015 | 4:37 |
| 3 | 11/1/2015 | 4:47 |
| 4 | 11/1/2015 | 18:24 |
| 5 | 11/4/2015 | 17:55 |
| 6 | 11/4/2015 | 18:05 |
| 7 | 11/4/2015 | 18:05 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-54 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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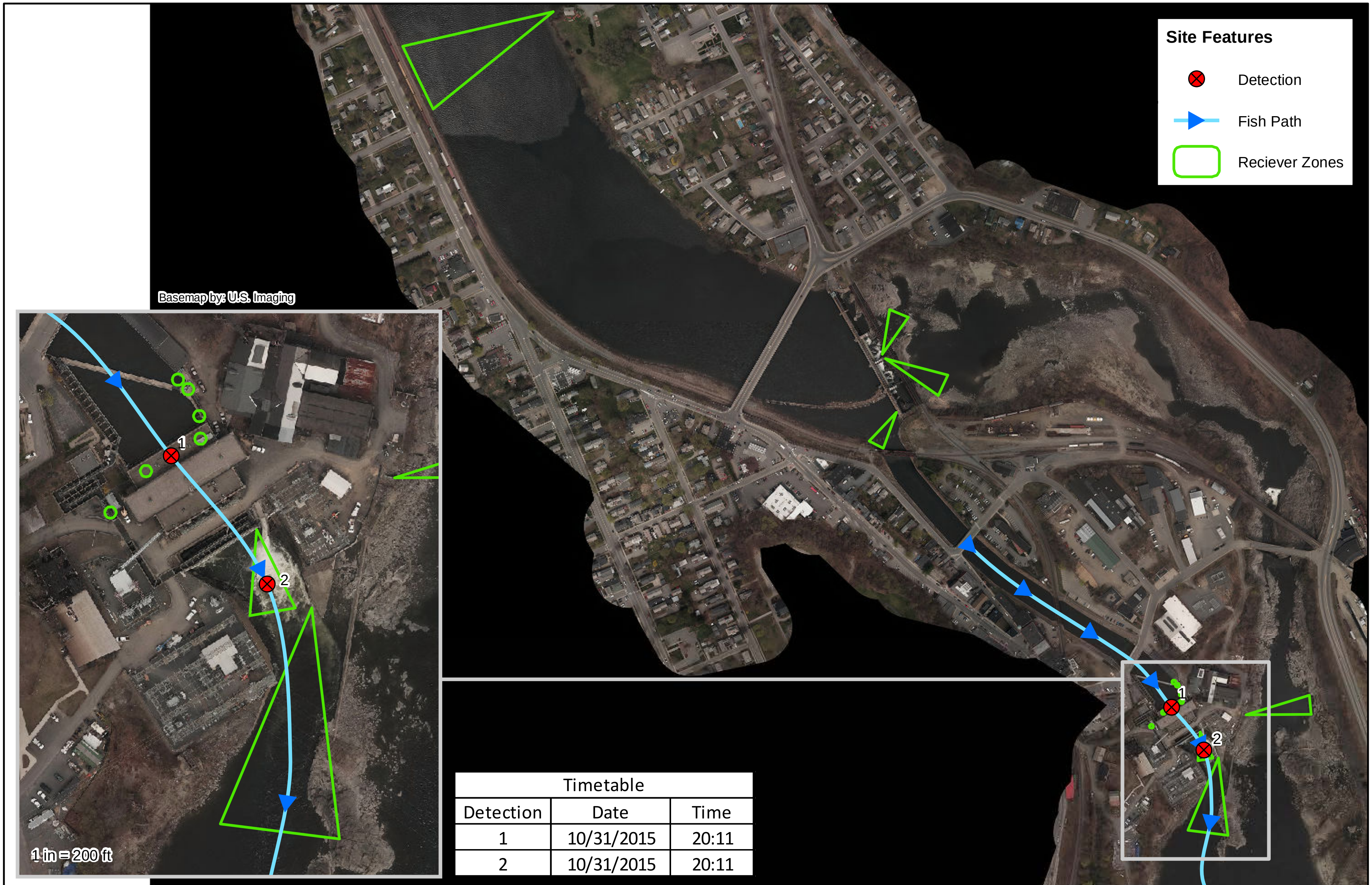


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:11 |
| 2 | 10/31/2015 | 20:11 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 34-55 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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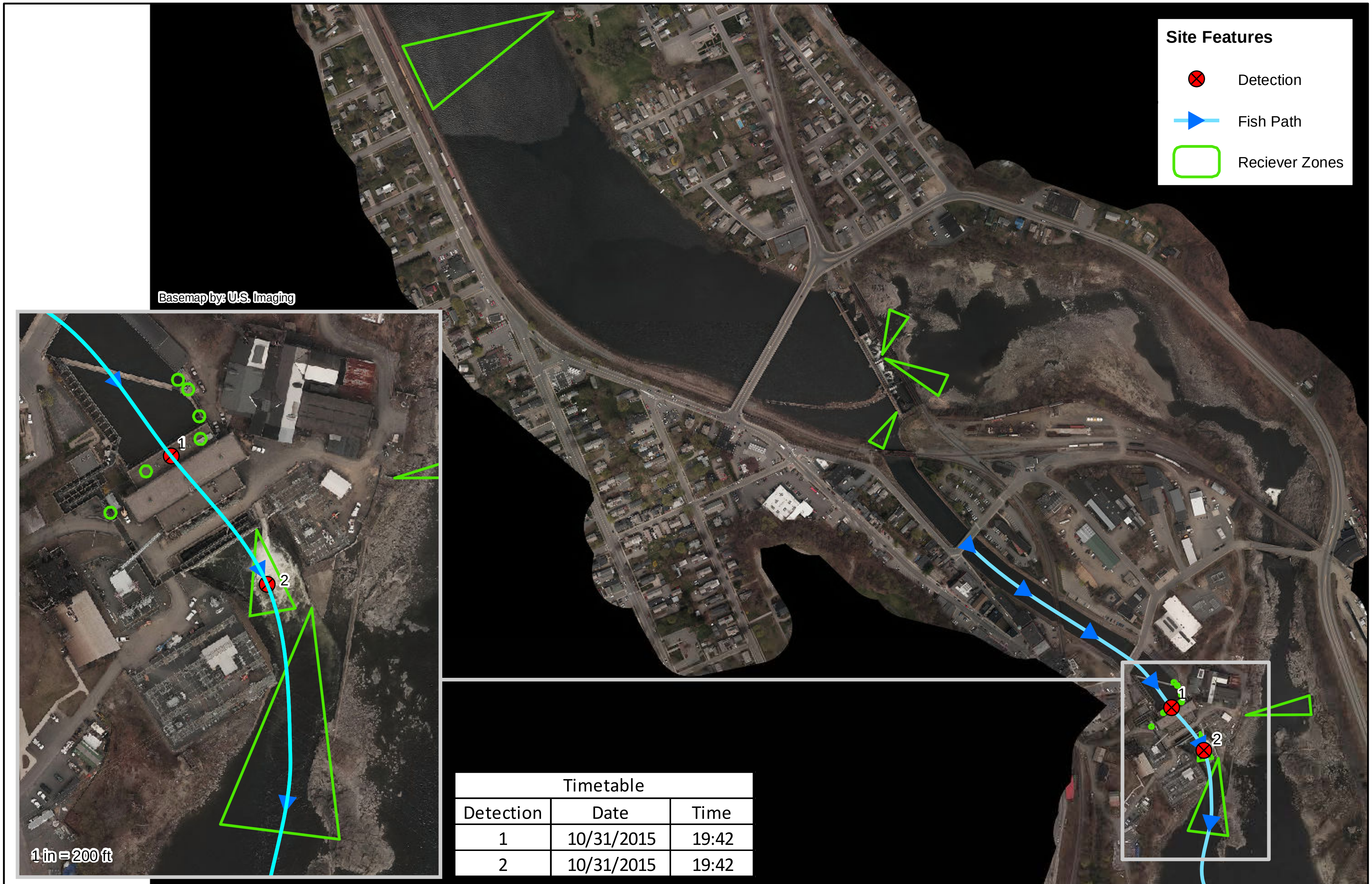
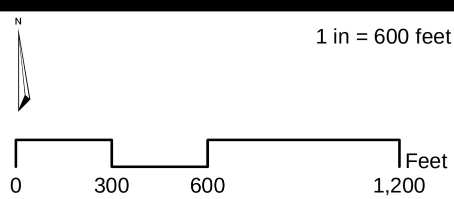



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 19:42 |
| 2 | 10/31/2015 | 19:42 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 34-56 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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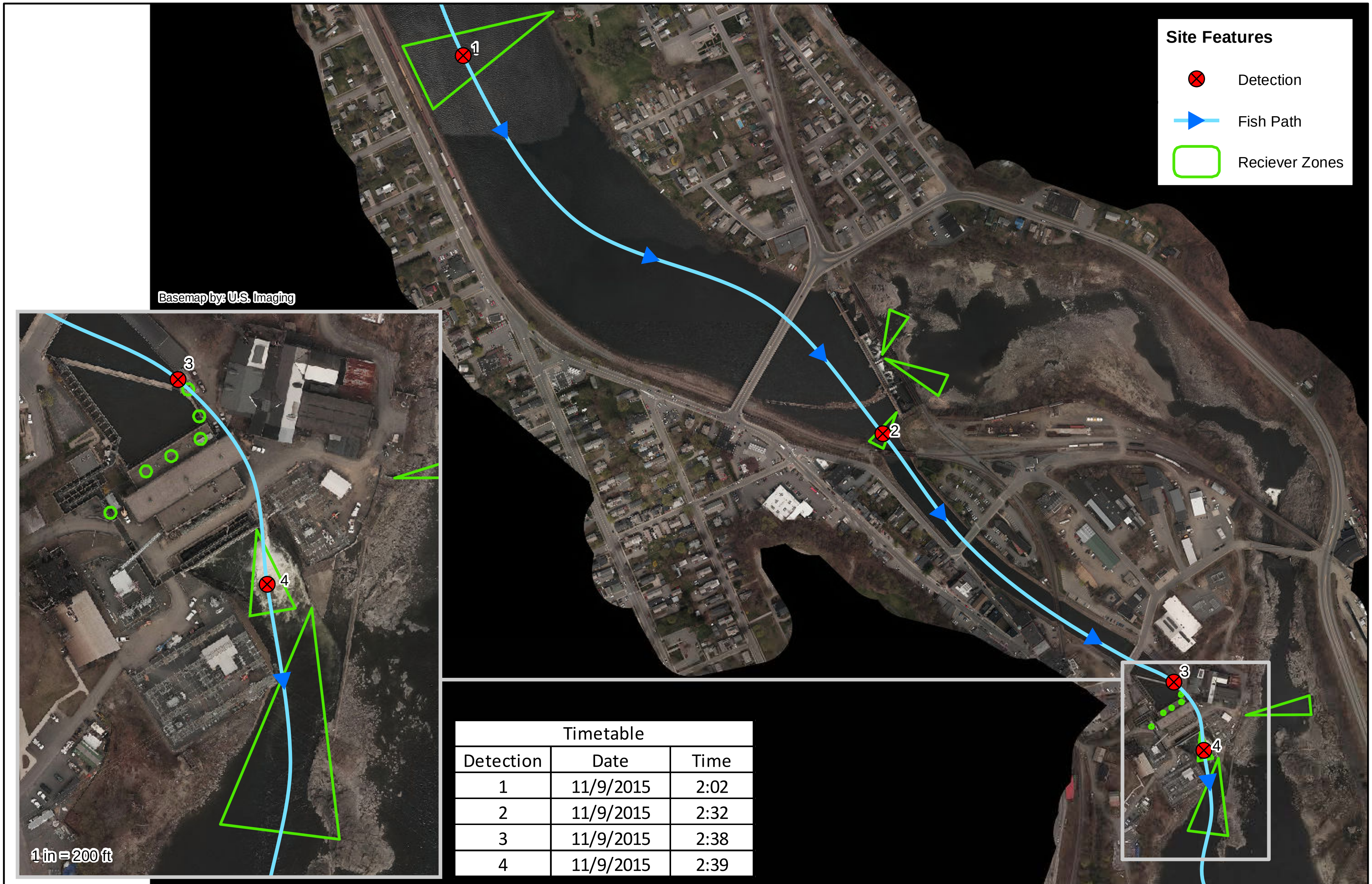


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 2:02 |
| 2 | 11/9/2015 | 2:32 |
| 3 | 11/9/2015 | 2:38 |
| 4 | 11/9/2015 | 2:39 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 34-57 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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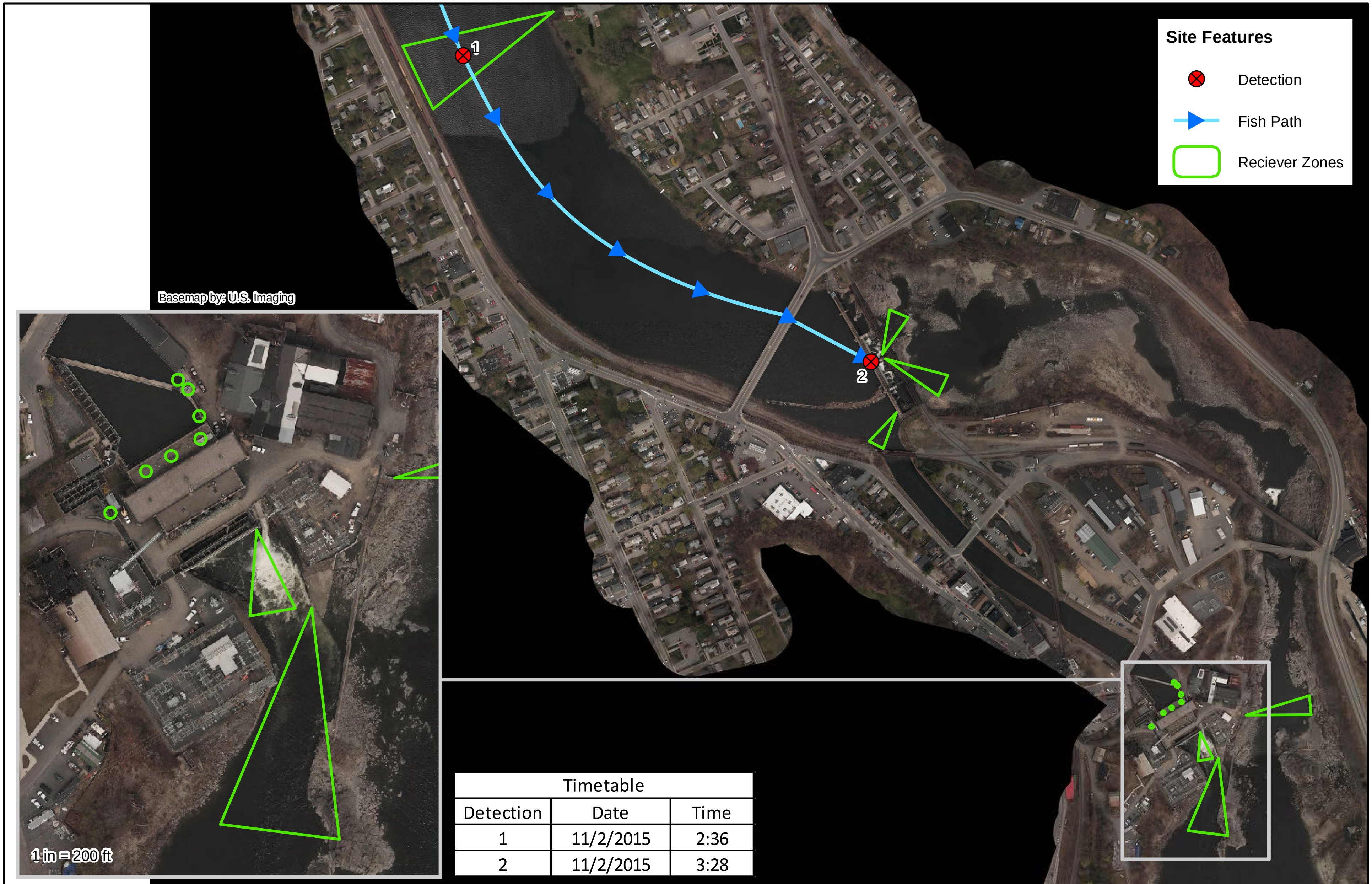


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 2:36 |
| 2 | 11/2/2015 | 3:28 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-171 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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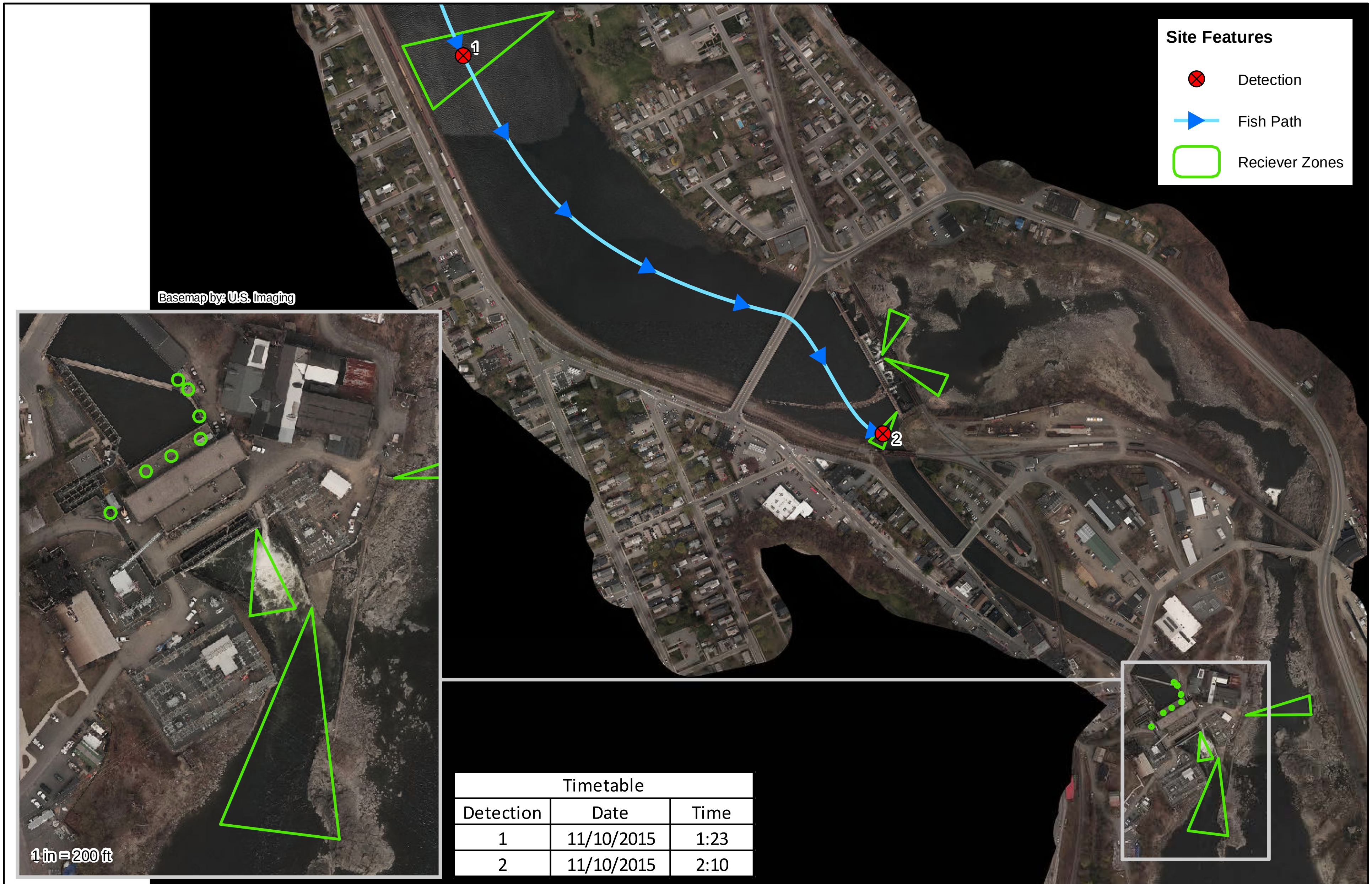


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 1:23 |
| 2 | 11/10/2015 | 2:10 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-172 (A1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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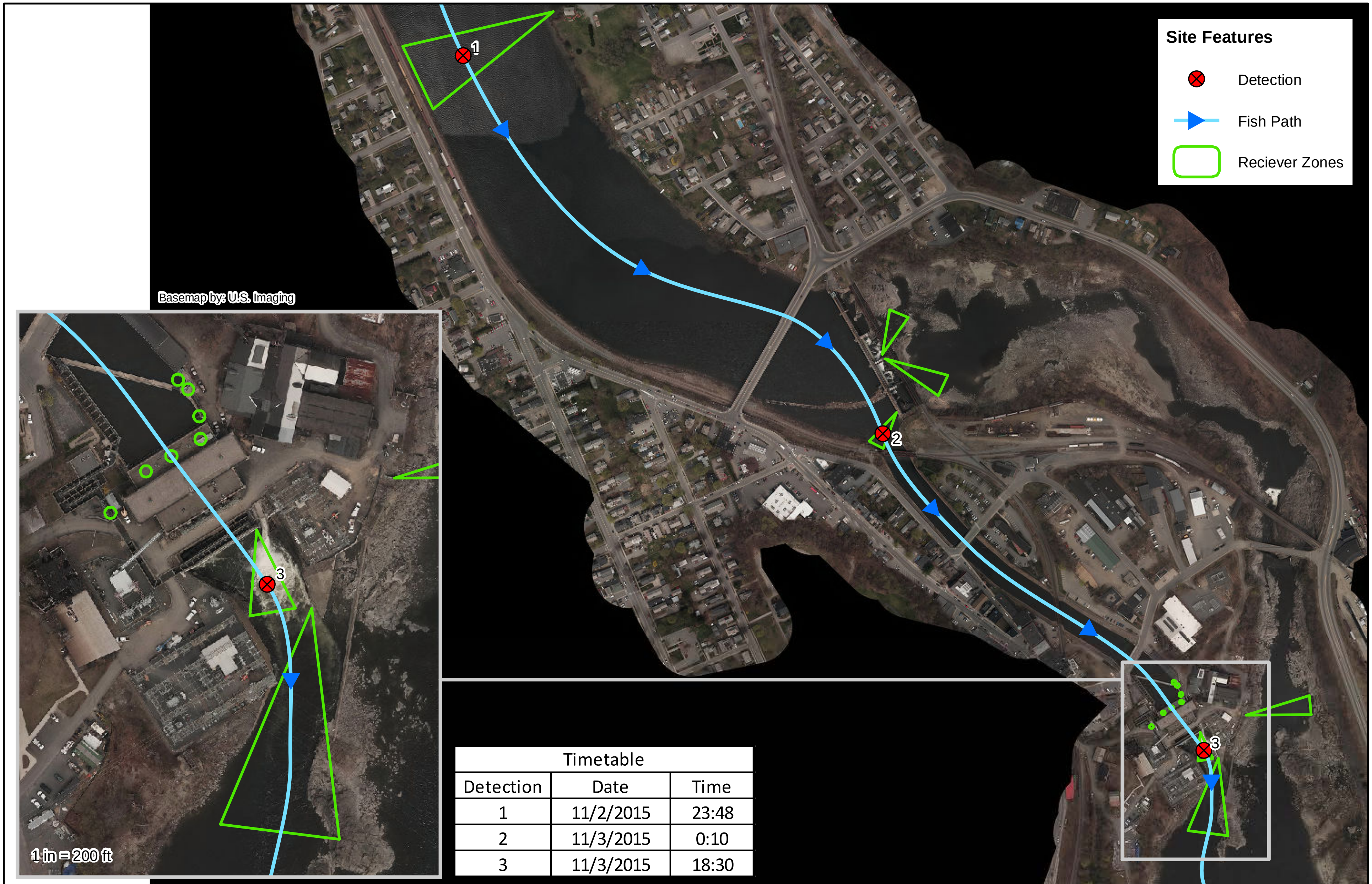
J:\Jen_TEST\TransCanada\S19\Background_FishPaths\MXD\Bellows\TC_Bellows_34_172_A1_040516.mxd




| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 23:48 |
| 2 | 11/3/2015 | 0:10 |
| 3 | 11/3/2015 | 18:30 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-173 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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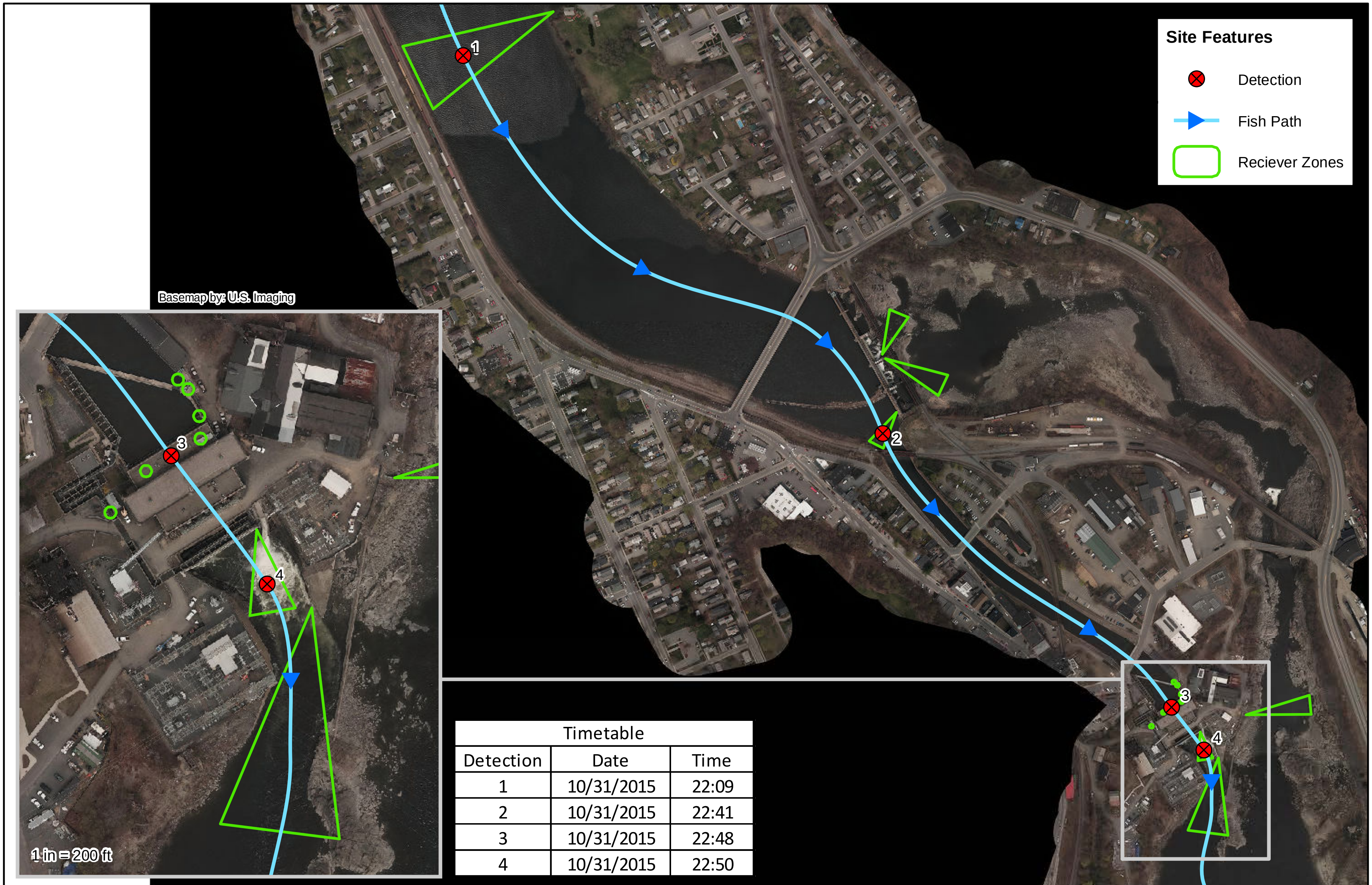


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 22:09 |
| 2 | 10/31/2015 | 22:41 |
| 3 | 10/31/2015 | 22:48 |
| 4 | 10/31/2015 | 22:50 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 34-174 (A1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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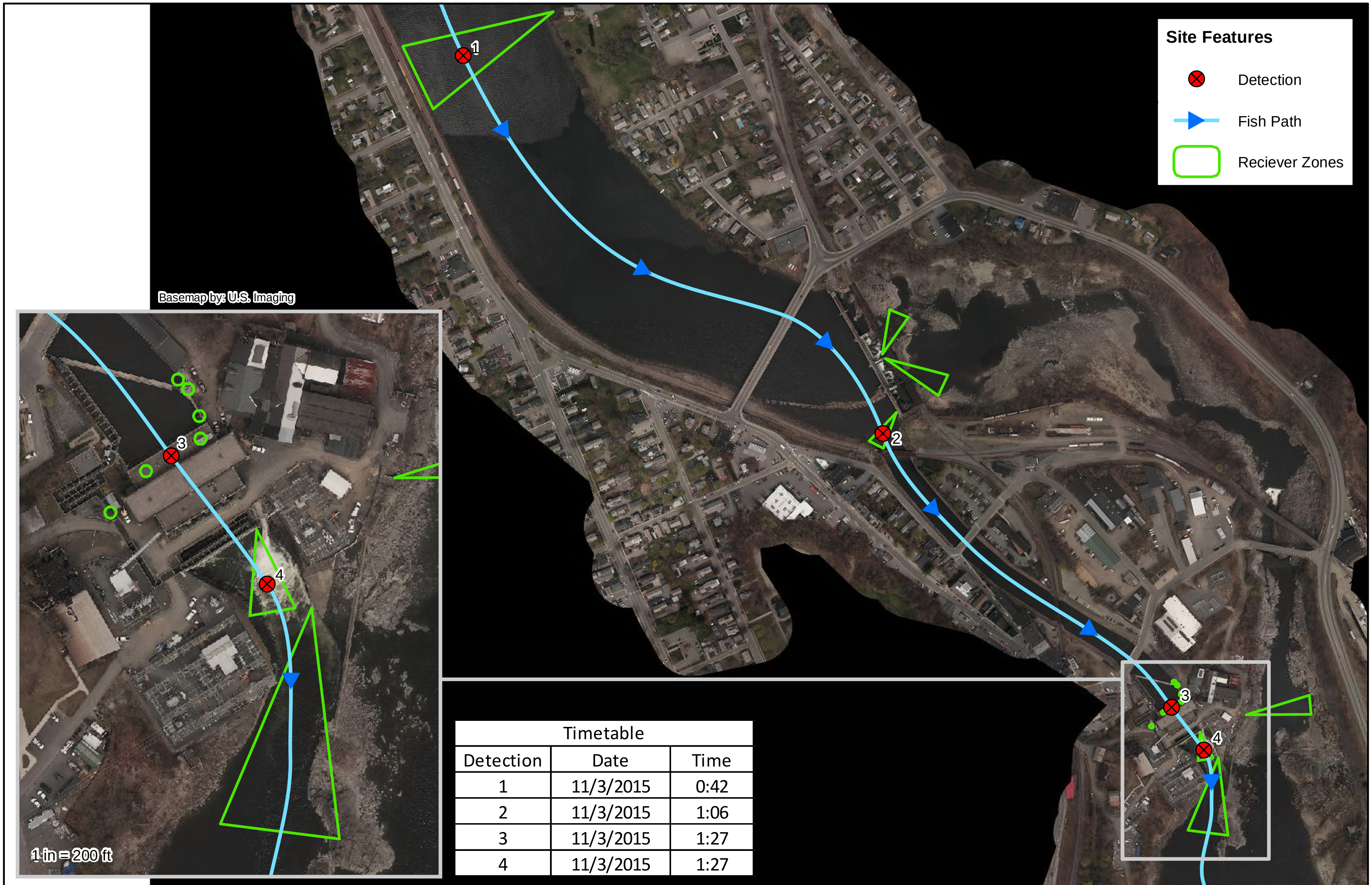
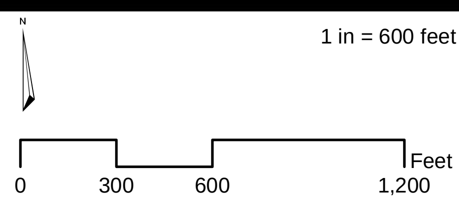



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 0:42 |
| 2 | 11/3/2015 | 1:06 |
| 3 | 11/3/2015 | 1:27 |
| 4 | 11/3/2015 | 1:27 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 34-181 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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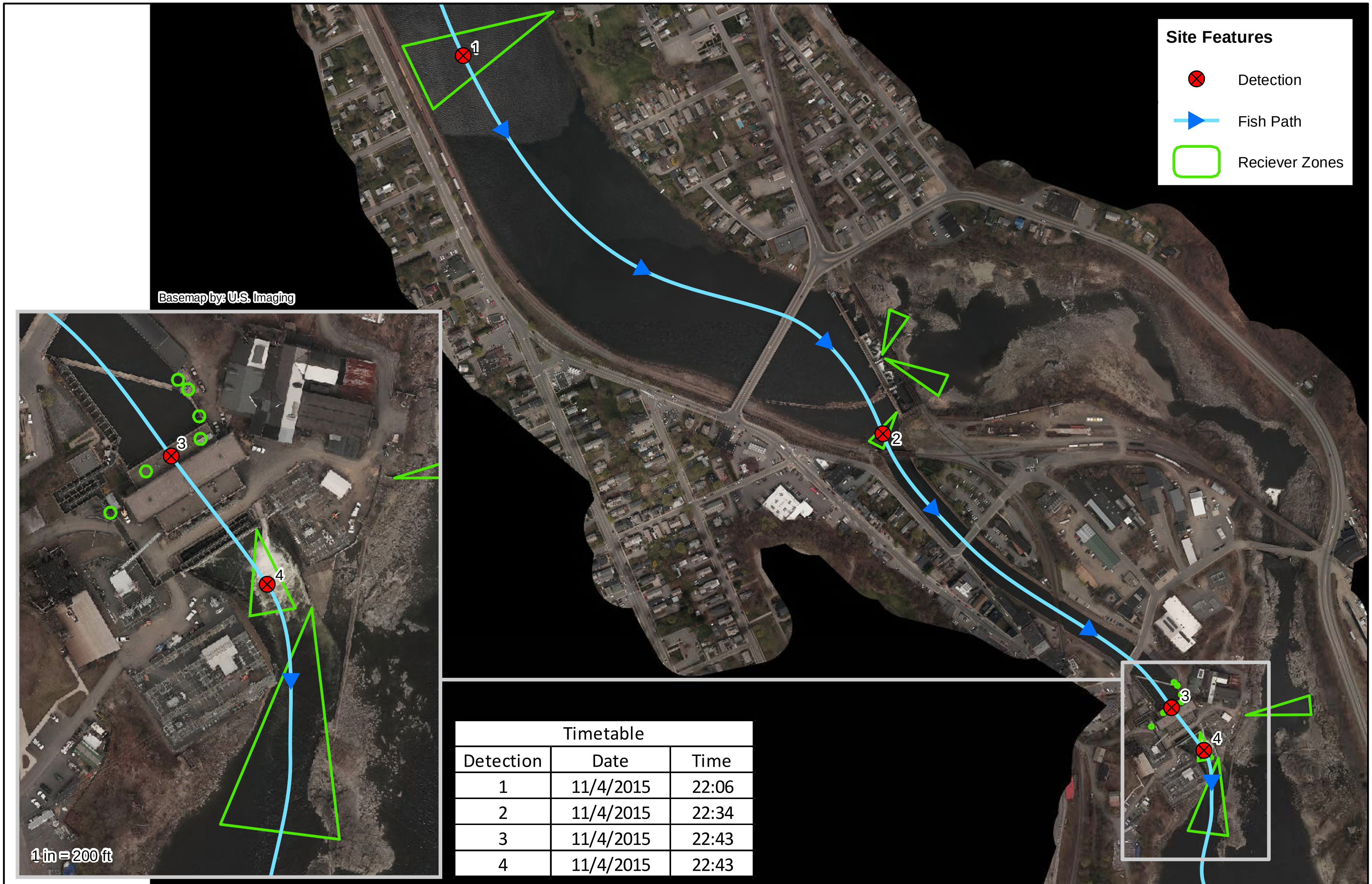


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 22:06 |
| 2 | 11/4/2015 | 22:34 |
| 3 | 11/4/2015 | 22:43 |
| 4 | 11/4/2015 | 22:43 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 34-183 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21


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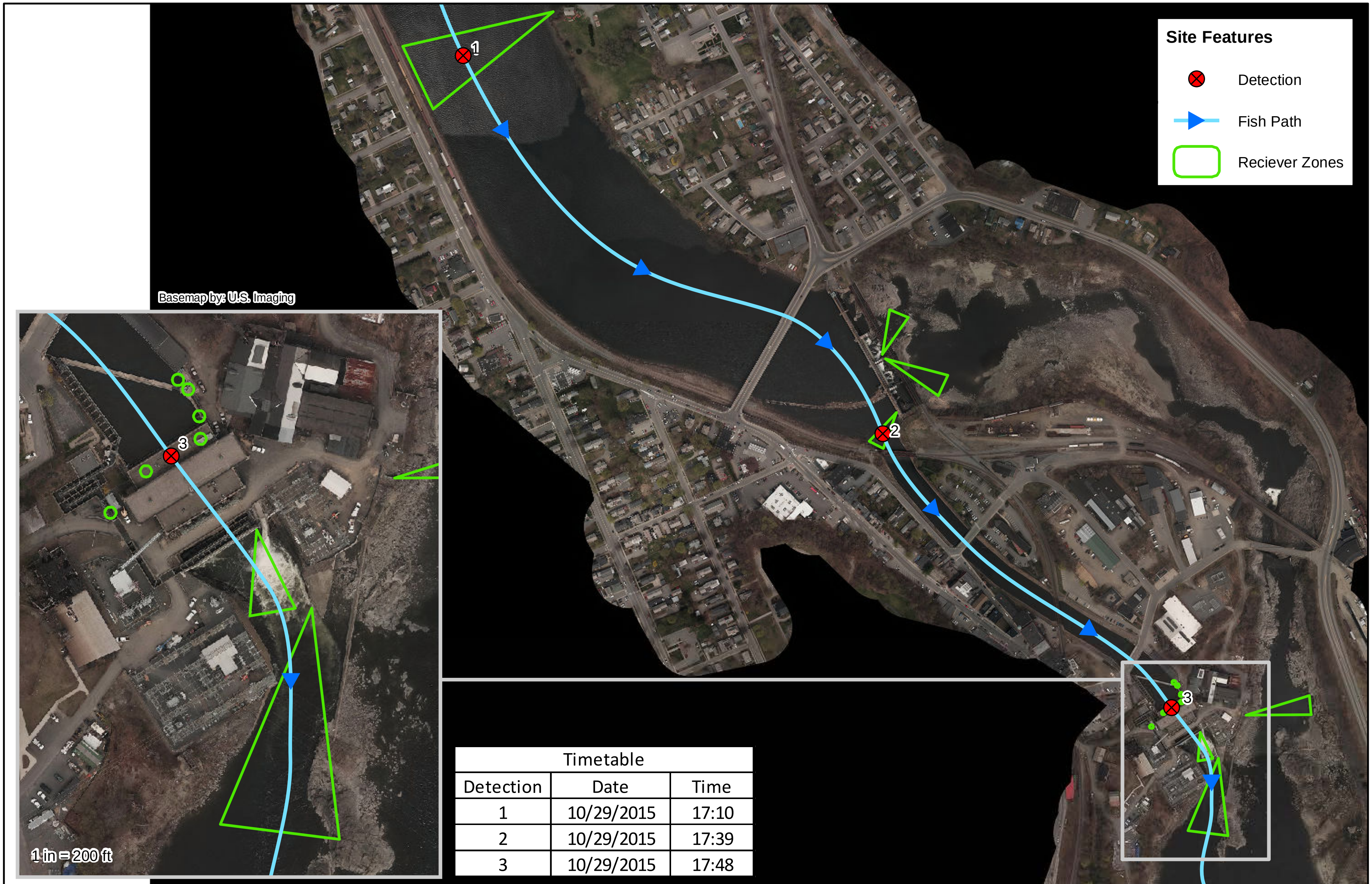


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 17:10 |
| 2 | 10/29/2015 | 17:39 |
| 3 | 10/29/2015 | 17:48 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-115 (A1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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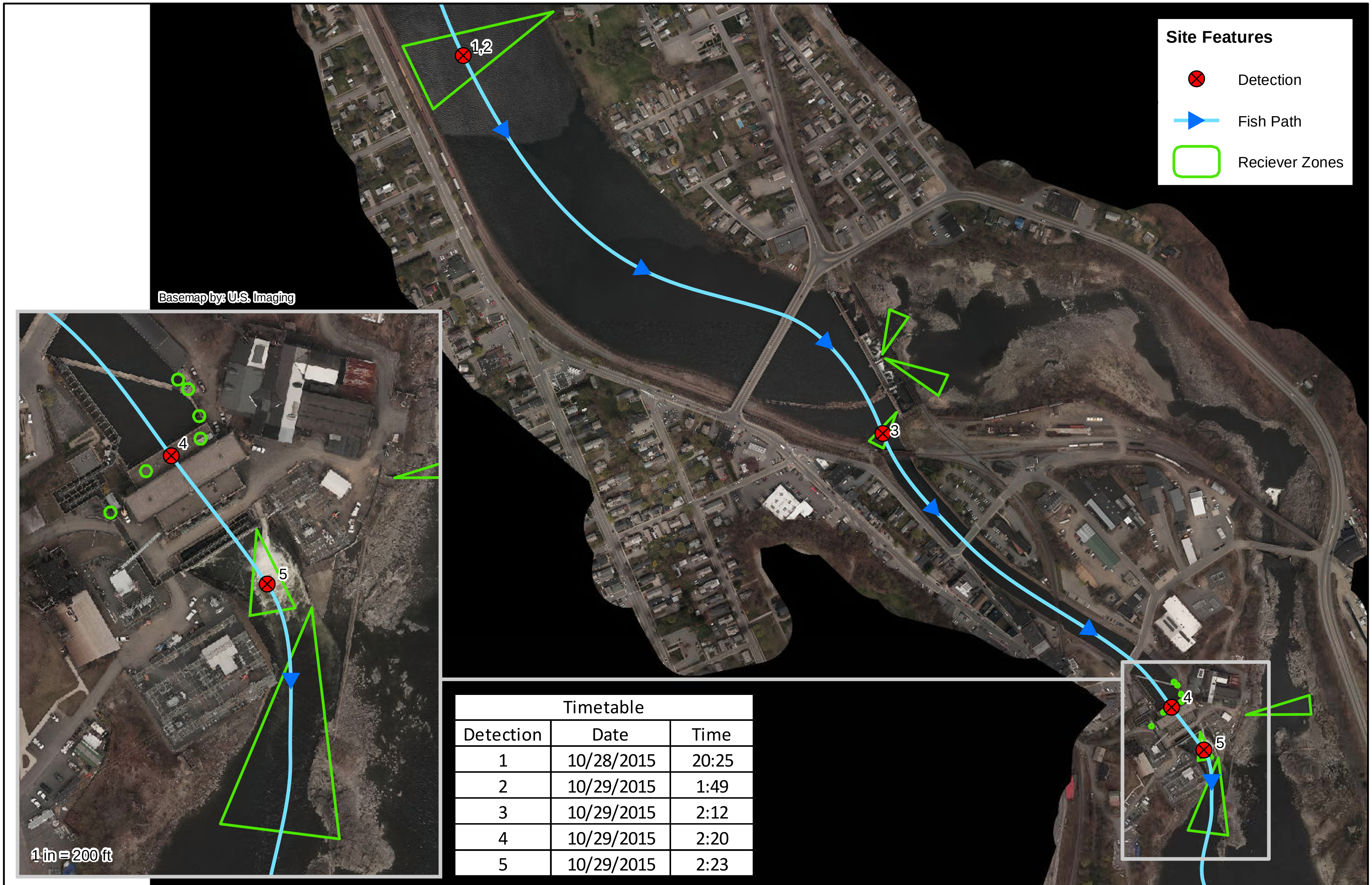


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 20:25 |
| 2 | 10/29/2015 | 1:49 |
| 3 | 10/29/2015 | 2:12 |
| 4 | 10/29/2015 | 2:20 |
| 5 | 10/29/2015 | 2:23 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-116 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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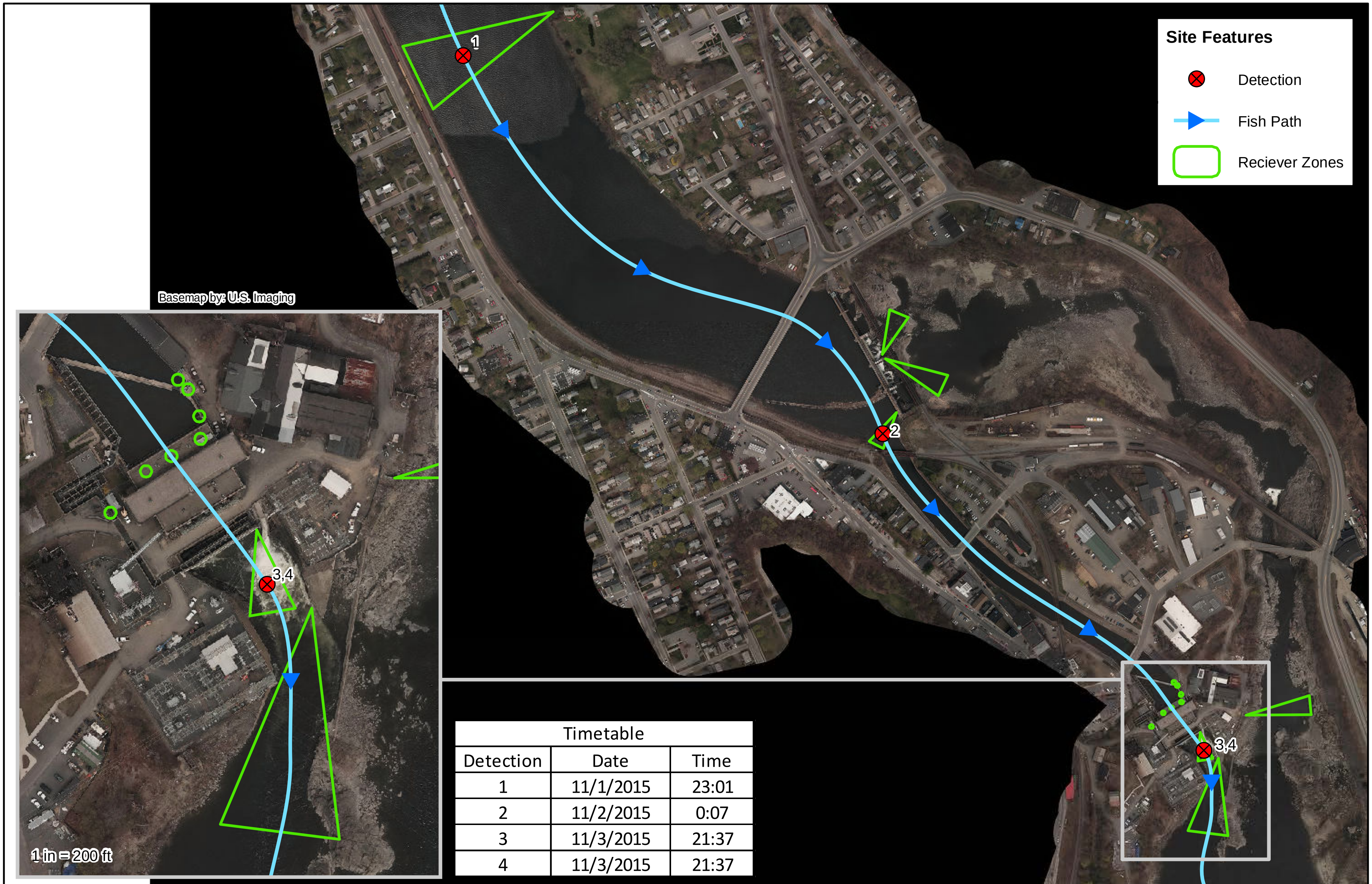


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 23:01 |
| 2 | 11/2/2015 | 0:07 |
| 3 | 11/3/2015 | 21:37 |
| 4 | 11/3/2015 | 21:37 |

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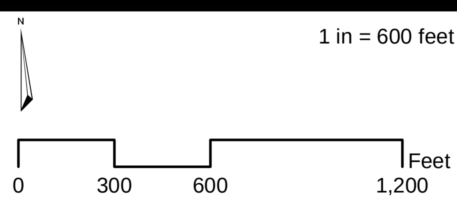
**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 36-117 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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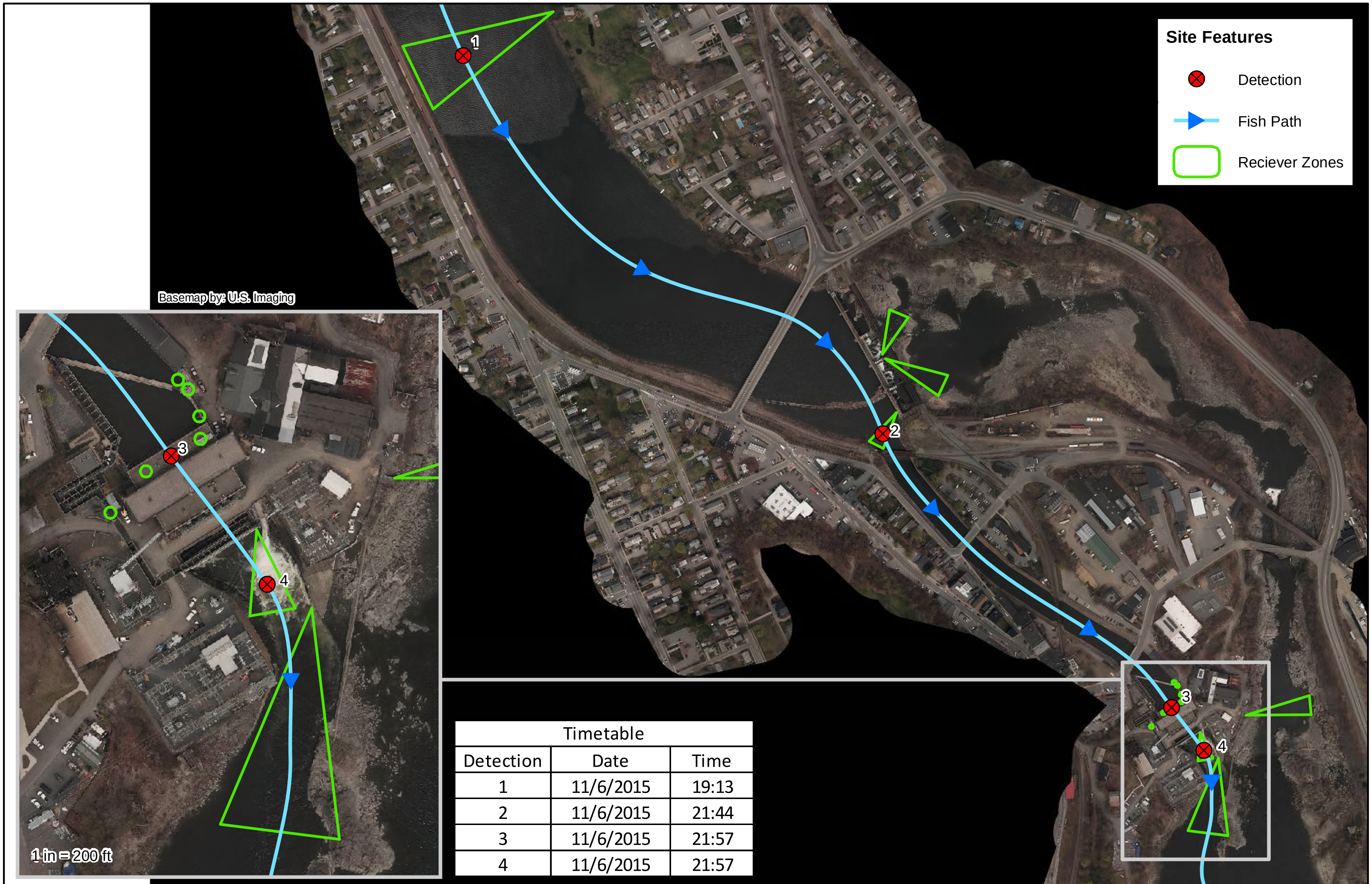


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:13 |
| 2 | 11/6/2015 | 21:44 |
| 3 | 11/6/2015 | 21:57 |
| 4 | 11/6/2015 | 21:57 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-119 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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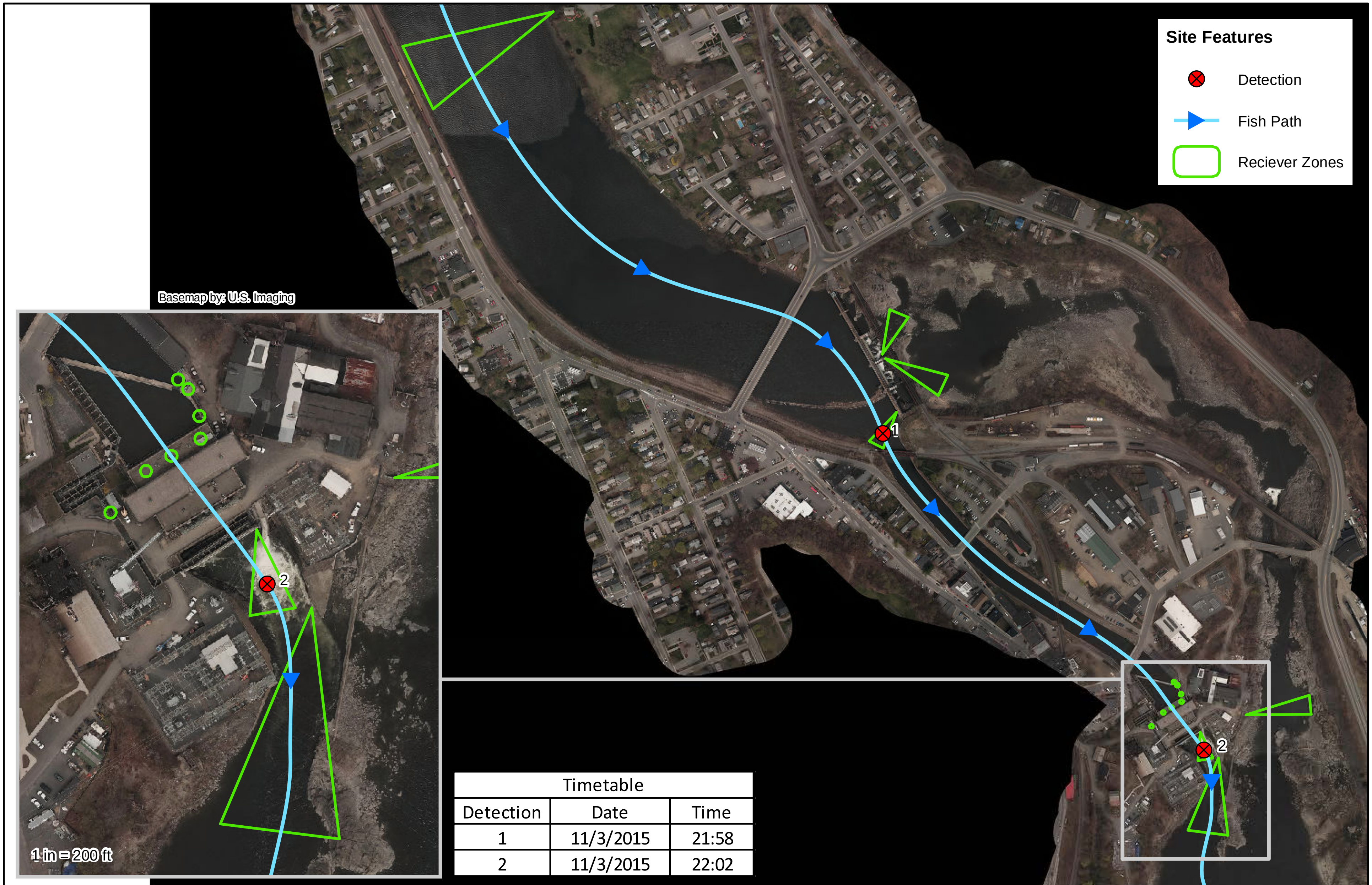


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 21:58 |
| 2 | 11/3/2015 | 22:02 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-120 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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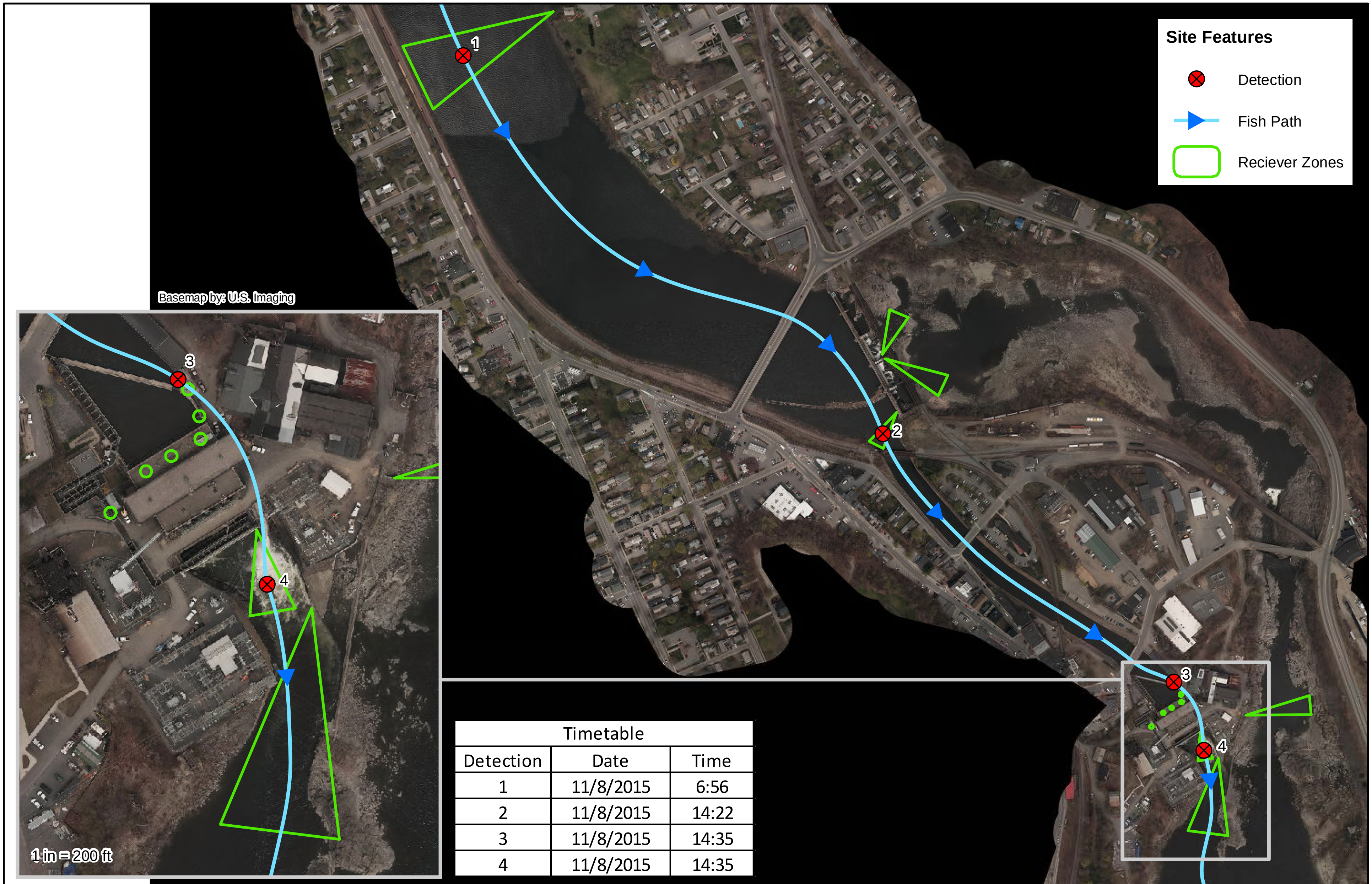


**Site Features**

- Detection
- Fish Path
- Reciever Zones

| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 6:56 |
| 2 | 11/8/2015 | 14:22 |
| 3 | 11/8/2015 | 14:35 |
| 4 | 11/8/2015 | 14:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N
1 in = 600 feet
0 300 600 1,200 Feet

**Study 19 Fish Number: 36-122 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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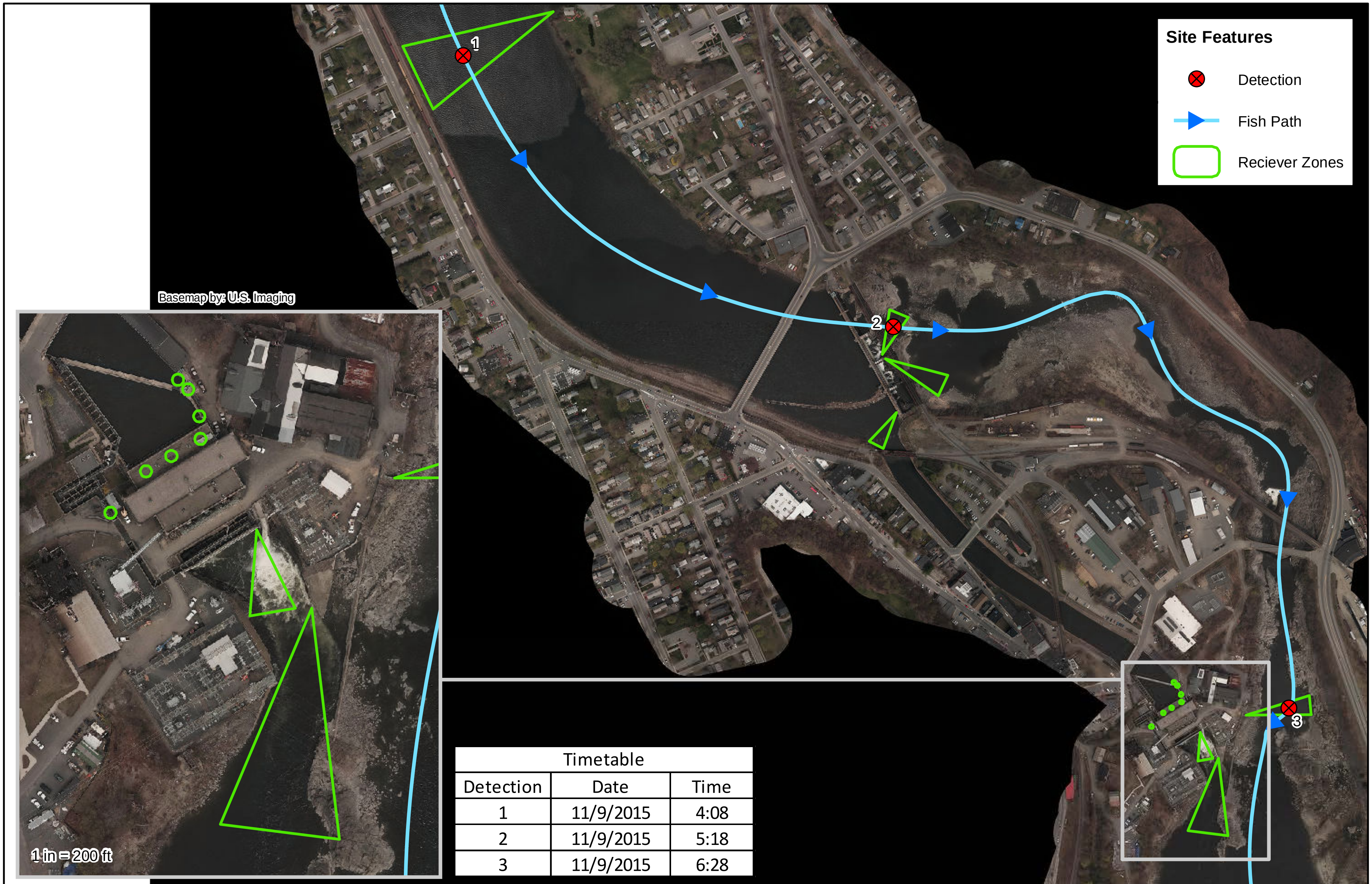


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 4:08 |
| 2 | 11/9/2015 | 5:18 |
| 3 | 11/9/2015 | 6:28 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-123 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32


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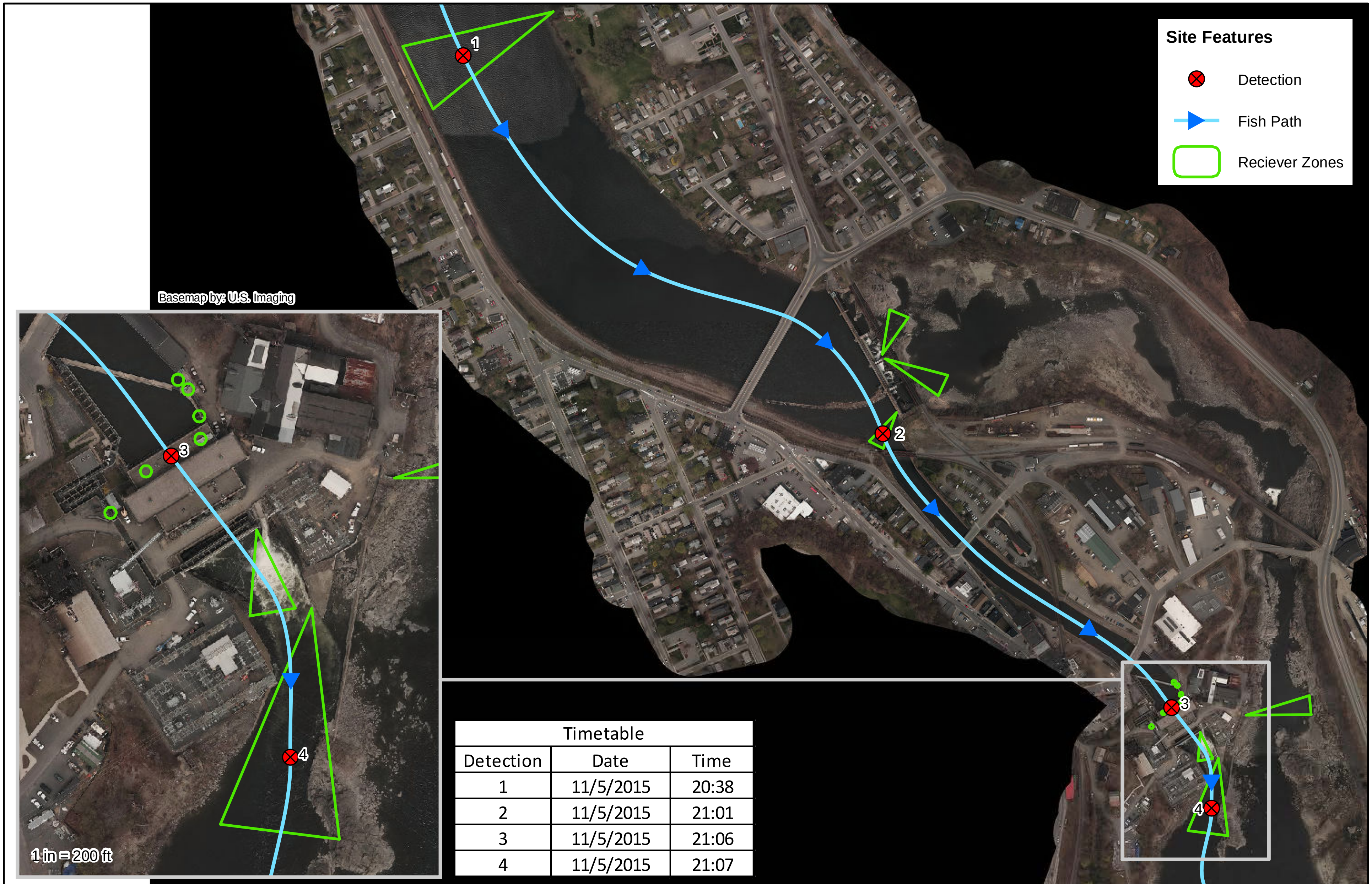


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 20:38 |
| 2 | 11/5/2015 | 21:01 |
| 3 | 11/5/2015 | 21:06 |
| 4 | 11/5/2015 | 21:07 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-141 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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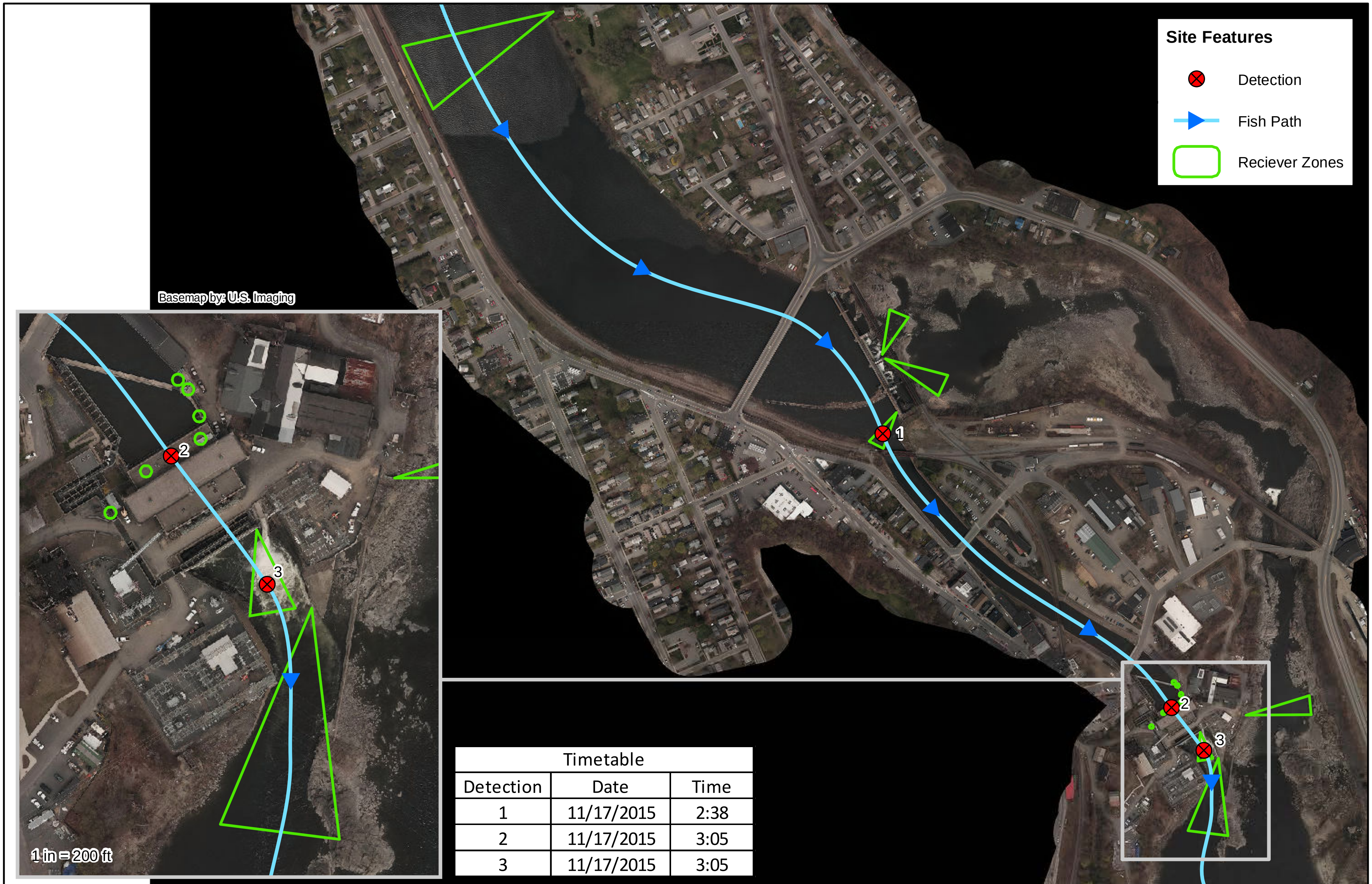


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/17/2015 | 2:38 |
| 2 | 11/17/2015 | 3:05 |
| 3 | 11/17/2015 | 3:05 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-142 (A1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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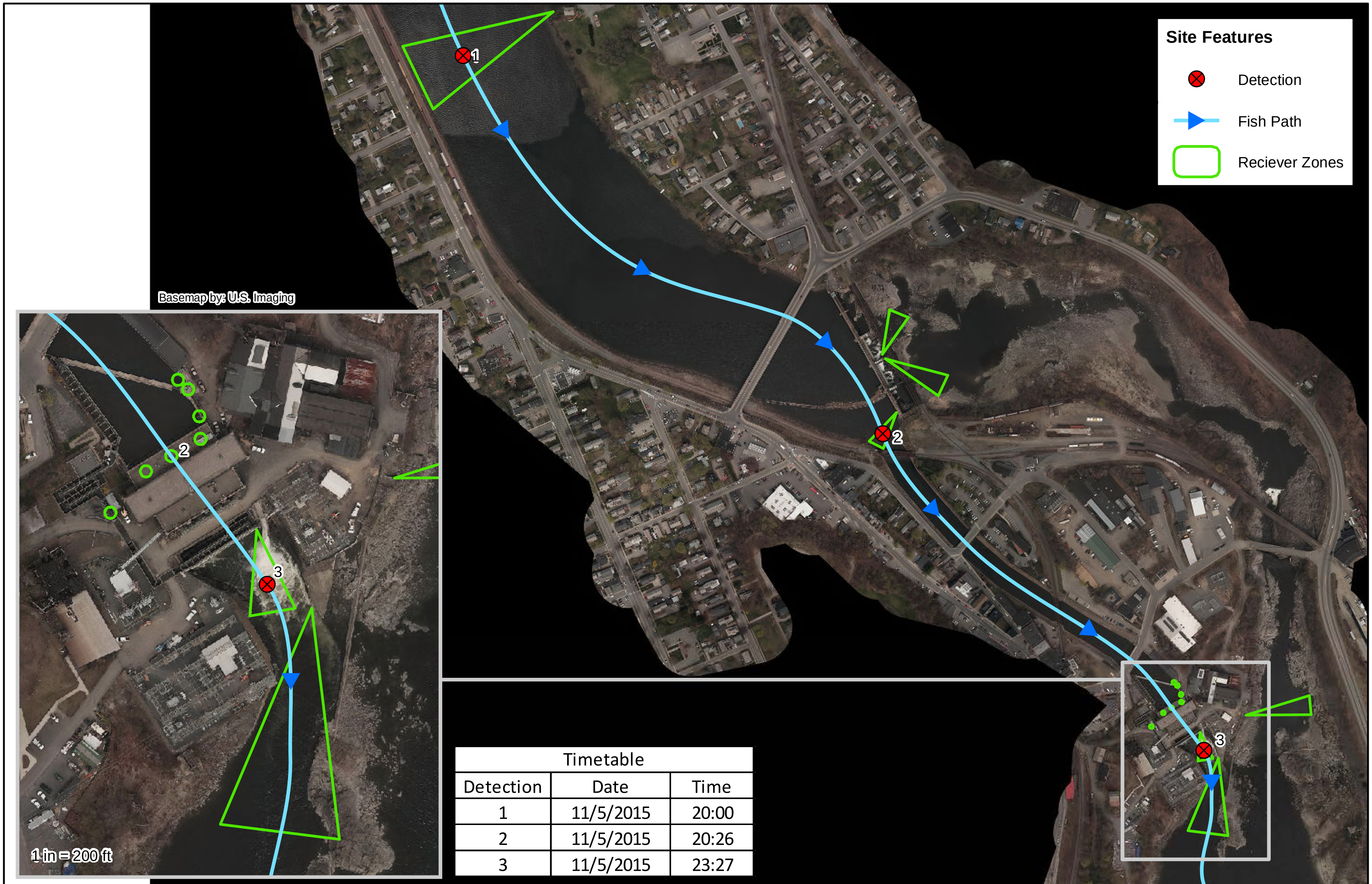


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 20:00 |
| 2 | 11/5/2015 | 20:26 |
| 3 | 11/5/2015 | 23:27 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-143 (A1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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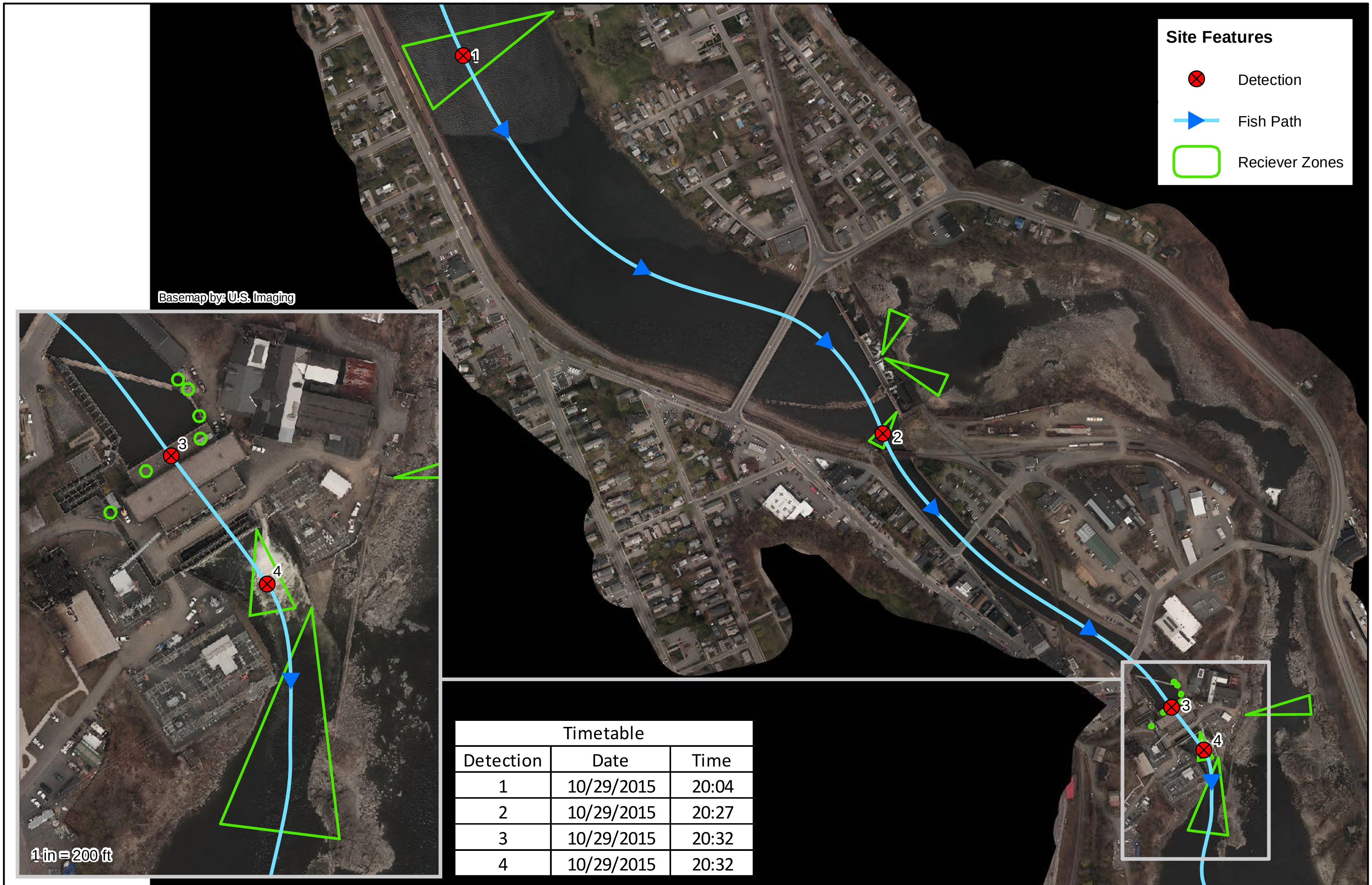


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 20:04 |
| 2 | 10/29/2015 | 20:27 |
| 3 | 10/29/2015 | 20:32 |
| 4 | 10/29/2015 | 20:32 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-144 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52


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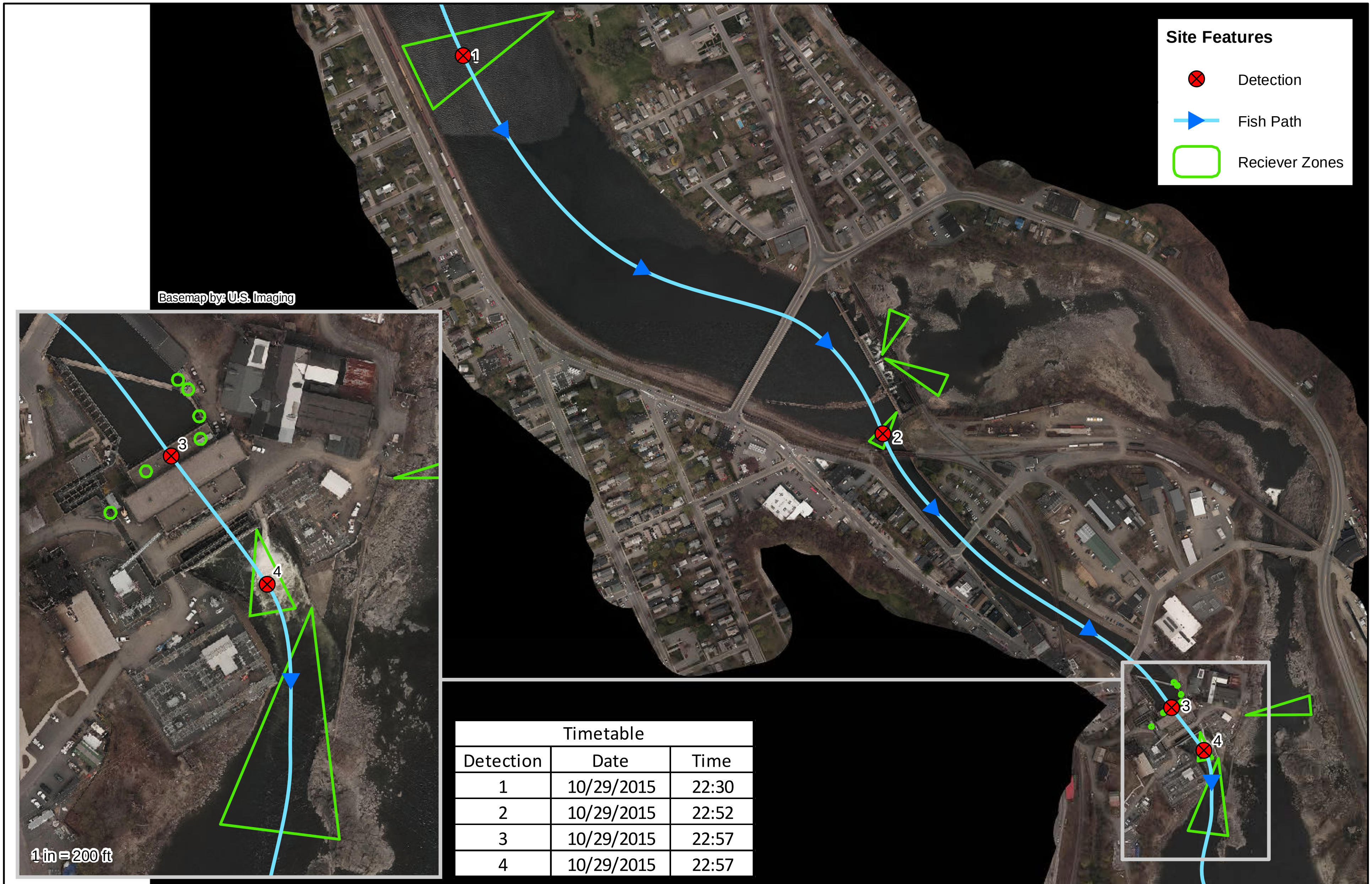


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 22:30 |
| 2 | 10/29/2015 | 22:52 |
| 3 | 10/29/2015 | 22:57 |
| 4 | 10/29/2015 | 22:57 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-145 (A1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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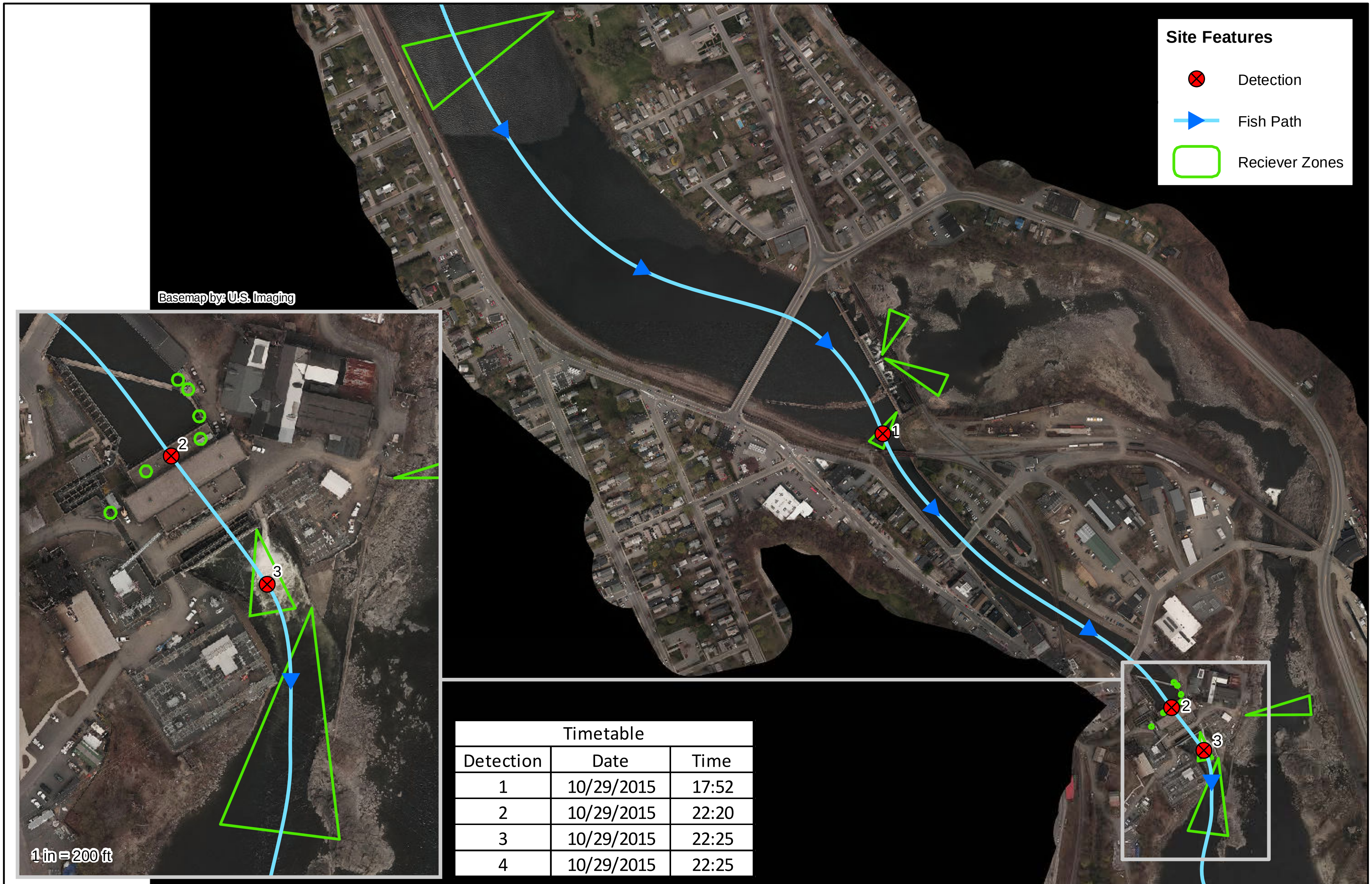


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 17:52 |
| 2 | 10/29/2015 | 22:20 |
| 3 | 10/29/2015 | 22:25 |
| 4 | 10/29/2015 | 22:25 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-146 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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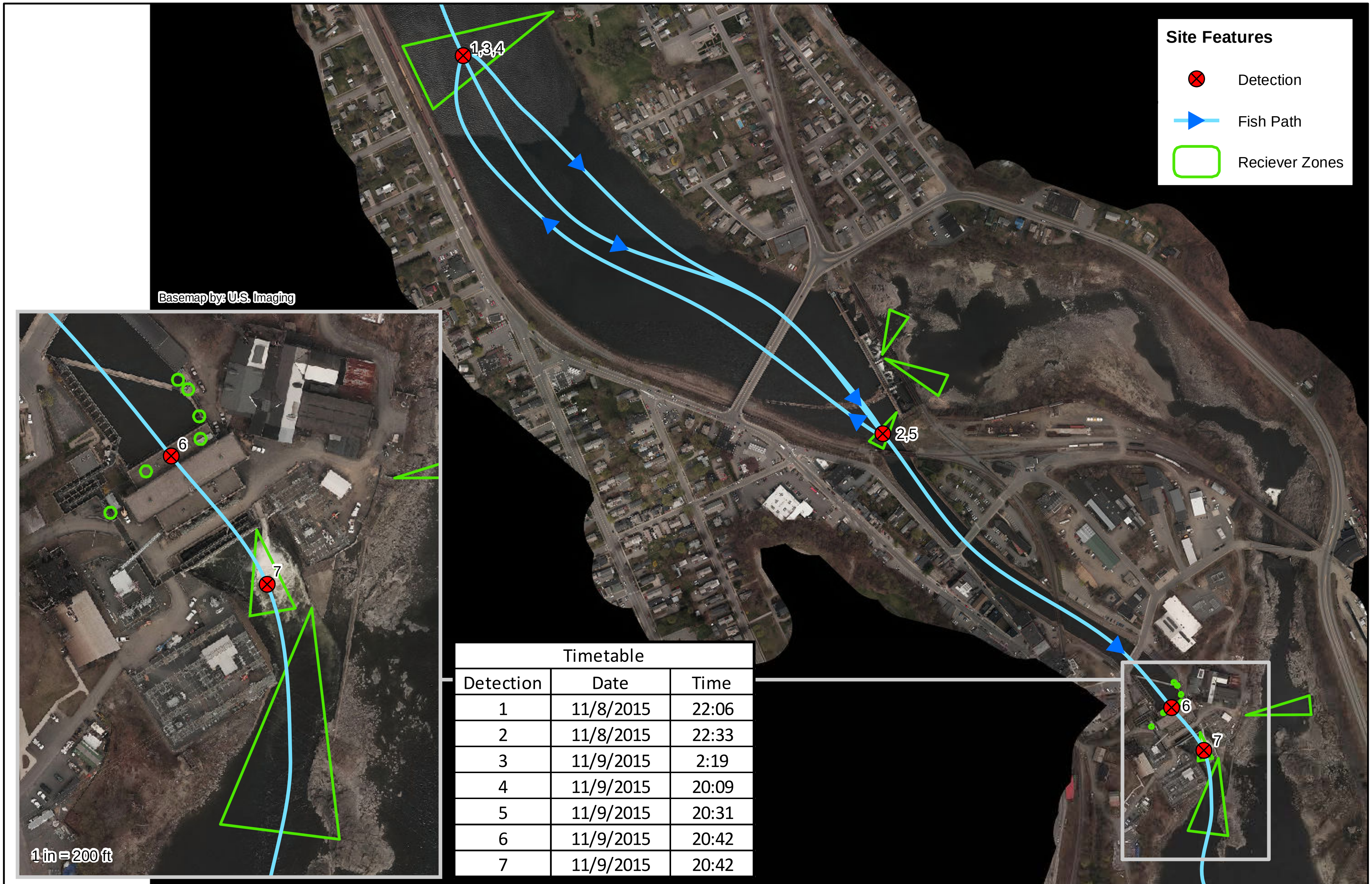


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 22:06 |
| 2 | 11/8/2015 | 22:33 |
| 3 | 11/9/2015 | 2:19 |
| 4 | 11/9/2015 | 20:09 |
| 5 | 11/9/2015 | 20:31 |
| 6 | 11/9/2015 | 20:42 |
| 7 | 11/9/2015 | 20:42 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-147 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52


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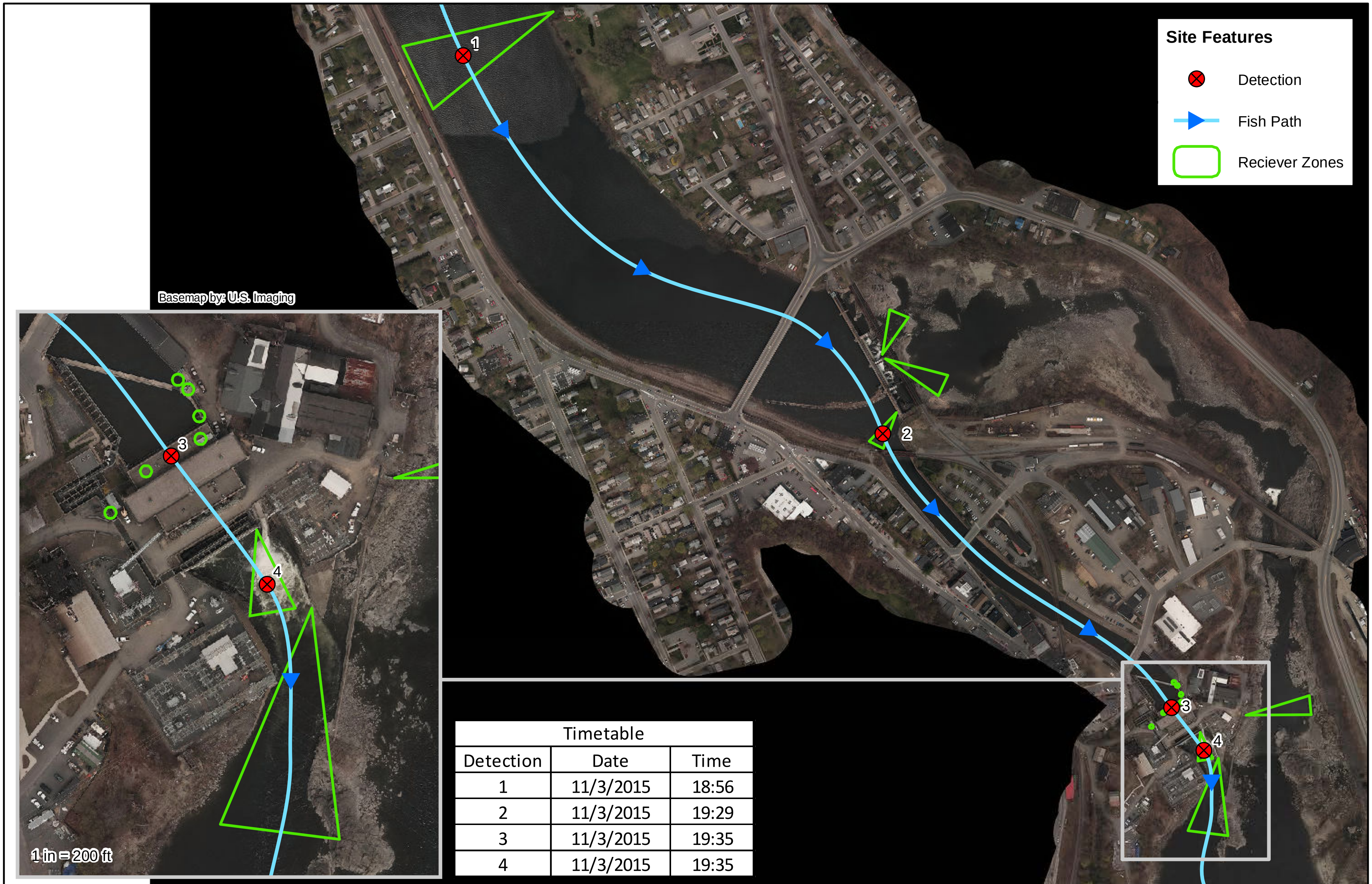


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 18:56 |
| 2 | 11/3/2015 | 19:29 |
| 3 | 11/3/2015 | 19:35 |
| 4 | 11/3/2015 | 19:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 36-155 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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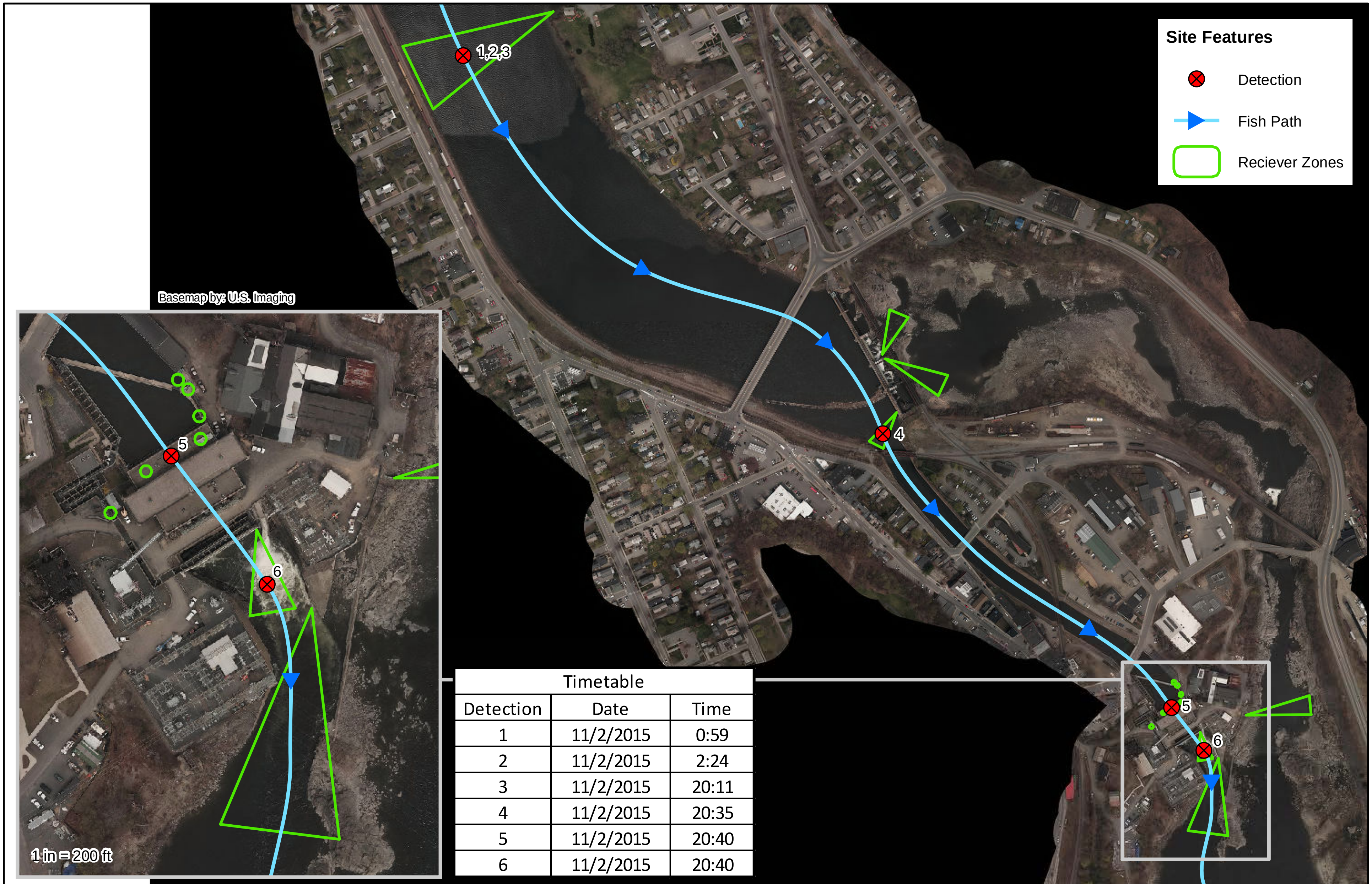
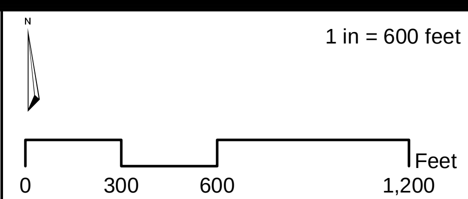



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 0:59 |
| 2 | 11/2/2015 | 2:24 |
| 3 | 11/2/2015 | 20:11 |
| 4 | 11/2/2015 | 20:35 |
| 5 | 11/2/2015 | 20:40 |
| 6 | 11/2/2015 | 20:40 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 36-156 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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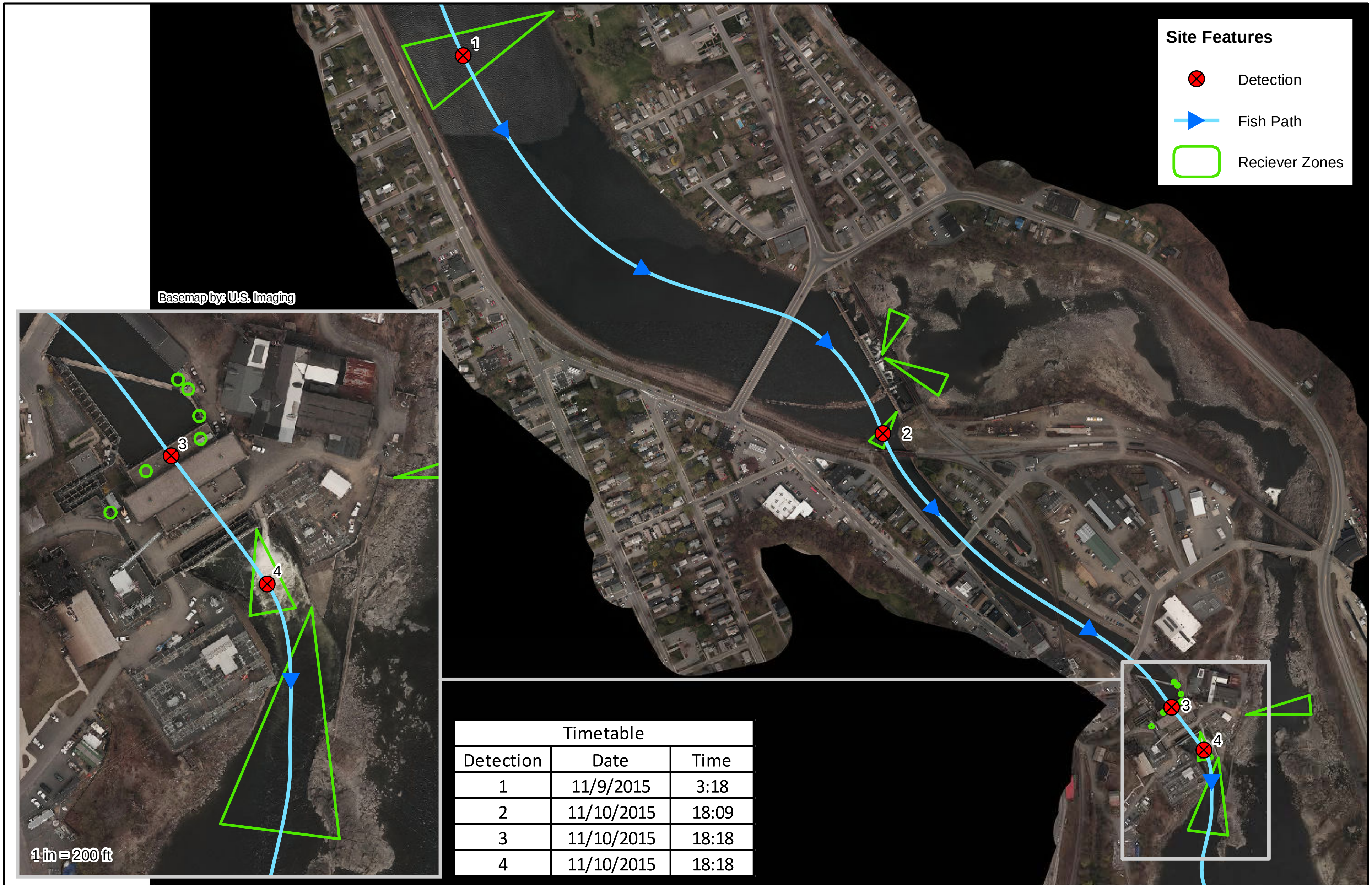


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 3:18 |
| 2 | 11/10/2015 | 18:09 |
| 3 | 11/10/2015 | 18:18 |
| 4 | 11/10/2015 | 18:18 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 36-158 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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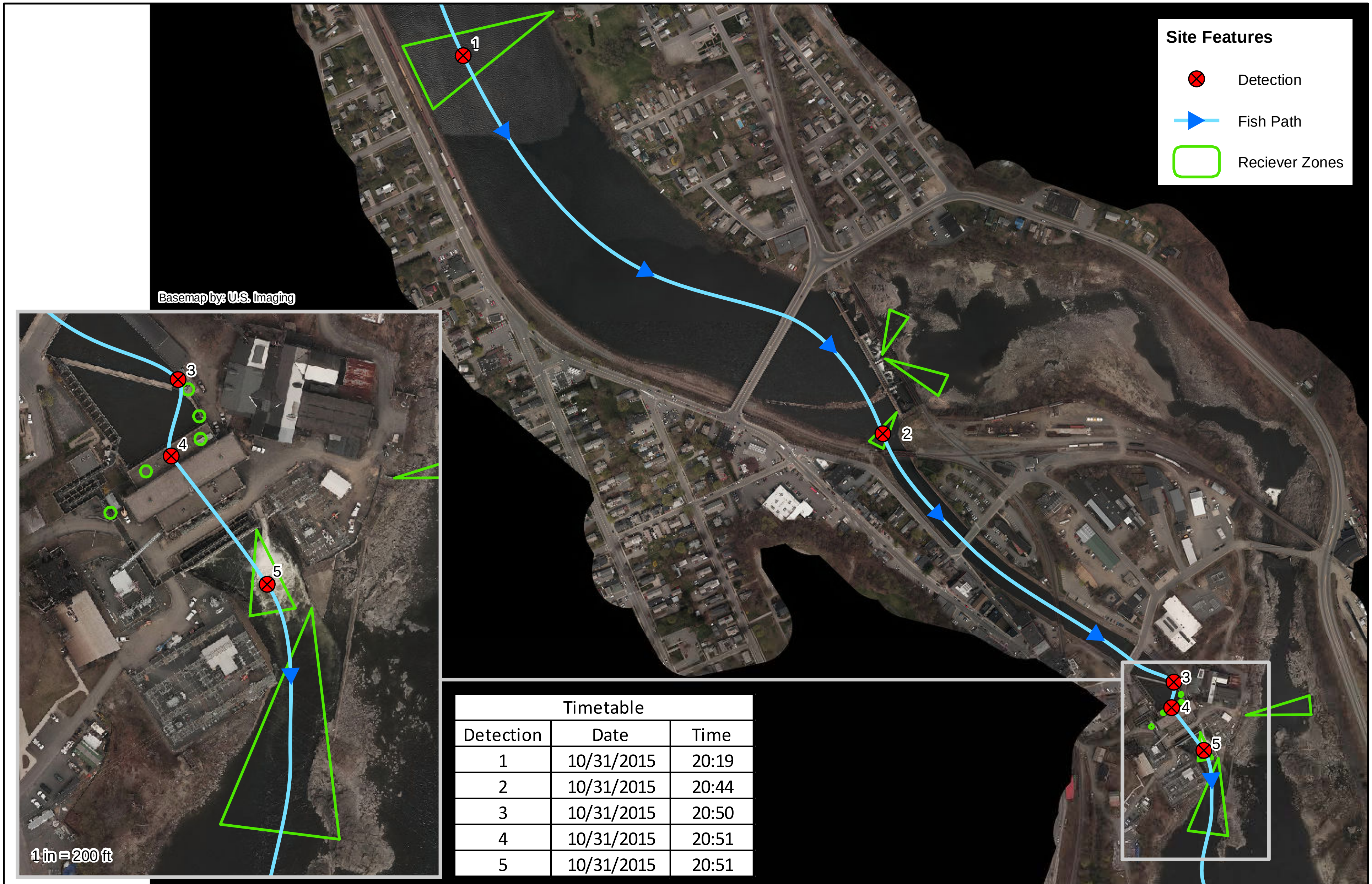


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:19 |
| 2 | 10/31/2015 | 20:44 |
| 3 | 10/31/2015 | 20:50 |
| 4 | 10/31/2015 | 20:51 |
| 5 | 10/31/2015 | 20:51 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-175 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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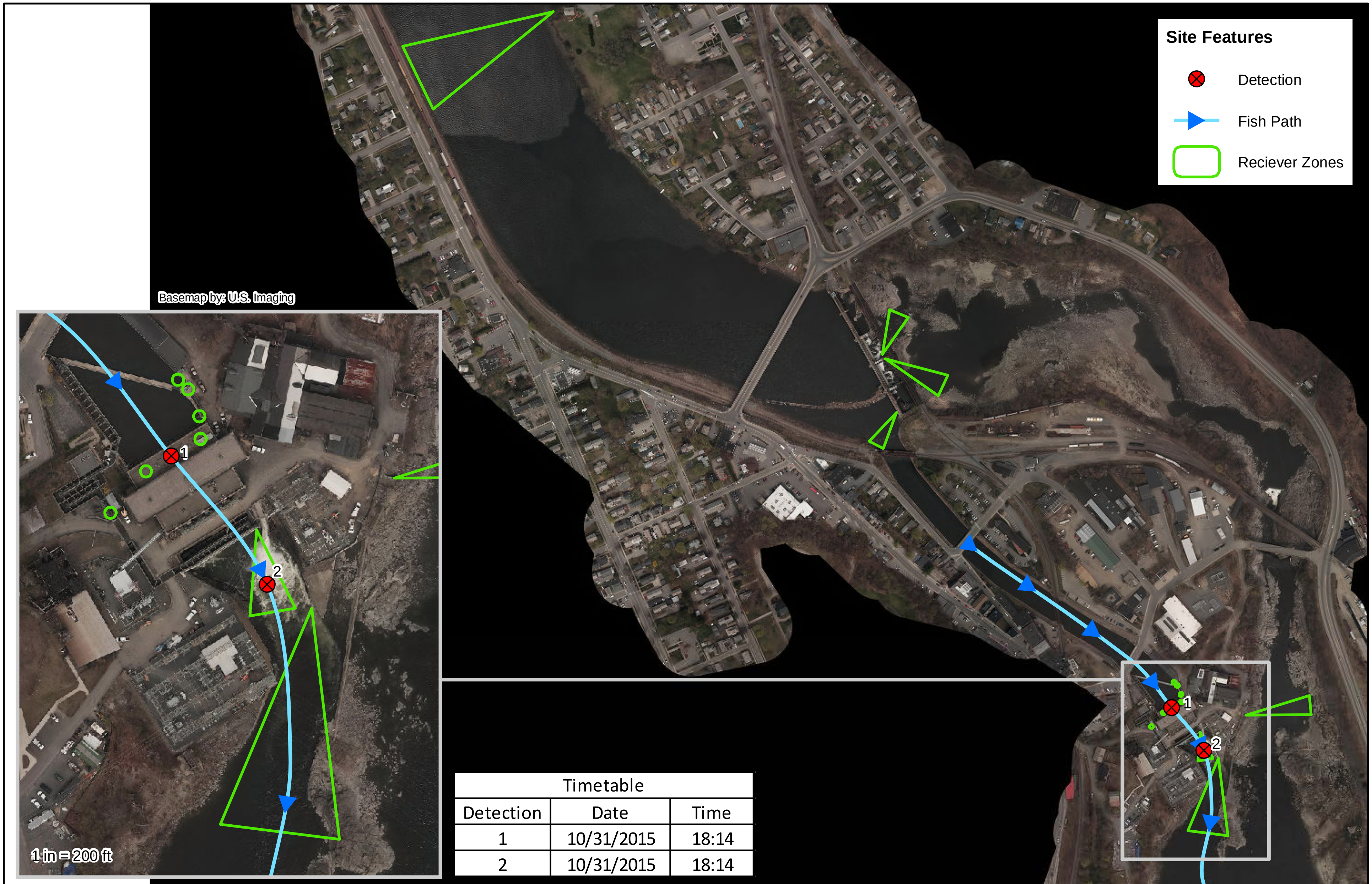


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
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| 2 | 10/31/2015 | 18:14 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-51 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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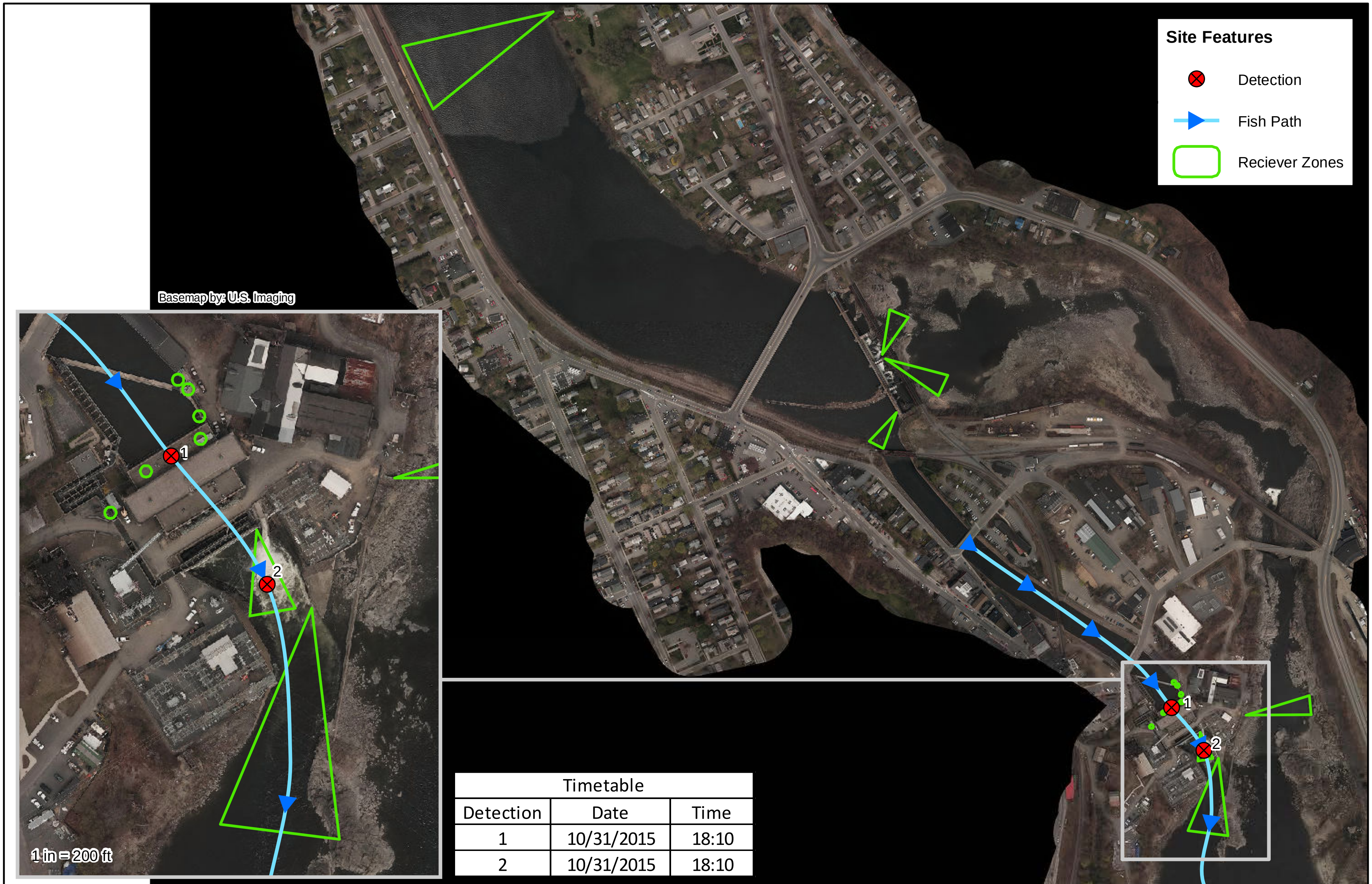


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 18:10 |
| 2 | 10/31/2015 | 18:10 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-52 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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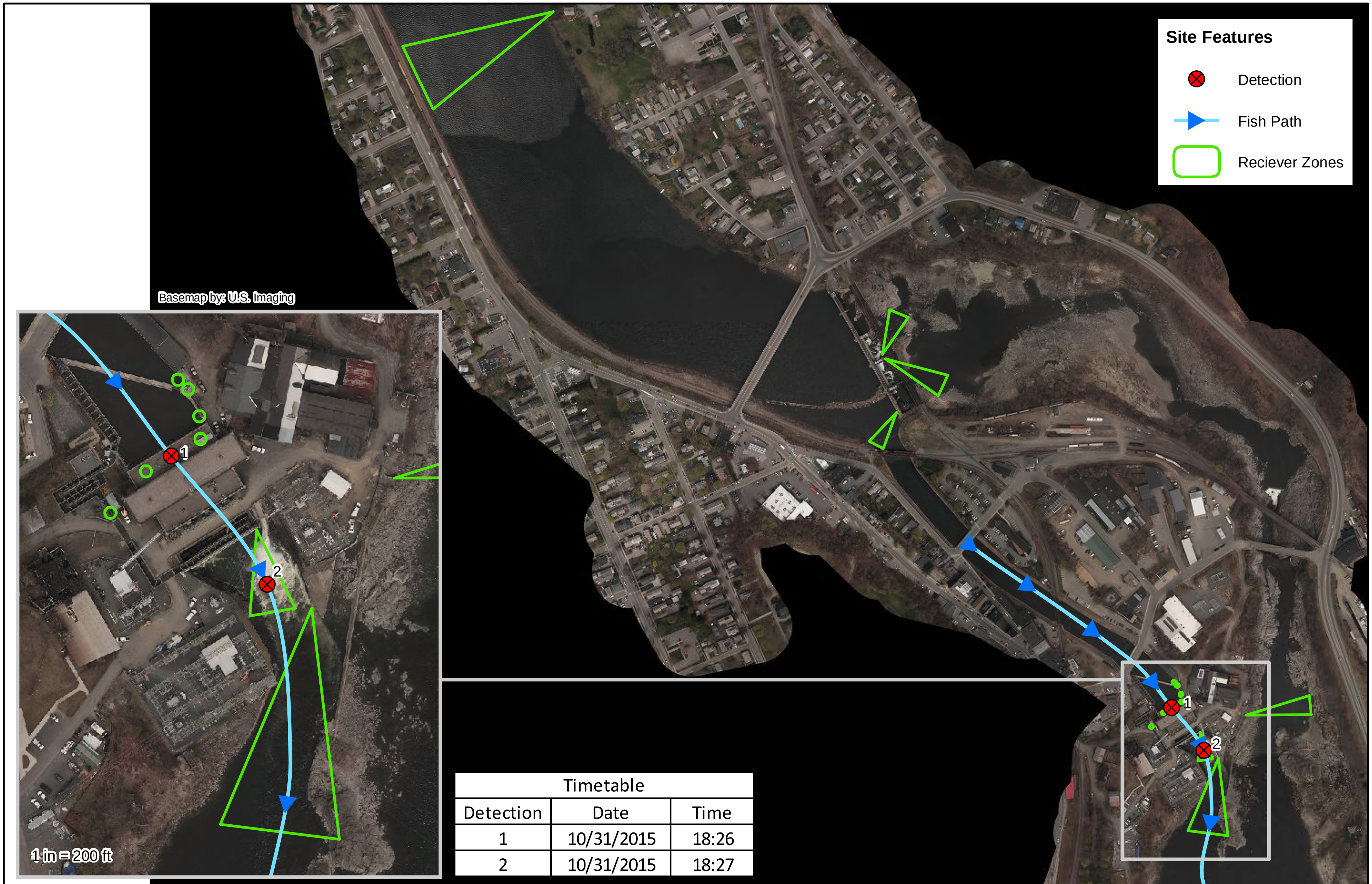


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 18:26 |
| 2 | 10/31/2015 | 18:27 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-53 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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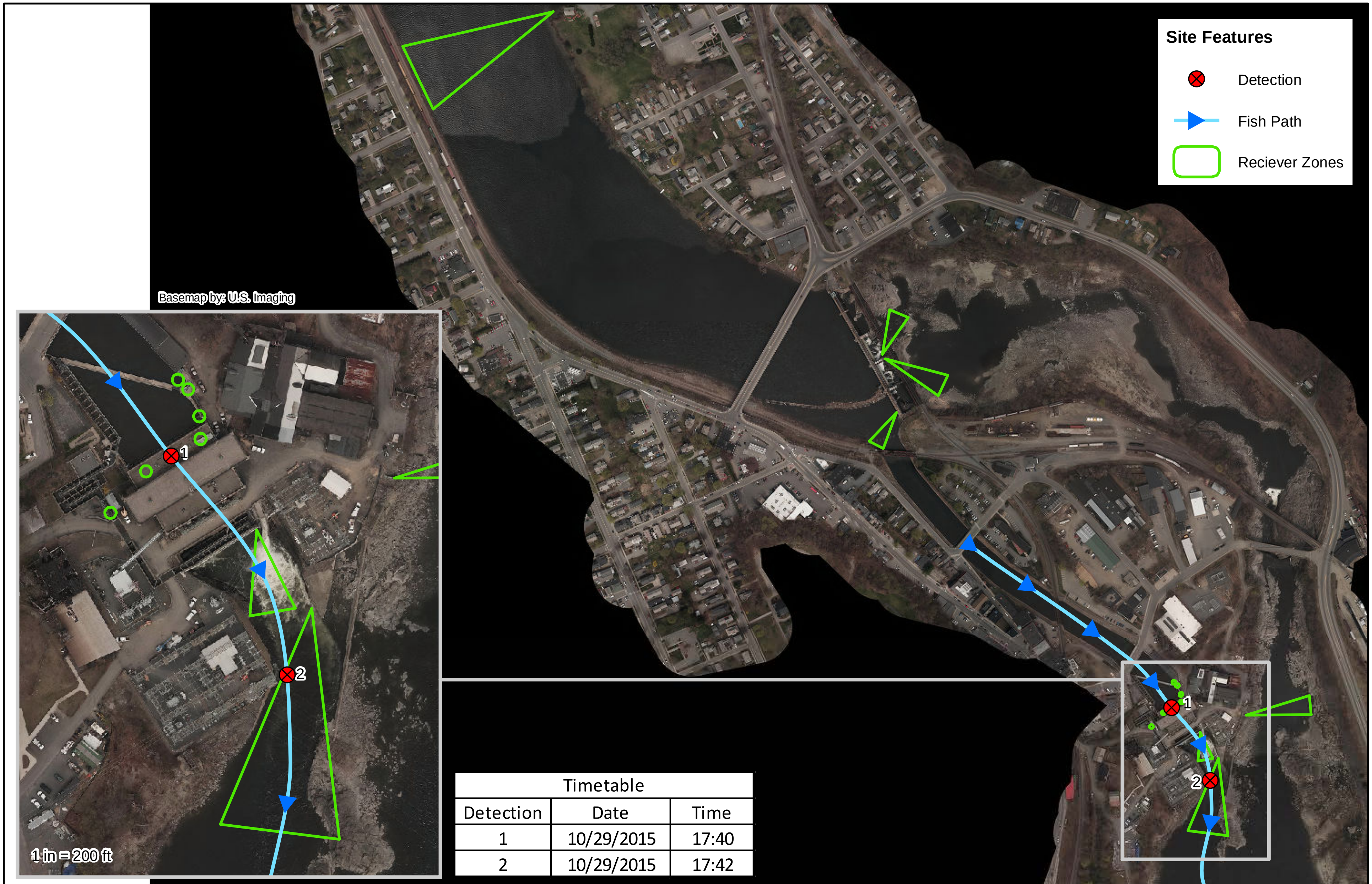


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 17:40 |
| 2 | 10/29/2015 | 17:42 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N
1 in = 600 feet
0 300 600 1,200 Feet

**Study 19 Fish Number: 36-68 (A1)**
Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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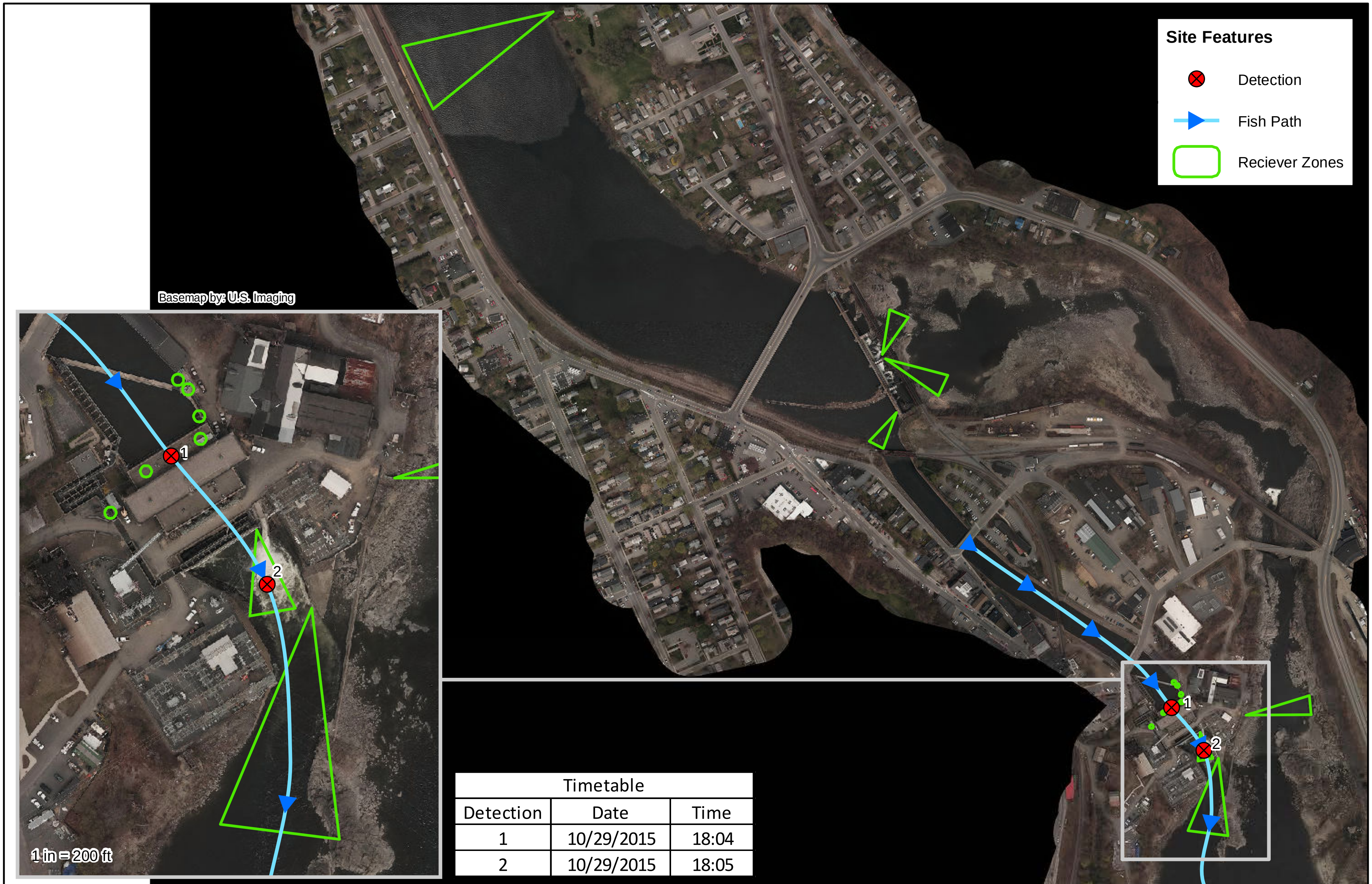


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:04 |
| 2 | 10/29/2015 | 18:05 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-69 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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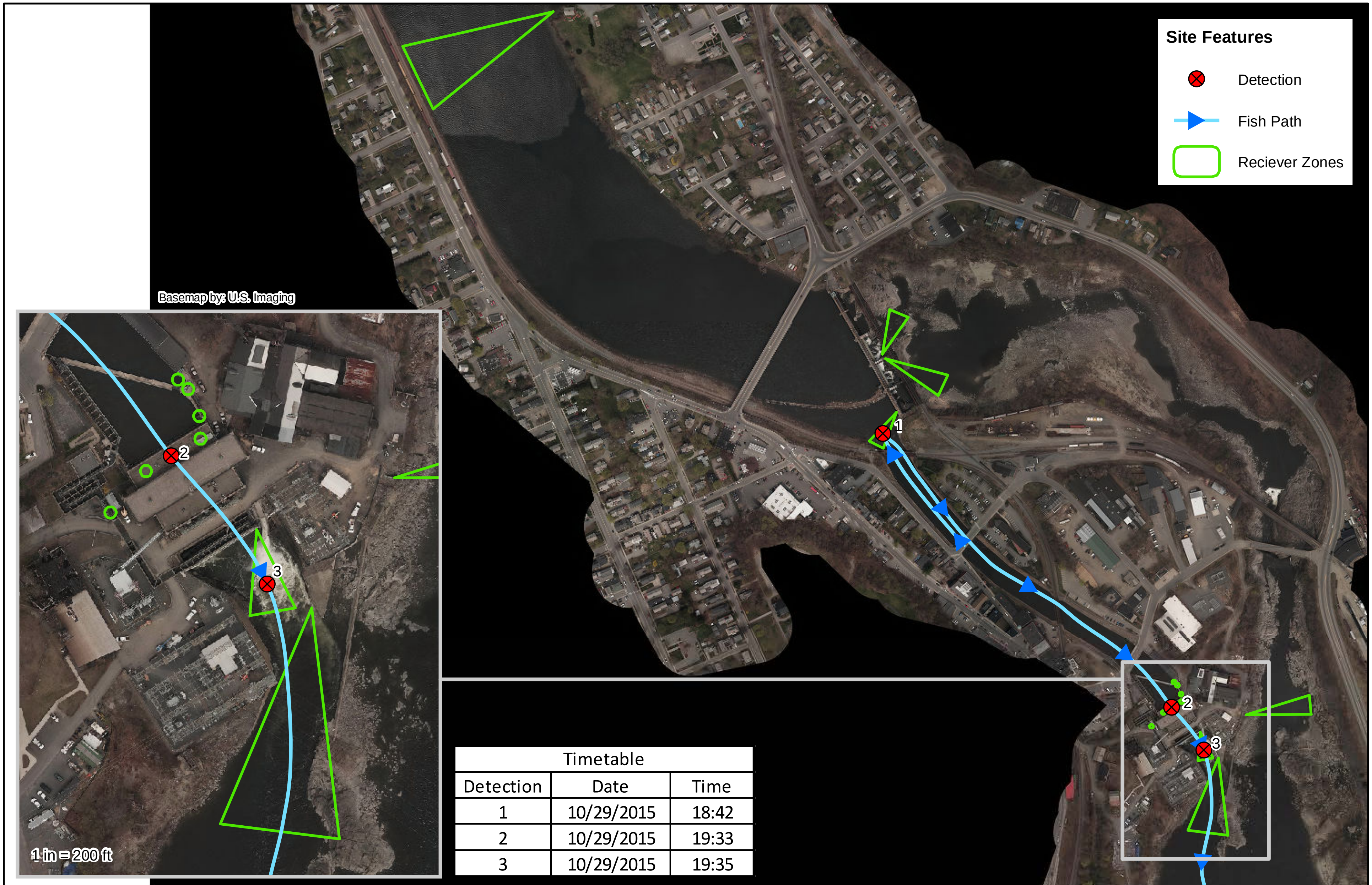


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:42 |
| 2 | 10/29/2015 | 19:33 |
| 3 | 10/29/2015 | 19:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-70 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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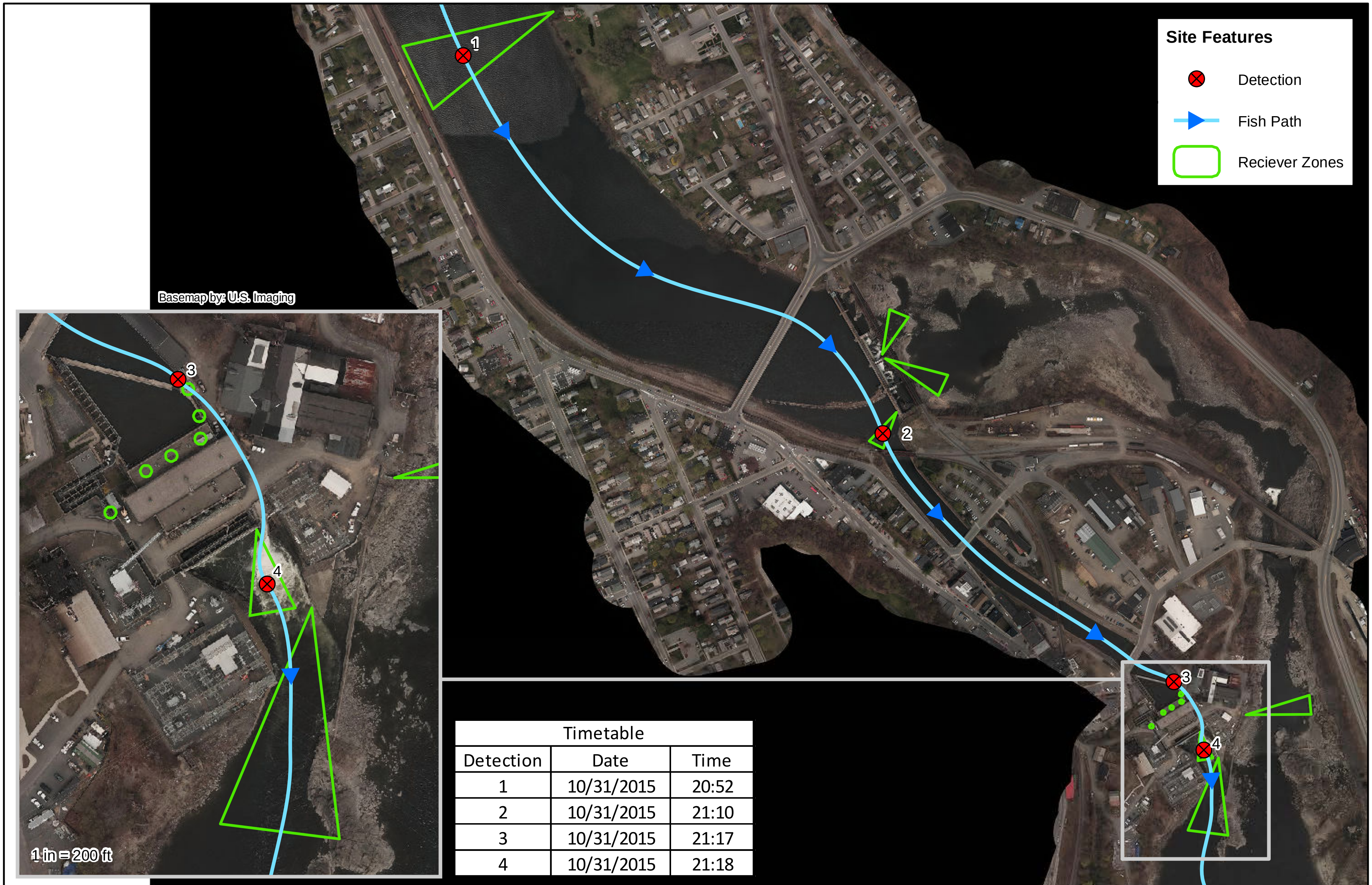


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:52 |
| 2 | 10/31/2015 | 21:10 |
| 3 | 10/31/2015 | 21:17 |
| 4 | 10/31/2015 | 21:18 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 36-176 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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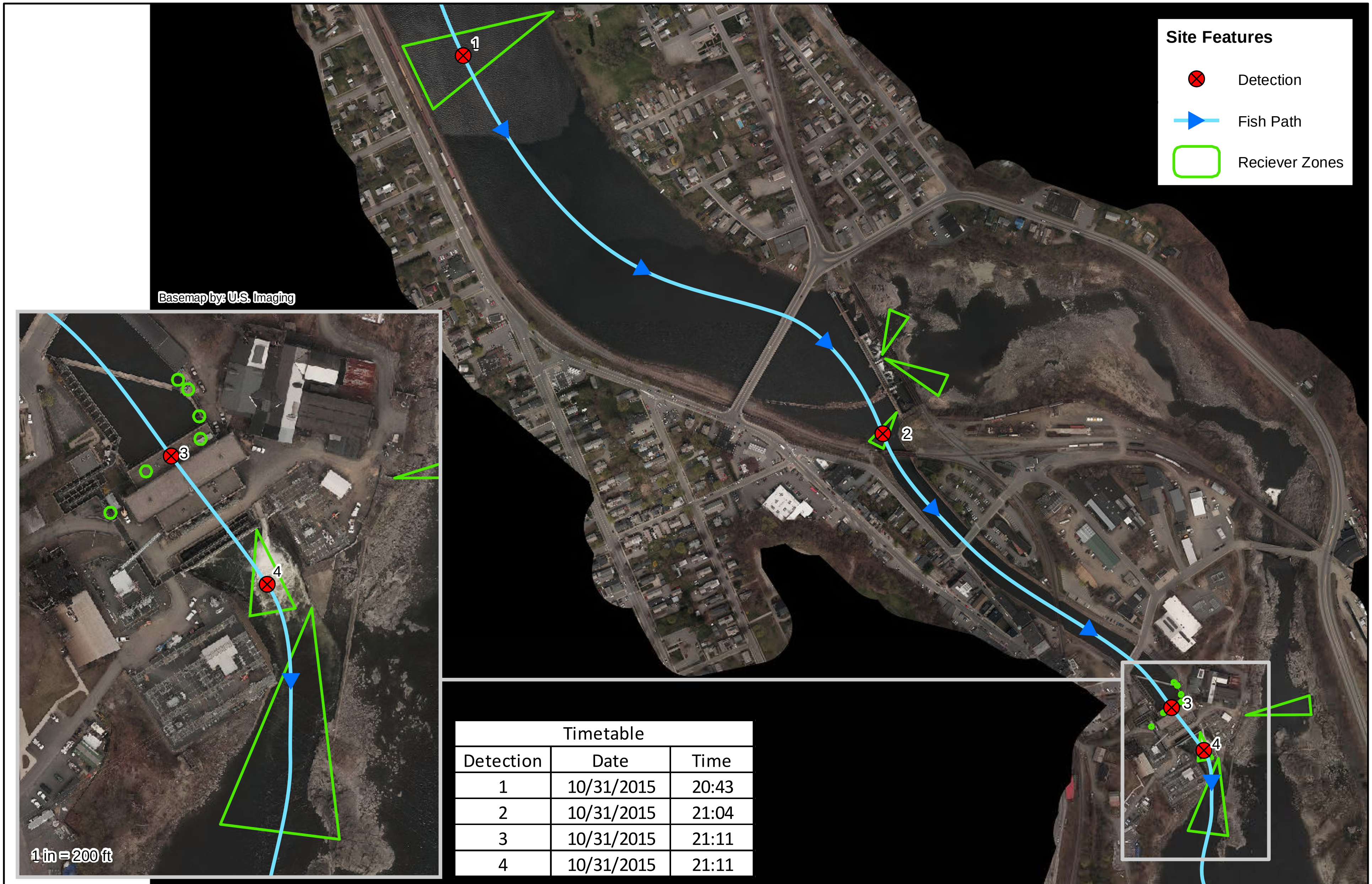


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:43 |
| 2 | 10/31/2015 | 21:04 |
| 3 | 10/31/2015 | 21:11 |
| 4 | 10/31/2015 | 21:11 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-177 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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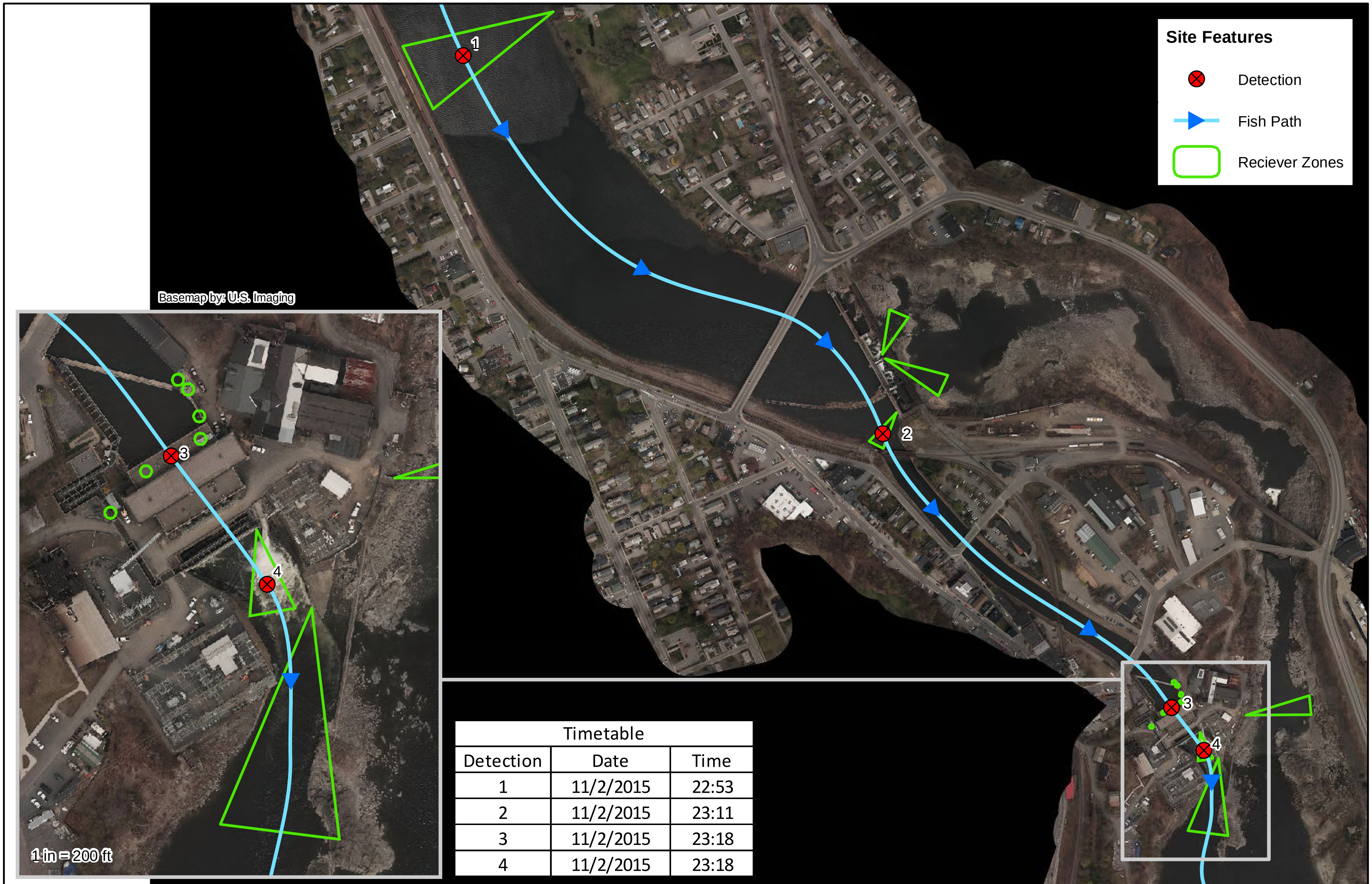


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 22:53 |
| 2 | 11/2/2015 | 23:11 |
| 3 | 11/2/2015 | 23:18 |
| 4 | 11/2/2015 | 23:18 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-184 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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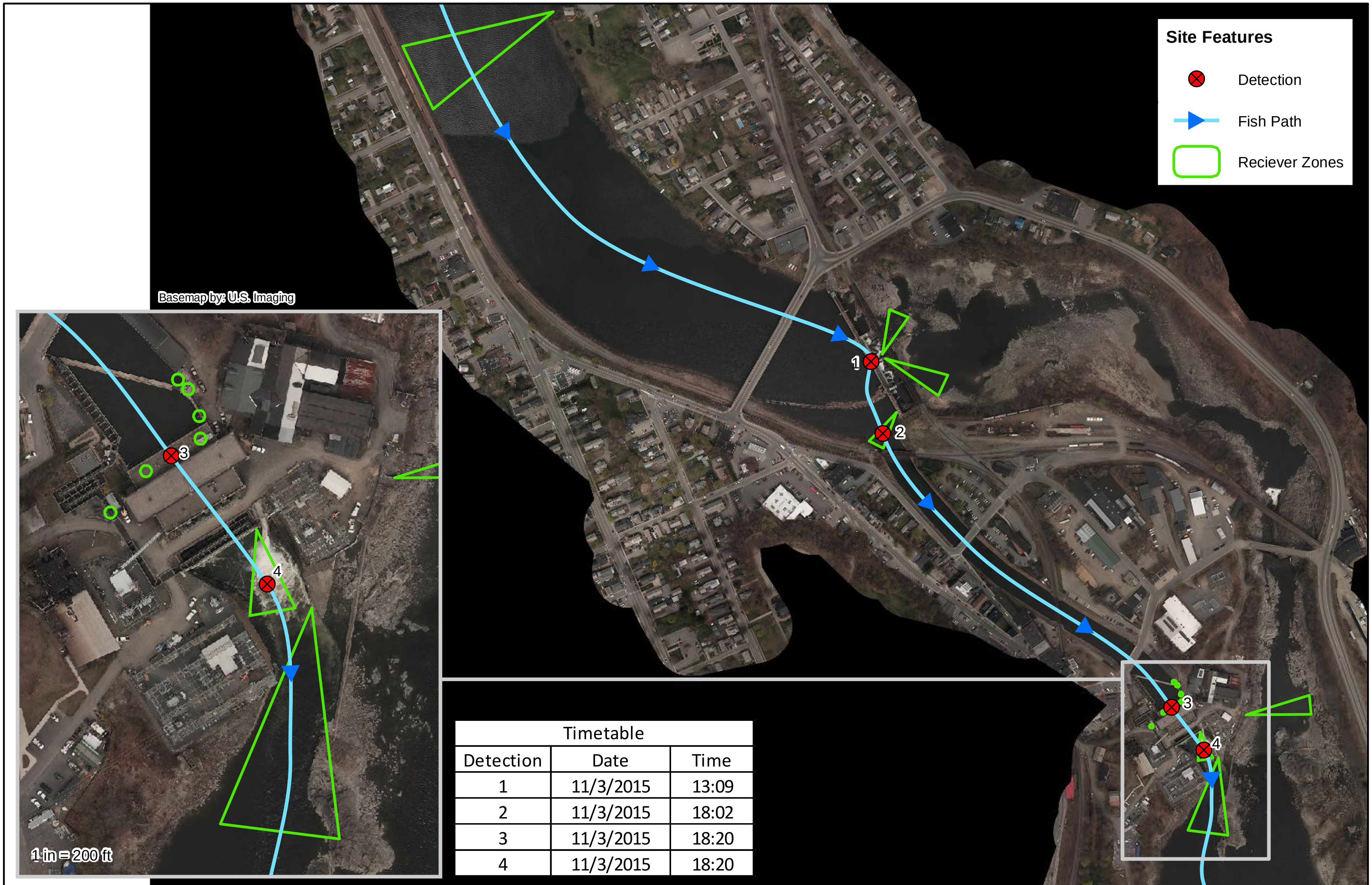


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 13:09 |
| 2 | 11/3/2015 | 18:02 |
| 3 | 11/3/2015 | 18:20 |
| 4 | 11/3/2015 | 18:20 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 36-187 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21


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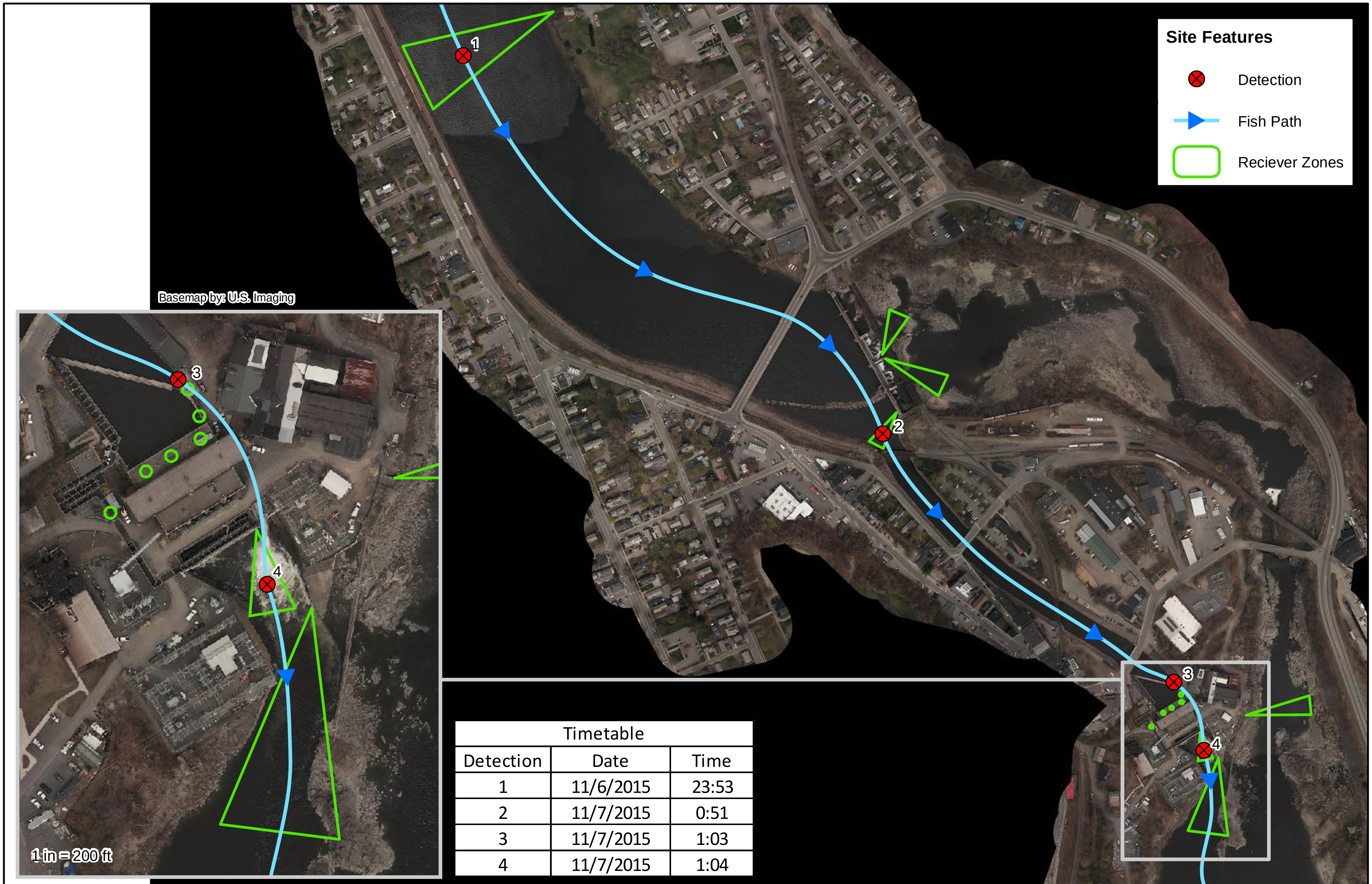


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 23:53 |
| 2 | 11/7/2015 | 0:51 |
| 3 | 11/7/2015 | 1:03 |
| 4 | 11/7/2015 | 1:04 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-111 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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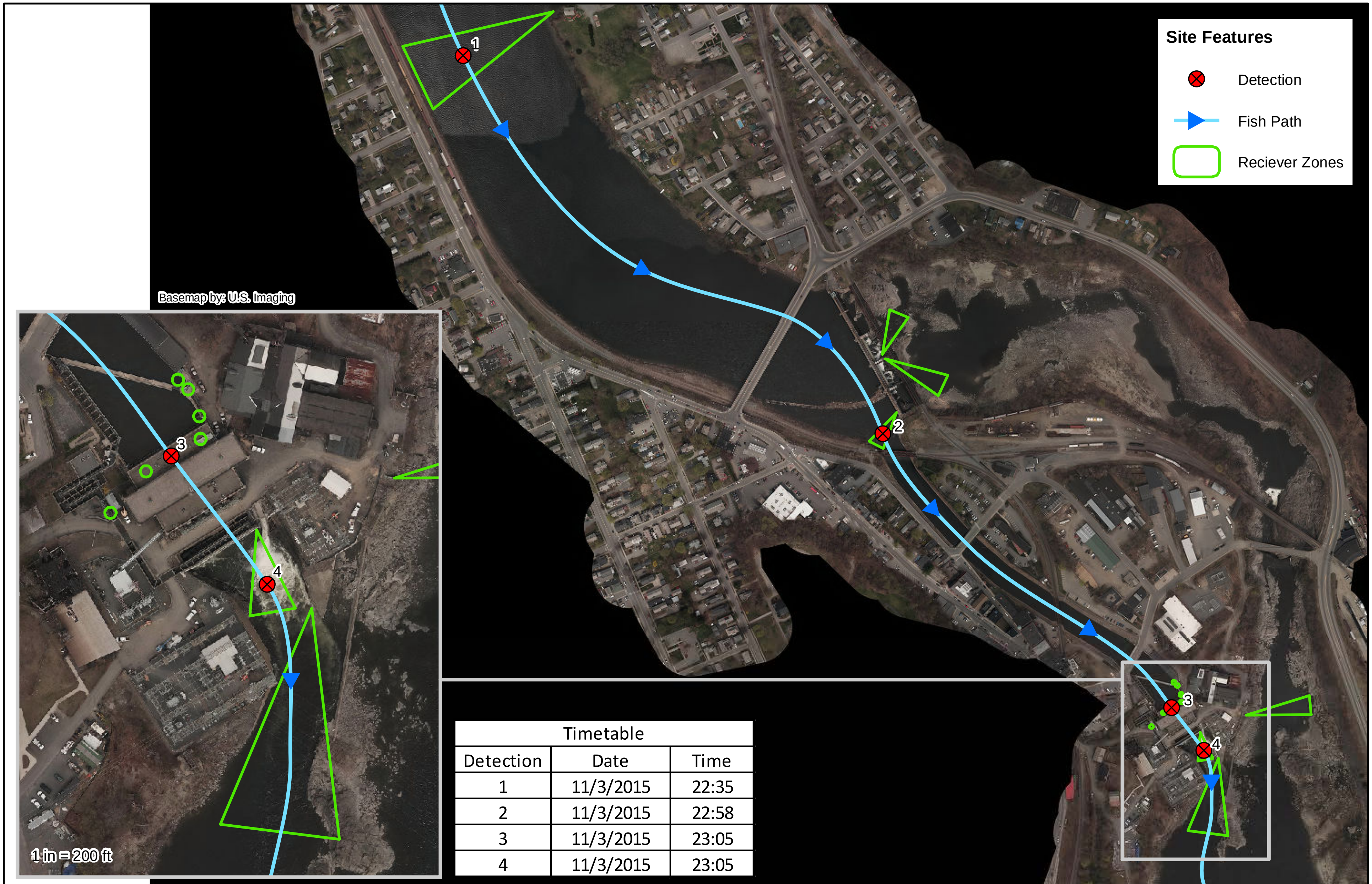


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 22:35 |
| 2 | 11/3/2015 | 22:58 |
| 3 | 11/3/2015 | 23:05 |
| 4 | 11/3/2015 | 23:05 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-112 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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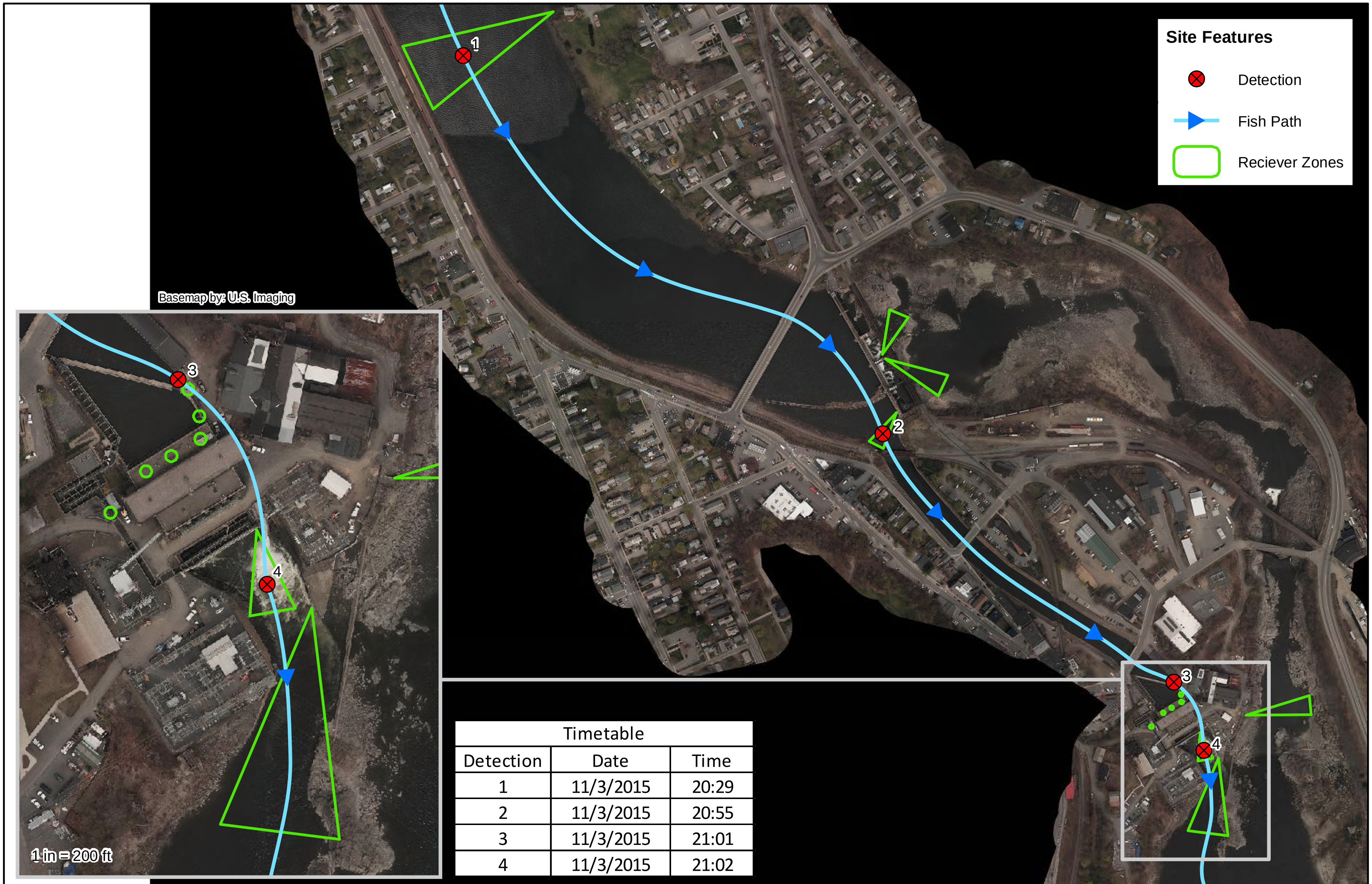


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
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| 2 | 11/3/2015 | 20:55 |
| 3 | 11/3/2015 | 21:01 |
| 4 | 11/3/2015 | 21:02 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-113 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45


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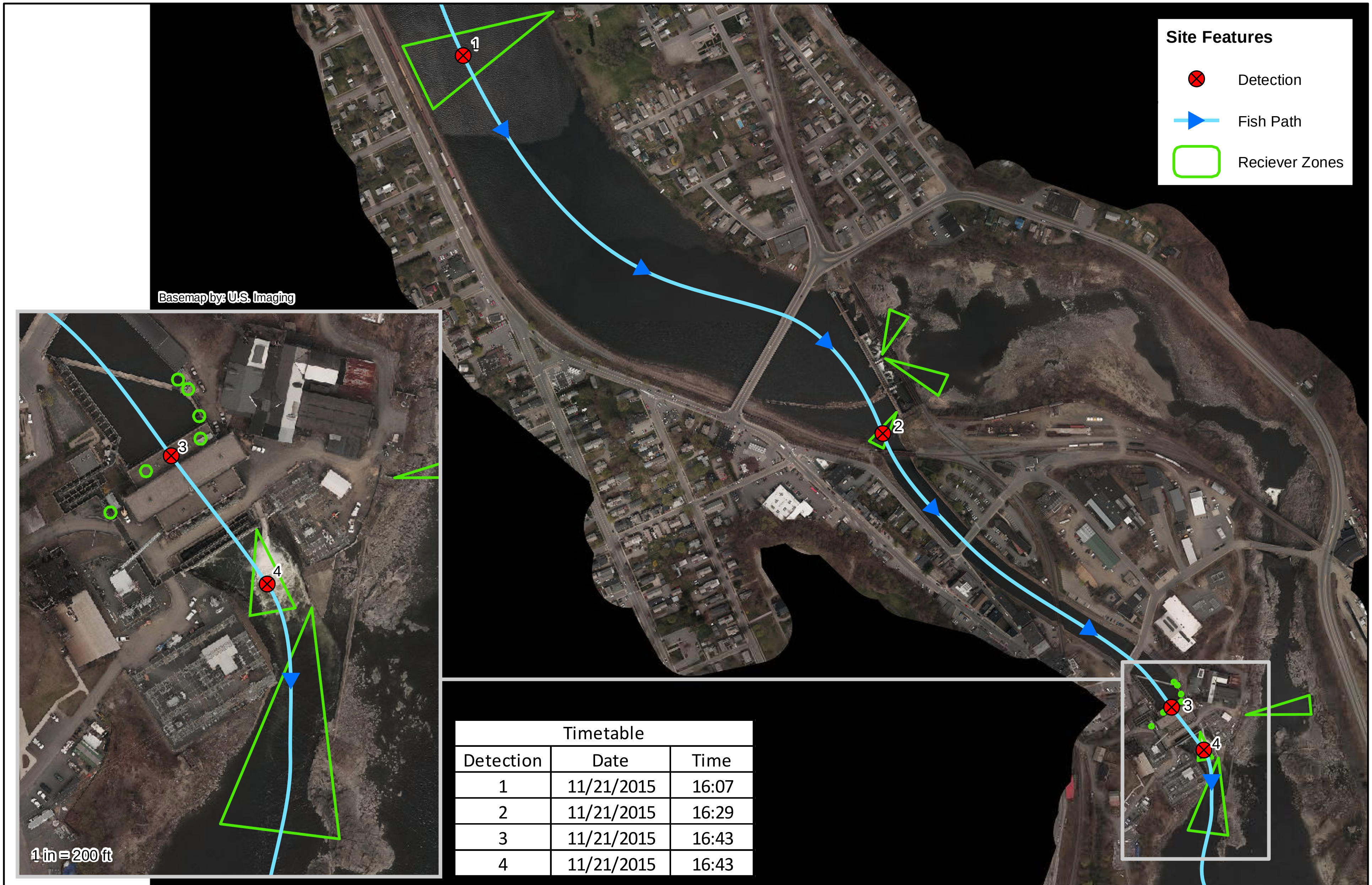


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/21/2015 | 16:07 |
| 2 | 11/21/2015 | 16:29 |
| 3 | 11/21/2015 | 16:43 |
| 4 | 11/21/2015 | 16:43 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-114 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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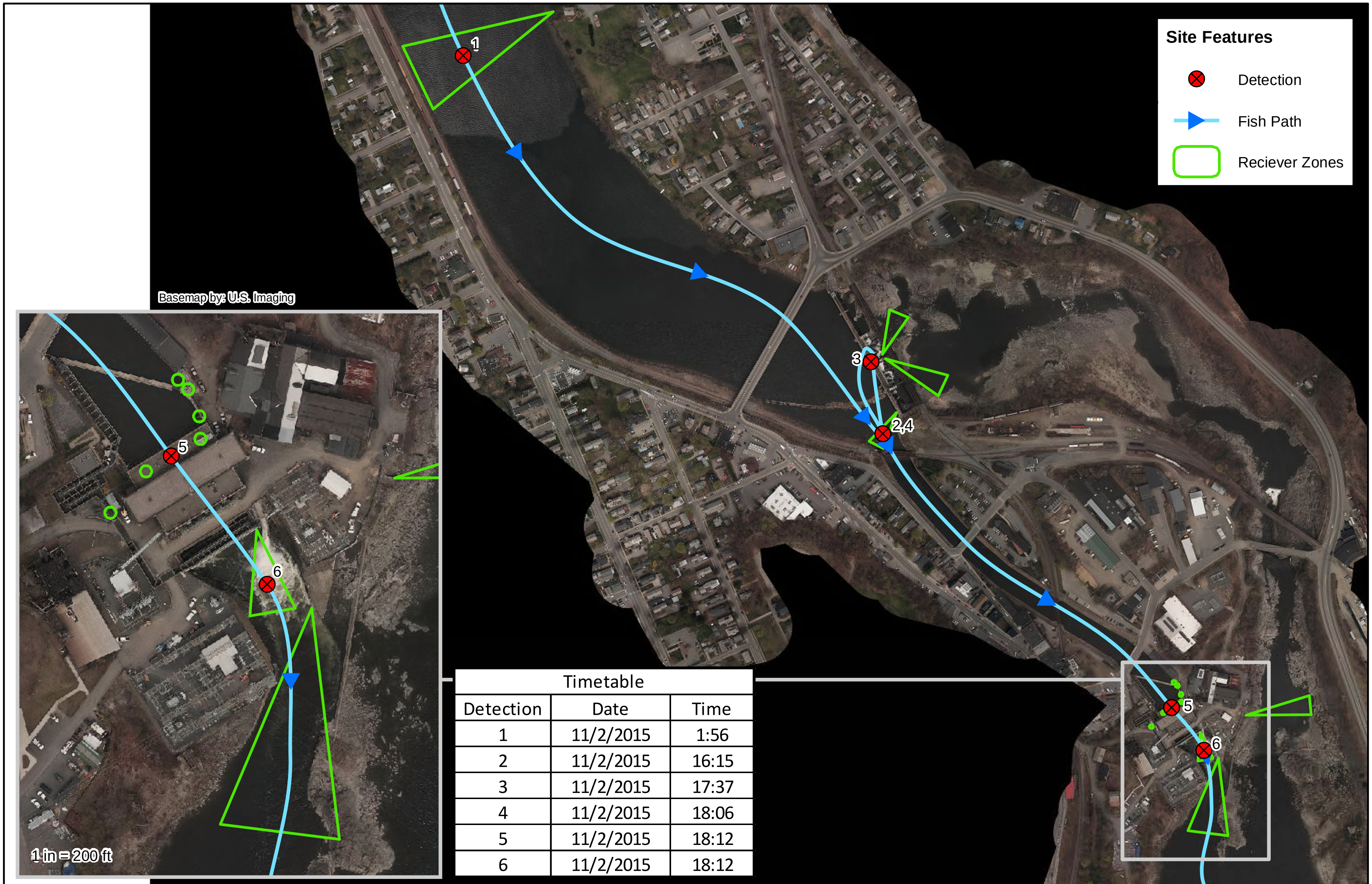


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 1:56 |
| 2 | 11/2/2015 | 16:15 |
| 3 | 11/2/2015 | 17:37 |
| 4 | 11/2/2015 | 18:06 |
| 5 | 11/2/2015 | 18:12 |
| 6 | 11/2/2015 | 18:12 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-118 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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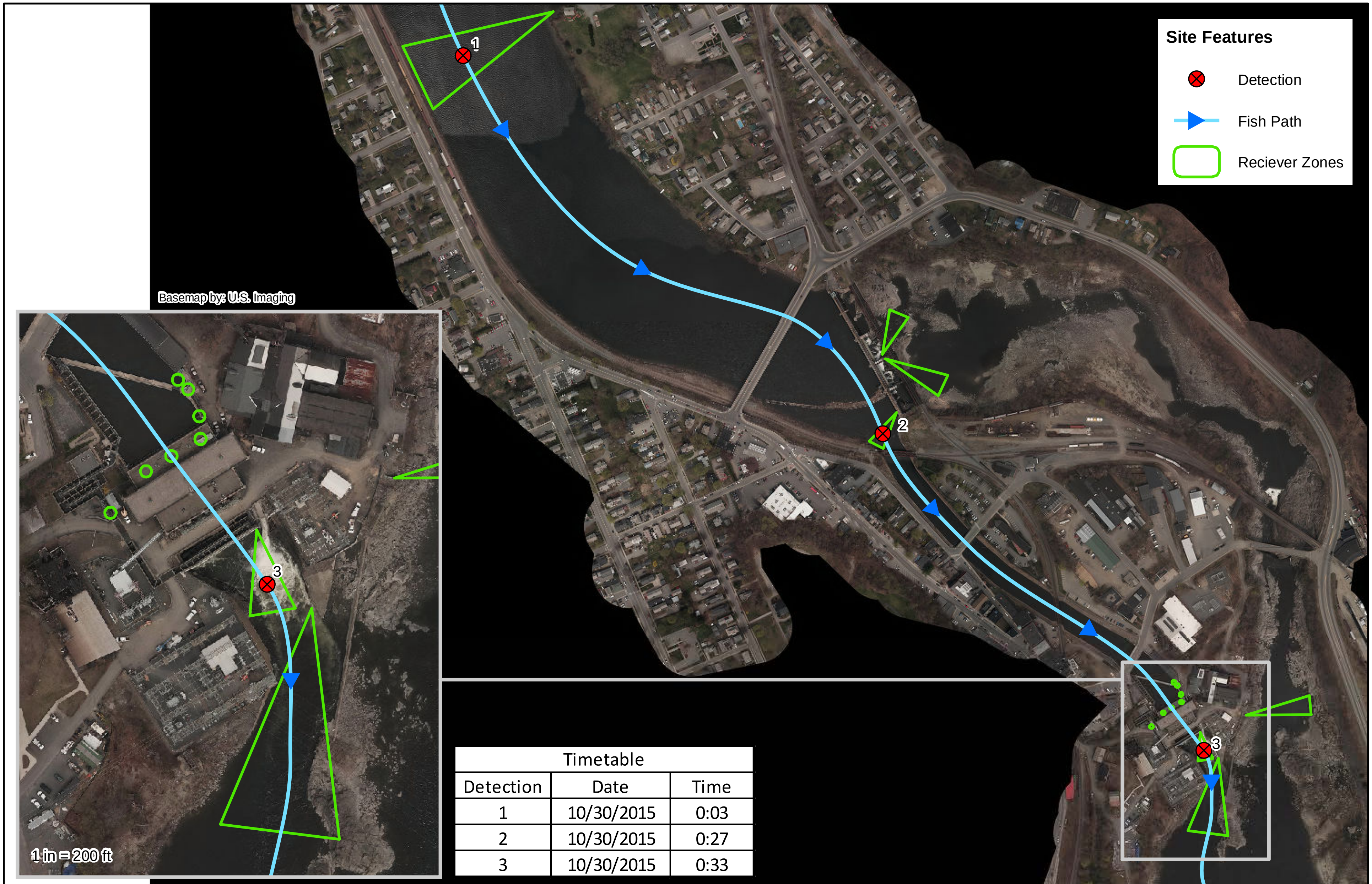


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 0:03 |
| 2 | 10/30/2015 | 0:27 |
| 3 | 10/30/2015 | 0:33 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-119 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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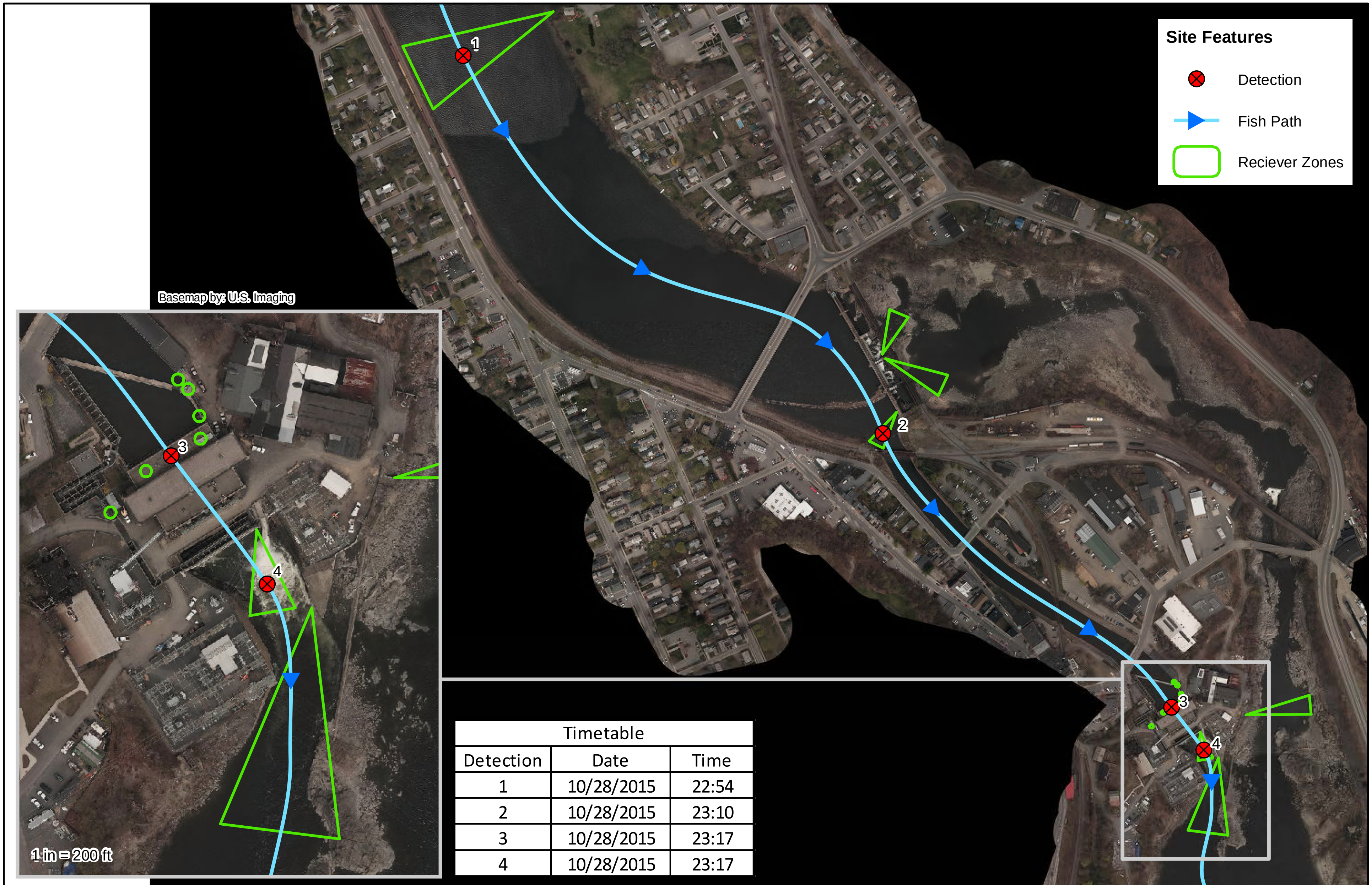


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
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| 2 | 10/28/2015 | 23:10 |
| 3 | 10/28/2015 | 23:17 |
| 4 | 10/28/2015 | 23:17 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-120 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20


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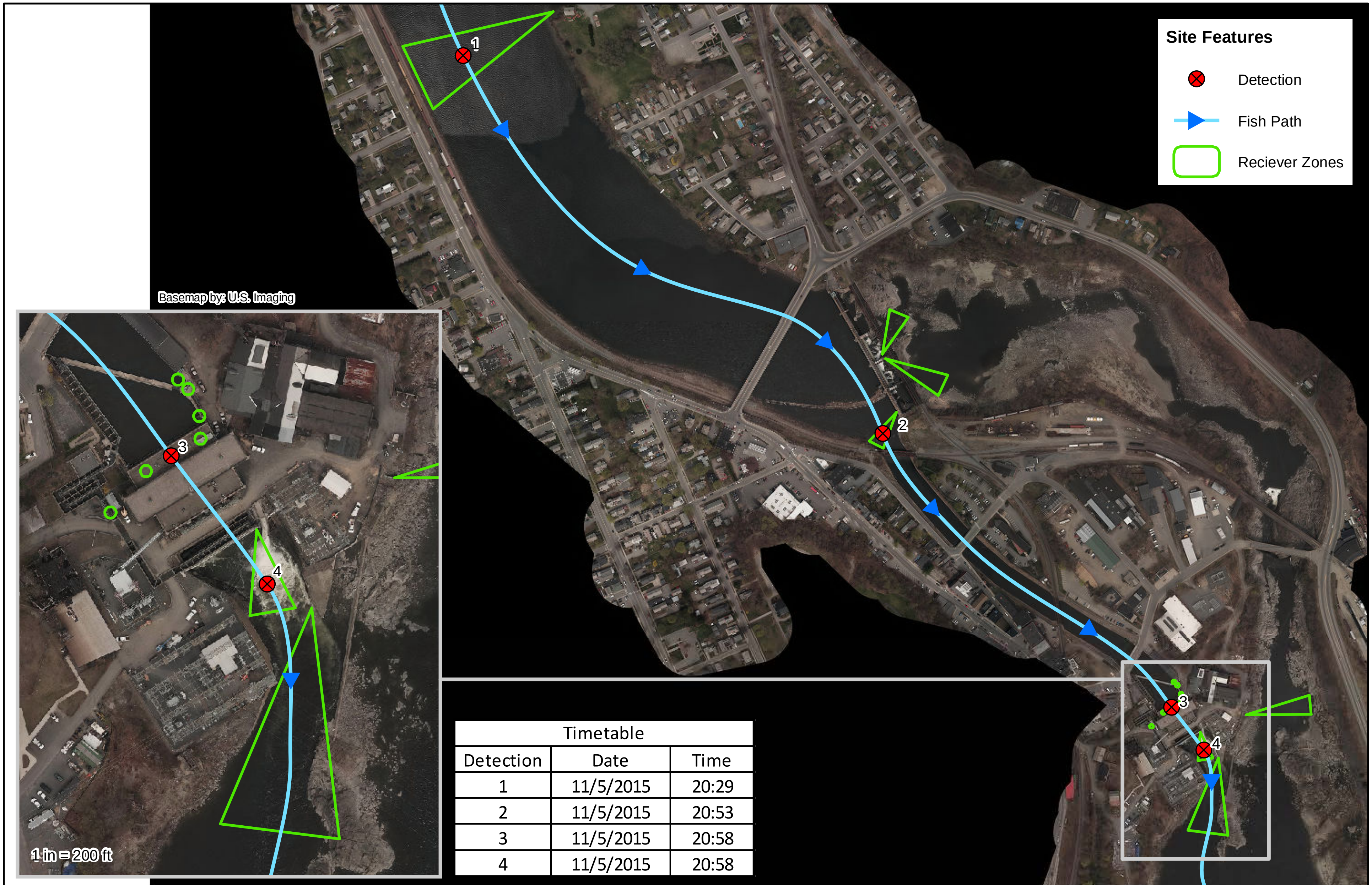


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
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| 2 | 11/5/2015 | 20:53 |
| 3 | 11/5/2015 | 20:58 |
| 4 | 11/5/2015 | 20:58 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-124 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 17:32

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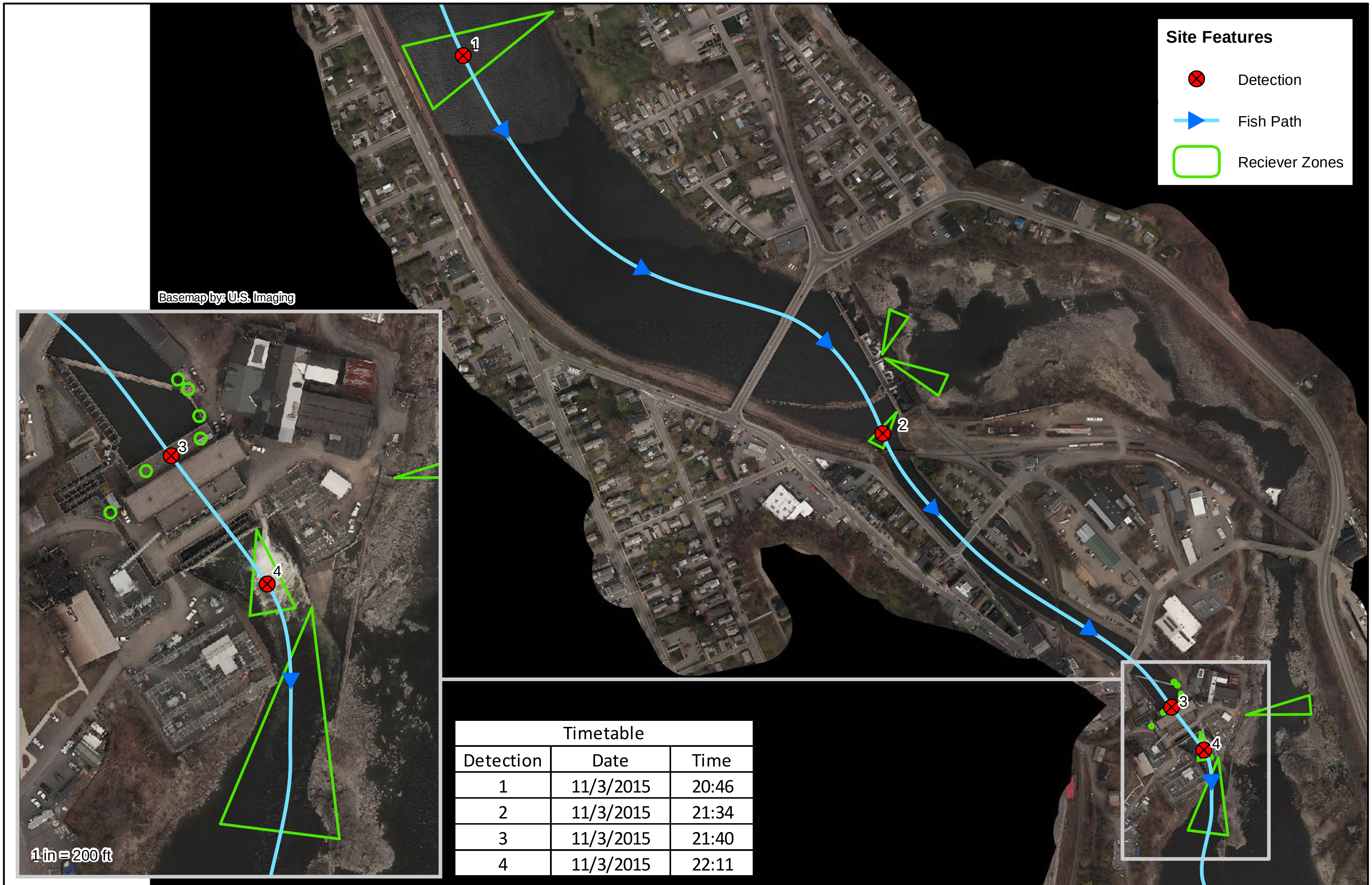


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 20:46 |
| 2 | 11/3/2015 | 21:34 |
| 3 | 11/3/2015 | 21:40 |
| 4 | 11/3/2015 | 22:11 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-130 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05


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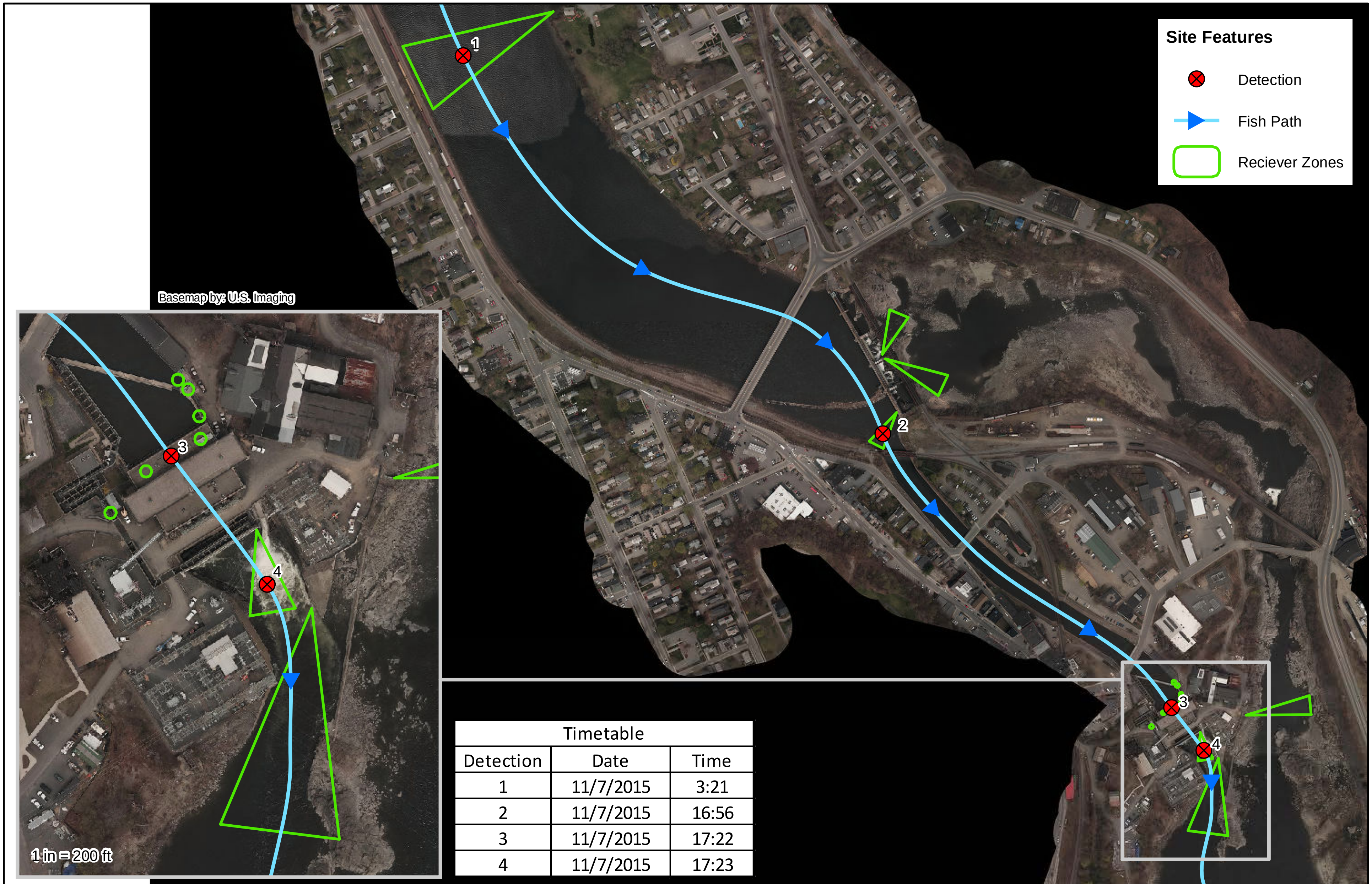


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 3:21 |
| 2 | 11/7/2015 | 16:56 |
| 3 | 11/7/2015 | 17:22 |
| 4 | 11/7/2015 | 17:23 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

**Study 19 Fish Number: 38-145 (A1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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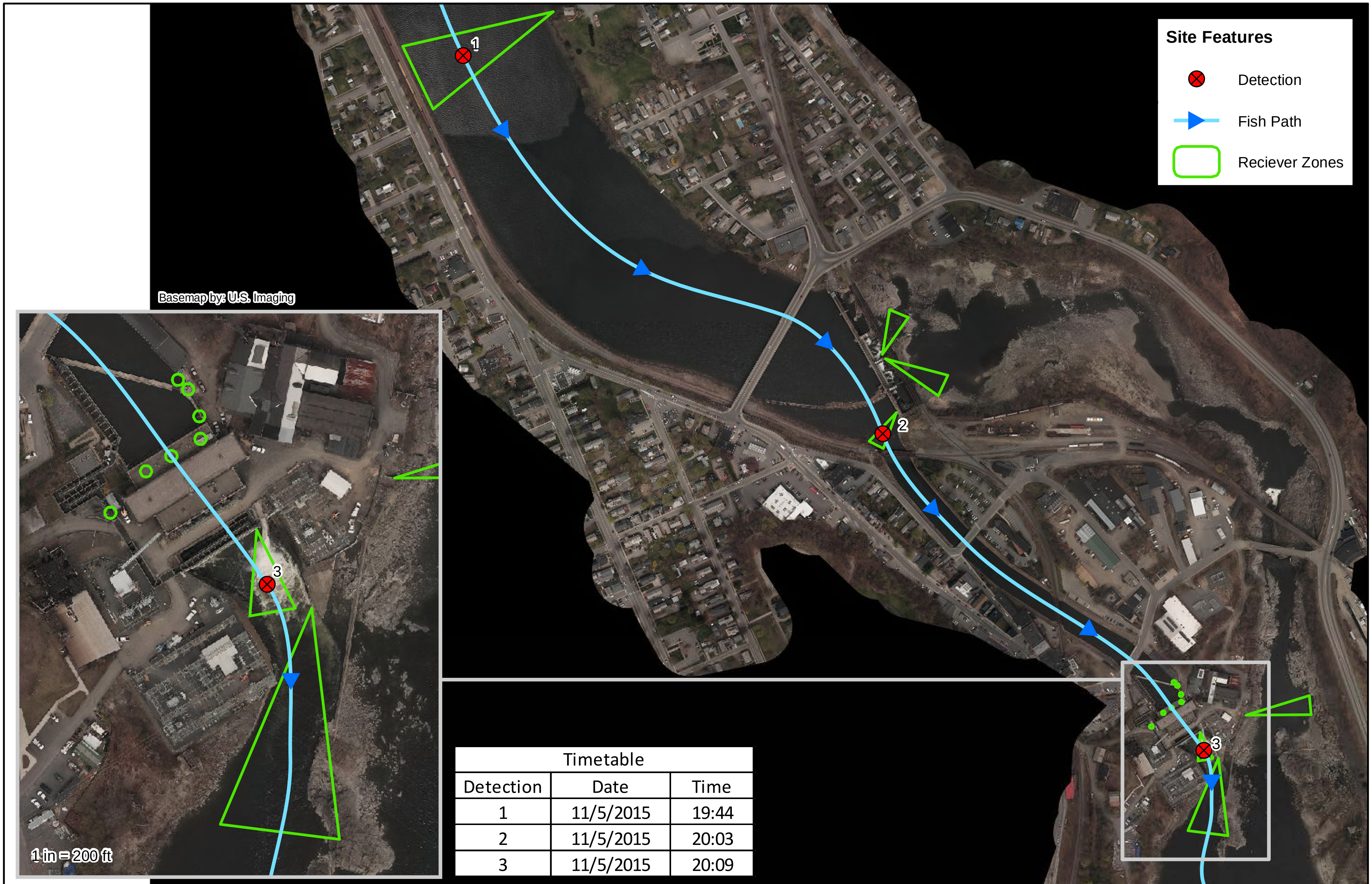


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 19:44 |
| 2 | 11/5/2015 | 20:03 |
| 3 | 11/5/2015 | 20:09 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-146 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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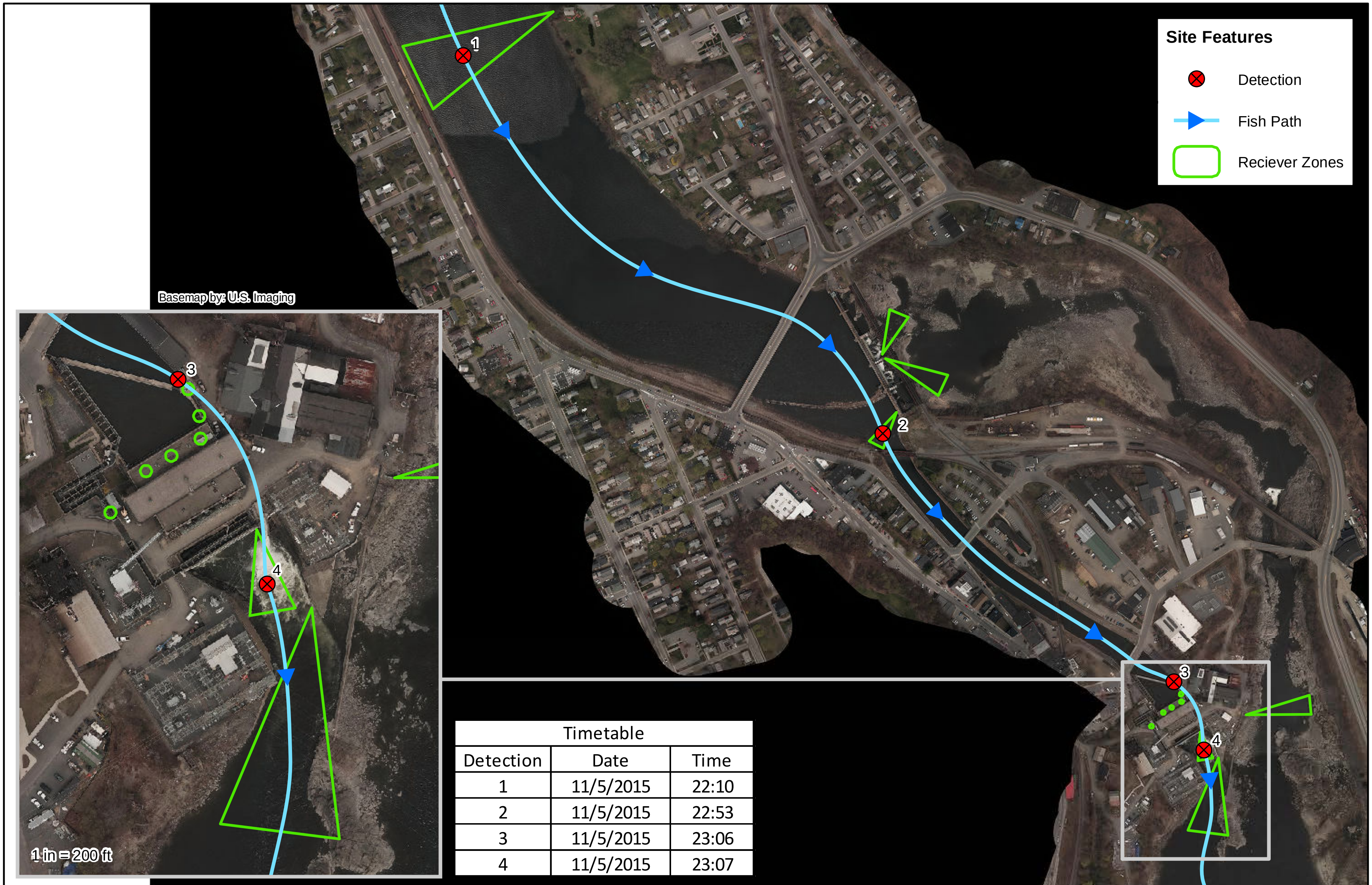


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 22:10 |
| 2 | 11/5/2015 | 22:53 |
| 3 | 11/5/2015 | 23:06 |
| 4 | 11/5/2015 | 23:07 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-147 (A1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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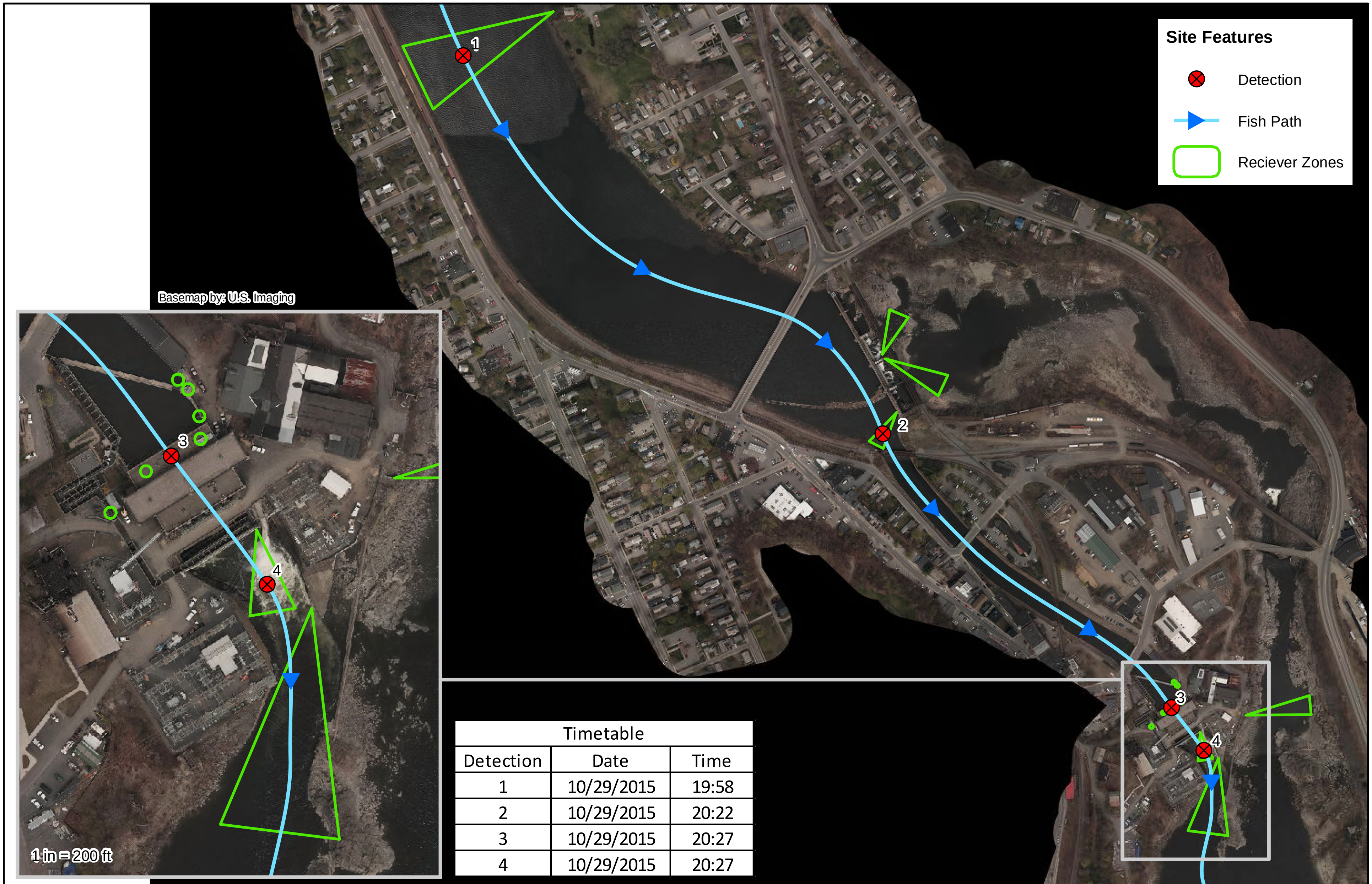


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 19:58 |
| 2 | 10/29/2015 | 20:22 |
| 3 | 10/29/2015 | 20:27 |
| 4 | 10/29/2015 | 20:27 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-148 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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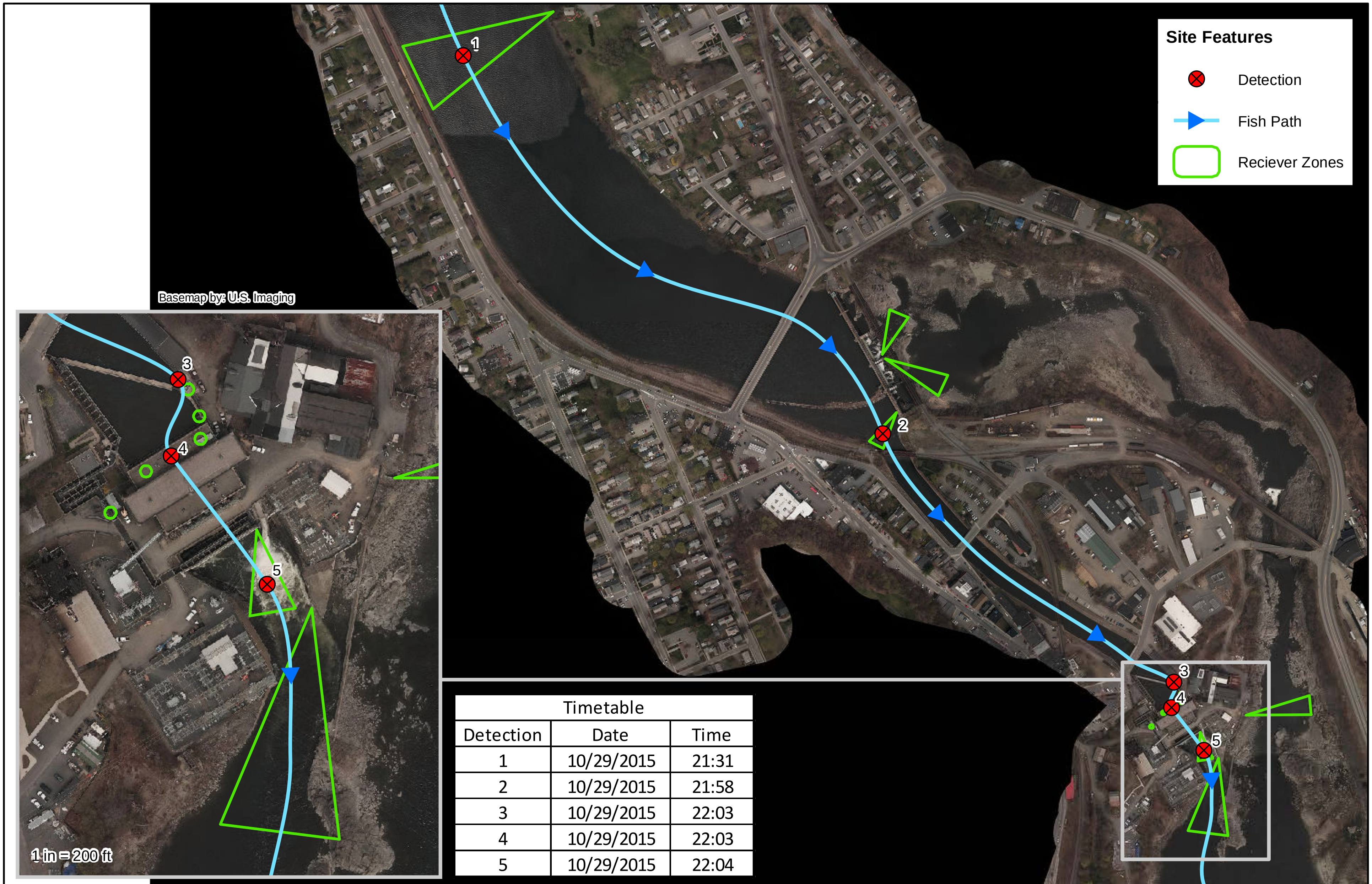


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:31 |
| 2 | 10/29/2015 | 21:58 |
| 3 | 10/29/2015 | 22:03 |
| 4 | 10/29/2015 | 22:03 |
| 5 | 10/29/2015 | 22:04 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-149 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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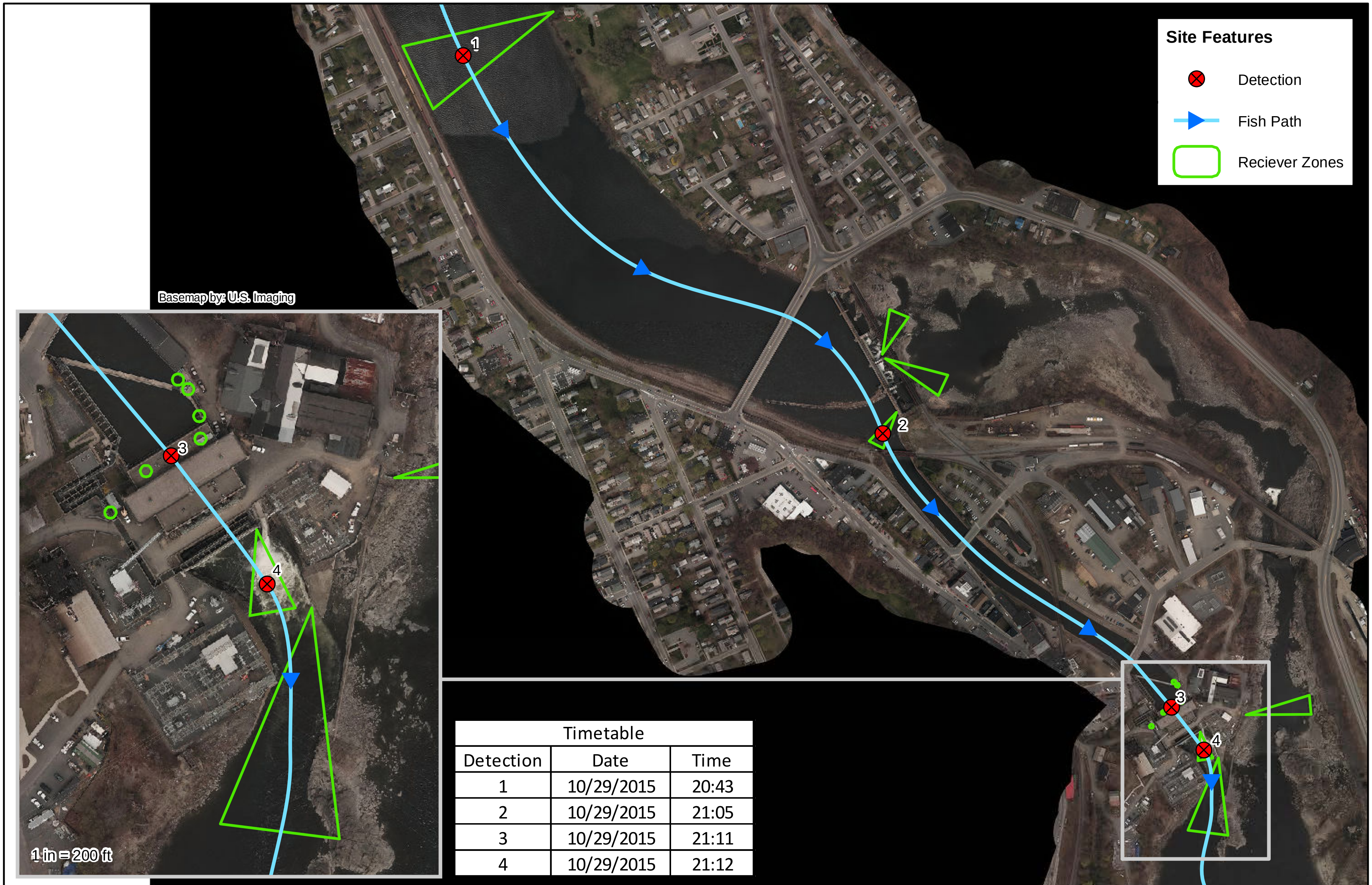


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 20:43 |
| 2 | 10/29/2015 | 21:05 |
| 3 | 10/29/2015 | 21:11 |
| 4 | 10/29/2015 | 21:12 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-150 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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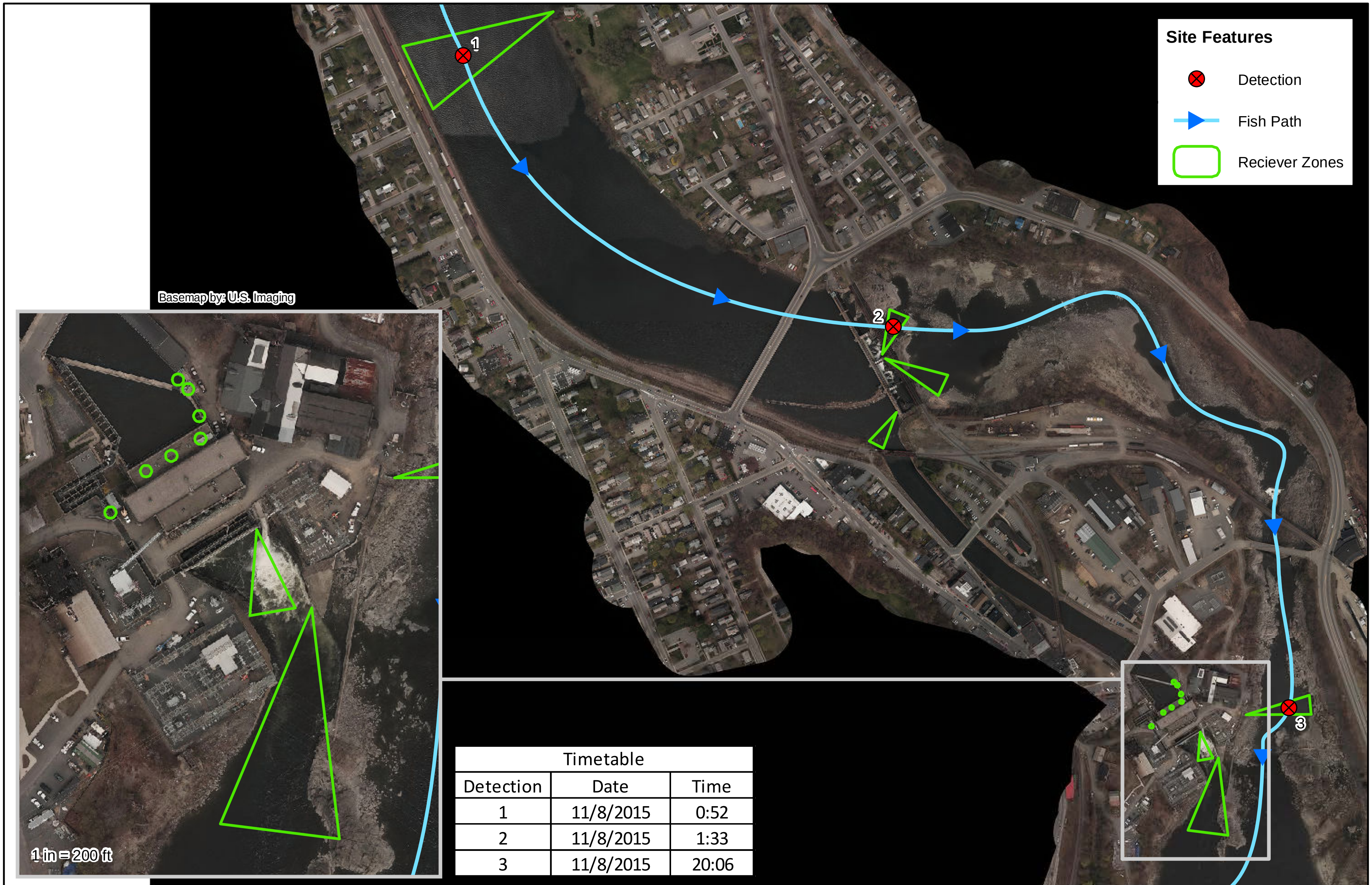


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 0:52 |
| 2 | 11/8/2015 | 1:33 |
| 3 | 11/8/2015 | 20:06 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-152 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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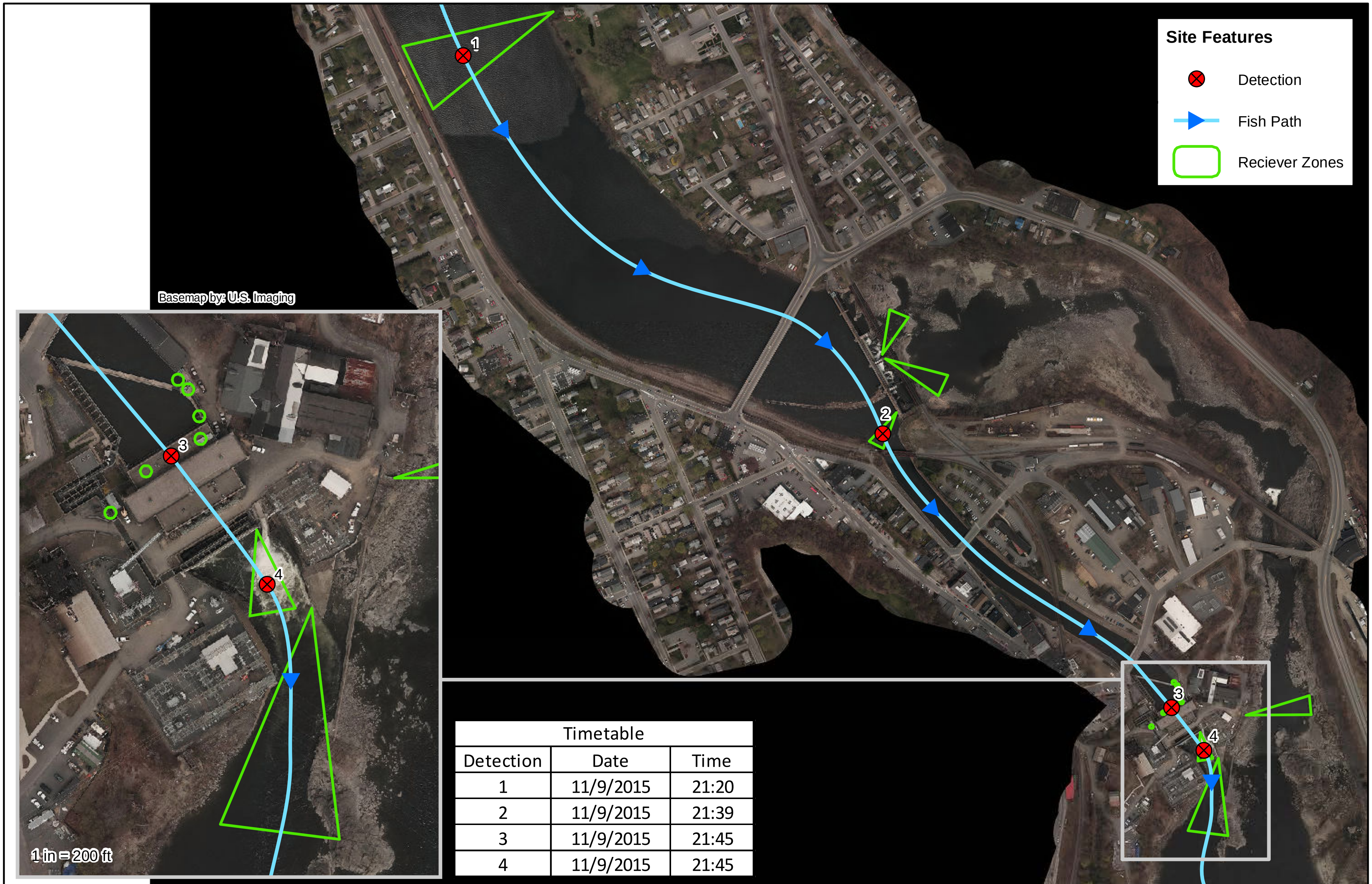


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 21:20 |
| 2 | 11/9/2015 | 21:39 |
| 3 | 11/9/2015 | 21:45 |
| 4 | 11/9/2015 | 21:45 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-153 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 17:05

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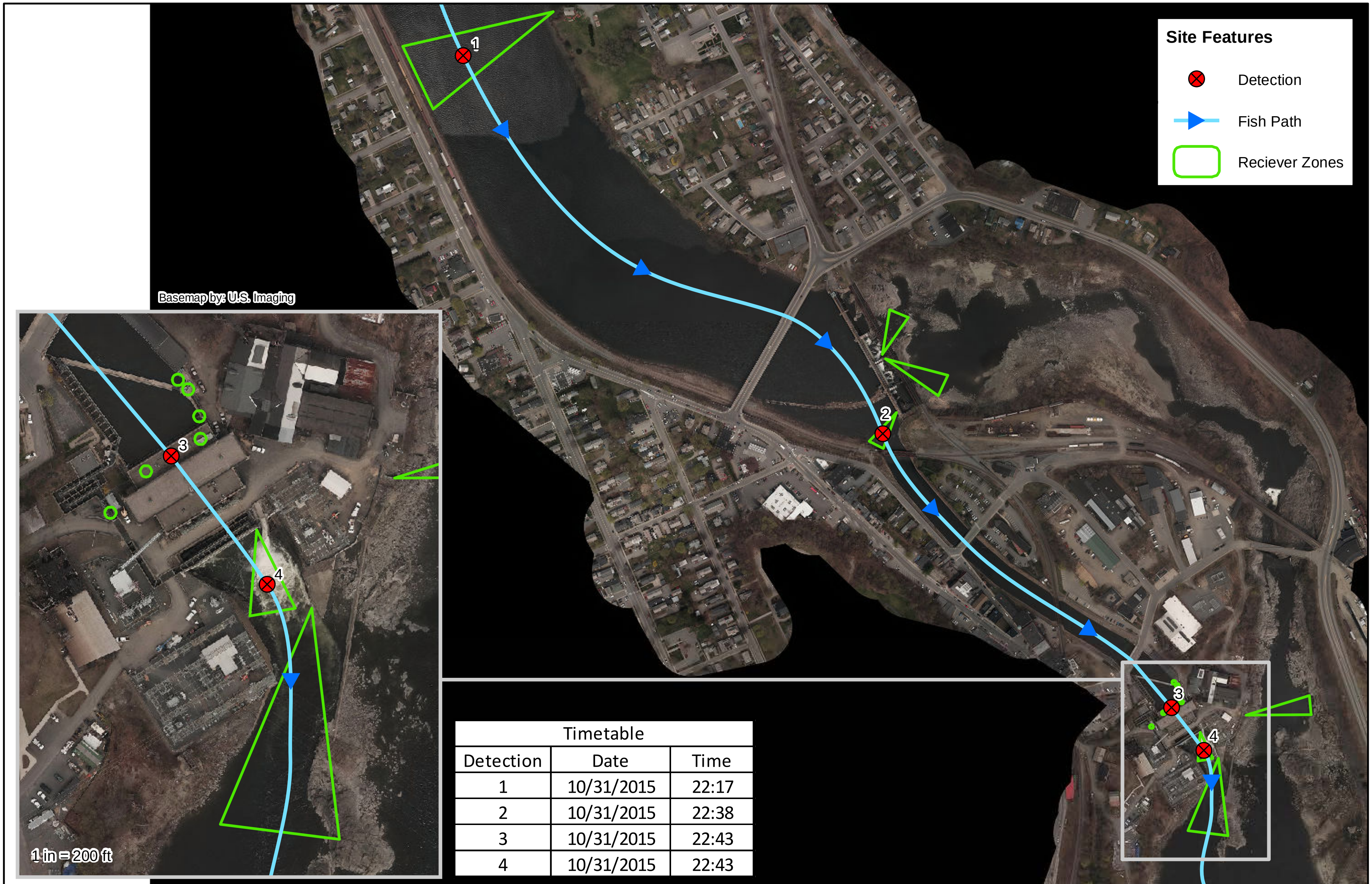
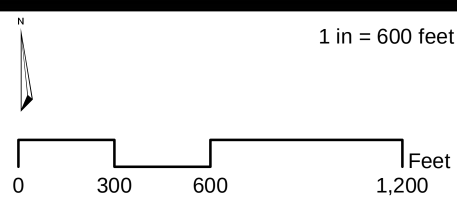



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 22:17 |
| 2 | 10/31/2015 | 22:38 |
| 3 | 10/31/2015 | 22:43 |
| 4 | 10/31/2015 | 22:43 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 38-158 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43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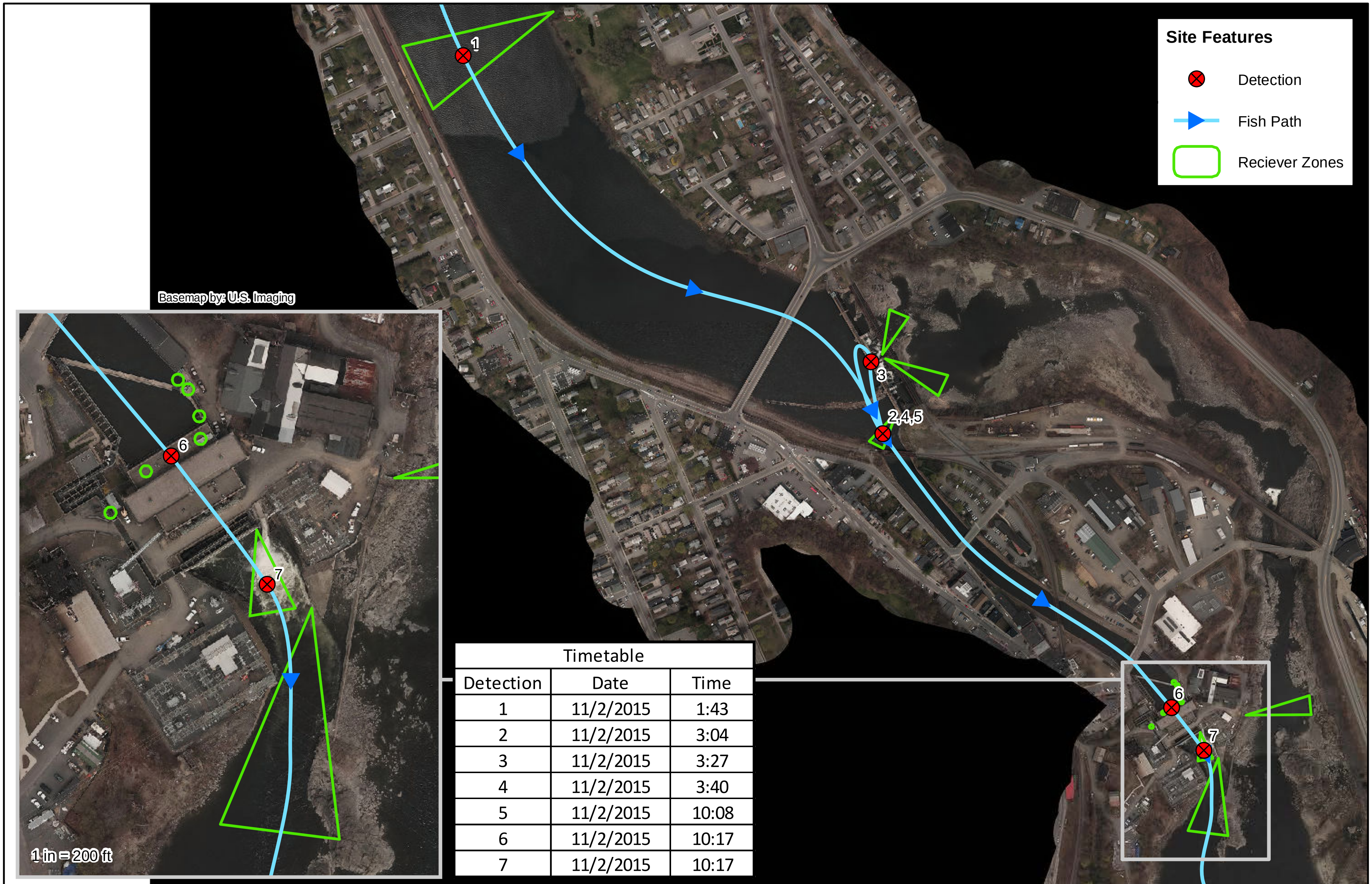


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 1:43 |
| 2 | 11/2/2015 | 3:04 |
| 3 | 11/2/2015 | 3:27 |
| 4 | 11/2/2015 | 3:40 |
| 5 | 11/2/2015 | 10:08 |
| 6 | 11/2/2015 | 10:17 |
| 7 | 11/2/2015 | 10:17 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-159 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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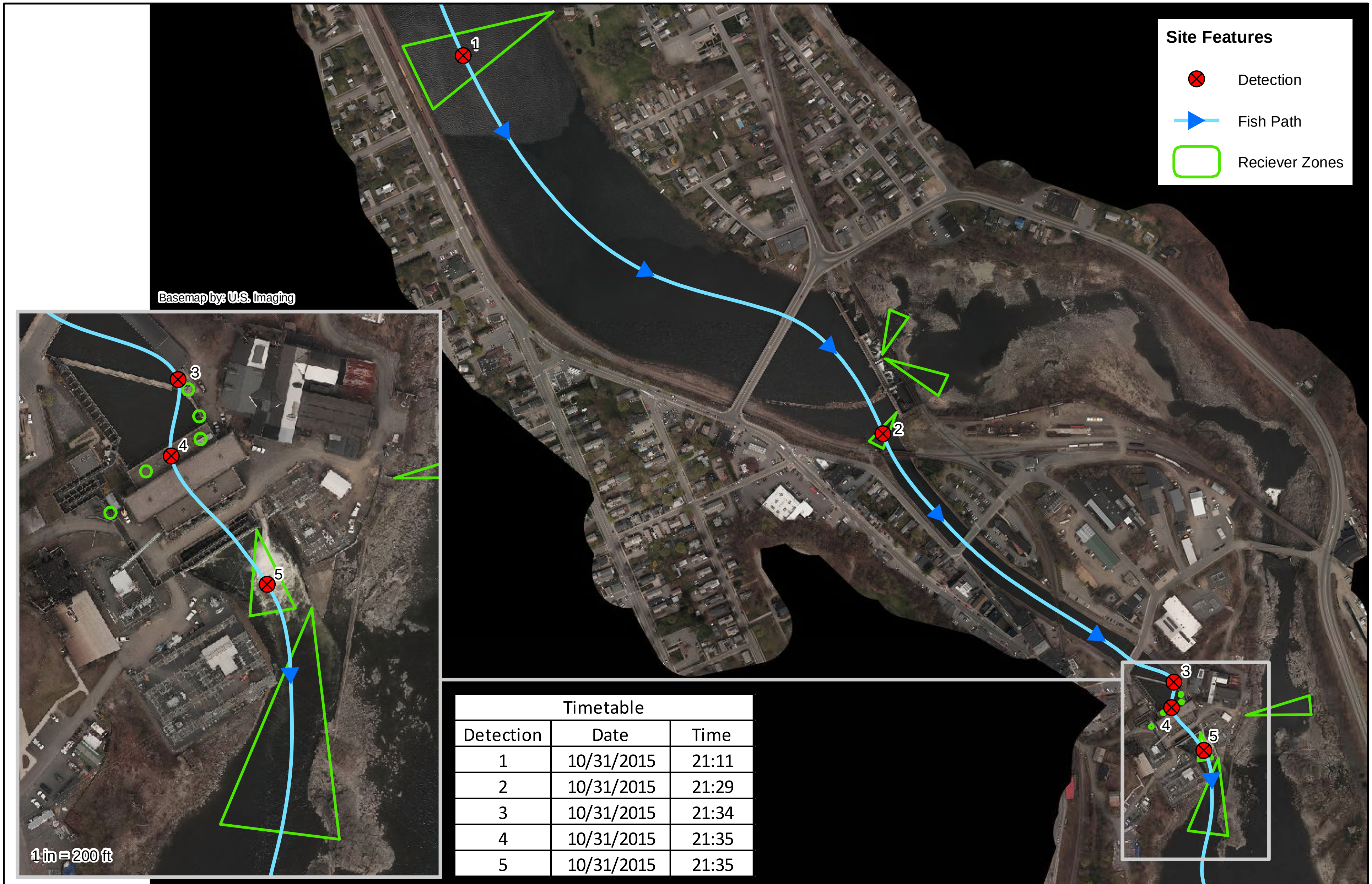
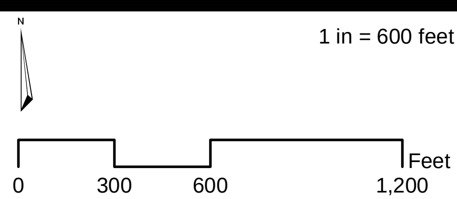



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 21:11 |
| 2 | 10/31/2015 | 21:29 |
| 3 | 10/31/2015 | 21:34 |
| 4 | 10/31/2015 | 21:35 |
| 5 | 10/31/2015 | 21:35 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 38-178 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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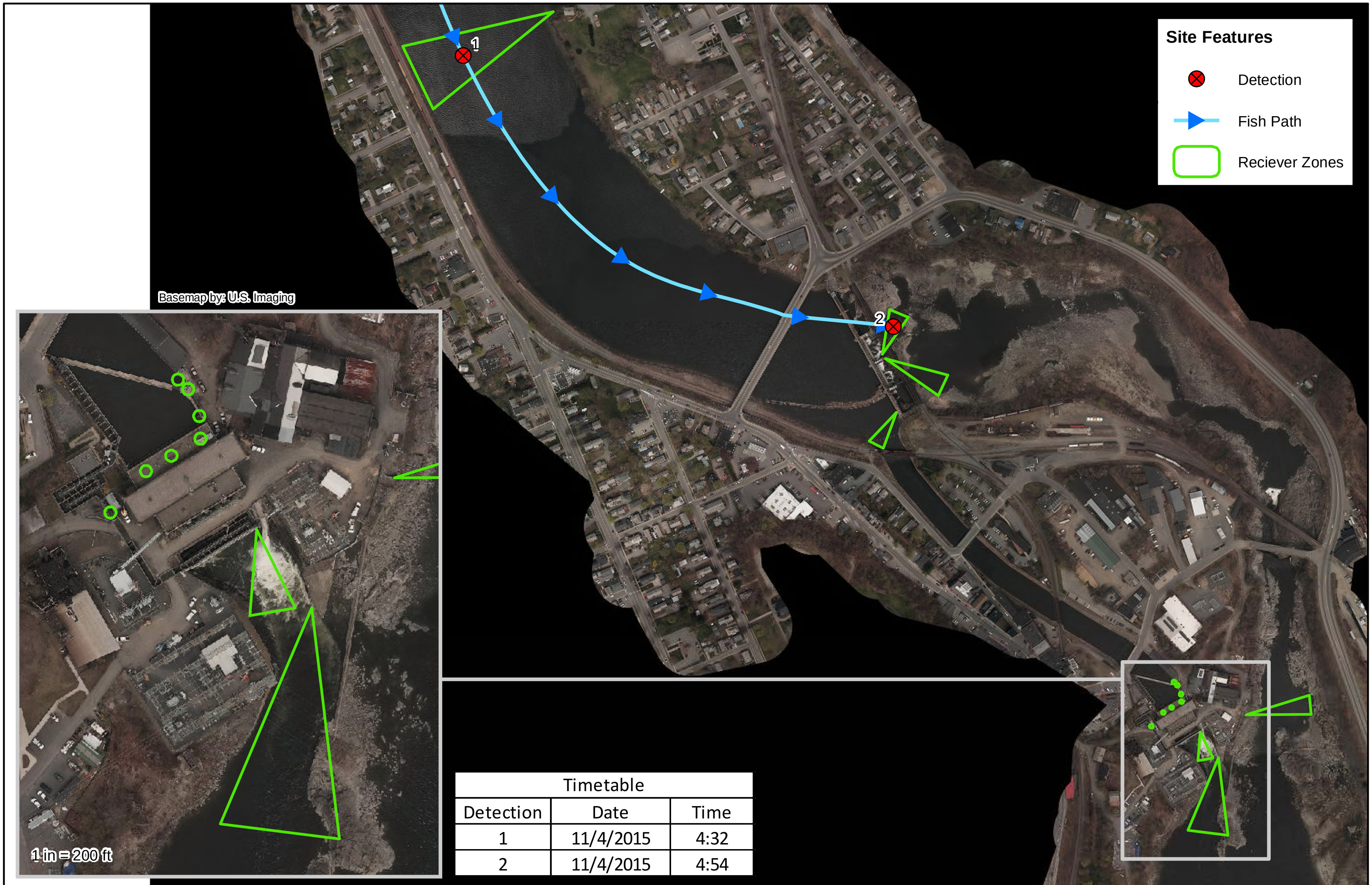


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 4:32 |
| 2 | 11/4/2015 | 4:54 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-179 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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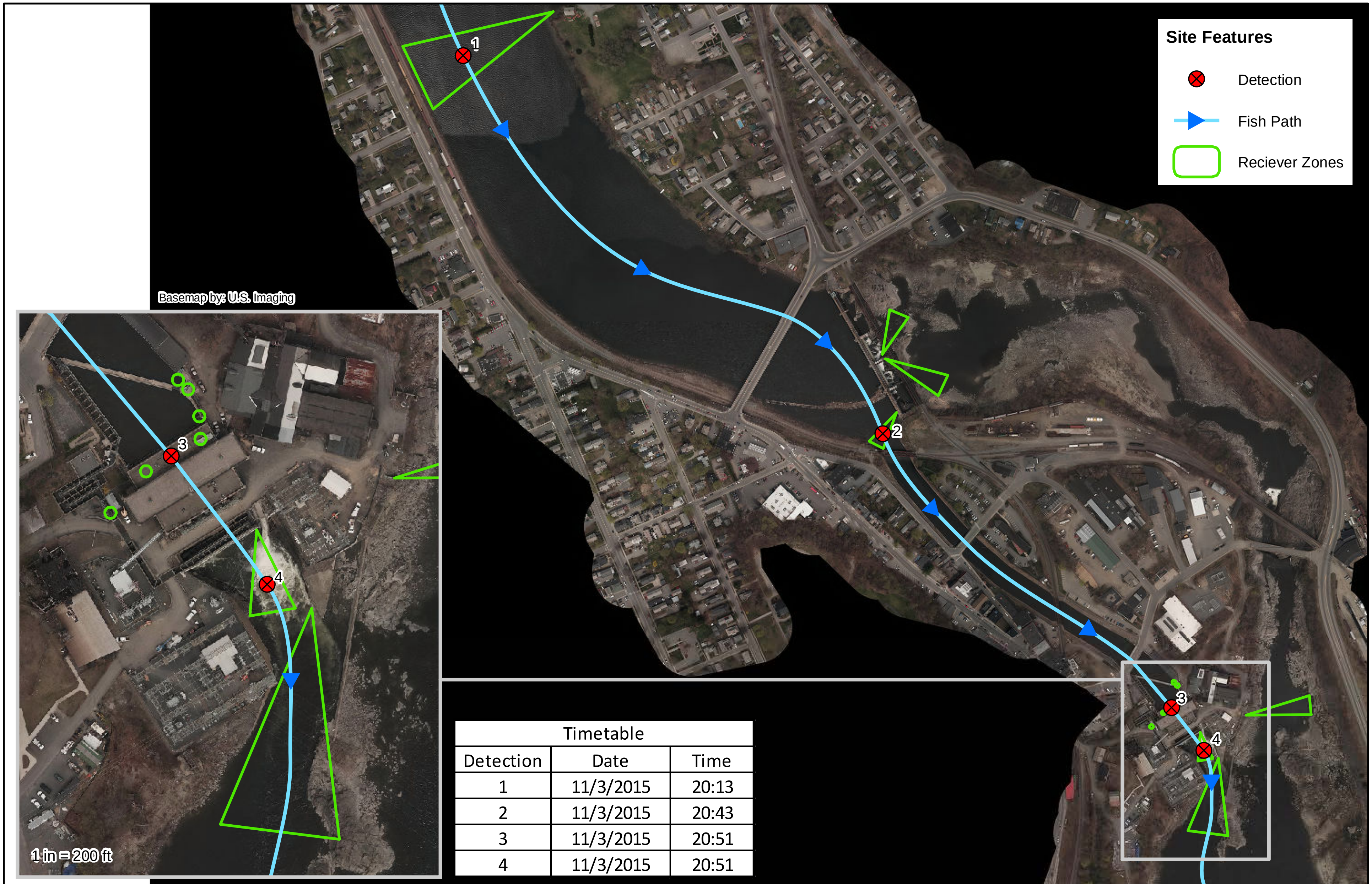


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 20:13 |
| 2 | 11/3/2015 | 20:43 |
| 3 | 11/3/2015 | 20:51 |
| 4 | 11/3/2015 | 20:51 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-180 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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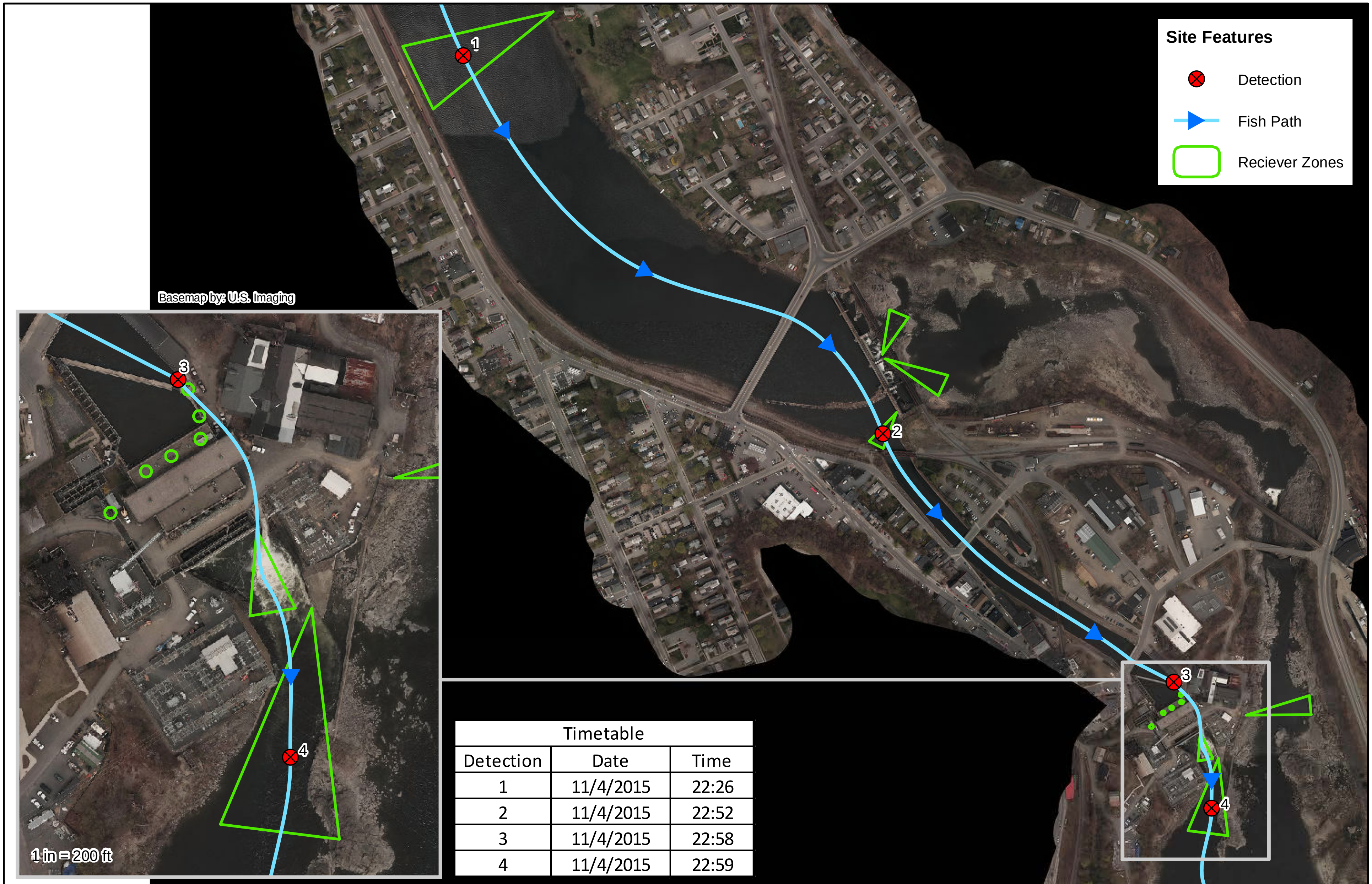
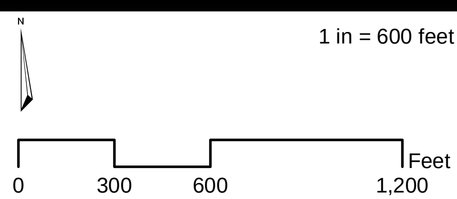



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 22:26 |
| 2 | 11/4/2015 | 22:52 |
| 3 | 11/4/2015 | 22:58 |
| 4 | 11/4/2015 | 22:59 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 38-188 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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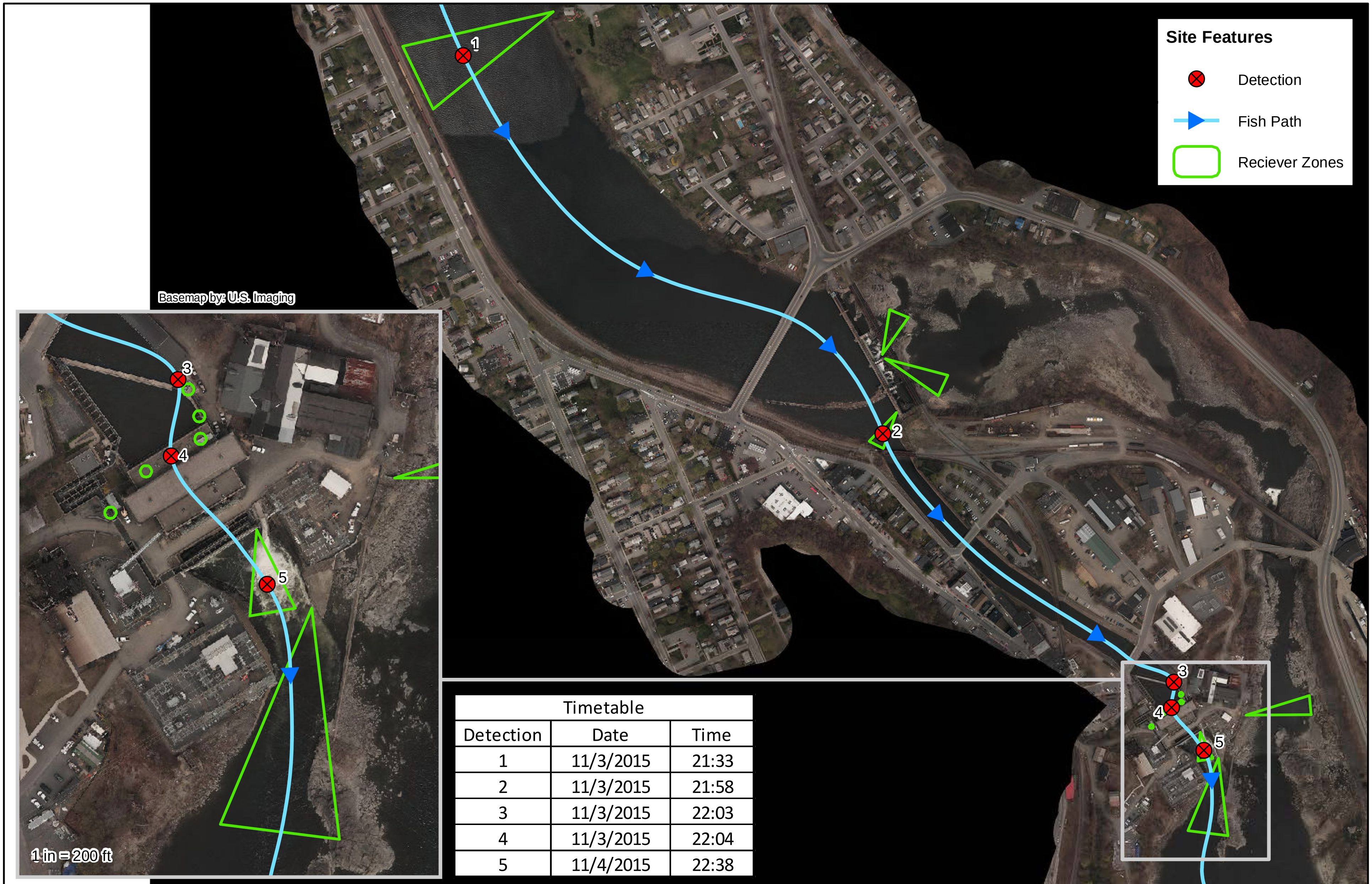


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 21:33 |
| 2 | 11/3/2015 | 21:58 |
| 3 | 11/3/2015 | 22:03 |
| 4 | 11/3/2015 | 22:04 |
| 5 | 11/4/2015 | 22:38 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-189 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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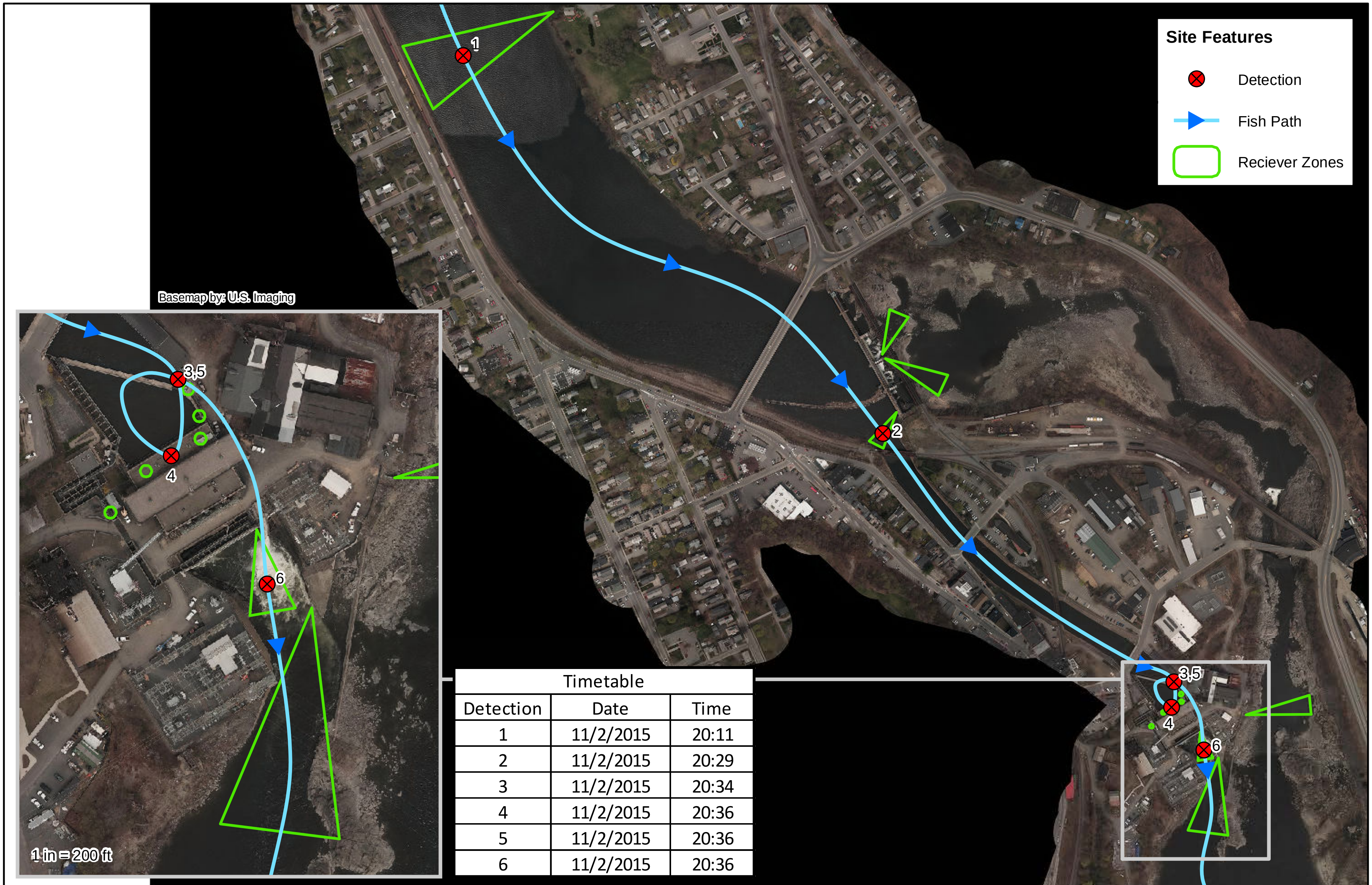


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 20:11 |
| 2 | 11/2/2015 | 20:29 |
| 3 | 11/2/2015 | 20:34 |
| 4 | 11/2/2015 | 20:36 |
| 5 | 11/2/2015 | 20:36 |
| 6 | 11/2/2015 | 20:36 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-190 (A1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 19:21

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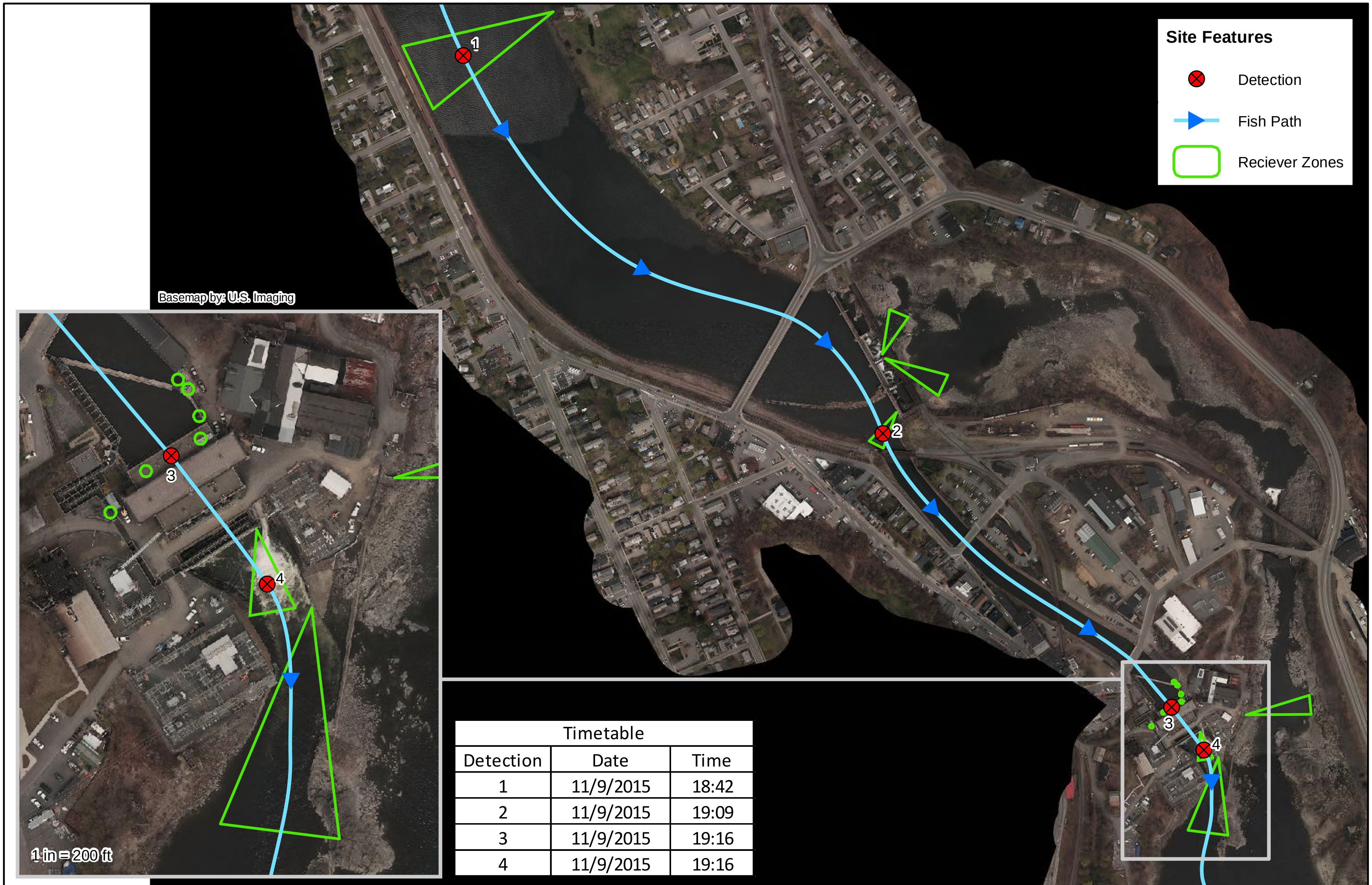


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 18:42 |
| 2 | 11/9/2015 | 19:09 |
| 3 | 11/9/2015 | 19:16 |
| 4 | 11/9/2015 | 19:16 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-58 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 17:32

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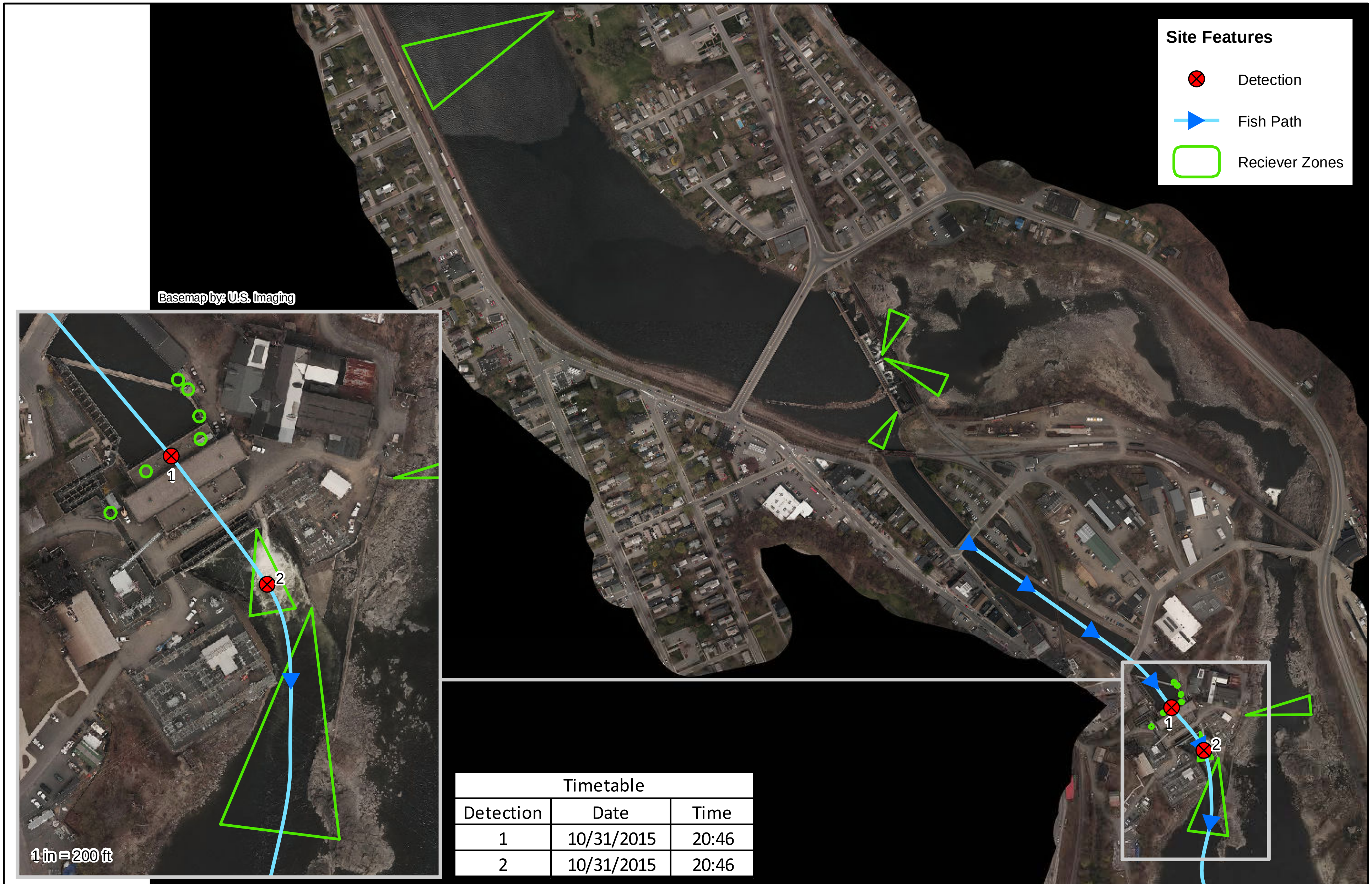


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:46 |
| 2 | 10/31/2015 | 20:46 |

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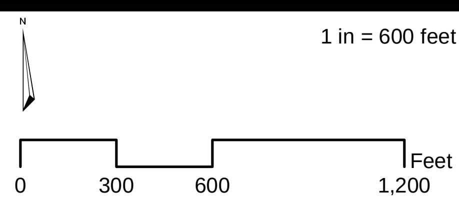
**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**




**Study 19 Fish Number: 38-59 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05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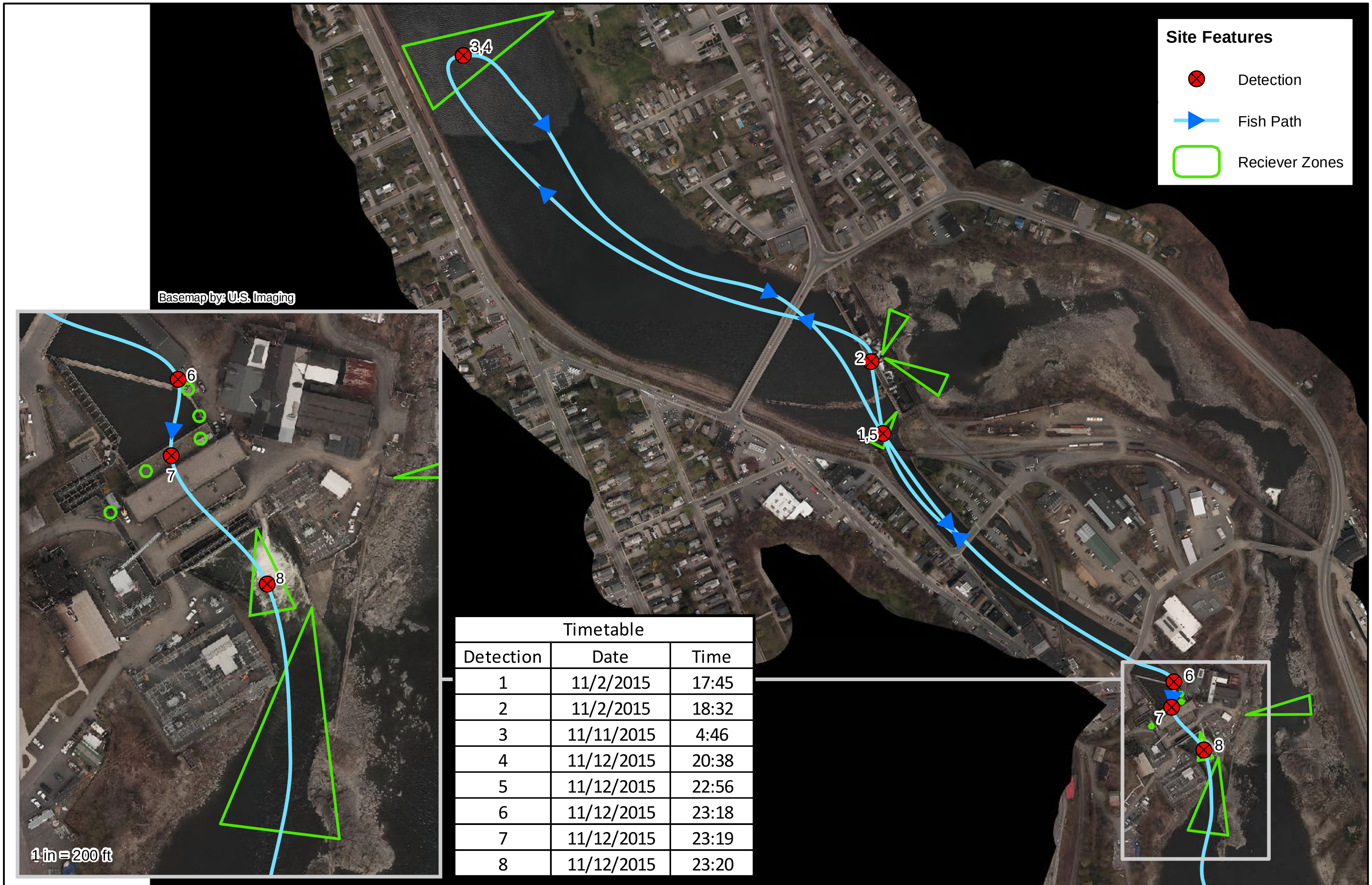


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 17:45 |
| 2 | 11/2/2015 | 18:32 |
| 3 | 11/11/2015 | 4:46 |
| 4 | 11/12/2015 | 20:38 |
| 5 | 11/12/2015 | 22:56 |
| 6 | 11/12/2015 | 23:18 |
| 7 | 11/12/2015 | 23:19 |
| 8 | 11/12/2015 | 23:20 |

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-60 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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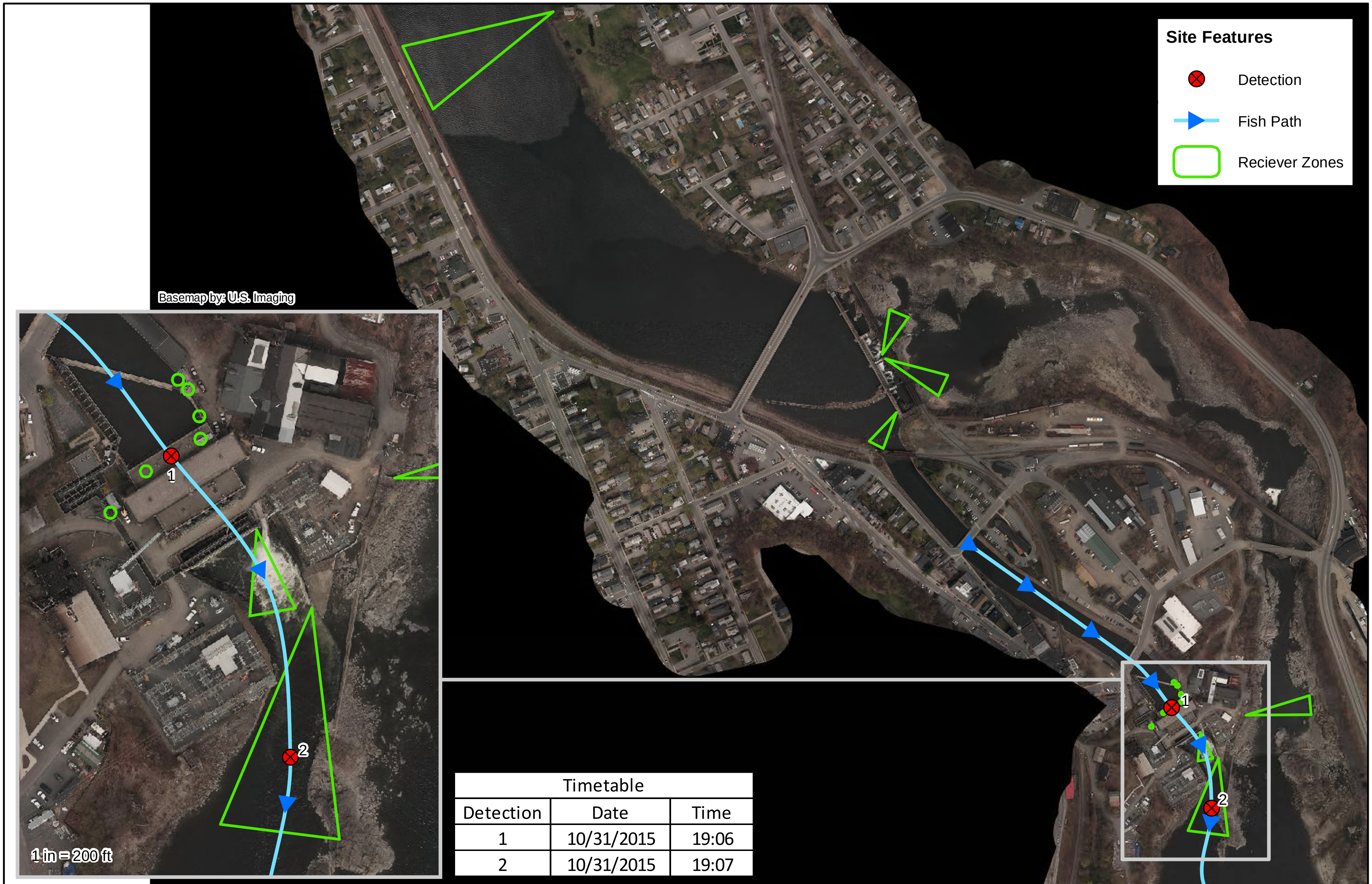


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 19:06 |
| 2 | 10/31/2015 | 19:07 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-61 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05


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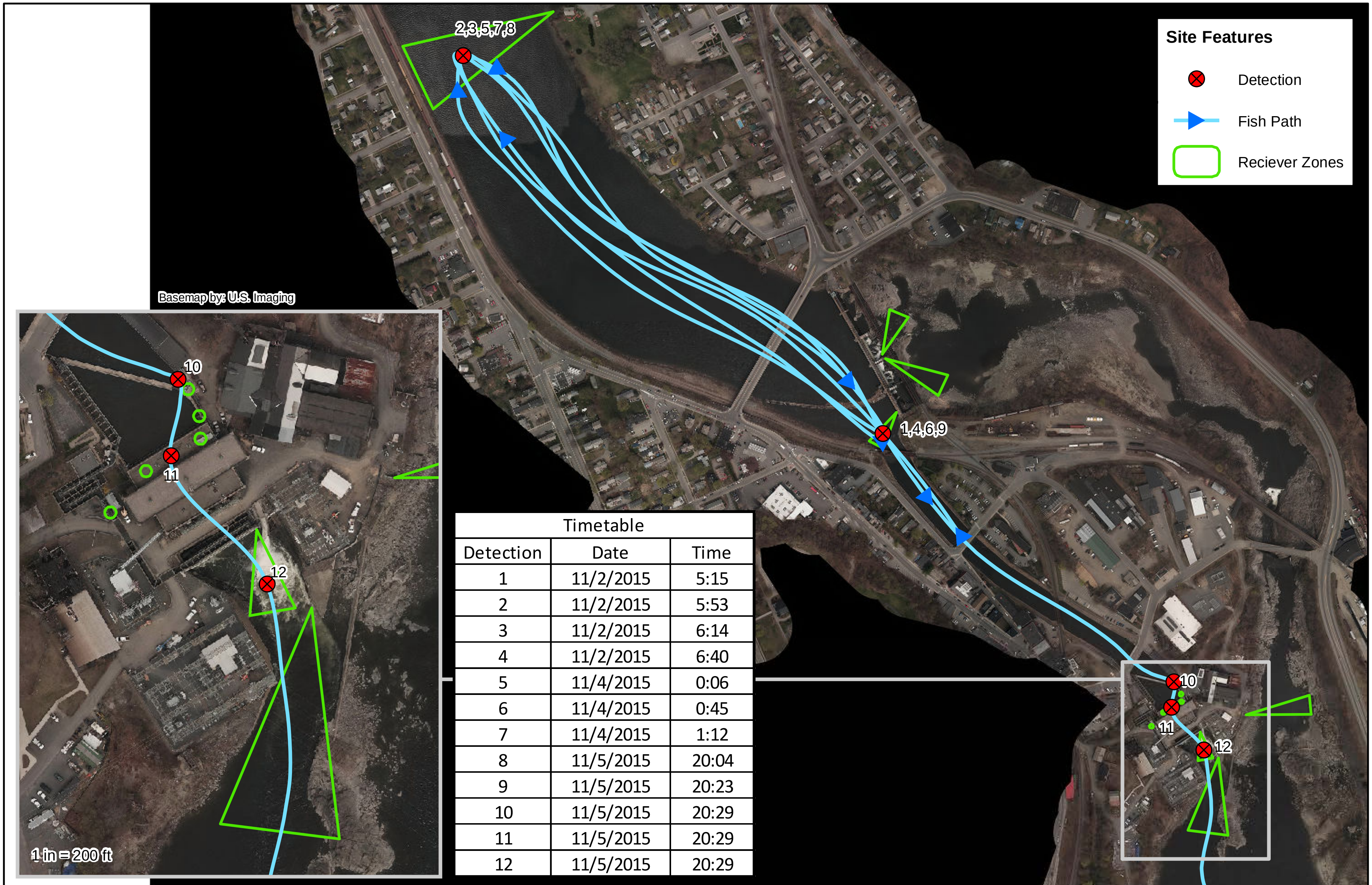


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 5:15 |
| 2 | 11/2/2015 | 5:53 |
| 3 | 11/2/2015 | 6:14 |
| 4 | 11/2/2015 | 6:40 |
| 5 | 11/4/2015 | 0:06 |
| 6 | 11/4/2015 | 0:45 |
| 7 | 11/4/2015 | 1:12 |
| 8 | 11/5/2015 | 20:04 |
| 9 | 11/5/2015 | 20:23 |
| 10 | 11/5/2015 | 20:29 |
| 11 | 11/5/2015 | 20:29 |
| 12 | 11/5/2015 | 20:29 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-62 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/31/2015
Time Released: 18:05

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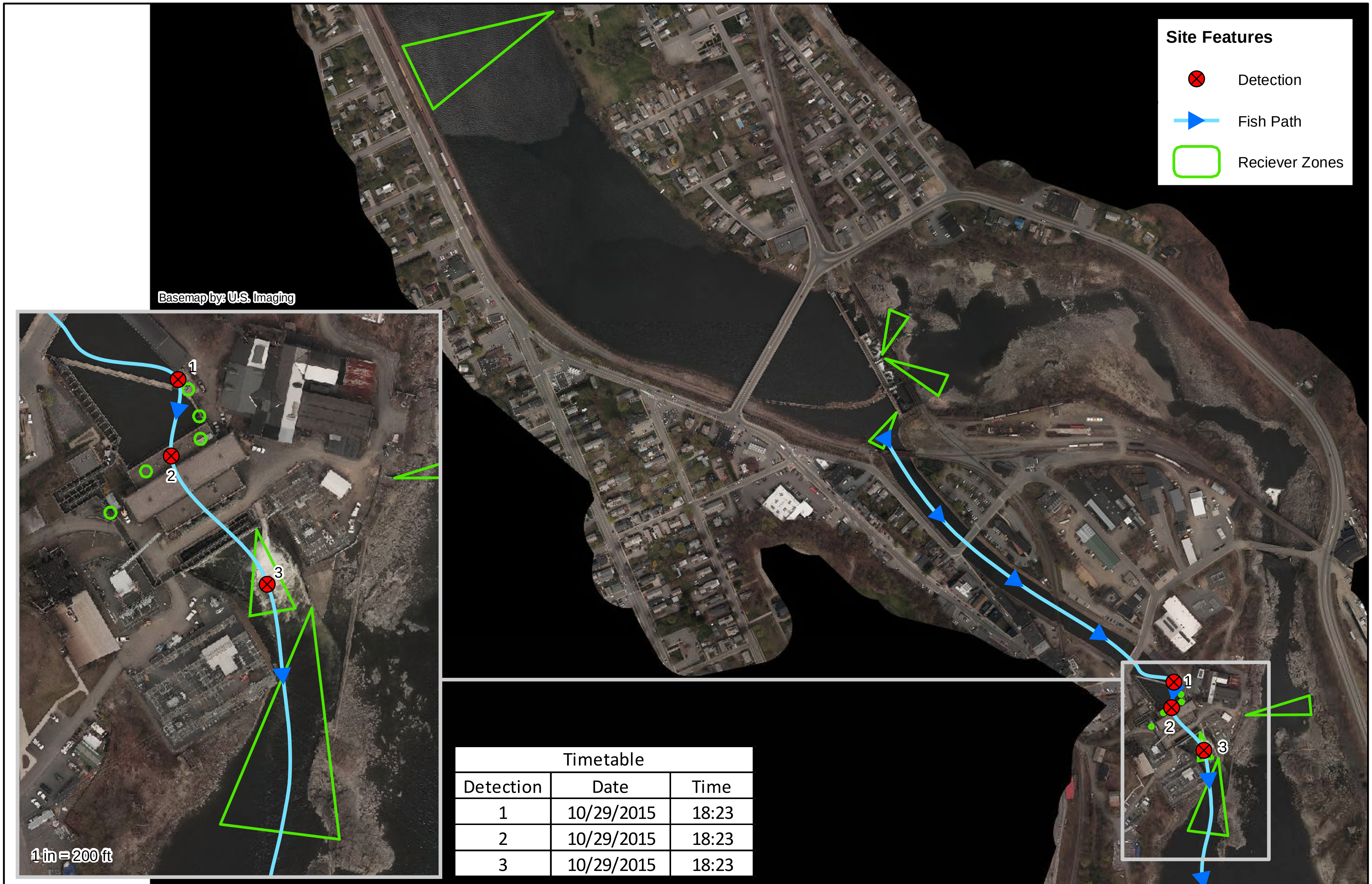


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:23 |
| 2 | 10/29/2015 | 18:23 |
| 3 | 10/29/2015 | 18:23 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-63 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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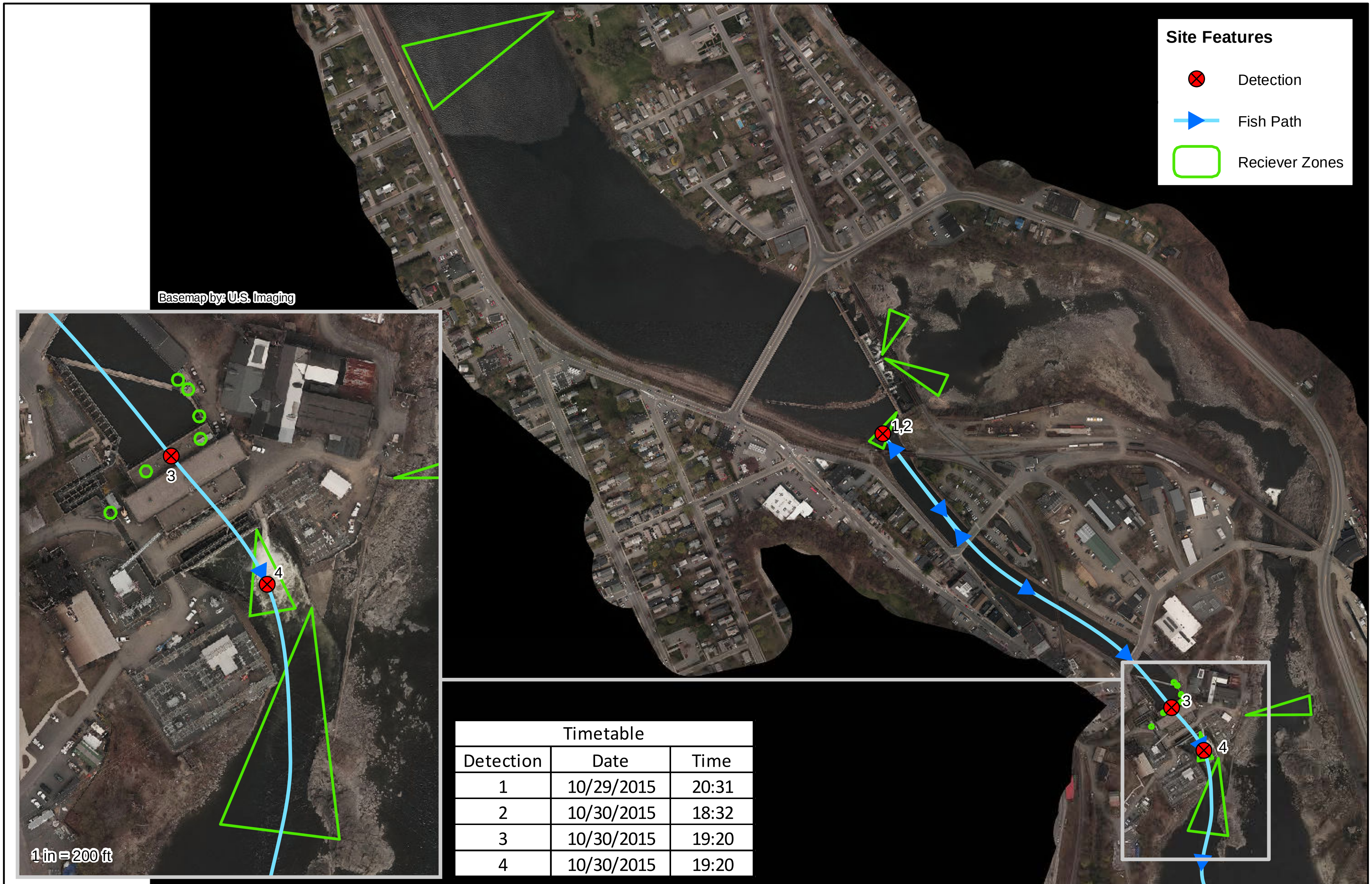


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 20:31 |
| 2 | 10/30/2015 | 18:32 |
| 3 | 10/30/2015 | 19:20 |
| 4 | 10/30/2015 | 19:20 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-64 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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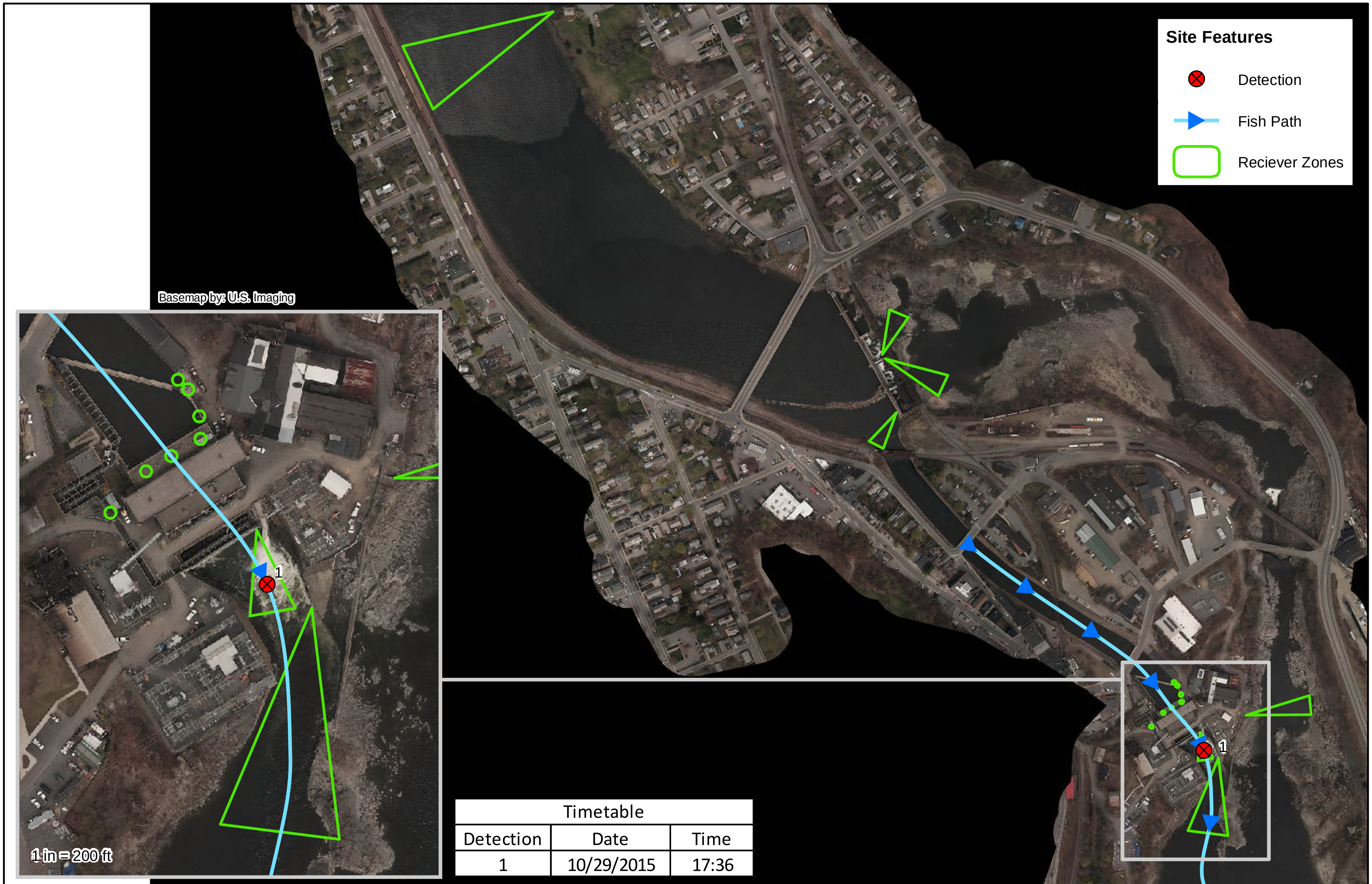


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 17:36 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

N

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-65 (T1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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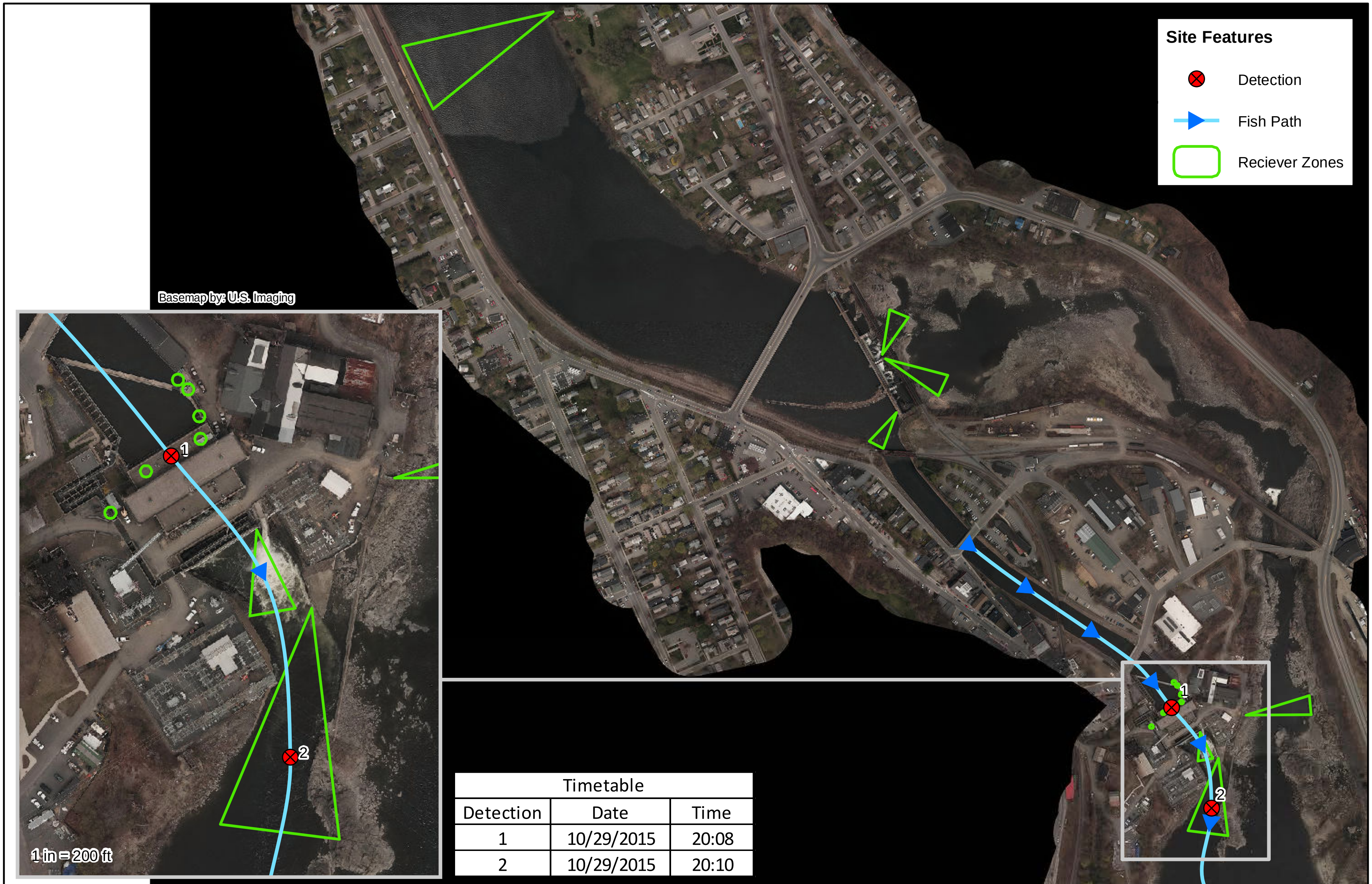


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 20:08 |
| 2 | 10/29/2015 | 20:10 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Bellows Falls Dam**

1 in = 600 feet

0 300 600 1,200 Feet

**Study 19 Fish Number: 38-66 (A1)**

Release: Bellows Falls Canal, VT
Date Released: 10/29/2015
Time Released: 17:32

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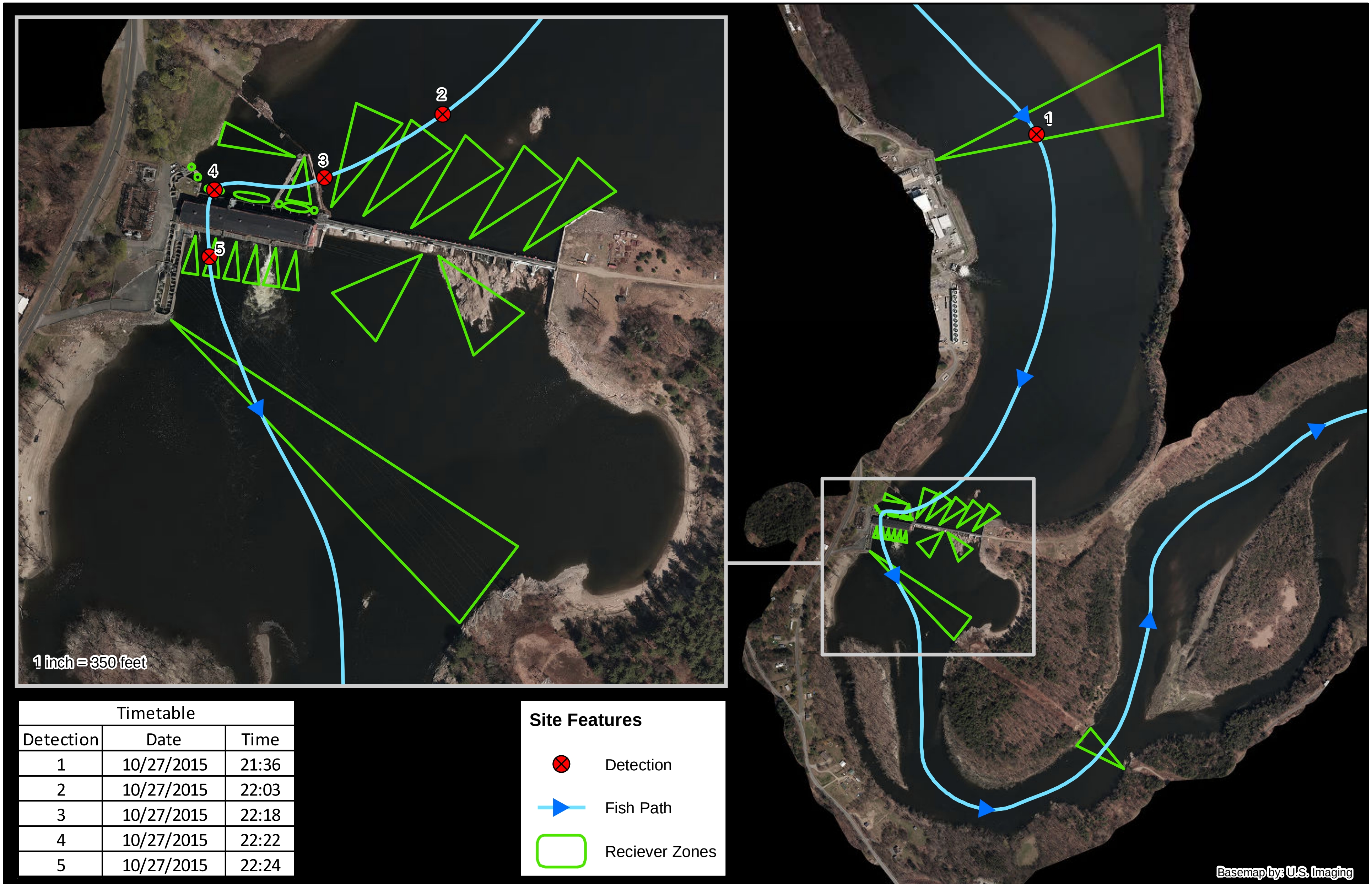


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/27/2015 | 21:36 |
| 2 | 10/27/2015 | 22:03 |
| 3 | 10/27/2015 | 22:18 |
| 4 | 10/27/2015 | 22:22 |
| 5 | 10/27/2015 | 22:24 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-101 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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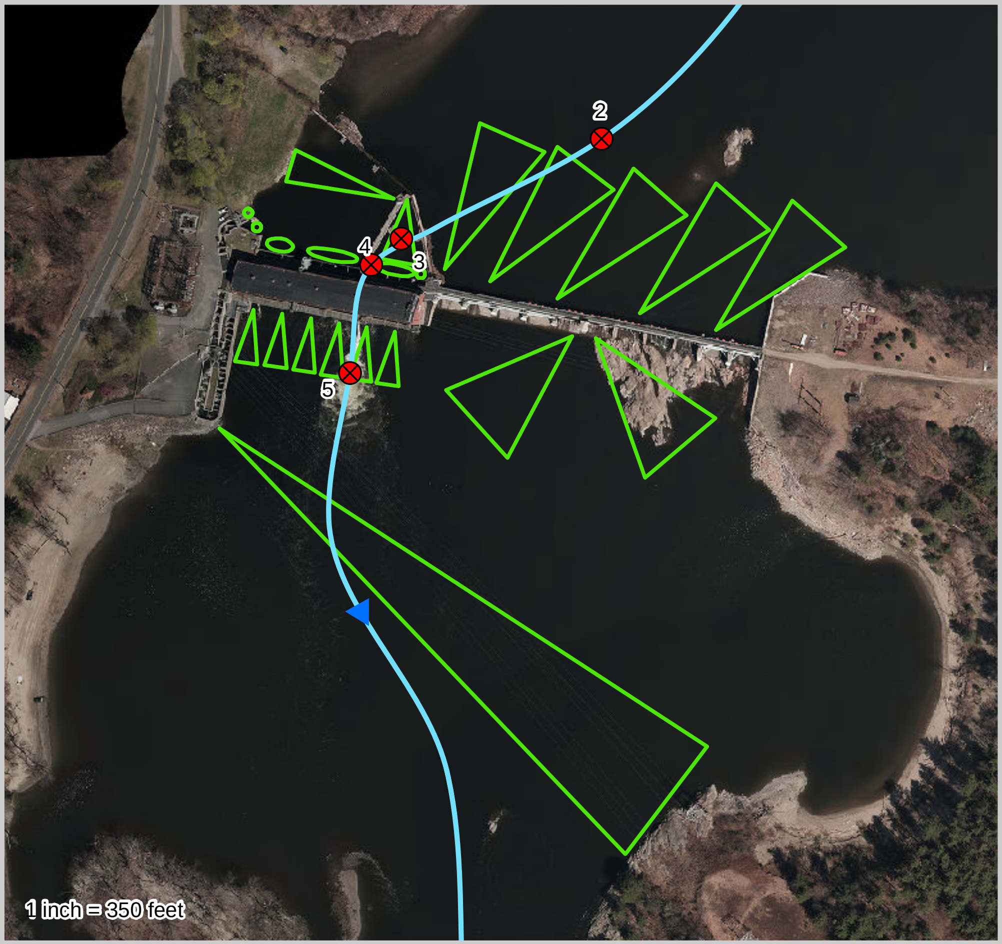


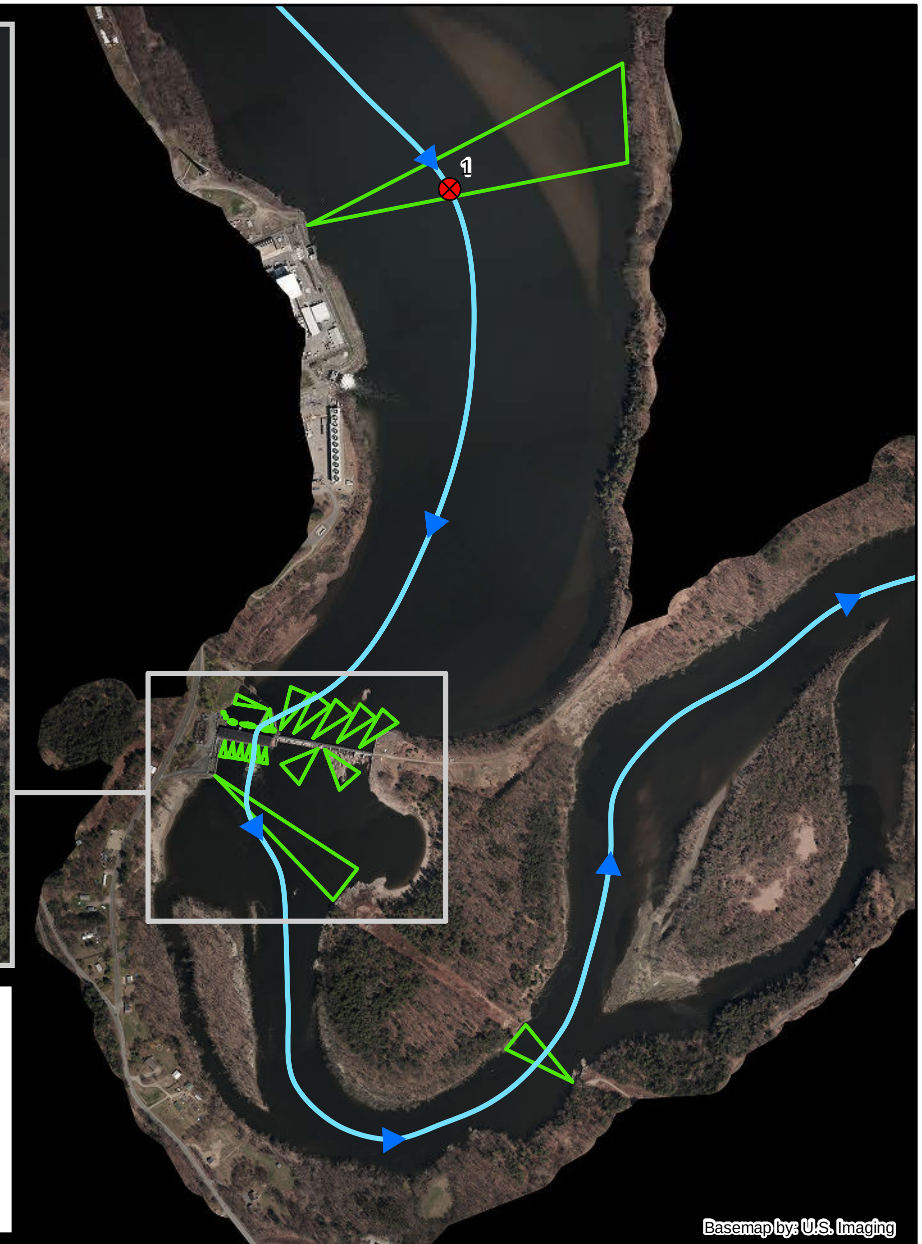


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:33 |
| 2 | 10/29/2015 | 19:02 |
| 3 | 10/29/2015 | 19:08 |
| 4 | 10/29/2015 | 19:08 |
| 5 | 10/29/2015 | 19:08 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-102 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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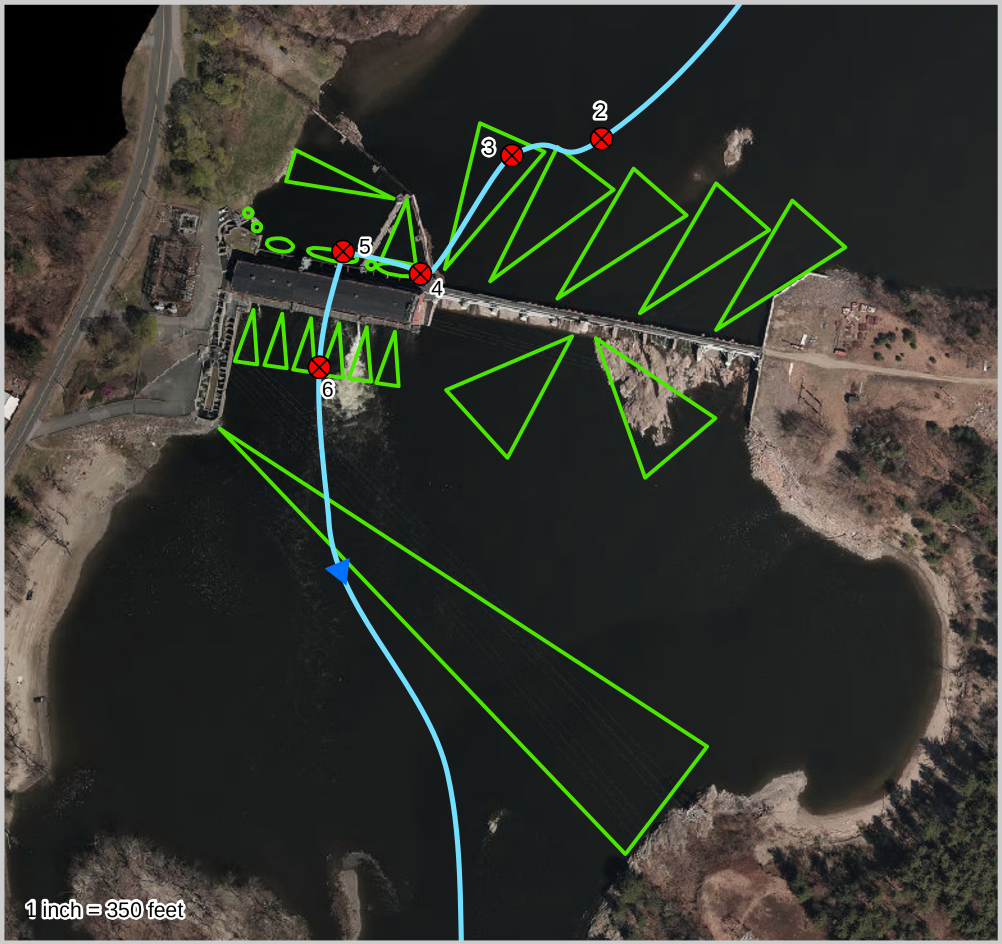


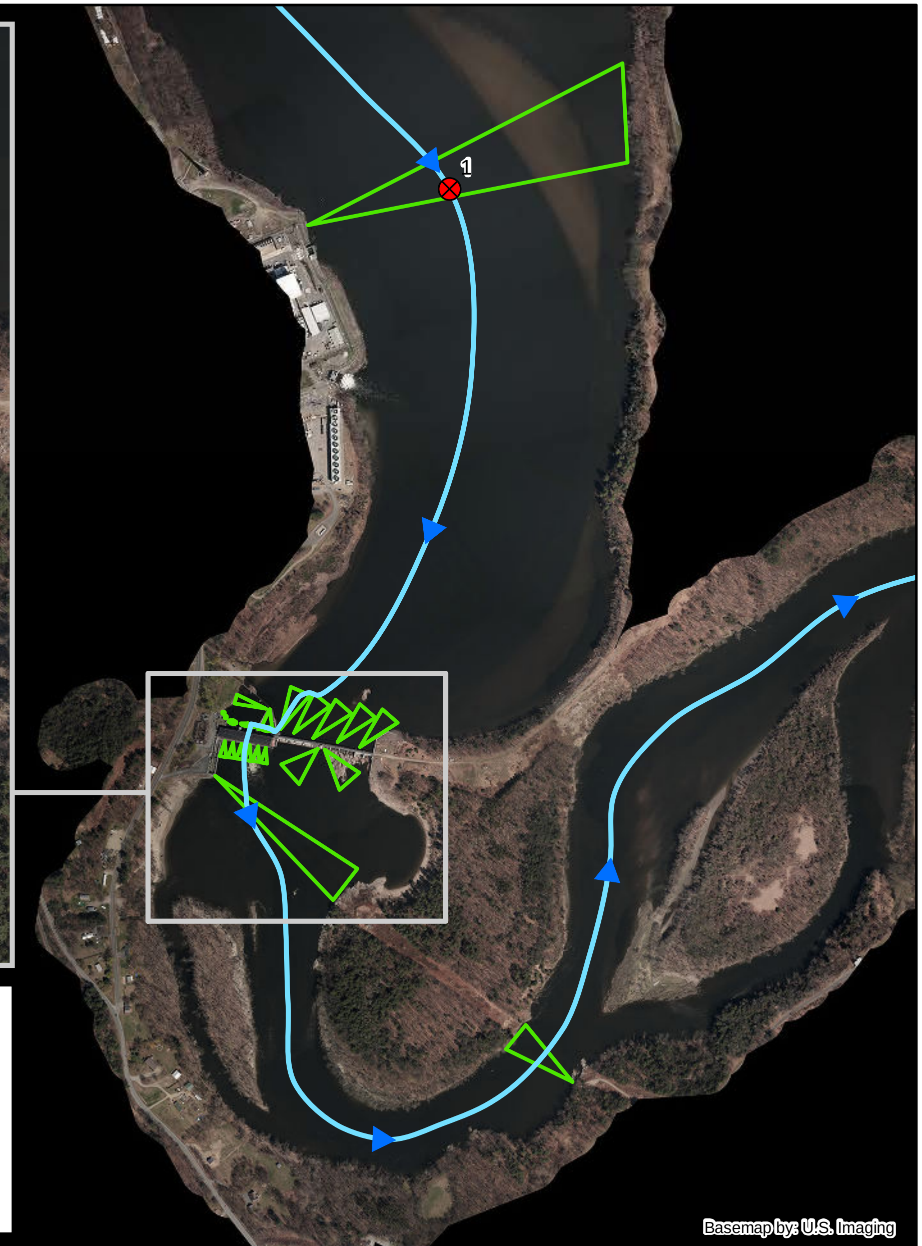


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 19:52 |
| 2 | 10/28/2015 | 20:33 |
| 3 | 10/28/2015 | 20:35 |
| 4 | 10/28/2015 | 20:37 |
| 5 | 10/28/2015 | 20:38 |
| 6 | 10/28/2015 | 20:38 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-103 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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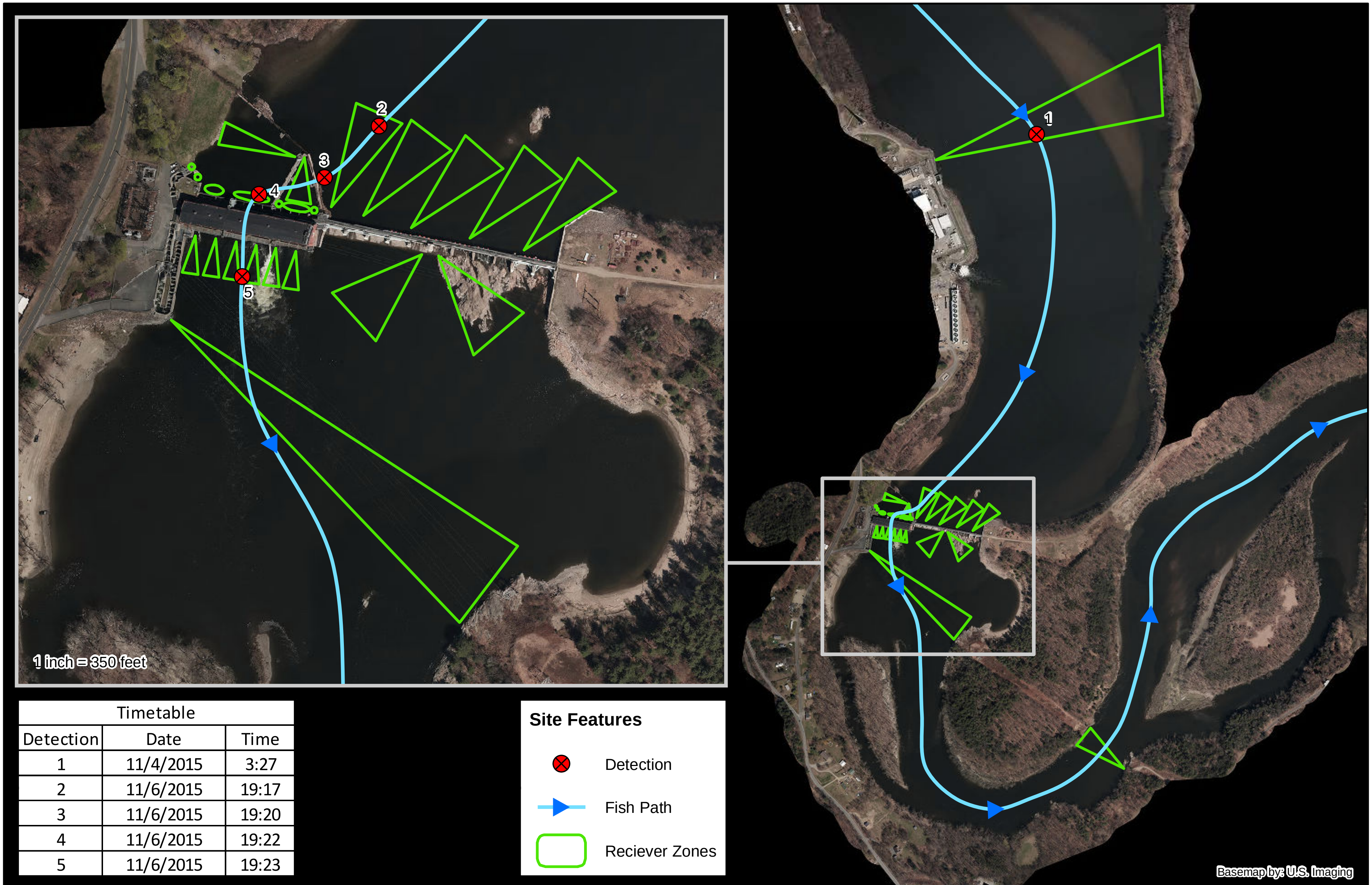


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/4/2015 | 3:27 |
| 2 | 11/6/2015 | 19:17 |
| 3 | 11/6/2015 | 19:20 |
| 4 | 11/6/2015 | 19:22 |
| 5 | 11/6/2015 | 19:23 |

**Site Features**

Detection

Fish Path

Reciever Zones

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-104 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55

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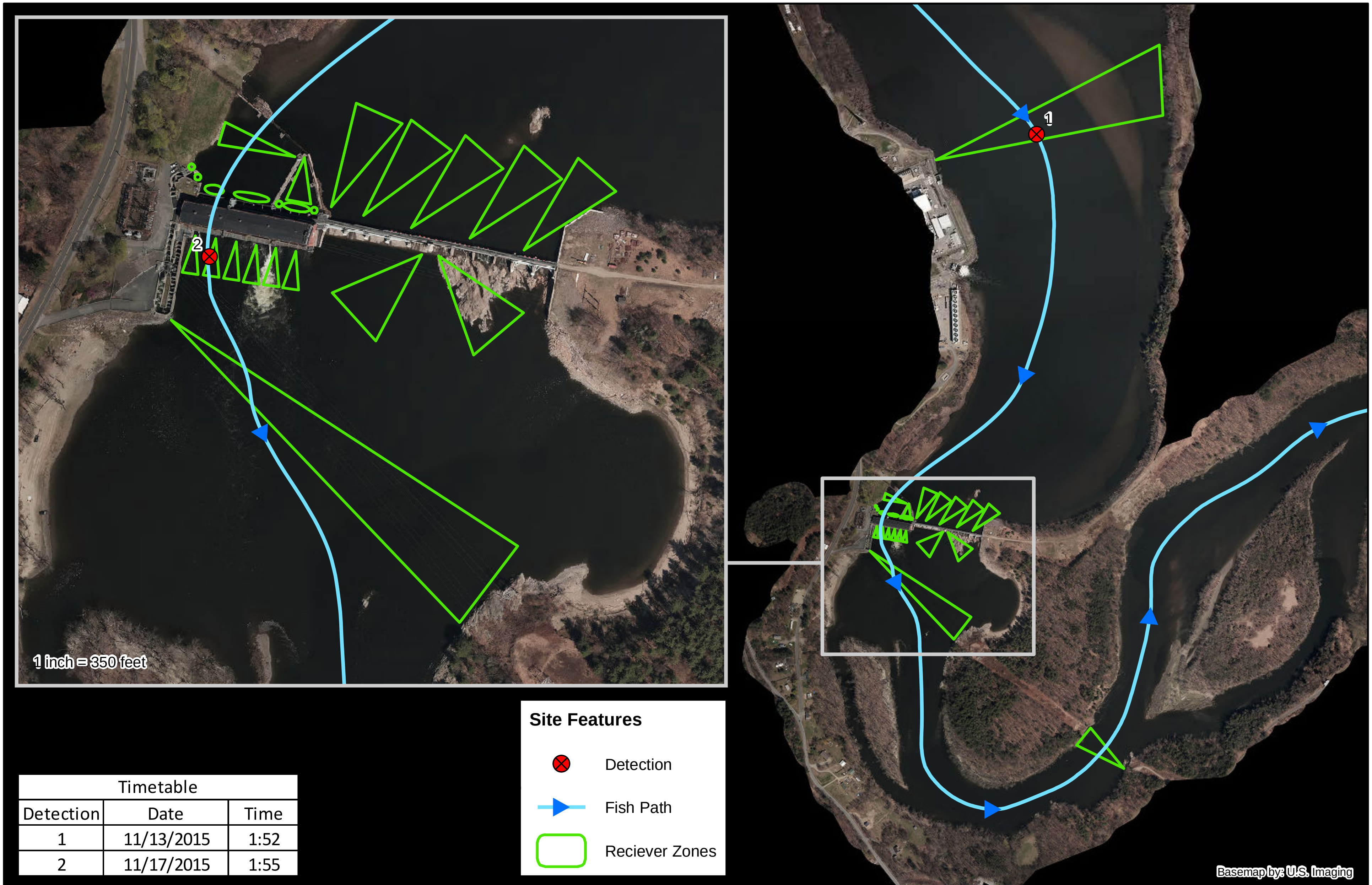


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/13/2015 | 1:52 |
| 2 | 11/17/2015 | 1:55 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-105 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55

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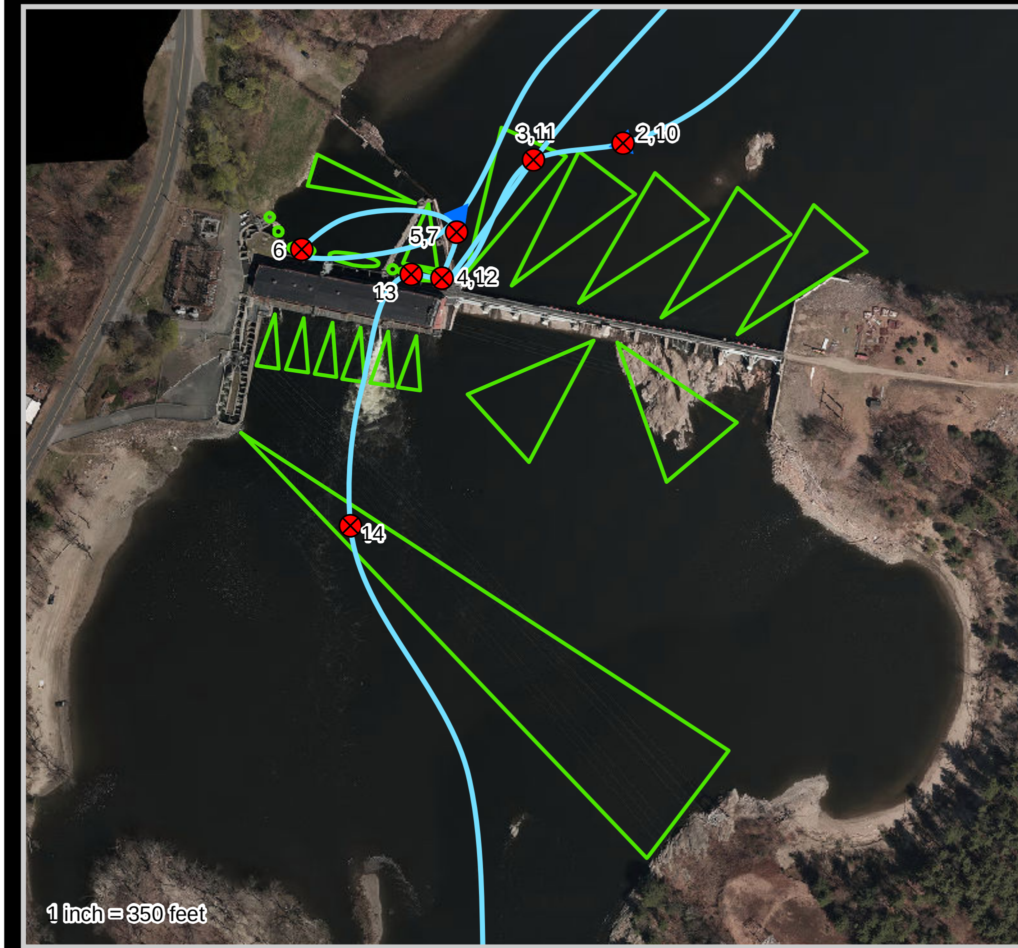
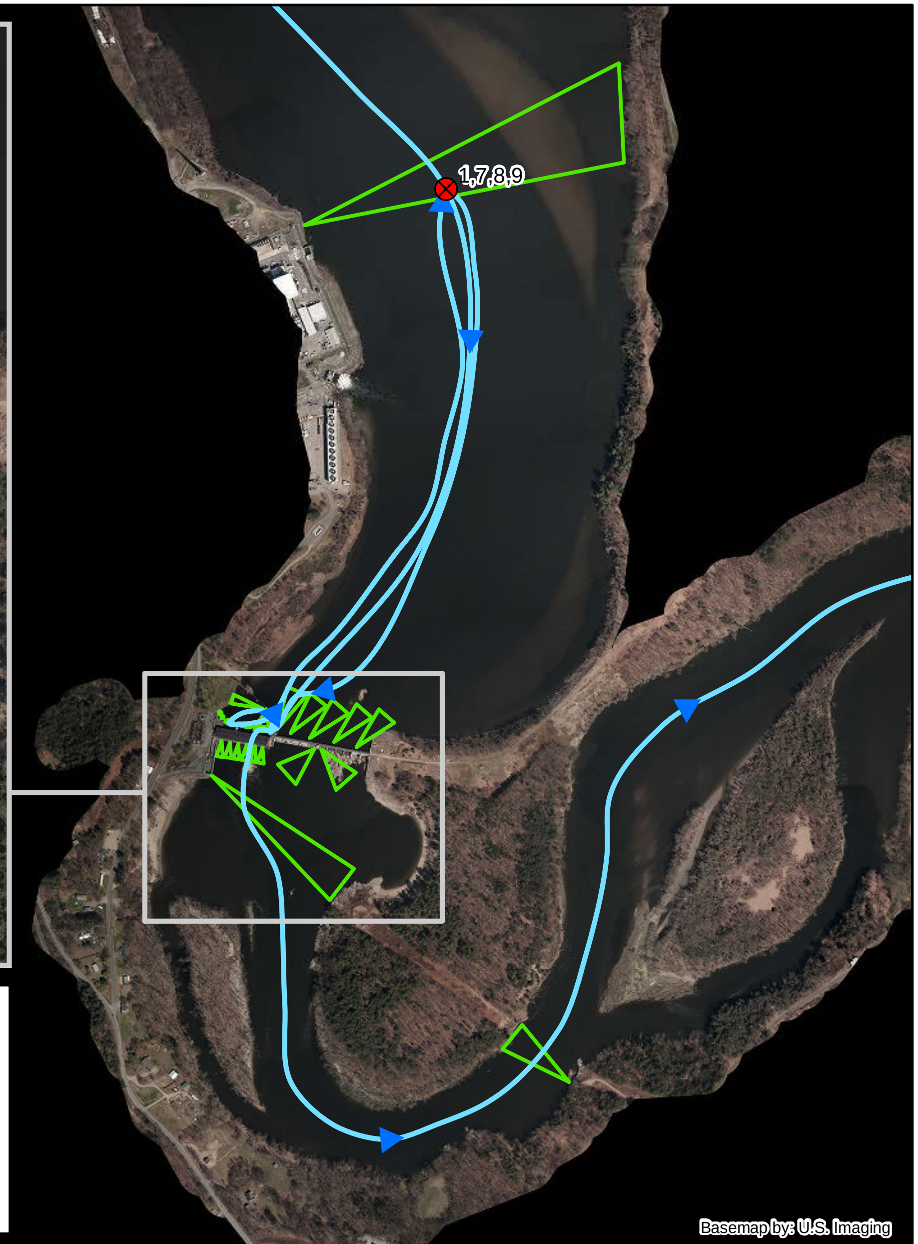



| Detection | Date | Time | Detection | Date | Time |
|---|---|---|---|---|---|
| 1 | 11/6/2015 | 20:19 | 8 | 11/9/2015 | 1:48 |
| 2 | 11/6/2015 | 21:42 | 9 | 11/10/2015 | 20:04 |
| 3 | 11/6/2015 | 21:48 | 10 | 11/10/2015 | 21:28 |
| 4 | 11/6/2015 | 21:49 | 11 | 11/10/2015 | 21:32 |
| 5 | 11/6/2015 | 21:57 | 12 | 11/10/2015 | 21:36 |
| 6 | 11/6/2015 | 22:09 | 13 | 11/10/2015 | 21:37 |
| 7 | 11/7/2015 | 0:28 | 14 | 11/10/2015 | 21:39 |

Timetable

**Site Features**

- Detection
- Fish Path
- Reciever Zones




**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-107 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55

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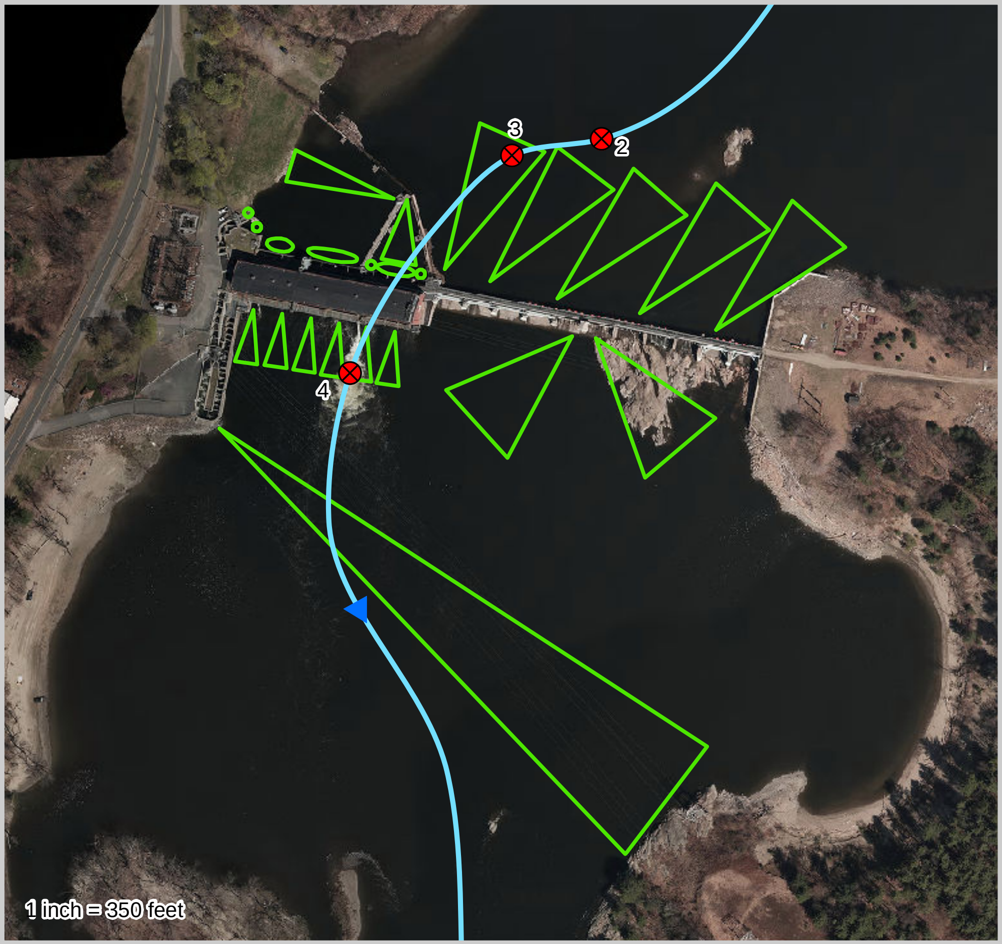


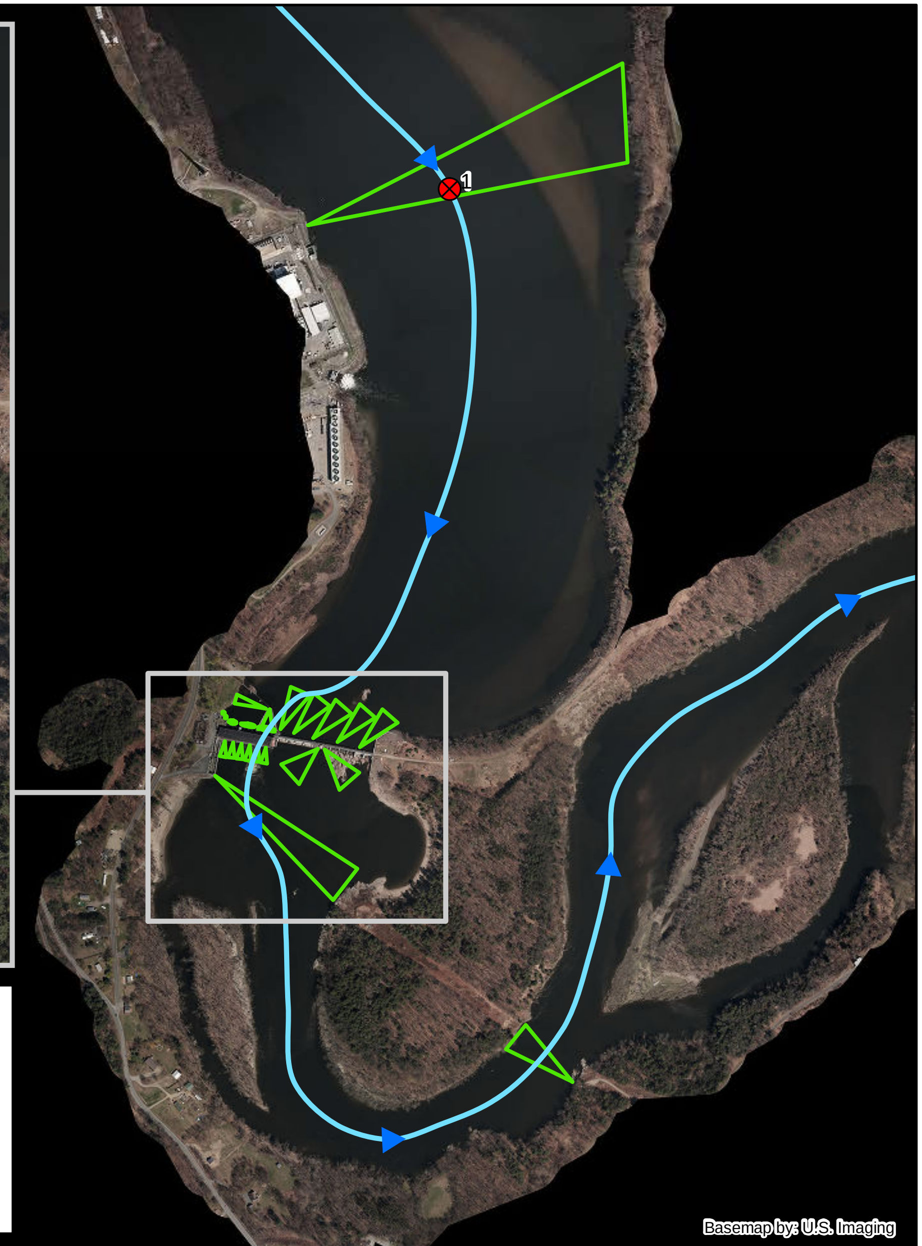


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:41 |
| 2 | 10/29/2015 | 22:13 |
| 3 | 10/29/2015 | 22:19 |
| 4 | 10/29/2015 | 22:21 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-111 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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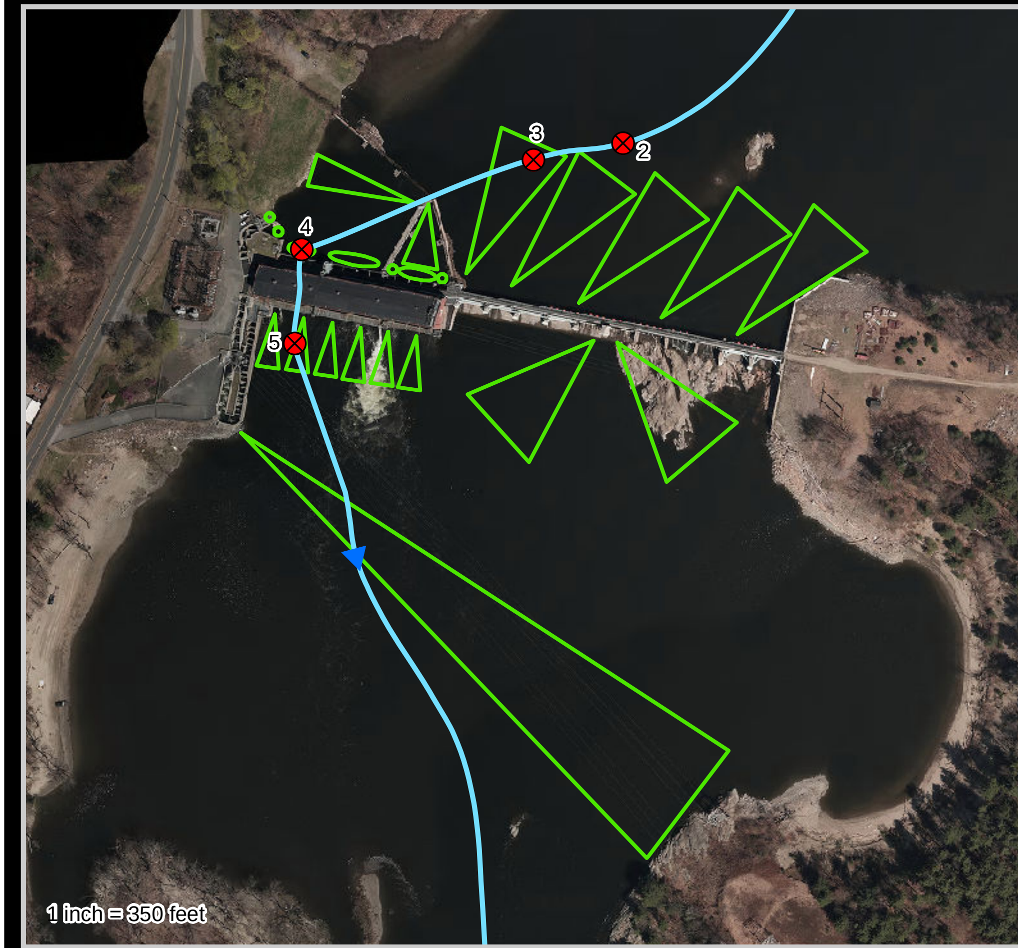


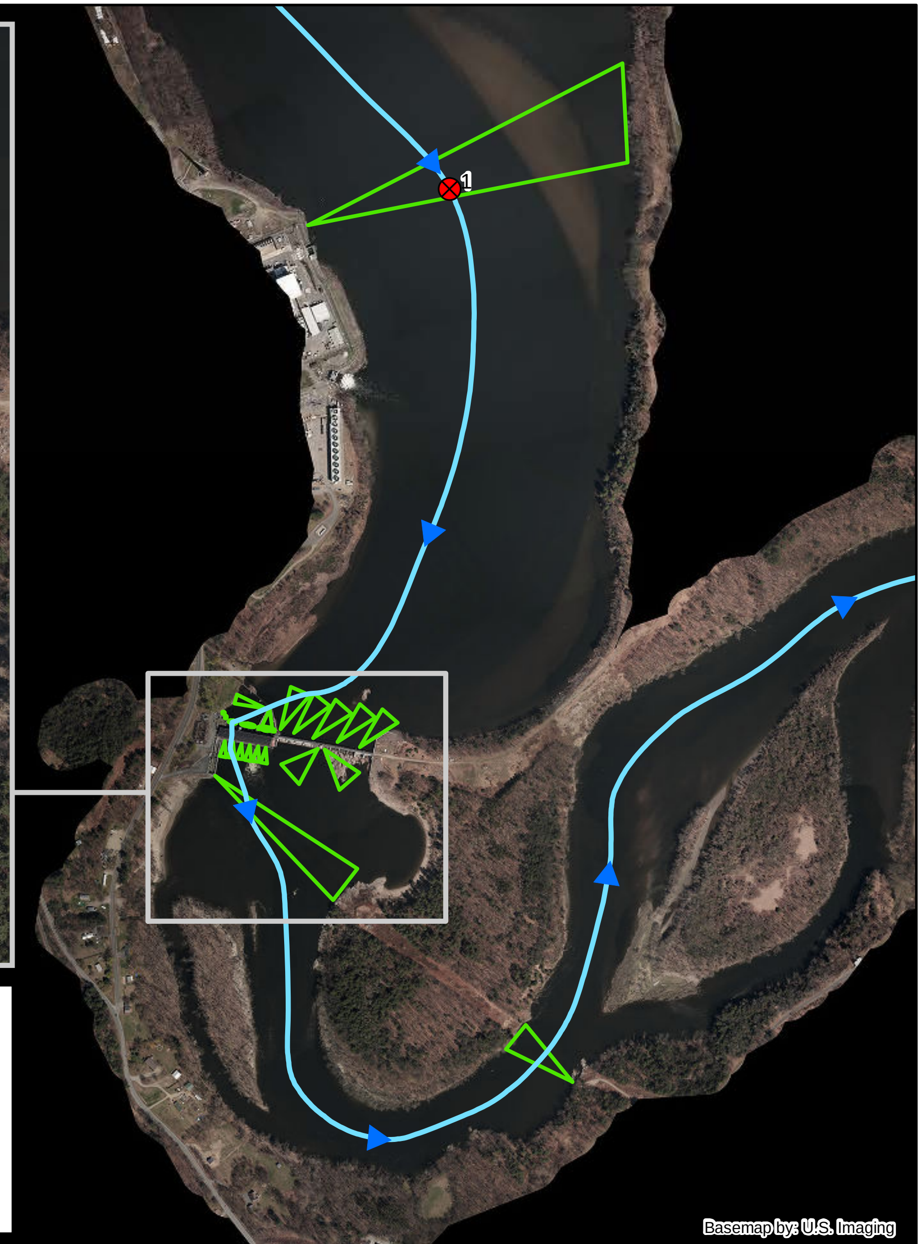


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 22:31 |
| 2 | 11/5/2015 | 23:13 |
| 3 | 11/5/2015 | 23:16 |
| 4 | 11/5/2015 | 23:23 |
| 5 | 11/5/2015 | 23:24 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-112 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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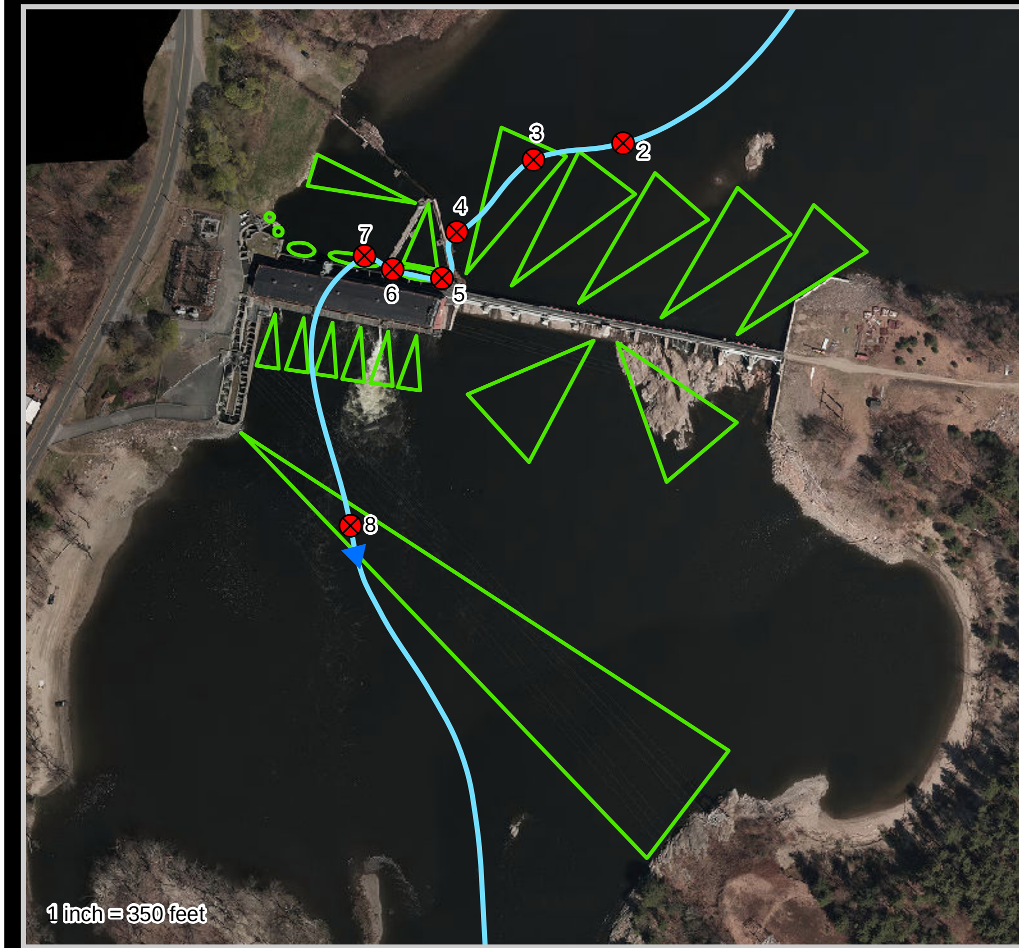


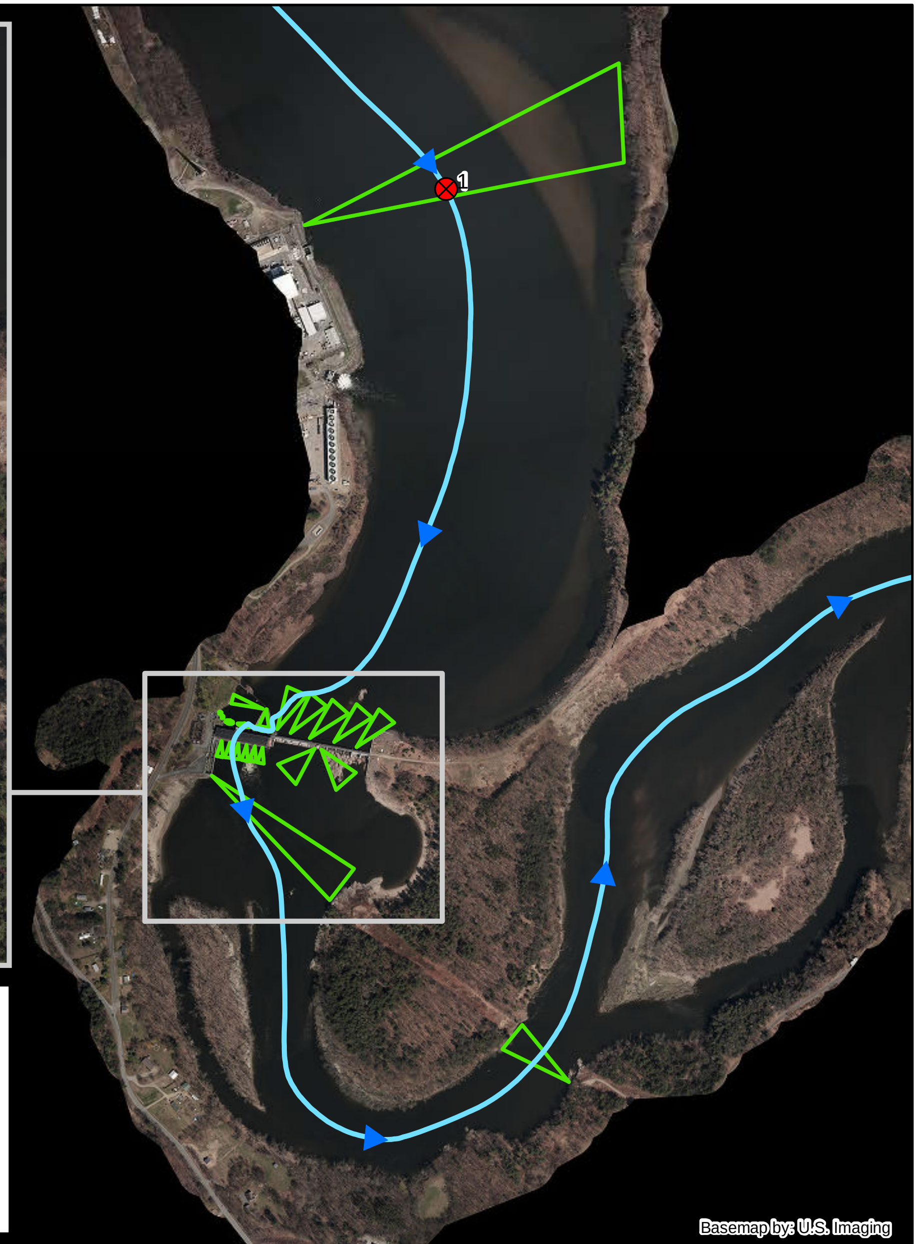


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/20/2015 | 4:19 | 6 | 11/20/2015 | 22:31 |
| 2 | 11/20/2015 | 22:09 | 7 | 11/20/2015 | 22:32 |
| 3 | 11/20/2015 | 22:25 | 8 | 11/20/2015 | 22:33 |
| 4 | 11/20/2015 | 22:28 | | | |
| 5 | 11/20/2015 | 22:31 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-116 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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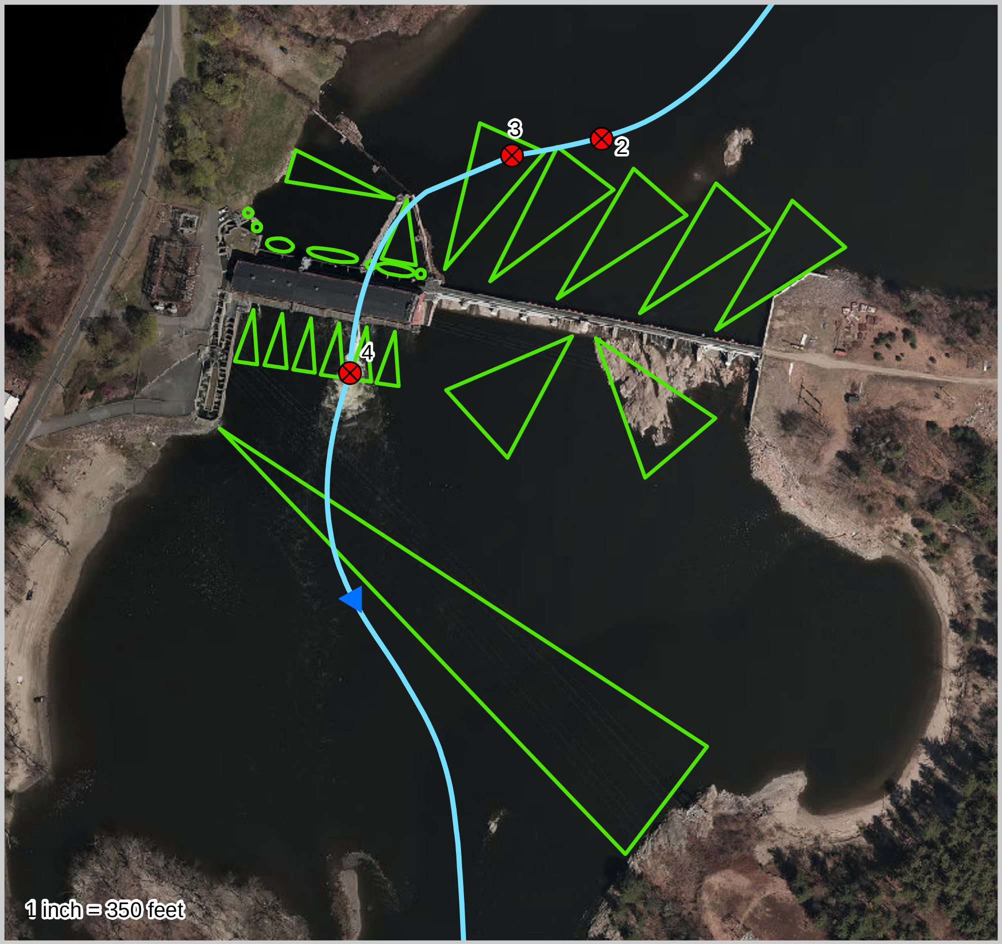


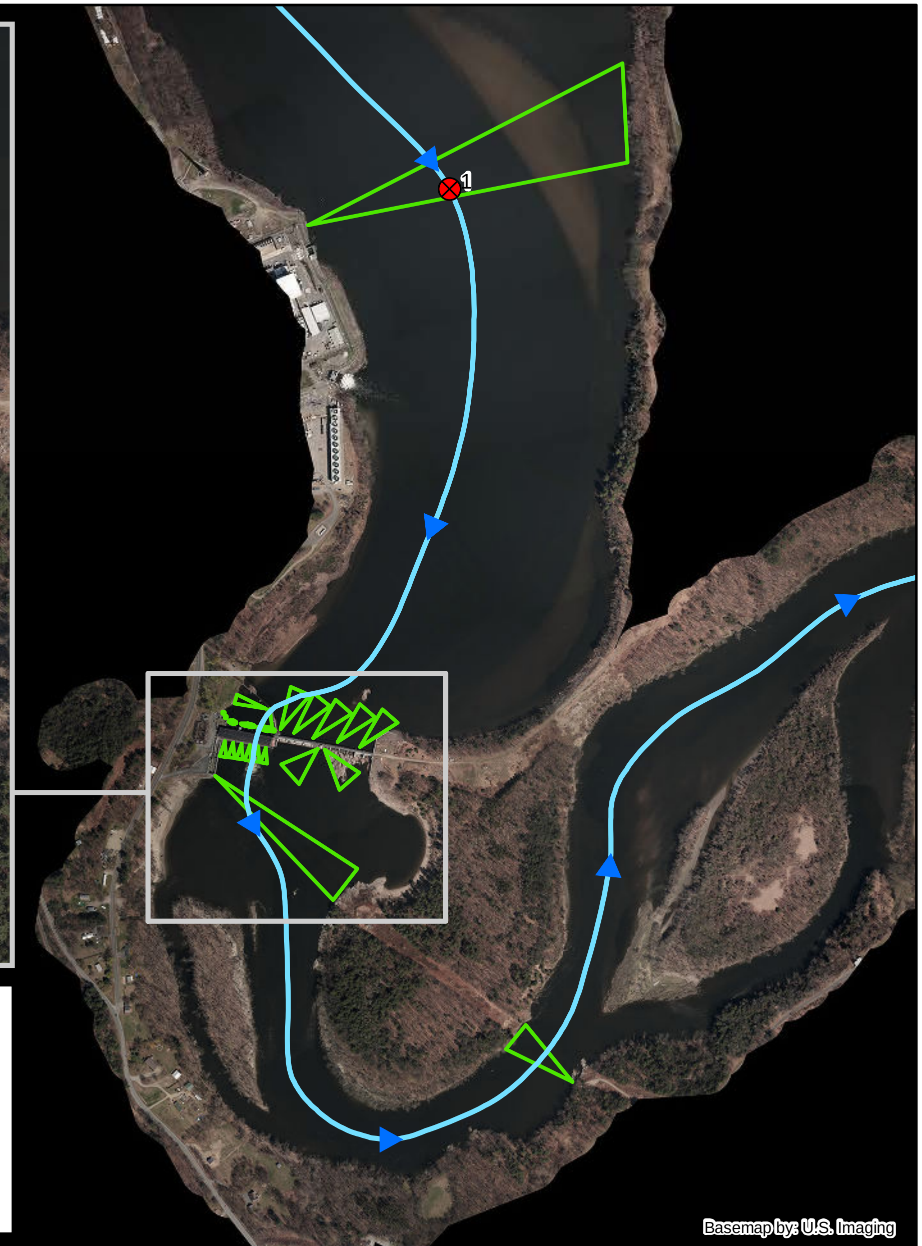


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 12/24/2015 | 16:35 |
| 2 | 12/24/2015 | 17:02 |
| 3 | 12/24/2015 | 17:06 |
| 4 | 12/24/2015 | 17:13 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-117 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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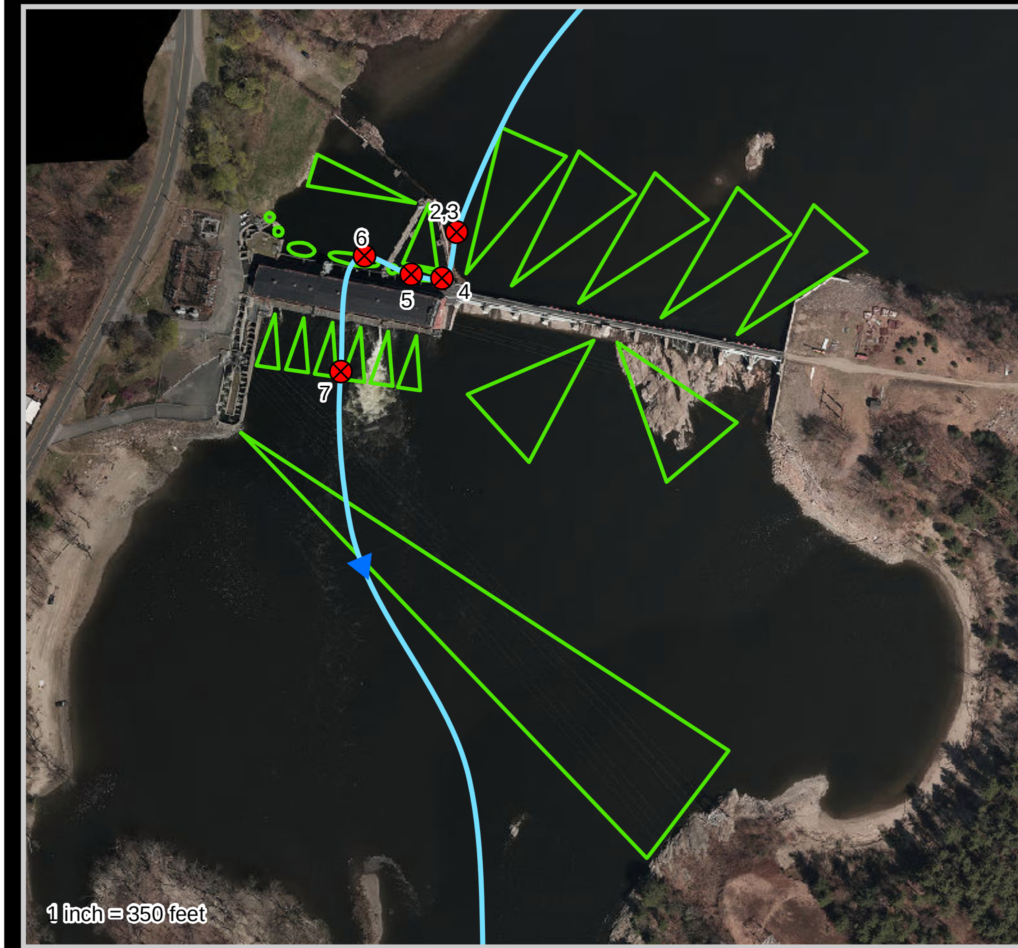


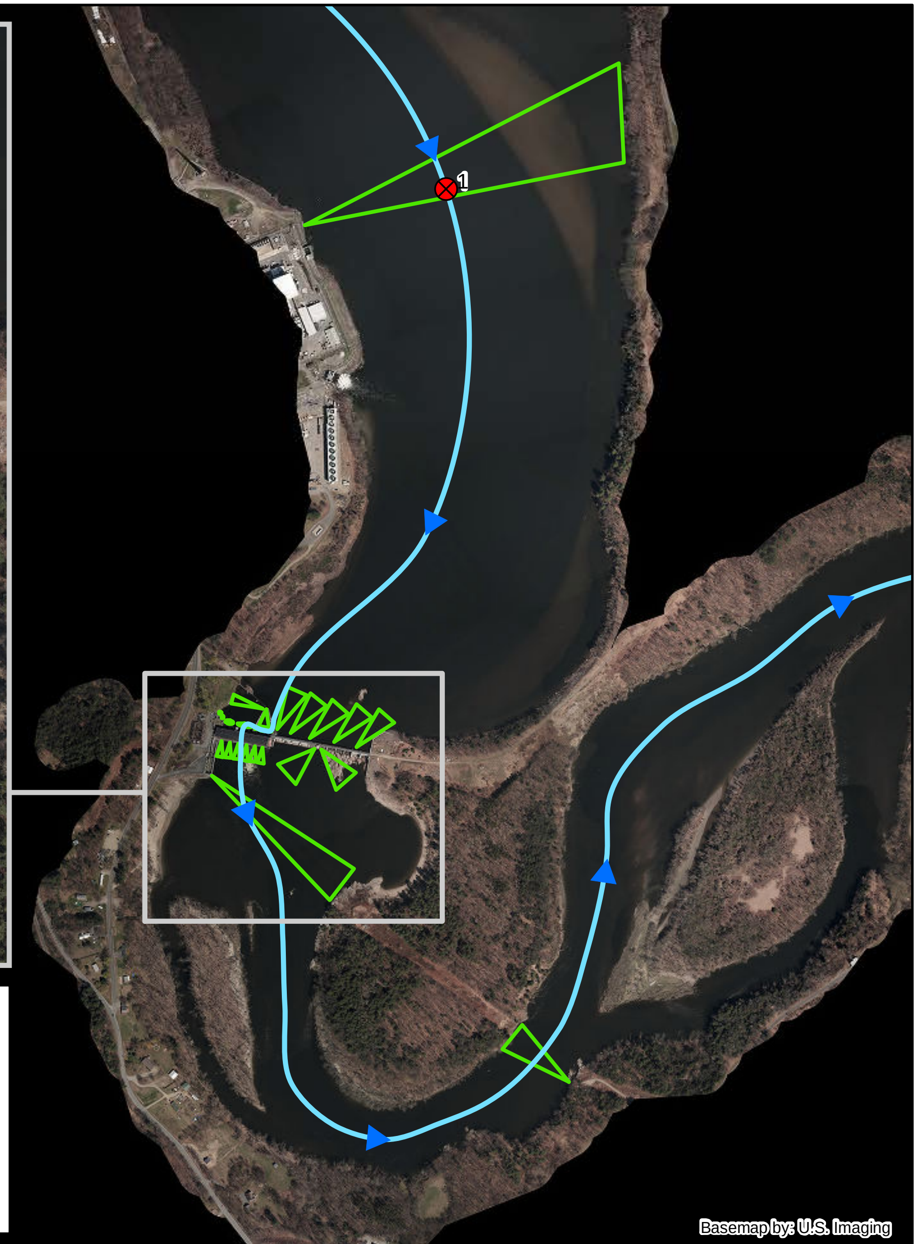


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/14/2015 | 5:22 | 6 | 11/14/2015 | 18:34 |
| 2 | 11/14/2015 | 18:26 | 7 | 11/14/2015 | 18:34 |
| 3 | 11/14/2015 | 18:31 | | | |
| 4 | 11/14/2015 | 18:32 | | | |
| 5 | 11/14/2015 | 18:33 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-118 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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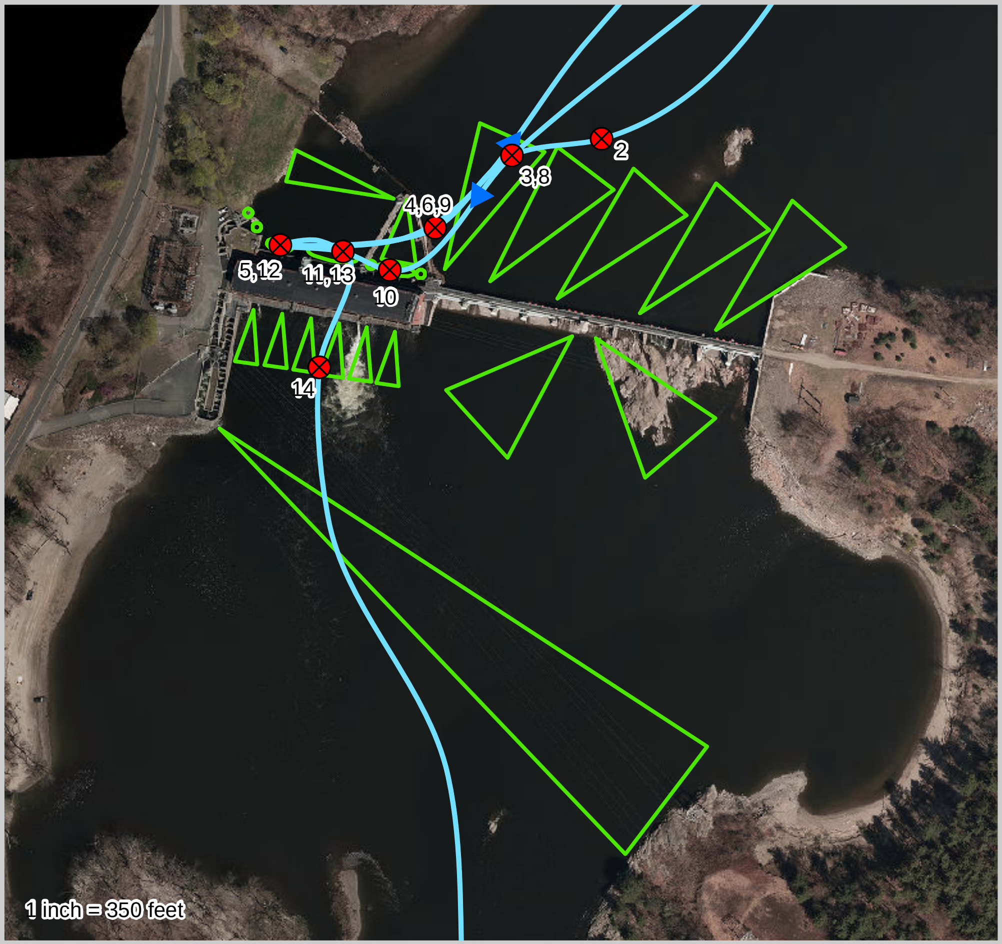


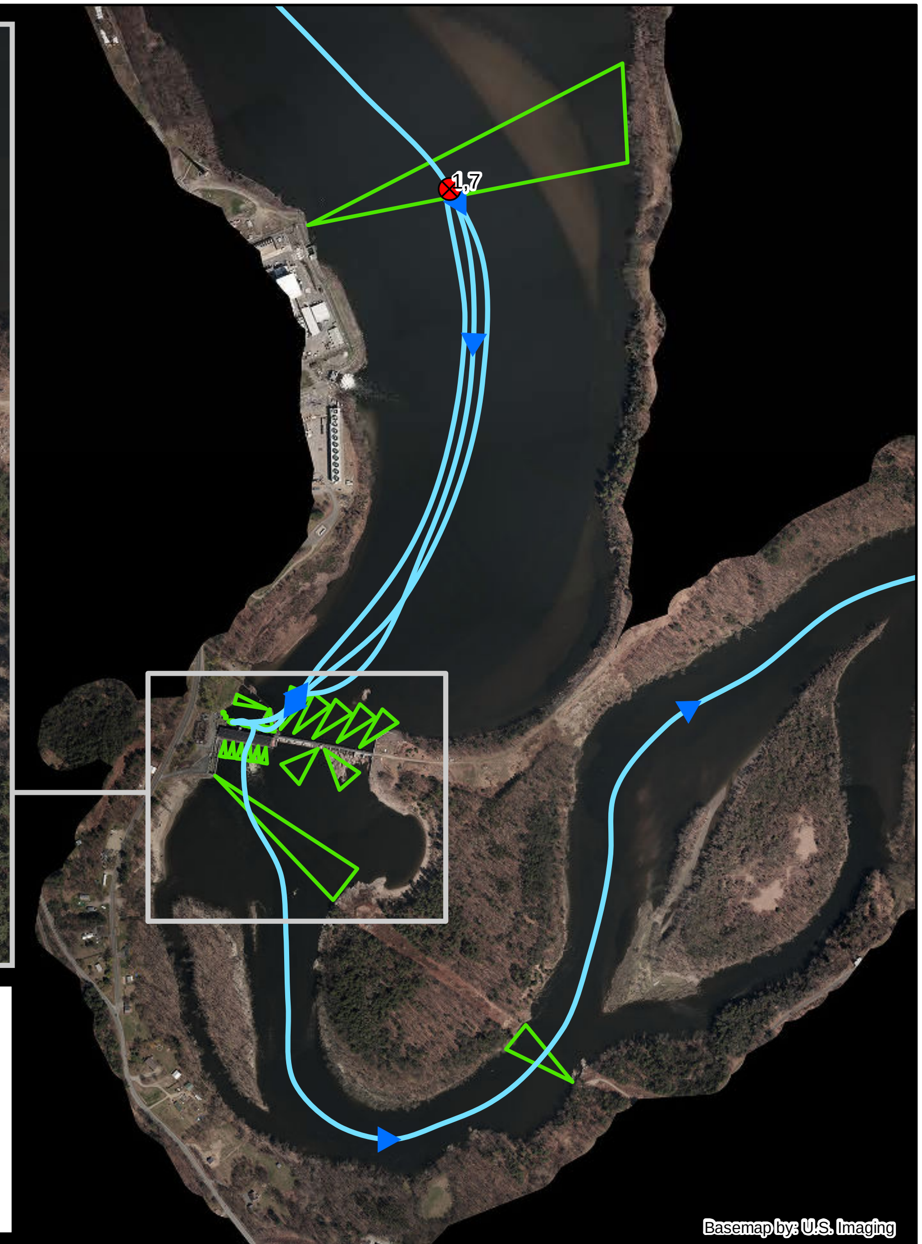


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/1/2015 | 23:55 | 8 | 11/2/2015 | 19:04 |
| 2 | 11/2/2015 | 2:58 | 9 | 11/2/2015 | 19:06 |
| 3 | 11/2/2015 | 3:03 | 10 | 11/2/2015 | 19:09 |
| 4 | 11/2/2015 | 3:04 | 11 | 11/2/2015 | 19:10 |
| 5 | 11/2/2015 | 3:12 | 12 | 11/2/2015 | 19:27 |
| 6 | 11/2/2015 | 3:14 | 13 | 11/2/2015 | 19:49 |
| 7 | 11/2/2015 | 4:37 | 14 | 11/2/2015 | 19:49 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-121 (T1)**

Release: Norwich, VT
Date Released: 10/27/2015
Time Released: 20:05


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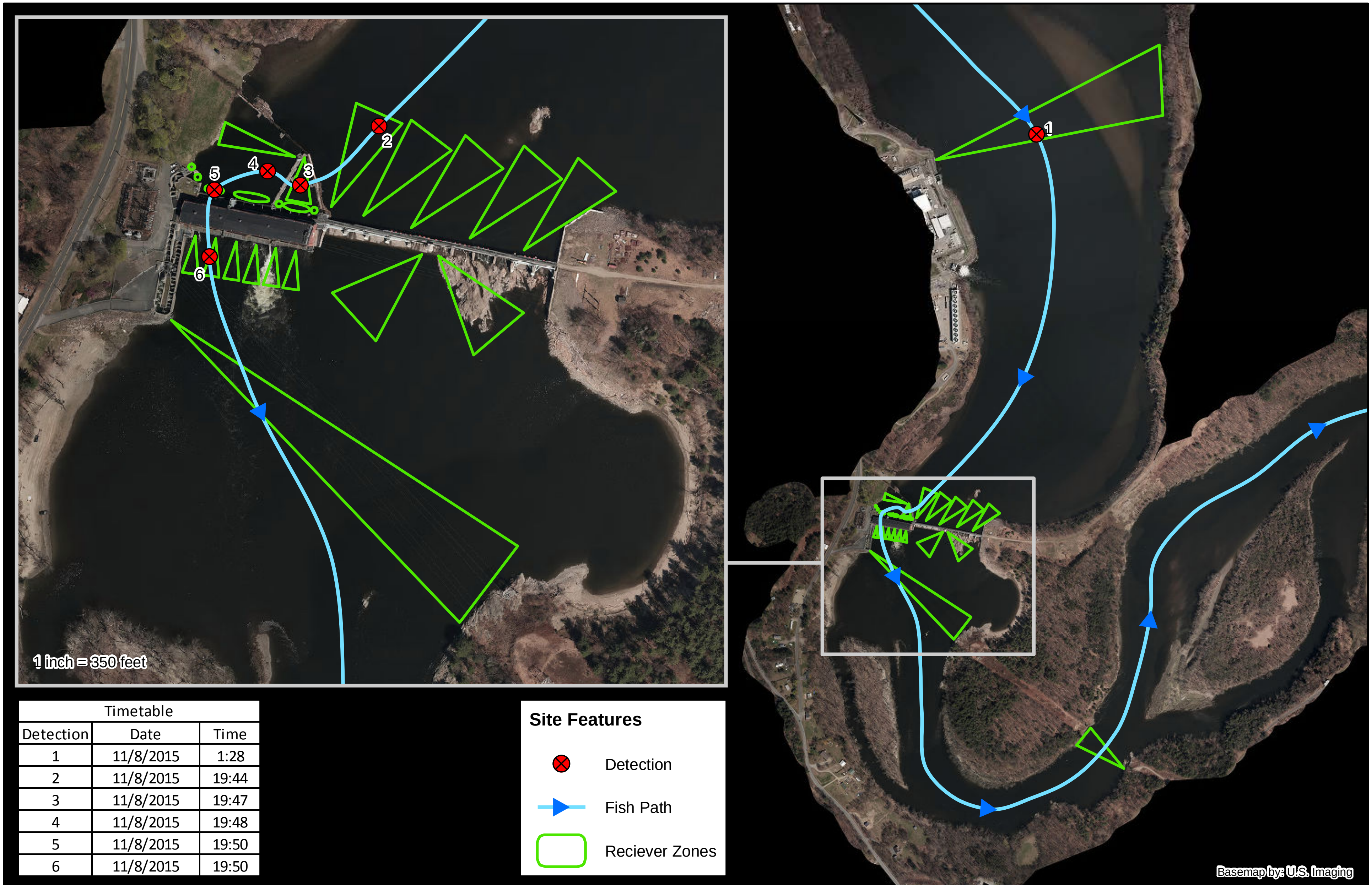


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 1:28 |
| 2 | 11/8/2015 | 19:44 |
| 3 | 11/8/2015 | 19:47 |
| 4 | 11/8/2015 | 19:48 |
| 5 | 11/8/2015 | 19:50 |
| 6 | 11/8/2015 | 19:50 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-128 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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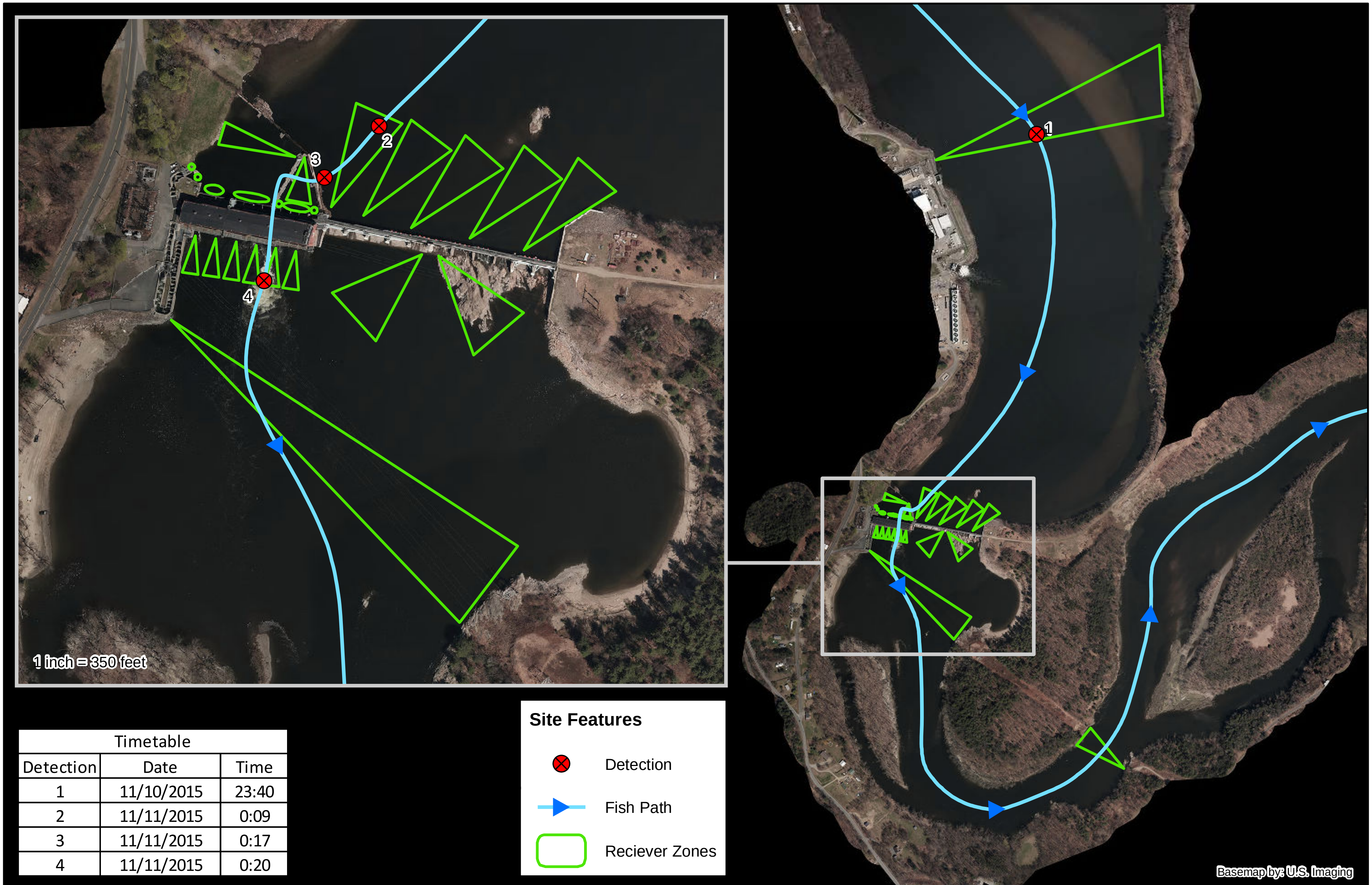


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 23:40 |
| 2 | 11/11/2015 | 0:09 |
| 3 | 11/11/2015 | 0:17 |
| 4 | 11/11/2015 | 0:20 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-129 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32

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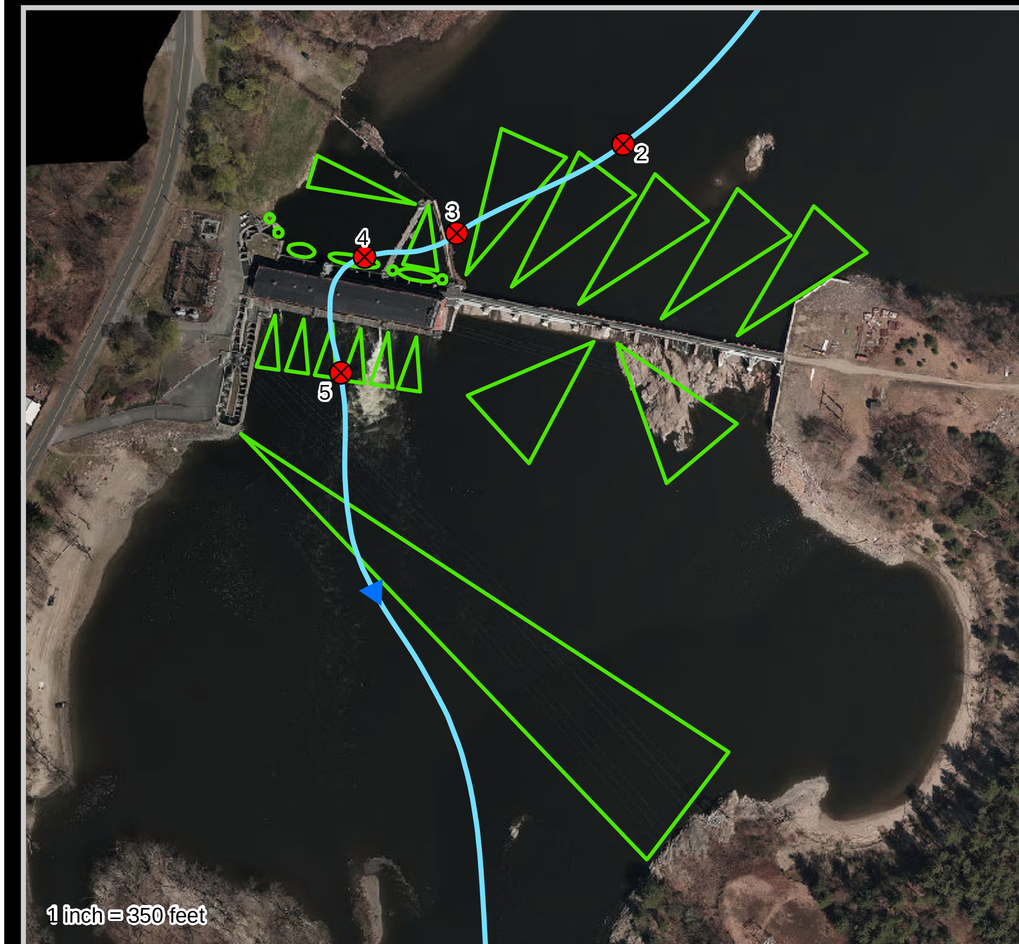


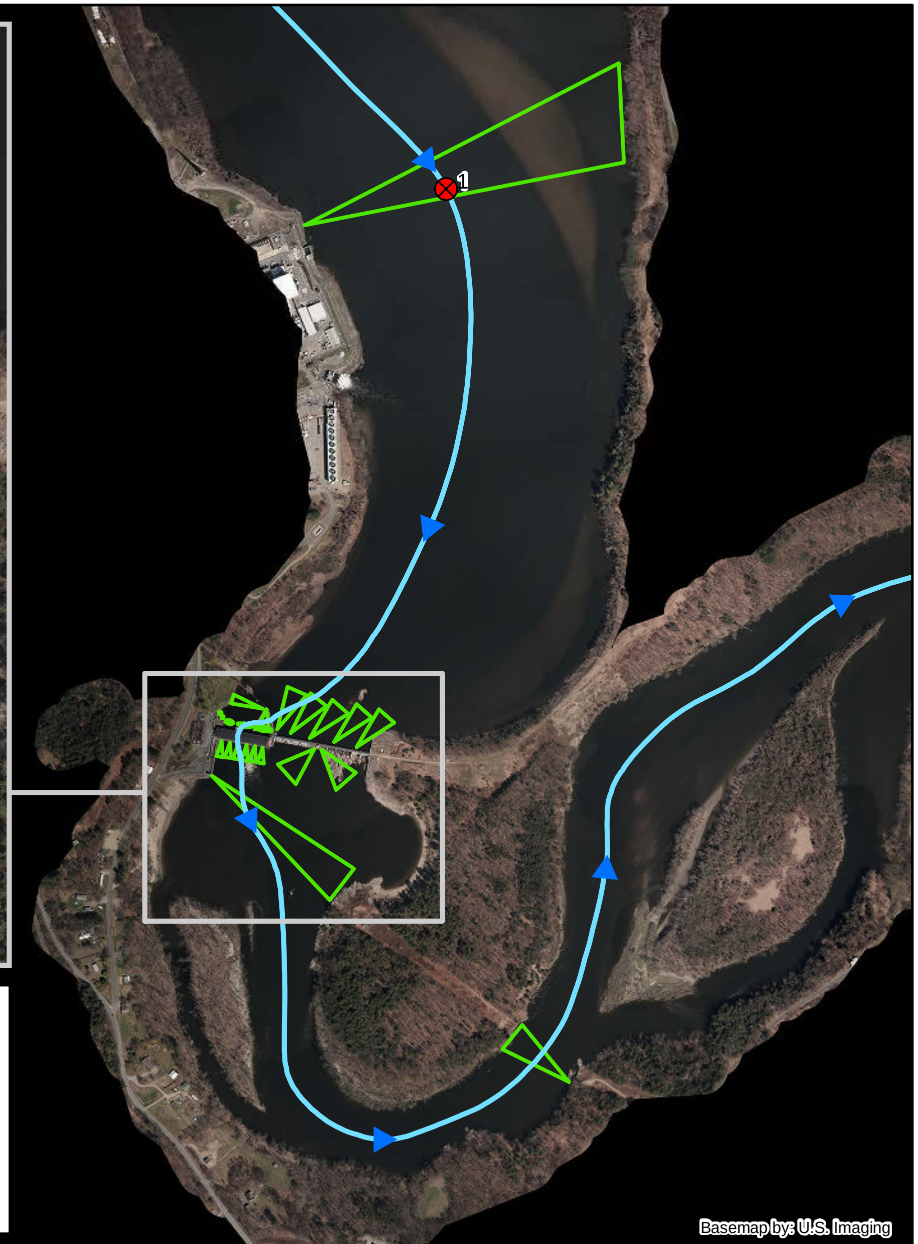


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 22:23 |
| 2 | 10/29/2015 | 22:58 |
| 3 | 10/29/2015 | 23:03 |
| 4 | 10/29/2015 | 23:05 |
| 5 | 10/29/2015 | 23:05 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-131 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05

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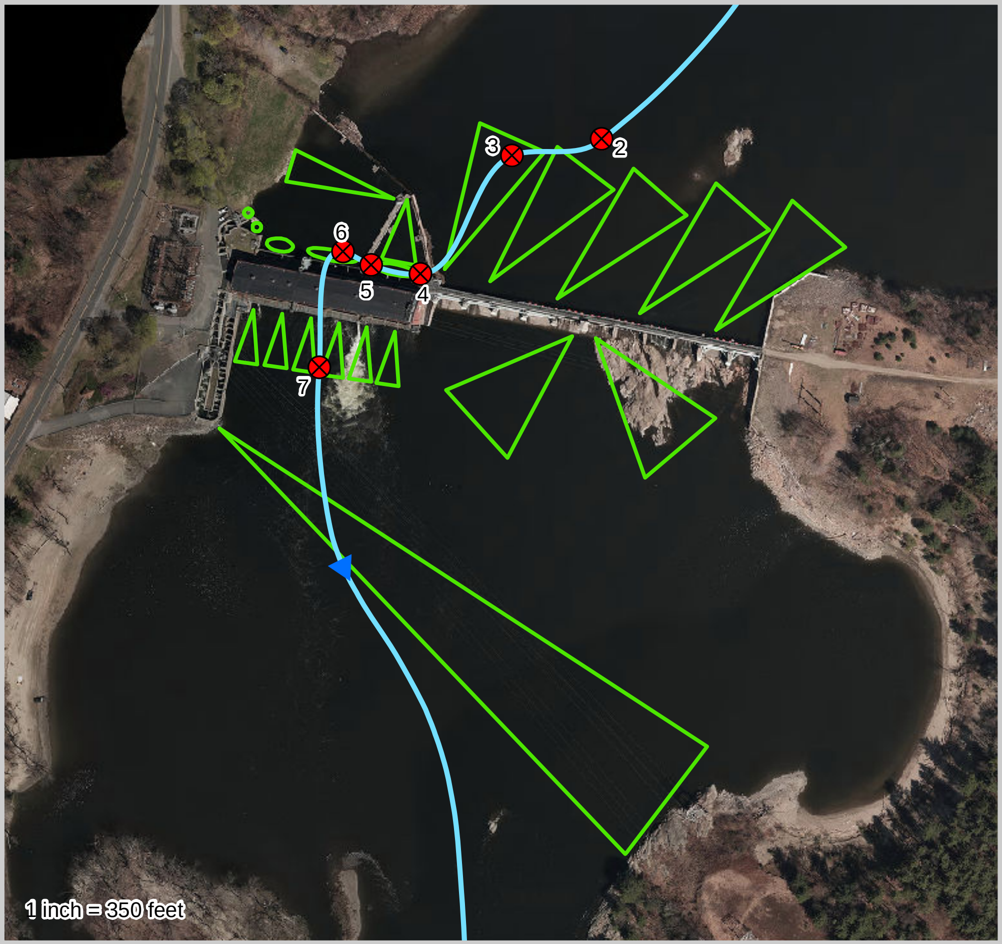


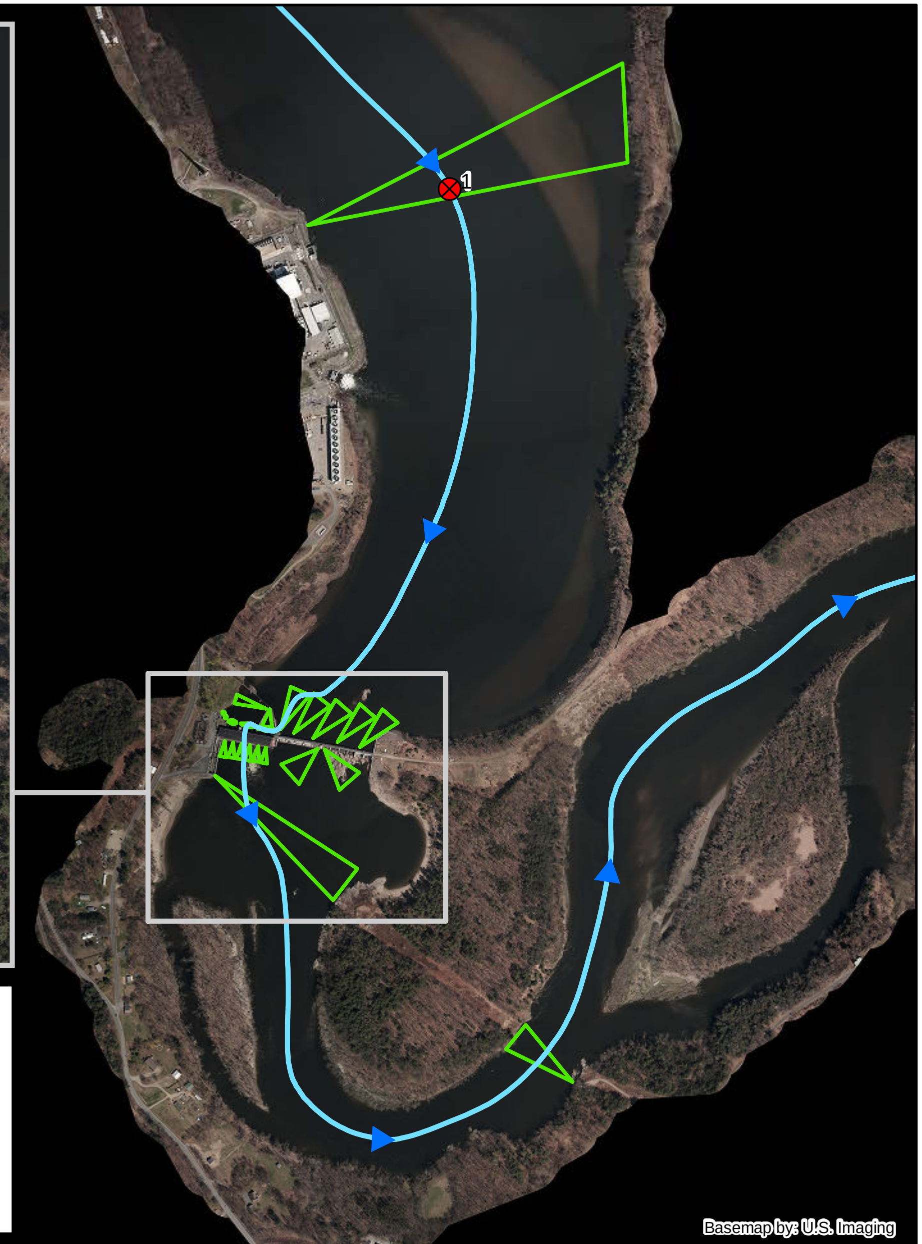


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/29/2015 | 19:49 | 6 | 10/29/2015 | 20:24 |
| 2 | 10/29/2015 | 20:15 | 7 | 10/29/2015 | 20:24 |
| 3 | 10/29/2015 | 20:21 | | | |
| 4 | 10/29/2015 | 20:22 | | | |
| 5 | 10/29/2015 | 20:23 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-133 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05

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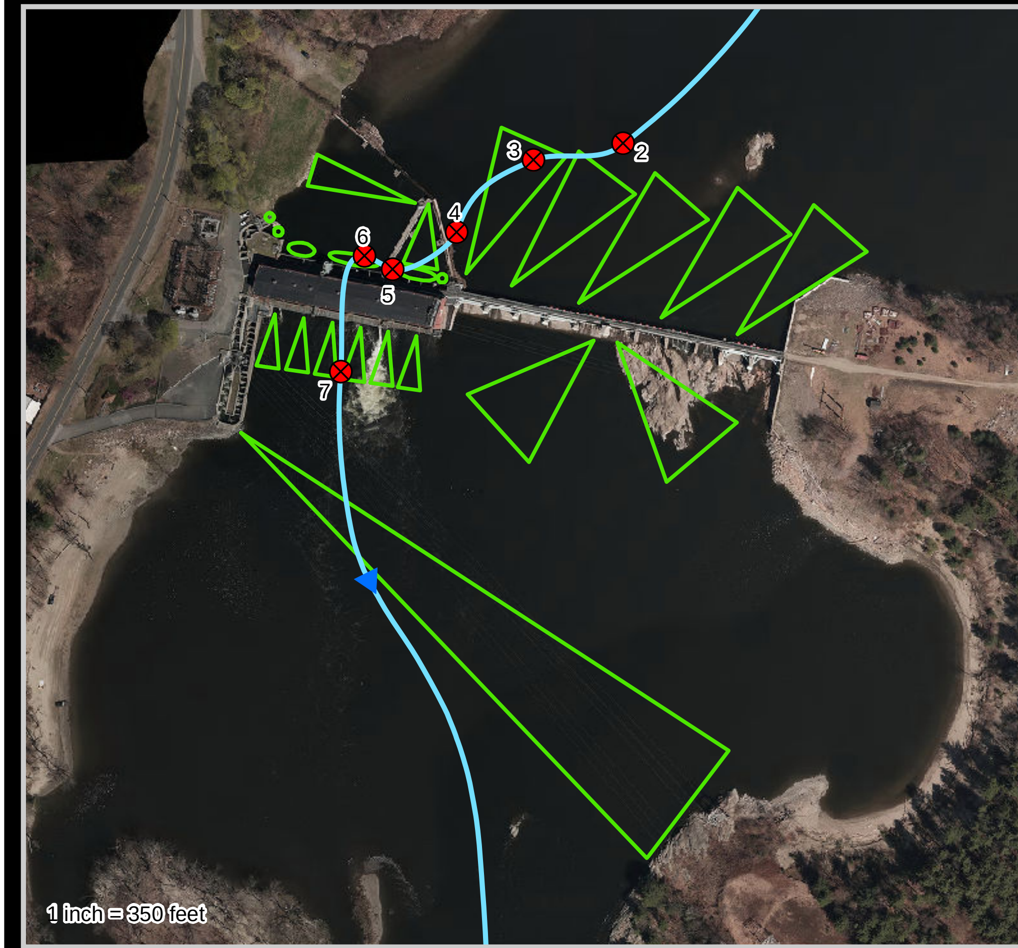


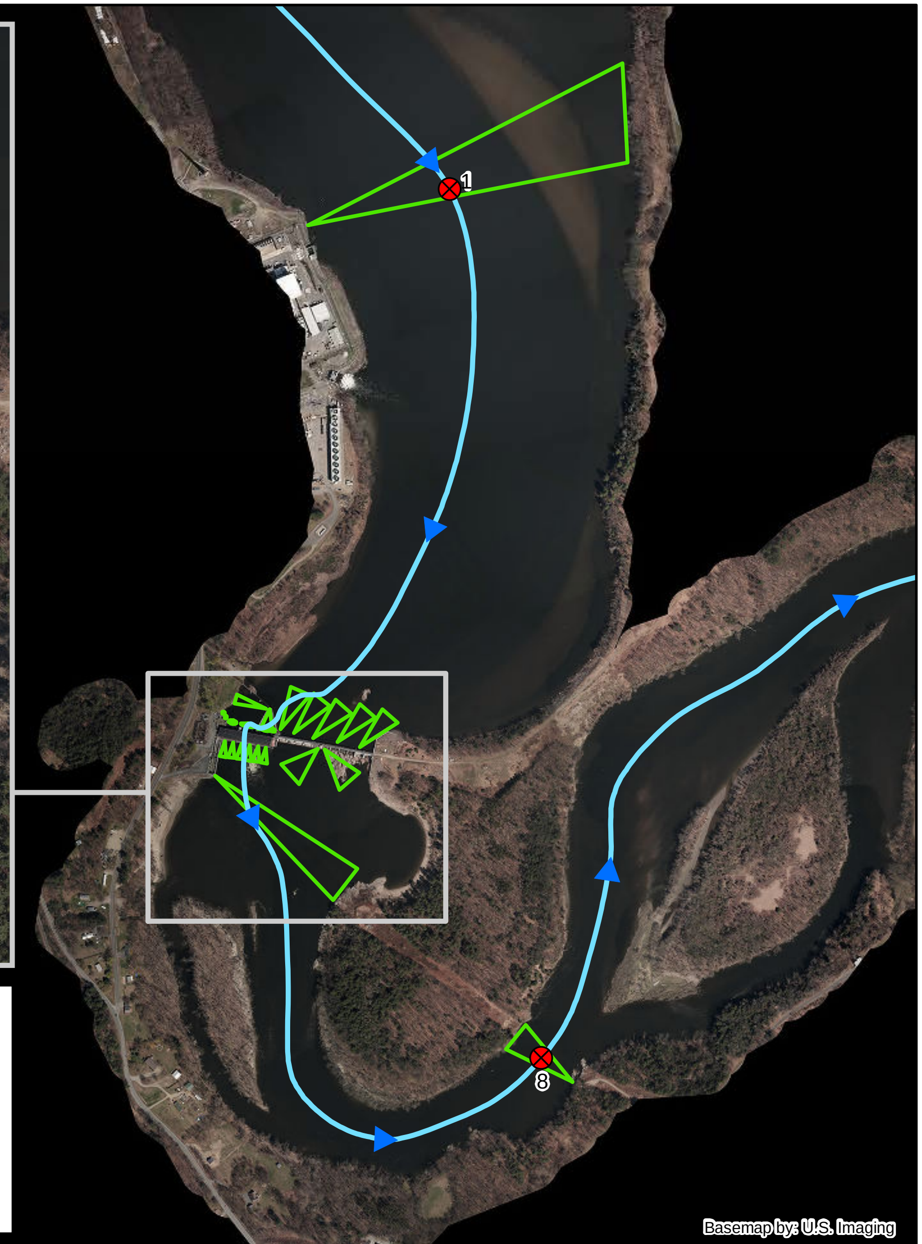


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/29/2015 | 18:02 | 6 | 10/29/2015 | 18:46 |
| 2 | 10/29/2015 | 18:36 | 7 | 10/29/2015 | 18:46 |
| 3 | 10/29/2015 | 18:42 | 8 | 10/30/2015 | 18:58 |
| 4 | 10/29/2015 | 18:43 | | | |
| 5 | 10/29/2015 | 18:45 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-134 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05


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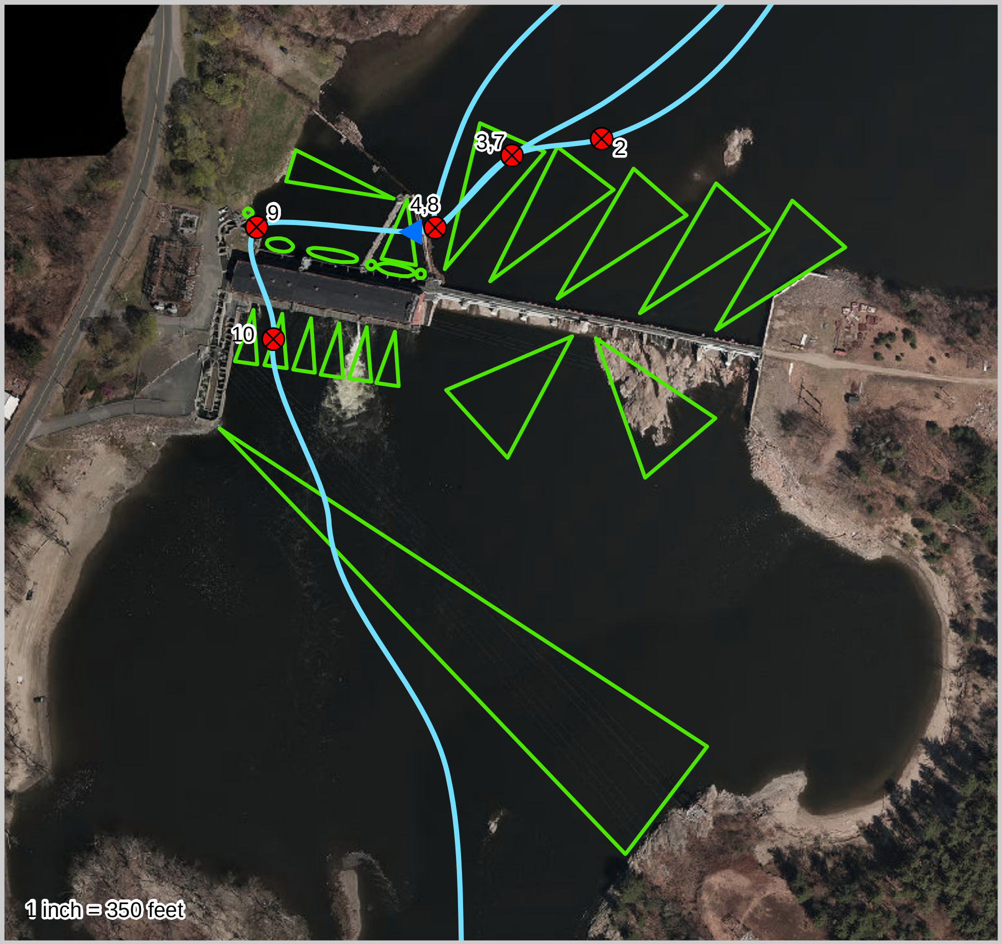


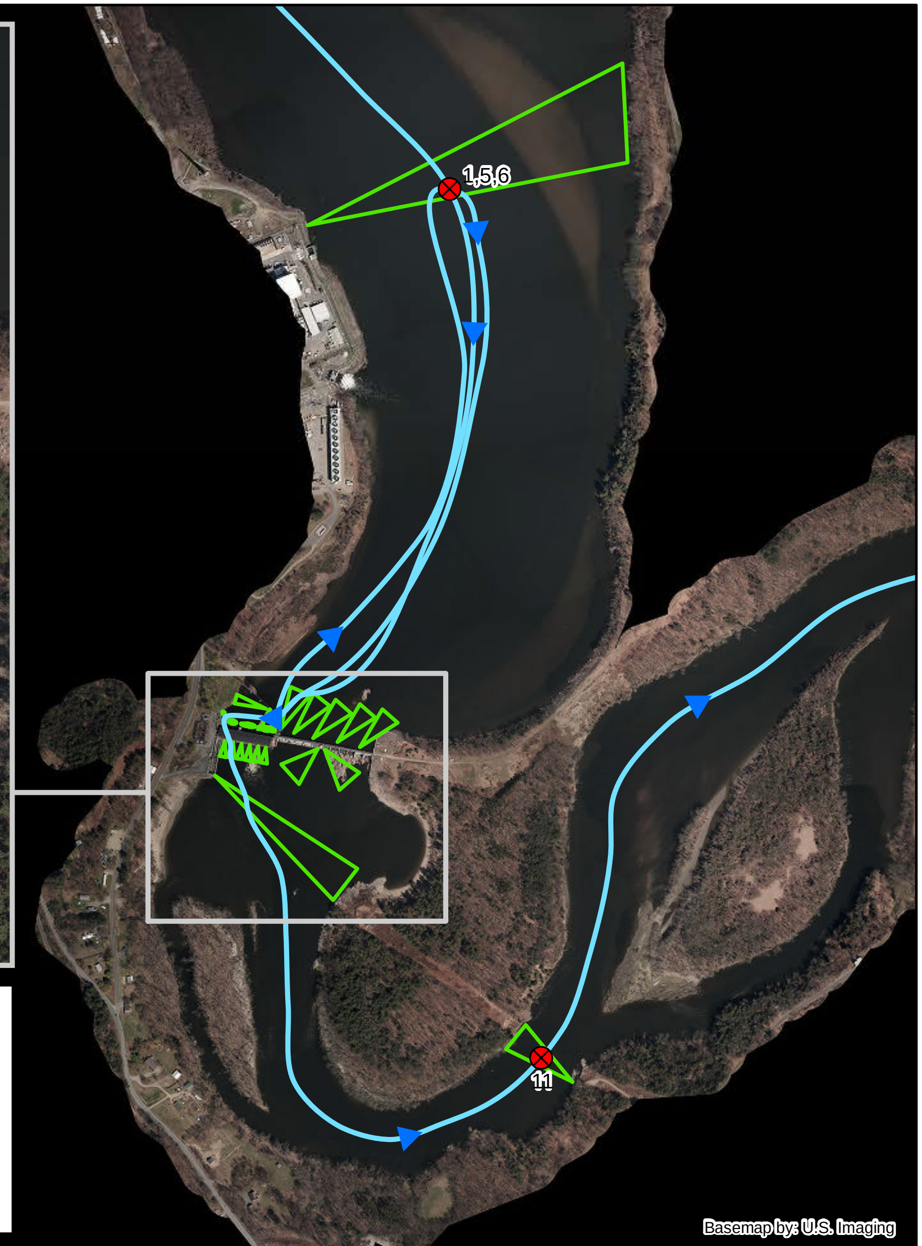


Timetable

| Detection | Date | Time | Detection | Date | Time |
|---|---|---|---|---|---|
| 1 | 11/8/2015 | 19:24 | 7 | 11/13/2015 | 2:51 |
| 2 | 11/8/2015 | 21:04 | 8 | 11/13/2015 | 2:54 |
| 3 | 11/8/2015 | 21:08 | 9 | 11/13/2015 | 3:04 |
| 4 | 11/8/2015 | 21:13 | 10 | 11/13/2015 | 3:04 |
| 5 | 11/8/2015 | 22:39 | 11 | 11/13/2015 | 4:29 |
| 6 | 11/13/2015 | 1:53 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-135 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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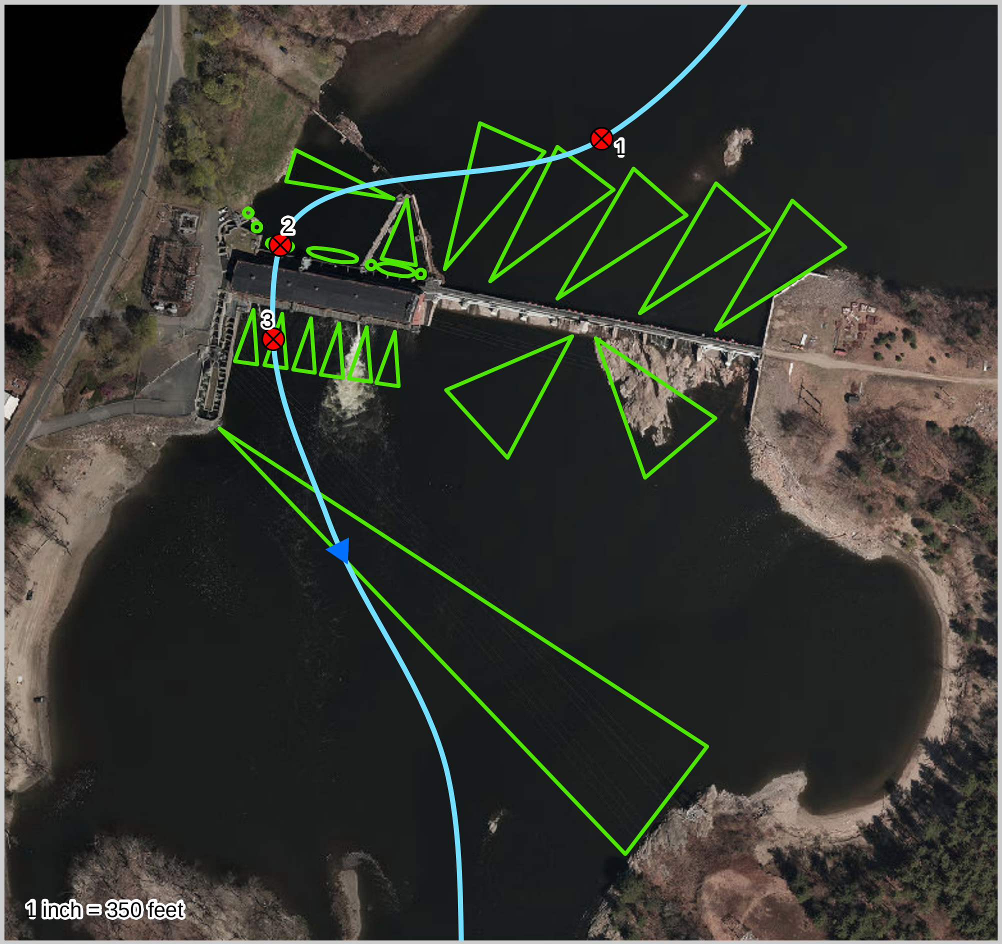


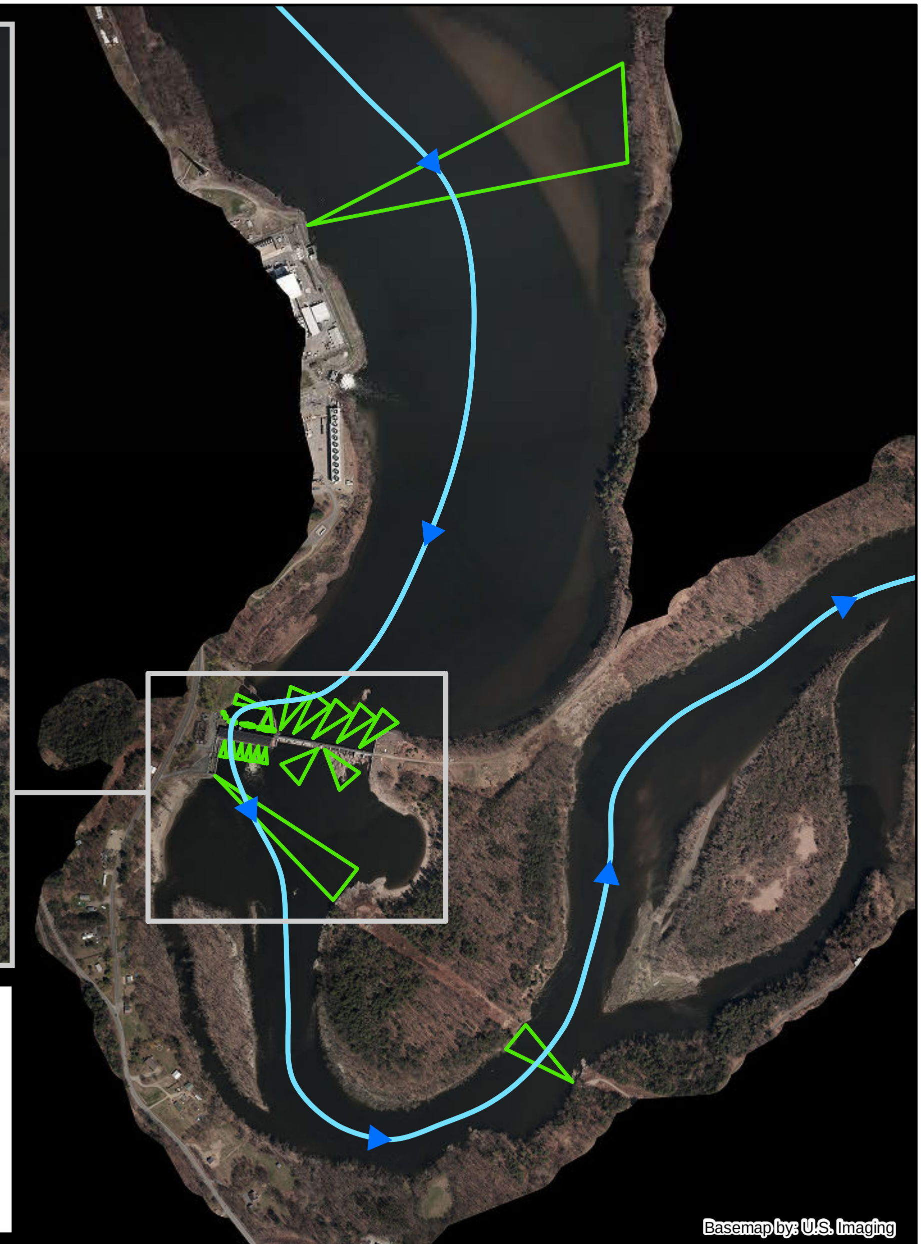


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 16:01 |
| 2 | 11/5/2015 | 16:07 |
| 3 | 11/5/2015 | 16:07 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-136 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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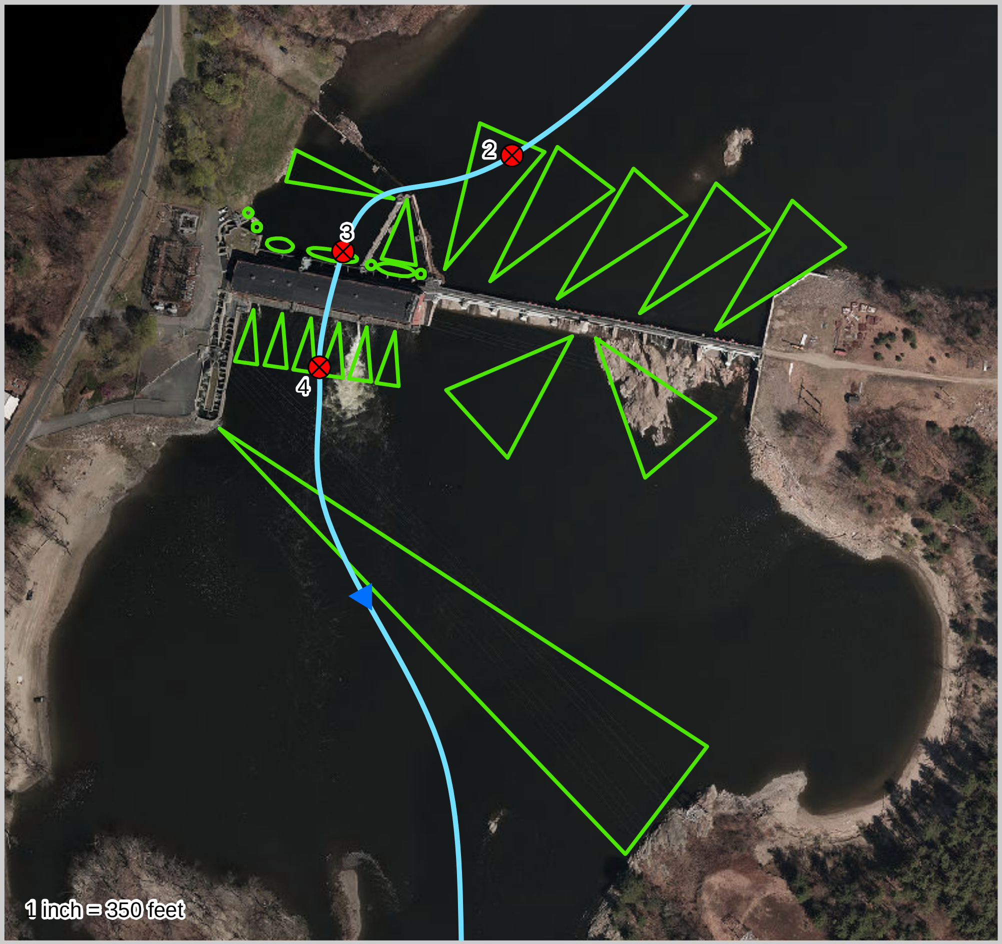


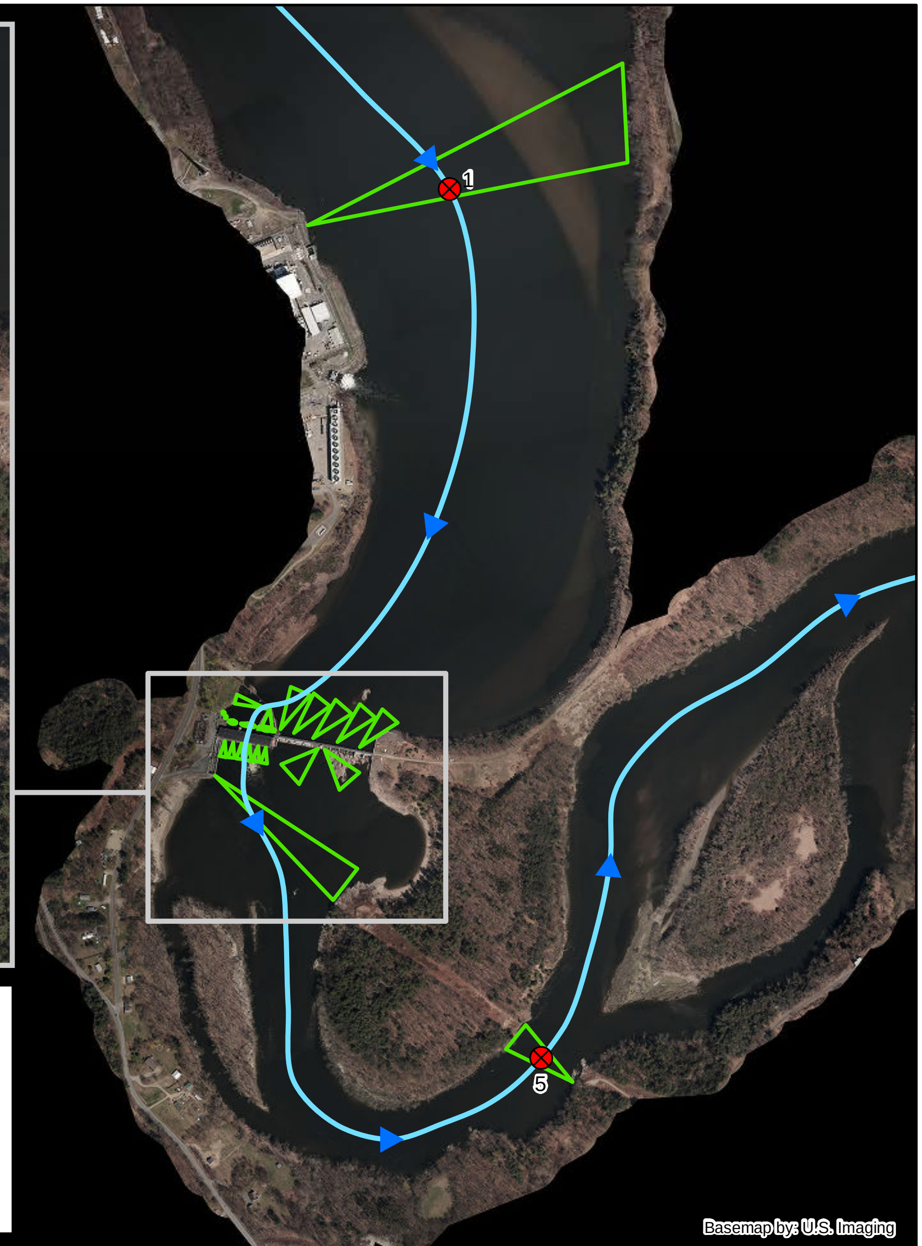


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 0:26 |
| 2 | 11/5/2015 | 1:00 |
| 3 | 11/5/2015 | 1:05 |
| 4 | 11/5/2015 | 1:06 |
| 5 | 11/5/2015 | 3:36 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-141 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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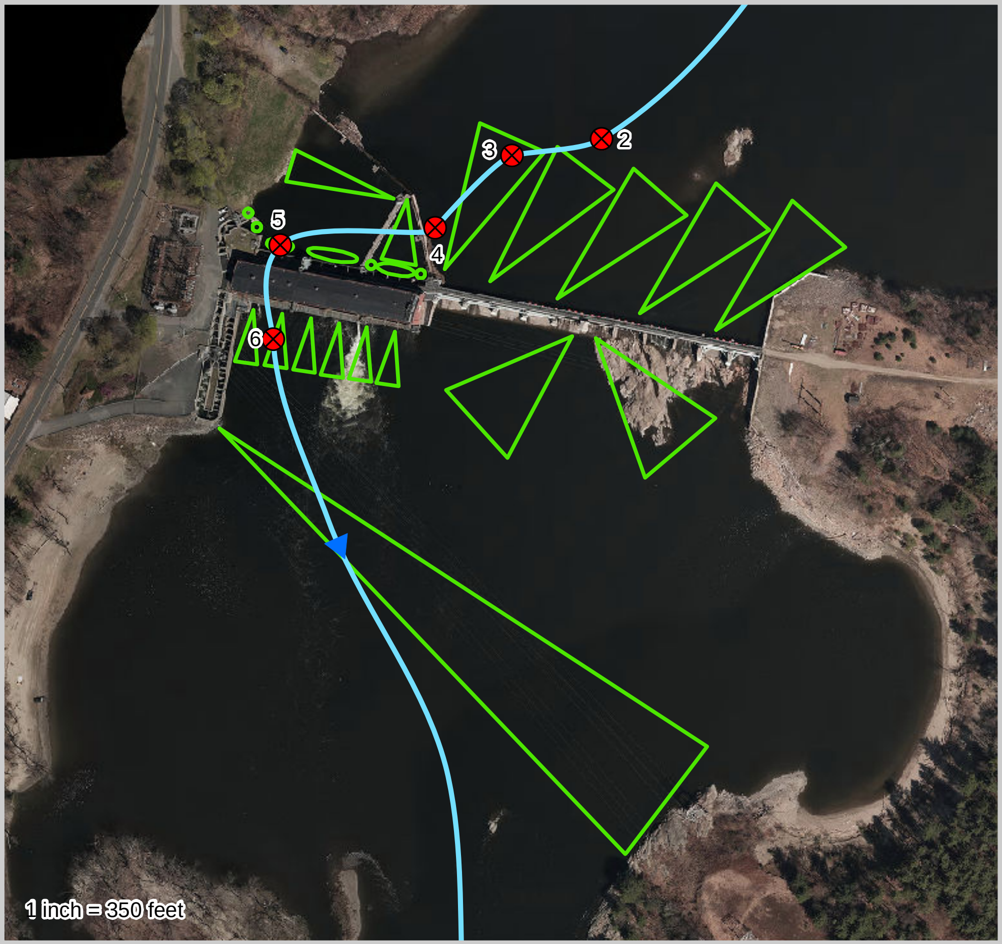


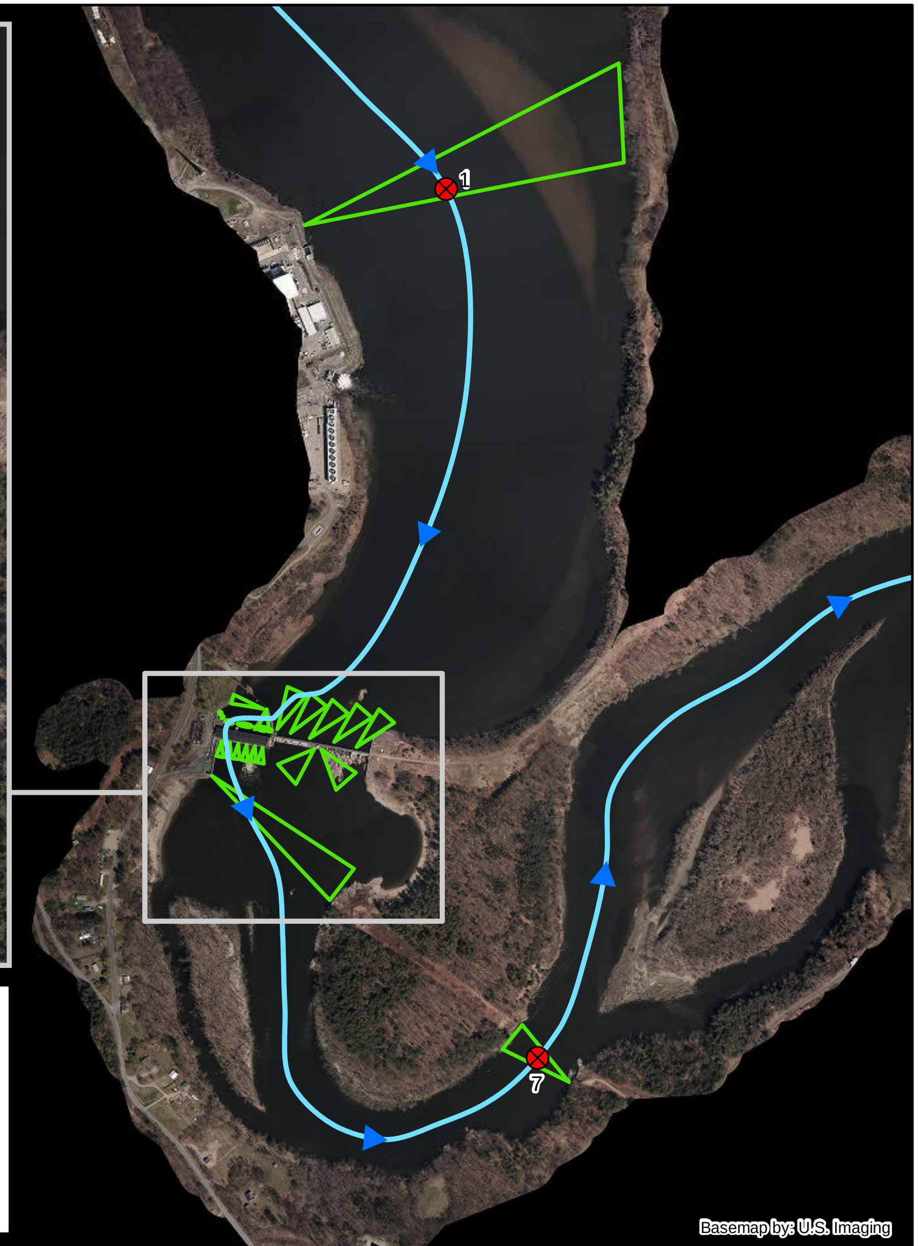


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/5/2015 | 19:44 | 6 | 11/5/2015 | 20:33 |
| 2 | 11/5/2015 | 20:20 | 7 | 11/5/2015 | 22:01 |
| 3 | 11/5/2015 | 20:27 | | | |
| 4 | 11/5/2015 | 20:30 | | | |
| 5 | 11/5/2015 | 20:31 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-142 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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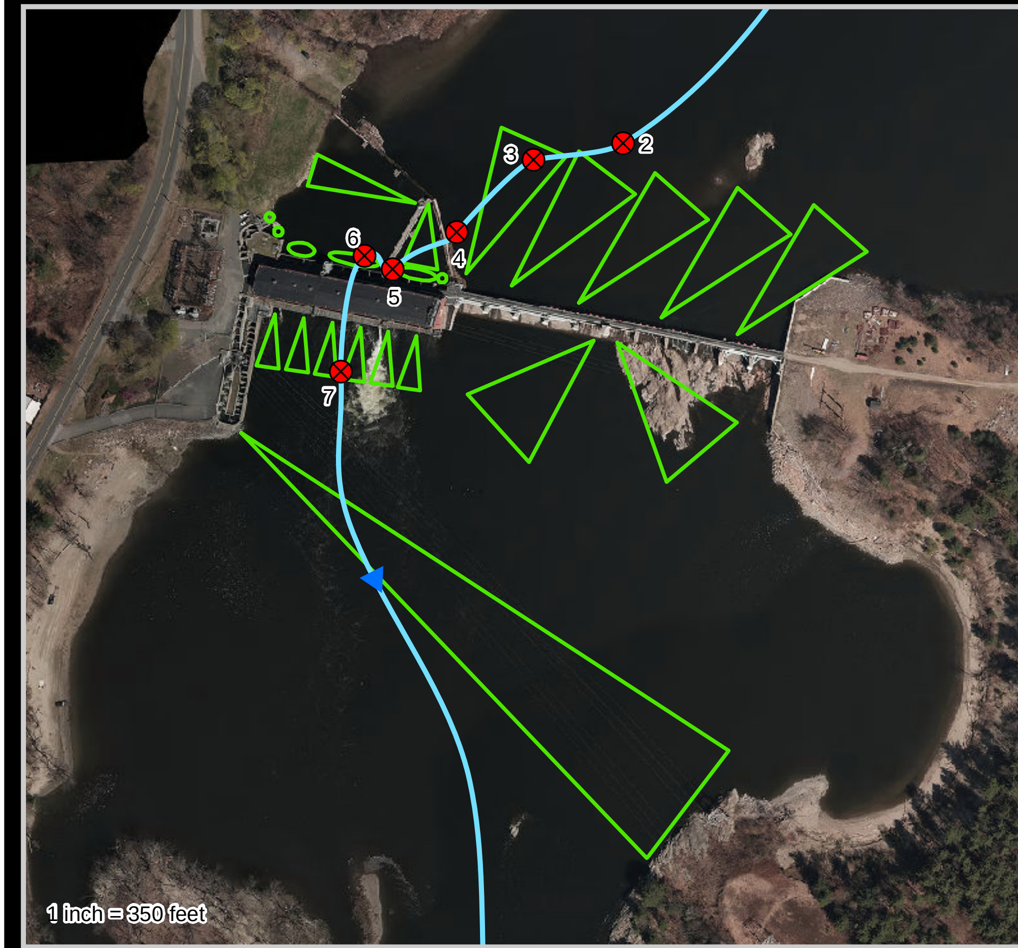


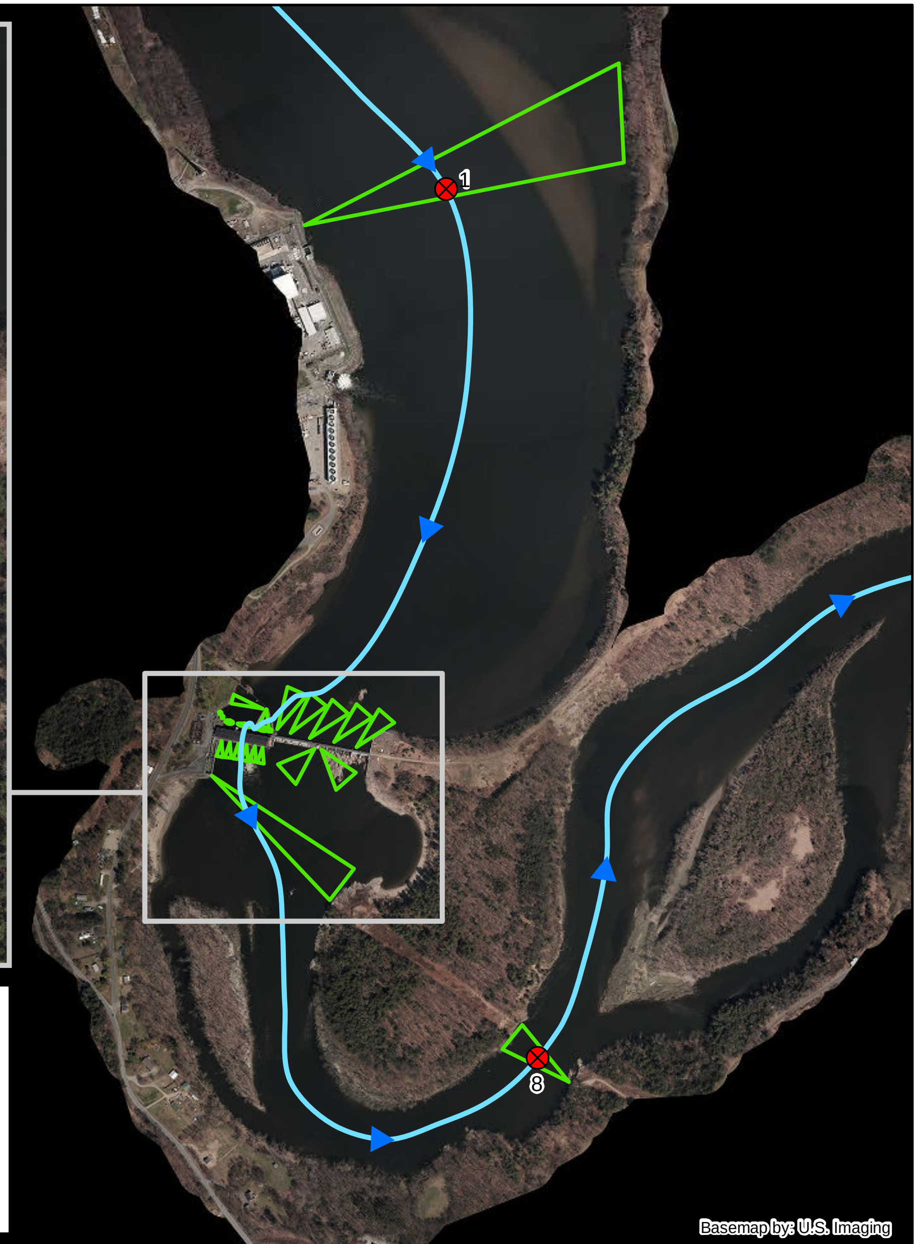


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 20:12 | 6 | 11/4/2015 | 21:28 |
| 2 | 11/4/2015 | 21:06 | 7 | 11/4/2015 | 21:28 |
| 3 | 11/4/2015 | 21:25 | 8 | 11/4/2015 | 21:43 |
| 4 | 11/4/2015 | 21:26 | | | |
| 5 | 11/4/2015 | 21:27 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-143 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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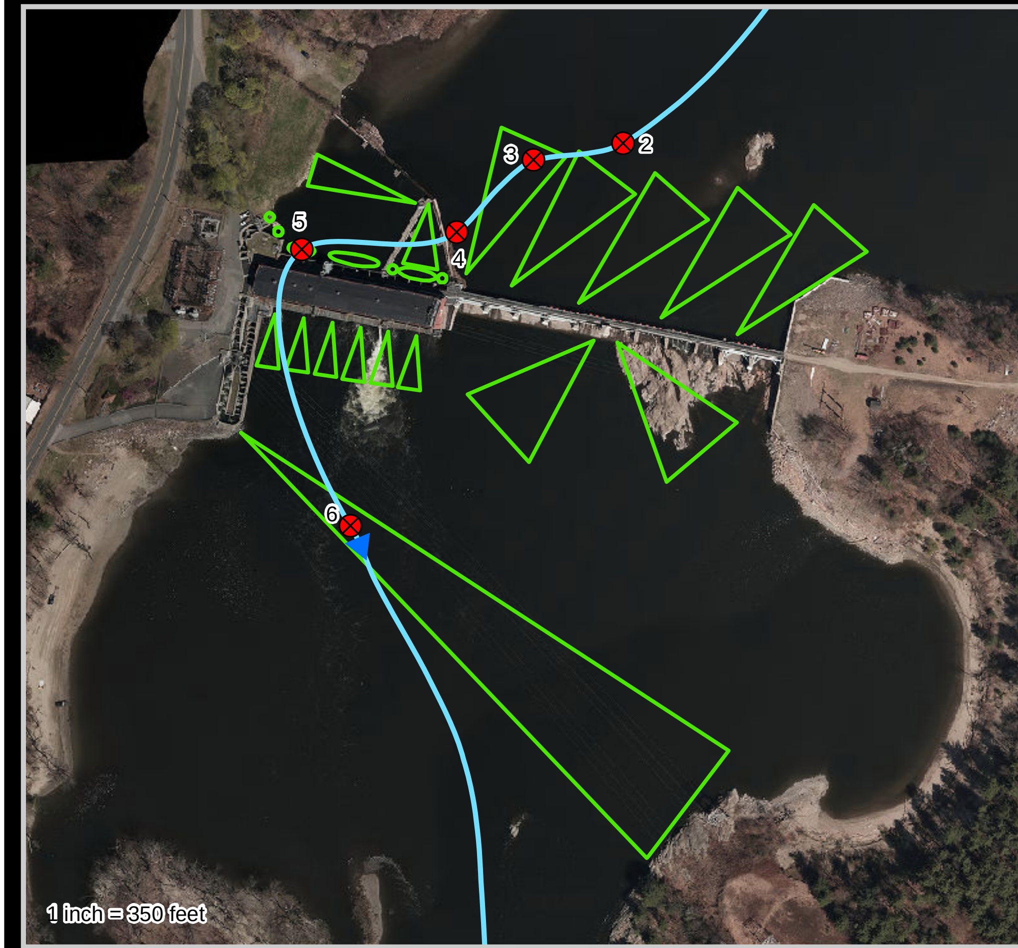
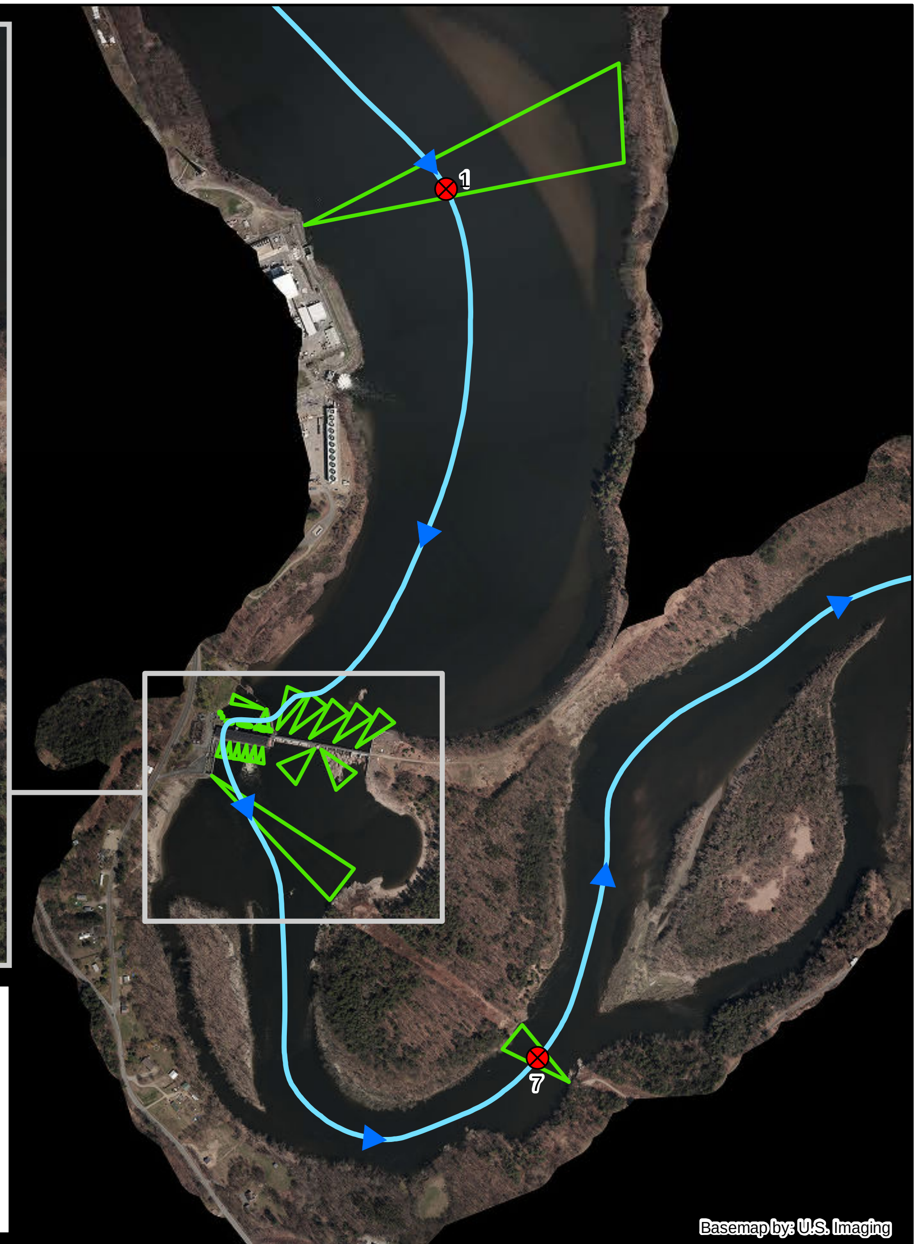



| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 12/18/2015 | 9:06 | 6 | 12/18/2015 | 12:01 |
| 2 | 12/18/2015 | 11:00 | 7 | 12/18/2015 | 12:49 |
| 3 | 12/18/2015 | 11:28 | | | |
| 4 | 12/18/2015 | 11:42 | | | |
| 5 | 12/18/2015 | 11:59 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones




**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-149 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20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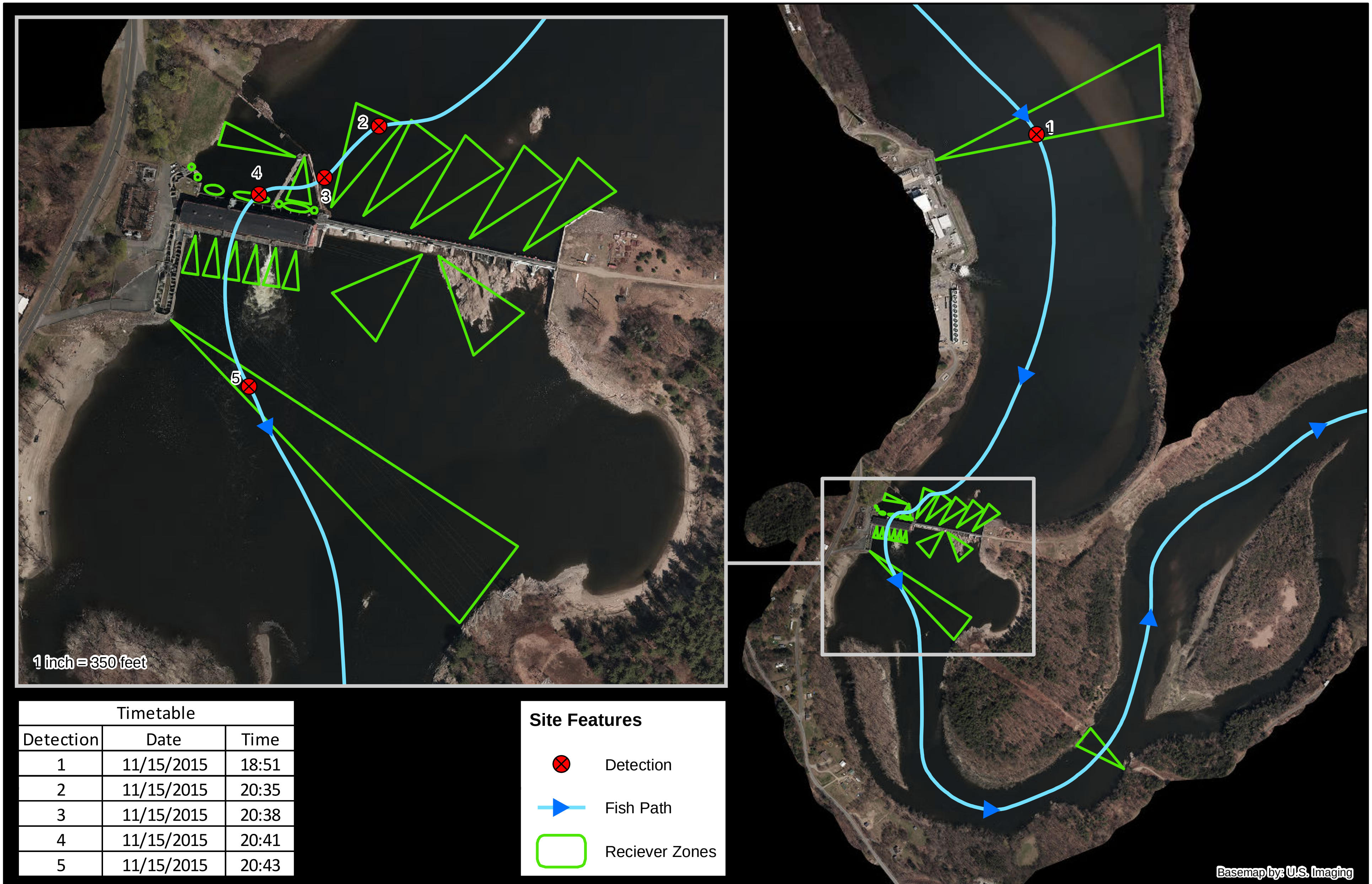


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/15/2015 | 18:51 |
| 2 | 11/15/2015 | 20:35 |
| 3 | 11/15/2015 | 20:38 |
| 4 | 11/15/2015 | 20:41 |
| 5 | 11/15/2015 | 20:43 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-150 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20


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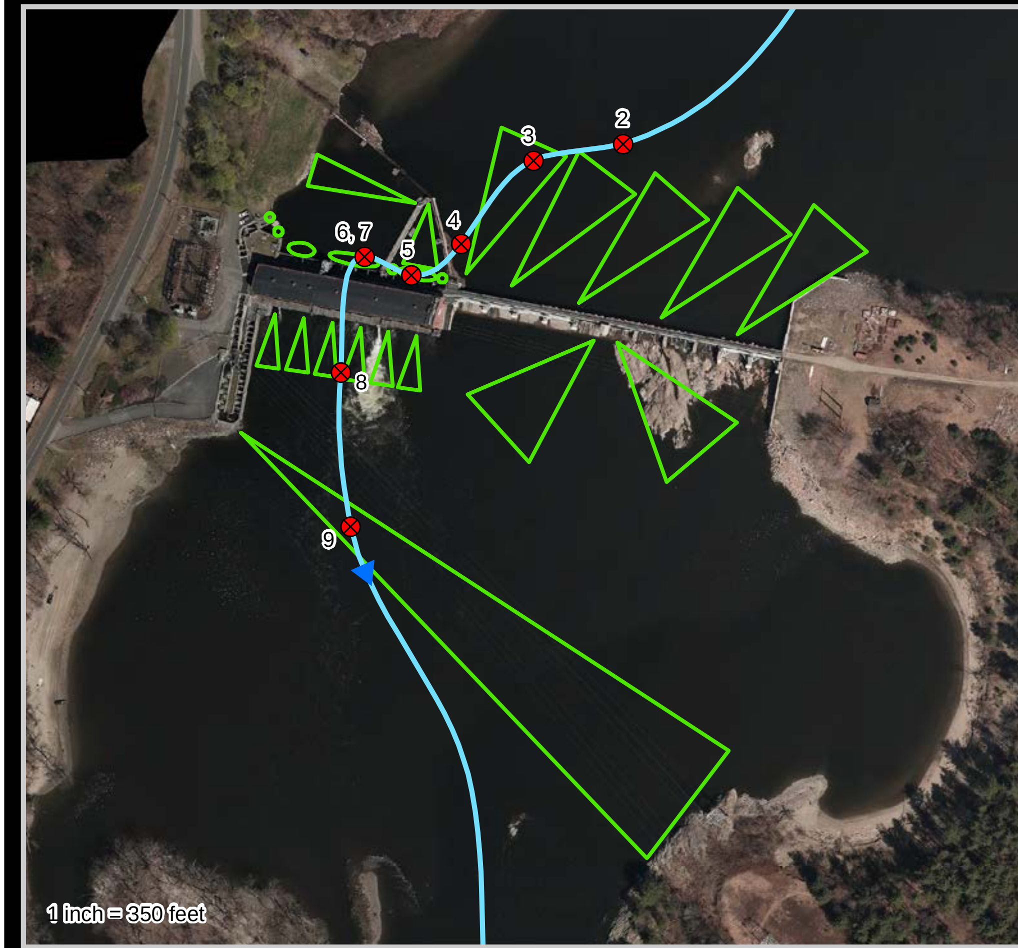


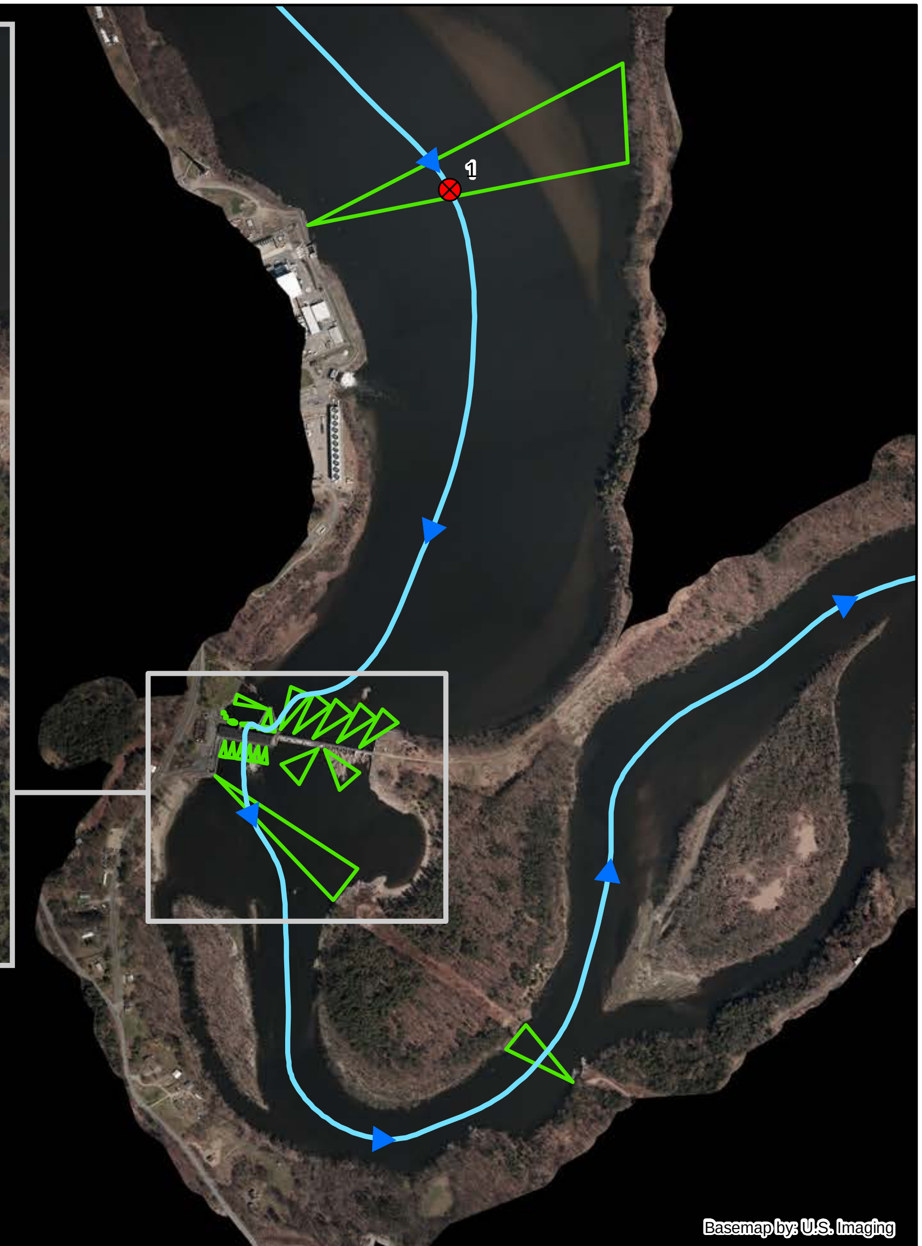


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/30/2015 | 21:29 | 6 | 10/30/2015 | 22:22 |
| 2 | 10/30/2015 | 22:11 | 7 | 10/30/2015 | 22:22 |
| 3 | 10/30/2015 | 22:17 | 8 | 10/30/2015 | 22:22 |
| 4 | 10/30/2015 | 22:21 | 9 | 10/30/2015 | 23:13 |
| 5 | 10/30/2015 | 22:21 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-53 (T1)**

Release: Bellows Falls Canal
Date Released: 10/29/2015
Time Released: 17:32

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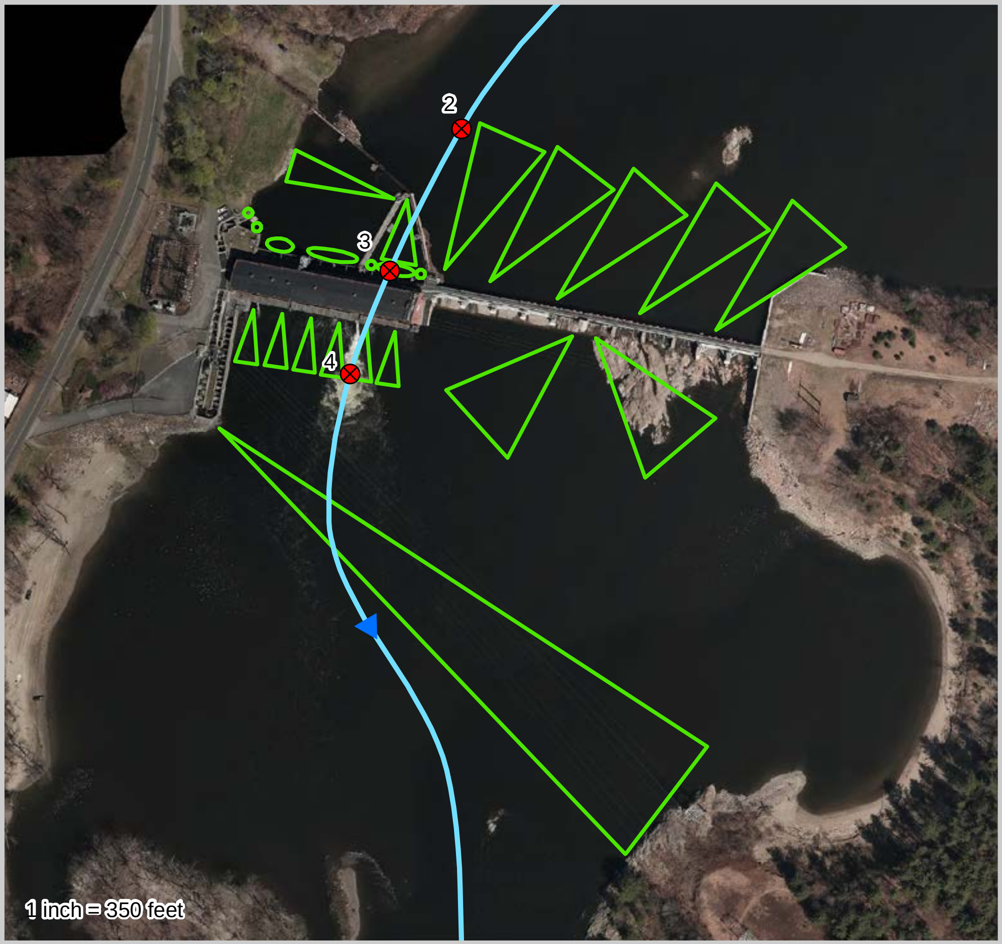


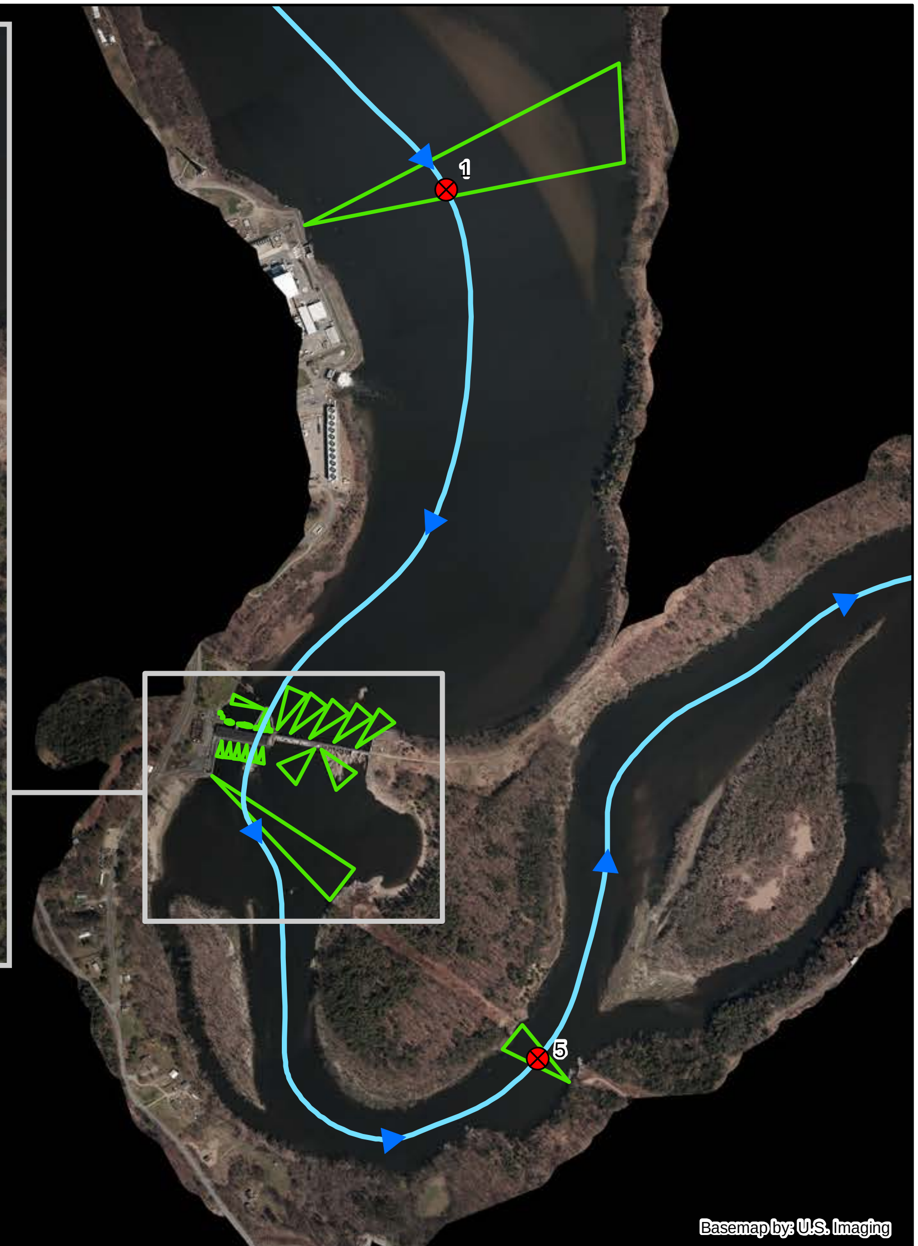


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 19:31 |
| 2 | 11/10/2015 | 20:38 |
| 3 | 11/10/2015 | 21:08 |
| 4 | 11/10/2015 | 21:10 |
| 5 | 11/11/2015 | 2:24 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-54 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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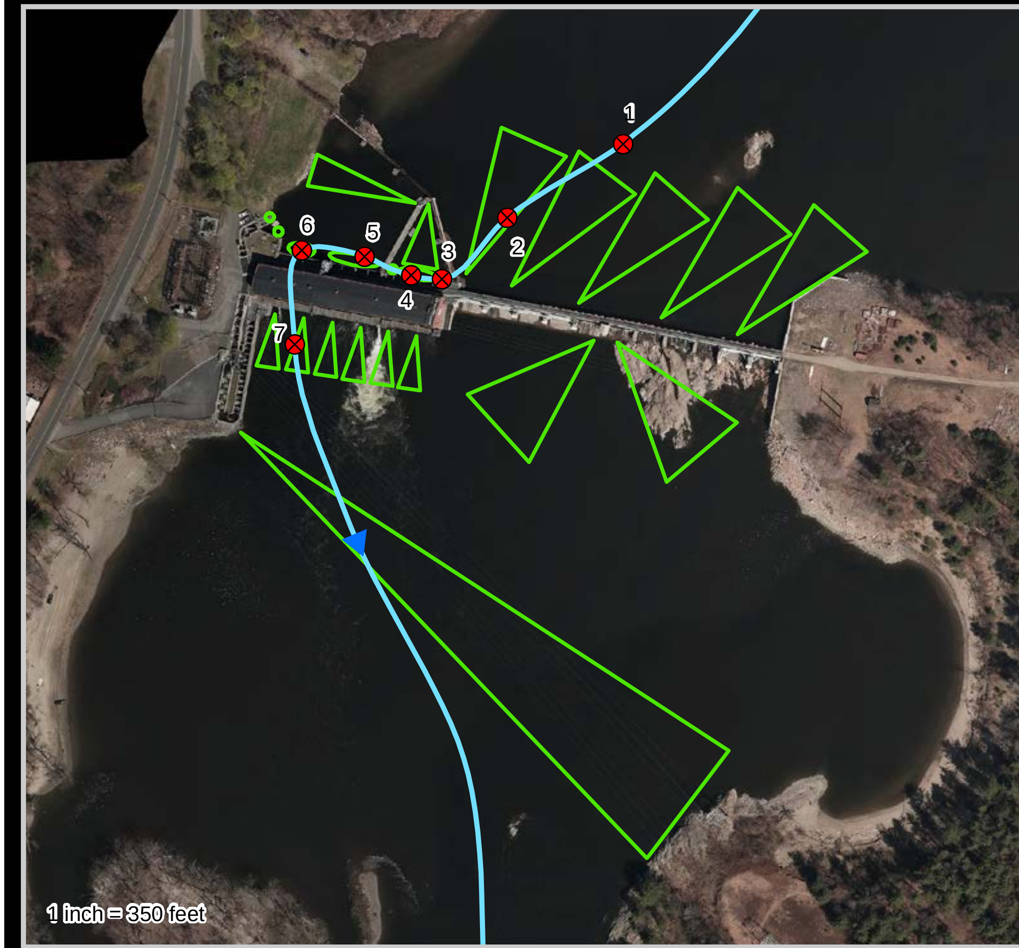


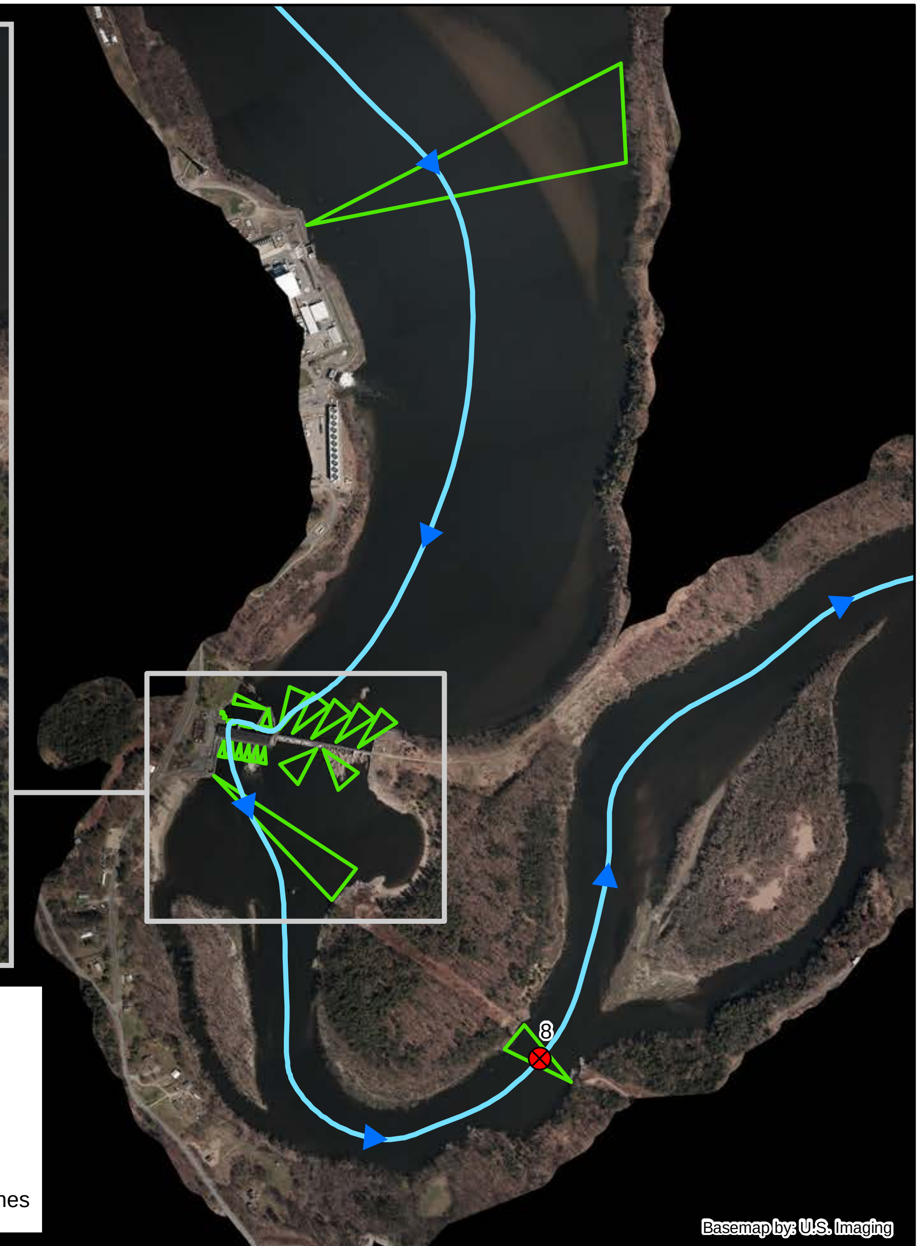


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/5/2015 | 12:52 | 5 | 11/5/2015 | 13:11 |
| 2 | 11/5/2015 | 12:58 | 6 | 11/5/2015 | 13:49 |
| 3 | 11/5/2015 | 13:00 | 7 | 11/5/2015 | 13:52 |
| 4 | 11/5/2015 | 13:00 | 8 | 11/5/2015 | 15:24 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-55 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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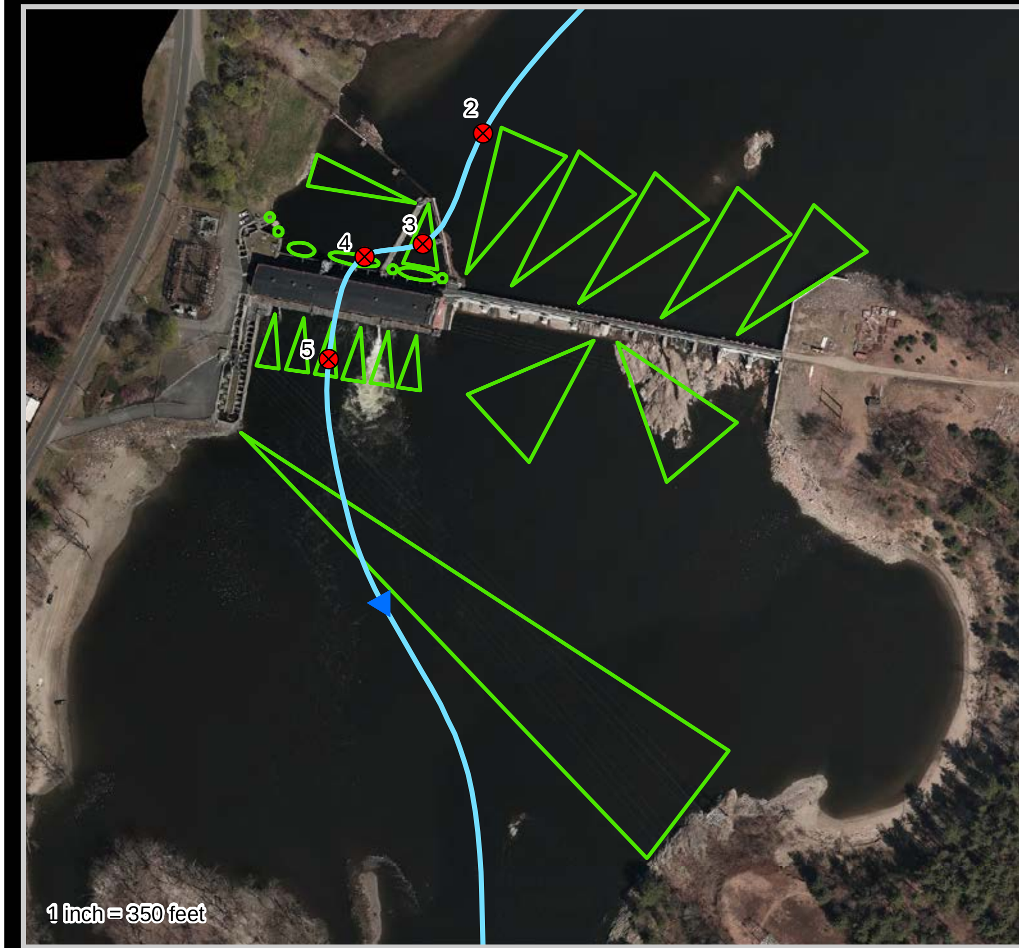


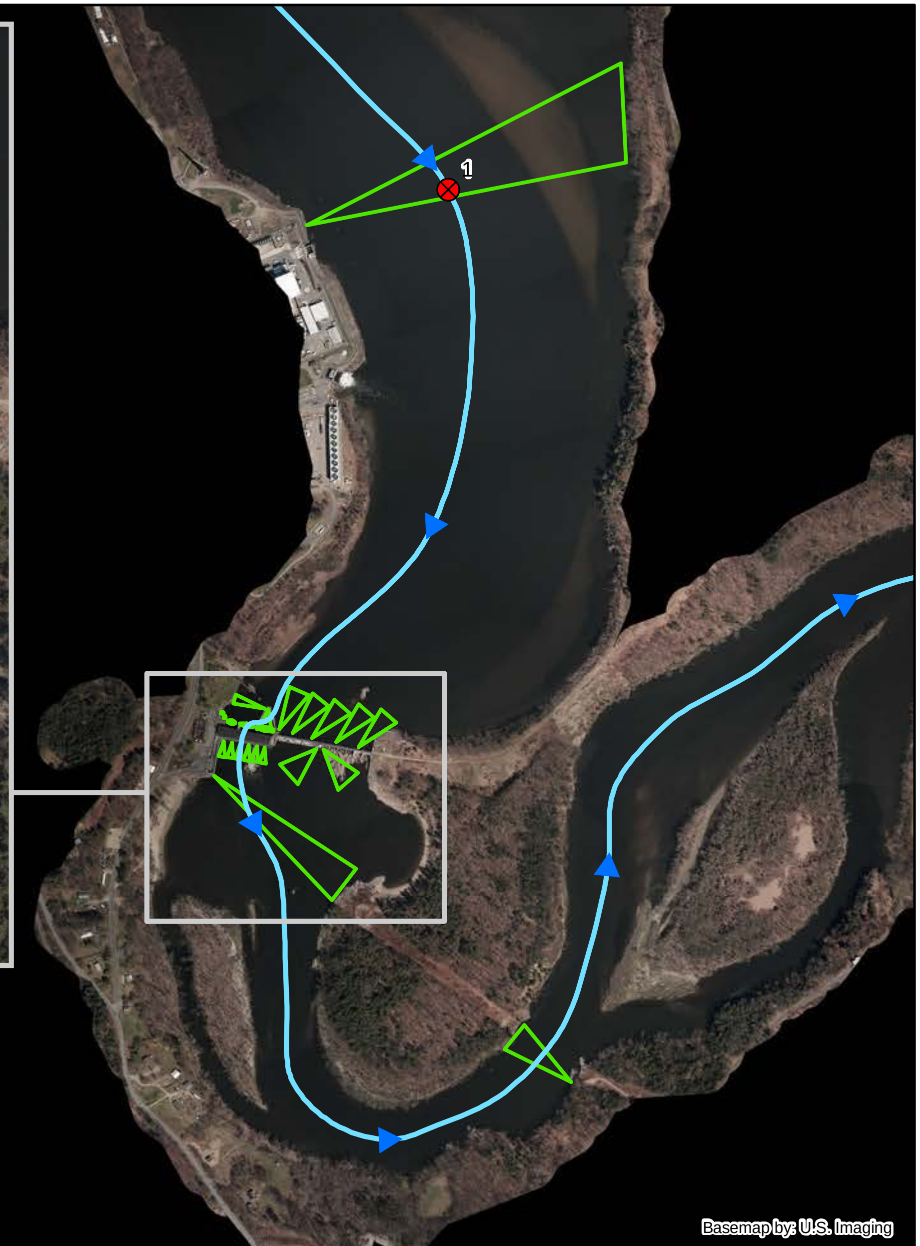


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 21:14 |
| 2 | 11/10/2015 | 21:46 |
| 3 | 11/10/2015 | 21:48 |
| 4 | 11/10/2015 | 21:51 |
| 5 | 11/10/2015 | 21:51 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-57 (T1)**

Release: Norwich, VT
Date Released: 11/5/2015
Time Released: 17:05


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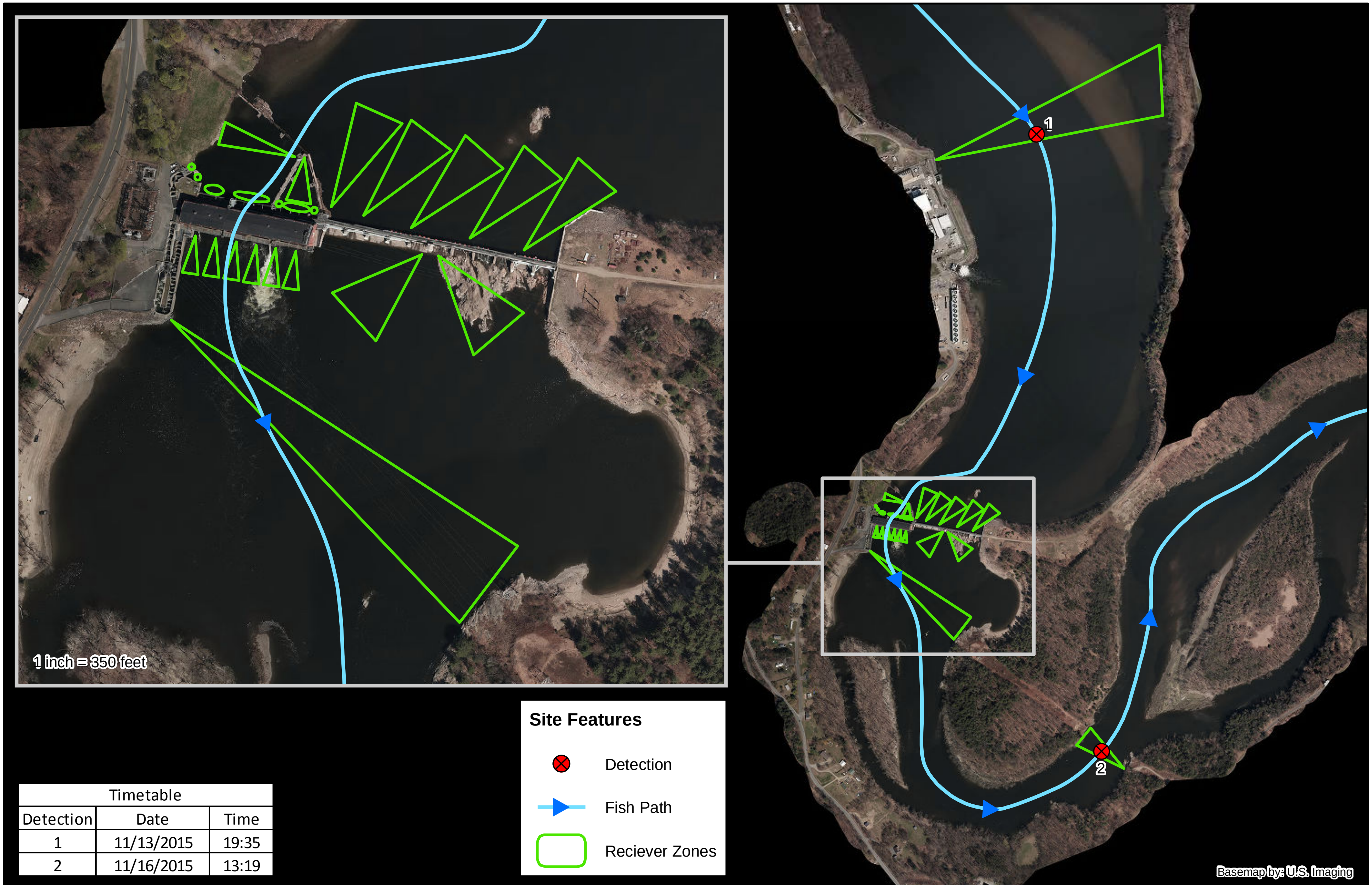


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/13/2015 | 19:35 |
| 2 | 11/16/2015 | 13:19 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-151 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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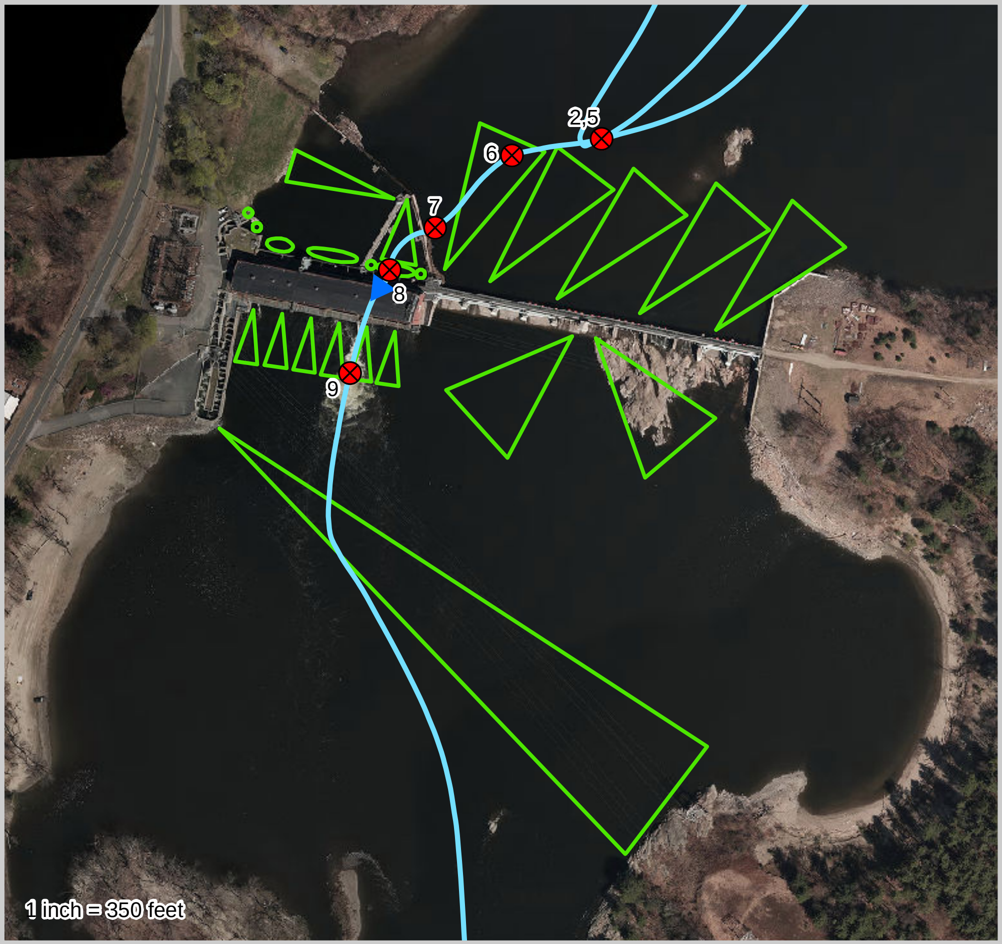


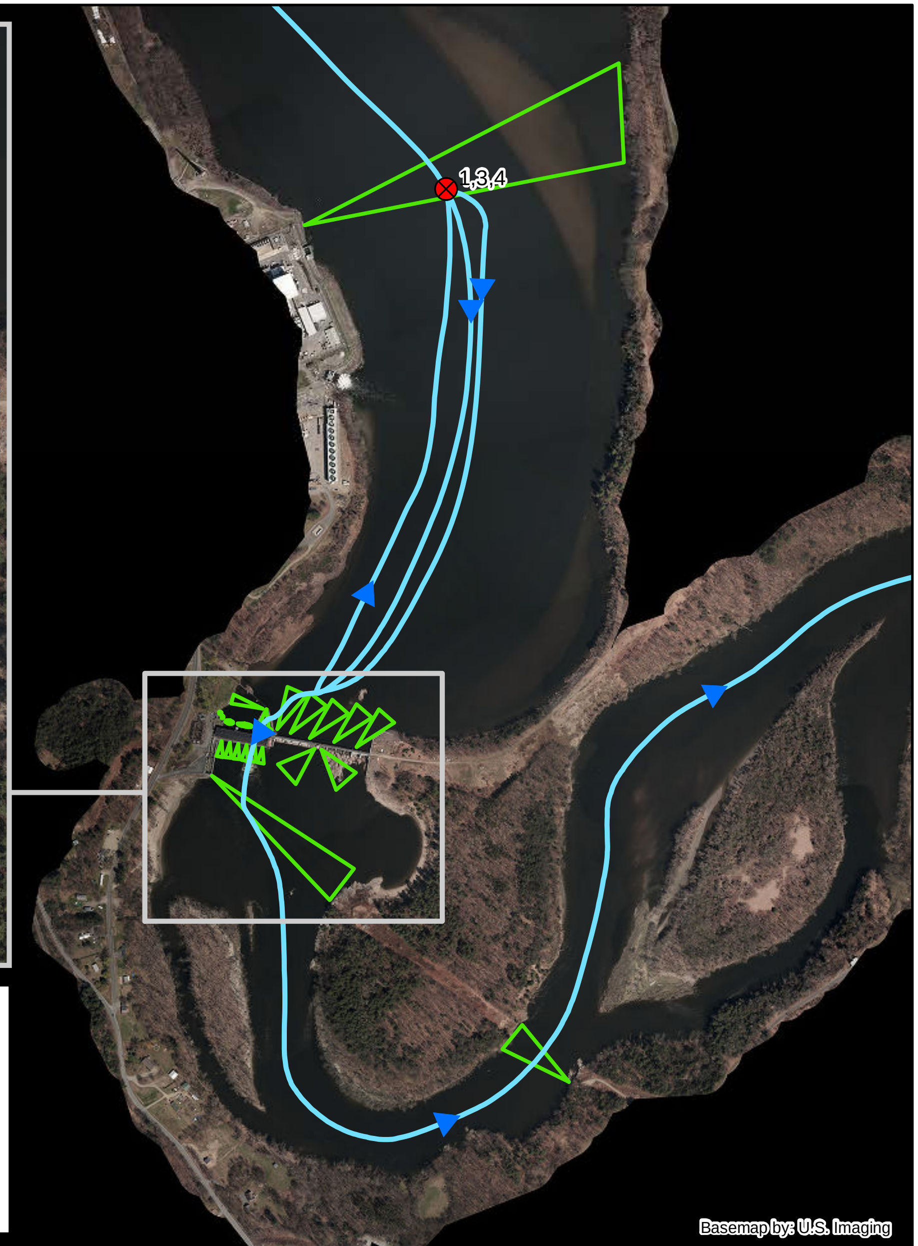


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/3/2015 | 0:53 | 6 | 11/3/2015 | 20:15 |
| 2 | 11/3/2015 | 2:07 | 7 | 11/3/2015 | 20:16 |
| 3 | 11/3/2015 | 3:04 | 8 | 11/3/2015 | 20:18 |
| 4 | 11/3/2015 | 19:39 | 9 | 11/3/2015 | 20:19 |
| 5 | 11/3/2015 | 20:07 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-152 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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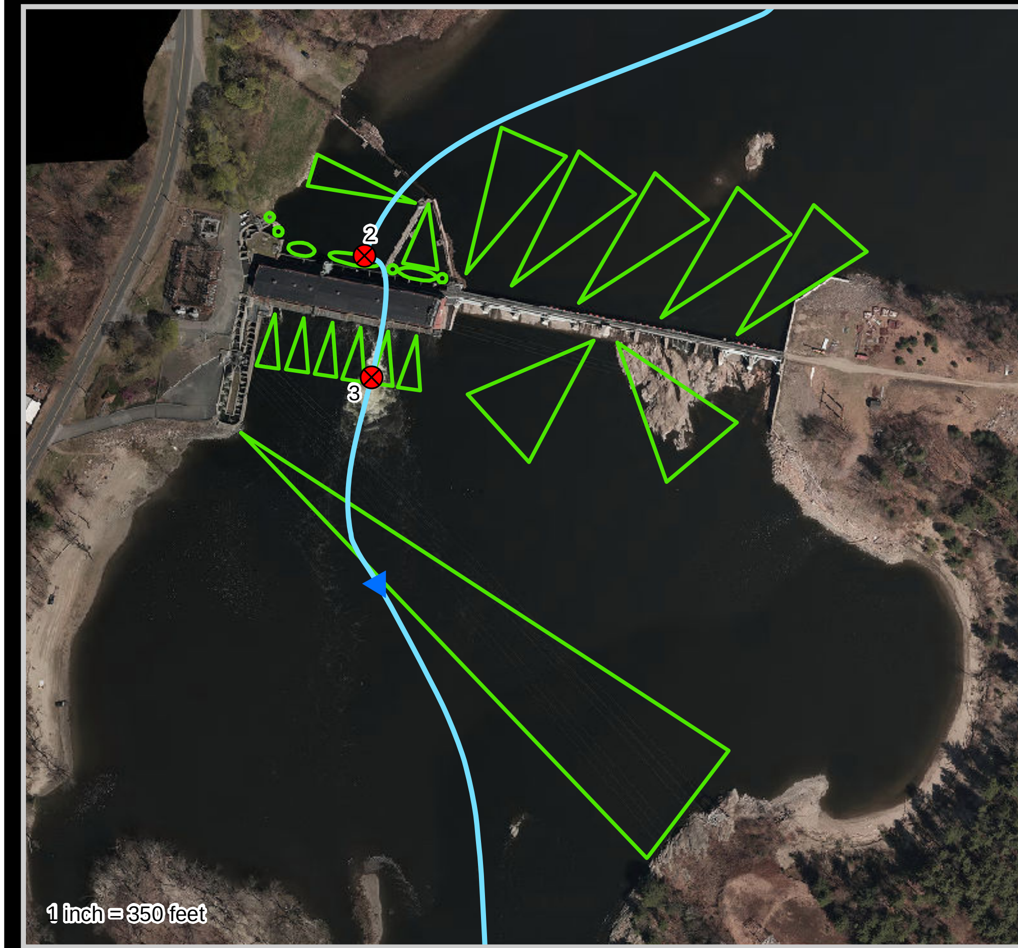


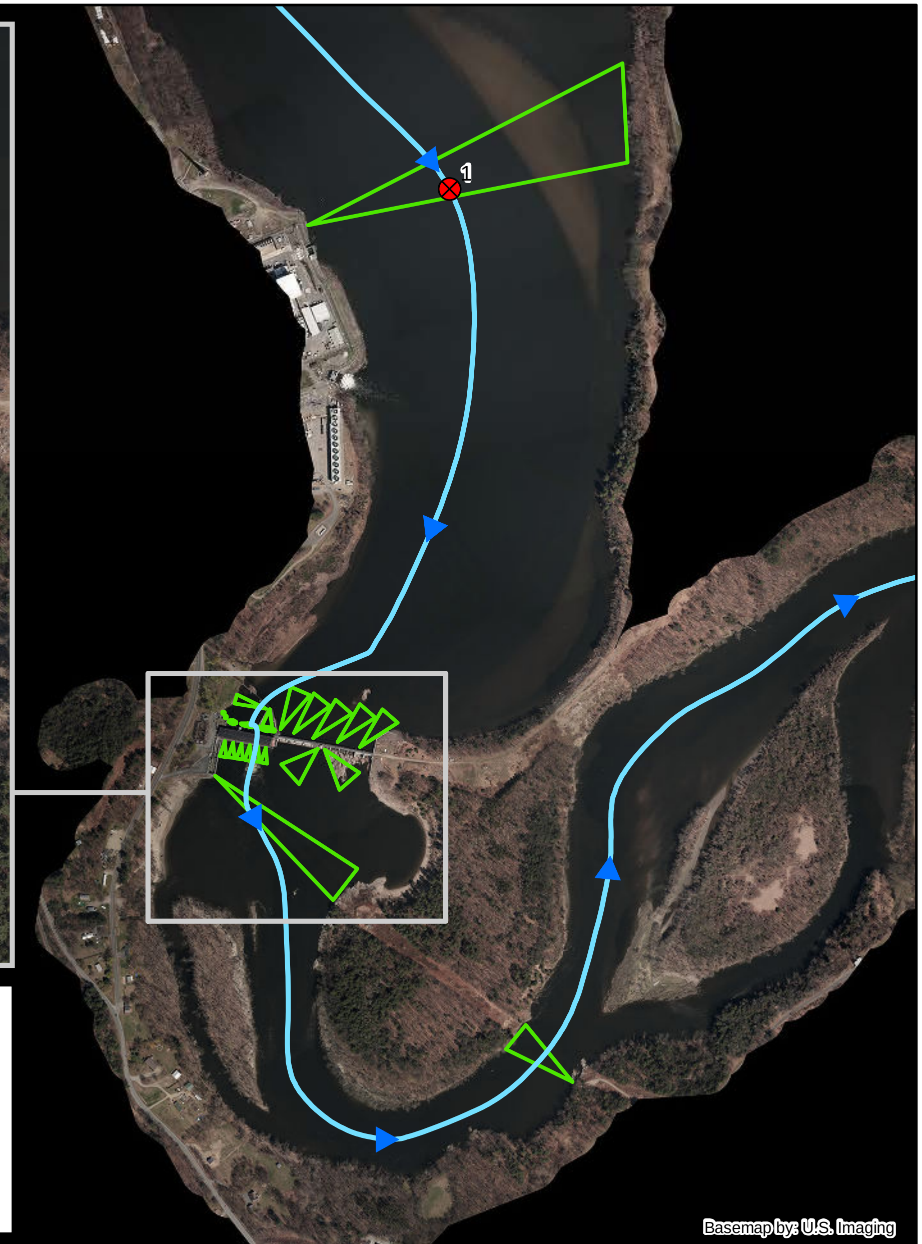


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 22:33 |
| 2 | 11/1/2015 | 22:55 |
| 3 | 11/1/2015 | 23:11 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-153 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43


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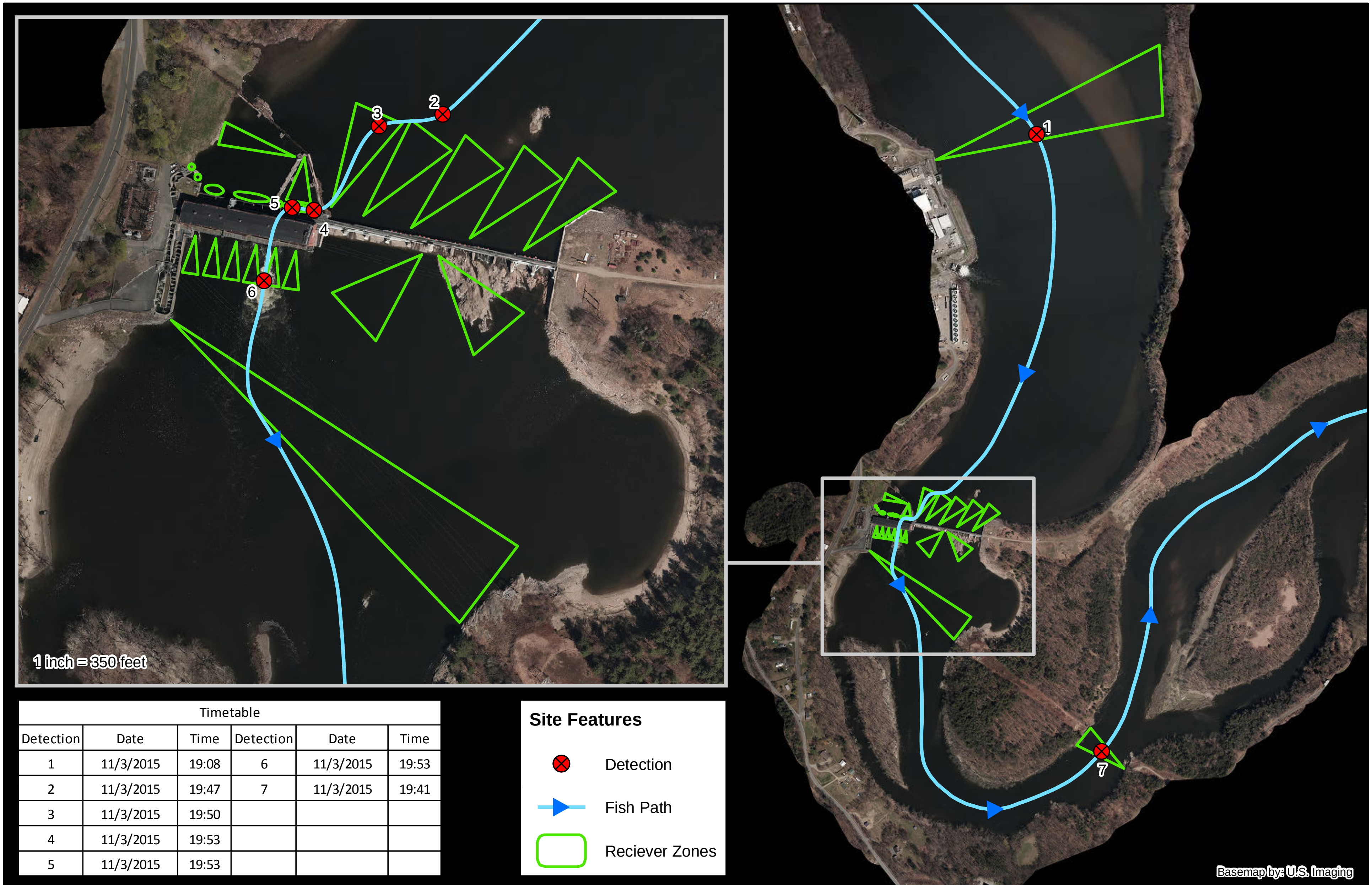


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/3/2015 | 19:08 | 6 | 11/3/2015 | 19:53 |
| 2 | 11/3/2015 | 19:47 | 7 | 11/3/2015 | 19:41 |
| 3 | 11/3/2015 | 19:50 | | | |
| 4 | 11/3/2015 | 19:53 | | | |
| 5 | 11/3/2015 | 19:53 | | | |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-161 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/2015
Time Released: 13:40

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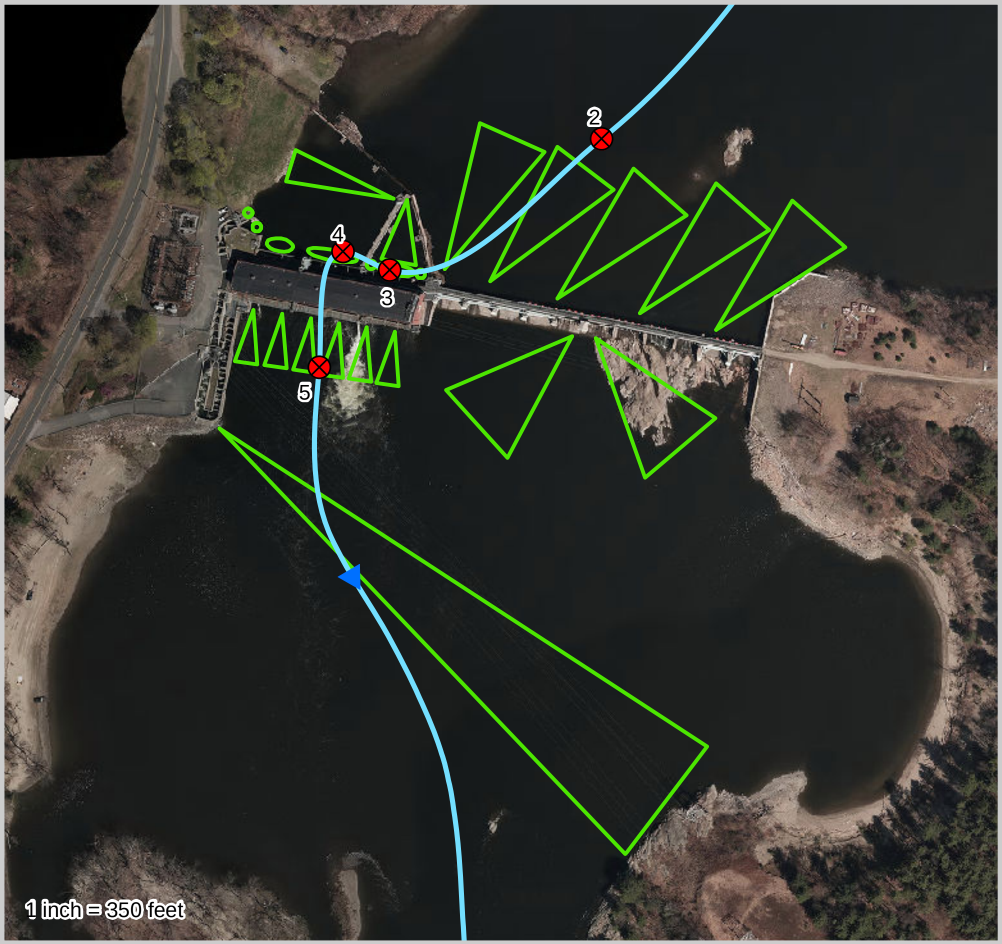


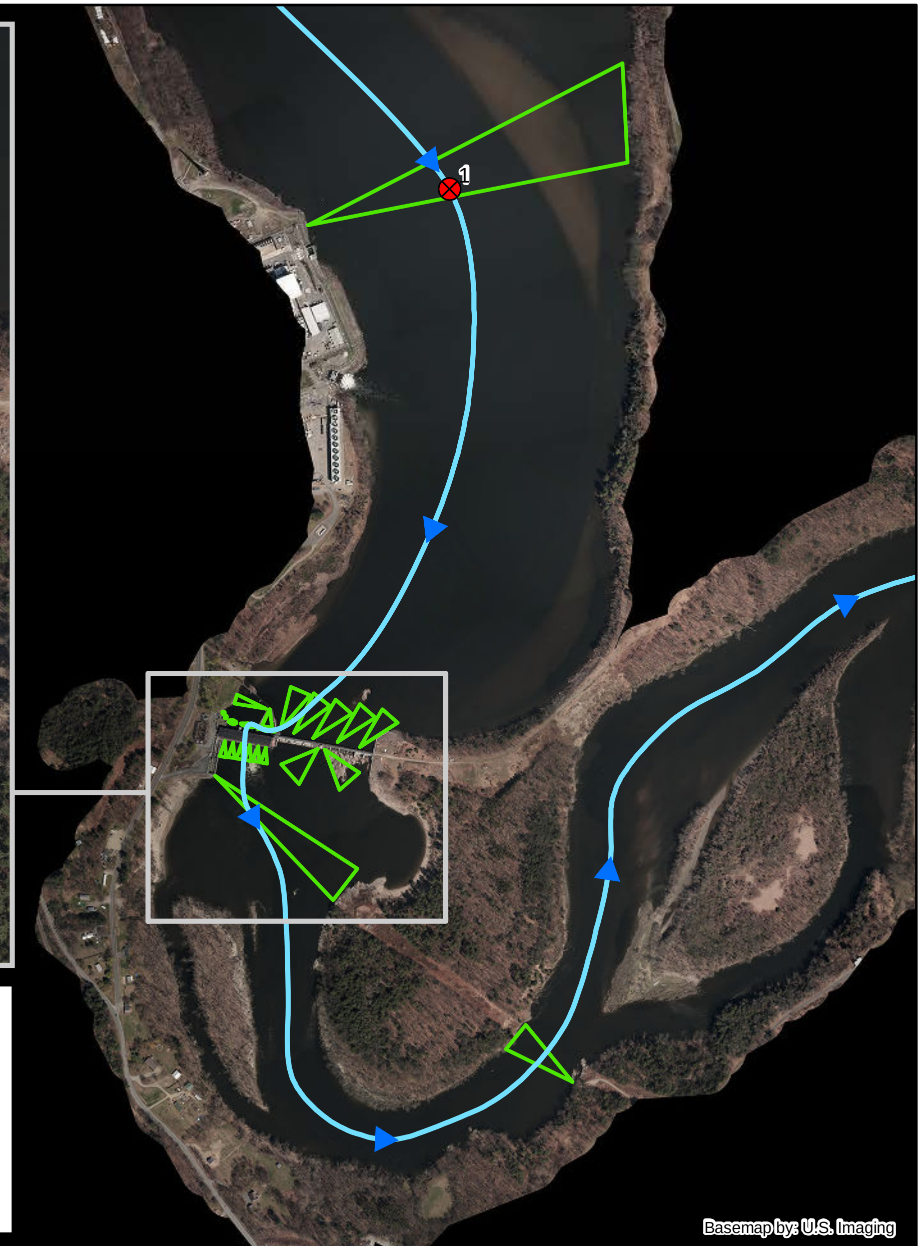


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/31/2015 | 20:43 |
| 2 | 10/31/2015 | 21:07 |
| 3 | 10/31/2015 | 21:09 |
| 4 | 10/31/2015 | 21:10 |
| 5 | 10/31/2015 | 21:10 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-163 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/2015
Time Released: 13:40


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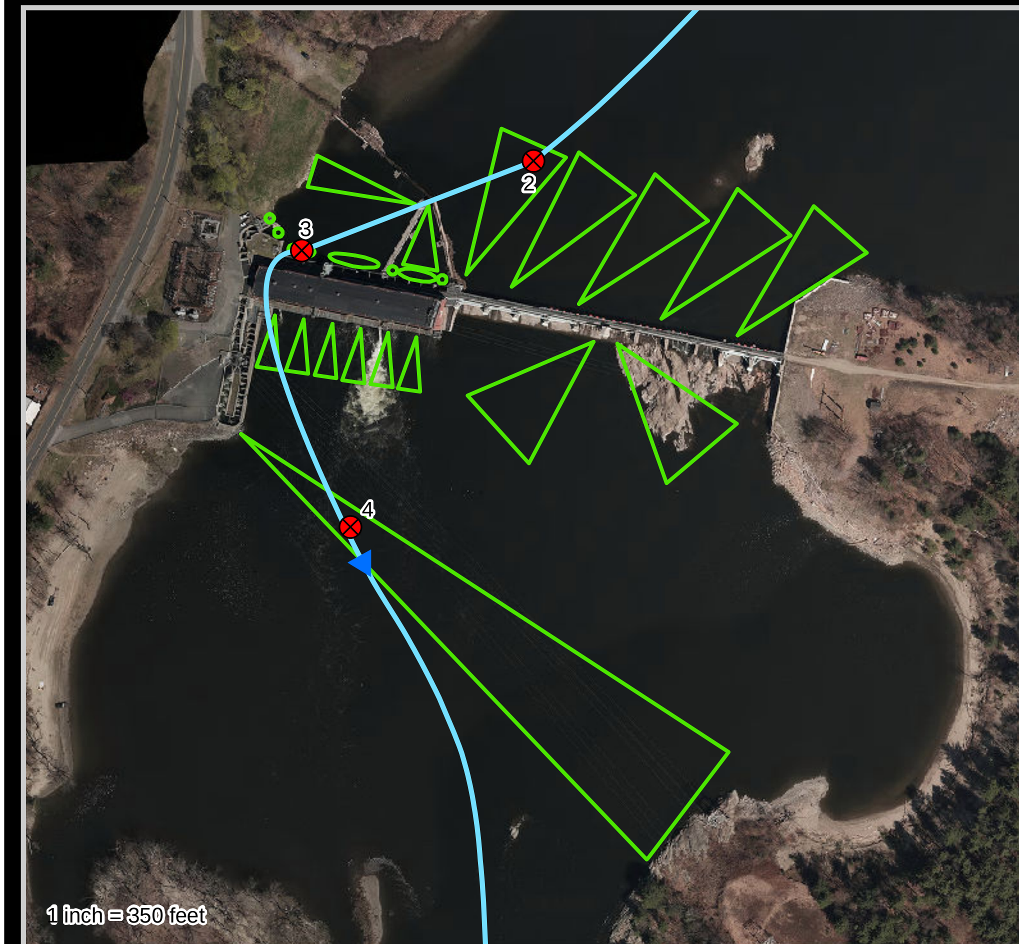


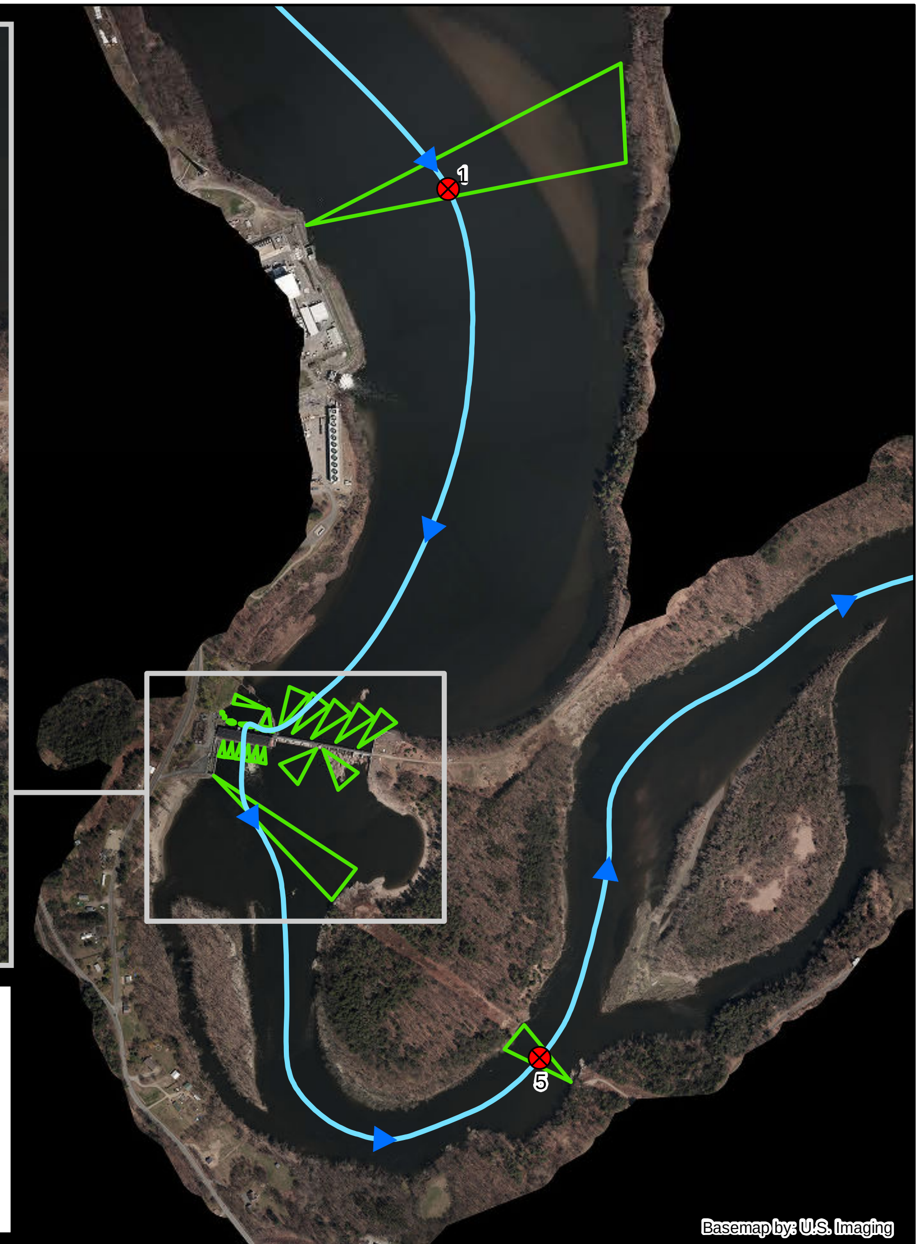


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 23:29 |
| 2 | 11/9/2015 | 0:28 |
| 3 | 11/9/2015 | 0:35 |
| 4 | 11/9/2015 | 0:38 |
| 5 | 11/9/2015 | 1:18 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-173 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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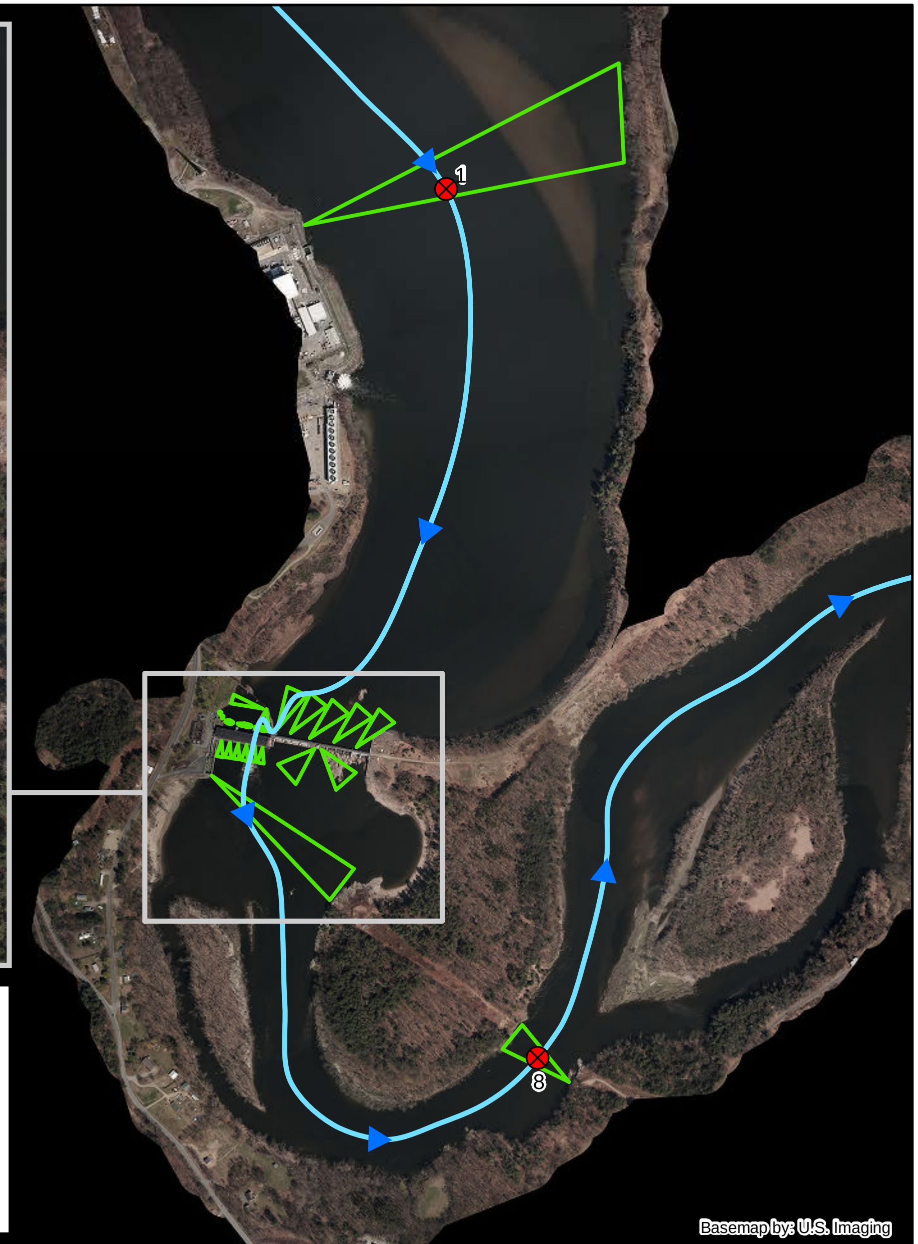
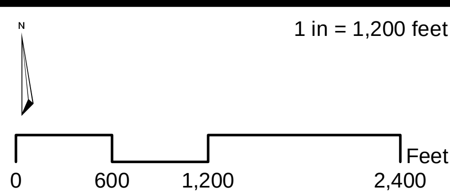



| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 4:32 | 6 | 11/4/2015 | 5:31 |
| 2 | 11/4/2015 | 5:07 | 7 | 11/4/2015 | 5:31 |
| 3 | 11/4/2015 | 5:28 | 8 | 11/4/2015 | 6:02 |
| 4 | 11/4/2015 | 5:30 | | | |
| 5 | 11/4/2015 | 5:31 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**




**Study 19 Fish Number: 34-181 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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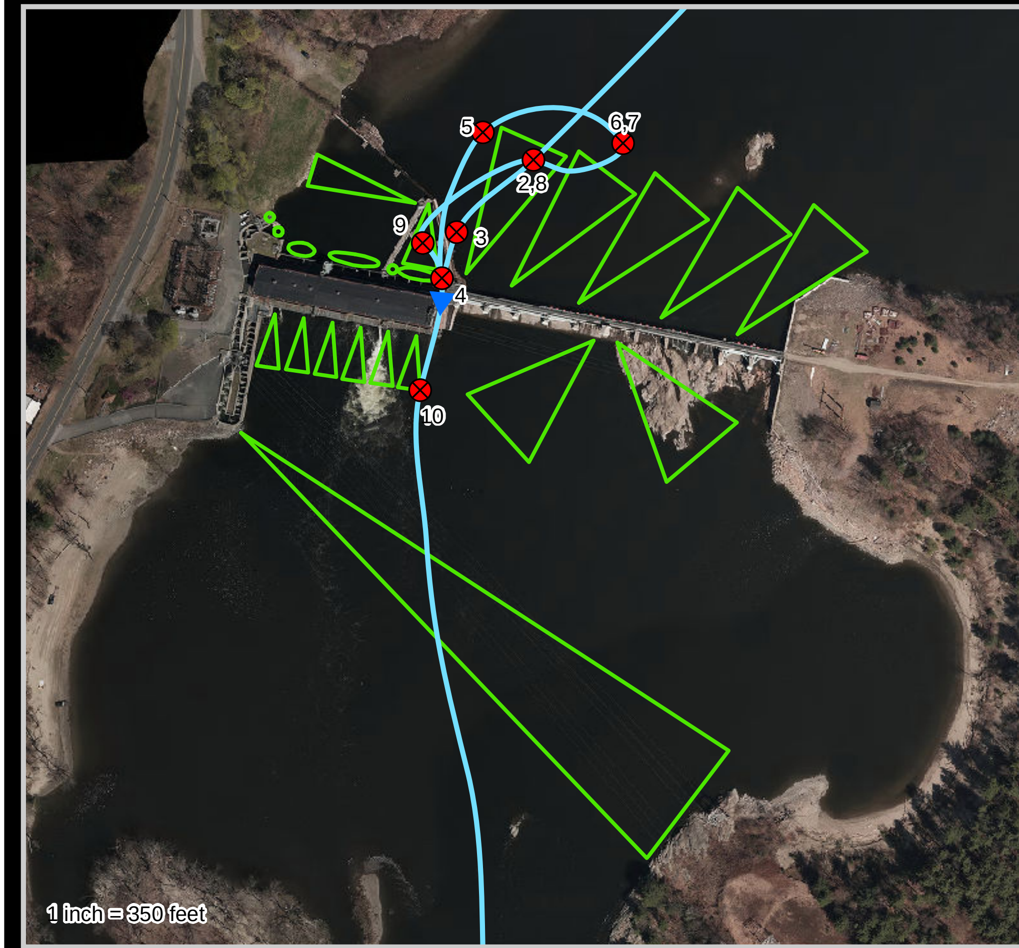


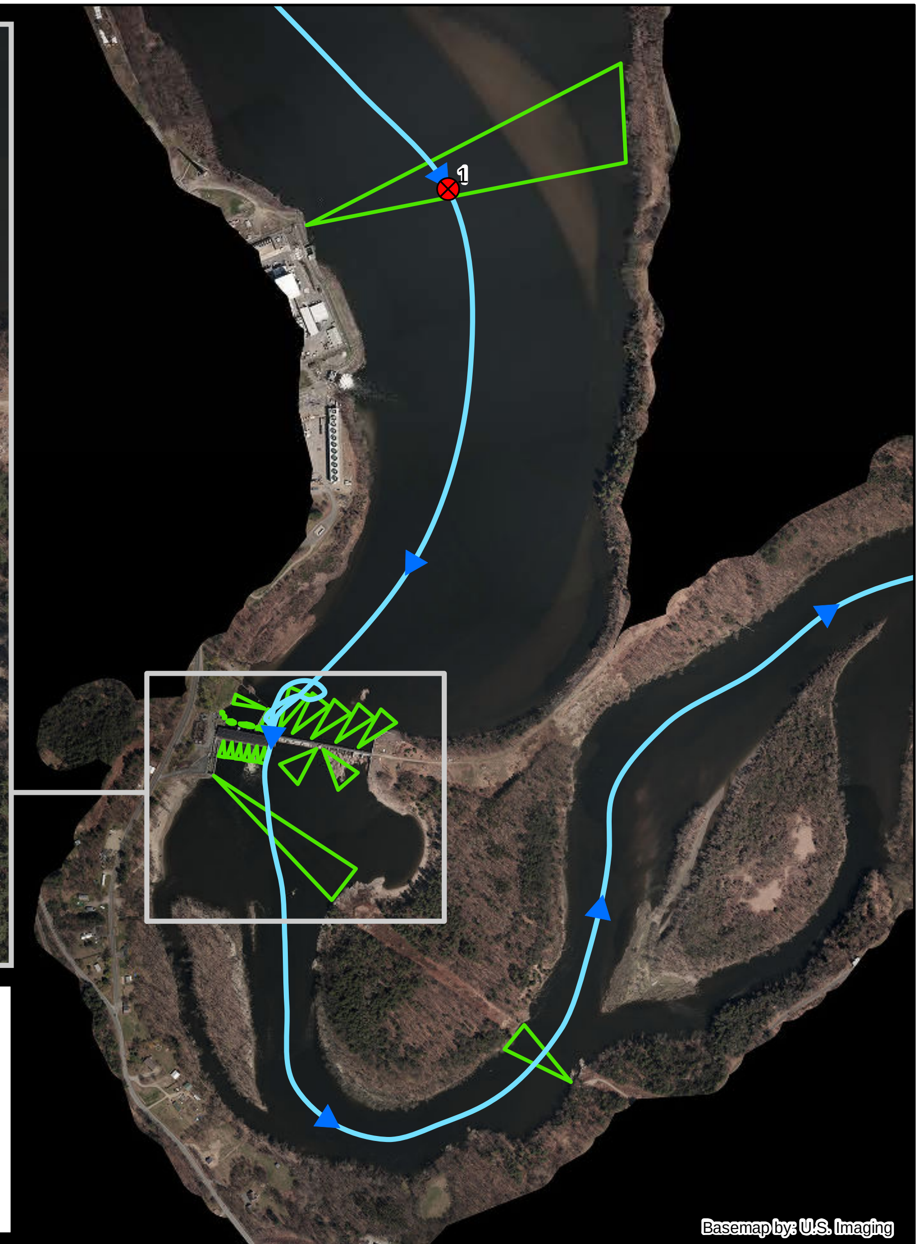


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/7/2015 | 19:54 | 6 | 11/8/2015 | 17:44 |
| 2 | 11/7/2015 | 20:29 | 7 | 11/8/2015 | 18:32 |
| 3 | 11/7/2015 | 20:32 | 8 | 11/8/2015 | 19:04 |
| 4 | 11/7/2015 | 20:33 | 9 | 11/8/2015 | 19:36 |
| 5 | 11/8/2015 | 11:38 | 10 | 11/8/2015 | 19:39 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 34-183 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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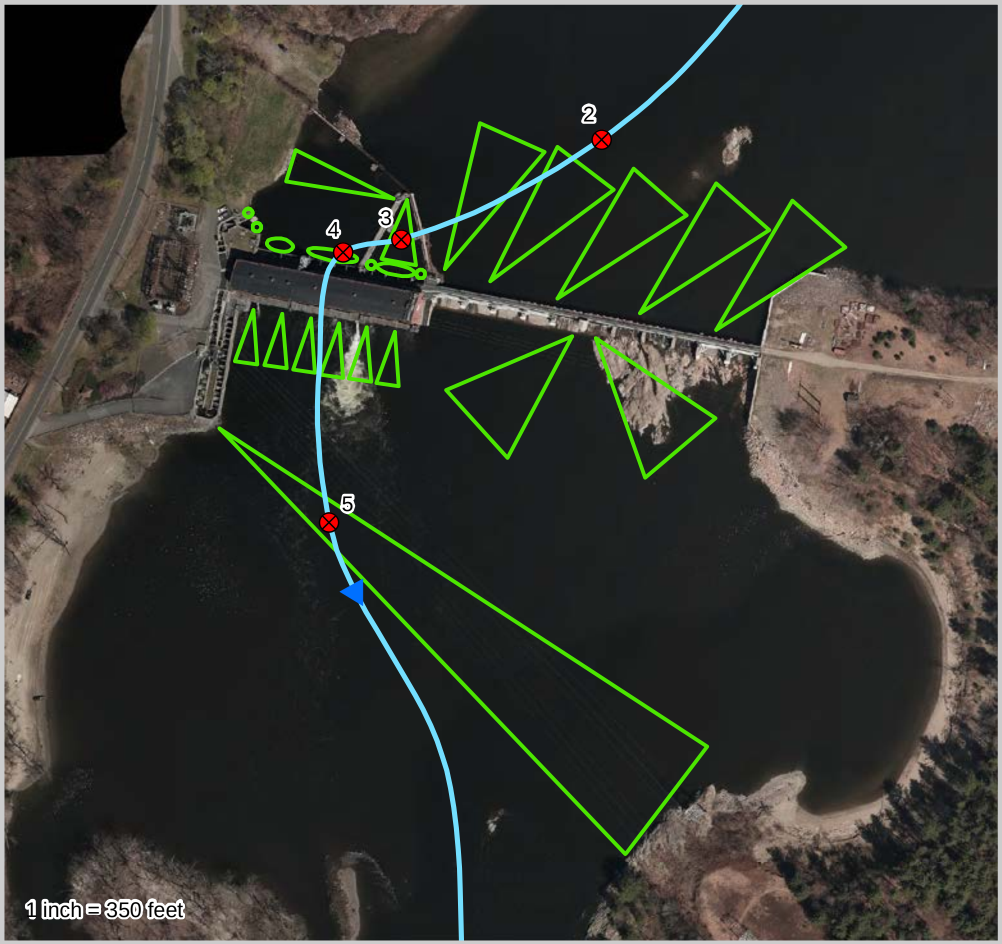


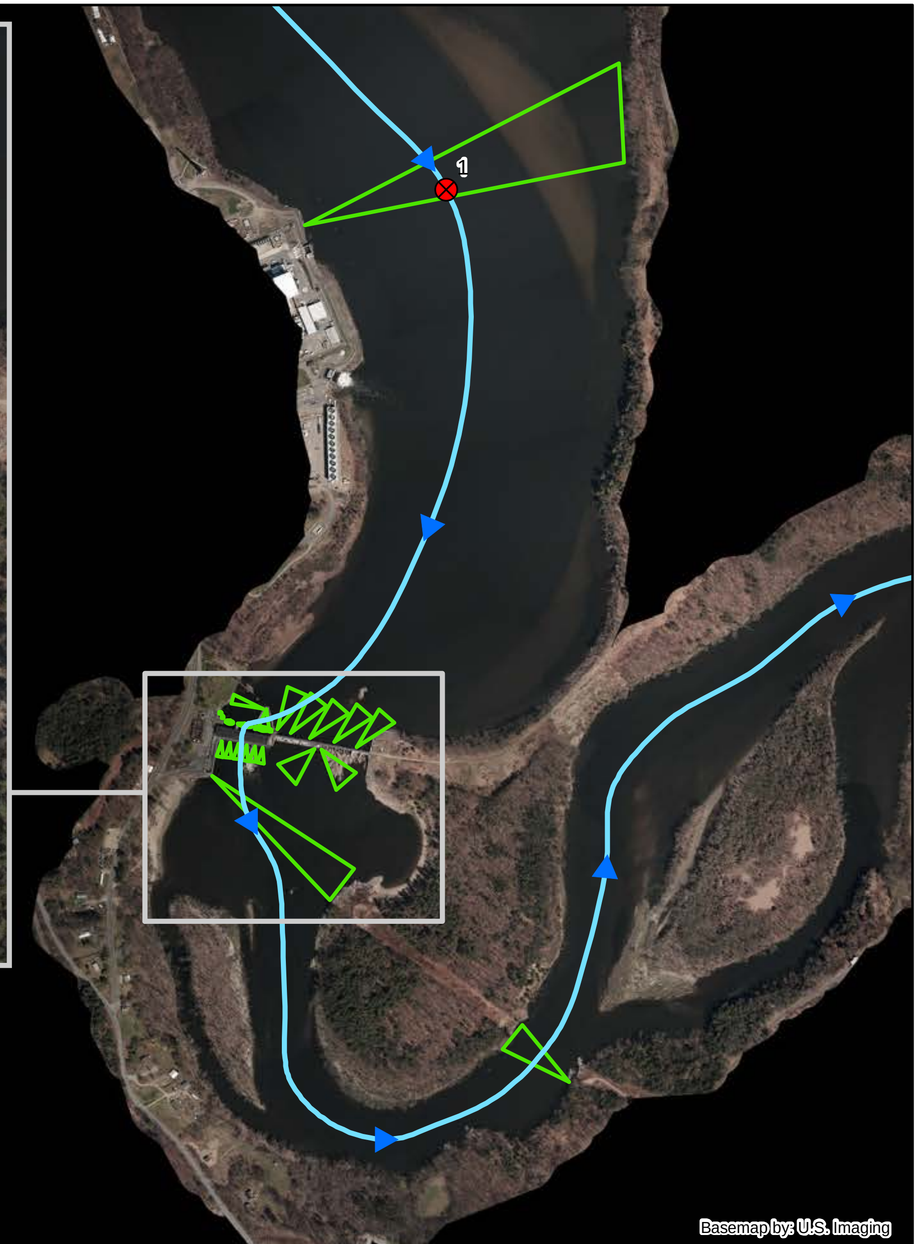


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/28/2015 | 21:43 |
| 2 | 10/28/2015 | 22:26 |
| 3 | 10/28/2015 | 23:42 |
| 4 | 10/29/2015 | 17:55 |
| 5 | 10/29/2015 | 17:55 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-104(T1)**
Release: Riverside Industrial Center
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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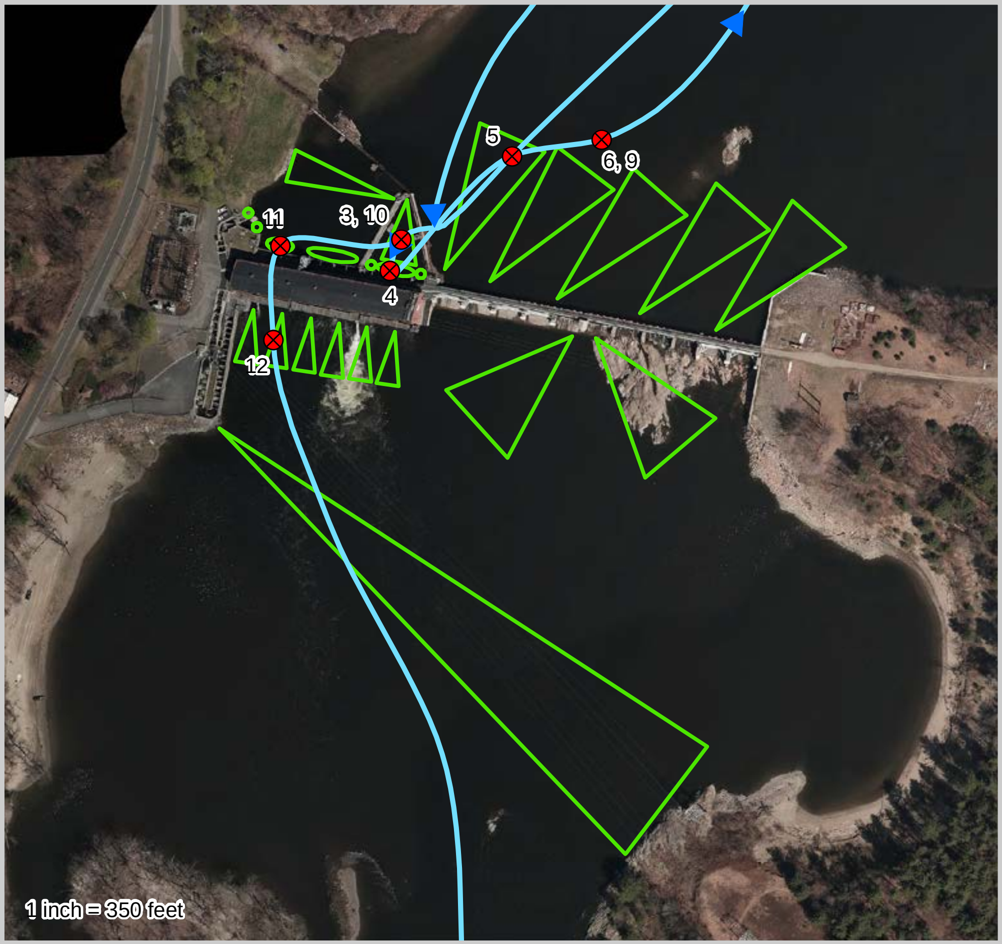


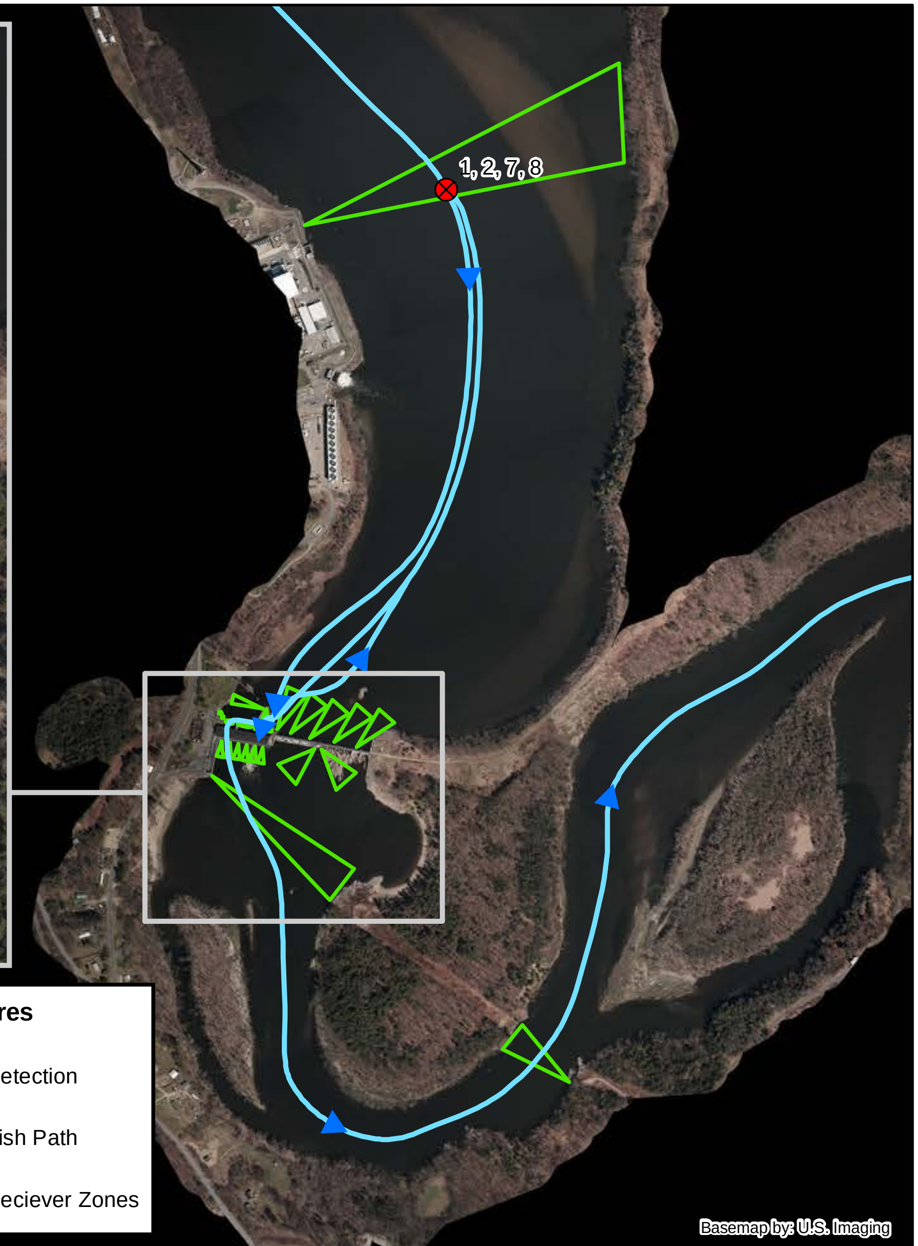


| Timetable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time | Detection | Date | Time |
| 1 | 11/1/2015 | 2:01 | 6 | 11/18/2015 | 21:32 | 11 | 11/20/2015 | 5:39 |
| 2 | 11/18/2015 | 20:03 | 7 | 11/18/2015 | 23:20 | 12 | 11/20/2015 | 5:40 |
| 3 | 11/18/2015 | 21:15 | 8 | 11/20/2015 | 3:57 | | | |
| 4 | 11/18/2015 | 21:22 | 9 | 11/20/2015 | 4:48 | | | |
| 5 | 11/18/2015 | 21:23 | 10 | 11/20/2015 | 5:32 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-105(T1)**
Release: Riverside Industrial Center
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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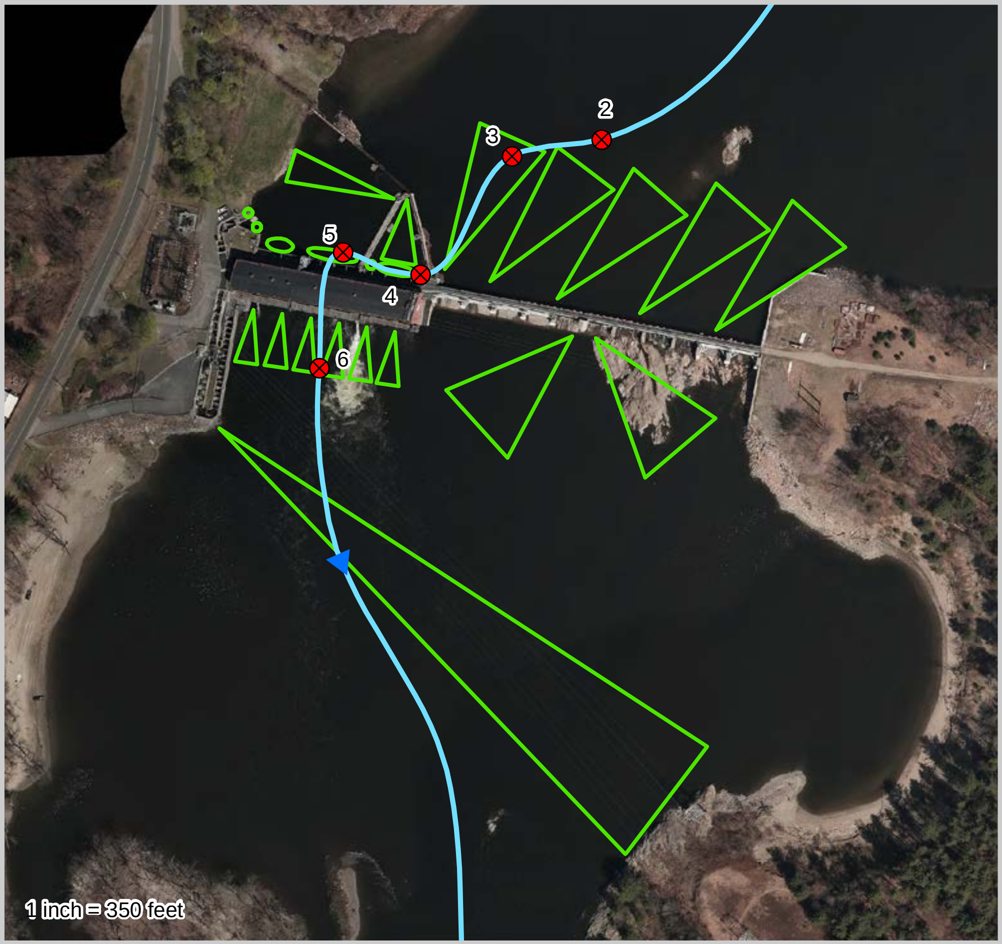


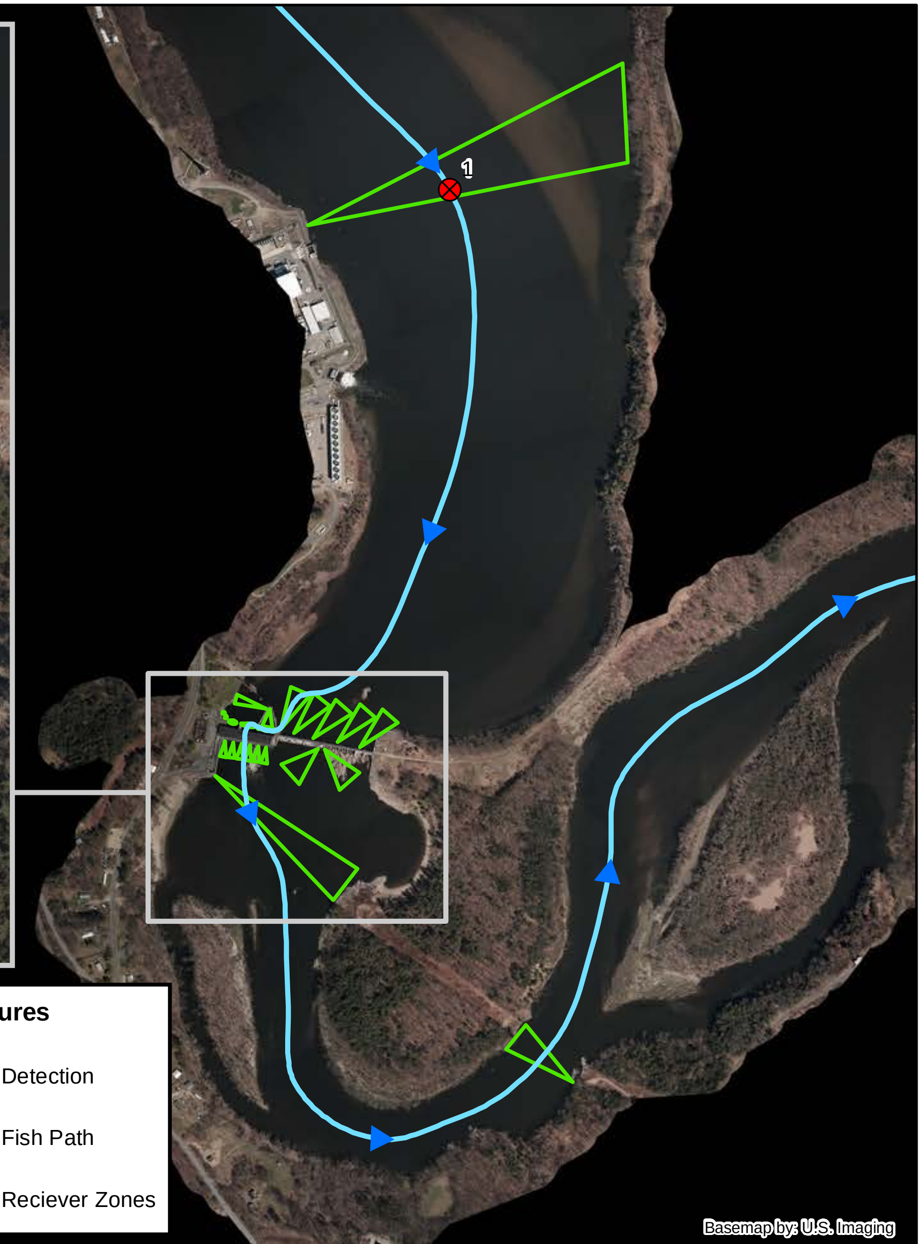


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/3/2015 | 0:56 | 4 | 11/4/2015 | 19:55 |
| 2 | 11/4/2015 | 19:48 | 5 | 11/4/2015 | 19:58 |
| 3 | 11/4/2015 | 19:53 | 6 | 11/4/2015 | 19:58 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-106(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45


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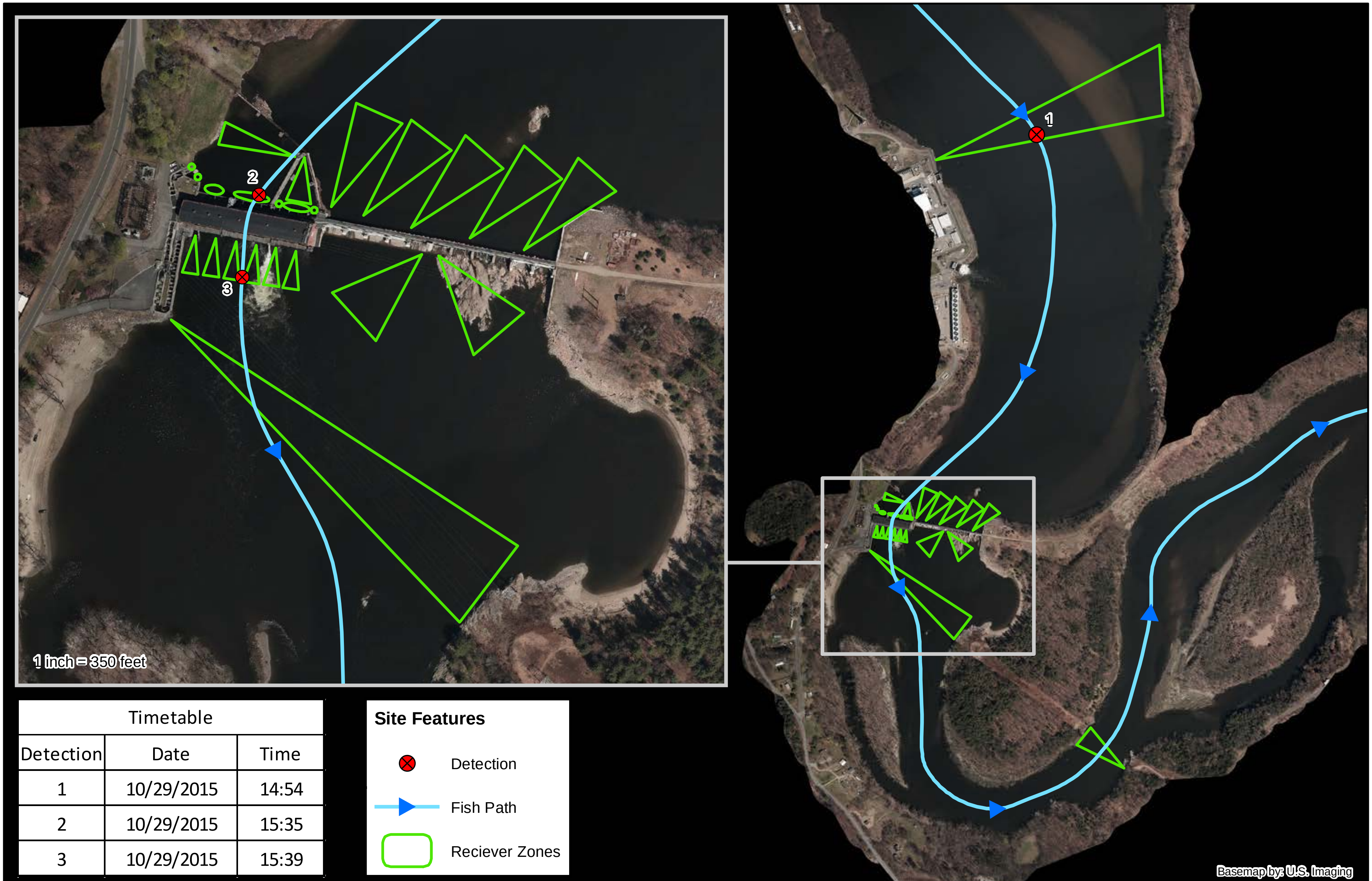


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 14:54 |
| 2 | 10/29/2015 | 15:35 |
| 3 | 10/29/2015 | 15:39 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-107(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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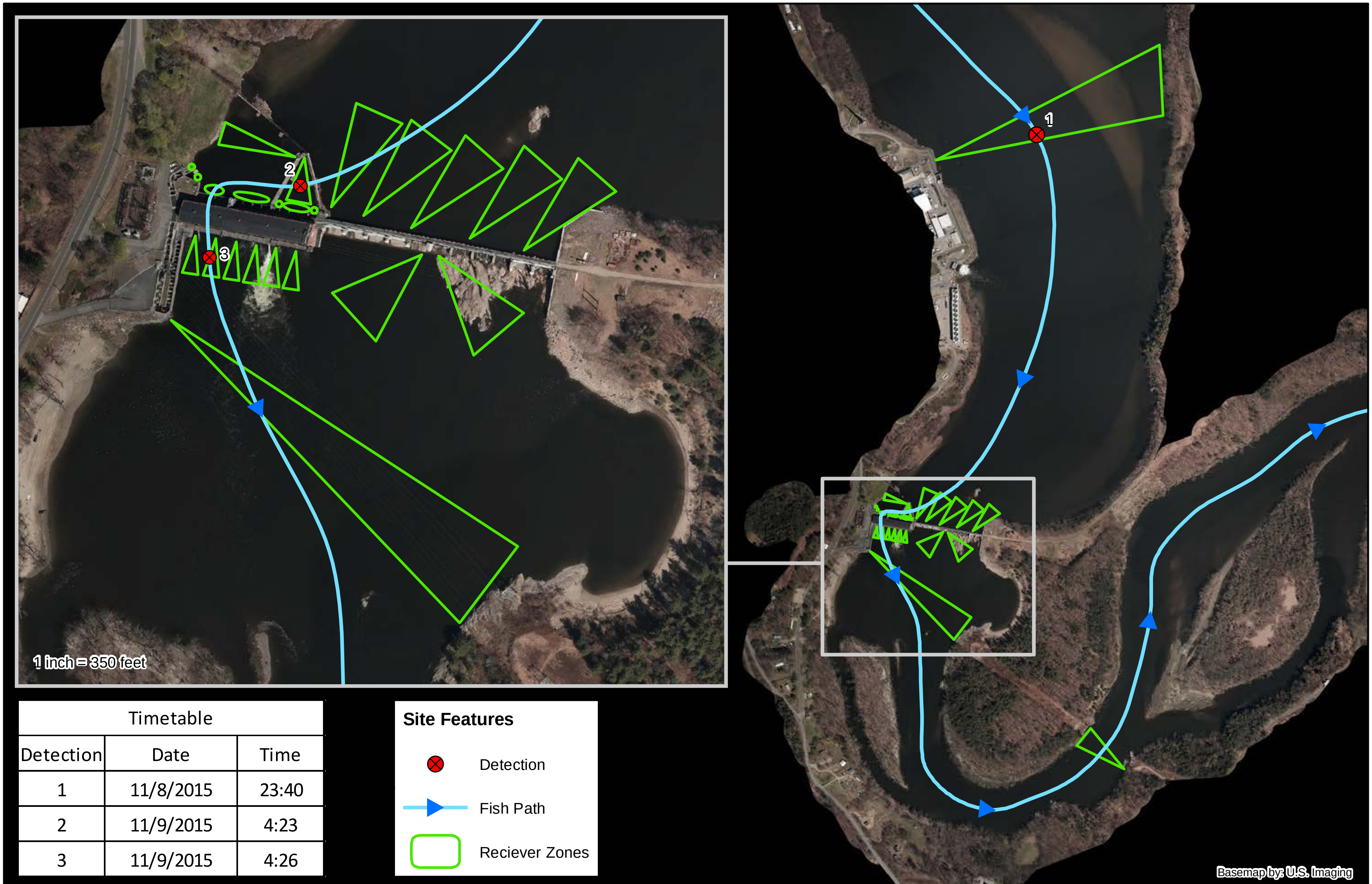


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 23:40 |
| 2 | 11/9/2015 | 4:23 |
| 3 | 11/9/2015 | 4:26 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-108(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/3/2015
Time Released: 15:55

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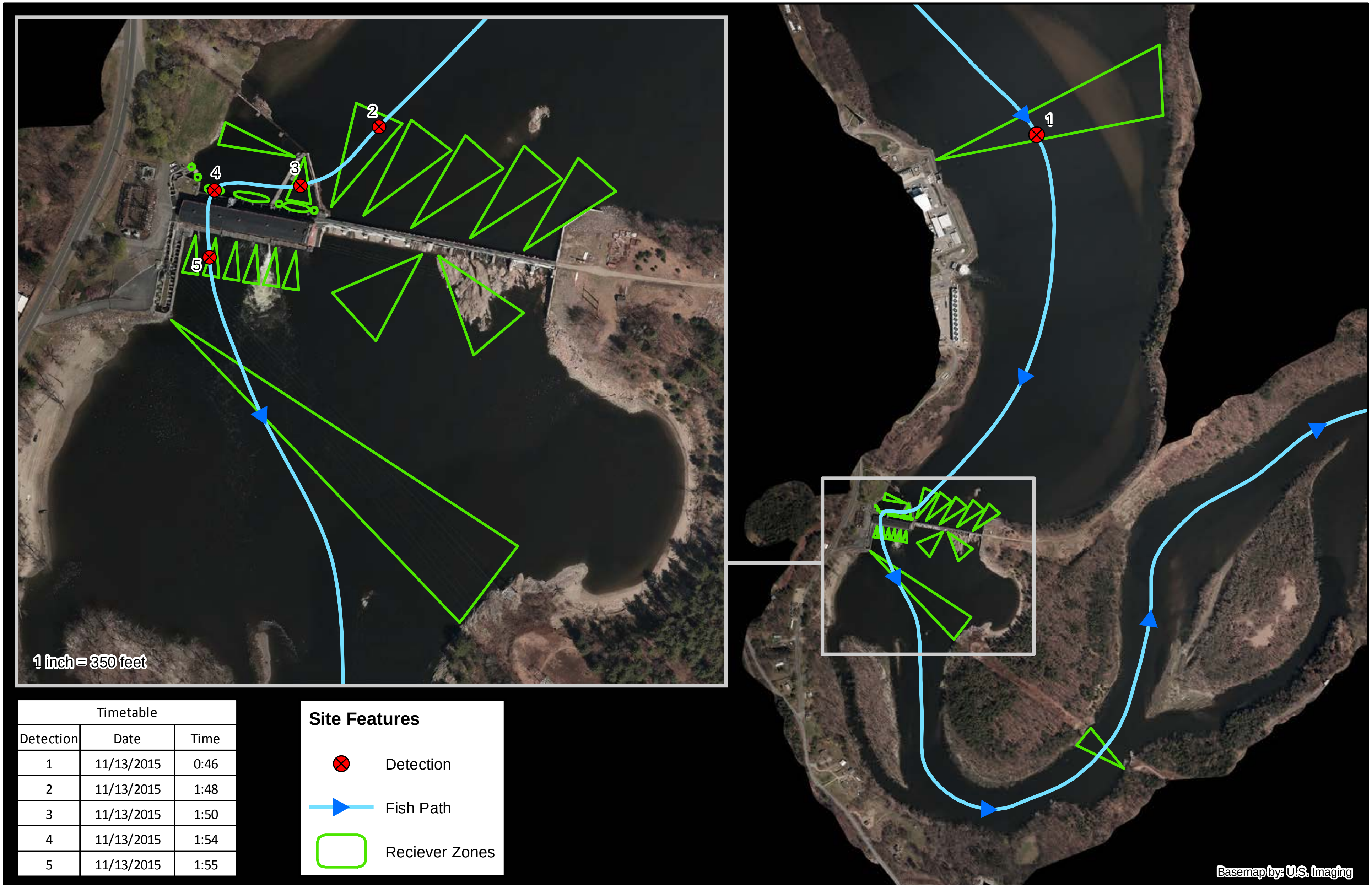


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/13/2015 | 0:46 |
| 2 | 11/13/2015 | 1:48 |
| 3 | 11/13/2015 | 1:50 |
| 4 | 11/13/2015 | 1:54 |
| 5 | 11/13/2015 | 1:55 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-109(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/3/2015
Time Released: 15:55

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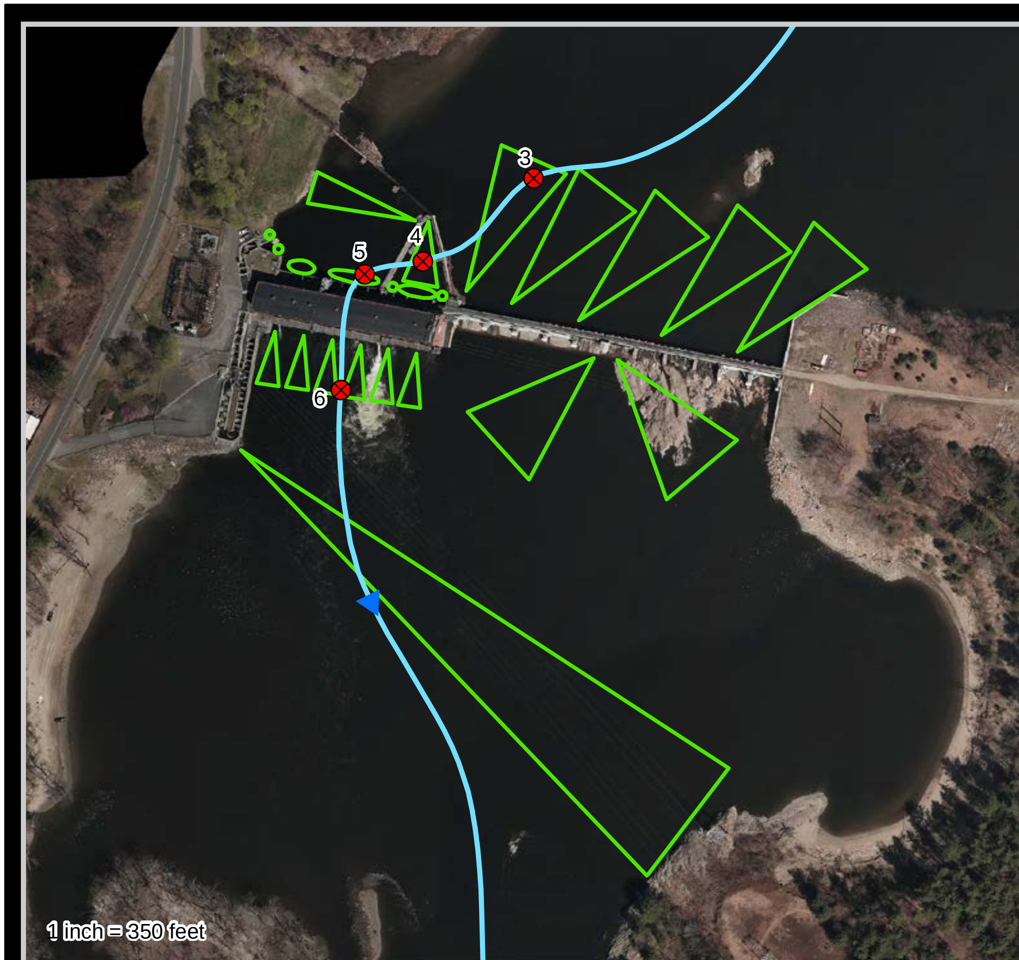


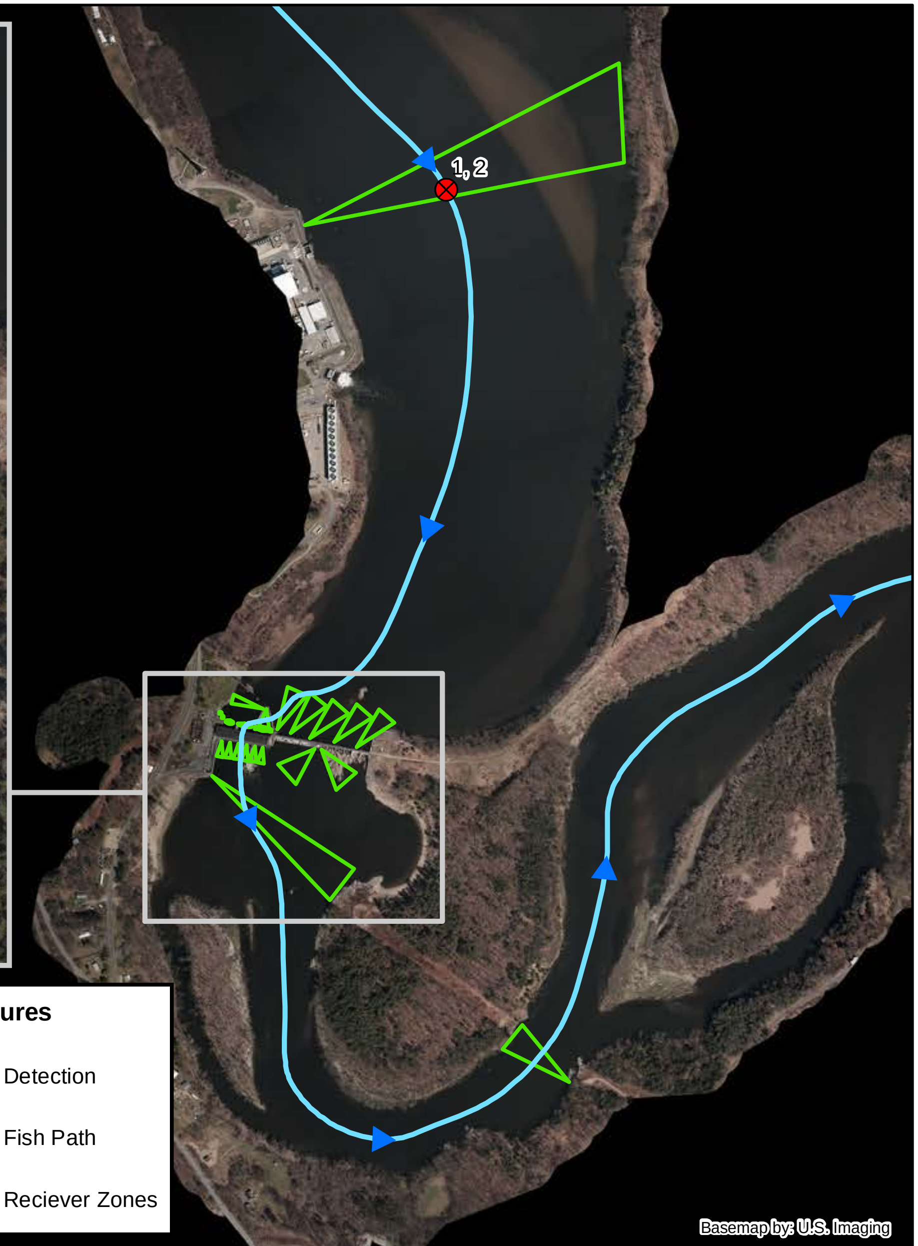


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 11:27 | 4 | 11/5/2015 | 20:30 |
| 2 | 11/5/2015 | 19:31 | 5 | 11/5/2015 | 20:32 |
| 3 | 11/5/2015 | 20:24 | 6 | 11/5/2015 | 20:33 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-110(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/3/2015
Time Released: 15:55

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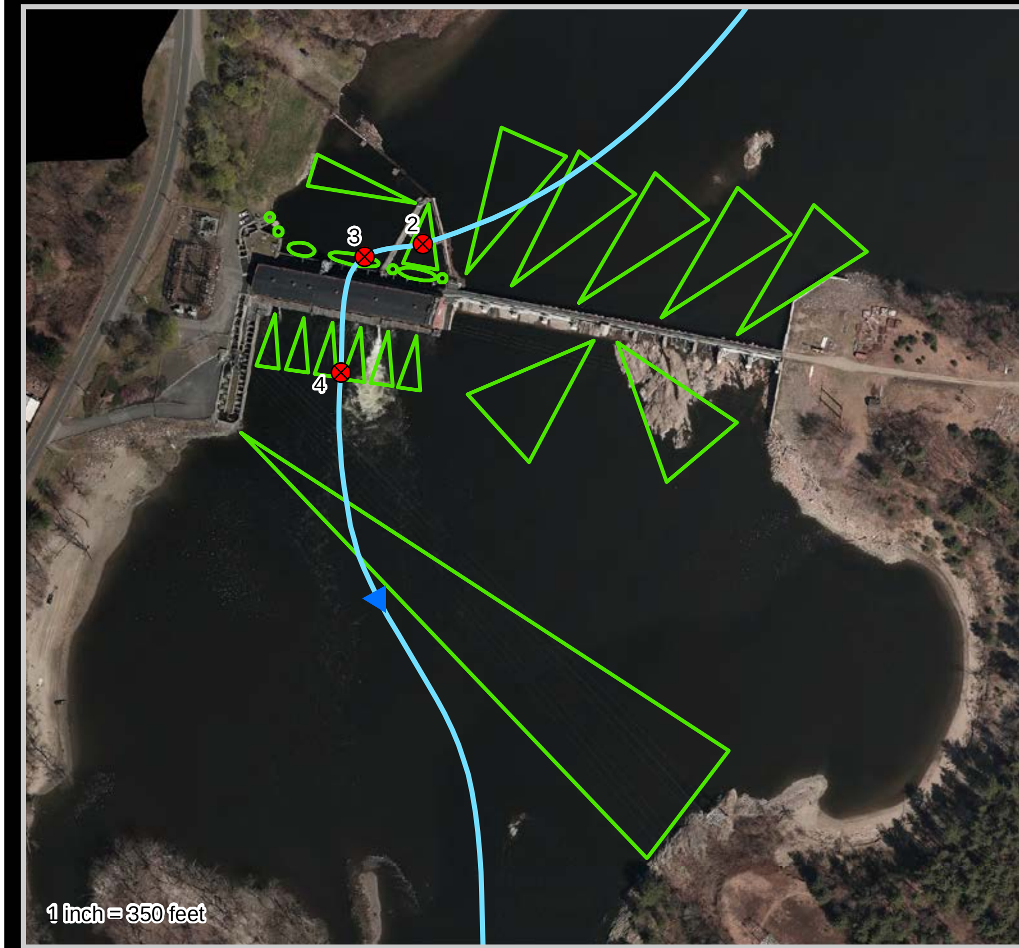


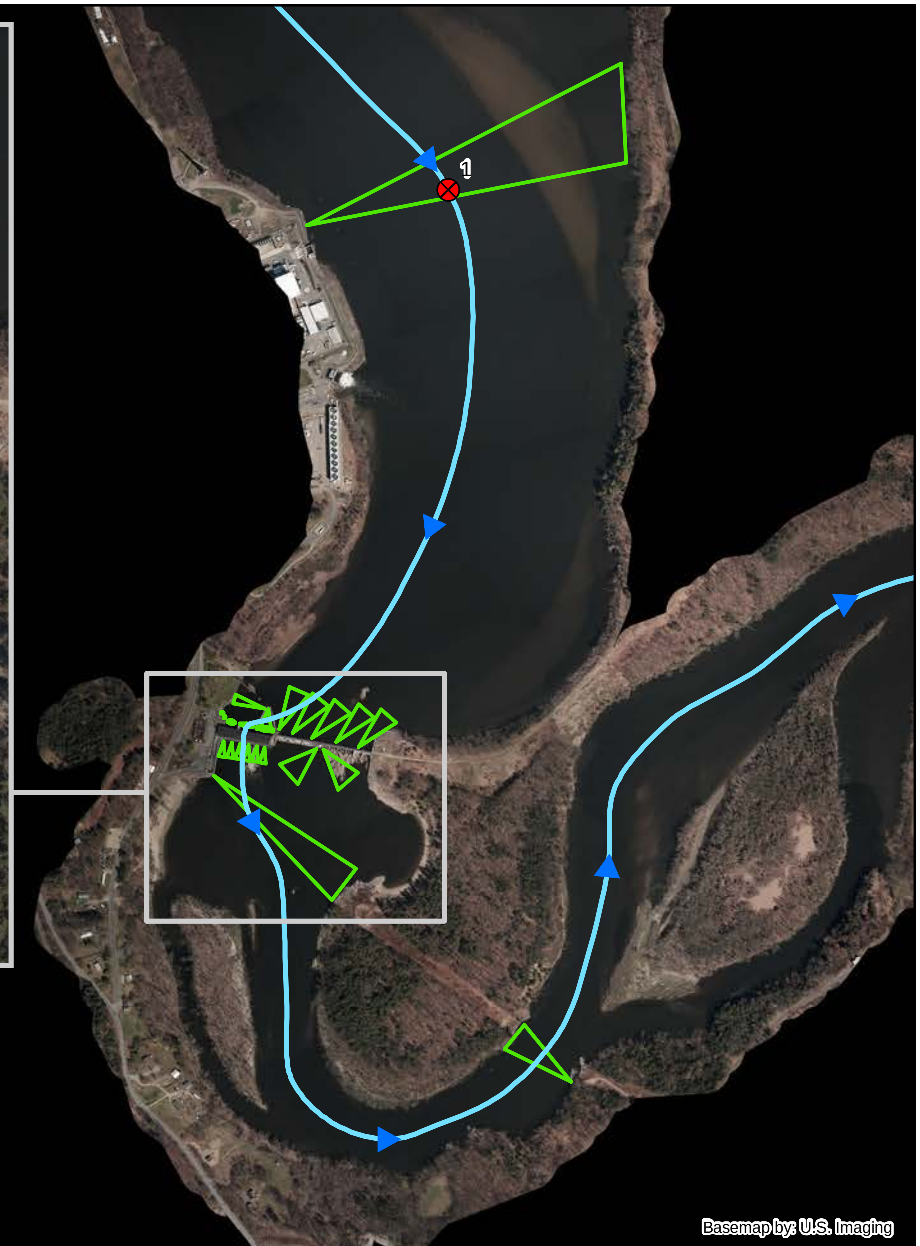


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/30/2015 | 19:58 |
| 2 | 10/30/2015 | 20:35 |
| 3 | 10/30/2015 | 20:37 |
| 4 | 10/30/2015 | 20:37 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-116(T1)**

Release: Herricks Cove, VT
Date Released: 10/27/15
Time Released: 18:20

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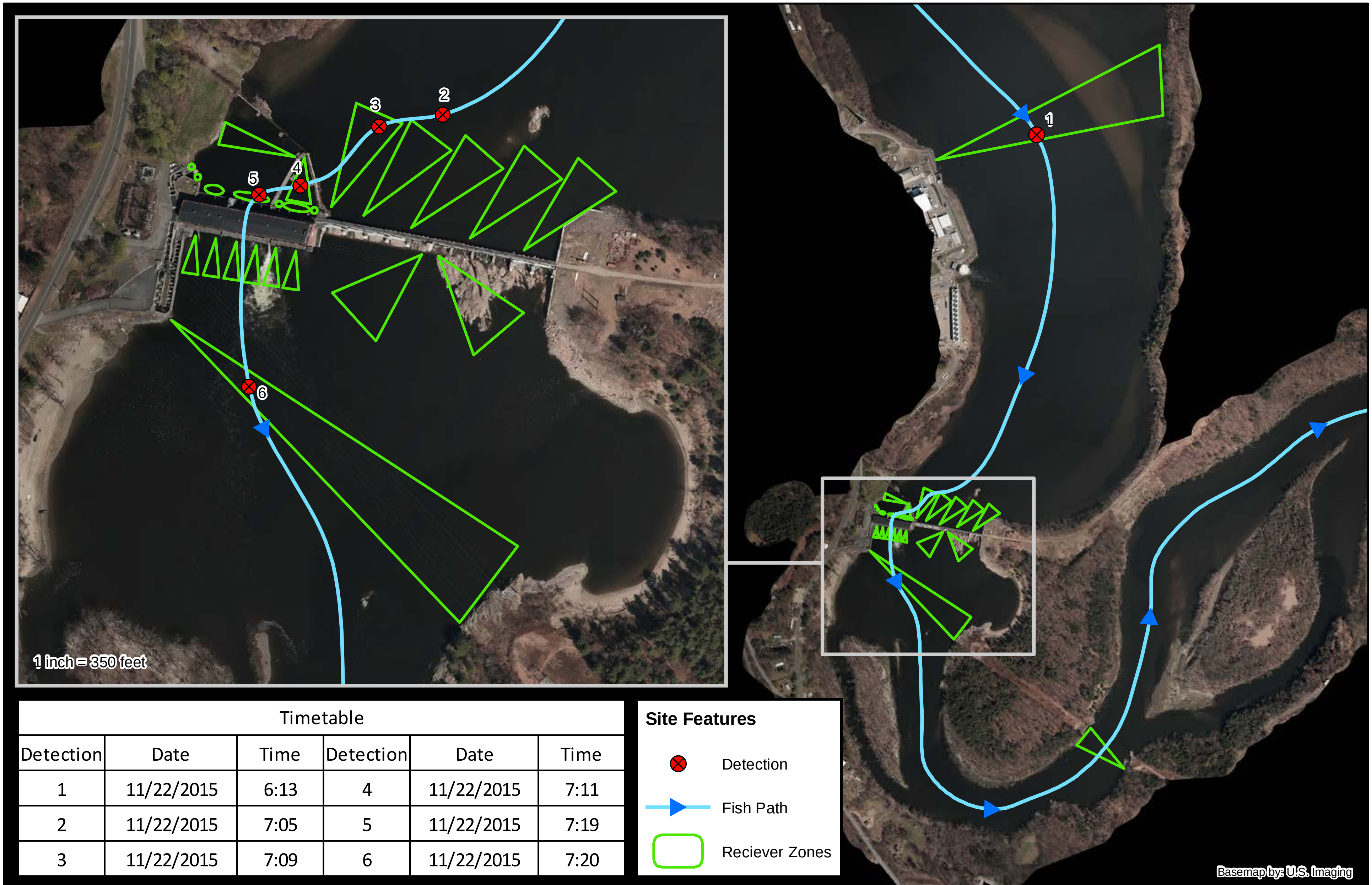


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/22/2015 | 6:13 | 4 | 11/22/2015 | 7:11 |
| 2 | 11/22/2015 | 7:05 | 5 | 11/22/2015 | 7:19 |
| 3 | 11/22/2015 | 7:09 | 6 | 11/22/2015 | 7:20 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-117(T1)**

Release: Herricks Cove, VT
Date Released: 10/27/15
Time Released: 18:20

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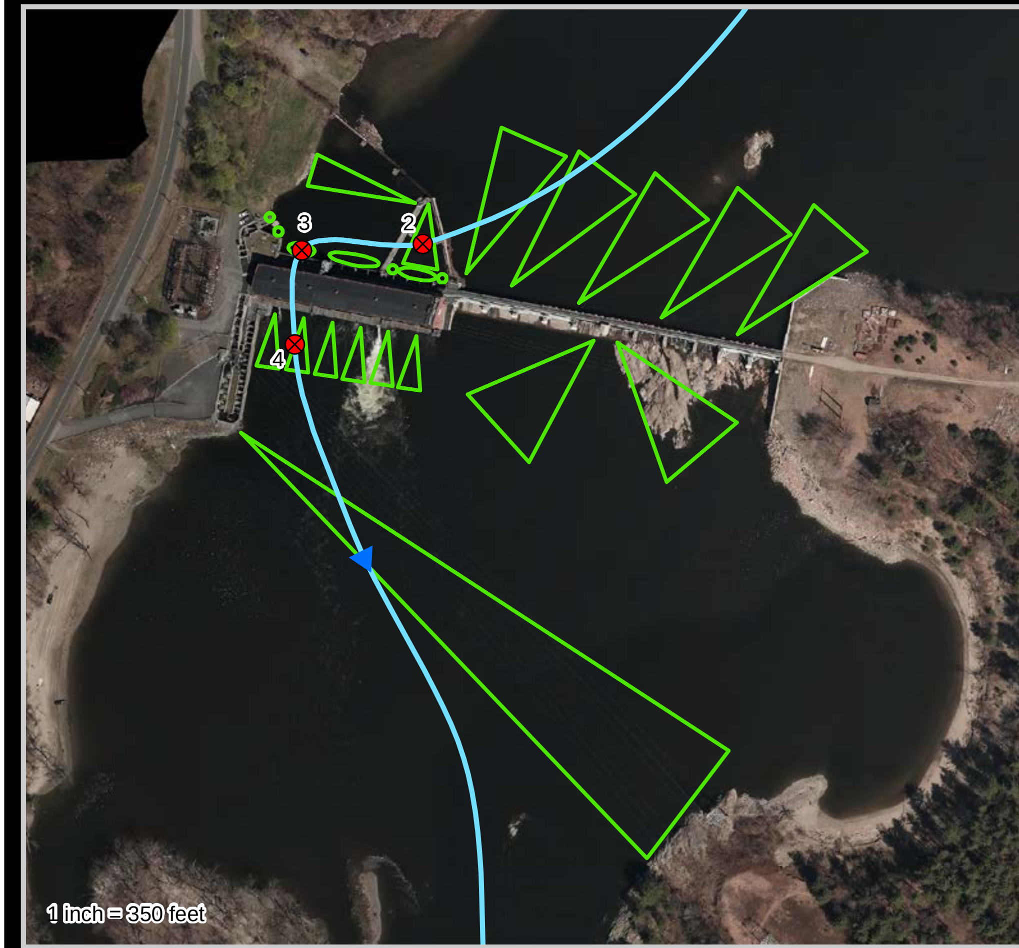


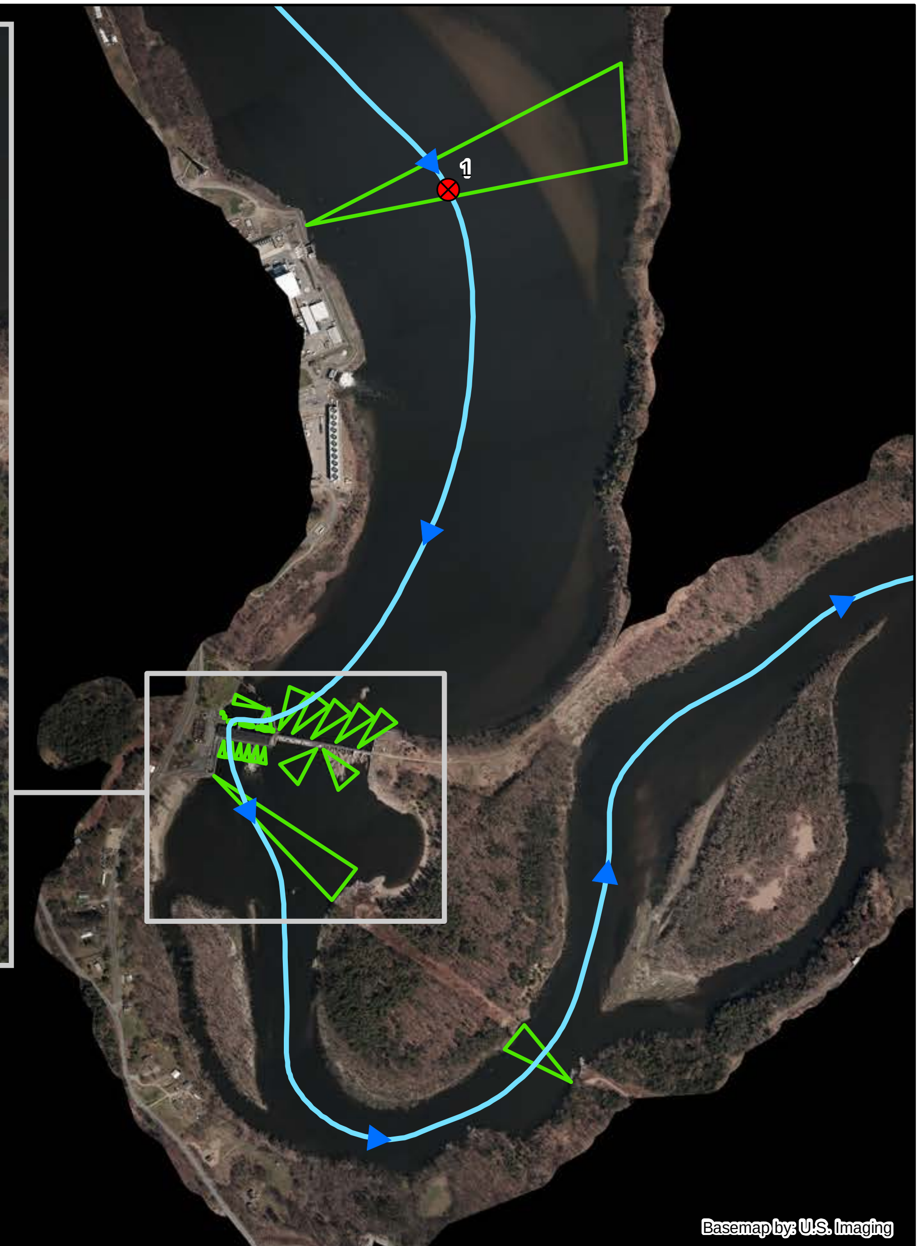


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 3:48 |
| 2 | 11/10/2015 | 17:58 |
| 3 | 11/10/2015 | 18:02 |
| 4 | 11/10/2015 | 18:02 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-119(T1)**

Release: Herricks Cove, VT
Date Released: 11/3/15
Time Released: 16:45

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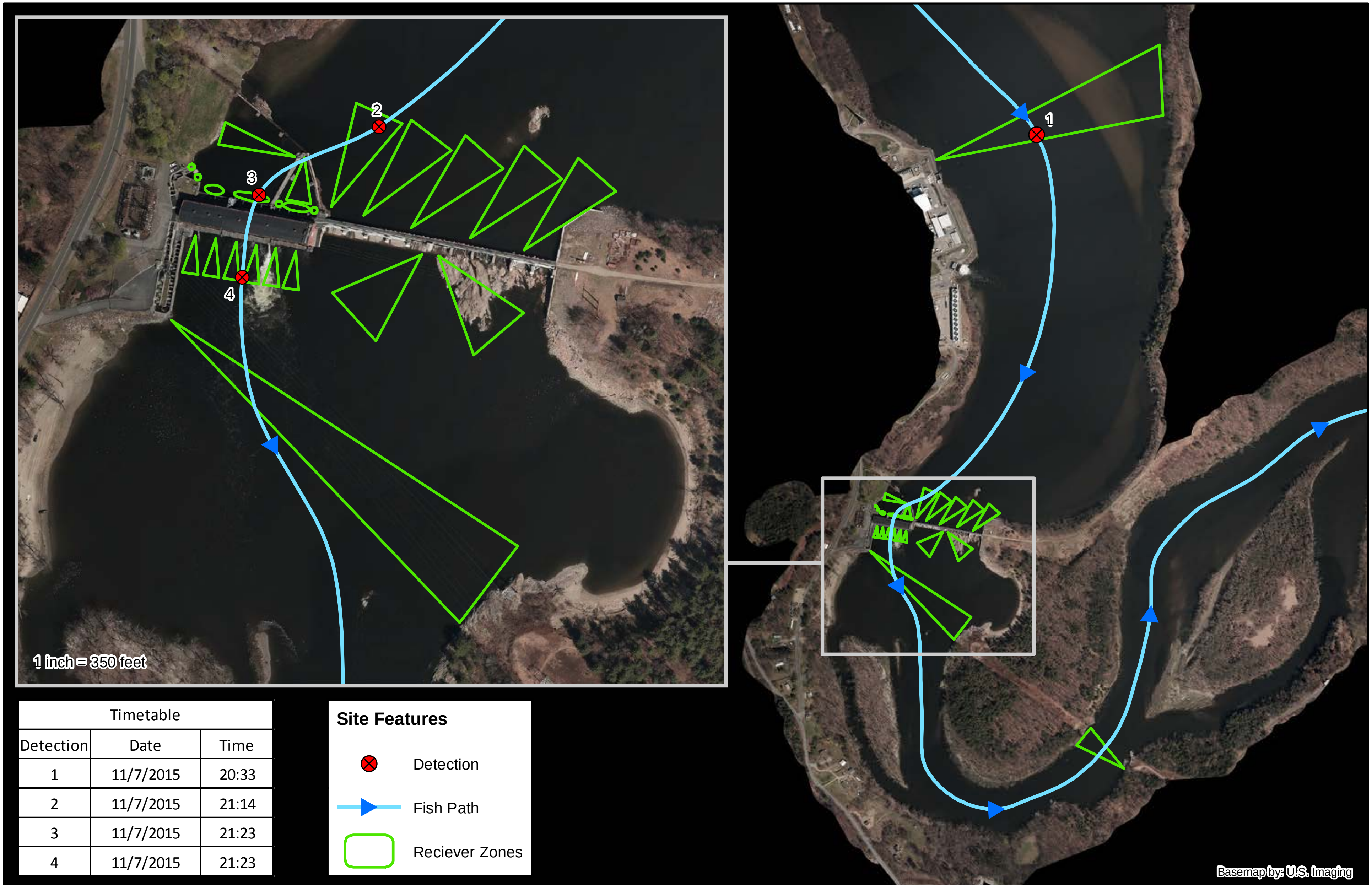


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 20:33 |
| 2 | 11/7/2015 | 21:14 |
| 3 | 11/7/2015 | 21:23 |
| 4 | 11/7/2015 | 21:23 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-120(T1)**

Release: Herricks Cove, VT
Date Released: 11/3/15
Time Released: 16:45


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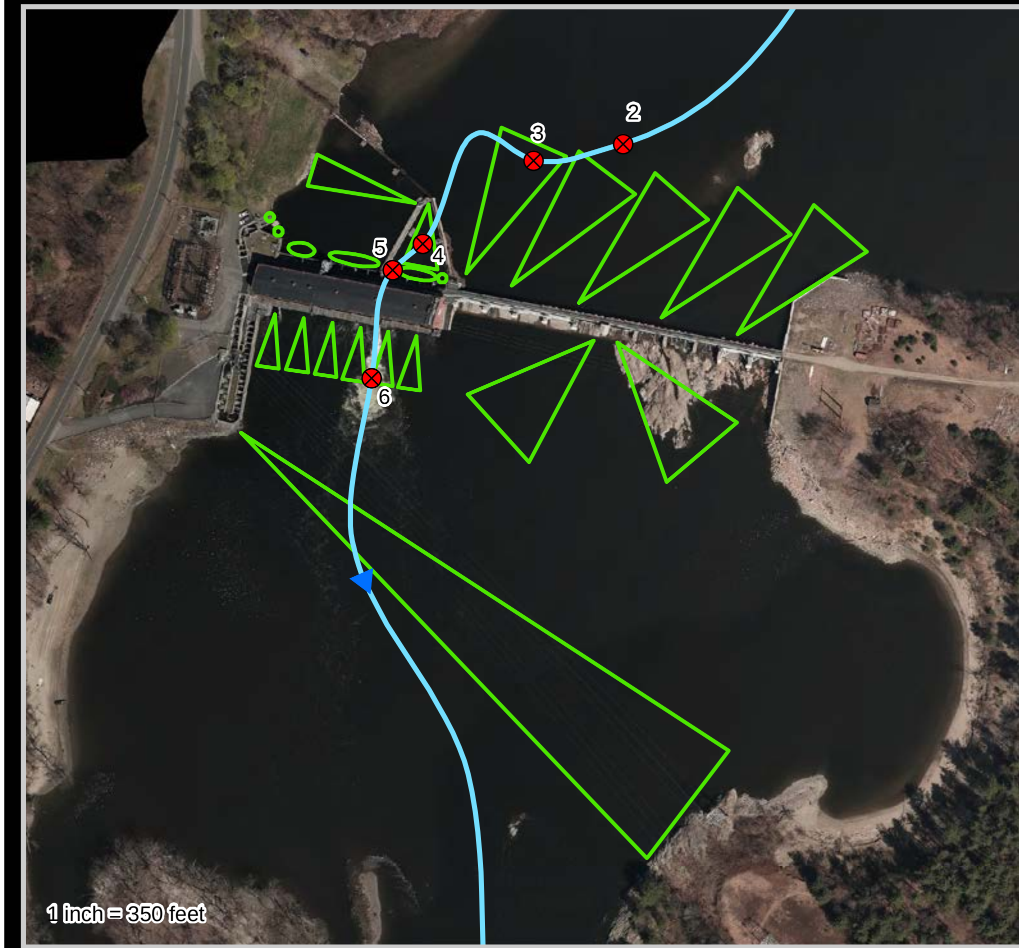


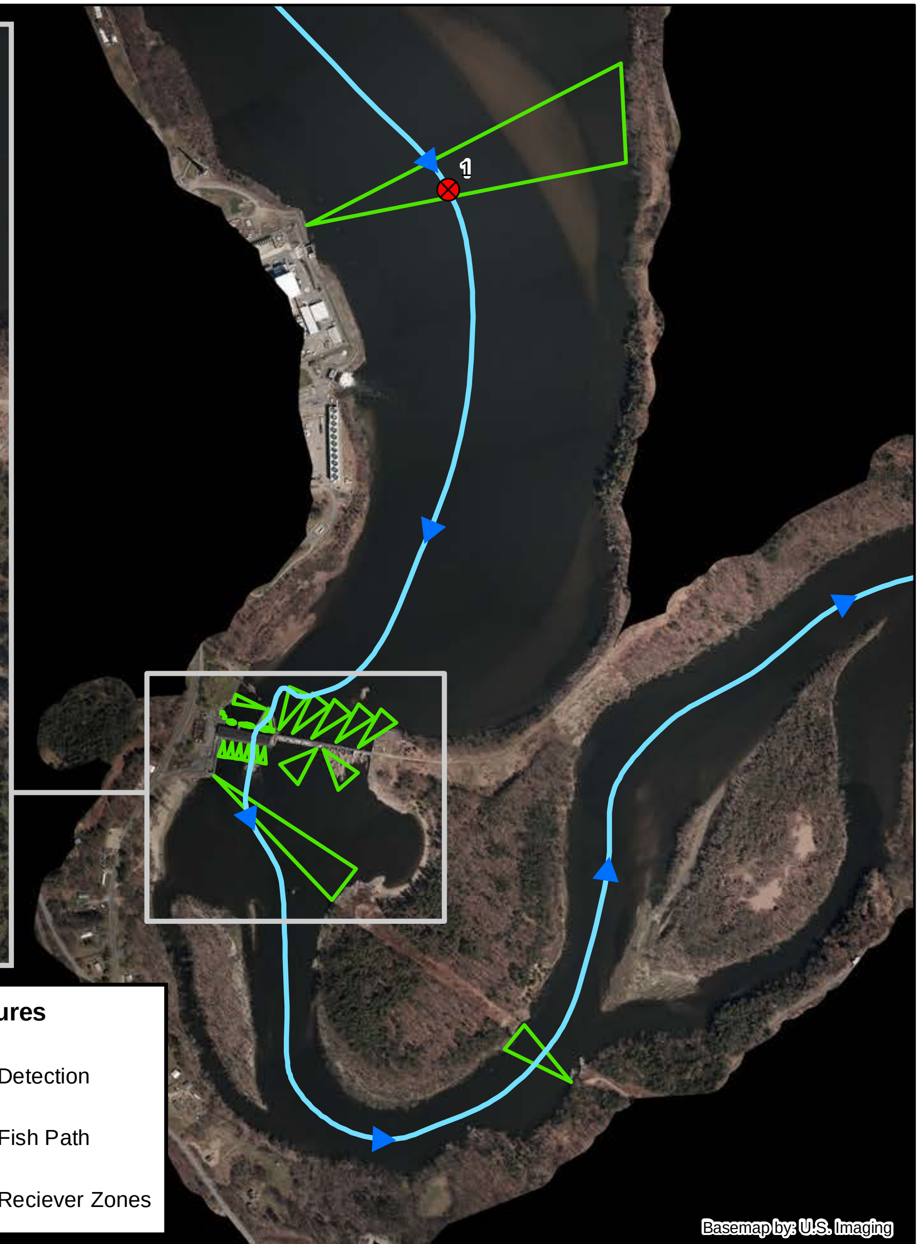


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/9/2015 | 11:25 | 4 | 11/9/2015 | 22:45 |
| 2 | 11/9/2015 | 22:41 | 5 | 11/9/2015 | 22:48 |
| 3 | 11/9/2015 | 22:42 | 6 | 11/9/2015 | 22:50 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-122(T1)**

Release: Norwich, VT
Date Released: 11/3/15
Time Released: 17:32

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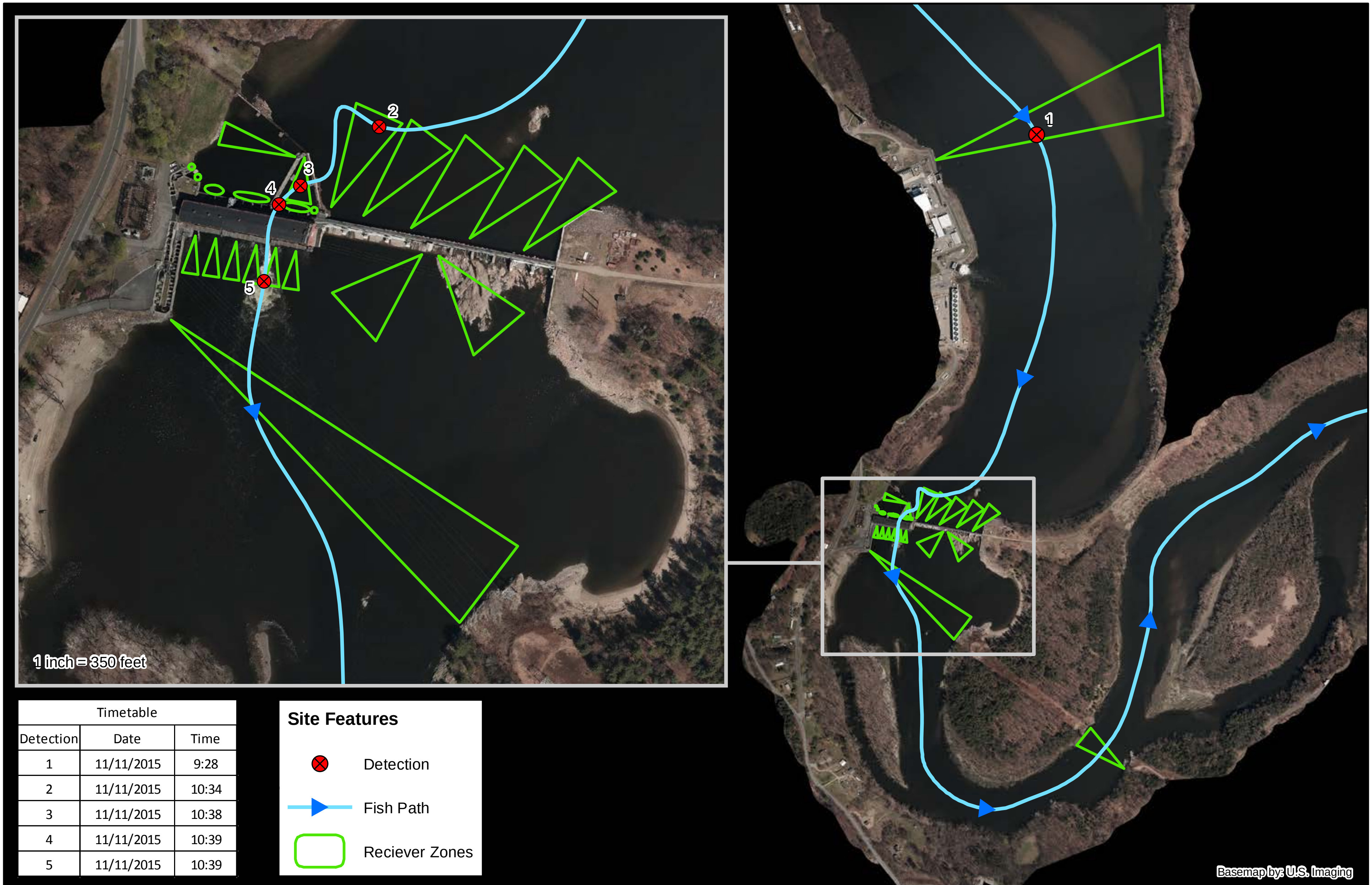


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/11/2015 | 9:28 |
| 2 | 11/11/2015 | 10:34 |
| 3 | 11/11/2015 | 10:38 |
| 4 | 11/11/2015 | 10:39 |
| 5 | 11/11/2015 | 10:39 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-123(T1)**

Release: Norwich, VT
Date Released: 11/3/15
Time Released: 17:32

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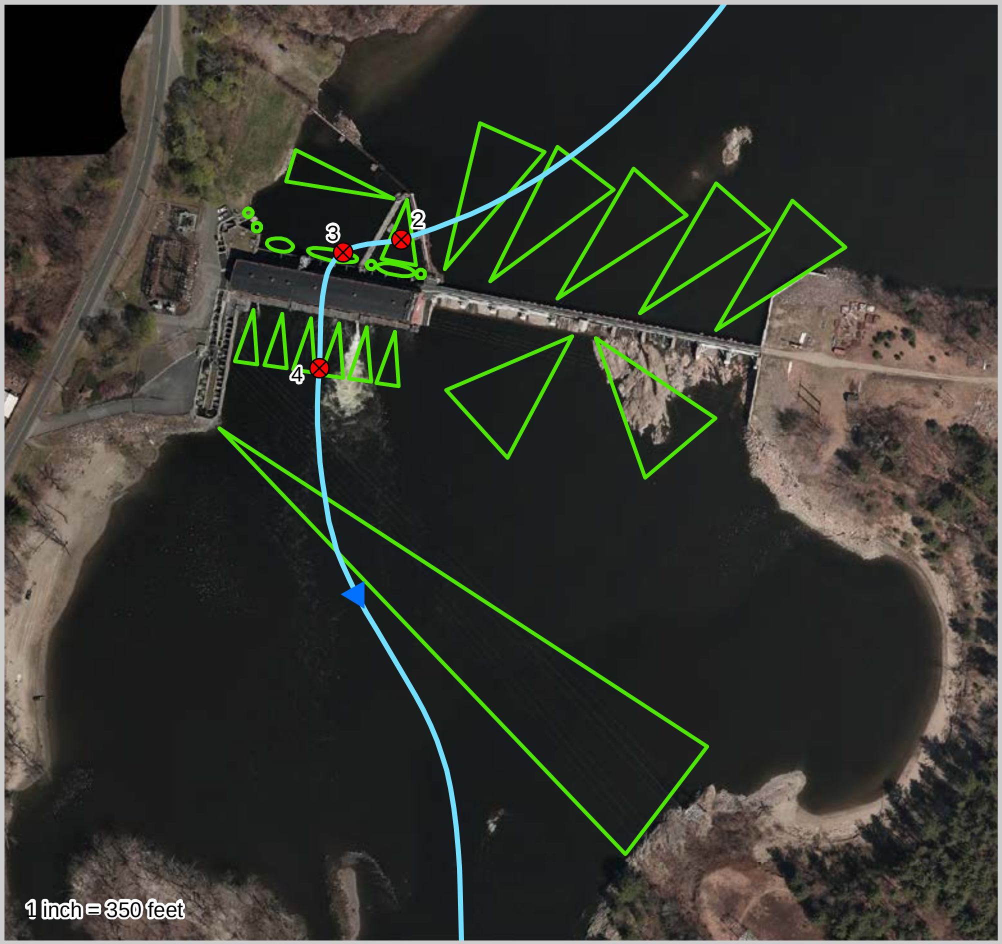


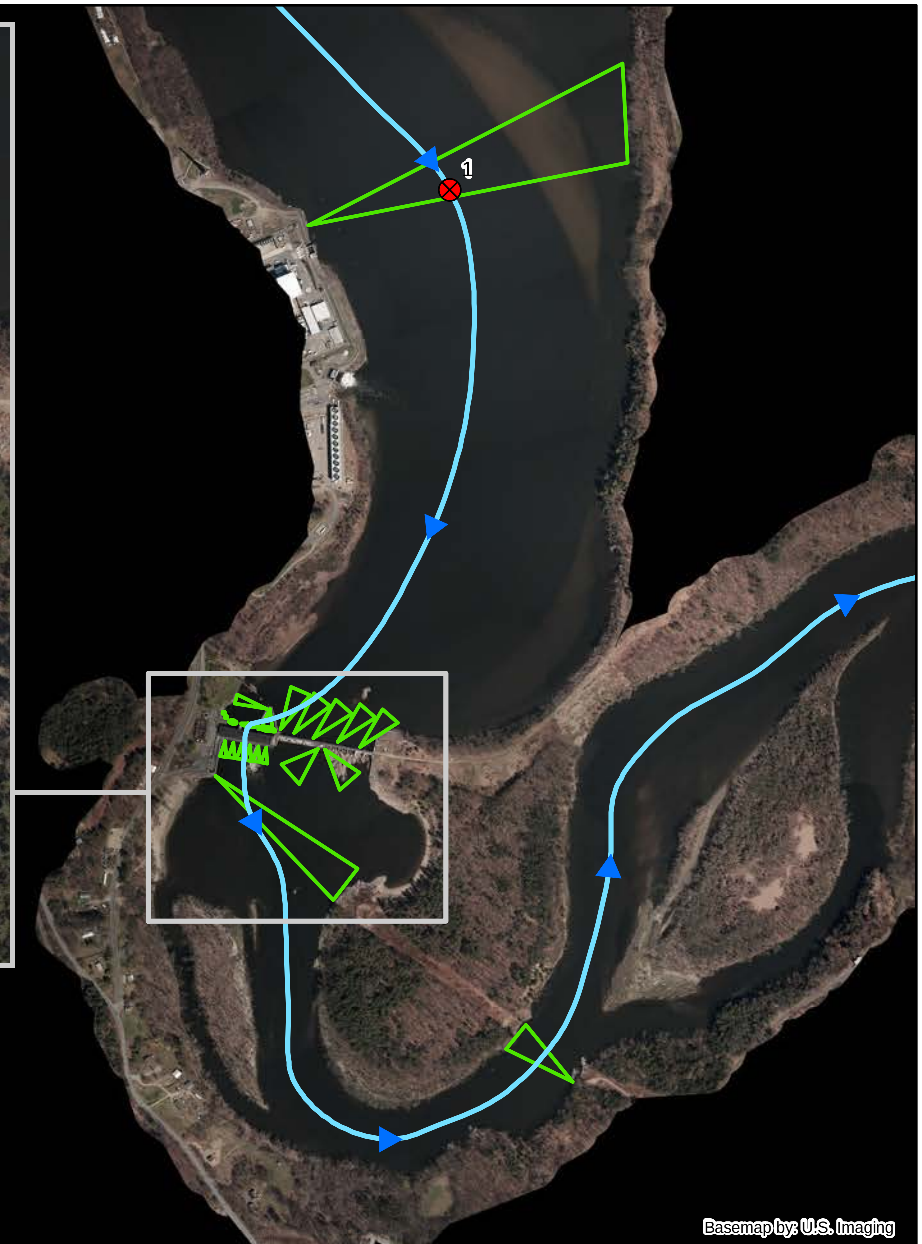


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:51 |
| 1 | 10/29/2015 | 19:29 |
| 3 | 10/29/2015 | 19:31 |
| 4 | 10/29/2015 | 19:31 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-135(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/15
Time Released: 13:05

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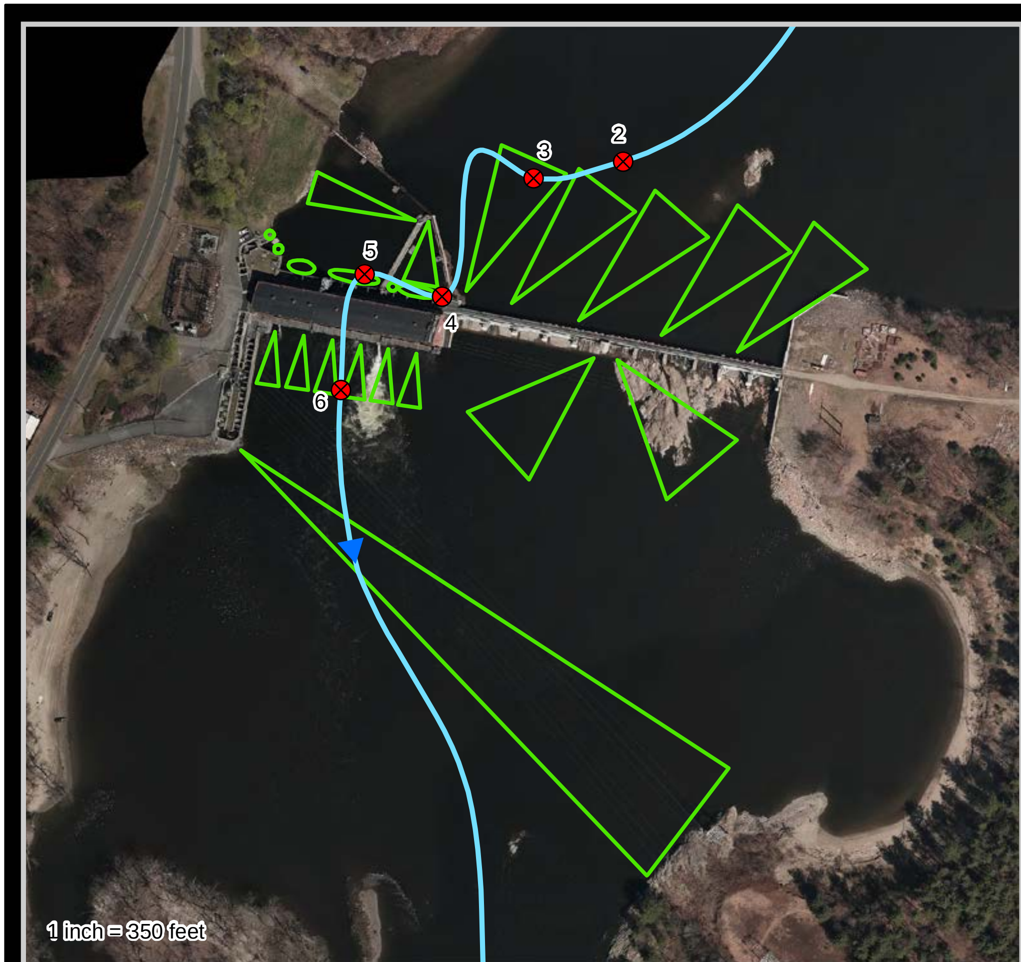


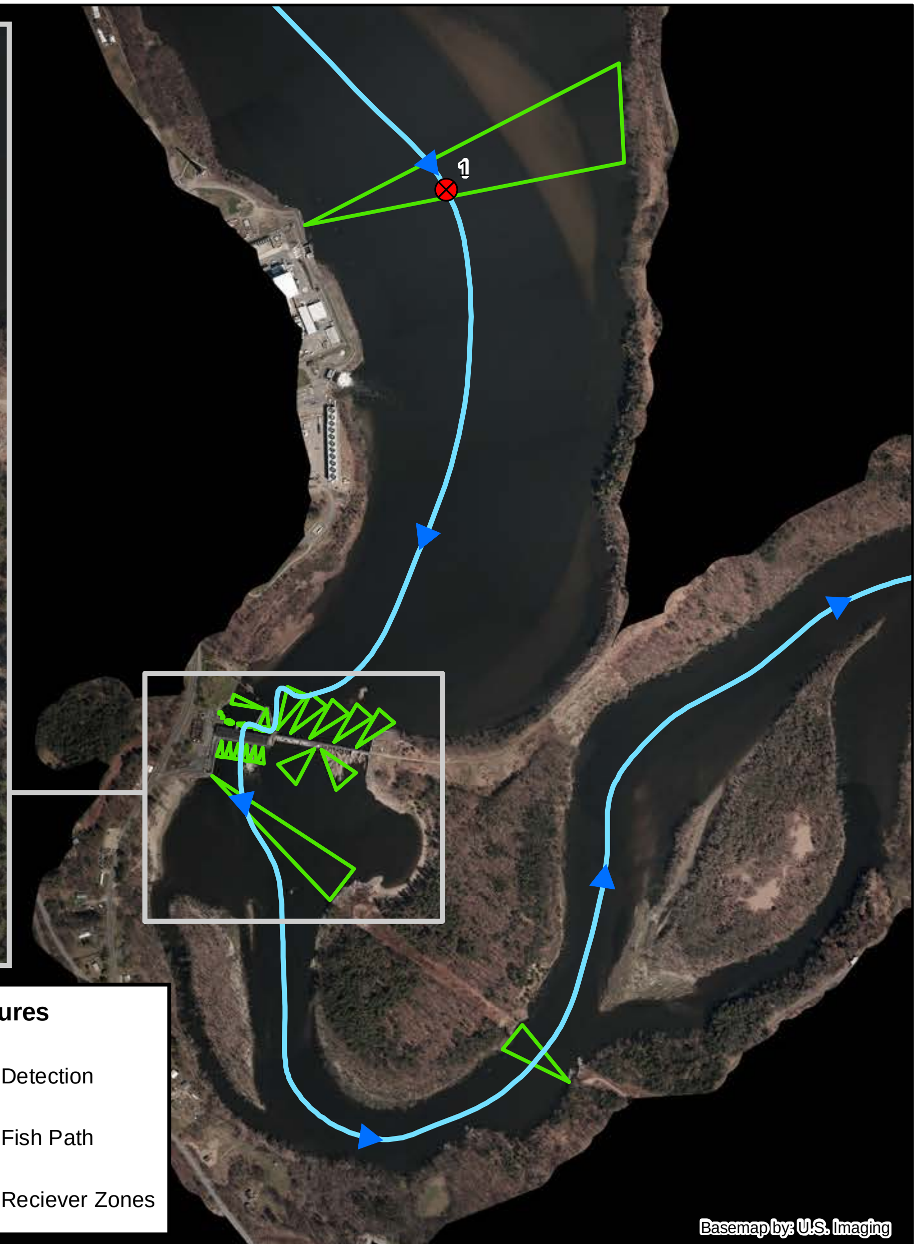


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/29/2015 | 18:26 | 4 | 10/29/2015 | 18:59 |
| 2 | 10/29/2015 | 18:53 | 5 | 10/29/2015 | 18:59 |
| 3 | 10/29/2015 | 18:58 | 6 | 10/29/2015 | 18:59 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-136(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/15
Time Released: 13:05

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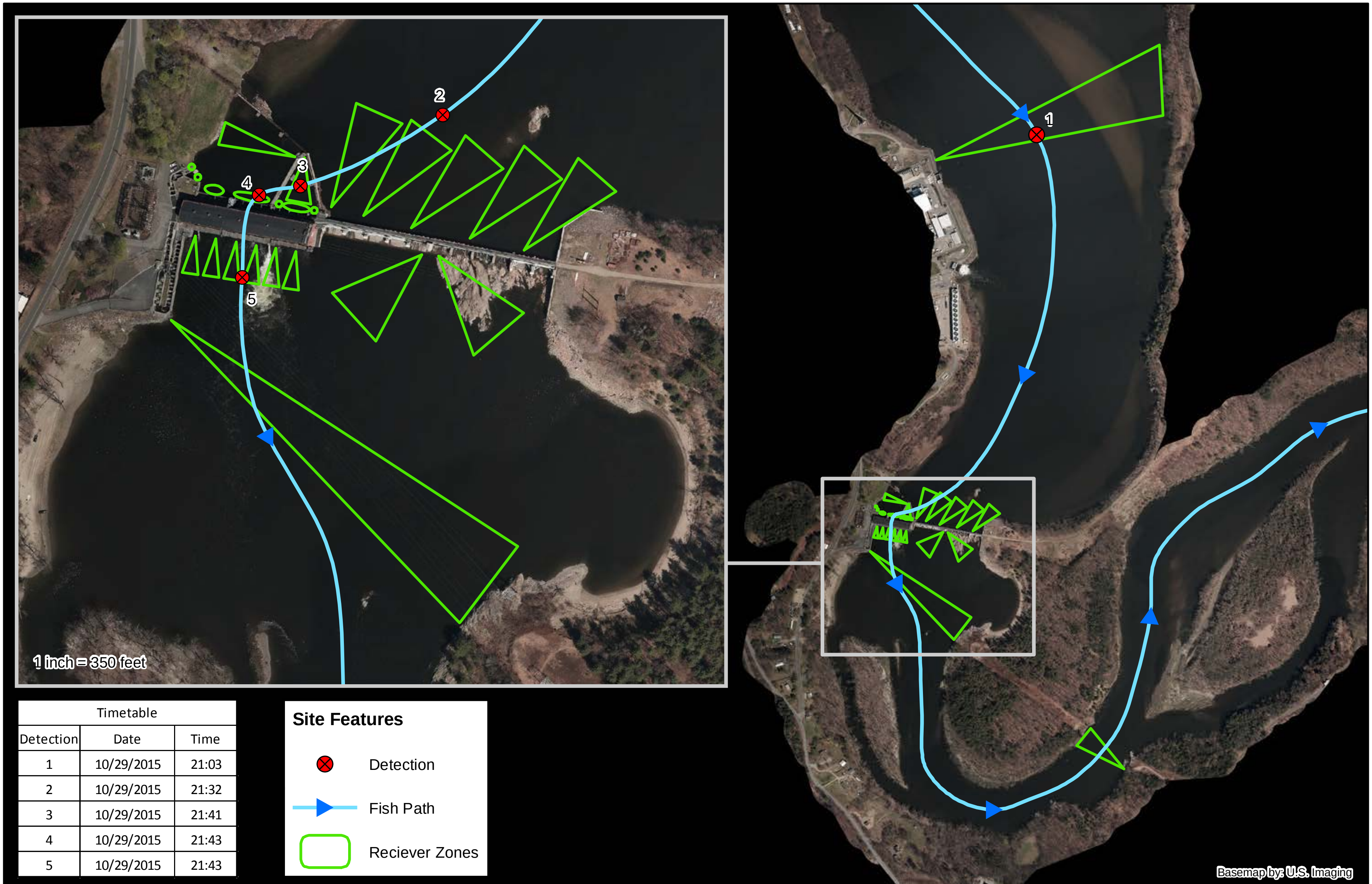


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:03 |
| 2 | 10/29/2015 | 21:32 |
| 3 | 10/29/2015 | 21:41 |
| 4 | 10/29/2015 | 21:43 |
| 5 | 10/29/2015 | 21:43 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-137(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/15
Time Released: 13:05

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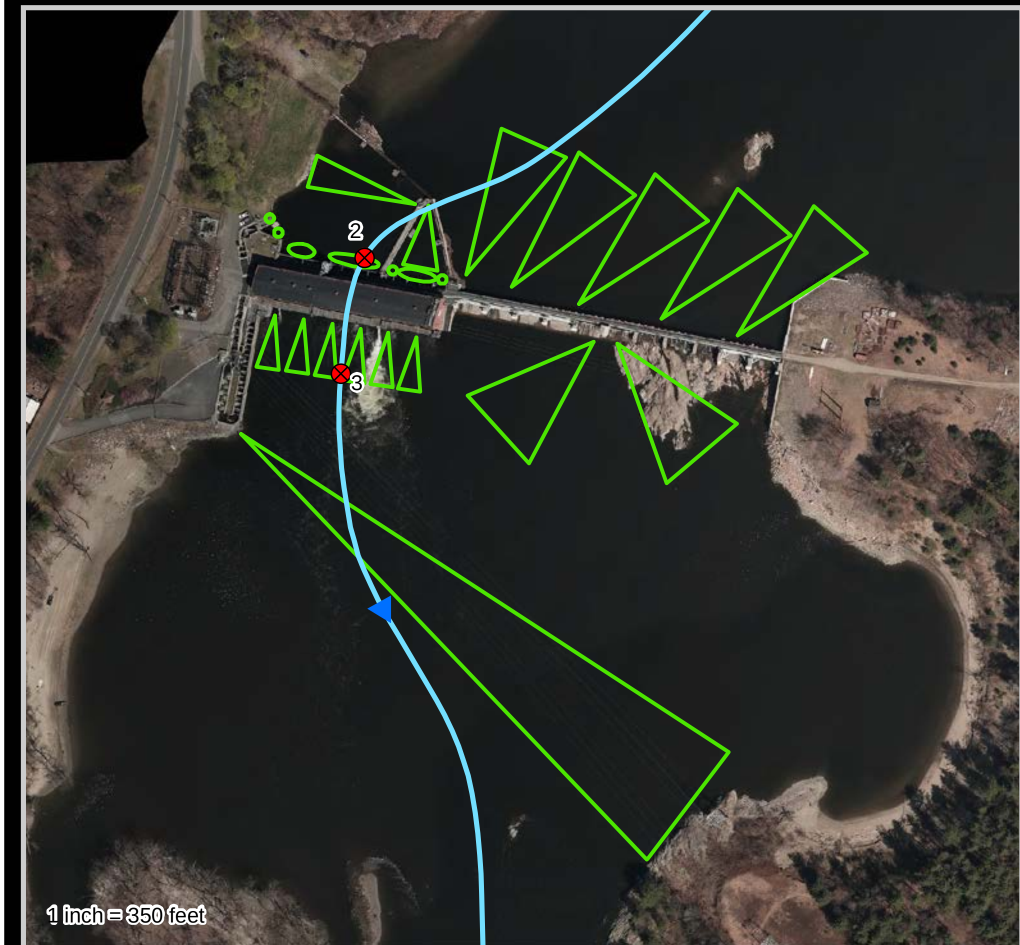


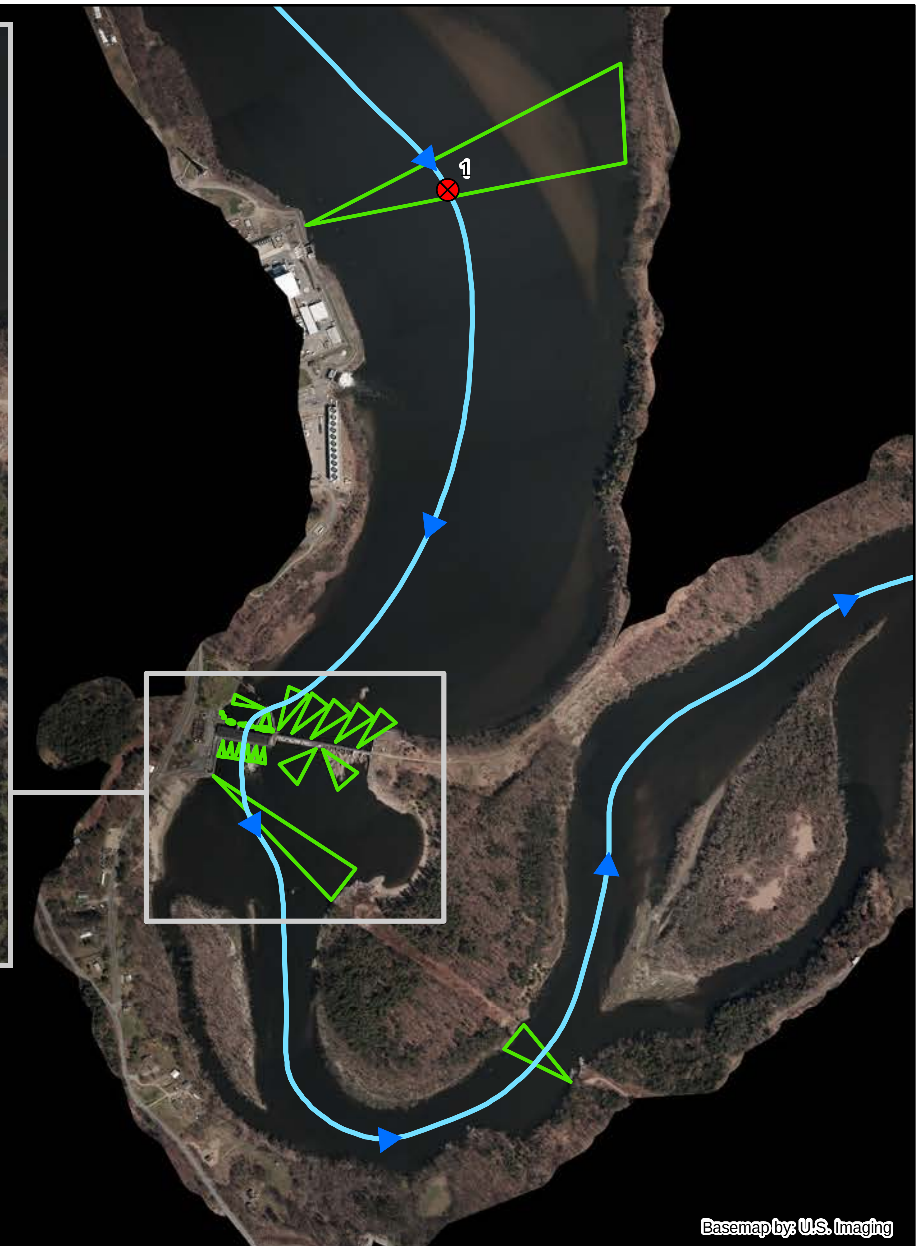


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 22:30 |
| 1 | 11/5/2015 | 23:05 |
| 3 | 11/5/2015 | 23:05 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-138(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/5/15
Time Released: 15:35


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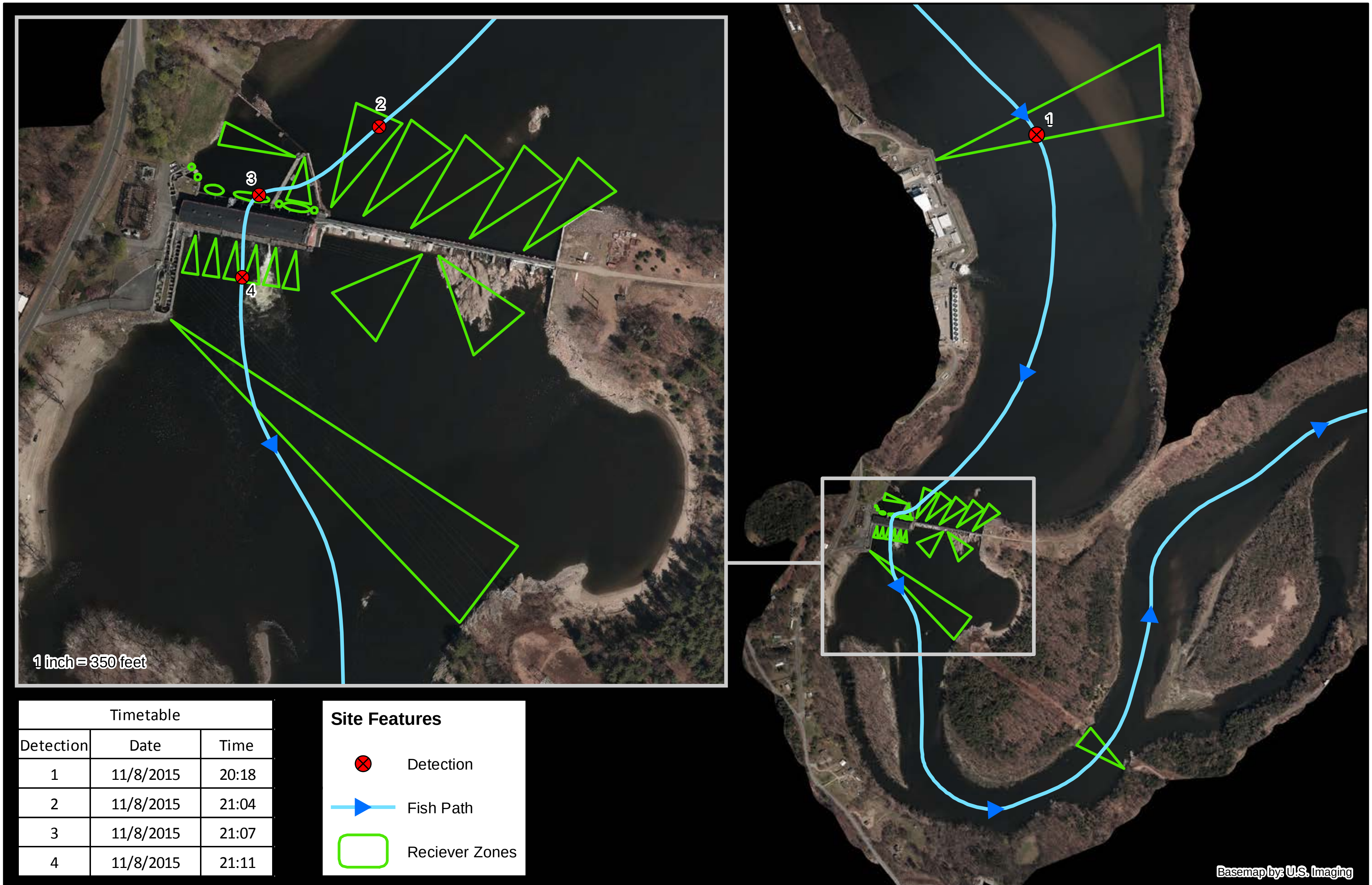


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 20:18 |
| 2 | 11/8/2015 | 21:04 |
| 3 | 11/8/2015 | 21:07 |
| 4 | 11/8/2015 | 21:11 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-139(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/5/15
Time Released: 15:35

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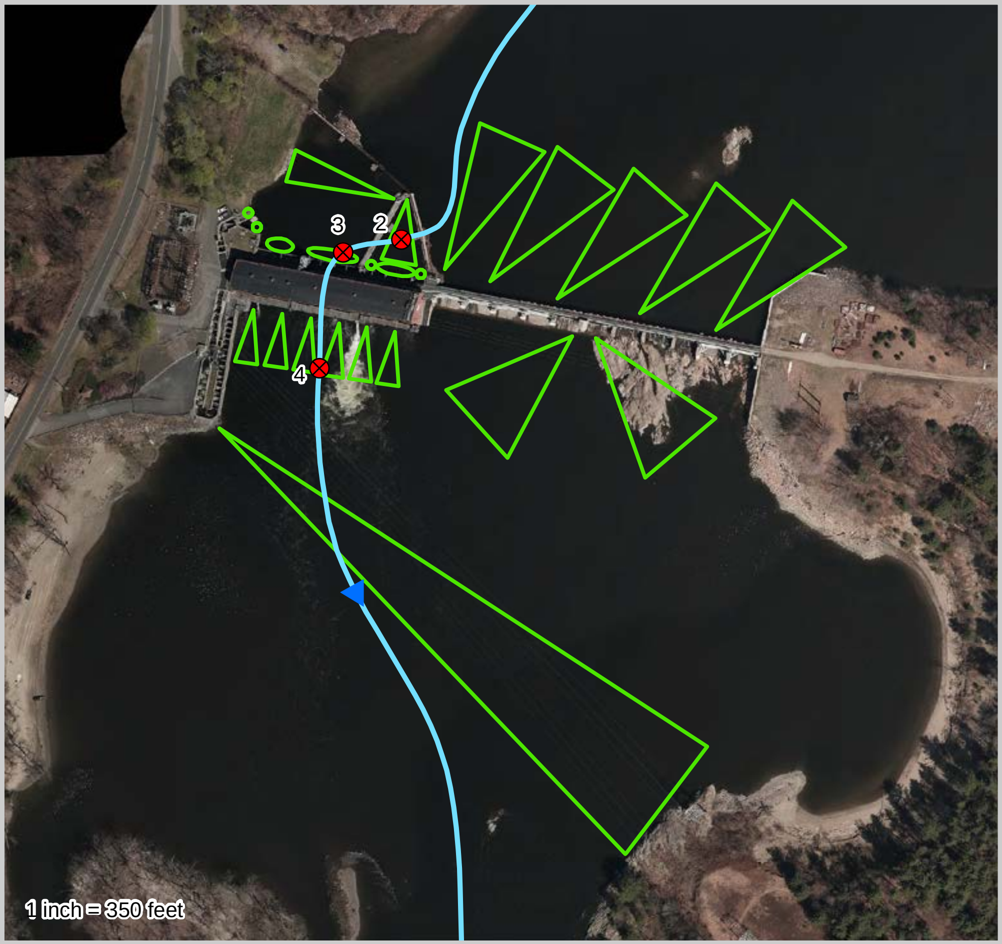


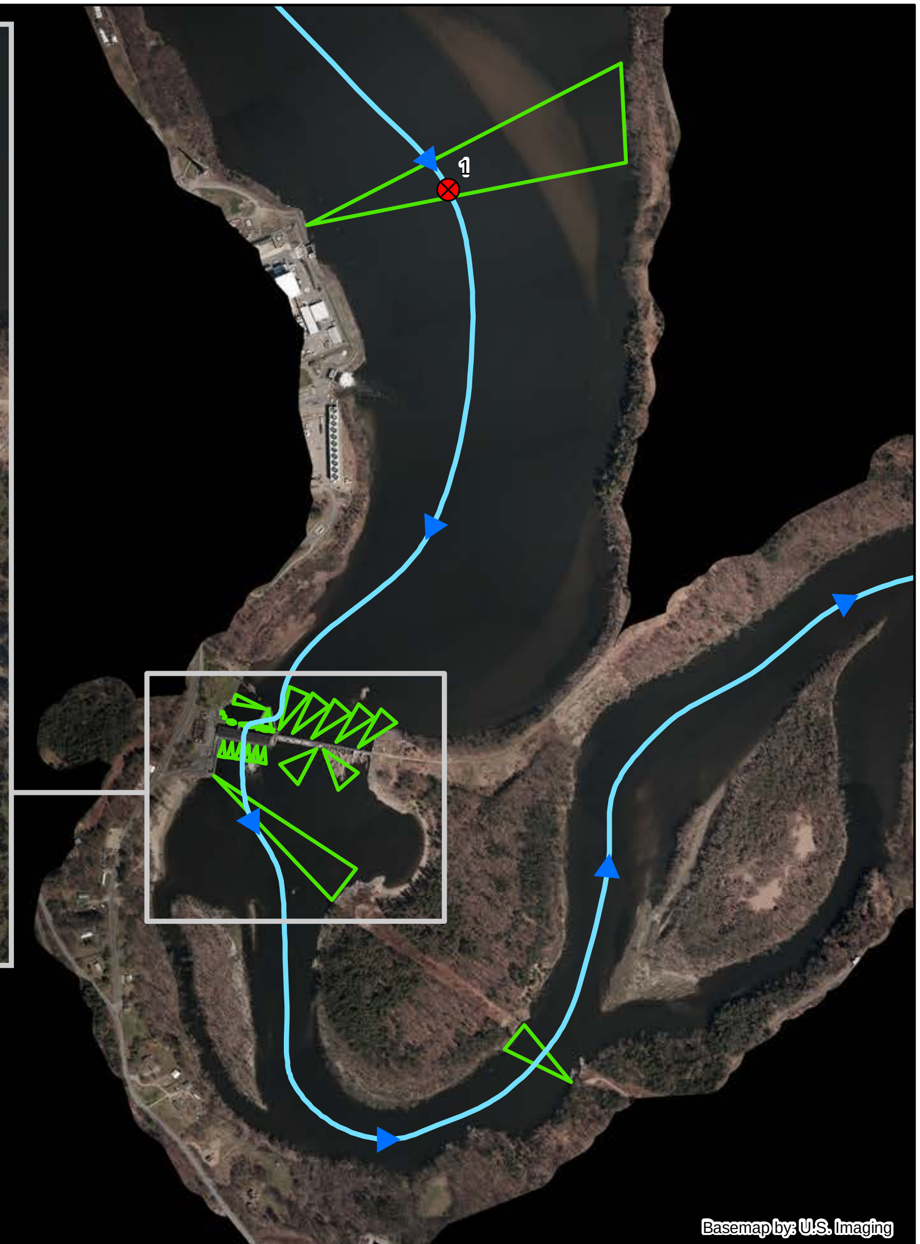


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 23:04 |
| 2 | 11/3/2015 | 0:09 |
| 3 | 11/3/2015 | 0:12 |
| 4 | 11/3/2015 | 0:12 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-51 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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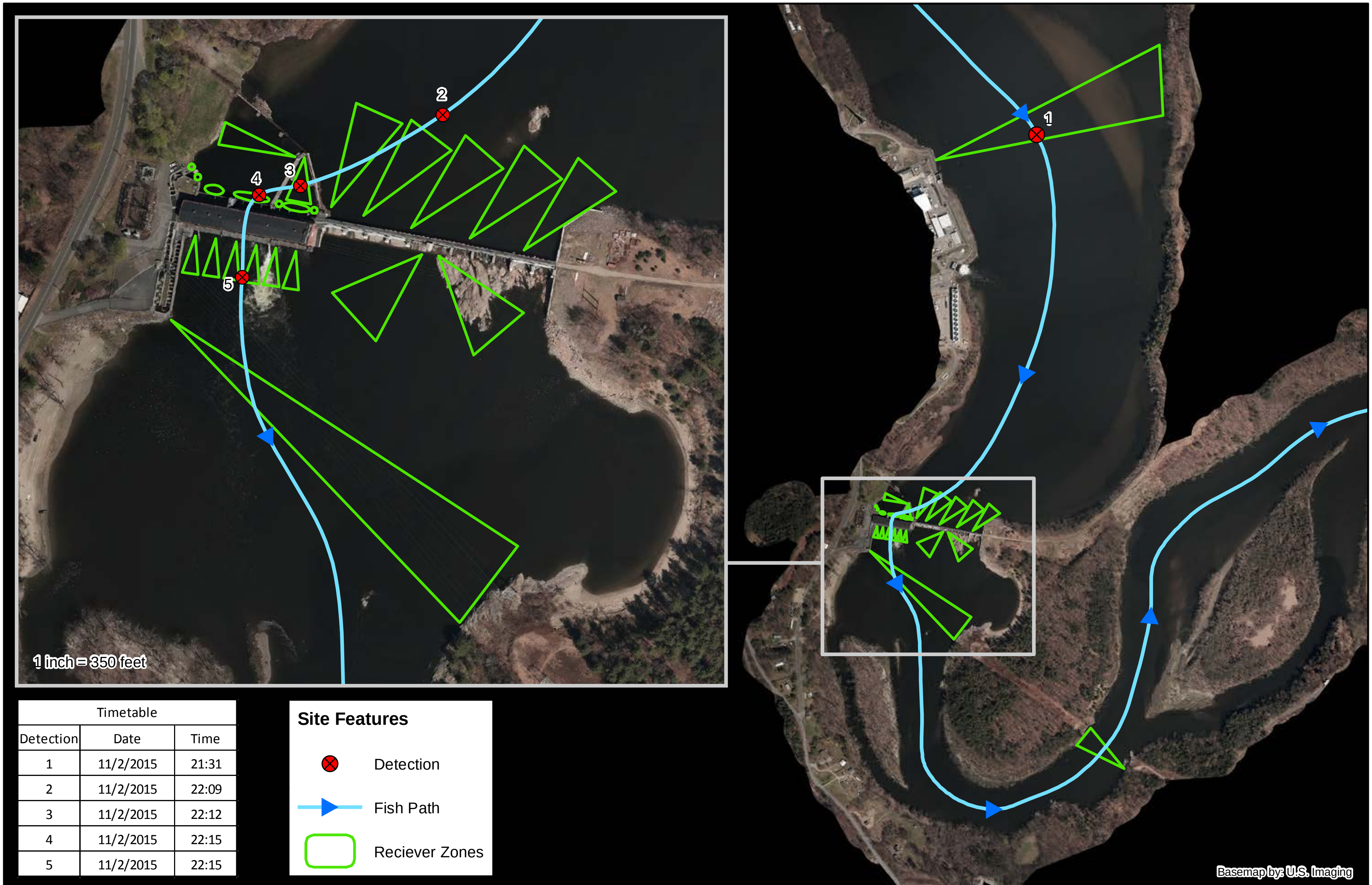


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 21:31 |
| 2 | 11/2/2015 | 22:09 |
| 3 | 11/2/2015 | 22:12 |
| 4 | 11/2/2015 | 22:15 |
| 5 | 11/2/2015 | 22:15 |

**Site Features**

Detection

Fish Path

Reciever Zones

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-52 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05


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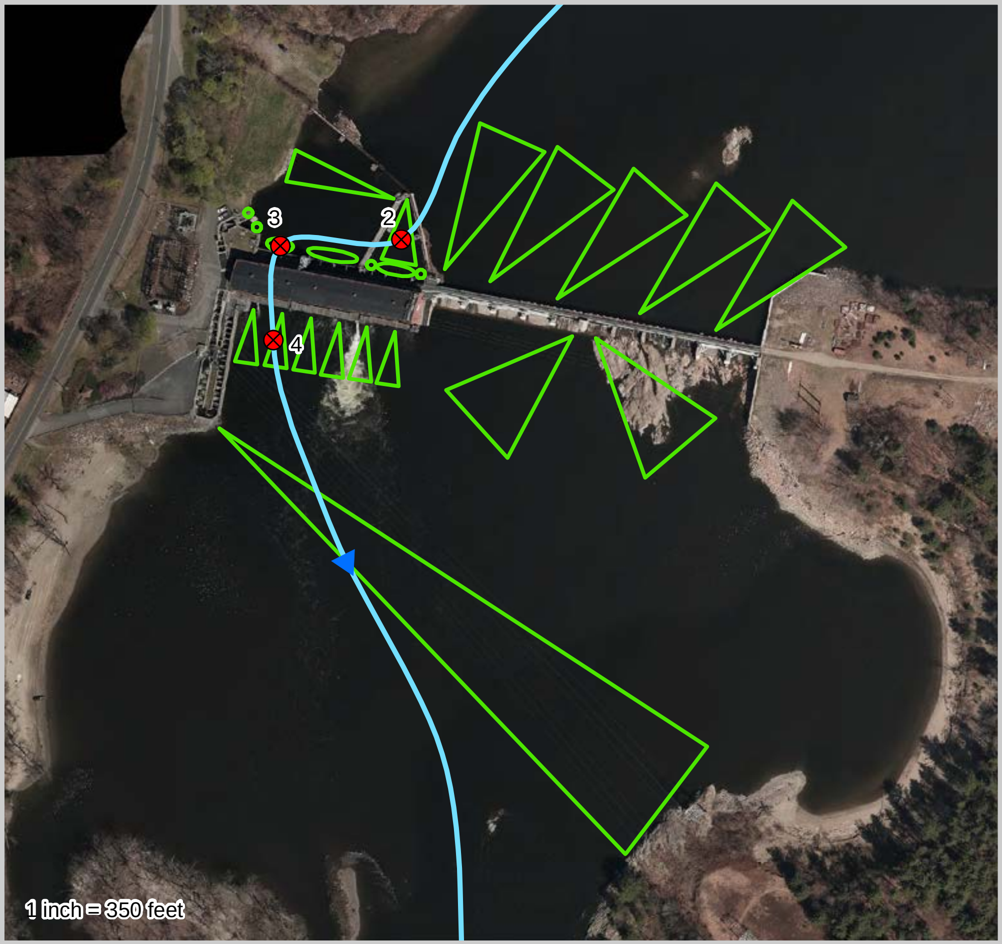


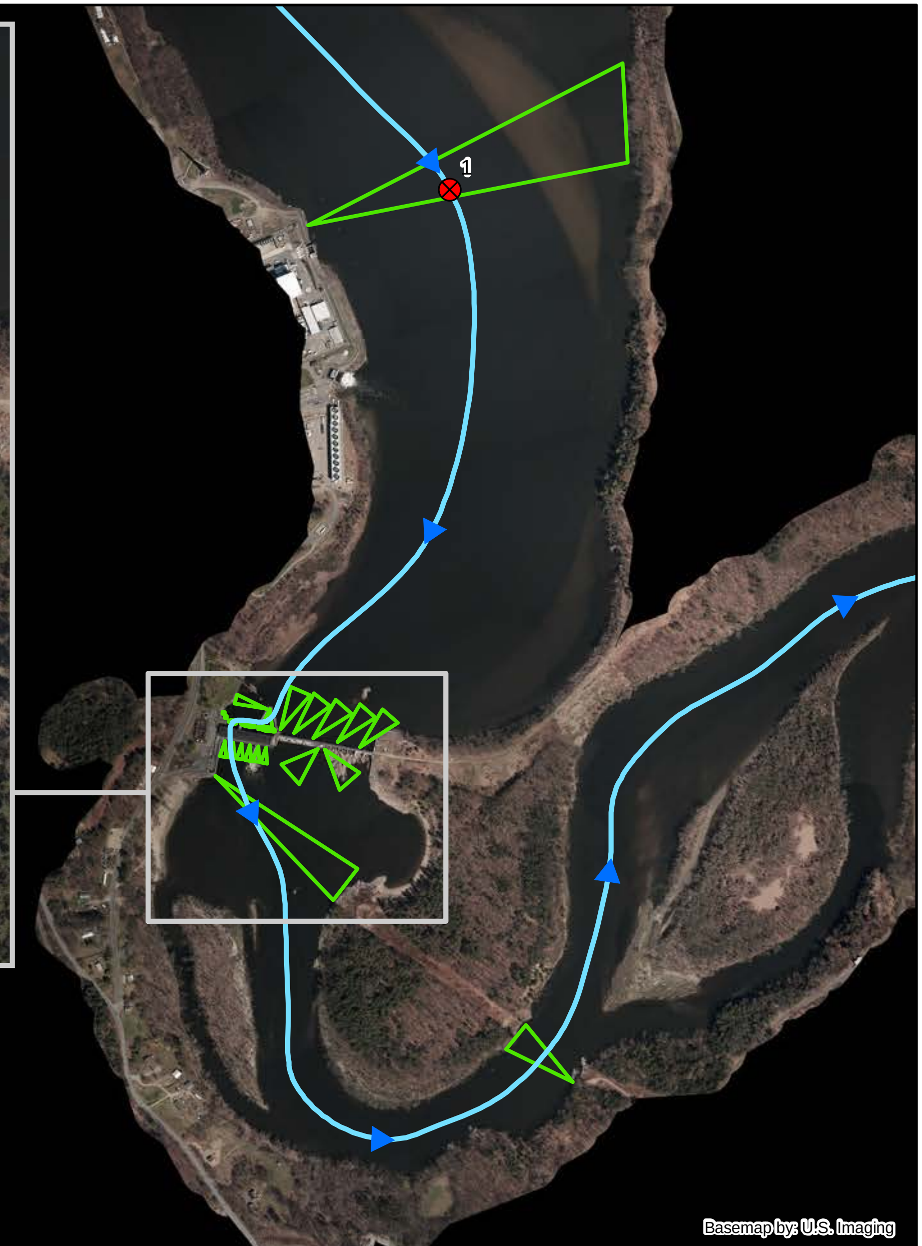


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 18:57 |
| 2 | 11/2/2015 | 19:47 |
| 3 | 11/2/2015 | 19:49 |
| 4 | 11/2/2015 | 19:51 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-53 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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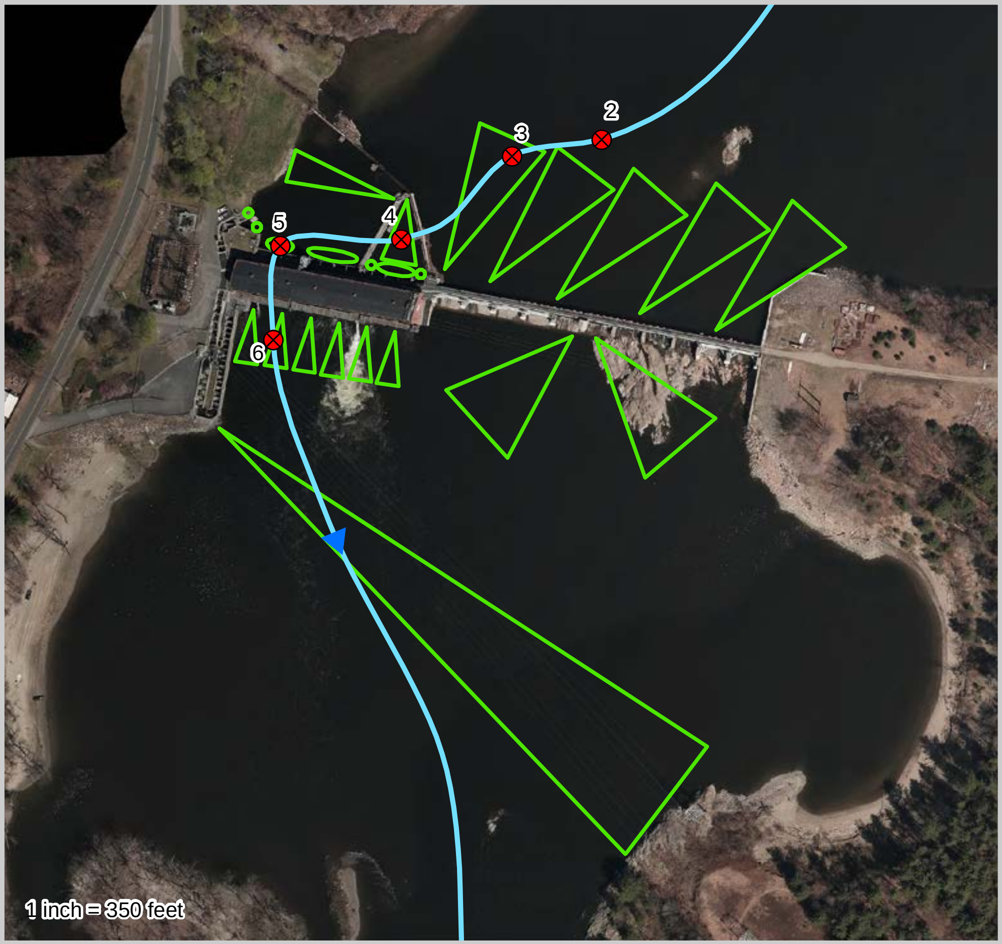


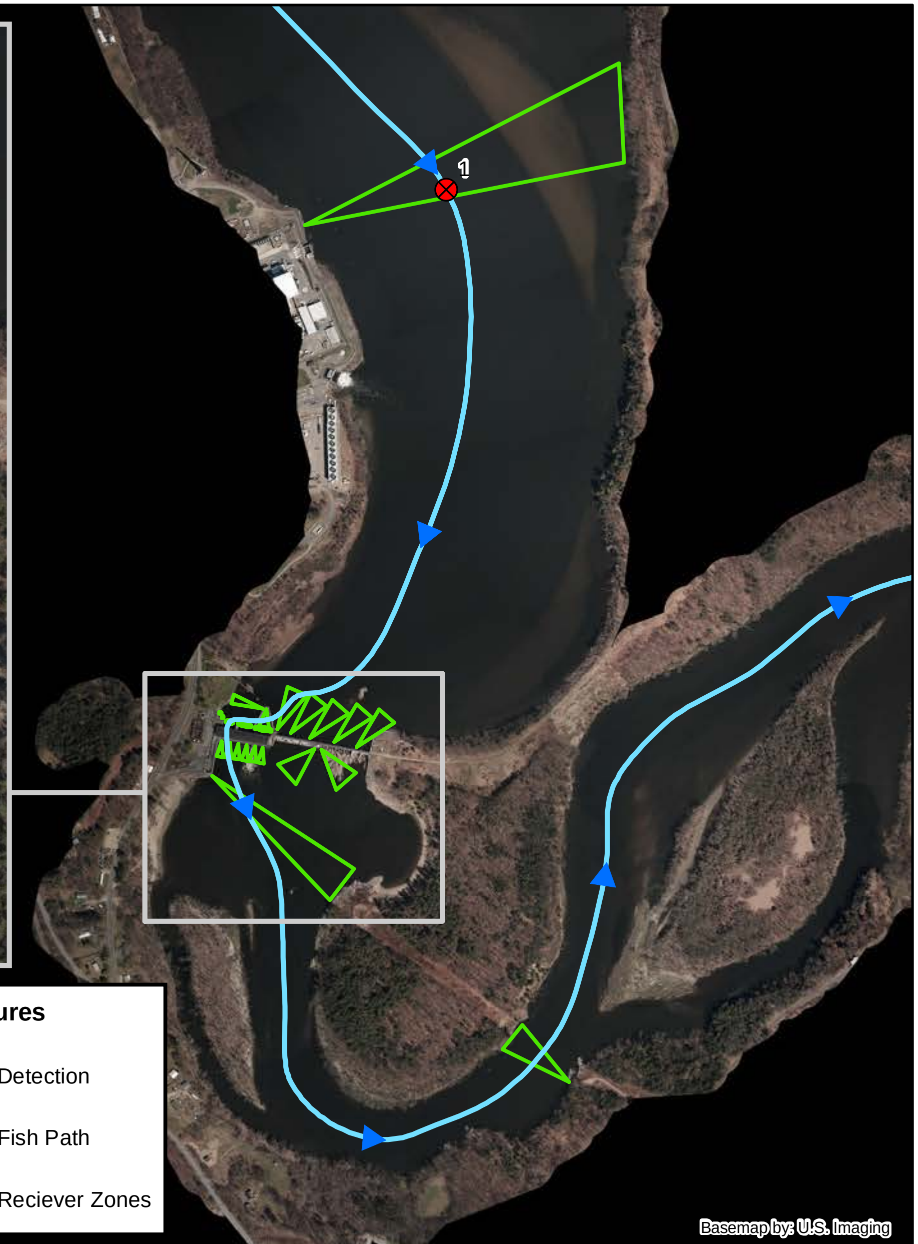


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/7/2015 | 23:35 | 4 | 11/8/2015 | 0:32 |
| 2 | 11/8/2015 | 0:24 | 5 | 11/8/2015 | 0:36 |
| 3 | 11/8/2015 | 0:29 | 6 | 11/8/2015 | 0:42 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-140(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/5/15
Time Released: 15:35

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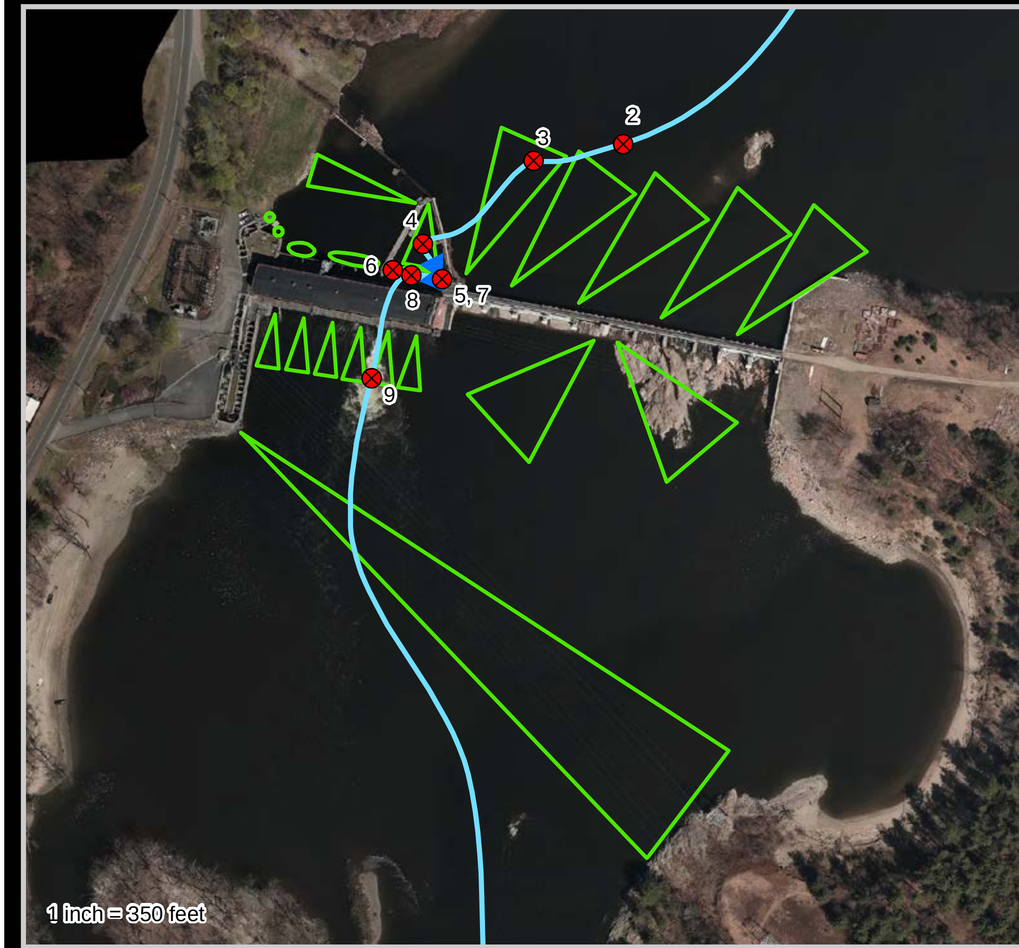


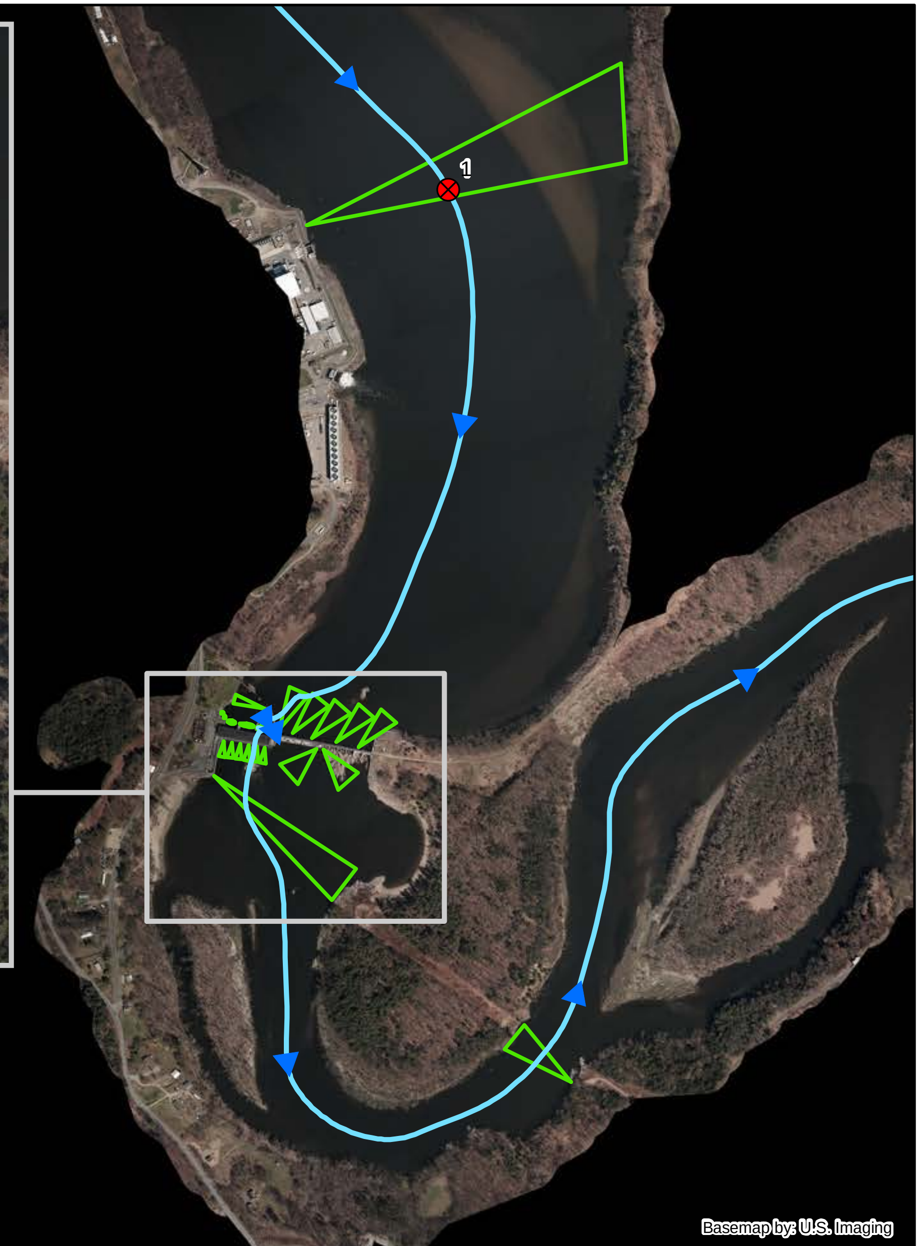


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/8/2015 | 21:38 | 6 | 11/8/2015 | 22:37 |
| 2 | 11/8/2015 | 22:27 | 7 | 11/8/2015 | 22:41 |
| 3 | 11/8/2015 | 22:33 | 8 | 11/8/2015 | 22:45 |
| 4 | 11/8/2015 | 22:35 | 9 | 11/8/2015 | 22:45 |
| 5 | 11/8/2015 | 22:36 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-141(T1)**

Release: Herricks Cove, VT
Date Released: 11/5/15
Time Released: 16:20

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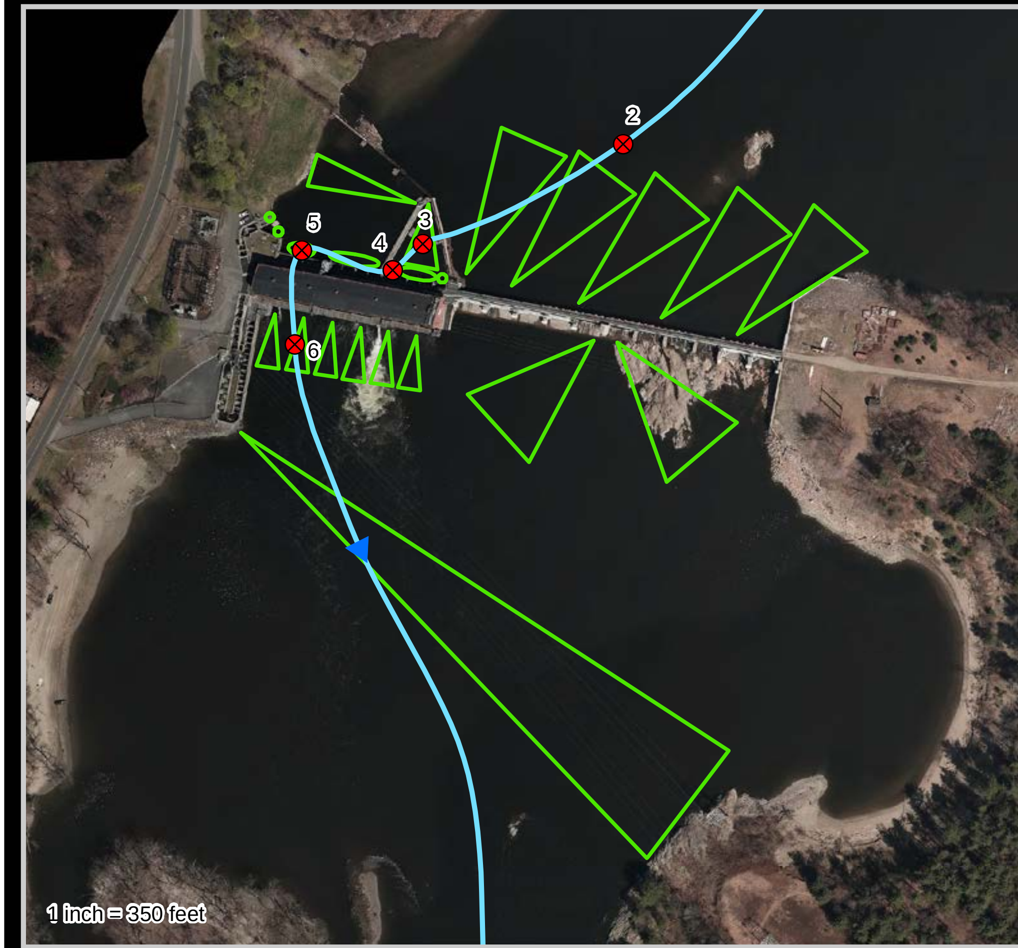


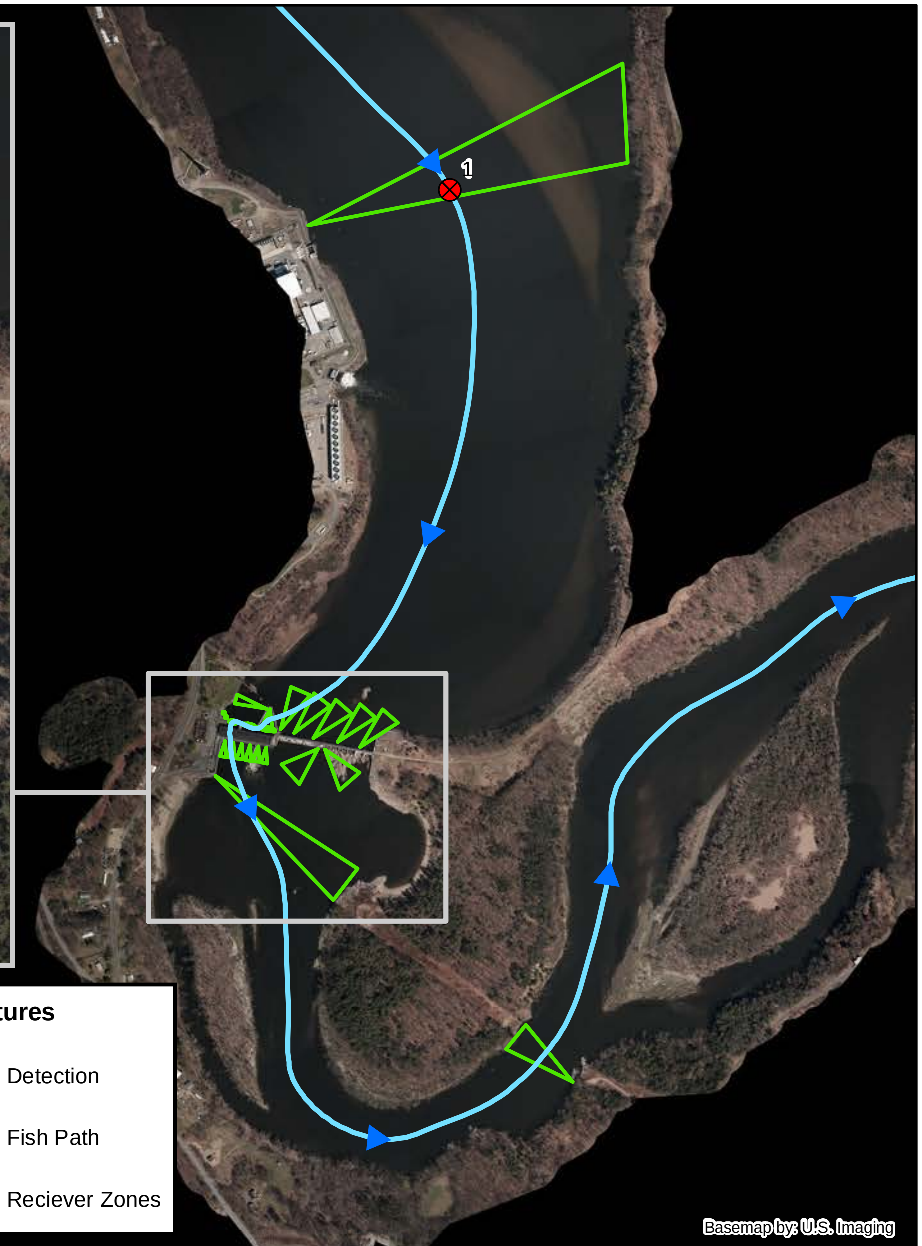


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/30/2015 | 11:01 | 4 | 10/30/2015 | 11:42 |
| 2 | 10/30/2015 | 11:36 | 5 | 10/30/2015 | 11:47 |
| 3 | 10/30/2015 | 11:41 | 6 | 10/30/2015 | 11:50 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-144(T1)**

Release: Herricks Cove, VT
Date Released: 10/29/15
Time Released: 17:52


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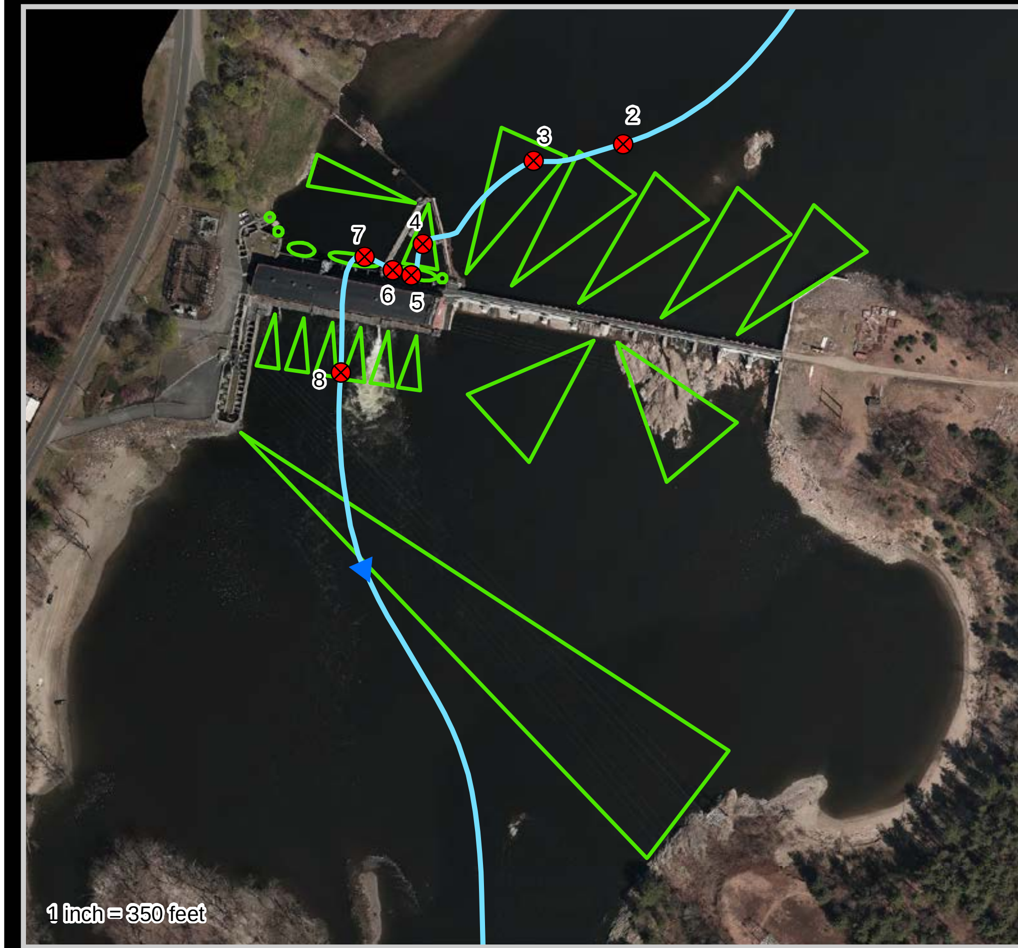


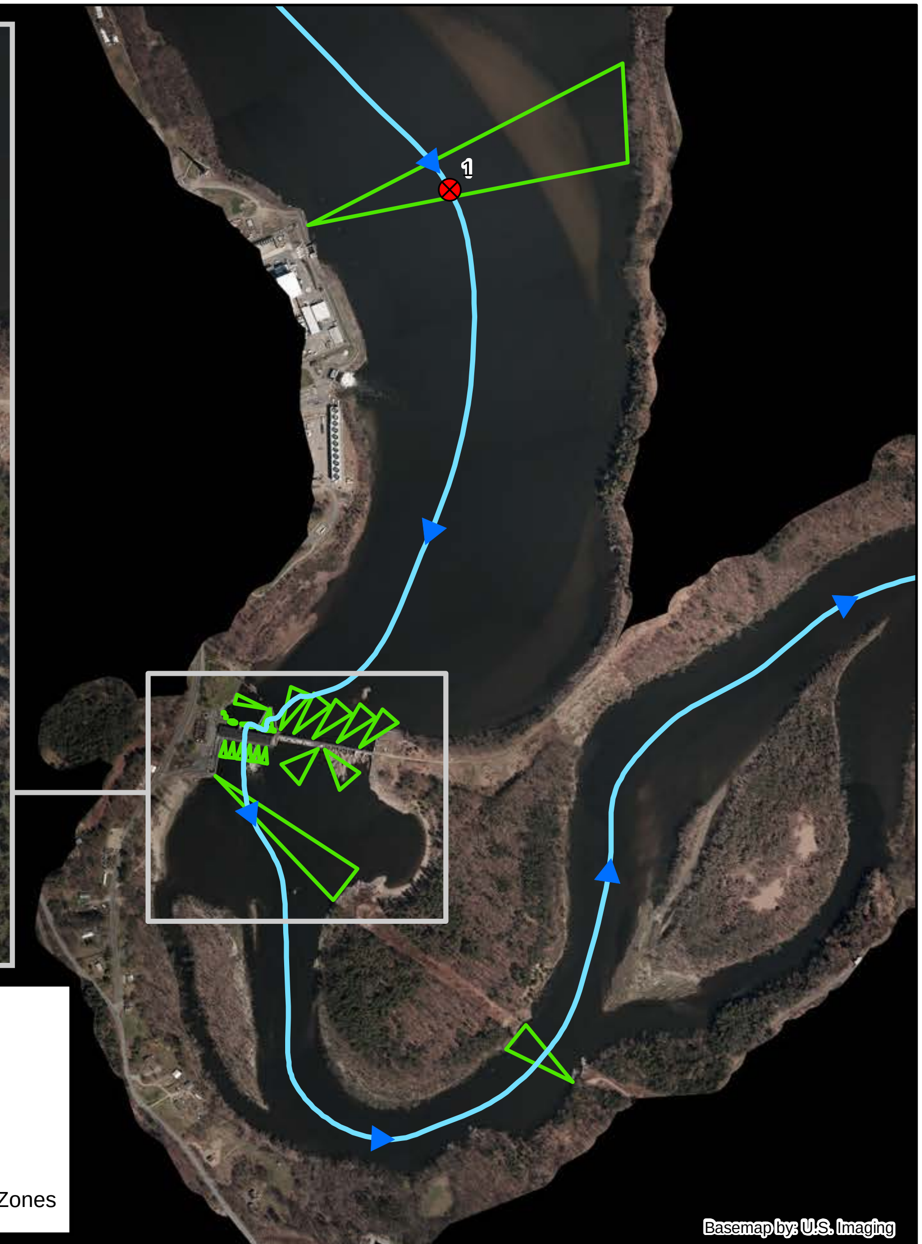


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/31/2015 | 23:45 | 5 | 11/1/2015 | 6:59 |
| 2 | 11/1/2015 | 6:42 | 6 | 11/1/2015 | 6:59 |
| 3 | 11/1/2015 | 6:57 | 7 | 11/1/2015 | 7:00 |
| 4 | 11/1/2015 | 6:58 | 8 | 11/1/2015 | 7:00 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-146(T1)**

Release: Herricks Cove, VT
Date Released: 10/29/15
Time Released: 17:52

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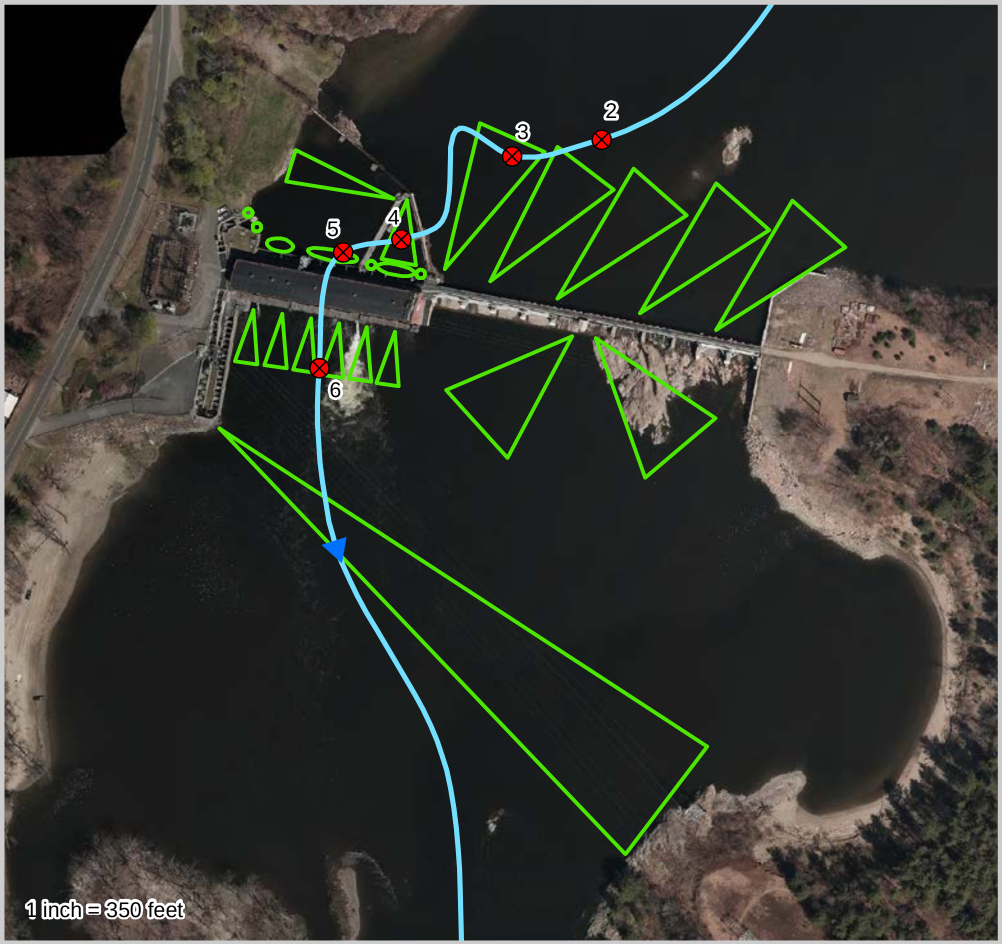


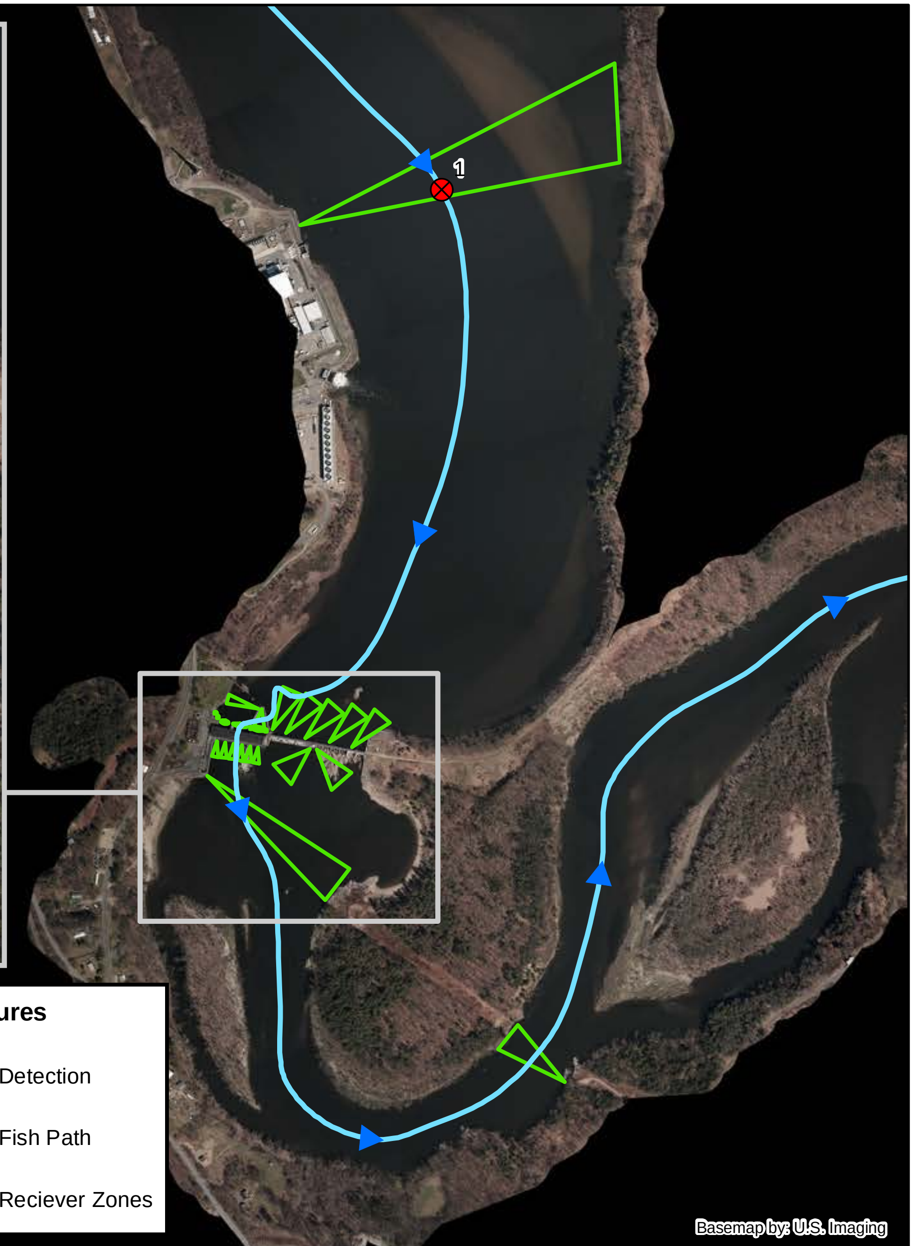


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/20/2015 | 19:46 | 4 | 11/20/2015 | 20:39 |
| 2 | 11/20/2015 | 20:25 | 5 | 11/20/2015 | 20:43 |
| 3 | 11/20/2015 | 20:35 | 6 | 11/20/2015 | 20:43 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-147(T1)**

Release: Herricks Cove, VT
Date Released: 10/29/15
Time Released: 17:52

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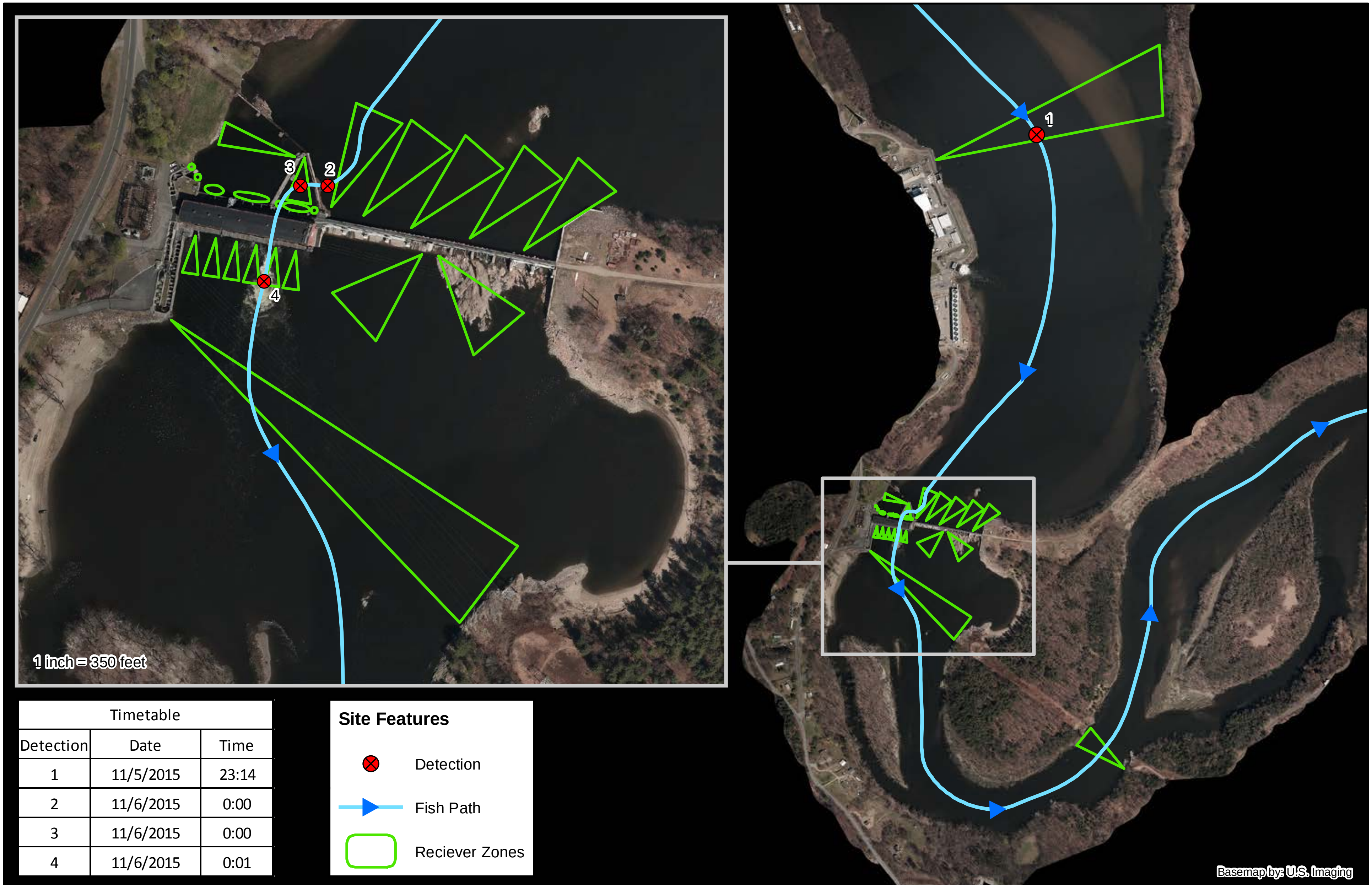


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 23:14 |
| 2 | 11/6/2015 | 0:00 |
| 3 | 11/6/2015 | 0:00 |
| 4 | 11/6/2015 | 0:01 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-155(T1)**

Release: Norwich, VT
Date Released: 10/29/15
Time Released: 18:43


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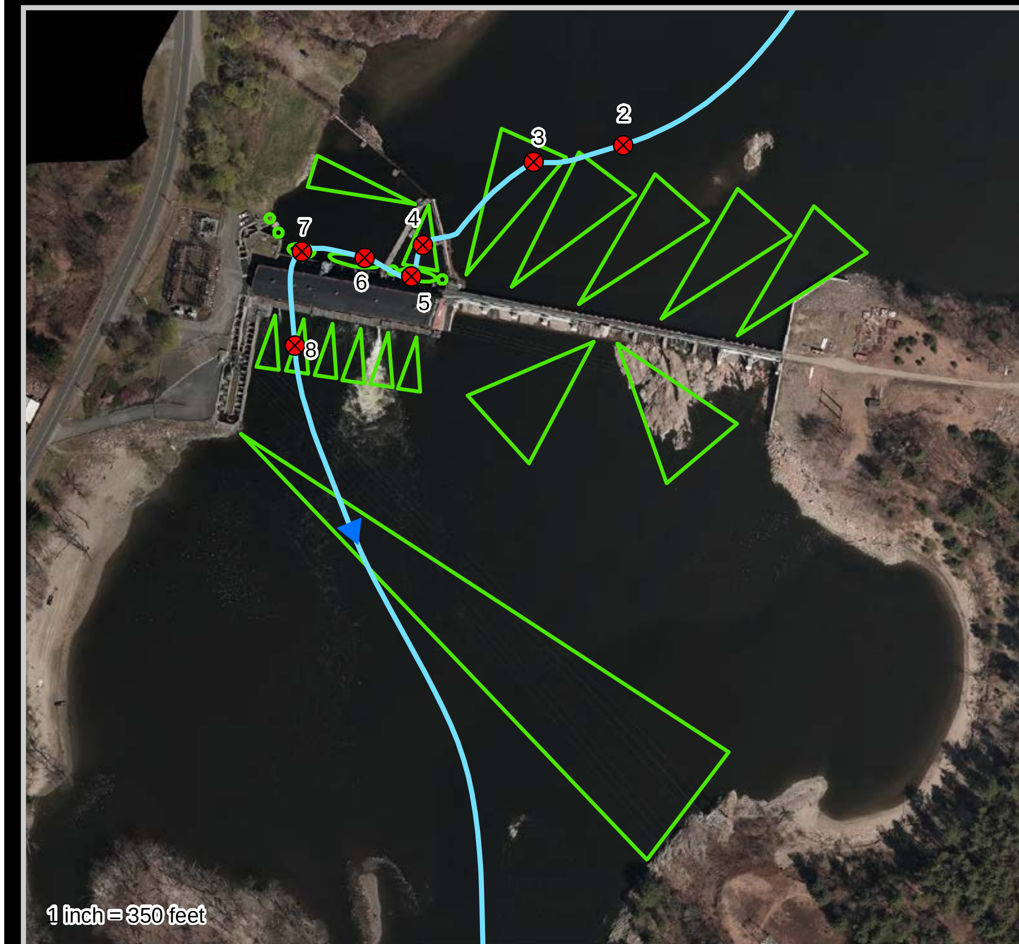


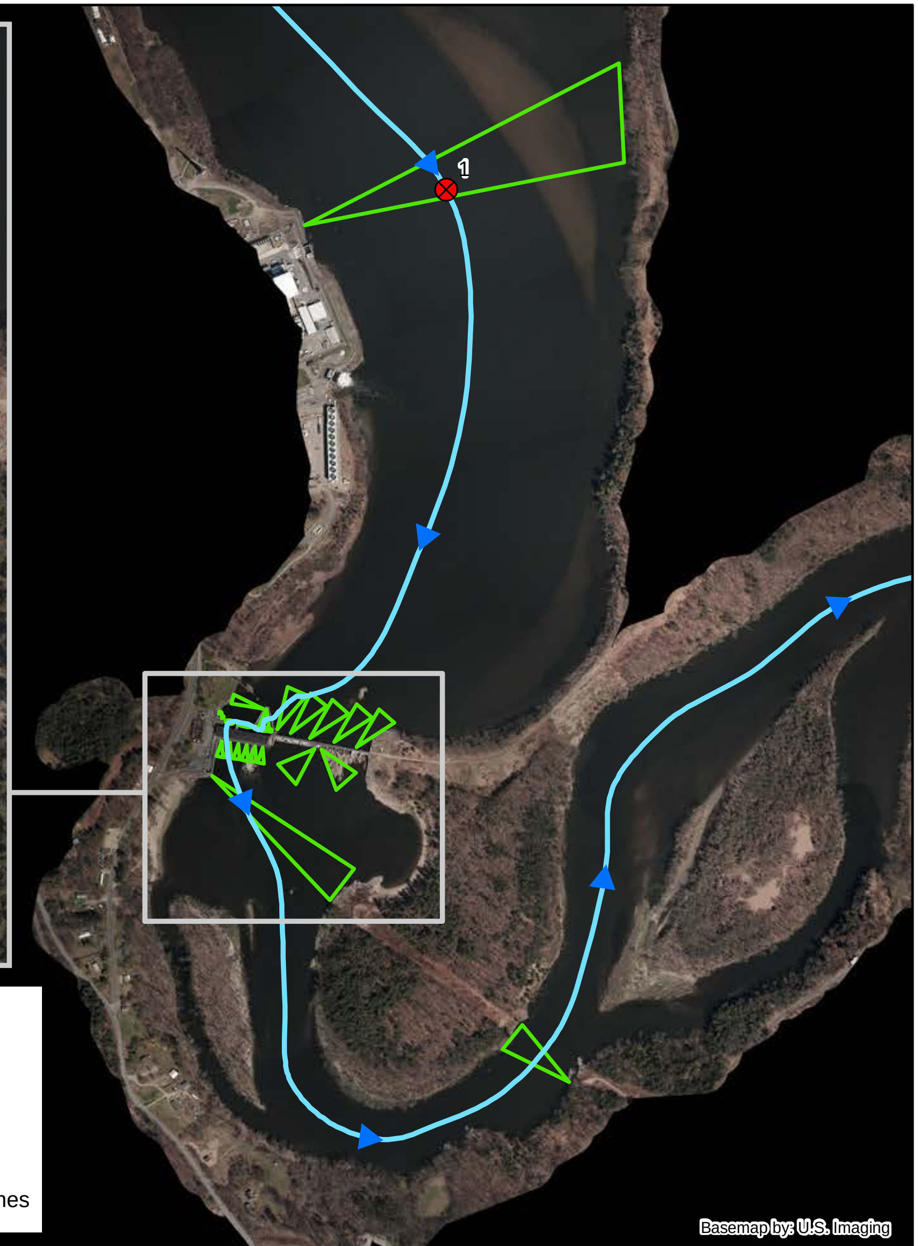


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 4:43 | 5 | 11/4/2015 | 6:03 |
| 2 | 11/4/2015 | 5:57 | 6 | 11/4/2015 | 6:06 |
| 3 | 11/4/2015 | 5:57 | 7 | 11/4/2015 | 6:07 |
| 4 | 11/4/2015 | 6:01 | 8 | 11/4/2015 | 6:11 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-156(T1)**

Release:Norwich, VT
Date Released: 10/29/15
Time Released: 18:43

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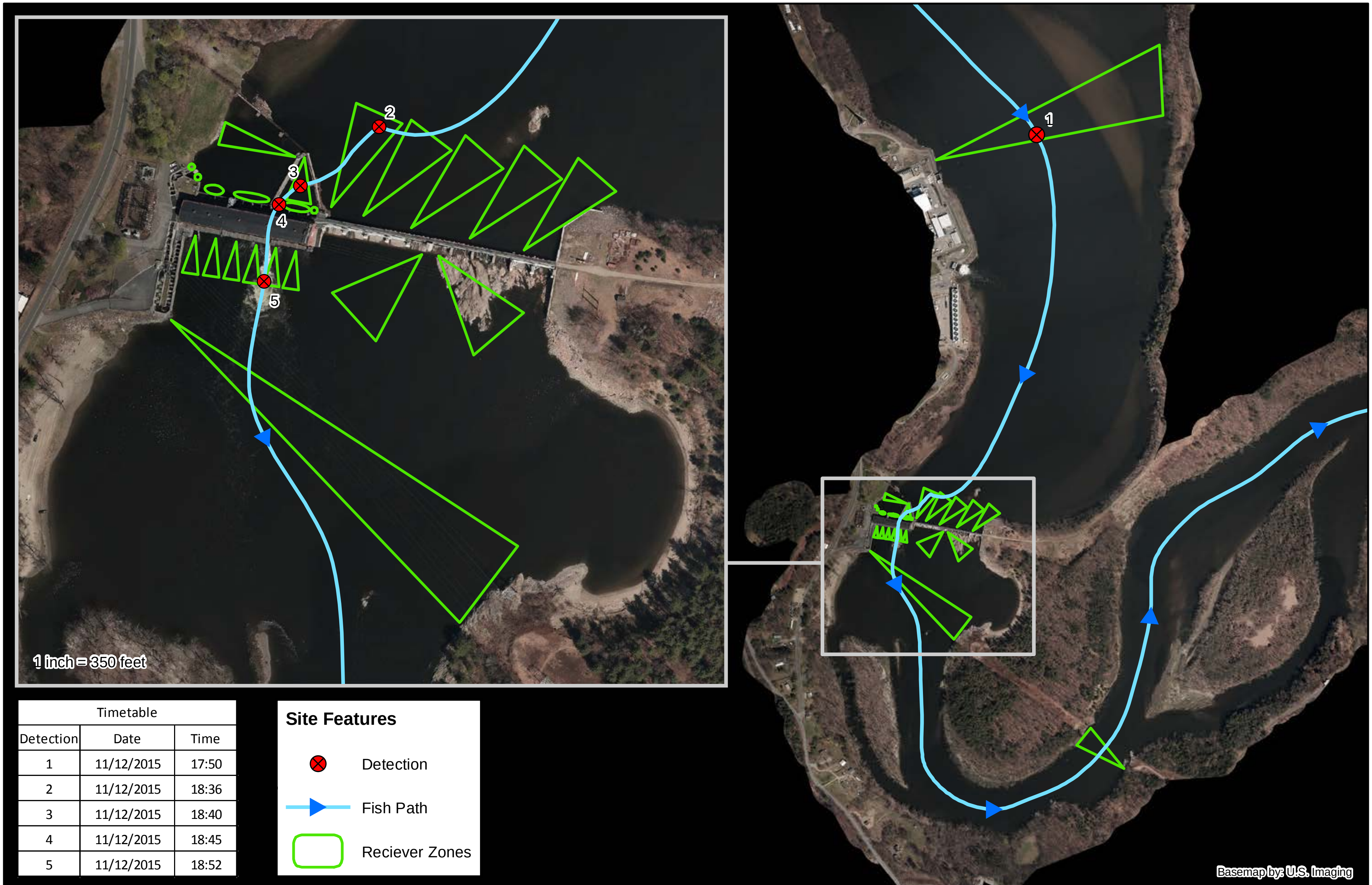


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/12/2015 | 17:50 |
| 2 | 11/12/2015 | 18:36 |
| 3 | 11/12/2015 | 18:40 |
| 4 | 11/12/2015 | 18:45 |
| 5 | 11/12/2015 | 18:52 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-158(T1)**
Release: Norwich, VT
Date Released: 11/5/15
Time Released: 17:05

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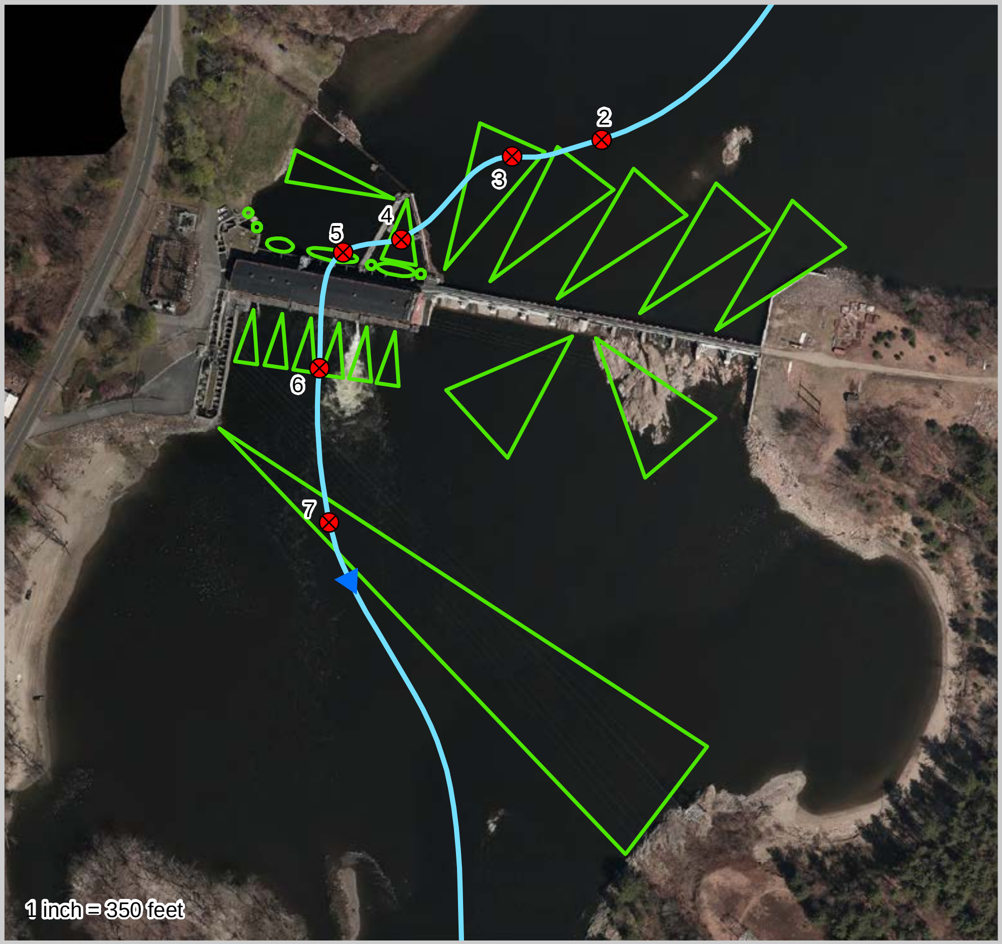


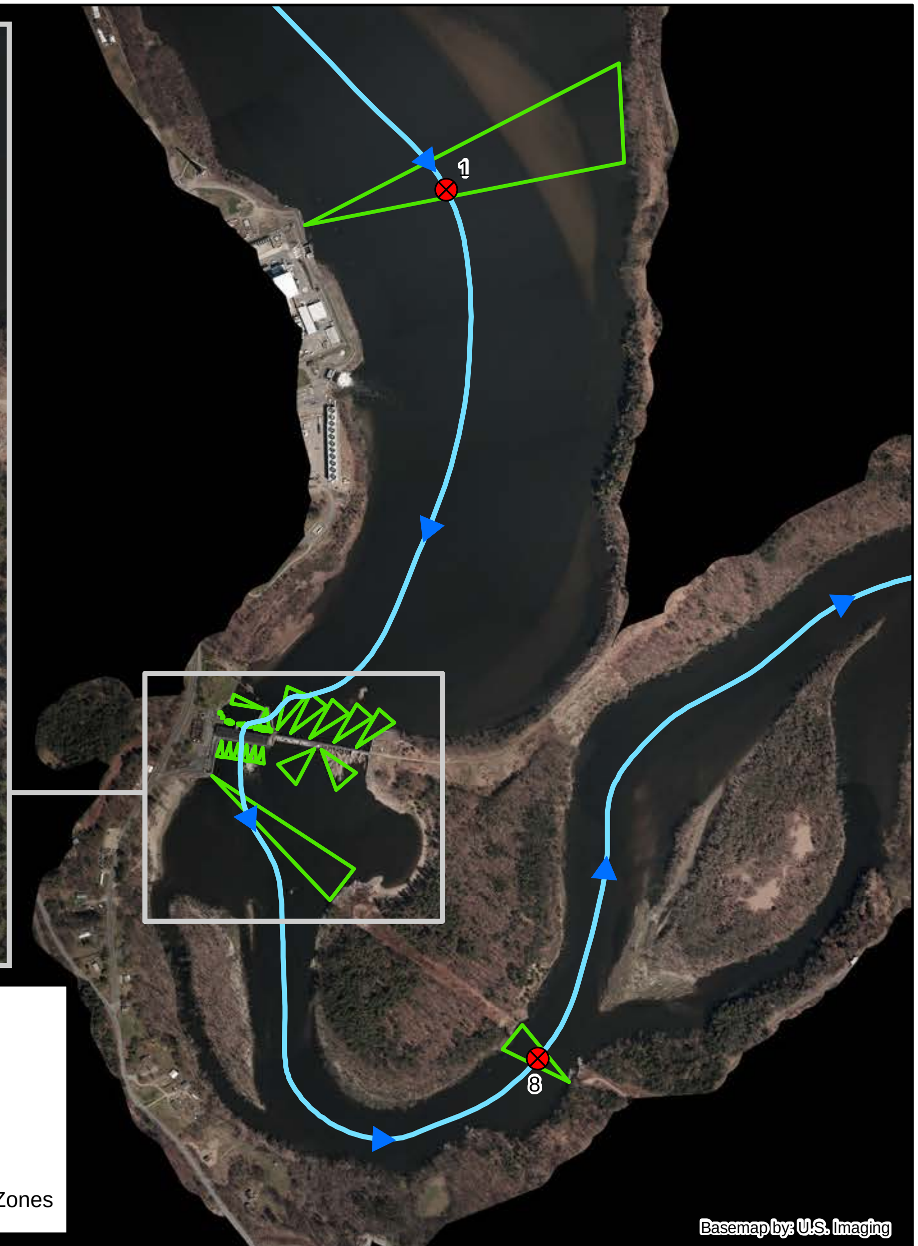


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/31/2015 | 21:18 | 5 | 10/31/2015 | 21:59 |
| 2 | 10/31/2015 | 21:50 | 6 | 10/31/2015 | 21:59 |
| 3 | 10/31/2015 | 21:53 | 7 | 10/31/2015 | 22:01 |
| 4 | 10/31/2015 | 21:59 | 8 | 10/31/2015 | 22:44 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-164(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/15
Time Released: 13:40

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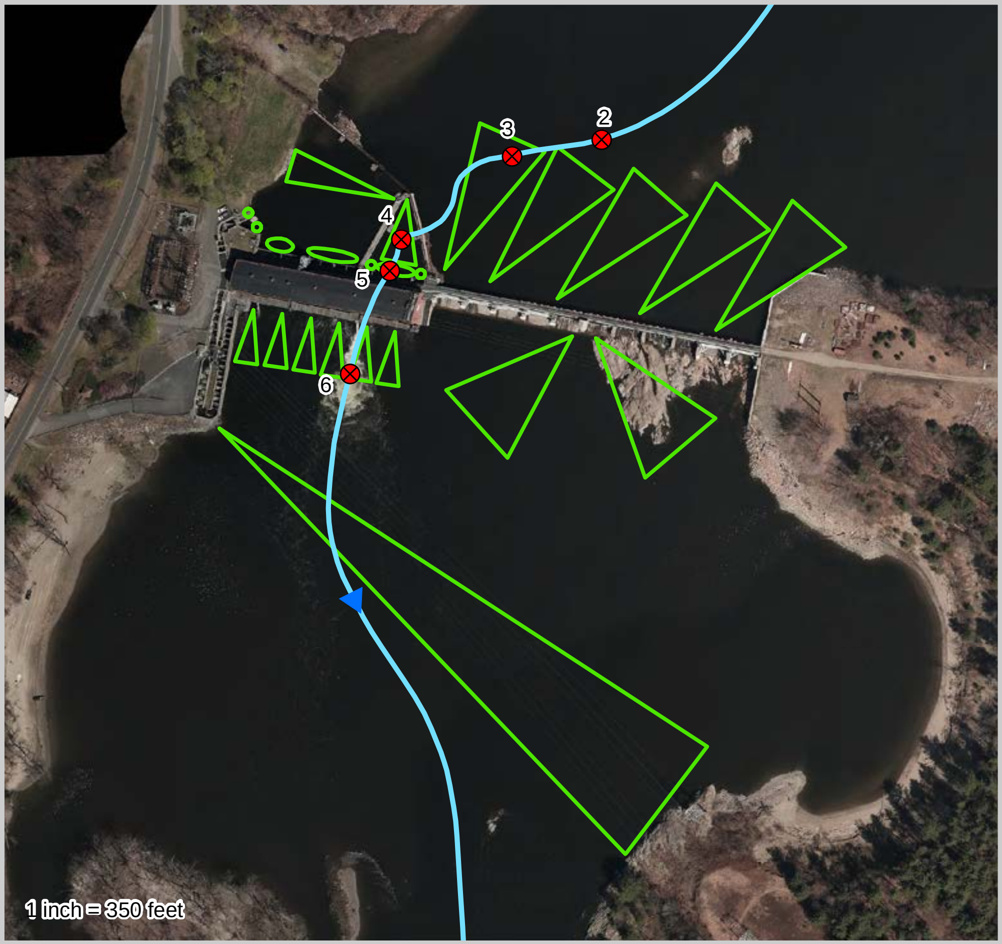


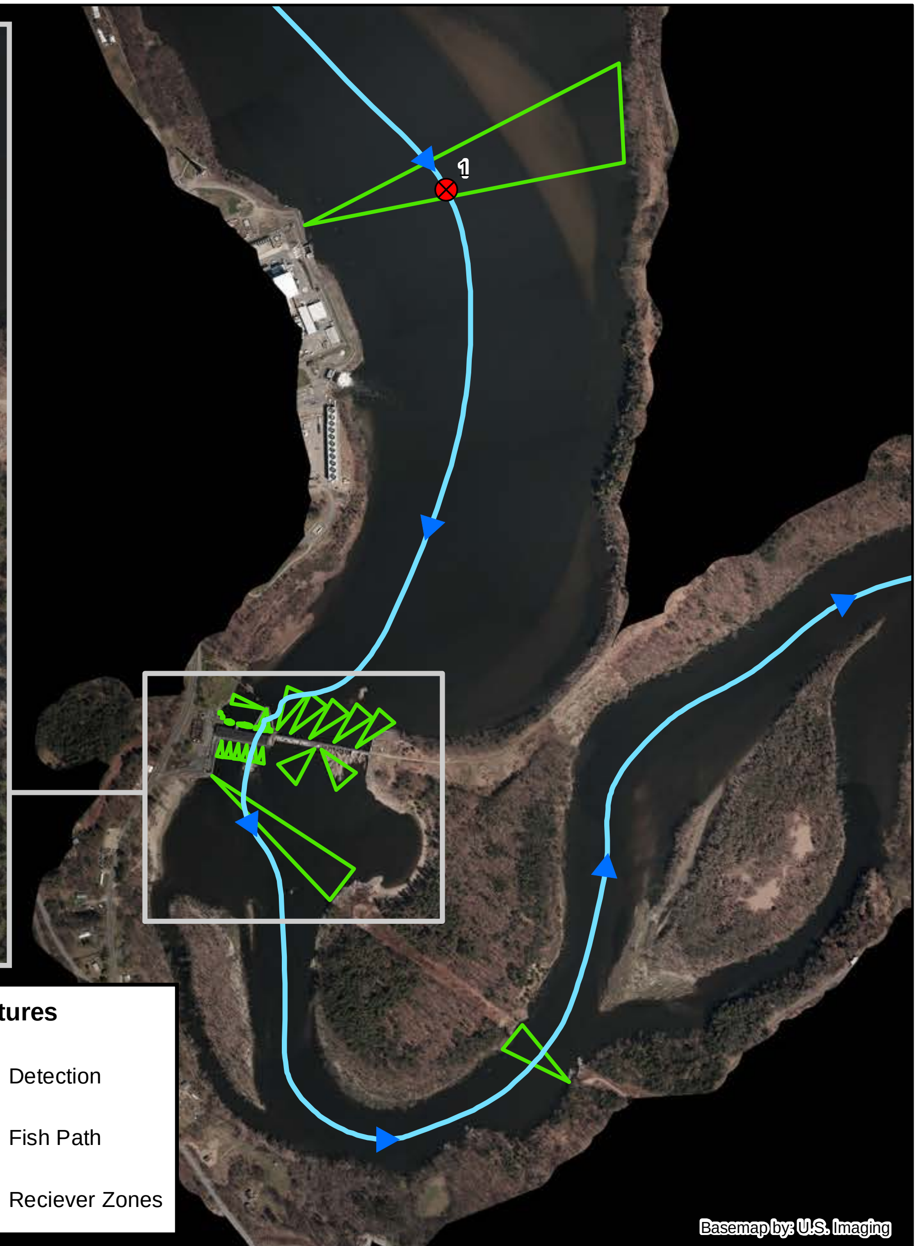


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/31/2015 | 21:20 | 4 | 11/2/2015 | 21:12 |
| 2 | 11/2/2015 | 20:59 | 5 | 11/2/2015 | 21:13 |
| 3 | 11/2/2015 | 21:06 | 6 | 11/2/2015 | 21:13 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-165(T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/15
Time Released: 13:40

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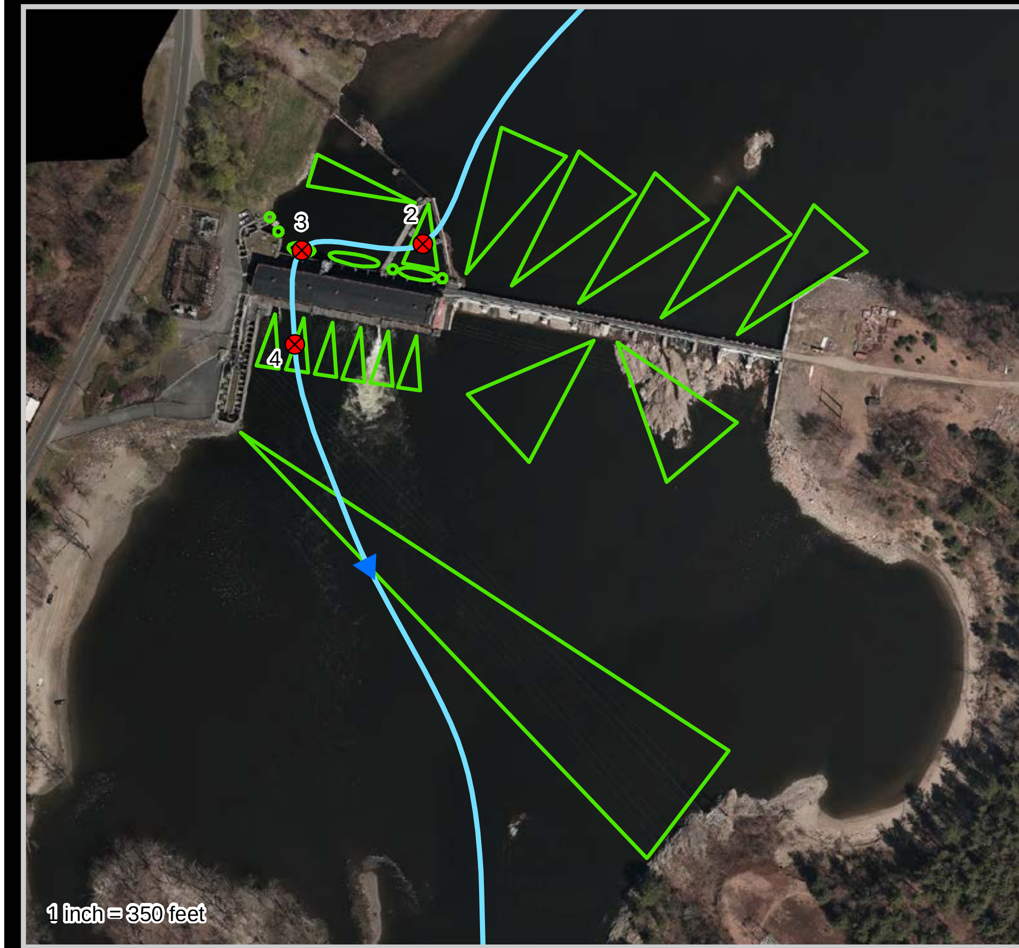


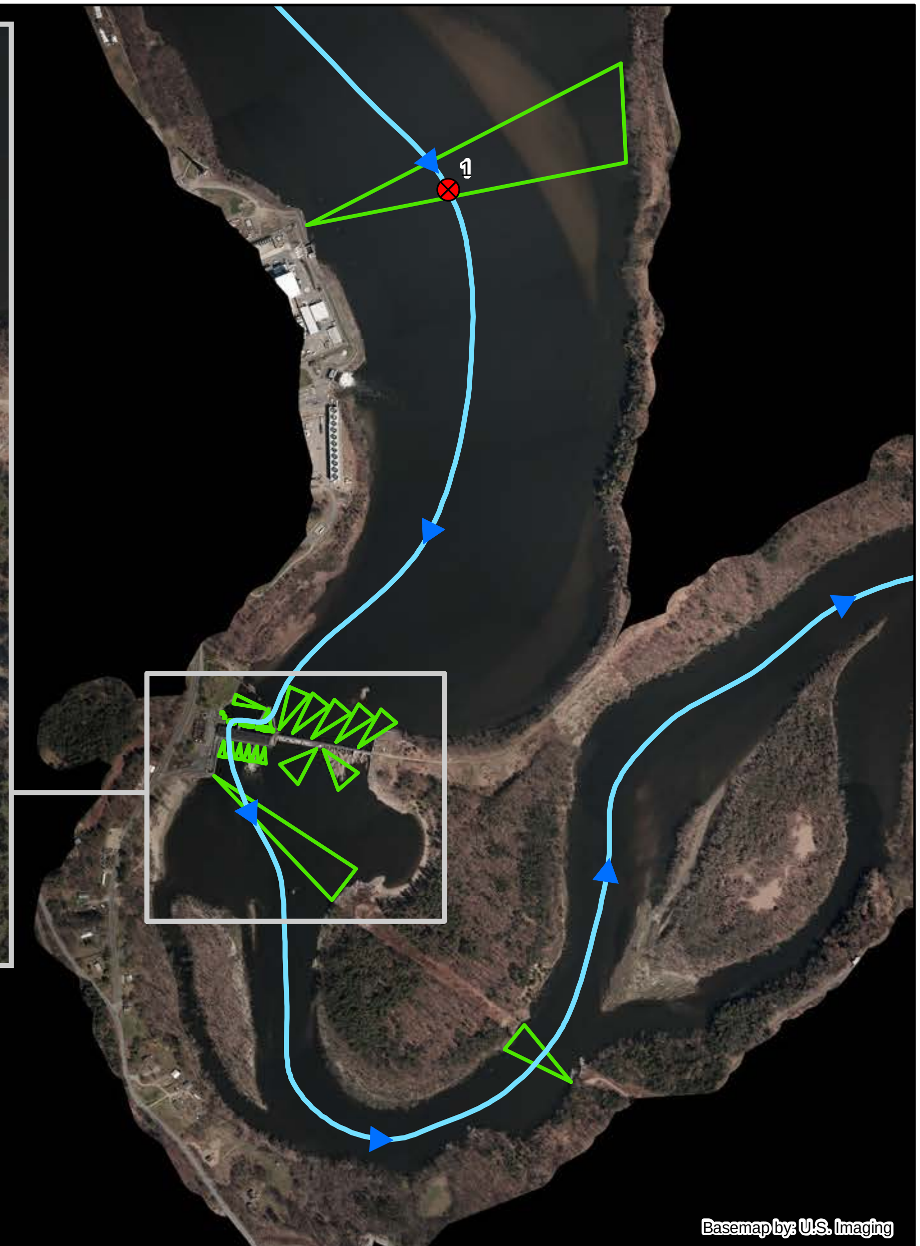


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 21:17 |
| 2 | 11/6/2015 | 22:12 |
| 3 | 11/6/2015 | 22:29 |
| 4 | 11/6/2015 | 22:30 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-166(T1)**

Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/15
Time Released: 13:40


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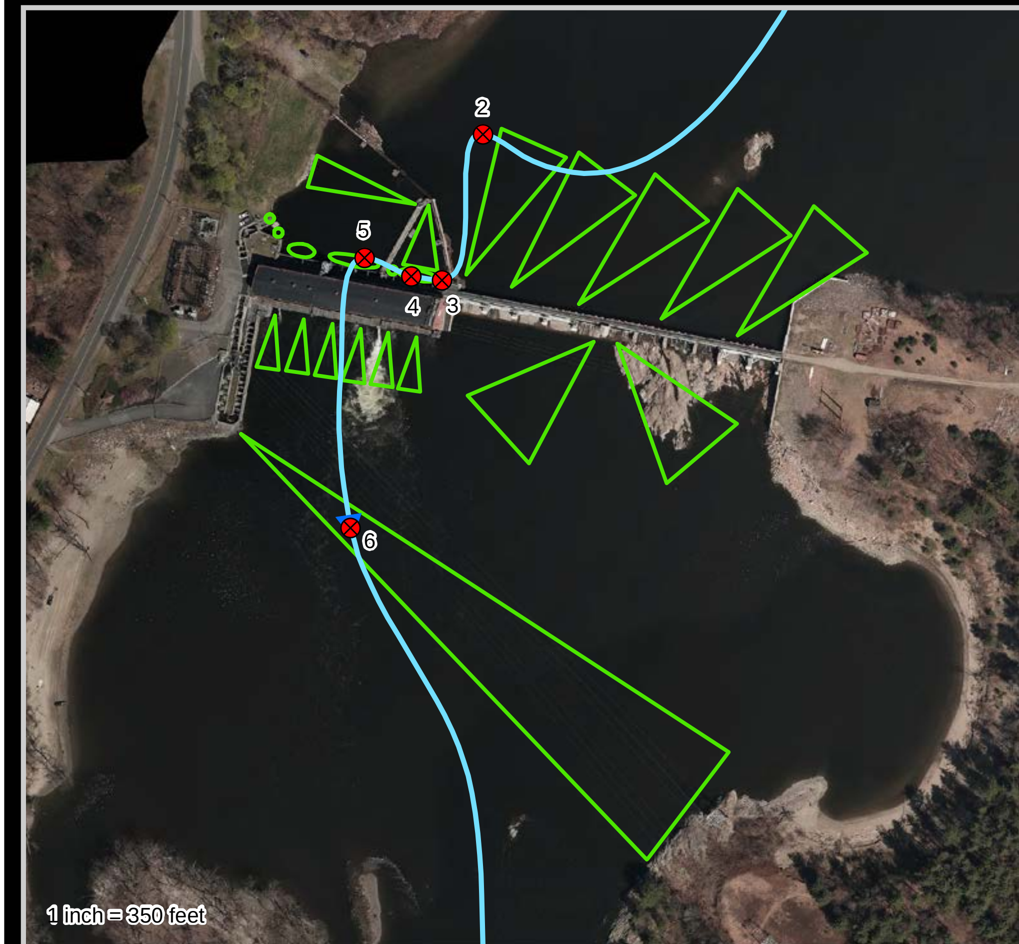


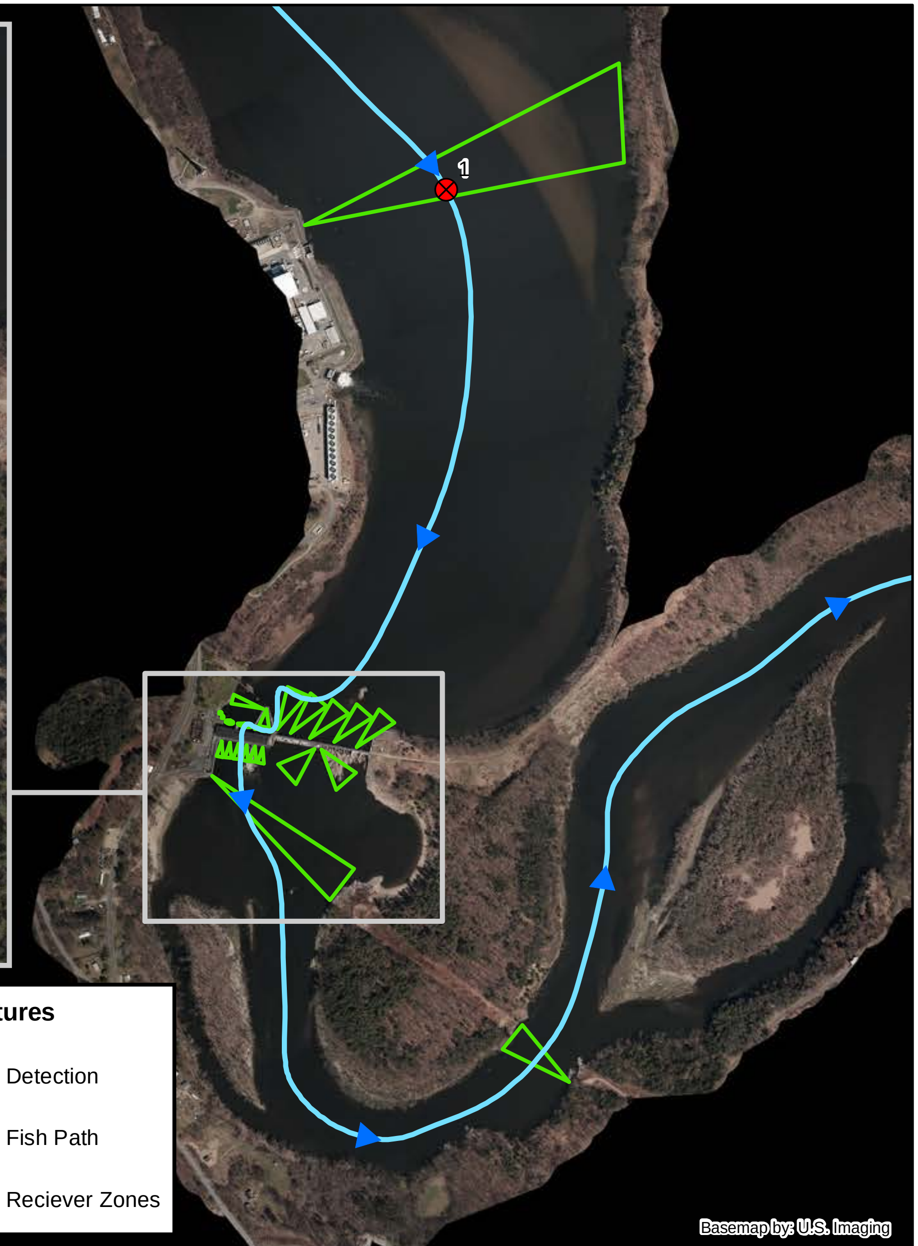


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/9/2015 | 19:59 | 4 | 11/9/2015 | 22:43 |
| 2 | 11/9/2015 | 21:05 | 5 | 11/9/2015 | 22:53 |
| 3 | 11/9/2015 | 22:42 | 6 | 11/9/2015 | 23:01 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-175(T1)**

Release: Herricks Cove, VT
Date Released: 10/31/15
Time Released: 18:22


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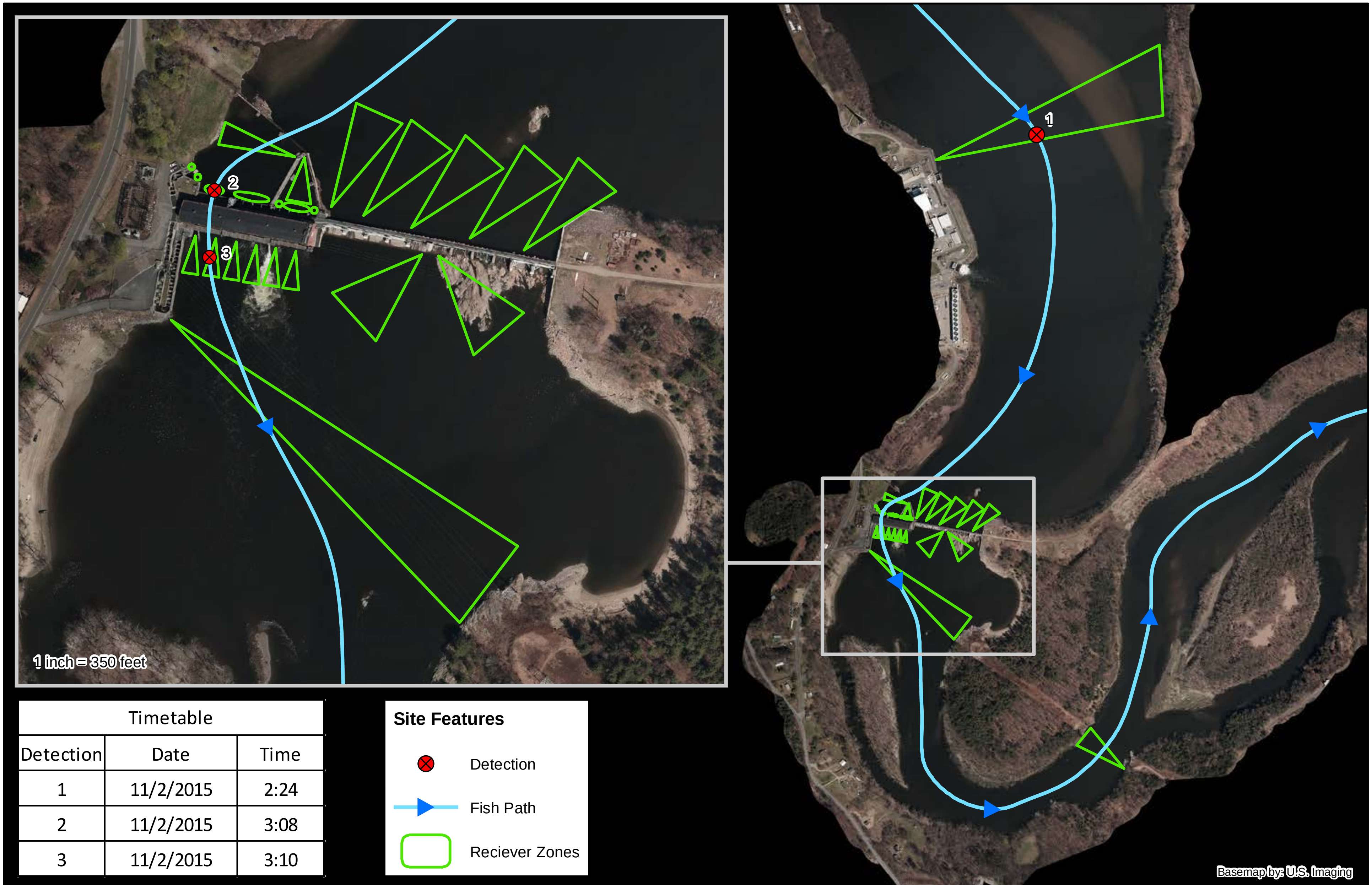


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/2/2015 | 2:24 |
| 2 | 11/2/2015 | 3:08 |
| 3 | 11/2/2015 | 3:10 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-176(T1)**

Release: Herricks Cove, VT
Date Released: 10/31/15
Time Released: 18:22

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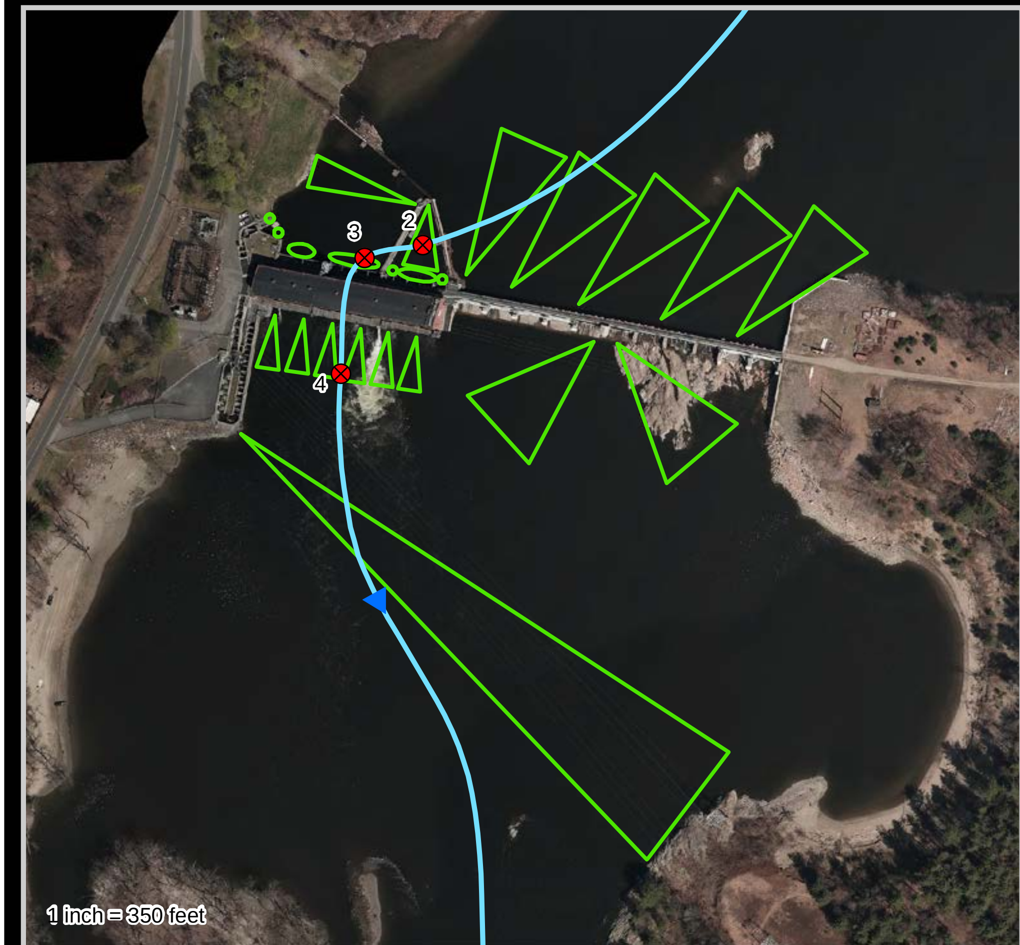


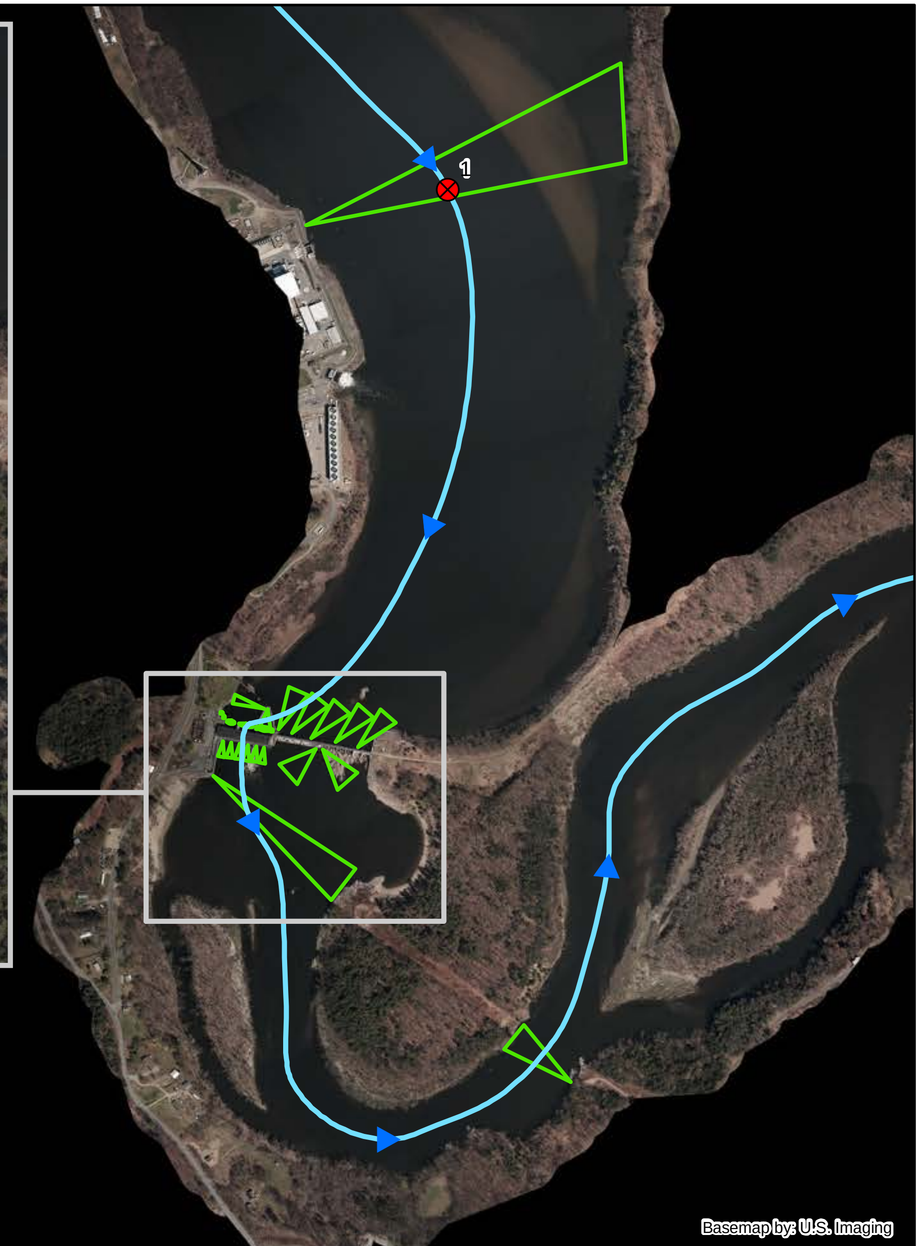


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 18:39 |
| 2 | 11/3/2015 | 19:14 |
| 3 | 11/3/2015 | 19:15 |
| 4 | 11/3/2015 | 19:15 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-177(T1)**

Release: Herricks Cove, VT
Date Released: 10/31/15
Time Released: 18:22


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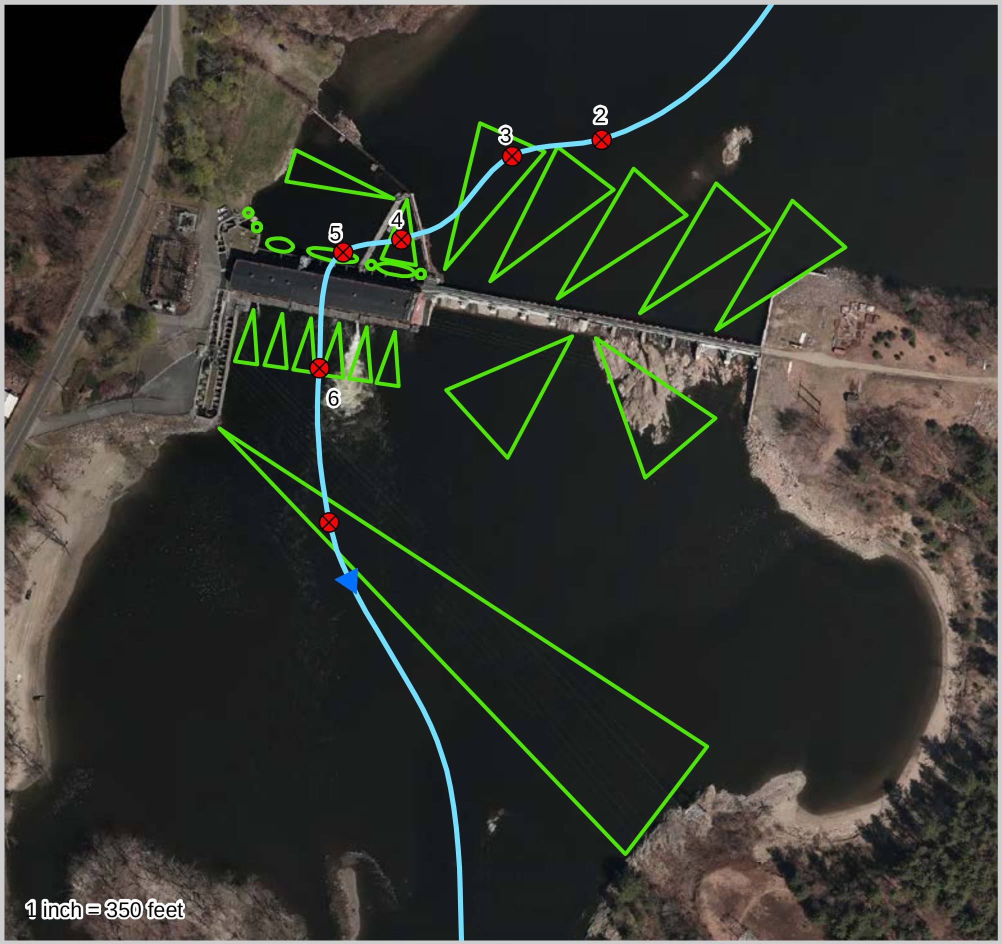


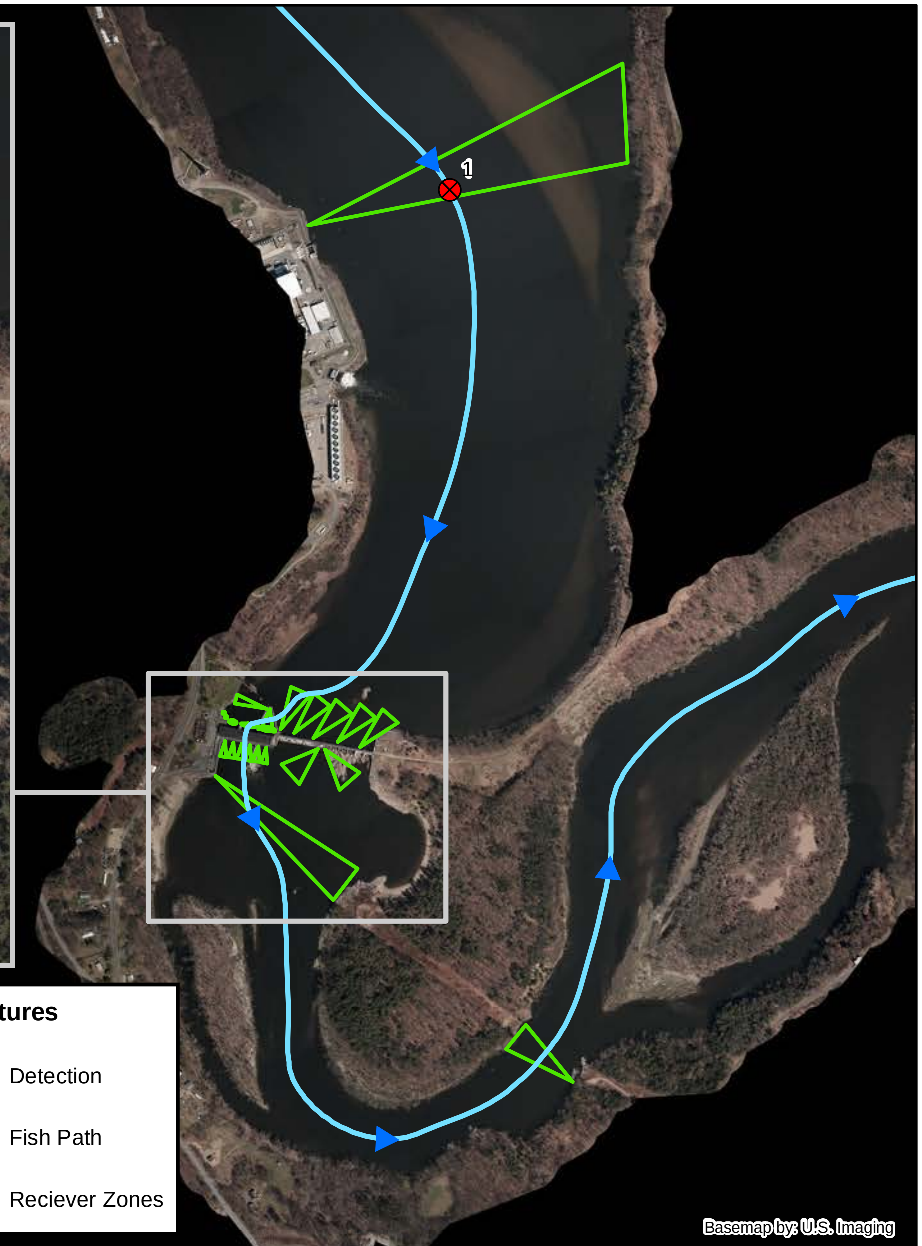


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 18:39 | 4 | 11/4/2015 | 19:12 |
| 2 | 11/4/2015 | 19:04 | 5 | 11/4/2015 | 19:12 |
| 3 | 11/4/2015 | 19:08 | 6 | 11/4/2015 | 19:13 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-184(T1)**

Release: Norwich, VT
Date Released: 10/31/15
Time Released: 19:21


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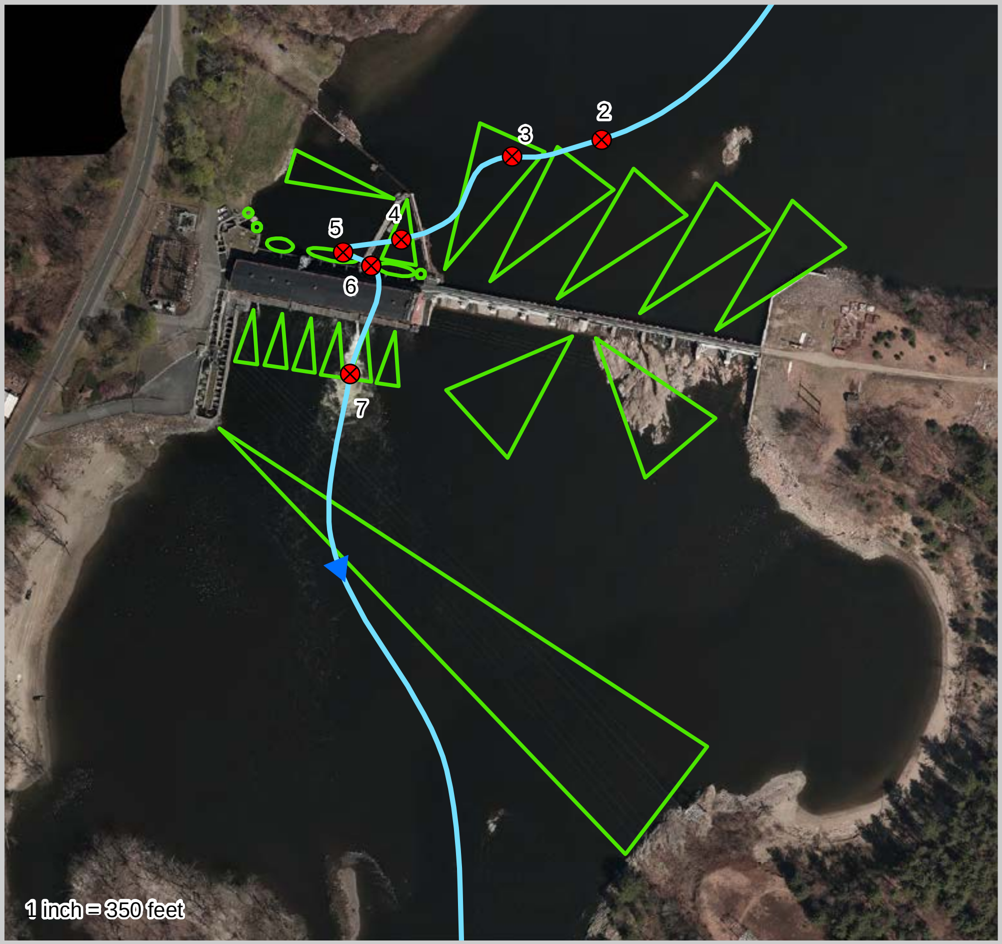


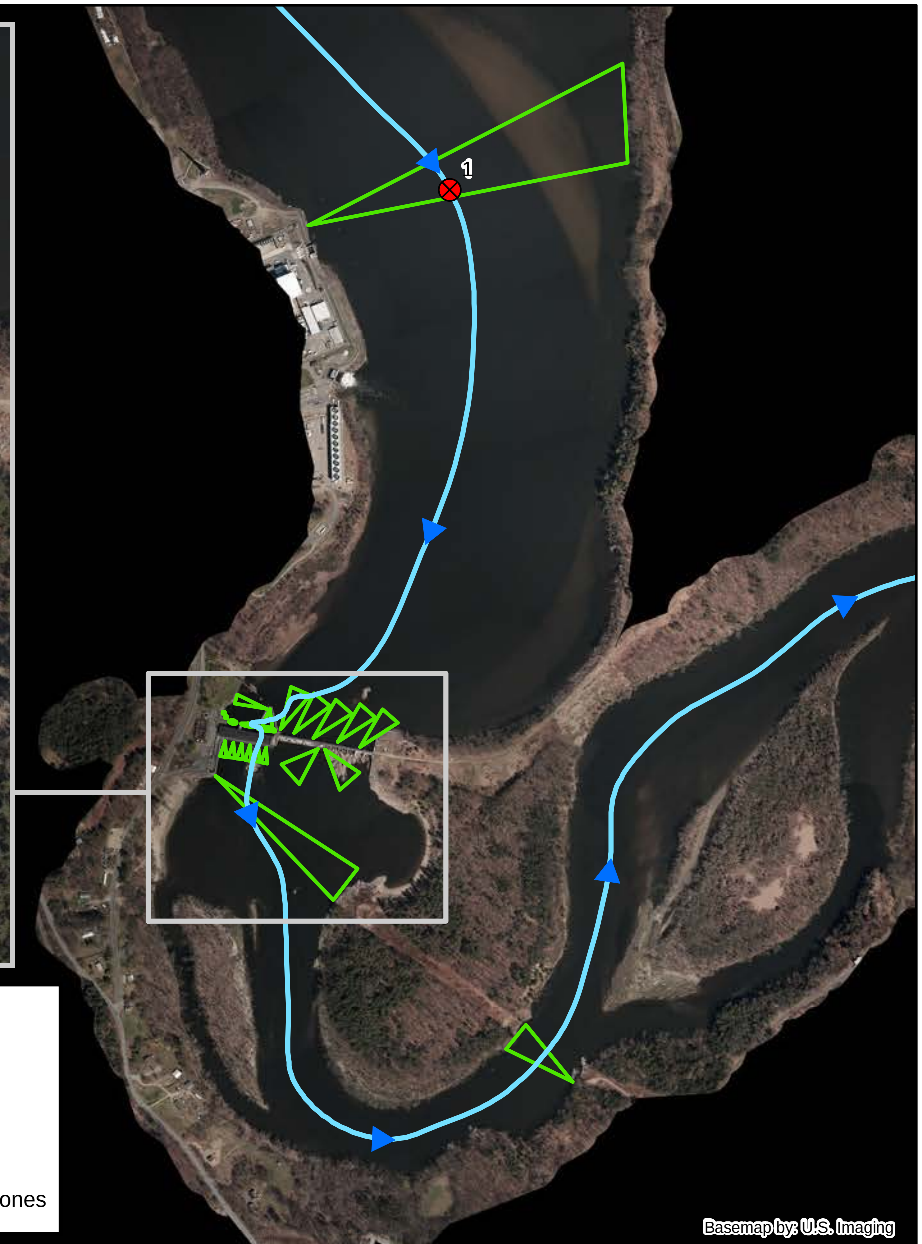


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/5/2015 | 3:36 | 5 | 11/6/2015 | 1:13 |
| 2 | 11/5/2015 | 4:34 | 6 | 11/6/2015 | 1:14 |
| 3 | 11/6/2015 | 1:10 | 7 | 11/6/2015 | 1:15 |
| 4 | 11/6/2015 | 1:10 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 36-187(T1)**

Release: Norwich, VT
Date Released: 10/31/15
Time Released: 19:21

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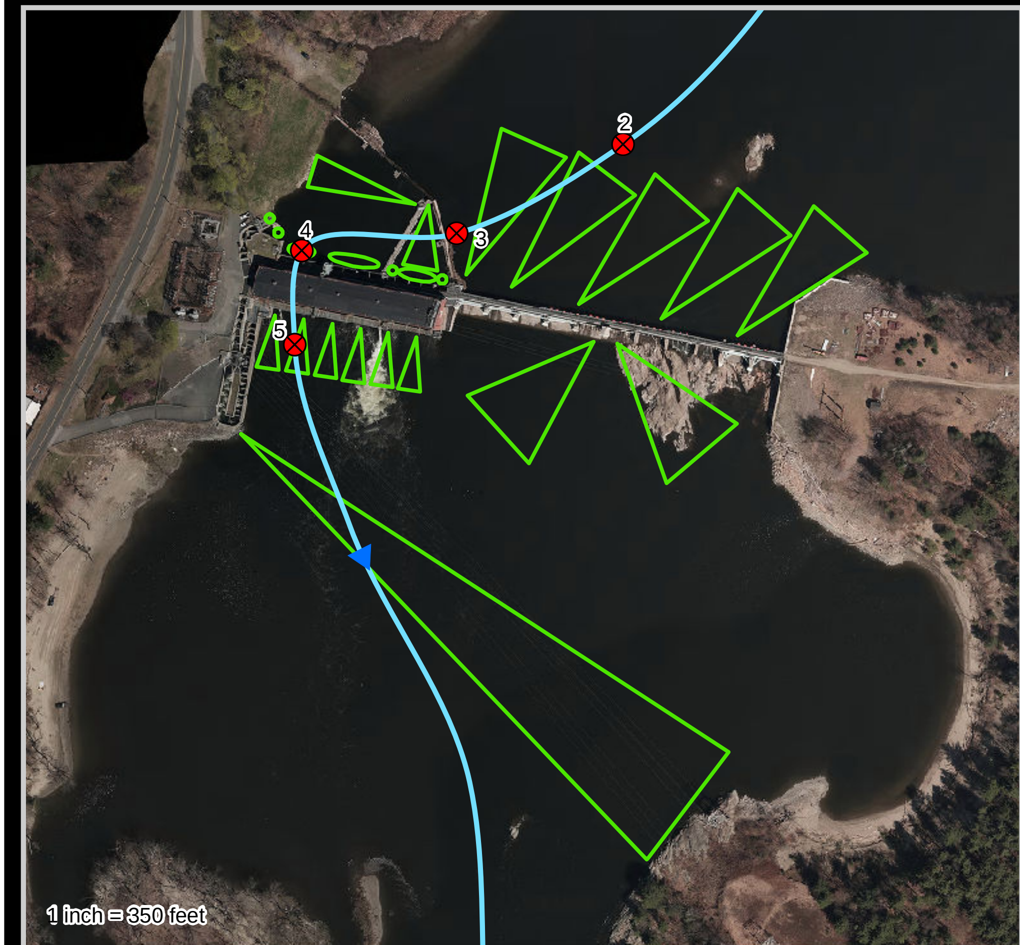


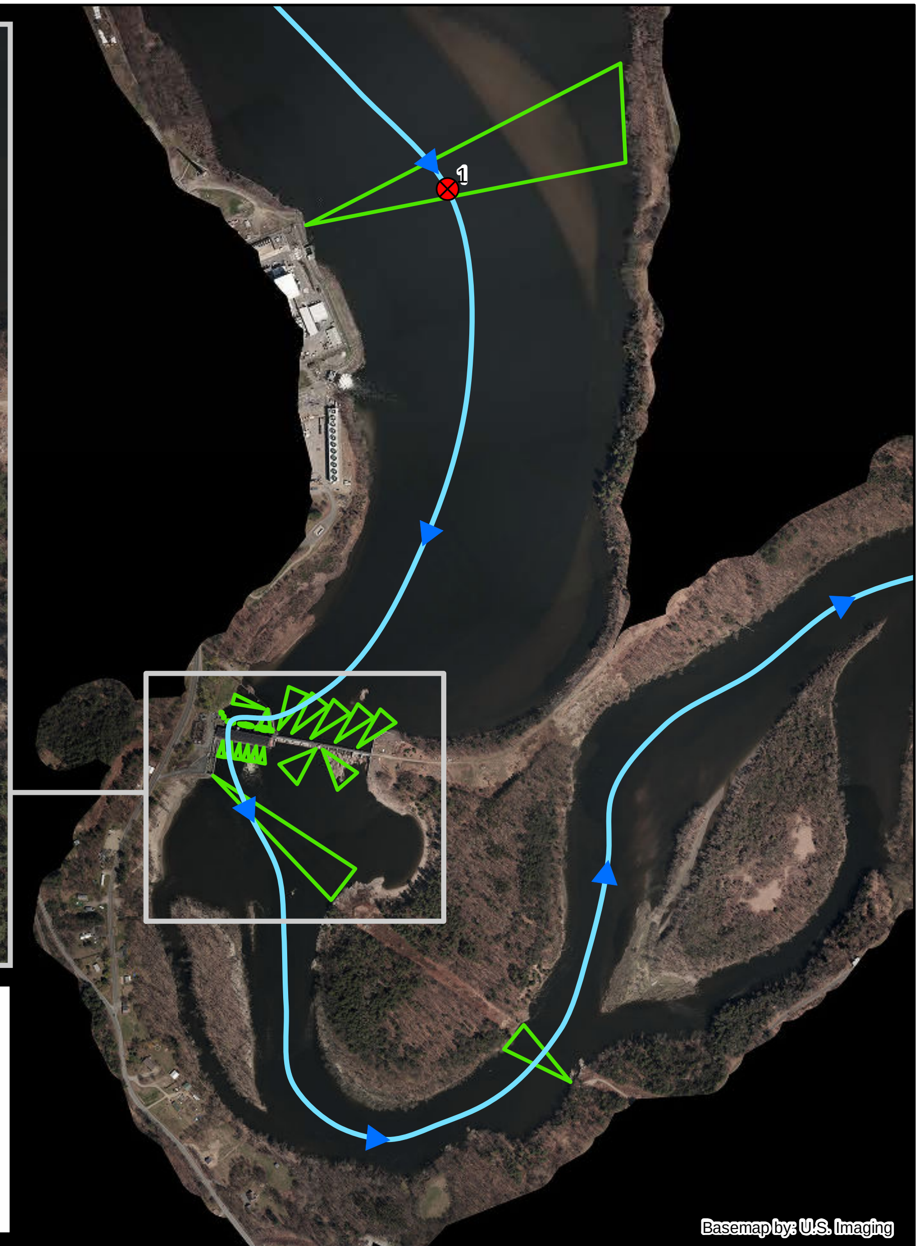


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/3/2015 | 22:03 |
| 2 | 11/3/2015 | 22:49 |
| 3 | 11/3/2015 | 23:03 |
| 4 | 11/3/2015 | 23:05 |
| 5 | 11/3/2015 | 23:07 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-101 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55


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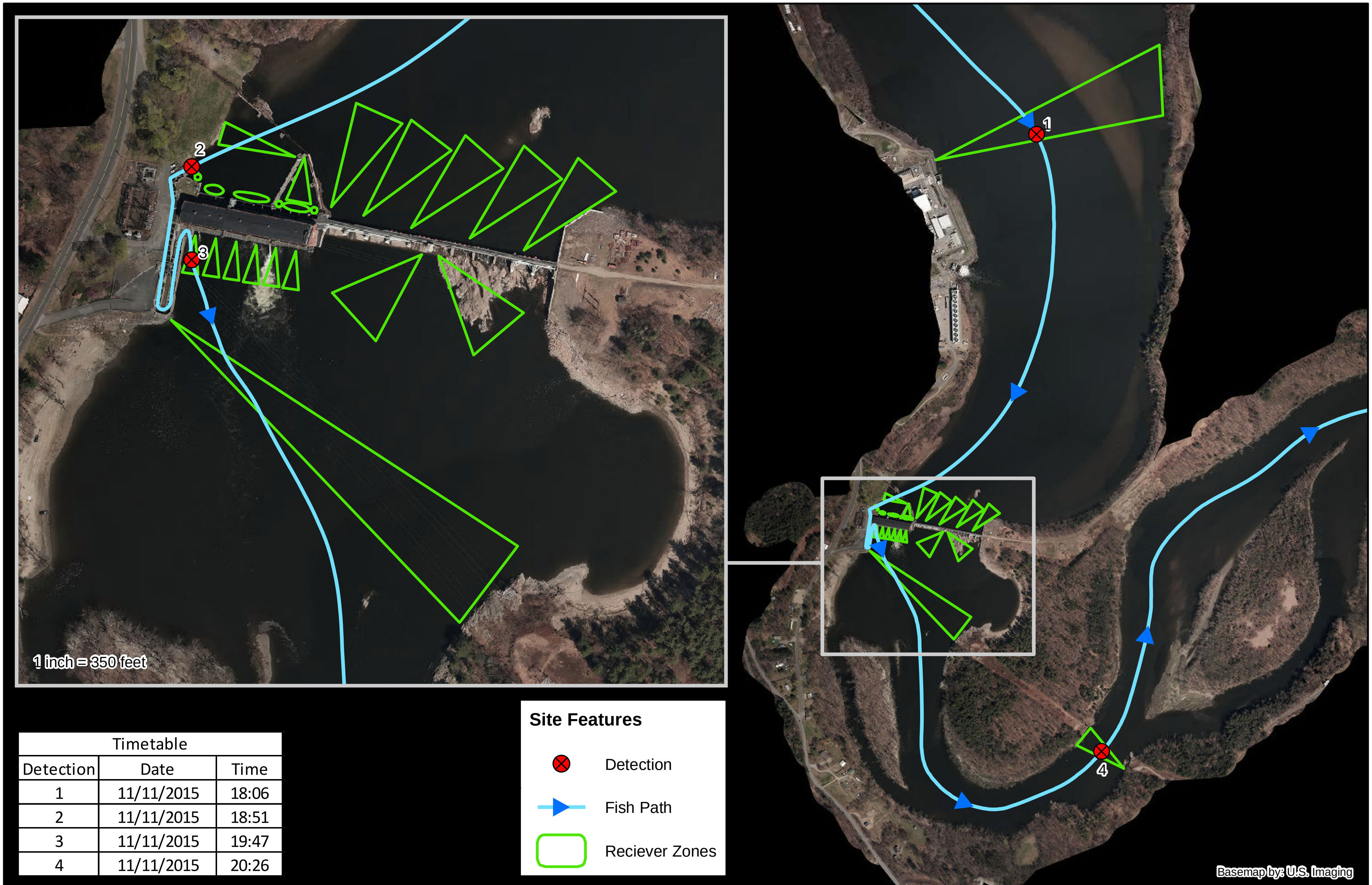
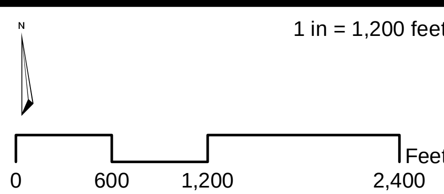



| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/11/2015 | 18:06 |
| 2 | 11/11/2015 | 18:51 |
| 3 | 11/11/2015 | 19:47 |
| 4 | 11/11/2015 | 20:26 |

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**




**Study 19 Fish Number: 38-102 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55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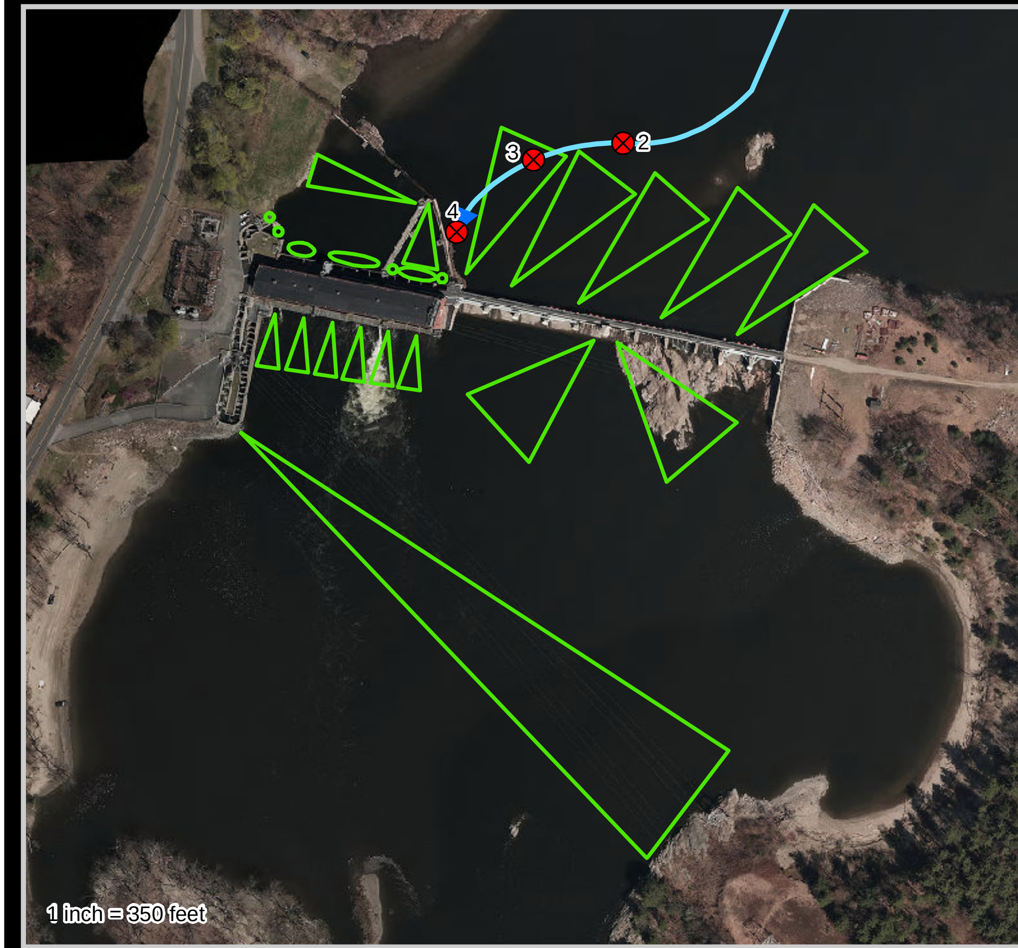


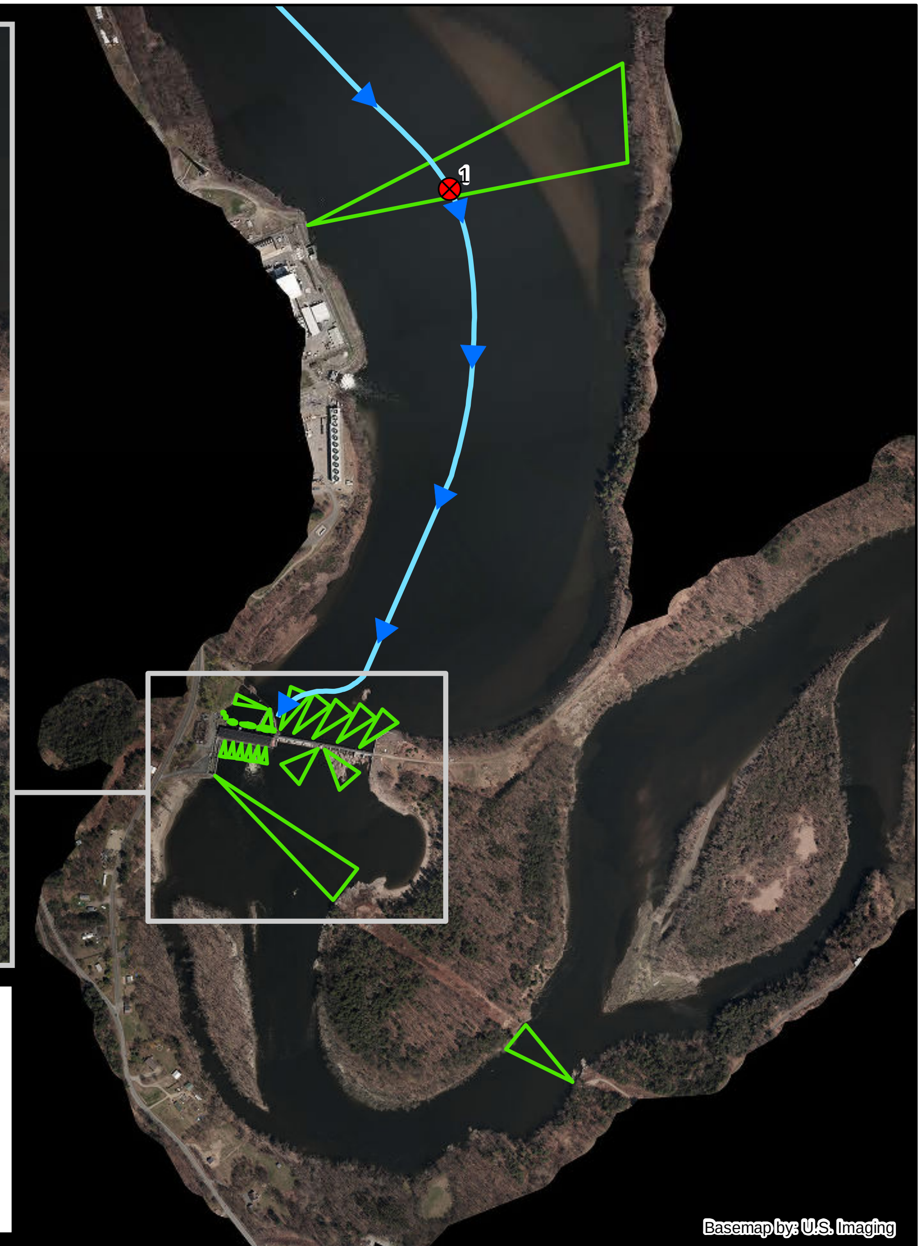


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 11:58 |
| 2 | 11/11/2015 | 22:23 |
| 3 | 11/11/2015 | 22:40 |
| 4 | 11/11/2015 | 23:08 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-103 (A1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/03/2015
Time Released: 15:55

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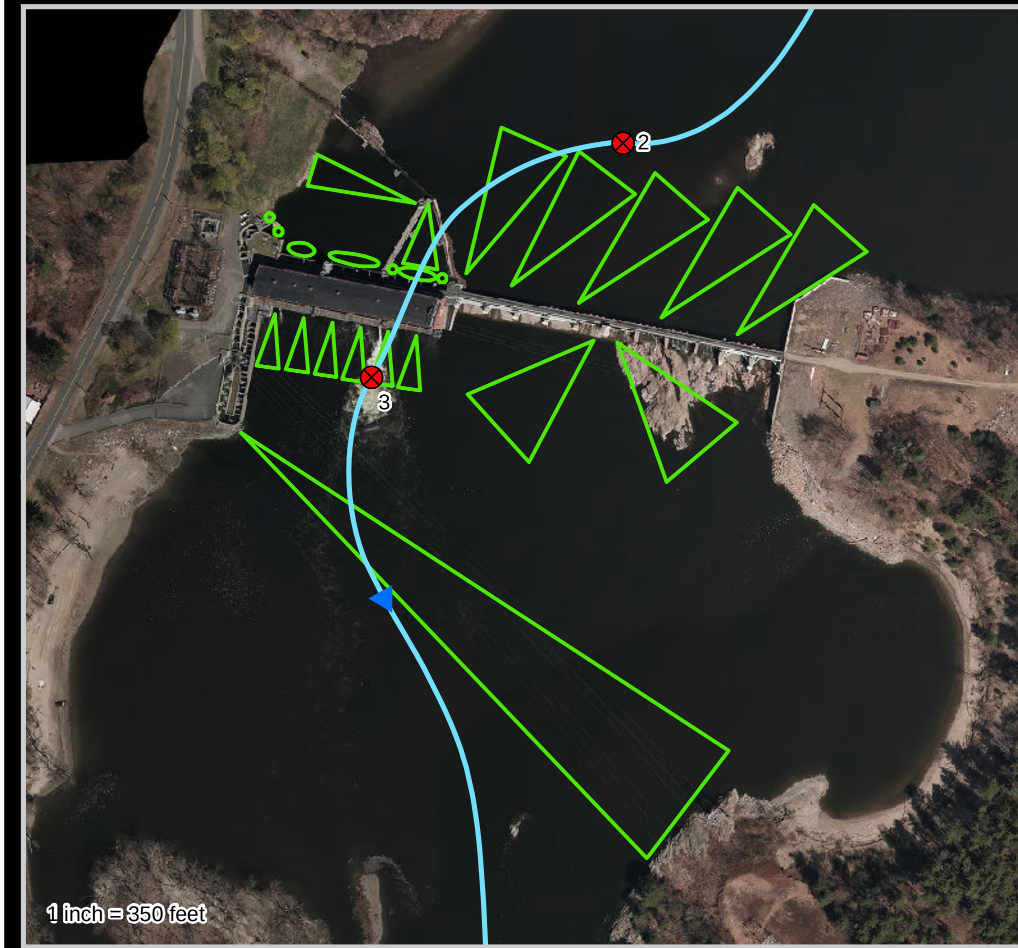


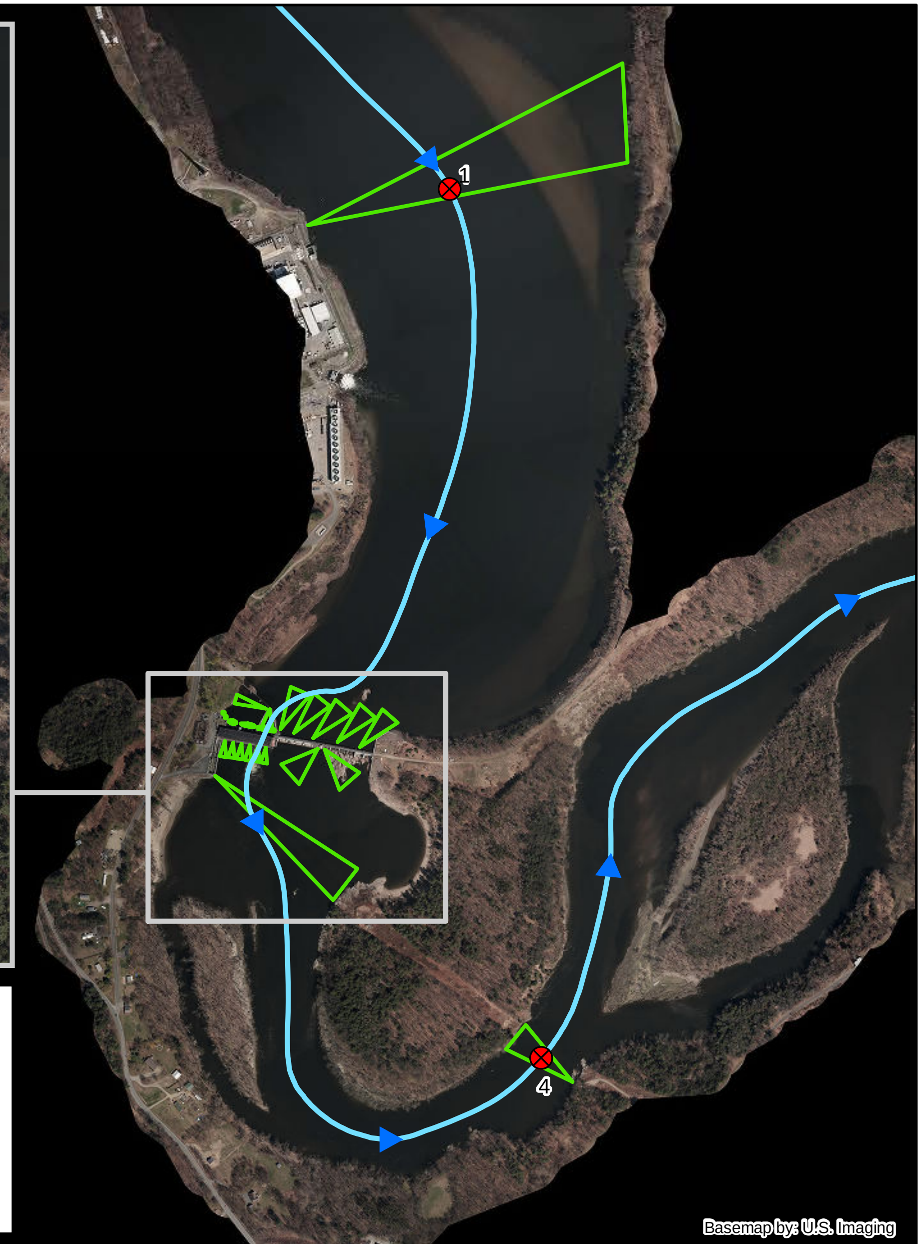


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 19:09 |
| 2 | 10/29/2015 | 19:33 |
| 3 | 10/29/2015 | 19:39 |
| 4 | 10/29/2015 | 20:16 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-108 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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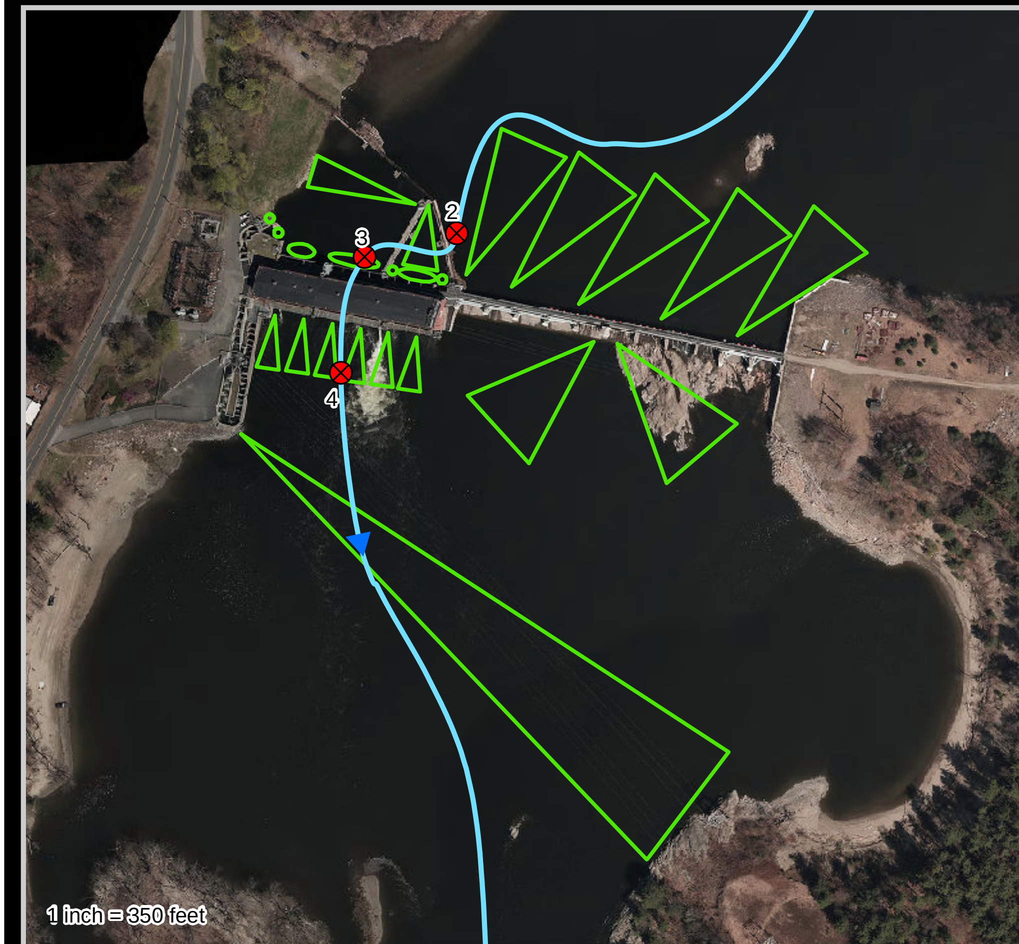


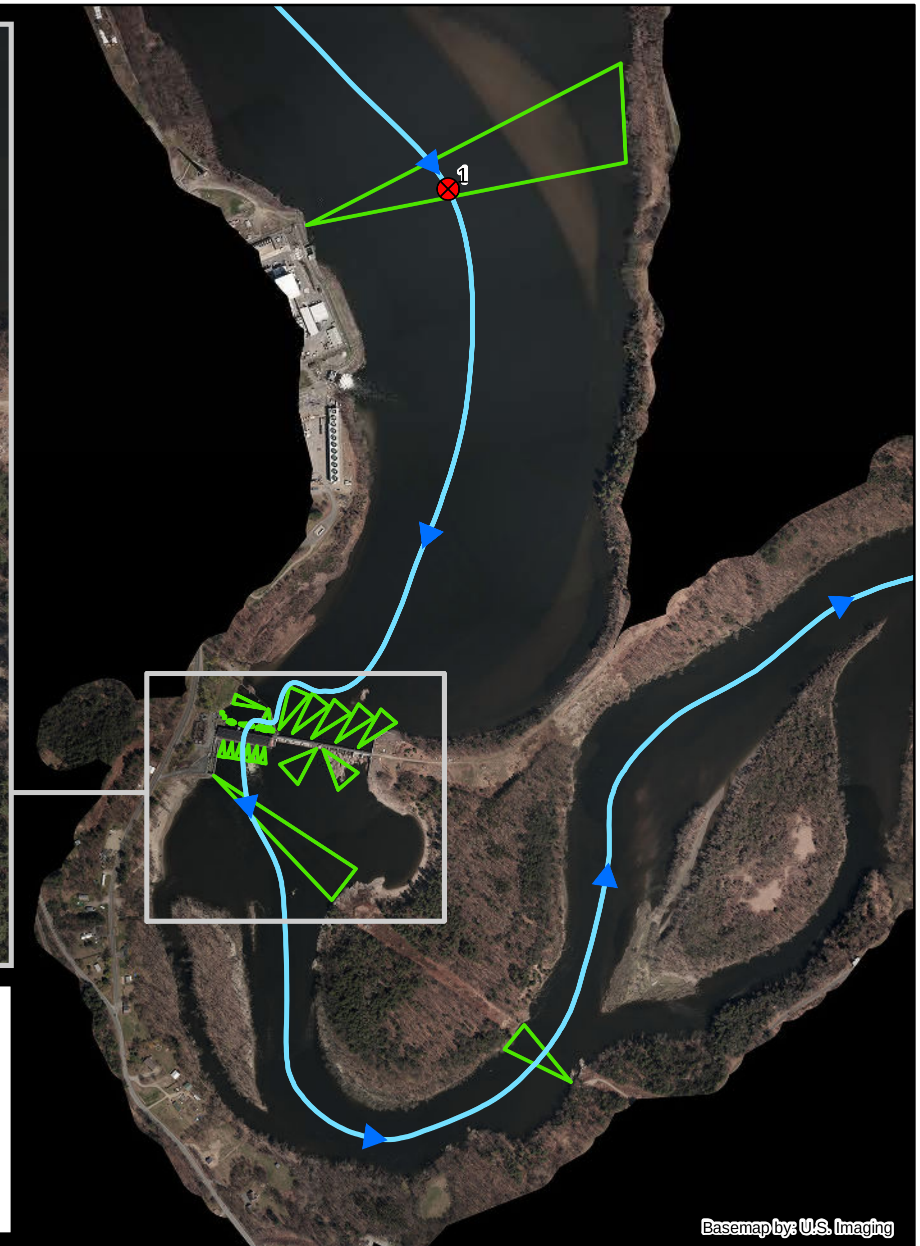


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 23:51 |
| 2 | 10/30/2015 | 0:32 |
| 3 | 10/30/2015 | 0:33 |
| 4 | 10/30/2015 | 0:34 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-109 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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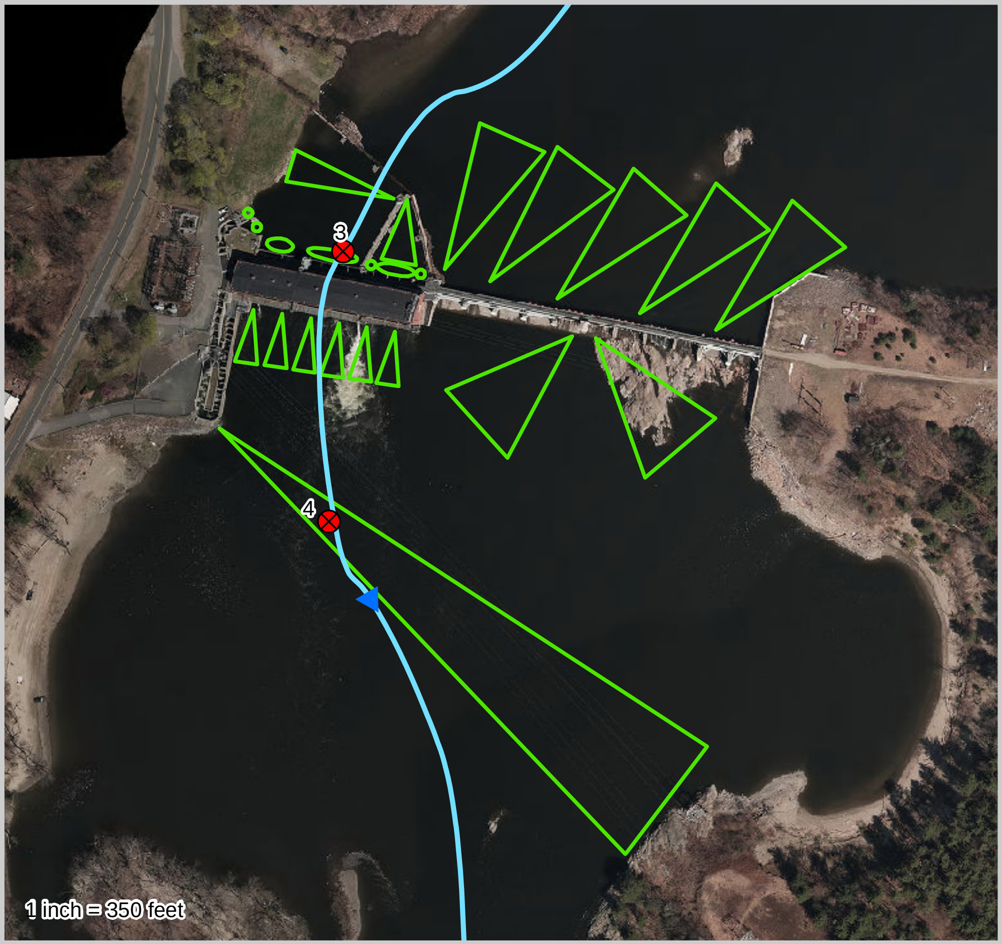


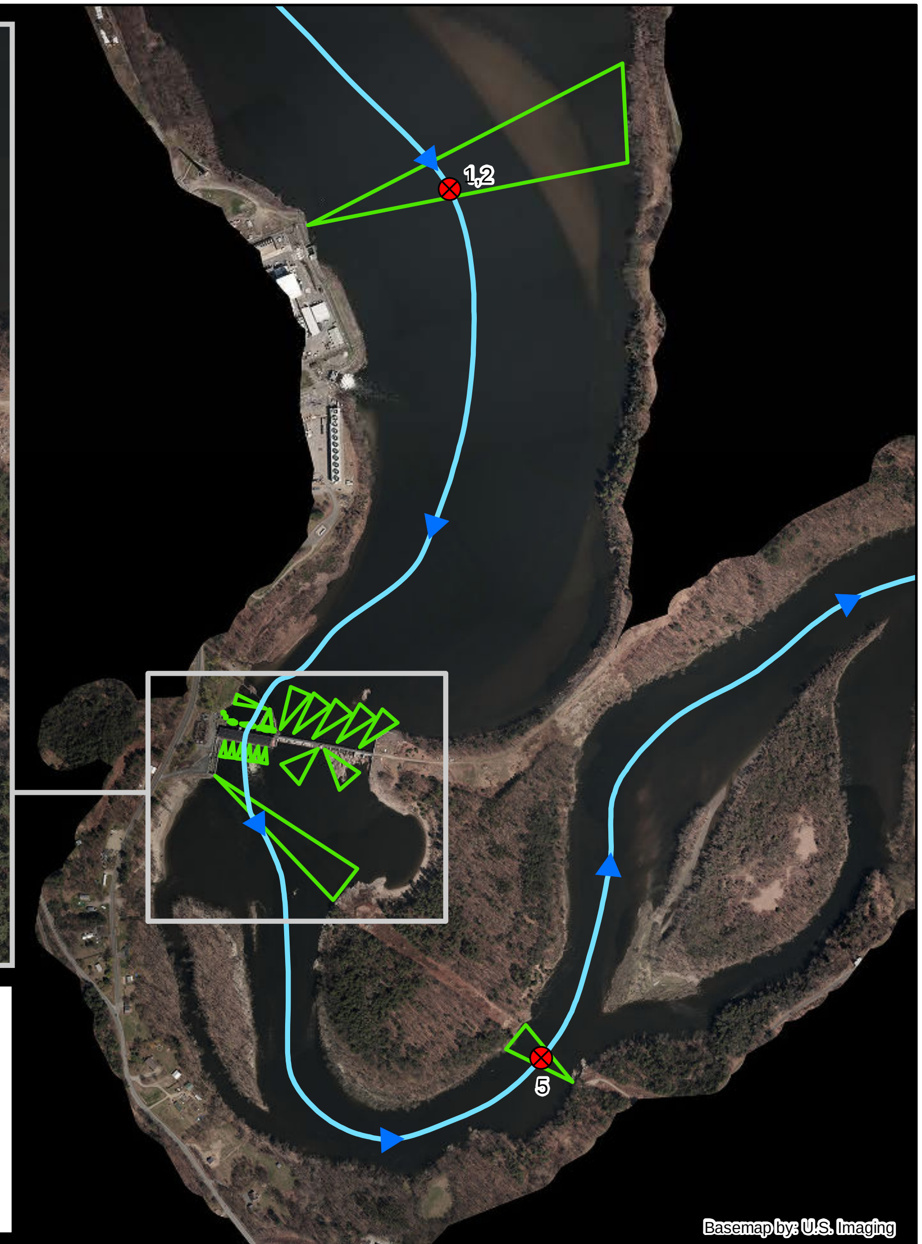


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 11:36 |
| 2 | 10/29/2015 | 20:29 |
| 3 | 10/29/2015 | 20:57 |
| 4 | 10/29/2015 | 20:59 |
| 5 | 10/29/2015 | 21:34 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-110 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/27/2015
Time Released: 17:45

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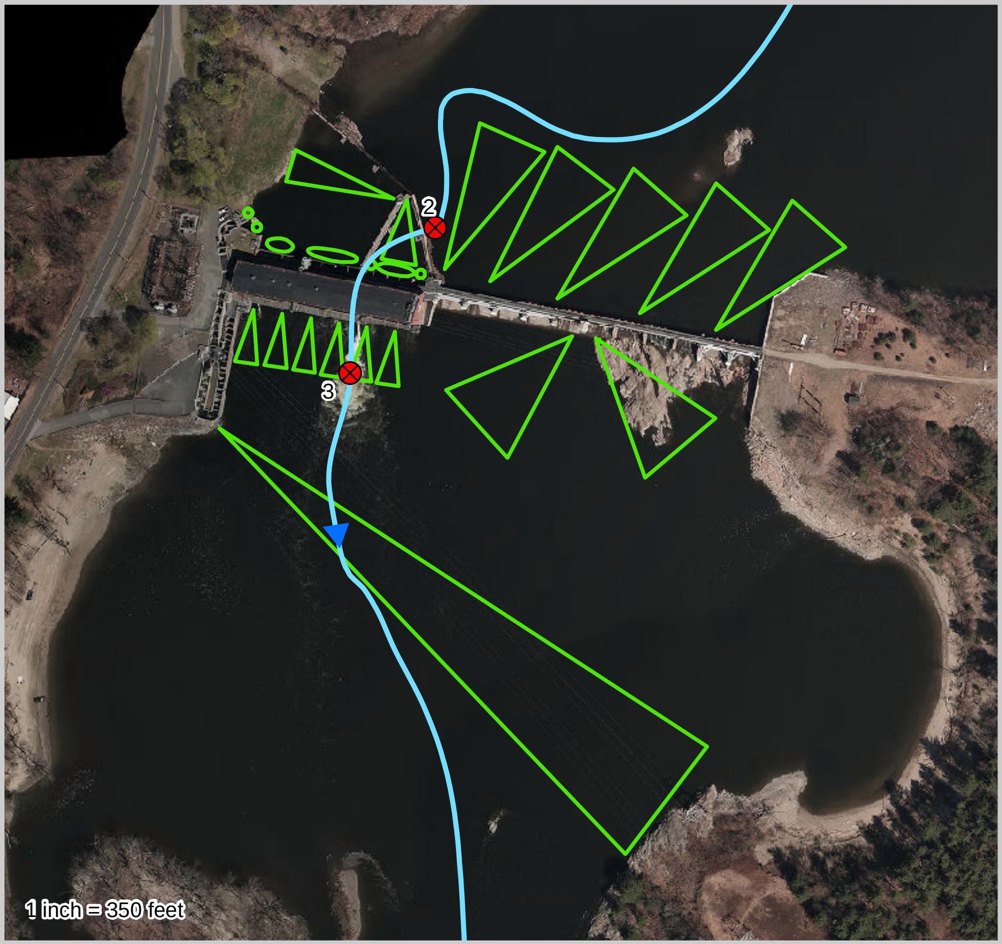


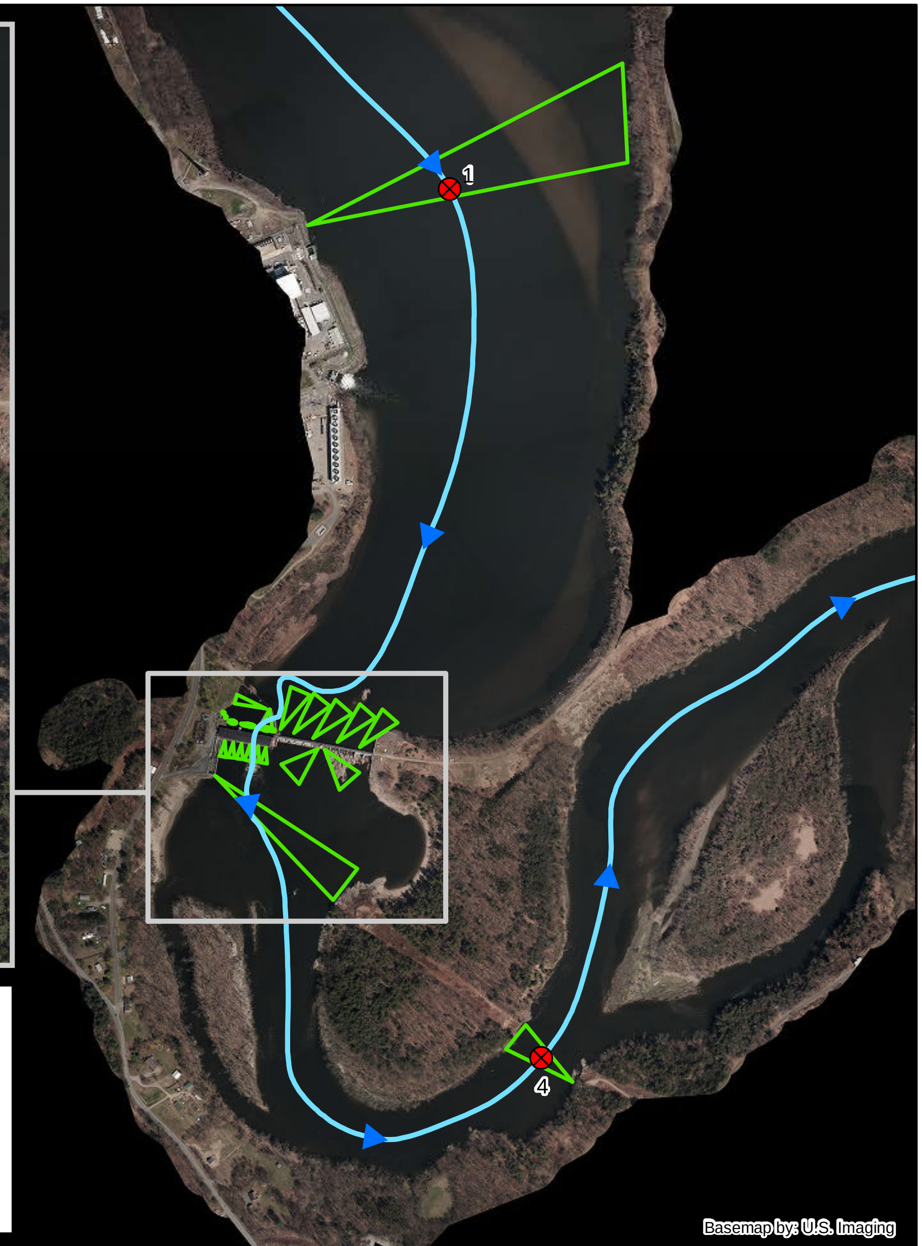


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 22:41 |
| 2 | 11/8/2015 | 23:34 |
| 3 | 11/8/2015 | 23:36 |
| 4 | 11/10/2015 | 21:44 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-111 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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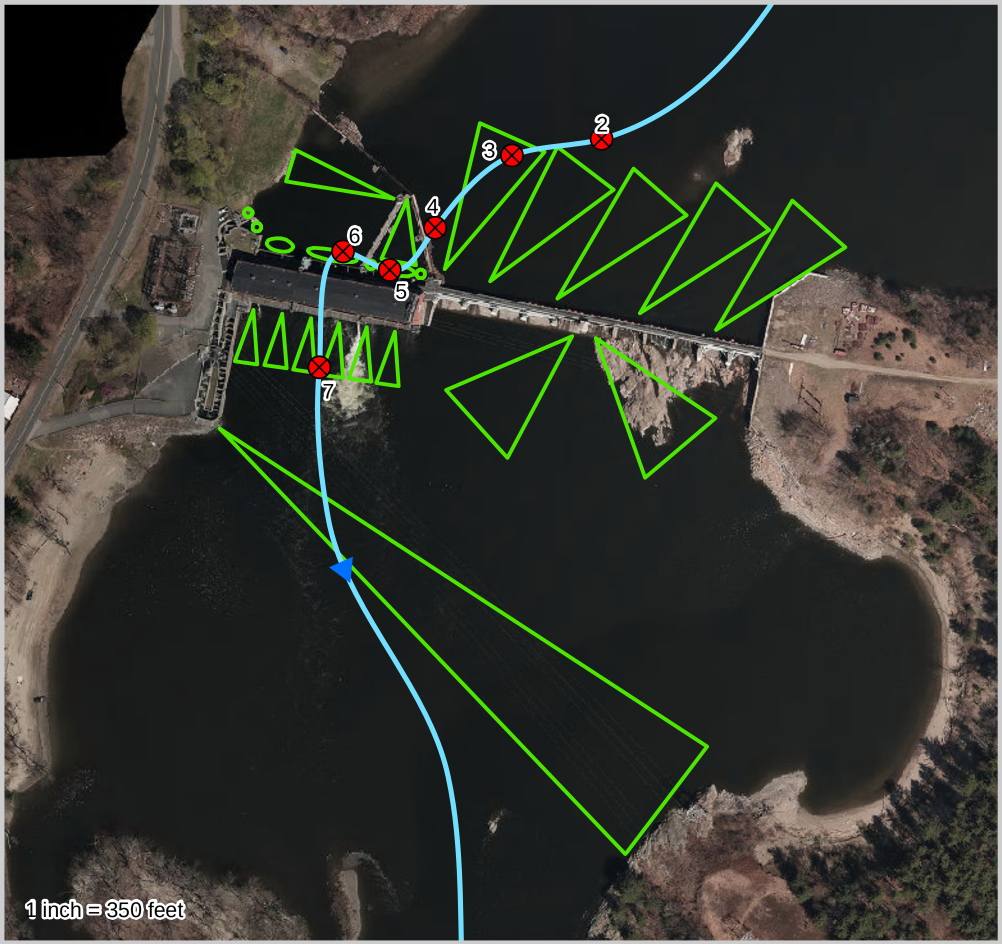


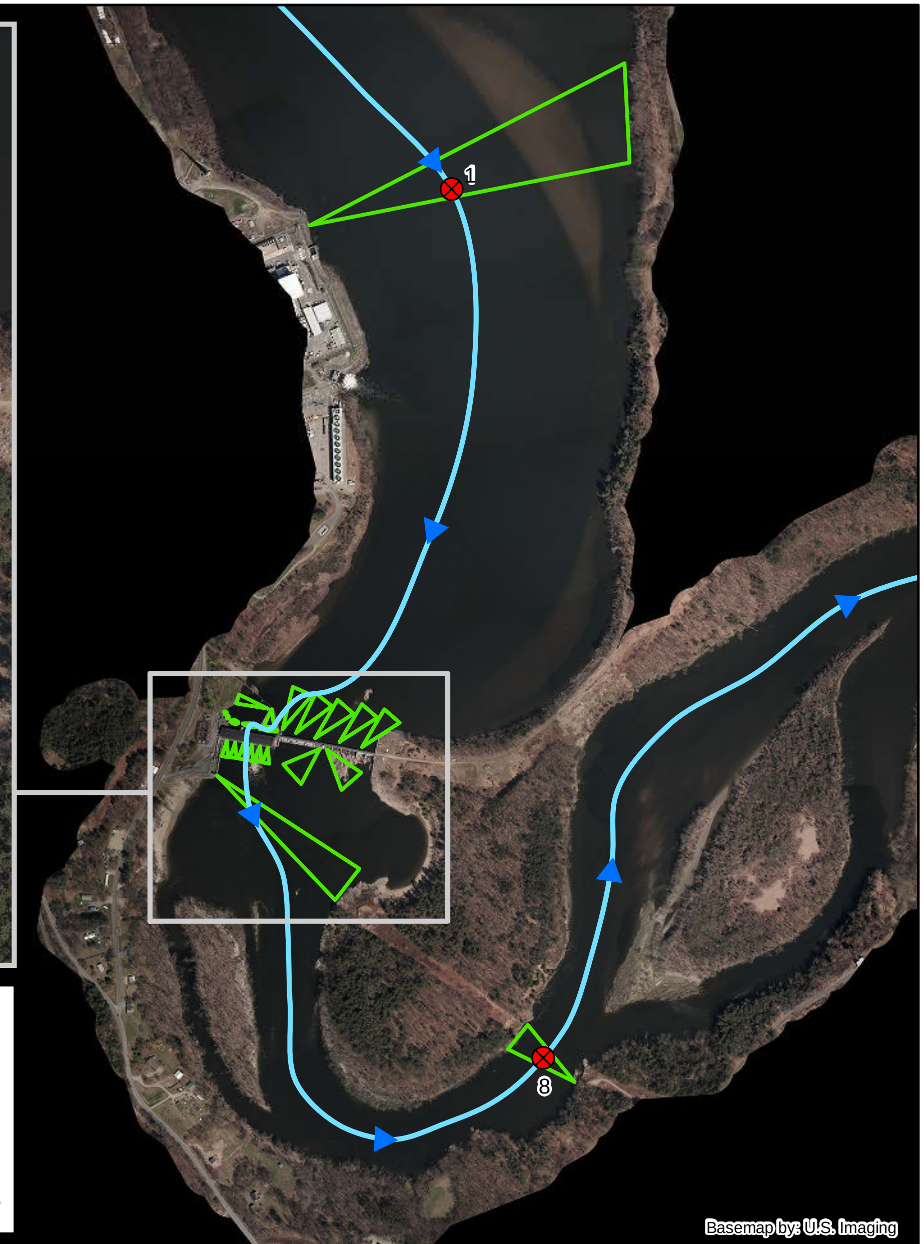


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/7/2015 | 0:40 | 6 | 11/7/2015 | 18:42 |
| 2 | 11/7/2015 | 18:31 | 7 | 11/7/2015 | 18:42 |
| 3 | 11/7/2015 | 18:37 | 8 | 11/7/2015 | 19:27 |
| 4 | 11/7/2015 | 18:39 | | | |
| 5 | 11/7/2015 | 18:41 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-112 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45


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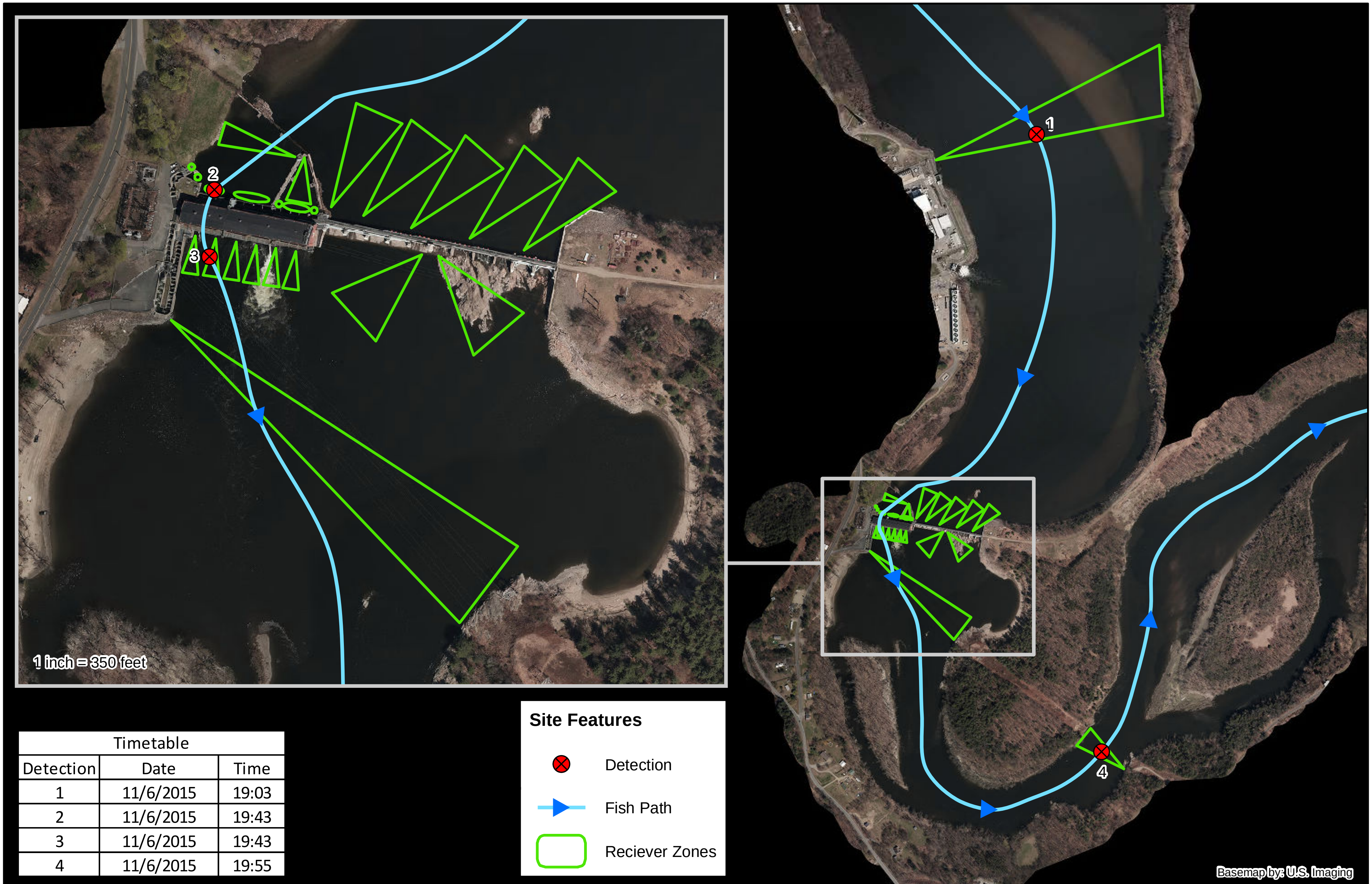


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 19:03 |
| 2 | 11/6/2015 | 19:43 |
| 3 | 11/6/2015 | 19:43 |
| 4 | 11/6/2015 | 19:55 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-113 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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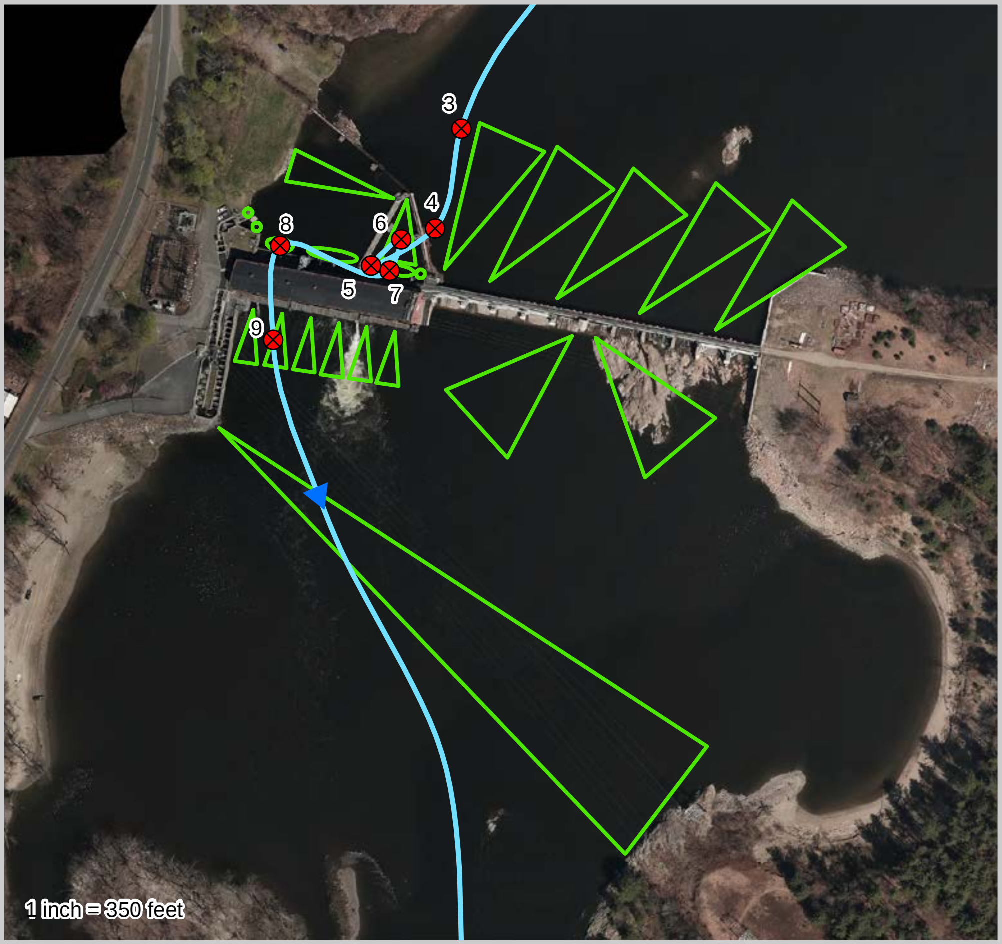


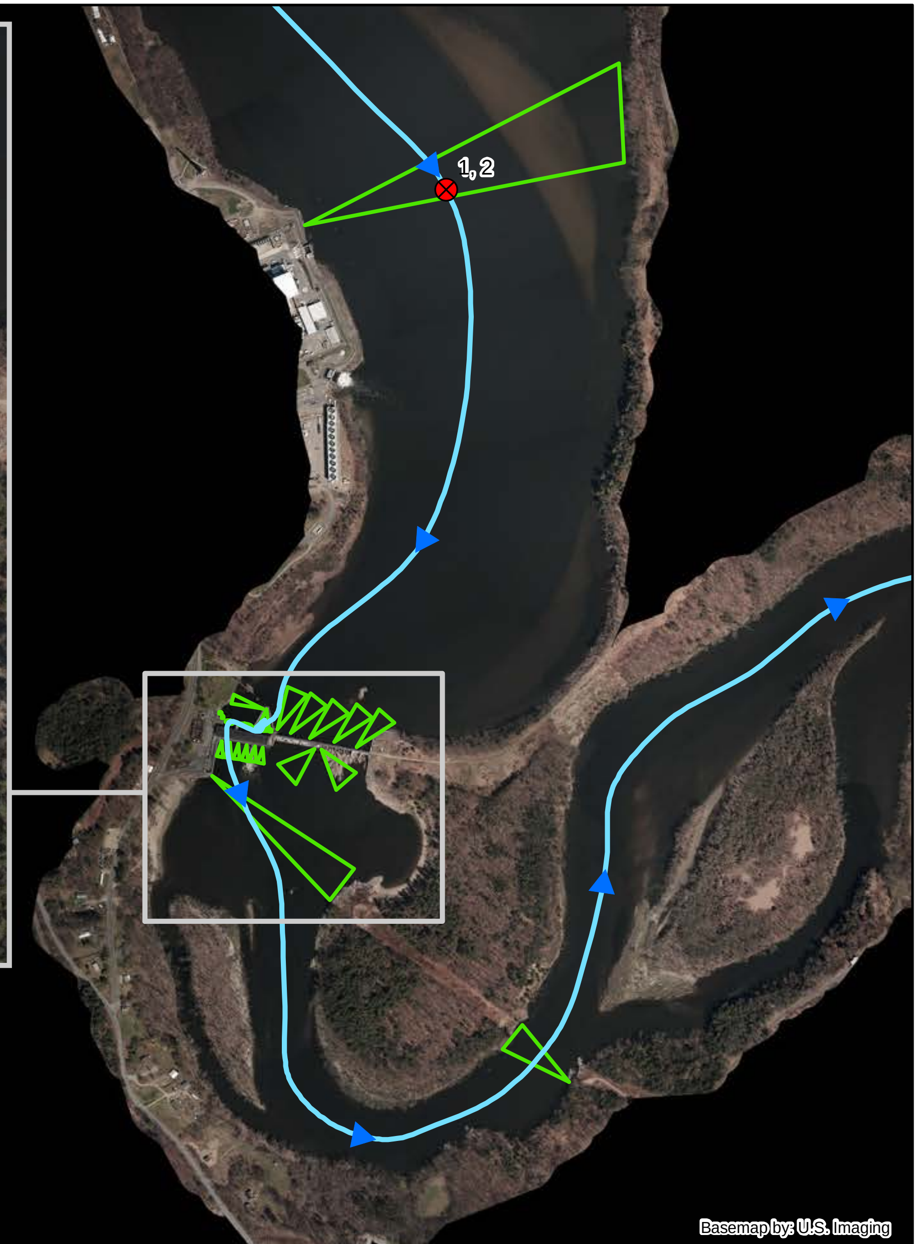


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/11/2015 | 5:02 | 6 | 11/11/2015 | 19:23 |
| 2 | 11/11/2015 | 18:37 | 7 | 11/11/2015 | 19:25 |
| 3 | 11/11/2015 | 19:10 | 8 | 11/11/2015 | 19:29 |
| 4 | 11/11/2015 | 19:13 | 9 | 11/11/2015 | 19:29 |
| 5 | 11/11/2015 | 19:21 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-58 (T1)**

Release: Norwich, VT
Date Released: 11/3/2015
Time Released: 17:32

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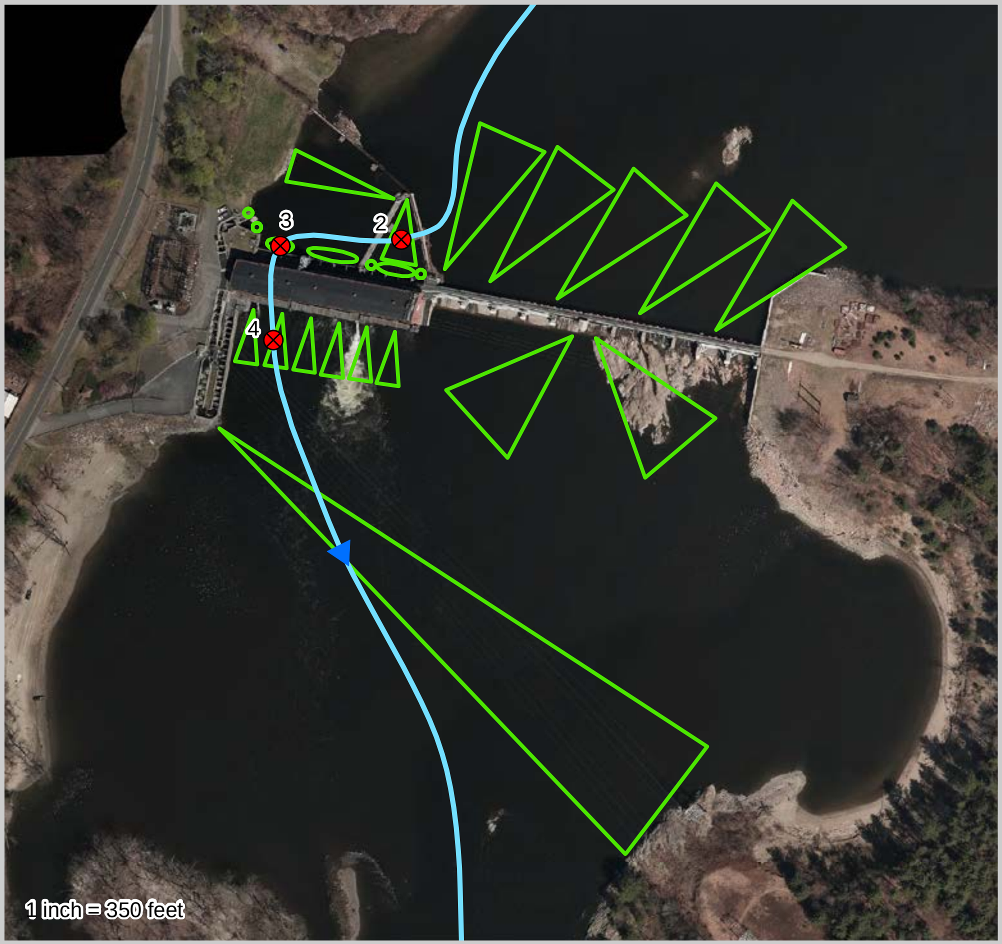


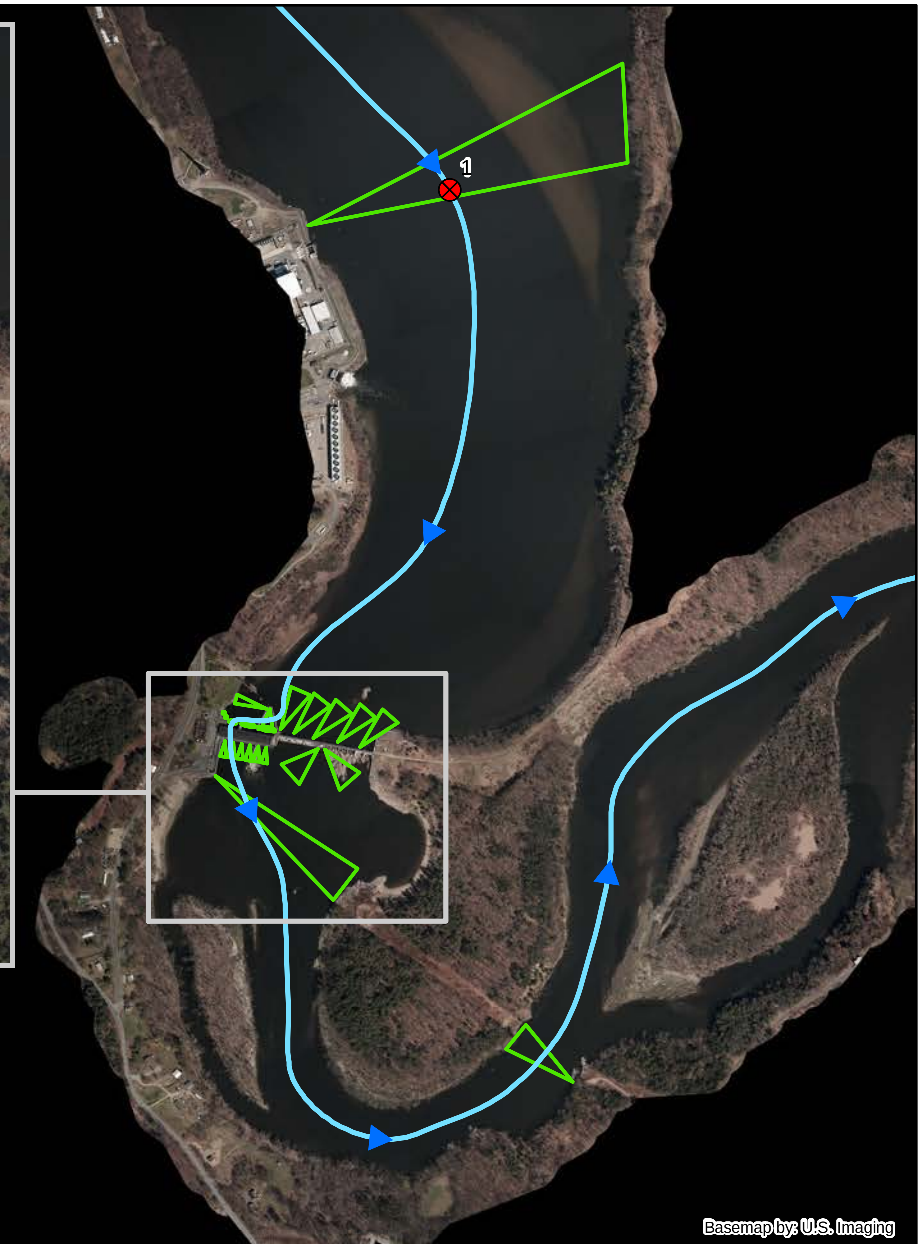


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 3:02 |
| 2 | 11/5/2015 | 3:50 |
| 3 | 11/5/2015 | 3:52 |
| 4 | 11/5/2015 | 3:53 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-59 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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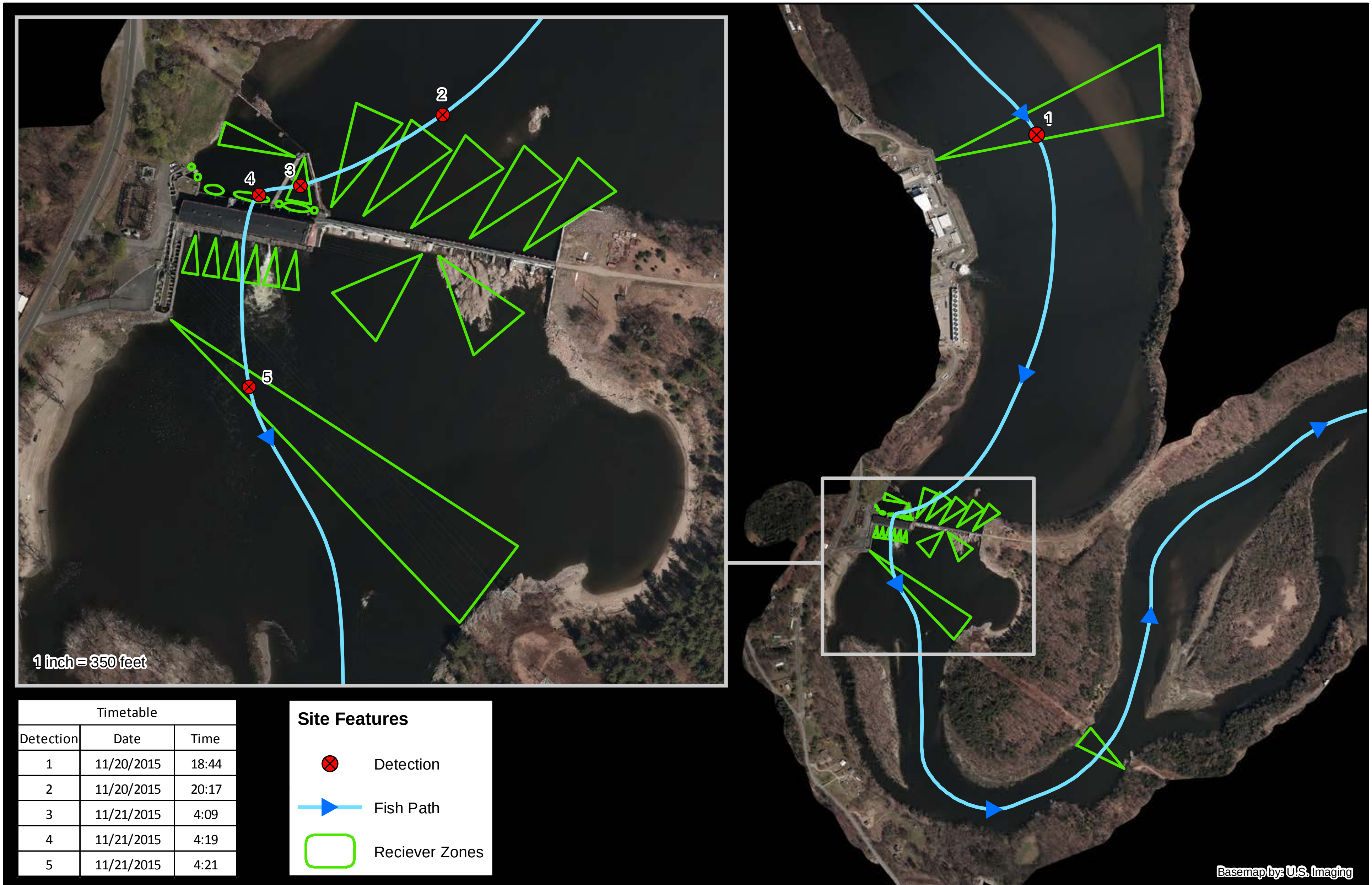


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/20/2015 | 18:44 |
| 2 | 11/20/2015 | 20:17 |
| 3 | 11/21/2015 | 4:09 |
| 4 | 11/21/2015 | 4:19 |
| 5 | 11/21/2015 | 4:21 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-60 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05

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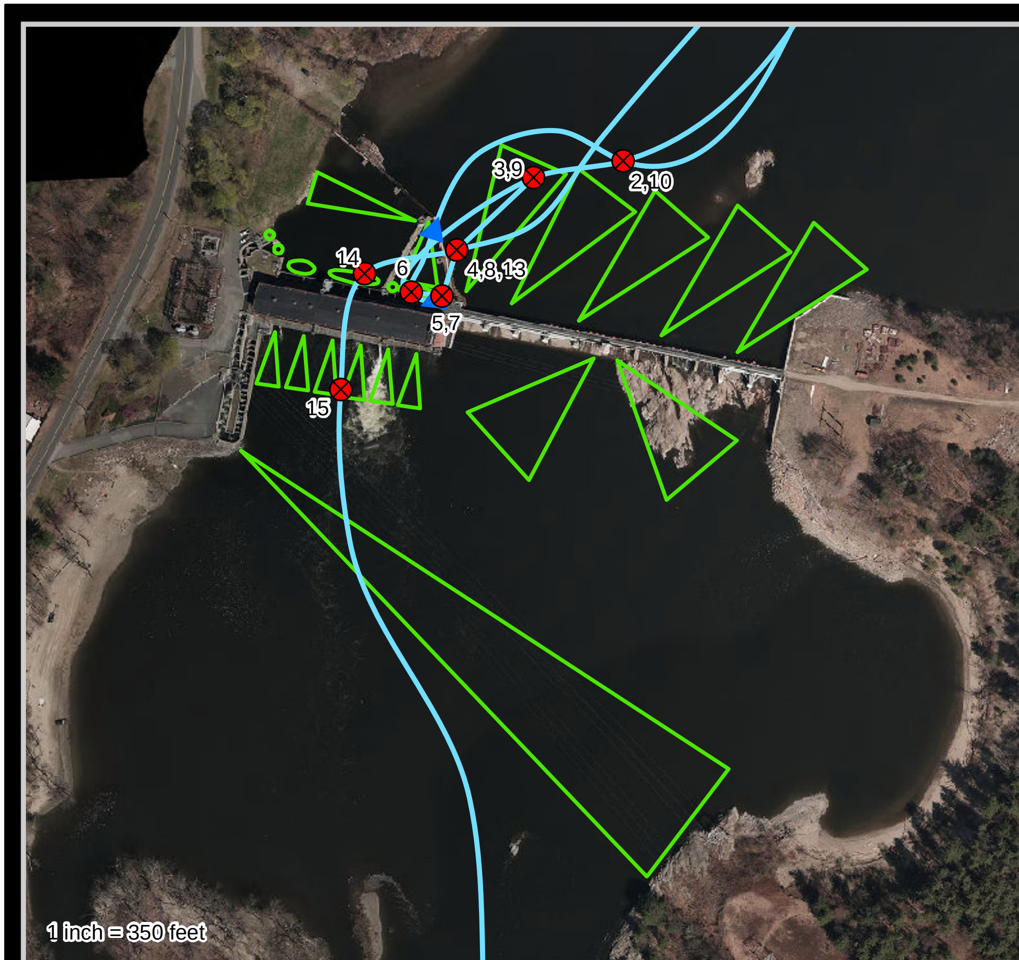


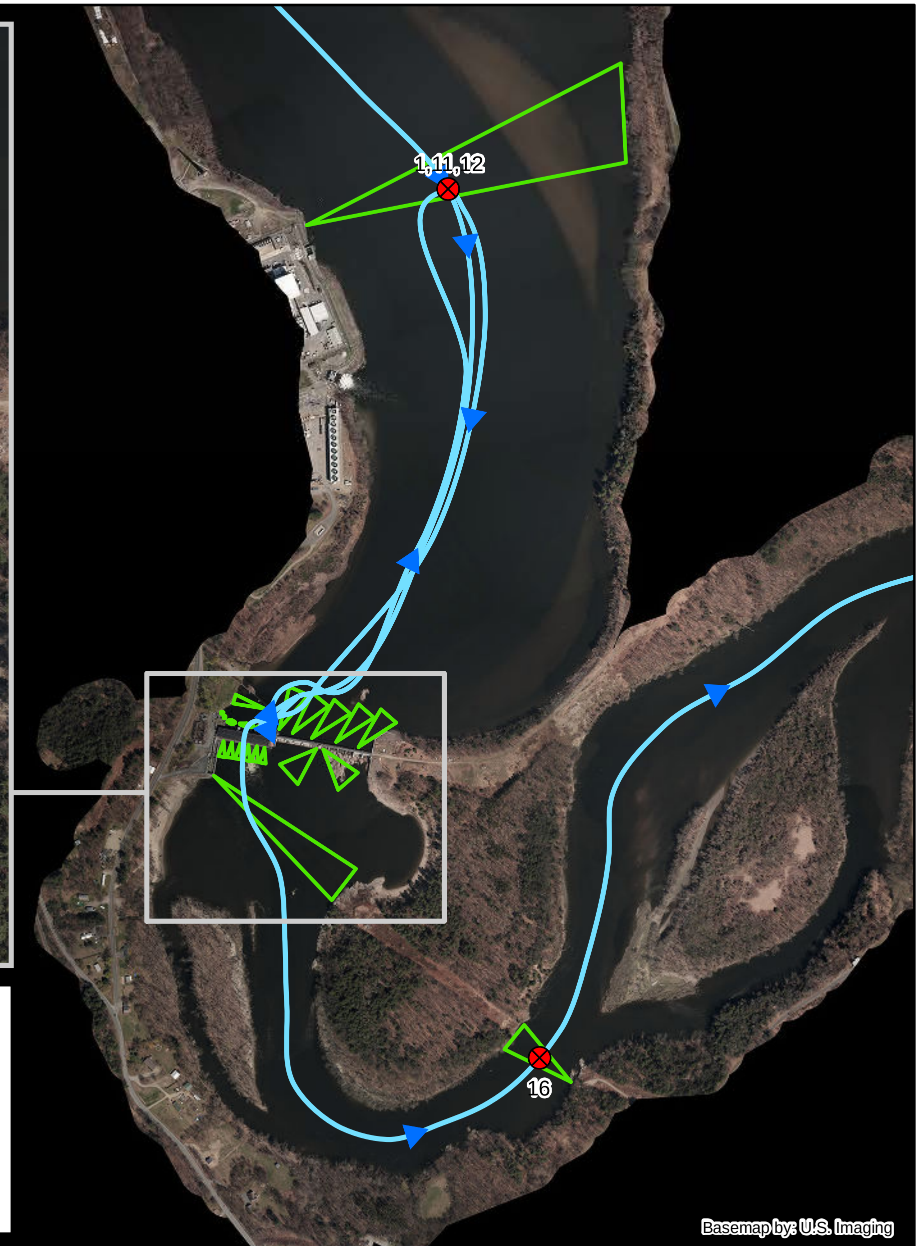


| Detection | Date | Time | Detection | Date | Time |
|---|---|---|---|---|---|
| 1 | 11/8/2015 | 21:38 | 9 | 11/8/2015 | 23:16 |
| 2 | 11/8/2015 | 22:12 | 10 | 11/8/2015 | 23:22 |
| 3 | 11/8/2015 | 22:19 | 11 | 11/9/2015 | 0:16 |
| 4 | 11/8/2015 | 22:19 | 12 | 11/9/2015 | 3:58 |
| 5 | 11/8/2015 | 22:20 | 13 | 11/10/2015 | 19:03 |
| 6 | 11/8/2015 | 22:20 | 14 | 11/10/2015 | 19:07 |
| 7 | 11/8/2015 | 22:22 | 15 | 11/10/2015 | 19:07 |
| 8 | 11/8/2015 | 23:15 | 16 | 11/10/2015 | 21:34 |

Timetable

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-62 (T1)**

Release: Bellows Falls Canal
Date Released: 10/31/2015
Time Released: 18:05


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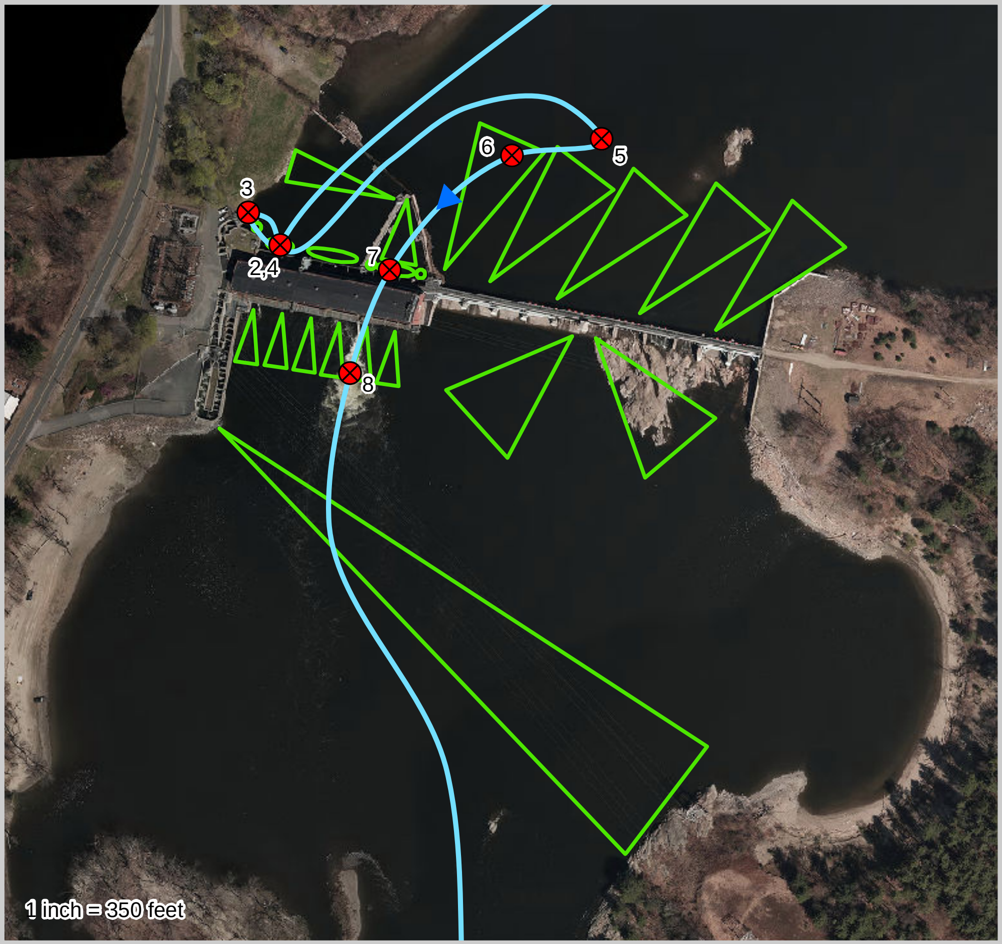


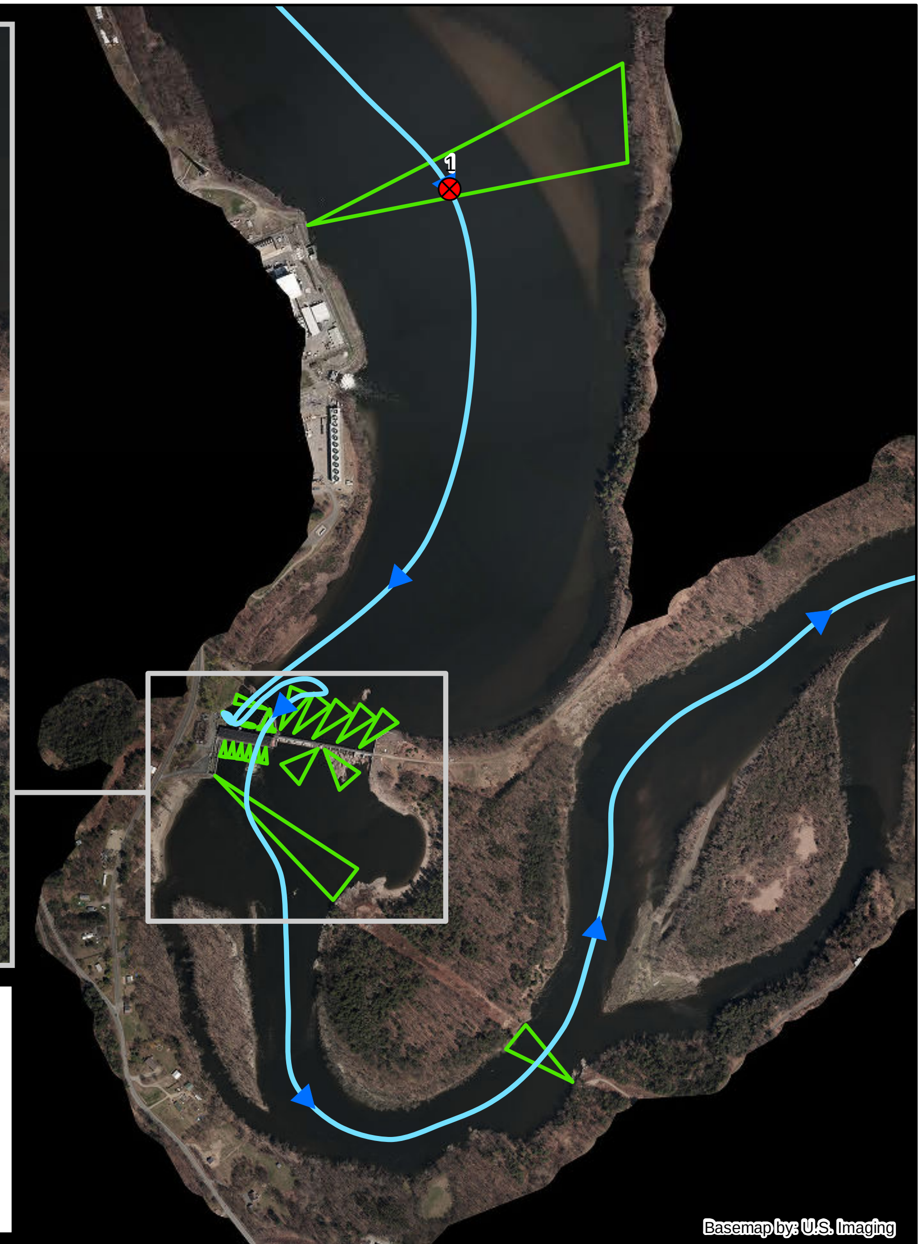


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/31/2015 | 0:56 | 6 | 10/31/2015 | 18:17 |
| 2 | 10/31/2015 | 13:58 | 7 | 10/31/2015 | 18:19 |
| 3 | 10/31/2015 | 14:43 | 8 | 10/31/2015 | 18:20 |
| 4 | 10/31/2015 | 15:02 | | | |
| 5 | 10/31/2015 | 18:10 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-63 (T1)**

Release: Bellows Falls Canal
Date Released: 10/29/2015
Time Released: 17:32

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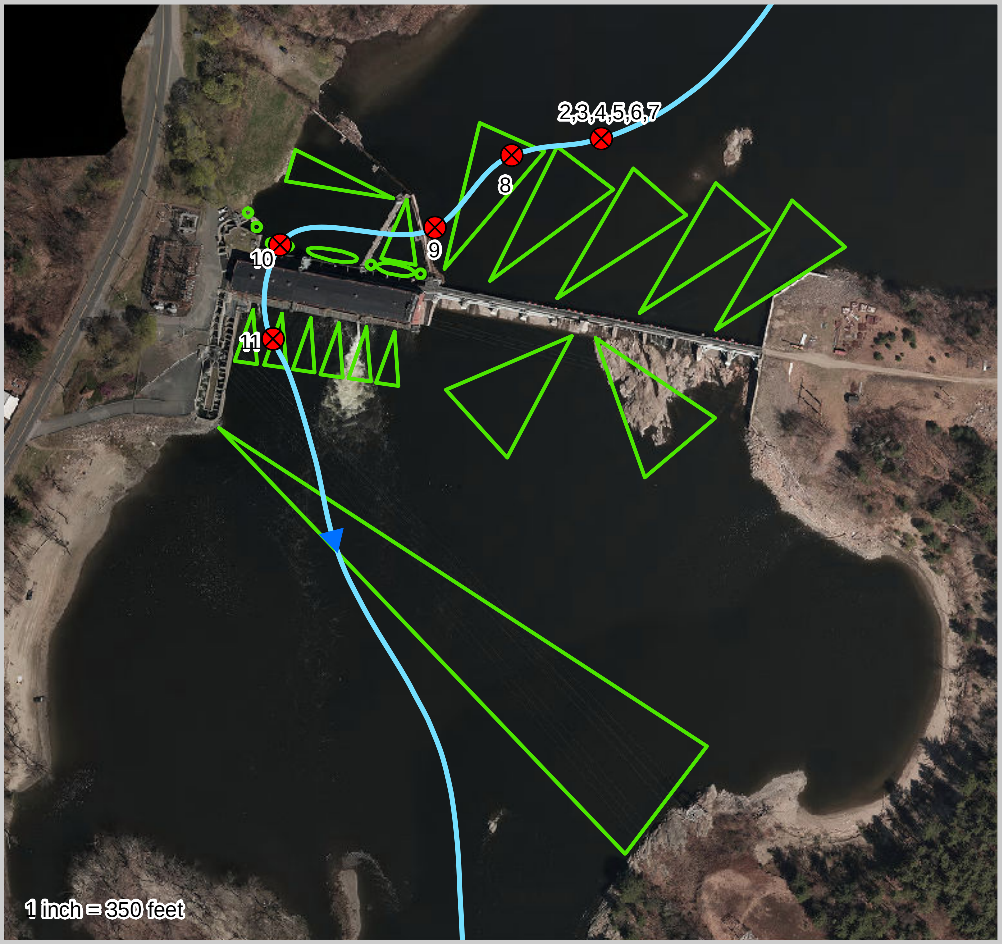


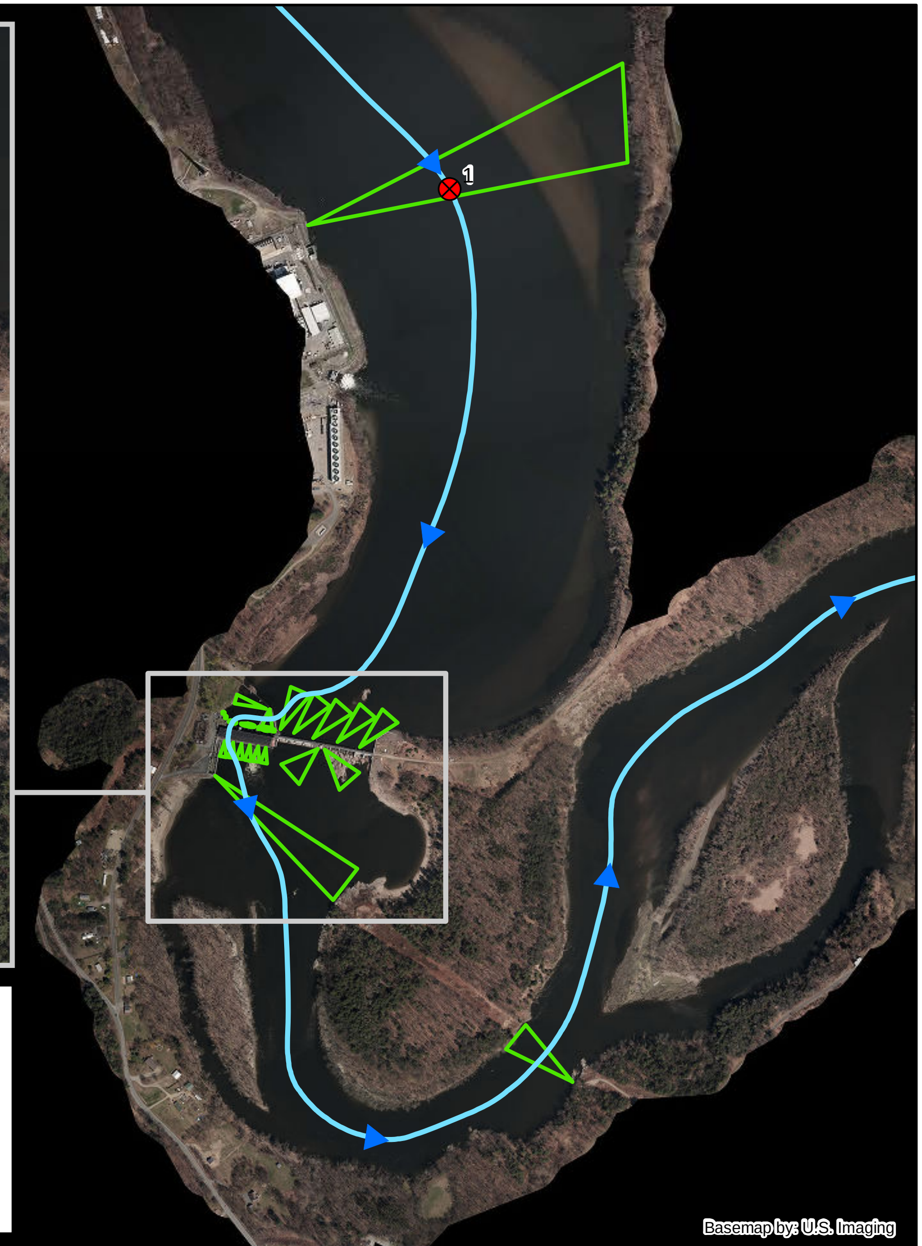


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/24/2015 | 1:21 | 7 | 12/28/2015 | 19:29 |
| 2 | 11/24/2015 | 2:10 | 8 | 12/28/2015 | 19:59 |
| 3 | 12/4/2015 | 0:12 | 9 | 12/28/2015 | 21:03 |
| 4 | 12/28/2015 | 11:20 | 10 | 12/28/2015 | 21:05 |
| 5 | 12/28/2015 | 15:10 | 11 | 12/28/2015 | 21:05 |
| 6 | 12/28/2015 | 16:04 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-114 (T1)**

Release: Herricks Cove, VT
Date Released: 11/03/2015
Time Released: 16:45

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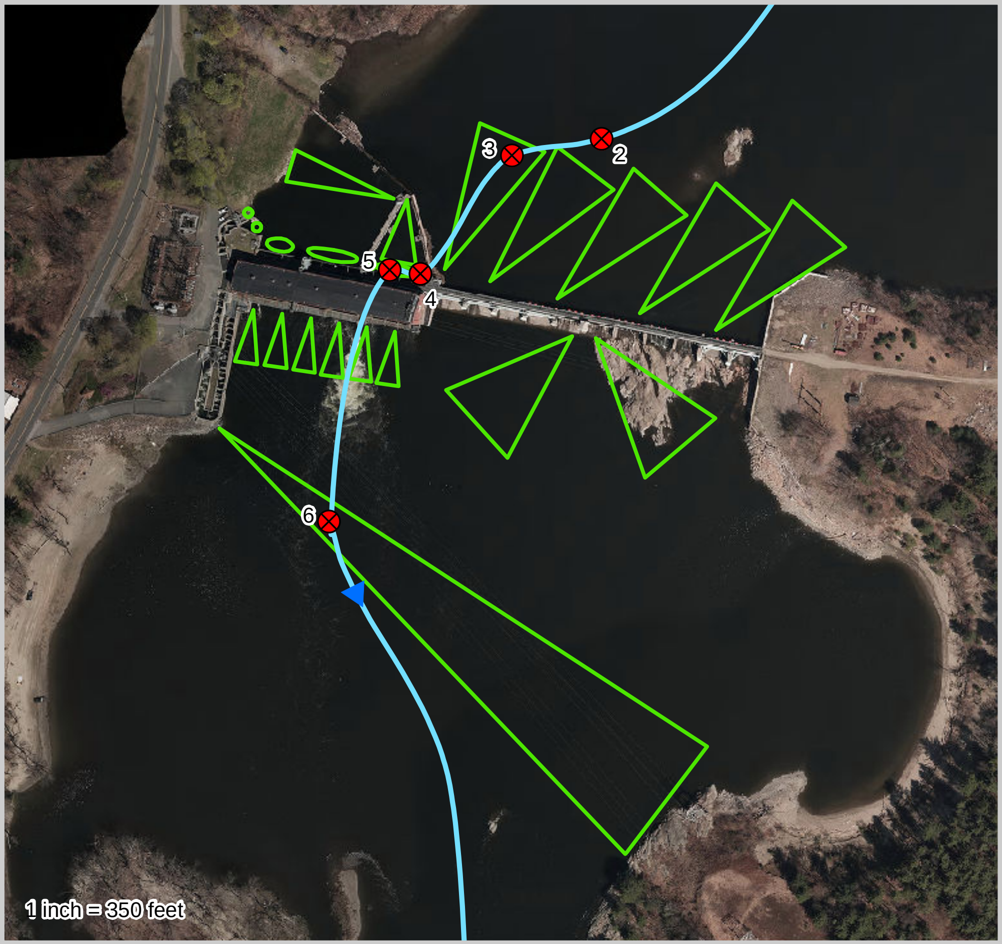


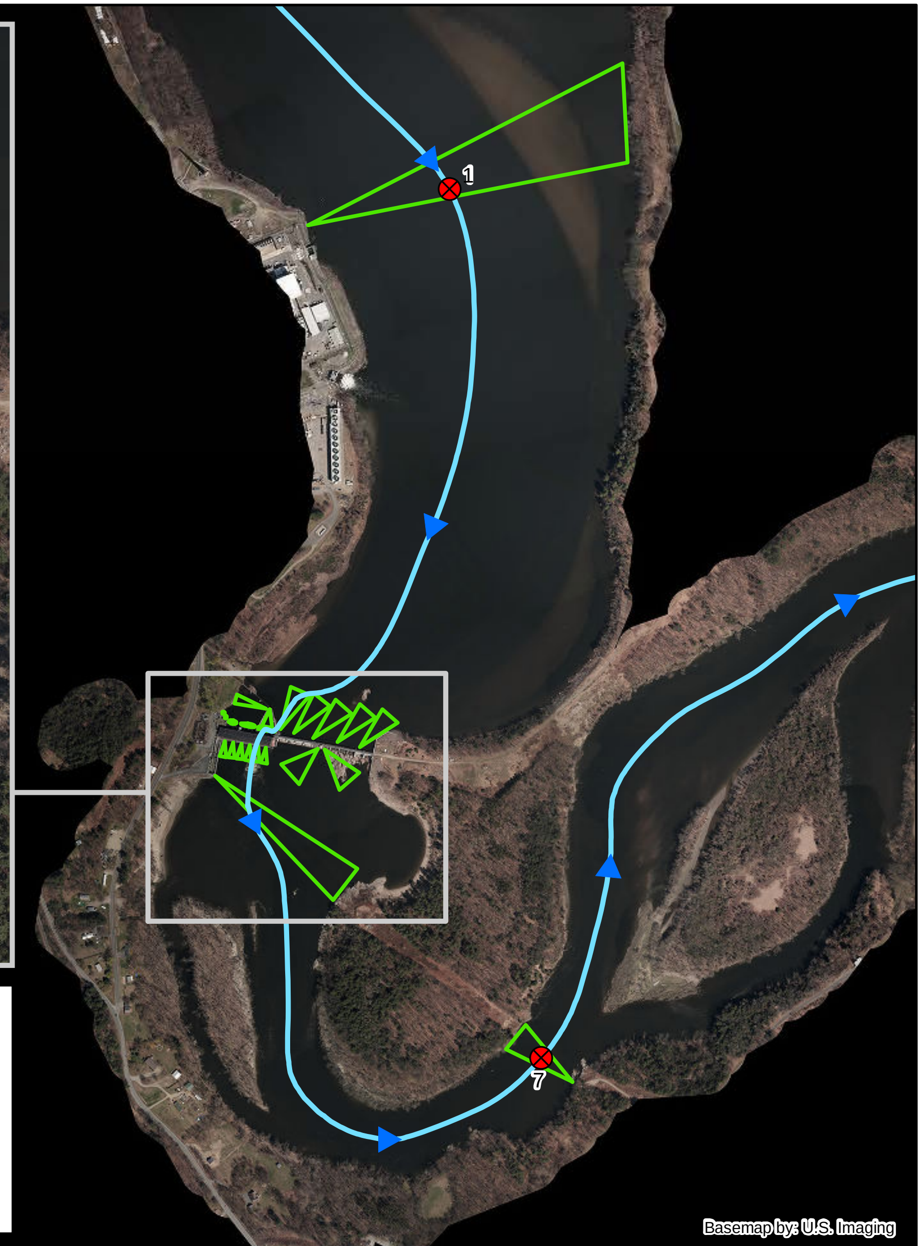


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/6/2015 | 11:03 | 6 | 11/6/2015 | 23:39 |
| 2 | 11/6/2015 | 23:02 | 7 | 11/6/2015 | 23:52 |
| 3 | 11/6/2015 | 23:08 | | | |
| 4 | 11/6/2015 | 23:12 | | | |
| 5 | 11/6/2015 | 23:37 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-118 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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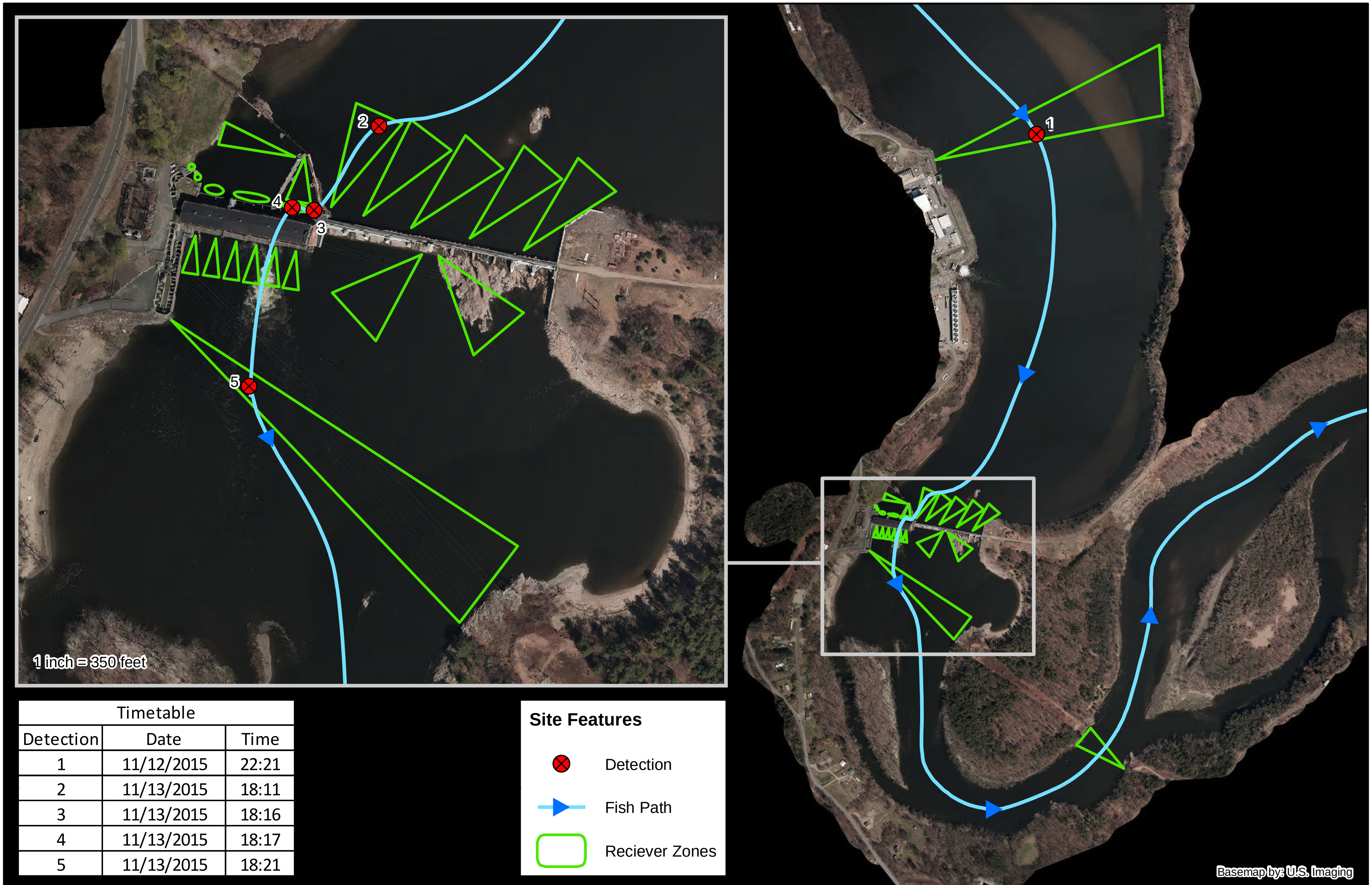


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/12/2015 | 22:21 |
| 2 | 11/13/2015 | 18:11 |
| 3 | 11/13/2015 | 18:16 |
| 4 | 11/13/2015 | 18:17 |
| 5 | 11/13/2015 | 18:21 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

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**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-119 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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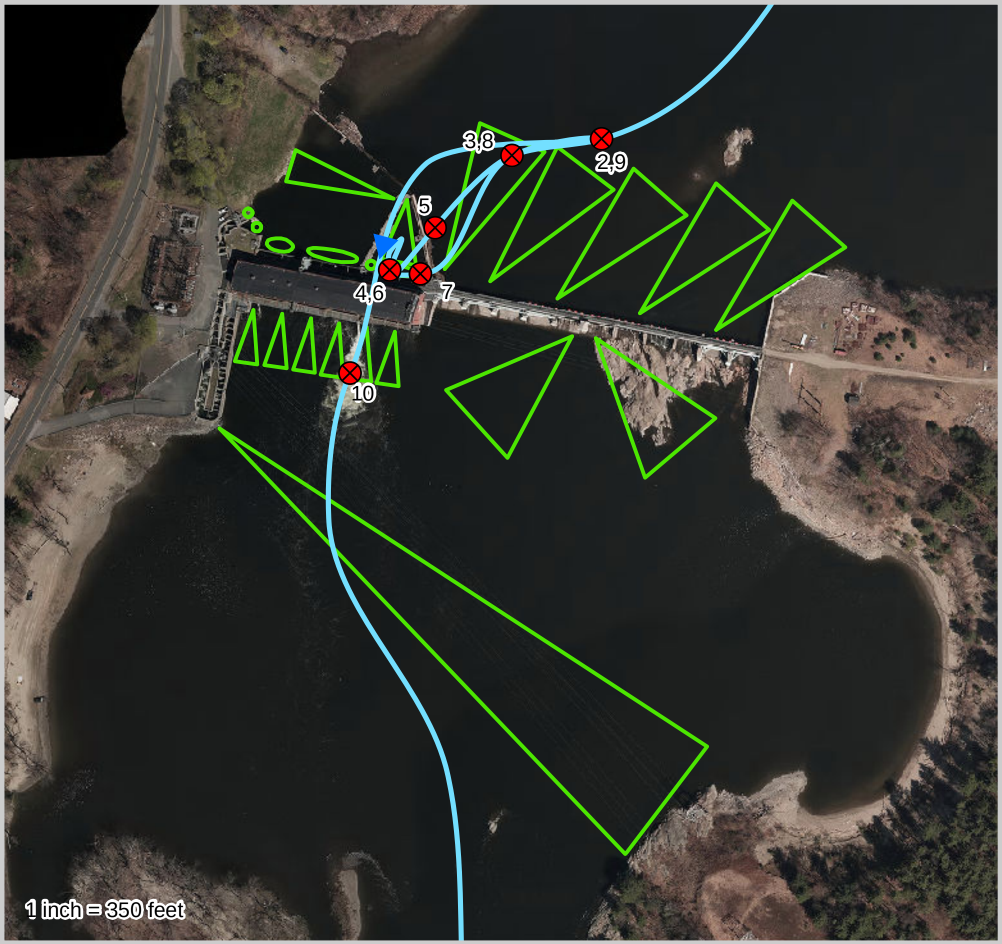


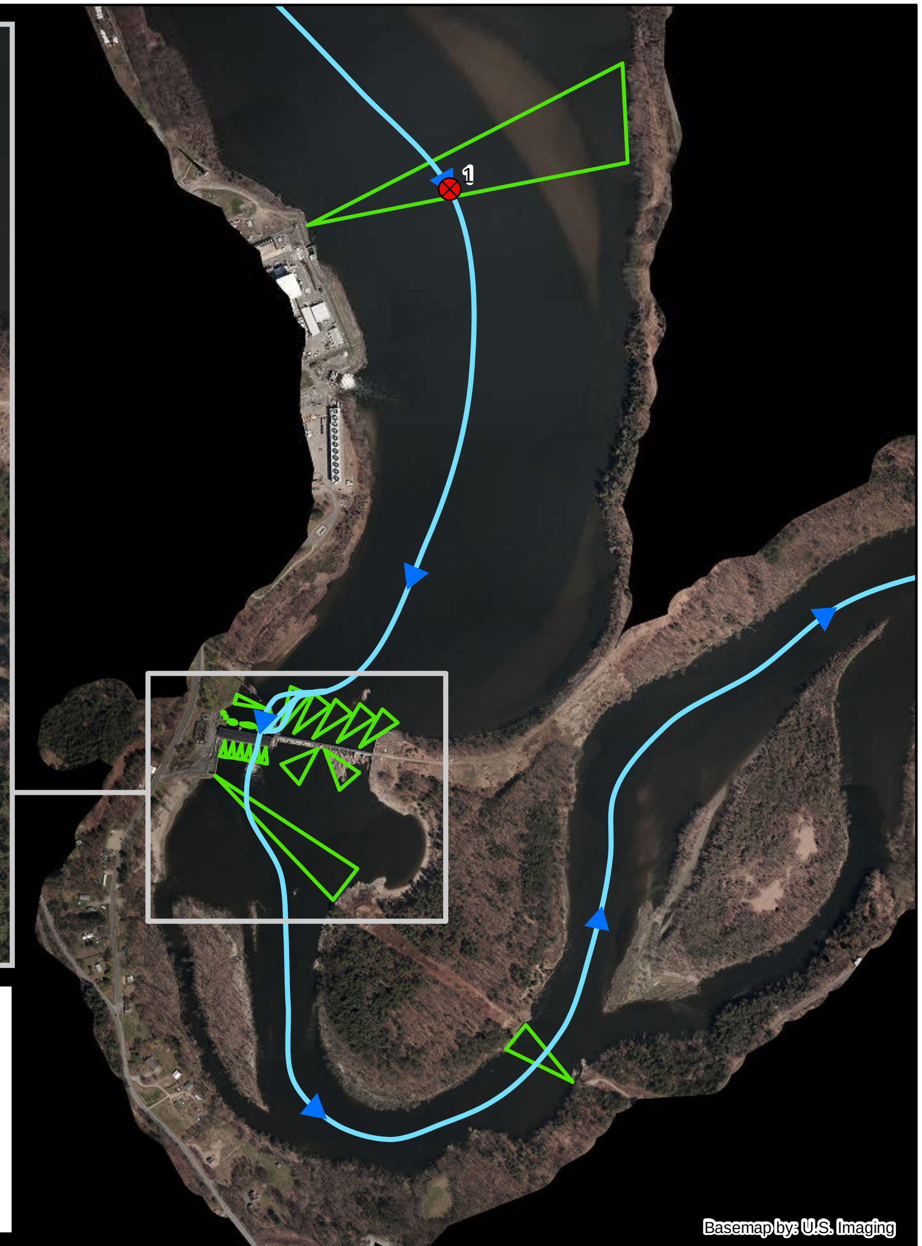


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/13/2015 | 20:33 | 6 | 11/13/2015 | 23:06 |
| 2 | 11/13/2015 | 21:49 | 7 | 11/13/2015 | 23:57 |
| 3 | 11/13/2015 | 22:58 | 8 | 11/14/2015 | 0:29 |
| 4 | 11/13/2015 | 23:02 | 9 | 11/14/2015 | 0:32 |
| 5 | 11/13/2015 | 23:03 | 10 | 11/14/2015 | 5:19 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-120 (T1)**

Release: Herricks Cove, VT
Date Released: 10/27/2015
Time Released: 18:20

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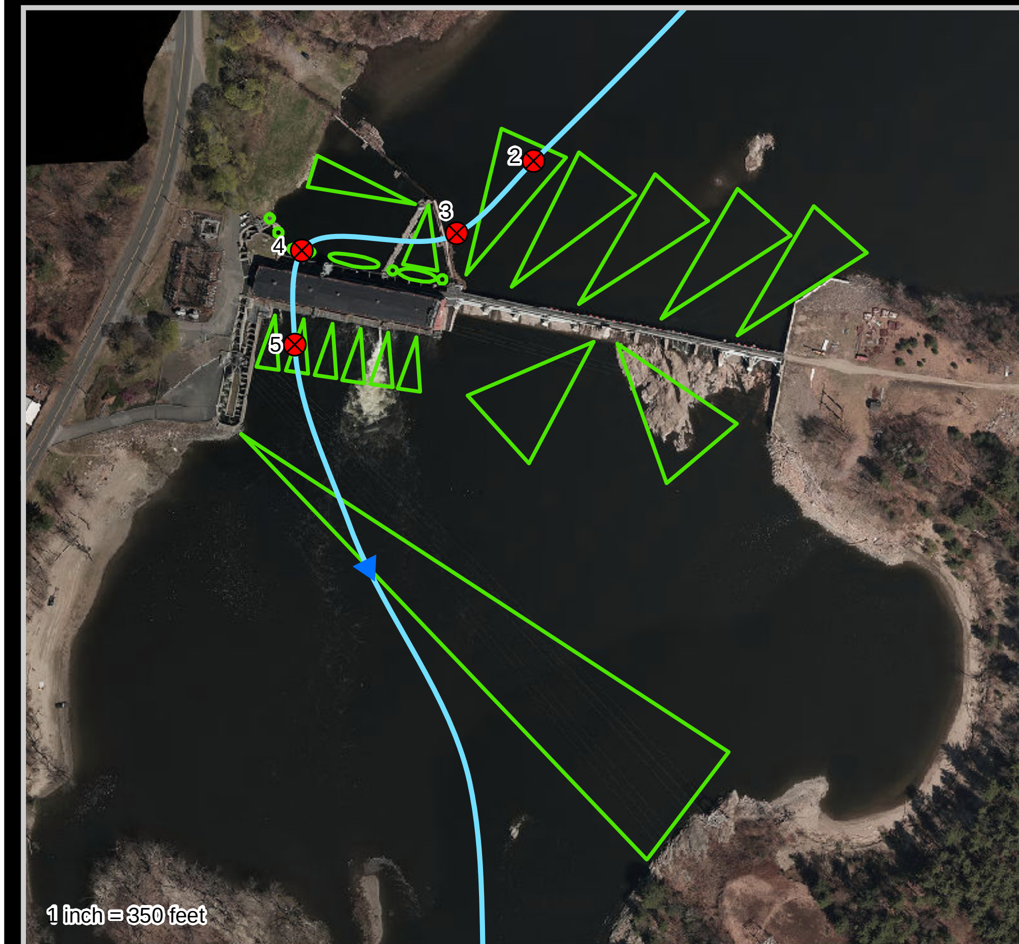


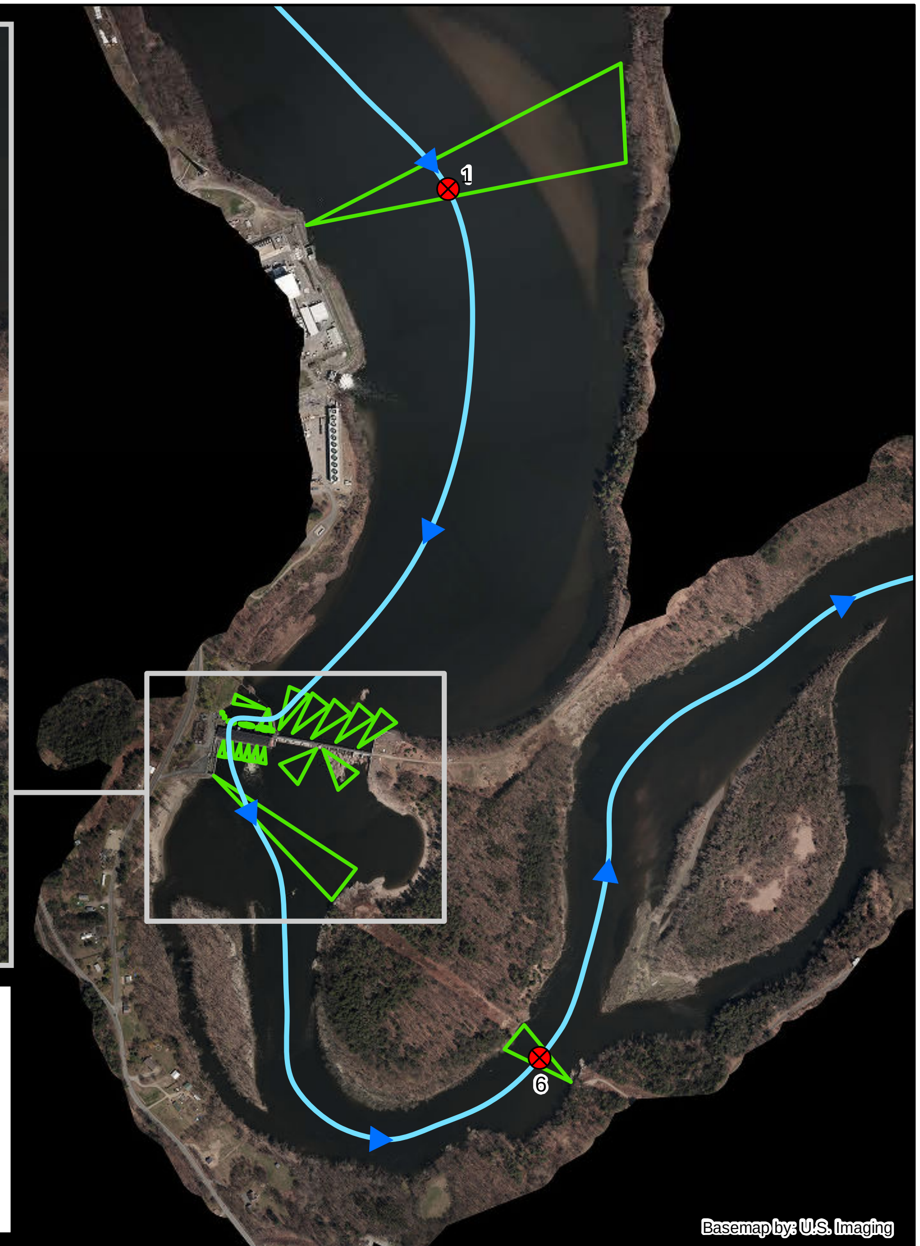


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 20:47 |
| 2 | 11/7/2015 | 21:24 |
| 3 | 11/7/2015 | 21:27 |
| 4 | 11/7/2015 | 21:32 |
| 5 | 11/7/2015 | 21:33 |
| 6 | 11/7/2015 | 21:58 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-124 (T1)**

Release: Norwich, VT
Date Released: 11/03/2015
Time Released: 17:32


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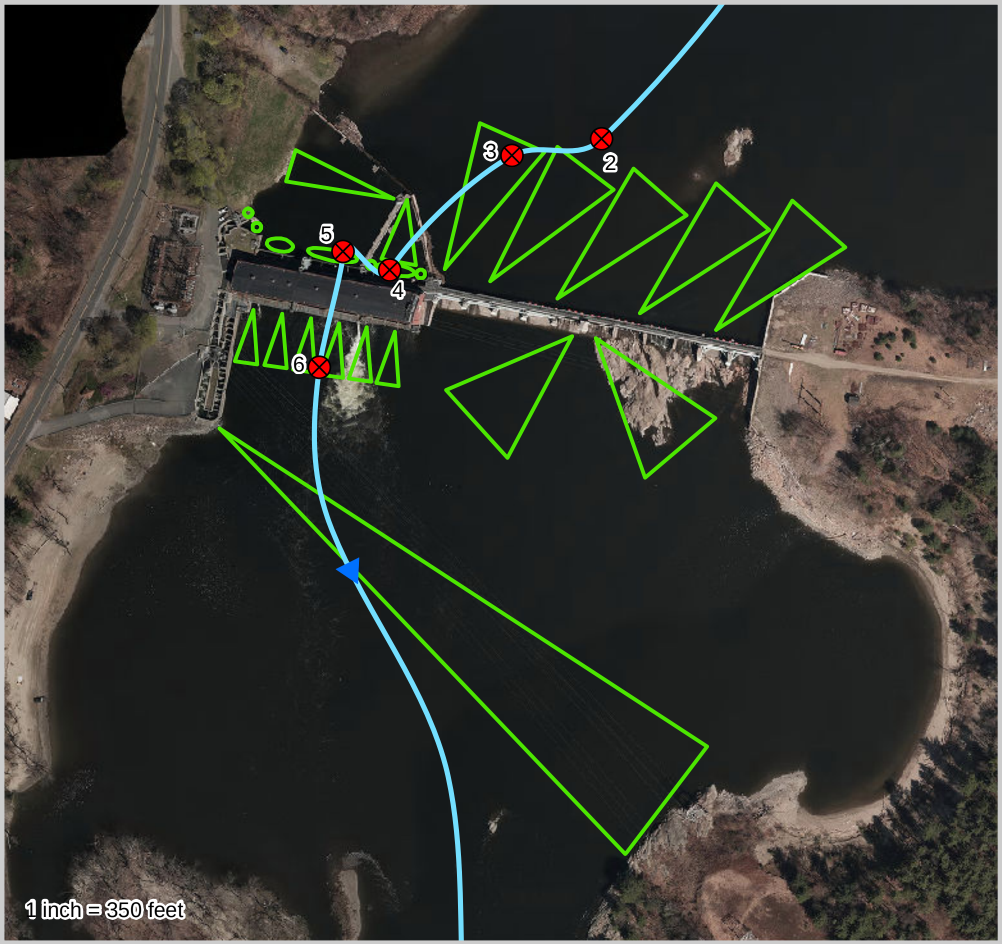


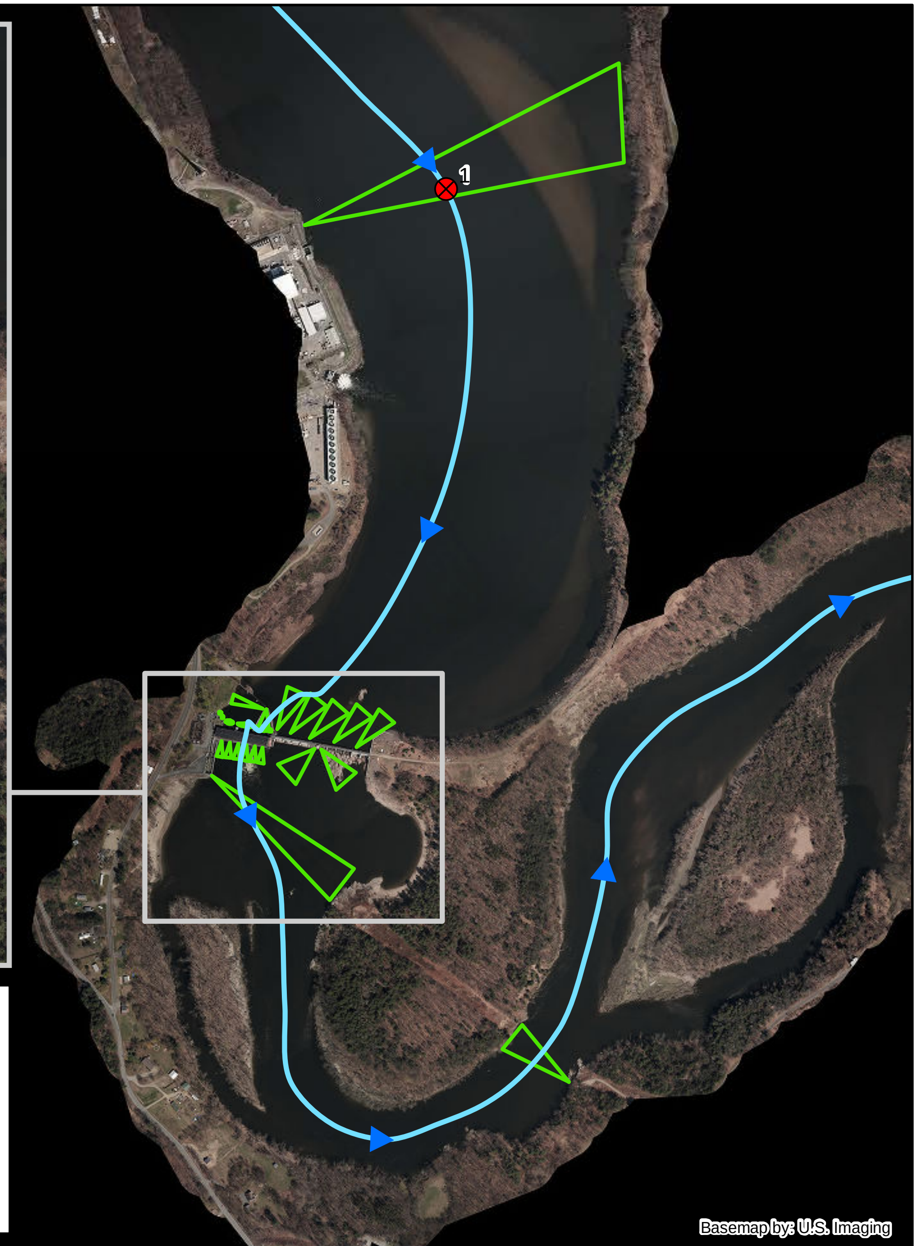


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/8/2015 | 21:22 |
| 2 | 11/8/2015 | 22:40 |
| 3 | 11/8/2015 | 22:51 |
| 4 | 11/8/2015 | 22:53 |
| 5 | 11/8/2015 | 23:01 |
| 6 | 11/8/2015 | 23:01 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-131 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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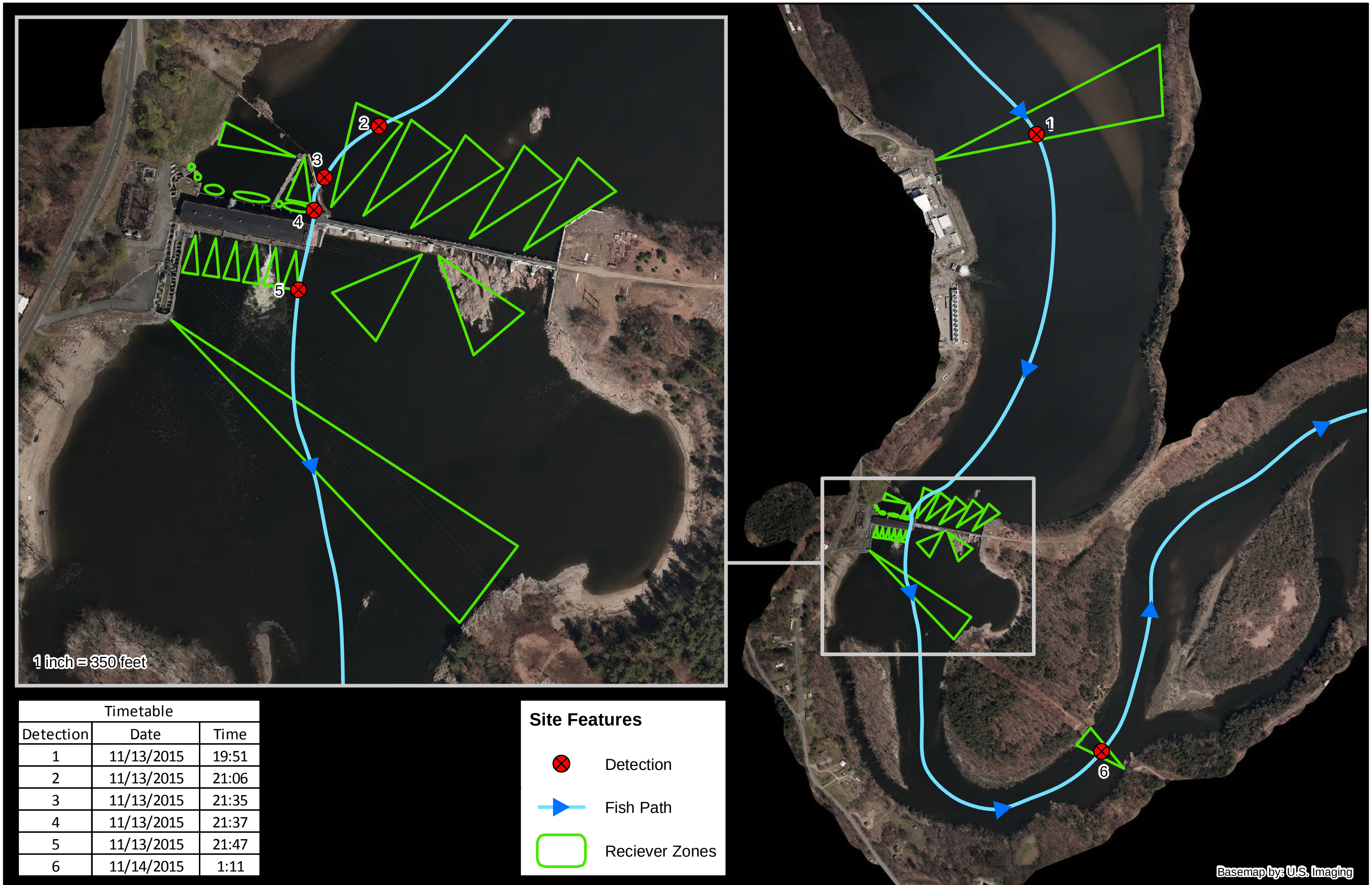


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/13/2015 | 19:51 |
| 2 | 11/13/2015 | 21:06 |
| 3 | 11/13/2015 | 21:35 |
| 4 | 11/13/2015 | 21:37 |
| 5 | 11/13/2015 | 21:47 |
| 6 | 11/14/2015 | 1:11 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-132 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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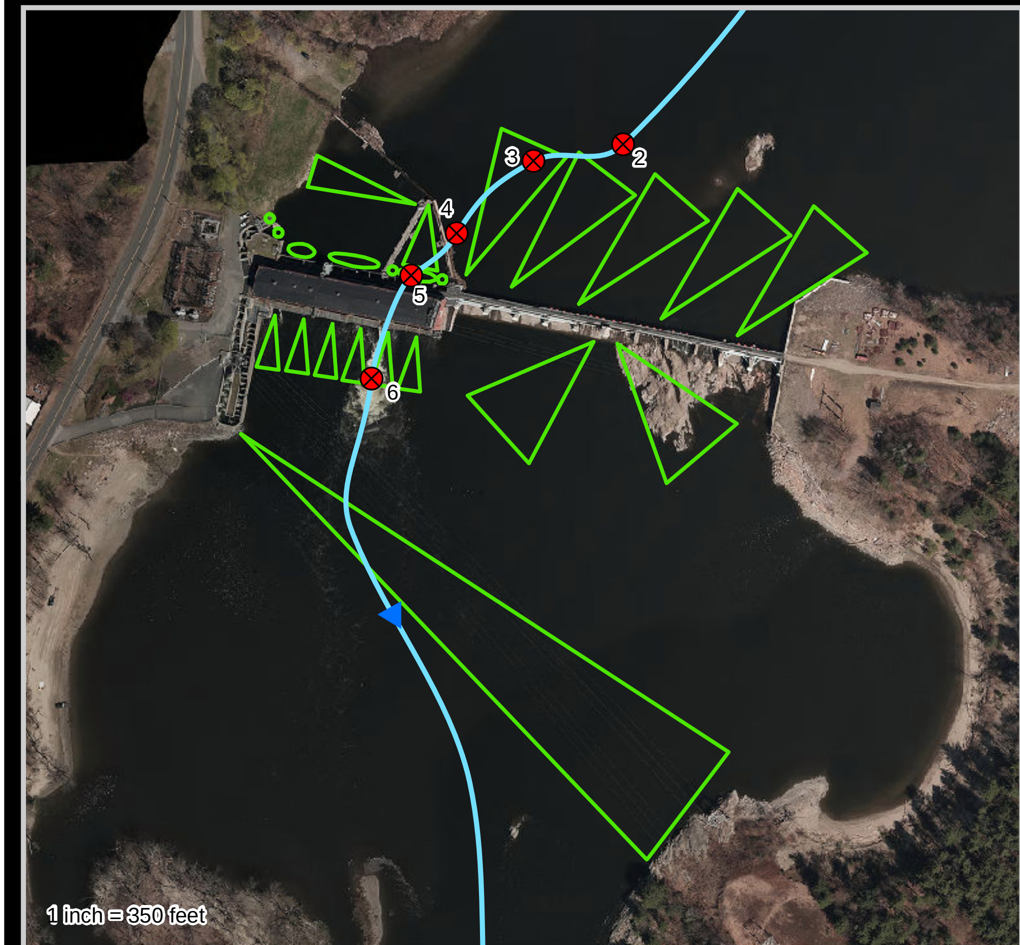


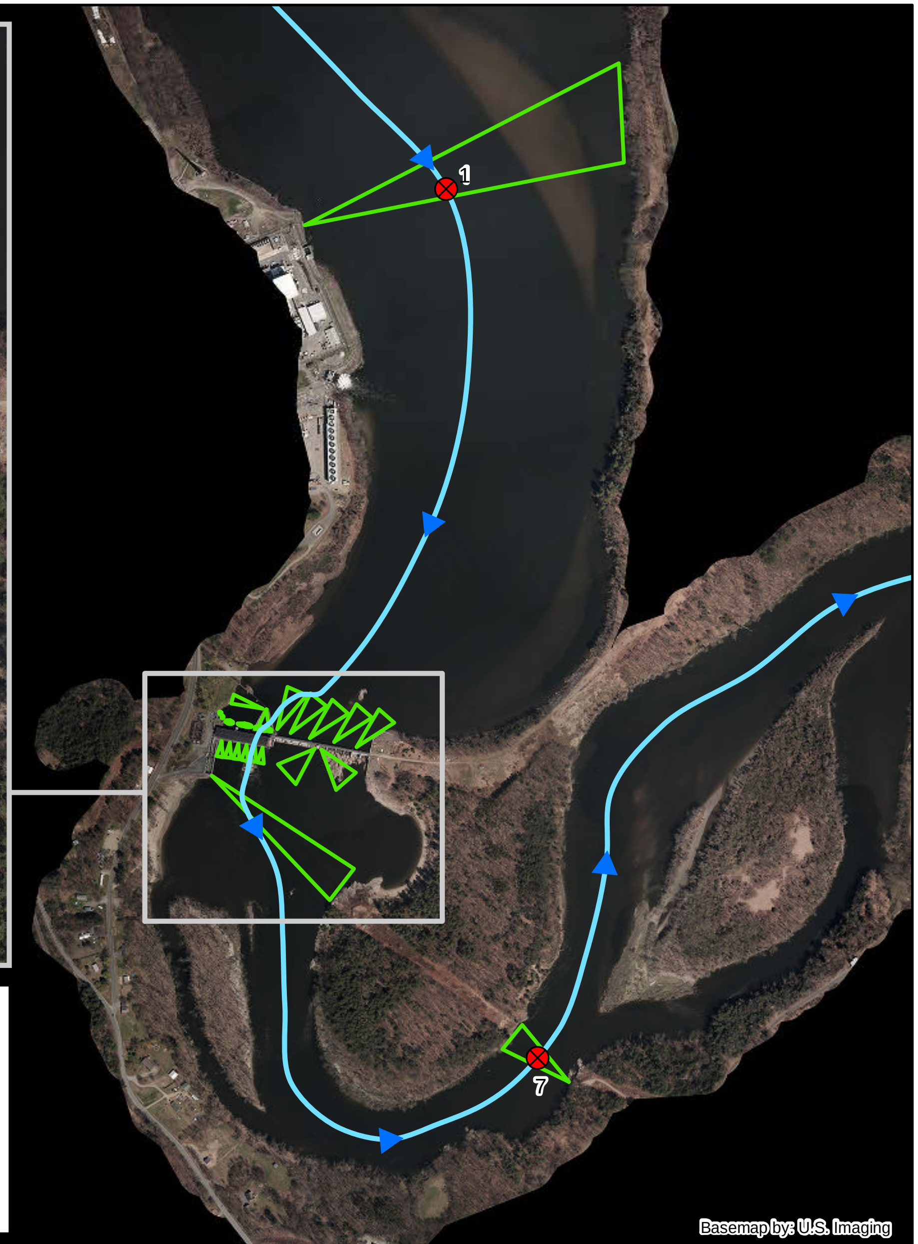


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/7/2015 | 2:01 | 6 | 11/7/2015 | 4:19 |
| 2 | 11/7/2015 | 4:09 | 7 | 11/7/2015 | 5:00 |
| 3 | 11/7/2015 | 4:12 | | | |
| 4 | 11/7/2015 | 4:16 | | | |
| 5 | 11/7/2015 | 4:18 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-133 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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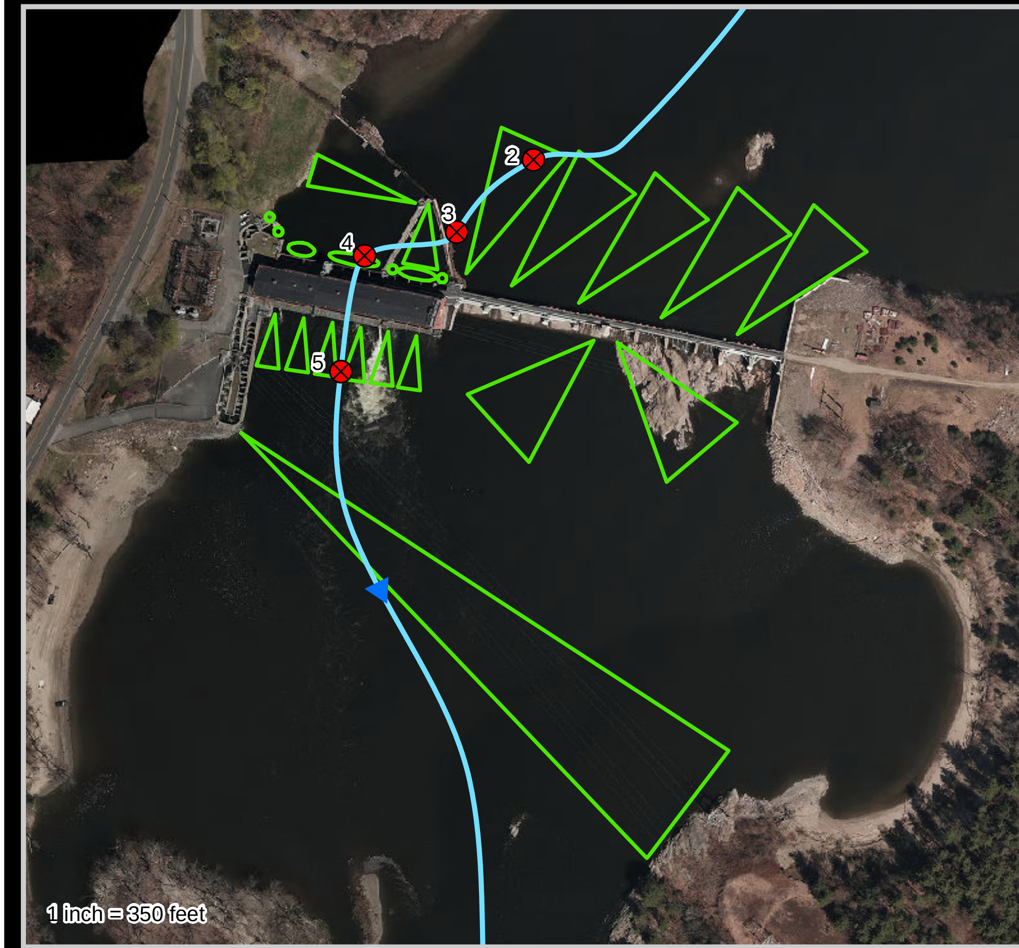


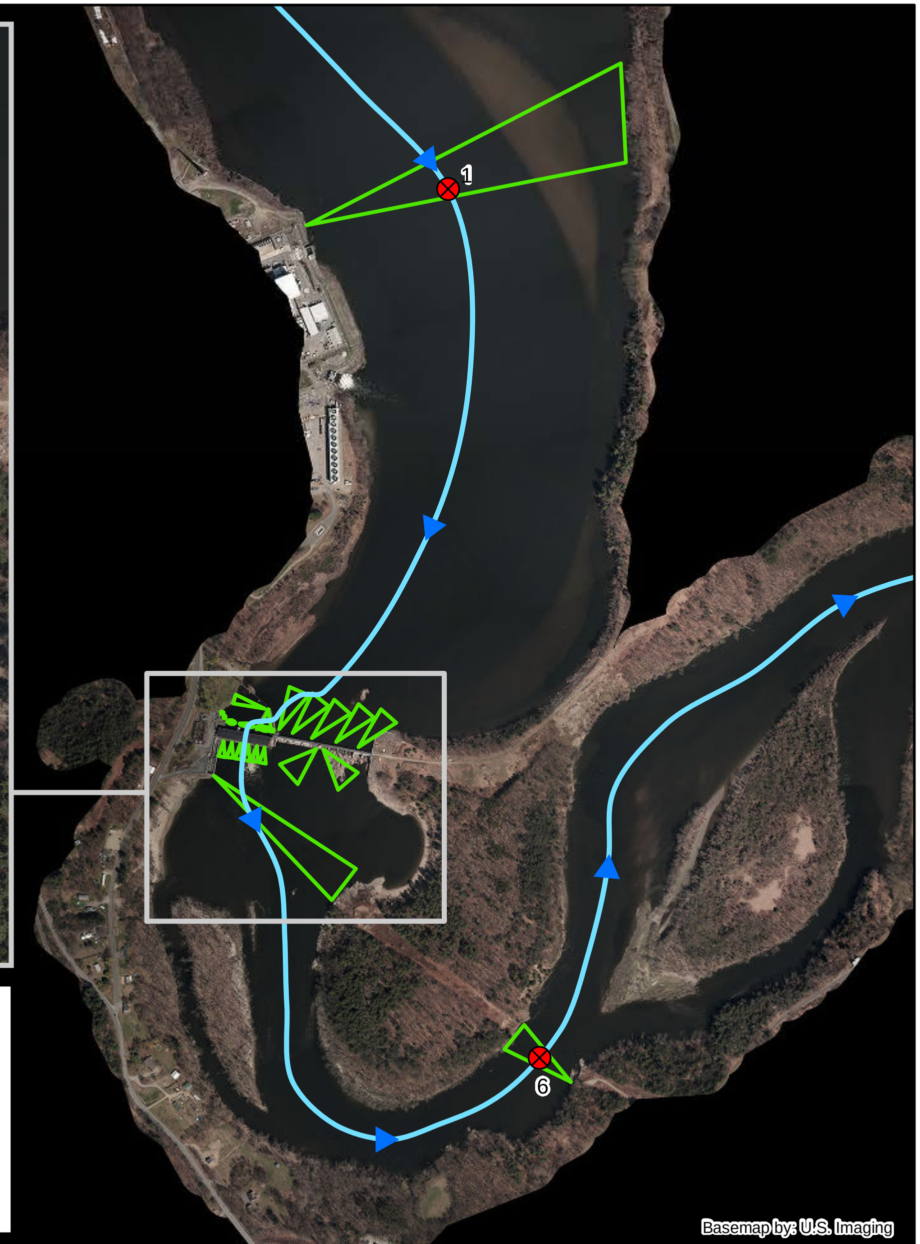


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/5/2015 | 22:14 |
| 2 | 11/5/2015 | 22:58 |
| 3 | 11/5/2015 | 23:01 |
| 4 | 11/5/2015 | 23:06 |
| 5 | 11/5/2015 | 23:06 |
| 6 | 11/5/2015 | 23:38 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-134 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 11/05/2015
Time Released: 15:35

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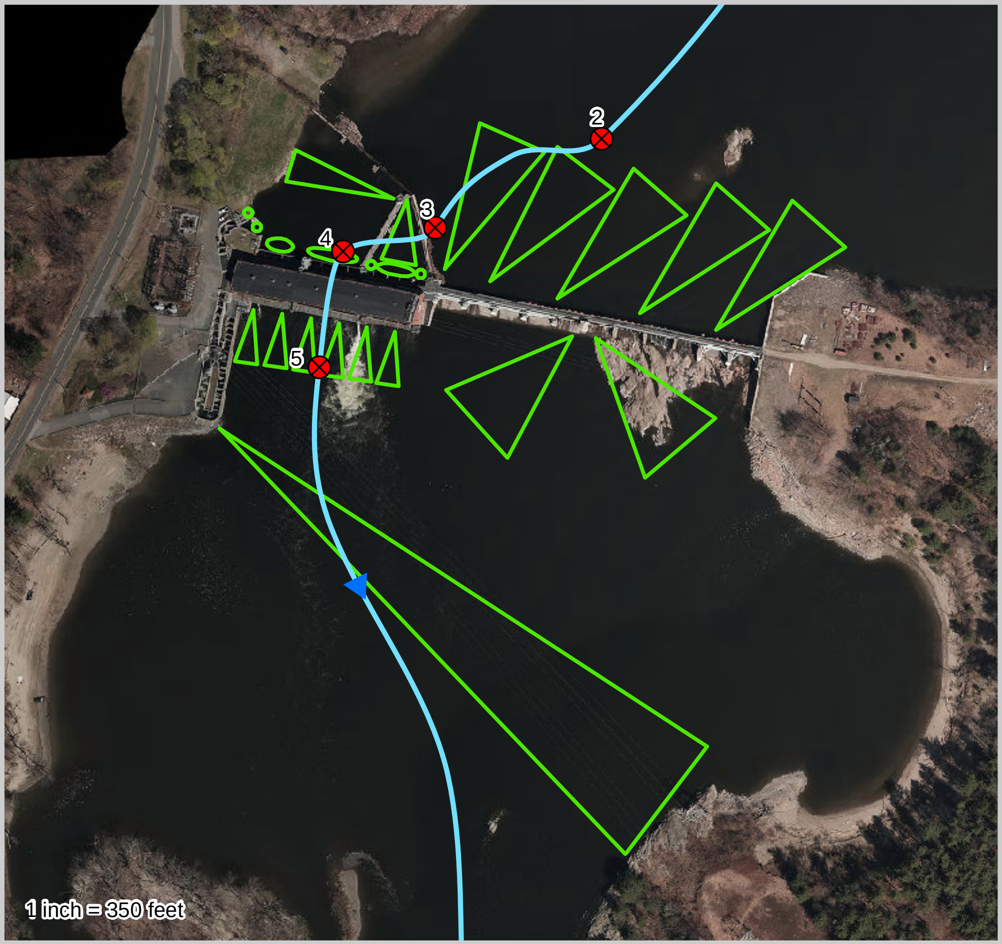


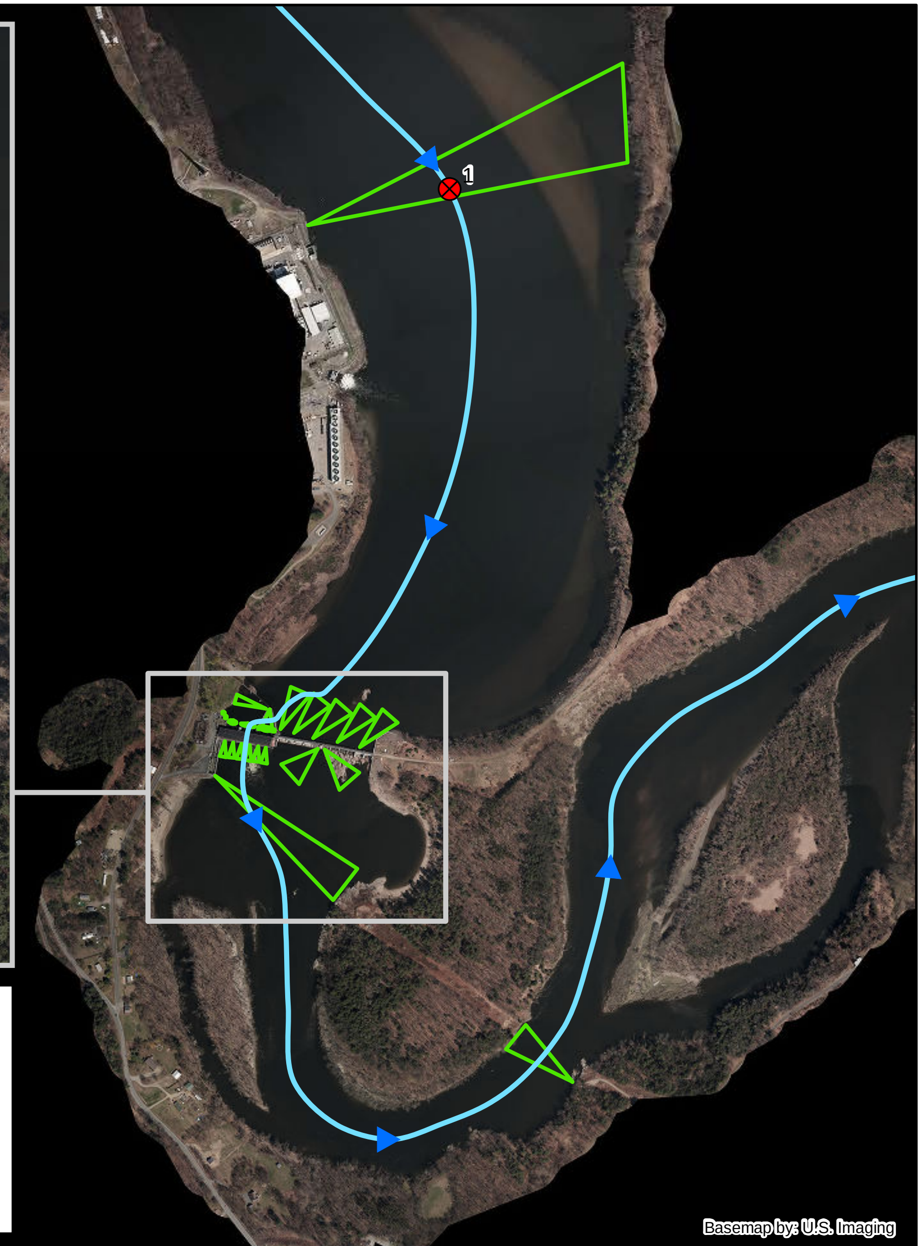


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 21:18 |
| 2 | 10/29/2015 | 21:45 |
| 3 | 10/29/2015 | 21:53 |
| 4 | 10/29/2015 | 21:54 |
| 5 | 10/29/2015 | 22:10 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-138 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05

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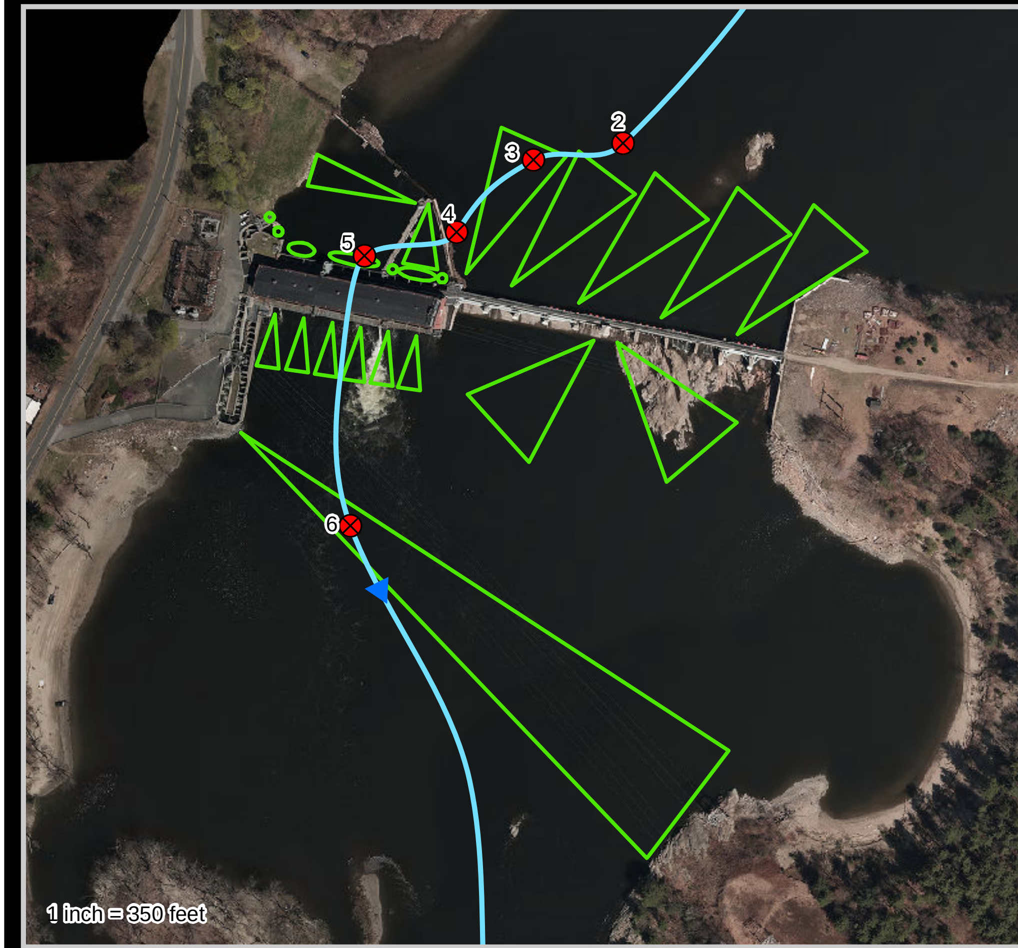


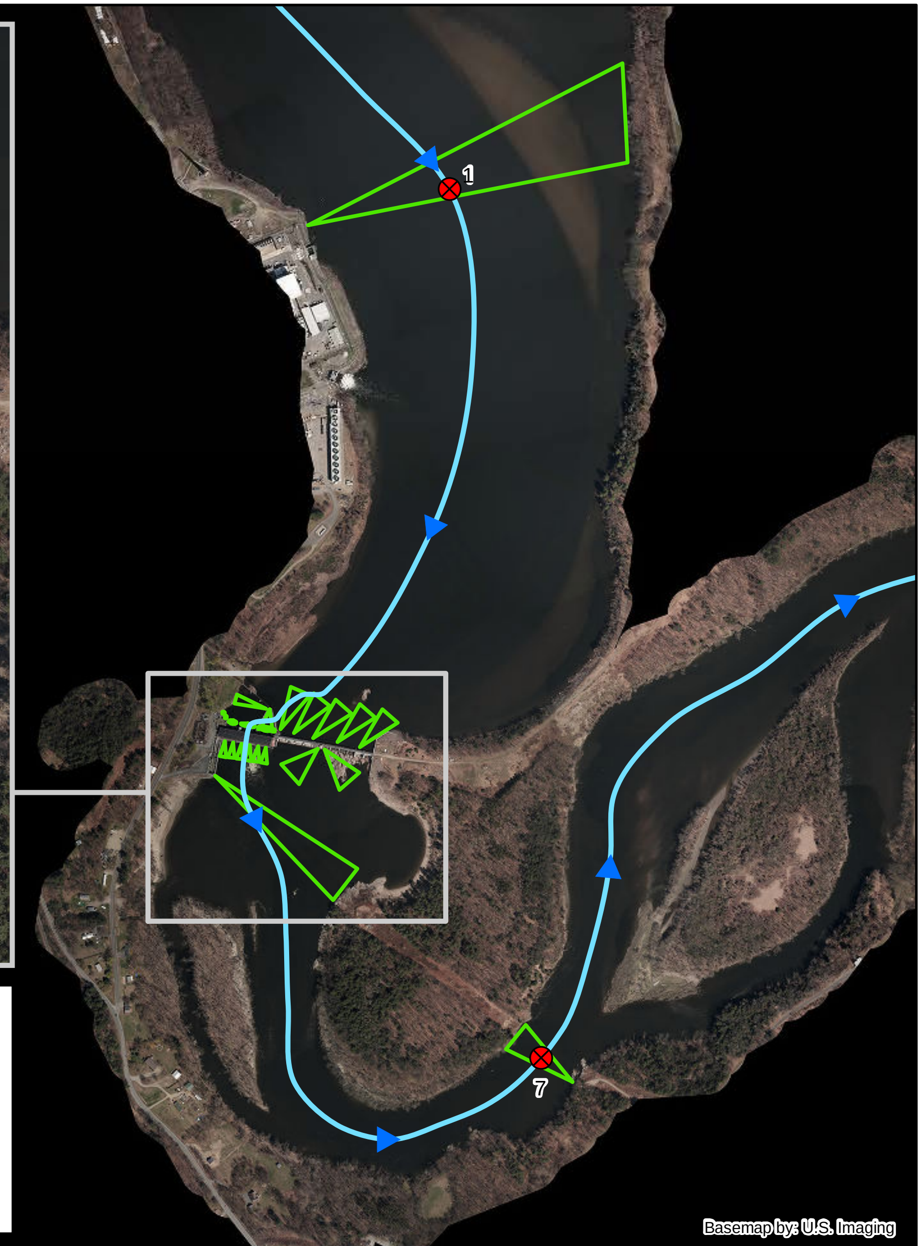


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 10/30/2015 | 22:11 | 6 | 10/31/2015 | 1:03 |
| 2 | 10/31/2015 | 0:48 | 7 | 10/31/2015 | 2:38 |
| 3 | 10/31/2015 | 0:54 | | | |
| 4 | 10/31/2015 | 0:57 | | | |
| 5 | 10/31/2015 | 1:02 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-139 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05

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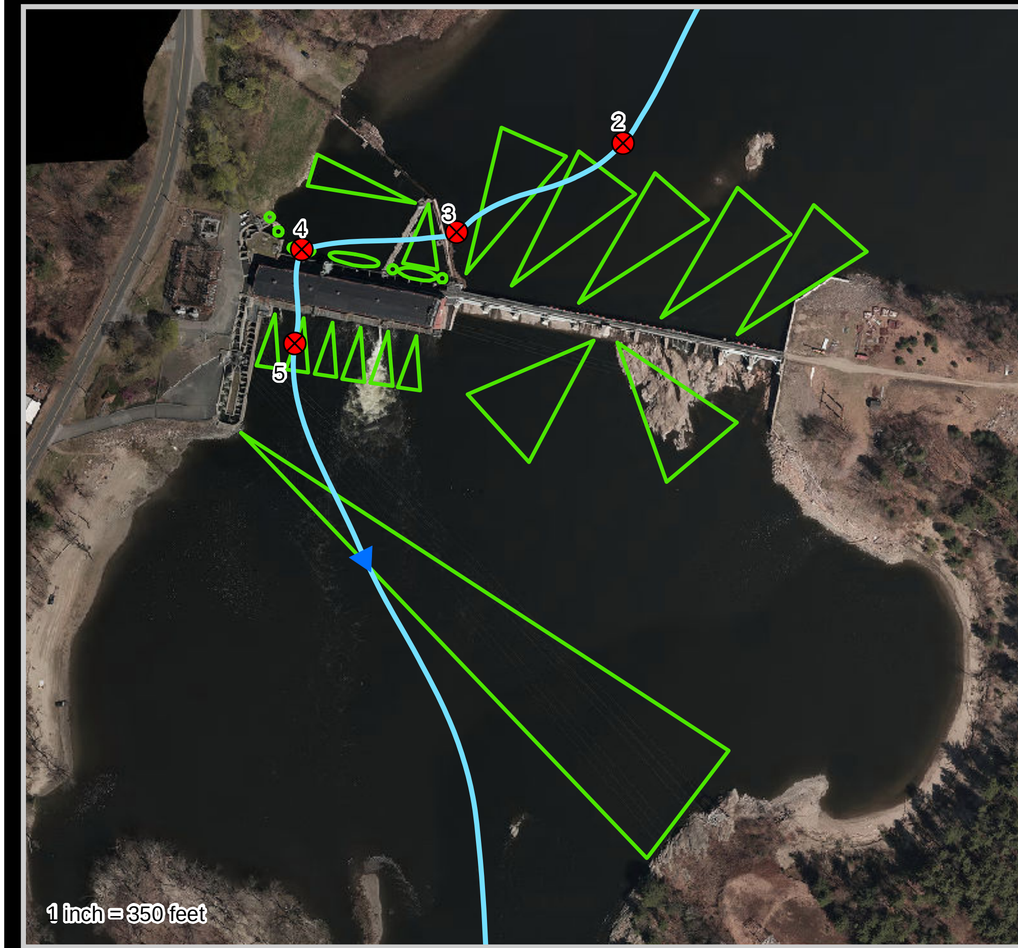


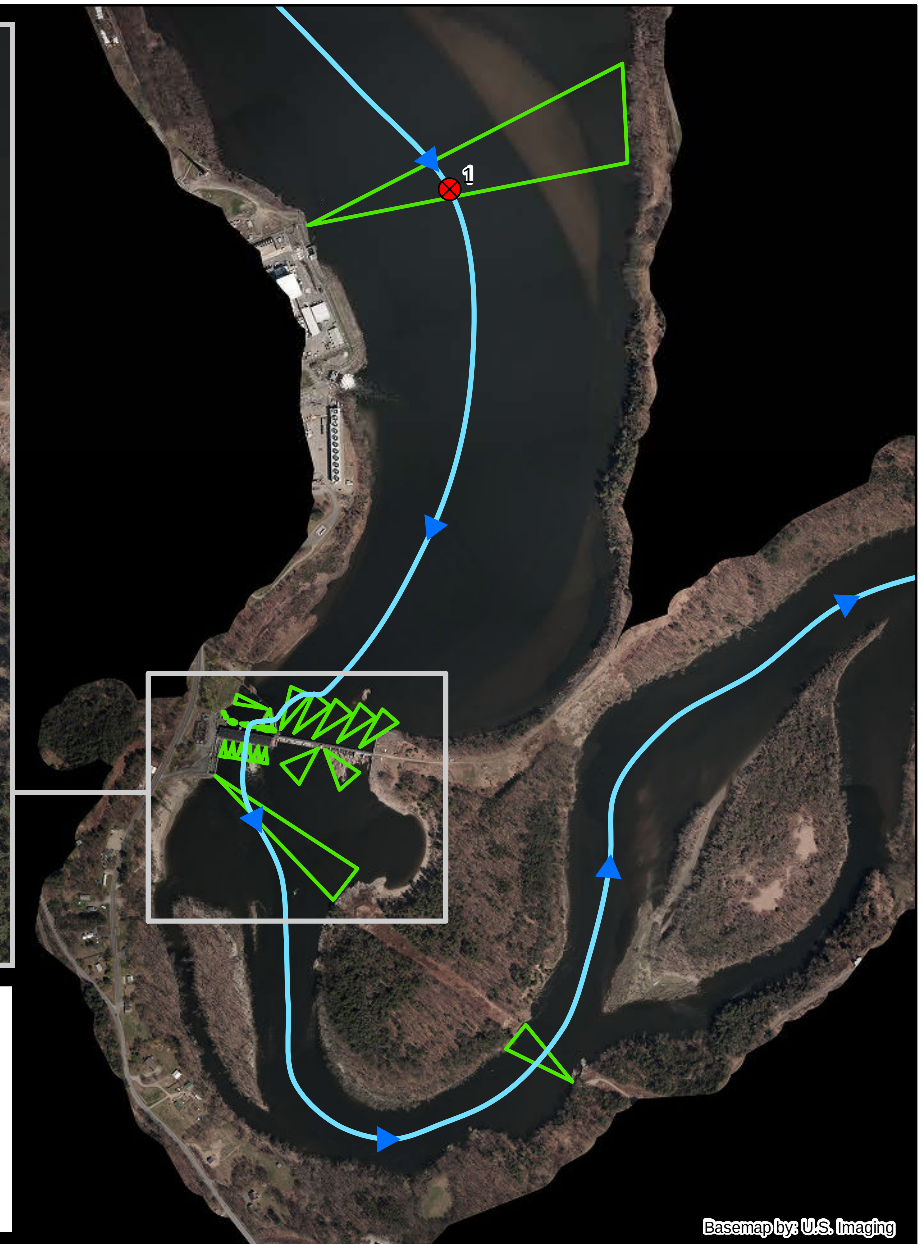


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 10/29/2015 | 18:27 |
| 2 | 10/29/2015 | 18:57 |
| 3 | 10/29/2015 | 19:02 |
| 4 | 10/29/2015 | 19:04 |
| 5 | 10/29/2015 | 19:06 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-140 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/29/2015
Time Released: 13:05


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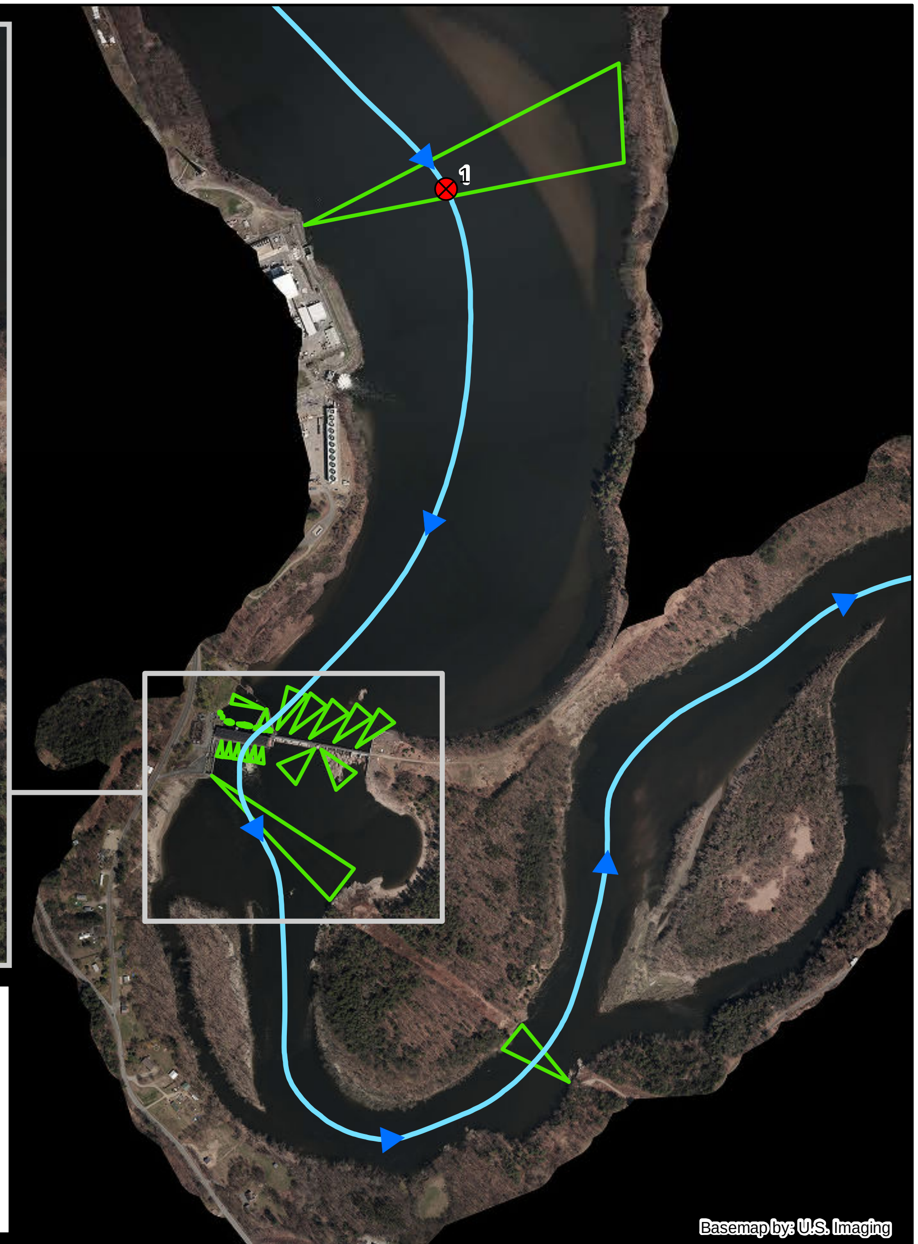


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 18:44 |
| 2 | 11/7/2015 | 19:23 |
| 3 | 11/7/2015 | 19:26 |
| 4 | 11/7/2015 | 19:26 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-146 (T1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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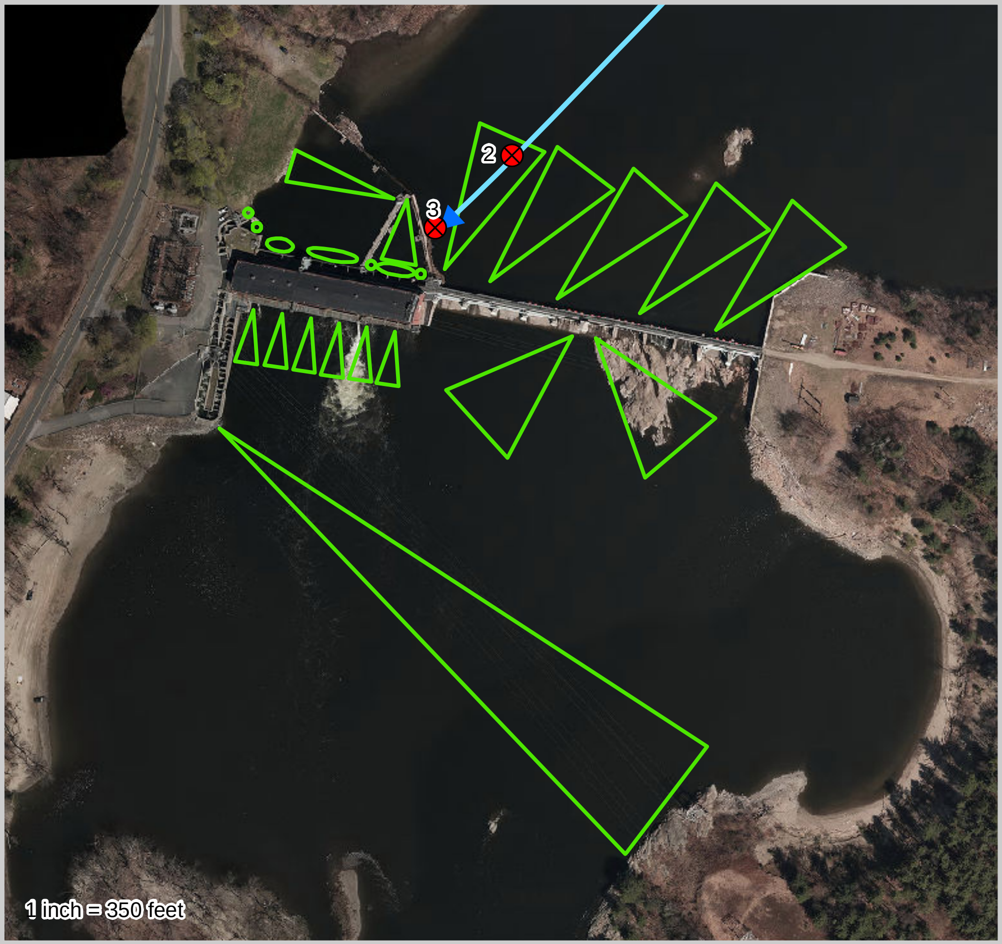


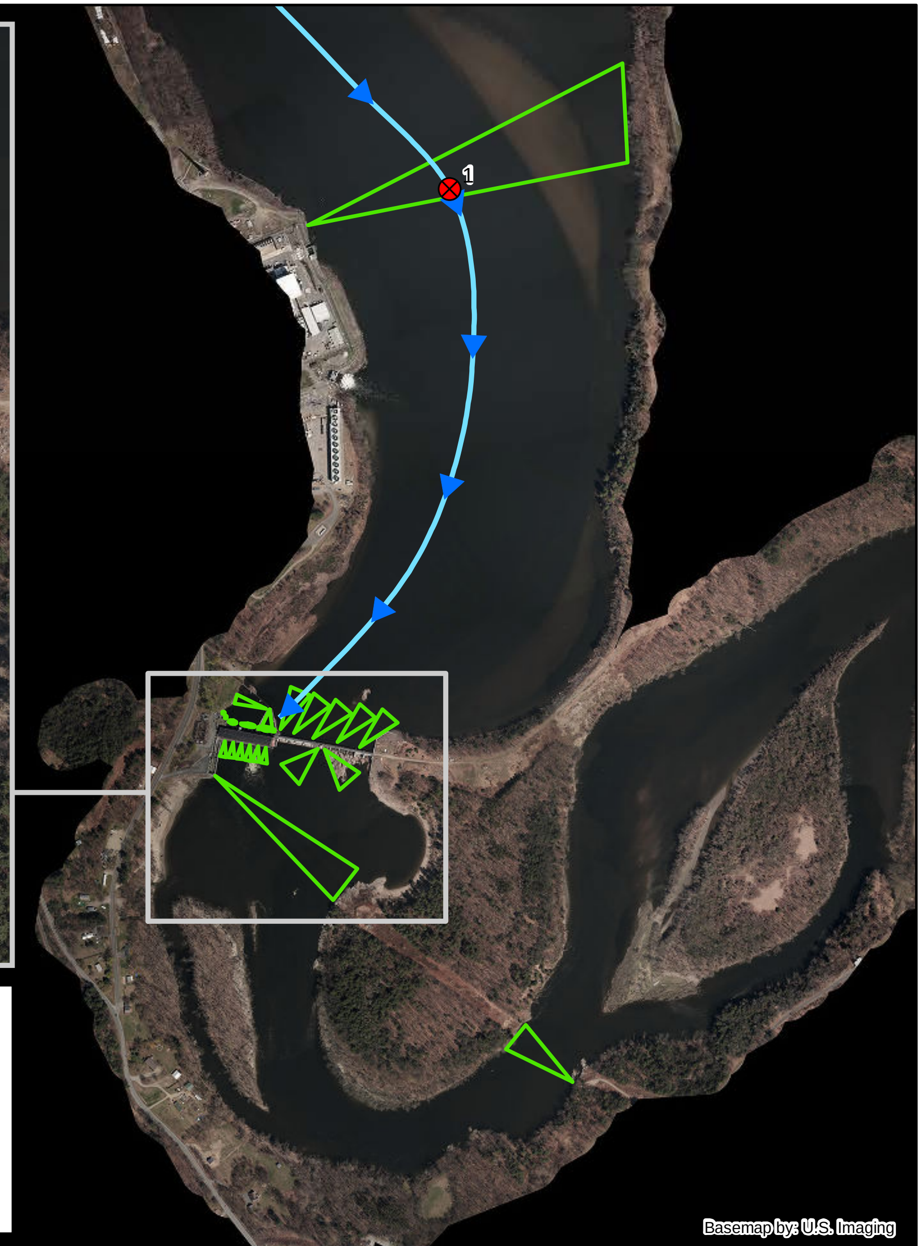


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/9/2015 | 0:48 |
| 2 | 11/9/2015 | 18:21 |
| 3 | 11/9/2015 | 18:25 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-147 (A1)**

Release: Herricks Cove, VT
Date Released: 11/05/2015
Time Released: 16:20

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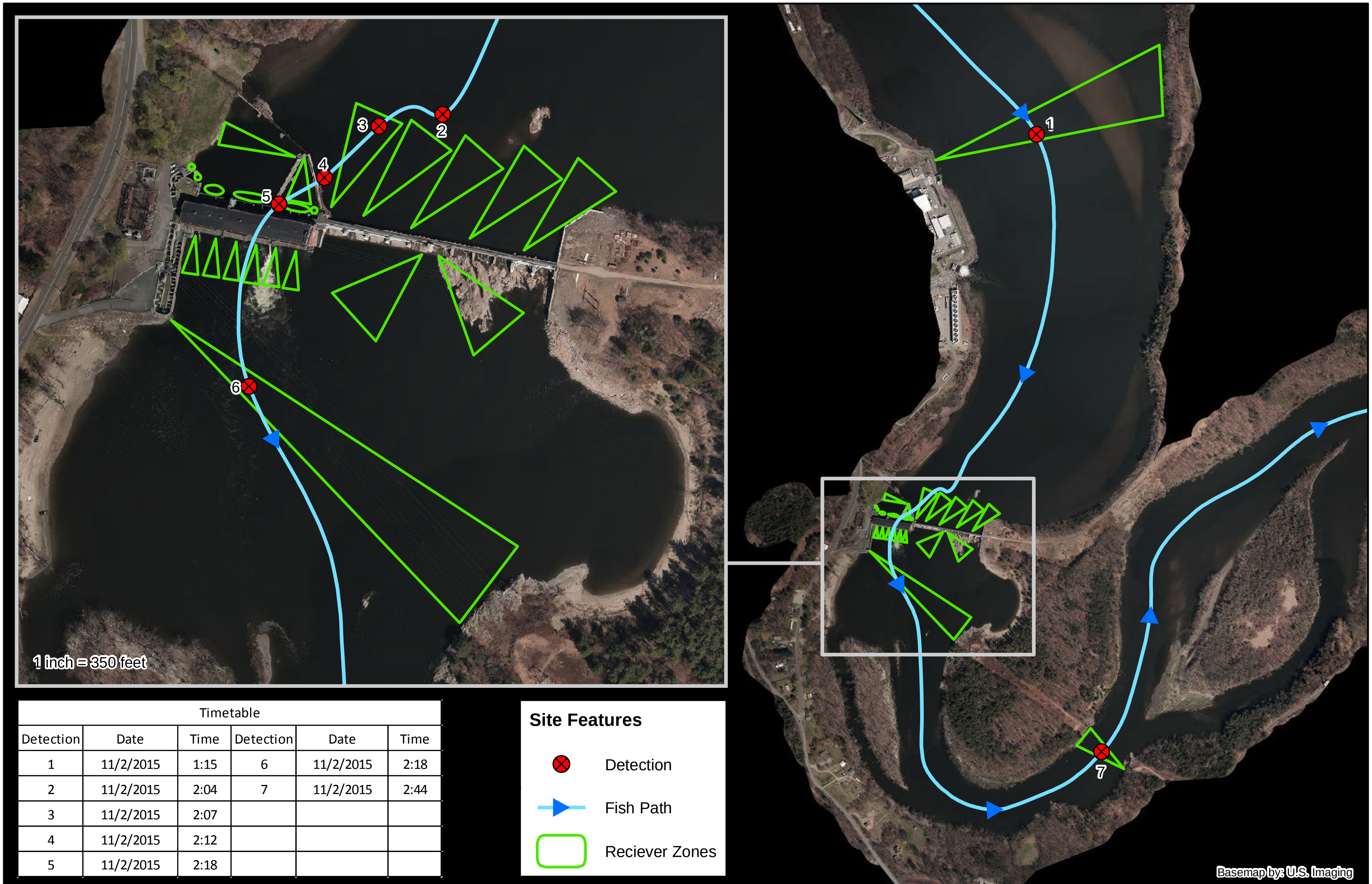


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/2/2015 | 1:15 | 6 | 11/2/2015 | 2:18 |
| 2 | 11/2/2015 | 2:04 | 7 | 11/2/2015 | 2:44 |
| 3 | 11/2/2015 | 2:07 | | | |
| 4 | 11/2/2015 | 2:12 | | | |
| 5 | 11/2/2015 | 2:18 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

1 in = 1,200 feet

N

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-149 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52


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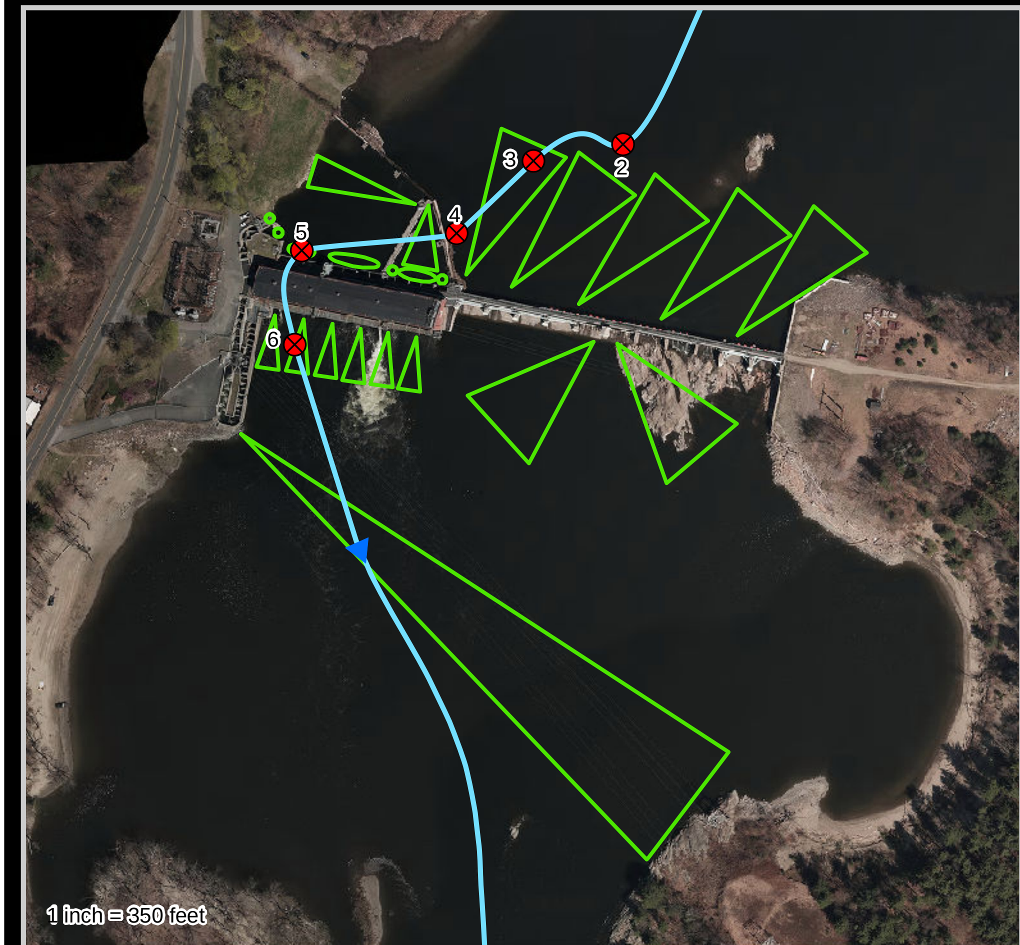


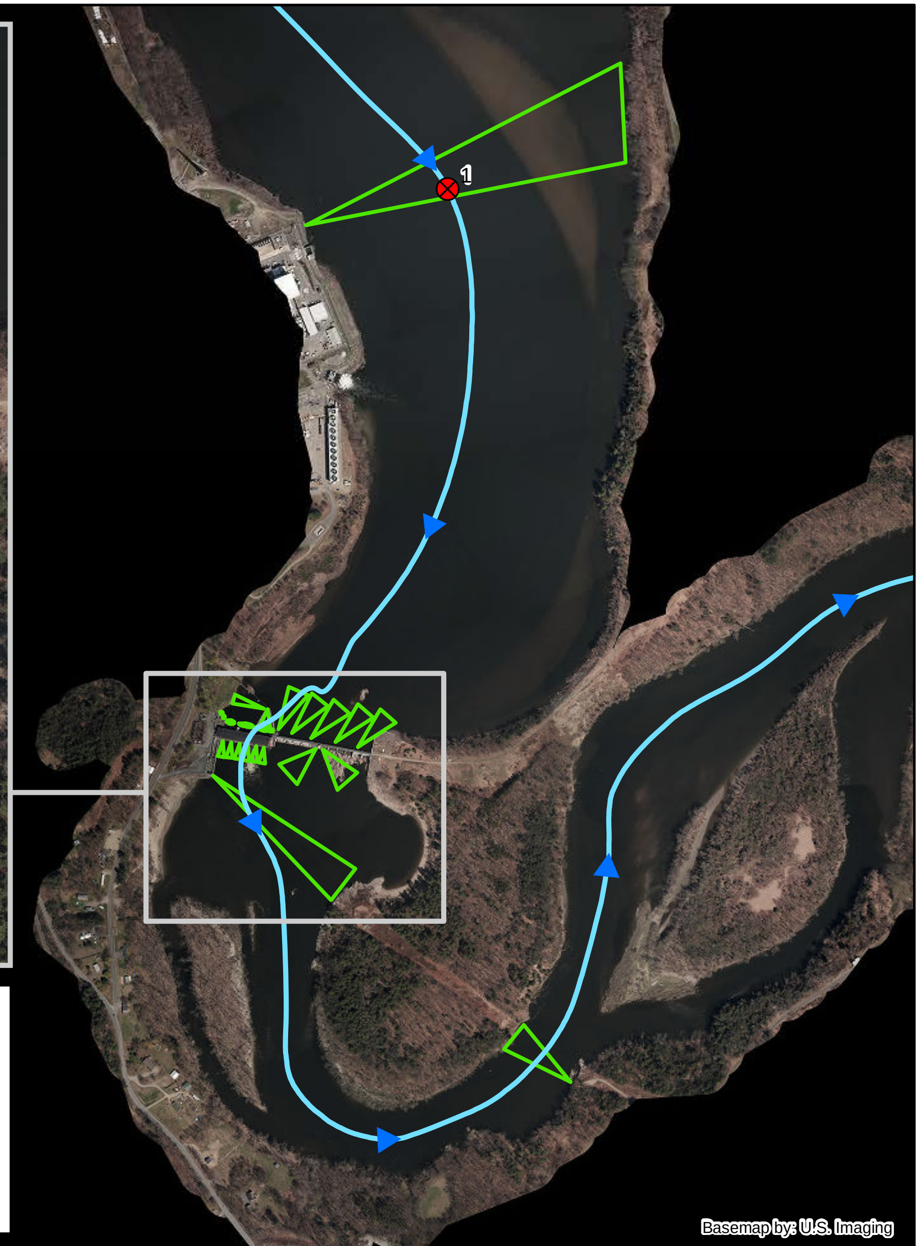


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/1/2015 | 21:25 |
| 2 | 11/1/2015 | 22:25 |
| 3 | 11/1/2015 | 22:28 |
| 4 | 11/1/2015 | 22:29 |
| 5 | 11/1/2015 | 22:32 |
| 6 | 11/1/2015 | 22:33 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-150 (T1)**

Release: Herricks Cove, VT
Date Released: 10/29/2015
Time Released: 17:52

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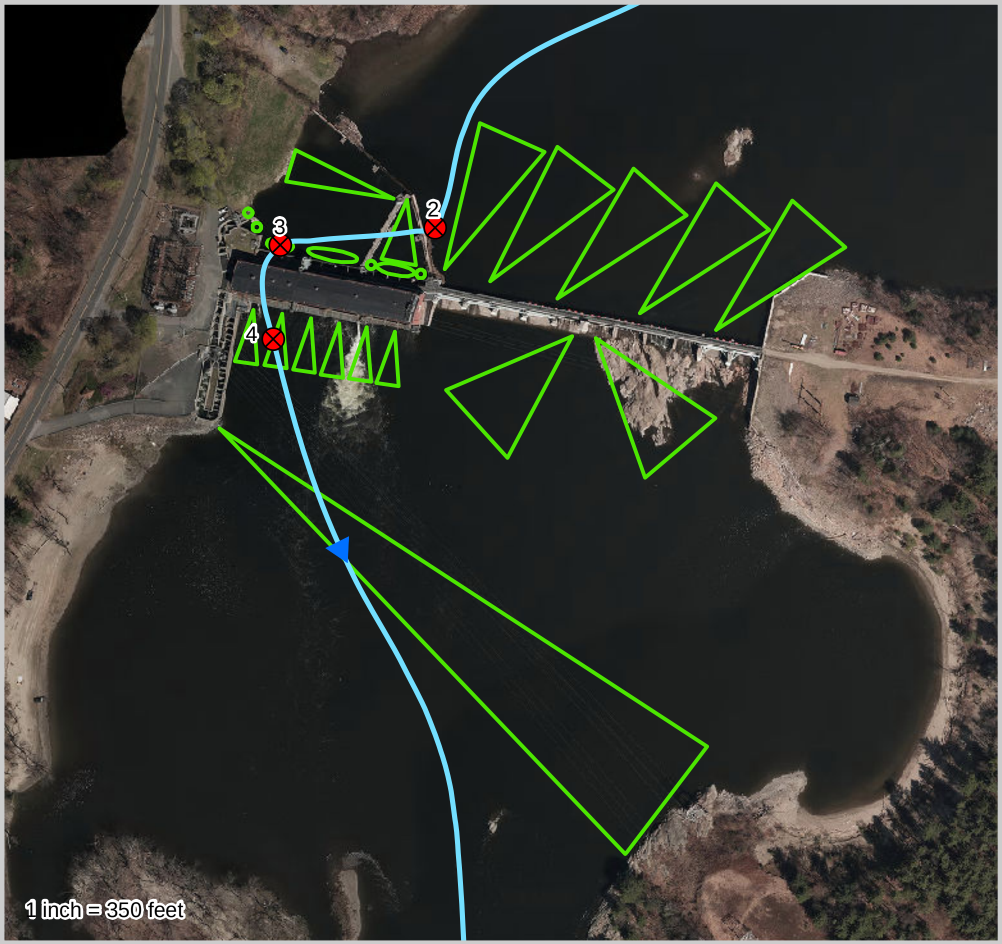


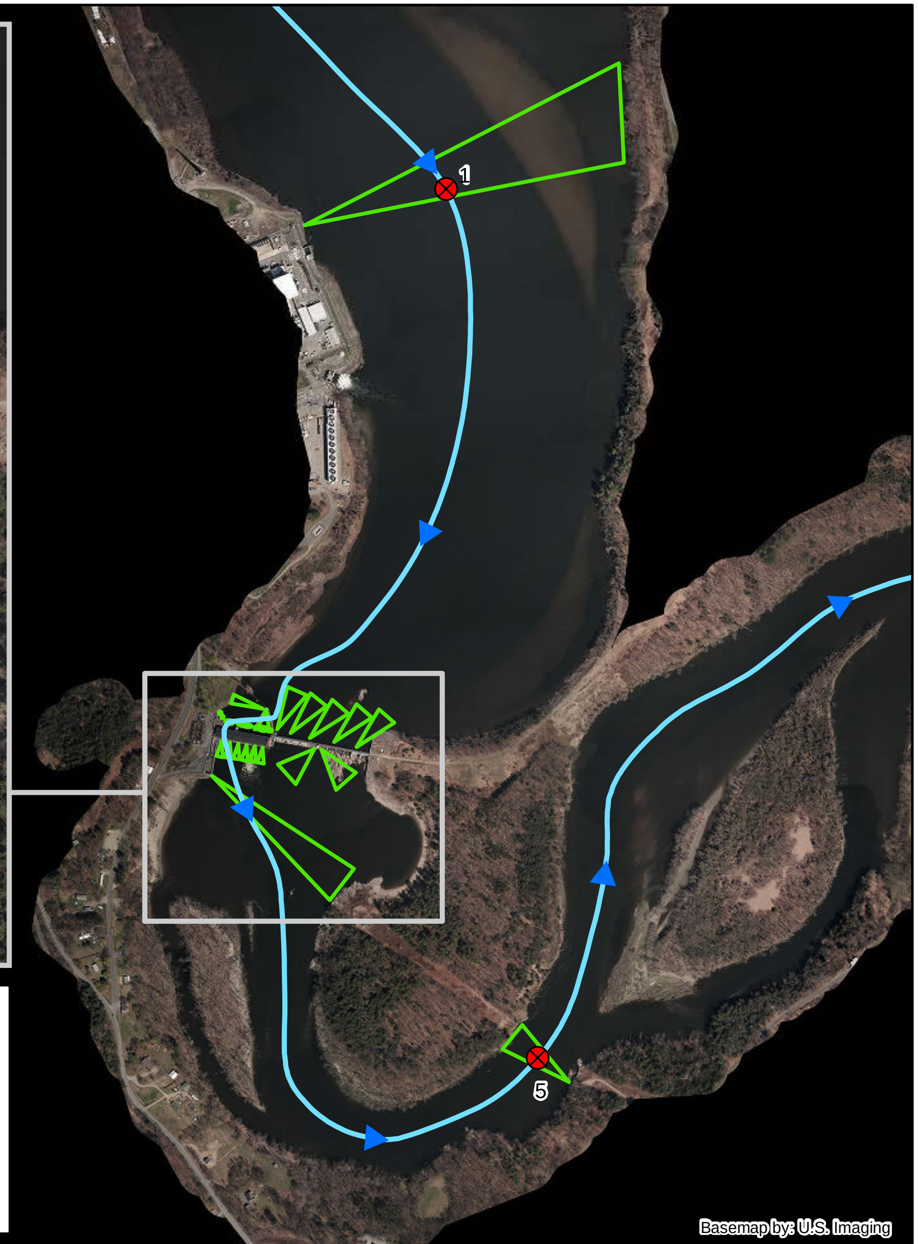


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/10/2015 | 1:16 |
| 2 | 11/10/2015 | 18:57 |
| 3 | 11/10/2015 | 19:02 |
| 4 | 11/10/2015 | 19:02 |
| 5 | 11/10/2015 | 19:18 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-152 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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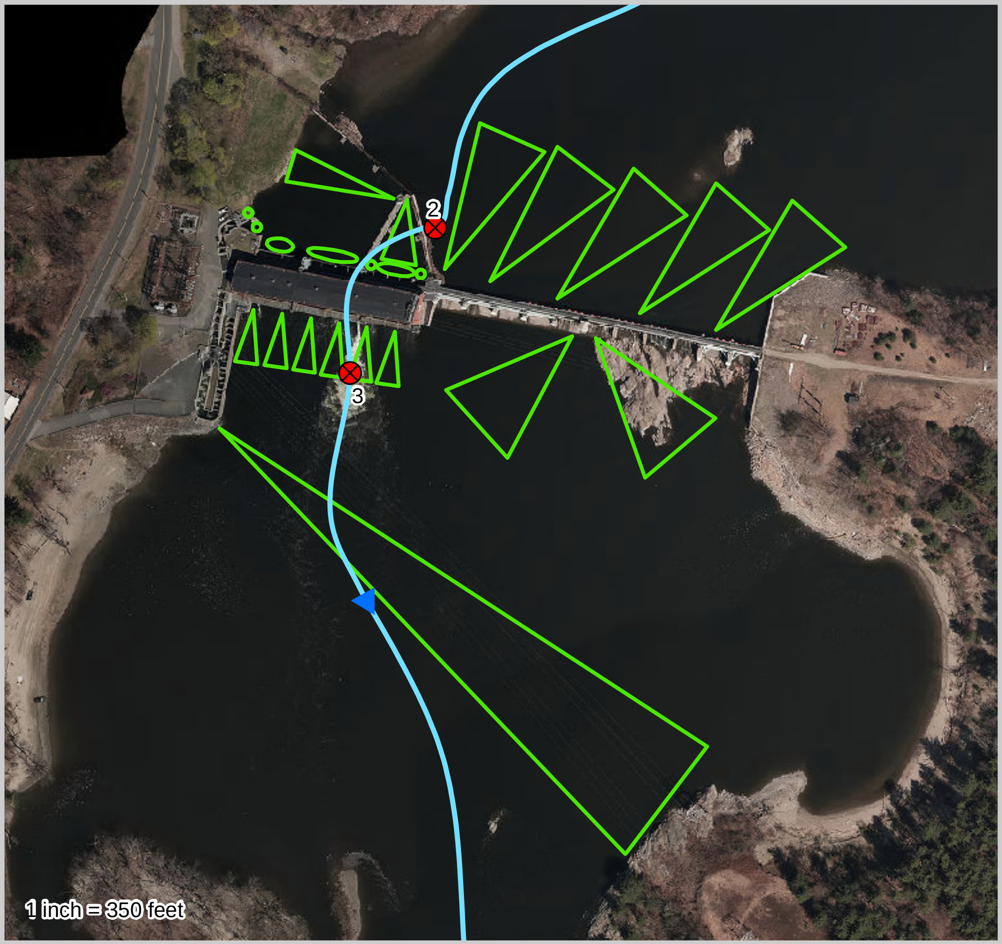


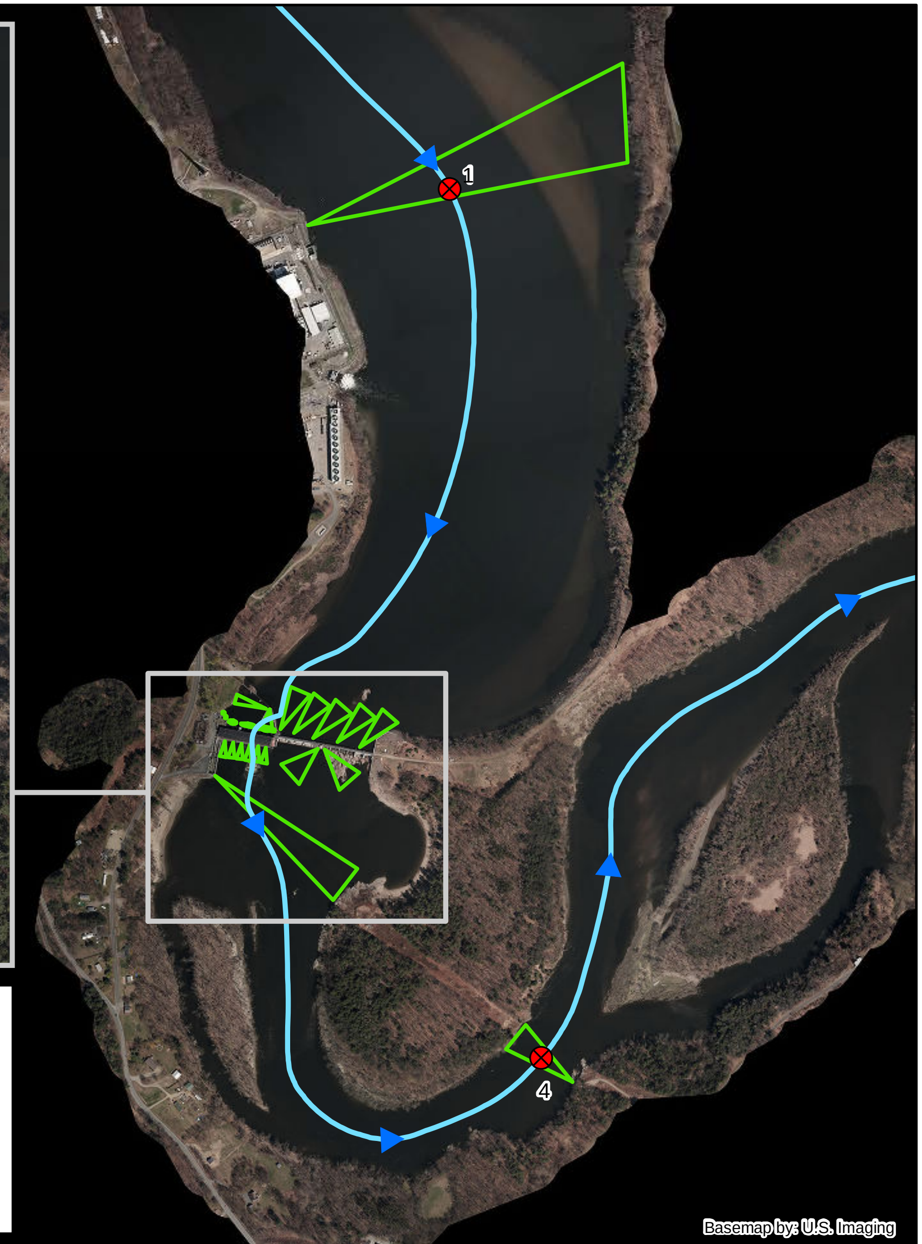


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/11/2015 | 1:45 |
| 2 | 11/11/2015 | 20:16 |
| 3 | 11/11/2015 | 20:16 |
| 4 | 11/11/2015 | 20:28 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-153 (T1)**

Release: Norwich, VT
Date Released: 11/05/2015
Time Released: 17:05

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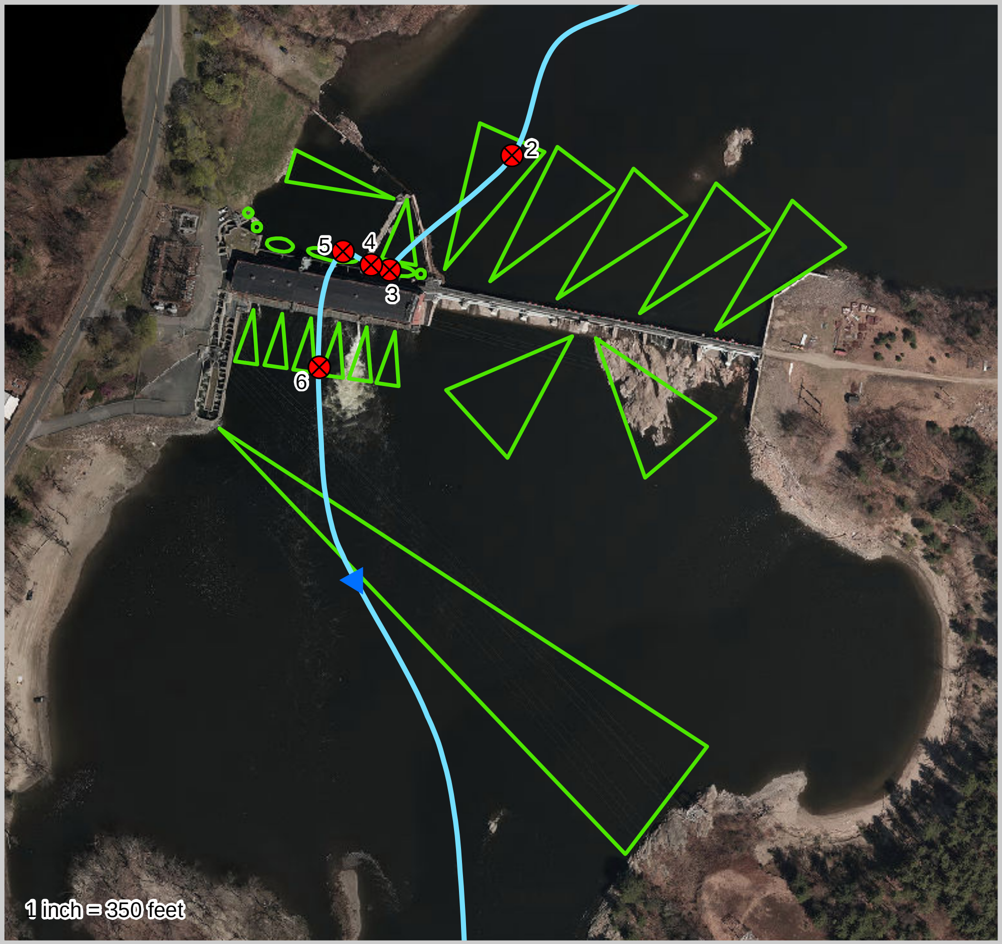


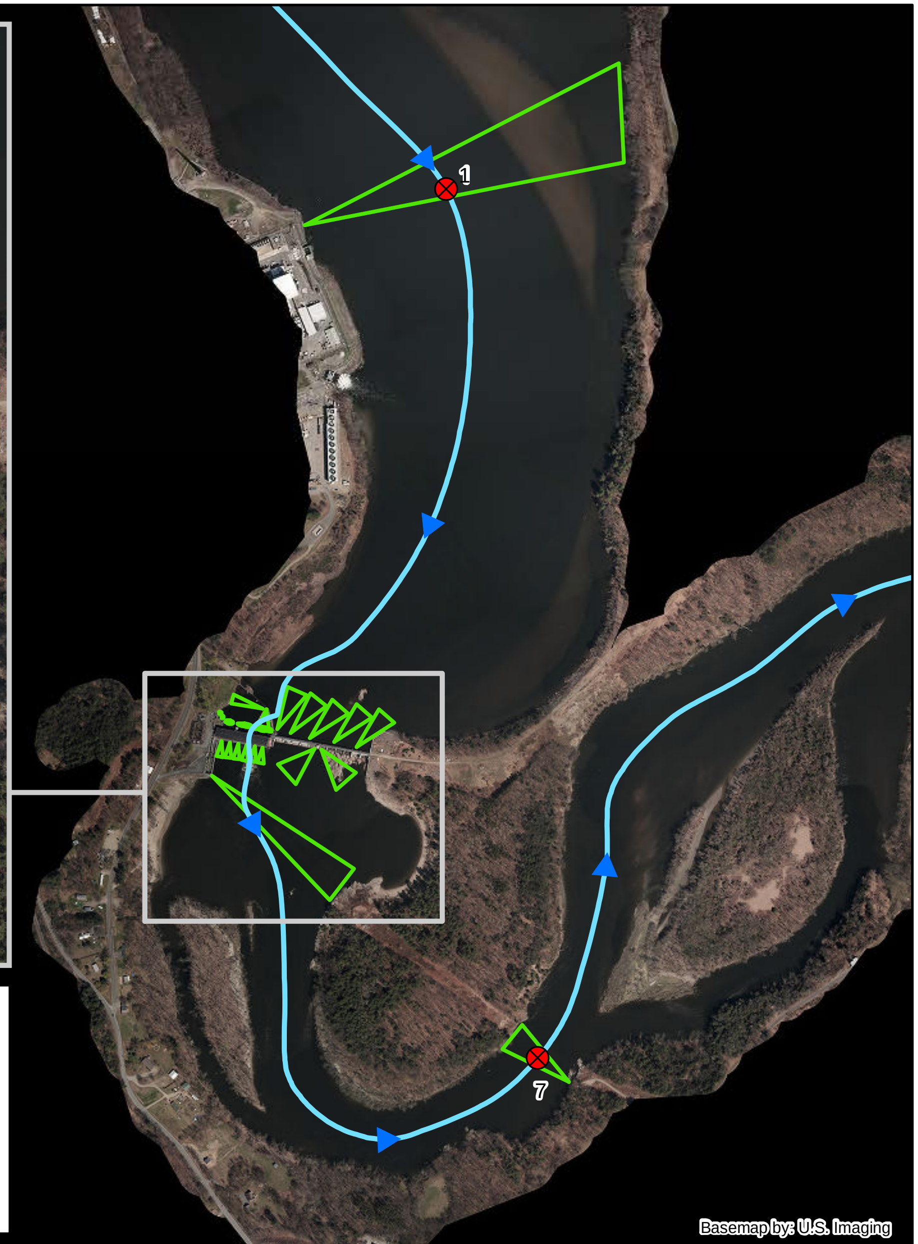


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/6/2015 | 0:00 | 6 | 11/7/2015 | 20:34 |
| 2 | 11/7/2015 | 19:44 | 7 | 11/7/2015 | 20:51 |
| 3 | 11/7/2015 | 20:31 | | | |
| 4 | 11/7/2015 | 20:34 | | | |
| 5 | 11/7/2015 | 20:34 | | | |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-158 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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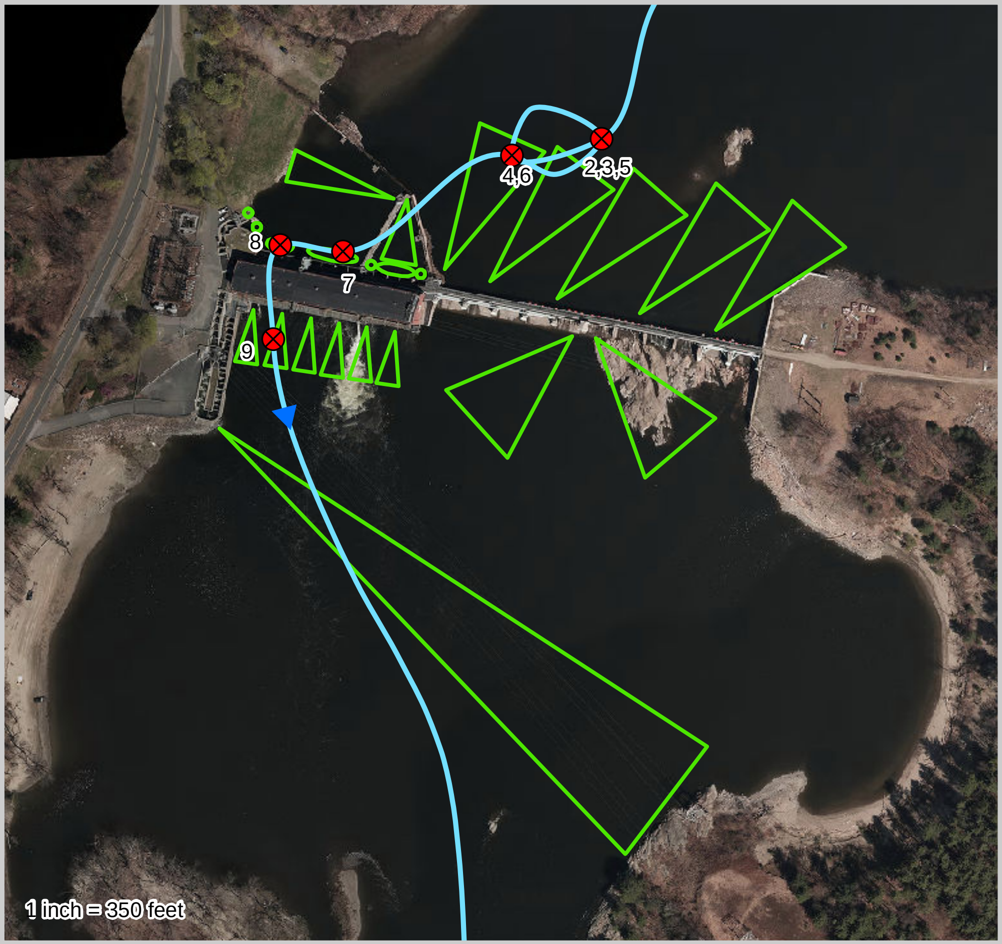


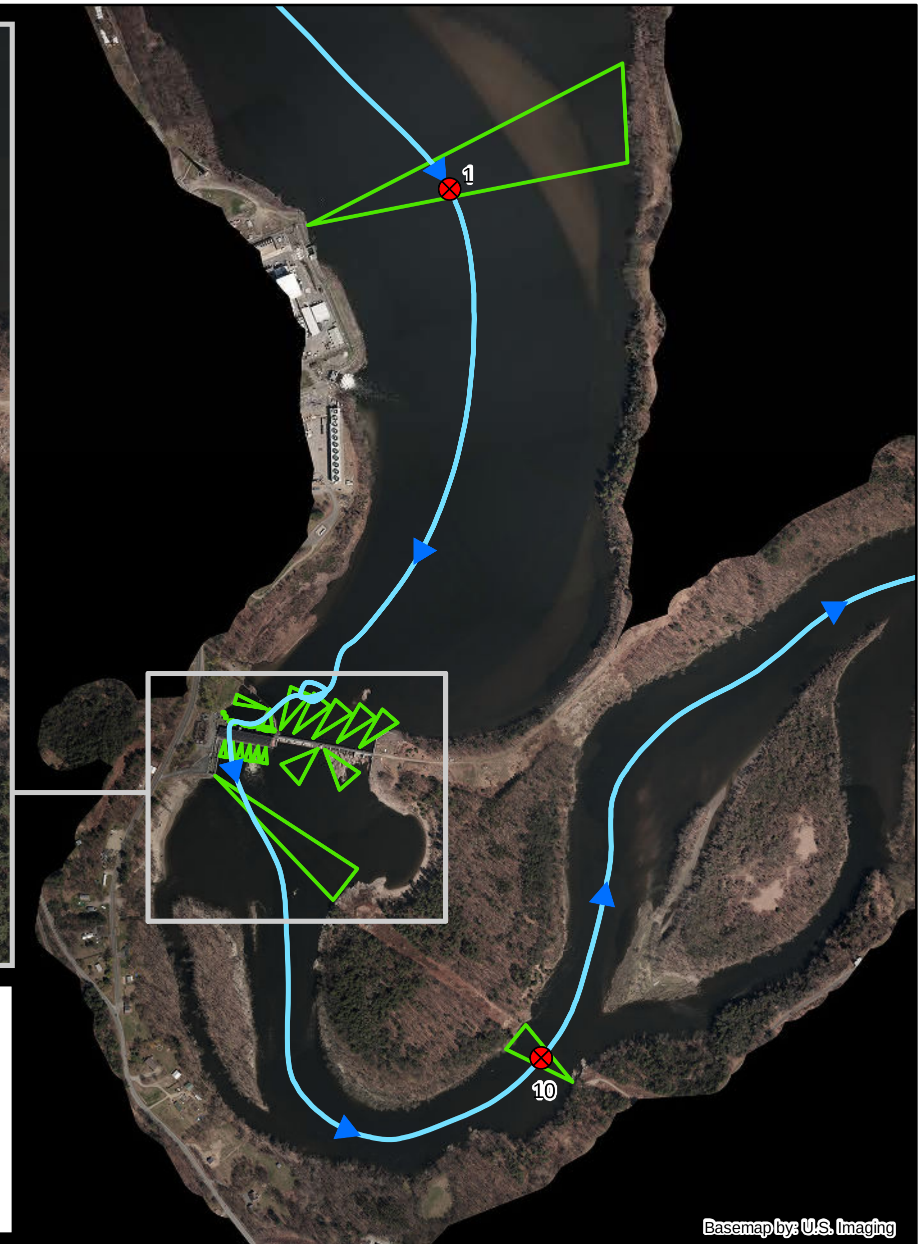


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/3/2015 | 15:17 | 6 | 11/3/2015 | 17:13 |
| 2 | 11/3/2015 | 16:27 | 7 | 11/3/2015 | 17:19 |
| 3 | 11/3/2015 | 16:46 | 8 | 11/3/2015 | 17:20 |
| 4 | 11/3/2015 | 16:58 | 9 | 11/3/2015 | 17:22 |
| 5 | 11/3/2015 | 17:01 | 10 | 11/3/2015 | 17:39 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-159 (T1)**

Release: Norwich, VT
Date Released: 10/29/2015
Time Released: 18:43

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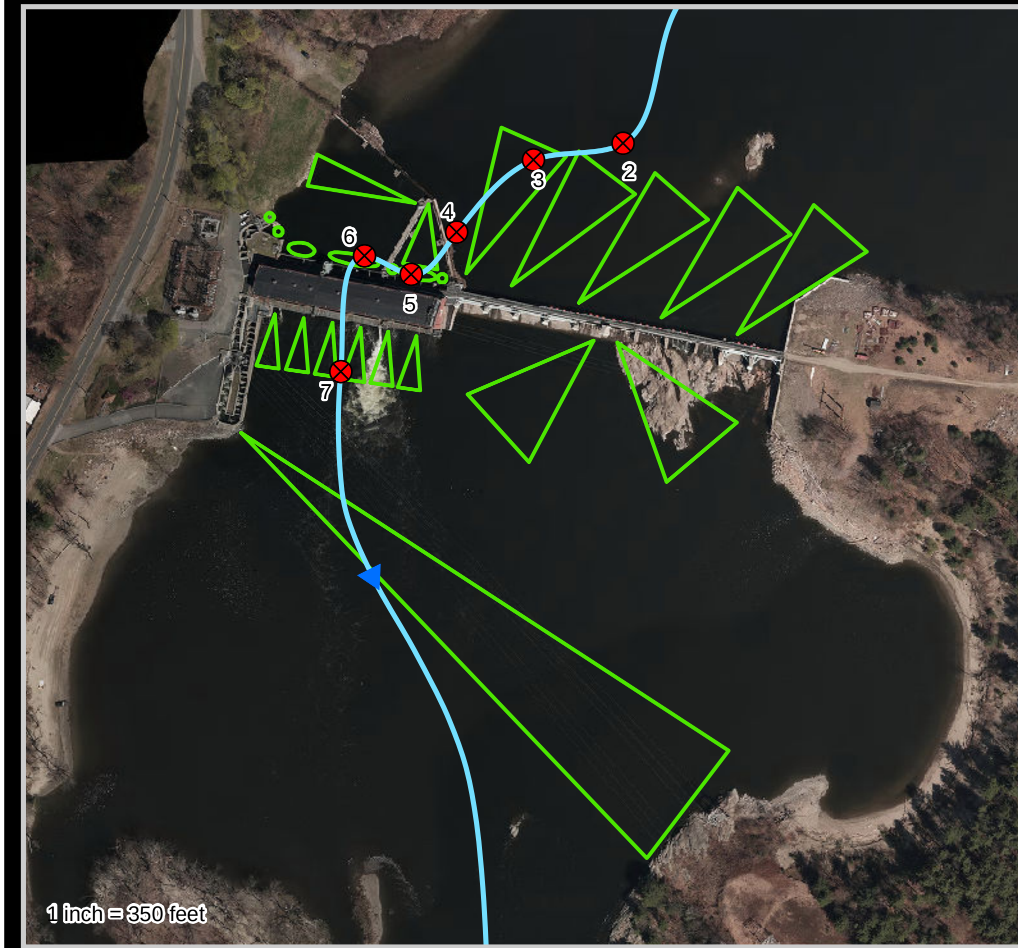


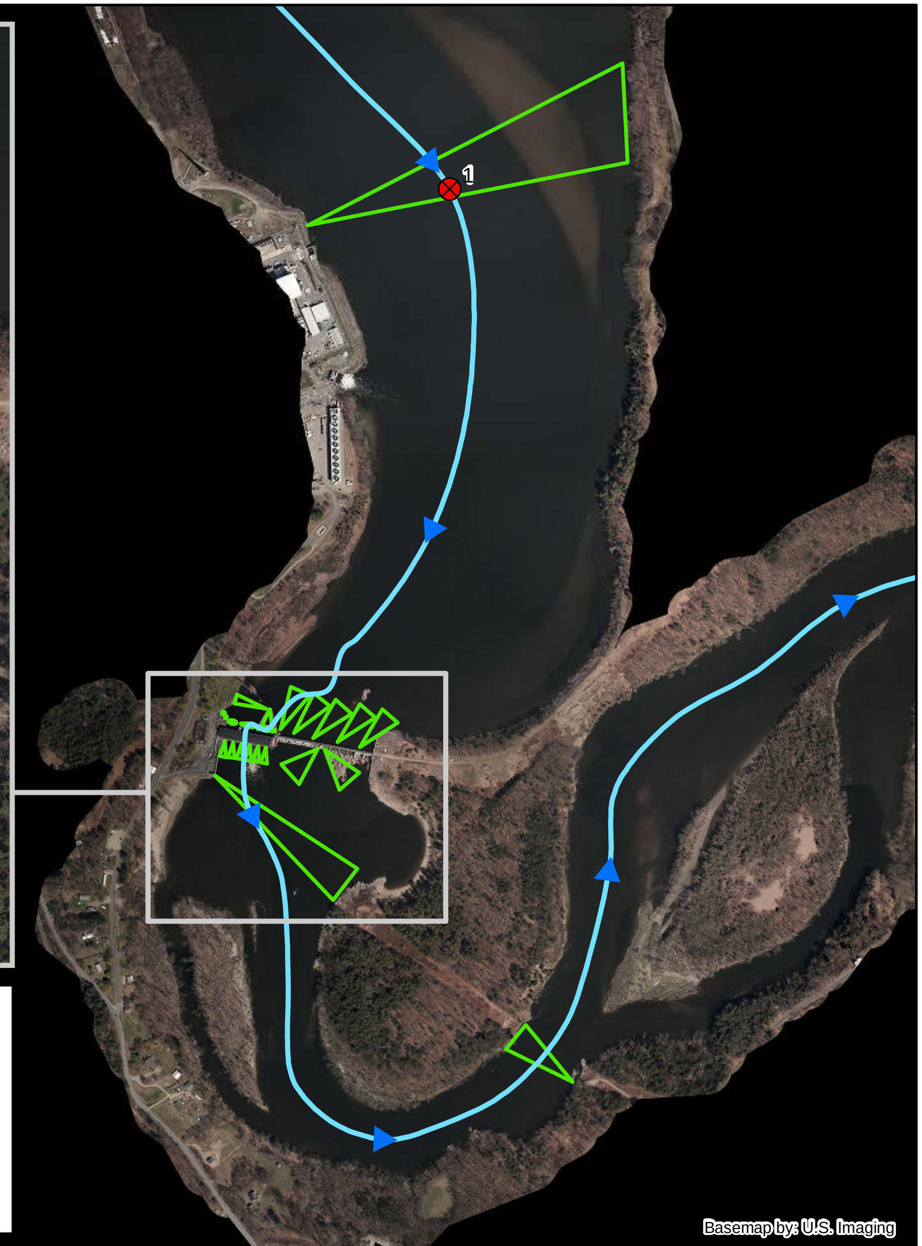


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/2/2015 | 19:54 | 6 | 11/2/2015 | 20:39 |
| 2 | 11/2/2015 | 20:29 | 7 | 11/2/2015 | 20:56 |
| 3 | 11/2/2015 | 20:34 | | | |
| 4 | 11/2/2015 | 20:35 | | | |
| 5 | 11/2/2015 | 20:36 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-167 (T1)**
Release: Riverside Industrial Complex
Brattleboro, VT
Date Released: 10/31/2015
Time Released: 13:40

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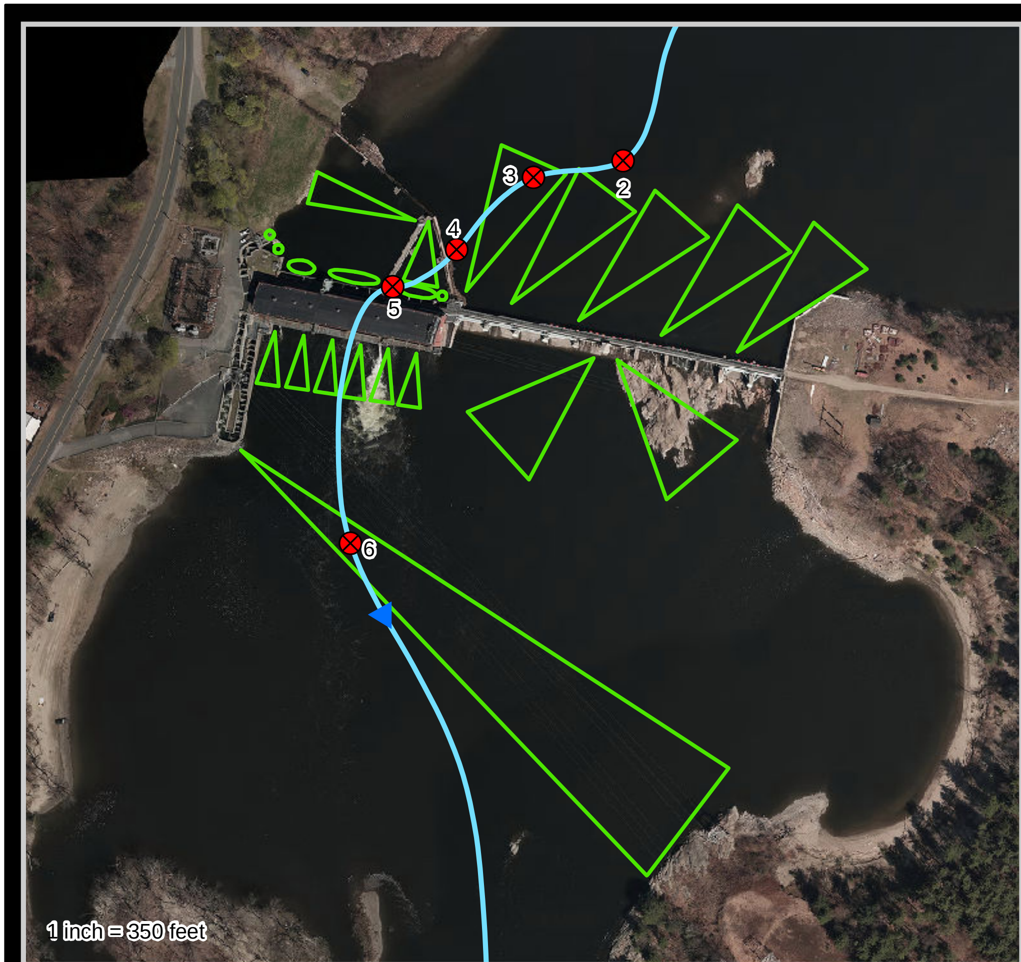


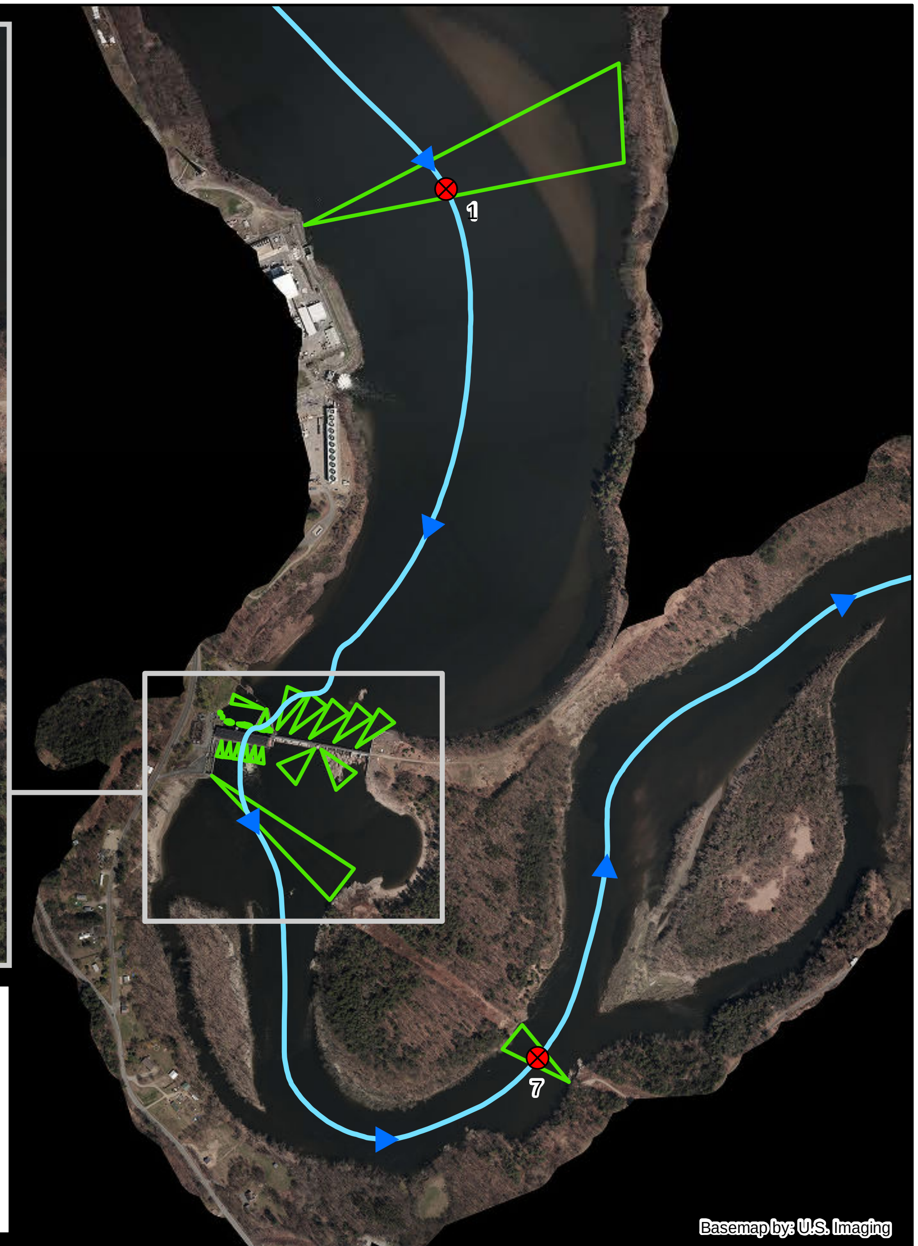


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/1/2015 | 3:20 | 6 | 11/1/2015 | 4:33 |
| 2 | 11/1/2015 | 4:13 | 7 | 11/1/2015 | 4:45 |
| 3 | 11/1/2015 | 4:22 | | | |
| 4 | 11/1/2015 | 4:26 | | | |
| 5 | 11/1/2015 | 4:33 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-170 (T1)**

Release: Vernon
Date Released: 10/31/2015
Time Released: 13:40

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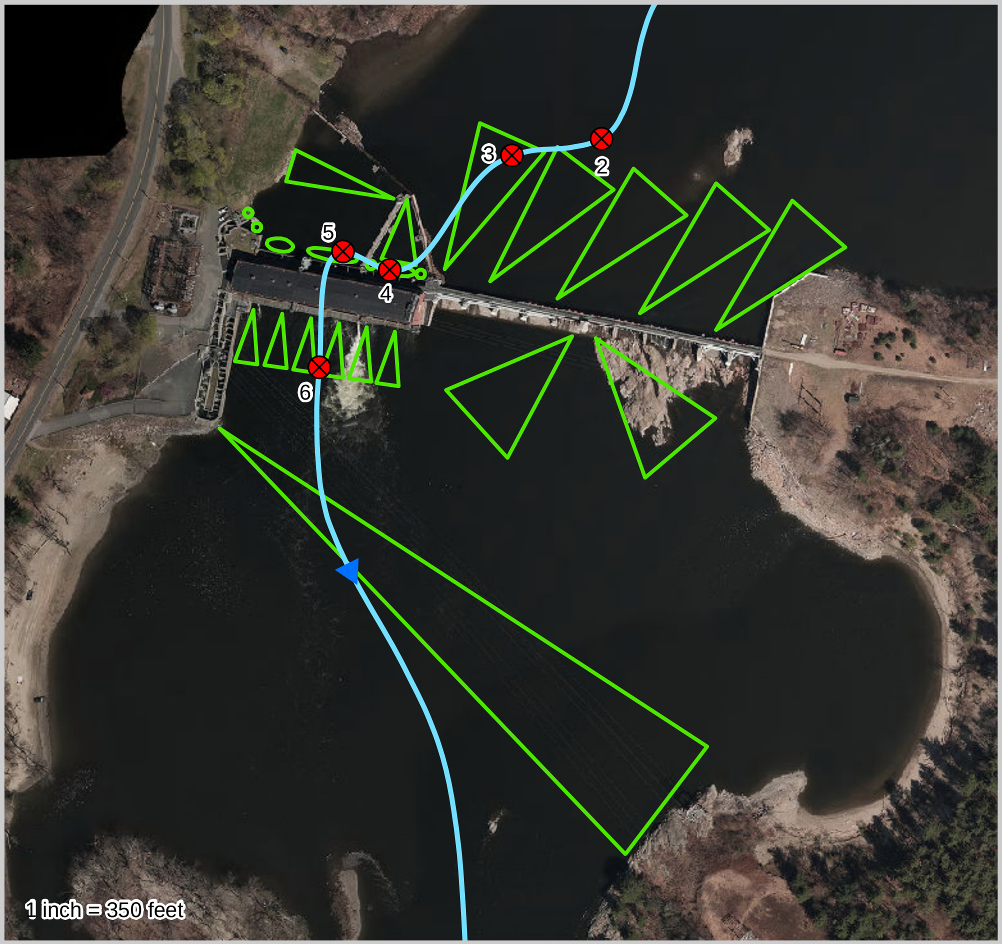


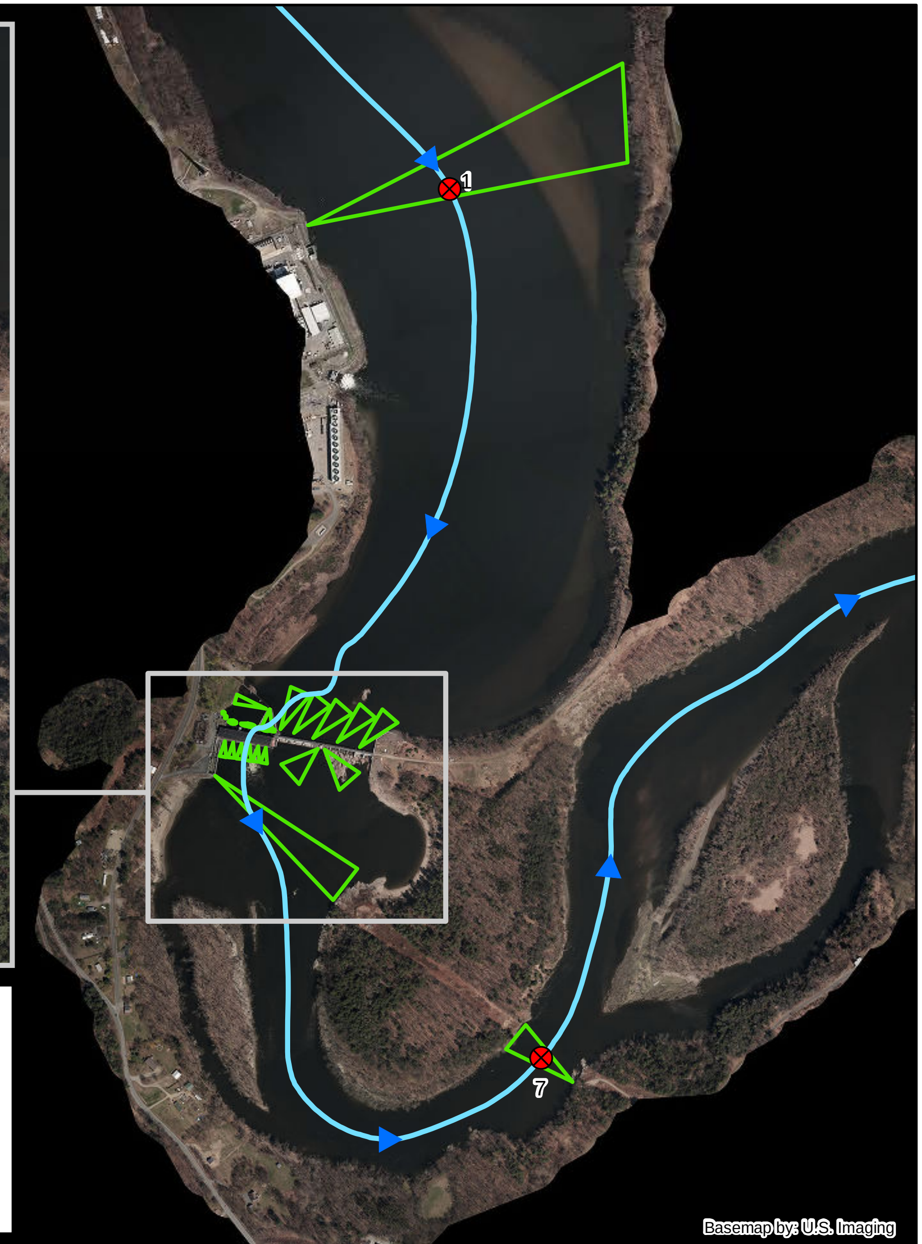


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/4/2015 | 19:44 | 6 | 11/4/2015 | 20:26 |
| 2 | 11/4/2015 | 20:12 | 7 | 11/5/2015 | 3:41 |
| 3 | 11/4/2015 | 20:19 | | | |
| 4 | 11/4/2015 | 20:20 | | | |
| 5 | 11/4/2015 | 20:21 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-178 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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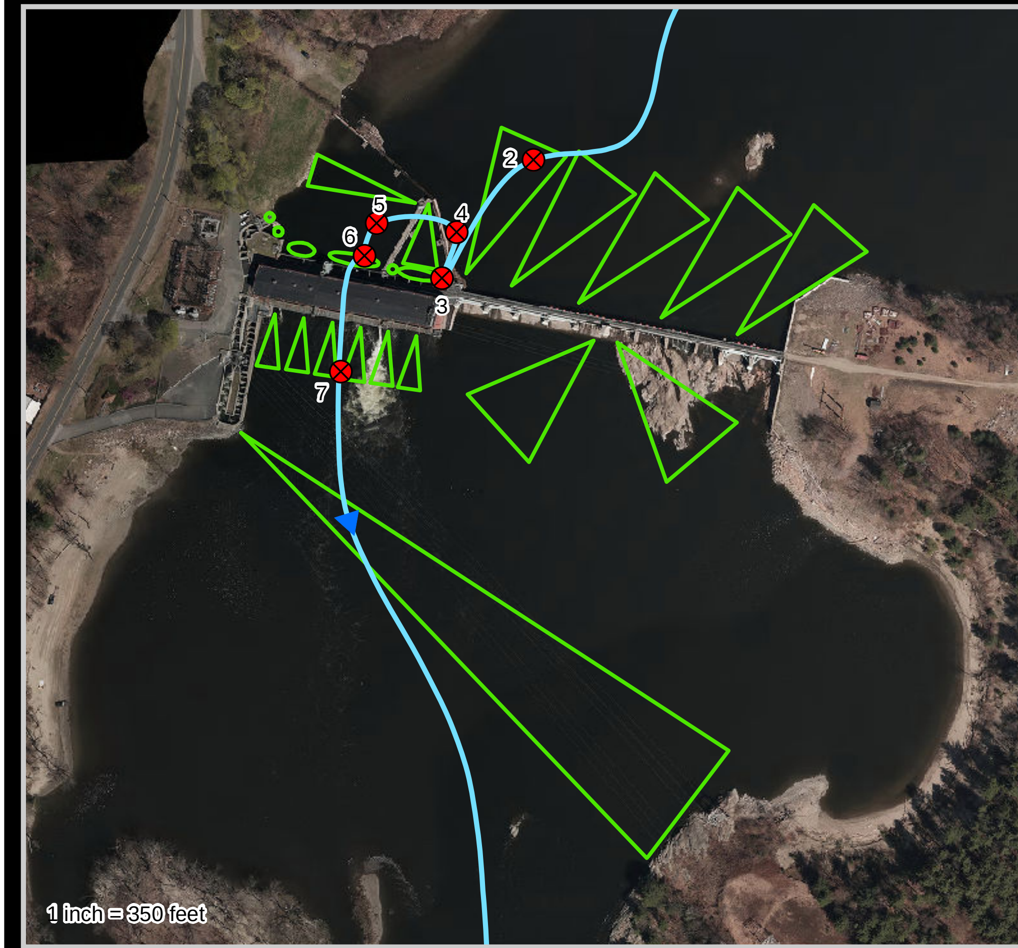


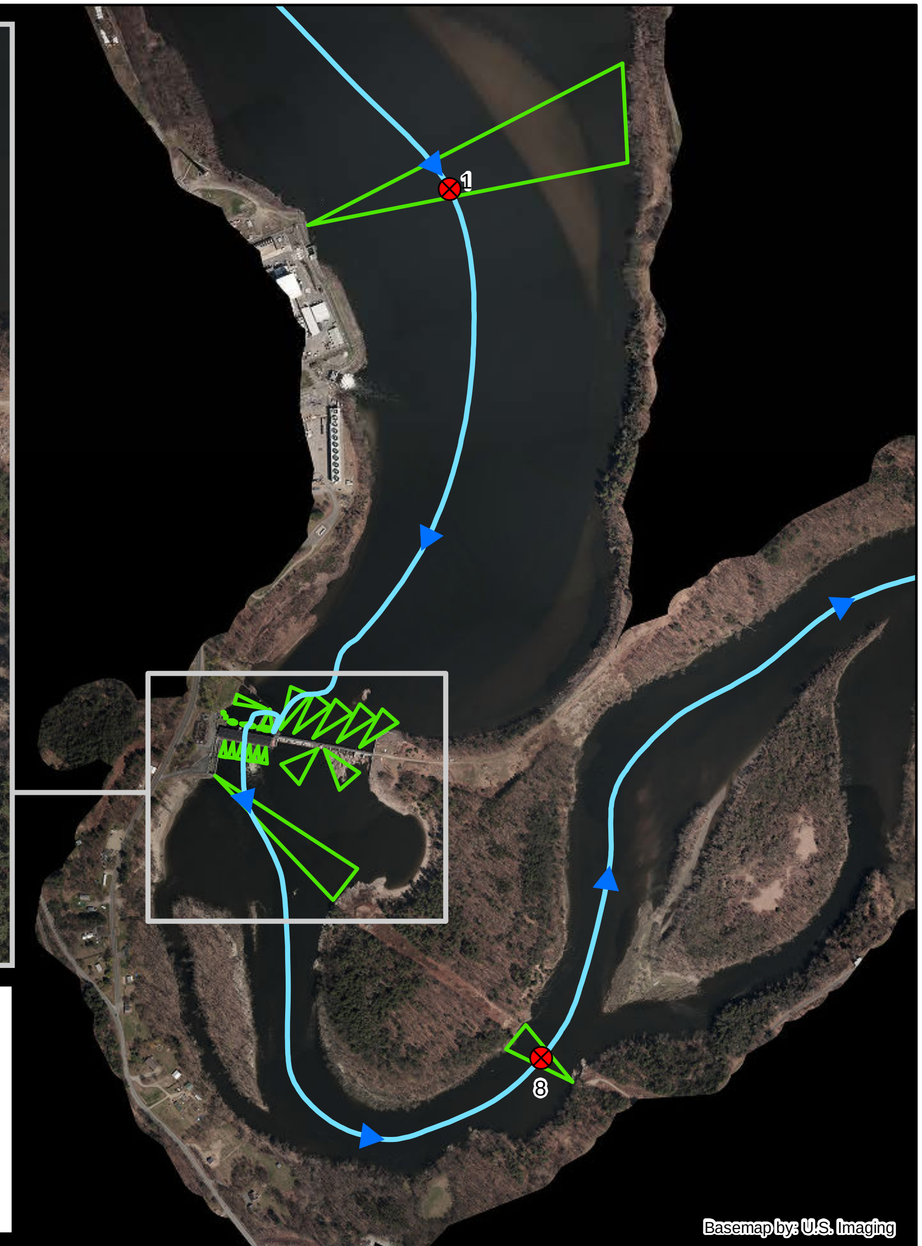


| Timetable | | | | | |
|---|---|---|---|---|---|
| Detection | Date | Time | Detection | Date | Time |
| 1 | 11/9/2015 | 4:31 | 6 | 11/10/2015 | 22:11 |
| 2 | 11/10/2015 | 21:52 | 7 | 11/10/2015 | 22:11 |
| 3 | 11/10/2015 | 21:58 | 8 | 11/10/2015 | 23:53 |
| 4 | 11/10/2015 | 22:03 | | | |
| 5 | 11/10/2015 | 22:05 | | | |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-180 (T1)**

Release: Herricks Cove, VT
Date Released: 10/31/2015
Time Released: 18:22

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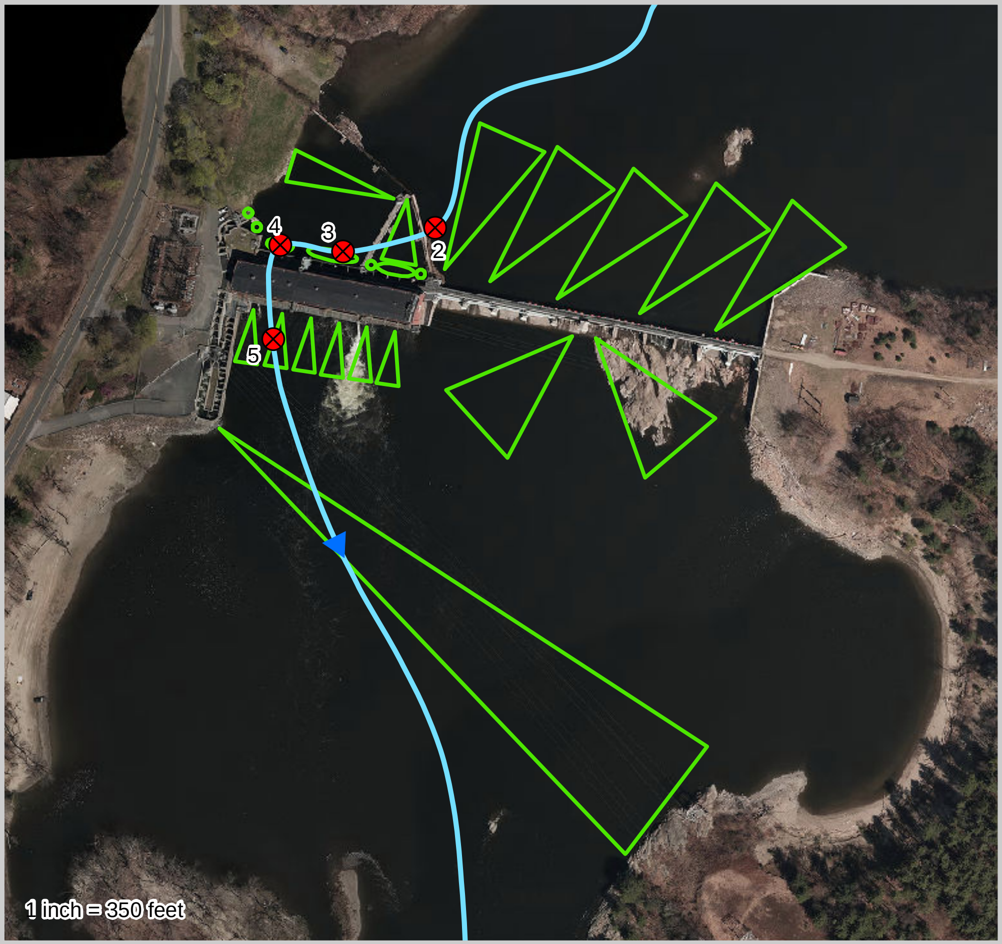


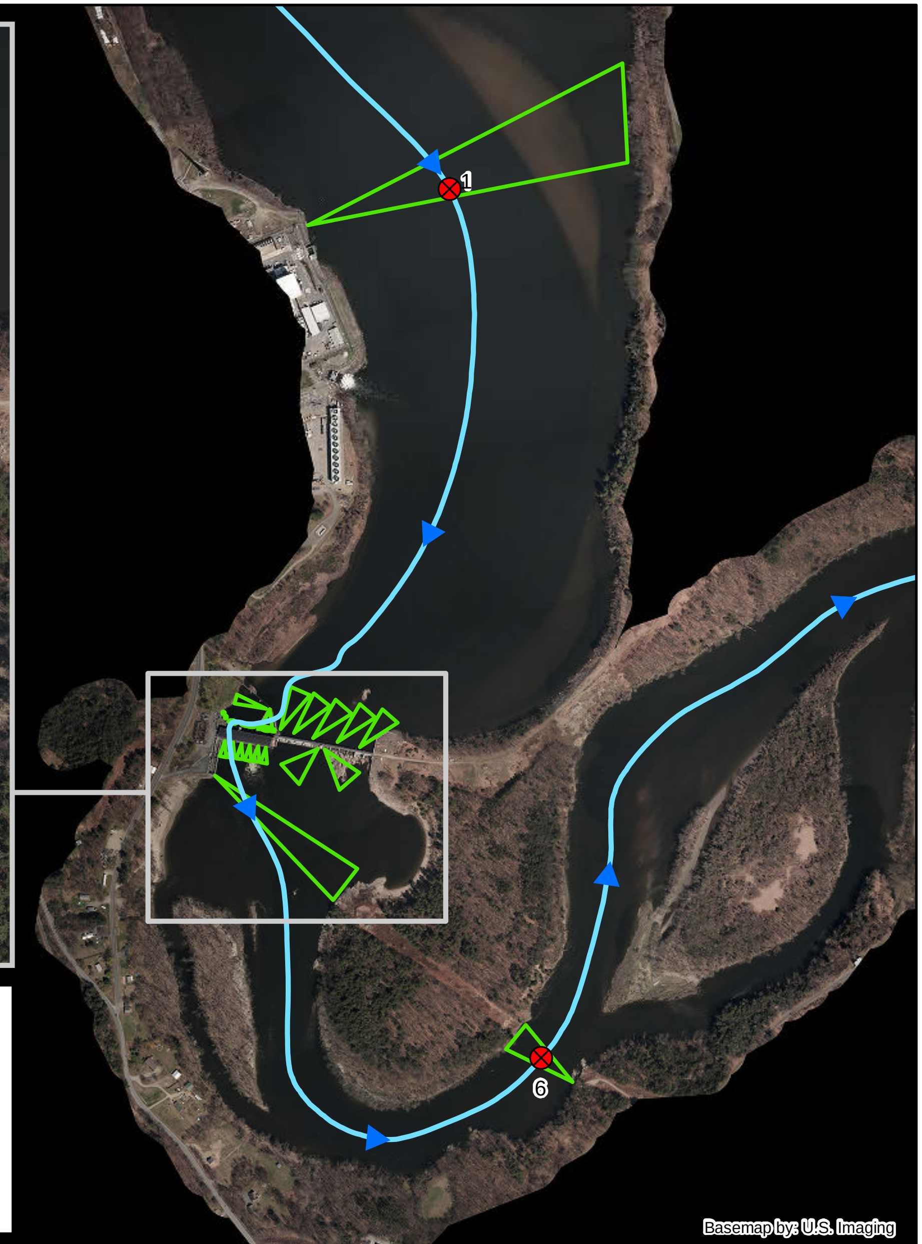


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/6/2015 | 18:22 |
| 2 | 11/6/2015 | 19:11 |
| 3 | 11/6/2015 | 19:13 |
| 4 | 11/6/2015 | 19:14 |
| 5 | 11/6/2015 | 19:15 |
| 6 | 11/6/2015 | 20:30 |

**Site Features**

Detection

Fish Path

Reciever Zones

**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-188 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21


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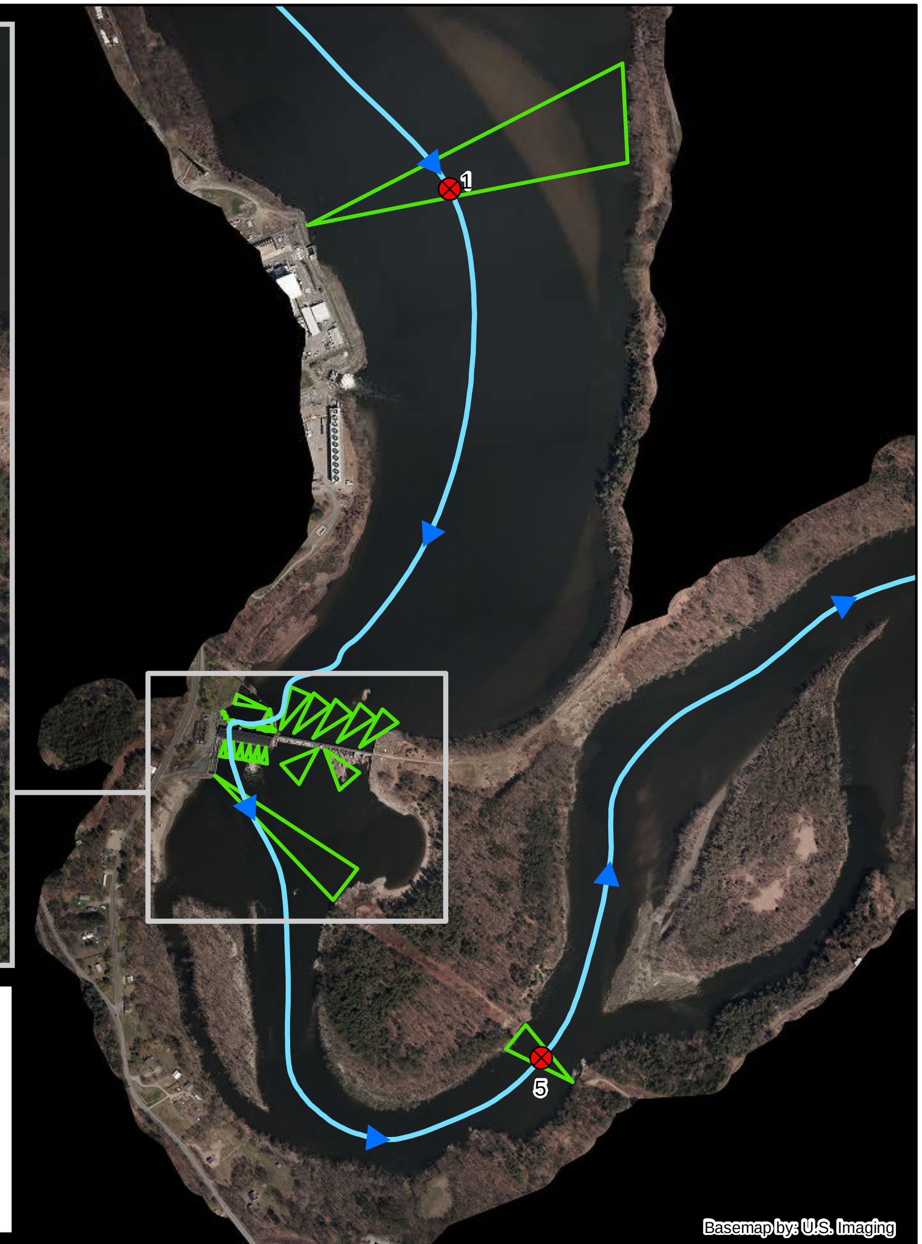


| Timetable | | |
|---|---|---|
| Detection | Date | Time |
| 1 | 11/7/2015 | 2:05 |
| 2 | 11/7/2015 | 18:18 |
| 3 | 11/7/2015 | 18:18 |
| 4 | 11/7/2015 | 18:21 |
| 5 | 11/7/2015 | 19:06 |

**Site Features**

- Detection
- Fish Path
- Reciever Zones

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**TransCanada Hydro Northeast Inc.**
**ILP Study 19**
**Vernon Dam**

N

1 in = 1,200 feet

0 600 1,200 2,400 Feet

**Study 19 Fish Number: 38-189 (T1)**

Release: Norwich, VT
Date Released: 10/31/2015
Time Released: 19:21

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