# Williams Dam Flooding Analysis

## Londonderry, Vermont

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SLR Project No.: 146.20433.00002

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Making Sustainability Happen

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# 1.0 Introduction

## 1.1 Purpose

The Town of Londonderry has retained SLR Consulting (SLR) to perform a flood analysis of Williams Dam and the surrounding area along the West River in Londonderry, Vermont. The goal of this project is to provide the Town with information to assist with the decision to remove, repair, or replace the dam. Specifically, we will provide results of field assessment and hydraulic modeling to show the influence of dam removal. There is a long history of flooding at the dam and along the West River in Londonderry. In 2023, VT Route 11 and the area adjacent to the dam flooded in July and December. The analysis presented in this report builds upon past studies (D&K, 2022; NRCS, 2022) (Appendix A and B).

## 1.2 Project Location

Williams Dam is located on the West River 20 feet downstream of the Vermont Route 11 Bridge in Londonderry (Figure 1 and Figure 2).

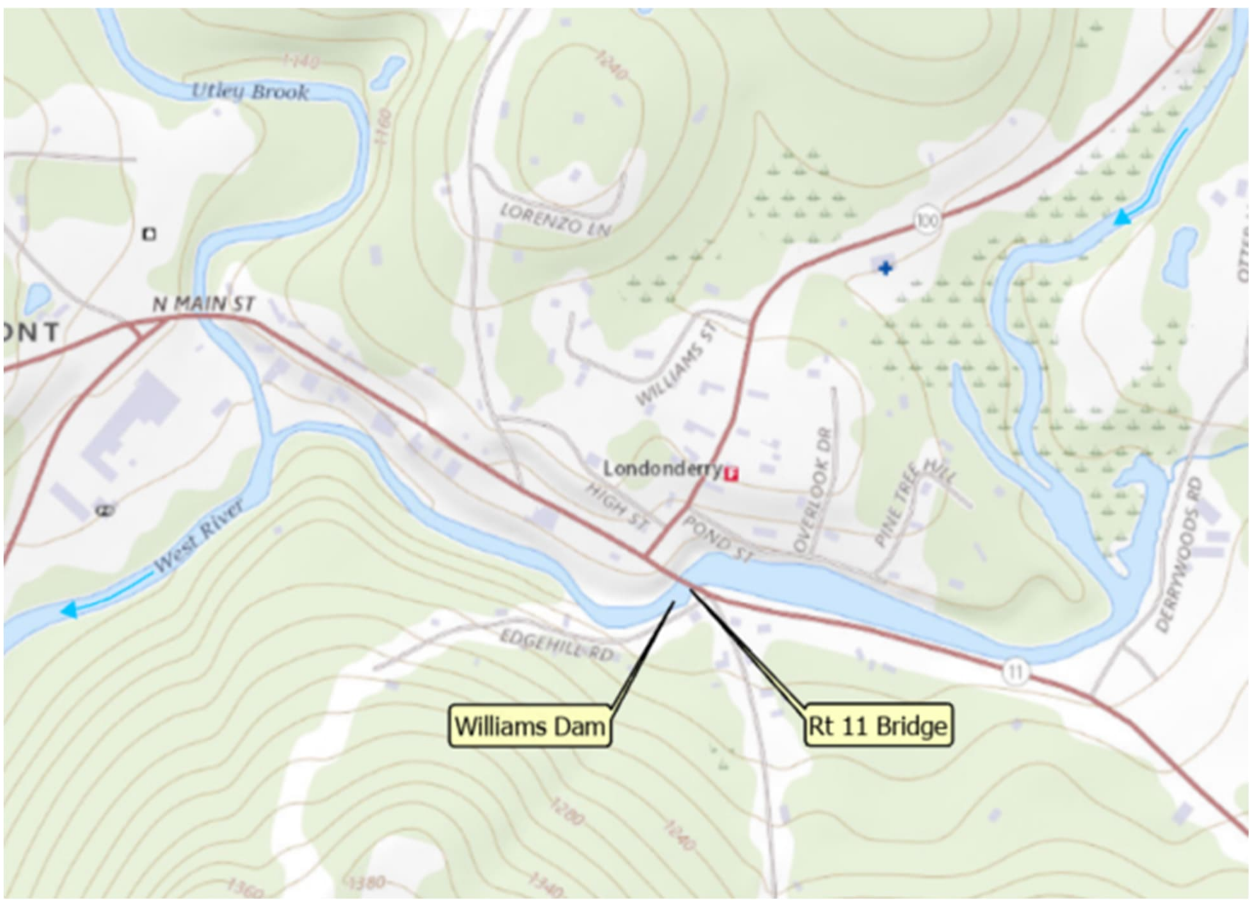


**Figure 1: Topographic Location Map**


**Figure 2: Location Map with Aerial**

## 1.3 Scope

The scope of work for this study includes the following tasks.

- Review of past studies
- Stream assessment of the West River in the project area
- Supplemental survey of the river channel
- 2-Dimensional hydraulic modeling
- Dam removal alternatives analysis
- Reporting

# 2.0 Williams Dam

Williams Dam (VT ID #115.01) is a 17-foot-tall, 90-foot-long, run-of-river dam composed of stone masonry capped with concrete. The dam was originally constructed in the late 1800s to provide hydropower for a nearby machine shop. Based on the Vermont Dam Inventory, the normal surface area is 9.3 acres and the normal storage volume is 24.2 acre-feet. The maximum storage is 97.1 acre-feet at the top of the dam.

The primary spillway is a broad crested weir that is 66 feet long. The weir extends between the south (i.e., river left looking downstream) abutment and the concrete gatehouse along the north abutment. The gatehouse contains a low-level outlet that consists of a 6-foot-diameter corrugated metal pipe (CMP) with a vertical sluicegate at the inlet and a concrete flume at the outlet. A concrete training wall extends 15 feet upstream from the gate house, tying into the north abutment of the Route 11 Bridge. The south abutment is in direct contact with a bedrock outcropping.

In August 2015, the Vermont Dam Safety Program (VTDSP) performed an inspection of Williams Dam and rated the dam's overall conditions as Poor due to numerous structural deficiencies (Appendix C). VTDSP advised the Town of Londonderry to retain an engineering firm to perform a detailed assessment of Williams Dam and provide recommendations to address the deficiencies. DuBois & King, Inc. (D&K) was hired in 2021 to inspect the dam, perform a hydraulic analysis, and evaluate several alternatives for addressing the dam's deficiencies. D&K identified several other issues at the dam such as leakage through the bedrock and around the south abutment leading to erosion of the riprap along Edge Hill Road; continued deterioration of the concrete throughout the structure; and insufficient hydraulic capacity of the spillway.

In 2022, VTDSP performed a dam breach analysis for Williams Dam to evaluate the risks of dam failure (Appendix D). Based on the results of the analysis the hazard classification for Williams Dam was changed from Low to Significant. The hazard classification for Williams Dam was increased because the dam breach analysis showed that the dam could potentially impact public infrastructure, impact private property, lead to economic loss, lead to environmental damage, and disrupt lifeline facilities if the structure were to fail. Based on VT dam safety regulations for Significant hazard dams, Williams Dam is required to convey the 1,000-year flood without overtopping. According to modeling results from the D&K analysis, the dam currently does not have the hydraulic capacity to pass the 50-year flood.

SLR visited the project site December 21, 2023 and May 15, 2024 to verify information and collect supplemental field data. The deteriorated condition persists at the dam. A large tree was resting on the spillway. Sediment probing and close-up view of the dam from a canoe downstream illustrates seepage on the north side of the structure and a lower channel on the south side (Figure 3). The seepage is reported to vary with flow and time since the last large flood. The cross section below the seepage represents a potential bedrock shape and elevation that would remain if the dam were removed and is used in the hydraulic modeling to evaluate the effects of dam removal. Similar confined bedrock channel sections exist just downstream of the dam on the West River (Figure 4).

**Figure 3: Williams Dam (Looking Upstream) and the Potential Underlying Bedrock Channel Section (Yellow Line)**

**Figure 4: Confined Bedrock Channel Section 420 Feet Downstream of Williams Dam (Looking Downstream)**

# 3.0 VT Route 11 Bridge

The Vermont Route 11 Bridge is located approximately 20 feet upstream of Williams Dam (Figure 5). A bridge has crossed the West River at this location for over 100 years, and over the years the bridge had been replaced several times due to flood damages. The current bridge was built in 1995. The total span is 88 feet with a center pier. The dam and bridge are structurally connected by the concrete training wall that extends between the south abutments of each structure. The hydraulic model analysis by D&K suggests that the Route 11 Bridge constricts flows causing flooding upstream along Route 11 during the 10-year flood. During larger floods such as the 50-year flood, Williams Dam backwaters the Route 11 Bridge causing the bridge to overtop.

**Figure 5: VT Route 11 Bridge (Looking Upstream from the Dam)**

The bridge is not only a severe constriction of the West River channel but it also is hydraulically inefficient due to its poor alignment. Review of historic photos of the bridges in this location illustrate increasing fill on the bridge approaches that has narrowed the channel, the introduction of a center pier that has removed hydraulic capacity, and increasing skew relative to the river channel to presumably improve the highway alignment. The current bridge increases flood risks.

The bottom of the concrete bridge beams slope from downstream to upstream resulting in a smaller hydraulic opening at the upstream face of the bridge than at the downstream face of the bridge. This slope further reduces the hydraulic capacity of the bridge. The combination of the narrowed upstream bridge opening and the backing up of water through the bridge from the downstream due to Williams Dam, the combined structures limit flood capacity and increase local flood risks. Model runs with the dam removed and dam and bridge removed (i.e., natural conditions) were performed to evaluate the effect on flood patterns due to the structures.

The VT Route 11 Bridge is founded on channel-spanning bedrock at an average elevation of 1130 feet NAVD88 (Appendix E). This elevation aligns with recent sediment probing data and observations around the dam indicating the likely bottom of channel if the dam were removed. Note that the elevations in the VTrans bridge plans are given in the vertical datum of NGVD29 so need to be converted to the current vertical datum of NAVD88 for use in this hydraulic study (NAVD88 = NGVD29 – 0.4).

# 4.0 Flood History

Major floods have taken place in Londonderry over the past century including December 2023, July 2023, August 2011, June 1973, and November 1927. During the July 2023 flood, water spilled out of the West River onto the floodplain, overtopped the highway, and damaged buildings (Figure 6). The bridge backwatered by the dam filled during the flood and water was diverted towards the intersection of VT Routes 11 and 100.

**Figure 6: July 2023 Flood (Looking Downstream) (Source: Town of Londonderry)**

Review of flood photos provided by the Town illustrate flooding took place upstream and downstream of the dam and bridge. The information suggests that the flood was too large to fit in the valley without impacting property and infrastructure. Modeling will be used to verify this, and if the changes in flood storage associated with dam removal and floodplain restoration at the Utley Brook confluence will reduce flooding.

The USGS Flood Event Viewer (Flood Event Viewer (usgs.gov)) has documented high water marks in the Town from the July 2023 flooding (Figure 7) that will be used to validate the hydraulic model.

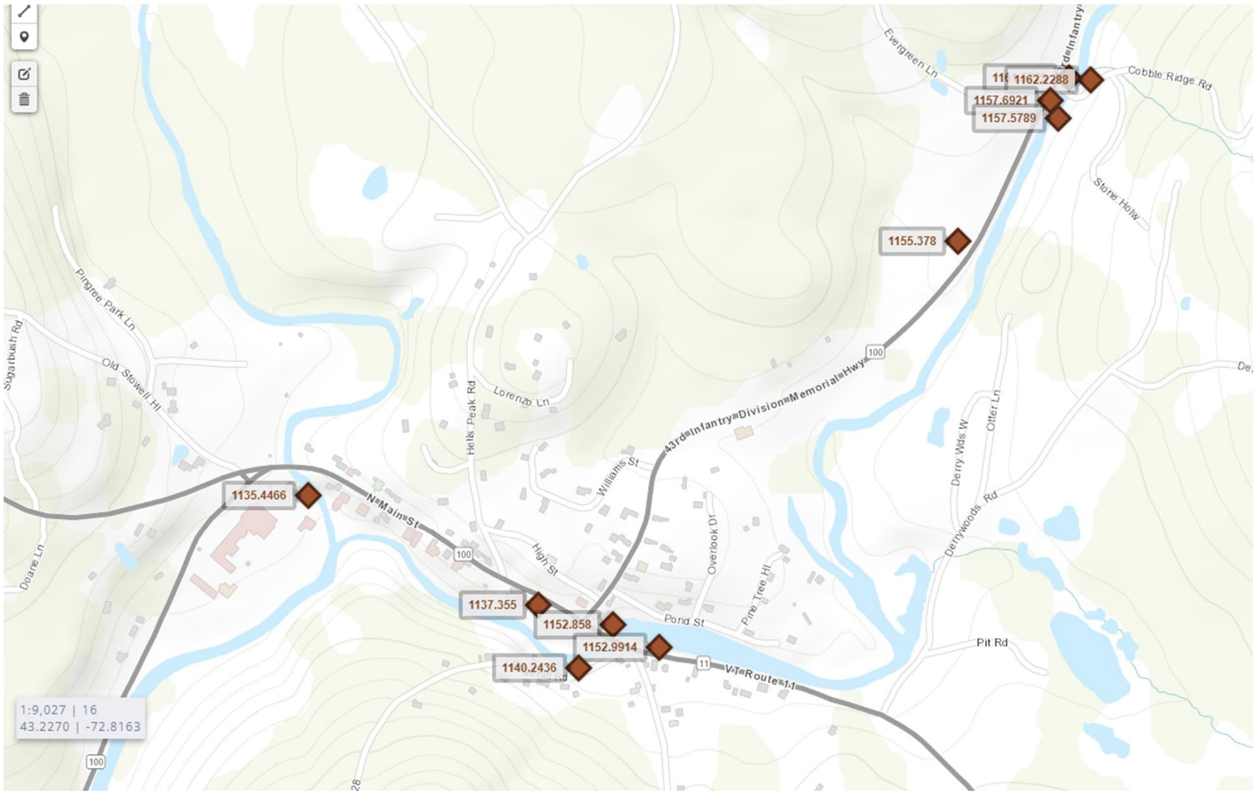


**Figure 7: High Water Marks from the July 2023 Flood (Source: USGS)**

# 5.0 Channel Morphology

## 5.1 The West River

The West River forms on the western slopes of South Mountain in Mount Holly, Vermont and flows south through Weston and Londonderry, eventually discharging into the Connecticut River in Brattleboro. The mountainous headwaters of the river transition form an average slope of almost 10% to a low slope of around 0.3% near Williams Dam (Figure 8). Upstream of Williams Dam, the river is moderately sinuous and has an estimated bankfull channel width of 71 feet (Olson, 2014). Downstream of the dam, the West River straightens and flows parallel to VT Route 100 through a narrow valley. There are several other dams located along the West River, including Weston Mill Dam, a small run-of-river dam located 7 miles upstream in the in the Town of Weston, and Ball Mountain Dam, a large flood control dam located 10 miles downstream in the Town of Jamaica (Figure 8).

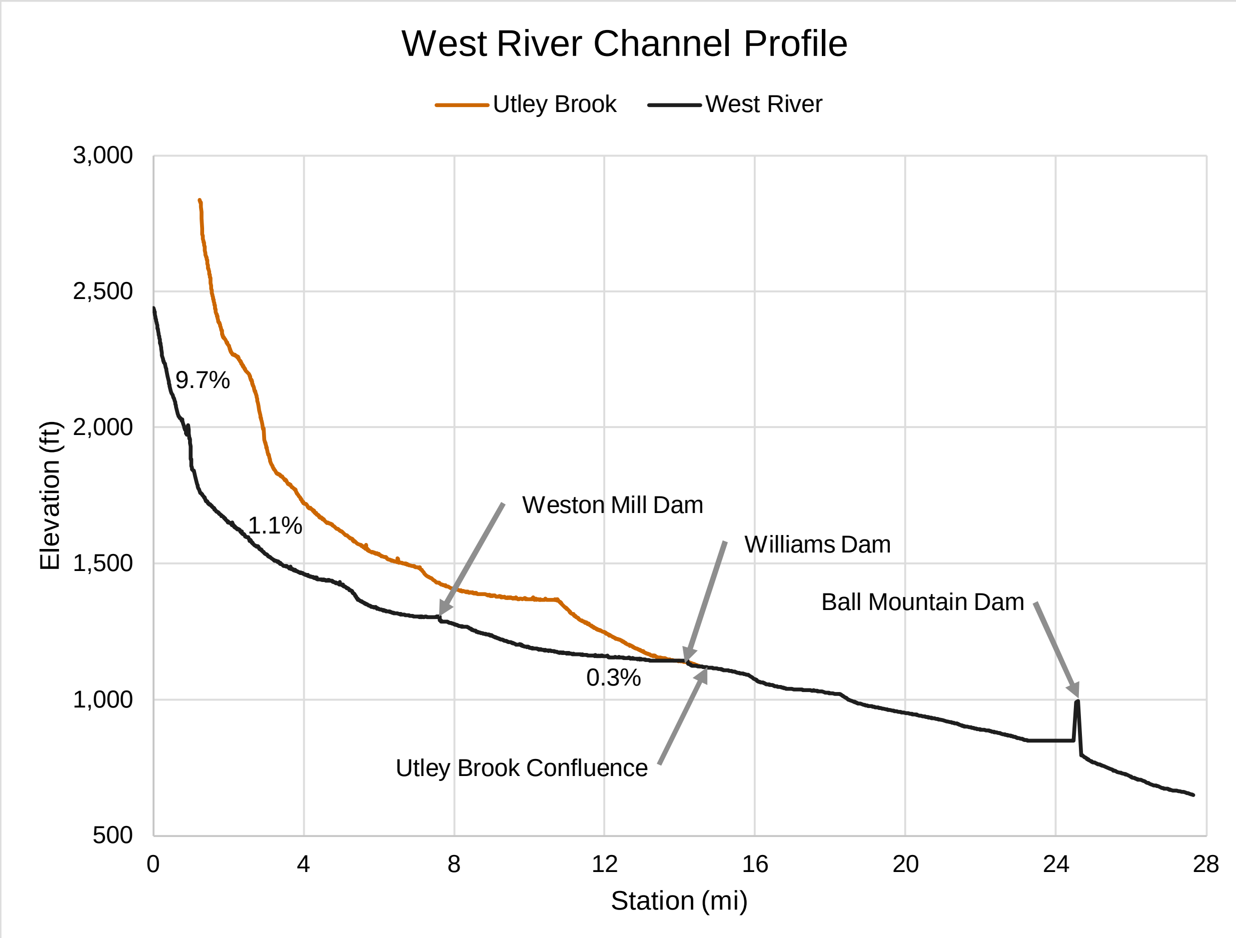


**Figure 8: West River Channel Profile Derived from LiDAR Data**

The West River in Londonderry is generally a meandering riffle-pool channel (Rosgen and Silvey, 1996) with a gravel and cobble bed, yet a paddle/wade down the river reveals three types of channels.

1. Where the channel is connected to naturally vegetated floodplains, a meandering gravel/cobble channel exists. Riverbanks tend to be tall due to past channel down-cutting. The bankfull channel width in this channel setting is typically between 60 and 70 feet.
2. Where broad floodplains exist and beavers are active building dams, flatter channels exist with several flow paths and ponded floodplains. Sediment is typically finer in these areas and floodprone widths are larger. This condition exists at the upstream end of the impoundment behind the dam. The bankfull channel width in this channel setting is typically between 65 and 70 feet.
3. In areas where the channel is made up of bedrock or where the river runs along property or infrastructure such as a road, the channel is straighter, steeper, and narrower. Bed material typically exists of cobble, boulder, or bedrock. This condition exists where bedrock controls the channel downstream of the dam, and where Route 100 parallels

the river close to the banks. The bankfull channel width in this channel setting is typically between 60 and 65 feet.

## 5.2 The Impoundment

The impoundment is filled with water and sediment that has accumulated to near the top of the spillway crest (Figure 9). Under normal flow (i.e., normal pool), the impoundment extends 3,600 feet upstream of the dam. This location is apparent in the field as downstream movement of water becomes visible, sandy sediment accumulation is replaced by a cobble bed, and the banks have erosion typical of flowing water. As with most run-of-river dams that are not regularly maintained, accumulated sediment fills more of the impoundment than water. Based on sediment probing, approximately 40,000 cubic yards of sediment is sitting upstream of Williams Dam. At normal pool, approximately 39,500 cubic yards of water (24 acre-feet) are regularly stored at the dam.

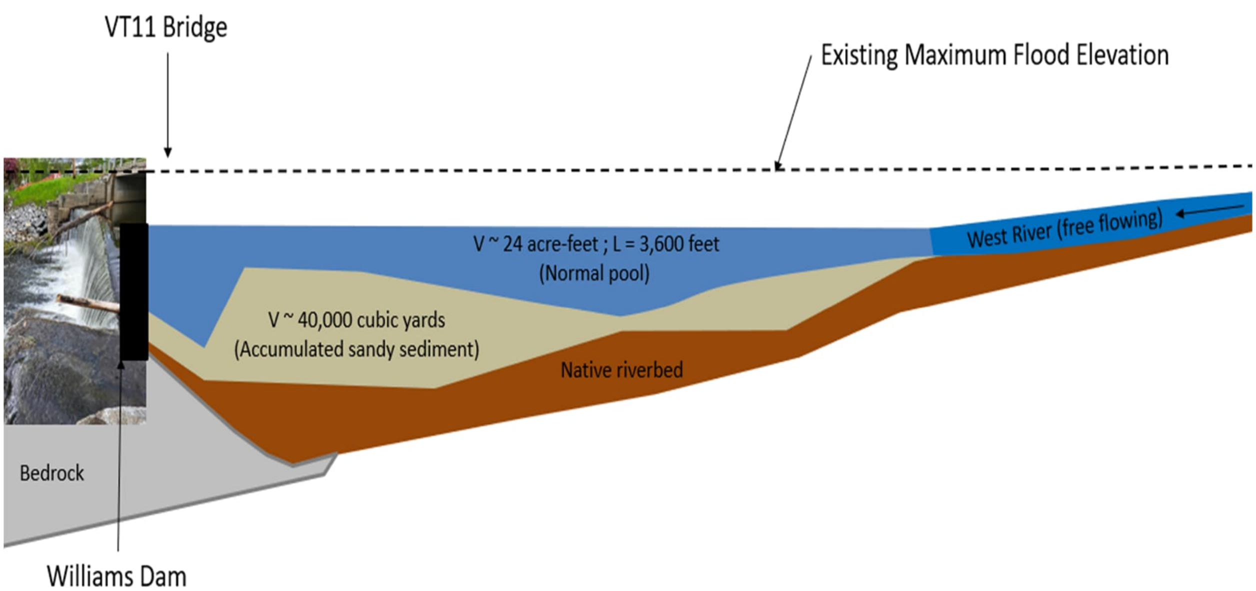


**Figure 9: Impoundment Diagram – Existing Storage**

During a flood, the impoundment swells to 4,800 feet long. The available storage capacity upstream of the dam/bridge before flooding takes place is 131 acre-feet (Figure 10, light blue area). Above this value, water starts to flow across the floodplains and infrastructure and property are at risk. Including the normal pool storage and volume taken up by accumulated sediment, the total volume of stored water and sediment upstream of the dam/bridge is 180 acre-feet. During a flood event, this volume is not available for storing and attenuating peak flows.

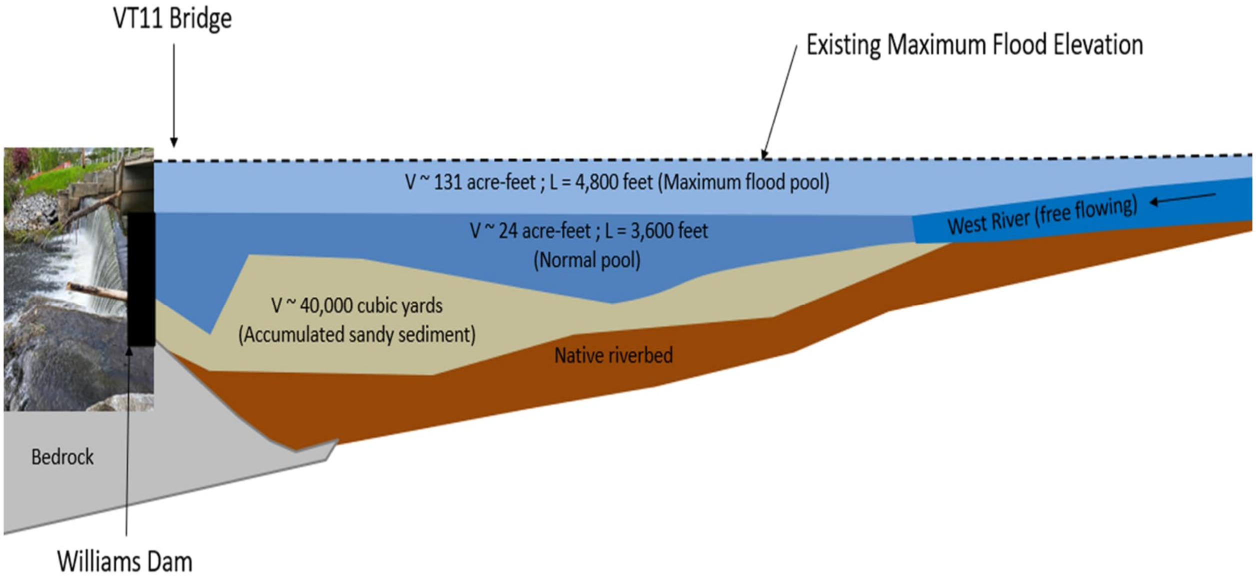


**Figure 10: Impoundment Diagram – Full Storage Condition**

# 6.0 Hydrology

## 6.1 Introduction

The West River has a drainage area of 40.8 square miles at Williams Dam (Figure 11). The drainage area increases to 68.6 square miles at the confluence with Utley Brook. The land throughout the watershed is primarily forested with some towns and farmland along the bottom of the river valley.

The flood flows for both the West River and Utley Brook were estimated using the USGS StreamStats software (Olson, 2014) and flood frequency analysis from nearby USGS stream gauges. Flow estimates were refined during hydraulic model validation to replicate the surveyed high water marks during the July 2023 flood.

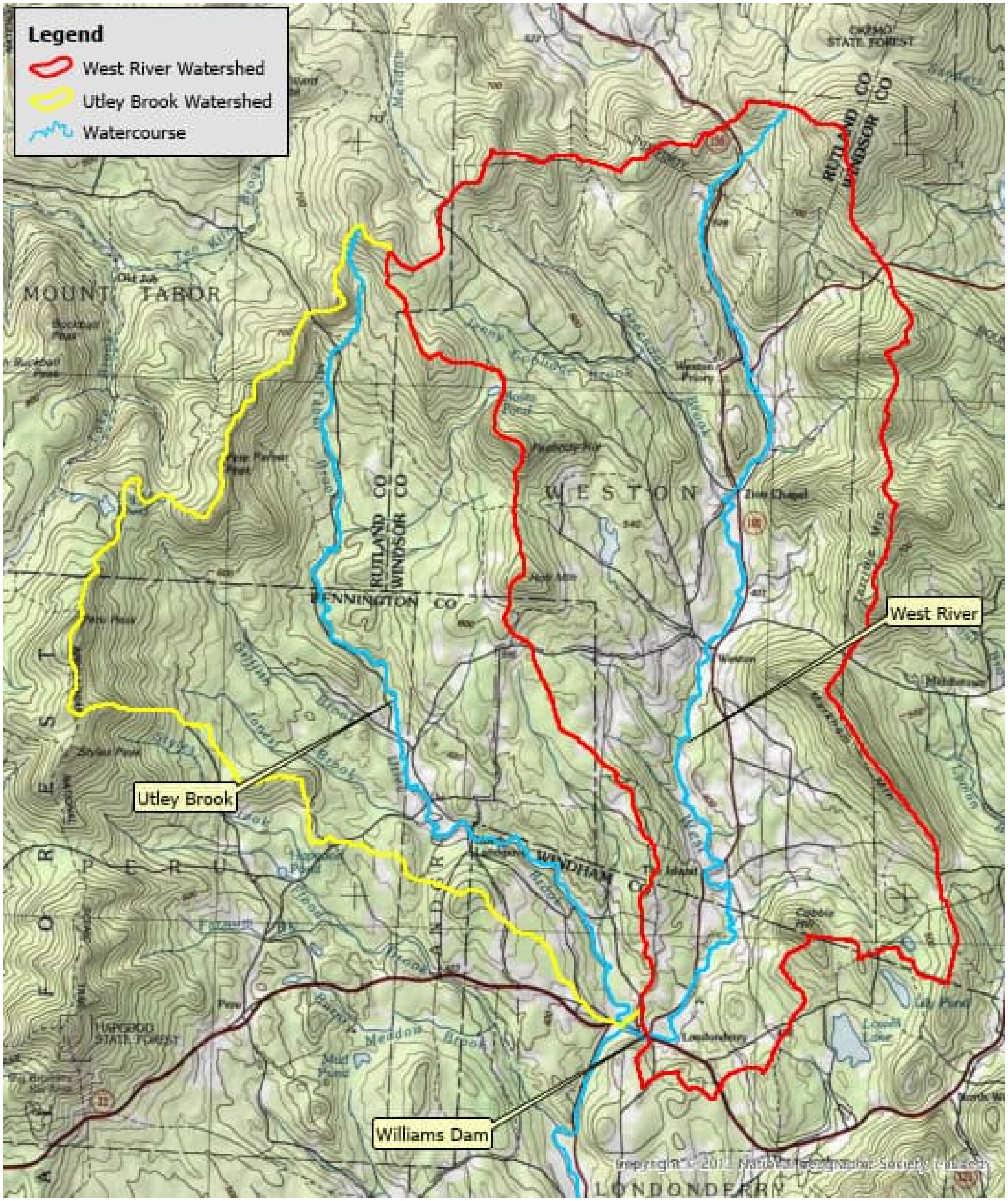


**Figure 11: West River Watershed**

### 6.1.1 FEMA Effective Flows

The effective flows were extracted from the FEMA flood insurance study (FIS) (Table 1). These peak flows were not used for the flood analysis because the flow estimates are based on a hydrologic analysis from 1977.

**Table 1: FEMA Flood Flows (Windham County FIS, 2007)**

| Annual Exceedance Probability (AEP) | Return Frequency (Years) | West River Peak Flow (cfs) | Utley Brook Peak Flow (cfs) |
|---|---|---|---|
| 10% | 10 | 5,400 | 3,451 |
| 2% | 50 | 9,386 | 6,406 |
| 1% | 100 | 11,734 | 7,966 |
| 0.2% | 500 | 20,534 | 14,766 |

### 6.1.2 USGS StreamStats

Peak flows were initially estimated with the USGS web-based StreamStats software (Table 2) (Olson, 2014). Synthetic hydrographs were developed for peak flows to allow for time-varying (i.e., unsteady) hydraulic modeling (Figure 12).

**Table 2: Estimated Peak Flood Flows (Olson, 2014)**

| Annual Exceedance Probability (AEP) | Return Frequency (Years) | West River Peak-Flow (cfs) | Utley Brook Peak-Flow (cfs) |
|---|---|---|---|
| 50% | 2 | 1,650 | 1,140 |
| 20% | 5 | 2,550 | 1,780 |
| 10% | 10 | 3,250 | 2,280 |
| 4% | 25 | 4,280 | 3,010 |
| 2% | 50 | 5,170 | 3,640 |
| 1% | 100 | 6,120 | 4,320 |
| 0.5% | 200 | 7,170 | 5,080 |
| 0.2% | 500 | 8,770 | 6,220 |

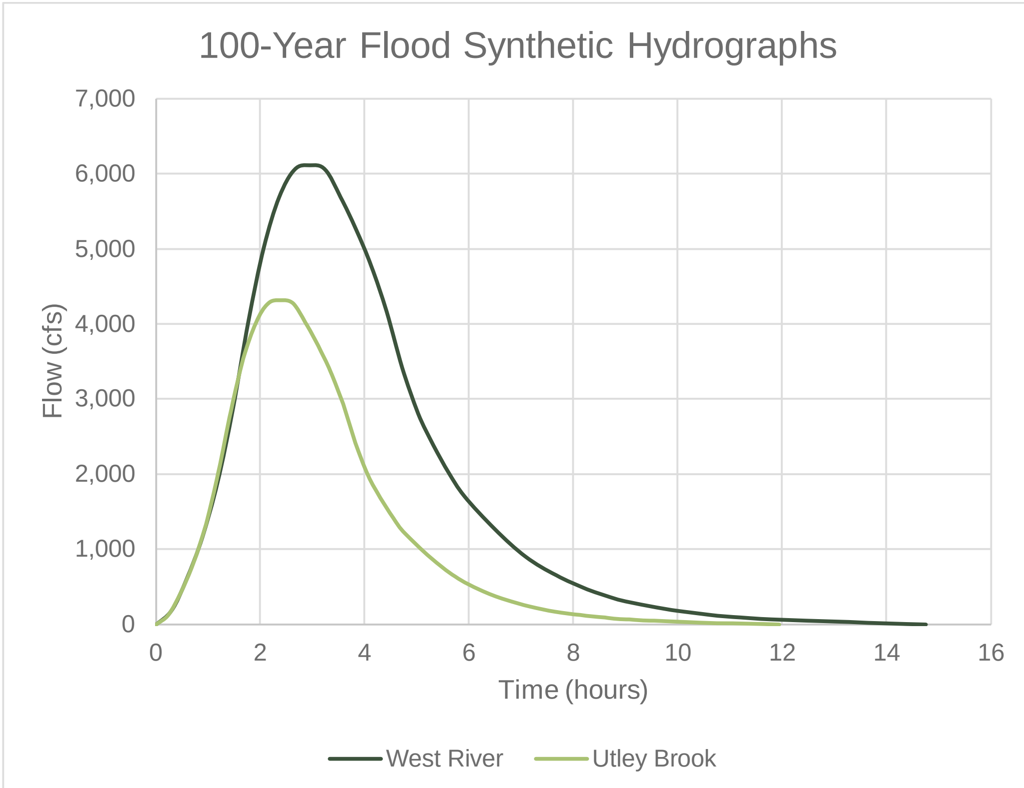


**Figure 12: Synthetic Hydrographs for the 100-Year Flood**

### 6.1.3 Gauge Analysis

Flood frequency analysis (USGS, 1982) was performed using scaled gauge data from USGS gauges located on the Williams River (USGS 01153550 Williams River near Rockingham, VT) (Table 3) and the Saxtons River (USGS 01154000 Saxtons River at Saxtons River, VT) (Table 4). The scaled flood flow estimates are generally larger than the StreamStats flow estimates.

**Table 3: Estimated Peak Flood Flows Scaled from the Williams River**

| Annual Exceedance Probability (AEP) | Return Frequency (Years) | West River Peak-Flow (cfs) | Utley Brook Peak-Flow (cfs) |
|---|---|---|---|
| 50% | 2 | 2,322 | 1,703 |
| 20% | 5 | 3,446 | 2,528 |
| 10% | 10 | 4,435 | 3,253 |
| 4% | 25 | 6,018 | 4,415 |
| 2% | 50 | 7,484 | 5,491 |

| Annual Exceedance Probability (AEP) | Return Frequency (Years) | West River Peak-Flow (cfs) | Utley Brook Peak-Flow (cfs) |
|---|---|---|---|
| 1% | 100 | 9,236 | 6,775 |
| 0.5% | 200 | 11,331 | 8,312 |
| 0.2% | 500 | 14,744 | 10,816 |

**Table 4: Estimated Peak Flood Flows Scaled from the Saxtons River**

| Annual Exceedance Probability (AEP) | Return Frequency (Years) | West River Peak-Flow (cfs) | Utley Brook Peak-Flow (cfs) |
|---|---|---|---|
| 50% | 2 | 1,651 | 1,211 |
| 20% | 5 | 2,763 | 2,027 |
| 10% | 10 | 3,821 | 2,803 |
| 4% | 25 | 5,640 | 4,138 |
| 2% | 50 | 7,435 | 5,454 |
| 1% | 100 | 9,696 | 7,113 |
| 0.5% | 200 | 12,540 | 9,199 |
| 0.2% | 500 | 17,449 | 12,801 |

Hydrographs were scaled from the surrogate gauge data to try and provide a more realistic shape for the regional July 2023 flood for use in the hydraulic modeling (Figure 13). Based on the results of the gauge analysis and calibration of the hydraulic model using high water marks, (see Section 7.2) the July 2023 flood had a return frequency between the 50- and 100-year event (i.e., 1% and 2% annual exceedance probability).

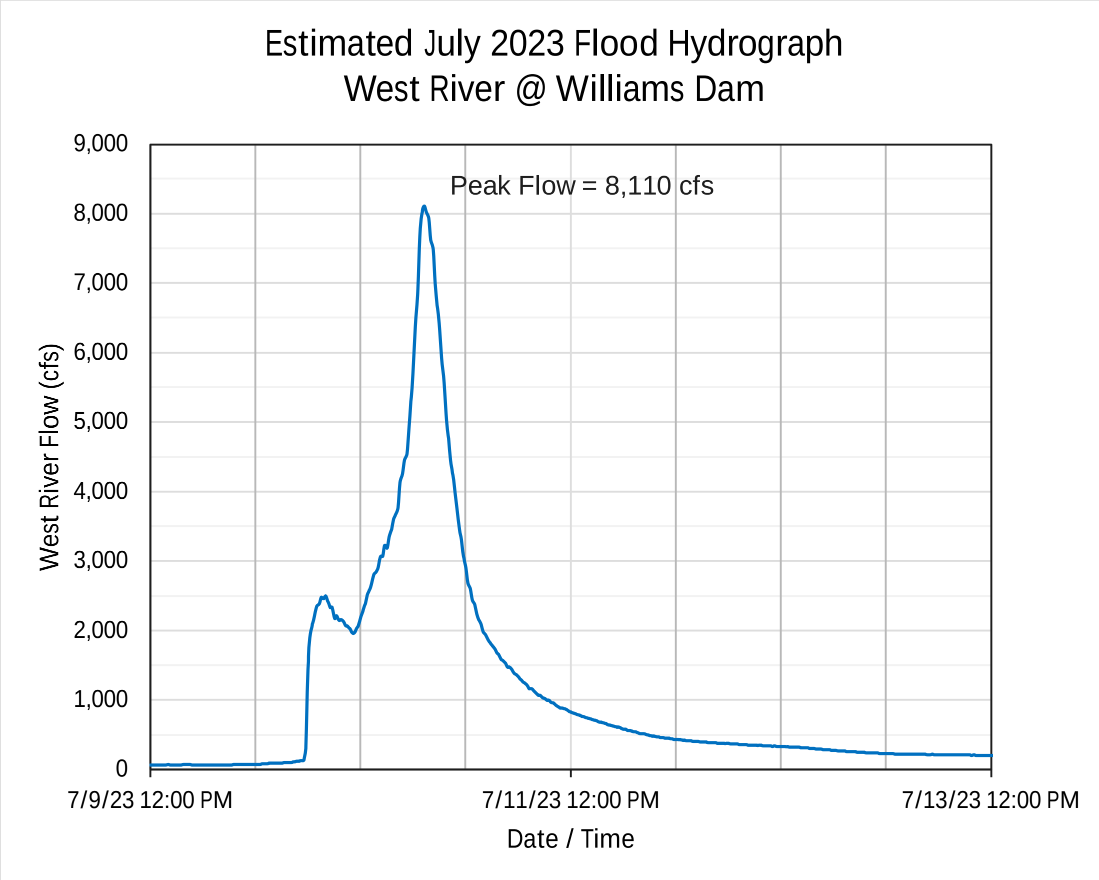


**Figure 13: Scaled Hydrograph for the 100-Year Flood on the West River**

# 7.0 Hydraulic Analysis

## 7.1 Introduction

A two-dimensional (2D) hydraulic model was developed to evaluate Williams Dam and the West River using the HEC-RAS river modeling software (USACE, 2023). Water surface elevations, flow depths, and velocities are computed for each cell in the 2D mesh based on the St. Venant shallow-water approximations of the Navier-Stokes equations that are solved using a finite-volume algorithm. Frictional energy losses are computed based on Manning's roughness coefficients applied to the terrain surface. Manning's roughness coefficients were categorized by landcover and assigned based on field assessment of vegetation type, cover, and density, and streambed material

The 2D mesh for the West River model has an area of 380 acres and extends 10,000 feet along the West River and 3,400 feet along Utley Brook (Figure 14). The model extent was selected to be able to explore changes to flood patterns from removal of Williams Dam and floodplain restoration at Utley Brook.

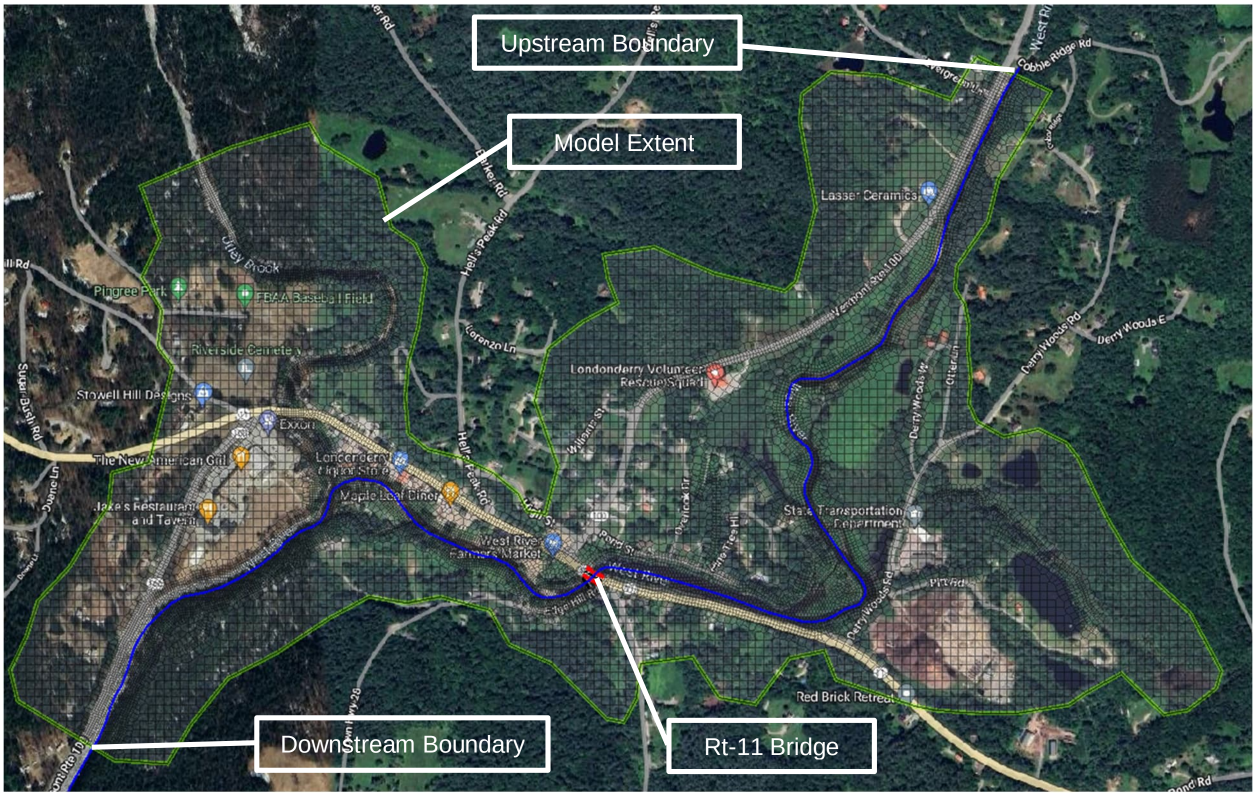


**Figure 14: Hydraulic Model Mesh**

## 7.2 Existing Conditions Model

### 7.2.1 Model Setup

The terrain for the model was developed from a combination of ground survey data collected by D&K in November 2021 and 0.7-meter resolution LiDAR data (VCGI, 2016). Various sections of the terrain were modified based on channel survey and field measurement performed by SLR. Buildings were incorporated into the terrain to simulate the flow around and between structures during a flood. Nominal node spacing in the computational domain was set to 50 feet. Breaklines were used to align the model cells with the stream channel, roadways, and other hydraulically significant terrain features. A cell spacing of 15 to 20 feet was used along the stream channel to help capture the details and shape of the channel. Williams Dam and the Route 11 Bridge were incorporated into the model mesh using a 2D connection that use weir, pressure, and momentum equations to simulate the hydraulics of each structure.

The hydraulic model was used to simulated both the estimated peak flood flows (i.e., steady flow) and the time-varying flood hydrographs (i.e., unsteady flow). Unsteady flow allows the model to account for the attenuating effects (i.e., flood reduction through storage) of the dam's impoundment and floodplain. The flows were input at upstream boundary conditions along the West River and Utley Brook in the hydraulic model. The downstream boundary condition for the model was determined using normal depth. Boundary conditions were located far enough upstream and downstream to avoid influencing modeling results in the primary study area around Williams Dam and the Utley Brook confluence.

### 7.2.2 Model Validation

Following the July 2023 flooding, USGS surveyed high water marks created by flood debris and staining on buildings in Londonderry (Figure 15). The elevations of the surveyed high water marks were compared to modeled flood water surface elevations for validation. Within the vicinity of Williams Dam, the difference between the measured and modelled water levels varied between 0.1 and 0.4 feet. The model was also validated by comparing the inundation extent in the model to aerial photos of the July 2023 flood (Figure 16). The validation effort indicated that the assembled hydraulic model is properly representing large floods in Londonderry and can be used for the Williams Dam flood analysis and evaluating flood mitigation alternatives.

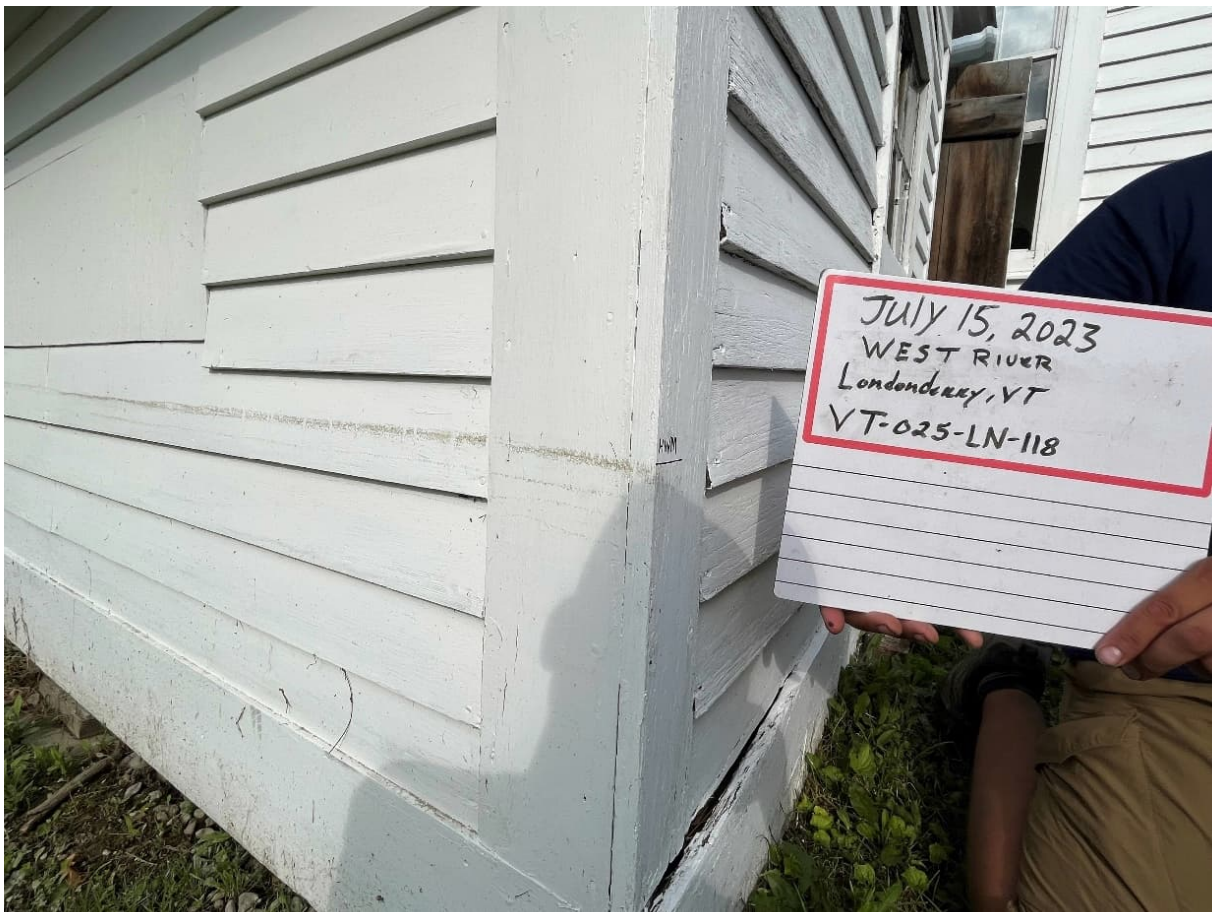


**Figure 15: High Water Mark Along Route 100 Upstream of Williams Dam**

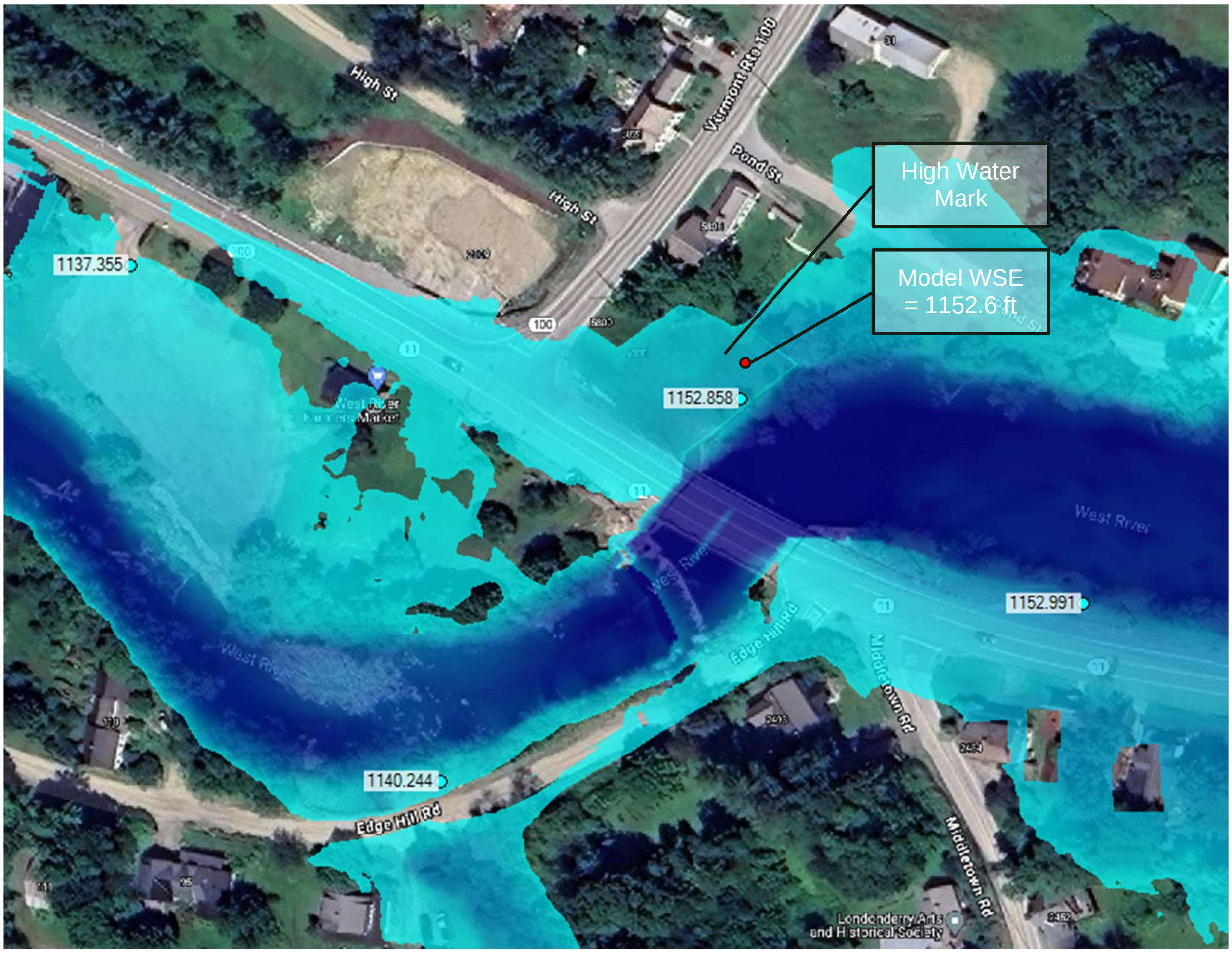


**Figure 16: Model Validation Using High Water Marks**

### 7.2.3 Comparison to Previous Hydraulic Model

This study expands upon previous studies of Williams Dam and its effect on flooding within Londonderry. The study performed by D&K in 2021 used a hydraulic model to evaluate dam removal as one of four alternatives for addressing the existing deficiencies of the dam. A new hydraulic model was created for this study to serve as an independent check on previous efforts. For the 10-year flood, the flood depths and extent in both models are similar with minor differences along the floodplain and near the model boundaries. The difference between the model results is larger for the 100-year flood, especially when comparing the inundation extend in the downtown shopping plaza.

The discrepancies between the model results can be attributed to a variety of factors included difference in Manning's roughness coefficients, model extent, channel measurements, and boundary conditions. One of the main differences between the models is that the river channel in the D&K model terrain appears to have been developed from LiDAR data outside of the survey area near the dam. SLR modified the model terrain to include the channel dimensions with surveyed cross sections. Another major difference between the models is that the D&K model appears to have applied a higher roughness coefficient to simulate flooding in the downtown area. SLR chose to incorporate the individual buildings into the model terrain to create more realistic simulation of the flooding around buildings.

### 7.2.4 Results

#### 7.2.4.1 Existing Conditions

Various flood events were simulated using the hydraulic model to the evaluated the effects of Williams Dam and the Route 11 Bridge on flooding in Londonderry. For the 10-year flood, the Route 11 Bridge does not overtop but flooding takes place upstream of the dam/bridge along Route 11 and Route 100, and downstream around the businesses and homes along Route 11.

During the 100-year flood, flows overtop the Route 11 Bridge by several feet, inundate the intersection of Route 11 and Route 100, and cause extensive flooding downtown. Similar results are produced for the July 2023 flood simulation (Figure 17). The bridge is not entirely overtopped but flood waters cross over Route 11 along both sides of the bridge and flow down the road through town. The model results show that the dam and bridge constrict flood flows along the West River raising the upstream water level and inundating roads and building along the edge of the impoundment. The influence of the dam/bridge constriction extends approximately one mile upstream to Cobble Ridge Road Bridge.

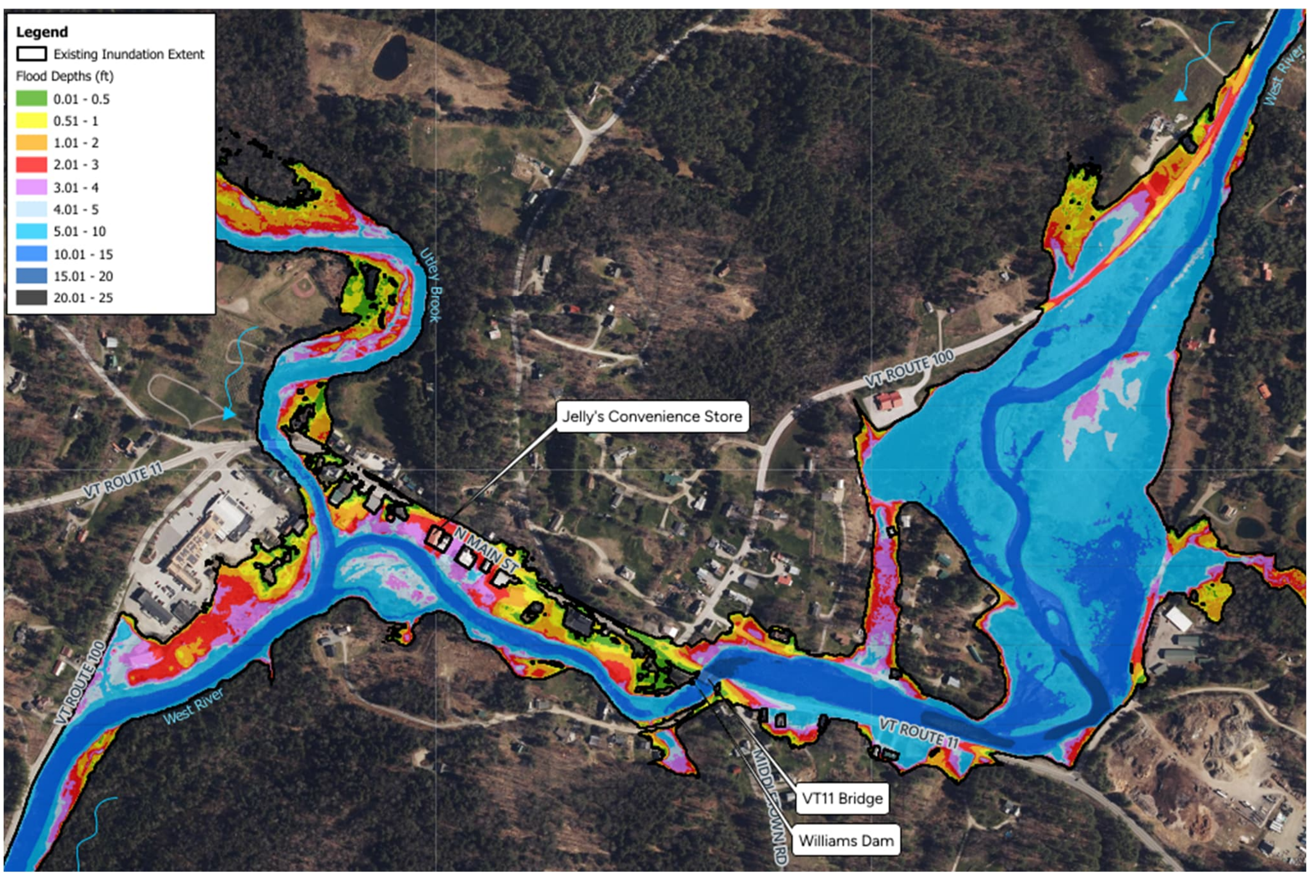


**Figure 17: Modeled Flood Depths – July 2023 Flood – Existing Conditions**

Model results indicate that the storage provided by the impoundment does not provide reduction of peak flows or reduce the extent of flooding downstream of the dam. Flood attenuation generated by the existing dam was evaluated by comparing the results from two model simulations – 1) the estimated flood hydrograph from the July 2023 flood and 2) the estimated constant peak flow from the July 2023 flood. The resulting flood extents produced by both simulations are nearly identical suggesting that the dam's impoundment does not provide enough storage to reduce flooding downtown during large floods.

#### 7.2.4.2 Dam Removal

If Williams Dam were removed, more flood storage would be available as the water would start at a lower elevation when a flood arrives. Removing the dam and accumulated sediment could increase the total volume available for flood storage by 46 acre-feet. Due to the bedrock that the dam sits on, a small volume of water (approximately 3 acre-feet) would remain impounded at the site even if the dam is removed. Under the same flood flow conditions where the existing impoundment storage would be filled, the West River could provide an additional 91 acre-feet of storage if the dam and sediment were removed (Figure 18).

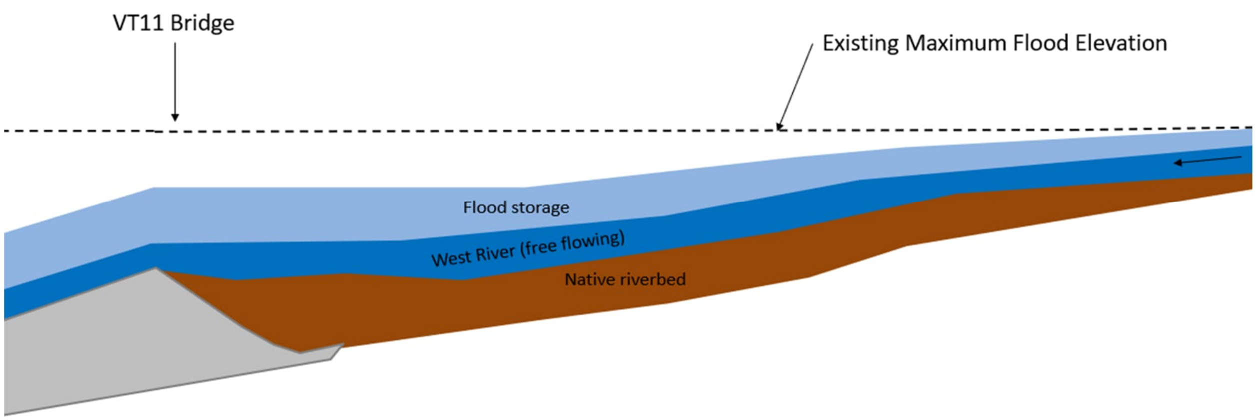


**Figure 18: Impoundment Diagram – Post-Dam Removal**

For the July 2023 flood, the model results suggest that dam removal would reduce flooding along Route 11 and Route 100 upstream of the dam/bridge. Removing the dam reduces the flow constriction at the Route 11 Bridge by increasing the flow area and hydraulic capacity of the bridge opening. The flood water elevation upstream of the dam/bridge would be reduced by up to 7.5 feet (Figure 19), preventing flood flows from crossing over Route 11.

Flood water would still inundate the upstream floodplains, but the depth of flooding would be reduced. The water level reductions would extend upstream to the Cobble Ridge Road Bridge. In the downtown area, flood depths and extent would remain unchanged following dam removal (Figure 20). The attenuation provided by the existing impoundment is insignificant compared to the size of the July 2023 flood. The impoundment fills long before the flood reaches its peak.

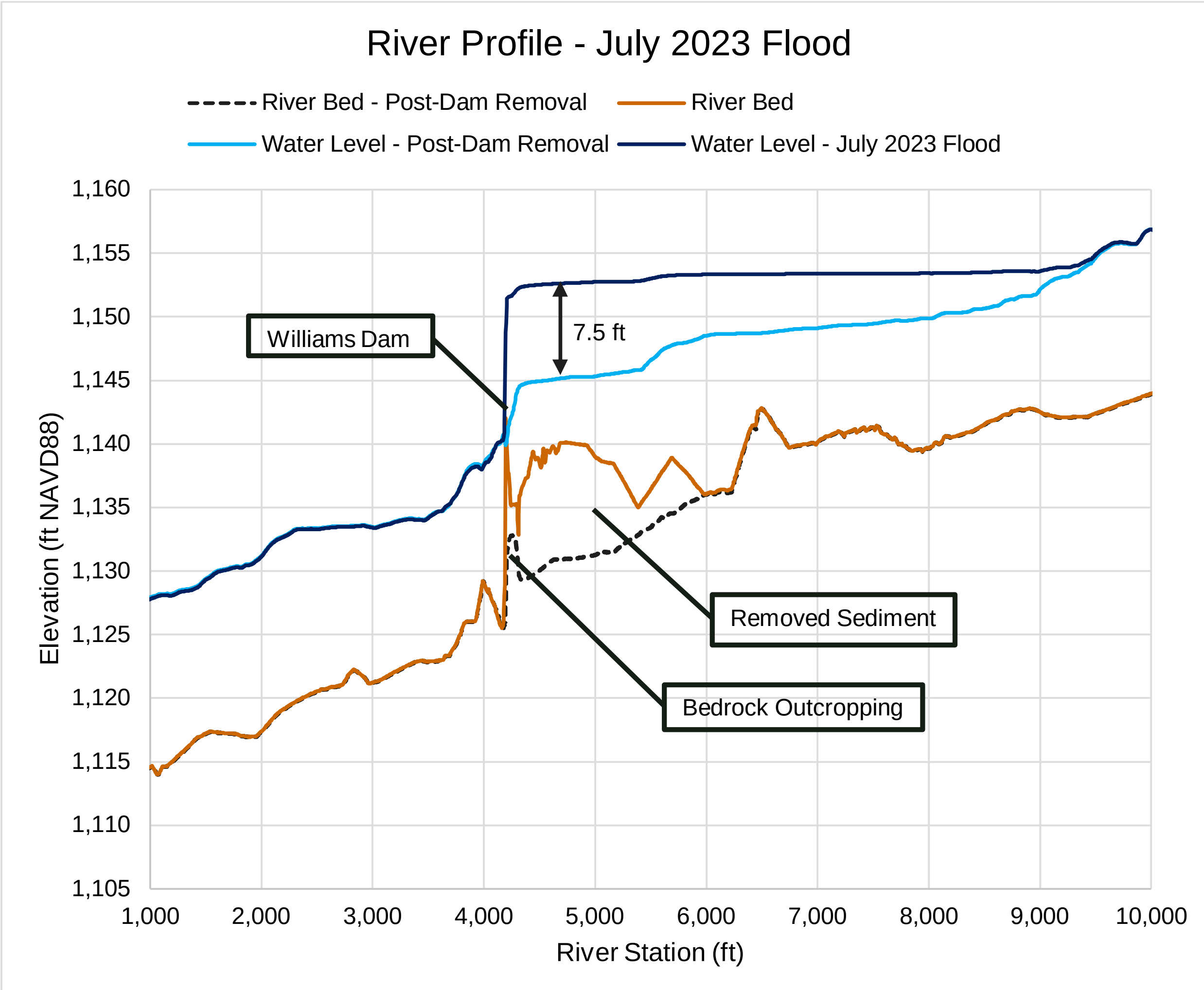


**Figure 19: Flood Profile from the Hydraulic Model – July 2023 Flood**

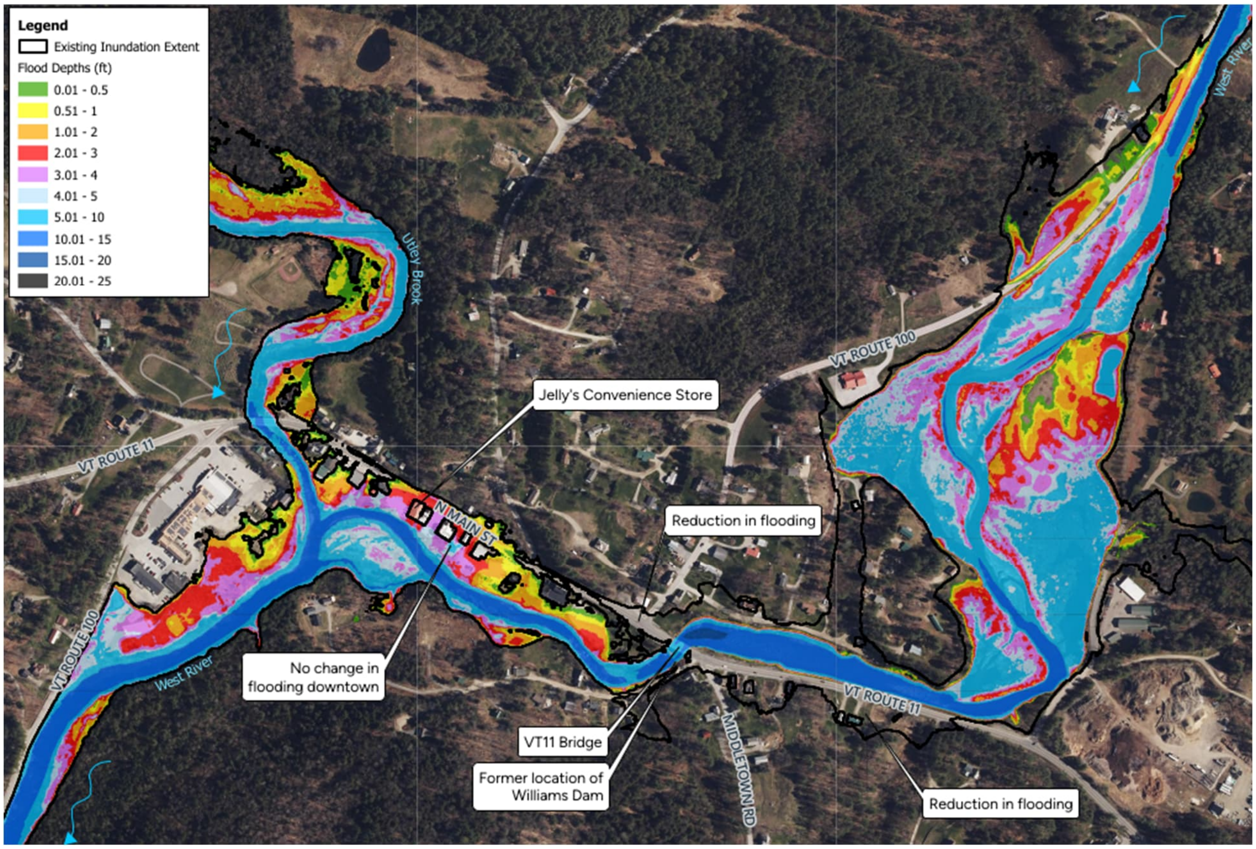


**Figure 20: Modeled Flood Depths – July 2023 Flood – Post-Dam Removal**

Model results indicate that the flood velocities within the upstream channel and the channel just downstream of Williams Dam would increase if the dam is removed. The formerly impounded water would be free to naturally flow downstream. At the Route 11 Bridge the flood flows that crossed over Route 11 would remain in the channel during large floods. The effects on velocity caused by the removal of the dam would extend a short distance downstream from the bridge. A steep, bedrock/boulder riffle, located approximately 200 feet downstream of Williams Dam controls flow depths and velocities (i.e., is a tailwater control). Below this riffle before the river bends to the right facing downstream, the river will not experience any changes due to dam removal.

### 7.2.4.3 Dam Removal and Bridge Removal (Natural Conditions)

Together, the dam and bridge create a major constriction along the West River. Upstream of the dam, the width of flow across the floodplain is over 800 feet in some locations. Flood flows must squeeze through a bridge opening that is only 88 feet wide (85 feet wide if you exclude the width of the pier). The dam reduces the hydraulic capacity of the bridge by raising the water level.

While the hydraulic capacity of the bridge would increase if the dam were removed, the bridge itself still constricts flood flows and raises the upstream water level. A simulated was performed with both the dam and bridge removed to determine how the constriction effects flooding and evaluate if a larger bridge would reduce flood levels upstream.

The model results suggest that the bridge raises the upstream water level, but that widening the bridge would only provide a slight reduction in water level during a flood. If Williams Dam and the accumulated sediment were removed, the channel upstream of the bridge would convey most of the flood flows. The bridge does not act as a major constriction under these conditions.

During large floods, Route 11 would be inundated before the bridge is overtopped. With the dam removed, the effects of the bridge only extend 1,300 feet upstream.

#### 7.2.4.4 Floodplain Restoration at Utley Brook Confluence

The hydraulic model was used to evaluate if restoration of the floodplain located near the confluence of Utley Brook and the West River (Figure 21) would reduce flood levels. The floodplain covers an area of 2.1 acres. Results from the model suggest that excavating the floodplain to improve connection to the river and store more flood water will not reduce flood depth or extent during the July 2023 flood (Figure 22). The flood water level along Route 11 would decrease by less than 0.1 feet due to the floodplain restoration project. The floodplain reduces flood depths by up to 0.5 feet during the 10-year flood. The flood water surface profile suggests that a downstream floodplain constriction and the additional inflows from Utley Brook are backwatering the area and reducing the potential benefits of the floodplain reconnection.


**Figure 21: Proposed Floodplain Restoration Site**

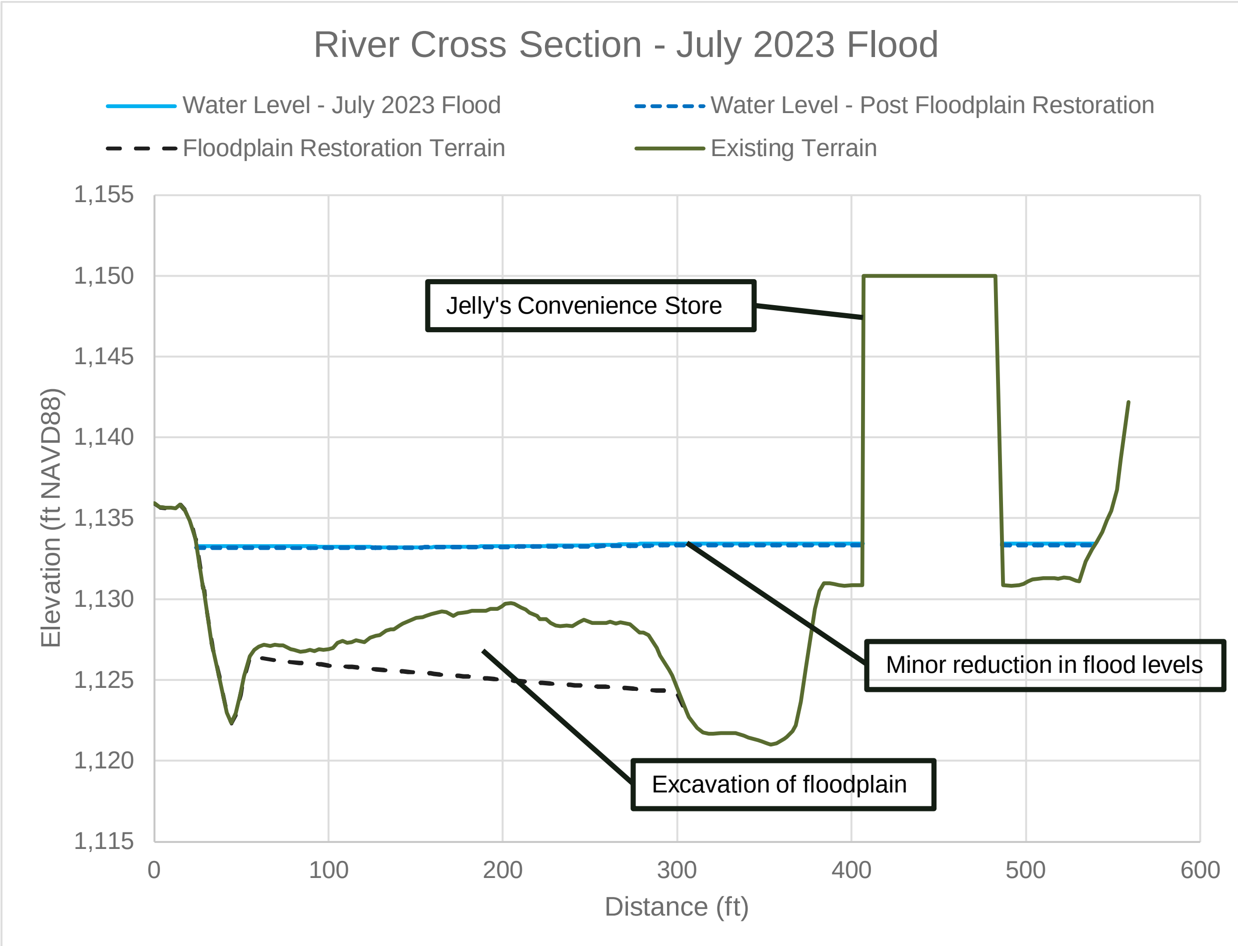


**Figure 22: River Cross Section – July 2023 Flood – Floodplain Restoration**

# 8.0 Conclusions and Recommendations

Based on the results of the hydraulic analysis, Williams Dam is constricting flood flows along the West River, increasing the depth of flooding, and increasing the extent of flooding upstream of the dam. The storage provided by the dam is insufficient to reduce flooding during large floods. Changes to downstream flooding are not predicted if the dam is removed.

Removal of the dam would increase the hydraulic capacity of the Route 11 Bridge, reduce flooding along Route 11 and Route 100, and reduce flooding for the properties upstream of the dam.

Previous study evaluated four alternatives for addressing the deficiencies with Williams Dam. Due to the poor condition of the structure, the “No Action” alternative was deemed to not be acceptable. Given the poor condition of the dam, the Town must either remove, replace, or repair the dam.

Previous information and the analysis performed here point to the recommendation for dam removal to eliminate the obsolete structure that requires substantial investment to repair or replace. Dam removal provides small, local flood reduction benefits illustrated by the current hydraulic modeling, and more importantly eliminates the potential for a dam breach causing a large, unexpected flood wave in Town. If the dam fails, the large volume of sediment stored behind the dam would impact channel stability, fish habitat, and water quality for years as the material works its way through the system.

The removal of the dam will improve the hydraulic performance of the Route 11 Bridge.

Dam removal will slow the buildup of ice and reduce the likelihood of breakup ice jams. The lower starting water surface with the dam removed provides additional ice storage during thaws and spring ice out. The anticipated bedrock falls at the current dam location will continue to break up larger ice sheets that make it to the dam location. Dam removal will likely reduce ice jam flooding.

The anticipated presence of a bedrock cascade or falls at the dam site following removal will preserve the aesthetics of the site. The site and sound of falling water will be preserved in the center of Town, albeit at a lower elevation. If removal is selected by the Town, installation of a sigh at the dam site is recommended to document the history of the dam.

Dam removal would eliminate dam registration fees and maintenance costs that are likely to be required with the recent changes to Vermont Dam Safety Rules. Many funding sources exist for dam removal so it is likely that the Town would be able to work with partners that would assist with project management and funding for dam removal.

# 9.0 References

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# Appendix A Williams Dam (D&K, 2022)

## Williams Dam Flooding Analysis

**Londonderry, Vermont**

SLR Project No.: 20433.00002

January 5, 2024

# Appendix B Williams Dam, Londonderry, VT (NRCS, 2022)

## Williams Dam Flooding Analysis

**Londonderry, Vermont**

SLR Project No.: 20433.00002

January 5, 2024

# Appendix C VTDSP Dam Inspection

## Williams Dam Flooding Analysis

**Londonderry, Vermont**

SLR Project No.: 20433.00002

January 5, 2024

# Appendix D VTDSP Dam Breach Analysis

## Williams Dam Flooding Analysis

**Londonderry, Vermont**

SLR Project No.: 20433.00002

January 5, 2024

# Appendix E VTrans Boring Data for VT Route 11 Bridge

## Williams Dam Flooding Analysis

**Londonderry, Vermont**

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January 5, 2024

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