Fall 2004 FES 829 River Processes and Restoration

# Hoosic River Restoration Plan

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Table of Contents

**Introduction and Acknowledgements**

The idea of restoring the Hoosic River in the Town of Adams, Massachusetts is not a new one. The town has been discussing restoration with the Army Corps of Engineers for several years, and last year released a master plan for the redevelopment of downtown Adams, which emphasized improving the Hoosic River. As students of river restoration, we are excited to be a part of these larger efforts. The potential for Adams and the Hoosic is great; it does not take much imagination to see a more vibrant downtown and a healthier river, both of which would improve the quality of life for residents and visitors. The two goals are closely connected. A more natural river with access for recreation will bring visitors to Adams for fishing, walking or biking along the newly-developed trail, or simply enjoying the natural beauty. We hope that our proposal will be considered as an addition and complement to the current plans.

Many thanks to our instructors Jim McBroom for spending a Saturday in the cold on the Hoosic and Roy Schiff for the many hours he spent helping us design pools and riffles. And special thanks to Elena Traister for introducing us to the Hoosic and Adams and for all her help and encouragement.

## Background

Situated in northwestern Massachusetts, the Town of Adams is a picturesque community of 9,500 residents. The eastern edge of the town is bordered by Mount Greylock, Massachusetts tallest peak, which is part of the Berkshire Mountain Range.

The Town of Adams has a long history with the first settlers arriving in the 1760s. These ambitious pioneers were members of the Society of Friends (Quakers) who believed in living simple, peaceful lives. Their meetinghouse, completed in 1786, still stands as one of the many historic monuments in the town. By the $19^{th}$ Century, the development of Adams was similar to that of many other New England towns. Textile mills grew up along the Hoosic River where they had a ready source of water and power. The town was best known for its textile production. In 1878, North Adams split off from the Town of Adams. Even after the towns separated, they were still the second and third largest municipalities in Berkshire County (Berkshire website).

As the economy changed, the mills along the Hoosic have largely closed. However, Adams is fortunate to still have a large number of jobs available from Specialized Minerals and other businesses in the area. However, it is clear that the town of Adams is changing from one supported by industry to one that will increasingly rely on tourism dollars. Likewise, the Hoosic River should and can reflect this change. By playing a lesser role in industry, the river can resume its place in the natural beauty of the area.

## Hoosic River

The Hoosic River begins just south of Adams at the Chesire Reservoir and flows north for 60 miles through Adams, North Adams, then southern Vermont and New York state, where it eventually joins the Hudson river (Figures 1 and 2). The reservoir serves as the source of the South Branch of the Hoosic River. The reservoir has an area of 0.65 square miles and normal spillway elevation of 971 feet. This reservoir regulates the low-water flows and reduces the peak flood flows in Adams (FEMA, 1983).


**Figure 1-**Upper Hudson Watershed (USGS)

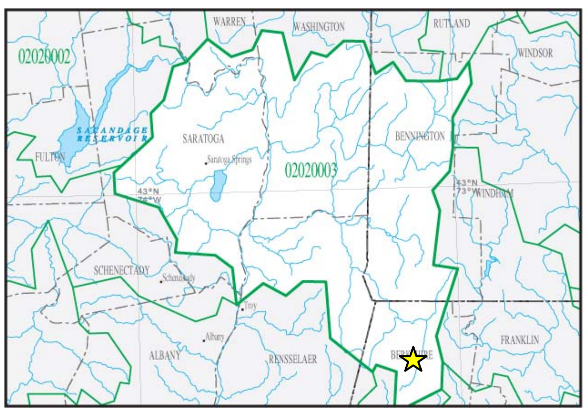


**Figure 2**- Hudson-Hoosic Watershed (USGS)

Frequent flooding in the first half of the 20th Century had devastating effects on the Town of Adams. Photos from a flood in 1901 show the foundations of houses washed out from underneath them (Figure 3). The peak flow diagram shows peaks that correspond with the 1938 hurricane and other floods in the 1940s. Data is not available before 1920, but reports indicate that flooding was a frequent problem (Traister, 2004). In response to these floods, an Army Corps of Engineers flood control program in the 1950s created cement channels and other features to save the many homes and businesses on the banks of the Hoosic from frequent flooding. The channels were designed to contain both the 100- and 500-year floods of the South Branch Hoosic River within the levee. The levee system meets the FEMA (Federal Emergency Management Agency) freeboard requirements, which requires that all levees must have a minimum of three foot freeboard against 100-year flooding to be considered a safe flood requirement (FEMA, 1983).

**Figure 3**-"Boys reclining on the face of a toppled house are making light of the devastating aftermath of the 1901 Flood. This photograph shows an East Hoosac Street house that was destroyed by the Miller Brook which runs along its back edge." (Adams Historical Society)

As a result of this flood control program, the Hoosic River in Adams belies the natural beauty of the surrounding area. Although situated in a small town, the river now more closely resembles one found in a large city. One of the major problems of this channel is that it was constructed for a much higher flow than the river currently experiences (Figure 5). This may be due to the fact that the valley has reforested after farms have been abandoned and water runoff is much less. As a result of this large, rectangular channel, the flow of the river is often insufficient to fill it. In summer months, the channel is often only half-covered with water. The highly modified channel efficiently and quickly moves floodwater through the town, but has rendered the river nearly devoid of life. The channel is topped with barbed wire that prevents the use of the river for any recreational purposes. The cement bottom and low flow conditions make it inhabitable to fish and macroinvertebrates. This lack of food and habitat discourages birds and other riparian species from making their home on the Hoosic.

Many rivers with similar designs have been successfully restored to more natural forms. This will be a challenge to Adams because of the many houses and businesses built directly abutting the river. A complete restoration would be prohibitively expensive and mean the destruction of many properties. However, there are still improvements that can be made to bring back some ecological functions and beauty to this stretch of river.

Adams is well-positioned to begin their restoration of the Hoosic. The Army Corps of Engineers has approved federal funding for a restoration under their Program for Habitat Restoration for Fish and Wildlife Resources. Under this program, Adams will be responsible for 25% of the overall cost of the project, with the ACOE providing the rest. Preliminary assessments and plans have been made as part of this program, but restoration has yet to begin. The stated goals of the ACOE project are to improve aquatic habitat and improve public access and enjoyment of the river. To increase trout populations, the ACOE suggests reducing the temperatures of the water throughout the flood control project and "to restore natural stream conditions along the channel bottom and sides, improving habitat for food organisms (insect larvae and benthics) and creating areas of refuge where fish could escape the heat and seek food and shelter in a more natural setting" (ACOE, 1999).

The Downtown Development Plan, an economic development plan released in July 2003, also recommended restoration of the Hoosic as a way to increase tourism, particularly fishermen and other people interested in outdoor recreation. The revival of a trout population is an important step towards realizing this goal.

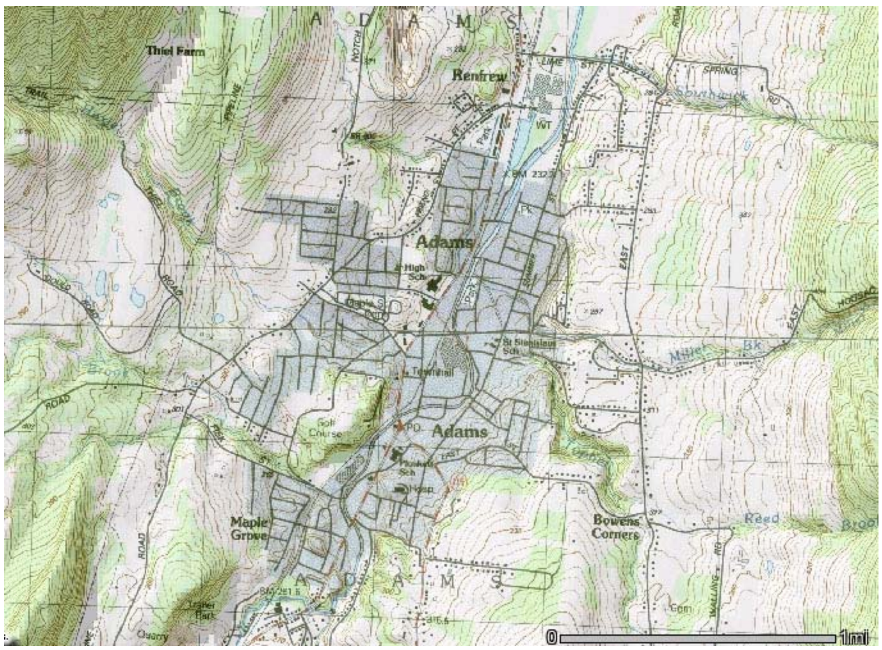


**Figure 4-**The town of Adams and the Hoosic River(MassGIS)

**Geomorphic and Physical Features**

The study of any river restoration should begin with an examination of the geomorphic features of the river. The floodway data (Table 1) and summary of discharges (Table 2) from FEMA illustrates the rivers planned discharges. With the data from and our own calculations and estimations, and we have developed the current condition for Hoosic river in Adams(Table 3). Our calculation of discharge is based on 73 years of data between 1931 and 2003 collected from USGS gauging station 01331500 Hoosic River at Adams, MA.

**Table 1-**Floodway Data

| Flooding Source | | Floodway | | |
|---|---|---|---|---|
| Cross Section | Distance (ft above corporate limit) | Width (ft) | Section Area (sqft) | Mean Velocity(fps) |
| Second Drop | 11380 | 70 | 434 | 14.2 |
| Above Confluence of Division Channel | 12370 | 165 | 883 | 7.0 |
| Cook Street | 12820 | 75 | 615 | 10.0 |

(FEMA, 1983)

**Table 2 -**Summary of Discharges

| Flooding Source and Location for South Branch Hoosic River | Drainage Area (sq.miles) | Peak Discharges(cfs) | | | |
|---|---|---|---|---|---|
| | | 10-year | 50-year | 100-year | 500-year |
| Below Tophet Brook | 59.5 | 2,783 | 4,925 | 6,159 | 10,067 |
| At Adams-North Adams Line | 65.7 | 2,990 | 5,291 | 6,617 | 10,816 |

(FEMA, 1983)

The calculations for the discharge for the table below were based on the data collected from field and Manning's equation for mean velocity of the river.

**Table 3-**Our Measurements and Estimations

| Cross Section | Floodway Width (ft) | Channel Width (ft) | Channel Height (ft) | Perimeter (ft) | Cross Section Area (sqft) | Channel Slope (%) | Mean Velocity (fps) | Discharge (cfs) |
|---|---|---|---|---|---|---|---|---|
| A | 93 | 60 | 9 | 97 | 729 | 0.6 | 14.7 | 10,716 |
| B | 70 | 54 | 9 | 78 | 558 | | 14.2 | 7923.6 |

(A: Above Second Drop, B: Below Cook Street)

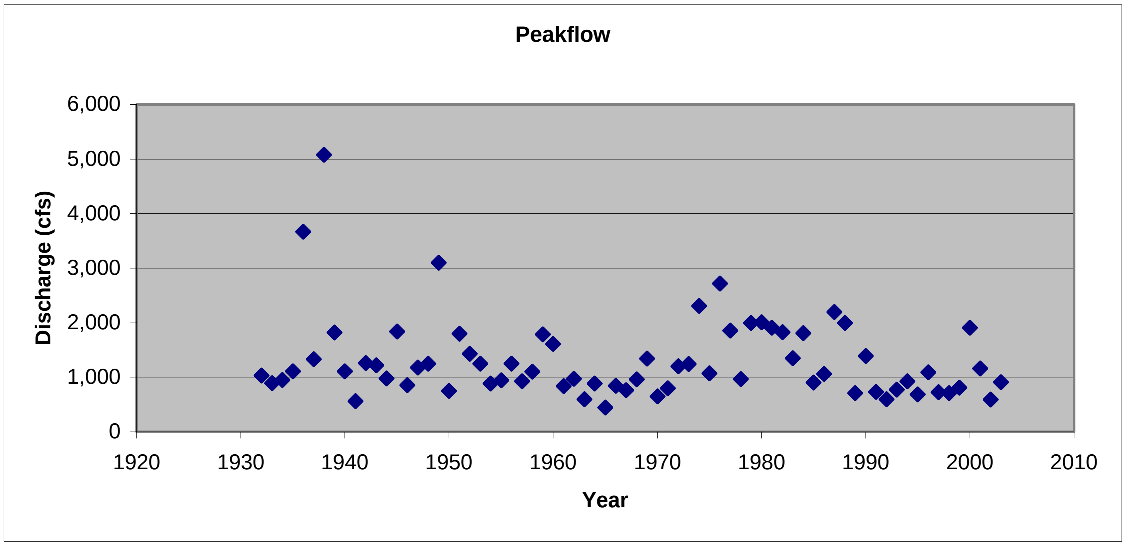


**Figure 5-**Peak Flow

Estimates for the recurrence interval show a linear equation of *y*=68.884*x*+968.82. The 1.5 year bankfull discharge for the Hoosic river is estimated to be 1072(cfs).

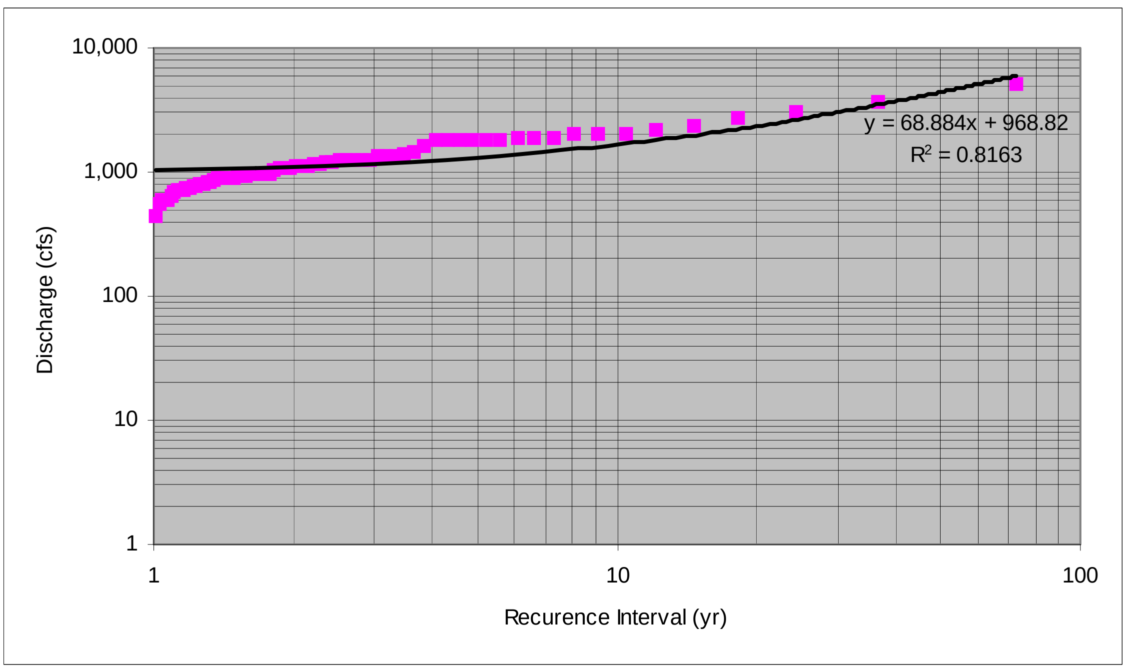


**Figure 6-**Flood Frequency Curve

**Table 4-** Hoosic-Adams Mean of Monthly Streamflows (1931~2003)

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discharge($ft^3/s$) | 85.8 | 83.4 | 150 | 214 | 118 | 72.4 | 48.7 | 42.6 | 45.7 | 52.8 | 77.9 | 86.3 |

(USGS, 2004)

The mean of monthly streamflows was observed to determine the lowest discharge in a year that would be critical point in the movement of trout. In case of the Hoosic River, the lowest streamflows were in summer. Therefore, the measurements taken in December could be regarded as an average state for the river.

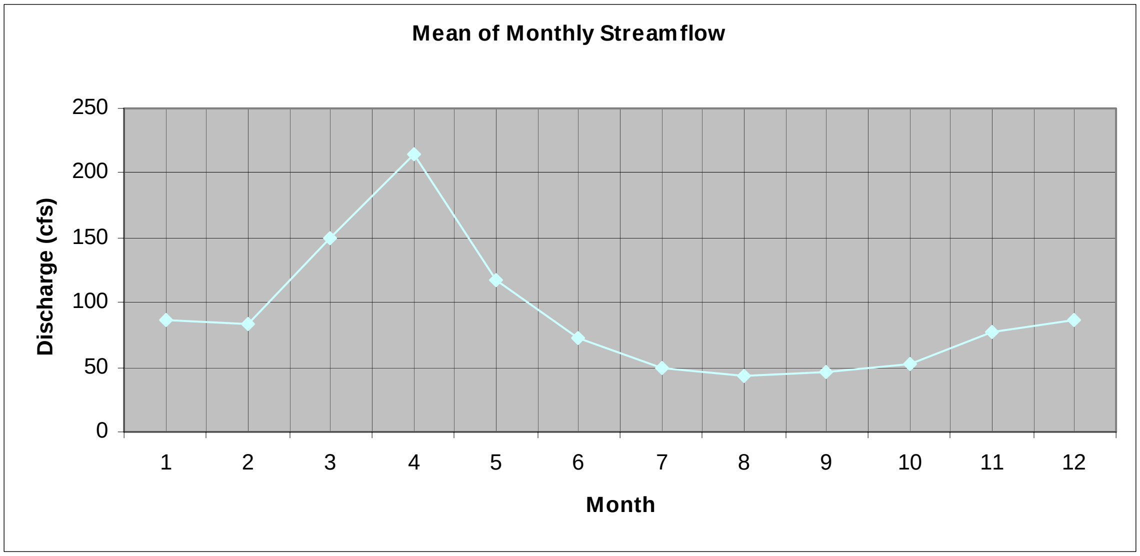


**Figure 7-**Mean Monthly Streamflow (1931~2003)

The main substrate in the section was cobble with the rest sand or gravel. From observing the substrates, it could be determined that the stream was in stable condition with substrates aggraded in this section of the river. If it were to be classified as a natural stream according to Rosgens classification, this part of the river might be able to be a B3 type channel. With this assumption it could be suggested that the section be restored into a similar B3 type stream.

## Restoration Plans

Although there are opportunities for restoration in the portion of the river lined with concrete, we chose to focus our recommendations for restoration on the “low hanging fruit” that is available to the Town of Adams. We fully recognize that river restorations can be costly and time consuming processes. However, there are a number of steps that Adams can take to begin to restore the Hoosic River. Any restoration is best tackled in a series of small steps, rather than trying to restore the entire river at one time. Furthermore, the success of a small project would increase support for further, more extensive restorations on more difficult reaches of the river.

### Recommendations for Downtown Adams

Restoration of the Hoosic in the channelized portion of town would be difficult. Properties are built so close to the river that there is little room to enact a full-scale restoration. One option Adams can explore, however, is removing the concrete bed of the channel, but allowing the walls to remain. The surface below the cement is most likely buried stream bed rather than bedrock, and excavation would be possible. A thalweg (a deeper section within the channel) would benefit trout and other fish in summer months when water levels are low. The thalweg may also allow canoers and kayakers to navigate the river, which would contribute to the goal of bringing more outdoor recreation to Adams. This would be a less expensive option than the plan outlined in the Downtown Development Plan.

### Cook Street Restoration Plan

At the Cook Street bridge, the concrete channel changes to a relatively open stretch of river that has earthen berms lined with rip rap on either side. It is at this site that we observed the most opportunities for river restoration that can occur in the near future.

This stretch of river begins with a small dam which drops 8 feet. This dam creates a standing wave and high velocities that are impassable to fish and dangerous to humans. Despite this highly engineered and unnatural feature, this is a popular spot for one man we met to catch brown trout, probably because the fish are washed over the dam and then rest in the pool.

On the opposite side of the bridge, the water flow is much calmer (estimated at 1-2 feet per second) and the cement channel gives way to an earthen berm with a rip rap lining. The slope was measured at .6%. The area is largely free of vegetation, as the town is required to keep the berm mowed. The channel narrows and grasses have been able to grow at the base of the rip rap. We observed ducks in this spot, so it is likely that this small amount of grass is providing them with food. However, the lack of shade in the summer means increased water temperatures which can be lethal to trout. It also leaves them vulnerable to predators. A satellite image shows just how exposed this section of river is (Figure 8). Ironically, the rectangular concrete channel gets shade at least part of the day, but this trapezoidal channel is completely open.

One promising feature in this stretch is the gravel and cobble lining of the channel. This is an ideal substrate for trout because it provides habitat for macroinvertebrates, their main source of food. It also can hold their eggs when they spawn. In addition, this coarse material is resistant to scouring and erosion (McBroom, 2004).

The water quality is clear and there is remarkably little trash. However, results of Elena Traister's water quality monitoring will reveal more about the health of the water.

This shallow, low slope reach extends for 1700 feet before reaching another 8 foot drop. This dam has the same problems for fish and recreation as the one upstream.


**Figure 8-**Site of proposed restoration

## Opportunities for Restoration

We have chosen this reach of river as the focus of our restoration plan because there are a variety of opportunities readily available. Recognizing the limitations facing small towns such as Adams, we present our recommendation in a series of least expensive and time consuming, to the most ambitious plan. We present these options in order of importance.

## Option 1: Do nothing

Any restoration plan should consider the alternatives to re-engineering the river. In this case, leaving the river as it is will do little to improve ecological function or promote recreation and tourism. Fish may be continually stocked upstream, but this practice is not sustainable in the long term if they cannot pass the dams to spawn. Another important consideration is maintaining the current system. Concrete has a life span of only about 100 years will need extensive repairs or replacement in the next 50 years.

## Option 2: Plant trees along berm and improve access for recreation

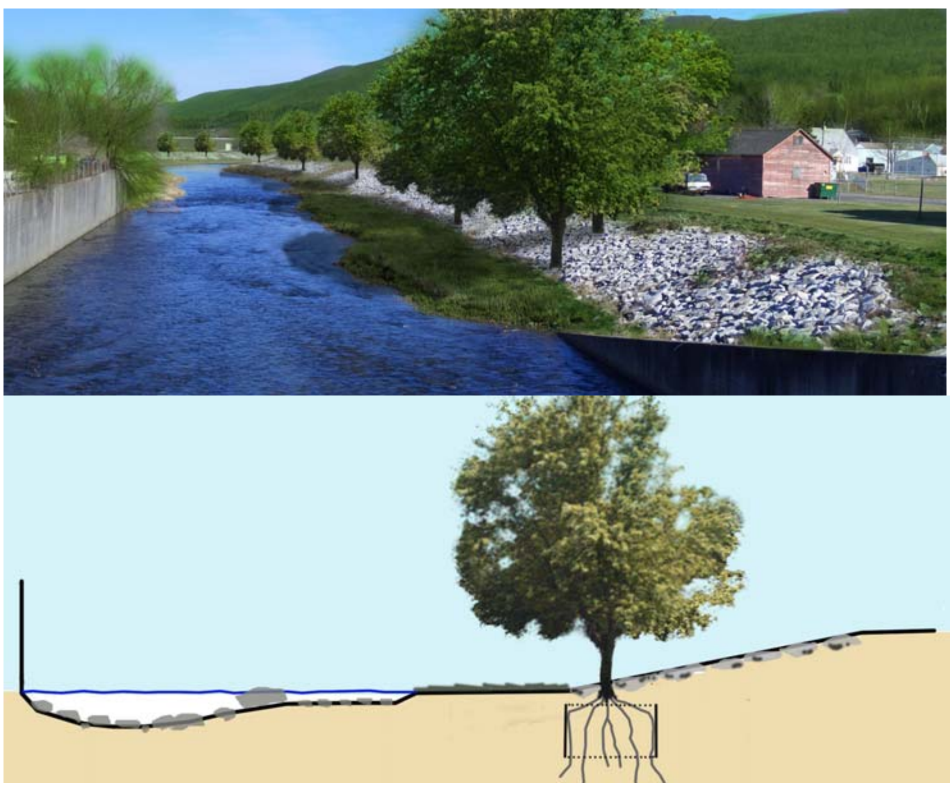

**Figure 9-**The Hoosic River with shade trees planted in the rip rap**.**

The Army Corps of Engineers has already given its approval for plantings in the rip rap. The Town of Adams should ake advantage of this relatively easy and inexpensive opportunity to improve the aesthetics and habitat value of the river. Large shade trees would provide shade and shelter for trout. Plantings on both sides of the river will be able to provide the aquatic habitat with shade in various sections. We recommend planting the trees in a "flower pot" method: place a 8 foot wide concrete pipe in the bank and plant the tree within it (Figure 9). This will keep the roots contained in one area. In the event of a hurricane or other catastrophic event, the tree may fall, but its roots will not rip a large hold in the rip-rap, creating greater flooding hazards. If there is further concern about trees washing out during flood conditions, they can also be anchored to a buried cement block

It is important to choose trees for this site that are going to tolerate the wet soil conditions and periodic flooding. Trees that are growing naturally in an undisturbed portion of the river can be good guides for what to plant. We recommend the following trees because they are frequently found in flood plains and their ranges extend beyond northern Massachusetts:

**Table 5-**Water Tolerant Vegetation

| Trees | | Shrubs |
|---|---|---|
| Red Maple | Black Gum | Speckled Alder |
| Silver Maple | Black Spruce | Buttonbush |
| River Birch | Black Willow | Pussy Willow |
| Cottonwood | Slippery Elm | Sand Bar Willow |
| Swamp White Oak | Sycamore | Common Elderberry |

(New England Wetland Plants, Inc.2004)

Trees would also make the river more inviting to people. To encourage recreation along this stretch of river, a simple solution would be to provide picnic tables or benches near the berm (Figure 10). A more extensive plan could include a handicapped-accessible ramp and platform at the edge of the river. This would allow elderly or disabled people to fish and enjoy views of the river. The demographics of Adams indicates that the population is elderly and would benefit from this form of passive recreation. For these reasons, Adams should consider making this river area into a town park. Extensive green space was encouraged in the Downtown Development Plan, and a park at this site would complement those plans. Drawing on the town's founding members, we tentatively call this area Friends Park. The town should explore other naming opportunities that would celebrate its long and rich history. There are a number of simple steps the town can take to develop this area into a park:

1. Signage: Clear signage can make people feel welcome and understand that they are not trespassing on private property. However, signs can do more than just announce the presence of a park. Clearly written interpretative signs are an important tool to communicate with the public about the river restoration project and about the environment in general.
2. Access: There is currently a playground and ball field just across the road from the river. Simply painting a cross walk and installing pedestrian signs would encourage the families using this park to extend their visit to the river.

3. Communication: Hold meetings and speak directly to the residents living closest to the river and the new park. Staying in communication with these stakeholders will increase their acceptance and use of the park.
4. Extend the Ashuwillticook Trail to this area. The bike path currently ends in the center of town, but could easily be extended to access this more natural part of the river.

**Figure 10-**The vision for a riverside park

**Option Three: Remove drops and regrade river bed**

The two eight-foot dams are currently impeding fish passage and discouraging human access and enjoyment of the river. A series of less dramatic drops would create a pool and riffle system that is passable by trout.

We considered a variety of designs for this slope and analyzed their flow using Manning's equation. Some had fewer, but more dramatic drops that would remain impassable to trout. We settled on this design with more drops but less severe (Table 6). This is ideal for trout passage because it features areas where the velocity is fast, followed by calmer areas in which the fish can rest. With the mean velocity of the current streamflow in the site, brook trout would not be able to swim more than 5 feet when the velocity is about 7ft per second (Figure 12). According to an article about designing culverts for fish passage, the velocity of water in the culvert (feet per second) should be based on the slowest sustained, swimming speed for the fish in the stream (UWEX). Another consideration is minimum water depth during low-flow periods. Fish may migrate during summer heat in search of cooler waters with higher oxygen levels. Brook trout should be maintained at a temperature of about 59°F and brown trout as high as 80°F (Massachusetts Department of Agricultural Resources). For these reasons, a thalweg should also be considered in stage of the project. This would remedy the low-flow conditions that are lethal to trout, and also create a run for canoes and kayaks.

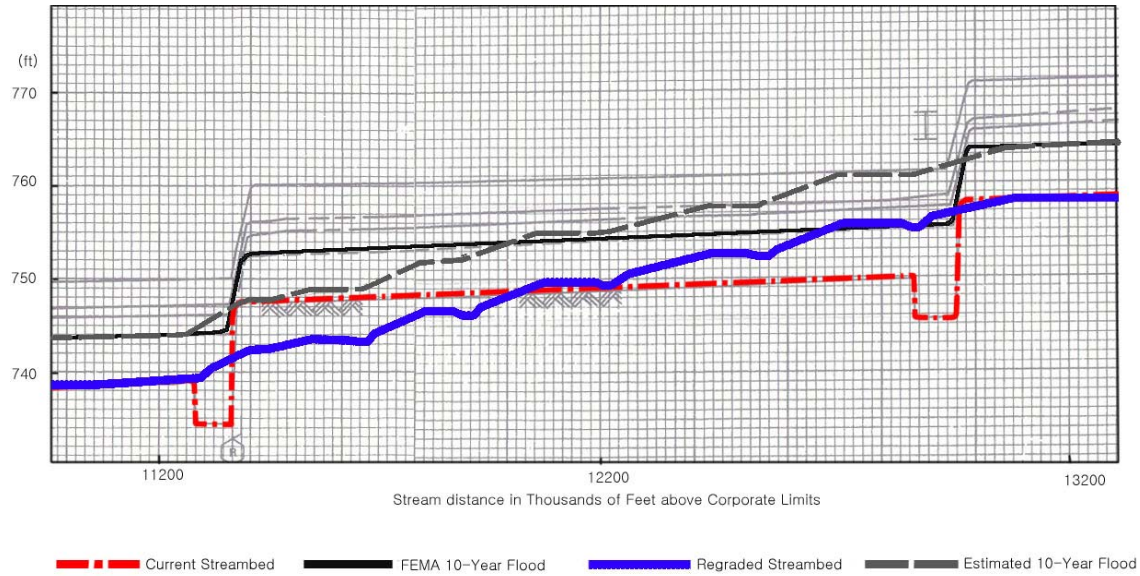


**Figure 11-**Regraded river bed (with FEMA Flood Profile)

**Table 6**-Pool-Riffle Spread Design

| Riffle number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
|---|---|---|---|---|---|---|---|---|
| Distance(ft) | 200 | 260 | 230 | 260 | 310 | 240 | 200 | 1700 |
| Channel Width(ft) | 70 | 62 | 65 | 68 | 180 | 86 | 66 | - |
| Slope | 0.0125 | 0.0108 | 0.014 | 0.0135 | 0.018 | 0.0175 | 0.0165 | - |
| Roughness | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | - |

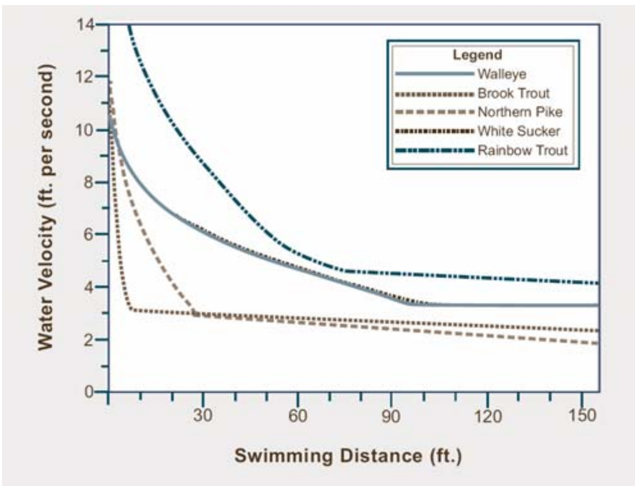


**Figure 12-**Limiting flow velocity for fish (Fish Friendly Culverts)

**Option Four: Move berm to accommodate wetland area**

Space is a luxury in the restoration of urban rivers, and Adams has the space to release the river from its highly symmetrical and contained shape. The adjacent property belonging to the Department of Public Works could easily be used to move the berm outwards, but left intact for flood control. This additional space could allow the river to be re-engineered to have a more natural meander, rather than running straight as it does now. A wetland area could also be included in the final design, which would contribute to the river's ecological and habitat values (Figure 13). Furthermore, a wetland would have value for birdwatchers and environmental education programs. The interpretative signage suggested in Option One could explain the functions of wetlands and identify plant and animals species that are common to this ecosystem. The access ramp also suggested in Option One would allow visitors to observe this area without damaging it.

The final diagram (Figure 14) shows the most ambitious restoration of this river, including all the pieces discussed above. While it may appear daunting, it can be accomplished over many years by restoring the river a portion at a time.

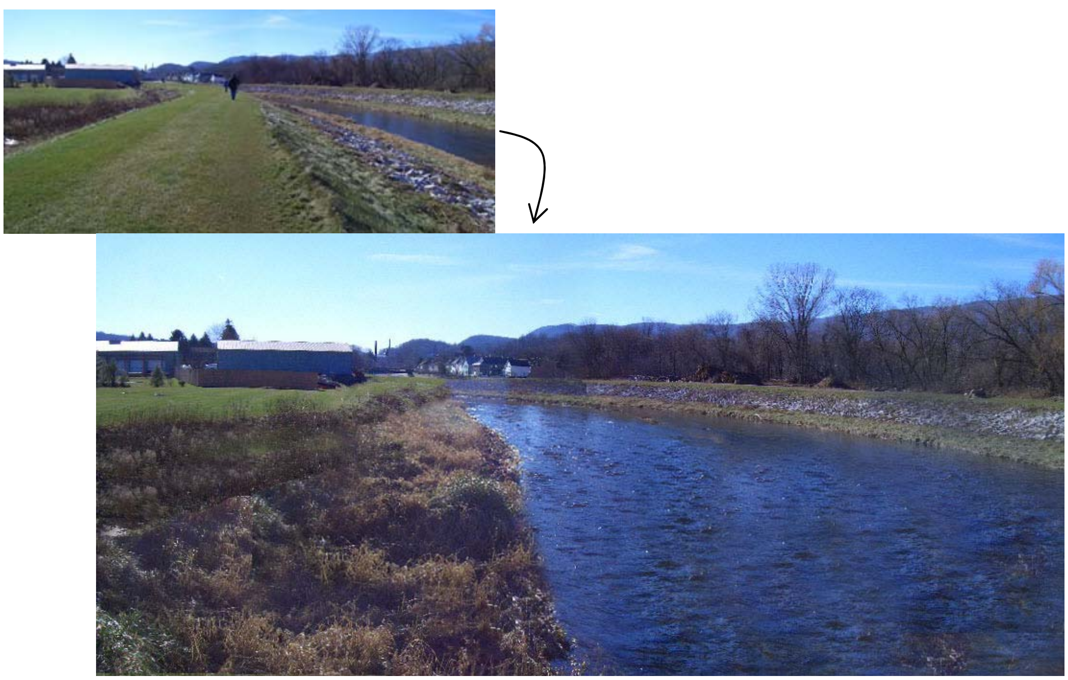

**Figure 13-**Creation of wetland area by moving berm


**Figure 14-**Master Plan

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