NYC Parks

Final Report on Fish Passage Construction at the East 182nd Street Dam, Bronx River

January 2015

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Prepared for:
Wildlife Conservation Society-National Oceanic and Atmospheric Administration
Lower Bronx River Partnership

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Other critical partners in this effort included: the Bronx River Alliance, the Wildlife Conservation Society, and the NYC Parks Capital Projects Division.

Finally, essential funding for this project came from our grantor, WCS-NOAA, as well as from Bronx Borough President, Rubén Díaz, Jr., the New York State Department of State Environmental Protection Fund and the National Fish and Wildlife Foundation.

NYC Parks

City of New York Parks and Recreation
Forestry, Horticulture and Natural Resources
Bill de Blasio, Mayor
Mitchell J. Silver, FAICP, Commissioner

Executive Summary

The objective of this Wildlife Conservation Society – National Oceanic and Atmospheric Administration (WCS-NOAA) Lower Bronx River Partnership funded project was to finalize designs and construction documents, obtain all necessary permits and approvals, and complete construction for the fish passage and canoe portage at the East 182nd Street Dam on the Bronx River in River Park, Bronx, NY (the River Park Fish Passage). Through this grant, our ultimate goal was to establish a sustainable river herring population in the Bronx River and thus to contribute to regional restoration efforts to protect anadromous fish by expanded access to freshwater spawning habitat. This project is a part of over a decade long effort by the City of New York Parks and Recreation, Natural Resources Group (NRG), our partner the Bronx River Alliance and other local, state and federal partners to restore the ecological integrity and maximize the ecological health and social value of the Bronx River.

Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), collectively known as river herring, are anadromous fish. They live most of their adult lives in the Atlantic Ocean with distribution from Newfoundland to North Carolina, and return to freshwater in the spring to spawn. Since the 1600s dams used for industry and agriculture have blocked fish migration on the Bronx River. Currently, alewife are known to swim up to the base of the first downstream dam at East 182nd Street, but have not been able to migrate upstream to suitable spawning habitat since they cannot navigate around the dam.

The River Park Fish Passage provides for access to 0.8 miles and approximately 12 acres of spawning habitat for river herring. This increased habitat availability will contribute to regional efforts to protect and restore habitat for river herring that serve as important prey for native fish and wildlife in our rivers, estuaries and the ocean. Through their migration, river herring also play an important role in nutrient and energy transport between freshwater and marine waters. The River Park Fish Passage is the first of three planned fish passages over dams on the Bronx River within Bronx, NY.

The final designs for this project included a structural fish passage, canoe portage, dam and retaining wall repairs and park improvements. Both the design work and construction funding was secured collaboratively by project partners from NYC Parks NRG and Capital Projects and the Bronx River Alliance.

WCS-NOAA originally granted NRG $375,000 for fish passage construction. In February 2012, NRG was awarded an additional $55,000 from WCS-NOAA for the project, making the total contribution $430,000. Bronx Borough President, Rubén Díaz, Jr. provided an additional $500,000, and New York State, Department of State Environmental Protection Fund awarded NRG $460,800 for the construction. The National Fish and Wildlife Foundation provided $150,000 for technical equipment and monitoring. The preparation of construction documents began in January 2010, and construction was complete in December 2014.

The River Park Fish Passage is slated to open for the first time in March 2015. This will be the first opportunity for river herring to migrate to spawn above the East 182nd Street Dam, which was originally constructed to power a mill, since the mid 1600s. Designs have recently been completed for the next two fish passage barriers on the Bronx River, the Bronx Zoo and Stone Mill Dams. NYC Parks and the Bronx River Alliance have secured partial funding for the construction of fish passage at the Bronx Zoo Dam and are seeking additional funding to complete both projects.

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Background

In 2002, the National Oceanic and Atmospheric Administration suggested that the City of New York Parks and Recreation (NYC Parks) Natural Resources Group (NRG) consider providing fish passage at the dams on the Bronx River to provide access to upstream habitat for river herring. River herring include alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*). These are anadromous fish, which live most of their adult lives in the Atlantic Ocean from Newfoundland to North Carolina, except when they return to freshwater streams in the spring to spawn. Since the 1600s, dams built for industry and agriculture have blocked fish migration on the Bronx River. As this was a new area of resource management for the NYC Parks, NRG gathered a team of expert advisors, and took steps to determine whether it would be possible to establish an anadromous fish run on the River.

The River Park Fish Passage is the first and furthest downstream of three planned fish passages over dams on the Bronx River within the Bronx, NY (Figure 1). The lower eight miles of the river is designated as the Bronx River Blueway by the National Water Trails System.

Anadromous Fish Restoration Feasibility Study

From 2003-2004, NRG and Lehman College conducted a WCS_NOAA funded study of the feasibility of restoring anadromous fish to the Bronx River[1]. The goal of the study was to identify and evaluate the relative importance of factors that could explain the absence of the fish, and that might limit river herring's access and ability to spawn and survive in the river. The study included review of historical river and fisheries information, extensive interviews with technical fisheries experts, collection of data on fish currently in the river system, and investigation of environmental variables that impact river herring and their habitat at various life stages. Critical environmental variables examined included water quality (temperature, dissolved oxygen, suspended sediment and contaminants), flow conditions (return frequency, velocity, and depth), and physical habitat conditions (substrate and channel bed morphology). The investigation focused on the most significant habitat in the lower two-thirds of the river (approximately 13 miles in length), where flow and channel conditions were thought to be most favorable for anadromous fish.

The study concluded that water quality, geomorphic, and hydrologic conditions were suitable for river herring survival, reproduction, and recruitment. The investigation also concluded that the removal of obstacles to upstream migration would allow access to spawning habitat for the fish, and help increase faunal diversity in the river. Water quality and hydrologic conditions have not changed significantly since the feasibility study was completed in 2004, according to on-going water quality sampling by the Bronx River Alliance, and hydrologic monitoring by the U.S. Geological Survey (USGS).

[1] http://www.nycgovparks.org/sub_about/parks_divisions/nrg/bronx_river_epa/aquatic_life/aquatic_life_pages/Anadromous_fish/Anadromous_Fish_reintroduction/anadromous_fish_reintroduction.html

Figure 1: Fish migration barriers on the Bronx River.

Fish Passage Goals and Approach

By 2004, in part as a result of the feasibility study, the Bronx River stakeholders agreed that improving access to upstream habitat through fish passage ways on the Bronx River would contribute to regional efforts to protect and restore habitat for river herring. These fish serve as important prey for native fish and wildlife in our rivers, estuaries and the ocean. Today's populations of river herring have been drastically reduced from historic levels and continue to decline in many locations in the Northeast due in part to migration barriers. Construction of fish passages around these barriers will help reverse this trend by expanding habitat available to river herring. The establishment of passageway will also help increase regional population size and sustainability of river herring that support recreational and commercial fisheries. Predators of river herring already present in the Bronx River system include striped bass (*Morone saxatilis*), redbreast sunfish (*Lepomis auritus*), snapping turtles (*Chelydra serpentina*), great blue heron (*Ardea herodias*) and osprey (*Pandion haliaetus*). The presence of adult and juvenile river herring in freshwater and estuarine systems could contribute to in an increase in prey available for these larger fish and wildlife.

To begin the process of establishing fish passage around the Bronx River dams in the Bronx, WCS-NOAA funded the design development for all three dams on the Bronx River. Milone and MacBroome, Inc. (MMI) an engineering firm with extensive fish passage design experience, was selected to develop the designs. After a three year process of working with property owners, land managers, technical advisors, and regulators, 50% designs were approved for each of the three dams. The community, as well as educators, boaters and naturalists along the Bronx River will benefit from the habitat connectivity and improved canoe portage that this project provides.

In addition to establishing fish passage, the feasibility study advised stocking adult alewife to spawn in the Bronx River. This stocking would jump start the fish run by ensuring that there would be a population of juvenile fish born in the Bronx River; alewife return to their natal river to spawn each year. NRG worked with the Connecticut Department of Energy and Environmental Protection (CTDEEP) on transplanting alewife to the Bronx River upstream of the East 182nd Street Dam in the spring of 2006 and 2007 through a WCS-NOAA funded project. The stocking appeared successful as evidenced by the survival of the adult fish and indications of juvenile fish in the summer after the stocking.

In 2009 and 2010, NRG conducted monitoring at the base of the East 182nd Street Dam through a 2007 National Fish and Wildlife Foundation (NFWF) grant. Alewife were captured swimming up to the base of the East 182nd Street Dam, indicating they would use an upstream passageway at the dam if it were available.

Current Project Objectives

The objective of this WCS-NOAA Lower Bronx River Community Partnership funded project was to finalize designs and construction documents, obtain all necessary permits and approvals, and complete construction for the fish passage and canoe portage at the East 182nd Street Dam on the Bronx River in River Park, Bronx, NY (the River Park Fish Passage). This fish passage contributes to our ultimate goal of establishing a sustainable river herring population in the Bronx River and thus to contributing to regional restoration efforts to protect anadromous fish by expanded access to freshwater spawning habitat. This project also presents a significant milestone in the more than decade long effort by NRG, our partner the Bronx River Alliance and other local, state and federal partners to restore the ecological integrity and maximize the ecological health and social value of the Bronx River. The River Park Fish Passage will provides for access to 0.8 miles and approximately 12 acres of spawning habitat for river herring

Design and Permitting

The final designs for this project included a structural fish passage, canoe portage, dam and retaining wall repairs and park improvements. Both the design work and construction funding was secured collaboratively by project partners from NYC Parks NRG, NYC Parks Capital Projects and the Bronx River Alliance. Fish passage monitoring equipment was designed by fish passage experts in the northeast.

Design Development and Review Process

The Bronx River Alliance contracted with MMI to advance the existing 50% design plans for the River Park Fish Passage with $57,000 in funding from WCS-NOAA. MMI designed the structural fish passage to include a prefabricated Alaskan SteepPass[2] which essentially consists of a series of trough-like aluminum ramps with baffles that dissipate the waters energy to allow fish to swim up them. The whole aluminum structure was encased in reinforced concrete to reduce the risk of vandalism at this heavily used site and to provide support for canoe portage. This design incorporated typical fish passage elements including flow designed to attract fish and turning and resting pools to allow the fish to swim up over the 17.7 foot high dam. MMI also incorporated dam rehabilitation and canoe portage into the design.

NRG collected comments during the design process from our technical advisory team that includes Steve Gephardt, Supervising Fisheries Biologist for Inland Fisheries at CTDEEP; Curt Orvis, Fish Passage and Water Resource Supervisor at U.S. Fish and Wildlife Service; Alex Haro, Ecologist and Section Leader for Fish Passage Engineering at the U.S. Geological Survey's S.O. Conte Anadromous Fish Research Center (USGS); and Jim Turek, Restoration

[2] The Alaskan SteepPass was manufactured by Sheepscott Machine Works, Newcastle, ME.

Ecologist at the NOAA Restoration Center. The designs also went through the NYC Parks Capital Projects review process, which included evaluation by a team of landscape architects, engineers and Parks commissioners. NRG also worked closely with WCS to review elements of the design on Bronx Zoo property including retaining wall improvements, riparian forest restoration, monitoring equipment installation and associated electrical work.

Design Elements

A landscape architect from the NYC Parks Capital Projects Design Team designed elements that were not related to the fish passage including landscape features and plantings, a stormwater retention swale and other amenities within the park. NRG contracted with Tectonic Engineering and Surveying Consultants, P.C. (Tectonic) to conduct the geotechnical investigation of the east side retaining wall, consisting of a topographic survey, engineering inspection of the dam cap and eastern retaining wall, and subsurface investigations (soil borings). Tectonic developed the analysis and recommendations for repairing the retaining wall. Parks' Capital Projects Engineering Team developed the design for the repair of the retaining wall based on the geotechnical work and recommendations by Tectonic. The final designs included canoe portage over the fish passage to accommodate the educational canoe trips that are led by the Bronx River Alliance. Final designs were completed in 2012.

Monitoring Equipment

Fish passage monitoring equipment was designed by experts in the northeast from USGS and CTDEEP and procured through a 2007 NFWF grant. The design is based on proven successful monitoring practices used on fish passages in Massachusetts and Connecticut. The design uses the best available technologies including a Smith-Root-1101 fish counter[3] and infrared Sea Drop Rugged Underwater Camera[4] which will be connected to Fish Tick[5] software to ease data collection and analysis. In the spring of 2012, the CTDEEP Office of Inland Fisheries tested the fish passage monitoring equipment for NRG at a fish passage at Brides Brook in East Lyme, CT. NRG visited CTDEEP in spring of 2014 to pick up the monitoring equipment, receive training on its use and installation and tour working fishways where similar equipment was used, such as the Moulson Pond Fishway on Eightmile River in Haddam, CT.

Dam Repair

The East 182nd Street Dam is a stone masonry dam, which once had a smooth face, but was transformed with boulders in the 1910s to generate a cascading, waterfall-like appearance. It has a smooth, concrete-top spillway where the water cascades over the dam (Photo 1), which may have been last updated in the 1950s, when the last repair work was done on the abutments of the dam. This dam has a low level intake system which at the time of design was defunct but is meant to lower the water level of the impoundment as a flood precautionary measure.

[3] Manufactured by Smith-Root, Vancouver, WA.
[4] Distributed by EZSpyCam, Los Angeles, CA.
[5] Manufactured by Salmonsoft, Portland, OR, to combine computer and video technology.

In addition to fish passage installation, this project was required by the New York State Department of Environmental Conservation (NYSDEC) Dam Safety Office to upgrade the dam to address dam safety issues. There was evidence of dam leakage on both sides of the dam, in the abutments and retaining walls, or non-overflow sections of the dam. Designs were developed to address the existing leakage and to either repair or remove the dam's defunct low level intake system.

Photo 1: Dam Spillway looking north before fish passage construction.

Permitting and Approvals

Several permits were required from regulatory agencies for construction of the fish passage. NRG applied for and obtained the permits, and MMI provided technical support and documentation.

NYSDEC-USACE Joint Permit

A NYSDEC / U.S. Army Corps of Engineers (USACE) Joint Permit was required because the project could disturb a stream, affect water quality and involved excavation. The USACE

reviewed our application and determined that an individual permit was not required by their office for this project. NRG received a permit from NYSDEC in December 2011.

NYSDEC Dam Safety

Due to the location of the fish passage on the dam, review and approval by NYSDEC's Dam Safety Office was required. The dam had to be in safe operating condition and NYSDEC determined that the east side retaining wall and dam low level intake needed rehabilitation.

Public Design Commission of the City of New York

The Public Design Commission of the City of New York (PDC) reviews proposed permanent structures on city owned property. The PDC approved construction of the fish passage and its related features in September 2010.

New York State Historic Preservation Office

The New York State Historic Preservation Office (SHPO) reviews projects in accordance with Section 106 of the National Historic Preservation Act of 1996 to determine effects on any significant historical resources. This project was reviewed by SHPO in September 2010 and it was determined to have no adverse effect upon historic resources.

New York City Environmental Quality Review

Agencies within the City of New York are required to review proposed projects, identify the effects that the projects may have on the environment, and prepare an environmental assessment statement to reveal any potential impacts that could be avoided by altering the project design. An environmental assessment statement results in either a positive or negative declaration. A positive declaration means that the project may have a significant effect on the environment and an environmental impact statement must be prepared. A negative declaration means that the project will not have a significant impact on the environment and the City Environmental Quality Review (CEQR) process is complete. In November 2011, the NYC Parks Assistant Commissioner for Planning and Parklands made a "negative declaration" determination for this fish passage because the project does not pose a significant adverse impact on the environment.

Tree Restitution

NRG worked with NYC Parks' Bronx Forestry Division on tree protection and restitution plans for the project, as required by NYC Local Law 3. These plans were incorporated into the final design plans.

Construction

Funding and Bid

WCS-NOAA originally granted NRG $375,000 for fish passage construction. In February 2012, NRG was awarded an additional $55,000 from WCS-NOAA for the project, making the total contribution $430,000. Bronx Borough President, Rubén Díaz, Jr. provided an additional $500,000, and New York State, Department of State Environmental Protection Fund awarded NRG $460,800 for the construction. State and local funds were used to pay for park amenities including new picnic tables and barbeque grills, non-natural area park plantings, railing and other amenities that are not related to fish passage. Thus, these elements are not included in this report. Fish passage monitoring equipment and the Alaskan SteepPass was purchased under the previously mentioned 2007 NFWF grant for $150,000.

The construction project was put out to bid with pre-qualifications that required that the contractor had experience with dam and in-water construction. A bid review was held in October 2012. NYC Parks received three bids for the project and awarded the work in December 2012 to the lowest bidder who met the pre-qualifications, as per NYC Parks requirements: Trocom Construction Corporation of Maspeth, NY.

Memorandum of Agreement

Since some elements of this project were constructed on the Bronx Zoo's campus, which is managed by WCS, a memorandum of agreement (MOA) was signed by the NYC Parks and WCS in April 2013 in order to create a formal understanding for the construction schedule, site access and security. Construction on the east side of the river was scheduled to coordinate with the Zoo's monorail operations. In December of 2013, WCS requested that plans be changed for the access road and fencing on the east side of the river. NYC Parks complied with the requests for the changes. The Bronx Zoo is under the jurisdiction of the U.S. Department of Agriculture Animal (USDA) and Plant Health Inspection Service (APHIS). All fencing around the Contractor Work Area was designed, constructed and maintained to satisfy USDA and APHIS regulations pertaining to perimeter fencing for zoological facilities.

NYC Parks worked closely with WCS staff to help the contractor obtain access to the Zoo's campus. The contractor accessed the Zoo utility gate adjacent to the Asia Exhibit from East 180th Street for work on the east side of the river. For work on the west side of the river, the contractor accessed the Zoo's campus from the service entrance at Boston Road. The monitoring equipment enclosure, on the west side of the river, was relocated from the original location on the plans to the southern fence near the Zoo's co-generator plant.

Construction Supervision

Supervision of the construction was conducted by a team including NRG, Parks Capital Projects and the design consultant, MMI. Parks Capital Projects provided the Resident Engineer and the Landscape Architect, who coordinated shop drawing submittals and issued the contractor design directives. NRG's Bronx River Ecological Restoration Project Manager and Director of Wetlands and Riparian Restoration oversaw technical aspects of fish passage construction, dam safety, erosion control and native plantings, advised the Resident Engineer and Landscape Architect and served as liaison to the design consultant.

The construction funding for fish passage and dam repair covered the contractor's bid price as well as onsite construction supervision and the required minimum 10% construction contingency. For the duration of the project, Parks' resident engineer was onsite at all times providing construction supervision. This had the advantage of ensuring Parks engineering standards were met. However, none of Parks' in house resident engineers had experience in fish passage construction or dam repair. To address this issue, NRG partnered with the Bronx River Alliance to seek additional funds from WCS-NOAA for a consulting engineer with expertise in fish passage construction, dam repair and water control on a flowing river, and construction of this particular steep-pass fish way.

Partnering with NRG, the Bronx River Alliance was awarded $70,000 to hire MMI, the same firm that designed the fish passage to perform technical construction supervision. NRG worked closely with the Alliance to manage the consultants. MMI redesigned the plans for unforeseen dam safety purposes (described in the following section), confirmed elevations in the field and reviewed shop drawings from the contractor during construction.

NRG led site tours with members of the fish passage technical advisory team. In May 2014, Jim Turek of the NOAA Restoration Center visited the site. In October 2014, Steve Gephard of CTDEEP, visited the site and provided insight on equipment security and maintenance.

Schedule

Due to unforeseen construction delays (which are described in the following sections), NRG applied for a grant extension with WCS. The extension was granted and the contract was completed on December 1, 2014.

Construction Elements

There were several components to the construction of this project: water control, fish passage, dam and retaining wall repairs, canoe portage and restoration planting.

Trocom was responsible for construction of the fish passage, and worked with subcontractors to complete the electrical, landscaping and metal work. The NYC Parks Resident Engineer was onsite daily. There were biweekly meetings with representatives from Trocom and their

subcontractors, NRG, Bronx River Alliance and Parks Capital Projects and Construction Divisions. NRG also visited the site at least once per week to facilitate work.

Trocom was issued an order to work on April 29, 2013. They did not submit shop drawings in advance of the order to work and there were delays in mobilization of the project site that Trocom attributed to staff changes. These delays and others prompted NRG to apply for a grant extension, as described previously. Work began in earnest in October 2013 and there were no contractor caused delays thereafter. The majority of the work was completed in a twelve month period between October 2013 and October 2014.

Water Control

The river was dewatered directly downstream of the dam to accommodate installation of the entrance of the fishway (Photos 2a, 2b) in October 2013. This area was dewatered using sandbags. The contractor was unsuccessful at their first attempt in dewatering this area in an attempt to cover a larger section of the river than needed. They moved the sandbags closer to the bank and were able to dewater a smaller section of the river. A coffer dam was used on the upstream side of the dam for water control during construction in October 2013. The coffer dam was installed beneath the river across approximately half of the dam's spillway (Photos 3a, 3b). Once the coffer dam was in place, the remaining water was pumped out of the upstream area behind the dam.

The coffer dam was breached on May 1, 2014, after an approximately five inch rain event (Photos 4a, 4b). The flow associated with this rain was approximately 1700 cfs (cubic feet per second) according to the USGS gauge at the New York Botanical Garden, approximately one mile north of the site (Figure 2). Fortunately, this happened the day after concrete work was completed on the upstream side of the dam.

Photo 2a: Downstream dewatering looking north.

Photo 2b: Downstream dewatering looking east.

Photo 3a: Installation of the coffer dam on the upstream side of the dam.

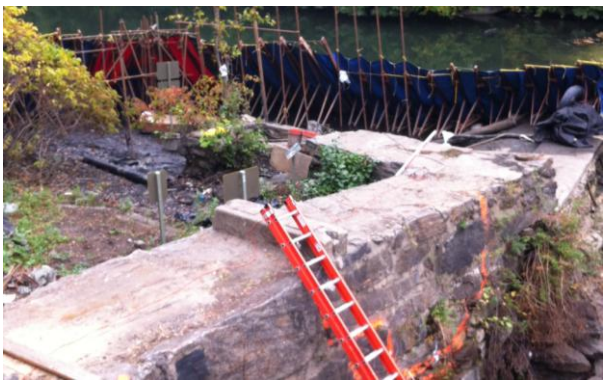

Photo 3b: Installed coffer dam on the upstream side of the dam.

Photo 4a: May 1, 2014 coffer dam breach facing north.

Photo 4b: May 1, 2014 coffer dam breach facing east.

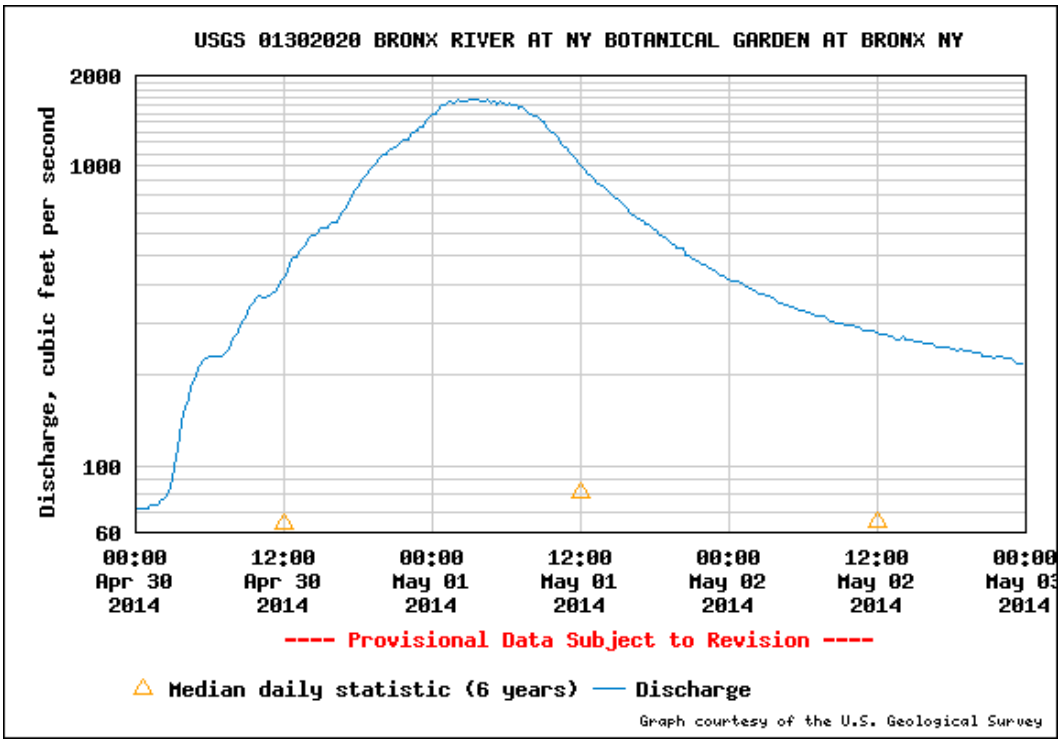

Figure 2: May 1, 2014 rain event created a 1700 CFS flow on the Bronx River, breaching the coffer dam at the construction site.

Fish Passage

As described in earlier sections, the River Park Fish Passage is composed of concrete and metal components. A temporary earthen ramp was built just downstream and to the west of the dam for heavy machinery to access the non-overflow section of the dam where the fish passage would be built. In order to install the fish passage, sections of the western portion of the non-overflow sections of the dam were removed (Photos 6a, 6b). All of the sections of the Alaskan SteepPass aluminum fish way were encased in reinforced concrete that was poured into plywood forms (Photos 7a-7e). The steeppass was installed in July 2014. Weir boards were used to keep water from flowing through the fish passage during construction; the same weir boards will be used to close the fish passage when river herring are not migrating. A flow test was conducted on July 14, 2014 and water flowed through the fish passage for the first time (Photo 8).

Photo 6a: Section removed from dam outlined in orange paint.

Photo 6b: Dam section being removed and looking north.

Photo 7a: Upstream reinforced concrete and forms.

Photo 7b: Upstream reinforced concrete and forms.

Photo 7c: Downstream reinforced concrete and forms.

Photo 7d: Downstream reinforced concrete and forms.

Photo 7e: Downstream reinforced concrete and forms.

Photo 8: Fish passage open test.

Low Level Intake System

The design plans called for rehabilitation of the low level intake system of the dam. The function of the low level intake is to lower the water level of the impoundment (area of ponded water upstream of the dam) as a flood precautionary measure. The elements of the low level intake system include a 36" intake pipe on the upstream side of the dam that conveys water into a concrete water chamber. Within the water chamber there is a steel gate that can open and close the 36" intake pipe and an output pipe (which is at a lower elevation than the intake pipe) that conveys water from the water chamber to the downstream side of the dam.

The dam's low level intake system differed from the 1958 plans on which the designs were based. After the upstream side of the dam was dewatered, the contractor discovered that rather than having a functioning gate to open and close the intake pipe within the water chamber, there was a concrete floor that sealed the gate within the water chamber (Photo 9a). Site inspections were performed with engineers from NYC Parks, MMI and NYSDEC's Dam Safety Office and alternatives for addressing the issue were proposed (Photo 9b). It was determined that the sediment load behind the dam was so high that even if the low level intake system functioned, it would not be able to significantly lower the water level of the impoundment. The contractor attempted to locate the intake pipe in the impoundment but was unable find it to due to the high sediment load. MMI revised the plans to decommission the low level intake system. This caused significant delays; multiple meetings and conference calls were held with NRG staff and the design consultant, to revise the design.

Photo 9a: Defunct low level intake water chamber.

Photo: 9b Inspection of low level intake water chamber.

Dam Leakage

Immediately following the removal of the coffer dam on May 28, 2014, water was observed flowing through the mortar between the existing and newly placed boulders in the western portion of the non-overflow section of the dam (which leaked prior to construction) (Photo 10a). NRG immediately notified the NYSDEC Dam Safety Office who performed a site inspection shortly thereafter. NRG also performed site visits with Jim MacBroom and other design engineers at MMI and came up with approaches to addressing the leakage.

This area of the dam did not leak when the coffer dam was breached during the May 1, 2014 rain event (see Photos 4a, 4b and 5 in previous section). This indicated that the origin of the dam leak was from an area farther east in the spillway and not directly behind the western portion of the dam through which the water was visibly flowing. Jim MacBroom stated that it is common that stone masonry dams leak, especially ones as old as the East 182nd Street Dam and that it is not always obvious where the leak originates.

NRG proposed monitoring the dam and reporting any changes in condition to the NYSDEC Dam Safety Office. The dam leakage has been variable but has decreased since the coffer dam was removed (Photo 10b). As of January 2015, there is little to no leakage.

Photo 10a: Dam leakage immediately after coffer dam removal on May 28, 2014.

Photo 10b: Dam leakage 12 days after coffer dam removal on June 9, 2014.

Retaining Wall Repairs

The NYSDEC Dam Safety Office required repairs to the retaining wall on the east side of the dam at the Bronx Zoo. The plans were designed in house by the NYC Parks Capital Projects Design Team and included leak repair, wall reinforcement and re-anchoring of the fencing around the Zoo's monorail (Photos 11a, 11b).

Photo 11a: East side retaining wall during construction.

Photo 11b: Repaired east side retaining wall with with boulder reinforcement.

Canoe Portage

As a National Water Trail, the Bronx River Blueway is open to recreational kayakers and canoeists year round. To ensure safety of paddlers, the East 182nd Street Dam canoe portage was closed during construction from March 2013 to December 2014. An improved canoe portage was incorporated into the construction of the fish passage. Grating and railing was placed over the concrete structure and granite steps were installed to lead paddlers down to the river (Photos 12a, 12b). After further review, the Bronx River Alliance determined that the height of the fish passage on the upstream side of the dam where paddlers exit their boats was too tall. They are currently seeking funding to install a step to accommodate paddlers.

Photo 12a: Steps for canoe portage.

Photo 12b: Grating and railing on canoe portage.

Restoration Plantings

Vegetated riparian areas on both sides of the river were disturbed due to the need to access the dam for construction. The undeveloped rocky ledge just south of the fish passage on the west

side was restored with riparian vegetation tolerant of shallow soils and potentially drought-like conditions; the dominant species planted here were bear oak (*Quercus ilicifolia)*, Virginia creeper (*Parthenocissus quinquefolia*) and meadowsweet (*Spirea latifolia*) (Photo 13, Figure 3, Appendix). The east side of the dam was replanted to establish a riparian forest; the dominant species planted here were red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*) and red oak (*Quercus rubra*) and seeded with native understory vegetation.

Photo 13: Planted area just south of the fish passage.

Figure 3: River Park Fish Passage and planted areas.

Next steps and On-going River Restoration

Next Steps

The construction of the River Park Fish Passage is a milestone for restoration on the Bronx River and has helped build momentum for furthering the anadromous fish restoration program. NRG and the Bronx River Alliance will be monitoring and maintaining the new fish passage, planning additional alewife stocking, as needed, and fund-raising for fish passage on the next two upstream migration barriers.

NRG will manage and monitor the River Park Fish Passage starting in the migration season of 2015. NRG has secured funding through the U.S. Environmental Protection Agency's Urban Waters Cooperative Agreement for maintenance and monitoring and for community engagement around the fish passage in 2015 and 2016. After the 2015 migration season, NRG, under the guidance of our technical experts, will determine whether it would be beneficial to stock alewife upstream of the River Park Fish Passage in 2016.

The next upstream dams are the Bronx Zoo and Stone Mill Dams. Final designs for the fish passage at these two dams were developed and approved in August 2014 by the landowners: NYC Parks, WCS and the New York Botanical Garden (NYBG). NRG and the Bronx River Alliance are actively seeking funding for construction of the next upstream fish migration barrier within the Bronx Zoo. Construction of the Bronx Zoo Dam fish passage will likely not be begin until successful fish migration is observed at the River Park Fish Passage. Subsequently, funds will be sought to construct the Stone Mill Dam fish passage after successful fish migration is observed at the Bronx Zoo Dam fish passage.

Future Considerations

Dam removal was not considered as a viable alternative for fish passage at the East 182nd Street Dam due to aesthetic and historical considerations valued by WCS. However, it should be noted that dam removal has been increasingly implemented around the country, including extensively in Pennsylvania, as well as in Ohio, Maine, Oregon and Washington, for long term ecological and safety benefits. The ecological benefits of dam removal often outweigh building fish passage for one species. These benefits include non-migratory fish movement within the river and sediment transport to the estuary. In the future, review of fish passage design alternatives on the Bronx River should include a thorough review of the dam removal alternative.

On-going River Restoration

Over the last decade, NRG has partnered with many local organizations and secured funding from state and federal agencies to improve in-stream habitat and riparian conditions along the Bronx River. Additional forest restoration work along the river has been funded by the PlaNYC initiative[6]. As part of this continuous effort, we have implemented bank stabilization, re-vegetation, and floodplain forest restoration projects in freshwater reaches in Bronx Park. NRG has also installed boulder vanes and large woody debris to restore some of the aquatic cover, in-stream structure, and pool habitat that was lost through channelization, channel clearing, and invasive species proliferation. Under NRG's guidance, the Bronx River Alliance modified their routine management of fallen trees so that limbs are cleared to allow canoe and kayak passage, while still allowing large woody debris to be retained in the river to provide aquatic habitat benefits. These restoration and management efforts are incrementally helping to reduce sediment and nutrient loads and increase the quantity and diversity of habitats available to fish, invertebrates, and other riverine species.

[6] http://www.nyc.gov/html/planyc/html/home/home.shtml

Appendix: Riparian Plantings

East Side Riparian Planting		West Side Riparian Planting	
Scientific Name	Common Name	Scientific Name	Common Name
Acer negundo	Boxelder	*Acer rubrum 'October Glory'*	Red Maple
Acer rubrum	Red Maple	*Aesculus x carnea*	Red Horsechestnut
Acer rubrum 'October Glory'	Red Maple	*Amelanchier arborea*	Serviceberry
Acer saccharinum	Silver Maple	*Betula nigra*	River Birch
Amelanchier canadensis	Serviceberry	*Catalpa speciosa*	Northern Catalpa
Betula lenta	Black Birch	*Liquidambar styraciflua*	Sweetgum
Betula nigra	River Birch	*Magnolia stellata*	Star Magnolia
Cornus florida	Flowering Dogwood	*Malus*	Prairie Fire Crabapple
Liquidambar styraciflua	Sweetgum	*Nyssa sylvatica*	Wildfire Black Gum
Liriodendron tulipifera	Tuliptree	*Pinus strobus*	Eastern White Pine
Nyssa sylvatica	Wildfire Black Gum	*Quercus rubra*	Red Oak
Platanus occidentalis	American Sycamore	*Rhododendrom maximum*	Rosebay Rhododendron
Prunus serotina	Black Cherry	*Salix discolor*	Pussy Willow
Quercus bicolor	Swamp White Oak	*Salix sericea*	Silky Willow
Quercus bicolor	Swamp White Oak	*Tilia americana*	Basswood
Quercus palustris	Pin Oak	*Ulmus americana*	American Elm
Quercus prinus	Chestnut Oak	*Aronia arbutifolia*	Red Chokeberry
Quercus rubra	Red Oak	*Abelia grandiflora*	Glossy Albelia
Salix discolor	Pussy Willow	*Cornus alba*	Varigated Dogwood
Salix nigra	Black Willow	*Cornus racemosa*	Gray Dogwood
Salix sericea	Silky Willow	*Cornus sericea*	Red-Twig Dogwood
Ulmus americana	American Elm	*Hydrangea quercifolia*	Oakleaf Hydrangea
Aronia arbutifolia	Red Chokeberry	*Ilex verticilata*	Winterberry
Cornus amomum	Silky Dogwood	*Itea virginica*	Sweetspire
Cornus racemosa	Gray Dogwood	*Jasminum nudiflorum*	Winter Jasmine
Cornus sericea	Red-Twig Dogwood	*Juniperus chinensis*	Angelica Blue Juniper
Ilex verticilata	Winterberry	*Lindera benzoin*	Spicebush
Lindera benzoin	Spicebush	*Rosa*	Sunny Knockout Rose
Parthenocissus quinquefolia	Virginia Creeper	*Viburnum dentatum*	Blue Muffin Arrowood Viburnum
Acer rubrum	Red Maple	*Yucca filamentosa*	Adam's needle
Aronia arbutifolia	Red Chokeberry	*Nepeta x faassenil*	Catmint
Betula lenta	Sweet Birch		
Liquidambar styraciflua	Sweetgum		
Quercus bicolor	Swamp White Oak		
Quercus palustris	Pin Oak		
Quercus prinus	Chestnut Oak		
Quercus rubra	Red Oak		
Lindera benzoin	Spicebush		