

Gilboa Dam Reconstruction Site Case Study: Using a Variety of Inventive Erosion, Sediment, and Stormwater Controls to Protect Natural Resources

Author:

Jennifer Cass, PE, Hazen and Sawyer, PC
498 Seventh Avenue, Eleventh Floor
New York, NY 10018
(212) 539-7034
(f) (212) 614-9049
jcass@hazenandsawyer.com

Biography:

Ms. Cass graduated with a BS in Environmental Engineering from Rensselaer Polytechnic Institute in 1998. She has over 10 years of practice in site design, stormwater management and conveyance, and erosion and sediment control design. She has been a member of IECA since 2008. She is a licensed Professional Engineer in the State of New York and a LEED Accredited Professional.

Abstract:

The New York City Department of Environmental Protection (NYCDEP) is undertaking a major rehabilitation of the Gilboa Dam utilizing innovative yet proven effective measures to control erosion and sediment during construction. This case study will discuss the extraordinary measures that will be taken to protect the sensitive natural resources surrounding the Gilboa Dam, located in the rural community of Gilboa, NY. Local natural resources include the Schoharie Reservoir, a 17.6 billion gallon reservoir that is a major component of the NYCDEP drinking water supply system; Schoharie Creek, which is fed by Schoharie Reservoir and flows downstream to the Blenheim Gilboa Reservoir; as well as several amphibian-breeding wetlands and small streams. The work on the Dam will be completed over six years in four phases, each with a customized set of erosion, sediment, and stormwater control measures protecting the adjacent surface water bodies. During an initial contract, site improvements include repaving of a roadway and installation of utilities within the Dam Embankment. Since this work will be adjacent to the Reservoir, perimeter erosion and sediment controls will be implemented to prevent migration of sediment into the Reservoir. In addition, stormwater quality improvement measures will be constructed, including bioretention cells and a sand filter. The second construction phase will prepare the 56-acre site surrounding the Dam for the main Dam Reconstruction project. This phase will involve the installation of temporary and permanent roadways, staging area, a field office complex, an on-site permanent disposal area, and perhaps most importantly, best management practices (BMP's) to protect both natural resources on and off site. Comprehensive erosion and sediment control practices include nine sediment traps/basins, six pipe slope drains, 18,000 feet of silt fence, 17,000 feet of diversion and on-site swales, truck washes, stabilized construction entrances, Reservoir containment booms, seeding and mulching, erosion control matting, and weir tanks equipped with polyacrylamide dosing. In addition, several stormwater wetlands will be constructed to reduce runoff flow rates and enhance water quality from permanent access roads. Under the third phase of work, the actual Dam Reconstruction will be performed and will rely heavily on the BMPs installed in the prior contract for protection of surface water bodies. However, maintenance of BMPs will be a very important part of this phase. The fourth phase of work will restore and improve the site from its preconstruction condition by removing temporary impervious surfaces, constructing additional stormwater quality wetlands, and planting native grasses, shrubs, and trees throughout the site. At each step of construction, the project will strive to protect sensitive natural resources with the use of innovative and tailored erosion and sediment control practices and permanent stormwater quality features that best match the respective application.

Key Words: Phased construction, customized erosion control, stormwater management

Introduction/Project Background

New York City Department of Environmental Protection (NYCDEP) has proposed major rehabilitation and improvements to appurtenances in and around the Gilboa Dam, to extend its service life and bring it into compliance with New York State Department of Environmental Conservation's (NYSDEC) dam safety guidelines. Designed by a joint venture of Hazen and Sawyer, PC and Gannett Fleming (H&S/GF), reconstruction of the Dam will be implemented over the next six years. In addition, supplementary flood control measures will be installed, two new permanent site access roads will be constructed, and a Dam overlook area will be renovated. To support this work, an extensive network of temporary facilities will be developed on site, resulting in a total project site of 86 acres and requiring a large amount of clearing and site disturbance. NYCDEP and H&S/GF recognized that this substantial project size requires tremendous attention to erosion and sediment control (ESC) and stormwater control, to protect the sensitive waterbodies and natural resources on and off site.

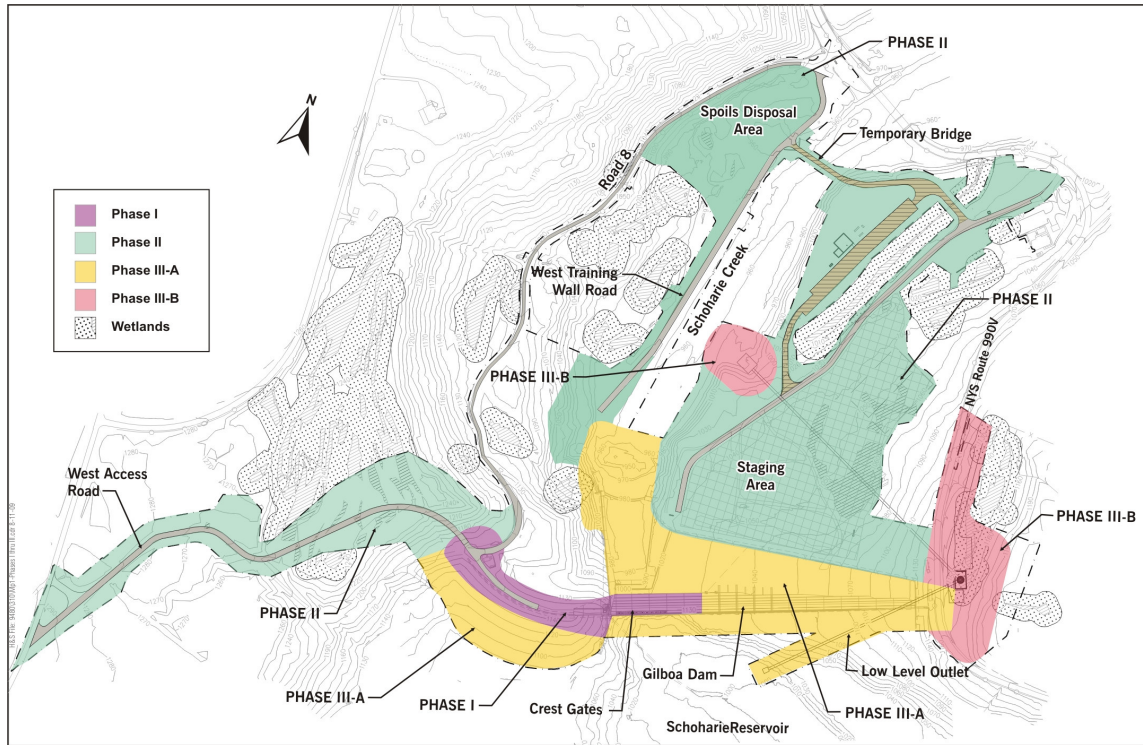
The Gilboa Dam and project site are located in a small rural community in upstate NY. The Gilboa Dam was originally constructed in the 1920s and serves to impound the north side of Schoharie Reservoir, which is part of the NYCDEP Water Supply System. The Schoharie Reservoir has an available storage capacity of 17.6 billion gallons and on average, provides sixteen percent of the NYC Water supply on an annual basis. Excess water from the Reservoir spills north over the Gilboa Dam spillway into Schoharie Creek, which flows through the center of the project site. The topography within the project area surrounding the Gilboa Dam consists of steep grades, ranging from 10 to 50 percent, sloping toward a fairly level creek floodplain, ranging from 3 to 10 percent grades, with an elevation change of 350 feet. The project area contains approximately 8.8 acres of freshwater wetlands, as well as numerous unnamed streams.

The chance for erosion and sedimentation on this project site is high due to the large amount of clearing and excavation necessary, steep slopes on site, and areas of fine soil. Protection from sedimentation is important due to the many sensitive waterbodies within or adjacent to the project site. Due to the complexity of the project and site, a comprehensive ESC plan, focusing on the unique situations of each contract, was needed. Without an effective, highly individualized ESC plan, there would be a high likelihood of sediment contamination of on-site waterbodies and Schoharie Reservoir, a drinking water source. If sediment deposition were to occur, plant and animal life in these waterbodies could be adversely affected. In addition, sediment deposition could increase the turbidity of Schoharie Reservoir, which is already impacted by natural erosion from steep slopes. Therefore, due to the project's large scope, duration, and size, the project work will be broken into the following four separate phases:

- Phase I - Crest Gates. This phase involves installation of crest gates in the Dam, which will provide enhanced flood control alternatives to NYCDEP. Although limited site disturbance will be required during this contract, it will involve site improvements adjacent to the Reservoir and will therefore require perimeter ESC measures. It will also result in a small increase in impervious surfaces and requires the installation of stormwater quality treatment measures.
- Phase II - Site Preparation. The goal of this phase is to prepare the site to be used for Dam Reconstruction. This contract will install permanent and temporary site access roads, Contractor's storage and staging areas, an on-site permanent spoils disposal area, a temporary internal bridge, trailers, a parking area, utilities, and ESC measures for the areas disturbed to construct these items. It will also install permanent stormwater treatment measures for the areas of the project that will be permanently stabilized during this phase of construction.
- Phase IIIA and Phase IIIB – Main Dam Reconstruction and Low Level Outlet. This phase will be divided into two contracts, the Main Dam Reconstruction and Low Level Outlet. Under Phase IIIA, the actual rehabilitation and reconstruction of the Gilboa Dam will be undertaken. Because the majority of the facilities needed to perform this phase of work will have been installed in the previous contract, limited site disturbance will result from this contract. ESC activities in this phase of work will focus on adjustment, maintenance, and repair of ESC measures. However management and control of washout from an on-site concrete batch plant and extensive dewatering facilities will be required. Phase IIIB will involve installation of a low level outlet from Schoharie Reservoir to Schoharie Creek, which will provide additional flood control alternatives to NYCDEP. This contract will require additional clearing of two small sites within the larger project area that are required for construction of a tunnel

shaft and a valve and discharge chamber. Customized ESC measures and stormwater management facilities for these two sites will be installed in this contract.

- Phase V – Site Restoration. This phase will involve removal of temporary impervious surfaces, including gravel, extensive replanting of native grasses, shrubs and trees, and wetland mitigation. ESC measures will be installed in this contract to supplement those installed in Phases II and IV around areas that will experience disturbance. After final stabilization, these measures will be removed from the site after final stabilization.



Phased Construction

By separating the project into four phases, we can see a clear benefit on ESC. From a design perspective, breaking the project into smaller, distinctive phases and areas allows the designer to develop ESC treatments that are appropriate to the specific area and application. For the Gilboa Dam site, rather than applying the same ESC measures across the entire project area and scope, each phase and area was examined to determine the appropriate and best ESC and stormwater measures for that project and area. From a construction and implementation perspective, this approach breaks the project into smaller phased areas in which focused ESC measures can be implemented, and site disturbance will be limited to smaller areas. It also breaks the project into shorter durations, requiring disturbed areas to be permanently stabilized more quickly. In the case of the Site Preparation contract, which has a total disturbance of 56 acres, and Phase III, the individual projects were divided into several project stages and several project areas. Breaking the site into smaller areas and phases allows the Contractor to progress work on site in multiple locations but eliminates clearcutting by only allowing clearing and grubbing in the area in which work is being performed. Before the subsequent project stage may proceed, all areas of the current project stage must have all ESC measures installed and disturbed areas must be stabilized.

Shifting the major site preparation activities from the Main Dam Reconstruction Contract into the Site Preparation Contract makes the installation of ESC measures one of the primary focuses of the Site Preparation Contract. This has an added benefit of allowing the Main Dam Reconstruction Contract to focus on the major rehabilitation activities that are necessary, while maintaining, repairing, and installing a limited amount of new ESC measures where necessary. Shifting the Site Restoration activities to a separate project phase has a similar benefit. Often, proper final site restoration is neglected and is difficult to enforce. Making permanent site restoration, including final plantings and stormwater-treating wetlands creation, a separate contract ensures it will be the primary focus of the final project phase.

Phase I

During Phase I, Crest Gates will be installed in the Dam spillway notch to provide Reservoir lowering capabilities as part of an enhanced flood attenuation program. Utility lines will be installed on the upstream side of the dam embankment, requiring trenched excavation. In addition, an equipment building and associated exterior equipment will be installed on the northwest (upstream) side of the Dam embankment. A portion of a Phase II access road approaching the Dam embankment will be constructed, requiring from 0 to 10 feet of fill to be placed on the western side of the Dam embankment. During construction, ESC measures for this phase will include silt fence placed along the perimeter of the site and embankment, stacked sand bags and a turbidity curtain placed in the Dam spillway to intercept any incidental sediment and debris that falls downstream of the Dam, and a containment boom within the Reservoir to intercept any incidental oil and floatable debris that falls upstream of the Dam. Jersey barriers will be placed along the upstream side of the Dam embankment to prevent any construction vehicles from entering the Reservoir. One culvert will be installed to provide a consistent flow path for a stream located near the Dam embankment and prevent this flow from entering the project site. The project site's unique configuration along the Dam and its embankment prohibits space for installation of a sediment trap or basin. Instead, water encountered during trench dewatering operations will be pumped through an above-grade portable sediment tank. Areas disturbed during this contract will be permanently stabilized with pavement, riprap, or topsoil and seeding. Repaving of the Dam embankment road and placement of the equipment building will result in a small increase in imperviousness, and thus, under NYSDEC rules, runoff from this area will require water quality treatment. Two bioretention cells and a sand filter, chosen for their ability to provide high quality stormwater treatment in a compact size, will be installed to provide treatment of this stormwater runoff.

Phase II

As mentioned previously, the total project area for Phase II will total fifty-six areas and will be broken down into three separate project areas and three stages. In the area of the project site east of Schoharie Creek, known as Area 1, a storage and staging area, temporary office complex area, an upgrade of existing access Road 16, a temporary bridge across Schoharie Creek, and an access road to the temporary bridge would be constructed. A twelve-acre area just north of the Dam will be cleared of vegetation to establish a Staging Area from which work for Phase IIIA will be organized. After clearing, grubbing, and minor grading, this area will be stabilized with temporary 12" thick layer of gravel. ESC measures for this area would include diversion swales to keep off-site runoff out of the staging area, a network of swales to convey flow to three sediment traps, perimeter silt fence, and piped slope drains to convey flow from the sediment traps down a steep slope to Schoharie Creek. A temporary office complex area will be prepared to accommodate an officer trailer and parking for NYCDEP employees, construction management, and workers. This area will be stabilized by a temporary 12" thick layer of gravel. To access this area, two bottomless culverts will be placed over streams that serve to outlet an important amphibian-breeding wetland on-site. Using bottomless culverts will provide the access needed but will prevent disturbance to the streambeds. In addition, jersey barriers will be placed around these wetlands to prevent vehicles from accidentally entering or disturbing them. Silt fence and swales will be installed along the perimeter of the office complex area to intercept runoff that will be routed through a sediment trap and conveyed to Schoharie Creek via a piped slope drain.

Road 16 will be widened, regraded, and resurfaced with twelve inches of gravel cover to provide an adequate pathway for construction traffic between public roads and site facilities east of Schoharie Creek. Swales along Road 16 will collect runoff from this area and convey it to a sediment trap that outlets to an off-site swale. In addition, at the beginning of Road 16, a truck wash station and stabilized construction entrance will be installed to remove sediment from trucks before they leave the site. To provide an internal site pathway for truck traffic from the east side of the Creek to the Spoils Disposal Area on the west side of the Creek, a temporary internal bridge traversing Schoharie Creek will be erected. In addition, a temporary Access Road to this temporary bridge will be provided from Road 16 to the east side of the Bridge; this access road will be surfaced with twelve inches of gravel. Cut slopes excavated to install this road will be treated with erosion control matting to promote vegetative growth and prevent erosion. A roadside swale will convey stormwater runoff to a small sediment trap located adjacent to the eastern abutment of the temporary bridge that will outlet directly adjacent to Schoharie Creek.

In the area of the project site west of Schoharie Creek and Reservoir, construction will involve a new West Training Wall Road, preparation of a Spoils Disposal Area, known as Area 2, and new West Access Road, known as Area 3. The West Training Wall Road, a new permanent paved roadway, will be constructed to provide access between public roads and internal facilities along the west side of Schoharie Creek. On the upslope side of the roadway, diversion swales will be placed to collect runoff from a large undisturbed hillside to the west of the West Training Wall Road and direct this flow out of the project area to prevent contamination of this runoff by contact with disturbed soils. The West Training Wall Road will be sloped away from the Creek, bordered by silt fence and a roadside swale to collect flow from the roadway and prevent sedimentation of Schoharie Creek. At the intersection of the West Training Wall Road and Temporary Bridge, a truck wash station will be installed to prevent tracking of sediment onto the Bridge and public roadways. Also on the west side of the Creek, a Spoils Disposal area will be prepared to store the majority of excess soil spoils generated during excavation and grading activities from Phase II and stone and concrete rubble produced during heavy Dam reconstruction in Phase IIIA with an estimated total of 200,000 cubic yards. This area will be cleared but not grubbed to prevent excessive erosion. Silt fence and swales equipped with check dams will be placed around the perimeter of the Spoils Area to intercept sediment and reduce runoff velocities. Temporary vegetation and geogrid or erosion control matting will be employed on the stockpile surface as construction allows, to stabilize stockpile slopes. Runoff from the West Training Wall Road and from the Spoils Area will be directed to a large sediment basin, which will settle out particles in the stormwater before it is discharged to Schoharie Creek.

The West Access Road will be a permanent paved access road that will serve to connect the western Dam Embankment to public roadways. The first half of this road will require grading less than five feet of fill. This area drains to an on-site stream that outlets to Schoharie Reservoir. In order to protect the on-site stream and Schoharie Reservoir from possible sedimentation, ESCs for this area include perimeter silt fence, diversion swales, roadside swales with check dams, a truck wash station, stabilized construction entrance, and a sediment trap. A spill containment kit will be kept within this project area in the event that a spill should occur. As an added measure, a containment boom will be installed in Schoharie Reservoir at the outlet of the on-site stream to restrict oils and other floatable debris in the unlikely event that contamination from construction reaches the Reservoir. As this area will be permanently stabilized during this phase of construction, a stormwater wetland will be installed for runoff from this area to improve stormwater quality, attenuate the stormwater flows, and maintain drainage conditions similar to the existing conditions.

The following half of the West Access Road will require soil cuts up to 45 feet high, mostly in clay and silty clay soil. Substantial multi-layered temporary and permanent measures are required to mitigate the potential for erosion and sedimentation in this area. As excavation proceeds, silt fence will be spaced every 65 feet down the embankment. Swales will be installed at the top of cut to prevent stormwater runoff from flowing down cut slopes and forming gullies, and seep drains will be installed to prevent erosion or slope instability. In addition, permanent erosion control matting will be placed on the cut slope to stabilize the surface and promote vegetative growth. Roadside swales will collect flow from the roadway and hillside and direct this flow into a sediment trap, which will discharge into a series of swales that flow into Schoharie Creek. If highly turbidity is observed in the sediment trap, flow will be directed into weir tanks equipped with PAM dosing, sand filter units, and/or bag filter units to further remove sediment from the site runoff. As this area will be permanently stabilized during this phase, two stormwater wetlands will be installed in series at the end of this phase to improve stormwater runoff quality and attenuate the stormwater flows, maintaining drainage conditions similar to the existing conditions.

Phase IIIA

Phase IIIA will include installation of a temporary concrete batch plant, the actual dam reconstruction efforts, and redevelopment of a Dam Overlook area, resulting in approximately six acres of added disturbance. The majority of clearing and site disturbance and ESC measures for this activity will have been completed during Phase II. Therefore, the focus of the ESC plan for Phase IIIA will be inspection, maintenance, and replacement of the features installed in Phase II. The Contractor will be provided with details of the items installed in Phase II. However, some new ESC measures will be necessary in Phase IIIA. Concrete washout associated with the batch plant is a major concern. Wastewater from concrete

equipment washout will be contained and directed to “dead-end” lagoons, where it will be allowed to evaporate or trucked off-site to an appropriate treatment facility. No concrete washout water will be allowed to be discharged to and surface waterbodies. In addition, the Dam reconstruction will require extensive dewatering operations. NYCDEP and H&S/GF developed a protocol establishing a testing procedure whereby effluent turbidity is monitored and a maximum limit is set as the pre-construction turbidity of the receiving waterbody. In all cases, the pumped water will be returned to the receiving waterbodies only after it is collected and treated by a portable sediment tanks system or sediment traps. The Dam Overlook area will require a small amount of disturbance of currently impervious areas. Erosion and sediment will be controlled by the use of silt fence, erosion control matting, and pumping dewatering water or runoff into a portable sediment tank. The amount of impervious area will not be increased, but bioretention cells will be used to treat the runoff from the overlook area; excess runoff from these cells will be discharged into the Dam spillway.

Phase IIIB

Phase IIIB will consist of the construction of a Low Level Outlet, resulting in approximately five of land disturbance over two areas. This project will involve installation of an inlet chamber within the Reservoir, a gate shaft east of the Dam, and a valve and discharge chamber on the eastern shore of Schoharie Creek, all connected by underground tunnels. The gate shaft site will require clearing, a small staging area, and a narrow access road, which will be bordered by swales and retaining walls on both sides. The use of retaining walls will minimize the amount of site disturbance by the access road. Other ESC measures include diversion swales for off-site flow, perimeter silt fence, a sediment trap, and a temporary construction entrance and truck wash. As part of permanently stabilizing the site, bioswales, porous pavement, and a micro-wetland will be installed for stormwater treatment and control.

The valve and discharge chamber will also require installation of a permanent access road. Construction of this access road will require side cut slopes, which will be treated with erosion control matting. Roadside swales with check dams and silt fence will be placed around the perimeter of this work to prevent sediment from entering the Creek. Because this area is adjacent to the Phase IIIA staging areas, and will end prior to Phase IIIB, permanent stormwater controls for Phase IIIB will be installed in Phase V.

Phase IV

The fourth and final phase of work will consist of general site restoration activities to address and/or mitigate the remaining environmental effects of the Dam reconstruction. All temporary impervious areas will be removed, including the graveled staging area, the office complex and graveled parking area, temporary access road to the internal bridge, and the internal bridge. In addition, the width of Road 16 and the West Training Wall Road will be reduced to minimize the amount of permanent impervious surfaces. Road 16, the West Training Wall Road and the West Access Road will be maintained to provide permanent access to points around the Dam and embankment. Stormwater wetlands will be constructed in the staging area to provide mitigation and stormwater quality and quantity control. The sediment basin that served to provide sediment control for the Spoils Area and West Training Wall work will be converted into a stormwater wetland during this phase. Native grasses, shrubs, and trees will be planted in and around these wetlands, and in other areas temporarily disturbed during the previous contracts, restoring the site to its natural condition prior to the Dam Reconstruction contracts.

Conclusion

The large construction effort described above is necessary to provide rehabilitation of the Gilboa Dam and improved flood attenuation and site facilities. By creating four phases of work for completion of these tasks, the land disturbance and ESC measures were also broken down into smaller incremental activities. This has allowed the design of each phase of this large project to draw from a wide variety of customized, site specific ESC and stormwater control measures. Techniques that are considered best for one area or phase of the site would not be appropriate for other areas of the site. Final stormwater control measures will be installed appropriately upon final stabilization of the respective distinctive area of the site, rather than at the end of the entire contract. This phased and focused approach to erosion, sediment, and stormwater control planning will prevent unwanted contamination and disturbance of precious natural resources in and around the Gilboa Dam site.