

2008 CASFM PROJECT AWARDS

MONTCLAIR STORM DRAINAGE PROJECT
CITY OF DENVER, COLORADO

June 2, 2008



WHPacific

Architecture | Building Engineering | Land Development
Surveying | Transportation | Water Resources

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PROJECT BACKGROUND

The Montclair Storm Drainage project is a \$25 million endeavor by the City of Denver to improve the drainage in the Montclair Basin and improve Ferril Lake in City Park. It includes converting Ferril Lake into a dual use facility (storm water detention and recreation), associated park improvements, a new storm sewer system in 17th Ave. and a new storm sewer/road reconstruction on the City Park Esplanade in front of East High School.

The Montclair Basin includes 9 square miles of fully developed urban area located east of downtown Denver. The basin is approximately 8.2 miles long, extending north from Fairmont Cemetery at its southern limit, to the outlet at the South Platte River near the Denver Coliseum. There is not a single open channel drainageway in the entire basin. Storm drainage is conveyed entirely in the streets and existing storm sewer system, which is predominantly brick storm sewer built in the 1930s. The storm sewer ranges in size from 10-inch lateral pipes to 10-ft diameter main lines at the outlet to the Platte River. Little has been done in the past to improve the drainage in the basin for the simple reason that the existing pipe system has less than a 2-year storm capacity and enlarging the main stem, including the outfall, is a very expensive and difficult proposition (the outfall actually runs under a portion of the Pepsi Bottling Plant).

WHPacific was selected to work with the City to create a Drainage Master Plan for the Montclair Basin. The Master Plan was completed in 2005 and project improvements were prioritized for the basin. The selected plan for the basin wide improvements revolved around construction of a regional stormwater detention storage facility in City Park, which is centrally located in the Montclair Basin. Construction of a 120 acre-feet stormwater detention facility at City Park would dramatically reduce flows to downstream basin areas, thereby eliminating the need for \$25 million in upsizing costs for the existing storm sewer system. The City and WHPacific then embarked on the design and construction of the Montclair Storm Drainage project, including the regional detention storage facility in City Park and a new storm sewer system in 17th Avenue and City Park Esplanade.

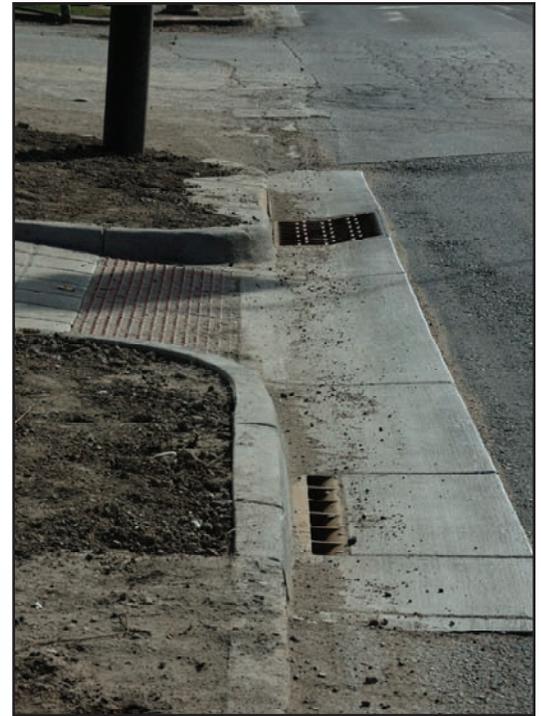
The Montclair Storm Drainage project was constructed in three phases over a two-year period. The first phase involved reconstruction of the Historic City Park Esplanade in front of East High School. The Esplanade is the historic “gateway” to City Park and is approximately 1,400 feet long, extending from Colfax Avenue on the south to 17th Avenue on the north. The project included removal of the entire street, installation of a storm sewer system, curb, gutter and walks, an Entry Plaza at East High School, irrigation system and landscaping. The project design required the review and approval of Denver’s Landmark Commission, to ensure the project was reconstructed within the “historical context” of the City Park Esplanade.



Installation of 72-inch storm sewer in 17th Avenue

The second phase of the project was the 17th Avenue Storm Sewer, which included 3,500 feet of new storm sewer ranging in size from 24-inch RCP to 7-ft x 4-ft concrete box culvert. The 17th Avenue storm sewer connects to the new storm sewer in the City Park Esplanade and runs east along 17th Avenue and then enters City Park near the east end of Ferril Lake. The storm sewer upgrades were accompanied by street improvements involving reconstruction of eight intersections along a major city arterial, including: curb, gutter and walks, handicap ramps, and 40 new inlets. Part of this project was the extensive use of slotted drains. These drains were used as temporary inlets to augment the inlet capacity until upstream phases of storm sewer systems are installed.

The third phase of the project involved construction of the stormwater detention facility in Ferril Lake, including an approximately 1,000 feet long cast-in-place drainage conduit, ranging in size from a 22-ft x 11-ft box culvert to double 16-ft x 7-ft box culverts, which collects water from the upstream storm sewer systems and conveys flow into Ferril Lake via a large underground overflow weir structure. Designing an underground conduit/overflow weir structure that can divert



Slotted Drains and a No. 16 inlet along 17th Avenue



Construction of lake Inflow Conduit - base slab of double 16'x 7' box culverts



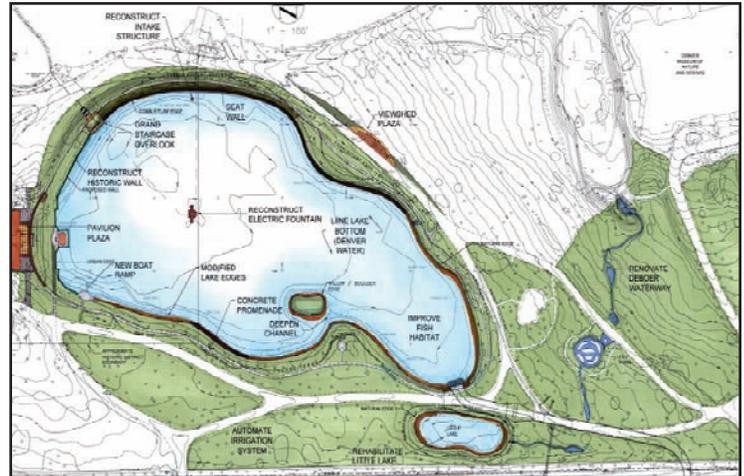
Construction of the 22'x11' Inflow Conduit

1,820 cfs into Ferril Lake during a 5-yr storm event was challenging; however, converting Historic Ferril Lake into a multi-use recreational/stormwater detention storage facility was equally as challenging. The lake is the major focal point of City Park and required careful planning, coordination and design to ensure the proposed changes to this 100-year old lake would not be perceived as a negative impact by the park users, the surrounding community and the Denver Parks Department.

ENHANCEMENT OF PUBLIC HEALTH, SAFETY AND WELFARE

The Montclair Project significantly enhances public safety by providing 120 ac-ft of runoff storage during 5-year and larger storm events. Prior to this project, the storm runoff had the potential to

overtop Ferril Lake and potentially flood the Denver Zoo and downstream residents. In addition, the existing undersized storm sewer system downstream of City Park will now have "residual" capacity due to reduced peak runoff rates from the upstream basin area. The net benefit will be less frequent surcharging of the downstream storm sewer system and significant reduction in local flooding problems. The newly constructed 17th Avenue storm sewer system on the south side of City Park removes a recurring flooding problem in 17th Avenue, one of the city's major arterial streets.



Ferril Lake Improvement Plan

The project improves the welfare of the public by upgrading Denver's Historic City Park, the crown jewel of the City Park system. The upgrades include: a modern automated irrigation system, new concrete bike/pedestrian paths, several new plaza areas, a variety of lake edge treatments, reconstructed park roads, reconstructed Historic Wall and railing, reconstructed Historic Electric Fountain, and renovation of the DeBoer Waterway. The project also significantly upgraded the City Park Esplanade in front of East High School. This portion of the project

removed the unsafe back-in diagonal parking and completely rebuilt the road, added curb and gutter and a new entry plaza, rebuilt the irrigation system, and added a storm sewer system.



Photograph of reconstructed Historic Wall

ENHANCEMENT OF THE SURROUNDING ENVIRONMENT

The Montclair Project significantly enhanced the surrounding environment by upgrading the existing park facilities. In order to provide 120 acre-feet of temporary stormwater detention storage in Ferril Lake, reconstruction of the entire lake was required. The normal lake level was lowered

by 2 feet, by means of excavation and muck removal, and the effective embankment height was raised by adding an eighteen inch high Seat Wall along the dam on the northwest side of the lake. These efforts



Preconstruction photo of island in Ferril Lake



Improved island/bird sanctuary in Ferril Lake

created the additional detention storage volume needed for the project. Lowering of the normal lake level required that the entire lake edge be reconstructed, the lake muck be removed to maintain the original volume, and the Electric Fountain and irrigation Intake Structure be reconstructed.

The reconstructed lake provides improved areas for fish habitat and fishing, and enhanced wetlands and riparian habitat for wildlife around the lake edge. The Parks Department was heavily involved in selecting the different lake edge treatments including: wetlands, cobbles, blue grass with a concrete edger, and reconstructing a portion of the Historic Wall.

Other parts of the project included rebuilding all impacted roads, a new concrete walkway around the lake, building the Pavilion Plaza, the Grand Staircase Plaza, and the Viewshed Plaza, reconstructing Little Lake, reconstructing the DeBoer Waterway, and installation of an automated irrigation system.

CREATIVE, UNIQUE OR INNOVATIVE SOLUTIONS OR DESIGNS

The Ferril Lake detention storage facility incorporated some innovative design solutions. Due to the physical site constraints and other aesthetic considerations, the storage volume needed had to be provided within the “footprint” of the existing lake. The lake level could not be lowered more than two feet below its normal pool elevation without noticeable visual impacts.



Seat Wall and concrete path (Promenade) along north side of Ferril Lake

Consequently, the “additional” storage volume would have to be obtained by raising the embankment height. Existing landforms and mature trees did not allow room for placement of additional fill on the embankment. To solve the problem, an 18-inch high concrete Seat Wall was designed to run along the top of the embankment on the west and north sides of the lake. The Seat Wall provides the “effective embankment” height needed for the storage volume while preserving the existing trees and landscaping around the lake. The flood control function of the Seat Wall is not noticeable to the public. The wall has been incorporated into the landscape design to be an attractive amenity that enhances the beauty and form of the concrete walkway around the lake.

Another innovative design solution involved the Inflow



Failing Historic Wall prior to demolition



Historic Wall after reconstruction

Conduit at the east end of Ferril Lake. The Inflow Conduit collects stormwater from the upstream



Box culvert and construction of weir structure to control lake level and stormwater flow into the lake.

storm sewer systems, diverts flow into Ferril Lake for temporary detention, and bypasses smaller flows via an 8-ft diameter diversion pipe into the existing 114-inch brick storm sewer that runs through City Park. Due to the constraints of the normal pool elevation in Ferril Lake, the elevation of the existing 114-inch storm sewer and the adjacent ground elevation, the hydraulics of the underground spill/diversion into Ferril Lake was challenging due to the minimum head available for the overflow spill into the lake. Conventional hydraulic analysis did not provide adequate understanding of the losses involved in the spill/diversion structure.



22'x11' inflow conduit and 8' diversion pipe

To avoid a “conservative” approach that might oversize the structure and add considerable costs to the project, WHPacific used “FLOW-3D” modeling software to simulate a 3-dimensional model of the proposed Inflow Conduit and spill/diversion structure. Utilizing FLOW-3D, different shapes and sizes of the spill/diversion structure were modeled to determine the minimize size structure needed to spill the required flow if 1,820 cfs into Ferril Lake while minimizing hydraulic losses through the system.

One of the unique aspects of the entire project is the Prismatic Electric Fountain in Ferril Lake. The fountain was originally constructed in time for the Democratic National Convention that was held in Denver in 1908. It was decided early in the design process that the entire fountain structure needed to be removed and reconstructed to maintain the historical appearance of the fountain with the new lower lake level. The project replaced the fountain with a replica identical in shape and dimensions to the original design. The dedication of the rebuilt fountain occurred on April 30, 2007 when Mayor Hickenlooper; Bill Vidal, Manager of Public Works; and Kim Bailey, Manager of Parks and Recreation visited the fountain to celebrate the reconstruction and history of the facility.

The Montclair Storm Project used an innovative process for contracting the construction activities. At the same time that plans were being developed to implement phase 1 of the Montclair Basin Master Plan, the City was embarking on the



Reconstructed Electric Fountain



Top deck of fountain days before demolition



Top deck of reconstructed fountain

lake material using excavators on steel mats so that they would not sink into the muck. Haul roads were constructed on the lake bottom and trucks were run 12 hours a day to remove the material. Multiple construction crews worked concurrently within the lake to lay pipelines, construct concrete walls, place rock riprap and cobbles, and construct the Electric Fountain.

MULTIPLE-OBJECTIVE MANAGEMENT

The Montclair Storm Project had multiple objectives over the course of the project. The main objectives at the outset were achieving adequate stormwater detention while also improving the park for recreational use. The Park's Planner for City Park was involved from the beginning in the planning and design of the project. The conversion of the lake into a stormwater detention facility could not leave the park in a

Integrated Construction Program. The IC program enabled the city to hire a construction management contractor (IC contractor) to handle multiple projects. The IC program removed many delays from the city process and gave the city flexibility to quickly select contractors and get work started in short order, even while plans were in the process of being completed. The first implementation of the IC program in the Montclair Basin was on the City Park Esplanade.

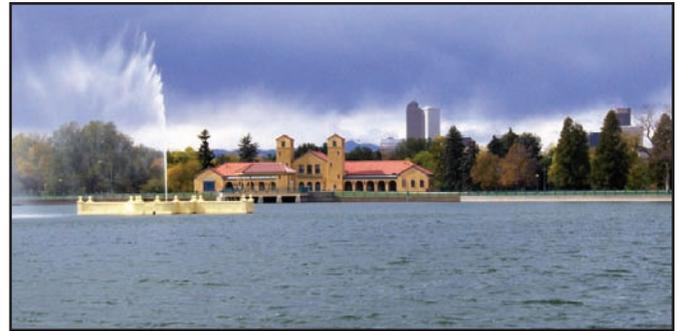
Since the Esplanade is located in front of East High School, the project had to start on June 1 (after school was out) and be complete by the time school was in session in early August. Normal contracting procedures would have delayed this project at least a year. The flexibility of the IC program allowed a unique approach for WHPacific to finalize the plans as the IC contractor put the project out for bid. Concrete Works of Colorado was selected for the project and completed the work in early August, a week before school was back in session.

The Montclair Storm Project had other innovative solutions to difficult problems. The most challenging aspect of the project construction was completing the work in Ferril Lake during a relatively short time frame (end of October to middle of April). Since Ferril Lake is the source of irrigation water for the entire City Park, work had to be completed during the non-irrigation season. This meant that the contractor had to drain the lake at the end of irrigation season, remove 90,000 cubic yards of material (sediment and muck), reconstruct the lake edge, reconstruct the Historic Electric Fountain, the irrigation Intake Structure and the Historic Wall, and refill the lake so that the park could be irrigated at the start of the following irrigation season. The contractor did an outstanding job to remove the



Excavation of 100 years of accumulated muck

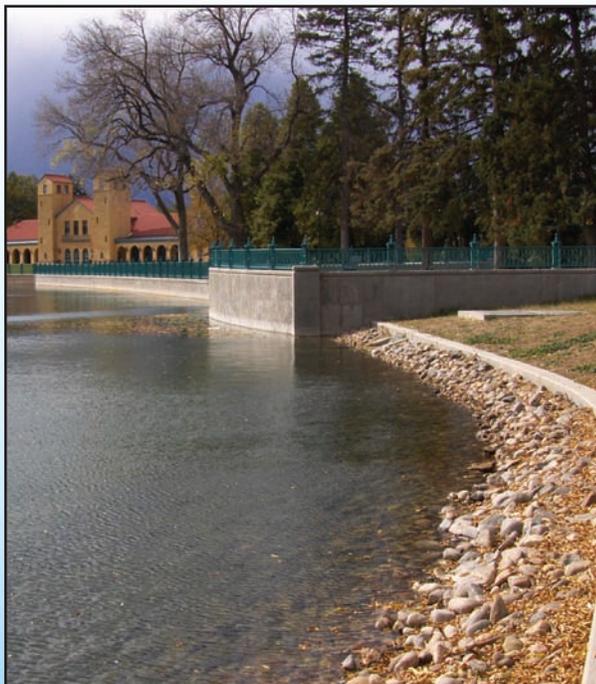
worse condition than before. Reconstruction of the Electric Fountain, the irrigation Intake Structure and the Historic Wall had to meet the historic preservation requirements and final approval of the Landmark Commission. The stormwater project had to improve the park in order for it to be viewed as a success by the public. Not only were Park's Department representatives heavily involved in the design, but other agencies, including Urban Drainage & Flood Control District, the Landmark Commission (historic considerations), East High School staff and parent organizations, Denver Zoo representatives, Museum of Nature and Science representatives, City Park Jazz, and local neighborhood groups, were also involved in the planning and design process. Two public meetings and a design charette were held to present the results of the planning and design processes and to receive public input.



Ferril Lake

MEETING GOALS IN PROBLEM SOLUTION, BUDGET AND SCHEDULE

The Montclair Storm Project was highly successful in creating a cost-effective solution to providing detention in a large, underserved basin. Construction of the Ferril Lake detention storage facility has saved the city \$25 million in upsizing costs for the downstream storm sewer system. In addition, City Park had a significant backlog of construction/reconstruction projects that far exceeded the Parks Department's annual budget. This project was able to leverage Public Works' resources to not only provide flood storage, but to help the Parks Department fund many of their reconstruction projects for the park.



Reconstructed Historic Wall, Grand Staircase Plaza and cobble lake edge during lake refilling

The project was very successful with respect to the schedule. The reconstruction of City Park Esplanade occurred during the summer and did not impact East High School during the school year. The original goal for the Ferril Lake work was to use two construction seasons to complete the project, but ultimately we were able to complete the activities in one season. This saved money and decreased the impact to the community, but required a significant amount of work to be done in a very short time frame. The work started in October of 2006 with the draining of Ferril Lake. The challenge at hand was to drain the lake, remove 90,000 cubic yards of muck, construct the Inflow Conduit/Overflow Weir Structure, and reconstruct the lake edge, the Historic Wall, the Electric Fountain and the irrigation Intake Structure to allow refilling for the summer of 2007. The refilling was vital because the lake is the source of the irrigation water for the entire park. The work was completed and the lake refilled in the summer of 2007, allowing the Parks Department to operate the irrigation system as usual.

MODEL FOR OTHER COMMUNITIES AND/OR OTHER PROJECTS

The Montclair Basin Storm Drainage project could serve as a model to other communities as it demonstrated that different city departments can work together to achieve multiple benefits with shared resources. A key to the success of this project was the integration and coordination with the Parks Department from the beginning of the project. Parks had already created a City Park Master Plan to improve the facility that had not received much maintenance in the past few decades. However, lack of funding prevented Parks from implementing their Master Plan. Both Parks and Recreation and Public Works saw an opportunity to improve the drainage in the Montclair Basin and implement portions of the City Park Master Plan. This was not an easy initial sell to Parks and Recreation, but they quickly got excited about the project. Having the Parks Department on board throughout the design process provided opportunities for integration of the storm drainage system into City Park that would not have otherwise occurred without their support. The team effort enabled Ferril Lake to be converted into a dual-use facility for storm water detention and recreation, while leveraging city resources. Not only was an essential storm water storage facility created, but City Park and the surrounding neighborhoods benefited significantly from upgraded facilities.



Renovated lake edge