



January 2016

Public Works Project
of the Year

Environment



Lyon Creek Flood Mitigation

City of Lake Forest Park, Washington



Overview

Completion of the Lyon Creek Flood Mitigation Project eliminated recurrent flooding in Lake Forest Park that had inundated the City's only fire station, largest commercial center, over 20 homes and State Route 522 (SR 522, Bothell Way). This \$6.94 million project also restored the lower reach of Lyon Creek, which is an urban salmon-bearing stream, with the removal of numerous fish barriers, installation of large woody debris, excavation of instream refuge pools and reestablishment of two wetlands.

Project design began in March 2013 and construction was completed in December 2015.



Flooded Northshore Fire Station, December 2007



Flooding in Sheridan Beach neighborhood, December 2007



Comparison photo of Sheridan Beach neighborhood

As the project was underway, the project team faced a variety of challenges including: a mid-design modification of culvert size requirements associated with a 2013 Federal court injunction regarding fish passage, a \$1.7 million funding gap as construction began in June 2015, state highway closure timing coordination with WSDOT and the risk of the community flooding if the project had been delayed.

The construction schedule provided 100 working days that was extended by 35 days with change orders and project additions. The last working day was December 15, 2015 while instream work was completed in September 2015.

Key project elements include:

- Replacement of four severely undersized and aging culverts on Lyon Creek with 20-foot wide culverts. Total installed culvert length was 400 feet.
 - Single weekend replacement of a fish-barrier culvert on SR 522,
 - Replacement of three culverts in the City's largest commercial center adjacent to SR 522,
 - Removal of numerous fish passage barriers, stream armoring and weirs,
- Re-establishment of two wetlands adjacent to Lyon Creek with a combined area of over 15,000 square feet,
- Improvement to 1,100 feet of stream channel with 48 pieces of large woody debris and 3,500 tons of streambed gravels, 12,000 native plants and 17 instream refuge pools,

- Conversion of a residential property into a seasonally flooded riparian wetland and floodplain,
- Transportation improvements, including installation of 530 feet of sidewalk adjacent to the project with viewing areas of the stream restoration,
- Ambitious and high-risk approach to funding utilizing federal, state and county funds to complete the project with the seemingly ever-changing and unclear requirements for culvert design and associated project costs.

Background

The most significant flood event in the City's history occurred on December 3, 2007, causing more than \$4 million of damage to public and private property. Over 20 homes, the City's only fire station, SR 522 and the City's largest commercial center, Lake Forest Park Town Center (Town Center), were inundated. Many structures were severely damaged. This flood event was the third for Lake Forest Park in less than 25 years with similar events in 1986 and 1997. The severity of the 2007 flood event combined with the frequency of the previous flood events prompted the City to initiate an in-depth flood reduction planning study to determine the cause and explore a variety of solutions. This work culminated in the 2009 Lake Forest Park Flood Reduction Planning Study (2009 Study).



Area between Lyon Creek and McAleer Creek with Fire Station in background, 2007 Flood Event

Lyon Creek originates in Mountlake Terrace and Brier, flowing through Lake Forest Park and into Lake Washington at Lyon Creek Waterfront Preserve.

With a watershed area of only 2,600 acres, it is one of the smallest fish-bearing Lake Washington tributaries. Increasing upstream urban development has created a basin that responds with dramatic runoff and a creek that floods quickly during short intense rain events. In fact, the 2009 Study determined that Lyon Creek had only half of the necessary conveyance capacity it needed during severe storms. This was causing it to quickly overflow its banks and jump into nearby McAleer Creek, flooding everything between the two creeks and downstream on McAleer Creek in the Sheridan Beach Neighborhood.

It appeared that the solution was simple: Keep Lyon Creek flows in Lyon Creek by increasing conveyance capacity. But the path to completing that goal, which became the highest priority for the City, was no easy task. Besides engineering and construction challenges, the project required coordination with multiple stakeholder agencies, permitting agencies and private and commercial property owners. Project challenges included:

- The City did not own a single culvert that would need to be replaced and only owned two short sections of stream channel that would be enhanced. As a result, extensive interagency coordination for the SR 522 culvert and property rights acquisition were necessary.
- Work on the SR 522 culvert had the potential to impact 45,000 vehicles trips each day.
- Instream construction work would severely restrict access to the shopping center, City Hall and the fire station.
- Lyon Creek is habitat for Endangered Species Act-listed salmon, triggering more complicated permitting and permit requirements.
- Construction work had to be completed in one brief summer season because of environmental requirements and unpredictable flood risks associated with phasing the project over a wet/flood season
- Increased flood flows in the new channel threatened a private vehicle bridge.
- Estimated cost of the work represented one-third of the Lake Forest Park's annual total Public Works budget and was clearly beyond the City's means without substantial outside funding.

Flood Comparison Photos

December 2007 Flood Event



Sheridan Beach Neighborhood

No Flood Comparison



Sheridan Beach Neighborhood



Inadequate stream channel capacity at Town Center



Town Center

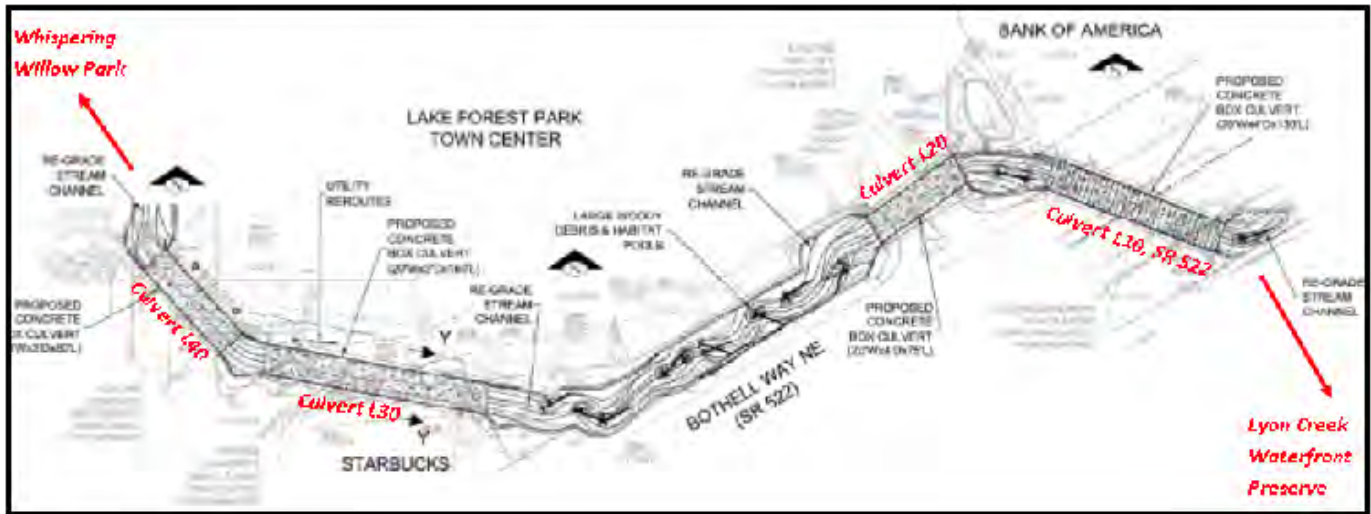


SR 522, Bothell Way NE



SR 522, Bothell Way NE

Fig. 1 - Lyon Creek Flood Mitigation Project Culvert Alignment



Key to Success

Keys to making this project a success included community support, involvement of stakeholders and permitting agencies early and often, development of funding partnerships and navigation of permit requirements. Successful delivery was the result of a collaborative effort between the City's design and construction inspection consultant Davido Consulting Group, Inc. (DCG,) environmental consultant The Watershed Company, contractor KLB Construction, hydrologic consultant Clear Creek Solutions, WSDOT, Lake Forest Park Public Works, Lake Forest Park residents, Seattle Public Utilities, King County Metro, Federal Emergency Management Agency and regulators, including the U.S. Army Corps of Engineers, Washington Department of Fish and Wildlife, the Muckleshoot Tribe, Lake Forest Park Planning Department and the U.S. Fish and Wildlife Service.

Construction Management and Schedule Management

Carefully orchestrated construction sequencing was critical. The length of the project and various project elements required that construction occur in six phases. Much of the project also required instream work that permitting agencies limited to July 1 – September 15. The project team also required completion in one construction season to provide flood protection for the 2015-16 wet season. In addition,

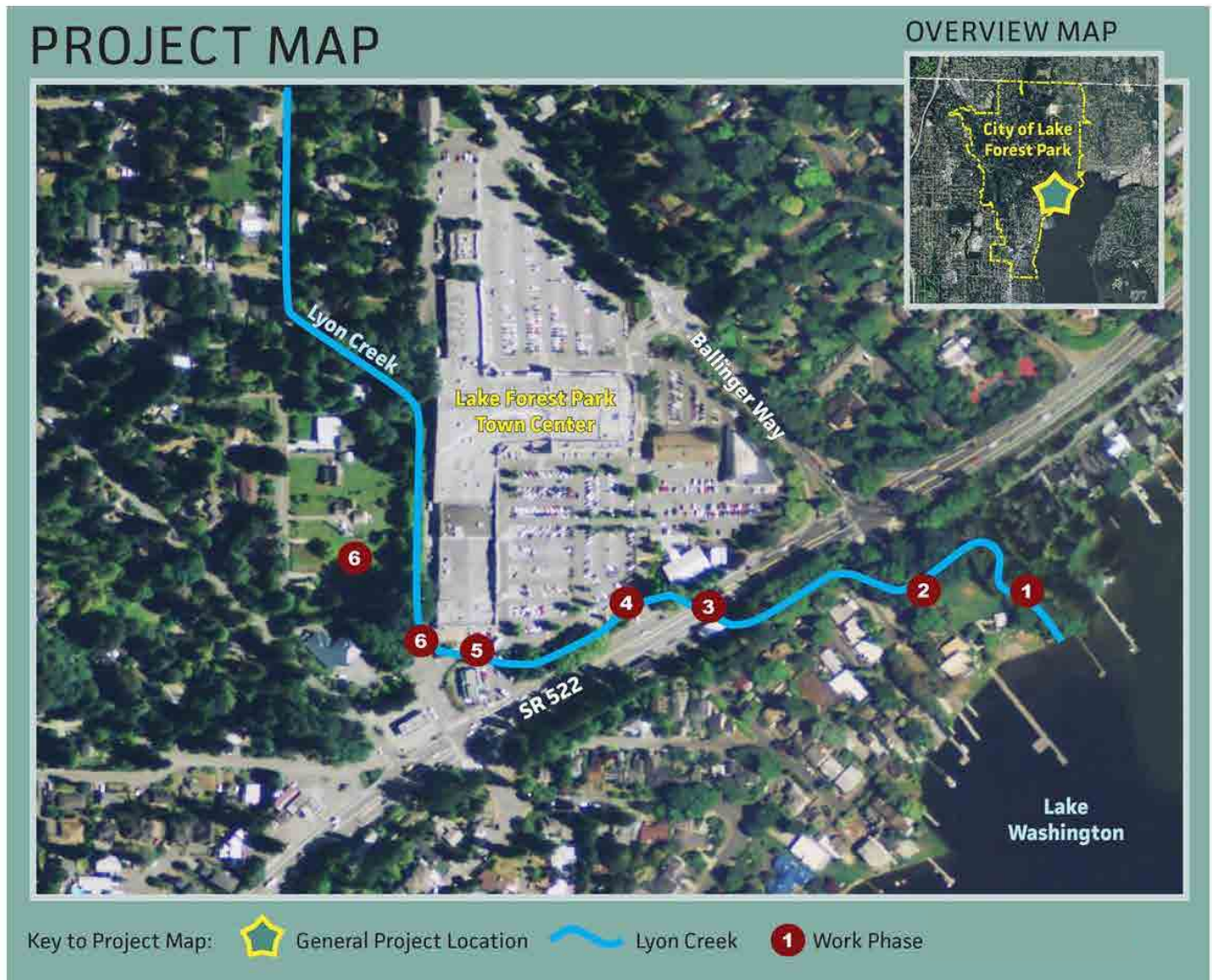
WSDOT would allow SR 522 to be closed for one weekend as long as it did not conflict with Seafair or SR 520 closures.

Engineering design of the culverts focused on maximizing constructability and cost-effectiveness without sacrificing functionality or environmental benefit. This focus is exemplified by the culvert design. Culverts were designed as a three-sided base with a lid, which allowed for faster installation of streambed materials within the culvert and reduced closure durations for SR 522 and within the Town Center. The culvert design was subject to several constraints: overall culvert depth was limited by the existing stream profile and surrounding pavement grades, and this depth had to include both a lid designed to carry heavy traffic loads and a culvert cross sectional area of sufficient size to convey the design stream flow.

Culverts and bridge crossings were designed to meet Washington Department of Fish and Wildlife's water crossing design guidelines, including stream simulation design criteria. Culvert widths were determined based on Lyon Creek's bankful width, or active channel width, and are wide enough to allow for natural stream meandering and channel formation within each structure.

Where possible, the project reused existing aggregates including streambed substrates, pavement subgrade materials, and rock for retaining walls. These reuse efforts demonstrated a commitment to sustainability by reducing the volume of imported and exported materials, and minimizing

Fig. 2 - Lyon Creek Flood Mitigation Project Phases I-VI



emissions resulting from the transportation of materials.

The project also successfully overcame adverse conditions, which could have otherwise negatively impacted the construction schedule. Unsuitable subgrade conditions were encountered at all four culverts and required quick decisions from the project's geotechnical engineer to amend onsite subgrade with quarry spalls. Many of these decisions had to be made in the middle of the night so the project would not be delayed.

Phase I - Lyon Creek Waterfront Preserve Improvements (June - July 2015):

In an effort to begin in-stream work on July 1, 2015, KLB Construction began upland floodplain grading near the mouth



Phase I: Lyon Creek Waterfront Preserve stream armoring



Phase I: Anchored woody debris armoring

of Lyon Creek on June 15, 2015, and mobilized much of the equipment necessary to construct all phases of the project. On July 1, the lower reaches of Lyon Creek were de-fished by electrofishing and flows were bypassed around the work

area using a pump. This dewatering method was used for all phases of the project.

Phase II - Lake Forest Park Civic Club Bridge Replacement (July 2015):

Once grading was complete in Lyon Creek Waterfront Preserve, the private vehicle bridge immediately upstream



Phase II: Lake Forest Park Civic Club vehicle bridge installation

of the Preserve was demolished and replaced in 10 working days to allow use of the property during the prime summer boating season.

The aging bridge had been inspected by a King County engineer as part of design of the project, and the engineer quickly determined the bridge could not accommodate additional flows and was, in fact, not structurally sound. Demolition was very simple as the bridge collapsed with a tap of the excavator bucket. The new vehicle bridge at Lake Forest Park Civic Club was designed to use prefabricated abutments and bridge decking in order to expedite construction and minimize impacts to culb users. The Civic Club contributed a substantial amount of the cost to replace the bridge.

Phase III - SR 522 Culvert Replacement, Culvert L10 (July 17-19, 2015):

The project team's initial plan was to construct the SR 522 culvert over a period of weeks, moving lane closures with extensive traffic control measures. WSDOT suggested closure of SR 522 for a single weekend as an alternative to reduce costs and construction risks. The project team jumped at the opportunity, but scheduling the work was



Phase III: L10 culvert sections placed during weekend highway closure



Phase III: SR 522 Culvert replacement, night work. Culvert replaced in 60 hours

difficult. The SR 522 closure could not conflict with other planned SR 520 closures and could not occur if there was a significant rain event that would overwhelm the stream bypass pumps. The project team and contractor selected July 17-19 as the weekend to perform the work. Lane closures began the evening of Friday, July 17, and by 9:00PM, the highway was fully closed and a detour route through local streets was implemented. The culvert replacement work, which proceeded on a 24-hour work schedule, included temporary stream bypass, temporary de-energizing of high-voltage overhead power lines, demolition and excavation, subgrade preparation, precast concrete culvert installation, stream channel grading, backfill, paving, and channelization. All work was completed in time to re-open the busy highway to traffic by 5:00AM on Monday, July 20. It was an impressive coordination effort between the City of Lake Forest Park, WSDOT, Seattle City Light and CenturyLink, and adjacent property owners including the Lake Forest Park Town Center.

Phase IV – First Town Center Culvert, Culvert L20 (July 13-25):

Construction proceeded immediately upstream into the Lake Forest Park Town Center with replacement of culvert L20. The culvert design and installation method was the same for all of the culverts allowing the contractor to gain efficiencies as construction proceeded. The 40-foot length of channel between culvert L10 and L20 was also regraded, new retaining walls constructed, large woody debris installed, in-stream refuge pools excavated and a variety of native plantings to shade the creek were planted. This element of the project required closure of one of the primary entrances to the Lake Forest Park Town Center. Traffic was rerouted around the project area and adaptive management was employed to improve traffic circulation. Construction on the Town Center property was carefully phased to ensure that no more than one entrance to the commercial property was closed at any time during the project.



Phase IV: Culvert L20 installation and backfill



Phase IV: 40-ft open channel between culverts L10 and L20

Phase V - Culvert L30 (July 23 - August 17):



Phase V: 300-ft of open stream channel and setback retaining walls constructed, woody debris installed



Phase V: Excavation for Culvert L30, 150-ft culvert length



Phase V: 300-ft of open channel complete

This phase included regrading 300 feet of open stream channel, installation of 11 pieces of woody debris,

replacement of two long retaining walls, excavation of seven habitat pools and replacement of the 150 feet of culvert between commercial buildings. The work was primarily on private commercial property requiring the contractor to work in the barely adequate easement areas. Much of the culvert replacement work occurred at night to mitigate impacts to businesses and SR 522 traffic. The combined stream enhancement for this phase was 450 feet of stream channel, the longest of the project.

Phase VI - Culvert L40 (August 15 - September 15):



Phase VI: Stream meander, looking into Whispering Willow Park

This phase included construction of the final culvert (L40), stream channel regrading, trail construction connecting the Town Center to Whispering Willow Park on top of a flood berm, restoration of wetland in the same park and construction of a stream channel meander area in the park. During this phase two flash floods forced the contractor to stop work for days at a time. The project team could not identify the source of the increased flows as it wasn't raining and upstream discharges could not be located. Despite the flash floods, the contractor completed instream work by September 15 as required by the permitting agencies.

Additional Project Elements:

The Lake Forest Park Town Center ownership group requested that the contractor make changes on its property. These additions extended the project by 25 working days and were funded by the property owner. The City

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Before and after images from the Lyon Creek Flood Mitigation project

Before

After



Culvert L40 (6-ft wide) – Private gate, flood event



Culvert L40 (20-ft wide) - New public access to Whispering Willow Park



Downstream of Culvert L30 (6-ft wide) – Flood event



Culvert L30 (20-ft wide) -Channel widened, installation of woody debris and native plants; photo taken from new sidewalk on a winter day

Before

After



Upstream of culvert L20 (6-ft wide) – Flood event



Culvert L20 (20-ft wide) - Channel widened, native plants and woody debris installed

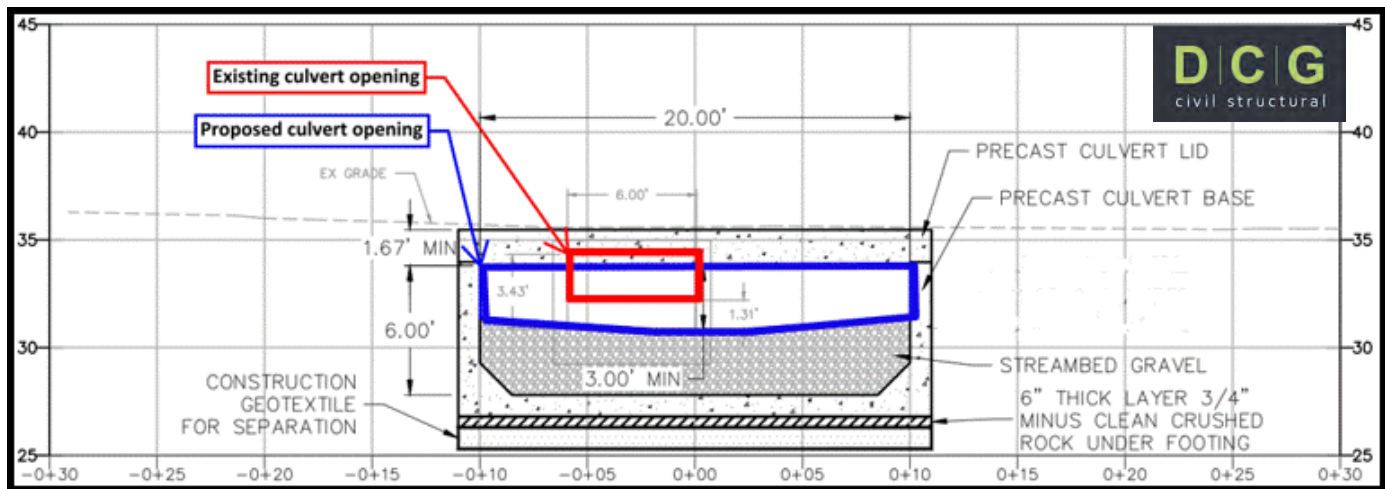


Culvert L10 (8-ft total width) – SR 522



Culvert L10 (20-ft wide) – SR 522

Fig. 3 - Old and new culvert opening dimension comparison



also opted to add a sidewalk along SR 522, connecting two bus stops on Ballinger Way NE (SR 104) to bus stops and businesses on SR 522. The sidewalk also increased channel capacity, further protecting SR 522 from flooding. It overlooks the open channel sections of the project.

Basis of Design: Hydrologic and Hydraulic Modeling

Extensive hydrologic and hydraulic modeling was required to quantify the pre-project floodplain interaction between Lyon Creek and nearby McAleer Creek, design the project's stream and culvert improvements, and delineate the project's flood mitigation benefit. The first step in this process was hydrologic modeling of the two creek's drainage basins, which together include nearly 7,650 acres. Clear Creek Solutions, Inc. used the Western Washington Hydrology Model (WWHM) to model the basins and determine peak stream flows at several points of interest in both creeks.

DCG used the results of the WWHM modeling to develop hydraulic models for Lyon Creek and McAleer Creek using the U.S. Army Corps of Engineers' HEC-RAS software. HEC-RAS was first used to model existing conditions for both creeks, as well as the overflows from Lyon Creek to McAleer Creek and flows routed through McAleer Creek's existing high-flow bypass pipe, and delineate the existing conditions floodplains for the 100-year storm event. The extent of the Lyon Creek model is from 860 feet upstream of the project area to the outlet into Lake Washington; a total of 2,860 feet. The extent of McAleer Creek model is from 450 feet

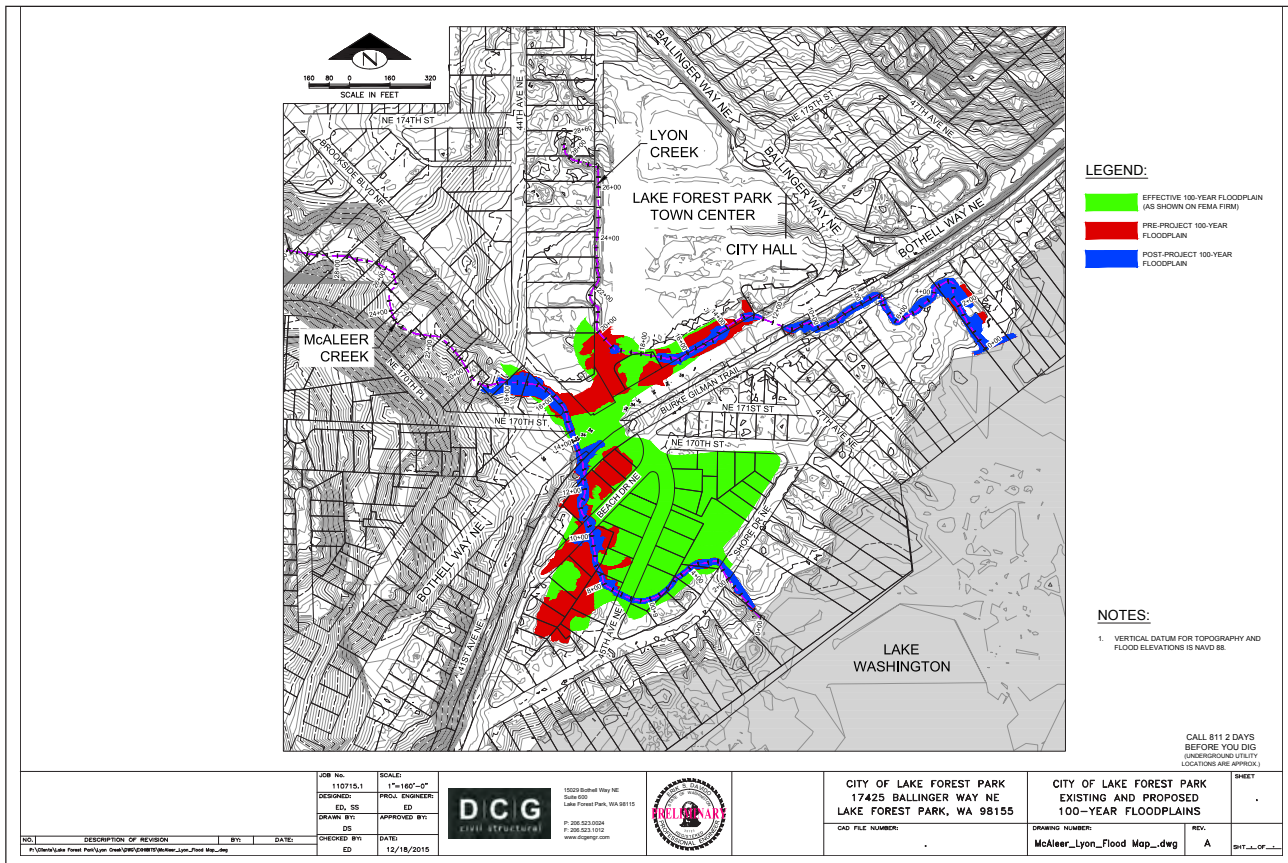
upstream of SR 522 to the outlet into Lake Washington; a total of 1,800 feet. DCG used a combination of survey and LIDAR data to create a three-dimensional topographic surface of the modeled area, including stream channel, floodplain, and roadway geometries, and imported the surface into HEC-RAS. The HEC-RAS geometry was calibrated using stream gauge data and photographs taken during historical storm events.

Proposed conditions HEC-RAS models were used to determine finish grades in the improved stream channel and floodplain areas, design new culverts and bridges with increased conveyance capacity, and delineate the post-project 100-year floodplains. The project resulted in greatly reduced 100-year floodplain extents in both Lyon Creek and McAleer Creek, removing all structures and SR 522 from the floodplain area. DCG and Clear Creek Solutions are currently working with the Federal Emergency Management Agency to revise flood insurance rate maps to reflect the project's flood mitigation benefit -- with an ultimate goal of reducing the flood insurance burden on the local residents.

Funding

The City did not have the financial capacity to design or construct the Lyon Creek Flood Mitigation Project. Fortunately, City leadership agreed that something must be done to improve the health of the stream channel and protect homes, businesses and infrastructure from future flood events.

Fig. 4 - Lyon Creek/McAleer Creek floodplain map. Green=FEMA 100-yr floodplain, Red=modeled floodplain (pre-project)



In 2011 and again in 2012, the City applied for a Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation grant. The 2011 application did not receive funding, but the 2012 application was funded. In fact, the City's project was awarded all of the PDM grant funding available to the state that year and the maximum amount allowed - \$3 million. In the meantime, the City had been awarded a \$1.05 million grant from the King County Flood Control District (KCFCD.) In 2013, the City issued a request for qualifications and eventually contracted with Davido Consulting Group, Inc. and The Watershed Company to provide engineering, design and inspection services for the project. The cost estimate for the project was just over \$4 million. As design moved forward and coordination with the permitting agencies was underway, it became clear that the 2013 Federal Court injunction requiring the state to increase its efforts to remove state-owned culverts that block habitat for salmon would significantly affect the scope and cost of the project. The preliminary \$4 million engineer's cost estimate for the project barely provided

adequate funding to replace the culverts with culverts sized for the 100-year flood event, using the hydraulic method. The computer modeled hydraulic method yielded 14-16 foot wide culverts through the reach. The 2013 Federal Court injunction required the use of the stream simulation design criteria to determine the required culvert replacement size. Using this more empirical criteria yielded a culvert width of 20 feet for all four culverts. This increase in width required additional engineering, property acquisition and construction costs. The cost increased from just over \$4 million to \$6.94 million. The project team now had a \$2.9 million budget shortfall with six months to construction start, nearly sinking the project.

Coincidentally, the SR 522 culvert was on Washington State Department of Transportation's short list for replacement. The City and its consultant team organized a series of meetings with WSDOT, and eventually they agreed to fund the design and replacement of the SR 522 culvert on a reimbursement basis through the City for up to \$1.5 million. This did not complete the funding for the project but it was close enough

that the City decided to proceed with construction despite the financial risks. Construction began in June 2015 with a \$1.4 million budget shortfall. The City worked closely with its state legislators and KCFCD as the project was under construction to close the budget gap. The 2015 State Biennial Budget passed in July 2015 and included \$1.275 million in project funding and KCFCD generously contributed an additional \$125,000. The project was under construction and fully funded.

Safety Performance

The Lyon Creek Flood Mitigation Project had zero lost time accidents with no accident reports. Each work week started with a safety meeting and regular meetings for the crews. The City also met with the engineering team, inspection team and contractor weekly using an agenda that included safety as a key topic.

Police provided traffic flagging and control services for the duration of the SR 522 closure at each of the four intersections of the detour. The project was also in the immediate vicinity of the Northshore Fire Station so the contractor's traffic control technicians were prepared to allow passage of emergency vehicles at a moment's notice.

Environmental Benefits

While solving serious flooding problems in the Lake Forest Park Town Center area, the Lyon Creek project also enhanced adjacent wetlands, improved habitat for salmonids, created a new neighborhood park and enhanced valuable shoreline habitat in Lyon Creek Waterfront Preserve on Lake Washington.

The project design sought to allow natural meandering and channel formation throughout the project area, while limiting the ability of the stream to create unsafe conditions or degrade in-stream habitat. Sizing of streambed sediment gradations was integral to this objective. The design team developed a mix of rounded, fish-friendly material of sufficient size to allow for an equilibrium of sediment transport into and out of the project area. Large, angular material was used sparingly, and only where absolutely necessary to protect critical infrastructure.



Fish barrier weirs removed by the project, downstream of culvert L10 (SR 522)

Environmental features of the project included:

- Construction or enhancement of valuable wetland and wetland buffers;
- Installation of approximately 3,500 tons of streambed gravels for salmonid spawning and 48 in-stream log features to form and maintain pool habitat with cover to provide juvenile rearing and adult holding habitat for salmonid fish;
- Re-grading of the channel profile to accommodate better fish passage;
- Planting of more than 12,000 native trees, shrubs and groundcovers to replace existing aggressive invasive non-native species and restore riparian habitat;
- Design and construction of Whispering Willow Park, a new neighborhood park on the site of a former residence that suffered substantial flooding, including a new boardwalk and neighborhood connector trail that links residential areas to the City's commercial center; and
- Enhancements to the shoreline of Lyon Creek Waterfront Park, including installation of valuable log habitat features and habitat pools to aid fish rearing, protection, and migration.

Lyon Creek, including the confluence area with Lake Washington at its mouth, is potentially home to three federally listed species of salmonids (Chinook salmon, bull trout, and steelhead) and one salmonid species of concern (coho salmon). In particular, coho salmon are known to spawn and



Whispering Willow Park, Lyon Creek in the background, Fall 2015

rear in the creek, yet its valuable habitat has been seriously affected by urban runoff, increasingly flashy flows, frequent flooding, denuded banks and elimination of critical wetlands.

Restoration of habitat in concert with culvert replacement to solve flooding problems smoothed project permitting,

enhanced public access and aesthetics, and provided tremendous environmental benefits to fish and wildlife as well as Lake Forest Park citizens.

Wetlands

The Lyon Creek project's mitigation plan, designed by The Watershed Company, resulted in net improvement to the existing wetland communities through berm relocation and reduction, and wetland and buffer restoration. The area of the berms needed to contain flood flows was minimized by having steeper side slopes, and the relocated berm now runs generally along the perimeter of the wetland to minimize disturbance and fragmentation.

New wetlands were created and existing wetlands and their buffers were restored and connected to the creek, allowing them to serve a critical role in the natural flood control process and hydrologic function. A regraded floodplain bench in the new Whispering Willow Park provides both new productive wetlands and flood storage during high storm events. The project impacted 4,500 square feet of existing



Restored wetland adjacent to Lyon Creek - Whispering Willow Park

wetland and buffer area. Mitigation work enhanced or created more than 20,600 square feet of wetlands.

Extensive hand labor, thorough mulching, locally sourced landscape materials and a palate of vigorous native plants were used to further reduce impacts and promote success.

Fish and Stream

Lyon Creek is typical of most urbanizing streams -- subject to flashy flows and severely diminished natural habitat as it struggles with deteriorating water quality. The Lyon Creek Flood Mitigation project gave the creek an opportunity to improve fish passage by evening out the stream channel profile and eliminating partial migration barriers, greatly increasing vegetative cover, and improving overall habitat diversity.

While the existing four culverts through the project site were fish passable, two steep weirs downstream of Bothell Way



Whispering Willow Park (pre-project). Post project comparison to the right

created a blockage. These weirs were removed and the Lyon Creek stream channel profile was adjusted upstream for a distance of approximately 1,100 feet. Streambed gravel substrate was carefully graded and the channel gradient steepened slightly from 0.72% to 0.93%. Gravel was supplemented to a depth of up to 18 inches. The increased width and capacity to carry flow through the four new box culverts also ease fish and wildlife migration through the corridor.

Habitat logs and specimen boulders were placed in Whispering Willow Park, along the shopping center channel and downstream of Bothell Way to Waterfront Park. Single and multiple log structures create pools and cover and are sufficiently submerged such that they are well-wetted under low flow conditions. Log structures were analyzed hydraulically against modeled flows up to and including the 100-year flow event. Rounded gravel mix included up to 5-inch material, predominantly in the 3/4 to 3-inch size range, typically used for habitat purposes such as fish spawning and aquatic insect habitat. Aquatic insects are a primary food source for juvenile salmonid fish.

Habitat features at Lyon Creek's mouth in Waterfront Park provide another benefit for fish and wildlife unique to Lake Washington. Fish passage into small streams emptying into the lake can be particularly challenging since it has a "reverse hydroperiod." Management at the Hiram Chittenden locks in Ballard maintains a high lake level in summer and a low level in winter, contrary to the normal and natural regime. Adult fish seeking to migrate during the fall can face impossibly shallow



Trail at Whispering Willow Park, looking toward Lyon Creek, house removed, floodplain/wetland restored

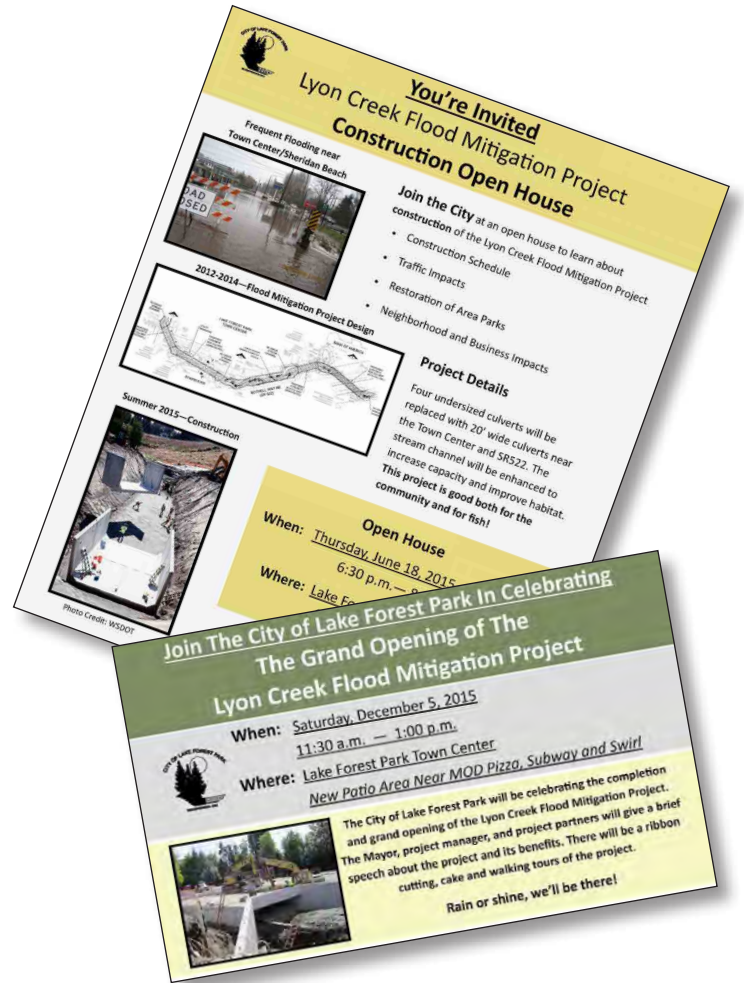
flows dispersed across creek deltas. New habitat features help to direct and maintain deeper, less dispersed flow approaching the Lyon Creek mouth.

Parks, Walkability and Community

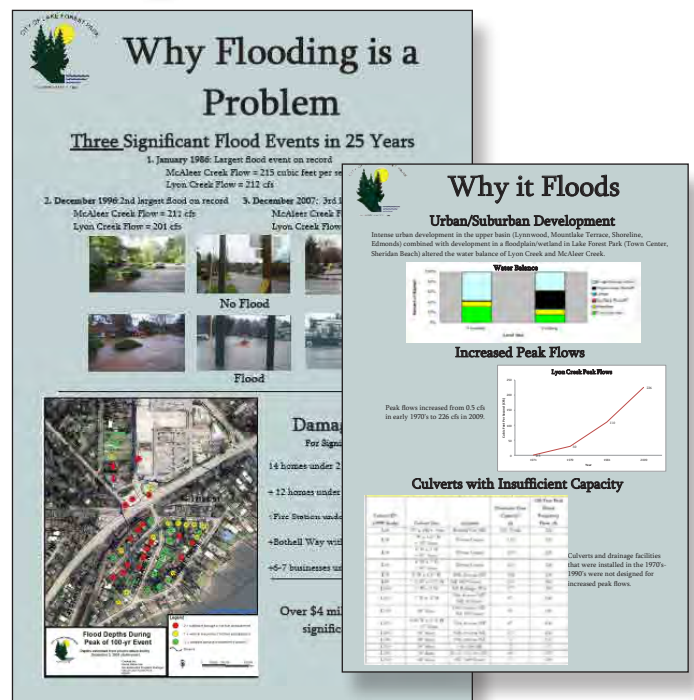
The Lyon Creek Flood Mitigation project is located at the very heart of Lake Forest Park – in the middle of the City’s main shopping center and community gathering place, adjacent to City Hall and a fire station and along two major regional arterials, Bothell Way NE (SR 522) and Ballinger Way NE (SR 104) as well as the popular Burke Gilman Trail.

While the project created a new park and enhanced another, citizens were worried about impacts to their privacy and neighborhood. A community process with charrettes led by Watershed Company landscape architects enabled a citizen Task Force to have an extensive say in the new park’s design. A weeping willow tree, treasured by neighbors, was preserved and became the park’s namesake, chosen by community acclamation.

Over two-thirds of Whispering Willow Park is seasonally-flooded wetland with the remaining land including a natural play and picnic area, raised boardwalk, parking, edible berry bushes, and diverse native plantings. Instead of walking to the Town Center over busy streets, citizens can now access the center on a soft surface trail to return to a bench on the boardwalk, coffee in hand, for some quiet contemplation.



Erik Davido, Project Engineer, DCG, answering questions at public meeting



Public Meeting posters

At Lyon Creek Waterfront Park, the project engineers and landscape architects worked collaboratively to regrade the park to create a central floodplain while maintaining universally accessible pathways to the park’s main amenities, which include a dock on Lake Washington and a viewing platform over Lyon Creek. Site furnishings, including benches and a pedestrian bridge, and park circulation were reconfigured to allow safe and consistent use of the park year-round, regardless of high-water periods and events. The park underwent additional landscape enhancements to remove invasive vegetation, improve and frame views, and restore wetland and riparian habitat.

Community Coordination

The City used a variety of public outreach methods to notify residents, travelers, emergency services, businesses, shoppers of the closure of SR 522 and the closure of entrances to the Lake Forest Park Town Center. These methods included:

- Frequent newsflash postings to the City webpage that include an email blast,
- Thousands of postcards mailed to residents,
- Articles in the quarterly City Newsletter,
- Open house events leading up to construction,
- Articles in the Shoreline Area News,
- Coordination with WSDOT to post highway closure, notices on I-5 and I-405 reader boards, postings to their website and to their popular Twitter account,
- Social media paid promotions based on geographic area reached 17,000 Facebook users in the area,
- Presentations to the Lake Forest Park Merchant’s Association,
- Press releases to local newspapers.

Residents

The City used its webpage and social media extensively to reach Lake Forest Park residents. The City’s webpage is hosted by CivicPlus, which has a News Flash tool that allows interested residents to sign up to receive City news via email. Over 1,400 residents have registered to receive City News this way and the City used this tool to warn of pending

construction impacts, project progress and project benefits.

Social media may have been the most successful method of reaching residents. While the City does not have a large group of followers, the City purchased social media boosts for less than \$100 to reach up to 17,000 social media users. The social media platforms allowed the City to target users in the project area, even users that do not follow the City. The cost of social media boosts is determined by the number of users the post reaches.

Commercial Businesses

The City frequently sent representatives to the Lake Forest Park Merchant’s Association meetings to discuss the project with the business owners and managers. Through these meetings the merchants were able share their calendars and discuss merchant needs. Often the City was able to accommodate their requests for access or construction



Multiple media communication outlets used

sequencing. For instance, the local book store was hosting a book signing for former President Jimmy Carter during one of the key phases of construction. The City worked with the contractor to end work early that day and re-open the parking areas.

The City also invited the ownership group of the Lake Forest Park Town Center to attend the weekly coordination meetings. This led to project changes and collaboration that was not anticipated when construction began, including addition of a large patio area near a daylighted section of the stream on the commercial property.

Highway Travelers

This project included a weekend closure of SR 522 that began at 9:00PM on Friday, July 17, and re-opened the highway by 5:00AM on Monday, July 20. The closure had to be carefully coordinated with other WSDOT groups and King County METRO. The City met with WSDOT's public relations manager to discuss options to notify travelers of the closure. WSDOT used their Twitter account (@wsdot) to promote notices of the closure – WSDOT has 117K followers. The project team also provided interviews for the local media to share the details of the closure and the project.

Unusual Accomplishments under Adverse Conditions

Performing in-water work in a salmon-bearing stream adjacent to a highway and a large commercial property presented numerous challenges and a variety of opportunities for design and construction. Staging areas for pumps and materials were extremely limited and required careful coordination of construction phases and stream dewatering. As a result, the project was designed to be constructed in six phases. Each phase used a pump system to dewater the stream and pump the flows around the construction area. The pumps were operated 24/7 but during three large flow events the pumps were overwhelmed and the excavation area flooded. Fortunately, the contractor was prepared for these events and quickly stopped work and allowed the high flows to move through the area until they subsided. Once the flows

returned to normal the excavation area was de-fished and the pumps were restarted, in that order.



Lyon Creek Waterfront Preserve - wetland restored adjacent to Lyon Creek near its mouth



Sidewalk/viewing area adjacent to SR 522 after completion



New sidewalk adjacent to SR 522 after project completion



Completed Lyon Creek Flood Mitigation project

Additional Considerations – *Sidewalks and Easements*

During design of the project, the team realized that a berm at the upstream end of the project could be constructed as a pedestrian pathway connecting the Lake Forest Park Town Center with the Whispering Willow Park. The berm already required that the City purchase an easement from the property owner and decided it would not be a stretch to include a pathway in the easement.

During construction, the City worked with the contractor to install 530 feet of sidewalk adjacent to SR 522 and Lyon Creek. The sidewalk provides additional channel capacity in an extreme flood event and connects pedestrians on Ballinger Way to bus stops and businesses on Bothell Way.

Storms of 2015-2016

Shortly after construction completion in December 2015, the Puget Sound area and Lyon Creek faced the largest rainfall

events it has experienced in two years. Flows would have been very close to or exceed capacity of the stream channel under previous conditions. With the new culverts and stream channel capacity improvements, the capacity of the channel was never in danger of causing flooding.



December 7, 2015 - Rainfall event