CITY OF KIRKLAND
Department of Public Works
123 Fifth Avenue, Kirkland, WA 98033 425.587.3809
www.kirklandwa.us

MEMORANDUM

To: Kurt Triplett, City Manager

From: Pam Bissonnette, Interim Public Works Director
Dave Snider, P.E., Capital Projects Manager

Date: February 21, 2013

Subject: Totem Lake Culvert Replacement Project
Precast Concrete Culvert Fabrication – Award Contract

RECOMMENDATION:

It is recommended that City Council award the Precast Concrete Culvert Fabrication contract, for the Totem Lake Culvert Replacement Project, to Advantage Precast Company, Kaiser, OR, in the amount of $490,554.53.

BACKGROUND AND DISCUSSION:

HISTORY

In the past, the Totem Lake area has experienced a number of flooding events during fall and winter months due primarily to an overflowing of the lake at Totem Lake. Development in the basin, surface water runoff and natural erosion, combined with the growth of invasive vegetation, and the accumulation of sediment along the watercourse, downstream of Totem Lake, have been restricting its natural flow resulting in localized flooding. Fixing the flooding problem was one of the key recommendations of the first Totem Lake Symposium on September 16, 2010 and was identified as an early action item in the subsequent Totem Lake Action Plan that was adopted by the Council on December 7, 2010.

In early 2011, the City contracted with a Bellevue consulting firm, CH2M Hill, to undertake a detailed survey of the drainage system leaving from Totem Lake. The Study limits were the outfall of Totem Lake to approximately Juanita High School where the existing drainage system includes piped conveyance and natural open channels for this Juanita Creek tributary that eventually enters Lake Washington at Juanita Beach Park. Using GIS and survey techniques, the Consultant, in working with City staff, measured the water surface level along the Project limits to ascertain the system and watercourse geometry, providing a profile of the stream/watercourse and channel bottom.

In late 2011, following the results of the Study, the City implemented a 2-pronged approach for dealing with the Totem Lake flooding issue – between July and September, 2011, the City contracted with King County to remove sediment and vegetation accumulated between Totem Lake and I-405, followed by an aggressive fall and winter emergency pumping program to

insure water moved through the natural drainage outfall on the west side of I-405 during high intensity rainfall events (Attachment A). This approach proved successful in that for the 2011/12 rainy season, the lake did not overflow and the local roads did not flood.

In addition to providing flood control for the winter of 2011/12, the pumping operation also provided an opportunity for closer inspection of the existing corrugated metal pipe (CMP) drainage system that leaves Totem Lake. Specifically, there are twin 42-inch CMP culverts that convey water from Totem Lake, extending along the edge of Totem Lake Boulevard and crossing under 120th Avenue NE. These culverts are old and at the end of their anticipated design life. Until the pumping operation of 2011/2012 inspection of these culverts had not been possible due to the high water level and accumulated sediment within the drainage system. The 2011 removal of sediment and vegetation, combined with the subsequent emergency pumping activities, reduced the existing water level allowing City maintenance staff to visually inspect the condition of the twin pipes. From these inspections, three significant conditions were observed:

- one culvert (south side) is severely clogged with sediment,
- one culvert (north side) is partially crushed, and
- sections of both culverts have deteriorated significantly

In addition to past flooding issues in the area a sinkhole has also reoccurred near the northwestern corner of the intersection of Totem Lake Boulevard NE and 120th Avenue NE at various times over the past several years. Though the culvert inspection, as outlined above, the cause of this sink hole was determined to be deterioration of the northern-most of the existing twin culverts. This sinkhole is also near a Washington State Department of Transportation (WSDOT) signal pole and signal control cabinet and it was concluded that, if left unattended, the sink hole could compromise the integrity of the signal pole and controller.

CURRENT PROJECT

For reference, the Totem Lake drainage system has been divided into 4 segments between the outlet of Totem Lake and I-405 (see Attachment B).

On April 17, 2012 staff provided an update to Council regarding measures taken to control flooding in the Totem Lake area and recommended approval of a new Capital Improvement Project (CSD-0075) to replace Segment 1 of the existing twin culverts (Attachment C). That same month, a second sinkhole developed in the center lane of Totem Lake Boulevard shown as Segment 3 (Attachment B). At the time of the sinkhole repair, City maintenance and engineering staff concluded the cause of the new sink hole was also age related deterioration of the twin 42–inch culverts that cross Totem Lake Boulevard. As a result, the scope of work for SD-0075 was expanded to include replacement of existing culvert crossing under Totem Lake Boulevard with a new culvert along the new Segment 3 alignment (Attachment B).

As the design efforts continued many consultations with various regulatory agencies including the Washington State Departments of Ecology and of Fish and Wildlife, the Army Corps of Engineers, the Tribes and WSDOT were conducted. As an outcome of these meetings several types of culvert materials and shapes were considered, and the scope of work was further expanded to include the removal of sediment and vegetation along Segment 4 in order to achieve better hydraulic conditions at the outlet of the new Segment 3 culvert. The

requirements for providing fish passage, of managing the existing utilities, of dealing with existing grade differences for achieving a practical slope for the new conveyance system, and the existing underlying soil types all contributed to the engineering decision to use a concrete box culvert, as outlined within the engineering consultant's design Technical Memorandum (Attachment D).

The cost of the expanded scope of the Project was more fully estimated at $5,269,000 within the 2013 -2018 Capital Improvement Program process, as approved by City Council on December 7, 2012 (Attachment E). The current Project budget is made up of nearly $1.6M in utility rate revenue plus $3.67M in Surface Water Capital Reserves; the currently projected estimated ending year (2014) balance for that Reserve fund is $2.8M.

The Project is now on track for going to construction this summer, including a permit specified "fish-window" timeline for work within the normal watercourse that leaves Totem Lake. The elements of all work on this Project include:

- The replacement of approximately 700 feet of deteriorated and clogged corrugated metal pipe (CMP) with a new concrete box culvert in two separate sections (Segment 1 and Segment 3).

- The relocation of a WSDOT traffic signal in conflict with the culvert alignment (Segment 1), including the placement of a temporary signal for use during the construction period.

- The cleaning and inspection of 300 feet of 72-inch culvert (Segment 2), and

- Sediment and vegetation removal within an open section of drainage channel (Segment 4).

CONCRETE CULVERTS

Typically, a general construction contract would include culvert procurement and installation by the contractor; however, permitting conditions require that the culvert replacement work be completed between June 1 and September 31, 2013. With fabrication time being a critical path element for the Project's schedule, the culvert procurement was advertised and bid separately in order to pre-order and make the culverts available for the contractor to immediately begin installation in June.

With an engineer's estimate of $462,000, the Procurement of the concrete culverts was advertised for bids on January 14, 2013. The bid opening was on January 28, 2013 with two bids received, as shown below:

Contractor	Total Bid
Engineers Estimate	*$462,000.00*
Advantage Precast Company	$490,554.53
Oldcastle Precast	$572,045.52

The total construction budget, including the culvert fabrication cost, is $3,263,400. With an engineer's estimate of $2,772,845 for the installation and the $490,555 for fabrication, the resultant overall Project budget contingency is $362,600, or 11% of the estimated total construction cost (Attachment E).

A majority of the culvert alignment is on private property, or within the WSDOT controlled access of the I-405 off-ramp at 120th Ave NE and Totem Lake Boulevard. All regulatory agency environmental permits for the work have been secured and the WSDOT utility franchise permit has been issued. The Project does require the acquisition of temporary construction (TCE) and permanent utility easements (UE) from three properties; Bank of America, Totem Lake Mall and Totem Station Mall. Staff has met with each of the property owners, or their representatives, several times throughout development of the Project to discuss their respective concerns. All property owners are currently reviewing copies of the two easement document types (TCE and UE) and the finalizing of the easements is scheduled to be complete on or before March 21, 2013.

SCHEDULE

With a contract award, fabrication will begin in March with on-site deliveries starting in June, 2013.

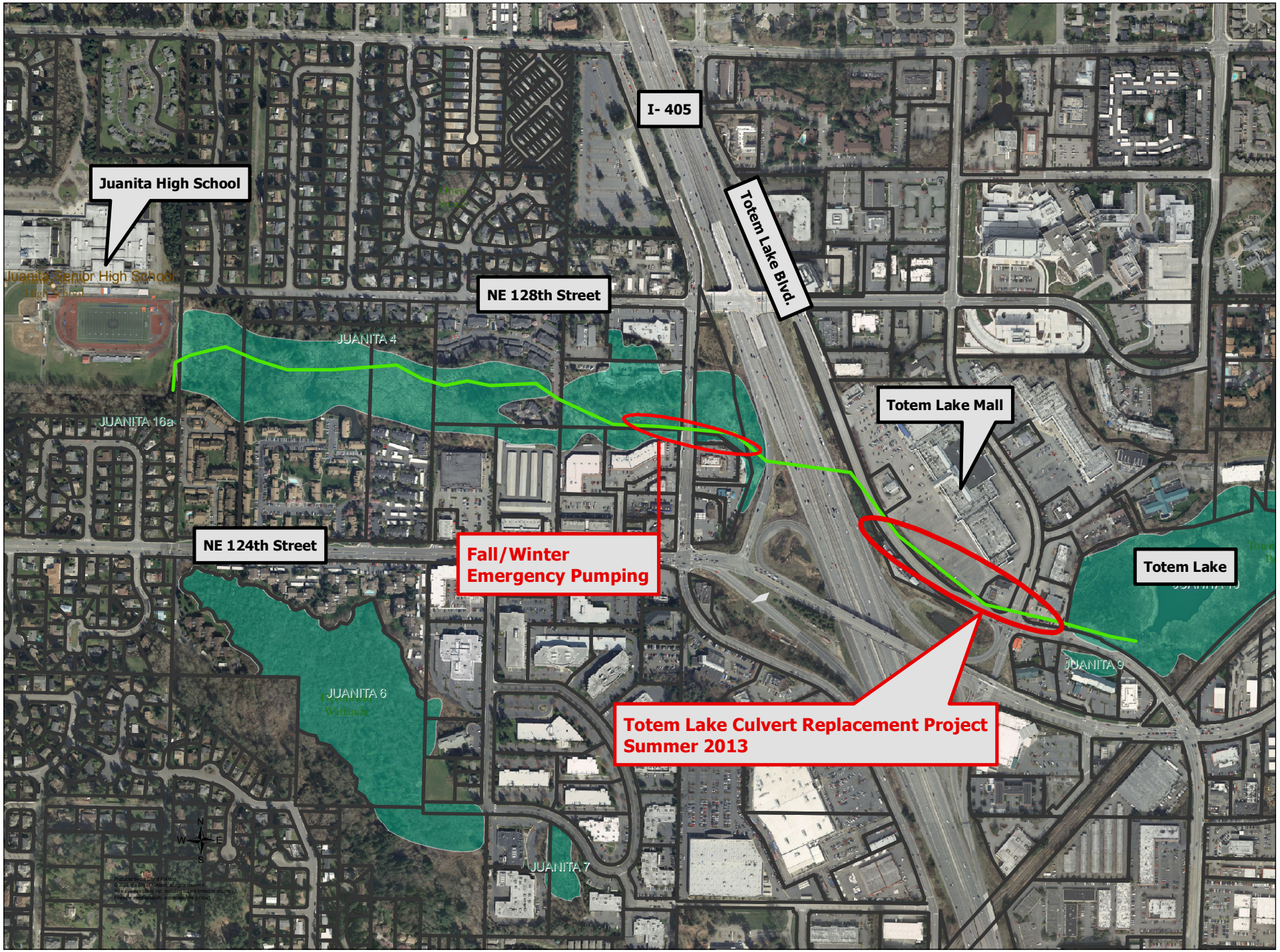
The current schedule for all other related work efforts for this Project is:

Notice to proceed with culvert fabrication	March, 2013
Bid Opening for construction/installation	March, 2013
Easements Secured	March, 2013
Recommend award of construction contract	April, 2013
Notice to proceed with construction	May, 2013
Begin delivery of prefabricated concrete box culverts	June, 2013
Complete delivery and installation of concrete box culverts	September, 2013
Project complete	October, 2013

Attachment A: Area Map
Attachment B: Site Map
Attachment C: 4/10/12 Council Memo
Attachment D: Technical Memo
Attachment E: Project Budget Report

Totem Lake Area Map

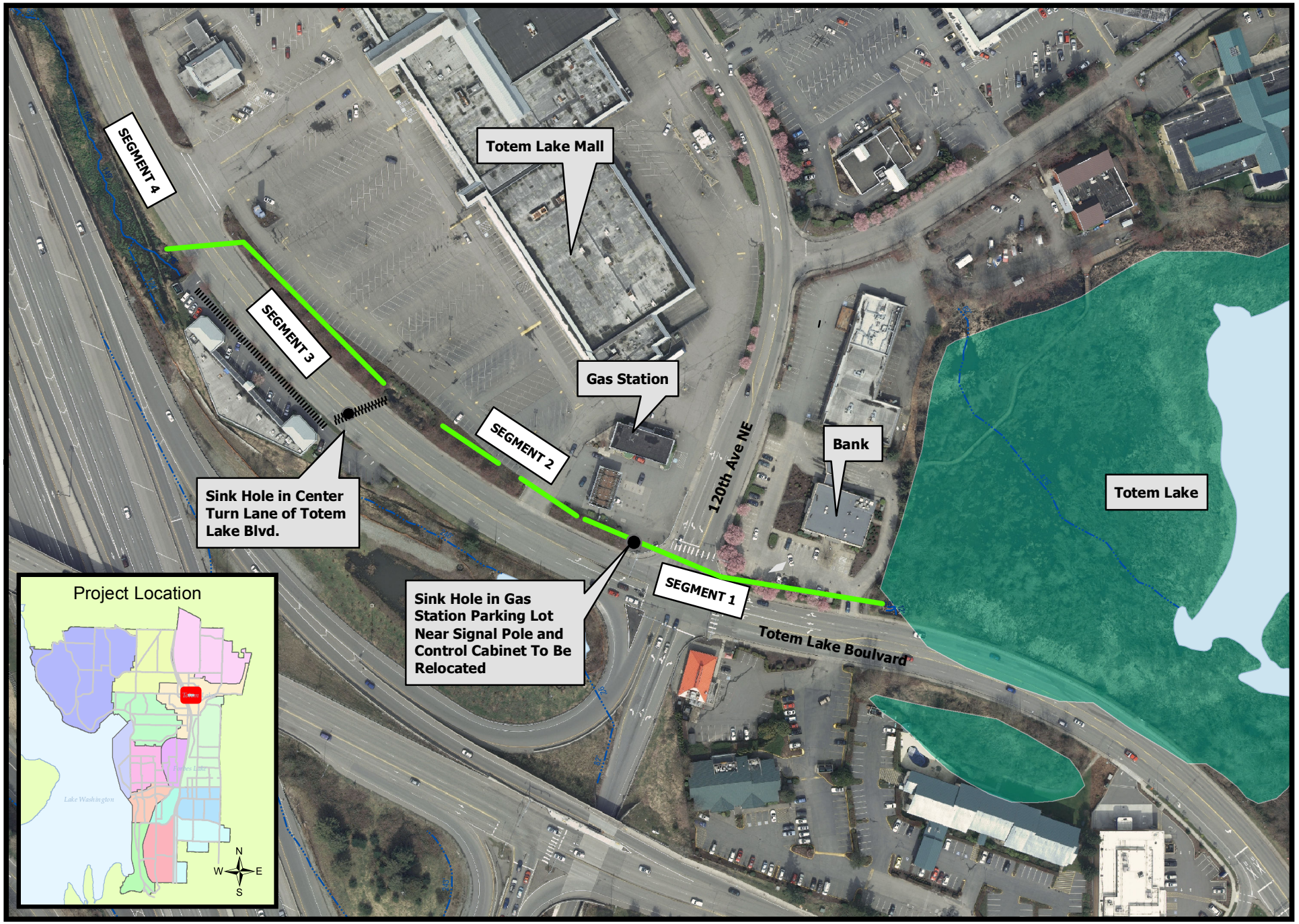
Attachment A



Attachment A

Attachment B

TOTEM LAKE CULVERT REPLACEMENT PROJECT
SITE MAP



Attachment B

CITY OF KIRKLAND
Department of Public Works
123 Fifth Avenue, Kirkland, WA 98033 425.587.3800
www.kirklandwa.gov

MEMORANDUM

To: Kurt Triplett, City Manager

From: Dave Snider, P.E., Capital Projects Manager
Ray Steiger, P.E., Public Works Director

Date: April 10, 2012

Subject: TOTEM LAKE FLOOD CONTROL MEASURES –UPDATE/FUNDING APPROVAL

RECOMMENDATION:

It is recommended that City Council receives an update on measures taken over the fall and winter months to alleviate flooding in the vicinity of Totem Lake. It is also recommended that City Council approve funds for replacement of a series of twin 42-inch culverts that serve as outlets to Totem Lake.

These actions are part of the 2012 City Work Program Item *"Implementing Totem Lake Action Plan regulatory changes, Phase II flooding projects and NE 120th Street construction to revitalize the Totem Lake Business District to further the goal of* ***Economic Development****."*

BACKGROUND DISCUSSION:

At their regular meeting on November 3, 2011, City Council received information on summer 2011 activities related to the Totem Lake Flood control measures (Attachment A). That update described the work completed in 2011 and identified the ongoing plan to provide emergency pumping as a means to minimize possible occurrences of Totem Lake flooding through the 2011-2012 winter/wet season. Totem Lake pumping began in November, 2011.

The on-going pumping operations have been successful, and prior to Sunday, April 8th, 2012, there were no lane closures on Totem Lake Boulevard since March, 2011, despite a number of relatively significant rainfall events. The following table compares the outcomes of various storms over the last 30-month period:

Date	Rainfall (inches)	Totem Lake Blvd	Notes
Prior to measures			
October 17, 2009	2.06	Road closed	2-day storm
December 11-12, 2010	4.72	Road closed	3-day storm ("Pineapple Express")
January 13, 2011	1.62	South curb lane closed	2-day storm /1-in. rain/several of snow)
March 14, 2011	1.81	North curb lane closed	3-day storm
After measures			
November 21-24, 2011	3.40	No closure	4-day rain storm
January. 20-22, 2012	1.66	No closure	3-day rain storm / 4-6 in. of snow
March 9-15, 2012	3.39	No closure	7-day rain storm
April 8, 2012	NA	Southbound lane closure	Sink-hole developed

TABLE 1. Storm related closures of Totem Lake Boulevard before and after flood control measures

On April 8th, the southbound center turn lane of Totem Lake Boulevard developed what was reported by Kirkland Police as a "pot hole" (Attachment B). City staff responding to the scene discovered what had developed into a 2-3 foot diameter sinkhole in the road immediately above two large diameter storm drains; the roadway has continued to give way and efforts to shore the cavity and cover the hole have been put in place temporarily. As of this memo, staff had steel plates on the center turn lane of Totem Lake Boulevard and is working with a local contractor to assist in dewatering of the pipes to determine the level of failure. Information will be relayed to City Council at their April 17th meeting along with a likely funding request for storm drain and pipe replacement.

In addition to successfully providing flood control this winter, the emergency pumping operation at Totem Lake has also provided an opportunity for closer inspection of the existing corrugated metal pipe (CMP) drainage system that outlets from Totem Lake. Specifically, there is a series of twin (side by side) 42-inch CMP culverts that convey water from Totem Lake along the northern/eastern edge of Totem Lake Boulevard, under 120th Avenue NE, and then under Totem Lake Boulevard. From there, water is conveyed under I-405 and to the west as Juanita Creek. These twin culverts are approximately 60-years old and are at the end of their anticipated design life. Until this year, inspection of these culverts had not been possible due to depth of the pipes and the high water level in the drainage system. The removal of sediments and vegetation last summer, combined with the on-going pumping activities, has reduced the water level to allow maintenance staff to visually inspect the condition of the twin pipes. Additionally, due to the failure on April 8th, staff has been able to observe three significant conditions:

120th Ave NE culverts --

1. The southern culvert crossing 120th Ave NE is severely clogged with sediment;
2. The northern culvert crossing 120th Ave NE is partially crushed and is the cause of a sink hole on the Chevron property near the intersection of Totem Lake Boulevard and 120th Ave NE; and
3. Sections of each of the culverts show signs of significant deterioration.

The combination of these conditions is cause for taking immediate action to replace the existing culverts. At this time, the culverts are operating at a capacity that is less than half of their original design flow capacity, and their replacement will restore the flow capacity and improve overall drainage out of Totem Lake. In addition to the drainage improvements, replacement will eliminate the potential collapse of 120th Avenue NE or Totem Lake Boulevard were the culverts to fail due to further structural degradation.

Staff requests City Council's authorization to fund this project in order to immediately begin the design and necessary permitting efforts for the replacement of the twin culverts. This is the primary project that was contemplated as the *"Phase II flooding projects"* in the Work Program. The funding needed for the engineering and permitting costs is estimated to be $390,000 and is available from the 2011 Annual Storm Drain Replacement Program (Attachment C & D). It is anticipated that design will be completed in 2012. Permitting through agencies that include the Washington State Departments of Fish and Wildlife, Ecology, and Transportation, the Army Corps of Engineers, the King Conservation District and the City will be completed by late spring 2013, and construction will follow immediately thereafter. Funding for the construction phase is currently being identified in the 2013-2018 Capital Improvement Program with a total project cost of approximately $1.5M (CSD-0075).

Given City Council approval, design and permitting will be completed in time to bid the Project for construction during the fish work window of July through September, 2013. Until construction, staff will continue to address sediment, vegetation, and beaver dam removal throughout the Totem Lake drainage system concurrent with ongoing pumping operations. Emergency pumping permits have been secured through 2014.

ATTACHMENT A
Council Meeting: 11/15/2011
Agenda: Unfinished Business
Item #: 10. a.

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www.kirklandwa.gov

MEMORANDUM

To: Kurt Triplett, City Manager

From: Noel Hupprich, P.E., Senior Project Engineer
Ray Steiger, P.E., Public Works Director

Date: November 3, 2011

Subject: TOTEM LAKE FLOOD CONTROL MEASURES – PROJECT UPDATE

RECOMMENDATION:

It is recommended that City Council receive this update on the Totem Lake Flood Control Measures Project (CSD-0059)

BACKGROUND DISCUSSION:

It was their regular meeting on July 19, 2011, that City Council received an earlier update on the Totem Lake Flood Control Measures Project. That update described analysis and design work completed by staff and the City's consultant, CH2MHill, Bellevue, WA, together with recommendations for maintenance work that would reduce the frequency and severity of flooding in the Totem Lake area. The analysis included a detailed survey of the Totem Lake drainage system and located "stream barriers" where accumulation of sediment, invasive vegetation and beaver dams are impacting the flow of water out of Totem Lake. The recommended maintenance work involved removal of accumulated sediment and vegetation at three locations, and the removal of one active beaver dam (Attachment A).

The original Project budget for 2011 was $117,000 and estimates to perform the recommended work exceeded that amount. At their regular meeting of August 2, 2011, City Council authorized the use of an additional $218,000 from the Surface Water Reserve Fund to complete the work, bringing the total available funding for 2011 to $335,000. Permitting conditions required that the sediment and vegetation removal be completed by August 31, 2011; this was accomplished by an expedited permitting review process, cooperation from private property owners and from WSDOT, along with the City's ability to contract with the King County Rivers Team through an existing interlocal agreement. The sediment and vegetation removal work began in mid August and was complete by the end of August; the beaver dam removal was permitted separately and City crews completed that work in early September.

The following photos show the before (May, 2011) and the after (September, 2011) conditions at the three sediment and vegetation removal locations, including the beaver dam:

1 - Totem Lake Outlet

May, 2011

September, 2011

2 - Settling Basin

May, 2011

September, 2011

3 - Drainage Channel East Side of I-405

May, 2011

September, 2011

4 - Beaver Dam West of 116th Ave NE

May, 2011

September, 2011

The City's consultant, CH2MHill, conducted a new survey and collected water surface elevations after the maintenance work was finished. The results of that survey showed a decrease in the water surface elevation of three feet within the drainage system, between Totem Lake and the east side of I-405. The drop in water surface elevation exposed culverts within the system that had been submerged for over ten years, providing City crews an opportunity to inspect and repair one culvert known to be damaged, but previously submerged and inaccessible.

The work completed this year focused on "stream barriers" located between I-405 and Totem Lake. These activities allowed for the identification of other barriers not previously evident, particularly the area of drainage channel from the west side of I-405 to 116th Ave NE. The initial survey of the drainage channel found the area to be built up with sediment and vegetation; now that the drainage channel upstream has been cleaned out, it is clear that sediment and vegetation removal in the area between I-405 and 116th Ave NE will further improve flows out of Totem Lake. City staff and the design consultant will be working together to develop a plan for 2012 work to address further maintenance needs in this area.

To immediately address the stream barriers on the west side of I-405 during this year's wet season (November through April), staff is currently working on a hydraulic pumping plan to move water around the sediment and vegetation "hump" that exists between I-405 and 116th Ave NE. The strategy for pumping during the wet season is to begin this activity in advance of significant storm events, or when the lake level rises above a determined elevation. The intent is to maintain storage capacity in the Lake to allow for an increase in volume during large storm events. The City's consultant is currently working on the analysis to define a water level that will trigger pumping.

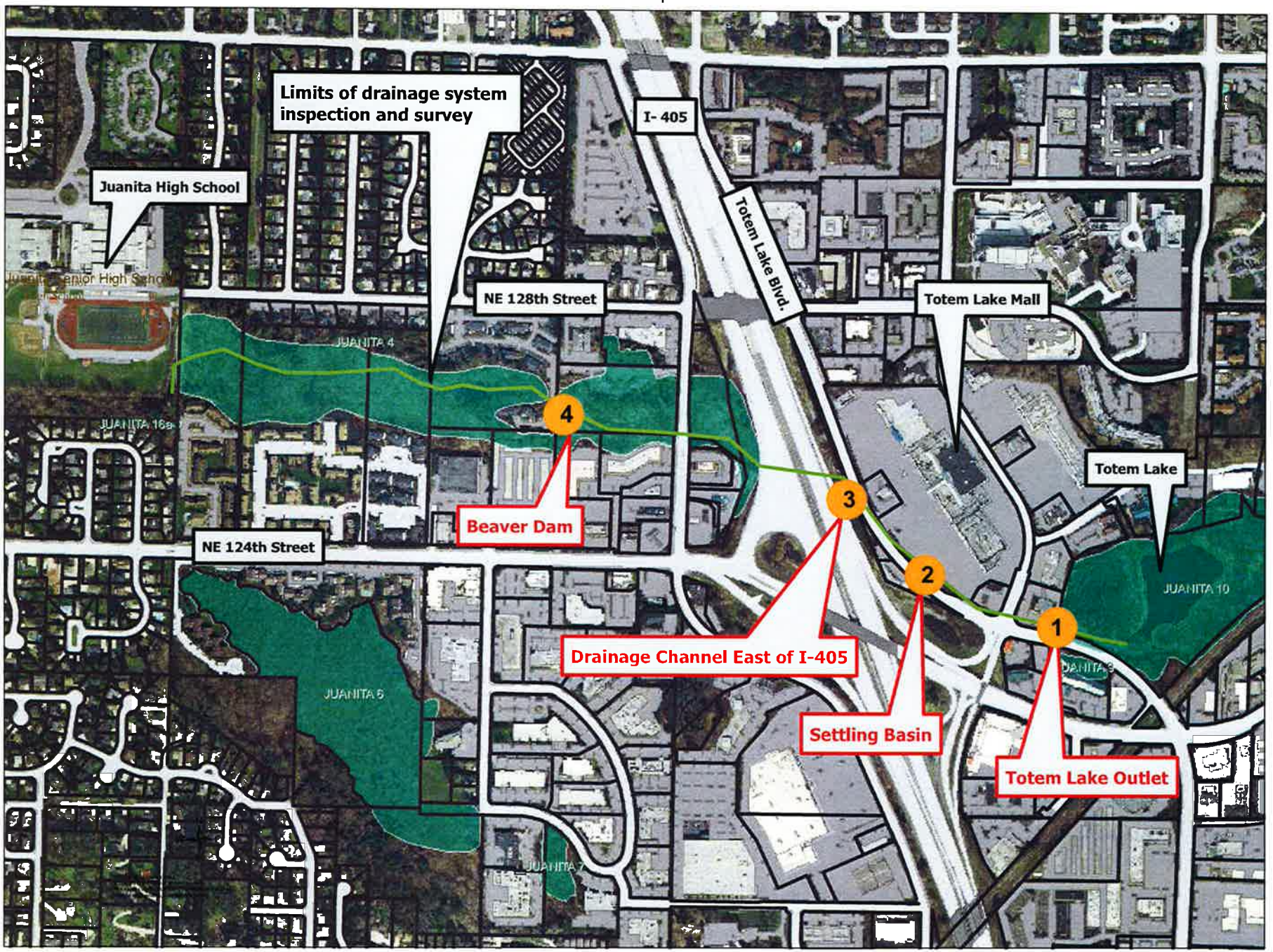
The pumping plan will draw water from culverts beneath I-405 and divert it around the sediment and vegetation between I-405 and 116th Ave NE. The discharge water will be moved downstream where the drainage channel gradient is steeper and water does not typically back up (Attachment B). City maintenance crews are securing all material and equipment needed for the pumping system. The system will be comprised of a rigid intake pipe and a flexible hose discharge line. A large capacity pump will be brought to the site as needed; however, the intake and discharge lines will be left in place to allow for quick and easy set up.

City staff and the consultant have met with representatives from Department of Ecology, the Army Corps of Engineers, and the Washington Department of Fish and Wildlife (WDFW) to secure all necessary environmental permits. Staff has applied for a general Hydraulic Project Approval (HPA) from WDFW and the pumping plan is presently going through a standard SEPA determination process. All formal permits are expected to be received and the pumping system will be in place by the end of November. In the mean time, WDFW has approved temporary emergency pumping through its emergency HPA process, which is based on verbal authorization in the event that flooding is eminent.

Last winter, staff sent out flood preparedness letters to business and property owners who have been affected by flooding in the Totem Lake area. This year staff has prepared a follow up letter to provide an update on the flood control efforts completed to date and to continue to encourage individual preparedness (Attachment C). The letter describes the work the City is doing to reduce the frequency and severity of flooding, and offers flood awareness advice with web based links for additional information.

Attachments: (3)

Totem Lake Flood Control Measures
Site Map



Totem Lake Flood Control
Pumping Plan

Sample Letter

Attachment C

November 16, 2011

[Name]
[Address]

RE: Totem Lake Flood Preparedness

Dear [Property Owner],

The City would like to update you on flood control efforts around Totem Lake. We have made significant progress towards reducing the severity and duration of seasonal flooding. Further work to minimize flooding is planned, which will provide a greater level of protection. In the meantime, we hope for the best, prepare for the worst and encourage you to also be prepared. Along with specifics of how the City has been working on this critical area, we have included our seasonal reminders of steps that individuals can take to minimize potential property impacts due to heavy rains or snow events.

This summer the City completed the first steps in a multi-year process to address flood control in the area near Totem Lake. The work included a detailed survey of 5000 feet of conveyance channel downstream of Totem Lake, water surface level monitoring, and coordination with regulatory agencies. The survey identified several areas along the drainage channel where sediment and vegetation are impacting the outflow of Totem Lake. In August the City partnered with WSDOT and King County to remove built up sediment and vegetation along the conveyance channel between Totem Lake and the east side of I-405. This work increased the conveyance capacity of the drainage channel and lowered the level of the Lake by approximately three feet which will allow for greater storage of runoff from winter rains.

The work completed this year has improved flood control in the area; however, more work is necessary. Currently, the City is completing an emergency pumping plan that will be in place shortly to further reduce the risk of flooding, and Phase II of the multi-year project (scheduled for next construction season) will include the removal of the remaining sediment and vegetation in the conveyance system from I-405 downstream and to the west along the Totem Lake conveyance channel.

In the meantime, the City is continuing to maintain its monitoring of critical drainage structures. When wet weather is anticipated, City Crews are dispatched to ensure that the structures are clean and ready to function as they were designed. In addition, a traffic detour plan has been developed for use if the intersection of Totem Lake Boulevard and 120th Ave NE becomes inundated. With some planning now on your part, your business can continue uninterrupted through the winter rains.

Winter in the Pacific Northwest, especially in a second-in-a-row La Nina year as has been predicted, can mean large amounts of rainfall. The attached map shows areas that may be at risk of flooding when the level of Totem Lake rises in response to rainfall. Your business is located in one of these areas, and we want to assist you in locating sources of information on how to prepare for flooding and how to minimize your risk of damage from it. Because of its urban nature, Totem Lake can rise quickly depending on rainfall patterns (4 feet in about 8 hours during a large storm according to recent modeling), so it is important to be prepared before a rain event starts.

Flood Preparedness

Make Plans:

- Do you have flood insurance? If not, consider purchasing flood insurance. The majority of businesses around the lake are outside the FEMA 100-year flood plain (which is used by the National Flood Insurance Program to set flood insurance premiums), so insurance costs should be relatively low. See www.floodsmart.gov for details.
- Identify areas of your property that may flood. Make a plan to move valuable items, equipment and materials out of range of floodwaters permanently or, if that is not possible, temporarily during an event (i.e. identify alternative storage locations).
- Teach employees how and when to safely turn off gas, electricity, and water lines.
- Stock sandbags and plan for sandbag placement.

During a Flood:

- Watch the weather.
    - Monitor Seattle Rain Watch (www.atmos.washington.edu/SPU/) to get a feel for how much rain has fallen and how much is coming. Totem Lake usually rises the most in response to large storm events (3 inches or more over a 24 hour period).
    - Look at the level of Totem Lake. Totem Lake Boulevard near the intersection of 120th Avenue NE is usually one of the first spots to be impacted by heavy rains, and may indicate that floodwaters are rising toward your property.
- Mark flood elevations on building and take pictures. This will help in filing flood insurance claims, and will assist engineers with modeling conditions and designing flood reduction projects.
- Follow detour routes and do not drive through floodwaters. If your car stalls in a flooded area, abandon it as soon as possible and walk to safety from the direction you came.

After a Flood:

- When re-entering your place of business, be cautious of potential gas leaks, electrical shorts, and live wires.
- Follow procedures for safe cleanup of household items, food, water supply, and property. For more information, go to www.kingcounty.gov/health/preparedness.
- Contact the City of Kirkland Building Department at (425) 587-3600 regarding any questions on repairs that normally require a building permit such as foundation repairs, drywall and insulation replacement.

Further information and resources on flood preparedness is available at www.govlink.org/storm/floods.asp.

If you would like further information about Totem Lake or about flood preparedness, please contact Jenny Gaus, Environmental Services Supervisor, at (425) 587-3850 or jgaus@ci.kirkland.wa.us. Thank you for your efforts to protect yourselves through this winter and beyond.

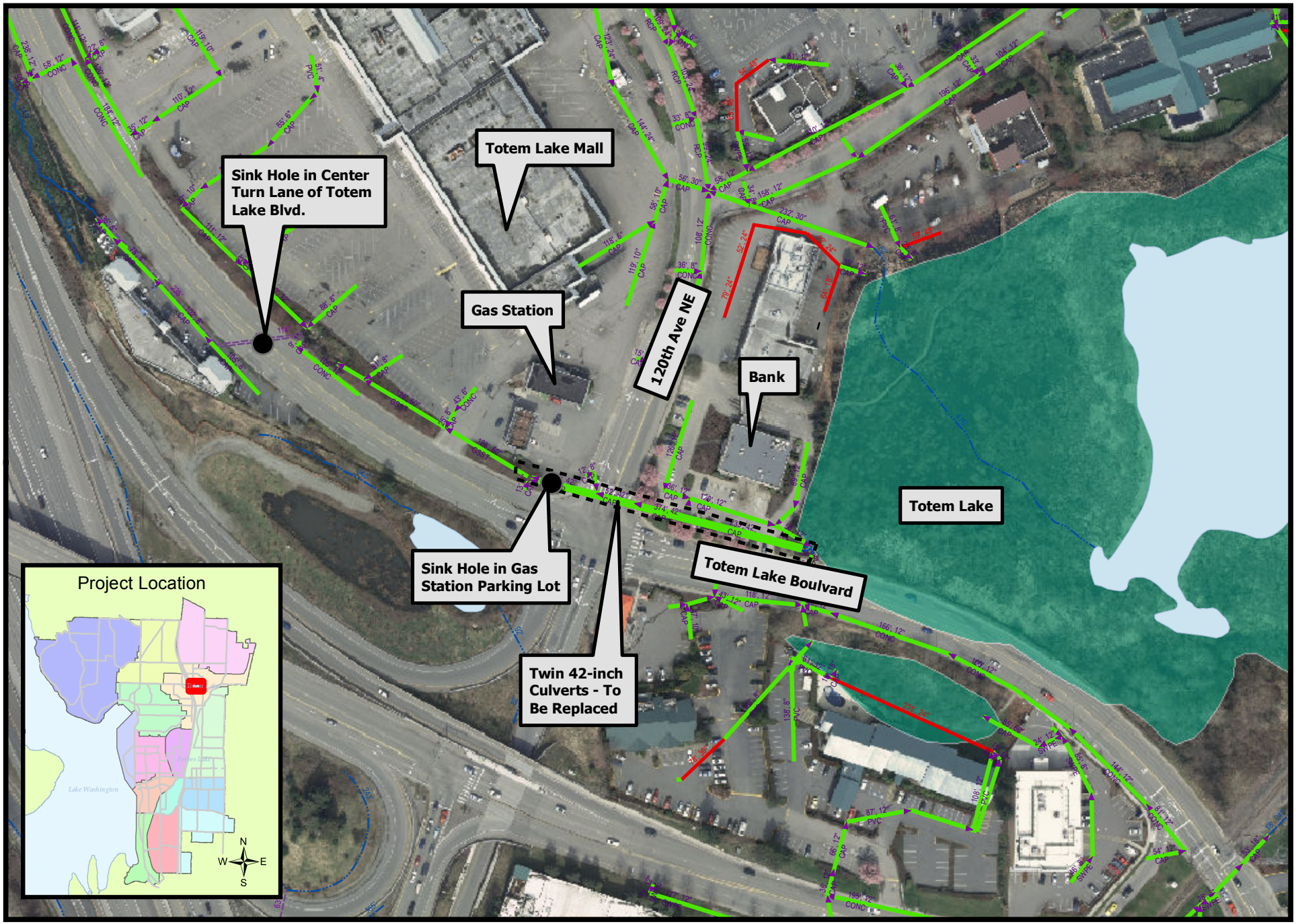
Sincerely,
City of Kirkland

Ellen Miller-Wolfe
Economic Development Manager

Jenny Gaus, PE, CSM
Environmental Services Supervisor

Site Map
Twin 42-inch Culvert Replacement

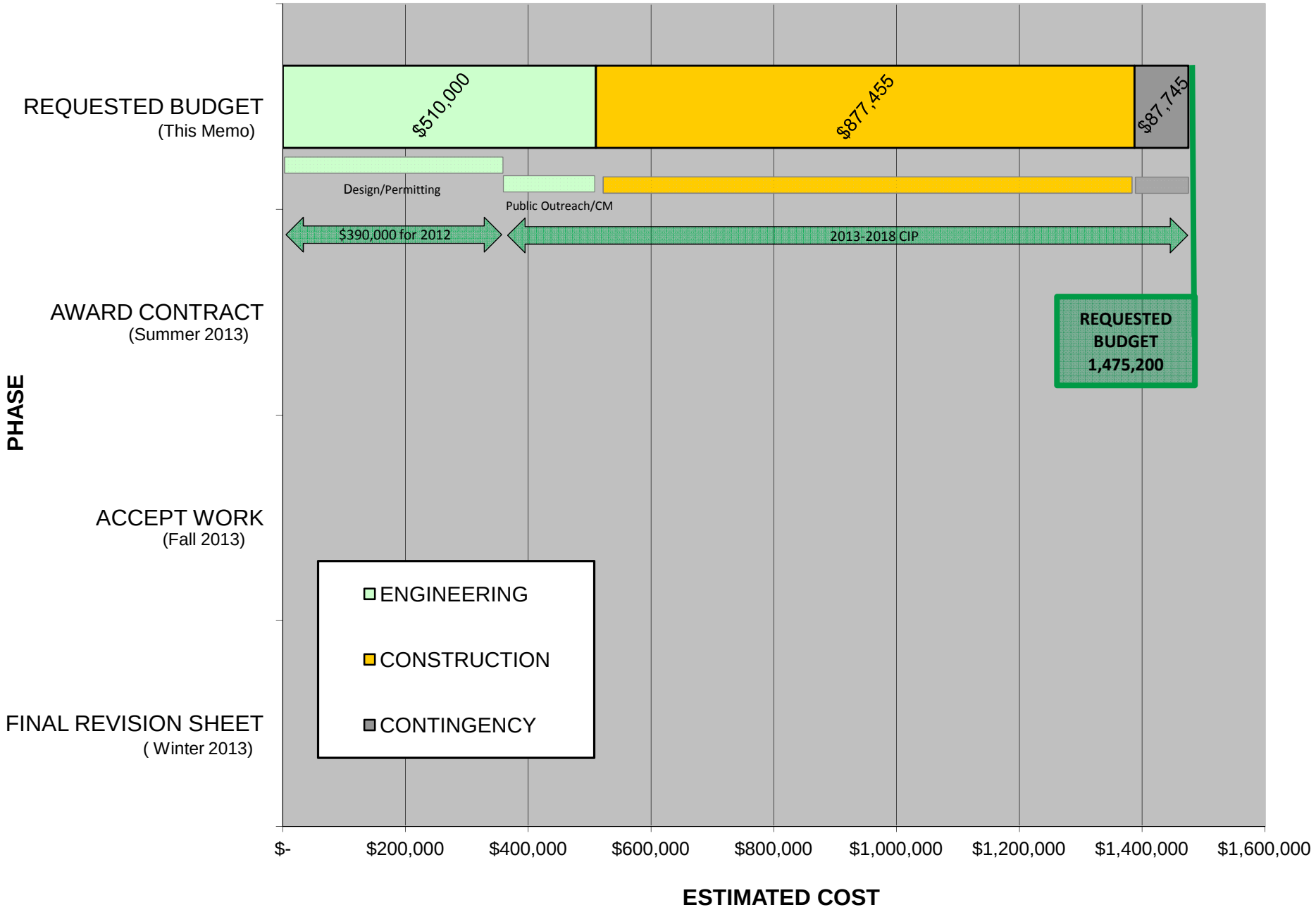
Attachment B



Attachment C

Totem Lake Twin 42-inch Culvert Replacement (CSD-0075)

Project Budget Report



ATTACHMENT D

FISCAL NOTE

CITY OF KIRKLAND

Source of Request

Ray Steiger, Public Work Director

Description of Request

Request for funding of $390,000 for a new project to replace culverts in Totem Lake as part of flood control efforts (CSD 0075). This project is funded as a candidate from the Annual Storm Drain Replacement program (CSD 9999). Total project costs for CSD 0075 are estimated to be $1,475,200. The balance will be funded in the upcoming 2013-18 CIP for completion in 2013.

Legality/City Policy Basis

Fiscal Impact

The **Annual Storm Drain Replacement Program** project is an approved 2011-16 CIP project with a total 2011-12 budget of $922,600 funded by utility rates. There is sufficient balance in this project to fund this request.

Recommended Funding Source(s)

	Description	2012 Est End Balance	Prior Auth. 2011-12 Uses	Prior Auth. 2011-12 Additions	Amount This Request	Revised 2012 End Balance	2012 Target
Reserve							
Revenue/Exp Savings							
Other Source	Annual Storm Drain Replacement Project balance. Estimated revised ending 2012 project balance is $532,600 after funding this request for $390,000.						

Other Information

Prepared By	Neil Kruse, Senior Financial Analyst	Date	April 3, 2012

TECHNICAL MEMORANDUM CH2MHILL®

Totem Lake Twin 42-Inch Culvert Replacement Project – Conduit Materials Evaluation DRAFT

PREPARED FOR: Noel Hupprich, P.E./City of Kirkland, WA

PREPARED BY: M. H. VanDerAa, P.E.

DATE: September 14, 2012

PROJECT NUMBER: 434855.03.35.40.10

Purpose and Summary

The results of an evaluation of conduit materials for the Totem Lake Twin 42-inch Culvert Replacement Project (Project) are summarized in this technical memorandum. Reinforced concrete box culvert is the recommended culvert replacement material for both Segment 1 and Segment 3.

Site Conditions Summary

The Project is located in a busy commercial area near the intersection of Totem Lake Boulevard and 120th Avenue NE, and near state highway Interstate-405, in Kirkland, Washington. Geotechnical conditions are a major consideration in culvert materials evaluation. The underlying soils along the culvert replacement alignments are peat and other soft compressible soils to depths below ground surface of 30 feet to 40 feet. The groundwater table is shallow, and excavation for culvert replacement will extend 5 feet or more below the groundwater table. Additional information on geotechnical conditions at the Project site is presented in *Totem Lake Twin 42-Inch Culvert Replacement Geotechnical Data Report (CH2M HILL 2012a)* and *Totem Lake Twin 42-Inch Culvert Replacement Geotechnical Design Criteria and Recommendations (CH2M HILL 2012b)*. Avoiding conflicts with existing buried utilities and adjacent facilities is also a major consideration.

Existing Culvert Material

The existing culvert pipes are galvanized corrugated steel. Staff at the City has expressed a strong preference that the galvanized steel not be used for the replacement based on corrosion experience with the existing culvert. Laboratory analysis of soil and groundwater samples confirmed that very corrosive conditions exist at the site, and that galvanized steel would not be an acceptable replacement material.

Fish Passage

Fish passage is an important consideration for design of the replacement culverts. Consultation on September 12, 2012, with the area habitat biologist, Stewart Reinbold, of the Washington Department of Fish and Wildlife resulted in the following criteria being established for the replacement culverts:

- Conduit width will be 8 feet, if possible.
- Because there are vertical restrictions and the slopes of the existing culverts are very flat, the longitudinal slopes replacement culverts will match those of the existing culverts.
- Countersinking and placement of streambed gravel inside culverts will not be required.

Evaluation Considerations

Conduit shape and material must be considered together because some shapes are available in only one material. Service life (corrosion), weight, minimum depth and width of excavation, structural performance in the existing soil conditions, construction issues such as handling and jointing, avoiding conflicts with existing utilities, and costs were considered in the evaluation. Conformance with the fish passage conduit width results in all conduit

alternatives having hydraulic capacity for the design flow; therefore, hydraulic capacity was not a factor in the evaluation.

Materials Evaluated

Circular pipe, pipe arch, and rectangular box shapes were evaluated. Open profile wall high density polyethylene (HDPE) pipe (Spirolite®) was selected for initial evaluation of circular pipe because of its light weight, corrosion resistance, smooth interior wall, and availability in 8 feet diameter. Pipe arch is produced only in corrugated galvanized steel and corrugated aluminum. Corrugated aluminum pipe arch was evaluated because it was determined that it has acceptable resistance to corrosion, but galvanized steel was not acceptable due to susceptibility to corrosion. Rectangular box shapes are produced only using reinforced concrete.

Segment 1

Figure 1 is a cross section showing the existing twin 42-inch culvert pipes and the replacement conduits that were evaluated. Vertical shoring will be needed to limit disruption to Totem Lake Boulevard, Bank of America parking lot, and other adjacent facilities and improvements. An excavation width of approximately 14 feet is needed for removal of the existing culvert and installation of the replacement conduit. Also illustrated in Figure 1 is that the existing culvert passes under utilities (water, gas, electric power, and communications) and over an existing 10-inch sanitary sewer in 120th Avenue NE. It has been determined using information obtained from exploratory excavations and as-built drawings of the existing utilities that the replacement culvert must have approximately 4.5-foot depth of cover (similar to the existing culvert) to avoid possible conflicts with one or more of the utilities it will pass under. Additionally illustrated in Figure 1 are piling supporting the adjacent Bank of America parking lot concrete pavement, some of which are shown on an as-built drawing of the parking lot being very close to the existing culvert.

Circular Pipe

Circular pipe would not be acceptable for several reasons. First and foremost as seen in Figure 1, it would conflict with the existing 10-inch sanitary sewer. In addition, circular pipe would require the deepest excavation of all the alternatives, and the lower half of the pipe would need to be filled.

Pipe Arch

For a given span (width) pipe arch is available only in a single rise (height). The rise of a corrugated aluminum pipe arch having an 8-foot span is 6 feet. The corrugated aluminum pipe arch would, therefore, not be acceptable because of conflict with the existing 10-inch sanitary sewer. A large increase in excavation width would also be required to replace existing soft soil with materials that would provide side support needed for this type of conduit to resist vertical loads. Also similar to circular pipe, the bottom portion would need to be filled.

Box Culvert

Reinforced concrete box culvert sections are produced in several rises (heights) for a particular span (width). For Segment 1, a 3-foot rise and an 8-foot span would be used. The invert of the box culvert can be installed to match the invert or the existing culvert so no fill will be needed in the replacement. Box culverts do not depend on side support of adjacent soils to withstand vertical loads so excavation width would be minimized and limited to that required to remove the existing culvert. The disadvantage of the concrete box culvert is that an 8-foot span and 3-foot rise weighs approximately 2,800 pounds per linear foot. The installation would need to be designed to not increase loading on the underlying soft soils that would cause settling of the culvert and surface improvements.

Recommended Material

Reinforced concrete box culvert sections are the recommended Segment 1 culvert replacement material because it will not conflict with the existing 10-inch sewer in 120th Avenue NE and will require the minimum depth, width, and volume of excavation

Segment 3

Although Segment 3 does not have the conflicts with existing utilities and adjacent facility issues as in Segment 1, other considerations such as minimizing the volume, width, and depth of excavation, and avoiding the need to fill

the lower parts of circular pipe and pipe arch are similar to those for Segment 1. Reinforced concrete box culvert sections are, therefore, the recommended Segment 3 culvert replacement material.

References

CH2M HILL. 2012a. *Draft Totem Lake Twin 42-Inch Culvert Replacement Geotechnical Data Report.* Prepared for the City of Kirkland by CH2M HILL, Bellevue, WA. September 2012.

CH2M HILL. 2012b. *Totem Lake Twin 42-Inch Culvert Replacement Geotechnical Design Criteria and Recommendations*. Prepared for the City of Kirkland by CH2M HILL, Bellevue, WA. September 2012.

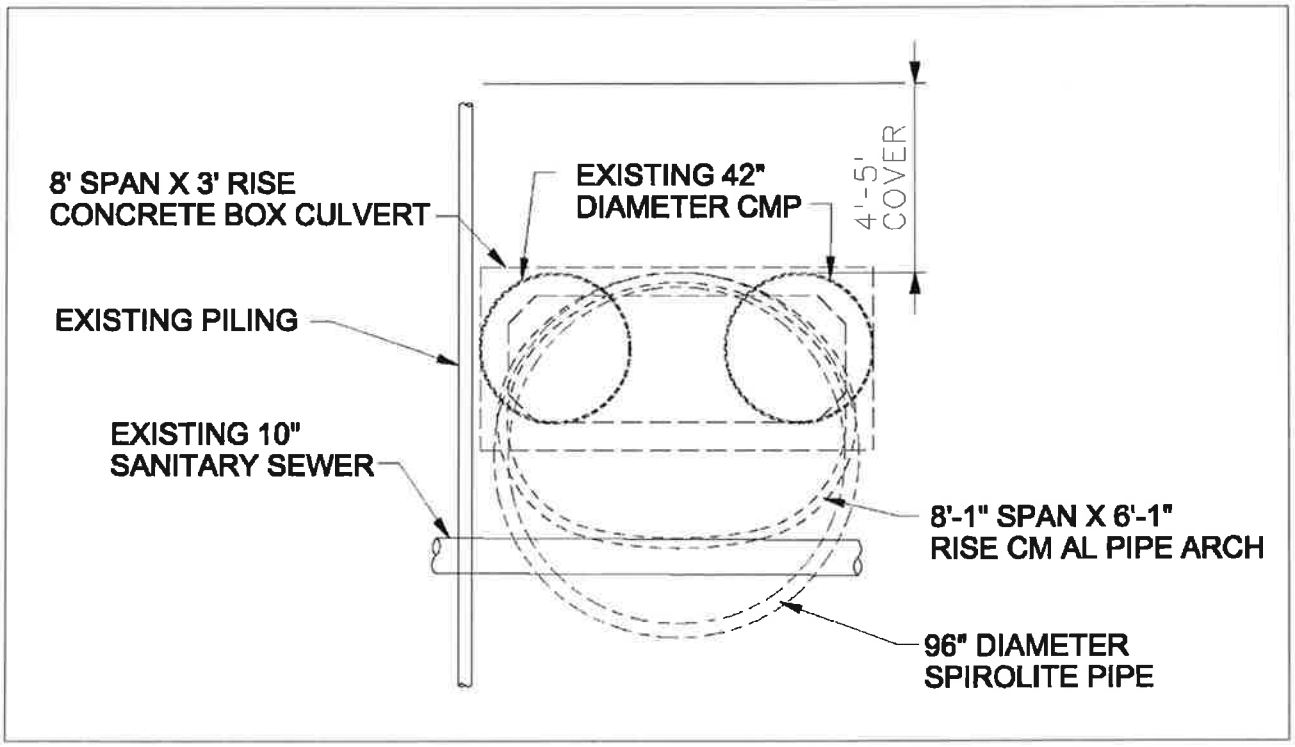


Figure 1
Segment 1 Culvert Replacement Materials Alternatives

TOTEM LAKE CULVERT REPLACEMENT PROJECT
(SD-0075)
Project Budget Report