Analysis of Flood Management Alternatives in Lents

Background

Based on past history, the Lents area faces a high risk each winter that Johnson Creek will overflow its banks and flood nearby community roads and properties. Consider these facts.

- 37 out-of-bank flood events since 1941
- 28 resulted in property damage
- 21 were "nuisance events" (a 10-year flood or less)

Given this reality, finding ways to manage frequent flooding is a key component in future urban renewal planning processes.

The City of Portland Bureau of Environmental Services (BES) has been working with the Lents community and other city bureaus since November 2000 to develop flood management alternatives as part of the Portland Development Commission Lents Urban Renewal Project. The objective is to store waters generated by up to 10-year flood events (nuisance floods) in ways that will improve the environment while also expanding options for community redevelopment.

Storing the Nuisance Flood

The nuisance flood event is the target level of flood protection endorsed by the City of Portland through the *Johnson Creek Restoration Plan*. The concept was first suggested in the *Johnson Creek Resource Management Plan* as a level of flood protection that would relieve the most frequently flooded areas, have good benefit versus cost, and be practical to manage. Recommendations for flood management in the Lents area will store floodwaters up to the nuisance flood event. While this level of protection is greater than what exists now, it will not reduce all flood impacts in the area. Flooding greater than the nuisance event will still flood large areas in Lents.

In February 2001, BES submitted draft "footprint" maps showing four alternative concepts of how nuisance floods might be managed both north and south of Foster Road between 122nd Avenue and I-205. These preliminary maps, created by computer-generated models, used limited available data. During spring 2001, BES conducted more extensive data gathering, such as testing for groundwater depths, and hired an environmental consultant to help refine the design of flood management alternatives.

In July 2001, Environmental Services published Technical Memo 1 (TM1). This document summarized historical and existing conditions within the Johnson Creek floodplain, and described technical issues and design considerations that would be used to refine flood management alternatives for Lents. This memo included technical and policy information compiled by BES, Parks and Recreation, Portland Department of Transportation and the Bureau of Planning. BES staff distributed this document to the Lents Urban Renewal Advisory Committee on July 10, 2001.

Flood Management Approaches

The next Technical Memo (TM2) offers more detailed technical analysis of ways in which nuisance floodwaters could be managed, and evaluates which approaches would be most successful. Management alternatives that were considered incorporated a mix of components grouped in three general categories. These categories include:

- **Existing Main Channel Modifications**: This involves physically reshaping the Johnson Creek banks by creating a tiered, two-stage channel to increase water storage capacity while improving in-stream habitat south of Foster Road.

- **Modification to the Adjacent Floodplain**: When floodwaters leave the creek channel, these modifications would route and store water in adjacent, excavated channels and basins south of Foster Road to reduce flooding in other areas north of Foster.
- **Structural Diversions**: This approach would use engineered structures, such as diversion channels funneled through culverts, to move water to flood storage areas north of Foster Road.

Four Alternatives Initially Considered

The Bureau of Environmental Services used the flood management components described above to create four potential approaches for storing nuisance floodwaters. Two options focused on moving water beneath SE Foster Road to storage areas north of the road. The other two options kept water south of SE Foster Road between SE 112th Avenue and Interstate 205.

A technical team comprising representatives from BES, Parks, Planning, Transportation and the Endangered Species program evaluated each alternative against a set of design considerations. These considerations were:

- Ability to store the nuisance flood
- Difficulty of construction
- Long term stability of channel or floodplain modifications
- Ease of long term operations and maintenance
- Use of existing public lands
- Downstream impacts
- Environmental impacts and ability to obtain permits

Recommended Alternative

Only one of the four alternatives ranked as feasible when analyzed against the design considerations. This approach would manage nuisance floodwaters south of SE Foster Road between SE 112th and Interstate 205. Construction would include creating a wider, two-stage channel within Johnson Creek. The design would also include off-channel storage areas within the adjacent floodplain and flood relief channels to route waters to storage locations or create alternative downstream flow paths. BES has submitted this recommendation as part of the Lents Urban Renewal planning process.

Full implementation of this proposal would require willing seller acquisition of existing private properties along SE 106th and SE 108th Avenues, except at the south end, and complete removal of those roads. Properties along SE 110th and SE 112th would also be needed. This project also requires additional flood storage excavation along Johnson Creek west of I-205 to handle increased upstream flows.

The recommended design would also include a widened creek channel with a flood relief storage area on the north side and a flood relief channel along the southern boundary of Freeway Land Company. This relief channel would provide floodwaters a second return route to the creek before it flows beneath I-205.

Rejected Alternatives

South of Foster with SE 106th and SE 108th Avenues remaining in place – Computer modeling of flood storage capacity showed that leaving the streets would prevent full capture of a nuisance flood, and likely allow water onto Foster Road.

Routing floodwater north under SE Foster Road - 1. – This option would use channels and culverts to route water under Foster to storage areas between the road and Springwater Corridor and into Beggars Tick Marsh. Computer modeling shows this option might be marginally feasible if private properties such as the car recycling and parts businesses and Foster Road were allowed to flood. However, the engineering challenges, risk of trapping protected fish, and uncertainty about effectiveness led to rejection of this option.

Routing floodwater north under SE Foster Road - 2. – This option is the same as the first north of Foster option except that flooding would be routed around private businesses immediately south of the Springwater Corridor. Modeling analysis shows that the nuisance flood can not be guided to areas north of the Springwater Corridor without causing flooding on properties to the south of the corridor. This is primarily due to flat topography and shallow groundwater.

Next Steps

This information will be integrated with other urban renewal goals such as economic development, transportation and parks, then ultimately integrated into the revitalization plan for Lents.

Future decisions to allocate funds to flood storage projects will be influenced in part by community acceptance of this proposed alternative.

There is no capital funding currently allocated for floodplain restoration in the Lents area. The bureau has limited funds to continue property purchases from owners who want to sell lands within the project area.

In addition, implementing the flood management project over the next decade will require funding from a combination of BES capital revenues, Portland Development Commission funds, and state and federal grants. BES will consider developing the flood management components in phases as future property purchases consolidate public ownership within the floodplain.

Overview

This report combines portions of two technical memorandums written to evaluate nuisance flood management design alternatives for the Lents area of Johnson Creek. The first document (Technical Memo #1 - June 2001) provided background and described the technical and policy issues that were considered in refining flood management alternatives. For example, TM1 provided a summary of natural conditions and identified flood management challenges in Lents.

The second document (Technical Memo #2 - prepared over the past year) describes the details of the flood management alternatives. These details include channel and floodplain concept designs, Foster Road crossing issues, Springwater Corridor right of way issues, and the flow of waters to areas north of Foster Road.

This memo documents the planning and early design evaluation, feasibility analyses and conclusions that identify the most workable alternative for nuisance flood management in the Lents area. TM2 describes the flood management alternative selected by the technical team to forward to PDC for the Lents Urban Renewal Concept Planning process.

Flood Management Components

Flood management alternatives use a mix of components, which can be grouped into three general categories:
(1) existing main channel modifications,
(2) modifications to the adjacent floodplain,
(3) structural diversions.

The components can be used alone or in combination with others. In all cases the proposed alternative will modify the existing channel (historically engineered and natural portions) and floodplain of Johnson Creek into a stable new system for flood management.

Thirty-five (35) historical floods from 1916 to 1996 were used to identify repeatedly flooded areas and changes in flood pattern over time. Flood extents were extrapolated from secondary sources including flood reports, newspaper articles, resident interviews, aerial photographs, and field surveys.

- Frequently flooded areas in Lents included:
- Along the creek from 117th to 101st
- Foster Road between 111th and 101st
- Springwater Trail from 111th to Foster Road
- Beggar's Tick Marsh and associated marshlands

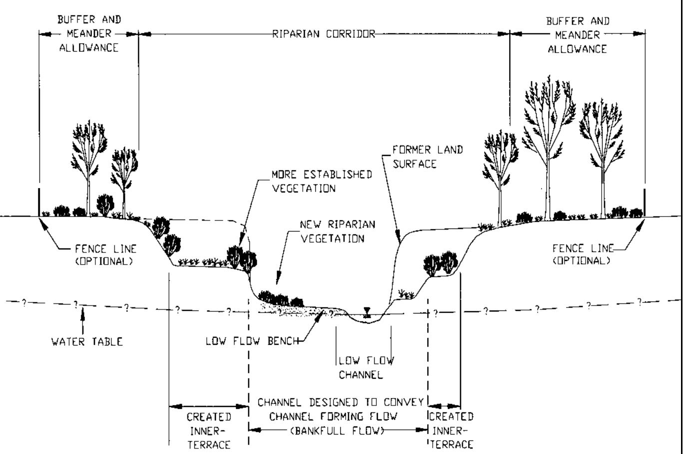
These are areas that begin to flood during 5-year events and are completely flooded during 10-year events. There were also some noticeable changes in flood inundation areas since the late 70's or early 80's from local development, channel modifications, and filling.

Technical feasibility of each flood relief component is site specific and based on physical, ecological, or cost factors. The designs are *not* intended to restore historic channel and floodplain conditions that existed prior to human disturbance.

These disturbances to the physical channel, floodplain, and water flow patterns have been extensive enough that complete restoration is not technically nor financially practical. Restoration to historic conditions is not necessary to achieve a stable channel and floodplain system.

Modifying the Main Channel

The existing Johnson Creek channel throughout the Lents area has been substantially changed by channel construction projects and by hydrologic pattern changes The channel has been altered from its natural geomorphic evolution and is currently in a highly controlled and manipulated state. In general terms the channel has been deepened with very steep entrenched banks, armored with riprap rockwork, and straightened in the downstream portion of the project area.



CONCEPTUAL CROSS SECTION OF A DESIGNED TWO-STAGE CHANNEL

"Concept Design of a Two-Stage Channel" shows the conceptual shape of this channel treatment overlaid on theoretical existing ground conditions within the project area. The proposed treatments are shown in solid lines with the existing conditions (original ground level) shown in dashed lines. Several different geomorphic or topographic components are shown that would be created by excavation.

How a Two-Stage Channel Works

A Two-Stage Channel is proposed as one component of the overall flood management strategy. The existing steep banks would be excavated to create two inner-benches at different elevations adjacent to the main channel and at elevations below the existing valley floor adjacent to the channel. This method involves substantial re-shaping of the cross-section of the main channel of Johnson Creek throughout the project area. The existing channel bed elevations would be altered very little but the channel cross-section dimensions would be substantially transformed.

Channel design dimensions are intended to be adjustable, allowing the channel to evolve and refine the original constructed designs over time. Urban channel conditions are subject to high rates of disturbance and altered hydrologic regimes so this degree of flexibility is important. Ultimately these natural adjustments will enhance overall channel stability. Key components of a two-stage channel are described below:

- *Low Flow Channel*: This component is designed to provide width to depth ratio dimensions to convey low flows and provide stability under high flow conditions when exposed to bedload transport (sediment loads moved during flood stages).

- *Low Flow Bench*: This component influences the long-term shape and size of the channel. Sediments and debris will deposit in this zone. Vegetation along this bench will be dominated by tree and shrub species that are hydrophytic (wetland species that prefer wet and poorly drained soil conditions) and tolerate regular flood disturbance. Native willows and dogwoods will dominate this zone. These small tree and shrub plants drop foliage during winter when higher flows occur. Their trunks are flexible and will bend or break during flood disturbance. They regenerate rapidly after disturbance and have prolific root systems that stabilize the soil.

- *Inner-Terrace (or Overflow Bench)*: This is a common geomorphic component adjacent to stable meandering channels that are not entrenched. Inner-terraces provide floodwater conveyance immediately adjacent to the active channel, are geomorphically stable, and provide high quality ecological support. Dimensions and elevations vary based on design requirements. The elevation of the bench is set based on an estimate of the channel forming flow elevation. The width of the bench will vary with location and is driven by flood conveyance requirements.

- *Riparian Buffer Area and Meander Allowance*: This zone will convey larger flood events across the existing valley floor. The two-stage design option by itself does not require any physical land alterations in this zone because this area is beyond the channel. Ecologically this area will be planted and managed as a native riparian forest area. The forest would naturally recruit and retain debris and sediment transported during flood events.

Placement Objectives

The Two-Stage Channel would be physically constructed directly over the existing Johnson Creek main channel alignment. Some localized departures and modifications may be required as design refinement proceeds.

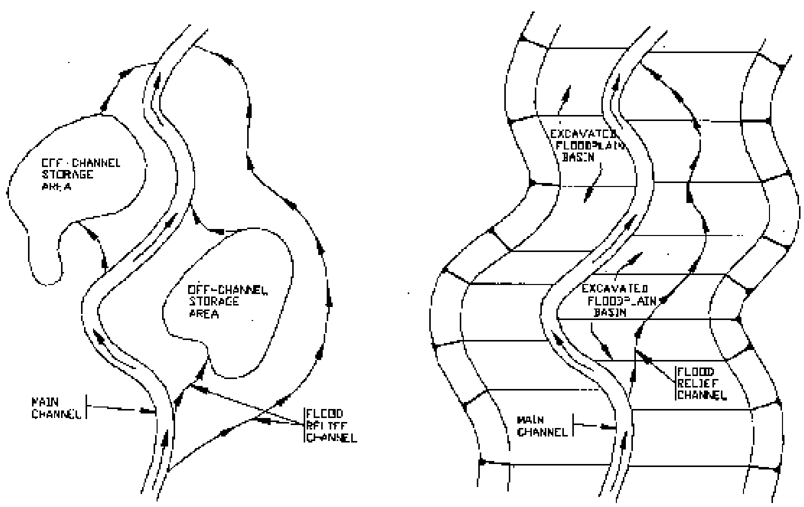
Design Benefits

The benefits of this design option are listed below.

- *Geomorphic stability*: The physical channel design follows more natural flow patterns that allow the channel to evolve and adjust over time.The channel can transport flow, sediment, and large woody debris with good connection to adjacent components (benches and valley floor) where sediment and wood can be deposited.
- *Flood capacity improvements*: This design element increases the channel's capacity to transport larger volumes of floodwater.
- *Ecological function*: The design includes diverse vegetative communities supported through soils with varying moisture content, and an increased streamside habitat.
- *Water table interception*: Groundwater from the excavated slopes will seep into the bench and terrace areas. The groundwater will provide a water source to wetland and riparian plant communities in the dry summer season.
- *Direct positive drainage back to the main channel*: Flood relief areas must connect with the main channel and have a positive gradient to drain water back to the main channel. This protects against trapping fish in isolated depressions on the valley floor during small and medium sized flood events.
- *In-channel and adjacent channel floodwater storage*: The two-stage design increases floodwater conveyance and increases storage.

Design Constraints
A two-stage channel also faces potential challenges. These include:

- *Impact to existing perched wetlands*: Excavation will likely intercept some localized perched shallow groundwater that provides seasonal water support to wetland areas. It is expected that the land area of wetland disturbed by this option would be exceeded in area by the amount of wetland created.
- *Short-term impacts to established riparian corridor vegetation*: Existing vegetation in the pathway of the new channel would be lost during construction. The new channel would provide a net increase in riparian vegetative community over time.
- *Removal of select bridges and roads*: Some bridges and roads would need to be removed or modified to accommodate the new channel dimensions.
- *Requires continuous land area*: Design depends on the availability of a continuous landmass adjacent to the existing main channel.



Off-Channel Storage Areas With Flood Relief Channels

Flood Storage Basins With Flood Relief Channels

Modifying the Adjacent Floodplain

The following section describes the three physical landscape modifications proposed to create flood storage and improve habitat within the floodplain.

Flood Relief Channel (FRCs)

Flood Relief Channels are smaller than the main channel in both physical dimension and water conveyance capacity. FRCs provide conveyance channels on the floodplain and convey floodwater between other designed flood relief components (i.e. off-channel storage areas and basins described later). In all cases they are located within areas prone to flooding and are designed to mitigate the depth and duration of nuisance flood events.

How Flood Relief Channels Work

Individual FRCs are designed to connect to the main channel at optimal upstream and downstream locations. The bed elevations (thalweg) of the FRCs are set equal to the bankfull depth elevations (over flow bench) at the upstream and downstream confluence points with the main channel.

FRCs will mimic natural over-bank channels on floodplains where the main channel is not entrenched. These non-entrenched systems have a high degree of hydraulic connectivity between the main channel and the surrounding floodplain and terrace surfaces. This contrasts with the existing highly entrenched main channel within the project area.

Placement Objectives

Decisions on where to locate the FRCs components within the various floodplain options were driven by the following design criteria:

- Existing main channel alignment and sinuosity in conjunction with floodplain and terrace shape and available space;
- Locating ingress and egress confluences with the main channel at locations that are relatively stable with respect to erosion and deposition and free of direct impingement by high velocity waters. To date this has only been done at an initial 10 percent design level. Greater refinement will be required as design work is refined;
- Providing connectivity between existing or proposed flood relief facilities or components, particularly in the north of Foster Road options;
- Existing infrastructure facilities (e.g. roads, sewers, etc.) that create barriers and space limitations for constructing FRCs;
- Vertical elevation locations determined by bankfull depth estimates;
- Potential risk of flood waters breaking through banks along the pathway of a side channel. In the case of the FRCs proposed for Johnson Creek the risk of such a breakthrough, known as *avulsion,* will be reduced by the following provisions or naturally existing conditions:
    - Extremely flat floodplain and terrace system, resulting in slow velocity waters with reduced erosive power;
    - Sinuosity in the design of the FRCs adding friction, thus reducing water velocity and erosive power; and
    - The confluence of the FRCs with the main channel will be located in stable locations not prone to erosion or deposition.

Design Benefits

Flood relief channels offer several advantages both for flood management and fish. These include:

- Reduced fish trapping potential. A network of FRCs connects floodplain areas with the main channel allowing improved hydraulic connectivity between the two areas. Post flood event drawdown and return flow back to the main channel from floodplain areas occur more rapidly and create a perceptible flow direction to fish that might otherwise be stranded;
- Hydraulic connectivity with the floodplain and other created flood relief components is substantially increased;
- Improved terrestrial habitat corridors are created between the main channel, the floodplain, and created flood relief components; and
- Sediment loads disperse to adjacent floodplain areas, improving water quality in the main channel.

Design Constraints

Constructed Flood Relief Channels will require enough land to provide a long, continuous flow path. Full implementation will be a long-term process, based on ability to acquire property or otherwise control property for public benefit. BES will consider developing the flood management components in phases as future property purchases consolidate public ownership within the floodplain.

Off-Channel Storage Areas

Off-channel storage areas are excavations in the existing valley floor. The off-channel storage areas are physically separated from the main channel by un-excavated portions of the valley floor that are left in an undisturbed state. The off-channel storage areas are hydraulically connected to the main channel through FRCs as described previously.

How Off-Channel Storage Works

Off-channel storage areas may be designed "in-line" with FRCs in which case an FRC's path flows directly through an off-channel storage area. The off-channel storage area may be connected to FRCs by means of small ingress/egress spur channels. The maximum excavation depth in the off-channel storage areas should not exceed the depth of the FRC. Designed in this manner, the FRCs provides positive drainage of the off-channel storage area back to the main channel following a flood event.

Once floodwater elevations within the main channel rise and flow into the off-channel storage areas they will spread out and fill the available storage area. When floodwaters recede in the main channel the water stored in the off-channel storage areas will drain back to the main channel. In this manner the off-channel storage areas will help attenuate flood peaks within the project.

In contrast to flood storage basins, the off-channel storage areas are smaller and do not have internal drainage divides or berms (see description of "Flood Storage Basins" below).

Placement Objectives

The off-channel storage areas are located within valley floor areas, close to the main channel and within areas that are topographically lower in elevation. This design minimizes the amount of excavation required to gain storage volumes. Off-channel storage areas are positioned within flow paths that are either already occupied by floodwaters, were historically occupied by floodwaters, or are contiguous with areas subject to regular flooding. These facilities will be designed and located to prevent channel migration and high-flow breakouts (avulsion) where water cuts into existing banks seeking new flow paths.

Design Benefits

- Floodwaters will be stored within the off-channel storage areas, reducing the frequency and intensity of nuisance (out-of-channel) flood events within the project area;
- Floodwaters will be attenuated within the project area and will reduce flood impacts downstream;
- Creating off-channel storage areas requires less excavation than basins;
- Floodplain and riparian wetland ecosystems may be established within these components because of the potential for increased hydro-period from groundwater interaction and increased coverage during times of high water; and
- Creation of topographically varied landscapes, which create a greater diversity of ecosystems and habitat complexes.

Design Constraints

- Although these components will be designed to last and naturally improve ecologically over time, long-term sedimentation of the off-channel storage

areas can occur, altering storage volumes and hydraulic flow patterns. Fish trapping could also occur as a result of altered drainage patterns. Specific attention to system maintenance will be necessary for long term effectiveness;
- An abundance of vegetative growth including herbaceous, tree, and shrub layers will be established. This is a favorable condition and will contribute to habitat value and water quality improvement. However, this evolution could also reduce storage capacity and affect the ability of fish to enter and retreat from the area; and
- Short-term disturbance to existing riparian and forest habitat areas will occur. However the long-term benefits will result in a net gain of higher quality riparian and wetland habitat due to restoration designs and an expanded hydro-period effecting more land area.

Flood Storage Basins

In contrast with the off-channel storage areas, flood storage basins are much larger excavation areas contiguous with the main channel. The basins are not separated from the main channel. When floodwaters rise within the main channel they spill over into the basin area. The hydraulic connection is formed by means of a sheet flow process rather than by a single thread channel connection via the FRCs flow paths described above.

How Basins Work

Once excavated the flood storage basins occupy an elevation and topographic surface adjacent to the main channel recreating the relationship of a floodplain to its channel in a non-entrenched channel condition. This component differs from the FRC in that it is not a channel that directs flow off of the main channel but functions as a floodplain adjacent to the main channel. It also differs from the off-channel storage areas because it dissipates the floodwaters over a larger area with a shallower depth.

Placement Objectives

Flood storage basin areas are located immediately adjacent to the main channel and are accessed by floodwaters by means of sheet flow over a full range of flood event magnitudes. Some of the larger basin areas that extend a distance away from the edge of the channel are designed with additional drainage components such as FRCs. FRCs are incorporated within larger basins to improve the efficiency of inflow and outflow hydraulics. Interior drainage divide berms are added to provide intermediate high points within the basins to facilitate drainage efficiency.

Design Benefits

- Floodwaters are stored within the basin areas reducing the frequency and intensity of nuisance (out-of-channel) flood events within the project area;
- Floodwaters will be slowed-down within the project area;
- Floodplain and riparian wetland ecosystems may develop within these components due to the potential for increased hydro-period from groundwater interaction, and increased coverage during times of high water;
- The basin components will create a more topographically varied landscape and a greater diversity of ecosystems and habitat complexes; and
- Drainage into and out of these components is dominated by sheet flow hydraulics and there is less risk of fish trapping than in the off-channel storage area components.

Design Constraints

- Basin excavation will require more volume removed than off-channel storage areas due to larger areas being shaped, but will in turn yield more storage area;
- Short-term disturbance to riparian forest and wetland habitat areas will occur. However, the long-term impact is a net gain of more area and higher quality riparian and wetland habitat due to restoration designs and an expanded hydro-period effecting more land area.

Structural Diversions

The following section describes structural diversions that are evaluated in two of the four proposed alternatives. These diversions consist of culverts used for conveying flows under roads and the Springwater Trail.

Road and Springwater Trail Crossings

Early alternative analyses considered raising the elevation of Foster Road. Given the cost, technical difficulty of maintaining current road and driveway connections, and the difficulty in protecting properties north of the road from flooding, this option was not pursued in later design alternatives. An alternative to raising Foster Road is installing culverts under the roadways to access areas north of the trail.

Engineering and Regulatory Requirements Limit Culvert Choices

In order to move floodwaters north of Foster Road, it would be necessary to provide flow paths under Foster Road and perhaps SE 111th Drive. The placing of culverts under the roads require adherence to the following design and regulatory restrictions:

- Minimum 1.5 foot road deck depth
- Maximum culvert width of 2 times the culvert height
- Endangered Species Act requirements for fish passage
- Groundwater depth sufficient to prevent submergence of the culvert during the wet season
- Geomorphic stability

Culvert Design Requirements

Consultation with the City's ESA program indicated a preference for open-bottom, arched culverts to provide the best conditions for fish passage. Open bottom culverts provide more resistance to flow than those with concrete bottoms.

Most Johnson Creek Flow Comes from Upstream of Lents

Analysis of nuisance flood events indicates that of the total flow volume passing down Johnson Creek into the Willamette River, approximately 85% is coming from sources upstream of Lents, 6% from Lents itself, and 9% from sources downstream of Lents.

The large flow contribution from the upper half of the watershed would indicate a focus on managing upstream flows as a preferred method of flood management. While limited flood storage opportunities do exist upstream, steeper topography throughout most of the upper watershed would require a highly engineered structural barriers (dams, flow gates, etc.) to hold back a significant amount of floodwaters. The large amounts of water detained by these structures would pose a significant safety hazard to those downstream population and property should they fail.

To gain the maximum benefit for flood storage, water quality, and fish and wildlife habitat, while maximizing public safety and cost benefit, projects that promote natural floodplain function were chosen as the focus of the *Johnson Creek Restoration Plan*. This puts the focus on historic floodplain areas such as Lents where flooding occurs naturally, due to topographic and channel conditions. Other flood storage projects at Alsop-Brownwood and the Gresham Stream Corridor will provide a significant amount of storage when completed. Further analysis will determine actual downstream benefits.

Refined Flood Management Alternatives

The following sections describe the flood management alternatives that were analyzed, and contain details on the two alternatives considered feasible. Specifics include use of channel and floodplain components, model adjustments made to reflect those components, and the modeling results indicating the alternative's ability to manage the Nuisance flood.

It should be noted that all alternatives for managing floods east of Interstate 205 include the project site in West Lents, between SE 89th and SE 85th. This location is very important in reducing water surface levels in the vicinity of SE 92nd and SE Flavel where the creek twists through two bridge openings in quick succession. Allowing the creek floodplain access at this location lowers the downstream water surface and allows floodwaters to move through the bridge spans more quickly.

Alternative #1 – Flood Storage South of Foster Road

This alternative focuses on a two-stage channel design combined with FRCs, basins, and off-channel storage areas. The model for this alternative assumed removal of the roads and bridges at SE 106th and SE 108th Avenues so the floodplain can be reshaped without interruption and FRCs will not be constrained by the roadways. An additional road from the east would be needed to provide access to properties outside the management area at the foot of Mt Scott.

Analysis of a variation on this alternative, with roads remaining in place, showed that leaving existing roads intact would not contain the nuisance flood. Shallow groundwater and the need for sufficient slope for drainage, make it impossible to fit culverts underneath SE 106th and SE 108th without flooding the roads.

Alternative Design

This alternative is entirely located south of Foster Road, keeping flood waters close to the main channel of the creek. A two-stage channel design will be used through out the length of the main channel within the project area. The design will be based on reference cross sections collected along the project reach. A network of off channel storage areas and basins adjacent to the channel interconnected by Flood Relief Channels (FRCs) is incorporated into the alternative. Existing channels and areas adjacent to floodplains will provide additional attenuation.

Design Results

The flood storage footprint produced for this alternative is representative of the nuisance flood surface water elevations modeled along the creek length. In locations where the flows remained in bank, a buffer of approximately 25 feet was added on either side to allow for variations in conditions. A computer model predicts the presence of several "islands" within the footprint located along the divides between the main channel and the flood relief channels (FRC). The flood management plan calls for low-impact, passive use of these areas because these areas would be completely surrounded by water and in imminent danger of flooding during larger flood events.

Downstream of I-205, the flows are generally contained within the channel. At SE 89th where an existing high-flow channel continues straight while the main channel swerves off to the right, the floodwaters will be allowed to leave the channel into a 12 acre flood basin spanning both sides of the creek.

Flows also exit the main channel near SE 84th Avenue, where the natural topography opens up in a 1.5 acre wooded area to the south of the creek.

The current 100-year floodplain (adopted in December 2000) for this area could be altered by sending flows along the south border of the Freeway Land Company site, potentially increasing the floodplain in some areas, and decreasing it in others.

Alternative #2 -- Flood Storage North of SE Foster Road

This option uses culverts and FRCs to direct floodwaters under Foster Road and into a managed floodplain north of the road. This option includes flooding the land bounded approximately by 111th Ave. on the east, Foster Road on the south and the Springwater Trail. Analysis showed that managing floodwaters north of Foster Road entirely within public lands, without flooding the area of privately-owned commercial land, was not feasible.

The flat topography in Lents causes limitations on how far floodwaters can be directed northward. As such, the SE 111th/Foster/Springwater area, currently occupied by private businesses, is in a potentially important location for flood storage. The site is immediately adjacent to SE Foster Road and would not require a highly engineered flow path to receive floodwaters

Issues Affecting Feasibility

This alternative poses several significant issues. Because of groundwater and road clearance issues, slopes on the culverts are very flat. Any blockage of one or more culverts may lead to flooding of the surrounding properties. Groundwater is especially an issue at the return flow culvert under Foster Road at the Springwater Trail. Groundwater was 4 feet below the surface in winter 2001 and it is likely to rise higher during a wet year. High groundwater levels would reduce the rate at which water can return to the main channel. There is a high likelihood that over the long run, Foster Road would flood during a nuisance event.

Another major issue with this alternative is that land within the 111th/Foster/Springwater boundary currently supports commercial businesses that contribute to the Lents economy. Converting these properties to flood storage may not be justified.

Evaluation of Alternatives #1 and #2

Technical and policy issues, defined in TM1 as "design considerations" guided evaluation of the flood management alternatives in this memorandum. Flood management alternatives for South of Foster Road – with roads removed, and North of Foster Road - Including private lands within the 111th/Foster/Springwater boundary described above, were evaluated against the full set of design considerations.

The other alternatives that would protect private lands north of Foster, and leave roads south of Foster in place do not provide enough capacity to contain the nuisance flood event and were not considered further.

The following table reviews and ranks each design alternative on whether it strongly supports (√+), supports (√) or fails to support objectives (√-). The section following the table describes the findings in more detail.

(√+) = Conditions highly support design consideration relative to other alternatives.	Ranking Key (√) = Conditions support design considerations relative to other alternatives.	(√ -) = Conditions do not support design considerations relative to other alternatives.
Design Considerations	**Alternative - South of Foster removing Roads**	**Alternative - North of Foster including private properties**
Natural System Conditions		
1) Floodwater Volume Storage (Does it store nuisance flood event?)	√+ Room for additional flood storage available	√– Model predicts nuisance flood barely stored.
2) Groundwater (Range of depth to Groundwater and difficulty of design)	√ Impacts of seasonal fluctuations requires further study. Assumed that groundwater will not prohibit design. Positive drainage to channel exists.	√– Levels are shallow within 3-feet of ground surface. Effects of seasonal fluctuations require further study and could create a fatal flaw.
3) Hydraulic Connectivity (Level of connectivity and importance to design)	√+ Floodwater connection to main channel exists with no significant barriers to floodplain reconnection.	√– Hydraulic connection of floodwaters achieved through culverts. Potential difficulty in diverting waters off the main channel.
4) Excavation and Constructability	√ 430,000 cubic yards of material to be excavated. No obvious limitations to design.	√– 200,000 cubic yards of material to be excavated. Technical issuesexist related to the design. Potential lack of substantial hydraulic head to move water to the north, shallow groundwater levels, large amount of roadwork, multiple utilities, and potential brownfields.
5) Geomorphic Stability (Stability of design)	√+	√ (May have significant sedimentation problems due to flatness of topography.)
Public Ownership and Infrastructure		
1) Publicly Owned Land (Approximate amount of land currently in public ownership; feasibility of starting construction of concept within next 4 years, assuming no additional willing seller and funding is available)	√ Phase 1 construction within 4 years with existing publicly owned properties is feasible.	√– Significant land acquisition barriers exist north of Foster.
2) Foster Road (Necessity of crossing and conveyance of floodwaters)	√+ No crossing necessary	√– 3 crossings of Foster and 1 crossing of or 111th required.
3) Springwater Corridor (Necessity of Springwater Corridor right of way and swale conveyance)	√+ No crossings necessary	√– Use of right of way will be necessary. Additional issue with the relocation of a transmission tower.

Regulatory Issues		
1) Federal Permitting & consultations (ACOE; NMFS; USFWS)	√ May be viewed favorably by permitting agencies, keeping water in a natural floodplain system, closer to channel, and not relying on artificial or engineered structures.	√– Likely to reach permitting barriers: Increased distance from main channel and lack of restoration benefits. Potential for fish trappage, due to culverts and directing of fish away form channel.
2) State Permitting (Presumed level of difficulty in getting the project permitted)	√ Immediate impacts may be viewed as negative but ultimate outcome with long term benefits of restored functions assumed to be permittable. Unforeseen contamination issues on industrial site may lower ranking.	√– Potential directing of water over a possible brownfield.
3) Local Permitting (Presumed level of difficulty in getting the project permitted)	√ Permitting will be difficult due to EP zones and tree cutting ordinances but not prohibitive. Permitting difficulties will increase with more recreational components such as trails and other parks components.	√ Same as South of Foster
Other		
1) Cost ($$)	√	√
2) Downstream Impacts	√ West Lents flood mitigation must be constructed as part of the East Lents flood mitigation.	√ West Lents flood mitigation must be constructed as part of the East Lents flood mitigation.
3) O&M	√ (Assumed to be funded and implementable. O&M issues will not create failure of flood storage.	√– Due to the need for an engineered system there exists a small margin for error.

Design Considerations for Natural System Conditions

Floodwater Storage Volume

The South of Foster Road alternative received a higher rating (√ +) for flood storage than the north of Foster Road alternative (√ -). Though both designs store the nuisance flood event, the South of Foster Road alternative, through the use of the two-stage channel and floodplain design, allows adequate room for modeling error. The North of Foster Road alternative narrowly stores the nuisance flood event, leaving very little room for modeling error.

Groundwater Depths Affect Options

Within the East Lents project area, groundwater tends to be shallower to the north of Foster Road as compared to south of Foster Road. Therefore, groundwater would have less potential to detrimentally impact the South of Foster Road design (√). Whereas to the north this shallower condition makes it difficult to create adequate storage and effectively transport water away from the creek, and is more complicated to construct (√ -). There is currently a lack of information on the seasonal variability of groundwater in this area.

This lack of information is less of a factor concerning the South of Foster Road alternative because the ground water depths are greater. Seeps caused by intersections between groundwater and the ground surface could be a potential benefit by providing sources of water to wetland plant communities. Groundwater can sustain wetland plant communities in the dry summer season, and create positive drainage back to the main channel providing protection against fish trapping in isolated depressions.

However, on the north side of Foster Road, because groundwater depths are shallow, any seasonal variations could seriously limit effectiveness of any effort to store and convey floodwaters.

Hydraulic Connectivity

The South of Foster Road alternative effectively meets the design considerations for hydraulic connectivity (√ +). This alternative maintains a natural system with flood relief areas in direct hydrologic proximity to the main channel and a designed positive gradient back to the main channel. In addition, this alternative is not dependent on engineered structures to provide connectivity. A non-engineered approach provides additional habitat for a diversified vegetative community through varying soil moisture zones and increased edge habitat.

In comparison, the North of Foster Road alternative does not support this consideration (√ -). Storage areas are not adjacent to the main channel, and hydraulic connectivity would be achieved though a hardened structural system, creating a less natural environment. It may also prove difficult, if not impossible, to achieve enough flow momentum in the system to move water north.

Excavation and Constructability

The South of Foster Road alternative is effective in meeting the design considerations for excavation and constructability (√). The South of Foster Road alternative requires a significant volume of dirt to be moved and graded. However, the outcome will provide a more natural system that will mimic natural conditions. The North of Foster Road alternative was not effective in meeting the design considerations (√ -) because it would require a significant amount of work under roads that includes multiple utility crossings and culvert construction. Groundwater elevations are shallower to the north, which may restrict excavation depths. There are also constructability issues including interaction with potential brownfields, and difficulty moving floodwaters off-channel due to flat terrain.

Geomorphic Stability

The south of Foster Road alternative was evaluated as presenting a more stable (√ +) system overtime. By keeping the two-stage channel and basin/ off-channel storage area floodplain design, the channel is able to evolve and adjust geomorphically over time. In addition the channel is able to transport flow, sediment, and large wood with good connectivity to adjacent geomorphic components (benches and valley floor) where sediment and wood can be deposited.

In comparison the north of Foster Road design was evaluated as having the potential of not being stable (√ -) overtime. Because the north of Foster Road design relies on a hardened structural system it may be more difficult for the system to naturally adjust to fluctuating sediment loads and flows. There may also be increased sedimentation issues due to the flatness of the topography causing water to slow down and sedimentation to occur.

Design Considerations for Public Ownership and Infrastructure

Publicly owned land

Currently the city of Portland owns 40% of the property needed for the South of Foster Road alternative (√ +). Continued willing seller acquisitions over the next decade could allow the first phase of construction, depending on available funds. In contrast, significant land ownership issues exist North of Foster Road (√ -) and require resolution before any work could be started.

Foster Road Issues

The South of Foster Road alternative highly supports (√ +) this consideration where as the North of Foster Road alternative does not (√ -). The design to the south would not cross Foster Road, removing any of the associated issues. Whereas the design to the north would require at least three separate crossings and one crossing of SE 111th Ave.

Springwater Corridor

The right of way along the Springwater Corridor would not be affected in the South of Foster Road alternative (√ +). In the North of Foster Road alternative, a right of way would have to be used for floodwater conveyance. The availability of this right of way is uncertain and would have to be resolved. Also, a transmission tower near the trail would have to be relocated.

Design Considerations for Regulatory Issues

All flood management project alternatives carry significant environmental impacts. Each alternative must be evaluated in the context of federal, state and local regulatory requirements designed to protect fish and wildlife habitats, water quality and certain fish and wildlife species.

All project designs will be judged on how well they meet environmental protection and related permitting conditions. Failure to do so could eliminate an alternative. The impacts of flood management projects that must be addressed include:

- Short-term habitat degradation during project excavation that could cause soil erosion and in-stream turbidity;
- Removal of existing riparian vegetation and cover that could cause short-term erosion, increase of Johnson Creek water temperatures, and loss of habitat;

- Direct impacts on fish or wildlife species that may be present during construction;
- Creation of structures or flood storage areas that may trap migratory fish or obstruct migratory passage.
- Erosion control

Federal Permitting Process

Before any design can be implemented, the City of Portland must go through federal permitting and comply with the following agencies:

- U.S. Army Corps of Engineers (USCOE) (*Nationwide 404 Permit*)
- National Marine Fisheries Service (NMFS) (*Federal Endangered Species Act (ESA)).*
- U.S. Fish and Wildlife Service (USFWS) (*Federal Endangered Species Act (ESA)).*
- Oregon Department of Environmental Quality (*State Water Quality Certifications 401 of the federal Clean Water Act).*

Federal ESA guidelines likely will require the most evaluation for either of the designs being considered. Such analysis is beyond the scope of this report, and is not possible until more detailed plans are prepared. However, some of the key issues that are likely to arise during this analysis are summarized below.

Conclusions Regarding Permit Issues:

- Both alternatives have considerable short-term impacts that will need careful planning and implementation of Best Management Practices
- The South of Foster Road alternative has the potential over the long-term to significantly improve a number of components of properly functioning conditions
- The North of Foster Road alternative will face considerable obstacles in the permitting process, and may not be approved due to issues of cost or practicality.

State Permitting Process

State permitting will be a consideration with both designs. The Oregon Division of State Lands and the Oregon Department of Environmental Quality must approve any final design.

The South of Foster Road design meets design considerations for state permitting (√), where the North of Foster Road design (√ -) does not. Even though immediate impacts may be viewed as negative, the ultimate outcomes of the south design provide long term benefits that restore natural functions to Johnson Creek. The north design does not provide these long-term restoration benefits. Both of the designs create the possibility of directing water over a possible brownfield.

Local Permitting Process

Both designs meet the design considerations for local permitting (√). Either design will be difficult, but not impossible, due to environmental protection zones and the removal of trees.

Other Considerations

Cost Comparisons

With appropriate partnerships both project designs were assumed to be doable (√) based on costs. The South of Foster Road design will require more excavation and grading, where the North of Foster Road design will require more funding in engineering systems. Currently, funding has not been identified to design or construct either of these alternatives.

Downstream Impacts

Both projects effectively meet this design consideration (√), with the assumption that flood management alternatives include West Lents. If West Lents is not included, neither alternative will effectively meet this design consideration (√-).

Operations and Maintenance (O&M)

The South of Foster Road design meets design considerations for Operations and Maintenance (√), whereas the North of Foster Road design does not (√ -) . The latter design requires an engineered system that will potentially require additional maintenance to keep the system functioning properly.

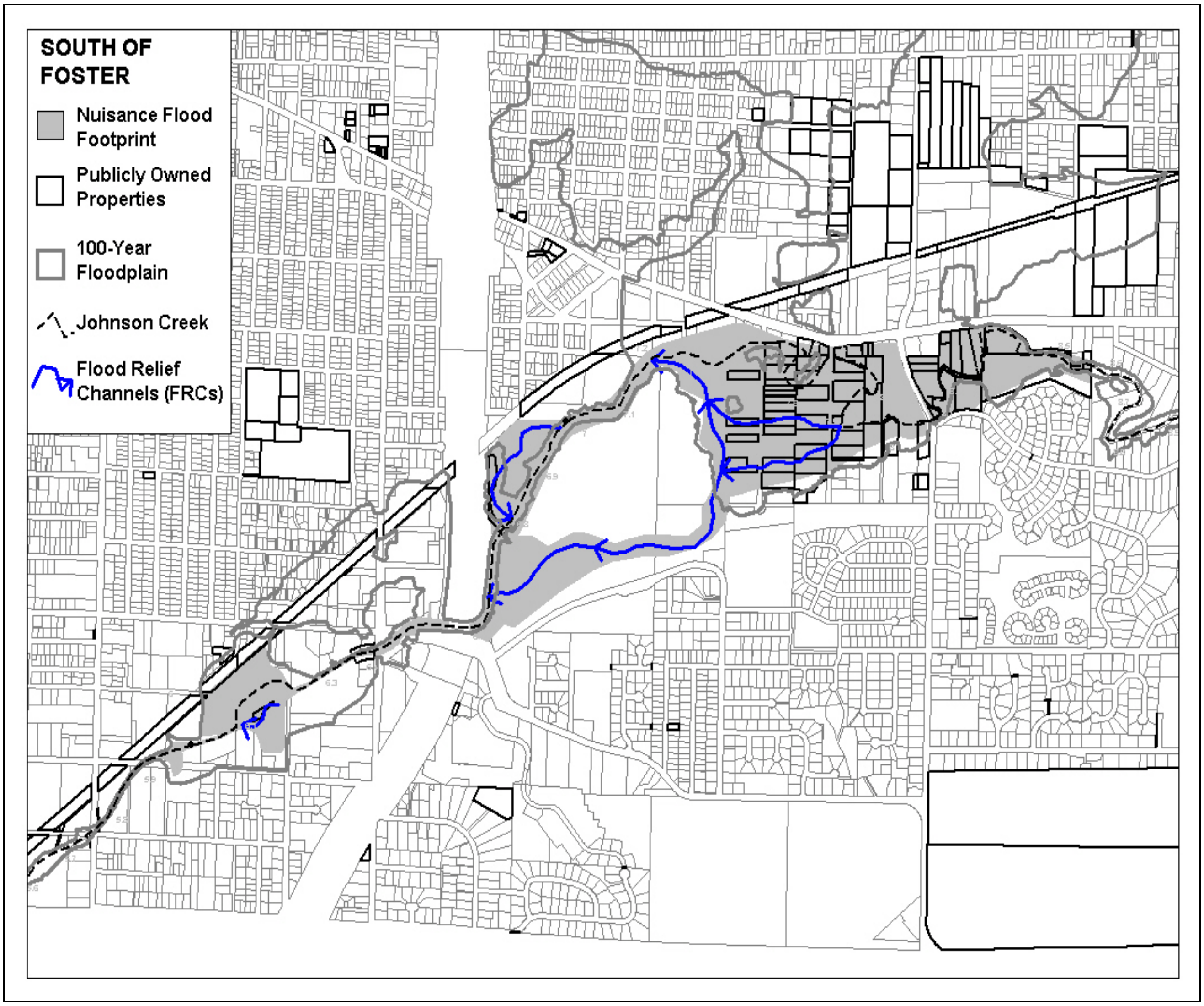
Maintenance problems to the north could create a flood storage failure. The success of the South of Foster Road design is not dependent on ongoing structural maintenance.

Conclusion

The goal of this BES technical evaluation process is to offer a genuine and sustainable approach for managing the Nuisance Flood in Lents, which in turn supports future redevelopment within the Lents Urban Renewal area. The South of Foster Road Alternative #1 ranked as the best choice compared with the other alternatives to meet this goal, while also accomplishing significant environmental restoration and enhancement.

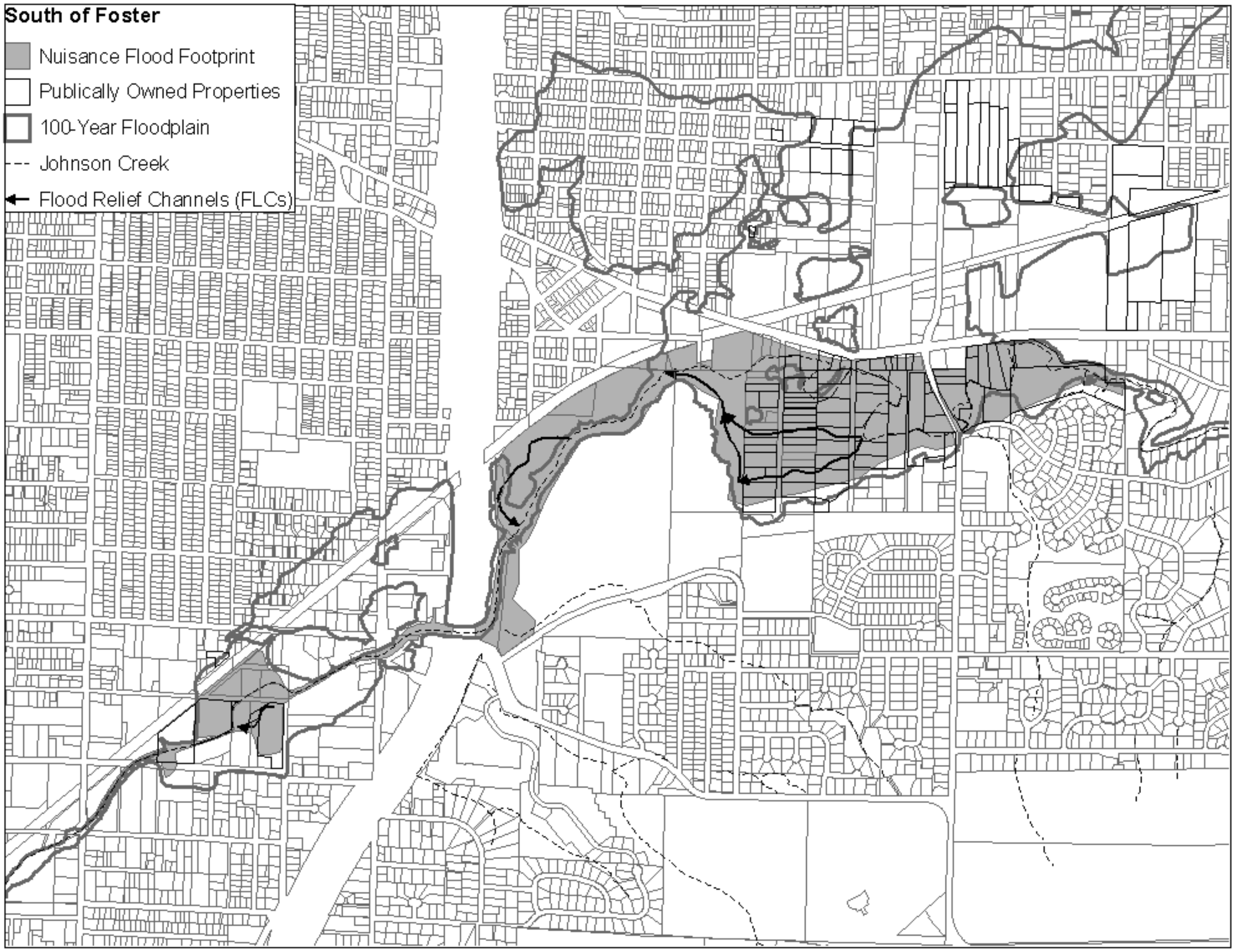
Rejected alternatives are not feasible either because they would not contain the nuisance flood, would be significantly harder to implement, or left doubt about long-term benefits for flood management, natural resource protection and community redevelopment. This technical information, including the proposed flood storage footprint illustrated below, is intended to inform and guide future community decision making within the Lents Urban Renewal process.

Alternative #1
Recommended Flood Management Footprint



Based on 2002 BES Analysis

Alternative #2
Preferred Flood Management Footprint



Based on 2003 BES Analysis and collaboration with Freeway Land Company property owners and the Portland Development Commission