Steps will also be taken to prevent long-term erosion (wind or water) on any embankment, roadway shoulder, drainage channel segment, or graded section as part of the proposed project by use of Best Management Practices (BMPs), within their design parameters. These areas will be reviewed and revegetated, as needed, with erosion control grass mixtures, or protected by other sediment control measures such as, but not limited to, wind/water erosion control mat (natural or synthetic) material, additional plants and bushes where warranted, and proper maintenance of other permanent BMPs. A Storm Water Site Plan will be developed for both temporary and permanent measures using BMPs. The site plan will also address the requirements of the National Pollution Discharge Elimination System (NPDES).

Mitigation

No mitigation is proposed.

Waterways and Hydrological Systems

Studies and Coordination

Information for this report was obtained from the U.S. Geological Survey (USGS), the Washington State Department of Ecology (ECOLOGY), the city of Spokane Planning and Programming Office, and the Engineering Division of the Spokane County Public Works Department. The following references were also used:

- USGS Topographical Maps
- *Groundwater*, R. Allan Freeze and John A. Cherry
- *The Spokane Aquifer, Washington: Its Geologic Origin and Water-Bearing and Water-Quality Characteristics*, Dee Molenaar, USGS
- Communications with the Corps of Engineers (Refer to the Public and Agency Coordination Section of this EIS.)

The EPA is a cooperating agency, but has directed WSDOT to confer with Spokane County on matters related to the Spokane Sole Source Aquifer. The Spokane County Stormwater Aquifer protection requirements will be followed. This program has been approved by Ecology and the E.P.A.

The route alternative sites were inspected to determine possible additional hydraulic and hydrologic impacts. The infiltration capacity of the soils was also analyzed, to assess the potential impact of high storm water runoff rates during a design storm with a 10-year recurrence interval (see Table 4-20).

A Hydraulic Project Approval (HPA) permit will be obtained from the Department of Fish and Wildlife (WDFW), a Shoreline Permit from the city of Spokane and/or the county, Nationwide 404 permit numbers 13 and 15 from the Corps of Engineers, and a Flood Plain Development Review will be conducted by Spokane County prior to each final North Spokane Freeway (NSF) phase project approval (when required).
Affected Environment

Sole Source Aquifer

The Spokane Aquifer and the Spokane River are the primary hydrologic features in the study area. They both have been shown to exchange water continuously from

State Line to the Nine Mile Falls area. Coordination with the county has included updating and ensuring the accuracy of information about the water quality of the aquifer. The aquifer's underground characteristics are more fully discussed in the Geology and Soils section of this EIS.

The city of Spokane is developing a Wellhead Protection Plan. The plan will define wellhead protection areas that will be established as sensitive sites. WSDOT has coordinated with the city and the county on public well location and will continue to coordinate with them as the wellhead plan is developed.

Waterways and Other Hydrological Systems

Existing waterways and other hydrological systems in the study area include rivers, wetlands, lakes, streams/creeks, and intermittent runoff channels. See Figures 4-8 through 4-11.

The Spokane River flows at an average annual rate of 178,595 liters per second (L/s) (6,307 cubic feet per second [cfs]) at Post Falls, Idaho. The maximum recorded flow rate was on December 25, 1933, at 1,418,675 L/s (50,100 cfs), during which there was little or no over-bank flooding. The average high flow is 549,063 L/s (19,390 cfs), which typically occurs during May. The minimum recorded flow was 1840 L/s (65 cfs), in July 1973.

Market/Greene Alternative (Preferred Alternative)

There are riparian zones, including narrow band wetlands, associated with the Spokane River (refer to Wetland Area 1 of the Wetland section of this EIS) in the area of the proposed bridge (see Figure 4-8).

Market/Greene — North Option (Preferred Alternative) and South Option

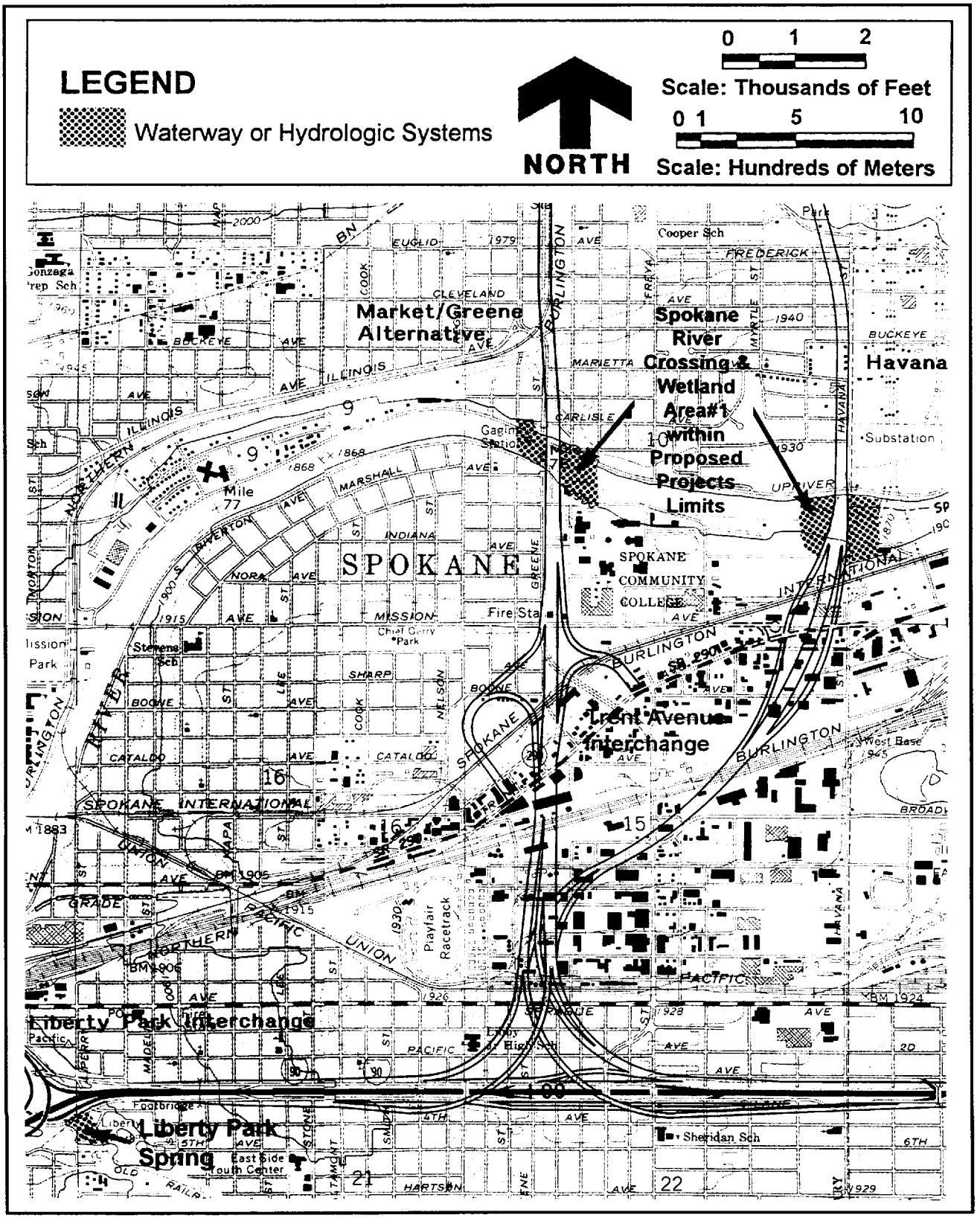
The Little Spokane River is to the north of the project termini. Wandermere Lake, an unnamed creek, and a small wetland (see Wetland Area 3 in the Wetland section of this chapter) are also in the vicinity of the northern project termini. The unnamed creek originates southeast of Dart Hill from an underground spring and flows north along the east side of the original US 395 alignment (US 395 was recently realigned farther to the west) until it reaches the Little Spokane River (see Figure 4-11). There are also two unnamed seasonal (sinking) streams, one from Gerlach Road and another from Mt. St. Michael Scholasticate (see Figure 4-10). Seasonal flows from these sinking streams infiltrate into the ground and are not tributary to another surface water body. These areas of stream infiltration are considered to be sensitive sites.

Havana Alternative

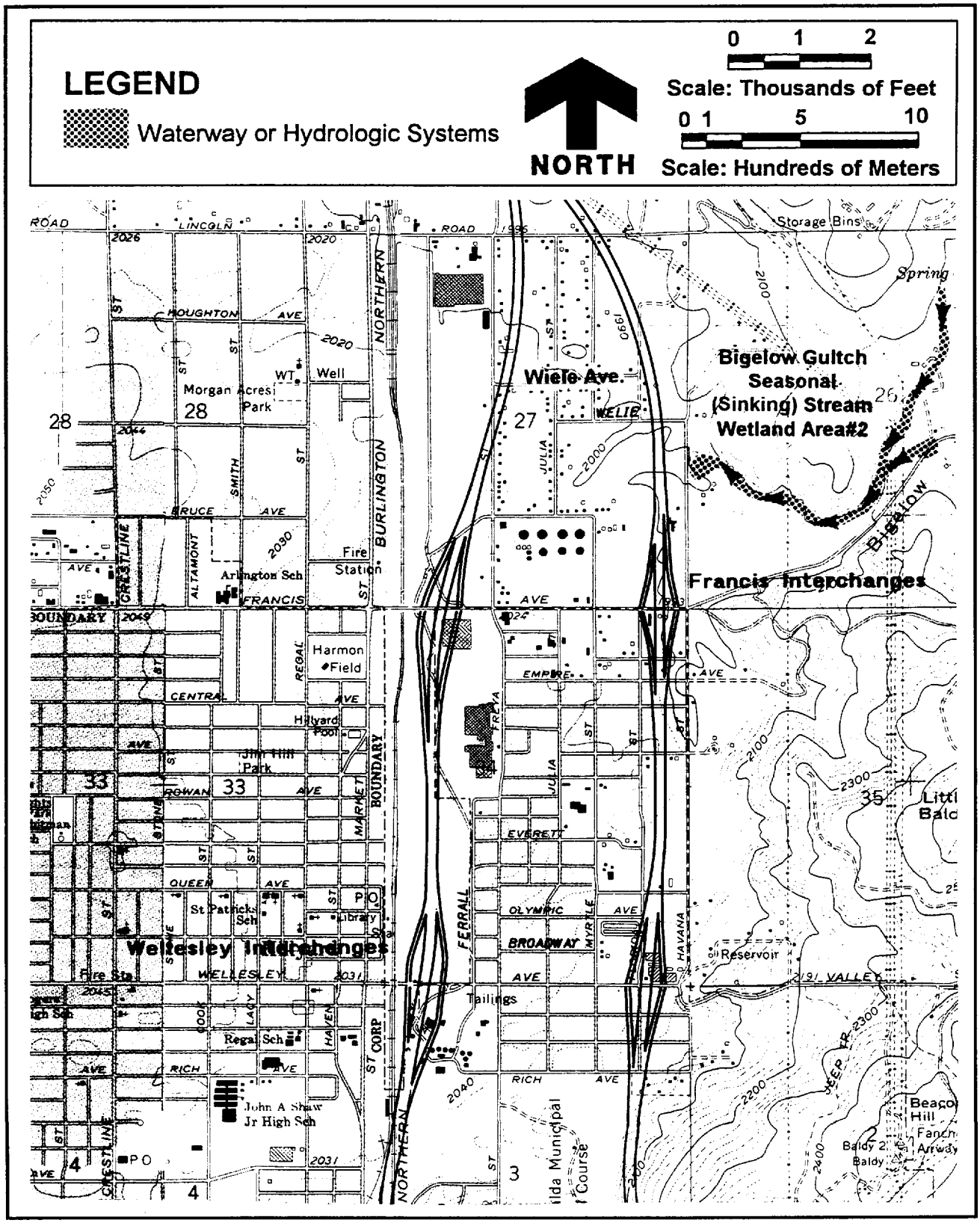
There are riparian zones, including narrow band wetlands (see the Wetland section of this chapter), associated with the Spokane River in the project area (see Figure 4-8). A seasonal (sinking) stream that flows out of Bigelow Gulch into a very small wetland near the Francis Avenue interchange may be considered another sensitive site (see Figure 4-9).

Havana Alternative — North Option and South Option

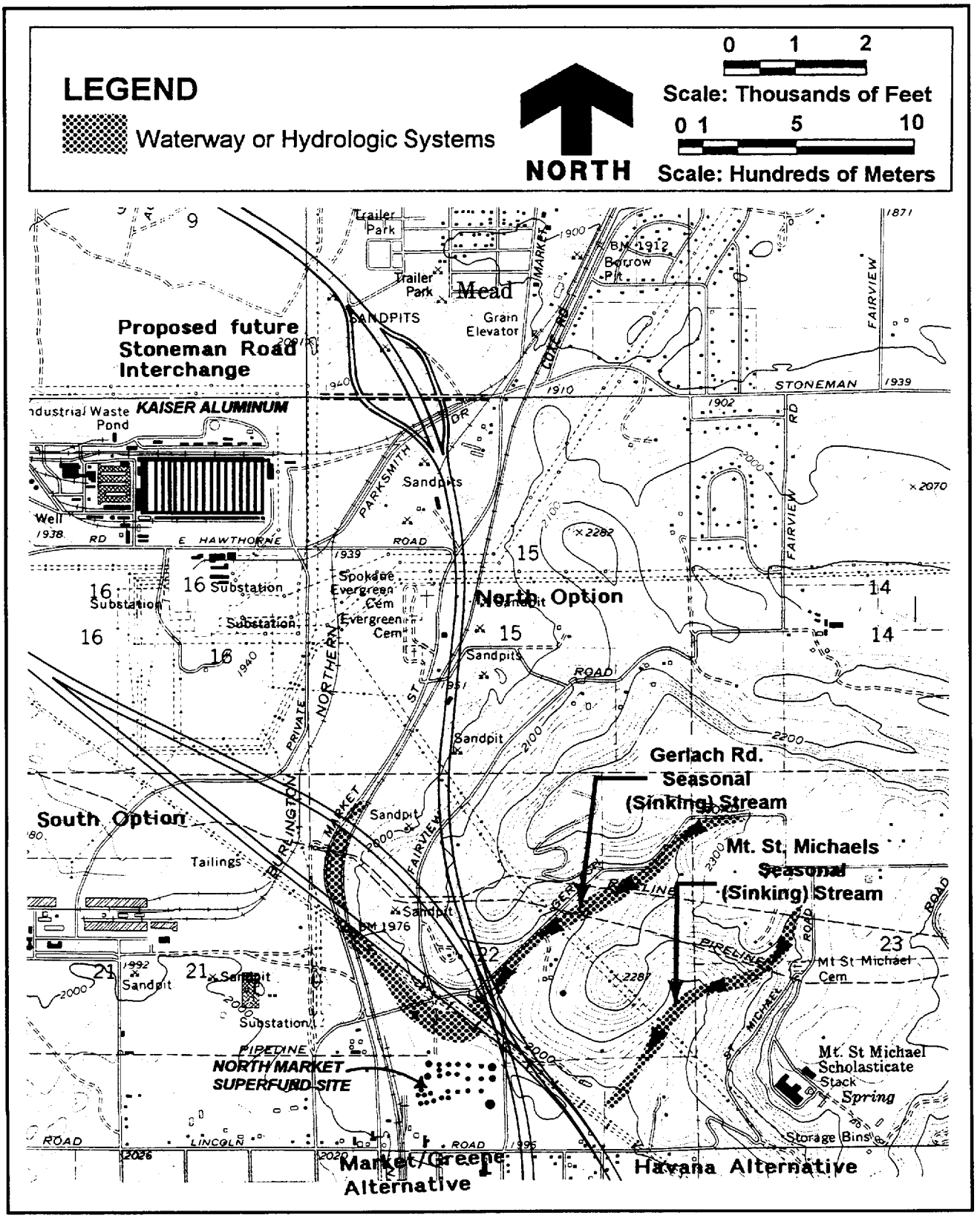
See Market/Greene North Option and South Option.



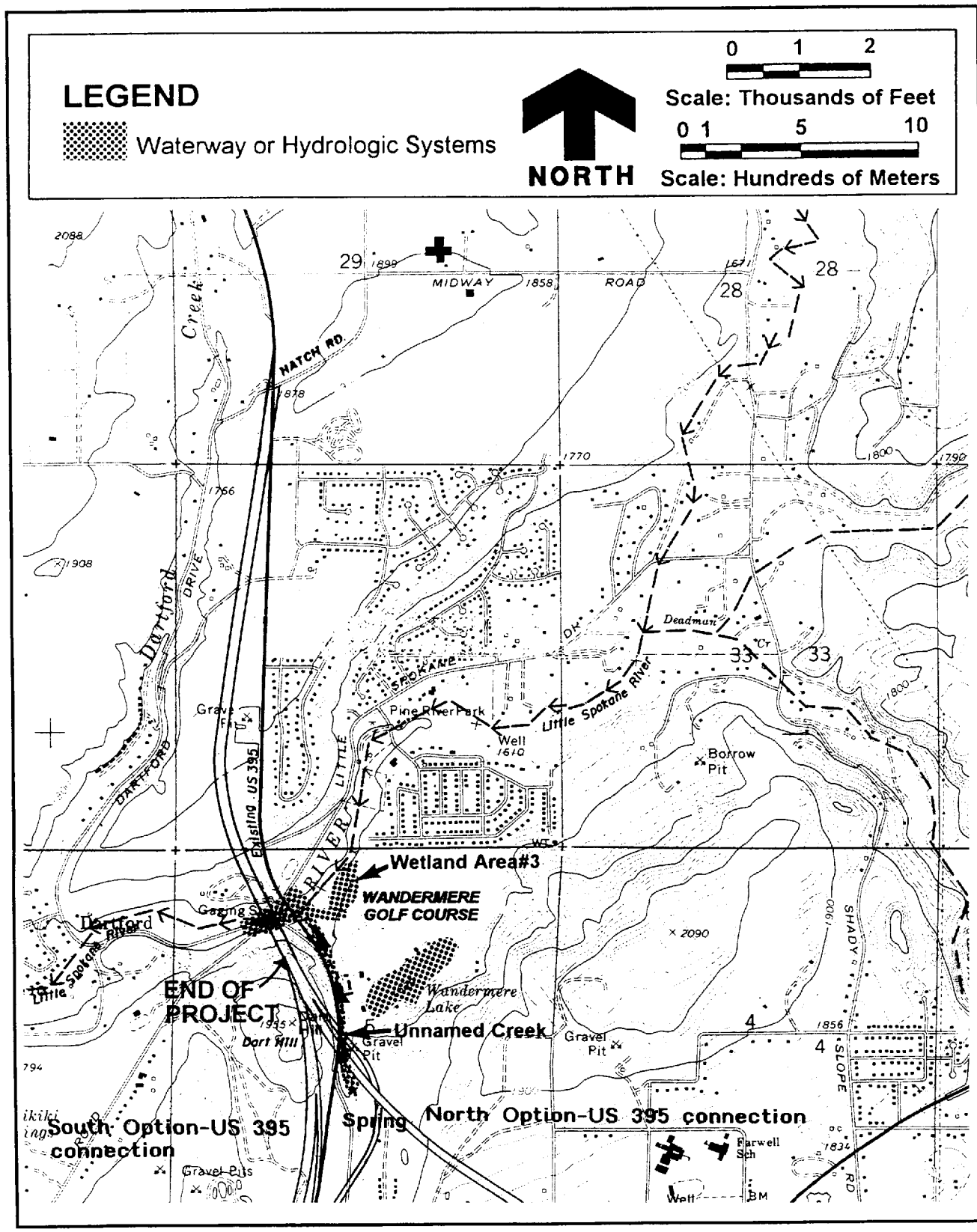
Market/Greene (Preferred Alternative) and Havana Alternative Waterways or Hydrologic Systems — Area 1
Figure 4-8



Market/Greene (Preferred Alternative) and Havana Alternative Waterways or Hydrologic Systems — Area 2
Figure 4-9



North Option (Preferred Alternative) and South Options
Waterways or Hydrologic Systems — Area 3
Figure 4-10



North Option (Preferred Alternative) and South Option Waterways or Hydrologic Systems — Area 4
Figure 4-11

I-90 Collector/Distributor (C/D) System (part of the Preferred Alternative)

In Liberty Park there is a spring that is intercepted by the city of Spokane sewer system. Two asphalt-lined ponds previously accepted this spring water; these ponds are no longer in use (see Figure 4-8).

Impacts

No-Build Alternative

(For discussion of construction activity impacts, see the Construction Activity Impacts section of this EIS.)

There is no indication that existing roadways have any hydrologic or hydraulic impact on water supply wells in the study area or on the Spokane Aquifer, from which all the wells are fed. If the freeway were not constructed, there would also be no change to the existing waterways and hydrological systems, unless additional impervious area is added by improvements to existing roadways. Therefore, there are no additional operational impacts anticipated under the No-Build Alternative.

"Build" Alternatives

~~No impacts are expected to the waterways and hydrological systems, including the acquifer, in the vicinity of the proposed NSF.~~

Possible impacts to waterways, hydrological systems, and the aquifer will be minor. Best management practices will be employed to mitigate those minor impacts.

The Spokane River, flood plains, wetlands, creeks, and streams will be avoided, or will be spanned by proposed structures where applicable.

Whenever practicable, curbs will not be used for delineation and control of stormwater runoff. This will promote the sheet flow of water off the highway and decrease the amount of piping required for stormwater management. Stormwater runoff will be routed through grass swales or other integrated stormwater detention/sedimentation basin systems. These systems (water quality/quantity BMPs) both filter and slow the water flow, to avoid direct discharges (within their design parameters) of highway runoff to receiving waters (including ground water).

All future land uses or developments above the Spokane Aquifer are subject to the Spokane County Aquifer Protection Plan. The plan requires that roadway stormwater discharges be routed through integrated grass retention swale systems, wherever practicable, before entering the ground.

Grass infiltration swales outside the city of Spokane will conform to Spokane County's Guidelines for Storm Water Management. These guidelines require that runoff in grass infiltration swales be no more than six inches deep; capacity prior to overflow is limited to the first 12.7 millimeters (1/2 inch) of runoff from the drainage area above the swale. If infiltration and routing calculations indicate that outflow from an infiltration swale will be greater than natural flow for the design storm, detention must also be provided.

Future wellhead and other sensitive site protection plans may require additional pollution control measures for storm water discharges to grass swales, such as, but not limited to, sediment traps, spill protection, and other best management practice measures. The city of Spokane is developing a Wellhead Protection Plan to define

wellhead protection areas. WSDOT will conform with the Wellhead Protection Plan once it is completed and approved.

BMPs such as, but not limited to, matting, mulch, or ground cover (seeding or plantings) will be used and maintained for long-term stabilization of slopes.

A Stormwater Site Plan will be developed and approved for both temporary and permanent BMPs as detailed in the WSDOT Highway Runoff Manual and the Water Quality Study for Waters of the State of Washington, WAC 173-201A.
The Stormwater Site Plan will meet the requirements of the NPDES.

Areas within the proposed right of way that will need special stormwater management measures are summarized below. Refer to the Water Quality section of this chapter for further information.

Market/Greene Alternative (Preferred Alternative)

Overland flow to the natural channels could exceed their hydraulic carrying capacities (refer to footnoted entries in Table 4-20 covering expected infiltration capacity versus runoff rate). This is particularly likely along the viaduct section between I-90 and the Spokane River. Runoff volumes that exceed the capacity of grass infiltration swales, natural channels, and stormwater sewers will be addressed. Possibilities include a detention basin system, transfer system, and/or expanding the right of way in specific locations to include sufficient area for effective grass infiltration swales.

Havana Alternative

There is a rock formation along the east side of the right of way, and soil with low permeability (refer to footnoted entries in Table 4-20 covering expected infiltration capacity versus runoff rate) along the west side of the right of way in the Minnehaha Rocks section, from Frederick Avenue north to Broad Avenue. Freeway operation may result in localized flooding during periods of runoff from stormwater or snow melt. Stormwater detention basins or equivalent runoff control structures (BMPs) will be installed and maintained for the cut section between Esmeralda Golf Course and Beacon Hill. Equivalent runoff control structures include using new storm sewers (transfer system) to route flows to grass infiltration swales to the north or south of the Beacon Hill cut.

Overland flow to the natural channels could exceed their hydraulic carrying capacities. This is particularly likely along the viaduct section between I-90 and the Spokane River. Runoff volumes that exceed the capacity of grass infiltration swales, natural channels, and stormwater sewers will be addressed. Possibilities include a detention basin system, transfer system, and/or expanding the right of way in specific locations to include sufficient area for effective grass infiltration swales.

North Option (Preferred Alternative) and South Option

The roadway cut east of Market Street in the vicinity of Gerlach Road has rock and soil with low permeability (refer to footnoted entries in Table 4-20) on both sides of the freeway. Freeway operation may result in localized flooding during periods of runoff from stormwater or snow melt. Runoff volumes that exceed the capacity of grass infiltration swales and natural channels will be addressed. Possibilities include a detention basin system, transfer system, and/or expanding the right of way in specific locations to include sufficient area for effective grass infiltration swales.

Runoff Rate meter3/sec/meter alternative Soil	Infiltration Capacity (ft3/min/ft)	meter/sec (ft/min)
Market/Greene-GgA (Garrison gravelly loam)	3.1X10-5 (0.02)	4.22X10-6 (0.00083)
Market/Greene-GgA	6.19X10-5 (0.04)	4.22X10-6 (0.00083)
Market/Greene-McB (Marble variant)	6.19X10-5 (0.04)	1.41X10-5 (0.00278)
Havana-GgA	3.1X10-5 (0.02)	4.22X10-6 (0.00083)
Havana-SpC (Spokane loam)	6.19X10-5 (0.04)	4.22X10-6 (0.00083)
Havana-SuE (Spokane extremely rocky complex)	6.19X10-5 (0.04)	none on east side 1
Havana-StC (Spokane very rocky complex)	6.19X10-5 (0.04)	none on east side 1
Havana-SsC (Spokane complex)	6.19X10-5 (0.04)	4.22X10-6 (0.00083)
Havana-NcA (Narcisse silt loam)	6.19X10-5 (0.04)	4.22X10-6 (0.00083)
North Option-McB	1.55X10-5 (0.01)	1.41X10-5 (0.00278)
North Option-PoA (Peone silt loam)	1.55X10-5 (0.01)	4.22X10-6 (0.00083)
North Option-SpC	1.55X10-5 (0.01)	4.22X10-6 (0.00083)
North Option-HhA (Hardesty silt loam)	4.64X10-5 (0.03)	<5.08X10-7 (<0.0001) 1
North Option-MbC (Marble)	4.64X10-5 (0.03)	3.53X10-5 (0.00694)
North Option-BaB (Bernhill silt loam)	4.64X10-5 (0.03)	4.22X10-6 (0.00083)
North Option-BfD (Bernhill very stony silt loam)	4.64X10-5 (0.03)	4.22X10-6 (0.00083)
North Option-Rock	4.64X10-5 (0.03)	<5.08X10-7 (<0.0001) 1
North Option-SxB (Springdale gravelly sandy loam deep)	1.55X10-5 (0.01)	1.41X10-5 (0.00278)
North Option-SwB (Springdale gravelly sandy loam)	1.55X10-5 (0.01)	1.41X10-5 (0.00278)
North Option-SpD (Spokane loam, steep slopes)	1.55X10-5 (0.01)	3.53X10-5 (0.00694)
South Option-MbC	1.55X10-5 (0.01)	3.53X10-5 (0.00694)
South Option-Rock	1.55X10-5 (0.01)	<5.08X10-7 (<0.0001) 1
South Option-McB	4.64X10-5 (0.03)	1.41X10-5 (0.00278)
South Option-SwB	4.64X10-5 (0.03)	1.41X10-5 (0.00278)
South Option-HhA	4.64X10-5 (0.03)	<5.08X10-7 (<0.0001) 1
I-90-GgA	1.39X10-4 (0.09)	4.22X10-6 (0.00083)
NOTE: 1. Area where peak runoff exceeds infiltration capacity		

Expected Infiltration Capacity Versus Expected Runoff Rate

Table 4-20

I-90 Collector/Distributor (C/D) System (part of the Preferred Alternative)

Grass infiltration swales constructed on the native soils will not have sufficient hydraulic capacity to dispose of a 12.7 millimeters (1/2 inch) of runoff (refer to footnoted entry in Table 4-20) from impervious area along the I-90 C/D. Part of the existing stormwater disposal system from the freeway discharges into the city of Spokane's storm sewer collection system. However, existing city policy is not to add stormwater connections to the combined sewer system. This is because flow rates in the combined sewers exceed interceptor and treatment plant capacity during storm events. Overflows through the Combined Sewer Overflow (CSO) regulating systems are to the Spokane River and its tributaries. The city is preparing a CSO Reduction Plan intended to reduce the volume and frequency of CSO.

The city of Spokane will probably allow the continued use of the combined sewers along the proposed C/D as long as there is no additional runoff volume or higher peak flow rates (1993 and 1994 phone communication with Lars Hendron, Engineering/Planning, city of Spokane). The stormwater system for handling the

runoff from the proposed C/D would involve a combination of treatment measures. Based on the statement above, a portion of the runoff could be placed into the existing system. The amount would correspond to the existing impervious surface area as represented by present streets (2nd and 3rd Avenues in the city and 3rd and 4th in the county) and portions of I-90 that would be replaced by the proposed C/D. The remaining (net increase) would be handled through other BMPs.

Mitigation

No mitigation is proposed.

Flood Plains

Studies and Coordination

Flood plain information was obtained from the Washington State Department of Ecology (Ecology), the city of Spokane Planning Office, and the Engineering - Division of the Spokane County Public Works Office. The following references were also used:

1. Flood Plain Management Handbook for Local Administrators
2. U.S. Geological Survey (USGS) Topographical Maps
3. Federal Emergency Management Agency (FEMA) coordination
    - National Flood Insurance Program Flood Insurance Rate Maps (FIRM)
    - Floodway Maps
    - FEMA computer flood plain model for backwater studies.
4. *The Spokane Aquifer, Washington: Its Geologic Origin and Water-Bearing and Walter-Quality Characteristics*, by Dee Molenaar
5. Corps of Engineers coordination
6. City of Spokane and Spokane County planning agency officials (Shoreline Permit and Flood Plain Development Review)

Refer to the Public and Agency Coordination Section of this EIS for additional information.

Any new bridge constructed within the Spokane River or adjacent wetlands/ - habitat/shoreline will require a 404 nationwide permit from the Corps of Engineers (Corps) and a Hydraulic Project Approval (HPA) permit from the Washington Department of Fish and Wildlife (WDFW). The work is expected to qualify for 404 nationwide permit numbers 13 and 15. The Corps Regional Engineer has been consulted regarding this project; see Chapter 5 for specific information about this coordination.

A Shoreline Permit and Flood Plain Development review by the city of Spokane will be required for any new bridge over the Spokane River, prior to construction. The city of Spokane adopted its Shoreline Master Program in 1976 to regulate development within 61 meters (200 feet) of the ordinary high water mark (ordinary high water mark is determined by the permitting agency).

- A backwater analysis will be done before final bridge design. Cross sectional measurements of the river will be taken and modeled (using the FEMA computer model) to ensure that construction of the structure will not decrease the channel carrying capacity or increase the 100-year flood plain elevation by