Final Report

Stormwater Management Plan for the West Plains Planning Area

Prepared for
Spokane County
Stormwater Utility
1026 West Broadway Avenue
Spokane, Washington 99260-0180

February 2003

URS
1501 Fourth Avenue, Suite 1400
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and

Brown and Caldwell
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Seattle, WA 98101

Updates and Corrections to the Stormwater Management Plan for the West Plains Planning Area Final Report Prepared by URS and Brown and Caldwell Dated February 2003

Some of the information used for parts of the West Plains Stormwater Management Plan has changed. This short update/corrections document provides information current in October 2005. For example, at the time the plan was written stormwater control ordinances were in place for Glenrose and North Spokane, but in September 2003 a court ruled that ordinance was invalid. The ordinance has not been replaced.

Mapped information in the Stormwater Management Plan such as land uses, wetlands and floodplains is generalized in this planning level document. More detailed and current information is available from the various map sources used in the plan.

In the corrections and updates below, underlining indicates added language while strikethrough indicates deleted language.

Page ES-3, second bullet, second line: this note is added:
"(Note: The Glenrose and North Spokane Stormwater Control Ordinances are no longer in effect.)"

Page ES-4, final line: this note is added:
"(Note: The information and recommendations in this plan were considered in a funding study for the entire Stormwater Service Area. In August 2004 the County adopted funding recommendations including stormwater rate increases, bonding and system development charges.)"

Page 1-1, second paragraph, last line is changed:
" . . . County's ~~interim~~ Urban Growth Boundary Area."

Page 4-4, Information Management, first line is changed:
" . . . County Stormwater ~~Water~~ Utility staff should continue to track areas of known drainage and . . . "

Page 4-5, Design Reviews and Site Inspections, first line is changed:
" . . . County Stormwater ~~Water~~ Utility staff should continue to review proposed private and public . . "

Page 5-1, this note is added at the beginning of this section:
"(Note: The information and recommendations in this chapter were considered in a funding study for the entire Stormwater Service Area. In August 2004 the County adopted funding recommendations including stormwater rate increases, bonding and system development charges.)"

Prepared by Stormwater Utility Staff in October 2005.

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BROWN AND CALDWELL

February 14, 2003

Ms. Brenda Sims
Stormwater Utility Manager
Spokane County Public Works
1026 W. Broadway Avenue
Spokane, Washington 99260-0180 14-21930.001

Subject: Stormwater Management Plan for the West Plains Planning Area

Dear Ms. Sims:

Please find enclosed five copies of the final Stormwater Management Plan (SMP) for the West Plains Planning Area. We have also enclosed a CD with copies of all text files, spreadsheets, and figures. It has been a great pleasure working with you on this project and we sincerely appreciate the opportunity to be of service to the Spokane County Stormwater Utility. We look forward to working with you to present the SMP recommendations to County stakeholders and decision-makers and to provide support as you proceed with implementation efforts.

Very truly yours,

BROWN AND CALDWELL

Stephen Anderson FOR

Michael Milne
Project Manager

MM:em

P:\21930 West Plains\Plan\Final\Cover Letter.doc

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EXECUTIVE SUMMARY

In 1992, the Spokane Board of County Commissioners established a Stormwater Utility to provide stormwater quantity and quality management for the developed and developing areas of unincorporated Spokane County. To that end, the Stormwater Utility is developing stormwater management plans for the major planning areas in the County's jurisdiction, including the West Plains area.

The West Plains planning area encompasses roughly 37 square miles between the Spokane River and Latah and Marshall Creeks on the east, and Airway Heights on the west (Figure ES-1). Most of the northern portion of the area is rural or park land. The southern portion contains industrial, commercial, residential, and agricultural land uses. Much of the planning area lies within the County's Urban Growth Area.

Stormwater drainage facilities in the West Plains include road drainage ditches and culverts and a number of on-site facilities, such as grassed percolation swales. There are no regional stormwater collection/conveyance systems at present. Much of the planning area has shallow soils, seasonally high groundwater conditions, and generally flat topography. Because of the topography and geology, on-site infiltration systems have generally not worked well in much of the West Plains area. Flooding has been a problem at a number of locations, especially in the western portion of the planning area. As this portion of the basin has developed with residential, industrial, and commercial land uses, drainage problems have become increasingly common. Potential degradation of groundwater quality is also a concern.

Much of the planning area within the County's Urban Growth Area has been designated for industrial and commercial development in the Spokane County Comprehensive Plan (2002). Moreover, the City of Spokane currently provides water supply and sewer service to much of the West Plains area. Thus, the West Plains area is poised to undergo significant commercial and industrial development in the future. However, the absence of regional stormwater facilities, combined with the poor infiltrative capacity of the soils, generally limits developers to design/construction of evaporation ponds for stormwater disposal. These facilities are land intensive, requiring from 35 to 50 percent of site area. Such large land requirements are of great concern to landowners within the West Plains Planning Area, and could actually have other negative effects such as increasing the extent of surface water area around the airport (of concern due to bird-strike issues). To address these and other issues, the County prepared this Stormwater Management Plan (SMP) for the West Plains area to ensure appropriate, cost-effective stormwater management measures are identified before significant additional development occurs.

The County prepared the West Plains SMP in three phases. The first phase involved review of existing information to characterize the existing conditions and problems relevant to stormwater management. The second phase involved collection of additional information to address key data gaps identified in Phase 1 and engineering analyses to size potential structural alternatives. The third phase involved working with area residents, businesses, and local and state agencies to develop the stormwater management measures and implementation strategies presented in this SMP.

The first phase of work culminated with preparation of the *Existing Conditions, Problems, and Opportunities for the West Plains Stormwater Management Planning Area* report (URS Corp., May 2001).

Data collected during this phase of work indicated the potential presence of buried "paleo-channels." These large, deep channels were incised into the basalt underlying the study area during the last ice ages and later filled with sedimentary material, forming buried channels not visible on the surface today. These buried channels offer potential locations for stormwater disposal. The Existing Conditions report identified "opportunity areas" from which stormwater could be collected and routed to these paleo-channels and other potential disposal sites.

During Phase 2 of the planning effort, alternative structural solutions (e.g., regional infiltration and evaporation facilities, improved conveyance systems, outfalls to streams, etc.) were developed for each of the opportunity areas. These alternatives were then screened with planning area stakeholders to eliminate those with fatal flaws, and the remaining measures evaluated in greater detail. Field inspections were conducted of many of the possible facility sites within opportunity areas, and the paleo-channel north of the airport was better defined using geophysical survey techniques. These technical analyses enabled the County to rule out additional alternatives due to technical infeasibility. The final recommended measures were then identified by weighing each remaining alternative against other factors (e.g., FAA guidelines, permitting requirements, etc.). The resulting recommendations include:

- Drainage response measures
- Spot drainage improvements
- Basin-specific development management measures
- Coordination of road improvements with new development and maintenance activities
- Gravity flow to infiltration facility in paleo-channel north of airport

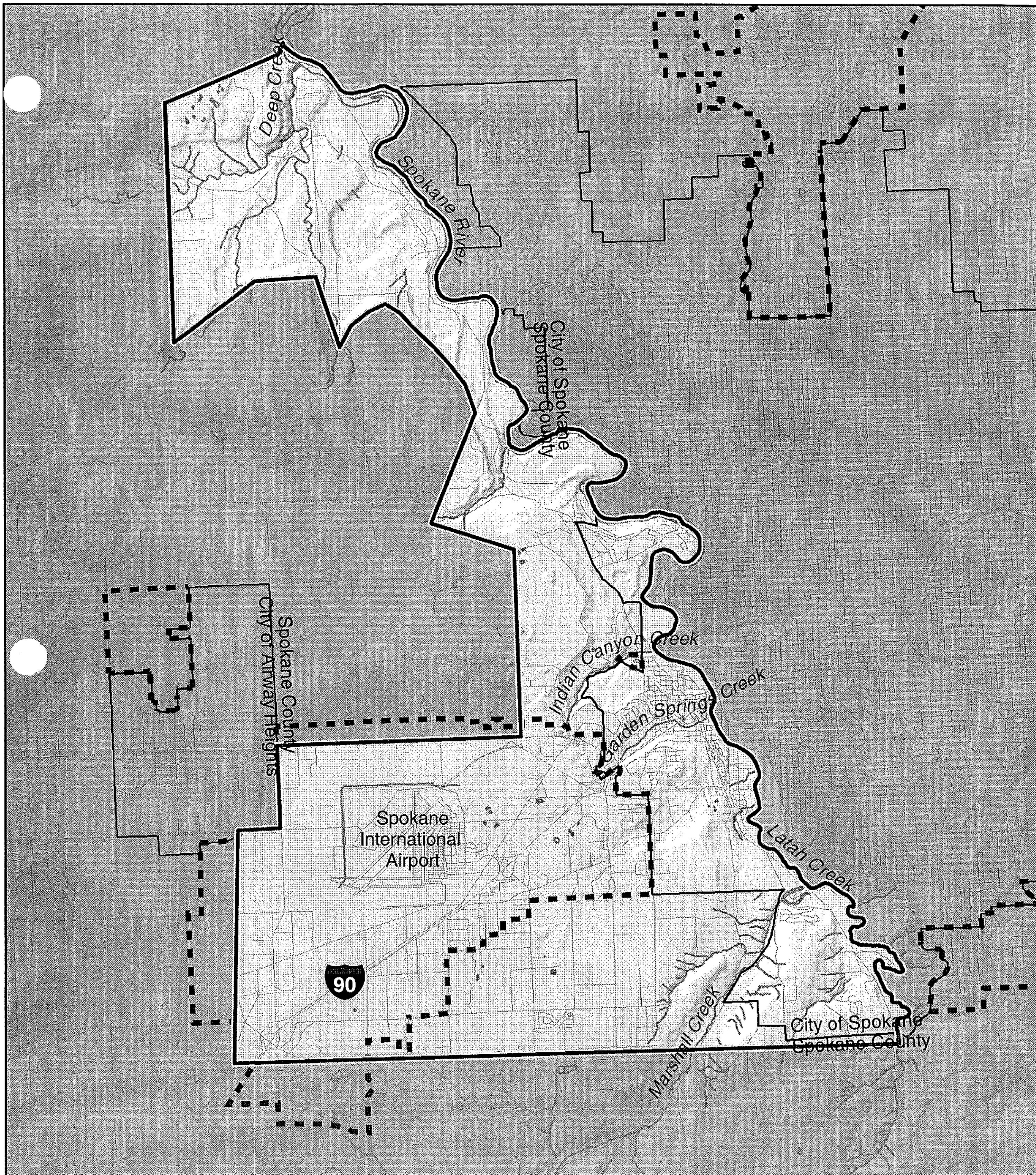
The below summarizes each of these measures. Note that coordination of road improvements with new development and maintenance activities is encompassed within the broader category of "Basin-Specific Development Management Measures."

Drainage Response Measures

The Characterization Report identified numerous complaints of nuisance (i.e., not impacting health or safety) flooding. In these situations, drainage problems are often isolated or maintenance-related, such as clogged inlets or culverts, as opposed to system-wide issues. This recommendation calls for County staff to continue to track complaints and to set up a process to prioritize problems and determine appropriate response measures (i.e., maintenance or spot drainage improvements).

Spot Drainage Improvements

This recommendation relates to procedures for identifying, prioritizing, and implementing small capital drainage improvements. Such recommendations will emerge from the drainage response process defined above. The County should track and rank these small capital improvements for implementation as feasible with existing funds. Examples of such projects include isolated



N
W E
S

Planning Area Boundary
Urban Growth Area Boundary
City Boundary
Roads
Watercourses/Waterbodies

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URS

ES-1
West Plains Planning Area
Spokane County

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure ES-1.mxd improvements such as new inlet installations or culvert improvements as opposed to a system of improvements such as a regional collection system and a pump station.

Basin-Specific Development Management Measures

- ***Information Management.*** County Stormwater Utility staff should continue to track areas of known drainage and flooding problems. Database and GIS files should be updated regularly to ensure that the latest possible information is used throughout the process of managing new development activities. For example, the County may wish to obtain additional aerial photos of inundated areas during the next high precipitation season.

- ***Basin-Specific Stormwater Ordinance.*** This recommendation involves adoption of a basin-specific ordinance, similar to those adopted for the Glenrose and North Spokane Basins. The most significant aspects of this ordinance would include a requirement to tie into any regional facilities eventually built (e.g., infiltration facility in paleo-channel north of airport), basin specific evaporation pond sizing guidelines (based on continuous hydrologic simulation conducted during this planning effort), and allowance for developers to propose sharing facilities between multiple projects (i.e., sub-regional facilities) prior to completion of any regional public facilities. Figure ES-2 illustrates the proposed High Risk Drainage Area within which the ordinance would apply.

- ***Pre-Application Meetings.*** County staff should show maps of bedrock and seasonally inundated areas to applicants and discuss potential measures to minimize import of water into the area. Locations where roads overlap with seasonal inundation areas should also be flagged and applicants apprised of the need to work with the County Engineering and Roads Division to ensure access routes are adequately elevated. The meeting should also serve as an opportunity to share information regarding requirements of the basin-specific stormwater ordinance.

- ***Design Reviews and Site Inspections.*** County Stormwater Water Utility staff should continue to review proposed private and public projects for identification of possible surface water problems. For instance, whenever County road improvements are proposed, Utility staff should work with the Engineering and Roads Division to identify potential areas of road flooding. Similarly, if private developments are proposed in an area where access roads are known to have potential inundation problems, Storm Water Utility staff should highlight these areas for the Development Services Section of the Engineering and Roads Division. Utility staff should also review drainage components of site submittals for ordinance compliance, and conduct facility inspections for compliance both during construction and after completion.

Gravity Flow to Infiltration Facility in Paleo-Channel North of Airport

The most significant recommendation of this plan is the construction of drainage improvements and a regional infiltration pond to serve a large area of industrial-zoned land in the area around the airport. The proposed location and service area for this facility is shown on Figure ES-2. Implementation of this facility would require a network of collection ditches to deliver water to the infiltration basin, which would be located in the paleo-channel north of the airport. This alternative was determined to be significantly more cost-effective than on-site evaporation ponds due to the loss to development of 35 to 50 percent of each site's developable land to stormwater facilities under the latter option.

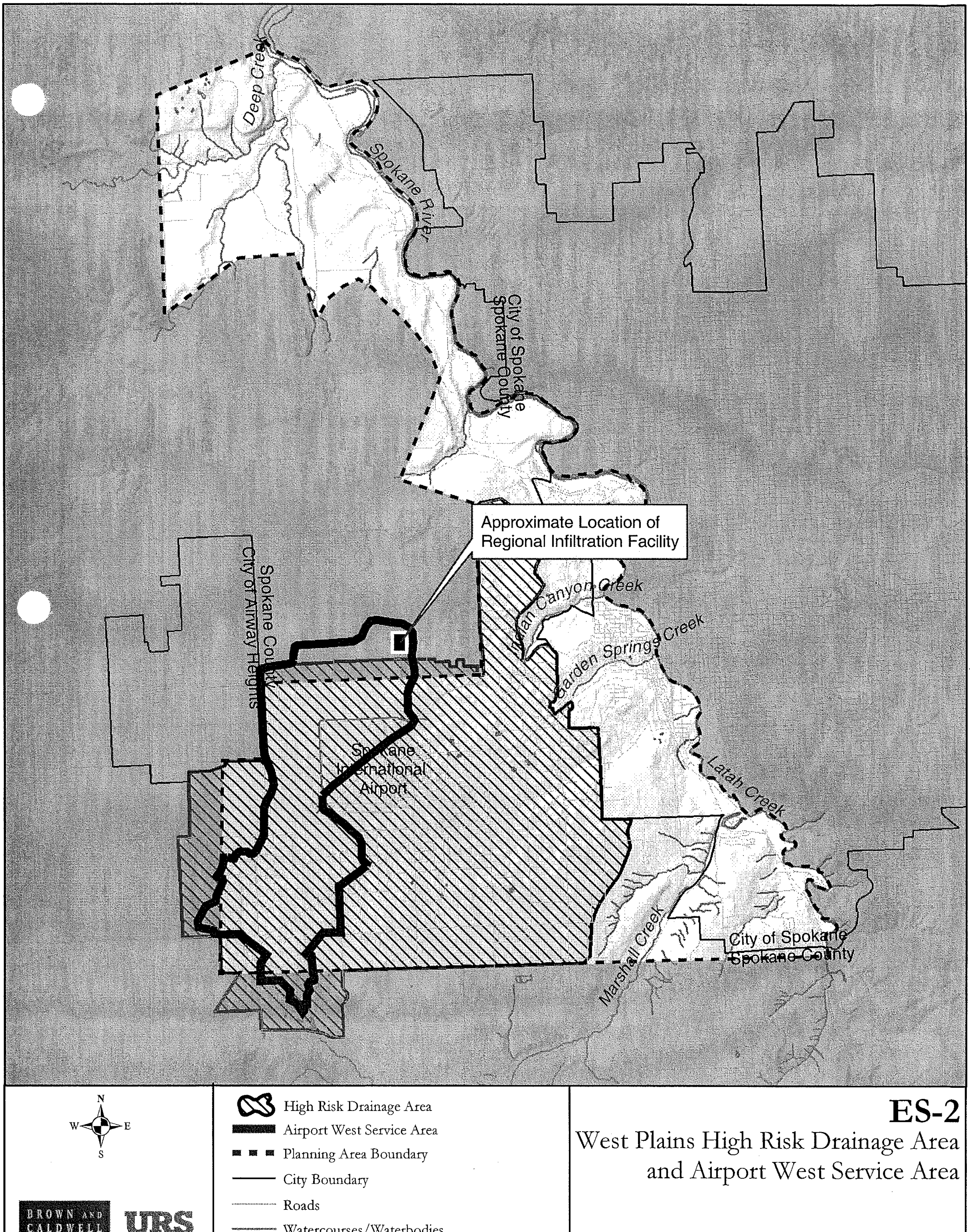
The County has involved affected stakeholders throughout the development of the above recommendations. Key tools and forums used to communicate with and obtain feedback from stakeholders have included:

- Surveys
- Public open house meetings
- Business forums
- West Plains Ad Hoc Committee
- West Plains Economic Development Alliance
- Contacts with neighborhood associations

County staff have also routinely contacted City representatives at key junctures throughout the project to discuss findings, and made a significant effort to involve and inform Spokane International Airport and Ecology staff in the planning process.

The cost associated with the recommended measures is $15.57 million in 2003 dollars. This cost is entirely for the collection system and regional infiltration facility located in the paleo-channel north of the airport. Other recommended measures were assumed to be achievable under existing funding levels. Since the area served by the regional infiltration facilty has been designated by the County for intensive industrial development that would benefit all County residents through an increased tax base and job opportunities, spreading the cost of the recommended structural improvements across the entire Stormwater Utility may be appropriate.

Assuming costs are spread across the entire Stormwater Utility, capital for the regional facility would be raised via two equal revenue bonds, one to be issued in 2004, and another in 2007, each with a twenty year life. This approach results in a maximum annual rate of $30.84 per Equivalent Residential Unit in 2008. The amount diminishes after this point due to an annual ERU growth rate assumption of 3.26 percent.



ES-2

West Plains High Risk Drainage Area and Airport West Service Area

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

In 1992, the Spokane Board of County Commissioners established a Stormwater Utility to provide stormwater quantity and quality management for the developed and developing areas of unincorporated Spokane County. To that end, the Stormwater Utility is developing stormwater management plans for the major planning areas in the County's jurisdiction, including the West Plains area.

The West Plains planning area encompasses roughly 37 square miles between the Spokane River and Latah and Marshall Creeks on the east, and Airway Heights on the west (Figure 1-1). Most of the northern portion of the area is rural or park land. The southern portion contains industrial, commercial, residential, and agricultural land uses. Much of the planning area lies within the County's interim Urban Growth BoundaryArea.

Stormwater drainage facilities in the West Plains include road drainage ditches and culverts and a number of on-site facilities, such as grassed percolation swales. There are no regional stormwater collection/conveyance systems at present. Much of the planning area has shallow soils, seasonally high groundwater conditions, and generally flat topography. Because of the topography and geology, on-site infiltration systems have generally not worked well in much of the West Plains area. Flooding has been a problem at a number of locations, especially in the western portion of the planning area. As this portion of the basin has developed with residential, industrial, and commercial land uses, drainage problems (such as flooded basements and roads) have become increasingly common. Potential degradation of groundwater quality is also a concern.

As noted above, much of the planning area lies within the County's Urban Growth Boundary Area and has been designated for industrial and commercial development in the Spokane County Comprehensive Growth Management Plan (2002). Moreover, the City of Spokane currently provides water supply and sewer service to much of the West Plains area. Thus, the West Plains area is expected to undergo significant commercial and industrial development in the future. The County prepared this Stormwater Management Plan (SMP) for the West Plains area to ensure appropriate, cost-effective stormwater management measures are identified before significant additional development occurs.

This SMP identifies surface and stormwater management facilities and area-specific regulatory controls to mitigate existing problems and minimize future drainage and water quality problems. The County prepared the SMP in three phases. The first phase involved review of existing information to characterize the existing conditions and problems relevant to stormwater management. The second phase involved collection of additional data to address key data gaps identified in Phase 1 and engineering analyses to size potential structural alternatives. The third phase involved working with area residents, businesses, and local and state agencies to develop the measures and implementation strategies presented in this SMP. Figure 1-2 is a timeline of project team activities over the course of SMP development.

1.2 GOALS AND OBJECTIVES OF THE SMP

The goals of the West Plains SMP are to:

- Mitigate existing drainage and water quality problems
- Avoid future such problems with expected new development

To achieve these goals, this SMP has the following specific objectives:

- Identify cost-effective capital improvements to manage stormwater
- Identify non-structural measures (e.g., basin specific development standards) to minimize future property damage
- Recommend appropriate mechanisms to fund recommended measures

1.3 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 summarizes the existing conditions and problems in the planning area
- Section 3 summarizes the process used for identifying and evaluating alternative structural and non-structural measures
- Section 4 presents structural and non-structural recommendations
- Section 5 presents the proposed implementation plan for the recommended measures
- Section 6 lists references for the planning effort
- Appendix A contains a detailed listing of all the preliminary alternatives considered during this planning effort
- Appendix B contains technical documentation for field work performed to define characteristics of the sub-surface paleo-channel north of the airport
- Appendix C presents flows generated by the HSPF model used to simulate current and future conditions hydrology within the study area
- Appendix D contains spreadsheets used for sizing facilities
- Appendix E contains cost estimation spreadsheets
- Appendix F contains a white paper prepared during the planning effort that discusses available funding mechanisms

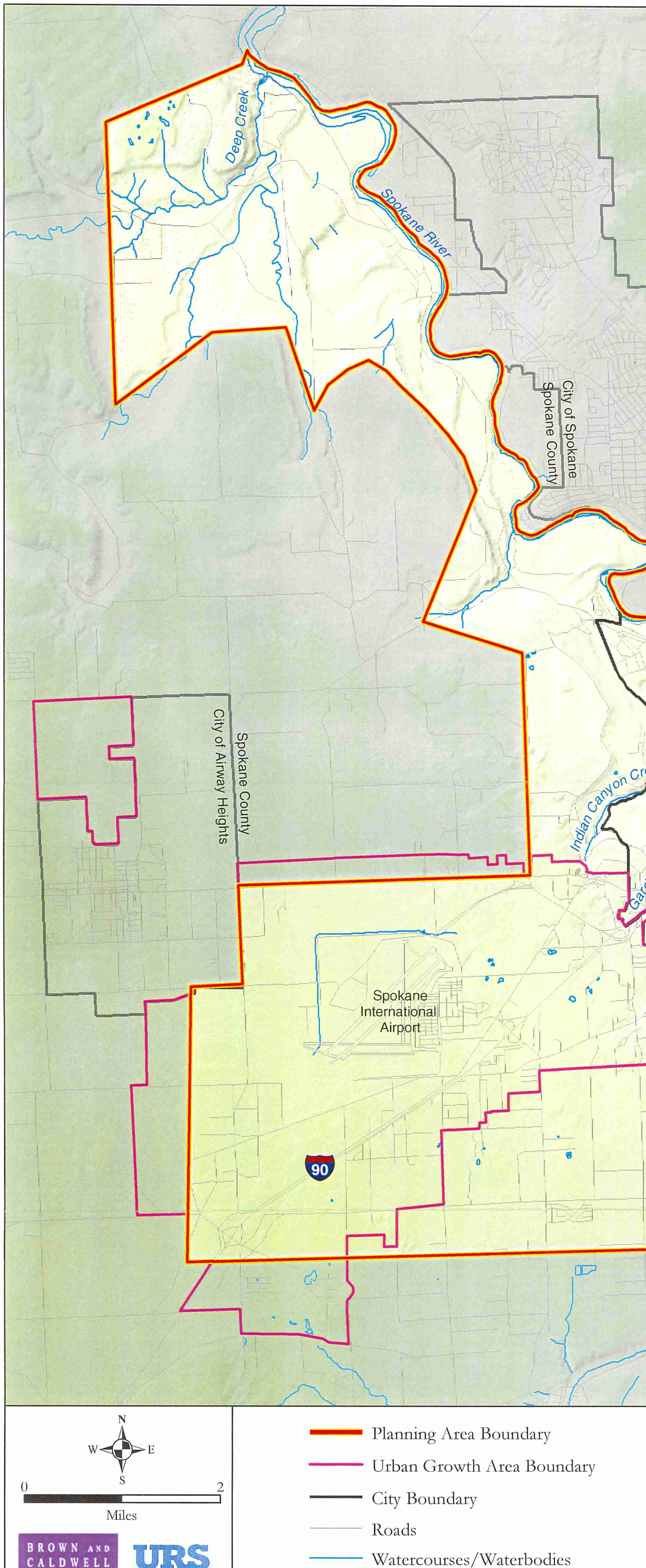

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Figure 1-1
West Plains Planning Area
Spokane County

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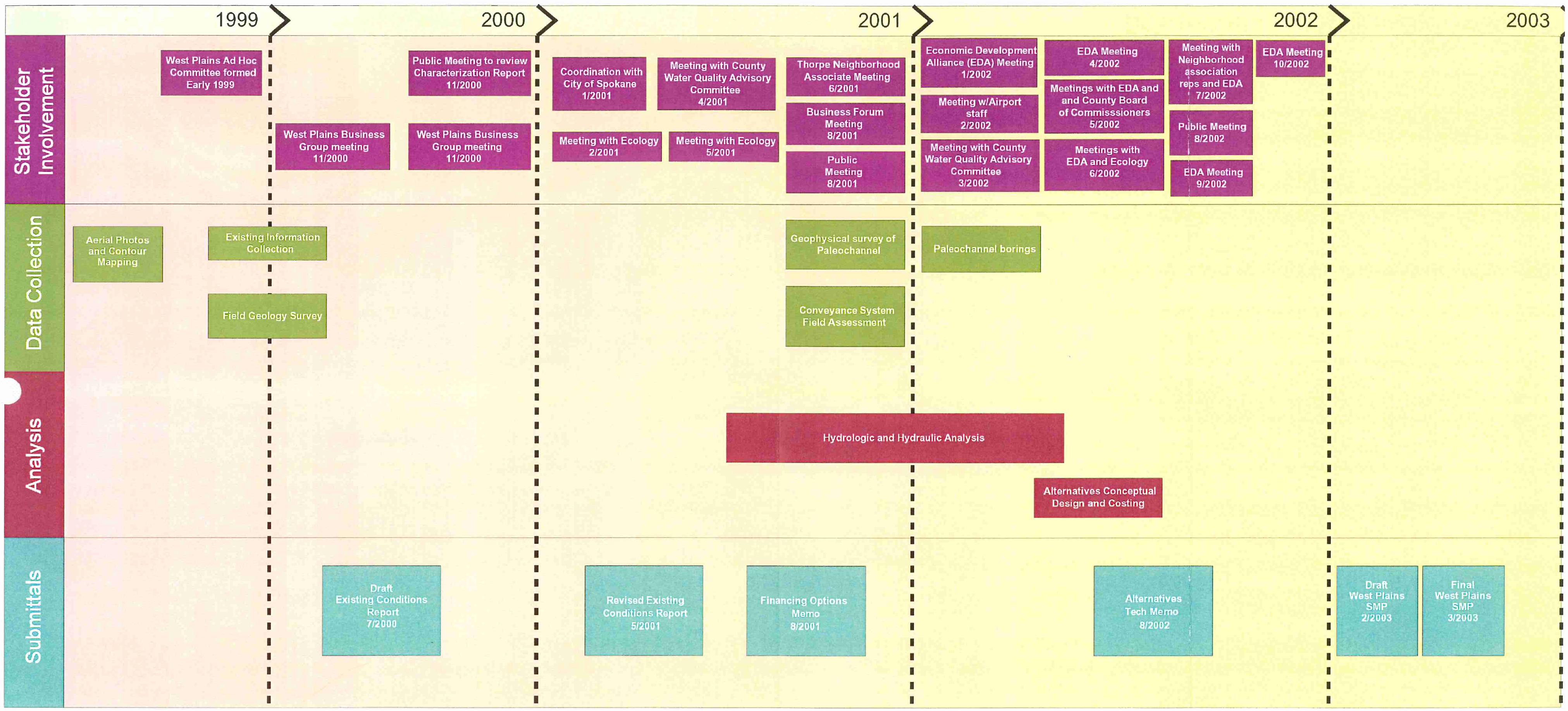

Figure 1-2.
West Plains Stormwater Management Plan Development Timeline

SECTION 2

SUMMARY OF EXISTING CONDITIONS AND PROBLEMS

This section summarizes the Existing Conditions, Problems, and Opportunities for the West Plains Stormwater Management Planning Area report (Existing Conditions Report) (July 2000, URS).

2.1 EXISTING CONDITIONS

2.1.1 Geology

The geology and land forms in the West Plains planning area are the result of two major geologic events: (1) the series of volcanic episodes lasting about 11 million years that deposited a sequence of basalt units, collectively known as the Columbia River Basalt Group and, (2) the advance and retreat of continental glaciers in the Pleistocene Era that followed.

The West Plains area of Spokane County is located on the northeast edge of the Columbia Plateau, a broad geologic feature comprised mainly of Columbia River Basalt. The basalt formations experienced erosion and sedimentation during the advance and retreat of continental glaciers, and then by large-scale floods that resulted from the catastrophic failure of glacially-dammed lakes, creating the existing "channeled scabland" surface pattern of coulees, potholes, channels and remnant basalt "islands" (Washington Department of Natural Resources, 1990). In some areas of the Columbia Plateau, large, deep channels were incised into the basalt, and were later filled with sedimentary material, forming buried "paleo-channels" not visible on the surface today. These buried channels, together with the layered stratigraphy described above, can have a significant impact on local and regional groundwater movement.

Using existing well logs the County was able to estimate the thickness of the sedimentary material, termed "overburden," above the basalt throughout the West Plains study area. Overburden thickness is less than 10 feet throughout much of the western portion of the planning area, although, in spots the thickness may be 40 or more feet. In general, overburden varies in thickness over the study area from less than 1 foot to greater than 180 feet. Maps created of overburden depth illustrate the presence of four paleo-channels in the study area. Figure 2-1 illustrates overburden depth in the central portion of the planning area and the approximate locations of the paleo-channels.

2.1.2 Drainage Basins, Streams, and Wetlands

The topography within the planning area generally slopes from the southwest to the northeast. Steep hillsides are present along the incised channels of Marshall Creek and Deep Creek, and also along the floodplains of Latah Creek and the Spokane River. The central and southern portions within the planning area near the airport, Interstate 90 (I-90), and Geiger Heights generally exhibit flat surface topography, with the major topographic features consisting of scattered rock outcrops, roads, and ditches. In other areas, the surface topography is irregular where basalt outcrops are present, particularly along the eastern edge of the planning area.

The major streams in the planning area are the Spokane River and its tributaries, including Marshall Creek, Latah Creek, and Deep Creek. In the southwestern portion of the planning area, the formation of perennial streams is limited by the gentle topography and shallow bedrock, thus natural surface drainage is limited. In these areas, precipitation and snowmelt infiltrates, evaporates, is used by plants, or collects in ponds or wetlands.

For the SMP planning process, four surface water sub-basins were delineated in the planning area based on surface topography. These are the Deep Creek, Airway Heights, I-90, and Marshall Creek sub-basins (see Figure 2-2). Surface drainage in all sub-basins is generally to the northeast. However, the western portions of the I-90 and Airway Heights sub-basins do not have well-defined surface drainage channels, and probably do not contribute much surface runoff to the stream channels in the lower (eastern) portions of these sub-basins. Runoff from Spokane International airport appears to generally collect in the northeast corner of the facility and evaporate or infiltrate (this area appears to be tributary to Indian Canyon Creek). Flows from the west and northern perimeters of the airport are collected in a large ditch that routes flows to the northeast corner, while internal flows are collected and directed to the same location. The eastern portion of the I-90 sub-basin has several small streams including Indian Canyon Creek, Garden Springs Creek, and an unnamed creek near Thorpe Road.

Wetlands are present throughout the West Plains area as shown in Figure 2-2. Wetland locations are based on the results of a remote sensing wetland inventory conducted by the Geography Department at Eastern Washington University (EWU) and field reconnaissance conducted by URS Greiner-Woodward Clyde (URSGWC) in 1999. As further site-specific wetland inventories are completed, additional wetlands may be identified.

2.1.3 Groundwater

The two major aquifers in the West Plains area are the Wanapum and Grande Ronde aquifers. These aquifers are bounded geographically by the Spokane River, Deep Creek, and Latah Creek, and are used by some West Plains residents for domestic water supply. These aquifers occur at different depths below the ground surface, and are separated by the Wanapum basalt formation. Groundwater in the Wanapum aquifer lies at a higher elevation than groundwater in the underlying Grande Ronde aquifer. Static water levels in the Wanapum generally vary between two and 89 feet below the ground surface.

The Wanapum aquifer recharges via infiltration of precipitation, while the Grande Ronde aquifer recharges via downward leakage from the Wanapum, and possibly by lateral inflow through paleo-channels to the east of the planning area. The Wanapum also discharges laterally to springs along the Deep Creek, Marshall Creek and Spokane River valleys.

A shallow, perched aquifer also occurs in the West Plains area. The perched aquifer provides little or no domestic water for use in the West Plains area due to its discontinuous nature and potential for contamination from surface sources. High water levels in the perched aquifer may cause surface flooding in some areas with shallow bedrock.

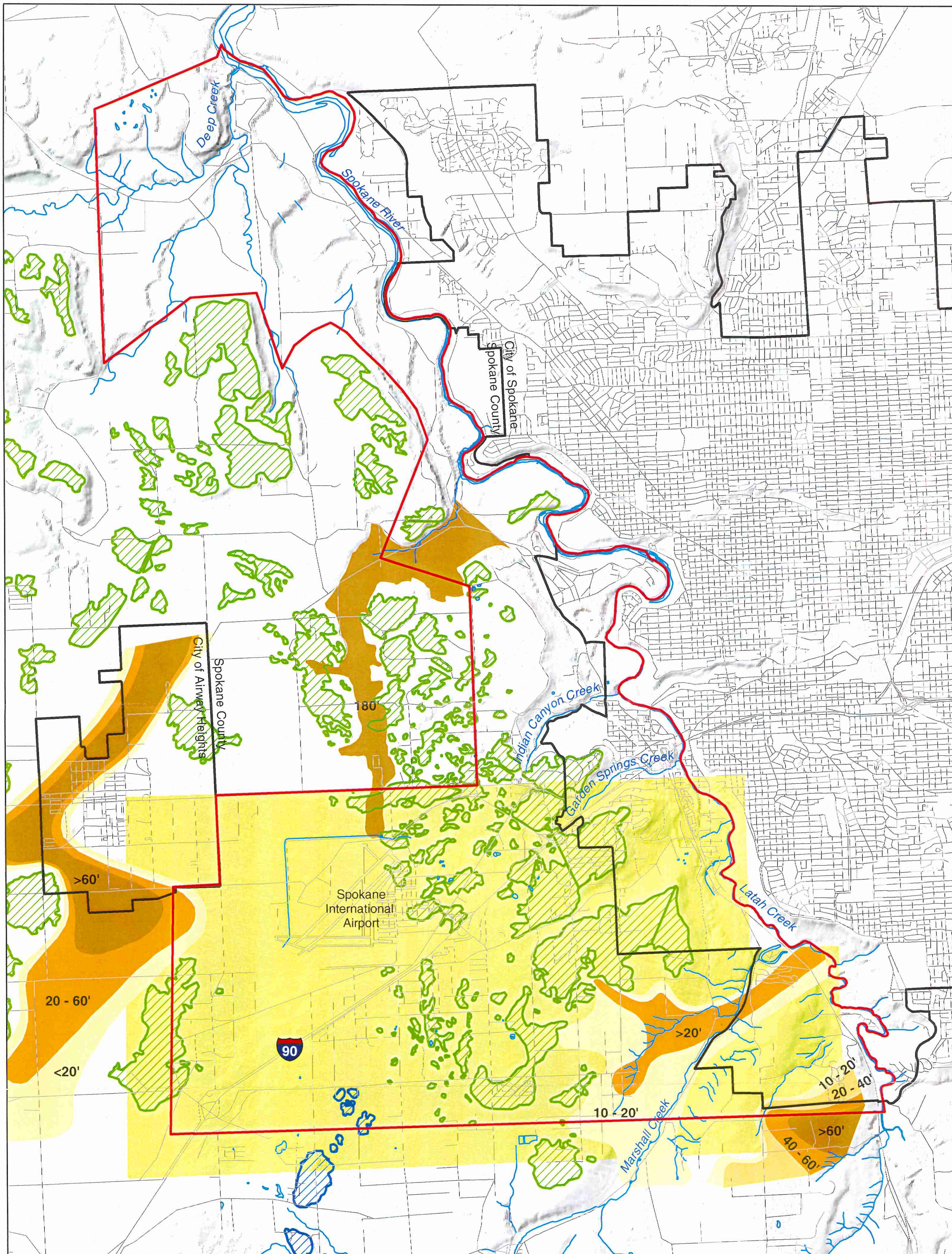

Figure 2-1

Planning Area Overburden Depth and Paleo-Channel Location

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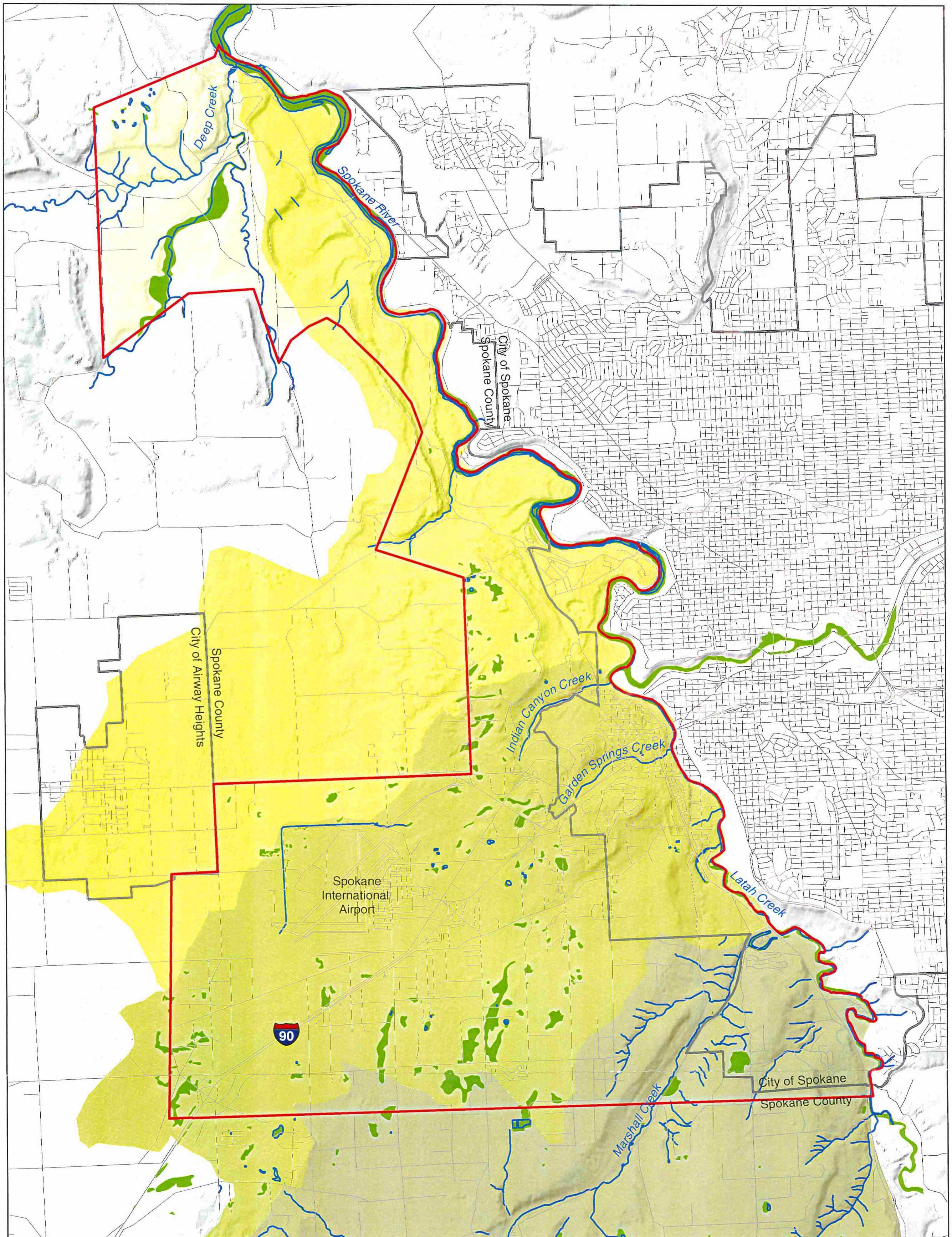

Deep Creek Basin

Airway Heights Basin

I-90 Basin

Marshall Creek Basin

Wetlands

Planning Area Boundary

City Boundary

Roads

Watercourses/ Waterbodies

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Figure 2-2

Planning Area Streams, Drainage Basins and Wetlands

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2.1.4 Water Quality

The Spokane River is the ultimate receiving water body for stormwater runoff discharged from the West Plains area. Surface runoff from the eastern portion of the planning area reaches the River via several tributaries including Marshall Creek, Latah Creek, Deep Creek, Indian Canyon Creek, and Garden Springs Creek. Since the western portion of the planning area does not have a well-defined surface drainage network, it probably contributes little, if any, surface runoff to the Spokane River. Some of the stormwater that infiltrates down to the Wanapum aquifer could reach the River indirectly via groundwater inflow.

While both the Spokane River and Latah Creek are classified as "water quality limited" by the State Department of Ecology, studies to date indicate that these problems are largely unrelated to West Plains land uses, and due instead to past and present mining activities in Idaho and agricultural practices in Latah Creek watershed areas upstream of the City. The limited data available for runoff quality in the West Plains planning area further suggest it is unlikely that stormwater runoff from the West Plains is having a major impact on water quality in the Spokane River or Latah Creek. Moreover, only the eastern portion of the planning area contributes direct stormwater discharges to the Creek and the River. The dominant existing land uses in this area are public park, agricultural, single family residential, and vacant. There is little commercial or industrial land use.

While there is little existing data regarding groundwater quality, available groundwater quality data do not indicate significant groundwater quality problems in most of the West Plains area.

2.1.5 Existing Stormwater Drainage System

Spokane County has no stormwater collection and conveyance systems for the West Plains area, other than roadside drainage ditches. Many of these ditches simply retain or slowly infiltrate the runoff. In some areas of new industrial development, inlets have been installed along roadways to collect stormwater, which is then conveyed to private, on-site facilities such as dry wells and infiltration/evaporation basins. There are approximately 20 dry wells within the County right-of-ways in the West Plains area.

Figure 2-3 shows the location of known County stormwater management facilities in the West Plains area (Spokane County, 1999). Additional private stormwater facilities observed during the area reconnaissance are also shown.

2.1.6 Zoning and Land Use

The West Plains area is currently zoned for residential (rural, semi-rural, suburban, and urban), agricultural (exclusive and general), commercial (neighborhood, community, and regional), industrial (light, heavy, and industrial park), mining and forestry uses. Current (as of 1999) land use and zoning in the West Plains area are shown on Figures 2-4 and 2-5, respectively. Tables 2-1 and 2-2 below summarize current and zoned land uses, respectively. Neither of the land use and zoning tables reflect road and river areas, and the zoning table does not include zoning within the City of Spokane.

A large portion of the West Plains Planning Area is located within the Interim Urban Growth Area (IUGA) for Spokane County. As mentioned earlier, significant growth is anticipated in this area. Most of this area is currently zoned for industrial use, with a small percentage currently zoned for urban and rural residential use. As shown in the tables, about 260 acres are currently used for industrial activities, while more than 6,000 acres are zoned for industrial land use.

Table 2-1. Existing Land Uses in the West Plains Planning Area

Category	Area (Acres)	% of West Plains Area
Public	7,569	26.8
Vacant	6,174	21.8
Residential	4,611	16.3
Agriculture	2,119	7.5
Other	1,389	4.9
Open Space	258	0.9
Industrial	259	0.9
Forestry	157	0.6
Pending Building Permits	137	0.5

Source: Spokane County GIS (1999)

Table 2-2. Zoned Land Uses in the West Plains Planning Area

Zoning Classification	Area (Acres)	% of West Plains Area
Agriculture	10,651	37.7
Industrial	6,413	22.7
Residential	2,326	8.2
Urban	1,833	6.5
Business	323	1.1
Forestry	62	0.2

Source: Spokane County GIS (1999)

2.2 DRAINAGE AND WATER QUALITY PROBLEMS

This section describes recent drainage and flooding problems in the West Plains Planning Area and likely causes.

2.2.1 Current Drainage Problems

During Phase 1, drainage problem areas were identified based on review of the following sources:

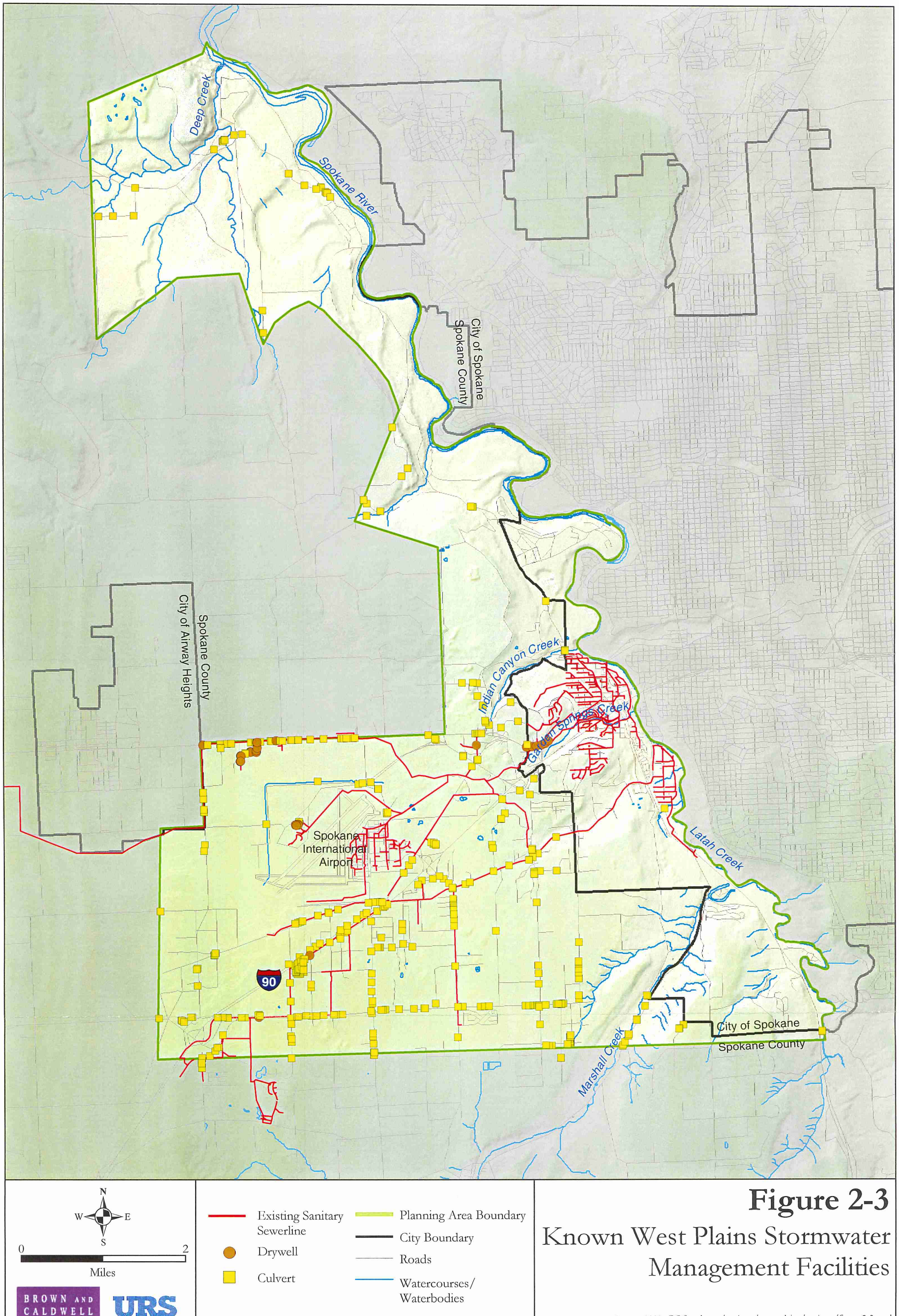

Figure 2-3
Known West Plains Stormwater Management Facilities

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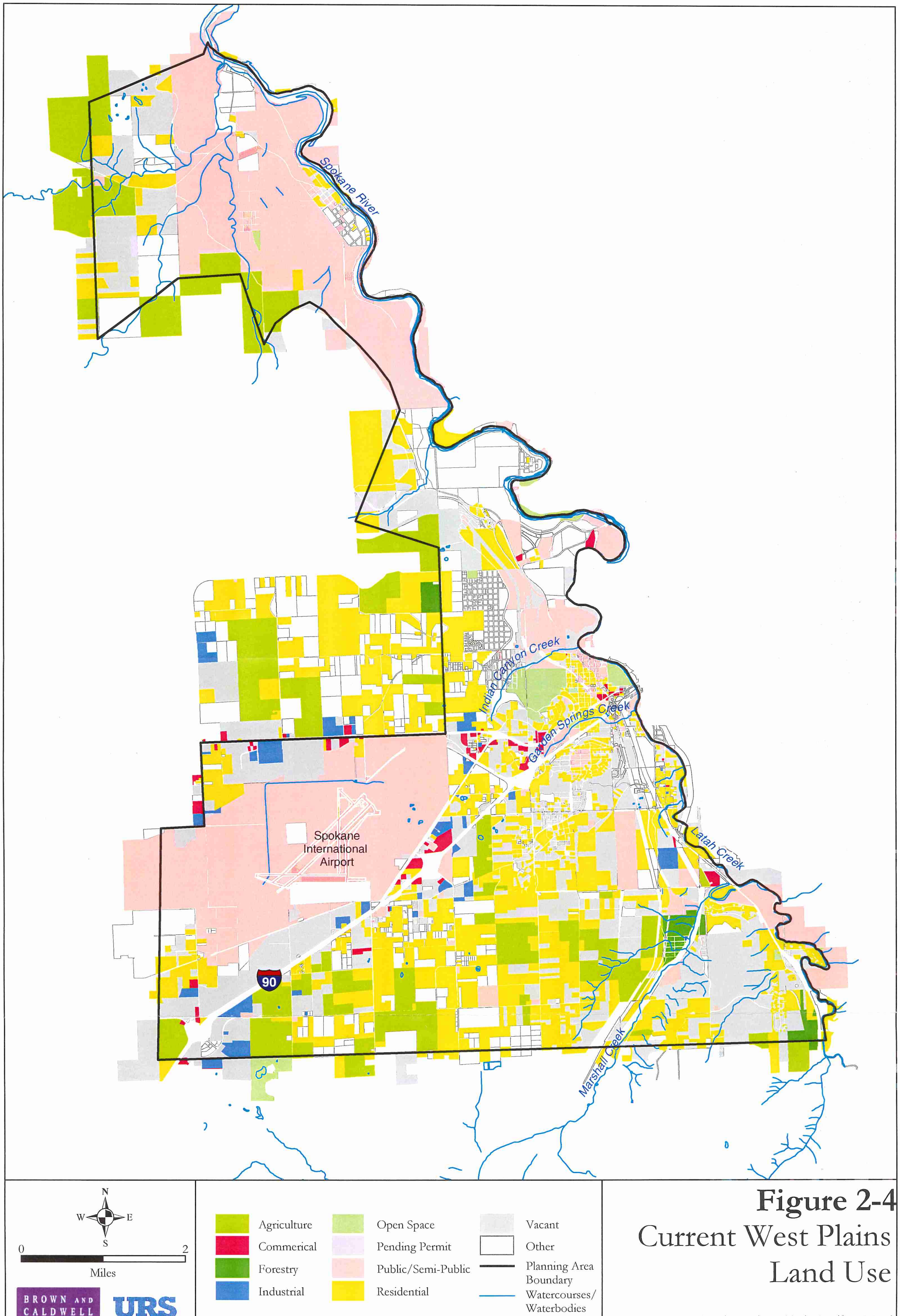

Figure 2-4
Current West Plains Land Use

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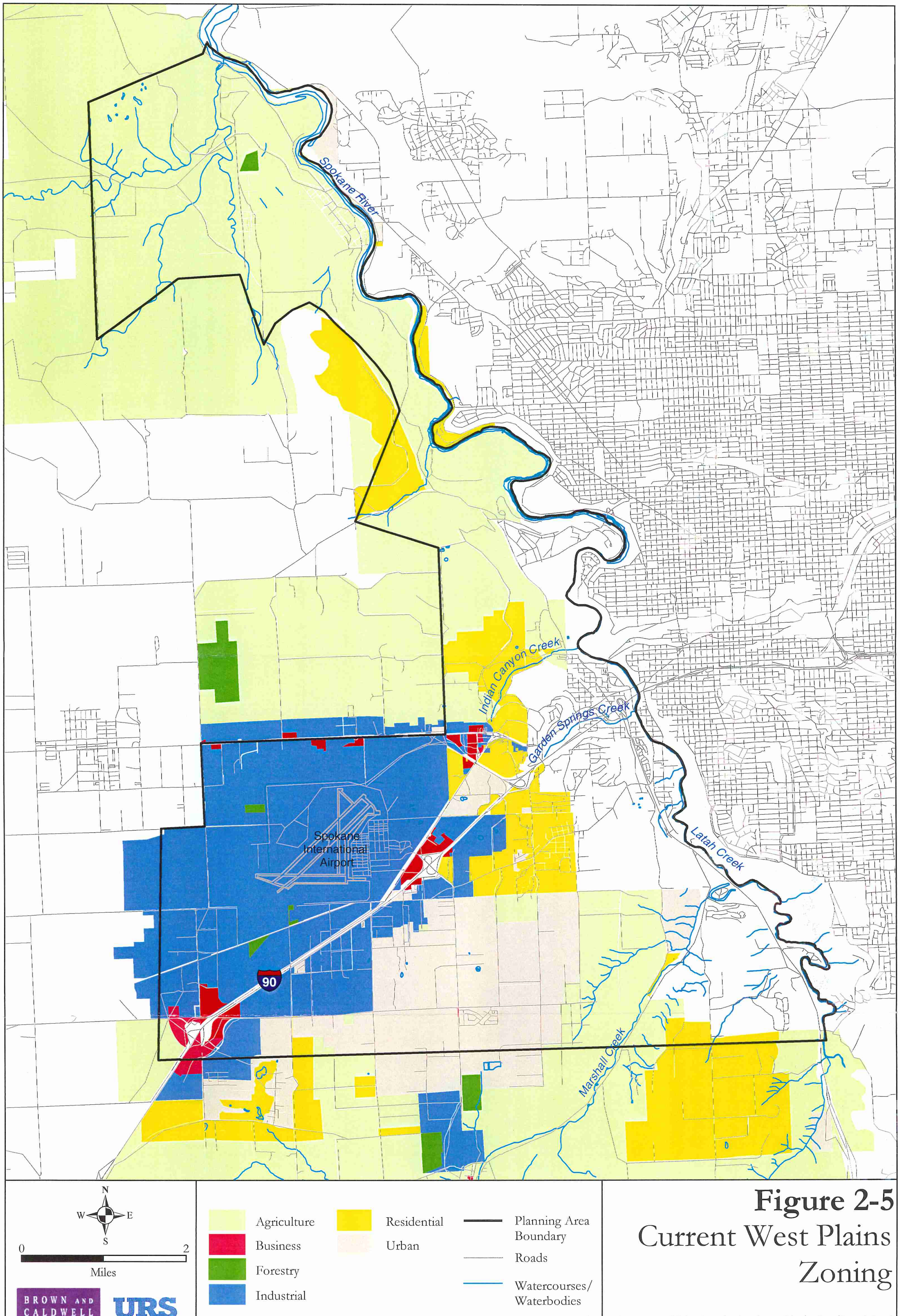

Figure 2-5
Current West Plains Zoning

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- County flood complaint files
- Responses from area residents and businesses to a recent stormwater management survey
- Aerial photos taken in April of 1999
- Interviews with County staff

The following paragraphs summarize problem areas within each sub-basin based on review of the above data sources. Drainage complaint and surface ponding locations are also illustrated on Figure 2-6.

Deep Creek Sub-Basin

Only a few drainage problems have been reported for this sub-basin, all of which are associated with blocked culverts or ditches. No surface ponding was evident on the April 1999 aerial photographs, which were taken after an exceptionally wet winter.

Airway Heights Sub-Basin

Only the eastern and southern portions of this sub-basin lie within the West Plains planning area. Reported drainage problems were nuisance-type flooding problems associated with culverts and ditches. Two flooding problems associated with high groundwater table conditions were reported in the southern portion of the sub-basin near the Spokane International Airport. Several areas of surface ponding were also delineated from aerial photographs; however, they do not appear to coincide with the complaints described above.

I-90 Sub-Basin

Most of the flooding problems in the West Plains planning area are in the I-90 sub-basin. Drainage problems in the western portion of the sub-basin differ from those in the eastern portion. The locations and causes for the flooding problems in each area are described below.

Eastern Portion of the I-90 Sub-Basin

Most of the drainage problems in the eastern portion of the sub-basin (generally, east of Spokane International Airport) can be characterized as short-term "nuisance" flooding of streets. Basement flooding associated with seasonally high groundwater is also a problem in some locations. Undersized or obstructed culverts and ditches appear to contribute to some of these problems. Seasonally high groundwater conditions probably contribute to the street flooding problems in some areas. As the perched water table rises, groundwater can begin flowing into roadside ditches, thereby reducing the available capacity for storm runoff or snowmelt.

Western Portion of the I-90 Sub-Basin

Drainage problems in the western portion of the I-90 sub-basin are generally more extensive and persistent than these in the eastern portion. In addition to extensive surface flooding, basement flooding has been a significant problem in this area.

The drainage problems in this area appear to be associated primarily with the local geology and topography. The surface topography is relatively flat; thus, rainfall and snowmelt tend to pond and infiltrate rather than run off, and there are no significant natural surface drainage channels in this part of the basin. The average depth to bedrock in much of the area is less than 10 feet. However, this depth fluctuates considerably, from several tens of feet below the ground surface to above the ground surface (rock outcrops). The undulating bedrock impedes the lateral movement of perched groundwater, causing the perched water table continues to rise during wet periods.

Marshall Creek Sub-Basin

Most of the Marshall Creek sub-basin lies outside of the West Plains planning area. Drainage problems have been reported for eight locations within the planning area portion of this sub-basin. Most of these have been related to ponding behind obstructed or undersized culverts. Two surface flooding problems have been reported for the Qualchan Hills subdivision in the City of Spokane.

2.2.2 Potential for Future Drainage Problems

Based on the current zoning, most of the new development in the planning area is expected to occur in the I-90 sub-basin. In the eastern portion of the sub-basin, the new development will be mostly residential. In the western portion, the zoning allows for substantial increases in industrial and commercial land uses, particularly around the Spokane Airport and the I-90 corridor.

New impervious surfaces in the eastern portion of the West Plains planning area could exacerbate the current drainage problems associated with undersized or obstructed ditches and culverts described above. The County's Guidelines for Stormwater Management are intended to reduce impacts such as these. The existing drainage system could be improved to mitigate existing problems and reduce the potential for future problems, as discussed in Section 3.

New development in the western I-90 basin could also lead to increased drainage problems. However, these problems would arise primarily because of the topography and geology of the area, rather than the creation of new impervious surfaces. New development in this area could cause problems mostly by placing structures in areas that are already prone to surface ponding and high water table conditions, rather than by increasing peak surface runoff flows or volumes. [Mike's question: does HSPF modeling confirm this?]

2.2.3 Potential for Future Water Quality Problems

Very little information is available regarding water quality in the West Plains planning area. As noted in Section 2.1.6, the existing surface water quality data for the major receiving water bodies (Spokane River and Latah Creek) do not point to specific problems associated with West Plains runoff. Groundwater quality data in the West Plains planning area is more readily available, but do not indicate any significant problems to date. Moreover, new development in the planning area would generally be serviced by City sewer and water supply.

Under current zoning, there is potential for increases in industrial and commercial land uses which could adversely affect stormwater quality. Moreover, if traditional stormwater collection and

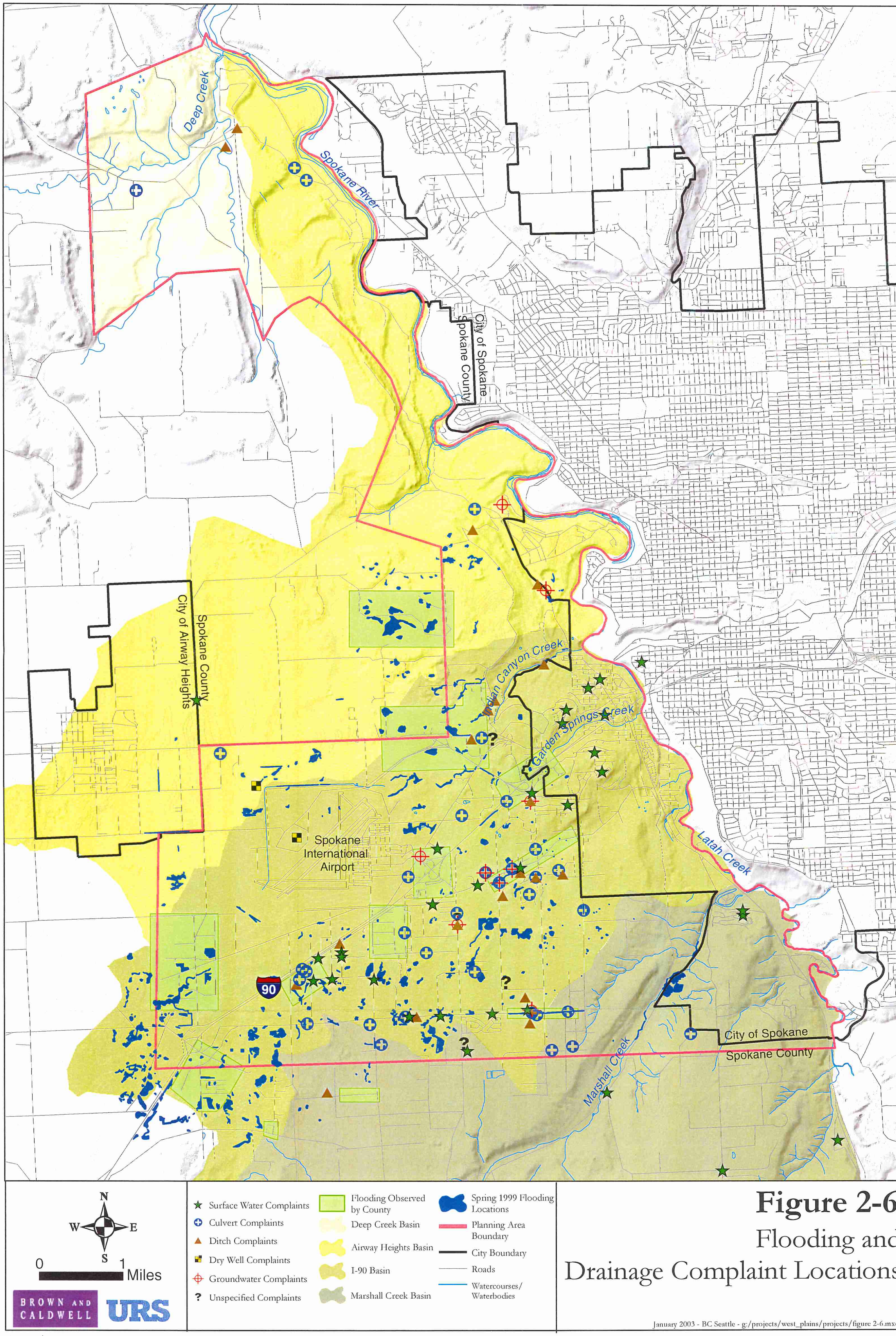

Figure 2-6
Flooding and Drainage Complaint Locations

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure 2-6.mxd

conveyance systems are installed (e.g., in the eastern portion of the I-90 sub-basin), runoff that is now retained (and ultimately infiltrated or evaporated) would be conveyed to a receiving water body. This would result in point source discharges to waters of the United States, which would then be subject to federal Municipal NPDES Phase 2 Stormwater regulations.

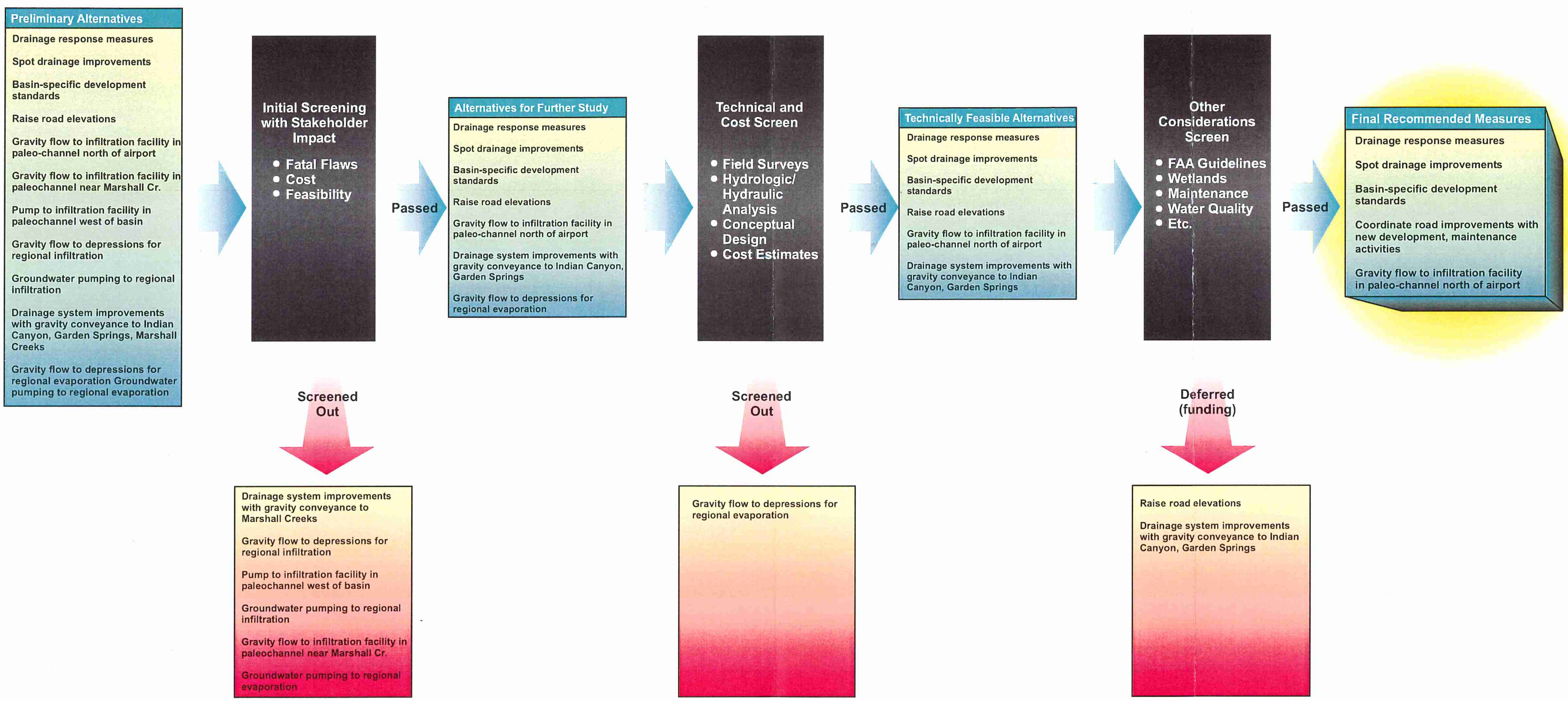

Figure 3-1.
Alternative Development, Screening and Evaluation Process

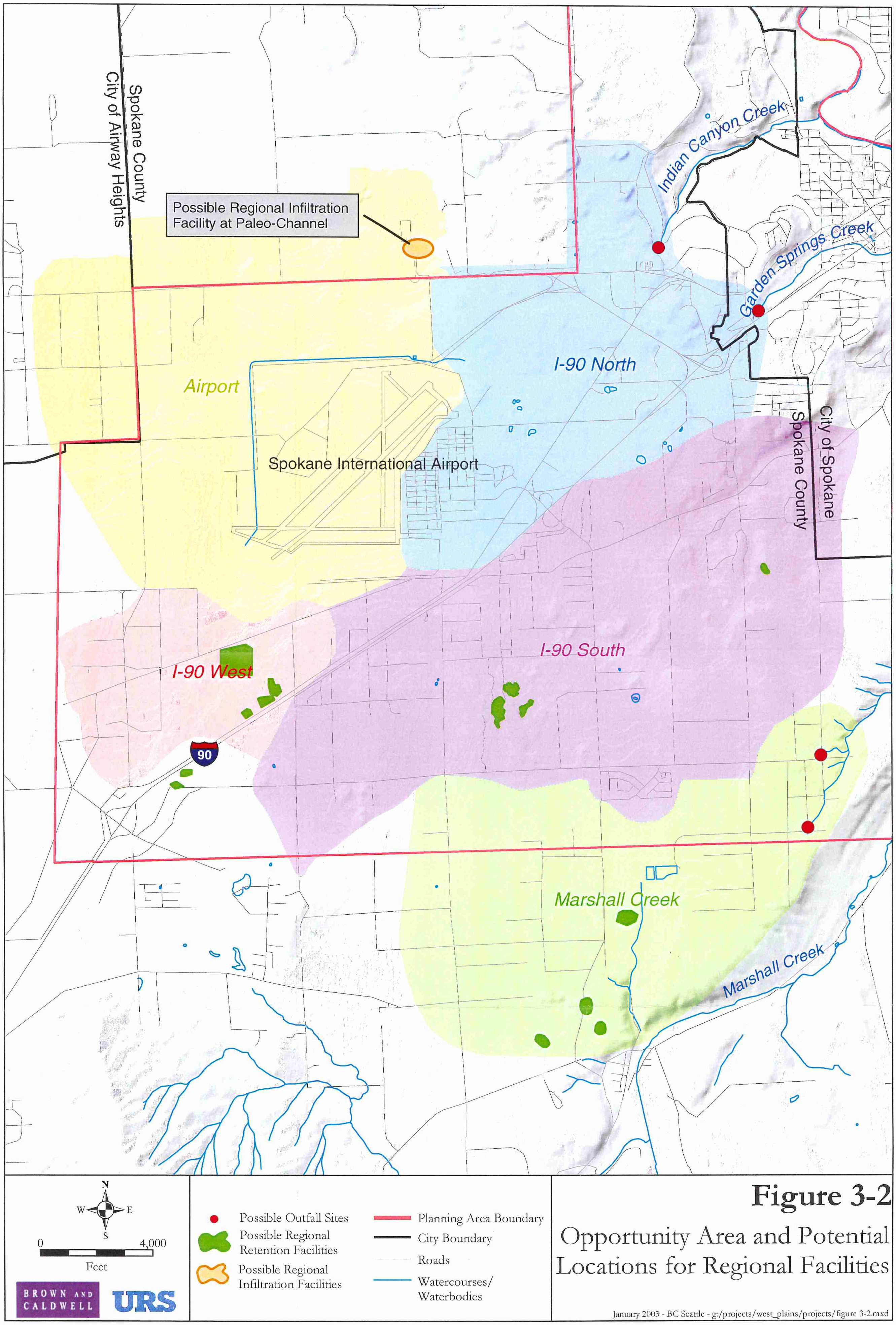

Figure 3-2

Opportunity Area and Potential Locations for Regional Facilities

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure 3-2.mxd

Table 3-1. Preliminary Stormwater Management Alternatives

Preliminary Alternatives	Deep Creek/NE Airway Heights	I-90 North	I-90 South	Marshall Creek	Airport	I-90 West
• Drainage response measures	•	•	•	•	•	•
• Spot drainage improvements	•	•	•	•	•	•
• Basin-specific development standards (e.g., on-site retention, regulate basement construction)	•	•	•		•	•
• Raise road elevations in flood-prone areas		•			•	•
• Gravity flow to existing depressions for regional infiltration			•	•	•	•
• Gravity flow to existing depressions for regional evaporation			•			•
• Groundwater pumping to regional infiltration or evaporation facilities			•			•
• Drainage system improvements with gravity conveyance to Spokane River tributaries (Indian Canyon, Garden Springs, Marshall Creeks)		•	•	•		
• Gravity flow to infiltration facility in paleochannel north of airport					•	
• Pump to infiltration facility in paleochannel west of basin						•
• Gravity flow to infiltration facility in paleochannel near Marshall Cr.				•		

3.2.2 Alternative Screening Process

In August of 2001, the preliminary alternatives for each of the planning areas were presented at a West Plains Business Forum and at an open house for the general public. Based on input obtained at these meetings, the County screened the preliminary alternatives and selected several for further evaluation and possible inclusion in the West Plains Stormwater Management Plan. Conversely, some of the preliminary alternatives were excluded from further evaluation, and the northern portion of the planning area (Deep Creek Sub-basin and north-east portion of the Airway Heights sub-basin) were removed entirely from the planning area due to a lack of significant existing problems and limited likely future issues (very low development pressure).

This early screening was qualitative, and driven by two primary factors: expected capital and operations and maintenance costs and technical feasibility. Table 3-2 below presents the measures which passed the screening process. Required follow-up evaluations are described as well. Measures that passed the initial screening are shaded and italicized.

Table 3-2. Screened Stormwater Management Alternatives

Preliminary Alternatives	Follow-up Evaluations
• *Drainage response measures*	▪ *None needed. County to identify drainage complaint response procedures for West Plains Area.*
• *Spot drainage improvements*	▪ *None needed. County to address problems as identified.*
• *Basin-specific development standards (e.g., on-site retention, regulate basement construction)*	▪ *Refine concepts, estimate costs for hypothetical 100-acre site*
• *Raise road elevations in flood-prone areas*	▪ *Estimate costs based on 1999 flooding*
• Gravity flow to existing depressions for regional infiltration	▪ None - eliminated from further consideration due to basin geology
• *Gravity flow to existing depressions for regional evaporation*	▪ *Field inspect candidate sites*
• Groundwater pumping to regional infiltration or evaporation facilities	▪ None - eliminated from further consideration due to numerous factors including technical feasibility and expected high cost
• *Drainage system improvements with gravity conveyance to Spokane River tributaries (Indian Canyon and Garden Springs Creeks)*	▪ *Estimate future flows* ▪ *Identify conveyance bottlenecks* ▪ *Estimate costs for system improvements* ▪ ***Note: Marshall Creek eliminated from further consideration for this alternative due to limited extent of problems, low expected development pressures, and high expected cost***
• *Gravity flow to infiltration facility in paleo-channel north of airport*	▪ *Estimate future flows* ▪ *Perform seismic survey & well drilling to estimate infiltration capacity of paleo-channel* ▪ *Estimate costs for regional conveyance improvements & infiltration facility*
• Pump to infiltration facility in paleochannel west of basin	▪ None - eliminated from further consideration due to expected high cost and availability of paleo-channel north of airport
• Gravity flow to infiltration facility in paleochannel near Marshall Cr.	▪ None - eliminated from further consideration due to limited extent of problems, low expected development pressures, and high cost

The preliminary alternatives table in Appendix A presents the above alternatives sorted according to opportunity area, along with brief discussions of the pros/cons of each, and further evaluations conducted to provide a basis for final recommendation selection.

3.2.3 Evaluation of Screened Structural Alternatives

As described above, evaluation of the screened structural alternatives required additional data collection and analyses. Following the August, 2001 meetings, the planning team performed the following tasks:

- Field inspections of potential regional retention facility sites
- Geophysical investigations of paleo-channel north of airport
- Borings in paleo-channel north of airport
- Conveyance system inspections
- Engineering analysis to support evaluation of regional infiltration facility, on-site retention (i.e., for new developments), and conveyance improvements
- Identification of possible road elevation areas of concern
- Cost estimation

Field Inspections of Potential Regional Retention Sites

Field inspections were conducted of the sites identified as potential regional retention opportunity areas during preparation of the Characterization Report. These inspections determined that none of the sites were suitable due to:

- Limited storage capacity (e.g., bedrock on site would require blasting to excavate) would require large surface areas
- Limited areas that could be served by gravity drains
- Shallow groundwater inflow may limit storage capacity of sites visited
- Significant permitting/mitigation issues for sites with wetlands

Sites visited during the field inspections are shown on Figure 3-2.

Geophysical Investigations and Well Drilling in Paleo-Channel North of Airport

In 2001, the project team conducted a geophysical investigation of the paleo-channel north of Spokane International Airport area using seismic refraction techniques. The intent of this effort was to further evaluate the feasibility of siting a regional infiltration facility in this area by better defining the depth, extent, and permeability of the paleo-channel.

The seismic refraction method involves inducing compressional energy into the ground at one location, and measuring the amount of time that elapses before the energy wave is received at another location. From this "travel time" the velocity of the induced wave can be calculated. The velocity of the wave will vary depending on the density, compressibility, pore space and fluid content of the material (alluvium or basalt) through which the wave travels. Based on the difference in wave velocities, the configuration of the alluvium and basalt can be inferred, as well as the water table. The seismic field surveys are generally performed in a series of parallel and perpendicular survey lines (profiles). The length of each line depends on the depth of the basalt and the conditions encountered. Typically, several borings are subsequently advanced to "ground-truth" the interpretation of the seismic data. These boring can also be used to conduct hydrologic testing of the sedimentary material to evaluate the infiltration capacity.

Figure 3-3 illustrates the extent of the paleo-channel north of the airport as refined based on the results of the seismic refraction study. Appendix B contains a copy of the report summarizing the results of the geophysical investigation. Figure 3-4 is a cross section illustrating overburden depth along one of the survey profiles.

As mentioned above, borings are usually necessary to better understand the hydrogeologic properties of the surveyed material. Therefore, two new borings were drilled in the paleo-channel north of the airport in March 2002. The locations of the borings are also shown on Figure 3-3, and copies of the well logs are included in Appendix B. The data from this effort indicates that infiltration rates can vary substantially (e.g., from less than 1"/hour to over 200"/hour) with location and depth within the paleochannel.

Additionally, GeoEngineers recently conducted a study of the paleochannel area south of Highway 2 (GeoEngineers April 2002). This study found substantially higher infiltration rates in this portion of the paleochannel (e.g., up to 450 inches per hour (iph) for a test drywell). Their analysis of the hydraulic conductivity of the glaciofluvial sediments that comprise the unconfined aquifer in the paleochannel yielded rates of 30 inches per hour for the unsaturated material and 280 inches per hour for the saturated material. Based on these permeability test results, the report recommends a design infiltration rate of 100 inches per hour, which includes a factor of safety of 2.4.

The spatial variability in infiltration rates described above suggests that further study will be necessary to confirm that infiltration is feasible, select an appropriate site, and size a facility.

Conveyance System Inspections

In order to evaluate the adequacy of the existing conveyance systems, additional inspections were necessary to identify flow paths, culvert dimensions, and other information. Field reconnaissance was conducted east of the airport and north of I-90 to locate and survey existing drainage pathways and culverts in the upper reaches of Indian Canyon and Garden Springs Creek. Field reconnaissance was also conducted of drainage conditions at the airport. Due to limited access of highway right of ways, WSDOT records were obtained to locate culverts associated with I-90 and SR-2.

3.2.4 Engineering Analyses

The project team performed hydrologic modeling to estimate runoff volumes and rates, and then used this information to evaluate existing and proposed culverts and channels and the proposed regional infiltration facility.

Due to funding limitations (the project scope funded detailed assessment of structural systems for up to three areas), the modeling effort was limited to the Indian Canyon and Garden Springs Creek watersheds in the southeast portion of the study area, and the west portion of the study area from which drainage could gravity flow to a regional infiltration facility in the paleo-channel north of the airport. This area, essentially a combination of the Airport and I-90 West Opportunity Areas (see

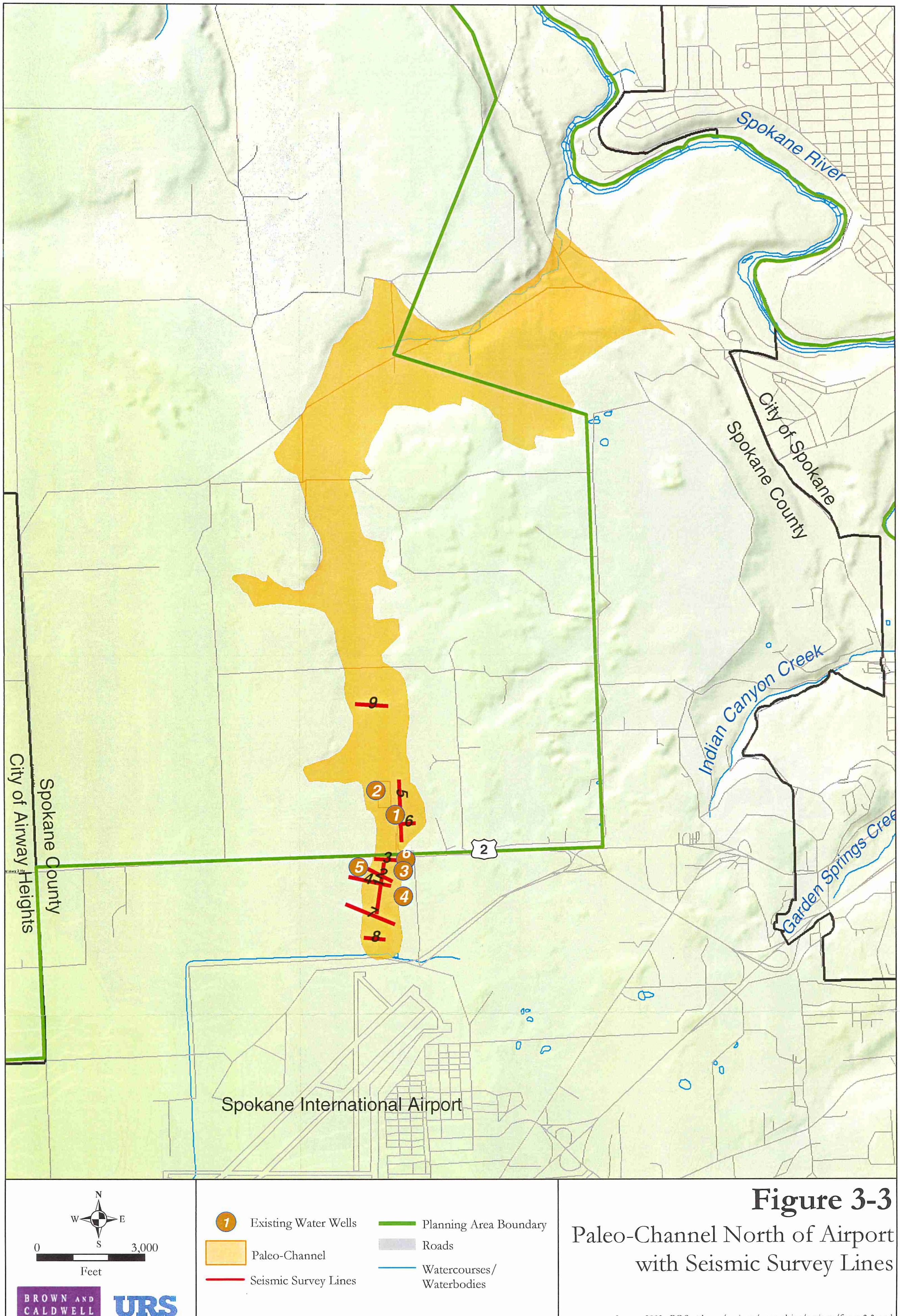

Figure 3-3

Paleo-Channel North of Airport with Seismic Survey Lines

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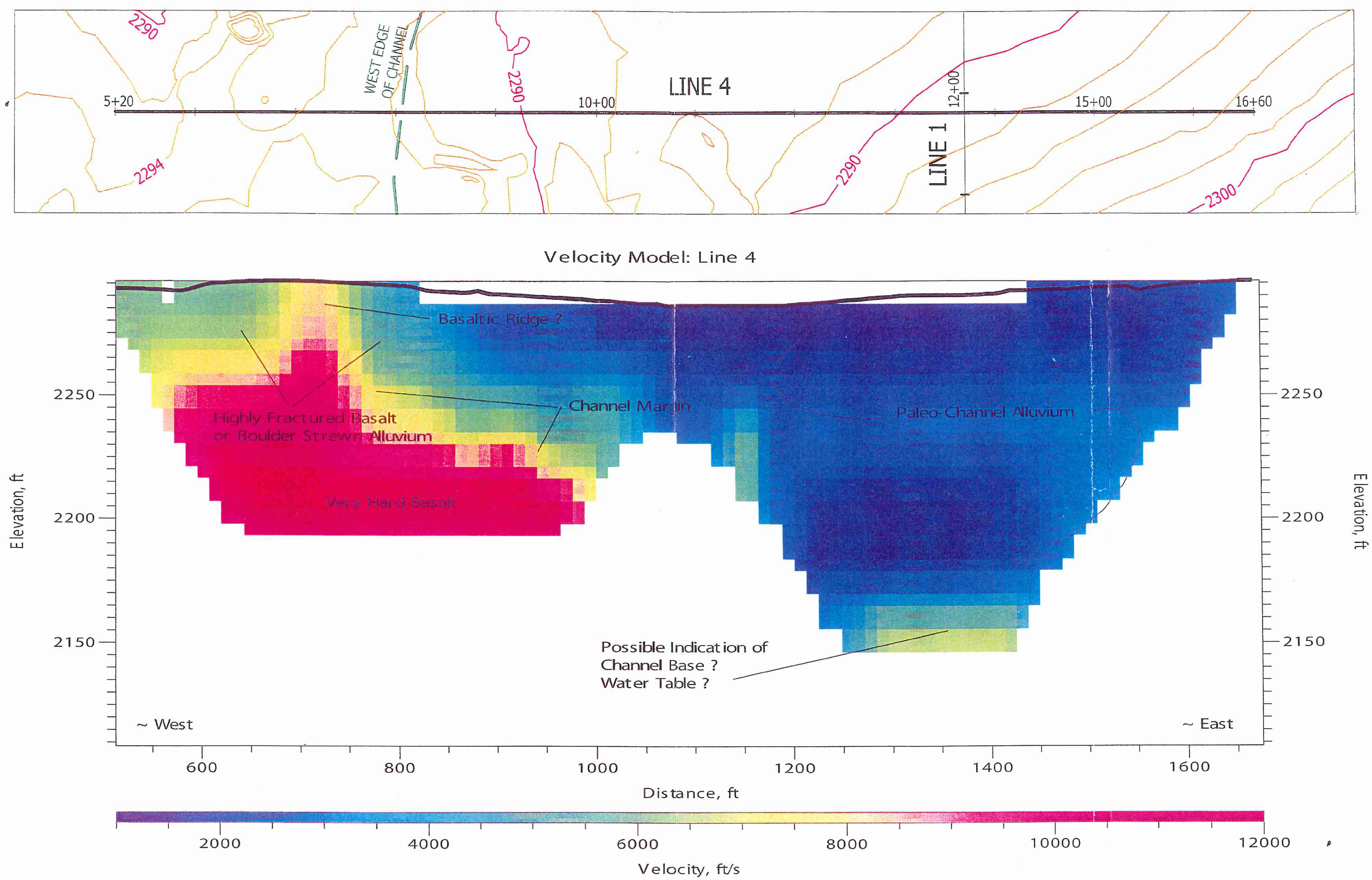

By: Siemens & Associates. Bend, Oregon

VELOCITY MODEL: LINE 4		FIGURE 3-4
PALEO-CHANNEL INVESTIGATION AIRWAY HEIGHTS, WASHINGTON	DATE 1/03	BROWN AND CALDWELL
		BUDINGER & ASSOCIATES, INC.

Figure 3-2), is hereinafter referred to as the "Airport West" Service Area. These three areas were selected for further technical study due to the high development pressure and associated potential for future drainage problems.

The team also designed a hypothetical on-site retention facility to provide a basis for comparison between a regional infiltration facility and on-site private facilities. On-site infiltration ponds were not considered as an viable option because it has been demonstrated that their use in this area has limited effectiveness due to shallow soils and low infiltration rates.

Hydrologic Modeling

Hydrologic modeling was done to estimate design flow rates and volumes at key locations (e.g., above culverts with known flooding problems). The hydrologic modeling for this study was accomplished by modifying an HSPF model provided by the County. The continuous simulation HSPF model was used instead of a design storm model because HSPF provides a better simulation of flooding associated with prolonged wet weather and snowmelt events, both of which are important in the West Plains area. In addition, the HSPF model can be used to evaluate the performance of evaporation and infiltration facilities over long periods of time. The HSPF model for the West Plains could not be calibrated due to lack of stream flow or water stage data. Therefore, the model results are suitable for general planning purposes only. Figure 3-5 shows sub-basin boundaries used for calculating flows during the hydrologic modeling. Flows generated by the model and used for facility sizing can be found in Appendix C.

Culverts and Channels

Culvert and conveyance channel sizing was based on the HSPF output for the sub-basins. The cumulative runoff in a watershed was assumed to be the sum of the upstream sub-basins or portions of sub-basins. This approach does not account for any lag or delay in the flows from the upstream sub-basins so it tends to over-estimate the flow rates. For the purpose of this study, the sum of the sub-basin flows without any lag or delay was considered acceptable because the results would overestimate actual flow rates and provide an additional factor of safety. Appendix D contains spreadsheets used for computing culvert and channel capacities.

Figure 3-6 illustrates the locations of the proposed culvert and channel improvements and the boundaries of the sub-basins that contribute flow upstream of these improvements. These tributary areas are hereafter referred to as "service areas." The service area boundaries do not necessarily match the opportunity area boundaries. For instance, the Airport West service area boundary actually extends further south than the I-90 West opportunity area. The reason for this is that the original opportunity areas were created based on a visual assessment of topography and an estimate of how much area might actually be served by a gravity collection drainage system. With the more detailed analysis conducted to size the conveyance system, it was actually determined that even more area could be served. The Indian Canyon and Garden Springs service areas do not include sub-basin areas below proposed culvert upgrades, as these areas do not contribute flows to the area of concern. Additionally, a significant portion of Spokane International Airport has been left out of any service area. Runoff from this area collects in the northeast corner of the airport where it infiltrates or evaporates. This infiltrated water may discharge to Indian Canyon Creek as base flow, since the potentiometric surface of the Wanapum Aquifer slopes in this direction. This area could be added to the Airport West service area at a later date, but would likely require an increase in the size of any associated infiltration facility.

Table 3-3 below identifies new channel improvements within each service area. These measures would be necessary to ensure that runoff within each tributary area is efficiently collected and delivered to the proposed disposal alternative (i.e., paleo-channel regional infiltration facility and stream outfalls). All improvements are designed to ensure road flooding does not occur with the 100-year flow event, as determined with the HSPF model. All listed channel improvements in Table 3-3 are new construction with the exception of modifications to the existing airport ditch. It should be noted that the County does not currently have legal access to modify the existing ditch west of the airport, therefore such an upgrade would need to be performed in consultation with Spokane International Airport.

Table 3-3. New Conveyance Measures for Airport West Drainage Area

New Improvements	Quantity	Units
Airport West Improvements		
Collection Ditches/Laterals I-90 Area	40750	LF
I-90 Crossing (144"W x 48"H Box) -Two	400	LF
Collection Ditches/Laterals	27500	LF
Modify Existing Airport Ditch	9000	LF
Ditch North to SR-2 (8'W X 6'D)	3000	LF
SR-2 Crossing (144"W x 48"H Box)	200	LF
Ditch North to Infilt. Pond (12'W X 6'D)	4500	LF
Outlet to Pond (144"W x 48"H Box)	100	LF
Indian Canyon Creek Improvements		
Collection Ditches/Laterals	12000	LF
Garden Springs Creek Improvements		
Collection Ditches/Laterals	11500	LF

Table 3-4 below lists culvert improvements to upgrade culverts in the three service areas that are currently undersized. The table presents conveyance capacities of existing culverts as determined via comparison to HSPF flow return periods generated with current land use, as well as capacities of proposed replacement culverts as determined via comparison to model results generated with future land use.

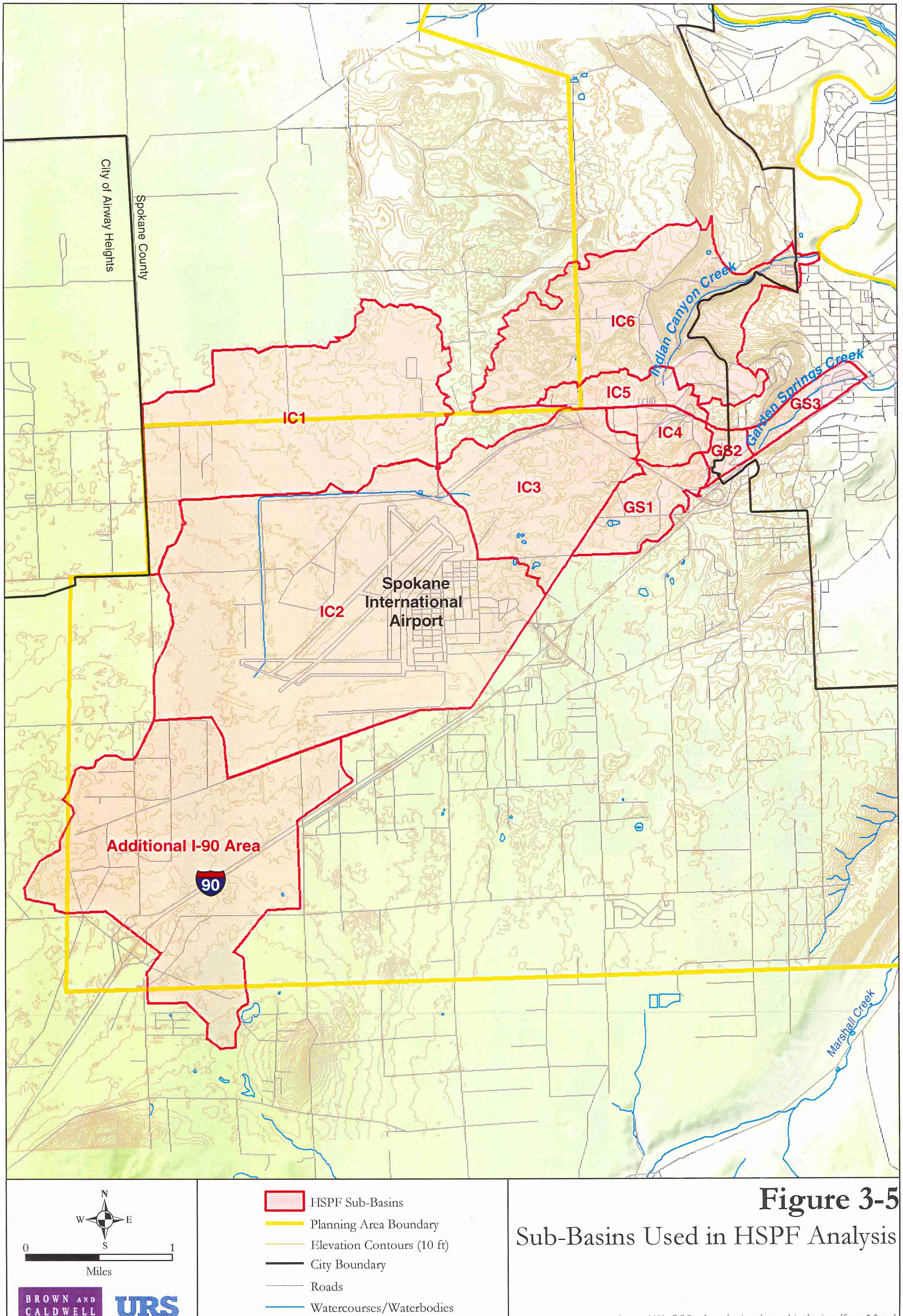

Figure 3-5
Sub-Basins Used in HSPF Analysis

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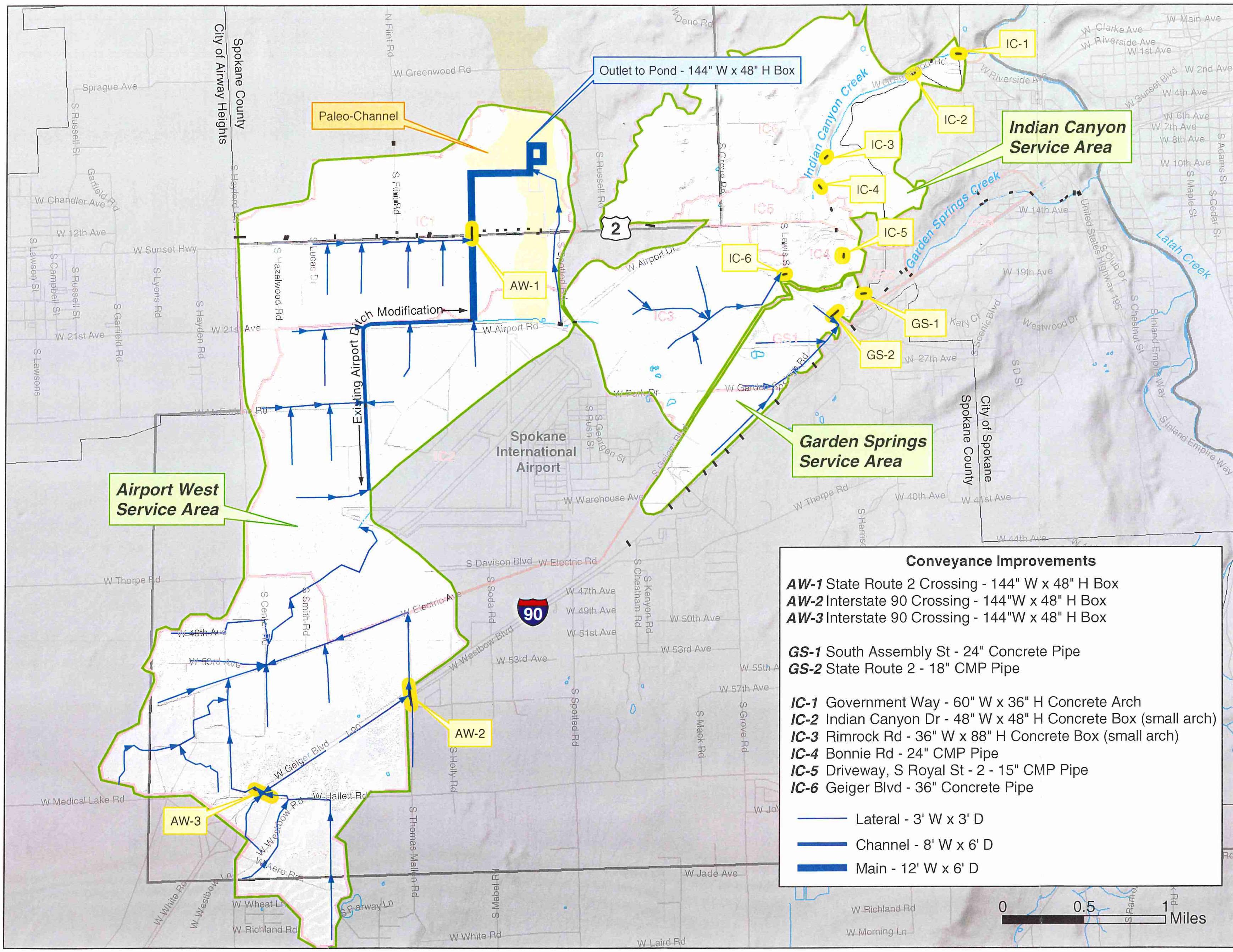
Figure 3-6

Service Areas and Potential Conveyance Improvements



Planning Area Boundary
City Boundary
Roads
Watercourses/ Waterbodies
HSPF Sub-Basins
Service Areas
Culvert Improvements

URS
BROWN AND CALDWELL

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Table 3-4. Indian Canyon/Garden Springs Culvert Improvements

Location/Crossing	Existing Size	Capacity with Current Land Use	Proposed Size	Capacity with Future Land Use
		Airport West Culvert Improvements		
I-90 Crossing	NA	NA	Two-144"W x 48"H	100-yr
SR-2 Crossing	NA	NA	144" x 48"H	100-yr
		Indian Canyon Creek Culvert Improvements		
Government Way	60"W x 36"H	10-yr	72"W x 48"H Box	100-yr
Indian Canyon Dr.	48"W x 48"H	50-yr	72"W x 48"H Box	100-yr
Below Rimrock Rd.	36"W x 38"H	100-yr	72"W x 36"H Box	>100-yr
Bonnie Rd.	24"	<2-yr	72"W x 36"H Box	>100-yr
Driveway	Two - 15"	<2-yr	60"W x 36"H Box	100-yr
Geiger Blvd.	36"	500-yr	60"W x 36"H Box	100-yr
		Garden Springs Creek Culvert Improvements		
Abbot Road	24"	50-yr	Add 24"	>100-yr
SR 2 (N. Side of I-90)	18"	<2-yr	36"	>500-yr

Figure 3-5 illustrates the locations of the above potential conveyance improvements along with the service area boundaries.

Regional Infiltration Facility (Paleo-Channel North of Airport)

Flows simulated by the HSPF model were used to estimate the size of a potential regional infiltration facility north of the airport. The assumed tributary drainage area is shown on Figure 3-6. Appendix D contains pond sizing spreadsheets.

The geotechnical investigation showed that infiltration rates within the paleo-channel can vary dramatically. Therefore, several design rates and depths were used to assess the impact of infiltration rates on facility size and costs. The preliminary design is based on a goal of no overtopping during the approximately fifty year period of record simulated in the HSPF model (see Figure 3-7), an infiltration rate of 20 inches per hour (recommended by County staff), and a depth of five feet. This results in an infiltration facility with 11.5 acres of storage area, with an overall land requirement of approximately 20 acres (includes pretreatment area, access roads, and berms). Figure 3-8 is a conceptual drawing of the proposed regional infiltration facility.

Sizing of the facility was also evaluated in conjunction with on-site detention in order to determine if this would result in significant cost savings (i.e., a substantially smaller pond). While on-site detention was determined to have a minor impact on the pond land area requirements, it was ruled out as a potential basin-specific development standard for several reasons. First, the prevalence of on-site detention would increase the overall surface area of exposed water bodies in the area tributary to the airport (a negative attribute near the airport due to bird attraction). Second, the flat topography, shallow bedrock, and generally poor drainage characteristics of much of the area could make on-site detention impractical at many sites. Lastly, part of the philosophical intent of the regional facility is to ensure cost-effective performance over the long-term. While on-site detention would slightly reduce the initial public costs for the paleo-channel infiltration facility, it would greatly increase combined public/private storm water management costs due to increased overall land and maintenance requirements.

On-Site Evaporation Ponds

In order to determine whether on-site retention would be more cost-effective than the Airport West regional infiltration facility, the project team sized an on-site evaporation pond for a hypothetical 100 acre site (Figure 3-9). Pond size was calculated using both the existing County stormwater design guidance and the HSPF model described above. Using the existing County guidance, the hypothetical on-site facility required 36 acres of site area. Using the results of the HSPF model, the hypothetical on-site facility required 40 acres of site area. It should be noted that the HSPF-based approach to retention facility sizing will result in a more appropriate pond size since it is based on actual precipitation data and evaporation rates.

This hypothetical pond size was then extrapolated to develop an estimate of the total resultant surface area of retention ponds if they were required for all new developments throughout the Airport West Drainage Area. Figure 3-10 compares the total required area of the regional infiltration facility to the combined total area of on-site retention facilities dispersed throughout the drainage area.

Appendix D contains copies of spreadsheets used to calculate evaporation pond size both using the existing County Guidelines for Stormwater Management (February 1998) and the results of the HSPF model.

Water Quality Treatment

The evaluation of the regional infiltration facility assumed that Grassed Percolation Areas (GPAs) would be infeasible at most sites due to soil impermeability, but that developers would continue to install on-site swales to meet water quality treatment requirements prior to discharging stormwater to the regional system.

The evaluation of the on-site retention (evaporation pond) option assumed that developers would not be required to use GPAs or swales, since there would be no off-site discharge of stormwater.

3.2.5 Identification of Potential Road Inundation Areas

By overlaying Figure 2-6 (Drainage/Flooding Complaints and Spring 1999 Inundated Areas) with a map of Spokane County roads, the planning team was able to identify possible areas where roads may be overtopped. Given the flat topography in much of the West Plains, there is considerable uncertainty regarding the actual extent of such potential overtopping. Since the topography used for this analysis involved two foot contour intervals, the data is not adequate for predicting capital costs (difficult to ascertain flooding depths). However, as discussed in Section 4.0, this information could be used over time to flag potential areas of concern as road improvements are conducted by either the County or by private land developers.

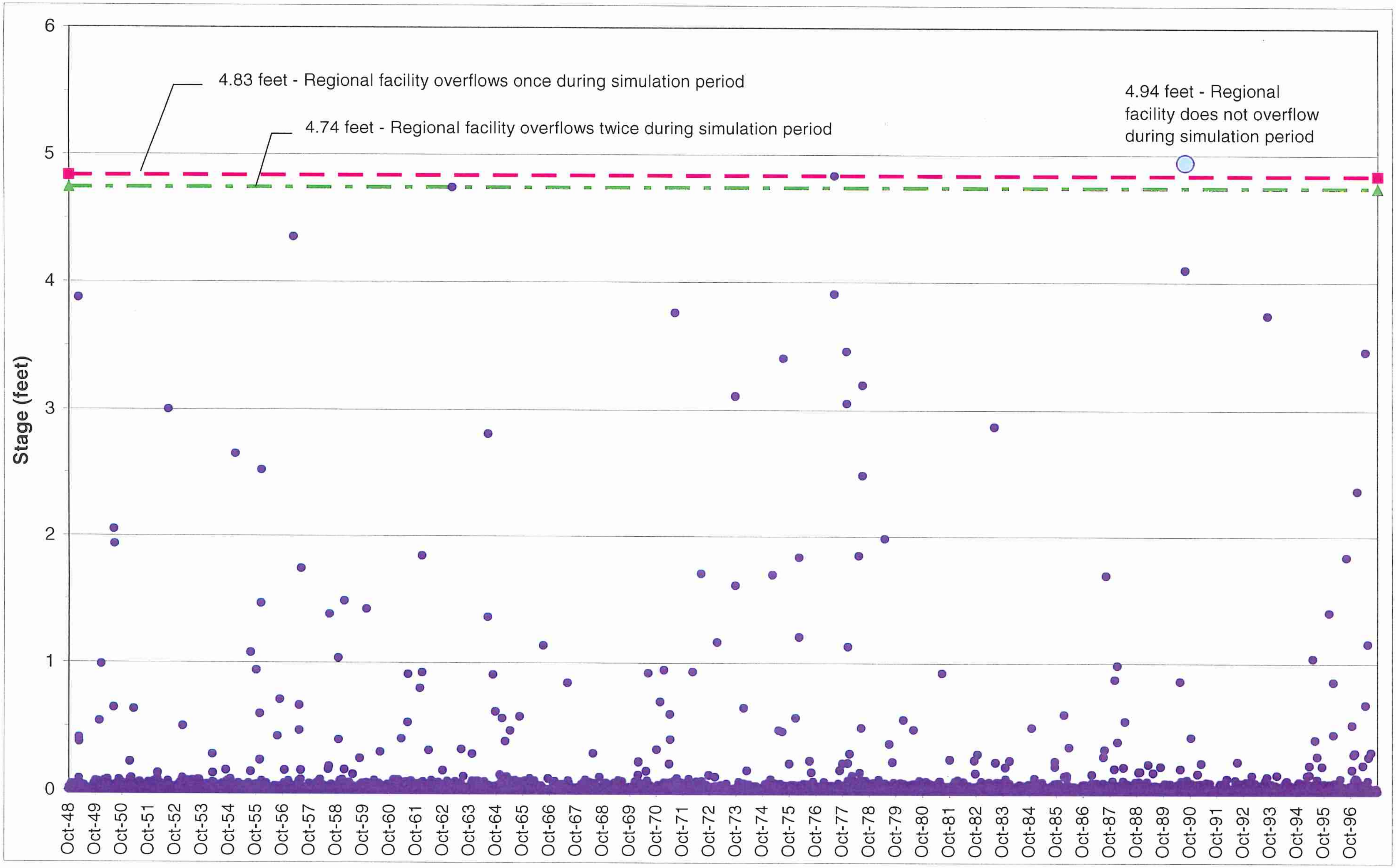


Figure 3-7 Subbasins IC1 and 1/2 IC2, West Plains, Spokane County
Simulated Daily Maximum Stage (Assumed No On-Site Detention Pond), 10/1/1948 - 9/30/1997
20"/hr, 11.5-ac, 5-ft Pond

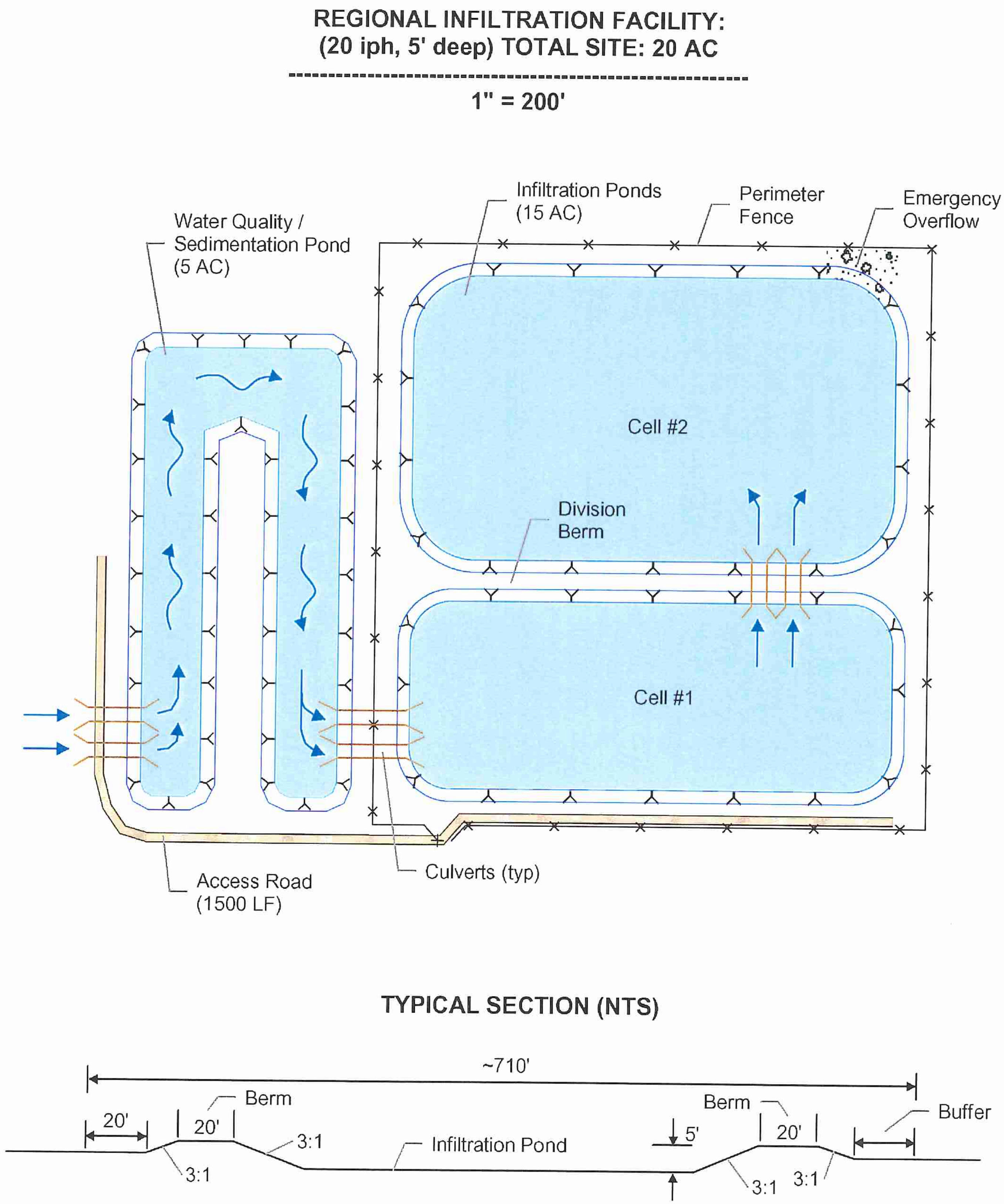
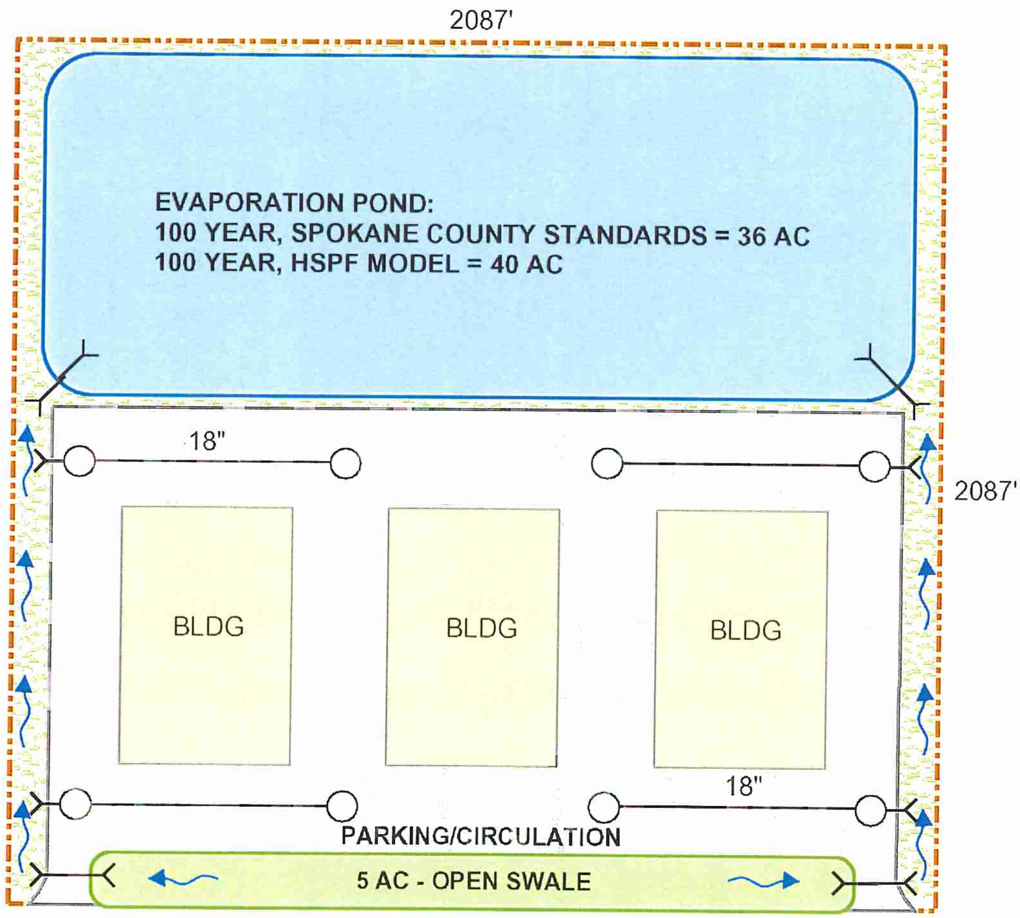


Figure 3-8 Conceptual Regional Infiltration Facility at Northern Paleo-Channel

West Plains Stormwater Management Plan

EVAPORATION POND - HYPOTHETICAL 100 ACRE SITE



100-AC SITE

Figure 3-9 Conceptual Retention Facility for Hypothetical 100 Acre Site

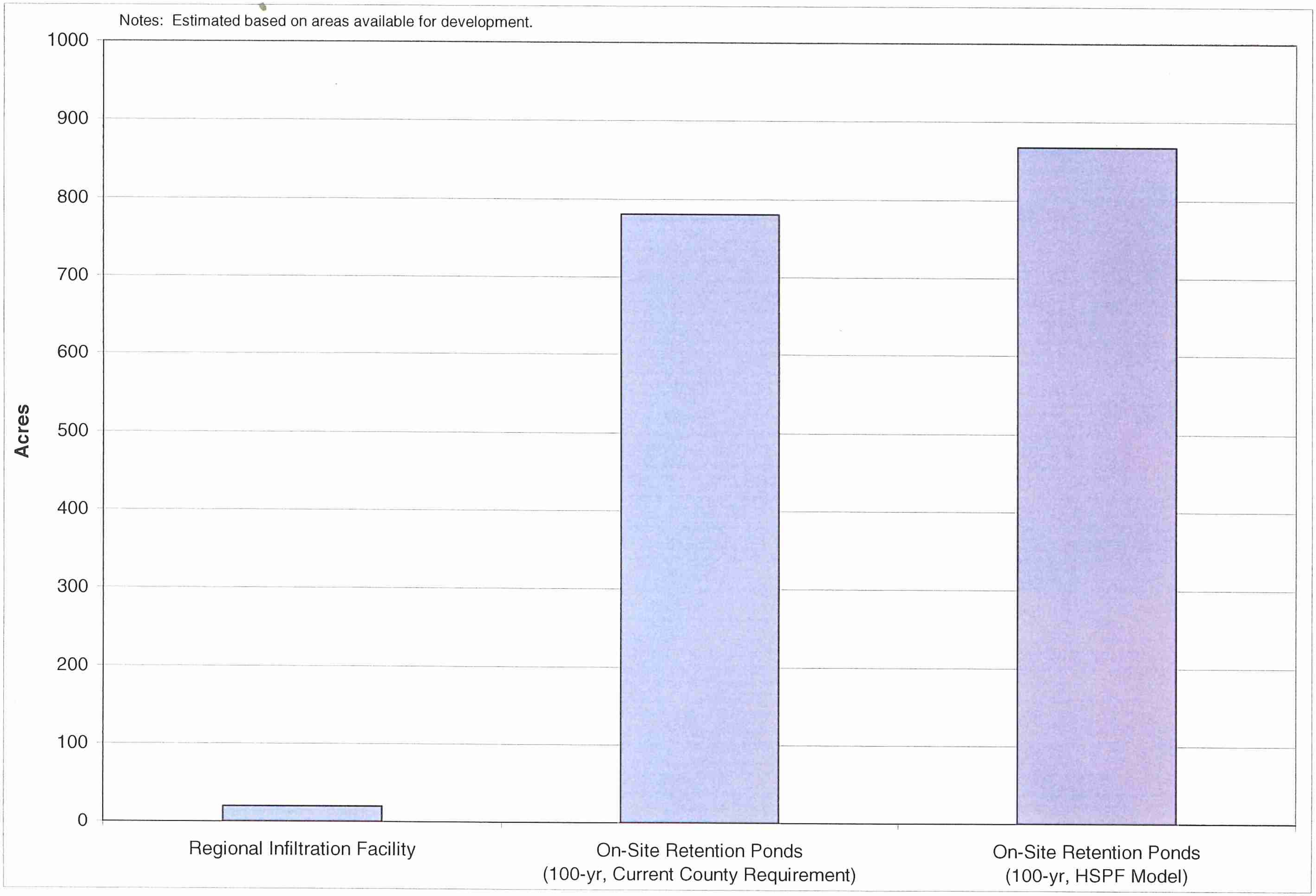


Figure 3-10 Total Surface Area - Paleo-Channel Infiltration vs. On-Site Retention

3.2.6 Cost Estimation

The planning team prepared construction cost estimates based on quantity take-offs from conceptual design sketches and 2001 construction cost data. The cost data includes unit cost data supplied by the County on similar types of construction projects. The concept design option estimates include allowances for mobilization, erosion control, traffic control and general clean-up and restoration. The following administrative and overhead cost factors were applied to the estimated construction costs to determine the total cost of each option:

- Washington State Sales Tax – 8.6%
- Survey and Design Engineering – 10%
- Permitting – 5%
- Construction Administration – 10%
- Contingency – 20%

The regional projects also included the following cost factors since it was assumed they would be public works projects and have additional associated costs:

- Project Administration – 5%
- Easement Acquisition – 1%

Land costs were based on land cost data supplied by the County. The information provided by the County was determined from sales of various parcels in the area and showed land costs for industrial land (Zoned I-2) in the range of $0.27 to $0.48 per square foot or $12,000 to $21,000 per acre. The cost estimates used $20,000 per acre for the cost of land for on-site stormwater facilities. The cost data showed that agricultural land (Zoned GA) cost in the range of $3,900 to $4,300 per acre. The cost estimates used the cost of $4,300 per acre for acquisition of land for the proposed regional infiltration facility.

The cost estimates for new or upgraded channels includes a contingency for excavating through rock of approximately 15%. This percentage was estimated by overlaying the proposed channel improvements with the exposed bedrock layer. The analysis indicated that about five percent of the channel excavation would be through areas of exposed bedrock. In addition to those outcrops, bedrock may be present just below the ground surface in some areas. Therefore, ten percent was added as a safety factor to account for potential shallow bedrock.

Table 3-5 below summarizes the cost estimates for the evaluated alternatives discussed above. Costs were estimated for land acquisition and construction, and hence do not include studies, operation or maintenance, or mitigation. These costs are included in the final recommendation in Section 4.0. Detailed cost estimate tables are included in Appendix E.

Table 3-5. Estimated Capital Costs of Structural Alternatives

West Plains Area Structural Alternatives	Total Cost	Cost Per Imperv. Acre	Regional Component /Public Share
Airport West Service Area:			
On-site Retention Ponds			
(100-yr, Current County Requirements)	$27,400,000	$52,000	NA
(100-yr, HSPF Model)	$30,700,000	$62,000	NA
Regional Infiltration Facility			
(20 iph, 5 ft deep)	$25,170,000	$12,000	$13,950,000
Garden Springs Creek Service Area:			
Channel/Culvert Improvements	$1,955,000	$14,000	$1,340,000
Indian Canyon Creek Service Area:			
Channel/Culvert Improvements	$2,825,000	$14,000	$1,900,000

The reason cost per impervious acre was calculated is that while on-site retention ponds are relatively similar in total cost to the regional infiltration facility, their actual cost per impervious acre is substantially higher. This is due to the fact that they would consume nearly half of the available developable land. Figure 3-11 illustrates this cost difference.

3.3 OTHER CONSIDERATIONS

Following the evaluation of the screened structural alternatives discussed above, the County gave consideration to several other factors before arriving at the measures recommended in Section 4.0.

3.3.1 Permitting

The structural measures considered will all require various permits to implement. However, the most significant permitting issue would appear to be associated with the creation of point source stormwater discharges to Garden Springs and Indian Canyon Creeks. The County does not currently have any point source discharges to waters of the United States; thus it should not require coverage under the Phase 2 Municipal NPDES Permit for Stormwater Discharges. The Indian Canyon and Garden Springs conveyance improvements and stormwater discharges would result in point source discharges to waters of the United States and would require the County to obtain NPDES permit coverage.

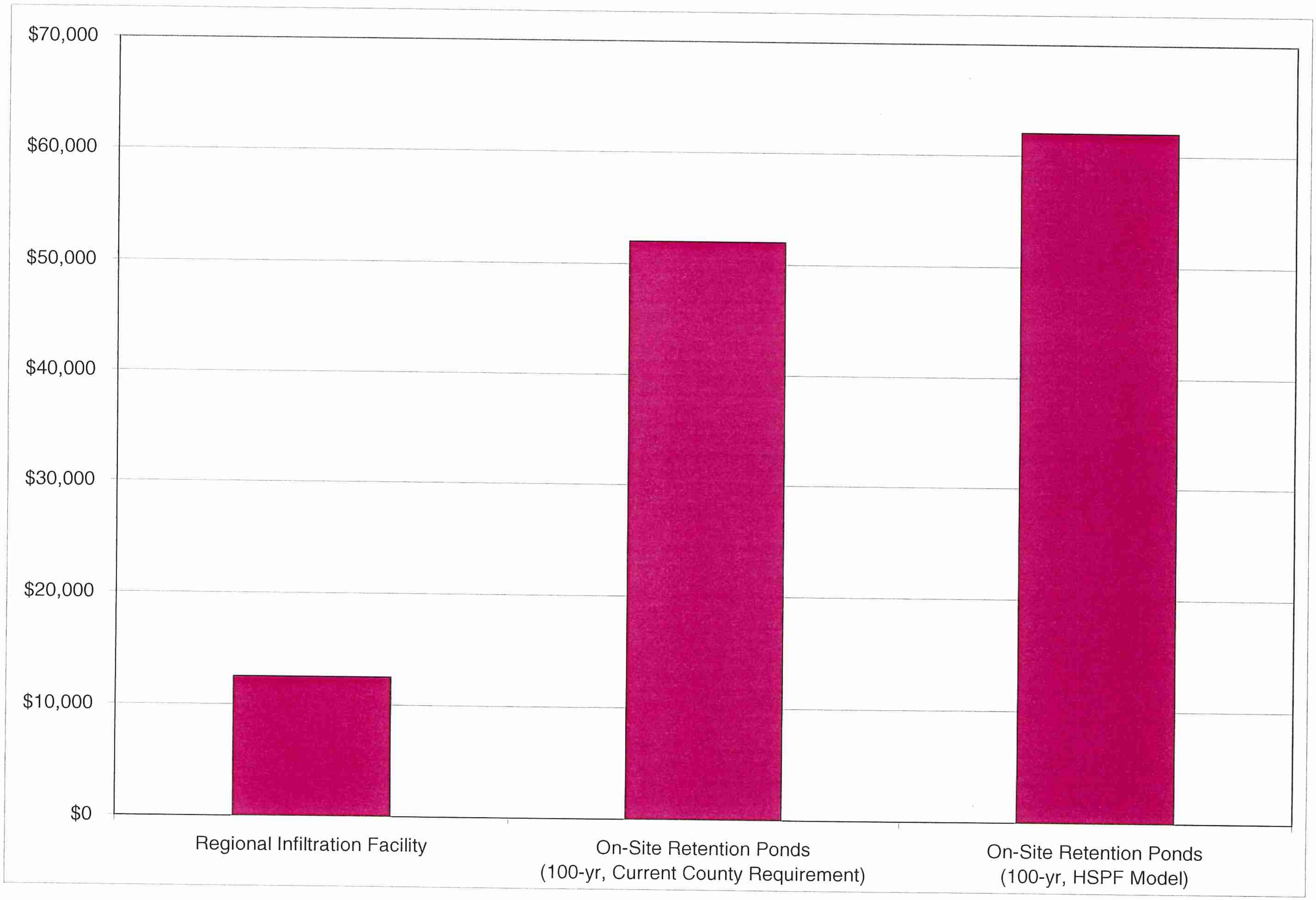


Figure 3-11 Per Acre Costs - On-Site Retention vs. Regional Infiltration Facility

3.3.2 Wetlands

While no structural alternatives are under consideration that would fill wetlands, the various conveyance and disposal improvements (including on-site retention) evaluated for the Airport West, Indian Canyon and Garden Springs service areas could locally lower perched groundwater tables. This could decrease water levels in wetlands (vernal or otherwise) in areas in proximity to the conveyance systems. Therefore, contingency funding for wetland mitigation may need to be considered for such measures.

3.3.3 Groundwater Impacts

Construction of a regional infiltration facility at the paleo-channel north of the airport has potential groundwater impacts that should be assessed before final design and installation. Potential issues to evaluate prior to design and construction would include water quality impacts to the Wanapum Aquifer and downgradient impacts related to localizing infiltration of larger volumes of surface water (e.g., possible reductions in base flows in Indian Canyon and Garden Springs Creeks and seepage in new locations).

3.3.4 Mosquitoes

A regional infiltration facility has a much lower potential for mosquito breeding than on-site retention facilities because 1) retention facilities store water for much longer periods due to the time requirement for evaporation as opposed to infiltration and 2) the total exposed water surface areas (see Figure 3-10) is much lower.

3.3.5 FAA Guidelines

Federal Aviation Authority (FAA) Advisory Circular 150/5200-33 (FAA 1997) describes FAA policy regarding wildlife attraction near airports. The circular states that any activity or land use on or near an airport that threatens aircraft safety by attracting or sustaining hazardous wildlife is an incompatible land use. While the FAA identifies stormwater detention and retention facilities as compatible land uses at or near airports, it also recognizes they can attract hazardous wildlife. Therefore the FAA provides design and siting guidelines to ensure facility design minimizes hazards associate with wildlife attraction.

When considered in light of FAA guidelines, the paleo-channel infiltration facility offers obvious advantages over the use of on-site retention within the Airport West area. This is due to the fact that the infiltration facility can be designed to drain relatively quickly compared to evaporation facilities, and the required surface area for one such facility is much lower than that required for numerous on-site retention facilities (see Figure 3-10). Other measures that should be considered when designing any surface water management facilities include plantings, sideslopes, and covers to minimize attraction of waterfowl and wildlife.

3.3.6 Long Term Maintenance

Each of the structural alternatives was also evaluated in light of likely long term maintenance requirements. As might be expected, where feasible, regional stormwater management facilities are typically preferred to on-site facilities. First, maintenance is easier to ensure when responsibility is held by a public agency as opposed to a private landowner. Second, it is typically easier and less expensive to maintain one large facility versus multiple smaller facilities.

SECTION 4

RECOMMENDATIONS

Following the alternative evaluation activities presented above, the County and project team presented results at a public meeting and a meeting of the West Plains Economic Development Alliance in the summer of 2002. Based on the feedback obtained at these meetings, the County selected a final set of recommended structural and non-structural measures.

4.1 STRUCTURAL RECOMMENDATIONS

Based on the screening and evaluation process described in Section 3, and frequent input from basin stakeholders (citizens, businesses, City, Airport, etc.) throughout the planning process, the County has decided that the following structural measures are the highest priority for implementation:

- Gravity flow to infiltration facility in paleo-channel north of airport
- Spot drainage improvements

The costs identified for conveyance upgrades in the Indian Canyon Creek and Garden Springs Creek service areas were high relative to both existing and potential future flood damages. Moreover, as mentioned earlier, such measures would be considered point source discharges to waters of the United States, which would then be subject to federal Municipal NPDES Stormwater Phase 2 regulations. Therefore, the County has decided to consider these improvements a lower priority. The County intends to continue to monitor drainage related complaints in these areas, and address when appropriate with drainage response teams and possible spot drainage improvements.

The costs of elevating roads above floodwaters was difficult to estimate with accuracy, therefore the County has decided to flag potential problem areas during road improvement or private development design reviews. This is discussed further in Section 4.2 below, Non-Structural Recommendations.

4.1.1 Gravity Flow to Infiltration Facility in Paleo-Channel North of Airport

The analysis described earlier in Section 3.2.4 resulted in a recommended regional infiltration facility with the following characteristics:

Service Area

The service area contributing flow to the regional facility is shown in Figure 4-1. This area, which totals 4,228 acres, is based on the assumption that the conveyance improvements described below will be made.

Regional Conveyance Improvements

Conveyance improvements necessary to efficiently transport flows to the regional infiltration facility are listed in Section 3.2.4, and shown on Figure 4-1.

Water Quality Pretreatment

A five acre area is assumed for water quality pretreatment. To minimize open water that could attract waterfowl, it is currently anticipated that this facility will be a dry pond. The specifications for the pretreatment pond will be defined during the project's design phase.

Infiltration Rate

As noted in Section 3.0, infiltration rates in the paleo-channel varied from less than one inch per hour to over 200 inches per hour. Based on evaluation of existing and new well logs and consultation with the County, an infiltration rate of 20 inches per hour was assumed for facility design purposes. Additional investigation is needed to determine the optimal facility location within the paleo-channel as well as a final infiltration rate to use for design.

Design Storm Event/Dimensions

The facility was sized by creating a hypothetical facility in the HSPF model, and then varying the dimensions while routing runoff from the 50-year rainfall time series through the hypothetical pond. The selected dimensions result in zero overtoppings for the entire period of record of rainfall data (approximately 50 years).

Other selected design parameters and resulting dimensions include:

- Depth = 5 feet was assumed
- Infiltration rate = 20 inches per hour
- Water surface area = 11.5 acres
- Total surface area (with berms, access facilities, pretreatment area) = 20 acres
- Storage volume = 55 acre-feet

FAA Guidelines

The facility would need to be designed to minimize water fowl attraction per FAA guidelines (e.g., steep sideslopes, etc.).

Cost

The total planning level cost of the proposed alternative "Gravity Flow to Infiltration Facility in Paleo-Channel North of Airport" breaks out as follows:

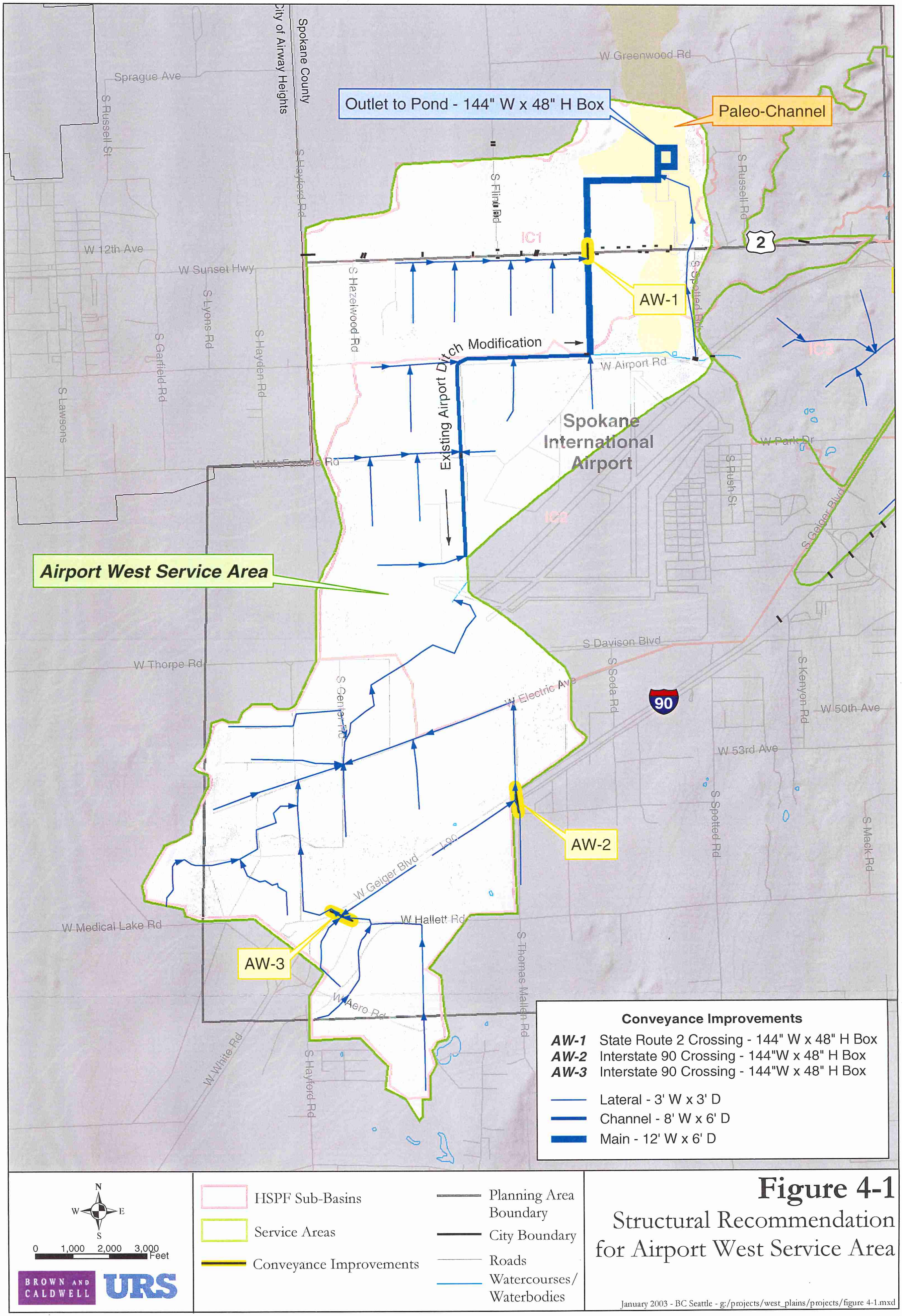


Figure 4-1

Structural Recommendation for Airport West Service Area

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure 4-1.mxd

Table 4-1. Total Cost for Airport West Service Area Structural Improvements

Element	Cost
Additional Water Quality Studies	$70,000
Additional Groundwater Studies	$300,000
Regional Conveyance Improvements	$11,600,000
Wetland Mitigation	$1,000,000
Regional Infiltration Pond	$2,400,000
Adaptive Management	$200,000
Total	$15,570,000

The additional studies are needed to 1) identify the best location and final design parameters for the proposed infiltration facility within the paleo-channel, and 2) ensure that potential groundwater quality and quantity impacts of collecting and recharging groundwater at the proposed paleo-channel site are considered. These issues were discussed earlier in Section 3.3.

The wetland mitigation figure is a contingency allowance due to the potential for the drainage improvements to lower perched water tables, thereby affecting some wetlands. The allowance is based on a total potential acreage of wetlands in the Airport West service area of approximately 53 acres (as calculated by overlaying the GIS wetland layer for the planning area with the Airport West service area), the assumption that 10 to 15 percent of these wetlands may be affected, and a unit replacement cost of $140k/acre. While there is no way to predict which wetlands might be affected, and these features may not actually turn out to be jurisdictional wetlands, it would be prudent nonetheless to provide a reserve for this possibility.

An adaptive management contingency is included because system operations may need to be modified over time. No funding is allocated for operation and maintenance, since that is assumed to come from the Stormwater Utility's operating budget.

4.1.2 Spot Drainage Improvements

As mentioned below in Section 4.2.2, drainage complaints in the West Plains area will likely result in identification of small projects to address local drainage problems (e.g., short-term road flooding, crushed culverts, etc). These "spot drainage" improvements should be tracked in the County's database, prioritized, and funded using Utility operating funds as available. This is similar to existing County practices, therefore this plan does not show any new cost associated with these activities.

4.2 NON-STRUCTURAL RECOMMENDATIONS

Numerous non-structural recommendations were considered during the planning process. The recommended measures are intended to ensure future new development is designed to minimize impacts related to poor site drainage and high groundwater levels. Each recommendation is discussed further below.

4.2.1 Development Management Activities

Pre-Application Meetings

The County currently uses permit pre-application meetings to present information to developers regarding conditions in the West Plains planning area. Moving forward, County staff should show maps of bedrock and seasonally inundated areas to applicants (Figures 2-1 and 2-6, blown up to larger scale) and discuss potential measures to minimize import of water into the area (e.g., xeriscaping). Locations where roads overlap with seasonal inundation areas should also be flagged and applicants apprised of the need to work with the County Engineering and Roads Division to ensure that access routes are adequately elevated.

The meeting should also serve as an opportunity to share information regarding County requirements for basements/key facilities, on-site stormwater control, and ultimate connection to regional facilities.

Information Management

County Stormwater Water Utility staff should continue to track areas of known drainage and flooding problems. Database and GIS files should be updated regularly to ensure that the latest possible information is used throughout the process of managing new development activities. For example, the County may wish to obtain additional aerial photos of inundated areas during the next high precipitation season.

Basin Specific Stormwater Control Ordinance

Because of the generally poor drainage characteristics in the I-90 portion of the West Plains basin, and the significant risks for damage to new development due to shallow bedrock and high groundwater tables, the County should adopt a Stormwater Control Ordinance similar to those in effect for Glenrose/Central Park (0-0610) and North Spokane (0-0558), with requirements for:

- Preservation of Natural Locations of Drainage Systems
- Major Land-Disturbing Activities
- Establishment of Regional Facilities
- High Risk Drainage Problem Areas

The boundaries of the proposed West Plains High Risk Drainage Problem Area are roughly as shown on Figure 4-2. Note that the Deep Creek, most of the northern portion of the Airway Heights, and Marshall Creek drainage areas are not included in this area. This is due to the generally better drainage characteristics of these portions of the planning area, as well as the more limited development pressures (see discussion in Section 2.0).

Developers are already required to use the County's *Guidelines for Stormwater Management* to design on-site stormwater management measures. However, in much of the West Plains Area, infiltration facilities are unlikely to work due to shallow bedrock and high groundwater. Therefore, the County should continue its recent policy of requiring developers proposing infiltration facilities in the West Plains area to perform borings and study local hydrogeology to demonstrate that an infiltration facility will perform as designed. This performance should be assured by the private engineer in a

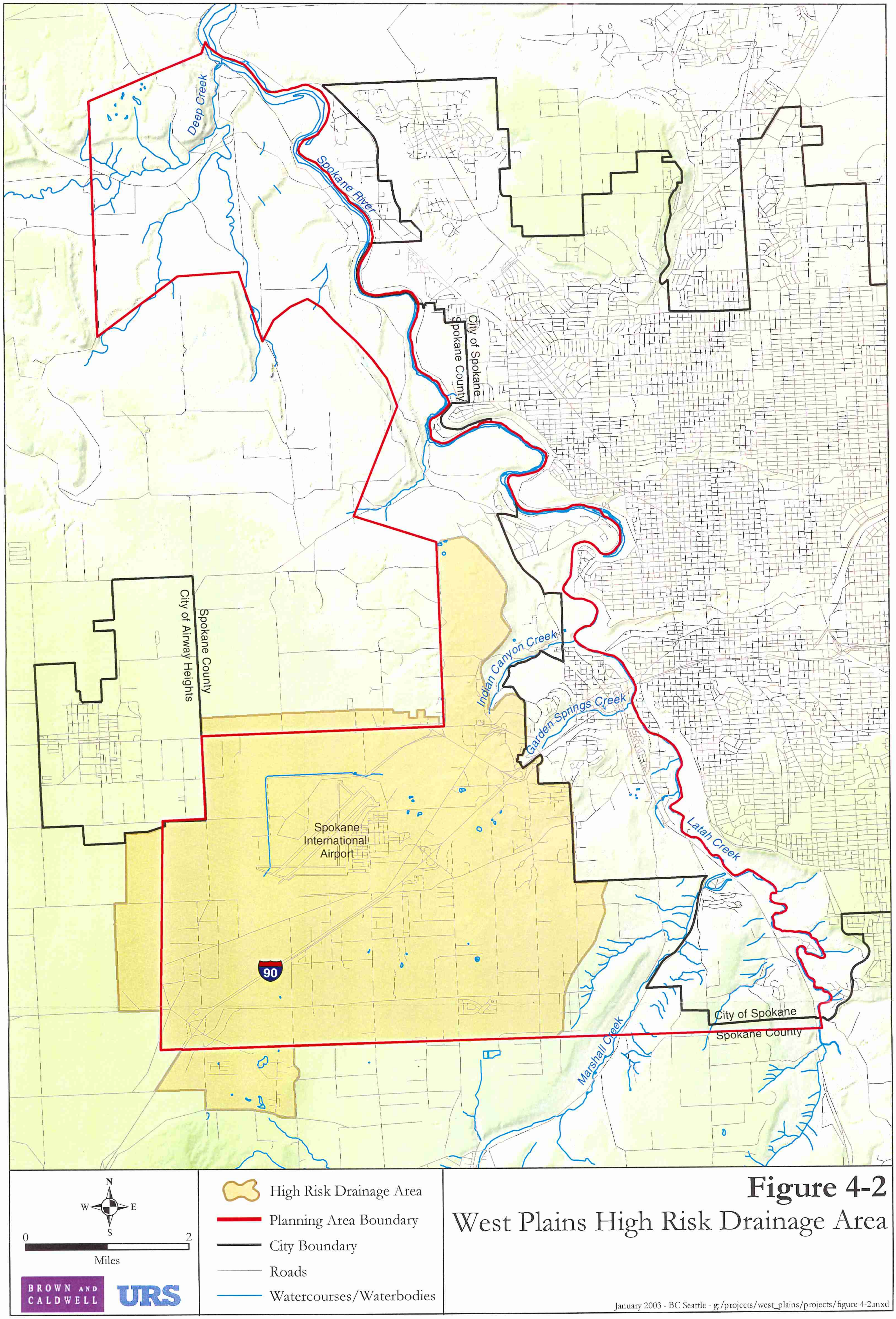


Figure 4-2

West Plains High Risk Drainage Area

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure 4-2.mxd

signed, stamped certification statement. The facility should also be noted on the property title, along with maintenance requirements.

Since on-site infiltration is not likely to work in much of the West Plains area, evaporation facilities will generally be required for on-site stormwater disposal. For evaporation facilities, developers should use the West Plains HSPF model results to size facilities. These results have been compiled into a simple spreadsheet program with a calculator, whereby a developer can enter various site parameters to determine the required size of evaporation pond (based on regression questions fit to the HSPF model results). Appendix D contains a print out that clearly illustrates how the program is to be used.

Given the large area required by evaporation ponds, the County should consider writing the ordinance to allow multiple sites to share one facility at their discretion. This section of the ordinance should require parties proposing such joint facilities to prepare and submit facility plans that clearly outline operation and maintenance responsibilities. Moreover, developer engineers must demonstrate that the storage volume required for the proposed evaporation facility will not be infringed upon by groundwater or off-site runon.

Ultimately, the County is proposing to build the regional infiltration facility described in Section 4.1.1 above at the paleo-channel north of the airport. When that facility comes on-line, all developments constructed in the interim that are located in the tributary drainage area should be required to disconnect their on-site infiltration or evaporation facilities and direct their stormwater to the new regional facility. The land formerly devoted to these onsite retention facilities would then be available for development (in accordance with applicable zoning).

Design Reviews and Site Inspections

County Stormwater Water Utility staff should continue to review proposed private and public projects for identification of possible surface water problems. For instance, whenever County road improvements are proposed, Utility staff should work with the Engineering and Roads Division to identify potential areas of road flooding. Similarly, if private developments are proposed in an area where access roads are known to have potential inundation problems, Storm Water Utility staff should highlight these areas for the Development Services Section of the Engineering and Roads Division.

With the adoption of a West Plains Stormwater Control Ordinance, Utility staff will review drainage components of site submittals for ordinance compliance, and require facility inspections for compliance both during construction and after completion. Inspections will be designed to ensure facilities are built to specifications and are properly maintained. Permitting and inspection related follow up activities should be reimbursed via development fees.

4.2.2 Drainage Response Measures

Drainage response measures are operational measures that the County should pursue to address nuisance flooding throughout the planning area.

Education

The County should continue to clearly communicate drainage complaint reporting information to citizens. This should include correct numbers to call, and criteria for determining whether a problem is public or private. When people call in to report drainage problems, County staff fielding the calls should evaluate the problem priority and whether the problem is public or private. For problems determined to be private, staff should explain private landowner responsibilities to the reporting citizen. When the problem appears to be a public problem, staff must ascertain whether the problem is an urgent threat to public health and safety (e.g., clogged drain flooding public road) or simply a nuisance. Prioritized problems can then be referred to the drainage field crews.

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Reported problems prioritized as urgent should be addressed by field crews immediately. All problems should be tracked in a database and classified as to whether maintenance is an appropriate solution or whether small capital improvement program (CIP) projects are needed. These small CIP projects can then be prioritized for funding as spot drainage improvements.

4.2.3 Costs of Non-Structural Measures

Costs of the non-structural measures described above are limited to County salary costs. For the purposes of this plan, it is assumed that such costs will be offset by existing utility charges and new permit and inspection fees.

SECTION 4

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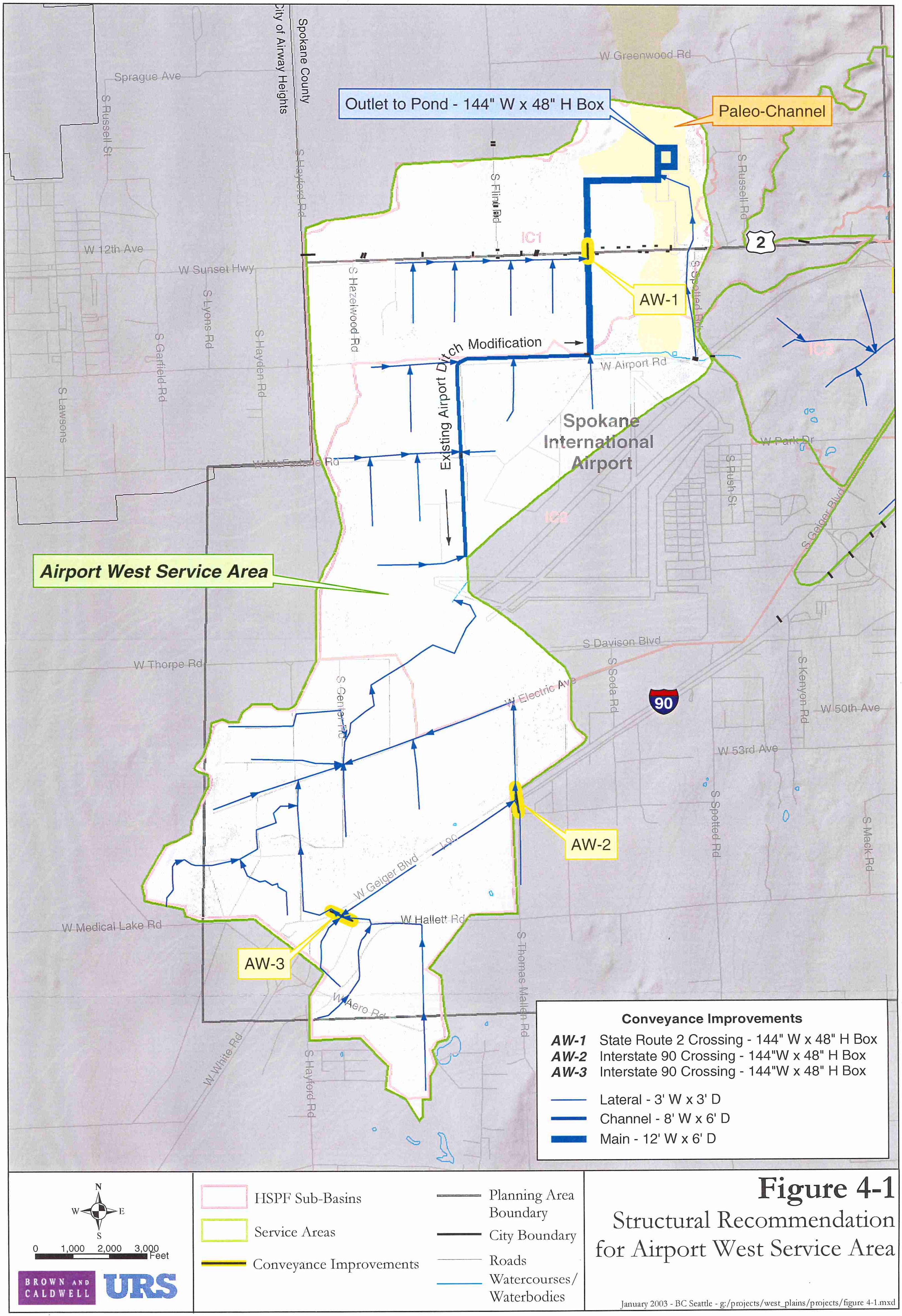

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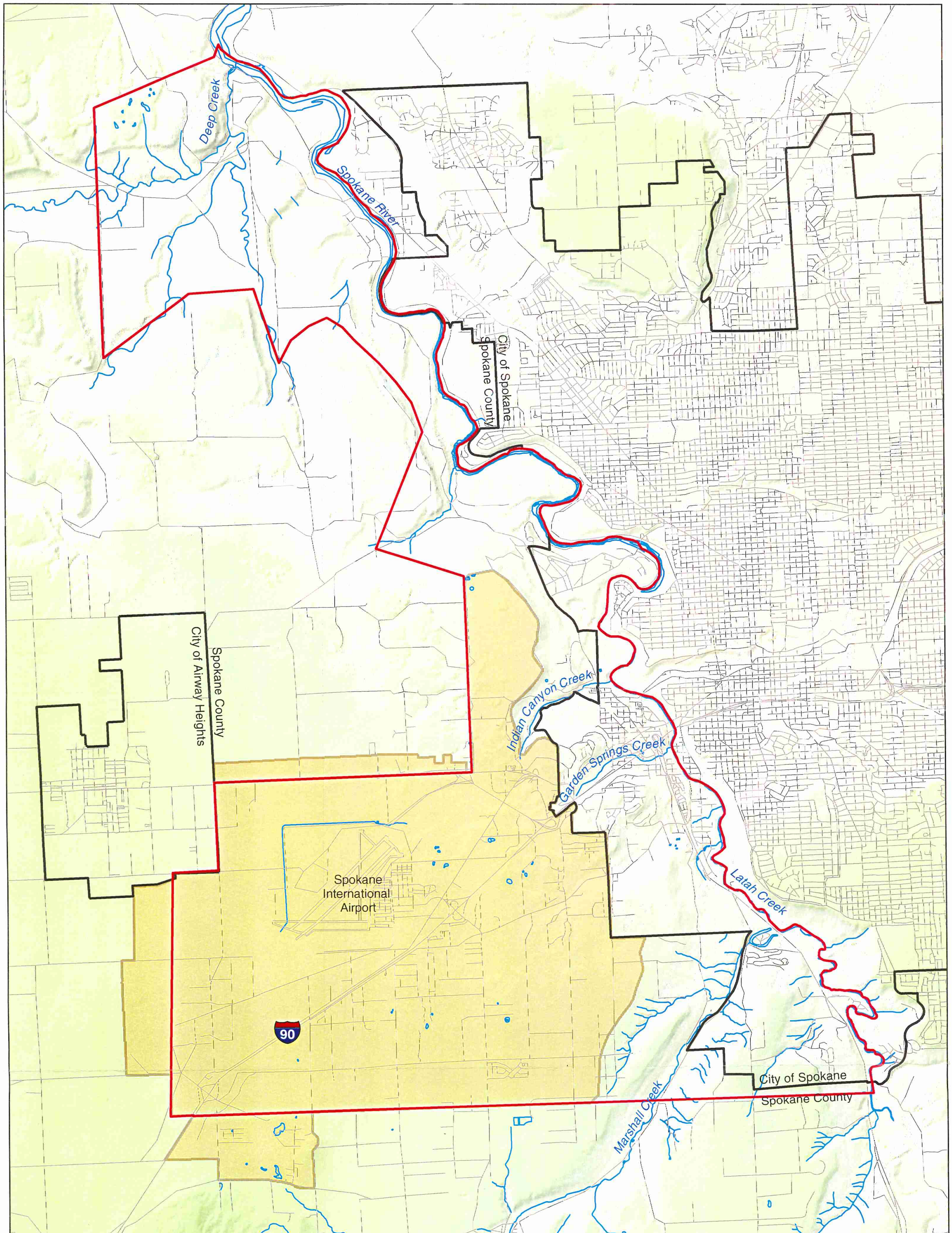

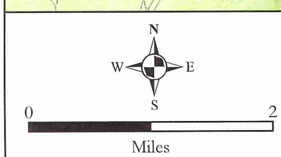

High Risk Drainage Area

Planning Area Boundary

City Boundary

Roads

Watercourses/Waterbodies

BROWN AND CALDWELL

URS

Figure 4-2

West Plains High Risk Drainage Area

January 2003 - BC Seattle - g:/projects/west_plains/projects/figure 4-2.mxd

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With the adoption of a West Plains Stormwater Control Ordinance, Utility staff will review drainage components of site submittals for ordinance compliance, and require facility inspections for compliance both during construction and after completion. Inspections will be designed to ensure facilities are built to specifications and are properly maintained. Permitting and inspection related follow up activities should be reimbursed via development fees.

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Drainage response measures are operational measures that the County should pursue to address nuisance flooding throughout the planning area.

Education

The County should continue to clearly communicate drainage complaint reporting information to citizens. This should include correct numbers to call, and criteria for determining whether a problem is public or private. When people call in to report drainage problems, County staff fielding the calls should evaluate the problem priority and whether the problem is public or private. For problems determined to be private, staff should explain private landowner responsibilities to the reporting citizen. When the problem appears to be a public problem, staff must ascertain whether the problem is an urgent threat to public health and safety (e.g., clogged drain flooding public road) or simply a nuisance. Prioritized problems can then be referred to the drainage field crews.

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Reported problems prioritized as urgent should be addressed by field crews immediately. All problems should be tracked in a database and classified as to whether maintenance is an appropriate solution or whether small capital improvement program (CIP) projects are needed. These small CIP projects can then be prioritized for funding as spot drainage improvements.

4.2.3 Costs of Non-Structural Measures

Costs of the non-structural measures described above are limited to County salary costs. For the purposes of this plan, it is assumed that such costs will be offset by existing utility charges and new permit and inspection fees.

SECTION 5

IMPLEMENTATION PLAN

5.1 FUNDING APPROACH

The project team considered a variety of funding approaches over the course of alternative development. After staff review and public feedback on the various options, the County decided to further explore issuance of revenue bonds to fund the proposed capital improvements (see Appendix F for a discussion of different funding options prepared during the planning process). The primary challenge to bond funding is that the County will need to identify a new revenue stream for debt service.

Further analysis was conducted for the following debt service scenarios:

1. A more significant utility fee increase applied only to the properties contributing runoff to the proposed regional infiltration facility

2. A smaller utility fee increase spread across the entire stormwater utility

Staff also gave extensive consideration to implementation of a Tax Increment Finance (TIF) area as a means to issue General Obligation bonds and handle debt service, but ultimately decided that this approach, while offering many advantages, had significant limitations for providing regional stormwater facilities in the West Plains. TIF financing is discussed further following presentation of each of the two utility increase options.

The Stormwater Uility is working on a separate funding study that will determine the most appropriate and acceptable method(s) of financing stormwater management plan implementation across the entire Stormwater Service Area. In that analysis financing for the West Plains Stormwater Management Plan will be further evaluated.

5.1.1 Option 1 – Contributing Area Utility Fee Increase

Under this scenario, the entire bond debt service would be paid out of utility increases paid by the properties contributing runoff to the proposed regional infiltration facility in the paleo-channel north of the airport. The rationale behind this approach would be that the properties using the capital improvements would be responsible for funding. The following assumptions were used in creating the model predicting required utility rates for the proposed capital improvements:

- 10,710 ERUs in Aiport West Service Area
- Annual ERU growth rate of 3.26 percent
- Two issues with 20 year life for each indenture

- First bond issue in 2004, second in 2007
- Both issues assumed to be parity serial revenue bonds
- Coverage of 25% of maximum annual debt service, coverage requirement is funded from bond proceeds for both issues
- Reserve at one percent of maximum annual debt service; reserve requirement is funded from bond proceeds for both issues
- Interest rate @ 4.75% per guidance from Seattle Northwest Securities Corp. (David Taylor, August, 2002)
- Debt service assumed to be level, no term bonds or amortization of premium/discount
- Each bond amount will be $7.5 M
- First bond issue

Given the above assumptions, monthly utility rates in the benefited area would be as shown in Figure 5-1. There would likely be some adjustments at the actual time of bond issuance, since interest rates may be different at that time, and final project costs may be better defined.

5.1.2 Option 2 – Utility-Wide Fee Increase

Option 2 involves passing a smaller utility fee increase across the entire utility. The rationale for this approach is that the County designated the area that will drain to the regional infiltration facility as an area for industrial growth. Since all Utility rate payers will benefit from the higher property taxes from the new development, and to some extent from the increased jobs and the concentration of industrial development away from residential areas, it would seem reasonable to evenly distribute the initial capital costs of the regional infiltration facility over the entire utility rate base.

The model used for Option 1 was adjusted to illustrate application to the entire County Utility rate base (73,700 ERUs), which resulted in the annual rate increases shown in Figure 5-1.

5.1.3 Tax Increment Finance (TIF) Funding

Passage of a TIF resolution (House Bill 1418 passed in 2001) would allow the County to pledge and use a portion of property tax collections for funding construction of projects within the TIF. The assumption behind the TIF bill is that construction of such projects will increase property values within the TIF area and a portion of that increased value (under statute no more than 75% of that increased value) can be diverted to pay the principal and interest on the general obligations issued to provide the money for construction of the projects.

The Act requires an agreement among jurisdictions representing no less than 75% of the regular property taxes to be levied within a tax increment financing area, to permit a diversion of taxes by

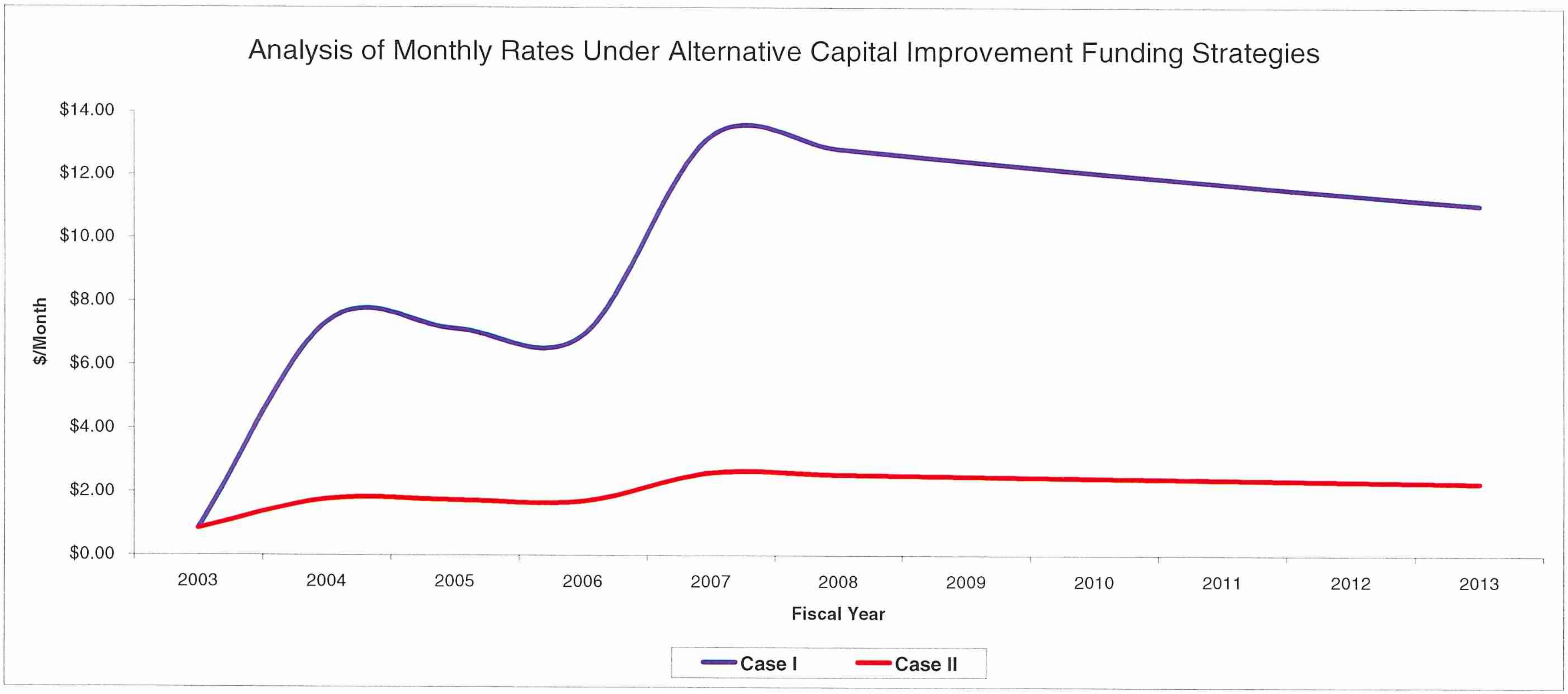
Figure 5-1

Spokane County - Stormwater Management Program

West Plains Watershed (Airport West Improvements)

Analysis of Monthly Rates Under Alternative Capital Improvement Funding strategies

Case Description	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Case I - Monthly rates paid by contributing customers within the Airport West service area (assumes 10,710 Equivalent Residential Units)	$0.83	$7.35	$7.15	$6.94	$13.22	$12.83	$12.45	$12.08	$11.72	$11.37	$11.04
Case II - Monthly rates paid by all customers within the entire utility service area (assumes 73,700 Equivalent Residential Units)	$0.83	$1.78	$1.75	$1.72	$2.63	$2.57	$2.51	$2.46	$2.40	$2.35	$2.30



the sponsoring municipality. In an increment area that includes any portion of a fire protection district as defined in Title 52 RCW, the fire protection district must agree to participate in the community revitalization financing of the project under this act, for the project to proceed.

While a TIF area may seem a logical approach for West Plains, their implementation requires several difficult steps under the law:

- jurisdiction must adopt an ordinance designating the TIF area and identifying the project(s) to be financed.
- local government taxing districts (excluding the state) that impose at least 75% of the regular property taxes within the proposed TIF area must sign agreements approving the TIF.
- a public hearing must be held.
- fire protection districts having territory within the TIF area must approve.

Moreover, once a TIF is approved, additional difficulties may ensue. While the TIF may issue G.O. bonds to be paid off by the tax increment value resulting from the proposed improvements, it is difficult to say exactly what the increase will be and when it will occur. In the meantime, the County is still obligated to service the debt. While a TIF may also be used to service debt on revenue bonds, it is not likely that a bond underwriter would participate given the uncertainty regarding the debt service revenue stream.

5.1.4 Recommended Funding Approach

Given the current economic climate and the difficulties discussed above, this plan does not recommend a TIF as a means for funding the proposed structural improvements. Of the two funding options requiring utility rate increases, this plan recommends pursuit of Option 2. Option 1 would incur extremely high utility rates on an as yet mostly undeveloped area. Since it is the County's vision that industrial development of this area will benefit the entire County via increased jobs, higher property tax revenues, and the concentration of industrial activities, it may be reasonable to spread the up-front capital costs of the proposed drainage improvements over a broader rate base.

5.2 IMPLEMENTATION SCHEDULE

Figure 5-2 is an approximate schedule for implementation of the recommendations contained in this plan. The schedule assumes bond funds are not available until 2004, but that Utility capital reserves can be used to fund studies leading up to implementation of the structural recommendations. The schedule assumes construction windows from April through October of each year.

5.3 IMPLEMENTATION RESPONSIBILITIES

Table 5-1 outlines departmental responsibilities for the various structural and non-structural recommendations:

Table 5-1. Implementation Responsibilities

Recommendation	County Public Works		
	Stormwater Utility	Engineering and Roads: Development Services	Engineering and Roads: Maintenance Section
Structural Measures			
• Regional Infiltration Facility			
o Pass utility increase	X		
o Issue revenue bonds	X		
o Design facility	X		
o Acquire land	X		
o Build facility	X		
o Monitor, maintain, & manage facility	X		
• Spot Drainage Improvements			X
Non Structural Measures			
• Development management activities			
o Pre-application meetings	X	X	
o Information management	X		X
o Basin-specific Stormwater Ordinance	X		
o Design reviews	X	X	
o Site inspections	X		
• Drainage response			
o Education	X		
o Response Team			X

ID	Task Name
1	**Utility Increase and Bond Measures**
2	Define/package/propose utility increase
3	Pass utility increase
4	Issue revenue bonds
5	Service bond debt
6	**Non-Structural Measures**
7	Continue data management
8	Draft basin-specific ordinance (including fee structure)
9	Adopt basin-specific ordinance
10	Implement pre-application meetings
11	Implement design reviews
12	Implement site inspections
13	**Airport West Paleo-Channel Infiltration Facility**
14	Add'l geologic investigations
15	Go-no go decision point
16	Establish design criteria
17	Pre-design & Permitting (SEPA, NPDES Construction, Grading)
18	Land acquisition
19	Design
20	Bidding process
21	Construction contract
22	Construction
23	**Airport West Conveyance Improvements**
24	Pre-design
25	Design
26	Bidding process
27	Construction contract
28	Construction

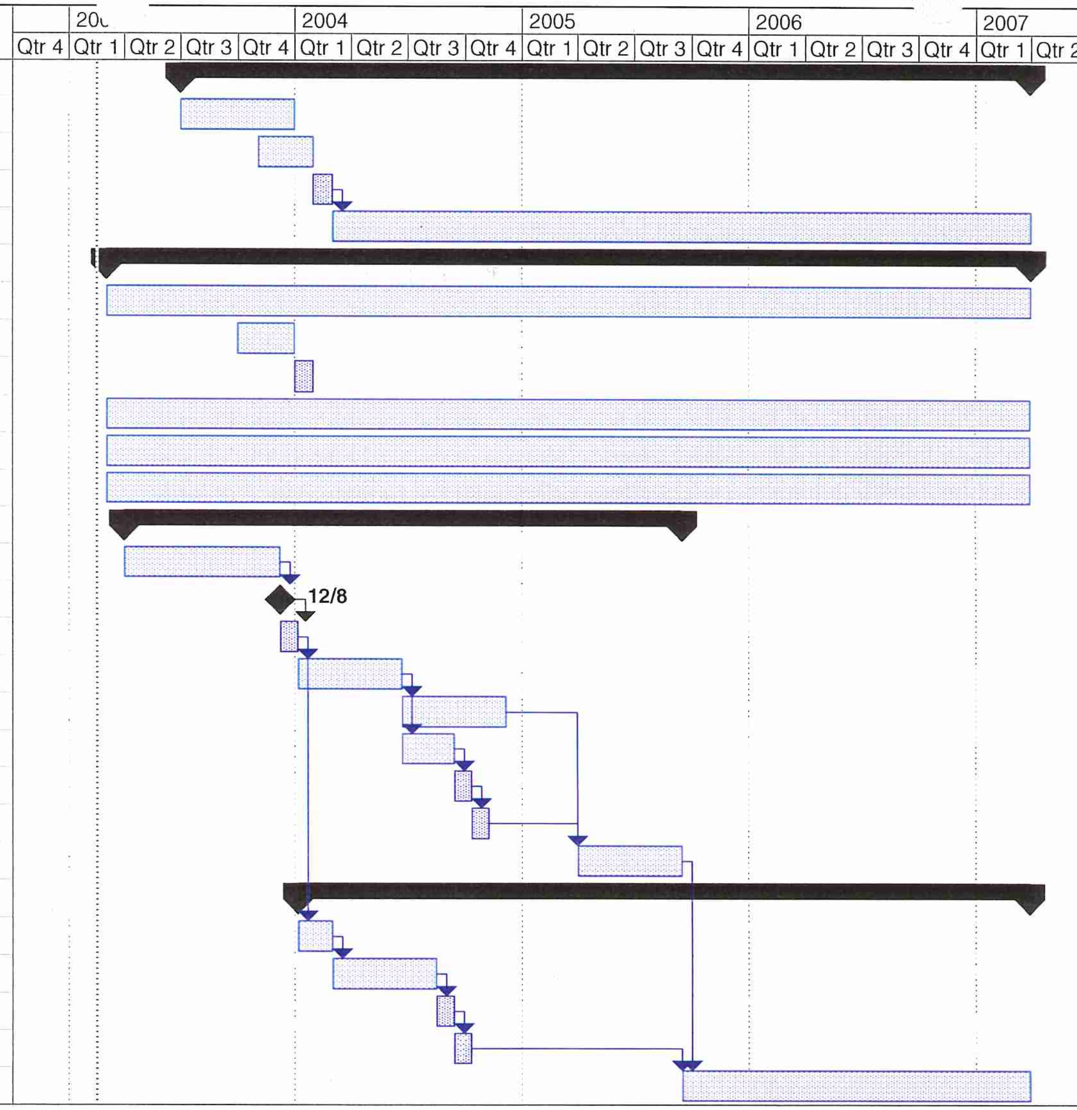


Figure 5-2
West Plains SMP Implementation Schedule
Fri 2/14/03

Task | Milestone | External Tasks
Split | Summary | External Milestone
Progress | Project Summary | Deadline

SECTION 6

REFERENCES

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APPENDIX A

PRELIMINARY ALTERNATIVES TABLE

STORMWATER MANAGEMENT

West Plains – Northeast Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Green Colored Area	Status: Aug. 2001	Status: July 2002
S-1. Develop response measures to address specific drainage complaints on a case-by-case basis. **Pros:** No regional facilities are needed. Low cost. **Cons:** Lower priority problems may be deferred until additional budget becomes available.	Further Evaluation	Additional study not necessary, County to address problems as noted.
B-1. New development standards for specific areas designed to minimize stormwater impacts, such as: – **Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed.** – **No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas.** – **Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps.** – **Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters)** – **Develop on-site retention requirements based on area-specific information (use "look-up" tables)** – **Implement annual County inspection of private stormwater facilities** **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities. **Cons:** Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate existing nuisance flooding.	Further Evaluation	Much of this area does not require additional regulatory control, County to address spot problems on a case by case basis as they arise.

STORMWATER MANAGEMENT

West Plains – Southeast Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Gray Colored Area	Status: Aug. 2001	Status: July 2002
I-4. Raise road elevations in flood-prone areas. **Pros:** Would alleviate nuisance flooding of roads. **Cons:** May be costly depending on length & type of road to be raised.	Further Evaluation	Estimated costs based on 1999 flooding.
I-5. Drainage system improvements: gravity conveyance to Spokane River tributaries. **Pros:** Regional system would alleviate existing nuisance flooding. Regional system could be designed to handle flows from future development. **Cons:** May require detention ponds to avoid downstream flooding & erosion impacts. Anticipate high construction costs. Low slope will limit conveyance capacity in some areas. Shallow groundwater could flow into ditches/pipes during wet season, limiting conveyance capacity. Potential water quality impacts to Spokane River tributaries.	Further Evaluation	Estimated future flows. Identified conveyance bottlenecks. Estimated costs for system improvements.
I-6. Spot drainage improvements to address specific drainage complaints on a case-by-case basis. **Pros:** No regional facilities needed. Low cost. **Cons:** Lower priority problems may be deferred until additional budget becomes available. May not work at locations with high groundwater or topographic depressions. New development could exacerbate existing problems or create new problems.	Further Evaluation	Additional study not necessary, County to address problems as noted.
B-1. New development standards for specific areas designed to minimize stormwater impacts, such as: – Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed. – No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas. – Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps. – Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters) – Develop on-site retention requirements based on area-specific information (use "look-up" tables) – Implement annual County inspection of private stormwater facilities **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities. **Cons:** Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate existing nuisance flooding.	Further Evaluation	Refined concepts, estimated costs for typical site.

STORMWATER MANAGEMENT

West Plains – Southeast Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Pink Colored Area	Status: Aug. 2001	Status: July 2002
I-2(a). Gravity flow to existing excavated or depressional areas for regional infiltration, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Would recharge Wanapum aquifer, could help preserve baseflow in associated springs. No pumping required. **Cons:** Anticipate limited infiltration capacity. Limited gravity drainage area. Not feasible if hydrogeologic studies find that soils are not suitable for infiltration. Potential water quality impacts to Wanapum aquifer; pre-treatment would be required. Potential clogging of facility, especially during construction activities.		No further investigation warranted due to limited areas suitable for infiltration pond.
I-2(b). Gravity flow to existing excavated or depressional areas for regional retention, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Potential for park or wetland/wildlife habitat. No pumping required. **Cons:** Limited storage capacity in existing excavated/depressional areas will limit area that can be served. Limited gravity drainage area. Large surface area may be needed due to shallow bedrock/groundwater. Shallow groundwater inflow may limit storage capacity. Significant permitting/mitigation issues if associated with wetland.	Further Evaluation	No further investigation warranted due to limited areas suitable for retention (high water table).
I-2(c). Groundwater collection and pumping to regional retention/infiltration sites, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Can serve a larger area, independent of slope. Could be used periodically to pump shallow groundwater when it rises above some threshold. **Cons:** Shallow groundwater is in isolated pockets so very hard to collect efficiently. Requires construction of force main, pumps, wells/galleries. High O&M costs. Potential water quality impacts to Wanapum aquifer. Periodic pumping of high groundwater may not be possible due to technical and regulatory issues.		No further investigation warranted due to limited areas suitable for facility and the O&M costs of pumping.

- Continued -

Preliminary Alternatives – Pink Colored Area, Continued	Status: Aug. 2001	Status: July 2002
I-4. Raise road elevations in flood-prone areas. **Pros:** Would alleviate nuisance flooding of roads. **Cons:** May be costly depending on length & type of road to be raised.	Further Evaluation	Estimated costs based on 1999 flooding.
I-5. Drainage system improvements: gravity conveyance to Spokane River tributaries. **Pros:** Regional system would alleviate existing nuisance flooding. Regional system could be designed to handle flows from future development. **Cons:** May require detention ponds to avoid downstream flooding & erosion impacts. Anticipate high construction costs. Low slope will limit conveyance capacity in some areas. Shallow groundwater could flow into ditches/pipes during wet season, limiting conveyance capacity. Potential water quality impacts to Spokane River tributaries.	Further Evaluation	Limited area suitable for gravity conveyance, field review indicated significant obstructions to gravity drainage due to I-90 construction and natural topography. Improvements would be costly and are not warranted under current level of development.
I-6. Spot drainage improvements to address specific drainage complaints on a case-by-case basis. **Pros:** No regional facilities needed. Low cost. **Cons:** Lower priority problems may be deferred until additional budget becomes available. May not work at locations with high groundwater or topographic depressions. New development could exacerbate existing problems or create new problems.	Further Evaluation	Additional study not necessary, County to address problems as noted.
B-1. New development standards for specific areas designed to minimize stormwater impacts, such as: – **Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed.** – **No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas.** – **Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps.** – **Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters)** – **Develop on-site retention requirements based on area-specific information (use "look-up" tables)** – **Implement annual County inspection of private stormwater facilities** **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities.	Further Evaluation	Refined concepts, estimated costs for typical site.

Cons: Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate existing nuisance flooding.		

STORMWATER MANAGEMENT

West Plains – Southeast Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Blue Colored Area	Status: Aug. 2001	Status: July 2002
M-1. Drainage system improvements, pre-treatment, discharge to Marshall Creek. **Pros:** Regional system would alleviate existing nuisance flooding. Regional system could be designed to handle flows from future development. **Cons:** May require detention ponds to avoid downstream flooding & erosion impacts. Anticipate high construction costs. Low slope will limit conveyance capacity in some areas. Shallow groundwater could flow into ditches/pipes during wet season, limiting conveyance capacity. Potential water quality impacts to Marshall Creek and its tributaries.		Extent of current problems does not warrant regional approach, significant large-scale development not expected for the area in the future.
M-2. Conveyance to regional infiltration facility located in gravel pit south of planning area (possible paleo-channel). **Pros:** Regional facility allows larger % of private properties to be developed. Efficient operation and maintenance. Would recharge paleo-channel aquifer. No pumping required. **Cons:** Paleo-channel location and depth are uncertain; requires seismic study to assess potential suitability. Not feasible if hydrogeologic study finds low permeability layers in paleo-channel. Anticipate high construction costs. Potential water quality impacts to paleo-channel aquifer and Marshall Creek.		Further investigation to confirm presence and location of paleo-channel was not warranted given the expected high cost.
B-1. New development standards for specific areas designed to minimize stormwater impacts, such as: – **Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed.** – **No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas.** – **Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps.** – **Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters)** – **Develop on-site retention requirements based on area-specific information (use "look-up" tables)** – **Implement annual County inspection of private stormwater facilities** **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities. **Cons:** Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate	Further Evaluation	Refined concepts, estimated costs for typical site.

existing nuisance flooding.		

STORMWATER MANAGEMENT

West Plains – West Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Yellow Colored Area	Status: Aug. 2001	Status: July 2002
I-2(a). Gravity flow to existing excavated or depressional areas for regional infiltration, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Would recharge Wanapum aquifer, could help preserve baseflow in associated springs. No pumping required. **Cons:** Anticipate limited infiltration capacity. Limited gravity drainage area. Not feasible if hydrogeologic studies find that soils are not suitable for infiltration. Potential water quality impacts to Wanapum aquifer; pre-treatment would be required. Potential clogging of facility, especially during construction activities.		Pumping operation and maintenance costs were assumed to be cost prohibitive particularly with the options for gravity flow.
I-2(b). Gravity flow to existing excavated or depressional areas for regional retention, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Potential for park or wetland/wildlife habitat. No pumping required. **Cons:** Limited storage capacity in existing excavated/depressional areas will limit area that can be served. Limited gravity drainage area. Large surface area may be needed due to shallow bedrock/groundwater. Shallow groundwater inflow may limit storage capacity. Significant permitting/mitigation issues if associated with wetland.	Further Evaluation	No further investigation warranted due to limited areas suitable for facility (high water table).
I-2(c). Groundwater collection and pumping to regional retention/infiltration sites, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Can serve a larger area, independent of slope. Could be used periodically to pump shallow groundwater when it rises above some threshold. **Cons:** Shallow groundwater is in isolated pockets so very hard to collect efficiently. Requires construction of force main, pumps, wells/galleries. High O&M costs. Potential water quality impacts to Wanapum aquifer. Periodic pumping of high groundwater may not be possible due to technical and regulatory issues.		No further investigation warranted due to inherent inefficiencies in the system and expected high O&M costs.

Preliminary Alternatives – Yellow Colored Area, Continued	Status: Aug. 2001	Status: July 2002
I-3. Collect & pump to regional infiltration facility in potential paleo-channel west of sub-basin, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Efficient operation and maintenance. Would recharge paleo-channel aquifer. **Cons:** Paleo-channel location & depth are uncertain; would require seismic study to assess potential suitability for regional infiltration facility. Not feasible if hydrogeologic study finds low permeability layers in paleo-channel. Anticipate high construction costs. High O&M costs. Potential water quality impacts to paleochannel aquifer and associated springs/streams. Potential water rights issues if considered interbasin transfer.		Further investigation to confirm location of west paleo-channel (Airway Heights) was not warranted given the option of a paleo-channel north of the airport. Pumping option O&M costs not feasible with viable options for gravity conveyance.
I-4. Raise road elevations in flood-prone areas. **Pros:** Would alleviate nuisance flooding of roads. **Cons:** May be costly depending on length & type of road to be raised.	Further Evaluation	Estimated costs based on 1999 flooding
B-1. New development standards for specific areas designed to minimize stormwater impacts, such as: – **Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed.** – **No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas.** – **Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps.** – **Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters)** – **Develop on-site retention requirements based on area-specific information (use "look-up" tables)** – **Implement annual County inspection of private stormwater facilities** **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities. **Cons:** Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate existing nuisance flooding.	Further Evaluation	Refined concepts, estimated costs for typical site.

STORMWATER MANAGEMENT

West Plains – West Portion of Planning Area

Preliminary Drainage Alternatives

Preliminary Alternatives – Gold Colored Area	Status: Aug. 2001	Status: July 2002
I-1(a). Gravity conveyance to regional infiltration facility in paleo-channel north of airport, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Efficient operation and maintenance. Various facility design options (e.g., above-ground basin or underground infiltration gallery). Would recharge paleo-channel aquifer. No pumping required. **Cons:** Shallow bedrock may increase construction costs of ditches/pipes. Limited gravity drainage area. Potential water quality impacts to paleo-channel aquifer. Regional and on-site pre-treatment required to protect aquifer. Potential clogging of infiltration facility. Not feasible if hydrogeologic study finds low permeability layers in paleo-channel.	Further Evaluation	Estimated future flows. Seismic survey & well drilling to estimate infiltration capacity of paleochannel. Estimated costs for regional conveyance & infiltration.
I-1(b). Pumping to regional infiltration facility in paleo-channel north of airport. **Pros:** Same as I-1(a), except pumping is required. Can serve a larger area, independent of slope. Could be used periodically to pump shallow groundwater when it rises above some threshold. **Cons:** Not feasible if hydrogeologic study finds low permeability layers in paleo-channel. Higher capital and O&M costs than gravity conveyance. Potential water quality impacts to paleo-channel aquifer. Periodic pumping of high groundwater may not be possible due to technical and regulatory issues.		No further investigation warranted due to inherent inefficiencies in the system and expected high O&M costs.
I-3. Collect & pump to regional infiltration facility in potential paleo-channel west of sub-basin, with on-site pre-treatment. **Pros:** Regional facility allows larger % of private properties to be developed. Efficient operation and maintenance. Would recharge paleo-channel aquifer. **Cons:** Paleo-channel location & depth are uncertain; would require seismic study to assess potential suitability for regional infiltration facility. Not feasible if hydrogeologic study finds low permeability layers in paleo-channel. Anticipate high construction costs. High O&M costs. Potential water quality impacts to paleo-channel aquifer and associated springs/streams. Potential water rights issues if considered an interbasin transfer.		Further investigation to confirm location of west paleo-channel was not warranted given the option of a paleo-channel north of the airport. Pumping option O&M costs not feasible with viable options for gravity conveyance.

Preliminary Alternatives – Gold Colored Area, Continued	Status: Aug. 2001	Status: July 2002
I-4. Raise road elevations in flood-prone areas. **Pros:** Would alleviate nuisance flooding of roads. **Cons:** May be costly depending on length & type of road to be raised.	Further Evaluation	Estimated costs based on 1999 flooding.
B-1. New **development standards for specific areas designed to minimize stormwater impacts, such as:** – **Require geotech borings to assess soil and depth to bedrock prior to site development, if infiltration or basements are proposed.** – **No on-site infiltration in areas with shallow bedrock (based on geotech borings) or mapped flooded areas.** – **Elevate key site areas (e.g., access roads, loading docks) if appropriate based on geotech borings or flood area maps.** – **Encourage site designs that reduce hydrologic impacts (e.g., xeriscaping, stormwater planters)** – **Develop on-site retention requirements based on area-specific information (use "look-up" tables)** – **Implement annual County inspection of private stormwater facilities.** **Pros:** Helps property owners and County avoid future drainage problems. Provides flexibility in site planning to reduce retention needs, improve aesthetics, and reduce costs. County inspections could help assure on-site facilities maintain their functions over the long term and reduce the need for regional facilities. **Cons:** Requires more plan review, enforcement by County. Potentially numerous facilities requiring O & M by property owners. On-site retention could occupy large % of site. Wouldn't mitigate existing nuisance flooding.	Further Evaluation	Refined concepts, estimated costs for typical site.

APPENDIX B

GEOPHYSICAL SURVEY REPORT AND WELL LOGS

[To be provided by URS]

APPENDIX B

GEOPHYSICAL SURVEY REPORT AND WELL LOGS

[To be provided by URS]

APPENDIX C

HSPF FLOWS

Flows for Hydraulic Evaluation:

West Plains Stormwater Management

May 30, 2002

Indian Canyon Creek Flows (cfs) (w/ 50% of IC3 flows) - Existing Conditions

	50% of IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	17.1	10.5	27.6	11.9	39.4	42.2	81.6
5-yr	23.2	14.3	37.4	16.1	53.5	56.9	110.4
10-yr	27.2	16.9	44.0	19.1	63.1	67.2	130.3
25-yr	32.2	20.4	52.6	23.2	75.7	80.5	156.2
50-yr	35.9	23.2	59.0	26.4	85.4	90.9	176.3
100-yr	39.6	26.1	65.6	29.7	95.3	101.6	196.9
200-yr	43.3	29.1	72.4	33.3	105.7	112.6	218.3
500-yr	48.3	33.4	81.6	38.2	119.8	128.0	247.8

Indian Canyon Creek Flows (cfs) (w/ 50% of IC3 flows) - Future Conditions

	50% of IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	18.7	10.3	29.0	10.9	39.8	43.0	82.8
5-yr	25.5	13.9	39.4	14.5	53.9	57.8	111.7
10-yr	30.0	16.3	46.2	17.1	63.3	68.2	131.5
25-yr	35.4	19.5	54.9	20.4	75.3	81.9	157.1
50-yr	39.4	22.0	61.4	23.0	84.4	92.6	176.9
100-yr	43.3	24.5	67.8	25.7	93.5	103.7	197.2
200-yr	47.2	27.2	74.4	28.5	102.9	115.3	218.2
500-yr	52.4	31.0	83.3	32.4	115.7	131.6	247.3

Indian Canyon Creek Flows (cfs) (w/100% of IC3 flows) - Future Conditions with Added Flows

	IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	37.4	10.3	47.7	10.9	58.5	43.0	101.5
5-yr	51.1	13.9	64.9	14.5	79.4	57.8	137.2
10-yr	59.9	16.3	76.2	17.1	93.3	68.2	161.4
25-yr	70.9	19.5	90.3	20.4	110.7	81.9	192.6
50-yr	78.8	22.0	100.8	23.0	123.8	92.6	216.3
100-yr	86.7	24.5	111.2	25.7	136.9	103.7	240.6
200-yr	94.5	27.2	121.7	28.5	150.1	115.3	265.4
500-yr	104.7	31.0	135.7	32.4	168.1	131.6	299.6

Garden Springs Creek Flows (cfs) - Existing Conditions							
			Upper Reach		Lower Reach		
	GS1	GS2	Subtotal	GS3	Total		
2-yr	9.0	4.4	13.4	5.0	18.4		
5-yr	12.2	5.9	18.0	6.8	24.8		
10-yr	14.3	7.0	21.2	7.9	29.1		
25-yr	17.1	8.4	25.5	9.5	34.9		
50-yr	19.2	9.5	28.7	10.6	39.3		
100-yr	21.5	10.7	32.1	11.7	43.8		
200-yr	23.8	11.9	35.6	12.9	48.5		
500-yr	26.9	13.6	40.5	14.5	55.0		

Garden Springs Creek Flows (cfs) - Future Conditions							
			Upper Reach		Lower Reach		
	GS1	GS2	Subtotal	GS3	Total		
2-yr	9.8	4.9	14.7	5.5	20.2		
5-yr	13.0	6.7	19.7	7.3	27.0		
10-yr	15.2	8.0	23.1	8.7	31.8		
25-yr	17.9	9.6	27.5	10.3	37.8		
50-yr	20.0	11.0	31.0	11.5	42.5		
100-yr	22.2	12.3	34.4	12.8	47.2		
200-yr	24.4	13.7	38.1	14.1	52.1		
500-yr	27.4	15.8	43.2	15.9	59.0		

Garden Springs Creek Flows (cfs) - Future Conditions with Added Flows							
			Upper Reach		Lower Reach		
	2 x GS1	GS2	Subtotal	GS3	Total		
2-yr	19.6	4.9	24.5	5.5	30.0		
5-yr	25.9	6.7	32.6	7.3	39.9		
10-yr	30.3	8.0	38.3	8.7	46.9		
25-yr	35.8	9.6	45.4	10.3	55.7		
50-yr	40.0	11.0	51.0	11.5	62.5		
100-yr	44.3	12.3	56.6	12.8	69.4		
200-yr	48.7	13.7	62.4	14.1	76.5		
500-yr	54.8	15.8	70.6	15.9	86.4		

Flows to Paleochannel (cfs) - Existing Conditions							
	IC2	50% of IC2	IC1	Total			
2-yr	127.8	63.9	33.8	97.7			
5-yr	173.2	86.6	44.8	131.4			
10-yr	202.9	101.4	51.8	153.2			
25-yr	240.0	120.0	60.5	180.5			
50-yr	267.4	133.7	66.8	200.5			
100-yr	294.7	147.3	73.0	220.3			
200-yr	322.0	161.0	79.2	240.2			
500-yr	358.4	179.2	87.4	266.5			
Flows to Paleochannel (cfs) - Future Conditions							
	IC2	50% of IC2	IC1	Total			
2-yr	160.6	80.3	69.3	149.6			
5-yr	221.3	110.6	94.5	205.1			
10-yr	261.0	130.5	112.1	242.6			
25-yr	310.8	155.4	135.5	290.9			
50-yr	347.6	173.8	153.7	327.5			
100-yr	384.1	192.0	172.6	364.6			
200-yr	420.6	210.3	192.4	402.6			
500-yr	469.1	234.6	220.0	454.6			
Flows to Paleochannel (cfs) w/added I-90 Flows - Future Conditions							
	Revised IC2	40% Rev. IC2	70% Rev.IC2	IC1	Total		
2-yr	271.9	108.7	190.3	69.3	259.6		
5-yr	374.0	149.6	261.8	94.5	356.3		
10-yr	440.8	176.3	308.6	112.1	420.7		
25-yr	524.2	209.7	366.9	135.5	502.4		
50-yr	585.6	234.2	409.9	153.7	563.6		
100-yr	646.5	258.6	452.5	172.6	625.1		
200-yr	707.3	282.9	495.1	192.4	687.5		
500-yr	788.2	315.3	551.7	220.0	771.7		
Flows to Paleochannel (cfs) Existing Conditions (flow estimate w/lag)							
	IC2	50% of IC2	IC1	Total			
2-yr	83.2	41.6	24.9	66.5			
5-yr	109.3	54.6	32.2	86.8			
10-yr	125.1	62.5	36.4	98.9			
25-yr	143.7	71.9	41.3	113.2			
50-yr	156.8	78.4	44.7	123.1			
100-yr	169.2	84.6	47.9	132.4			
200-yr	181.1	90.6	50.8	141.4			
500-yr	196.3	98.1	54.5	152.6			

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	95-pct Confidence Limits for Bull. 17B Estimates Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
GS1	2-yr	9.0	9.0	9.0	8.3	9.7	**9.0**		
	5-yr	12.0	12.0	12.1	11.0	13.3	**12.2**		
	10-yr	14.0	14.0	14.2	12.7	15.8	**14.3**		
	25-yr	16.6	16.6	17.0	14.9	19.3	**17.1**		
	50-yr	18.6	18.6	19.2	16.4	22.0	**19.2**		
	100-yr	20.7	20.7	21.5	18.0	24.9	**21.5**		
	200-yr	22.8	22.8	24.0	19.6	27.9	**23.8**		
	500-yr	25.6	25.6	27.5	21.7	32.1	**26.9**		
GS2	2-yr	4.3	4.3	4.3	4.0	4.7	**4.4**		
	5-yr	5.8	5.8	5.8	5.3	6.4	**5.9**		
	10-yr	6.8	6.8	6.9	6.2	7.7	**7.0**		
	25-yr	8.1	8.1	8.3	7.2	9.5	**8.4**		
	50-yr	9.2	9.2	9.5	8.1	10.9	**9.5**		
	100-yr	10.2	10.2	10.7	8.9	12.4	**10.7**		
	200-yr	11.4	11.4	12.0	9.7	14.0	**11.9**		
	500-yr	12.9	12.9	13.9	10.9	16.3	**13.6**		
GS3	2-yr	5.0	5.0	5.0	4.6	5.4	**5.0**		
	5-yr	6.6	6.6	6.7	6.1	7.4	**6.8**		
	10-yr	7.8	7.8	7.8	7.0	8.8	**7.9**		
	25-yr	9.2	9.2	9.3	8.2	10.7	**9.5**		
	50-yr	10.2	10.2	10.5	9.0	12.1	**10.6**		
	100-yr	11.3	11.3	11.7	9.8	13.6	**11.7**		
	200-yr	12.3	12.3	12.9	10.6	15.1	**12.9**		
	500-yr	13.8	13.8	14.7	11.7	17.2	**14.5**		
IC1	2-yr	33.7	33.7	33.7	31.2	36.4	**33.8**		
	5-yr	44.2	44.2	44.5	40.7	48.9	**44.8**		
	10-yr	50.9	50.9	51.4	46.3	57.3	**51.8**		
	25-yr	59.0	59.0	60.1	53.0	68.0	**60.5**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
	50-yr	64.9	64.9	66.5	57.6	76.0	**66.8**		
	100-yr	70.7	70.7	73.0	62.1	83.9	**73.0**		
	200-yr	76.3	76.3	79.5	66.5	91.9	**79.2**		
	500-yr	83.7	83.7	88.4	72.1	102.6	**87.4**		
IC2	2-yr	127.3	127.3	127.3	117.0	138.5	**127.8**	83.2	65%
	5-yr	170.9	170.9	171.8	156.2	190.2	**173.2**	109.3	63%
	10-yr	198.9	198.9	201.1	179.7	226.0	**202.9**	125.1	62%
	25-yr	233.7	233.7	238.2	207.8	272.2	**240.0**	143.7	60%
	50-yr	259.0	259.0	266.1	227.8	307.0	**267.4**	156.8	59%
	100-yr	284.1	284.1	294.4	247.1	342.2	**294.7**	169.2	57%
	200-yr	309.0	309.0	323.2	266.1	377.8	**322.0**	181.1	56%
	500-yr	341.9	341.9	362.7	290.8	425.9	**358.4**	196.3	55%

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
IC2	2-yr	215.9	215.9	215.9	198.5	234.9	**216.7**		
(Revised)	5-yr	289.9	289.9	291.5	264.9	322.7	**293.8**		
	10-yr	337.5	337.5	341.2	304.9	383.4	**344.2**		
	25-yr	396.4	396.4	404.1	352.5	461.7	**407.1**		
	50-yr	439.4	439.4	451.4	386.4	520.8	**453.6**		
	100-yr	481.9	481.9	499.3	419.2	580.4	**499.8**		
	200-yr	524.1	524.1	548.2	451.3	640.9	**546.1**		
	500-yr	580.0	580.0	615.2	493.2	722.4	**607.8**		
IC3	2-yr	34.1	34.1	34.1	31.4	37.1	**34.3**		
	5-yr	45.8	45.8	46.0	41.8	50.9	**46.4**		
	10-yr	53.3	53.3	53.9	48.2	60.5	**54.4**		
	25-yr	62.6	62.6	63.9	55.7	72.9	**64.3**		
	50-yr	69.5	69.5	71.4	61.1	82.3	**71.7**		
	100-yr	76.3	76.3	79.1	66.4	91.9	**79.2**		
	200-yr	83.1	83.1	87.0	71.6	101.6	**86.6**		
	500-yr	92.1	92.1	97.8	78.3	114.7	**96.5**		
IC4	2-yr	10.5	10.5	10.5	9.6	11.3	**10.5**		
	5-yr	14.0	14.0	14.1	12.9	15.6	**14.3**		
	10-yr	16.5	16.5	16.7	15.0	18.7	**16.9**		
	25-yr	19.8	19.8	20.3	17.7	23.1	**20.4**		
	50-yr	22.4	22.4	23.1	19.7	26.6	**23.2**		
	100-yr	25.0	25.0	26.2	21.7	30.4	**26.1**		
	200-yr	27.8	27.8	29.4	23.8	34.4	**29.1**		
	500-yr	31.6	31.6	34.2	26.6	40.1	**33.4**		
IC5	2-yr	11.8	11.8	11.8	10.9	12.8	**11.9**		
	5-yr	15.9	15.9	16.0	14.6	17.6	**16.1**		
	10-yr	18.8	18.8	19.0	17.0	21.2	**19.1**		
	25-yr	22.5	22.5	23.1	20.0	26.3	**23.2**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
	50-yr	25.5	25.5	26.3	22.4	30.4	**26.4**		
	100-yr	28.6	28.6	29.9	24.7	34.7	**29.7**		
	200-yr	31.8	31.8	33.7	27.1	39.4	**33.3**		
	500-yr	36.2	36.2	39.2	30.4	46.0	**38.2**		
IC6	2-yr	42.1	42.1	42.1	38.8	45.6	**42.2**		
	5-yr	56.2	56.2	56.5	51.6	62.2	**56.9**		
	10-yr	65.9	65.9	66.6	59.8	74.5	**67.2**		
	25-yr	78.4	78.4	80.1	69.9	91.1	**80.5**		
	50-yr	88.0	88.0	90.7	77.4	104.3	**90.9**		
	100-yr	97.8	97.8	101.9	85.0	118.1	**101.6**		
	200-yr	107.9	107.9	113.8	92.6	132.6	**112.6**		
	500-yr	121.7	121.7	130.8	102.9	153.1	**128.0**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
C1, 3-hr La	2-yr	24.8	24.8	24.8	23.1	26.7	**24.9**		
	5-yr	31.8	31.8	31.9	29.4	34.9	**32.2**		
	10-yr	35.8	35.8	36.1	32.8	40.0	**36.4**		
	25-yr	40.5	40.5	41.0	36.6	46.0	**41.3**		
	50-yr	43.6	43.6	44.4	39.2	50.2	**44.7**		
	100-yr	46.5	46.5	47.7	41.5	54.2	**47.9**		
	200-yr	49.3	49.3	50.8	43.6	58.0	**50.8**		
	500-yr	52.7	52.7	54.7	46.3	62.7	**54.5**		
C2, 6-hr La	2-yr	82.9	82.9	82.9	76.8	89.6	**83.2**		
	5-yr	107.9	107.9	108.4	99.3	119.2	**109.3**		
	10-yr	122.9	122.9	124.0	112.0	138.1	**125.1**		
	25-yr	140.4	140.4	142.6	126.3	161.1	**143.7**		
	50-yr	152.6	152.6	155.9	136.1	177.4	**156.8**		
	100-yr	164.1	164.1	168.7	145.1	193.2	**169.2**		
	200-yr	175.1	175.1	181.2	153.7	208.5	**181.1**		
	500-yr	189.0	189.0	197.5	164.3	228.2	**196.3**		
2, 10-hr L	2-yr	77.6	77.6	77.6	71.8	84.1	**78.0**		
	5-yr	101.5	101.5	102.0	93.3	112.3	**102.8**		
	10-yr	115.8	115.8	116.9	105.4	130.4	**117.9**		
	25-yr	132.6	132.6	134.7	119.1	152.4	**135.8**		
	50-yr	144.2	144.2	147.4	128.4	168.1	**148.3**		
	100-yr	155.3	155.3	159.6	137.0	183.3	**160.2**		
	200-yr	165.8	165.8	171.6	145.2	198.0	**171.6**		
	500-yr	179.2	179.2	187.3	155.4	217.0	**186.2**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
GS1	2-yr	9.8	9.8	9.8	9.1	10.5	**9.8**		
	5-yr	12.8	12.8	12.9	11.8	14.1	**13.0**		
	10-yr	14.9	14.9	15.0	13.6	16.7	**15.2**		
	25-yr	17.5	17.5	17.8	15.7	20.1	**17.9**		
	50-yr	19.4	19.4	20.0	17.2	22.8	**20.0**		
	100-yr	21.4	21.4	22.2	18.8	25.5	**22.2**		
	200-yr	23.4	23.4	24.6	20.3	28.4	**24.4**		
	500-yr	26.2	26.2	28.0	22.4	32.4	**27.4**		
GS2	2-yr	4.9	4.9	4.9	4.5	5.3	**4.9**		
	5-yr	6.6	6.6	6.6	6.1	7.3	**6.7**		
	10-yr	7.8	7.8	7.9	7.1	8.8	**8.0**		
	25-yr	9.3	9.3	9.6	8.3	10.9	**9.6**		
	50-yr	10.5	10.5	10.9	9.3	12.6	**11.0**		
	100-yr	11.8	11.8	12.3	10.2	14.3	**12.3**		
	200-yr	13.1	13.1	13.9	11.2	16.2	**13.7**		
	500-yr	14.9	14.9	16.1	12.6	18.9	**15.8**		
GS3	2-yr	5.4	5.4	5.4	5.0	5.9	**5.5**		
	5-yr	7.2	7.2	7.3	6.6	8.0	**7.3**		
	10-yr	8.5	8.5	8.6	7.7	9.6	**8.7**		
	25-yr	10.0	10.0	10.2	8.9	11.6	**10.3**		
	50-yr	11.2	11.2	11.5	9.8	13.2	**11.5**		
	100-yr	12.3	12.3	12.8	10.7	14.9	**12.8**		
	200-yr	13.5	13.5	14.2	11.6	16.5	**14.1**		
	500-yr	15.1	15.1	16.1	12.8	18.9	**15.9**		
IC1	2-yr	69.1	69.1	69.1	63.6	75.0	**69.3**		
	5-yr	93.3	93.3	93.8	85.4	103.6	**94.5**		
	10-yr	109.9	109.9	111.3	99.4	124.8	**112.1**		
	25-yr	131.8	131.8	134.7	117.0	153.9	**135.5**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS									
				Expected	95-pct Confidence Limits		95% Conf. Level	Flow w/	Percent
	Recurrence	Bull.17B	Systematic	Probability'	for Bull. 17B Estimates		Ave.Upper and Lower	6hr lag	Attenuation
Subbasin	Interval	Estimate	Record	Estimate	Lower	Upper	Bull. 17B Estimates		
	50-yr	148.6	148.6	153.4	130.2	177.2	**153.7**		
	100-yr	165.9	165.9	173.3	143.4	201.7	**172.6**		
	200-yr	183.8	183.8	194.5	156.9	227.8	**192.4**		
	500-yr	208.7	208.7	225.0	175.3	264.7	**220.0**		
IC2	2-yr	159.9	159.9	159.9	146.3	174.8	**160.6**		
	5-yr	218.0	218.0	219.3	198.2	244.3	**221.3**		
	10-yr	255.6	255.6	258.5	229.5	292.5	**261.0**		
	25-yr	302.0	302.0	308.1	266.9	354.7	**310.8**		
	50-yr	335.9	335.9	345.4	293.4	401.7	**347.6**		
	100-yr	369.3	369.3	383.0	319.1	449.0	**384.1**		
	200-yr	402.5	402.5	421.5	344.2	496.9	**420.6**		
	500-yr	446.3	446.3	473.9	376.8	561.4	**469.1**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS									
Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
IC2	2-yr	270.7	270.7	270.7	247.8	295.9	**271.9**		
Revised	5-yr	368.6	368.6	370.7	335.2	412.8	**374.0**		
	10-yr	431.6	431.6	436.5	387.9	493.7	**440.8**		
	25-yr	509.4	509.4	519.6	450.4	597.9	**524.2**		
	50-yr	566.2	566.2	581.9	494.8	676.3	**585.6**		
	100-yr	622.0	622.0	644.8	537.7	755.2	**646.5**		
	200-yr	677.3	677.3	708.8	579.6	835.0	**707.3**		
	500-yr	750.3	750.3	796.1	634.0	942.4	**788.2**		
IC3	2-yr	37.2	37.2	37.2	34.1	40.6	**37.4**		
	5-yr	50.3	50.3	50.6	45.8	56.3	**51.1**		
	10-yr	58.7	58.7	59.3	52.8	67.0	**59.9**		
	25-yr	68.9	68.9	70.2	61.1	80.6	**70.9**		
	50-yr	76.3	76.3	78.3	66.8	90.8	**78.8**		
	100-yr	83.5	83.5	86.4	72.4	100.9	**86.7**		
	200-yr	90.6	90.6	94.6	77.8	111.1	**94.5**		
	500-yr	99.8	99.8	105.6	84.7	124.7	**104.7**		
IC4	2-yr	10.3	10.3	10.3	9.5	11.1	**10.3**		
	5-yr	13.7	13.7	13.7	12.6	15.1	**13.9**		
	10-yr	16.0	16.0	16.1	14.5	18.0	**16.3**		
	25-yr	19.0	19.0	19.4	17.0	21.9	**19.5**		
	50-yr	21.3	21.3	21.9	18.8	25.1	**22.0**		
	100-yr	23.6	23.6	24.6	20.6	28.4	**24.5**		
	200-yr	26.1	26.1	27.6	22.5	31.9	**27.2**		
	500-yr	29.5	29.5	31.7	25.0	36.9	**31.0**		
IC5	2-yr	10.8	10.8	10.8	10.0	11.7	**10.9**		
	5-yr	14.4	14.4	14.4	13.2	15.8	**14.5**		
	10-yr	16.8	16.8	17.0	15.3	18.9	**17.1**		
	25-yr	19.9	19.9	20.3	17.8	23.0	**20.4**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS									
				Expected	95-pct Confidence Limits		95% Conf. Level	Flow w/	Percent
	Recurrence	Bull.17B	Systematic	Probability'	for Bull. 17B Estimates		Ave.Upper and Lower	6hr lag	Attenuation
Subbasin	Interval	Estimate	Record	Estimate	Lower	Upper	Bull. 17B Estimates		
	50-yr	22.3	22.3	23.0	19.7	26.3	**23.0**		
	100-yr	24.8	24.8	25.8	21.6	29.8	**25.7**		
	200-yr	27.3	27.3	28.8	23.5	33.4	**28.5**		
	500-yr	30.8	30.8	33.2	26.2	38.6	**32.4**		
IC6	2-yr	42.9	42.9	42.9	39.6	46.4	**43.0**		
	5-yr	57.1	57.1	57.4	52.5	63.1	**57.8**		
	10-yr	66.9	66.9	67.7	60.8	75.5	**68.2**		
	25-yr	79.8	79.8	81.5	71.2	92.5	**81.9**		
	50-yr	89.7	89.7	92.5	79.0	106.1	**92.6**		
	100-yr	99.9	99.9	104.2	86.9	120.5	**103.7**		
	200-yr	110.4	110.4	116.7	94.9	135.7	**115.3**		
	500-yr	125.1	125.1	134.8	105.8	157.3	**131.6**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
C2, 1/2 are	2-yr	78.7	78.7	78.7	72.0	86.1	**79.1**		
	5-yr	107.6	107.6	108.3	97.8	120.7	**109.3**		
	10-yr	126.3	126.3	127.8	113.4	144.7	**129.1**		
	25-yr	149.5	149.5	152.6	132.0	175.9	**154.0**		
	50-yr	166.5	166.5	171.2	145.3	199.4	**172.4**		
	100-yr	183.2	183.2	190.1	158.1	223.1	**190.6**		
	200-yr	199.9	199.9	209.4	170.7	247.2	**209.0**		
	500-yr	221.9	221.9	235.8	187.0	279.7	**233.4**		

APPENDIX C

HSPF FLOWS

Flows for Hydraulic Evaluation:

West Plains Stormwater Management

May 30, 2002

Indian Canyon Creek Flows (cfs) (w/ 50% of IC3 flows) - Existing Conditions

	50% of IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	17.1	10.5	27.6	11.9	39.4	42.2	81.6
5-yr	23.2	14.3	37.4	16.1	53.5	56.9	110.4
10-yr	27.2	16.9	44.0	19.1	63.1	67.2	130.3
25-yr	32.2	20.4	52.6	23.2	75.7	80.5	156.2
50-yr	35.9	23.2	59.0	26.4	85.4	90.9	176.3
100-yr	39.6	26.1	65.6	29.7	95.3	101.6	196.9
200-yr	43.3	29.1	72.4	33.3	105.7	112.6	218.3
500-yr	48.3	33.4	81.6	38.2	119.8	128.0	247.8

Indian Canyon Creek Flows (cfs) (w/ 50% of IC3 flows) - Future Conditions

	50% of IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	18.7	10.3	29.0	10.9	39.8	43.0	82.8
5-yr	25.5	13.9	39.4	14.5	53.9	57.8	111.7
10-yr	30.0	16.3	46.2	17.1	63.3	68.2	131.5
25-yr	35.4	19.5	54.9	20.4	75.3	81.9	157.1
50-yr	39.4	22.0	61.4	23.0	84.4	92.6	176.9
100-yr	43.3	24.5	67.8	25.7	93.5	103.7	197.2
200-yr	47.2	27.2	74.4	28.5	102.9	115.3	218.2
500-yr	52.4	31.0	83.3	32.4	115.7	131.6	247.3

Indian Canyon Creek Flows (cfs) (w/100% of IC3 flows) - Future Conditions with Added Flows

	IC3	IC4	Upper Reach Subtotal	IC5	Middle Reach Subtotal	IC6	Lower Reach Total
2-yr	37.4	10.3	47.7	10.9	58.5	43.0	101.5
5-yr	51.1	13.9	64.9	14.5	79.4	57.8	137.2
10-yr	59.9	16.3	76.2	17.1	93.3	68.2	161.4
25-yr	70.9	19.5	90.3	20.4	110.7	81.9	192.6
50-yr	78.8	22.0	100.8	23.0	123.8	92.6	216.3
100-yr	86.7	24.5	111.2	25.7	136.9	103.7	240.6
200-yr	94.5	27.2	121.7	28.5	150.1	115.3	265.4
500-yr	104.7	31.0	135.7	32.4	168.1	131.6	299.6

Garden Springs Creek Flows (cfs) - Existing Conditions							
			Upper Reach		Lower Reach		
	GS1	GS2	Subtotal	GS3	Total		
2-yr	9.0	4.4	13.4	5.0	18.4		
5-yr	12.2	5.9	18.0	6.8	24.8		
10-yr	14.3	7.0	21.2	7.9	29.1		
25-yr	17.1	8.4	25.5	9.5	34.9		
50-yr	19.2	9.5	28.7	10.6	39.3		
100-yr	21.5	10.7	32.1	11.7	43.8		
200-yr	23.8	11.9	35.6	12.9	48.5		
500-yr	26.9	13.6	40.5	14.5	55.0		

Garden Springs Creek Flows (cfs) - Future Conditions							
			Upper Reach		Lower Reach		
	GS1	GS2	Subtotal	GS3	Total		
2-yr	9.8	4.9	14.7	5.5	20.2		
5-yr	13.0	6.7	19.7	7.3	27.0		
10-yr	15.2	8.0	23.1	8.7	31.8		
25-yr	17.9	9.6	27.5	10.3	37.8		
50-yr	20.0	11.0	31.0	11.5	42.5		
100-yr	22.2	12.3	34.4	12.8	47.2		
200-yr	24.4	13.7	38.1	14.1	52.1		
500-yr	27.4	15.8	43.2	15.9	59.0		

Garden Springs Creek Flows (cfs) - Future Conditions with Added Flows							
			Upper Reach		Lower Reach		
	2 x GS1	GS2	Subtotal	GS3	Total		
2-yr	19.6	4.9	24.5	5.5	30.0		
5-yr	25.9	6.7	32.6	7.3	39.9		
10-yr	30.3	8.0	38.3	8.7	46.9		
25-yr	35.8	9.6	45.4	10.3	55.7		
50-yr	40.0	11.0	51.0	11.5	62.5		
100-yr	44.3	12.3	56.6	12.8	69.4		
200-yr	48.7	13.7	62.4	14.1	76.5		
500-yr	54.8	15.8	70.6	15.9	86.4		

Flows to Paleochannel (cfs) - Existing Conditions							
	IC2	50% of IC2	IC1	Total			
2-yr	127.8	63.9	33.8	97.7			
5-yr	173.2	86.6	44.8	131.4			
10-yr	202.9	101.4	51.8	153.2			
25-yr	240.0	120.0	60.5	180.5			
50-yr	267.4	133.7	66.8	200.5			
100-yr	294.7	147.3	73.0	220.3			
200-yr	322.0	161.0	79.2	240.2			
500-yr	358.4	179.2	87.4	266.5			
Flows to Paleochannel (cfs) - Future Conditions							
	IC2	50% of IC2	IC1	Total			
2-yr	160.6	80.3	69.3	149.6			
5-yr	221.3	110.6	94.5	205.1			
10-yr	261.0	130.5	112.1	242.6			
25-yr	310.8	155.4	135.5	290.9			
50-yr	347.6	173.8	153.7	327.5			
100-yr	384.1	192.0	172.6	364.6			
200-yr	420.6	210.3	192.4	402.6			
500-yr	469.1	234.6	220.0	454.6			
Flows to Paleochannel (cfs) w/added I-90 Flows - Future Conditions							
	Revised IC2	40% Rev. IC2	70% Rev.IC2	IC1	Total		
2-yr	271.9	108.7	190.3	69.3	259.6		
5-yr	374.0	149.6	261.8	94.5	356.3		
10-yr	440.8	176.3	308.6	112.1	420.7		
25-yr	524.2	209.7	366.9	135.5	502.4		
50-yr	585.6	234.2	409.9	153.7	563.6		
100-yr	646.5	258.6	452.5	172.6	625.1		
200-yr	707.3	282.9	495.1	192.4	687.5		
500-yr	788.2	315.3	551.7	220.0	771.7		
Flows to Paleochannel (cfs) Existing Conditions (flow estimate w/lag)							
	IC2	50% of IC2	IC1	Total			
2-yr	83.2	41.6	24.9	66.5			
5-yr	109.3	54.6	32.2	86.8			
10-yr	125.1	62.5	36.4	98.9			
25-yr	143.7	71.9	41.3	113.2			
50-yr	156.8	78.4	44.7	123.1			
100-yr	169.2	84.6	47.9	132.4			
200-yr	181.1	90.6	50.8	141.4			
500-yr	196.3	98.1	54.5	152.6			

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
GS1	2-yr	9.0	9.0	9.0	8.3	9.7	**9.0**		
	5-yr	12.0	12.0	12.1	11.0	13.3	**12.2**		
	10-yr	14.0	14.0	14.2	12.7	15.8	**14.3**		
	25-yr	16.6	16.6	17.0	14.9	19.3	**17.1**		
	50-yr	18.6	18.6	19.2	16.4	22.0	**19.2**		
	100-yr	20.7	20.7	21.5	18.0	24.9	**21.5**		
	200-yr	22.8	22.8	24.0	19.6	27.9	**23.8**		
	500-yr	25.6	25.6	27.5	21.7	32.1	**26.9**		
GS2	2-yr	4.3	4.3	4.3	4.0	4.7	**4.4**		
	5-yr	5.8	5.8	5.8	5.3	6.4	**5.9**		
	10-yr	6.8	6.8	6.9	6.2	7.7	**7.0**		
	25-yr	8.1	8.1	8.3	7.2	9.5	**8.4**		
	50-yr	9.2	9.2	9.5	8.1	10.9	**9.5**		
	100-yr	10.2	10.2	10.7	8.9	12.4	**10.7**		
	200-yr	11.4	11.4	12.0	9.7	14.0	**11.9**		
	500-yr	12.9	12.9	13.9	10.9	16.3	**13.6**		
GS3	2-yr	5.0	5.0	5.0	4.6	5.4	**5.0**		
	5-yr	6.6	6.6	6.7	6.1	7.4	**6.8**		
	10-yr	7.8	7.8	7.8	7.0	8.8	**7.9**		
	25-yr	9.2	9.2	9.3	8.2	10.7	**9.5**		
	50-yr	10.2	10.2	10.5	9.0	12.1	**10.6**		
	100-yr	11.3	11.3	11.7	9.8	13.6	**11.7**		
	200-yr	12.3	12.3	12.9	10.6	15.1	**12.9**		
	500-yr	13.8	13.8	14.7	11.7	17.2	**14.5**		
IC1	2-yr	33.7	33.7	33.7	31.2	36.4	**33.8**		
	5-yr	44.2	44.2	44.5	40.7	48.9	**44.8**		
	10-yr	50.9	50.9	51.4	46.3	57.3	**51.8**		
	25-yr	59.0	59.0	60.1	53.0	68.0	**60.5**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
	50-yr	64.9	64.9	66.5	57.6	76.0	**66.8**		
	100-yr	70.7	70.7	73.0	62.1	83.9	**73.0**		
	200-yr	76.3	76.3	79.5	66.5	91.9	**79.2**		
	500-yr	83.7	83.7	88.4	72.1	102.6	**87.4**		
IC2	2-yr	127.3	127.3	127.3	117.0	138.5	**127.8**	83.2	65%
	5-yr	170.9	170.9	171.8	156.2	190.2	**173.2**	109.3	63%
	10-yr	198.9	198.9	201.1	179.7	226.0	**202.9**	125.1	62%
	25-yr	233.7	233.7	238.2	207.8	272.2	**240.0**	143.7	60%
	50-yr	259.0	259.0	266.1	227.8	307.0	**267.4**	156.8	59%
	100-yr	284.1	284.1	294.4	247.1	342.2	**294.7**	169.2	57%
	200-yr	309.0	309.0	323.2	266.1	377.8	**322.0**	181.1	56%
	500-yr	341.9	341.9	362.7	290.8	425.9	**358.4**	196.3	55%

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS									
Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
IC2	2-yr	215.9	215.9	215.9	198.5	234.9	**216.7**		
(Revised)	5-yr	289.9	289.9	291.5	264.9	322.7	**293.8**		
	10-yr	337.5	337.5	341.2	304.9	383.4	**344.2**		
	25-yr	396.4	396.4	404.1	352.5	461.7	**407.1**		
	50-yr	439.4	439.4	451.4	386.4	520.8	**453.6**		
	100-yr	481.9	481.9	499.3	419.2	580.4	**499.8**		
	200-yr	524.1	524.1	548.2	451.3	640.9	**546.1**		
	500-yr	580.0	580.0	615.2	493.2	722.4	**607.8**		
IC3	2-yr	34.1	34.1	34.1	31.4	37.1	**34.3**		
	5-yr	45.8	45.8	46.0	41.8	50.9	**46.4**		
	10-yr	53.3	53.3	53.9	48.2	60.5	**54.4**		
	25-yr	62.6	62.6	63.9	55.7	72.9	**64.3**		
	50-yr	69.5	69.5	71.4	61.1	82.3	**71.7**		
	100-yr	76.3	76.3	79.1	66.4	91.9	**79.2**		
	200-yr	83.1	83.1	87.0	71.6	101.6	**86.6**		
	500-yr	92.1	92.1	97.8	78.3	114.7	**96.5**		
IC4	2-yr	10.5	10.5	10.5	9.6	11.3	**10.5**		
	5-yr	14.0	14.0	14.1	12.9	15.6	**14.3**		
	10-yr	16.5	16.5	16.7	15.0	18.7	**16.9**		
	25-yr	19.8	19.8	20.3	17.7	23.1	**20.4**		
	50-yr	22.4	22.4	23.1	19.7	26.6	**23.2**		
	100-yr	25.0	25.0	26.2	21.7	30.4	**26.1**		
	200-yr	27.8	27.8	29.4	23.8	34.4	**29.1**		
	500-yr	31.6	31.6	34.2	26.6	40.1	**33.4**		
IC5	2-yr	11.8	11.8	11.8	10.9	12.8	**11.9**		
	5-yr	15.9	15.9	16.0	14.6	17.6	**16.1**		
	10-yr	18.8	18.8	19.0	17.0	21.2	**19.1**		
	25-yr	22.5	22.5	23.1	20.0	26.3	**23.2**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
	50-yr	25.5	25.5	26.3	22.4	30.4	**26.4**		
	100-yr	28.6	28.6	29.9	24.7	34.7	**29.7**		
	200-yr	31.8	31.8	33.7	27.1	39.4	**33.3**		
	500-yr	36.2	36.2	39.2	30.4	46.0	**38.2**		
IC6	2-yr	42.1	42.1	42.1	38.8	45.6	**42.2**		
	5-yr	56.2	56.2	56.5	51.6	62.2	**56.9**		
	10-yr	65.9	65.9	66.6	59.8	74.5	**67.2**		
	25-yr	78.4	78.4	80.1	69.9	91.1	**80.5**		
	50-yr	88.0	88.0	90.7	77.4	104.3	**90.9**		
	100-yr	97.8	97.8	101.9	85.0	118.1	**101.6**		
	200-yr	107.9	107.9	113.8	92.6	132.6	**112.6**		
	500-yr	121.7	121.7	130.8	102.9	153.1	**128.0**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
C1, 3-hr La	2-yr	24.8	24.8	24.8	23.1	26.7	**24.9**		
	5-yr	31.8	31.8	31.9	29.4	34.9	**32.2**		
	10-yr	35.8	35.8	36.1	32.8	40.0	**36.4**		
	25-yr	40.5	40.5	41.0	36.6	46.0	**41.3**		
	50-yr	43.6	43.6	44.4	39.2	50.2	**44.7**		
	100-yr	46.5	46.5	47.7	41.5	54.2	**47.9**		
	200-yr	49.3	49.3	50.8	43.6	58.0	**50.8**		
	500-yr	52.7	52.7	54.7	46.3	62.7	**54.5**		
C2, 6-hr La	2-yr	82.9	82.9	82.9	76.8	89.6	**83.2**		
	5-yr	107.9	107.9	108.4	99.3	119.2	**109.3**		
	10-yr	122.9	122.9	124.0	112.0	138.1	**125.1**		
	25-yr	140.4	140.4	142.6	126.3	161.1	**143.7**		
	50-yr	152.6	152.6	155.9	136.1	177.4	**156.8**		
	100-yr	164.1	164.1	168.7	145.1	193.2	**169.2**		
	200-yr	175.1	175.1	181.2	153.7	208.5	**181.1**		
	500-yr	189.0	189.0	197.5	164.3	228.2	**196.3**		
2, 10-hr L	2-yr	77.6	77.6	77.6	71.8	84.1	**78.0**		
	5-yr	101.5	101.5	102.0	93.3	112.3	**102.8**		
	10-yr	115.8	115.8	116.9	105.4	130.4	**117.9**		
	25-yr	132.6	132.6	134.7	119.1	152.4	**135.8**		
	50-yr	144.2	144.2	147.4	128.4	168.1	**148.3**		
	100-yr	155.3	155.3	159.6	137.0	183.3	**160.2**		
	200-yr	165.8	165.8	171.6	145.2	198.0	**171.6**		
	500-yr	179.2	179.2	187.3	155.4	217.0	**186.2**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
GS1	2-yr	9.8	9.8	9.8	9.1	10.5	**9.8**		
	5-yr	12.8	12.8	12.9	11.8	14.1	**13.0**		
	10-yr	14.9	14.9	15.0	13.6	16.7	**15.2**		
	25-yr	17.5	17.5	17.8	15.7	20.1	**17.9**		
	50-yr	19.4	19.4	20.0	17.2	22.8	**20.0**		
	100-yr	21.4	21.4	22.2	18.8	25.5	**22.2**		
	200-yr	23.4	23.4	24.6	20.3	28.4	**24.4**		
	500-yr	26.2	26.2	28.0	22.4	32.4	**27.4**		
GS2	2-yr	4.9	4.9	4.9	4.5	5.3	**4.9**		
	5-yr	6.6	6.6	6.6	6.1	7.3	**6.7**		
	10-yr	7.8	7.8	7.9	7.1	8.8	**8.0**		
	25-yr	9.3	9.3	9.6	8.3	10.9	**9.6**		
	50-yr	10.5	10.5	10.9	9.3	12.6	**11.0**		
	100-yr	11.8	11.8	12.3	10.2	14.3	**12.3**		
	200-yr	13.1	13.1	13.9	11.2	16.2	**13.7**		
	500-yr	14.9	14.9	16.1	12.6	18.9	**15.8**		
GS3	2-yr	5.4	5.4	5.4	5.0	5.9	**5.5**		
	5-yr	7.2	7.2	7.3	6.6	8.0	**7.3**		
	10-yr	8.5	8.5	8.6	7.7	9.6	**8.7**		
	25-yr	10.0	10.0	10.2	8.9	11.6	**10.3**		
	50-yr	11.2	11.2	11.5	9.8	13.2	**11.5**		
	100-yr	12.3	12.3	12.8	10.7	14.9	**12.8**		
	200-yr	13.5	13.5	14.2	11.6	16.5	**14.1**		
	500-yr	15.1	15.1	16.1	12.8	18.9	**15.9**		
IC1	2-yr	69.1	69.1	69.1	63.6	75.0	**69.3**		
	5-yr	93.3	93.3	93.8	85.4	103.6	**94.5**		
	10-yr	109.9	109.9	111.3	99.4	124.8	**112.1**		
	25-yr	131.8	131.8	134.7	117.0	153.9	**135.5**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS									
				Expected	95-pct Confidence Limits		95% Conf. Level	Flow w/	Percent
	Recurrence	Bull.17B	Systematic	Probability'	for Bull. 17B Estimates		Ave.Upper and Lower	6hr lag	Attenuation
Subbasin	Interval	Estimate	Record	Estimate	Lower	Upper	Bull. 17B Estimates		
	50-yr	148.6	148.6	153.4	130.2	177.2	**153.7**		
	100-yr	165.9	165.9	173.3	143.4	201.7	**172.6**		
	200-yr	183.8	183.8	194.5	156.9	227.8	**192.4**		
	500-yr	208.7	208.7	225.0	175.3	264.7	**220.0**		
IC2	2-yr	159.9	159.9	159.9	146.3	174.8	**160.6**		
	5-yr	218.0	218.0	219.3	198.2	244.3	**221.3**		
	10-yr	255.6	255.6	258.5	229.5	292.5	**261.0**		
	25-yr	302.0	302.0	308.1	266.9	354.7	**310.8**		
	50-yr	335.9	335.9	345.4	293.4	401.7	**347.6**		
	100-yr	369.3	369.3	383.0	319.1	449.0	**384.1**		
	200-yr	402.5	402.5	421.5	344.2	496.9	**420.6**		
	500-yr	446.3	446.3	473.9	376.8	561.4	**469.1**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
IC2	2-yr	270.7	270.7	270.7	247.8	295.9	**271.9**		
Revised	5-yr	368.6	368.6	370.7	335.2	412.8	**374.0**		
	10-yr	431.6	431.6	436.5	387.9	493.7	**440.8**		
	25-yr	509.4	509.4	519.6	450.4	597.9	**524.2**		
	50-yr	566.2	566.2	581.9	494.8	676.3	**585.6**		
	100-yr	622.0	622.0	644.8	537.7	755.2	**646.5**		
	200-yr	677.3	677.3	708.8	579.6	835.0	**707.3**		
	500-yr	750.3	750.3	796.1	634.0	942.4	**788.2**		
IC3	2-yr	37.2	37.2	37.2	34.1	40.6	**37.4**		
	5-yr	50.3	50.3	50.6	45.8	56.3	**51.1**		
	10-yr	58.7	58.7	59.3	52.8	67.0	**59.9**		
	25-yr	68.9	68.9	70.2	61.1	80.6	**70.9**		
	50-yr	76.3	76.3	78.3	66.8	90.8	**78.8**		
	100-yr	83.5	83.5	86.4	72.4	100.9	**86.7**		
	200-yr	90.6	90.6	94.6	77.8	111.1	**94.5**		
	500-yr	99.8	99.8	105.6	84.7	124.7	**104.7**		
IC4	2-yr	10.3	10.3	10.3	9.5	11.1	**10.3**		
	5-yr	13.7	13.7	13.7	12.6	15.1	**13.9**		
	10-yr	16.0	16.0	16.1	14.5	18.0	**16.3**		
	25-yr	19.0	19.0	19.4	17.0	21.9	**19.5**		
	50-yr	21.3	21.3	21.9	18.8	25.1	**22.0**		
	100-yr	23.6	23.6	24.6	20.6	28.4	**24.5**		
	200-yr	26.1	26.1	27.6	22.5	31.9	**27.2**		
	500-yr	29.5	29.5	31.7	25.0	36.9	**31.0**		
IC5	2-yr	10.8	10.8	10.8	10.0	11.7	**10.9**		
	5-yr	14.4	14.4	14.4	13.2	15.8	**14.5**		
	10-yr	16.8	16.8	17.0	15.3	18.9	**17.1**		
	25-yr	19.9	19.9	20.3	17.8	23.0	**20.4**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
	50-yr	22.3	22.3	23.0	19.7	26.3	**23.0**		
	100-yr	24.8	24.8	25.8	21.6	29.8	**25.7**		
	200-yr	27.3	27.3	28.8	23.5	33.4	**28.5**		
	500-yr	30.8	30.8	33.2	26.2	38.6	**32.4**		
IC6	2-yr	42.9	42.9	42.9	39.6	46.4	**43.0**		
	5-yr	57.1	57.1	57.4	52.5	63.1	**57.8**		
	10-yr	66.9	66.9	67.7	60.8	75.5	**68.2**		
	25-yr	79.8	79.8	81.5	71.2	92.5	**81.9**		
	50-yr	89.7	89.7	92.5	79.0	106.1	**92.6**		
	100-yr	99.9	99.9	104.2	86.9	120.5	**103.7**		
	200-yr	110.4	110.4	116.7	94.9	135.7	**115.3**		
	500-yr	125.1	125.1	134.8	105.8	157.3	**131.6**		

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED RECURRENCE INTERVALS

Subbasin	Recurrence Interval	Bull.17B Estimate	Systematic Record	Expected Probability' Estimate	95-pct Confidence Limits for Bull. 17B Estimates Lower	Upper	95% Conf. Level Ave.Upper and Lower Bull. 17B Estimates	Flow w/ 6hr lag	Percent Attenuation
C2, 1/2 are	2-yr	78.7	78.7	78.7	72.0	86.1	**79.1**		
	5-yr	107.6	107.6	108.3	97.8	120.7	**109.3**		
	10-yr	126.3	126.3	127.8	113.4	144.7	**129.1**		
	25-yr	149.5	149.5	152.6	132.0	175.9	**154.0**		
	50-yr	166.5	166.5	171.2	145.3	199.4	**172.4**		
	100-yr	183.2	183.2	190.1	158.1	223.1	**190.6**		
	200-yr	199.9	199.9	209.4	170.7	247.2	**209.0**		
	500-yr	221.9	221.9	235.8	187.0	279.7	**233.4**		

APPENDIX D

FACILITY SIZING INFORMATION

West Plains Stormwater Management

March 6, 2002

Evaporation Pond based on Guidelines for Stormwater Management, February 1998

Condition A - No surface discharge

Vin - Vout = DVmonth

Sum Vmonth = DVyear

DVyear +V100 = Vtotal

P100, 24-hr =2.4 inches (from Isopluvial) + 0.57" from snowmelt = 2.97 inches

V100 = 1078110 cu. ft.

S=1000/CN-10 CN=98 for all months

Site Area: 100 Acres Evap. Area: 36 Acres

Month	Precip. (inches)	Pan Evap. (inches)	Actual Evap. (71.5%)
Jan	2.05	0.61	0.44
Feb	1.57	1.11	0.79
Mar	1.38	2.28	1.63
Apr	1.11	4.45	3.18
May	1.37	6.69	4.78
Jun	1.27	8.14	5.82
Jul	0.5	10.7	7.65
Aug	0.6	9.42	6.74
Sep	0.8	5.9	4.22
Oct	1.22	2.58	1.84
Nov	2.02	0.92	0.66
Dec	2.22	0.51	0.36
	16.11	53.31	38.12

Water Balance Calculation:

Year 1

	P	S	Q (Runoff-inches)	Vin (cf)	Vol. Before Evaporation (cf)	Actual Evaporation (inches)	Vout (cf)	Storage Required (cf)	Storage Required (ac-ft)	F.S.=1.2 Storage Required (ac-ft)
V100			2.97	1078110						
Oct	1.22	0.20	1.02	368778	1446888	1.84	241065	1205823	27.7	33.2
Nov	2.02	0.20	1.82	659178	1865001	0.66	85961	1779040	40.8	49.0
Dec	2.22	0.20	2.02	731778	2510818	0.36	47652	2463166	56.5	67.9
Jan	2.05	0.20	1.85	670068	3133234	0.44	56996	3076238	70.6	84.7
Feb	1.57	0.20	1.37	495828	3572067	0.79	103714	3468352	79.6	95.5
Mar	1.38	0.20	1.18	426858	3895211	1.63	213035	3682176	84.5	101.4
Apr	1.11	0.20	0.91	328848	4011025	3.18	415791	3595234	82.5	99.0
May	1.37	0.20	1.17	423228	4018462	4.78	625088	3393374	77.9	93.5
Jun	1.27	0.20	1.07	386928	3780302	5.82	760571	3019731	69.3	83.2
Jul	0.5	0.20	0.30	107418	3127150	7.65	999767	2127382	48.8	58.6
Aug	0.6	0.20	0.40	143718	2271101	6.74	880169	1390932	31.9	38.3
Sep	0.8	0.20	0.60	216318	1607250	4.22	551274	1055977	24.2	29.1

Year 2

	P	S	Q (Runoff-inches)	Vin (cf)	Vol. Before Evaporation (cf)	Actual Evaporation (inches)	Vout (cf)	Storage Required (cf)	Storage Required (ac-ft)	F.S.=1.2 Storage Required (ac-ft)
Oct	1.22	0.20	1.02	368778	1424755	1.84	241065	1183690	27.2	32.6
Nov	2.02	0.20	1.82	659178	1842868	0.66	85961	1756907	40.3	48.4
Dec	2.22	0.20	2.02	731778	2488685	0.36	47652	2441033	56.0	67.2
Jan	2.05	0.20	1.85	670068	3111101	0.44	56996	3054105	70.1	84.1
Feb	1.57	0.20	1.37	495828	3549933	0.79	103714	3446219	79.1	94.9
Mar	1.38	0.20	1.18	426858	3873077	1.63	213035	3660043	84.0	100.8
Apr	1.11	0.20	0.91	328848	3988891	3.18	415791	3573100	82.0	98.4
May	1.37	0.20	1.17	423228	3996328	4.78	625088	3371240	77.4	92.9
Jun	1.27	0.20	1.07	386928	3758169	5.82	760571	2997598	68.8	82.6
Jul	0.5	0.20	0.30	107418	3105016	7.65	999767	2105249	48.3	58.0
Aug	0.6	0.20	0.40	143718	2248967	6.74	880169	1368798	31.4	37.7
Sep	0.8	0.20	0.60	216318	1585117	4.22	551274	1033843	23.7	28.5

Year 3

Oct	1.22	0.20	1.02	368778	1402622	1.84	241065	1161556	26.7	32.0
Nov	2.02	0.20	1.82	659178	1820735	0.66	85961	1734773	39.8	47.8
Dec	2.22	0.20	2.02	731778	2466552	0.36	47652	2418899	55.5	66.6
Jan	2.05	0.20	1.85	670068	3088967	0.44	56996	3031971	69.6	83.5
Feb	1.57	0.20	1.37	495828	3527800	0.79	103714	3424086	78.6	94.3
Mar	1.38	0.20	1.18	426858	3850944	1.63	213035	3637909	83.5	100.2
Apr	1.11	0.20	0.91	328848	3966758	3.18	415791	3550967	81.5	97.8
May	1.37	0.20	1.17	423228	3974195	4.78	625088	3349107	76.9	92.3
Jun	1.27	0.20	1.07	386928	3736035	5.82	760571	2975465	68.3	82.0
Jul	0.5	0.20	0.30	107418	3082883	7.65	999767	2083116	47.8	57.4
Aug	0.6	0.20	0.40	143718	2226834	6.74	880169	1346665	30.9	37.1
Sep	0.8	0.20	0.60	216318	1562983	4.22	551274	1011710	23.2	27.9

Spokane County

West Plains Planning Area - Regression Equations for Evaporation Pond Sizing Based on HSPF Runoff Model

maximum pond depth = 4'

Required Pond Area = $0.5968 \; {}^{*}A_{imperviousness} + \; -0.0887 \; {}^{*}A_{tree} + \; 0.0762 \; {}^{*}A_{proposed\ site}$

Required Pond Volume = $2.0976 \; {}^{*}A_{imperviousness} + \; -0.2065 \; {}^{*}A_{tree} + \; 0.2984 \; {}^{*}A_{proposed\ site}$

Acreage of Proposed Site	100
Impervious Area, excluding the pond (acre)	55
Tree (acre)	5

Required Pond Area (acre)	**40**
Required Pond Volume (ac-ft)	**144.2**
Remaining Turf or Shrub Area (acre)	0

Step 1: Enter total site acreage
Step 2: Enter proposed impervious area acreage
Step 3: Enter forested area

General Guidance:
The maximum percentage of impervious area excluding the pond will be 55%.
If "Pond Area too Large for Site" is prompted, please decrease the impervious area and/or increase the tree planting.

West Plains Stormwater Management

June 28, 2002
Infiltration Pond Sizing Calculations

Scenario - Area of Pond (acres)	Infiltration Rate (iph)	Surface Area (sf)	Model Depth	Side Slope (x:1)	Length of Side at Surface (ft)	Length of Side at Bottom (ft)	Bottom Area	Volume Required (cuft)	Volume Required (ac-ft)
39	0.1	1698840	22	3	1303	1171.4	1372168	33781083	776
16.4	1	714384	22	3	845	713.2	508672	13453615	309
8.7	10	378972	22	3	616	483.6	233876	6741325	155
6	20	261360	22	3	511	379.2	143818	4456961	102
3.6	50	156816	22	3	396	264.0	69696	2491632	57

Earthwork Calculations

Excavation

Scenario - Area of Pond (acres)		Side Slope (x:1)	Exc. Depth (ft)	Length of Side at Ground Surf. (ft)	Top Area sf	Base Area sf	Vol cf	Volume of Exc. cy
39	0.1	3	15	1261	1591119	1372168	22224648	823135
16.4	1	3	15	803	645150	508672	8653666	320506
8.7	10	3	15	574	329025	233876	4221756	156361
6	20	3	15	469	220180	143818	2729990	101111
3.6	50	3	15	354	125316	69696	1462590	54170

Fill

Scenario - Area of Pond (acres)		Side Slope (x:1)	Perimeter Berm Height	Top of Berm ft	Base Berm ft	Berm Xsect sf	Approx Length of Berm lf	Volume of Berm cy
39	0.1	3	7	50	92	497.0	1353	99650
16.4	1	3	7	50	92	497.0	895	65914
8.7	10	3	7	50	92	497.0	666	49008
6	20	3	7	50	92	497.0	561	41323
3.6	50	3	7	50	92	497.0	446	32839

Typical Division Berm

Scenario - Area of Pond								
39	0.1	2	20	5	85	900.0	1261	42047
16.4	1	2	20	5	85	900.0	803	26774
8.7	10	2	20	5	85	900.0	574	19120
6	20	2	20	5	85	900.0	469	15641
3.6	50	2	20	5	85	900.0	354	11800

Total Pond Area

Scenario - Area of Pond (acres)		Length of Side To CL of Berm	Length to Outside Berm	Buffer	Area (sf)	Area Ac	Perimeter Fence (ft)
39	0.1	1353	1445	20	2206400	51	5942
16.4	1	895	987	20	1055165	24	4109
8.7	10	666	758	20	636177	15	3190
6	20	561	653	20	480573	11	2773
3.6	50	446	538	20	334084	8	2312

West Plains Stormwater Management

June 28, 2002

Infiltration Pond Sizing Calculations

Scenario - Area of Pond (acres)	Infiltration Rate (iph)	Surface Area (sf)	Model Depth	Side Slope (x:1)	Length of Side at Surface (ft)	Length of Side at Bottom (ft)	Bottom Area	Volume Required (cuft)	Volume Required (ac-ft)
89	0.1	3876840	5	3	1969	1939.0	3759602	19091105	438
43	1	1873080	5	3	1369	1338.6	1791864	9162359	210
14.1	10	614196	5	3	784	753.7	568074	2955674	68
8.7	20	378972	5	3	616	585.6	342936	1804769	41
5	50	217800	5	3	467	436.7	190699	1021246	23
18.8	10	818928	5	3	905	874.9	765531	3961148	91
11.5	20	500940	5	3	708	677.8	459374	2400784	55

Earthwork Calculations

Scenario - Area of Pond (acres)		Excavation Side Slope (x:1)	Exc. Depth (ft)	Length of Side at Ground Surf. (ft)	Top Area sf	Base Area sf	Vol cf	Volume of Exc. cy
89	0.1	3	3	1957	3829729	3759602	11383996	421629
43	1	3	3	1357	1840377	1791864	5448362	201791
14.1	10	3	3	772	595531	568074	1745407	64645
8.7	20	3	3	604	364341	342936	1060916	39293
5	50	3	3	455	206743	190699	596163	22080
18.8	10	3	3	893	797353	765531	2344327	86827
11.5	20	3	3	696	484097	459374	1415207	52415

Fill

Scenario - Area of Pond (acres)		Side Slope (x:1)	Perimeter Berm Height	Top of Berm ft	Base Berm ft	Berm Xsect sf	Approx Length of Berm lf	Volume of Berm cy
89	0.1	3	2	20	32	52.0	1989	15322
43	1	3	2	20	32	52.0	1389	10697
14.1	10	3	2	20	32	52.0	804	6192
8.7	20	3	2	20	32	52.0	636	4897
5	50	3	2	20	32	52.0	487	3749
18.8	10	3	2	20	32	52.0	925	7126
11.5	20	3	2	20	32	52.0	728	5607

Typical Division Berm

Scenario - Area of Pond								
89	0.1	2	3	5	17	33.0	1957	2392
43	1	2	3	5	17	33.0	1357	1658
14.1	10	2	3	5	17	33.0	772	943
8.7	20	2	3	5	17	33.0	604	738
5	50	2	3	5	17	33.0	455	556
18.8	10	2	3	5	17	33.0	893	1091
11.5	20	2	3	5	17	33.0	696	850

Total Pond Area

Scenario - Area of Pond (acres)		Length of Side To CL of Berm	Length to)utside Berm	Buffer	Area (sf)	Area Ac	Perimeter Fence (ft)
89	0.1	1989	2021	20	4247594	98	8244
43	1	1389	1421	20	2133367	49	5842
14.1	10	804	836	20	766862	18	3503
8.7	20	636	668	20	500708	11	2830
5	50	487	519	20	312135	7	2235
18.8	10	925	957	20	993902	23	3988
11.5	20	728	760	20	639634	15	3199

West Plains Stormwater Management

March 3, 2002

Detention Pond Footprint Calculations - based on volumes calculated by URS March 2000.

Scenario	Length (ft)	Area (sf)	Depth (ft)	Side Slope (x:1)	Volume (cf)	Volume (Ac-ft)	Overall Dimension	Area (Ac.)
Detention Pond 50yr SCS	270	72900	3	3	204606	4.7	290	1.931
Detention Pond 50yr SCS MS Long2	320	102400	3	3	290406	6.7	340	2.654
Evaporation Pond	1100	1210000	4	3	4735552	108.7	1120	28.797

GPA Area Calculations - based on Feb. 1998 Standards (1/2 inch of runoff)

	Area of Impervious (ac)	Volume Required (cf)	Length (ft)	Width (ft)	Depth (ft)	Volume Provided (cf)	Area for Volume Prov. (ac)
92 Acres of Developed Area	92	166980	8000	20	1	160000	3.7
93 Acres of Developed Area	93	168795	8000	20	1	160000	3.7

Culvert Hydraulic Evaluation:

West Plains Stormwater Management

May 30, 2002

Indian Canyon Creek - HW/D=1

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=1 (cfs)	Existing Conditions Maximum Storm Event	Future Conditions Maximum Storm Event	Future Cond. w/Added Flows Maximum Storm Event	Reach
1	Gov't Way	60"W x 36"H	Arch	Conc.	Headwall	66	<2-yr	<2-yr	<2-yr	Lower
2	Greenwood Rd	96"W x 48"H	Box	Conc.	Headwall	164	25-yr	25-yr	10-yr	Lower
3	Indian Canyon Dr.	48"W x 48"H	Box(small arch)	Conc.	Headwall	82	2-yr	2-yr	<2-yr	Lower
4	Below Rimrock Rd.	36"W x 38"H	Box(small arch)	Conc.	Headwall	45	2-yr	2-yr	<2-yr	Middle
5	Bonnie Rd.	24"	Pipe	CMP	Projecting	11.5	<2-yr	<2-yr	<2-yr	Middle
6	Deska Rd.	96"W x 72"H	Box	Conc.	Headwall	296	>500-yr	>500-yr	>500-yr	Middle
7	Sunset Blvd.	60"W x 66"H	Box	Conc.	Headwall	162.5	>500-yr	>500-yr	200-yr	Middle
8	Dwy	2- 15"	Pipe	CMP	Projecting	7	<2-yr	<2-yr	<2-yr	Upper
9	Geiger Blvd.	36"	Pipe	Conc.	Projecting	38	5-yr	2-yr	<2-yr	Upper

Indian Canyon Creek - HW/D=2

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=2 (cfs)	Maximum Storm Event	Maximum Storm Event	Maximum Storm Event	Reach	Proposed Improvement -Future with Added Flows Size	Capacity HW/D=2 (cfs)	Maximum Storm Event
1	Gov't Way	60"W x 36"H	Arch	Conc.	Headwall	140.5	10-yr	10-yr	5-yr	Lower	72"W x 48"H	264	100-yr
2	Greenwood Rd	96"W x 48"H	Box	Conc.	Headwall	352	>500-yr	>500-yr	>500-yr	Lower	none	352	>500-yr
3	Indian Canyon Dr.	48"W x 48"H	Box(small arch)	Conc.	Headwall	176	50-yr	50-yr	10-yr	Lower	72"W x 48"H	264	100-yr
4	Below Rimrock Rd.	36"W x 38"H	Box(small arch)	Conc.	Headwall	97.5	100-yr	100-yr	10-yr	Middle	72"W x 36"H	169	>500-yr
5	Bonnie Rd.	24"	Pipe	CMP	Projecting	22	<2-yr	<2-yr	<2-yr	Middle	72"W x 36"H	169	>500-yr
6	Deska Rd.	96"W x 72"H	Box	Conc.	Headwall	640	>500-yr	>500-yr	>500-yr	Middle	none	640	>500-yr
7	Sunset Blvd.	60"W x 66"H	Box	Conc.	Headwall	350	>500-yr	>500-yr	>500-yr	Middle	none	350	>500-yr
8	Dwy	2- 15"	Pipe	CMP	Projecting	14	<2-yr	<2-yr	<2-yr	Upper	60"W x 36"H	140.5	>500-yr
9	Geiger Blvd.	36"	Pipe	Conc.	Projecting	80	200-yr	200-yr	10-yr	Upper	60"W x 36"H	140.5	>500-yr

Indian Canyon Creek - HW/D=3

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=3 (cfs)	Maximum Storm Event	Maximum Storm Event	Maximum Storm Event	Reach
1	Gov't Way	60"W x 36"H	Arch	Conc.	Headwall	195	50-yr	50-yr	25-yr	Lower
2	Greenwood Rd	96"W x 48"H	Box	Conc.	Headwall	480	>500-yr	>500-yr	>500-yr	Lower
3	Indian Canyon Dr.	48"W x 48"H	Box(small arch)	Conc.	Headwall	240	200-yr	200-yr	100-yr	Lower
4	Below Rimrock Rd.	36"W x 38"H	Box(small arch)	Conc.	Headwall	129	>500-yr	>500-yr	50-yr	Middle
5	Bonnie Rd.	24"	Pipe	CMP	Projecting	28	<2-yr	<2-yr	<2-yr	Middle
6	Deska Rd.	96"W x 72"H	Box	Conc.	Headwall	880	>500-yr	>500-yr	>500-yr	Middle
7	Sunset Blvd.	60"W x 66"H	Box	Conc.	Headwall	475	>500-yr	>500-yr	>500-yr	Middle
8	Dwy	2- 15"	Pipe	CMP	Projecting	18	<2-yr	<2-yr	<2-yr	Upper
9	Geiger Blvd.	36"	Pipe	Conc.	Projecting	105	>500-yr	>500-yr	50-yr	Upper

Garden Springs Creek - HW/D=1

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=1 (cfs)	Maximum Storm Event	Maximum Storm Event	Maximum Storm Event	Reach
1	SR 195	Two-36"	Pipe	Conc.	Headwall	78	>500-yr	>500-yr	200-yr	Lower
2	Old RR Embank.	Two-36"	Pipe	CMP	Headwall	70	>500-yr	>500-yr	100-yr	Lower
3	Lindeke St.	60"	Pipe	Conc.	Projecting	130	>500-yr	>500-yr	>500-yr	Lower
4	RR	48"	Pipe	CMP	Projecting	64	>500-yr	>500-yr	50-yr	Lower
5	I-90 at Rosamond Ave.	48"W x 36"H	Box	Conc.	Headwall	52.8	200-yr	200-yr	10-yr	Lower
6	"D" St.	42"	Pipe	CMP	Headwall	50	200-yr	100-yr	10-yr	Lower
7	"F" St.	36"	Pipe	Conc.	Projecting	38	200-yr	200-yr	10-yr	Upper
8	Decorative Foot Path	29"	Pipe	Conc.	Headwall	24	10-yr	10-yr	2-yr	Upper
9	Rustle Rd./SP-Line	36"	Pipe	Conc.	Headwall	39	200-yr	200-yr	10-yr	Upper
10	Ramp E (N. Side of I-90)	36"	Pipe	CMP	Projecting	31	50-yr	50-yr	2-yr	Upper
11	Abbot???	24"	Pipe	Conc.	Projecting	14	2-yr	2-yr	<2-yr	Upper
12	SR 2 (N. Side of I-90)	18"	Pipe	CMP	Projecting	5.6	<2-yr	<2-yr	<2-yr	Upper

Garden Springs Creek - HW/D=2

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=2 (cfs)	Maximum Storm Event	Maximum Storm Event	Maximum Storm Event	Reach	Proposed Improvement Size	Capacity HW/D=2 (cfs)	Maximum Storm Event	
1	SR 195	Two-36"	Pipe	Conc.	Headwall	162	>500-yr	>500-yr	>500-yr	Lower	none	162	>500-yr	
2	Old RR Embank.	Two-36"	Pipe	CMP	Headwall	150	>500-yr	>500-yr	>500-yr	Lower	none	150	>500-yr	
3	Lindeke St.	60"	Pipe	Conc.	Projecting	280	>500-yr	>500-yr	>500-yr	Lower	none	280	>500-yr	
4	RR	48"	Pipe	CMP	Projecting	125	>500-yr	>500-yr	>500-yr	Lower	none	125	>500-yr	
5	I-90 at Rosamond Ave.	48"W x 36"H	Box	Conc.	Headwall	112.4	>500-yr	>500-yr	>500-yr	Lower	none	112.4	>500-yr	
6	"D" St.	42"	Pipe	CMP	Headwall	100	>500-yr	>500-yr	>500-yr	Lower	none	100	>500-yr	
7	"F" St.	36"	Pipe	Conc.	Projecting	80	>500-yr	>500-yr	>500-yr	Upper	none	80	>500-yr	
8	Decorative Foot Path	29"	Pipe	Conc.	Headwall	50	>500-yr	>500-yr	50-yr	Upper	none	55	100-yr	HW/D=2.5
9	Rustle Rd./SP-Line	36"	Pipe	Conc.	Headwall	81	>500-yr	>500-yr	>500-yr	Upper	none	81	>500-yr	
10	Ramp E (N. Side of I-90)	36"	Pipe	CMP	Projecting	60	>500-yr	>500-yr	100-yr	Upper	none	60	100-yr	
11	Abbot???	24"	Pipe	Conc.	Projecting	30	50-yr	25-yr	2-yr	Upper	2-24"	60	100-yr	
12	SR 2 (N. Side of I-90)	18"	Pipe	CMP	Projecting	11	<2-yr	<2-yr	<2-yr	Upper	36"	81	>500-yr	

Garden Springs Creek - HW/D=3

Culvert No.	Location/Crossing	Size	Configuration	Material	End Condition	Capacity HW/D=3 (cfs)	Maximum Storm Event	Maximum Storm Event	Maximum Storm Event	Reach
1	SR 195	Two-36"	Pipe	Conc.	Headwall	190	>500-yr	>500-yr	>500-yr	Lower
2	Old RR Embank.	Two-36"	Pipe	CMP	Headwall	190	>500-yr	>500-yr	>500-yr	Lower
3	Lindeke St.	60"	Pipe	Conc.	Projecting	370	>500-yr	>500-yr	>500-yr	Lower
4	RR	48"	Pipe	CMP	Projecting	160	>500-yr	>500-yr	>500-yr	Lower
5	I-90 at Rosamond Ave.	48"W x 36"H	Box	Conc.	Headwall	156	>500-yr	>500-yr	>500-yr	Lower
6	"D" St.	42"	Pipe	CMP	Headwall	112	>500-yr	>500-yr	>500-yr	Lower
7	"F" St.	36"	Pipe	Conc.	Projecting	105	>500-yr	>500-yr	>500-yr	Upper
8	Decorative Foot Path	29"	Pipe	Conc.	Headwall	57	>500-yr	>500-yr	100-yr	Upper
9	Rustle Rd./SP-Line	36"	Pipe	Conc.	Headwall	95	>500-yr	>500-yr	>500-yr	Upper
10	Ramp E (N. Side of I-90)	36"	Pipe	CMP	Projecting	79	>500-yr	>500-yr	>500-yr	Upper
11	Abbot???	24"	Pipe	Conc.	Projecting	38	200-yr	200-yr	10-yr	Upper
12	SR 2 (N. Side of I-90)	18"	Pipe	CMP	Projecting	14	2-yr	2-yr	<2-yr	Upper

Channel Sizing:

West Plains Stormwater Management

May 30, 2002

Indian Canyon Creek w/50% IC3 - Existing Conditions - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	28	**3**	**1.2**	2.5	0.01	0.03	30	4.1	7.2	9.5
5-yr	37	**3**	**1.4**	2.5	0.01	0.03	41	4.5	9.1	10.5
10-yr	44	**3**	**1.5**	2.5	0.01	0.03	47	4.7	10.1	11.1
25-yr	53	**3**	**1.6**	2.5	0.01	0.03	54	4.8	11.2	11.6
50-yr	59	**3**	**1.7**	2.5	0.01	0.03	62	5.0	12.3	12.2
100-yr	66	**3**	**1.8**	2.5	0.01	0.03	70	5.2	13.5	12.7
200-yr	72	**3**	**1.9**	2.5	0.01	0.03	79	5.3	14.7	13.2
500-yr	82	**3**	**2.0**	2.5	0.01	0.03	88	5.5	16.0	13.8

Indian Canyon Creek w/50% IC3 - Existing Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	82	**5**	**1.4**	2.5	0.02	0.03	81	6.8	11.9	12.5
5-yr	110	**5**	**1.7**	2.5	0.02	0.03	118	7.5	15.7	14.2
10-yr	130	**5**	**1.8**	2.5	0.02	0.03	133	7.8	17.1	14.7
25-yr	156	**5**	**2.0**	2.5	0.02	0.03	165	8.2	20.0	15.8
50-yr	176	**5**	**2.1**	2.5	0.02	0.03	182	8.5	21.5	16.3
100-yr	197	**5**	**2.2**	2.5	0.02	0.03	200	8.7	23.1	16.8
200-yr	218	**5**	**2.3**	2.5	0.02	0.03	220	8.9	24.7	17.4
500-yr	248	**5**	**2.5**	2.5	0.02	0.03	262	9.3	28.1	18.5

Indian Canyon Creek w/50% IC3 - Future Conditions - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	29	**3**	**1.2**	2.5	0.01	0.03	30	4.1	7.2	9.5
5-yr	39	**3**	**1.4**	2.5	0.01	0.03	41	4.5	9.1	10.5
10-yr	46	**3**	**1.5**	2.5	0.01	0.03	47	4.7	10.1	11.1
25-yr	55	**3**	**1.6**	2.5	0.01	0.03	54	4.8	11.2	11.6
50-yr	61	**3**	**1.7**	2.5	0.01	0.03	62	5.0	12.3	12.2
100-yr	68	**3**	**1.8**	2.5	0.01	0.03	70	5.2	13.5	12.7
200-yr	74	**3**	**1.9**	2.5	0.01	0.03	79	5.3	14.7	13.2
500-yr	83	**3**	**2.0**	2.5	0.01	0.03	88	5.5	16.0	13.8

Indian Canyon Creek w/50% IC3 - Future Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	83	**5**	**1.4**	2.5	0.02	0.03	81	6.8	11.9	12.5
5-yr	112	**5**	**1.7**	2.5	0.02	0.03	118	7.5	15.7	14.2
10-yr	131	**5**	**1.8**	2.5	0.02	0.03	133	7.8	17.1	14.7
25-yr	157	**5**	**2.0**	2.5	0.02	0.03	165	8.2	20.0	15.8
50-yr	177	**5**	**2.1**	2.5	0.02	0.03	182	8.5	21.5	16.3
100-yr	197	**5**	**2.2**	2.5	0.02	0.03	200	8.7	23.1	16.8
200-yr	218	**5**	**2.3**	2.5	0.02	0.03	220	8.9	24.7	17.4
500-yr	247	**5**	**2.5**	2.5	0.02	0.03	262	9.3	28.1	18.5

Indian Canyon Creek w/100% IC3 - Future Conditions with Added Flows - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	48	**3**	**1.5**	2.5	0.01	0.03	47	4.7	10.1	11.1
5-yr	65	**3**	**1.7**	2.5	0.01	0.03	62	5.0	12.3	12.2
10-yr	76	**3**	**1.9**	2.5	0.01	0.03	79	5.3	14.7	13.2
25-yr	90	**3**	**2.1**	2.5	0.01	0.03	98	5.6	17.3	14.3
50-yr	101	**3**	**2.2**	2.5	0.01	0.03	108	5.8	18.7	14.8
100-yr	111	**3**	**2.3**	2.5	0.01	0.03	120	5.9	20.1	15.4
200-yr	122	**3**	**2.4**	2.5	0.01	0.03	131	6.1	21.6	15.9
500-yr	136	**3**	**2.5**	2.5	0.01	0.03	144	6.2	23.1	16.5

Indian Canyon Creek w/100% IC3 - Future Conditions with Added Flows - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	102	**5**	**1.6**	2.5	0.02	0.03	105	7.3	14.4	13.6
5-yr	137	**5**	**1.8**	2.5	0.02	0.03	133	7.8	17.1	14.7
10-yr	161	**5**	**2.0**	2.5	0.02	0.03	165	8.2	20.0	15.8
25-yr	193	**5**	**2.2**	2.5	0.02	0.03	200	8.7	23.1	16.8
50-yr	216	**5**	**2.3**	2.5	0.02	0.03	220	8.9	24.7	17.4
100-yr	241	**5**	**2.4**	2.5	0.02	0.03	240	9.1	26.4	17.9
200-yr	265	**5**	**2.5**	2.5	0.02	0.03	262	9.3	28.1	18.5
500-yr	300	**5**	**2.7**	2.5	0.02	0.03	308	9.7	31.7	19.5

Garden Springs Creek - Existing Conditions - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	13	**4**	**0.7**	2.5	0.01	0.03	13	3.2	4.0	7.8
5-yr	18	**4**	**0.8**	2.5	0.01	0.03	17	3.4	4.8	8.3
10-yr	21	**4**	**0.9**	2.5	0.01	0.03	21	3.7	5.6	8.8
25-yr	25	**4**	**1.0**	2.5	0.01	0.03	25	3.9	6.5	9.4
50-yr	29	**4**	**1.1**	2.5	0.01	0.03	30	4.1	7.4	9.9
100-yr	32	**4**	**1.1**	2.5	0.01	0.03	30	4.1	7.4	9.9
200-yr	36	**4**	**1.2**	2.5	0.01	0.03	36	4.3	8.4	10.5
500-yr	41	**4**	**1.3**	2.5	0.01	0.03	42	4.5	9.4	11.0

Garden Springs Creek - Existing Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	18	**5**	**0.6**	2.5	0.02	0.03	17	4.3	3.9	8.2
5-yr	25	**5**	**0.7**	2.5	0.02	0.03	22	4.7	4.7	8.8
10-yr	29	**5**	**0.8**	2.5	0.02	0.03	28	5.0	5.6	9.3
25-yr	35	**5**	**0.9**	2.5	0.02	0.03	35	5.3	6.5	9.8
50-yr	39	**5**	**1.0**	2.5	0.02	0.03	42	5.7	7.5	10.4
100-yr	44	**5**	**1.1**	2.5	0.02	0.03	51	6.0	8.5	10.9
200-yr	48	**5**	**1.1**	2.5	0.02	0.03	51	6.0	8.5	10.9
500-yr	55	**5**	**1.2**	2.5	0.02	0.03	60	6.2	9.6	11.5

Garden Springs Creek - Future Conditions - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	15	**4**	**0.8**	2.5	0.01	0.03	17	3.4	4.8	8.3
5-yr	20	**4**	**0.9**	2.5	0.01	0.03	21	3.7	5.6	8.8
10-yr	23	**4**	**1.0**	2.5	0.01	0.03	25	3.9	6.5	9.4
25-yr	28	**4**	**1.1**	2.5	0.01	0.03	30	4.1	7.4	9.9
50-yr	31	**4**	**1.2**	2.5	0.01	0.03	36	4.3	8.4	10.5
100-yr	34	**4**	**1.2**	2.5	0.01	0.03	36	4.3	8.4	10.5
200-yr	38	**4**	**1.3**	2.5	0.01	0.03	42	4.5	9.4	11.0
500-yr	43	**4**	**1.4**	2.5	0.01	0.03	49	4.7	10.5	11.5

Garden Springs Creek - Future Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	20	**5**	**0.7**	2.5	0.02	0.03	22	4.7	4.7	8.8
5-yr	27	**5**	**0.8**	2.5	0.02	0.03	28	5.0	5.6	9.3
10-yr	32	**5**	**0.9**	2.5	0.02	0.03	35	5.3	6.5	9.8
25-yr	38	**5**	**1.0**	2.5	0.02	0.03	42	5.7	7.5	10.4
50-yr	42	**5**	**1.0**	2.5	0.02	0.03	42	5.7	7.5	10.4
100-yr	47	**5**	**1.1**	2.5	0.02	0.03	51	6.0	8.5	10.9
200-yr	52	**5**	**1.1**	2.5	0.02	0.03	51	6.0	8.5	10.9
500-yr	59	**5**	**1.2**	2.5	0.02	0.03	60	6.2	9.6	11.5

Garden Springs Creek - Future Conditions with Added Flows - Upper Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	25	**4**	**1.0**	2.5	0.01	0.03	25	3.9	6.5	9.4
5-yr	33	**4**	**1.2**	2.5	0.01	0.03	36	4.3	8.4	10.5
10-yr	38	**4**	**1.3**	2.5	0.01	0.03	42	4.5	9.4	11.0
25-yr	45	**4**	**1.4**	2.5	0.01	0.03	49	4.7	10.5	11.5
50-yr	51	**4**	**1.5**	2.5	0.01	0.03	56	4.8	11.6	12.1
100-yr	57	**4**	**1.6**	2.5	0.01	0.03	64	5.0	12.8	12.6
200-yr	62	**4**	**1.6**	2.5	0.01	0.03	64	5.0	12.8	12.6
500-yr	71	**4**	**1.7**	2.5	0.01	0.03	73	5.2	14.0	13.2

Garden Springs Creek - Future Conditions with Added Flows - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	30	**5**	**0.9**	2.5	0.02	0.03	35	5.3	6.5	9.8
5-yr	40	**5**	**1.0**	2.5	0.02	0.03	42	5.7	7.5	10.4
10-yr	47	**5**	**1.1**	2.5	0.02	0.03	51	6.0	8.5	10.9
25-yr	56	**5**	**1.2**	2.5	0.02	0.03	60	6.2	9.6	11.5
50-yr	62	**5**	**1.3**	2.5	0.02	0.03	70	6.5	10.7	12.0
100-yr	69	**5**	**1.3**	2.5	0.02	0.03	70	6.5	10.7	12.0
200-yr	76	**5**	**1.4**	2.5	0.02	0.03	81	6.8	11.9	12.5
500-yr	86	**5**	**1.5**	2.5	0.02	0.03	92	7.0	13.1	13.1

Paleochannel Conveyance - Existing Conditions - Airport Area

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	64	**8**	**1.5**	2.5	0.005	0.03	66	3.7	17.6	16.1
5-yr	87	**8**	**1.8**	2.5	0.005	0.03	93	4.1	22.5	17.7
10-yr	101	**8**	**1.9**	2.5	0.005	0.03	103	4.2	24.2	18.2
25-yr	120	**8**	**2.1**	2.5	0.005	0.03	125	4.5	27.8	19.3
50-yr	134	**8**	**2.2**	2.5	0.005	0.03	136	4.6	29.7	19.8
100-yr	147	**8**	**2.3**	2.5	0.005	0.03	149	4.7	31.6	20.4
200-yr	161	**8**	**2.4**	2.5	0.005	0.03	162	4.8	33.6	20.9
500-yr	179	**8**	**2.6**	2.5	0.005	0.03	190	5.0	37.7	22.0

Paleochannel Conveyance - Existing Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	98	**12**	**1.6**	2.5	0.005	0.03	104	4.1	25.6	20.6
5-yr	131	**12**	**1.8**	2.5	0.005	0.03	129	4.3	29.7	21.7
10-yr	153	**12**	**2.0**	2.5	0.005	0.03	156	4.6	34.0	22.8
25-yr	181	**12**	**2.2**	2.5	0.005	0.03	186	4.8	38.5	23.8
50-yr	201	**12**	**2.3**	2.5	0.005	0.03	202	5.0	40.8	24.4
100-yr	220	**12**	**2.5**	2.5	0.005	0.03	236	5.2	45.6	25.5
200-yr	240	**12**	**2.6**	2.5	0.005	0.03	255	5.3	48.1	26.0
500-yr	267	**12**	**2.7**	2.5	0.005	0.03	273	5.4	50.6	26.5

Paleochannel Conveyance - Future Conditions - Airport Area

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	80	**8**	**1.7**	2.5	0.005	0.03	83	4.0	20.8	17.2
5-yr	111	**8**	**2.0**	2.5	0.005	0.03	113	4.4	26.0	18.8
10-yr	131	**8**	**2.2**	2.5	0.005	0.03	136	4.6	29.7	19.8
25-yr	155	**8**	**2.4**	2.5	0.005	0.03	162	4.8	33.6	20.9
50-yr	174	**8**	**2.5**	2.5	0.005	0.03	175	4.9	35.6	21.5
100-yr	192	**8**	**2.6**	2.5	0.005	0.03	190	5.0	37.7	22.0
200-yr	210	**8**	**2.8**	2.5	0.005	0.03	220	5.2	42.0	23.1
500-yr	235	**8**	**2.9**	2.5	0.005	0.03	236	5.3	44.2	23.6

Paleochannel Conveyance - Future Conditions - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	150	**12**	**2.0**	2.5	0.005	0.03	156	4.6	34.0	22.8
5-yr	205	**12**	**2.3**	2.5	0.005	0.03	202	5.0	40.8	24.4
10-yr	243	**12**	**2.6**	2.5	0.005	0.03	255	5.3	48.1	26.0
25-yr	291	**12**	**2.8**	2.5	0.005	0.03	293	5.5	53.2	27.1
50-yr	327	**12**	**3.0**	2.5	0.005	0.03	335	5.7	58.5	28.2
100-yr	365	**12**	**3.2**	2.5	0.005	0.03	379	5.9	64.0	29.2
200-yr	403	**12**	**3.4**	2.5	0.005	0.03	426	6.1	69.7	30.3
500-yr	455	**12**	**3.5**	2.5	0.005	0.03	451	6.2	72.6	30.8

Paleochannel Conveyance - Future Conditions, with I-90 Area Added - I-90 Area

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	109	**8**	**1.9**	2.5	0.005	0.03	103	4.2	24.2	18.2
5-yr	150	**8**	**2.4**	2.5	0.005	0.03	162	4.8	33.6	20.9
10-yr	176	**8**	**2.5**	2.5	0.005	0.03	175	4.9	35.6	21.5
25-yr	210	**8**	**2.8**	2.5	0.005	0.03	220	5.2	42.0	23.1
50-yr	234	**8**	**2.9**	2.5	0.005	0.03	236	5.3	44.2	23.6
100-yr	259	**8**	**3.1**	2.5	0.005	0.03	270	5.5	48.8	24.7
200-yr	283	**8**	**3.2**	2.5	0.005	0.03	288	5.6	51.2	25.2
500-yr	315	**8**	**3.4**	2.5	0.005	0.03	326	5.8	56.1	26.3

Paleochannel Conveyance - Future Conditions, with I-90 Area Added - Airport Area

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	190	**8**	**2.6**	2.5	0.005	0.03	190	5.0	37.7	22.0
5-yr	262	**8**	**3.1**	2.5	0.005	0.03	270	5.5	48.8	24.7
10-yr	309	**8**	**3.3**	2.5	0.005	0.03	307	5.7	53.6	25.8
25-yr	367	**8**	**3.6**	2.5	0.005	0.03	367	6.0	61.2	27.4
50-yr	410	**8**	**3.8**	2.5	0.005	0.03	411	6.2	66.5	28.5
100-yr	453	**8**	**4.0**	2.5	0.005	0.03	458	6.4	72.0	29.5
200-yr	495	**8**	**4.2**	2.5	0.005	0.03	508	6.5	77.7	30.6
500-yr	552	**8**	**4.4**	2.5	0.005	0.03	560	6.7	83.6	31.7

Paleochannel Conveyance - Future Conditions, with I-90 Area Added - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	260	**12**	**2.7**	2.5	0.005	0.03	273	5.4	50.6	26.5
5-yr	356	**12**	**3.1**	2.5	0.005	0.03	356	5.8	61.2	28.7
10-yr	421	**12**	**3.4**	2.5	0.005	0.03	426	6.1	69.7	30.3
25-yr	502	**12**	**3.7**	2.5	0.005	0.03	504	6.4	78.6	31.9
50-yr	564	**12**	**4.0**	2.5	0.005	0.03	588	6.7	88.0	33.5
100-yr	625	**12**	**4.2**	2.5	0.005	0.03	648	6.9	94.5	34.6
200-yr	687	**12**	**4.3**	2.5	0.005	0.03	680	6.9	97.8	35.2
500-yr	772	**12**	**4.6**	2.5	0.005	0.03	779	7.2	108.1	36.8

Paleochannel Conveyance (w/lag flows) - Airport Area

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	42	**6**	**1.4**	2.5	0.005	0.03	46	3.5	13.3	13.5
5-yr	55	**6**	**1.5**	2.5	0.005	0.03	53	3.6	14.6	14.1
10-yr	63	**6**	**1.7**	2.5	0.005	0.03	67	3.9	17.4	15.2
25-yr	72	**6**	**1.8**	2.5	0.005	0.03	75	4.0	18.9	15.7
50-yr	78	**6**	**1.9**	2.5	0.005	0.03	84	4.1	20.4	16.2
100-yr	85	**6**	**2.0**	2.5	0.005	0.03	93	4.2	22.0	16.8
200-yr	91	**6**	**2.0**	2.5	0.005	0.03	93	4.2	22.0	16.8
500-yr	98	**6**	**2.1**	2.5	0.005	0.03	102	4.3	23.6	17.3

Paleochannel Conveyance (w/lag flows) - Lower Reaches

	Flow	**Base Width**	**Depth**	Side Slope	Long. Slope	Roughness	Flow	Velocity	Area	Wetted
	(cfs)	**(ft)**	**(ft)**	Horiz:1' vert.	(ft/ft)		(cfs)	(fps)		Perimeter
2-yr	67	**8**	**1.6**	2.5	0.005	0.03	74	3.9	19.2	16.6
5-yr	87	**8**	**1.8**	2.5	0.005	0.03	93	4.1	22.5	17.7
10-yr	99	**8**	**1.9**	2.5	0.005	0.03	103	4.2	24.2	18.2
25-yr	113	**8**	**2.0**	2.5	0.005	0.03	113	4.4	26.0	18.8
50-yr	123	**8**	**2.1**	2.5	0.005	0.03	125	4.5	27.8	19.3
100-yr	132	**8**	**2.2**	2.5	0.005	0.03	136	4.6	29.7	19.8
200-yr	141	**8**	**2.3**	2.5	0.005	0.03	149	4.7	31.6	20.4
500-yr	153	**8**	**2.4**	2.5	0.005	0.03	162	4.8	33.6	20.9

APPENDIX E

COST ESTIMATION SPREADSHEETS

West Plains Stormwater Management

July 25, 2002

Summary of Costs for Options

West Plains Area - Regional Facility Options		Total Cost	Cost Per Acre (Acre of Impervious)	Regional Component /Public Funding
Evaporation Pond Option (100-yr, Current County Requirements)		$27,860,257	$51,880	
Evaporation Pond Option (100-yr, HSPF Model)		$30,697,478	$62,360	
Detention Pond Option (50-yr SCS, Current County Requirements)		$6,177,444	$7,422	
Detention Pond Option (50-yr, 72-hr, Winter Storm, SCS, Draft Req.)		$6,857,661	$8,328	
Regional Facility Option (1 iph, 22 ft deep, w/ On-site Detention)		$21,769,936	$26,154	$15,592,491
Regional Facility Option (1 iph, 22 ft deep w/o On-site Detention)		$20,221,547	$23,782	$15,592,491
Regional Facility Option (10 iph, 22 ft deep w/o On-site Detention)		$16,389,945	$19,276	$11,760,889
Regional Facility Option (10 iph, 5 ft deep w/o On-site Detention)		$14,543,075	$17,104	$9,914,019
Regional Facility Option (20 iph, 5 ft deep w/o On-site Detention)		$13,874,336	$16,318	$9,245,280
Regional Facility Option (10 iph, 5 ft deep w/o On-site Detention)	w/added I90 Area	$26,072,253	$12,654	$14,854,831
Regional Facility Option (20 iph, 5 ft deep w/o On-site Detention)	w/added I90 Area	$25,168,877	$12,215	$13,951,455
Garden Springs Creek - East of Airport:				
Creek Culvert Improvements w/ Exist. 10-yr Detention		$2,208,338	$16,231	$1,344,875
Creek Culvert Improvements w/o 10-yr Detention		$1,955,239	$14,371	$1,344,875
Indian Canyon Creek - East of Airport				
Creek Culvert Improvements w/ Exist. 10-yr Detention		$3,211,980	$15,515	$1,898,195
Creek Culvert Improvements w/o 10-yr Detention		$2,826,882	$13,655	$1,898,195

West Plains Stormwater Management

July 25, 2002
Cost Analysis for Options for Regional Infiltration

Area Calculations (Acres)

		IC1	IC2	Total	IC1	Rev. IC2 (w/added I-90 area)	Rev. Total
Total Area		1317	2427	3744	1317	4125	5442
Area Trib. to Reg. Infl. (Portion of IC2))		1317	1213.5	2530.5	1317	2911.5	4228.5
Less Airport Facilities			(344)	(344)		(344)	(344)
Less Open Space	10%	(132)	(121)	(253)	(132)	(291)	(423)
Less Agriculture Zone	50%	(659)		(659)	(659)		(659)
Less Existing Development	5%	(66)	(61)	(127)	(66)	(146)	(211)
Less Roads/Circulation	10%	(132)	(121)	(253)	(132)	(291)	(423)
Available for Development		**329**	**566**	**895**	**329**	**1840**	**2169**
Industrial Land Cost/Acre		$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Agricultural Land Cost/Acre		$4,300	$4,300	$4,300	$4,300	$4,300	$4,300
Evaporation Pond Option (100-yr, Current County Requirements)							
Impervious	60%	198	339	537	198	1104	1301
Conveyance Ditches	5%	16	28	45	16	92	108
Evaporation Pond	35%	115	198	313	115	644	759
Total	100%	329	566	895	329	1840	2169
Evaporation Pond & Ditch Land Cost		$2,634,000	$4,526,179	$7,160,179	$2,634,000	$14,717,000	$17,351,000
Evaporation Pond & Site Imp.		$7,614,894	$13,085,184	$20,700,078	$7,614,894	$42,546,847	$50,161,741
Total Cost		$10,248,894	$17,611,363	$27,860,257	$10,248,894	$57,263,847	$67,512,741
Cost/Acre of Developed Land		$51,880	$51,880	$51,880	$51,880	$51,880	$51,880
Evaporation Pond Option (100-yr, HSPF Model)							
Impervious	55%	181	311	492	181	1012	1193
Conveyance Ditches	5%	16	28	45	16	92	108
Evaporation Pond	40%	132	226	358	132	736	868
Total	100%	329	566	895	329	1840	2169
Evaporation Pond & Ditch Land Cost		$2,963,250	$5,091,951	$8,055,201	$2,963,250	$16,556,625	$19,519,875
Evaporation Pond & Site Imp.		$8,329,367	$14,312,910	$22,642,276	$8,329,367	$46,538,833	$54,868,200
Total Cost		$11,292,617	$19,404,861	$30,697,478	$11,292,617	$63,095,458	$74,388,075
Cost/Acre of Developed Land		$62,360	$62,360	$62,360	$62,360	$62,360	$62,360

Detention Pond Option (50-yr SCS, Current County Requirements)

Impervious	93%	306	526	832	306	1711	2017
GPA/Water Quality Swale	5%	16	28	45	16	92	108
Detention Pond	2%	7	11	18	7	37	43
Total	100%	329	566	895	329	1840	2169
Detention Pond & GPA Land Cost		$460,950	$792,081	$1,253,031	$460,950	$2,575,475	$3,036,425
Detention Pond & Site Imp.		$1,811,534	$3,112,880	$4,924,413	$1,811,534	$10,121,617	$11,933,150
Total Cost		$2,272,484	$3,904,961	$6,177,444	$2,272,484	$12,697,092	$14,969,575
Cost/Acre of Developed Land		$7,422	$7,422	$7,422	$7,422	$7,422	$7,422

Detention Pond Option (50-yr, 72-hr, Winter Storm, SCS, Draft Req.)

Impervious	92%	303	521	823	303	1692	1995
GPA/Water Quality Swale	5%	16	28	45	16	92	108
Detention Pond	3%	10	17	27	10	55	65
Total	100%	329	566	895	329	1840	2169
Detention Pond & GPA Land Cost		$526,800	$905,236	$1,432,036	$526,800	$2,943,400	$3,470,200
Detention Pond & Site Imp.		$1,995,914	$3,429,712	$5,425,626	$1,995,914	$11,151,807	$13,147,720
Total Cost		$2,522,714	$4,334,948	$6,857,661	$2,522,714	$14,095,207	$16,617,920
Cost/Acre of Developed Land		$8,328	$8,328	$8,328	$8,328	$8,328	$8,328

Regional Facility Option (1 iph, 22 ft deep, w/ On-site Detention)

Impervious	93%	306	526	832
GPA/Water Quality Swale	5%	16	28	45
Detention Pond	2%	7	11	18
Total	100%	329	566	895
Detention Pond & GPA Land Cost		$460,950	$792,081	$1,253,031
Detention Pond & Site Imp.		$1,811,534	$3,112,880	$4,924,413
Regional Facility Land Cost		$46,226	$79,434	$125,660
Regional Conveyance		$2,647,829	$4,549,942	$7,197,771
Regional Infiltration		$3,041,922	$5,227,138	$8,269,060
Total Cost		$8,008,460	$13,761,475	$21,769,936
Public Component		$5,735,977	$9,856,514	$15,592,491
Cost/Acre of Developed Land		$26,154	$26,154	$26,154

Regional Facility Option (1 iph, 22 ft deep w/o On-site Detention)

Impervious	95%	313	537	850
GPA/Water Quality Swale	5%	16	28	45
Detention Pond	0%	0	0	0
Total	100%	329	566	895
GPA Land Cost		$329,250	$565,772	$895,022
Site Improvements		$1,373,631	$2,360,402	$3,734,033
Regional Facility Land Cost		$46,226	$79,434	$125,660
Regional Conveyance		$2,647,829	$4,549,942	$7,197,771
Regional Infiltration		$3,041,922	$5,227,138	$8,269,060
Total Cost		$7,438,858	$12,782,689	$20,221,547
Public Component		$5,735,977	$9,856,514	$15,592,491
Cost/Acre of Developed Land		$23,782	$23,782	$23,782

Regional Facility Option (10 iph, 22 ft deep w/o On-site Detention)

Impervious	95%	313	537	850
GPA/Water Quality Swale	5%	16	28	45
Detention Pond	0%	0	0	0
Total	100%	329	566	895
GPA Land Cost		$329,250	$565,772	$895,022
Site Improvements		$1,373,631	$2,360,402	$3,734,033
Regional Facility Land Cost		$31,011	$53,289	$84,300
Regional Conveyance		$2,647,829	$4,549,942	$7,197,771
Regional Infiltration		$1,647,613	$2,831,205	$4,478,818
Total Cost		$6,029,334	$10,360,610	$16,389,945
Public Component		$4,326,453	$7,434,435	$11,760,889
Cost/Acre of Developed Land		$19,276	$19,276	$19,276

Regional Facility Option (10 iph, 5 ft deep w/o On-site Detention)

Impervious	95%	313	537	850	313	1748	2060
GPA/Water Quality Swale	5%	16	28	45	16	92	108
Detention Pond	0%	0	0	0	0	0	0
Total	100%	329	566	895	329	1840	2169
GPA Land Cost		$329,250	$565,772	$895,022	$329,250	$1,839,625	$2,168,875
Site Improvements		$1,373,631	$2,360,402	$3,734,033	$1,373,631	$7,674,916	$9,048,547
Regional Facility Land Cost		$35,757	$61,443	$97,200	$18,158	$101,454	$119,612
Regional Conveyance		$2,647,829	$4,549,942	$7,197,771	$1,754,386	$9,802,317	$11,556,703
Regional Infiltration		$963,464	$1,655,584	$2,619,048	$482,520	$2,695,996	$3,178,516
Total Cost		$5,349,930	$9,193,145	$14,543,075	$3,957,946	$22,114,307	$26,072,253
Public Component		$3,647,049	$6,266,970	$9,914,019	$2,255,065	$12,599,767	$14,854,831
Cost/Acre of Developed Land		$17,104	$17,104	$17,104	$12,654	$12,654	$12,654

Regional Facility Option (20 iph, 5 ft deep w/o On-site Detention)

Impervious	95%	313	537	850	313	1748	2060
GPA/Water Quality Swale	5%	16	28	45	16	92	108
Detention Pond	0%	0	0	0	0	0	0
Total	100%	329	566	895	329	1840	2169
GPA Land Cost		$329,250	$565,772	$895,022	$329,250	$1,839,625	$2,168,875
Site Improvements		$1,373,631	$2,360,402	$3,734,033	$1,373,631	$7,674,916	$9,048,547
Regional Facility Land Cost		$26,092	$44,835	$70,927	$12,849	$71,792	$84,641
Regional Conveyance		$2,647,829	$4,549,942	$7,197,771	$1,754,386	$9,802,317	$11,556,703
Regional Infiltration		$727,121	$1,249,461	$1,976,582	$350,691	$1,959,420	$2,310,111
Total Cost		$5,103,923	$8,770,413	$13,874,336	$3,820,807	$21,348,070	$25,168,877
Public Component		$3,401,042	$5,844,238	$9,245,280	$2,117,926	$11,833,529	$13,951,455
Cost/Acre of Developed Land		$16,318	$16,318	$16,318	$12,215	$12,215	$12,215

West Plains Stormwater Management

March 8, 2002

Cost Analysis for Options - Indian Canyon Creek and Garden Springs Creek

Area Calculations

		Added to GS1	IC3
Total Area		209	636
50% Trib. To Creek			318
Less Open Space	10%	(21)	(32)
Less Roads/Circulation	20%	(42)	(64)
Available for Development		**146**	**223**
Land Cost/Acre		$20,000	$20,000

Evaporation Pond Option (100-yr, Current County Requirements)

Impervious	60%	88	134
Open Space	5%	7	11
Evaporation Pond	35%	51	78
Total	100%	146	223
Evaporation Pond Land Cost		$1,024,100	$1,558,200
Evaporation Pond & Site Imp.		$3,383,626	$5,148,293
Total Cost		$4,407,726	$6,706,493
Cost/Acre of Developed Land		$50,213	$50,213

Detention Pond Option - 10-yr SCS, Current County Requirements)

Impervious	93%	136	207
Open Space	5%	7	11
Detention Pond	2%	3	4
Total	100%	146	223
Detention Pond Land Cost			
Detention Pond & Site Imp.			
Total Cost		$0	$0
Cost/Acre of Developed Land		$0	$0

Evaporation Pond Option (100-yr, HSPF Model)

Impervious	55%	80	122
Open Space	5%	7	11
Evaporation Pond	40%	59	89
Total	100%	146	223
Evaporation Pond Land Cost			
Evaporation Pond & Site Imp.			
Total Cost		$0	$0
Cost/Acre of Developed Land		$0	$0

Detention Pond Option 50-yr, 72-hr, Winter Storm, SCS, Proposed County Requirements)

Impervious	92%	135	205
Open Space	5%	7	11
Evaporation Pond	3%	4	7
Total	100%	146	223
Detention Pond Land Cost			
Detention Pond & Site Imp.			
Total Cost		$0	$0
Cost/Acre of Developed Land		$0	$0

Creek Culvert Improvements w/ Exist. 10-yr Detention

Impervious	93%	136	207
Open Space	5%	7	11
Detention Pond	2%	3	4
Total	100%	146	223
Detention Pond Land Cost		$58,520	$89,040
Detention Pond & Site Imp.		$804,943	$1,224,745
Culvert Improvements		$1,344,875	$1,898,195
Total Cost		$2,208,338	$3,211,980
Public Component		$1,344,875	$1,898,195
Cost/Acre of Developed Land		$16,231	$15,515

Creek Culvert Improvements w/o 10-yr Detention

Impervious	93%	136	207
Open Space	7%	10	16
Detention Pond	0%	0	0
Total	100%	146	223
Site Imp.		$610,364	$928,687
Culvert Improvements		$1,344,875	$1,898,195
Total Cost		$1,955,239	$2,826,882
Public Component		$1,344,875	$1,898,195
Cost/Acre of Developed Land		$14,371	$13,655

Construction Cost Estimates:

West Plains Stormwater Management
April 8, 2002

Typical Stormwater System - Evaporation Pond, 100 Ac. Site, Current Standards

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$72,000	$72,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$28,000	$28,000
4	Clearing and Grubbing	41	AC	$2,000	$82,000
5	Excavate Evaporation Pond Incl. Liner	174240	CY	$6	$1,045,440
6	18" Diam. Pipe	3200	LF	$40	$128,000
7	Manholes	8	EA	$2,000	$16,000
8	GPA/Water Quality Swale	1000	CY	$8	$8,000
9	Hydroseed	41	AC	$2,000	$82,000
10	Restoration and Cleanup	1	LS	$50,000	$50,000
11					$0
12					$0
13					$0
14					$0
15					$0
				Subtotal	$1,521,440
				WSST	$130,844
				Construction Cost Total	**$1,652,000**
				Survey and Design Engineering (10%)	$165,200
				Permitting (5%)	$82,600
				Construction Administration (5%)	$82,600
				Contingency (20%)	$330,400
				Total Project Cost	**$2,312,800**
				Cost /Acre	**$23,128**

Construction Cost Estimates:

West Plains Stormwater Management
April 8, 2002

Typical Stormwater System - Evaporation Pond, 100 Ac. Site, Proposed per HSPF

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$79,000	$79,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$31,000	$31,000
4	Clearing and Grubbing	45	AC	$2,000	$90,000
5	Excavate Evaporation Pond (40 Ac)	193600	CY	$6	$1,161,600
6	18" Diam. Pipe	3200	LF	$40	$128,000
7	Manholes	8	EA	$2,000	$16,000
8	GPA/Water Quality Swale	1000	CY	$8	$8,000
9	Hydroseed	45	AC	$2,000	$90,000
10	Restoration and Cleanup	1	LS	$50,000	$50,000
11					$0
12					$0
13					$0
14					$0
15					$0
				Subtotal	$1,663,600
				WSST	$143,070
				Construction Cost Total	**$1,807,000**
				Survey and Design Engineering (10%)	$180,700
				Permitting (5%)	$90,350
				Construction Administration (5%)	$90,350
				Contingency (20%)	$361,400
				Total Project Cost	**$2,529,800**
				Cost /Acre	**$25,298**

Construction Cost Estimates:

West Plains Stormwater Management
July 25, 2002

Typical Stormwater System - On-Site Conveyance (No Detention Pond) 100 Ac. Site

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$13,000	$13,000
2	Erosion Control	1	LS	$5,000	$5,000
3	Traffic Control	2%	LS	$5,000	$5,000
4	Clearing and Grubbing	5	AC	$2,000	$10,000
5	Excavate Detention Pond (3 Ac.)	0	CY	$5	$0
6	18" Diam. Pipe	3500	LF	$40	$140,000
7	24" Diam. Pipe	100	LF	$50	$5,000
8	Manholes	10	EA	$2,000	$20,000
9	Flow Control Structure		EA	$4,500	$0
10	GPA/Water Quality Swale	6400	CY	$8	$51,200
11	Hydroseed	5	AC	$2,000	$10,000
12	Restoration and Cleanup	1	LS	$15,000	$15,000
13					$0
14					$0
15					$0
				Subtotal	$274,200
				WSST	$23,581
				Construction Cost Total	**$298,000**
				Survey and Design Engineering (10%)	$29,800
				Permitting (5%)	$14,900
				Construction Administration (5%)	$14,900
				Contingency (20%)	$59,600
				Total Project Cost	**$417,200**
				Cost /Acre	**$4,172**

Construction Cost Estimates:

West Plains Stormwater Management
June 8, 2002

Regional Stormwater Conveyance System

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$205,000	$205,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$80,000	$80,000
4	Clearing and Grubbing	1	AC	$2,000	$2,000
5	Collection Ditches/Laterals	27500	LF	$50	$1,375,000
6	Modify Ex. Airport Ditch	9000	LF	$100	$900,000
7	Ditch North to SR-2 (8'W X 6'D)	3000	LF	$170	$510,000
8	SR-2 Crossing (144"W x 48"H Box)	200	LF	$1,000	$200,000
9	Ditch North to Infilt. Pond (12'W X 6'D)	4500	LF	$200	$900,000
10	Outlet to Pond (144"W x 48"H Box)	100	LF	$800	$80,000
11	Restoration and Cleanup	1	LS	$50,000	$50,000
12					$0
13					$0
14					$0
15					$0
				Subtotal	$4,312,000
				WSST	$370,832
				Construction Cost Total	**$4,683,000**
				Survey and Design Engineering (10%)	$468,300
				Permitting (5%)	$234,150
				Construction Administration (10%)	$468,300
				Contingency (20%)	$936,600
				Subtotal	$6,790,350
				Project Administration (5%)	$339,518
				Easement Acquisition (1%)	$67,904
				Total Project Cost	**$7,197,771**

Construction Cost Estimates:

West Plains Stormwater Management
April 8, 2002

Typical Stormwater System - Detention Pond, 100 Ac. Site

(SCS Type II, 50 yr storm, Ex. Spokane County Standards)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$17,000	$17,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$7,000	$7,000
4	Clearing and Grubbing	7	AC	$2,000	$14,000
5	Excavate Detention Pond (2 Ac.)	12907	CY	$5	$64,533
6	18" Diam. Pipe	3500	LF	$40	$140,000
7	24" Diam. Pipe	100	LF	$50	$5,000
8	Manholes	10	EA	$2,000	$20,000
9	Flow Control Structure	1	EA	$4,500	$4,500
10	GPA/Water Quality Swale	6300	CY	$8	$50,400
11	Hydroseed	7	AC	$2,000	$14,000
12	Restoration and Cleanup	1	LS	$15,000	$15,000
13					$0
14					$0
15					$0
				Subtotal	$361,433
				WSST	$31,083
				Construction Cost Total	**$393,000**
				Survey and Design Engineering (10%)	$39,300
				Permitting (5%)	$19,650
				Construction Administration (5%)	$19,650
				Contingency (20%)	$78,600
				Total Project Cost	**$550,200**
				Cost /Acre	**$5,502**

Construction Cost Estimates:

West Plains Stormwater Management
June 8, 2002

Regional Stormwater Conveyance System (w/I-90 area)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$330,000	$330,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$129,000	$129,000
4	Clearing and Grubbing	1	AC	$2,000	$2,000
5	Collection Ditches/Laterals I-90 Area	40750	LF	$50	$2,037,500
6	I-90 Crossing (144"W x 48"H Box) -Two	400	LF	$1,000	$400,000
7	Collection Ditches/Laterals	27500	LF	$50	$1,375,000
8	Modify Ex. Airport Ditch	9000	LF	$100	$900,000
9	Ditch North to SR-2 (8'W X 6'D)	3000	LF	$170	$510,000
10	SR-2 Crossing (144"W x 48"H Box)	200	LF	$1,000	$200,000
11	Ditch North to Infilt. Pond (12'W X 6'D)	4500	LF	$200	$900,000
12	Outlet to Pond (144"W x 48"H Box)	100	LF	$800	$80,000
13	Restoration and Cleanup	1	LS	$50,000	$50,000
14					$0
15					$0
				Subtotal	$6,923,500
				WSST	$595,421
				Construction Cost Total	**$7,519,000**
				Survey and Design Engineering (10%)	$751,900
				Permitting (5%)	$375,950
				Construction Administration (10%)	$751,900
				Contingency (20%)	$1,503,800
				Subtotal	$10,902,550
				Project Administration (5%)	$545,128
				Easement Acquisition (1%)	$109,026
				Total Project Cost	**$11,556,703**

Construction Cost Estimates:

West Plains Stormwater Management
April 8, 2002

Typical Stormwater System - Detention Pond, 100 Ac. Site

(SCS MGSLONG2, 50 yr storm, Proposed Spokane County Standards)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$19,000	$19,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$7,000	$7,000
4	Clearing and Grubbing	8	AC	$2,000	$16,000
5	Excavate Detention Pond (3 Ac.)	19360	CY	$5	$96,800
6	18" Diam. Pipe	3500	LF	$40	$140,000
7	24" Diam. Pipe	100	LF	$50	$5,000
8	Manholes	10	EA	$2,000	$20,000
9	Flow Control Structure	1	EA	$4,500	$4,500
10	GPA/Water Quality Swale	6200	CY	$8	$49,600
11	Hydroseed	8	AC	$2,000	$16,000
12	Restoration and Cleanup	1	LS	$15,000	$15,000
13					$0
14					$0
15					$0
				Subtotal	$398,900
				WSST	$34,305
				Construction Cost Total	**$433,000**
				Survey and Design Engineering (10%)	$43,300
				Permitting (5%)	$21,650
				Construction Administration (5%)	$21,650
				Contingency (20%)	$86,600
				Total Project Cost	**$606,200**
				Cost /Acre	**$6,062**

Construction Cost Estimates:

West Plains Stormwater Management
June 8, 2002

Regional Stormwater Infiltration System - (1.0 in/hr, 16.4 Ac Pond, 22 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$236,000	$236,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$92,000	$92,000
4	Clearing and Grubbing	29.2	AC	$2,000	$58,447
5	Excavate Detention Pond	320506	CY	$5	$1,602,531
6	Construct Perimeter Berms	65914	CY	$4	$263,657
7	Berms/Cell Division	26774	CY	$10	$267,737
8	Dispose of Excess Excavation	227818	CY	$8	$1,822,546
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	29.2	AC	$2,500	$73,058
12	Fencing	2773	LF	$10	$27,729
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$4,954,338
				WSST	$426,073
				Construction Cost Total	**$5,380,000**
				Survey and Design Engineering (10%)	$538,000
				Permitting (5%)	$269,000
				Construction Administration (10%)	$538,000
				Contingency (20%)	$1,076,000
				Subtotal	$7,801,000
				Project Administration (5%)	$390,050
				Easement Acquisition (1%)	$78,010
				Total Project Cost	**$8,269,060**

Construction Cost Estimates:

West Plains Stormwater Management
June 26, 2002

Regional Stormwater Infiltration System - (10 in/hr, 8.7 Ac Pond, 22 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$128,000	$128,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$50,000	$50,000
4	Clearing and Grubbing	19.6	AC	$2,000	$39,209
5	Excavate Detention Pond	156361	CY	$5	$781,807
6	Construct Perimeter Berms	49008	CY	$4	$196,034
7	Berms/Cell Division	19120	CY	$10	$191,202
8	Dispose of Excess Excavation	88233	CY	$8	$705,862
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	19.6	AC	$2,500	$49,012
12	Fencing	3190	LF	$10	$31,904
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$2,683,662
				WSST	$230,795
				Construction Cost Total	**$2,914,000**
				Survey and Design Engineering (10%)	$291,400
				Permitting (5%)	$145,700
				Construction Administration (10%)	$291,400
				Contingency (20%)	$582,800
				Subtotal	$4,225,300
				Project Administration (5%)	$211,265
				Easement Acquisition (1%)	$42,253
				Total Project Cost	**$4,478,818**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Regional Stormwater Infiltration System - (10 in/hr, 14.1 Ac, 5 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$75,000	$75,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$29,000	$29,000
4	Clearing and Grubbing	22.6	AC	$2,000	$45,209
5	Excavate Detention Pond	64645	CY	$5	$323,224
6	Construct Perimeter Berms	6192	CY	$4	$24,766
7	Berms/Cell Division	943	CY	$10	$9,432
8	Dispose of Excess Excavation	57510	CY	$8	$460,080
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	22.6	AC	$2,500	$56,512
12	Fencing	3503	LF	$10	$35,028
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$1,568,884
				WSST	$134,924
				Construction Cost Total	**$1,704,000**
				Survey and Design Engineering (10%)	$170,400
				Permitting (5%)	$85,200
				Construction Administration (10%)	$170,400
				Contingency (20%)	$340,800
				Subtotal	$2,470,800
				Project Administration (5%)	$123,540
				Easement Acquisition (1%)	$24,708
				Total Project Cost	**$2,619,048**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Regional Stormwater Infiltration System - (20 in/hr, 8.7 Ac, 5 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$56,000	$56,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$22,000	$22,000
4	Clearing and Grubbing	16.5	AC	$2,000	$32,989
5	Excavate Detention Pond	39293	CY	$5	$196,466
6	Construct Perimeter Berms	4897	CY	$4	$19,586
7	Berms/Cell Division	738	CY	$10	$7,377
8	Dispose of Excess Excavation	33659	CY	$8	$269,271
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	16.5	AC	$2,500	$41,237
12	Fencing	2830	LF	$10	$28,304
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$1,183,864
				WSST	$101,812
				Construction Cost Tota	**$1,286,000**
				Survey and Design Engineering (10%)	$128,600
				Permitting (5%)	$64,300
				Construction Administration (10%)	$128,600
				Contingency (20%)	$257,200
				Subtotal	$1,864,700
				Project Administration (5%)	$93,235
				Easement Acquisition (1%)	$18,647
				Total Project Cost	**$1,976,582**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Regional Stormwater Infiltration System - (10 in/hr, 18.8 Ac, 5 ft deep) - Added I-90 Are

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$91,000	$91,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$35,000	$35,000
4	Clearing and Grubbing	27.8	AC	$2,000	$55,634
5	Excavate Detention Pond	86827	CY	$5	$434,135
6	Construct Perimeter Berms	7126	CY	$4	$28,502
7	Berms/Cell Division	1091	CY	$10	$10,914
8	Dispose of Excess Excavation	78610	CY	$8	$628,880
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	27.8	AC	$2,500	$69,542
12	Fencing	3988	LF	$10	$39,878
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$1,904,118
				WSST	$163,754
				Construction Cost Tota	**$2,068,000**
				Survey and Design Engineering (10%)	$206,800
				Permitting (5%)	$103,400
				Construction Administration (10%)	$206,800
				Contingency (20%)	$413,600
				Subtotal	$2,998,600
				Project Administration (5%)	$149,930
				Easement Acquisition (1%)	$29,986
				Total Project Cost	**$3,178,516**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Regional Stormwater Infiltration System - (20 in/hr, 11.5 Ac, 5 ft deep) - Added I-90 Are

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$66,000	$66,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	2%	LS	$26,000	$26,000
4	Clearing and Grubbing	19.7	AC	$2,000	$39,368
5	Excavate Detention Pond	52415	CY	$5	$262,075
6	Construct Perimeter Berms	5607	CY	$4	$22,426
7	Berms/Cell Division	850	CY	$10	$8,504
8	Dispose of Excess Excavation	45958	CY	$8	$367,665
9	Water Quality/Sedimentation Pond (5 Ac)	32267	CY	$8	$258,133
10	Misc. Culverts and Piping (60" Diam.)	400	LF	$200	$80,000
11	Hydroseed	19.7	AC	$2,500	$49,210
12	Fencing	3199	LF	$10	$31,991
13	Access Road	1500	LF	$75	$112,500
14	Restoration and Cleanup	1	LS	$50,000	$50,000
15					$0
				Subtotal	$1,383,873
				WSST	$119,013
				Construction Cost Tota	**$1,503,000**
				Survey and Design Engineering (10%)	$150,300
				Permitting (5%)	$75,150
				Construction Administration (10%)	$150,300
				Contingency (20%)	$300,600
				Subtotal	$2,179,350
				Project Administration (5%)	$108,968
				Easement Acquisition (1%)	$21,794
				Total Project Cost	**$2,310,111**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Indian Canyon Creek Culvert Upgrades

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$54,000	$54,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	5%	LS	$51,000	$51,000
4	Clearing and Grubbing	1	AC	$2,000	$2,000
5	Collection Ditches/Laterals	12000	LF	$50	$600,000
6	Gov't Way - 72"W x 48"H Box	150	LF	$1,200	$180,000
7	Indian Canyon Dr. - 72"W x 48"H Box	50	LF	$800	$40,000
8	Below Rimrock - 72"W x 36"H Box	50	LF	$800	$40,000
9	Bonnie Rd - 72"W x 36"H Box	50	LF	$800	$40,000
10	Driveway - 60"W x 36"H Box	25	LF	$600	$15,000
11	Geiger Blvd - 60"W x 36"H Box	100	LF	$750	$75,000
12	Restoration and Cleanup	6	LS	$5,000	$30,000
13					$0
14					$0
15					$0
				Subtotal	$1,137,000
				WSST	$97,782
				Construction Cost Total	**$1,235,000**
				Survey and Design Engineering (10%)	$123,500
				Permitting (5%)	$61,750
				Construction Administration (10%)	$123,500
				Contingency (20%)	$247,000
				Subtotal	$1,790,750
				Project Administration (5%)	$89,538
				Easement Acquisition (1%)	$17,908
				Total Project Cost	**$1,898,195**

Construction Cost Estimates:

West Plains Stormwater Management
June 28, 2002

Garden Springs Creek Culvert Upgrades

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$38,000	$38,000
2	Erosion Control	1	LS	$10,000	$10,000
3	Traffic Control	5%	LS	$36,000	$36,000
4	Clearing and Grubbing	1	AC	$2,000	$2,000
5	Collection Ditches/Laterals	11500	LF	$50	$575,000
6	Abbot Rd. - 24" Diam Conc.	80	LF	$180	$14,400
7	SR 2 - 36" Diam. Conc.	300	LF	$400	$120,000
8	Restoration and Cleanup	2	LS	$5,000	$10,000
9			LF		$0
10			LF		$0
11			LF		$0
12			LS		$0
13					$0
14					$0
15					$0
				Subtotal	$805,400
				WSST	$69,264
				Construction Cost Total	**$875,000**
				Survey and Design Engineering (10%)	$87,500
				Permitting (5%)	$43,750
				Construction Administration (10%)	$87,500
				Contingency (20%)	$175,000
				Subtotal	$1,268,750
				Project Administration (5%)	$63,438
				Easement Acquisition (1%)	$12,688
				Total Project Cost	**$1,344,875**

Construction Cost Estimates:

West Plains Stormwater Management
January 15, 2003

Wetland Mitigation - Typical 2.5 Acre Wetland (4 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$10,000	$10,000
2	Erosion Control	1	LS	$5,000	$5,000
3	Traffic Control	1%	LS	$2,000	$2,000
4	Clearing and Grubbing	3	AC	$2,000	$6,000
5	Excavation	15016	CY	$5	$75,081
6	Fine Grading	12844	SY	$1	$12,844
7	Soil Amendment (6")	2141	CY	$15	$32,111
8	Planting	115600	SF	$0.50	$57,800
9	Restoration and Cleanup	1	LS	$10,000	$10,000
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
				Subtotal	$210,837
				WSST	$18,132
				Construction Cost Total	**$229,000**
				Survey and Design Engineering (10%)	$22,900
				Permitting (5%)	$11,450
				Construction Administration (10%)	$22,900
				Contingency (20%)	$45,800
				Subtotal	$332,050
				Project Administration (5%)	$16,603
				Easement Acquisition (1%)	$3,321
				Total Project Cost	**$351,973**
				Cost per Acre	**$140,789**

Construction Cost Estimates:

West Plains Stormwater Management
January 15, 2003

Wetland Mitigation - Typical 2.5 Acre Wetland (2 ft deep)

Item No.	Bid Item	Quantity	Unit	Unit Price	Amount
1	Mobilization/Demobilization	5%	LS	$8,000	$8,000
2	Erosion Control	1	LS	$5,000	$5,000
3	Traffic Control	1%	LS	$2,000	$2,000
4	Clearing and Grubbing	3	AC	$2,000	$6,000
5	Excavation	8074	CY	$5	$40,370
6	Fine Grading	12844	SY	$1	$12,844
7	Soil Amendment (6")	2141	CY	$15	$32,111
8	Planting	115600	SF	$0.50	$57,800
9	Restoration and Cleanup	1	LS	$10,000	$10,000
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
				Subtotal	$174,126
				WSST	$14,975
				Construction Cost Total	**$189,000**
				Survey and Design Engineering (10%)	$18,900
				Permitting (5%)	$9,450
				Construction Administration (10%)	$18,900
				Contingency (20%)	$37,800
				Subtotal	$274,050
				Project Administration (5%)	$13,703
				Easement Acquisition (1%)	$2,741
				Total Project Cost	**$290,493**
				Cost per Acre	**$116,197**

APPENDIX F

FUNDING OPTIONS MEMORANDUM

SPOKANE COUNTY
West Plains Stormwater Management Plan

FUNDING OPTIONS

The broad goal of the financial component of the West Plains Stormwater Management Plan is to assist Spokane County in refining or developing funding mechanism(s) to carry out the actions identified in the master plan document. In this section, the characteristics of several potential study funding sources are summarized, their applicability to the program is evaluated, and a general strategy for pursuing funding from applicable sources is identified.

Background

Spokane County currently funds surface water management activities in the West Plains Watershed (and the County's overall service area) through its surface water utility rate structure. When Spokane County established its Stormwater Utility in 1991 and began collecting service charges effective 1992, little specific information had been developed regarding present and future needs of the system, as watershed planning had not been initiated. Funding requirements were addressed through establishment of a rate-making process, based on gaining public acceptance and responding to "rate elasticity" concerns rather than on a complete revenue requirements ⇒ cost of service analysis ⇒ rate calculation. The primary objective was to establish a stand-alone funding source and to win acceptance for a philosophy based on a fee for service/utility approach. This has been accomplished.

The County is now requesting through this West Plains Watershed funding analysis, an order of magnitude financial evaluation of its rate structure in terms of the feasibility of moving ahead with the program's operational, maintenance and capital requirements. At the same time, a brief discussion of overall funding mechanisms has also been included in this chapter.

Utility

A surface water utility, as the one in place within Spokane County's service area, is authorized in RCW sections 36.89 and 36.94 as a stand-alone entity, usually set up as an enterprise fund, within the governmental structure. It is defined as being financially and organizationally self-sufficient, and can be designed to furnish a comprehensive set of services related to surface water quantity and quality management. A "county" utility operates under the purview of the county legislative authority.

A utility may issue revenue bonds or pledge its revenues to meet county-issued general obligation bond debt service requirements. In the latter instance, the full faith and credit of the county would be pledged to secure general obligation bond funding, to the extent that capacity under the statutory debt ceiling is available. In most cases, a general obligation bond issue would require a vote of the people.

Spokane County implemented its utility in 1990 and 1991. The rate of $.83 per ERU has not been changed since that time and in terms of current buying power and the program requirements being defined through the watershed studies, does not approach the actual rate requirement.

System Development Charges or General Facilities Charges

System Development Charges (SDCs) are one-time charges imposed as conditions of development, and are designed to recover an equitable share of the cost of existing facilities as well as a share of planned capital investment to be incurred by the Utility. As such, SDCs are made up of two components: (1) a "buy-in" to existing facilities, or a reimbursement fee, and (2) a proportionate share of planned facilities, or an improvement fee. Each component is calculated by dividing the allocable cost of facilities, existing or planned, by the appropriate estimate of system capacity.

In order to implement a system development charge, the Utility must have adequate documentation of existing assets, planning documents to identify expansion needs, estimated costs, and capacity provided. In the case of the West Plains Watershed area, this calculation is complicated by several factors. Existing facilities in the study area have been paid for through grant funds and other sources. There is no basis for requiring new development to "buy in" to existing facilities, when they have likely paid a share through their own taxes. RCW 36.89 authorizes the imposition on rates and charges for the furnishing of services to those currently or prospectively receiving services or benefits from stormwater control facilities. RCW 36.94 supplements RCW 36.89; it also authorizes the imposition of rates and charges including system development charges.

PUBLIC AND PRIVATE PARTNERSHIPS

Public and private sector partnership is another method that will be actively sought. Spokane County and interested businesses could share the cost of building or oversizing capital improvement facilities that promote flood and erosion control and water quality protection. Interested businesses will have the option to provide land and/or help construct stormwater facilities. In turn, the County may provide wetland banking credits and/or offer "latecomers" agreements, in which the initial developer constructs a regional facility and is reimbursed by subsequent development which will make use of the facility. This should lower stormwater management costs to the community.

SPECIAL GRANT AND LOAN PROGRAMS

Several special State-administered grant and loan programs are described below. Special grants and loans can significantly reduce the surface water program's cost to the County, however, competition for funding is fierce and successful acquisition of that funding cannot be assured.

The Flood Control Assistance Account Program

The Flood Control Assistance Account Program (FCAAP) administered by the Washington Department of Ecology, assists local jurisdictions in comprehensive planning and maintenance efforts to reduce flood hazards and flood damages. To be eligible for grant funding, flood hazard management activities must be approved by the Washington Departments of Ecology and Fish and Wildlife. In addition, local jurisdictions must participate in the National Flood Insurance Program (NFIP).

Grants are available for the following activities:

- Comprehensive Flood Hazard Management Plans,
- Flood Control Maintenance Projects, and
- Emergency Flood Control Projects.

Planning activities may receive grants of up to 75 percent of the eligible cost; specific projects are eligible for grants of up to 50 percent of eligible cost; and emergency projects are eligible for grants of up to 80 percent of eligible cost. A total appropriation is made to the Flood Control Assistance Account for each fiscal biennium. Of this appropriation, an allocation ceiling is established for any one county, including all jurisdictions within that county.

Applicants may submit applications at any time during the biennium, although funds may not be available after the initial allocation. Initial selection and allocation of funds occurs prior to the beginning of each biennium (the biennium begins in July). The deadline for applications to be considered in the current biennium is the previous January.

The Centennial Clean Water Fund (CCWF), administered by the Washington Department of Ecology, provides grants and low-cost loans to public bodies to plan, design and construct facilities and to conduct planning, implementation, education and other activities related to improving water quality. The costs of facilities and activities solely related to flood control, or quantity management, are not eligible.

CONVENTIONAL DEBT INSTRUMENTS

The most commonly used long-term debt instruments are revenue and general obligation bonds. Bond Anticipation Notes are available for short-term "interim" capital financing.

Revenue Bonds

Revenue bonds are the most common source of funds for construction of major utility improvements. There are no statutory limitations on the amount of revenue bonds a county can issue; however, the Utility would be required to meet a yearly net operating income coverage requirement of up to 1.5 times the annual debt service.

Revenue bond debt service is paid out of rate and system development charge revenues. The terms on revenue bonds are not as favorable as general obligation bonds, but carry the advantage of leaving the county's debt capacity undisturbed. Interest rates vary depending on market conditions.

General Obligation Bonds

General obligation bonds are secured by the taxing power of the county, and are typically paid through property tax revenues. However, the county may choose to repay the debt from utility revenues and increase property taxes only if the Utility fails to meet its debt obligation.

The financing costs of general obligation bonds are lower than revenue bonds due to (1) lower interest rates available, (2) no coverage requirements, and (3) no reserve requirements.

By statute, a county may issue general obligation bonds without the assent of the voters as long as the total amount of indebtedness from such issues does not exceed 3/4 of one percent of the value of taxable property in the county. With the assent of three-fifths of the voters, a county may incur a total amount of indebtedness of no more than 2 1/2 percent of the value of taxable property in that county.

Short-Term Debt Instruments

Short-term "interim" financing mechanisms are also available for capital costs. Bond anticipation notes can provide interim financing during construction, while allowing flexibility in the choice of long-term financing instruments. Typically, bond anticipation notes have lower interest rates than bonds, but add to issuance costs.

OTHER FUNDING MECHANISMS

Tax Increment Financing

The 2001 Washington State Legislature passed and the Governor signed into law House Bill 1418 entitled “An Act Related to Community Revitalization Financing”. This act authorizes a new system of property tax increment financing (TIF) which allows, as a specific example, a county, city, town or port district to pledge and use a portion of property tax collections for funding the construction of projects within the tax increment area by diverting a percentage of the regular property taxes imposed by local governments.

For purposes of the West Plains Stormwater Management Plan, a TIF area could be established to finance construction of “storm water and drainage systems” where these projects promote both community revitalization and private development thereby increasing the fair market value of property within the TIF area. The law stipulates that the private development promoted through a TIF area be consistent with countywide planning policies adopted under the Growth Management Act. The logic supporting TIF is that construction of project(s) within the TIF area will increase property values and a portion of that increased value (under statute no more than 75% of that increased value) can be diverted to pay the principal and interest on the general obligations issued to provide the money for construction of the projects.

The law requires a series of steps to establish a TIF area including: a) the jurisdiction adopts an ordinance designating the TIF area and identifies the project(s) to be financed; b) the local government taxing districts (excluding the state) that impose at least 75% of the regular property taxes within the proposed TIF area sign agreements approving the TIF; c) a public hearing is held; d) fire protection districts having territory within the TIF area approve; and e) the jurisdiction adopts a TIF area ordinance.

Based on the projects identified in the West Plains Stormwater Management Plan, it would appear that many would be eligible for funding under a TIF area given the fact that they are consistent with the statute's community revitalization objectives. Under this new law, the TIF approach is now a viable option which should be considered for financing projects identified through this stormwater master planning.

Fees for Direct Services

The County may wish to consider direct charges/fees and contract agreements for additional funding. This could allow the County to recover its direct costs (plan review, inspection) for services performed for a customer or class of customers not generally related to the overall service charge. In addition, special maintenance and operation contract agreements could allow the County to service private facilities without encumbering liability of ownership.