Hazel's Creek Sub-basin Planning & Schematic Design

PREPARED FOR: Mr. Bill Peacock, P.E.
City of Spokane, Wastewater
Management Department

PREPARED BY: Mark Brower, P.E.

DATE: April 26, 2012

Background and Purpose

This memorandum serves to report on the planning and schematic design of a regional stormwater management system within the Hazel's Creek (HC) sub-basin. The Hazel's Creek sub-basin is located on the plateau of Spokane's south hill. The project location and sub-basin area is provided on ***Attachment A – Figure 1***.

Purpose and Objectives

The purpose of this project is to develop a regional stormwater management system, upstream of the Hazel's Creek Regional Drainage and Conservation Area (HCRDCA) that:

- Takes advantage of downstream infiltration capacity for stormwater disposal at HCRDCA to accept outflow of 1.5 GPM/Acre for developing infill parcels
- Concepts provide alternatives to utilize the existing evaporative ponds on 55th/57th and the KXLY A.M. Antenna Site as locations for stormwater facilities
- Allows for multiple site uses for regional stormwater facilities, consistent with Comprehensive Plan, and developer agreements, such as bike/pedestrian trails, viewscapes, etc.
- Sets the stage for economic development by reducing the amount of high value commercial infill land required to serve stormwater purposes via evaporative ponds
- Allows for flexibility to implement in phases as needed to meet demand.

Additional key benefits for implementing a regional stormwater management system within the HC sub-basin include:

- Opportunity to accommodate properties along the 57th Street Corridor, from Palouse Highway to the Spokane County evaporation ponds, west of Regal Street.
- Maximum allowable peak flows of 1.5 PM/Acre for developing parcels helps manage basin-wide infrastructure size requirements and capital costs (detention pond sizes, conveyance sizes).
- Avoids exacerbation of known groundwater issues through use of piped conveyance and lined ponds.
- Opportunity to convert Spokane County evaporation ponds to detention ponds, minimizing the footprint of standing water, and thereby improving vector control, safety, etc.
- Creates opportunities to for development of multiple infrastructure improvements, such as:
  - Bicycle/pedestrian trails for neighborhood connectivity
  - Public spaces such as soccer fields, walking paths, interpretive sites, view corridors, etc. at the KXLY Antenna site
  - A safe 4-Way intersection at Regal Street and Palouse Highway

Technical Requirements Summary

In 2008, WHPacific, Inc. (under agreement with the City of Spokane and KXLY) conducted a site master plan study for the KXLY antenna site, whereby specific parameters for regional stormwater facilities have been defined. See ***Attachment B – "Altamont Stormwater Area Pond Project – Technical Requirements Summary, WHPacific, July 30, 2008."*** These parameters were reviewed to ensure they are current, and were subsequently leveraged for development of the schematic concepts defined herein, *with modifications as described below.*

Hydrology and Downstream Disposal

Managed Peak Flow Rates. Since the 2008 WHPacific study was complete, the City of Spokane has undertaken studies of the HCRDCA to ascertain a better understanding of the capacity of the regional stormwater treatment and infiltration facility to handle basin inflows. Once this was understood, the City distributed the capacity over the sub-basin area to determine the maximum peak flow rates that could be accepted at the site from any given site development project. The result was 1.5 gallons/minute/acre (GPM/Acre).

The ability for commercial projects to discharge at this pre-determined rate will allow them to construct detention ponds for stormwater control rather than evaporative ponds, which traditionally occupy 30%-40% of the developed parcel. Stormwater treatment will still be required with the detention ponds, and may be either integrated into the detention ponds, or designed as a standalone treatment process.

Further, this determined rate helps the City manage regional stormwater management infrastructure capital costs, by managing the sizes of conveyance and detention facilities to handle mitigated peak flows, rather than uncontrolled peak flow rates.

For the purpose of this study, parcels that have been identified as likely to develop or redevelop have been analyzed as contributing flows of 1.5 GPM/Acre. Existing street systems and existing contributing sites that are not targeted for redevelopment are assumed to be contributing at full-force peak flow rates.

Contributing Areas. Since the 2008 WHPacific study was complete, the City of Spokane has been working with developers to implement stormwater solutions using the managed peak flow rates and onsite treatment and detention Best Management Practices (BMPs). Developments have primarily been focused east of Regal Street, and north of 57th Avenue. Infrastructure has been designed and developed to direct flows from recent development to existing storm mains in Regal Street, and directly north to the HCRDCA. This infrastructure may serve other developing parcels in this sub-area.

Contributing parcels under consideration for this study are primarily located adjacent to the 57th Ave. corridor or are west of Regal Street, between 57th Ave. and 43rd Ave. Contributing parcels considered are shown in ***Attachment A – Figure 2.*** Stormwater calculations are provided in ***Attachment C.***

Implementation Flexibility. The City of Spokane would like to be as flexible as possible to accommodate market-driven commercial development opportunities within the sub-basin. As such, the City would like to leverage as much of the existing infrastructure as practicable, including conveyance systems and Spokane County's evaporation ponds. Opportunities to leverage these facilities to quickly respond to stormwater needs must be considered. For example, the County's existing evaporation ponds may be used as a 'pass-through' facility, where 1.5 gpm is released for each acre of commercial property that is developed within the subbasin and connected to the County's 57th Avenue piping system.

Regional Stormwater Facilities

Groundwater at KXLY Antenna Site. Due to seasonal presence of high groundwater on the KXLY Antenna Site the pond bottoms must be covered with an impermeable liner, and constructed above the seasonal high groundwater elevation. Seasonal groundwater may reach as high as 2-feet below ground surface at locations on the site[1].

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[1] Geotechnical Engineering Evaluation – Proposed Altamont Stormwater Detention Ponds, GeoEngineers, February 12, 2009

KXLY Site Constraints. Previous studies[2] and ongoing dialogue with KXLY operations personnel have provided a comprehensive understanding of the physical and operational constraints associated with the KXLY antenna site. Overall, the site is well suited for secondary use as a regional stormwater facility in that it is relatively flat, and is located in the historic natural drainage path. There is shallow rock located in the NE corner of the site, and seasonally fluctuating perched groundwater[1].

Operationally, two significant A.M. radio antenna towers occupy the site and function as an emergency broadcasting facility. The towers are surrounded by security fencing. The two towers have significant foundations, and have bare copper grounding wires that radiate out from the antenna bases 350', approximately 6 to 10 inches below the ground surface. There is a communications and power corridor that extends from the operations/maintenance building to the antennae, and maintenance access to the towers will need to be maintained. KXLY has indicated that the presence of surface water near the antenna bases serves to boost the AM signal. KXLY operations personnel must be directly involved with any proposed project on the site.

Implementation Concepts

Three stormwater management solutions were identified to meet the aforementioned goals and objectives of the project:

- Concept 1: Pumped Bypass to Regal Main
- Concept 2: Gravity Route to Regal Main via KXLY Antenna Site
- Concept 3: Stormwater Facilities at KXLY Antenna Site

The phase solutions are described in detail as follows.

Concept 1: Pumped Bypass to Regal Main

Concept 1 consists of modifying the existing County lined evaporation ponds at 57th and/or 55th Avenues so that additional flows from new commercial development are passed through the ponds. This would be achieved by constructing a discharge outlet, as well as conveyance piping that would tie them to the existing stormwater main in Regal Street. ***Attachment A, Figure 3*** provides an overview of this concept.

The elevation of the Regal Street stormwater main is higher than the outlet elevation for the ponds. A pump will be necessary to convey the flows to the Regal Street main. The pumped outlet system will allow for flexibility to manage outflow rates for the ponds as desired.

Within Concept 1, there are two alternatives for the location of the discharge outlet and the conveyance route to the Regal Street stormwater main:

- Alternative 1: Outlet to 57th pond only, on 55th Avenue
- Alternative 2: Outlet to 57th and 55th ponds, on 53rd Avenue

Both alternatives are favorable to provide additional stormwater capacity for development needs. Locating the outlet on 53rd Avenue provides the additional benefit of being able to manage the available stormwater capacity across both sites, such that pond sizes and locations may be altered as needed for possible complementary or alternate site uses.

Key Benefits. Implementation of Concept 1 provides the following benefits:

- Relatively low capital cost.
- Allows for rapid response to developer capacity needs on 57th corridor.
- Allows for reconfiguration of 57th/55th pond sites for alternative and/or complementary site uses, such as non-motorized connectivity, or other public uses.
- Potential to drain the ponds after storm events, reducing standing water issues.

2 Altamont Stormwater Area Project – Pond and Site Use Concepts, WHPacific, Inc., November 26, 2008

- Leverages available capacity in existing facilities, and at the HCRDCA.

Key Technical Issues. The following technical issues will need to be addressed during implementation of Concept 1:

- Capacity of Regal Street stormwater main. This facility was designed with 30% spare capacity. Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.
- Capacity of the 57th Avenue stormwater main. The existing conveyance main in 57th Avenue varies in size from 18" to 30". Previous studies of this conveyance indicate that additional capacity exists. See ***Attachment D – "Capacity Analysis – 57th Ave. Stormwater Conveyance System, WHPacific, August, 2007."*** Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.
- Sizing of stormwater pumping system. Elements of the pumping system, such as the wet well and force main, must be sized to accommodate increasing flows as additional properties are developed in the subbasin. It is likely that the pumps themselves will be replaced and upsized as this development occurs.

Concept 2: Gravity Route to Regal Main via KXLY Antenna Site

Concept 2 consists of converting the existing County lined evaporation ponds at 57th and/or 55th Avenues to detention facilities by providing an gravity outlet and conveyance pipe that would tie the ponds to the existing stormwater main in Regal Street via an easement through the KXLY Commercial Site. ***Attachment A, Figure 4*** provides an overview of this concept.

With this option, the outlet conveyance from the 55th/57th ponds would be sized to convey, by gravity, the 1.5 GPM/Acre peak flows from the ultimate assumed build-out condition which would include all of the contributing parcels identified in ***Attachment A, Figure 2***. The conveyance would direct flows from the ponds to the KXLY Antenna site via Smith Court. The flows may combine with direct stormwater discharge flows from the KXLY Commercial site in an appropriately-sized detention pond.

Key Benefits. Implementation of Concept 2 provides the following benefits:

- Moderate capital cost with managed conveyance flows and infrastructure sizes, potentially offset by significant capacity for development, and associated revenues.
- Allows for meeting developer capacity needs on 57th corridor, 55th/53rd corridors, and the KXLY and Black Commercial sites on Regal Street.
- Allows for potential elimination of 57th pond and reconfiguration of 55th pond site for alternative and/or complimentary site uses, such as non-motorized connectivity, or higher uses.
- Potential to drain the ponds after storm events, reducing standing water issues.
- Leverages capacity in existing facilities, and at the HCRDCA.
- Allows for complementary site uses for KXLY Antenna site, consistent with the City's Comprehensive Plan.
- Allows for potential use of stormwater in a year-round irrigation pond site amenity.
- No need for a stormwater pump station.

Key Technical Issues. The following technical issues will need to be addressed during implementation of Concept 2:

- Capacity of Regal Street stormwater main. This facility was designed with 30% spare capacity. Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.
- Capacity of the 57th Avenue stormwater main. The existing conveyance main in 57th Avenue varies in size from 18" to 30". Previous studies of this conveyance indicate that additional capacity exists. See ***Attachment D – "Capacity Analysis – 57th Ave. Stormwater Conveyance System, WHPacific, August, 2007."*** Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.
- KXLY site constraints. As previously discussed, physical constraints at the KXLY site, such as shallow bedrock and groundwater will need to be considered. Further, operational constraints such as antenna security, electrical and communications pathways, maintenance access needs, and antenna grounding infrastructure will need to be considered.

Concept 3: Stormwater Facilities at KXLY Antenna Site

Concept 3 consists of converting the existing County lined evaporation ponds at 57th and/or 55th Avenue to much smaller detention facilities (or eliminating them entirely), by providing a gravity outlet and conveyance pipe that would extend the piping system in 57th Avenue to new ponds on the KXLY Commercial Site. ***Attachment A, Figure 5*** provides an overview of this concept.

With this concept, the 55th/57th ponds may be partially or completely replaced with new stormwater detention facilities on the KXLY antenna site. Gravity conveyance would carry flows from 57th through the 55th/57th pond sites, then via Smith Court to the KXLY antenna site. Conveyance would be sized to carry 100-year peak flows from all of the contributing parcels, as described in ***Attachment A, Figure 2***. The ponds would be sized to manage 25-year peak flow volumes, and would discharge to the Regal Street stormwater main at a maximum rate of 1.5GPM/Acre of total contributing area.

Key Benefits. Implementation of Concept 3 provides the following benefits:

- High capital costs, potentially offset by significant capacity for development, and associated revenues.
- Opportunity to free up evaporation pond parcels on 55th/57th for higher uses, and associated revenues.
- Allows for meeting developer capacity needs on 57th corridor, 55th/53rd corridors, and the KXLY and Black Commercial sites on Regal Street.
- Leverages capacity in existing facilities, and at the HCRDCA.
- Allows for complementary site uses for KXLY Antenna site, consistent with City's Comprehensive Plan.
- Allows for potential use of stormwater in a year-round irrigation pond site amenity.
- No need for a stormwater pump station.

Key Technical Issues. The following technical issues will need to be addressed during implementation of Concept 3:

- Capacity of Regal Street stormwater main. This facility was designed with 30% spare capacity. Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.
- Capacity of the 57th Avenue stormwater main. The existing conveyance main in 57th Avenue varies in size from 18" to 30". Previous studies of this conveyance indicate that additional capacity exists. See ***Attachment D – "Capacity Analysis – 57th Ave. Stormwater Conveyance System, WHPacific, August, 2007."*** Analyses will be required as new inputs to the system are planned to ensure spare capacity is available.

- KXLY site constraints. As previously discussed, physical constraints at the KXLY site, such as shallow bedrock and groundwater will need to be considered. Further, operational constraints such as antenna security, electrical and communications pathways, maintenance access needs, and antenna grounding infrastructure will need to be considered.

Budget-Level Cost Estimates

Budget-level cost estimates were prepared for each of the Concepts described, and are summarized in Table 1. Cost estimates for each Concept are mutually exclusive, and do not account for accomplishment of work on a previous Concept. Detailed cost estimates are provided in ***Attachment E.***

TABLE 1
Budget-Level Cost Estimate Summary

	Concept 1	Concept 2	Concept 3
Construction Cost[a]	$158,000	$765,000	$1,524,000
Design & Construction Management	$28,000	$138,000	$274,000
TOTAL COST BUDGET	**$186,000**	**$903,000**	**$1,798,000**

[a] Costs to not include relocation of KXLY/Spokane Radio Infrastructure or implementation of complimentary site uses/amenities, including non-motorized facilities, playfields, irrigation pond, etc.

Stakeholder Coordination & Public Outreach Summary

A public-private stakeholder group was assembled and met regularly throughout this brief planning and schematic design effort. The group consisted of City staff and management from several departments, including Wastewater, Parks, Economic Development, Legal, and Finance. The group also included developer representatives from NAI Black and KXLY. The group developed and refined the project goals and objectives, and collaborated on a number of technical, political, and financial issues surrounding this effort. The group held coordination meetings on the following dates:

- August 24, 2011
- September 28, 2011
- November 2, 2011
- December 7, 2011

In addition, members of the stakeholder group attended a Southgate Neighborhood Association meeting on October 12, 2011. At this meeting, an overview of the proposed storm drainage concept was presented by Doug Busko, CH2M HILL.

Available coordination meeting notes are provided in ***Attachment F***.

ATTACHMENT A

FIGURES

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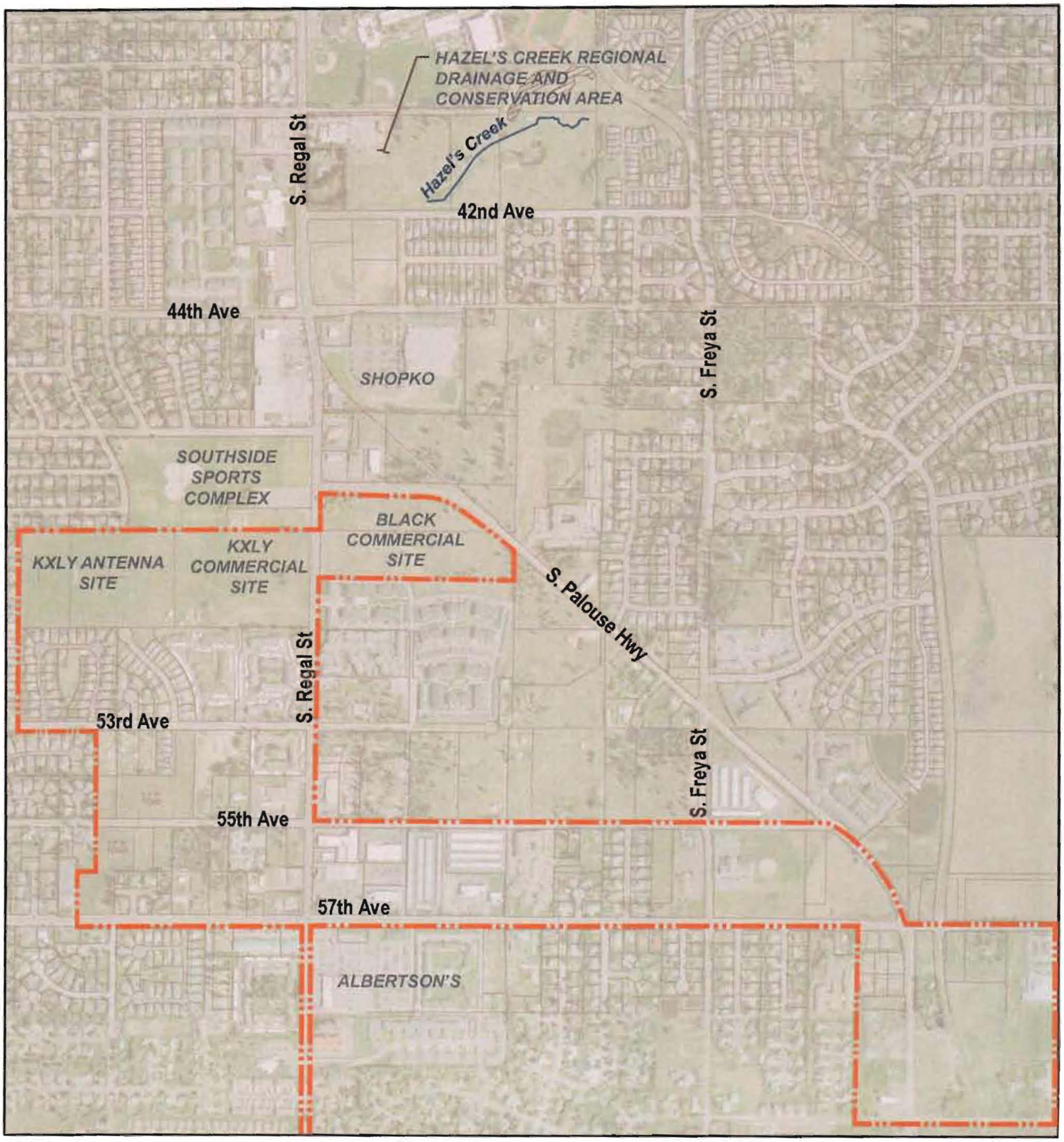


LEGEND:

Basin Boundary

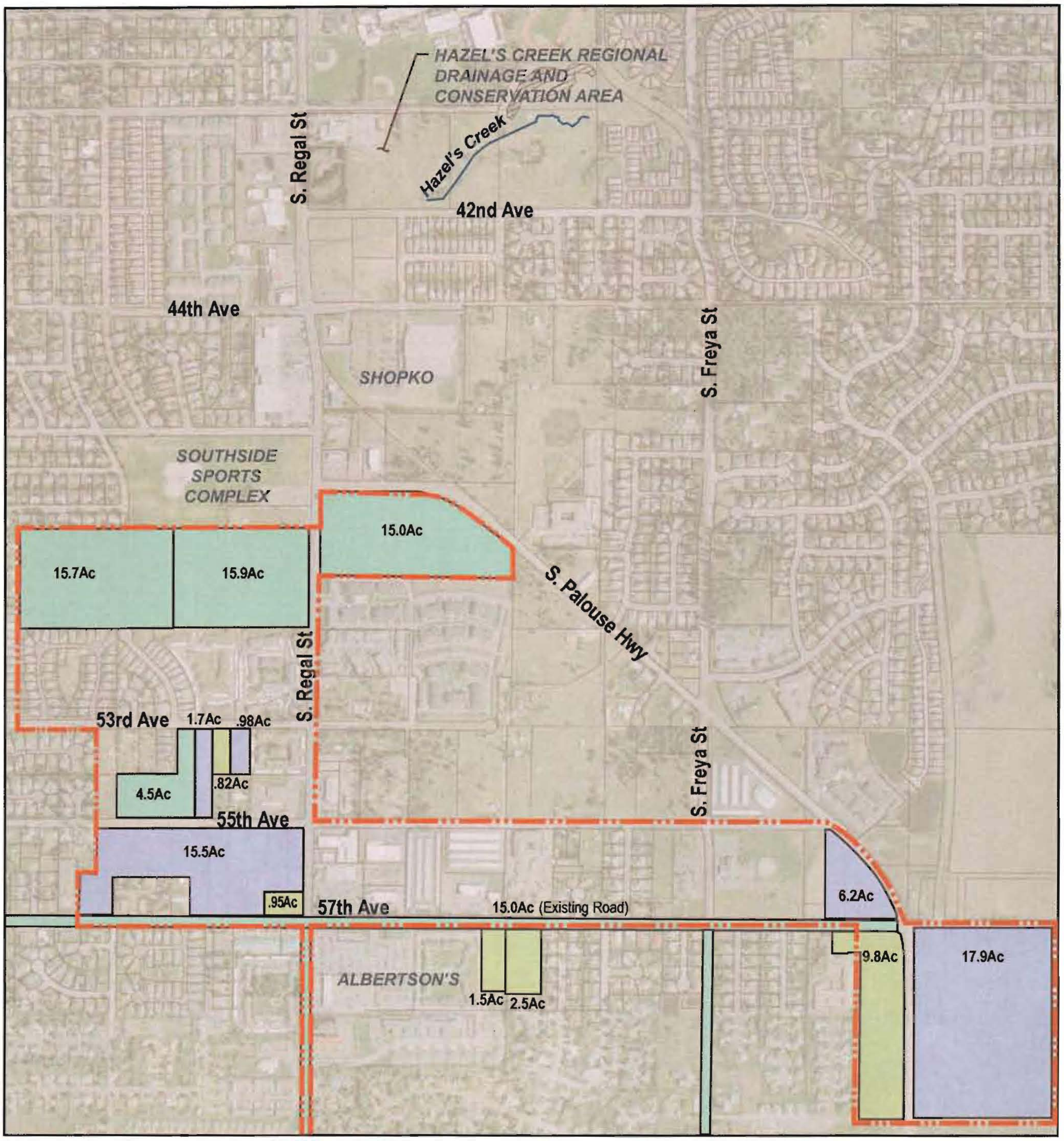
North

0 300 600 900

Approximate scale in feet

CH2MHILL.

FIGURE 1
Project Vicinity Map
City of Spokane



LEGEND:

Land Type	Peak Flow Assumptions
Redevelop	1.5 GMP/Acre
Undeveloped	1.5 GMP/Acre
To Be Developed	Full Development Flow

North

0 300 600 900
Approximate scale in feet

CH2MHILL.

FIGURE 2
Contributing Areas Plan
City of Spokane

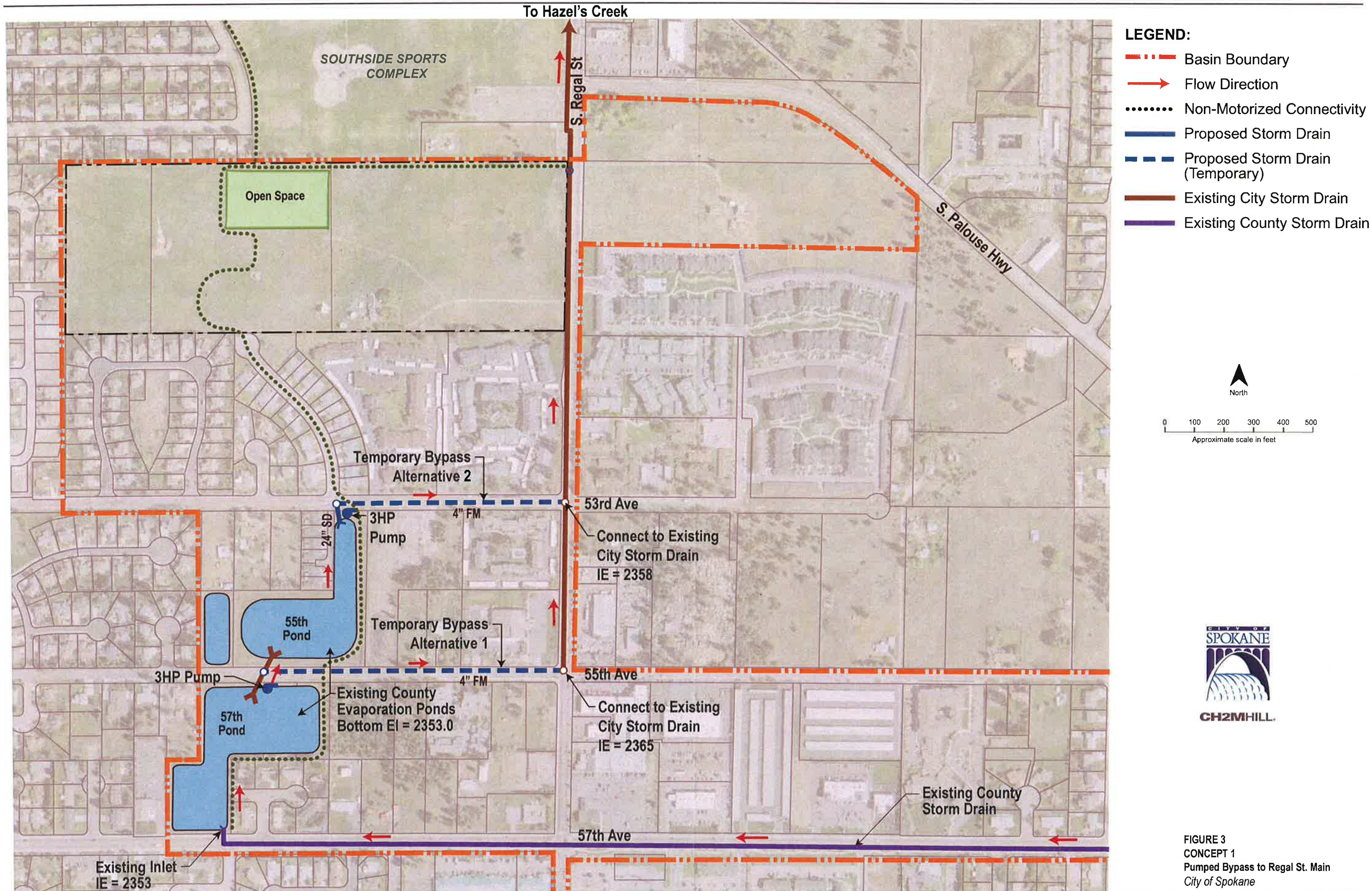


FIGURE 3
CONCEPT 1
Pumped Bypass to Regal St. Main
City of Spokane

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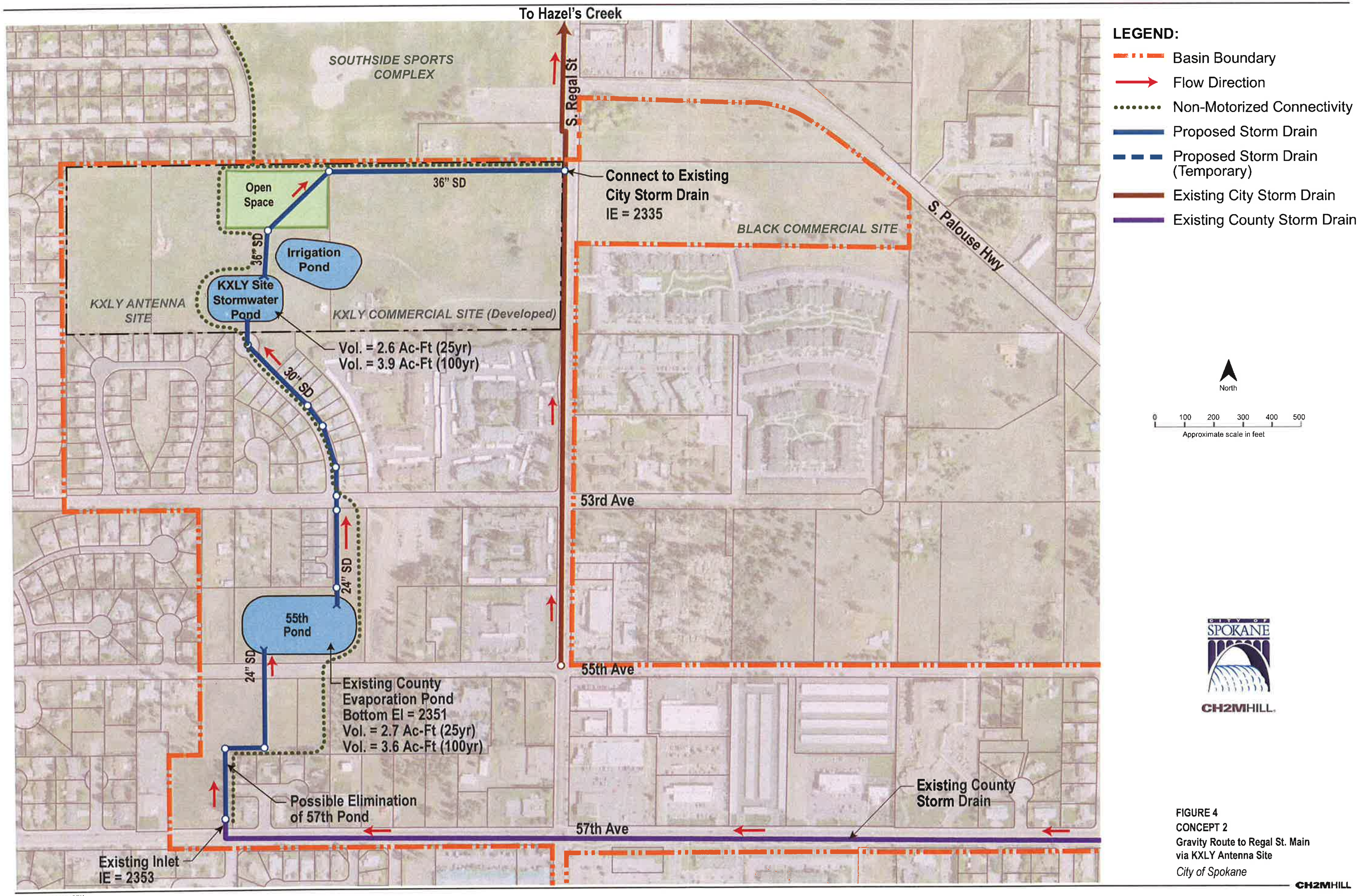
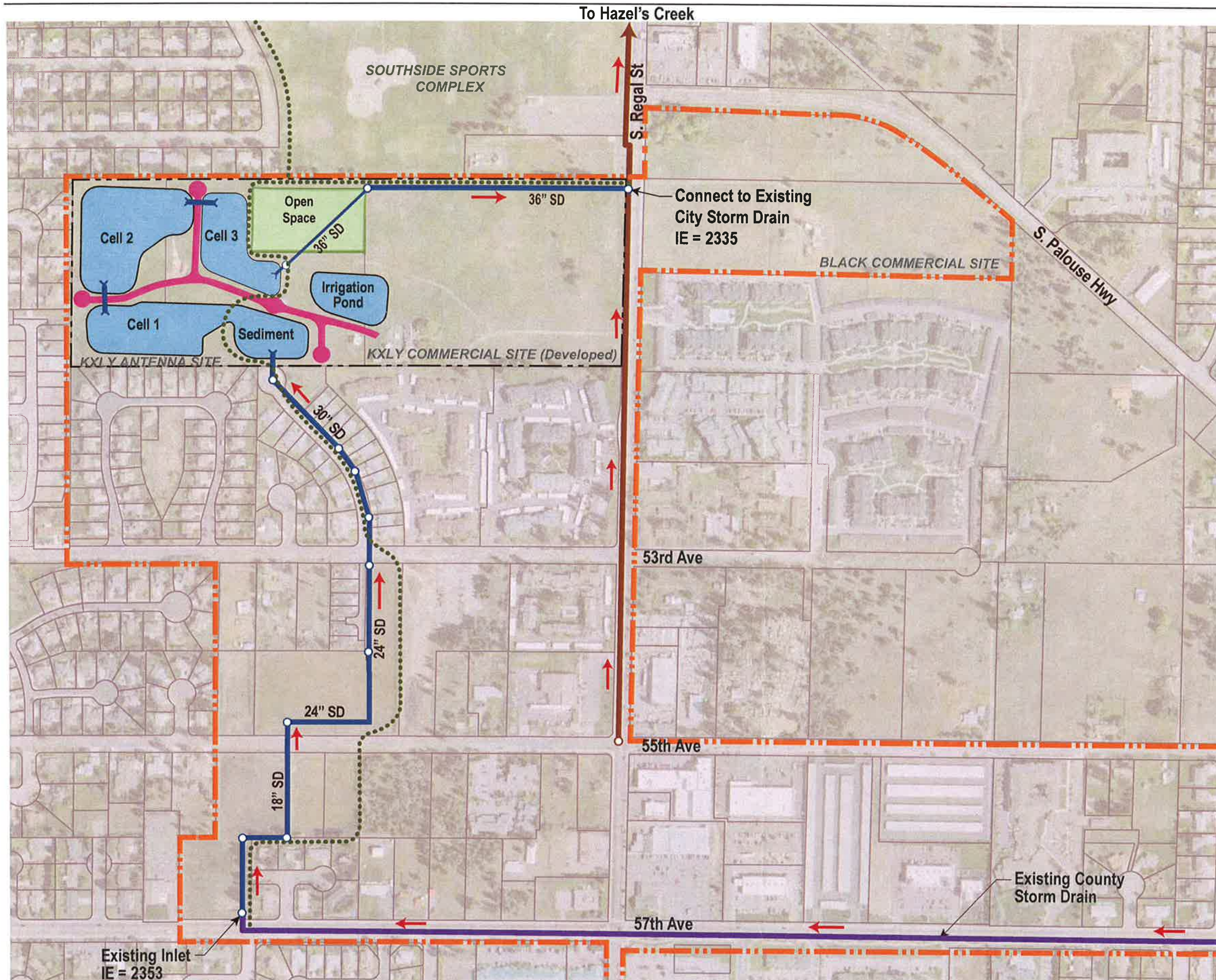


FIGURE 4
CONCEPT 2
Gravity Route to Regal St. Main via KXLY Antenna Site
City of Spokane
CH2MHILL



WBG101011024354SPK

LEGEND:

- Basin Boundary
- Flow Direction
- Non-Motorized Connectivity
- Proposed Storm Drain
- Proposed Storm Drain (Temporary)
- Existing City Storm Drain
- Existing County Storm Drain
- Maintenance Access Route/Path

North

0 100 200 300 400 500
Approximate scale in feet

Pond	Depth(ft)	Bottom Elev	Bottom Area (Ac)
Sediment	1.5'	2341.00	0.9Ac
Cell 1	1.0'	2341.50	2.8Ac
Cell 2	1.25'	2341.25	2.4Ac
Cell 3	1.5'	2341.00	1.3Ac

Total Vol. = 6.6 Ac-Ft (25yr)
10.8 Ac-Ft (100yr)

CITY OF SPOKANE

CH2MHILL.

FIGURE 5
CONCEPT 3
Stormwater Facilities at KXLY Antenna Site
City of Spokane

ATTACHMENT B

ALTAMONT STORMWATER AREA POND PROJECT – TECHNICAL REQUIREMENTS SUMMARY

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MEMORANDUM

TO: JIM MACINNIS, P.E., MARCIA DAVIS, P.E., CITY OF SPOKANE

FROM: MARK BROWER, P.E.

DATE: JULY 30, 2008

FILE NO: 035215

RE: ALTAMONT STORMWATER AREA POND PROJECT - TECHNICAL REQUIREMENTS SUMMARY

BACKGROUND AND PURPOSE

This memorandum serves to report on the technical requirements relating to a regional stormwater facility on Spokane's South Hill.

The purpose of this effort is to review and summarize documented applicable requirements and criteria:

1. Revised Code of Washington: RCW 90.03.350;
2. Washington Administrative Code: WAC 173-175 - Dam Safety;
3. Spokane Regional Stormwater Manual;
4. Spokane City Code - Stormwater Facilities.

RESULTS

The following are a summary of integral items pertaining to stormwater facilities:

RCW 90.03.350: This part of the code specifies that any construction or modification to "controlling works for the storage of ten acre feet or more of water, shall before beginning said construction or modification, submit plans and specifications of the same to the department for examination and approval as to its safety."

WAC 173-175 - Dam Safety: This code specifies conditions under which a project must be considered as a dam. The two applicable provisions are:

(1) These regulations are applicable to dams which can impound a volume of ten acre-feet or more of water as measured at the dam crest elevation. The ten acre-feet threshold applies to dams which can impound water on either an intermittent or permanent basis. Only water that can be stored above natural ground level or which could be released by a failure of the dam is considered in assessing the storage volume.

(2) For a dam whose dam height is six feet or less and which meets the conditions of subsection (1) of this section, the department may elect to exempt the dam from these regulations.

This code section further states all of the guidelines for dams subject to full dam safety codes and regulations.

Spokane City Code – Stormwater Facilities: This document specifies that "the director of wastewater management may recommend that the City assume responsibility for the further design, construction, operation, and/or maintenance of the drainage facilities, or any increment of the responsibility for the facilities, on a specific development property." The site is within the Moran Prairie Special Drainage District as designated by the City of Spokane. This adds special requirements found in sections 17D.060.140, 17F.040.085, 17D.060.150, and 17D.060.160. These sections strictly limit the work that can be done in natural drainage ways. The director of engineering services may grant exemptions or modify conditions based on: existing, accepted engineering principles; and consistent with the policies and purpose of this chapter; and in writing and posted on the department of engineering services website for ten calendar days following issuance of the decision and provided to the office of neighborhood services within two working days of issuance.

Spokane Regional Stormwater Manual: This manual gives guidelines and regulations adopted by Spokane County, the City of Spokane, and City of Spokane Valley relating to stormwater. Chapter 7 describes flow control facilities. The following are key requirements relating to detention facilities:

Design Storm:

NRCS Type 1A 24 hour storm event is the design storm to be used for all flow control facilities that use a surface discharge.

Sizing Requirements:

- Flow Control Facilities (surface discharge): Retain 2-year and 25-year with applicable release rates. Provide 100-year overflow route.
- Conveyance Systems: 10-year (25-yr for regional systems)

Release Rate:

- Flow Control Facilities: < 2-year pre-developed, < 25-year pre-developed.

Dam Safety:

- 10 Acre-feet above natural ground.
- Dams that are 6 feet or more in height.

Setbacks:

- Pond Overflow Structures shall be located a minimum of 10' from any structure or property line.
- The toe of the berm or top of bank shall be a minimum of 5' from any structure or property line.
- Setbacks for any pond shall be at least 30' when located up-gradient for 10' when located down-gradient from septic tanks or drain fields.

Side slopes:

- Pond side slopes shall meet one of the following requirements:
  1. Interior side slopes shall not be steeper than 3:1 (horizontal to vertical);
  2. Interior side slopes may be increased to a maximum of 2:1 if the surrounding grade

creates a cut or fill with no greater depth than 1.0 foot;

3. Exterior side slopes shall not be steeper than 2:1 unless analyzed for stability by a geotechnical engineer.
4. Pond walls may be vertical retaining walls, provided that: A fence is provided along the top of the wall for walls 2.5 feet or taller and a 4-foot wide access ramp to the pond bottom is provided, with slopes less than 4:1 and the design is stamped by an engineer with structural expertise if the wall is surcharged or if it is 4 feet or more in height. A separate building permit may be required by the local jurisdiction if the wall height exceeds 4 feet.

Emergency Overflow Spillway:

- Emergency overflow spillways shall be provided for detention ponds with constructed berms of 2 feet or more in height.
- Spillway requirements located in Spokane Regional Stormwater Manual Section 7.8.5.

Embankments:

- The height of an embankment is measured from the top of the berm to the catch point of the native soil at the lowest elevation. Embankments shall meet the following minimum requirements (SRSM Section 7.8.6):
  1. Embankments 4 feet or more in height shall be constructed as recommended by a geotechnical engineer.
  2. The berm top width shall be a minimum of 4'.
  3. Etc.

Fencing:

- Drainage facilities with the first overflow at 2 or more feet above the pond bottom;
- Drainage facilities with retaining walls 2.5 feet high or taller.
- Drainage facilities located at, or adjacent to, schools, nursing homes, daycares, or similar facilities.
- At the discretion of the local jurisdiction, if a pond is proposed as an amenity (i.e. enhancements to the disposal facility are proposed, such as rocks, boulders, waterfalls, fountains, creative landscaping, or plant materials), the design will be reviewed on a case-by-case basis, such that the fencing may be reduced or waived.

Ponds:

- Pond bottoms shall be located a minimum of 0.5

feet below the outlet to provide sediment storage

- In general, all pond bottoms shall be flat.

Regional Stormwater Facilities:

- Regional facilities may reduce a community's long term costs for stormwater management.
- All projects shall be reviewed for the presence of natural drainageways, and a determination will be made as to their significance with regard to preservation of natural conveyance and potential use as part of a regional system.

Special Drainage Areas:

- Unless specifically approved by the local jurisdiction, the peak rate and volume of stormwater runoff from any proposed land development to any natural or constructed point of discharge downstream shall not exceed the pre-development peak rate or volume of runoff. A down-gradient analysis demonstrating that there will be no expected adverse impacts on down-gradient properties will be required. Exceptions with regard to rate and volume control can be made for regional facilities planned by the local jurisdiction.

ATTACHMENT C

CALCULATIONS

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Job No.

Sheet No.

Job Name

Date 3/1/2012

Subject HAZZCS CREEK

Computed By RWL

Checked By

Pump sizing

Flow rate = 95 AC × 1.5 gpm/AC 143 gpm

$$hf = \frac{10.44 \times 1350\,LF \times 143\,gpm^{1.85}}{140^{1.85} \times (4")^{4.8655}}$$

$$= 12.8'$$

$Q = 143\,gpm$ OR $0.32\,c/s$

Pipe ø = 4".

$A = 0.0872\,SF$.

$V = Q/A = 3.7\,fps$ ok

$\Delta h = 17'$

Total head loss = 30' + 10% for minor losses & losses @ fittings

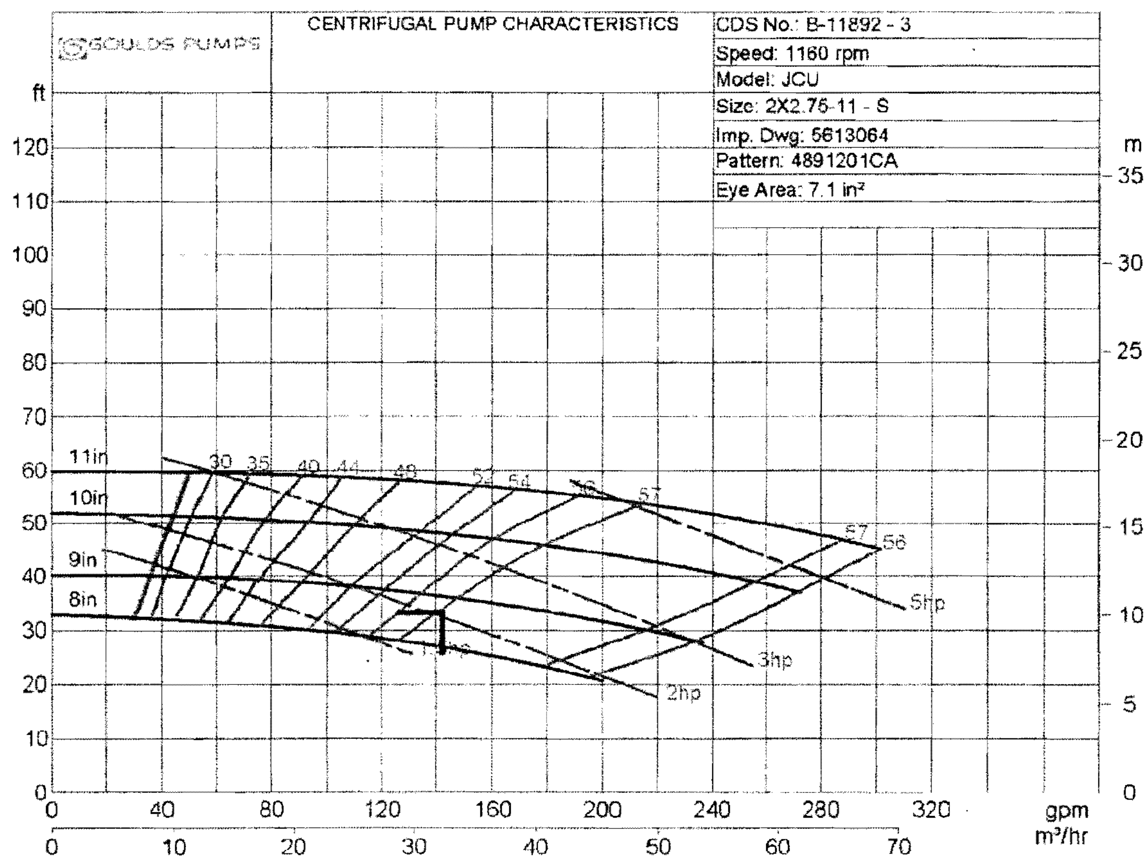
= 33'

Model: JCU	Size: 2X2.75-11	Group: S	60Hz	RPM: 1160	Stages: 1

Job/Inq.No. :					
Purchaser :	UNDEFINED				
End User:		Issued by :			
Item/Equip.No. :	ITEM 001	Quotation No. :		Date :	03/01/2012
Service :					
Order No. :				Rev. :	0

Operating Conditions		Pump Performance			
Liquid:	Water	Published Efficiency:	57.0 %	Suction Specific Speed:	
Temp.:	70.0 deg F	Rated Pump Efficiency:	57.0 %	Min. Hydraulic Flow:	35.0 gpm
S.G./Visc.:	1.000/1.000 cp	Rated Total Power:	2.1 hp	Min. Thermal Flow:	N/A
Flow:	143.0 gpm	Non-Overloading Power:	2.7 hp		
TDH:	33.0 ft	Imp. Dia. First 1 Stg(s):	8.7500 in		
NPSHa:	0.0 ft	NPSHr:			
Solid size:		Shut off Head:	38.4 ft		
% Susp. Solids (by wtg):		Vapor Press:			
Max. Solids Size:	0.8750 in				

Notes: 1.The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above. 2. Magnetic drive eddy current and viscous effect on power and efficiency is not included. 3. Elevated temperature effects on performance are not included. 4. Non Overloading power does not reflect v-belt/gear losses.



Scenario Calculation Summary

Scenario Summary	
ID	21
	PHASE 2 – 25 Year Analysis
Notes	
Active Topology	Future Active Topology
Hydrology	Future Hydrology
Rainfall Runoff	25 year
Physical	Future Physical
Initial Condition	Future Initial Condition
Boundary Condition	Future Boundary Condition
Infiltration and Inflow	Future Infiltration and Inflow
Output	Future Output
User Data Extensions	Future User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050hours	Duration	24.000hours

Rainfall Summary			
Return Event Tag	25	Rainfall Type	Time-Depth Curve
Total Depth	2.0in	Storm Event	25 Year Storm

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
55-1	Future 25 year	25	None	0.343	8.000	0.87	(N/A)	(N/A)
55thPond (IN)	Future 25 year	25	None	2.906	8.150	6.69	(N/A)	(N/A)
55thPond (OUT)	Future 25 year	25	None	0.226	24.000	0.20	2,353.87	2.680
57-1	Future 25 year	25	None	0.551	7.950	1.67	(N/A)	(N/A)
D57-3	Future 25 year	25	None	2.240	8.200	5.83	(N/A)	(N/A)
KXLY Pond C3 (IN)	Future 25 year	25	None	2.996	8.000	8.05	(N/A)	(N/A)
KXLY Pond C3 (OUT)	Future 25 year	25	None	0.362	24.000	0.33	2,342.47	2.635
KXLY-1	Future 25 year	25	None	1.087	8.000	2.94	(N/A)	(N/A)
KXLY-2	Future 25 year	25	None	1.683	8.000	5.05	(N/A)	(N/A)
O-REGAL	Future 25 year	25	None	0.362	24.000	0.33	(N/A)	(N/A)

TOT VOL = 5.3 ac-ft

Scenario Calculation Summary

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
R57-10	Future 25 year	25	None	0.890	7.950	2.69	(N/A)	(N/A)
R57-11	Future 25 year	25	None	0.101	7.900	0.31	(N/A)	(N/A)
R57-6	Future 25 year	25	None	1.021	8.400	2.23	(N/A)	(N/A)
R57-8	Future 25 year	25	None	0.369	7.900	1.14	(N/A)	(N/A)
R57-9	Future 25 year	25	None	0.508	7.950	1.54	(N/A)	(N/A)
U55-2	Future 25 year	25	None	0.187	7.950	0.57	(N/A)	(N/A)
U55-3	Future 25 year	25	None	0.093	7.900	0.27	(N/A)	(N/A)
U55-4	Future 25 year	25	None	0.104	7.950	0.31	(N/A)	(N/A)
U57-2	Future 25 year	25	None	1.091	7.950	3.30	(N/A)	(N/A)
U57-4	Future 25 year	25	None	0.159	7.950	0.48	(N/A)	(N/A)
U57-5	Future 25 year	25	None	0.737	7.950	2.28	(N/A)	(N/A)
U57-7	Future 25 year	25	None	1.984	8.400	4.13	(N/A)	(N/A)
VOnSiteD (IN)	Future 25 year	25	None	7.793	8.000	18.83	(N/A)	(N/A)
VOnSiteD (OUT)	Future 25 year	25	None	0.323	7.700	0.22	2,600.70	7.470

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction
55 Outlet	Pond Outlet	Upstream	2.906	8.150	6.69	55thPond	Pond Inflow
55 Outlet	Pond Outlet	Outflow	0.226	24.000	0.20	55thPond	Pond Outflow
55 Outlet	Pond Outlet	Link	0.226	24.000	0.20		
55 Outlet	Pond Outlet	Downstream	2.996	8.000	8.05	KXLY Pond C3	
KXLY Outlet	Pond Outlet	Upstream	2.996	8.000	8.05	KXLY Pond C3	Pond Inflow
KXLY Outlet	Pond Outlet	Outflow	0.362	24.000	0.33	KXLY Pond C3	Pond Outflow
KXLY Outlet	Pond Outlet	Link	0.362	24.000	0.33		
KXLY Outlet	Pond Outlet	Downstream	0.362	24.000	0.33	O-REGAL	

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
Outlet-12	Pond Outlet	Upstream	7.793	8.000	18.83	VOnSiteD	Pond Inflow
Outlet-12	Pond Outlet	Outflow	0.323	7.700	0.22	VOnSiteD	Pond Outflow
Outlet-12	Pond Outlet	Link	0.323	7.700	0.22		
Outlet-12	Pond Outlet	Downstream	2.906	8.150	6.69	55thPond	

Scenario Calculation Summary

Scenario Summary	
ID	22
Label	**PHASE 2 – 100 Year Analysis**
Notes	
Active Topology	~~Future Active Topology~~
Hydrology	Future Hydrology
Rainfall Runoff	100 year
Physical	Future Physical
Initial Condition	Future Initial Condition
Boundary Condition	Future Boundary Condition
Infiltration and Inflow	Future Infiltration and Inflow
Output	Future Output
User Data Extensions	Future User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050hours	Duration	24.000hours

Rainfall Summary			
Return Event Tag	100	Rainfall Type	Time-Depth Curve
Total Depth	2.6in	Storm Event	100 Year Storm

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
55-1	Future 100 year	100	None	0.543	8.000	1.51	(N/A)	(N/A)
55thPond (IN)	Future 100 year	100	None	3.875	8.100	9.09	(N/A)	(N/A)
55thPond (OUT)	Future 100 year	100	None	0.277	24.000	0.24	2,354.16	3.598
57-1	Future 100 year	100	None	0.790	7.950	2.44	(N/A)	(N/A)
D57-3	Future 100 year	100	None	2.993	8.200	7.72	(N/A)	(N/A)
KXLY Pond C3 (IN)	Future 100 year	100	None	4.367	8.000	12.30	(N/A)	(N/A)
KXLY Pond C3 (OUT)	Future 100 year	100	None	0.454	24.000	0.40	2,343.05	3.913
KXLY-1	Future 100 year	100	None	1.675	8.000	4.83	(N/A)	(N/A)
KXLY-2	Future 100 year	100	None	2.415	8.000	7.37	(N/A)	(N/A)
O-REGAL	Future 100 year	100	None	0.454	24.000	0.40	(N/A)	(N/A)

TOTAL VOL = 7.5 ac-ft

Scenario Calculation Summary

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
R57-10	Future 100 year	100	None	1.276	7.950	3.94	(N/A)	(N/A)
R57-11	Future 100 year	100	None	0.145	7.900	0.45	(N/A)	(N/A)
R57-6	Future 100 year	100	None	1.466	8.400	3.28	(N/A)	(N/A)
R57-8	Future 100 year	100	None	0.492	7.900	1.50	(N/A)	(N/A)
R57-9	Future 100 year	100	None	0.729	7.950	2.25	(N/A)	(N/A)
U55-2	Future 100 year	100	None	0.269	7.950	0.83	(N/A)	(N/A)
U55-3	Future 100 year	100	None	0.131	7.900	0.39	(N/A)	(N/A)
U55-4	Future 100 year	100	None	0.149	7.950	0.46	(N/A)	(N/A)
U57-2	Future 100 year	100	None	1.565	7.950	4.84	(N/A)	(N/A)
U57-4	Future 100 year	100	None	0.228	7.950	0.70	(N/A)	(N/A)
U57-5	Future 100 year	100	None	1.032	7.950	3.22	(N/A)	(N/A)
U57-7	Future 100 year	100	None	2.797	8.400	6.06	(N/A)	(N/A)
VOnSiteD (IN)	Future 100 year	100	None	11.070	8.000	27.38	(N/A)	(N/A)
VOnSiteD (OUT)	Future 100 year	100	None	0.339	6.750	0.22	2,600.98	10.729

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction
55 Outlet	Pond Outlet	Upstream	3.875	8.100	9.09	55thPond	Pond Inflow
55 Outlet	Pond Outlet	Outflow	0.277	24.000	0.24	55thPond	Pond Outflow
55 Outlet	Pond Outlet	Link	0.277	24.000	0.24		
55 Outlet	Pond Outlet	Downstream	4.367	8.000	12.30	KXLY Pond C3	
KXLY Outlet	Pond Outlet	Upstream	4.367	8.000	12.30	KXLY Pond C3	Pond Inflow
KXLY Outlet	Pond Outlet	Outflow	0.454	24.000	0.40	KXLY Pond C3	Pond Outflow
KXLY Outlet	Pond Outlet	Link	0.454	24.000	0.40		
KXLY Outlet	Pond Outlet	Downstream	0.454	24.000	0.40	O-REGAL	

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
Outlet-12	Pond Outlet	Upstream	11.070	8.000	27.38	VOnSiteD	Pond Inflow
Outlet-12	Pond Outlet	Outflow	0.339	6.750	0.22	VOnSiteD	Pond Outflow
Outlet-12	Pond Outlet	Link	0.339	6.750	0.22		
Outlet-12	Pond Outlet	Downstream	3.875	8.100	9.09	55thPond	

Scenario Calculation Summary

Scenario Summary	
ID	~~21~~
Label	**PHASE 3 – 25 Year Analysis**
Notes	
Active Topology	Future ~~Active Topology~~
Hydrology	Future Hydrology
Rainfall Runoff	25 year
Physical	Future Physical
Initial Condition	Future Initial Condition
Boundary Condition	Future Boundary Condition
Infiltration and Inflow	Future Infiltration and Inflow
Output	Future Output
User Data Extensions	Future User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050hours	Duration	24.000hours

Rainfall Summary			
Return Event Tag	25	Rainfall Type	Time-Depth Curve
Total Depth	2.0in	Storm Event	25 Year Storm

ICPM Output Summary			
Target Convergence	0.00ft³/s	ICPM Time Step	0.050hours
Maximum Iterations	35		

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
55-1	Future 25 year	25	None	0.343	8.000	0.87	(N/A)	(N/A)
57-1	Future 25 year	25	None	0.551	7.950	1.67	(N/A)	(N/A)
D57-3	Future 25 year	25	None	2.740	8.200	5.83	(N/A)	(N/A)
KXLY POND ~~C2 (IN)~~	Future 25 year	25	None	1.944	9.400	3.83	(N/A)	(N/A)
KXLY POND C2 (OUT)	Future 25 year	25	None	0.003	10.650	0.15	2,342.48	2.689
~~KXLY POND~~ C2 (Reverse)	Future 25 year	25	None	-0.741	9.150	-2.27	(N/A)	(N/A)
KXLY Pond C1 (IN)	Future 25 year	25	None	4.236	8.100	10.44	(N/A)	(N/A)

TOTAL VOL ≈ 6.6 ac-ft

Scenario Calculation Summary

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
KXLY Pond C1 (OUT)	Future 25 year	25	None	1.944	9.400	3.83	2,342.48	2.289
KXLY Pond C3 (IN)	Future 25 year	25	None	2.026	7.900	7.50	(N/A)	(N/A)
KXLY Pond C3 (OUT)	Future 25 year	25	None	0.430	24.000	0.37	2,342.49	1.595
KXLY-1	Future 25 year	25	None	1.087	8.000	2.94	(N/A)	(N/A)
KXLY-2	Future 25 year	25	None	1.683	8.000	5.05	(N/A)	(N/A)
KXLY-3	Future 25 year	25	None	1.586	8.000	4.69	(N/A)	(N/A)
O-REGAL	Future 25 year	25	None	0.430	23.950	0.37	(N/A)	(N/A)
R57-10	Future 25 year	25	None	0.890	7.950	2.69	(N/A)	(N/A)
R57-11	Future 25 year	25	None	0.101	7.900	0.31	(N/A)	(N/A)
R57-6	Future 25 year	25	None	1.021	8.400	2.23	(N/A)	(N/A)
R57-8	Future 25 year	25	None	0.369	7.900	1.14	(N/A)	(N/A)
R57-9	Future 25 year	25	None	0.508	7.950	1.54	(N/A)	(N/A)
U55-2	Future 25 year	25	None	0.187	7.950	0.57	(N/A)	(N/A)
U55-3	Future 25 year	25	None	0.093	7.900	0.27	(N/A)	(N/A)
U55-4	Future 25 year	25	None	0.104	7.950	0.31	(N/A)	(N/A)
U57-2	Future 25 year	25	None	1.091	7.950	3.30	(N/A)	(N/A)
U57-4	Future 25 year	25	None	0.159	7.950	0.48	(N/A)	(N/A)
U57-5	Future 25 year	25	None	0.737	7.950	2.28	(N/A)	(N/A)
U57-7	Future 25 year	25	None	1.984	8.400	4.13	(N/A)	(N/A)
VOnSiteD (IN)	Future 25 year	25	None	6.136	8.000	19.70	(N/A)	(N/A)
VOnSiteD (OUT)	Future 25 year	25	None	0.410	24.000	0.53	2,600.72	7.724

Executive Summary (Links)

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft³/s)	End Point	Node Flow Direction
KXLY Outlet	Pond Outlet	Upstream	2.026	7.900	7.50	KXLY Pond C3	Pond Inflow
KXLY Outlet	Pond Outlet	Outflow	0.430	24.000	0.37	KXLY Pond C3	Pond Outflow
KXLY Outlet	Pond Outlet	Link	0.430	23.950	0.37		
KXLY Outlet	Pond Outlet	Downstream	0.430	23.950	0.37	O-REGAL	
Outlet-11	Pond Outlet	Upstream	4.236	8.100	10.44	KXLY Pond C1	Pond Inflow
Outlet-11	Pond Outlet	Outflow	1.944	9.400	3.83	KXLY Pond C1	Pond Outflow
Outlet-11	Pond Outlet	Link	1.941	9.400	3.83		
Outlet-11	Pond Outlet	Downstream	1.944	9.400	3.83	KXLY POND C2	
Outlet-17	Pond Outlet	Upstream	8.136	8.000	19.70	VOnSiteD	Pond Inflow
Outlet-17	Pond Outlet	Outflow	0.410	24.000	0.53	VOnSiteD	Pond Outflow
Outlet-17	Pond Outlet	Link	0.410	24.000	0.53		
Outlet-17	Pond Outlet	Downstream	4.236	8.100	10.44	KXLY Pond C1	
Outlet-C2	Pond Outlet	Upstream	1.944	9.400	3.83	KXLY POND C2	Pond Inflow
Outlet-C2	Pond Outlet	Outflow	0.003	10.650	0.15	KXLY POND C2	Pond Outflow
Outlet C2	Negative Flow	Outflow	-0.741	9.150	-2.27	KXLY POND C2	Pond Outflow
Outlet-C2	Pond Outlet	Link	0.003	10.650	0.15		
Outlet-C2	Negative Flow	Link	-0.741	9.150	-2.27		
Outlet-C2	Pond Outlet	Downstream	2.026	7.900	7.50	KXLY Pond C3	

Scenario Calculation Summary

Scenario Summary	
ID	~~22~~
Label	**PHASE 3 – 100 Year Analysis**
Notes	
Active Topology	~~Future Active Topology~~
Hydrology	Future Hydrology
Rainfall Runoff	100 year
Physical	Future Physical
Initial Condition	Future Initial Condition
Boundary Condition	Future Boundary Condition
Infiltration and Inflow	Future Infiltration and Inflow
Output	Future Output
User Data Extensions	Future User Data Extensions
PondPack Engine Calculation Options	Base Calculation Options

Output Summary			
Output Increment	0.050hours	Duration	24.000hours

Rainfall Summary			
Return Event Tag	100	Rainfall Type	Time-Depth Curve
Total Depth	2.6in	Storm Event	100 Year Storm

ICPM Output Summary			
Target Convergence	0.00ft³/s	ICPM Time Step	0.050hours
Maximum Iterations	35		

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)	
55-1	Future 100 year	100	None	0.543	8.000	1.51	(N/A)	(N/A)	
57-1	Future 100 year	100	None	0.790	7.950	2.44	(N/A)	(N/A)	
D57-3	Future 100 year	100	None	2.993	8.200	7.72	(N/A)	(N/A)	
KXLY POND C2 (IN)	Future 100 year	100	None	3.151	9.150	5.86	(N/A)	(N/A)	TOTAL VOL
KXLY POND C2 (OUT)	Future 100 year	100	None	0.032	23.750	0.59	2,343.15	4.279	= 10.8 ac-ft
KXLY POND C2 (Reverse)	Future 100 year	100	None	-1.159	8.550	-5.05	(N/A)	(N/A)	
KXLY Pond C1 (IN)	Future 100 year	100	None	7.223	8.050	14.39	(N/A)	(N/A)	

Scenario Calculation Summary

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
KXLY Pond C1 (OUT)	Future 100 year	100	None	3.151	9.150	5.86	2,343.17	4.061
KXLY Pond C3 (IN)	Future 100 year	100	None	2.957	7.900	9.97	(N/A)	(N/A)
KXLY Pond C3 (Reverse)	Future 100 year	100	None	0.000	8.850	-0.01	(N/A)	(N/A)
KXLY Pond C3 (OUT)	Future 100 year	100	None	0.524	24.000	0.46	2,343.15	2.433
KXLY-1	Future 100 year	100	None	1.675	8.000	4.83	(N/A)	(N/A)
KXLY-2	Future 100 year	100	None	2.415	8.000	7.37	(N/A)	(N/A)
KXLY-3	Future 100 year	100	None	2.275	8.000	6.88	(N/A)	(N/A)
O-REGAL	Future 100 year	100	None	0.524	23.950	0.46	(N/A)	(N/A)
R57-10	Future 100 year	100	None	1.276	7.950	3.94	(N/A)	(N/A)
R57-11	Future 100 year	100	None	0.145	7.900	0.45	(N/A)	(N/A)
R57-6	Future 100 year	100	None	1.466	8.400	3.28	(N/A)	(N/A)
R57-8	Future 100 year	100	None	0.492	7.900	1.50	(N/A)	(N/A)
R57-9	Future 100 year	100	None	0.729	7.950	2.25	(N/A)	(N/A)
U55-2	Future 100 year	100	None	0.269	7.950	0.83	(N/A)	(N/A)
U55-3	Future 100 year	100	None	0.131	7.900	0.39	(N/A)	(N/A)
U55-4	Future 100 year	100	None	0.149	7.950	0.46	(N/A)	(N/A)
U57-2	Future 100 year	100	None	1.565	7.950	4.84	(N/A)	(N/A)
U57-4	Future 100 year	100	None	0.228	7.950	0.70	(N/A)	(N/A)
U57-5	Future 100 year	100	None	1.032	7.950	3.22	(N/A)	(N/A)
U57-7	Future 100 year	100	None	2.797	8.400	6.06	(N/A)	(N/A)
VOnSiteD (IN)	Future 100 year	100	None	11.613	8.000	28.89	(N/A)	(N/A)
VOnSiteD (OUT)	Future 100 year	100	None	1.955	24.000	3.39	2,600.89	9.657

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
KXLY Outlet	Pond Outlet	Upstream	2.957	7.900	9.97	KXLY Pond C3	Pond Inflow
KXLY Outlet	Negative Flow	Upstream	0.000	8.850	-0.01	KXLY Pond C3	Pond Inflow
KXLY Outlet	Pond Outlet	Outflow	0.524	24.000	0.46	KXLY Pond C3	Pond Outflow
KXLY Outlet	Pond Outlet	Link	0.524	23.950	0.46		
KXLY Outlet	Pond Outlet	Downstream	0.524	23.950	0.46	O-REGAL	
Outlet-11	Pond Outlet	Upstream	7.223	8.050	14.39	KXLY Pond C1	Pond Inflow
Outlet-11	Pond Outlet	Outflow	3.151	9.150	5.86	KXLY Pond C1	Pond Outflow
Outlet-11	Pond Outlet	Link	3.139	9.150	5.86		
Outlet-11	Pond Outlet	Downstream	3.151	9.150	5.86	KXLY POND C2	
Outlet-17	Pond Outlet	Upstream	11.613	8.000	28.89	VOnSiteD	Pond Inflow
Outlet-17	Pond Outlet	Outflow	1.955	24.000	3.39	VOnSiteD	Pond Outflow
Outlet-17	Pond Outlet	Link	1.955	24.000	3.39		
Outlet-17	Pond Outlet	Downstream	7.223	8.050	14.39	KXLY Pond C1	
Outlet-C2	Pond Outlet	Upstream	3.151	9.150	5.86	KXLY POND C2	Pond Inflow
Outlet-C2	Pond Outlet	Outflow	0.032	23.750	0.59	KXLY POND C2	Pond Outflow
Outlet-C2	Negative Flow	Outflow	-1.159	8.550	-5.05	KXLY POND C2	Pond Outflow
Outlet-C2	Pond Outlet	Link	0.032	23.750	0.59		
Outlet-C2	Negative Flow	Link	-1.161	8.550	-5.05		
Outlet-C2	Pond Outlet	Downstream	2.957	7.900	9.97	KXLY Pond C3	
Outlet-C2	Negative Flow	Downstream	0.000	8.850	-0.01	KXLY Pond C3	

CH2MHILL.

Job Name ______

Subject HAZEL'S CREEK

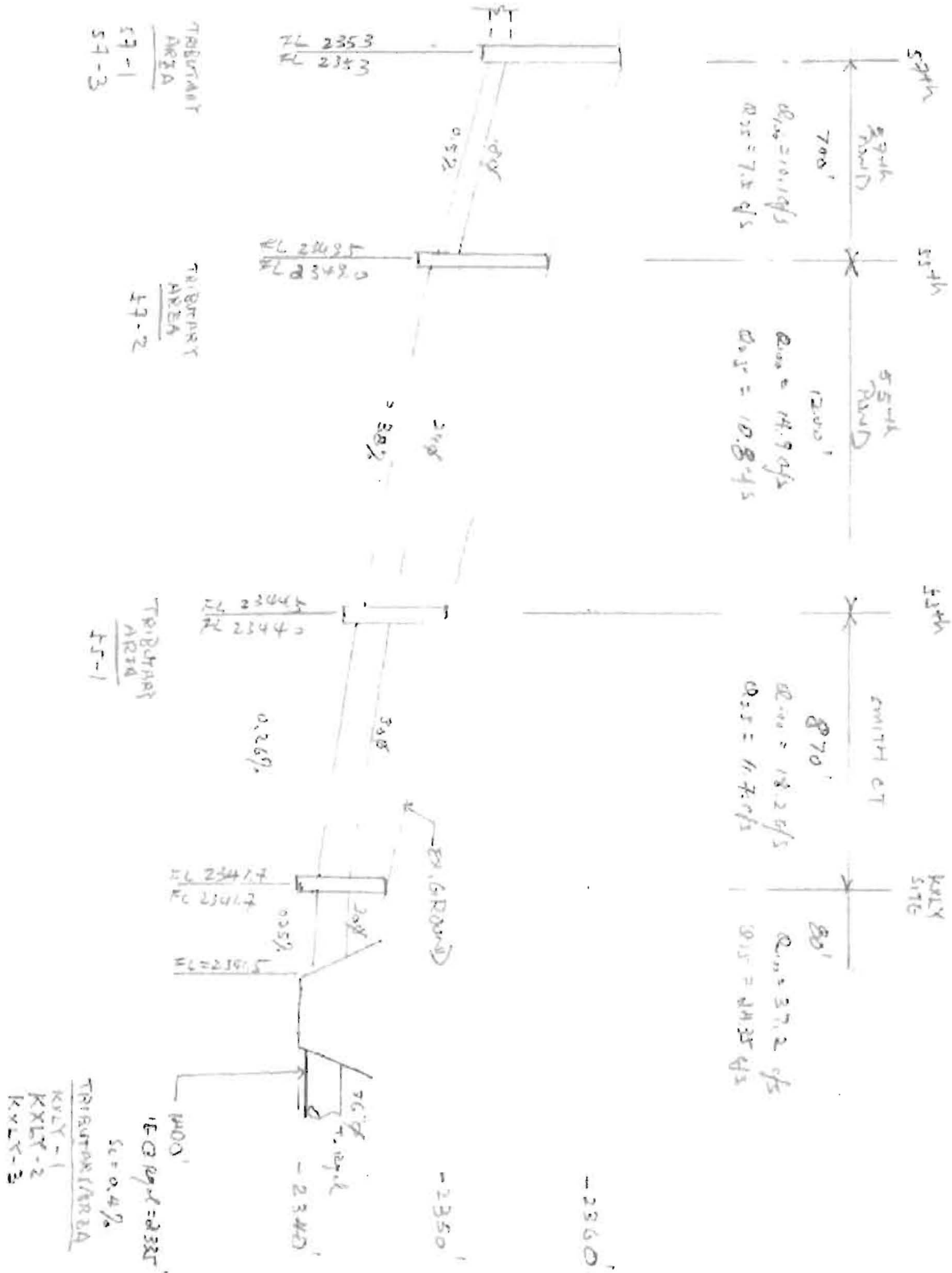
Job No. ______

Sheet No. ______

Date NOV 2011

Computed By RWK

Checked By ______



Worksheet for Circular Pipe - 18"

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.05000	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	25.44	ft³/s

Results

Discharge		25.44	ft³/s
Normal Depth		1.50	ft
Flow Area		1.77	ft²
Wetted Perimeter		4.71	ft
Hydraulic Radius		0.38	ft
Top Width		0.00	ft
Critical Depth		1.49	ft
Percent Full		100.0	%
Critical Slope		0.04634	ft/ft
Velocity		14.40	ft/s
Velocity Head		3.22	ft
Specific Energy		4.72	ft
Froude Number		0.00	
Maximum Discharge		27.37	ft³/s
Discharge Full		25.44	ft³/s
Slope Full		0.05000	ft/ft
Flow Type	SubCritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Circular Pipe - 18"

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.49	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.04634	ft/ft

Worksheet for Circular Pipe - 24"

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00380	ft/ft
Normal Depth	2.00	ft
Diameter	2.00	ft
Discharge	15.11	ft^3/s

Results

Discharge	15.11	ft^3/s
Normal Depth	2.00	ft
Flow Area	3.14	ft^2
Wetted Perimeter	6.28	ft
Hydraulic Radius	0.50	ft
Top Width	0.00	ft
Critical Depth	1.40	ft
Percent Full	100.0	%
Critical Slope	0.00541	ft/ft
Velocity	4.81	ft/s
Velocity Head	0.36	ft
Specific Energy	2.36	ft
Froude Number	0.00	
Maximum Discharge	16.25	ft^3/s
Discharge Full	15.11	ft^3/s
Slope Full	0.00380	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Circular Pipe - 24"

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.40	ft
Channel Slope	0.00380	ft/ft
Critical Slope	0.00541	ft/ft

Worksheet for Circular Pipe - 30"

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00260	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	22.66	ft^3/s

Results

Discharge	22.66	ft^3/s
Normal Depth	2.50	ft
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Hydraulic Radius	0.63	ft
Top Width	0.00	ft
Critical Depth	1.62	ft
Percent Full	100.0	%
Critical Slope	0.00459	ft/ft
Velocity	4.62	ft/s
Velocity Head	0.33	ft
Specific Energy	2.83	ft
Froude Number	0.00	
Maximum Discharge	24.37	ft^3/s
Discharge Full	22.66	ft^3/s
Slope Full	0.00260	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Circular Pipe - 30"

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.50	ft
Critical Depth	1.62	ft
Channel Slope	0.00260	ft/ft
Critical Slope	0.00459	ft/ft

Worksheet for Circular Pipe - 36"

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00400	ft/ft
Normal Depth	3.00	ft
Diameter	3.00	ft
Discharge	45.70	ft³/s

Results

Discharge	45.70	ft³/s
Normal Depth	3.00	ft
Flow Area	7.07	ft²
Wetted Perimeter	9.42	ft
Hydraulic Radius	0.75	ft
Top Width	0.00	ft
Critical Depth	2.20	ft
Percent Full	100.0	%
Critical Slope	0.00506	ft/ft
Velocity	6.46	ft/s
Velocity Head	0.65	ft
Specific Energy	3.65	ft
Froude Number	0.00	
Maximum Discharge	49.16	ft³/s
Discharge Full	45.70	ft³/s
Slope Full	0.00400	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for Circular Pipe - 36"

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.00	ft
Critical Depth	2.20	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00506	ft/ft

ATTACHMENT D

CAPACITY ANALYSIS - 57TH AVE. STORMWATER CONVEYANCE SYSTEM

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CAPACITY ANALYSIS

57th Ave. Stormwater Conveyance System

From Corner of Palouse Highway and 57th Avenue

to

250' West of Cook Street

A Part of the Glenrose Basin, Spokane County, WA

DRAFT August, 2007

Prepared for:

Black Development
Spokane County, Public Works & Utilities

Prepared by:

W&H PACIFIC

W&H Pacific, Inc.
12409 East Mirabeau Parkway, Suite 300
Spokane, Washington 99216

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APPENDICES

1.0 PROJECT SUMMARY

1.1 Limits of Analysis

This report summarizes the analysis of an existing stormwater conveyance system installed as part of Spokane County ("the County") Road Project No. 2694 which was completed in 1998. The system is located within the Glenrose Basin which is a watershed that covers approximately 9 square miles located in Spokane County on Spokane's South Hill (see Figure 1 – Vicinity Map). The limits of the study are from the beginning of the piped conveyance system on the corner of Palouse Highway and 57th Ave., to the system outfall located at the County surface water evaporation ponds located on 57th Ave., approximately 250' west of Cook St.

1.2 Project Background and Purpose

Over the years, the County has relied on mandated private, self-contained surface water facilities as the primary means of managing surface water runoff for residential and commercial developments. As a result, this portion of Spokane County has been largely developed without regional stormwater infrastructure. Early on, this was not an issue because the development in the area was limited and confined to areas of open space with relatively flat slopes. However, development has continued and has spread to areas with steeper slopes. Natural drainage conveyance channels have been altered and surface water runoff volumes and flow rates have increased due to the increase of impervious area. Due to these changes, common problems within the study area include erosion, sedimentation, and both surface and groundwater flooding.

To address increasing problems in the area, the County implemented the Final Glenrose Stormwater Management Plan in December of 2002 and a 6-year Stormwater Capital Improvement Plan in November 2006. According to the Stormwater CIP, regional and comprehensive surface water management systems are now planned for the Glenrose Basin.

The County identified the 57th Ave. conveyance system as a potential regional facility within the Glenrose Basin. The purpose of this study is to analyze the existing conveyance system, including all of the current contributing surface water drainage areas, and identify if there is sufficient capacity to serve additional drainage areas for regional purposes.

The County is also actively seeking an outlet and ultimate disposal facility such that the existing evaporation ponds on 57th may be converted to detention facilities, and additional capacity may be realized for regional purposes. It should be noted that this study does not attempt to address the capacity of the existing County disposal ponds on 57th Ave.

This study has been funded by Black Development in an effort to encourage regional stormwater conveyance systems within the Glenrose Basin that will:

- Directly benefit future commercial infill development by greatly reducing the amount of developable area historically required for on-site surface water control facilities;
- Directly benefit the County and citizens by addressing problematic stormwater issues within the area, allowing for more tax revenue-generating developable areas, and potentially providing for the reconfiguration of the 57th Ave. evaporation ponds to a more suitable and integrated public amenity.

1.3 Agency Requirements

Spokane County, City of Spokane and City of Spokane Valley have developed the Spokane Regional Stormwater Manual (SRSM) to provide clear stormwater management requirements and best management practices for the region. The SRSM requires that new storm drain conveyance systems be designed with sufficient capacity to convey the peak flow rate for the level of service required for the surface water control/disposal facility. If the SCS Method was used to design the surface water control/disposal facility, the same method and design storm may be used to design the storm conveyance system.

For the purposes of this study, the hydrologic inputs to the surface water conveyance system were analyzed by modeling a 2, 10, 25, 50 and 100-year return period storm events, considering the Regional Storm (Region 3), and reviewing the Short-duration storm (resembles area thunderstorms) in accordance with the Stormwater Management Manual for Eastern Washington (SMMEW), as published by the Washington State Department of Ecology (DOE).

It is our understanding that the 57th conveyance system was originally designed with 50-year storm peak flows, which may be consistent with the intent for this to be a County regional conveyance facility. For practical purposes, both the 50-year and 10-year peak flows have been modeled hydraulically and are reported herein.

2.0 METHODOLOGY

In order to ascertain the capacity of the 57th Ave. conveyance system, the following steps were accomplished:

- Step 1: Hydrologic analysis of current contributing areas
- Step 2: Hydraulic analysis of 57th Ave. conveyance system w/inputs from existing contributing areas
- Step 3: Hydraulic analysis of 57th Ave. conveyance system for full flow capacity (as constructed)
- Step 4: Comparison of Steps 2 and 3 to determine additional capacity of system for potential future addition of flows.

2.1 Hydrologic Analysis of Current Contributing Areas

An overall view of the sub-basin study area is provided in Figure 2 - Existing Conditions Sub Basin Plan. Generally, the grades are from the southeast to the northwest with grades ranging from 0.5% to 4%.

Currently contributing areas were identified by an initial screening of area contours, and were validated by subsequent detailed records research, field reconnaissance, and discussions with County staff. The currently contributing areas are indicated by the rose-colored shading on Figure 2, and have been assigned a unique 'basin' identifier. The contributing areas are a mix of agriculture, commercial, public, single family residences and multifamily residences. Detailed descriptions of each of the contributing areas are provided in Appendix A. While most of the contributing areas are currently fully developed, it is assumed that future peak flows from the site will not exceed the current flows from the site.

Each contributing area was assigned a hydrologic soil group classification based on the current Spokane County NRCS map. The type of land cover ranges from agricultural crops to impervious asphalt pavement with woods, grassland and herbaceous mixtures in between. Group B soils are highly prevalent in the area however there are some Group A and C soils as well.

Curve Numbers (CN) were assigned to each area, based on the level of development and resulting runoff-producing impervious surface. In some instances, a weighted curve number was developed for sites with mixed use in accordance with the SRSM.

Time of concentration (T_c) was generated for each site according to how flow moves through. Flow paths are indicated on Figure 2.

A summary of all of the hydrologic input parameters used to calculate stormwater runoff flows for each contributing basin is provided in Appendix B. Hydraflow "Hydrographs", by Intellisolve was used with a Santa Barbara Urban Hydrograph (SBUH) for the runoff calculations. Precipitation values for the different storm recurrence intervals were derived from the Isopluvial Maps provided in the SRSM.

The detailed "Hydrographs" summary report is provided in Appendix C. The peak flows are summarized in Table 1 below.

Table 1 – Summary of Surface Water Runoff from Current Contributing Areas:

Basin ID	Peak Flow (cfs) 10-yr, Regional Storm	Peak Flow (cfs) 50-yr, Regional Storm
A-1	1.22	1.90
A-2	0.39	0.51
B-1	0.05	0.11
B-2	0.13	0.29
B-3	0.09	0.20
C	0.08	0.17
D	0.10	0.23
E	0.08	0.17
F-1	0.17	0.37
F-2	0.65	0.83
F-3	0.42	0.94
F-4	0.58	1.28
F-5	0.60	1.02
*O-1 to O-19	See Appendix C	See Appendix C

"O"-Basins represent 57th Ave. roadway drainage into the system.

2.2 Hydraulic Analysis of 57th Ave Conveyance System

57th Ave. is a typical crowned roadway section that sheets runoff away from the centerline. The runoff is then routed along the curb where it is collected by catch basins connected to the storm drainage collection system. The collection system consists of catch basins on the north side of 57th which convey flow through 10" PVC laterals to catch basins on the south side of 57th which are interconnected by the main conveyance pipe. The catch basins are typically paired and spaced an average of 300 feet apart. The main conveyance pipe runs east to west and starts as an 18" diameter corrugated polyethylene (CPEP) pipe and increases in size to a maximum of 30" where it outlets to the evaporation ponds.

A schematic model of the conveyance system with the hydrologic inputs is provided in Figure 3. Hydraflow "Storm Sewers", by Intellisolve was used to model the as-constructed conveyance system with input flows. Manning's equation was used to analyze the as-constructed conveyance system for theoretical "full-flow" capacity. The hydraulic analysis is summarized in Appendix D.

3.0 RESULTS

A comparison of the full-flow hydraulic capacity (cfs) to the peak flow rates in the conveyance system, as generated from the 50-year Regional Storm design flow (see highlighted columns in Appendix D), indicates that the system is currently at approximately 67% of its total capacity. If the 10-year Regional Storm is evaluated, the system is currently at approximately 40% of its total capacity.

The conveyance system, as designed, appears to have a 20cfs full-flow capacity throughout much of the system. However, the as-constructed system is bottlenecked from pipe segments P-10 to P-13 and P-15 to P-16, due to the slope at which these facilities were constructed. If there are feasible means to address this +/- 1,500 lf of pipe to increase capacity, the system capacity may be increased.

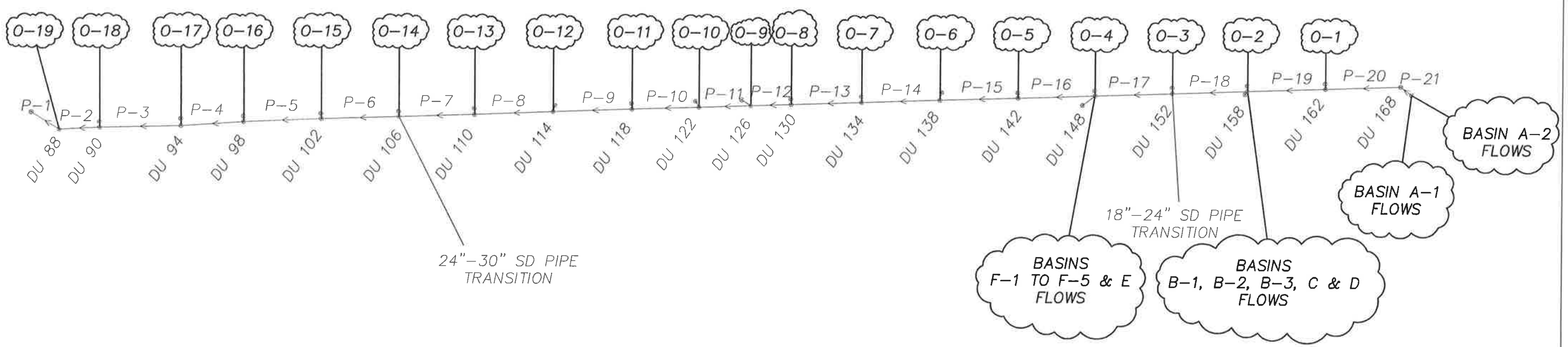
While there appears to be sufficient capacity to consider flows from additional contributing areas in the future, and utilize the conveyance facility for regional purposes, it is recommended that the County:

- Study and implement a means to mitigate the current system bottleneck;
- Study and implement a system to effectively manage offsite flows to this regional system from future-developed areas within the sub-basin.

FIGURE 1: VICINITY MAP


DRAFT - FOR REVIEW ONLY
FIGURE 2
57TH AVE CORRIDOR SUB-BASIN
EXISTING CONDITIONS
S.D. PIPE
S.D. MANHOLE OR CATCH BASIN
FLOW CONTROL/
DISPOSAL FACILITY
CITY BOUNDARY
57TH AVE DRAINAGE BOUNDARY
HAZEL'S CREEK SUB BASIN
BOUNDARY
TIME OF CONCENTRATION
CONTRIBUTING BASIN AREA
57TH AVE.
DRAINAGE PONDS
53RD
55TH
57TH AVE.
58TH
61ST. AVE.
REGAL ST.
COOK ST.
FREYA
SYCAMORE
REBECCA
MORAN
JULIA
THISTLE
PALOUSE HIGHWAY
24" TO 30"
PVC
18" TO 24"
PVC
O-1
O-2
O-3
O-4
O-5
O-6
O-7
O-8
O-9
O-10
O-11
O-12
O-13
O-14
O-15
O-16
O-17
O-18
O-19
O-20
O-21
O-22
A-1
A-2
B-1
B-2
B-3
C
D
E
F-1
F-2
F-3
F-4
F-5
N
SCALE
500 0 250 500 1000
(FEET)
1 INCH = 500 FT
AUGUST 7, 2007
W&H
PACIFIC

FIGURE 3: SCHEMATIC MODEL WITH HYDROLOGICAL INPUTS
57TH AVE. CONVEYANCE SYSTEM



LEGEND:

CONTRIBUTING BASIN INPUT	X-XX
CONVEYANCE SYSTEM SEGMENT IDENTIFIER	P-XX
CRP NO. 2694 STRUCTURE IDENTIFIER	DU-XX

DESCRIPTIONS OF EXISTING CONTRIBUTING AREAS

Basin A-1

Basin A-1 is bound by roads on all four sides; 57th Ave. to the north, Ben Burr to the east, 61st to the south and Palouse Hwy. to the west. Currently, the basin is developed as a plant nursery with a few residential single family homes. The basin generally flows from south to north. Flows eventually collect in a roadside ditch, run north along Palouse Highway and then cross via a culvert at the southeast corner of Palouse Hwy. and 57th Ave. The flows are then collected in a catch basin on the southwest corner of Palouse Highway and 57th Ave. and enter the storm system on 57th Ave. Basin A-1 is expected to be developed as a commercial property, which would increase runoff.

Basin A-2

Basin A-2 is the west half of Palouse Hwy. from 61st to 57th. Currently, the basin is half of a road section comprised of pavement, shoulder and roadside ditch. Runoff flows from south to north. Flows are collected in a roadside ditch and conveyed north to a catch basin on the southwest corner of Palouse Highway and 57th Ave., where they enter the storm system on 57th Ave. Little change is expected for this basin, with the exception of a road widening which could include curb and drainage structures.

Basin B-1

Basin B-1 is a housing development on 58th Ave. It is bordered by housing developments to the south and north, Palouse Hwy. to the east and a retirement home to the west. Runoff flows from east to west, where the flows are collected by a pond on the west edge of the basin. The pond has an overflow to a conveyance ditch that flows to a large pond located on the retirement home property, also in Basin D. Currently, this development is considered to be built out residential.

Basin B-2

Basin B-2 is comprised of the Moran Prairie Grange building and a housing development that is currently half completed. The basin is bordered by Palouse Hwy. to the east, 61st Ave. to the south and developments to the west and north. Runoff generally flows from southeast to northwest. Flows are mainly over ground flows that, through grading, lead toward the pond in the northwestern corner; however, there are structures that collect flows in front of the duplex type properties and convey them via pipe to the pond as well. This pond, like the pond in Basin B-1, also has an overflow to the conveyance ditch. Currently, the un-developed piece has a separate system where runoff is collected in a ditch and infiltrates; however, future development will require larger or additional facilities. It is assumed that the Grange will most likely remain as is or be improved in a similar configuration well into the future.

Basin C

Basin C is a comprised of two single family residential houses and two duplex type properties. These residences are bordered by a retirement home to the west and the south, a development to the south, Palouse Hwy. to the east and 57th Ave. to the north. Runoff generally flows northeasterly to 57th Ave. Stormwater won't flow to 57th Ave. until it reaches a certain storm level due to the lower elevations of the property compared to 57th Ave. Currently, it appears that the pond serving the duplex property does not have a direct outlet to the storm system on 57th Ave.; therefore, it is assumed that it would overflow into the street. The single residences don't have any storm features, like many home sites, and will flow into the street at a certain storm level. Based on the date of the duplexes it assumed that these will remain into the future. However, the single residences will most likely become commercial developments.

Basin B-3

Basin B-3 is a retirement home site that is bordered by housing developments all around except for 57th to the north. Runoff travels in a variety of directions, however, it generally flows to the north. Flows are collected in a conveyance ditch, flow over pavement and along curbs to a pond via pipe outlets and curb inlets. The pond has a structure that outlets into the storm pipe system on 57th Ave. Ponds in Basin B-1 and B-2 also overflow into the conveyance ditch. Currently, this basin is completely developed.

Basin D

Basin D is the east half of a portion of a housing development and contains the east half of Rebecca St. It is bordered by a retirement home to the east, housing developments to the south and west and 57th Ave. to the north. Runoff generally flows from south to north. Flows run to a curb and gutter and flow north along Rebecca St. to a pond located on the north edge of the basin. This pond has a structure that outlets to the storm pipe system on 57th Ave. Currently, this basin is completely developed.

Basin E

Basin E is the west half of a portion of a housing development and contains the west half of Sycamore St. It is bordered by housing developments to the south, east, and west and 57th Ave. to the north. Runoff generally flows from south to north into a detention pond in the northwest corner of the basin. This pond has a structure that outlets to the storm pipe system on 57th Ave. Currently, this basin completely developed.

Basin F-1

Basin F-1 is the east half of Freya St., a portion of the north side of 61st and the rear portions of lots in a housing development from 61st Ave. to 57th Ave. The basin is bordered by housing developments to the east and 57th Ave. to the north. The basin consists of half widths of pavement, roadside ditch and fenced backyards. Runoff generally flows from south to north. Flows collect in a roadside ditch and are conveyed north along Freya St. to a structure connecting to the storm pipe system on 57th Ave. via a storm pipe. Basin F-1 collects flows from Basins F-3, F-4 and F-5. Basin F-3 enters mid-basin via an outlet pipe into the ditch. The ditch of Basin F-4, which includes Basin F-5 flows, enters the basin at the intersection of 61st and Freya St. via a culvert. Currently, this basin is completely developed except for one home site that could be made into two home sites.

Basin F-2

Basin F-2 is the west half of Freya St. from approximately 61st Ave. to 57th Ave. The basin is bordered by vacant land and a large lot development to the west, natural grade breaks to the south and 57th Ave. to the north. The basin consists of a typical rural road section which, in this case, would be half of a road and a roadside ditch. Runoff generally flows from south to north. Flow runs north along Freya St. in a roadside ditch until both the ditch and flow terminate near the southwest corner of Freya St. and 57th Ave. Currently, the basin is limited in size; however, when future development occurs it would increase both pervious and impervious flows.

Basin F-3

Basin F-3 is a development that contains single family housing. The basin is bordered by housing developments all around except for a retirement home that borders a portion to the north. The basin contains the southern portions of Sycamore St. and Rebecca St., Julia St. and half of 61st Ave. Runoff generally flows from the southeast corner to the west. Flow runs west along 61st Ave. and enters Julia St., which conveys it north to structures connected to a storm pipe system. The storm pipe system conveys flows west to an outlet pipe that releases them into a roadside ditch that continues the flow north along Freya St. Flows run north along Rebecca and Sycamore to structures also connected to the same storm pipe system. Currently, the basin is completely developed.

Basin F-4

Basin F-4 is farm land with two single family structures and agriculture related structures. The basin is bordered by natural grade breaks to the south. The basin contains half of Palouse Hwy. to the east, Waneta Rd. to southeast, half of 61st Ave. to the north and Freya St. to the west. Runoff generally flows from the southeast corner to the west. There are roadside ditches along Waneta Rd., 61st Ave. and Freya St. that convey flows. The ditch along Waneta Rd. flows to the northeast. The ditch along 61st Ave. flows to the west and terminates at the ditch along Freya St., which runs north. Flows from Basin F-5 are collected in a culvert that crosses the Palouse Hwy. and conveyed in the roadside ditch that runs along 61st Ave. The flows from Basin F-4 enter Basin F-1 via a culvert that crosses 61st Ave. They continue north along another roadside ditch that runs along Freya St. Currently, the basin is mostly farm land and will be fully developed in the future with residential housing.

Basin F-5

Basin F-5 is a small basin with a fire station that is bordered by a natural grade break to the south. The basin also contains half of Ben Burr Rd. to the east, half of 61st Ave. to the north and half of Palouse Hwy. to the west. Runoff generally flows from the southeast corner to the west. There are roadside ditches along Ben Burr Rd., 61st Ave. and Palouse Hwy. that convey flows. The ditches along Ben Burr Rd. and Palouse Hwy. flow to the north and the ditch along 61st Ave. flows west. Flows in the ditch along Ben Burr enter the ditch that runs along 61st Ave. The flows from Basin F-5 enter Basin F-4 via a culvert the crosses Palouse Hwy. They continue west along another roadside ditch that runs along 61st Ave. Currently, this site is developed with a fire station however it is possible that future commercial development will occur.

EXISTING CONDITIONS ANALYSIS INPUT PARAMETERS SUMMARY

Hydrologic Input Parameters Summary
Existing Conditions

Basin ID	Total Area (sf)	Total Area (ac)	Sheet Flow (ft)	Slope (%)	Mannings n-value	Shallow Flow (ft)	Slope (%)	Paved or Unpaved	Channel Flow (ft)	Slope (%)	Mannings n-value	Soil Name	Soil Group	CN Existing	Notes:
A-1	383492	8.80	200	2.00%	0.170	270	2.00%	U	1000	2.00%	0.025	Glenrose	B	86	Existing Nursery and Residential, weighted CN
A-2	46499	1.07	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
B-1*	94206	2.16	150	2.00%	0.150	250	2.00%	P	-	-	-	Glenrose/Uhlig	B	75	Built Out Residential
B-2*	267106	6.13	200	2.00%	0.025	150	2.00%	U	400	1.25%	0.026	Glenrose/Uhlig	B	82	Mixed Use, weighted CN
B-3*	181023	4.16	100	1.50%	0.150	-	-	-	550	1.50%	0.015	Glenrose/Uhlig	B	95	Existing Assited Living Center
C	67703	1.55	100	2.50%	0.150	400	2.50%	P	-	-	-	Glenrose	B	75	Built Out Residential
D	101292	2.33	140	1.00%	0.150	500	1.00%	P	-	-	-	Marble/Uhlig	A/B	75	Built Out Residential
E	65684	1.51	70	1.00%	0.150	500	1.00%	P	-	-	-	Marble/Uhlig	A/B	75	Built Out Residential
F1	149767	3.44	100	1.00%	0.150	-	-	-	1550	1.00%	0.025	Bong/Phoebe	A/B	75	Built Out Residential
F2	79684	1.83	50	2.00%	0.150	-	-	-	1500	1.00%	0.025	Bong/Phoebe	A/B	98	Road Area
F3	412723	9.47	150	1.50%	0.150	550	1.75%	P	800	3.00%	0.013	Marble/Uhlig	A/B	75	Built Out Residential
F4	833867	19.14	150	1.00%	0.150	450	1.00%	P	1250	1.00%	0.025	Glenrose/Uhlig	B	72	Farm house, mostly cultivated soils
F5	249210	5.72	200	2.50%	0.150	350	2.75%	U	-	-	-	Glenrose/Uhlig	B	82	Firestation with grassland, weighted CN
O1	21163	0.49	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O2	24247	0.56	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O3	22841	0.52	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O4	23493	0.54	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O5	23959	0.55	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O6	24229	0.56	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O7	23637	0.54	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O8	23916	0.55	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O9	17752	0.41	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O10	11653	0.27	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O11	19159	0.44	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O12	24038	0.55	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O13	23947	0.55	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O14	25232	0.58	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O15	21071	0.48	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O16	20999	0.48	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O17	18449	0.42	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O18	22935	0.53	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O19	5945	0.14	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O20	16479	0.38	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O21	47106	1.08	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area
O22	20252	0.46	Tc = 5 min.									Glenrose/Uhlig	B	98	Road Area

* Due to Existing on-site detention facilities, this area was modeled assuming pre-existing conditions. See sheet 2 of 2.

Hydrologic Input Parameters Summary
Pre-Existing Conditions

Basin ID	Total Area (sf)	Total Area (ac)	Sheet Flow (ft)	Slope (%)	Mannings n-value	Shallow Flow (ft)	Slope (%)	Paved or Unpaved	Channel Flow (ft)	Slope (%)	Mannings n-value	Soil Name	Soil Group	CN Existing	Notes:
B-1	94206	2.16	150	2.00%	0.170	250	2.00%	U	-	-	-	Glenrose/Uhlig	B	69	Pasture, Grassland, or Range - Fair Condition
B-2	267106	6.13	200	2.00%	0.170	550	2.00%	U	-	-	-	Glenrose/Uhlig	B	69	Pasture, Grassland, or Range - Fair Condition
B-3	181023	4.16	100	1.50%	0.170	550	1.50%	U	-	-	-	Glenrose/Uhlig	B	69	Pasture, Grassland, or Range - Fair Condition

TABLE 5-1
RUNOFF CURVE NUMBERS
ANTECEDENT RUNOFF CONDITION (ARC) II

Cover type and hydrologic condition	A	B	C	D
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.): [1]				
Poor condition (grass cover <50% of the area)	68	79	86	89
Fair condition (grass cover on 50% to 75% of the area)	49	69	79	84
Good condition (grass cover on >75% of the area)	39	61	74	80
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Porous Pavers and Permeable Interlocking Concrete (assumed as 85% impervious and 15% lawn):				
Fair lawn condition (weighted average CNs)	91	94	96	97
Gravel	76	85	89	91
Dirt	72	82	87	89
Pasture, Grassland, or Range-Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Cultivated Agricultural Lands:				
Row Crops (good) e.g. corn, sugar beets, soy beans	64	75	82	85
Small Grain (good) e.g. wheat, barley, flax	60	72	80	84
Meadow (continuous grass, protected from grazing and generally mowed for hay)	30	58	71	78
Brush (brush-weed-grass mixture with brush the major element):				
Poor (<50% ground cover)	48	67	77	83
Fair (50% to 75% ground cover)	35	56	70	77
Good (>75% ground cover)[2]	30	48	65	73
Woods - grass combination (orchard or tree farm)[3]:				
Poor	57	73	82	86
Fair	43	65	76	82
Good	32	58	72	79
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning)	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Herbaceous (mixture of grass, weeds, and low-growing brush, with brush the minor element)[4]:				
Poor (<30% ground cover)		80	87	93
Fair (30% to 70% ground cover)		71	81	89
Good (>70% ground cover)		62	74	85
Sagebrush with Grass Understory[4]:				
Poor (<30% ground cover)		67	80	85
Fair (30% to 70% ground cover)		51	63	70
Good (>70% ground cover)		35	47	55
For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).				

[1] Composite CNs may be computed for other combinations of open space cover type.
[2] Actual curve number is less than 30; use CN = 30 for runoff computations.
[3] CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pasture.
[4] Curve numbers have not been developed for group A soils.

Manning's n-Values

Previous Top

Description	Manning's "n"
Pipes	
Reinforced concrete	0.013
Vitrified clay pipe	0.013
Smooth welded pipe	0.011
Corrugated metal pipe	0.023
Polyvinyl chloride (PVC)	0.010
Natural Channels	
Gravel beds, Straight	0.025
Gravel beds, large boulders	0.040
Earth, straight, some grass	0.026
Earth, winding, no vegetation	0.030
Earth, winding	0.050
Miscellaneous	
Smooth surfaces (concrete, asphalt, bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils	0.06-0.17
Short grass	0.15
Dense grass	0.24
Bermuda grass	0.41
Light underbrush woods	0.40
Dense underbrush woods	0.80

Source: Soil Conservation Service TR-55

W&H PACIFIC
AN ASCG COMPANY

planners
surveyors
engineers
landscape architects

CALCULATIONS: CURVE NUMBER & WEIGHTED CURVE NUMBER SUMMARY

BASIN A1:

Woods - Grass Combination, Fair	1.94	65
Pasture, Grassland, or Range; Poor	1.79	79
Impervious Areas - Gravel	0.83	85
Impervious Areas - Roofs	1.73	98
Impervious Areas - Pavement & ROW	2.51	98
		85.6 ≈ 86

BASIN A2:
Impervious Area - Pavement & Row 98

BASIN B1:
CN = 75 Residential Development Analysis

BASIN B2:

Impervious Areas - Dirt	1.73	82
Residential	1.64	75
Impervious Areas - Gravel	2.77	85
		81.5 ≈ 82

BASIN B3:
CN = 95 Commercial Development Analysis

BASIN C: CN = 75 Residential

BASIN D: CN = 75 Residential

BASIN E: CN = 75 Residential

BASIN F1: CN = 75 Residential

BASIN F2: Impervious Areas - Pavement & Row 98

BASIN F3: CN = 75 Residential

BASIN F4: Cultivated Agriculture Lands - Small Grain 72

BASIN F5:

Commercial	2.86	95
Pasture, Grassland, or Range - Fair	2.86	69
		82

Project 57th Study Subject Curve Number Summary Sheet No. 1 of 1

Job No. 35119 Prepared by NAP Date 8/7/07 Checked by ______ Date ______

HYDROLOGIC CALCULATIONS SUMMARY

REGIONAL (REGION 3) STORM

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	0.612	6	726	17,865	----	------	------	Basin A-1
2	SBUH Runoff	0.280	6	720	5,353	----	------	------	Basin A-2
3	Combine	0.874	6	720	23,219	1, 2	------	------	Com. 1,2
4	SBUH Runoff	0.125	6	720	2,401	----	------	------	Basin 0-1
5	Combine	0.999	6	720	25,620	3, 4	------	------	Com. 3,4
6	SBUH Runoff	0.146	6	720	2,802	----	------	------	Basin 0-2
7	SBUH Runoff	0.017	6	1434	742	----	------	------	Basin B-1
8	SBUH Runoff	0.047	6	1434	2,102	----	------	------	Basin B-2
9	SBUH Runoff	0.032	6	1434	1,429	----	------	------	Basin B-3
10	Combine	0.096	6	1434	4,272	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.022	6	816	1,111	----	------	------	Basin C
12	SBUH Runoff	0.033	6	840	1,725	----	------	------	Basin D
13	Combine	1.163	6	720	35,530	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	0.170	6	720	3,252	----	------	------	Basin 0-3
15	Combine	1.333	6	720	38,782	13, 14	------	------	Com. 13,14
16	SBUH Runoff	0.141	6	720	2,702	----	------	------	Basin 0-4
17	SBUH Runoff	0.022	6	816	1,118	----	------	------	Basin E
18	SBUH Runoff	0.248	6	726	8,333	----	------	------	Basin F5
19	SBUH Runoff	0.196	6	1410	9,960	----	------	------	Basin F4
20	Combine	0.329	6	840	18,293	18, 19	------	------	Com. 18,19
21	SBUH Runoff	0.134	6	840	7,012	----	------	------	Basin F3
22	Combine	0.464	6	840	25,305	20, 21	------	------	Com. 20,21
23	SBUH Runoff	0.460	6	720	9,156	----	------	------	Basin F2
24	SBUH Runoff	0.050	6	840	2,547	----	------	------	Basin F1
25	Combine	0.751	6	720	37,008	22, 23, 24	------	------	Com. 22-24
26	Combine	2.233	6	720	79,609	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	0.144	6	720	2,752	----	------	------	Basin 0-5
28	SBUH Runoff	0.144	6	720	2,752	----	------	------	Basin 0-6
29	Combine	2.521	6	720	85,112	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	0.141	6	720	2,702	----	------	------	Basin 0-7
31	SBUH Runoff	0.136	6	720	2,602	----	------	------	Basin 0-8
32	Combine	2.798	6	720	90,416	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	0.107	6	720	2,051	----	------	------	Basin 0-9

57th Regional Storm.gpw	Return Period: 2 Year	Monday, Aug 6, 2007

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.073	6	720	1,401	----	------	------	Basin 0-10
35	Combine	2.978	6	720	93,868	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	0.120	6	720	2,301	----	------	------	Basin 0-11
37	SBUH Runoff	0.146	6	720	2,802	----	------	------	Basin 0-12
38	Combine	3.245	6	720	98,971	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	0.146	6	720	2,802	----	------	------	Basin 0-13
40	SBUH Runoff	0.154	6	720	2,952	----	------	------	Basin 0-14
41	Combine	3.545	6	720	104,724	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	0.128	6	720	2,451	----	------	------	Basin 0-15
43	SBUH Runoff	0.105	6	720	2,001	----	------	------	Basin 0-16
44	Combine	3.778	6	720	109,177	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	0.115	6	720	2,201	----	------	------	Basin 0-17
46	SBUH Runoff	0.149	6	720	2,852	----	------	------	Basin 0-18
47	Combine	4.042	6	720	114,230	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.039	6	720	750	----	------	------	Basin 0-19
49	Combine	4.081	6	720	114,981	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	1.222	6	726	32,029	----	------	------	Basin A-1
2	SBUH Runoff	0.393	6	720	7,660	----	------	------	Basin A-2
3	Combine	1.595	6	720	39,689	1, 2	------	------	Com. 1,2
4	SBUH Runoff	0.176	6	720	3,436	----	------	------	Basin 0-1
5	Combine	1.772	6	720	43,125	3, 4	------	------	Com. 3,4
6	SBUH Runoff	0.206	6	720	4,009	----	------	------	Basin 0-2
7	SBUH Runoff	0.045	6	816	2,290	----	------	------	Basin B-1
8	SBUH Runoff	0.125	6	840	6,488	----	------	------	Basin B-2
9	SBUH Runoff	0.086	6	840	4,410	----	------	------	Basin B-3
10	Combine	0.256	6	840	13,189	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.081	6	726	2,629	----	------	------	Basin C
12	SBUH Runoff	0.102	6	750	4,083	----	------	------	Basin D
13	Combine	2.236	6	720	67,034	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	0.239	6	720	4,653	----	------	------	Basin 0-3
15	Combine	2.475	6	720	71,687	13, 14	------	------	Com. 13,14
16	SBUH Runoff	0.198	6	720	3,866	----	------	------	Basin 0-4
17	SBUH Runoff	0.078	6	726	2,646	----	------	------	Basin E
18	SBUH Runoff	0.602	6	726	16,266	----	------	------	Basin F5
19	SBUH Runoff	0.576	6	816	26,439	----	------	------	Basin F4
20	Combine	1.035	6	750	42,706	18, 19	------	------	Com. 18,19
21	SBUH Runoff	0.422	6	750	16,595	----	------	------	Basin F3
22	Combine	1.457	6	750	59,301	20, 21	------	------	Com. 20,21
23	SBUH Runoff	0.648	6	720	13,100	----	------	------	Basin F2
24	SBUH Runoff	0.168	6	726	6,028	----	------	------	Basin F1
25	Combine	2.212	6	726	78,429	22, 23, 24	------	------	Com. 22-24
26	Combine	4.921	6	720	156,628	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	0.202	6	720	3,937	----	------	------	Basin 0-5
28	SBUH Runoff	0.202	6	720	3,937	----	------	------	Basin 0-6
29	Combine	5.325	6	720	164,502	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	0.198	6	720	3,866	----	------	------	Basin 0-7
31	SBUH Runoff	0.191	6	720	3,722	----	------	------	Basin 0-8
32	Combine	5.715	6	720	172,091	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	0.151	6	720	2,935	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.103	6	720	2,004	----	------	------	Basin 0-10
35	Combine	5.968	6	720	177,030	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	0.169	6	720	3,293	----	------	------	Basin 0-11
37	SBUH Runoff	0.206	6	720	4,009	----	------	------	Basin 0-12
38	Combine	6.343	6	720	184,332	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	0.206	6	720	4,009	----	------	------	Basin 0-13
40	SBUH Runoff	0.217	6	720	4,224	----	------	------	Basin 0-14
41	Combine	6.766	6	720	192,564	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	0.180	6	720	3,508	----	------	------	Basin 0-15
43	SBUH Runoff	0.147	6	720	2,863	----	------	------	Basin 0-16
44	Combine	7.093	6	720	198,935	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	0.162	6	720	3,150	----	------	------	Basin 0-17
46	SBUH Runoff	0.209	6	720	4,080	----	------	------	Basin 0-18
47	Combine	7.464	6	720	206,166	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.055	6	720	1,074	----	------	------	Basin 0-19
49	Combine	7.519	6	720	207,239	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	1.669	6	726	42,325	----	------	------	Basin A-1
2	SBUH Runoff	0.468	6	720	9,203	----	------	------	Basin A-2
3	Combine	2.117	6	720	51,528	1, 2	------	------	Com. 1,2
4	SBUH Runoff	0.210	6	720	4,128	----	------	------	Basin 0-1
5	Combine	2.327	6	720	55,656	3, 4	------	------	Com. 3,4
6	SBUH Runoff	0.245	6	720	4,817	----	------	------	Basin 0-2
7	SBUH Runoff	0.083	6	810	3,662	----	------	------	Basin B-1
8	SBUH Runoff	0.230	6	816	10,375	----	------	------	Basin B-2
9	SBUH Runoff	0.158	6	810	7,052	----	------	------	Basin B-3
10	Combine	0.471	6	810	21,088	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.142	6	720	3,862	----	------	------	Basin C
12	SBUH Runoff	0.181	6	726	5,999	----	------	------	Basin D
13	Combine	3.243	6	720	91,421	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	0.285	6	720	5,591	----	------	------	Basin 0-3
15	Combine	3.528	6	720	97,012	13, 14	------	------	Com. 13,14
16	SBUH Runoff	0.236	6	720	4,644	----	------	------	Basin 0-4
17	SBUH Runoff	0.136	6	726	3,888	----	------	------	Basin E
18	SBUH Runoff	0.873	6	726	22,247	----	------	------	Basin F5
19	SBUH Runoff	1.001	6	750	40,366	----	------	------	Basin F4
20	Combine	1.841	6	726	62,613	18, 19	------	------	Com. 18,19
21	SBUH Runoff	0.754	6	726	24,381	----	------	------	Basin F3
22	Combine	2.595	6	726	86,994	20, 21	------	------	Com. 20,21
23	SBUH Runoff	0.772	6	720	15,740	----	------	------	Basin F2
24	SBUH Runoff	0.296	6	726	8,856	----	------	------	Basin F1
25	Combine	3.598	6	726	111,590	22, 23, 24	------	------	Com. 22-24
26	Combine	7.453	6	720	217,134	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	0.241	6	720	4,731	----	------	------	Basin 0-5
28	SBUH Runoff	0.241	6	720	4,731	----	------	------	Basin 0-6
29	Combine	7.934	6	720	226,595	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	0.236	6	720	4,644	----	------	------	Basin 0-7
31	SBUH Runoff	0.228	6	720	4,472	----	------	------	Basin 0-8
32	Combine	8.398	6	720	235,712	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	0.179	6	720	3,526	----	------	------	Basin 0-9

57th Regional Storm.gpw	Return Period: 25 Year	Monday, Aug 6, 2007

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.123	6	720	2,408	----	------	------	Basin 0-10
35	Combine	8.700	6	720	241,647	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	0.201	6	720	3,956	----	------	------	Basin 0-11
37	SBUH Runoff	0.245	6	720	4,817	----	------	------	Basin 0-12
38	Combine	9.147	6	720	250,419	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	0.245	6	720	4,817	----	------	------	Basin 0-13
40	SBUH Runoff	0.258	6	720	5,075	----	------	------	Basin 0-14
41	Combine	9.650	6	720	260,311	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	0.214	6	720	4,214	----	------	------	Basin 0-15
43	SBUH Runoff	0.175	6	720	3,440	----	------	------	Basin 0-16
44	Combine	10.04	6	720	267,965	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	0.193	6	720	3,784	----	------	------	Basin 0-17
46	SBUH Runoff	0.250	6	720	4,903	----	------	------	Basin 0-18
47	Combine	10.48	6	720	276,652	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.066	6	720	1,290	----	------	------	Basin 0-19
49	Combine	10.55	6	720	277,942	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	1.901	6	726	47,654	----	------	------	Basin A-1
2	SBUH Runoff	0.506	6	720	9,976	----	------	------	Basin A-2
3	Combine	2.386	6	720	57,630	1, 2	------	------	Com. 1,2
4	SBUH Runoff	0.227	6	720	4,475	----	------	------	Basin 0-1
5	Combine	2.613	6	720	62,105	3, 4	------	------	Com. 3,4
6	SBUH Runoff	0.265	6	720	5,221	----	------	------	Basin 0-2
7	SBUH Runoff	0.112	6	726	4,430	----	------	------	Basin B-1
8	SBUH Runoff	0.291	6	810	12,552	----	------	------	Basin B-2
9	SBUH Runoff	0.203	6	750	8,532	----	------	------	Basin B-3
10	Combine	0.599	6	750	25,514	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.175	6	720	4,530	----	------	------	Basin C
12	SBUH Runoff	0.226	6	726	7,037	----	------	------	Basin D
13	Combine	3.801	6	720	104,407	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	0.307	6	720	6,060	----	------	------	Basin 0-3
15	Combine	4.108	6	720	110,467	13, 14	------	------	Com. 13,14
16	SBUH Runoff	0.255	6	720	5,034	----	------	------	Basin 0-4
17	SBUH Runoff	0.168	6	726	4,560	----	------	------	Basin E
18	SBUH Runoff	1.017	6	726	25,390	----	------	------	Basin F5
19	SBUH Runoff	1.280	6	750	48,033	----	------	------	Basin F4
20	Combine	2.294	6	726	73,423	18, 19	------	------	Com. 18,19
21	SBUH Runoff	0.938	6	726	28,601	----	------	------	Basin F3
22	Combine	3.232	6	726	102,024	20, 21	------	------	Com. 20,21
23	SBUH Runoff	0.834	6	720	17,061	----	------	------	Basin F2
24	SBUH Runoff	0.367	6	726	10,389	----	------	------	Basin F1
25	Combine	4.363	6	726	129,474	22, 23, 24	------	------	Com. 22-24
26	Combine	8.849	6	720	249,536	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	0.260	6	720	5,128	----	------	------	Basin 0-5
28	SBUH Runoff	0.260	6	720	5,128	----	------	------	Basin 0-6
29	Combine	9.370	6	720	259,791	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	0.255	6	720	5,034	----	------	------	Basin 0-7
31	SBUH Runoff	0.246	6	720	4,848	----	------	------	Basin 0-8
32	Combine	9.871	6	720	269,673	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	0.194	6	720	3,822	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.132	6	720	2,610	----	------	------	Basin 0-10
35	Combine	10.20	6	720	276,106	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	0.217	6	720	4,289	----	------	------	Basin 0-11
37	SBUH Runoff	0.265	6	720	5,221	----	------	------	Basin 0-12
38	Combine	10.68	6	720	285,616	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	0.265	6	720	5,221	----	------	------	Basin 0-13
40	SBUH Runoff	0.279	6	720	5,501	----	------	------	Basin 0-14
41	Combine	11.22	6	720	296,337	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	0.232	6	720	4,568	----	------	------	Basin 0-15
43	SBUH Runoff	0.189	6	720	3,729	----	------	------	Basin 0-16
44	Combine	11.64	6	720	304,634	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	0.208	6	720	4,102	----	------	------	Basin 0-17
46	SBUH Runoff	0.269	6	720	5,314	----	------	------	Basin 0-18
47	Combine	12.12	6	720	314,051	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.071	6	720	1,398	----	------	------	Basin 0-19
49	Combine	12.19	6	720	315,449	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	2.136	6	726	53,082	----	------	------	Basin A-1
2	SBUH Runoff	0.543	6	720	10,749	----	------	------	Basin A-2
3	Combine	2.659	6	720	63,830	1, 2	------	------	Com. 1,2
4	SBUH Runoff	0.244	6	720	4,822	----	------	------	Basin 0-1
5	Combine	2.903	6	720	68,652	3, 4	------	------	Com. 3,4
6	SBUH Runoff	0.284	6	720	5,626	----	------	------	Basin 0-2
7	SBUH Runoff	0.149	6	726	5,247	----	------	------	Basin B-1
8	SBUH Runoff	0.369	6	750	14,867	----	------	------	Basin B-2
9	SBUH Runoff	0.262	6	726	10,106	----	------	------	Basin B-3
10	Combine	0.770	6	750	30,220	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.211	6	720	5,228	----	------	------	Basin C
12	SBUH Runoff	0.273	6	726	8,121	----	------	------	Basin D
13	Combine	4.384	6	720	117,847	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	0.330	6	720	6,530	----	------	------	Basin 0-3
15	Combine	4.714	6	720	124,377	13, 14	------	------	Com. 13,14
16	SBUH Runoff	0.274	6	720	5,425	----	------	------	Basin 0-4
17	SBUH Runoff	0.202	6	720	5,263	----	------	------	Basin E
18	SBUH Runoff	1.164	6	726	28,618	----	------	------	Basin F5
19	SBUH Runoff	1.609	6	726	56,107	----	------	------	Basin F4
20	Combine	2.773	6	726	84,725	18, 19	------	------	Com. 18,19
21	SBUH Runoff	1.131	6	726	33,008	----	------	------	Basin F3
22	Combine	3.904	6	726	117,733	20, 21	------	------	Com. 20,21
23	SBUH Runoff	0.896	6	720	18,383	----	------	------	Basin F2
24	SBUH Runoff	0.441	6	726	11,990	----	------	------	Basin F1
25	Combine	5.165	6	726	148,106	22, 23, 24	------	------	Com. 22-24
26	Combine	10.31	6	720	283,170	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	0.279	6	720	5,525	----	------	------	Basin 0-5
28	SBUH Runoff	0.279	6	720	5,525	----	------	------	Basin 0-6
29	Combine	10.87	6	720	294,220	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	0.274	6	720	5,425	----	------	------	Basin 0-7
31	SBUH Runoff	0.264	6	720	5,224	----	------	------	Basin 0-8
32	Combine	11.41	6	720	304,869	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	0.208	6	720	4,119	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.142	6	720	2,813	----	------	------	Basin 0-10
35	Combine	11.76	6	720	311,800	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	0.234	6	720	4,621	----	------	------	Basin 0-11
37	SBUH Runoff	0.284	6	720	5,626	----	------	------	Basin 0-12
38	Combine	12.28	6	720	322,046	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	0.284	6	720	5,626	----	------	------	Basin 0-13
40	SBUH Runoff	0.300	6	720	5,927	----	------	------	Basin 0-14
41	Combine	12.86	6	720	333,599	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	0.249	6	720	4,922	----	------	------	Basin 0-15
43	SBUH Runoff	0.203	6	720	4,018	----	------	------	Basin 0-16
44	Combine	13.31	6	720	342,540	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	0.223	6	720	4,420	----	------	------	Basin 0-17
46	SBUH Runoff	0.289	6	720	5,726	----	------	------	Basin 0-18
47	Combine	13.83	6	720	352,686	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.076	6	720	1,507	----	------	------	Basin 0-19
49	Combine	13.90	6	720	354,192	47, 48	------	------	Com. 47,48

SHORT-DURATION STORM

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	4.295	5	70	17,876	----	------	------	Basin A-1
2	SBUH Runoff	3.587	5	60	5,355	----	------	------	5
3	Combine	6.997	5	60	23,231	1, 2	------	------	Com. 1,2
4	SBUH Runoff	1.563	5	60	2,402	----	------	------	Basin 0-1
5	Combine	8.560	5	60	25,633	3, 4	------	------	Com. 3,4
6	SBUH Runoff	1.824	5	60	2,803	----	------	------	Basin 0-2
7	SBUH Runoff	0.140	5	75	743	----	------	------	Basin B-1
8	SBUH Runoff	0.368	5	75	2,104	----	------	------	Basin B-2
9	SBUH Runoff	0.280	5	75	1,430	----	------	------	Basin B-3
10	Combine	0.788	5	75	4,278	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.361	5	70	1,112	----	------	------	Basin C
12	SBUH Runoff	0.376	5	75	1,727	----	------	------	Basin D
13	Combine	11.06	5	60	35,552	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	2.117	5	60	3,253	----	------	------	Basin 0-3
15	Combine	13.18	5	60	38,805	13, 14	------	------	Com. 13,14
16	SBUH Runoff	1.759	5	60	2,703	----	------	------	Basin 0-4
17	SBUH Runoff	0.328	5	70	1,119	----	------	------	Basin E
18	SBUH Runoff	2.212	5	70	8,339	----	------	------	Basin F5
19	SBUH Runoff	1.911	5	75	9,970	----	------	------	Basin F4
20	Combine	4.038	5	70	18,309	18, 19	------	------	Com. 18,19
21	SBUH Runoff	1.584	5	75	7,018	----	------	------	Basin F3
22	Combine	5.621	5	70	25,328	20, 21	------	------	Com. 20,21
23	SBUH Runoff	4.496	5	60	9,159	----	------	------	Basin F2
24	SBUH Runoff	0.672	5	70	2,549	----	------	------	Basin F1
25	Combine	9.633	5	65	37,036	22, 23, 24	------	------	Com. 22-24
26	Combine	23.41	5	60	79,663	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	1.791	5	60	2,753	----	------	------	Basin 0-5
28	SBUH Runoff	1.791	5	60	2,753	----	------	------	Basin 0-6
29	Combine	27.00	5	60	85,168	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	1.759	5	60	2,703	----	------	------	Basin 0-7
31	SBUH Runoff	1.693	5	60	2,602	----	------	------	Basin 0-8
32	Combine	30.45	5	60	90,473	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	1.335	5	60	2,052	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	0.912	5	60	1,401	----	------	------	Basin 0-10
35	Combine	32.69	5	60	93,926	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	1.498	5	60	2,302	----	------	------	Basin 0-11
37	SBUH Runoff	1.824	5	60	2,803	----	------	------	Basin 0-12
38	Combine	36.02	5	60	99,031	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	1.824	5	60	2,803	----	------	------	Basin 0-13
40	SBUH Runoff	1.921	5	60	2,953	----	------	------	Basin 0-14
41	Combine	39.76	5	60	104,787	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	1.596	5	60	2,452	----	------	------	Basin 0-15
43	SBUH Runoff	1.303	5	60	2,002	----	------	------	Basin 0-16
44	Combine	42.66	5	60	109,241	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	1.433	5	60	2,202	----	------	------	Basin 0-17
46	SBUH Runoff	1.856	5	60	2,853	----	------	------	Basin 0-18
47	Combine	45.95	5	60	114,296	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.488	5	60	751	----	------	------	Basin 0-19
49	Combine	46.44	5	60	115,046	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	7.898	5	70	32,045	----	------	------	Basin A-1
2	SBUH Runoff	5.034	5	60	7,662	----	------	------	5
3	Combine	11.73	5	60	39,708	1, 2	------	------	Com. 1,2
4	SBUH Runoff	2.199	5	60	3,437	----	------	------	Basin 0-1
5	Combine	13.93	5	60	43,145	3, 4	------	------	Com. 3,4
6	SBUH Runoff	2.565	5	60	4,010	----	------	------	Basin 0-2
7	SBUH Runoff	0.506	5	75	2,292	----	------	------	Basin B-1
8	SBUH Runoff	1.340	5	75	6,494	----	------	------	Basin B-2
9	SBUH Runoff	1.014	5	70	4,414	----	------	------	Basin B-3
10	Combine	2.856	5	75	13,200	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	0.932	5	65	2,631	----	------	------	Basin C
12	SBUH Runoff	0.980	5	70	4,086	----	------	------	Basin D
13	Combine	19.57	5	60	67,072	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	2.977	5	60	4,655	----	------	------	Basin 0-3
15	Combine	22.55	5	60	71,727	13, 14	------	------	Com. 13,14
16	SBUH Runoff	2.474	5	60	3,867	----	------	------	Basin 0-4
17	SBUH Runoff	0.845	5	70	2,648	----	------	------	Basin E
18	SBUH Runoff	4.486	5	70	16,276	----	------	------	Basin F5
19	SBUH Runoff	5.658	5	70	26,461	----	------	------	Basin F4
20	Combine	10.14	5	70	42,736	18, 19	------	------	Com. 18,19
21	SBUH Runoff	4.144	5	70	16,607	----	------	------	Basin F3
22	Combine	14.29	5	70	59,344	20, 21	------	------	Com. 20,21
23	SBUH Runoff	6.390	5	60	13,105	----	------	------	Basin F2
24	SBUH Runoff	1.742	5	70	6,033	----	------	------	Basin F1
25	Combine	20.82	5	65	78,481	22, 23, 24	------	------	Com. 22-24
26	Combine	43.98	5	65	156,723	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	2.519	5	60	3,939	----	------	------	Basin 0-5
28	SBUH Runoff	2.519	5	60	3,939	----	------	------	Basin 0-6
29	Combine	48.69	5	60	164,600	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	2.474	5	60	3,867	----	------	------	Basin 0-7
31	SBUH Runoff	2.382	5	60	3,724	----	------	------	Basin 0-8
32	Combine	53.55	5	60	172,190	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	1.878	5	60	2,936	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	1.283	5	60	2,005	----	------	------	Basin 0-10
35	Combine	56.71	5	60	177,131	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	2.107	5	60	3,294	----	------	------	Basin 0-11
37	SBUH Runoff	2.565	5	60	4,010	----	------	------	Basin 0-12
38	Combine	61.38	5	60	184,436	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	2.565	5	60	4,010	----	------	------	Basin 0-13
40	SBUH Runoff	2.703	5	60	4,225	----	------	------	Basin 0-14
41	Combine	66.65	5	60	192,671	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	2.245	5	60	3,509	----	------	------	Basin 0-15
43	SBUH Runoff	1.832	5	60	2,864	----	------	------	Basin 0-16
44	Combine	70.72	5	60	199,044	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	2.016	5	60	3,151	----	------	------	Basin 0-17
46	SBUH Runoff	2.611	5	60	4,082	----	------	------	Basin 0-18
47	Combine	75.35	5	60	206,277	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.687	5	60	1,074	----	------	------	Basin 0-19
49	Combine	76.04	5	60	207,351	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	10.53	5	70	42,345	----	------	------	Basin A-1
2	SBUH Runoff	5.993	5	60	9,206	----	------	------	5
3	Combine	15.16	5	60	51,551	1, 2	------	------	Com. 1,2
4	SBUH Runoff	2.620	5	60	4,130	----	------	------	Basin 0-1
5	Combine	17.78	5	60	55,681	3, 4	------	------	Com. 3,4
6	SBUH Runoff	3.057	5	60	4,818	----	------	------	Basin 0-2
7	SBUH Runoff	0.857	5	70	3,664	----	------	------	Basin B-1
8	SBUH Runoff	2.250	5	70	10,383	----	------	------	Basin B-2
9	SBUH Runoff	1.719	5	70	7,058	----	------	------	Basin B-3
10	Combine	4.825	5	70	21,105	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	1.410	5	65	3,864	----	------	------	Basin C
12	SBUH Runoff	1.474	5	70	6,003	----	------	------	Basin D
13	Combine	26.29	5	60	91,471	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	3.548	5	60	5,592	----	------	------	Basin 0-3
15	Combine	29.84	5	60	97,063	13, 14	------	------	Com. 13,14
16	SBUH Runoff	2.947	5	60	4,646	----	------	------	Basin 0-4
17	SBUH Runoff	1.267	5	65	3,890	----	------	------	Basin E
18	SBUH Runoff	6.226	5	65	22,259	----	------	------	Basin F5
19	SBUH Runoff	8.970	5	70	40,395	----	------	------	Basin F4
20	Combine	15.18	5	70	62,654	18, 19	------	------	Com. 18,19
21	SBUH Runoff	6.227	5	70	24,397	----	------	------	Basin F3
22	Combine	21.41	5	70	87,051	20, 21	------	------	Com. 20,21
23	SBUH Runoff	7.648	5	60	15,745	----	------	------	Basin F2
24	SBUH Runoff	2.604	5	70	8,862	----	------	------	Basin F1
25	Combine	29.87	5	65	111,658	22, 23, 24	------	------	Com. 22-24
26	Combine	60.96	5	65	217,258	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	3.002	5	60	4,732	----	------	------	Basin 0-5
28	SBUH Runoff	3.002	5	60	4,732	----	------	------	Basin 0-6
29	Combine	65.87	5	60	226,722	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	2.947	5	60	4,646	----	------	------	Basin 0-7
31	SBUH Runoff	2.838	5	60	4,474	----	------	------	Basin 0-8
32	Combine	71.65	5	60	235,842	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	2.238	5	60	3,528	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	1.528	5	60	2,409	----	------	------	Basin 0-10
35	Combine	75.42	5	60	241,778	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	2.511	5	60	3,958	----	------	------	Basin 0-11
37	SBUH Runoff	3.057	5	60	4,818	----	------	------	Basin 0-12
38	Combine	80.98	5	60	250,554	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	3.057	5	60	4,818	----	------	------	Basin 0-13
40	SBUH Runoff	3.220	5	60	5,076	----	------	------	Basin 0-14
41	Combine	87.26	5	60	260,448	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	2.674	5	60	4,216	----	------	------	Basin 0-15
43	SBUH Runoff	2.183	5	60	3,441	----	------	------	Basin 0-16
44	Combine	92.12	5	60	268,106	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	2.402	5	60	3,786	----	------	------	Basin 0-17
46	SBUH Runoff	3.111	5	60	4,904	----	------	------	Basin 0-18
47	Combine	97.63	5	60	276,795	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.819	5	60	1,291	----	------	------	Basin 0-19
49	Combine	98.45	5	60	278,086	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	11.89	5	70	47,677	----	------	------	Basin A-1
2	SBUH Runoff	6.471	5	60	9,979	----	------	------	5
3	Combine	16.92	5	60	57,655	1, 2	------	------	Com. 1,2
4	SBUH Runoff	2.830	5	60	4,477	----	------	------	Basin 0-1
5	Combine	19.75	5	60	62,132	3, 4	------	------	Com. 3,4
6	SBUH Runoff	3.301	5	60	5,223	----	------	------	Basin 0-2
7	SBUH Runoff	1.058	5	70	4,433	----	------	------	Basin B-1
8	SBUH Runoff	2.780	5	70	12,561	----	------	------	Basin B-2
9	SBUH Runoff	2.121	5	70	8,539	----	------	------	Basin B-3
10	Combine	5.959	5	70	25,533	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	1.678	5	65	4,533	----	------	------	Basin C
12	SBUH Runoff	1.748	5	70	7,041	----	------	------	Basin D
13	Combine	29.92	5	60	104,463	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	3.832	5	60	6,062	----	------	------	Basin 0-3
15	Combine	33.75	5	60	110,524	13, 14	------	------	Com. 13,14
16	SBUH Runoff	3.184	5	60	5,036	----	------	------	Basin 0-4
17	SBUH Runoff	1.510	5	65	4,563	----	------	------	Basin E
18	SBUH Runoff	7.169	5	65	25,403	----	------	------	Basin F5
19	SBUH Runoff	10.85	5	70	48,066	----	------	------	Basin F4
20	Combine	17.96	5	70	73,469	18, 19	------	------	Com. 18,19
21	SBUH Runoff	7.381	5	70	28,619	----	------	------	Basin F3
22	Combine	25.34	5	70	102,088	20, 21	------	------	Com. 20,21
23	SBUH Runoff	8.275	5	60	17,067	----	------	------	Basin F2
24	SBUH Runoff	3.082	5	70	10,398	----	------	------	Basin F1
25	Combine	34.87	5	65	129,551	22, 23, 24	------	------	Com. 22-24
26	Combine	70.21	5	65	249,675	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	3.243	5	60	5,129	----	------	------	Basin 0-5
28	SBUH Runoff	3.243	5	60	5,129	----	------	------	Basin 0-6
29	Combine	75.24	5	60	259,933	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	3.184	5	60	5,036	----	------	------	Basin 0-7
31	SBUH Runoff	3.066	5	60	4,850	----	------	------	Basin 0-8
32	Combine	81.49	5	60	269,819	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	2.417	5	60	3,824	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	1.651	5	60	2,611	----	------	------	Basin 0-10
35	Combine	85.55	5	60	276,254	32, 33, 34	------	------	Com. 32-34
36	SBUH Runoff	2.712	5	60	4,290	----	------	------	Basin 0-11
37	SBUH Runoff	3.301	5	60	5,223	----	------	------	Basin 0-12
38	Combine	91.57	5	60	285,766	35, 36, 37	------	------	Com. 35-37
39	SBUH Runoff	3.301	5	60	5,223	----	------	------	Basin 0-13
40	SBUH Runoff	3.478	5	60	5,502	----	------	------	Basin 0-14
41	Combine	98.35	5	60	296,491	38, 39, 40	------	------	Com. 38-40
42	SBUH Runoff	2.889	5	60	4,570	----	------	------	Basin 0-15
43	SBUH Runoff	2.358	5	60	3,730	----	------	------	Basin 0-16
44	Combine	103.60	5	60	304,791	41, 42, 43	------	------	Com. 41-43
45	SBUH Runoff	2.594	5	60	4,103	----	------	------	Basin 0-17
46	SBUH Runoff	3.360	5	60	5,316	----	------	------	Basin 0-18
47	Combine	109.55	5	60	314,211	44, 45, 46	------	------	Com. 44-46
48	SBUH Runoff	0.884	5	60	1,399	----	------	------	Basin 0-19
49	Combine	110.43	5	60	315,610	47, 48	------	------	Com. 47,48

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SBUH Runoff	13.32	5	65	53,106	----	------	------	Basin A-1
2	SBUH Runoff	6.948	5	60	10,752	----	------	------	5
3	Combine	18.73	5	60	63,858	1, 2	------	------	Com. 1,2
4	SBUH Runoff	3.040	5	60	4,823	----	------	------	Basin 0-1
5	Combine	21.76	5	60	68,682	3, 4	------	------	Com. 3,4
6	SBUH Runoff	3.546	5	60	5,627	----	------	------	Basin 0-2
7	SBUH Runoff	1.263	5	70	5,251	----	------	------	Basin B-1
8	SBUH Runoff	3.323	5	70	14,878	----	------	------	Basin B-2
9	SBUH Runoff	2.531	5	70	10,113	----	------	------	Basin B-3
10	Combine	7.116	5	70	30,241	7, 8, 9	------	------	Com. 7-9
11	SBUH Runoff	1.959	5	65	5,231	----	------	------	Basin C
12	SBUH Runoff	2.034	5	70	8,126	----	------	------	Basin D
13	Combine	33.63	5	60	117,908	5, 6, 10, 11, 12	------	------	Com. 5,6,10-12
14	SBUH Runoff	4.116	5	60	6,532	----	------	------	Basin 0-3
15	Combine	37.74	5	60	124,440	13, 14	------	------	Com. 13,14
16	SBUH Runoff	3.419	5	60	5,426	----	------	------	Basin 0-4
17	SBUH Runoff	1.765	5	65	5,266	----	------	------	Basin E
18	SBUH Runoff	8.142	5	65	28,633	----	------	------	Basin F5
19	SBUH Runoff	12.83	5	70	56,144	----	------	------	Basin F4
20	Combine	20.88	5	70	84,777	18, 19	------	------	Com. 18,19
21	SBUH Runoff	8.589	5	70	33,028	----	------	------	Basin F3
22	Combine	29.47	5	70	117,805	20, 21	------	------	Com. 20,21
23	SBUH Runoff	8.902	5	60	18,389	----	------	------	Basin F2
24	SBUH Runoff	3.581	5	70	11,998	----	------	------	Basin F1
25	Combine	40.09	5	65	148,192	22, 23, 24	------	------	Com. 22-24
26	Combine	79.77	5	65	283,324	15, 16, 17, 25	------	------	Com. 15-17,25
27	SBUH Runoff	3.483	5	60	5,527	----	------	------	Basin 0-5
28	SBUH Runoff	3.483	5	60	5,527	----	------	------	Basin 0-6
29	Combine	84.94	5	60	294,378	26, 27, 28	------	------	Com. 26-28
30	SBUH Runoff	3.419	5	60	5,426	----	------	------	Basin 0-7
31	SBUH Runoff	3.293	5	60	5,225	----	------	------	Basin 0-8
32	Combine	91.65	5	60	305,030	29, 30, 31	------	------	Com. 29-31
33	SBUH Runoff	2.596	5	60	4,120	----	------	------	Basin 0-9

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
34	SBUH Runoff	1.773	5	60	2,814	----	----	----	Basin 0-10
35	Combine	96.02	5	60	311,963	32, 33, 34	----	----	Com. 32-34
36	SBUH Runoff	2.913	5	60	4,622	----	----	----	Basin 0-11
37	SBUH Runoff	3.546	5	60	5,627	----	----	----	Basin 0-12
38	Combine	102.48	5	60	322,213	35, 36, 37	----	----	Com. 35-37
39	SBUH Runoff	3.546	5	60	5,627	----	----	----	Basin 0-13
40	SBUH Runoff	3.736	5	60	5,929	----	----	----	Basin 0-14
41	Combine	109.76	5	60	333,769	38, 39, 40	----	----	Com. 38-40
42	SBUH Runoff	3.103	5	60	4,924	----	----	----	Basin 0-15
43	SBUH Runoff	2.533	5	60	4,020	----	----	----	Basin 0-16
44	Combine	115.39	5	60	342,713	41, 42, 43	----	----	Com. 41-43
45	SBUH Runoff	2.786	5	60	4,421	----	----	----	Basin 0-17
46	SBUH Runoff	3.609	5	60	5,728	----	----	----	Basin 0-18
47	Combine	121.79	5	60	352,862	44, 45, 46	----	----	Com. 44-46
48	SBUH Runoff	0.950	5	60	1,507	----	----	----	Basin 0-19
49	Combine	122.74	5	60	354,369	47, 48	----	----	Com. 47,48

HYDRAULIC CALCULATIONS SUMMARY

Hydraulic Analysis Summary
57th Ave. Conveyance System - 10-yr Regional Storm

Pipe	Line Length (ft)	Additional Flow (cfs)	Total Flow (cfs)	Full Flow Capacity (cfs)	Velocity (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev. Up (ft)	Invert Elev. Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Rim Elev. Up (ft)	Rim Elev. Dn (ft)
P-1	120	0.1	8.0	87.1	3.7	30	4.51	2371.41	2366.00	2372.35	2367.43	2376.69	N/A
P-2	152	0.0	7.9	38.2	3.8	30	0.87	2372.73	2371.41	2373.67	2372.77	2378.05	2376.69
P-3	308	0.4	7.9	42.9	3.8	30	1.09	2376.12	2372.75	2377.06	2374.09	2381.40	2378.05
P-4	265	0.0	7.5	41.3	3.7	30	1.02	2378.82	2376.13	2379.74	2377.48	2384.12	2381.40
P-5	298	0.3	7.5	49.4	3.7	30	1.45	2383.13	2378.80	2384.05	2380.14	2388.45	2384.12
P-6	298	0.0	7.2	51.2	3.7	30	1.56	2387.80	2383.15	2388.70	2384.45	2393.13	2388.45
P-7	293	0.4	7.2	20.0	5.4	24	0.78	2390.64	2388.34	2391.59	2389.17	2395.41	2393.13
P-8	292	0.0	6.8	21.1	3.8	24	0.87	2393.18	2390.65	2394.10	2392.08	2397.96	2395.41
P-9	309	0.4	6.8	21.9	3.8	24	0.94	2396.05	2393.16	2396.97	2394.57	2400.95	2397.96
P-10	241	0.0	6.4	16.2	3.7	24	0.51	2397.27	2396.04	2398.17	2397.44	2403.20	2400.95
P-11	205	0.3	6.4	16.0	3.8	24	0.50	2398.33	2397.30	2399.23	2398.61	2403.60	2403.20
P-12	148	0.0	6.2	16.3	3.7	24	0.52	2399.08	2398.31	2399.96	2399.67	2403.73	2403.60
P-13	298	0.4	6.2	16.7	3.7	24	0.55	2400.68	2399.05	2401.56	2400.39	2405.37	2403.73
P-14	303	0.0	5.8	20.4	3.6	24	0.82	2403.17	2400.70	2404.02	2401.99	2407.86	2405.37
P-15	293	0.4	5.8	18.7	3.6	24	0.69	2405.15	2403.14	2406.00	2404.42	2409.87	2407.86
P-16	298	0.0	5.4	17.3	3.6	24	0.58	2406.94	2405.20	2407.76	2406.40	2411.63	2409.87
P-17	298	2.7	5.4	22.2	3.6	24	0.97	2409.84	2406.96	2410.66	2408.14	2414.54	2411.63
P-18	298	0.2	2.7	14.3	3.7	18	1.86	2415.91	2410.37	2416.53	2411.04	2420.12	2414.54
P-19	298	0.7	2.4	16.4	3.0	18	2.43	2423.17	2415.94	2423.77	2416.82	2427.91	2420.12
P-20	273	0.2	1.8	19.7	2.6	18	3.50	2432.81	2423.25	2433.32	2424.03	2437.07	2427.91
P-21	30	1.6	1.6	0.0	0.9	18	-1.00	2432.51	2432.81	2434.32	2434.31	2434.50	2437.07

Hydraulic Analysis Summary
57th Ave. Conveyance System - 50-yr Regional Storm

Pipe	Line Length (ft)	Additional Flow (cfs)	Total Flow (cfs)	Full Flow Capacity (cfs)	Velocity (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev. Up (ft)	Invert Elev. Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Rim Elev. Up (ft)	Rim Elev. Dn (ft)
P-1	120	0.1	12.7	87.1	4.9	30	4.51	2371.41	2366.00	2372.60	2367.43	2376.69	N/A
P-2	152	0.0	12.6	38.2	4.4	30	0.87	2372.73	2371.41	2373.92	2373.23	2378.05	2376.69
P-3	308	0.5	12.6	42.9	4.4	30	1.09	2376.12	2372.75	2377.31	2374.55	2381.40	2378.05
P-4	265	0.0	12.2	41.3	4.3	30	1.02	2378.82	2376.13	2379.99	2377.94	2384.12	2381.40
P-5	298	0.4	12.2	49.4	4.3	30	1.45	2383.13	2378.80	2384.30	2380.59	2388.45	2384.12
P-6	298	0.0	11.7	51.2	4.3	30	1.56	2387.80	2383.15	2388.95	2384.90	2393.13	2388.45
P-7	293	0.5	11.7	20.0	6.0	24	0.78	2390.64	2388.34	2391.85	2389.53	2395.41	2393.13
P-8	292	0.0	11.2	21.1	4.7	24	0.87	2393.18	2390.65	2394.37	2392.65	2397.96	2395.41
P-9	309	0.5	11.2	21.9	4.7	24	0.94	2396.05	2393.16	2397.24	2395.12	2400.95	2397.96
P-10	241	0.0	10.7	16.2	4.3	24	0.51	2397.27	2396.04	2398.52	2397.99	2403.20	2400.95
P-11	205	0.3	10.7	16.0	4.7	24	0.50	2398.33	2397.30	2399.49	2398.98	2403.60	2403.20
P-12	148	0.0	10.4	16.3	4.0	24	0.52	2399.08	2398.31	2400.43	2400.20	2403.73	2403.60
P-13	298	0.5	10.4	16.7	4.8	24	0.55	2400.68	2399.05	2401.82	2400.61	2405.37	2403.73
P-14	303	0.0	9.9	20.4	4.4	24	0.82	2403.17	2400.70	2404.28	2402.52	2407.86	2405.37
P-15	293	0.5	9.9	18.7	4.4	24	0.69	2405.15	2403.14	2406.26	2404.95	2409.87	2407.86
P-16	298	0.0	9.4	17.3	4.3	24	0.58	2406.94	2405.20	2408.02	2406.93	2411.63	2409.87
P-17	298	5.2	9.4	22.2	4.3	24	0.97	2409.84	2406.96	2410.92	2408.66	2414.54	2411.63
P-18	298	0.3	4.2	14.3	3.7	18	1.86	2415.91	2410.37	2416.69	2411.56	2420.12	2414.54
P-19	298	1.3	3.9	16.4	3.5	18	2.43	2423.17	2415.94	2423.92	2417.12	2427.91	2420.12
P-20	273	0.2	2.6	19.7	2.9	18	3.50	2432.81	2423.25	2433.43	2424.32	2437.07	2427.91
P-21	30	2.4	2.4	0.0	1.4	18	-1.00	2432.51	2432.81	2434.33	2434.31	2434.50	2437.07

Attachment E

Budget-Level Cost Estimates

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HAZEL'S CREEK SUB-BASIN PLANNING & SCHEMATIC DESIGN
BUDGET-LEVEL COST ESTIMATE

STORMWATER FACILITY ITEMS

			PHASE 1 PUMPED BYPASS TO REGAL ST. STORMWATER MAIN			PHASE 2 GRAVITY ROUTE TO REGAL ST. STORMWATER MAIN VIA KXLY ANTENNA SITE			PHASE 3 STORMWATER FACILITIES AT KXLY ANTENNA SITE		
NO.	ITEMS OF WORK AND MATERIALS	UNIT	TOTAL ESTIMATED QUANTITY	UNIT PRICE	TOTAL	ESTIMATED QUANTITY	UNIT PRICE	TOTAL	ESTIMATED QUANTITY	UNIT PRICE	TOTAL
	GENERAL ITEMS										
1	General Conditions & Mobilization (10%)	LS	1	11,700	$ 11,700	1	56,400	$ 56,400	1	112,400	$ 112,400
2	Erosion Control (1%)	LS	1	1,200	$ 1,200	1	5,600	$ 5,600	1	11,200	$ 11,200
3	Construction Staking (2%)	LS	1	2,300	$ 2,300	1	11,300	$ 11,300	1	22,500	$ 22,500
	CLEARING, GRUBBING & DEMO ITEMS										
4	Misc. Removals	LS	1	2,000	$ 2,000	1	4,000	$ 4,000	1	8,000	$ 8,000
5	Clearing and Grubbing	ACRE	0	1,200	$ -	1	1,200	$ 1,200	15	1,200	$ 18,000
6	Demolish Lined Detention Pond	ACRE	1	5,000	$ 5,000	2	5,000	$ 10,000	10	5,000	$ 50,000
	GRADING & SURFACING										
7	Pond Excavation	CY	0	12.00	$ -	6300	12.00	$ 75,600	17500	12.00	$ 210,000
8	Gravel Maintenance Road (6" Depth x 15' Width)	SY	0	8.00	$ -	700	8.00	$ 5,600	2500	8.00	$ 20,000
9	Roadway Surfacing Restoration (3" ACP / 6" Base)	SY	440	27.00	$ 11,880	2210	27.00	$ 59,670	2440	27.00	$ 65,880
	DRAINAGE										
10	Dainage Structure	EA	0	2,400	$ -	9	2,400	$ 21,600	12	2,400	$ 28,800
11	Stormwater Lift Station Assembly, Complete (Incl. Control Valve, Redundancy)	EA	1	45,000	$ 45,000	0	45,000	$ -	0	45,000	$ -
12	Drainage Pipe (< 24" Diameter)	LF	1000	50.00	$ 50,000	800	50.00	$ 40,000	800	50.00	$ 40,000
13	Drainage Pipe (24" to 36" Diameter)	LF	0	80.00	$ -	2650	80.00	$ 212,000	3000	80.00	$ 240,000
14	Drainage Outfall Pads	EA	0	1,000	$ -	1	1,000	$ 1,000	3	1,000	$ 3,000
15	Pond Maintenance Access Path	LS	0	2,000	$ -	1	2,000	$ 2,000	3	2,000	$ 6,000
16	Pond Liner	SY	0	12.00	$ -	9500	12.00	$ 114,000	32000	12.00	$ 384,000
	LANDSCAPING & IRRIGATION										
17	Hydroseeding (Dry-Land Grass)	AC	2	1,500	$ 3,000	5.0	1,500	$ 7,500	10.0	1,500	$ 15,000
18	Landscape Mulching around Ponds	SY	0	10.00	$ -	500	10.00	$ 5,000	1500	10.00	$ 15,000
19	Landscaping (Trees and Shrubs)	LS	0	0.00	$ -	1	5,000.00	$ 5,000	1	20,000.00	$ 20,000
	TOTAL STORMWATER FACILITY ITEMS				**$ 132,080**			**$ 637,470**			**$ 1,269,780**

	Phase 1	Phase 2	Phase 3
SUBTOTAL	$ 132,080	$ 637,470	$ 1,269,780
CONTINGENCIES (20%)	$ 26,000	$ 127,500	$ 254,000
TOTAL CONSTRUCTION	**$ 158,000**	**$ 765,000**	**$ 1,524,000**
DESIGN ENGINEERING (12%)	$ 19,000	$ 92,000	$ 183,000
CONSTRUCTION MANAGEMENT (6%)	$ 9,000	$ 46,000	$ 91,000
TOTAL ENGINEERING & CONSTRUCTION MANAGEMENT	**$ 28,000**	**$ 138,000**	**$ 274,000**
TOTAL STORMWATER FACILITY COST (Rounded)	**$ 186,000**	**$ 903,000**	**$ 1,798,000**

ESTIMATE DOES NOT INCLUDE:

*KXLY/Spokane Radio Infrastructure Relocation onto KXLY Antenna Site
*Implementation of Complimentary Site Uses/Amenities (Open Space, Non-Motorized Facilties, etc.)
*KXLY Irrigation Pond
*Backfilling 57th Pond to Level Site

ATTACHMENT F

COORDINATION MEETING NOTES

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MEETING NOTES

CH2MHILL

CLIENT:	CITY OF SPOKANE
PROJECT:	HAZEL'S CREEK BASIN PLANNING
PROJECT NO.:	426188

MEETING DATE & TIME: August 24, 2011 9:30 a.m.

Attendees:		
	Dale Arnold (City)	Stan Schwartz (Witherspoon Kelly)
	Dave Black (NAI Black)	Leroy Eadie (City)
	Mark Brower (CH2M HILL)	Jamie Hutchinson (NAI Black)
	Doug Busko (CH2M HILL)	Greg Sweeney (TPM)
	Teresa Brum (City)	Tim Anderson (KXLY)
	Carrie Holtan (City)	Steve Herling (Morgan Murphy/KXLY)
	Mike Edwards (City)	Teddie Gibbon (KXLY)

FINAL MEETING NOTES – COORDINATION MEETING

INTRODUCTIONS

BACKGROUND

- Purpose and Objectives
  - M . Brower reviewed purpose and objectives of the CH2M Hill/City project with the group. Mark emphasized that input from the group is needed to ensure the project is successful and meaningful to the key stakeholders. The following input to the goals and objectives was provided:
    - Mike E. suggested that there should be an objective to optimize economic development such that the associated revenue generation benefits follow (fees, taxes, job creation, etc.)
    - Greg S. offered that there needs to be commitment from all parties within a 60 day timeline to commit to implementation of the stormwater solution, including coordination with Parks, Spokane County, KSPS as needed for the 4-way intersection, potential use of the South Side Sports Complex for 100-year overflow, etc.
    - See attached revised Purpose and Objectives
- Distributed Detention Concept Overview & Key Benefits
  - Mark B provided an overview of how the hybrid distributed detention concept would operate and leverage the $57^{th}/55^{th}$ Avenue Detention ponds and the KXLY Antenna Site for detention facilities and reviewed the key benefits (see attached).

COORDINATION

- Dale A. noted that there is commitment from his department to accomplish the preliminary design of the distributed detention system.
- Dave B. suggested that discussing the specifics of the stormwater system would not get us to the end goal. There needs to be collaboration and ownership of the key coordination issues. He added that the City has been good to work with for storm water solutions that may be needed in the interim, should the distributed detention system not be in place, and further, cost/availability of land will determine how his developments accommodate stormwater requirements.
- Dale A. suggested that the City favors ownership of the land that the detention pond facilities would occupy.
  - Steve Herling referred to a 2006 letter to the City that confirms KXLY's commitment to working with the City to accomplish the required land agreement.
  - Leroy E. suggested that sales of park lands are highly problematic and inquired to Stan S. as to whether it would be as difficult to swap lands, or dedicate permanent easements.
- Greg S. requested that the City provide a side-by-side comparison of the previous distributed stormwater concepts, including financial analysis with the current proposal.

  - Stan S. referred to the December '07 IDEA Economic Analysis document produced by the City.
- Greg S. said that he's coordinated recently with Spokane County (Colleen Little) regarding the County transferring ownership of the 57th Ave. evaporation ponds, as well as commercial connecting properties to the existing storm drain mainline in 57th that discharge to the evaporation ponds. The County is very amenable to both proposals.
- Leroy E. said Parks would like to reconfigure the South Side Complex to gain another playfield; group consensus was that this was a good idea, and should be incorporated into any property transactions.

ACTION ITEMS

- Teresa Brum offered to collect action items from the group needed to make progress. Action items are summarized as follows:
  - ***Dave B. to provide a developer "Letter of Intent" to Teresa (for use with negotiations with Spokane County) regarding timing for development at 57th and Palouse.***
  - ***Carrie H. will coordinate with Elizabeth Schoedel to spearhead discussions with Spokane County (Colleen Little) regarding joint agency agreements needed to modify the 55th/57th ponds.***
  - ***Teresa B. will review the 2006 IDEA Economic Analysis, lead production of a comparable document for the current scenario, and apprise the Mayor of the effort and its results.***
  - ***Dave B., Steve H. will collaborate and initiate the required Integrated Site Plan with Bernardo-Wills Architects.***
  - ***Teresa B. and Mike E. will convene an internal City discussion on possible land exchange, including school district staff.***
  - ***Mark B. will move forward with analysis to identify pond sizes and will report back with initial findings by the next meeting.***
  - ***Teresa B. will coordinate with Jonathan Mallahan to facilitate presentations to the Southgate Neighborhood Council, September 14th and October 12th.***
  - ***Dale A. will coordinate with work with City Planning (director) to investigate potential credits for utilizing Low Impact Development options, combining stormwater facilities with landscape requirements.***
  - ***Elizabeth Schoedel, Carrie H. and Stan Schwartz will collaborate to develop a draft MOA for KXLY purchase/lease/trade.***
  - ***The attendees at this meeting will reconvene in approximately 30 days (target: September 28th) to review progress and develop further action items.***

FINAL HAZEL CREEK STORMWATER COORDINATION MEETING NOTES
Wednesday, September 28, 2011 2:00 pm

Attendees:	*Dale Arnold (City)*	*Stan Schwartz (Witherspoon Kelly)*
	Mike Edwards (City)	*Greg Sweeney (TPM)*
	Gerry Gemmill (City)	*Teddie Gibbon (KXLY)*
	Teresa Brum (City)	*Tim Anderson (KXLY)*
	Elizabeth Schoedel (City)	*Jamie Hutchinson (NAI Black)*
	Bill Peacock (City)	*Stephen Pohl (NAI Black)*
	Rick Romero (City)	*Doug Busko (CH2M Hill)*

Presentation and Discussion:

The pond and pipe system as presented by Doug Busko and discussed by the task force will provide sufficient capacity to collect stormwater based on the identified vacant and underutilized parcels identified within the stormwater basin.

The soccer fields no longer are in play for storing the 100 year flood event, as the flood volume will be stored in a dedicated pond on the KXLY property.

A future step will be to determine the cost of the system as presented and discussed with a more traditional underground pipe system.

The system as presented could result in the reduction in footprint or removal of the 55^{th} and 57^{th} street ponds for future development. County must agree.

The development scenario focused on big box retail will likely make more sense financially to the City of Spokane than mixed-use and residential.

The developers are driving the need for a four-leg intersection at Palouse and Regal, but all see the value in reorganizing the idea of a 'center' as a project deliverable. The cost of the intersection will be part of the over-all project improvements.

The City needs to consider a wider range of benefits including direct, indirect and induced values for the City portion and county portion of the Hazel's Creek basin.

A regulation soccer field is 114 yards by 74 yards. CH2M HILL will work on locating a future playfield in the NE corner of the west KXLY parcel, directly adjacent to the sports complex.

Next Steps:

- Jamie Hutchison to work with Elizabeth Schoedel on a developer "Letter of Intent" (for use with negotiations with Spokane County) regarding timing for development at 57th and Palouse.
- Elizabeth Schoedel to spearhead discussions with Spokane County (Colleen Little) regarding joint agency agreements needed to modify the 55th/57th ponds.
- Rick Romero, Mike Edwards, Jamie Hutchinson, Stephen Pohl and Greg Sweeney will continue to review the 2006 IDEA Economic Analysis, and lead production of a comparable document for the current scenario. Doug Busko will coordinate information on undeveloped and redeveloped parcels. The meeting is set for Tuesday, October 4, 2011 at 2:00 pm.
- Doug Busko will modify layout to incorporate the expanded soccer fields.
- Bill Peacock will work with Spokane County to look at geotechnical issues, including seasonal groundwater levels.
- Peacock and Busko will coordinate with the Department of Ecology on the applicability of the State's Dam Safety rules to the project.
- Dave B. and Steve H. will collaborate with Bernardo-Wills Architects on the required Integrated Site Plan.
- Teresa Brum will convene internal City discussions on possible land exchange and four-leg intersection at Palouse and Regal. Kathy Ely of the school district will be invited to the discussions. KXLY will meet with Leroy Eadie on site.
- Teresa Brum will coordinate with Jonathan Mallahan to facilitate presentations to the Southgate Neighborhood Council on October 12th.
- Dale Arnold will coordinate with new City Planning director to investigate potential credits for utilizing Low Impact Development options, combining stormwater facilities with landscape requirements.
- Leroy Eadie to discuss with staff and draft a project priority list (parking, restrooms) in exchange for the Park property at the interchange (contingent on final Park Board approval).
- Elizabeth Schoedel and Stan Schwartz will collaborate to develop a draft MOA for KXLY purchase/lease/trade.
- Teresa Brum and Gerry Gemmill will apprise the Mayor of the effort and its results. Presentation at Mayor's Executive Team presentation October 20, 2011.
- The attendees at this meeting will reconvene in approximately 30 days (target November 2nd) to review progress and develop further action items.

Note: Southgate Neighborhood Council is October 12th.

FINAL HAZEL'S CREEK STORMWATER MEETING NOTES
Wednesday, November 2, 2011 9:30 am

Attendees:

Dale Arnold (City)
Mike Edwards (City)
Gary Bernardo (Bernardo Wills)
Dave Black (NAI Black)
Carrie Holtan (City)
Jonathan Mallahan (City)
Bill Peacock (City)
Rick Romero (City)
Mark Brower (CH2M HILL)
Stan Schwartz (Witherspoon Kelly)
Greg Sweeney (TPM)
Steve Herling (KXLY)
Tim Anderson (KXLY)
Jamie Hutchinson (NAI Black)
Leroy Eadie (City)
Stephen Pohl (NAI Black)
Doug Busko (CH2M Hill)

Presentation and Discussion:

Dale said there are three property owners talking to the City about discharging to Hazel's Creek at 1.5 gpm/acre: 1) Prescott – apartments on 53rd east of Regal; 2) Traditions on Palouse Highway; 3) Prescott – former "Summer Walking" west of Traditions.

Dale also mentioned a proposal for all developers to pay the connection fee based on entire parcel area instead of just the developed area. Stan Schwartz suggested that the fee just be applied to the developed area.

Rick Romero presented the issues surrounding the cost of developing a regional stormwater facility, and potential areas of annexation. The original stormwater fee was to be $5,600 per acre when the cost of constructing the Hazel's Creek improvements was $5-$6 million; the estimated cost is now $7-$8 million. The patchwork of parcels might conceivably hook into the Hazel's Creek drainage system will not generate enough revenue for construction, even with WWM shouldering 50% of the cost.

Rick laid out three tools that may be investigated and deployed to finance the capital project, in addition to developer fees and WWM funds.

1. A Tax Increment District may be leveraged, whereby the City would pledge a portion of the income to finance the project. Tax base would be established now when land prices are low, and finance based on incremental increases in the base.
2. Strategic annexation would be necessary for a TIF, but most existing development immediately south of the current City limits is residential; therefore, the cost of services will outweigh the gained revenue. On top of that, the City would lose the utility premium they receive from these County properties. Rick

suggested that annexation efforts focus on the properties along 57th, including the evaporation ponds, as well as the commercial properties north of 57th. A suggestion was made that the value of the neighborhood amenities (pathways, stormwater/aesthetic ponds, etc.) be included in the financial calculations.

3. Implement the stormwater improvements in phases, to meet demand. Demand is currently focused east of Regal, North of 57th. Provide a system to meet this demand, initially, and plan for phased approaches for incorporating additional parcels within each drainage subarea.

Gary Bernardo stated that he has begun to look at the Integrated Site Plan (ISP), and is talking to Teresa and Tammy at the City.

Jonathan Mallahan suggested that the neighborhood connectivity plan is the source document for understanding how the neighborhood views the development projects in context with the connectivity vision.

There is a meeting scheduled with the vested parties to discuss the 4-leg intersection at Palouse Highway & Regal. Leroy mentioned that the Park Board can't approve easements longer than three years in duration, so perpetual access easement across South Side complex for the school district would have to be approved by the City Council, which might take six months. Leroy will confirm the desired soccer field size.

Next Steps:

- Gary Bernardo to work with developers to move forward on ISP effort.
- Stan Schwartz will draft an initial "letter of intent" to be available for review at the next group meeting.
- CH2M HILL to evaluate size and elevation of conveyance pipe from 57th, to 55th pond, to KXLY property.
- KXLY, Bernardo, Sweeney et al, and Brum to collaborate on bringing the ISP, the connectivity plan, and the community plaza plan together as a unified vision.

Arnold, D

From: Arnold, Dale
Sent: Thursday, June 16, 2011 10:21 AM
To: Arnold, Dale
Subject: FW: Hazel's Creek Regional Stormwater Facilities

Total evaporative pond system require 30 to 40 percent of a projects gross acreage. From our calculations, allowing a 1.5 gpm/acre discharge lessens land requirements. Approximately 6.2 percent of gross area is required with this allowance.

>A twenty (20) parcel would require 7 or 8 acres to accommodate the evaporation pond scenario.

>> Allowing 1.5 gpm/acre reduces that to approximately 1.25 to 1.5 acres.

The 1.5 gpm/ac requiring approximately 670 total gpm over the un/underdevelopment HC Basin. Accept 100 gpm of this at Hazels Creek leaving approximately 570 gpm for discharge at 37th and Rebecca. This seems in line with preliminary geotechnical thinking and the 570 gpm could be handled through a 12" gravity sewer in existing easements.

ADDITIONAL Capital Costs & O/M for Hazel Creek Stormwater District

These fees are additional to the City's Current Residential and Commercial stormwater fees Specific to Hazels Creek Stormwater District and those parcels and developments directly connected to it.

Capital Costs	$4,700,000
Spread over 442 acres is a Connection Charge of	$11,300
with 50% Subsidized by Current SW Utility results in	$5650 per acre

Additional District O&M costs based	$50,000 per year
Spread over 442 acres is	$10 a month or $120 per year/ Acre