Site Development Associates, LLC

Sabegh Property

Level One Downstream Analysis

Project Location:
10850 NE 68th Street
Kirkland, WA 98033

Prepared For:
Anthony Sabegh
6413 Lake Washington Blvd.
Kirkland, WA 98033

Prepared By:
Ken McIntyre
Site Development Associates, LLC
10117 Main Street
Bothell, WA 98011

Date:
February 22, 2007

Project Number:
205-001-07

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TABLE OF CONTENTS

SECTION 1

PROJECT OVERVIEW

PROJECT OVERVIEW

The Sabegh property occupies approximately 0.5 acres on the north side of NE 68th Street in Kirkland, Washington, east of 6th Street South. The project lies in the SE ¼ of Section 8, Township 25 North, Range 5 East, W.M. More specifically, the project is located at 10850 NE 68th Street.

The project proposes the installation of an underground culvert to convey surface runoff which originates upstream of the property. Currently, the surface runoff flows across the property through an existing ditch. Recent discussions with City of Kirkland staff have indicated that the ditch has experienced recent flooding problems which have affected the neighboring downstream property. The underground culvert is proposed to alleviate the flooding situation, and possibly allow for future development of the subject property.

The purpose of this report is to identify the upstream area and flowrate tributary to the subject property, and determine the size of pipe necessary to provide sufficient conveyance capacity.

King County Department of Development and Environmental Services

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner
ANTHONY SARGENT

Address
6913 LAKE WASHINGTON BLVD
KIRKLAND, WA 98033

Phone
(425) 820-2269

Project Engineer
KEN MCINTYRE, P.E.

Company SITE DEVELOPMENT ASSOC.

Address/Phone (425) 486-6533

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name SARGENT PROPERTY

Location

Township 25N

Range 5E

Section 8

Part 3 TYPE OF PERMIT APPLICATION

- Subdivison
- Short Subdivision
- Grading
- Commercial
- X Other DRAINAGE IMPROVEMENT

Part 4 OTHER REVIEWS AND PERMITS

DFW HPA	Shoreline Management
COE 404	Rockery
DOE Dam Safety	Structural Vaults
FEMA Floodplain	Other
COE Wetlands	

Part 5 SITE COMMUNITY AND DRAINAGE BASIN

Community CEDAR RIVER / LAKE WASHINGTON

Drainage Basin EAST LAKE WASHINGTON - BELLEVUE NORTH

Part 6 SITE CHARACTERISTICS

River	Floodplain
Stream CROSSING SITE	Wetlands
Critical Stream Reach	Seeps/Springs
Depressions/Swales	High Groundwater Table
Lake	Groundwater Recharge
Steep Slopes	Other

Part 7 SOILS

Soil Type	Slopes	Erosion Potential	Erosive Velcoties
Alderwood (AgC)	9%	Low - Moderate	

Additional Sheets Attached

Part 8 DEVELOPMENT LIMITATIONS

REFERENCE	LIMITATION/SITE CONSTRAINT
Ch. 4 – Downstream Analysis	

Additional Sheets Attached

Part 9 ESC REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
Sedimentation Facilities	Stabilize Exposed Surface
Stabilized Construction Entrance	Remove and Restore Temporary ESC Facilities
Perimeter Runoff Control	Clean and Remove All Silt and Debris
Clearing and Graing Restrictions	Ensure Operation of Permanent Facilities
Cover Practices	Flag Limits of SAO and open space preservation areas
Construction Sequence	Other
X Other - Stabilize Exposed Soils	

Part 10 SURFACE WATER SYSTEM

Grass Lined Channel	Tank	Infiltration	Method of Analysis: KCRTS
Pipe System	Vault	Depression	
Open Channel	Energy Dissapator	Flow Dispersal	Compensation/Mitigation of Eliminated Site Storage:
Dry Pond	Wetland	Waiver	
Wet Pond	Stream	Regional Detention	

Brief Description of System Operation: PIPE CONVEYANCE ACROSS PROPERTY

Facility Related Site Limitations

Reference	Facility	Limitation

Part 11 STRUCTURAL ANALYSIS

- Cast in Place Vault
- Retaining Wall
- Rockery > 4' High
- Structural on Steep Slope
- Other NONE

Part 12 EASEMENTS/TRACTS

- Drainage Easement
- Access Easement
- Native Growth Protection Easement
- Tract
- Other

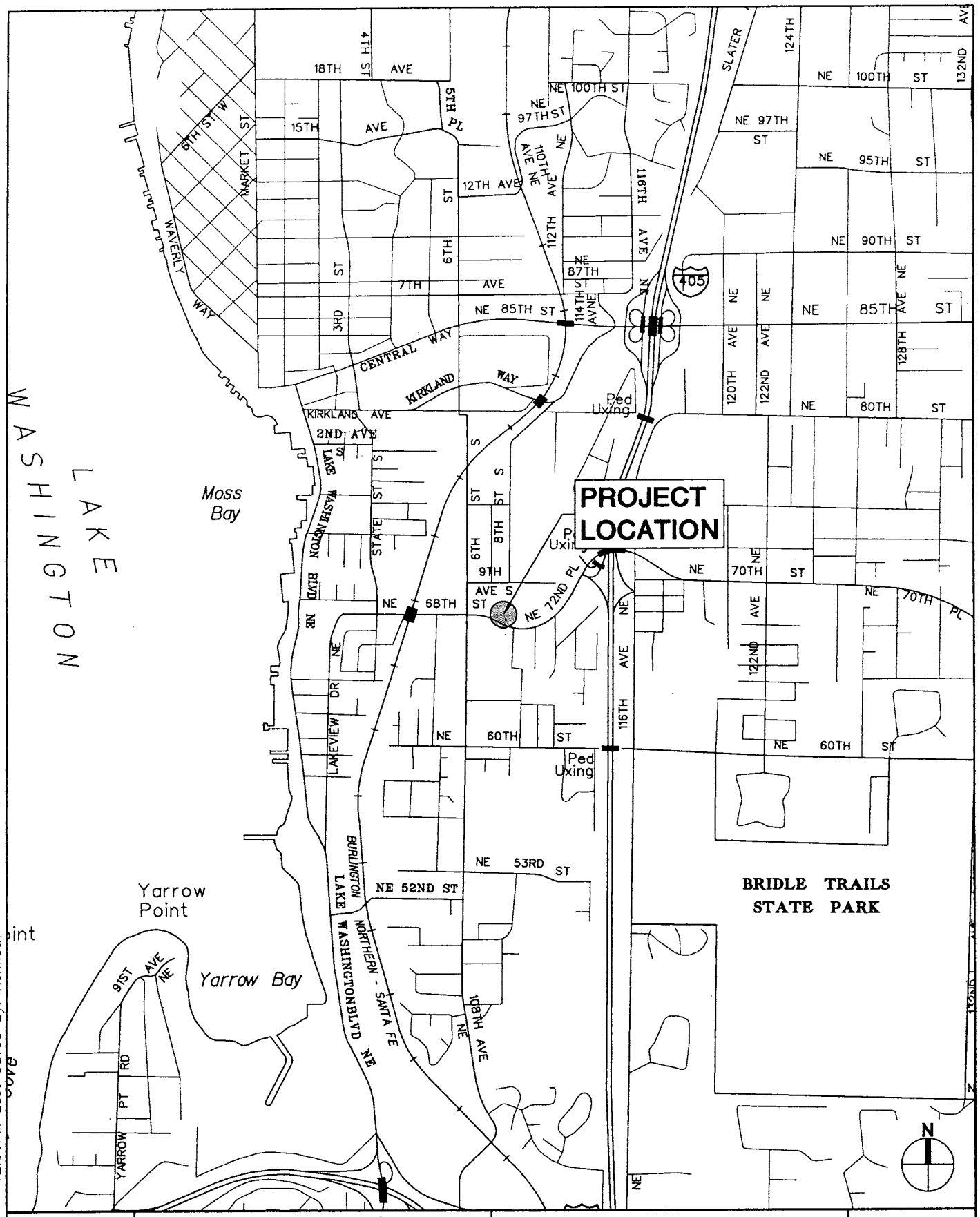
Part 13 SIGNATURE OF PROFESSIONAL ENGINEER

I or a civil engineer under my supervision my supervision have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attachments. To the best of my knowledge the information provided here is accurate.

[signature] 2/22/07

Signed/Date

Exhibit B
APL08-00006 & APL08-00009

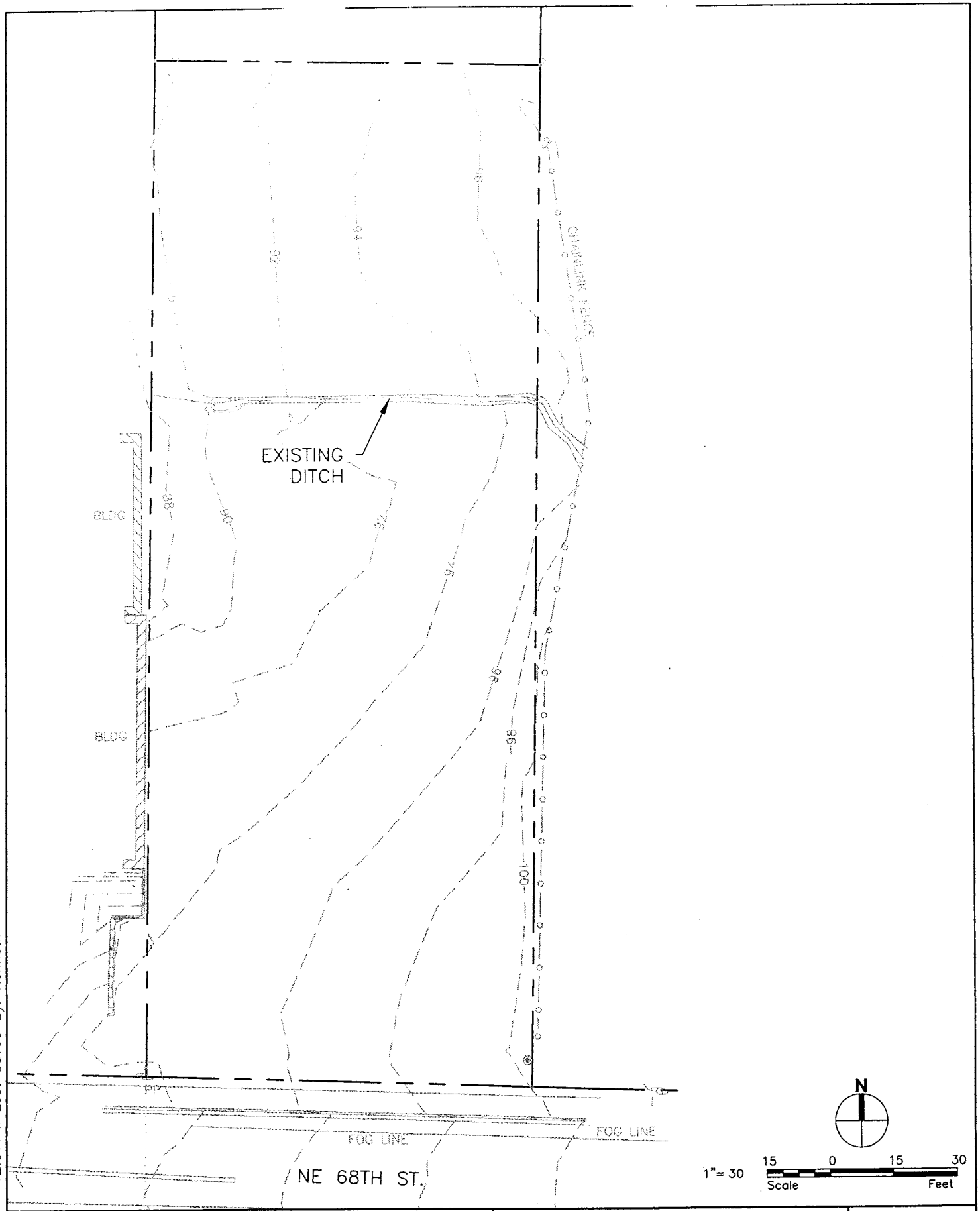


KJM Design JDZ Drawn 2/23/2007 Date 205-001-07 MS Project No.	Site Development Associates, LLC 10117 Main Street; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593 www.sdaengineers.com	**Sabegh Property** **VICINITY MAP**	FIG 02 Sketch No. RFI No. N.T.S. Scale

Feb 23, 2007 – 12:36PM Last Saved By: Kenneth

R:\Projects\205 (Sabegh)\001-07 (Sabegh Culvert)\dwg\figures\TIR Figures\Vicinity Map.dwg – Scale: 40

Exhibit B
APL08-00006 & APL08-00009



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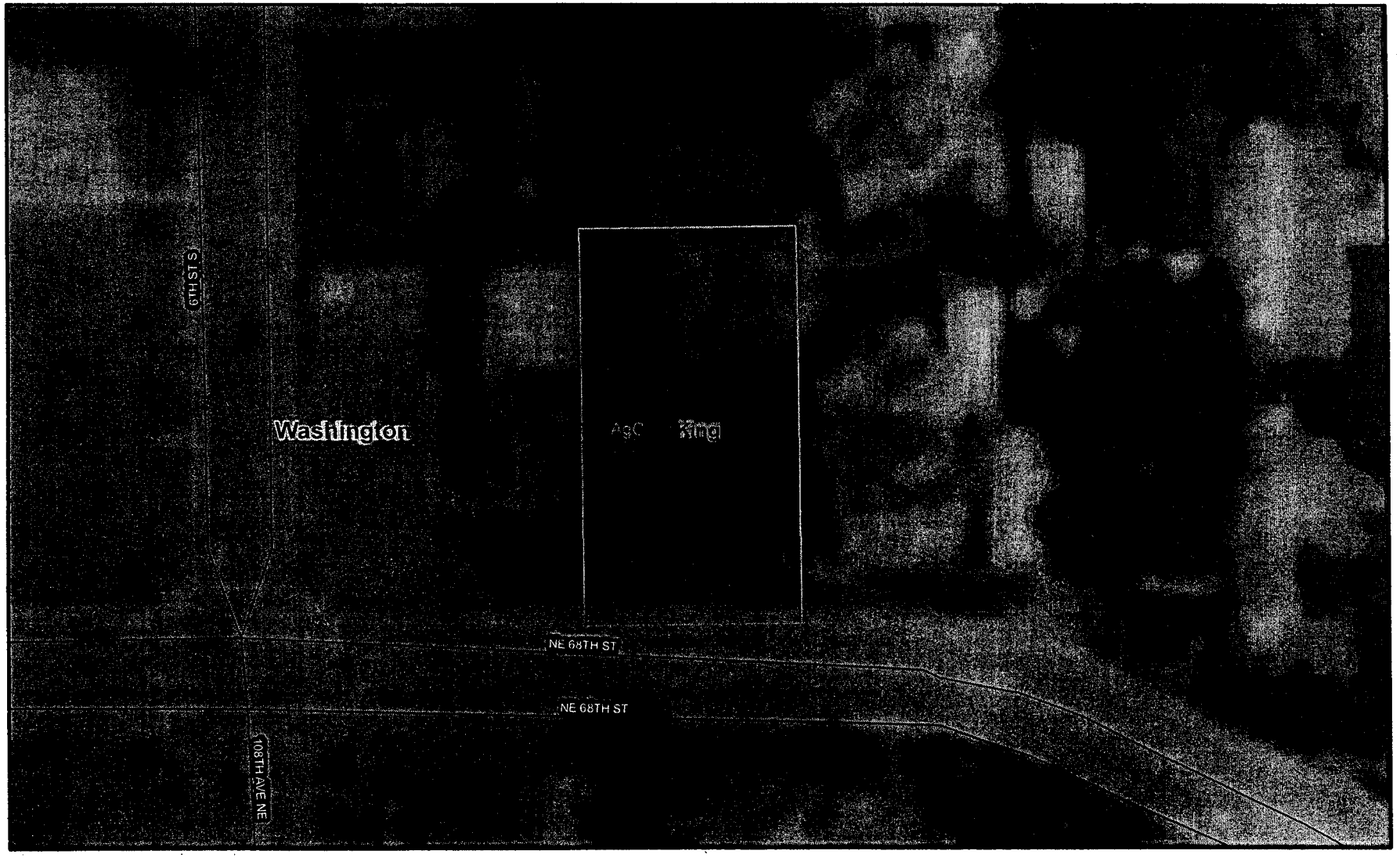
KJM Design KJM Drawn 2/22/07 Date 205-001-07 MS Project No.	Site Development Associates, LLC 10117 Main Street; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593 www.sdaengineers.com	**Sabegh Property** **SITE CHARACTERISTICS**	FIG 03 Sketch No. RFI No. 1"=30' Scale

SOIL SURVEY OF KING COUNTY AREA, WASHINGTON

Sabegh Property



Meters
0 5 10 20

Feet
0 25 50 100 150 200

Sabegh Property

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 10

Soil Survey Area: King County Area, Washington
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
7/10/1990; 7/18/1990

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend Summary

King County Area, Washington

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AgC	Alderwood gravelly sandy loam, 6 to 15 percent slopes	0.4	100.0

AOI = area of impact

SECTION 2

CONDITIONS & REQUIREMENTS SUMMARY

SUMMARY OF CORE REQUIREMENTS

- ***Core Requirement #1 – Discharge at Natural Location***

  The project proposes the installation of a culvert which will maintain the current flowpath of the existing ditch.

- ***Core Requirement #2 – Offsite Analysis***

  An upstream analysis and level-one downstream analysis are included in this document.

- ***Core Requirement #3 – Flow Control***

  No flow control is proposed for this project.

- ***Core Requirement #4 – Conveyance Sytem***

  An analysis of the proposed conveyance pipe system is included in this document.

- ***Core Requirement #5 – Erosion & Sediment Control***

  No formal erosion and sediment control is warranted for this project other than stabilizing disturbed soil upon completion of construction.

- ***Core Requirement #6 – Maintenance & Operations***

  No maintenance and operations guidelines are necessary for this project.

- ***Core Requirement #7 – Financial Guarantees & Liabilities***

  Any necessary financial guarantees required by the City will be addressed by the project applicant.

- ***Core Requirement #8 – Water Quality***

  The project does not propose an increase in impervious surface area, and therefore, does not warrant stormwater quality measures.

SUMMARY OF SPECIAL REQUIREMENTS

- ***Special Requirement #1 – Other Adopted Area-Specific Requirements***

  No other area-specific requirements are pertinent to this project.

- ***Special Requirement #2 – Flood Hazard Area Delineation***

  The project is shown on FEMA Flood Insurance Rate Map Panel No. 53033C0365F. A portion of this map is shown in Appendix 3-B.

- ***Special Requirement #3 – Flood Protection Facilities***

  No flood protection facilities exist in the vicinity of the project.

- ***Special Requirement #4 – Source Control***

  No source control is required for the proposed culvert installation.

- ***Special Requirement #5 – Oil Control***

  No oil control is required for the proposed culvert installation.

SUMMARY OF ADDITIONAL REQUIREMENTS

The site does not appear to be subject to any additional requirements beyond the 8 Core Requirements and 5 Special Requirements listed above.

SECTION 3

OFFSITE ANALYSIS

Task 1 – Study Area Definition & Maps

Figure #5 of this report shows the hydrologic study area for this project. The study area includes the upstream area tributary to the project site, as well as the downstream flowpath for ¼-mile from the site.

The upstream area which is tributary to the project site is very large. Based on GIS information obtained from the City of Kirkland (a portion of which is shown in Figure 5), the upstream basin extends easterly, and includes a portion of the I-405 corridor, as well as a large residential region east of I-405. However, approximately ¼-mile upstream of the project site, a flow-splitting catch basin exists. The primary flowpath from this splitter is westerly, eventually passing through the subject property. However, once the flow depth in this system reaches a specific depth, flow is allowed to discharge through a second pipe, which continues southwesterly, along NE 68th St.

The downstream flowpath was located and verified to be consistent with what is shown in the City's GIS information.

Task 2 – Resource Review

- ***Adopted Basin Plans***

  No adopted basin plans are pertinent to this project.

- ***Finalized Drainage Studies***

  No finalized drainage studies are pertinent to this project.

- ***Basin Reconnaissance Summary Reports***

  The King County Basin Reconnaissance Summary Reports are outdated, and have not been consulted for this report. However, the project was determined to lie in the Cedar River / Lake Washington Watershed. The project does not appear to be near, or tributary to a waterway for which a monitoring program is in effect.

- ***Critical Drainage Areas***

  No critical drainage areas exist on or near the project site.

- ***FEMA Flood Insurance Rate Maps***

  The project is shown on FEMA Flood Insurance Rate Map Panel No. 53033C0365F. A portion of this map is shown in Appendix 3-B.

  located in zone X = outside 500 yr floodplain

- ***Sensitive Areas Folio***

  A Districts and Development Conditions report was obtained from King County for this project, and it has not identified any environmental hazard areas associated with this site. The Districts and Development Report is included in Appendix 3-B.

- ***Road Drainage Problems***

  No road drainage problems are known to exist near the property.

- ***USDA Soil Survey for King County***

  The project site is underlain by Alderwood gravelly sandy loam, according o the USDA Soil Survey for King County. This type of soil is generally considered to be a "Till" soil, with relatively low permeability and moderate runoff potential. The erosion potential for this type of soil is generally considered to be low to moderate.

- ***Migrating River Studies***

  No migrating river studies are pertinent to the project site.

Task 3 – Field Inspection

The site was visited on the afternoon of February 20th, 2007. The weather conditions were clear and cool, with no significant precipitation having occurred within the previous 48 hours. Stormwater runoff was observed flowing through the underground pipe network upstream and downstream of the project site, and also through the on-site ditch.

The field investigation began approximately ¼-mile upstream (east) of the project site. Previous conversations with the applicant, and City of Kirkland staff have indicated that a flow-splitting catch basin exists at this location. This facility was located and observed. The flow-splitting catch basin consists of one 24" dia. inlet pipe (from the east) and one 24" outlet pipe (to the west), which have been set at nearly the same elevation. The catch basin also contains an 18" outlet pipe (to the southwest) with an invert elevation approximately 16" higher than the two 24" pipes. The secondary outlet is only utilized when flow through the structure has staged above a depth of 16". The existence of a flow-splitting structure at this location is evidence that the flowrates through this area have probably exceeded the capacity of the primary conveyance system in the past. Furthermore, the next catch basin in the primary downstream flowpath lies lower than the flow-splitting structure, and also lies in the rear yard of a multi-family residential property. It is likely that the flow-splitting structure may have been installed to alleviate a past flooding problem.

The upstream flowpath between the flow-splitting catch basin and the project site lies on private property, and could not be observed. A ditch exists on the project site, and appears to have recently been cleaned. The ditch outfalls to an 18" polyethylene pipe which conveys flow westerly toward 108th Avenue NE. Stormwater then flows north along 108th Avenue NE beyond the required ¼-mile analysis distance.

Task 4 – Drainage System Description and Problem Description

The project site contains a ditch, approximately 18" wide and 12" deep, which appears to have been recently cleaned. The ditch is earth-lined and has a series of sand-bags at the downstream end. The site and immediate downstream flowpath are shown in Photos #1 & #2. The ditch ends at a 18" polyethylene pipe, which conveys flow westerly through the adjacent property, which contains a 7-11 store. The downstream system continues westerly, then enters a catch basin just east of the sidewalk fronting 108th Avenue NE. The pipe network continues south for a short distance to pick up runoff from the 7-11 parking lot. From this point, the downstream flowpath continues west to the public storm drainage network within 108th Avenue NE. The pipe network in the vicinity of the 7-11 store is shown in Photos #3 & #4. The remainder of the downstream flowpath continues northerly, via 30" pipe along the west side of 108th Avenue NE. This route is shown in photo #'s 5-8.

It appears that a small portion of the site which fronts NE 68th Street could be tributary to the roadway, rather than to the existing ditch. Those flows which discharge to the fronting street appear to flow westerly along the north curbline of NE 68th Street. These flows enter a catch basin approximately 50 feet east of the site. This flow is directed southerly, across NE 68th Street, then flows west along the south curbline of NE 68th Street until reaching 108th Avenue NE. Flow continues north from this point through a pipe network flowing along NE 68th Street. Approximately 200 feet north of the intersection of NE 68th Street and 108th Ave. NE, this flowpath merges with the flowpath described in the paragraph above. This flowpath continues northerly along 108th Avenue NE beyond the ¼-mile limit of this analysis. Although this flowpath is not directly related to the culvert installation, it may be beneficial for future development which may take place on the property. Since both flowpaths converge within ¼-mile of the project site, the entire site lies within a common threshold discharge basin, which would allow flows from a future development on the site to be discharged either to the ditch, or to the public storm drainage system in NE 68th Street.

The entire downstream flowpath was observed to be in relatively good operating condition. No significant sedimentation or trash accumulation was noted in the pipe system downstream of the project site. Conversations with the applicant and City staff have indicated that a nuisance flooding condition has recently existed on the site, most likely due to debris that had accumulated in the existing ditch. The applicant recently had the ditch cleaned of debris, which should help to alleviate the flooding issue. The proposed pipe installation is not expected to aggrevate any existing flooding problems.

Photo #1
Looking east from adjacent (west) property

Photo #2
Looking west near east property line

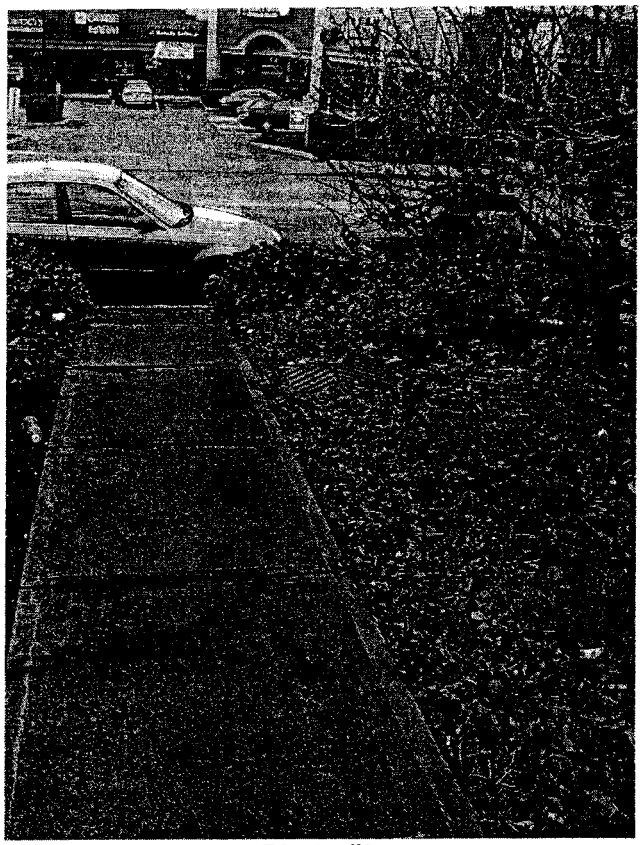


Photo #3
Looking west on adjacent property

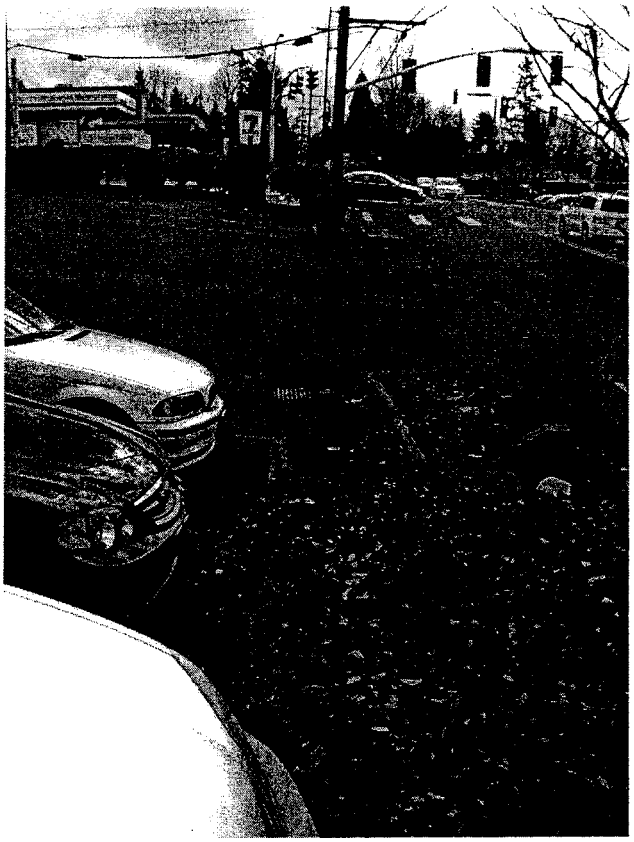


Photo #4
Looking South on Adjacent property

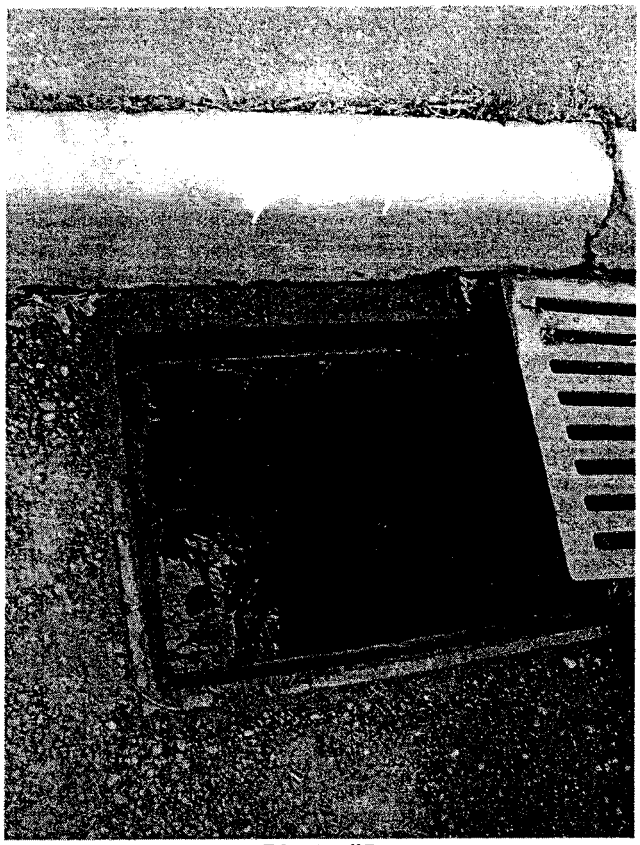


Photo #5
Looking at CB on 108th Ave NE which receives runoff from the site.

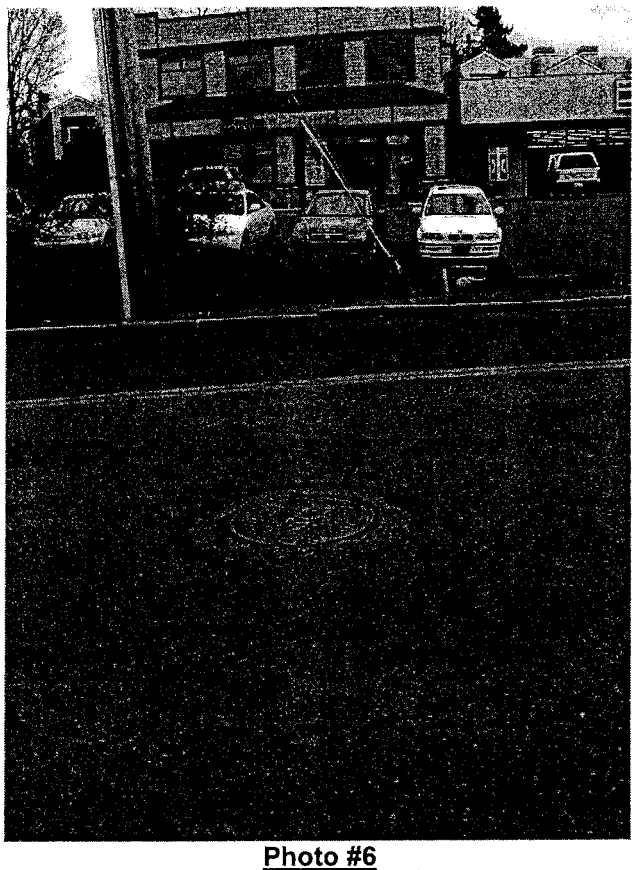


Photo #6
Looking west across 108th Ave NE

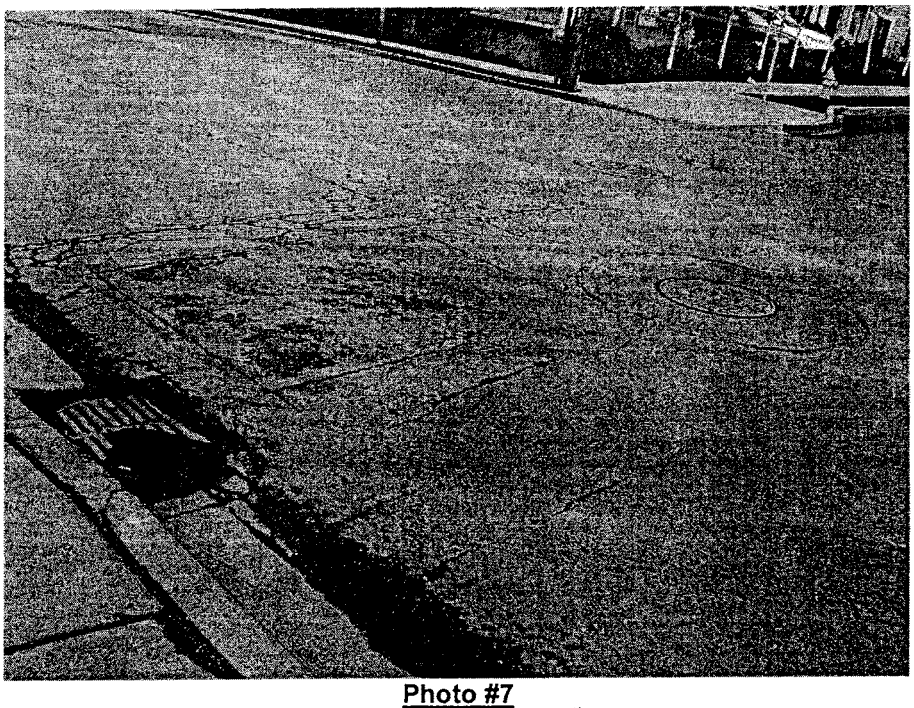


Photo #7
Looking Northeast along 108th Ave NE

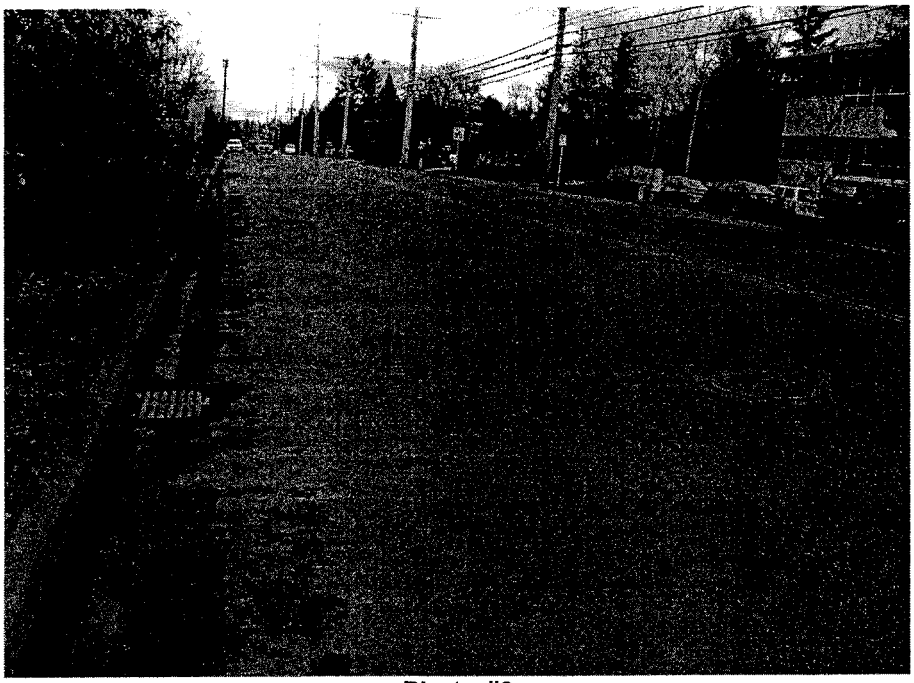
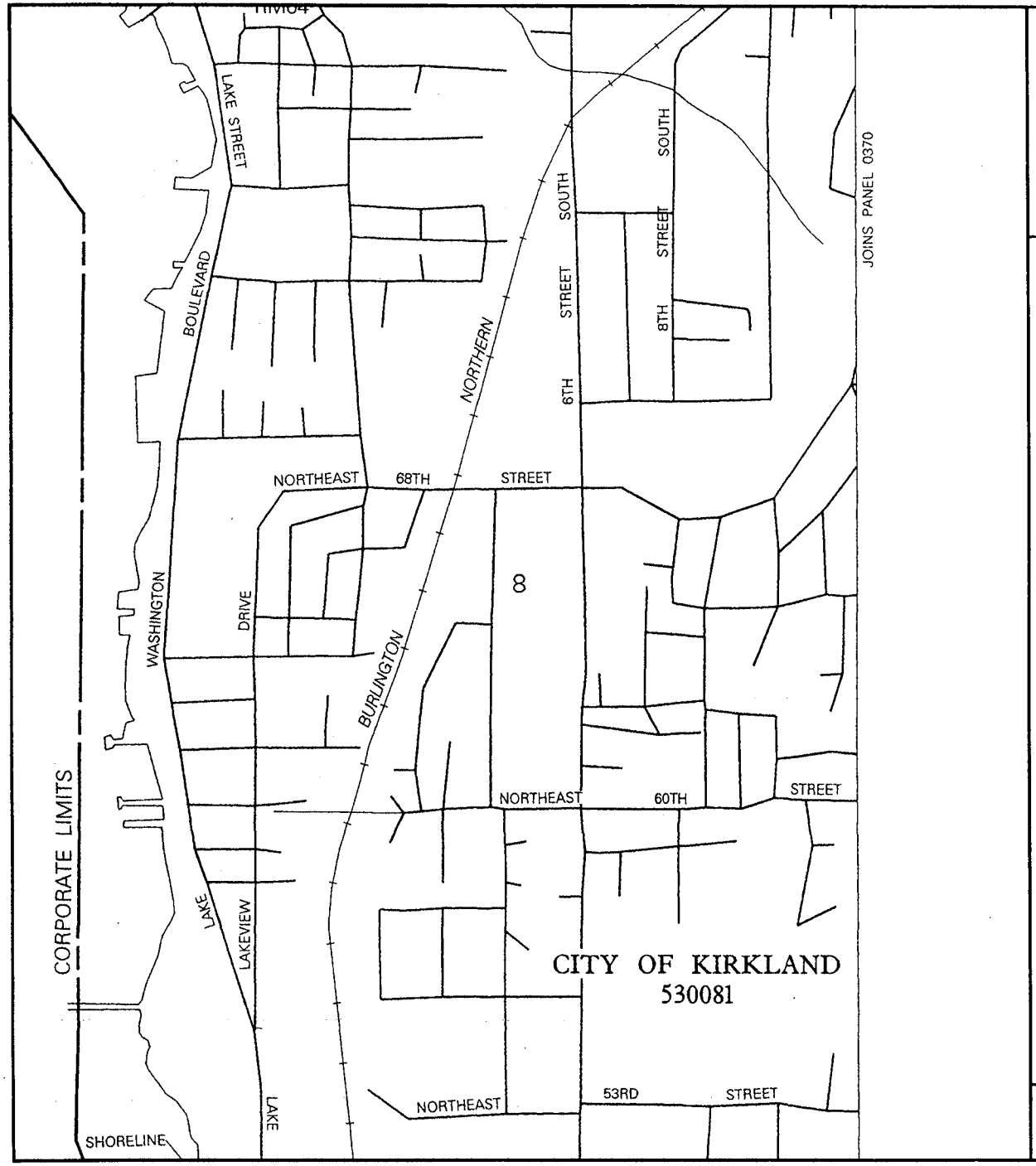


Photo #8
Looking North along 108th Ave NE

Task 5 – Mitigation of Existing or Potential Problems

An existing nuisance flooding condition has been identified by City staff and the project applicant. The flooding condition is thought to have been caused by debris in the ditch channel, which has recently been removed. The existing channel was observed to be free-flowing and clear of debris.



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

KING COUNTY,
WASHINGTON AND
INCORPORATED AREAS

PANEL 365 OF 1725

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BELLEVUE, CITY OF	530074	0365	F
KING COUNTY, UNINCORPORATED AREAS	530071	0365	F
KIRKLAND, CITY OF	530081	0365	F
SEATTLE, CITY OF	530089	0365	F

MAP NUMBER
53033C0365 F

MAP REVISED:
MAY 16, 1995

Federal Emergency Management Agency

PARCEL REPORT

Districts and Development Conditions

for Parcel number: **0825059081**

Administrative Districts and Areas

Address	Not Available
Jurisdiction	**Kirkland**
Zipcode	**98033**
King County Council District (COUNCIL IN TRANSITION)	Council District:**6** Council Member: **Jane Hague** Phone: **(206) 296-1006** **Web site**
School District	**Lake Washington #414**
Fire District	Not Available
Water District	None
Sewer District	None
Water and Sewer District	None
Water Service Planning Area	**Kirkland, City of**
Tribal Lands	No

Planning Designations

King County Zoning	Not Available
Comprehensive Plan Land Use	Not Available
Urban Growth Area	**Urban**
Community Planning Area	**Eastside**
Unincorporated Area Council	None
P-Suffix Conditions	None
Kroll Map Page	**431**
Thomas Guide Map Page	**536**
Agricultural Production District	No
Forest Production District	No
Roads MPS Zone	**87**
Transportation Concurrency Zone	**240**

Environmental Areas

Drainage Basin	**East Lake Washington - Bellevue North**
Rural Clearing Limits Apply	Not Available
Watershed Name	**Cedar River / Lake Washington**
WRIA Name	**Cedar-Sammamish**
WRIA Number	**8**
Wetland	None mapped
100-Year Flood Plain	None mapped
Coal Mine Hazards	None mapped
Erosion Hazards	None mapped
Landslide Hazards	None mapped
Seismic Hazards	None mapped
Critical Aquifer Recharge Area	None mapped

DDES Permitting Information
Assessor Property Characteristics Report
Zoom to Parcel - iMAP (High Speed Internet Connection)
Zoom to Parcel - Parcel Viewer (All Internet Connections)

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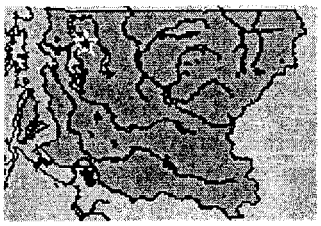
PARCEL REPORT

Districts and Development Conditions

for Parcel number: **0825059081**



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Fire District	Not Available
Water District	None
Sewer District	None
Water and Sewer District	None
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Tribal Lands	No

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Landslide Hazards	None mapped
Seismic Hazards	None mapped
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SECTION 4

FLOW CONTROL & WATER QUALITY ANALYSIS & DESIGN

No flow control or water quality features are proposed for this project.

SECTION 5

CONVEYANCE SYSTEM ANALYSIS AND DESIGN

Conveyance System

The project proposes the installation of a pipe across the property to convey upstream flow through the property. The upstream tributary area is very large, and contains a variety of residential, commercial, and Interstate Freeway area. Additionally, it appears that the upstream tributary basin extends beyond the limits of the GIS information that was provided. Therefore, the hydrology of the upstream basin is difficult to accurately define.

A reasonably accurate estimate of the maximum upstream tributary flow can be determined by analyzing a flow-splitting structure which exists upstream of the site. The primary flowpath through this structure is via a 24" diameter concrete pipe which enters from the east, and discharges to the west. This flowpath is eventually tributary to the subject property. The structure contains a secondary outlet, consisting of an 18" diameter concrete pipe which discharges southwesterly along NE 68th Street, and is not tributary to the subject property. The invert of this pipe lies approximately 16" above the invert of the primary outlet.

The calculations in this section will estimate the maximum capacity of the primary 24" diameter pipe which lies immediately downstream of the flow-splitting structure. This will be calculated using Manning's equation for open-channel pipe flow. Any flows above this capacity will be assumed to discharge through the secondary outlet. Once the maximum capacity of this pipe is calculated, it will be added to the peak flowrate of an immediate upstream basin which appears to be tributary to the site. The proposed on-site pipe will be designed to convey this total flow.

Capacity Calculation – 24" Pipe Immediately Downstream of Flow-Splitting Structure

Based on field-measurements, it appears that the slope of this pipe is approximately 3%. The capacity of this pipe has been calculated to be 42.56 cfs. The calculation is included in Appendix 5-A. It is likely that one or more of the pipes between this reach and the subject property was installed at a lesser slope, and will limit the flow further. Using this flowrate will provide a conservative design of the on-site pipe.

The immediate upstream basin has been measured to be approximately 13.04 acres. This area is comprised primarily of multi-family residential development. The 1998 King County Surface Water Design Manual (KCSWDM) estimates these areas to have an effective impervious area of approximately 80% (See KCSWDM Table 3.2.2.E). A hydrologic model of this area has been prepared using KCRTS hydrologic modeling software. The 100-yr flowrate for this area has been computed as 5.48 cfs (See Appendix 5-A).

The total 100-yr flowrate tributary to the site is estimated to be 48.04 cfs (42.56 + 5.48). Based on pipe-design calculations that have been included in Appendix 5-A, the following pipe design options would be sufficient to convey the flows originating upstream of this site:

18" Diameter Pipe - Minimum Slope = 17.73%
21" Diameter Pipe - Minimum Slope = 7.79%
24" Diameter Pipe - Minimum Slope = 3.82%
30" Diameter Pipe - Minimum Slope = 1.16%

APPENDIX 5-A

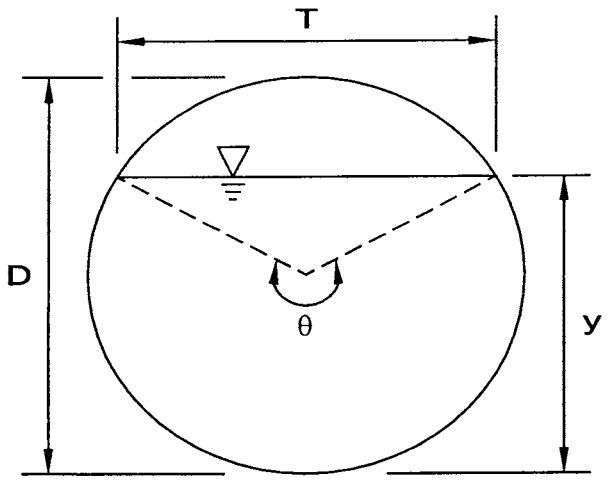
CONVEYANCE CALCULATIONS

Open Channel Flow Calculator For Circular Pipes	Site Development Associates, LLC 18322 Bothell Way NE; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593

Project Name: Sabegh Property
Description: 24" pipe capacity

Project No.: 205-001-07
Date: 2/23/2007
Calc. By: KJM

Pipe Diameter (D) =	24	in
Pipe Slope (S) =	3.00	%
Flow Depth (y) =	2.00	ft
Flowrate (Q) =	**42.56**	**cfs**
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	3.14	ft^2
Wet. Perimeter (P) =	6.28	ft
Hydraulic Radius (R) =	0.50	cfs
Top Width (T) =	0.00	ft
Flow Velocity =	13.55	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

Top Width (T): $T = \sin\left(\theta/2\right)d$

Input Parameters:

Till Grass	2.61 ac.
Impervious	10.43 ac.
Sea-Tac Zone, Scale Factor	1.0
1-hr Reduced Time Series	

Flow Frequency Analysis
Time Series File:sabegh.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

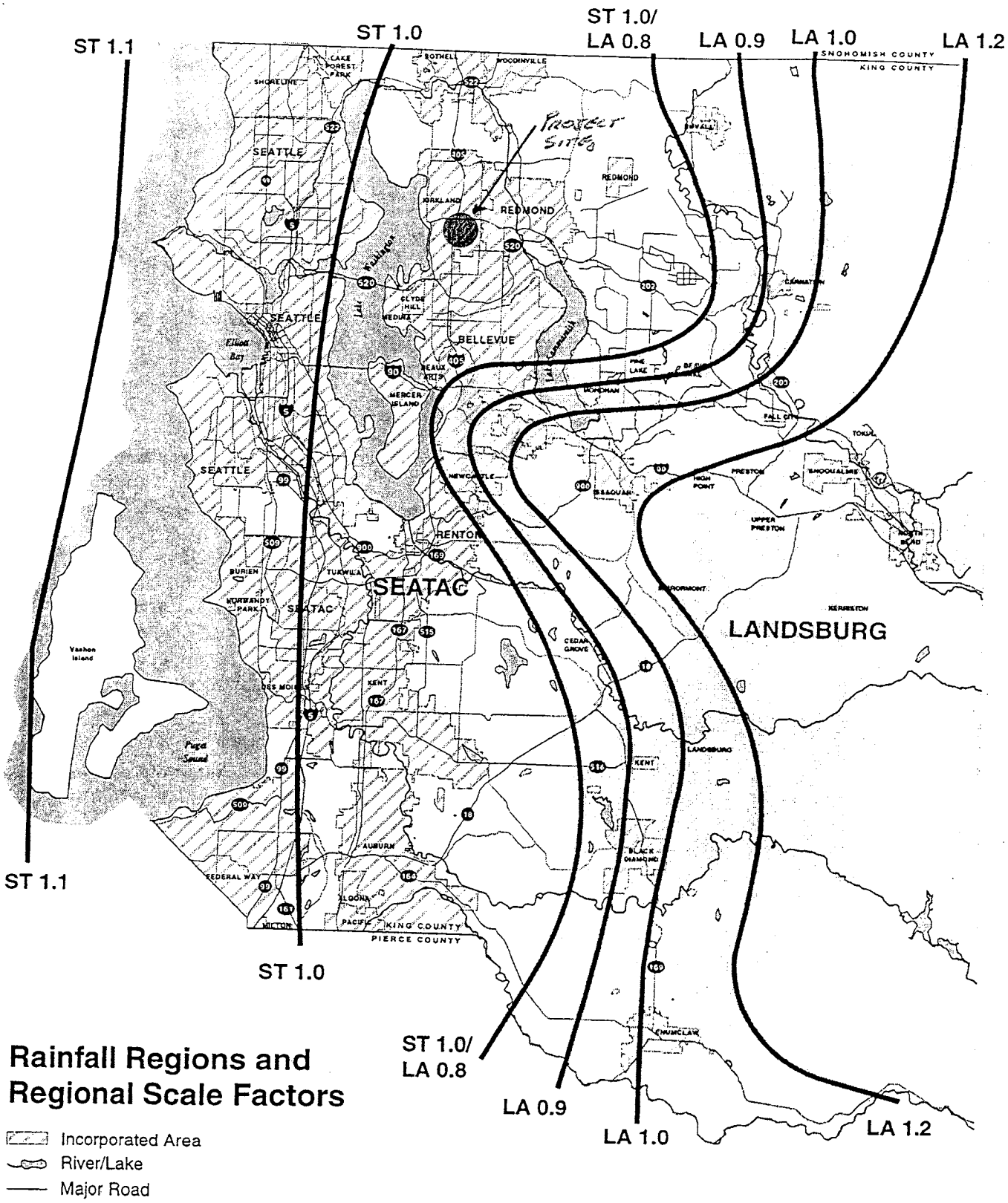
Flow Rate (CFS)	Rank	Time of Peak
2.76	6	2/09/01 2:00
2.34	8	1/05/02 16:00
3.31	3	12/08/02 18:00
2.65	7	8/26/04 2:00
3.16	4	10/28/04 16:00
2.94	5	1/18/06 16:00
3.85	2	10/26/06 0:00
5.48	1	1/09/08 6:00

Computed Peaks

-----Flow Frequency Analysis-------

- - Peaks - - (CFS)	Rank	Return Period	Prob
5.48	1	100.00	0.990
3.85	2	25.00	0.960
3.31	3	10.00	0.900
3.16	4	5.00	0.800
2.94	5	3.00	0.667
2.76	6	2.00	0.500
2.65	7	1.30	0.231
2.34	8	1.10	0.091
4.94		50.00	0.980

FIGURE 3.2.2.A RAINFALL REGIONS AND REGIONAL SCALE FACTORS

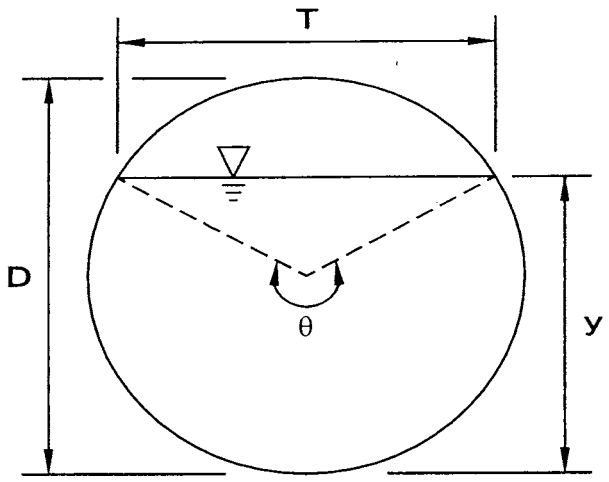


Open Channel Flow Calculator For Circular Pipes	Site Development Associates, LLC 18322 Bothell Way NE; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593

Project Name: Sabegh Property
Description: On-site Pipe Design

Project No.: 205-001-07
Date: 2/28/2007
Calc. By: KJM

Pipe Diameter (D) =	18	in
Pipe Slope (S) =	17.73	%
Flow Depth (y) =	1.50	ft
Flowrate (Q) =	48.04	cfs
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	1.77	ft^2
Wet. Perimeter (P) =	4.71	ft
Hydraulic Radius (R) =	0.38	cfs
Top Width (T) =	0.00	ft
Flow Velocity =	27.18	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

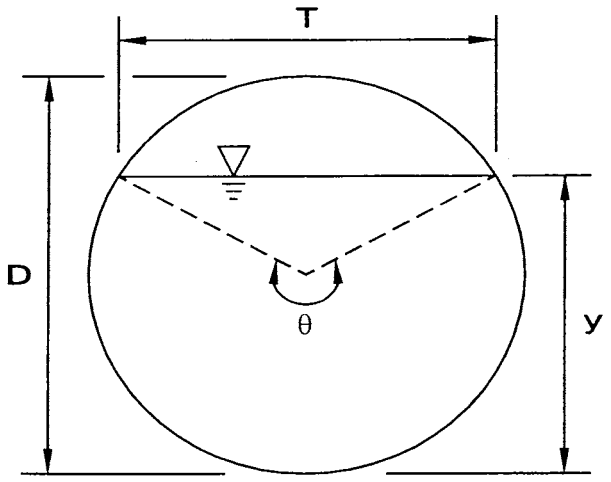
Top Width (T): $T = \sin(\theta/2)d$

Open Channel Flow Calculator For Circular Pipes	Site Development Associates, LLC 18322 Bothell Way NE; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593

Project Name: Sabegh Property
Description: On-site Pipe Design

Project No.: 205-001-07
Date: 2/28/2007
Calc. By: KJM

Pipe Diameter (D) =	21	in
Pipe Slope (S) =	7.79	%
Flow Depth (y) =	1.75	ft
Flowrate (Q) =	48.04	cfs
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	2.41	ft^2
Wet. Perimeter (P) =	5.50	ft
Hydraulic Radius (R) =	0.44	cfs
Top Width (T) =	0.00	ft
Flow Velocity =	19.97	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

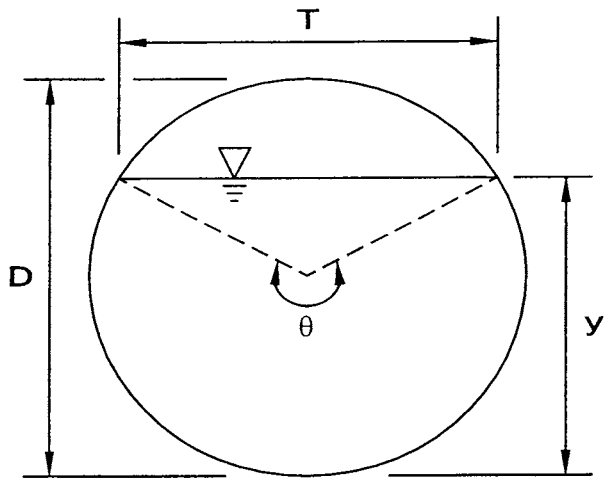
Top Width (T): $T = \sin(\theta/2)d$

Open Channel Flow Calculator For Circular Pipes	Site Development Associates, LLC 18322 Bothell Way NE; Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593

Project Name: Sabegh Property
Description: On-site Pipe Design

Project No.: 205-001-07
Date: 2/28/2007
Calc. By: KJM

Pipe Diameter (D) =	24	in
Pipe Slope (S) =	3.82	%
Flow Depth (y) =	2.00	ft
Flowrate (Q) =	48.04	cfs
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	3.14	ft^2
Wet. Perimeter (P) =	6.28	ft
Hydraulic Radius (R) =	0.50	cfs
Top Width (T) =	0.00	ft
Flow Velocity =	15.29	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

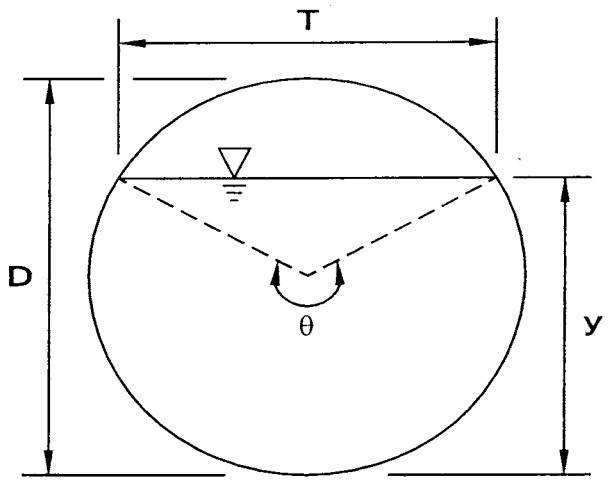
Top Width (T): $T = \sin(\theta/2)d$

Open Channel Flow Calculator For Circular Pipes	Site Development Associates, LLC 18322 Bothell Way NE, Bothell, Washington 98011 Office: 425.486.6533 Fax: 425.486.6593

Project Name: Sabegh Property
Description: On-site Pipe Design

Project No.: 205-001-07
Date: 2/28/2007
Calc. By: KJM

Pipe Diameter (D) =	30	in
Pipe Slope (S) =	1.16	%
Flow Depth (y) =	2.50	ft
Flowrate (Q) =	48.04	cfs
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	4.91	ft^2
Wet. Perimeter (P) =	7.85	ft
Hydraulic Radius (R) =	0.63	cfs
Top Width (T) =	0.00	ft
Flow Velocity =	9.79	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

Top Width (T): $T = \sin\left(\theta/2\right)d$

SECTION 6

SPECIAL REPORTS AND STUDIES

Special Reports and Studies

None of the special reports and studies listed in Section 2.3.1.1 of the KCSWDM have been prepared for this project.

SECTION 7

OTHER PERMITS

Other Permits

This project will not require an HPA, Corps of Engineers, or other outside permit. All applicable permits shall be obtained from the City of Kirkland prior to construction.

SECTION 8

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN ANALYSIS & DESIGN

SECTION 9

BOND QUANTITIES, FACILITY SUMMARIES AND DECLARATION OF COVENANT

Bond Quantities, Facility Summary, and Declaration of Covenant

The size and scope of the proposed improvements are not expected to warrant bonding of the project. No stormwater detention or treatment facilities are proposed, and no maintenance covenant is expected to be needed.

SECTION 10

OPERATIONS AND MAINTENANCE

Operations & Maintenance

The proposed pipe shall be kept clear of debris, and in good operating condition. No further operations and maintenance