CONFLUENCE
ENVIRONMENTAL COMPANY

To: Laurie Cropp, Homeowner
cc: Richard Flake, RWF Homes

From: Kerrie McArthur

and

Christina Merten

Date: April 18, 2017

Re: 4803 Forest Ave SE Watercourse Evaluation

Enclosures: Photo Appendix
Online GIS Databases Results
Topographic and Boundary Survey
Modeling Results

Confluence Environmental Company (Confluence) was contracted to conduct a watercourse evaluation on two properties located at 4803 Forest Ave SE, Mercer Island, Washington (Tax parcels 2577300021 and 4045000145). The watercourse evaluation was conducted to determine the presence and extend of any watercourse on the properties, as requested by the City of Mercer Island (City).

METHODS

This section describes the methods used to evaluate the presence and extend of watercourses on the property.

Desktop Analysis

Confluence searched online GIS databases to determine if others have identified watercourses on the property. The following online GIS databases were searched:

- Washington Department of Natural Resources Water Type GIS Database (DNR 2017)
- Washington Department of Fish and Wildlife Priority Habitat and Species GIS Database (WDFW 2015)

- King County iMAP Hydrology GIS Database (King County 2015)
- City IGS Database (Mercer Island 2017)

In addition, the Washington State Stream Catalog was also searched for records of a possible watercourse on the property (Williams et al 1975)

Site Visit

On July 22, 2015, Confluence conducted a site visit to evaluate the site for the presence and extent of watercourses on the property. Confluence assessed the watercourse according to the City and Washington Administrative Code (WAC). The WAC defines the ordinary high water mark (OHWM) as "that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland" (RCW 90.58.030). The Washington State Department of Ecology (Ecology) has published a guide (Olson and Stockdale 2010) to interpret the code and provide guidance for field OHWM determinations.

The City of Mercer Island City Code (MICC) defines watercourses as a course or route, formed by nature and generally consisting of a channel with a bed, banks, or sides throughout substantially all its length, along which surface waters, with some regularity (annually in the rainy season), naturally and normally flow in draining from higher to lower lands. This definition does not include irrigation and drainage ditches, grass-lined swales, canals, storm water runoff devices, or other courses unless they are used by fish or to convey waters that were naturally occurring prior to construction.

During the site visit, Confluence evaluated the property for indicators of OHWM, beds, banks, or any other indications that a watercourse was present.

Modeling

Surface water runoff was analyzed for the contributing basin using the Western Washington Hydrologic Model 2012 (WWHM2012) (Clear Creek Solutions 2014) to determine what flows may have been seen prior to development and what flows are estimated through the current stormwater control system. Land use areas used for modeling the contributing basin were determined using aerial photo interpretation. The pre-developed and developed land covers were estimated using the 1936 and 2013 aerial photos on King County's iMAP website, respectively (King County 2015a and 2015b).

RESULTS

Desktop Analysis

Several state and local databases were searched for the recorded presence of a watercourse on or adjacent to the property. Only one database, the City's IGS database, identified a watercourse on the property. Confluence contacted the City's GIS Department and requested the metadata used to create

the watercourse feature. According to the City's GIS Department, the watercourse feature was generated from a report prepared by Adolfson Associates, Inc. (2005) for the City. Adolfson Associates, Inc. (Adolfson) prepared the report to describe the watercourse inventory it conducted, and the peer review conducted for the City during the development of proposed updated to the MICC Chapter 19.07 that pertains to watercourses and wetlands. According to Adolfson, the watercourse inventories conducted in 2002(by Watershed Company) and 2005 (by Adolfson) used GIS analysis of King County LIDAR imagery with limited field verifications. The GIS analysis takes topographic data from LIDAR and delineates basins and models watercourses within each of the basins. Field verifications of the GIS generated watercourses were limited to observations of watercourses made from public properties such as right of ways or parks.

According to Adolfson (2005), the watercourse mapped on the property was rated as "not rated". A "not rated" rating indicates that the GIS generated watercourse was not directly observed because the area either occurred on private property or the area was densely vegetated. Adolfson suggested that in the absence of direct observations, it should be assumed that the "not rated" GIS generated watercourses be identified as a Type III watercourse, unless direct observations result in a different rating; thus the Type III Watercourse rating in the City's GIS database.

Site Visit

During the site visit, no signs of a stream or watercourses were observed on the properties. Photos of the site and relevant features are attached.

The eastern portion of the property is a vegetated slope, dominated by giant horsetail (*Equisetum giganteum*), English ivy (*Hedera helilx*), Himalayan blackberry (*Rubus armeniacus*), field bindweed (*Convolvulus arvensis*) and big leaf maple (*Acer macrophyllum*) (Photo 1).

At the base of the hillslope is a concrete pond (Topographic and Boundary Survey; Photo 3). The inlet of the pond is a 6-inch diameter corrugated plastic pipe (Photo 4). The pipe extended upslope approximately 30 feet east before it was no longer observed (Photos 5 and 6). The inlet of the pipe was not found. The pipe appears to have been laid in the low spot of the hillslope. No visual indicators of a watercourse were identified adjacent to the pipe or upslope of where the pipe could be seen (Photos 5, 6, 7 and 8).

The pond discharges into another 6-inch diameter corrugated plastic pipe via a perched outlet pipe (Photos 2 and 3). This corrugated plastic pipe goes west approximately 20 feet where it discharges into a catch basin (Photo 9). Stormwater runoff from the garage and upper driveway also enter this catch basin. This catch basin enters Lake Washington via a 12-inch diameter corrugated metal pipe (Photo 10). Water from the house and lower driveway enter the 12-inch diameter corrugated metal pipe downslope of the catch basin. The outlet of this pipe is located above the ordinary high water of the lake, in the yard. Despite the collection and concentrated discharge of runoff, there are no indicators of a watercourse or stream between the pipe outlet and the lake.

Modeling

Results from the analysis of the contributing basin based on WWHM2012 are attached. Based on a review of the aerial photos and observations made during the site visit, the post-developed contributing basin is assumed to be slightly smaller than the pre-developed basin due to roof drains being routed outside of the contributing basin.

The WWHM2012 model results show that annual peak flow into Lake Washington from the pre-developed basin ranged from 0.0021 cubic feet per second (cfs) to 0.0485 cfs for the period of record analyzed (1949 to 2009). Development of the basin has resulted in increased runoff due to increased impervious surface. These runoffs are now estimated to be in the range of 0.4719 cfs to 1.4141 cfs for the same period of record.

DISCUSSION

Based on the desktop analysis, a Type III watercourse was mapped on the property. However, further investigation into the attribute data of the watercourse lead to the determination that the watercourse was a result of GIS and LIDAR analysis, was never field verified and a preliminary rating if Type III was given to the watercourse, on the recommendation of the Adolfson report.

During the site visit, no watercourse was observed. Runoff from the hillslope is collected into a concrete pond and discharged to Lake Washington via a series of catch basins and pipes. In addition, runoff from the properties impervious surfaces (i.e. roof and driveway) is collected into this pipe system and discharged to the Lake. The lack of a visible watercourse at the outlet of the pipe indicated that despite this collection and concentrated discharge, there is not sufficient water volume to create a watercourse at the pipe outlet. If this water volume is insufficient to create a watercourse, which includes the site's impervious surface runoff, then the volume of water generated by the hillslope is not sufficient to generate a watercourse.

Based on model results using WWHM2012, stormwater runoff in the contributing basin would not have resulted in enough flow to create a defined water course. The stormwater control system that was observed during the field visit would be large enough to contain the majority of flows that would come from the developed house and driveway impervious surfaces. Therefore, it is not likely that a defined watercourse would have existed in this area prior to development and the development has been constructed such that the additional runoff from impervious surfaces is adequately contained.

In summary, the Type III watercourse mapped on the properties in the City's online IGS database was generated by GIS analysis and had not been field verified. Confluence did not observe any indicators of an ordinary high water mark or a watercourse. In additional, WWHM2012 modeling of pre-development runoff in the basin indicates that the pre-development runoff from the basin was not sufficient to create a defined watercourse. Based on this analysis, there is no watercourse on the properties.

REFERENCES

Clear Creek Solutions (Clear Creek Solutions, Inc.). 2014. Western Washington Hydrology Model 2012.

DNR (Washington Department of Natural Resources). 2017. Forest Practices Application Mapping Tool: Water Type Map for Township 24N, Range 4E, Section 24. Washington Department of Natural Resources, Forest Practices, Olympia, WA. https://fortress.wa.gov/dnr/protectiongis/fpamt/index.html (accessed April 18, 2017).

King County. 2015. King County iMAP – 1936 air photo. King County GIS Center, Seattle WA. http://gismaps.kingcounty.gov/iMap/ (accessed July 22, 2015).

King County. 2015. King County iMAP – 2013 air photo. King County GIS Center, Seattle WA. http://gismaps.kingcounty.gov/iMap/ (accessed August 3, 2015).

Mercer Island (City of Mercer Island). 2017. Mercer Island GIS Portal. Mercer Island Information and Graphic Services. http://pubmaps.mercergov.org (accessed July 22, 2015).

Watershed Company. 2002. Use of Best Available Science in the City of Mercer Island Critical Areas Regulations for Watercourses and Wetlands. Prepared for the City of Mercer Island, WA by the Watershed Company, Kirkland, WA.

WDFW (Washington Department of Fish and Wildlife). 2015.PHS on the Web. http://wdfw.wa.gov/mapping/phs/ (accessed July 20, 2015)

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization. Washington Department of Fisheries, Olympia, Washington.

1128-001 Cropp Watercourse memo 041817.doc

PHOTO APPENDIX

Photo 1— View to east of hillside east of proposed development; where Mercer Island IGS has mapped watercourse.

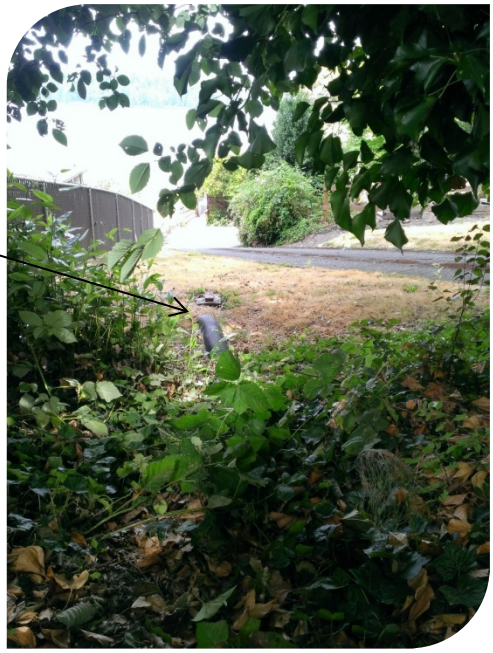


Photo 2— View to west at toe of hillside, where Mercer Island IGS has mapped watercourse.

Photo 3— Concrete pond at toe of hillside. Screened, perched outlet in foreground.

Photo 4— Inlet of runoff collection basin. Note lack of channel.

Photo 5— Upslope of inlet pipe.

Photo 6— Upslope of inlet pipe with vegetation cleared. Note lack of channel.

Photo 7— Upslope of Photo 6. Note lack of channel

.

Photo 8— Upslope of Photo 7. Note lack of channel.

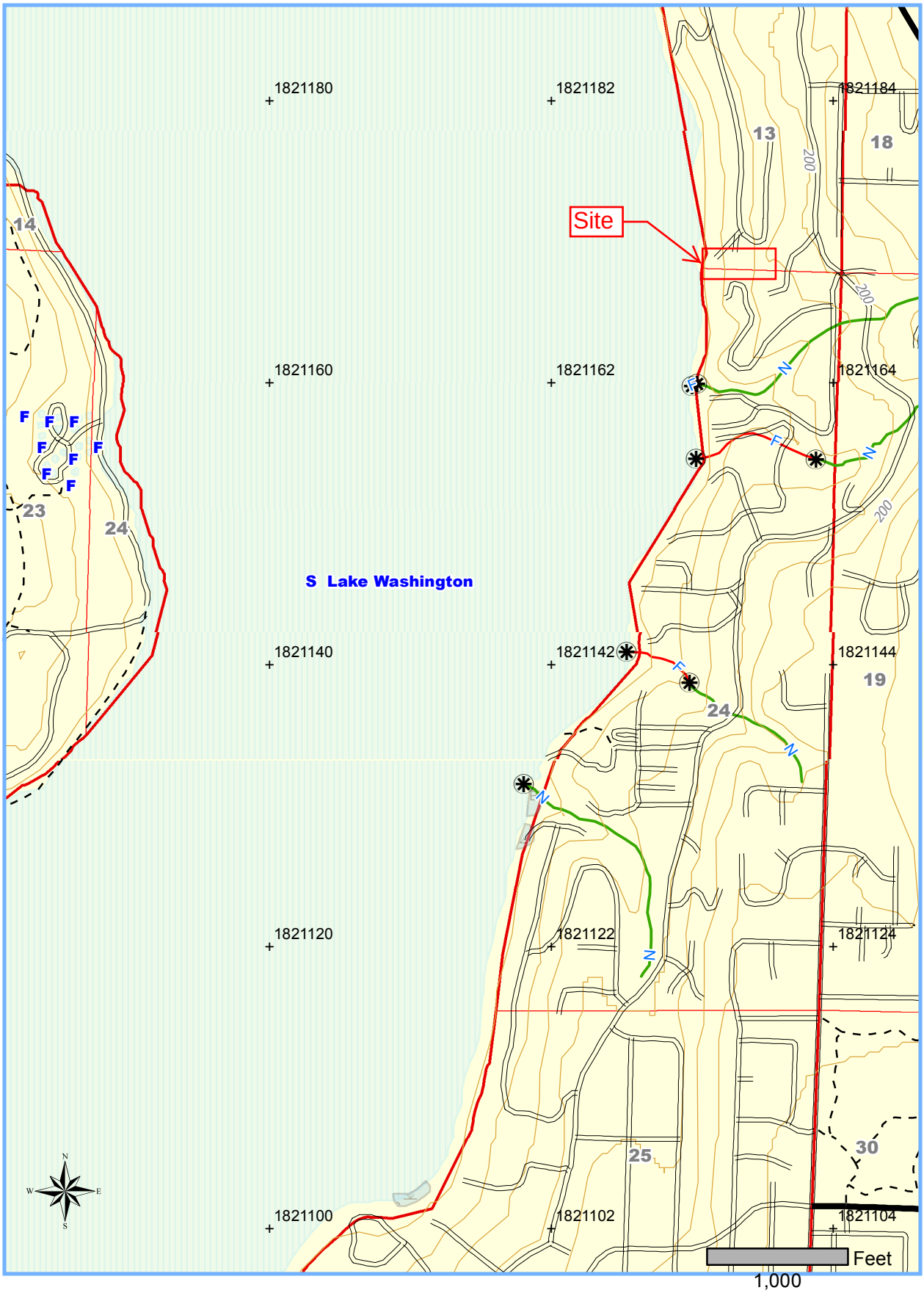
Photo 9— Catch basin collecting roof, driveway, and collection basin runoff.

Photo 10— Outlet downslope of catch basin. Note lack of channel.

FOREST PRACTICE WATER TYPE MAP

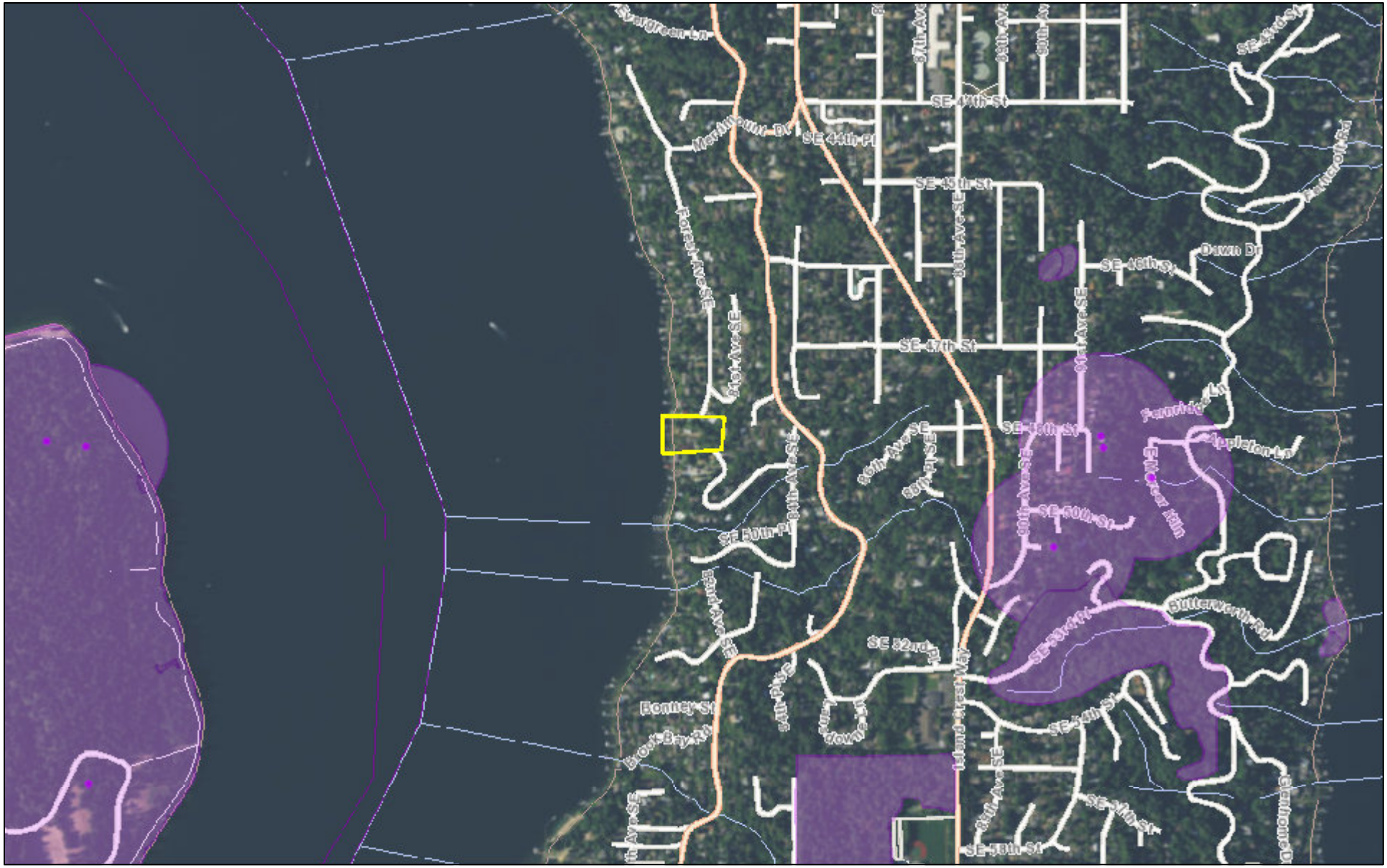
TOWNSHIP 24 NORTH HALF 0, RANGE 04 EAST (W.M.) HALF 0, SECTION 24

Application #: _____



Date: 4/18/2017 Time: 1:23:48 PM
NAD 83
Contour Interval: 40 Feet

WDFW Test Map



April 18, 2017

PHS Report Clip Area

PT

LN

POLY

AS MAPPED

SECTION

QTR-TWP

TOWNSHIP

1:19,842

0 0.15 0.3 0.6 mi

0 0.275 0.55 1.1 km

Washington Fish and Wildlife
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY HABITATS AND SPECIES REPORT

SOURCE DATASET: PHSPlusPublic
REPORT DATE: 04/18/2017 1.43

Query ID: P170418134252

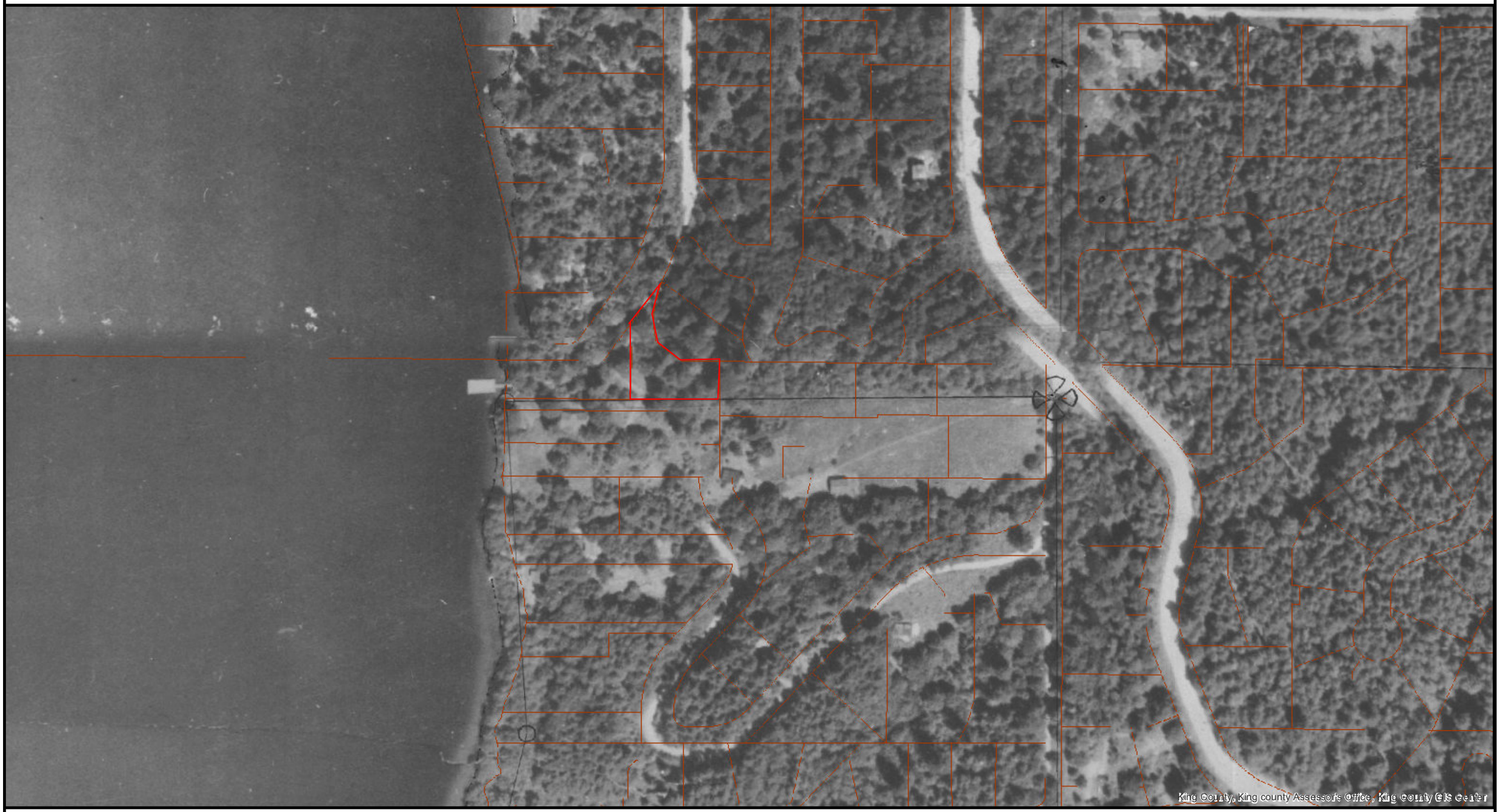
Common Name	Site Name	Priority Area	Accuracy	Federal Status	Sensitive Data	Source Entity
Scientific Name	Source Dataset	Occurrence Type		State Status	Resolution	Geometry Type
	Source Record	More Information (URL)		PHS Listing Status		
Notes	Source Date	Mgmt Recommendations				

King County iMap

Date: 8/3/2015 Notes:

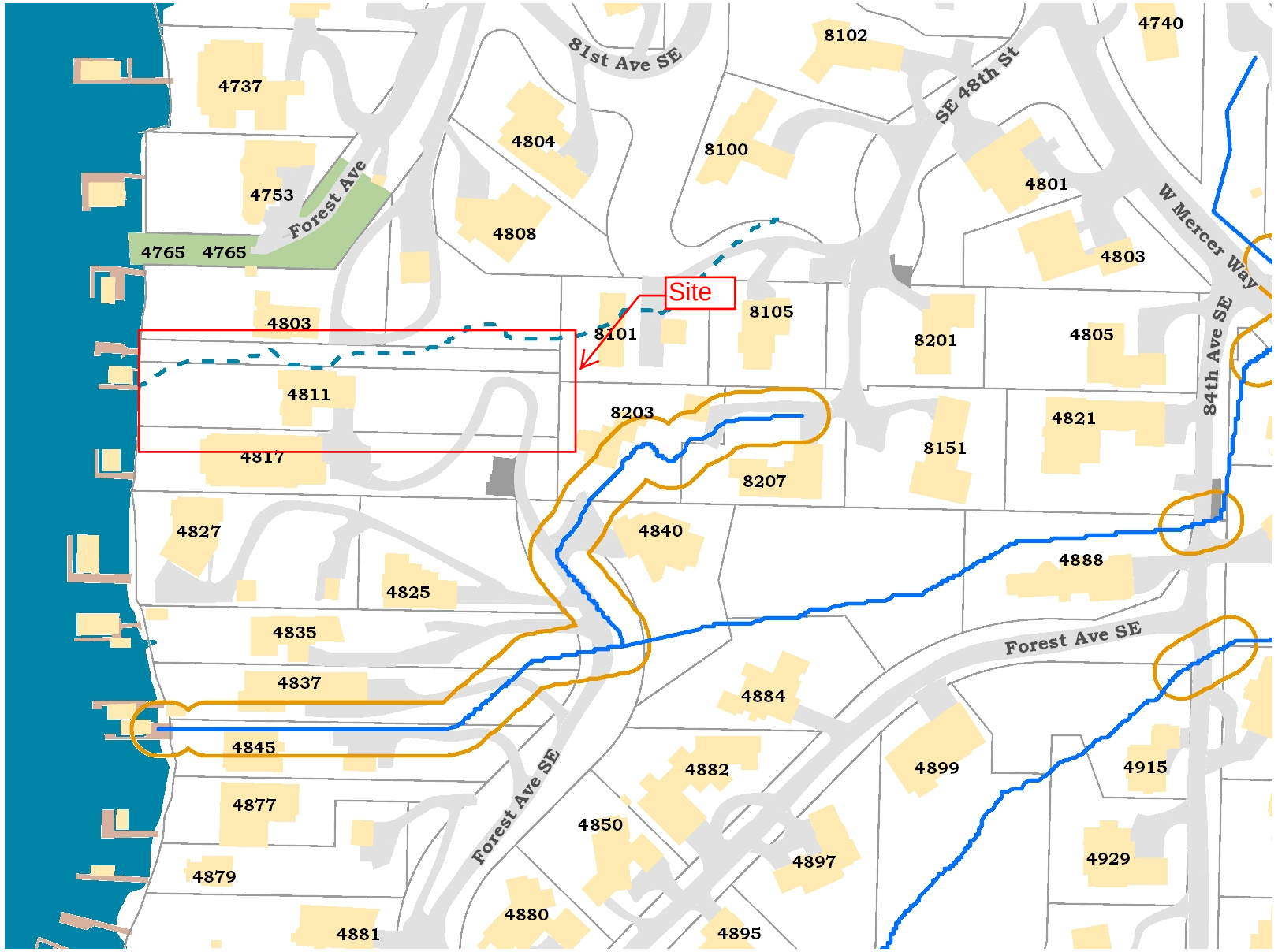
King County
GIS Center

King County



Date: 7/22/2015

King County
GIS Center



Legend

- Eagle Nest
- Eagle Nest Buffer
  - 330 Ft
  - 660 Ft
- Watercourse
  - 1-Potential Fish Use
  - 2-Perennial
  - 3-Seasonal
- Piped WaterCourses 25ft Buffe
- Bridge
- Paved Road
- Streets
- SideWalk
- Paved Driveway
- Paved Parking Area
- Address
- Building
- Parcels
- Docks
- Parks

1: 1,700

283.3 0 141.67 283.3 Feet

Map Printed: April 18, 2017

Notes

TOPOGRAPHIC & BOUNDARY SURVEY

LEGAL DESCRIPTION

BASIS OF BEARINGS

PER PLAT OF LAKE ISLE CENTERLINE OF FOREST AVE SE BEARS N 00°05'56" W BETWEEN FOUND MONUMENTS.

REFERENCES

1. LAKE ISLE, RECORDED IN VOL. 19 OF PLATS, PAGE 35, IN KING COUNTY, WASHINGTON.
2. FLOODS ACRE GARDENS, RECORDED IN VOL. 7 OF PLATS, PAGE 26, IN KING COUNTY, WASHINGTON.

VERTICAL DATUM

PER US ARMY CORPS OF ENGINEERS MONITORING OF LAKE WASHINGTON – BALLARD DATUM

SURVEYOR'S NOTES

1. THE TOPOGRAPHIC SURVEY SHOWN HEREON WAS PERFORMED IN MARCH OF 2015. THE FIELD DATA WAS COLLECTED AND RECORDED ON MAGNETIC MEDIA THROUGH AN ELECTRONIC THEODOLITE. THE DATA FILE IS ARCHIVED ON DISC OR CD. WRITTEN FIELD NOTES MAY NOT EXIST. CONTOURS ARE SHOWN FOR CONVENIENCE ONLY. DESIGN SHOULD RELY ON SPOT ELEVATIONS.

2. BURIED UTILITIES SHOWN BASED ON RECORDS FURNISHED BY OTHERS AND VERIFIED WHERE POSSIBLE IN THE FIELD. GEODIMENSIONS ASSUMES NO LIABILITY FOR THE ACCURACY OF THOSE RECORDS OR ACCEPT RESPONSIBILITY FOR UNDERGROUND LINES WHICH ARE NOT MADE PUBLIC RECORD. FOR THE FINAL LOCATION OF EXISTING UTILITIES IN AREAS CRITICAL TO DESIGN CONTACT THE UTILITY OWNER/AGENCY. AS ALWAYS, CALL 1-800-424-5555 BEFORE CONSTRUCTION.

3. SUBJECT PROPERTY TAX PARCEL NO. 404500-0145 & 257730-0021

4. SUBJECT PROPERTY AREA PER THIS SURVEY IS MEASURED TO THE ORDINARY HIGH WATER LINE
   PARCEL NO. 404500-0145 = 14,656± S.F. (0.34 ACRES)
   PARCEL NO. 257730-0021 = 17,448± S.F. (0.40 ACRES)

5. THIS SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE REPORT. EASEMENTS AND OTHER ENCUMBRANCES MAY EXIST THAT ARE NOT SHOWN HEREON.

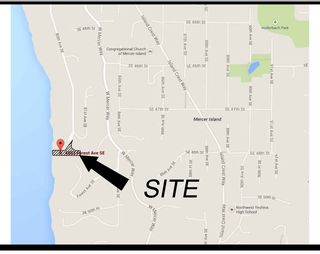
6. INSTRUMENTATION FOR THIS SURVEY WAS A TRIMBLE ELECTRONIC DISTANCE MEASURING UNIT. PROCEDURES USED IN THIS SURVEY WERE DIRECT AND REVERSE ANGLES, NO CORRECTION NECESSARY. MEETS STATE STANDARDS SET BY WAC 332-130-090.

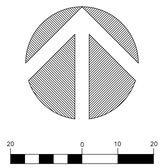
LEGEND

- AREA DRAIN
- ASPHALT SURFACE
- BOL BOLLARD
- BUILDING
- CENTERLINE ROW
- CONCRETE SURFACE
- CONCRETE WALL
- DECK
- DITCH (FLOWLINE)
- FENCE LINE (CHAIN LINK)
- FENCE LINE (WOOD)
- GAS LINE
- IP INLET (STORM DRAIN) / IRON PIPE (FOUND)
- NAIL AS NOTED
- MB MAIL BOX
- MH MAINTENANCE HOLE
- MONUMENT IN CASE (FOUND)
- PIPE END
- P POWER METER
- PT POWER TRANSFORMER
- REBAR AS NOTED-FOUND / REBAR & CAP-SET (LS #51800)
- ROCKERY
- SS SEWER LINE
- SEWER MAINTENANCE
- SD STORM DRAIN LINE
- SIZE TYPE TREE (W/DRIP LINE)
- W WATER LINE
- WM WATER METER
- WV WATER VALVE

VICINITY MAP

N.T.S.





(IN FEET)
1 inch = 20 ft.

measure success

TOPOGRAPHIC & BOUNDARY SURVEY
SE 1/4 OF THE SE 1/4 OF SEC. 13, TWP. 24N., RGE. 4E., W.M.
TAX PARCEL NO. 257730-0021 & 404500-0145

CROPP RESIDENCE
4803 FOREST AVE SE
MERCER ISLAND, WA

PRELIMINARY

SEAN F. MILLER
STATE OF WASHINGTON
PROFESSIONAL LAND SURVEYOR

GeoDimensions
GeoDimensions, Inc., 10801 Main Street, Suite 102, Bellevue, WA 98004
support@geodimensions.net
phone 425.458.4488
www.geodimensions.net

JOB NUMBER:	150317
DATE:	4/2/15
DRAFTED BY:	TLR
CHECKED BY:	SRM
SCALE:	1"= 20'

REVISION HISTORY

SHEET NUMBER
1 OF 1

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	default[1]
Site Name:	Cropp
Site Address:	4803 Forest Ave SE
City:	Mercer Island
Report Date:	8/4/2015
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.00
Version:	2014/09/12

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Forest Avenue

Bypass: No

GroundWater: No

Pervious Land Use	Acres
A B, Forest, Mod	3.32
A B, Pasture, Flat	0.22
Pervious Total	3.54

Impervious Land Use	Acres
Impervious Total	0
Basin Total	3.54

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Forest Avenue

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
A B, Forest, Mod	1.49
A B, Pasture, Flat	0.12
Pervious Total	1.61

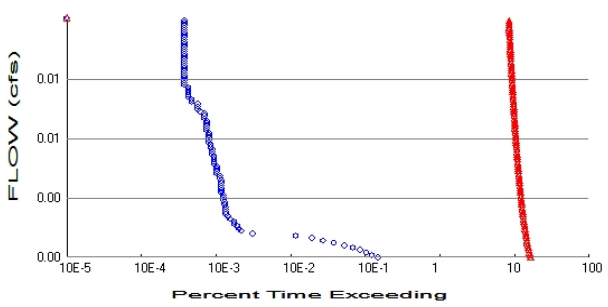
Impervious Land Use	Acres
ROADS MOD	0.5
ROOF TOPS FLAT	0.86
DRIVEWAYS MOD	0.36
Impervious Total	1.72
Basin Total	3.33

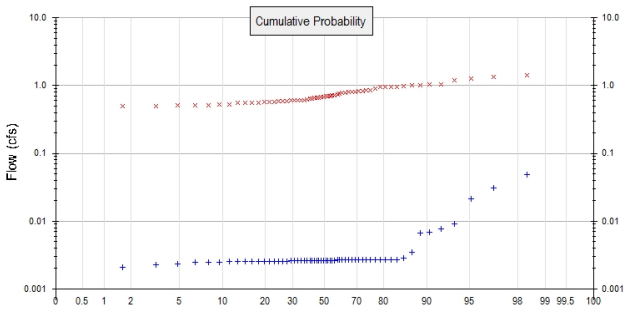
Element Flows To:

Surface	Interflow	Groundwater

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 3.54
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.61
Total Impervious Area: 1.72

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00293
5 year	0.00505
10 year	0.006999
25 year	0.010244
50 year	0.013347
100 year	0.017148

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.704983
5 year	0.893351
10 year	1.021653
25 year	1.188403
50 year	1.316248
100 year	1.447373

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.002	0.908
1950	0.009	0.963
1951	0.008	0.554
1952	0.003	0.472
1953	0.003	0.554
1954	0.003	0.567
1955	0.003	0.669
1956	0.003	0.609
1957	0.003	0.695
1958	0.003	0.583

1959	0.003	0.622
1960	0.003	0.600
1961	0.003	0.586
1962	0.003	0.526
1963	0.003	0.608
1964	0.003	0.604
1965	0.003	0.711
1966	0.003	0.491
1967	0.003	0.841
1968	0.003	1.042
1969	0.003	0.652
1970	0.003	0.653
1971	0.003	0.787
1972	0.021	0.762
1973	0.003	0.505
1974	0.003	0.727
1975	0.003	0.803
1976	0.003	0.575
1977	0.002	0.596
1978	0.003	0.810
1979	0.002	1.032
1980	0.003	0.986
1981	0.003	0.709
1982	0.003	1.006
1983	0.003	0.828
1984	0.003	0.504
1985	0.003	0.690
1986	0.002	0.611
1987	0.003	0.950
1988	0.003	0.581
1989	0.003	0.863
1990	0.003	1.189
1991	0.007	1.003
1992	0.003	0.507
1993	0.002	0.559
1994	0.003	0.527
1995	0.003	0.636
1996	0.031	0.749
1997	0.003	0.648
1998	0.003	0.676
1999	0.007	1.414
2000	0.002	0.676
2001	0.003	0.797
2002	0.003	0.837
2003	0.003	0.776
2004	0.003	1.351
2005	0.003	0.563
2006	0.003	0.515
2007	0.048	1.267
2008	0.003	0.953
2009	0.003	0.957

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0485	1.4141
2	0.0306	1.3507
3	0.0211	1.2673

4	0.0092	1.1891
5	0.0077	1.0421
6	0.0069	1.0316
7	0.0066	1.0065
8	0.0035	1.0026
9	0.0028	0.9855
10	0.0027	0.9633
11	0.0027	0.9573
12	0.0027	0.9529
13	0.0027	0.9501
14	0.0027	0.9079
15	0.0027	0.8630
16	0.0027	0.8412
17	0.0027	0.8373
18	0.0027	0.8281
19	0.0027	0.8098
20	0.0027	0.8031
21	0.0027	0.7971
22	0.0027	0.7874
23	0.0027	0.7761
24	0.0027	0.7623
25	0.0027	0.7494
26	0.0026	0.7267
27	0.0026	0.7113
28	0.0026	0.7090
29	0.0026	0.6953
30	0.0026	0.6902
31	0.0026	0.6760
32	0.0026	0.6756
33	0.0026	0.6688
34	0.0026	0.6532
35	0.0026	0.6524
36	0.0026	0.6483
37	0.0026	0.6364
38	0.0026	0.6220
39	0.0026	0.6111
40	0.0026	0.6089
41	0.0026	0.6079
42	0.0026	0.6045
43	0.0026	0.6002
44	0.0026	0.5959
45	0.0026	0.5855
46	0.0026	0.5832
47	0.0026	0.5811
48	0.0026	0.5745
49	0.0026	0.5672
50	0.0025	0.5634
51	0.0025	0.5592
52	0.0025	0.5538
53	0.0025	0.5535
54	0.0025	0.5272
55	0.0025	0.5262
56	0.0025	0.5153
57	0.0025	0.5070
58	0.0024	0.5051
59	0.0022	0.5035
60	0.0021	0.4910
61	0.0021	0.4719

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0015	3136	349707	11151	Fail
0.0016	2609	343076	13149	Fail
0.0017	2186	337087	15420	Fail
0.0018	1798	331526	18438	Fail
0.0019	1450	326393	22509	Fail
0.0021	1116	321260	28786	Fail
0.0022	808	316768	39203	Fail
0.0023	580	312490	53877	Fail
0.0024	407	308426	75780	Fail
0.0025	249	304577	122320	Fail
0.0027	65	300940	462984	Fail
0.0028	46	297518	646778	Fail
0.0029	43	294096	683944	Fail
0.0030	41	290888	709482	Fail
0.0031	37	287893	778089	Fail
0.0033	37	284899	769997	Fail
0.0034	33	282118	854903	Fail
0.0035	31	279552	901780	Fail
0.0036	29	276985	955120	Fail
0.0037	29	274418	946268	Fail
0.0039	29	272066	938158	Fail
0.0040	29	269713	930044	Fail
0.0041	28	267360	954857	Fail
0.0042	28	265221	947217	Fail
0.0043	27	263082	974377	Fail
0.0045	27	260943	966455	Fail
0.0046	27	259018	959325	Fail
0.0047	25	257093	1028372	Fail
0.0048	25	254954	1019816	Fail
0.0049	25	253243	1012972	Fail
0.0051	25	251318	1005272	Fail
0.0052	25	249607	998428	Fail
0.0053	25	247896	991584	Fail
0.0054	24	246185	1025770	Fail
0.0055	24	244474	1018641	Fail
0.0057	22	242977	1104440	Fail
0.0058	22	241266	1096663	Fail
0.0059	22	239768	1089854	Fail
0.0060	22	238271	1083050	Fail
0.0061	20	236774	1183870	Fail
0.0063	20	235277	1176385	Fail
0.0064	20	233993	1169965	Fail
0.0065	20	232496	1162480	Fail
0.0066	19	231213	1216910	Fail
0.0067	19	229716	1209031	Fail
0.0069	19	228432	1202273	Fail
0.0070	18	227149	1261938	Fail
0.0071	18	225866	1254811	Fail
0.0072	17	224796	1322329	Fail
0.0073	17	223513	1314782	Fail
0.0075	17	222230	1307235	Fail
0.0076	17	221160	1300941	Fail
0.0077	17	219877	1293394	Fail
0.0078	16	218807	1367543	Fail

0.0079	16	217524	1359525	Fail
0.0081	16	216455	1352843	Fail
0.0082	16	215385	1346156	Fail
0.0083	16	214316	1339475	Fail
0.0084	15	213246	1421640	Fail
0.0085	15	212156	1414373	Fail
0.0087	15	211193	1407953	Fail
0.0088	13	210188	1616830	Fail
0.0089	12	209204	1743366	Fail
0.0090	12	208177	1734808	Fail
0.0091	12	207172	1726433	Fail
0.0093	10	206209	2062090	Fail
0.0094	10	205247	2052469	Fail
0.0095	9	204263	2269588	Fail
0.0096	9	203343	2259366	Fail
0.0097	9	202445	2249388	Fail
0.0099	9	201525	2239166	Fail
0.0100	9	200670	2229666	Fail
0.0101	8	199814	2497675	Fail
0.0102	8	198937	2486712	Fail
0.0103	8	198103	2476287	Fail
0.0105	8	197312	2466400	Fail
0.0106	8	196371	2454637	Fail
0.0107	8	195494	2443675	Fail
0.0108	8	194638	2432975	Fail
0.0109	8	193804	2422550	Fail
0.0111	8	193034	2412925	Fail
0.0112	8	192200	2402500	Fail
0.0113	8	191344	2391800	Fail
0.0114	8	190617	2382712	Fail
0.0115	8	189783	2372287	Fail
0.0117	8	189013	2362662	Fail
0.0118	8	188307	2353837	Fail
0.0119	8	187558	2344475	Fail
0.0120	8	186831	2335387	Fail
0.0121	8	186083	2326037	Fail
0.0123	8	185313	2316412	Fail
0.0124	8	184628	2307850	Fail
0.0125	8	183922	2299025	Fail
0.0126	8	183216	2290200	Fail
0.0127	8	182511	2281387	Fail
0.0129	8	181805	2272562	Fail
0.0130	8	181099	2263737	Fail
0.0131	8	180350	2254375	Fail
0.0132	8	179730	2246625	Fail
0.0133	8	179046	2238075	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   default[1].wdm
MESSU       25   Predefault[1].MES
            27   Predefault[1].L61
            28   Predefault[1].L62
            30   POCdefault[1]1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      PERLND       4
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Forest Avenue              MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                       in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
    4     A/B, Pasture, Flat      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
    4         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
    4         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
    4              0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
    4              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
    4         0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
    2              0         0         0         0         3          1          0
    4              0         0         0         0         3          1          0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                 in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
```

```
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Forest Avenue***
PERLND   2                        3.32     COPY   501     12
PERLND   2                        3.32     COPY   501     13
PERLND   4                        0.22     COPY   501     12
PERLND   4                        0.22     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   default[1].wdm
MESSU       25   Mitdefault[1].MES
            27   Mitdefault[1].L61
            28   Mitdefault[1].L62
            30   POCdefault[1]1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       2
      PERLND       4
      IMPLND       2
      IMPLND       4
      IMPLND       6
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Forest Avenue             MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    2     A/B, Forest, Mod        1    1    1    1   27    0
    4     A/B, Pasture, Flat      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    2         0    0    1    0    0    0    0    0    0    0    0    0
    4         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    2         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    2         0    0    0    0    0    0    0    0    0    0    0
    4         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    2              0         5         2       400       0.1       0.3     0.996
    4              0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    2              0         0         2         2         0         0         0
    4              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    2          0.2       0.5      0.35         0       0.7       0.7
    4         0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
    2              0         0         0         0         3         1         0
    4              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2      ROADS/MOD              1    1    1   27    0
    4      ROOF TOPS/FLAT         1    1    1   27    0
    6      DRIVEWAYS/MOD          1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
    4         0    0    1    0    0    0
    6         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
    6         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
    4         0    0    0    0    0
    6         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2           400      0.05       0.1      0.08
    4           400      0.01       0.1       0.1
    6           400      0.05       0.1      0.08
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2             0         0
    4             0         0
    6             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2             0         0
    4             0         0
    6             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->           <--Area-->     <-Target->   MBLK   ***
<Name>   #           <-factor->     <Name>   #   Tbl#   ***
Forest Avenue***
PERLND   2                  1.49     COPY   501     12
PERLND   2                  1.49     COPY   501     13
PERLND   4                  0.12     COPY   501     12
PERLND   4                  0.12     COPY   501     13
IMPLND   2                   0.5     COPY   501     15
IMPLND   4                  0.86     COPY   501     15
IMPLND   6                  0.36     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
```

```
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL       1             PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL       1             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76             IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Disclaimer

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