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PARKWOOD TERRACE

Preliminary Technical Information Report

prepared for:
Quadrant Homes

date:
March 12, 2015

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CITY OF WOODINVILLE
DEVELOPMENT SERVICES

BLUELINE LAND DEVELOPMENT CONSULTING
25 CENTRAL WAY SUITE 400 KIRKLAND WA 98033 ■ TEL 425-216-4051 FAX 425-216-4052 ■ THEBLUELINEGROUP.COM

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Parkwood Terrace

Woodinville, Washington

Preliminary Technical Information Report

Prepared for

Quadrant Homes

14725 SE 36th, Suite 200

Bellevue, WA 98006

Date: June 16, 2014

Revision Date: November 4, 2014, **March 12, 2015**

Blueline Job No. 14-175

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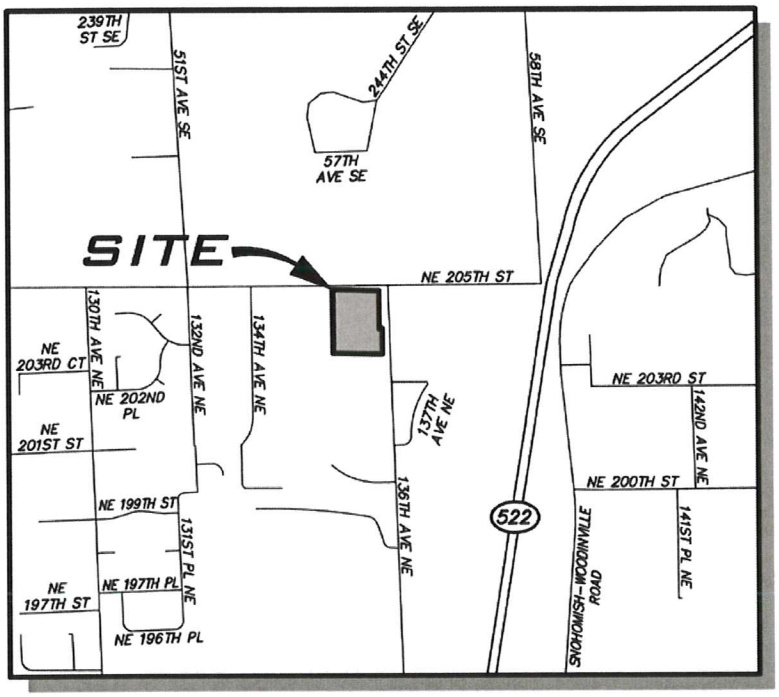
Section 1 Project Overview

The Parkwood Terrace project (formerly known as the Church project) is located at 13457 NE 205th Street, Woodinville WA. More generally, the site is located in Section 3, Township 26N, Range 5E in King County. Please see the Vicinity Map below.



Vicinity Map
Not to Scale

The site contains two adjacent parcels. The smaller parcel, 0326059049, contains access provided by a shared gravel driveway in the northwest portion of the parcel. The larger parcel, 0326059095, is located in the south and eastern portion of the site. The pre-developed site is approximately 3.09 acres including ROW dedication along NE 205th Street that is included in the frontage area along 136th Ave NE totaling approximately 0.41 acres. A sensitive area buffer of approximately 0.32 acres is located at the northwestern corner of the site and will be excluded from the site area for hydrologic modeling purposes.

In the existing condition, both parcels are comprised of single family residences with associated driveways and several sheds and garages. The site contains gravel drive aisles, gravel parking areas, maintained residential lawn, and thick brush and forested cover at the

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southern and eastern portions of the site. A stream was defined along the northwestern edge of the site by the critical areas assessment included in the Appendix of this Report.

The Parkwood Terrace project proposes to subdivide the two existing parcels into 15 lots with supporting infrastructure, including roadway, utilities, drainage tract, and a sensitive area tract. Existing residences, infrastructure, and all sheds and garages will be removed, and access will provided on the eastern boundary of the site from 136th Ave NE.

Stormwater elements for Parkwood Terrace are designed according to the guidelines and requirements established in the 2009 King County Surface Water Design Manual (KCSWDM) as adopted by the City of Woodinville. The proposed detention facilities are designed to meet the *Level II Flow Control (Conservation) Standard*. Water quality treatment facilities are designed according to the *Basic Water Quality Menu*.

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Section 2 Conditions and Requirements Summary

CORE REQUIREMENTS

Core Requirement #1: Discharge at the Natural Location

The proposed detention and water quality treatment facilities are located to maintain the existing natural discharge location. These facilities are shown on the Preliminary Plans under separate. The natural discharge location is described further in Section 3 and Section 4 of this report.

Core Requirement #2: Off-site Analysis

Section 3 of this report contains the offsite analysis.

Core Requirement #3: Flow Control

See Section 4. The project is subject to a Full Drainage Review according to KCSWDM requirements as adopted by the City of Woodinville. Flow control for the site will be provided with a detention vault. The facility will release post-development runoff according to the Level II Flow Control Standard.

Core Requirement #4: Conveyance System

To be provided at Final Engineering. The conveyance system will be designed according to the 2009 KCSWDM.

Core Requirement #5: Erosion and Sediment Control

To be provided at Final Engineering. The temporary erosion and sediment control plan will consist of temporary measures (rock entrance, inlet protection, silt fence, etc) as well as permanent measures (hydroseeding and landscaping).

Core Requirement #6: Operations and Maintenance

To be provided at Final Engineering in Section 10.

Core Requirement #7: Financial Guarantees and Liability

A Bond Quantities Worksheet will be included in Section 9 at Final Engineering.

Core Requirement #8: Water Quality

See Section 4. The project is subject to meet Basic Water Quality treatment requirements.

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Special Requirement #1: Other Adopted Area-Specific Requirements

There are no known additional requirements for the subject project.

Special Requirement #2: Flood Hazard Area Delineation

The Offsite Analysis (Section 3) identifies all sensitive areas associated with the project. The project is not located within or nearby a flood hazard area. This Special Requirement, therefore, is not applicable.

Special Requirement #3: Flood Protection Facilities

The site does not rely on nor will the site modify an existing flood protection facility or construct a new flood protection facility. This Special Requirement, therefore, is not applicable.

Special Requirement #4: Source Control

The subject project is a single family development and not a commercial development. This Special Requirement, therefore, is not applicable.

Special Requirement #5: Oil Control

The proposed project is a single family development and not a high-use site. This Special Requirement, therefore, is not applicable.

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Section 3 Offsite Analysis

A Level 1 offsite analysis was conducted for the Parkwood Terrace Plat at 13457 NE 205th Street, Woodinville WA, on May 25, 2014, a partly sunny day, 62°F, with scattered showers and Tuesday August 26th, 2014.

TASK 1: STUDY AREA DEFINITION AND MAPS

See Section 1 of this Report for a description of the site.

TASK 2: RESOURCE REVIEW

The best available resource information, including King County iMAP and City of Woodinville resource maps, were reviewed for existing or potential problems. The following is a summary of the findings from the information used in preparing this report.

- The site soils consist predominately of glacial till, per the geotechnical report included in the Appendix of this Report.
- Per the critical areas assessment included in the Appendix, a stream and associated buffer is located along the northwestern portion of the site.
- The site is not located within a Flood Plain as indicated on the King County iMAP system.
- The site is not located within an Erosion Hazard Area.
- The site is not located in a Landslide Hazard Area.
- The site is not located in a Seismic Hazard Area.
- The site is located in the Little Bear West Subbasin of the Little Bear Creek Basin.
- The site contains some steep slopes (>40%) per the geotechnical report included in the Appendix.

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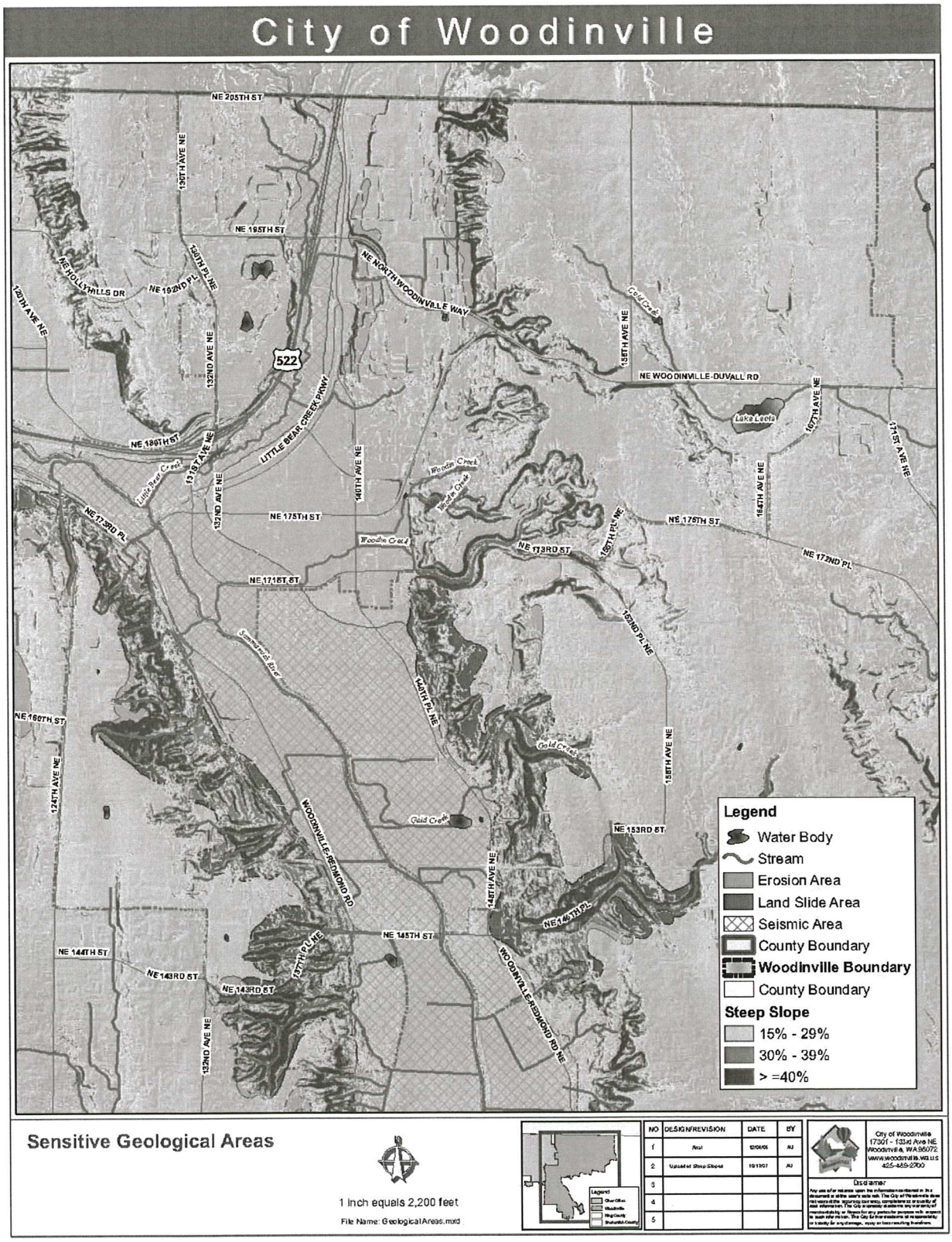
WOODINVILLE SENSITIVE GEOLOGICAL AREAS MAP



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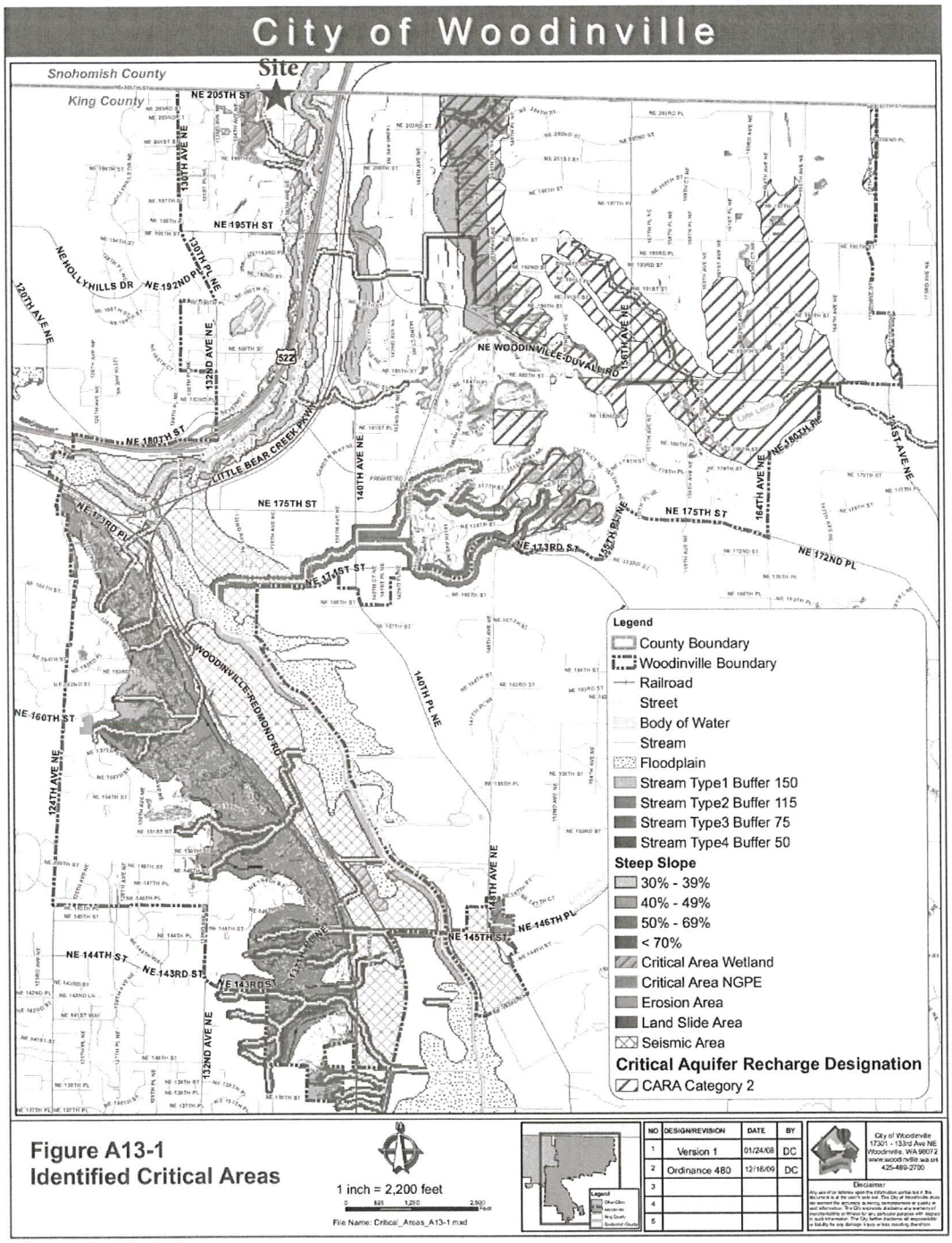
WOODINVILLE CRITICAL AREAS MAP



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TASK 3: FIELD INSPECTION

A field inspection was conducted on May 25, 2014, a partly sunny day, with scattered showers and temperatures around 62°F. Another field inspection was conducted on August 26, 2014, to verify the location of a downstream culvert outlet. Drainage path descriptions for the onsite basin are provided in Task 4 of this Section. Please see the *Existing Conditions Exhibit* and the *Developed Drainage Exhibit* in reference to the narrative included in Section 4 of this Report.

ONSITE BASIN

The site contains two single-family residences, various sheds, a garage along with residential gravel drives to each of the houses. The residences are surrounded by lawn dissipating into scattered trees and thick brush and forest cover near the fringes of the site. The geotechnical report included in the Appendix indicates onsite soils consist predominantly of glacial till.

The site consists of one drainage basin. The site topography drains outward toward the northwestern corner as well as the northern and eastern boundaries of the site.

UPSTREAM BASIN

There are no tributary basins to the site.

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DOWNSTREAM DRAINAGE PATH

The majority of the project site is fairly flat with surrounding topography of gradual to moderate slopes. A subtle drainage ridge routes flow to two general discharge locations that combine within ¼ mile of the site. The proposed grading and location of the detention facility will route developed flows to the northeastern natural discharge location. The site is surrounded by residential properties to the south and west, NE 205th Street right-of-way to the north, and 136th Ave NE to the east. There is no upstream area tributary to the site.

The northwest portion of the site sheet flows northwest into a small stream and is conveyed to a culvert pipe under NE 205th Street. The majority of this tributary area will remain unchanged in the NGPA tract in the developed conditions. Flow then outfalls from the pipe and flows generally to the east via pipe and sheet flow to reach Little Bear Creek north of NE 205th Street.

Flows from majority of the site are collected by ditches along the south side of NE 205th Street and the west side of 136th Ave NE respectively and conveyed toward a catch basin at the SW corner of NE 205th Street and 136th Ave NE. Flow then is conveyed east toward Little Bear Creek via pipe and surface flow.

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TASK 4: DRAINAGE SYSTEM DESCRIPTION

Section 4 is organized according to each of the onsite discharge locations. A *Downstream Drainage Inventory Table* and *Downstream Drainage Photos* are included in this section for reference.

Flows from the northwest portion of the site are conveyed north by northwest from the driveway via sheet flow to the northwestern boundary (photos 1 and 2). Flow is collected in a small stream west of the site (photo 3). Flow is then conveyed north in open channel flow with various wooded and miscellaneous stream debris for approximately 277 feet (photo 4). Flow is conveyed into a concrete culvert under NE 205th Street for approximately 38 feet (photo 5). During the inspection a joint in the concrete pipe was found to be pulled apart approximately 10 feet from the north side of the roadway (photo 6). This gap in the pipe was allowing some flow to escape and move east through thick brush and forested land cover (photo 7). From this point flow characteristics and structures were not able to be inspected due heavy brush and forest cover (photo 8). Flow is assumed to reflect storm utility maps provided by the City of Woodinville. The majority of flow up to this joint is assumed to be contained within the pipe and conveyed approximately 20 feet north to outfall and continue to sheet flow east by southeast for approximately 365 feet. Flow is then conveyed east via pipe for approximately 261 feet (photo 9). Flow was visually confirmed to exit the pipe at this point (photo 10) and is conveyed to the east for approximately 160 feet via overland flow (photo 11) and outfalls into Little Bear Creek (photo 12). Little Bear Creek continues south for approximately 41 feet, passing under NE 205th Street through a concrete box culvert. (photo 13). Upon exiting the culvert the topography widens and flattens, slowing the velocity of the flow and the banks of the creek widen (photo 14). Within approximately 50 – 60' the creek narrows to resume previous dimensions and characteristics (photo 15) and continues for approximately 112 feet south by southeast.

Flows from the Northeast portion of the site sheet flow to the north and east to be collected by ditches along NE 205th Street and 136th Ave NE. Flow collected on the south side of NE 205th Street is conveyed east via ditch flow for approximately 247 feet (photo 16). Flow is then conveyed into a catch basin at the southwest corner of NE 205th Street and 135th Ave NE via a 12" CPEP for approximately 20 feet. (photo 17). Flow is then conveyed to the southeast via pipe for approximately 65 feet (photo 18).

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Additional sheet flow from the southeast portion of the site enters this catch basin from the south on 136th Ave NE. Runoff sheet flows over gradual slopes in forested land cover and is collected on the west side of 136th Ave NE and conveyed via ditch flow to the north for approximately 389 feet (photo 19). From this catch basin (photo 18) flow continue east and outfall into a ravine that begins at the southeast corner of NE 205th Street and 136th Ave NE (photo 20). The outfall of flow into the ravine from the conveyance system (photo 20a) was verified on August 26, 2014 once service crews cleared the vegetation and uncovered the buried pipe. Flow in the ravine was observed (photo 21) and appeared to match the flow path shown on the Storm Utility Maps provided by the City of Woodinville. Flows continue southeast for approximately 280 feet (photo 22) and outfall into Little Bear Creek just south of NE 205th Street (photo 14) to combine with flow from the northwest discharge location. The combined flows continue under typical conditions to a distance ¼ mile downstream noted in the downstream path exhibit. Little Bear Creek ultimately continues south and west for a distance greater than one mile until it reaches the Sammamish River.

Due to dense vegetative land cover, runoff near the southern boundary of the site was difficult to confirm, but appeared to discharge east and south, with a downstream drainage path as described above. Any possible runoff discharged to the properties to the south was considered negligible if any.

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DOWNSTREAM DRAINAGE PATH EXHIBIT

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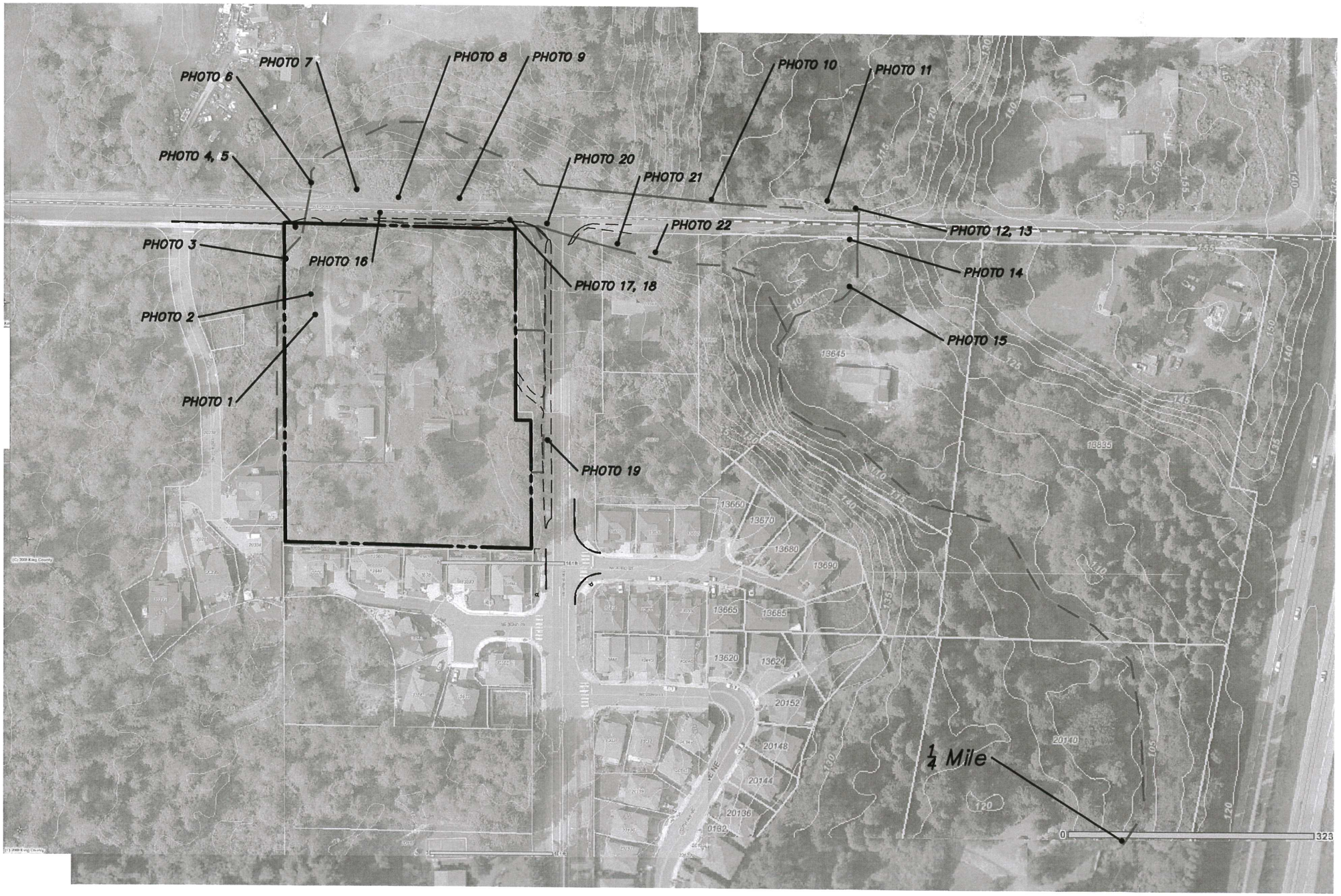
DOWNSTREAM PATH EXHIBIT



BLUELINE

DOWNSTREAM PATH EXHIBIT
CHURCH
PRELIM TECHNICAL INFORMATION REPORT

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SCALE	AS NOTED
PROJECT MANAGER	GEOFF TAMBLE
DESIGNED BY	JUSTIN RODDA
DRAWN BY	CHESTER BENNETT
PLOT DATE	June 17, 2014

JOB NUMBER: 14–175

FIGURE: 3.4

Jun 17, 2014 – 8:55am – User cbennett
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DOWNSTREAM PATH PHOTOS

Photo 1: Looking south along gravel driveway at near western boundary of the site. Runoff is conveyed west over grass and forest cover via sheet flow.

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Photo 2: Looking north along gravel drive at western border of site. Runoff is conveyed west over grass and forest cover via sheet flow.

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Photo 3: Looking west at stream approximately 10' from western boundary of the project site. Sheet flow is collected by stream all along western boundary.

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Photo 4: Looking north along at stream where flow is conveyed between 5 feet and 275 feet via open channel flow to the north.

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Photo 5: Looking north at concrete culvert pipe at northwestern corner of site. Flow enters pipe and is conveyed approximately 58 feet in total to the north to outfall to heavily forested land cover.

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Photo 6: Looking to the northwest at separated / broken joint in concrete pipe 10 feet from the north edge of NE 205th Street.

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Photo 7: Looking south at sheet flow through heavily forested land cover typical of the area north of NE 205th Street. Flow from joint of concrete pipe in photo 6 is conveyed east for approximately 300 feet via sheet flow and ditch flow.

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Photo 8: Looking north at edge of NE 205th Street into land cover where flow is conveyed via sheet flow and ditch flow generally to the east for approximately 362 feet.

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Photo 9: Looking north from edge of NE 205th Street into land cover where flow then enters a pipe and is conveyed to the east for approximately 261 feet.

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Photo 10: Flow outfalls from pipe and is conveyed to the east for approximately 160 feet via sheet flow and then open channel flow prior to entering Little Bear Creek.

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Photo 11: Looking west at open channel flow prior to runoff outfall into Little Bear Creek in approximately 10 feet.

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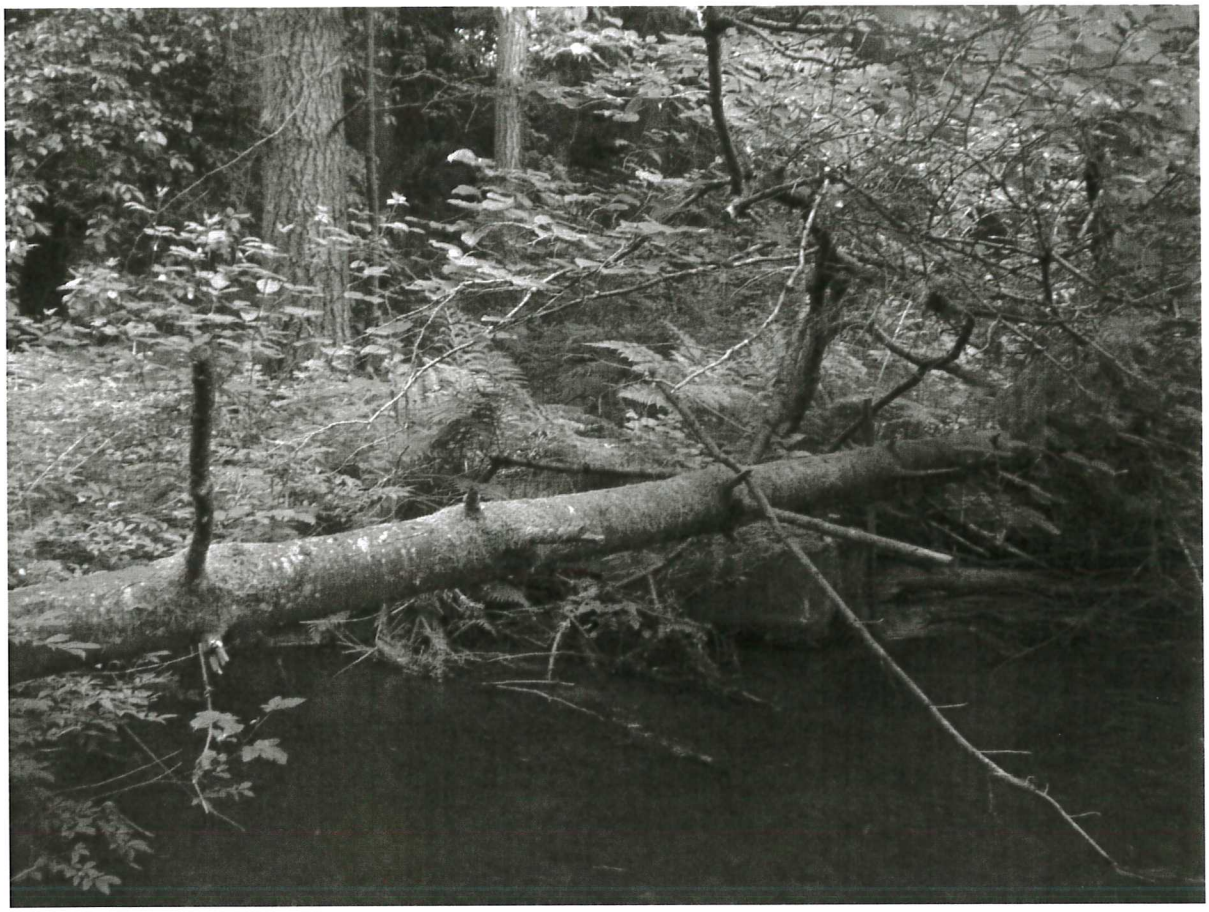

Photo 12: Looking east at Little Bear Creek where surface runoff sheet flow and open channel flow outfall into the creek and are then conveyed south under NE 205th Street through a concrete box culvert.

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Photo 13: Looking south at box culvert where flow is conveyed in Little Bear Creek for approximately 41 feet under NE 205th Street.

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Photo 14: Looking down and south from NE 205th Street where Little Bear Creek exits the concrete box culvert to widen and convey flow to the southwest for approximately 50 – 60 feet.

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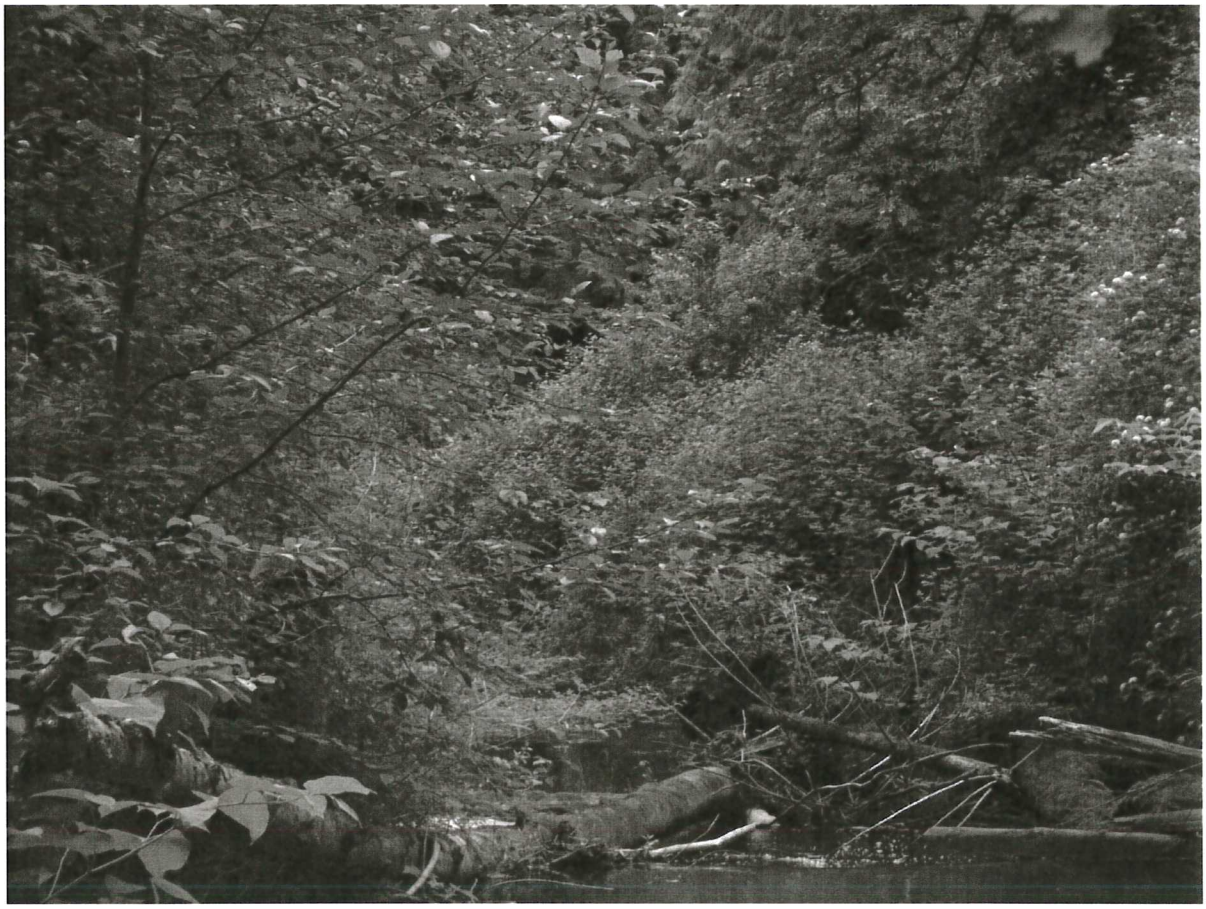

Photo 15: Looking southwest at typical conditions of Little Bear Creek where flow narrows and is conveyed southwest in the creek for approximately 115 feet at which point reaches ¼ mile downstream from the project site.

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Photo 16: Looking east along NE 205th Street from entrance drive at existing property. Flow sheet flows to the north over steep slopes seen to the right of the roadway and enters a ditch that stretches the length of the northern boundary of the site. Flow is conveyed to the east via ditch flow for approximately 247 feet.

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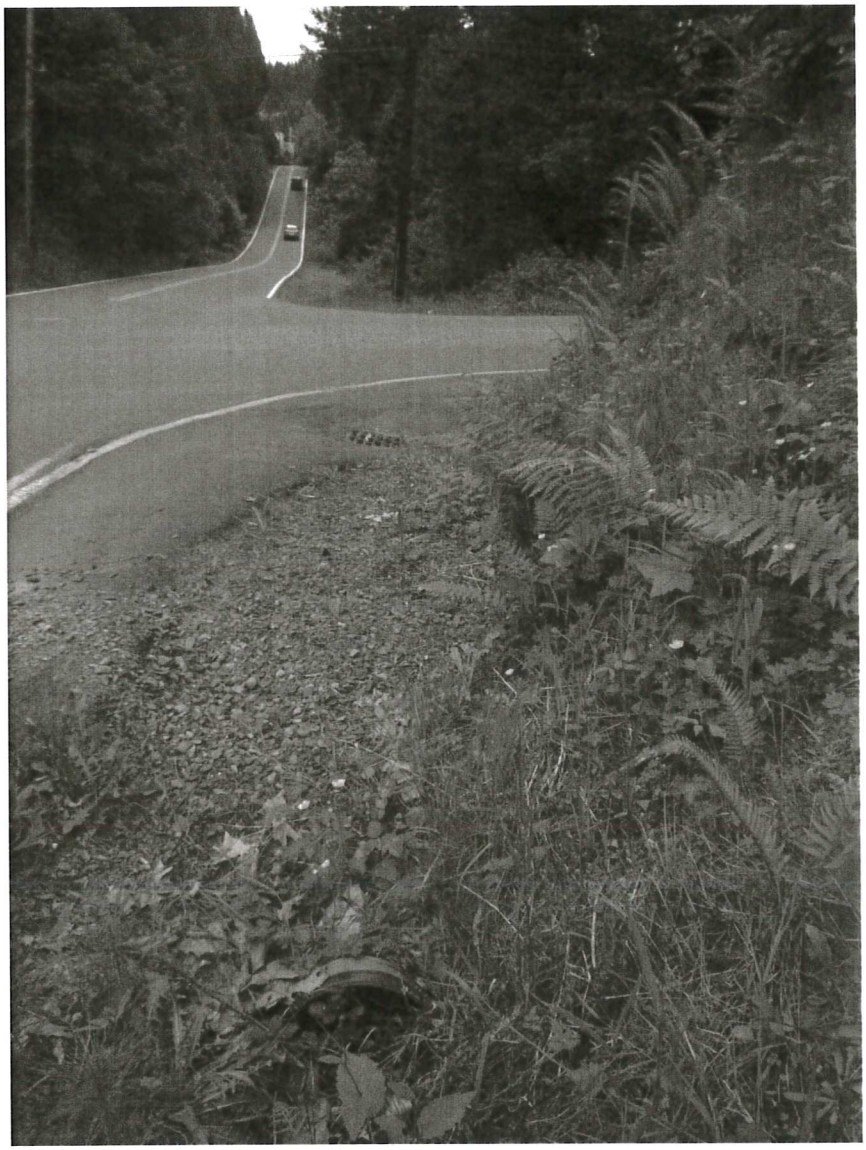

Photo 17: Looking east toward corner of NE 205th Street and 136th Ave NE. Flow enters a 12" pipe and is conveyed approximately 20 feet to the east.

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Photo 18: Looking southeast at a catch basin located at the corner of NE 205th Street and 136th Ave NE. Flows enter catch basin from west via ditch flow and pipe flow from the northern basin, as well as from the south from sheet flow and ditch flow form the southeastern basin. Flows combine and are conveyed approximately 68 feet to the southeast across 136th Ave NE.

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Photo 19: Looking north along 136th Ave NE where runoff sheet flows over forested land cover to sheet flow / ditch flow along gravel and roadway to the north for approximately 389 feet.

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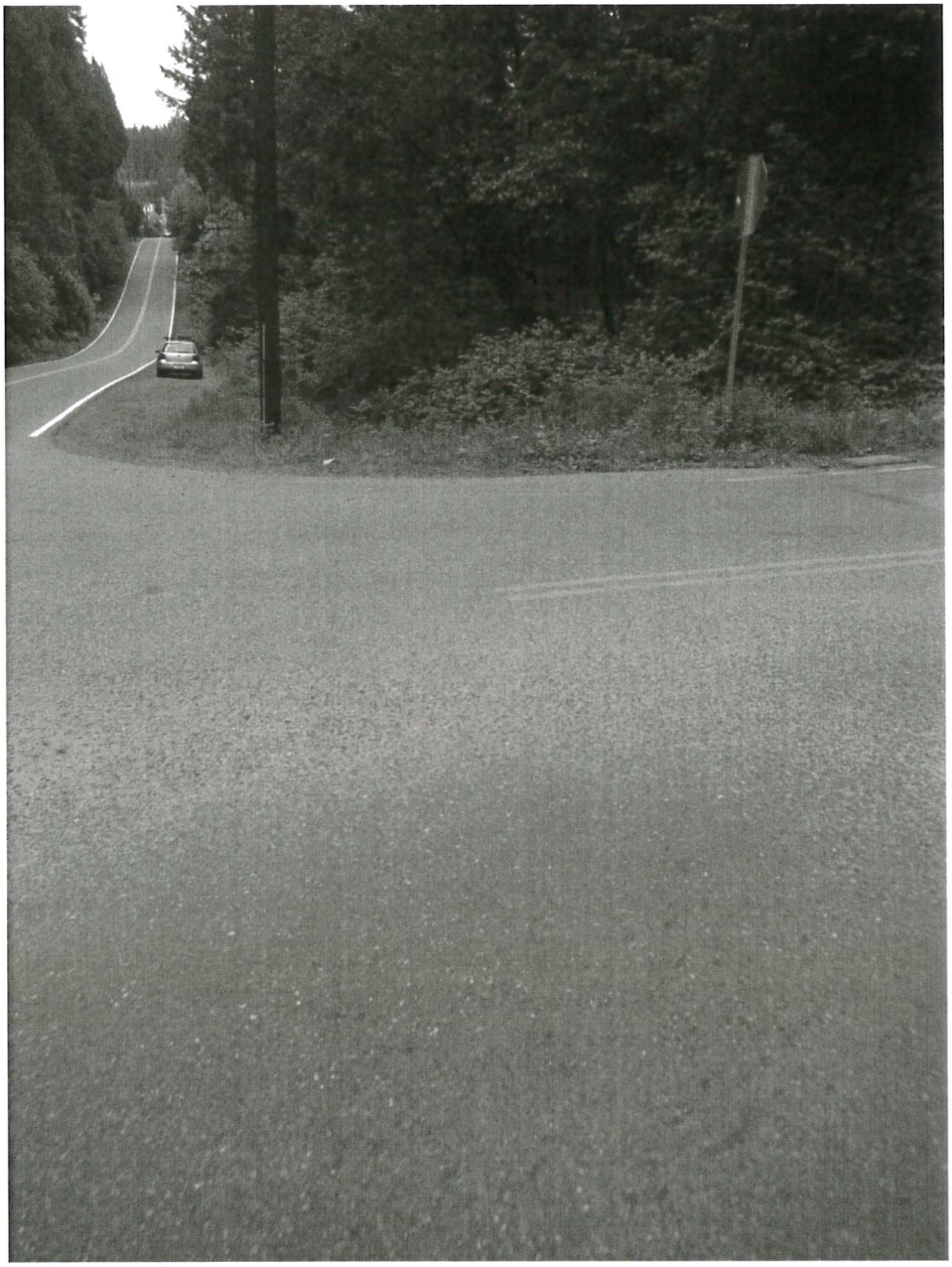

Photo 20: Looking east at the southeastern corner of NE 205th Street and 136th Ave NE. Flow continues east from the catch basin 136th Ave NE (Photo 18) for 68 feet to outfall into ravine.

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Photo 20.A: Looking northwest at the southeastern corner of NE 205th Street and 136th Ave NE where flow outfalls from concrete pipe into ravine.

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Photo 21: Looking to the southeast and down at open channel / sheet flow confirmed in ravine downstream from catch basin at the corner of NE 205th Street and 136th Ave NE. Flow was confirmed to match flow shown on GIS maps and is conveyed to the southeast for approximately 280 feet through typical conditions and land cover.

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Photo 22: Looking southeast at land cover where flow is conveyed via sheet flow / channel flow for approximately 280 feet before flow outfalls into Little Bear Creek just south of NE NE 205th Street as seen in Photo 14 where it combines and proceeds downstream as described.

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TASK 5: MITIGATION OF EXISTING OF POTENTIAL PROBLEMS

The downstream drainage path does not contain a Severe Erosion Problem or a Severe Flooding Problem as described in Section 1.2.2.1 of the KCSWDM. A minor nuisance problem was noted with the concrete culvert just north of NE 205th Street. Roughly 2 inches of separation has occurred in a pipe joint section. No major or minor erosion problems were observed in this area as a result of this issue. In the developed conditions runoff will not significantly increase to this discharge point and land cover of the tributary area will be maintained and modeled as in the existing conditions.

Runoff from the proposed project will be detained to the Conservation Flow Control (Level II) Standard to minimize any impact to the downstream drainage path. A Stormwater Pollution Prevention Plan (SWPPP) and Temporary Erosion and Sediment Control (TESC) Plan will minimize the impact of construction to the downstream drainage path.

The owner of Parcel No. 27053400301900 located in Snohomish County reported Little Bear Creek rising occasionally during heavy rainfall within the last 4 years into the low lying garden area and brush cover at the southeastern corner of the property, consistent with low banks, wide stream bed, and topography observed at that location. The owner also reported within the last 6 years water has reached the driveway and patio areas adjacent to the house. The owner suspects the culvert that conveys Little Bear Creek under NE 205th Street to be undersized and a probable cause of the flooding. Runoff will not be increased to this area, and flows will be routed to the south of NE 205th Street via an alternate natural discharge location that will bypass the culvert at Little Bear Creek and NE 205th Street.

There are no existing drainage complaints within the City of Woodinville limits along the downstream path from the site. The City of Woodinville Stormwater Management Plan-Section 5.2 "Problem Ranking and CIP Development" was reviewed. Additionally, King County does not indicate a record of any drainage complaints along the downstream route within the last ten years.

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Section 4 Flow Control and Water Quality Analysis and Design

A detention vault will be utilized to provide flow control for the site. Water quality treatment will be provided with a stormfilter located in 136th Ave NE. King County Runoff Time Series (KCRTS) program was used to analyze the existing and developed site hydrology. A stream and buffer area along the northwest portion of the property will not be developed, and is therefore excluded from the hydrologic analysis. The site includes frontage area along NE 205th Street and 136th Ave NE to be improved. The total site area is therefore equal to 3.09 acres (2.98 acres property area, less 0.32 acres of stream and buffer area to remain, plus 0.43 acres of ROW area to be improved). The site will discharge to a proposed conveyance system in the ROW of 136th Ave NE which will tie into the existing storm system at the intersection of NE 205th Street and 136th Ave NE, which is the general natural discharge location of the site.

EXISTING HYDROLOGY

The site is located at 13457 NE 205th Street. The site is bordered by residential properties. The total site consists of approximately 3.09 acres; 2.68 acres is comprised of the subject property, 0.41 acres is comprised of right of way area to be improved in the developed conditions. A stream and buffer located on the property are excluded from the site development.

Approximately 0.320 acres of area within the project's site boundary is tributary to the stream. Runoff from this area contributes to the stream hydrology and runoff will be matched in the developed conditions. This area is further described in section 3 of this report. Please see the exhibit and KCRTS model for this Stream Tributary Area included on the following pages.

Currently two existing single family residences with associated outbuildings are located on the site. The site generally slopes north, northwest, and east. Per the geotechnical report included in the Appendix, site soils consist predominantly of glacial till. Ground cover consists of a combination of impervious surfaces associated with the existing residence, landscaping, and forest. Access to the site is via NE 205th Street and 136th Ave NE. The site consists of one drainage basin tributary to Bear Creek subbasin.

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The developed drainage from the site will be detained and treated based on the 2009 KCSWDM. The drainage analysis for detention and water quality was modeled using KCRTS. The onsite existing area and ROW area to be improved is modeled as forest. Please see the *Existing Conditions Exhibit* and KCRTS flow frequency analysis included below and on the following page.

EXISTING CONDITION AREAS

EXISTING BASIN	Total Area = 3.09 acre
GROUND COVER	AREA
Forest (Till)	3.09 ac.

Flow Frequency Analysis
Time Series File:14175predev.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.195	2	2/09/01 18:00	0.249	1	100.00	0.990
0.053	7	1/06/02 3:00	0.195	2	25.00	0.960
0.145	4	2/28/03 3:00	0.149	3	10.00	0.900
0.005	8	3/24/04 20:00	0.145	4	5.00	0.800
0.086	6	1/05/05 8:00	0.126	5	3.00	0.667
0.149	3	1/18/06 21:00	0.086	6	2.00	0.500
0.126	5	11/24/06 4:00	0.053	7	1.30	0.231
0.249	1	1/09/08 9:00	0.005	8	1.10	0.091
Computed Peaks			0.231		50.00	0.980

EXISITING CONDITIONS EXHIBIT

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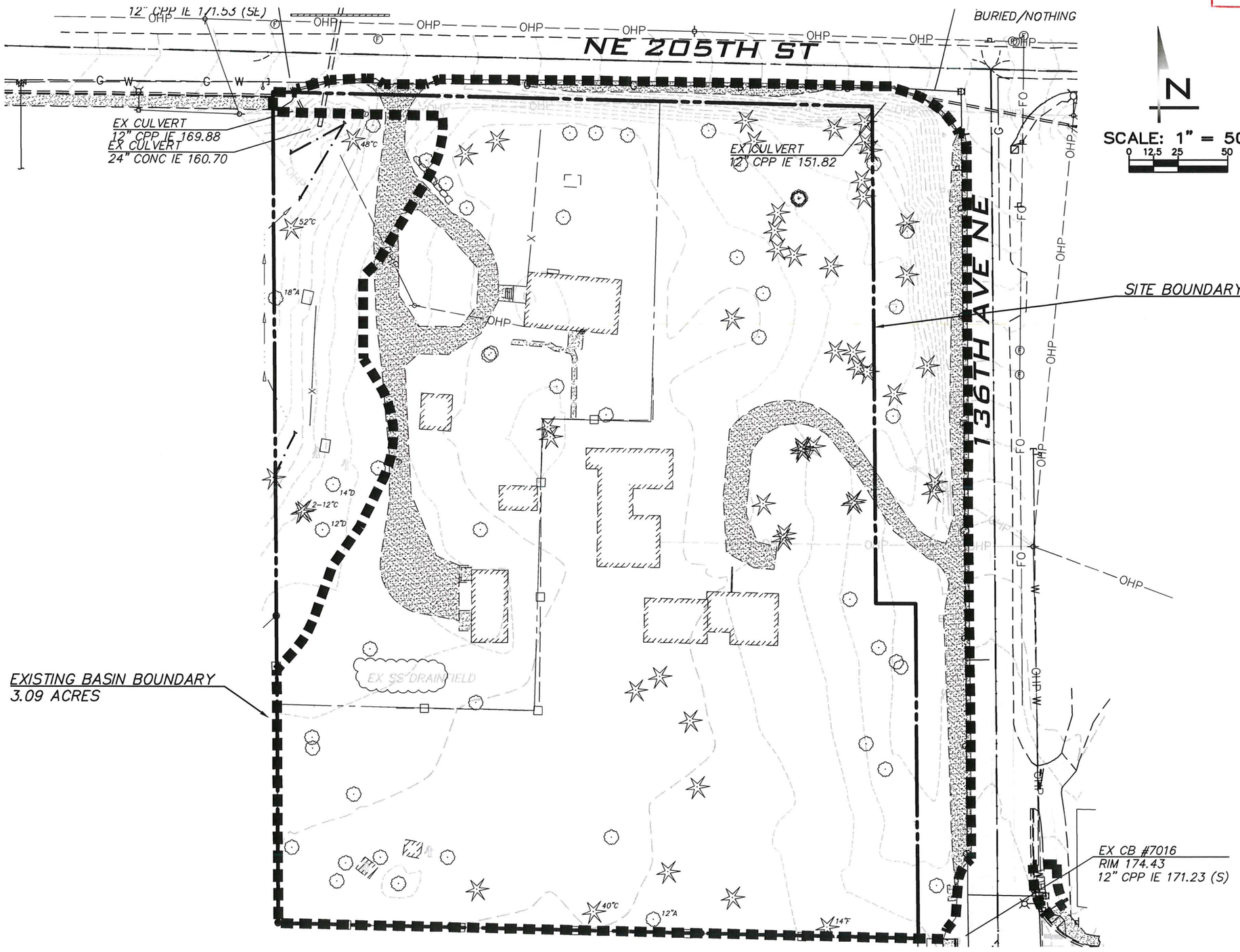

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EXISTING CONDITIONS EXHIBIT
PARKWOOD TERRACE
(FKA CHURCH PROPERTY)

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SCALE	AS NOTED
PROJECT MANAGER	GEOFF TAMBLE, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	March 10, 2015

JOB NUMBER: 14-175

FIGURE: EC-01

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EXISTING STREAM HYDROLOGY

KCRTS was used to generate existing conditions flows from the site to the stream with land cover modeled in the forested condition. See summary table and KCRTS flow frequency analysis below.

Onsite Stream Tributary Basin	Total Area = 0.65 acres
GROUND COVER	AREA
Forested	0.65 acres

Flow Frequency Analysis
Time Series File:14175strmbypass.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.041	2	2/09/01 18:00	0.053	1	100.00	0.990
0.011	7	1/06/02 3:00	0.041	2	25.00	0.960
0.030	4	2/28/03 3:00	0.032	3	10.00	0.900
0.001	8	3/24/04 21:00	0.030	4	5.00	0.800
0.018	6	1/05/05 8:00	0.027	5	3.00	0.667
0.032	3	1/18/06 20:00	0.018	6	2.00	0.500
0.027	5	11/24/06 4:00	0.011	7	1.30	0.231
0.053	1	1/09/08 9:00	0.001	8	1.10	0.091
Computed Peaks			0.049		50.00	0.980

EXHIBIT 16
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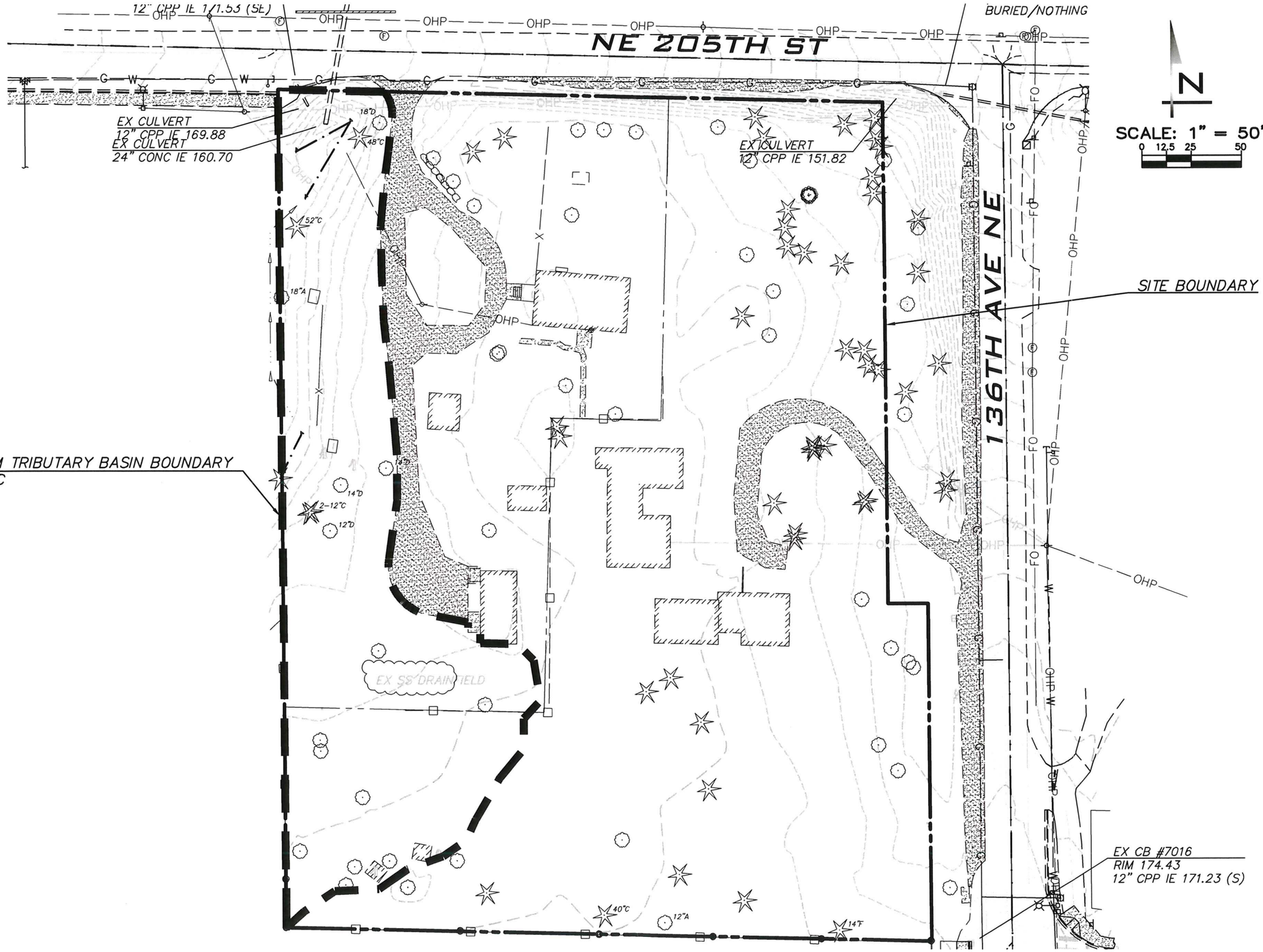
EXISITING CONDITIONS STREAM TRIBUTARY BASIN



Mar 10, 2015 – 3:09pm – User cbennett
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BLUELINE

STREAM TRIBUTARY AREA EXIHIBIT
PARKWOOD TERRACE
(FKA CHURCH PROPERTY)

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SCALE	AS NOTED
PROJECT MANAGER	GEOFF TAMBLE, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	March 10, 2015

JOB NUMBER: 14-175

FIGURE: EC-02

EXHIBIT 16
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DEVELOPED HYDROLOGY

Proposed development will include the creation of 15 single family residential lots with associated utilities and infrastructure, drainage tract with flow control facility, new plat road, and frontage improvements. Existing discharge locations from the site will be preserved; however, a small area to be developed that discharges to the northwest in the existing conditions will discharge to the northeast in the developed conditions via the detention vault, to provide flow control and water quality treatment for this area.

The stream that flows northeast on the northwestern boundary will not see increased flows due to development. The backyards of lots 7 – 11will sheet flow to the stream to match flows from the existing conditions.

The developed basin boundary area is the same as the existing boundary area, 3.09 acres. The developed site conditions include impervious surfaces such as roofs, patios, driveways, sidewalk, a new plat road and an access road to the detention vault and landscaped/lawn area. The lots will be limited to an impervious area of 1.01 acres. This will be further detailed on a lot by lot basis during final engineering. The reduced impervious area will be recorded on the face of the final plat. The following table summarizes the developed conditions land coverage. Please see the *Developed Conditions Exhibit* included on the following page.

Developed Area:

Impervious

Lots (15 ea)	*1.01*	*acres*
Access Tract	*0.08*	*acres*
Drainage Tract	*0.01*	*acres*
ROW	*0.74*	*acres*
Impervious Total	***1.84***	***acres***

Landscape/Lawn

Lots	*0.93*	*acres*
Drainage Tract	*0.03*	*acres*
ROW	*0.29*	*acres*
Pervious Total	***1.25***	***acres***
Total	***3.09***	***acres***

DEVELOPED CONDITION AREAS

EXHIBIT 16
PAGE 47 OF 147

DEVELOPED BASIN	Total Area = 3.09 acre
GROUND COVER	AREA
Impervious	1.84 ac.
Lawn (Till)	1.25 ac.

```
  Flow Frequency Analysis
  Time Series File:14175dev.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---      -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak       - - Peaks - -  Rank  Return  Prob
   (CFS)                              (CFS)            Period
   0.558      6   2/09/01  2:00        1.13          1  100.00   0.990
   0.450      8   1/05/02 16:00       0.700          2   25.00   0.960
   0.671      3   2/27/03  7:00       0.671          3   10.00   0.900
   0.482      7   8/26/04  2:00       0.592          4    5.00   0.800
   0.581      5  10/28/04 16:00       0.581          5    3.00   0.667
   0.592      4   1/18/06 16:00       0.558          6    2.00   0.500
   0.700      2  10/26/06  0:00       0.482          7    1.30   0.231
    1.13      1   1/09/08  6:00       0.450          8    1.10   0.091
Computed Peaks                       0.990               50.00   0.980
```

A portion of the site improvements in frontage areas along NE 205th Street and 136th Ave NE cannot be physically conveyed to the project's detention facility and will be treated as bypass areas.

A portion of the backyards at lots 7 – 11 along the western boundary of the property will also be allowed to drain to the stream to maintain flows similar to the exisiting conditions. Please see *Developed Conditions Exhibit, KCRTS flow frequency analysis,* and summary tables included *on the following pages.*

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An additional portion of existing pavement adjacent to the site will naturally drain to the project's conveyance system and will be routed to the project's detention facility. This area will be "swapped" with an equivalent type and sized portion from the bypass area for modeling purposes. The detention facility will also over detain with appropriate flow control structures to meet the Conservation Flow Control Requirements.

Please reference the *Developed Conditions Exhibit* included on the following pages that shows the areas described above. A summary of the areas to be swapped and the resulting net Bypass and Detention Tributary Areas to the onsite detention facility are also included below.

Gross Bypass Area:

Impervious

ROW pavement & sidewalks	*0.27*	*acres*
Impervious Total	*0.27*	*acres*

Landscape/Lawn

Lots 7-11 Backyards	*0.16*	*acres*
ROW	*0.14*	*acres*
Pervious Total	*0.30*	*acres*
Gross Bypass Area	***0.57***	***acres***

Existing Pavement Area:

Impervious

Existing ROW pavement	*0.03*	*acres*
Impervious Total	*0.03*	*acres*
Gross Swap Area	***0.03***	***acres***

Net Bypass Area – Flow Control:

Gross Bypass Area	0.57	acres
Gross Swap Area	- 0.03	acres
Net Bypass Area	***0.54***	***acres***

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The tables on this and the following pages are a summary of areas and flow control calculations modeled per KCRTS for the Onsite Basin.

BASIN TRIBUTARY TO DETENTION FACILITY	Total Area = 2.55 acre
GROUND COVER	AREA
Impervious	1.60 ac.
Lawn (Till)	0.95 ac.

Flow Frequency Analysis
Time Series File:14175tributary.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
0.473	6	2/09/01 2:00
0.385	8	1/05/02 16:00
0.568	3	2/27/03 7:00
0.416	7	8/26/04 2:00
0.501	5	10/28/04 16:00
0.502	4	1/18/06 16:00
0.605	2	10/26/06 0:00
0.957	1	1/09/08 6:00
Computed Peaks		

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

- - Peaks - - (CFS)	Rank	Return Period	Prob
0.957	1	100.00	0.990
0.605	2	25.00	0.960
0.568	3	10.00	0.900
0.502	4	5.00	0.800
0.501	5	3.00	0.667
0.473	6	2.00	0.500
0.416	7	1.30	0.231
0.385	8	1.10	0.091
0.840		50.00	0.980

NET BYPASS BASIN	Total Area = 0.54 acre
GROUND COVER	AREA
Impervious	0.24 ac.
Lawn (Till)	0.30 ac.

Flow Frequency Analysis
Time Series File:14175netbypass.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
0.085	5	2/09/01 2:00
0.065	8	1/05/02 16:00
0.103	2	2/27/03 7:00
0.065	7	8/26/04 2:00
0.080	6	10/28/04 16:00
0.090	4	1/18/06 16:00
0.095	3	10/26/06 0:00
0.177	1	1/09/08 6:00
Computed Peaks		

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

- - Peaks - - (CFS)	Rank	Return Period	Prob
0.177	1	100.00	0.990
0.103	2	25.00	0.960
0.095	3	10.00	0.900
0.090	4	5.00	0.800
0.085	5	3.00	0.667
0.080	6	2.00	0.500
0.065	7	1.30	0.231
0.065	8	1.10	0.091
0.152		50.00	0.980

Total Basin Area = 0.54 ac (bypass) + 0.03 ac (swap) + 2.52 ac (detained) = 3.09 acres

EXHIBIT 16
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Developed Stream Tributary Basin	Total Area = 0.48 acres
GROUND COVER	AREA
Forested	0.32 acres
Lawn (Till)	0.16 acres

Flow Frequency Analysis
Time Series File:14175devstrm.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---

Flow Rate (CFS)	Rank	Time of Peak
0.033	2	2/09/01 15:00
0.012	7	1/05/02 16:00
0.031	3	2/27/03 7:00
0.003	8	3/24/04 19:00
0.017	6	1/05/05 8:00
0.029	4	1/18/06 16:00
0.026	5	11/24/06 4:00
0.057	1	1/09/08 6:00

Computed Peaks

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

- - Peaks - - (CFS)	Rank	Return Period	Prob
0.057	1	100.00	0.990
0.033	2	25.00	0.960
0.031	3	10.00	0.900
0.029	4	5.00	0.800
0.026	5	3.00	0.667
0.017	6	2.00	0.500
0.012	7	1.30	0.231
0.003	8	1.10	0.091
0.049		50.00	0.980

EXHIBIT 16
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NE 205TH ST

136TH AVE NE

STREAM BUFFER AREA
(FORESTED) – 0.32 AC

ONSITE VAULT TRIBUTARY
BASIN (2.52 AC)

ONSITE STREAM BYPASS AREA
(LAWN) – 0.16 AC

PROJECT SITE BOUNDARY (TYP)
3.09 AC

TREES TO BE SAVED (TYP)

PROPOSED DETENTION VAULT

PROPOSED STORMFILTER

ADDITIONAL AREA TRIBUTARY TO
WATER QUALITY TREATMENT (TYP)
(0.21 AC)

FLOW CONTROL BYPASS AREA (TYP)
(0.41 AC)

EXISTING PAVEMENT AREA
TRIBUTARY TO VAULT
(0.03 AC)

N

SCALE: 1" = 50'
0 12.5 25 50

BLUELINE

DEVELOPED CONDITIONS EXHIBIT
PARKWOOD TERRACE
(FKA CHURCH PROPERTY)

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SCALE	AS NOTED
PROJECT MANAGER	GEOFF TAMBLE, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	March 12, 2015

JOB NUMBER: 14–175

FIGURE: DC

Mar 12, 2015 – 1:27pm – User cbennett
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PERFORMANCE STANDARDS AND GOALS

The project requires water quality treatment subject to basic water quality menu, as described later in this section. The project requires Level II flow control as described later in this section

FLOW CONTROL SYSTEM

Flow control was modeled using KCRTS. Per the geotechnical report included in the Appendix, the site soils till. The Level II flow control standard requires that stormwater discharges shall match developed discharge durations to pre-developed durations for a range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow, and match the 2-year and 10-year peak discharge rate. A detention vault with vertical walls will be located in the eastern portion of the site. The vault and control structure has been designed to mitigate for the bypass area not tributary to the detention vault.

The required surface area for the proposed vault is 4,560 square feet. See KCRTS printout below. The maximum water surface elevation (100 year water surface elevation) is 12.24 feet which corresponds to a total required detention storage of 12.24 ft*4,560 sq ft = 55,815 cubic feet.

```
Retention/Detention Facility


        Type of Facility: Detention Vault
        Facility Length:      120.00  ft
         Facility Width:       38.00  ft
          Facility Area:     4560.    sq. ft
Effective Storage Depth:       12.20  ft
      Stage 0 Elevation:        0.00  ft
         Storage Volume:    55632.    cu. ft
             Riser Head:       12.20  ft
         Riser Diameter:       12.00  inches
     Number of orifices:        3

                                        Full Head    Pipe
   Orifice #      Height  Diameter  Discharge  Diameter
                    (ft)     (in)      (CFS)      (in)
      1             0.00     0.55      0.029
      2            10.25     0.81      0.025     4.0
      3            11.50     2.25      0.115     6.0
         Top Notch Weir: None
```

EXHIBIT 16
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Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	46.	0.001	0.001	0.00
0.02	0.02	91.	0.002	0.001	0.00
0.03	0.03	137.	0.003	0.002	0.00
0.04	0.04	182.	0.004	0.002	0.00
0.05	0.05	228.	0.005	0.002	0.00
0.29	0.29	1322.	0.030	0.004	0.00
0.52	0.52	2371.	0.054	0.006	0.00
0.76	0.76	3466.	0.080	0.007	0.00
1.00	1.00	4560.	0.105	0.008	0.00
1.24	1.24	5654.	0.130	0.009	0.00
1.48	1.48	6749.	0.155	0.010	0.00
1.72	1.72	7843.	0.180	0.011	0.00
1.96	1.96	8938.	0.205	0.011	0.00
2.20	2.20	10032.	0.230	0.012	0.00
2.44	2.44	11126.	0.255	0.013	0.00
2.68	2.68	12221.	0.281	0.013	0.00
2.92	2.92	13315.	0.306	0.014	0.00
3.16	3.16	14410.	0.331	0.015	0.00
3.39	3.39	15458.	0.355	0.015	0.00
3.63	3.63	16553.	0.380	0.016	0.00
3.87	3.87	17647.	0.405	0.016	0.00
4.11	4.11	18742.	0.430	0.017	0.00
4.35	4.35	19836.	0.455	0.017	0.00
4.59	4.59	20930.	0.480	0.018	0.00
4.83	4.83	22025.	0.506	0.018	0.00
5.07	5.07	23119.	0.531	0.018	0.00
5.31	5.31	24214.	0.556	0.019	0.00
5.55	5.55	25308.	0.581	0.019	0.00
5.79	5.79	26402.	0.606	0.020	0.00
6.03	6.03	27497.	0.631	0.020	0.00
6.27	6.27	28591.	0.656	0.021	0.00
6.50	6.50	29640.	0.680	0.021	0.00
6.74	6.74	30734.	0.706	0.021	0.00
6.98	6.98	31829.	0.731	0.022	0.00
7.22	7.22	32923.	0.756	0.022	0.00
7.46	7.46	34018.	0.781	0.022	0.00
7.70	7.70	35112.	0.806	0.023	0.00
7.94	7.94	36206.	0.831	0.023	0.00
8.18	8.18	37301.	0.856	0.023	0.00
8.42	8.42	38395.	0.881	0.024	0.00
8.66	8.66	39490.	0.907	0.024	0.00
8.90	8.90	40584.	0.932	0.024	0.00
9.14	9.14	41678.	0.957	0.025	0.00
9.38	9.38	42773.	0.982	0.025	0.00
9.61	9.61	43822.	1.006	0.025	0.00
9.85	9.85	44916.	1.031	0.026	0.00
10.09	10.09	46010.	1.056	0.026	0.00
10.25	10.25	46740.	1.073	0.026	0.00

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10.26	10.26	46786.	1.074	0.026	0.00
10.27	10.27	46831.	1.075	0.027	0.00
10.28	10.28	46877.	1.076	0.028	0.00
10.29	10.29	46922.	1.077	0.030	0.00
10.30	10.30	46968.	1.078	0.030	0.00
10.31	10.31	47014.	1.079	0.031	0.00
10.32	10.32	47059.	1.080	0.031	0.00
10.33	10.33	47105.	1.081	0.031	0.00
10.57	10.57	48199.	1.107	0.037	0.00
10.80	10.80	49248.	1.131	0.040	0.00
11.04	11.04	50342.	1.156	0.043	0.00
11.28	11.28	51437.	1.181	0.046	0.00
11.50	11.50	52440.	1.204	0.048	0.00
11.52	11.52	52531.	1.206	0.049	0.00
11.55	11.55	52668.	1.209	0.053	0.00
11.57	11.57	52759.	1.211	0.060	0.00
11.59	11.59	52850.	1.213	0.069	0.00
11.62	11.62	52987.	1.216	0.081	0.00
11.64	11.64	53078.	1.219	0.094	0.00
11.66	11.66	53170.	1.221	0.105	0.00
11.69	11.69	53306.	1.224	0.109	0.00
11.93	11.93	54401.	1.249	0.141	0.00
12.17	12.17	55495.	1.274	0.165	0.00
12.20	12.20	55632.	1.277	0.169	0.00
12.30	12.30	56088.	1.288	0.485	0.00
12.40	12.40	56544.	1.298	1.060	0.00
12.50	12.50	57000.	1.309	1.790	0.00
12.60	12.60	57456.	1.319	2.590	0.00
12.70	12.70	57912.	1.329	2.880	0.00
12.80	12.80	58368.	1.340	3.140	0.00
12.90	12.90	58824.	1.350	3.390	0.00
13.00	13.00	59280.	1.361	3.610	0.00
13.10	13.10	59736.	1.371	3.820	0.00
13.20	13.20	60192.	1.382	4.020	0.00
13.30	13.30	60648.	1.392	4.210	0.00
13.40	13.40	61104.	1.403	4.390	0.00
13.50	13.50	61560.	1.413	4.570	0.00
13.60	13.60	62016.	1.424	4.740	0.00
13.70	13.70	62472.	1.434	4.900	0.00
13.80	13.80	62928.	1.445	5.060	0.00
13.90	13.90	63384.	1.455	5.210	0.00
14.00	14.00	63840.	1.466	5.360	0.00

Hyd	Inflow	Outflow	Peak Stage	Peak Elev	Storage (Cu-Ft)	Storage (Ac-Ft)
1	0.96	0.03	10.09	10.09	46011.	1.056
2	0.47	0.03	10.46	10.46	47684.	1.095
3	0.48	0.02	8.66	8.66	39475.	0.906
4	0.57	0.04	10.93	10.93	49847.	1.144
5	0.50	0.02	6.70	6.70	30558.	0.702
6	0.50	0.01	2.31	2.31	10520.	0.242
7	0.38	0.02	7.33	7.33	33443.	0.768
8	0.42	0.01	3.20	3.20	14576.	0.335

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Hyd	R/D Facility Outflow	Tributary Inflow	Reservoir Inflow	POC Outflow Target	POC Outflow Calc
1	0.03	0.18	********	0.25	0.20
2	0.03	0.08	********	*******	0.10
3	0.02	0.08	********	*******	0.11
4	0.04	0.10	********	*******	0.11
5	0.02	0.09	********	*******	0.11
6	0.01	0.08	********	*******	0.09
7	0.02	0.06	********	*******	0.08
8	0.01	0.07	********	*******	0.08

Route Time Series through Facility
Inflow Time Series File:14175tributary.tsf
Outflow Time Series File:14175rdout
POC Time Series File:14175dsout

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.957 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.239 CFS at 19:00 on Feb 9 in Year 1
Peak Reservoir Stage: 12.22 Ft
Peak Reservoir Elev: 12.22 Ft
Peak Reservoir Storage: 55732. Cu-Ft
: 1.279 Ac-Ft

Add Time Series:14175netbypass.tsf
Peak Summed Discharge: 0.285 CFS at 19:00 on Feb 9 in Year 1
Point of Compliance File:14175dsout.tsf
Flow Frequency Analysis
Time Series File:14175rdout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.239	1	2/09/01 19:00	0.239	12.22	1	100.00	0.990
0.023	6	1/14/02 1:00	0.131	11.85	2	25.00	0.960
0.131	2	3/06/03 22:00	0.026	10.09	3	10.00	0.900
0.015	8	8/26/04 10:00	0.025	9.28	4	5.00	0.800
0.023	5	1/08/05 7:00	0.023	7.87	5	3.00	0.667
0.022	7	1/23/06 4:00	0.023	7.72	6	2.00	0.500
0.025	4	11/28/06 15:00	0.022	6.91	7	1.30	0.231
0.026	3	1/10/08 19:00	0.015	3.20	8	1.10	0.091
Computed Peaks			0.203	12.21		50.00	0.980

Flow Frequency Analysis
Time Series File:14175dsout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
0.284	1	2/09/01 19:00	0.284	1	100.00	0.990

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0.085	7	1/05/02 16:00	0.198	2	25.00	0.960
0.160	3	3/06/03 20:00	0.160	3	10.00	0.900
0.078	8	8/26/04 2:00	0.107	4	5.00	0.800
0.088	6	10/28/04 16:00	0.106	5	3.00	0.667
0.107	4	1/18/06 16:00	0.088	6	2.00	0.500
0.106	5	11/24/06 3:00	0.085	7	1.30	0.231
0.198	2	1/09/08 6:00	0.078	8	1.10	0.091
Computed Peaks			0.255		50.00	0.980

Flow Duration from Time Series File:14175rdout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.004	25939	42.301	42.301	57.699	0.577E+00
0.010	14358	23.415	65.716	34.284	0.343E+00
0.017	12703	20.716	86.432	13.568	0.136E+00
0.024	7375	12.027	98.459	1.541	0.154E-01
0.030	627	1.023	99.481	0.519	0.519E-02
0.037	83	0.135	99.617	0.383	0.383E-02
0.044	105	0.171	99.788	0.212	0.212E-02
0.050	75	0.122	99.910	0.090	0.897E-03
0.057	10	0.016	99.927	0.073	0.734E-03
0.064	5	0.008	99.935	0.065	0.652E-03
0.070	3	0.005	99.940	0.060	0.603E-03
0.077	2	0.003	99.943	0.057	0.571E-03
0.084	1	0.002	99.945	0.055	0.554E-03
0.090	1	0.002	99.946	0.054	0.538E-03
0.097	3	0.005	99.951	0.049	0.489E-03
0.104	0	0.000	99.951	0.049	0.489E-03
0.110	4	0.007	99.958	0.042	0.424E-03
0.117	3	0.005	99.962	0.038	0.375E-03
0.124	6	0.010	99.972	0.028	0.277E-03
0.131	5	0.008	99.980	0.020	0.196E-03
0.137	2	0.003	99.984	0.016	0.163E-03
0.144	2	0.003	99.987	0.013	0.130E-03
0.151	2	0.003	99.990	0.010	0.978E-04
0.157	1	0.002	99.992	0.008	0.815E-04
0.164	2	0.003	99.995	0.005	0.489E-04
0.171	1	0.002	99.997	0.003	0.326E-04
0.177	0	0.000	99.997	0.003	0.326E-04
0.184	0	0.000	99.997	0.003	0.326E-04
0.191	0	0.000	99.997	0.003	0.326E-04
0.197	0	0.000	99.997	0.003	0.326E-04
0.204	0	0.000	99.997	0.003	0.326E-04
0.211	1	0.002	99.998	0.002	0.163E-04
0.217	0	0.000	99.998	0.002	0.163E-04
0.224	0	0.000	99.998	0.002	0.163E-04
0.231	0	0.000	99.998	0.002	0.163E-04
0.238	0	0.000	99.998	0.002	0.163E-04

Flow Duration from Time Series File:14175dsout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.004	26895	43.860	43.860	56.140	0.561E+00
0.012	15212	24.808	68.668	31.332	0.313E+00

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0.020	11894	19.397	88.064	11.936	0.119E+00
0.028	5218	8.509	96.574	3.426	0.343E-01
0.036	1114	1.817	98.390	1.610	0.161E-01
0.044	447	0.729	99.119	0.881	0.881E-02
0.052	232	0.378	99.498	0.502	0.502E-02
0.060	118	0.192	99.690	0.310	0.310E-02
0.068	57	0.093	99.783	0.217	0.217E-02
0.076	38	0.062	99.845	0.155	0.155E-02
0.084	21	0.034	99.879	0.121	0.121E-02
0.092	15	0.024	99.904	0.096	0.962E-03
0.100	12	0.020	99.923	0.077	0.766E-03
0.108	7	0.011	99.935	0.065	0.652E-03
0.116	6	0.010	99.945	0.055	0.554E-03
0.124	5	0.008	99.953	0.047	0.473E-03
0.132	4	0.007	99.959	0.041	0.408E-03
0.140	3	0.005	99.964	0.036	0.359E-03
0.148	3	0.005	99.969	0.031	0.310E-03
0.156	5	0.008	99.977	0.023	0.228E-03
0.164	4	0.007	99.984	0.016	0.163E-03
0.172	1	0.002	99.985	0.015	0.147E-03
0.180	1	0.002	99.987	0.013	0.130E-03
0.188	2	0.003	99.990	0.010	0.978E-04
0.196	2	0.003	99.993	0.007	0.652E-04
0.204	1	0.002	99.995	0.005	0.489E-04
0.212	0	0.000	99.995	0.005	0.489E-04
0.220	0	0.000	99.995	0.005	0.489E-04
0.228	1	0.002	99.997	0.003	0.326E-04
0.236	0	0.000	99.997	0.003	0.326E-04
0.243	1	0.002	99.998	0.002	0.163E-04
0.251	0	0.000	99.998	0.002	0.163E-04
0.259	0	0.000	99.998	0.002	0.163E-04
0.267	0	0.000	99.998	0.002	0.163E-04
0.275	0	0.000	99.998	0.002	0.163E-04
0.283	0	0.000	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: 14175predev.tsf
New File: 14175dsout.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.043	0.95E-02	0.95E-02	-0.2	0.95E-02	0.043	0.043	-0.1
0.054	0.63E-02	0.43E-02	-31.9	0.63E-02	0.054	0.048	-11.5
0.066	0.50E-02	0.23E-02	-53.3	0.50E-02	0.066	0.052	-21.2
0.078	0.37E-02	0.15E-02	-59.7	0.37E-02	0.078	0.057	-26.7
0.089	0.29E-02	0.10E-02	-63.4	0.29E-02	0.089	0.062	-30.9
0.101	0.22E-02	0.73E-03	-66.9	0.22E-02	0.101	0.067	-33.4
0.113	0.15E-02	0.57E-03	-61.1	0.15E-02	0.113	0.078	-30.4
0.124	0.10E-02	0.46E-03	-54.8	0.10E-02	0.124	0.091	-27.3
0.136	0.62E-03	0.41E-03	-34.2	0.62E-03	0.136	0.109	-19.8
0.148	0.34E-03	0.29E-03	-14.3	0.34E-03	0.148	0.145	-2.1
0.160	0.23E-03	0.21E-03	-7.1	0.23E-03	0.160	0.156	-2.3
0.171	0.16E-03	0.15E-03	-10.0	0.16E-03	0.171	0.170	-0.6
0.183	0.11E-03	0.13E-03	14.3	0.11E-03	0.183	0.187	2.0
0.195	0.16E-04	0.65E-04	300.0	0.16E-04	0.195	0.284	46.0

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```
Maximum positive excursion = 0.092 cfs ( 47.6%)
occurring at 0.192 cfs on the Base Data:14175predev.tsf
and at 0.284 cfs on the  New Data:14175dsout.tsf

Maximum negative excursion = 0.034 cfs (-33.6%)
occurring at 0.102 cfs on the Base Data:14175predev.tsf
and at 0.068 cfs on the  New Data:14175dsout.tsf
Duration Comparison Anaylsis
   Base File: 14175predev.tsf
    New File: 14175rdout.tsf
Cutoff Units: Discharge in CFS
```

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.043	0.95E-02	0.24E-02	-75.0	0.95E-02	0.043	0.025	-41.9
0.054	0.63E-02	0.78E-03	-87.7	0.63E-02	0.054	0.026	-52.3
0.066	0.50E-02	0.65E-03	-86.8	0.50E-02	0.066	0.031	-52.5
0.078	0.37E-02	0.57E-03	-84.5	0.37E-02	0.078	0.037	-51.8
0.089	0.29E-02	0.54E-03	-81.1	0.29E-02	0.089	0.041	-54.2
0.101	0.22E-02	0.49E-03	-77.9	0.22E-02	0.101	0.043	-57.1
0.113	0.15E-02	0.42E-03	-71.1	0.15E-02	0.113	0.046	-58.9
0.124	0.10E-02	0.28E-03	-72.6	0.10E-02	0.124	0.049	-61.0
0.136	0.62E-03	0.18E-03	-71.1	0.62E-03	0.136	0.070	-48.5
0.148	0.34E-03	0.13E-03	-61.9	0.34E-03	0.148	0.120	-18.5
0.160	0.23E-03	0.82E-04	-64.3	0.23E-03	0.160	0.129	-19.2
0.171	0.16E-03	0.33E-04	-80.0	0.16E-03	0.171	0.141	-17.5
0.183	0.11E-03	0.33E-04	-71.4	0.11E-03	0.183	0.150	-17.8
0.195	0.16E-04	0.33E-04	100.0	0.16E-04	0.195	0.238	22.5

```
Maximum positive excursion = 0.046 cfs ( 23.9%)
occurring at 0.192 cfs on the Base Data:14175predev.tsf
and at 0.238 cfs on the  New Data:14175rdout.tsf

Maximum negative excursion = 0.076 cfs (-61.1%)
occurring at 0.124 cfs on the Base Data:14175predev.tsf
and at 0.048 cfs on the  New Data:14175rdout.tsf

-----------------------------------
Route Time Series through Facility
  Inflow Time Series File:14175tributary.tsf
 Outflow Time Series File:14175rdout
     POC Time Series File:14175dsout

Inflow/Outflow Analysis
   Peak Inflow Discharge:      0.957 CFS at  6:00 on Jan  9 in Year
8
  Peak Outflow Discharge:      0.239 CFS at 19:00 on Feb  9 in Year
1
    Peak Reservoir Stage:      12.22  Ft
     Peak Reservoir Elev:      12.22  Ft
  Peak Reservoir Storage:   55732.    Cu-Ft
                        :       1.279 Ac-Ft

Add Time Series:14175netbypass.tsf
   Peak Summed Discharge:      0.285 CFS at 19:00 on Feb  9 in Year
1
```

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Point of Compliance File:14175dsout.tsf
Flow Frequency Analysis
Time Series File:14175rdout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.239	1	2/09/01 19:00	0.239	12.22	1	100.00	0.990
0.023	6	1/14/02 1:00	0.131	11.85	2	25.00	0.960
0.131	2	3/06/03 22:00	0.026	10.09	3	10.00	0.900
0.015	8	8/26/04 10:00	0.025	9.28	4	5.00	0.800
0.023	5	1/08/05 7:00	0.023	7.87	5	3.00	0.667
0.022	7	1/23/06 4:00	0.023	7.72	6	2.00	0.500
0.025	4	11/28/06 15:00	0.022	6.91	7	1.30	0.231
0.026	3	1/10/08 19:00	0.015	3.20	8	1.10	0.091
Computed Peaks			0.203	12.21		50.00	0.980

Flow Frequency Analysis
Time Series File:14175dsout.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.284	1	2/09/01 19:00	0.284	1	100.00	0.990
0.085	7	1/05/02 16:00	0.198	2	25.00	0.960
0.160	3	3/06/03 20:00	0.160	3	10.00	0.900
0.078	8	8/26/04 2:00	0.107	4	5.00	0.800
0.088	6	10/28/04 16:00	0.106	5	3.00	0.667
0.107	4	1/18/06 16:00	0.088	6	2.00	0.500
0.106	5	11/24/06 3:00	0.085	7	1.30	0.231
0.198	2	1/09/08 6:00	0.078	8	1.10	0.091
Computed Peaks			0.255		50.00	0.980

Flow Duration from Time Series File:14175rdout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.004	25939	42.301	42.301	57.699	0.577E+00
0.010	14358	23.415	65.716	34.284	0.343E+00
0.017	12703	20.716	86.432	13.568	0.136E+00
0.024	7375	12.027	98.459	1.541	0.154E-01
0.030	627	1.023	99.481	0.519	0.519E-02
0.037	83	0.135	99.617	0.383	0.383E-02
0.044	105	0.171	99.788	0.212	0.212E-02
0.050	75	0.122	99.910	0.090	0.897E-03
0.057	10	0.016	99.927	0.073	0.734E-03
0.064	5	0.008	99.935	0.065	0.652E-03
0.070	3	0.005	99.940	0.060	0.603E-03
0.077	2	0.003	99.943	0.057	0.571E-03
0.084	1	0.002	99.945	0.055	0.554E-03
0.090	1	0.002	99.946	0.054	0.538E-03
0.097	3	0.005	99.951	0.049	0.489E-03
0.104	0	0.000	99.951	0.049	0.489E-03
0.110	4	0.007	99.958	0.042	0.424E-03
0.117	3	0.005	99.962	0.038	0.375E-03

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0.124	6	0.010	99.972	0.028	0.277E-03
0.131	5	0.008	99.980	0.020	0.196E-03
0.137	2	0.003	99.984	0.016	0.163E-03
0.144	2	0.003	99.987	0.013	0.130E-03
0.151	2	0.003	99.990	0.010	0.978E-04
0.157	1	0.002	99.992	0.008	0.815E-04
0.164	2	0.003	99.995	0.005	0.489E-04
0.171	1	0.002	99.997	0.003	0.326E-04
0.177	0	0.000	99.997	0.003	0.326E-04
0.184	0	0.000	99.997	0.003	0.326E-04
0.191	0	0.000	99.997	0.003	0.326E-04
0.197	0	0.000	99.997	0.003	0.326E-04
0.204	0	0.000	99.997	0.003	0.326E-04
0.211	1	0.002	99.998	0.002	0.163E-04
0.217	0	0.000	99.998	0.002	0.163E-04
0.224	0	0.000	99.998	0.002	0.163E-04
0.231	0	0.000	99.998	0.002	0.163E-04
0.238	0	0.000	99.998	0.002	0.163E-04

Flow Duration from Time Series File:14175dsout.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.004	26895	43.860	43.860	56.140	0.561E+00
0.012	15212	24.808	68.668	31.332	0.313E+00
0.020	11894	19.397	88.064	11.936	0.119E+00
0.028	5218	8.509	96.574	3.426	0.343E-01
0.036	1114	1.817	98.390	1.610	0.161E-01
0.044	447	0.729	99.119	0.881	0.881E-02
0.052	232	0.378	99.498	0.502	0.502E-02
0.060	118	0.192	99.690	0.310	0.310E-02
0.068	57	0.093	99.783	0.217	0.217E-02
0.076	38	0.062	99.845	0.155	0.155E-02
0.084	21	0.034	99.879	0.121	0.121E-02
0.092	15	0.024	99.904	0.096	0.962E-03
0.100	12	0.020	99.923	0.077	0.766E-03
0.108	7	0.011	99.935	0.065	0.652E-03
0.116	6	0.010	99.945	0.055	0.554E-03
0.124	5	0.008	99.953	0.047	0.473E-03
0.132	4	0.007	99.959	0.041	0.408E-03
0.140	3	0.005	99.964	0.036	0.359E-03
0.148	3	0.005	99.969	0.031	0.310E-03
0.156	5	0.008	99.977	0.023	0.228E-03
0.164	4	0.007	99.984	0.016	0.163E-03
0.172	1	0.002	99.985	0.015	0.147E-03
0.180	1	0.002	99.987	0.013	0.130E-03
0.188	2	0.003	99.990	0.010	0.978E-04
0.196	2	0.003	99.993	0.007	0.652E-04
0.204	1	0.002	99.995	0.005	0.489E-04
0.212	0	0.000	99.995	0.005	0.489E-04
0.220	0	0.000	99.995	0.005	0.489E-04
0.228	1	0.002	99.997	0.003	0.326E-04
0.236	0	0.000	99.997	0.003	0.326E-04
0.243	1	0.002	99.998	0.002	0.163E-04
0.251	0	0.000	99.998	0.002	0.163E-04

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0.259	0	0.000	99.998	0.002	0.163E-04
0.267	0	0.000	99.998	0.002	0.163E-04
0.275	0	0.000	99.998	0.002	0.163E-04
0.283	0	0.000	99.998	0.002	0.163E-04

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WATER QUALITY SYSTEM

The project will create over 5,000 sf of Pollution Generating Impervious Surfaces (PGIS) therefore, water quality treatment is required. Water quality treatment will be provided per the Basic treatment menu with a stormfilter located in the ROW of 136th Ave NE. This stormfilter will be sized to treat the discharge from the vault in addition the areas as shown in the *Developed Conditions Exhibit* included in the previous pages.

The additional areas routed through the stormfilter along 136th Ave NE will be greater than bypass areas of the frontage unable to be physically routed to the stormfilter and vault to mitigate the volume of water treated to meet the Basic Water Quality Control Menu. Further details and calculations will be provided at Final Engineering.

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Section 5 Conveyance System Analysis and Design

Conveyance system analysis will be provided during final engineering.

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Section 6 Special Reports and Studies

The following reports are relevant to the project and are included in the appendix at the end of this Report.

- Geotechnical Engineering Study prepared by Terra Associates, Inc., dated October 31, 2014
- Critical Areas Assessment, prepared by Raedeke Associates, Inc., revision dated February 11, 2015
- Safe Walk Report prepared by The Blueline Group, dated March 10, 2015

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Section 7 Other Permits

At this time, there are no additional permits associated with this project.

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Section 8 TESC Analysis and Design

A SWPPP will be provided during final engineering. See TESC plan under separate cover for an overview of the preliminary TESC design.

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Section 9 Bond Quantities and Facilities Summary

A Site Improvement Bond Quantity Worksheet will be provided during final engineering.

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Section 10 Operations and Maintenance

An operations and maintenance manual will be provided at Final Engineering.

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APPENDIX

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GEOTECHNICAL REPORT

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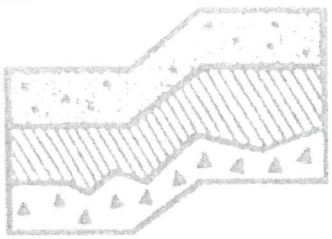
PRELIMINARY GEOTECHNICAL REPORT

Church-Nutu Property
NE 205th Street and 136th Avenue NE
Woodinville, Washington

Project No. T-7011



Terra Associates, Inc.

Prepared for:

Quadrant Homes
Bellevue Washington

March 3, 2014

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TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

March 3, 2014
Project No. T-7011

Mr. Paul Ollestad
Quadrant Homes
14725 SE 36th Street, Suite 200
Bellevue, Washington 98006

Subject: Preliminary Geotechnical Report
Church-Nutu Property
NE 205th Street and 136th Avenue NE
Woodinville, Washington

Dear Mr. Ollestad:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

On the existing developed parcel soil conditions we observed in the test pits generally consisted of one to six inches of sod and topsoil overlying medium dense to dense glacial sediments composed mostly of silty sand with gravel and sandy silt (glacial till). Outwash sediments composed of silt and relatively clean sand were also observed below the glacial till in Test Pits TP-1 and TP-2 excavated in the south portion of the site. We did not observe groundwater seepage in the test pits at the time of our exploration.

In our opinion, the native soils on the site will be suitable for support of the proposed development provided the recommendations present in this report are incorporated into project design and construction.

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

Ben Schepper
Staff Geologist

THEODORE J. SCHEPPER
STATE OF WASHINGTON
PROFESSIONAL ENGINEER

3-3-14

Theodore J. Schepper, P.E.
President

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Preliminary Geotechnical Report
Church-Nutu Property
NE 205th Street and 136th Avenue NE
Woodinville, Washington

1.0 PROJECT DESCRIPTION

The project consists of redeveloping the approximately three-acre property with residential building lots, access roadways, and utilities. Grading and development plans were not available at the time of this report. However based on current site topography, we expect minimal grading will be required to establish lot and roadway elevations. We expect that the residential structures constructed on the lots will be two- to three-story, wood-framed buildings with their main floor levels framed over a crawl space. Attached garage floors will be constructed at grade. Structural loading should be relatively light; with bearing walls caring loads of 2 to 3 kips per foot and isolated columns caring maximum loads of 30 to 40 kips.

The recommendations in the following sections of this report are based on our understanding of the preceding design features. We should review final design drawings as they become available to verify that our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

On February 14, 2014, we observed soil conditions at 4 test pits excavated between 9 and 10 feet below existing site grades. Using the information obtained from the subsurface exploration along with laboratory test results, we performed analyses to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following on a preliminary basis:

- Soil and groundwater conditions
- Seismic design parameters per 2012 International Building Code (IBC)
- Geologic Hazards per current City of Woodinville Municipal Code
- Site preparation and grading
- Excavation
- Foundations
- Floor slabs at grade
- Drainage
- Stormwater vault
- Utilities
- Pavement

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment (i.e., humidity, mildew, and mold) are beyond Terra Associates' purview. A building envelope specialist or contractor should be consulted to address these issues, as needed.

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3.0 SITE CONDITIONS

3.1 Surface

The project site consists of 2 tax parcels totaling approximately 3 acres located at 13457 NE 205th Street and 20325 – 136th Avenue NE in Woodinville, Washington. The approximate site location is shown on Figure 1.

The site is currently occupied with three single-family residences, a large abandoned barn and detached garage, and several small outbuildings. The majority of the site is covered with grass, dense brush, and mature trees. Site topography is generally flat with the 20325 parcel on 136th Avenue NE sloping from south to north towards NE 205th Street in the northeast corner of the property. The site is bordered by residential homes to the south and west with roadways to the north and east of the parcels.

3.2 Subsurface

Soil conditions we observed in the test pits generally consisted of one to six inches of sod and dark brown silty sand topsoil overlying glacial sediments composed mostly of medium dense to dense silty sand with gravel and sandy silt (glacial till). What appear to be glacial outwash sediments composed of silt and relatively clean sand were observed at depths of six to seven feet below the predominant till soils at Test Pits TP-1 and TP-2 respectively.

The *Geologic Map of King County* by Derek B. Booth, Kathy A. Troost, & Aaron P. Wisher (2007), maps the site as Vashon Till (Qvt) and Vashon Recessional Outwash (Qvr). Soil conditions observed in the test pits are generally consistent with the mapped geology.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Pit Logs in Appendix A.

3.3 Groundwater

We did not observe any groundwater seepage during our exploration. On glacial till sites groundwater seepage will fluctuate with low volumes of shallow seepage generally present during the wet winter months. This seepage typically diminishes with the onset of the normally drier summer months and often times is absent in the fall time of the year.

4.0 GEOLOGICAL HAZARDS

4.1 Seismic Considerations

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sand that is below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength.

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The glacial deposits observed at the site are older deposits that have been well consolidated by the glacial ice sheet. This coupled with the absence of an established groundwater table precludes the potential for soil liquefaction to occur. It is our opinion that the hazard for soil liquefaction or settlement during an earthquake and the associated risk or impact is negligible and the site is not a seismic hazard area as defined by the Woodinville Municipal Code (WMC).

Based on soil conditions observed in the test borings and our knowledge of the area geology, per Chapter 16 of the 2012 International Building Code (IBC), site class "C" should be used in structural design. Based on this site class, in accordance with the 2012 IBC, the following parameters should be used in computing seismic forces:

Seismic Design Parameters (IBC 2012)

Spectral response acceleration (Short Period), S_{Ms}	1.165
Spectral response acceleration (1 – Second Period), S_{M1}	0.559
Five percent damped .2 second period, S_{Ds}	0.777
Five percent damped 1.0 second period, S_{D1}	0.373

Values determined using the United States Geological Survey (USGS) Ground Motion Parameter Calculator accessed on February 20, 2014 at the web site http://earthquake.usgs.gov/research/hazmaps/design/index.php.

4.2 Erosion Hazard Areas

The soils observed on-site are classified as Everett gravelly sandy loam 5 to 15 percent slopes by the United States Department of Agriculture Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service. With the existing slope gradients, these soils will have a slight to moderate potential for erosion when exposed. Therefore, the site is not an erosion hazard area as defined by the WMC. Regardless, erosion protection measures as required by the City of Woodinville will need to be in place prior to starting grading activities on the site. This would include perimeter silt fencing to contain erosion on-site and cover measures to prevent or reduce soil erosion during and following construction.

4.3 Landslide Hazard Areas

The property does not contain any steep slopes or landslide hazard areas.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

Based on our study, there are no geotechnical considerations that would preclude development of the site as currently planned. Residences can be supported on conventional spread footings bearing on competent native soils observed below the upper six inches of organic surface soil or on structural fill placed and compacted above these native soils. Pavement and floor slabs can be similarly supported.

Most of the native and existing fill soils encountered at the site contain a significant amount of fines and will be difficult to compact as structural fill when too wet. The ability to use native and existing fill soil from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import clean granular material for use as structural fill and backfill.

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The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious material should be stripped and removed from below the building lots and roadway areas. Surface stripping depths of approximately one to six inches should be expected to remove the organic surface soils on the developed parcels with a stripping depth of about 12 inches required in areas outside of the developed areas. Organic topsoil will not be suitable for use as structural fill, but may be used for limited depths in nonstructural areas.

In the developed portions of the site, demolition of existing structures should include removal of existing foundations and abandonment of underground septic systems and other buried utilities. Abandoned utility pipes that fall outside of new building areas can be left in place provided they are sealed to prevent intrusion of groundwater seepage and soil.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates to verify soil conditions are as expected and suitable for support of new fill. Our representative may request a proofroll using heavy rubber-tired equipment to determine if any isolated soft and yielding areas are present. If excessively yielding areas are observed, and they cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill. Beneath embankment fills or roadway subgrade if the depth of excavation to remove unstable soils is excessive, the use of geotextile fabrics, such as Mirafi 500X, or an equivalent fabric, can be used in conjunction with clean granular structural fill. Our experience has shown that, in general, a minimum of 18 inches of a clean, granular structural fill placed and compacted over the geotextile fabric should establish a stable bearing surface.

The native and existing fill soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet or too dry. The ability to use native and existing fill soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. When wet soils are encountered, the contractor will need to dry the soils by aeration during dry weather conditions. Alternatively, the use of an additive such as Portland cement or lime to stabilize the soil moisture can be considered. If the soil is amended, additional Best Management Practices (BMPs) addressing the potential for elevated pH levels will need to be included in the Storm Water Pollution Prevention Program (SWPPP) prepared with the Temporary Erosion and Sedimentation Control (TESC) plan.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

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Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within minus one to plus three percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

5.3 Excavation

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the upper one to four and one-half feet of weathered native soils would be classified as Type C soil. The dense native soils below four and one-half feet would be classified as Type A soil.

Accordingly, temporary excavations in Type C soils should have their slopes laid back at an inclination of 1.5:1 (Horizontal:Vertical) or flatter, from the toe to the crest of the slope. Side slopes in Type A soils can be laid back at a slope inclination of 0.75:1 or flatter. For temporary excavation slopes less than 8 feet in height in Type A soils, the lower 3.5 feet can be cut to a vertical condition, with a 0.75:1 slope graded above. For temporary excavation slopes greater than eight feet in height, the slope above the 3.5-foot vertical portion will need to be laid back at a minimum slope inclination of 1:1. All exposed temporary slope faces that will remain open for an extended period of time should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

The above information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project general contractor.

5.4 Foundation Support

The residences can be supported on conventional spread footing foundations bearing on competent native soils, competent existing fill soils, or on structural fills placed above competent soils. Foundation subgrade should be prepared as recommended in Section 5.2 of this report.

Perimeter foundations exposed to the weather should bear a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

Foundations bearing on competent native soils, competent existing fill soils, or on compacted structural fill can be dimensioned for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With structural loading as anticipated and this bearing stress applied, estimated total settlements are between one-quarter and one-half inch.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing and buried portion of the foundation stem wall can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 350 pcf. We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill as described in Section 5.2 of this report. The values recommended include a safety factor of 1.5.

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5.5 Floor Slab-on-Grade

Slab-on-grade floors may be supported on subgrade prepared as recommended in Section 5.2 of this report. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and to aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the 2003 American Concrete Institute (ACI) Manual of Concrete Practice, Part 2, 302.1R-96, for further information regarding vapor barrier installation below slab-on-grade floors.

5.6 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a gradient of at least three percent for a minimum distance of ten feet from the building perimeters. If this gradient cannot be provided, surface water should be collected adjacent to the structures and disposed to appropriate storm facilities.

Subsurface

We recommend installing perimeter foundation drains adjacent to shallow foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe that is enveloped in washed pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

Infiltration

The predominant native silty sand and sandy silt till soils that are present at the site exhibit low permeability and would not be suitable for using retention/infiltration elements or facilities to manage development stormwater runoff. The relatively clean outwash sand observed at a depth of seven feet at Test Pit TP-2 would exhibit permeability that normally would be favorable for infiltration discharge. However this deposit appears isolated and of limited extent and; therefore, would not likely have the volumetric storage capacity to be a suitable receptor soil for infiltration discharge.

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5.7 Stormwater Detention Vault

We expect that development stormwater will be routed to a below-grade detention vault for treatment and controlled release to the drainage basin. We also anticipate the vault floor grade will be eight to ten feet below current site elevations. At this depth, dense to very dense till or dense outwash silt/sand would be exposed. Vault foundations supported by these dense to very dense native soils may be designed for an allowable bearing capacity of 6,000 pounds per square foot (psf). For short-term loads, such as seismic, a one-third increase in this allowable capacity can be used. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.4.

The magnitude of earth pressures developing on the vault walls will depend in part on the quality and compaction of the wall backfill. We recommend placing and compacting wall backfill as structural fill. To prevent development of hydrostatic pressure and uplift on the vault, wall drainage must be installed. A typical recommended wall drainage detail is shown on Figure 3. If it is not possible to discharge collected water at the footing invert elevation, we recommend setting the invert elevation of the wall drainpipe equivalent to the outfall invert and connecting the drain to the outfall pipe for discharge.

With the recommended wall backfill and drainage, we recommend designing the restrained vault walls for an earth pressure imposed by an equivalent fluid weighing 50 pcf. For any portion of the wall that falls below the invert elevation of the wall drain, an earth pressure equivalent to a fluid weighing 85 pcf should be used. For evaluating walls under seismic loading, an additional uniform earth pressure equivalent to 8H psf, where H is the height of the below-grade wall in feet, can be used. These values assume a horizontal backfill condition.

5.8 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or the City of Woodinville specifications. As a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2 of this report. As noted, depending on the soil moisture when excavated most inorganic native soils on the site should be suitable for use as backfill material during dry weather conditions. However, if utility construction takes place during the wet winter months, it will likely be necessary to import suitable wet weather fill for utility trench backfilling.

5.9 Pavement

Pavement subgrade should be prepared as described in the Section 5.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tire construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. For residential access, with traffic consisting mainly of light passenger vehicles with only occasional heavy traffic, and with a stable subgrade prepared as recommended, we recommend the following pavement sections:

- Two inches of hot mix asphalt (HMA) over four inches of crushed rock base (CRB)
- Three and one-half inches of full depth HMA.

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA and CRB aggregate.

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Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical service during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Church-Nutu Property project. This report is for the exclusive use of the Quadrant Homes and its authorized representatives.

The analyses and recommendations present in this report are based on data obtained from the test pits done on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

EXHIBIT 1e
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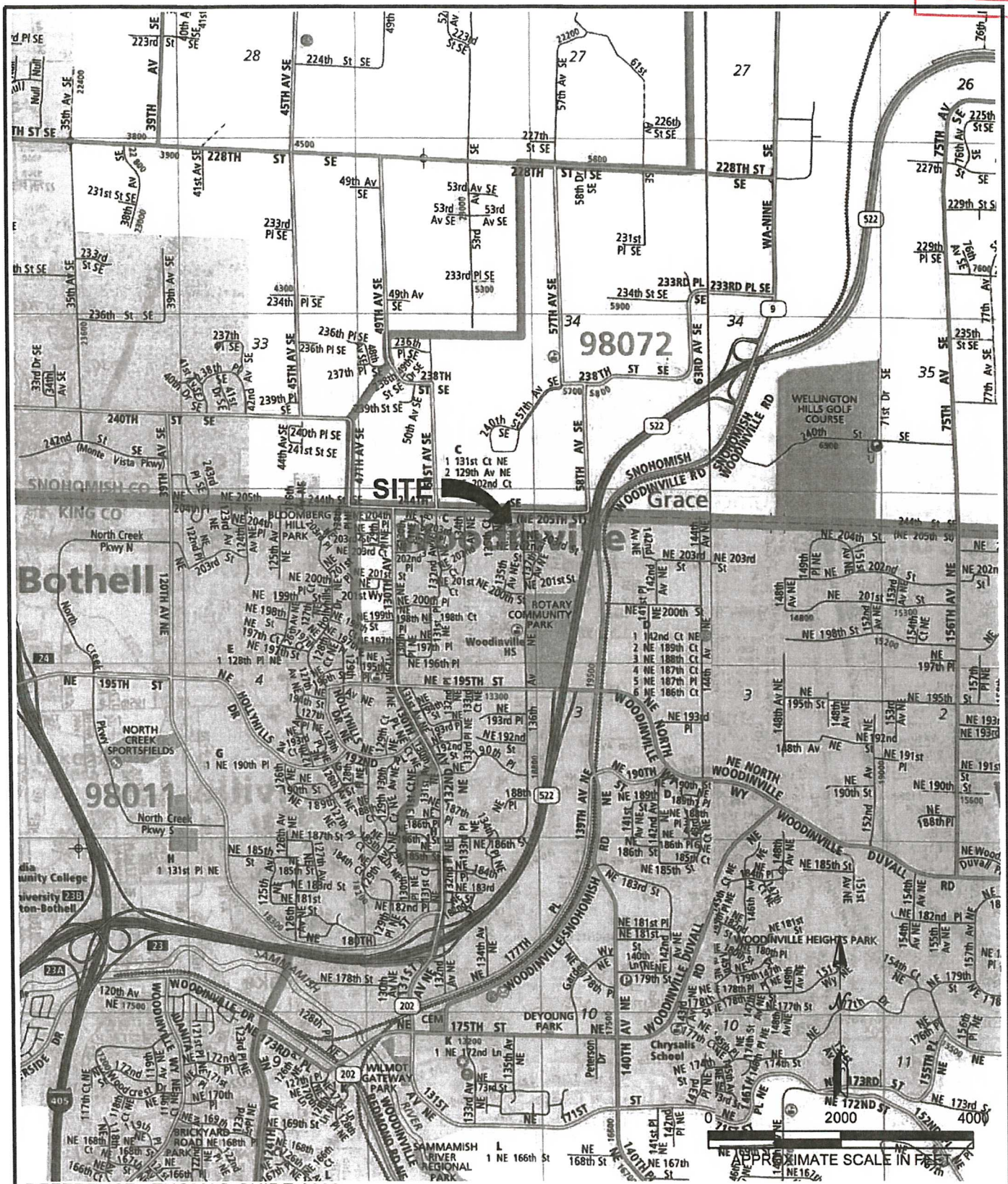

REFERENCE: THOMAS GUIDE 2008

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Geology and
Environmental Earth Sciences

VICINITY MAP
CHURCH-NUTU PROPERTY
WOODINVILLE, WASHINGTON

Proj. No.T-7011	Date MAR 2014	Figure 1

EXHIBIT 16
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0 75 150

APPROXIMATE SCALE IN FEET

NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: pol.pictometry.com

LEGEND:

APPROXIMATE TEST PIT LOCATION

N

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EXPLORATION LOCATION PLAN
CHURCH-NUTU PROPERTY
WOODINVILLE, WASHINGOTN

Proj. No.T-7011	Date MAR 2014	Figure 2

EXHIBIT 16
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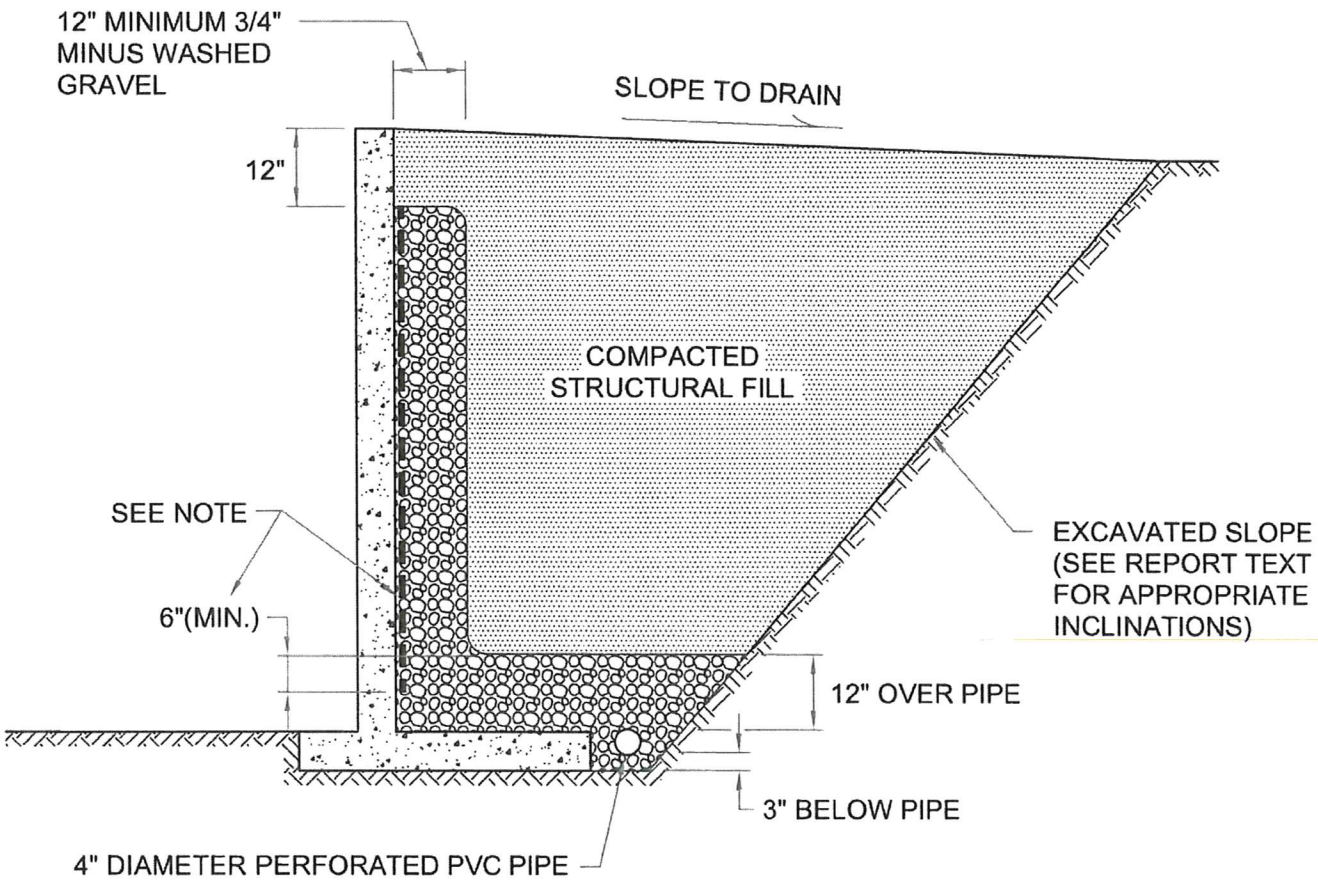

NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
CHURCH-NUTU PROPERTY
WOODINVILLE, WASHINGTON

Proj. No.T-7011	Date MAR 2014	Figure 3

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APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Church-Nutu Property
Woodinville, Washington

On February 14, 2014, we completed our site exploration by observing soil conditions at 4 test pits. The test pits were excavated using a small excavator to a maximum depth of 10 feet below existing site grades. Test pit locations were determined in the field by measurements from existing site features. The approximate location of the recent and previous test pits is shown on the attached Exploration Location Plan, Figure 2. Test Pit Logs are attached as Figures A-2 through A-5.

A geotechnical engineer and geologist from our office conducted the field explorations. Our representatives classified the soil conditions encountered, maintained a log of each test pit, obtained representative soil samples, and recorded water levels observed during excavation. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test pits were placed in closed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the individual Test Pit Logs. Grain size analysis was completed on 3 represented samples with results shown on attached Figures A-6 and A-7.

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MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (More than 50% material larger than No. 200 sieve size)	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
			SP	Poorly-graded sands, sands with gravel, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS (More than 50% material smaller than No. 200 sieve size)	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity. (Lean clay)
			OL	Organic silts and organic clays of low plasticity.
	SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
			CH	Inorganic clays of high plasticity. (Fat clay)
			OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

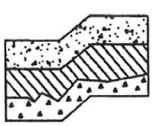
COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
II	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot



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UNIFIED SOIL CLASSIFICATION SYSTEM
CHURCH-NUTU PROPERTY
WOODINVILLE, WASHINGTON

Proj. No.T-7011	Date MAR 2014	Figure A-1

EXHIBIT 16
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LOG OF TEST PIT NO. 1

FIGURE A-2

PROJECT NAME: Church-Nutu Property PROJ. NO: T-7011 LOGGED BY: BS

LOCATION: Woodinville, Washington SURFACE CONDS: Dense Brush APPROX. ELEV: _____

DATE LOGGED: February 14, 2014 DEPTH TO GROUNDWATER: N/A DEPTH TO CAVING: N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
		Brown/tan silty SAND with gravel, fine to medium grained, moist, trace organics. (SM) (Topsoil)	Loose	13.7		
1		Tan silty SAND with gravel, fine to medium grained, moist, weathered. (SM)	Loose			
2						
3		Tan SAND with silt and gravel, fine to medium grained, moist. (SM)		4.0		
4			Medium Dense			
5						
6		Tan/gray SILT with sand, fine to medium grained, moist. (ML)		36.6		
7			Dense			
8		Gray SILT with sand, fine to medium grained, moist. (ML)		31.8		
9			Dense			
10		Test pit terminated at approximately 10 feet. No groundwater seepage observed. No caving.				
11						
12						
13						
14						
15						

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

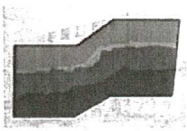

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EXHIBIT 14
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LOG OF TEST PIT NO. 2

FIGURE A-3

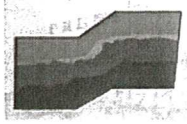
PROJECT NAME: Church-Nutu Property PROJ. NO: T-7011 LOGGED BY: BS

LOCATION: Woodinville, Washington SURFACE CONDS: Dense Brush APPROX. ELEV: _____

DATE LOGGED: February 14, 2014 DEPTH TO GROUNDWATER: N/A DEPTH TO CAVING: N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
1		Brown/tan silty SAND with gravel, fine to medium grained, moist, trace organics. (SM) (Topsoil)	Loose			
2		Tan/gray silty SAND, fine to medium grained, moist. (SM)	Medium Dense	17.8		
4		Tan/gray silty SAND with gravel, fine to medium grained, moist. (SM)	Dense	17.4		
7		Tan/gray SAND with trace gravel, fine to medium grained, moist. (SP)	Dense	16.1		
9		Test pit terminated at approximately 9 feet. No groundwater seepage observed. No caving.				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. 3

FIGURE A-4

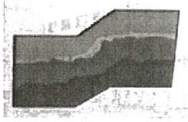
PROJECT NAME: Church-Nutu Property **PROJ. NO:** T-7011 **LOGGED BY:** BS

LOCATION: Woodinville, Washington **SURFACE CONDS:** Light Brush/Mature Trees **APPROX. ELEV:**

DATE LOGGED: February 14, 2014 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
0		Brown/tan silty SAND with gravel, fine to medium grained, moist, trace organics. (SM) (Topsoil)	Loose			
1–2		Tan silty SAND with gravel, fine to medium grained, moist, trace organics. (SM)	Loose	19.6		
3			Medium Dense	19.4		
4–5		Tan/gray SAND with silt and gravel, fine to medium grained, moist. (SM)	Dense	13.8		
6–8				16.3		
9		Test pit terminated at approximately 9 feet. No groundwater seepage observed. No caving.				
10–15						

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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LOG OF TEST PIT NO. 4

FIGURE A-5

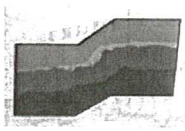
PROJECT NAME: Church-Nutu Property **PROJ. NO:** T-7011 **LOGGED BY:** BS

LOCATION: Woodinville, Washington **SURFACE CONDS:** Short Grass/Driveway **APPROX. ELEV:**

DATE LOGGED: February 14, 2014 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

DEPTH (FT.)	SAMPLE NO.	DESCRIPTION	CONSISTENCY/ RELATIVE DENSITY	W (%)	POCKET PEN. (TSF)	REMARKS
1		Brown/tan silty SAND with gravel, fine to medium grained, moist, trace organics. (SM) (Topsoil)	Loose			
		Tan/brown silty SAND with gravel, fine to medium grained, moist, trace organics. (SM)	Medium Dense	31.2		
2		Gray/tan SILT with sand, fine to medium grained, moist, 12-inch diameter boulder at 3 feet. (ML)	Dense	28.1		
3						
4						
5				11.1		
6		Gray/tan silty SAND with gravel, fine to medium grained, moist. (SM)	Dense			
7				12.5		
8						
9						
10		Test pit terminated at approximately 9 feet. No groundwater seepage observed. No caving.				
11						
12						
13						
14						
15						

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



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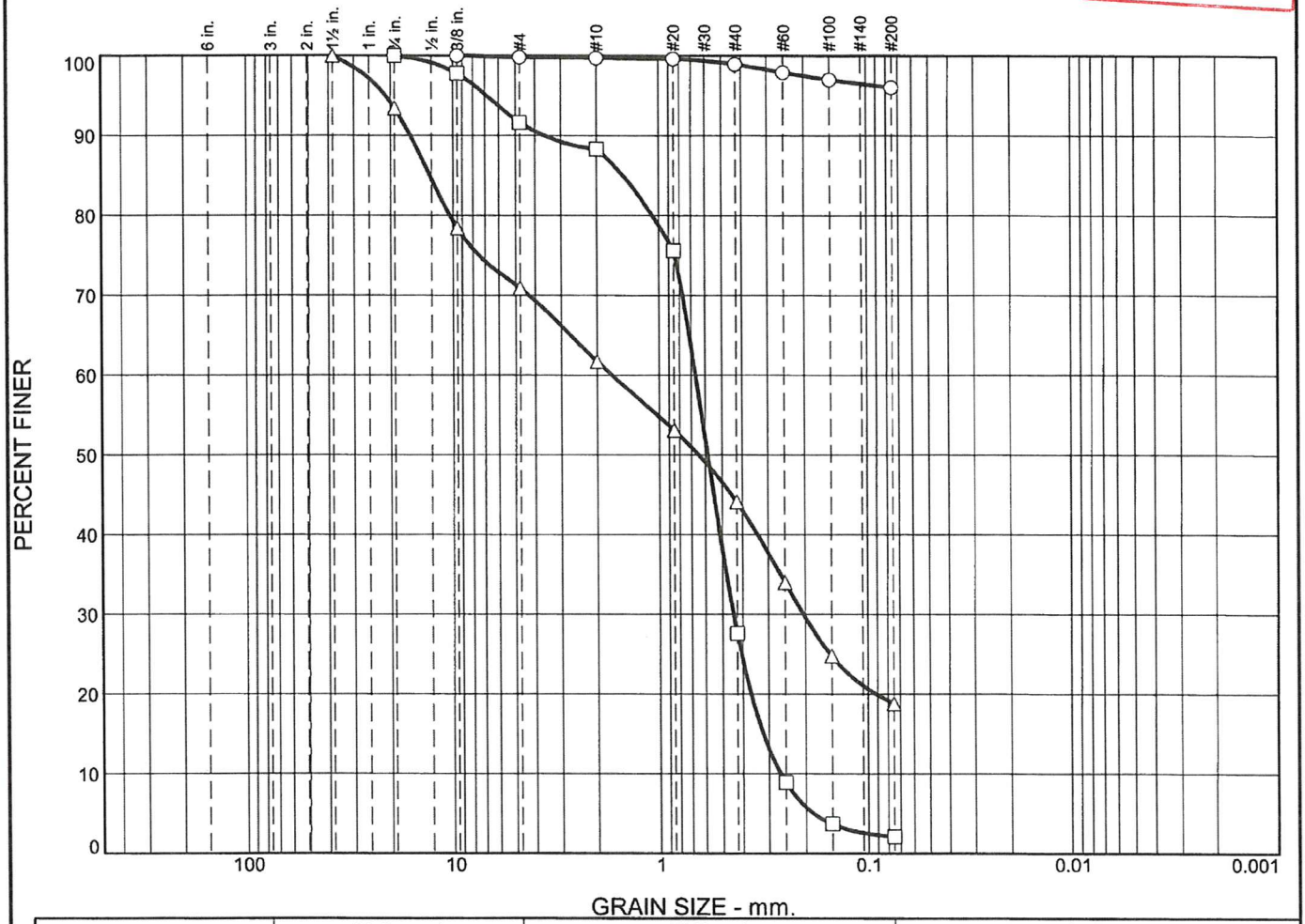
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.1	0.8	2.9	96.0	
□	0.0	0.0	8.4	3.3	60.7	25.5	2.1	
△	0.0	6.6	22.5	9.2	17.6	25.3	18.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										
□			1.4912	0.6664	0.5837	0.4421	0.3205	0.2647	1.11	2.52
△			12.9580	1.6982	0.6448	0.2041				

	Material Description	USCS	AASHTO
○			
□			
△			

Project No. 7011 **Client:** Quadrant Homes

Project: Church-Nutu Property

○ **Location:** TP-1 **Depth:** -8'

□ **Location:** Tp-2 **Depth:** -7'

△ **Location:** Tp-3 **Depth:** -5'

Remarks:

Terra Associates, Inc.

Kirkland, WA

Figure A-6

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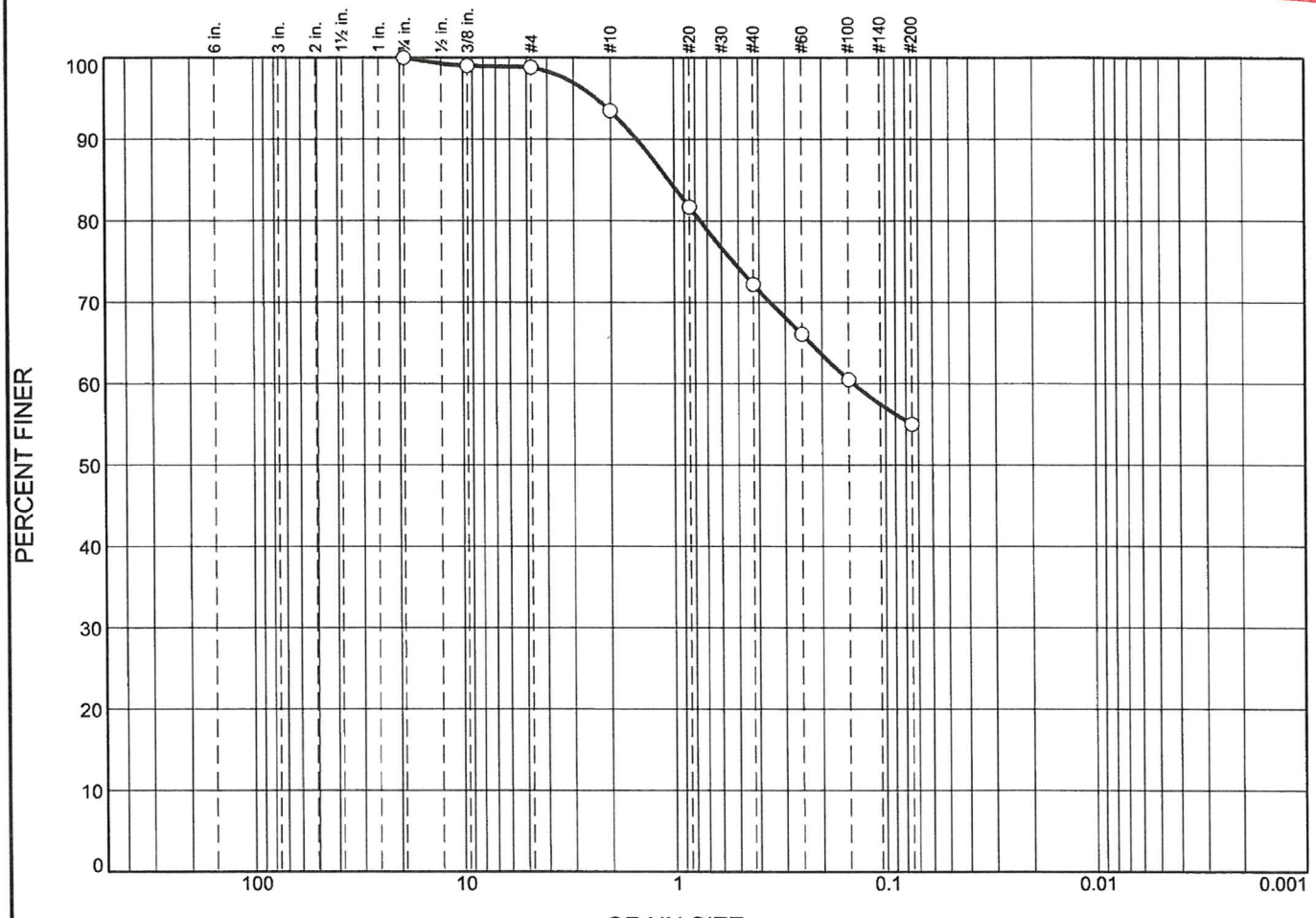
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.2	5.3	21.3	17.2	55.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.0603	0.1424						

	Material Description	USCS	AASHTO
○			

Project No. 7011 **Client:** Quadrant Homes

Project: Church-Nutu Property

○ **Location:** Tp-4 **Depth:** -3'

Remarks:

Terra Associates, Inc.

Kirkland, WA

Figure A-7

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CRITICAL AREAS ASSESSMENT

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CRITICAL AREAS ASSESSMENT

Church Property

Woodinville, Washington

June 11, 2014
Revised November 4, 2014
Revised February 11, 2015

RAEDEKE ASSOCIATES, INC.

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Raedeke Associates, Inc.

Wetland & Aquatic Sciences
Wildlife Ecology
Landscape Architecture

Report To:	Mr. Matt Perkins Quadrant Homes 14725 SE 36th Suite 100 Bellevue WA 98006
Title:	Critical Areas Assessment for the Church Property, Woodinville, Washington
Project Number:	2014-013-003
Date:	June 11, 2014 Revised November 4, 2014 Revised February 11, 2015

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Raedeke Associates, Inc.

Wetland & Aquatic Sciences
Wildlife Ecology
Landscape Architecture

Project Manager: Christopher W. Wright
Principal / Soil & Wetland Scientist

Project Personnel: Bryce Vanderkolk
Wetland Ecologist

Anne Cline, M.L.A.
Landscape Architect

Submitted by:

Signature

Christopher W. Wright
Printed Name

February 11, 2015
Date

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1.0 INTRODUCTION

1.1 PURPOSE

This report documents the results of our field investigations and critical areas assessment of the Church property in Woodinville, Washington (Figure 1). The objectives of this study are to: (1) identify and delineate any portions of the property that could be classified as wetlands or streams, (2) provide baseline biological information on the wildlife habitat on the Church property and (3) propose buffer enhancement for a reduction of standard stream buffer width.

1.2 PROJECT LOCATION

The Church property is comprised of two parcels totaling approximately 2.98 acres, located at the southwest corner of the intersection of NE 205th Street and 136th Avenue NE in the City of Woodinville, Washington (Figure 1). This places the property in Section 3, Township 26 North, Range 5 East W.M.

1.3 SITE DESCRIPTION

The property is developed and contains houses, garages, sheds, and barns. The area near the houses is maintained as lawn while the remainder of the site contains a mixed deciduous and coniferous forest plant community. A stream occurs along the western property boundary (Figure 2).

1.4 PROPOSED DEVELOPMENT PLAN

The proposed development would convert the site to 15 single-family residential lots with a common access from 136th Avenue NE. A stormwater detention vault would be located in the eastern portion of the site (Figure 3).

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2.0 METHODS

2.1 DEFINITIONS AND METHODOLOGIES

Wetlands and streams are protected by federal law as well as by state and local regulations. Federal law (Section 404 of the Clean Water Act) prohibits the discharge of dredged or fill material into "Waters of the United States", including certain wetlands, without a permit from the U.S. Army Corps of Engineers (COE 2012). The COE makes the final determination as to whether an area meets the definition of a wetland and whether the wetland is under their jurisdiction.

The COE wetland definition was used to determine if any portions of the project area could be classified as wetland. A wetland is defined as an area "inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Federal Register 1986:41251).

We based our investigation upon the guidelines of the COE Wetlands Delineation Manual (Environmental Laboratory 1987), as further clarified in the Regional Supplement to the Corps of Engineers Delineation Manual: Western Mountains, Valleys, and Coasts Region (COE 2010). The COE wetlands manual is required by state law (WAC 173-22-035, as revised) for all local jurisdictions. As outlined in the 1987 wetland delineation manual, wetlands are distinguished by three diagnostic characteristics: hydrophytic vegetation (wetland plants), hydric soil (wetland soil), and wetland hydrology. Definitions for these terms are provided below.

Hydrophytic vegetation is defined as "macrophytic plant life growing in water, soil or substrate that is at least periodically deficient in oxygen as a result of excessive water content" (Environmental Laboratory 1987). The U.S. Fish and Wildlife Service (USFWS) Wetland Indicator Status (WIS) ratings were used to make this determination (Lichvar and Kartesz 2009). The WIS ratings "reflect the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetland versus non-wetland across the entire distribution of the species" (Reed 1988:8). Plants are rated, from highest to lowest probability of occurrence in wetlands, as obligate (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and upland (UPL), respectively. In general, hydrophytic vegetation is present when the majority of the dominant species are rated OBL, FACW, and FAC.

A hydric soil is defined as "a soil that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register 1995: 35681). The morphological characteristics of the soils in the study area were examined to determine whether any could be classified as hydric.

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According to the 1987 methodology, wetland hydrology could be present if the soils were saturated (sufficient to produce anaerobic conditions) within the majority of the rooting zone (usually the upper 12 inches) for at least 5% of the growing season, which in this area is usually at least 2 weeks (COE 1991a). It should be noted, however, that areas having saturation to the surface between 5% and 12% of the growing season may or may not be wetland (COE 1991b). Depending on soil type and drainage characteristics, saturation to the surface would occur if water tables were shallower than about 12 inches below the soil surface during this time period.

Positive indicators of wetland hydrology include direct observation of inundation or soil saturation, as well as indirect evidence such as driftlines, watermarks, surface encrustations, and drainage patterns (Environmental Laboratory 1987). Hydrology was further investigated by noting drainage patterns and surface water connections between wetlands and streams within and adjacent to the project area.

Delineation of the ordinary high water mark (OHWM) of streams found within the project area was based upon the Washington State Shoreline Management Act of 1971 definitions found in RCW 90.58.030 (2) (b) and WAC 173-22-030 (6).

2.2 Background Research

2.2.1 Wetlands and Streams

Prior to conducting our field investigations, we collected and analyzed background information available for the site from the U.S. Fish and Wildlife Service (USFWS 2014) National Wetland Inventory (NWI) and the U.S.D.A. Natural Resources Conservation Service (USDA NRCS 2014) Web Soil Survey. Washington Department of Natural Resources (WDNR 2014) Forest Practices Base Map, Snohomish County (2014a, 2014b) reference maps, and City of Woodinville (2007, 2009) reference maps. We reviewed aerial photographs (King County iMap 2014) to assist in the definition of existing plant communities, drainage patterns, and land use.

2.2.2 Wildlife

In preparation for our wildlife reconnaissance site visit, we reviewed information from the PHS database (WDFW 2014a) for documented information on the potential occurrence of federal- or state-listed endangered, threatened, sensitive, candidate, other priority, or monitor wildlife species (hereafter "species of concern"), or priority habitats on the project site and vicinity. State priority species are defined as those fish and wildlife species "requiring protective measures and/or management actions to ensure their survival", and State priority habitats are defined as habitat types "with unique or significant value to many species" (WDFW 2008). We also reviewed database information maintained by the Washington Natural Heritage Program (2011) for occurrence of endangered, threatened, and sensitive plants in the vicinity of the project site.

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Reference lists maintained by the WDFW (2008) were consulted for information on the status of wildlife species of concern that could use the site during at least some part of the year. Species accounts and management recommendations provided by WDFW (e.g., Rodrick and Milner 1991, Larsen 1997, Azerrad 2004, Larsen et al. 2004) were consulted to determine habitat associations of such species and to evaluate the likelihood of their occurrence on the project site. During the field investigation, we searched for the presence of these species, or signs thereof, which could be found on the property.

2.3 Field Sampling Procedures

We visited the site on February 4, 2014 to search for wetlands or streams and describe vegetation communities and wildlife habitat conditions.

2.3.1 Wetlands

During our field investigation, we inventoried, classified, and described representative areas of plant communities, soil profiles, and hydrologic conditions in both uplands and wetlands. We searched specifically for areas with positive indicators of hydrophytic vegetation, hydric soil, and wetland hydrology.

Vegetation, soils, and hydrology were examined in representative portions of the study area according to the procedures described in the Regional Supplement (COE 2010). Plant communities were inventoried, classified, and described during our field investigation. We estimated the percent coverage of each species. Plant identifications were made according to standard taxonomic procedures described in Hitchcock and Cronquist (1976), with nomenclature as updated by COE National Wetland Plant List (Lichvar and Kartesz 2009). Wetland classification follows the USFWS wetland classification system (Cowardin et al. 1992).

We excavated pits to at least 18 inches below the soil surface, where possible, in order to describe the soil and hydrologic conditions throughout the study area. We sampled soil at locations that corresponded with vegetation sampling areas and potential wetland areas. Soil colors were determined using the Munsell Soil Color Chart (Munsell Color 2009). We used the indicators described in the Regional Supplement (COE 2010) to determine the presence of hydric soils and wetland hydrology.

Our evaluation of potential occurrence of wetlands boundaries was based on a determination of whether hydric soil, hydrophytic vegetation, and indicators of wetland hydrology are present on the site. Topographic changes within the context of the landscape were used to aid in our review of the previously delineated the wetland boundaries.

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2.3.2 Wildlife

During this field investigation, we documented wildlife presence, sign, and habitat while inventorying and describing plant communities. We recorded information regarding reproduction, habitat use, and activities of all wildlife species observed. In addition, we noted special habitat features such as large and/or hollow trees, snags [standing dead or partly dead trees at least 4 inches diameter at breast height (dbh) and 6 feet tall], and large down logs. Historic and present land-use of the site and immediate vicinity were noted from direct observations in the field and analysis of aerial photographs.

During our field surveys, we also searched specifically for the presence, sign, or habitats of any wildlife species of concern that may occur on the project site or vicinity. In particular, we searched for the presence of large stick-type nests, hollow trees, tree cavities, and pileated woodpecker foraging sign. Large stick nests are built and used by several species of concern, including bald eagles and great blue herons. Tree cavities are created and used by woodpeckers, including species of concern such as the pileated woodpecker, and can provide habitat for a host of bird and mammal species, including species of concern such as purple martins, various cavity-nesting duck species, and various bats. Hollow trees are used as daytime roost for priority species including various bat species, as well as Vaux's swifts.

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3.0 EXISTING CONDITIONS

3.1 Results of Background Investigation

3.1.1 Wetlands

The USFWS NWI (2014) shows no wetlands within the project site. The map does depict a wetland (palustrine scrub-shrub, seasonally flooded) approximately 500 feet to the northwest of the property.

Soils on the project site are mapped as Everett gravelly sandy loam, 5% to 15% slopes (USDA NRCS 2014). Everett soils are well-drained (non-hydric) soils formed in glacial till.

3.1.2 Streams

The City of Woodinville (2009) critical areas map does not identify a stream on the property. However it does depict a stream segment downstream of the site to the south that is mapped as Type 3. The on-site stream is also not shown on the Washington Department of Natural Resources (2014) Forest Practices Water Type map or on the WDFW (2014b) Salmonscape map. However, the SalmonScape map depicts Rowland Creek tributary to Little Bear Creek north of 205th Street, several hundred feet northeast of the project site. The Snohomish County (2014a, 2014b) reference maps show an unnamed stream drainage that flows easterly along the north side of NE 205th Street, and the WDFW (2014b) Salmonscape map shows two blockages to fish passage along this drainage course northeast of the site. The on-site stream appears to flow northerly into this unnamed stream via a buried pipe and culvert under NE 205th Street.

3.1.3 Wildlife

The WDFW (2014a) PHS database map shows no occurrences of species of concern, including endangered, threatened, sensitive, or other priority species or habitats on or adjacent to the project site. The Washington Natural Heritage Program (2011) database contains no records of Natural Heritage Features (e.g., listed plant species) in the section in which the project site occurs.

3.2 Results of Field Investigations

3.2.1 General Property and Site Description

The Church property consists of fairly flat terrain that slopes down sharply on the northeast and northwest corners of the site, and is bordered by NE 205th Street on the north, and 136th Avenue NE to the east. The site contains houses, driveways, barns, sheds, and garages. The undeveloped northeastern and southern portions of the property contain a mixed coniferous deciduous forest. Undeveloped area occurs to the west of the site. A subdivision of residences occurs directly south of the Church property.

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3.2.2 Vegetation and Habitat Descriptions

Vegetation Community

Raedeke Associates, Inc. did not identify or delineate any wetlands on the property. The upland forest was dominated by Douglas fir and western red cedar, and included a well-developed but patchy layer of tall shrubs, primarily Himalayan blackberry, with smaller amounts of salmonberry, red elderberry, and western sword-fern (see Appendix A for sample plot data). The vegetation community would not be considered hydrophytic, as most of the dominant species were not rated FAC or wetter (Reed 1988; Lichvar and Kartesz 2009).

Soils were generally consistent with the Everett soil series mapped for the site, with no positive indicators of hydric soil. The soil profile within the topographic swale consisted a brown (10YR 4/3) sandy loam to at least 16 inches, with no redoximorphic features (see Appendix A).

On-site Stream

Raedeke Associates, Inc. did identify and delineate the ordinary high water mark (OHWM) of a stream along the western boundary of the site (Figure 3). The stream flows north along the western property boundary before flowing below NE 205th Street via a culvert. The stream channel is 3- to 5-feet wide and was approximately 6- to 8-inches deep during our February 4, 2014 site visit. The substrate of the stream is sand, silt, and small gravel. The on-site portion of the stream has a slope of less than 5%. Portions of the stream west of the site received a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) on February 24, 2005. In that HPA, the WDFW determined that "fish passage is not a concern", indicating that the stream is not fish bearing. The upland area adjacent to the east side of the stream contains existing structures, driveways, and non-native plant species, such as a lawn, and as such is considered degraded and not in a natural condition.

Special Habitat Features

Special habitat features include biologic elements such as snags, coarse woody debris (down logs), and edges between plant communities or successional stages, which are often important to wildlife (Brown 1985, Thomas and Verner 1986). Snags provide important foraging habitat, as well as breeding and cover sites for invertebrates and a variety of vertebrate wildlife species. Raedeke Associates, Inc. noted a few small snags and downed logs in the southern portion of the site. We observed no evidence of foraging on the snags or downed logs. The WDFW (2014a) PHS database does not depict any occurrences of priority species or habitats on the site or immediate vicinity.

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3.2.3 Wildlife

Wildlife Use and Observations

A wide variety of wildlife species may be expected to inhabit lowland mixed forest communities in the Pacific Northwest, such as that found on the Church site. Of the more than 300 vertebrate wildlife species expected to occur in west side forests of Oregon and Washington, over 230 species occur within west side lowland mixed coniferous and deciduous forests (Johnson and O'Neil 2001). A more limited number of species are expected to occur within lowland mixed forests of western Washington, particularly King County: over 80 species, nearly 60% of which are birds, about 25% are mammals, and the rest are amphibians and reptiles (King County 1987). The number of species expected to inhabit a particular forest stand depends on its size, landscape context, and surrounding uses. Relatively small stands such as that on the Church property that are surrounded by urban residential uses, would be expected to support a more limited number of wildlife species. Those that do occur there may be further adversely affected by surrounding human activity and predation or other influences from urban-adapted species (such as crows and starlings), or other invasive species.

A variety of bird species are likely to inhabit the site and vicinity at different times of the year. Many of these are spring and summer residents that migrate out of the area for the fall and winter, as well as year-round residents. We observed no raptors (eagles, hawks, falcons and related species) during our field reconnaissance, and no raptor nests were found on any of the trees within the site. Most of the larger trees had intact tops and lacked appropriate branching structures to support large raptor nests such as bald eagles.

We observed no mammals or their sign during our field reconnaissance. Several species of small and medium-sized mammals likely use the site, though many are secretive and/or nocturnal and are therefore unlikely to be observed during a general site reconnaissance. The limited down woody debris was widely scattered within the site. This, along with areas of dense areas of shrub and ground cover, provide potential cover and breeding habitat for small mammals. In addition, on-site trees and snags provide potential cover and breeding locations for medium-sized mammals such as raccoons and squirrels. The presence of domestic dogs and cats in the area may limit the suitability of the forest on site, as they can act as highly effective predators on native wildlife species in urban and suburban areas, particularly those that nest or inhabit the ground (Penland 1984, Maestas et al. 2003, Odell and Knight 2001, Leu et al. 2008).

We did not observe any reptiles, amphibians, or their sign during our field reconnaissance, though a small number of species of each group could be present. The minimal amount of down woody debris on the site may limit the number of Puget Sound lowland terrestrial-breeding amphibians that could occupy the site. Potential cover and foraging habitat is present on the site for some reptiles, including garter snakes, and some amphibians. In addition, the relatively undeveloped nature of off-site areas to the west of

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the property provide for potential source populations of amphibians and reptiles, which may use portions of the project site.

Endangered, Threatened, Sensitive, or Other Priority Species

We observed no species listed as endangered, threatened, or sensitive within the project site or immediate vicinity, nor are any of these species considered to have a primary association with the project site. No snags appeared to be large and tall enough to provide suitable nesting or roosting habitat for pileated woodpeckers. No other priority or other species of concern were observed or likely to occur within the project site.

Wildlife Habitat Movement Corridors and Networks

Wildlife habitat networks or corridors can take different forms, depending on the landscape. Corridors can be in the form of hedgerows or fencerows connecting woodlots in an agricultural landscape. In a fragmented forested landscape, corridors are linear patches of forest or forested riparian zones connecting larger patches of forest. They can also be non-forested linear patches, such as utility easements, or wetland and stream systems, in a landscape that is forested. In an urbanizing environment, open space or native forestland can act as corridors connecting otherwise disjunct habitat for wildlife species.

Corridors can provide (1) habitat for certain species; (2) movement pathways; (3) extensions of foraging ranges for large, wide-ranging species; and (4) escape from predators (Harris 1984, Levenson 1981, Noss 1987, Noss and Harris 1986, Simberloff and Cox 1987). Corridors may also have disadvantages, such as (1) providing conduits for disease, fire, pests, and exotic species; (2) increasing exposure to predation; and, (3) potentially having negative genetic impacts on a population (Noss 1987, Simberloff and Cox 1987).

The Church property is situated generally within a larger area of residential development. The forested habitat of the site (primarily in the northeastern and southern parts of the site) is separated from other forested habitat in the area by existing roads on the north, east, south, and just off-site to the west. The on-site stream flows north into a culvert under NE 205th, then easterly along NE 205th Street. The road separates off-site riparian habitat from the on-site area. Because of the surrounding development, these habitats are relatively isolated from other native habitats within the City of Woodinville or in Snohomish County to the north and therefore do not provide linkages to other such habitats.

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4.0 REGULATORY CONSIDERATIONS

4.1 STREAMS

Streams and other waters of the United States are protected by Section 404 of the Federal Clean Water Act and other state and local policies and ordinances including the City of Woodinville (2014) code. The stream along the west property boundary appears to meet the City of Woodinville (2014) criteria as a Type 3 stream. The feature was rated as a Type 3 Stream because the stream is not depicted on the City of Woodinville (2009) critical areas map, which shows a mapped stream segment to the south of the site that is mapped as Type 3. The stream is also not mapped on the WDNR (2014) Forest Practices Water Type map. The on-site stream is also not shown on the WDFW (2014b) SalmonScape map. However, the Salmonscape map depicts two Total Blockage culverts (102 L009 and 102 L008) along an unnamed stream shown on Snohomish County (2014a, 2014b) reference maps along the north side of NE 205th Street east of the property. Since these blockages to fish passage are located downstream of the on-site stream segment, the on-site stream is not considered accessible to salmonid fish. City of Woodinville Code (WMC 21.24.370) identifies Type 3 streams as those with perennial or intermittent flow, used by fish other than salmonids as Type 3 streams. No study of fish use was conducted as part of this study. However, the presence of two downstream total blockage culverts likely precludes use of this stream segment by salmonids, and therefore the classification of Type 3 is the highest classification the stream can receive.

As stated previously, the WDFW issued a HPA for in-stream work to the west of the Parkwood Terrace in February 2005. That HPA documents that the stream is not fish bearing and as such would be a Type 4 water under WAC 222-16-031. WDFW Type 4 waters and City of Woodinville Type 3 streams are analogous.

The City of Woodinville (2014) code requires a 75 foot buffer on Type 3 streams. The code (WMC 21.24.380(1)(a)) allows for reduction of the buffer to 50 feet wide provided that certain criteria are met and the retained buffer is enhanced to protect stream functions:

> *(a) The standard buffer width will be established unless the existing stream buffer is significantly degraded. If the existing stream buffer is significantly degraded, the applicant may use the reduced buffer as referenced in subsection (1) of this section as long as enhancement measures are implemented to provide a net improvement in overall stream and buffer function and value as determined by a qualified biologist. Enhancement measures shall be conducted in accordance with a plan approved by the Development Services Director.*

As stated above, the stream buffer is considered degraded, as it contains existing structures, an access drive, and a lawn, its basin is already developed with residential housing and associated roads, approximately 17% of the standard buffer area on-site is

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currently impervious surface. Consequently, the City code allows provision of a reduced buffer of 50 feet as long as buffer enhancement is proposed.

4.2 WILDLIFE

4.2.1 State of Washington

State law provides protections for wildlife species listed as endangered (WAC 232-12-014), as well as threatened, sensitive, or "other protected" species (WAC 232-232-011). Recently, bald eagles have been de-listed at the State and federal level. However, eagles in Washington, currently listed as state sensitive, are still protected by the Bald Eagle Protection Act of 1984 (RCW 77.12.655), and the Bald Eagle Protection Rules (WAC 232-12-292). The Bald Eagle Protection rules have been amended such that state bald eagle management plans are no longer required unless bald eagles are again listed as Threatened or Endangered in Washington State. WDFW will not be asking local governments to require a bald eagle management plan prior to issuing local permits.

The WDFW (2014a) PHS and HRTG databases show no known nest or roost sites of eagles or other listed raptor species in the vicinity of the project site. In addition, we found no nests or potentially suitable nest trees on the project site or in the vicinity. In addition, the WDFW (2008) has developed management recommendations for "species of concern," which include state listed and other priority species, as well as priority habitats. Occurrences or signs of priority species or habitats in the vicinity of the project site are noted above. These management recommendations are often referenced in local critical area ordinances, such as the City of Woodinville in protection of "Fish and Wildlife Habitat Conservation Areas," or FWHCA.

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5.0 IMPACTS

5.1 IMPACTS TO VEGETATION

The proposed development would remove the forest habitat on the site and replace it with single-family residential housing and associated access road and landscaping. The on-site stream and a 50-foot buffer would be retained. As outlined below, existing structures, access drives, and non-native plant species within the retained buffer would be replaced with a native plant community of trees, shrubs, and ground covers. Existing native trees within the 50-foot buffer would be retained.

5.2 IMPACTS TO STREAMS

No direct impacts to streams would occur under the proposal. The planned development would reduce the buffer width adjoining the stream to 50 feet (Figure 3). Under current conditions the standard 75 foot wide buffer is not functional. The buffer contains a driveway, mowed and managed lawn, and a well. A total of 3,690 square-feet of the buffer area is comprised of impervious surfaces, approximately 17% of the 21,415 square-feet of buffer area. The proposal would remove the existing development within 50 feet of the stream and replace it with a mix of native shrubs, trees, and ground covers that would provide a functional buffer to the stream. Existing native trees within the 50-foot buffer would be retained. Figures 3 and 4 detail the proposed buffer restoration on the Church property.

The Woodinville Code (WMC 21.24.380) allows for reduction of stream buffers in situations where the existing stream buffer is degraded. The stream is not a Type 1 stream, the stream is piped below NE 205th Street in a buried culvert, the buffer is developed, and the sub-basin is highly developed. The buffer meets all criteria for buffer reduction identified in the code.

5.3 IMPACTS TO WILDLIFE

Direct alteration (reduction) to the distribution, composition, and amount of native vegetation resulting from the proposed residential development would affect the distribution and composition of native wildlife on the property.

Upon completion, the proposed residential development would eliminate the forest habitat available for native wildlife on the site. This would reduce the local populations of most native species on the property. Grading and construction activities associated with the proposed development, as well as increased levels of human activity on-site, would also result in increased short- and long-term disturbance to wildlife species. Over the long term, native forest vegetation would be expected to develop in the enhanced buffer area along the on-site stream and provide some on-site habitat for wildlife.

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5.4 Impacts to Endangered, Threatened, Sensitive, or Other Priority Species or Habitats

Because endangered, threatened, and sensitive wildlife species are not known or likely to occur on or in the site or have a primary association with any impacted habitats, no impacts to these species are expected.

No other priority species, or species of local importance, are known or likely to inhabit the site. Thus, the proposed development would not adversely affect such species.

The proposed site development plan would have no direct impact to streams or other habitats designated as fish and wildlife conservation areas, because none occur within the site. Consequently, no habitats or habitat features known or suspected to be used by other priority species or species of local importance would be affected by the proposed site plan.

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6.0 MITIGATION

Mitigation has been defined by the State Environmental Policy Act (SEPA) (WAC 197-11-768; cf. Cooper 1987), and more recently in a Memorandum of Agreement between the Environmental Protection Agency and the U.S. Army Corps of Engineers (Anonymous 1989). In order of desirability, mitigation may include:

1. ***Avoidance*** - avoiding impacts by not taking action or parts of an action;

2. ***Minimization*** - minimizing impacts by limiting the degree or magnitude of the action and its implementation;

3. ***Compensation*** - which may involve:

    a) repairing, rehabilitating, or restoring the affected environment;

    b) replacing or creating substitute resources or environments;

    c) mitigation banking.

6.1 AVOIDANCE AND MINIMIZATION

Conversion of the Church property to a residential development would incorporate one or more mitigating measures that would avoid, or minimize for impacts to on-site habitat (Figures 3 and 4):

- Direct impacts to the Type 3 on-site stream would be avoided, and the stream would be protected with a 50-foot buffer within a designated open space tract;
- No residential structures, impervious surfaces, or trails would be located within the designated open space tract;
- The proposed development would route stormwater runoff to a detention pond to provide water quality treatment and discharge it at controlled rates to existing conveyance facilities to protect downstream resources;
- Temporary erosion and sediment control (TESC) measures would be installed during construction and would utilize appropriate best management practices (BMPs) designed to prevent sediment from on-site open space tracts and off-site areas;

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6.2 Compensatory Mitigation

6.2.1 Proposed Buffer Enhancement

Compensation for the proposed buffer reduction of approximately 8,300 square feet would be provided by enhancing the retained 50-foot buffer (more than 13,100 square feet) by removing existing structures, access drive, 1,245 square-feet of impervious surface, and non-native plant communities and planting a mixture of native trees, shrubs, and ground covers (Figures 3 and 4). The buffer enhancement is intended to restore native forest community adjacent to the stream. Successful implementation of the enhancement plan would over time result in enhanced functioning of the stream buffer for protection of stream functions, such as protection of water quality, wildlife habitat, and recruitment of organic matter, compared with current degraded conditions of the buffer.

All plant materials would be locally grown and be of local origin. Tree stock would be two or five gallon container, 3- to 4-feet tall, and well-rooted and branched. Trees would be planted on 9-foot centers. Shrub stock would be one gallon, 18- to 24-inches tall, well-rooted and branched. Shrub plantings would be spaced on 5-foot centers. Existing native trees within the 50-foot buffer would be retained.

Prior to planting, a minimum of 12 inches of topsoil would be installed throughout the buffer enhancement area, as needed, to provide favorable growing conditions for the tree and shrub plantings establishment and growth. Topsoils must be approved by the project biologist prior to installation. Soil amendments, such as compost that has been prior-approved by the project biologist, may be added to salvaged on-site soils in order to create favorable soil conditions for tree and shrub planting establishment and growth.

The project biologist would review plant materials, soil amendment, and mulch for quality and quantity for consistency with the approved plans, as well as review and approve plant locations and supervise installation procedures. Tree and shrub plantings and all soils, soil amendments, or mulch cannot be installed within the buffer enhancement and buffer restoration areas without prior review and approval by the project biologist

All grading or other soil disturbing activities for site preparation should occur between March 1 and September 30 unless otherwise required by the City. All such work at any time of the year during inclement weather will not be permitted to occur without prior approval by the project biologist and may require use of techniques or equipment designed to minimize impacts to the stream.

Planting would occur between October 1 and March 1 to take advantage of seasonal rains and greater availability of plant material. Planting at any other time or during periods of abnormally hot, dry, or freezing weather conditions would not occur without prior

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approval by the project biologist and may require plant substitutions and supplemental irrigation.

A temporary irrigation system will be installed to provide supplemental water for all tree and shrub plantings during the first two growing seasons following installation. Irrigation will occur from June 1 through September 30 or other periods of hot, dry weather and will deliver approximately 1 inch of water per week throughout the buffer enhancement area. Any erosion will be rectified immediately upon discovery.

The enhanced buffer is designed to be self-sustaining. To ensure the success of the plantings, additional replanting and control of undesirable plant species may be necessary after initial installation. Invasive species would be controlled by methods that do not compromise the rest of the buffer plantings. Manual removal of invasive species is preferred, but does require early detection and action to be effective.

The on-site stream and its buffer would be placed into a sensitive areas tract and recorded with the City of Woodinville. A 3 to 4-foot-tall, split-rail cedar fence would be installed along the outer perimeter of the on-site portion of the wetland buffers in order to mark boundary of the environmentally sensitive area.

6.2.2 Monitoring

Because of the variable success of wetland and stream mitigation projects in the Pacific Northwest, the City of Woodinville (2014) requires that mitigation areas be monitored in order to evaluate their success in replacing lost wetland values and functions. Therefore, this plan includes a systematic monitoring program of the enhanced stream buffer to evaluate the success of the mitigation efforts. The results of the monitoring will be used to develop needed modifications to or alterations of the site in subsequent years.

The monitoring process would consist of three distinct phases: (1) construction monitoring; (2) compliance monitoring; and (3) long-term monitoring. Construction monitoring serves to ensure proper site preparation and plant placement relative to actual site conditions. The "time-zero" or baseline composition, structure, and cover abundance would be documented during the compliance monitoring phase. The long-term monitoring program would document the survival of planted vegetation and rates of colonization by other plants (i.e., in bare soil areas) over a five-year period after implementation of the mitigation plant is completed.

During long-term monitoring, plant species would be identified, and the cover and abundance would be estimated for each plant species within sample plots established during compliance monitoring. Vegetation descriptors measured at each sample plot consist of percent cover and species composition. In addition, plant counts would be made during monitoring in order to document the percent survival of each planted species. Plant identifications would be made according to standard taxonomic procedures

described in Hitchcock and Cronquist (1976), with nomenclature as updated by the U.S. Army Corps of Engineers National Wetland Plant List (Lichvar and Kartesz 2009). Signs of planting stress or damage, presence of invasive species, as well as signs of vigor, and rates of colonization by other plants (i.e., in bare soil areas) would be documented during each year of the long-term monitoring.

Photos would be taken annually to provide physical documentation of the condition of the enhancement area. Photographs would be taken from all locations established during the compliance monitoring site visit and each year thereafter of the monitoring period from the established location points.

Formal monitoring of the enhanced stream buffer would occur after the season's growth is virtually complete (recommended during August or September). In addition, spring and mid-summer site checks would be conducted during each year of the three-year long-term monitoring period to assess site progress and to determine whether site maintenance is needed.

Monitoring reports would be prepared following the completion of the growing season of each year of the five-year long-term monitoring period for submittal to the City of Woodinville. The long-term monitoring period will commence following acceptance of the compliance report and "as-built" drawings by the City of Woodinville.

Monitoring reports would be submitted for review and approval by the City of Woodinville as soon as possible after the monitoring has been completed, with a target date of December 31 of each monitoring year. The report would document conditions within the enhanced areas and make recommendations for correcting any problems encountered.

6.2.3 Performance Standards

Specific performance standards to be used in the five-year long-term monitoring are the following:

- 100% survival of all planted shrubs and trees in the enhanced and restored buffers following completion of the first year after planting. All plantings that do not survive during the first year must be replaced with the same or similar species and specifications. Upon installation of replacement plantings at the conclusion of the first year, the 100% survival performance standard will be considered to be met;
- 85% survival of all planted shrubs and trees in the enhanced and restored buffers following completion of the third year after planting. Sufficient plantings will be replaced, as necessary, with the same or similar species and specifications in order to meet the 85% survival standard. If the mitigation site fails to meet this performance standard, the reason for the failure will be evaluated, replacement

plantings will be provided, and additional monitoring may be required by the City to verify that a self-sustaining native plant community has been established;

- 75% survival of all planted shrubs and trees in the enhanced and restored buffers following completion of the fifth year after planting. Sufficient plantings will be replaced, as necessary, with the same or similar species and specifications in order to meet the 75% survival standard. If the mitigation site fails to meet this performance standard, the reason for the failure will be evaluated, replacement plantings will be provided, and additional monitoring may be required by the City to verify that a self-sustaining native plant community has been established;
- There will be no more than 10% cover by Himalayan blackberry or other invasive plant species, as identified by the project biologist at any time during the five-year monitoring period;

6.2.4 Contingency Plan, Implementation Schedule, and Bonding

Contingency plans are needed if post-buffer enhancement monitoring shows that objectives and performance standards have not been met. It should be noted, however, that it is not possible to develop a detailed contingency plan until the specific problems that need to be addressed are known. It would be unproductive to try to anticipate all possible problems and their solutions at this time.

However, common problems, both human and natural, that might arise can be identified and general remedial recommendations proposed. For example, if after the second year, area cover or species composition by planted trees and shrubs is not at an acceptable level, it may be necessary to replant with new or different stock, provide additional watering or irrigation during critical seasons, or augment the soil.

Spring and late summer site checks will be made during each year of the long-term monitoring to determine if there are any developing problems within the mitigation site prior to the long-term monitoring site visits. With early identification, plant replacement, additional irrigation, or maintenance can be accomplished prior to the long-term monitoring site visits and thus, development of the mitigation site can be better assured.

Implementation of a contingency plan may require extension of the monitoring phase of the project, especially if major changes in the plan are required. The project biologist should make recommendations for identified problems. All contingency measures must be reviewed and approved by the City of Woodinville.

Upon approval of this conceptual enhancement plan, final construction documents would be prepared for review and approval by the City of Woodinville. In addition to plant species, sizes, quantities, and locations, the final documents would specify such items as: (1) general notes, (2) planting details, (3) construction timing, (4) protection of existing

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vegetation, (5) source of plant material, (6) soil amendments, (7) watering, (8) maintenance, and (9) a bond estimate.

Bond provisions, to ensure that mitigation is completed as designed and that restoration or rehabilitation is performed if any portion of the project fails within five years of implementation, are required by the City of Woodinville. These will be prepared upon final review of permits from the City of Woodinville, based on the final buffer enhancement plans, which as noted above would include detailed planting plans and construction notes.

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7.0 LIMITATIONS

We have prepared this report for the exclusive use of Quadrant Homes and their consultants. No other person or agency may rely upon the information, analysis, or conclusions contained herein without permission from Quadrant Homes.

The determination of ecological system classifications, functions, values, and boundaries is an inexact science, and different individuals and agencies may reach different conclusions. With regard to wetlands, the final determination of their boundaries for regulatory purposes is the responsibility of the various agencies that regulate development activities in wetlands. We cannot guarantee the outcome of such determinations. Therefore, the conclusions of this report should be reviewed by the appropriate regulatory agencies.

We warrant that the work performed conforms to standards generally accepted in our field, and prepared substantially in accordance with then-current technical guidelines and criteria. The conclusions of this report represent the results of our analysis of the information provided by the project proponent and their consultants, together with information gathered in the course of the study. No other warranty, expressed or implied, is made.

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FIGURES

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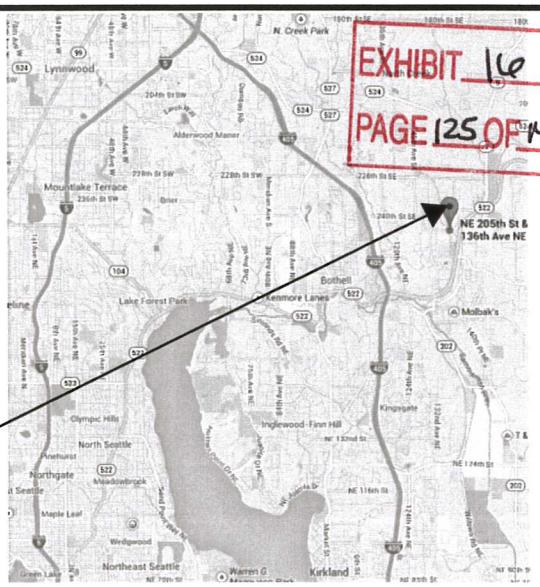
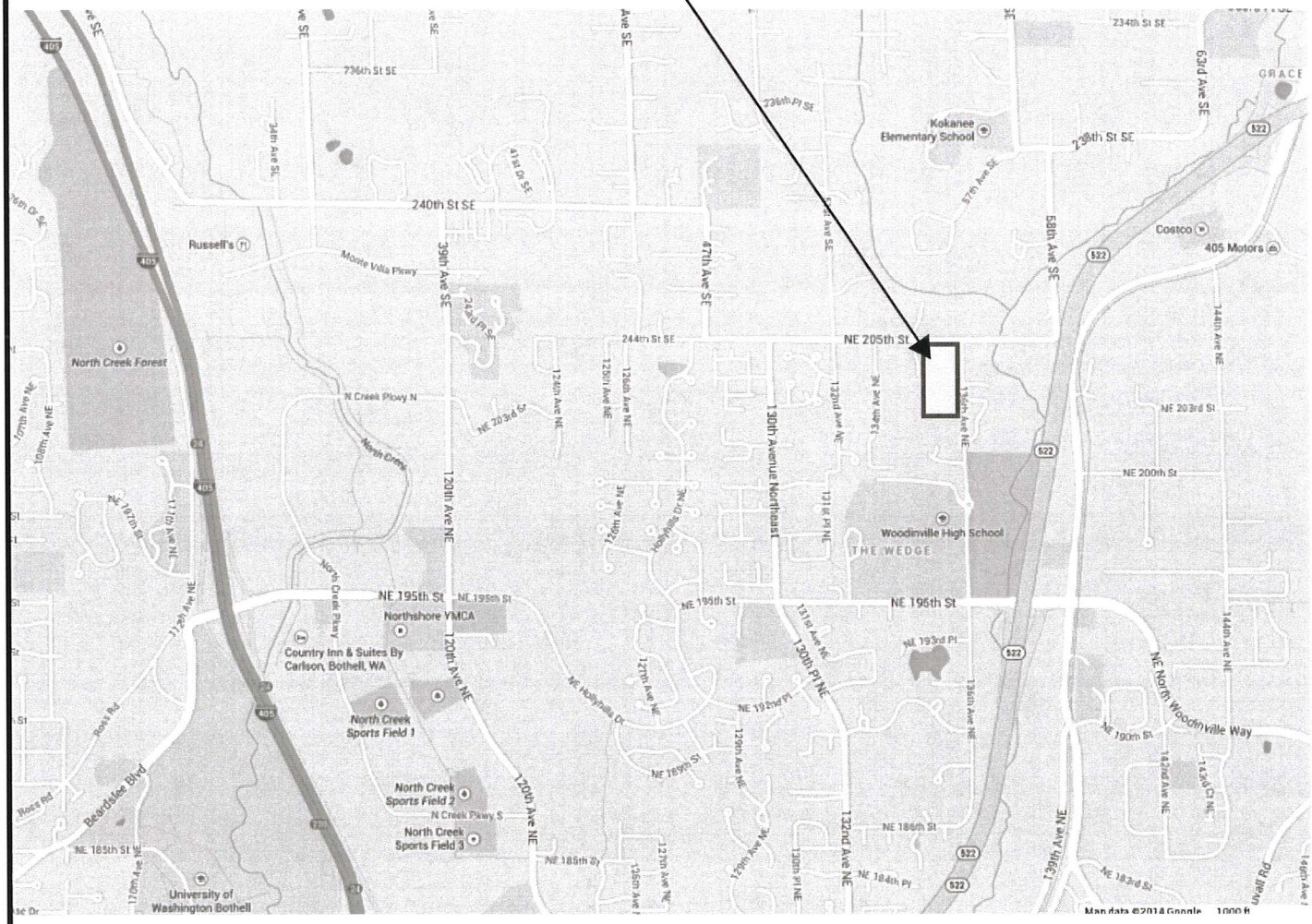


PROJECT LOCATION



SOURCE: Google Maps. Available at: https://www.google.com/maps. Accessed on 6/09/14.

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FIGURE 1

REGIONAL & VICINITY MAP

CHURCH PROPERTY

WOODINVILLE, WA

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI # 2014-013

FIGURE 2

QUADRANT

CHURCH PROPERTY

CRITICAL AREAS ASSESSMENT

EXISTING CONDITIONS

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NE 205TH STREET

N 88°45'15" W 1318.82'

363.15'

STREAM 1

EX. DRIVEWAY

TPN 032605-9049-06

LAWN

EX. BUILDING

75' STREAM 1 BUFFER

GEORGIAN HEIGHTS PHASE 4

STREAM 1 CONTINUES OFF-SITE

EX. DRIVEWAY

EX. BUILDING

437.18'

14"F
12"A
16"F
24"COT
16"F
18"F
18"D

LAWN

EX. BUILDING

BARN

EX. BUILDING

136TH AVE NE

N 00°22'51" W 453.31'

TPN 032605-9095-09

BOUNDARY 1

GEORGIAN HEIGHTS PHASE 5

LEGEND

- PROJECT BOUNDARY
- STREAM OHWM
- 75' STREAM BUFFER
- EXISTING TREES

BUFFER

STREAM CHANNEL

NORTH

0 25' 50' 100'

SCALE: 1" = 50'

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI PROJECT: 2014-013-002

DATE: MARCH 10, 2015

DRAWN BY:AC | PM:CW

BASE INFORMATION: SURVEY & SITE PLAN
BLUELINE | 25 Central Way, Suite 400
Kirkland, WA 98033 Ph: 425.216.4051

T:\2014\2014-013 Quadrant Church\11x17 2014-013 Church.dwg

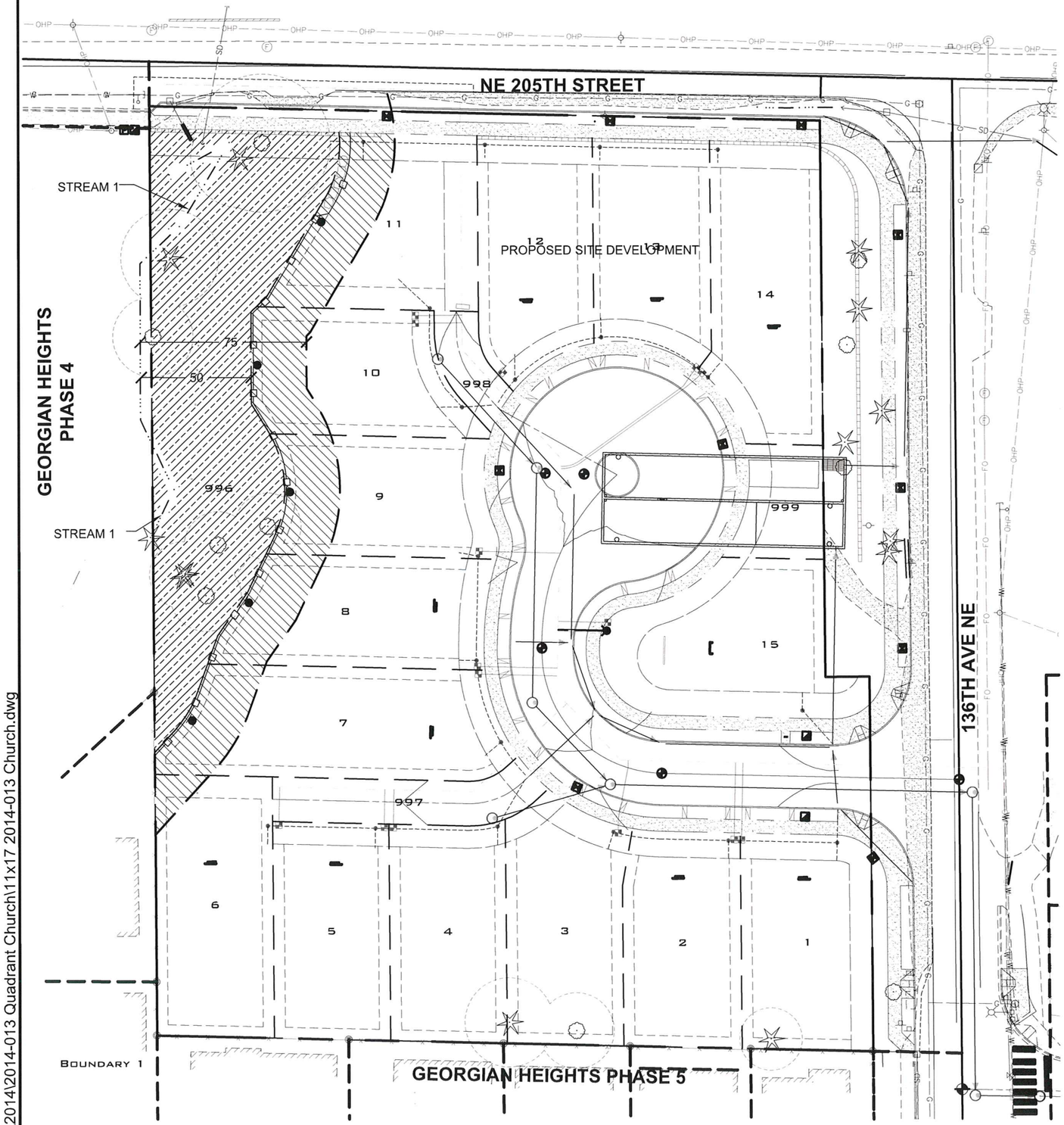
FIGURE 3

QUADRANT

CHURCH PROPERTY

CRITICAL AREAS ASSESSMENT

PROPOSED SITE PLAN & MITIGATION



LEGEND

- PROJECT BOUNDARY
- EXISTING CONTOURS
- STREAM OHWM
- 75' STREAM BUFFER
- PROPOSED 50' STREAM BUFFER
- REMAINING TREES
- BUFFER REDUCTION 8,300 SF APPROX.
- BUFFER ENHANCEMENT 13,115 SF APPROX.
- SPLIT RAIL NGPA FENCE (SEE DETAIL 1)
- CRITICAL AREAS SIGN (SEE DETAIL 2)

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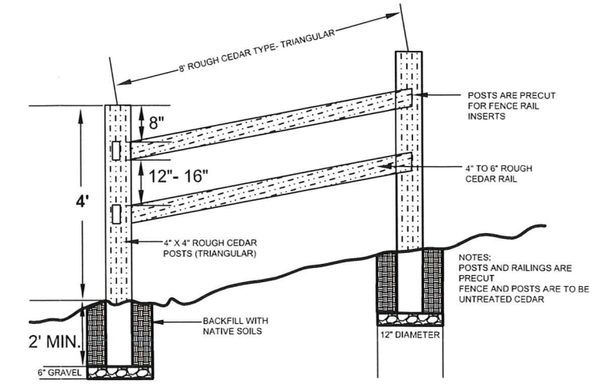
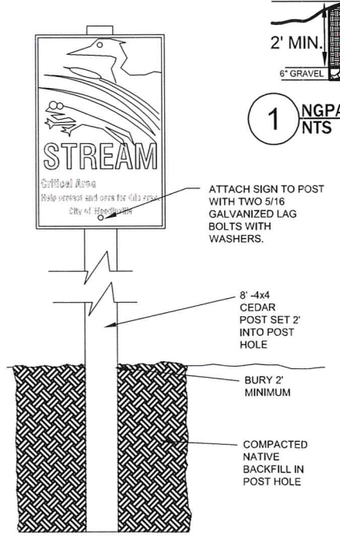


1 NGPA SPLIT RAIL CEDAR FENCE
NTS



NOTES:
Critical Area signs shall be mounted on posts set into the ground at 100' intervals or 1 per lot for smaller lots.

2 CRITICAL AREA SIGN
NTS

NORTH

0 25' 50' 100'

SCALE: 1" = 50'

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI PROJECT: 2014-013-002	
DATE: MARCH 10, 2015	
DRAWN BY:AC	PM:CW

BASE INFORMATION: SURVEY & SITE PLAN
BLUELINE | 25 Central Way, Suite 400
Kirkland, WA 98033 Ph: 425.216.4051

T:\2014\2014-013 Quadrant Church\11x17 2014-013 Church.dwg

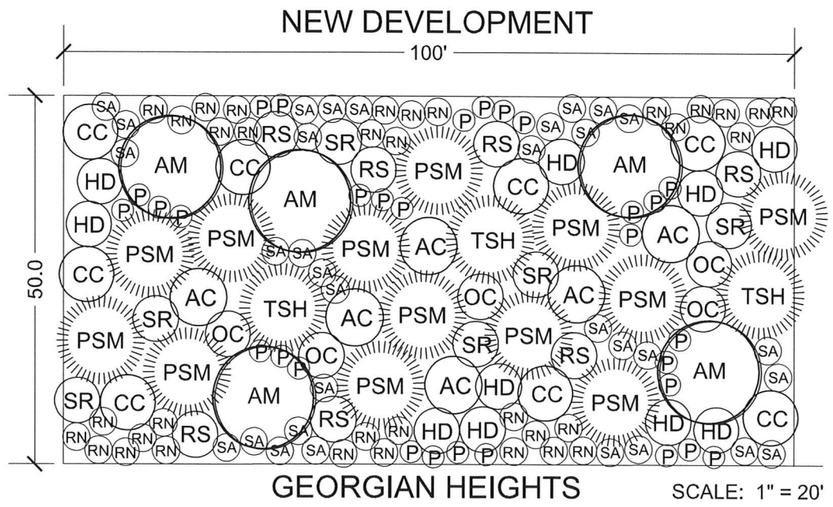
PLANT LEGEND

TREES

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MIN. SIZE
AM	*Acer macrophyllum*	Big Leaf Maple	4' tall
PSM	*Pseudotsuga menziesii*	Douglas Fir	4' tall
TP	*Thuja plicata*	Western red Arborvitea	4' tall

SHRUBS

SYMBOL	SCIENTIFIC NAME	COMMON NAME	MIN. SIZE (container)
AC	*Acer circinatum*	Vine Maple	5 gal.
CC	*Corylus cornuta*	Beaked Hazelnut	3 gal.
HD	*Holodiscus discolor*	Creambush	3 gal.
OC	*Oemleria cerasiformis*	Osoberry	3 gal.
P	*Polystichum munitum*	Pineland Swordfern	1 gal.
RS	*Ribes sanguineum*	Redflower Currant	3 gal.
rn	*Rosa nutkana*	Nootka Rose	1 gal.
SR	*Sambucus racemos*	Red Elder	3 gal.
S	*Symphoricarpos albus*	Common Snowberry	1 gal.



PLANT TYPICAL

CONSTRUCTION SEQUENCE

1. CONTRACTOR SCHEDULES AND ATTENDS A PRE-CONSTRUCTION MEETING WITH THE PROJECT BIOLOGIST, LANDSCAPE DESIGNER/ ARCHITECT AND CITY OF WOODINVILLE BIOLOGIST.
2. CONTRACTOR WILL FLAG ALL THE LIMITS OF THE ENHANCEMENT AREAS FOR PROJECT BIOLOGIST APPROVAL. CONTRACTOR WILL WALK THE SITE WITH THE PROJECT BIOLOGIST TO CLARIFY LIMITS OF CONSTRUCTION AND THE WORK TO BE PERFORMED.
3. CONTRACTOR WILL INSTALL TEMPORARY EROSION/SEDIMENT CONTROL MEASURES AS REQUIRED FOR PROJECT BIOLOGIST APPROVAL PRIOR TO THE COMMENCEMENT OF WORK.
4. CONTRACTOR WILL REMOVE ALL GARBAGE, DEBRIS, HARD SURFACE MATERIAL, GRAVEL AND INVASIVE SPECIES FROM BUFFER ENHANCEMENT AREA AS DIRECTED BY THE PLANS AND PROJECT BIOLOGIST.
5. CONTRACTOR WILL DE-COMPACT SOIL AS NECESSARY AND AMEND EXISTING SOIL WITH COMPOST AS NECESSARY.
6. CONTRACTOR WILL LAY OUT NURSERY-GROWN PLANTS PER PLANS FOR APPROVAL BY THE PROJECT BIOLOGIST. FOLLOWING LAYOUT APPROVAL, CONTRACTOR TO INSTALL PLANTS, SEED AND MULCH AS DIRECTED BY PLANS.
7. THE PROJECT BIOLOGIST WILL APPROVE PLANT INSTALLATION.
8. CONTRACTOR SUBMITS AS-BUILT DRAWING AND COPIES OF INVOICES FOR ALL PLANT, SOIL AMENDMENT, AND MULCH MATERIALS USED TO THE PROJECT BIOLOGIST.
9. PROJECT BIOLOGIST SUBMITS AS-BUILT REPORT TO THE CITY OF WOODINVILLE FOR REVIEW AND APPROVAL.

GOALS AND OBJECTIVES

THE OVERALL CRITERIA FOR THE ENHANCED BUFFER AREA IS TO CREATE A NATIVE PLANT COMMUNITY THAT WILL BUFFER THE STREAM FROM THE HOUSING COMMUNITY WITH NATIVE PLANTS APPROPRIATE FOR THE PROXIMITY OF THE ROAD. THE OVERALL CRITERIA FOR THE ENHANCED BUFFER WOULD BE BASE ON THE SUCCESSFUL ESTABLISHMENT OF DESIRED PLANT COMMUNITIES. EVALUATION CRITERIA FOR SUCCESS OF THE MITIGATION PLAN WOULD NOT BE 100 PERCENT SURVIVAL OF INDIVIDUAL PLANT MATERIALS (EXPECT AS NOTED BELOW) BUT RATHER THE ESTABLISHMENT OF DESIRABLE PLANT COMMUNITIES WITHIN THE ENHANCED BUFFER. OBJECTIVES OF THE MITIGATION PLAN CONSIST OF THE FOLLOWING

1. ENHANCE EXISTING STREAM AND BUFFER FUNCTIONS THROUGH THE INSTALLATION OF NATIVE TREES AND SHRUBS
2. REMOVE INVASIVE SPECIES IDENTIFIED BY THE PROJECT BIOLOGIST FORM THE AREAS OF ENHANCEMENT.

PERFORMANCE STANDARDS

1. 100% SURVIVAL OF ALL PLANTED SHRUBS AND TREES FOR ONE YEAR AFTER PLANTING. ALL PLANTINGS THAT DO NOT SURVIVE THROUGH THE END OF THE FIRST GROWING SEASON WILL BE REPLACED WITH THE SAME OR SIMILAR SPECIES AND SPECIFICATIONS. UPON INSTALLATION OF REPLACEMENT PLANTING AT THE CONCLUSION OF THE 1ST YEAR, THE 100% SURVIVAL STANDARD WILL BE CONSIDERED TO BE MET:
2. 85% SURVIVAL OF ALL PLANTED SHRUBS AND TREES AFTER THREE YEARS. SUFFICIENT PLANTINGS WILL BE REPLACED, AS NECESSARY, WITH THE SAME OR SIMILAR SPECIES AND SPECIFICATIONS IN ORDER TO MEET THE 85% SURVIVAL. UPON INSTALLATION OF REPLACEMENT PLANTING AT THE CONCLUSION OF THE 3RD YEAR, THE 85% SURVIVAL STANDARD WILL BE CONSIDERED TO BE MET:
3. TOTAL COVERAGE BY SHRUB AND TREE SPECIES (INCLUDING NATIVE VOLUNTEER SPECIES) WITHIN THE BUFFER ENHANCEMENT AREA SHALL BE:
   - AT LEAST 5% AFTER ONE YEAR
   - AT LEAST 20% AFTER THREE YEARS
   - AT LEAST 50% AFTER FIVE YEARS
4. AT THE TIME OF COMPLIANCE MONITORING THERE SHALL BE 0% INVASIVE SPECIES. THERE SHALL BE LESS THAN 10% CUMULATIVE COVER OF THE FOLLOWING INVASIVE PLANT SPECIES WITHIN THE BUFFER ENHANCEMENT AREA AT THE END OF THE FIVE YEAR MONITORING PERIOD: HIMALAYAN BLACKBERRY (*RUBUS ARMENIACUS*), CUTLEAF BLACKBERRY (*RUBUS LACINATUS*), REED CANARYGRASS (*PHALARIS ARUNDINACEA*), SCOT'S BROOM (*CYTISUS SCOPARIUS*), OR OTHER SPECIES AS DETERMINED BY THE PROJECT BIOLOGIST.

FIGURE 4

QUADRANT

CHURCH PROPERTY

CRITICAL AREAS ASSESSMENT

BUFFER ENHANCEMENT PLAN

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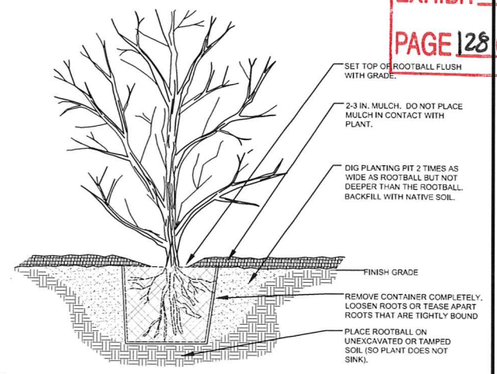

1 CONTAINER TREE OR SHRUB PLANTING DETAIL
NTS

PERFORMANCE BOND

IF THE APPLICANT SEEKS A DEVELOPMENT PERMIT THAT IS CONTINGENT ON THE PERFORMANCE OF A MITIGATION PROJECT, AN ASSIGNMENT OF FUNDS FOR 150% OF THE COST OF THE MITIGATION MUST BE SUBMITTED TO THE PERMIT CENTER PRIOR TO ISSUANCE OF THE DEVELOPMENT PERMIT. THE ASSIGNMENT OF FUNDS WILL BE HELD UNTIL THE MITIGATION HAS BEEN COMPLETED AND APPROVED BY THE CITY OF WOODINVILLE'S ENVIRONMENTAL SPECIALIST. ONCE THE MITIGATION HAS BEEN APPROVED, THE ASSIGNMENT OF FUNDS WILL CONVERT TO A MAINTENANCE MONITORING ASSIGNMENT OF FUNDS.

Raedeke Associates, Inc.
9510 Stone Avenue North
Seattle, WA 98103

RAI PROJECT: 2014-013-002

DATE: MARCH 10, 2015

DRAWN BY:AC | PM:CW

BASE INFORMATION: SURVEY & SITE PLAN
BLUELINE | 25 Central Way, Suite 400
Kirkland, WA 98033 Ph: 425.216.4051

T:\2014\2014-013 Quadrant Church\11x17 2014-013 Church.dwg

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PAGE 129 OF 147

APPENDIX A:

Sample Plot Data Sheets

EXHIBIT 16
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WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Quadrant Church City/County: Woodinville/King Sampling Date: 2-4-14

Applicant/Owner: Quadrant State: WA Sampling Point: SP-1

Investigator(s): Chris Wright Section, Township, Range: S3 T26N R5E

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): Convex Slope (%): 5

Subregion (LRR): Northwest forests & coasts (LRR-A) Lat: 47 46 31.73N Long: 122 09 36.37W Datum: unknown

Soil Map Unit Name: Alderwood gravelly sandy loam, 8 to 16 percent slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Sample point is located near wetland boundary flag 1. Sample plot is located within a pasture that is actively grazed by cattle.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Thuja plicata (western red cedar)	25	Y	FAC
2.			
3.			
4.			
	25 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m radius)			
1. Rubus armeniancus (Himalayan blackberry)	25	Y	FACU
2. Rubus spectabilis (Salmon rasberry)	20	Y	FAC
3.			
4.			
5.			
	45 = Total Cover		
Herb Stratum (Plot size: 1m radius)			
1. Gramineae spp.	20	NA	NI
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	20 = Total Cover		
Woody Vine Stratum (Plot size: 3m radius)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 40

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☒ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☒ No ☐

Remarks: Sample plot between driveway and west boundary fence

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SOIL

Sampling Point: SP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 4/3	100					sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: lack of hydric indicators

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No hydrology to 16 inches

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WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Quadrant Church City/County: Woodinville/King Sampling Date: 2-4-14

Applicant/Owner: Quadrant State: WA Sampling Point: SP-2

Investigator(s): Chris Wright Section, Township, Range: S3 T26N R5E

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): Convex Slope (%): 5

Subregion (LRR): Northwest forests & coasts (LRR-A) Lat: 47 46 31.73N Long: 122 09 36.37W Datum: unknown

Soil Map Unit Name: Alderwood gravelly sandy loam, 8 to 16 percent slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Sample point is located near wetland boundary flag 1. Sample plot is located within a pasture that is actively grazed by cattle.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Thuja plicata (western red cedar)	25	Y	FAC
2. Alnus rubra (red alder)	30	Y	FAC
3.			
4.			
	55	= Total Cover	
Sapling/Shrub Stratum (Plot size: 3m radius)			
1. Rubus armeniancus (Himalayan blackberry)	40	Y	FACU
2.			
3.			
4.			
5.			
	40	= Total Cover	
Herb Stratum (Plot size: 1m radius)			
1. Polystichum munitum (sword fern)	20	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	20	= Total Cover	
Woody Vine Stratum (Plot size: 3m radius)			
1.			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum 40

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species 55	x 3 = 165
FACU species 60	x 4 = 240
UPL species	x 5 =
Column Totals: 115 (A)	405 (B)

Prevalence Index = B/A = 3.52

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ☐ No ☒

Remarks: Sample plot in southwestern portion of site

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SOIL

Sampling Point: SP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 4/3	100					gr. s. loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: lack of hydric indicators

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No hydrology to 16 inches

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SAFE WALK REPORT

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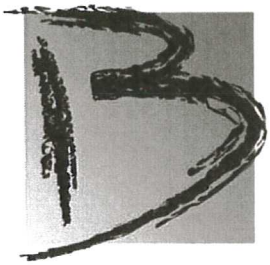

Parkwood Terrace

City of Woodinville, Washington

Safe Walk Report

Prepared for
Quadrant Homes
14725 SE 36th Suite 200
Bellevue, WA 98006

Date: March 10th, 2015

Blueline Job No. 14-175

Prepared by: Chester Bennett
Reviewed by: Geoff Tamble, PE

BLUELINE LAND DEVELOPMENT CONSULTING
25 CENTRAL WAY SUITE 400 KIRKLAND WA 98033 ■ TEL 425-216-4051 FAX 425-216-4052 ■ THEBLUELINEGROUP.COM

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SECTION 2 SAFE WALK ROUTES EXISTING CONDITIONS....2-1
SECTION 3 SIDEWALK DEFICIENCY PHOTOS....3-1

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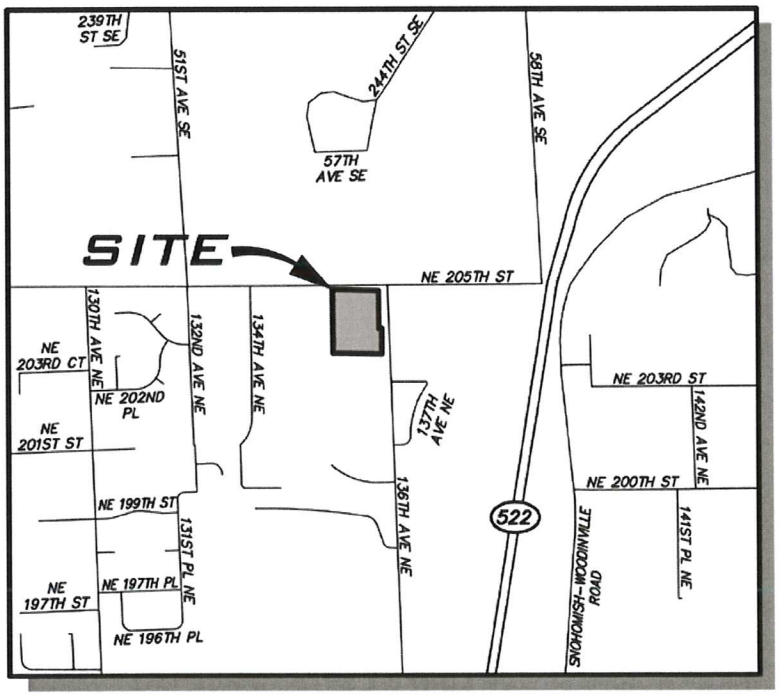
Section 1 Project Overview

The Parkwood Terrace project (formerly known as the Church project) is located at 13457 NE 205th Street, Woodinville WA. The site contains two adjacent parcels that make up the southwest corner at the intersection of NE 205th Street and 136th Ave NE.



Vicinity Map
not to scale

In the existing condition, both parcels are comprised of single family residences with associated driveways and several sheds and garages. The site contains gravel drive aisles, gravel parking areas, maintained residential lawn, and thick brush and forested cover at the southern and eastern portions of the site.

The Parkwood Terrace project proposes to subdivide the two existing parcels into 15 lots with supporting infrastructure, including roadway, utilities, drainage tract, and a sensitive area tract. Existing residences, infrastructure, and all sheds and garages will be removed, and access will be provided on the eastern boundary of the site from 136th Ave NE.

The purpose of this report is to identify and detail safe walking routes to nearby elementary and high schools for the subject property described above.

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Section 2 Safe Walk Routes Existing Conditions

The project is required to provide safe walk routes to the nearest high school as well as elementary school. One reasonable walking path was identified as a route to Woodinville High School and two reasonable walking paths were identified as routes to Woodin Elementary School. Please see the *Safe Walk Route Exhibit* at the end of this section that shows the routes described below. Photos noted in the description below indicate regions of sidewalk deficiencies found at the time of the field investigation see Section 3 for these photos and further descriptions.

Woodinville High School

The High School route is approximately 1,651 feet in length. The route begins at the corner of NE 205th Street and 136th Ave NE and follows 136th Ave NE to the south. The walking path to Woodinville High School

From the starting point there is a gravel / dirt shoulder (photo 1) on the west and east side of the 136th Ave NE that ranges from approximately 3 – 7 feet in width. These shoulders extend south along the west and east sides of 136th Ave NE for approximately 379 feet.

At this point a paved sidewalk begins on the east side of 136th Ave NE that extends 789 feet. The paved walk then transitions into a gravel walk near the Rotary Community Park and continues along the east side of 136th Ave NE for approximately 483 feet to meet a paved sidewalk at the traffic circle adjacent to the northeastern corner of the Woodinville High School property.

Returning to the west side of the street, 379 feet from the corner of NE 205th Street and 136th Ave NE the gravel / dirt shoulder on the west side of 136th Ave NE continues for approximately 55 feet. At this point a paved sidewalk begins on the west side of 136th Ave NE and extends south for approximately 180 feet before ending. At this point a gravel / dirt shoulder begins that is approximately 5 – 8 feet in width (photo 2) and extends south for approximately 398 feet. The remaining distance of the walking path on the west side of 136th Ave NE to Woodinville High School, approximately 639 feet, is outfitted with paved sidewalk along with appropriately signed and marked cross walks traversing roadways and access roads. The Safe Walk Route analysis was terminated at the northeastern corner of the Woodinville High School property along 136th Ave NE.

Woodin Elementary School

Elementary Route 1 is approximately 4,575 feet in length. The route begins at the corner of NE 205th Street and 136th Ave NE and follows 136th Ave NE to the south. The route continues along NE 195th Street to end at Woodin Elementary School. From the starting point there is a gravel / dirt shoulder

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(photo 1) on the west and east side of the 136th Ave NE that ranges from approximately 3 – 7 feet in width. These shoulders extend south along the west and east sides of 136th Ave NE for approximately 379 feet.

At this point a paved sidewalk begins on the east side of 136th Ave NE that extends 789 feet. The paved walk transitions into a crushed gravel walking path that continues along the east side of 136th Ave NE for approximately 483 feet to meet a paved sidewalk at the traffic circle. The paved sidewalk continues around the traffic circle for approximately 150 feet. At this point the paved sidewalk ends and a crushed gravel walking path continues south along the east side of 136th Street for approximately 610 feet. A paved sidewalk begins and continues 251 feet until the intersection of 136th Ave NE and NE 195th Street. The remaining distance of the walking path along the north side of NE 195th Street to Woodin Elementary School, approximately 1,913 feet, is outfitted with paved sidewalks and appropriately signed and marked cross walks traversing roadways and access roads. The safe walk route analysis was terminated at the northeastern corner of the Woodin Elementary School property along NE 195th Street.

Returning to the west side of the street, 379 feet from the corner of NE 205th Street and 136th Ave NE, a gravel / dirt shoulder on the west side of 136th Ave NE continues for approximately 55 feet. At this point a paved sidewalk begins and extends south for approximately 180 feet before ending. At this point a gravel / dirt shoulder begins that is approximately 5 – 8 feet in width (photo 2) and extends south for approximately 398 feet. At this point a paved sidewalk begins on the west side of 136th Ave NE and continues along 136th Ave NE for approximately 1,650 feet until the intersection of 136th Ave NE and NE 195th Street. This section of the walking path is outfitted with paved sidewalks and appropriately signed and marked cross walks traversing roadways and access roads. The remaining distance of the walking path along the north side of NE 195th Street to Woodin Elementary School, approximately 1,913 feet, is outfitted with paved sidewalks and appropriately signed and marked cross walks traversing roadways and access roads. The safe walk route analysis was terminated at the northeastern corner of the Woodin Elementary School property along NE 195th Street.

Elementary Route 2 is approximately 4,535 feet in length. The route begins at the corner of NE 205th Street and 136th Ave NE and follows NE 205th Street to the west. The route then extends south on 132nd Ave NE, 131st Place NE, then west on NE 197th Place, and south on 130th Ave NE to end at Woodin Elementary School. From the starting point the north side of NE 205th Street has a narrow shoulder ranging between 1 – 2 feet (photo 3) that extends approximately 489 feet until a driveway. At this point a shoulder ranging between 3 – 8 feet of grass / dirt (photo 4) extends approximately 771 feet on the north side of the street to the corner of NE 205th Street and 132nd Ave NE.

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From the starting point at the corner of NE 205th Street there is a grassy / dirt shoulder (photo 3) on the south side of the NE 205th Street that ranges from approximately 3 – 4 feet in width with an adjacent ditch approximately 2 feet deep. This shoulder extends west along NE 205th Street for approximately 351 feet until just past the northwestern corner of the subject property. At this point there is no shoulder present for approximately 40 feet as the shoulder slopes severely over and around a stream (photo 5). After the stream a paved shoulder flares toward the south side of NE 205th Street to meet a paved sidewalk that extends west for approximately 65 feet until 135th Court NE interrupts the sidewalk and a crosswalk and ramp is provided to cross 135th Court NE. The sidewalk resumes and continues west for approximately 400 feet until 134th Ave NE interrupts the sidewalk and a crosswalk and ramp is provided to cross 134th Ave NE. The sidewalk continues west along NE 205th Street for approximately 73 feet. At this point the sidewalk terminates and a paved shoulder tapers to meet the roadway edge within approximately 20 feet (photo 6). Continuing west along the south side of NE 205th Street there is a ditch approximately 2 feet in depth directly adjacent to the edge of pavement of NE 205th Street. There is no shoulder present for approximately 311 feet (photo 7) until the intersection of NE 205th Street and 132nd Ave NE.

At the corner of NE 205th Street and 132nd Ave NE the walking path along the east side of 132nd Ave NE continues south. From the intersection there is a 6-10 foot shoulder of grass / dirt that extends south along the east side of 132nd Ave NE for approximately 194 feet (photo 8). A paved shoulder then begins to taper to a paved sidewalk within approximately 75 feet. From this point the walking path continues south along 136th Ave NE for approximately 132 feet and ends at residential grass and front yards. Grass of the front yards and a plantar strip continue south with an abutting gravel driveway for approximately 339 feet (photo 9). From this point a paved sidewalk continues south on the east side of 132nd Ave NE for approximately 563 feet. The sidewalk path meanders south through the residential neighborhood along 131st Place NE and west along NE 197th Place for approximately 1,294 feet and is outfitted with paved sidewalks on both sides of the street.

From the intersection of NE 205th Street and 132nd Ave NE the walking path along the west side of 132nd Ave NE extends south as a paved sidewalk for approximately 762 feet. The paved sidewalk ends and transitions into a gravel parking area for approximately 100 feet (photo 10). A shoulder, approximately 2 – 3 feet wide, then extends south along the west side of 132nd Ave NE as it meanders through the neighborhood for approximately 503 feet. At this point a paved sidewalk begins on the west side of 132nd Ave NE and 131st Place NE for approximately 60 feet. The remaining distance, approximately 1,172 feet, of the walking path that meanders south through the residential neighborhood along 131st Place NE and west along NE 197th Place is outfitted with paved sidewalks on both sides of the street.

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At the intersection of NE 197th Place and 130th Ave NE the walking path continues south along 130th Ave NE with a paved sidewalk along the east side of 130th Ave NE for the remaining distance to Woodin Elementary School, approximately 674 feet. The safe walk route analysis was terminated at the northeastern corner of the Woodin Elementary School property.

SAFE WALK PATH EXHIBIT

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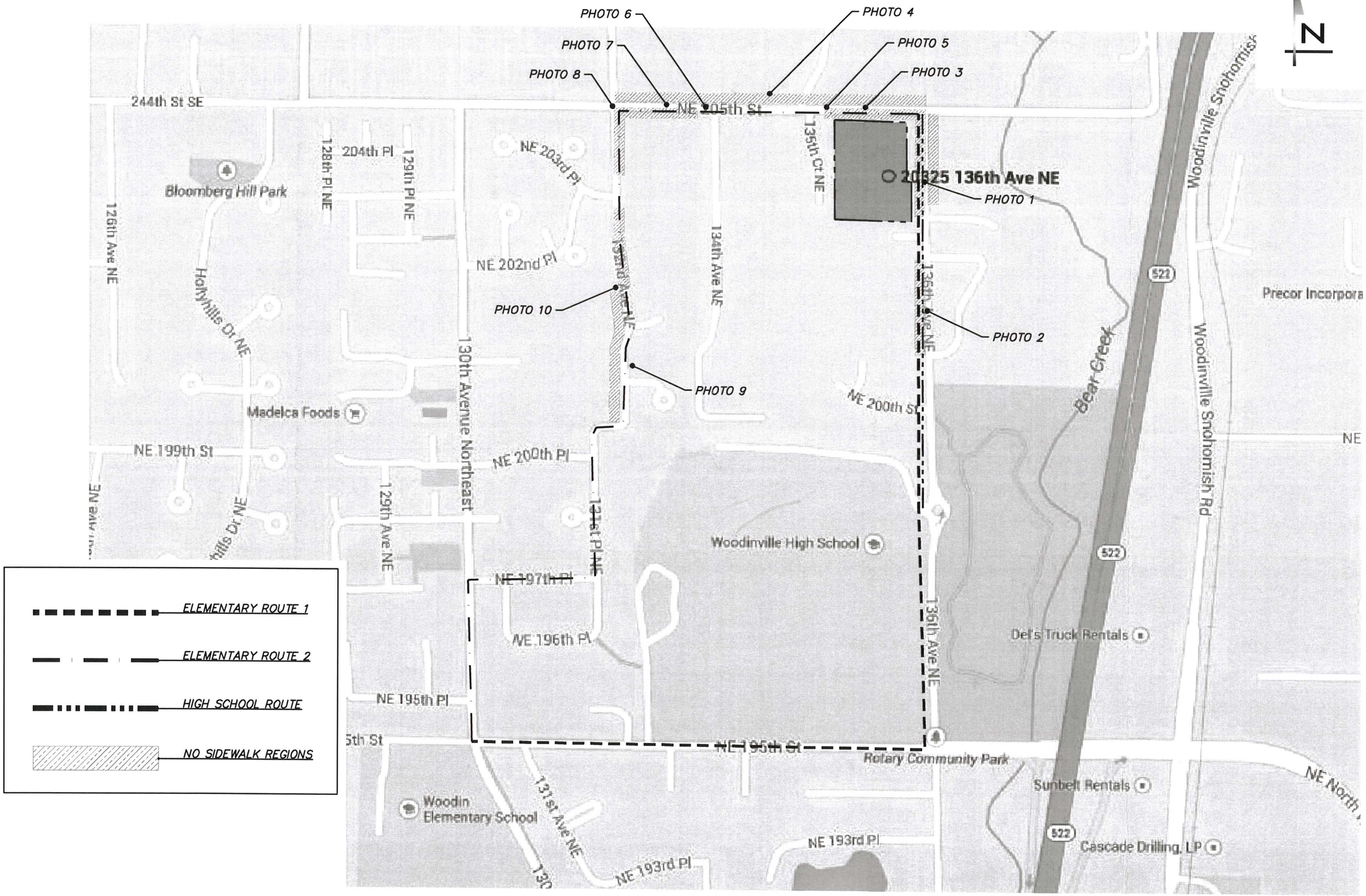

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BLUELINE

SAFE WALK PATH EXHIBIT
PARKWOOD TERRACE
SAFE WALK REPORT

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SCALE	NOT TO SCALE
PROJECT MANAGER	GEOFF TAMBLE, PE
DESIGNED BY	CHESTER BENNETT
DRAWN BY	CHESTER BENNETT
PLOT DATE	March 10, 2015

JOB NUMBER: 14–175

FIGURE: SW

Mar 10, 2015 – 9:50am – User cbennett
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Section 3 Sidewalk Deficiency Photos

High School Route and Elementary School Route 1 Photos

Photo 1: Looking north at shoulder along 136th Ave NE

Photo 2: Looking north at shoulder along 136th Ave NE

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Elementary School Route 2 Photos

Photo 3: Looking east at shoulder and ditch along NE 205th Street

Photo 4: Looking west at grass shoulder on north side of NE 205th Street

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Photo 5: Looking east at stream shoulder area along NE 205th Street

Photo 6: Looking west along NE 205th Street where sidewalk terminates and paved shoulder taper begins toward roadway edge.

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Photo 7: Looking east at ditch along the south side of NE 205th Street

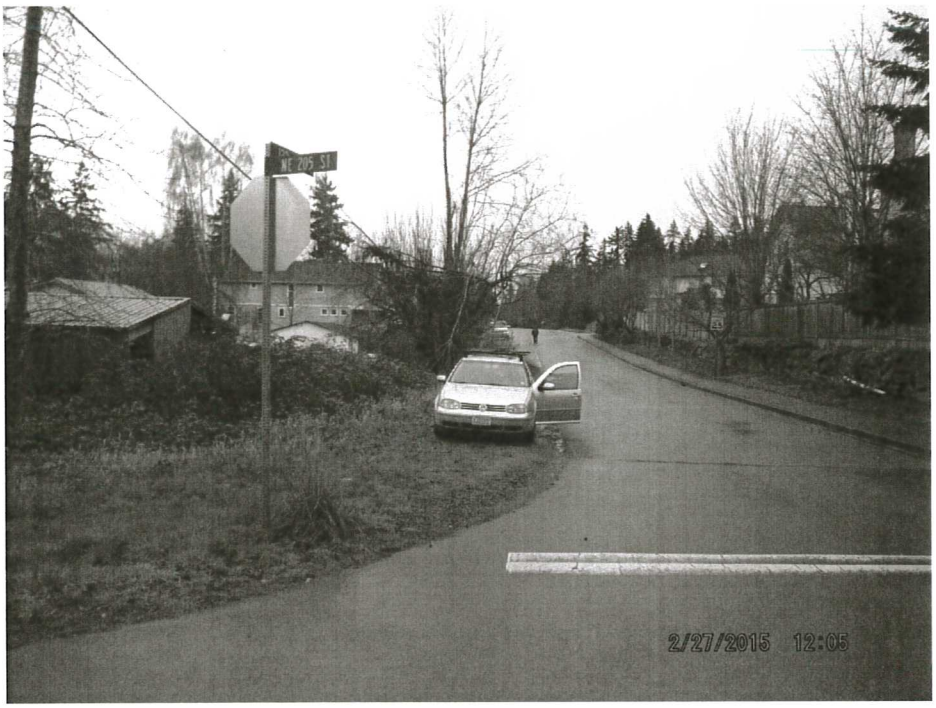

Photo 8: Looking south along 132nd Ave NE at grass / dirt shoulder and paved tapered shoulder in the distance.

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Photo 9: Looking north along 132nd Ave NE at the grass front lawn in the far distance. The planter strip and gravel drive way is present in the foreground.

Photo 10: Look south along 132nd Ave NE at gravel parking / turnaround and narrow shoulder in distance on the west side of 132nd Ave NE.