



LAND
DEVELOPMENT

PLANNING

ENGINEERING

CONSTRUCTION
MANAGEMENT

MANAGEMENT

LARKSPUR SUBDIVISION

A RESIDENTIAL PROJECT

STORMWATER TIR

DATE:

JULY 2018

SUBMITTED TO:

CITY OF CAMAS, WA
616 NE 4TH AVENUE
CAMAS, WA 98607

OWNER:

PROVENCE LLC
701 COLUMBIA ST. STE 111
VANCOUVER, WA 98660

APPLICANT:

HARB ENGINEERING, INC.
701 COLUMBIA STREET, SUITE 111
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TABLE OF CONTENTS

SECTION A – PROJECT OVERVIEW.....	1
SECTION B – MINIMUM REQUIREMENTS.....	1
SECTION C –SOILS EVALUATION.....	2
SECTION D – SOURCE CONTROL.....	2
SECTION E – ON-SITE STORMWATER MANAGEMENT BMPs.....	3
SECTION F – RUNOFF TREATMENT ANALYSIS AND DESIGN.....	3
SECTION G – FLOW CONTROL ANALYSIS AND DESIGN.....	4
SECTION H – FLOW CONTROL SYSTEM PLAN.....	4
SECTION I – WETLANDS PROTECTION.....	4

APPENDICES

Appendix A files

- A-1 Location and Other Maps**
- A-2 Basin Maps – Reference from Parklands**
- A-3 Soils Map**
- A-4 Isopluvial Maps**

Appendix B files

- B-1 through B-3 Basin Maps**

Appendix C files – Hydrology/Hydraulics

- C-1 Basin Area Input – HCAD**
- C-2 Basin Areas - Offsite Plus Site**
- C-2 Water Quality Treatment Design**

Section A – Project Overview

The “**Larkspur Subdivision**” proposal is to subdivide an existing parcel of land into a residential development, totaling approximately 2.09 acres. The property, tax parcel numbers 175961-00, and is located in a portion of the SW and SE ¼ Section 28, Township 2 North, Range 3 East of the Willamette Meridian, Clark County, Washington. The site will be developed into 10 single family residences within the R-7.5 Zone. The site address for parcel 175961-000 is 6215 NW Lakspur ST Camas WA 98607.

The property is currently undeveloped. The site topography slopes downhill from the south, northeasterly towards the north boundary which is developed as The Village at Camas Meadows. There is a large area of offsite natural runoff that flows overland from the south, northeasterly, toward the site and through the site. The site is currently covered with some trees, brush, and open field.

Construction of the “**Larkspur Subdivision**” will consist of grading approximately 2.09 acres for construction of private streets, sidewalks, 10 single family residential lots, underground utilities, and stormwater mitigation facilities (quality control).

Due to soil properties in this area it is unlikely stormwater management by infiltration BMPs will **not** be applicable.

Section B – Minimum Requirements

This project site was part of The “**Parklands Executive Residential Subdivision and Parklands Business Park**” proposal. Under this proposal the drainage area (onsite and offsite) contained only one threshold discharge area (TDA) and was subject to consideration of minimum requirements 1 – 10. However, only requirements 1-6, 9 and 10 were applicable. Therefore, runoff is allowed to discharge directly from this site. However, water quality treatment is required for runoff from pollution generating impervious surface and pervious surface runoff that mixes with these impervious surfaces.

Table B -1 - Summary of Land Disturbing Activities

The defined site area is 2.09 acres.

1. Amount of Existing Impervious surface	None
2. Amount of New Impervious surface*	11.43 ac.
3.Amount of Replaced Impervious surface	None
4. Amount of Native Vegetation converted to lawn or landscaping	12.03
5. Amount of Native Vegetation converted to pasture	None
6. Amount of Native Vegetation converted to pervious access area	None
7. Total amount of land-disturbing activity	2.09 acres

* Roofs at individual lots assumed at 3,500 sq ft per lot on this project and driveways at individual lots assumed at 500 sq ft per lot on this project

This project includes a design for management of runoff from offsite areas located upslope from this project and which presently drain overland to and through this site. The defined offsite **drainage area** is 13.47 acres

1. Amount of Existing Impervious surface	None
2. Amount of New Impervious surface*	0.220 ac. (street) 0.067 ac (sidewalk) 0.918 (roofs & drives)
3.Amount of Replaced Impervious surface	None
4. Amount of Native Vegetation converted to lawn or landscaping	0.885
5. Amount of Native Vegetation converted to pasture	None
6. Amount of Native Vegetation converted to pervious access area	None
7. Total amount of land-disturbing activity	2.09 acres

* Roofs and drives at individual lots assumed at 4,000 sq ft per lot on this project

Table B-2 - TDA Minimum Requirement Summary

TDA Number	Req'd to meet runoff control (treatment) requirements listed in Min. Requirement 6	Req'd to meet flow control requirements listed in Min. Requirement 7	Req'd to meet wetlands protection requirements listed in Min. Requirement 8
TDA # 1	Yes	N/A – large water body	Yes

The effective impervious area for the street ROW portion is 0.26 acres.

Section C – Soils Evaluation

The “Soil Survey of Clark County, Washington” indicates the soil at this site consists of the following:

(HcB) Hesson clay loam, 0 to 8 percent slopes, (HcD) Hesson clay loam, 8 to 20 percent slopes.

Clark County GIS indicates that the site soils are designed as Soil Group 3 – Moderately Drained Soils for use with the Western Washington Hydrology Model (WWHM2012).

See the soils map in Appendix A for additional information. Subsurface infiltration testing was not performed.

Section D – Source Control

There are not any prohibited discharges planned for this site. A SWPP will be developed for the Final TIR that will further identify and list BMPs for Source Control and will include BMPS to prohibit sediment laden runoff from leaving the site and impacting any local or State waters. In addition, BMPs will be implemented as necessary to prevent pollutants from coming in contact with stormwater.

The proposed site is being developed with activities that are pollution generating. The following BMP categories have some degree of applicability, in particular, BMPs for Landscaping and Lawn/ Vegetation Management and Maintenance of Stormwater Drainage and Treatment Systems.

All source control BMPs in the public right-of-way will be the responsibility of Camas City forces per their established maintenance procedures. The stormwater facilities will be publicly owned and maintained in a manner consistent with the Stormwater Facility Maintenance Manual and BMPs for Landscaping and Lawn/Vegetation Management.

Individual lot owners will be responsible for source control BMPs related to installing and maintaining landscaping and roof downspout systems on their respective lots. This responsibility includes the prevention of introduction of pollutants into their system(s). Application of appropriate maintenance measures will also provide source control.

Additional Reference: SMMWW, Volume IV, Chapter 2 - Selection of Operational and Structural Source Control BMPs; 2.2 Pollutant Source-Specific BMPs

BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots

BMPs for Landscaping and Lawn/ Vegetation Management

BMPs for Maintenance of Stormwater Drainage and Treatment Systems

BMPs for Urban Streets

Section E – Onsite Stormwater Management BMPs

An Erosion Control Plan will be developed for implementation of BMPs to manage stormwater during grading activities. These BMPs will be shown on the erosion control plan.

Individual lot owners will be responsible for installing and maintaining roof downspout systems on their respective lots consistent with Volume III, Chapter 3.1.1 of the SMMWW.

Section F – Runoff Treatment and Design

- 1) Basic stormwater treatment is required for the private streets in this project.
- 2) Phosphorous removal is also required.

The runoff from areas requiring treatment will be routed to specific Old Castle PerkFilter Systems (or Contech Stormfilter Systems). The systems will be off-line in nature and be sized to treat the off-line flow rate determined from a WWHM2012 analysis.

The management of flows above the WQ flow rates will be directed to the particular storm line system. The existing site release is the main wetland in “The Parklands Executive Residential

Subdivision and Parklands Business Park” with the release then flowing overland north into Lacamas Lake.

Initial installation cost and the expenses associated with long-term maintenance are expected to be typical of projects with similar street sections and with runoff from interior lots. The lots along the west side will have pervious surfaces that will run onto pollution-generating impervious surfaces (PGIS). The amount of pollution-generating surfaces is:

Street ROW = 0.296 acres impervious portion
From Lots & ROW = 0.361 ac. pervious + 0.374 ac. roofs/drives
Total = 1.031 acres

See App C-3 for sizing.

Section G – Flow Control Analysis and Design

This property was included as a developed site in “**The Parklands Executive Residential Subdivision and Parklands Business Park**” TIR submittal. That TIR addressed the requirement for flow control, i.e., established that there is no further requirement for this project.

Section H – Flow Control System Plan

This project is exempt as established in “**The Parklands Executive Residential Subdivision and Parklands Business Park**” TIR submittal and approval.

There is no proposed runoff from this site to other downslope property. The offsite areas with runoff onto and across this present site will be intercepted in a perimeter french drain and piped system. The 100-yr peak flow rate to the west property line is estimated as 1.72 cfs and to the south property line as 2.32 cfs. The interception rate required per linear foot of french drain is 0.005 cfs and 0.009 cfs respectively.

The storm system pipe size along the north property line to the outfall point is sized to manage these offsite areas.

Section I – Wetlands Protection

Camas Stormwater Design Standards Manual – Submittal Requirements

For projects with stormwater discharges to a wetland, either directly or indirectly through a conveyance system, the preliminary TIR shall describe wetland protection measures to be implemented in accordance with Minimum Requirement 8. The narrative shall describe the measures that will maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses.

This property was included as a developed site in “**The Parklands Executive Residential Subdivision and Parklands Business Park**” TIR submittal. That TIR addressed the requirement for Wetland Protection, i.e., established that there is no further requirement for this project other than to provide erosion control during construction until the site is fully stabilized.

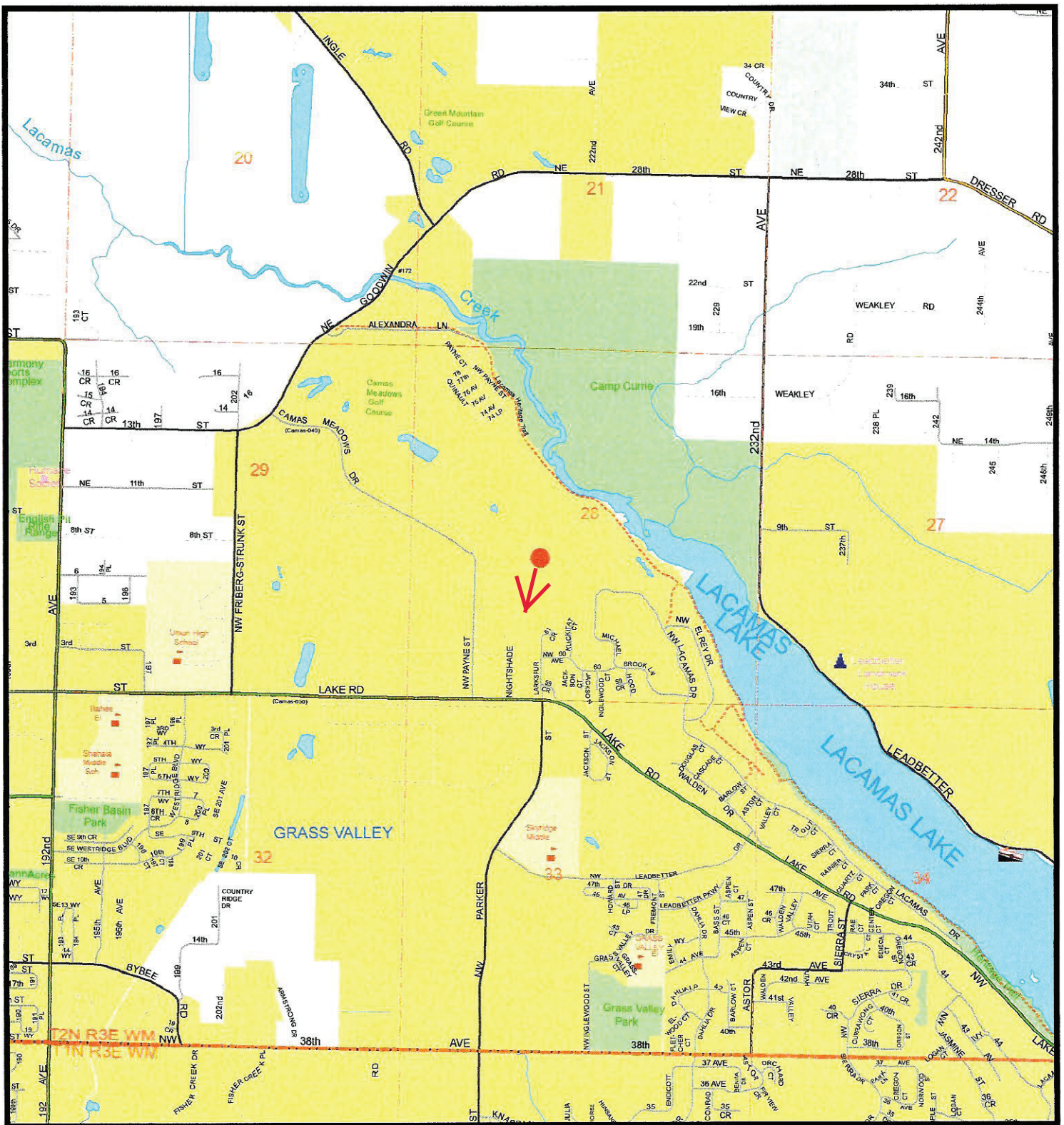
Appendix A files

A-1 Location and Other Maps

A-2 Basin Maps – Reference from Parklands

A-3 Soils Map

A-4 Isopluvial Maps

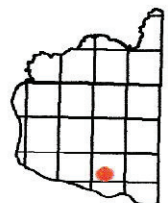


General Location Map

Account No: 175948000, 986031650
 Owner: CHINOOK LAND OWNERS GROUP LLC
 Address: 1400 NW 63RD ST
 C/S/Z: VANCOUVER, WA 98663

 Subject Property Location

Printed on: February 04, 2015



Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.

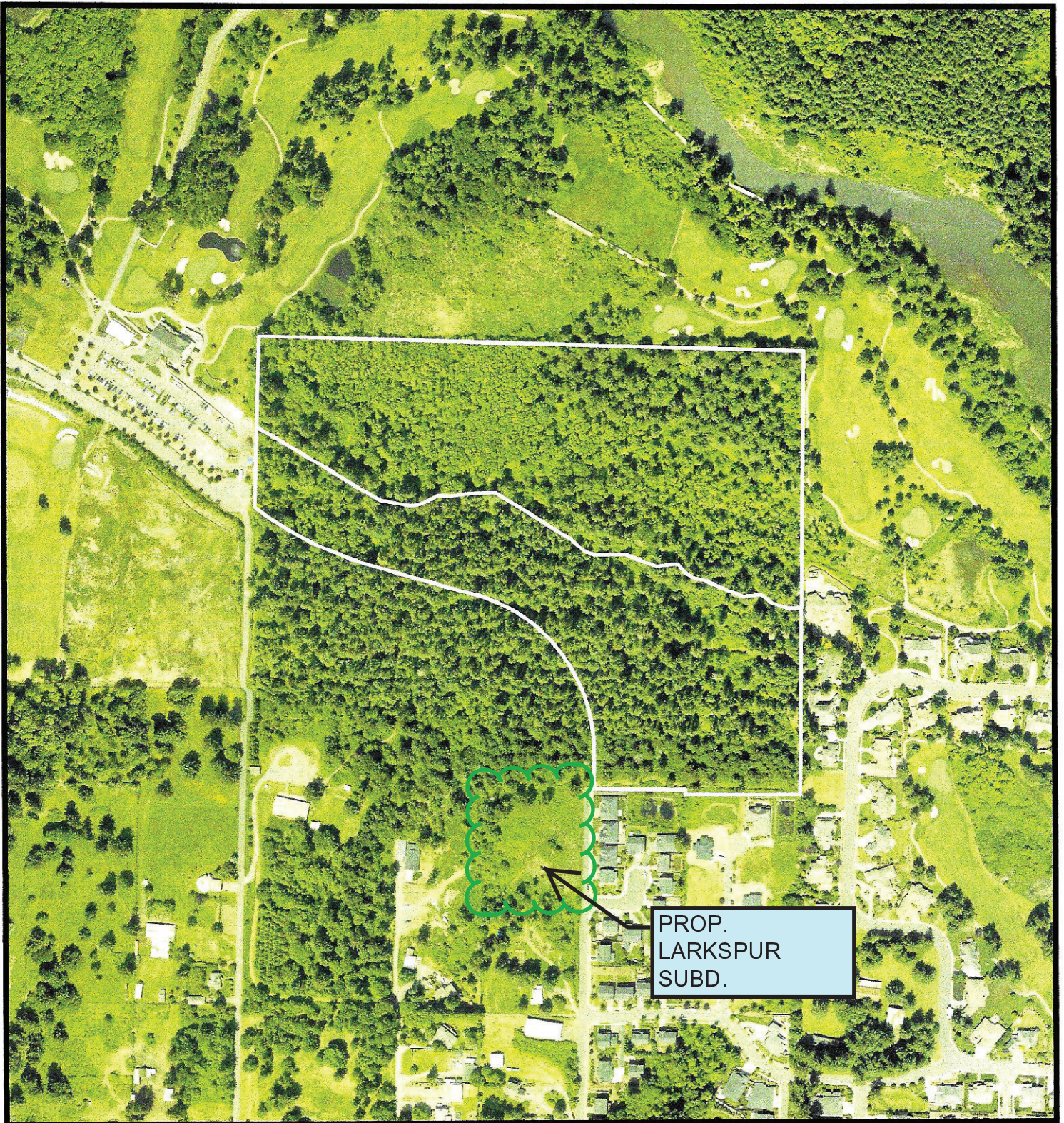


Geographic Information System

1:24,000

0 0.1 0.2 0.3 0.4 0.5 Miles

Developer's GIS Packet: Page 1 of 15



Geographic Information System

1:4,800

0 200 400 600 Feet

Developer's GIS Packet: Page 4 of 15

2014 Aerial Photography

Account No: 175948000, 986031650

Owner: CHINOOK LAND OWNERS GROUP LLC

Address: 1400 NW 63RD ST

C/S/Z: VANCOUVER, WA 98663

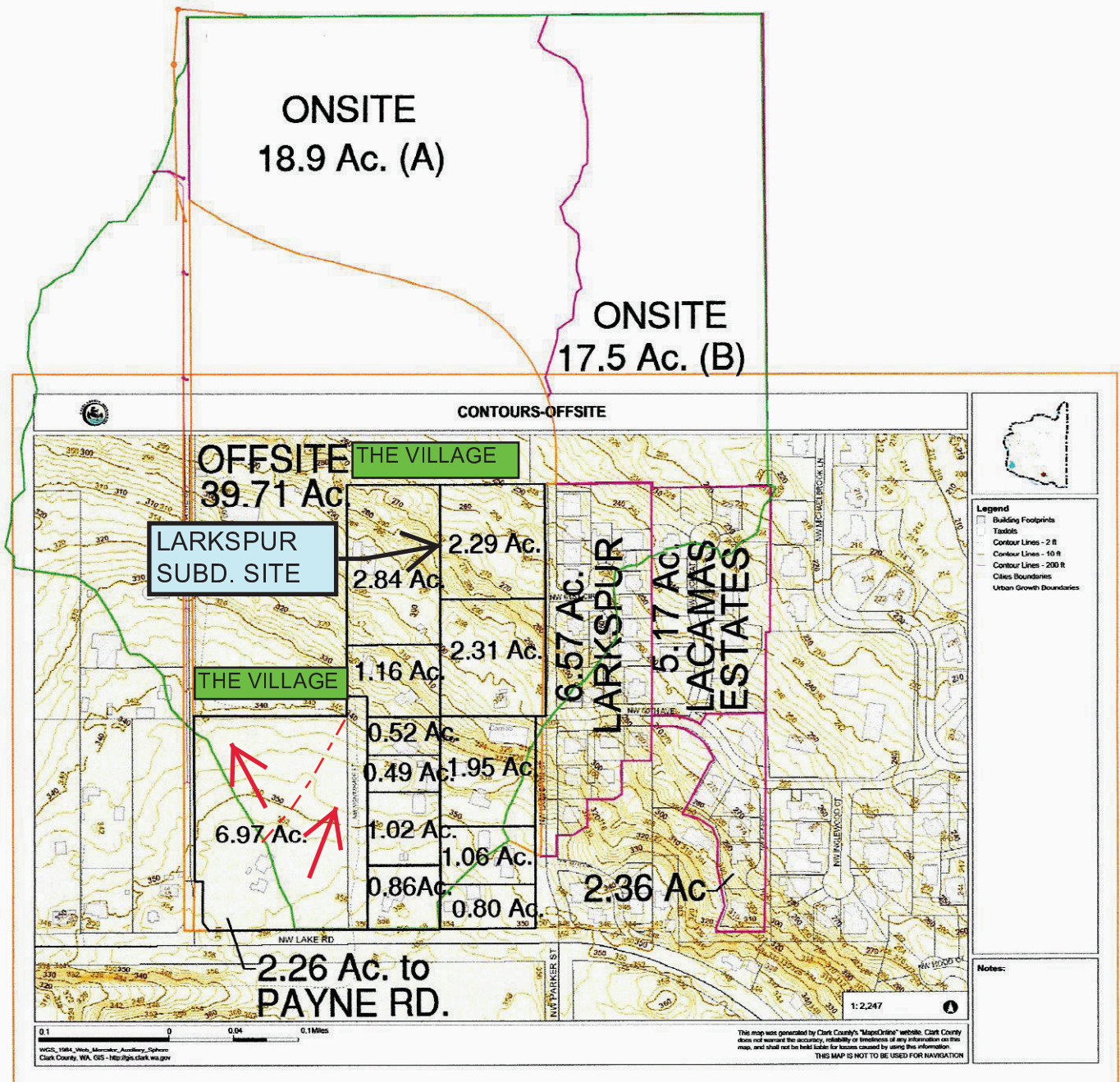
 Proposed Development Area

Printed on: February 04, 2015

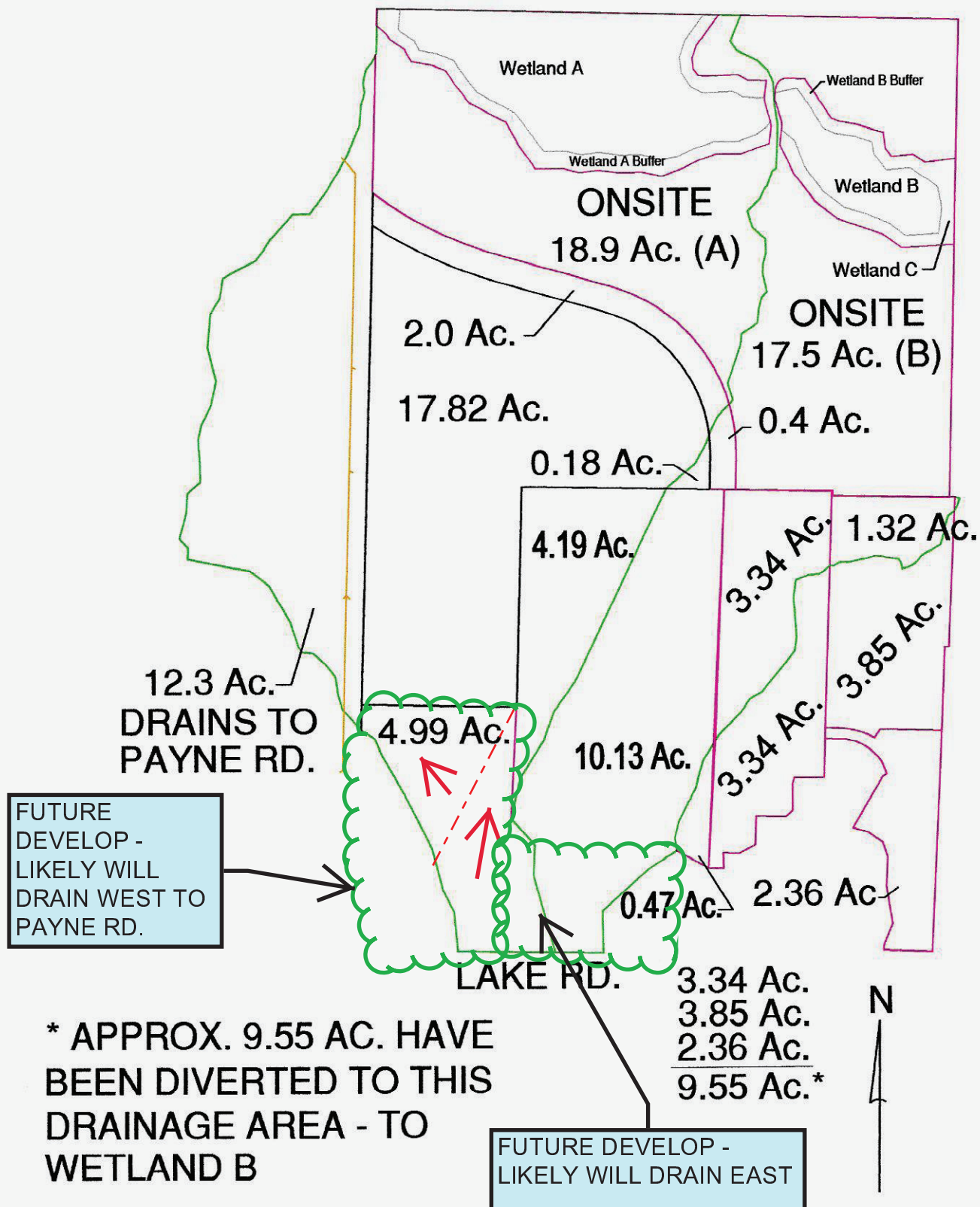
23120	23121	23122
23129	23128	23127
23132	23133	23134

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.

Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.



CONTOURS - BASIS FOR DELINEATION
 ALSO MAPS AND AS-BUILT INFO FROM
 LACAMAS ESTATES & LARKSPUR SUBD.
FIG. 2B EXISTING BASIN MAP



APPROXIMATELY 90.3 AC.

FIG. 2C EXISTING BASIN MAP

Parklands 36.33 Ac.

25.68 Ac. SITE PORTION

2.76 Ac. CAMAS MEADOWS DRIVE PORTION

10.95 Ac. WETLANDS AND BUFFERS

39.39 Ac. (or 36.63 Ac. without CMD)

1.97 Ac.

14.95 Ac.

19.64 Ac.

36.56 Ac.

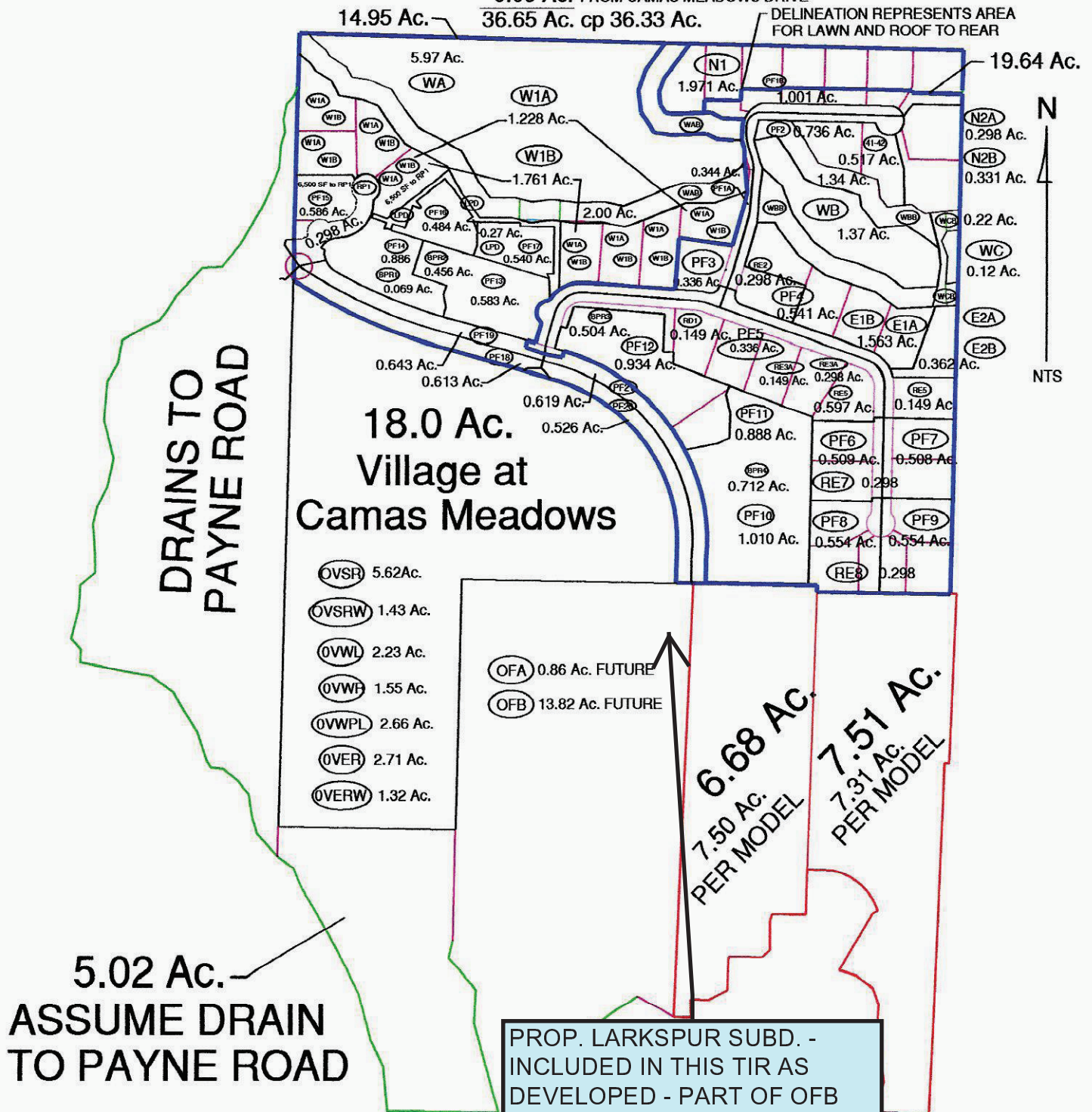
0.09 Ac.

FROM CAMAS MEADOWS DRIVE

36.65 Ac. cp 36.33 Ac.

NOTE: PORTIONS FROM N1, N2A/N2B,
AND 41-42 DRAIN TO LONGBOW LN.

DELINEATION REPRESENTS AREA
FOR LAWN AND ROOF TO REAR



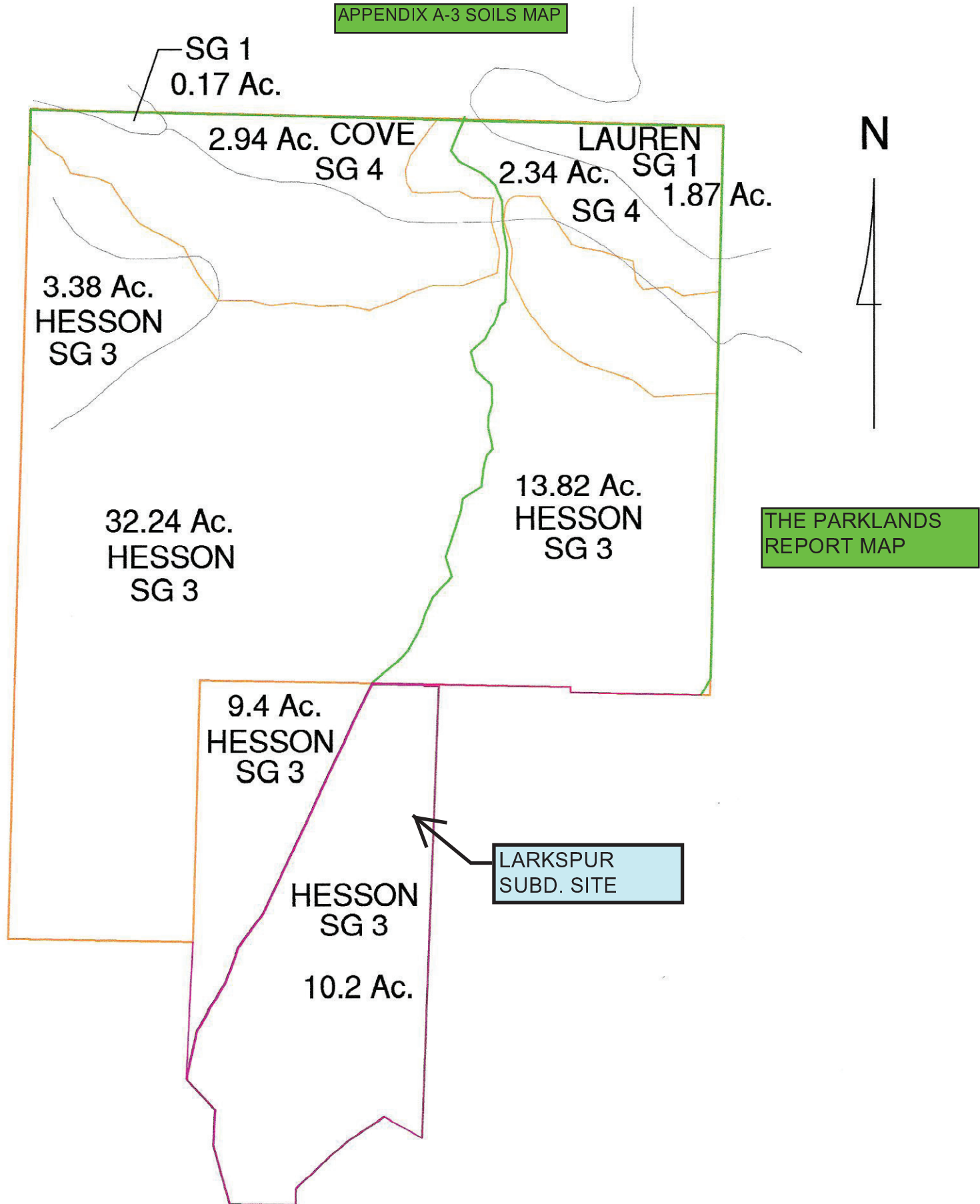
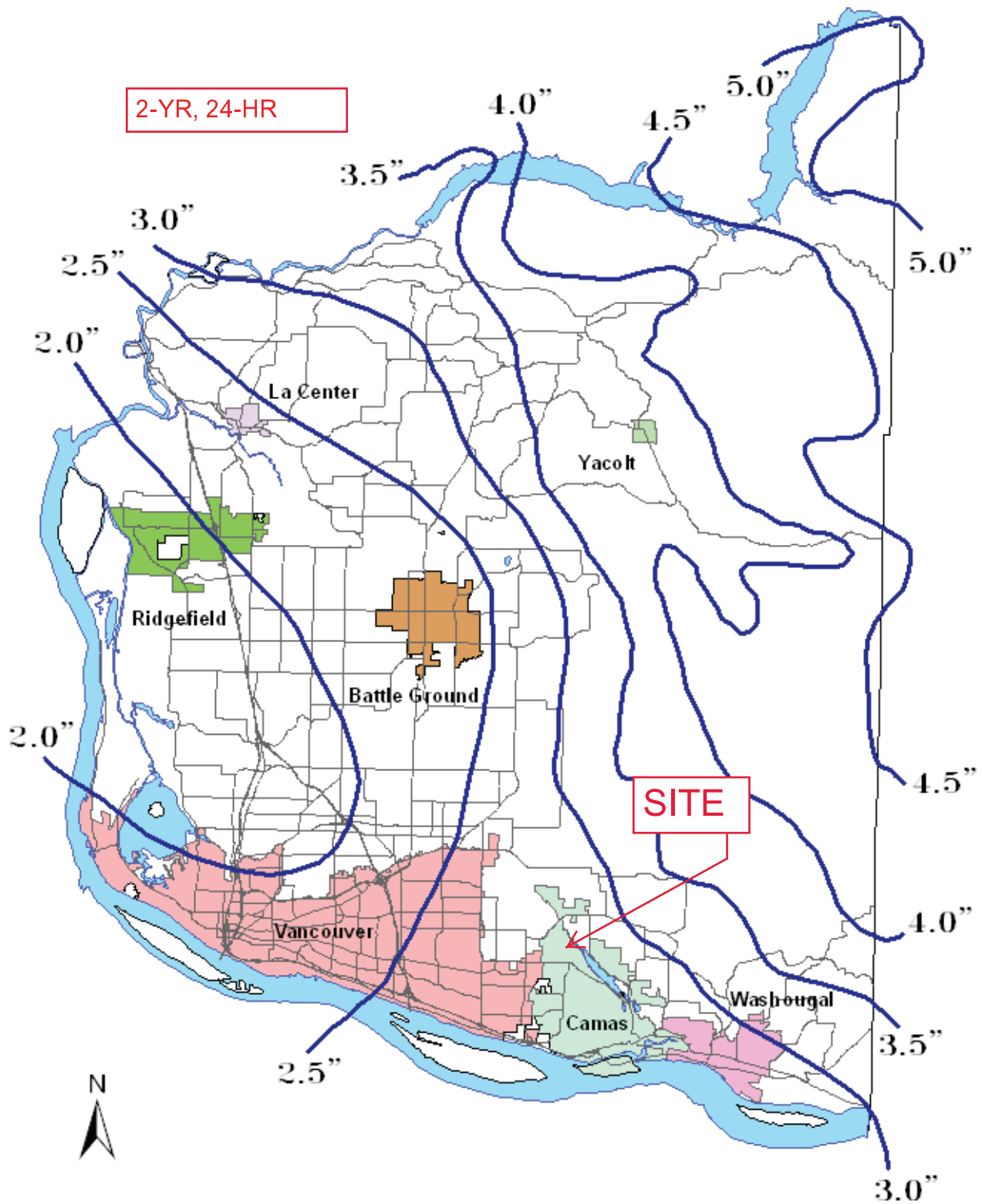
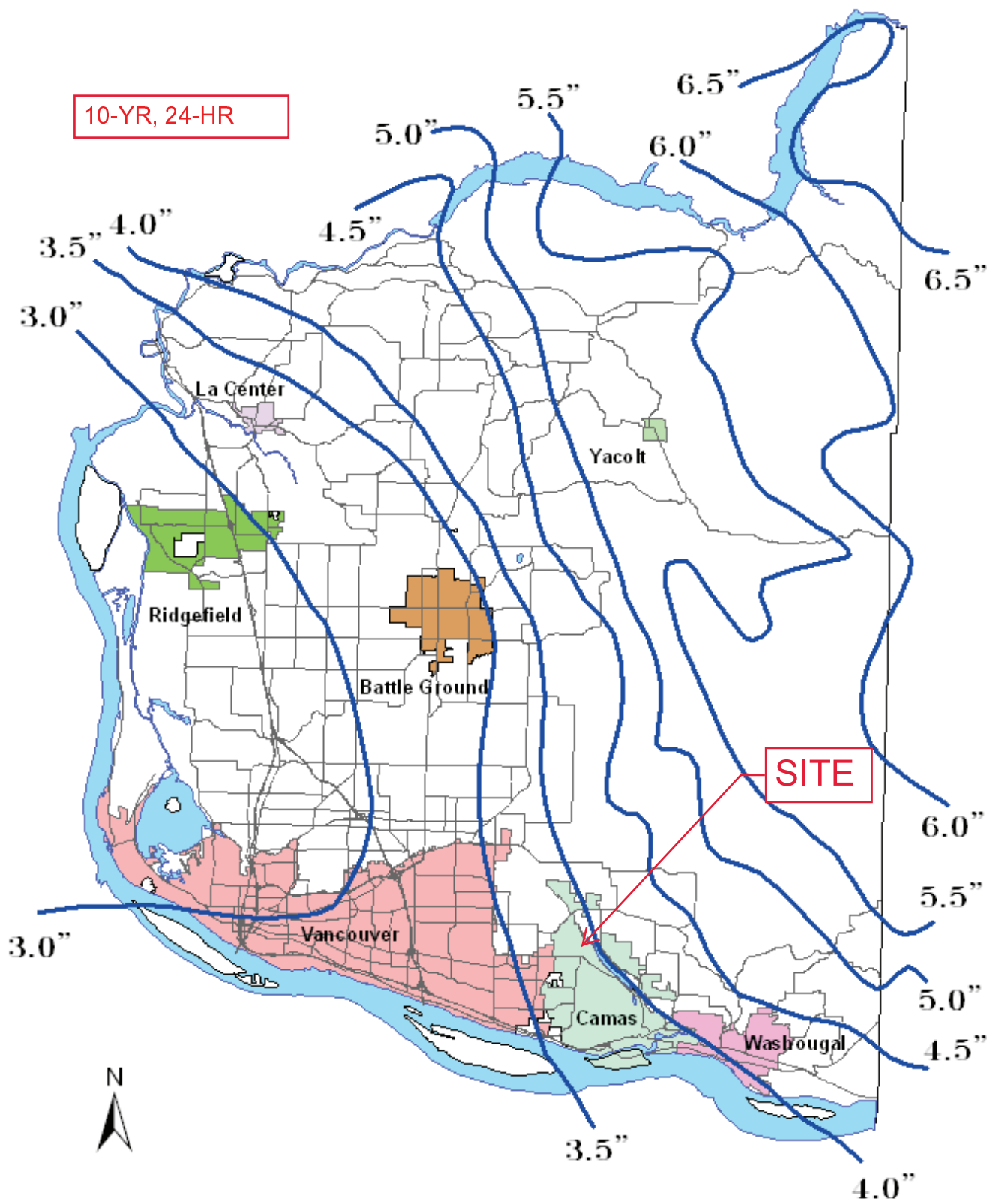


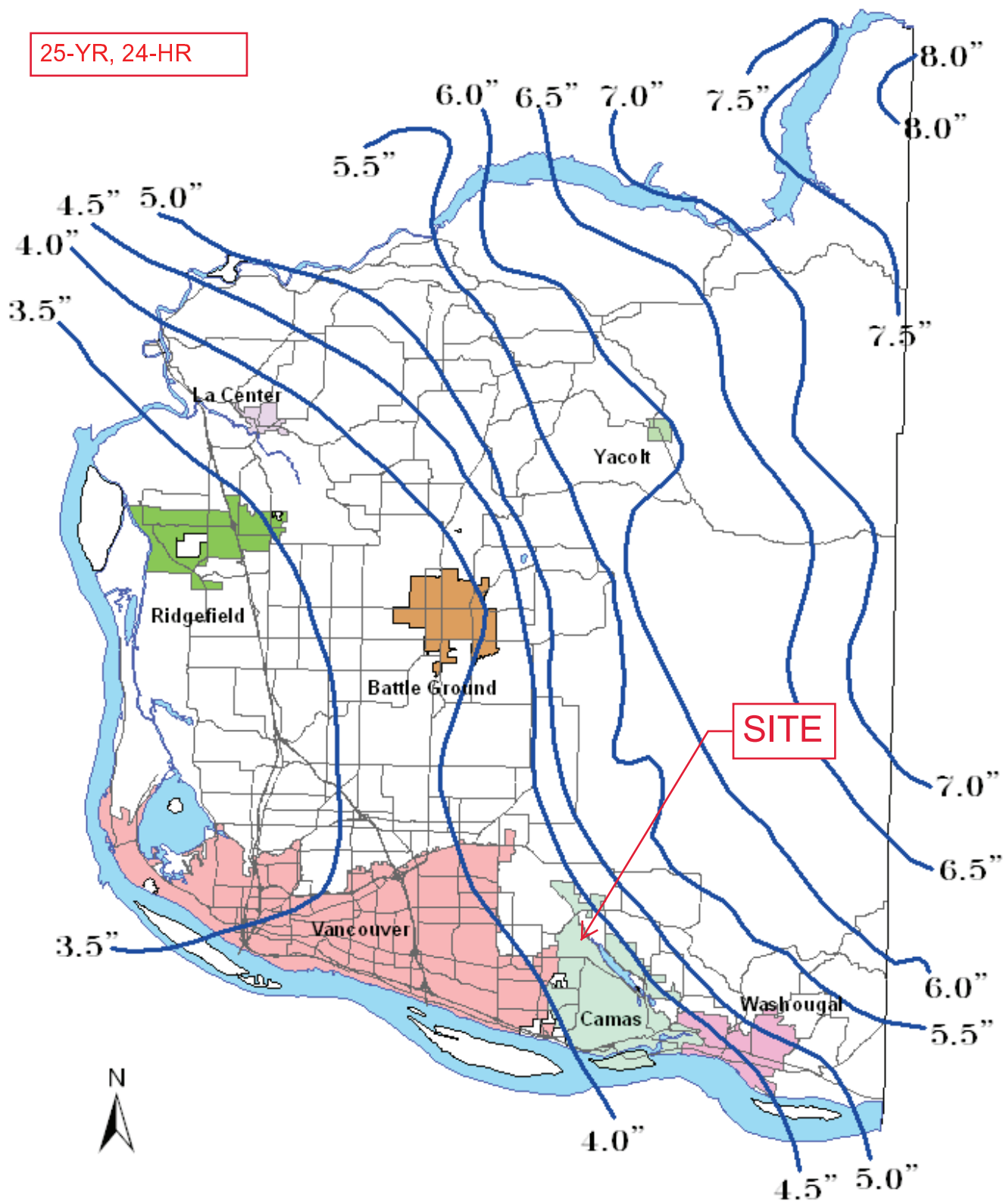
FIG. A-4 SOILS MAP

APPENDIX A-4

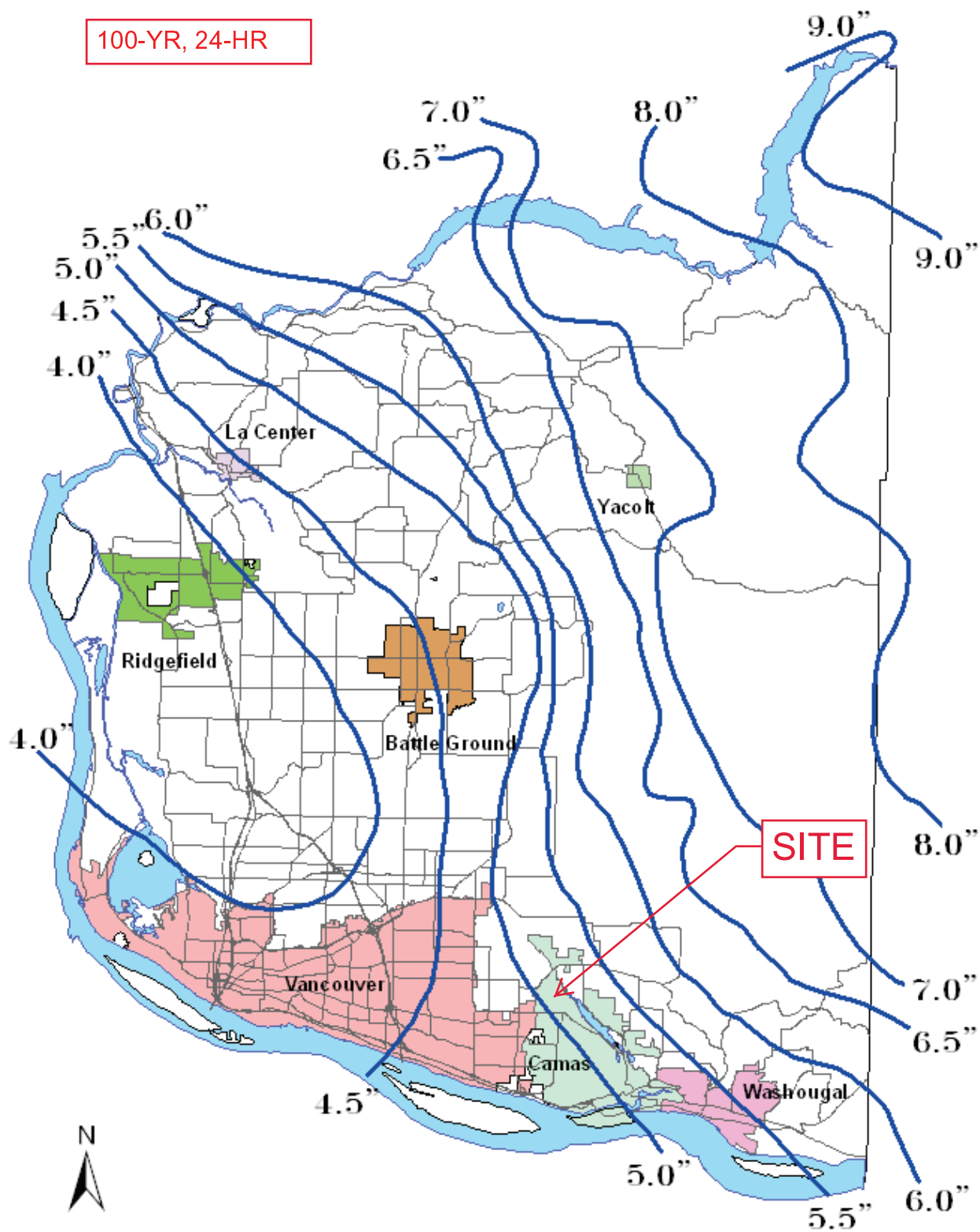




25-YR, 24-HR



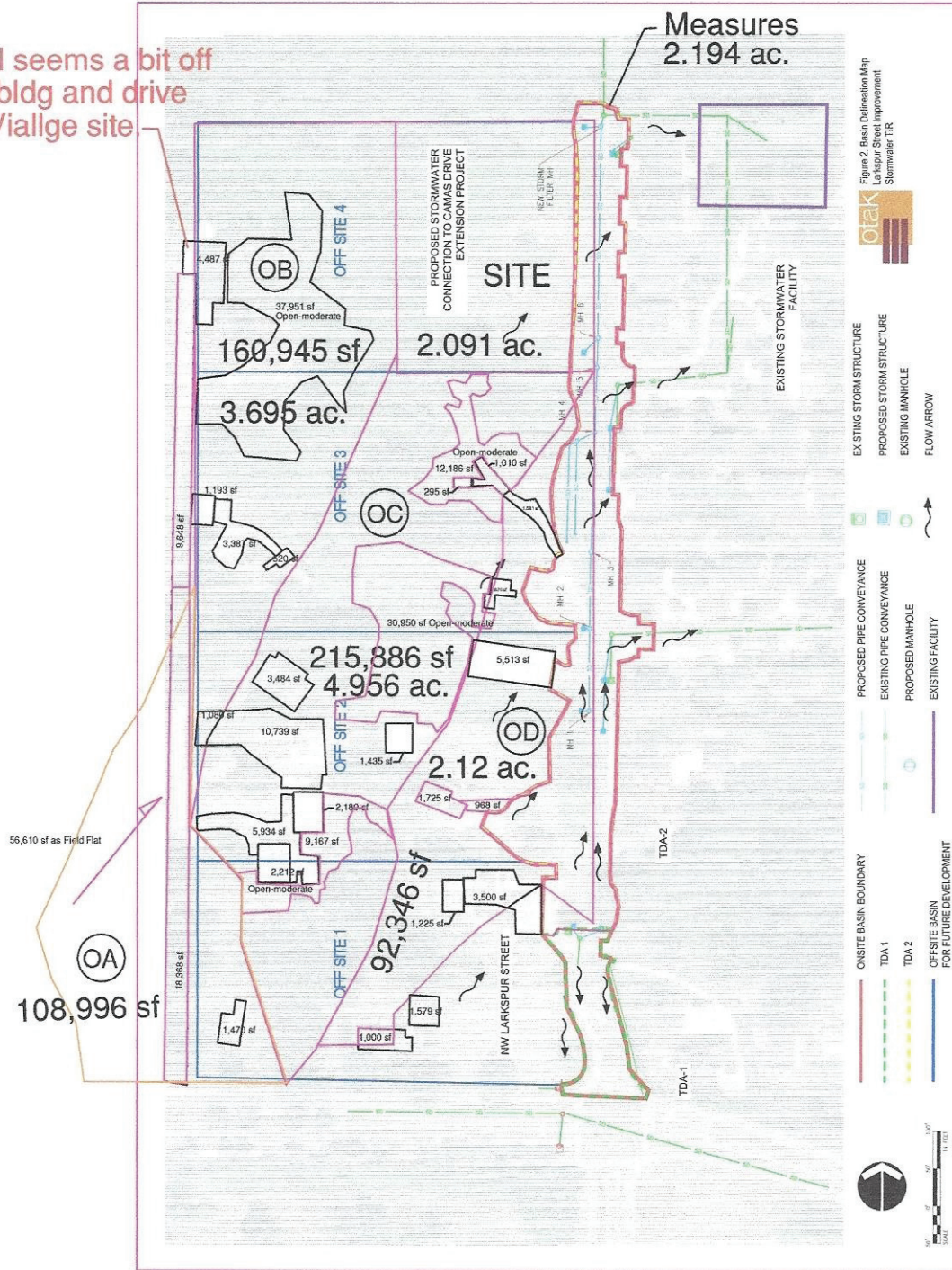
100-YR, 24-HR



Appendix B files

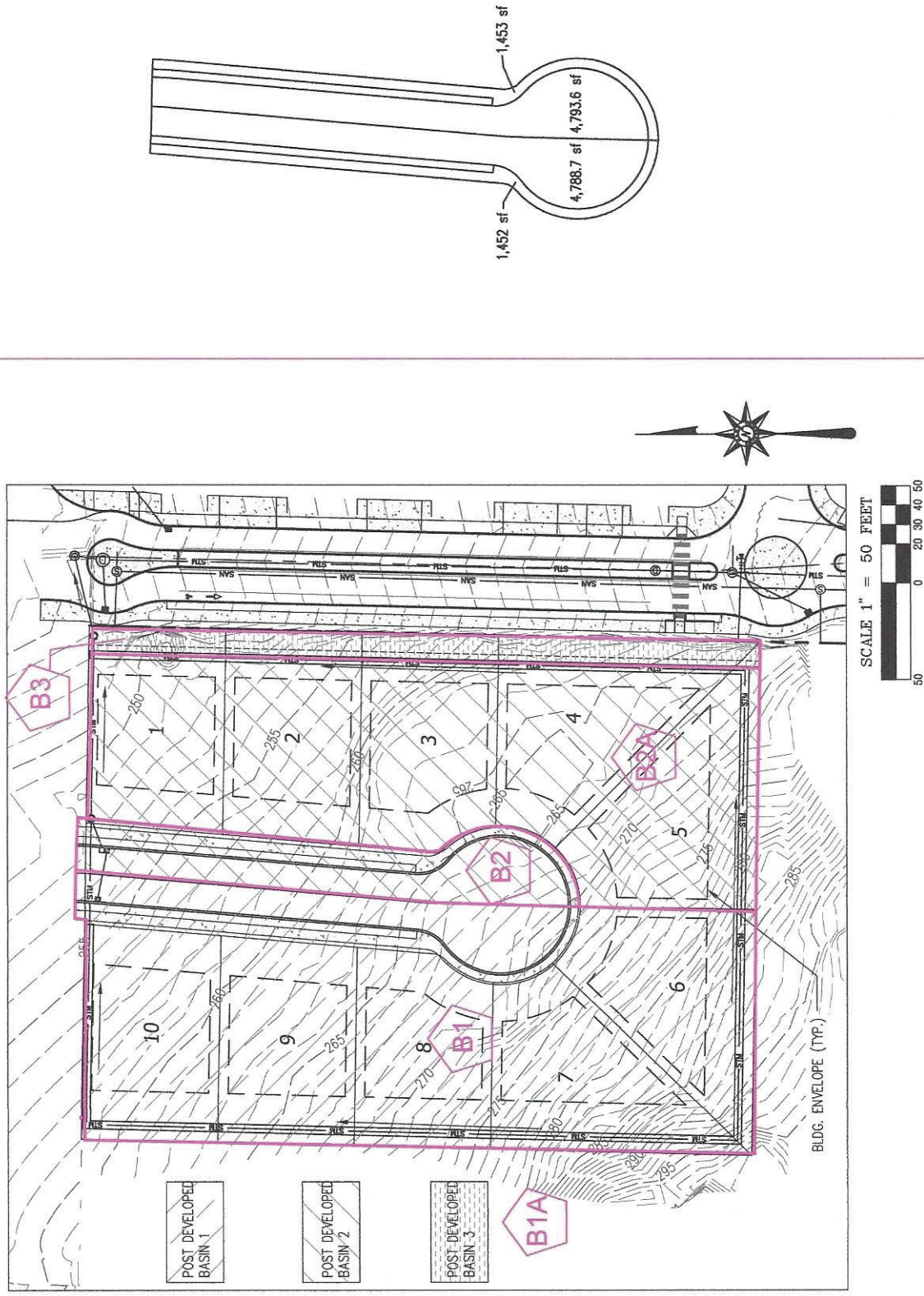
B-1 through B-3 Basin Maps

This aerial seems a bit off
looks like bldg and drive
is in The Vialge site



HCAD MODEL

MAP B-2- POST SUBBASIN AREAS



HCAD MODEL

MAP B-3- POST SUBBASIN AREAS

Appendix C files – Hydrology/Hydraulics

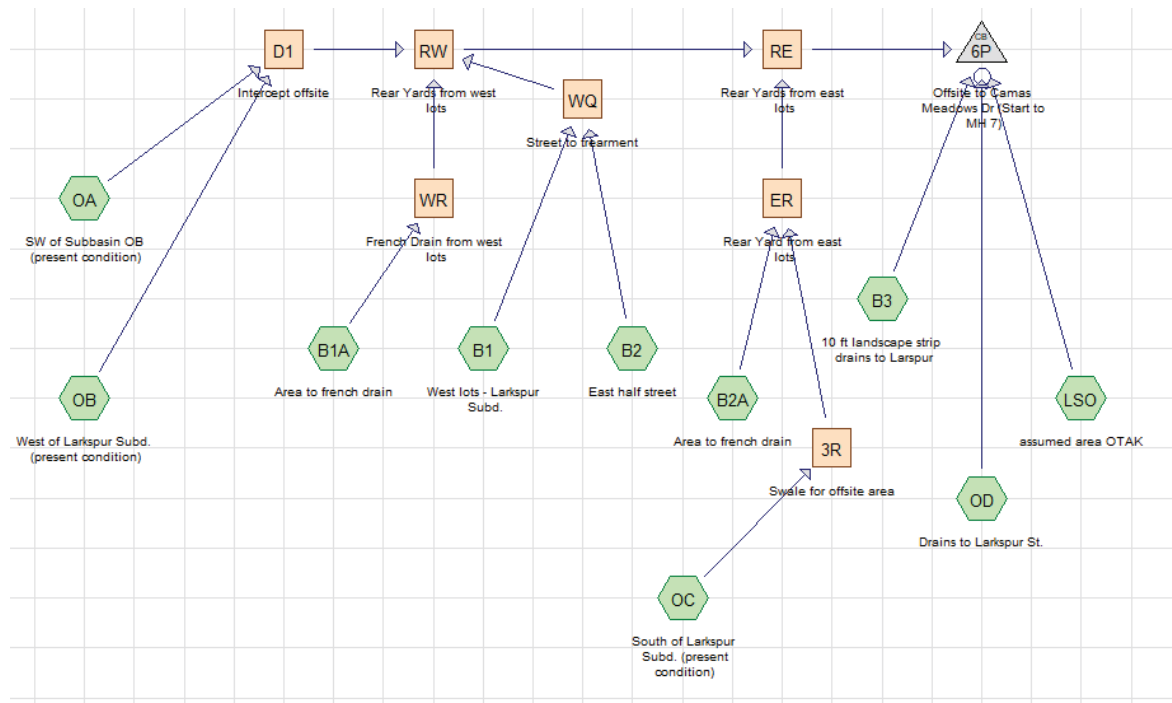
C-1 Basin Area Input – HCAD

C-2 Baisn Areas - Offsite Plus Site

C-2 Water Quality Treatment Design

APPENDIX C LARKSPUR SUBD. - HYDROLOGY/HYDRAULICS CALCS.

C-1 BASIN AREA INPUT SUMMARIES - HCAD



SITE AREAS

Summary for Subcatchment B1: West lots - Larkspur Subd.

Runoff = 0.29 cfs @ 7.92 hrs, Volume= 0.098 af, Depth= 1.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	4,789	98.0	Street-west portion
*	1,452	98.0	Sidewalk
*	14,000	98.0	4 Roofs
*	1,000	98.0	2 drives from west lots (500 ea)
*	1,290	98.0	3 drives from west lots (430ea)
*	210	98.0	drive across landscape
*	14,485	86.0	Pervious
	37,226	93.3	Weighted Average
	14,485	86.0	38.91% Pervious Area
	22,741	98.0	61.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Assumed

APPENDIX C LARKSPUR SUBD. - HYDROLOGY/HYDRAULICS CALCS.

C-1 BASIN AREA INPUT SUMMARIES - HCAD

Summary for Subcatchment B1A: Area to french drain

Runoff = 0.05 cfs @ 7.94 hrs, Volume= 0.019 af, Depth= 1.20"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	4,833	86.0	Bypass
*	3,500	98.0	Roof tie-in from Lot 10
	8,333	91.0	Weighted Average
	4,833	86.0	58.00% Pervious Area
	3,500	98.0	42.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Assumed

Summary for Subcatchment B2: East half street

Runoff = 0.07 cfs @ 7.90 hrs, Volume= 0.024 af, Depth= 1.57"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	4,794	98.0	Street-west portion
*	1,453	98.0	Sidewalk
*	210	98.0	drive across landscape
*	485	86.0	Pervious
*	967	86.0	Pervious (front of Lot 5)
	7,909	95.8	Weighted Average
	1,452	86.0	18.36% Pervious Area
	6,457	98.0	81.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Assumed

APPENDIX C LARKSPUR SUBD. - HYDROLOGY/HYDRAULICS CALCS.

C-1 BASIN AREA INPUT SUMMARIES - HCAD

Summary for Subcatchment B2A: Area to french drain

Runoff = 0.25 cfs @ 7.92 hrs, Volume= 0.087 af, Depth= 1.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	13,366	86.0	Bypass
*	17,500	98.0	5 lots - roofs at 3,500 sf each
*	1,000	98.0	2 drives at 500 sf each
*	1,290	98.0	3 drives at 430 sf each
	33,156	93.2	Weighted Average
	13,366	86.0	40.31% Pervious Area
	19,790	98.0	59.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Assumed

Summary for Subcatchment B3: 10 ft landscape strip drains to Larspur

Runoff = 0.02 cfs @ 7.98 hrs, Volume= 0.007 af, Depth= 0.82"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	4,465	86.0	Pervious
	4,465	86.0	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Assumed

APPENDIX C LARKSPUR SUBD. - HYDROLOGY/HYDRAULICS CALCS.

C-1 BASIN AREA INPUT SUMMARIES - HCAD

OFFSITE AREAS

Summary for Subcatchment OA: SW of Subbasin OB (present condition)

Runoff = 0.24 cfs @ 8.31 hrs, Volume= 0.186 af, Depth= 0.89"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

Area (sf)	CN	Description
* 19,838	98.0	Roofs and Drives
* 56,610	86.0	Lawn/field, moderate (HSG C)
* 32,548	80.0	Trees (with deciduous), moderate (HSG C)
108,996	86.4	Weighted Average
89,158	83.8	81.80% Pervious Area
19,838	98.0	18.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.6	300	0.0233	0.14		Sheet Flow, Field/lawn Grass: Dense n= 0.240 P2= 2.80"
28.0	840		0.50		Direct Entry, assumed
62.6	1,140	Total			

Summary for Subcatchment OB: West of Larkspur Subd. (present condition)

Runoff = 0.24 cfs @ 8.38 hrs, Volume= 0.208 af, Depth= 0.68"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.96"

Area (sf)	CN	Description
* 10,667	98.0	Roofs and Drives
* 37,951	86.0	Lawn/field, moderate (HSG C)
* 112,327	80.0	Trees (with deciduous), moderate (HSG C)
160,945	82.6	Weighted Average
150,278	81.5	93.37% Pervious Area
10,667	98.0	6.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.7	300	0.0870	0.14		Sheet Flow, field/trees n= 0.500 P2= 2.80"
18.0	540		0.50		Direct Entry, assumed
54.7	840	Total			

APPENDIX C LARKSPUR SUBD. - HYDROLOGY/HYDRAULICS CALCS.

C-1 BASIN AREA INPUT SUMMARIES - HCAD

Summary for Subcatchment OC: South of Larkspur Subd. (present condition)

Runoff = 0.37 cfs @ 8.35 hrs, Volume= 0.310 af, Depth= 0.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.03 hrs

Type IA 24-hr WQ Rainfall=1.96"

	Area (sf)	CN	Description
*	27,289	98.0	Roofs and Drives
*	52,323	86.0	Lawn/field, moderate (HSG C)
*	136,274	80.0	Trees (with deciduous), moderate (HSG C)
	215,886	83.7	Weighted Average
	188,597	81.7	87.36% Pervious Area
	27,289	98.0	12.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.9	300	0.0400	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.80"
17.3	520		0.50		Direct Entry, field/treed - assume velocity
59.2	820	Total			

APPENDIX C LARKSPUR SUBD - HYDROLOGY/HYDRAULICS CALCS

C-2 BASIN AREA SUMMARY FOR OFFSITE AREAS

Offsite Basin Data Area per Parklands Model Modeled as Fully Developed

Basin ID	Area (sf)	Area (ac)
OFA	37,500	0.861
OFB	602,064	13.821
	639,564	14.682

Modeled Input Parameters		
37,500	modeled at CN 98	Larkspur widening
9,800	modeled at CN 86	Larkspur widening
217,800	modeled at CN 96	Business - developed
374,464	modeled at CN 92	Residential- developed

639,564 Total (sf)

14.682 Total (ac)

Offsite Basin Data Area (Correct Relative OTAK's Basin Delineation along Larkspur Widening)* Remaning Offsite Delineation Update Modeled at Present Condition

Basin ID	Area (sf)	Area (ac)
OA**	108,996	2.502
OB	160,945	3.695
OC	215,886	4.956
	485,827	11.153

* the southern portion of these subbasin areas will likely be directed to the storm system in the south end of Larkspur St. when(if) developed. This existing storm in Larkspur does not drain north.

** This area was assumed as future development with flow to the west development with flow to west (Payne Rd)
(Payne Rd storm system). Now assume as existing condition with some runoff toward the proposed site.

Site	79,385	1.822
OTAK	55,586	1.276
OD	92,346	2.120
	227,317	5.218
(add 11.153)		16.372
16.37 - 14.68 =		1.69 ac

APPENDIX C LARKSPUR SUBD - HYDROLOGY/HYDRAULICS CALCS

C-2 BASIN AREA SUMMARY FOR OFFSITE AREAS

Notes:

1. The OTAK basin delineation did not indicate this area as part of main runoff area at Larkspur street.
2. The Otak basin map (Fig. 2) divides this offsite area west of Larkspur as 4 future equal future areas (future with the runoff WQ treatment) and then piped to storm system in Larkspur Street.
3. The 1.69 increase in the area modeled does not increase the previously determined runoff to the storm system in Camas Meadows Drive (CMD) as designed and approved with The Parklands project.

100-yr peak runoff rate to CMD (Larkspur Subdivision)	9.62 cfs
100-yr peak runoff rate to CMD (Parklands)	15.33 cfs

** In the hydrology/hydraulics model for The Parklands project, this area was assumed as developed and with discharge to the Payne Road storm system. At Payne Rd and Camas Meadows Drive the flow was proportioned to account for the increase due to development. The split flow amount was applied in the analysis for flow to and through the wetland evaluated with The Parklands project.

APPENDIX C LARKSPUR SUBD. –HYDROLOGY/HYDRAULICS CALCS.

C-3 WATER QUALITY SYSTEM DESIGN

WWHM2012 Larkspur Subd - WQ STREET & W LOTS

File Edit View Help Summary Report

Predeveloped/Pre-Project Report Summary

Predeveloped Scenario Report Options

Landuse Basins

Street and W Lots

Basin Downstream Connections

Surface Flow Interflow Groundwater

Pervious and Impervious Landuse Types and Areas

PERLND Name	Area(ac)	IMPLND Name	Area(ac)
C, Lawn, Flat	0.3659	ROADS/FLAT	0.6703

WWHM2012 Larkspur Subd - WQ STREET & W LOTS

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Analysis

Run Analysis

Water Quality

On-Line BMP	Off-Line BMP
24 hour Volume (ac-ft)	
Standard Flow Rate (cfs)	Standard Flow Rate (cfs)

Water Quality BMP Flow and Volume Calculations

On-line facility volume (ac-ft):	0.0995
On-line facility target flow (cfs):	0.1439
Adjusted for 15 min (cfs):	0.1439
Off-line facility target flow (cfs):	0.081
Adjusted for 15 min (cfs):	0.081

APPENDIX C LARKSPUR SUBD. –HYDROLOGY/HYDRAULICS CALCS. C-3 WATER QUALITY SYSTEM DESIGN

Design for PerkFilter

Kristar/Oldcastle Precast, Inc. FloGard Perk Filter™ (using ZPC Filter Media)

Ecology's Decision:

Based on Kristar/Oldcastle's application submissions, including the Draft Technical Evaluation Report, dated April 2010, Ecology hereby issues the following use level designations:

1. **General use level designation (GULD) for the Perk Filter™ for basic treatment:**
 - Using a zeolite-perlite-carbon (ZPC) filter media as specified by Kristar/Oldcastle.
 - Sized at hydraulic loading rate of no more than 1.5 gpm/ft² of media surface area, per Table 1.

Table 1. Design Flowrate per Cartridge

Effective Cartridge Height (inches)	12	18
Cartridge Flowrate (gpm/cartridge)	6.8	10.2

2. **General use level designation (GULD) for the Perk Filter™ for phosphorus treatment:**
 - Using a zeolite-perlite-carbon (ZPC) filter media as specified by Kristar/Oldcastle.
 - Sized at hydraulic loading rate of no more than 1.5 gpm/ft² of media surface area, per Table 1.
3. **Ecology approves Perk Filter™ units for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate for an off-line system. The internal weir in the inlet chamber functions as a bypass to route flow in excess of the water quality design flow rate around the treatment chamber. Calculate the water quality design flow rate using the following procedures:**

6.8 gpm (12" cartridge) = 0.0152 cfs and $0.081/0.0152 = 5.33$ cartridges – requires 6 cartridges

Use: 3 unit with 12" + 12" stacks (allowable rate = 0.091 cfs)

APPENDIX C LARKSPUR SUBD. –HYDROLOGY/HYDRAULICS CALCS.

C-3 WATER QUALITY SYSTEM DESIGN

Contech StormFilter – alternate

1. As a basic stormwater treatment practice for total suspended solids (TSS) removal,
 - Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,
 - Sized at a hydraulic loading rate of 1 gpm/ft² of media surface area, per Table 1, and
 - Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.

Table 1. StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	12	18	27
Cartridge Flow Rate (gpm/cartridge)	5	7.5	11.3

2. Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, and sized based on the water quality design flow rate for an off-line system. Contech designs their StormFilter systems to maintain treatment of the water quality design flow while routing excess flows around the treatment chamber during periods of peak bypass. The water quality design flow rates are calculated using the following procedures:

WQ System Designation	Off-line (cfs)	12" @ 5 gpm or 0.011 cfs	18" @ 7.5 gpm or 0.017 cfs	27" @ 11.3 gpm or 0.025 cfs
Larkspur Subd.	0.081	----	----	3.24 factor = 4 filters