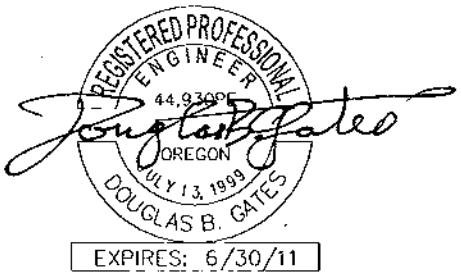
Stormwater Drainage Report
ODOT Solar Array in West Linn

Prepared for

Oregon Department of Transportation (ODOT)



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January 2010.

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APPENDICES

1. INTRODUCTION

In 2008, the Oregon Department of Transportation (ODOT) and its partners completed the nation's first solar highway project constructed in highway right-of-way. Several other sites around the state are now in the developmental stage. One of these sites is known as the West Linn site (adjacent to the southbound lanes of Interstate 205 (I-205) between mileposts 6 and 7). The purpose of this report is twofold: 1) to provide preliminary drainage analysis and to propose a stormwater management strategy for the West Linn Solar Array site, and 2) to assure the strategy does not route flows to downstream areas impacted by a January 1, 2009, flood event, nor does it create similar flooding conditions or circumstances.

2. PROJECT DESCRIPTION

The proposed West Linn Solar Highway project will place enough solar arrays alongside the highway to generate 3 Megawatts of renewable energy to power Oregon's transportation system. This will be the second project of its type on the I-205 corridor and will represent the largest solar highway project in the world to date. The proposed solar array location is in the Oregon Department of Transportation's right-of-way immediately north of Interstate 205 in West Linn, Clackamas County, Oregon (see Appendix A, Figure 1).

2.1 SITE DESCRIPTION

The site is characterized by steep slopes separated by two terraces comprised of fill material overlooking the Willamette River (see Appendix B, Cross Section A-A excerpt from the Draft Slope Stability Evaluation, November 2009). These terraces were constructed as a method of slope stabilization after a landslide occurred at the site during the construction of I-205 in the late 1960s. The east side of the lower of the two terraces is currently used as a storage yard for ODOT with access from I-205 at milepost 7.2. The west side of the lower terrace is undeveloped and contains non-jurisdictional wetlands.[1] The upper terrace is currently undeveloped and includes stands of deciduous and coniferous trees dispersed in areas of pasture grasses. Fill on the site consists of dense gravel with varying proportions of silt, sand, and clay. The fill overlays bedrock consisting of weathered Columbia River Basalt. Depth to this bedrock layer varies between 10 and 49 feet below ground surface according to the exploration logs in the Slope Stability Evaluation by GeoDesign in November 2009.

The area adjacent to the project site is primarily residential to the east, west, and north. I-205 borders the site to the south, and the Willamette River is approximately 1,000 feet farther south. The area south of I-205 and north of the river is primarily residential and commercial property.

2.2 OVERALL BASIN DESCRIPTION

A small area north of the proposed solar array layout area contributes flows to the site (see Appendix A, Figure 3). The western side of the project site contains a natural perennial drainage system conveying flow from northwest offsite areas. This offsite flow will not impact the proposed site improvements. Currently, 12.18 acres (ac) of the project site contribute flow to this system. Downstream of the project site, this system transitions to a conveyance capacity limited system as identified in the West Linn 2006 Surface Water

[1] Wetlands deemed as non-jurisdictional by the Oregon Department of State Lands, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency on November 30, 2009.

Management Plan (2006 SWMP) (see excerpt in Appendix F). The proposed stormwater management strategy avoids utilizing this system.

The project site is bordered on the south by an I-205 stormwater ditch system that conveys flow in a westerly direction. Ditch flow is intercepted by a series of culverts upstream, downstream, and within the vicinity of the site (see Appendix F). Some of these culverts also serve as I-205 crossings of drainage basins of various sizes. These culverts cross I-205 and convey flow to downstream systems that eventually discharge to the Willamette River. The east side off the solar array site drainage is defined by one of these culverts (Culvert 4). See Appendix A, Figure 2, Existing Drainage Patterns.

Upstream and east of the project site, a box culvert draining the Tanner Creek basin crosses I-205. On January 1, 2009, an extreme storm event exacerbated by debris accumulation resulted in the failure of this culvert. This event and culvert system are further described below and in Section 4.4.2. During that event, flows were diverted down the I-205 ditch system described above, overwhelming most of the downstream I-205 culvert crossings and thereby resulting in drainage system damage and flooding. The proposed solar array stormwater management strategy avoids contributing flows to the downstream areas impacted by the January 1, 2009, storm event.

Currently, flows from the pending solar array area drain to three culvert systems crossing I-205. A fourth culvert defines the eastern edge of the site drainage area (see Appendix A, Figure 2). The capacities of the three culverts draining the site are shown in Table 1. At the time of this report, the upstream invert elevation of the fourth culvert is unknown, and thus its capacity cannot be determined. This report assumes that this culvert has the capacity to convey flows directed to it, but we recommend it be verified. This fourth culvert is further described below.

The westernmost culvert (Culvert #1) is 24 inches in diameter, and is part of the capacity-limited conveyance system described above. This conveyance system is the location of several 2006 SWMP recommended conveyance improvement projects (see Appendix F). Currently, about 12.18 ac of the project site contribute flows to this culvert system.

Moving to the east, a 15-inch-diameter culvert (Culvert #2) crosses I-205. Culvert 2 outfalls to an open channel system that conveys flows to and combines with the capacity-limited system described above. The proposed stormwater management strategy avoids utilizing this system. Currently, about 24.43 ac of the project site contribute flows to this culvert system.

Further east is an 18-inch-diameter culvert (Culvert #3) crossing I-205. The 2006 SWMP does not describe the conveyance system downstream of Culvert 3, but it also does not include any of it in its inventory of capacity-limited systems (see Appendix F). Currently, approximately 16.11 ac of the project site are draining to this culvert system. The proposed project stormwater management strategy includes utilizing Culvert 3 to convey all flows in excess of what cannot be infiltrated onsite.

The easternmost culvert in the area of the Solar Array site is labeled as Culvert #4 (see Appendix A, Figure 2). ODOT site survey crews found the upstream end of this culvert to be buried in gravel, and they were unable to locate it. Given the downstream topography, it is assumed that this culvert system is similar or greater in slope than Culvert 3 and has the capacity to intercept upstream flows and convey them south across I-205. We recommend that the upstream invert be located in order to quantify the culvert's actual capacity.

South of the project site, on the north side of I-205, exists a drainage ditch that parallels the freeway and conveys flow to the west. Ditch flow is intercepted by culverts crossing the interstate, including those described above. Per interviews with ODOT staff, on January 1,

2009, an intense storm event combined with clogging of the I-205 culvert crossing at Tanner Creek resulted in flow bypassing downstream and inundating the culverts previously mentioned, on down to and including the 10th Street exit culvert system. The result was localized flooding in the 10th Street exit area and downstream of it. The 2006 SWMP identifies the box culvert conveying Tanner Creek flows across I-205 as slightly capacity deficient in the existing condition (see 2006 SWMP excerpts in Appendix F). We recommend a further study of the Tanner Creek crossing culvert system to determine what (if any) improvements are needed to prevent bypassing flows to downstream culverts. The proposed project stormwater management strategy assumes that all culvert systems upstream and through the project site will be properly maintained so as to avoid future flow bypass of those systems.

3. DRAINAGE PATTERNS

3.1 EXISTING DRAINAGE PATTERNS

Flow from the site currently drains into one of two subbasins (Bernert Creek and Willamette River) as previously described. Figure 2 shows the existing flow patterns throughout the site. A ditch along the north side of I-205 conveys flow to Culverts 1 through 4. Culverts 1 and 2 convey flow beneath I-205 to the lower Bernert Creek basin, while Culverts 3 and 4 convey flow to the Willamette River basin. Basins A, B, and C as shown in Figure 2 delineate the site areas currently contributing flow to Culverts 1, 2, and 3, respectively. As mentioned above, Culvert 4 defines the eastern boundary of site areas contributing flows from the site. Sizes and capacities of Culverts 1–3 are shown in Table 1 (see Appendix C for capacity calculations).

The 2006 SWMP has identified several deficiencies in culvert sizes in multiple locations of the Bernert Creek Basin, including the area downstream of the project site (see Appendix F). Culvert 1 currently conveys flow from two subbasins delineated in the 2006 SWMP. These include subbasin ID BE3N1 and BE3N2. While the project will have no effect on subbasin BE3N2, site Basins A and B combined represent the majority of the BE3N1.[2]

Culvert 3 currently drains an area of approximately 16.11 acres to the south side of I-205. The culvert outfall is located in the vicinity of a pond shown on PGE property. Information on how flow from this outfall is directed to the Willamette River is currently unavailable. Culvert 4 drains flow from the area to the east of the project site and is shown to represent the eastern edge of the site drainage. Site culverts were investigated by ODOT survey crews in December 2009, but they were unable to locate the Culvert 4 upstream invert and the upstream site access road culvert invert to the west. Subsequent maintenance efforts have exposed Culvert 4 and it is said to now be fully functional; however, at the time of this report, the culvert invert elevation has not been determined. In order to confirm the capacity and adequacy of this system to manage flows draining to it, we recommend that Culvert 4 and the access road crossing culvert inverts be surveyed.

To quantify the expected amount of runoff discharged from the site under existing conditions, an analysis was performed for each basin for the 25-, 50-, and 100-year, 24-hour storm events (see Appendix D for analysis figures and output reports). Storm event data were based on the

[2] Subbasin BE3N1 is approximately 47.4 acres, and site Basins A and B combined are 36.6 acres, or 77% of the subbasin.

2006 SWMP. Table 1 summarizes the results of this analysis. Two assumptions made for analysis purposes were the geometry of the drainage ditch on the north side of I-205 (2-foot-deep and 4-foot-wide V-shaped ditch) and the curve number for the site (assumed CN = 69 based on good grass cover and an assumed hydrologic soil group of B[3]). Note that the peak flows determined for Culvert 1 are only the portion of the total flow going to that culvert.

Table 1. Culvert Capacity and Existing Storm Event Peak Flow Analysis Results[4]

Culvert	Size, in	Capacity, cfs	Q^{25}, cfs	Q^{50}, cfs	Q^{100}, cfs
1	24	72.1	2.35	3.04	3.40
2	15	20.0	5.28	6.52	7.17
3	18	26.3	3.39	4.19	4.61

cfs = cubic feet per second
in = inches

3.2 PROPOSED DRAINAGE PATTERNS

The proposed solar arrays are arranged in rows upon the existing site terraces. The terraces will be regraded to maximize runoff infiltration between each row (see figures in Appendix A). Ideally this includes north-south terrace cross slopes of 0.5 percent and east-west terrace longitudinal slopes of 2 percent. Runoff from the solar array panels will sheet flow across infiltration strips. Any flow in excess of infiltration potential will be collected in infiltration swales between each row of panels. Swale flow that is not infiltrated will be conveyed down the terraces to proposed ditches. Flow will then continue to Culvert 3 for conveyance to the Willamette River.

The proposed project will result in approximately 6.83 acres of new impervious area, primarily solar array panels installed on two site terraces. According to the 2006 SWMP and as describe above, the culvert system downstream of Culverts 1 and 2 is deficient in capacity (see Appendix F). Because the downstream Bernert Creek conveyance system has limited capacity, the proposed design will divert runoff flow from the solar array area to Culvert 3 and away from Culverts 1 and 2. Figure 3 shows the proposed flow patterns for the site, and Figure 9 shows the proposed Concept Stormwater Management Plan. Given a worst case scenario of total saturation (or frozen ground), calculations (see Appendix C) indicate that this culvert has the capacity to convey existing flows plus all contributing flow from the solar array area. By routing flows from the solar array area to Culvert 3, a total of 36.61 acres of flow-generating area will be diverted out of the capacity-limited Bernert Creek system. As stated above, the 2006 SWMP does not identify any capacity deficiencies in the system downstream of Culvert 3. According to limited West Linn Geographic Information System (GIS) data, the downstream system includes a simple roadside ditch system (approximately 1,100 feet) combining flows from Culvert 4 and collecting them into a single culvert crossing Willamette Drive. Downstream of this culvert it appears that flow is conveyed about 60 feet via a ditch that outfalls into a large private pond adjacent to the Willamette River. Metro GIS

[3] The assumed hydrologic soils group is based on the description of the soils overlaying bedrock as described in the Draft Slope Stability Evaluation.

[4] Analysis was performed using the Santa Barbara Unit Hydrograph method using StormNET®, Version 4.20.0.675, by BOSS International.

taxlot data suggest that the property containing the 25.4-acre pond is owned by PGE. However, West Linn GIS data suggest that the pond is owned by West Linn Paper WFD.

We recommend that solar array site infiltration testing and a corresponding downstream capacity analysis be performed in order to quantify what site runoff should be expected, and what (if any) corresponding downstream improvements are needed. If capacity is limited downstream of Culvert 3, in either the roadside ditch or the culvert road crossing, we recommend assessing whether downstream conveyance improvements, or solar site stormwater detention are the most appropriate and cost-effective stormwater management measures. We also recommend approaching the owners and operators of the private pond to assure that there are no operational impacts associated with the proposed stormwater discharges.

The proposed stormwater management strategy will result in reduced flows to Culverts 1 and 2. Flow from 20.6 acres of solar site area currently contributing flow to Culvert 2 will be diverted to Culvert 3. Flow from 12.18 acres of the site area currently contributing to Culvert 1 will also be diverted to Culvert 3. Subsequently, the capacity-deficient system in the Bernert Basin downstream of Culverts 1 and 2 will see reduced flows and should benefit. Table 2 shows the analysis results for flow to Culvert 3 under the proposed conditions. Appendix E shows all associated analysis reports.

Table 2. Proposed Peak Flow Drainage Analysis for Culvert 3

Event	Peak Runoff, cfs
Q^{WQ}	1.93
Q^{25}	14.21
Q^{50}	17.41
Q^{100}	19.07

cfs = cubic feet per second

The results of the peak flow drainage analysis for Culvert 3 compared to available capacity presented in Table 1 indicate that the culvert will have sufficient capacity to convey the 100-year, 24-hour storm event.

4. PRELIMINARY DESIGN

4.1 DESIGN STANDARDS

Stormwater management facilities are designed per ODOT Hydraulics Manual requirements. Water quality treatment will be provided onsite via Low Impact Development (LID) infiltration Best Management Practices (BMPs).

4.2 WATER QUALITY TREATMENT DESIGN

For this preliminary phase in the assessment of the site, it is assumed that LID strategies will be adequate to achieve the stormwater treatment standards. Proposed treatment facilities include vegetated filter/infiltration strips and bio-filtration/infiltration swales. The Draft Slope Stability Evaluation, November 2009, suggests that infiltration, "may be possible within the site." However, infiltration testing will be needed to confirm this.

4.3 DETENTION DESIGN

The proposed stormwater management strategy includes utilizing one culvert (see Culvert 3, Figure 3, Appendix A) to collect and convey any flow in excess of that which cannot be infiltrated on site in the solar array area. Calculations show that Culvert 3 has the capacity to convey the worst case scenario of total runoff and little or no infiltration. Infiltration testing is needed to determine what the anticipated flows to Culvert 3 will be. Subsequently, the downstream system should be assessed to determine if there are any conveyance capacity constraints. If capacity is limited in either the roadside ditch or the culvert road crossing, we recommend assessing whether conveyance improvements or solar site stormwater detention are the most appropriate and cost-effective stormwater management measures.

4.4 OFF-SITE FLOW CONSIDERATIONS

4.4.1 Bernert Creek Basin Impact

The system contributed to by Culverts 1 and 2 is currently under capacity as previously described. A critical component of the preliminary stormwater management analysis is to avoid routing flow to this culvert system. The stormwater management strategy outlined will meet these criteria, with the added benefit of reducing existing flows to Culverts 1 and 2 by utilizing available capacity in Culvert 3.

4.4.2 Tanner Creek Basin Impacts

Upstream of the site, the Tanner Creek Basin system crosses I-205 via a box culvert. According to the 2006 SWMP, this culvert system is slightly under capacity for the 25-year stormwater event, and significantly under capacity for larger events. As described above, ODOT maintenance staff reported that a sequence of events on January 1, 2009, resulted in the inundation of this system, and the subsequent flow bypassed and inundated downstream culvert systems down to and beyond the 10th Street culvert system. Crews report removing debris from the Tanner Creek Culvert at 9 p.m., only to find it load up again with debris a few hours later. Some of the debris appeared angularly cut, indicating that yard debris thrown in the drainage system was contributing to the culvert trash rack clogging. The proposed solar array site stormwater management strategy relies on utilizing Culvert 3, which is one of the downstream culverts impacted by the January 1, 2009, event. The solar array site strategy assumes that culverts upstream are maintained or upgraded and are fully functional in order to handle flows from the basins that they are draining. We recommend further investigation of the Tanner Creek culvert crossing in order to determine how to minimize future bypass potential.

5. CONCLUSIONS

Preliminary analysis, including a worst case scenario of saturated conditions with no infiltration, indicates that proposed versus existing drainage will not negatively impact the downstream capacity-deficient systems identified in the 2006 SWMP, specifically downstream in the Bernert Creek system. The proposed strategy may even improve drainage in the Bernert Creek system by routing site flows to Culvert 3 with adequate conveyance capacity. Additionally, the proposed stormwater management strategy will not route flows to downstream areas impacted by a January 1, 2009, flood event, nor does it create similar flooding conditions or circumstances. These conclusions assume culverts upstream of the site and those discharging flows from the site are maintained and fully functional.

Summary of Recommendations

1. The Culvert 4 upstream invert elevation should be located in order to quantify the culvert's actual capacity and ability to manage runoff directed toward it.

2. Further study the Tanner Creek crossing culvert system to determine what (if any) improvements are needed to prevent bypassing flows to downstream culverts.

3. Solar array site infiltration testing and a corresponding downstream capacity analysis should be performed in order to quantify what site runoff is anticipated, and what if any corresponding downstream improvements are needed. If capacity is limited downstream of Culvert 3, in either the roadside ditch or the culvert road crossing, we recommend assessing whether downstream conveyance improvements or solar site stormwater detention are the most appropriate and cost-effective stormwater management measures.

4. Approach the owners and operators of the private pond downstream of Culvert 3 to assure that there are no operational impacts associated with the proposed stormwater discharges.

6. REFERENCES

GeoDesign, Inc. Draft Slope Stability Evaluation. November 20, 2009.

NRCS (Natural Resources Conservation Service). Web Soil Survey. Accessed at: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

ODOT. Hydraulics Manual.

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APPENDIX A

Figures

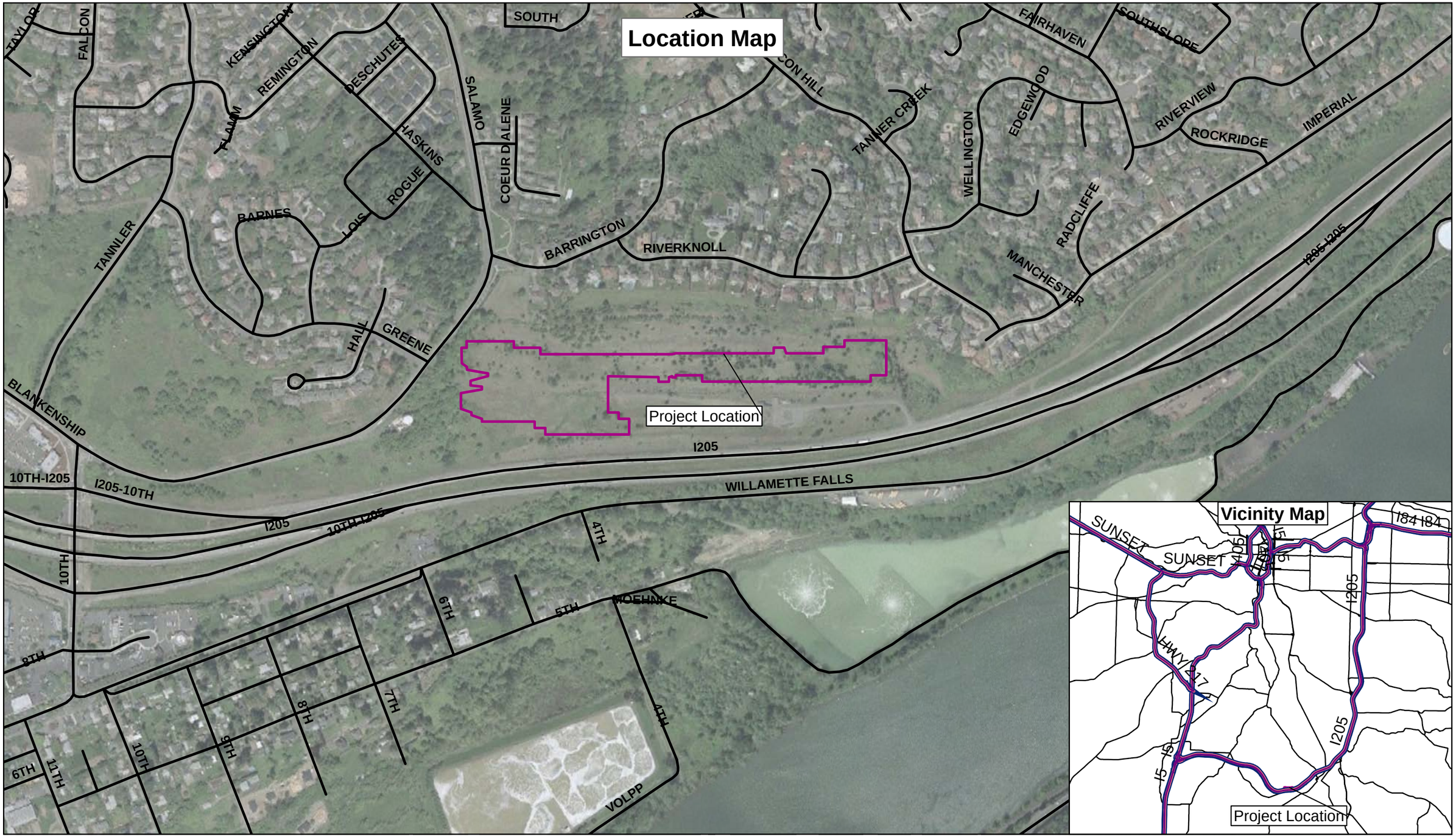

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Figure 1
Site Location and Vicinity Map

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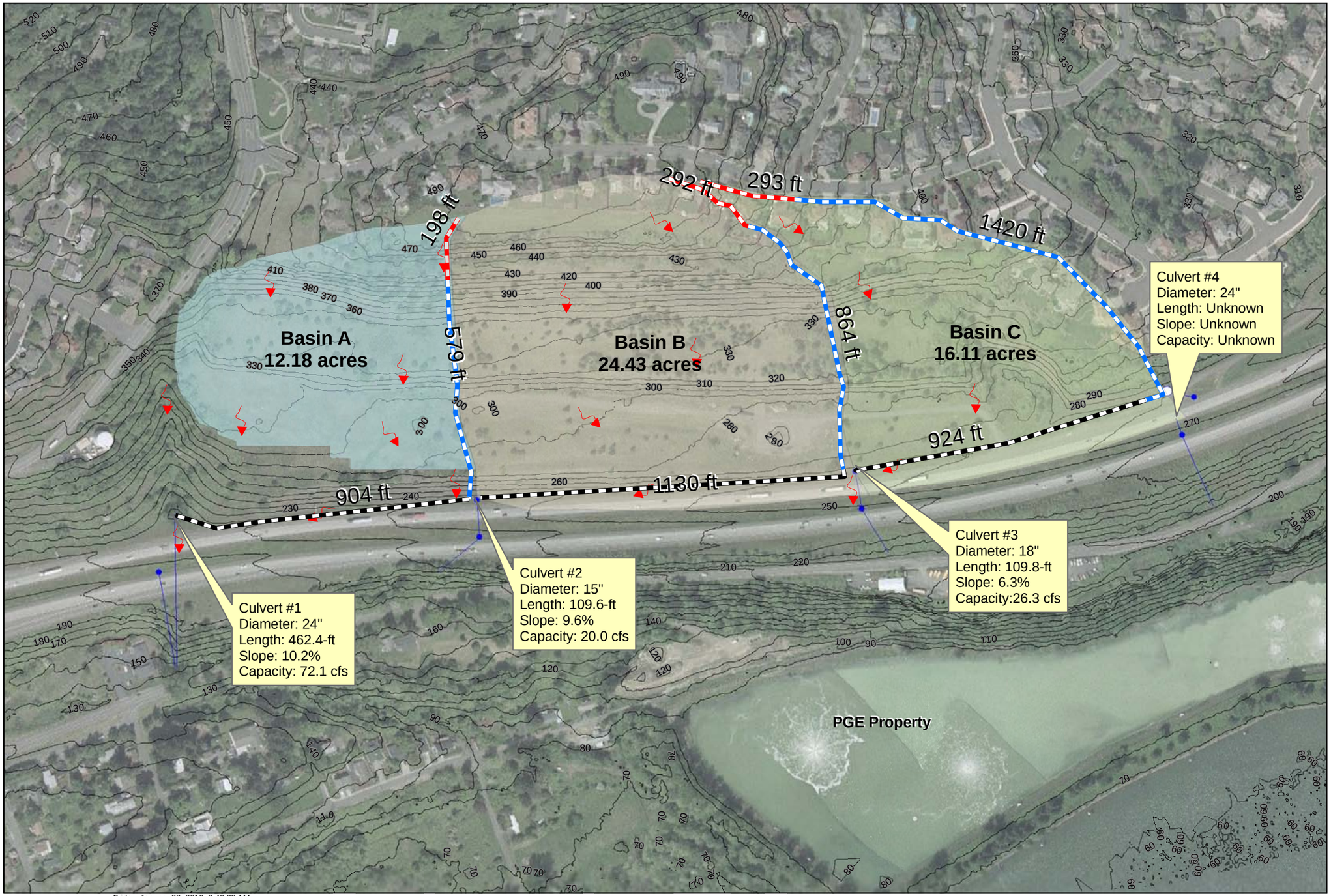
West Linn, Oregon



LEGEND

- Sheet Flow
- Shallow Concentrated Flow
- Channel Flow

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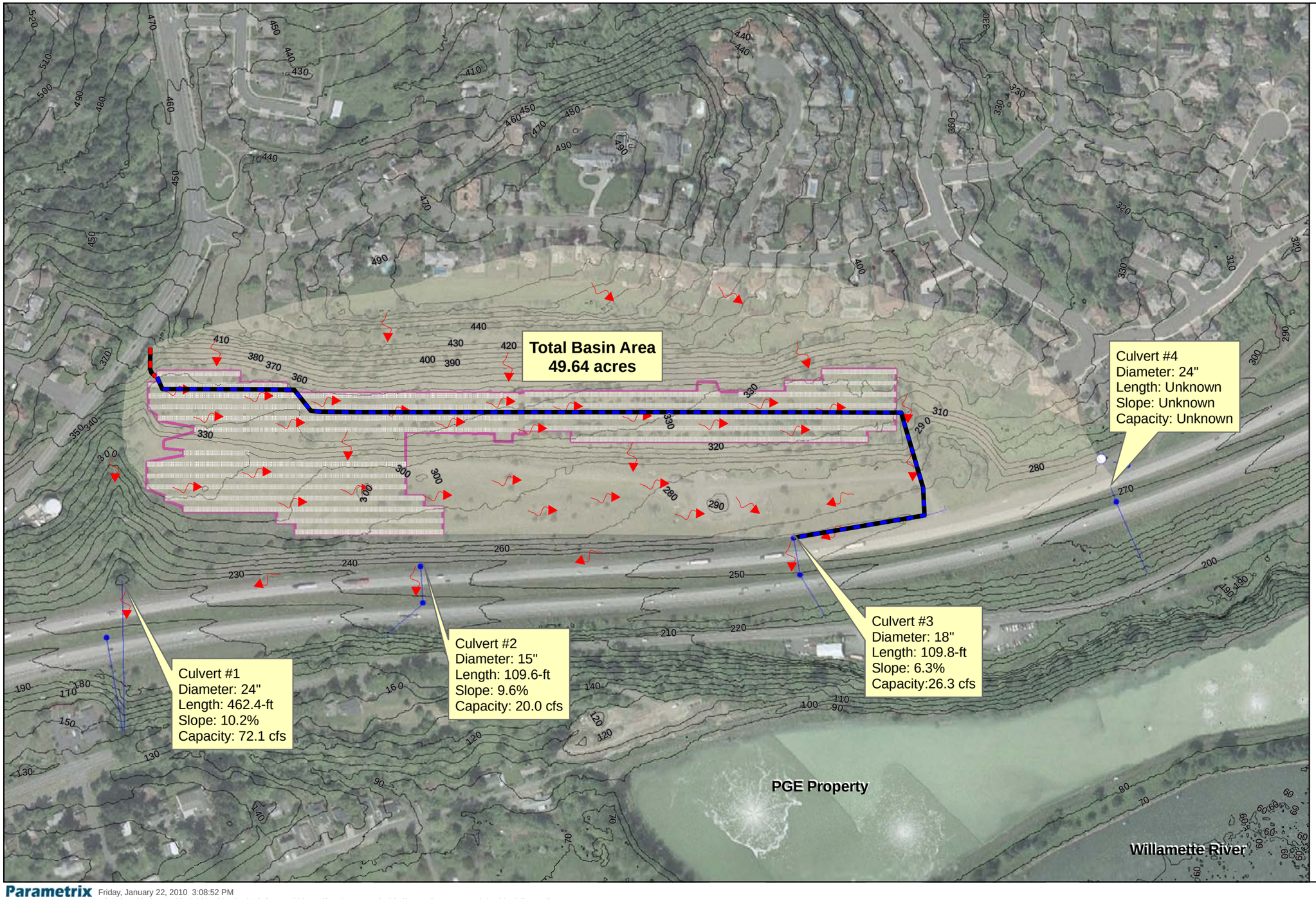
Figure 2
Existing Drainage Patterns

ODOT Solar Highway Project
West Linn, Oregon



Legend

- Proposed Flow Direction
- Culverts
- 98 Ft Sheet Flow
- 3078 Ft Channel Flow

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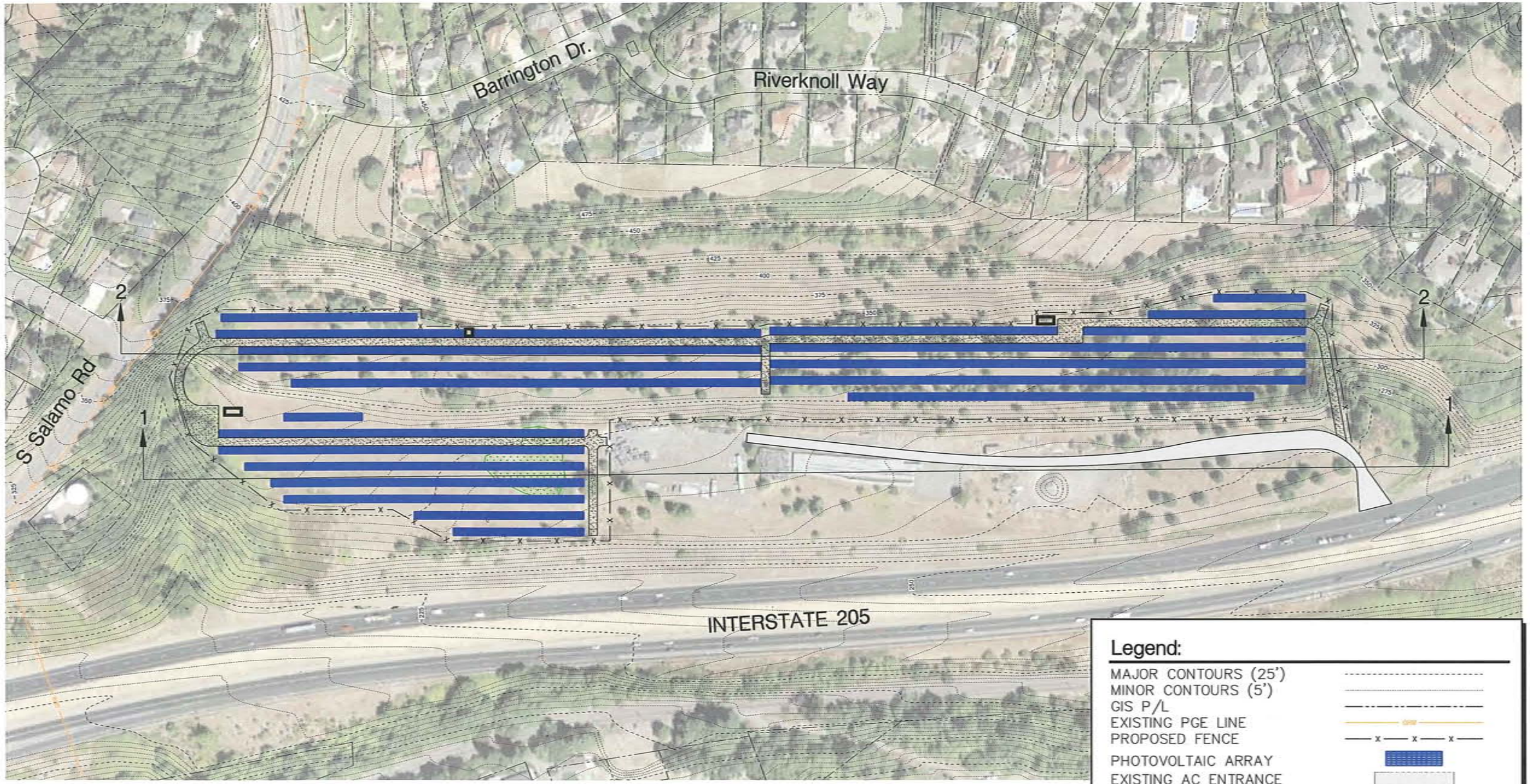
Figure 3
Proposed Drainage Patterns

ODOT Solar Highway Project
West Linn, Oregon



ODOT Solar Power Facility (West Linn)

I-205, Clackamas County

Moyano LEADERSHIP GROUP INC.

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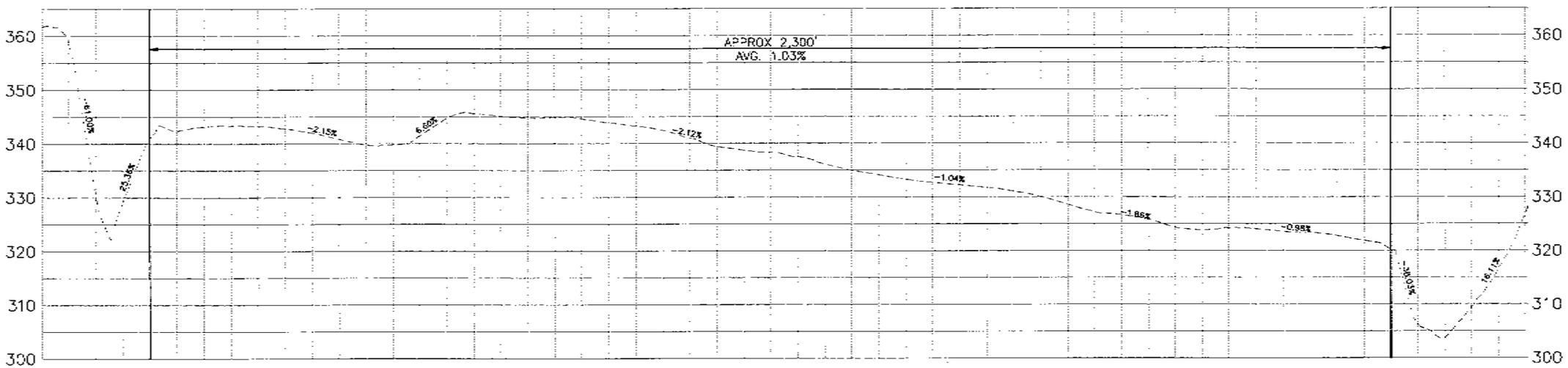

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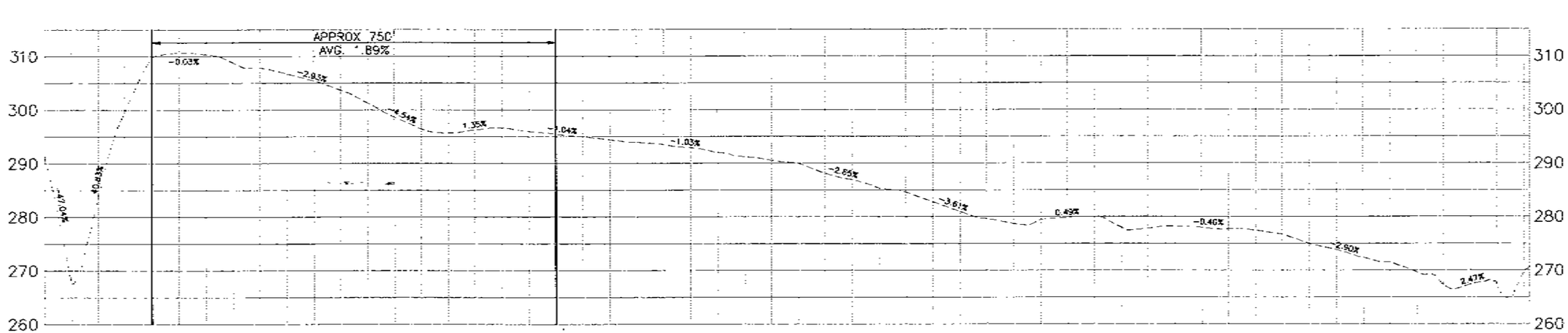

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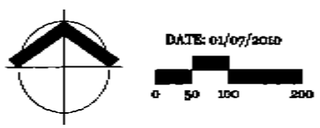

ODOT Solar Power Sections (West Linn)

I-205, Clackamas County

Moyano LEADERSHIP GROUP INC.

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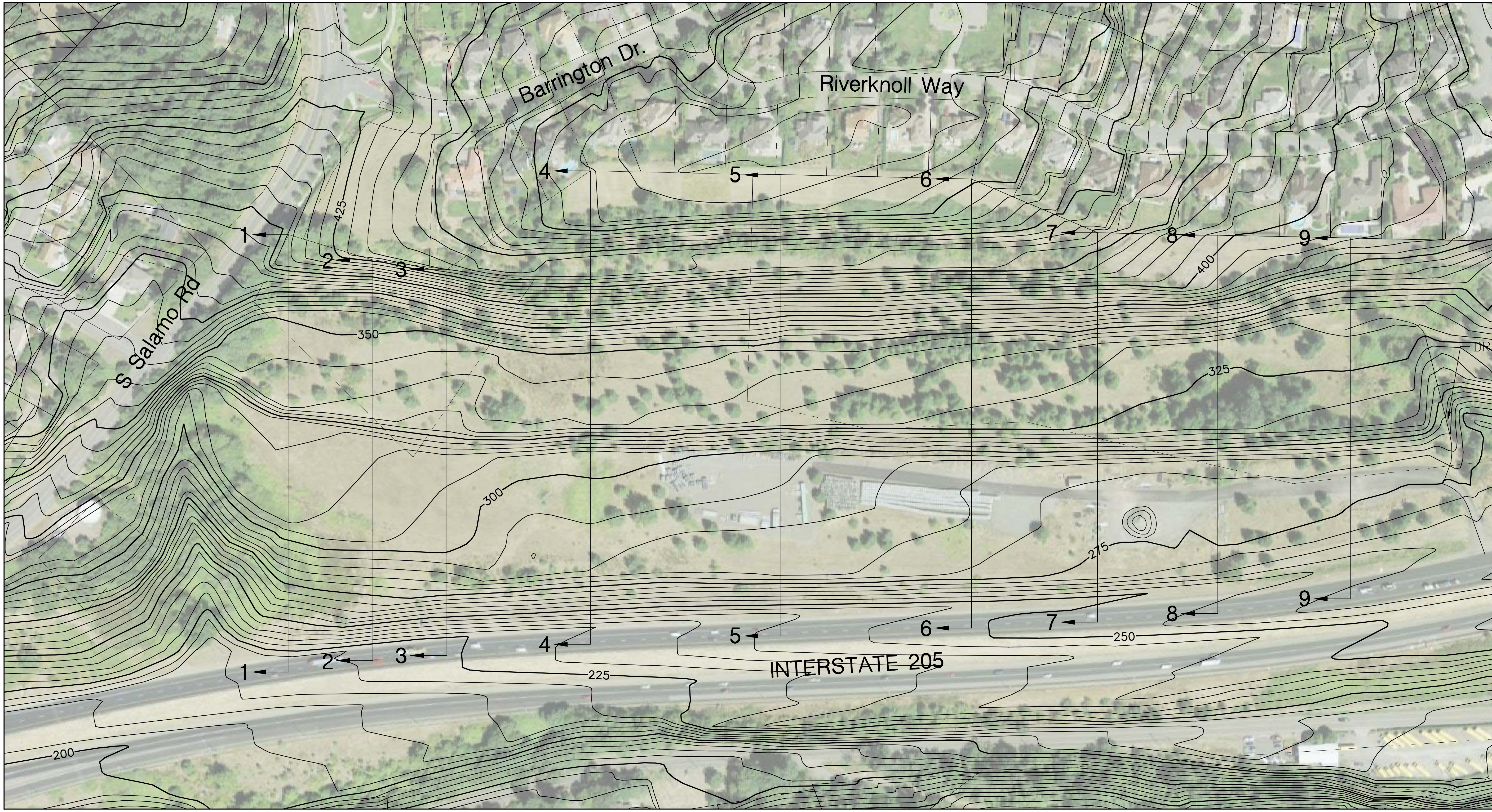

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GIS P/L

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WEST LINN 5MW SOLAR FACILITY

Moyano Leadership Group
West Linn, Oregon

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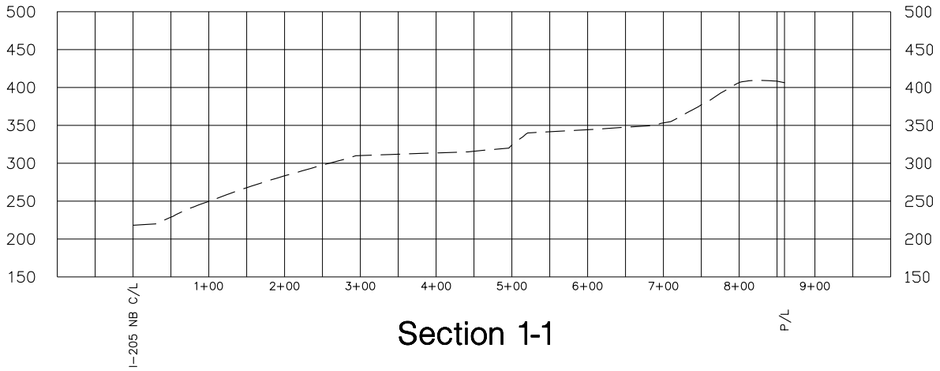
DATE: 10/10/08
BY: CBM
SHEET NO. —



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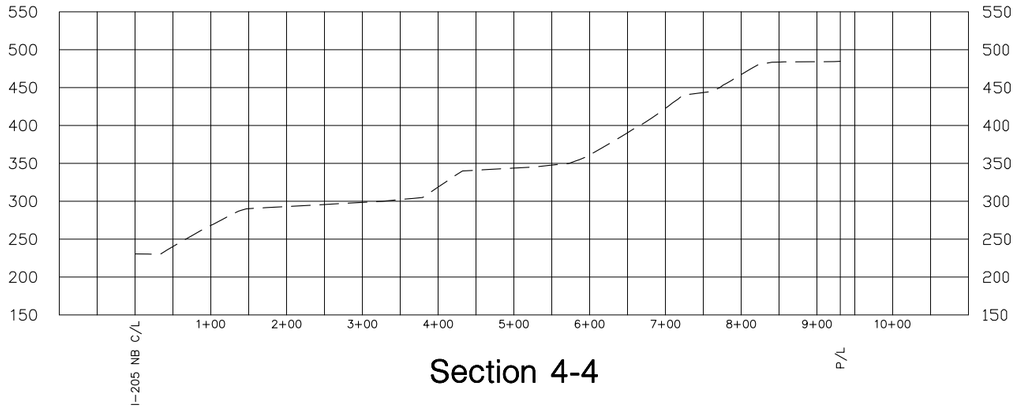

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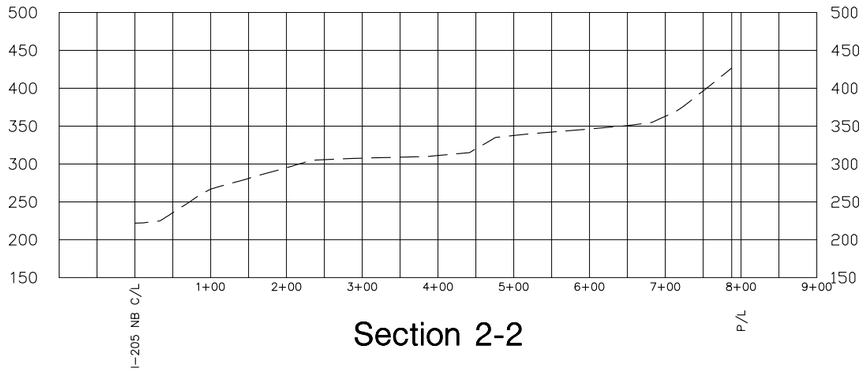

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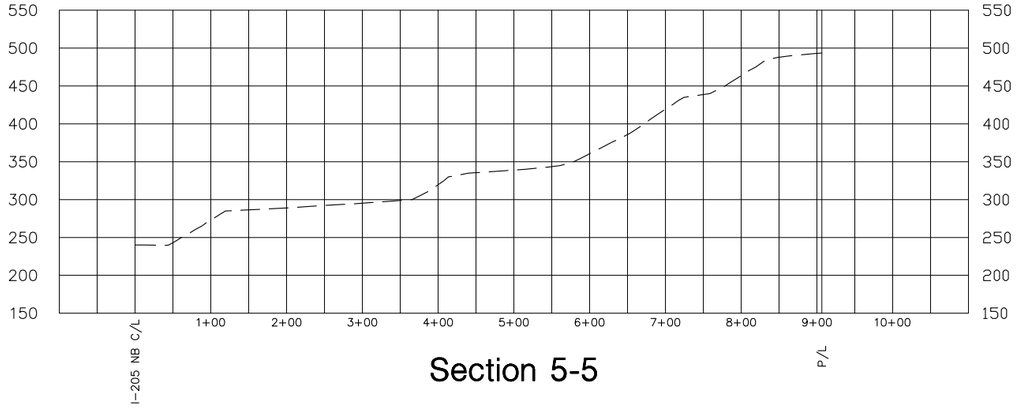

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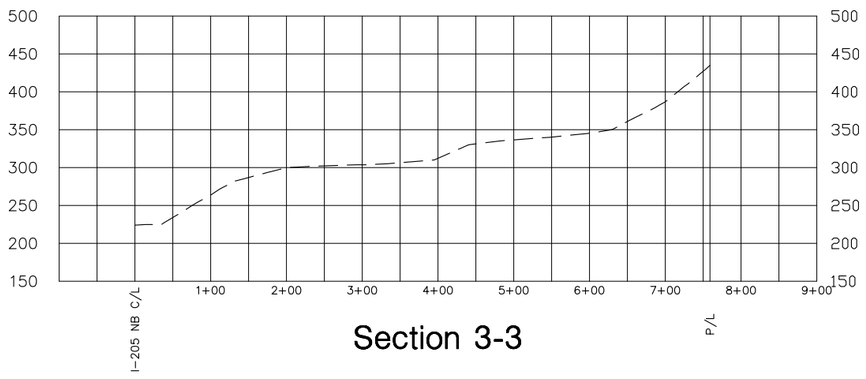

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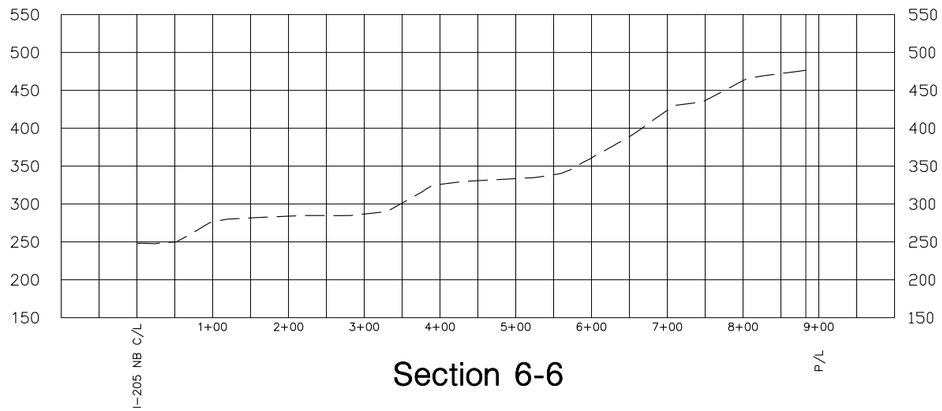

Section 6-6

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WEST LINN 5MW SOLAR FACILITY SECTIONS

Moyano Leadership Group
West Linn, Oregon

PROJECT NO. MOY8485
DATE: 10/10/08
BY: CBM
SHEET NO. —

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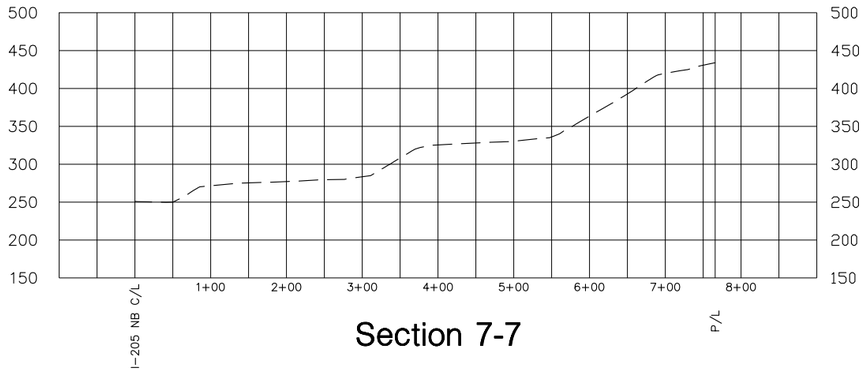
PORTLAND ■ LAS VEGAS ■ PHOENIX
SACRAMENTO ■ BOISE ■ CHARLOTTE
PLANNERS ■ ENGINEERS ■ LANDSCAPE ARCHITECTS ■ SURVEYORS



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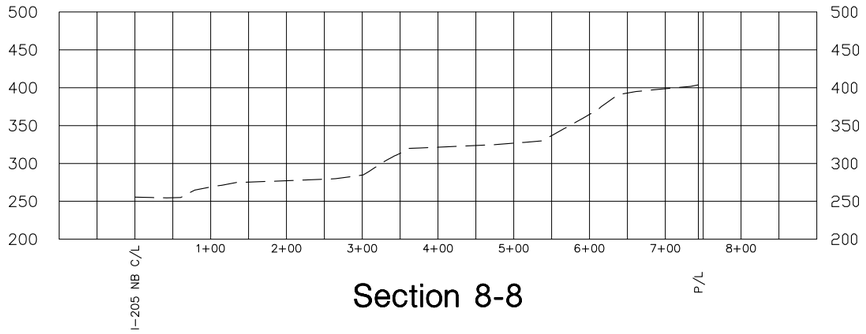

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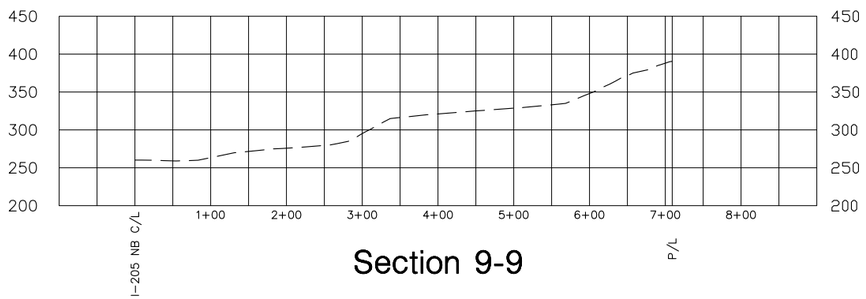
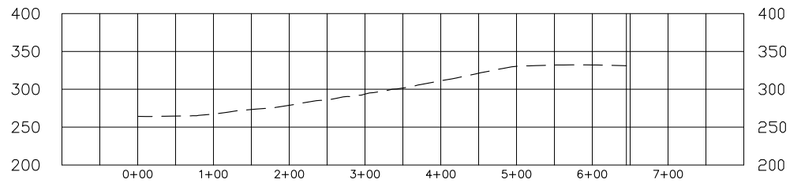


Section 9-9



Driveway Profile

SCALE: 1"=200'

200 100 0 200

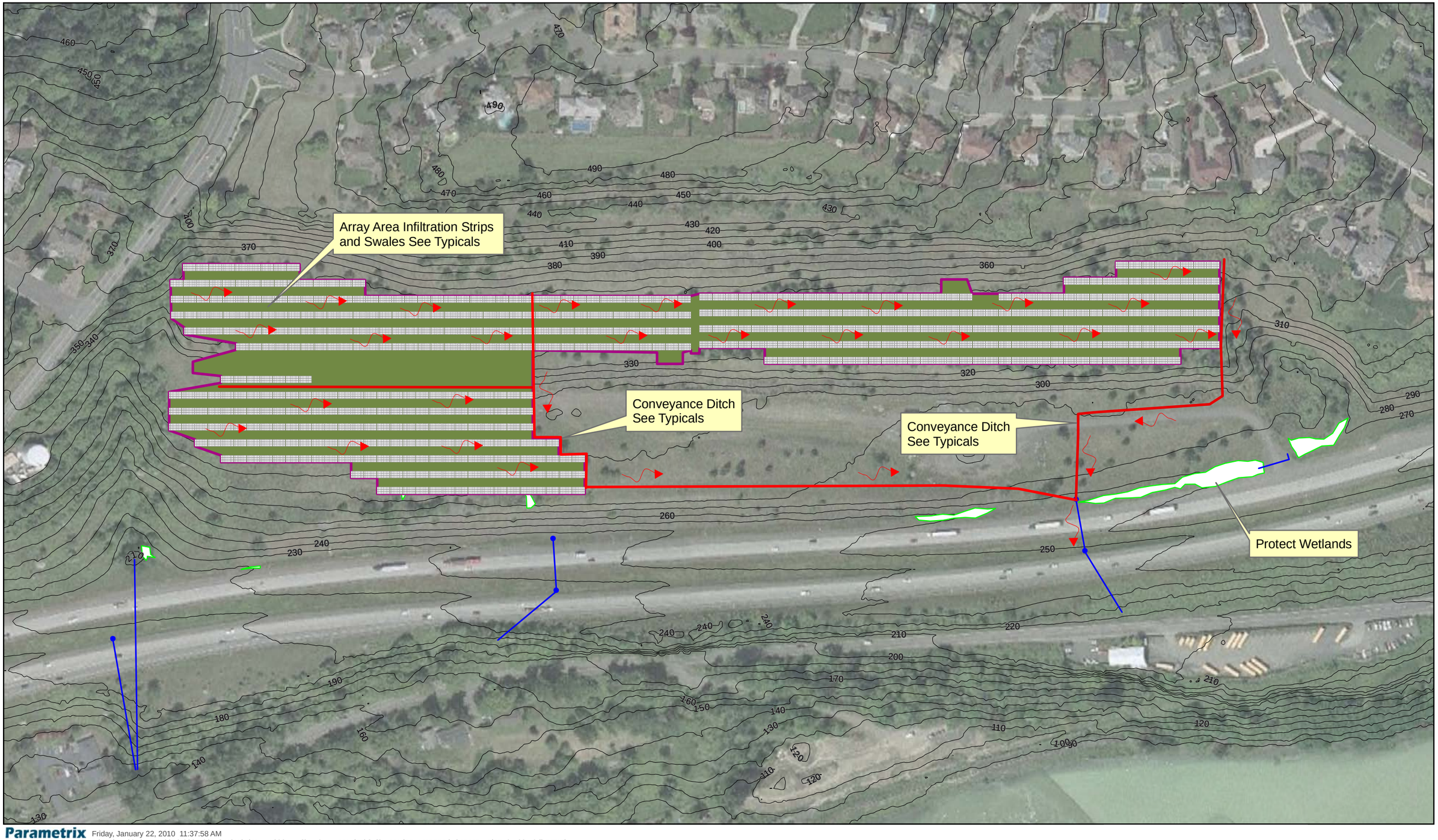
WEST LINN 5MW SOLAR FACILITY SECTIONS

PROJECT NO. MOY8485
DATE: 10/10/08
BY: CBM
SHEET NO. —

Moyano Leadership Group
West Linn, Oregon

W R G DESIGN INC.

PORTLAND ▪ LAS VEGAS ▪ PHOENIX
SACRAMENTO ▪ BOISE ▪ CHARLOTTE
PLANNERS ▪ ENGINEERS ▪ LANDSCAPE ARCHITECTS ▪ SURVEYORS



Parametrix

Friday, January 22, 2010 11:37:58 AM
P:\Projects\276 Water\276-2395-067-ODOTSolarHWY\02 WBS\PH01- West Linn\GIS\WestLinn_Proposed_Concept_Plan_01-22-10dbg.mxd

N

0 200

Scale in Feet

1 inch = 200 feet

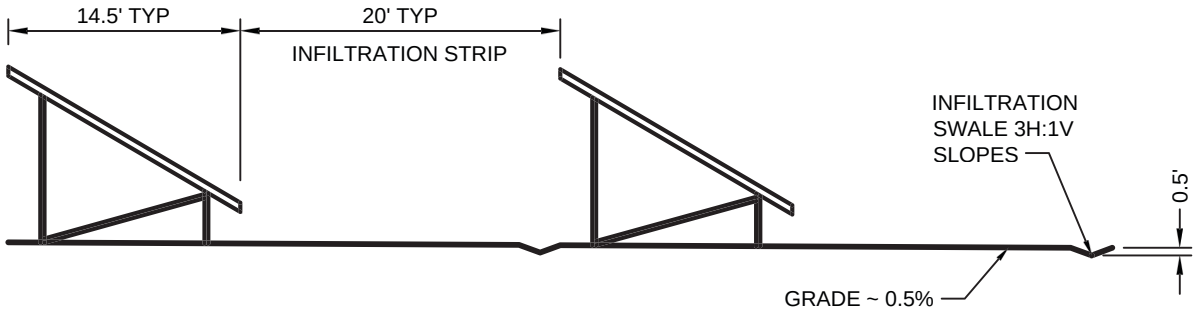
PV Array

Wetland

Proposed Flow Direction

Culvert

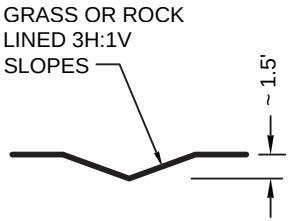
Figure 9
Proposed Stormwater Concept Plan
ODOT Solar Highway Project
West Linn, Oregon



TYPICAL SECTION

NTS

LONGITUDINAL
SLOPE ~ 2%



TYPICAL DITCH SECTION

NTS

Parametrix DATE: Jan 20, 2010 FILE: TypicalsDBG011910

N

FIGURE 10
ODOT SOLAR HWY
WEST LINN
SECTIONS

P:\Projects\276 Water\276-2395-067-ODOTSolarHWY\02 WBS\PH01- West Linn\CAD\Dougs Dwgs\TypicalsDBG011910.dwg, 1/20/2010 10:04:37 AM

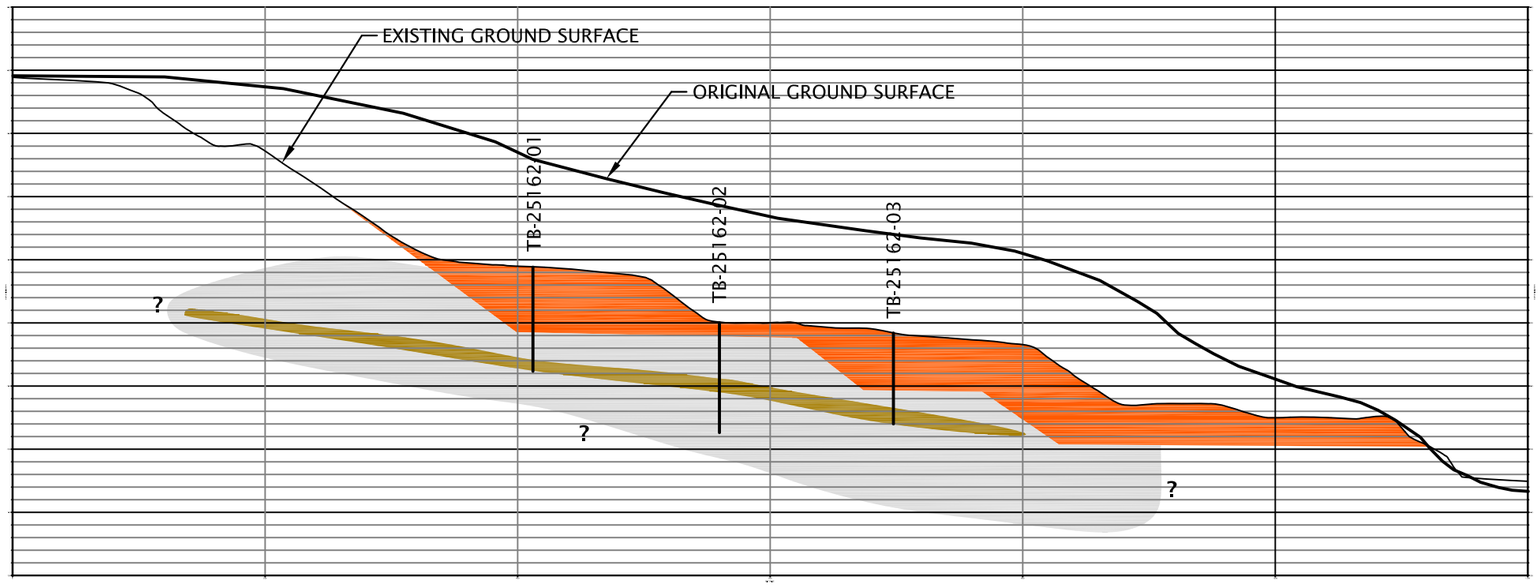
APPENDIX B

Excerpts from the Draft Slope Stability Evaluation, November 2009

DRAFT

A

A'



LEGEND:

- FILL
- COLUMBIA RIVER BASALT (FLOW INTERIOR)
- COLUMBIA RIVER BASALT (FLOW CONTACT ZONE)

0 120 240

(SCALE IN FEET)

CROSS SECTION A - A'

OREGON SOLAR HIGHWAY - WEST LINN PROJECT
WEST LINN, OR

FIGURE 3

ODOT-51-01

NOVEMBER 2009

GEODESIGN INC
1201 SE Tech Center Drive - Suite 160
Vancouver WA 98683
Off 360.693.8416 Fax 360.693.8426

Printed By: ssooter | Print Date: 11/19/2009 3:12:15 PM
File Name: J:\M-R\ODOT\ODOT-51\ODOT-51-01\Figures\CAD\ODOT-51-01-SPI01.dwg | Layout: FIGURE 3

APPENDIX C

Culvert Capacity Calculations

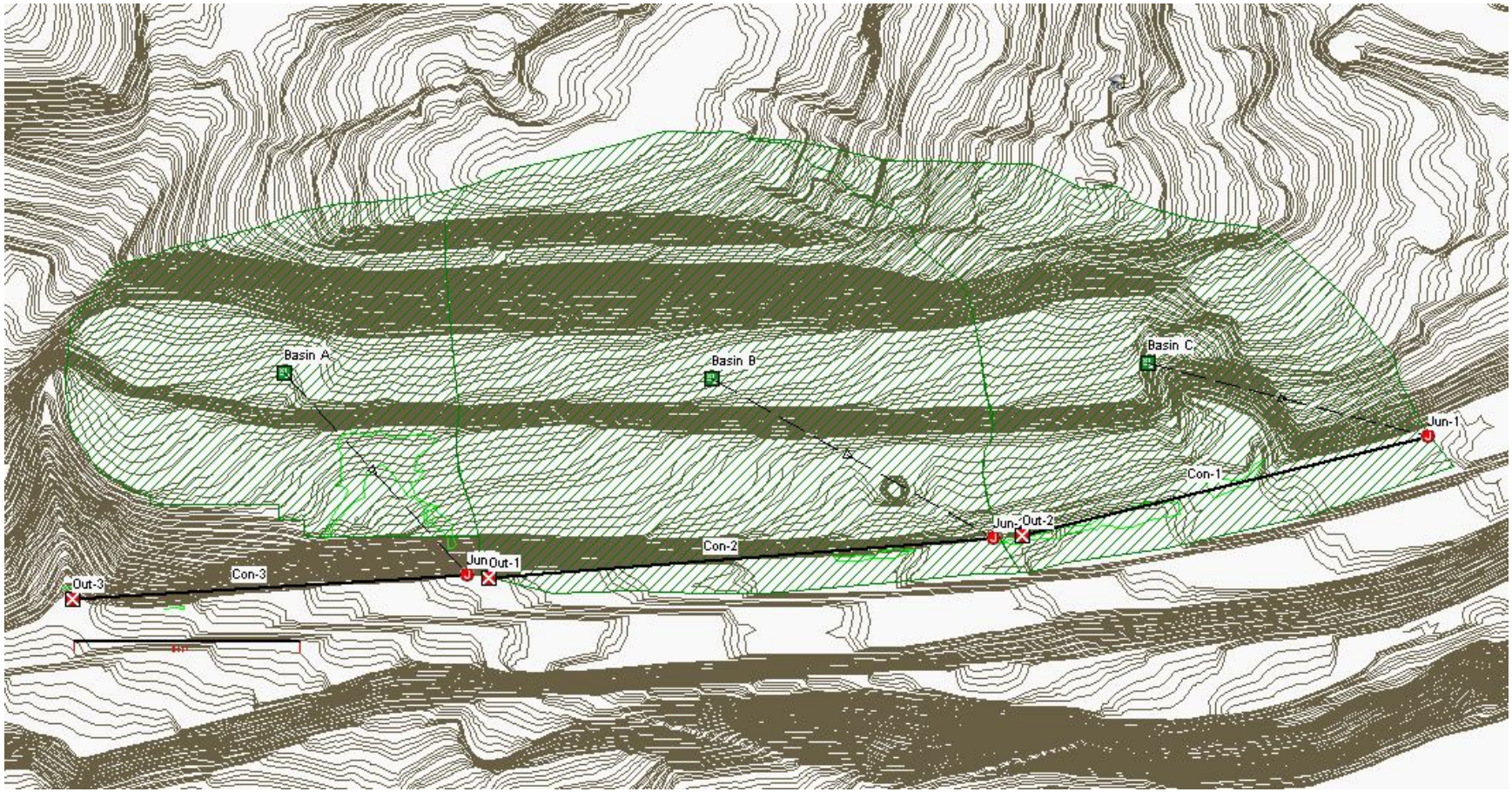
Calculations of Culvert Capacities Using the Manning's Equation

Culvert	Size, in	U.S. Invert Ele.	D.S. Invert Ele.	Manning's n	Slope, ft/ft	Flow, cfs
1	24	198.1	151.1	0.013	0.102	72.10
2	15	228	217.5	0.013	0.096	19.99
3	18	245.8	238.9	0.013	0.063	26.32

APPENDIX D

Existing Basin Stormwater Analysis

Existing Drainage Analysis Map



BOSS International StormNET® - Version 4.20.0 (Build 675)

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date DEC-08-2009 00:00:00
Ending Date DEC-11-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 3
Number of nodes 6
Number of links 3

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-1	TS-3	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Basin A	12.18	5.00	Gage-1
Basin B	24.43	15.00	Gage-1
Basin C	16.11	15.00	Gage-1

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	270.00	275.00	0.00	
Jun-2	JUNCTION	255.00	260.00	0.00	
Jun-3	JUNCTION	235.00	240.00	0.00	
Out-1	OUTFALL	5.00	230.00	0.00	
Out-2	OUTFALL	5.00	247.00	0.00	
Out-3	OUTFALL	5.00	200.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Con-1	Jun-1	Out-2	CHANNEL	967.8	2.5840	0.0320
Con-2	Jun-2	Out-1	CHANNEL	1169.9	2.3084	0.0320
Con-3	Jun-3	Out-3	CHANNEL	113.9	34.3609	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-1	TRIANGULAR	2.00	4.00	1	4.00	0.71	23.70
Con-2	TRIANGULAR	2.00	4.00	1	4.00	0.71	22.40
Con-3	TRIANGULAR	2.00	4.00	1	4.00	0.71	86.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	17.128	3.899
Surface Runoff	6.669	1.518
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	6.669	2.173
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Basin A

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	12.18		70.45

Subbasin Basin B

Soil/Surface Description	Area (acres)	Soil Group	CN

Composite Area & Weighted CN	24.43		73.35

Subbasin Basin C

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	16.11		73.35

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Basin A

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	198.22	0.00	0.00
Slope (%):	20.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.50	0.00	0.00
Velocity (ft/sec):	0.20	0.00	0.00
Computed Flow Time (minutes):	16.72	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	614.13	0.00	0.00
Slope (%):	26.00	0.00	0.00
Surface Type:	Unpaved	Unpaved	Unpaved
Velocity (ft/sec):	8.23	0.00	0.00
Computed Flow Time (minutes):	1.24	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	864.32	0.00	0.00
Channel Slope (%):	6.00	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	2.82	0.00	0.00
Velocity (ft/sec):	15.36	0.00	0.00
Computed Flow Time (minutes):	0.94	0.00	0.00

==========

Total TOC (minutes):	18.90

==========

Subbasin Basin B

Sheet Flow Computations

```
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
          Flow Length (ft):                        292.23                0.00
0.00
          Slope (%):                                17.00                0.00
0.00
          2 yr, 24 hr Rainfall (in):                 2.50                0.00
0.00
          Velocity (ft/sec):                         0.20                0.00
0.00
          Computed Flow Time (minutes):             24.34                0.00
0.00

  Shallow Concentrated Flow Computations
  -------------------------------------
                                                Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        863.99                0.00
0.00
          Slope (%):                                21.00                0.00
0.00
          Surface Type:                           Unpaved              Unpaved
Unpaved
          Velocity (ft/sec):                         7.39                0.00
0.00
          Computed Flow Time (minutes):              1.95                0.00
0.00

  Channel Flow Computations
  ------------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.03                0.00
0.00
          Flow Length (ft):                       1148.02                0.00
0.00
          Channel Slope (%):                         1.30                0.00
0.00
          Cross Section Area (ft²):                  4.00                0.00
0.00
          Wetted Perimeter (ft):                     2.82                0.00
0.00
          Velocity (ft/sec):                         7.15                0.00
0.00
          Computed Flow Time (minutes):              2.68                0.00
0.00

=============================================================================================
          Total TOC (minutes):                      28.97

=============================================================================================


  --------------
  Subbasin Basin C
  --------------

  Sheet Flow Computations
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
```

```
          Flow Length (ft):                          293.00               0.00
0.00
          Slope (%):                                  17.00               0.00
0.00
          2 yr, 24 hr Rainfall (in):                   2.50               0.00
0.00
          Velocity (ft/sec):                           0.20               0.00
0.00
          Computed Flow Time (minutes):               24.39               0.00
0.00

  Shallow Concentrated Flow Computations
  --------------------------------------
                                                  Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        1420.00                0.00
0.00
          Slope (%):                                  11.00               0.00
0.00
          Surface Type:                             Unpaved             Unpaved
Unpaved
          Velocity (ft/sec):                           5.35               0.00
0.00
          Computed Flow Time (minutes):                4.42               0.00
0.00

  Channel Flow Computations
  -------------------------
                                                  Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                         0.03               0.00
0.00
          Flow Length (ft):                          957.60               0.00
0.00
          Channel Slope (%):                           1.60               0.00
0.00
          Cross Section Area (ft²):                    4.00               0.00
0.00
          Wetted Perimeter (ft):                       2.82               0.00
0.00
          Velocity (ft/sec):                           7.93               0.00
0.00
          Computed Flow Time (minutes):                2.01               0.00
0.00

================================================================================================
          Total TOC (minutes):                        30.83

================================================================================================


  **********************
  Subbasin Runoff Summary
  **********************

  ------------------------------------------------------------------------
  Subbasin             Total     Total      Peak  Weighted          Time of
  ID                  Precip    Runoff    Runoff     Curve     Concentration
                         in        in       cfs    Number    days  hh:mm:ss
  ------------------------------------------------------------------------
  Basin A              3.899     1.328     2.353    70.450       0  00:18:54
  Basin B              3.899     1.575     5.282    73.350       0  00:28:58
  Basin C              3.899     1.575     3.395    73.350       0  00:30:49
  ------------------------------------------------------------------------
  System               3.899     1.518     11.02
```

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.20	0.97	270.97	0	08:06	0	0	0:00:00
Jun-2	0.24	1.16	256.16	0	08:04	0	0	0:00:00
Jun-3	0.10	0.52	235.52	0	08:02	0	0	0:00:00
Out-1	223.24	224.16	229.16	0	08:09	0	0	0:00:00
Out-2	240.20	240.96	245.96	0	08:10	0	0	0:00:00
Out-3	193.10	193.52	198.52	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
Jun-1	JUNCTION	3.40	3.40	0	08:06	0.00		
Jun-2	JUNCTION	5.28	5.28	0	08:04	0.00		
Jun-3	JUNCTION	2.35	2.35	0	08:02	0.00		
Out-1	OUTFALL	0.00	5.26	0	08:09	0.00		
Out-2	OUTFALL	0.00	3.39	0	08:10	0.00		
Out-3	OUTFALL	0.00	2.35	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	37.69	1.43	5.26
Out-2	37.53	0.95	3.39
Out-3	35.18	0.64	2.35
System	36.80	3.02	10.94

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence	Maximum Velocity Attained	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow /Design	Ratio of Total Time Surcharged

```
                                   days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     Minutes

-------------------------------------------------------------------------------------------------
------------------
  Con-1                CHANNEL      0  08:10      3.65    1.00        3.39       23.70      0.14
0.48           0
  Con-2                CHANNEL      0  08:09      3.91    1.00        5.26       22.40      0.23
0.58           0
  Con-3                CHANNEL      0  08:02      8.78    1.00        2.35       86.42      0.03
0.26           0


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.

  WARNING 107 : Initial elevation defined for Junction Jun-1 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-2 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-2 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-3 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-3 is below maximum elevation.
Assumed junction maximum elevation.

  Analysis begun on:  Fri Dec 11 13:57:49 2009
  Analysis ended on:  Fri Dec 11 13:57:51 2009
  Total elapsed time: 00:00:02
```

BOSS International StormNET® - Version 4.20.0 (Build 675)

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date DEC-08-2009 00:00:00
Ending Date DEC-11-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 3
Number of nodes 6
Number of links 3

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-1	TS-4	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Basin A	12.18	5.00	Gage-1
Basin B	24.43	15.00	Gage-1
Basin C	16.11	15.00	Gage-1

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	270.00	275.00	0.00	
Jun-2	JUNCTION	255.00	260.00	0.00	
Jun-3	JUNCTION	235.00	240.00	0.00	
Out-1	OUTFALL	5.00	230.00	0.00	
Out-2	OUTFALL	5.00	247.00	0.00	
Out-3	OUTFALL	5.00	200.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Con-1	Jun-1	Out-2	CHANNEL	967.8	2.5840	0.0320
Con-2	Jun-2	Out-1	CHANNEL	1169.9	2.3084	0.0320
Con-3	Jun-3	Out-3	CHANNEL	113.9	34.3609	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-1	TRIANGULAR	2.00	4.00	1	4.00	0.71	23.70
Con-2	TRIANGULAR	2.00	4.00	1	4.00	0.71	22.40
Con-3	TRIANGULAR	2.00	4.00	1	4.00	0.71	86.42

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	18.884	4.298
Surface Runoff	7.904	1.799
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	7.904	2.576
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Basin A

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	12.18		70.45

Subbasin Basin B

Soil/Surface Description	Area (acres)	Soil Group	CN

Composite Area & Weighted CN	24.43		73.35

Subbasin Basin C

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	16.11		73.35

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Basin A

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	198.22	0.00	0.00
Slope (%):	20.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.50	0.00	0.00
Velocity (ft/sec):	0.20	0.00	0.00
Computed Flow Time (minutes):	16.72	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	614.13	0.00	0.00
Slope (%):	26.00	0.00	0.00
Surface Type:	Unpaved	Unpaved	Unpaved
Velocity (ft/sec):	8.23	0.00	0.00
Computed Flow Time (minutes):	1.24	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	864.32	0.00	0.00
Channel Slope (%):	6.00	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	2.82	0.00	0.00
Velocity (ft/sec):	15.36	0.00	0.00
Computed Flow Time (minutes):	0.94	0.00	0.00

==========

Total TOC (minutes):	18.90

==========

Subbasin Basin B

Sheet Flow Computations

```
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
          Flow Length (ft):                        292.23                0.00
0.00
          Slope (%):                                17.00                0.00
0.00
          2 yr, 24 hr Rainfall (in):                 2.50                0.00
0.00
          Velocity (ft/sec):                         0.20                0.00
0.00
          Computed Flow Time (minutes):             24.34                0.00
0.00

  Shallow Concentrated Flow Computations
  -------------------------------------
                                                Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        863.99                0.00
0.00
          Slope (%):                                21.00                0.00
0.00
          Surface Type:                            Unpaved              Unpaved
Unpaved
          Velocity (ft/sec):                         7.39                0.00
0.00
          Computed Flow Time (minutes):              1.95                0.00
0.00

  Channel Flow Computations
  ------------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.03                0.00
0.00
          Flow Length (ft):                       1148.02                0.00
0.00
          Channel Slope (%):                         1.30                0.00
0.00
          Cross Section Area (ft²):                  4.00                0.00
0.00
          Wetted Perimeter (ft):                     2.82                0.00
0.00
          Velocity (ft/sec):                         7.15                0.00
0.00
          Computed Flow Time (minutes):              2.68                0.00
0.00

=============================================================================================
          Total TOC (minutes):                      28.97

=============================================================================================


  --------------
  Subbasin Basin C
  --------------

  Sheet Flow Computations
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
```

```
          Flow Length (ft):                          293.00               0.00
0.00
          Slope (%):                                  17.00               0.00
0.00
          2 yr, 24 hr Rainfall (in):                   2.50               0.00
0.00
          Velocity (ft/sec):                           0.20               0.00
0.00
          Computed Flow Time (minutes):               24.39               0.00
0.00

  Shallow Concentrated Flow Computations
  --------------------------------------
                                                  Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        1420.00                0.00
0.00
          Slope (%):                                  11.00               0.00
0.00
          Surface Type:                             Unpaved             Unpaved
Unpaved
          Velocity (ft/sec):                           5.35               0.00
0.00
          Computed Flow Time (minutes):                4.42               0.00
0.00

  Channel Flow Computations
  -------------------------
                                                  Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                         0.03               0.00
0.00
          Flow Length (ft):                          957.60               0.00
0.00
          Channel Slope (%):                           1.60               0.00
0.00
          Cross Section Area (ft²):                    4.00               0.00
0.00
          Wetted Perimeter (ft):                       2.82               0.00
0.00
          Velocity (ft/sec):                           7.93               0.00
0.00
          Computed Flow Time (minutes):                2.01               0.00
0.00

================================================================================================
          Total TOC (minutes):                        30.83

================================================================================================


  **********************
  Subbasin Runoff Summary
  **********************

  ------------------------------------------------------------------------
  Subbasin             Total     Total      Peak  Weighted          Time of
  ID                  Precip    Runoff    Runoff     Curve     Concentration
                         in        in       cfs    Number    days  hh:mm:ss
  ------------------------------------------------------------------------
  Basin A              4.298     1.599     3.040    70.450       0  00:18:54
  Basin B              4.298     1.859     6.524    73.350       0  00:28:58
  Basin C              4.298     1.859     4.191    73.350       0  00:30:49
  ------------------------------------------------------------------------
  System               4.298     1.799     13.75
```

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.22	1.04	271.04	0	08:06	0	0	0:00:00
Jun-2	0.26	1.26	256.26	0	08:04	0	0	0:00:00
Jun-3	0.11	0.57	235.57	0	08:02	0	0	0:00:00
Out-1	223.26	224.26	229.26	0	08:09	0	0	0:00:00
Out-2	240.22	241.04	246.04	0	08:09	0	0	0:00:00
Out-3	193.11	193.57	198.57	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
Jun-1	JUNCTION	4.19	4.19	0	08:06	0.00		
Jun-2	JUNCTION	6.52	6.52	0	08:04	0.00		
Jun-3	JUNCTION	3.04	3.04	0	08:02	0.00		
Out-1	OUTFALL	0.00	6.50	0	08:09	0.00		
Out-2	OUTFALL	0.00	4.18	0	08:09	0.00		
Out-3	OUTFALL	0.00	3.04	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	37.88	1.68	6.50
Out-2	37.73	1.11	4.18
Out-3	35.33	0.77	3.04
System	36.98	3.56	13.63

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence	Maximum Velocity Attained	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow /Design Flow	Ratio of Total Time Surcharged

```
                                   days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     Minutes

-------------------------------------------------------------------------------------------------
-------------------
  Con-1                CHANNEL      0  08:09      3.85    1.00        4.18       23.70      0.18
0.52           0
  Con-2                CHANNEL      0  08:09      4.12    1.00        6.50       22.40      0.29
0.63           0
  Con-3                CHANNEL      0  08:02      9.36    1.00        3.04       86.42      0.04
0.28           0


  ******************************
  Highest Flow Instability Indexes
  ******************************
  All links are stable.

  WARNING 107 : Initial elevation defined for Junction Jun-1 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-2 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-2 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-3 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-3 is below maximum elevation.
Assumed junction maximum elevation.

  Analysis begun on:  Fri Dec 11 13:59:32 2009
  Analysis ended on:  Fri Dec 11 13:59:34 2009
  Total elapsed time: 00:00:02
```

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****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date DEC-08-2009 00:00:00
Ending Date DEC-11-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 3
Number of nodes 6
Number of links 3

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-1	TS-5	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Basin A	12.18	5.00	Gage-1
Basin B	24.43	15.00	Gage-1
Basin C	16.11	15.00	Gage-1

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	270.00	275.00	0.00	
Jun-2	JUNCTION	255.00	260.00	0.00	
Jun-3	JUNCTION	235.00	240.00	0.00	
Out-1	OUTFALL	5.00	230.00	0.00	
Out-2	OUTFALL	5.00	247.00	0.00	
Out-3	OUTFALL	5.00	200.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
Con-1	Jun-1	Out-2	CHANNEL	967.8	2.5840	0.0320
Con-2	Jun-2	Out-1	CHANNEL	1169.9	2.3084	0.0320
Con-3	Jun-3	Out-3	CHANNEL	113.9	34.3609	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-1	TRIANGULAR	2.00	4.00	1	4.00	0.71	23.70
Con-2	TRIANGULAR	2.00	4.00	1	4.00	0.71	22.40
Con-3	TRIANGULAR	2.00	4.00	1	4.00	0.71	86.42

********** Runoff Quantity Continuity **********	Volume acre-ft	Depth inches
Total Precipitation	19.763	4.498
Surface Runoff	8.541	1.944
Continuity Error (%)	0.000	

********** Flow Routing Continuity **********	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	8.542	2.783
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.000	

****
Composite Curve Number Computations Report
****

Subbasin Basin A

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	12.18		70.45

Subbasin Basin B

Soil/Surface Description	Area (acres)	Soil Group	CN

Composite Area & Weighted CN	24.43		73.35

Subbasin Basin C

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	16.11		73.35

****
SCS TR-55 Time of Concentration Computations Report
****

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Basin A

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	198.22	0.00	0.00
Slope (%):	20.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.50	0.00	0.00
Velocity (ft/sec):	0.20	0.00	0.00
Computed Flow Time (minutes):	16.72	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	614.13	0.00	0.00
Slope (%):	26.00	0.00	0.00
Surface Type:	Unpaved	Unpaved	Unpaved
Velocity (ft/sec):	8.23	0.00	0.00
Computed Flow Time (minutes):	1.24	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	864.32	0.00	0.00
Channel Slope (%):	6.00	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	2.82	0.00	0.00
Velocity (ft/sec):	15.36	0.00	0.00
Computed Flow Time (minutes):	0.94	0.00	0.00

==========

Total TOC (minutes):	18.90

==========

Subbasin Basin B

Sheet Flow Computations

```
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
          Flow Length (ft):                        292.23                0.00
0.00
          Slope (%):                                17.00                0.00
0.00
          2 yr, 24 hr Rainfall (in):                 2.50                0.00
0.00
          Velocity (ft/sec):                         0.20                0.00
0.00
          Computed Flow Time (minutes):             24.34                0.00
0.00

  Shallow Concentrated Flow Computations
  -------------------------------------
                                                Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        863.99                0.00
0.00
          Slope (%):                                21.00                0.00
0.00
          Surface Type:                           Unpaved              Unpaved
Unpaved
          Velocity (ft/sec):                         7.39                0.00
0.00
          Computed Flow Time (minutes):              1.95                0.00
0.00

  Channel Flow Computations
  ------------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.03                0.00
0.00
          Flow Length (ft):                       1148.02                0.00
0.00
          Channel Slope (%):                         1.30                0.00
0.00
          Cross Section Area (ft²):                  4.00                0.00
0.00
          Wetted Perimeter (ft):                     2.82                0.00
0.00
          Velocity (ft/sec):                         7.15                0.00
0.00
          Computed Flow Time (minutes):              2.68                0.00
0.00

=============================================================================================
          Total TOC (minutes):                      28.97

=============================================================================================


  --------------
  Subbasin Basin C
  --------------

  Sheet Flow Computations
  ----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
```

```
          Flow Length (ft):                          293.00               0.00
0.00
          Slope (%):                                  17.00               0.00
0.00
          2 yr, 24 hr Rainfall (in):                   2.50               0.00
0.00
          Velocity (ft/sec):                           0.20               0.00
0.00
          Computed Flow Time (minutes):               24.39               0.00
0.00

  Shallow Concentrated Flow Computations
  --------------------------------------
                                                  Subarea A          Subarea B          Subarea
C
          Flow Length (ft):                        1420.00               0.00
0.00
          Slope (%):                                  11.00               0.00
0.00
          Surface Type:                             Unpaved             Unpaved
Unpaved
          Velocity (ft/sec):                           5.35               0.00
0.00
          Computed Flow Time (minutes):                4.42               0.00
0.00

  Channel Flow Computations
  -------------------------
                                                  Subarea A          Subarea B          Subarea
C
          Manning's Roughness:                         0.03               0.00
0.00
          Flow Length (ft):                          957.60               0.00
0.00
          Channel Slope (%):                           1.60               0.00
0.00
          Cross Section Area (ft²):                    4.00               0.00
0.00
          Wetted Perimeter (ft):                       2.82               0.00
0.00
          Velocity (ft/sec):                           7.93               0.00
0.00
          Computed Flow Time (minutes):                2.01               0.00
0.00

================================================================================================
          Total TOC (minutes):                        30.83

================================================================================================


  **********************
  Subbasin Runoff Summary
  **********************

  ------------------------------------------------------------------------
  Subbasin             Total     Total      Peak  Weighted          Time of
  ID                  Precip    Runoff    Runoff     Curve     Concentration
                         in        in       cfs    Number    days  hh:mm:ss
  ------------------------------------------------------------------------
  Basin A              4.498     1.739     3.400    70.450       0  00:18:54
  Basin B              4.498     2.006     7.172    73.350       0  00:28:58
  Basin C              4.498     2.006     4.608    73.350       0  00:30:49
  ------------------------------------------------------------------------
  System               4.498     1.944     15.17
```

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.22	1.08	271.08	0	08:04	0	0	0:00:00
Jun-2	0.26	1.30	256.30	0	08:04	0	0	0:00:00
Jun-3	0.11	0.59	235.59	0	08:02	0	0	0:00:00
Out-1	223.26	224.30	229.30	0	08:08	0	0	0:00:00
Out-2	240.22	241.08	246.08	0	08:09	0	0	0:00:00
Out-3	193.11	193.59	198.59	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
Jun-1	JUNCTION	4.61	4.61	0	08:04	0.00		
Jun-2	JUNCTION	7.17	7.17	0	08:04	0.00		
Jun-3	JUNCTION	3.40	3.40	0	08:02	0.00		
Out-1	OUTFALL	0.00	7.14	0	08:08	0.00		
Out-2	OUTFALL	0.00	4.60	0	08:09	0.00		
Out-3	OUTFALL	0.00	3.40	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	37.97	1.81	7.14
Out-2	37.82	1.20	4.60
Out-3	35.40	0.84	3.40
System	37.06	3.84	15.04

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence	Maximum Velocity Attained	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum /Design Flow	Ratio of Total Time Surcharged

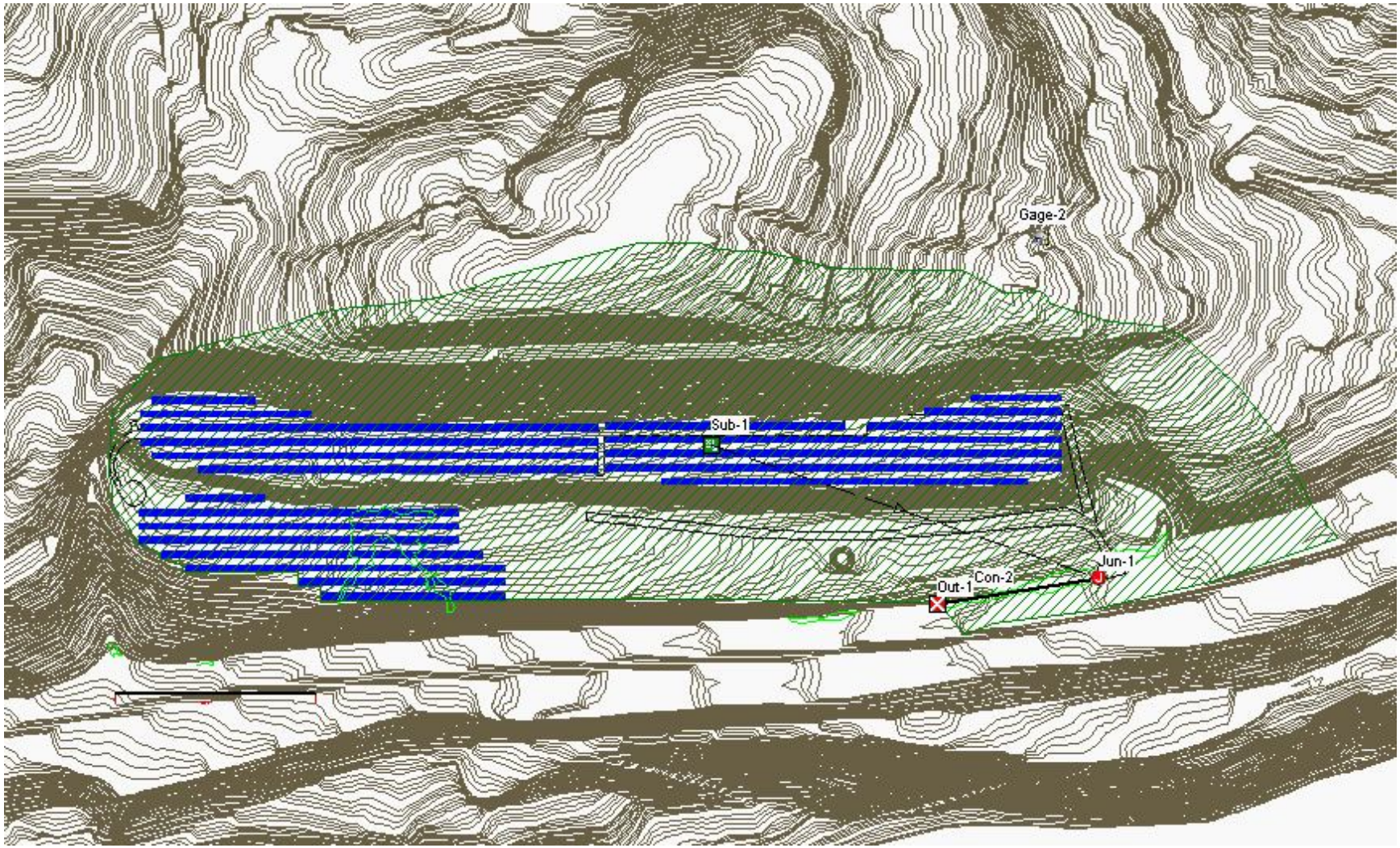
			days	hh:mm	ft/sec		cfs	cfs	Flow Depth	Minutes
Con-1	CHANNEL	0	08:09	3.94	1.00	4.60	23.70	0.19	0.54	0
Con-2	CHANNEL	0	08:08	4.22	1.00	7.14	22.40	0.32	0.65	0
Con-3	CHANNEL	0	08:02	9.62	1.00	3.40	86.42	0.04	0.30	0

```
  ******************************
  Highest Flow Instability Indexes
  ******************************
  All links are stable.

  WARNING 107 : Initial elevation defined for Junction Jun-1 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-2 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-2 is below maximum elevation.
Assumed junction maximum elevation.
  WARNING 107 : Initial elevation defined for Junction Jun-3 is below invert elevation. Assumed
junction invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction Jun-3 is below maximum elevation.
Assumed junction maximum elevation.

  Analysis begun on:  Fri Dec 11 14:00:44 2009
  Analysis ended on:  Fri Dec 11 14:00:47 2009
  Total elapsed time: 00:00:03
```

APPENDIX E

Proposed Basin Stormwater Analysis

Proposed Drainage Analysis Map



BOSS International StormNET® - Version 4.20.0 (Build 675)

The following project depicts the site
basin area for initial determination of
the peak runoff from the impervous areas

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date OCT-27-2009 00:00:00
Ending Date OCT-30-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 1
Number of nodes 2
Number of links 1

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-2	Water Quality	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Sub-1	49.64	16.00	Gage-2

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	256.00	260.00	0.00	
Out-1	OUTFALL	247.00	250.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness

Con-2	Jun-1	Out-1	CHANNEL	415.8	2.1653	0.0320

Cross Section Summary

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-2	TRIANGULAR	3.00	6.00	1	9.00	1.06	63.96

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	5.169	1.250
Surface Runoff	0.775	0.187
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	0.775	0.253
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Composite Curve Number Computations Report

Subbasin Sub-1

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	49.64		73.64

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

$$Tc = (0.007 * ((n * Lf)^{0.8})) / ((P^{0.5}) * (Sf^{0.4}))$$

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)

P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Sub-1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	51.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.50	0.00	0.00
Velocity (ft/sec):	0.25	0.00	0.00
Computed Flow Time (minutes):	6.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C

Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	3078.00	0.00	0.00
Channel Slope (%):	3.70	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	5.66	0.00	0.00
Velocity (ft/sec):	7.58	0.00	0.00
Computed Flow Time (minutes):	6.77	0.00	0.00

Total TOC (minutes):	13.31

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Sub-1	1.250	0.187	1.930	73.640	0	00:13:18
System	1.250	0.187	1.93			

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.14	0.81	256.81	0	08:00	0	0	0:00:00
Out-1	0.14	0.81	247.81	0	08:01	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-1	JUNCTION	1.93	1.93	0	08:00	0.00		
Out-1	OUTFALL	0.00	1.92	0	08:01	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	33.13	0.39	1.92
System	33.13	0.39	1.92

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained ft/sec	Length Factor	Peak Flow during Analysis cfs	Design Flow Capacity cfs	Ratio of Maximum /Design Flow	Ratio of Total Maximum Depth	Time Surcharged Minutes
Con-2	CHANNEL	0 08:01	2.98	1.00	1.92	63.96	0.03	0.27	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation. Assumed junction maximum elevation.

Analysis begun on: Fri Dec 11 14:06:11 2009
Analysis ended on: Fri Dec 11 14:06:12 2009
Total elapsed time: 00:00:01

BOSS International StormNET® - Version 4.20.0 (Build 675)

The following project depicts the site
basin area for initial determination of
the peak runoff from the impervous areas

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date OCT-27-2009 00:00:00
Ending Date OCT-30-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 1
Number of nodes 2
Number of links 1

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-2	TS-25	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Sub-1	49.64	16.00	Gage-2

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	256.00	260.00	0.00	
Out-1	OUTFALL	247.00	250.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness

Con-2	Jun-1	Out-1	CHANNEL	415.8	2.1653	0.0320

Cross Section Summary

Link ID	Shape	Depth/ Diameter	Width	No. of Barrels	Cross Sectional Area	Full Flow Hydraulic Radius	Design Flow Capacity
		ft	ft		ft²	ft	cfs
Con-2	TRIANGULAR	3.00	6.00	1	9.00	1.06	63.96

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	16.127	3.899
Surface Runoff	6.617	1.600
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	6.617	2.156
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Composite Curve Number Computations Report

Subbasin Sub-1

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	49.64		73.64

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)

```
         P  = 2 yr, 24 hr Rainfall (inches)
         Sf = Slope (ft/ft)

  Shallow Concentrated Flow Equation
  ----------------------------------

         V  = 16.1345 * (Sf^0.5) (unpaved surface)
         V  = 20.3282 * (Sf^0.5) (paved surface)
         V  = 15.0 * (Sf^0.5) (grassed waterway surface)
         V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
         V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
         V  = 7.0 * (Sf^0.5) (short grass pasture surface)
         V  = 5.0 * (Sf^0.5) (woodland surface)
         V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
         Tc = (Lf / V) / (3600 sec/hr)

         Where:

         Tc = Time of Concentration (hrs)
         Lf = Flow Length (ft)
         V  = Velocity (ft/sec)
         Sf = Slope (ft/ft)

  Channel Flow Equation
  ---------------------

         V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
         R  = Aq / Wp
         Tc = (Lf / V) / (3600 sec/hr)

         Where:

         Tc = Time of Concentration (hrs)
         Lf = Flow Length (ft)
         R  = Hydraulic Radius (ft)
         Aq = Flow Area (ft²)
         Wp = Wetted Perimeter (ft)
         V  = Velocity (ft/sec)
         Sf = Slope (ft/ft)
         n  = Manning's Roughness

  --------------
  Subbasin Sub-1
  --------------

  Sheet Flow Computations
  -----------------------
                                              Subarea A           Subarea B           Subarea
C
         Manning's Roughness:                      0.40                0.00
0.00
         Flow Length (ft):                        98.00                0.00
0.00
         Slope (%):                               51.00                0.00
0.00
         2 yr, 24 hr Rainfall (in):                2.50                0.00
0.00
         Velocity (ft/sec):                        0.25                0.00
0.00
         Computed Flow Time (minutes):             6.54                0.00
0.00

  Channel Flow Computations
  -------------------------
                                              Subarea A           Subarea B           Subarea
C
```

Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	3078.00	0.00	0.00
Channel Slope (%):	3.70	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	5.66	0.00	0.00
Velocity (ft/sec):	7.58	0.00	0.00
Computed Flow Time (minutes):	6.77	0.00	0.00

Total TOC (minutes):	13.31

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Sub-1	3.899	1.600	14.214	73.640	0	00:13:18
System	3.899	1.600	14.21			

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.31	1.71	257.71	0	08:02	0	0	0:00:00
Out-1	0.31	1.71	248.71	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-1	JUNCTION	14.21	14.21	0	08:02	0.00		
Out-1	OUTFALL	0.00	14.20	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	35.09	3.17	14.20
System	35.09	3.17	14.20

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow	Maximum Velocity	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow	Ratio of Total Maximum Depth	Time Surcharged
		Occurrence days hh:mm	Attained ft/sec		cfs	cfs	/Design Flow		Minutes
Con-2	CHANNEL	0 08:02	4.89	1.00	14.20	63.96	0.22	0.57	0

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation. Assumed junction maximum elevation.

Analysis begun on: Fri Dec 11 14:07:25 2009
Analysis ended on: Fri Dec 11 14:07:27 2009
Total elapsed time: 00:00:02

BOSS International StormNET® - Version 4.20.0 (Build 675)

The following project depicts the site
basin area for initial determination of
the peak runoff from the impervous areas

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date OCT-27-2009 00:00:00
Ending Date OCT-30-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 1
Number of nodes 2
Number of links 1

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-2	TS-50	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Sub-1	49.64	16.00	Gage-2

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	256.00	260.00	0.00	
Out-1	OUTFALL	247.00	250.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness

Con-2	Jun-1	Out-1	CHANNEL	415.8	2.1653	0.0320

Cross Section Summary

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-2	TRIANGULAR	3.00	6.00	1	9.00	1.06	63.96

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	17.781	4.298
Surface Runoff	7.799	1.885
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	7.799	2.541
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Composite Curve Number Computations Report

Subbasin Sub-1

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	49.64		73.64

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

$$Tc = (0.007 * ((n * Lf)^{0.8})) / ((P^{0.5}) * (Sf^{0.4}))$$

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)

P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin Sub-1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	98.00	0.00	0.00
Slope (%):	51.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	2.50	0.00	0.00
Velocity (ft/sec):	0.25	0.00	0.00
Computed Flow Time (minutes):	6.54	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C

Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	3078.00	0.00	0.00
Channel Slope (%):	3.70	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	5.66	0.00	0.00
Velocity (ft/sec):	7.58	0.00	0.00
Computed Flow Time (minutes):	6.77	0.00	0.00

Total TOC (minutes):	13.31

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Sub-1	4.298	1.885	17.412	73.640	0	00:13:18
System	4.298	1.885	17.41			

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.33	1.84	257.84	0	08:02	0	0	0:00:00
Out-1	0.33	1.84	248.84	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-1	JUNCTION	17.41	17.41	0	08:02	0.00		
Out-1	OUTFALL	0.00	17.41	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	35.22	3.72	17.41
System	35.22	3.72	17.41

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow	Maximum Velocity	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow /Design Flow	Total Time Surcharged Minutes
		days hh:mm	ft/sec		cfs	cfs	Depth	
Con-2	CHANNEL	0 08:02	5.15	1.00	17.41	63.96	0.27	0
							0.61	

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation. Assumed junction maximum elevation.

Analysis begun on: Fri Dec 11 14:08:44 2009
Analysis ended on: Fri Dec 11 14:08:46 2009
Total elapsed time: 00:00:02

BOSS International StormNET® - Version 4.20.0 (Build 675)

The following project depicts the site
basin area for initial determination of
the peak runoff from the impervous areas

****
Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. Santa Barbara UH
Time of Concentration..... SCS TR-55
Link Routing Method ..... Kinematic Wave
Pond Exfiltration..... None
Starting Date OCT-27-2009 00:00:00
Ending Date OCT-30-2009 00:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of rain gages 1
Number of subbasins 1
Number of nodes 2
Number of links 1

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Interval hours
Gage-2	TS-100	INTENSITY	0.03

****
Subbasin Summary
****

Subbasin ID	Total Area acres	Imperv. Area %	Raingage
Sub-1	49.64	16.00	Gage-2

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Jun-1	JUNCTION	256.00	260.00	0.00	
Out-1	OUTFALL	247.00	250.00	0.00	

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness

Con-2	Jun-1	Out-1	CHANNEL	415.8	2.1653	0.0320

Cross Section Summary

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
Con-2	TRIANGULAR	3.00	6.00	1	9.00	1.06	63.96

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	18.608	4.498
Surface Runoff	8.407	2.032
Continuity Error (%)	0.000	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	8.407	2.740
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Composite Curve Number Computations Report

Subbasin Sub-1

Soil/Surface Description	Area (acres)	Soil Group	CN
Composite Area & Weighted CN	49.64		73.64

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)

```
          P  = 2 yr, 24 hr Rainfall (inches)
          Sf = Slope (ft/ft)

  Shallow Concentrated Flow Equation
  ----------------------------------

          V  = 16.1345 * (Sf^0.5) (unpaved surface)
          V  = 20.3282 * (Sf^0.5) (paved surface)
          V  = 15.0 * (Sf^0.5) (grassed waterway surface)
          V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
          V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
          V  = 7.0 * (Sf^0.5) (short grass pasture surface)
          V  = 5.0 * (Sf^0.5) (woodland surface)
          V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
          Tc = (Lf / V) / (3600 sec/hr)

          Where:

          Tc = Time of Concentration (hrs)
          Lf = Flow Length (ft)
          V  = Velocity (ft/sec)
          Sf = Slope (ft/ft)

  Channel Flow Equation
  ---------------------

          V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
          R  = Aq / Wp
          Tc = (Lf / V) / (3600 sec/hr)

          Where:

          Tc = Time of Concentration (hrs)
          Lf = Flow Length (ft)
          R  = Hydraulic Radius (ft)
          Aq = Flow Area (ft²)
          Wp = Wetted Perimeter (ft)
          V  = Velocity (ft/sec)
          Sf = Slope (ft/ft)
          n  = Manning's Roughness

  --------------
  Subbasin Sub-1
  --------------

  Sheet Flow Computations
  -----------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
          Flow Length (ft):                         98.00                0.00
0.00
          Slope (%):                                51.00                0.00
0.00
          2 yr, 24 hr Rainfall (in):                 2.50                0.00
0.00
          Velocity (ft/sec):                         0.25                0.00
0.00
          Computed Flow Time (minutes):              6.54                0.00
0.00

  Channel Flow Computations
  -------------------------
                                                Subarea A           Subarea B           Subarea
C
```

Manning's Roughness:	0.03	0.00	0.00
Flow Length (ft):	3078.00	0.00	0.00
Channel Slope (%):	3.70	0.00	0.00
Cross Section Area (ft²):	4.00	0.00	0.00
Wetted Perimeter (ft):	5.66	0.00	0.00
Velocity (ft/sec):	7.58	0.00	0.00
Computed Flow Time (minutes):	6.77	0.00	0.00

Total TOC (minutes):	13.31

****
Subbasin Runoff Summary
****

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Sub-1	4.498	2.032	19.073	73.640	0	00:13:18
System	4.498	2.032	19.07			

****
Node Depth Summary
****

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-1	0.34	1.91	257.91	0	08:02	0	0	0:00:00
Out-1	0.34	1.91	248.91	0	08:02	0	0	0:00:00

****
Node Flow Summary
****

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	hh:mm
Jun-1	JUNCTION	19.07	19.07	0	08:02	0.00		
Out-1	OUTFALL	0.00	19.07	0	08:02	0.00		

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-1	35.28	4.01	19.07
System	35.28	4.01	19.07

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow	Maximum Velocity	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow /Design Flow	Total Time Surcharged Minutes
		days hh:mm	ft/sec		cfs	cfs	Depth	
Con-2	CHANNEL	0 08:02	5.27	1.00	19.07	63.96	0.30	0
							0.64	

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 108 : Surcharge elevation defined for Junction Jun-1 is below maximum elevation. Assumed junction maximum elevation.

Analysis begun on: Fri Dec 11 14:09:32 2009
Analysis ended on: Fri Dec 11 14:09:34 2009
Total elapsed time: 00:00:02

APPENDIX F

Excerpts from the 2006 West Linn Surface Water Management Plan

Appendix C
CULVERT AND PIPE INVENTORY WITH HYDRAULIC DEFICIENCIES

Count	Watershed	PWR ID	HEC-HMS Subbasin	Drainage Area (mi^2)	Location / Description	Existing Structure								25-Year Design Flow (cfs)		Is it Deficient?		100-Year Design Flow (cfs)		Is it Deficient?	
						Diam (ft)	Length (ft)	Inlet Type	Material	Shape	Slope (ft/ft)	Capacity (cfs)	Structure Type	Existing	Future	Now	Future	Existing	Future	Now	Future
1	ARBOR	495	ARJ5N1	0.156	PIPE FROM SCENIC DR TO HILLSIDE DR.	1.50	400	HW45	CONC	CIRC	0.170	24.5	P	18.6	19.4	NO	NO	21.4	22.3	NO	NO
2	ARBOR	496	ARJ9	0.033	FROM BRAEMAR CT TO SKYE PARKWAY	4.00	390	HW45	CMP	CIRC	0.164	4.0	P	11.2	10.7	YES	YES	12.8	12.3	YES	YES
3	ARBOR	497	ARR5-6	0.087	ENTRANCE TO PIEP SYSTEM UNDER UPPER MIDHILL	3.00	92	HW90	CONC	CIRC	0.158	103.9	C	24.2	26.4	NO	NO	27.7	30.4	NO	NO
4	ARBOR	657	ARJ3	0.356	CULVERT UNDER PACIFIC HIGHWAY NR ARBOR DR.	2.00	72	HW90	CONC	CIRC	0.083	70.8	C	66.2	72.8	NO	YES	76.6	84.0	YES	YES
5	ARBOR	659	ARR5-5N1	0.156	ENTRANCE TO PIPE SYSTEM UNDER COLLEGE HILLPL.	1.50	275	HW90	CONC	CIRC	0.113	55.1	C	18.6	19.4	NO	NO	21.4	22.3	NO	NO
6	ARBOR	660	ARR5-6	0.087	PIPE UNDER UPPER MIDHILL NR COLLEGE HILL PL.	2.00	33	HW45	CONC	CIRC	0.606	109.8	P	24.2	26.4	NO	NO	27.7	30.4	NO	NO
7	ARBOR	661	ARJ6	0.087	UNDER HILLSIDE CT.	4.00	150	PROJ	CONC	CIRC	0.173	161.6	C	24.2	26.4	NO	NO	27.7	30.4	NO	NO
8	ARBOR	662	ARJ5N2	0.062	ENTRANCE TO PIPE SYSTEM UNDER SKYE PARKWAY	3.00	420	HW90	CONC	CIRC	0.217	34.5	P	9.1	9.4	NO	NO	10.6	11.0	NO	NO
9	ARBOR	663	AR5N1W1	0.078	ENTRANCE TO PIPE SYSTEM AT SCENIC DR.	2.25	170	HW90	CONC	CIRC	0.382	19.7	P	7.4	7.4	NO	NO	8.5	8.5	NO	NO
10	ARBOR	664	ARJ8	0.049	UPSTREAM OF BRAEMAR CT.	4.00	120	HW45	CONC	CIRC	0.017	12.5	P	16.7	16.2	YES	YES	19.1	18.6	YES	YES
11	BARLOW	481	BAJ8	0.048	UNDER ROSEPARK DR. AT LUPIN CT.	3.00	60	PROJ	CMP	CIRC	0.117	39.9	C	7.3	10.2	NO	NO	8.3	11.6	NO	NO
12	BARLOW	597	BAJ6	0.127	UNDER SUMMIT ST AT HORTON RD.	3.00	140	PROJ	CMP	CIRC	0.050	10.9	C	26.2	29.8	YES	YES	30.0	34.4	YES	YES
13	BARLOW	598	BAJ5	0.142	UNDER RANDALL ST.	2.00	265	HW45	CONC	CIRC	0.159	70.8	P	28.5	33.4	NO	NO	32.8	38.7	NO	NO
14	BARLOW	599	BAJ5	0.142	PIPE ENTRANCE AT BUCK ST.	2.50	164	HW90	CMP	CIRC	0.048	46.8	C	28.5	33.4	NO	NO	32.8	38.7	NO	NO
15	BARLOW	600	BAJ3	0.184	PIPE UNDER LOWRY DR.	2.00	70	HW90	CONC	CIRC	0.214	34.5	C	39.2	46.0	YES	YES	45.2	53.1	YES	YES
16	BARLOW	601	BAJ4	0.159	UNDER WILLAMETTE DR. NR RANDALL ST.	2.25	87	PROJ	CMP	CIRC	0.082	39.9	C	32.2	38.9	NO	NO	37.2	45.0	NO	YES
17	BARLOW	602	BAJ4	0.159	UNDER WILLAMETTE DR. NR RANDALL ST.	2.00	110	PROJ	CMP	CIRC	0.167	22.8	C	32.2	38.9	YES	YES	37.2	45.0	YES	YES
18	BARLOW	603	BAR2-3	0.184	UNDER WILLAMETTE VIEW CT.	2.00	150	PROJ	CMP	CIRC	0.140	14.8	C	39.2	46.0	YES	YES	45.2	53.0	YES	YES
19	BARLOW	604	BAJ2	0.241	CULVERT UNDER FAILING STREET	2.00	317	PROJ	CMP	CIRC	0.098	9.1	C	55.6	62.9	YES	YES	64.3	72.6	YES	YES
20	BERNERT	443	BEJ5S1	0.021	UNDER 10TH STREET	1.00	600	HW45	CONC	CIRC	0.044	12.5	P	8.4	8.4	NO	NO	9.6	9.6	NO	NO
21	BERNERT	444	BER5W1-5W1S1	0.038	ALONG 13TH AVENUE	3.00	120	HW45	CONC	CIRC	0.029	4.5	P	12.3	12.3	YES	YES	14.0	14.0	YES	YES
22	BERNERT	445	BEJ5W1S1	0.038	FROM 16TH AVENUE TO 13TH AVENUE	1.25	1000	HW45	CONC	CIRC	0.050	4.5	P	12.3	12.3	YES	YES	14.1	14.1	YES	YES
23	BERNERT	446	BEJ5W1N1	0.059	UNDER I-205 AT 13TH AVENUE	2.50	526	HW45	CONC	CIRC	0.009	36.9	P	22.9	23.2	NO	NO	29.2	29.3	NO	NO
24	BERNERT	447	BEJ5W2	0.018	UNDER I-205 AT VIRGINIA LN.	3.50	288	HW45	CONC	CIRC	0.010	5.2	P	8.9	8.9	YES	YES	10.1	10.1	YES	YES
25	BERNERT	448	BEJ4N1	0.011	UNDER I-205	2.50	538	HW90	CMP	CIRC	0.210	8.1	C	2.1	2.1	NO	NO	2.8	2.8	NO	NO
26	BERNERT	449	BEJ4N1	0.011	ABOVE I-205	3.00	115	HW90	CONC	CIRC	0.280	7.9	C	2.1	2.1	NO	NO	2.8	2.8	NO	NO
27	BERNERT	450	BEJ9	0.019	ALONG TANNLER NR FALCON DR	1.50	214	HW90	CONC	CIRC	0.114	12.5	P	6.4	6.4	NO	NO	7.3	7.3	NO	NO
28	BERNERT	451	BEJ9	0.019	ALONG TANNLER NR FALCON DR	2.00	214	HW90	CONC	CIRC	0.079	9.1	P	6.4	6.4	NO	NO	7.3	7.3	NO	NO
29	BERNERT	452	BER3N1-3N2	0.049	DOWN TO WILLAMETTE FALLS DR.	3.00	484	PROJ	CONC	CIRC	0.178	28.6	C	5.7	8.7	NO	NO	6.7	10.1	NO	NO
30	BERNERT	453	BEJ3N2	0.049	UNDER SALAMO NR HALL CT.	1.50	150	HW45	CONC	CIRC	0.020	6.6	P	5.7	8.7	NO	YES	6.7	10.1	YES	YES
31	BERNERT	454	BE2W1	0.111	UNDER 9TH ST. NR VOLPP ST.	2.00	80	PROJ	CONC	CIRC	0.004	7.0	C	23.3	34.5	YES	YES	27.6	39.7	YES	YES
32	BERNERT	523	BER6-7	0.081	ALONG TANNER RD TO BLANKENSHIP RD	2.00	900	HW45	CONC	CIRC	0.128	70.8	P	15.1	23.6	NO	NO	20.6	29.3	NO	NO
33	BERNERT	524	BEJ7	0.081	ALONG TANNER D DOWNSTREAM OF GREENE ST	1.50	335	HW45	CMP	CIRC	0.119	26.1	P	15.2	23.7	NO	NO	20.6	29.6	NO	YES
34	BERNERT	525	BEJ8	0.06	ALONG TANNER RD UNDER GREENE STREET	1.50	100	HW45	CONC	CIRC	0.250	25.7	P	10.9	18.8	NO	NO	14.8	22.7	NO	NO
35	BERNERT	526	BEJ9	0.019	AT TANNLER AND REMINGTON	1.25	83	HW90	CONC	CIRC	0.060	12.5	P	6.4	6.4	NO	NO	7.3	7.3	NO	NO
36	BERNERT	527	BEJ6	0.128	UNDER SALAMO AT TANNER DR.	2.00	390	HW45	CONC	CIRC	0.019	70.8	P	31.6	33.6	NO	NO	35.9	44.2	NO	NO
37	BERNERT	528	BEJ6	0.128	UNDER I-205	3.00	538	HW90	CMP	CIRC	0.026	35.9	C	31.6	33.6	NO	NO	35.9	44.2	NO	YES
38	BERNERT	529	BER5-5W1	0.224	UNDER 10TH	1.25	150	HW90	CONC	CIRC	0.040	70.8	C	72.0	74.6	YES	YES	84.7	87.5	YES	YES
39	BERNERT	530	BEJ4	0.528	NR 7TH	1.00	100	HW90	CONC	CIRC	0.050	25.7	C	166.0	171.5	YES	YES	192.4	199.5	YES	YES
40	BERNERT	531	BER3-4	0.528	UNDER WILLAMETTE FALLS DR NR 6TH ST.	1.25	160	PROJ	CMP	CIRC	0.040	92.5	C	165.7	171.3	YES	YES	191.9	199.0	YES	YES
41	BERNERT	532	BEJ3N1	0.124	UNDER WILLAMETTE FALLS DR AT 6TH ST.	3.50	90	HW45	CMP	CIRC	0.043	105.8	P	39.0	40.4	NO	NO	44.3	46.2	NO	NO
42	BERNERT	533	BEJ3N1	0.124	PAIR UNDER WILLAMETTE FALLS DR AT 6TH ST.	3.00	50	HW45	CONC	CIRC	0.132	25.7	P	39.0	40.4	YES	YES	44.3	46.2	YES	YES
43	BERNERT	534	BER2-3	0.682	UNDER 5TH AVENUE AT MOEHNKE ST.	2.00	37	PROJ	CONC	CIRC	0.076	49.9	C	213.2	220.6	YES	YES	245.6	254.5	YES	YES
44	BERNERT	535	BER2-2W1	0.111	UNDER 4TH ST. NR OUTFALL	1.50	45	PROJ	CONC	CIRC	0.016	66.0	C	21.7	31.9	NO	NO	25.8	36.8	NO	NO
45	BOLTON	590	BOR2-3	0.134	PIPE FROM HWY 43 TO HOLMES ST S. OF BUCK	1.75	520	HW45	CONC	CIRC	0.052	23.4	P	35.0	42.8	YES	YES	40.8	49.0	YES	YES
46	BOLTON	591	BOJ3	0.134	PIPE FROM HWY 43 TO FAILING ST. S. OF BUCK	2.50	250	HW45	CONC	CIRC	0.065	28.5	P	35.1	42.9	YES	YES	40.9	49.1	YES	YES
47	BOLTON	592	BOJ3	0.134	UNDER HIGHWAY 43 AT WEST A ST.	2.67	90	HW90	CONC	BOX	0.001	81.9	C	35.1	42.9	NO	NO	40.9	49.1	NO	NO
48	BOLTON	593	BOJ4	0.108	PIPE ALONG HWY 43 AT WEST A ST.	2.00	228	HW45	CONC	CIRC	0.036	25.7	P	27.2	34.5	YES	YES	31.9	39.6	YES	YES
49	BOLTON	594	BOJ5	0.083	UNDER CAUFIELD ST.	2.25	61	PROJ	CONC	CIRC	0.033	49.9	C	20.8	26.2	NO	NO	24.3	30.1	NO	NO
50	BOLTON	595	BOJ6	0.064	UNDER FIRWOOD CT.	2.00	230	PROJ	CONC	CIRC	0.130	20.5	C	16.5	20.2	NO	NO	19.3	23.2	NO	YES
51	BOLTON	596	BOJ7	0.042	UNDER SKYLINE DR NR. WOODWINDS CT.	2.50	140	PROJ	CMP	CIRC	0.057	22.8	C	9.6	12.3	NO	NO	11.3	14.2	NO	NO
52	CASCADE SPRINGS	475	CSJ3	0.036	DOWNSTREAM OF MCKILLICAN ST.	1.50	250	HW45	CONC	CIRC	0.011	25.5	P	10.7	11.5	NO	NO	12.4	13.2	NO	NO
53	CASCADE SPRINGS	574	CSJ4	0.027	PIPE ALONG MCKILLICAN FROM WEST A ST. TO	2.00	975	HW45	CONC	CIRC	0.105	12.5	P	7.7	8.4	NO	NO	9.0	9.6	NO	NO
54	CASCADE SPRINGS	575	CSJ3	0.036	UNDER PORTLAND AVENUE AT MCKILLICAN	2.50	167	HW45	CONC	CIRC	0.071	12.5	P	10.7	11.5	NO	NO	12.4	13.2	NO	YES
55	CASCADE SPRINGS	576	CSJ2	0.086	CULVERT UNDER RIVER STREET	2.00	60	PROJ	CONC	CIRC	0.142	48.2	C	26.5	29.4	NO	NO	30.6	33.7	NO	NO
56	DOLLAR	520	DOJ1	0.123	OUTFALL PIPE	2.00	325	HW45	CMP	CIRC	0.110	12.7	P	30.4	35.0	YES	YES	35.1	40.1	YES	YES
57	DOLLAR	521	DOJ2	0.089	ALONG BORLAND FROM OSTMAN TO OUTFALL PIPE	2.00	1200	HW45	CONC	CIRC	0.037	25.7	P	24.9	27.0	NO	YES	28.9	30.9	YES	YES
58	DOLLAR	522	DOJ3	0.049	FROM BEXHILL TO BORLAND	1.50	420	HW45	CONC	CIRC	0.053	25.7	P	13.5	14.7	NO	NO	15.7	16.8	NO	NO
59	FERN	434	FNJ2-ARJ1	0.994	CULVERTS NR ARBOR DRIVE (8", 12", 30" UNDER PVT.	#N/A	20	PROJ	CMP	CIRC	0.010	25.5	C	197.6	215.0	YES	YES	228.4	247.7	YES	YES
60	FERN	500	FNJA	0.065	PAIR UNDER CARRIAGE WAY	2.00	100	PROJ	CONC	CIRC	0.050	23.8	C	11.7	10.4	NO	NO	15.6	14.8	NO	NO
61	FERN	500	FNJA	0.065	PAIR UNDER CARRIAGE WAY	2.00	100	PROJ	CONC	CIRC	0.050	20.6	C	11.7	10.4	NO	NO	15.6	14.8	NO	NO
62	FERN	636	FNJ7	0.196	CULVERT NR KANTARA WAY	3.50	65	PROJ	CONC	CIRC	0.108	28.6	C	30.2	31.0	YES	YES	39.7	41.1	YES	YES

Appendix C

CULVERT AND PIPE INVENTORY WITH HYDRAULIC DEFICIENCIES

						Existing Structure								25-Year Design Flow (cfs)		Is it Deficient?		100-Year Design Flow (cfs)		Is it Deficient?	
Count	Watershed	PWR ID	HEC-HMS Subbasin	Drainage Area (mi^2)	Location / Description	Diam (ft)	Length (ft)	Inlet Type	Material	Shape	Slope (ft/ft)	Capacity (cfs)	Structure Type	Existing	Future	Now	Future	Existing	Future	Now	Future
192	SUNSET	468	SSR6-7	0.016	RUNNING PARALLEL TO BITTNER ST.	1.50	275	HW45	CONC	CIRC	0.051	7.9	P	3.7	4.8	NO	NO	4.4	5.6	NO	NO
193	SUNSET	470	SSJ7	0.016	PIPE UNDER EXETER STREET	2.00	180	HW45	CONC	CIRC	0.018	18.4	P	3.7	4.8	NO	NO	4.4	5.6	NO	NO
194	SUNSET	471	SSR6-7	0.016	PIPE UNDER LONG ST.	1.75	125	HW45	CONC	CIRC	0.208	9.3	P	3.7	4.8	NO	NO	4.4	5.6	NO	NO
195	SUNSET	472	SSJ6	0.061	UNDER CHARMAN ST.	1.25	81	PROJ	CMP	CIRC	0.025	19.3	C	18.4	19.9	NO	YES	21.3	22.8	YES	YES
196	SUNSET	473	SSR3-4	0.079	PIPE FROM SUNSET AVE. TO IMPERIAL DR.	2.00	250	HW90	CONC	CIRC	0.028	25.7	P	24.4	26.0	NO	YES	28.1	29.8	YES	YES
197	SUNSET	558	SSJ5	0.07	UNDER KELLEY STREET	1.33	60	PROJ	CMP	CIRC	0.050	22.8	C	21.5	23.1	NO	YES	24.8	26.5	YES	YES
198	SUNSET	559	SSJ4	0.079	ENTRANCE PIPE FROM SUNSET AVE. TO IMPERIAL DR.	2.00	412	HW90	CONC	CIRC	0.143	14.8	C	24.4	26.1	YES	YES	28.2	29.9	YES	YES
199	SUNSET	560	SSR3-4	0.079	FROM IMPERIAL DR. TO I-205	2.00	188	HW45	CONC	CIRC	0.128	25.3	P	24.4	26.0	NO	YES	28.1	29.8	YES	YES
200	SUNSET	561	SSJ3	0.101	UNDER I-205	2.00	172	HW45	CONC	CIRC	0.023	7.0	P	31.3	33.5	YES	YES	36.2	38.4	YES	YES
201	SUNSET	562	SSJ3	0.101	UNDER WILLAMETTE FALLS DR.	2.25	90	PROJ	CONC	CIRC	0.007	20.1	C	31.3	33.5	YES	YES	36.2	38.4	YES	YES
202	SUNSET	563	SSR1-2	0.109	CULVERT TO OUTFALL	1.25	420	PROJ	CONC	CIRC	0.075	28.6	C	34.1	36.3	YES	YES	39.4	41.6	YES	YES
203	TANNER	455	TAJ8W2	0.061	CHELAN DR TO PONDERAY DR.	3.00	179	HW45	CONC	CIRC	0.035	25.7	P	21.4	21.4	NO	NO	25.5	25.5	NO	NO
204	TANNER	456	TAR8W2-8W3	0.022	FROM BELKNAP TO CHELAN	2.00	278	HW45	CONC	CIRC	0.031	25.7	P	8.5	8.5	NO	NO	11.3	11.3	NO	NO
205	TANNER	457	TAJ8W3	0.022	FROM SALAMO TO BELKNAP	2.00	668	HW45	CONC	CIRC	0.032	25.7	P	8.9	8.9	NO	NO	11.5	11.5	NO	NO
206	TANNER	458	TAJ3E1	0.033	PIPE UNDER FAIRHAVEN DR	1.75	601	HW45	CONC	CIRC	0.080	7.9	P	8.5	10.0	YES	YES	10.0	11.5	YES	YES
207	TANNER	459	TAJF	0.035	NEW PIPE NR MIDDLE SCHOOL	1.75	339	HW90	CONC	CIRC	0.025	44.9	C	8.8	10.2	NO	NO	10.3	11.7	NO	NO
208	TANNER	460	TAJE	0.059	CULVERT UNDER DAY RD. NR HOOD CT.	2.00	76	PROJ	CONC	CIRC	0.011	45.7	P	13.3	14.2	NO	NO	15.6	16.4	NO	NO
209	TANNER	461	TAJB	0.122	PIPE UNDER PARKER RD.	2.50	150	HW90	CONC	CIRC	0.029	70.8	P	19.9	25.4	NO	NO	25.2	31.6	NO	NO
210	TANNER	536	TAJF	0.035	UNDER ROSEMONT NR PARKER RRD	2.50	50	PROJ	CONC	CIRC	0.118	20.5	C	8.8	10.2	NO	NO	10.3	11.7	NO	NO
211	TANNER	536	TAJF	0.035	UNDER ROSEMONT NR PARKER RRD	2.50	50	HW90	CONC	CIRC	0.118	18.4	C	8.8	10.2	NO	NO	10.3	11.7	NO	NO
212	TANNER	537	TAJC	0.098	CULVERT UNDER PARKER RD.	1.25	40	PROJ	CONC	CIRC	0.088	49.9	C	16.9	19.7	NO	NO	21.7	25.3	NO	NO
213	TANNER	538	TAJB	0.122	CULVERT UNDER PARKER RD	4.50	50	PROJ	CONC	CIRC	0.065	28.6	C	19.9	25.4	NO	NO	25.2	31.6	NO	YES
214	TANNER	539	TARA-B	0.122	CULVERT UNDER PATH	4.50	20	PROJ	CMP	CIRC	0.030	6.1	C	19.8	25.2	YES	YES	25.1	31.6	YES	YES
215	TANNER	540	TAJ8E1	0.079	UNDER PARKER RD NR COHO LN	1.00	65	HW45	CONC	CIRC	0.054	25.7	C	11.3	23.5	NO	NO	14.9	28.5	NO	YES
216	TANNER	541	TAJ9E1	0.075	UNDER PARKER RD.	2.00	66	PROJ	CONC	CIRC	0.030	13.9	C	12.3	19.5	NO	YES	16.5	24.2	YES	YES
217	TANNER	548	TAJ5E1	0.042	UNDER FAIRHAVEN DR.	3.00	60	PROJ	CONC	CIRC	0.017	78.7	C	8.7	11.8	NO	NO	10.2	13.6	NO	NO
218	TANNER	549	TAJ5-SAJ1	0.93	CULVERTS BETWEEN PONDS	1.50	78	HW90	CMP	CIRC	0.004	66.2	C	164.3	203.0	YES	YES	210.2	263.2	YES	YES
219	TANNER	549	TAJ5-SAJ1	0.93	CULVERTS BETWEEN PONDS	6.00	78	HW90	CMP	CIRC	0.004	66.2	C	164.3	203.0	YES	YES	210.2	263.2	YES	YES
220	TANNER	549	TAJ5-SAJ1	0.93	CULVERTS BETWEEN PONDS	4.50	78	HW90	CMP	CIRC	0.004	66.2	C	164.3	203.0	YES	YES	210.2	263.2	YES	YES
221	TANNER	550	TAJ4E1	0.013	FROM WELLINGTON DR TO WELLINGTON CT.	2.00	325	HW45	CONC	CIRC	0.129	11.5	P	3.7	4.1	NO	NO	4.4	4.7	NO	NO
222	TANNER	551	TAR4-4E1	0.013	ALONG WELLINGTON CT.	1.25	82	HW45	CONC	CIRC	0.265	25.7	P	3.7	4.1	NO	NO	4.4	4.7	NO	NO
223	TANNER	552	TAR4-4E1	0.013	UNDER WELLINGTON CT.	2.50	50	HW45	CONC	CIRC	0.005	17.4	P	3.7	4.1	NO	NO	4.4	4.7	NO	NO
224	TANNER	553	TAR4-5	0.93	UNDER WELLINGTON CT.	8.50	100	PROJ	CMP	CIRC	0.005	162.6	C	164.0	202.6	YES	YES	210.1	262.7	YES	YES
225	TANNER	554	TAR3-3E1	0.033	PIPE FROM RADCLIFF TO IMPERIAL	5.00	83	HW90	CONC	CIRC	0.012	12.5	P	8.5	9.9	NO	NO	10.0	11.4	NO	NO
226	TANNER	555	TAR3-4	0.995	UNDER IMPERIAL DR	2.00	90	PROJ	CMP	CIRC	0.011	613.8	C	179.2	220.2	NO	NO	229.4	282.5	NO	NO
227	TANNER	556	TAJ2	1.076	CULVERT UNDER I-205 NR RADCLIFF CT.	5.00	502	HW90	CONC	BOX	0.001	194.5	C	195.7	242.9	YES	YES	250.6	306.4	YES	YES
228	TANNER	557	TAJ1	1.094	WILLMETTE FALLS DR TO OUTFALL	2.00	280	PROJ	CONC	CIRC	0.246	282.2	C	199.6	247.0	NO	NO	254.7	310.4	NO	YES
229	TRILLIUM	494	TRJ6	0.046	PIPE SYSTEM UNDER MAPLETON, OUTFALL TO POND	2.00	75	HW45	CONC	CIRC	0.009	105.9	P	93.0	96.4	NO	NO	107.5	111.6	YES	YES
230	TRILLIUM	612	TRRA-B	0.046	CULVERT UNDER PRIVATE DRIVE NR CLUB HOUSE	2.25	49	PROJ	CONC	CIRC	0.027	35.2	C	19.9	21.9	NO	NO	23.0	25.2	NO	NO
231	TRILLIUM	613	TRJA	0.046	PIPE UNDER SANTA ANITA DR.	2.00	150	PROJ	CONC	CIRC	0.053	36.2	C	29.8	33.7	NO	NO	34.3	38.8	NO	YES
232	TRILLIUM	618	TRJ7	0.046	UNDER PACIFIC HIGHWAY NR CHOW MEIN LN. (HAS	2.25	90	HW90	CONC	CIRC	0.111	44.9	C	90.0	93.5	YES	YES	103.7	108.1	YES	YES
233	TRILLIUM	619	TRJ6	0.046	PIPE BETWEEN MAPLETON AND POND	2.00	180	PROJ	CONC	CIRC	0.041	52.9	P	93.0	96.4	YES	YES	107.5	111.6	YES	YES
234	TRILLIUM	620	TRJ6	0.046	ENTRANCE PIPE TO SYSTEM UNDER MAPLETON DR.	2.50	75	HW90	CONC	CIRC	0.011	25.4	C	93.0	96.4	YES	YES	107.5	111.6	YES	YES
235	TRILLIUM	620	TRJ6	0.046	ENTRANCE PIPE TO SYSTEM UNDER MAPLETON DR.	2.50	75	HW90	CONC	CIRC	0.011	25.4	C	93.0	96.4	YES	YES	107.5	111.6	YES	YES
236	TRILLIUM	626	TRJ5	0.046	PAIR UNDER KENTHORPE WAY	3.00	50	PROJ	CONC	CIRC	0.056	20.2	C	51.6	108.0	YES	YES	119.3	124.9	YES	YES
237	TRILLIUM	626	TRJ5	0.046	PAIR UNDER KENTHORPE WAY	4.00	50	PROJ	CONC	CIRC	0.056	90.7	C	103.2	108.0	YES	YES	119.3	124.9	YES	YES
238	TRILLIUM	627	TRR4-5	0.046	THREE CULVERTS UNDER CEDAR OAK DR	1.75	50	PROJ	CONC	CIRC	0.028	44.2	C	103.2	107.8	YES	YES	119.2	124.8	YES	YES
239	TRILLIUM	627	TRR4-5	0.046	THREE CULVERTS UNDER CEDAR OAK DR	3.50	50	PROJ	CONC	CIRC	0.028	65.4	C	103.2	107.8	YES	YES	119.2	124.8	YES	YES
240	TRILLIUM	627	TRR4-5	0.046	THREE CULVERTS UNDER CEDAR OAK DR	2.50	50	PROJ	CONC	CIRC	0.028	65.4	C	103.2	107.8	YES	YES	119.2	124.8	YES	YES
241	TRILLIUM	633	TRJ3-RBJ1	0.046	NEW CULVERT -TRILLIUM DR AT GLEN TERRACE	3.00	85	PROJ	CONC	CIRC	0.035	147.2	C	201.4	211.7	YES	YES	232.6	244.5	YES	YES
242	TRILLIUM	634	TRJ2	0.046	THREE CULVERTS UNDER ELMRAN AVE NR TRILLIUM	3.00	90	PROJ	CONC	CIRC	0.007	36.4	C	211.9	224.0	YES	YES	244.8	258.7	YES	YES
243	TRILLIUM	634	TRJ2	0.046	THREE CULVERTS UNDER ELMRAN AVE NR TRILLIUM	4.50	90	PROJ	CONC	CIRC	0.007	36.4	C	211.9	224.0	YES	YES	244.8	258.7	YES	YES
244	TRILLIUM	634	TRJ2	0.046	THREE CULVERTS UNDER ELMRAN AVE NR TRILLIUM	2.50	90	PROJ	CONC	CIRC	0.007	36.4	C	211.9	224.0	YES	YES	244.8	258.7	YES	YES
245	TRILLIUM	635	TRR1-2	0.046	UNDER CALAROGA DR.	2.50	54	PROJ	CONC	CIRC	0.059	190.6	C	211.7	223.6	YES	YES	244.8	258.6	YES	YES

Note: Prior to project design all field conditions shall be verifie

SURFACE WATER MANAGEMENT PLAN

Project Location Map

N

0 500 1,000 Feet

scale 1" = 1000'

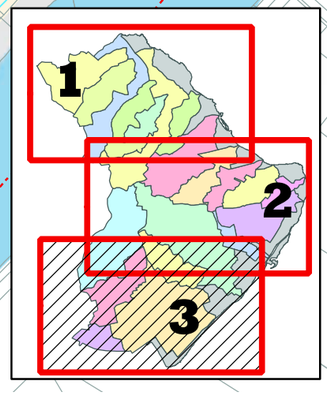
Figure 7.3
Project Locations
Sheet 3 of 3

Fritchie Creek
Tanner Creek
McLean Creek
Sunset Creek
Salamo Creek
Summerlinn Creek
Bernert Creek
Dollar Creek
Willamette River

TARA-B 15 in.
TAJ9E1 18 in.
MCR3-3W1 24 in.
MCJ3W2 18 in.
MCJ3W1 21 in.
MCJ3W1 18 in.
SSJ4 24 in.
SSJ3 15 in.
SSR1-2
SSJ3 24 in.
SAJ8 30 in.
SAJ5N1 12 in.
SAJ5N1 18 in.
SAJ3 36 in.
SAJ1 4 in.
TAJ3E1-1 15 in.
TAR4-5 72 in.
TAJ2 72 in.
42 in.
Project Site
FR1S2 15 in.
FR1S2 12 in.
FRJ1S3 24 in.
FRJ1S3 15 in.
SLJA 12 in.
SLJA 15 in.
SLJ9 0 in.
FRJ2 (2) 32 in.
FRJ1S2 30 in.
SLR1-2 36 in.
SLR1-2 15, 36 in.
SLR1-2 60 in.
SLJ5N1 15 in.
SLJ3S1 12 in.
SL3S1 12 in.
BEJ5W2 15 in.
BEJ5W1S1 12 in.
BEJ3N1 24 in.
BEJ3N1 42 in.
BER2-3 30 in.
BER3-4 42 in.
BEJ4 24 in.
BER5W1-5W1S1 12 in.
BER5-5W1 30 in.
BE2W1 18 in.
DOJ1 18 in.

see sheet 1 for first half of basin & project table

CITY Table				Model Table			
BASIN	PROJECT_NU	SIZE	MODEL_SIZE	MODEL_DESCRIPTION	WIDTH_FT	LGTH_FT	MATERIAL
ROBINWOOD	RWJ1S1	14	14	PIPE SYSTEM BETWEEN VISTA CT AND ROSE CT.	1.00	230	CONC
ROBINWOOD	RWJ1S1	12	12	PIPE SYSTEM BETWEEN VISTA CT AND ROSE CT.	1.00	230	CONC
ROBINWOOD	RWJ1S1	12	10	PIPE SYSTEM BETWEEN VISTA CT AND ROSE CT.	1.00	230	CONC
ROBINWOOD	RWJ1S1	18	24	PIPE SYSTEM BETWEEN VISTA CT AND ROSE CT.	1.00	230	CONC
ROBINWOOD	RWJ1W2S1	12	15	UNDER PACIFIC HIGHWAY NR S. EXIT OF LAZY RIVER	1.25	98	CONC
ROBINWOOD	RWJ2	27	27	CULVERT PAIR UNDER SHADY HOLLOW	2.25	68	CONC
ROBINWOOD	RWJ2	18	27	CULVERT PAIR UNDER SHADY HOLLOW	2.25	68	CONC
ROBINWOOD	RWJ3	24	24	CULVERT UNDER PACIFIC HIGHWAY NRROBINWOOD WAY	2.00	84	CONC
ROBINWOOD	RWJ4	24	24	CULVERT UNDER UPPER MIDHILL NR ROBINWOOD WAY	2.00	75	CMP
BERNERT	BEJ3N1	42	42	UNDER WILLAMETTE FALLS DR AT 6TH ST.	3.50	90	CMP
BERNERT	BEJ3N1	24	24	UNDER WILLAMETTE FALLS DR AT 6TH ST.	3.50	90	CMP
BERNERT	BEJ3N1	24	24	UNDER WILLAMETTE FALLS DR AT 6TH ST.	3.50	90	CMP
SALAMO	SAJ3	42	42	NR CRYSTAL TERRACE AND HASKINS	3.00	78	CONC
SALAMO	SAJ3	36	36	NR CRYSTAL TERRACE AND HASKINS	3.00	78	CONC
SALAMO	SAJ5N1	12	12	NR SALAMO RD AND VISTA RIDGE DR.	1.00	657	CONC
SALAMO	SAJ5N1	18	18	NR SALAMO RD AND VISTA RIDGE DR.	1.00	657	CONC
SALAMO	SAJ8	30	30	UNDER SALAMO INTO POND	2.50	90	CMP
SUMMERLINN	SL3S1	12	15	IN BLANKENSHIP DR	1.25	240	CONC
SUMMERLINN	SLJ3S1	12	15	JOHNSON RD. NR 19TH AVENUE	1.25	300	CONC
SUMMERLINN	SLJ5N1	15	15	UNDER DEBOK AT VILLAGE PARK PL.	1.25	180	CMP
SUMMERLINN	SLJ9	0	15	MATTERHORN COURT	1.25	119	CONC
SUMMERLINN	SLJA	15	15	LUCERNE PALCE	1.25	240	CONC
SUMMERLINN	SLJA	12	10	LUCERNE PALCE	1.25	240	CONC
SUMMERLINN	SLJA	12	15	LUCERNE PALCE	1.25	240	CONC
SUMMERLIN	SLR1-2	60	60	UNDER MEADOWVIEW CT.	5.00	70	CMP
SUMMERLINN	SLR1-2	15	36	UNDER MEADOWVIEW CT.	5.00	70	CMP
SUMMERLINN	SLR1-2	36	36	UNDER MEADOWVIEW CT.	5.00	70	CMP
SUMMERLINN	SLR1-2	36	36	UNDER MEADOWVIEW CT.	5.00	70	CMP
SUNSET	SSJ3	24	24	UNDER I-205	1.25	172	CONC
SUNSET	SSJ3	15	15	UNDER I-205	1.25	172	CONC
SUNSET	SSJ4	24	24	ENTRANCE PIPE FROM SUNSET AVE. TO IMPERIAL DR.	2.00	412	CONC
SUNSET	SSR1-2	0	0	CULVERT TO OUTFALL	2.00	420	CONC
TANNER	TAJ2	72	72		0.00	0	
TANNER	TAJ3E1	15	15	PIPE UNDER FAIRHAVEN DR	1.25	601	CONC
TANNER	TAJ5-SAJ1	54	54	CULVERTS BETWEEN PONDS	4.50	78	CMP
TANNER	TAJ5-SAJ1	54	54	CULVERTS BETWEEN PONDS	4.50	78	CMP
TANNER	TAJ5-SAJ1	54	54	CULVERTS BETWEEN PONDS	4.50	78	CMP
TANNER	TAJ9E1	18	18	UNDER PARKER RD.	1.50	66	CONC
TANNER	TAR4-5	72	72	UNDER WELLINGTON CT.	6.00	100	CMP
TANNER	TARA-B	15	15	CULVERT UNDER PATH	1.25	20	CMP
TRILLIUM	TRJ3-RBJ1	54	54	NEW CULVERT -TRILLIUM DR AT GLEN TERRACE	4.50	85	CONC
TRILLIUM	TRJ5	21	21	PAIR UNDER KENTHORPE WAY	1.75	50	CONC
TRILLIUM	TRJ5	42	21	PAIR UNDER KENTHORPE WAY	1.75	50	CONC
TRILLIUM	TRJ7	24	30	UNDER PACIFIC HIGHWAY NR CHOW MEIN LN. (HAS 24"HI-FLO	2.50	90	CONC
TRILLIUM	TRR1-2	60	60	UNDER CALAROGA DR.	5.00	54	CONC
TRILLIUM	TRR4-5	36	30	THREE CULVERTS UNDER CEDAR OAK DR.	2.50	50	CONC
TRILLIUM	TRR4-5	30	30	THREE CULVERTS UNDER CEDAR OAK DR.	2.50	50	CONC
TRILLIUM	TRR4-5	36	30	THREE CULVERTS UNDER CEDAR OAK DR.	2.50	50	CONC



West Linn GIS
GEOGRAPHIC INFORMATION SYSTEMS

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