Lam Research Corporation
TUD CMS Addition
Tualatin, Oregon

Preliminary Stormwater Report

Date:	February 21, 2020
Owner:	Lam Research Corporation 2025 Gateway Place, Suite 228 San Jose, California 95110
Client:	SSOE Group 7431 NW Evergreen Parkway, Suite 110 Hillsboro, Oregon 97124
Engineering Contact:	John P. Christiansen, PE (503) 563-6151 | johnc@aks-eng.com
Engineering Firm:	AKS Engineering & Forestry, LLC 12965 SW Herman Road, Suite 100 Tualatin, Oregon 97062
AKS Job Number:	7860

AKS ENGINEERING & FORESTRY
www.aks-eng.com

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REGISTERED PROFESSIONAL ENGINEER
76382PE
PRELIMINARY
OREGON
JUNE 29, 2009
JOHN P. CHRISTIANSEN
RENEWAL DATE: 12/31/21

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Preliminary Stormwater Report
LAM RESEARCH – TUD CMS ADDITION
TUALATIN, OREGON

1.0 Purpose of Report
The purpose of this report is to analyze the effects the proposed development will have on the existing stormwater conveyance system; document the criteria, methodology, and informational sources used to design the proposed stormwater system; and present the results of the hydraulic analysis.

2.0 Project Location/Description
The project is located in the central region of the Lam Research Industrial Campus, approximately 1,500-feet northwest of the intersection of Leveton Drive and SW 108th Avenue. The site address is 11361 Leveton Drive, Tualatin, Oregon, 97062 (Tax Lot 100, Tax Map 2S 1 22AB).

The project consists of a ±6,900-square-foot building addition, paved side yards, and relocation of existing private underground utilities. Stormwater runoff generated by the project will use available capacity within an existing stormwater facility for water quantity and quality management. The existing facility is an extended dry basin pond, identified as "Pond B" in prior stormwater management reports prepared for former projects on-site. The project's hydromodification impacts will be mitigated through a Hydromodification Fee-In-Leu, in accordance with newly adopted Clean Water Services (CWS) stormwater requirements for hydromodification.

The results of this stormwater analysis are based on similar assumptions and the available capacity documented in a former drainage report, titled *Stormwater Management Report,* prepared for the Lam Research Parking Master Plan project (City of Tualatin AR-16-0010), by Mackenzie, with a final revision date of August 10, 2017.

Additional information used in the preparation of this report also references the drainage report prepared for the original site development, titled *Storm Calculations – Novellus Tualatin, Oregon,* by Mackenzie, with a final revision date of March 6, 2001.

3.0 Regulatory Design Criteria
3.1 STORMWATER QUANTITY
Per CWS *Design and Construction Standards* (R&O 19-5), Section 4.02 – Water Quantity Control Requirements for Conveyance Capacity, on-site detention is required when any of the following conditions exist:

1. *There is an identified downstream deficiency and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.*

2. *There is an identified regional detention site within the boundary of the development.*

3. *Water quantity facilities are required by District-adopted watershed management plans or adopted subbasin master plans or District-approved subbasin strategy.*

An existing on-site stormwater facility will be used for stormwater quantity management and no modifications to the facility are proposed.

3.2 HYDROMODIFICATION

Per CWS R&O 19-5, Section 4.03 – Hydromodification Approach Requirements, the implementation or funding of techniques to reduce impacts to the downstream receiving water body is required when a new development, or other activities, creates or modifies 1,000 square feet or more of impervious surfaces or increases the amount or rate of surface water leaving the site. The following techniques may be used to mitigate impacts to the downstream receiving water body:

a. Construction of permanent LIDA designed in accordance with this Chapter; or

b. Construction of a permanent stormwater detention facility designed in accordance with this Chapter; or

c. Construction or funding of a hydromodification approach that is consistent with a District-approved subbasin strategy; or

d. Payment of a Hydromodification Fee-In-Lieu.

Per Section 4.03.2, unless specifically waived in writing by the District, a Hydromodification Assessment is required of all activities described in Section 4.03.1, unless the activity meets any of the following criteria:

a. The project results in the addition and/or modification of less than 12,000 square feet of impervious surface.

b. The project is located within a District-approved subbasin strategy with an identified regional stormwater management approach for hydromodification.

This project will result in the addition and/or modification of 11,997 square feet of impervious surface. Therefore, per Section 4.03.2.a, a hydromodification assessment is not required. Hydromodification will be addressed by a payment of a Hydromodification Fee-In-Lieu in accordance with District rates and charges.

3.3 STORMWATER QUALITY

Per CWS R&O 19-5, Section 4.04 Water Quality Treatment Requirements, an on-site water quality approach is required when a new development or other activities create or modify 1,000 square feet or greater of impervious surfaces, or increase the amount of stormwater runoff or pollution leaving the site.

An existing on-site stormwater facility will be used for stormwater quality management and no modifications to the facility are proposed.

4.0 Design Methodology

Per the 2001 Novellus Storm Calculations, existing storm drainage piping and detention volumes were sized using Soil Conservation Service (SCS) methodology. This method utilizes the SCS Type 1A 24-hour design storm. The former stormwater calculation procedures used for the original design are still applicable under current CWS standards. Representative curve numbers (CNs) obtained from *Technical Release 55* (TR-55) for the project area are included in Appendix C.

5.0 Design Parameters

5.1 DESIGN STORMS

Per CWS requirements, design storms used in peak flow hydrologic analyses shall utilize a 24-hour duration. The original 2001 Novellus Storm Calculations used SCS calculation methods to size storm drainage piping and detention ponds. The rainfall intensities used in the prior analysis are still current with present-day standards and are summarized in the table below:

Table 5-1: Rainfall Intensities

Recurrence Interval (Years)	Total Precipitation Depth (Inches)
2	2.5
10	3.45
25	3.90

5.2 PRE-DEVELOPED SITE CONDITIONS

5.2.1 Site Topography

This project is located within the central region of a developed industrial campus with localized topography that varies from the overall site. Existing on-site grades are generally flat and drain to the central portion of the project area with slopes up to ±5 percent. Small landscaped embankments exist in the northwest and eastern portions of the project area with slopes up to a ratio of 3:1, horizontal to vertical. On-site runoff is managed by a private stormwater drainage network that discharges to a private stormwater facility located on the south side of the property near Leveton Drive. The project area has a high point of ±167 feet around the project boundary and a low point of ±161 feet near the central region.

5.2.2 Land Use

The project area consists of a grass lawn area bordered by existing buildings and paved parking and private drive aisles.

5.3 SOIL TYPE

Subsurface soils at the project site are classified as Hillsboro Loam according to the Natural Resources Conservation Service (NRCS) Soil Survey for Washington County. The following table lists the Hydrologic Soil Group rating for each soil type:

Table 5-2: Hydrologic Soil Group Ratings

NRCS Map Unit Identification	NRCS Soil Classification	Hydrologic Soil Group Rating
21B	Hillsboro Loam	B

A Soil Group Map and additional information can be found in the NRCS Soil Resource Report included in Appendix B.

5.4 POST-DEVELOPED SITE CONDITIONS

5.4.1 Site Topography

On-site slopes will remain similar to the existing condition.

5.4.2 Land Use

The project will add ±6,900 square feet of building area and ±5,097 square feet of paved side yards.

5.4.3 Post-Developed Input Parameters

Refer to the HydroCAD Analysis in Appendix A.

5.4.4 Description of Off-Site Contributing Basins

This project will modify existing private storm drains within the localized project area to accommodate the building addition. Off-site basins are not evaluated in this analysis.

6.0 Stormwater Analyses

6.1 PROPOSED STORMWATER CONDUIT SIZING AND INLET SPACING

New stormwater drainage piping and inlets will be sized and spaced to properly convey stormwater runoff to the existing private storm drainage network. New storm drainage piping was designed using Manning's equation and sized to convey peak flows generated by the 25-year design storm event. Per the 2001 Novellus Storm Calculations, existing storm drainage piping was designed to convey the 25-year design storm using the SCS methodology. The former design rainfall depths are consistent with present-day standards.

6.2 PROPOSED STORMWATER QUALITY CONTROL FACILITY

Stormwater quality treatment for newly created impervious surfaces will be addressed by utilizing excess capacity of an existing stormwater facility that was designed and sized during the initial development to accommodate future improvements on-site. Per the impervious area summary table in the 2017 Parking Master Plan Stormwater Management Report, there are 2.07 acres of unused impervious area capacity within Pond B. The following table summarizes the newly added treatment area and remaining capacity within Pond B after completion of this project:

Table 6-1: Pond B Treatment Area Summary

Sizing Parameter	Area
Design Impervious Area	11.66 acres
Constructed Impervious Area	9.59 acres
Existing Excess Capacity	2.07 acres
TUD CMS Addition Impervious Area	0.275 acres
Unutilized Capacity (after TUD CMS Addition)	1.79 acres

6.3 HYDROMODIFICATION

This project will result in the addition and/or modification of less than 12,000 square feet of impervious surface. Therefore, per Section 4.03.2.a, a hydromodification assessment is not required. Hydromodification will be addressed by a payment of a Hydromodification Fee-In-Lieu in accordance with District rates and charges.

6.4 PROPOSED STORMWATER QUANTITY CONTROL FACILITY

Stormwater quantity management for the project will be provided by existing Pond B. The pond was originally designed to detain post-development peak runoff to levels equal to or below pre-development

peak rates for the 2-year, 10-year, and 25-year design rainfall events, for a total of 23.32 acres of impervious area. The following table summarizes the newly added impervious area and remaining capacity within Pond B after completion of this project:

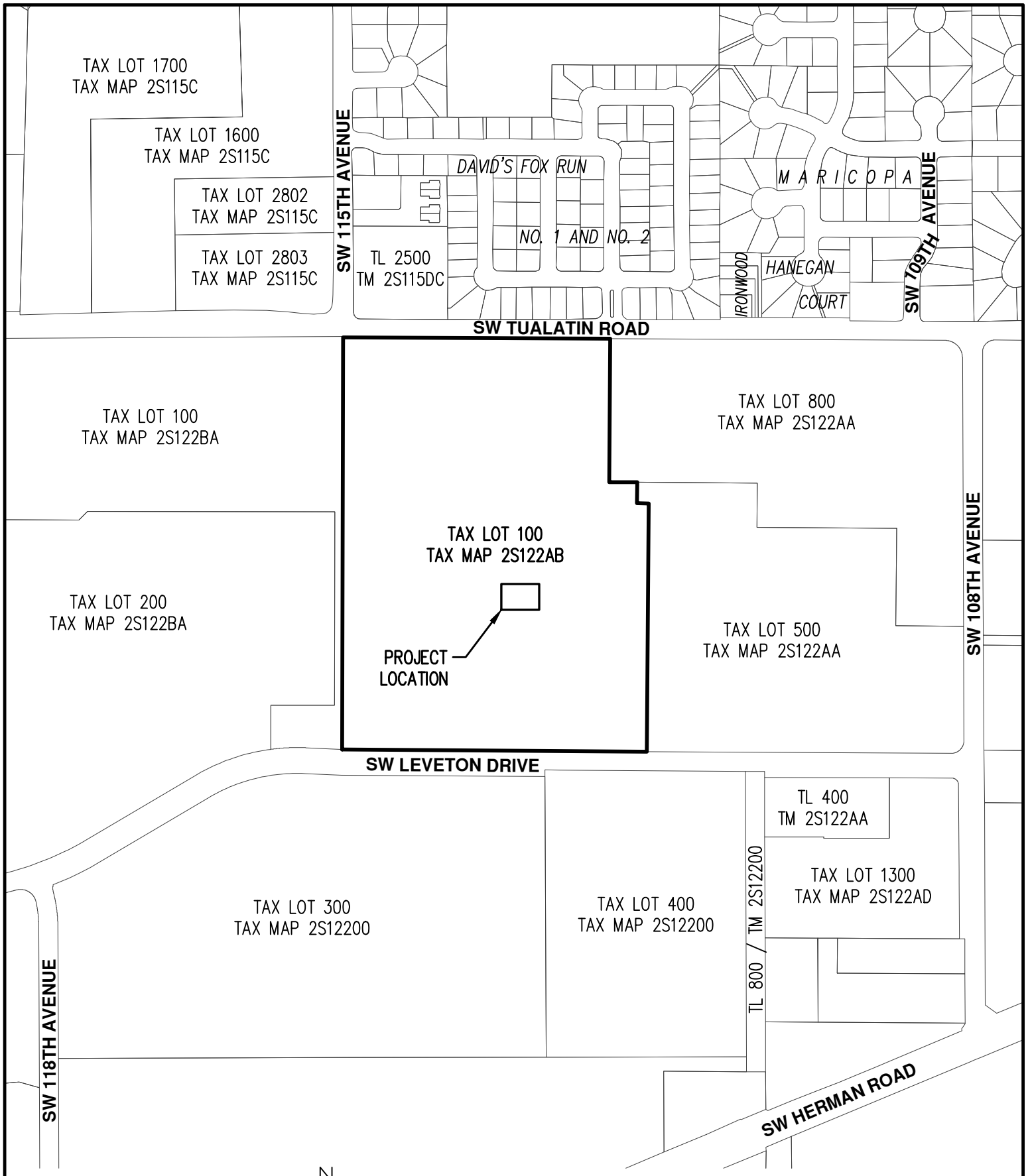
Table 6-2: Pond B Impervious Area Summary

Sizing Parameter	Area
Design Impervious Area	23.32 acres
Constructed Impervious Area	18.35 acres
Existing Excess Capacity	4.97 acres
TUD CMS Addition Impervious Area	0.275 acres
Unused Capacity (after TUD CMS Addition)	4.69 acres

6.5 DOWNSTREAM ANALYSIS

Increased runoff generated by the project will be managed by existing Pond B, which was designed to accommodate full build-out conditions of the Lam Research campus. Post-developed peak runoff rates will not exceed the rates determined in the original 2001 Novellus Storm Calculations; therefore, the public conveyance system downstream of the site was not reviewed.

Exhibit A:
Vicinity Map



DATE: 02/21/2020

VICINITY MAP	SHEET A
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD, STE 100 TUALATIN, OR 97062 503.563.6151 WWW.AKS-ENG.COM	DRWN: JDS CHKD: AKS JOB: 7860

DWG: 7860 VICINITY MAP 8_5X11 | VICINITY MAP

Exhibit B:
Storm Drain Facilities Map

CONNECT TO EXISTING STORM DRAIN PIPE

(N) TUD CMS ADDITION

ELECTRICAL ROOM

SCRUBBER PAD

SKY BRIDGE

BUILDING E

BUILDING D NORTH

BUILDING D

BUILDING C

EXISTING PRIVATE STORM MAIN

EXISTING STORM DRAIN OUTLET TO POND B

POND B

N

SCALE: 1"= 60 FEET

60 0 12 30 60

ORIGINAL PAGE SIZE: 11" x 17"

DATE: 02/21/2020

STORM DRAIN FACILITIES MAP	EXHIBIT
TUD CMS ADDITION	B

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
503.563.6151 WWW.AKS-ENG.COM

DRWN: BDL
CHKD: JDS
AKS JOB: 7860

Exhibit C:
Project Area Stormwater Catchment Map

BUILDING F

SUBCATCHMENT "1S" BOUNDARY

EXISTING ASPHALT DRIVE AISLE AND PARKING

CONNECT TO EXISTING STORM DRAIN PIPE

EXISTING STORM PIPE #59 PER 2001 NOVELLUS STORM CALCULATIONS REPORT

(N) TUD CMS ADDITION

ELECTRICAL ROOM

GENERATOR PAD

SCRUBBER PAD

SKY BRIDGE

EXISTING ASPHALT DRIVE AISLE

BUILDING D NORTH

STM

169 168 167 166 165 164 163 162

LEGEND

EXISTING GROUND CONTOUR (1 FT)

EXISTING GROUND CONTOUR (5 FT) 350

FINISHED GRADE CONTOUR (1 FT)

FINISHED GRADE CONTOUR (5 FT) 345

N

SCALE: 1"= 30 FEET

30 0 6 15 30

ORIGINAL PAGE SIZE: 11" x 17"

DATE: 02/21/2020

PROJECT AREA STORMWATER CATCHMENT MAP	EXHIBIT C
TUD CMS ADDITION	
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD, STE 100 TUALATIN, OR 97062 503.563.6151 WWW.AKS-ENG.COM	DRWN: BDL CHKD: JDS AKS JOB: 7860

DWG: 7860 POST-DEV MAP | POST-DEV MAP

Appendix A:
Peak Flow Calculations – HydroCAD Analysis

Post-Developed 25-yr Storm Event Peak Flow Calculations

Summary for Subcatchment 1S: TUD CMS Addition

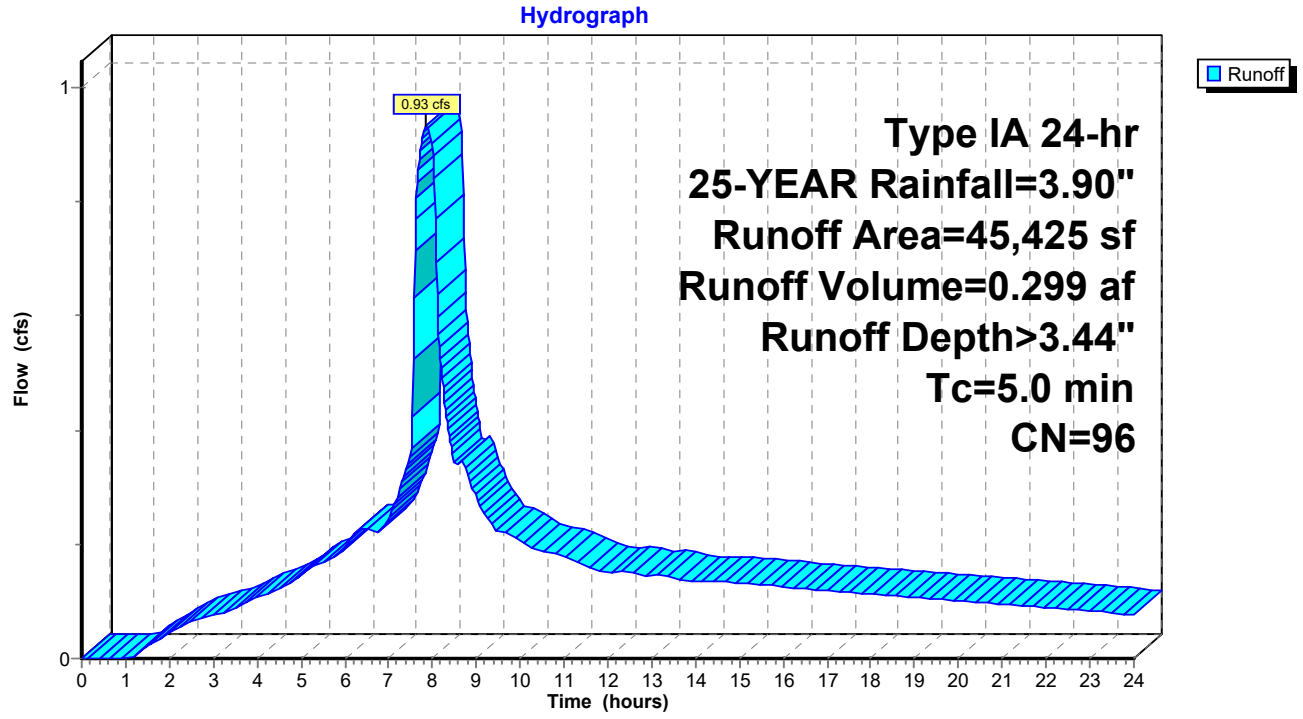
Runoff = 0.93 cfs @ 7.87 hrs, Volume= 0.299 af, Depth> 3.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25-YEAR Rainfall=3.90"

	Area (sf)	CN	Description
*	40,541	98	Paved/roof area
	4,884	79	<50% Grass cover, Poor, HSG B
	45,425	96	Weighted Average
	4,884		10.75% Pervious Area
	40,541		89.25% Impervious Area

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

Subcatchment 1S: TUD CMS Addition



Appendix B:
USDA – NRCS Soil Resource Report

Hydrologic Soil Group—Washington County, Oregon
(Lam Research - TU D CMS Addition)

Map Scale: 1:510 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 20 40 80 120

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
21B	Hillsboro loam, 3 to 7 percent slopes	B	1.0	100.0%
Totals for Area of Interest			**1.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C:
TR-55 Runoff Curve Numbers

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

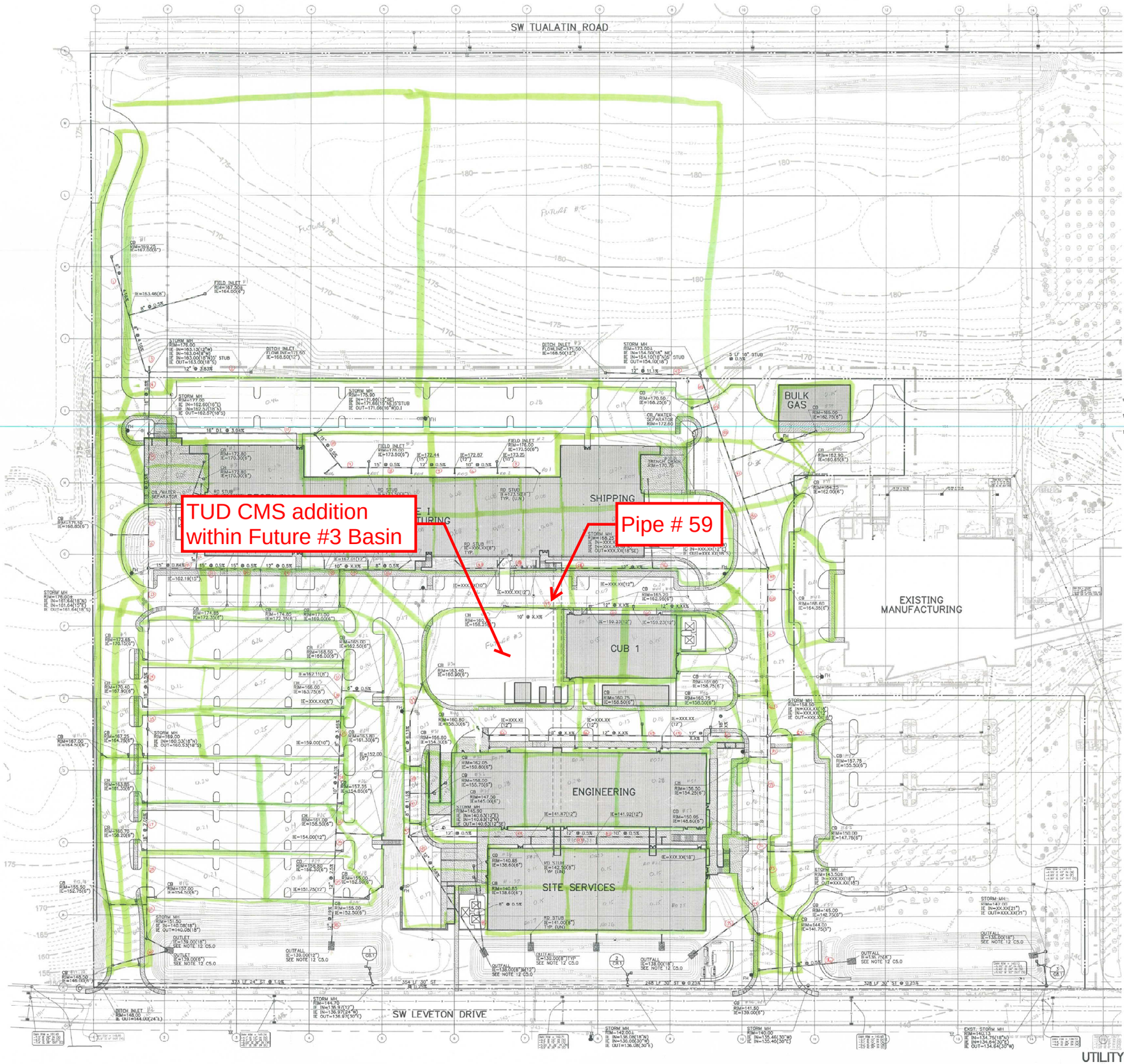
[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Appendix D:
Pipe Sizing Capacities from 2001 Novellus Storm Calculations



GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

UTILITY NOTES

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF TUALATIN, THE UNIFIED SEWAGE AGENCY, AND THE CURRENT EDITION OF THE UNIFORM PLUMBING CODE AND THE UNIFORM BUILDING CODE. ALL WORK WITHIN THE PUBLIC R.O.W. REQUIRES A PUBLIC WORKS PERMIT.
2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES LAYING WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDING SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER IF THERE ARE ANY DISCREPANCIES.
3. PROVIDE CLEANOUTS AS REQUIRED IN THE CURRENT UNIFORM PLUMBING CODE CHAPTER 7, SECTIONS 707 AND 719, AND CHAPTER 11, SECTION 1103.04. NOTE: NOT ALL REQUIRED CLEANOUTS ARE SHOWN ON THE PLANS.
4. ALL STORM PIPING IS SIZED FOR A MANNING'S "N" VALUE = 0.013. ALL STORM PIPING IS DESIGNED USING CONCENTRIC PIPE TO PIPE AND WYE FITTINGS.
5. SEE MECHANICAL DRAWINGS FOR UTILITIES LOCATED WITHIN THE BUILDING AND TO 5' OUTSIDE THE BUILDING.
6. ALL ROOF DRAIN LEADERS TO BE 8" AT 2.0% MIN. UNLESS NOTED OTHERWISE.
7. VERIFY LOCATION, SIZE AND DEPTH OF EXISTING UTILITIES BY POTHOLING PRIOR TO CONSTRUCTION. NOTIFY ENGINEER OF DISCREPANCIES.
8. PROVIDE 2" PVC DRAIN LINE FROM DOMESTIC WATER METER VAULT AND BACKFLOW PREVENTER VAULT TO THE DOUBLE DETECTOR CHECK VALVE (FIRE) VAULT. PROVIDE 1/3 HP SUMP PUMP AT BASE OF FIRE VAULT AND INSTALL 2" PVC DRAIN LINE WITH BACKFLOW VALVE FROM SUMP PUMP TO DAYLIGHT AT NEAREST CURB. FURNISH ¾ INCH DIAMETER CONDUIT FROM BUILDING ELECTRICAL ROOM TO FIRE VAULT FOR SUMP PUMP ELECTRICAL SERVICE. NOTE: COORDINATE WITH FIRE PROTECTION CONTRACTOR FOR FLOW SENSOR INSTALLATION AND CONDUIT REQUIREMENTS.
9. THE SURVEY INFORMATION SHOWN AS A BACKGROUND SCREEN ON THIS SHEET IS BASED ON A SURVEY PREPARED BY HIGHMAN AND ASSOCIATES.
10. CONTRACTOR TO PROVIDE POWER TO IRRIGATION CONTROLLER. SEE SPECIFICATIONS AND LANDSCAPE PLANS.
11. SEE BUILDING PLUMBING DRAWINGS FOR PIPING WITHIN THE BUILDING AND UP TO 5' OUTSIDE THE BUILDING, INCLUDING ANY FOUNDATION DRAINAGE PIPING.
12. PROVIDE MINIMUM 12'x8'x12" THICK TYPE II RIP-RAP AT 12" AND LARGER STORM OUTFALLS. PROVIDE MINIMUM 8'x6'x12" THICK TYPE II RIP-RAP AT 10" AND SMALLER OUTFALLS.

PROPOSED UTILITY LEGEND

STORM SEWER LINE	
SANITARY SEWER LINE	
FIRE WATER LINE	FW
WATER METER	
MANHOLE	
CATCH BASIN/DITCH INLET	
FIELD INLET	
FIRE HYDRANT ASSEMBLY	
UNLESS NOTED	U.N.

EXISTING UTILITY LEGEND

SITE BOUNDARY	
ADJOINING OR INTERIOR PROPERTY LINE	
RIGHT-OF-WAY CENTERLINE	
WATER LINE	W
GAS LINE	G
SANITARY SEWER LINE	S
UNDERGROUND TELEPHONE LINE (GTE)	T
STORM DRAINAGE LINE	D
UNDERGROUND POWER LINE	P
OVERHEAD POWER LINE	OHP
FIRE HYDRANT	
WATER VALVE	W
WATER METER	
GAS VALVE	G
CATCH BASIN	
CURB LINE	
EDGE OF PAVEMENT	
STREET SIGN	
SANITARY SEWER MANHOLE	
EVERGREEN TREE WITH DIAMETER	
DECIDUOUS TREE WITH DIAMETER	
CHAIN LINK FENCE LINE	
LIGHT POLE	
6" BOLLARD	
ROOF DRAIN (SHOOT ON ROOF)	
GAS METER	
POWER TRANSFORMER	
CAMERA TOWER	
POWER POLE	
GUY ANCHOR	
SIDE INLET CATCH BASIN	
MAIL BOX	
STORM SEWER MANHOLE	

UTILITY PERMIT REVIEW SUBMITTAL 2/14/01

NOVELLUS

SWINERTON BUILDERS

Project
NOVELLUS TUALATIN FACILITY

Tualatin, Oregon

Architecture, Structural Engineer
Civil Engineer
Group Mackenzie
0690 SW Bancroft Street
Portland, Oregon 97201
Phone: (503)224-9560
FAX: (503)228-1285

Group Mackenzie Consultants

Landscape Architect
Greenworks PC
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FAX: (503)222-2283

Safety & Health Consultant
Miller Safety
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FAX: (503)478-2500

Swinerton Consultants

Mechanical Engineer
Southland Industries
Phone: (503)255-7118
FAX: (503)255-7955

Mechanical Consultant
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REGISTERED PROFESSIONAL ENGINEER #19178 OREGON JULY 15, 1997 ROBERT L FRENTRESS JR
EXPIRES: 12/31/01

REVISIONS:

REVISION NO.	LAST REVISION THIS SHEET	REVISION EDITION CLOSING DATE

SHEET TITLE:
SITE STORM SEWER PLAN PHASE I

FIRST ISSUED:
LAST ISSUED:
DRAWN BY:
CHECKED BY:

SHEET C5.0
OF

GROUP MACKENZIE JOB NO. 000366
CONSULTANT JOB NO.

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min)		In./Hr.	AREA (Acres)				RUNOFF (C.F.S.) (I) W (c·A)	SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (c)	INCR. EQUIV. (c·A)	TOTAL EQUIV. AREA (Increm. Sum) cf		SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n = 0.012	LENGTH (Ft.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RO #12 (53)									0.07	0.07	2.0	6"	0.86				
RO #13 (54)									0.07	0.21	0.5	12"	2.73				
RO #14 (55)									0.07	0.21	0.5	12"	2.73				
RO # 15,16 (56)									0.32	0.53	0.5	12"	2.73				
(52) + (56) = (57)										4.36	2.65	18"	18.53				
CB #42 (58)									0.17	4.53	2.65	18"	18.53				
CB #43 FLT #3 (59)									0.58	0.58	0.75	10"	2.06				
CB # 41, RO # 17 (60)									0.18	0.76	0.75	10"	2.06				
CB # 45, RO #18 (61)									0.28	1.04	0.49	12"	2.70				
(58) + (61) = (62)										5.57	2.65	12"	6.28				
CB #46 (63)									0.20	5.77	2.65	12"	6.28				
CB # 47 (64)									0.29	0.29	2%	6"	0.86				

Pipe # 59

Pipe Capacity = 2.06 cfs