

6727Apt

**PRELIMINARY DRAINAGE REPORT
FOR**

**Liberty Road Apartments
Salem, Oregon**

**Prepared For:
Harrison Industries, LLC
10355 Liberty Road S
Salem, Oregon 97306**

September 2, 2020



1155 13th Street SE
Salem OR 97302
www.mtengineering.net

PHONE: (503) 363-9227
FAX: (503) 364-1260
EMAIL: mhendrick@mtengineering.net



Contents

Introduction	1
Existing Conditions.....	1
Soils	2
Infiltration	2
Water Quality Methodology	2
Water Quality Analysis.....	2
Stormwater Quantity Analysis	2
Detention System.....	4
Stormwater Quality Analysis.....	5
Conclusion.....	5

Appendix A	Maps
Appendix B	Soils Report
Appendix C	Time of Concentration
Appendix D	Stormwater Analysis with Plans
Appendix E	Water Quality Analysis

INTRODUCTION

The Liberty Road apartments are a proposed 66-unit complex located at 5871 Liberty Road S. The parcel of land to be developed is a portion of Tax Lot 600 of Marion County Assessor's Map 08 3W 16C. A vicinity map and supporting maps are in Appendix A of this report. An aerial image of the site can be seen below.




Project Site

Green Stormwater Infrastructure (GSI) to the Maximum Extent Feasible (MEF) is being used for the new developed areas per City of Salem Administrative Rules, Chapter 109, Division 004, Stormwater System, Appendix 4E (Standards). Stormwater facilities will be constructed to meet the City of Salem standards.

EXISTING CONDITIONS

The 3.21-acre site is generally rectangular in the shape. Surface conditions consists of grass, brush and minimal trees. There are no identified wetlands, streams or sensitive areas located on the property. A topographical high point is located on the southwesterly corner of the site. Drainage from this high point flows predominately northeasterly. The maximum relief is approximately 34-feet with a high point elevation of 572. The abutting properties are zoned residential with nearby public improvements that include storm water conveyance systems. Appendix A contains multiple maps of the site.



It should be noted that the westerly portion of the site will be subdivided into multiple lots. Stormwater infrastructure will be designed and constructed to serve the development. This includes a storm main that traverses through the apartment site. In addition, the existing storm main located in Liberty Road is under sized and will be upgraded as part of the subdivision improvements.

Soils

The Natural Resources Conservation Service (NRCS) Soil Resource Report for Marion County was used to determine a Hydrological Soil Group classification for runoff calculations. The report identifies the site soils to be Jory, and McAlpin soils. All the soils are in the hydrologic soil group C. The report is in Appendix B.

Infiltration

Infiltration testing will be performed at the site to determine percolation rates of the soil. It is anticipated that test results will recommend design infiltration rates below 0.5 inches per hour.

WATER QUALITY METHODOLOGY

Because of expected poor percolation rates of the soils, green stormwater facilities will be designed as combination facilities.

WATER QUALITY ANALYSIS

Water quality flow rates were calculated with HydroCAD 10.00. The SCS TR-20 Unit Hydrograph method will be used to generate the hydrographs. A Type 1A storm and a 24-hour rainfall depth of 1.38 inches per hour was used to determine the water quality flow rate.

STORMWATER QUANTITY ANALYSIS

Stormwater quantity (Flow Control) is being handled by on-site detention. Runoff from the 3.21-acre development is being routed to the on-site facility that ultimately controls runoff to pre-developed flow rates.

Per Subsection 4.2(p)(3)(A) of the standards, one-half of the post development peak runoff rate of the two-year storm must be equal to or less than one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm. This also applies to the 10-year, 24-hour storm event.

The pre-developed flow rates were calculated using HydroCAD 10.00. Table 1 below lists the 24-hour rainfall depths used in the analysis of each storm event. Please note that the 2-year event was halved and then analyzed.

Table 1

Storm Event (year)	24-hour Rainfall Depth (in)
Half of 2	1.1
10	3.2
WQ	1.38

For the pre-developed conditions, a time of concentration of 24 minutes was calculated. The time of concentration data is in Appendix C. The calculations are incorporated in the HydroCAD output located in Appendix D. The entire area was classified as "City of Salem Pre-Development, HSG C" with a Curve Number (CN) of 72. A pre-developed basin map is in Appendix A.

The SCS TR-20 Unit Hydrograph method was used to generate the hydrographs. A Type 1A rainfall distribution was used with the above rainfall depths. Table 2 below identifies the allowable pre-developed release rates for each storm event.

Table 2

Storm Event	Basin #1 Allowable Release Rate (cfs)
Half of 2-year	0.01
10-year	0.44

The post-developed flow rates were calculated using HydroCAD 10.00. A time of concentration of 5 minutes was assumed for the basin. The calculations are incorporated in the HydroCAD output located in Appendix D. The site was classified as 55% Impervious, HSG C" with a CN of 98 and 45% grass cover, HSG C" with a CN of 74. Table 3 below lists the CN values for the developed basin area. A developed basin map is in Appendix A.

Table 3

Basin	Impervious Area (AC) CN = 98	>75% Grass Cover (Ac) CN = 74	TOTAL Area (Ac)	Composite CN
Lot 1	1.77	1.44	3.21	87

DETENTION SYSTEM

In the detention analysis, the 3.21-acre site was considered a single basin draining into the combination facility. Site grading and conveyance pipe will direct stormwater runoff to the system. It should be noted that the facility has a capacity to detain approximately 7,800 cubic feet of water. This exceeds the required detention volume of 6,800 cubic feet.

Based on the above design parameters, the half of the 2-year and 10-year pre-developed release rates are controlled at 0.01 and 0.40 cfs. The release rates and detention requirements were generated from the HydroCAD software, which can be seen in Appendix D. Table 4 below summarizes the requirements for half the 2-year and 10-year storm events.

Table 4

Storm Event	Allowable Release Rate (cfs)	Release Rate (cfs)	Required Detention Volume (ft ³)	Provided Detention Volume (ft ³)
Half of 2-year	0.01	0.01	2,825	7,800
10-year	0.44	0.40	6,800	7,800

(Detention Summary)

Flow control is achieved with multiple orifices in a standard City of Salem control structure. The sizing of the orifice uses the standard orifice equation provided in the City of Salem Stormwater Management Manual. Table 5 below identifies orifice size, elevation and the water surface elevation.

Table 5

Storm Event	Control Orifice (#)	Release Rate (cfs)	Orifice Diameter (inches)	Elevation (feet)	W.S. Elevation (feet)
Half of 2-year	1	0.01	0.50	538.25	541.13
10-year	2	0.40	4.50	541.40	542.01
Overflow	Weir			542.00	

(Orifice Summary)

STORMWATER QUALITY ANALYSIS

Water quality flow rates were calculated using HydroCAD 10.00. The SCS TR-20 Unit Hydrograph method was used to generate the hydrographs. A Type 1A rainfall distribution was used with a 1.38 rainfall depth. Appendix E contains the analysis.

Table 6 below identifies the top of media elevation, water surface elevation and overflow elevation for the combination facility.

Table 10

Basin	WQ Flow Rate (cfs)	Media Elevation (feet)	W.S. Elevation (feet)	Rim Elevation (feet)
1	0.21	541.00	541.02	541.25

(Water Quality Summary)

CONCLUSION

Based on the presented information, the preliminary design can meet the City of Salem water quality and quantity standards. If there are any questions regarding this analysis or the design, please contact Matthew Hendrick at Multi/Tech Engineering by phone at (503) 363-9227 or via e-mail at mhendrick@mtengineering.net.



Appendix A

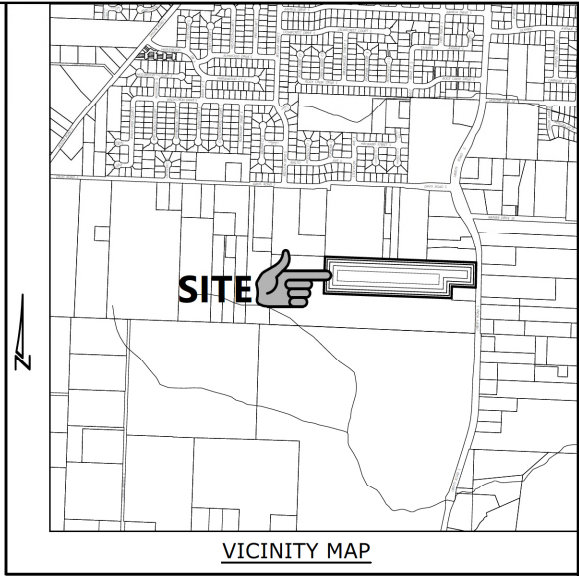
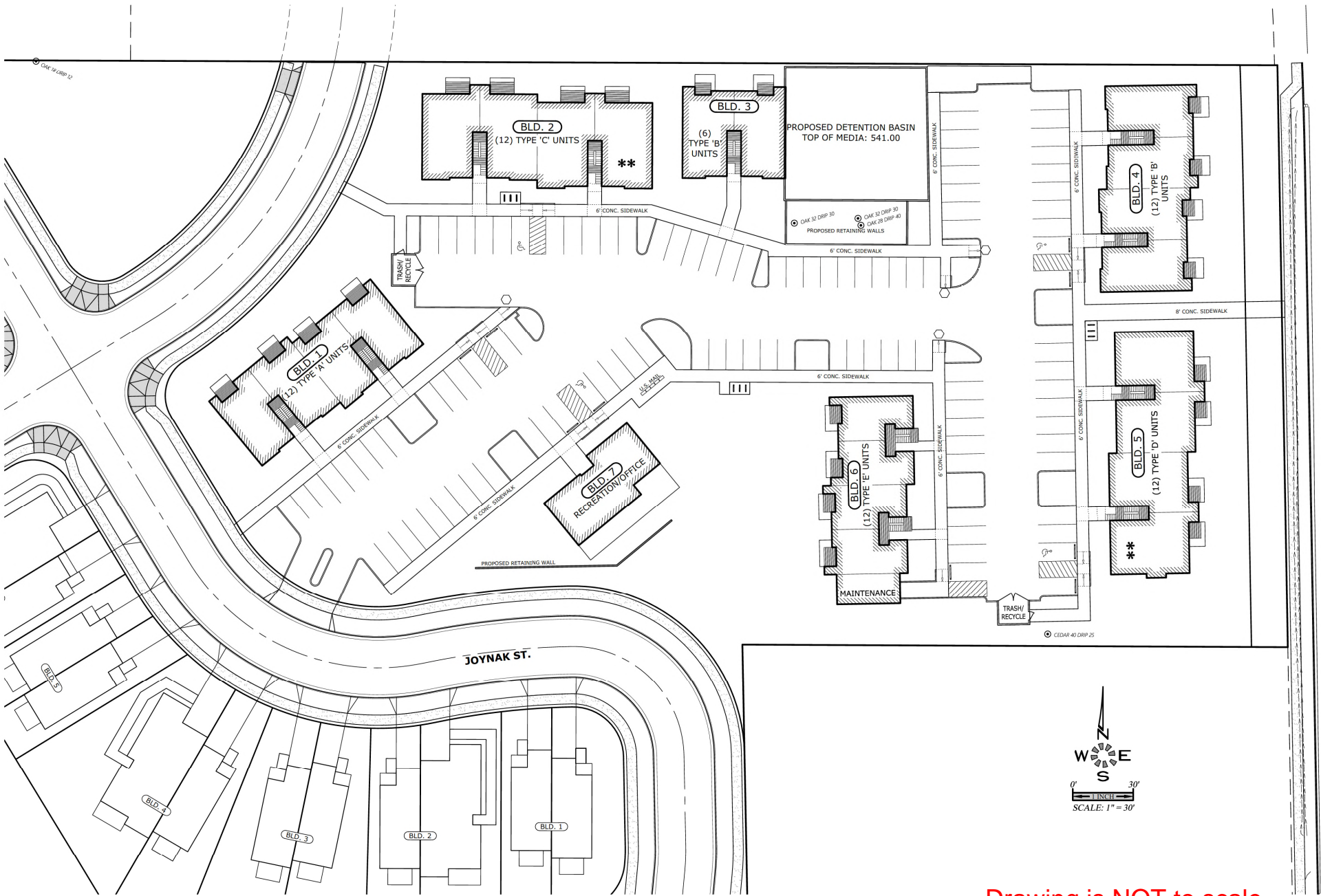
LIBERTY ROAD APARTMENTS

SEC. 16, T. 8 S., R. 3 W., W.M.
CITY OF SALEM
MARION COUNTY, OREGON

Owner / Developer:

HARRISON INDUSTRIES, L.L.C.

10355 Liberty Road S.
SALEM, OREGON 97306



SHEET INDEX	
SDR1	COVER SHEET
SDR2	EXISTING CONDITIONS PLAN
SDR3	SITE PLAN
SDR4	OPEN SPACE PLAN
SDR5	GRADING & DRAINAGE PLAN
SDR6	PRIVATE SANITARY SEWER PLAN
SDR7	PRIVATE DOMESTIC WATER PLAN
SDR8	PRIVATE FIRE SERVICE PLAN
L1.1	SCHEMATIC LANDSCAPE PLAN

BUILDING 1 (TYPE 'A' UNITS)
A1.3 LOWER FLOOR PLAN
A1.4 MIDDLE & UPPER FLOOR PLAN
A1.8 BUILDING ELEVATIONS

BUILDING 2 (TYPE 'C' UNITS)
A2.3 LOWER FLOOR PLAN
A2.4 UPPER FLOOR PLAN
A2.8 BUILDING ELEVATIONS

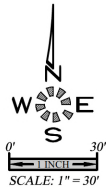
BUILDING 3 (TYPE 'B' UNITS)
A3.3 LOWER FLOOR PLAN
A3.4 MIDDLE & UPPER FLOOR PLAN
A3.8 BUILDING ELEVATIONS

BUILDING 4 (TYPE 'B' UNITS)
A4.3 LOWER FLOOR PLAN
A4.4 MIDDLE & UPPER FLOOR PLAN
A4.8 BUILDING ELEVATIONS

BUILDING 5 (TYPES 'D' UNITS)
A5.3 LOWER FLOOR PLAN
A5.4 MIDDLE FLOOR PLAN
A5.5 UPPER FLOOR PLAN
A5.9 BUILDING ELEVATIONS

BUILDING 6 (TYPE 'E' UNITS)
A6.3 LOWER FLOOR PLAN
A6.4 MIDDLE & UPPER FLOOR PLAN
A6.8 BUILDING ELEVATIONS

BUILDING 7 (RECREATION BUILDING)
A7.3 LOWER FLOOR PLAN
A7.6 BUILDING ELEVATIONS



Drawing is NOT to scale



ENGINEERING SERVICES, INC.
11455 LIBERTY RD. SE. SALEM, OR 97306
PH: (503) 363-9227 FAX: (503) 364-1260
www.mtengineering.net office@mtengineering.net

COVER SHEET

LIBERTY ROAD
APARTMENTS

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT THE WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.
DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design: M.D.G.
Drawn: P.H.S.
Checked: M.D.G.
Date: JAN. 2020
Scale: AS SHOWN



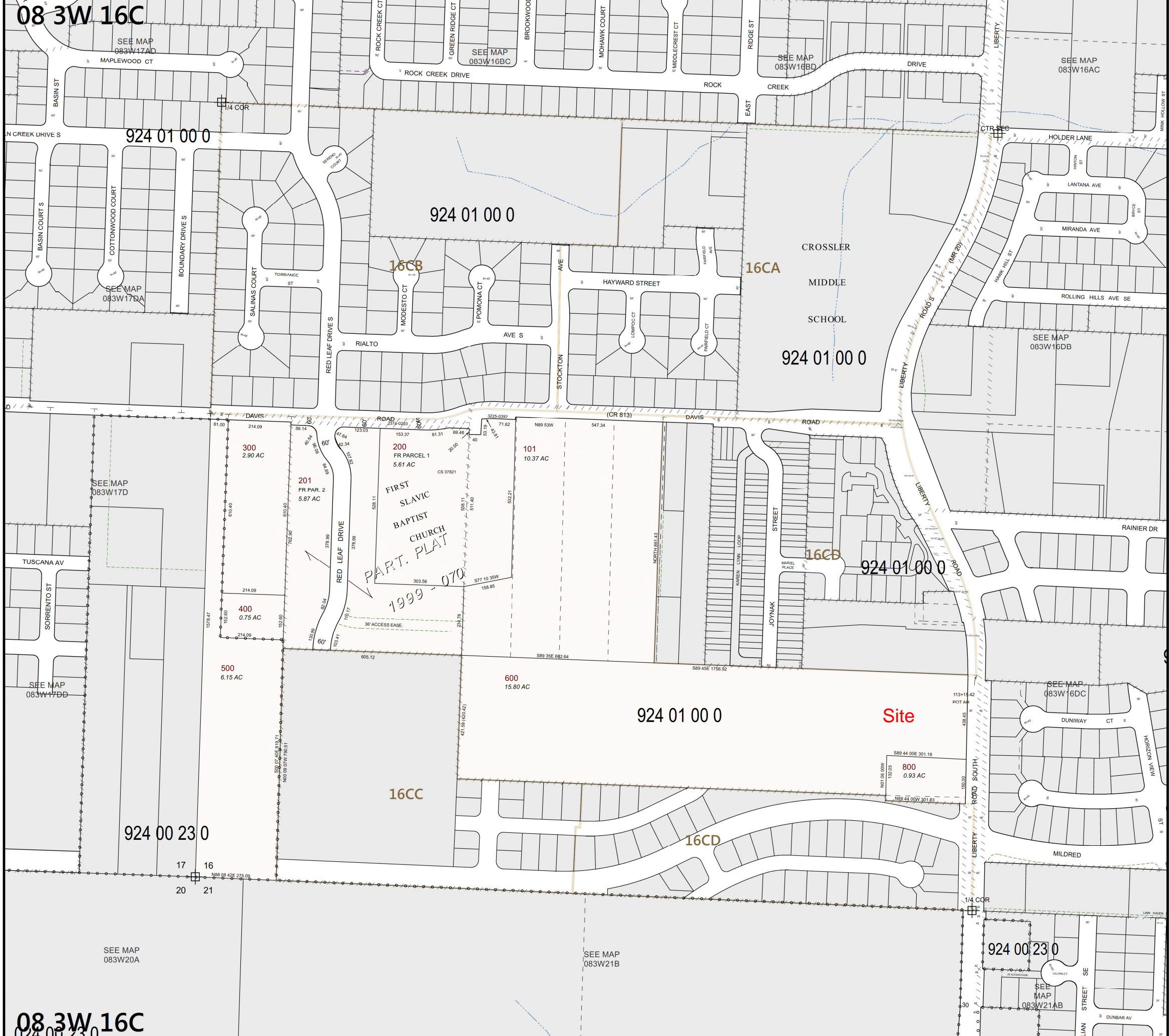
EXPIRES: 06-30-2021
JOB # 6727

SDR1

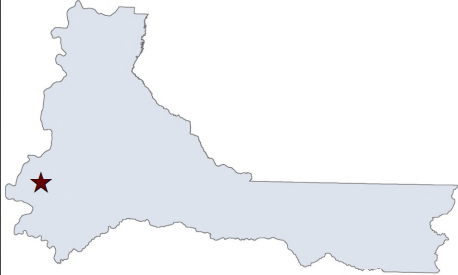
08 3W 16C

924 01 00 0

08 3W 16C



08 3W 16C
SALEM



MARION COUNTY, OREGON
SW1/4 SEC16 T8S R3W W.M.
SCALE 1" = 200'

LEGEND

- LINE TYPES
- | | |
|--------------------------|-----------------------|
| Taxlot Boundary | Historical Boundary |
| Road Right-of-Way | Easement |
| Railroad Right-of-Way | Railroad Centerline |
| Private Road ROW | Taxcode Line |
| Subdivision/Plat Bndry | Map Boundary |
| Waterline - Taxlot Bndry | Waterline - Non Bndry |

- CORNER TYPES
- | | |
|-----------------------|------------------|
| + 1/16TH Section Cor. | 1/4 Section Cor. |
| © DLC Corner | Section Corner |

NUMBERS

Tax Code Number

000 00 00 0

Acreage 0.25 AC All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

Scale: 1" = 200'

CANCELLED NUMBERS

100			
700			

DISCLAIMER: THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSES ONLY



FOR ADDITIONAL MAPS VISIT OUR WEBSITE AT www.co.marion.or.us

PLOT DATE: 1/24/2018
SALEM
08 3W 16C



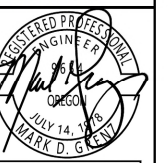
MULTI/TECH

ENGINEERING SERVICES, INC.
 1155 13TH ST. S.E. SALEM, OR. 97302
 PH. (503) 363 - 9227 FAX (503) 364-1260
www.intengineering.net office@intengineering.net

LIBERTY ROAD
APARTMENTS

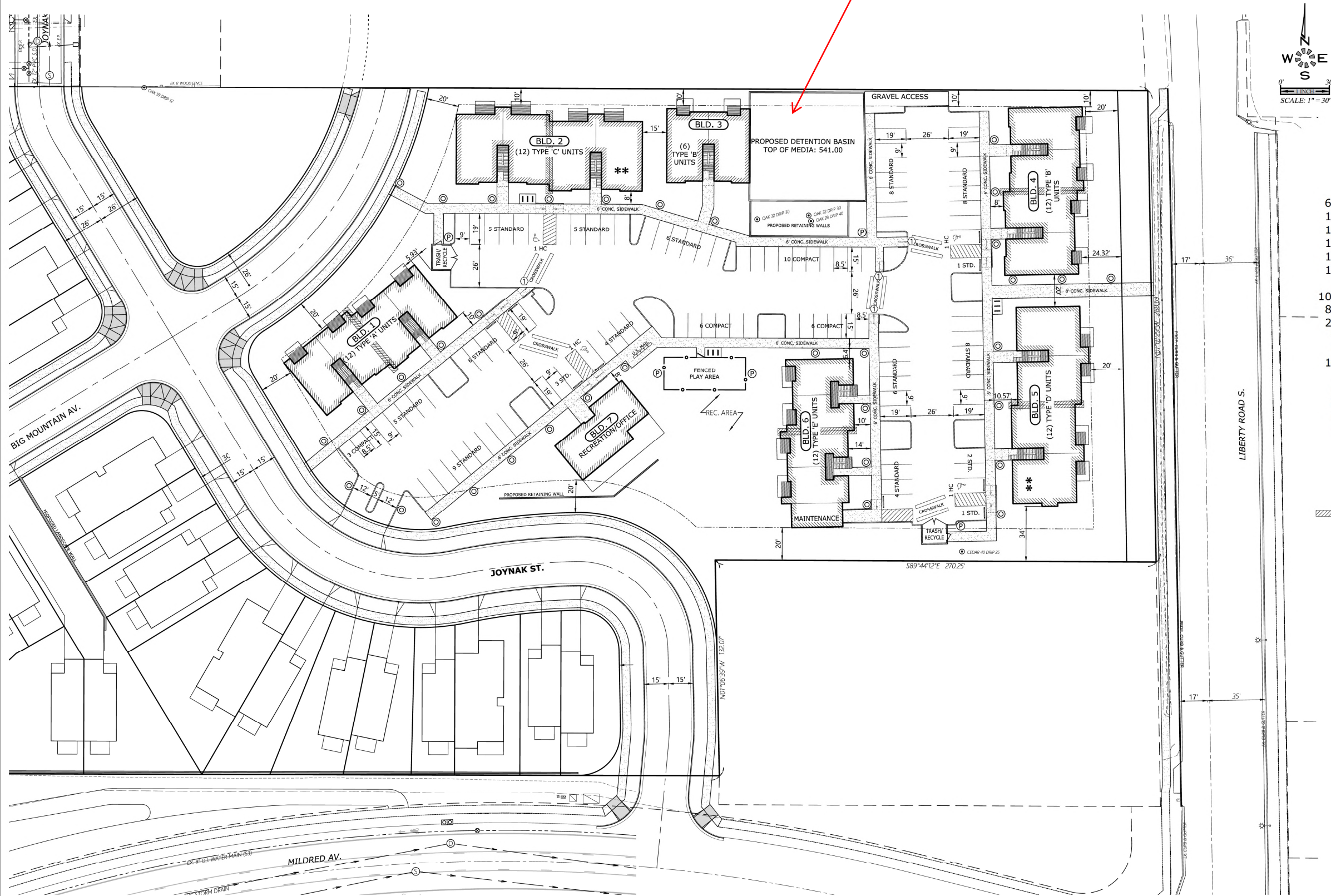
**NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.**

Design: M.D.G.
Drawn: P.H.S.
Checked: M.D.G.
Date: JAN. 2020
Scale: AS SHOWN



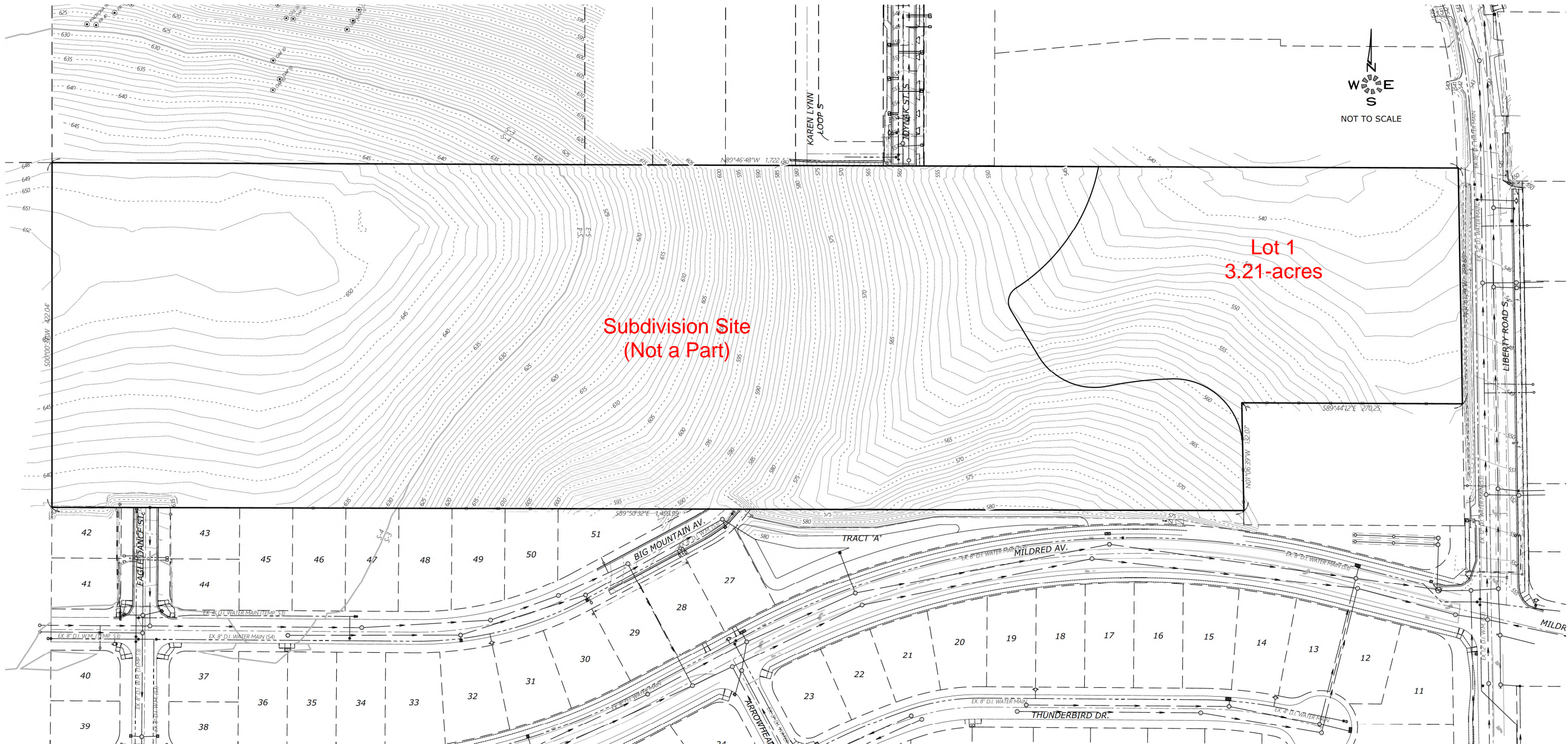
EXPIRES:	06-30-2021
----------	------------

SDR3



**** THE INDICATED LOWER FLOOR UNITS IN BUILDINGS 2 & 5 ARE TO BE TYPE A UNITS IN ACCORDANCE WITH THE 2019 OSSC SEC. 1107.6.2.1.1 (NOTED ON FLOOR PLANS). ALL OTHER LOWER FLOOR UNITS TO BE TYPE B UNITS IN ACCORDANCE WITH THE 2019 OSSC SEC. 1107.6.2.1.2**

J:\6700-6799\6727-Liberty(5871)\Dwg v18\6727p.dwg, SDRSITE, 8/27/2020 8:24:05 AM, P'Saunders



Existing Conditions

City of Salem Pre-developed, HSG C
CN = 72
3.21 acres

Developed Conditions

Impervious Area, HSG C
CN = 98
1.77 acres

> Grass Cover, Good, HSG C
CN = 74
1.44 acres

Composite CN = 87

EXISTING
CONDITIONS
PLAN

LIBERTY ROAD
SUBDIVISION AND
APARTMENTS

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT THE WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.

DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design: M.D.G.
Drawn: P.H.S.
Checked: M.D.G.
Date: JAN. 2020
Scale: AS SHOWN



Appendix B



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

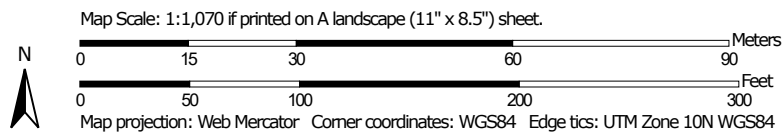
Custom Soil Resource Report for Marion County Area, Oregon

Liberty Road Apartments



June 25, 2020

Hydrologic Soil Group—Marion County Area, Oregon (Liberty Road Apartments)




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: Marion County Area, Oregon
 Survey Area Data: Version 16, 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, 2018—Aug 31, 2018

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
JoB	Jory silty clay loam, 2 to 7 percent slopes	C	3.6	83.7%
JoC	Jory silty clay loam, 7 to 12 percent slopes	C	0.0	0.9%
JoD	Jory silty clay loam, 12 to 20 percent slopes	C	0.7	15.3%
MaA	McAlpin silty clay loam, 0 to 3 percent slopes	C	0.0	0.1%
Totals for Area of Interest			4.3	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.

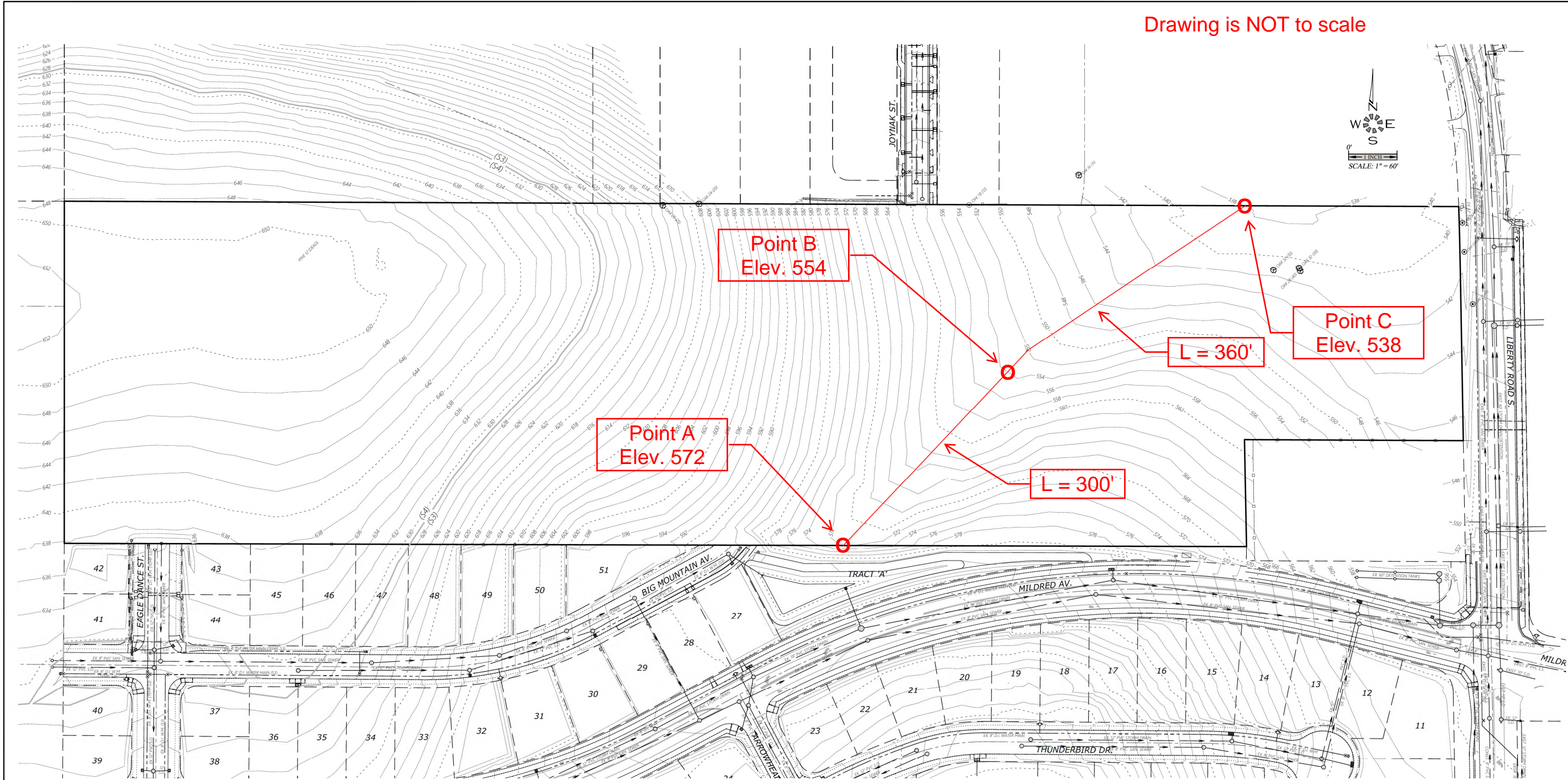
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

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.



Appendix C



Drawing is NOT to scale

Time of Concentration

**EXISTING
CONDITIONS
PLAN**

**LIBERTY ROAD APARTMENT
COMPLEX**

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT THE WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.
DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design:	M.D.G.
Drawn:	D.G.G.
Checked:	M.D.G.
Date:	JAN. 2020
Scale:	AS SHOWN

308 # 6727

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project Liberty Road Apartments	By M. Hendrick	Date 6/2020
Location Salem, Oregon	Checked	Date

Check one: ☒ Present ☐ Developed

Check one: ☒ T_c ☒ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

Segment ID	A-B	
1. Surface description (Table 4D-4)	Meadow/Pasture/Farm	
2. Manning's roughness coefficient, n (Table 4D-4)	0.15	
3. Flow length, L (total L \geq 300 ft) ft	300	
4. Two-year 24-hour rainfall, P_2 in	2.2	
5. Land slope, s ft/ft	0.060	
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t hr	0.306	+
		= 0.306

Shallow concentrated flow

Segment ID	B-C	
7. Surface description (paved or unpaved)	Minimum Tillage	
8. Flow length, Lft	360	
9. Watercourse slope, s ft/ft	0.044	
10. Average velocity, V (figure 3-1) ft/s	1.0	
11. $T_t = \frac{L}{3600 V}$ Compute T_t hr	0.100	+
		= 0.100

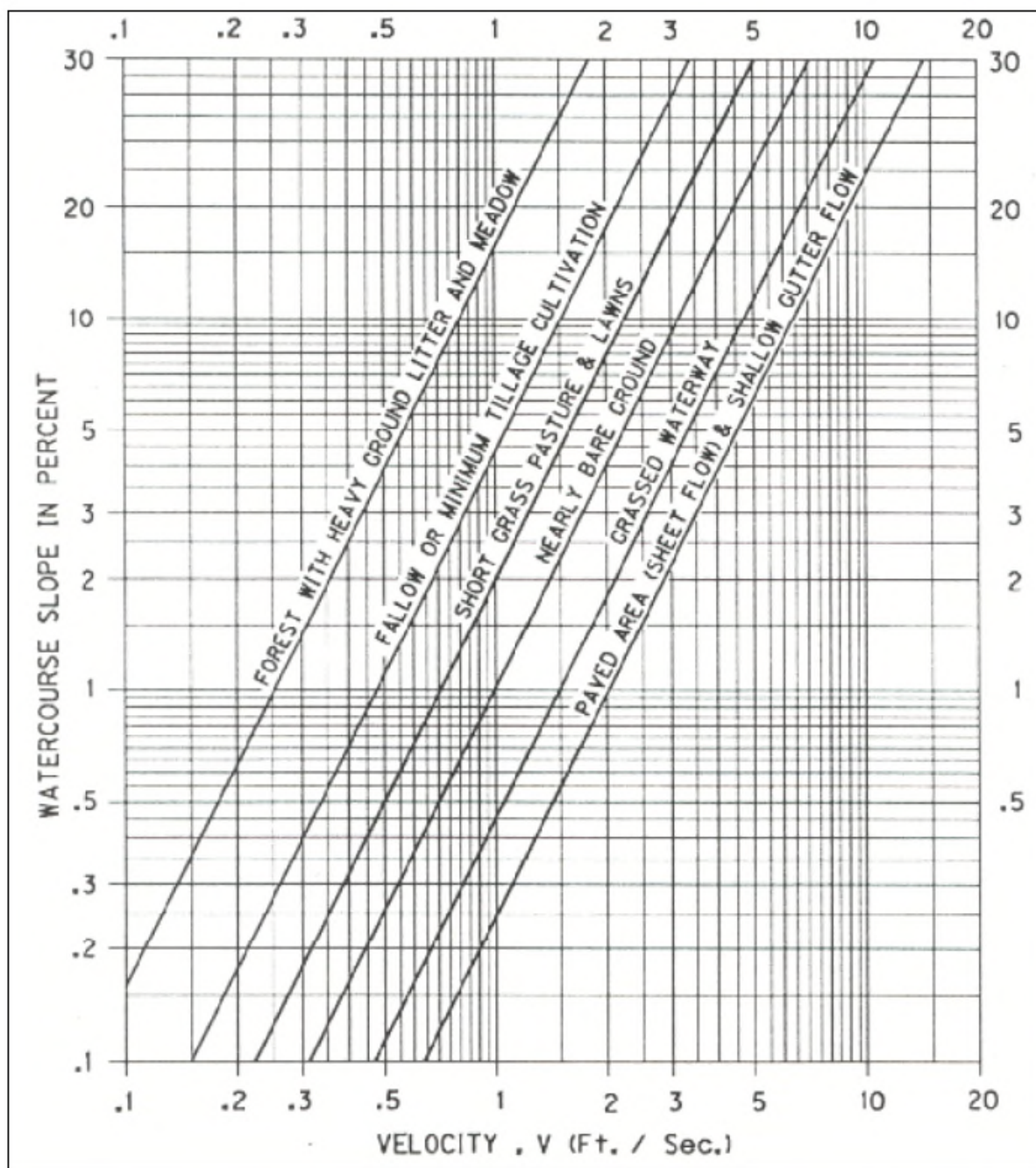
Channel flow

Segment ID		
12. Cross sectional flow area, a ft ²		
13. Wetted perimeter, p_w ft		
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft		
15. Channel slope, s ft/ft		
16. Manning's roughness coefficient, n		
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute Vft/s		
18. Flow length, L ft		
19. $T_t = \frac{L}{3600 V}$ Compute T_t hr		+
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr		= 0.406

0.406 Hrs = 24 Minutes

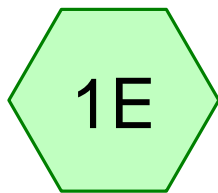
Manning's Roughness Coefficients for Overland Sheet Flow	
Surface Types:	n
Impervious Areas	0.014
Gravel Pavement	0.02
Developed: Landscape Areas (Except Lawns)	0.08
Undeveloped: Meadow, Pasture, or Farm	0.15
Developed: Lawns	0.24
Pre-developed: Mixed	0.30
Pre-developed: Woodland and Forest	0.40
Development Types:	n
Commercial Development	0.015
Industrial Development, Heavy	0.04
Industrial Development, Light	0.05
Dense Residential (over 6 units/acre)	0.08
Normal Residential (3 to 6 units/acre)	0.20
Light Residential (1 to 3 units/acre)	0.30
Parks	0.40

Table 4D-4. Manning's Roughness Coefficients for Overland Sheet Flow

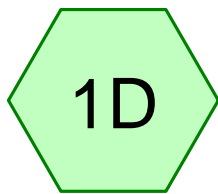




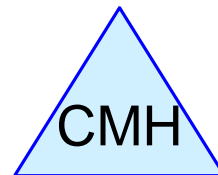
Appendix D



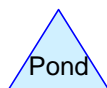
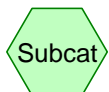
Existing Conditions



Developed Conditions



Control Manhole



Routing Diagram for Apartment Hydrology

Prepared by Multitech Engineering Services, Inc., Printed 9/2/2020
HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr Half of 2-year Rainfall=1.10"

Printed 9/2/2020

Summary for Subcatchment 1E: Existing Conditions

Runoff = 0.01 cfs @ 22.80 hrs, Volume= 287 cf, Depth= 0.02"

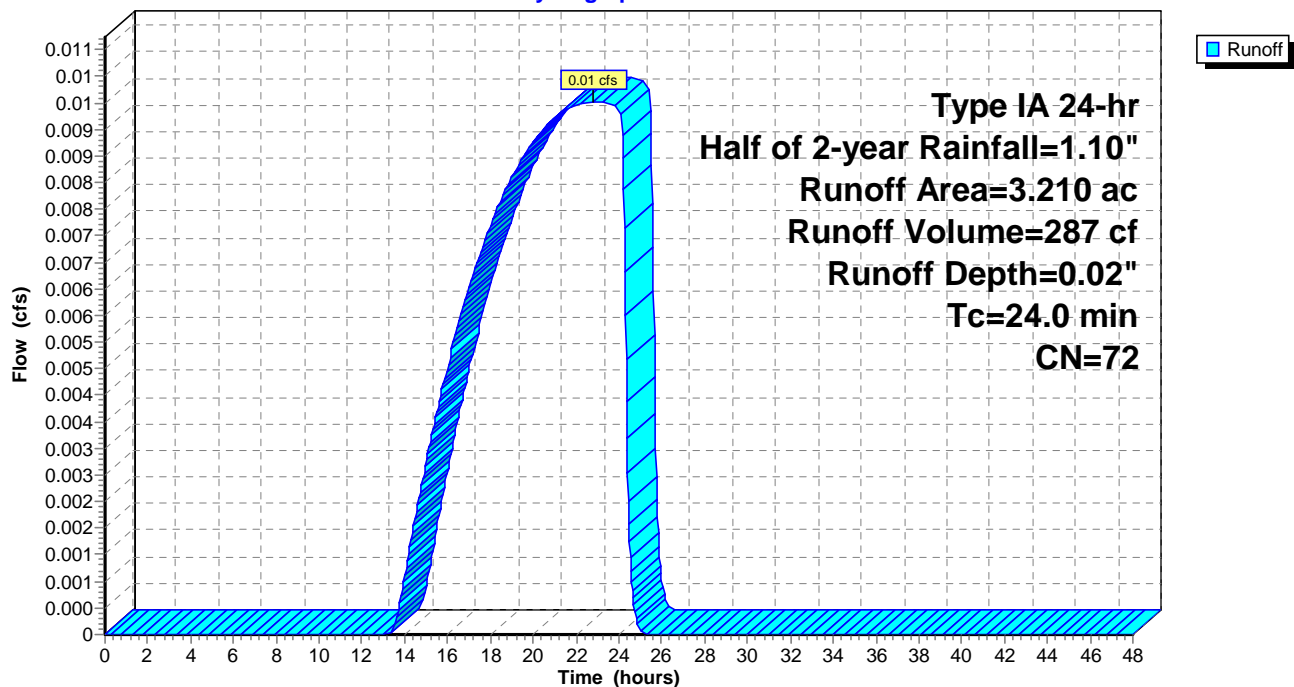
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr Half of 2-year Rainfall=1.10"

Area (ac)	CN	Description
* 3.210	72	City of Salem Pre-developed
3.210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0					Direct Entry, TR-55 Worksheet

Subcatchment 1E: Existing Conditions

Hydrograph



Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr Half of 2-year Rainfall=1.10"

Printed 9/2/2020

Summary for Subcatchment 1D: Developed Conditions

Runoff = 0.14 cfs @ 8.01 hrs, Volume= 3,258 cf, Depth= 0.28"

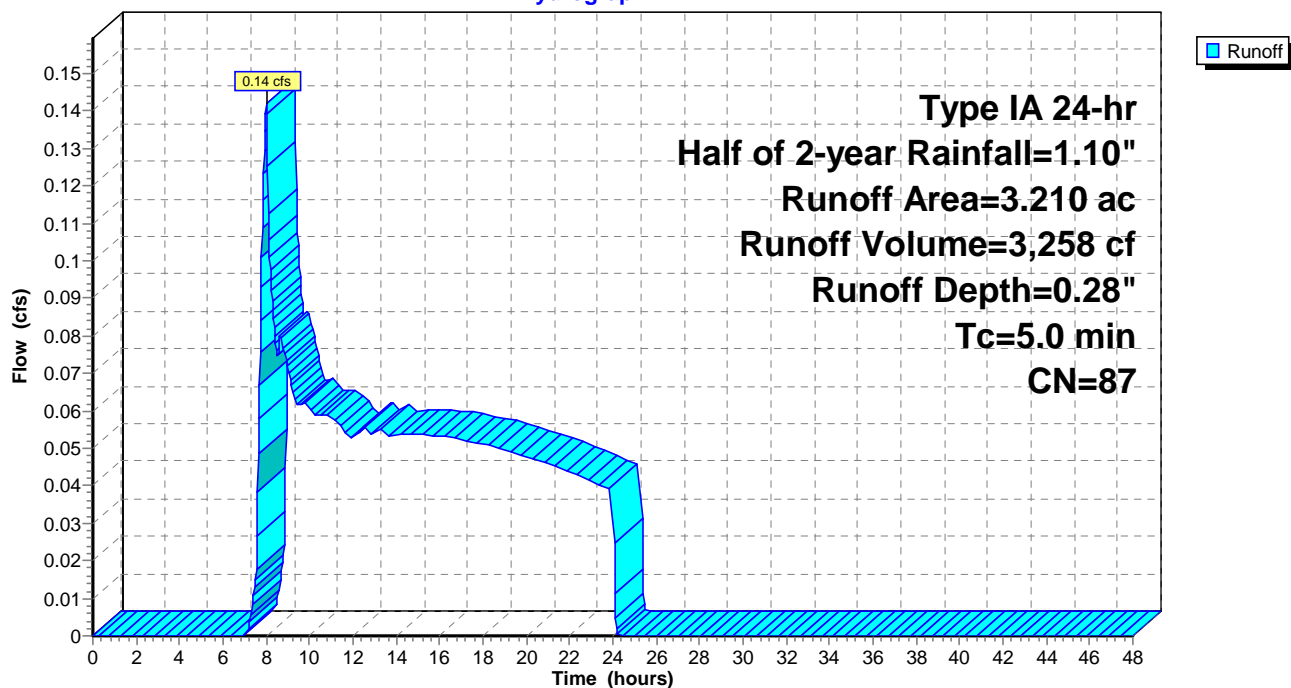
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr Half of 2-year Rainfall=1.10"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG C
1.440	74	>75% Grass cover, Good, HSG C
3.210	87	Weighted Average
1.440		44.86% Pervious Area
1.770		55.14% Impervious Area

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

Subcatchment 1D: Developed Conditions

Hydrograph



Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr Half of 2-year Rainfall=1.10"

Printed 9/2/2020

Summary for Pond CMH: Control Manhole

Inflow Area = 139,828 sf, 55.14% Impervious, Inflow Depth = 0.28" for Half of 2-year event
Inflow = 0.14 cfs @ 8.01 hrs, Volume= 3,258 cf
Outflow = 0.01 cfs @ 24.10 hrs, Volume= 1,333 cf, Atten= 92%, Lag= 965.1 min
Primary = 0.01 cfs @ 24.10 hrs, Volume= 1,333 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 541.13' @ 24.10 hrs Surf.Area= 4,500 sf Storage= 2,825 cf
Flood Elev= 543.00' Surf.Area= 4,500 sf Storage= 11,239 cf

Plug-Flow detention time= 1,190.2 min calculated for 1,333 cf (41% of inflow)
Center-of-Mass det. time= 896.1 min (1,791.1 - 894.9)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	11,239 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
538.00	4,500	0.0	0	0
538.24	4,500	0.0	0	0
538.25	4,500	40.0	18	18
539.24	4,500	40.0	1,782	1,800
539.25	4,500	5.0	2	1,802
540.99	4,500	5.0	392	2,194
541.00	4,500	100.0	45	2,239
542.00	4,500	100.0	4,500	6,739
543.00	4,500	100.0	4,500	11,239

Device	Routing	Invert	Outlet Devices
#1	Primary	537.89'	15.0" Round 15" Pipe L= 51.4' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 537.89' / 537.78' S= 0.0021 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	538.25'	0.5" Vert. Orifice #1 C= 0.600 Limited to weir flow at low heads
#3	Device 1	541.40'	4.5" Vert. Orifice #2 C= 0.600 Limited to weir flow at low heads
#4	Device 1	542.00'	15.0" Horiz. Overflow C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 24.10 hrs HW=541.13' (Free Discharge)

↑ **1=15" Pipe** (Passes 0.01 cfs of 9.41 cfs potential flow)
↑ **2=Orifice #1** (Orifice Controls 0.01 cfs @ 8.14 fps)
↑ **3=Orifice #2** (Controls 0.00 cfs)
↑ **4=Overflow** (Controls 0.00 cfs)

Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

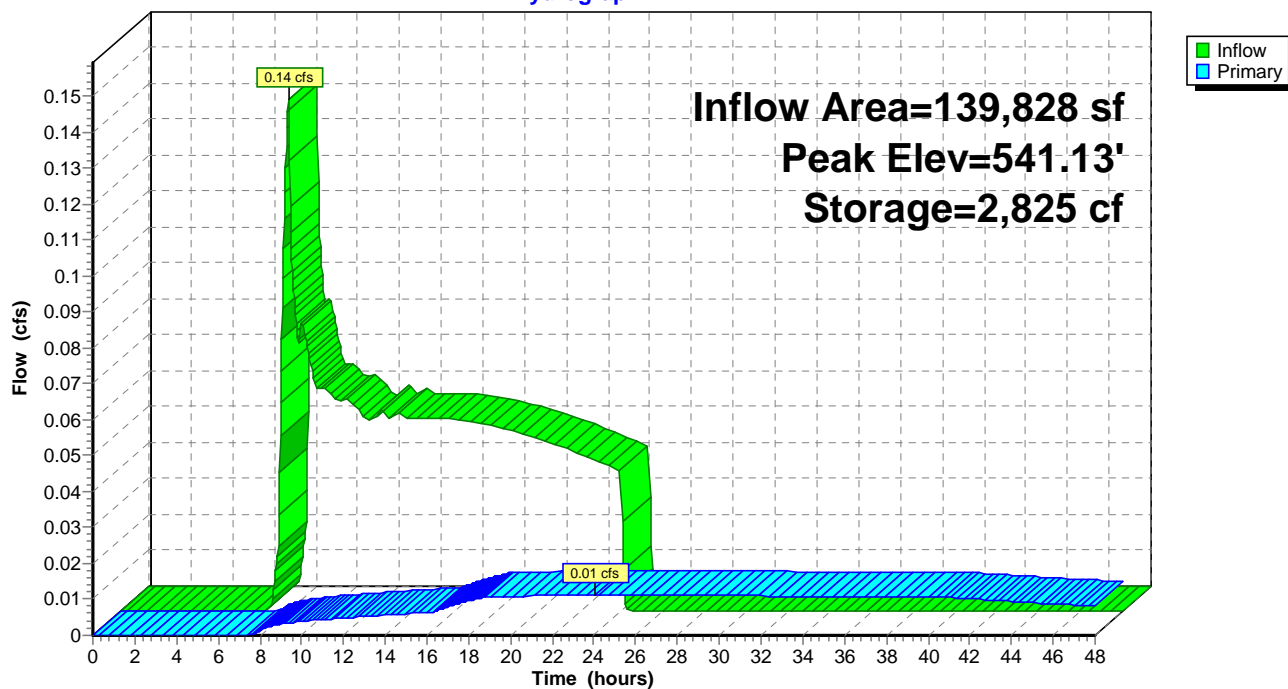
HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr Half of 2-year Rainfall=1.10"

Printed 9/2/2020

Pond CMH: Control Manhole

Hydrograph



Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr 10-year Rainfall=3.20"

Printed 9/2/2020

Summary for Subcatchment 1E: Existing Conditions

Runoff = 0.44 cfs @ 8.22 hrs, Volume= 10,833 cf, Depth= 0.93"

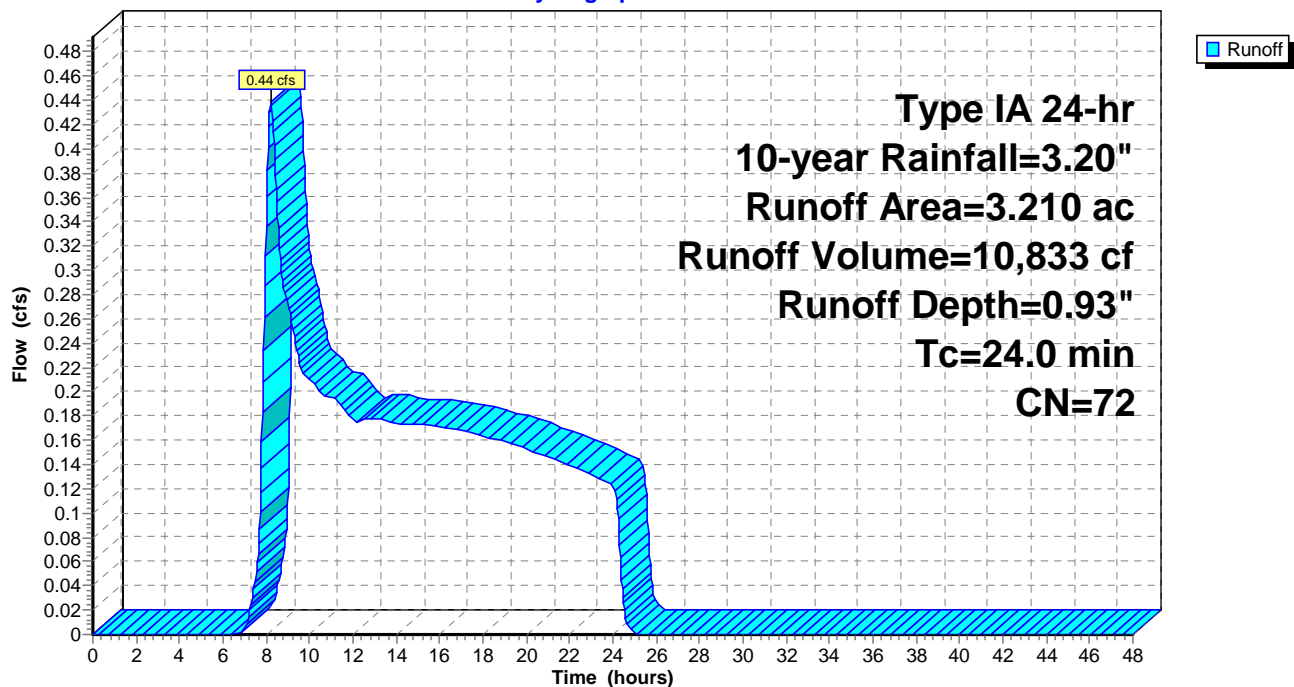
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr 10-year Rainfall=3.20"

Area (ac)	CN	Description
* 3.210	72	City of Salem Pre-developed
3.210		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0					Direct Entry, TR-55 Worksheet

Subcatchment 1E: Existing Conditions

Hydrograph



Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr 10-year Rainfall=3.20"

Printed 9/2/2020

Summary for Subcatchment 1D: Developed Conditions

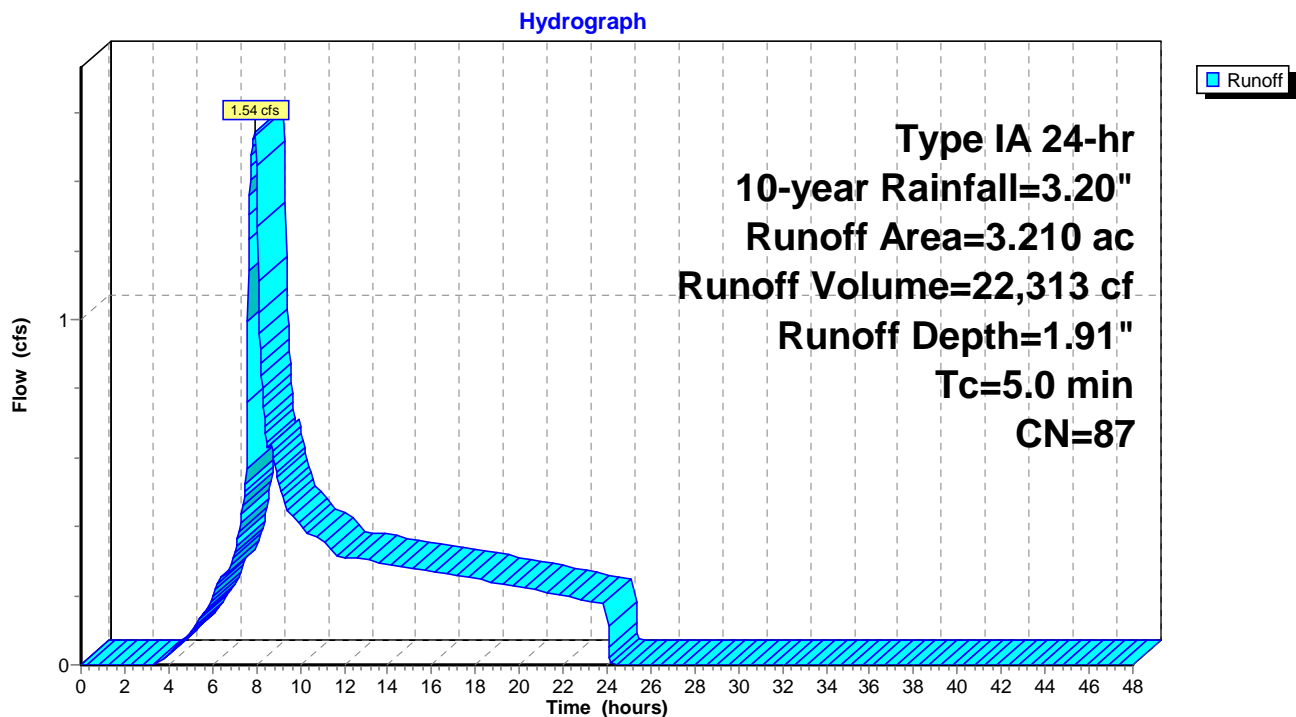
Runoff = 1.54 cfs @ 7.93 hrs, Volume= 22,313 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr 10-year Rainfall=3.20"

Area (ac)	CN	Description
1.770	98	Paved parking, HSG C
1.440	74	>75% Grass cover, Good, HSG C
3.210	87	Weighted Average
1.440		44.86% Pervious Area
1.770		55.14% Impervious Area

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

Subcatchment 1D: Developed Conditions



Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr 10-year Rainfall=3.20"

Printed 9/2/2020

Summary for Pond CMH: Control Manhole

Inflow Area = 139,828 sf, 55.14% Impervious, Inflow Depth = 1.91" for 10-year event
Inflow = 1.54 cfs @ 7.93 hrs, Volume= 22,313 cf
Outflow = 0.40 cfs @ 10.08 hrs, Volume= 18,871 cf, Atten= 74%, Lag= 128.6 min
Primary = 0.40 cfs @ 10.08 hrs, Volume= 18,871 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 542.01' @ 10.08 hrs Surf.Area= 4,500 sf Storage= 6,799 cf
Flood Elev= 543.00' Surf.Area= 4,500 sf Storage= 11,239 cf

Plug-Flow detention time= 343.4 min calculated for 18,871 cf (85% of inflow)
Center-of-Mass det. time= 247.4 min (1,017.3 - 769.9)

Volume	Invert	Avail.Storage	Storage Description
#1	538.00'	11,239 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
538.00	4,500	0.0	0	0
538.24	4,500	0.0	0	0
538.25	4,500	40.0	18	18
539.24	4,500	40.0	1,782	1,800
539.25	4,500	5.0	2	1,802
540.99	4,500	5.0	392	2,194
541.00	4,500	100.0	45	2,239
542.00	4,500	100.0	4,500	6,739
543.00	4,500	100.0	4,500	11,239

Device	Routing	Invert	Outlet Devices
#1	Primary	537.89'	15.0" Round 15" Pipe L= 51.4' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 537.89' / 537.78' S= 0.0021 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	538.25'	0.5" Vert. Orifice #1 C= 0.600 Limited to weir flow at low heads
#3	Device 1	541.40'	4.5" Vert. Orifice #2 C= 0.600 Limited to weir flow at low heads
#4	Device 1	542.00'	15.0" Horiz. Overflow C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.38 cfs @ 10.08 hrs HW=542.01' (Free Discharge)

↑ **1=15" Pipe** (Passes 0.38 cfs of 11.22 cfs potential flow)
↑ **2=Orifice #1** (Orifice Controls 0.01 cfs @ 9.31 fps)
↑ **3=Orifice #2** (Orifice Controls 0.35 cfs @ 3.14 fps)
↑ **4=Overflow** (Weir Controls 0.02 cfs @ 0.38 fps)

Apartment Hydrology

Prepared by Multitech Engineering Services, Inc.

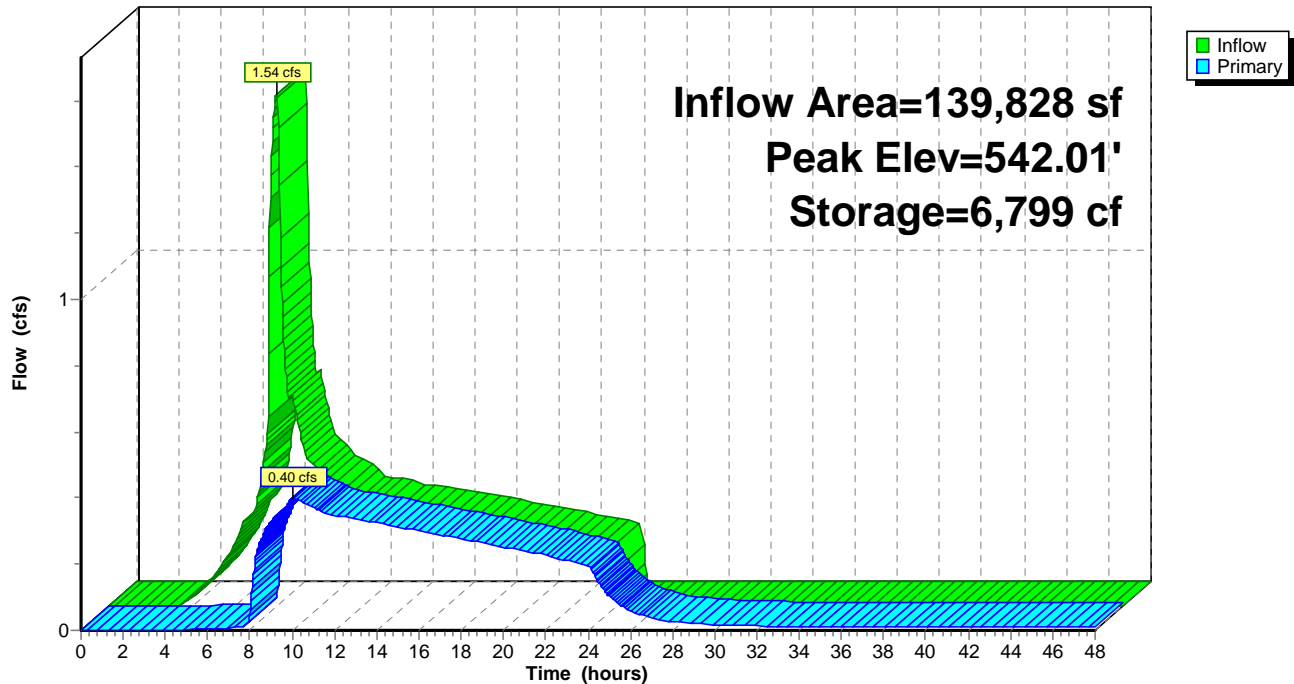
HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr 10-year Rainfall=3.20"

Printed 9/2/2020

Pond CMH: Control Manhole

Hydrograph



Drawing is NOT to scale

GRADING & DRAINAGE
PLAN

LIBERTY ROAD
APARTMENTS

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT THE WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.

DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design: M.D.G.
Drawn: P.H.S.
Checked: M.D.G.
Date: JAN. 2020
Scale: AS SHOWN

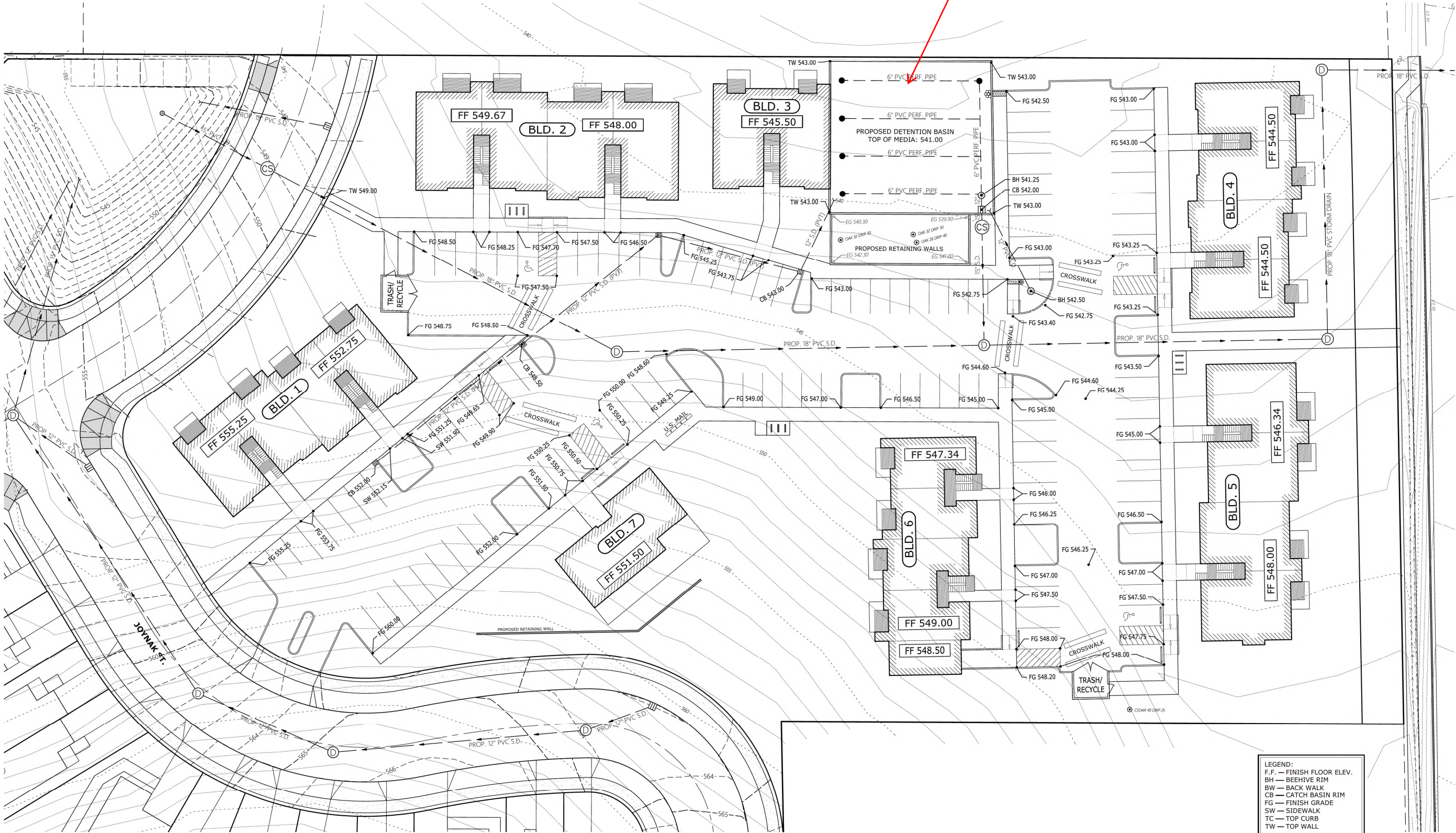
REGISTERED PROFESSIONAL
ENGINEER
MARK D. GREEN
JULY 14, 1978
OREGON
EXPIRES: 06-30-2021

JOB # 6727

SDR5



Combination
Facility
Location



LEGEND:
F.F. — FINISH FLOOR ELEV.
BH — BEEHIVE RIM
BW — BACK WALK
CB — CATCH BASIN RIM
FG — FINISH GRADE
SW — SIDEWALK
TC — TOP CURB
TW — TOP WALL

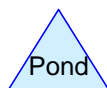
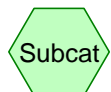


Appendix E



Developed Conditions

Planter Media



Routing Diagram for Apartment WQ Hydrology
Prepared by Multitech Engineering Services, Inc., Printed 9/2/2020
HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Apartment WQ Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.38"

Printed 9/2/2020

Summary for Subcatchment 1D: Developed Conditions

Runoff = 0.32 cfs @ 8.00 hrs, Volume= 5,566 cf, Depth= 0.50"

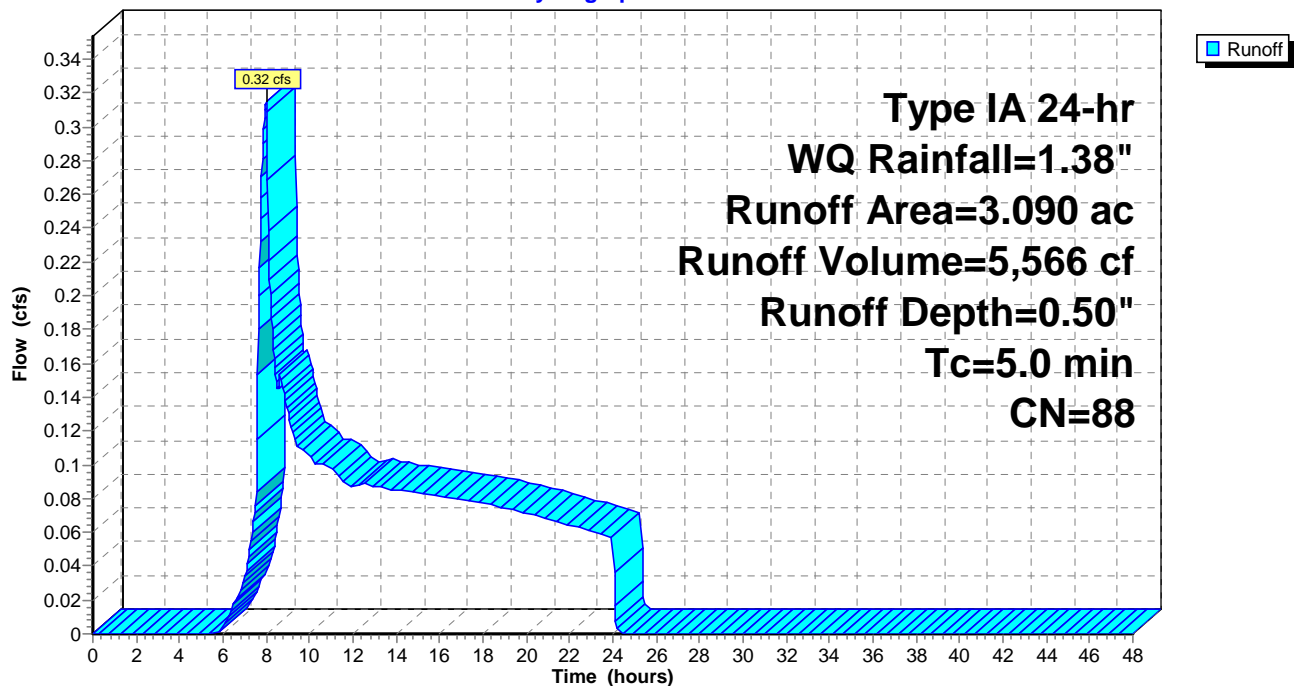
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Type IA 24-hr WQ Rainfall=1.38"

Area (ac)	CN	Description
1.750	98	Paved parking, HSG C
1.340	74	>75% Grass cover, Good, HSG C
3.090	88	Weighted Average
1.340		43.37% Pervious Area
1.750		56.63% Impervious Area

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

Subcatchment 1D: Developed Conditions

Hydrograph



Apartment WQ Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.38"

Printed 9/2/2020

Summary for Pond WQ: Planter Media

Inflow Area = 134,600 sf, 56.63% Impervious, Inflow Depth = 0.50" for WQ event
Inflow = 0.32 cfs @ 8.00 hrs, Volume= 5,566 cf
Outflow = 0.21 cfs @ 8.16 hrs, Volume= 5,566 cf, Atten= 34%, Lag= 10.0 min
Discarded = 0.21 cfs @ 8.16 hrs, Volume= 5,566 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.03 hrs
Peak Elev= 541.02' @ 8.16 hrs Surf.Area= 4,500 sf Storage= 152 cf
Flood Elev= 543.00' Surf.Area= 4,500 sf Storage= 9,045 cf

Plug-Flow detention time= 4.3 min calculated for 5,566 cf (100% of inflow)
Center-of-Mass det. time= 4.3 min (852.6 - 848.3)

Volume	Invert	Avail.Storage	Storage Description
#1	540.99'	9,045 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
540.99	4,500	0.0	0	0
541.00	4,500	100.0	45	45
542.00	4,500	100.0	4,500	4,545
543.00	4,500	100.0	4,500	9,045

Device	Routing	Invert	Outlet Devices
#1	Discarded	540.99'	2.000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 525.00'
#2	Primary	542.00'	15.0" Horiz. Overflow C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.21 cfs @ 8.16 hrs HW=541.02' (Free Discharge)

↑ **1=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=540.99' (Free Discharge)

↑ **2=Overflow** (Controls 0.00 cfs)

Apartment WQ Hydrology

Prepared by Multitech Engineering Services, Inc.

HydroCAD® 10.10-4a s/n 09412 © 2020 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.38"

Printed 9/2/2020

Pond WQ: Planter Media

Hydrograph

