GSI Water Solutions, Inc.

Technical Memorandum

To: Kevin Timmins, PE – OTAK

From: Steven Kuhlmeier, EIT – GSI Water Solutions, Inc.
Jason Melady, RG, CWRE – GSI Water Solutions, Inc.

Date: September 2, 2016

Re: **Tigard Area Preliminary Infiltration Characterization**

Introduction

This technical memorandum summarizes published infiltration characteristics about the area in and near Tigard, Oregon, in Washington County. The following sections provide a preliminary evaluation of available shallow soil and geologic data relevant to infiltration capacity. No field investigations were conducted as part of this effort. Subsequent conclusions and recommendations are intended to provide guidance for planning-level evaluations for stormwater infiltration facility designs.

Geologic Setting

The geologic setting of the Tigard area generally is characterized by sequences of sedimentary rock and outcroppings of volcanic rock (basalt). Basalt units of the Columbia River Basalt Group (CRBG) are overlaid by wind-deposited loess in the higher elevations, and are located predominantly near Bull Mountain and Canterbury Lane (Madin, 1990). Pleistocene-aged Catastrophic Flood Deposits inlay surrounding valley features and generally consist of fine-grained sands, silts, and clay. These deposits are estimated to be 30 to 60 feet thick with thicknesses potentially reaching 180 feet in some locations and generally are finer-grained near the surface (Montgomery Watson and Golder Associates, 2001). The Catastrophic Flood Deposits extend north and east of the Bull Mountain area with more recent unconsolidated alluvial deposits near Fanno Creek and the Tualatin River.

Shallow lithology figures were developed using available water well drilling reports from the Oregon Water Resources Department (OWRD) database. Well logs with insufficient or ambiguous geologic descriptions, and logs with inaccurate location information were not included for assessment of depth to the top of basalt. As available, well logs were georeferenced with preference given to logs that included latitude and longitude location information, followed by logs with street addresses, and, lastly, logs that contained only Township, Range, and Section information. In the varied descriptive geologic information contained in well logs,

weathered basalt was not delineated from competent basalt and overlying non-basalt soils were not categorized. Few well logs exceeded a total depth of 50 feet in the central and northeast regions of incorporated Tigard; of those borings, depth to basalt appears to be greater the 300 feet below ground surface (bgs). For relevance to stormwater infiltration and storage, basalt contouring was screened from depths exceeding 100 feet for visual clarity. Boring logs that were used to create a top-of-basalt contour map, with associated depth to basalt, are summarized in Table 1.

Basalt units in the CRBG create most of the visible topography in the Tigard area and, therefore, depth to basalt is much closer to the surface near Bull Mountain in southwest Tigard and the Canterbury Lane area. Geologic mapping by Madin (1990) depicts shallow Columbia River Basalt extending from Beef Bend Road north and west following the Bull Mountain and Cooper Mountain summits. Existing surface topographic contouring was overlaid on a depth-to-basalt surface to better articulate basalt contouring (Figure 1). Madin (1990) characterizes Bull Mountain to have more than 5 feet of Pleistocene loess overlaying basalt. Available boring logs and shallow exploratory work conducted by GeoDesign (2009) on the south and west sides of Bull Mountain indicate basalt occurring as shallow as 3 feet bgs and generally less than 15 feet bgs. Basalt flows of the CRBG generally create a vertical barrier to water mobility, and as a result, reduced infiltration capacity should be expected in areas where basalt is located close to the land surface, as in the Bull Mountain area.

Moving east and north from Bull Mountain toward lower elevations, the basalt units are structurally offset and are much deeper, with available well logs encountering basalt layers at depths exceeding 100 feet bgs. In well logs overlying the deeper basalt, Catastrophic Flood Deposits generally are described as fine-grained materials.

Surface Soil Infiltration Characterization

Shallow infiltration characteristics were determined using available data from the National Resource Conservation Service's (NRCS) online Soil Survey Geographic Database (SSURGO) (NCRS, 2016). NRCS soil surveys provide planning-level characterization of soil properties from depths of zero to 200 centimeters (cm) (zero to 6.5 feet). Figure 2 depicts the Tigard city limits subdivided by shallow soil type and NRCS map symbol. NRCS map symbols are correlated to respective descriptions in Table 2. Quantitative values in Table 2, such as saturated hydraulic conductivity, are generalized for native soils and provide an estimation by soil type. Depth to shallow water table, hydraulic conductivity, depth to restrictive layer, and slope were used as the primary factors in evaluating infiltration potential. Depth-to-basalt determinations were combined with spatial NRCS data to correlate shallow basalt occurrences as an impermeable layer to infiltration.

Infiltration Potential Ranking

The City of Tigard's comprehensive plan references Clean Water Services' Design and Construction Standards for stormwater management recommendations. No specific criteria for evaluating infiltration facilities are provided in the standards (Clean Water Services, 2007). As an alternative, NRCS soil properties and estimated depth to basalt were compared to the City of

Portland's *Stormwater Management Manual* guidance to classify infiltration potential (City of Portland, 2016). In the stormwater manual, the City of Portland requires:

- A minimum infiltration rate of 2 inches per hour (in/hr) for all infiltration facilities
- A minimum setback of 100 feet for facilities with slopes exceeding 10 percent
- A minimum 5-foot difference between the bottom of an infiltration facility and the highest shallow water table.

Based on that guidance, an infiltration evaluation protocol for Tigard was established for rankings of good, fair, and poor infiltration potential.

- Depths to restrictive layer or shallow water table less than 200 cm (6.5 feet) were used as initial screens for "poor" infiltration potential. A water table is considered a saturated zone lasting for 1 month or longer, based on NRCS soil property data. The highest water table annually was evaluated in this exercise. Figure 3 depicts plotted depth to restrictive layer, and Figure 4 shows depth to shallow water table.
- Slopes greater than 10 percent reduced a rating from "good" to "fair" or "fair" to "poor." Figure 5 depicts the Tigard area delineated by representative slopes greater than or less than 10 percent.
- Saturated hydraulic conductivity was used as the primary factor in characterizing infiltration with values greater than 2 in/hr as "good," between 0.5 and 2 in/hr as "fair," and less than 0.5 in/hr as "poor"(Figure 6).
- Areas with attributed depth to basalt less than 15 feet were evaluated as "poor" infiltration potential. Basalt would be expected to act as a confining layer, reducing storage capacity and long-term infiltration capacity. As noted in GeoDesign's investigation in the Bull Mountain area (GeoDesign, 2009), there is a large degree of horizontal variability in shallow basalt depths; the 15-foot delineation is considered a conservative threshold for infiltration impairment (Figure 1).

Overall infiltration potential rankings presented Table 2 with soil characteristics and spatially in Figure 7.

Conclusions and Recommendations

Based on the above criteria, infiltration potential was characterized as generally "poor" throughout most of the Tigard area, although some sections have "fair" and "good" infiltration characteristics. Low hydraulic conductivity values, steep slopes, and shallow depths to a hydraulically limiting layer negatively impact potential stormwater infiltration and storage. Infiltration potential rankings were applied to the NRCS soil mapping and reproduced in Figure 7. As seen in Figure 5, most areas fall in the "fair" range for saturated hydraulic conductivity; however, because of a high seasonal water table (Figure 4), the rating was downgraded. "Good" infiltration potential can be seen predominantly south of Bonita Road and east of Hall Boulevard, where high conductivity Hillsboro silt loam is prevalent. Given the proximity to the Tualatin River, a closer evaluation of depth to groundwater table is recommended, in addition to site-specific infiltration testing.

References

City of Portland. 2016. Stormwater Management Manual. Bureau of Environmental Services. August. Available online at: https://www.portlandoregon.gov/

Clean Water Services. 2007. Chapter 4: Runoff Treatment and Control. Design & Construction Standards. http://www.cleanwaterservices.org/permits-development/design-construction-standards/

GeoDesign. 2009. Report of Preliminary Geological Evaluation West Bull Mountain Planning Area. November.

Madin, I.A. 1990. Earthquake-hazard geology maps of the Portland metropolitan area, Oregon: Oregon Department of Geology and Mineral Industries, Open File Report O-90-02, 1 CD.

Montgomery Watson and Golder Associates. 2001. Phase I – ASR Feasibility Report, City of Tigard. June.

NRCS. 2009. Part 630 Hydrology National Engineering Handbook. Chapter 7: Hydrologic Soil Groups. U.S. Department of Agriculture, National Resource Conservation Service (NRCS). January. Available online at: http://soils.usda.gov/technical/handbook/

NRCS. 2016. Web Soil Survey. Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture. Available online at: http://websoilsurvey.nrcs.usda.gov/

Tables

Table 1. Basalt Characterization Details
Tigard, Oregon

Log ID	Date Installed	Screened Depth to Basalt (ft bgs)	Depth to Basalt (ft bgs)	Data Source	Address	Township-Range-Section	Elevation (ft)	Latitude	Longitude
CLAC 52931	Dec-97	100	325	Boring Log Description	SW McEwan Rd, Tualatin	--	--	--	--
MULT 115978	May-14	100	509	Boring Log Description	10106 SW 61st Ave, Portland 97219	--	--	--	--
WASH 9228	Aug-38	100	>67	OWRD/GPS	--	--	196	45.44007	-122.78962
WASH 9237	May-68	100	358	Boring Log Description	9055 SW N Dakota Street	--	--	--	--
WASH 104	Aug-90	77	77	OWRD/1:24,000 MAP	--	--	185	45.42678	-122.81427
WASH 106	Jul-90	100	>80	OWRD/1:24,000 MAP	--	--	--	45.41706	-122.79843
WASH 107	Aug-90	12	12	OWRD/1:24,000 MAP	--	--	--	45.41234	-122.78260
WASH 11106	Jun-69	100	285	OWRD/GPS	--	--	310	45.42235	-122.80622
WASH 11408	Sep-61	100	678	OWRD/UNKNOWN	--	--	145	45.42551	-122.76156
WASH 11425	Mar-66	100	635	Boring Log Description	--	2S-1W-2	--	--	--
WASH 11436	Apr-60	100	408	OWRD/UNKNOWN	--	--	295	45.43109	-122.81724
WASH 11449	Mar-58	54	54	OWRD/GPS	--	--	390	45.42584	-122.81558
WASH 11549	Sep-67	8	8	Boring Log Description	14255 SW Beef Bend Rd	--	--	--	--
WASH 11552	Oct-60	9	9	Boring Log Description	13435 SW Beef Bend Rd	--	--	--	--
WASH 11559	Aug-72	100	>270	Boring Log Description	14185 SW 117th St	2S-1W-10	--	--	--
WASH 11562	Jul-68	100	292	Boring Log Description	17310 SW 131st Ave, Tigard	--	--	--	--
WASH 11574	Apr-62	18	18	Boring Log Description	11165 SW Naeve Street	--	--	--	--
WASH 11577	Sep-59	15	15	Boring Log Description	12230 SW Beef Bend Rd	--	--	--	--
WASH 11584	May-63	13	13	Boring Log Description	11000 SW Naeve Street	--	--	--	--
WASH 11587	Apr-67	100	291	Boring Log Description	15475 SW Pacific Hwy	2S-1W-10	--	--	--
WASH 11590	Oct-66	71	71	Boring Log Description	15055 SW 122nd Ave	2S-1W-10	--	--	--
WASH 11592	Jul-49	29	29	OWRD/GPS	--	--	389	45.41702	-122.80060
WASH 11595	Nov-66	100	>190	OWRD/UNKNOWN	--	--	200	45.40464	-122.77785
WASH 11598	Aug-70	58	58	OWRD/UNKNOWN	--	--	265	45.41362	-122.77324
WASH 11603	Jul-61	100	185	Boring Log Description	8800 SW Sattler Rd	--	--	--	--
WASH 11608	Aug-61	100	222	Boring Log Description	12280 SW Fischer Rd	--	--	--	--
WASH 11613	Feb-90	100	335	OWRD/GPS	--	--	173	45.41156	-122.74661
WASH 11627	Dec-64	100	>76	OWRD/UNKNOWN	--	--	200	45.41012	-122.76149
WASH 11645	Feb-89	100	560	OWRD/GPS	--	--	--	45.40571	-122.75002
WASH 11705	Sep-71	100	582	OWRD/UNKNOWN	--	--	180	45.40051	-122.77198
WASH 11707	Jun-53	100	590	OWRD/UNKNOWN	Tigard High School	--	195	45.40391	-122.76817
WASH 11724	Apr-80	100	682	Boring Log Description	11675 SW Hazelbrook	--	--	--	--
WASH 11801	Jun-71	100	280	Boring Log Description	16630 SW 131st Ave, Tigard	--	--	--	--
WASH 3886	Jun-94	100	483	Boring Log Description	17755 SW 131st Ave, Tigard	--	--	--	--
WASH 50234, WASH 11778	Feb-69	100	653	Boring Log Description	11565 SW Hazelbrook Rd, Tualatin	--	--	--	--
WASH 51246	Sep-96	90	90	OWRD/GPS	--	--	285	45.42435	-122.80788
WASH 51548	Nov-98	15	15	Boring Log Description	13425 SW Menlor Lane, Tigard	--	--	--	--
WASH 53749	May-05	29	29	Boring Log Description	11455 SW Bull Mtn Rd	--	--	--	--
WASH 55816	Mar-00	13	13	Boring Log Description	16548 SW Loon Drive, Beaverton	--	--	--	--
WASH 58003	Nov-01	59	59	OWRD/GPS	--	--	400	45.41417	-122.78434
WASH 59309	Nov-02	100	>27	Boring Log Description	12475 SW Main Street	--	--	--	--
WASH 60661	Oct-03	13	13	Boring Log Description	13040 SW Bull Mountain Rd (Tax Lot 2100)	--	--	--	--

Table 1. Basalt Characterization Details
Tigard, Oregon

Log ID	Date Installed	Screened Depth to Basalt (ft bgs)	Depth to Basalt (ft bgs)	Data Source	Address	Township-Range-Section	Elevation (ft)	Latitude	Longitude
WASH 60822	Oct-03	10	10	Boring Log Description	13040 SW Bull Mountain Road	--	--	--	--
WASH 61621	Jun-04	8	8	Boring Log Description	150th and Woodhue ST	--	--	--	--
WASH 61622	Aug-04	20	20	OWRD/LAND SURVEY	--	--	474	45.41373	-122.80480
WASH 64693	Sep-06	23	23	Boring Log Description	13001 SW Bull Mountain Road	--	--	--	--
WASH 65490	Jun-07	5	5	Boring Log Description	15650 SW 133rd Ave	--	--	--	--
WASH 66115	Aug-07	21	21	OWRD/APPL MAP & DOQ	--	--	550	45.41379	-122.81110
WASH 67601	Dec-08	55	55	Boring Log Description	12475 SW Bull Mountain Road	--	--	--	--
WASH 70924	Jul-12	100	>100	Boring Log Description	13500 SW Hall Blvd	--	--	--	--
WASH 71835	Jul-13	100	>41	Boring Log Description	SW Dartmouth St & SW 72nd Ave	--	--	--	--
WASH 72694	May-14	12	12	Boring Log Description	15399 SW 150th Ave, Portland, OR 97224	--	--	--	--
WASH 53011	Nov-97	35	35	Boring Log Description	16399 SW Hoops Ct, Tigard OR	--	--	--	--
WASH 11451	Mar-87	13	13	Boring Log Description	13985 SW 164th, Tigard	--	--	--	--
WASH 60154	May-03	37	37	Boring Log Description	--	--	--	45.42878	-122.83173
WASH 51547	Nov-96	12	12	Boring Log Description	13425 Menlor Lane, Tigard	--	--	--	--
WASH 51983	Mar-97	100	104	Boring Log Description	14515 SW Scholls Ferry Rd	--	--	--	--
WASH 69343	Jul-10	100	>100	Boring Log Description	14460 Sexton Mountain Drive	--	--	--	--

Notes:

OWRD = Oregon Water Resources Department

ft bgs = feet below ground surface

"--" = No data

Table 2. NRCS Soil Properties
Tigard, Oregon

Map Units Symbol	Map Unit Name	Acres in AOI[1]	Percent of AOI[1]	Depth to High Water Table (cm)	Depth to Restrictive Layer (cm)	Representative Slope	Saturated Hydraulic Conductivity K_{sat} (in/hr)	Hydrologic Soil Group	Screened Rating
1	Aloha silt loam	1,716.10	22.70%	54	>200	2%	0.53	C/D	Fair
4B	Briedwell silt loam, 0 to 7 percent slopes	25.4	0.30%	>200	>200	4%	1.28	B	Fair
5B	Briedwell stony silt loam, 0 to 7 percent slopes	11.4	0.20%	>200	>200	4%	1.28	B	Fair
5C	Briedwell stony silt loam, 7 to 12 percent slopes	8.9	0.10%	>200	>200	10%	1.28	B	Fair
7B	Cascade silt loam, 3 to 7 percent slopes	144.9	1.90%	61	68	5%	0.64	C	Poor
7C	Cascade silt loam, 7 to 12 percent slopes	149.1	2.00%	61	68	10%	0.64	C	Poor
7D	Cascade silt loam, 12 to 20 percent slopes	51.5	0.70%	61	68	16%	0.64	C	Poor
7E	Cascade silt loam, 20 to 30 percent slopes	11.8	0.20%	61	68	25%	0.64	C	Poor
9	Chehalis silty clay loam, occasional overflow	24.4	0.30%	>200	>200	2%	1.28	B	Fair
10	Chehalis silt loam, occasional overflow	37.4	0.50%	>200	>200	2%	1.28	B	Fair
11B	Cornelius and Kinton silt loams, 2 to 7 percent slopes	594.6	7.90%	86	96	4%	0.85	C	Poor
11C	Cornelius and Kinton silt loams, 7 to 12 percent slopes	551.1	7.30%	86	96	10%	0.85	C	Poor
11D	Cornelius and Kinton silt loams, 12 to 20 percent slopes	128.5	1.70%	86	96	16%	0.85	C	Poor
11E	Cornelius and Kinton silt loams, 20 to 30 percent slopes	161.2	2.10%	86	96	25%	0.85	C	Poor
11F	Cornelius and Kinton silt loams, 30 to 60 percent slopes	50.7	0.70%	86	96	45%	0.85	C	Poor
12A	Cornelius variant silt loam, 0 to 3 percent slopes	59.1	0.80%	38	99	2%	0.88	C/D	Poor
13	Cove silty clay loam	327.6	4.30%	15	>200	1%	0.08	D	Poor
14	Cove clay	34.2	0.50%	15	>200	1%	0.03	D	Poor
15	Dayton silt loam	17.9	0.20%	30	41	1%	0.75	D	Poor
16C	Delena silt loam, 3 to 12 percent slopes	45.8	0.60%	23	56	8%	0.49	D	Poor

Table 2. NRCS Soil Properties
Tigard, Oregon

Map Units Symbol	Map Unit Name	Acres in AOI[1]	Percent of AOI[1]	Depth to High Water Table (cm)	Depth to Restrictive Layer (cm)	Representative Slope	Saturated Hydraulic Conductivity K_{sat} (in/hr)	Hydrologic Soil Group	Screened Rating
19B	Helvetia silt loam, 2 to 7 percent slopes	60.6	0.80%	137	>200	5%	0.57	C	Fair
19C	Helvetia silt loam, 7 to 12 percent slopes	34.6	0.50%	137	>200	10%	0.57	C	Fair
19D	Helvetia silt loam, 12 to 20 percent slopes	4.4	0.10%	137	>200	16%	0.57	C	Fair
19E	Helvetia silt loam, 20 to 30 percent slopes	7.3	0.10%	137	>200	25%	0.57	C	Fair
21A	Hillsboro loam, 0 to 3 percent slopes	58	0.80%	>200	>200	2%	4.82	B	Good
21B	Hillsboro loam, 3 to 7 percent slopes	145.7	1.90%	>200	>200	4%	4.82	B	Good
21C	Hillsboro loam, 7 to 12 percent slopes	75.1	1.00%	>200	>200	10%	4.82	B	Good
21D	Hillsboro loam, 12 to 20 percent slopes	7.9	0.10%	>200	>200	16%	4.82	B	Good
22	Huberly silt loam	351.8	4.70%	23	64	2%	0.37	C/D	Poor
30	McBee silty clay loam	146.3	1.90%	76	>200	2%	1.00	C	Fair
37A	Quatama loam, 0 to 3 percent slopes	406.1	5.40%	76	>200	2%	0.63	C	Fair
37B	Quatama loam, 3 to 7 percent slopes	613.7	8.10%	76	>200	5%	0.63	C	Fair
37C	Quatama loam, 7 to 12 percent slopes	100.6	1.30%	76	>200	10%	0.63	C	Fair
37D	Quatama loam, 12 to 20 percent slopes	27	0.40%	76	>200	16%	0.63	C	Fair
38D	Saum silt loam, 12 to 20 percent slopes	9.3	0.10%	>200	127	16%	0.81	C	Poor
41	Urban land	209.3	2.80%	>200	>200	0%	0.00		Poor
42	Verboort silty clay loam	133.3	1.80%	31	48	2%	0.20	D	Poor
43	Wapato silty clay loam	158.7	2.10%	15	>200	2%	0.59	C/D	Fair
45A	Woodburn silt loam, 0 to 3 percent slopes	91.2	1.20%	64	>200	2%	0.72	C	Fair
45B	Woodburn silt loam, 3 to 7 percent slopes	525.8	7.00%	64	>200	5%	0.72	C	Fair

Table 2. NRCS Soil Properties
Tigard, Oregon

Map Units Symbol	Map Unit Name	Acres in AOI[1]	Percent of AOI[1]	Depth to High Water Table (cm)	Depth to Restrictive Layer (cm)	Representative Slope	Saturated Hydraulic Conductivity K_{sat} (in/hr)	Hydrologic Soil Group	Screened Rating
45C	Woodburn silt loam, 7 to 12 percent slopes	109.4	1.40%	64	>200	10%	0.72	C	Fair
45D	Woodburn silt loam, 12 to 20 percent slopes	50.2	0.70%	64	>200	16%	0.72	C	Fair
46F	Xerochrepts and Haploxerolls, very steep	38	0.50%	>200	>200	40%	1.01	B	Fair
47D	Xerochrepts-Rock outcrop complex	8	0.10%	>200	25	18%	1.28	D	Poor
W	Water	24.5	0.30%	>200	>200	--	--	--	Poor

Notes:

[1]AOI = Area of Interest/ Tigard City Limits. Total Soil Survey Area or AOI = 7,548.2 acres

NRCS = National Resource Conservation Survey

Data accessed from U.S. Department of Agriculture NRCS Web Soil Survey application June, 2016

cm = centimeter

in/hr = inch per hour

"--" = Not applicable

Figures

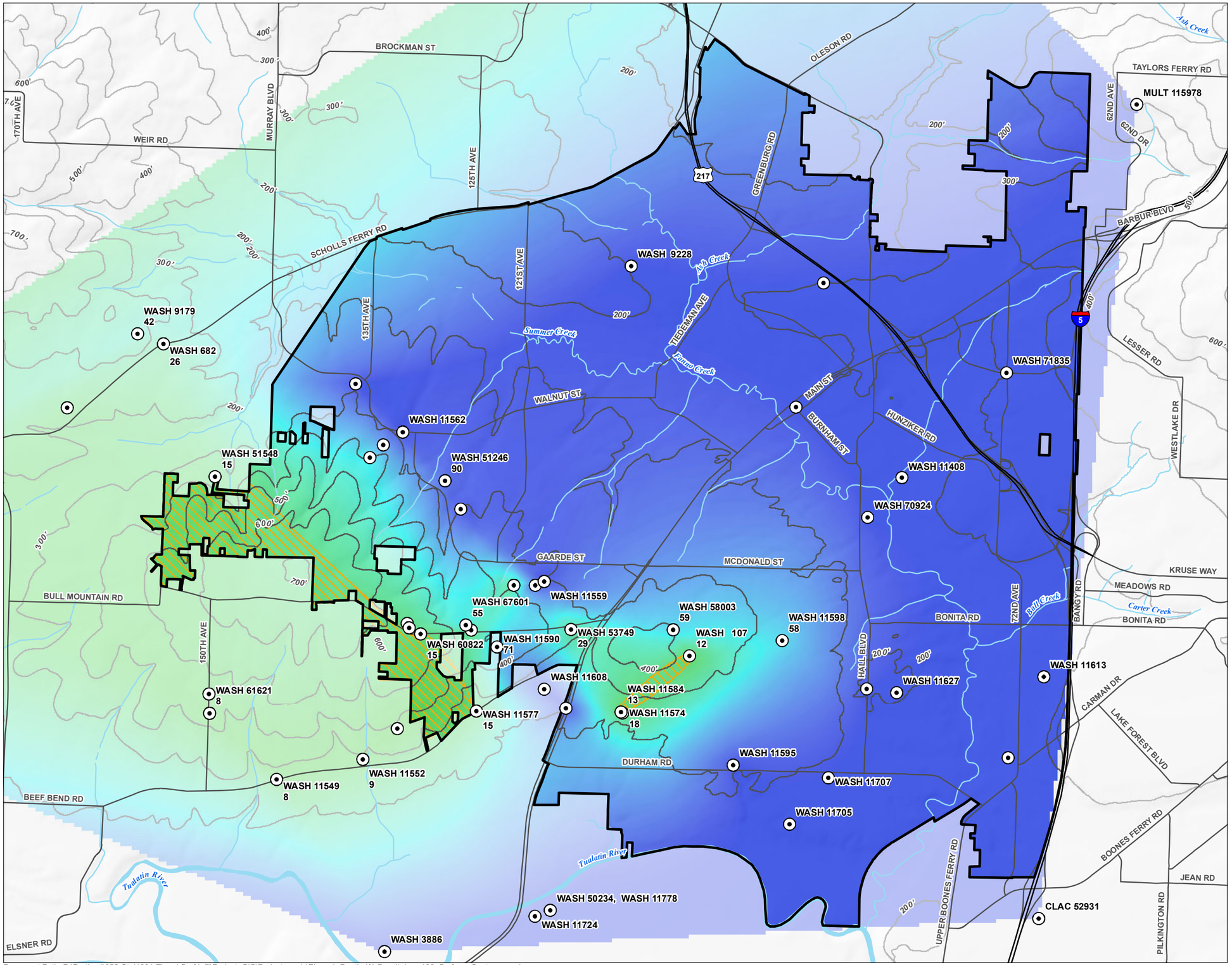


FIGURE 1

Depth to Basalt

Tigard, Oregon

LEGEND

- Well
- Depth to Basalt Less Than 15'
- Surface Elevation Contour, 100' Interval

Depth to Weathered Basalt

100

5

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

N

0 1,250 2,500 3,750

Feet

Date: July 15, 2016

Data Sources: METRO, OWRD, USGS

GSI Water Solutions, Inc.

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure1_Depth_WxBasalt_Less100_Surface_Contours.mxd

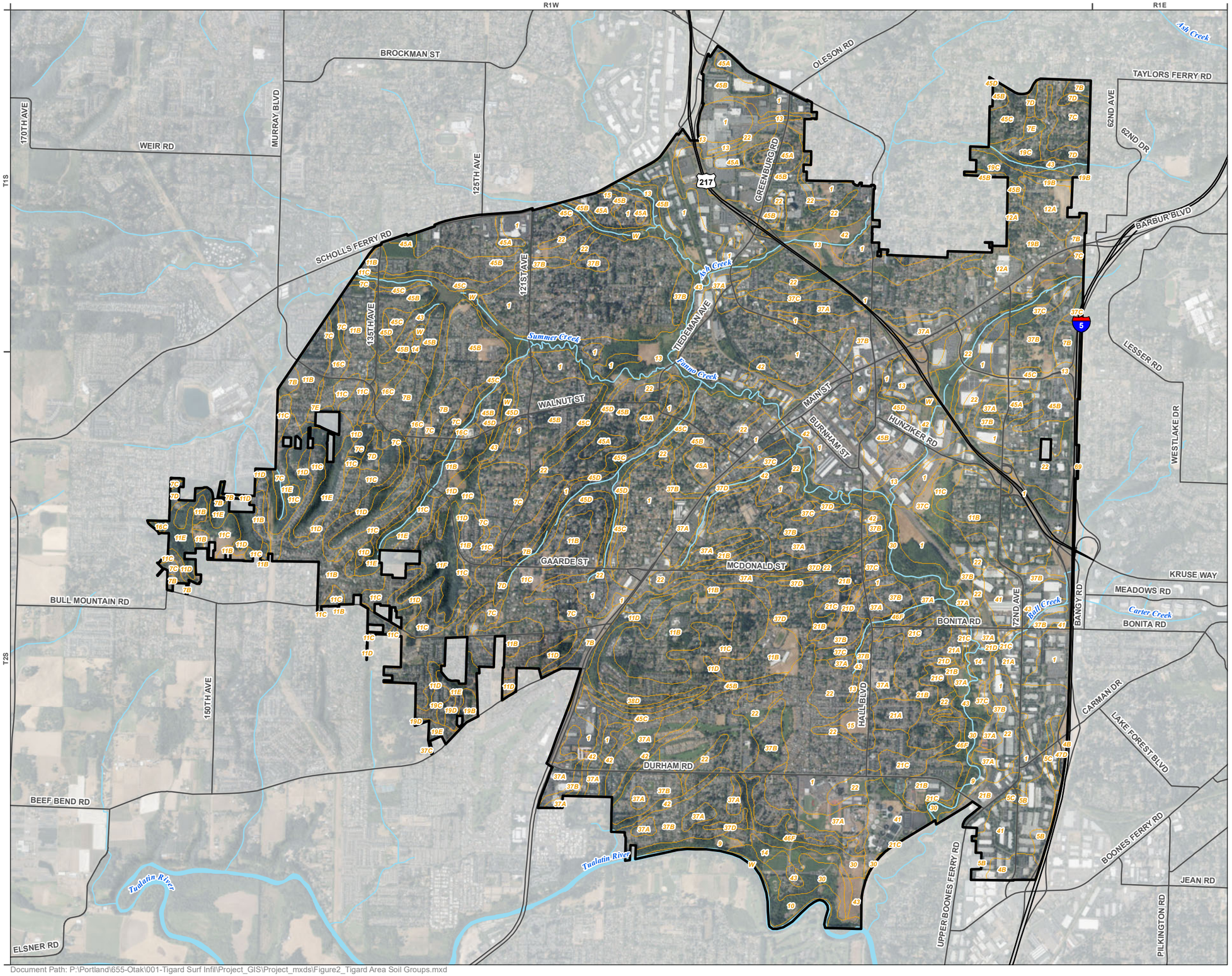


FIGURE 2

Tigard Area Soil Groups

Tigard, Oregon

LEGEND

Soil Type

All Other Features

City of Tigard

Freeway

Major Road

Watercourse

Waterbody

N

0 1,250 2,500 3,750

Feet

Date: July 15, 2016

Data Sources: OWRD, METRO, USGS, NRCS, Air Photo Summer 2015 COP

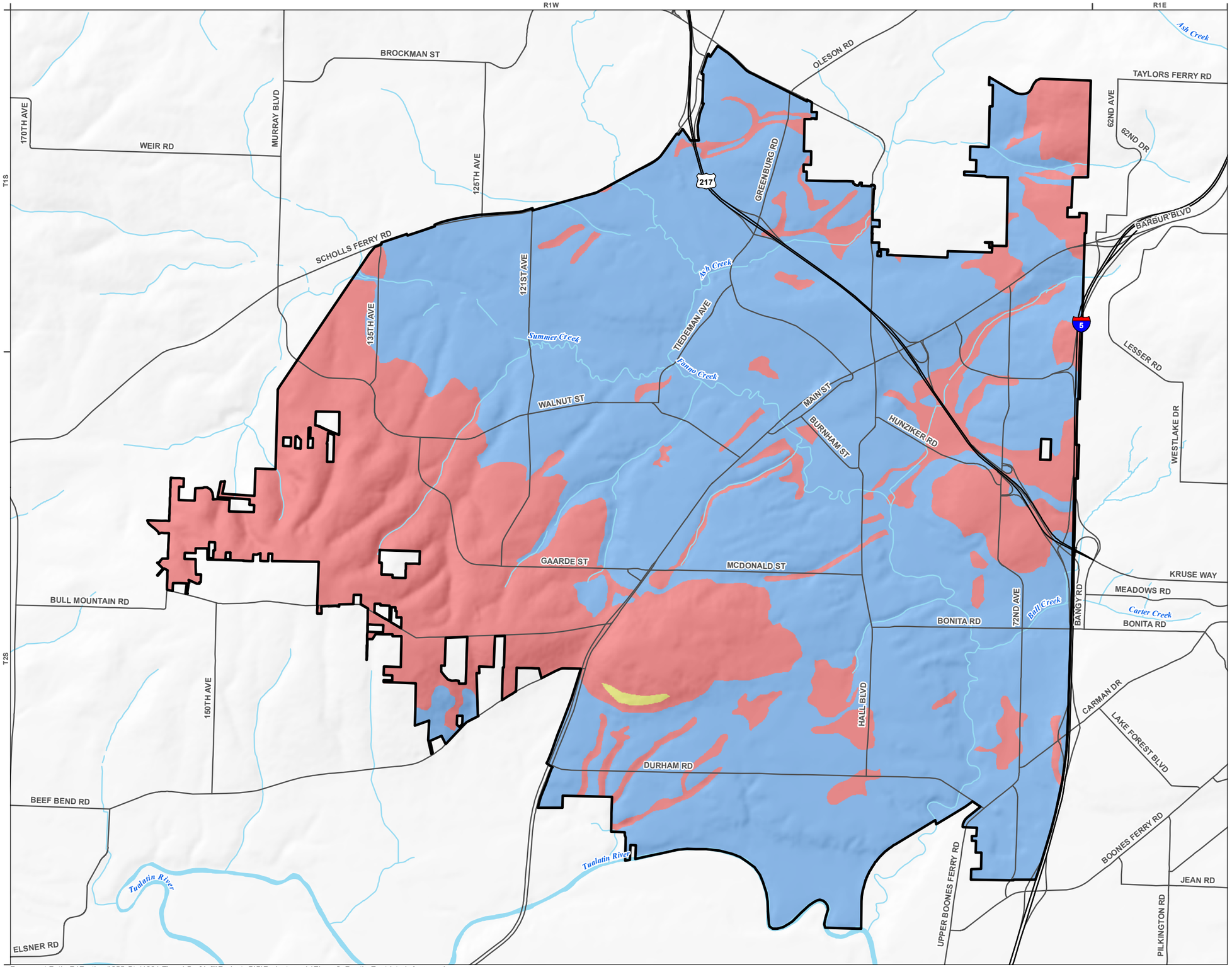
GSI Water Solutions, Inc.

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure2_Tigard Area Soil Groups.mxd

FIGURE 3

Depth to Restrictive Layer

Tigard, Oregon



LEGEND

Depth to Restrictive Layer

- 0 - 100 cm (0 - 3.3 ft)
- 100 - 200 cm (3.3 - 6.5 ft)
- >200 cm (>6.5ft)

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

N

0 1,250 2,500 3,750
Feet

Date: July 15, 2016
Data Sources: OWRD, METRO, USGS, NRCS

GSI Water Solutions, Inc.

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure3_Depth_Restricted_Area.mxd

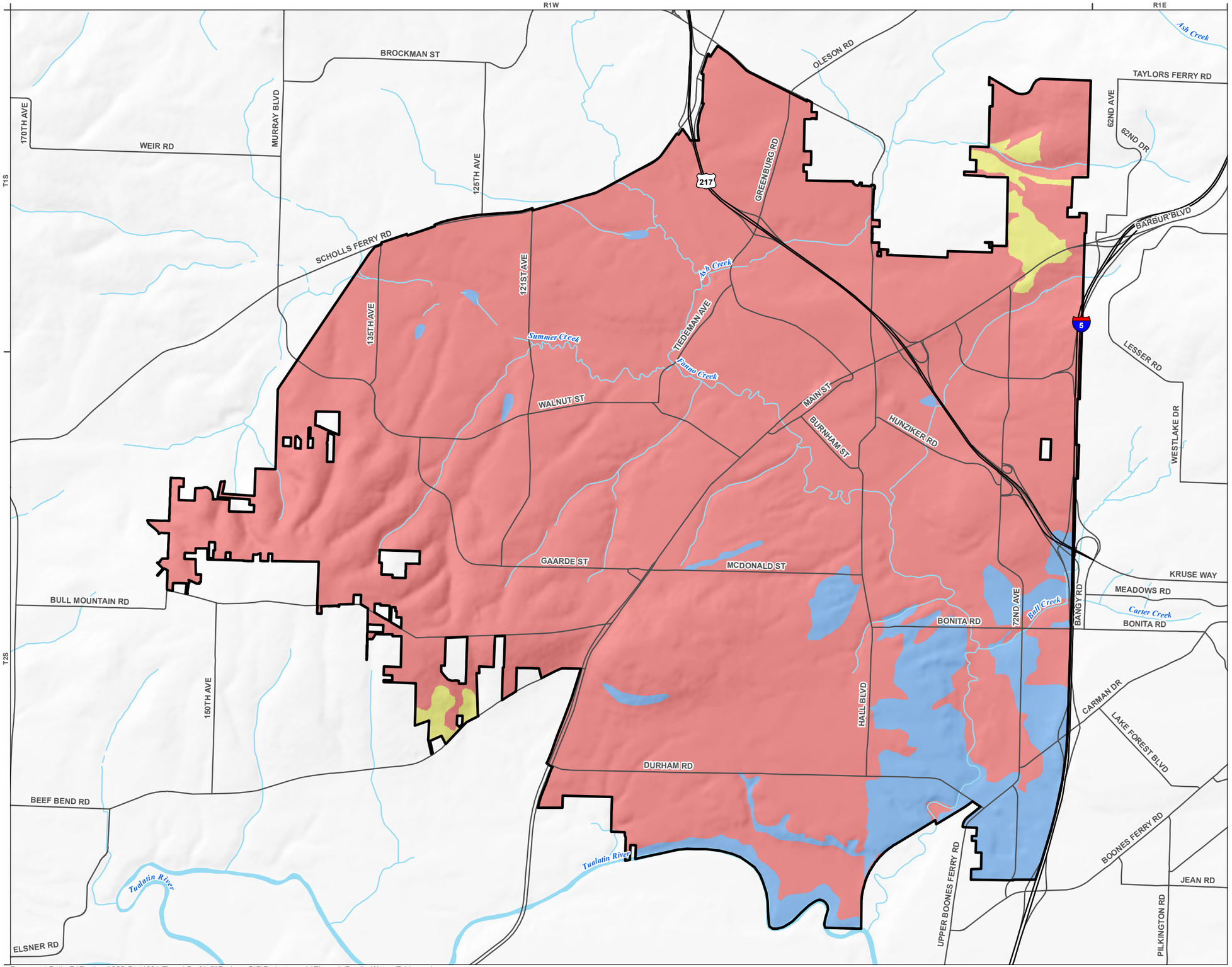


FIGURE 4

Depth to Shallow Water Table

Tigard, Oregon

LEGEND

Depth to Water Table

- 0 - 100 cm (0 - 3.3 ft)
- 100 - 200 cm (3.3 - 6.5 ft)
- >200 cm (>6.5ft)

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

NOTE

"Water table" refers to a saturated zone in the soil. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, redoximorphic features in the soil.

N

0 1,250 2,500 3,750

Feet

Date: July 15, 2016

Data Sources: OWRD, METRO, USGS, NRCS

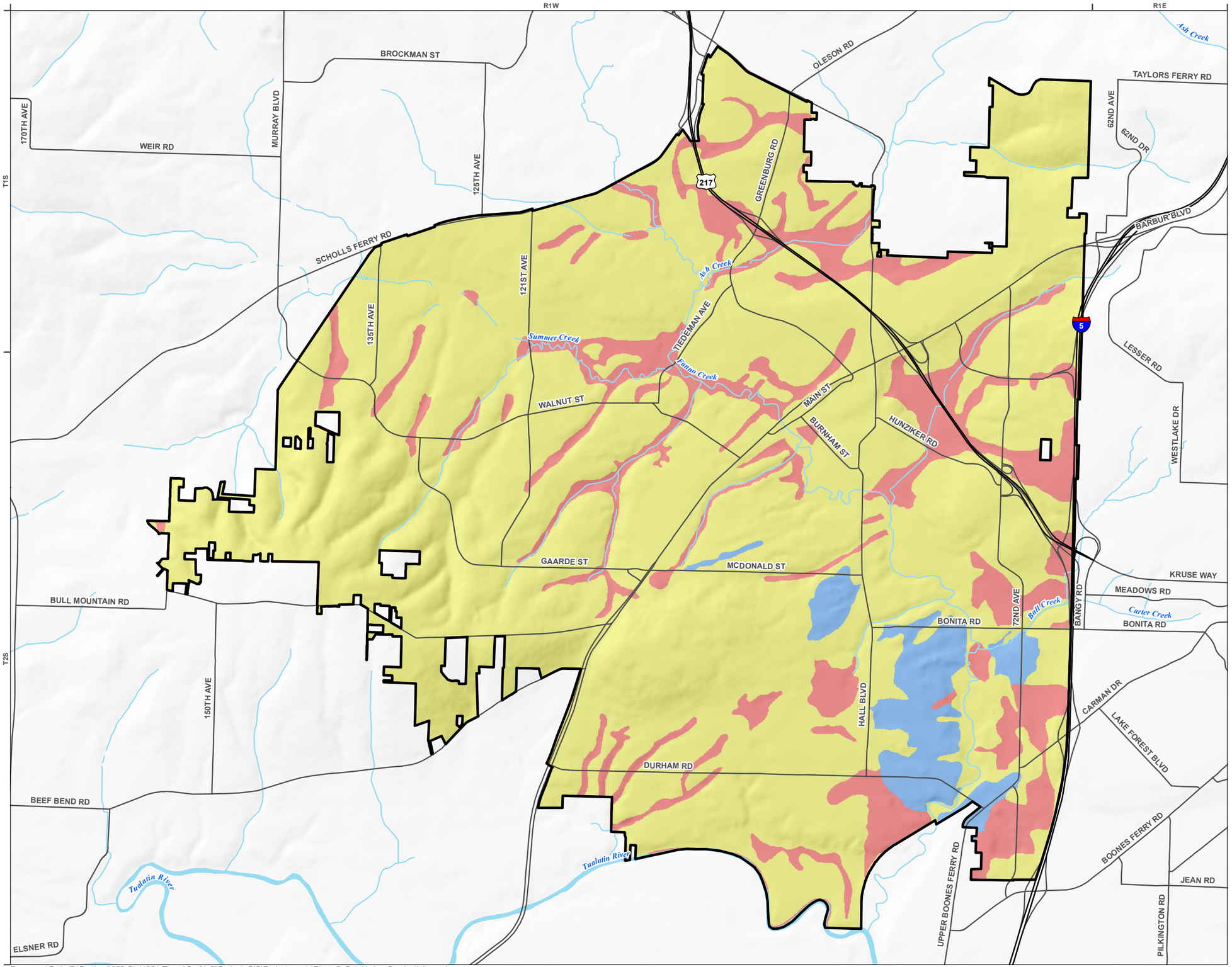
GSI Water Solutions, Inc.

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure4_Depth_Water_Table.mxd

FIGURE 5

Saturated Hydraulic Conductivity

Tigard, Oregon



LEGEND

Ksat Rating, in/hr

- 0 - 0.5
- 0.5 - 2
- >2

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

N

0 1,250 2,500 3,750

Feet

GSI Water Solutions, Inc.

Date: July 15, 2016

Data Sources: OWRD, METRO, USGS, NRCS

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure5_Sat_Hydro_Conductivity.mxd

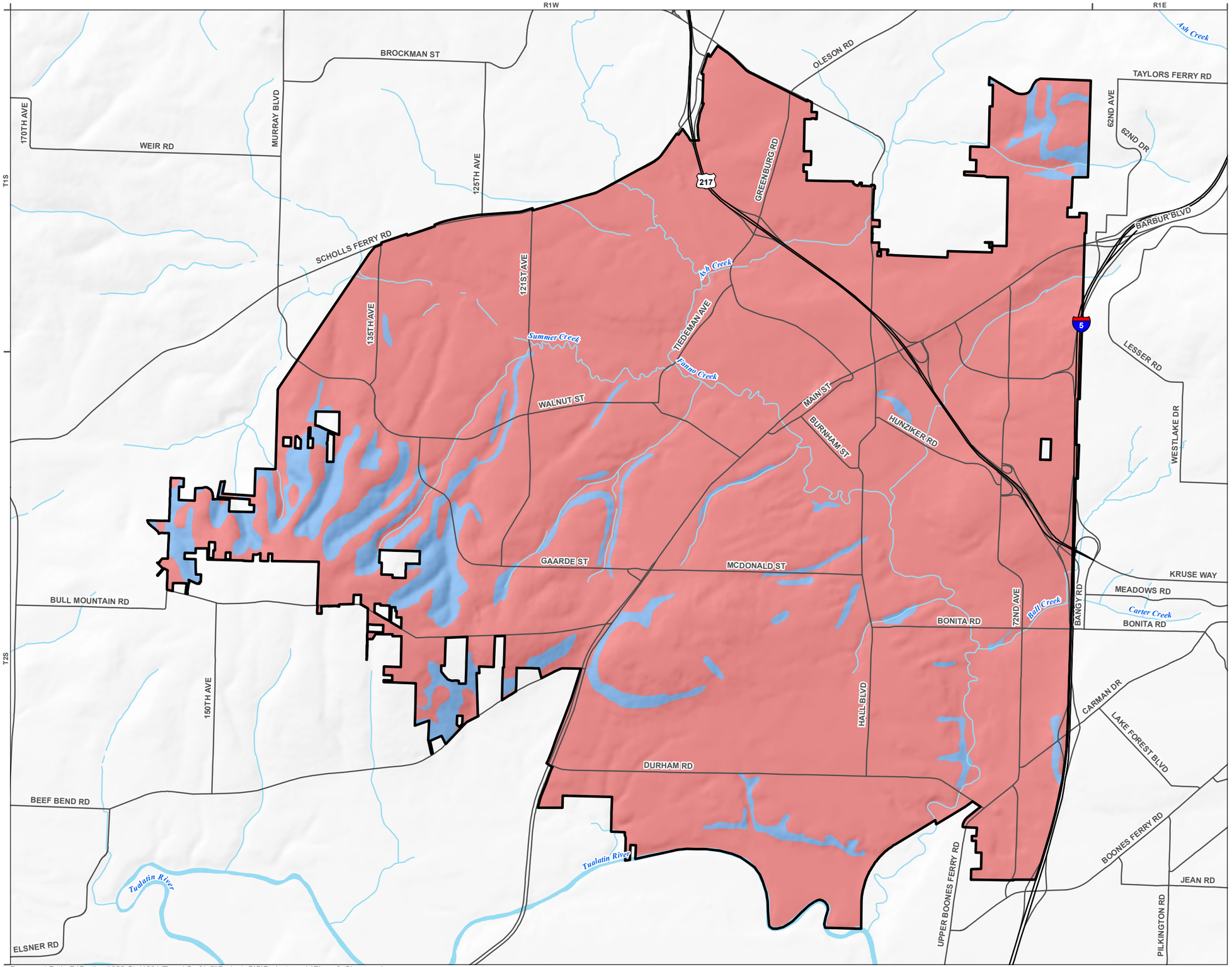


FIGURE 6

Representative Slope

Tigard, Oregon

LEGEND

Slope, %

- 0 - 10
- >10

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

N

0 1,250 2,500 3,750

Feet

GSI Water Solutions, Inc.

Date: July 15, 2016

Data Sources: OWRD, METRO, USGS, NRCS

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure6_Slope.mxd

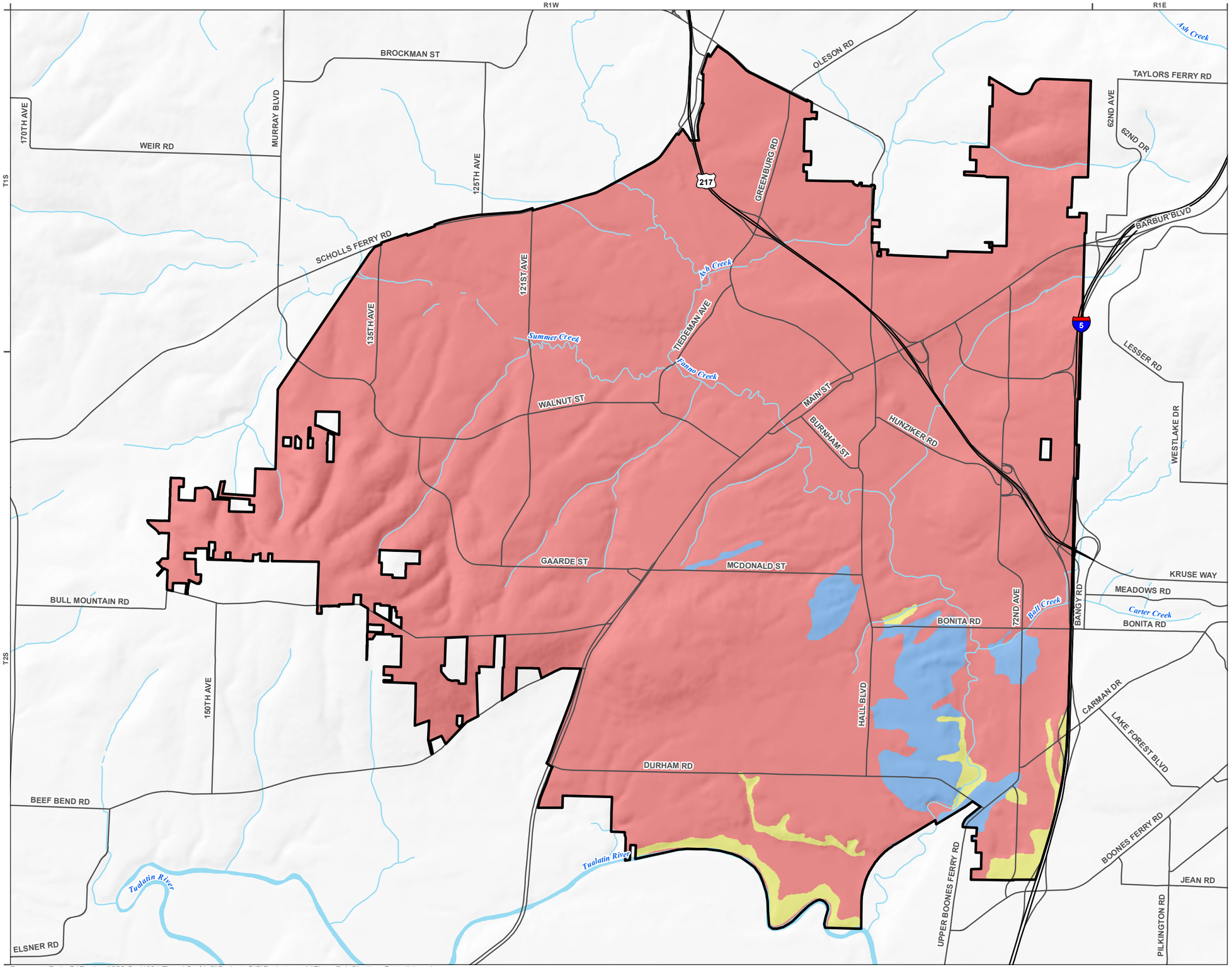


FIGURE 7

Infiltration Potential

Tigard, Oregon

LEGEND

Infiltration Rating

- Poor
- Fair
- Good

All Other Features

- City of Tigard
- Freeway
- Major Road
- Watercourse
- Waterbody

NOTE

Infiltration potential screened by the following criteria:

- Saturated hydraulic conductivity values greater than 2 in/hr being "good", between 0.5 and 2 in/hr "fair", and less than 0.5 in/hr "poor".
- Depth to shallow water table or restrictive layer less the 200 cm were evaluated as "poor".
- Rating downgraded for representative slopes greater than 10%.
- Areas with depth basalt shallower less than 15 feet evaluated as "poor".

N

0 1,250 2,500 3,750

Feet

Date: July 15, 2016

Data Sources: OWRD, METRO, USGS, NRCS

GSI Water Solutions, Inc.

Document Path: P:\Portland\655-Otak\001-Tigard Surf Infil\Project_GIS\Project_mxds\Figure7_Infiltration_Potential.mxd