Application for a State Waste Discharge Permit to Discharge Industrial Wastewater to Ground Water by Land Treatment or Application

DEPARTMENT OF ECOLOGY
State of Washington

This application is for a state waste discharge permit as required by Chapter 90.48 RCW and Chapter 173-216 WAC. Permit applications provide Ecology with information on pollutants in the waste stream, materials that may enter the waste stream, the flow characteristics of the discharge, and the site characteristics at the point of discharge.

Ecology may request additional information to clarify the conditions of this discharge. The applicant should reference information previously submitted to Ecology that applies to this application in the appropriate section.

SECTION A. GENERAL INFORMATION

1. Applicant name: Farmland Reserve, Inc.

2. Facility name: (if different from applicant) River Point Farms Onion Processing Facility

3. Applicant mail address: 79 S Main St., Suite 1100
   Street
   Salt Lake City, UT — 84111
   City/State — Zip

4. Facility location address: (if different from above) Plymouth Commercial Road
   Street
   Plymouth, WA — 99346
   City/State — Zip

5. UBI No. 602-003-452

   Sometimes called a registration, tax, "C," or resale number, the Unified Business Identifier (UBI) number is a nine-digit number used to identify persons engaging in business activities. The number is assigned when a person completes a Master Business Application to register with or obtain a license from state agencies. The Departments of Revenue, Licensing, Employment Security, Labor and Industries, and the Corporations Division of the Secretary of State are among the state agencies participating in the UBI program.

6. Latitude/longitude of the processing facility as decimal degrees (NAD83/WGS84):
   45.944400 / -119.370166

FOR ECOLOGY USE ONLY	Check One	New/Renewal ☐ Modification ☐
Date application received		Application/Permit no.
Date application accepted		Date fee paid

7. Person to contact who is familiar with the information contained in this application:

Gary Ransom	Director Strategy and Analysis
Name	Title
(801) 715-9100	
Telephone number	Fax number

8. Check One:

☐ **Permit renewal** (including renewal of temporary permits authorized by RCW 90.48.200)

Does this application request a greater amount of wastewater discharge, a greater amount of pollutant discharge, or a discharge of different pollutants than specified in the last permit application for this facility? ☐ YES ☐ NO

For permit renewals, the current permit is an attachment, by reference, to this application.

☐ **Permit modification** ☐ **Existing unpermitted discharge** ☒ **Proposed discharge**

Anticipated date of discharge:

June 2021

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and/or imprisonment for knowing violations.

Patrick Tolman	Sep 4, 2020	V.P.
Signature*	Date	Title

Patrick Tolman

Printed name

*Applications must be signed as follows: Corporations, by a principal executive officer of at least the level of vice-president; partnership, by a general partner; sole proprietorship, by the proprietor. If these titles do not apply to your organization, the person who makes budget decisions for this facility must sign the application.

The application signatory may delegate signature authority for submittals required by the permit, such as monthly reports, to a suitable employee. You can delegate this authority to a qualified individual or to a position, which you expect to fill with a qualified individual. If you wish to delegate signature authority, please complete the following:

Kerri Macomber	Sep 4, 2020	Water Systems Engineer
Signature of delegated employee	Date	Title or function at the facility

Kerri Macomber

Printed name

SECTION B. PRODUCT INFORMATION

1. Briefly describe all manufacturing processes and products, and/or commercial activities at this facility. Provide the applicable Standard Industrial Category (SIC) and the North American Industry Classification System (NAICS) Code(s) for each activity (see *North American Industrial Classification System,* 2007 ed.). You can find the 1997 NAICS codes and the corresponding 1987 Standard Industry Category (SIC) codes at (http://www.census.gov/epcd/naics/frames3.htm).

Description: Processing fresh onions. Onions are peeled (outside skin is removed), ends cut off (topped/tailed) then run through a water basin to rinse off surface bacteria. Product can be shipped whole or diced ahead of packaging and shipping to designated customers.

2007 NAICS Code = 311991 (Perishable Prepared Food Manufacturing - Sub heading: Vegetables, cut or peeled, fresh, manufacturing)

2099 SIC Code = 2099 (Food Preparations, Not Elswhere classified - Sub heading: Vegetables peeled for the trade)

2. List raw materials and products:

Type	**RAW MATERIALS** **Quantity**
Potatoes (Example)	*20 million tons per year*
Onions	138 million pounds per year
Type	**PRODUCTS** **Quantity**
French fries (Example)	*10 million pounds per year*
Diced Onions	8 million pounds per year
Whole peeled Onions	82 million pounds per year

SECTION C. PLANT OPERATIONAL CHARACTERISTICS

1. For each process listed in B.1that generates wastewater, list the process, assign the waste stream a name and ID #, and describe whether it is a batch or continuous flow.

Process	Waste Stream Name	Waste Stream ID#	Batch (B) or Continuous (C) Process
Receiving raw potatoes (Example)	*Mud Water*	*1*	*C*
Fresh Cut	Rinse Tank - vegetable rinse water	1	Continuous
Fresh Cut	Cleanup - Equipment	2	Batch

2. On a separate sheet, produce a schematic drawing showing production processes and water flow through the facility and wastewater treatment devices *(label as attachment C2).* The drawing should indicate the source of intake water and the operations contributing wastewater to the effluent and should label the treatment units. Construct the water balance by showing average flows between intakes, operations, treatment units, and points of discharge to land. If a water balance cannot be determined *(e.g., for certain mining activities)*, provide a description of the nature and amount of any sources of water and any collection or treatment measures.

3. What is the highest daily discharge flow from the processing facility: (Specify the time period for the value given) — 71,000 gallons per day

   What is the highest daily discharge flow to the sprayfields/infiltration basin: (Specify the time period for the value given) — inches/acre/month OR 1,107,000 gallons per day

   What is the highest average monthly discharge flow (daily flows averaged over a month) from the processing facility: (Specify the time period for the value given) — 61,839 gallons/day?

   What is the highest average monthly discharge flow to the sprayfields: (Specify the time period for the value given) — 1.52 inches/acre/month OR gallons per day

4. Describe any planned wastewater treatment or sprayfield/infiltration improvements and the schedule for the improvements or changes. *(Use additional sheets, if necessary and label as attachment C4.)*

   New system not yet constructed. The wastewater from the new system will flow from floor gutter drains into a pretreatment screen then into one 7.5 million gallon storage pond before being land applied for treatment.

5. If production processes are subject to seasonal variations, provide the following information. List discharge for each wastestream in gallons or million gallons per month. The combined value for each month should equal the estimated total monthly flow. Please indicate the proper unit by checking one of the following boxes:

☐ gallons per day ☐ gallons per month ☒ million gallons per month

Waste Stream ID#	MONTHS											
	J	F	M	A	M	J	J	A	S	O	N	D
#1 (Example)	*1000*	*1000*	*1000*	*1000*	*6000*	*2000*	*2000*	*2000*	*1000*	*1000*	*5000*	*4000*
1 and 2	1.85	1.7	1.92	1.85	1.85	1.85	1.85	1.92	1.85	1.85	1.85	1.92
Estimated total gallons												

6. If this is a discharge from the processing facility to a storage or evaporative lagoon, what is the size of the lagoon (give square footage for the bottom of the lagoon and the total volume of the lagoon at full operating depth). *10,000 square feet; 10 million gallons (Example)*

39,877 square feet; 7.5 million gallons

7. Check the applicable box. Is this is a discharge to a sprayfield ☒ or an infiltration bed ☐? Provide the average gallons per acre per day proposed for each month in the following table.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept.	Oct	Nov	Dec
Estimated gallons per acre per day	0	0	1,334	345	334	334	345	346	345	334	334	0

8. How many hours a day does this facility typically operate? 16

How many days a week does this facility typically operate? 6

How many weeks per year does this facility typically operate? 52

9. List all incidental materials such as oil, paint, grease, solvents, and cleaners that are used or stored on site (list only those with quantities greater than 10 gallons for liquids and 50 pound quantities for solids). For solvents and solvent-based cleaners, include a copy of the material safety data sheet for each material and estimate the quantity used. *Use additional sheets, if necessary and label as attachment C.7.)*

Materials/Quantity Stored:

ChlorClean
Sterile Clean
BHS SD10 (D-Foamer)
Pro Quat 5
Bioside HS 15%
Alpet E3 Plus Liquid and Wipes
Phos Clean Plus
Alpet D2
Sterilex Ultra Step
PAA Acid Test Reagents 1-5
Buffer PH 4-PH10
Toluidine Blue 0
QAC DT
Sulfuric Acid 0.5N
Complexing Reagent
Phenophthalein Indicator
Primo Food Garde Equipment Lube
Safety-Kleen Solvent
Aero Care M80

Stored amounts are yet to be determined, since this is a new facility

			Yes	No
10.	Some types of facilities are required to have spill or waste control plans. Does this facility have:		Yes	No
	a.	A spill prevention, control, and countermeasure plan (40 CFR 112)?	☐	☒
	b.	An Oil Spill Contingency Plan (chapter 173-182 WAC)?	☐	☒
	c.	An emergency response plan (per WAC 173-303-350)?	☐	☒
	d.	A runoff, spillage, or leak control plan (per WAC 173-216-110(f))?	☐	☒
	e.	Any spill or pollution prevention plan required by local, state or federal authorities? If yes specify: _____	☐	☒
	f.	A solid waste control plan?	☐	☒

SECTION D. WATER CONSUMPTION AND WATER LOSS

1. Potable water source(s):

   ☐ Public system (Specify name) _____

   ☒ Private well ☒ Surface water (Specify name of water body) Columbia River

   a. Water right permit number: Application Number

   b. Legal description of water source:

      NE ¼S, NW ¼S, 12 , Section, 5N TWN, 27E R

2. Potable water use

   a. Indicate total water use: Gallons per day (average) 84,560

      Gallons per day (maximum) 84,560

   b. Is water metered? ☐ YES ☒ NO

3. Supplemental Irrigation water source(s):

   ☐ Public system or Irrigation District (Specify name) _____

   ☐ Private well ☒ Surface water (Specify name of water body) Columbia River

   a. Water right permit number: S$ - 13134(A)C

   b. Legal description of water source:

      NW ¼S, NW ¼S, 15 , Section, 5N TWN, 27E R

This page purposely left blank

SECTION E. WASTEWATER INFORMATION

1. How are the water intake and effluent flows measured?

   Intake: Estimated from the equipment design water use requirements

   Effluent It will be metered at each field at the land treatment site

2. Describe the collection method for the samples analyzed below. (*i.e.*, grab, 24-hour composite). Applicants must collect grab samples (not composites) for analysis of pH, temperature, cyanide, total phenols, residual chlorine, oil and grease, fecal coliform (including E. coli), and Enterococci (previously known as fecal streptococcus at § 122.26 (d)(2)(iii)(A)(3)),or volatile organics.

   Grab

3. Has the effluent been analyzed for any other parameters than those identified in question E.4.? ☐ YES ☒ NO
   If yes, attach results and label as attachment E.4. This data must clearly show the date, method and location of sampling. *(Note: Ecology may require additional testing.)*

4. Provide measurements or range of measurements for treated wastewater prior to discharge to the POTW for the parameters with an "X" in the left column. If you obtain the application from the internet, contact Ecology's regional office to see if testing for a subset of these parameters is permissible. All analyses (except pH) must be conducted by a laboratory registered or accredited by Ecology (WAC 173-216-125). If this is an application for permit renewal, provide data for the last year for those parameters that are routinely measured. For parameters measured only for this application, place the values under "Maximum." Report the values with units as specified in the parameter name or in the detection level.

   The Permittee must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table unless Ecology approves an alternate method or the method used produces measurable results in the sample and EPA has listed it as an EPA approved method in 40 CFR Part 136. If the Permittee uses an alternative method as allowed above, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

X	Parameter	Measurement Values Minimum	Maximum	Average	Number of Analyses	Analytical Method Std. Methods 19th,20th edition or EPA	Detection Limit/Quantitation Level
X	BOD (5 day)	840	4,936	2,303	12	SM 5210 B	/2 mg/l
X	COD	840	8,410	3,924	12	SM 5220 D	/10 mg/l
X	Total suspended solids	26	26	26	1	SM 2540 D	/5 mg/l
X	Fixed Dissolved Solids	490	980	648	11	SM 2540 E	
X	Total dissolved solids	2,392	5,000	2,392	12	SM 2540 C	
X	Conductivity (micromhos/cm)	933	1,622	1,300	11	SM 2510 B	
X	Ammonia-N as N	1	20	10	12	SM 4500-NH_3 C	/0.3 mg/L
X	pH	4.4	7.6	5.1	11	SM 4500-H	0.1 standard units
	Fecal coliform (organisms/100 mL)					SM 9221 E or 9222 D	
	Total coliform (organisms/100 mL)					SM 9221 B or 9222 B	
	Dissolved oxygen					SM 4500-O C/G	
X	Nitrate + nitrite-N as N	14	33	24	12	SM 4500-NO_3 E	100 µg/L
X	Total kjeldahl N as N	18	118	58	12	SM 4500-N_{org} C/E/FG	300 µg/l
	Ortho-phosphate-P as P					SM 4500-P E/F	10 µg/l
	Total-phosphorous-P as P					SM 4500-P E/P/F	10 µg/l
	Total Oil & grease					EPA 1664A	1.4/5 mg/l
	NWTPH - Dx					Ecology NWTPH Dx	250/250 µg/l
	NWTPH - Gx					Ecology NWTPH Gx	250/250 µg/l
	Calcium					EPA 200.7	10 µg/l
	Chloride					SM 4500-Cl C	0.15 µg/l
	Fluoride					SM 4500-F E	.025/0.1 mg/l
	Magnesium					EPA 200.7	10/50 µg/l
	Potassium					EPA 200.7	700/ µg/l

X	Parameter	Measurement Values Minimum	Maximum	Average	Number of Analyses	Analytical Method Std. Methods 19th,20th edition or EPA	Detection Limit/Quantitation Level
	Sodium					EPA 200.7	29/ µg/l
	Sulfate					SM 4500-SO_4 C/D	/200 µg/l
	Alkalinity as $CaCO_3$					SM 2320 B	/5 mg/L as $CaCO_3$
	Arsenic(total)					EPA 200.8	0.1/0.5 µg/l
	Barium (total)					EPA 200.8	0.5/2 µg/l
	Cadmium (total)					EPA 200.8	.05/.25 µg/l
	Chromium (total)					EPA 200.8	0.2/1 µg/l
	Copper (total)					EPA 200.8	0.4/2 µg/l
	Iron (total)					EPA 200.7	12.5/50 µg/l
	Lead (total)					EPA 200.8	0.1/.5 µg/l
	Manganese (total)					EPA 200.8	0.1/0.5 µg/l
	Mercury (total) pg/L					EPA 1631E	0.2/0.5 pg/l
	Molybdenum(total)					EPA 200.8	0.1/0.5 µg/l
	Nickel(total)					EPA 200.8	0.1/0.5 µg/l
	Selenium (total)					EPA 200.8	1/1 µg/l
	Silver (total)					EPA 200.8	.04/.2 µg/l
	Zinc (total)					EPA 200.8	0.5/2.5 µg/l

Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.

Quantitation Level (QL) also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer. (64 FR 30417).
ALSO GIVEN AS:
The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency December 2007).

This page purposely left blank

5. Does this facility use any of the following chemicals as raw materials in production, produce them as part of the manufacturing process, or are they present in the wastewater? (*The number following the chemical name is the Chemical Abstract Service (CAS) reference number to aid in identifying the compound.*) ☐ YES ☒ NO

If yes, specify how the chemical is used and the quantity used or produced *(Use additional sheets, if necessary and label as attachment E5.)*:

Acrylamide/79-06-1
Acrylonitrile/107-13-1
Aldrin/309-00-2
Aniline/62-53-3
Aramite/140-57-8
Arsenic/7440-38-2
Azobenzene/103-33-3
Benzene/71-43-2
Benzidine/92-87-5
Benzo(a)pyrene/50-32-8
Benzotrichloride/98-07-7
Benzyl chloride/100-44-7
Bis(chloroethyl)ether/111-44-4
Bis(chloromethyl)ether/542-88-1
Bis(2-ethylhexyl) phthalate/ 117-81-7
Bromodichloromethane/75-27-4
Bromoform/75-25-2
Carbazole/86-74-8
Carbon tetrachloride/56-23-5
Chlordane/57-74-9
Chlorodibromomethane/124-48-1
Chloroform/67-66-3
Chlorthalonil/1897-45-6
2,4-D/94-75-7
DDT/50-29-3
Diallate/2303-16-4
1,2 Dibromoethane/106-93-4
1,4 Dichlorobenzene/106-46-7
3,3' Dichlorobenzidine/91-94-1
1,1 Dichloroethane/75-34-3
1,2 Dichloroethane/107-06-2
Nitrofurazone/59-87-0
N-nitrosodiethanolamine/ 1116-54-7
N-nitrosodiethylamine/55-18-5
N-nitrosodimethylamine/62-75-9
N-nitrosodiphenylamine/86-30-6
N-nitroso-di-n-propylamine/ 621-64-7
N-nitrosopyrrolidine/930-55-2
N-nitroso-di-n-butylamine/ 924-16-3
N-nitroso-n-methylethylamine/ 10595-95-6
PAH/NA
PBBs/NA
PCBs/1336-36-3
1,2 Dichloropropane/78-87-5
1,3 Dichloropropene/542-75-6
Dichlorvos/62-73-7
Dieldrin/60-57-1
3,3' Dimethoxybenzidine/119-90-4
3,3 Dimethylbenzidine/119-93-7
1,2 Dimethylhydrazine/540-73-8
2,4 Dinitrotoluene/121-14-2
2,6 Dinitrotoluene/606-20-2
1,4 Dioxane/123-91-1
1,2 Diphenylhydrazine/122-66-7
Endrin/72-20-8
Epichlorohydrin/106-89-8
Ethyl acrylate/140-88-5
Ethylene dibromide/106-93-4
Ethylene thioureae/96-45-7
Folpet/133-07-3
Furmecyclox/60568-05-0
Heptachlor/76-44-8
Heptachlor epoxide/1024-57-3
Hexachlorobenzene/118-74-1
Hexachlorocyclohexane (alpha)/ 319-84-6
Hexachlorocyclohexane (tech.)/ 608-73-1
Hexachlorodibenzo-p-dioxin, mix/19408-74-3
Hydrazine/hydrazine sulfate/ 302-01-2
Lindane/58-89-9
2 Methylaniline/100-61-8
2 Methylaniline hydrochloride/ 636-21-5
4,4' Methylene bis(N,N- dimethyl)aniline/101-61-1
Methylene chloride (dichloromethane)/75-09-2
Mirex/2385-85-5
O-phenylenediamine/106-50-3
Propylene oxide/75-56-9
2,3,7,8-Tetrachlorodibenzo-p-dioxin/ 1746-01-6
Tetrachloroethylene/127-18-4
2,4 Toluenediamine/95-80-7
o-Toluidine/95-53-4
Toxaphene/8001-35-2
Trichloroethylene/79-01-6
2,4,6-Trichlorophenol/88-06-2
Trimethyl phosphate/512-56-1
Vinyl chloride/75-01-4

6. Are any other pesticides, herbicides, or fungicides used at this facility? ☐ YES ☒ NO

   If yes, specify the material and quantity used.

7. Are there other pollutants that you know of or believe to be present? ☐ YES ☒ NO

   If yes, specify the pollutants and their concentration if known (attach laboratory analyses if available). ☐ DON'T KNOW

SECTION F. GROUND WATER INFORMATION

Provide available data measurements or range of measurements from monitoring wells or supply wells in the area of discharge. Provide the analytical method and detection limit, if known. Provide the location of each well on the map required in G.3 below. Attach well logs when available. Copy this page as necessary for each well. Provide the latitude and longitude in decimal format.

Ecology Well Tag ID # _____ *(exampleAAB123)* Well ID # _______ *(example MW-1)*

Latitude: _____ Longitude: _____

Well Elevation (to the nearest 0.01 feet) _____ Check the appropriate box; the elevation measurement is relative to: the NAVD88 standard ☐ mean sea level ☐

Parameter	Units	Range of Measurements	Number of Analyses	Analytical Method	Detection Limit
BOD (5 day)	mg/L				
COD	mg/L				
Total organic carbon	mg/L				
Total dissolved solids	mg/L				
Dissolved Fixed Solids	mg/L				
pH	Standard units				
Conductivity	(micromhos/cm)				
Alkalinity	mg/L as $CaCO_3$				
Total hardness	mg/L				
Fecal coliform	organisms/100mL				
Total coliform	organisms/100mL				
Dissolved oxygen	mg/L				
Ammonia-N	mg/L				
Nitrate + nitrite-N, nitrate as N	mg/L				
Total kjeldahl N as N	mg/L				
Ortho-phosphate-P as P	mg/L				
Total-phosphate-P as P	mg/L				
Total Oil and Grease	mg/L				
Total petroleum hydrocarbon	☐mg/L ☐ µg/l				
Calcium	☐mg/L ☐ µg/l				
Chloride	☐mg/L ☐ µg/l				
Fluoride	☐mg/L ☐ µg/l				
Magnesium	☐mg/L ☐ µg/l				
Potassium	☐mg/L ☐ µg/l				
Sodium	☐mg/L ☐ µg/l				
Sulfate	☐mg/L ☐ µg/l				
Barium	☐mg/L ☐ µg/l				
Cadmium	☐mg/L ☐ µg/l				
Chromium	☐mg/L ☐ µg/l				
Copper	☐mg/L ☐ µg/l				
Iron	☐mg/L ☐ µg/l				
Lead	☐mg/L ☐ µg/l				
Manganese	☐mg/L ☐ µg/l				

Groundwater quality data is not readily available for the area.

Parameter	Units	Range of Measurements	Number of Analyses	Analytical Method	Detection Limit
Mercury	☐mg/L ☐ µg/l				
Selenium	☐mg/L ☐ µg/l				
Silver	☐mg/L ☐ µg/l				
Zinc	☐mg/L ☐ µg/l				
Depth to water level (to the nearest .01 feet)					

SECTION G. SITE ASSESSMENT

The local library and local city or county planning offices may be helpful in providing the information required in this section. You may consult the Department of Ecology Water Resources Program to help identify wells within one mile of your site.

1. Land Application Sites: Provide the information below for each land application site. Provide the latitude/longitude (approximate center of the site; NAD83/WGS84 reference datum.) Attach a copy of the contract(s) authorizing use of any private land(s) used for each treatment site. Add table rows as necessary.

Legal Description (section/township/range) Field 124 (T5N R27E Sections 2 and 3)			
Latitude	Longitude	Acreage	Owner
45.940435	-119.413895	44 acres	Farmland Reserve, Inc.
Legal Description (section/township/range) Field 125 (T5N R27E Section 2)			
Latitude	Longitude	Acreage	Owner
45.940472	-119.407636	44 acres	Farmland Reserve, Inc.
Legal Description (section/township/range) Field 138 (T5N R27E Section 11)			
Latitude	Longitude	Acreage	Owner
45.935013	-119.400491	117 acres	Farmland Reserve, Inc.
Legal Description (section/township/range)			
Latitude	Longitude	Acreage	Owner

2. If this is a new discharge, list all environmental control permits or approvals needed for this project; for example, SEPA review, engineering reports, hydrogeologic reports, , , or air emissions permits.

   SEPA review, engineering report including hydrogeologic information, engineering plans and specifications, operation and maintenance manual.

3. Attach an original United States Geological Survey (USGS) 7.5 minute topographic map and aerial photograph(s) from an internet mapping site that shows the processing facility and sprayfield site(s). **USGS topographical maps are available from the Department of Natural Resources (360 902-1234), Metsker Maps (206 588-5222), some local bookstores, and internet sites.** Show the following on this map: Figures G.3-1, G.3-2, G.3-3

   a. Location and name of internal and adjacent streets.
   b. Surface water drainage systems within ¼ mile of the site.
   c. All wells within 1 mile of the site.
   d. Wastewater discharge points.
   e. Land uses and zoning adjacent to the wastewater application site.
   f. Groundwater gradient.

4. Describe the soils on the site using information from local soil survey reports. **Soils information is available from your local County Conservation District or from information contained in the sites hydrogeologic report**. *(Submit on separate sheet and label as attachment G.4.)*

5. Describe the local geology and hydrogeology within one mile of the site. Include any groundwater quality data. **The local library or local Soil Conservation Service may have this information**. *(Submit on separate sheet and label as attachment G.5.)*

6. List the names and addresses of contractors or consultants who provided information and cite sources of information by title and author.

   Consultant:

   Cascade Earth Sciences

   12725 E Nora Avenue, Suite A

   Spokane Valley, Washington

   Sources: As described in Figures G.3-1, G.3-2, G.3-3 and attachments G.4 and G.5

SECTION H. STORMWATER

1. Do you have coverage under the Washington State Industrial Stormwater NPDES General permit? ☐ YES ☒ NO
   If yes, please list the permit number here. _____

   If no, have you applied for coverage under the Washington State Industrial Stormwater NPDES general permit? ☐ YES ☒ NO

Note: If you answered "no" to both questions above, complete the following questions 2 through 8.

2. Describe the size of the stormwater collection area.
   a. Unpaved area 185,667 sq.ft.
   b. Paved area 102,465 sq.ft.
   c. Other collection areas (roofs) 42,533 sq.ft.

3. Does your facility's stormwater discharge to: *(Check all that apply)*
   - ☐ Storm sewer system; name of storm sewer system *(operator):*
   - ☐ Sanitary sewer
   - ☐ Directly to surface waters of Washington State *(e.g., river, lake, creek, estuary, ocean).*
     Specify waterbody name _____
   - ☐ Indirectly to surface waters of Washington State *(i.e., flows over adjacent properties first).*
   - ☒ Directly to ground waters of Washington State via:
     - ☒ Dry well
     - ☒ Drainfield
     - ☐ Other

4. Areas with industrial activities at facility: *(check all that apply)*
   - ☒ Manufacturing building
   - ☐ Material handling
   - ☐ Material storage
   - ☐ Hazardous waste treatment, storage, or disposal *(refers to RCRA, Subtitle C facilities only)*
   - ☐ Waste treatment, storage, or disposal
   - ☒ Application or disposal of wastewaters
   - ☐ Storage and maintenance of material handling equipment
   - ☐ Vehicle maintenance
   - ☐ Areas where significant materials remain
   - ☐ Access roads and rail lines for shipping and receiving
   - ☐ Other _____

5. Material handling/management practices

   a. Types of materials handled and/or stored outdoors: *(check all that apply)*

☐ Solvents	☐ Hazardous wastes
☐ Scrap metal	☐ Acids or alkalies
☐ Petroleum or petrochemical products	☐ Paints/coatings
☐ Plating products	☐ Woodtreating products
☐ Pesticides	☐ Other *(please list)*: _____

   b. Identify existing management practices employed to reduce pollutants in industrial storm water discharges: *(check all that apply)*

☐ Oil/water separator	☐ Detention facilities
☐ Containment	☐ Infiltration basins
☐ Spill prevention	☐ Operational BMPs
☐ Surface leachate collection	☐ Vegetation management
☐ Overhead coverage	☐ Other *(please list)*: _____

6. Attach a map showing stormwater drainage/collection areas, disposal areas and discharge points. This may be a hand drawn map if no other site map is available. Label this as attachment H.8.

SECTION I. OTHER INFORMATION

1. Describe liquid or solid wastes generated that are not disposed of in the waste stream(s) and describe the method of disposal. For each type of waste, provide type of waste, name, address, and phone number of hauler.

   Solid waste will not be applied to the land treatment site. General industrial and municipal solid waste (e.g., general refuse, metal, paper, wood, plastics, etc.) will be recycled, depending on local recycling market capability, or transported and disposed of in a permitted waste disposal facility.

   Solid organic waste (i.e., soil, peels, tops and bottoms of onions, and organic debris) from process operations and removed from the filtration screens will be loaded into trucks within the waste receiving area and delivered to an offsite location for use as livestock feed. The specific hauler will be determined at a later date.

2. Describe any storage areas used for raw materials, products, and wastes.

   Raw product will be received and stored in an approximate 3,000 square foot indoor storage area located on the eastern side of the processing facility. Onion product will be stored in an approximate 7,200 square foot finished goods cooler located in the western side of the processing facility. Solid organic wastes from onion processing operations will be stored in containers located in an approximate 2,200 square feet storage area on the eastern side of the processing faciliy.

Summary of attachments that may be required for this application:
(Please check those attachments that are included)

- ☒ C.2. Production schematic flow diagram and water balance
- ☐ C.4. Wastewater treatment improvements
- ☐ C.7. Additional incidental materials
- ☐ E.4. Additional results of effluent testing
- ☐ G.1. Copies of land use contracts
- ☒ G.3. USGS topographical map
- ☒ G.4. Soils description
- ☒ G.5. Local geology and hydrology
- ☒ H.8. Stormwater drainage map

If you need this document in a format for the visually impaired, call the Water Quality Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

ATTACHMENTS

Attachment C.2.

Process Flow Diagram

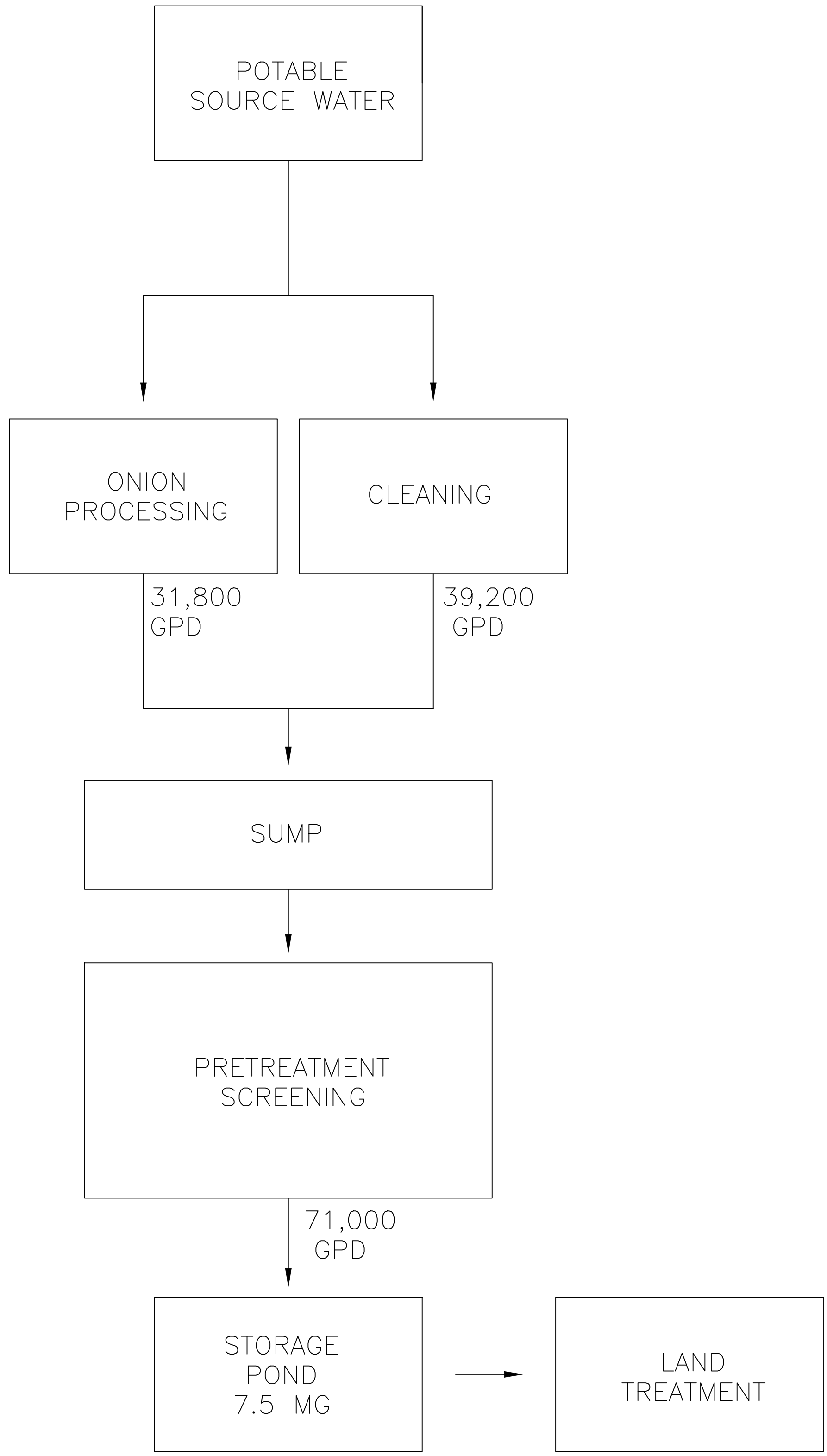


Figure C.2 Process Flow Diagram

EXPLANATION

GPD GALLONS PER DAY
MG MILLION GALLONS

PROJECT NUMBER: 2019210039
DATE: 8/17/2020
DWG NO: 2019210039 C.2.DWG
DWG BY: 6DJR
PROJECT MANAGER: 6SVR
REVISED:

River Point Farms
Land Treatment System Permit Application

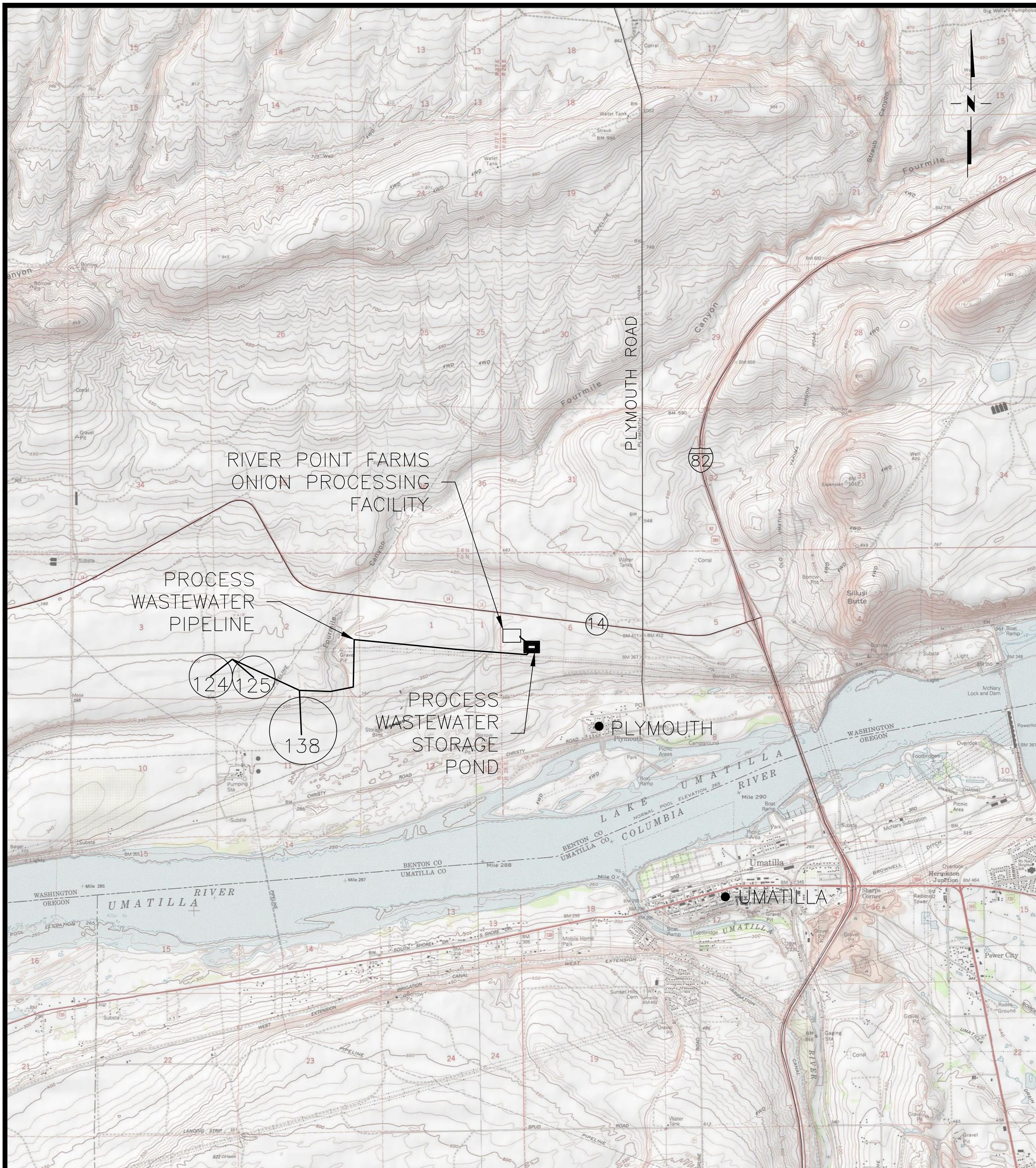
AgReserves
Plymouth, Washington

CES CASCADE EARTH SCIENCES

Attachment G.3.

USGS Topographical Maps

G.3-1. Vicinity Map
G.3-2. Water Wells within 1-Mile of the Site
G.3-3. Land Uses and Zoning



EXPLANATION:

(124) PROCESS WASTEWATER LAND TREATMENT FIELDS

0 5,000'

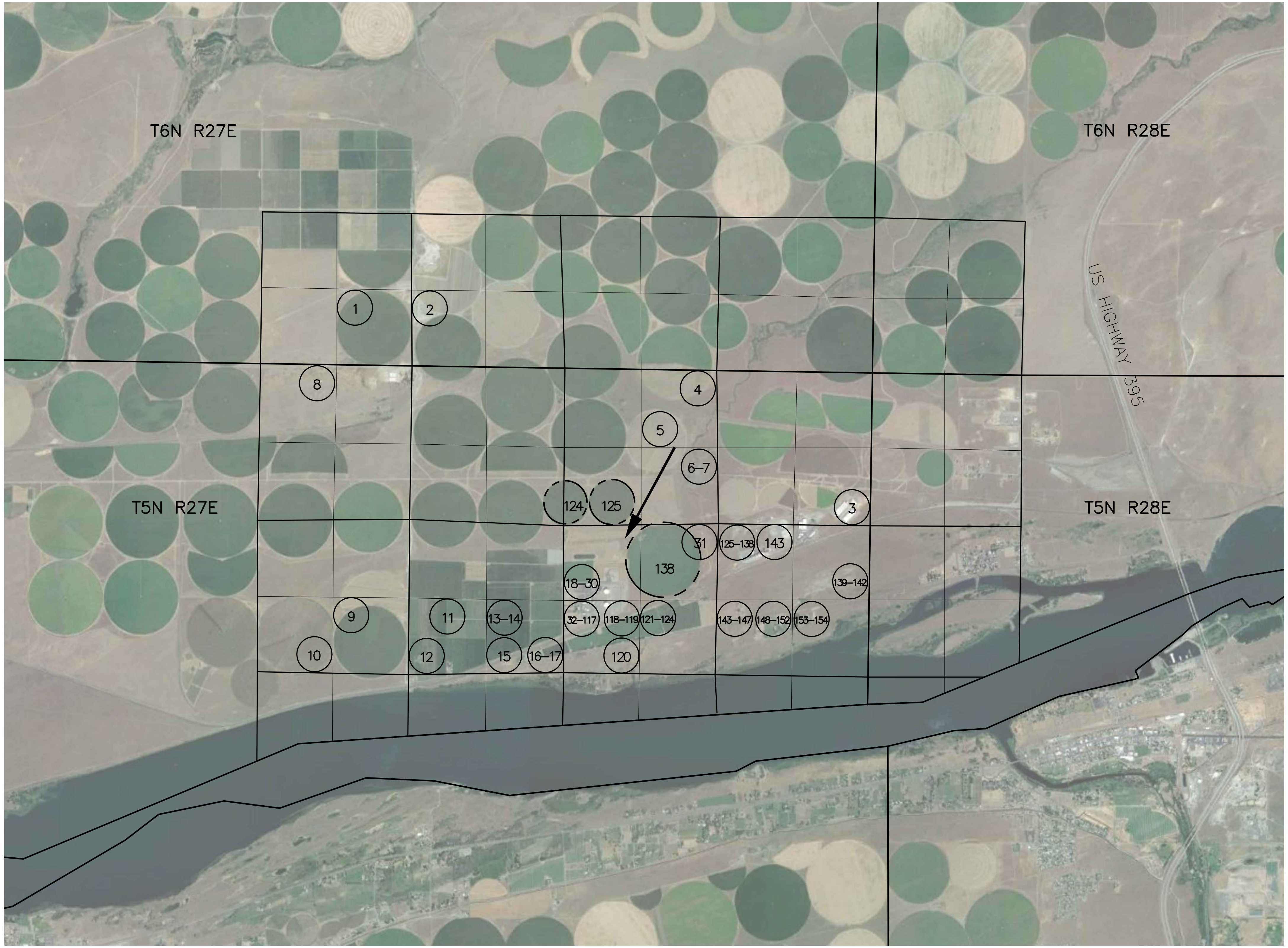
1"=5,000'

(SCALE AND LOCATION ARE APPROXIMATE)

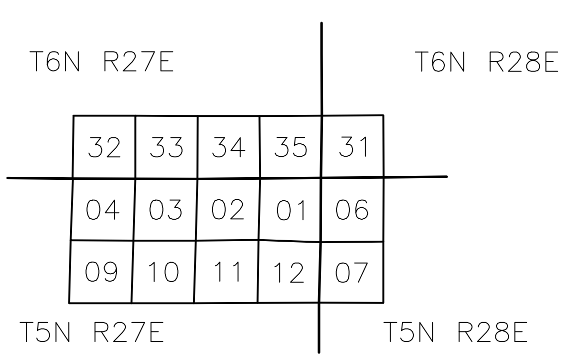
Figure G.3–1. Vicinity Map

PROJECT NUMBER: 2019210039	River Point Farms Land Treatment System Permit Application
DATE: 6/17/2020	
DWG NO: 2019210039 G.3-1.DWG	AgReserves Plymouth, Washington
DWG BY: 6DJR / PROJECT MANAGER: 6SVR	
REVISED:	CES CASCADE EARTH SCIENCES

S:\[Working Drafting]\2019210039 AgReserves\DWG\Permit Application\2019210039 G.3-1.dwg July 13, 2020 NG711452



SECTION KEY:



EXPLANATION:

(59) Well Location Identification Quarter Quarter of Section

(125) Process Wastewater Land Treatment Fields

→ Approximate Groundwater Direction and Hydraulic Gradient of 0.030 ft/ft

0 4000'

1" = 4000'

(SCALE AND LOCATIONS ARE APPROXIMATE)

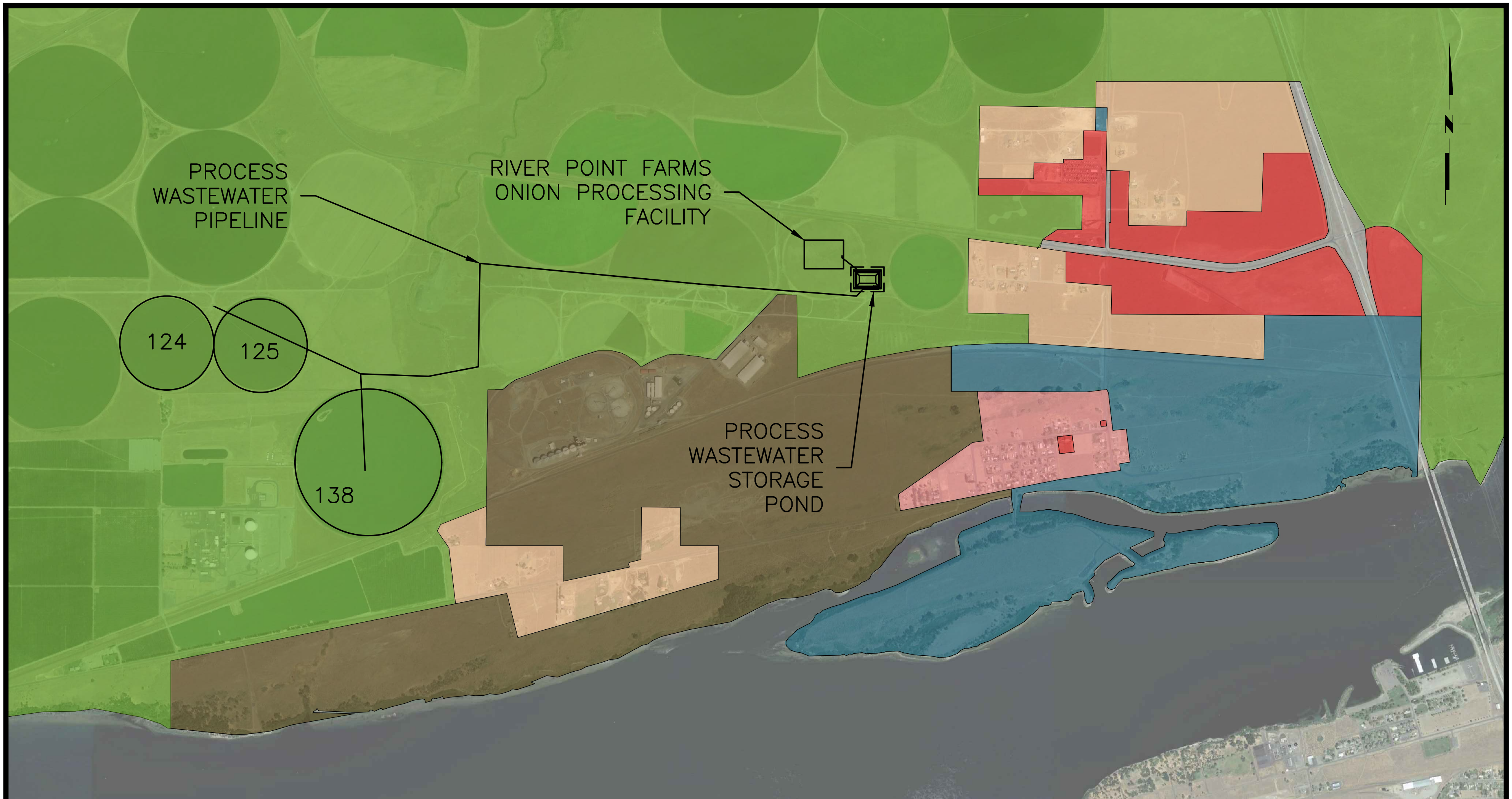
(SOURCE: Google Earth Pro Image July 2018, ©2020 Google™)

N

Figure G.3–2. Water Wells within 1–Mile of the Site

PROJECT NUMBER: 2019210039	River Point Farms Land Treatment System Permit Application
DATE: 6/17/2020	
DWG NO: 2019210039 G.3–2.DWG	AgReserves Plymouth, Washington
DWG BY: 6DJR / PROJECT MANAGER: 6SLV	
REVISED:	CES CASCADE EARTH SCIENCES

S:\[Working Drafting]\2019210039 AgReserves\DWG\Permit Application\2019210039 G.3–2.dwg June 9, 2020 DR702784



EXPLANATION:

- COMMUNITY CENTER RESIDENTIAL
- GMA AG
- HEAVY INDUSTRIAL
- INTERCHANGE COMMERCIAL
- PARK DISTRICT
- RL–5

0 2,500'

1"=2,500'

(SCALE AND LOCATION ARE APPROXIMATE)

Figure G.3–3. Land Uses and Zoning

PROJECT NUMBER: 2019210039	River Point Farms Land Treatment System Permit Application
DATE: 6/16/2020	
DWG NO: 2019210039 FIGURE 1.DWG	AgReserves Plymouth, Washington
DWG BY: 6DJR / PROJECT MANAGER: 6SLV	
REVISED:	CES CASCADE EARTH SCIENCES

Attachment G.4.

Soils Description

124
125
138

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

Benton County Area, Washington

June 10, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

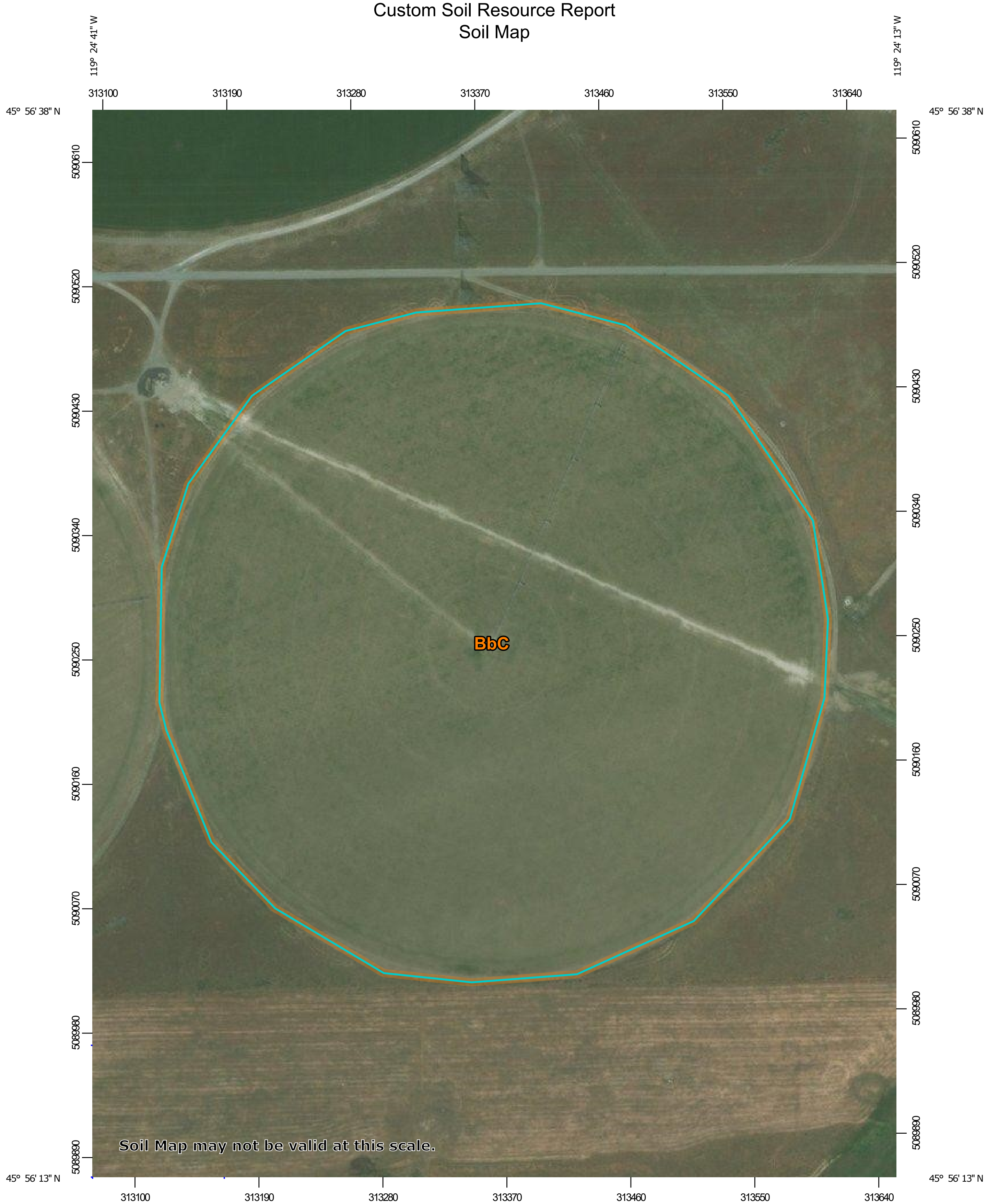
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

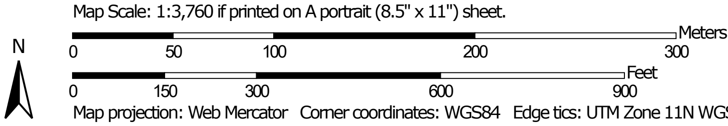
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:3,760 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: Benton County Area, Washington
Survey Area Data: Version 15, Sep 16, 2019

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

Date(s) aerial images were photographed: Jul 7, 2014—Nov 10, 2016

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BbC	Burbank loamy fine sand, 0 to 15 percent slopes	47.0	100.0%
Totals for Area of Interest		**47.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Benton County Area, Washington

BbC—Burbank loamy fine sand, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2bb6
Elevation: 300 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 160 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Burbank and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Burbank

Setting

Landform: Terraces
Parent material: Mixed alluvium and/or eolian deposits over gravelly and stony alluvium

Typical profile

H1 - 0 to 5 inches: loamy fine sand
H2 - 5 to 16 inches: loamy sand
H3 - 16 to 30 inches: very gravelly loamy sand
H4 - 30 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Benton County Area, Washington														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
BbC—Burbank loamy fine sand, 0 to 15 percent slopes														
Burbank	0-5	-81-	-17-	0- 3- 5	1.50-1.55-1.60	42.00-92.00-141.00	0.07-0.09-0.11	0.0- 1.5- 2.9	0.5- 0.8-1.0	.24	.24	3	2	134
	5-16	-81-	-16-	0- 3- 5	1.50-1.58-1.65	42.00-92.00-141.00	0.06-0.09-0.11	0.0- 1.5- 2.9	0.0- 0.3-0.5	.17	.24			
	16-30	-82-	-16-	0- 2- 4	1.50-1.58-1.65	42.00-92.00-141.00	0.04-0.06-0.07	0.0- 1.5- 2.9	0.0- 0.3-0.5	.10	.24			
	30-60	-98-	- 2-	0- 1- 2	1.50-1.58-1.65	141.00-300.00-705.00	0.01-0.02-0.03	0.0- 1.5- 2.9	0.0- 0.3-0.5	.02	.05			

Particle Size and Coarse Fragments

This table shows estimates of particle size distribution and coarse fragment content of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Total fragments is the content of fragments of rock and other materials larger than 2 millimeters in diameter on volumetric basis of the whole soil.

Fragments 2-74 mm refers to the content of coarse fragments in the 2 to 74 millimeter size fraction.

Fragments 75-249 mm refers to the content of coarse fragments in teh 75 to 249 millimeter size fraction.

Fragments 250-599 mm refers to the content of coarse fragments in the 250 to 599 millimeter size fraction.

Fragments >=600 mm refers to the content of coarse fragments in the greater than or equal to 600 millimeter size fraction.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Particle Size and Coarse Fragments–Benton County Area, Washington										
Map symbol and soil name	**Horizon**	**Depth**	**Sand**	**Silt**	**Clay**	**Total fragments**	**Fragments 2-74 mm**	**Fragments 75-249 mm**	**Fragments 250-599 mm**	**Fragments >=600 mm**
		In	*L-RV-H Pct*	*L-RV-H Pct*	*L-RV-H Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*
BbC—Burbank loamy fine sand, 0 to 15 percent slopes										
Burbank	H1	0-5	-81-	-17-	0- 3- 5	8	6	2	—	—
	H2	5-16	-81-	-16-	0- 3- 5	15	13	2	—	—
	H3	16-30	-82-	-16-	0- 2- 4	39	32	7	—	—
	H4	30-60	-98-	- 2-	0- 1- 2	51	33	18	—	—

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

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

Benton County Area, Washington

June 10, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:3,840 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: Benton County Area, Washington
Survey Area Data: Version 15, Sep 16, 2019

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

Date(s) aerial images were photographed: Jul 7, 2014—Nov 10, 2016

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BbC	Burbank loamy fine sand, 0 to 15 percent slopes	42.8	90.6%
FeC	Finley fine sandy loam, 0 to 15 percent slopes	4.4	9.4%
Totals for Area of Interest		**47.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Benton County Area, Washington

BbC—Burbank loamy fine sand, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2bb6
Elevation: 300 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 160 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Burbank and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Burbank

Setting

Landform: Terraces
Parent material: Mixed alluvium and/or eolian deposits over gravelly and stony alluvium

Typical profile

H1 - 0 to 5 inches: loamy fine sand
H2 - 5 to 16 inches: loamy sand
H3 - 16 to 30 inches: very gravelly loamy sand
H4 - 30 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

FeC—Finley fine sandy loam, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2bc8
Elevation: 300 to 1,800 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 135 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Finley and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Finley

Setting

Landform: Terraces
Parent material: Alluvium

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 13 inches: fine sandy loam
H3 - 13 to 28 inches: very gravelly loam
H4 - 28 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: SANDY 6-10 PZ (R007XY501WA)
Hydric soil rating: No

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Benton County Area, Washington														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
BbC—Burbank loamy fine sand, 0 to 15 percent slopes														
Burbank	0-5	-81-	-17-	0- 3- 5	1.50-1.55-1.60	42.00-92.00-141.00	0.07-0.09-0.11	0.0- 1.5- 2.9	0.5- 0.8-1.0	.24	.24	3	2	134
	5-16	-81-	-16-	0- 3- 5	1.50-1.58-1.65	42.00-92.00-141.00	0.06-0.09-0.11	0.0- 1.5- 2.9	0.0- 0.3-0.5	.17	.24			
	16-30	-82-	-16-	0- 2- 4	1.50-1.58-1.65	42.00-92.00-141.00	0.04-0.06-0.07	0.0- 1.5- 2.9	0.0- 0.3-0.5	.10	.24			
	30-60	-98-	- 2-	0- 1- 2	1.50-1.58-1.65	141.00-300.00-705.00	0.01-0.02-0.03	0.0- 1.5- 2.9	0.0- 0.3-0.5	.02	.05			
FeC—Finley fine sandy loam, 0 to 15 percent slopes														
Finley	0-3	-66-	-27-	4- 7- 10	1.15-1.25-1.35	14.00-28.00-42.00	0.13-0.14-0.15	0.0- 1.5- 2.9	0.7- 0.9-1.0	.28	.28	3	3	86
	3-13	-66-	-27-	4- 7- 10	1.30-1.40-1.50	14.00-28.00-42.00	0.09-0.11-0.13	0.0- 1.5- 2.9	0.0- 0.3-0.5	.17	.37			
	13-28	-48-	-45-	4- 7- 10	1.30-1.40-1.50	14.00-28.00-42.00	0.08-0.10-0.11	0.0- 1.5- 2.9	0.0- 0.3-0.5	.17	.49			
	28-60	-97-	- 2-	0- 2- 4	1.40-1.50-1.60	141.00-300.00-705.00	0.03-0.04-0.05	0.0- 1.5- 2.9	0.0- 0.3-0.5	.02	.05			

Particle Size and Coarse Fragments

This table shows estimates of particle size distribution and coarse fragment content of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Total fragments is the content of fragments of rock and other materials larger than 2 millimeters in diameter on volumetric basis of the whole soil.

Fragments 2-74 mm refers to the content of coarse fragments in the 2 to 74 millimeter size fraction.

Fragments 75-249 mm refers to the content of coarse fragments in teh 75 to 249 millimeter size fraction.

Fragments 250-599 mm refers to the content of coarse fragments in the 250 to 599 millimeter size fraction.

Fragments >=600 mm refers to the content of coarse fragments in the greater than or equal to 600 millimeter size fraction.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Particle Size and Coarse Fragments–Benton County Area, Washington										
Map symbol and soil name	**Horizon**	**Depth**	**Sand**	**Silt**	**Clay**	**Total fragments**	**Fragments 2-74 mm**	**Fragments 75-249 mm**	**Fragments 250-599 mm**	**Fragments >=600 mm**
		In	*L-RV-H Pct*	*L-RV-H Pct*	*L-RV-H Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*	*RV Pct*
BbC—Burbank loamy fine sand, 0 to 15 percent slopes										
Burbank	H1	0-5	-81-	-17-	0- 3- 5	8	6	2	—	—
	H2	5-16	-81-	-16-	0- 3- 5	15	13	2	—	—
	H3	16-30	-82-	-16-	0- 2- 4	39	32	7	—	—
	H4	30-60	-98-	- 2-	0- 1- 2	51	33	18	—	—
FeC—Finley fine sandy loam, 0 to 15 percent slopes										
Finley	H1	0-3	-66-	-27-	4- 7- 10	9	7	2	—	—
	H2	3-13	-66-	-27-	4- 7- 10	28	26	2	—	—
	H3	13-28	-48-	-45-	4- 7- 10	41	37	2	—	2
	H4	28-60	-97-	- 2-	0- 2- 4	55	35	17	—	3

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

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

Benton County Area, Washington

June 10, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

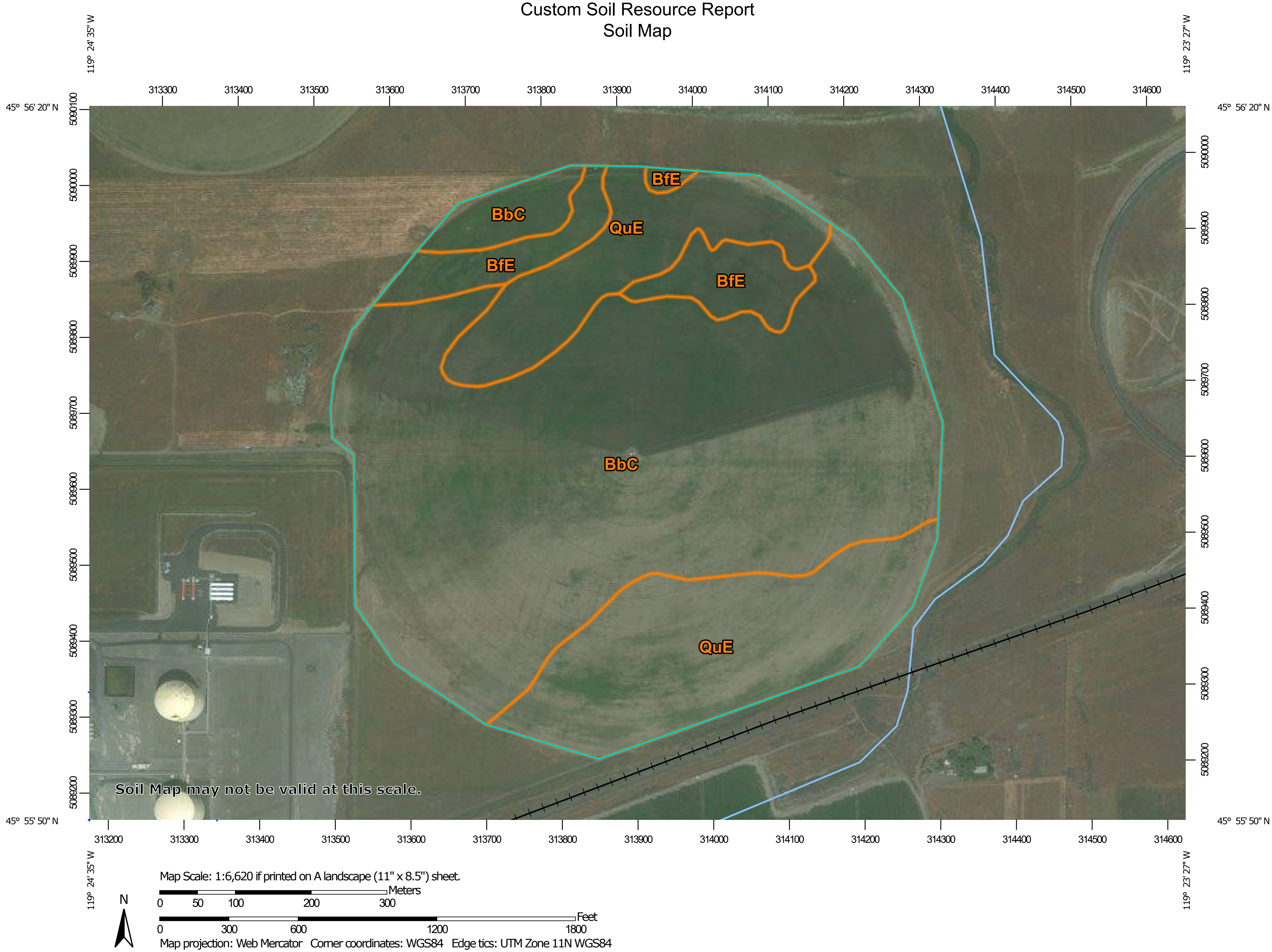
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


119° 24' 35" W
119° 23' 27" W
45° 56' 20" N
45° 55' 50" N
313300
313400
313500
313600
313700
313800
313900
314000
314100
314200
314300
314400
314500
314600
313200
5090100
5090000
5089900
5089800
5089700
5089600
5089500
5089400
5089300
5089200
BbC
QuE
BfE
BbC
BfE
BfE
BbC
QuE
Soil Map may not be valid at this scale.
Map Scale: 1:6,620 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
50
100
200
300
Feet
0
300
600
1200
1800
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: Benton County Area, Washington
Survey Area Data: Version 15, Sep 16, 2019

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

Date(s) aerial images were photographed: Jul 7, 2014—Nov 10, 2016

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BbC	Burbank loamy fine sand, 0 to 15 percent slopes	79.2	64.6%
BfE	Burbank rocky loamy fine sand, basalt substratum, 0 to 30 percent slopes	8.8	7.2%
QuE	Quincy loamy sand, 0 to 30 percent	34.6	28.2%
Totals for Area of Interest		**122.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Benton County Area, Washington

BbC—Burbank loamy fine sand, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2bb6
Elevation: 300 to 1,300 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 160 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Burbank and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Burbank

Setting

Landform: Terraces
Parent material: Mixed alluvium and/or eolian deposits over gravelly and stony alluvium

Typical profile

H1 - 0 to 5 inches: loamy fine sand
H2 - 5 to 16 inches: loamy sand
H3 - 16 to 30 inches: very gravelly loamy sand
H4 - 30 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

BfE—Burbank rocky loamy fine sand, basalt substratum, 0 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2bb9
Elevation: 200 to 790 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 54 degrees F
Frost-free period: 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Burbank and similar soils: 50 percent
Rock outcrop: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Burbank

Setting

Landform: Terraces
Parent material: Mixed alluvium and/or eolian deposits over residuum weathered from basalt

Typical profile

H1 - 0 to 4 inches: loamy fine sand
H2 - 4 to 17 inches: loamy sand
H3 - 17 to 25 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Rock Outcrop

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

QuE—Quincy loamy sand, 0 to 30 percent

Map Unit Setting

National map unit symbol: 2bd5
Elevation: 200 to 4,500 feet
Mean annual precipitation: 6 to 12 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 100 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Quincy and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quincy

Setting

Landform: Terraces
Parent material: Eolian sands

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 60 inches: loamy fine sand

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: SANDS 6-10 PZ (R007XY502WA)
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Attachment G.5.

Local Geology and Hydrology
G.3-1. Vicinity Map
G.5-1. Geologic Map

Attachment G.5. Local Geology and Hydrogeology
River Point Farms Onion Processing Facility - Process Wastewater Land Treatment Area AgReserves, Inc., Plymouth, Washington

PURPOSE AND LOCATION

AgReserves, Inc. is submitting an Application for a State Waste Discharge Permit to Discharge Industrial Wastewater to Ground Water by Land Treatment or Application (application). The application is for the irrigation of onion process wastewater on up to 3 center pivot fields (Fields 124, 125, and 138) located in Township 5 North, Range 27 East, Sections 2, 3, and 11 of the Willamette Meridian (Figure G.3-1). The land treatment site (Site) is located approximately 2 miles west of Plymouth, Washington. The purpose of this document is to summarize the local geology and hydrogeology of the Site to support the application.

LOCAL GEOLOGY

The Site lies within the Yakima Fold Belt subprovince. The subprovince is characterized by long narrow faulted anticlines to broad synclines that trend in an easterly to southeasterly direction from the western margin of the Columbia Plateau to its center (Bauer & Hansen, Jr, 2000). The folded and faulted rock is a sequence of Miocene Age basalt flows of the Columbia River Basalt Group. The numerous basalt flows are sub-divided into 4 formations, starting with oldest to youngest, Imnaha Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt (Drost, Whiteman, & Gonthier, 1990). All of the formations, are believed to be present or at depth below the Site (Figure G.5). The Saddle Mountain Basalt is the youngest basalt unit and is exposed at the surface in many areas around the Site, including an outcrop that forms a ridge in the northwest portion of Field 138 that trends to the west for approximately 2 miles where it turns to the southwest. Water well reports indicate that basalt is encountered from 28 to 56 feet below ground surface (ft bgs) in the vicinity of Field 138. Depth to basalt in the area of Fields 124 and 125 range from 19 to 110 ft bgs (Department of Ecology, n.d.).

The unconsolidated fluvial and glaciofluvial sediments (also known as flood deposits) make up the other major geologic unit of the subprovince. The fluvial and glaciofluvial deposits are from the late Miocene to the middle Pliocene period (8.5 to 3.4 million years ago), is the oldest geologic unit overlying the basalt sequence (Lindsey, 1996). This formation is believed to be present at depth across the region based on geologic mapping (Schuster, 2005).

Windblown silt (loess), which occurs throughout much of the Columbia Plateau, is present north of the Site on higher elevations. The loess is generally a thin mantel covering the alluvial and fluvial sediment and basalt and below.

LOCAL HYDROGEOLOGY

Two groundwater systems are present in the region: a shallow localized unconfined aquifer in areas with high recharge from infiltration of irrigation water and precipitation; or in areas adjacent to perennial bodies of surface water, and a deep, generally confined basalt aquifer (Bauer, Vaccaro, & Lane, 1985). Based on water wells near the Site, an unconfined aquifer is present in the unconsolidated formations and upper fractured/weathered portion the basalt bedrock (Department of Ecology, n.d.). The shallow localized unconfined aquifer is the first aquifer that could be affected by irrigation of process wastewater. Based on available water well reports, groundwater is estimated to range from 31 to 35 ft bgs near Field 138 and from 33 to 90 ft bgs in the vicinity of Fields 124 and 125. Groundwater flow direction is estimated to be south-southwest with a hydraulic gradient of 0.030 feet/foot.

REFERENCES

Bauer, H. H., & Hansen, Jr, A. J. (2000). *Hydrology of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho*, (Water-Resources Investigations Report No. 96-4106). Tacoma, WA: U.S. Department of the Interior, U.S. Geological Survey, Information Services.

Bauer, H. H., Vaccaro, J. J., & Lane, R. C. (1985). *Maps showing ground-water levels in the Columbia River Basalt Group and overlying materials, spring 1983, southeastern Washington state*, (Water-Resources Investigations Report No. 84-4360). U.S.Department of the Interior, U.S. Geological Survey.

Department of Ecology. (n.d.). *Registered water well reports for wells in Township 5N, Range 27E, Sections 1, 2, 4, and 9 through 12; Township 6N, Range 27E, Sections 33 and 34.*, [Data file]. Retrieved November 2019, from Washington State Well Report Viewer: https://fortress.wa.gov/ecy/wellconstruction/map/WCLSWebMap/default.aspx.

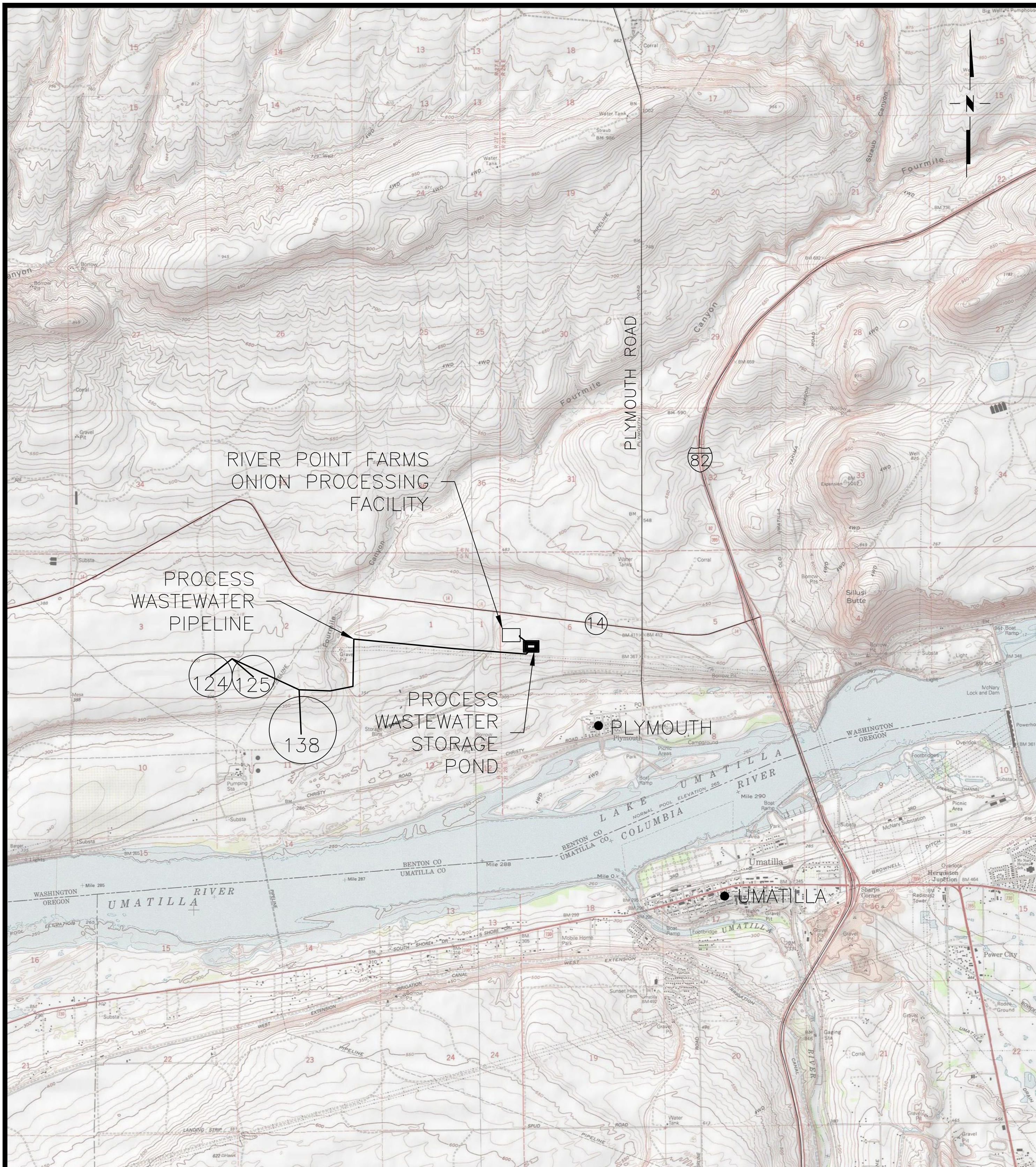
Drost, B. W., Whiteman, K. J., & Gonthier, J. B. (1990). *Geologic framework of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho*, (Water-Resources Investigations Report No. 87-4238). Portland, OR: Department of the Interior, U.S. Geologic Survey.

Lindsey, K. A. (1996). *The Miocene to Pliocene Ringold formation and associated deposits of the ancestral Columbia River system, south-central Washington and north-central Oregon*, (Open File Report 96-8). Olympia, WA: Washington State Department of Natural Resources.

Schuster, J. E. (2005). *Geologic map of Washington state*, (Geologic Map GM-53). Olympia, WA: Washington State Department of Natural Resources, Washington Division of Geology and Earth Resources.

DRW/jbk:sjr

Att: Figure G.3-1. Vicinity Map
Figure G.5-1. Geologic Map



EXPLANATION:

(124) PROCESS WASTEWATER LAND TREATMENT FIELDS

0 5,000'

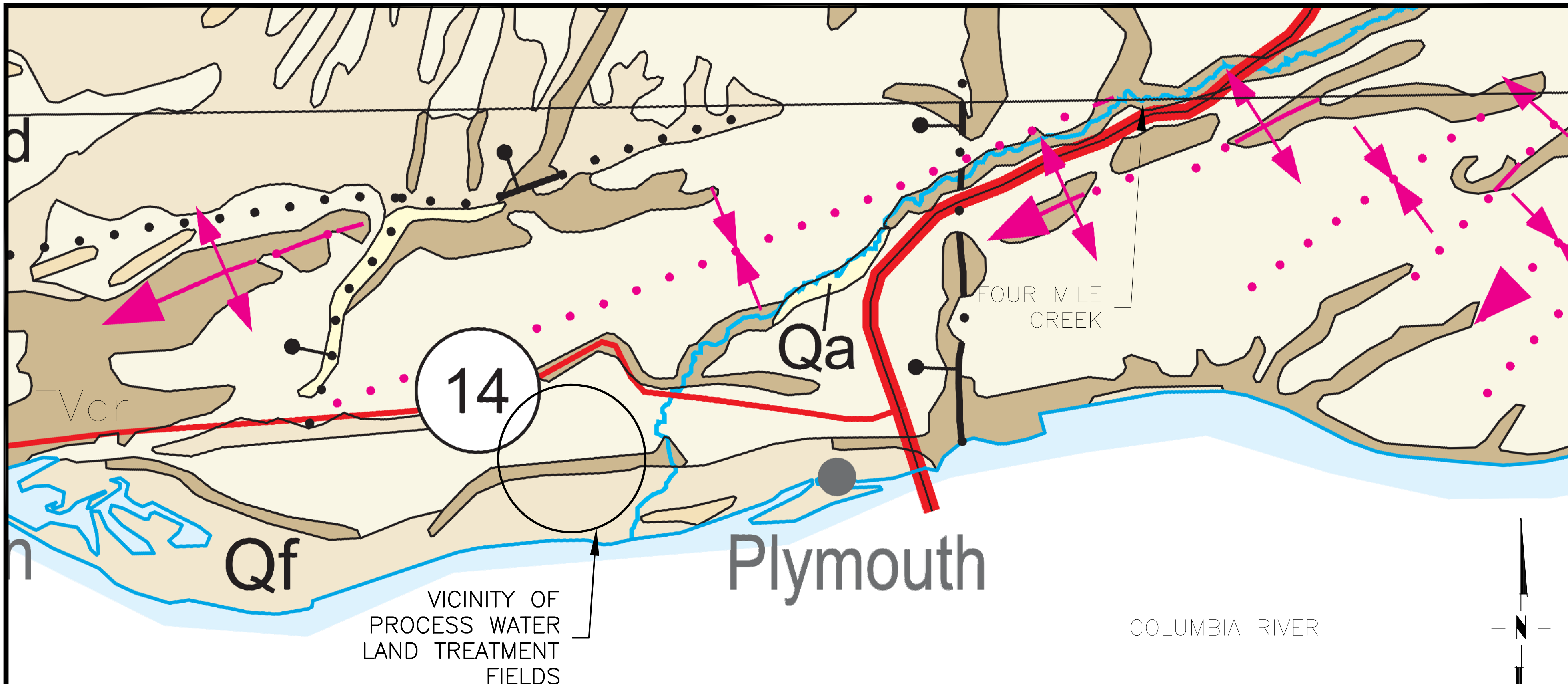
1"=5,000'

(SCALE AND LOCATION ARE APPROXIMATE)

Figure G.3–1. Vicinity Map

PROJECT NUMBER: 2019210039	River Point Farms Land Treatment System Permit Application
DATE: 6/17/2020	
DWG NO: 2019210039 G.3–1.DWG	AgReserves Plymouth, Washington
DWG BY: 6DJR / PROJECT MANAGER: 6SVR	
REVISED:	CES CASCADE EARTH SCIENCES

S:\[Working Drafting]\2019210039 AgReserves\DWG\Permit Application\2019210039 G.3–1.dwg July 13, 2020 NG711452



Geologic Symbols

- Contact
- Anticline – Showing direction of plunge; dotted where concealed
- Syncline – Showing direction of plunge; dotted where concealed
- Dip–slip fault – Bar and ball on downthrown side; long–dashed where approximately located, short–dashed where inferred, dotted where concealed, queried where uncertain; bar and ball omitted in crowded areas

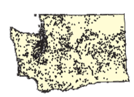
Roads

- 90 Interstate Highway
- 20 Washington State Highway

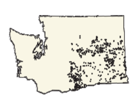
Key to Geologic Units

Unconsolidated Sediments


Qd Holocene dune sand


Qa Quaternary alluvium


Qf Pleistocene outburst–flood deposits


Ql Quaternary loess

Volcanic Rocks and Deposits


Tvcr Tertiary volcanic rocks, Columbia River Basalt Group

0 10,000 FEET

1"=10,000'
(SCALE AND LOCATION ARE APPROXIMATE)

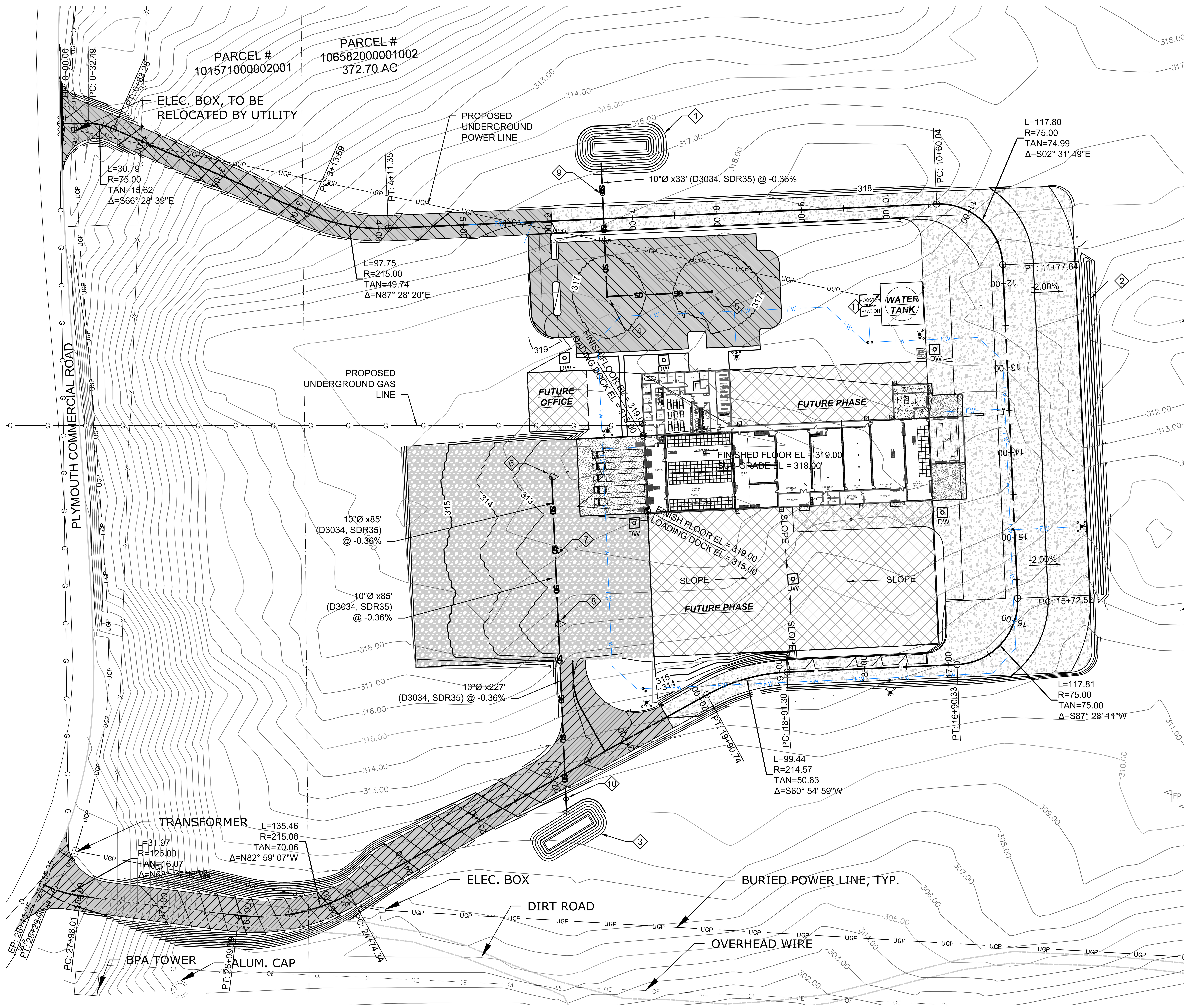
Figure G.5–1. Geologic Map

PROJECT NUMBER: 2019210039 DATE: 6/17/2020	River Point Farms Land Treatment System Permit Application
DWG NO: 2019210039 G.5–1.DWG DWG BY: 6DJR | PROJECT MANAGER: 6SLV	AgReserves Plymouth, Washington
REVISED:	CES CASCADE EARTH SCIENCES

SOURCE: Geologic Map of Washington State 2005, Washington Department of Natural Resources

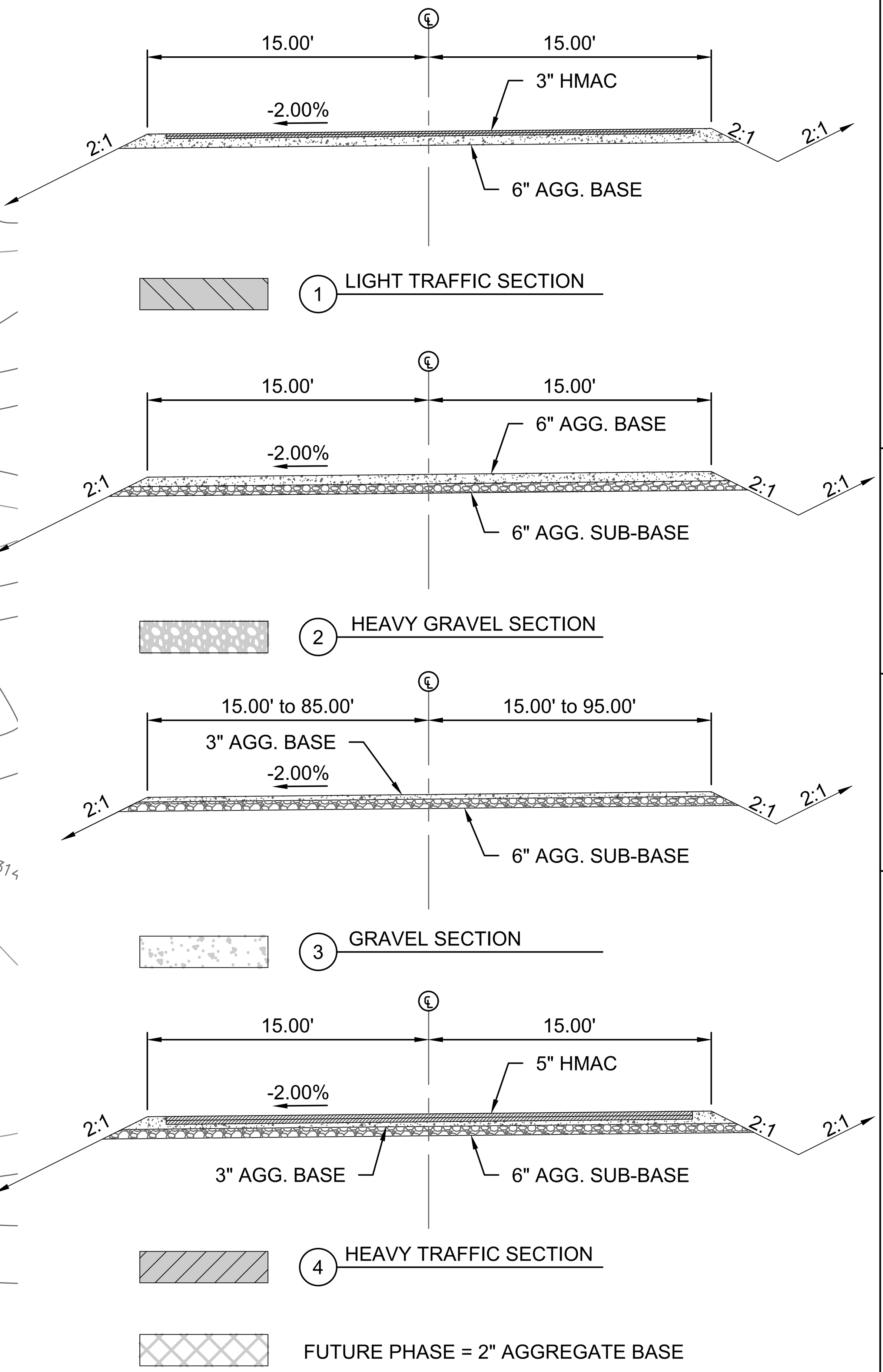
Attachment H.6.

Stormwater Drainage Map



SITE PLAN & GRADING

60 0 60 120
(IN FEET)



KEYNOTES:

1. PROPOSED STORM WATER INFILTRATION POND 1
   STORAGE CAPACITY = 9291 cu. ft.
   MAX. WATER SURFACE EL = 312.65
   TOP OF BERM = 313.65
   BOTTOM EL = 308.15
2. PROPOSED STORM WATER INFILTRATION POND 2
   STORAGE CAPACITY = 7814 cu. ft.
   MAX. WATER SURFACE EL = 312.00
   TOP OF BERM = 313.00
   BOTTOM EL = 310.00
3. PROPOSED STORM WATER INFILTRATION POND 3
   STORAGE CAPACITY = 8969 cu. ft.
   MAX. WATER SURFACE EL = 308.00
   TOP OF BERM = 309.00
   BOTTOM EL = 303.50
4. WSDOT TYPE 1P CATCH BASIN
   GRATE = 317.00
   INV IN = 313.87
   INV OUT =313.77
5. WSDOT TYPE 1P CATCH BASIN
   GRATE = 317.00
   INV OUT =314.92
6. WSDOT TYPE 1P CATCH BASIN
   GRATE = 313.00
   INV OUT = 309.46
7. WSDOT TYPE 1P CATCH BASIN
   GRATE = 313.00
   INV IN = 309.16
   INV OUT =309.06
8. WSDOT TYPE 1P CATCH BASIN
   GRATE = 313.00
   INV IN = 308.74
   INV OUT =308.64
9. POLLUTION CONTROL MANHOLE
   RIM EL = 317.53
   INV IN = 312.86
   INV OUT = 312.76
10. POLLUTION CONTROL MANHOLE
    RIM EL = 310.58
    INV IN = 308.17
    INV OUT = 308.07
11. AREA TO BE GRADED FLAT FOR FUTURE WATER TANK,

DW — DRY WELL - PROCESSING PLANT ROOF DRAINAGE ONLY. CONSTRUCT 10.00' FROM BUILDING

EARTHWORK:

STRIPPING:
AREA = 860' x 570' = 490,200 sq. ft.
VOLUME @ 1ft DEEP = 18,156 cu. yds.

SITE GRADING:
CUT = 21,812 cu. yds. (BANK)
FILL = 21,224 cu. yds. (BANK)

NOTE: SITE GRADING VOLUMES WERE OBTAINED BY COMPARING FINISHED SUB-GRADE AND THE STRIPPED GROUND SURFACE. NO SHRINK/SWELL OR COMPACTION FACTORS WERE APPLIED.

STORM WATER DETENTION POND EARTHWORK:

POND 1:	600 cu. yds.
POND 2:	684 cu. yds.
POND 3:	334 cu. yds.

H.8. STORMWATER DRAINAGE MAP

TRUE

AKANA
Plan • Design • Engineer • Manage
6400 SE Lake Road, Ste 270
Portland, Oregon 97222
Voice (503) 652-9090

HANSEN-RICE CONSTRUCTION INC.
1717 E Chisholm Dr.
Nampa, ID 83687
P 208 465 0200
F 208 465 0272
WWW.HANSEN-RICE.COM

PROFESSIONAL SEAL

90% SUBMITTAL NOT FOR CONSTRUCTION

DO NOT SCALE DRAWINGS

CONTRACTOR SHALL VERIFY ALL CONDITIONS AND DIMENSIONS AT THE JOB SITE AND NOTIFY HANSEN-RICE, INC. OF ANY DIMENSIONAL ERRORS, OMISSIONS, OR DISCREPANCIES BEFORE BEGINNING OR FABRICATING ANY WORK.

PLYMOUTH, WASHINGTON

PROCESS BUILDING

CLIENT DESCRIPTION: RIVER POINT FARMS

NO.	DESCRIPTION	DATE
A	ISSUED FOR GRADING PERMIT	10/16/2019
B	REVISED & REISSUED FOR GRADING PERMIT	2/27/2020
C	FUNCTIONAL DESIGN SUBMITTAL (60% DESIGN)	3/17/2020
D	FUNCTIONAL DESIGN SUBMITTAL (90% DESIGN)	04/15/2020

JOB NUMBER: AK19-036	SCALE @ 24"x36": 1" = 60'-0"
DRAWN BY: W.A.	DATE: 10/09/19

SHEET NAME: SITE PLAN & GRADING

REVISION: C | SHEET: C-100

8/27/2019 11:12:29 AM

AgReserves SWDP Application 20200901

Final Audit Report 2020-09-04

Created:	2020-09-04
By:	Kevin Barnard (KPBarnard@agrinw.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAA-8Et0jnuNN4eC2_8fEvH_xKCesqp6z4o

"AgReserves SWDP Application 20200901" History

Document created by Kevin Barnard (KPBarnard@agrinw.com)

2020-09-04 - 0:04:17 AM GMT- IP address: 68.116.6.98

Document emailed to Kerri Macomber (kmacomber@riverpointfarms.com) for signature

2020-09-04 - 0:06:19 AM GMT

Email viewed by Kerri Macomber (kmacomber@riverpointfarms.com)

2020-09-04 - 2:56:02 PM GMT- IP address: 209.27.48.106

Document e-signed by Kerri Macomber (kmacomber@riverpointfarms.com)

Signature Date: 2020-09-04 - 2:57:43 PM GMT - Time Source: server- IP address: 209.27.48.106

Document emailed to Patrick Tolman (ptolman@agreserves.com) for signature

2020-09-04 - 2:57:47 PM GMT

Email viewed by Patrick Tolman (ptolman@agreserves.com)

2020-09-04 - 3:34:20 PM GMT- IP address: 68.116.6.98

Document e-signed by Patrick Tolman (ptolman@agreserves.com)

Signature Date: 2020-09-04 - 3:35:32 PM GMT - Time Source: server- IP address: 68.116.6.98

Signed document emailed to Kerri Macomber (kmacomber@riverpointfarms.com), Patrick Tolman (ptolman@agreserves.com), mchild@agrinw.com, Kevin Barnard (KPBarnard@agrinw.com), and 1 more

2020-09-04 - 3:35:32 PM GMT