CRITICAL AREAS REPORT AND HABITAT MANAGEMENT PLAN

STANWOOD SEPTAGE RECEIVING PLANT, STANWOOD, WASHINGTON

Prepared For:

McDay Holdings, Inc.
Stanwood, Washington

Prepared By:

TALASAEA CONSULTANTS, INC.
Woodinville, Washington

20 July 2016

Critical Areas Report and Habitat Management Plan

Stanwood Septage Receiving Plant
Stanwood, Washington

Prepared For:

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20 July 2016

EXECUTIVE SUMMARY

PROJECT NAME:	Stanwood Septage Receiving Plant
SITE LOCATION:	The Site is located at the southwest corner of the intersection of 270th Street NW and Marine Drive in Stanwood, Washington. The Public Land Survey System location is Section 19, T32N, R4E, Willamette Meridian.
CLIENT:	McDay Holdings, Inc.
PROJECT STAFF:	William E. Shiels, Principal, David R. Teesdale, Senior Wetland Ecologist
FIELD SURVEY:	The initial Site reconnaissance was conducted on 9 November 2015. Groundwater monitoring wells were installed on 15 December 2015. Monitoring ceased on 22 January 2016.

DETERMINATION: Groundwater monitoring, along with an analysis of patterns of precipitation for the current water year, indicate that wetland conditions do not occur on the Site. No other critical areas (streams or wildlife habitat) were identified on the Site.

PROPOSED PROJECT: The Client proposes to construct a septage receiving plant on the northern half of the site. The remaining half of the site will not be developed.

FLOODPLAIN IMPACTS: The proposed development will impact approximately 2,369 CY of 100-year flood storage capacity on the Site.

PROPOSED MITIGATION: Mitigation for the potential loss of 2,369 CY of flood storage capacity will be through excavating existing high ground on the Site and creating approximately 2,652 CY of new flood storage volume. There will be a net increase of flood storage capacity of approximately 283 CY resulting from the proposed development plan.

HABITAT MANAGEMENT PLAN: Known populations of State- and Federally-listed threatened or endangered species exist within ½ mile of the project site. However, the Site itself provides no habitat for such populations, nor is it adjacent to any such habitat. The proposed development should have no effect on listed threatened or endangered species. Hence, no habitat management plan is proposed for this project.

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Chapter 1. INTRODUCTION

1.1 Report Purpose

This report is the result of a critical areas study of the property located southwest of the intersection of 270th Street NW and Marine Drive in the City of Stanwood, Washington (**Figure 1**). This property (referred to as "Site" hereinafter) is the location of a proposed septage receiving and treatment facility. The purpose of this report is to: 1) identify and describe existing site conditions, including critical areas on or adjacent to the Site; 2) identify and describe wildlife habitat on or adjacent to the Site; 3) assess the Site's potential to impact critical areas or wildlife habitat (if any); and 4) propose mitigation to offset said impacts. This report has been prepared to comply with the requirements of §17.114 and §17.120 of the City of Stanwood's Municipal Code.

This report will provide and describe the following information:

- General property description;
- Methodology for critical areas and wildlife habitat investigations
- Results of critical areas background review and field investigations;
- Regulatory review;
- Assessment of potential project impacts to critical areas and wildlife habitat; and
- Propose mitigation and habitat management to offset impacts to critical areas and wildlife habitat (if any).

1.2 Statement of Accuracy

Wetland and habitat delineation, characterization, and ratings were conducted by trained professionals at Talasaea Consultants, Inc., and adhered to the protocols, guidelines, and generally accepted industry standards available at the time work was performed. The conclusions in this report are based on the results of analyses performed by Talasaea Consultants and represent our best professional judgment. To that extent, and within the limitations of project scope and budget, we believe the information provided herein is accurate and true to the best of our knowledge. Talasaea Consultants does not warrant any assumptions or conclusions not expressly made in this report, or based on information or analyses other than what is included herein.

Chapter 2. GENERAL PROPERTY DESCRIPTION

2.1 Site Location

The Stanwood Septage Receiving Plant is located on an assemblage of four parcels totaling approximately 3.3 acres (**Figure 2**). The parcels included in the assemblage are 32041900307900 (Parcel A), 32041900307900 (Parcel B), 32041900310000 (Parcel C), and 32041900310100 (Parcel D). The Public Land Survey System location of the Site is Section 19, T32N, R4E, Willamette Meridian.

2.2 Site Description

The Site is currently undeveloped and mostly vegetated with grasses and small colonies of non-native blackberry. The southern boundaries of Parcels C and D are forested with some scattered trees (red alder and black cottonwood) existing northward to the center

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of the Site. The two parcels located at the Site's northwest corner appear to be developed as single-family residential and an automobile service and repair business. It is bordered by Marine Drive on its east side, 270th Street NW on its north side, 87th Avenue NW on its west side, and by SR-532 on its south side.

Parcel A is mostly flat and level with a LIDAR-derived elevation of approximately eight feet above mean sea level (amsl). The topography of Parcel B is more variable with a low ridge extending through its middle from its western boundary to its eastern boundary. This ridge ranges from eight feet amsl to a maximum of 16 feet amsl. Parcel C is mostly flat with an elevation of approximately nine feet amsl. Parcel D is mostly flat with elevations ranging between seven feet amsl to eight feet amsl.

2.3 Historic Land Uses

We reviewed legacy aerial imagery dating from 1933 through 2009 to see how land uses have changed on the Site. We believe that Parcels C and D extended further to the south prior to the construction of SR-532. However, parcel map data from before the construction of SR-532 is not readily available. It appears that Parcel A was used for business purposes from 1933 through 1990.

An aerial photograph from 1933 (**Figure 3**) shows Parcel A developed with two buildings. Parcels B, C, and the northern ½ of Parcel D appear to be used for agriculture. The southern ½ of Parcel D is developed with a single-family residence. Irvine Slough is visible as a broad vegetated band extending up to the southwest corner of the original extent of Parcel C.

Irvine Slough is no longer as well vegetated up to the southwest corner of Parcel C by 1941 (**Figure 4**). The 1941 aerial image does appear to indicate that Irvine Slough likely extended up through Parcel C and onto Parcel B. An additional building appears on Parcel A on the 1941 aerial photo. Parcels B, C, and the northern ½ of Parcel D appear to be in continued use for agriculture. The extent of land use activity on the southern ½ of Parcel D appears to have diminished by the time the 1941 aerial image was taken.

By 1954, the lumber business located on Parcel A appears to have expanded onto Parcel B, where it appears to have been used as a lumber storage yard (**Figure 5**). Parcels C and the northern ½ of Parcel D are still in use for agriculture. The southern ½ of Parcel D is still developed with a single-family residence.

SR-532 was built at some time prior to the 2 September 1968 aerial photograph (**Figure 6**). We believe that the current shapes of Parcels C and D were defined between 1954 and 1968 as WSDOT likely acquired land for road right-of-way. The house on the southern ½ of Parcel D was demolished for the construction of SR-532. Eighty-seventh Avenue NW was extended south to cross SR-532 and connect with Marine Drive (along the south side of SR-532). The reach of Irvine Slough between the Site and 87th Avenue NW is now filled and the adjacent parcels to the west of the Site are in the process of being developed. The new Irvine Slough channel is now apparent as a ditch

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along the south side of SR-532. The apparent expansion of the lumberyard onto Parcel B had ceased by 1968, with Parcel B becoming revegetated.

Parcels to the west of the Site were developed by 1990, including the parcel to the west of Parcel A (**Figure 7**). Agricultural use of Parcels B, C, and D appear to have ended by 1990 with the existing vegetation appearing to be composed mostly by shrubby species.

At some point between 1990 and 2005, the lumberyard development on Parcel A was cleared and the parcel reverted back to a vegetated state (**Figures 2** and **12**). The shrubby vegetation that was apparent on the 1990 aerial image is mostly gone with a band of trees now bordering the Site on its south side (WSDOT right-of-way). Some trees and shrubs appear on the Site on Parcel C and extending up to Parcel B.

Chapter 3. METHODOLOGY

The critical areas analysis portion of the Site consisted of a two-part effort. The first part consisted of a preliminary assessment of the Site and the immediate surrounding area using published environmental information. This information included:

1. Wetland and soils information from resource agencies;
2. Critical areas map information from City of Stanwood and Snohomish County;
3. Orthophotography (historical and current);
4. LIDAR terrain data;
5. Climatological data from local and Federal weather sources;
6. FEMA floodplain information, including map revisions and amendments;
7. Threatened and Endangered Species habitat usage and life history data from Federal and State sources, and,
8. Relevant studies completed or ongoing in the vicinity of the Site.

The second part consisted of a site investigation where direct observations and measurements of existing environmental conditions were made. Observations included plant communities, soils, and hydrology. Hydrology was monitored using automatic recording dataloggers suspended within shallow groundwater monitoring wells. This information was used to help characterize the existing conditions of the Site, and to identify and delineate critical areas or fish and wildlife habitats (See **Section 3.2 – Field Investigation** below).

3.1 Background Data Reviewed

Background information from the following sources was reviewed prior to field investigations:

- US Fish and Wildlife Service (USWFS) Wetlands Online Mapper (National Wetlands Inventory) (www.wetlandsfws.er.usgs.gov/wtlnds/launch.html);
- Natural Resources Conservation Service Web Soil Survey (www.websoilsurvey.nrcs.usda.gov/app/);
- Snohomish County GIS database (Snohomish County, 2011)
- City of Stanwood Critical Areas Maps (accessed 2016)

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- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) database;
- Washington Department of Natural Resources (WDNR) Natural Heritage database;
- Earth Explorer GIS orthophotography repository (earthexplorer.usgs.gov);
- Historic Aerials by NETROnline (www.historicaerials.com);
- Puget Sound LIDAR Consortium terrain data (pugetsoundlidar.ess.washington.edu);
- Normal climatic data from NCDC; and
- Current weather data from Weather Underground (www.wunderground.com);

3.2 Field Investigation

Initial site reconnaissance was conducted on 9 November 2015. The herbaceous vegetation had been mowed prior to the start of the dormant season, which makes plant identification difficult, but not impossible. However, most of the non-woody vegetation consists of various grasses. The most commonly observed pasture grasses in the Pacific Northwest are facultative, which means that patterns of vegetation at most point locations within the Site will likely satisfy the requirements for hydrophytic vegetation, but will not be conclusive in making a wetland determination. Due to the time of year and the site's proximity to tidally influenced water levels, it was decided that shallow groundwater levels needed to be monitored to see if wetland conditions existed on the Site.

Shallow groundwater wells were installed in two locations on the Site (**Figure 2**). Wells were installed following the methodology outlined by the U.S. Army Corps of Engineers (U.S. Army Corps of Engineers 2005). One well (North Well) was installed in Parcel B approximately ten feet south of the middle of the shared boundary line between Parcels A and B. The second well (South Well) was installed approximately in the center of Parcel D. A Solinst Levelogger Model 3001 datalogger was installed in each well using braided polyester fishing line[1]. The depth to the datalogger's reference measurement line from the ground surface was recorded at the time of installation. The dataloggers were programmed to record water level and temperature readings once every hour. The dataloggers were allowed to remain on site from 15 December 2015 through 22 January 2016. The dataloggers were then retrieved and the data downloaded and compensated for barometric pressure changes over the same time period (Solinst Barologger barometric pressure recorder).

After data compensation, the water levels recorded by the dataloggers were adjusted by the depth each datalogger was suspended below ground so that the data indicated the actual depth to water level at each well over time. These data are shown on Exhibits contained within **Appendix A**.

In order to draw a valid conclusion from the shallow groundwater monitoring data, an analysis of climatic conditions must also be made. The Army Corps of Engineer's

[1] Braided polyester fishing line was used because it neither stretches under weight, nor does it significantly expand or contract during diurnal temperature changes.

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definition of a wetland is "[*t]hose areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.*" Determining "normal circumstances" involves an analysis of patterns of precipitation against a range of normal precipitation. This is done either by reviewing monthly precipitation totals against monthly totals averaged over a 30-year period, or by comparing a 30-day rolling total against the same averaged range of precipitation data (See **Determining Patterns of Normal Precipitation** in **Appendix C**). The 30-year precipitation metrics are provided by the NCDC on "WETS" tables. These tables provide three numbers for each month: 1) an average monthly precipitation amount, 2) a precipitation amount at the 30th percentile point, and 3) a precipitation amount at the 70th percentile point. For any particular year, if the monthly total precipitation is between the 30th percentile and 70th percentile points from the WETS table, the conditions are said to be within the range of normal conditions. If the monthly total precipitation is less than the 30th percentile point, conditions are said to be dryer than normal. Likewise, if the monthly total precipitation is greater than the 70th percentile point, conditions are said to be wetter than normal.

Chapter 4. RESULTS

4.1 Analysis of Existing Information

This section describes the results of our in-house research and field investigation. For the purposes of this report, the term "vicinity" describes an area approximately ¼ mile around the Site.

4.1.1 National Wetland Inventory Maps

The National Wetland Inventory Map for the Stanwood Quadrangle maps six wetlands within the vicinity of the Site (**Figure 8**). These wetland classification codes, classification code interpretations, and current status are contained on **Table 1**.

Table 1. NWI Wetland Codes, Interpretations, and Status

Wetland Code	Wetland Code Interpretation	Current Wetland Status
L1UBHx	Lacustrine limnetic with an unconsolidated bottom, excavated and permanently flooded.	Appears to be a settling lagoon for a sewage treatment plant
E1UBL	Estuarine subtidal wetland with an unconsolidated bottom,	Main stem of the Stilliguamish River
E2EMN	Estuarine intertidal emergent wetland that is regularly flooded	On right bank of the Stilliguamish River
PSSC	Palustrine scrub-shrub wetland that is seasonally flooded,	To the north of the Site. Appears to be filled and developed.
PEMA	Palustrine emergent wetland that is temporarily flooded,	Wetland area encompasses most of Parcels C and D.

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PEM/SCC	Palustrine emergent and scrub-shrub wetland.	To the east of the Site. Appears to be mostly filled and developed.

4.1.2 NRCS Soils Map

The Natural Resources Conservation Service maps the site as Puget silty clay loam (**Figure 9**). Puget silty clay loam is a very deep soil in depressional areas on flood plains. It is artificially drained. This soil formed from alluvium. The surface layer is dark grayish brown silty clay loam to approximately nine inches. The underlying material is olive gray and gray silt loam. The National Technical Committee on Hydric Soils includes this soil on its list of hydric soils.

4.1.3 Snohomish County Critical Areas Map

Snohomish County Critical Areas database maps nine wetlands, two streams, and one waterbody within the vicinity of the Site (**Figure 10**). The waterbody is identified as the Stilliguamish River. The stream nearest the Site is identified as Irvine Slough. The Snohomish County Streams GIS database rates the reach of Irvine Slough in the vicinity of the Site as a seasonal, non-fish-bearing water (Type 5, or Type Ns using the permanent water-typing rule). The second stream is identified as Church Creek. This stream is rated as a fish-bearing water (Type 3, or Type F using the permanent water-typing rule). The Snohomish County wetlands GIS database does not provide any additional information regarding classification or rating of these wetlands. No wetlands, streams, or waterbodies are mapped on the Site by Snohomish County.

4.1.4 City of Stanwood Critical Areas Map

The City of Stanwood's wetland map is an amalgam of NWI, Snohomish County, and City-mapped data. There are no City-mapped critical areas in the vicinity of the Site.

4.1.5 FEMA Floodplain Map

FEMA has mapped the entire Site to be within a 100-year floodplain (**Figure 11**). The base elevation for flooding is 10 feet (NGVD29). This corresponds roughly to 13.7 feet (NAVD88), which is the datum that most modern survey and terrain data are provided.

4.1.6 Priority Habitats and Species

The WDFW Priority Habitats and Species (PHS) web-mapping program indicates two bald eagle breeding locations and habitat or presence of Chinook and coho salmon, and bull trout. The bald eagle point locations are both approximately ½ mile south of the Site. The Chinook and bull trout presence is mapped on the Stilliguamish River only. Coho presence is mapped on the Stilliguamish River and Church Creek. Priority habitats mapped by WDFW are limited to the same wetland areas indicated by the NWI map. No PHS species are mapped on the Site by WDFW.

4.1.7 StreamNet and SalmonScape Databases

The StreamNet and SalmonScape databases were accessed for fish presence within the vicinity of the site. The results of these searches are contained on **Table 2**.

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Table 2. StreamNet and SalmonScape Search Results.

Species	Waterbody	StreamNet Usage Type	SalmonScape Usage Type
Fall Chinook (*Oncorhynchus tshawytscha*)	Stilliguamish	Migration	Presumed presence
	Church Creek	No data	Modeled presence
	Irvine Slough	No data	Modeled presence
Summer Chinook (*O. tshawytscha*)	Stilliguamish	Spawning and Rearing	Documented presence
	Church Creek	No data	No data
	Irvine Slough	No data	No data
Coho (*O. kisutch*)	Stilliguamish	Migration	Documented presence
	Church Creek	Migration	Documented presence
	Irvine Slough	No data	Modeled presence
Chum (*O. keta*)	Stilliguamish	Migration	Documented presence
	Church Creek	Migration	Documented presence
	Irvine Slough	No data	Modeled presence
Pink (*O. gorbuscha*)	Stilliguamish	Migration	Documented presence
	Church Creek	No data	Presumed presence
	Irvine Slough	No data	No data
Sockeye (*O. nerka*)	Stilliguamish	Migration	Presumed presence
	Church Creek	No data	No data
	Irvine Slough	No data	No data
Winter steelhead (*O. mykiss*)	Stilliguamish	Migration	Documented presence
	Church Creek	Migration	Documented presence
	Irvine Slough	No data	Modeled presence
Bull trout (*Salvelinus confluentus*)	Stilliguamish	Migration	Documented presence
	Church Creek	Migration	Presumed presence
	Irvine Slough	Migration	Presumed presence

It should be noted that the term “modeled presence” under SalmonScape means that a particular waterbody meets the general criteria for providing habitat for a particular species of fish, but no direct observations to support documented presence have been made. Irvine Slough has been significantly modified since the establishment of the City of Stanwood. Currently, water within the slough is pumped out into the Old Stilliguamish River Channel. This represents a total physical barrier to fish passage, as indicated by SalmonScape.

4.2 Observed Conditions

Our initial reconnaissance indicated that there are no waterbodies or streams on or adjacent to the Site (**Figure 2**). Parcels A and B are currently mowed and have several large piles of debris scattered about **(Photo 1**). The piles consisted mostly of construction materials, including pieces of concrete, asphalt, metallic remains of an old sawmill, brush, trash, truck tires, wood waste, and other refuse.

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Photo 1. Panoramic View of Site from SE to SW Showing Debris Piles

The southern halves of both Parcels C and D have tree and shrub vegetation that could indicate the presence of wetland conditions. However, the vegetative component did not provide a compelling argument to support the existence of wetlands on the Site. The soils on the Site are mapped as hydric (see **Section 4.1.2**). The presence of wetland hydrology (inundation or saturation within the upper part of the soil for a minimum of 12 consecutive days during the growing season) would provide conclusive proof for the presence of wetland conditions. As previously mentioned in **Section 3.2** of this report, we monitored groundwater levels on the Site to determine if wetland hydrologic conditions occurred anywhere within the Site.

The Site is mostly flat and level, except for the mounding on Parcel B and the lower ground elevations on parts of Parcel D. We chose two representative points for the installation of our groundwater monitoring wells: one on the Site average elevation on Parcel A and one in the depression areas on Parcel D (**Figure 12**). These data are shown graphically in **Appendix A**.

The groundwater levels measured at the two wells are nearly identical in slope, varying only by the depth to groundwater. The south well was installed at a lower elevation and the measured groundwater was consistently closer to the surface than the groundwater at the north well. At no time between when we began monitoring groundwater (15 December 2015) and when we ceased monitoring (22 January 2016) did groundwater levels in either well meet the general definition of wetland hydrology.

This in and of itself is not conclusive evidence of the presence or absence of wetland conditions. Since we are basing our wetland determination on groundwater monitoring, it must also be shown that “normal conditions” also existed during our monitoring period. We analyzed patterns of precipitation for the three-month period starting prior to 15 December 2015 and ending on 22 January 2016 using the methodology described by Sprecher and Warne ((Sprecher and Warne 2000). These data are contained in **Appendix B**, with an explanation of the methodology for determining “normal conditions” contained in **Appendix C**.

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Precipitation patterns were determined to be drier than normal for the first four days of shallow groundwater monitoring. Precipitation patterns were within the range of normal conditions for the remaining 35 days of groundwater monitoring. We can conclude from the analysis of precipitation patterns that normal conditions existed during the time of our groundwater monitoring work and that the data collected can be used to determine whether wetland hydrology exists on the Site.

At no time during our 38-day groundwater monitoring study did groundwater remain within 12 inches of the soil surface for the minimum 12 consecutive days. Groundwater levels on 16 December 2105 were high with the South Well showing water within an inch of the soil surface. However, this level dropped down quickly and never reached this extreme level again during the monitoring period. It should be noted that while patterns of precipitation the monitoring period was determined to be within the range of normal conditions, patterns of precipitation from 22 December 2015 through 9 January 2016 were wetter than normal based on the 30-day rolling total. During the period between 22 December and 9 January, groundwater levels consistently remained below approximately 2 ½ feet. It is our conclusion based on these data that wetland hydrology does not exist and that wetlands are not present on the Site.

Chapter 5. PROPOSED PROJECT

The Site is the location of a proposed septage receiving plant for the purpose of receiving and treating septic tank waste (**Figure 13**). The plant will consists of an operations office, pump stations, and processing, equalization, and filtration tanks. Trucks will enter the plant off of 270th Street NW and exit onto Marine Drive. All proposed development will occur within Parcels A and B.

Since the entire Site is within a 100-year floodplain, any development that potentially reduces flood storage volume must be mitigated by providing an equal or greater amount of flood storage onsite. It is estimated that the volume of the structures within the 100-year flood elevation on the Site is approximately 2,369 CY. The Client proposes to mitigate for this potential loss of floodplain storage volume by excavating an area of high ground in Parcel B. The proposed mitigation will provide approximately 2,652 CY of new flood storage (an increase of approximately 283 CY). The remainder of the Site (Parcels C and D) will remain in their current condition.

5.1 Stormwater Management

The site is required to meet Washington State's minimum stormwater management requirements 1 through 10 per the 2005 Western Washington Stormwater Management Manual issued by the Washington State Department of Ecology. The minimum requirements dictate that stormwater from pollution generating surfaces, such as pavement for vehicles and landscaping areas is treated. Stormwater from buildings or undisturbed areas of the site do not need treatment. Due to the proximity of the project to fish bearing waters, the level of treatment must be enhanced for the removal of sediment and metals (such as zinc and copper) from stormwater.

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In addition to treatment of pollution generating surfaces, the entire site is subject to flow control to reduce the peak stormwater event flows to pre-developed (before settlement) conditions.

To provide stormwater treatment for the site, stormwater from the paved areas will be directed to an amended filter strip (BMP 9.40) located on the west side of the proposed roadway. The amended filter strip is a basic filter strip with 6 inches of compost-amended soil tilled into the existing soil to support enhanced treatment. The filter strip must be a minimum of 16 feet in width, but can be wider. After the stormwater flows over the filter strip, it enters an open channel and be directed towards a catch basin. A pipe from the catch basin will direct the stormwater under the pavement into a detention pond (Section 3.2.1 of the stormwater manual).

The detention pond will have a bottom area of approximately 12,500 square feet. Requirements for the pond are 6 inches of sediment storage at the bottom of the pond (dead storage) and one foot of freeboard. The proposed detention pond has been designed to have one foot of active storage, making the total required pond depth 2.5 feet. Outflow from the pond is controlled by three orifice outlets to ensure the pond meets pre-development discharge rates.

5.2 Site Construction Methods and Flood Protection

Standard construction methods per WSDOT 2016 Standard Specifications are proposed for the Facility piping, access road, storage tanks, equipment, and building. The site is located in a floodplain and all structures are to be either elevated 1’ above the 100-year floodplain elevation or designed to be submerged in water without compromising the operational requirements. Tankage will be cast-in-place reinforced concrete (Mt Baker Silo or equal). Piping will be subject to standard hydrostatic pressure test requirements. Due to the soft soil conditions, piles will be used to support structure foundations. Piles are proposed under all 3 concrete tanks, the septage receiving structure, the pump station, and the Control Building. The Control Building will include room for the biosolids processing equipment from FKC, Inc. (package unit including flocculation tank, polymer dosing station, rotary drum thickener, screw press, boiler, conveyor equipment, and controls). The Control Building will also include an office, restroom, and stair access. No elevators are included in the preliminary layout. Finish floor elevation of the proposed building will be located approximately 10-ft above existing grade (1’ above the 100-year floodplain elevation).

5.3 Site Operations

The Septage Facility System will be designed to:

1. Accept raw septage from tanker trucks,
2. Pretreat septage with an automatic grit removal/screening facility (Honey Monster, or equal),
3. Transfer liquid septage to a 90,000+/- gallon equalization tank,
4. Transfer liquid septage from the equalization tank to a 75,000+/- gallon processing tank,
5. Dose liquid septage with powdered quick lime,

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After 24 hours and satisfactory pH test results, septage is to be transferred to the flocc/thickener/dewatering equipment area, Polymer is to be dosed in the flocc tank, just prior to the thickening process (rotary drum thickener), Steam is to be dosed to the biosolids as the dewatering process begins, raising biosolids temperature to 72 degrees C, Filtrate/Pressate are to be discharge to the City Sewer System, and dewatered biosolids (cake) is to be conveyed and discharged to an on-site truck with trailer.

Projected Quantities:

Lime Dose:

Typically 300 to 400 lbs. quick lime per dry ton of biosolids.
For a 5 dry ton batch, anticipate **2000 lbs. lime** needed per batch

Polymer Dose:

Typically 25 lbs. active polymer per dry ton of biosolids.
Anticipate using a neat polymer emulsion with 50% active polymer (approx.), therefor 50 lbs. neat polymer per dry ton. For a 5 dry ton batch, anticipate 50 x 5 = 250 lbs. neat polymer emulsion needed per batch.
250 lbs. / 8.5 lbs. per gallon = **30 gallons neat polymer emulsion** needed per batch

Make down water dose:

Dilute polymer to 0.5% concentration.
30 gallons at 50% = 3,000 gallons at 0.5%.
For a 5 dry ton batch, anticipate **3,000 gallons of potable water** (City Water) needed per batch

Filtrate and Pressate:

The volume of filtrate and pressate is typically 90% of the raw sewage volume + make down water volume. 40,000 gallons + 3,000 gallons = 43,000 gallons.
43,000 gallons x 90% = **38,700** gallons per batch.

Based on similar process data, it is noted that the filtrate & pressate concentration will typically fall into a range of 170 to 750 mg/L BOD and a range of 34 to 84 mg/L TSS. Based on this data, we anticipate the average concentration will be 460 mg/L BOD and 59 mg/L TSS. This will be discharged through a flow meter device and to the City sewer.

Operation time: It is anticipated that 40,000+/- gallons of septage delivered to the site each day. Individual truckloads will range from 1,000 gallons per load to 6,000 gallons per load. Septage will be stored in a 90,000-gallon concrete equalization tank. Each batch will be limed for at least 24 hours. Each batch will be thickened and dewatered after liming. The thickening and dewatering process will take approximately 18 to 24 hours to complete. In total, it is anticipated that it will take three days to process a single batch. However, a new batch can be started on each consecutive day. For planning purposes, we anticipate that five batches will be processed per week. Each

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batch to consist of approximately 40,000 gallons of raw septage with approximately 1.5% to 3.0% solids concentration.

The anticipated maximum production of the facility is the production of approximately five dry tons of biosolids per day. Over a five-day workweek and a 50-week work year, the Site will produce approximately 1,250 tons of biosolids per year.

Based on WAC 173-308-150, quarterly sampling (four times per year) will be required for biosolids monitoring. This monitoring includes vector attraction reduction requirements (WAC 173-308-180), pathogen density requirements (WAC 173-308-170), and biosolid pollutants listed in Tables 1, 2, and 3 of WAC 173-308-160.

Proposed method for Vector Attraction Reduction will be WAC 173-308-180(4) Alternative 4: pH Adjustment. The pH of the biosolids must be raised to 12 or higher by alkali addition and, without the addition of more alkali, must remain at pH 12 or higher for two hours, and then at pH 11.5 or higher for an additional twenty two hours.

Proposed method for Pathogen Reduction will be WAC 173-308-170(1) Class A – Alternative 1: Time and Temperature. Temperature will be raised to 72 degrees C for a minimum of 30 minutes. The final percentage of solids will be less than 7% of the total.

Percent Solids anticipated:

- Flocc Tank: 1.5% to 3.0%
- Rotary Drum Thickener: 8% to 10%
- Screw Press: 30% to 40%

5.3.1 Septage Facility Monitoring and Reporting

This Septage Facility will require a Biosolids Permit per WAC 173-308 – Biosolids Management. The required monitoring and reporting are identified in this WAC, including an annual report which must be submitted to the Department of Ecology by March 1 of each year (WAC 173-308-295).

The final design plans and specifications will be included with the Biosolids Permit, and submitted to the Department of Ecology. The Department of Ecology anticipates a 180-day processing timeframe for the Biosolids Permit.

Chapter 6. HABITAT MANAGEMENT PLAN

Stanwood Municipal Code requires that development within the 100-year floodplain must also have a Habitat Management Plan prepared. This plan must show how habitat for State- and Federally-listed threatened and endangered species will be protected. The following section describes the current habitat conditions of the Old Stilliguamish River Channel as it pertains to Federally-listed threatened or endangered species.

6.1 Occurrences of Federally-Listed Species

The USFWS and NMFS websites show Federally-listed and proposed endangered and threatened species occurring within the action area for the Site. WDFW maintains a list

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of Priority Habitats and Species. SalmonScape (WDFW) and StreamNet.org both maintain interactive mappers that show stream usage by various listed threatened or endangered species in Washington State (as well as adjacent states). Species potentially present within the ½ mile Action Area include Puget Sound Chinook, coho, steelhead, and bull trout (**Figure 14**). Species potentially affected by incidental take of Puget Sound Chinook and coho salmon include the SRKW population. Species list and status by State and Federal listing is shown on **Table 3,** below.

Table 3. Federally- and State-listed Species

Scientific Name	Common Name	Federal Status	State Status
Oncorhynchus tshawytscha	Puget Sound Fall Run Chinook Salmon	Threatened	Candidate
Oncorhynchus kisutch	Puget Sound Coho Salmon	Species of Concern	None
Oncorhynchus mykiss	Puget Sound Steelhead Trout	Threatened	Candidate
Salvelinus confluentus	Bull Trout	Threatened	Candidate
Orchinus orca	Southern Resident Killer Whale	Endangered	Endangered

6.1.1 Puget Sound Fall Chinook Salmon

6.1.1.1 Habitat Requirements and Population Status

Chinook salmon are found from the Ventura River in southern California up to Point Hope, Alaska. The species is also found from the Anadyr River in the Russian Federation south to Hokkaido, Japan. Puget Sound fall-run Chinook are listed as an Evolutionarily Significant Unit by the National Marine Fisheries Service. Puget Sound fall-run Chinook salmon are documented within the Stilliguamish River drainage basin. Summer and Fall Chinook salmon, which migrate upstream from late July through September, tend to be the most abundant Puget Sound salmon run.

Chinook salmon require gravel-bedded rivers and streams with clear, cold (42-58°F), well-oxygenated waters. The streambed gravels need to be relatively free from silts and fine sands to allow free flow of water and oxygen to eggs deposited in the gravel spaces. Eggs incubate for several weeks to months before hatching as alevins. Juvenile Chinook (fry) emerge from the gravel and either spend hours to several years in freshwater before migrating to the ocean. Juvenile and sub-adult Chinook spend from one to five years in the ocean before returning to freshwater to spawn.

The Stillaguamish River supports both fall and summer Chinook salmon. Fall and summer Chinook enter the Stillaguamish River generally in mid-July and spawn from mid-September through November (Myers, et al., 1998). Critical habitat for Chinook salmon in the Stilliguamish River basin includes riparian zones functionally adjacent to stream channels. Juvenile Chinook may remain in fresh water from a few days to three years (Wydoski and Whitney 1979). Juveniles that remain in fresh water prefer to

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remain in main stem rivers and streams, generally seeking cover in pools and backwaters.

Puget Sound Chinook salmon numbers have been directly impacted by loss of tributary and main stem habitat from dam construction, slough and side-channel habitat from diking, dredging, and hydromodification (Good, *et al*., 2005). Puget Sound Chinook salmon are a Federally-threatened and State candidate species. The Puget Sound population of Chinook salmon was listed as a Federally-threatened species on 16 March 1999. Chinook salmon habitat throughout the Evolutionarily Significant Unit (ESU) is degraded as the result of stream blockages, forest practices impacting upper tributaries, and agriculture and urbanization impacting lower tributaries and main stem rivers.

6.1.1.2 Known Occurrences in the Project Vicinity

The Stillaguamish River is known to support runs of Chinook salmon (Williams, *et al*., 1975). Data from SalmonScape (WDFW) and StreamNet indicate summer and fall Chinook presence in the Stillaguamish River. StreamNet further indicates that the primary usage of the Stillaguamish River in the vicinity of the Site is for spawning and rearing of summer Chinook and migration of fall Chinook. SalmonScape models presences of fall Chinook in Irvine Slough.

6.1.2 Puget Sound Coho Salmon

6.1.2.1 Habitat Requirements and Population Status

Coho salmon occur from Monterey Bay, California north to Point Hope, Alaska, and from the Anadyr River in the Russian Federation south to Hokkaido, Japan. Puget Sound coho are listed as an ESU by NMFS. The majority of streams and rivers without barriers to fish passage that drain into Puget Sound supports runs of coho salmon. The Stilliguamish River is known to support runs of coho salmon.

Most west coast coho salmon enter rivers in October, and spawn from November to December. Coho spawn in the gravel of stream riffles. Eggs will hatch in approximately six to eight weeks as alevins. Fry emerge from the gravel and congregate in schools in stream pools and backwaters. Coho will live in fresh water for up to 15 months, rearing in fresh water before migrating to the ocean. Peak out-migration timing of juvenile coho generally occurs in May. After approximately one year in their natal streams, the coho smolts out-migrate relatively quickly to the open ocean where they live for up to two years before returning as adult spawners.

Coho salmon are at risk due to human-induced changes in critical salmon habitat, typically the streams where coho spawn. These streams are easily impacted by point and non-point pollution, loss of wetland habitat, and loss of vegetative cover. Native coho stocks appear to be diminishing in the face of increased numbers of hatchery-released stock, a stock that threatens the genetic diversity of the ESU. Coho salmon are listed as a Federal species of concern as of 15 April 2004.

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6.1.2.2 Known Occurrences in the Project Vicinity

The Stillaguamish River is known to support runs of coho salmon (Williams, *et al*., 1975). Data from SalmonScape indicate the presence of coho in the Stillaguamish River and modeled presence in Irvine Slough. Data from StreamNet indicate coho presence only in the Old Stilliguamish River Channel for rearing and migration.

6.1.3 Puget Sound Steelhead

6.1.3.1 Habitat Requirements and Population Status

Runs of steelhead trout are present in many streams and rivers that drain into Puget Sound that do not have barriers to fish passage. Spawning generally starts in late March, and is usually completed by early June. Puget Sound steelhead begin life in streams and migrate to seawater as smolts. In Washington, they become smolts between the ages of 2 and 3. They are variable with respect to the time (1-7 years) they spend feeding in freshwater before migrating to the Pacific Ocean (Wydowski and Whitney, 2003). Puget Sound Steelhead is listed as a Federally-threatened species.

6.1.3.2 Known Occurrences in the Project Vicinity

SalmonScape and StreamNet indicate that the Stillaguamish River is utilized by summer-run and winter-run steelhead in the vicinity of the Site. StreamNet indicates that summer- and winter-run steelhead utilize the Stillaguamish River for migration only.

6.1.4 Bull Trout

6.1.4.1 Habitat Requirements and Population Status

The historic range of bull trout has contracted from pre-settlement times to today. Bull trout were found throughout the Columbia River Basin to western Montana, south to the Jarbridge River in Northern Nevada, the Klamath Basin in Oregon, the McCloud River in California, and north to Alberta, British Columbia, and southeastern Alaska. The current range of bull trout is now confined to upper tributary streams. They have been eliminated from main stem rivers and are now extinct in northern California.

Bull trout are native char, most often found in high, glacially-fed watersheds or near cold perennial springs. In Puget Sound, an anadromous component of the bull trout population is also found in estuarine waters near the mouths of natal rivers. Bull trout are able to forage in different river systems, accessing them from the Puget Sound. Bull trout were listed throughout the conterminous United States as a Federally-threatened species on 1 November 1999.

Generally, spawning in most bull trout populations occurs in September and October when water temperatures drop below 9ºC. In this region, the downstream limit of successful char spawning is always upstream of the winter snow line (that elevation at which snow is present on the ground for much of the winter (WDFW, 1999). Fry are usually found in shallow, backwater side channels and eddies. Older, larger individuals are often found in deeper stream pools or in lakes in deep water with temperatures less than 15ºC (Pratt, 1992).

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Bull trout populations have been impacted through destruction of suitable rearing and migration habitat. These fish require cold, clean water. Increased water temperatures, reduced water quality, and reduced stream flows severely impact bull trout populations.

6.1.4.2 Known Occurrences in the Project Vicinity

SalmonScape and StreamNet both indicate bull trout presence in the Stillaguamish River in the vicinity of the Site. StreamNet indicates that bull trout utilization of the Stillaguamish River is for migration only.

6.1.5 Southern Resident Killer Whale

6.1.5.1 Habitat Requirements and Population Status

Southern resident killer whale (SRKW) is included in this BE because the health of this whale population is directly linked with the health of salmon runs. These whales are not known to use any other animals as food (such as other marine mammals or birds). SRKW was listed as endangered on 18 November 2005 (CFR 70 FR 69903). These whales occur primarily in waters off of Washington State and British Columbia during the summer and fall months. The SRKW population declined by approximately 20 percent between the years 1996 and 2001. This decline resulted in a 2003 determination (CFR 68 FR 31980) that the SRKW stock was below its optimum sustainable population and its eventual listing as endangered.

Threats to SRKW include pollution, vessel traffic, and decline in prey base. The decline in prey, notably endangered runs of salmon, may force the whales to spend more time foraging, which, in turn, can reduce reproductive rates and increase mortality rates (CFR 70 FR 69903).

6.1.5.2 Known Occurrences in the Project Vicinity

There are no known occurrences of SRKW in the vicinity of the Site, since the site does not have direct exposure to a marine environment. However, factors that may negatively affect salmon populations in WRIA 5, which includes the Stillaguamish River, can also affect the long-term recovery of SRKW.

6.2 Environmental Baseline Conditions

6.2.1 Existing Environmental Baseline

Information concerning historical land usage is discussed in Section 2.3 of this report. Currently, the site is undeveloped and vegetated mostly with various grass species. Black cottonwood and red alder trees exist along the southern boundary of the Site and extend northward towards the center of the Site. Properties to the west are developed with a single-family residence and an automobile service and repair business.

The ½-mile action area (**Figure 14**) for the Site includes a portion of the Old Stillaguamish River channel (Old Channel) and Irvine Slough. The action area also includes most of the business district of the City of Stanwood, as well as some neighboring farm fields.

The Old Stillaguamish River channel is one of two channels that connect the Stillaguamish River with the Salish Sea (Port Susan area). The source of fresh water for the Old Channel is from the Stillaguamish River, Church Creek, Douglas Slough,

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Miller Creek, and Irvine Slough. However, flow of fresh water into the channel is limited in the summer so that it functioned more like a tidal slough in the past (reference). A reverse tidal gate was installed near the head of the Old Channel in 2003 that acts to enhance the inflow of freshwater. Additionally, the City of Stanwood's wastewater treatment plant, which discharges into the Old Channel, was upgraded in 2004 to improve the quality of water released.

A portion of Irvine Slough originally extended onto the Site at the Site's southwest corner. However, land management practices and the construction of SR-532 have rerouted this portion of the slough. The slough now is located south of SR-532 and southeast of the Site. The slough is mostly disconnected from the Old Stilliguamish River Channel by an earthen dam. Water is currently pumped out of the slough into the Old Stilliguamish River Channel by three-pump station build 35 years ago. This pump station, however, does not have sufficient capacity to handle all the stormwater that flows into the slough. Therefore, a dam (called Larson Dam locally) was built approximately 2,800 ft upstream of the pump station (approximately 1,700 feet west southwest of the Site) to limit the volume of stormwater the pump station needed to handle at any one time (Everett Herald 24 June 2016).

6.2.2 Relationship between Habitat in the Action Area and the Biological Requirements of the Species

The action area for the Site includes portions of the Old Stillaguamish River Channel and Irvine Slough. Irvine Slough, however, does not provide documented habitat for Federally- or State-listed threatened or endangered species. The baseline conditions for the Old Channel are summarized on **Table 4**.

Table 4. Environmental Baseline of the Action Area – Old Stillaguamish River Channel

Pathways	Environmental Baseline(1)		
Indicators	**Properly Functioning**	**At Risk**	**Not Properly Functioning**
		Water Quality	
Temperature		**X(2)**	
Sediment	**X(3)**		
Chemical Contaminants/ Nutrients			**X(4)**
		Habitat Access	
Physical Barriers	**X(5)**		
		Habitat Elements	
Substrate		**X(6)**	
Large Woody Debris		**X(7)**	
Pool Frequency		**X(8)**	
Pool Quality		**X(9)**	
Off-channel Habitat			**X(10)**

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Pathways	Environmental Baseline(1)		
Indicators	**Properly Functioning**	**At Risk**	**Not Properly Functioning**
Refugia			**X(11)**
Channel Condition and Dynamics			
Width/Depth Ratio		**X(12)**	
Streambank Condition			**X(13)**
Floodplain Connectivity		**X(14)**	
Flow/Hydrology			
Peak/Base Flows		**X(15)**	
Drainage Network Increase		**X(16)**	
Watershed Conditions			
Road Density and Location		**X(17)**	
Disturbance History			**X(18)**
Riparian Reserves			**X(19)**

1) This table briefly summarizes the baseline environmental quality of the "action area" (modified from National Marine Fisheries Service, 1996).
2) Temperature in parts of the Stilliguamish River frequently exceeded the temperature criteria required for the health and survival of salmon. However, temperature within the Old Stilliguamish River Channel is listed as a Category 2 water, meaning that exceedances have occurred, but are not sufficient to warrant remedial action.
3) Washington State Water Quality Standards require that levels of turbidity for Core Summer Habitat not exceed 5 NTUs when background turbidity is less than 50 NTUs. Washington Department of Ecology does not list any 303(d) exceedances of the Stilliguamish River for turbidity.
4) Water quality data provided by the Washington Department of Ecology's 303(d) list indicates that the reach of the Stilliguamish River within the action area is a Category 5 water dissolved oxygen.
5) There are no fish barriers on the Stilliguamish River from its mouth at the Salish Sea to the action area.
6) The Stilliguamish River has a continuous source of new substrate from erodible material located at its headwaters. However, land use practices (i.e., agriculture, drainage ditches, and bank armoring) in the lower reaches can alter the natural movement of bed material through excessive scouring or embedding of gravel.
7) Logging and agriculture have altered the ability of the Stilliguamish River to recruit new large woody debris. Some material is still available in the upper reaches where logging has not occurred recently. New material is scarce in the lower reaches where land adjacent to the river has been under agricultural uses for many decades.
8) The Old Stilliguamish River Channel is contained within levees, receives a limited amount of water from the main Stilliguamish River channel, and is affected by daily tides. The net effect is that stream flows are frequently insufficient to flush out sediments within the Old Stilliguamish Channel. .
9) Same as #8 above.
10) The Old Stilliguamish River channel flows through agricultural lands. These areas are protected from minor flooding by levees. The Old Stilliguamish River Channel is disconnected from any off-channel habitat.
11) Same as #10 above.
12) The Old Stilliguamish River Channel is confined by low levees, but is still able to extend floodwaters into a floodplain.
13) The stream banks along the Old Stilliguamish River Channel are poorly vegetated. Vegetation typically consists of reed canarygrass and non-native blackberries. There are very few native trees or shrubs along the streambank.
14) Levees have been constructed along the banks of the Stilliguamish River, including the Old Stilliguamish River Channel. However, the river is still able to flow into its historical flood plain during large storm events.
15) Logging in the upper reaches and the construction of drainage ditches on agricultural lands can have the effect of altering the flow dynamics of a river system. Continued logging in the headwater areas for the Stilliguamish River could result in higher than normal peak flows.
16) Agriculture has already altered the drainage network of the lower reaches of the Stilliguamish River. This alteration can be considered stable provided that these agricultural lands are not converted to other uses, such

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as commercial, industrial or residential.

17) See #16 above.
18) The lower Stilliguamish River reach has been significantly modified since the time of European colonization. The Stilliguamish River valley from the City of Arlington westward to its confluence with the Salish Sea has been modified for agricultural uses.
19) There is, for all practical purposes, no intact riparian reserve system for the lower Stilliguamish River, or the Old Stilliguamish River Channel. Most of the historic floodplain has been converted to agriculture, uses. Vegetation along the stream banks consists predominantly of non-native low-growing species. The community composition along the stream banks is relatively poor.

6.2.3 Stilliguamish River Watershed

The Stilliguamish River Watershed includes an area approximately 684 square miles in size. The river, itself, starts as two forks near the ghost town of Monte Cristo. The south fork of the Stilliguamish River begins at Three Fingers Mountain. The south fork of the Stilliguamish River flows in a westerly direction towards the City of Granite Falls, then in a northwesterly direction to the City of Arlington.

The north fork of the Stilliguamish starts as glacial and snow meltwater from Whitehorse Mountain, near the City of Darrington. The north fork of the Stilliguamish River flows in a westerly direction towards the City of Arlington.

The north and south forks of the Stilliguamish River combine at the north end of the City of Arlington and flows in a westerly direction towards the Salish Sea near the City of Stanwood. The River divides just west of I-5 with the main river flow in the northern channel and the remainder of the flow through Cook Slough. The Stilliguamish River and Cook Slough recombine approximately 2 ¼ miles to the west.

The Stilliguamish River forks again approximately 2 ¾ miles west of the confluence of the main Stilliguamish River channel and Cook Slough. Historically, the Stilliguamish River flowed north to Skagit Bay, north of Camano Island with a smaller flow through Hatt's Slough emptying into Port Susan. However, flooding in the past has diverted most of the Stilliguamish River's flow through Hatt's Slough, with a minor amount of flow in what is now called the Old Stilliguamish River Channel.

6.2.3.1 Water Quality

Water quality of the Old Stilliguamish River Channel in the action area is rated At Risk to Not Properly Functioning for water quality parameters. Data collected for the 2014 303(d) list of impaired waters in Washington State identified the Stilliguamish River as a Category 5[2] water for dissolved oxygen exceedances, with Category 5 impaired water flowing in from Church Creek (dissolved oxygen and pH). Juvenile salmon require relatively cool, well-oxygenated water to survive while rearing. While water temperature within the Old Stilliguamish River Channel is a concern (Category 2 water rating), exceedances from State water quality standards are not severe enough to warrant the preparation of a Water Quality Improvement project. The Old Stilliguamish River Channel was rated as Properly Functioning for sediments.

[2] The State of Washington rates water quality on a scale of 1 to 5 for various pollutant categories. Category 1 indicates pristine waters meeting State water quality standards for a pollutant. Category 5 is an impaired water requiring a management plan to rectify.

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6.2.3.2 Habitat Access and Connectivity

The Stilliguamish River was rated as Functioning Properly for Habitat Access. There are no man-made barriers to fish migration from the Salish Sea to the action area.

6.2.3.3 Habitat Elements

The Stilliguamish River was rated as At Risk for the Substrate, Large Woody Debris, Pool Frequency, and Pool Quality pathway indicators, and Not Properly Functioning for Off-channel Habitat and Refugia. The headwater areas for the north and south forks of the Stilliguamish River are relatively unaltered, save for some logging operations within the National Forest. These relatively unaltered areas provide substrate material and large woody debris recruitment. However, continued logging can alter the precipitation runoff into the river, increasing the potential for higher than normal peak flows. This condition could scour out existing bed load or cause increased deposition of gravel within existing pools. Similarly, logging reduces the availability of large woody material for recruitment into the river. Forests in Washington State that have been clear-cut must be replanted within three years of harvest. However, it takes many decades for these trees to reach a size where they could be considered an important source of large woody debris.

6.2.3.4 Channel Conditions and Dynamics

The reach of the Old Stilliguamish River Channel in the action area was rated as At Risk for width/depth ratio and floodplain connectivity and Not Functioning Properly for Streambank Condition. The Stilliguamish River is lined with levees throughout most of its reach from the City of Arlington west to the Salish Sea. These levees, however, do get overtopped by floodwaters during heavy precipitation events. We rated the Streambank Condition to be Not Functioning Properly due to the levees and the general lack of native tree and shrub vegetation.

6.2.3.5 Flow/Hydrology

The headwater areas for the north and south forks of the Stilliguamish River are still relatively intact. Recent changes in climate and lower-than-expected snowpack currently lower the amount of water available to the Stilliguamish River. Transformation of the Stilliguamish River Valley to agricultural uses has also contributed to the alteration of historical flow conditions.

We have rated the Flow/Hydrology condition of the Stilliguamish River as At Risk. While changes in seasonal precipitation are a natural condition, continued logging in the headwater areas of the Stilliguamish River and its major tributaries could negatively impact river flow and hydrology.

6.2.3.6 Watershed Conditions

The Stilliguamish River was rated as At Risk for Road Density and Location, and Not Functioning Properly for Disturbance History, and Riparian Reserves. The Stilliguamish River Valley is developed mostly for agricultural purposes. The existing road network is not as extensive as more industrialized or residential area. However, as urban development pushes out, the conditions of the watershed could deteriorate.

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The Site itself does not contain habitat for listed threatened or endangered species. The nearest potential critical area that could provide such habitat is Irvine Slough, which is located along the south right-of-way for SR-532. As mentioned previously in **Section 4.1**, Irvine Slough is not documented as providing habitat for threatened or endangered fish species, nor is it likely for threatened or endangered species to access the slough except under extreme flooding events. Water quality within the slough is very likely to affect the quality of habitat of the Stilliguamish River downstream if its confluence with Irvine Slough.

No development activities are proposed on or adjacent to Irvine slough. SR-532 effectively separates the Site from Irvine slough, thereby preventing habitat conditions on the Site to provide significant value for fish and wildlife habitat, shade and temperature control, woody debris recruitment, water quality improvements, erosion control, and recreational or educational opportunities. There will be no increase in effective impervious surfaces within 300 feet and no development whatsoever within 150 feet of the slough.

6.3 Effects Analysis

The Effects Analysis is limited to habitat pathways associated with the Old Stilliguamish River Channel. Irvine Slough is mapped as having modeled presence of Federally-listed threatened or endangered salmonid species. However, the mouth of Irvine Slough is blocked at its confluence with the Old Stilliguamish River Channel by a man-made berm. Water is actively pumped from Irvine Slough to the Old Stilliguamish River Channel. Federally-listed threatened or endangered salmonid species would only have access to Irvine Slough during times of major flooding. Therefore, only the Effects Matrix for Old Stilliguamish River Channel is included on **Table 5**.

Table 5. Effects of Projected Actions

Pathways	Environmental Baseline			Effects of Projected Actions on Environmental Conditions		
Indicators	**Properly Functioning**	**At Risk**	**Not Properly Functioning**	**Improved**	**Maintained**	**Degraded**
Water Quality						
Temperature		**X(1)**			**X(1)**	
Sediment	**X(2)**				**X(2)**	
Chemical Contaminants/ Nutrients			**X(3)**		**X(3)**	
Habitat Access						
Physical Barriers	**X(4)**				**X(4)**	
Habitat Elements						
Substrate		**X(5)**			**X(5)**	
Large Woody Debris		**X(6)**			**X(6)**	
Pool Frequency		**X(7)**			**X(7)**	

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Pathways	Environmental Baseline			Effects of Projected Actions on Environmental Conditions		
Indicators	**Properly Functioning**	**At Risk**	**Not Properly Functioning**	**Improved**	**Maintained**	**Degraded**
Pool Quality		**X(8)**			**X(8)**	
Off-channel Habitat			**X(9)**		**X(9)**	
Refugia			**X(10)**		**X(10)**	
Channel Condition and Dynamics						
Width/Depth Ratio		**X(11)**			**X(11)**	
Streambank Condition			**X(12)**		**X(12)**	
Floodplain Connectivity		**X(13)**			**X(13)**	
Flow/Hydrology						
Peak/Base Flows		**X(14)**			**X(14)**	
Drainage Network Increase		**X(15)**			**X(15)**	
Watershed Conditions						
Road Density and Location		**X(16)**			**X(16)**	
Disturbance History			**X(17)**		**X(17)**	
Riparian Reserves			**X(18)**		**X(18)**	

1) Temperatures recorded in the Old Stilliguamish River Channel frequently exceed State water quality limits. The scope of the project is too small to have an effect on water temperature throughout most of the watershed. The Effects of the Projected Actions is “Maintained.”
2) No work within the ordinary high water mark of the Old Stilliguamish River Channel will occur. The Effects of the Projected Actions is “Maintained.”
3) The construction project design protects against additional inputs of chemical contaminants and nutrients. The finished project will not increase inputs of chemical contaminants and nutrients. The Effects of the Projected Actions is “Maintained.”
4) There are no known physical barriers to fish migration from the Salish Sea to the action area. No activities will occur in the Old Stilliguamish River Channel that will create physical barriers to fish migration. Therefore, the Effects of the Projected Actions is “Maintained.”
5) No activities will occur within the ordinary high water mark of the Old Stilliguamish River Channel. There will be no change in the substrate of the river within the action area. Therefore, the Effects of the Projected Actions is “Maintained.”
6) The reach of the Old Stilliguamish River Channel within the action area is At Risk in terms of numbers of LWD per river mile. It should be noted that the banks of the Old Stilliguamish River Channel in the action area do not have sufficient tree cover to provide local recruitment of LWD. No work is planned to install LWD within the Old Stilliguamish River Channel or increase the number of streambank trees. The Effects of the Projected Actions is “Maintained.”
7) Changes in stream hydrology caused by upstream sediment deposition have altered the frequency of pools within the Old Stilliguamish River Channel. Pool frequency within the watershed is beyond the scope and scale of the proposed project. The Effects of the Projected Actions is “Maintained.”
8) Pool quality within the Old Stilliguamish River Channel watershed is affected by many of the same factors as pool frequency. Pool quality issues within the watershed are beyond the scope and scale of the proposed

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project. The .Effects of the Projected Actions is “Maintained.”

9) Off-channel habitat is generally lacking within the Old Stilliguamish River Channel. This lack of off-channel habitat is beyond the scope and scale of the proposed project. The Effects of the Proposed Actions is “Maintained.”
10) Refugia is generally lacking within the Old Stilliguamish River Channel. See #9 above. The Effects of the Proposed Actions is “Maintained.”
11) The channel width to depth ratio was determined to be At Risk. The proposed project will not alter the Old Stilliguamish River Channel and will have no effect on the width to depth ratio. The Effects of the Proposed Actions is “Maintained.”
12) Decades of agricultural land uses adjacent to the Old Stilliguamish River Channel have significantly altered the vegetation community of the streambank. The banks are currently vegetated predominantly by non-native grasses and blackberries. No work is planned within the ordinary high water mark for the Old Stilliguamish River Channel. The Effects of the Projected Actions is “Maintained.”
13) The construction of relatively low levees along the Lower Old Stilliguamish River Channel aids in preventing minor flooding of the adjacent agricultural lands. However, the Stilliguamish River, including the Old Stilliguamish River Channel, is able to flood into its historical floodplain during heavy precipitation events. No work will occur within the ordinary high water mark of the Old Stilliguamish River Channel that might otherwise affect floodplain continuity. The Effects of the Proposed Actions is “Maintained.”
14) Logging in the upper reaches of the Stilliguamish River and drainage improvements on agricultural lands has altered the peak/base flow hydrograph of the Stilliguamish River, including the Old Stilliguamish River Channel. The proposed project will not affect peak or base flows for the Old Stilliguamish River Channel. The Effects of the Proposed Actions is “Maintained.”
15) The primarily agricultural uses of the lower reaches of the Stilliguamish River have significantly altered the drainage within the lower Stilliguamish River floodplain. The proposed project will not increase or decrease the drainage network in any appreciable way. The Effects of the Proposed Actions is “Maintained.”
16) The primarily agricultural use of the lower reaches of the Stilliguamish River has increased the density of the road network compared to pre-European settlement conditions. However, the same predominantly agricultural uses restrict the increase of road density within the floodplain. The Effects of the Proposed Actions is “Maintained.”.
17) The current agricultural land uses along the Old Stilliguamish River Channel provides a high level of historic disturbance. The proposed project will neither increase nor decrease the amount of disturbance in any appreciable way. The Effects of the Proposed Actions is “Maintained.”
18) Same as Item #13 above. The proposed project will not create any new riparian reserves. The Effects of the Proposed Actions is “Maintained.”

6.3.1 Construction Effects (Direct Effects)

The potential direct effects from redevelopment of the project include temporary increases in dust, noise, and exhaust from construction equipment. These potential impacts are likely to be localized to and contained within the construction site through implementation of Best Management Practices (pursuant to TESC protocols). There will be no direct impacts to Federally- or State-listed threatened or endangered species resulting from the proposed project.

6.3.2 Potential Operational Effects

The proposed Stanwood Septage Receiving Plant will not have any increase in effects on habitat within the action area above current levels. It is likely that improvements in stormwater management and onsite treatment may reduce the amounts of contaminants from the Site (sediments, oils, heavy metals, etc.). It is likely that any reduction of contaminant release from the proposed business center will have a negligible effect on the surrounding natural habitats and will have no effect on the Old Stilliguamish River Channel.

6.3.3 Indirect (Long-term Effects)

The long-term viability of anadromous fish in the Stilliguamish River watershed is affected by the levels of development within the watershed. The upper reaches of the Stilliguamish in the vicinity of its headwaters, is at risk of increasing sediment loading

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and runoff from logging practices. The lower Stilliguamish River is currently impacted by existing agricultural practices, including drainage, sediment runoff from tilled fields, and the use of agricultural chemicals. These factors impact the ability of the Stilliguamish River to support healthy populations of anadromous fish.

The proposed project will not increase the amount of developmental impact to the Stilliguamish River. In essence, the developmental footprint will remain the same. Improvements in stormwater management and treatment, reduced-impact building techniques, and other pollution reduction technologies either implemented by the septage receiving plant or indirectly by society may reduce some of the impacts to the Old Stilliguamish River Channel locally in the long-term. Such factors are difficult to quantify at this time. It is our conclusion that the proposed project will not increase the indirect, or long-term, impacts on the Old Stilliguamish River Channel.

6.3.4 Cumulative Impacts

Development on the banks of the Old Stilliguamish River Channel in the vicinity of the action area is mostly agricultural. As land values in the Valley change, it is possible that agriculture will not be a viable economic use of the land. It is likely that the agricultural uses could be replaced by other, more high-intensity land uses (residential, commercial, or industrial). These types of land use would increase the human-made impact on the Old Stilliguamish River Channel and could impact Federally- and State-listed threatened or endangered species.

6.4 Determination of Effects

The essence of an effects determination is to evaluate a proposed action on a listed species, or “take.” Take is defined by Section 3 of the Endangered Species Act as “to harass, harm, pursue, hunt, shoot, would, trap, capture, collect, or attempt to engage in any such conduct. The US Fish and Wildlife Service further defines “harm” as “significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. The USFWS further defines “harass” as “actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to. Breeding, feeding, or sheltering.”

The different effects determinations possible for a proposed project are: no effect, may affect, but is not likely to adversely affect, may adversely affect, and likely to adversely affect. A “no effect” determination states that the proposed project will in no way affect the listed species. This determination is appropriate for cases where it can be conclusively shown that nothing occurring within the action area will alter the viability of a listed species, or that a listed species is not within the watershed, or that critical habitat for a species is not included within the action area. Failing that level of connection, the proposed action must be determined to affect a listed species. This is not always a bad thing. An action may improve habitat quality for a listed species. This is still an effect. For those instances where a positive affect will occur, or that a negative effect will result in a negligible probability of a take of a listed species, the determination must be “may affect, but is not likely to adversely affect.” For actions that

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create conditions where there is more than a negligible probability of a take of a listed species, the determination must be “likely to adversely affect.”

6.4.1 Puget Sound Fall Chinook Salmon

Puget Sound Fall Chinook utilize the Old Stilliguamish River channel within the action area for migration, spawning, and rearing. We anticipate that the proposed project will not affect the ability for Chinook salmon to spawn, migrate, or rear in the Old Stilliguamish River Channel in any demonstrable way. It is expected that the proposed action ***may affect,*** but is ***not likely to adversely affect (NLAA)*** Puget Sound Fall Chinook salmon.

6.4.2 Puget Sound Coho Salmon

Puget Sound coho salmon are known to utilize the Stilliguamish River, including the Old Stilliguamish River Channel, for migration and rearing. We anticipate that the proposed project will not alter the habitat conditions in any demonstrable way that would negatively affect the ability of coho salmon to rear or migrate in the Stilliguamish River. It is expected that the proposed action ***may affect,*** but is ***not likely to adversely affect (NLAA)*** Puget Sound coho salmon.

6.4.3 Bull Trout

Bull trout are known to utilize the Stilliguamish River for migration. We anticipate that the proposed project will not affect the ability of bull trout to migrate through the action area in the Old Stilliguamish River Channel. It is expected that the proposed action ***may affect***, but is ***not likely to adversely affect (NLAA)*** bull trout.

6.4.4 Southern Resident Killer Whale

The long-term viability of the southern resident killer whale population in the Puget Sound region is directly tied with the long-term health of Puget Sound salmon stocks. We do not anticipate any adverse affects to existing salmon stocks within the Stilliguamish River basin resulting from the proposed project. Therefore, by extension, we do not anticipate any affects to populations of SRKW resulting from the proposed project. It is expected that the proposed action ***may affect***, but is ***not likely to adversely affect (NLAA)*** populations of southern resident killer whales.

Chapter 7. SUMMARY

The Client proposes to construct a septage receiving plant on approximately 1.73 acres of an approximately 3.4-acre property. The plant will consist of an operations building, pump stations, and treatment tanks and will occupy approximately 2,369 CY of a 100-year floodplain. Mitigation for flood storage loss will be provided by creating approximately 2,652 CY of new flood storage on the Site in an area of high ground. The Site does not provide, nor is adjacent to critical habitat for State- or Federally-listed threatened or endangered species. There will be no effect to known populations of threatened or endangered species resulting from the development of this property.

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Chapter 8. REFERENCES

City of Stanwood. 2016. Stanwood Municipal Code. (www.codepublishing.com/wa/stanwood)

Cowardin, Lewis M., Virginia Carter, Francis C. Golet, and Edward T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service.

Hitchcock, C. Leo, Arthur Cronquist, Marion Owensby, and J. W. Thompson. 1969. *Vascular Plants of the Pacific Northwest.* Seattle: University of Washington Press.

Iowa State University. 1995. *Hydric Soils of Washington State.* U.S. Department of Agriculture, Natural Resources Conservation Service.

Lichvar, R.W. 2012. *The National Wetland Plant List.* ERDC/CRREL TR-12-11, Hanover, NH: U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory. http://acwc.sdp.sirsi.net/client/search/asset:asset?t:ac=$N/1012381.

Natural Resources Conservation Service. 2012. *National Technical Committee for Hydric Soils - Hydric Soils List.* April. Accessed January 2016. http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/.

Sprecher, S. T., and A. G. Warne. 2000. *Accessing and Using Meteorological Data to Evaluate Wetland Hydrology. ERDC/EL TR-WRAP-00-1.* Technical Report, U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. 2005. *Technical Standard for Water-Table Monitoring of Potential Wetland Sites. WRAP Technical Notes Collection (ERDC TN-WRAP-05-2.* Technical Note, Vicksburg, MS: U.S. Army Reseach and Development Center.

U.S. Department of Agriculture. 1991. *Hydric Soils of The United States.* Washington, DC: Soil Conservation Service.

U.S. Fish and Wildlife Service. 1983. "National Wetlands Inventory Map." Stanwood Quadrangle.

Washington Department of Fish and Wildlife. 2008. *Priority Species and Habitats .* Report in the Vicinity of T32, R04E, S19, Olympia: WDFW.

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FIGURES

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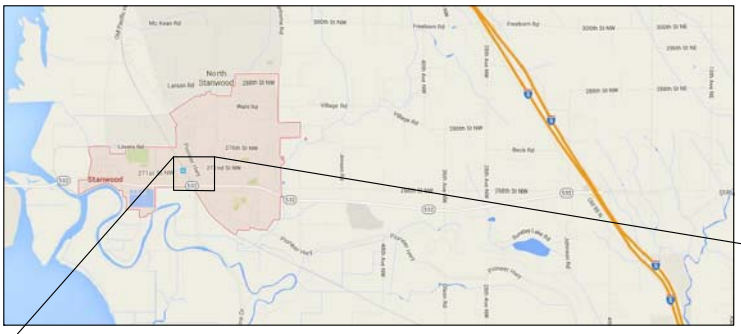

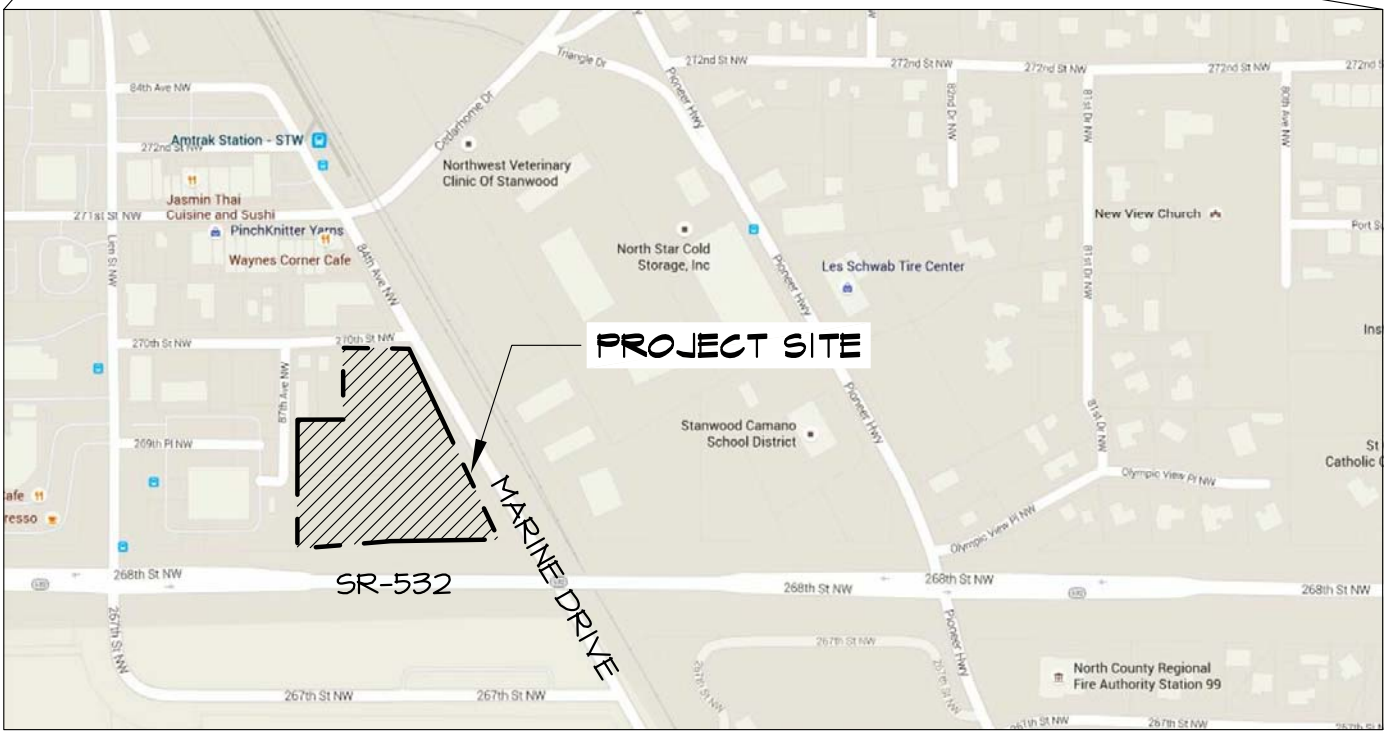

IMAGE SOURCE: GOOGLE MAPS, WWW.MAPS.GOOGLE.COM (ACCESSED 1 FEB 2016)

DRIVING DIRECTIONS:

1. FROM EVERETT WASHINGTON TAKE I-5 NORTH TOWARD VANCOUVER, BC
2. TAKE EXIT 212, FOR WA-532 WEST.
3. CONTINUE ONTO WA-532 WEST TOWARD CAMANO ISLAND/STANWOOD
4. TURN RIGHT ONTO PIONEER HWY
5. TURN LEFT ONTO CEDARHOME DRIVE NW
6. TURN LEFT ONTO 84TH AVE NW IN STANWOOD.
7. ARRIVE AT DESTINATION ON YOUR FIRST RIGHT.
8. TAKE FIRST RIGHT ONTO 270TH STREET NW TO ACCESS DESTINATION.

APPROXIMATE DESTINATION ADDRESS:
26782 84TH AVE NW
STANWOOD, WA 98292

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15020 Bear Creek Road Northeast
Woodinville, Washington 98077
Bus (425)861-7550 - Fax (425)861-7549

FIGURE #1

VICINITY MAP & DIRECTIONS
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		1
REVISED		

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SOURCE: GOOGLE EARTH (IMAGE DATE JULY 2014)

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FIGURE #2

MONITORING WELL LOCATION MAP
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

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SCALE NTS		
DATE 4-15-2016		2
REVISED		

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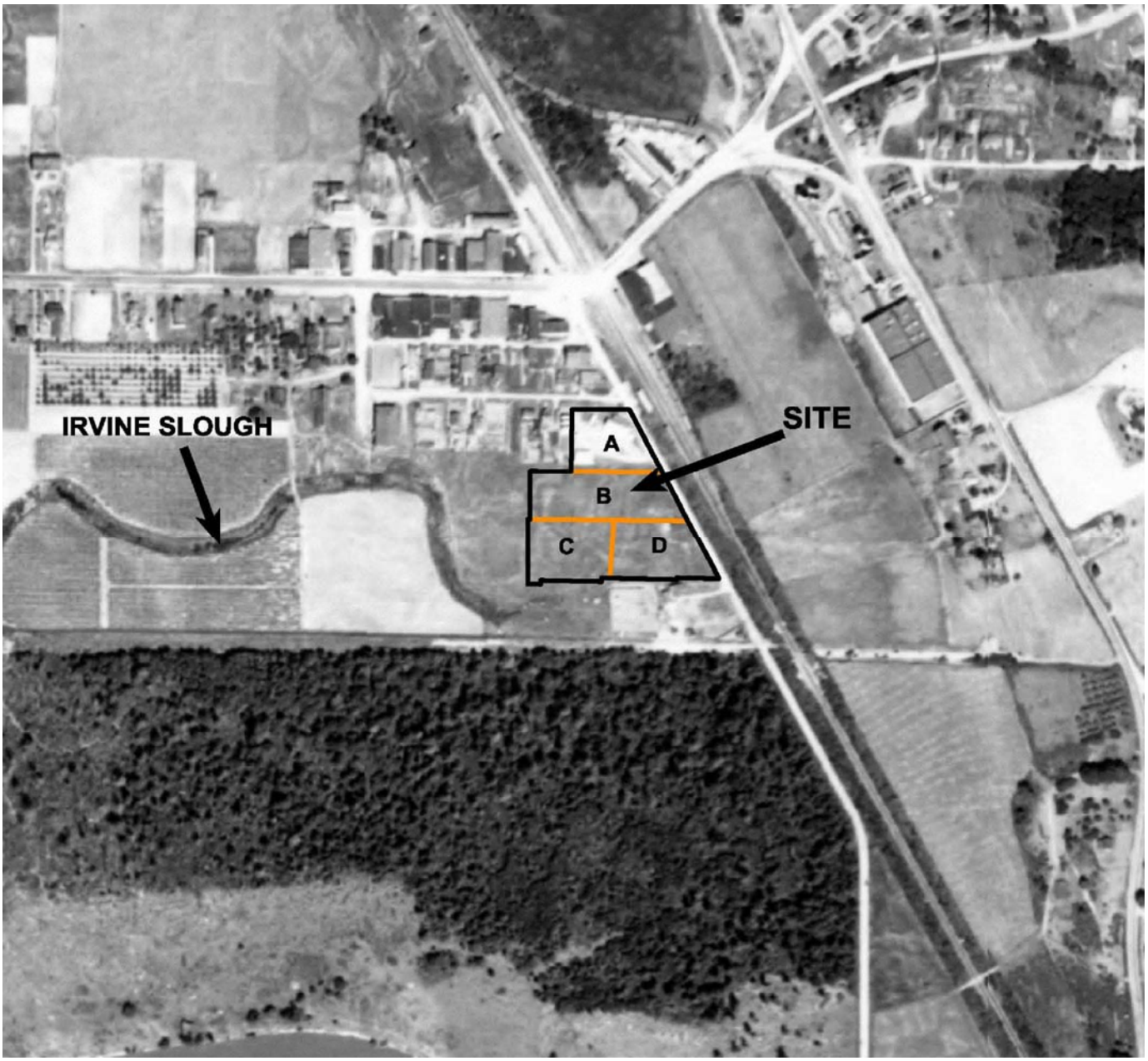

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FIGURE #3

SITE CONDITIONS IN 1933
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		3
REVISED		

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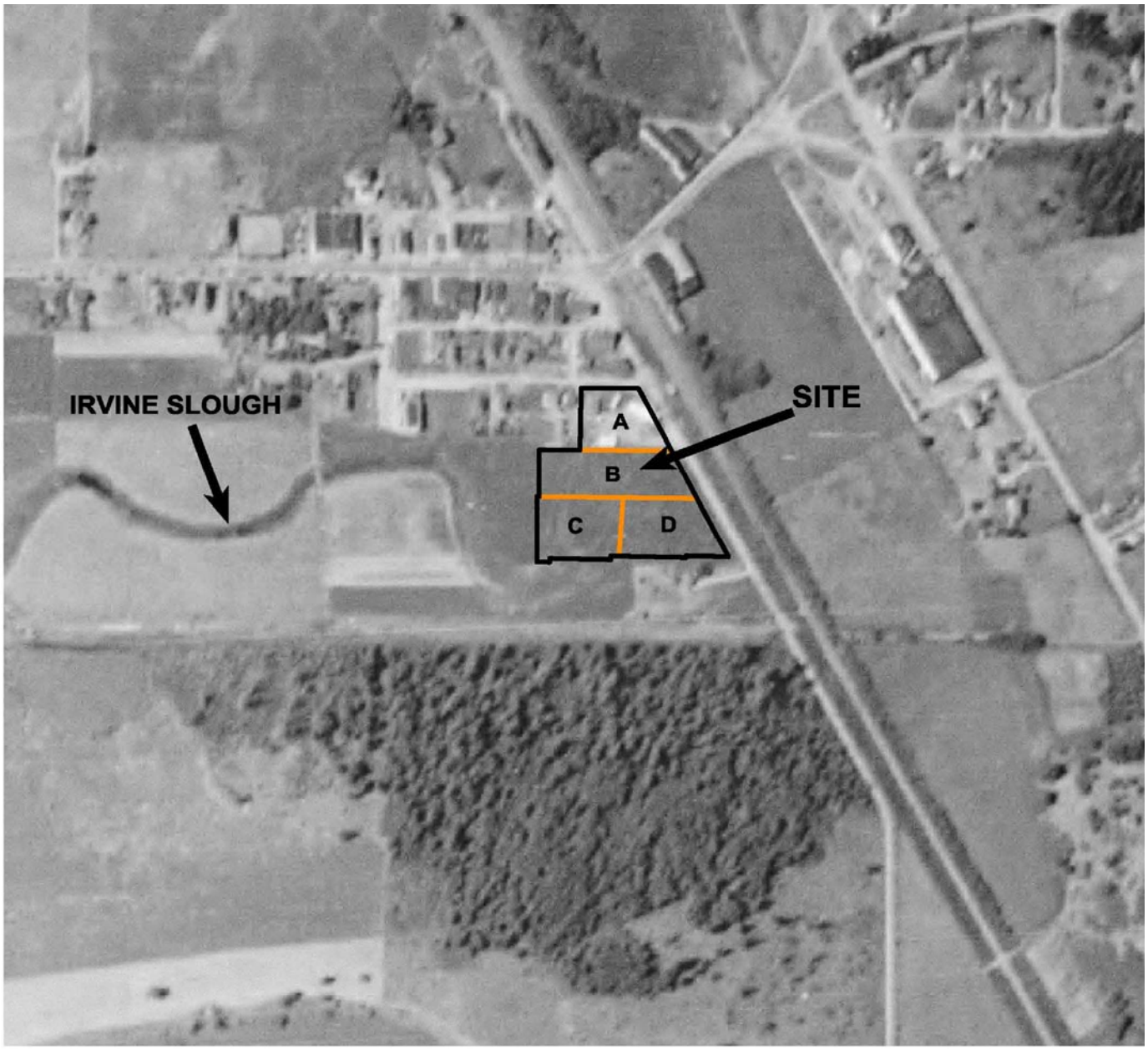

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FIGURE #4

SITE CONDITIONS IN 1941
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

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	ABS	1536
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DATE	4-15-2016	
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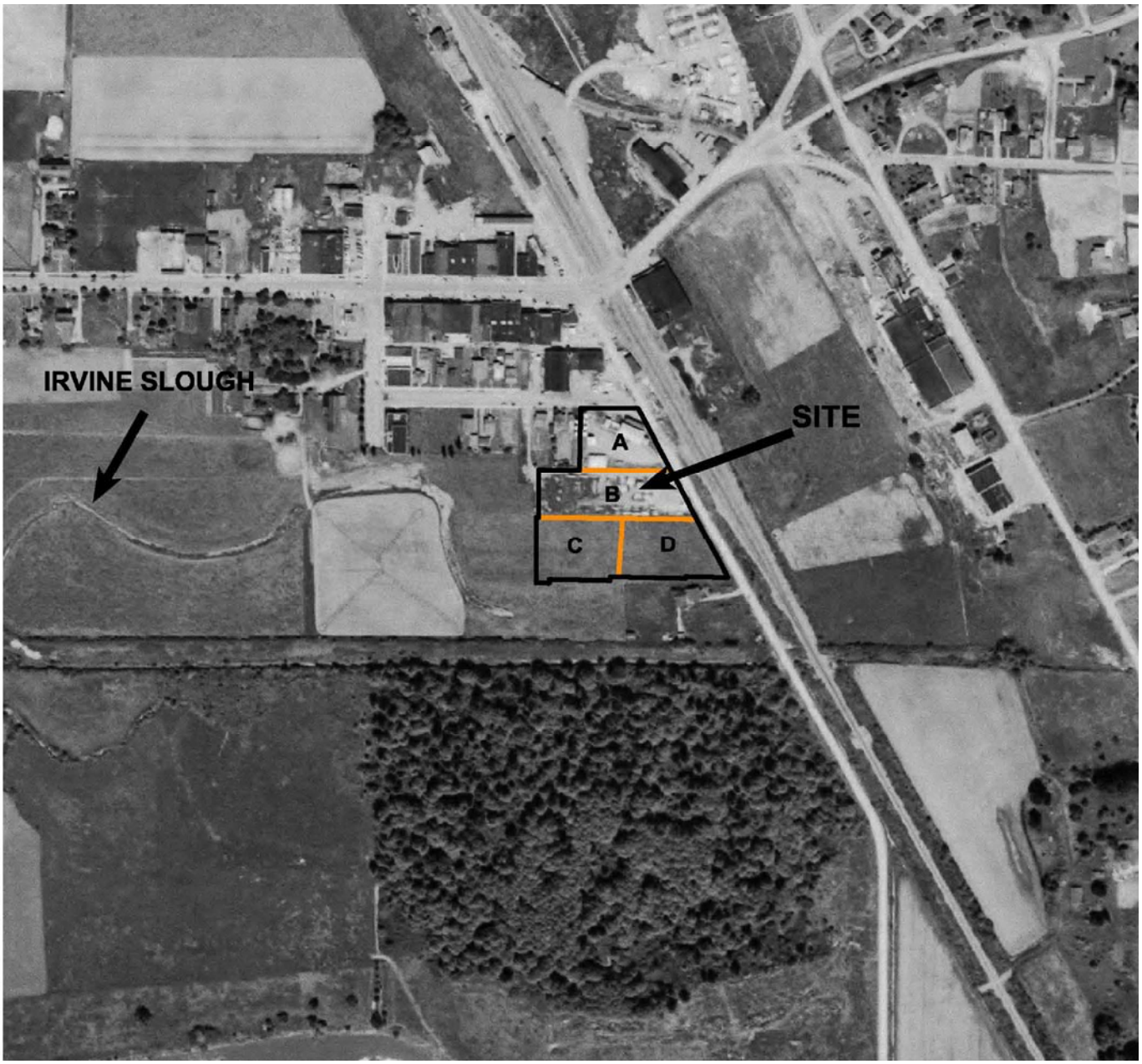

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FIGURE #5

SITE CONDITIONS IN 1954
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		5
REVISED		

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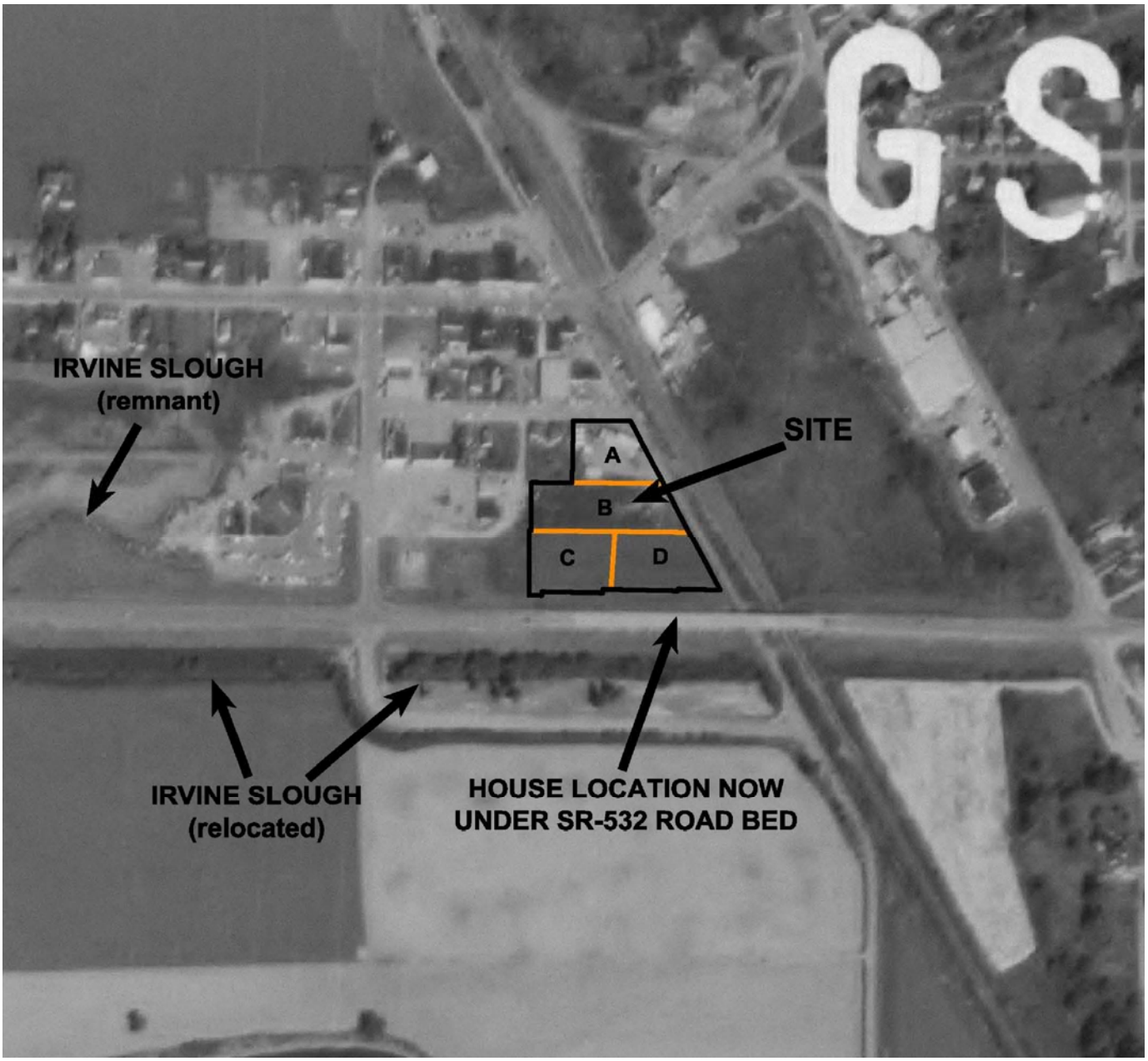

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FIGURE #6

SITE CONDITIONS IN 1968
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

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	ABS	1536
SCALE NTS		
DATE 4-15-2016		6
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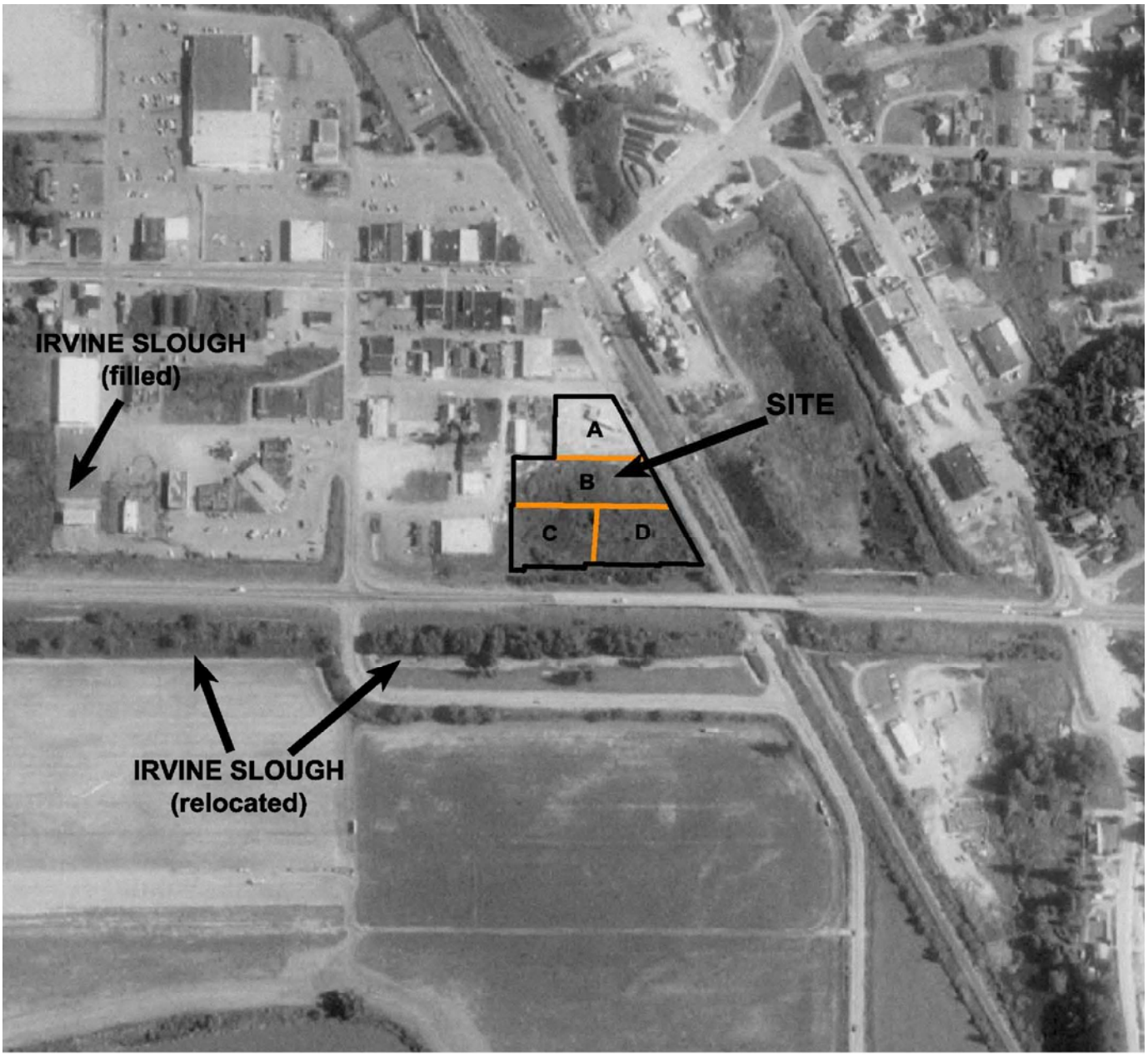

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FIGURE #7

SITE CONDITIONS IN 1990
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		7
REVISED		

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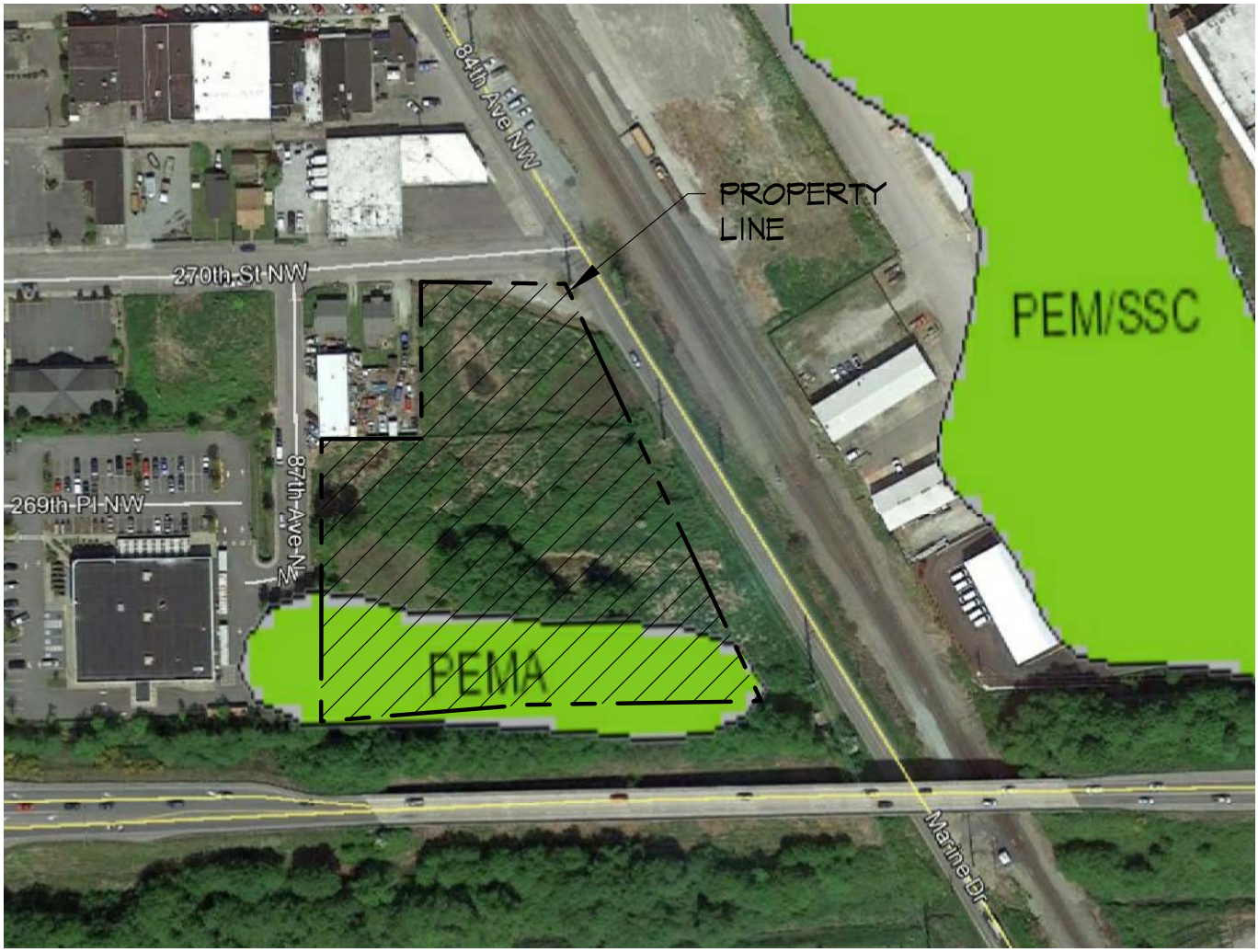

LEGEND

TYPE	DESCRIPTION
PEMA	PALUSTRINE EMERGENT TEMPORARY FLOODED

SOURCE: U.S. FISH AND WILDLIFE SERVICE, (JAN 2015). NATIONAL WETLANDS INVENTORY WEBSITE, U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE, WASHINGTON D.C. http://www.fws.gov/wetlands/data/wetland-codes.html (ACCESSED 4/1/2016)

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FIGURE #8

NATIONAL WETLAND INVENTORY
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

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LEGEND

TYPE	DESCRIPTION, SLOPES
55	PUGET SILTY CLAY LOAM

SOURCE: SOIL SURVEY STAFF, NATURAL RESOURCES CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, WEB SOIL SURVEY. AVAILABLE ONLINE AT http://websoilsurvey.nrcs.usda.gov/. ACCESSED (MONTH/DAY/YEAR).

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FIGURE #9

NRCS
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

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	ABS	1536
SCALE NTS		
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REVISED		

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IMAGE SOURCE: SNOHOMISH COUNTY GIS, ACCESSED 2014
EARTH EXPLORER 2009, DOWNLOADED 2016

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FIGURE #10

SNOHOMISH COUNTY CRITICAL AREA
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		10
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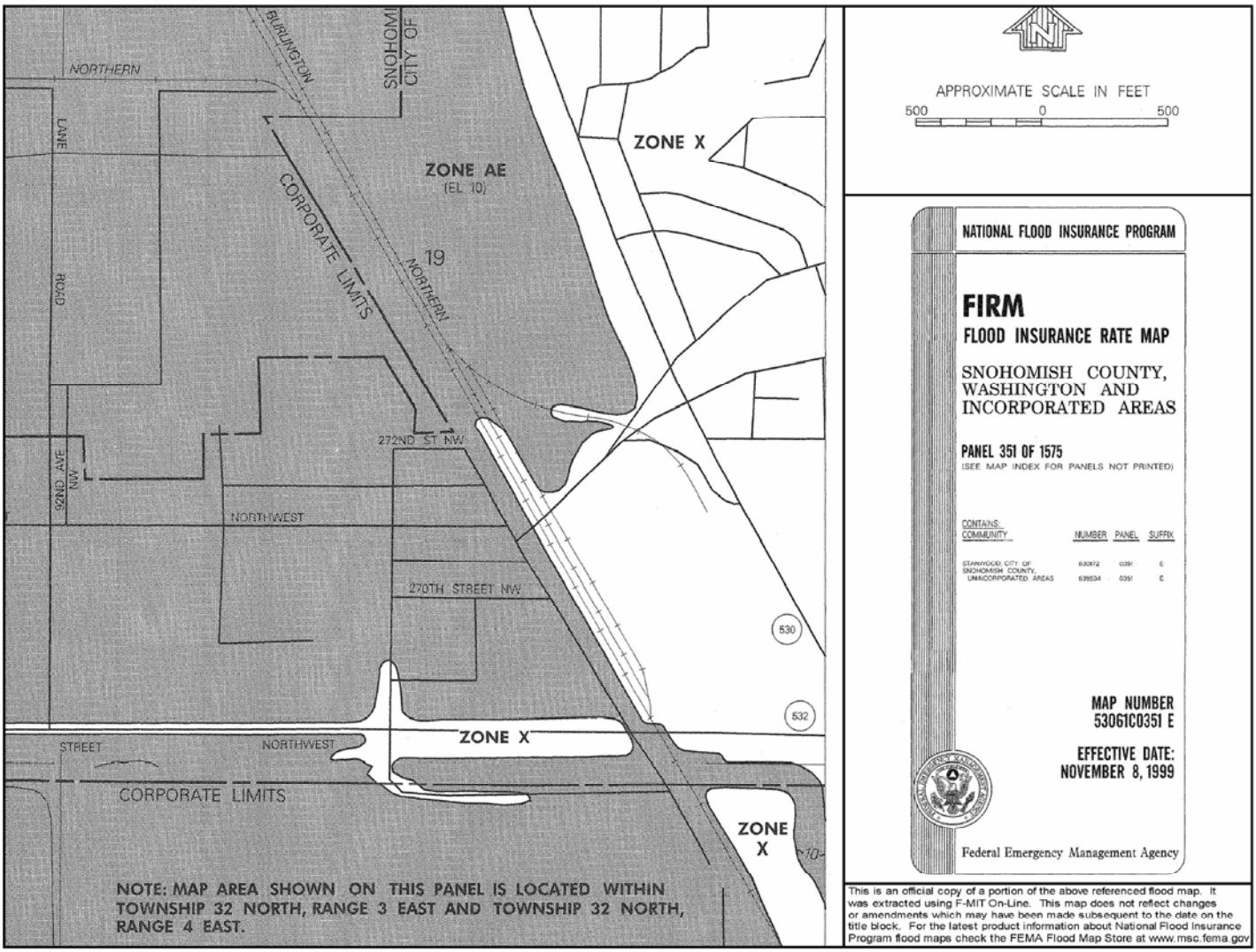

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FIGURE #11

FEMA FLOOD PLAIN
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		11
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AERIAL IMAGE SOURCE: IMAGE DATE JULY 2014 GOOGLE EARTH, ACCESSED 4/1/2016

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FIGURE #12

EXISTING CONDITIONS OVERVIEW
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		12
REVISED		

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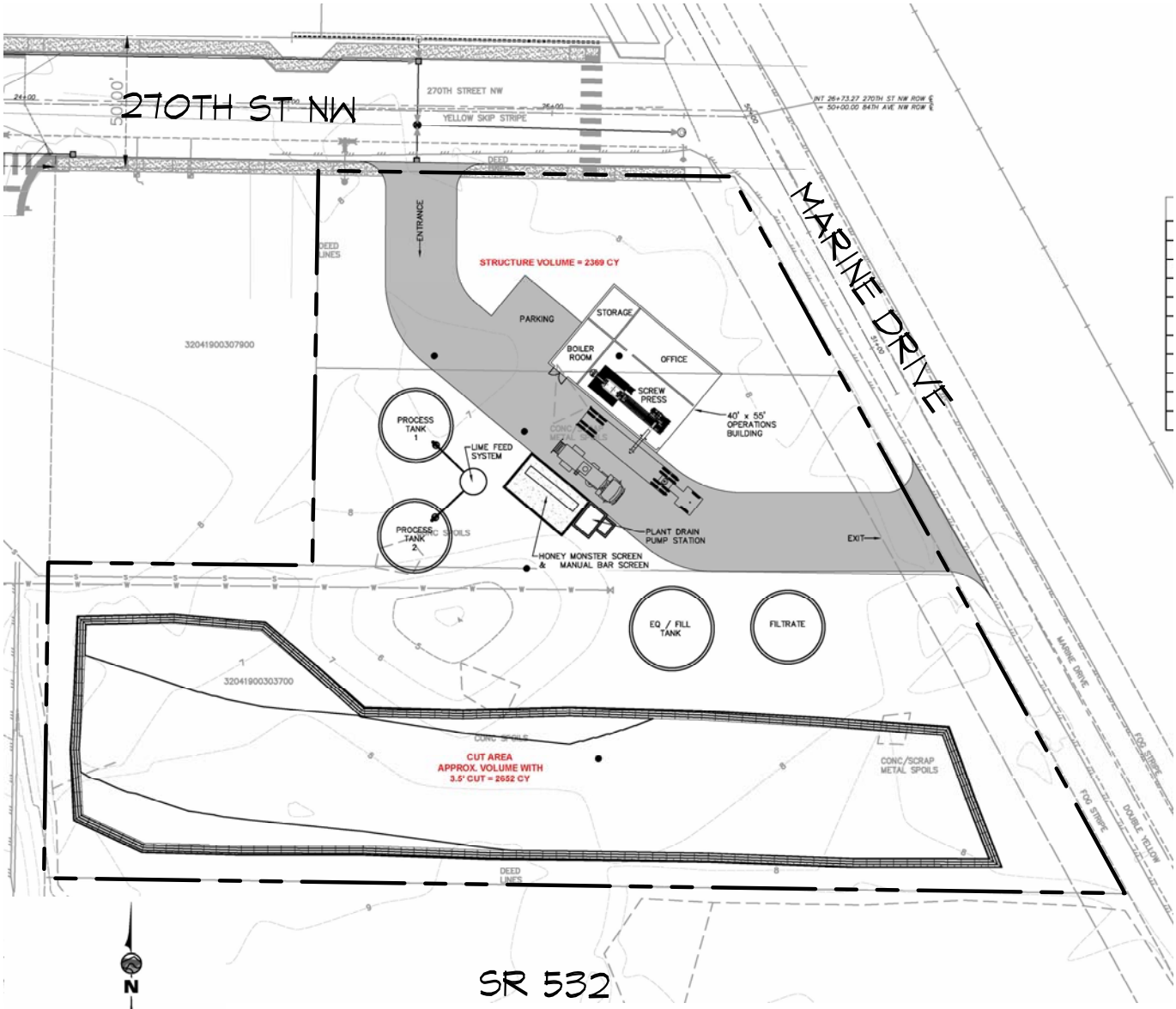

ITEM	AREA
Operations Building	2200 SF
Asphalt Driveway	9139.27 SF
Process Tanks	1847.25 SF
Eq. Tank	804.25 SF
Lime Silo Tank	78.54 SF
Headworks	490.17 SF
Pump Station	94.42 SF
TOTAL	14653.9 SF
TOTAL SITE AREA	147,745 SF
10%	14,774.5 SF

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FIGURE #13

SITE PLAN
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		13
REVISED		

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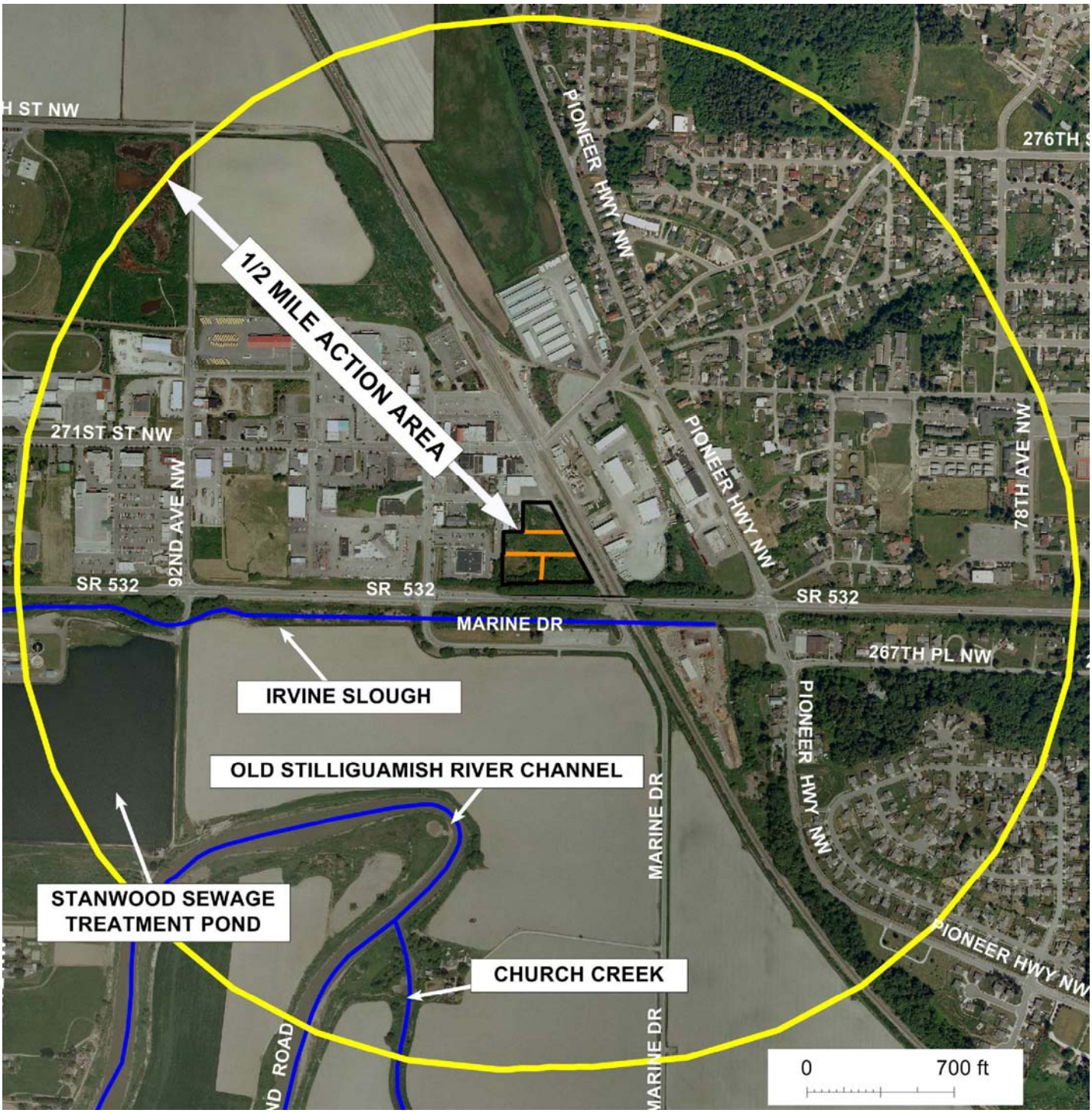

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SCALE: 1" = 700'

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FIGURE #14

1/2 MILE ACTION AREA
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	ABS	1536
SCALE NTS		
DATE 4-15-2016		14
REVISED		

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APPENDIX A

SOLINST DATALOGGER GROUNDWATER MONITORING FIGURES

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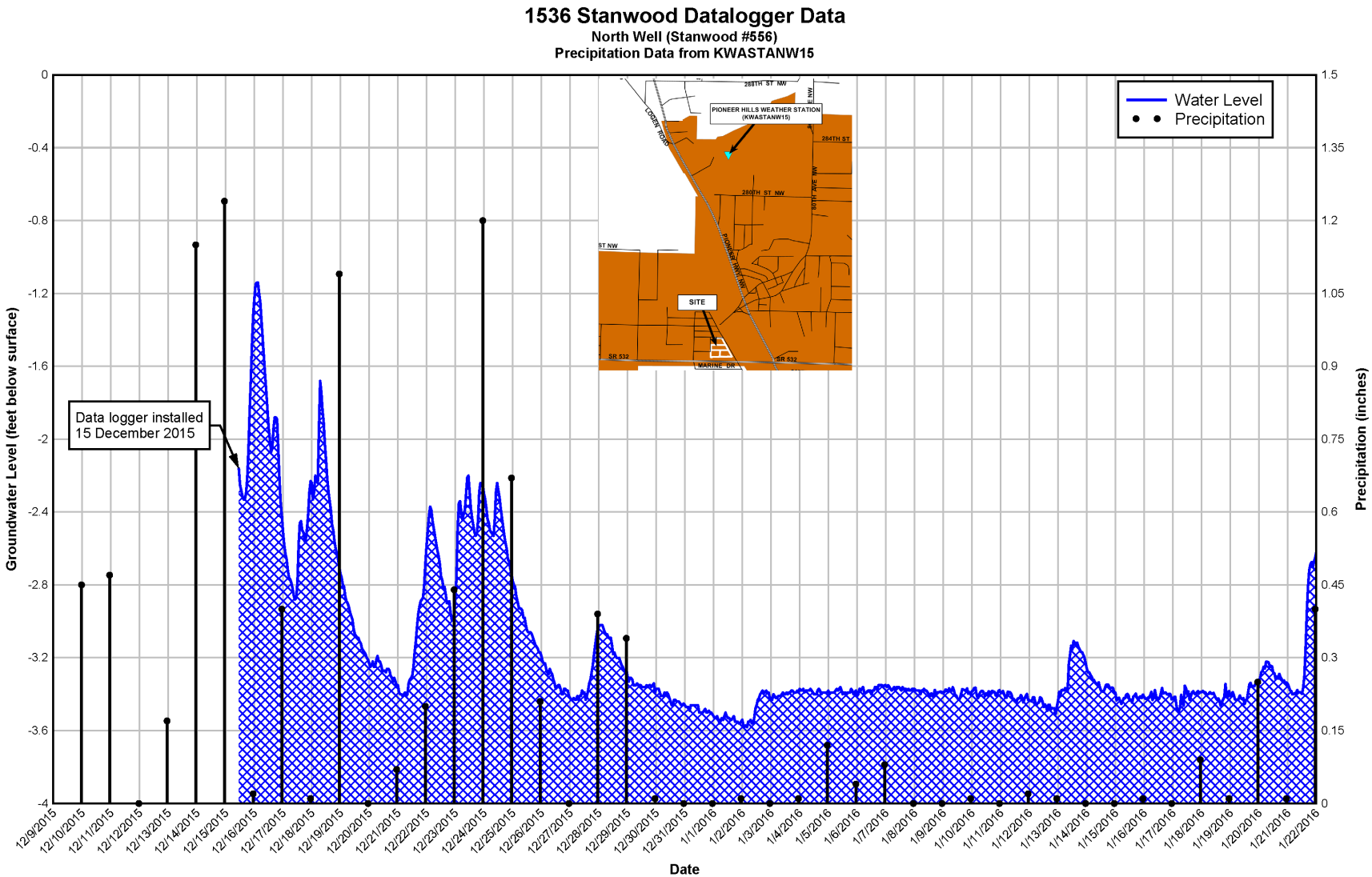

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FIGURE A1

SOLINST DATALOGGER NORTH WELL
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	DRT	1536

SCALE
NOT TO SCALE

DATE
15 APR 2016

REVISED

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1536 Stanwood Datalogger Data

South Well (Stanwood #583)
Precipitation Data from KWASTANW15

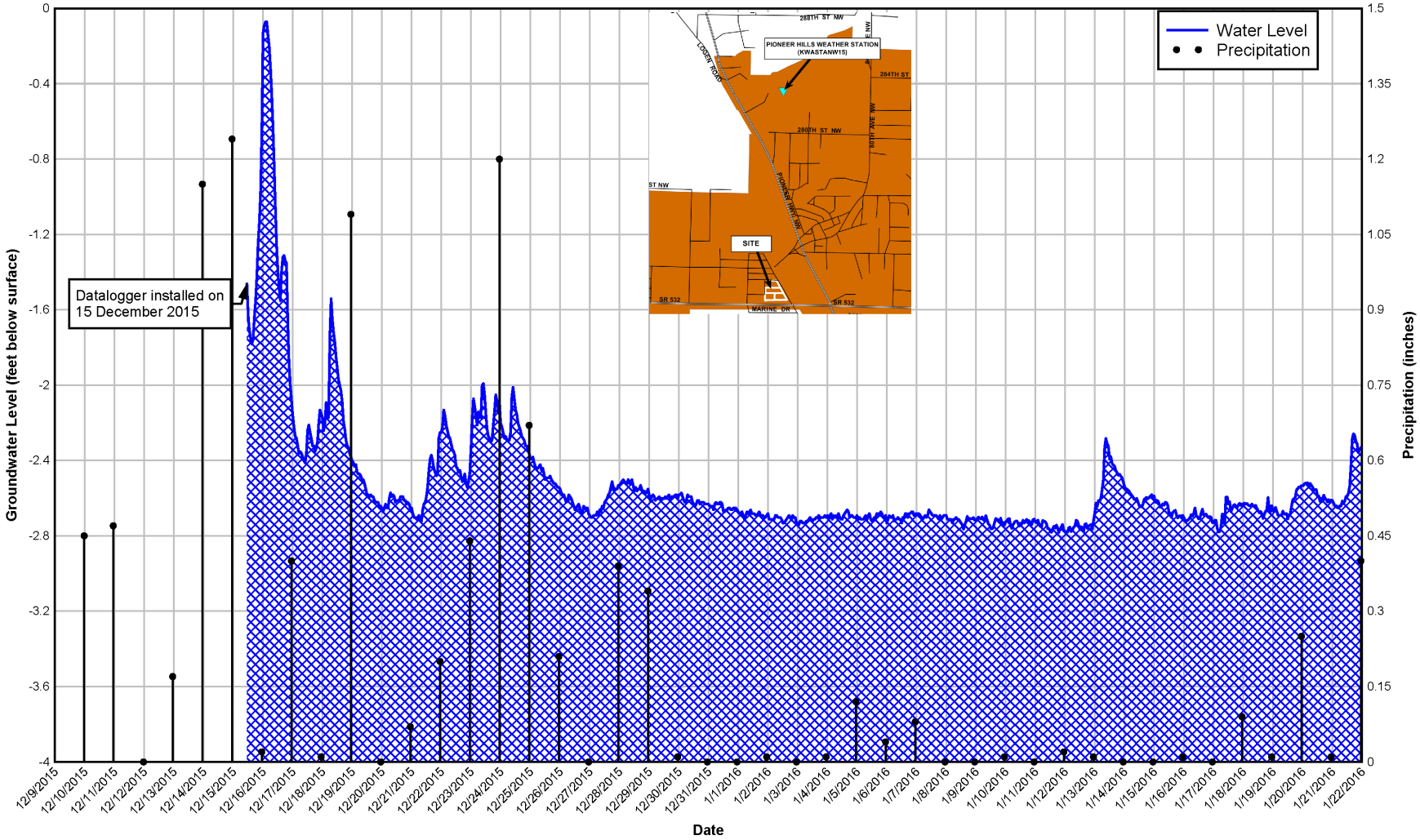

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FIGURE A2

SOLINST DATALOGGER SOUTHWELL
STANWOOD SEPTAGE RECEIVING PLANT
STANWOOD, WASHINGTON

DESIGN	DRAWN	PROJECT
	DRT	1536

SCALE: NOT TO SCALE

DATE: 15 APR 2016

REVISED

A2

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APPENDIX B

NORMAL PRECIPITATION WORKSHEETS AND CURVE

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Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/15/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/15/2015 to 11/15/2015	5.60	↔	7.49	5.63	Normal	2	**3**	6
2nd 30-day Period Prior	11/14/2015 to 10/15/2015	4.46	↔	7.01	4.01	Dry	1	**2**	2
3rd 30-day Period Prior	10/14/2015 to 10/14/2015	2.22	↔	4.33	0	Dry	1	**1**	1

Sum: 9

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal		X	
10 to 14	Normal			
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/16/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/16/2015 to 11/16/2015	5.58	↔	7.43	5.59	Normal	2	**3**	6
2nd 30-day Period Prior	11/15/2015 to 10/16/2015	4.55	↔	7.09	4.36	Dry	1	**2**	2
3rd 30-day Period Prior	10/15/2015 to 10/15/2015	2.28	↔	4.42	0	Dry	1	**1**	1

Sum: 9

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal		X	
10 to 14	Normal			
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/17/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/17/2015 to 11/17/2015	5.56	↔	7.38	5.17	Dry	1	**3**	3
2nd 30-day Period Prior	11/16/2015 to 10/17/2015	4.63	↔	7.17	4.41	Dry	1	**2**	2
3rd 30-day Period Prior	10/16/2015 to 10/16/2015	2.34	↔	4.51	0	Dry	1	**1**	1

Sum: 6

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal		X	
10 to 14	Normal			
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/18/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/18/2015 to 11/18/2015	5.55	↔	7.32	5.48	Dry	1	**3**	3
2nd 30-day Period Prior	11/17/2015 to 10/18/2015	4.72	↔	7.25	5.23	Normal	2	**2**	4
3rd 30-day Period Prior	10/17/2015 to 10/17/2015	2.40	↔	4.60	0	Dry	1	**1**	1

Sum: 8

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal		X	
10 to 14	Normal			
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/19/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/19/2015 to 11/19/2015	5.53	↔	7.27	5.76	Normal	2	**3**	6
2nd 30-day Period Prior	11/18/2015 to 10/19/2015	4.80	↔	7.33	5.23	Normal	2	**2**	4
3rd 30-day Period Prior	10/18/2015 to 10/18/2015	2.46	↔	4.69	0	Dry	1	**1**	1

Sum: 11

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/20/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/20/2015 to 11/20/2015	5.52	↔	7.21	6.05	Normal	2	**3**	6
2nd 30-day Period Prior	11/19/2015 to 10/20/2015	4.89	↔	7.41	5.24	Normal	2	**2**	4
3rd 30-day Period Prior	10/19/2015 to 10/19/2015	2.52	↔	4.79	0	Dry	1	**1**	1

Sum: 11

Determination:

If Sum is	Then Period is	Determination	
6 to 9	Drier than Normal		
10 to 14	Normal	X	
15 to 18	Wetter than Normal		

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/21/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/21/2015 to 11/21/2015	5.50	↔	7.16	6.52	Normal	2	**3**	6
2nd 30-day Period Prior	11/20/2015 to 10/21/2015	4.98	↔	7.50	5.24	Normal	2	**2**	4
3rd 30-day Period Prior	10/20/2015 to 10/20/2015	2.58	↔	4.88	0	Dry	1	**1**	1

Sum: 11

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/22/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/22/2015 to 11/22/2015	5.48	↔	7.10	6.86	Normal	2	**3**	6
2nd 30-day Period Prior	11/21/2015 to 10/22/2015	5.06	↔	7.58	5.24	Normal	2	**2**	4
3rd 30-day Period Prior	10/21/2015 to 10/21/2015	2.64	↔	4.97	0	Dry	1	**1**	1

Sum: 11

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/23/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/23/2015 to 11/23/2015	5.47	↔	7.05	7.11	Wet	3	**3**	9
2nd 30-day Period Prior	11/22/2015 to 10/23/2015	5.15	↔	7.66	5.24	Normal	2	**2**	4
3rd 30-day Period Prior	10/22/2015 to 10/22/2015	2.71	↔	5.06	0	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Method: 30-Day Rolling Total

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Date of Observation: 12/24/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/24/2015 to 11/24/2015	5.45	↔	7.00	7.35	Wet	3	**3**	9
2nd 30-day Period Prior	11/23/2015 to 10/24/2015	5.23	↔	7.74	5.46	Normal	2	**2**	4
3rd 30-day Period Prior	10/23/2015 to 10/23/2015	2.77	↔	5.15	0	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/25/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/25/2015 to 11/25/2015	5.43	↔	6.94	7.65	Wet	3	**3**	9
2nd 30-day Period Prior	11/24/2015 to 10/25/2015	5.32	↔	7.82	5.42	Normal	2	**2**	4
3rd 30-day Period Prior	10/24/2015 to 10/24/2015	2.83	↔	5.24	0	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/26/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/26/2015 to 11/26/2015	5.42	↔	6.89	7.95	Wet	3	**3**	9
2nd 30-day Period Prior	11/25/2015 to 10/26/2015	5.41	↔	7.90	5.41	Normal	2	**2**	4
3rd 30-day Period Prior	10/25/2015 to 10/25/2015	2.89	↔	5.33	0	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/27/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/27/2015 to 11/27/2015	5.40	↔	6.83	8.25	Wet	3	**3**	9
2nd 30-day Period Prior	11/26/2015 to 10/27/2015	5.49	↔	7.98	5.41	Dry	1	**2**	2
3rd 30-day Period Prior	10/26/2015 to 10/26/2015	2.95	↔	5.43	0	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination	
6 to 9	Drier than Normal		
10 to 14	Normal	X	
15 to 18	Wetter than Normal		

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 12/28/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/28/2015 to 11/28/2015	5.39	↔	6.78	8.54	Wet	3	**3**	9
2nd 30-day Period Prior	11/27/2015 to 10/28/2015	5.58	↔	8.06	5.23	Dry	1	**2**	2
3rd 30-day Period Prior	10/27/2015 to 10/27/2015	3.01	↔	5.52	0	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/29/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/29/2015 to 11/29/2015	5.37	↔	6.72	8.83	Wet	3	**3**	9
2nd 30-day Period Prior	11/28/2015 to 10/29/2015	5.66	↔	8.14	5.13	Dry	1	**2**	2
3rd 30-day Period Prior	10/28/2015 to 10/28/2015	3.07	↔	5.61	0	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	12/30/2015

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	12/30/2015 to 11/30/2015	5.35	↔	6.67	9.12	Wet	3	**3**	9
2nd 30-day Period Prior	11/29/2015 to 10/30/2015	5.75	↔	8.22	5.04	Dry	1	**2**	2
3rd 30-day Period Prior	10/29/2015 to 10/29/2015	3.13	↔	5.70	0	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/1/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/1/2016 to 12/2/2015	5.32	↔	6.62	9.37	Wet	3	**3**	9
2nd 30-day Period Prior	12/1/2015 to 11/1/2015	5.82	↔	8.25	4.49	Dry	1	**2**	2
3rd 30-day Period Prior	10/31/2015 to 10/31/2015	3.25	↔	5.88	2.03	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/2/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/2/2016 to 12/3/2015	5.31	↔	6.63	8.85	Wet	3	**3**	9
2nd 30-day Period Prior	12/2/2015 to 11/2/2015	5.80	↔	8.19	4.44	Dry	1	**2**	2
3rd 30-day Period Prior	11/1/2015 to 11/1/2015	3.34	↔	5.96	1.93	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/3/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/3/2016 to 12/4/2015	5.30	↔	6.64	8.83	Wet	3	**3**	9
2nd 30-day Period Prior	12/3/2015 to 11/3/2015	5.79	↔	8.14	5.25	Dry	1	**2**	2
3rd 30-day Period Prior	11/2/2015 to 11/2/2015	3.43	↔	6.04	2	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/4/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/4/2016 to 12/5/2015	5.28	↔	6.65	9.1	Wet	3	**3**	9
2nd 30-day Period Prior	12/4/2015 to 11/4/2015	5.77	↔	8.08	5.56	Dry	1	**2**	2
3rd 30-day Period Prior	11/3/2015 to 11/3/2015	3.51	↔	6.12	2.01	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/5/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/5/2016 to 12/6/2015	5.27	↔	6.66	9.34	Wet	3	**3**	9
2nd 30-day Period Prior	12/5/2015 to 11/5/2015	5.76	↔	8.03	5.37	Dry	1	**2**	2
3rd 30-day Period Prior	11/4/2015 to 11/4/2015	3.60	↔	6.20	2.01	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/6/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Conditiion	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/6/2016 to 12/7/2015	5.25	↔	6.67	9.49	Wet	3	**3**	9
2nd 30-day Period Prior	12/6/2015 to 11/6/2015	5.74	↔	7.98	5.42	Dry	1	**2**	2
3rd 30-day Period Prior	11/5/2015 to 11/5/2015	3.68	↔	6.29	2.23	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination	
6 to 9	Drier than Normal		
10 to 14	Normal	X	
15 to 18	Wetter than Normal		

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/7/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/7/2016 to 12/8/2015	5.24	↔	6.68	9.25	Wet	3	**3**	9
2nd 30-day Period Prior	12/7/2015 to 11/7/2015	5.72	↔	7.92	5.22	Dry	1	**2**	2
3rd 30-day Period Prior	11/6/2015 to 11/6/2015	3.77	↔	6.37	1.93	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/8/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Conditiion	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/8/2016 to 12/9/2015	5.23	↔	6.69	9.31	Wet	3	**3**	9
2nd 30-day Period Prior	12/8/2015 to 11/8/2015	5.71	↔	7.87	5.7	Dry	1	**2**	2
3rd 30-day Period Prior	11/7/2015 to 11/7/2015	3.86	↔	6.45	2.27	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination	
6 to 9	Drier than Normal		
10 to 14	Normal	X	
15 to 18	Wetter than Normal		

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/9/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/9/2016 to 12/10/2015	5.21	↔	6.70	9.29	Wet	3	**3**	9
2nd 30-day Period Prior	12/9/2015 to 11/9/2015	5.69	↔	7.81	5.77	Normal	2	**2**	4
3rd 30-day Period Prior	11/8/2015 to 11/8/2015	3.94	↔	6.53	2.33	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/10/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/10/2016 to 12/11/2015	5.20	↔	6.71	9.28	Wet	3	**3**	9
2nd 30-day Period Prior	12/10/2015 to 11/10/2015	5.68	↔	7.76	5.98	Normal	2	**2**	4
3rd 30-day Period Prior	11/9/2015 to 11/9/2015	4.03	↔	6.61	2.08	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/11/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/11/2016 to 12/12/2015	5.18	↔	6.72	9.21	Wet	3	**3**	9
2nd 30-day Period Prior	12/11/2015 to 11/11/2015	5.66	↔	7.70	5.95	Normal	2	**2**	4
3rd 30-day Period Prior	11/10/2015 to 11/10/2015	4.11	↔	6.69	2.18	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/12/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Conditiion	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/12/2016 to 12/13/2015	5.17	↔	6.73	8.52	Wet	3	**3**	9
2nd 30-day Period Prior	12/12/2015 to 11/12/2015	5.64	↔	7.65	5.74	Normal	2	**2**	4
3rd 30-day Period Prior	11/11/2015 to 11/11/2015	4.20	↔	6.77	2.22	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination	
6 to 9	Drier than Normal		
10 to 14	Normal	X	
15 to 18	Wetter than Normal		

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/13/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/13/2016 to 12/14/2015	5.16	↔	6.74	7.78	Wet	3	**3**	9
2nd 30-day Period Prior	12/13/2015 to 11/13/2015	5.63	↔	7.59	5.94	Normal	2	**2**	4
3rd 30-day Period Prior	11/12/2015 to 11/12/2015	4.29	↔	6.85	2.51	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/14/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/14/2016 to 12/15/2015	5.14	↔	6.75	7.47	Wet	3	**3**	9
2nd 30-day Period Prior	12/14/2015 to 11/14/2015	5.61	↔	7.54	5.67	Normal	2	**2**	4
3rd 30-day Period Prior	11/13/2015 to 11/13/2015	4.37	↔	6.93	3	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/15/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/15/2016 to 12/16/2015	5.13	↔	6.76	7.47	Wet	3	**3**	9
2nd 30-day Period Prior	12/15/2015 to 11/15/2015	5.60	↔	7.49	5.63	Normal	2	**2**	4
3rd 30-day Period Prior	11/14/2015 to 11/14/2015	4.46	↔	7.01	4.01	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/16/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/16/2016 to 12/17/2015	5.11	↔	6.77	7.07	Wet	3	**3**	9
2nd 30-day Period Prior	12/16/2015 to 11/16/2015	5.58	↔	7.43	5.59	Normal	2	**2**	4
3rd 30-day Period Prior	11/15/2015 to 11/15/2015	4.55	↔	7.09	4.36	Dry	1	**1**	1

Sum: 14

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/17/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/17/2016 to 12/18/2015	5.10	↔	6.78	6.84	Wet	3	**3**	9
2nd 30-day Period Prior	12/17/2015 to 11/17/2015	5.56	↔	7.38	5.17	Dry	1	**2**	2
3rd 30-day Period Prior	11/16/2015 to 11/16/2015	4.63	↔	7.17	4.41	Dry	1	**1**	1

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/18/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/18/2016 to 12/19/2015	5.09	↔	6.79	6.55	Normal	2	**3**	6
2nd 30-day Period Prior	12/18/2015 to 11/18/2015	5.55	↔	7.32	5.48	Dry	1	**2**	2
3rd 30-day Period Prior	11/17/2015 to 11/17/2015	4.72	↔	7.25	5.23	Normal	2	**1**	2

Sum: 10

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/19/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/19/2016 to 12/20/2015	5.07	↔	6.80	6.5	Normal	2	**3**	6
2nd 30-day Period Prior	12/19/2015 to 11/19/2015	5.53	↔	7.27	5.76	Normal	2	**2**	4
3rd 30-day Period Prior	11/18/2015 to 11/18/2015	4.80	↔	7.33	5.23	Normal	2	**1**	2

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/20/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/20/2016 to 12/21/2015	5.06	↔	6.81	6.03	Normal	2	**3**	6
2nd 30-day Period Prior	12/20/2015 to 11/20/2015	5.52	↔	7.21	6.05	Normal	2	**2**	4
3rd 30-day Period Prior	11/19/2015 to 11/19/2015	4.89	↔	7.41	5.24	Normal	2	**1**	2

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date:	4/1/2016	Project Number: TAL-	1536
Project Name:	Stanwood Septage	Precipitation Data Source:	Stanwood
Weather Station:	Arlington	County:	Snohomish
Landowner:	Gilday	State:	Washington
Soil Name:	Puget silty clay loam	Growing Season:	No
Method:	30-Day Rolling Total	Date of Observation:	1/21/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/21/2016 to 12/22/2015	5.04	↔	6.82	6.09	Normal	2	**3**	6
2nd 30-day Period Prior	12/21/2015 to 11/21/2015	5.50	↔	7.16	6.52	Normal	2	**2**	4
3rd 30-day Period Prior	11/20/2015 to 11/20/2015	4.98	↔	7.50	5.24	Normal	2	**1**	2

Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

Rainfall Documentation Worksheet

(adapted from Chapter 19, Part 650 Engineering Field Handbook, USDA. 1977)

Date: 4/1/2016
Project Name: Stanwood Septage
Weather Station: Arlington
Landowner: Gilday
Soil Name: Puget silty clay loam

Project Number: TAL- 1536
Precipitation Data Source: Stanwood
County: Snohomish
State: Washington
Growing Season: No

Method: 30-Day Rolling Total

Date of Observation: 1/22/2016

	30-day Period	Long-term Rainfall Records: 3 yrs in 10 less than	Normal	3 yrs in ten greater than	Rainfall	Condition	Month Value	Month Weight Value	Product of previous columns
1st 30-day Period Prior	1/22/2016 to 12/23/2015	5.03	↔	6.83	5.63	Normal	2	**3**	6
2nd 30-day Period Prior	12/22/2015 to 11/22/2015	5.48	↔	7.10	6.86	Normal	2	**2**	4
3rd 30-day Period Prior	11/21/2015 to 11/21/2015	5.06	↔	7.58	5.24	Normal	2	**1**	2

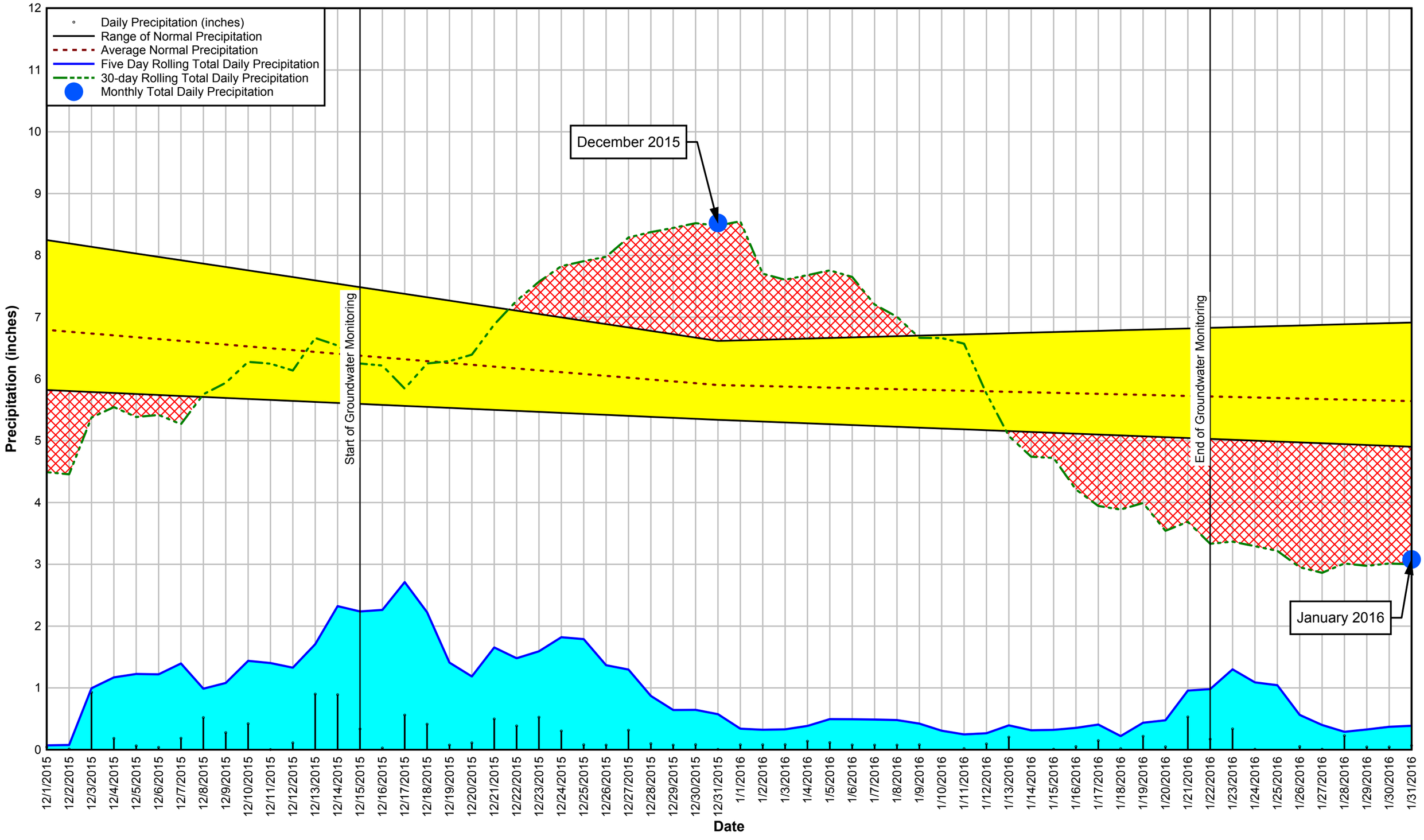
Sum: 12

Determination:

If Sum is	Then Period is	Determination		
6 to 9	Drier than Normal			
10 to 14	Normal		X	
15 to 18	Wetter than Normal			

1536 Normal Precipitation Graph

Stanwood Weather - Averaged (KWASTANW8, 15, 17, and KWACAMAN14)
Arlington WETS Table 2010 (USC00450257)



APPENDIX C

DETERMINING PATTERNS OF NORMAL PRECIPITATION

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Wetlands are defined by the Army Corps of Engineers *Wetland Delineation Ma*nual (1987), the *Federal Manual for Identifying and Delineating Wetlands* (1989), and the Washington State *Wetland Identification and Delineation Manual* (1997) as:

"*Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."*

The wording of this definition makes it clear that saturation or inundation by surface and groundwater is the driving force of wetland existence. Without hydrology (inundation or saturation of soil), there is no wetland. The existence of wetland hydrology is often readily apparent. Direct observation of wetland hydrology in the field is often made by measuring the depth of free water or saturation within an observation hole, or obvious signs of inundation. Indirect observations of wetland hydrology can be made as well. These include drainage patterns, marks on vegetation indicating ponding or flowing water, terrain features, or a predominance of wetland-adapted plants (FAC - neutral test).

Corroborating evidence of wetland hydrology includes the presence of plant communities dominated by wetland-adapted species and the presence of hydric soil characteristics. Plant communities dominated by wet-adapted plants lends credence to support the existence of a wetland in the area. Soils that have been inundated or saturated to the surface for a period of time during the growing season often have distinctive coloration and features. Under conditions of saturation or inundation, soil microflora will quickly use up available oxygen and switch to less efficient elements for energy production. These include manganese, iron, sulfur, and ultimately carbon. Reduction of manganese and iron allows these ions to move freely in the water-soil column, often leaching out or re-oxidizing in specific areas. Concentrations of iron form brightly colored "mottles" or redoximorphic features. Loss of iron and manganese in the soil will remove the brighter red and/or yellow colors leaving duller grays and black colors. When sulfur is utilized for energy production, hydrogen sulfide is produced. This gas has a distinctive odor.

Delineating wetland boundaries involves the examination of wetland hydrology (or evidence thereof), patterns of wetland-adapted vegetation, and hydric soil conditions. When all three of these parameters are present, the area is considered to be a wetland. Wetland boundaries are sometimes very distinct in the landscape. Other times the boundary is a gradual change from upland to wetland conditions.

Delineation of wetland boundaries becomes more difficult when examinations of wetland vegetation, soil, or visible signs of hydrology are not well differentiated. Such conditions may include a plant community dominated by seral FAC-rated plants, soils that formed under hydric conditions at one time, or sites where changes have occurred, either natural or human-caused, that has eliminated one or more of the three wetland parameters. Previously farmed land often falls into this category. The vegetative community on previously farmed land is often early successional and/or non-native and the soils in the upper 10-inches may have been disturbed by plowing.

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Monitoring of shallow groundwater wells is often the only method to determine the existence and extent of wetlands under disturbed conditions. This concept ties back to the wetland definition quoted above where an area is "*inundated or saturated…at a frequency and duration sufficient to support…a prevalence of vegetation typically adapted for life in saturated soil conditions*." The frequency and duration sufficient to support wetland vegetation is defined, albeit loosely, in the Washington State Wetland Delineation Manual as continual saturation or inundation to the surface for greater than 12.5% of the growing season. Ancillary to this, continual saturation or inundation to the surface for a period of time between 5% and 12.5% of the growing season **may** be wetland (emphasis added). Conditional to both of these benchmarks is the term "*…under normal conditions…*"

Shallow Groundwater Monitoring

Shallow groundwater monitoring wells are installed in the area to be studied in accordance with the methodology outlined by the Army Corps of Engineers (*Technical Standard for Water-Table Monitoring of Potential Wetland Sites*, Wetlands Regulatory Assistance Program, ERDC TN-WRAP-05-2, June, 2005)[3], and ideally placed to provide stochastically adequate coverage of all the study area. These wells are shallow monitoring wells, approximately 18 inches in length and installed to a maximum depth of 15 inches below the soil surface. The wells are slotted along the entire length, except for the top three inches, which are sealed. Wells are installed in holes dug slightly larger in diameter than the wells to a depth of approximately 15 inches. The excess space between the hole and the well is filled with clean, coarse quartz sand. The top three inches of the hole around the well is sealed with bentonite clay to prevent surface water from filling the well and skewing the monitoring results. A loose-fitting cap prevents precipitation and debris from entering the well while allowing for pressure equalization within the well as water levels fluctuate. Wells are typically monitored at least twice weekly during the growing season; more frequently during periods of significant precipitation.

Well monitoring provides data that can be used to determine if an area meets the definition of wetland hydrology. Soil that has free groundwater within 12 inches of the soil surface are considered to be saturated to the surface through capillary action (for sandy soils, free groundwater must be within six inches). If groundwater measured in a well is at or above 12 inches from the soil surface continuously for more than 12.5% of the growing season, the well is within a definable wetland. Examination of wells showing wetland hydrology provides information on the size and shape of the wetland.

This information, however, must be compared to antecedent precipitation patterns in order to satisfy all parts of the accepted wetland definition. Specifically again, the

[3] The Wetlands Regulatory Assistance Program no longer provides guidance for the usage of piezometers in wetland hydrology determination. Piezometers more accurately measure changes in groundwater pressure rather than groundwater levels and may give erroneous indications of wetland hydrology existence.

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phrase " under normal conditions…" as described previously. Two methods are available for determining the "normality" of antecedent precipitation.

Normal Precipitation Conditions

Normal conditions include patterns of precipitation. Obviously, precipitation patterns for a specific area vary from year to year. Therefore, the term "normal conditions" is based on an average of total monthly precipitation over a thirty-year period of data as defined by the National Climate Data Center. The National Weather Service Cooperative Network supplies these data for various weather stations around the nation on WETS tables[4] (**Exhibit 1)**. Also included on these tables are values for which monthly precipitation occurs 30% of the time below or above a certain value. This is a statistical calculation based on a curve defined by the distribution of monthly rainfall data. In a Kent example below, the 30-year mean precipitation for March is 4.13-inches. Thirty percent of the data under this March curve will be contained for values less than 3.15-inches and 30% of the data under the curve for March will be contained for values greater than 4.81-inches. The area of the curve between 3.15-inches and 4.81-inches accounts for 40% of the data. For any particular subsequent year, the total precipitation for March is compared to these three values. If it is less than 3.15-inches, then the precipitation is considered drier than normal. Likewise, if it is greater than 4.18-inches, it is considered wetter than normal. Any value for total March precipitation between 3.15-inches and 4.18-inches is considered normal.

Daily values of precipitation are available from several on-line sources, including the weather stations from which the WETS tables are generated. Many cities and counties maintain weather stations with on-line data access. Also, automatic recording precipitation gauges can be installed on site. The closer the source of precipitation data is to the site, the more accurate the analysis will be.

The NRCS Methodology

The NRCS created a methodology for using groundwater observations to determine wetland boundaries. This methodology is based on estimations of normality related to a non-parametric weighted estimate of the normality of precipitation for the previous three months. The NRCS method is described in Chapter 19 of the NRCS Engineering Field Handbook (1997). The NRCS method uses the data contained on the WETS table for the nearest weather station and compares these mean values (average monthly precipitation, 30% greater than, and 30% less than) to the monthly precipitation values for three months previous to the wetland determination. It is important to note the date of the hydrologic observation. If the date of hydrologic observation was performed after April 15, the biologist compares precipitation for the months of April, March, and February to determine normality. If the hydrologic observation was made before April 15, the biologist compares precipitation for the months of March, February, and January

[4] WETS is an acronym with no apparent defined meaning.

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to determine normality. A table is provided in the Engineering Field Guide to aide in estimation (working examples are contained in **Exhibit 2**).

The average precipitation data from the WETS table along with the corresponding 30% exceedance values are entered under the appropriate headings on the table. Then, the monthly measured precipitation for the preceding three months is entered into the appropriate area of the table. For each of the three preceding months, if the monthly total precipitation value is less than the 30-percent low value, then the month is given the conditional name of “dry.” If it is greater than the 30-percent high value, then it is given the conditional name of ‘wet.” Otherwise, it is given the conditional value of “normal.” Next, the month is given a conditional value related to its conditional name: dry = 1, normal = 2, and wet = 3. This conditional value is then multiplied by a weighting value based on the proximity of the month to the time of observation. The first preceding month is likely to have the greatest effect on site hydrology, so the multiplier for this month is 3. The second month’s multiplier is 2, and the third month’s multiplier is 1.

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Exhibit 1. Sample WETS Table (Kent, Washington)

WETS Station : KENT, WA4169
Latitude: 4724 Longitude: 12214 Elevation: 00030
State FIPS/County(FIPS): 53033 County Name: King
Start yr. - 1971 End yr. - 2000

Month	Temperature (Degrees F.) avg daily max	avg daily min	avg	Precipitation (Inches) avg	30% chance will have less than	more than	avg # of days w/.1 or more	avg total snow fall
January	46.8	34.1	40.5	5.29	3.93	6.20	11	0.8
February	51.1	35.5	43.3	4.42	2.89	5.31	11	0.1
March	55.3	37.6	46.4	4.13	3.15	4.81	11	0.4
April	61.0	40.4	50.7	2.82	1.89	3.37	8	0.0
May	67.0	45.4	56.2	2.03	1.37	2.43	5	0.0
June	72.0	50.1	61.0	1.68	1.03	2.03	4	0.0
July	77.3	53.1	65.2	0.91	0.46	1.13	2	0.0
August	77.7	53.2	65.5	1.18	0.42	1.42	2	0.0
Sept.	72.2	48.9	60.5	1.75	0.61	2.16	4	0.0
October	61.3	43.0	52.2	3.36	2.02	4.07	7	0.0
Nov.	51.6	37.7	44.6	5.95	4.07	7.09	12	0.1
Dec.	46.0	33.9	40.0	5.74	4.10	6.79	12	0.4
Annual	-----	-----	-----	------	30.80	39.66	--	----
Average	61.6	42.7	52.2	------	------	------	--	----
Total	-----	-----	-----	39.26	------	------	89	1.8

GROWING SEASON DATES

Probability	Temperature: 24 F or higher	28 F or higher	32 F or higher
	Beginning and Ending Dates / Growing Season Length		
50 percent *	> 365 days	3/ 8 to 11/11	4/13 to 10/26
	> 365 days	249 days	196 days
70 percent *	> 365 days	2/26 to 11/22	4/ 4 to 11/ 5
	> 365 days	270 days	216 days

* Percent chance of the growing season occurring between the Beginning and Ending dates.

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Exhibit 2. Rainfall Documentation Worksheet

Rainfall Documentation Worksheet
(adapted from Chapter 19, Part 650 Engineering Field Handbook, UDSA. 1997)

Date: _____ Project Number.: TAL-_____
Project Name: _____

Weather Station: _____ Precipitation Data Source: _____
Landowner: _____ County: _____State: _____

Soil Name: _____Growing Season: ____

Method: _____
Date of Observation: _____

		Long-term rainfall records							
	30-day Period	3 yrs in 10 less than	Normal	3 yrs in 10 greater than	Rainfall	Condition (Dry, Normal, Wet)	*Conditional Value	Month Weight Value	Product of previous two columns
1st 30-day Period Prior			↔					3	
2nd 30-day Period Prior			↔					2	
3rd 30-day Period Prior			↔					1	

Sum:

*Conditional value:
Dry: =1
Normal: =2
Wet: =3

Determination:

If Sum is	Then period is	Determination
6 – 9	Drier than Normal	
10 - 14	Normal	
15 - 18	Wetter than Normal	

Conclusions:

The weighted conditional values are summed up and compared to a set of value rules. If the sum is between 6 and 9, the precipitation for the previous three months is considered dryer than normal. If the sum is between 10 and 14, then the precipitation for the previous three months is considered normal. Finally, if the sum is between 15

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and 18, then the precipitation for the previous three months is considered wetter than normal.

The strengths of this method are that the data are readily available and that the determination is quick and easy. However, the main weakness of this method is that precipitation values are reset to zero at the end of each month. For analysis occurring prior to the middle of the month, precipitation between the first of the month and the analysis date is not considered. For analysis occurring after the middle of the month, precipitation that occurred after the date of analysis to the end of the month is included. In the latter case, precipitation that had not yet occurred by the time of the analysis can affect the determination. The methodology also assumes that precipitation is evenly distributed throughout any particular month.

The 30-day Rolling Totals Methodology

One way to avoid the limitations of the NRCS method is to calculate and compare values using a 30-day rolling total. This method incorporates the strengths of the NRCS method while properly considering antecedent precipitation (or precipitation within a month of observation) and ignoring precipitation that had not occurred by the time of the analysis.

Daily precipitation data for a time period of over three months is necessary to calculate the 30-day rolling total. Specifically, daily precipitation data must be available for 120 days prior to the first date of well observation in order to calculate the 30-day rolling total for the period 90 days prior to the first well observation. Daily precipitation data is available from many on-line sources, or by using automatic precipitation recording devices installed on site. The closer the source of data to the site, the more accurate the analysis will be.

For any particular day, the precipitation for that day is summed with the previous 29 days (total of 30 days). This calculation is carried through all days of available precipitation data. For instance, the 30-day rolling total for January 30 is the sum of all precipitation for January 1 through January 30. The next rolling total is the sum of all precipitation from January 2 through January 31. The next total is the sum of all precipitation from January 3 through February 1.

When these data have been calculated, the next step is to prepare a graph showing the normal range of precipitation for the year based on the data from the WETS table (**Exhibit 3**). The 30-day rolling total data are overlain on this graph along with values for daily rainfall. This image is then used to visually determine whether precipitation was within the normal range. Spike data for daily rainfall provide an indication of how precipitation on any given day affects the overall 30-day rolling total.

The strengths of this method are that antecedent precipitation is considered in the evaluation and that it uses a graphical representation that is easily analyzed. A weakness in the method is that a large input of precipitation remains in the rolling total for 30 days before dropping out. Under a system that would model the effects of this

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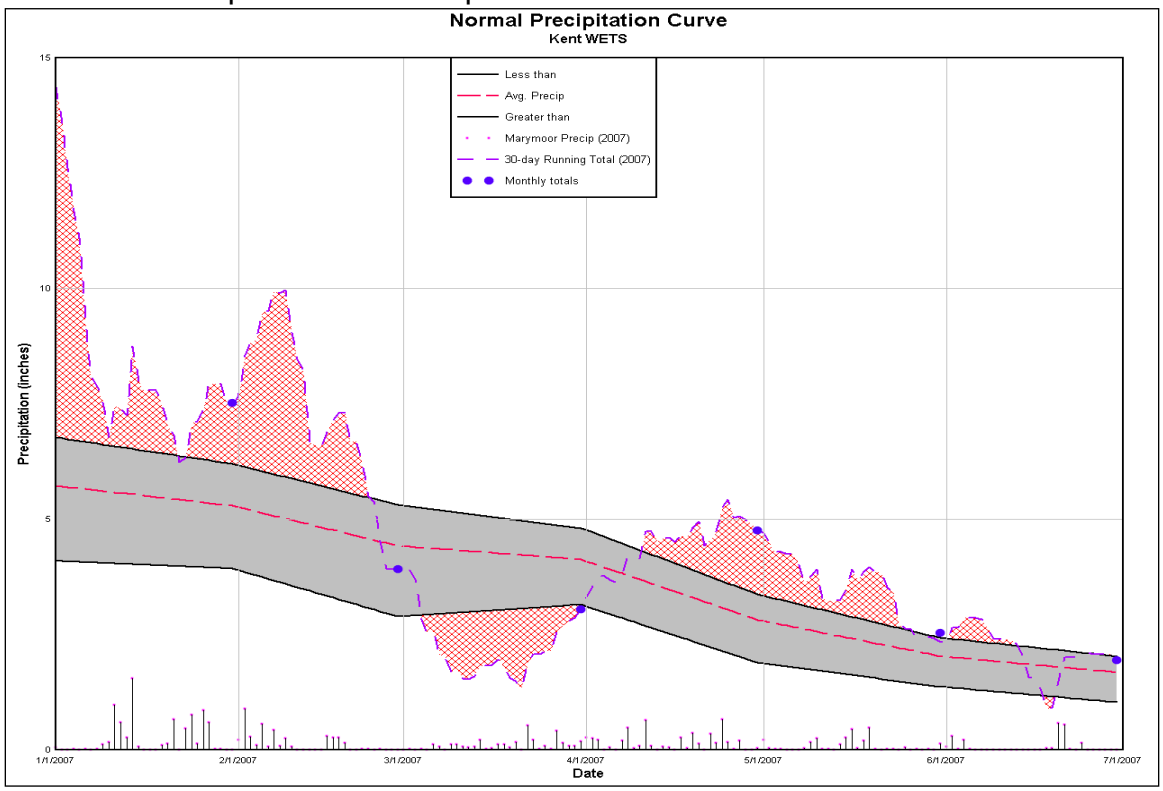
large input more naturally, the effect would ameliorate over time, dependent on soil conditions, groundwater levels, and antecedent precipitation.

Exhibit 1. Sample Normal Precipitation Curve.



The Combined Methodology

Combining the rolling total and the NRCS methods is appropriate where precipitation influences a site's hydrology for two to three months (Sprecher and Warne, 2000). The Combined Method involves blocking off three 30-day blocks of the 30-day rolling total starting from the date of the interest. These blocks are indicated on the graph prepared as described above for the 30-day rolling total methodology. This graph is then used to visually determine whether precipitation in each 30-day block was above, below, or within the normal range. Professional judgment is used when the 30-day rolling total does not appear to fall clearly within the normal, wetter than normal, or dryer than normal portion of the graph for a majority of the 30-day block. This information is entered into the NRCS table and the 30-day blocks are rated using the weighted conditional values, as described in the NRCS methodology. The sum of the weighted conditional values indicates whether the precipitation for the three month period prior to the date of interest was within normal bounds for precipitation. The procedure above is repeated for each day of the well monitoring period.

Another way to calculate the status of the 30-day rolling total is to use an electronic spreadsheet to interpolate data between the monthly values indicated on the WETS table. This method is assumed by creating the graph described above.

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The data provided by the WETS table are graphically illustrated by plotting the low range values and high range values by month and drawing two lines; one to connect the low range values and one to connect the high range values. This forms the base figure that is used in both the NRCS and Combined methods for determining normal total precipitation.

By drawing these lines, we are graphically interpolating data between the monthly values. This interpolation can be accomplished mathematically using spreadsheets. The procedure is described below.

The initial interpolation uses the first three columns on the spreadsheet (**Table 1**). The first column contains all the dates for the period of analysis (water year, calendar year, or any portion of a year). The second column is for the low range values. The third column is for the high range values. Since these values are calculated based on one month's data, the listed low and high range values for a month are placed next to the ending date for that month in their respective columns. The date column is filled with all the dates from the beginning of the observation period to the end (**Table 2**). The low and high values for each month are entered into the appropriate columns at the end of each month.

Table 1. Preliminary Interpolation Spreadsheet

Date	30% less than (range value)	30% greater than (range value)	30-day Rolling Total	Determination
March 31	3.15	4.81		
April 30	1.89	3.37		
May 31	1.37	2.43		

Table 2. Preparing to Interpolate between Month-end Values.

Date	30% less than (range value)	30% greater than (range value)	30-day Rolling Total	Determination
March 31	3.15	4.81		
April 1				
April 2				
April 3				
April 4				
April 5				
--	--	--	--	--
April 28				
April 29				
April 30	1.89	3.37		

An interpolation factor is used to calculate daily values between each month. The formula for this factor is:

$F_I = (V_2 - V_1)/\text{Days}$

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Where:

"F_I" is the Interpolation Factor,
"V_2" is the range value for the ending month (April, in this example),
"V_1" is the range value for the starting month (March, in this example), and
"Days" is the number of days in the month (30 days for April).

In the example shown on Table 2, the expression for the "30% less than" range is calculated as follows.

V_2= ,1.89
V_1 = 3.15
Days = 30
F_I = (1.89-3.15)/30 = -0.042.

Calculating the values between V_1 and V_2 is an iterative process (**Table 3**). F_I is added to V_1 and the result placed in the next cell down. F_I is added to this result, and so on until V_2 is reached. This process is repeated for each month for the low range values and the high range values. Charting these interpolated data yields the same curves described earlier.

Table 3. Iterative Calculation of Range Values.

Date	30% less than (range value)	30% greater than (range value)	30-day Rolling Total	Determination
March 31	3.15	4.81		
April 1	3.11	4.76		
April 2	3.07	4.71		
April 3	3.02	4.67		
April 4	=3.02-0.042	=4.67-0.048		

The spreadsheet of interpolated values also lends itself to precisely determining where a particular 30-day rolling total falls (i.e. dry, normal, or wet). To do this, the 30-day rolling totals are listed by date next to the corresponding low range values and high range values (**Table 4**). The next column is used to determine whether the 30-day rolling total is normal or not. The 30-day rolling total is compared to the low range value and the high range value. If the 30-day rolling total is less than the low-range value, then a minus one (-1) is placed in that cell. Similarly, if the 30-day rolling total is higher than the high range value, then a positive one (1) is placed in that cell. Otherwise, a zero is placed in that cell. The cells in this column can have only three values: minus one, zero, or positive one. Minus one denotes drier than normal, zero denotes normal, and positive one denotes wetter than normal. Using this iterative spreadsheet technique, ambiguities caused by analyzing graphed data where the 30-day rolling total is very close to the range values is avoided.

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Table 4. Normal Precipitation Determination.

Date	30% less than (range value)	30% greater than (range value)	30-day Rolling Total	Determination
March 31	3.15	4.81	2.66	-1
April 1	3.11	4.76	2.75	-1
April 2	3.07	4.71	3.10	0
April 3	3.02	4.67	4.50	0
April 4	2.98	4.62	4.68	1

The Combined Method involves a comparison of the 30-day rolling totals over three consecutive 30-day periods. The first period is the 30-day period preceding a specific date. The second 30-day period is the 30-day period preceding the first period. The third period is the 30-day period preceding the second period. The relative conditional value for each of these periods is determined using the graphic depicting the 30-day rolling total against the range of normal precipitation and supplemented by an analysis of the average of the instantaneous conditional values. The visual determination involves best professional judgment of the 30-day periods on the graph (such as **Exhibit 3**) and determining whether the range of precipitation within that period generally tended to be normal, wetter than normal, or drier than normal. In areas of transition (from drier than normal to normal, or wetter than normal to normal), it is helpful to look at the 30-day average values of the instantaneous determinations previously calculated. These integer values have a range of minus one to one.

This method of analyzing the 30-day average of instantaneous conditional values is not to be used to make a final determination of conditional value for the 30-day period being determined. Thirty-day periods that have a significant difference at one end of the period compared to the other (i.e., a major rain event sharply brings the 30-day rolling total out of drier than normal and into wetter than normal, resulting in a spike) may indicate a different conclusion of conditional value than an examination of the 30-day average of instantaneous conditional values. The instantaneous conditional values do not take into consideration rainfall data; only whether the 30-day rolling total on a date was drier than normal, normal, or wetter than normal. The strength of the analysis of the 30-day average of instantaneous conditional values is in situations where the graph is not completely clear as to the point of transition, that is, where the graph data at either end of the 30-day period appears mostly balanced between drier than normal and wetter than normal.

All of these analyses are used to determine the validity of well monitoring data. Wetland hydrology must be present for 12.5% of the growing season to meet the definition of wetland hydrology. Wells that show continuous inundation or saturation to the surface continuously for 12.5% of the growing season may be considered to be in wetlands, provided that precipitation during that specific period of time is within the confines of normality. If defined wetland hydrology is present and precipitation during that period was either normal or drier than normal, then it may be concluded that the well is within a wetland. However, if the precipitation was wetter than normal, then true wetland hydrology may not be present and further study is warranted. Likewise, if a well does

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not show continuous inundation or saturation to the surface for 12.5% of the growing season and precipitation during that period was either normal or wetter than normal, then it may be concluded that the well is not within a wetland. Similarly, if the precipitation during that period was drier than normal, wetland hydrology may not be apparent, again warranting further study.

Finally, best professional judgment must be used when making an evaluation, especially in cases where precipitation patterns are not consistently drier than normal, normal, or wetter than normal. Analysis must consider how groundwater levels change with changing patterns of precipitation.

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