WCE No. 2013-1166

Whipple Consulting Engineers, Inc.

Revised
March 6, 2019

City of Spokane Valley
11707 E Sprague Ave, Suite 106
Spokane Valley, WA 99206

Attn: Mr. Henry Allen, P.E.

Re: Painted Hills Flood Control Development Narrative

Dear Henry:

This letter is provided as a description of the flood control plan associated with grading and site improvements that would be completed in conjunction with a future mixed-use development on approximately 99.5-acres of a former golf course property located at 4403 S Dishman-Mica Road. It is intended as an update to previous flood control narrative descriptions provided to the City by Whipple Consulting Engineers dated July 23, 2015, October 13,2016, and July 6, 2017.

Since the date of the last narrative provided to the City, the applicant has modified the proposed site design in order to obtain a Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency (FEMA). This design update to obtain a CLOMR using fill approval represents a change in the FEMA re-map effort for the project, which was formerly designed to revise the FEMA mapping through a Conditional Letter of Map Revision (CLOMR) process resulting from levee improvements and levee certifications. This change to a CLOMR using fill was implemented due to concerns raised by the City at a meeting held on November 9th. 2017 wherein long-term levy maintenance was questioned by City staff. A call between FEMA representatives, WCE, WEST, and City staff occurred on January 18, 2018.

The project site is located within the area identified as Storage Area 1 (SA1) in the effective FEMA Flood Insurance Study (FIS). SA 1 is designated as a compensatory storage area. Within a compensatory storage area loss of flood storage capacity due to placement of fill must be mitigated with an equivalent compensatory volume of storage or through a reduction in flows such that the net condition causes no adverse impact to the base flood or floodway elevations within the storage area. In addition, loss of infiltration capacity due to placement of fill or impervious surfaces must be mitigated in such a way that the decrease in infiltration capacity will cause no adverse impact to the base flood or floodway elevations within the storage area. The overall purpose of the "compensatory" requirement is to ensure that development activities do not cause an adverse impact on flood elevations within the storage area, or downstream of the development (e.g. increasing downstream flows due to reduced infiltration capacity within the storage area). With the current plan to pursue a CLOMR using fill, the applicant is proposing to control and manage floodwaters and address compensatory storage requirements on the site through a combination of on-site fill, enhanced conveyance facilities (culverts) and infiltration galleries. Chester Creek main channel will remain unchanged, even with the widening of Thorpe Road which uses a box culvert to rest over the exiting channel.

The intent of the Painted Hills PRD flood control design is to mimic the flood control project that Spokane County did on the Chester Creek mainstem, when the Kokomo area was taken out of the flood plain, by digging two deep borrow pits just West of Dishman-Mica Road and South of 28th Avenue.

This narrative restates and clarifies background information regarding the FEMA mapping for the site and further describes the current proposed plan.

MAPPED FLOODPLAIN CONDITIONS

History of Site Flood Analysis (source: BSW Painted Hills PRD)

A hydrologic and hydraulic analysis for Chester Creek Basin was completed by Michael Baker Jr., Inc. and approved by Spokane County in a letter to the Federal Emergency Management Agency dated August 6, 1990. There are no long-term gage records for Chester Creek. The limited gage measurements on Chester Creek were collected near the Dishman-Mica Road crossing of Chester Creek for December 1994 through March 1995 and November 1995 through February 1996 when no significant flood events occurred. In February 2006, the hydraulic analysis for Chester Creek was revised by WEST Consultants, Inc. under a FEMA contract. The analysis established updated flood magnitude-frequency estimates for the watercourse. A steady flow hydraulic model has been developed for Chester Creek. [1]

The reports concluded that spring floods in the upper Spokane River basin are due to snowmelt runoff from high elevation watersheds. Such floods are of less significance on Chester Creek because of the lower elevation of the water shed limit and the size of the snowpack. Spring runoff occurs about a month earlier with the more gradual rates than on the Spokane River. Nearly all maximum annual flood peaks on Chester Creek occur during the winter. Warm winds and rain can melt the snow rapidly. When winter rain causes snowmelt on partially frozen soil conditions, short-duration, intense runoff generates a flood peak during winter storms. During the more extreme events, Chester Creek runs over its banks filling localized depressions in the flood zone. [1]

The duration of flooding is generally between 100 hours and 1000 hours, or between four days and forty days with smaller events occurring with greater frequency than large events. [1]
Channel geometry for Chester Creek was developed from surveys conducted in March 2003. Overbank geometry was developed from topography developed by TerraPoint (2003). Flood plain boundaries for Chester Creek and the Unnamed Tributary to Chester Creek were delineated using 2-foot contour interval maps developed by TerraPoint from LiDAR data. [1]

A watershed plan for Chester Creek was previously designed with management recommendations for drainage, flooding, water quality, and riparian habitat. As a result, flood control improvements have been implemented along Chester Creek. The improvements to the area began at the Painted Hills Golf Course. In 1998, a project to install new culverts and extensive dredging of the channel between Thorpe Road and Schafer Road was implemented. Two large volume borrow pits were constructed downstream. Each pit was designed for the retention and infiltration of Chester Creek floodwaters up to a 25-year event. One borrow pit for the unnamed Tributary to Chester Creek was constructed just north of E 40th Avenue and the other borrow pit for Chester Creek just West of Dishman Mica and South of 28th Avenue.

Before the storage areas #1 (compensatory area) and #6 (triangle pond) are to be modified (see Site Element Plan), it is important to understand where they are within the Chester Creek Basin, and what floodwaters they receive. Within the Chester Creek Basin, the storage areas are generally located in the northeast corner of the basin along the edge of the valley floor. Specifically, north of Thorpe Road and along Madison Road (Storage Area 1) and to the northeast of 40th Avenue (Storage Area 6).

The flood condition flows, as identified by WEST Consultants, are separated into three parts in relation to the three directions of flow that enters into the Painted Hills Development: the main flow (Golf Course Overflow Reach) across Thorpe Road, the secondary (Unnamed Tributary) flow from Highway 27, and the secondary flow across Madison Road. The project is proposing to redirect the anticipated flows of the identified flood events for storage area #1 (main flow and Madison secondary flow) to a discharge point at the north end of the development and for storage area #6 (Unnamed Tributary) to an existing offsite discharge point to the east of the development.

Storage Area #1 (compensatory area) is a large storage area that encompasses the majority of the former Painted Hills Golf Course as well as areas to the east of Madison Road. There is no outflow route for this storage area so it is classified as compensatory storage and is allowed to infiltrate through the native soils and into the Spokane Valley Rathdrum Prairie Aquifer. The soils below the storage area include the Spokane Valley Rathdrum Prairie Aquifer as its base followed by layers of course sands that are topped by soils of an alluvial fan or an area of natural deposit from Chester Creek, before the creek was channelized.

The floodwaters that enter Storage Area #1 are identified on the July 6, 2010 FIRM Map as the Chester Creek Golf Course Overflow. The Chester Creek Golf Course Overflow originates at a point to the south of Thorpe Road where there was at one time a breach in the man-made channel of Chester Creek. The breach was reportedly from a lack of maintenance and the overgrowth of vegetation in the main channel that blocked the main channel during a storm event. This flow of floodwater enters the storage area from the south at a low point in Thorpe Road through three 15" culverts and, if flow is larger, by overtopping Thorpe Road.

Storage Area #6 (triangle pond) is a smaller storage area that is located east of 40th Avenue primarily within a 30-foot-deep gravel pit that was excavated during the early development years of Spokane Valley. Spokane County obtained a drainage easement over the pit in 1983 for storm drainage (flood flow) purposes. The overflow route of storage area #6 is along the south side of 40th Avenue and flows into Storage Area #1 via culverts under Madison Road. The soils below the storage area include the Spokane Valley Rathdrum Prairie Aquifer as its base followed by layers of course sands and gravels that were further exposed by the gravel pit excavation.

The Main Flow Across Thorpe Road

Concept Design and Process

For the concept design the 100-year flood event was used to size facilities. When reviewing the Geotechnical Evaluations, Phase I (December 31, 2013 – Revised August 29, 2016) and Phase II (July 23, 2015) it was evident that there are "valley gravels" or well-draining soils that lead directly to the Spokane Valley Rathdrum Prairie Aquifer under the poor draining soils that cover the site. Therefore, we concluded that if we conducted flood waters into these well-draining soils the flood waters may be treated and discharged. Through extensive review, analysis and confirmation from geotechnical evaluations, it was determined that gravel galleries at the north end of the proposed development represented the optimal location for floodwater infiltration due to the fact that the groundwater depth in this location is much deeper than other locations on the site. See Supplemental Geotechnical Evaluation by IPEC dated April 19, 2016.

Proposed Design

See Site Element Plan in the attachments.

100 Year Flood Event

There is currently a shallow channel to the South of Thorpe Road that conveys the flood water flow from the breach North to Thorpe Road. This 100-year flood event, known as the Golf Course overflow Reach has a peak flow rate of 64 cfs, at the crossing of Thorpe Road, based on the existing FEMA FIS. Since the levee on the east side of Chester Creek immediately downstream of Thorpe

Road is not certified to protect against the 100-year flood, a peak flow of 91 cfs will be used as the design flow at Thorpe Road instead of the 64 cfs in the effective FIS. The larger 91 cfs flow is more conservative and simulates additional flow that could be contributed to the Golf Course Overflow Reach from the main channel of Chester Creek in the event of a failure of the non-certified levee (without-levee scenario). This provides a conservative design flow which accounts for a potential levee breach or additional overflows that could occur due to the continued mainstream Chester Creek Channel issues, primarily a lack of upstream channel maintenance, which could result in additional overflows. In addition to the overflow from Chester Creek the hillside above Madison Road has a peak design inflow of 15 cfs through the four operational 18" culverts of Madison Road. Therefore, the total peak 100-yr event flow rate used for conveyance and infiltration design for Storage Area #1 is 106 cfs.

System Summary

On the south side of Thorpe Road, the waters from a 100-year without-levee flood event, the 91 cfs peak flow rate, is proposed to enter a box culvert on the south side of Thorpe Road. The box culvert has a capacity of 216 cfs. From the box culvert the floodwater enters an open channel to a sloped headwall that holds two 48" concrete pipes. Each pipe has a capacity of 77 cfs for a total capacity of 154 cfs. The two 48" pipes extend north from the headwall along Madison Road, with manholes strategically placed to connect to the existing 18" culverts in Madison Road. This connection allows the design flow rate of 15 cfs from the Madison hills to be added to the 91 cfs, for a total design flow rate of 106 cfs. The two 48" pipes end at a vertical headwall where the floodwater splashes out onto a concrete pad and flows across a level spreader into a sloped biofiltration swale. The biofiltration swale cross section has a capacity of 269 cfs. Within the biofiltration swale the suspended solids are stripped out by the tall grasses. At the end of the biofiltration swale is a settling pond that allows the floodwater to settle and rise 1 foot in elevation before flowing over a 20-foot-wide rock weir into the infiltration pond that is 2 feet below the elevation of the rock weir. Within the infiltration pond the floodwater can begin to infiltrate through the pond bottom. When the floodwater in the infiltration pond rises 1 foot in elevation the floodwater will crest over the rim of the 48 drywells and fall into the infiltration trench where the floodwater will then infiltrate into the native soils and enter the Spokane Valley-Rathdrum aquifer. The infiltration trenches have a design capacity of 162 cfs. As demonstrated the flood control system has the capacity to handle the peak 100-yr event without-levee flood design flow rate of 106 cfs with a Factor of Safety of 1.53+/-. The following are descriptions of each design element in more detail.

Box Culvert/Open Channel

The Golf Course Overflow Reach flows coming from the upstream flow split on Chester Creek is anticipated to approach Thorpe Road as it currently does at the low point in the Thorpe Road profile where there are currently three 15" culverts within the natural drainage way of the Golf Course Overflow Reach. The flow will then enter into a 30-foot-wide by 3-foot-high box culvert under Thorpe Road, replacing the 3 existing culverts. The roadside ditches along Thorpe Road will be regraded to ensure positive flow toward the box culvert. Given the topography of the area, aside from shallow puddles caused by upstream localized depressions, all stormwater will enter into the proposed box culvert. The flow will exit on the north side of Thorpe Road and enter into a concrete open channel with a concrete bottom and vertical concrete walls and then flow to the sloped headwall of the two 48" Pipes.

Pipe Mainline

At the terminus of the open channel the flow will enter into a two-pipe, parallel, buried pipe system with WSDOT Type II catch basins along the East side of Madison Road. Once inside, the two 48" concrete pipes the flood flow will continue to the north end of the project with an outfall into a biofiltration swale. Each WSDOT Type II catch basin will have a sump for the settling of particles in low flow conditions. These particles or silt can then be vactored out of the manholes as part of the routine maintenance, prior to reaching the bio-filtration swale.

Bio-filtration Swale (Channel)/Settling Pond

The bio-filtration channel receives the flood water upon discharge from the two 48" concrete pipes. The filtration will be planted with tall dryland grasses. The flow of the floodwater overland through the tall grass provides an initial phase of silt and solid removal before the floodwater flows into a settling pond where additional silt will settle before cresting over a 1' rock weir with 8" minus rock compacted in place.

Bio-infiltration pond

The crested flood water from the settling pond then flows into an open surface bio-infiltration pond. Within the infiltration pond the suspended particles will continue to decelerate and settle downward to the pond bottom while the clear surface water crests over the rim of the drywells that leads into a gravel gallery system only when the floor dictates. Assuming that the infiltration pond discharges at the rate of $1.6x10^{-4}$cfs/sf the pond bottom in a non-frozen ground event would discharge ($61,000x1.6x10^{-4}$) 9.76 cfs directly to the underlying soils, and not enter the drywells. Therefore, a flow represented by 9.76 cfs is generally consistent with a pre-project flow over Thorpe Road of 0.25' or 3 inches, which has been experienced once during the preparation of this project and documented on February 17, 2017. The gravel gallery system is for the ultimate disposal into the aquifer, its final destination. See Bio-infiltration worksheet in the attachments.

Gravel Gallery System

Once floodwater flows exceed bottom infill rates it will rise to a depth of one foot and enter the discharge drywells which will evenly distribute the floodwater through gravel galleries by either flowing through the drywell barrels or distributing through the interconnected 12" perforated pipes and galleries along the pond's entire length.

The gravel gallery system is based upon a system of 10-foot wide by 10-foot deep infiltration trenches with 3 trenches at 340 feet, a trench at 330 feet, and a trench at 100 feet. the trenches are lined with geo-fabric per WSDOT Std. Spec. 9-33.2(1) and filled with gravel drywell material in conformance with WSDOT Std. Spec. 9-03.12(5). Within the top 3 feet of the infiltration trench runs a 12" perforated pipe at a 0% slope that connects the trench drywells within each trench segment. As treated floodwater crests over the rims of the drywells, the floodwater fills from the bottom up, and equalizes throughout the trench. Once filled the gallery is at its maximum design infiltration rate of 162.64 cfs (see gravel gallery worksheet in the attachments). For analysis the 100-year storm has a peak flow rate of 91 cfs, plus the 15 cfs from the Madison Hills for a total design peak flow rate of 106 cfs. So, with a design outflow rate over 1.5 times greater than the design inflow rate the system will adequately discharge the 100-year flood. This is a conservative measure of protection.

Infiltration Rate

A full-scale drywell test was performed at the north end of the site. Based on this test we used the design flow rate of 1.8×10^{-3} cfs/sf for design of the gravel galleries in the open space area north of the proposed Cottages residential area. See attached IPEC Geotechnical Report dated June 28, 2016.

Maintenance of the pipe, bioswale, road and gravel gallery system is a semi-annual inspection of the gallery through the system drywells looking for a build-up of sediment and debris, and if needed, the removal of the sediment and debris by a vactor truck.

Secondary Protection

As a secondary measure of protection, a detention facility is proposed at the south end of the project in the park area. A 176,181-sf area located in the park area has been lowered 3 feet +/- from the existing ground surface. This area will be covered with grass turf and will function as park open space, with gentle 3:1 side slopes for easy access. If for whatever reason an emergency situation exceeds the capacity of the pipe headwall or if the 48" concrete pipe inlets are blocked by debris, floodwater is intended to crest over the open channel wall and flow into the park as a temporary containment measure. The detention facility has an outlet located in the NE Corner. The outlet is a catch basin with a rim elevation placed 1 foot above the bottom of the park. The catch basin has an 18" pipe that connects into the western 48" concrete Pipe that runs along Madison Road. Below the rim of the catch basin the detention facility has a holding capacity of 178,699 cf or 4.10-acre feet, at a final grade of 5 ft depth the detention facility has an ultimate holding capacity of 943,866 cf or 21.67-acre feet. While the detention facility is not the ultimate disposal point for flood water the detention facility provides a secondary containment that will detain the floodwater and drain flood water back into the flood control system without risking a flood of the subdivision streets.

Project Site Fill and Flood Protection Measures

The project site is protected from the main channel of Chester Creek by the existing levee type fill of property along the existing Chester Creek channel and along Dishman-Mica Road. As was originally proposed and noted the project was going to be a levy type flood control project. However, it has since been modified to strictly a fill project where all future building pads will be placed 1.0 feet above the Base Flood Elevation (BFE). The new fill elevation is proposed to be placed 1 foot or more above the Chester Creek Base Flood Elevation (BFE) and then be graded out across the site toward Madison Road. All building pads will be placed above the BFE and certified to FEMA during the development. The project proposes to place 328,289 +/- cy of compacted fill on site to achieve this goal, Therefore, it is incumbent upon the reader to understand that the grading plan of the project site will be to raise the overall site surface. So that all residential building pads will be at least 1.0 foot above the BFE and will therefore always be out of the floodplain, even if the discharge measures experience some catastrophic failure of infiltration during a flood event.

Design Elements

	Box Culvert	Open Channel	Pipes	Bioswale	Settling Pond	Rock Weir	Pond	Drywell	Infil. Trench
Width/Area	28'	28'	48"	6'	7,172 sf	2'	61,004 sf	48"	10
Length	45'	18'	*2,629'	334'	-	20'	-	-	*1,450
Slope	0.5%	1.0%	0.26%	1.0%	0.0%	0.0%	0.0%	-	0.0%
Depth	3'	6'	-	6'	6'	5'	7'	18'	10'
Elev: in/btm	2007.58	2007.36	2007.18	2000.04	1996.80	1997.80	1995.80	1996.80	1978.8
Elev: Out	2007.36	2007.18	2000.24	1996.80	-	-	-	-	-

*Indicates a total

The Secondary Flow Across Madison Road:

The flow across Madison Road is divided into 5 basins from the heights above and to the east of Madison Road that correspond to the 5 culverts that are placed under Madison Road. The most northerly culvert does not have an outlet on the west side of Madison Road. Therefore, the floodwater that should enter this culvert goes to the south to the culvert at Sta 30+42. The floodwaters on the east side of Madison Rd distribute along the east side of Madison and appear to be separated into the four culverts that cross Madison Road at Stations (S to N) 13+22, 20+44, 24+41 and 30+42. As the development proposes to widen Madison Road on the west side, the 4 culverts will be replaced and extended. Since the proposed inverts of the extended culverts will fall below the proposed grade of the roadside swales, the culverts will connect into the East 48" pipe.

The storm water along the west side of Madison Road will be collected in roadside swales where it will receive treatment. The swales will have catch basins with the rim set 6" above the swale bottom. Any excess treated flow that does not infiltrate and exceeds a 6" depth will enter the catch basins. The catch basins will be connected to the East 48" mainline pipe.

West Consultants provided the following 100-year storm flows for each culvert during the 100-year storm. We are using these flows to size and design floodwater facilities.

STA.	100 Year Storm Flow (cfs)
13+22	4
20+44	1
24+41	1
30+42	2
38+98	7
Total	**15**

Any floodwater generated west of the triangle pond along E 40th Avenue flows to the west. Then at Madison Road it flows south between the road and the easterly hillside. These flows will be intercepted with the replacement culverts installed at Stations 13+22 through 30+42 that are connected at manholes into the east 48" pipe.

North Pond Mounding Analysis

On August 22nd 2017 IPEC completed a mounding analysis of the infiltration galleries on the north side of the project. In 2017 the design was not a pond with galleries below, as it is today but simply a series of infiltration galleries that are smaller than the current design. The mounding analysis utilized the established infiltration rate and applied the rate to smaller infiltration area of the time. The result was a 9.01-foot-high mound at the center of the facility and a 6-inch-high mound at the edge of the facility. It was then concluded that the infiltration of stormwater would not have significant down gradient impacts. With the current larger pond and infiltration gallery it is anticipated that the mound would be reduced in height and the conclusion would be the same.

The Secondary Flow From Highway 27 (Spokane County)

Proposed Design

The existing and documented 16 cfs flood flow from Highway 27 (Unnamed Tributary) is currently conveyed via a 36" culvert (limiting factor) that empties into a ditch that flows West across the Gustin property (Parcel No. 45344.9108). The stormwater flows through the ditch and into the existing County borrow pit within the triangular parcel located northeast of E 40th Avenue (Parcel No. 45343.9052). The existing ditch has been maintained over the years by the property owner (Gustin) to ensure that whatever floodwater comes out of the culvert under Highway 27 will be conveyed to the existing borrow pit. With this or a separate project the ditch will be replaced with a 36" pipe that extends from Highway 27 to the proposed infiltration (triangle) pond bottom in barrow pit. With the pipe there is no potential for floodwater to flow in the natural drainage way to the West. The existing pond is anticipated to be regraded with 18 drywells being installed.

Design Elements:

Proposed Pond 17,060 sf @ El: 1990.00; 35,812 sf @ El. 1995.00; 84,416 sf @ El. 2000.00
Drywell spacing 30', total drywell outflow 18.0 cfs, negates pond bottom, frozen ground flow
Maintenance Access Road: 6" gravel, max grade 10%, min. radius 35'
Fenced with gate

Infiltration Pond

WCE proposes to improve the outflow of the (triangle pond) borrow pit by regrading and expanding the lowest bottom area of the borrow pit and installing 18 double depth drywells into the bottom of the internal pond. The drywells will provide outflow during a frozen ground condition. Each double depth drywell will provide a design outflow of 1.0 cfs for a total of 18 cfs per the recommendations in the Geotechnical Evaluation by IPEC dated October 14, 2014.

If you have any questions or comments in regard to this letter please feel free to contact us at (509) 893-2617.

Sincerely,
WHIPPLE CONSULTING ENGINEERS, INC.

TODD R. WHIPPLE
STATE OF WASHINGTON
25462
REGISTERED
PROFESSIONAL ENGINEER

3/11/19

Todd R. Whipple, PE

TRW/bng

Encl: Attachments

CC: File

ATTACHEMENTS

BIBLIOGRAPHY

1) Dawes, Larry. February 28, 2019. Biological Evaluation, Critical area Report, and Habitat Management Plan for the Painted Hills PRD. Biology Soil & Water, Inc., Spokane Valley, WA. 13-14.

PAINTED HILLS PRD

BIOLOGICAL EVALUATION, CRITICAL AREAS REPORT, AND HABITAT MANAGEMENT PLAN

Spokane County Tax Parcels #45336.9191 and 44041.9144

February 28, 2019

Biology

Soil &

Water, Inc.

BIOLOGICAL EVALUATION, CRITICAL AREAS REPORT, AND HABITAT MANAGEMENT PLAN

for the

PAINTED HILLS PRD

Spokane County Tax Parcels #45336.9191 and 44041.9144
February 28, 2019

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BIOLOGICAL EVALUATION, CRITICAL AREAS REPORT AND HABITAT MANAGEMENT PLAN for the PAINTED HILLS PRD Spokane County Tax Parcels #45336.9191 and 44041.9144 July 20, 2015 (Revised August 30, 2016, and February 2019)

1.0: Introduction

Biology Soil & Water, Inc. (BSW) was retained by Black Realty to complete a Biological Evaluation (BE) for the proposed Painted Hills Planned Residential Development (PRD) located in the City of Spokane Valley, WA. This BE also includes all of the Critical Areas Report and Habitat Management Plan (HMP) elements required by the City of Spokane Valley Municipal Code, Section 21.40 (SVMC 21.40).

South Dishman Mica Road defines the west boundary of the site, E. Thorpe Road defines the south boundary of the property, S. Madison Road defines the East boundary, and developed private property defines the north property boundary (Figures 1-3). The Painted Hills Golf Course formerly occupied this location. The former club house was renovated to expand the existing restaurant and the remainder of the site will become residential development and open space. The subject property is comprised of seven separate tax parcels totaling 99.5 acres (+/-) where 580 residential units are proposed, and a 10+ acre parcel on the south end of the site that will be designated as a wildlife travel corridor. The Action Area was defined as a half mile radius of the 99+ acre Project Area so the site investigation would characterize adjacent areas where listed species could live or be impacted by the project. This assessment addresses all Critical Areas and listed Priority Habitat and Species including Threatened, Endangered, Proposed, and Candidate Species in the Project Area.

The USFWS and NMFS species lists were accessed on their websites on 4/21/2015 and updated August 29, 2016 and January 29, 2019. No NMFS species are listed for the vicinity. The USF&W list indicated the potential presence of the species and critical habitat(s) shown in Table 1 (and in Appendix 1).

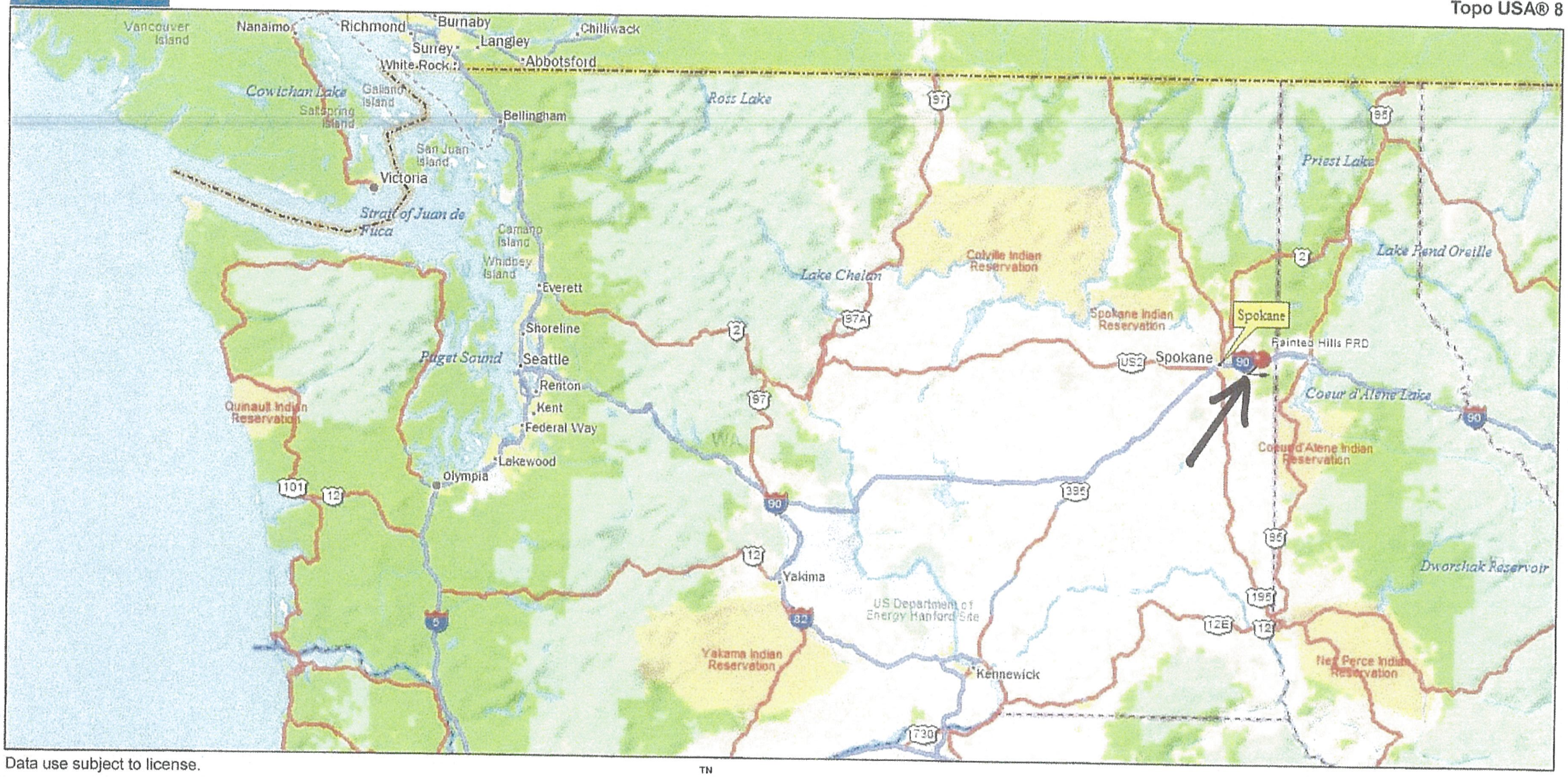
Table 1. USFWS listed species and critical habitats potentially present in the vicinity of

Species	ESU/DPS	Federal Status	Designated Critical Habitat
Bull trout *Salvelinus confluentus*	Columbia River DPS	*Threatened*	*Yes*
Water howellia, *Howellia aquatilis*		*Threatened*	*No*
Spalding's silene, *Silene spaldingii*		*Threatened*	*No*
Canada Lynx, *Lynx canadensis*		*Threatened*	*No*
Yellow-billed cuckoo, Coccyzus americanus,		*Threatened*	*No*

The undersigned investigated the Project and Action Areas on March 1, March 29, and April 19, 2015. The site conditions have not changed since the investigation in 2015. The conclusions of this plan are based on an evaluation of habitat and species data for Spokane County compiled by State and Federal jurisdictions, an evaluation of construction plans and specifications for the project, a literature review, and field investigations by the author of this report. The project will have no effect on Bull Trout or proposed Bull Trout Critical Habitat. The project will not result in the destruction or adverse modification of potential, designated or proposed Critical Habitat or Essential Fish Habitat for any fish species. The project will have no

DeLORME

Topo USA® 8



Data use subject to license.

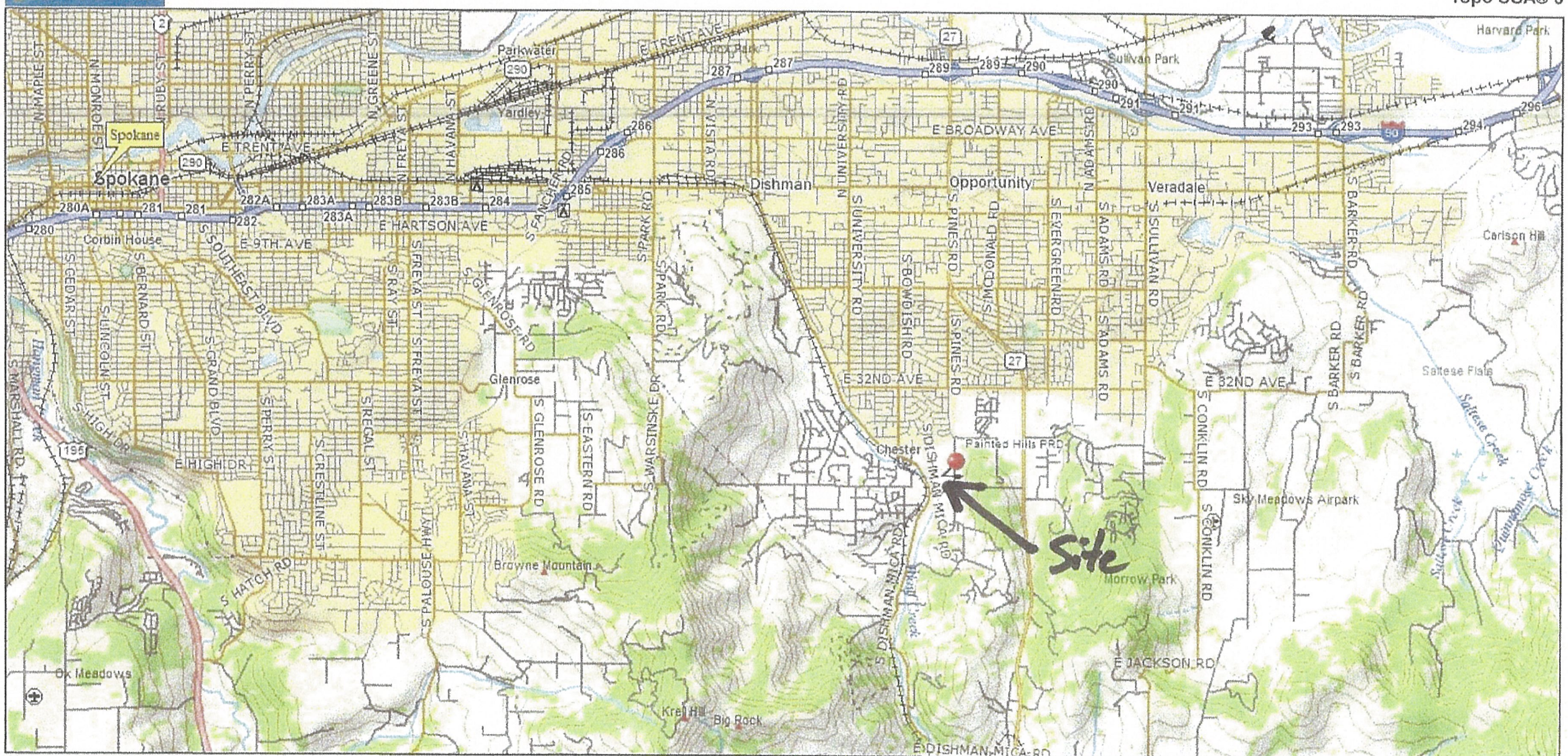
www.delorme.com

Figure 1: Site Location

Figure 2

DELORME

Topo USA® 8



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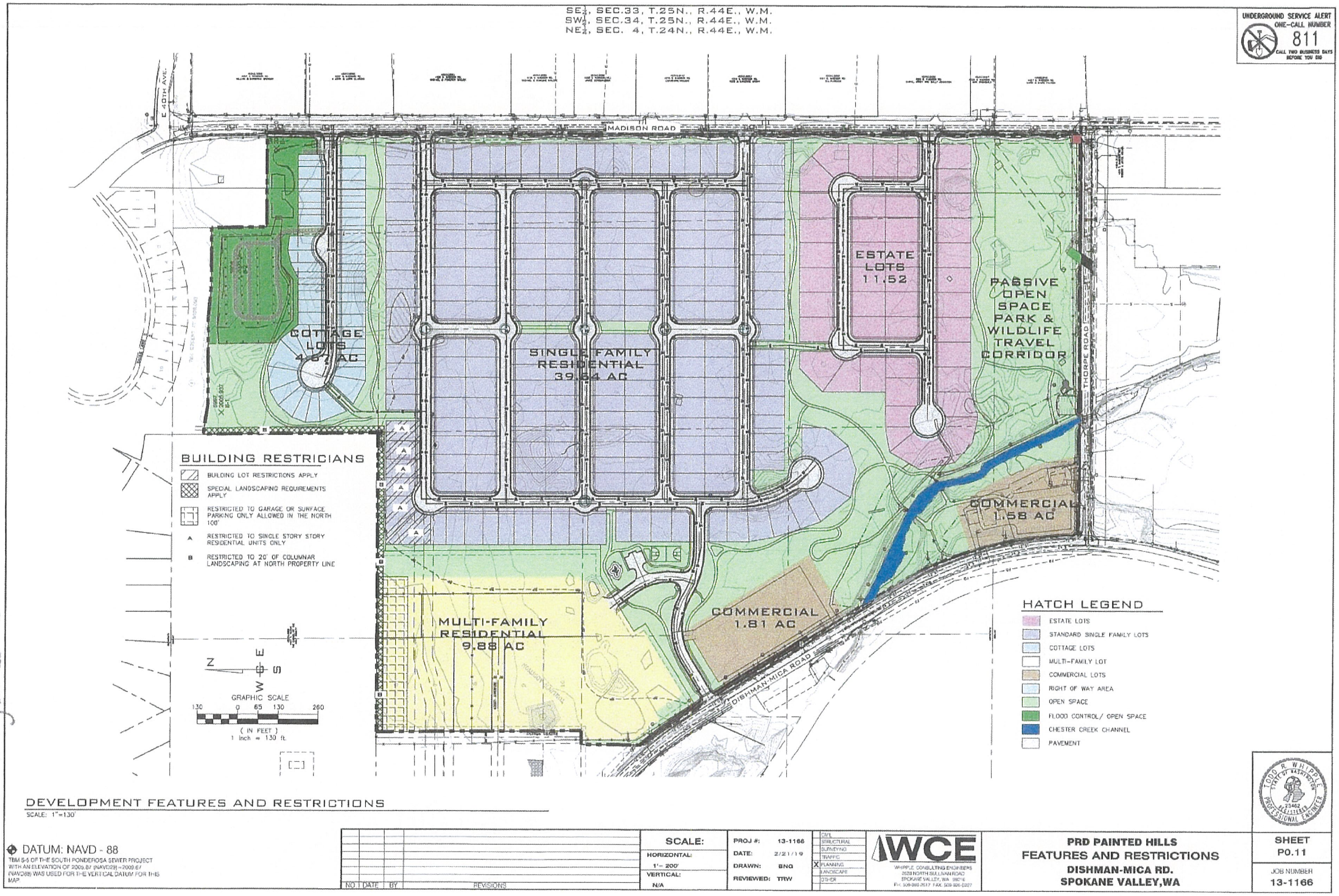
TN
MN (14.7°E)

Data Zoom 11-0

Figure 3



SE¼, SEC.33, T.25N., R.44E., W.M.
SW¼, SEC.34, T.25N., R.44E., W.M.
NE¼, SEC. 4, T.24N., R.44E., W.M.
UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG
E 40TH AVE.
MADISON ROAD
THORPE ROAD
DISHMAN-MICA ROAD
COTTAGE LOTS 4.67 AC
SINGLE FAMILY RESIDENTIAL 39.64 AC
ESTATE LOTS 11.52
PASSIVE OPEN SPACE PARK & WILDLIFE TRAVEL CORRIDOR
COMMERCIAL 1.58 AC
COMMERCIAL 1.81 AC
MULTI-FAMILY RESIDENTIAL 9.88 AC
BUILDING RESTRICIANS
BUILDING LOT RESTRICTIONS APPLY
SPECIAL LANDSCAPING REQUIREMENTS APPLY
RESTRICTED TO GARAGE OR SURFACE PARKING ONLY ALLOWED IN THE NORTH 100'
A RESTRICTED TO SINGLE STORY STORY RESIDENTIAL UNITS ONLY
B RESTRICTED TO 20' OF COLUMNAR LANDSCAPING AT NORTH PROPERTY LINE
GRAPHIC SCALE
130 0 65 130 260
(IN FEET)
1 inch = 130 ft.
HATCH LEGEND
ESTATE LOTS
STANDARD SINGLE FAMILY LOTS
COTTAGE LOTS
MULTI-FAMILY LOT
COMMERCIAL LOTS
RIGHT OF WAY AREA
OPEN SPACE
FLOOD CONTROL/ OPEN SPACE
CHESTER CREEK CHANNEL
PAVEMENT
DEVELOPMENT FEATURES AND RESTRICTIONS
SCALE: 1"=130'
DATUM: NAVD - 88
TBM S-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2009.87 (NAVD29) = 2009.67 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP
NO DATE BY REVISIONS
SCALE:
HORIZONTAL:
1"= 200'
VERTICAL:
N/A
PROJ #: 13-1166
DATE: 2/21/19
DRAWN: BNG
REVIEWED: TRW
CIVIL
STRUCTURAL
SURVEYING
TRAFFIC
X PLANNING
LANDSCAPE
OTHER
WCE
WHIPPLE CONSULTING ENGINEERS
PRD PAINTED HILLS
FEATURES AND RESTRICTIONS
DISHMAN-MICA RD.
SPOKANE VALLEY,WA
TODD R. WHIPPLE
STATE OF WASHINGTON
PROFESSIONAL ENGINEER
SHEET
P0.11
JOB NUMBER
13-1166

effect on the threatened species Water howellia, Spalding's silene, Canada lynx, or the Yellow-billed cuckoo. There will be no significant adverse effect on any listed Species of Concern. The site plan includes a 10+ acre wildlife travel corridor for deer and elk and over 30 acres of open space.

The Project Area does not meet any of the Department of Natural Resources (DNR) criteria for High Quality Terrestrial Habitat. Washington Department of Fish and Wildlife (WDF&W) maps (Appendix 2: Critical Areas Maps) indicate the subject property falls within an Elk polygon (WDF&W Priority Habitat). A 10+ acre wildlife travel corridor is proposed along the entire south end of the project and the corridor will be enhanced with vegetative plantings to accommodate animals traveling through the area.

Chester Creek and its associated 100-foot buffer bisects the SW corner of the property. Buffer Width Averaging is proposed to compensate for the encroachment of two lots and foot paths in the riparian buffer. The impact mitigation also includes riparian buffer enhancement. The existing buffer is almost totally devoid of woody vegetation because it was previously a driving range and/or maintained golf course fairway. An evaluation of streams and wetlands is included in this report.

2.0: Methods of Investigation

The north parcel of the Project Area is located in Sec. 33, T25N, R44E and the south parcel is located in Sec. 4, T24N, R44E of Spokane County, WA (Figures 1-3). Biology Soil & Water, Inc. (BSW) investigated the property on March 1 and 29, and April 19, 2015 for wetlands, riparian habitat, and species protected under the Federal, State, and local regulations. The undersigned is familiar with the soils, vegetation, and hydrologic characteristics of this property from previous investigations of adjacent properties in the immediate vicinity and throughout the drainage basin.

3.0: Description of the Action and Project Areas

Spokane is located in a valley at the westmost extent of the Rocky Mountains. From the north side of the Spokane River valley, the Selkirk Mountains extend north into Canada. On the south side of the Spokane River valley, a forested finger of the Bitterroot Mountains extends east from Lake Coeur d'Alene to Dishman Hills. The subject property is located in the Chester Creek valley with forested foothills on the east and west sides of the valley. The Painted Hills PRD is surrounded primarily by residential development with varying degrees of housing density, a few small undeveloped tracts of agricultural land in the Chester Creek valley, and forested land with varying densities of residential development (Figure 4).

3.1: Description of the Action Area

For purposes of describing habitat in the surrounding area, the Action Area is defined as a half mile radius of the project area. Habitat types in the Action Area would be described as a mosaic of urban developed, fragments of conifer forest, and small tract agriculture. From the north property line, dense residential development extends north into the City. A church and residential development border the painted Hills PRD at the NW corner. Horizon Middle School is located NE of the site. From the east property line (S. Madison Rd) hay fields and pasture extend 250-500 feet toward the toe of the surrounding forested slopes. Sparse residential extends east up the forested hillsides. Commercial and single-family residential development extends south from Thorpe Road except for the Chester Creek drainage and associated flood plain that is

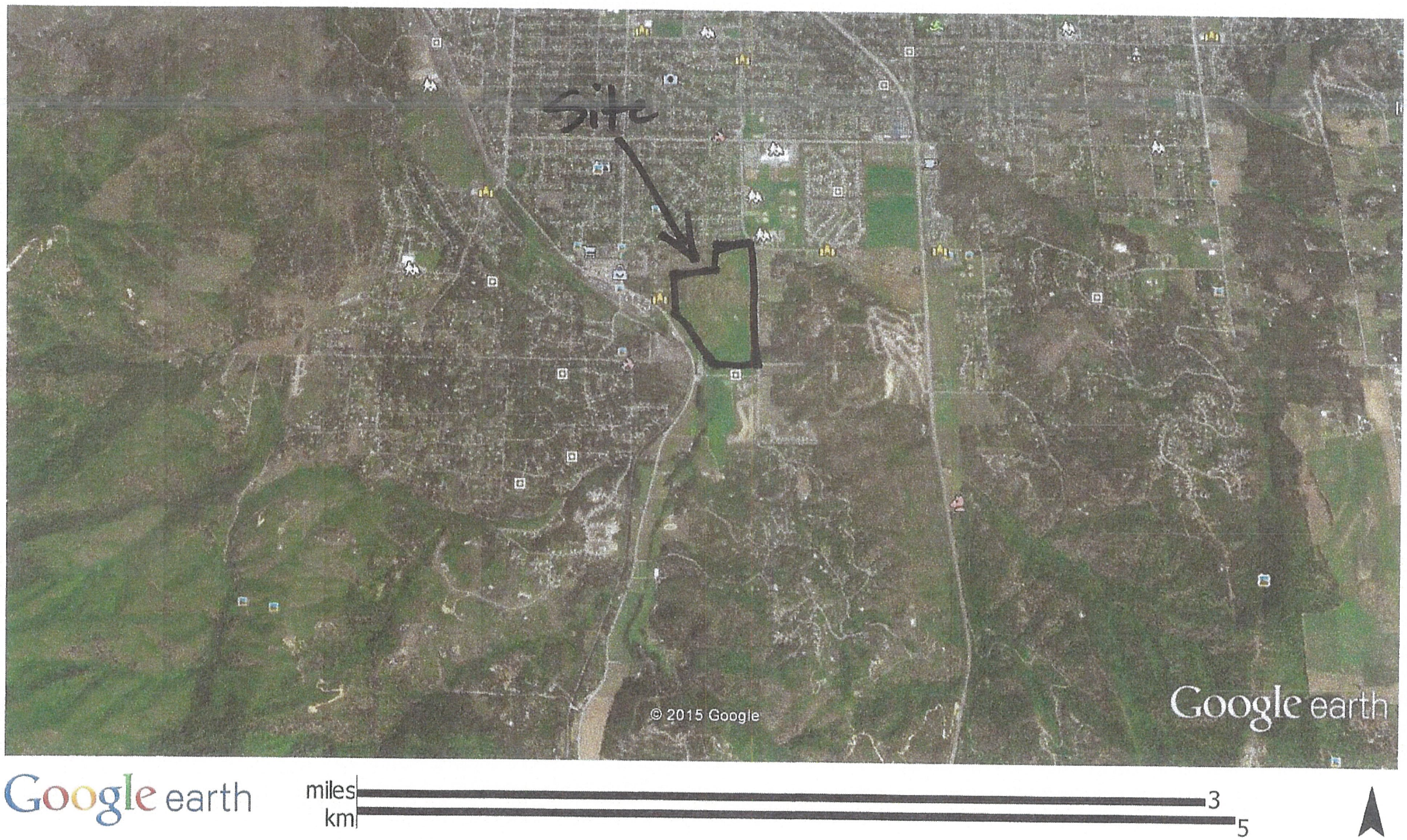


Figure 4

mainly forested and small tract agriculture. Undeveloped forested hillsides extend about 1200 feet east to the densely developed Ponderosa neighborhood. A mixture of commercial and residential land uses extend NW along Dishman-Mica Road.

Land uses in the Action Area are a mosaic of dense residential development on former agricultural land, remaining undeveloped small tracts of agricultural land, and forested land with varying densities of residential development. Large mammals that are willing to cross highways and residential developments interspersed with open farm land will find connectivity to a few hundred acres of wooded and sparsely populated foothills extending south and west from the Painted Hills PRD site to Dishman Hills.

3.2: Description of the Project Area

The 99+ acre Painted Hills PRD property was formerly a golf course. Black Realty Inc. bought the property in a trustees auction in the fall of 2013 after the owners filed for bankruptcy in 2012. Except for cart paths, sand traps, and man-made water hazards, the entire property was planted in non-native turf grasses with sparse conifer and deciduous trees lining some of the fairways. The turf grass was maintained by treatment with herbicides and regular mowing of the greens, fairways and rough. These practices virtually eliminated the native herbaceous plant community. Since golf course maintenance ceased, noxious weeds have invaded the site.

Honey willows were planted inside the Ordinary High Water Mark (OHWM) of Chester Creek whose channel was historically dredged and maintained for flood control. The banks of the channel are covered with Reed canarygrass. Outside the OHWM of the stream channel where the vegetation was not mowed or maintained, the vegetative community is dominated by Canarygrass. Teasel, tansy, thistle, wormwood, and lettuce are also well represented.

3.3: Comparison of three Development Alternatives

A State Environmental Policy Act (SEPA) Environmental Impact Statement (EIS) is being prepared for the project. The EIS provides a detailed analysis of three alternatives. Alternative #1 proposed no development. Alternative #2, the preferred development scenario, was for the Planned Residential Development discussed in this report. Alternative #3 was for a standard Residential Subdivision under the current zoning without PRD requirements and density. A detailed comparison of the three alternatives is provided later in this report.

4.0: Project Risk Assessment and Impacts

Listed threatened and endangered species identified by jurisdictions for potential occurrence in Spokane County include the Yellow-billed Cuckoo (*Coccyzus americanus*), Canada Lynx (*Lynx canadensis*), Bull trout (Salvelinus confluentus), Water howellia (*Howellia aquatilis*) and Spalding's silene (*Silene spaldingii*). A BSW field investigation determined that the project would have NO EFFECT on any of the above listed species.

4.1: Yellow-billed Cuckoo (*Coccyzus americanus*), Federal Status: Threatened

The yellow-billed cuckoo was formerly a very rare summer visitor to western Washington, especially in the Puget Sound area (Roberson 1980). Jewitt et al. (1953) described the former breeding range in Washington as ranging north to Bellingham, east to Ellensburg, south to Vancouver, and west to Grays Harbor. There are only two published records of yellow-billed cuckoo in eastern Washington. Yellowbilled cuckoos were detected on July 21, 1956, 20 miles north of Grand Coulee Dam in Okanogan County (Weber and Larrison 1977) and in June 1978 at George, Grant County (Roberson 1980).

The March and April investigations occurred before the Yellow-billed cuckoo would have migrated into the Spokane County area if it seasonally utilized the area for breeding or nesting. The investigation for the Yellow-billed cuckoo focused on specific habitat requirements of that species. Cuckoos prefer to nest in areas with at least 10 hectares (ha) (25 acres) of contiguous (riparian) woodland (Laymon 1998). The typical patch size is 20 ha (50 acres) or greater, and the likelihood of occupancy increases dramatically with increasing patch size, but they have been found breeding in patch sizes as small as 4 ha (10 acres) along the Colorado River in southern California (Johnson, Matthew J., 2007). Yellow-billed cuckoo's nest in undisturbed stands of cottonwood/willow galleries greater than 10 acres in total area and greater than 100 meters wide along waterways.

The project area does not contain, and is not in close proximity to, adequate habitat patches for that species. The largest habitat patch consisting of species utilized by the yellow-billed cuckoo is less than one tenth of the minimum patch size utilized by this reclusive species. The yellow-billed cuckoo is known not to utilize any habitat with characteristics of those found along Chester Creek adjacent to this project. This project will not impact yellow-billed cuckoo populations or habitat components. There is no suitable habitat for the yellow billed cuckoo in the vicinity of this project. **The project will have NO EFFECT on the yellow-billed cuckoo.**

4.2: Bull Trout (*Salvelinus confluentus*) Threatened

The U.S. Fish and Wildlife Service (USF&WS) lists the Columbia River population of bull trout as threatened. Small pockets of bull trout are present in isolated habitat fragments in the main stem and tributaries of the Columbia River. One isolated fragment of the Columbia River segment includes Coeur d'Alene Lake, its tributaries in the drainage basin, and the Spokane River. Bull trout populations have been identified in Coeur d'Alene Lake and three tributaries in its sub-basin, but no bull trout populations are known to occur presently, or have been noted historically, in the Spokane River downstream from the Post Falls Hydroelectric Dam (PBTTAT, 1998).

The Post Falls dam stops the migration of fish out of the Coeur d'Alene basin downstream into the Spokane River. Waterfalls and dams prevent the upstream and downstream migration of bull trout into the segment of the Spokane River and its tributaries in the vicinity of the project area. No dam on the Spokane River has a fish passage facility and all dams create fish barriers for upstream and downstream migration. EPA fact sheets for 1999 NPDES permits for wastewater treatment plants discharging to the Spokane River state that bull trout cannot get past the Post Falls Dam (EPA 2008). There is no known population of bull trout in the Spokane River downstream of the Post Falls dam (FERC 2006). The USFWS does not include the Spokane River and its tributaries located downstream from the Post Falls dam in bull trout recovery planning efforts (Federal Register / Vol. 75, No. 200 / Monday, October 18, 2010). **The project will have No Effect on Bull Trout.**

Bull Trout Critical Habitat

Activities that may adversely modify critical habitat include those that alter the primary constituent elements to an extent that the value of critical habitat for both the survival and recovery of the bull trout is appreciably reduced. The proposed project will not destroy or adversely modify critical habitat by altering primary constituent elements. The value of critical habitat for both the survival and recovery of the bull trout will not be reduced as a result of this project. The project will not alter the minimum flow or natural flow regime of the subject stream, alter any segment of the stream, riparian vegetation, or any chemical parameters so as to reduce water quality, alter channel morphology or create instream barriers to bull trout movement. No decrease in water quantity will occur because of the project. **The project will cause no significant and detrimental alterations to water quality and will have NO EFFECT on proposed Bull Trout Critical Habitat.**

4.3: Spalding's catchfly (*Silene spaldingii*), Federal Status: Threatened

The range of Spalding's silene (*Silene spaldingii*) includes eastern Washington, northeast Oregon, Idaho, and western Montana. Spalding's silene occurs primarily in open grasslands with minor shrub and/or (occasionally) scattered conifer components. Spalding's silene is found most commonly in Idaho fescue/snowberry associations at elevations of 1900-3050 feet. These sites are typically dominated by Idaho fescue and have sparse cover of snowberry where the total vegetative cover is greater than 100%. Some of these sites occur in a mosaic of grassland and ponderosa pine forest. Spalding's silene populations have been found on all aspects, although there seems to be a preference for slopes that face north. On drier sites, the species can be found on the bluebunch wheatgrass/Idaho fescue association.

Spalding's silene can occupy habitats that vary from sagebrush plains to mountain ridges. Spalding's silene generally occurs in native grasslands that are in reasonably good ecological condition, although populations have persisted in areas that have had moderate grazing pressure. Populations tend to be quite small and are currently quite fragmented, raising questions about their long-term viability. Fire may have historically played a role in maintaining habitat particularly in sites that are interspersed with ponderosa pine forest. Much of the historically suitable habitat has been lost through conversion or degradation.

The timing of the site investigation did not coincide with the flowering of listed plant species. The project biologist is a qualified botanist and wetland professional that routinely completes site investigations during all seasons when snow does not cover vegetation. Site investigations often occur when salient plant flowering parts are senescent or may not be sufficiently preserved to allow taxonomic identification beyond genus to the species level. Twenty years of experience in plant identification during all life history and seasonal growth habits has equipped the project biologist to conduct accurate plant identifications and wetland investigations in accordance with best available science and consistent with the accepted professional practices for the conditions at the time the work was performed.

Individual plants exhibit essential identification characteristics unique to their genera, but display sufficient variation so it is possible to categorize and differentiate each species within a genus using taxonomic keys. During plant senescence, individual characteristics often become blurred making it difficult or impossible for a botanist to differentiate among species within the genus. The sepals of the genus *Silene* form a bulbous calyx that is easily recognized and sufficient to identify the plant to genus. The Threatened species *Silene spaldingii* overlaps in range and is somewhat similar in appearance with some other species in the genus.

The field biologist is familiar with the species and has observed it at other locations. During the field investigation, the *Silene* genus was not identified in the Action or Project Areas. Previous years of cultivation, followed by the planting of turf grasses, years of mowing, and herbicide applications is sufficient grounds for discounting effects on Spalding's silene when considered alone. No populations of Spalding's silene were identified in the Project Area during the field investigation. **The project will have NO EFFECT on Spalding's Silene and will not result in the destruction or adverse modification of potential, designated or proposed Spalding's silene Critical Habitat.**

4.4: Water howellia (Howellia aquatilis)

Howellia is found in seasonal wetlands, ponds and lakes because its seeds do not germinate under water. Since seeds germinate in the fall and over-winter as seedlings Howellia requires a dry autumn followed by a wet spring in order to establish for the year. In addition to seasonally fluctuating ponds, Howellia requires fertile, highly organic soils, which are generally maintained by deciduous trees surrounding the ponds. Research indicates that Howellia does not form a persistent seed bank, making this annual especially dependent on year to year reproductive success in order to persist.

No Howellia was observed in the Project Area. Howellia is found in seasonal wetlands, ponds and lakes. No Howellia habitat occurs in the Project Area. **The project will have NO EFFECT on the Howellia aquatilis species and will not result in the destruction or adverse modification of potential, designated or proposed Howellia Critical Habitat.**

4.5: Canada lynx (Lynx canadensis) Federal Status: Threatened

Lynx prefer dense coniferous forest with sapling/pole thickets, rock outcrops, and wetlands at elevations of around 4000' to 4500'. The elevation of the Action Area is around 2010-2015 feet. Denning usually occurs in mature old growth stands with lots of deadfall. These forested stands do not occur in the Action Area. Lynx prefer snowshoe hare habitat, as they are dependent on snowshoe hare as a staple food item. Snowshoe hare prefers dense lodgepole stands that do not occur in the Project or Action Areas. BSW did not find any evidence of Canada lynx in the low elevations associated with the Project Area. **The project will have NO EFFECT on the Canada lynx or Canada lynx habitat. The Canada lynx does not appear on the 1/29/2019 official USFW species list for the site.**

4.6: Species of Concern

The site was also investigated for the presence of species from the Species of Concern list for Spokane County published by the U.S. Fish and Wildlife Service. Most of these species are also included in the WDF&W list of priority species that was adopted by the City of Spokane Valley. Each species is listed below, followed by an evaluation of available habitat, observed habitat utilization, and potential project effects.

Bald eagle *(Haliaeetus leucocephalus)*

The Bald eagle is listed as a State Sensitive species. Eagles do not nest near the Project Area. Human activity associated with major roads and urban development are limiting factors for Bald eagles in the Action Area. At any location in Spokane County road kill can provide food for transient opportunist eagles. However, Bald eagles do not routinely forage in the Action Area and no nest sites were observed by BSW within one-half mile of the Project Area. BSW concludes that noise and human activity during construction will not impact eagle nesting as no nests were identified in the Action Area. Perching and foraging opportunities occur on the stream bank and eagles could utilize the stream corridor. **The project will have NO EFFECT on the Bald eagle.**

Western Burrowing Owl ***(Athene cunicularia)*** No historical observation in the vicinity. No individuals, nests, or sign observed during the site survey. **No Effect from project.**
California floater ***(Anodonta californiensis)*** freshwater mussel. **No Effect from project.**
Ferruginous hawk ***(Buteo regalis)*** nests on rocky ledge or high ground vantage on prairie. **No Effect from project.**
Giant Columbia spire snail ***(Fluminicola columbiana)*** cold, unpolluted, medium to large streams. **No Effect from project.**
Loggerhead shrike ***(Lanius ludovicianus)*** A robin sized gray, black, and white bird of open areas. Community types not dominated by shrubs, such as grasslands and riparian areas, are not used. Loggerhead Shrikes prefer nesting in big sagebrush and antelope bitterbrush, and avoid spiny hopsage, rabbitbrush, and green rabbitbrush (*Chrysothamnus viscidiflorus*). Nest shrubs are taller, closer to an edge, and contain denser cover and fewer main stems than unoccupied shrubs. Roost shrubs are large, dense live shrubs, whereas tall, dead shrubs that provide good visibility are used for perching. **No Effect from project.**
Longeared myotis ***(Myotis evotis)*** Roosts are sometimes found in crevices in small basalt rock formations. Compared to random plots, roosts are in more open, rocky habitats, closer to the edge of forest stands, and relatively distant from sources of permanent water. Often roost in Ponderosa pine trees >30 cm in diameter and >12 m high. Less use of grasslands and closed pine than expected. **No significant effect if present in vicinity.**
Northern goshawk ***(Accipiter gentilis)*** goshawks select relatively closed-canopy conifferous/boreal forest habitat for nesting - **No significant effect.**
Olivesided flycatcher ***(Contopus cooperi)*** found in boreal and western coniferous forests - **No Effect**
Pallid Townsend's bigeared bat (Corynorhinus townsendii pallescens) Eastside mixed conifer forest, shrub-steppe, and riparian-wetlands. In Washington, old buildings, silos, concrete bunkers, barns, caves, and mines are common roost structures. **No effect on roosting or hibernicula**
Peregrine falcon (Falco peregrinus) Two subspecies of peregrine falcons (Falco peregrinus) occur in Washington state at present, (F. p. pealei and F. p. anatum). Peale's peregrine falcon is a coastal subspecies so our concern in Spokane County is with F. p. anatum (Continental peregrine falcon). DDT exposure totally eliminated this subspecies from former breeding sites in eastern Washington. Following a ban on the use of DDT, captive-reared young birds have been released at several sites in Spokane County in an attempt to augment natural reintroductions by wild birds. There is no potential for degradation or loss of critical habitat for peregrine falcons in the project area. Peregrine falcons nest on cliffs or even man-made structures such as buildings or bridges that do not occur in the project area so no action is required to protect nest sites from human disturbance. The primary method used to reintroduce falcons to the wild is called "hacking". WDF&W does not currently use any hack sites in the vicinity. **No significant effect**
Redband trout (Oncorhynchus mykiss) No Effect from project.
Sagebrush lizard ***(Sceloporus graciosus)*** **No Effect from project.**
Westslope cutthroat trout ***(Oncorhynchus clarki lewisi)*** **No Effect from project.**
Palouse goldenweed ***(Haplopappus liatriformis)*** palouse, not in our area **No Effect**

4.7: WDF&W Priority Species Deer, Elk, and Gray Wolf

Impacts to the WDF&W Priority Species White-tailed deer and Elk will be minimized by protecting a travel corridor through the site. The subject property is not mapped as White-tailed deer priority habitat. Wooded lands to the east and south are mapped as priority white-tailed deer habitat. However, deer utilize the site as they do all undeveloped parcels in the area. The site falls within the northern extent of the mapped Elk Habitat polygon in the Spokane Valley. The site does not provide cover or refugia required by elk and is not elk habitat, but Elk moving through the general area between Mica Peak and Dishman Hills could potentially cross the subject property on east/west treks. The developer will protect and enhance an east/west 10+ acre deer and elk travel corridor across the property. Woody vegetative plantings prescribed for the corridor will provide some habitat value and protective cover where none currently exists. Deer will continue to use the area set aside as a travel corridor.

The site is also mapped as Gray wolf habitat. It is possible that wolves could travel through the area in search of prey. There are deer and abundant small (domesticated) mammals available in this residential area so their presence would not be well received in the surrounding neighborhoods. Wolves could also utilize the 10+ acre travel corridor for safe east/west passage through the property. On May 5, 2011, wolves were federally delisted in the eastern one-third of Washington State.

4.8: Wetlands

Wetland Inventory Maps of the site show two wetlands on the property (Appendix 2). Both of the wetlands are shown to occur on the west side of Chester Creek. BSW investigated the mapped wetlands on March 1, 2015. In each mapped wetland, BSW dug a test hole on top of the creek bank in close proximity to the Chester Creek OHWM. On March 1, neither of the test holes had saturated soils in the top 16 inches of the soil profile. In Test Hole #1 the water table was at 21 inches and saturation occurred at 16 inches. In Test Hole 2, there was no saturation in the top 24 inches of the soil profile.

The test holes were inspected again on March 29th and the water level in test holes was lower than on March 1st. This result was expected due to the landscape position of the mapped wetlands. The year to date precipitation for Spokane was fluctuating between slightly above normal for the year to slightly below normal for the year to date making this year to date average in precipitation. Wetland hydrology should have been present in what was a normal year at the time of the investigation if the subject areas were wetlands. The argument that Spokane was below normal for the hydrologic year is also not valid for this drainage basin because it has a low elevation and runoff comes earlier in the year than many other drainages as will be explained in detail below.

The wetland hydrologic criteria was not met in either test hole at the start of the growing season when the water table should have been at its annual high. Stream high water conditions consistent with a high water table does not typically occur during the growing season on Chester Creek. Seasonal high water occurs in the winter during rain on snow and frozen ground conditions. During the growing season, wetland conditions do not occur outside of the stream OHWM where the National Wetland Inventory Map indicates the wetlands occur. David Moore, DOE, investigated the site on June 8, 2016 and concurred with that finding in the field and by phone after the site visit.

The hydrologic studies referenced in this report all conclude that Chester Creek is not influenced by a high water table so it loses water to the underlying sands and gravels. This prevents wetland conditions from occurring outside the area of flowing water in the channel. The author of this report concurs with those conclusions based on 20+ years of personal observations of hydrologic conditions and numerous wetland investigations in the Chester Creek drainage basin.

Most streams occur in the lowest elevational contour of a drainage basin where bedrock, or some restricting layer, prohibits the infiltration of water and causes a seasonal high water table. Under those physical conditions, the water table influences, or contributes to the stream through the winter and spring portions of the hydrologic year. The key feature to wetland occurrence in riparian zones is a high water table that generally correlates to the surface elevation of the stream. Wetland conditions form when the water table comes in close proximity to the soil surface during the growing season. The water level in the stream generally corresponds to the top of the water table in the surrounding basin. During the growing season, evapotranspiration lowers the water table at the same time annual precipitation decreases. When the water table falls, isolated depressions remain full of water until the water table drops allowing the depressional wetlands to dry out. When these depressions remain inundated or saturated for sufficient duration, DOE considers them to be wetlands within the stream channel. At some point the water table falls below the bottom of the stream and no longer contributes to base flow in the stream. The above scenario does not occur in Chester Creek.

Chester Creek loses water to the underlying sands and gravels all year long. Chester Creek flood events occur during the winter when heavy rains on frozen ground and/or snow prevent infiltration of stormwater in the contributing basin. Flood events do not occur during the growing season. The extent and duration of occasional flood events depends on how long the above normal precipitation continues and how far downstream the flooding spreads before infiltration exceeds hydrologic input. The frequency, duration, and extent of flooding have been attenuated by flood control measures thoughtfully implemented downstream. The flood control measures proposed with this project are a continuation of that process.

In summary, Chester Creek is not influenced by a high water table that creates wetlands. Chester Creek loses water to the underlying sands and gravels so wetlands do not occur outside of the channel of flowing water. The test holes evaluated with a shovel by BSW in 2015 and again in 2016 support that conclusion. That conclusion is backed by 20+ years of personal experience in the basin, previous hydrologic studies of the basin, Bore Hole Logs taken within the area of interest on Chester Creek, Bore Hole Logs throughout the Painted Hills project area, well logs of proximate properties, and the Geotechnical and Hydrologic Analysis of the same Bore Hole Logs. No wetlands occur adjacent to Chester Creek because is not influenced by a high water table. This conclusion is supported by the Geotechnical Evaluation of the area. The author of the Geotechnical Evaluation report reached the same conclusion as BSW, that Chester Creek loses water to the underlying well drained sands and gravels all year long preventing wetlands from forming.

4.8.1: Chester Creek Flood Frequency

A hydrologic and hydraulic analysis for Chester Creek was completed by Michael Baker Jr., Inc. and approved by Spokane County in a letter to the Federal Emergency Management Agency dated August 6, 1990. There are no long-term gage records for Chester Creek. The limited gage measurements on Chester Creek were collected near the Dishman-Mica Road crossing of Chester Creek from December 1994 through March 1995 and November 1995 through February 1996 when no flood events occurred. In February 2006, the hydraulic analysis for Chester Creek was revised by West Consultants, Inc. under a FEMA contract. The analysis established flood magnitude-frequency estimates for the watercourse. A steady flow model has been developed for Chester Creek.

The reports conclude that spring floods in the upper Spokane River basin are due to snowmelt runoff from high elevation watersheds. Such floods are of less significance on Chester Creek because the lower elevation of the watershed limits the size of the snowpack so spring runoff occurs about a month earlier and at more gradual rates than on the Spokane River. Nearly all maximum annual flood peaks on Chester Creek occur during the winter. Warm winds and rain can melt the snow rapidly. The May 1948 flood on Hangman Creek was a non-typical flood caused by a heavy snowpack, a late, cold spring, and heavy rains during the critical snow melting period. All other maximum annual flood peaks on Hangman Creek occurred during the winter. When winter rain causes snowmelt on frozen soil conditions, short-duration, intense runoff generates a flood peak during winter storms. During the more extreme events, Chester Creek runs over its banks filling depressions in the flood zone.

The duration of flooding is generally between 100 hours and 1000 hours, or between four days and forty days with smaller events occurring with greater frequency than large events. Hydric soils form under saturated soil conditions. Wetlands have to exhibit saturated soils during the growing season, but those conditions seldom occur outside of the stream channel on Chester Creek because flooding usually happens in the winter. Floods are typically of a small magnitude so when over bank flow fills depressions outside of the channel, the water has usually infiltrated before the growing season begins. The subject areas may have been exposed to more frequent flooding in the past, but good planning and flood control measures designed to minimize flooding have moderated those historical flood events to some degree. Chester Creek does not follow the same hydrograph as snowmelt dominated systems.

4.8.2: Flood Protection Measures

Channel geometry for Chester Creek were developed from surveys conducted in March 2003. Overbank geometry were developed from topography developed by TerraPoint (2003). Flood plain boundaries for Chester Creek and Unnamed Tributary to Chester Creek were delineated using 2-foot contour interval maps developed by TerraPoint from LiDAR data.

Previously, a watershed plan for Chester Creek was designed with management recommendations for drainage, flooding, water quality, and riparian habitat. As a result, flood control improvements have been implemented along Chester Creek. The improvement area began at the Painted Hills Golf Course. In 1998, a project to install new culverts and extensive dredging of the channel between Thorpe Road and Schaffer Road was implemented. Two large volume borrow pits were constructed downstream. Each pit was designed for the retention and infiltration of Chester Creek floodwaters up to a 25-year event. One borrow pit was constructed just north of E. 40th Avenue and the other just south of 28th Avenue.

The Chester Creek channel has been historically maintained as has been reported in the literature and supported by direct evidence of spoil piles on the channel banks. Dredging makes the channel deeper and the dredging spoil piles make the channel banks higher. As a result of channel dredging, the surrounding areas are dewatered faster and the water table falls a corresponding distance deeper below the soil surface. Soils in the areas mapped as NWI wetlands do exhibit some relic hydric characteristics from infrequent historical flooding, but with the exception of rare flood events, the water table is too far below the soil surface at the start of the growing season to meet the wetland hydrologic criteria.

The two mapped wetlands do not meet the hydrologic criteria so they are not wetlands. They are low lying areas adjacent to Chester Creek that have been historically flooded, but flooding is far too infrequent for the subject areas to meet the wetland hydrologic criteria. Even if they were wetlands, they are on the opposite side of the creek from where development is proposed so the riparian buffer would be more restrictive and extend further east into the development than a wetland buffer. However, there are no wetlands on the subject property.

Additional flood control measures are being incorporated into the project design (see the Painted Hills Flood Control Plan). In the proposed Alternative #2, a thirty-foot wide by 3-foot-deep box culvert will be installed in the Right of Way to prevent back up on the Haase property south of Thorpe. On the north side of Thorpe, water will proceed northeast in an open concrete channel and headwall for two 48-inch pipes. The pipes extend northeast across the park to Madison Road where it will be piped north to a headwall and bioswale. The bioswale is a long sloping reach that terminates in a settling pond. At the settling pond, water will rise one foot and crest over a weir into the infiltration pond located at the north end of the development. Inland Pacific Engineering Company (IPEC) developed an Operations and Maintenance Plan for the facility to ensure the flood control systems receive regular maintenance and inspections to minimize long term effects of sediments that may enter the system.

Other flood control measures will be required by the City of Spokane Valley who historically maintained the Chester Creek channel on an annual basis. To my knowledge, the channel was last dredged in 1998. The channel must be kept clear of deadfall that would impede flow in the channel. The property owners must implement the channel maintenance plan to insure flow in the channel is not impeded. WCE has also prepared a Chester Creek Levee Operation and Maintenance Manual for Level Operation and Maintenance for the Chester Creek Homeowners Association. This manual requires annual maintenance inspections and maintenance as required to maintain the integrity of the levee with additional inspections during all flood events.

Fill material shall be placed behind the existing levee turning the levee into an engineered slope and eliminating the possibility of a levee failure during a flood event. Fill material will reinforce the creek bank and raise the bank elevation to a minimum height of one foot above the Base Flood Elevation. Raising the property to an elevation 1 foot above the base Flood Elevation ensures to FEMA and the City that the property, and buildings on the property, will not be inundated by a flood event. The fill material will slope to the northeast through the proposed streets, with their own proposed storm drainage systems, and the ultimate low point where flood control ponds will be constructed at the north end of the project.

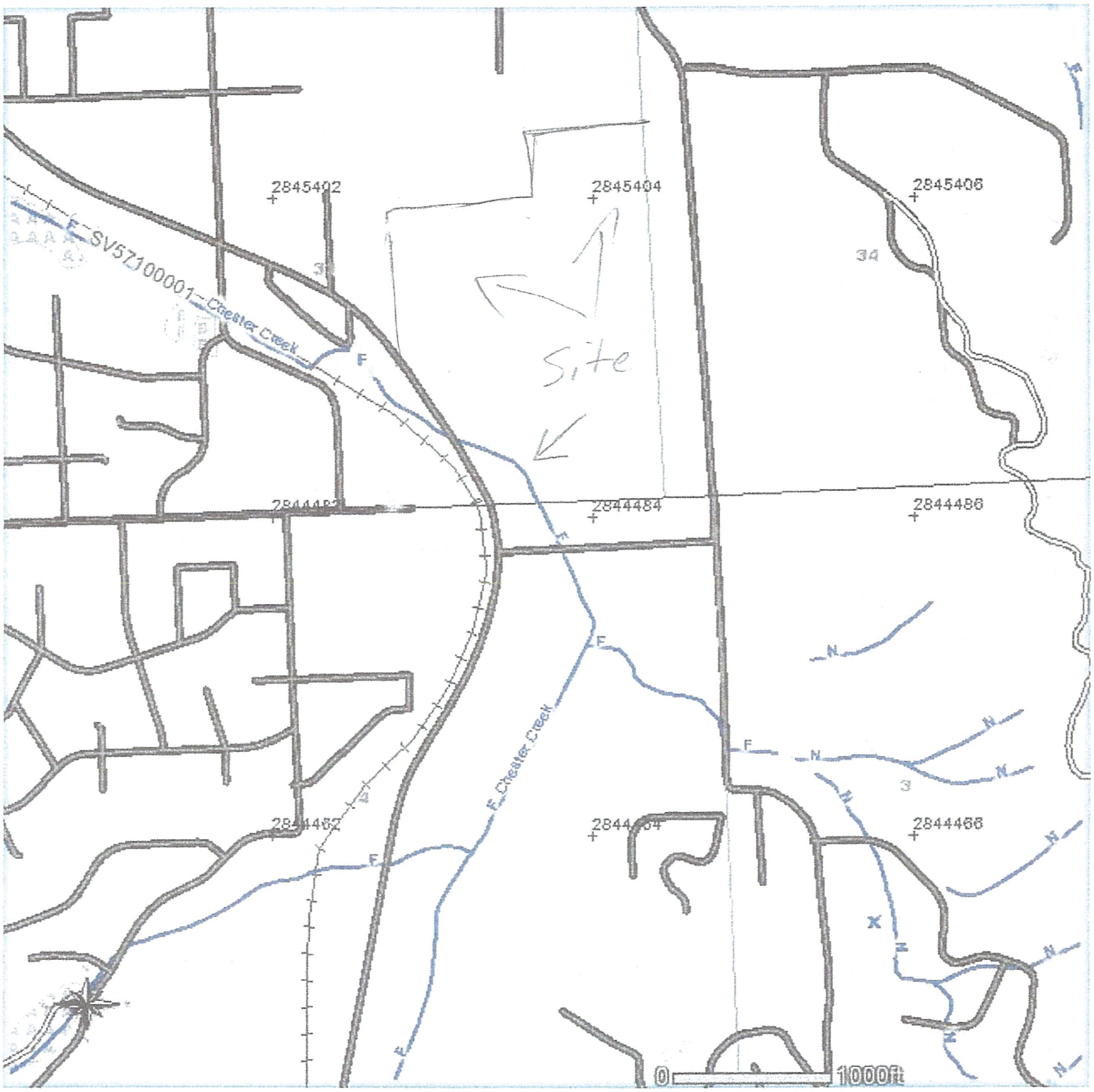
4.9: Riparian Areas

The DNR Water Type Map (Figure 5) defines Chester Creek as a Type F Water. Chapter 21.40 of the City of Spokane Valley Municipal Code, titled Critical Areas, bases stream buffer widths on the DNR Riparian Management Zones. Chester Creek is greater than 15 feet in width (bankfull) so the appropriate buffer width can be found in Table 21.40-10 of the City Code. The DNR guidance states that in Eastern Washington, if there is no site index information, as in this case, assume Site Class III unless site specific information indicates otherwise. The table indicates that a Type F Natural Water not classified as a Shoreline of the State, having a Site Class 3 designation, has a total buffer width of 100 feet. BSW delineated the Chester Creek OHWM in the field on March 31, 2015. The OHWM flags were surveyed and plotted on the site plan map along with the 100-foot riparian buffer by Whipple Consulting Engineers.

Figure 5: **FOREST PRACTICE WATER TYPE MAP**

TOWNSHIP 0 NORTH HALF undefined, RANGE 0 (W.M.) HALF undefined, SECTION 0

Application #:________________________________



4/1/2015 9:23:14 AM
NAD 83
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The DNR Water Type Map also identified a Type F Water located about one mile east of the subject property. The map showed the stream crossing SR27 and running NW across a cultivated field before disappearing. There is no stream in that location so a Water Type Modification Form was submitted to Spokane County. The form was circulated to all appropriate agencies, the Water Type change was approved, and that stream segment was removed from the map. However, the FEMA map shows potential flood waters traveling toward the proposed development from that general direction. So additional work was required by FEMA to pipe the flood water to the borrow pit located on adjacent Gussman property to the north. Several years ago, the ditch was proposed, approved, and created to convey stormwater to a borrow pit. After the pipe improvements required by FEMA, floodwater will have the same fate as stormwater and be conveyed into the borrow pit where it will infiltrate and have no impact on the proposed development. No impacts are proposed to regulated waters by this FEMA requirement so no mitigation is required.

5.0: Analysis of Three Development Alternatives (Figures 6-8)

5.1: Alternative #1 (no development, Figure 6)

The existing conditions would be maintained under the no development scenario of Alternative #1 (Figure 6). The existing conditions are turf grasses and vegetation consistent with a golf course with sparse woody vegetation bordering some of the fairways. The open space is utilized by deer and provides a potential travel corridor for elk moving between Madison Hills and Dishman Hills. These conditions would remain exactly the same in the Alternative #1 no development scenario. The entire property, stream buffer, trails, and bridges would remain in the existing condition.

In the existing condition, the buffer on the right stream bank (N/E side of the creek) has an area of 104,131.93+/- sq. ft.. The buffer on the left stream bank (S/W side of the creek) has an area of 78,329.96 +/- sq. ft.. The total area of stream buffer is 182,461.89+/- sq. ft.. The existing buildings, trails, and bridges result in 18,604.23+/- sq. ft. of buffer impact. All of the existing impact areas would remain exactly the same if no development occurred.

5.2: Alternative #3 (standard residential development, Figure 7)

In Alternative #3, a 3665.18 sq. ft. polygon on the west side of the creek, east of the existing restaurant parking lot, would be impacted (green hatched area in Figure #7). The 100-foot buffer width would be reduced to the 75-foot minimum width allowed by the City Code so the restaurant parking lot could be expanded. Alternative #3 also proposes a 1383.16 sq. ft. buffer impact (green hatched area in Figure # 7) from the City required improvement (widening) of Thorpe Road. According to the buffer averaging provisions of the City Code, buffer impact areas must be replaced with an equal or larger buffer area that is contiguous with the existing buffer so there is no net loss of buffer area. The 3665.18 sq. ft. and 1383.16 sq. ft. buffer impact areas total 5048.34 sq. ft. and would be replaced with a 5096.06 ft. sq. replacement area on the opposite side of the creek as represented by the blue hatched polygon in Figure # 7. The proposed 5048.34 sq. ft. buffer impact area would be mitigated with buffer averaging but also with vegetative enhancement of the buffer replacement area. The proposed buffer averaging will result in a small net increase in buffer area and habitat quality.

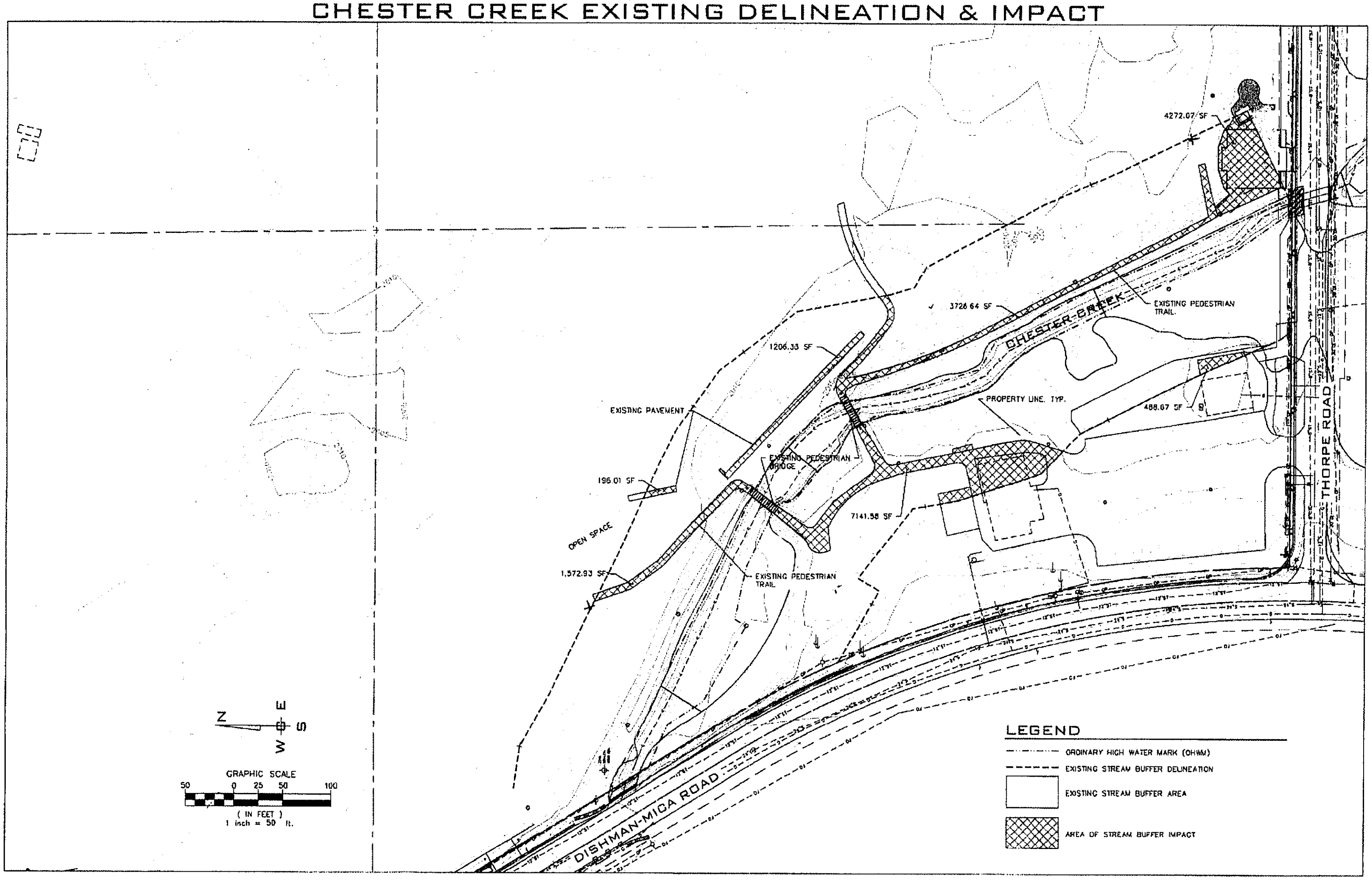
On the right stream bank (N/E side of the creek) fill material will cover the entire 104,131.93+/- sq. ft. of riparian buffer to bring the land surface elevation to a height of one foot

Figure 6

SE¼, SEC.33, T.25N., R.44E., W.M.
SW¼, SEC.34, T.25N., R.44E., W.M.
NE¼, SEC. 4, T.24N., R.44E., W.M.

CHESTER CREEK EXISTING DELINEATION & IMPACT

UNDERGROUND SERVICE ALERT ONE-CALL NUMBER 811 CALL TWO BUSINESS DAYS BEFORE YOU DIG



AREAS

NE STREAM BUFFER 104,131.93 SF ±
SW STREAM BUFFER 78,329.96 SF ±

TOTAL – 182,461.89 SF ±

EXISTING IMPACT AREA

1,572.93 SF ±
196.01 SF ±
1,206.33 SF ±
3,726.64 SF ±
4,272.07 SF ±
7,141.58 SF ±
488.67 SF ±

TOTAL 18,604.23 SF ±

STREAM BUFFER EXHIBIT
SCALE: 1"=50'

City of Spokane Valley Project/Permit No.:
SUB-2015-0001 (Subdivision)
FPD-2016-0007 (Flood Plain Development)
EGR-2016-0066 (Engineered Grading)

City of Spokane Valley Development Engineering
Reviewer: ______
New Street Sites – Public: ______
☐ Not Reviewed
☐ Reviewed for Conformance to Street Standards and Accepted per Chapter 1.2
Date Accepted ______
Acceptance Comments

PLANS NOT APPROVED BY AGENCY

DATUM: NAVD - 88
TBM 6-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2006.87 (NAVD29)=2009.87 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP.

NO	DATE	BY	REVISIONS
2	08-14-18	JPP	REVISED PLANS
1	06-12-18	JPP	ORIGINAL PREPARATION

SCALE:
HORIZONTAL: 1"=50'
VERTICAL: N/A

PROJ #: 13-1166
DATE: 08/14/18
DRAWN: BNG
REVIEWED: TRW

CIVIL
STRUCTURAL
SURVEYING
TRAFFIC
X PLANNING
LANDSCAPE
OTHER

WCE
WHIPPLE CONSULTING ENGINEERS
2528 NORTH SULLIVAN ROAD
SPOKANE VALLEY, WA 99216
PH: 509-893-2617 FAX: 509-926-0227

SPOKANE VALLEY PAINTED HILLS PRD
EXIST. STREAM BUFFER EXHIBIT (ALT1)
DISHMAN-MICA RD.
SPOKANE VALLEY, WA

TODD R. WHIPPLE, STATE OF WASHINGTON, 25482, REGISTERED PROFESSIONAL ENGINEER

SHEET 1 OF 3

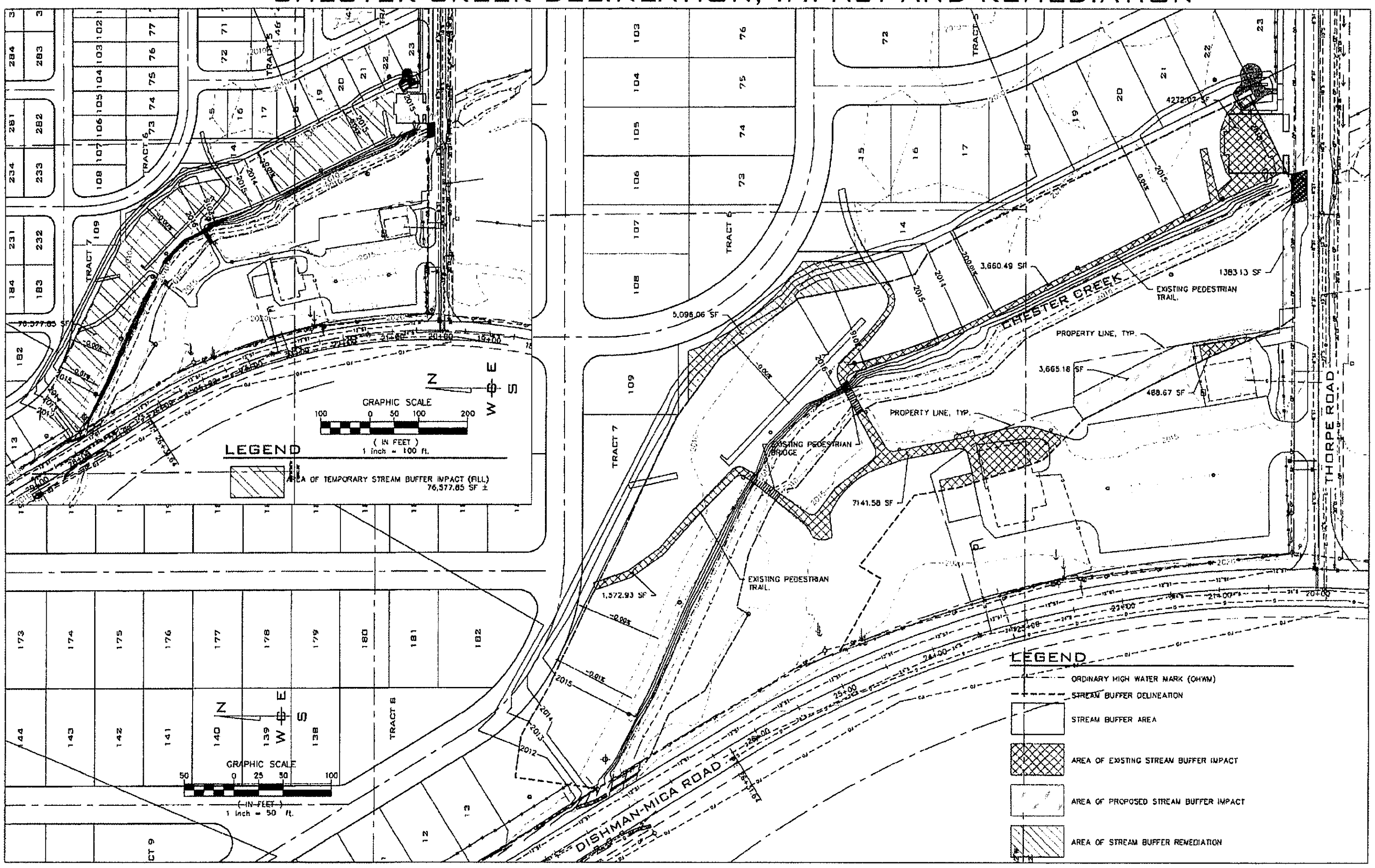
JOB NUMBER 13-1166

P:\WCE_WORK\2013 WCE PROJECTS\2013-1166 Walker - Painted Hills GC\DWG\1166-BSW EXHIBIT 2-11-19.dwg, 2/15/2019 2:17:00 PM, DWG To PDF.pc3

Figure 7

SE¼, SEC.33, T.25N., R.44E., W.M.
SW¼, SEC.34, T.25N., R.44E., W.M.
NE¼, SEC. 4, T.24N., R.44E., W.M.

CHESTER CREEK DELINEATION, IMPACT AND REMEDIATION



UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG

AREAS

NE STREAM BUFFER
104,131.93 SF ±
NE STREAM BUFFER REM.
5,096.06 SF ±
SW STREAM BUFFER
78,329.96 SF ±
TOTAL - 187,557.95 SF ±

IMPACTS

EXISTING IMPACTS:
1,572.93 SF ±
3,660.49 SF ±
4,272.07 SF ±
7,141.58 SF ±
+ 488.67 SF ±
17,135.74 SF ±

PROPOSED IMPACTS:
3,665.18 SF ±
+ 1,383.16 SF ±
5,048.34 SF ±

TOTAL IMPACTS:
22,184.08 SF ±

REMEDIATION

REMEDIATION:
5,096.06 SF ±

STREAM BUFFER REMEDIATION EXHIBIT
SCALE: 1"=50'

DATUM: NAVD - 88
TBM S-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2005.87 (NAVD29)~2009.67 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP.

NO	DATE	BY	REVISIONS

SCALE:
HORIZONTAL: 1"-50'/-100'
VERTICAL: N/A

PROJ #: 13-1166
DATE: 11/01/17
DRAWN: BNG
REVIEWED: TRW

STRUCTURAL
SURVEYING
TRAFFIC
X PLANNING
LANDSCAPE
OTHER

WCE
WHIPPLE CONSULTING ENGINEERS
SPOKANE VALLEY, WA 99216

PAINTED HILLS
PROP. STREAM BUFFER EXHIBIT (ALT 3)
DISHMAN-MICA RD.
SPOKANE VALLEY, WA

TODD R. WHIPPLE
STATE OF WASHINGTON
PROFESSIONAL ENGINEER

SHEET 3 OF 3
JOB NUMBER 13-1166

above the BFE (see blue hatched area in the upper left corner of Figure # 7). The buffer is currently planted in non-native golf course turf grass and is almost totally devoid of woody vegetation. Only a handful of trees and shrubs would be impacted by the fill. This is a temporary buffer impact that will be mitigated by vegetative enhancement. No loss of buffer area will occur as a result of temporary impact. Existing trails will be removed and new trails of the same width will be built to replace the existing trails in the same location. Compared to Alternative #1, the trail impact area will be slightly less in Alternative #3 because some of the existing trail area will be eliminated. Alternative #3 proposes no new permanent buffer impact on the right stream bank (N/E side of the creek).

The temporary buffer impact area on the right stream bank (N/E side of the creek) will be replanted with native grasses and native trees and shrubs at the industry standard rate of 350 stems per acre or 837 total plants. This represents a significant enhancement of wildlife habitat compared to the existing disturbed condition and previous land use as a golf course.

Due to the proposed buffer width averaging, the Alternative #3 buffer total area would increase slightly (47.72 sq. ft.) compared to the existing condition. In Alternative #3, two small trail segments in the buffer totaling 1468.49 sq. ft. will be eliminated and not replaced so the Riparian Buffer area will also increase by that small amount compared to the Alternative #1 no development scenario. The remainder of the property would be developed with residential lots. In Alternative #3, the 10+ acre vegetated park/wildlife corridor along the southern border of the site would not be established and that area would be developed.

Compared to the Alternative #1 no development scenario, Alternative #3 proposes 5048.34 sq. ft. of new buffer impact that would be replaced with a slightly larger 5096.06 sq. ft. replacement area as required for buffer width averaging. The proposed 5096.06 sq. ft. buffer replacement area would be enhanced with woody vegetative plantings.

5.3: Alternative #2 (Planned Residential Development, Figure #8)

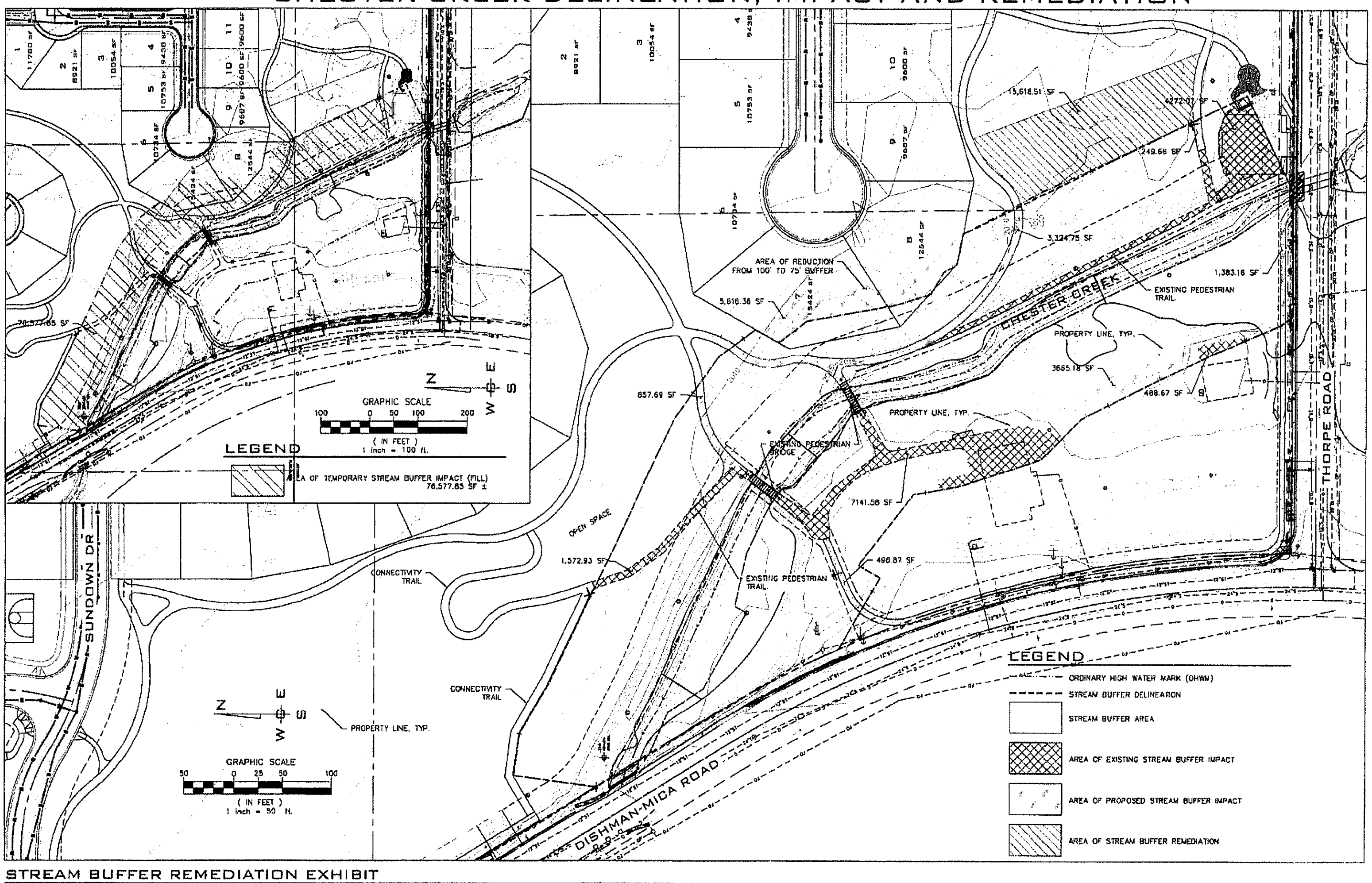
Alternative #2, a Planned Residential Development (PRD) is the preferred alternative due to the benefits of PRD mixed uses and the advantage of a 10+ acre park/wildlife corridor that is not offered in Alternative 3. Compared to Alternative #1, the Existing Buffer Impact Area is slightly smaller in Alternative #2 because some of the existing trail impacts in Alternative #1 are eliminated. The Alternative #2 and Alternative #3 scenarios both propose impacting the same 3665.18 sq. ft. buffer area polygon for expansion of the existing restaurant parking lot and the 1383.16 sq. ft. buffer impact from the required widening of Thorpe Road. Those two impacts are exactly the same as proposed in Alternative #3 and the impact area is included in the buffer averaging area.

In Alternative #2, a 3665.18 sq. ft. polygon on the west side of the creek, east of the existing restaurant parking lot, would be impacted (green hatched area in Figure #8). The 100-foot buffer width would be reduced to the 75-foot minimum width allowed by the City Code so the restaurant parking lot could be expanded. Alternative #2 also proposes a 1383.16 sq. ft. buffer impact (green hatched area in Figure #8) from the City required improvement (widening) of Thorpe Road. According to the buffer averaging provisions of the City Code, buffer impact areas must be replaced with an equal or larger buffer area that is contiguous with the existing buffer so there is no net loss of buffer area. The 3665.18 sq. ft. and 1383.16 sq. ft. buffer impact areas total 5048.34 sq. ft. and would be replaced with a 5096.06 ft. sq. replacement area on the opposite side of the creek as represented by the blue hatched polygon in Figure #8. The proposed 5048.34 sq. ft. buffer impact area would be mitigated with buffer averaging but also

Figure 8

SE¼, SEC.33, T.25N., R.44E., W.M.
SW¼, SEC.34, T.25N., R.44E., W.M.
NE¼, SEC. 4, T.24N., R.44E., W.M.

CHESTER CREEK DELINEATION, IMPACT AND REMEDIATION



STREAM BUFFER REMEDIATION EXHIBIT
SCALE: 1"=50'

UNDERGROUND SERVICE ALERT ONE-CALL NUMBER 811 CALL TWO BUSINESS DAYS BEFORE YOU DIG

AREAS

NE STREAM BUFFER 98,803.32 SF ±
NE STREAM BUFFER REM. 15,618.51 SF ±
SW STREAM BUFFER 78,329.96 SF ±
TOTAL – 192,751.79 SF ±

IMPACTS

EXISTING IMPACTS:
1,572.93 SF ±
2,174.04 SF ±
4,272.07 SF ±
7,141.58 SF ±
+ 488.67 SF ±
15,649.29 SF ±

PROPOSED IMPACTS:
857.69 SF ±
5616.36 SF ±
3,324.75 SF ±
249.66 SF ±
496.87 SF ±
3,665.18 SF ±
+ 1,383.16 SF ±
15,593.67 SF ±

TOTAL IMPACTS:
31,242.96 SF ±

REMEDIATION

REMEDIATION:
15,618.51 SF ±

City of Spokane Valley Project/Permit No.:
SUB-2015-0001 (Subdivision)
FPD-2016-0007 (Flood Plain Development)
EGR-2016-0066 (Engineered Grading)

City of Spokane Valley Development Engineering
☐ Not Reviewed
☐ Reviewed for Conformance to Street Standards and Accepted per Chapter 1.2
Date Accepted
Acceptance Comments

TODD R. WHIPPLE, STATE OF WASHINGTON, 25462, REGISTERED PROFESSIONAL ENGINEER

PLANS NOT APPROVED BY AGENCY

DATUM: NAVD - 88
TBM 5-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2005.87 (NAVD29)=2000.87 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP.

NO	DATE	BY	REVISIONS
2	08-14-18	JPP	REVISED PLANS
1	06-12-18	JPP	ORIGINAL PREPARATION

SCALE: HORIZONTAL: 1"=50'/=100' VERTICAL: N/A

PROJ #: 13-1166
DATE: 08/14/18
DRAWN: SNO
REVIEWED: TRW

CIVIL / STRUCTURAL / SURVEYING / TRAFFIC / X PLANNING / LANDSCAPE / OTHER

WCE — WHIPPLE CONSULTING ENGINEERS, 2528 NORTH SULLIVAN ROAD, SPOKANE VALLEY, WA 99216, PH 509-893-2617 FAX 509-926-0227

SPOKANE VALLEY PAINTED HILLS PRD
PROP. STREAM BUFFER EXHIBIT (ALT 2)
DISHMAN-MICA RD.
SPOKANE VALLEY,WA

SHEET 2 OF 3
JOB NUMBER 13-1166

with vegetative enhancement of the buffer replacement area. The proposed buffer averaging will result in a small net increase in buffer area and habitat quality. This proposed buffer impact and the proposed mitigation is exactly the same as in Alternative #3, but the proposed buffer replacement area is in a different location.

Compared to Alternative #3, the following additional 10,545.33 sq. ft. of buffer impacts are proposed in Alternative #2 on the right stream bank (N/E side of the creek). The additional impacts include three new trail segments and the extension of another trail segment. Some existing trail segments are eliminated in Alternative #2, and they offset part of the new trail impacts, but there will be a small net gain in trail impact area. The area of impact is included in the buffer replacement area proposed for impact mitigation.

Alternative #2 proposes using buffer width averaging to reduce the buffer width by 25% on two lots adjacent to the southmost bridge (Figure #8). This will result in a 5616.36 sq. ft. buffer impact that will be mitigated with buffer averaging. The Alternative #2 total combined buffer impact area is 15,593.67 sq. ft. Buffer Averaging is proposed for impact mitigation. The proposed Buffer Impact Replacement Area is 15,618.51 sq. ft. There will be no net loss of buffer area as a result of averaging. The Buffer Replacement Area is contiguous with the existing buffer. The mitigation area will be enhanced with the planting of trees and shrubs. The mitigation area is contiguous with the proposed 10+ acre Park/Wildlife Travel Corridor. Clusters of woody vegetative plantings will also be installed in this corridor to enhance wildlife habitat.

5.4: Summary of Alternative 1, 2, and 3 Buffer Impacts

The existing trail areas differ in all three alternatives because the trail segments that are both eliminated and added in Alternative #2 and Alternative #3 are different. The Thorpe Road improvement Area impacts are the same for Alternative 2 and 3. Buffer impacts from the proposed parking lot expansion area on the left (S/W) side of the creek are the same for Alternative 2 and 3. Buffer Averaging is proposed for mitigating those buffer impacts and the replacement areas have the same square footage in both Alternatives 2 and 3.

In both Alternatives #2 and #3, the 104,131.93+/- sq. ft. riparian buffer on the right stream bank (N/E side of the creek) will be filled with soil to a height of one foot above the Base Flood Elevation (see blue hatched area depicted in inset at top left corner of Figures 7 and 8). The buffer is currently planted in golf course turf grasses and is nearly devoid of woody vegetation. This temporary impact area will be mitigated by reseeding the area in native grasses and planting clusters of native woody vegetation. This will result in a significant improvement in buffer quality.

Alternative #2 proposes additional buffer impacts by reducing the 100-foot buffer width to 75 feet on two lots adjacent to the southmost bridge on the right stream bank (N/E side of the creek). That 5616.36 sq. ft. buffer impact is not proposed in Alternative #3 so the buffer replacement area is proportionally larger in Alternative #2. The buffer replacement area will be enhanced by planting native trees and shrubs. Alternative #2 also proposes a 10+ acre Park/Wildlife Habitat Travel Corridor across the southern project boundary that is not proposed in Alternative #3. The 10+ acre Park/Wildlife Habitat Travel Corridor (Figure 3) will be enhanced by the planting of native trees and shrubs.

5.5: Temporary Buffer Impact Mitigation

Any peripheral buffer areas that are inadvertently disturbed during construction will be planted with the specified native seed mix to prevent erosion. This work will be completed in strict accordance with the IPEC Operation and Maintenance Manual and Best Management Practices.

5.6: Buffer impact Area from the Chester Creek Culvert Extension

Thorpe Road will be made wider along its north side to meet City standards that require an additional 6.5 feet of pavement, a 2-foot curb, and 6-foot sidewalk. This will result in 1383.16 sq. ft. of riparian buffer impact. The impact area includes a new box culvert under the new road construction. A crane will install the concrete box culvert that will be capped and paved over. The culvert will be an extension of the existing culvert and will not cover or change the existing substrate on the stream bottom. All in-channel and over-channel work will occur during the summer/fall dry season so no over-water or in-water work will be required. The area of impact is counted in the total project buffer impact area calculations, buffer averaging replacement area calculations, and vegetative plantings are prescribed for the impact area as part of the proposed buffer impact mitigation for the project.

6.0: Rationale for Adjustment (Reductions) of Riparian Habitat Buffer

The City of Spokane Valley Municipal Code, Section 21.40.034 states that "the habitat buffer width may be averaged (reduced in width near a development but widened elsewhere to retain the overall area of the habitat buffer) if all of the following conditions are met. Each proposed buffer impact and reduction is discussed in the following section in the context of the conditions set forth in the City Code.

1) The FWHCA has significant differences in characteristics that affect its habitat functions, such as a native forested component adjacent to a degraded herbaceous component.

Alternative #2 Buffer Impacts from Two Lots

A proposed 25% buffer reduction resulting in 5616.36 sq. ft. of buffer impact is proposed on the right stream bank (N/E side of the creek). The proposed impact is in close proximity to the southmost bridge across Chester Creek. The proposed buffer impact area is planted in non-native golf course turf grasses. The turf grass was maintained by treatment with herbicides and regular mowing. The proposed impact area has no trees and only one shrub.

The 5616.36 sq. ft. area of proposed buffer impact experienced the highest intensity human activity on the property during the years of golf course operation. Foot and golf cart traffic from the club house was directed by cart paths over two bridges to the fairways, driving range, and practice areas across the creek where the buffer impact from two lots is proposed. In the Alternative #2 and #3 site plans, the existing bridges will be utilized and the golf cart paths will be extended east to connect the housing development on the east side of the creek to the bar and restaurant located in the former golf course clubhouse on the west side of the creek.

Due to the existing trails and bridges, the Alternative #2 proposed area of buffer width reduction from two lots will continue to experience the highest intensity human activity on the property. This part of the buffer experienced the highest degree of historical degradation and will continue to experience the greatest intensity of human activity and foot traffic on the existing trails and bridges. The proposed impact area occurs in an existing highly disturbed area that would benefit the least from protection because this area did not function as buffer historically and from a habitat perspective will not in the future due to the intensity of human traffic funneled through this corridor. Mitigation for the proposed buffer impact is proposed where it will have the greatest benefit for wildlife and greatest habitat function.

If development is approved under Alternatives #2 or #3, then the buffer impact from Thorpe Road improvements is an unavoidable impact. The impact area immediately adjacent to the road provides the least habitat function on the property. The buffer replacement area will part of the best habitat on the property.

If development is approved under Alternatives #2 or #3, then the buffer impact from expanding the existing parking lot on the left (west) side of the creek is the same for both alternatives. The impact area is immediately adjacent to an existing parking lot and building. The historically disturbed, high human traffic area has only herbaceous vegetation with no trees or shrubs to provide wildlife cover or habitat. The area where the buffer reduction is proposed will be enhanced with native trees and shrubs as will the buffer replacement area. The buffer reduction is proposed in a degraded herbaceous habitat component. The buffer will be replaced adjacent to the proposed 10+ acre wildlife corridor that will be enhanced with clusters of native trees and shrubs.

2) The buffer is increased adjacent to the higher functioning area of habitat or more sensitive portion of the FWHCA and decreased adjacent to the lower functioning or less sensitive portion.

The area where a 25% buffer reduction is proposed for two lots is the most disturbed buffer area on the site and the area where intense human activity will occur due to the existing trails and bridges that link the development on the east side of the creek to the commercial area on the west side of the creek. The trails and bridges create a corridor that runs perpendicular to the creek. The corridor passes through the entire buffer on both sides of the creek and funnels all human activity through that corridor. This area of concentrated activity is the lowest functioning part of the buffer on the property. This corridor for human traffic did not historically function as a buffer and will not in the future under either Alternative #2 or #3 development scenarios.

North of the area proposed for buffer reduction is a large area of open space on the right stream bank (N/E side of the creek) that extends out away from the buffer and effectively widens the buffer in that area. This area will have a much lower level of human activity compared to the trail and bridge corridor. This is a higher functioning area of buffer compared to the proposed buffer reduction area.

The buffer addition area is located south of the buffer impact area and expands the buffer eastward to connect with the designated wildlife travel corridor where human activity will be reduced to a minimum. The buffer replacement area will be planted with native grasses and clusters of native trees and shrubs. The intent is to make the buffer wider where there is least human activity and provide the most benefit for wildlife. Habitat functions are lowest where the reduction is proposed and highest where the buffer replacement will occur in a proposed wildlife travel corridor where dense vegetative plantings will be installed to enhance the existing woody vegetation and wildlife habitat. The buffer width increase will occur in the higher functioning area of habitat as suggested by the City Code and decrease adjacent to the least sensitive buffer. The Park/Wildlife Travel Corridor covers the entire southern border of the property, is over 350 feet wide, and has an area of over 10 acres.

Variations in sensitivity are created by the existing physical characteristics (bridges and trails), historical land uses (vegetation removal and intense human activity), and the continued concentration of human activity on trails and bridges through that narrow corridor across the stream and buffer on both sides. That corridor has the least habitat function because it has the least wildlife activity. The proposed buffer impact will occur in the least sensitive area from the perspective of wildlife presence, use, and function. Buffer enhancement will occur where there is the least human activity and the greatest benefit from the perspective of wildlife presence, use, and function. The total area contained within the buffer after averaging is greater than that contained within the standard buffer prior to averaging.

3) The total area of the buffer, after averaging, is equal or greater than the area required without averaging.

The buffer averaging proposed in Alternatives #2 and #3 result in a small increase in buffer area. Alternative #3 proposes a total buffer impact area of 5048.34 sq. ft. (0.116 acres). Alternative #3 proposes a total buffer impact replacement area of 5096.06 sq. ft.(0.117 acres). Alternative #2 proposes a total buffer impact area of 15,593.67 sq. ft. (0.358 acres). Alternative #2 proposes a total buffer impact replacement area of 15,618.51 sq. ft. (0.359 acres). No net loss of buffer will occur from Alternative #2 or Alternative #3.

4) The buffer at its narrowest point is never less than 75 percent of the original habitat buffer width.

Alternatives #2 and #3 propose buffer averaging. In each instance, the buffer will be reduced from 100 feet to 75 feet, so the buffer is not reduced to less than 75% of the original habitat buffer at any location.

Mitigation Rationale Summary

The continued use of the two bridges and trails crossing the stream and buffer has the effect of funneling, controlling, and limiting human access to this narrow corridor or choke point. Buffer reduction for two lots is proposed immediately adjacent to the high intensity human use corridor in the buffer. Three separate buffer impacts will occur from trails. Two of the impacts will result when the existing trails are extended from the bridges into the development and connected to a proposed trail in the 10+ acre wildlife travel corridor.

The proposed buffer mitigation provides adequate compensation for the proposed impacts as defined by the City Code. The areas of proposed buffer reduction will be enhanced by the planting of native tree and shrub patches. The remaining riparian buffer will also be enhanced by planting patches of native woody vegetation on both sides of the stream. The buffer replacement area will be enhanced by the planting of native tree and shrub patches. The buffer replacement area will be contiguous with the Wildlife Travel Corridor where additional tree and shrub plantings are proposed.

Alternative #2 is the preferred alternative because it provides the 10+ acre Park/Wildlife Travel Corridor not included in Alternative #3. The proposed vegetative enhancement of the remaining buffer areas, replacement buffer areas, and wildlife travel corridor provides generous mitigation to offset the impacts. The proposed vegetative enhancement represents a significant improvement compared to the existing condition and historical land uses of the last several decades.

Mitigation Sequencing

Several development plans have been scrutinized over the last three years by the City of Spokane Valley and various firms employed to certify the levee on the right (east) bank of Chester Creek. Numerous changes have been implemented to the stormwater and flood control plans for the site in order to arrive at the preferred final site plan. The levee certification involved earthwork on the levee, removal of all vegetation in the stream channel, and other options required for development approval. Those plan were all abandoned in favor of the three development alternatives analyzed in this report. In the end, Alternative #2 was favored by the City and the developer. While the preferred alternative results in more buffer impact than the other two alternatives, it was determined that the buffer enhancements and vegetative plantings proposed to improve habitat, the advantages of a Planned Residential Development, and the creation of a 10+ acre Park/Wildlife Travel Corridor far outweighed the benefits of the other two alternatives. The preferred alternative was determined to avoid the most impacts, minimize impacts to the stream channel. and provide the most benefits.

7.0 Impact Mitigation Strategy

7.1: Noxious weed control

The dominant invasive species that were identified on the site include tumble mustard and knapweed. These species are known for their ability to propagate and spread rapidly with catastrophic impacts on native species. As required by Washington State Noxious Weed Control law, RCW 17.10, and the Spokane County Noxious Weed Board, invasive species will be managed through control measures that do not adversely impact native vegetation. Funds will be allocated for noxious weed monitoring and herbicide control as part of the proposed mitigation for this project. Black Realty or their designated Homeowners Association shall contract their preferred weed control specialist to monitor the site and provide weed control in the mitigation areas at appropriate intervals throughout the growing season to prevent seed set.

7.2: Revegetation with Woody Plants

In addition to noxious weed control, mitigation for buffer impacts will include the planting of native trees and shrubs. The buffer will be re-vegetated with native plants including species from the tree, shrub, and grass vegetative strata. The replication of natural spatial relationships, structural complexity, vertical stratification, and microhabitat diversity will be stressed in the planting design to achieve a mosaic of open areas and dense tree/shrub clusters. Vegetation will not be planted in a uniform manner. Shrubs will be planted in grouped patches and interspersed with other shrub species and height classes. Patch size will be variable with curving edges. The incorporation of these elements will increase landscape diversity and promote habitat elements that are often scarce or absent at sites that have been disturbed. Native species and endemic plant materials will be selected for site revegetation to help maintain ecotypes that are adapted to local climatic and soil conditions and preserve local genotypes.

7.3: Rationale

Structural complexity refers to the arrangement and degree of interspersion of plant community types throughout the system. Complex structural patterns (such as variable patch size, curving edges, and high degree of interspersion between species) increase the value of a system for wildlife. Good wildlife habitat consists of open areas interspersed with clusters of vegetation, several horizontal layers, and a variable structural pattern. **Vertical stratification** describes a community with good structural diversity and several horizontal layers (logs, woody debris, forbs, shrubs, and trees). Woody debris provides travel routes, perch sites, cover, and thermal refuge for a variety of small mammals and ground nesting birds. **Microhabitat diversity** refers to variety in microhabitat types. Examples of microhabitat types include herbaceous cover and shrubs that provide food, habitat, and substrate for a variety of animals.

7.4: Objectives for the Restored Riparian Buffer

Restoration will be achieved by planting native trees, shrubs and grasses primarily to provide food and cover for wildlife. The Vegetation Plan will incorporate as many design features as possible for each function in order to increase the value for that function.

Objective a: Re-establish species diversity and structural diversity in the buffer by replanting native tree and shrub species from each vegetative class.

Objective b: Re-establish vegetative species and structural diversity to re-establish bird and mammal habitat values in the enhanced buffer areas.

Objective c: Re-establish vegetative density in the riparian buffer area.

8.0: Mitigation Planting Plan

Woody plant materials will be installed at the industry standard density of 360 stems per acre. The buffer replacement area is 15,618.51 (0.359 acres) X 360 stems/acre = 130 containers. The Buffer Replacement Area shall have 130 containers planted within that polygon. An additional 100 containers will be distributed throughout the east and west sides of the creek in the buffer reduction areas (Zone 1 and Zone 2, Figure 9). An additional 200 containers shall be planted in patches of 20 containers throughout the designated wildlife travel corridor. An additional 200 containers shall be planted in patches of 20 containers throughout the buffer on the right stream bank (N/E side of the creek) where fill material will create a temporary 104,131.93+/- sq. ft. (2.39 acres) buffer impact. The 2.39-acre area of temporary impact will also be seeded with the prescribed native upland grass seed mix.

Clusters of vegetation will be planted according to the guidelines prescribed above. The specified number of containers will be planted within each zone as shown in Figure 9.

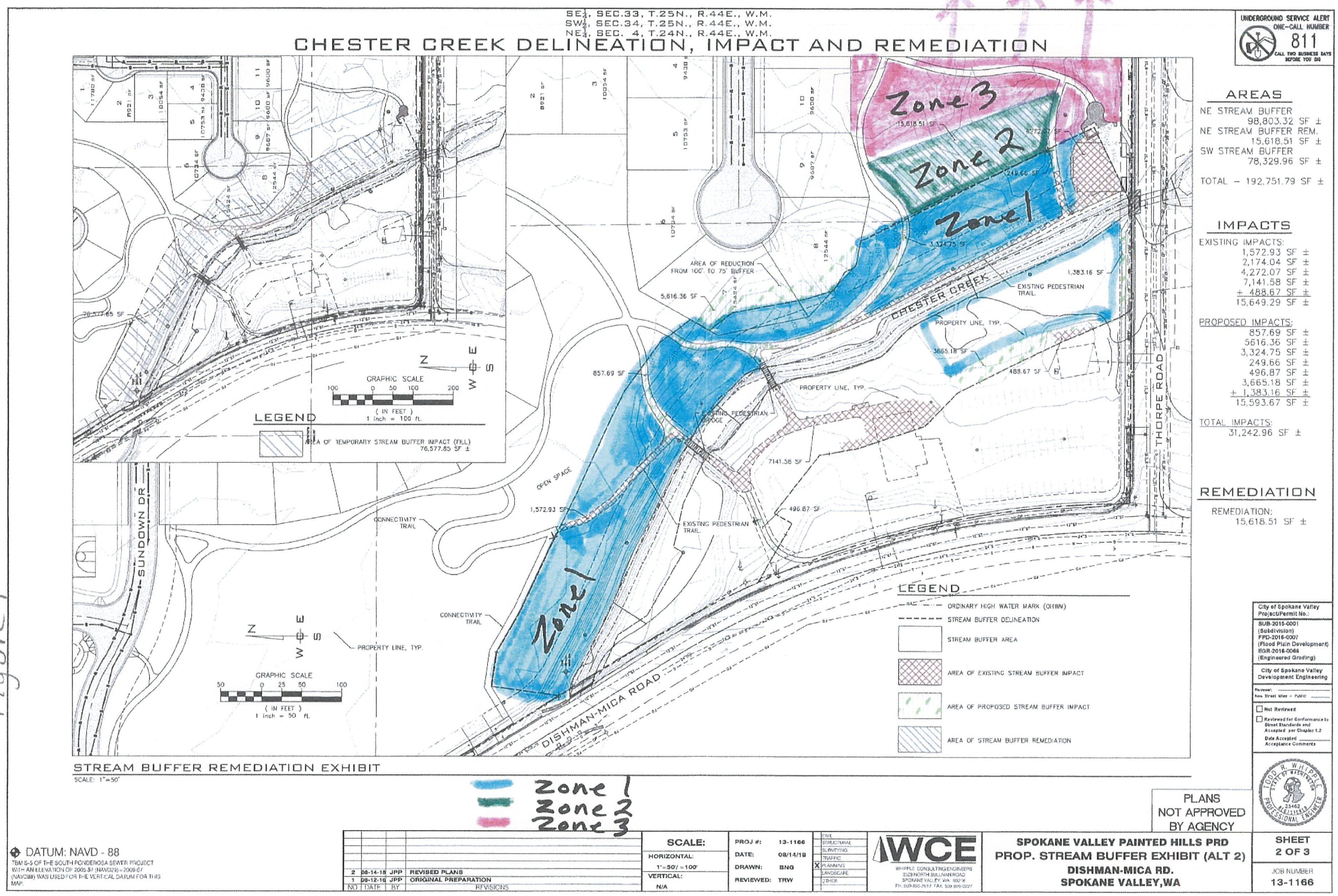
Area Mitigated	Number of Plants	Zone
buffer reduction areas	100	1
right stream bank fill impact area	250	1
buffer replacement Area	130	2
wildlife travel corridor	150	3
total	630	

Zone 1: Riparian Buffer on East and West Sides of Chester Creek

A total of 350 containers planted in existing buffer areas

	Common Name	Scientific Name	# Planted
Trees	Ponderosa pine	*Pinus ponderosa*	20
Large shrubs	serviceberry	*Amelanchier alnifoloia*	20
	Rocky mountain juniper	*Juniperous scopulorum*	30
	mock orange	*Philadelphus lewisii*	80
Small shrubs	Wood's rose	*Rosa woodsii*	60
	common snowberry	*Symphoricarpos albus*	60
	Phlox sp.	*Phlox speciosa or longifolia*	80
Total			350

Figure 9


SE1/4, SEC.33, T.25N., R.44E., W.M.
SW1/4, SEC.34, T.25N., R.44E., W.M.
NE1/4, SEC. 4, T.24N., R.44E., W.M.
CHESTER CREEK DELINEATION, IMPACT AND REMEDIATION
UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG
AREAS
NE STREAM BUFFER 98,803.32 SF ±
NE STREAM BUFFER REM. 15,618.51 SF ±
SW STREAM BUFFER 78,329.96 SF ±
TOTAL - 192,751.79 SF ±
IMPACTS
EXISTING IMPACTS:
1,572.93 SF ±
2,174.04 SF ±
4,272.07 SF ±
7,141.58 SF ±
± 488.67 SF ±
15,649.29 SF ±
PROPOSED IMPACTS:
857.69 SF ±
5616.36 SF ±
3,324.75 SF ±
249.66 SF ±
496.87 SF ±
3,665.18 SF ±
± 1,383.16 SF ±
15,593.67 SF ±
TOTAL IMPACTS:
31,242.96 SF ±
REMEDIATION
REMEDIATION:
15,618.51 SF ±
Zone 1
Zone 2
Zone 3
LEGEND
AREA OF TEMPORARY STREAM BUFFER IMPACT (FILL) 76,577.65 SF ±
GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.
SUNDOWN DR
CHESTER CREEK
THORPE ROAD
DISHMAN-MICA ROAD
OPEN SPACE
CONNECTIVITY TRAIL
EXISTING PEDESTRIAN TRAIL
EXISTING PEDESTRIAN BRIDGE
PROPERTY LINE, TYP.
AREA OF REDUCTION FROM 100' TO 75' BUFFER
GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.
LEGEND
ORDINARY HIGH WATER MARK (OHWM)
STREAM BUFFER DELINEATION
STREAM BUFFER AREA
AREA OF EXISTING STREAM BUFFER IMPACT
AREA OF PROPOSED STREAM BUFFER IMPACT
AREA OF STREAM BUFFER REMEDIATION
STREAM BUFFER REMEDIATION EXHIBIT
SCALE: 1"=50'
City of Spokane Valley Project/Permit No.:
SUB-2015-0001 (Subdivision)
FPD-2016-0007 (Flood Plain Development)
EGR-2016-0066 (Engineered Grading)
City of Spokane Valley Development Engineering
Not Reviewed
Reviewed for Conformance to Street Standards and Accepted per Chapter 1.2
PLANS NOT APPROVED BY AGENCY
DATUM: NAVD - 88
TBM S-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2005.87 (NAVD29) = 2009.07 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP.
2 08-14-18 JPP REVISED PLANS
1 08-12-16 JPP ORIGINAL PREPARATION
NO DATE BY REVISIONS
SCALE:
HORIZONTAL: 1"=50'/=100'
VERTICAL: N/A
PROJ #: 13-1166
DATE: 08/14/18
DRAWN: BNG
REVIEWED: TRW
WCE
WHIPPLE CONSULTING ENGINEERS
SPOKANE VALLEY PAINTED HILLS PRD
PROP. STREAM BUFFER EXHIBIT (ALT 2)
DISHMAN-MICA RD.
SPOKANE VALLEY, WA
SHEET 2 OF 3
JOB NUMBER 13-1166
TODD R. WHIPPLE
PROFESSIONAL ENGINEER

Zone 2 - Buffer Replacement Area on East Side of Chester Creek

130 plants in patches

	Common Name	Scientific Name	# Planted
Trees	Ponderosa pine	*Pinus ponderosa*	5
Large shrubs	serviceberry	*Amelanchier alnifoloia*	10
	Rocky mountain juniper	*Juniperous scopulorum*	10
	chokecherry	*Prunus virginiana*	10
	mock orange	*Philadelphus lewisii*	30
Small shrubs	Wood's rose	*Rosa woodsii*	20
	common snowberry	*Symphoricarpos albus*	25
	Phlox sp.	*Phlox speciosa or longifolia*	20
Total			130

Zone 3 - Wildlife Travel Corridor on East Side of Chester Creek

150 plants in patches

	Common Name	Scientific Name	# Planted
Trees	Ponderosa pine	*Pinus ponderosa*	20
Large shrubs	serviceberry	*Amelanchier alnifoloia*	20
	chokecherry	*Prunus virginiana*	10
	mock orange	*Philadelphus lewisii*	40
Small shrubs	Wood's rose	*Rosa woodsii*	30
	common snowberry	*Symphoricarpos albus*	30
Total			150

The minimum container size shall be one half gallon. Vegetation shall be planted at the landscapers discretion according to conditions on the ground and the location of existing vegetation. Plantings shall be interspersed around existing vegetation, and where possible, in patches of 15-25 plants of mixed size and species as indicated in the plan. Shrubs shall be planted in the approximate prescribed quantities depending on plant availability. Large shrubs should be planted in clusters on 10-foot centers. Small upland shrubs should be clustered on 3-6 foot centers around large shrubs.

Depending on availability, the mixture of grass species listed below should be drill seeded or hydroseeded at a density of 22 pounds PLS per acre in all disturbed areas. Grasses should be planted during the growing season when precipitation and temperature levels will insure germination and survival. Grasses should be planted early in the fall so that the crop is well established by October 15. If germination, growth, and root development are substantial before the end of the growing season, some degree of erosion control will be provided during the winter and spring months that follow. **It may be necessary to irrigate the soil surface to keep it in a moist condition for the first two weeks after seeding. Irrigation should supplement rainfall as required to achieve a total from combined sources of 2 inches per week and no more than 0.25 inches per hour.** Seed can also be installed to lie dormant over the winter and germinate in the spring.

Grasses

Common Name	Scientific Name	Bunch or Sod	PLS (lb/acre)
bluebunch wheatgrass	*Agropyron spicatum*	B	8.0
Idaho fescue	*Festuca idahoensis*	B	6.0
prairie junegrass	*Koeleria cristata*	B	8.0
Total			22.0

A list of suppliers who will prepare the prescribed grass seed mixtures and supply nursery stock specified in the vegetation plan follows.

Grass seed: Grassland West 1-800-582-2070
PO Box 489
908 Port Drive
Clarkston, WA 99403

Trees, & Shrubs:

Plants of the Wild
PO Box 866
Tekoa, WA 99033
509-284-2848

Wildlife Habitat Institute
1025 East Hatter Creek Road
Princeton, ID 83857
208-875-8704

8.1: Ponderosa Pine Planting

ALWAYS plant after December 15 and before March 31. Plant ONLY conservation grade seedlings 20-24 feet from fast growing deciduous trees. Plant seedlings **on 30 foot centers** with no shrubs inter-planted close to the trees to prevent shading and competition that greatly reduces survival. A mulch of Ponderosa pine needles applied in a 3-6 foot radius around the tree trunk at planting will greatly reduce competition and increase tree survival.

Ponderosa pine out-planting survival following *Rhizopogon rubescens* inoculation is 2-3 times higher compared to non-inoculated. Numerous studies have shown that ectomycorrhizal fungi can profoundly affect conifer performance by facilitating nutrient and water uptake, maintaining soil structure, and protecting roots from pathogens and environmental extremes. A specific ectomycorrhizal fungus, *Rhizopogon rubescens*, inoculated onto the root systems of Ponderosa pine seedlings greatly increase survival. Irrigation options are being explored at this mitigation site, but the landscaper should buy plants that have been inoculated or dust the planting holes with this fungi if it is available.

8.2: Additional Planting Guidelines

Depending on availability, the mixture of grass species listed above should be seeded at a density of 22 pounds PLS per acre. Grasses should be planted during the growing season when precipitation and temperature levels will insure germination and survival. Grasses should be planted in early April so that the crop is well established before dry weather, in the fall so that the crop is well established before October 15, or dormant seeded late in the fall so the seed will not germinate until spring. Site preparation and planting should occur in the fall and winter.

Seeding rates of live, germinable seed or Live Pure Seed (LPS) are a product of seed lot purity and germination percentage. LPS calculations are based on the number of seeds per pound and the number of seeds per square foot at one pound per acre. A nursery will prepare a custom seed mix with the prescribed LPS for each species.

Trees and shrubs should be planted after the end of the growing season when the plants are dormant. The best time to plant is late winter when sub-zero temperatures are over but plants are still dormant. Plants may be planted any time during the growing season when the daytime high temperatures are 70F or cooler if irrigation is available from the time of planting through the rest of the growing season. Each tree or shrub planted should be clearly identified with an easy to identify tag that identifies the species. Without such identification it is impossible for the monitoring biologist to tell which plants are enhancement plantings and which are native to the site.

8.3: Additional Fish and Wildlife Habitat Mitigation Requirements

Area irrigation heads should be installed where native grasses are planted to insure germination and survival in the buffer enhancement areas. Drip irrigation should be installed for woody plantings where there is no coverage by area sprinkler heads. Irrigation shall continue until the plants are well established as determined by the project biologist.

Mitigation plantings should be installed no later than the next growing season after completion of the buffer impacts, unless otherwise approved by the City Manager or designee. The timing may also depend on the installation of utilities and water supply for irrigation and will proceed as soon as those amenities are available. Regardless of which year construction begins, it is known that the first construction phase will include the stormwater plan and fill on the east side of the stream. **The irrigation should be installed at the same time as the plantings.** BSW will monitor site impacts and mitigation work to insure the work is completed as specified in this plan. The five year monitoring requirement for each phase will be implemented as described below.

Mitigation areas shall be maintained to insure the mitigation and management plan objectives are successful. Maintenance shall include corrective actions to rectify problems, including rigorous, as-needed elimination of undesirable plants; protection of trees and shrubs from herbivory and competition by grasses and herbaceous plants; and repair and replacement of any dead woody plants.

People may drive, park and passively enjoy recreation in the area so the enhancement areas must be protected from human traffic after planting. Signs should be posted every 100 feet to explain the sensitivity of the newly planted areas and discourage foot traffic in newly seeded areas. Permanent signs with Riparian Buffer Area, Natural Area Do Not Disturb, or similar language should be posted around the protected areas.

8.4: Willow Monitoring and Maintenance of the Chester Creek Channel

Honey willows were planted in the channel about thirty years ago. All subsequent channel maintenance and dredging has avoided the willows that have now grown quite large. Honey willows are prone to dropping very large branches that catch additional debris and create channel obstructions, as will the trees themselves when they die and fall into the channel. The channel must be monitored regularly so potential obstructions may be identified and removed to eliminate potential problems as is required by the Inland Pacific Engineering Company (IPEC) Operation and Maintenance Manual.

If channel obstruction, erosion, or maintenance is required, Best Management Practices and spill control protocols will be strictly adhered to and peripheral impacts will be held to a minimum. The channel may be dry, but the equipment operators must respect the sensitivity of the area, install construction fences to identify minimized work areas, and take all prudent measures to minimize impact in the buffer. All temporary impact areas will be restored at the earliest possible moment to prevent soil erosion. The replacement woody vegetation plantings cannot be placed in or within 15 feet of the stream channel all replacement planting will occur in the riparian buffer and wildlife travel corridor as detailed later in this report.

8.5: Timeline for Construction

Construction will begin as soon as permitted in 2019/2020 and continue is phases over the next few years.

8.6: ESA Compliance

The purpose of this report is to confirm that the project is in compliance with Sections 9 and 10 of the Endangered Species Act. The proposed project will have no effect on any listed species. Mitigation actions are enhancement of the existing facility and the proposed changes will have no effect on any listed habitat or species.

9.0 THE MONITORING PLAN

All monitoring plans require that a mitigation site be monitored annually to determine whether the goals and performance standards have been met. Monitoring typically lasts for 5 years or until the City of Spokane Valley is satisfied that the conditions of the mitigation plan have been met. The site should be monitored in the spring to evaluate the success of weed control from the previous year and prescribe weed control for the current year. The monitoring will also evaluate plant survival to insure that performance standards for percent ground cover of native vegetation are met. Planting of the original grass seed mixture will be repeated to fill in problem areas if they occur.

The City of Spokane Valley will be notified immediately after diagnosis of failing functions, hydrologic systems, or biological vitality and integrity of the plantings as determined through annual monitoring. The herbaceous vegetation will be managed to insure 80% areal cover with native grasses after five years (year 1=20%, year 2-30%, year 3=50%, year 4=70%, year 5=80%). Tree and shrub stock will be monitored to insure 100% survival after the first year and 80% for each subsequent year. Reinforcement plantings will be performed annually as necessary to insure performance standards are met at the end of five years.

If the final monitoring report clearly demonstrates that the site has achieved all of the goals and objectives set forth in this Habitat Management Plan, then the applicant shall be released from additional mitigation and reporting obligations. However, if performance objectives are not me at the end of five years, additional measures shall be implemented as required until the mitigation objectives are met.

10.0 Cost of Implementing Mitigation and Surety

The cost of purchasing and installing vegetation, weed control, replacement plantings, site monitoring, and reporting for 5 years is estimated below.

630 stems @ $28/stem =	**$17,640.00**
2 acres X 22/lbs per acre = 44lbs. X $80/lb =	**$3,500.00**
hydroseeding @ $3000 per acre X 2 acres =	**$6,000.00**
Annual weed control @ $10000/yr =	**$50,000.00**
Year 1 monitoring + as-built report	**$3,000.00**
5 years monitoring @ $800/year =	**$4,000.00**
5 years monitoring reports @ $1000/yr	**$5,000.00**
630 stems X 15% annual mortality replacement = 95 stems/yr X $28/stem = $2,660.00X 5 yrs =	**$13,300.00**
Total cost for 5 years	**$102,440.00**

10.0 LIMITATIONS

Within the limitations of scope, schedule, and budget, BSW services have been executed in accordance with best available science and generally accepted professional practices for the conditions at the time the work was performed. This report is not intended to represent a legal opinion. Specifically, there is no positive or negative recommendation towards the purchase, sale, lease, or construction on the subject property. No warrant, expressed or implied, is made.

Larry Dawes 3-8-2019

Larry Dawes Date
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Biology Soil & Water, Inc.
3102 N. Girard Road
Spokane Valley, WA 99212-1529
Phone 509-327-2684
Email: bswinc@icehouse.net

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Appendix 1
U.S. Fish & Wildlife Service
SPOKANE COUNTY
Updated 8/29/2015

LISTED

Threatened
Salvelinus confluentus) (Bull trout) – Columbia River distinct population segment
Howellia aquatilis (Water howellia), plant
Silene spaldingii (Spalding's silene), plant
Spiranthes diluvialis (Ute ladies'-tresses), plant
Lynx canadensis (Canada lynx)
Coccyzus americanus (Yellow-billed cuckoo)

SPECIES OF CONCERN
Bald eagle *(Haliaeetus leucocephalus)* (delisted, monitor status)
Burrowing owl *(Athene cunicularia)*
California floater *(Anodonta californiensis)*, mussel
Ferruginous hawk *(Buteo regalis)*
Giant Columbia spire snail *(Fluminicola columbiana)*
Loggerhead shrike *(Lanius ludovicianus)*
Long-eared myotis (*Myotis evotis*)
Northern goshawk *(Accipiter gentilis)*
Olive-sided flycatcher *(Contopus cooperi)*
Pallid Townsend's big-eared bat *(Corynorhinus townsendii pallescens)*
Peregrine falcon (*Falco peregrinus*) (Delisted, monitor status)
Redband trout *(Oncorhynchus mykiss)*
Sagebrush lizard *(Sceloporus graciosus)*
Westslope cutthroat trout *(Oncorhynchus clarki lewisi)*

Vascular Plants
Haplopappus liatriformis (Palouse goldenweed)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington Fish And Wildlife Office
510 Desmond Drive Se, Suite 102
Lacey, WA 98503-1263
Phone: (360) 753-9440 Fax: (360) 753-9405
http://www.fws.gov/wafwo/

In Reply Refer To: January 29, 2019
Consultation Code: 01EWFW00-2019-SLI-0368
Event Code: 01EWFW00-2019-E-00756
Project Name: Painted Hills PRD

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, and proposed species, designated and proposed critical habitat, and candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. The species list is currently compiled at the county level. Additional information is available from the Washington Department of Fish and Wildlife, Priority Habitats and Species website: http://wdfw.wa.gov/mapping/phs/ or at our office website: http://www.fws.gov/wafwo/species_new.html. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether or not the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:
http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.). You may visit our website at http://www.fws.gov/pacific/eagle/for information on disturbance or take of the species and information on how to get a permit and what current guidelines and regulations are. Some projects affecting these species may require development of an eagle conservation plan: (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Also be aware that all marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas. The importation of marine mammals and marine mammal products into the U.S. is also prohibited. More information can be found on the MMPA website: http://www.nmfs.noaa.gov/pr/laws/mmpa/.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Related website:
National Marine Fisheries Service: http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Washington Fish And Wildlife Office
510 Desmond Drive Se, Suite 102
Lacey, WA 98503-1263
(360) 753-9440

Project Summary

Consultation Code: 01EWFW00-2019-SLI-0368

Event Code: 01EWFW00-2019-E-00756

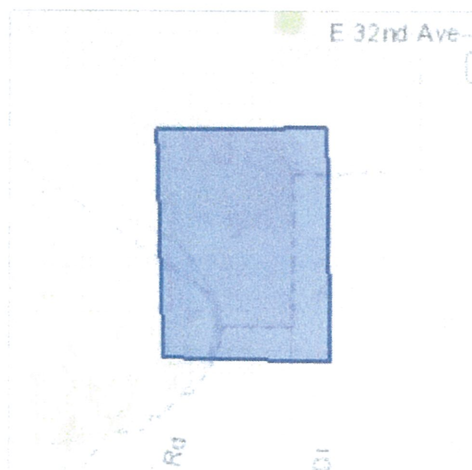
Project Name: Painted Hills PRD

Project Type: DEVELOPMENT

Project Description: The developer proposes constructing a 580 unit planned residential development. The project was planned for construction two years ago, and will be built as soon as permitted in 2019-2020.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/47.616722714208315N117.2421334615195W



Counties: Spokane, WA

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Fishes

NAME	STATUS
Bull Trout *Salvelinus confluentus* Population: U.S.A., conterminous, lower 48 states There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8212	Threatened

Flowering Plants

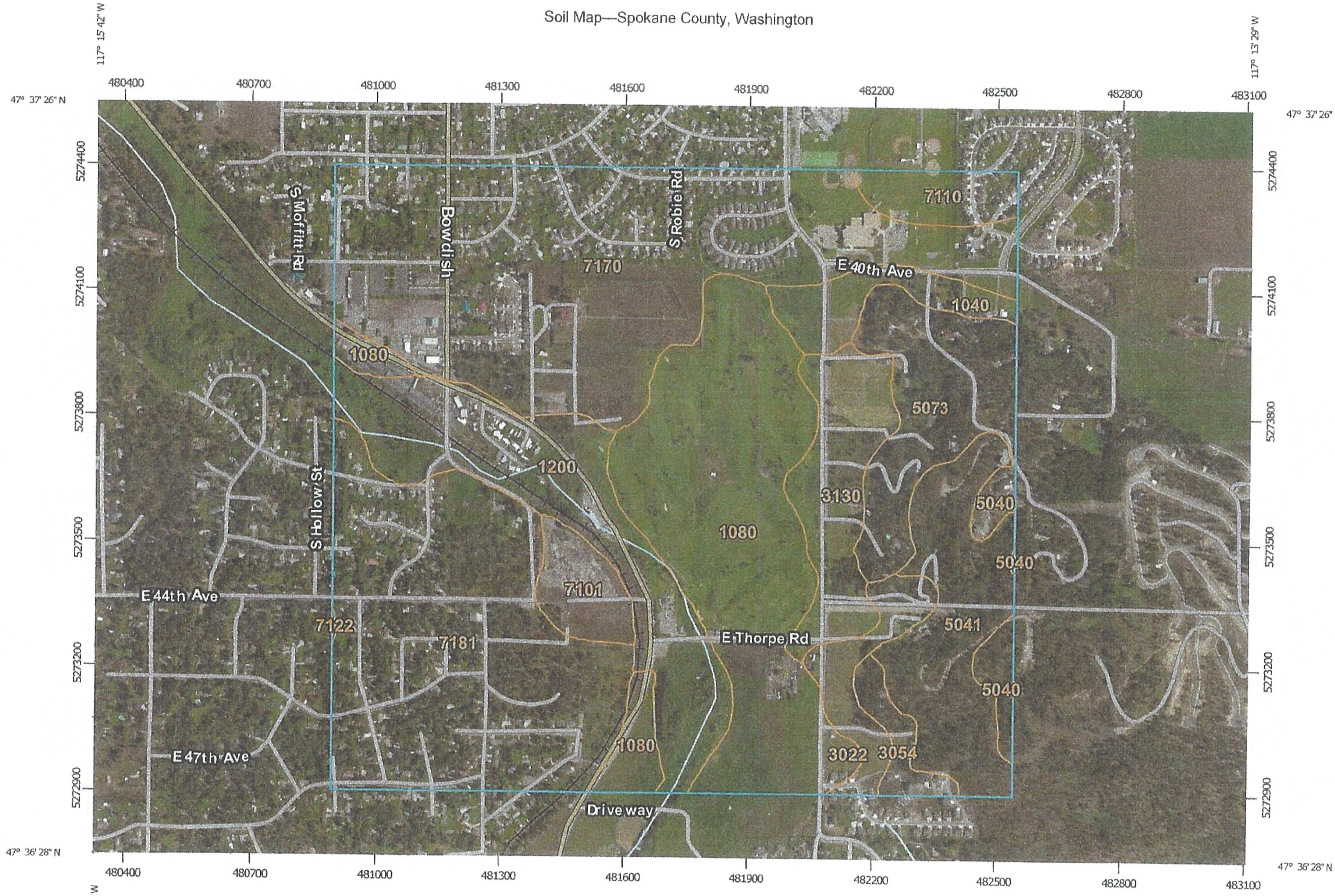
NAME	STATUS
Spalding's Catchfly *Silene spaldingii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3681	Threatened
Water Howellia *Howellia aquatilis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7090	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Appendix 2
Critical Areas Maps

Soil Map—Spokane County, Washington



Map Scale: 1:12,700 if printed on A landscape (11" x 8.5") sheet.

N

0 150 300 600 900 Meters

0 500 1000 2000 3000 Feet

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Spokane County, Washington
Survey Area Data: Version 5, Sep 4, 2014

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

Date(s) aerial images were photographed: Jun 4, 2011—Jul 5, 2011

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

Map Unit Legend

Spokane County, Washington (WA063)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1040	Hardesty ashy silt loam, 0 to 3 percent slopes	14.4	2.3%
1080	Narcisse silt loam, 0 to 3 percent slopes	108.4	17.7%
1200	Endoaquolls and Fluvaquents, 0 to 3 percent slopes	61.9	10.1%
3022	Bong ashy sandy loam, moist, 0 to 8 percent slopes	14.3	2.3%
3054	Clayton ashy fine sandy loam, 0 to 8 percent slopes	7.2	1.2%
3130	Phoebe ashy sandy loam, 0 to 3 percent slopes	29.2	4.8%
5040	Spokane-Swakane complex, 3 to 15 percent slopes	7.9	1.3%
5041	Spokane-Swakane complex, 15 to 30 percent slopes	43.1	7.0%
5073	Lenz-Rock outcrop complex, 15 to 30 percent slopes	37.6	6.1%
7101	Pits-Dumps complex	12.0	2.0%
7110	Urban land-Opportunity, disturbed complex, 0 to 3 percent slopes	11.4	1.9%
7122	Urban land-Marble, disturbed complex, 8 to 15 percent slopes	0.1	0.0%
7170	Urban land-Springdale, disturbed complex, 0 to 3 percent slopes	153.0	24.9%
7181	Urban land-Phoebe, disturbed complex, 3 to 8 percent slopes	112.9	18.4%
Totals for Area of Interest		**613.5**	**100.0%**

U.S. Fish and Wildlife Service

National Wetlands Inventory

May 14, 2015

Wetlands

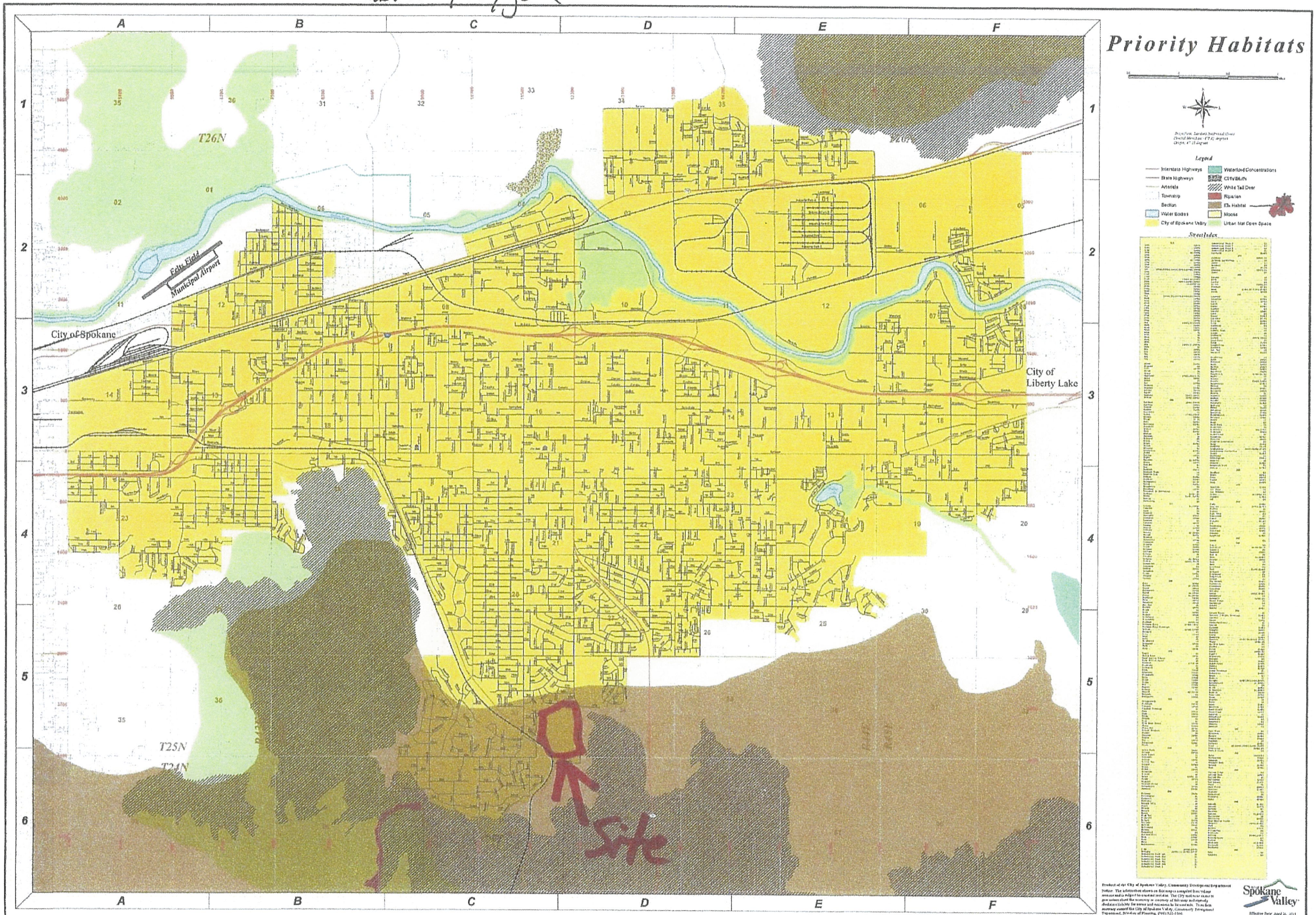
- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

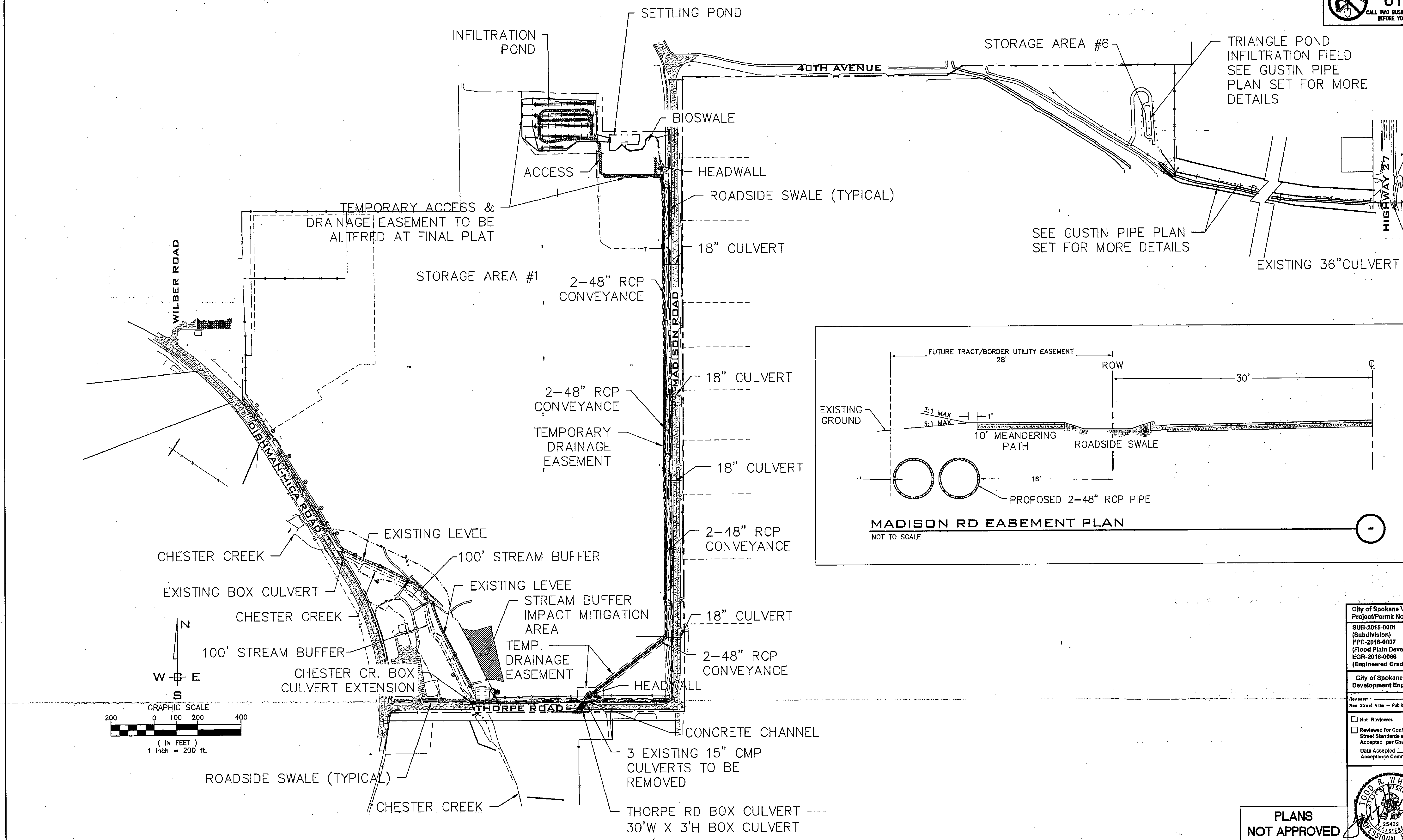
No wetland hydrology at either location. NOT a wetland.

Elk habitat polygon



SITE ELEMENT PLAN

Sheet C1.3



UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
811
CALL TWO BUSINESS DAYS BEFORE YOU DIG

City of Spokane Valley Project/Permit No.:
SUB-2015-0001 (Subdivision)
FPD-2016-0007 (Flood Plain Development)
EGR-2016-0066 (Engineered Grading)

City of Spokane Valley Development Engineering

Reviewer: ____
New Street Miles — Public: ____

☐ Not Reviewed
☐ Reviewed for Conformance to Street Standards and Accepted per Chapter 1.2
Date Accepted ____
Acceptance Comments

TODD R. WHIPPLE — STATE OF WASHINGTON — 25462 — REGISTERED PROFESSIONAL ENGINEER

PLANS NOT APPROVED BY AGENCY

DATUM: NAVD - 88
TBM S-5 OF THE SOUTH PONDEROSA SEWER PROJECT WITH AN ELEVATION OF 2005.87 (NAVD29)=2009.67 (NAVD88) WAS USED FOR THE VERTICAL DATUM FOR THIS MAP.

NO.	DATE	BY	REVISIONS
2	08-14-18	JPP	REVISED PLANS
1	08-12-16	JPP	ORIGINAL PREPARATION

SCALE:
HORIZONTAL: 1" = 200'
VERTICAL: N/A

PROJ #: 13-1166
DATE: 08/14/18
DRAWN: JPP
REVIEWED: TRW

X CIVIL
STRUCTURAL
SURVEYING
TRAFFIC
PLANNING
LANDSCAPE
OTHER

WCE
WHIPPLE CONSULTING ENGINEERS
2528 NORTH SULLIVAN ROAD
SPOKANE VALLEY, WA 99216
PH: 509-893-2617 FAX: 509-926-0227

SPOKANE VALLEY PAINTED HILLS PRD
SITE ELEMENT PLAN
DISHMAN-MICA RD.
SPOKANE VALLEY,WA

SHEET C1.3
JOB NUMBER 13-1166

100 Year Flood Event

Thorpe Road Crossing

64 cfs with Channel South of Thorpe

91 cfs without Channel South of Thorpe

Madison Hills Flow to Culverts

15 cfs through 4 - 18" Culverts

Gustin Pipe Flow to Triangle Pond

16 cfs through 36" Culvert under Highway 27

Ben Goodmansen

From: Ken Puhn <kpuhn@westconsultants.com>
Sent: Monday, July 16, 2018 8:37 AM
To: Ben Goodmansen
Subject: requested info for Painted Hills

Ben,

Per our conversation you had requested confirmation of water surface elevations in the vicinity of the Madison culverts and also the flood discharges entering your facilities. The 100-year water surface elevations calculated by our XPSWMM model within the Madison pipes are shown in the table below. The 100-yr discharges are shown in the 2nd table below. Note that the levee breach discharge came down slightly once I had the final design in the model.

Let me know if you need anything else.

Ken

Node	Max 100-yr WSE
Pipe_Inlet	2009.49
SDMH 1B	2008.30
SDMH 1A	2008.12
SDMH 2A	2007.61
SDMH 2B	2007.86
SDMH 3B	2006.51
SDMH 3A	2006.14
SDMH 4B	2005.64
SDMH 5B	2004.63
SDMH 4A	2004.11
SDMH 6B	2003.99
SDMH 5A	2003.81
Pipe_Outlet	2003.71
US of Spreader	2003.72

Location	100-yr (cfs)	100-yr levee breach (cfs)
Gustin Ditch Downstream of Hwy 27	16	n/a
Golf Course Overflow @ Thorpe	64	91
Golf Course Overflow plus Madison hills inflows	79	106

System Capacity

Box Culvert Capacity
216.4 cfs @ 2 ft of depth, 1 ft of Freeboard

Madison Mainline Pipe Capacity
154.32 cfs & 3.8 ft of depth

Bio Filtration Channel
269.86 cfs @ 6 ft of depth

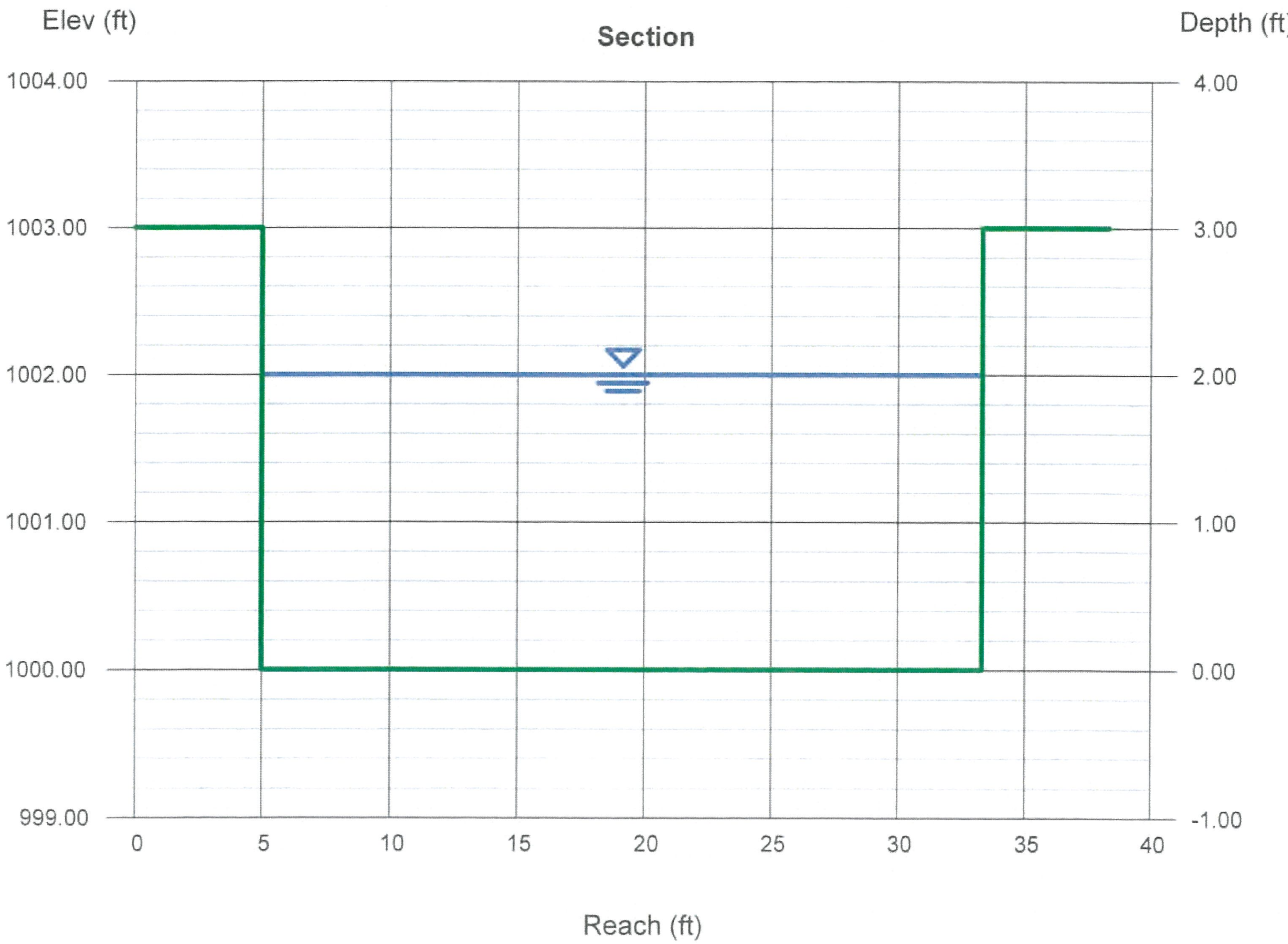
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 7 2018

Box Culvert Capacity

Rectangular		**Highlighted**	
Bottom Width (ft)	= 28.33	Depth (ft)	= 2.00
Total Depth (ft)	= 3.00	Q (cfs)	= 216.40
		Area (sqft)	= 56.66
Invert Elev (ft)	= 1000.00	Velocity (ft/s)	= 3.82
Slope (%)	= 0.50	Wetted Perim (ft)	= 32.33
N-Value	= 0.040	Crit Depth, Yc (ft)	= 1.22
		Top Width (ft)	= 28.33
Calculations		EGL (ft)	= 2.23
Compute by:	Q vs Depth		
No. Increments	= 30		

N-value come from SRSM page 5-11 table 5-4
Rock lined - Jagged & Irregular



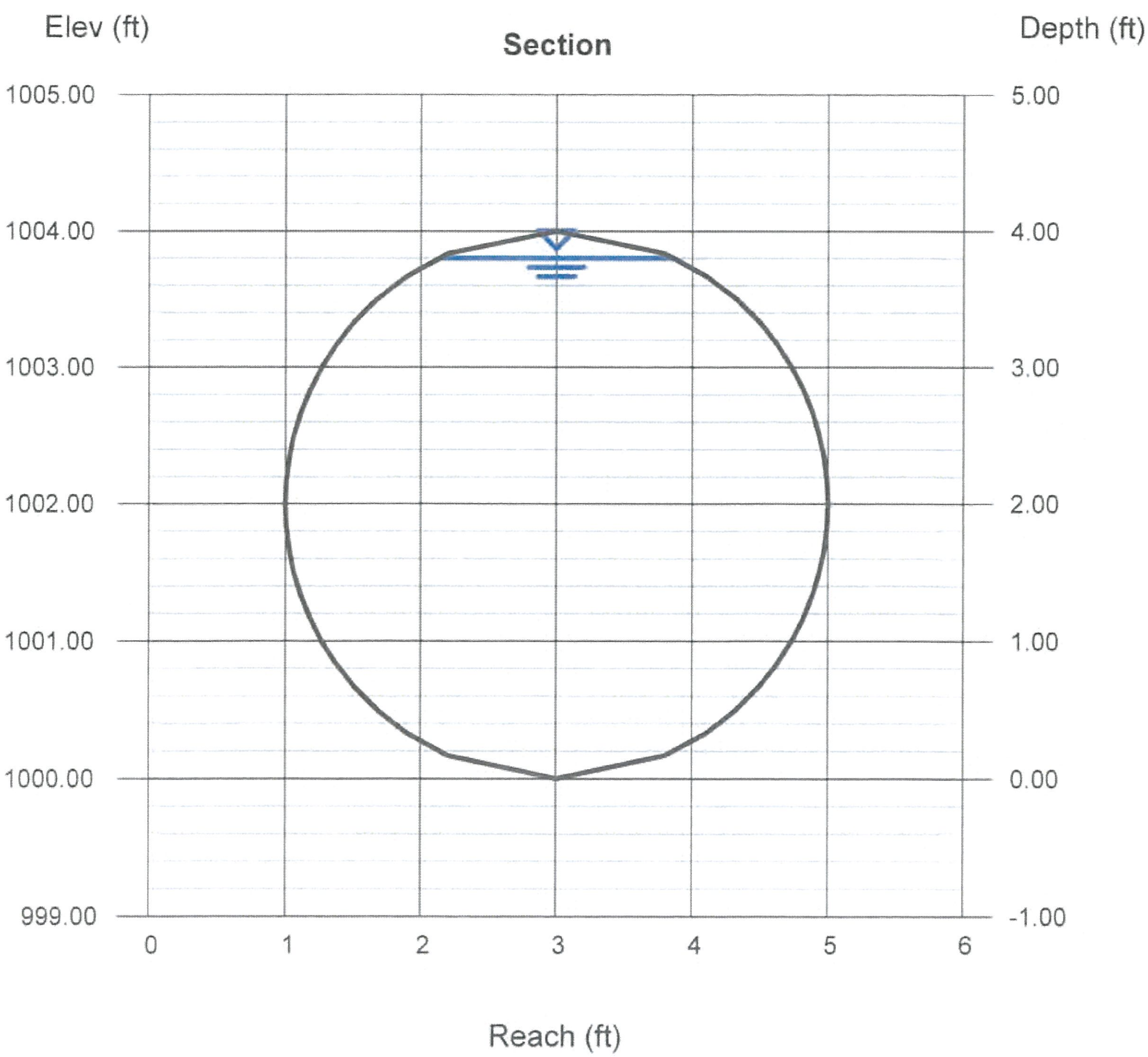
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Tuesday, Jun 19 2018

Madison Pipe (1- 48 in Pipe)

Circular		**Highlighted**	
Diameter (ft)	= 4.00	Depth (ft)	= 3.80
		Q (cfs)	= 77.16
		Area (sqft)	= 12.34
Invert Elev (ft)	= 1000.00	Velocity (ft/s)	= 6.25
Slope (%)	= 0.25	Wetted Perim (ft)	= 10.78
N-Value	= 0.013 — Per Table 8-4 SRSM	Crit Depth, Yc (ft)	= 2.66
		Top Width (ft)	= 1.73
Calculations		EGL (ft)	= 4.41
Compute by:	Q vs Depth		
No. Increments	= 20		

1 PIPE MAX FLOW (77.16)
2 PIPE MAX FLOW = 154.32 cfs

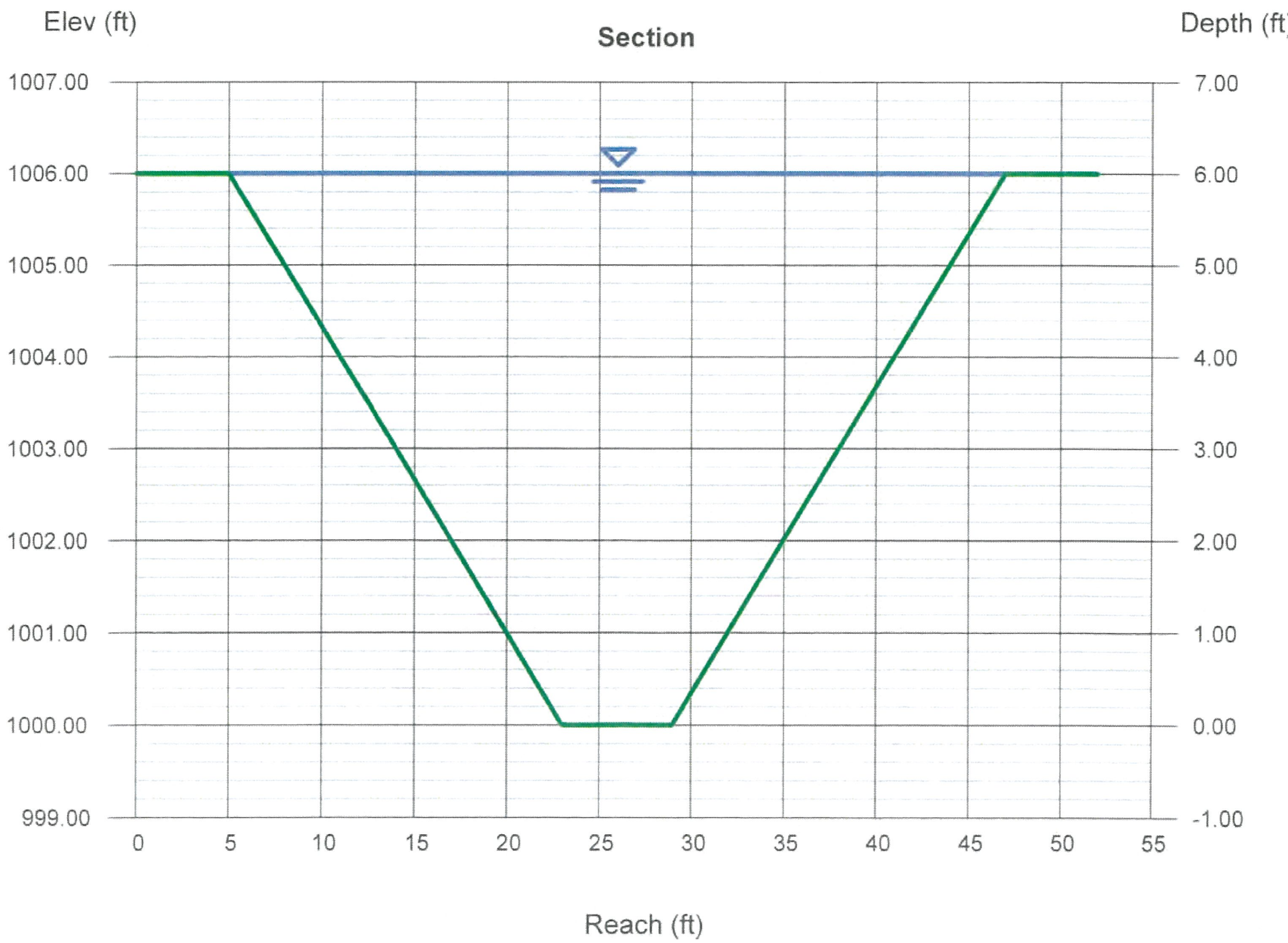


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 7 2018

Bioswale Capacity

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 6.00
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 269.86
Total Depth (ft)	= 6.00	Area (sqft)	= 144.00
Invert Elev (ft)	= 1000.00	Velocity (ft/s)	= 1.87
Slope (%)	= 1.00	Wetted Perim (ft)	= 43.95
N-Value	= 0.175	Crit Depth, Yc (ft)	= 2.64
		Top Width (ft)	= 42.00
Calculations		EGL (ft)	= 6.05
Compute by:	Q vs Depth		
No. Increments	= 20		



Storage and Discharge

Pond Summary Worksheet
- Settling Pond
- Infiltration Pond
- Emergency Park Storage

GRAVEL GALLERY WORKSHEET - NORTH
- Outflow 162.64 cfs – Storage Volume 109,805 cf

WHIPPLE CONSULTING ENGINEERS
POND VOLUME CALC SHEET

Date: 6/19/2018

Project: 13-1166 FLOOD PONDS
Designer: JPP

Volume to Bioswale Outlet

									Treatment			*Storage*
	Ponds	Bottom Area sf	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side Slope Volume cf	Total Volume to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	Total Volume to Inlet cf
	STORAGE	61,004	247	1995.80	1996.80	1997.80	61,004	1,482	62,486	122,008	5,928	127,936
	***SETTLING**	7,172	85	1996.80	1996.80	1997.80	0	0	0	7,172	508	7,680
Total		**68,176**							**62,486**			**135,616**

*Assumes portion of Bioswale to reach a depth of 1' but does not include additional volume

Volume to Pipe Inlet

	Ponds	Bottom Area sf	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side Slope Volume cf	Total Volume to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	*Total Volume to Inlet cf
	STORAGE	61,004	247	1995.80	1996.80	2000.24	61,004	1,482	62,486	270,858	29,214	300,072
	SETTLING	7,172	85	1996.80	1996.80	2000.24	0	0	0	24,672	6,013	30,685
Total		**68,176**							**62,486**			**330,757**

*Does not include additional storage provided by Bioswale

Emergency Park Storage

	Ponds	Bottom Area sf	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side Slope Volume cf	Total Volume to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	*Total Volume to Inlet cf
	Rim	176,181	420	2006.00	2007.00	2011.00	176,181	2,518	**178,699**	880,905	62,961	**943,866**
									ac-ft = 4.10			21.67

WHIPPLE CONSULTING ENGINEERS

GRAVEL GALLERY CALC SHEET

5/15/2018

13-1166 Painted Hills PRD
ENGINEER JPP

Note: infiltration rates per IPEC Geotechnical Report Dated December 31, 2013

Gallery Depth (Min)	Porosity of Gravel (Typ)			Infiltration Rate
ft	cf/cf			cfs/sf
10	0.3			1.80E-03
4	0.3			1.80E-03

Gallery		Number of Galleries	Length	Width	Ground Water EL.	Gravel Gallery Bott. EL	Volume	Storage Volume	Perimeter	Sidewall Area	Bottom Area	Outflow
			ft	ft	ft	ft	cf	cf	ft	sf	sf	cfs
CONTACT AREA		1	246.99	246.99	-	-	244016	73205	988	3,952	61,004	116.92
A		1	280.00	10.00	-	-	28,000	8,400	580	5,800	0	10.44
B		1	280.00	10.00	-	-	28,000	8,400	580	5,800	0	10.44
C		1	280.00	10.00	-	-	28,000	8,400	580	5,800	0	10.44
D		1	280.00	10.00	-	-	28,000	8,400	580	5,800	0	10.44
E		1	100.00	10.00	-	-	10,000	3,000	220	2,200	0	3.96
Totals								109,805				162.64

*Note: Btm Area = Gallery Area - Contact Area

Storage Volume = Volume* Porosity
Sidewall Area= Perimeter*Depth
OutFlow = Sidewall Area+ Bottom Area * Infiltration Rate

Note: Outflow Assumes a Full Gallery

BIO-FILTRATION CHANNEL WORKSHEET

79 cfs With Channel South of Thorpe
83% of treatment achieved

106 cfs Without Channel South of Thorpe
69% of treatment achieved

Open- Channel Hydraulics, Chow (reference)

Bio-filtration Swale Design

Based on King County 2005 Surface Water Design Manual (Section 6.2 and 6.3)

Modified to model flow of flood water utilizing reference Open Channel Hydraulics, CHOW

Design Flow:

Q_{wq} = **79.00 cfs** With channel south of Thorpe

Calculation of swale depth

$Q = 1.49\ A\ R^{0.67} S^{0.5}\ n^{-1}$ Manning's equation

OR

$b = Q_{wq}\ n_{wq}\ (1.49 * y^{1.67} S^{0.5})^{-1}$

OR

$y = [Q_{wq}\ n_{wq}\ (1.49 * b * S^{0.5})^{-1}]^{0.6}$

where

- b = bottom width of swale (ft)...minimum 2 ft width required, maximum 10 ft
- Q_{wq} = water quality design flow (cfs)
- n_{wq} = Manning's roughness coefficient for vegetal retardance conditions (CHOW)
- y = design flow depth
- S = longitudinal slope (along direction of flow) (ft/ft), slope shall be between 1%-6%. If less than 1.5%, underdrains must be provided. Slope less than 1% is considered a "wet biofiltration swale" and must be designed under those guidelines. Slope greater than 6% requires check dams with vertical drops of 12-inches

width known:

b = 6.00 ft

S = 0.010 ft/ft

n_{wq} = 0.175

y = 5.17 ft

Determining design flow velocity:

$V_{wq} = Q_{wq} / A_{wq}$, max 1.0 fps

$A_{wq} = b*y + Z*y^2$

where

- V_{wq} = design flow velocity (fps)
- A_{wq} = cross-sectional area of flow at design depth (sf)
- Z = side slope length per unit height (e.g. for 3:1, Z = 3)

Z = 2

A_{wq} = 111.10 sf

V_{wq} = 0.71 fps

Calculate swale length to achieve a minimum hydraulic residence time of 9 minutes (540 seconds):

$L = 540 * V_{wq}$, minimum swale length is 100 ft

L = 383.98 ft

Calculation to verify n - value

Per Table on page 182 of Open-Channel Hydraulics

Area	Wp	Rh	V
111.10	38.68	2.87	0.71

VRh =VR	n - plot
2.04	0.175

Channel Report

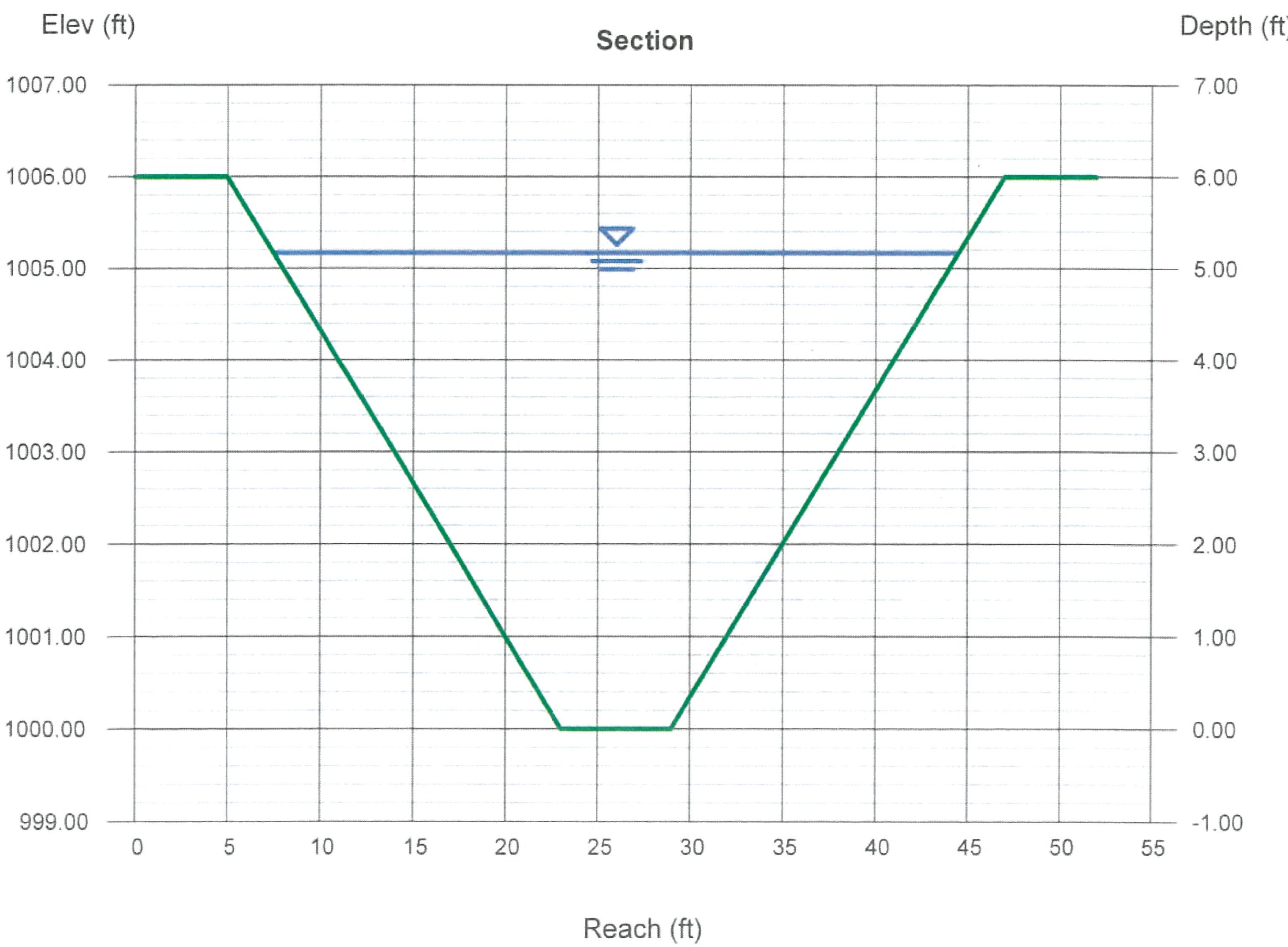
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 19 2018

Bioswale @79 cfs

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 5.17
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 190.65
Total Depth (ft)	= 6.00	Area (sqft)	= 111.08
Invert Elev (ft)	= 1000.00	Velocity (ft/s)	= 1.72
Slope (%)	= 1.00	Wetted Perim (ft)	= 38.68
N-Value	= 0.175	Crit Depth, Yc (ft)	= 2.22
		Top Width (ft)	= 37.00
Calculations		EGL (ft)	= 5.21
Compute by:	Q vs Depth		
No. Increments	= 36		

Depth from Biofiltration sheet

WP on Biofiltration sheet



Bio-filtration Swale Design

Based on King County 2005 Surface Water Design Manual (Section 6.2 and 6.3)

Modified to model flow of flood water utilizing reference Open Channel Hydraulics, CHOW

Design Flow:

Q_{wq} = **106.00 cfs** Without channel south of Thorpe

Calculation of swale depth

$Q = 1.49\ A\ R^{0.67} S^{0.5}\ n^{-1}$ Manning's equation

OR

$b = Q_{wq}\ n_{wq}\ (1.49 * y^{1.67} S^{0.5})^{-1}$

OR

$y = [Q_{wq}\ n_{wq}\ (1.49 * b * S^{0.5})^{-1}]^{0.6}$

where

b = bottom width of swale (ft)...minimum 2 ft width required, maximum 10 ft

Q_{wq} = water quality design flow (cfs)

n_{wq} = Manning's roughness coefficient for vegetal retardance conditions (CHOW)

y = design flow depth

S = longitudinal slope (along direction of flow) (ft/ft), slope shall be between 1%-6%. If less than 1.5%, underdrains must be provided. Slope less than 1% is considered a "wet biofiltration swale" and must be designed under those guidelines. Slope greater than 6% requires check dams with vertical drops of 12-inches

width known:

b = 6.00 ft

S = 0.010 ft/ft

n_{wq} = 0.130

y = 5.16 ft

Determining design flow velocity:

$V_{wq} = Q_{wq} / A_{wq}$, max 1.0 fps

$A_{wq} = b*y + Z*y^2$

where

V_{wq} = design flow velocity (fps)

A_{wq} = cross-sectional area of flow at design depth (sf)

Z = side slope length per unit height (e.g. for 3:1, Z = 3)

Z = 3

A_{wq} = 123.80 sf

V_{wq} = 0.86 fps

Calculate swale length to achieve a minimum hydraulic residence time of 9 minutes (540 seconds):

$L = 540 * V_{wq}$, minimum swale length is 100 ft

L = 462.36 ft

Calculation to verify n - value

Per Table on page 182 of Open-Channel Hydraulics

Area	Wp	Rh	V
123.80	38.63	3.20	0.86

VRh =VR	n - plot
2.74	0.175

Channel Report

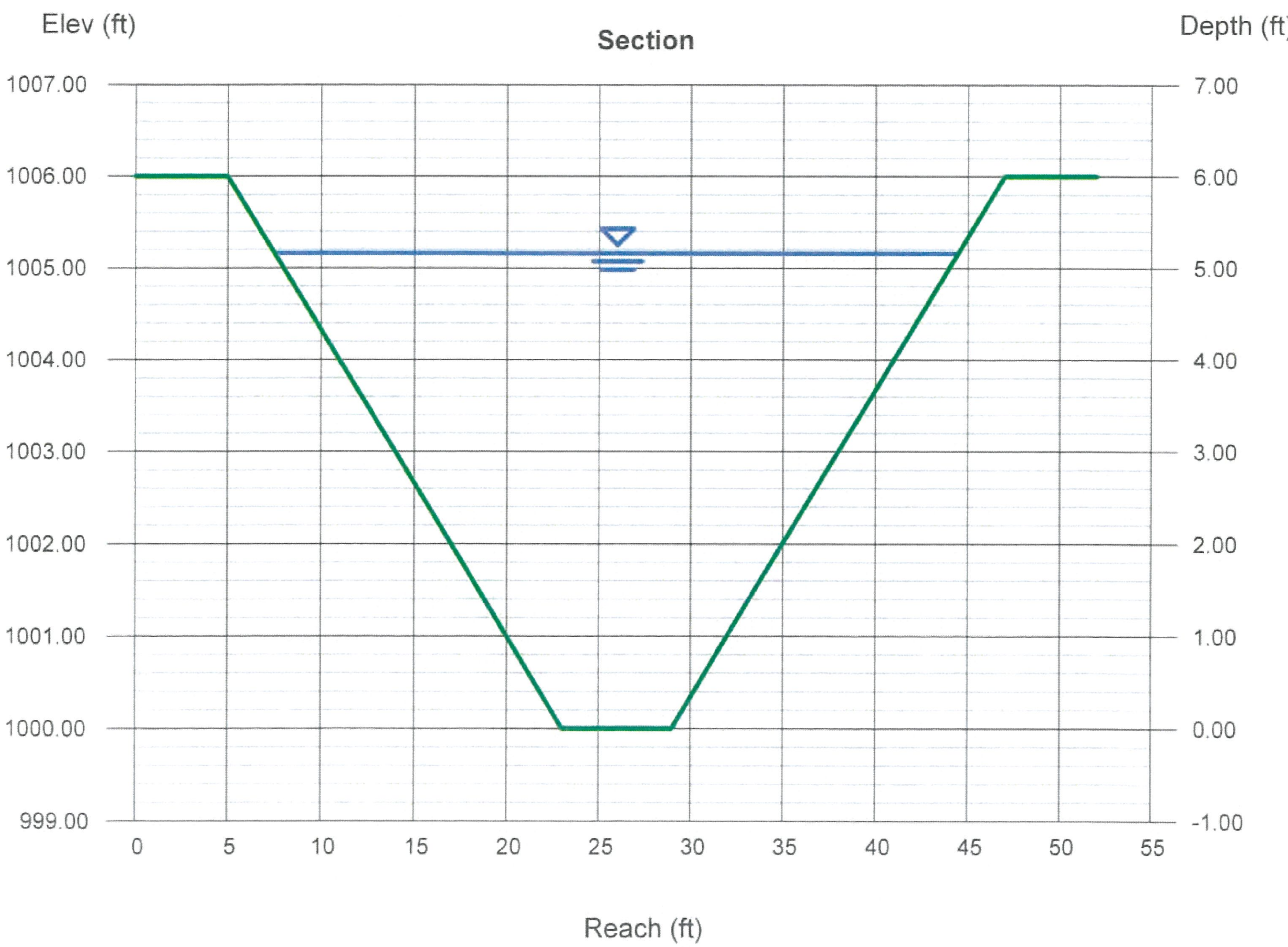
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jul 17 2018

Bioswale @ 106 cfs

Trapezoidal		Highlighted	
Bottom Width (ft)	= 6.00	Depth (ft)	= 5.16
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 255.89
Total Depth (ft)	= 6.00	Area (sqft)	= 110.84
Invert Elev (ft)	= 1000.00	Velocity (ft/s)	= 2.31
Slope (%)	= 1.00	Wetted Perim (ft)	= 38.63
N-Value	= 0.130	Crit Depth, Yc (ft)	= 2.57
		Top Width (ft)	= 36.96
		EGL (ft)	= 5.24

Calculations

Compute by:	Q vs Depth
No. Increments	= 50



OPEN-CHANNEL HYDRAULICS

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

McGRAW-HILL BOOK COMPANY

New York Toronto London

1959

TABLE 7-5. GUIDE IN SELECTION OF VEGETAL RETARDANCE*

Stand	Average length of grass, in.	Degree of retardance
Good	>30	A Very high
	11–24	B High
	6–10	C Moderate
	2–6	D Low
	<2	E Very low
Fair	>30	B High
	11–24	C Moderate
	6–10	D Low
	2–6	D Low
	<2	E Very low

* U.S. Soil Conservation Service [41].

7-18. The Permissible Velocity. The permissible velocity of flow in a grassed channel is the velocity that will prevent severe erosion in the channel for a reasonable length of time. Permissible velocities for different vegetal covers, channel slopes, and soil conditions, recommended on the basis of investigation by the Soil Conservation Service, are shown in Table 7-6.

7-19. Selection of Grass. The selection of grass for the channel lining depends mainly on the climate and soil in which the plant will grow and survive under the given conditions. From the hydraulic viewpoint, stability and other factors should also be considered. In general, a higher discharge requires a stronger or better lining. On steep slopes, bunch grasses, such as alfalfa, lespedeza, and kudzu, will develop channeling of the flow and, hence, are unsatisfactory for lining. For slopes greater than 5%, only fine and uniformly distributed sod-forming grasses, such as Bermuda grass, Kentucky bluegrass, and smooth brome, are recommended for lining where the main flow occurs. Because of the objectionable spreading nature of sod-forming grasses, the top portion of the sides and the berm may be planted with grasses that do not spread easily, such as weeping love grass. For fast establishment of the lining, Bermuda grass and weeping love grass are recommended. Sometimes annuals are used as temporary protection until permanent covers by native grasses are established. Silt deposition in channels may be controlled by lining with bunch grasses, which will develop channeled flow, increase velocity, and thus reduce silting.

7-20. Procedure of Design. After the kind of grass for channel lining is selected, the degree of retardance can be determined from the condition of the stem length and the density of growth. During the period of establishment, the grass will grow and the channel will be stabilized under a condition of low degree of retardance. The channel will not reach its maximum capacity until the grass cover is fully developed and well established. Therefore, it is suggested that the hydraulic design of a grassed channel consist of two stages. The first stage (*A*) is to design the channel for stability, that is, to determine the channel dimensions under the condition of a *lower* degree of retardance. The second stage

TABLE 7-6. PERMISSIBLE VELOCITIES FOR CHANNELS LINED WITH GRASS*

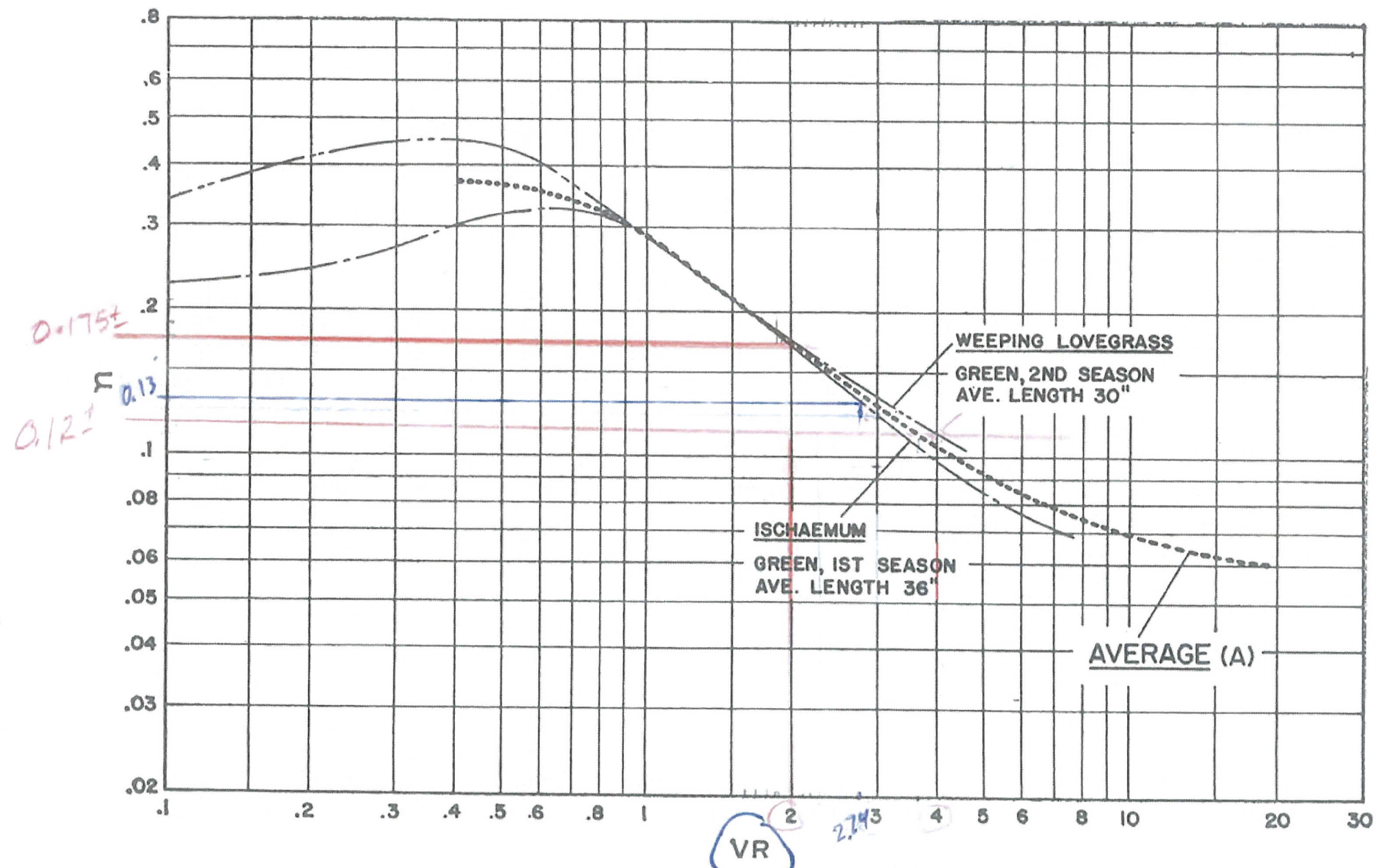
Cover	Slope range, %	Permissible velocity, fps	
		Erosion-resistant soils	Easily eroded soils
Bermuda grass	0–5 5–10 >10	8 7 6	6 5 4
Buffalo grass, Kentucky bluegrass, smooth brome, blue grama	0–5 5–10 >10	7 6 5	5 4 3
Grass mixture	0–5 5–10 Do not use on slopes steeper than 10%	5 4	4 3
Lespedeza sericea, weeping love grass, ischaemum (yellow bluestem), kudzu, alfalfa, crabgrass	0–5 Do not use on slopes steeper than 5%, except for side slopes in a combination channel	3.5	2.5
Annuals—used on mild slopes or as temporary protection until permanent covers are established, common lespedeza, Sudan grass	0–5 Use on slopes steeper than 5% is not recommended	3.5	2.5

REMARKS. The values apply to average, uniform stands of each type of cover. Use velocities exceeding 5 fps only where good covers and proper maintenance can be obtained.

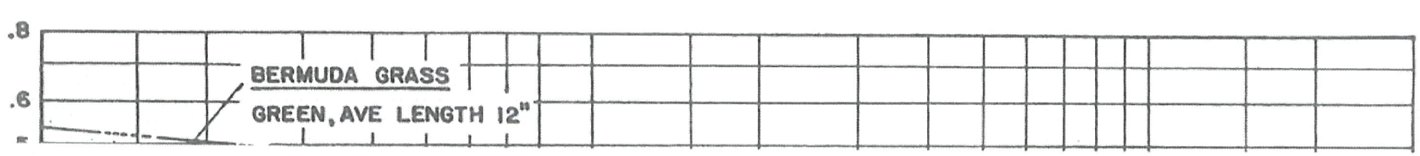
* U.S. Soil Conservation Service [41].

(*B*) is to review the design for maximum capacity, that is, to determine the increase in depth of flow necessary to maintain a maximum capacity under the condition of a *higher* degree of retardance. For instance, if common lespedeza is selected as the grass for lining, the common lespedeza of low vegetal retardance (green, average length 4.5 in.) is used for the first stage in design. Then, in the second stage, the common lespedeza of moderate vegetal retardance (green, uncut, average length 11 in.) should be used. Finally, a proper freeboard is added to the computed

OPEN CHANNEL HYDRAULICS, CHOW



(a) Curves for A or very high vegetal retardance.



Geotechnical Reports

Triangle Pond Infiltration (Storage Area 6)
IPEC Proposed Stormwater Pond dated October 14, 2014

North Pond Location Boring
IPEC Supplemental Geotechnical Evaluation dated April 19, 2016

Pavement Design (Public Roads)
IPEC Geotechnical Evaluation – Proposed Street Improvements dated June 26, 2017

Full-Scale Drywell Testing
IPEC Full-Scale Drywell Testing dated August 21, 2017
IPEC Addendum to Full-Scale Drywell Testing dated August 22, 2017

Mounding Analysis
IPEC Mounding Analysis dated August 22, 2017

REPORT 2

Geotechnical Evaluation, Proposed Stormwater Pond, dated October 14, 2014

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

October 14, 2014
Project No. 14-086

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Geotechnical Evaluation**
Proposed Stormwater Pond
Parcel No. 45343.9052
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed a geotechnical evaluation for geotechnical evaluation at the above-referenced site in Spokane Valley, Washington. The purpose of our services is to evaluate the subsurface soil and groundwater conditions relative to use as a stormwater management facility as part of the Painted Hills golf course property stormwater management system. This report summarizes the results of our site investigation, engineering analyses and recommendations.

PROJECT DESCRIPTION

We understand that the proposed project may consist of a residential development. The site consists of 91 acres currently developed as a golf course. Stormwater runoff will be treated using drywells and/or gravel galleries for subsurface infiltration. These type of facilities will also be used to manage potential floodwaters, if needed. To account for stormwater runoff volumes from the unnamed tributary along State Highway 27, you propose to use this parcel as a stormwater pond with drywells for subsurface infiltration.

P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

AVAILABLE INFORMATION

We were provided a conceptual site plan for the project by Whipple Consulting Engineers, Inc. (WCE). This plan showed the proposed pond limits, proposed and existing ground surface elevation contours, and property lines. This plan was prepared by WCE and was not dated.

FIELD EVALUATION

Procedures

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) observed the excavation of four test pits at the site. The test pits were excavated on October 1, 2014 using a rubber-tired backhoe operated by an independent firm working under subcontract to IPEC. The geotechnical engineer from IPEC observed the test pit excavations and logged the surface and subsurface conditions. Ground surface elevations at the test pits were interpolated from the contours shown on the site plan.

The soils encountered in the test pits were visually and manually classified in the field by our field personnel in accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedures)". The samples were returned to our facility for review of the classification by a geotechnical engineer and laboratory testing.

Soils Encountered

The test pist encountered glacially deposited silty sand at the surface overlying poorly graded sands to the termination depths of the test pits.

Groundwater was not encountered in the test pits during or after excavation. Well log data in the vicinity of the site indicate that groundwater levels range from approximately 90 to 100 feet.

Geologic maps indicate the soils in this area consist primarily of glacially deposited sands and gravels. According to the Soil Survey of Spokane County, the site soils are classified as Urban land-Springdale, disturbed complex. These soils are described as somewhat excessively drained soils that formed in sandy and gravelly glaciofluvial deposits with minor amounts of volcanic ash and loess in the upper part. The native soils exposed in the test pits were consistent with the NRCS data.

Laboratory Testing

We performed grain size analysis tests on samples obtained from the test pits. The tests were performed in accordance with ASTM Method of Test D 6913. The results of the tests performed are attached to this report.

ANALYSIS AND RECOMMENDATIONS

Stormwater Recommendations

Based on the data obtained from the test pits, field permeability test, and laboratory tests performed, it is our opinion that swales and drywells would be suitable for infiltration of stormwater.

We estimated a design outflow rate for drywells using the results of the laboratory tests and the procedures described in the SRSM manual, Appendix 4A (Spokane 200 Method). The following table summarizes the results of the analysis.

Test Pit	Depth (feet)	USCS Classification	Percent Fines	Normalized Outflow Rate (cfs/ft)	Recommended Design Drywell Outflow Rate (cfs)	
					Type A	Type B
TP-1	10 – 12	SP	1.0	0.5	0.3	1.0
TP-2	10 – 12	SP	1.5	0.5	0.3	1.0
TP-3	10 – 12	SP	1.4	0.5	0.3	1.0
TP-4	10 – 12	SP	1.6	0.5	0.3	1.0

These recommended design outflow rates include a safety factor of 1.3 as required by the SRSM.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Paul T. Nelson, P.E.
Principal Engineer

Attachments: Figure 1, Site Location Map
Figure 2, NRCS Map
Figure 3, Test Pit Location Map
Logs of Test Pits TP-1 through TP-4
Descriptive Terminology
Laboratory Test Results

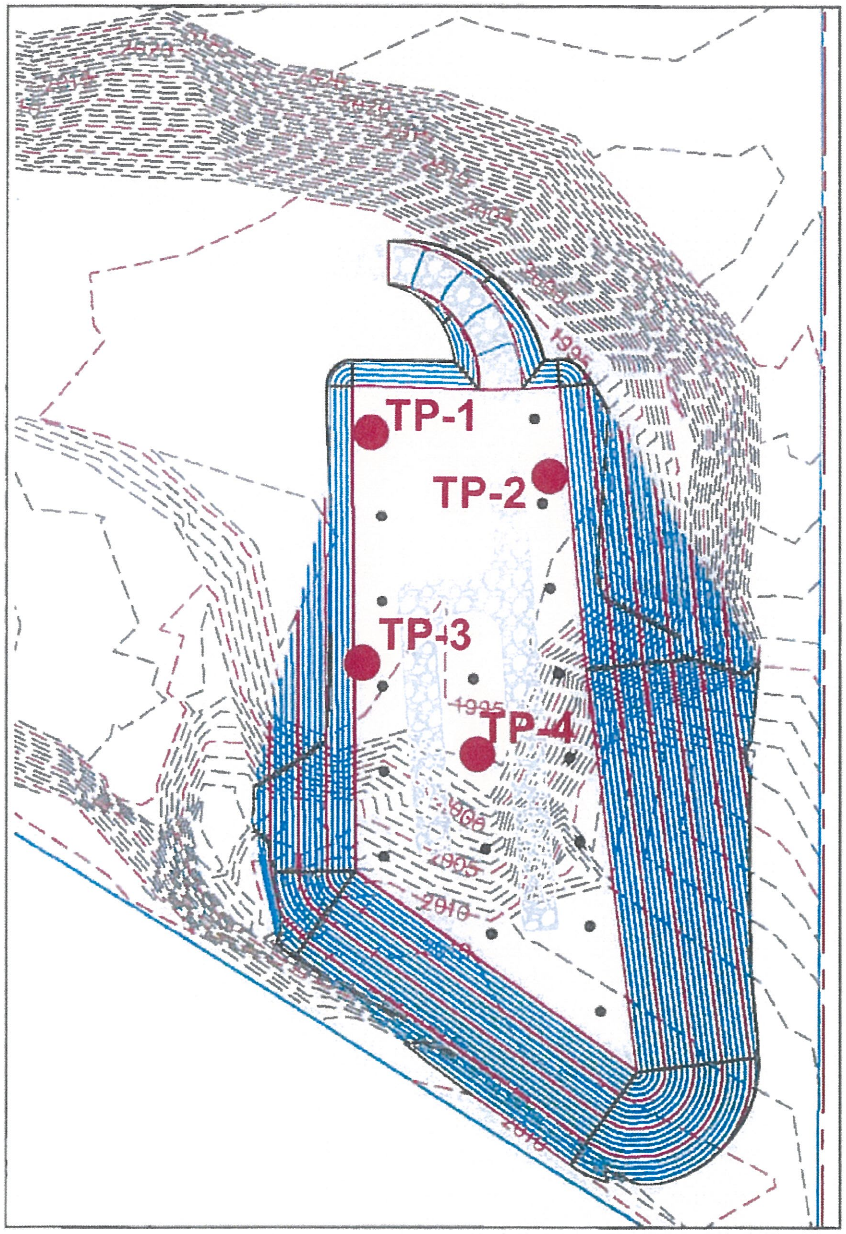
FIGURE 1

Site Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 14-086 Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	October 9, 2014

FIGURE 2

NRCS Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 14-086 Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	October 9, 2014

FIGURE 3



Test Pit Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 14-086	October 9, 2014
	Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	

LOG OF TEST PIT

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	TEST PIT: **TP-1** LOCATION: See Test Pit Location Map DATE: 10/1/14 SCALE: 1"=2'

ELEV. 1994.5	DEPTH 0.0	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1993.5	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
1979.5	15.0	SP	POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
			End of test pit. Groundwater not encountered. Test pit immediately backfilled.		

LOG OF TEST PIT

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

PROJECT:	14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	TEST PIT:	TP-2
		LOCATION:	See Test Pit Location Map
		DATE: 10/1/14	SCALE: 1"=2'

ELEV. 1994.5	DEPTH 0.0	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1993.0	1.5	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
1979.5	15.0	SP	POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
			End of test pit. Groundwater not encountered. Test pit immediately backfilled.		

LOG OF TEST PIT

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

PROJECT:	14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	TEST PIT:	TP-3
		LOCATION:	See Test Pit Location Map
		DATE: 10/1/14	SCALE: 1"=2'

ELEV. 1995	DEPTH 0.0	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1994	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
1980	15.0	SP	POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
			End of test pit. Groundwater not encountered. Test pit immediately backfilled.		

LOG OF TEST PIT

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	TEST PIT: **TP-4** LOCATION: See Test Pit Location Map DATE: 10/1/14 SCALE: 1"=2'

ELEV. 1996	DEPTH 0.0	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1995	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
1981	15.0	SP	POORLY GRADED SAND WITH GRAVEL,medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
			End of test pit. Groundwater not encountered. Test pit immediately backfilled.		

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

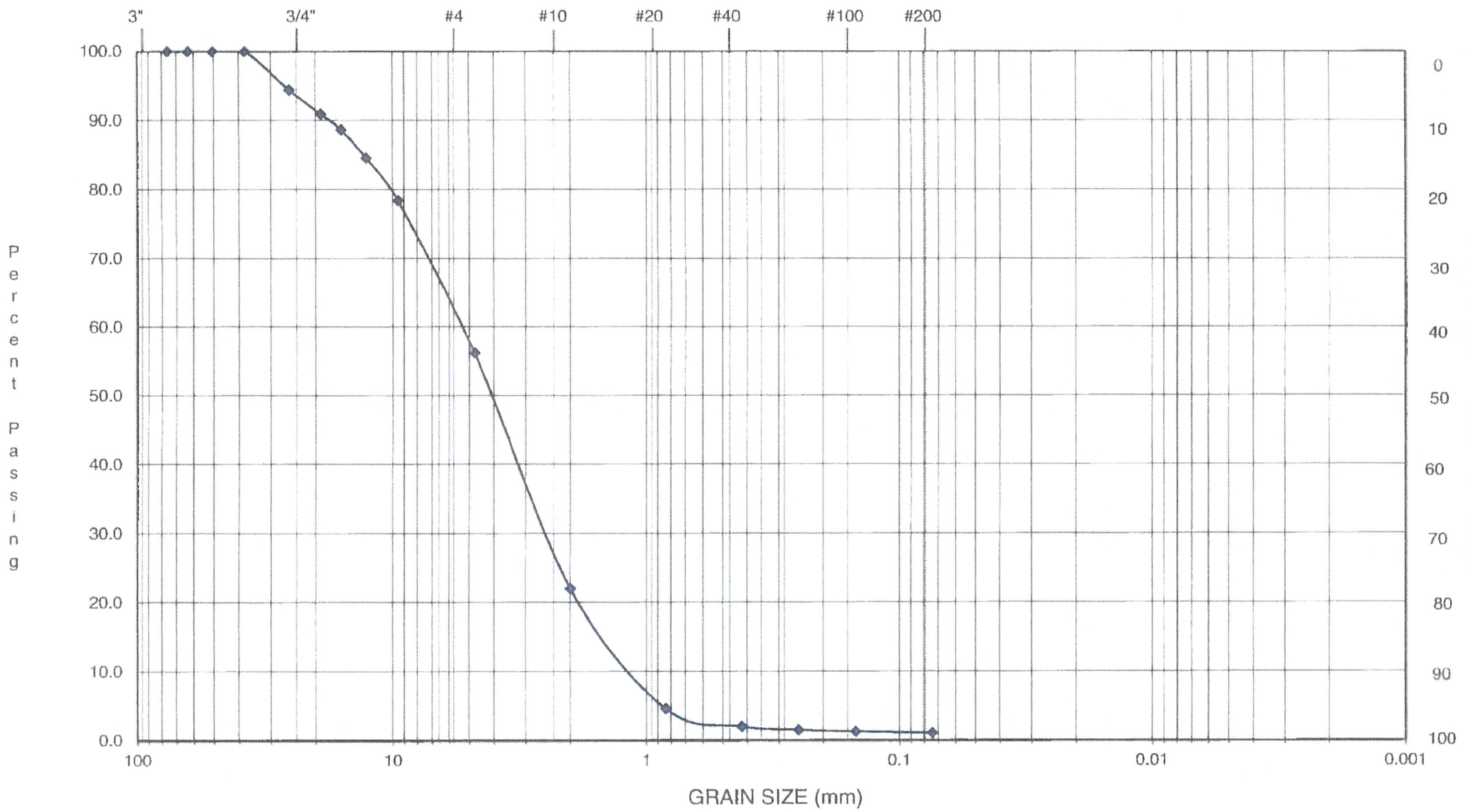
RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALVE			
COARSE-GRAINED SOILS		FINE-GRAINED SOILS	
DENSITY	N(BLOWS/FT)	CONSISTENCY	N(BLOWS/FT)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	4 - 10	Soft	2 - 3
Medium-Dense	11 - 30	Rather Soft	4 - 5
		Medium	6 - 8
Dense	31 - 50	Rather Stiff	9 - 12
		Stiff	13 - 16
Very Dense	> 50	Very Stiff	17 - 30
		Hard	> 30

USCS SOIL CLASSIFICATION				
MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse-Grained Soils	Gravel and	Gravel	GW	Well Graded Gravel
	Gravelly Soils	(with little or no fines)	GP	Poorly Graded Gravel
	<50% coarse fraction	Gravel	GM	Silty Gravel
	passes #4 sieve	(with >12% fines)	GC	Clayey Gravel
<50%	Sandy and	Sand	SW	Well Graded Sand
passes #200	Sandy Soils	(with little or no fines)	SP	Poorly Graded Sand
sieve	>50% coarse fraction	Sand	SM	Silty Sand
	passes #4 sieve	(with >12% fines)	SC	Clayey Sand
Fine-Grained Soils			ML	Silt
	Silt and Clay		CL	Lean Clay
	Liquid Limit < 50		OL	Organic Silt and Clay (low plasticity)
>50%			MH	Inorganic Silt
passes #200	Salt and Clay		CH	Fat Clay
sieve	Liquid Limit > 50		OH	Organic Clay and Silt (med to high plasticity)
Highly Organic Soils			PT	Peat / Muck

MODIFIERS	
DESCRIPTION	RANGE
Occasional	<5%
Trace	5% - 12%
With	>12%

MOISTURE CONTENT	
DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Dry of optimum moisture content
Wet	Wet of optimum moisture content

MAJOR DIVISIONS WITH GRAIN SIZE								
SIEVE SIZE								
12"	3"	3/4"	4	10	40	200		
GRAIN SIZE (INCHES)								
12	3	0.75	0.19	0.079	0.0171	0.0029		
Boulders	Cobbles	Gravel		Sand			Silt and Clay	
		Coarse	Fine	Coarse	Medium	Fine		



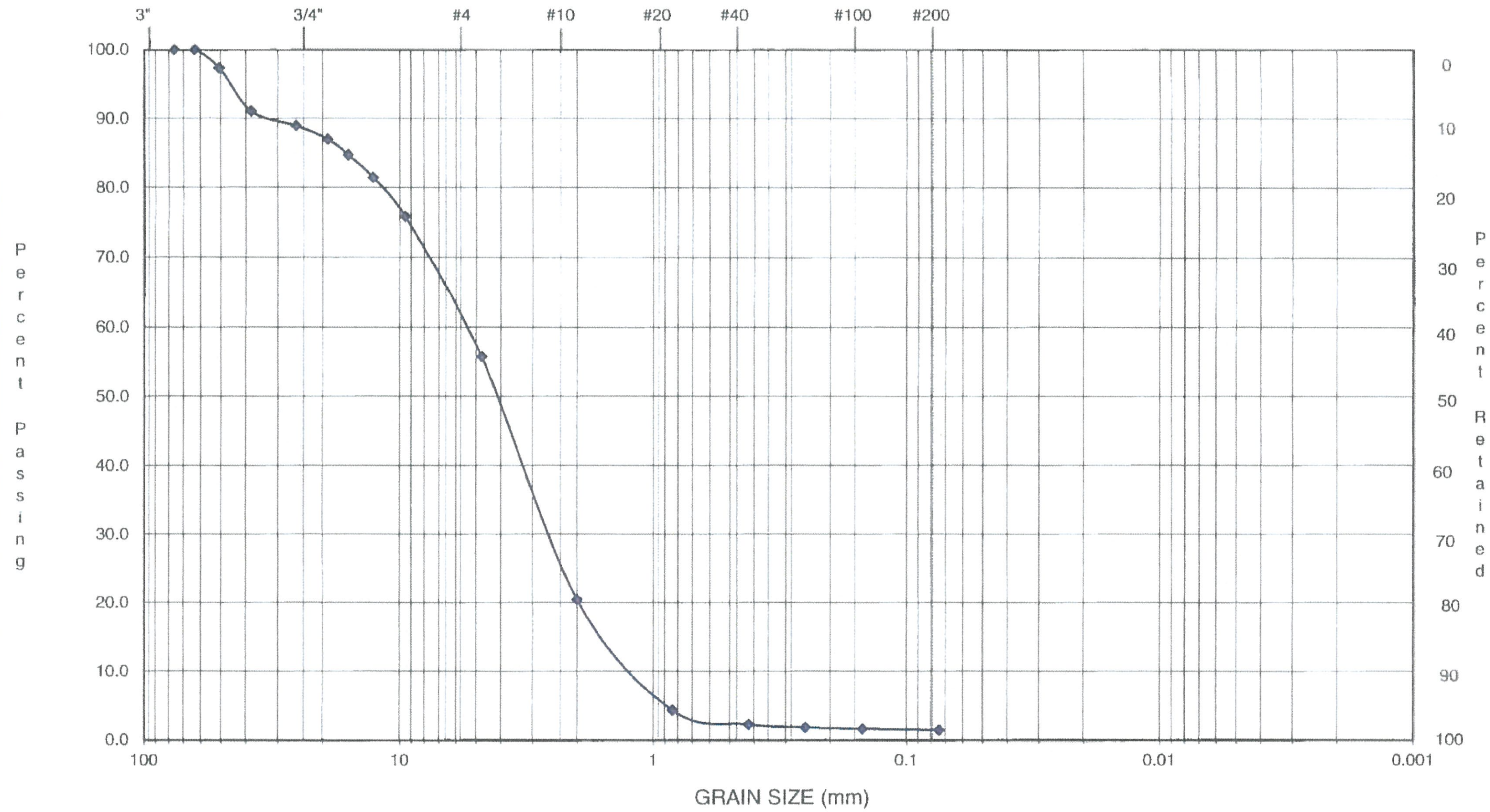
UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Sample Identification:	Sample Description:	Lab No.
L14-039	SP Poorly Graded Sand with Gravel	L14-039

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting
P.O Box 1566, Veradale, WA 99037 (509) 209-6262

GRAIN SIZE REPORT

Project:	40th Avenue Stormwater
Location:	TP-1 @ 10-12'
Job No.:	14-086
Date:	10/1/2014



UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Sample Identification: L14-040

Sample Description: SP Poorly Graded Sand with Gravel

Lab No. L14-040

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting
P.O Box 1566, Veradale, WA 99037 (509) 209-6262

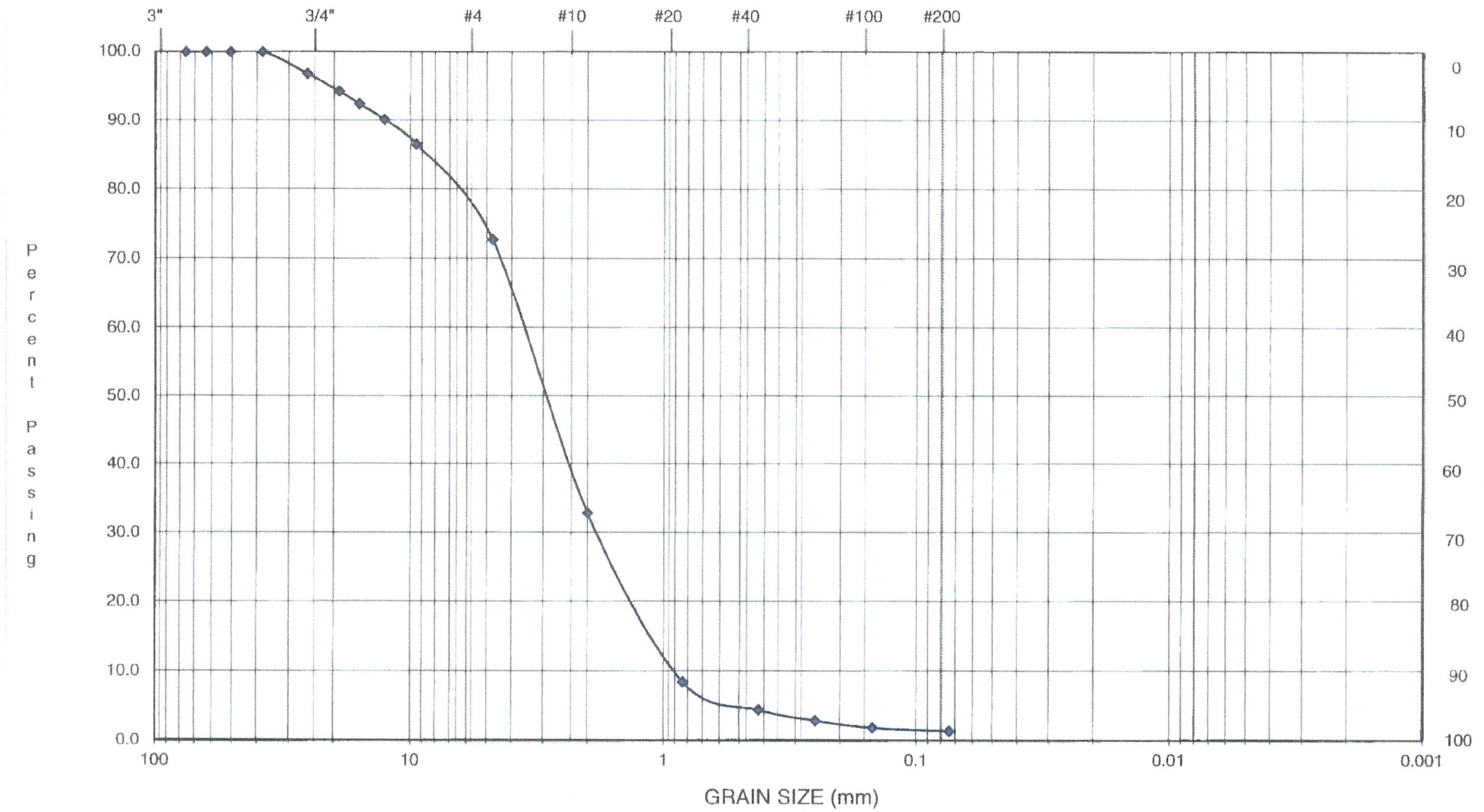
GRAIN SIZE REPORT

Project: 40th Avenue Stormwater

Location: TP-2 @ 10-12'

Job No.: 14-086

Date: 10/1/2014



UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Sample Identification: L14-041

Sample Description: SP Poorly Graded Sand with Gravel

Lab No. L14-041

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting
P.O Box 1566, Veradale, WA 99037 (509) 209-6262

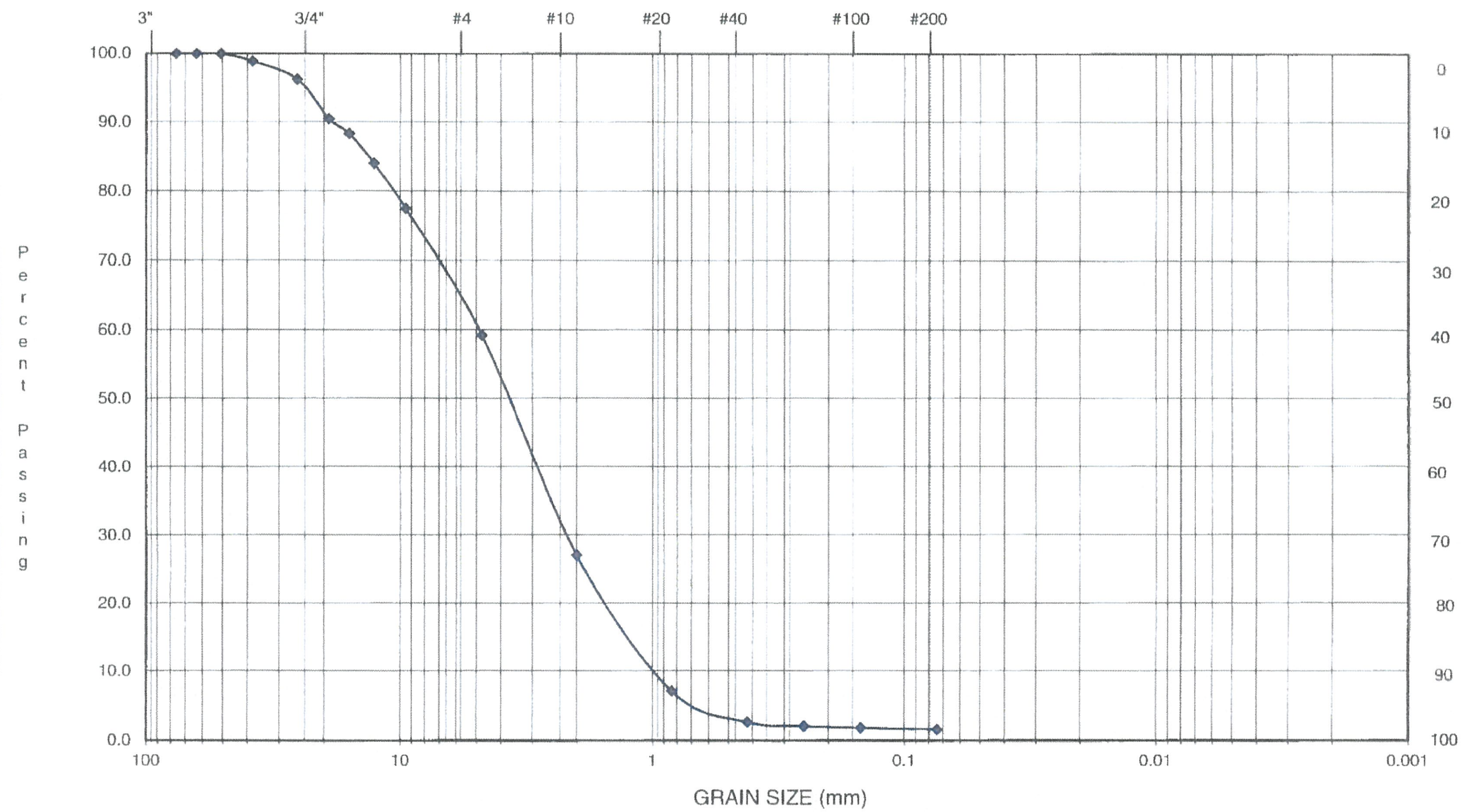
GRAIN SIZE REPORT

Project: 40th Avenue Stormwater

Location: TP-3 @ 10-12'

Job No.: 14-086

Date: 10/1/2014



UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Sample Identification:	Sample Description:	Lab No.
L14-042	SP Poorly Graded Sand with Gravel	L14-042

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting
P.O Box 1566, Veradale, WA 99037 (509) 209-6262

GRAIN SIZE REPORT

Project:	40th Avenue Stormwater
Location:	TP-4 @ 10-12'
Job No.:	14-086
Date:	10/1/2014

Royal Myhre

From: Gorman, Connie <Connie.Gorman@avistacorp.com>
Sent: Wednesday, March 06, 2019 10:53 AM
To: Royal Myhre
Subject: RE: [External] SEWER-WATER-STREETS-GAS-POWER-PHONE-CABLE PLANS FOR 19-2320
Attachments: Pittsburg and Rosewood - ELECT.pdf; Pittsburg and Rosewood - GAS.pdf

Here you go!!

From: Royal Myhre [mailto:royalm@whipplece.com]
Sent: Wednesday, March 06, 2019 10:22 AM
To: AITOR LACAMBRA (AITOR.LACAMBRA@CENTURYLINK.COM) <AITOR.LACAMBRA@CENTURYLINK.COM>; BRYAN RICHARDSON (BRYAN_RICHARDSON@CABLE.COMCAST.COM) <BRYAN_RICHARDSON@CABLE.COMCAST.COM>; Gorman, Connie <Connie.Gorman@avistacorp.com>; TIM NASH (TNASH@SPOKANECITY.ORG) <TNASH@SPOKANECITY.ORG>
Subject: [External] SEWER-WATER-STREETS-GAS-POWER-PHONE-CABLE PLANS FOR 19-2320

TO ALL,
WE ARE DOING A PROJECT ON THE NORTH WEST CORNER OSF PITTSBURG AND ROSEWOOD
WE WOULD LIKE TO GET THE ABOVE PLANS FOR OUR PROJECT

THANK YOU ALL FOR YOUR HELP

Royal Myhre
Engineering Tech, Whipple Consulting Engineers, Inc.
Phone: 509.893.2617 | Fax: 509.926.0227

WCE
Whipple Consulting Engineers

WCE provides Land Development services in the following areas: Land Surveying, Civil, Structural and Traffic Engineering, Land Planning and Landscape Architecture.

21 South Pines Road • Spokane Valley, WA 99206
WhippleCE.com

USE CAUTION - EXTERNAL SENDER
Do not click on links or open attachments that are not familiar.
For questions or concerns, please e-mail phishing@avistacorp.com

REPORT 8

Supplemental Geotechnical Evaluation, dated April 19, 2016

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

April 19, 2016
Project No. 16-249

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Supplemental Geotechnical Evaluation**
Painted Hills Golf Course Property
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed the supplemental geotechnical evaluation for the Painted Hills Golf Course property at the above-referenced site in Spokane Valley, Washington. The purpose of the supplemental evaluation is to provide additional soil and groundwater data to address concerns of the City of Spokane Valley. This report summarizes the results of our field investigation, laboratory testing, engineering analyses, and our opinions and recommendations for stormwater management.

PROJECT DESCRIPTION

We understand that the proposed project may consist of a residential development. The site consists of 91 acres currently developed as a golf course. Stormwater runoff will be treated using drywells and/or gravel galleries for subsurface infiltration. These type of facilities will also be used to manage potential floodwaters, if needed. This supplemental evaluation is intended to provide additional subsurface data at the north end of the site to assist in identifying areas where subsurface infiltration of stormwater may be feasible due to the presence of suitable soils at depth.

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Lastly, we performed a geotechnical evaluation in July 2015 consisting of ten 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

FIELD EVALUATION

Procedures

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) observed the drilling of three penetration test borings at the site. The borings were drilled between March 17 and 19, 2016 using a truck-mounted drill operated by an independent firm working under subcontract to IPEC. A geotechnical engineer or engineering assistant from IPEC observed the borings and logged the surface and subsurface conditions. After we logged the borings, they were abandoned in accordance with state requirements. Ground surface elevations at the borings were provided by WCE.

The soils encountered in the borings were visually and manually classified in the field by our field personnel in accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedures)". The samples were returned to our facility for review of the classification by a geotechnical engineer and laboratory testing.

Soils Encountered

In general, the borings encountered 2 feet of topsoil at the surface. Below the topsoil, the borings generally encountered glacially-deposited silty to clayey sands and/or gravels overlying poorly graded sands to termination depths of the borings. The clayey sands and gravels were generally encountered in the upper 12 to 18 feet.

Penetration resistances in the sands and gravels ranged from 15 to 90 blows per foot (BPF) and averaged 37 BPF, indicating that these soils were medium dense to very dense, but were typically dense.

Geologic maps indicate the soils in this area consist primarily of alluvial and/or glacially deposited silts, clays, sands, and gravels. According to the Soil Survey of Spokane County, the site soils are classified by the Natural Resource Conservation Service (NRCS) as Hardesty ashy silt loam, Narcisse silt loam, Endoaquolls and Fluvaquents, Phoebe ashy sandy loam, and Urban land-Springdale disturbed complex. The native soils encountered in the borings were consistent with the NRCS data.

Groundwater was encountered in Boring B-2 at a depth of 71 feet. This depth corresponds to an elevation of 1934.6. Groundwater was not encountered in the remaining borings. The observed water levels further indicates that groundwater levels drop generally from south to north with higher levels near Chester Creek. Fluctuations in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw and other seasonal and annual factors not evident at the time the observations were made.

ANALYSIS, OPINIONS, AND RECOMMENDATIONS

Based on the data obtained from the recent and previous borings, previous test pits, field permeability tests, and laboratory tests performed, it is our opinion that subsurface infiltration of stormwater is feasible. The most promising layers are the glacial sands and gravels. These soils would be suitable for infiltration using standard drywells.

We will perform a mounding analysis for the drywells after the proposed full-scale drywell test is completed to assess down-gradient impacts

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,

Paul T. Nelson, P.E.
Principal Engineer

PAUL T NELSON
STATE OF WASHINGTON
37228
REGISTERED
PROFESSIONAL ENGINEER
4-19-16

Attachments:
- Figure 1, Site Location Map
- Figure 2, NRCS Map
- Figure 3, Boring Location Map
- Logs of Borings B-1 through B-3
- Descriptive Terminology
- Laboratory Test Results

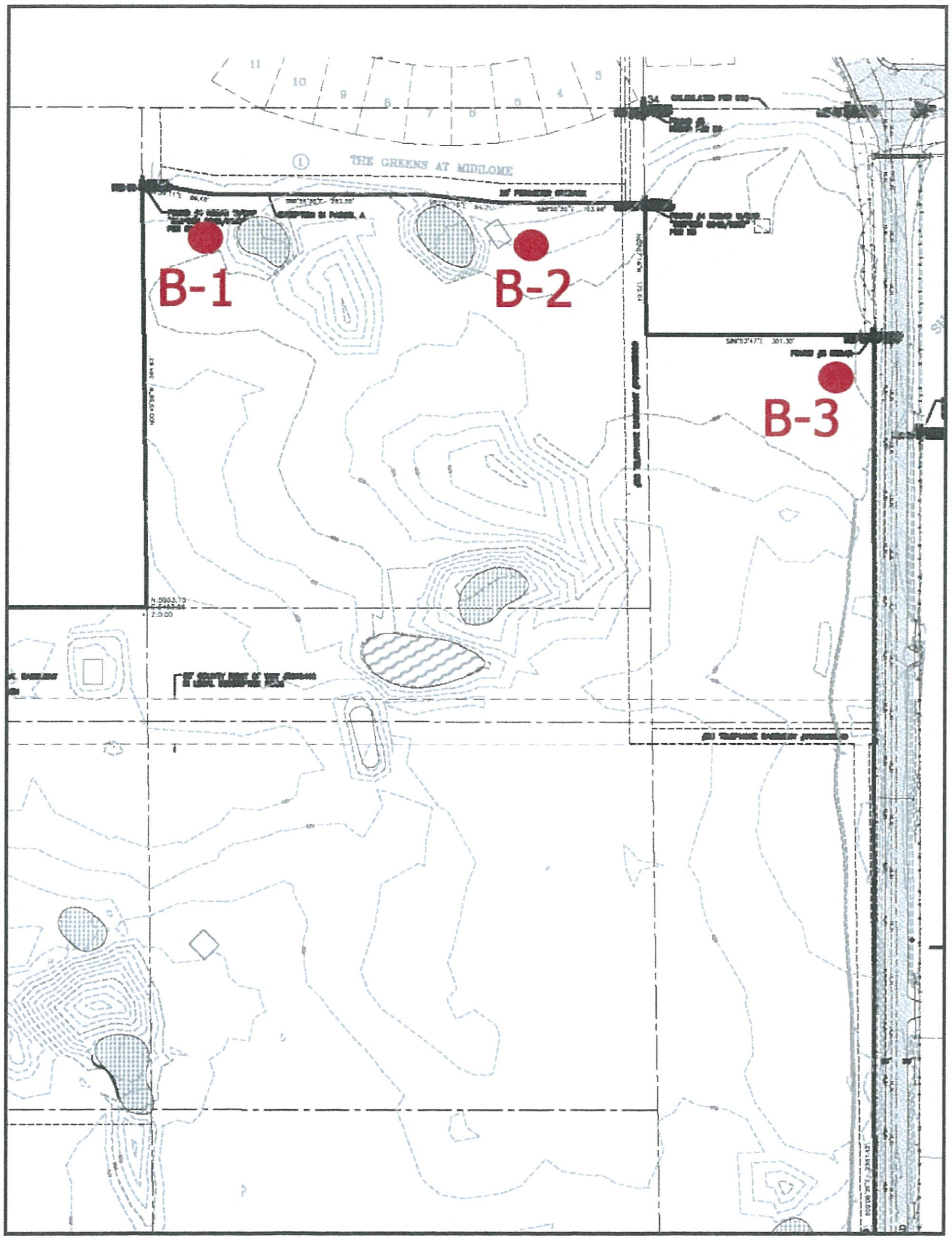
FIGURE 1

Site Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249 Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	April 19, 2016

FIGURE 2

NRCS Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249 Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	April 19, 2016

FIGURE 3



Boring Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249 Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	April 19, 2016

BORING NUMBER B-1

IPEC
Inland Pacific Engineering Company
3012 North Sullivan Road, Suite C
Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

CLIENT NAI Black
PROJECT NAME Painted Hills Supplemental
PROJECT NUMBER 16-249
PROJECT LOCATION 4403 South Dishman-Mica Road
DATE STARTED 3/17/16 **COMPLETED** 3/17/16
GROUND ELEVATION 2005.9 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING --- Not encountered
LOGGED BY PRF **CHECKED BY** PTN
AT END OF DRILLING --- Not encountered
NOTES
AFTER DRILLING --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM	2.0	(SM) SILTY SAND, fine to medium grained, with roots, dark brown, moist. (Topsoil) 2003.9
5	SS		SP-SM	17.0	(SP-SM) POORLY GRADED SAND with SILT, medium to coarse grained, a trace of Gravel, brown, moist, medium dense. (Glacial Outwash) 1988.9
10	SS				
15	SS				
20	SS		SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, brown, moist, very dense to medium dense. (Glacial Outwash)
25	SS				
30	SS	Fines = 7%			

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 4/5/16 11:26 - J:_IPEC PROJECTS_2016 PROJECTS\16-249 PAINTED HILLS SUPPLEMENTAL\GINT\16-249 PAINTED HILLS SUPPLEMENTAL.GPJ

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IPEC

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Telephone: 509-209-6262
Fax: 509-290-5734

BORING NUMBER B-1

CLIENT NAI Black
PROJECT NAME Painted Hills Supplemental
PROJECT NUMBER 16-249
PROJECT LOCATION 4403 South Dishman-Mica Road

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
			SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, brown, moist, very dense to medium dense. (Glacial Outwash) *(continued)*	
35	SS					
40	SS					
45	SS					
50	SS				50.5	1955.4

End of boring.

Groundwater not encountered with 49' of hollow-stem auger in the ground.

Groundwater not encountered immediately after withdrawal of the auger.

Bore hole then abandoned.

IPEC
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Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

BORING NUMBER B-2

CLIENT NAI Black
PROJECT NAME Painted Hills Supplemental
PROJECT NUMBER 16-249
PROJECT LOCATION 4403 South Dishman-Mica Road
DATE STARTED 3/17/16 **COMPLETED** 3/18/16
GROUND ELEVATION 2005.6 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING --- Not encontered
LOGGED BY PRF **CHECKED BY** PTN
AT END OF DRILLING 71.00 ft / Elev 1934.60 ft
NOTES
AFTER DRILLING 73.50 ft / Elev 1932.10 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				SM	2.0	(SM) SILTY SAND, fine to medium grained, with roots, dark brown, moist. (Topsoil) — 2003.6
				SC	6.5	(SC) CLAYEY SAND with GRAVEL, medium to coarse grained, brown, moist to wet, dense. (Glacial Outwash) — 1999.1
5	SS	12-33 (45)				
				GC	12.0	(GC) CLAYEY GRAVEL with SAND, fine to coarse grained, brown, moist, dense. (Glacial Outwash) — 1993.6
10	SS	24-20 (44)				
				SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, a trace of Cobbles, brown, moist, very dense to medium dense. (Glacial Outwash)
15	SS	24-29 (53)				
20	SS	25-28 (53)				
25	SS	10-18 (28)	Fines = 8%			
30	SS	11-13 (24)				

(Continued Next Page)

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Fax: 509-290-5734

BORING NUMBER B-2

CLIENT NAI Black **PROJECT NAME** Painted Hills Supplemental

PROJECT NUMBER 16-249 **PROJECT LOCATION** 4403 South Dishman-Mica Road

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
						(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, a trace of Cobbles, brown, moist, very dense to medium dense. (Glacial Outwash) *(continued)*
35	SS	28-37 (65)				
40	SS	50/5"				
45	SS	50/5"				
50	SS	50/5"		SP		
55						
60	SS	8-17 (25)				
65						

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Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

BORING NUMBER B-2

CLIENT NAI Black **PROJECT NAME** Painted Hills Supplemental
PROJECT NUMBER 16-249 **PROJECT LOCATION** 4403 South Dishman-Mica Road

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
70–75	SS	21-11 (32)		SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, a trace of Cobbles, brown, moist, very dense to medium dense. (Glacial Outwash) *(continued)*
75.0						1930.6

End of boring.

Groundwater encountered at 71' with 75' of hollow-stem auger in the ground.

Goundwater encountered at 73.5' 10 minutes later.

Groundwater not encountered to cave-in depth of 15' immediately after withdrawal of the auger.

Bore hole then abandoned.

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BORING NUMBER B-3

CLIENT NAI Black	PROJECT NAME Painted Hills Supplemental
PROJECT NUMBER 16-249	PROJECT LOCATION 4403 South Dishman-Mica Road
DATE STARTED 3/18/16 COMPLETED 3/19/16	GROUND ELEVATION 2004.5 ft HOLE SIZE 8 inches
DRILLING CONTRACTOR Johnson Exploration Drilling	GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger	AT TIME OF DRILLING --- Not encountered
LOGGED BY PRF CHECKED BY PTN	AT END OF DRILLING --- Not encountered
NOTES	AFTER DRILLING --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			ML		(ML) SANDY SILT, with roots, dark brown, moist. (Topsoil)
2.0					2002.5
5	SS		GC		(GC) CLAYEY GRAVEL with SAND, fine to coarse grained, brown, moist, dense. (Glacial Outwash)
8.0					1996.5
10	SS		SC		(SC) CLAYEY SAND with GRAVEL, medium to coarse grained, brown, moist to wet, dense. (Glacial Outwash)
12.0					1992.5
15	SS		GC		(GC) SILTY CLAYEY GRAVEL with SAND, fine to coarse grained, brown, moist, medium dense. (Glacial Outwash)
18.0					1986.5
20	SS		SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, a trace of Cobbles, brown, moist, very dense to medium dense. (Glacial Outwash)
25	SS		SP		
30	SS	Fines = 6%			

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BORING NUMBER B-3

CLIENT NAI Black **PROJECT NAME** Painted Hills Supplemental
PROJECT NUMBER 16-249 **PROJECT LOCATION** 4403 South Dishman-Mica Road

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
			SP		(SP) POORLY GRADED SAND with GRAVEL, medium to coarse grained, a trace of Cobbles, brown, moist, very dense to medium dense. (Glacial Outwash) *(continued)*
35	SS				
40	SS				
45	SS				
50	SS				50.5 — 1954.0

End of boring.

Groundwater not encountered with 49' of hollow-stem auger in the ground.

Groundwater not encountered immediately after withdrawal of the auger.

Bore hole then abandoned.

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALVE			
COARSE-GRAINED SOILS		FINE-GRAINED SOILS	
DENSITY	N(BLOWS/FT)	CONSISTENCY	N(BLOWS/FT)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	4 - 10	Soft	2 - 3
Medium-Dense	11 - 30	Rather Soft	4 - 5
		Medium	6 - 8
Dense	31 - 50	Rather Stiff	9 - 12
		Stiff	13 - 16
Very Dense	> 50	Very Stiff	17 - 30
		Hard	> 30

USCS SOIL CLASSIFICATION				
MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse-Grained Soils <50% passes #200 sieve	Gravel and Gravelly Soils <50% coarse fraction passes #4 sieve	Gravel (with little or no fines)	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravel (with >12% fines)	GM	Silty Gravel
			GC	Clayey Gravel
	Sandy and Sandy Soils >50% coarse fraction passes #4 sieve	Sand (with little or no fines)	SW	Well Graded Sand
			SP	Poorly Graded Sand
		Sand (with >12% fines)	SM	Silty Sand
			SC	Clayey Sand
Fine-Grained Soils >50% passes #200 sieve	Silt and Clay Liquid Limit < 50		ML	Silt
			CL	Lean Clay
			OL	Organic Silt and Clay (low plasticity)
	Salt and Clay Liquid Limit > 50		MH	Inorganic Silt
			CH	Fat Clay
			OH	Organic Clay and Silt (med to high plasticity)
Highly Organic Soils			PT	Peat / Muck

MODIFIERS	
DESCRIPTION	RANGE
Occasional	<5%
Trace	5% - 12%
With	>12%

MOISTURE CONTENT	
DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Dry of optimum moisture content
Wet	Wet of optimum moisture content

MAJOR DIVISIONS WITH GRAIN SIZE							
SIEVE SIZE							
12"	3"	3/4"	4	10	40	200	
GRAIN SIZE (INCHES)							
12	3	0.75	0.19	0.079	0.0171	0.0029	
Boulders	Cobbles	Gravel		Sand			Silt and Clay
		Coarse	Fine	Coarse	Medium	Fine	

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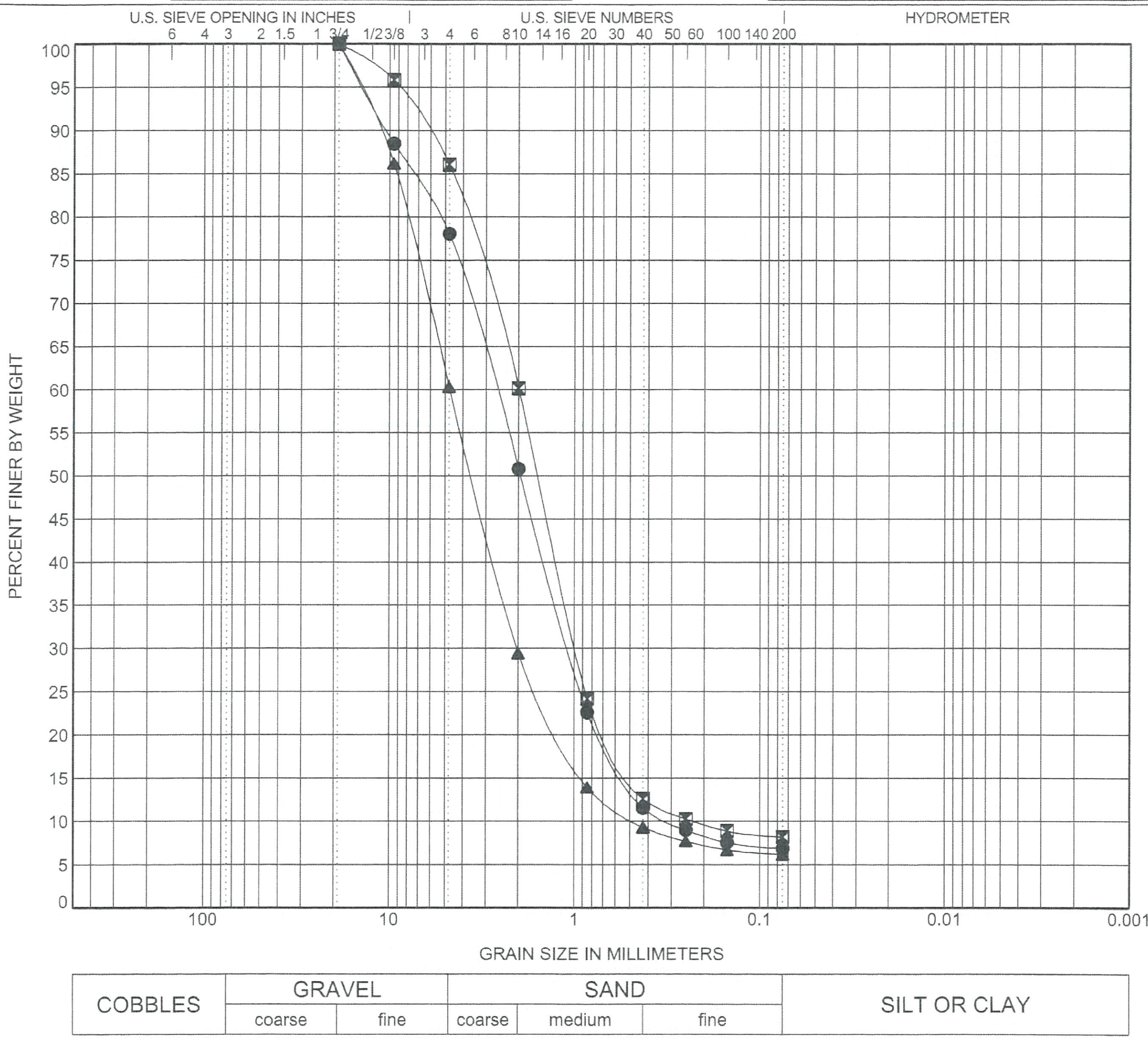
GRAIN SIZE DISTRIBUTION

CLIENT NAI Black
PROJECT NAME Painted Hills Supplemental
PROJECT NUMBER 16-249
PROJECT LOCATION 4403 South Dishman-Mica Road



BOREHOLE		DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**30.0**	**SP-SM Poorly Graded Sand with Silt**				**1.37**	**8.65**
⊠	**B-2**	**25.0**	**SP-SM Poorly Graded Sand with Silt**				**2.10**	**8.72**
▲	**B-3**	**30.0**	**SP-SM Poorly Graded Sand with Silt**				**1.85**	**9.95**

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**30.0**	**19**	**2.679**	**1.065**	**0.31**	**21.9**	**71.2**	**6.8**	
⊠	**B-2**	**25.0**	**19**	**1.992**	**0.977**	**0.228**	**13.9**	**77.9**	**8.2**	
▲	**B-3**	**30.0**	**19**	**4.708**	**2.032**	**0.473**	**39.7**	**54.1**	**6.2**	

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Telephone: 509-209-6262
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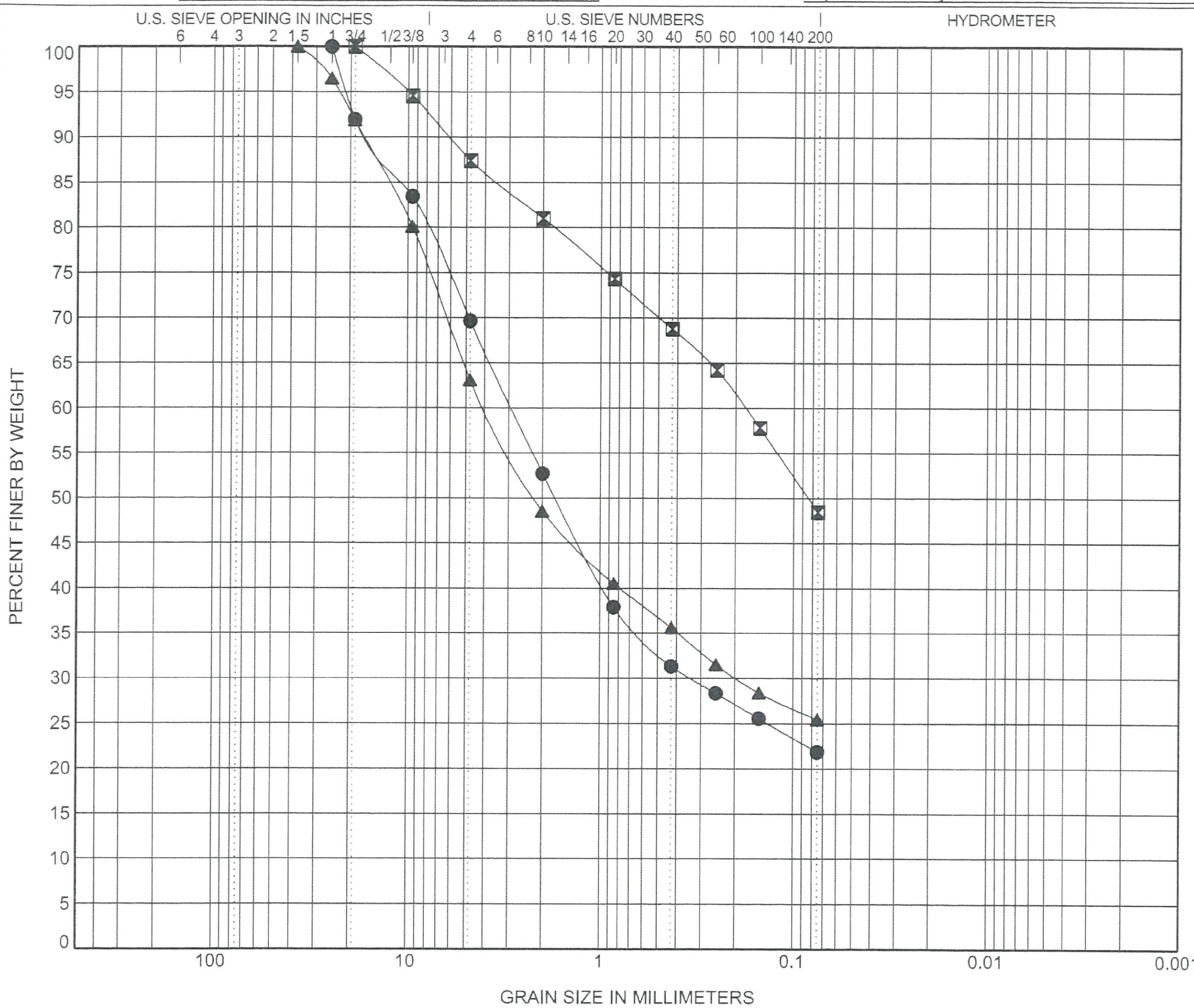
GRAIN SIZE DISTRIBUTION

CLIENT NAI Black
PROJECT NAME Gustin Levee
PROJECT NUMBER 14-037B
PROJECT LOCATION Spokane County



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	TP-3	3.5	**SM Silty Sand with Gravel**					
⊠	TP-5	4.0	**SM SIlty Sand**					
▲	TP-6	4.0	**SM Silty Sand with Gravel**					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-3	3.5	25	2.902	0.336		30.4	47.8	21.8	
⊠	TP-5	4.0	19	0.179			12.6	38.9	48.5	
▲	TP-6	4.0	37.5	3.959	0.195		36.9	37.6	25.4	

REPORT 10

Geotechnical Evaluation, Proposed Street Improvements (Pavement Design) dated June 26, 2017

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

June 26, 2017
Project No. 16-249D

Mr. Bryan Walker
NAI Black
107 S Howard
Suite 500
Spokane, WA 99201

Re: **Geotechnical Evaluation**
Proposed Street Improvements
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed a geotechnical evaluation for the proposed street improvements to the roadways adjacent to the above referenced site in Spokane Valley, Washington. The purpose of the evaluation is to provide earthwork recommendations and pavement design for the proposed improvements. This report summarizes the results of our site observations, engineering analyses and recommendations.

PROJECT DESCRIPTION

The project consists of street improvements to the roadways adjacent to the proposed Painted Hills residential development located at the above referenced address. The improvements consist of about 6,000 feet of roadway on South Dishman Mica Road, East Thorpe Road, and South Madison Road.

P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

We were also provided civil plans for the roadway improvements. The plans showed the layout and elevations of the proposed roadways and elevation contours. The plans were prepared by WCE and dated August 17, 2016.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Furthermore, we performed a supplemental geotechnical evaluation in July 2015 consisting of ten, 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

We also performed a second supplemental geotechnical evaluation at the north end of the property to evaluate soil conditions at depth and to better define the static groundwater elevation in this area. We then performed a full-scale drywell test on a drywell installed near Boring B-1 from our second supplemental geotechnical evaluation. The results of these evaluations are summarized in our Supplemental Geotechnical Evaluation dated April 19, 2016 and our Full-Scale Drywell Testing report dated June 28, 2016.

Lastly, we performed bore hole permeability testing at the north end of the property to evaluate infiltration rates at the depth of the drywell tested in our Full-Scale Drywell Testing report. We also tested infiltration rates at deeper depths. The results of that evaluation are summarized in our Bore Hole Permeability Testing report dated September 16, 2016.

FIELD EVALUATION

Procedures

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) observed the excavation of twelve test pits at the site. The test pits were excavated on February 23, 2017 using a backhoe operated by an independent firm under subcontract to IPEC. A geotechnical engineer from IPEC observed the test pit excavations and logged the surface and subsurface conditions. After we logged each test pit, the test pit was immediately backfilled.

The soils encountered in the test pits were visually and manually classified in the field by our field personnel in accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedures)". The samples were returned to our facility for review of the classification by a geotechnical engineer and potential laboratory testing.

Soils Encountered

Geologic maps indicate the soils in this area consist primarily of alluvial and/or glacially deposited silts, clays, sands, and gravels. According to the Soil Survey of Spokane County, the site soils are classified by the Natural Resource Conservation Service (NRCS) as Narcisse silt loam (1080), Endoaquolls and Fluvaquents (1200), Hardesty ashy silt loam (1040), Phoebe ashy sandy loam (3130), Bong ashy loam, moist (3022), and Urban land-Springdale, disturbed complex (7170). The native soils encountered in the teste pits were consistent with the NRCS data.

At the surface, the test pits encountered topsoil ranging from about ½ to 2 feet. The topsoil consisted of clayey to silty sand, silty gravel, and lean clay.

Below the topsoil, the test pits along Dishman-Mica and Thorpe Road generally encountered alluvial soils to their termination depths. The alluvial soils consisted of lean clay and clayey to silty sand. Below the topsoil, the test pits along Madison Road generally encountered glacial outwash or alluvial soils to their termination depths. The glacial outwash consisted of clayey and silty to poorly graded sand with silt and silty gravel. The alluvial soils consisted of lean clay and clayey sand.

Groundwater was encountered in Test Pits TP-4 through TP-7 at depths ranging from 2 to 4 feet below existing grades at the time of our exploration. Seasonal and annual fluctuations of groundwater levels should be anticipated.

Laboratory Testing

We obtained samples of the subgrade soil from Test Pit TP-2, TP-4, and TP-7 during our site investigation. Grain size analyses and modified Proctor tests were performed by us on the samples obtained from TP-4 and TP-7 in accordance with ASTM D6913 and ASTM D1557, respectively. The results of the tests are attached.

In addition, resilient modulus (M_r) tests were performed on the samples obtained from TP-4 and TP-7 in accordance with AASHTO T307. The M_r tests were performed by Braun Intertec in Bloomington, Minnesota. Attached are data sheets summarizing the tests performed.

ANALYSIS AND RECOMMENDATIONS

Subgrade Preparation

After removing the asphalt from the existing roadways, we anticipate the subgrade will consist of existing roadway embankment fill. We have assumed that during the construction of the existing roadways, the fill was compacted in accordance with local jurisdiction standards. Where road widening is planned, we recommend removing any existing topsoil.

We recommend that the upper 8 inches of the resulting subgrade be scarified, moistened or dried to within 3 percent of optimum moisture, and compacted to a minimum of 95 percent of the modified Proctor maximum dry density determined in accordance with ASTM D 1557. Where fill is required, we recommend that it be similarly moisture conditioned and compacted. If there are areas that cannot be compacted, we recommend that the unstable soils be removed and replaced with soils similar to the surrounding subgrade soils.

We recommend that the subgrade surface be shaped to provide for positive drainage to minimize the potential for water to pond in the subgrade. Because the site soils are low to highly frost-susceptible, it will be important to avoid creating "bathtubs" in the subgrade where water can pond and freeze, which could heave the pavement.

If site grading and construction are anticipated during cold weather, recommend that good winter construction practices be observed. All snow and ice should be removed from excavated and fill areas prior to additional earthwork or construction. No fill or pavements should be placed on soil which have frozen or contain frozen material. Frozen soils should not be used as backfill or fill.

Test Rolling

Prior to placing the aggregate base, we recommend that all subgrade areas be proof-rolled with a loaded dump truck. This precautionary measure would assist in detecting any localized soft areas. Any soft areas discovered during the proof-rolling operation should be excavated and replaced with a suitable structural fill material. The structural fill should be similar to the existing subgrade soil type to provide a uniform subgrade. We recommend that the proof-rolling process be observed by an experienced geotechnical engineer to make the final evaluation of the subgrade.

Pavement Section Design

We performed a pavement section analysis in accordance with the "AASHTO Guide for Design of Pavement Structures, 1993" by the American Association of State Highway and Transportation Officials (AASHTO). For our analysis, we were provided an Average Daily Traffic (ADT) value of 5,300 for Dishman-Mica Road, 1,400 for Thorpe Road, and 1,700 for Madison Road. We were also provided percent trucks values of 2 percent for Thorpe and Madison Road, and 5 percent for Dishman-Mica Road. We were provided a percent growth value of 1.1 percent.
Based on these provided parameters, we calculated the following Equivalent Single Axle Loads (ESAL):

- Dishman-Mica Road: 2,617,545
- Thorpe Road: 330,000
- Madison Road: 389,954

We used resilient modulus values from the laboratory test results of (M_r) of 5,821 pounds per square inch (psi) for Thorpe Road and an M_r of 11,985 psi for Dishman-Mica and Madison Road. We also used the following parameters in our analysis provided in Chapter 8 of the City of Spokane Valley Street Standards, dated December of 2009:

- Reliability: 90 percent
- Standard Deviation: 0.45
- Initial Serviceability Index: 4.2
- Terminal Serviceability Index:
    - Dishman-Mica Road: 2.50
    - Thorpe Road: 2.25
    - Madison Road: 2.25
- Structural Layer Coefficients:
        - Asphalt: 0.42
        - Aggregate Base: 0.14
- Drainage Layer Coefficient:
    - Dishman-Mica Road: 1.05
    - Thorpe Road: 0.85
    - Madison Road: 0.95

Based on this data, we calculated the following design structural numbers:

- Dishman-Mica Road: 3.4
- Thorpe Road: 3.1
- Madison Road: 2.5

Based on our analysis, we recommend the following pavement sections:

- Dishman-Mica Road:
  - 4 inches of asphalt overlying 12 inches of crushed aggregate base
- Thorpe Road:
  - 4 inches of asphalt overlying 12 inches of crushed aggregate base
- Madison Road:
  - 4 inches of asphalt overlying 6 inches of crushed aggregate base

We recommend specifying crushed aggregate base meeting the requirements of the Washington Department of Transportation (WSDOT) Standard Specification 9-03.9(3) for crushed gravel surfacing (base course and/or top course). We recommend that the asphalt concrete pavement meet the requirements of WSDOT Standard Specification for Class ½ inch HMA asphalt concrete pavements. We recommend that the crushed gravel surfacing be compacted to a minimum of 95 percent of the modified Proctor maximum dry density. We recommend that the asphaltic concrete surface be compacted to minimum of 92 percent of the Rice density.

GENERAL RECOMMENDATIONS

The analyses and recommendations submitted in this report are based on the data obtained from the test pits excavated at the locations indicated on the Test Pit Location Map on Figure 3. It should be recognized that the explorations performed for this evaluation reveal subsurface conditions only at discreet locations across the project site and that actual conditions in other areas could vary. Furthermore, the nature and extent of any such variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed at that time, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

We made water level observations in the test pits at the times and conditions stated on the test pit logs. These data were interpreted in the text of this report. The period of observation was relatively short and fluctuation in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Gregory J. Voigt, P.E.
Project Engineer

Paul T. Nelson, P.E.
Principal Engineer

Attachments: Figure 1, Site Location Map
Figure 2, NRCS Map
Figure 3, Test Pit Location Maps
Logs of Test Pits
Descriptive Terminology
Laboratory Test Results

GREGORY J. VOIGT
STATE OF WASHINGTON
54336
REGISTERED
PROFESSIONAL ENGINEER
6-26-17

FIGURE 1

Site Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249D Proposed Street Improvements 4403 S Dishman-Mica Rd Spokane Valley, WA	June 26, 2017

FIGURE 2

NRCS Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249D Proposed Street Improvements 4403 S Dishman-Mica Rd Spokane Valley, WA	June 26, 2017

FIGURE 3

Test Pit Location Map 1		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249D Proposed Street Improvements 4403 S Dishman-Mica Rd Spokane Valley, WA	June 26, 2017

IPEC
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Fax: 509-290-5734

TEST PIT NUMBER TP-1

CLIENT NAI Black
PROJECT NAME Proposed Street Improvements
PROJECT NUMBER 16-249D
PROJECT LOCATION Spokane Valley, WA
DATE STARTED 2/23/17 **COMPLETED** 2/23/17
GROUND ELEVATION ______ **TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR Alpine Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION --- Not encountered
LOGGED BY GV **CHECKED BY** PTN
AT END OF EXCAVATION --- Not encountered
NOTES ______
AFTER EXCAVATION --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SC	0.5	(SC) CLAYEY SAND, fine-grained, trace roots, dark brown, moist. (Topsoil)
2.5		CL	3.0	(CL) LEAN CLAY with SAND, brown, moist. (Alluvium)
5.0		SC	5.0	(SC) CLAYEY SAND, fine-grained, brown, moist. (Alluvium)

End of test pit.

Groundwater not encountered.

Test pit immediately backfilled.

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TEST PIT NUMBER TP-2

CLIENT NAI Black	**PROJECT NAME** Proposed Street Improvements
PROJECT NUMBER 16-249D	**PROJECT LOCATION** Spokane Valley, WA
DATE STARTED 2/23/17 **COMPLETED** 2/23/17	**GROUND ELEVATION** **TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR Alpine Excavating	**GROUND WATER LEVELS:**
EXCAVATION METHOD Backhoe	**AT TIME OF EXCAVATION** --- Not encountered
LOGGED BY GV **CHECKED BY** PTN	**AT END OF EXCAVATION** --- Not encountered
NOTES	**AFTER EXCAVATION** --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION
0.0		GM		0.5	(GM) SILTY GRAVEL, fine to coarse-grained, trace roots, dark brown, moist. (Topsoil)
2.5		CL		3.0	(CL) LEAN CLAY with SAND, brown, moist. (Alluvium)
5.0		SC		5.0	(SC) CLAYEY SAND, fine-grained, brown, moist. (Alluvium)

End of test pit.

Groundwater not encountered.

Test pit immediately backfilled.

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Fax: 509-290-5734

TEST PIT NUMBER TP-3

CLIENT NAI Black
PROJECT NAME Proposed Street Improvements
PROJECT NUMBER 16-249D
PROJECT LOCATION Spokane Valley, WA
DATE STARTED 2/23/17 **COMPLETED** 2/23/17
GROUND ELEVATION **TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR Alpine Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION --- Not encountered
LOGGED BY GV **CHECKED BY** PTN
AT END OF EXCAVATION --- Not encountered
NOTES
AFTER EXCAVATION --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SM	0.5	(SM) SILTY SAND, fine-grained, dark brown, moist. (Topsoil)
2.5		SM	5.0	(SM) SILTY SAND, fine-grained, brown, moist. (Alluvium)
5.0				

End of test pit.

Groundwater not encountered.

Test pit immediately backfilled.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 6/21/17 12:49 - J:_IPEC PROJECTS_2016 PROJECTS\16-249D PAINTED HILLS PAVEMENT DESIGN\GINT AND LAB TESTING\16-249D PAINTED HILLS PAVEMENT DESIGN.GPJ

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TEST PIT NUMBER TP-4

CLIENT NAI Black

PROJECT NAME Proposed Street Improvements

PROJECT NUMBER 16-249D

PROJECT LOCATION Spokane Valley, WA

DATE STARTED 2/23/17 COMPLETED 2/23/17

GROUND ELEVATION ______ TEST PIT SIZE 30 inches

EXCAVATION CONTRACTOR Alpine Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD Backhoe

AT TIME OF EXCAVATION 2.00 ft

LOGGED BY GV CHECKED BY PTN

AT END OF EXCAVATION 2.00 ft

NOTES ______

AFTER EXCAVATION 2.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			CL		(CL) LEAN CLAY with SAND, dark brown, moist. (Topsoil)
2.0		Fines = 38%	SM		(SM) SILTY SAND, fine-grained, with seams of Silt, brown, water-bearing. (Alluvium)
5.0					

End of test pit.

Groundwater encountered at 2 feet.

Test pit immediately backfilled.

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TEST PIT NUMBER TP-5

CLIENT NAI Black	PROJECT NAME Proposed Street Improvements
PROJECT NUMBER 16-249D	PROJECT LOCATION Spokane Valley, WA
DATE STARTED 2/23/17 COMPLETED 2/23/17	GROUND ELEVATION ______ TEST PIT SIZE 30 inches
EXCAVATION CONTRACTOR Alpine Excavating	GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe	AT TIME OF EXCAVATION 2.00 ft
LOGGED BY GV CHECKED BY PTN	AT END OF EXCAVATION 2.00 ft
NOTES	AFTER EXCAVATION 2.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		CL		(CL) LEAN CLAY with SAND, trace roots, dark brown, moist. (Topsoil)
2.0		CL		(CL) LEAN CLAY with SAND, brown, wet. (Alluvium)
5.0				

End of test pit.

Groundwater encountered at 2 feet.

Test pit immediately backfilled.

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TEST PIT NUMBER TP-6

CLIENT	NAI Black	**PROJECT NAME**	Proposed Street Improvements
PROJECT NUMBER	16-249D	**PROJECT LOCATION**	Spokane Valley, WA
DATE STARTED	2/23/17 **COMPLETED** 2/23/17	**GROUND ELEVATION**	**TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR	Alpine Excavating	**GROUND WATER LEVELS:**	
EXCAVATION METHOD	Backhoe	AT TIME OF EXCAVATION	3.50 ft
LOGGED BY	GV **CHECKED BY** PTN	AT END OF EXCAVATION	3.50 ft
NOTES		AFTER EXCAVATION	3.50 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SC	0.5	(SC) CLAYEY SAND, fine-grained, dark brown, moist. (Topsoil)
		SC	1.5	(SC) CLAYEY SAND, fine-grained, brown, moist. (Alluvium)
2.5		SP-SM		(SP-SM) POORLY GRADED SAND with SILT, fine to coarse-grained, brown, moist to water-bearing. (Glacial Outwash)
5.0			5.0	

End of test pit.

Groundwater encountered at 3 1/2 feet.

Test pit immediately backfilled.

TEST PIT NUMBER TP-7

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CLIENT	NAI Black	**PROJECT NAME**	Proposed Street Improvements
PROJECT NUMBER	16-249D	**PROJECT LOCATION**	Spokane Valley, WA
DATE STARTED	2/23/17 **COMPLETED** 2/23/17	**GROUND ELEVATION**	**TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR	Alpine Excavating	**GROUND WATER LEVELS:**	
EXCAVATION METHOD	Backhoe	AT TIME OF EXCAVATION	4.00 ft
LOGGED BY	GV **CHECKED BY** PTN	AT END OF EXCAVATION	4.00 ft
NOTES		AFTER EXCAVATION	4.00 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			CL		(CL) LEAN CLAY with SAND, trace roots, dark brown, moist. (Topsoil)
2.0		Fines = 50%	CL		(CL) SANDY LEAN CLAY, brown, moist to wet. (Alluvium)
5.0					

End of test pit.

Groundwater encountered at 4 feet.

Test pit immediately backfilled.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 6/21/17 12:49 - J:_IPEC PROJECTS_2016 PROJECTS\16-249D PAINTED HILLS PAVEMENT DESIGN\GINT AND LAB TESTING\16-249D PAINTED HILLS PAVEMENT DESIGN.GPJ

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TEST PIT NUMBER TP-8

CLIENT NAI Black	**PROJECT NAME** Proposed Street Improvements
PROJECT NUMBER 16-249D	**PROJECT LOCATION** Spokane Valley, WA
DATE STARTED 2/23/17 **COMPLETED** 2/23/17	**GROUND ELEVATION** ____ **TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR Alpine Excavating	**GROUND WATER LEVELS:**
EXCAVATION METHOD Backhoe	**AT TIME OF EXCAVATION** --- Not encountered
LOGGED BY GV **CHECKED BY** PTN	**AT END OF EXCAVATION** --- Not encountered
NOTES	**AFTER EXCAVATION** --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SC		(SC) CLAYEY SAND with GRAVEL, fine to medium-grained, dark brown, moist. (Topsoil)
			1.0	
2.5		SC		(SC) CLAYEY SAND with GRAVEL, fine to medium-grained, brown, moist. (Glacial Outwash)
5.0			5.0	

End of test pit.

Groundwater not encountered.

Test pit immediately backfilled.

IPEC
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TEST PIT NUMBER TP-9

CLIENT NAI Black	**PROJECT NAME** Proposed Street Improvements
PROJECT NUMBER 16-249D	**PROJECT LOCATION** Spokane Valley, WA
DATE STARTED 2/23/17 **COMPLETED** 2/23/17	**GROUND ELEVATION** **TEST PIT SIZE** 30 inches
EXCAVATION CONTRACTOR Alpine Excavating	**GROUND WATER LEVELS:**
EXCAVATION METHOD Backhoe	**AT TIME OF EXCAVATION** --- Not encountered
LOGGED BY GV **CHECKED BY** PTN	**AT END OF EXCAVATION** --- Not encountered
NOTES	**AFTER EXCAVATION** --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SC	1.0	(SC) CLAYEY SAND, fine-grained, dark brown, moist. (Topsoil)
		SM	2.0	(SM) SILTY SAND with GRAVEL, fine to medium-grained, brown, moist. (Glacial Outwash)
2.5		GM	5.0	(GM) SILTY GRAVEL, fine to coarse-grained, brown, moist. (Glacial Outwash)
5.0				

End of test pit.

Groundwater not encountered.

Test pit immediately backfilled.

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Geotechnical Engineering and Consulting

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALVE			
COARSE-GRAINED SOILS		FINE-GRAINED SOILS	
DENSITY	N(BLOWS/FT)	CONSISTENCY	N(BLOWS/FT)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	5 - 10	Soft	2 - 3
Medium-Dense	11 - 30	Rather Soft	4 - 5
		Medium	6 - 8
Dense	31 - 50	Rather Stiff	9 - 12
		Stiff	13 - 16
Very Dense	> 50	Very Stiff	17 - 30
		Hard	> 30

USCS SOIL CLASSIFICATION					
MAJOR DIVISIONS			GROUP DESCRIPTIONS		
Coarse-Grained Soils <50% passes #200 sieve	Gravel and Gravelly Soils <50% coarse fraction passes #4 sieve	Gravel (with little or no fines)	GW	Well Graded Gravel	
			GP	Poorly Graded Gravel	
		Gravel (with >12% fines)	GM	Silty Gravel	
			GC	Clayey Gravel	
	Sandy and Sandy Soils >50% coarse fraction passes #4 sieve	Sand (with little or no fines)	SW	Well Graded Sand	
			SP	Poorly Graded Sand	
		Sand (with >12% fines)	SM	Silty Sand	
			SC	Clayey Sand	
Fine-Grained Soils >50% passes #200 sieve	Silt and Clay Liquid Limit < 50		ML	Silt	
			CL	Lean Clay	
			OL	Organic Silt and Clay (low plasticity)	
	Salt and Clay Liquid Limit > 50		MH	Inorganic Silt	
			CH	Fat Clay	
			OH	Organic Clay and Silt (med to high plasticity)	
Highly Organic Soils			PT	Peat	Muck

MODIFIERS	
DESCRIPTION	RANGE
Occasional	<5%
Trace	5% - 12%
With	>12%

MOISTURE CONTENT	
DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Dry of optimum moisture content
Wet	Wet of optimum moisture content

MAJOR DIVISIONS WITH GRAIN SIZE							
SIEVE SIZE							
12"	3"	3/4"	4	10	40	200	
GRAIN SIZE (INCHES)							
12	3	0.75	0.19	0.079	0.0171	0.0029	
Boulders	Cobbles	Gravel		Sand			Silt and Clay
		Coarse	Fine	Coarse	Medium	Fine	

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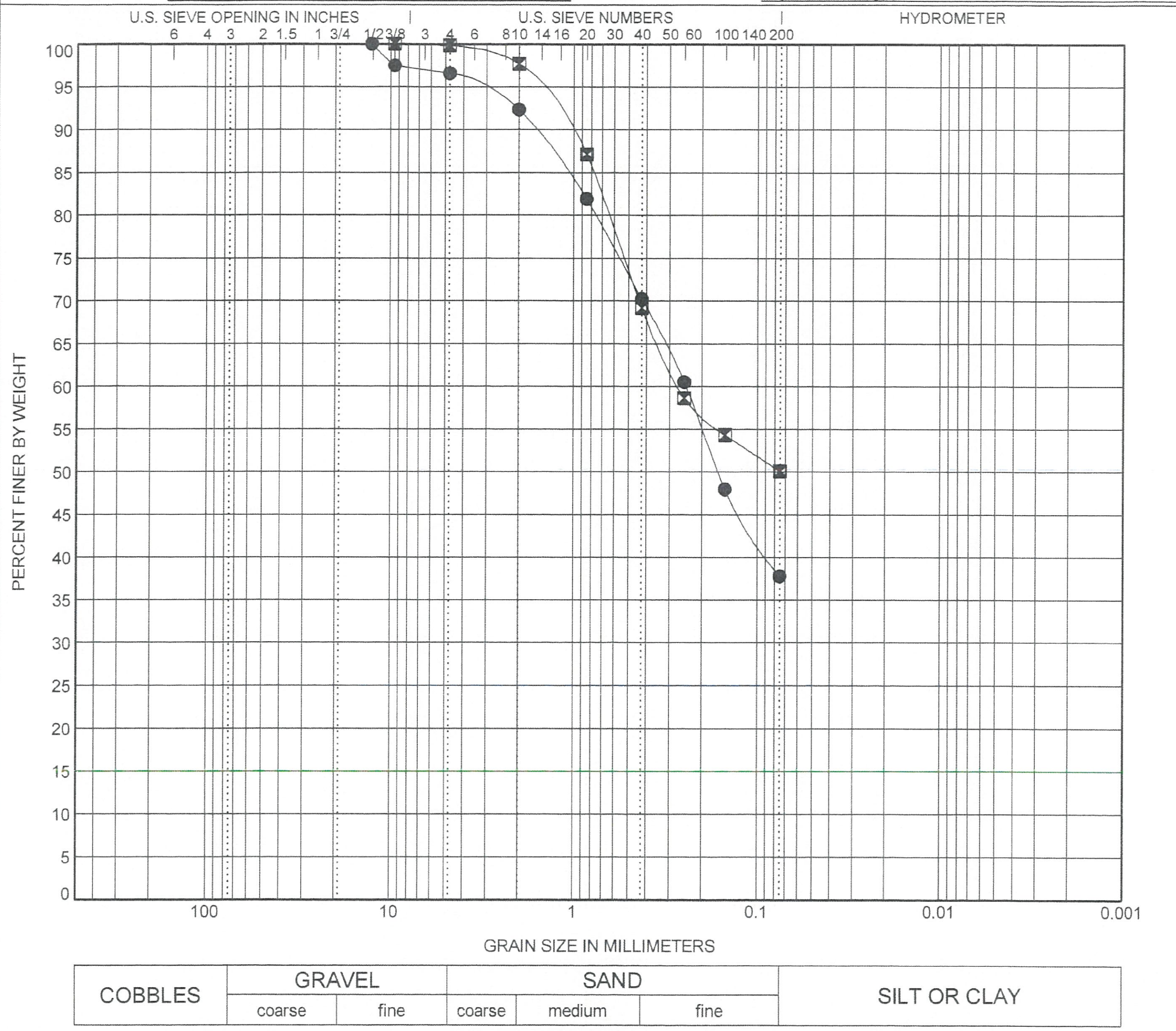
GRAIN SIZE DISTRIBUTION

CLIENT NAI Black **PROJECT NAME** Proposed Street Improvements

PROJECT NUMBER 16-249D **PROJECT LOCATION** Spokane Valley, WA



BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● **TP-4**	**3.0**	**SILTY SAND(SM)**					
⊠ **TP-7**	**3.0**	**SANDY LEAN CLAY(CL)**					

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **TP-4**	**3.0**	**12.7**	**0.245**			**3.4**	**58.8**	**37.8**	
⊠ **TP-7**	**3.0**	**9.5**	**0.268**			**0.2**	**49.7**	**50.1**	

Resilient Modulus Testing - AASHTO T307 US Customary Units

Date: April 10, 2017

Project: B1702069

Client:
Inland Pacific Engineering Company
Paul Nelson
P.O. Box 1566
Veradale, WA 99037

Project Description:
Resilient Modulus Test
AASHTO T307
Client ID: Proposed Street Improvements
Station: TP-4

Sample Information

Braun Sample ID./ File Name: 1
Sample Type: Type 2
Test Date: 06-Apr-2017
Comments: Spokane Valley, WA

Sample Diameter, in.: 2.82
Sample Height, in.: 5.58
Desired M.C., %: 13.5
Desired Dry Density., pcf: 98.8

Sample M.C., % before, after: 13.9, 13.6
Sample Dry Den., pcf: 97.8
Failed in Shear?: YES
Triaxial Shear Strength, psi: 44.2

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximum Axial Stress	Cycle No.	Actual Applied Maximum Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Maximum Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov Def. LVDT 1 Reading	Recov Def. LVDT 2 Reading	Average Recov Def. LVDT 1 and LVDT 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	c1	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	H average		Mr
UNIT	psi	psi	---	lbs.	lbs.	lbs.	psi	psi	psi	inches	inches	inches	in/in	psi
PRECISION	---.-	---.-	-	----.-	----.-	---.-	---.-	---.-	---.-	-.-----	-.-----	-.-----	-.-----	---
SEQUENCE 1	6.0	2.1	1	13.4	11.0	2.4	2.2	1.8	0.4	0.00074	0.00063	0.00069	0.00012	14,342
			2	13.4	11.0	2.4	2.1	1.8	0.4	0.00071	0.00060	0.00066	0.00012	15,062
			3	13.2	10.7	2.5	2.1	1.7	0.4	0.00078	0.00067	0.00072	0.00013	13,377
			4	13.3	10.9	2.4	2.1	1.8	0.4	0.00085	0.00074	0.00079	0.00014	12,325
			5	13.5	11.1	2.5	2.2	1.8	0.4	0.00082	0.00071	0.00077	0.00014	12,968
	COLUMN AVERAGE			13.4	10.9	2.4	2.1	1.8	0.4	0.00078	0.00067	0.00073	0.00013	13,615
	STANDARD DEV.			0.12	0.12	0.03	0.02	0.02	0.00	0.00006	0.00005	0.00006	0.00001	1,091

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 2	6.0	4.0	1	25.2	21.3	3.9	4.1	3.4	0.6	0.00168	0.00149	0.00159	0.00028	12,106
			2	25.2	21.3	3.9	4.0	3.4	0.6	0.00175	0.00156	0.00165	0.00030	11,586
			3	25.2	21.4	3.8	4.0	3.4	0.6	0.00154	0.00136	0.00145	0.00026	13,326
			4	25.2	21.6	3.6	4.1	3.5	0.6	0.00168	0.00149	0.00158	0.00028	12,307
			5	25.1	21.2	3.8	4.0	3.4	0.6	0.00168	0.00149	0.00159	0.00028	12,060
	COLUMN AVERAGE			25.2	21.4	3.8	4.0	3.4	0.6	0.00167	0.00148	0.00157	0.00028	12,277
	STANDARD DEV.			0.07	0.14	0.12	0.01	0.02	0.02	0.00008	0.00007	0.00008	0.00001	643
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 3	6.0	5.7	1	35.7	31.0	4.7	5.7	5.0	0.8	0.00257	0.00230	0.00244	0.00044	11,443
			2	35.4	30.4	5.1	5.7	4.9	0.8	0.00267	0.00239	0.00253	0.00045	10,797
			3	35.7	31.0	4.8	5.7	5.0	0.8	0.00257	0.00230	0.00243	0.00043	11,461
			4	35.6	30.7	4.9	5.7	4.9	0.8	0.00267	0.00239	0.00253	0.00045	10,906
			5	35.5	30.7	4.8	5.7	4.9	0.8	0.00278	0.00249	0.00264	0.00047	10,474
	COLUMN AVERAGE			35.6	30.8	4.8	5.7	4.9	0.8	0.00260	0.00233	0.00246	0.00044	11,016
	STANDARD DEV.			0.12	0.25	0.14	0.02	0.04	0.02	0.00006	0.00005	0.00006	0.00001	429
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 4	6.0	8.1	1	50.7	44.2	6.5	8.1	7.1	1.0	0.00385	0.00414	0.00400	0.00071	9,961
			2	50.6	43.8	6.8	8.1	7.0	1.1	0.00383	0.00412	0.00397	0.00071	9,914
			3	50.6	43.9	6.7	8.1	7.1	1.1	0.00384	0.00413	0.00398	0.00071	9,925
			4	50.5	43.8	6.7	8.1	7.0	1.1	0.00365	0.00393	0.00379	0.00068	10,400
			5	50.6	44.9	5.8	8.1	7.2	0.9	0.00384	0.00414	0.00399	0.00071	10,110
	COLUMN AVERAGE			50.6	44.1	6.5	8.1	7.1	1.0	0.00380	0.00409	0.00395	0.00070	10,062
	STANDARD DEV.			0.07	0.44	0.41	0.01	0.07	0.07	0.00008	0.00009	0.00009	0.00002	204

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 5	6.0	10.1	1	62.9	56.3	6.6	10.1	9.0	1.1	0.00483	0.00524	0.00503	0.00090	10,059
			2	62.8	56.0	6.8	10.1	9.0	1.1	0.00481	0.00521	0.00501	0.00089	10,073
			3	62.9	54.9	8.0	10.1	8.8	1.3	0.00482	0.00523	0.00502	0.00090	9,840
			4	62.9	55.0	7.9	10.1	8.8	1.3	0.00462	0.00500	0.00481	0.00086	10,292
			5	63.0	54.9	8.1	10.1	8.8	1.3	0.00481	0.00521	0.00501	0.00090	9,855
	COLUMN AVERAGE			62.9	55.4	7.5	10.1	8.9	1.2	0.00478	0.00518	0.00498	0.00089	10,024
	STANDARD DEV.			0.05	0.68	0.71	0.01	0.11	0.11	0.00009	0.00010	0.00010	0.00002	186

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 6	4.0	2.1	1	13.0	11.0	2.0	2.1	1.8	0.3	0.00057	0.00085	0.00071	0.00013	13,985
			2	13.0	11.0	2.0	2.1	1.8	0.3	0.00059	0.00088	0.00073	0.00013	13,512
			3	13.0	10.9	2.1	2.1	1.8	0.3	0.00062	0.00092	0.00077	0.00014	12,725
			4	13.0	11.0	2.0	2.1	1.8	0.3	0.00063	0.00093	0.00078	0.00014	12,771
			5	13.0	11.0	2.0	2.1	1.8	0.3	0.00058	0.00087	0.00073	0.00013	13,602
	COLUMN AVERAGE			13.0	11.0	2.0	2.1	1.8	0.3	0.00060	0.00089	0.00074	0.00013	13,319
	STANDARD DEV.			0.04	0.05	0.04	0.01	0.01	0.01	0.00003	0.00004	0.00003	0.00001	551

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 7	4.0	4.0	1	24.8	21.3	3.5	4.0	3.4	0.6	0.00194	0.00206	0.00200	0.00036	9,597
			2	24.8	21.7	3.1	4.0	3.5	0.5	0.00203	0.00215	0.00209	0.00037	9,312
			3	24.7	21.4	3.3	4.0	3.4	0.5	0.00193	0.00205	0.00199	0.00036	9,649
			4	25.0	21.7	3.3	4.0	3.5	0.5	0.00208	0.00220	0.00214	0.00038	9,128
			5	24.8	21.4	3.4	4.0	3.4	0.6	0.00195	0.00207	0.00201	0.00036	9,541
	COLUMN AVERAGE			24.8	21.5	3.3	4.0	3.5	0.5	0.00199	0.00211	0.00205	0.00037	9,445
	STANDARD DEV.			0.09	0.18	0.14	0.02	0.03	0.02	0.00006	0.00007	0.00007	0.00001	219

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 8	4.0	5.9	1	36.6	32.1	4.5	5.9	5.2	0.7	0.00319	0.00338	0.00328	0.00059	8,804
			2	36.6	32.2	4.4	5.9	5.2	0.7	0.00333	0.00353	0.00343	0.00061	8,450
			3	36.6	32.0	4.6	5.9	5.1	0.7	0.00318	0.00337	0.00328	0.00059	8,788
			4	36.7	32.1	4.6	5.9	5.2	0.7	0.00317	0.00336	0.00327	0.00058	8,845
			5	36.6	32.0	4.6	5.9	5.1	0.7	0.00346	0.00367	0.00356	0.00064	8,085
	COLUMN AVERAGE			36.6	32.1	4.5	5.9	5.2	0.7	0.00327	0.00346	0.00336	0.00060	8,595
	STANDARD DEV.			0.03	0.08	0.09	0.00	0.01	0.01	0.00012	0.00013	0.00013	0.00002	326
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 9	4.0	7.8	1	48.8	43.2	5.5	7.8	6.9	0.9	0.00444	0.00469	0.00457	0.00082	8,523
			2	48.6	42.9	5.7	7.8	6.9	0.9	0.00462	0.00488	0.00475	0.00085	8,120
			3	48.6	42.1	6.5	7.8	6.8	1.1	0.00463	0.00489	0.00476	0.00085	7,969
			4	48.7	43.8	4.9	7.8	7.0	0.8	0.00462	0.00489	0.00475	0.00085	8,295
			5	48.8	42.8	5.9	7.8	6.9	1.0	0.00463	0.00489	0.00476	0.00085	8,095
	COLUMN AVERAGE			48.7	43.0	5.7	7.8	6.9	0.9	0.00459	0.00485	0.00472	0.00084	8,200
	STANDARD DEV.			0.09	0.63	0.59	0.01	0.10	0.10	0.00008	0.00009	0.00008	0.00002	214
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 10	4.0	9.8	1	61.2	54.6	6.6	9.8	8.8	1.1	0.00562	0.00594	0.00578	0.00103	8,496
			2	61.3	54.0	7.2	9.8	8.7	1.2	0.00566	0.00598	0.00582	0.00104	8,358
			3	61.2	53.2	8.0	9.8	8.6	1.3	0.00565	0.00596	0.00580	0.00104	8,256
			4	61.2	54.4	6.8	9.8	8.7	1.1	0.00561	0.00591	0.00576	0.00103	8,497
			5	61.2	53.8	7.4	9.8	8.6	1.2	0.00539	0.00568	0.00554	0.00099	8,735
	COLUMN AVERAGE			61.2	54.0	7.2	9.8	8.7	1.2	0.00558	0.00589	0.00574	0.00103	8,468
	STANDARD DEV.			0.04	0.53	0.53	0.01	0.09	0.09	0.00011	0.00012	0.00012	0.00002	180

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 11	2.0	1.8	1	11.1	9.5	1.6	1.8	1.5	0.3	0.00041	0.00083	0.00062	0.00011	13,686
			2	11.1	9.5	1.6	1.8	1.5	0.3	0.00051	0.00095	0.00073	0.00013	11,774
			3	11.1	9.4	1.7	1.8	1.5	0.3	0.00045	0.00089	0.00067	0.00012	12,675
			4	11.1	9.5	1.6	1.8	1.5	0.3	0.00040	0.00083	0.00062	0.00011	13,915
			5	11.0	9.4	1.7	1.8	1.5	0.3	0.00049	0.00095	0.00072	0.00013	11,666
	COLUMN AVERAGE			11.1	9.5	1.6	1.8	1.5	0.3	0.00045	0.00089	0.00067	0.00012	12,743
	STANDARD DEV.			0.03	0.08	0.05	0.01	0.01	0.01	0.00005	0.00006	0.00005	0.00001	1,045
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 12	2.0	3.7	1	23.1	20.2	2.9	3.7	3.2	0.5	0.00234	0.00258	0.00246	0.00044	7,387
			2	23.0	20.2	2.8	3.7	3.2	0.5	0.00245	0.00268	0.00257	0.00046	7,088
			3	23.0	20.2	2.8	3.7	3.3	0.4	0.00244	0.00268	0.00256	0.00046	7,118
			4	23.0	20.2	2.9	3.7	3.2	0.5	0.00233	0.00256	0.00245	0.00044	7,413
			5	23.1	20.3	2.8	3.7	3.3	0.5	0.00234	0.00258	0.00246	0.00044	7,423
	COLUMN AVERAGE			23.0	20.2	2.8	3.7	3.2	0.5	0.00238	0.00262	0.00250	0.00045	7,286
	STANDARD DEV.			0.04	0.05	0.04	0.01	0.01	0.01	0.00006	0.00006	0.00006	0.00001	168
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 13	2.0	5.3	1	33.2	29.2	4.0	5.3	4.7	0.7	0.00393	0.00411	0.00402	0.00072	6,526
			2	33.2	28.9	4.3	5.3	4.6	0.7	0.00410	0.00429	0.00419	0.00075	6,200
			3	33.2	29.3	3.9	5.3	4.7	0.6	0.00409	0.00428	0.00419	0.00075	6,308
			4	33.2	28.7	4.4	5.3	4.6	0.7	0.00392	0.00411	0.00402	0.00072	6,441
			5	33.2	29.1	4.1	5.3	4.7	0.7	0.00391	0.00410	0.00401	0.00072	6,538
	COLUMN AVERAGE			33.2	29.0	4.1	5.3	4.7	0.7	0.00399	0.00418	0.00408	0.00073	6,402
	STANDARD DEV.			0.04	0.23	0.23	0.01	0.04	0.04	0.00009	0.00010	0.00009	0.00002	146

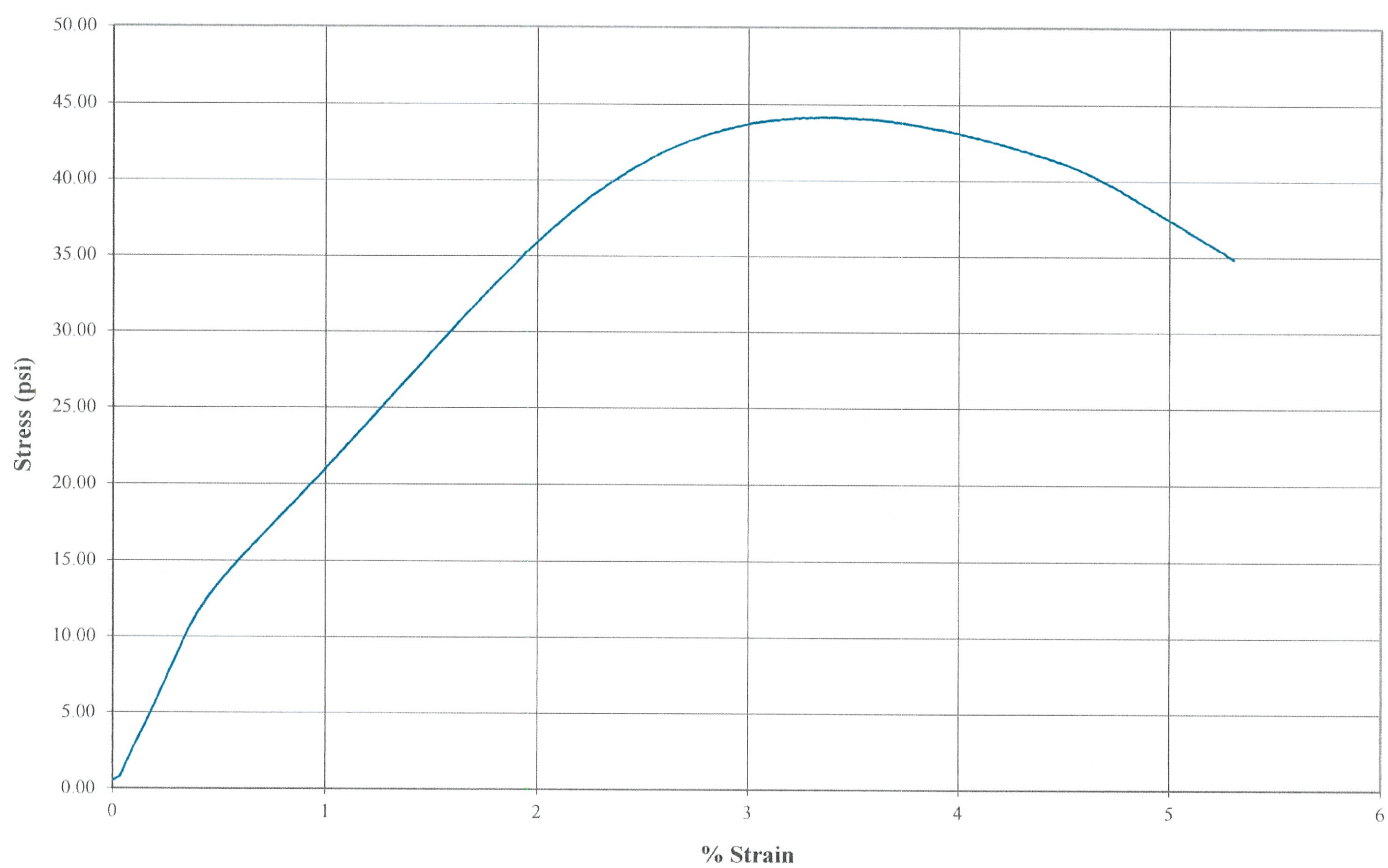
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 14	2.0	7.2	1	44.7	36.2	8.5	7.2	5.8	1.4	0.00547	0.00573	0.00560	0.00100	5,821
			2	44.6	36.8	7.8	7.2	5.9	1.3	0.00549	0.00575	0.00562	0.00100	5,886
			3	44.6	36.5	8.1	7.2	5.9	1.3	0.00523	0.00548	0.00536	0.00096	6,134
			4	44.6	37.3	7.3	7.2	6.0	1.2	0.00549	0.00575	0.00562	0.00100	5,978
			5	44.7	36.3	8.4	7.2	5.8	1.3	0.00548	0.00573	0.00560	0.00100	5,830
	COLUMN AVERAGE			44.7	36.6	8.0	7.2	5.9	1.3	0.00543	0.00569	0.00556	0.00099	5,930
	STANDARD DEV.			0.04	0.44	0.46	0.01	0.07	0.07	0.00011	0.00012	0.00011	0.00002	130
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 15	2.0	9.1	1	56.7	47.0	9.6	9.1	7.6	1.5	0.00669	0.00695	0.00682	0.00122	6,202
			2	56.7	48.2	8.6	9.1	7.7	1.4	0.00704	0.00729	0.00716	0.00128	6,050
			3	56.7	48.0	8.7	9.1	7.7	1.4	0.00704	0.00729	0.00716	0.00128	6,024
			4	56.7	47.9	8.9	9.1	7.7	1.4	0.00672	0.00696	0.00684	0.00122	6,298
			5	56.7	46.8	9.9	9.1	7.5	1.6	0.00674	0.00698	0.00686	0.00123	6,136
	COLUMN AVERAGE			56.7	47.6	9.1	9.1	7.6	1.5	0.00685	0.00709	0.00697	0.00124	6,142
	STANDARD DEV.			0.03	0.60	0.59	0.01	0.10	0.10	0.00017	0.00018	0.00018	0.00003	112

Sample ID: 1
Project: B1702069
Sheet No. 6 of 7

Erik J. Knudson
Laboratory Technician

Quick Shear
Confining Pressure 4 PSI

Peak Shear Stress (psi) = 44.2



Sample ID: 1
Project: B1702069
Sheet No. 7 of 7

Universal Model Calculations - US Customary Units

Braun Sample ID: 1
Station: TP-4

Project: B1702069

Seq.	Conf. psi	Axial Stress psi	Bulk psi	Deviator psi	M_r psi	Pred. Mr psi	Ln(Mr)	Ln(Bulk)	Ln(Dev)
1	6.0	2.1	20.1	1.8	13,615	16,232	9.519	3.003	0.563
2	6.0	4.0	22.0	3.4	12,277	12,263	9.415	3.093	1.233
3	6.0	5.7	23.7	4.9	11,016	10,688	9.307	3.166	1.598
4	6.0	8.1	26.1	7.1	10,062	9,465	9.217	3.263	1.959
5	6.0	10.1	28.1	8.9	10,024	8,828	9.213	3.336	2.187
6	4.0	2.1	14.1	1.8	13,319	13,025	9.497	2.645	0.569
7	4.0	4.0	16.0	3.5	9,445	10,061	9.153	2.772	1.239
8	4.0	5.9	17.9	5.2	8,595	8,818	9.059	2.884	1.640
9	4.0	7.8	19.8	6.9	8,200	8,112	9.012	2.987	1.932
10	4.0	9.8	21.8	8.7	8,468	7,672	9.044	3.084	2.161
11	2.0	1.8	7.8	1.5	12,743	9,796	9.453	2.052	0.418
12	2.0	3.7	9.7	3.2	7,286	7,662	8.894	2.272	1.178
13	2.0	5.3	11.3	4.7	6,402	7,026	8.764	2.428	1.540
14	2.0	7.2	13.2	5.9	5,930	6,853	8.688	2.578	1.773
15	2.0	9.1	15.1	7.6	6,142	6,534	8.723	2.714	2.034

Universal Model Calculations - US Customary Units

Braun Sample ID: 1

Station: TP-4

Project: B1702069

SUMMARY OUTPUT

ax5	k1	k2	k3
Value	3475.7918	0.606811974	-0.499551386
t-Stat	32.43723	5.954231958	-7.74275784

R-sqr Adj. 0.8169126

Std Err 0.1196666 or 12.71%

Regression Statistics	
Multiple R	0.918187299
R Square	0.843067917
Adjusted R Square	0.816912569
Standard Error	0.11966659
Observations	15

ANOVA

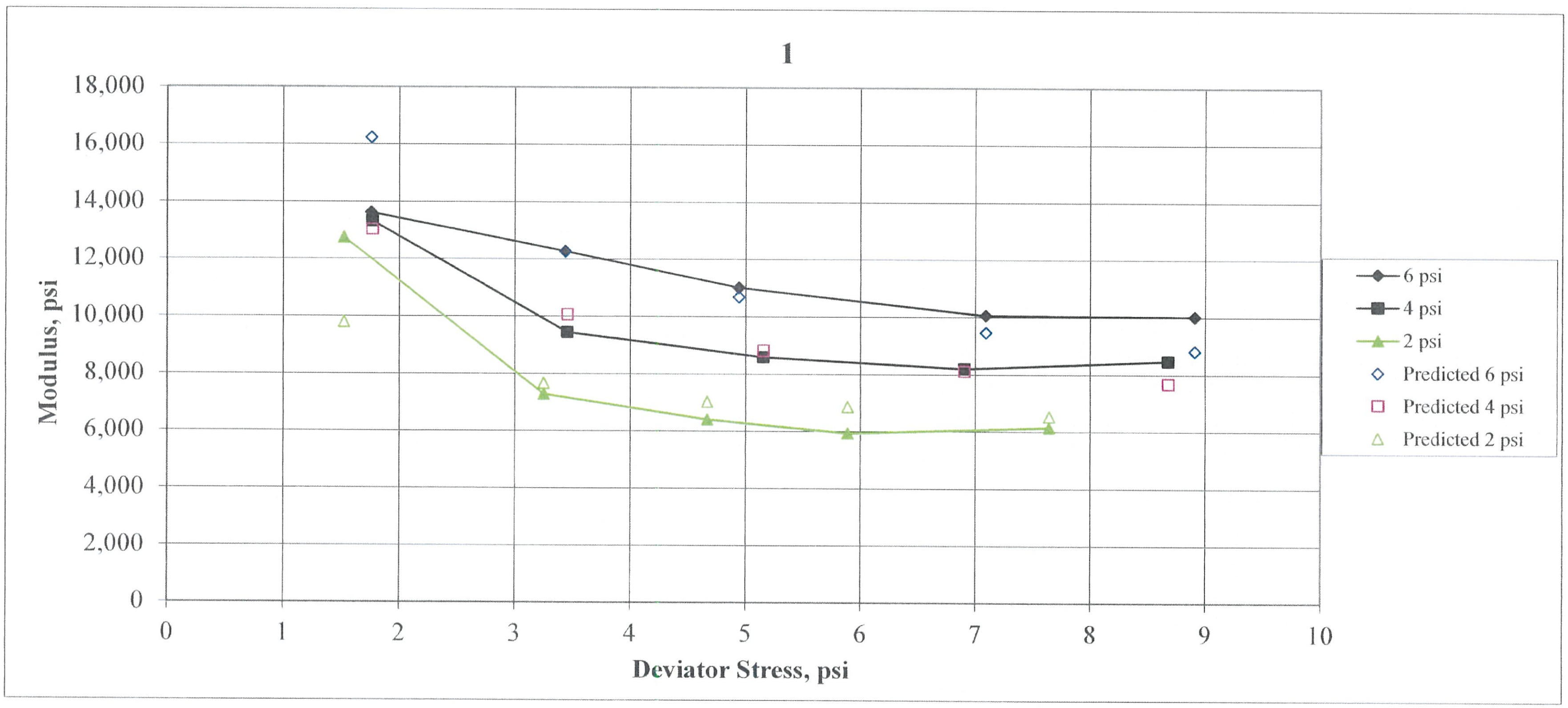
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.923161964	0.461581	32.2331	1.49372E-05
Residual	12	0.171841114	0.0143201		
Total	14	1.095003078			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	8.153577586	0.251364796	32.43723	4.661E-13	7.605900745	8.701254427	7.605900745	8.701254427
X Variable 1	0.606811974	0.10191272	5.954232	6.67E-05	0.384763232	0.828860715	0.384763232	0.828860715
X Variable 2	-0.49955139	0.064518534	-7.742758	5.246E-06	-0.640125196	-0.358977576	-0.640125196	-0.358977576

Universal Model Graph - US Customary Units

Braun Sample ID: 1
Station: TP-4

Project: B1702069



IPEC
Inland Pacific Engineering Company
3012 North Sullivan Road, Suite C
Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

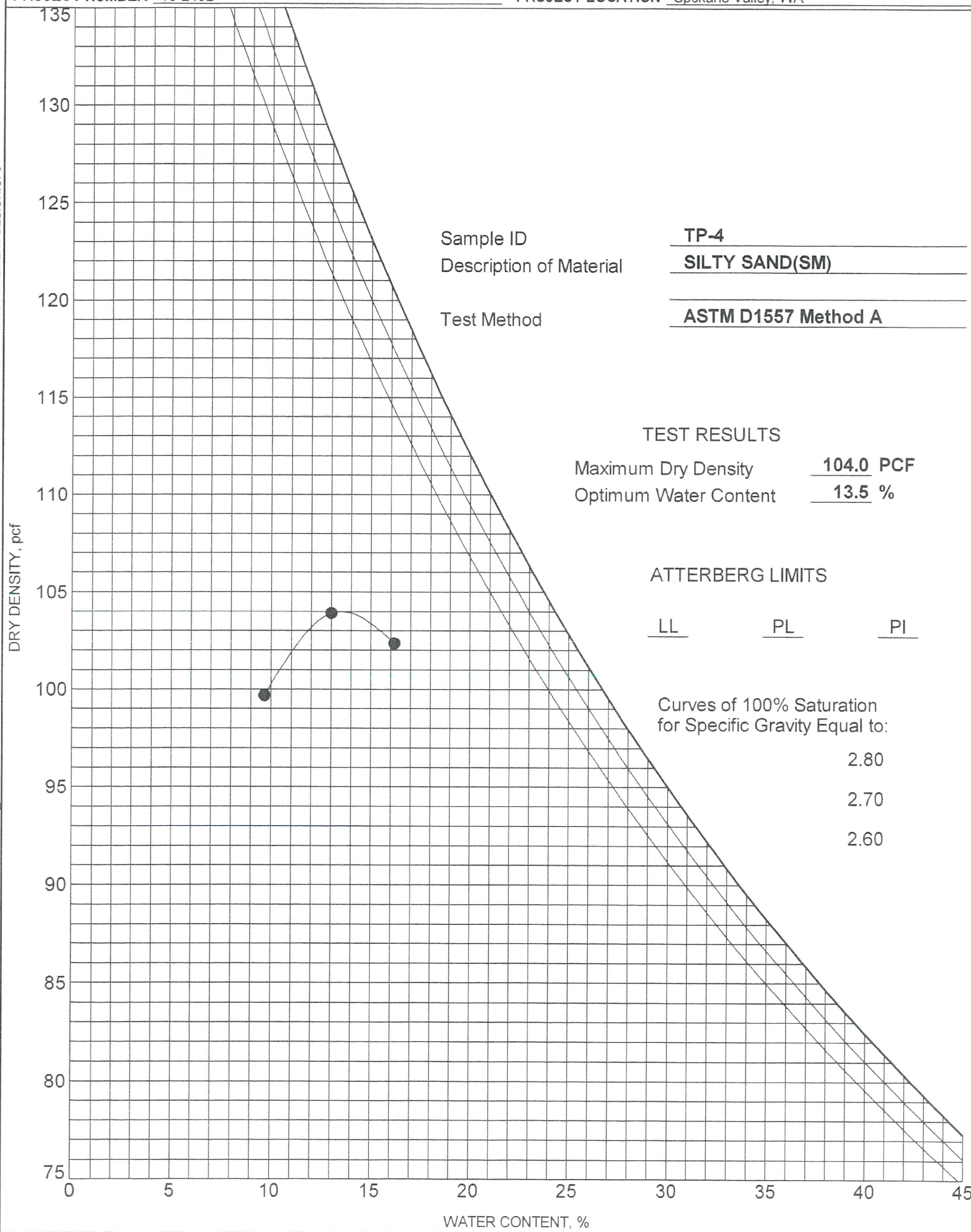
MOISTURE-DENSITY RELATIONSHIP

CLIENT NAI Black

PROJECT NAME Proposed Street Improvements

PROJECT NUMBER 16-249D

PROJECT LOCATION Spokane Valley, WA



Sample ID **TP-4**

Description of Material **SILTY SAND(SM)**

Test Method **ASTM D1557 Method A**

TEST RESULTS

Maximum Dry Density **104.0 PCF**

Optimum Water Content **13.5 %**

ATTERBERG LIMITS

LL	PL	PI

Curves of 100% Saturation
for Specific Gravity Equal to:

2.80

2.70

2.60

Resilient Modulus Testing - AASHTO T307 US Customary Units

Date: April 10, 2017

Project: B1702069

Client:
Inland Pacific Engineering Company
Paul Nelson
P.O. Box 1566
Veradale, WA 99037

Project Description:
Resilient Modulus Test
AASHTO T307
Client ID: Proposed Street Improvements
Station: TP-7

Sample Information

Braun Sample ID./ File Name:	1	Sample Diameter, in.:	2.80	Sample M.C., % before, after:	14.7, 14.2
Sample Type:	Type 2	Sample Height, in.:	5.51	Sample Dry Den., pcf:	106.1
Test Date:	06-Apr-2017	Desired M.C., %:	14.3	Failed in Shear?:	YES
Comments:	Spokane Valley, WA	Desired Dry Density., pcf:	104.7	Triaxial Shear Strength, psi:	45.3

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximum Axial Stress	Cycle No.	Actual Applied Maximum Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Maximum Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov Def. LVDT 1 Reading	Recov Def. LVDT 2 Reading	Average Recov Def. LVDT 1 and LVDT 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	c1	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	H average		Mr
UNIT	psi	psi	---	lbs.	lbs.	lbs.	psi	psi	psi	inches	inches	inches	in/in	psi
PRECISION	---.-	---.-	-	----.-	----.-	---.-	---.-	---.-	---.-	-.-----	-.-----	-.-----	-.-----	---
SEQUENCE 1	6.0	2.3	1	14.2	11.8	2.4	2.3	1.9	0.4	0.00049	0.00052	0.00051	0.00009	21,081
			2	14.3	11.9	2.3	2.3	1.9	0.4	0.00052	0.00057	0.00054	0.00010	19,724
			3	14.2	11.8	2.4	2.3	1.9	0.4	0.00051	0.00056	0.00053	0.00010	19,921
			4	14.2	11.8	2.4	2.3	1.9	0.4	0.00047	0.00051	0.00049	0.00009	21,508
			5	14.2	11.8	2.5	2.3	1.9	0.4	0.00050	0.00055	0.00053	0.00010	20,044
	COLUMN AVERAGE			14.2	11.8	2.4	2.3	1.9	0.4	0.00050	0.00054	0.00052	0.00009	20,456
	STANDARD DEV.			0.02	0.07	0.05	0.00	0.01	0.01	0.00002	0.00002	0.00002	0.00000	789

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 2	6.0	4.3	1	26.5	22.8	3.7	4.3	3.7	0.6	0.00104	0.00112	0.00108	0.00020	18,948
			2	26.5	22.9	3.6	4.3	3.7	0.6	0.00100	0.00107	0.00103	0.00019	19,938
			3	26.5	22.8	3.7	4.3	3.7	0.6	0.00099	0.00107	0.00103	0.00019	19,878
			4	26.4	22.8	3.6	4.3	3.7	0.6	0.00099	0.00107	0.00103	0.00019	19,906
			5	26.3	22.7	3.6	4.3	3.7	0.6	0.00095	0.00102	0.00099	0.00018	20,678
	COLUMN AVERAGE			26.4	22.8	3.6	4.3	3.7	0.6	0.00099	0.00107	0.00103	0.00019	19,870
	STANDARD DEV.			0.07	0.06	0.07	0.01	0.01	0.01	0.00003	0.00004	0.00003	0.00001	614
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 3	6.0	6.2	1	38.3	33.5	4.8	6.2	5.4	0.8	0.00165	0.00180	0.00173	0.00031	17,453
			2	38.3	33.4	4.9	6.2	5.4	0.8	0.00150	0.00164	0.00157	0.00028	19,131
			3	38.3	33.5	4.8	6.2	5.4	0.8	0.00157	0.00172	0.00164	0.00030	18,362
			4	38.4	33.6	4.8	6.2	5.4	0.8	0.00157	0.00172	0.00165	0.00030	18,344
			5	38.5	33.6	4.9	6.2	5.4	0.8	0.00156	0.00171	0.00164	0.00030	18,434
	COLUMN AVERAGE			38.4	33.5	4.8	6.2	5.4	0.8	0.00157	0.00172	0.00165	0.00030	18,345
	STANDARD DEV.			0.08	0.08	0.04	0.01	0.01	0.01	0.00007	0.00008	0.00008	0.00001	596
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 4	6.0	8.3	1	51.1	45.2	5.9	8.3	7.3	1.0	0.00218	0.00237	0.00227	0.00041	17,902
			2	51.2	45.2	6.0	8.3	7.3	1.0	0.00217	0.00237	0.00227	0.00041	17,907
			3	51.1	45.2	6.0	8.3	7.3	1.0	0.00227	0.00247	0.00237	0.00043	17,140
			4	51.2	45.3	5.8	8.3	7.3	0.9	0.00216	0.00235	0.00226	0.00041	18,047
			5	51.1	45.2	5.9	8.3	7.3	1.0	0.00226	0.00246	0.00236	0.00043	17,232
	COLUMN AVERAGE			51.2	45.2	5.9	8.3	7.3	1.0	0.00221	0.00240	0.00231	0.00042	17,645
	STANDARD DEV.			0.04	0.06	0.07	0.01	0.01	0.01	0.00005	0.00006	0.00005	0.00001	425

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 5	6.0	10.3	1	63.5	55.7	7.8	10.3	9.0	1.3	0.00279	0.00305	0.00292	0.00053	17,171
			2	63.5	56.3	7.2	10.3	9.1	1.2	0.00291	0.00319	0.00305	0.00055	16,615
			3	63.3	56.4	6.9	10.3	9.1	1.1	0.00278	0.00304	0.00291	0.00053	17,403
			4	63.6	56.5	7.1	10.3	9.1	1.2	0.00292	0.00319	0.00306	0.00055	16,605
			5	63.4	55.7	7.7	10.3	9.0	1.3	0.00295	0.00322	0.00308	0.00056	16,264
	COLUMN AVERAGE			63.5	56.1	7.3	10.3	9.1	1.2	0.00287	0.00314	0.00300	0.00054	16,812
	STANDARD DEV.			0.10	0.37	0.39	0.02	0.06	0.06	0.00008	0.00008	0.00008	0.00001	464
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 6	4.0	2.1	1	13.2	11.2	1.9	2.1	1.8	0.3	0.00046	0.00056	0.00051	0.00009	19,788
			2	13.2	11.2	2.0	2.1	1.8	0.3	0.00042	0.00052	0.00047	0.00009	21,408
			3	13.2	11.2	2.0	2.1	1.8	0.3	0.00040	0.00051	0.00046	0.00008	22,194
			4	13.2	11.3	1.9	2.1	1.8	0.3	0.00042	0.00052	0.00047	0.00009	21,464
			5	13.2	11.2	2.0	2.1	1.8	0.3	0.00046	0.00057	0.00051	0.00009	19,655
	COLUMN AVERAGE			13.2	11.2	2.0	2.1	1.8	0.3	0.00043	0.00054	0.00048	0.00009	20,902
	STANDARD DEV.			0.02	0.04	0.04	0.00	0.01	0.01	0.00002	0.00003	0.00003	0.00000	1,122
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 7	4.0	4.1	1	25.6	22.3	3.4	4.2	3.6	0.5	0.00109	0.00117	0.00113	0.00020	17,677
			2	25.6	22.2	3.4	4.1	3.6	0.6	0.00108	0.00116	0.00112	0.00020	17,900
			3	25.6	22.5	3.1	4.2	3.6	0.5	0.00108	0.00116	0.00112	0.00020	18,068
			4	25.5	22.2	3.3	4.1	3.6	0.5	0.00107	0.00115	0.00111	0.00020	18,003
			5	25.6	22.5	3.1	4.1	3.6	0.5	0.00113	0.00121	0.00117	0.00021	17,291
	COLUMN AVERAGE			25.6	22.3	3.3	4.1	3.6	0.5	0.00109	0.00117	0.00113	0.00020	17,788
	STANDARD DEV.			0.04	0.16	0.15	0.01	0.03	0.03	0.00002	0.00002	0.00002	0.00000	315

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 8	4.0	6.1	1	37.7	33.4	4.3	6.1	5.4	0.7	0.00184	0.00196	0.00190	0.00034	15,850
			2	37.8	33.5	4.3	6.1	5.4	0.7	0.00174	0.00186	0.00180	0.00033	16,722
			3	37.7	33.6	4.1	6.1	5.4	0.7	0.00184	0.00196	0.00190	0.00034	15,865
			4	37.8	33.2	4.6	6.1	5.4	0.7	0.00167	0.00178	0.00173	0.00031	17,283
			5	37.8	33.8	4.1	6.1	5.5	0.7	0.00168	0.00179	0.00174	0.00031	17,479
	COLUMN AVERAGE			37.8	33.5	4.3	6.1	5.4	0.7	0.00175	0.00187	0.00181	0.00033	16,640
	STANDARD DEV.			0.05	0.22	0.20	0.01	0.04	0.03	0.00008	0.00009	0.00008	0.00002	766
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 9	4.0	8.1	1	49.8	44.2	5.6	8.1	7.2	0.9	0.00247	0.00261	0.00254	0.00046	15,656
			2	49.9	44.3	5.6	8.1	7.2	0.9	0.00249	0.00263	0.00256	0.00046	15,588
			3	50.0	44.3	5.7	8.1	7.2	0.9	0.00247	0.00261	0.00254	0.00046	15,672
			4	49.9	43.9	6.0	8.1	7.1	1.0	0.00249	0.00263	0.00256	0.00046	15,404
			5	49.9	44.2	5.7	8.1	7.2	0.9	0.00248	0.00262	0.00255	0.00046	15,577
	COLUMN AVERAGE			49.9	44.2	5.7	8.1	7.2	0.9	0.00248	0.00262	0.00255	0.00046	15,579
	STANDARD DEV.			0.09	0.17	0.17	0.01	0.03	0.03	0.00001	0.00001	0.00001	0.00000	107
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 10	4.0	10.0	1	61.1	54.6	6.5	9.9	8.8	1.0	0.00320	0.00340	0.00330	0.00060	14,869
			2	60.6	53.2	7.4	9.8	8.6	1.2	0.00298	0.00317	0.00308	0.00055	15,573
			3	62.2	55.2	7.0	10.1	8.9	1.1	0.00317	0.00338	0.00328	0.00059	15,159
			4	62.0	54.7	7.3	10.0	8.9	1.2	0.00301	0.00321	0.00311	0.00056	15,843
			5	62.1	54.8	7.4	10.1	8.9	1.2	0.00331	0.00352	0.00342	0.00062	14,431
	COLUMN AVERAGE			61.6	54.5	7.1	10.0	8.8	1.1	0.00314	0.00334	0.00324	0.00058	15,175
	STANDARD DEV.			0.72	0.74	0.38	0.12	0.12	0.06	0.00014	0.00014	0.00014	0.00003	560

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 11	1.9	1.9	1	12.0	10.4	1.6	2.0	1.7	0.3	0.00028	0.00059	0.00043	0.00008	21,647
			2	12.0	10.4	1.6	1.9	1.7	0.3	0.00032	0.00063	0.00047	0.00009	19,828
			3	12.0	10.3	1.7	1.9	1.7	0.3	0.00028	0.00060	0.00044	0.00008	21,125
			4	12.0	10.3	1.7	1.9	1.7	0.3	0.00025	0.00055	0.00040	0.00007	23,217
			5	12.0	10.4	1.6	2.0	1.7	0.3	0.00028	0.00059	0.00044	0.00008	21,354
	COLUMN AVERAGE			12.0	10.4	1.7	1.9	1.7	0.3	0.00028	0.00059	0.00044	0.00008	21,434
	STANDARD DEV.			0.02	0.06	0.05	0.00	0.01	0.01	0.00002	0.00003	0.00002	0.00000	1,215
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 12	2.0	3.9	1	24.1	21.3	2.8	3.9	3.4	0.5	0.00130	0.00137	0.00134	0.00024	14,305
			2	24.0	21.3	2.7	3.9	3.5	0.4	0.00130	0.00137	0.00134	0.00024	14,336
			3	24.1	21.2	2.9	3.9	3.4	0.5	0.00131	0.00138	0.00134	0.00024	14,185
			4	24.1	21.2	2.9	3.9	3.4	0.5	0.00131	0.00138	0.00134	0.00024	14,196
			5	24.0	21.2	2.8	3.9	3.4	0.4	0.00119	0.00126	0.00123	0.00022	15,568
	COLUMN AVERAGE			24.1	21.2	2.8	3.9	3.4	0.5	0.00128	0.00135	0.00132	0.00024	14,518
	STANDARD DEV.			0.04	0.06	0.07	0.01	0.01	0.01	0.00005	0.00005	0.00005	0.00001	591
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 13	2.0	5.8	1	35.9	32.2	3.8	5.8	5.2	0.6	0.00212	0.00223	0.00217	0.00039	13,293
			2	35.9	31.9	4.0	5.8	5.2	0.7	0.00204	0.00214	0.00218	0.00038	13,745
			3	35.9	32.3	3.6	5.8	5.2	0.6	0.00213	0.00224	0.00218	0.00039	13,317
			4	36.0	32.3	3.7	5.8	5.2	0.6	0.00213	0.00224	0.00218	0.00039	13,323
			5	35.9	32.0	3.9	5.8	5.2	0.6	0.00203	0.00214	0.00209	0.00038	13,800
	COLUMN AVERAGE			35.9	32.1	3.8	5.8	5.2	0.6	0.00209	0.00220	0.00216	0.00039	13,496
	STANDARD DEV.			0.04	0.18	0.16	0.01	0.03	0.03	0.00005	0.00005	0.00004	0.00001	254

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 14	2.0	7.8	1	48.1	40.2	7.8	7.8	6.5	1.3	0.00287	0.00301	0.00294	0.00053	12,301
			2	48.0	41.5	6.5	7.8	6.7	1.1	0.00287	0.00300	0.00293	0.00053	12,736
			3	48.1	41.4	6.7	7.8	6.7	1.1	0.00300	0.00314	0.00307	0.00055	12,131
			4	48.0	39.9	8.1	7.8	6.5	1.3	0.00286	0.00299	0.00293	0.00053	12,280
			5	48.1	41.3	6.8	7.8	6.7	1.1	0.00300	0.00314	0.00307	0.00055	12,089
	COLUMN AVERAGE			48.0	40.9	7.2	7.8	6.6	1.2	0.00292	0.00305	0.00299	0.00054	12,307
	STANDARD DEV.			0.03	0.72	0.72	0.01	0.12	0.12	0.00007	0.00008	0.00007	0.00001	257
COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SEQUENCE 15	2.0	9.8	1	60.3	50.9	9.4	9.8	8.2	1.5	0.00352	0.00369	0.00361	0.00065	12,699
			2	60.2	51.1	9.2	9.8	8.3	1.5	0.00351	0.00367	0.00359	0.00065	12,792
			3	60.3	51.9	8.4	9.8	8.4	1.4	0.00352	0.00369	0.00361	0.00065	12,940
			4	60.2	52.4	7.8	9.8	8.5	1.3	0.00384	0.00402	0.00393	0.00071	11,985
			5	60.3	52.1	8.2	9.8	8.5	1.3	0.00369	0.00387	0.00378	0.00068	12,409
	COLUMN AVERAGE			60.2	51.7	8.6	9.8	8.4	1.4	0.00362	0.00379	0.00370	0.00067	12,565
	STANDARD DEV.			0.04	0.67	0.67	0.01	0.11	0.11	0.00014	0.00015	0.00015	0.00003	378

Sample ID: 1

Project: B1702069

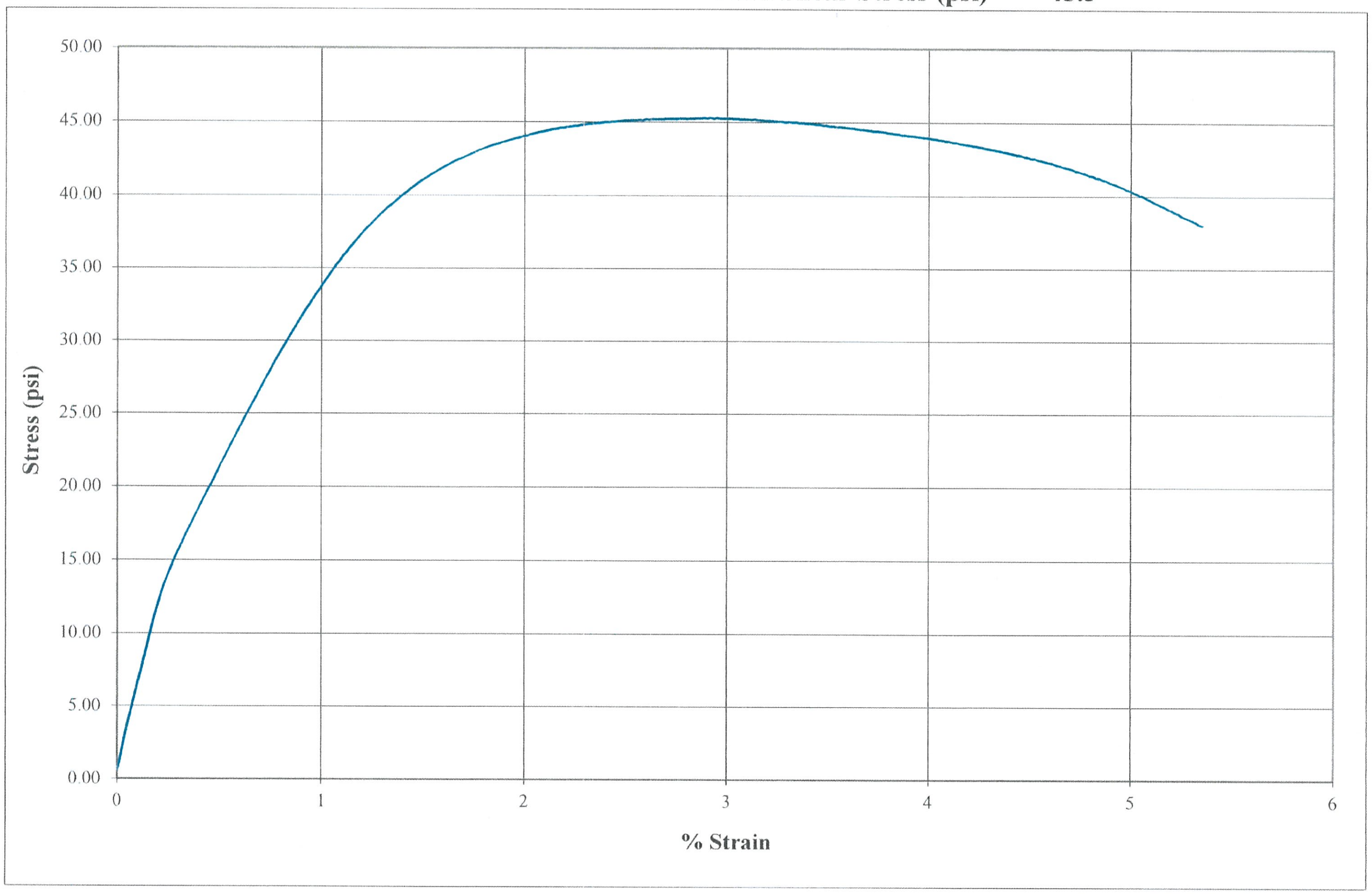
Sheet No. 6 of 7

Erik J. Knudson

Laboratory Technician

Quick Shear
Confining Pressure 4 PSI

Peak Shear Stress (psi) = 45.3



Sample ID: 1
Project: B1702069
Sheet No. 7 of 7

Universal Model Calculations - US Customary Units

Braun Sample ID: 1
Station: TP-7

Project: B1702069

Seq.	Conf. psi	Axial Stress psi	Bulk psi	Deviator psi	M_r psi	Pred. Mr psi	Ln(Mr)	Ln(Bulk)	Ln(Dev)
1	6.0	2.3	20.3	1.9	20,456	23,592	9.926	3.011	0.650
2	6.0	4.3	22.3	3.7	19,870	19,613	9.897	3.104	1.307
3	6.0	6.2	24.2	5.4	18,345	17,768	9.817	3.187	1.692
4	6.0	8.3	26.3	7.3	17,645	16,552	9.778	3.269	1.992
5	6.0	10.3	28.3	9.1	16,812	15,799	9.730	3.342	2.208
6	4.0	2.1	14.1	1.8	20,902	21,278	9.948	2.649	0.598
7	4.0	4.1	16.1	3.6	17,788	17,740	9.786	2.782	1.287
8	4.0	6.1	18.1	5.4	16,640	16,138	9.720	2.897	1.692
9	4.0	8.1	20.1	7.2	15,579	15,250	9.654	3.000	1.969
10	4.0	10.0	22.0	8.8	15,175	14,667	9.627	3.090	2.178
11	1.9	1.9	7.7	1.7	21,434	17,875	9.973	2.047	0.519
12	2.0	3.9	9.9	3.4	14,518	15,326	9.583	2.293	1.236
13	2.0	5.8	11.8	5.2	13,496	14,194	9.510	2.470	1.650
14	2.0	7.8	13.8	6.6	12,307	13,802	9.418	2.623	1.890
15	2.0	9.8	15.8	8.4	12,565	13,363	9.439	2.758	2.125

Universal Model Calculations - US Customary Units

Braun Sample ID: 1

Station: TP-7

Project: B1702069

SUMMARY OUTPUT

ax5	k1	k2	k3
Value	10724.224	0.332780325	-0.328339683
t-Stat	51.11372	4.526286657	-7.010227266

R-sqr Adj. 0.7739636

Std Err 0.0855097 or 8.93%

Regression Statistics	
Multiple R	0.897916763
R Square	0.806254513
Adjusted R Square	0.773963599
Standard Error	0.085509723
Observations	15

ANOVA

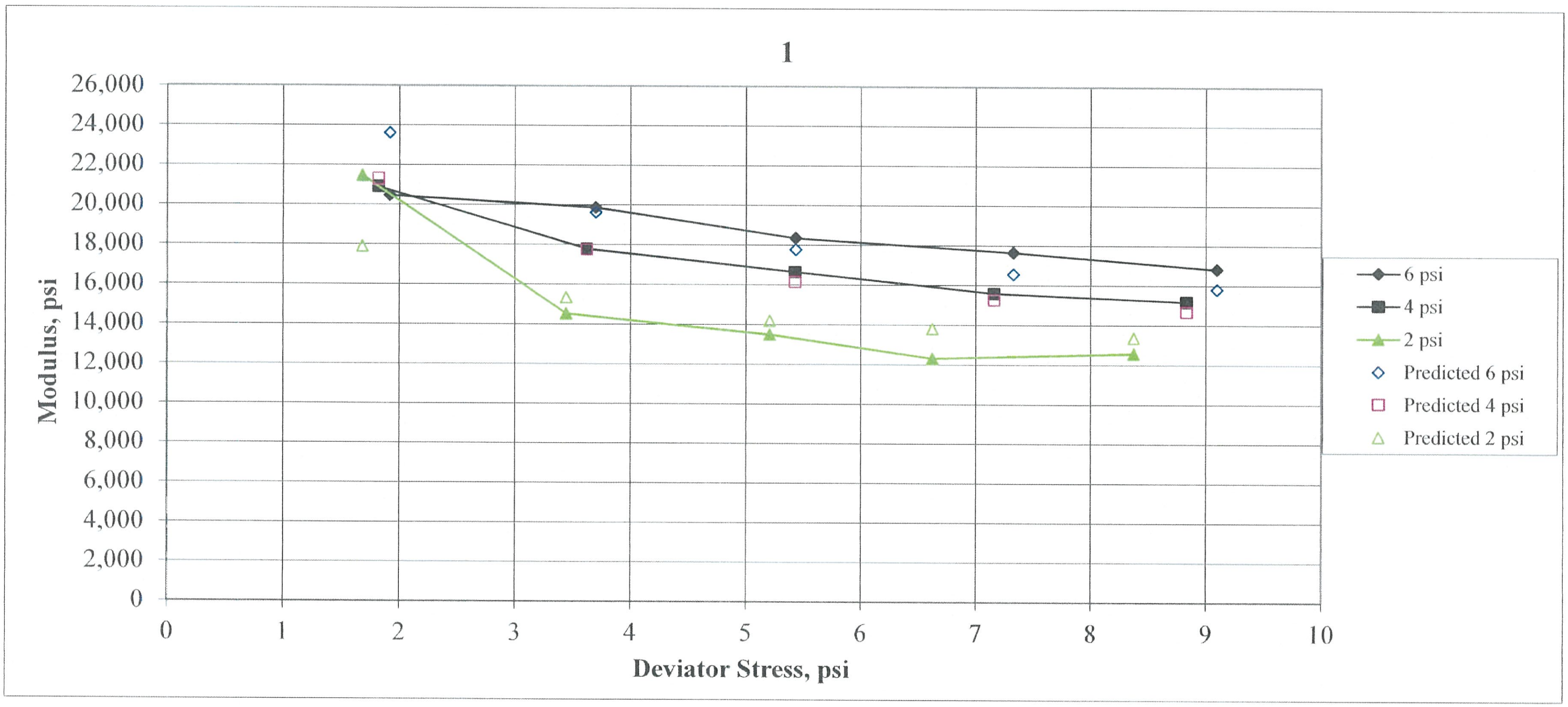
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.365134451	0.1825672	24.968463	5.28919E-05
Residual	12	0.087742953	0.0073119		
Total	14	0.452877404			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9.28026037	0.181561043	51.11372	2.065E-15	8.884672839	9.675847901	8.884672839	9.675847901
X Variable 1	0.332780325	0.073521708	4.5262867	0.0006942	0.172590285	0.492970365	0.172590285	0.492970365
X Variable 2	-0.32833968	0.046837238	-7.010227	1.414E-05	-0.430389258	-0.226290108	-0.430389258	-0.226290108

Universal Model Graph - US Customary Units

Braun Sample ID: 1
Station: TP-7

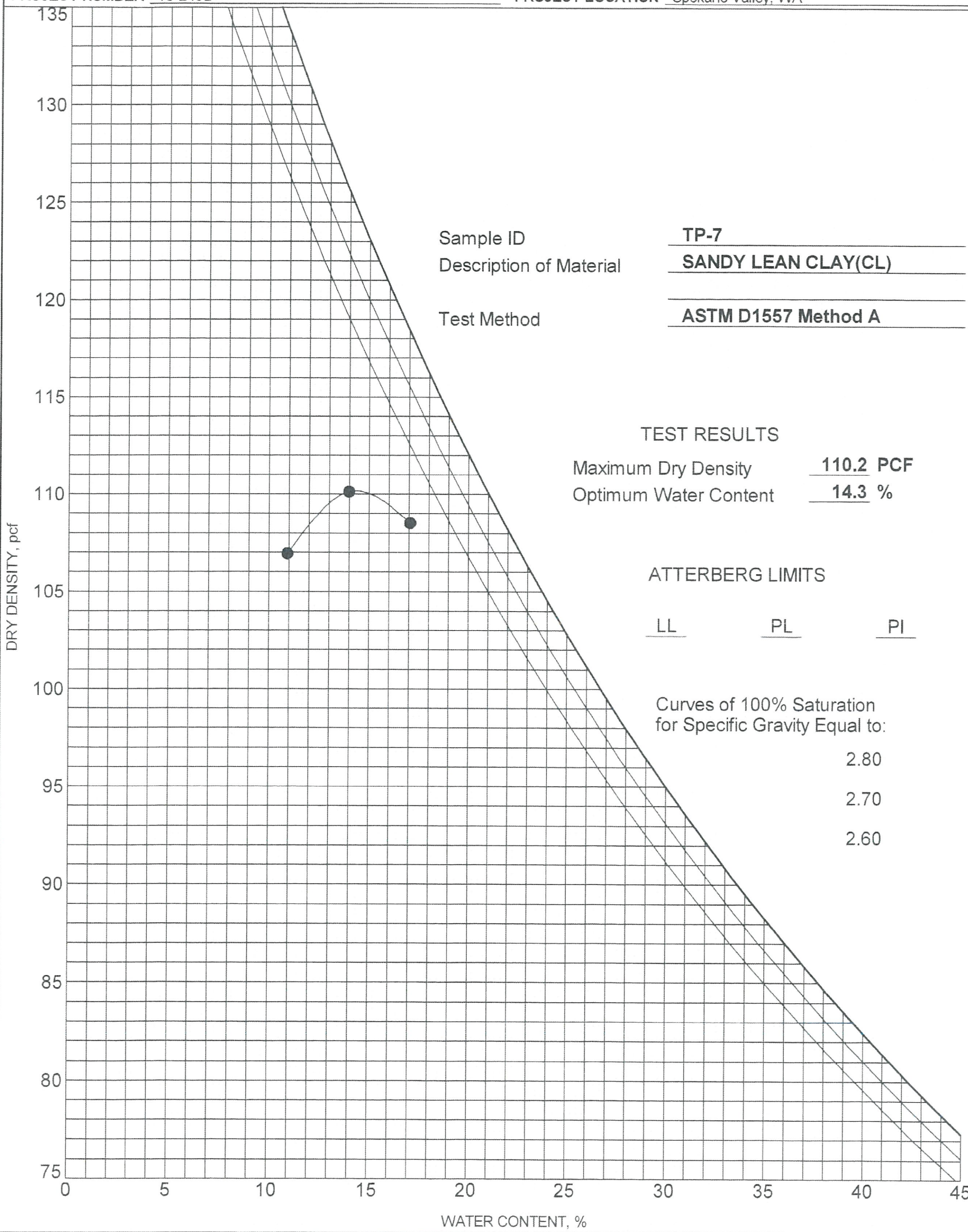
Project: B1702069



IPEC
Inland Pacific Engineering Company
3012 North Sullivan Road, Suite C
Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

MOISTURE-DENSITY RELATIONSHIP

CLIENT NAI Black
PROJECT NAME Proposed Street Improvements
PROJECT NUMBER 16-249D
PROJECT LOCATION Spokane Valley, WA



Sample ID **TP-7**
Description of Material **SANDY LEAN CLAY(CL)**

Test Method **ASTM D1557 Method A**

TEST RESULTS

Maximum Dry Density **110.2 PCF**
Optimum Water Content **14.3 %**

ATTERBERG LIMITS

LL	PL	PI

Curves of 100% Saturation
for Specific Gravity Equal to:

2.80
2.70
2.60

REPORT 9

Full-Scale Drywell Testing, dated June 28, 2016

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

August 22, 2017
Project No. 16-249A

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Addendum to Full-Scale Drywell Testing**
Proposed Stormwater Management Facility
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed a full-scale drywell test on the drywell installed at the above-referenced site in Spokane Valley, Washington. The purpose of the testing was to establish a design flow rate. This addendum provides our recommendations for a design infiltration rate for proposed gravel galleries between the drywells.

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Lastly, we performed a geotechnical evaluation in July 2015 consisting of ten 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

FIELD EVALUATION

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) performed a full-scale drywell test on the Type 2 drywell (double depth) on May 6, 2016. The drywell test was performed in accordance with the Spokane Regional Stormwater Manual, Appendix 4B procedures. The drywell was installed at the location shown on Figure 3 (attached).

ANALYSIS AND RECOMMENDATIONS

We calculated a design outflow rate for the existing drywell to be 1.05 cfs for design. This recommended design outflow rate included a safety factor of 1.1 as required by the SRSM. Using this design outflow rate and assuming a typical infiltration area of 600 square feet for a Type 2 drywell, we recommend using a design infiltration rate of 1.8×10^{-3} cubic feet per second per square foot (cfs/ft^2). This recommended infiltration rate also includes a safety factor of 1.1.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Paul T. Nelson, P.E.
Principal Engineer

PAUL T NELSON
STATE OF WASHINGTON
37228
REGISTERED
PROFESSIONAL ENGINEER
8-22-17

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

June 28, 2016
Project No. 16-249A

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Full-Scale Drywell Testing**
Proposed Stormwater Management Facility
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed a full-scale drywell test on the drywell installed at the above-referenced site in Spokane Valley, Washington. The purpose of the testing was to establish a design flow rate. This report summarizes the results of our site investigation, engineering analyses and recommendations.

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Lastly, we performed a geotechnical evaluation in July 2015 consisting of ten 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

FIELD EVALUATION

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) performed a full-scale drywell test on the Type 2 drywell on May 6, 2016. The drywell test was performed in accordance with the Spokane Regional Stormwater Manual, Appendix 4B procedures.

ANALYSIS AND RECOMMENDATIONS

We calculated a design outflow rate for the existing drywell using the results of the recent and previous laboratory tests and the procedures described in the SRSM manual, Appendix 4B (Full-Scale Drywell Test Method). Based on the test performed, we recommend using a design flow rate of 1.05 cfs for design. This recommended design outflow rate includes a safety factor of 1.1 as required by the SRSM.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Paul T. Nelson, P.E.
Principal Engineer

PAUL T NELSON
STATE OF WASHINGTON
37228
REGISTERED
PROFESSIONAL ENGINEER
6-28-16

Attachments: Figure 1, Site Location Map
Figure 2, NRCS Map
Laboratory Test Results
Full-Scale Drywell Test Results

FIGURE 1

Site Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249A	June 28, 2016
	Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	

FIGURE 2

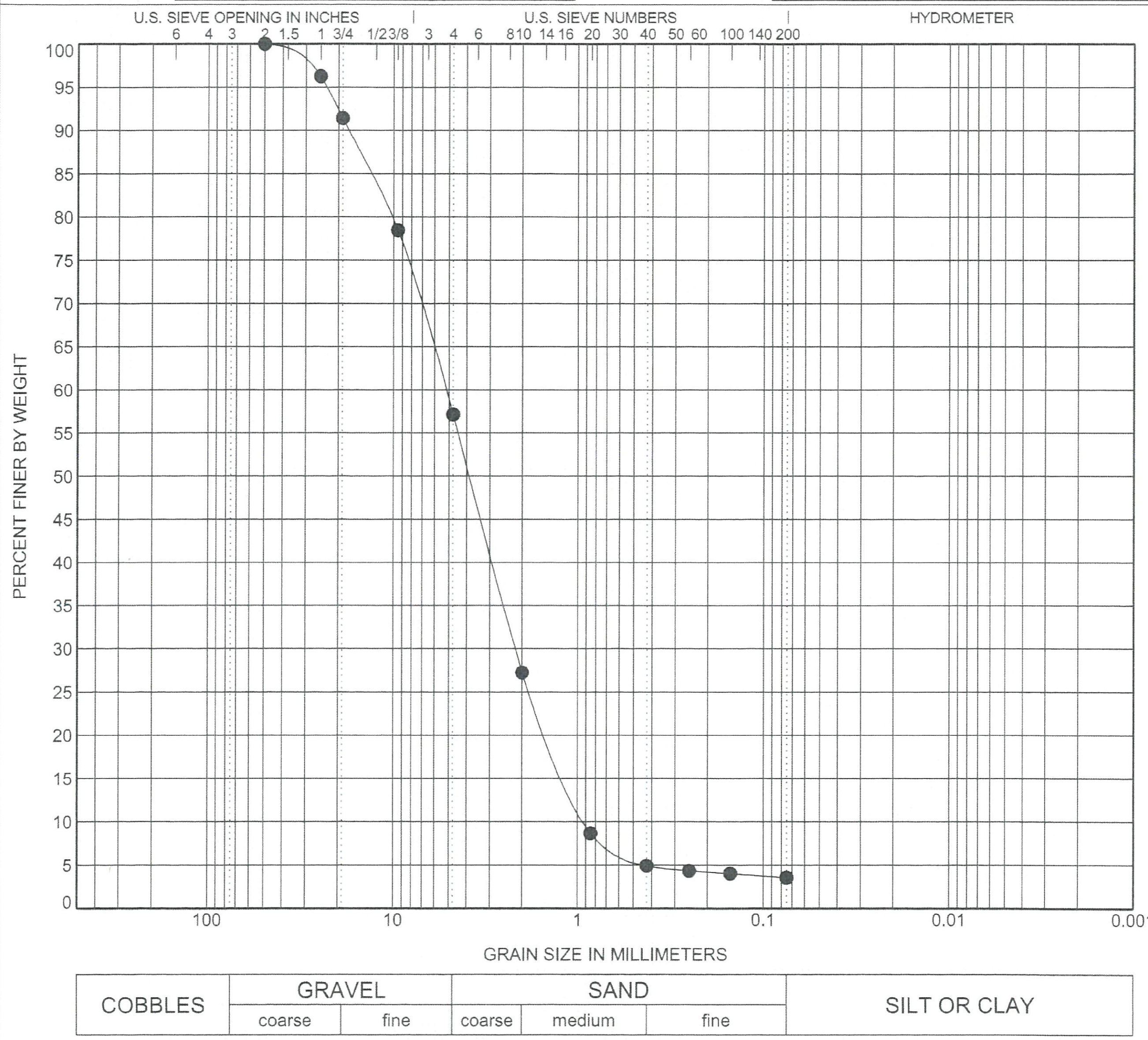
NRCS Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249A	June 28, 2016
	Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	

IPEC

Inland Pacific Engineering Company
3012 North Sullivan Road, Suite C
Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

GRAIN SIZE DISTRIBUTION

CLIENT NAI Black
PROJECT NAME Painted Hills Drywell Test
PROJECT NUMBER 16-249A
PROJECT LOCATION 4403 South Dishman-Mica Road



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**L16-057**	**20.0**	**SP Poorly Graded Sand with Gravel**				**1.00**	**5.76**

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**L16-057**	**20.0**	**50**	**5.212**	**2.167**	**0.904**	**42.9**	**53.6**	**3.5**	

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

Full-Scale Drywell Test Results

Project Name: Painted Hills Drywell Test

Project Number: 16-249A

Client: NAI Black

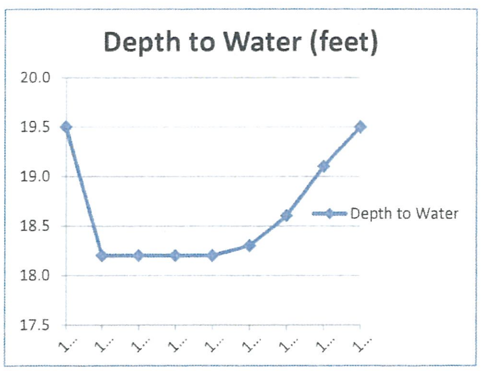
Test Date: 5/6/2016

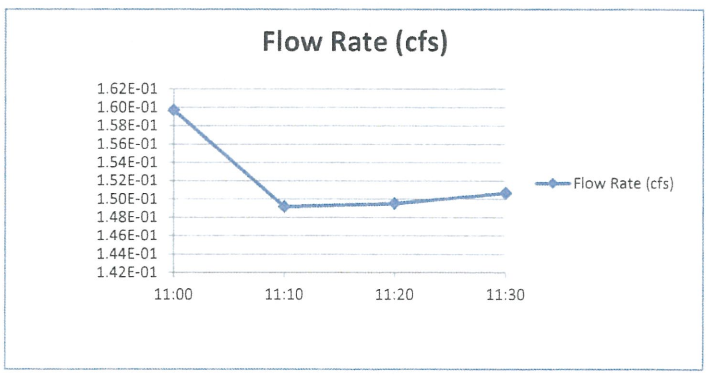
Test Location: Existing Drywell

Depth: 20'

Time	Elapsed Time (seconds)	Depth to Water (feet)	Flow Meter Reading (ft^3)	Volume of Water (ft^3)	Flow Rate (cfs)
10:00	0	19.5	596.6		
11:00	3600	18.2	1171.5	574.90	1.60E-01
11:10	600	18.2	1261.0	89.50	1.49E-01
11:20	600	18.2	1350.7	89.70	1.50E-01
11:30	600	18.2	1441.1	90.40	1.51E-01
11:35		18.3			
11:40		18.6			
11:45		19.1			
11:50		19.5			

Average Flow Rate: 1.50E-01





P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

OPERATIONS AND MAINTENANCE PLAN
FOR PAINTED HILLS PRD FLOOD CONTROL SYSTEM

Owner: Black Realty Inc.
Party responsible for Operations & Maintenance: Painted Hills PRD Homeowners Assn.
Parent Parcel Number(s): 45336.9191, 45334.0106, .0108, .0109, .0110, .0113, .0114, .9135, 44040.9144
LOCATED IN SECTION 33 & 34, T25N, R44E & SECTION 4, T24N, R44E, W.M.
SPOKANE COUNTY, WASHINGTON

The above parent parcels contain the Painted Hills PRD flood control drainage and levee system.

The residential lot owners, commercial property owners and multi-family property owners of Painted Hills PRD are benefitting from these flood control facilities. The homeowners association of this project is responsible for (details described later):

- The continued operations and maintenance, including repair and replacement as needed, of these facilities,
- Providing funds to finance the continued operation and maintenance of these facilities,
- The administration of this agreement with each property owner being bound by this agreement and with the responsibilities to be shared equally between each Painted Hills PRD property owner, and,
- Establishing a maintenance committee and designating a member to be responsible for the administration of this plan.

This operations and maintenance plan runs with the land and is binding upon the Painted Hills PRD Homeowners Association property owners, their heirs, successors and assigns.

The City of Spokane Valley assumes no responsibility at all for any operations or maintenance of facilities mentioned herein or the administration of this plan.

1.00 PURPOSE

This plan is to provide:

1. General operations and maintenance responsibilities for the facilities described herein, and

2. Cost estimates of the assessments to be paid by each property owner mentioned herein for the funding of this maintenance.

2.00 GENERAL OPERATIONAL CHARACTERISTICS

Drainage Facilities

The Painted Hills PRD flood control drainage and levee system is intended to collect and discharge stormwater runoff generated by upstream basins and, possibly, stormwater from adjacent properties that has historically flowed into the property and identified on FEMA panel as compensatory storage. The drainage facilities consist of a box culvert under Thorpe Road, a five foot wide concrete channel, a 48" and 60" concrete pipe mainline, manholes, a bio-infiltration swale and a drywell/gravel gallery infiltration field with associated pipe, manholes and headwalls. The system includes 4-18" culverts under Madison Road. A levee along the northerly side of Chester Creek between Thorpe Road and Dishman-Mica Road and then extending along the northerly side of Dishman-Mica Road to Wilbur Road is also a part of the system.

A portion of stormwater runoff from the upstream basins south of the project flows in the Chester Creek channel under Thorpe Road continuing northwesterly under Dishman-Mica Road. The levee provides flood protection of the development site from Chester Creek.

The remainder of stormwater runoff from upstream basins south of the project flows under Thorpe Road via the box culvert, enters the concrete channel, then flows in the pipe system, through the bio-infiltration swale into the drywell/gravel gallery infiltration field at the north end of the site where the flow is stored and infiltrated into the ground.

Stormwater runoff from upstream basins east of the project flows under Madison Road in 18" culverts and outfalls into the 60" pipeline via manholes.

It is important to provide adequate maintenance activities to ensure that the flood control facilities remain silt and debris free, as this silt and debris will affect their performance. Additionally, vegetation must be maintained to prevent erosion of the levee. Maintenance details are discussed below in Section 3.0.

3.00 MAINTENANCE REQUIREMENTS AND SCHEDULES

Drainage Facilities

The drainage facilities consist of several elements including: box culverts, stream channel, levee, concrete channel, storm drain mainline, culverts, outlet structure, bio-infiltration swale, inlet structure, drywell/gravel gallery infiltration field, manholes, catch basins, access roads, headwalls with trash racks and fencing. These elements are located as shown on the attached exhibit. The following describes these facilities and the recommended maintenance.

A comprehensive visual inspection of the complete flood control drainage facilities should be conducted twice a year. More frequent inspections for various elements may be required as described below. For long duration storms, greater than 24 hours, the drainage facilities should be inspected during the storm event to identify any developing problems and safely correct them before they become major problems. Signs shall be posted notifying all residents to look for "potential" problems and to notify the homeowners' association of those observations.
In general it is important to provide adequate maintenance activities to ensure that the vegetated areas and structures remain silt, dirt and debris free because accumulations of these will affect the facilities function for stormwater storage volume as well as the ability of the drywells/gravel galleries to discharge

stormwater. Should these facilities fill up or become clogged, the flood control system will not function as intended putting areas at risk of flooding. Therefore, periodic maintenance is a must.

Box Culvert:

There are three box culverts adjoining the project site. These box culverts are within the public road right of way and will be maintained by the agency having jurisdiction (AHJ) of the roadway. Any problems noticed while inspecting or maintaining other elements of the system should be reported to the AHJ.

Chester Creek and Levee:

Chester Creek extends across the southwest corner of the site from Thorpe Road northwesterly for approximately 900 feet where it crosses under Dishman-Mica Road. The creek carries seasonal flows from the foothills to the south. The site is protected from flood flows by a levee along the northerly side of the creek. The creek channel and levee need to be maintained to ensure flood flows are prevented from entering the site. Maintenance of the channel and levee shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Regular mowing, grass should be kept at about 2-4 inches in height,
- Removing trash, debris, noxious weeds plus items that reduce the amount of vegetative cover,
- Removing any starts of woody vegetation that appear in the channel or on the levee side slopes,
- Repairing any holes caused by animals on the levee side slopes,
- Inspecting the levee side slopes and channel bottom making sure there are no breaches or breaks or erosion. Immediately repair with a sandy loess soil, compacted in place and follow up after the storm event with seeding or sodding the repair and more substantial maintenance activities if needed,
- Repairing mowing damage,
- Removing and replacing of the grass and underlying soil if it becomes contaminated to the extent that the grass is not healthy.

Concrete Channel:

There is approximately 370 feet of 5 foot wide concrete open channel extending from the easterly box culvert under Thorpe Rd to the corner of Thorpe Road and Madison Road. At Madison Road the channel flow enters into a 48" pipe fitted with a trash rack. The channel needs to be maintained to ensure there is no debris or vegetation blocking the flow out of the box culvert and along the channel. Additionally, the trash rack at the end of the channel needs to be kept clear. Maintenance of the channel shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Visually inspecting twice a year the walls and floor surface of the channel for damage or wear that would compromise the channel integrity.
- Prior to each rainy season (August or September), inspecting the channel ensuring that there is no debris present.
- Following large storm events or rapid snow melt events performing a visual inspection and

remove any deleterious debris and trash.

- Instructing those performing other maintenance functions on the system to report any observed damage to the channel.

Storm Drain Mainline:

The storm drain mainline consists of 277 feet of 48" and 2174 feet of 60" RCP pipe from the downstream end of the concrete channel at Thorpe Rd and Madison Rd, running parallel to Madison Rd and ending at the bio-infiltration swale at the north end of the site. Additionally, there is 630 feet of 36" HDPE pipe from the downstream end of the bio-infiltration swale to the drywell/gravel gallery infiltration field. The pipes need to be maintained to prevent sediment and trash build-up in the bio-infiltration swale and the drywell/gravel gallery infiltration field. Maintenance of the storm drain mainline shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Annually inspecting the pipe openings on each end to ensure there is no blockage or damage to the ends.
- Every three years or after substantial storm runoff, performing a TV inspection of the pipe looking for blockages, damage, etc.,
- Removing sediment build-up from the pipe,
- Repairing any sections of damaged pipe.

Manholes & Catch Basins:

The mainline pipe system has manholes at pipe junctions and angle points. Along Madison Road there are catch basin connected by pipe to the mainline pipe system to drain overflow from the roadside swales. Manholes and catch basins need to be maintained to prevent blockage of flow within the system. Contact a professional to remove the debris, trash and sediment buildup. HOMEOWNERS ARE NOT TO ENTER THE MANHOLES. Maintenance of the manholes and catch basins shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- During routine landscape maintenance of roadside swales, removing any debris from catch basin grates.
- Annually inspecting catch basins for trash and sediment build-up and removing trash.
- When sediment build-up fills ½ the depth of the sump (about 1 foot), removing the sediment.
- Annually inspecting manhole lids and catch basin grates to ensure they are properly seated and are structurally sound.
- Every five years, inspecting the structure walls to ensure the concrete walls are in good condition and the joints remain sealed.
- Instructing those performing other maintenance functions on the system to report any missing lids or grates.

Cross Culverts:

The cross culverts consist of 18" CMP pipe crossing under Madison Road flowing from east to west in four locations. The culverts connect into manholes on the 60" storm drain mainline. The cross culverts need to be maintained to prevent the reduction of seasonal flows within the pipes. The reduction in flow may be caused by sediment or trash build-up within the pipe or obstruction of the pipe entrance on the east side of Madison Rd. Maintenance of the cross culverts shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Annually inspecting the culvert openings on the east side of Madison Rd to ensure there is no blockage or damage to the culvert end.
- Every five years performing a TV inspection of the pipe looking for blockages, damage, corrosion, etc.,
- Removing sediment build-up from the pipe,
- Repairing any sections of damaged or corroded pipe.

Bio-infiltration Swale:

The bio-infiltration swale consists of a grass lined channel approximately 450 feet long with a 6 foot bottom width and 3:1 side slopes. The swale needs to be maintained to perform the function of removing any remaining contaminants prior to storm water entering the infiltration field. Maintenance of the bio-infiltration swale shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Annually inspecting the channel bottom and side slopes to ensure there is a covering of grass.
- Reseeding any bare or dead areas of grass.
- Removing any noxious weeds.

Drywells/Gravel Gallery Infiltration Field:

The drywell/gravel gallery infiltration field consists of four trenches (10' wide by 13' deep by 450' long) filled with rock, 24" pipe running the length of each trench and drywells located at each end and at the middle. The drywells need to be maintained to prevent or reduce sediment buildup in the drywell barrel so as to not reduce infiltration into the surrounding ground. Maintenance of the drywells/gravel gallery infiltration field shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Visually inspecting twice a year the inside of the drywell barrel(s) by removing the lid to look into the structure. Have all debris and trash removed. Sediment must be removed before buildup reaches the bottom of the lowest slot out of the drywell in the barrel wall. Contact a professional to remove the debris, trash and sediment buildup. HOMEOWNERS ARE NOT TO ENTER THE DRYWELL.

Headwalls/Trash Racks:

The trash racks at the headwalls need to be maintained to ensure there is no debris preventing the flow of storm water through the system. Additionally, the trash racks need to be inspected for physical integrity to ensure that no one can enter into the pipe system unless required for inspection/repair. Maintenance of the headwalls/trash racks shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Visually inspecting twice a year the trash racks for damage or corrosion that would compromise the trash rack integrity.
- Prior to each rainy season (August or September), inspecting each trash rack ensuring that there is no debris present.
- Following large storm events or rapid snow melt events performing a visual inspection and remove any deleterious debris and trash.
- Instructing those performing other maintenance functions on the system to report any observed damage to the trash rack.

Fencing:

The fencing of various system elements needs to be maintained to restrict access to those elements and to protect the public. Maintenance of the fencing shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Visually inspect twice a year the entire fencing system for damaged fence fabric, posts, gates, etc.
- Prior to each rainy season (August or September), inspecting each access point ensuring that locks and gates are functional.
- Instructing those performing other maintenance functions on the system to report any observed breaches or damage to the fencing.

Access Roads/Parking Pads:

The access roads/parking pads to various system elements need to be maintained to allow maintenance vehicles access to those elements for periodic maintenance and emergency repairs to protect the public. Maintenance of the access roads/parking pads shall be the responsibility of the Painted Hills PRD Homeowner's Association.

Maintenance items include:

- Visually inspecting annually the entire access road/parking pad system for rutting, potholes, etc. Regrade and repair with additional aggregate as needed.
- Removing vegetation from the aggregate surface.
- Instructing those performing other maintenance functions on the system to report any observed damage to the access roads/parking pads.

4.00 SINKING FUNDS

A sinking fund is an account that is set up to receive regular deposits which are to be used for paying off future costs and debts. The sinking fund monies will be used to pay for planned and unplanned operation and maintenance costs along with certain future replacement costs for the storm drainage facilities. The sinking fund calculation should be revised as necessary to account for actual expenses and changes in rates.

In setting up the fund, first the future replacement costs are estimated and then they are converted to annual costs (or deposits) by the following calculations. These calculations assume that the inflation rate is 3% (for estimating the future replacement costs), the typical interest rate is 2% (for estimating the annual costs) and the number of years before replacement is 20. Equations and guidance for using other rates and years can be found in Appendix A.

1) Estimate the value that the item will have in the future when it is time to replace it using the following equation:
   FV=PV*1.8061, where: FV = future value
   PV = present value

2) Estimate how much money will need to be deposited each year in a bank account in order to have enough money accumulated in time to pay for the replacement using the following equation.
   A=FV*0.0412, where: A = annual payment (or deposit)
   FV = future value (from step 1, above)

Sinking Fund Calculation Results:

The developer shall provide $25,000 to initiate the set-up of maintenance funds.

The following values are the results of the calculations which are shown on the following page.

Annual cost for regular operation and maintenance	$25,954
Annual cost for replacements	$11,894
Total annual costs	$37,848
Total monthly costs (= total annual costs /12)	$3154
Number of units	580
Monthly cost per lot (= total monthly costs /# lots)	**$5.44**

Sinking Fund Calculations

REGULAR OPERATION AND MAINTENANCE COSTS

Description	Units	Annual Quantity x	Unit Price =	Annual Cost
Drywell cleaning	EA	12	$300	$3,600
Catch Basin cleaning	EA	4	$300	$1,200
Mowing	EA	4	$2,000	$8,000
Debris removal	EA	4	$2,000	$8,000
Channel/Trash Rack inspection	EA	2	$500	$1,000
Pipeline TV inspection(3 years-3,053)	LF	1018	$3	$3,054
Manhole inspection	EA	11	$100	$1,100
			Total	$25,954

REPLACEMENT COSTS (for more information on calculations in this table see Appendix A)

	Units	Quantity x	Unit Price =	Present Value, PV	n	Inflation Rate, i_1	Future Value, FV	Interest Rate, i_2	Annual Payment, A
Drywell(12)	EA	12	$4,000	$48,000	20	0.03	$86,693	0.02	$3,572
1/3 Manhole, 84" (9)	EA	3	$4,100	$12,300	20	0.03	$22,215	0.02	$915
¼ Manhole, 60" (2)	EA	0.5	$2,500	$1,250	20	0.03	$2,258	0.02	$93
18" Culvert (280)	LF	280	$50	$14,000	20	0.03	$25,286	0.02	$1,042
¼ Catch basin (4)	EA	1	$1,500	$1,500	20	0.03	$2,710	0.02	$112
Bio-infiltration swale-seeding (13,800)	SF	13,800	$0.10	$1,380	20	0.03	2,493$	0.02	$103
2" Asphalt pathway	SY	2340	$10	$23,400	20	0.03	$42,263	0.02	$1,742
6" CSTC Access Rd	CY	210	$40	$8,400	20	0.03	$15,172	0.02	$625
Grading Access Rd	SF	11,340	$1.25	$14,175	20	0.03	$25,602	0.02	$1,055
Fencing	LF	1770	$20	$35,400	20	0.03	$63,936	0.02	$2635
								Total	$11,894

Notes:
n = number of years to replacement
LS means Lump Sum, EA means Each, SY means square yard

IN WITNESS WHEREOF, the undersigned has reviewed the above information and determined it to be appropriate for the improvements proposed for this plan and has caused this instrument to be executed on this ____________day of ________________________, 20____.

Signature: ____

Name (print): ______________________________________

Title: ____

STATE OF WASHINGTON)
COUNTY OF SPOKANE)
CITY OF SPOKANE VALLEY) ss

I certify that I know or have satisfactory evidence that ________________________________is/are the individual(s) who personally appeared before me, and who acknowledged that he/she/they executed and signed this instrument and acknowledged it to be his/her/their free and voluntary act for the uses and purposes mentioned in this instrument.

Dated this __________ date of ______________________, 20____.

____
NOTARY PUBLIC
In and for the State of Washington,
Residing at ___________________________
My appointment expires: _________________

Appendix A

The future replacement costs can be estimated and then converted to annual costs (or deposits) by the following calculations.

1) Estimate the value that the item will have in the future when it is time to replace it using an assumed (best estimate) inflation rate and the following equation:

   $FV=PV*(1+i_1)^n$, where:

   FV = future value — i_1 = inflation rate

   PV = present value — n = number of years to replacement

   Example values for the factor: $(1+i)^n$

		n, years			
		5	**10**	**15**	**20**
i_1	**0.02**	1.1041	1.2190	1.3459	1.4859
	0.03	1.1593	1.3439	1.5580	1.8061
	0.04	1.2167	1.4802	1.8009	2.1911
	0.05	1.2763	1.6289	2.0789	2.6533

2) Estimate how much money will need to be deposited each year in a bank account in order to have enough money accumulated in time to pay for the replacement using an assumed (best estimate) interest rate and the following equation:

   $A=FV* i_2 / [(1+i_2)^n-1]$, where:

   A = annual payment — i_2 = interest rate

   FV = future value — n = number of years to replacement

   Example values for the factor: $i_2/[(1+i_2)^n-1]$

		n, years			
		5	**10**	**15**	**20**
i_2	**0.02**	0.1922	0.0913	0.0578	0.0412
	0.03	0.1884	0.0872	0.0538	0.0372
	0.04	0.1846	0.0833	0.0499	0.0336
	0.05	0.1810	0.0795	0.0463	0.0302

OPERATIONS AND MAINTENANCE PLAN FOR GUSTIN DITCH FLOOD CONTROL SYSTEM

Owner: Bar 4 Bar, Inc. & Timothy and Joanne Comer
Party responsible for Operations & Maintenance: Painted Hills PRD Homeowners Assn.
Parent Parcel Number(s): 45344.9108, 45343.9052
LOCATED IN SECTION 34, T25N, R44E, W.M.
SPOKANE COUNTY, WASHINGTON

The above parent parcels contain the Gustin ditch and levee drainage system.

The residents of Painted Hills PRD are benefitting from these flood control facilities. The homeowners association of the Painted Hills PRD project is responsible for (details described later):

- The continued operation and maintenance, including repair and replacement as needed, of these facilities,
- Providing funds to finance the continued operation and maintenance of these facilities,
- The administration of this agreement with each resident being bound by this agreement and with the responsibilities to be shared equally between each Painted Hills PRD property owner, and,
- Establishing a maintenance committee and designating a member to be responsible for the administration of this plan.

This operations and maintenance plan runs with the land and is binding upon the Painted Hills PRD Homeowners Association property owners, their heirs, successors and assigns until such time as the Gustin property (Parcel No. 45344.9108) develops and then the owner of that parcel will assume responsibility for this plan. Parcel No. 45343.9052 is covered by a storm drainage easement granted to Spokane County as recorded in Book 659 Page 1803.

Spokane County assumes no responsibility at all for any operations or maintenance of the facilities mentioned herein or the administration of this plan.

1.00 PURPOSE

This plan is to provide:

1. General operations and maintenance responsibilities for the facilities described herein, and

2. Cost estimates of the assessments to be paid by each property owner mentioned herein for the funding of this maintenance.

2.00 GENERAL OPERATIONAL CHARACTERISTICS

Drainage Facilities

The Gustin ditch and levee drainage system is intended to collect and discharge stormwater runoff generated by upstream basins and, possibly, stormwater from adjacent properties that has historically flowed into this ditch. The drainage facilities consist primarily of a 36" culvert outfall, a 3 foot bottom width ditch, a levee along the south side of the ditch, an existing gravel (borrow) pit (pond) and 18 drywells. Stormwater runoff from the upstream basins is routed under Hwy 27 through a 36" culvert into the ditch where the storm water flows to the west. At the west end of the ditch the storm water flows into the bottom of the existing borrow pit and infiltrates through the bottom of the pit. During larger storms the storm water will overflow into the drywells and infiltrate into the ground. It is important to provide adequate maintenance activities to ensure that the drainage facilities remain silt and dirt free, as this silt and dirt will affect their performance. Additionally, vegetation must be maintained to prevent erosion of the levee. Maintenance details are discussed below in Section 3.0.

3.00 MAINTENANCE REQUIREMENTS AND SCHEDULES

Drainage Facilities

The drainage facilities consist of a 36" culvert outfall, a 3 foot bottom width ditch, a levee along the south side of the ditch, an existing borrow pit (pond) and 18 drywells and are located as shown in the attached exhibit. The following describes these facilities and the recommended maintenance.

A visual inspection of the drainage facilities should be conducted each biennial. For long duration storms, greater than 24 hours, the drainage facilities should be inspected during the storm event to identify any developing problems and safely correct them before they become major problems.

In general it is important to provide adequate maintenance activities to ensure that the vegetated areas and structures remain silt, dirt and debris free because accumulations of these will affect the ditch's and pond's function for stormwater storage volume as well as the ability of the drywells to discharge stormwater. Should these facilities fill up or become clogged, the only remedy would be to remove the material. Therefore, periodic maintenance is a must.

Ditch with Levee:

The culvert outfall needs to be maintained to ensure there is no debris or vegetation blocking the flow out of the culvert. The ditch needs to be maintained to ensure a strong, healthy, dense vegetative cover and that it is free of debris. Maintenance of the ditch and outfall shall be the responsibility of the Painted Hills PRD Homeowner's Association until such time as the Gustin property (Parcel No. 45344.9108) is developed. At that time the owner(s) of the new development shall assume responsibility for maintenance of the ditch and levee.

Maintenance items include:

- Regular mowing, grass should be kept at about 2-4 inches in height,
- Removing trash, debris, noxious weeds plus items that reduce the amount of vegetative cover,
- Removing any starts of woody vegetation that appear in the ditch or on the levee side slopes,
- Repairing any holes caused by animals on the levee side slopes,
- Inspecting the ditch side slopes, levee side slopes and bottom making sure there are no breaches or breaks or erosion. Immediately repair with a sandy loess soil, compacted in place and follow up after the storm event with seeding or sodding of the repair and more substantial maintenance activities if needed,
- Repairing mowing damage,
- Removal and replacement of the grass and underlying soil if it becomes contaminated to the extent that the grass is not healthy.

Pond & Drywells:

At the borrow pit the pond bottom needs to be maintained to ensure there is no debris, vegetation or sediment preventing the infiltration of storm water through the bottom of the pond. Also, that no debris, vegetation or sediment buildup rise to a level that would allow it to enter into the drywells. Drywells need to be maintained to prevent or reduce sediment buildup in the drywell barrel so as to not reduce infiltration into the surrounding ground. Maintenance of the pond and drywells shall be the responsibility of the Painted Hills PRD Homeowner's Association until such time as the Gustin property (Parcel No. 45344.9108) is developed. At that time the owner(s) of the new development shall assume responsibility for maintenance.

Maintenance items include:

- Periodically visually inspect the grate and remove any deleterious debris and trash.
- Biennially visually inspect the inside of the drywell barrel(s) by removing the grate to look into the structure. Have all debris and trash removed. Sediment must be removed before buildup reaches the bottom of the lowest slot out of the drywell in the barrel wall. Contact a professional to vacuum out the debris, trash and sediment buildup. HOMEOWNERS ARE NOT TO ENTER THE DRYWELLS.

4.00 SINKING FUNDS

A sinking fund is an account that is set up to receive regular deposits which are to be used for paying off future costs and debts. The sinking fund monies will be used to pay for planned and unplanned operation and maintenance costs along with certain future replacement costs for the storm drainage facilities. The sinking fund calculation should be revised as necessary to account for actual expenses and changes in rates.

In setting up the fund, first the future replacement costs are estimated and then they are converted to annual costs (or deposits) by the following calculations. These calculations assume that the inflation rate is 3% (for estimating the future replacement costs), the typical interest rate is 2% (for estimating the annual costs) and the number of years before replacement is 20. Equations and guidance for using other rates and years can be found in Appendix A.

1) Estimate the value that the item will have in the future when it is time to replace it using the following equation:

   FV=PV*1.8061, where: FV = future value
   PV = present value

2) Estimate how much money will need to be deposited each year in a bank account in order to have enough money accumulated in time to pay for the replacement using the following equation.

   A=FV*0.0412, where: A = annual payment (or deposit)
   FV = future value (from step 1, above)

Sinking Fund Calculation Results:

- The following values are the results of the calculations which are shown on the following page.

Annual cost for regular operation and maintenance	$10,500
Annual cost for replacements	$7,076
Total annual costs	$17,576
Total monthly costs (= total annual costs /12)	$1,465
Number of units	580
Monthly cost per unit (= total monthly costs /# units)	**$2.53**

Sinking Fund Calculations

REGULAR OPERATION AND MAINTENANCE COSTS

Description	Units	Annual Quantity x	Unit Price =	Annual Cost
Drywell Cleaning	EA	18	$250	$4,500
Mowing	EA	4	$500	$2,000
Debris removal	EA	4	$1,000	$4,000
			Total	$10,500

REPLACEMENT COSTS (for more information on calculations in this table see Appendix A)

	Units	Quantity x	Unit Price =	Present Value, PV	n	Inflation Rate, i_1	Future Value, FV	Interest Rate, i_2	Annual Payment, A
Drainage Structures	LS	18	$4,000	$72,000	20	0.03	$130,040	0.02	$5,358
6" CSTC Access Rd	CY	221	$40	$8,840	20	0.03	$15,966	0.02	$658
Grading Access Rd	SF	11,400	$1.25	$14,250	20	0.03	$25,737	0.02	$1,060
								Total	$7,076

Notes:
n = number of years to replacement
LS means Lump Sum, EA means Each, SY means square yard

IN WITNESS WHEREOF, the undersigned has reviewed the above information and determined it to be appropriate for the improvements proposed for this plan and has caused this instrument to be executed on this ____________day of _________________________, 20____.

Signature: ____

Name (print): ____

Title: ____

STATE OF WASHINGTON)
COUNTY OF SPOKANE)
CITY OF SPOKANE VALLEY) ss

I certify that I know or have satisfactory evidence that ___________________________________is/are the individual(s) who personally appeared before me, and who acknowledged that he/she/they executed and signed this instrument and acknowledged it to be his/her/their free and voluntary act for the uses and purposes mentioned in this instrument.

Dated this __________ date of ______________________, 20____.

____
NOTARY PUBLIC
In and for the State of Washington,
Residing at ____________________________
My appointment expires: ___________________

Appendix A

The future replacement costs can be estimated and then converted to annual costs (or deposits) by the following calculations.

1) Estimate the value that the item will have in the future when it is time to replace it using an assumed (best estimate) inflation rate and the following equation:

   $FV=PV*(1+i_1)^n$, where:

   FV = future value — i_1 = inflation rate

   PV = present value — n = number of years to replacement

Example values for the factor: $(1+i)^n$

		n, years			
		5	**10**	**15**	**20**
i_1	**0.02**	1.1041	1.2190	1.3459	1.4859
	0.03	1.1593	1.3439	1.5580	1.8061
	0.04	1.2167	1.4802	1.8009	2.1911
	0.05	1.2763	1.6289	2.0789	2.6533

2) Estimate how much money will need to be deposited each year in a bank account in order to have enough money accumulated in time to pay for the replacement using an assumed (best estimate) interest rate and the following equation:

   $A=FV* i_2 / [(1+i_2)^n-1]$, where:

   A = annual payment — i_2 = interest rate

   FV = future value — n = number of years to replacement

Example values for the factor: $i_2/[(1+i_2)^n-1]$

		n, years			
		5	**10**	**15**	**20**
i_2	**0.02**	0.1922	0.0913	0.0578	0.0412
	0.03	0.1884	0.0872	0.0538	0.0372
	0.04	0.1846	0.0833	0.0499	0.0336
	0.05	0.1810	0.0795	0.0463	0.0302

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

August 21, 2017
Project No. 16-249A

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Full-Scale Drywell Testing**
Proposed Stormwater Management Facility
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As you authorized, we have completed a full-scale drywell test on the drywell installed at the above-referenced site in Spokane Valley, Washington. The purpose of the testing was to establish a design flow rate. This report summarizes the results of our site investigation, engineering analyses and recommendations.

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

P.O. Box 1566, Veradale, WA 99037
Phone 509-209-6262

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Lastly, we performed a geotechnical evaluation in July 2015 consisting of ten 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

FIELD EVALUATION

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) performed a full-scale drywell test on the Type 2 drywell (double depth) on May 6, 2016. The drywell test was performed in accordance with the Spokane Regional Stormwater Manual, Appendix 4B procedures. The drywell was installed at the location shown on Figure 3 (attached).

ANALYSIS AND RECOMMENDATIONS

We calculated a design outflow rate for the existing drywell using the results of the recent and previous laboratory tests and the procedures described in the SRSM manual, Appendix 4B (Full-Scale Drywell Test Method). Based on the test performed, we recommend using a design flow rate of 1.05 cfs for design. This recommended design outflow rate includes a safety factor of 1.1 as required by the SRSM. Attached are our calculations for the design outflow rate. If additional drywell barrels are added, the safety factor increases.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Paul T. Nelson, P.E.
Principal Engineer

PAUL T NELSON
STATE OF WASHINGTON
37228
REGISTERED
PROFESSIONAL ENGINEER
8-21-17

Attachments: Figure 1, Site Location Map
Figure 2, NRCS Map
Figure 3, Drywell Location Map
Laboratory Test Results
Full-Scale Drywell Test Results
Design Flow Rate Calculations

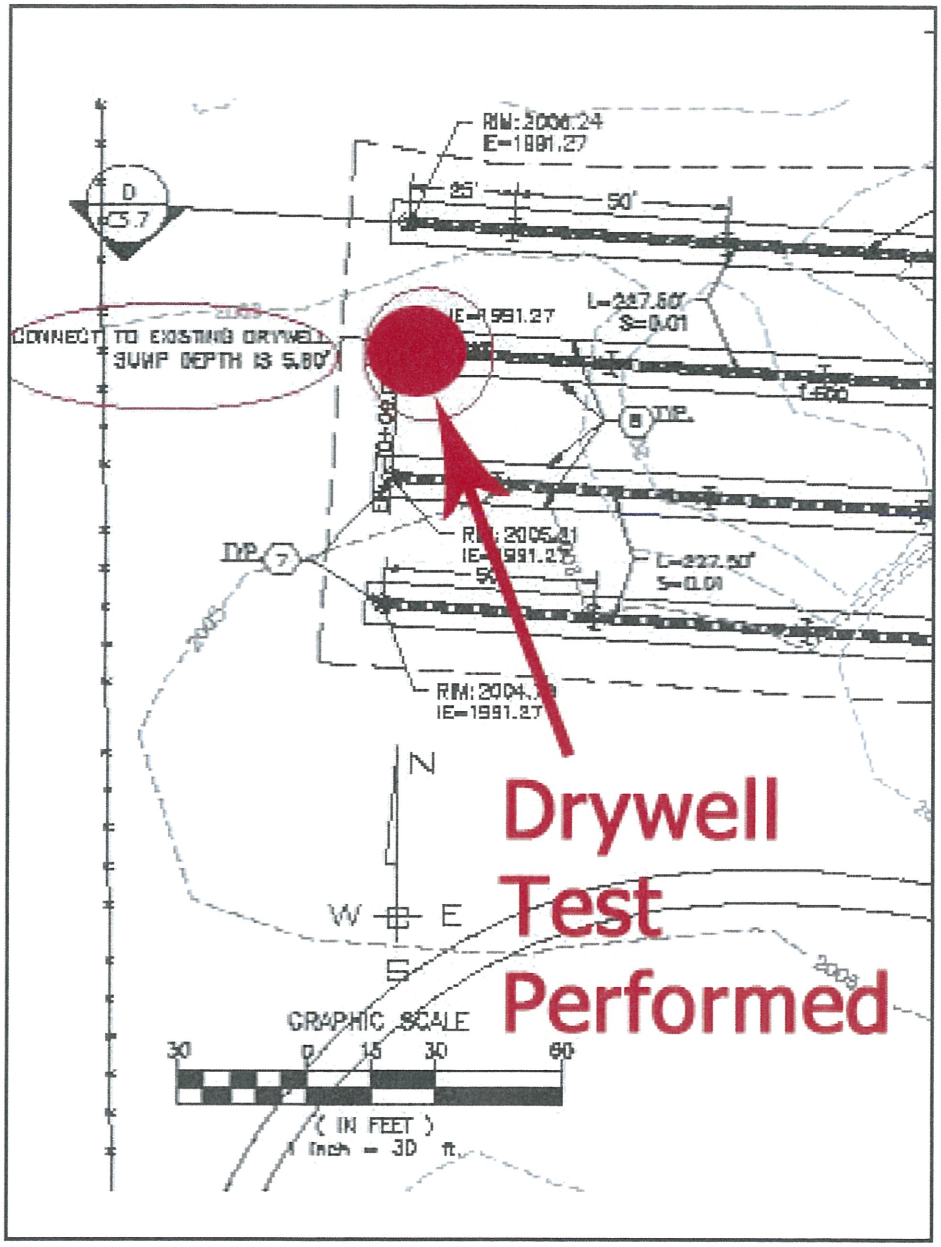
FIGURE 1

Site Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249A Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	June 28, 2016

FIGURE 2

NRCS Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249A Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	June 28, 2016

FIGURE 3



Boring Location Map		
IPEC Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 16-249A Painted Hills Golf Course 4403 South Dishman-Mica Road Spokane County, WA	August 21, 2017

IPEC

Inland Pacific Engineering Company
3012 North Sullivan Road, Suite C
Spokane Valley, WA 99216
Telephone: 509-209-6262
Fax: 509-290-5734

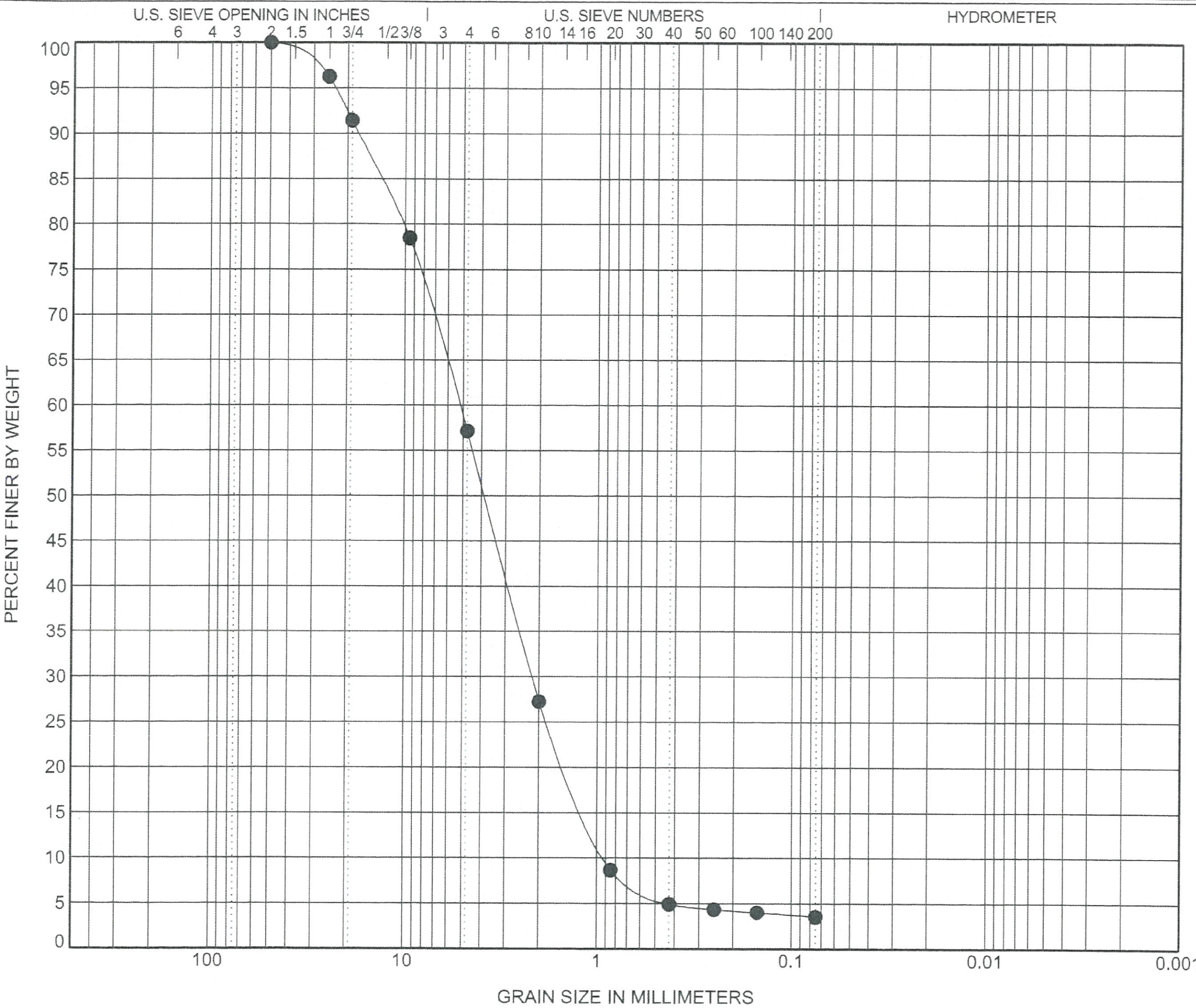
GRAIN SIZE DISTRIBUTION

CLIENT NAI Black

PROJECT NAME Painted Hills Drywell Test

PROJECT NUMBER 16-249A

PROJECT LOCATION 4403 South Dishman-Mica Road



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**L16-057**	**20.0**	**SP Poorly Graded Sand with Gravel**				**1.00**	**5.76**

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**L16-057**	**20.0**	**50**	**5.212**	**2.167**	**0.904**	**42.9**	**53.6**	**3.5**	

IPEC

Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

Full-Scale Drywell Test Results

Project Name: Painted Hills Drywell Test

Project Number: 16-249A

Client: NAI Black

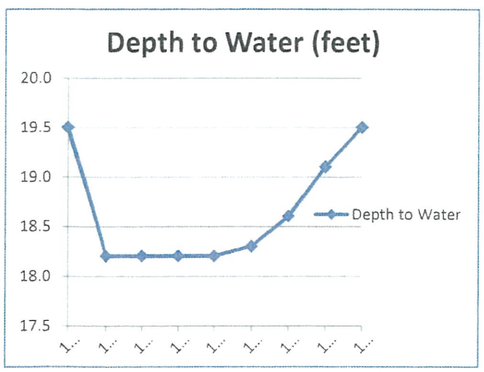
Test Date: 5/6/2016

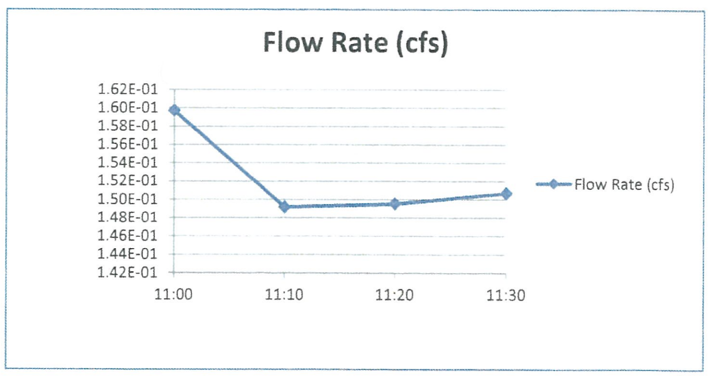
Test Location: Existing Drywell

Depth: 20'

Time	Elapsed Time (seconds)	Depth to Water (feet)	Flow Meter Reading (ft^3)	Volume of Water (ft^3)	Flow Rate (cfs)
10:00	0	19.5	596.6		
11:00	3600	18.2	1171.5	574.90	1.60E-01
11:10	600	18.2	1261.0	89.50	1.49E-01
11:20	600	18.2	1350.7	89.70	1.50E-01
11:30	600	18.2	1441.1	90.40	1.51E-01
11:35		18.3			
11:40		18.6			
11:45		19.1			
11:50		19.5			

Average Flow Rate: 1.50E-01





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Phone 509-209-6262

From SRSM Appendix B:

1.1 Calculate normalized outflow rate (q_A)

$$q_A = \left(\frac{Q}{H}\right) H_D$$

Q = stabilized flow rate from test
H = level of water in the drywell
H_D = maximum head in drywell (10 feet for double depth)

Q = 0.150 cfs
H = 1.3 ft
H_D = 10

$$q_A = \left(\frac{0.150}{1.3}\right)(10) = 1.15 \text{ cfs}$$

2.1 Determine Design Outflow rate (q_D)
From Table 4B-1 and 3.5% passing 200 sieve
FS = 1.1

$$q_D = \frac{q_A}{F.S.} = \frac{1.15}{1.1} = 1.05 \text{ cfs}$$

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Phone 509-209-6262

NAME OF PROJECT			SHEET NUMBER
Painted Hills Drywell Test			1 OF 1
COMPUTED BY	CHECKED BY	JOB NUMBER	DATE
ATN	ATN	16-249A	6-28-16

REPORT 11

Mounding Analysis (North Pond) Dated: August 22, 2017

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

August 22, 2017
Project No. 16-249

NAI Black
c/o Mr. Bryan Walker
107 South Howard
Suite 500
Spokane, WA 99201

Re: **Mounding Analysis**
Painted Hills Golf Course Property
4403 South Dishman-Mica Road
Spokane Valley, WA

Dear Mr. Walker:

As requested by Mr. Todd Whipple of Whipple Consulting Engineers, Inc. (WCE), we have prepared this report for the above-referenced site in Spokane Valley, Washington. The purpose of our services was to perform a mounding analysis for the proposed infiltration galleries at the north side of the site. This report summarizes the results of our additional engineering analyses and opinions.

AVAILABLE INFORMATION

We were provided a topographic survey for the project site by Whipple Consulting Engineers, Inc. (WCE). This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013. The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner.

We were also provided civil plans for the roadway improvements. The plans showed the layout and elevations of the proposed roadways and elevation contours. The plans were prepared by WCE and dated August 17, 2016.

In addition, we performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

We also performed a geotechnical evaluation for certification of the existing levee along Chester Creek in April 2014. The results of that evaluation are summarized in our Geotechnical Evaluation report dated February 12, 2015.

Furthermore, we performed a supplemental geotechnical evaluation in July 2015 consisting of ten, 50-foot borings in the south half of the property. The results of that evaluation are summarized in our Geotechnical Evaluation Phase 2 report dated July 23, 2015.

We also performed a second supplemental geotechnical evaluation at the north end of the property to evaluate soil conditions at depth and to better define the static groundwater elevation in this area. We then performed a full-scale drywell test on a drywell installed near Boring B-1 from our second supplemental geotechnical evaluation. The results of these evaluations are summarized in our Supplemental Geotechnical Evaluation dated April 19, 2016 and our Full-Scale Drywell Testing report dated June 28, 2016.

ANALYSIS AND OPINIONS

We performed a mounding analysis for the proposed infiltration galleries to assess potential down-gradient impacts due to infiltration of the 100-year flood event. We performed the analyses based on work by Bianchi and Muckel (1970) and using methods developed by Todd (1080). Using these methods, we estimated the geometry of groundwater mounding by using the hydraulic conductivity (permeability) calculated based on our full-scale drywell test using the United States Bureau of Reclamation USBR 7300-89 procedure and transmissivity of the soils to estimate the mounding as a function of distance from the center of an equivalent square pond basin.

We used a specific yield of 0.27 for the soils and an unsaturated aquifer thickness of 70 feet based on our previous borings. The annual stormwater volume and pond area were provided by WCE. The following table summarizes the input values.

Location	Water Volume (ft^3)	Total Gallery Area (ft^2)	Hydraulic Conductivity (cm/s)
Infiltration Gallery	72,384	33,928	7.1×10^{-3}

For the flood event stormwater volume, we calculated a groundwater mound height ranging from 9.01 feet at the pond center dissipating to less than 6 inches approximately 275 feet from the center of the pond. Based on the results of the mounding analysis and the depth to groundwater, it is our opinion that infiltration of stormwater in the proposed pond will not have significant down-gradient adverse impacts and will likely migrate north towards the Spokane River. Results of our mounding analysis are attached.

REMARKS

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

GENERAL REMARKS

It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,
Inland Pacific Engineering Company

Paul T. Nelson, P.E.
Principal Engineer

PAUL T NELSON — STATE OF WASHINGTON — 37228 REGISTERED — PROFESSIONAL ENGINEER
8-22-17

Attachments: 100-Year Flood Groundwater Mounding Analysis Results

IPEC
Inland Pacific Engineering Company
Geotechnical Engineering and Consulting

Project Number: 16-249 **Test Location:** Infiltration Gallery

Client: NAI Black

100-YEAR FLOOD GROUNDWATER MOUND HEIGHT CALCULATIONS - INFILTRATION GALLERY

Project: Painted Hills **k = 0.0071 cm/s**

Parameter	Symbol	Units	Distance										
Area of Infiltration	A_i	ft^2	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04	3.4E+04
Length of Equivalent Square for Basin	L	ft	184	184	184	184	184	184	184	184	184	184	184
Inflow Rate (total)	W_t	ft^3/day	72384	72384	72384	72384	72384	72384	72384	72384	72384	72384	72384
Inflow Rate (per unit surface area)	W	ft/day	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Time Since Start of Inflow	t	days	3	3	3	3	3	3	3	3	3	3	3
Distance From Center of Recharge	x	ft	0	92	184	276							
Hydraulic Conductivity	k	cm/s	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03	7.1E-03
Aquifer Thickness	b	ft	70	70	70	70	70	70	70	70	70	70	70
Transmissivity	T	ft^2/day	1409	1409	1409	1409	1409	1409	1409	1409	1409	1409	1409
Specific Yield	S_y	dimensionless	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Distance Ratio	x/L	dimensionless	0.00	0.50	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$L/(4Tt/S)^{0.5}$	ω	dimensionless	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
hS/Wt	ψ	dimensionless	0.38	0.25	0.14	0.02	0.00						
Mound Height	**H**	**ft**	**9.01**	**5.93**	**3.32**	**0.47**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Inland Pacific Engineering Company
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