Vine Creek Drainage Study

Matanuska-Susitna Borough

Prepared for:
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Final Report

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1.0 Introduction

Vine Creek drainage is located within the core area of the Matanuska-Susitna (Mat-Su) Valley. An area of Alaska which continues to show high rates of development. In response to concerns of increased urbanization and as part of the implementation of the Matanuska Susitna Borough (MSB) Stormwater Management Plan, the MSB contracted with HDL Engineering Consultants, LLC (HDL) to collect data and provide a comprehensive drainage investigation of Vine Creek. The primary goals of the study were to (1) collect stormwater field data that can be incorporated into the MSB GIS system, (2) investigate and define the extent of the creek connectivity, (3) identify contributing stormwater systems in need of improvement or replacement, and (4) incorporate the findings of this investigation together with summaries of other reports into one document for the Vine Creek watershed.

2.0 Scope

The anticipated scope of the study was created to provide some flexibility in final services, depending on the information discovered.

- **Field Investigation and Mapping-** HDL's field investigation evaluated drainage systems contributing to Vine Creek, culvert conditions, types and sizes, and areas of the creek that may present erosion or flooding hazards. Data collected from the field investigation was mapped using GIS. The GIS shape files were then transmitted to the MSB for use in their GIS database.

- **Preliminary Hydrological Analysis**- This report discusses applicable methods and assumptions for completing a hydrological analysis within the Vine Creek watershed. Peak flow estimates for key locations within the watershed are provided in Table 1.

- **Concept Designs and Estimates**- The intent of this task was to provide conceptual recommendations with preliminary cost estimates for needed improvements along the Vine Creek drainage area and should include Green Infrastructure as part of the concept design. The goal is for a future project, or projects to then take these concept designs and further develop them into final designs for implementation into the drainage corridor.

As the Mat-Su continues to be one of the fastest developing regions in southcentral Alaska, understanding the unique characteristics of the Vine Creek watershed is a key element in restoring stable hydrology and protecting water quality.

3.0 Background/ History

The Mat-Su Valley contains a dense network of wetlands, streams, and lakes, with many of them supporting anadromous and resident fish. Together, these features contribute to the Matanuska, Susitna, and Little Susitna Rivers all of which contribute directly to Cook Inlet. For this report we are investigating the Vine Creek watershed, which is a tributary to Little Meadow Creek and within the Fish Creek Watershed (HUC 19020~~5~~40~~514~~105) [1]. Vine Creek is located centrally within the core area of the Mat-Su Valley, northwest of the City of Wasilla. The

[1] Hydrologic Unit Code (HUC) were developed by the Advisory Committee on Water Information and the Federal Geographic Data Committee.

watershed extends from the wetlands west of Paradise Lake, and flows southwesterly under several road corridors (Seldon Road, Church Road, Parks Highway, and Vine Road) terminating in the wetlands or ground near Blodgett Lake. Blodgett Lake is spring fed, and a direct source to Little Meadow Creek, which connects to Meadow Creek to Big Lake to Fish Creek. The Vine Creek watershed in its entirety consists of approximately 10.7 square miles.[2]

Vine Creek is one of several mapped tributaries to Little Meadow Creek. A majority of the tributaries are unnamed. Identifying Vine Creek by name is a recent development. Some studies and maps simply identify this stream as part of the Little Meadow Creek watershed, or as an unnamed tributary. The United State Geological Survey (USGS) maps from the 1950's depict an unnamed stream at the Vine Creek location. The general location of Vine Creek can also be identified on an aerial photograph from 1951.

Based on earlier historical data, accounts of the area give no evidence of Vine Creek contributing surface flow as a tributary to Little Meadow Creek. A 1927, Bureau of Fisheries daily work log by J.E. Wilson, gives a detailed description of East Fork Meadow Creek (Little Meadow Creek), Lucille Creek, and Blodgett Lake. Mr. Wilson describes Blodgett Lake on June 10th, 1927 "*As this lake is formed by springs around the east end and along the south side, for about half its length, in addition to quite a number coming up through the lake bed, in the eastern portion."* The biologist doing this work was very detailed in describing other tributaries and identified no surface tributaries to Blodgett Lake or Little Meadow Creek near the vicinity of Vine Creek.

Today the watershed includes portions of undeveloped land, rural residential 1-acre parcels, aggregate quarries, and a few commercial/retail developments. With the highest concentration of development around the Meadow Lakes community.

4.0 Description of Study Area

4.1 Climate

The Mat-Su Valley is located in a transitional climatic zone varying between continental and maritime climates. The zone is characterized by pronounced diurnal and annual temperature variations, moderate annual precipitation, and moderate surface winds. Because of its proximity to the project area, the Wasilla 2 NE station was used for historical climate data. The station is located within the watershed, near Schrock Rd and has climate statistics from 16 years of data from 1968 to 1984. Climate data for the station was obtained from the Western Regional Climate Center.

In January, the average low temperature in the area is 6ºF and the average high temperature is 22ºF. In July, the average low temperature is 45ºF and the average high temperature is 67ºF. The area experiences an average of 55 wet days per year in which 0.1 inch or more of precipitation accumulates. Historical climate data is presented below:

- Mean Annual Temperature 35ºF
- Mean Annual Precipitation 18.3 inches
- Mean Annual Snowfall 59.3 inches
- Thawing Index 3000 degree days
- Freezing Index 3500 degree days

[2] Vine Creek Watershed (6,823Acres)- see Figure 1

4.2 Vine Creek Basin Soils

In general, soils in the Vine Creek watershed are part of the Kichatna-Deception-Kashwitna Association. This group of soils is typically well drained. The substratum ranges from extremely gravelly coarse sand to very gravelly loam. These soils typically have a high hydraulic conductivity which translates into high infiltration rates. The United States Department of Agriculture, Natural Resources Conservation Service describes these soils as follows:

Kichatna-Deception-Kashwitna (Western Matanuska Valley Glacial Uplands)- Composed of silt loams of very deep, well drained soils formed in loess over gravelly glacial drift. The loess mantle in these soils is an admixture of wind deposits from local braided floodplains, and volcanic ash from the southern Alaska Range and the Aleutian Range. Slopes range from nearly level to steep. The soil surface is typically covered with a thin layer of fibrous and partially decomposed moss and litter, and is typically silt loam 4 to 16 inches thick. The substratum of Kashwitna and Kichatna soils is extremely gravelly coarse sand. Deception has very gravelly loam or very gravelly sandy loam in the substratum. The relatively minor periodic additions of loess provide stable surface conditions and favorable soil development. Kichatna soils are part of Hydrologic Soil Group A. Kashwitna and Deception soils are part of the Hydrologic Soil Group B. Typically these soils have high to very high permeability 0.2 to 6.0 inches per hour.

The following minor soil components dominate the watershed streams, wetlands, and other natural depression areas:

- **Cryaquepts, depressional -** Composed of organic plant material over mucky gravelly loam with variable materials from 9 to 60 inches of depth. Very poorly drained, with a high ground water table of 0-18 inches. Part of hydrologic soil group D.
- **Histosols -** Composed of undecomposed to slightly decomposed organic material (Peat), beyond 60 inches is typically silty loam and extremely gravelly coarse sand. Very poorly drained, with a high ground water table of 0-3 inches. Part of hydrologic soil group D.

The Vine Creek watershed soils appear to play an important role in the activity of the streamflow. The above minor soil components are what you would expect to find in all areas of active streamflow. These minor components would have a very low hydraulic conductivity, with little to no infiltration. In intermittent stream flow areas you should expect to find soils more representative of the general properties of the Kichatna-Deception-Kashwitna Association, thus greater infiltration of the stream. It should be noted that the relatively shallow layer of Cyaquepts and Histosols over soil of high hydraulic conductivity results in a stream bed that is very sensitive to disturbance. For example, in the vicinity of Vine Road, it is possible that development may have disturbed an impervious surface layer, resulting in increased infiltration rates.

4.3 Vine Creek and Basin Characteristics

Vine Creek is best described as an intermittent, low-gradient, peatland stream hydrologically dominated by groundwater with broad wetlands. Direct surface water inputs are limited. One visible source is Zak Creek originating from Zak Lake. Zak Creek intercepts Vine Creek south of the Parks Highway and was actively flowing during our field investigation. Vine Creek then infiltrates into the ground east of Vine Road. During a heavy rainfall event, witnesses attest to runoff ponding on both sides of Vine Road with complete infiltration immediately west of Vine Road. Infiltration or intermittent stream conditions occur at several locations within the drainage, as shown in Figure 2.

In general, the Vine Creek watershed consists of moderate rolling terrain. The rolling terrain provides large areas of the watershed with no positive stormwater runoff outlet. This is commonly referred to as a "Sink" or "Depression". Several areas within the watershed can be found to have small natural sinks, which this investigation does not investigate entirely. Similar conditions could be created artificially as part of urban development. We have identified two urban development related sinks described as follows:

- **Wards Sink (1,950 acres)-** Containing the origin or headwaters of the watershed, this area of the basin is hydraulically isolated by two development impacts. Most notably is the installation of an undersized/perched culvert crossing at Wards Road. This culvert is located approximately 8-ft higher than the hydraulic gradeline of the creek. Further upstream, near the Seldon-Lucille intersection, is a rock quarry that was developed and also interrupts the stream flow, due to the depression created by the excavation of the quarry.
- **Spruce Sink (660 acres)-** Centered near the intersection of Spruce and Church Road. It is unclear if a stream or periodic surface runoff historically contributed to Vine Creek from this location. However, development impacts appear to have significantly decreased the potential for surface runoff to contribute to Vine Creek. Development appears to include two artificially constructed lakes and an active rock quarry. It is unclear what provisions the rock quarry maintains for hydraulic conductivity of the watershed. With this investigation no runoff was observed at or downstream of Church Road.

These sinks are depicted in Figure 3 of the Appendix.

Additionally the Vine Creek watershed was delineated into smaller sub-basins as shown in Figure 5. In general the sub-basin boundaries were created based on surface flow, land use, and soil properties. This information was completed using available digital data, with limited field verification.

5.0 Vine Creek Hydrology

5.1 Vine Creek Hydrological Analysis Recommendations

Because Vine Creek is an intermittent stream showing significant signs of groundwater influence, a hydrological analysis of the watershed, in whole, will likely produce inaccurate results. Typically the soils within the watershed infiltrate potential surface runoff at the source, leaving little to no surface contribution to Vine Creek. Developing an accurate hydrologic model to account for these conditions would require a significant amount of additional field data, which is outside the general scope/intent of this project. Common hydrologic analysis methods would be applicable to some very specific areas where parameters and assumptions can be defined and runoff is not directly infiltrated. For spring thaw conditions it should be assumed that the soil is saturated and frozen, essentially becoming impervious.

5.2 Estimating Flood Magnitude

The current recommendation by the State of Alaska Department of Transportation and Public Facilities (DOT&PF) for determining peak streamflow for Southcentral Alaska is a recently published statistical/data analysis method that was developed by the United States Geological Survey (USGS) in cooperation with the DOT&PF, Alaska Department of Natural Resources, and U.S. Army Corps of Engineers and was published as *Scientific Investigations Report 2016-*

5024[3]. In general, this method is valid for unregulated, non-urbanized watersheds, sized between 0.4 and 1,000 square miles. Vine Creek does have some urbanization and regulation, but the use of this equation still represents a valid estimate for the expected peak runoff from the Vine Creek watershed.

Regional regression equations for estimating annual exceedance-probability discharges for unregulated streams in Alaska are as follows:

$$Q_2 = 0.944A^{0.836} P^{1.023}$$

$$Q_5 = 2.47A^{0.795} P^{0.916}$$

$$Q_{10} = 4.01A^{0.775} P^{0.865}$$

$$Q_{25} = 6.53A^{0.755} P^{0.816}$$

$$Q_{50} = 8.79A^{0.743} P^{0.787}$$

$$Q_{100} = 11.4A^{0.732} P^{0.764}$$

$$Q_{200} = 14.3A^{0.723} P^{0.744}$$

$$Q_{500} = 18.7A^{0.712} P^{0.721}$$

Where

Q_T = T-year peak flow, in cubic feet per second (cfs)
A = drainage area in square miles (640 acres per sq mile)
P = Mean annual precipitation, Assume 20 inches

Table 1: Vine Creek Peak Flow Estimates

Basin Name (sq. miles)	*2-Year (cfs)*	*10-Year (cfs)*	*50-Year (cfs)*	*100-Year (cfs)*
Wards Sink (3.05)	51.4	127	213	254
Spruce Sink (1.03)	20.7	54.8	94.9	115
Vine Outlet at Parks Hwy (4.04)	65.0	158	262	312
Vine Outlet at Vine Rd (5.20)	80.3	192	316	376

For more information on how these numbers are determined please reference the USGS Report.

[3] *Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Based on Data through Water Year 2012; Scientific Investigations Report 2016-5024,* Published in 2016.

6.0 Existing Vine Creek Drainage Reports

HDL was asked to incorporate the findings of the following studies within this report. The reports are summarized as follows:

- **Lochcarron Glenn Subdivision; Road Inspection Report (2007) -** Completed by Erdman & Associates. Although this was identified as a drainage report, the purpose of the report was only to identify that a ditch was constructed at the intended location for subdividing purposes. The report did not provide detail of how the ditch would function during a storm event. HDL observed significant roadway flooding in Lochcarron Glenn Subdivision (January 2014) as documented with the Seldon Road and Lucille Street H&H Report.

- **Memory Lake (Subdivision) Drainage Study (2002) –** Completed by USKH. The study area of this report was the Meadow Lake Subdivision Unit II. The purpose of the study was to observe, identify, and document drainage problems and recommend improvement options that will improve the existing conditions. This report documents various drainage conditions impacting roads and developed properties. Additionally, this report discusses a berm located on Tract A-2, identified as obstruction #1. The berm, originally constructed in the 1960's, was breached in the 1970's. The report summarized the following conclusions:

    1. The drainage problems occur in areas that are relatively flat in which little or no provisions for drainage were made during construction. These problems are also the result of the roads in the subdivision blocking the natural drainage paths that existed.
    2. Adding additional material to the road in problem areas may fix the problem in that particular area, but will most likely just cause the problem to migrate to another location.
    3. The existing water table is naturally well below the existing ground surface and the water problems exist as a result of the blockage of drainage paths and ponding of surface water, not the surfacing of ground water.

- **Seldon Road and Lucille Street, Phase I & II; H&H Report (2015) –** Completed by HDL. This report was primarily associated with improvements to the Seldon Road & Lucille Street intersection. Seldon Road and Lucille Street cross Vine Creek near this intersection. This report evaluated both culverts and a general drainage evaluation of Vine Creek, both upstream and approximately ¼-mile downstream. Additionally, the history of flooding at Marilyn Circle Subdivision was discussed.

- **Parks Highway Connections – Museum Drive H&H Report (2010) –** Completed by HDL. This report was primarily associated with improvements to Museum Drive. Vine Creek crosses the Parks Highway near this location. This report includes an extensive discussion of Vine Creek and how development has likely changed the characteristics of the stream. The most notable characteristic is that Vine Creek just "Ends Abruptly" west of Vine Road. This location is also known to flood during the spring snowmelt when the ground is frozen and infiltration becomes impeded.

It should be noted that the HDL reports listed above evaluated peak runoff following USGS *Water-Resources Investigations Report 03-4188*, which is the predecessor to current *Scientific Investigations Report 2016-5024*. The current method estimates peak runoff rates approximately three times greater for the same basin criteria.

7.0 Other Useful Resources

Shallow Groundwater in the Matanuska-Susitna Valley, Alaska-Conceptualization and Simulation of Flow; USGS, Scientific Investigations Report 2013-5049
This report study's shallow groundwater movements within Mat-Su, including the interaction with small streams. Specifically, it discusses groundwater interactions with streams of similar characteristic and within close proximity to Vine Creek. Lucille Creek, located to the south of the Vine Creek watershed, was specifically mentioned.

8.0 Inadequate Storm Drainage Facilities & Proposed Improvements

Storm drainage structures within the watershed are limited to roadway culverts, catch basins, and ditches. In some areas west of Vine Road the exact location of stream flow appears to be unclear. Many areas of the historic flow path appear to have been filled in to promote development. Another significant concern for Vine Creek's natural state may be the reduction of runoff due to infiltration. Prior to urbanization the soils within the watershed would typically include a thin layer of organic topsoil capable of conveying a portion of surface runoff to the stream. Typical construction methods in the Mat-Su tend to disturb the organic topsoil layer, reducing runoff potential from the site and to the stream.

We have identified the following inadequate storm drainage areas and identified proposed improvements with preliminary project estimates:

Area A; Memory Lake Subdivision Berm- Drainage Obstruction #1, as identified in the Memory Lakes Drainage Study, still impedes runoff, forming a small lake on the upstream side. In general the berm appears to have little to no effect on adjacent residents, however it does present a risk to downstream homes and infrastructure. The breach resulted in a narrow channel and is susceptible to erosion, ice damming, and other possible regulation methods. These conditions could result in an unanticipated flood of water downstream of the berm. To reduce this potential condition, achieve greater continuity within the watershed, and provide a stable conveyance of runoff, widening and re-grading the breached channel is the minimum effort required. Complete removal of the berm and restoration of the area as a wetland would be the preferred solution, but likely require greater effort and construction impacts. A preliminary project estimate for permitting, design, excavation, and restoration of the wetland is $238,100.

Area B; Lucille Road- As identified in the previous reports, Vine Creek at Lucille Road is a location with a history of impact to adjacent properties. The poor culvert condition and tailwater ponding impacts the flow capacity of the culvert. The Seldon Road and Lucille Street Report identified replacement using an 87-inch span x 63-inch rise, arched culvert, which was a culvert in the MSB's storage inventory at the time. It is estimated that current sizing would minimally require placement of two 48-inch culverts, with a preliminary project estimate of $116,400.

Area C; Wards Road- During the field investigation it was noted that culverts at Wards Road were perched at an elevation significantly higher than the adjacent ground. While this culvert appears to have no impacts or safety concerns to the residents, maintaining hydrologic continuity within a stream basin is highly desirable. It is recommended that the culvert be replaced and located at an elevation that provides continuity within the watershed. It is estimated that sizing would require placement of two 48-inch culverts, with a preliminary project estimate of $119,400.

Area D; Meadow Lakes Urbanization- A collection of historical aerial photos document the changes to the Meadow Lakes area. Beginning around 1951, when the Parks Highway first started to reach this area, it can be seen how urbanization and construction improvements began interrupting the continuity of Vine Creek. At the time of this report there is very little evidence of Vine Creeks original flow path west of Vine Road in Meadow Lakes. Due to the high infiltration rate of the local soils, surface water is not a common occurrence, but should be expected during certain conditions. It is recommended that the MSB pursue a public awareness program and adopt some development requirements requiring drainage to be maintained throughout the area.

Itemized project estimates are shown with more detail in Appendix B of this report.

9.0 Limiting Factors to the Study

It is of particular importance to identify some limiting factors that may impact the study findings, results, or mapping accuracy. The general field conditions were not ideal for investigating overland stream flow, due to the lack of precipitation. In general, excessive or substantial rainfall is required to get a clear understanding of local stormwater inadequacies, ponding, and/or flooding. The fall of 2016 did not have such an event. HDL used other project reports as a testament to identifying areas with problems. The field investigation was limited to areas readily accessible by public property, ROW, or easements. The scope of the investigation was only intended to focus on Vine Creeks surface waters. While we were able to identify that Vine Creek is interacting with the groundwater, the details of this interaction was not further investigated.

10.0 Green Infrastructure

Green Infrastructure, as described by the EPA[4], uses vegetation, soils, and natural processes to manage water and create healthier urban environments. The intent is that Green Infrastructure reduces surface water pollutants by absorption and infiltration of the plants and soils at the source. This has the effect of reducing peak runoff flows in urbanized watersheds. The alternative method of managing stormwater is “Gray Infrastructure”, which is described as catch basins or other devices collecting runoff from impervious surfaces. Runoff is then piped or conveyed to an outlet, with little opportunity for infiltration or removal of pollutants. In general, Green Infrastructure was developed to improve stormwater quality of highly urbanized areas, primarily in the Lower 48 States. The existing stormwater systems are typically routing runoff directly to a stream or other surface water, with little to no opportunity for removal of pollutants. Additionally, the urbanization significantly increased the impervious area, increasing runoff

[4] Green Infrastructure Opportunities and Barriers in the Greater Los Angeles Region

volumes and peak flows from stormwater events. In these cases Green Infrastructure is typically introduced during redevelopment, with the goal of mitigating urban stormwater development impacts.

How can Green Infrastructure be applied to Vine Creek? Vine Creek does not contain infrastructure similar to the described "Gray Infrastructure" or have a problem with increased peak flow volumes. This is largely due to the very ample availability of infiltration within the area. The benefit to implementing Green Infrastructure on a formal level is to ensure adequate runoff contact with vegetation and topsoil. Vegetation and topsoil typically contain native microbes and other soil life that bind with and help breakdown pollutants. Additionally, this provides a surface elevation for the containment of pollutants. The following are some very simple Best Management Practices (BMP) that will provide an increased level of water quality and pollutant containment:

Bioswales- These are landscape elements designed to concentrate or remove silt and pollution from surface runoff. They consist of a swaled drainage course with gently sloped sides (less than 6%) and filled with vegetation. The water's flow path, along with the wide and shallow ditch, is typically designed to provide runoff 9-minutes of contact time with the vegetation[5], which is necessary for trapping pollutants and silt. Depending upon the geometry of land available, a bioswale may have a meandering or straight channel alignment.

Vegetated Strips - Also known as a Filter Strip, is a BMP that uses areas of dense vegetation (typically grass) with a flat cross slope to maintain sheet flow and remove sediment and other pollutants from runoff coming directly from pavement, or other impervious surfaces. Filter Strips are very effective along streets and other linear improvements.

Infiltration Basin- This is a type of BMP used to manage stormwater runoff, prevent flooding and downstream erosion, and improve water quality in an adjacent water body. It is essentially a shallow vegetated sump that is designed to infiltrate stormwater though permeable soils into the groundwater aquifer. Infiltration basins release water by infiltration and evaporation. A route for an emergency overflow should always be considered with the design.

As identified above, the key element to Green Infrastructure is to entrap pollutants and sediment in the vegetation and surface layer of the soil. Allowing runoff to infiltrate directly to sandy gravels does not provide this level of water quality treatment and could impact groundwater quality. It should be noted that some developments do produce pollutant runoff concentrations higher than the treatment capabilities of Green Infrastructure. The engineer should always implement a stormwater infrastructure capable of meeting the project requirements.

11.0 Conclusion

Field investigation, mapping, and research of Vine Creek was completed in the fall and winter of 2016. The investigation was primarily focused on identifying discharges to Vine Creek and

[5] *2012 Stormwater Management Manual for Western Washington as Revised 2014, Volume IV*

determining the extents of the watershed. ArcMap GIS database work was completed to display and manipulate the information.

The following key conclusions can be determined from this report:

1. In general, topography indicates Vine Creek is a tributary to Little Meadow Creek. Vine Creek is highly intermittent and appears to typically infiltrate into the ground prior to reaching a final surface termination point at Blodgett Lake. It is recommended that a drainage route be identified and protected from future development.

2. The soils within the Vine Creek watershed are generally coarse textured sands and gravels with high infiltration rates. Runoff tends to percolate through the soil rather than contribute to Vine Creek at the surface. Disturbance of the soil surface layer increases the infiltration potential. Recommendations for this include establishing Green Infrastructure improvements to increase entrapment of pollutants at the surface prior to contributing to the groundwater.

3. Development often occurs with little or no regard to the upstream or downstream conditions of the watershed. With development drainage is typically impacted to some extent. Local flooding could to be the result of a small change within the watershed. A recommendation is to require a drainage investigation stamped by a professional engineer familiar with hydrology to document the existing conditions and proposed upgrades, as part of the development or subdivision process.

4. In general, it was determined that approximately 30-percent of the upper portion of the watershed is not in continuity with the downstream portions. It is recommended that future improvements maintain continuity within the watershed. Additionally all estimation for peak runoff volumes should assume that the watershed has 100-percent continuity and frozen ground conditions impede infiltration.

The findings of this investigation support the fact that urbanization has a significant impact on the surface drainage and runoff patterns. In particular it should be noted that surface waters of Vine Creek are significantly influenced by groundwater and soil permeability. In general soil within the watershed has a very high permeability rate where runoff typically infiltrates prior to contributing to Vine Creek. It is therefore recommended that surface waters of Vine Creek be protected from urban development impacts as they are directly associated with groundwater.

Appendix A

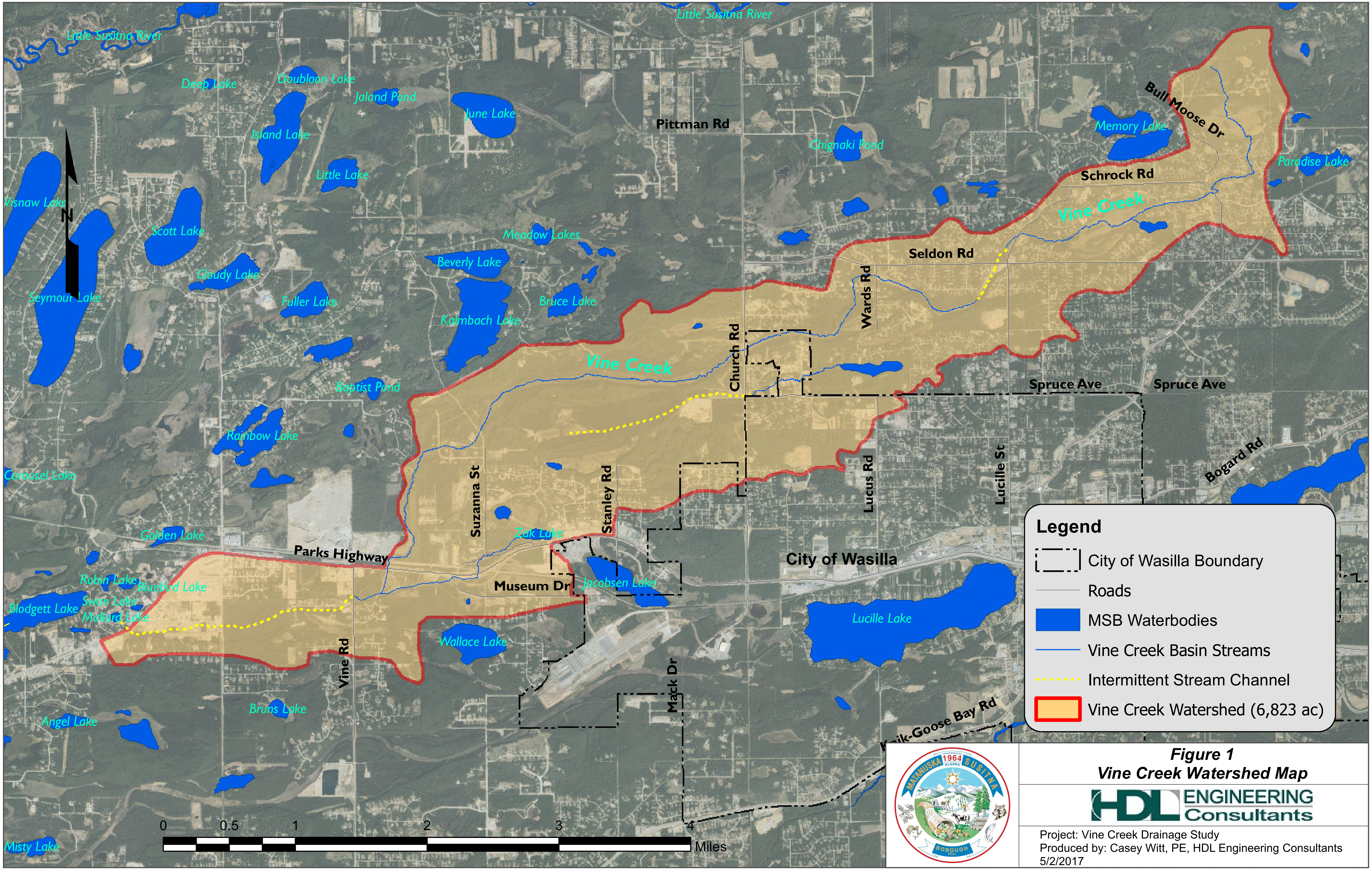
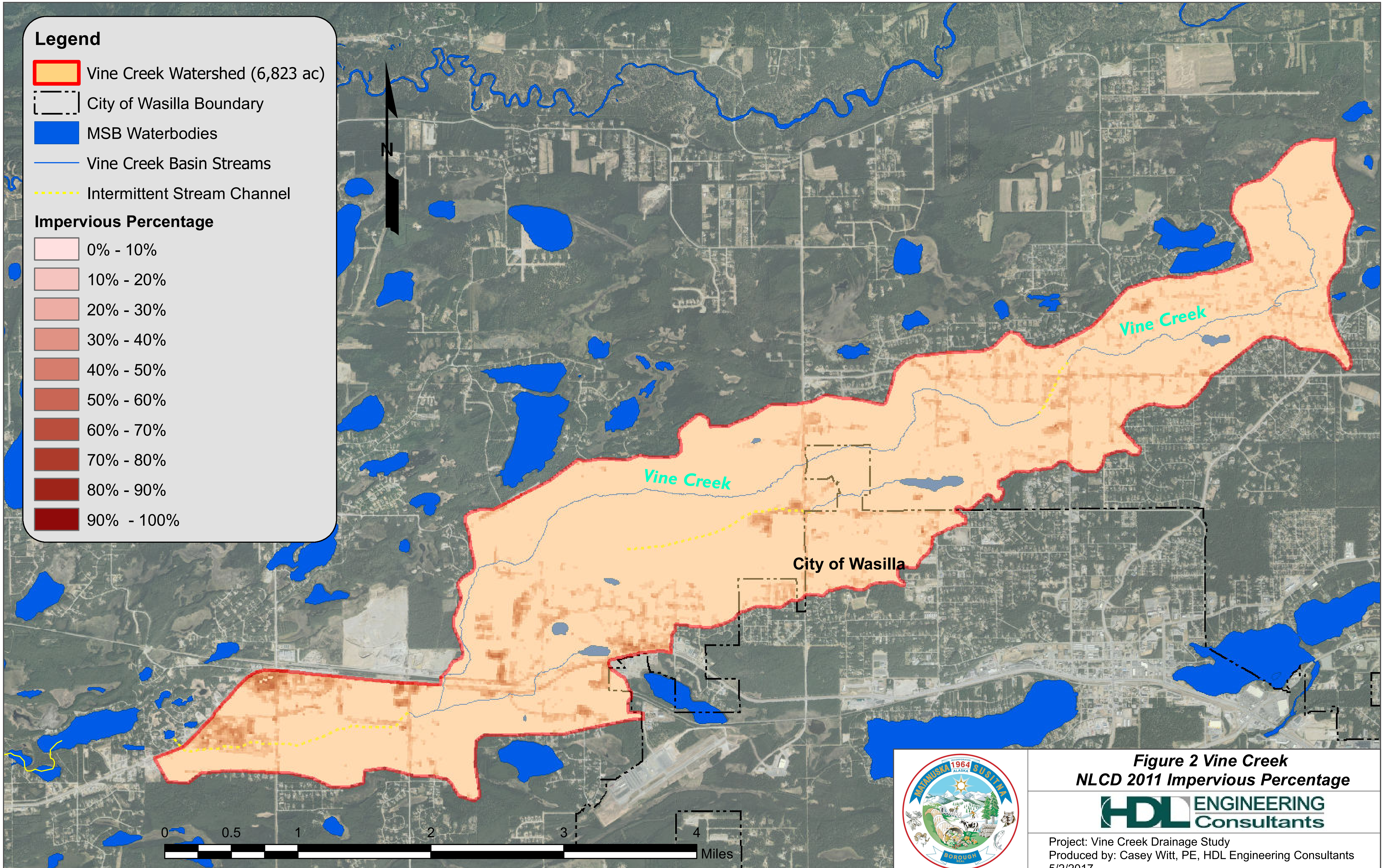


Figure 1
Vine Creek Watershed Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017


Legend
Vine Creek Watershed (6,823 ac)
City of Wasilla Boundary
MSB Waterbodies
Vine Creek Basin Streams
Intermittent Stream Channel
Impervious Percentage
0% - 10%
10% - 20%
20% - 30%
30% - 40%
40% - 50%
50% - 60%
60% - 70%
70% - 80%
80% - 90%
90% - 100%
N
Vine Creek
Vine Creek
City of Wasilla
0
0.5
1
2
3
4
Miles
Figure 2 Vine Creek
NLCD 2011 Impervious Percentage
HDL ENGINEERING Consultants
Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

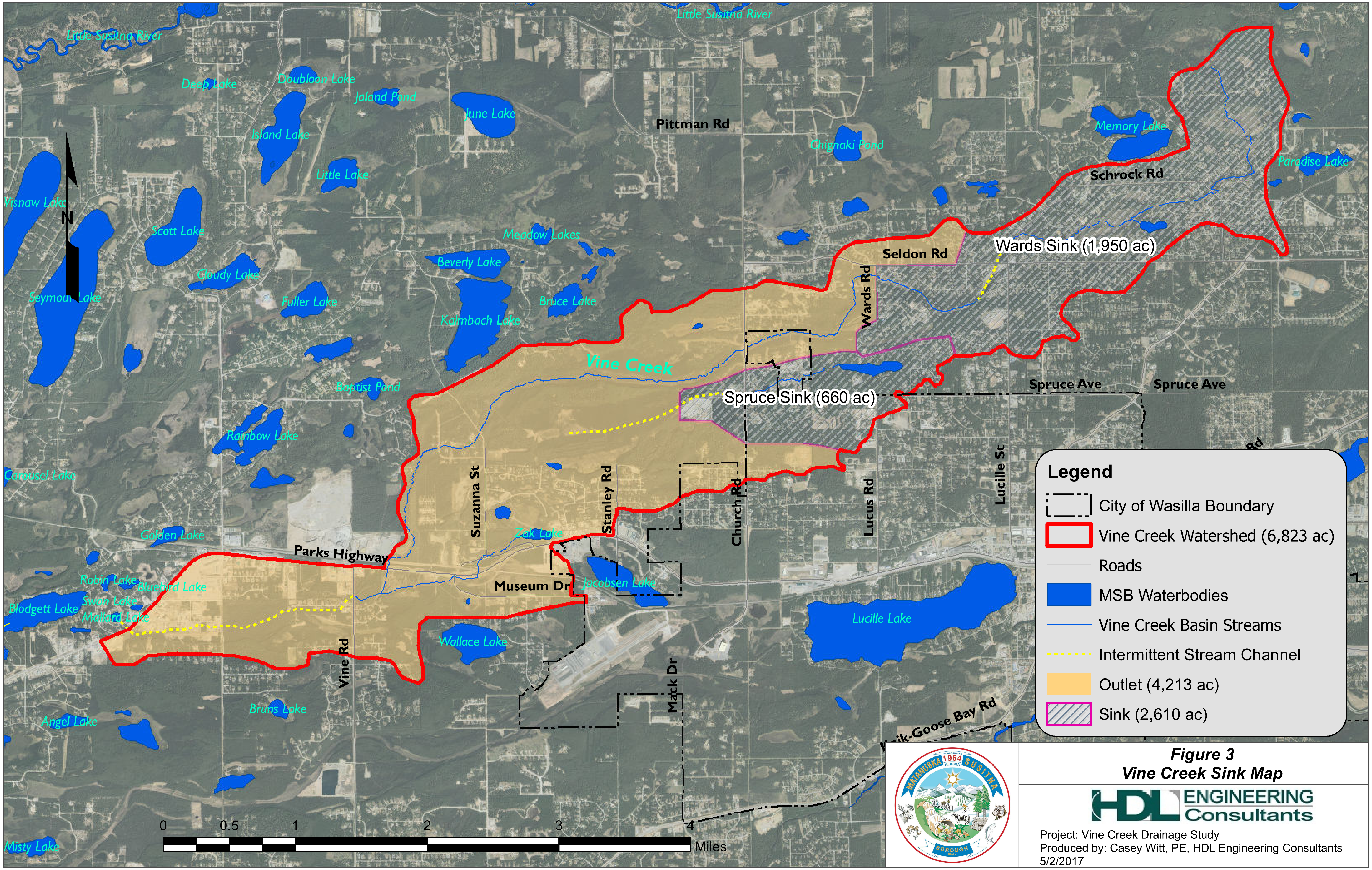


Figure 3
Vine Creek Sink Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

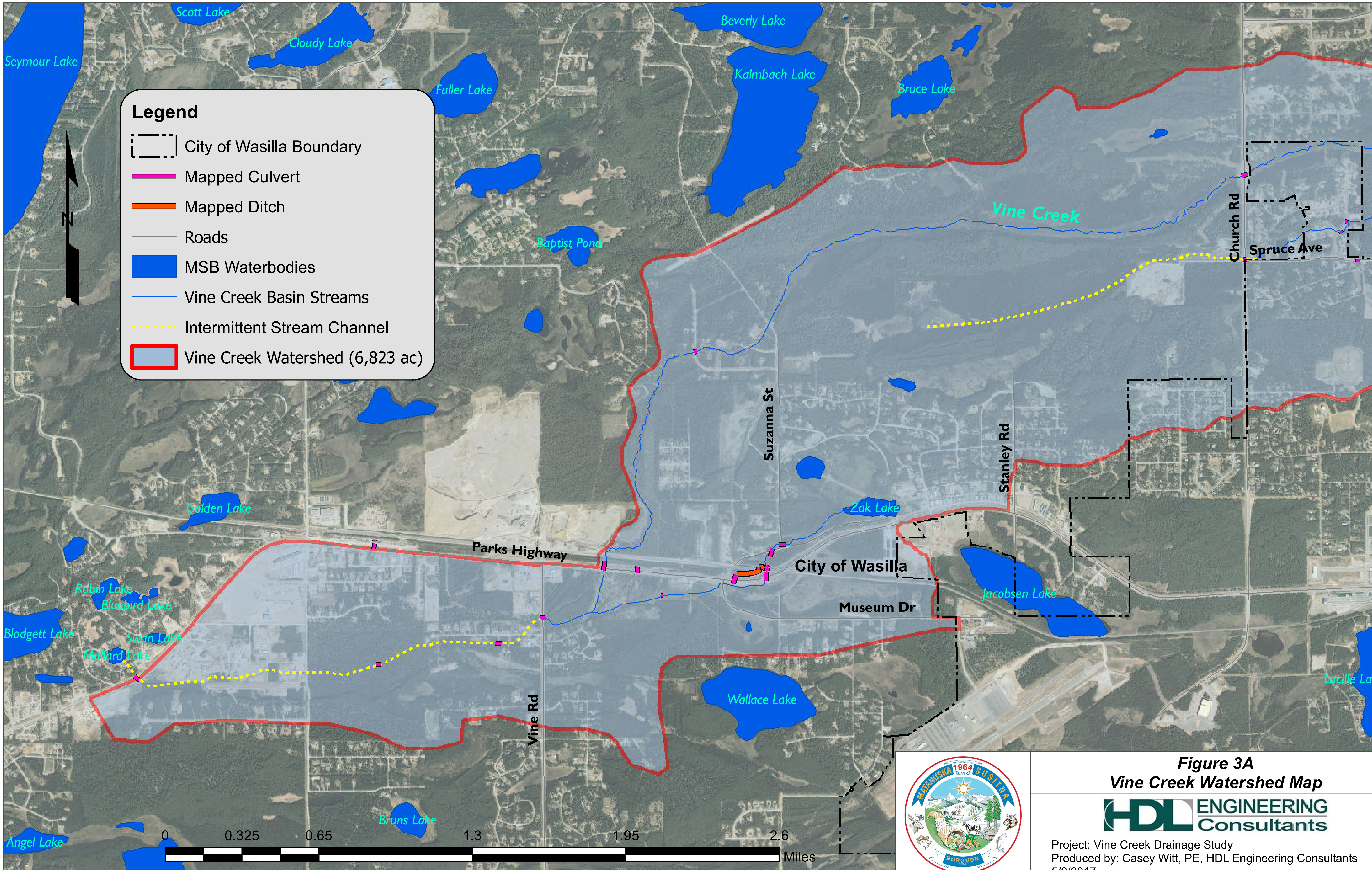


Figure 3A
Vine Creek Watershed Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

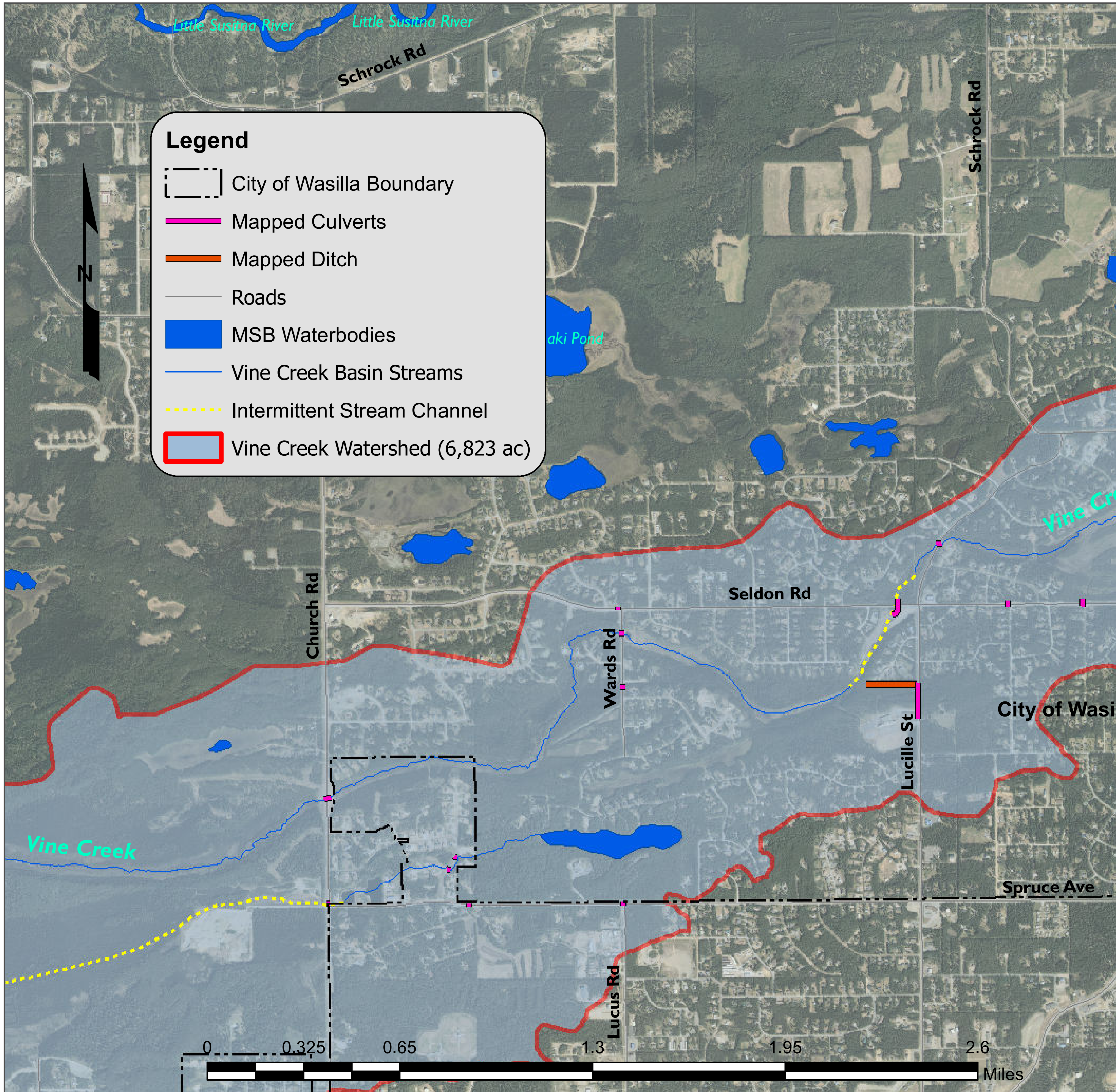


Figure 3B
Vine Creek Watershed Map

HDL ENGINEERING Consultants

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

B

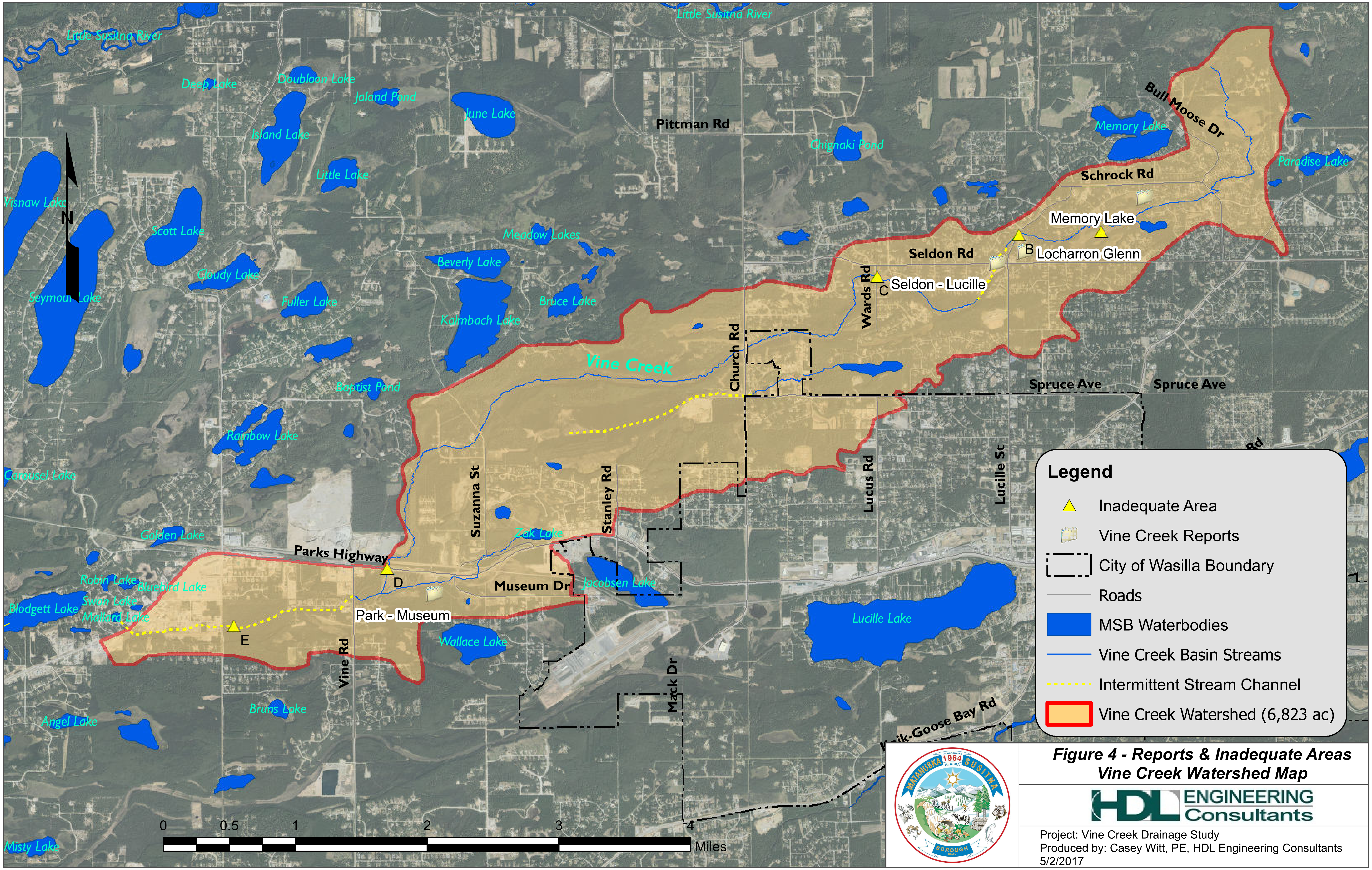


Figure 4 - Reports & Inadequate Areas
Vine Creek Watershed Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

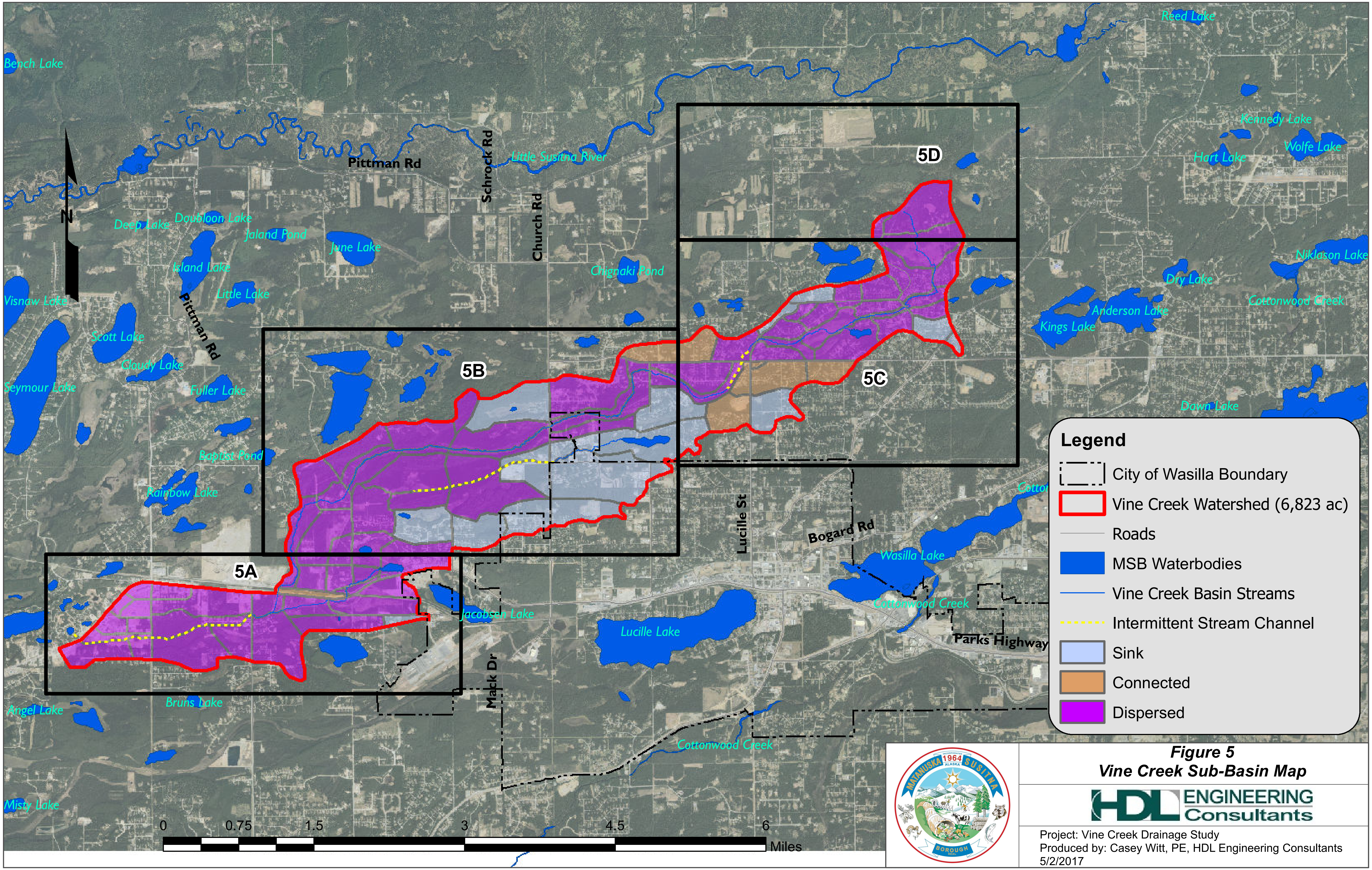


Figure 5
Vine Creek Sub-Basin Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

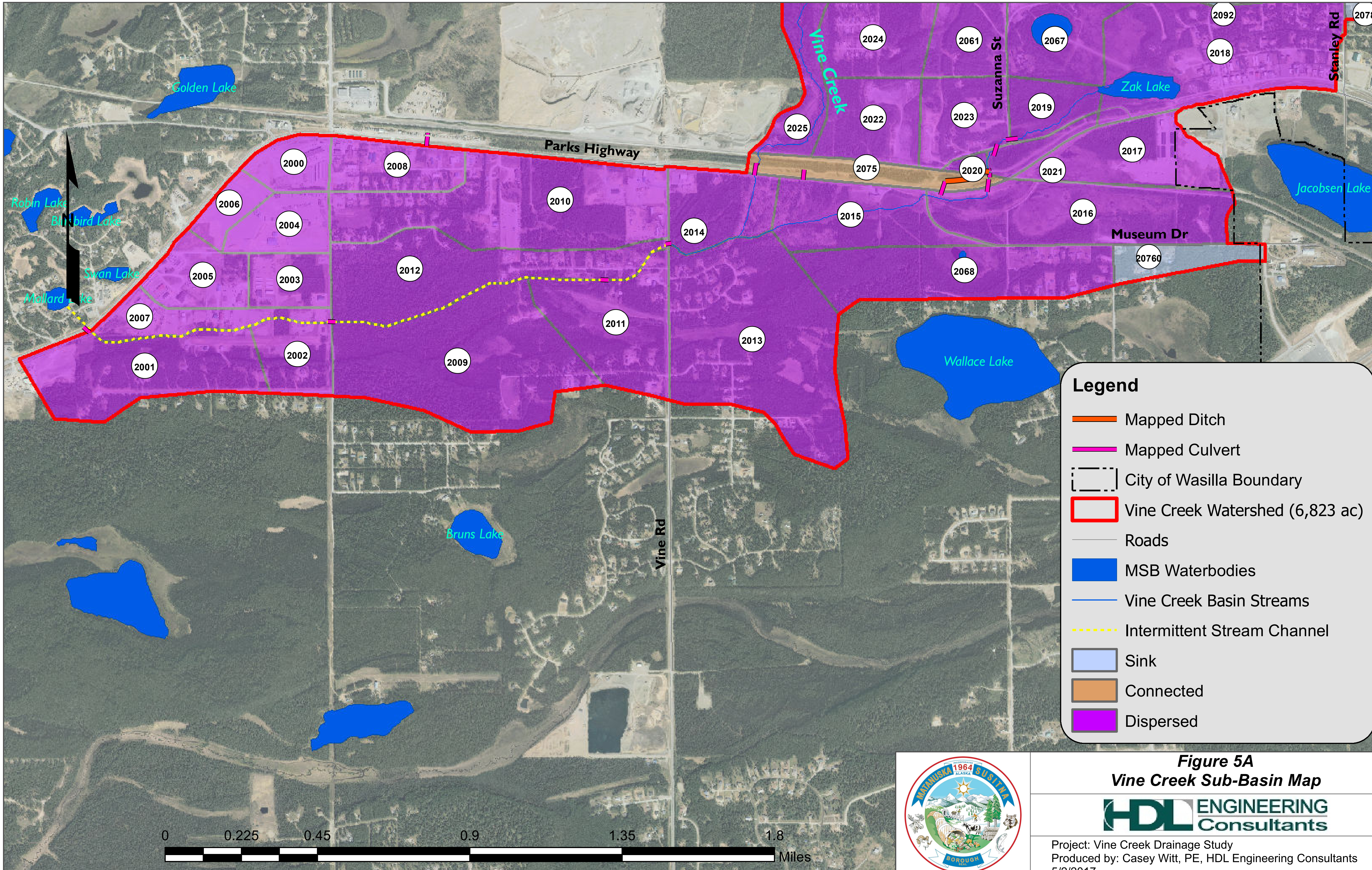
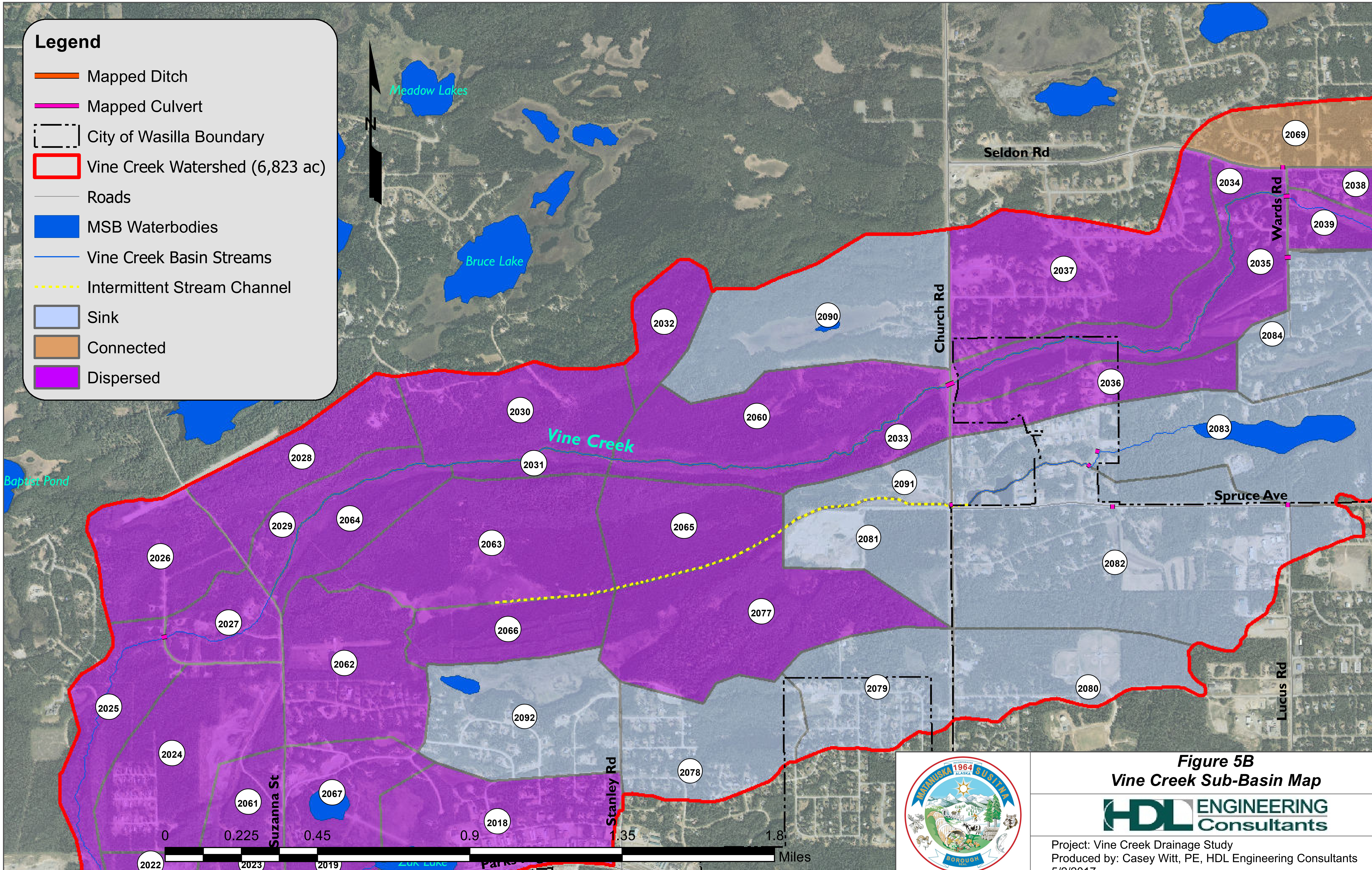


Figure 5A
Vine Creek Sub-Basin Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017



Legend
Mapped Ditch
Mapped Culvert
City of Wasilla Boundary
Vine Creek Watershed (6,823 ac)
Roads
MSB Waterbodies
Vine Creek Basin Streams
Intermittent Stream Channel
Sink
Connected
Dispersed
N
Meadow Lakes
Bruce Lake
Baptist Pond
Vine Creek
Seldon Rd
Church Rd
Wards Rd
Spruce Ave
Lucus Rd
Stanley Rd
Suzanna St
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2063
2081
2082
2026
2027
2077
2066
2062
2079
2080
2025
2092
2024
2078
2067
2061
2018
2022
2023
2019
0
0.225
0.45
0.9
1.35
1.8
Miles
Figure 5B
Vine Creek Sub-Basin Map
HDL ENGINEERING Consultants
Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

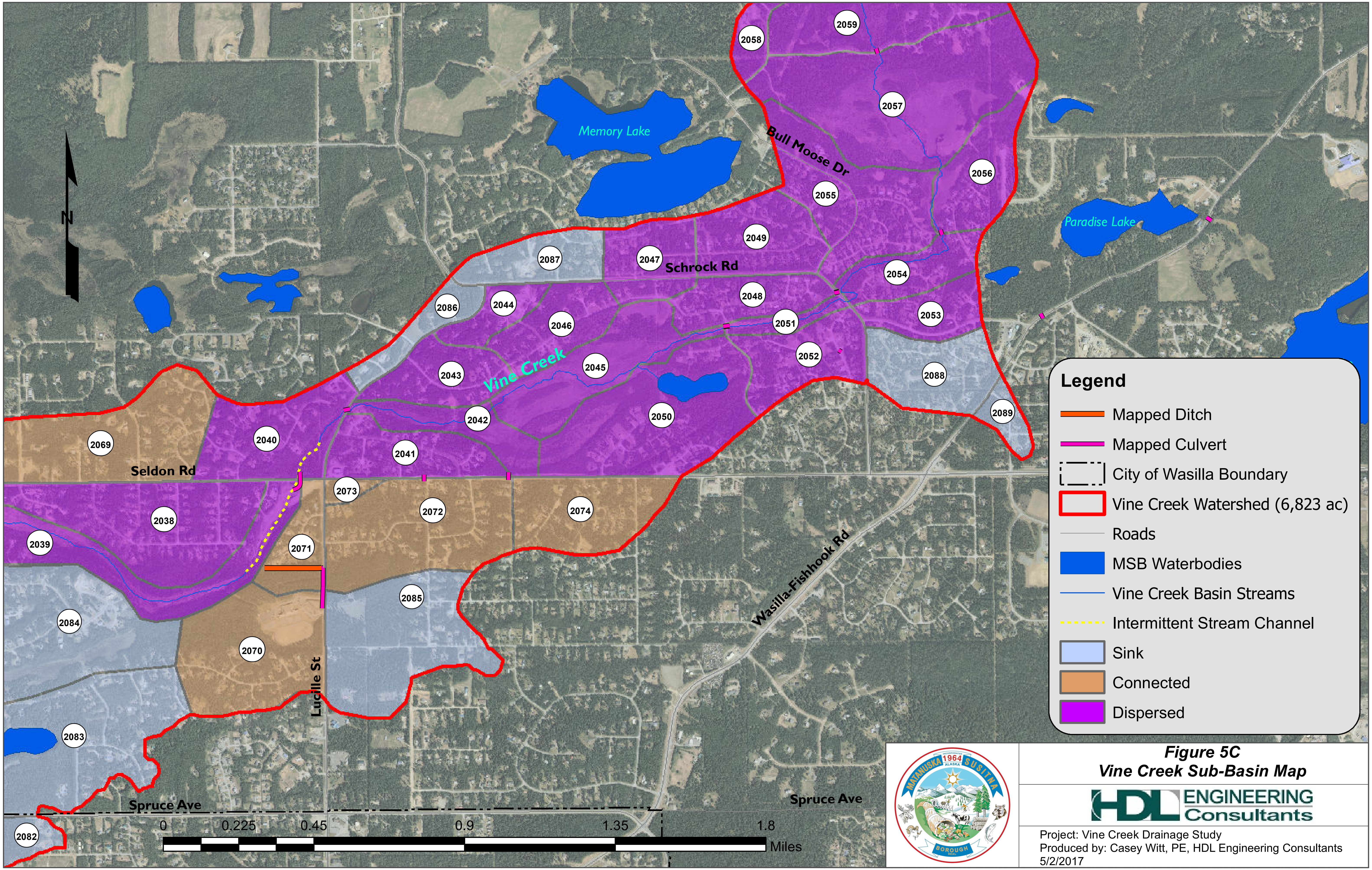

Figure 5C
Vine Creek Sub-Basin Map

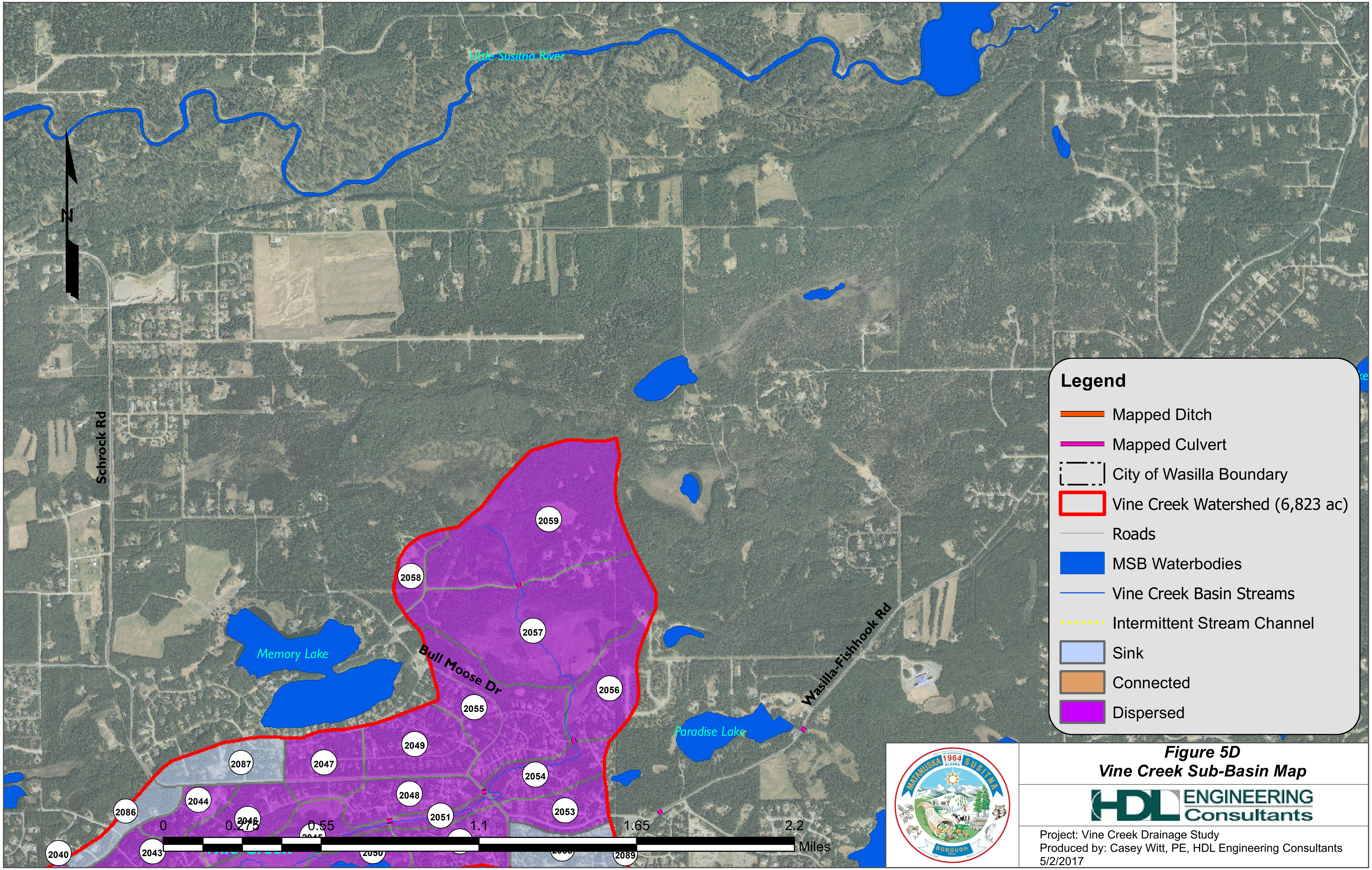

Figure 5D
Vine Creek Sub-Basin Map

Project: Vine Creek Drainage Study
Produced by: Casey Witt, PE, HDL Engineering Consultants
5/2/2017

Appendix B

Area A; Memory Lake Subdivision Berm

PAY ITEM NUMBER	PAY ITEM DESCRIPTION	ESTIMATED QUANTITY	PAY UNIT	UNIT BID PRICE	AMOUNT BID
	BASE BID				
201	Clearing & Grubbing	1.0	ACRE	$ 10,000.00	$ 10,000.00
203	Unclasified Excavation	4,000	CY	$ 18.00	$ 72,000.00
618	Seeding	50	Pound	$ 80.00	$ 4,000.00
620	Topsoil	4,840	SY	$ 4.00	$ 19,360.00
621	Landscaping (Trees & Plants & Monitoring)	1	LS	$ 25,000.00	$ 25,000.00
640	Mobilization and Demobilization	All Req'd	LS		$ 9,000.00
641	Erosion and Pollution Control Administration	All Req'd	LS		$ 10,000.00
641	Temporary Erosion and Pollution Control	All Req'd	LS		$ 35,000.00
TOTAL BASE BID				$	185,000.00

Subtotal		$ 185,000
Contingency	10%	$ 19,000
Total Construction Costs		$ 204,000
Construction Engineering	10%	$ 21,000
Permiting		$ 10,000
Design & Permitting Contingency	10%	$ 3,100
Total Project Cost		**$ 238,100**

Area B; Lucille Road

PAY ITEM NUMBER	PAY ITEM DESCRIPTION	ESTIMATED QUANTITY	PAY UNIT	UNIT BID PRICE	AMOUNT BID
	BASE BID				
201	Clearing & Grubbing	0.3	ACRE	$ 10,000.00	$ 2,500.00
203	Unclasified Excavation	500	CY	$ 12.00	$ 6,000.00
203	Borrow, Type A	600	Ton	$ 14.00	$ 8,400.00
301	Aggregate Surface, D-1	40	Ton	$ 14.00	$ 560.00
401	HMA	20	Ton	$ 200.00	$ 4,000.00
603	48-Inch Pipe	160	LF	$ 220.00	$ 35,200.00
618	Seeding	13	Pound	$ 100.00	$ 1,250.00
620	Topsoil	1,210	SY	$ 4.00	$ 4,840.00
640	Mobilization and Demobilization	All Req'd	LS		$ 8,000.00
643	Temorary Traffic Control	All Req'd	CS		$ 10,000.00
TOTAL BASE BID				$	81,000.00

Subtotal		$ 81,000
Contingency	10%	$ 9,000
Total Construction Costs		$ 90,000
Construction Engineering	15%	$ 14,000
Permiting		$ 10,000
Design & Permitting Contingency	10%	$ 2,400
Total Project Cost		**$ 116,400**

Area C; Wards Road

PAY ITEM NUMBER	PAY ITEM DESCRIPTION	ESTIMATED QUANTITY	PAY UNIT	UNIT BID PRICE	AMOUNT BID
		BASE BID			
201	Clearing & Grubbing	0.3	ACRE	$ 10,000.00	$ 2,500.00
203	Unclasified Excavation	600	CY	$ 12.00	$ 7,200.00
203	Borrow, Type A	700	Ton	$ 14.00	$ 9,800.00
301	Aggregate Surface, D-1	40	Ton	$ 14.00	$ 560.00
401	HMA	20	Ton	$ 200.00	$ 4,000.00
603	48-Inch Pipe	160	LF	$ 220.00	$ 35,200.00
618	Seeding	13	Pound	$ 100.00	$ 1,250.00
620	Topsoil	1,210	SY	$ 4.00	$ 4,840.00
640	Mobilization and Demobilization	All Req'd	LS		$ 8,000.00
643	Temorary Traffic Control	All Req'd	CS		$ 10,000.00
TOTAL BASE BID				$	84,000.00

Subtotal		$ 84,000
Contingency	10%	$ 9,000
Total Construction Costs		$ 93,000
Construction Engineering	15%	$ 14,000
Permiting		$ 10,000
Design & Permitting Contingency	10%	$ 2,400
Total Project Cost		**$ 119,400**