

WLRD Horseshoe Lake Pumping Guide

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1. Introduction

The purpose of the document is to provide guidelines for potential emergency pumping of Horseshoe Lake, King County WA to Lake Sawyer, via Rock Creek. This document will provide guidance for obtaining permits, mobilization of pumping, and pumping protocols, including water quality sampling.

2. History of Problem

Horseshoe Lake is a closed depression located in Southeast King County, 2.4 mile west of Black Diamond (Fig 1). The lake is located at the lowest point within a permeable geologic formation surrounded by impermeable till left by the glaciers that once covered the Puget Sound Region. This permeable deposit surrounded by the till acts like a bathtub without a surface outlet. During prolonged wet weather, the lake level is controlled by the level of the groundwater in the surrounding permeable deposit. Lake levels can rise well above the sealed portion of the lake bottom as groundwater levels rise in the basin surrounding the lake. When the County pumped the lake during the 1991, 1996, and 1997, to prevent flooding of homes and a sole access road to the homes, the regional groundwater levels inside the permeable deposit were six to ten feet higher than the average winter lake level. Water was pumped from Horseshoe Lake to Lake Sawyer, via Rock Creek. An intensive water quality sampling effort occurred during those events to make sure there were no adverse impacts to Lake Sawyer.

3. Mobilization protocols

The following lake level elevations will establish the following actions. The Lake Level elevations and accompanying mobilization protocols are based on elevations of homes along the lake and historical pumping activities in 1996 and 1997. Pumping operations would begin prior to any finished floor space becoming inundated.

These are the critical elevations of property and infrastructure surrounding Horseshoe Lake.

Lowest crawl space elevation	≈ 511-ft
Lowest Finished Floor Elevation	513.1
Lowest Road Elevation along 224 Ave SE/ 329 th St SE	≈ 516-517-ft

The septic systems of the homes surrounding the lake did not adversely affect fecal coli form water quality level of the lake during the past flood events in 1996 and 1997. Therefore, a lower lake level pumping threshold is not recommended.

Lake Water Elevation 509

- Horseshoe Lake volunteer lake monitors who measure the lake levels will inform King County WLRD about lake water level
- WLRD will secure Emergency HPA from WDFW (see example in Appendix A)
- WLRD will secure Emergency SEPA (see example in Appendix A)
- WLRD will work with the City of Black Diamond to prepare pumping protocols/water quality monitoring requirements

Lake Water Elevation 510.0

- Horseshoe Lake volunteer monitors will measure lake levels and inform WLRD
- WLRD will evaluate the precipitation data and lake level rise rate to predict if mobilization should occur
- WLRD will secure necessary Temporary Construction Easement(s) from property owners on which pumping and mobilization will occur (see potential property owner information (Appendix B).

Lake Water Elevation 510.5

- WLRD notifies Road Maintenance of the lake level and rising trend
- WLRD gets commitment from Roads Maintenance to perform mobilization or pumping
- If Roads Maintenance declines the work, a pumping contractor will be contacted and contracted
- WLRD meets with Roads maintenance or contractor on-site to discuss mobilization strategy
- Horseshoe Lake Homeowners are notified pumping mobilization will begin at Elevation 511.0 and lake pumping will begin at approximately elevation 512.0

Lake Water Elevation 511.0

- Pumping mobilization begins by Roads or contractor. Mobilization will take 6-8 days
- WLRD notifies WDFW and City of Black Diamond of pumping dates

Lake Water Elevation 512.0

- Pumping of lake begins

After lake levels have fallen and stabilized at Elevation 510, the pumping could cease. WLRD will make a decision whether to leave the pumps and pipe in place depending upon time of year and likelihood of potential pumping activities later in the rainy season.

4. Pumping Guidelines

Pumps should be set-up on tax parcel 3463407777 (see map) at the northeast portion of the lake. This was the site used for pumping in 1996 (Figure 3). If this parcel appears to be inadequate in the future, another parcel in the northwest corner of the lake could likely be used (with property owner permission) for lake pumping activities. A temporary construction easement will be necessary prior to the mobilization of equipment. The pipe (approximately 4200 lineal feet) will be placed along the south side of Auburn-Black Diamond Road in the King County Road Right-of-Way. The pipe will cross one road and intersection. Property owners shown in Figure 1 should be notified of the activities. The pipe should be placed in the .

The following are recommendations to reduce impacts of pumping Horseshoe Lake to Lake Sawyer via Rock Creek (King County, 1997 (see Appendix C))

- Maximum pumping rate should not exceed 5 cfs (2250 gpm)
- Do not pump to Lake Sawyer if its level is more than 0.8-ft above its outlet crest unless projected increases of up to 2.0 inches in Lake Sawyer level will not cause significant damage. This can be determined by field check and discussion with shoreline residents.
- Avoid pumping into Rock Creek if the flow at its outlet exceeds 20 cfs
- Pipe intake in Horseshoe Lake should be placed further from shore to avoid sediment intake. Sediment can adversely affect some water quality parameters such as total P,
- Discharge of pipe should

5. Water Quality Monitoring Requirements

The water quality monitoring program during the 1991, 1996 and 1997 emergency pumping events was aimed at preventing problems downstream resulting from the introduction of Horseshoe Lake water to Rock Creek and beyond to Lake Sawyer, which is on the EPA 303d list for phosphorus and for which a TMDL has been established.

Water quality stations were located in Horseshoe Lake, in Rock Creek both above and below the pipe outfall, and at the Lake Sawyer outlet, established in order to compare pumping inputs to concurrent creek inputs, as well as ambient Lake Sawyer concentrations. Results of water quality analyses were analyzed and then reported to WDFW, the City of Black Diamond, and King County staff involved in the project management and policy decisions.

Provisions should be made for similar testing to occur in any future pumping project as well. The following monitoring requirements and standards are based on the protocol set for past events, with some changes to allow for the variation in phosphorus and fecal coliform concentrations in the lakes and inlet stream over time.

Upper limits were established for total phosphorus (TP) and soluble reactive phosphorus (SRP, also known as orthophosphate) concentrations. When exceeded, the County agreed to cease pumping to Rock Creek until levels dropped. For the future, the threshold for TP should have two levels, based on results from samples taken at the pipe intake compared to results from other stations:

Alert for TP = pipe uptake value $> 0.75 * \text{measured TP concentration in Rock Creek above the outfall}$. Tolerance = $2 \mu\text{g/L}$.

Action = More frequent sampling should be undertaken; lab turnaround times should be decreased; and decision makers should be kept informed of results.

Warning for TP = Pipe uptake value $> \text{measured TP concentration in Rock Creek above the outfall}$. Tolerance = $2 \mu\text{g/L}$.

Action = Cease pumping until daily water quality results show concentrations have declined to equal or lower values than Rock Creek above the outfall. Tolerance =

Warning for SRP = pipe uptake value $> \text{measured SRP concentration at Lake Sawyer outlet}$. Tolerance = $2 \mu\text{g/L}$.

Action = Cease pumping until daily water quality results show concentrations have declined to equal or lower values than the Lake Sawyer outlet.

Measurements of fecal coliform (FC) concentrations were also compiled for evidence of septic system leakage due to high water levels. No threshold was established for fecal coliform, but testing indicated that bacteria levels at no point constituted a threat in any of the three previous pumping projects. The state standard of 50 cfu / 100mls for primary contact should be followed to make sure that there is no chance that high fecal coliform concentrations are introduced to Rock Creek as a result of the pumping. However, measurements can be highly variable, so some combination of results should be examined. A suggested framework for action follows:

Alert for FC = 3 consecutive pipe uptake values $> 50 \text{ cfu/ 100mls}$. Tolerance = 10 cfu/100.

Action = More frequent sampling should be undertaken; lab turnaround times should be decreased; and decision makers should be kept informed of results.

Warning for FC = 3 consecutive pipe uptake values $> 100 \text{ cfu/ 100mls}$. Tolerance = 10 cfu/100.

Action = Cease pumping until daily water quality results show concentrations have declined to 50 or below.

6. Cost Estimate

Two cost estimates were obtained for the pumping activities (Appendix D). A private vendor cost for one month of pumping (not including fuel costs or constructing an access road) was estimated at \$20,000. This estimate included: pump and pipe delivery, pipe and pump rental, setup/teardown. The estimate did not include constructing an access road, fuel costs, or pump monitoring.

King County Roads maintenance estimate was \$86,000 including pump rental set-up, pipe placement, and access road construction. Monitoring of the pump would be \$2000 per week of pumping. This does not include fuel for the pumps.

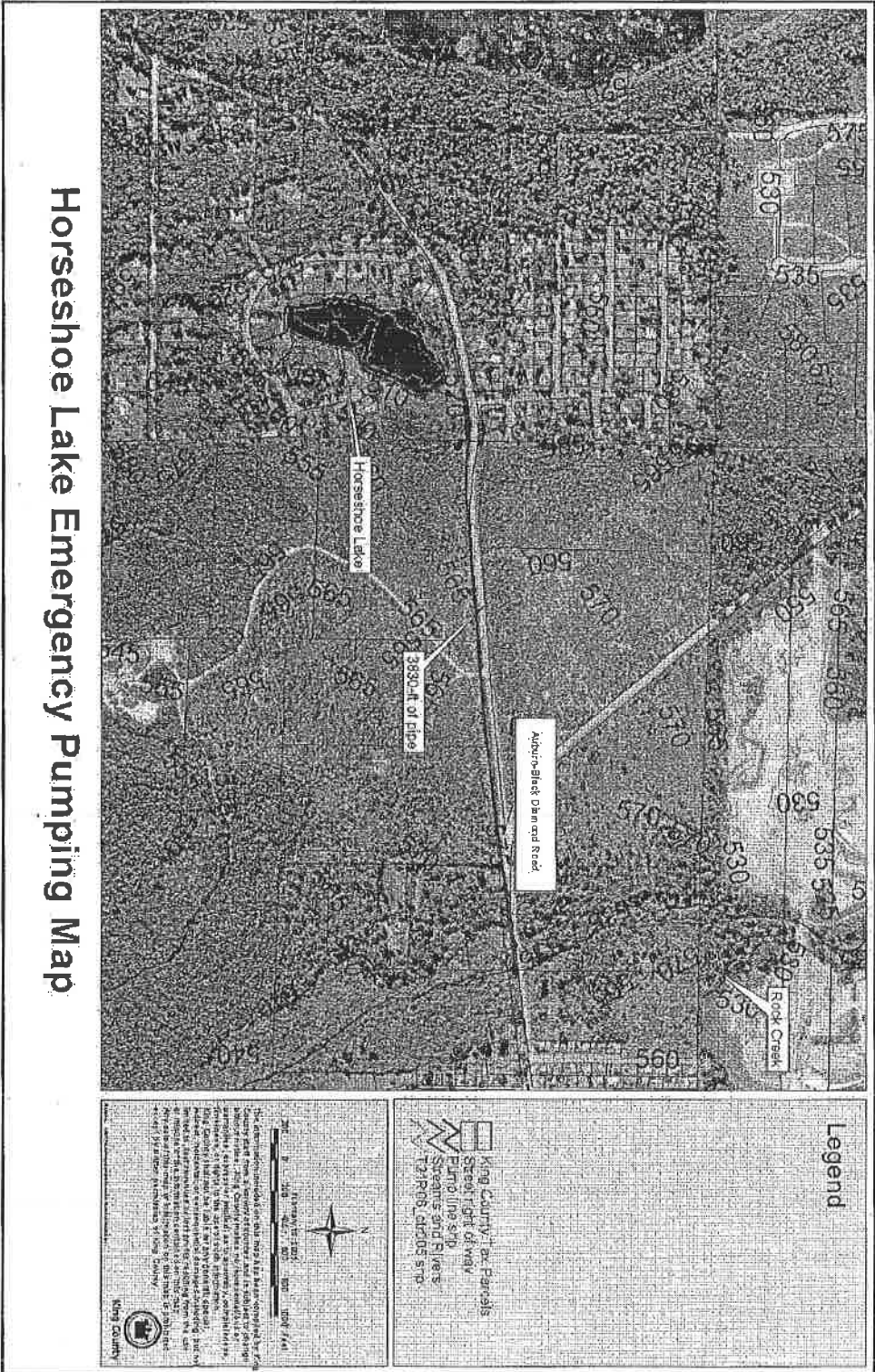


Figure 1. Overview Map

Figure 2. Horseshoe Lake Pumping

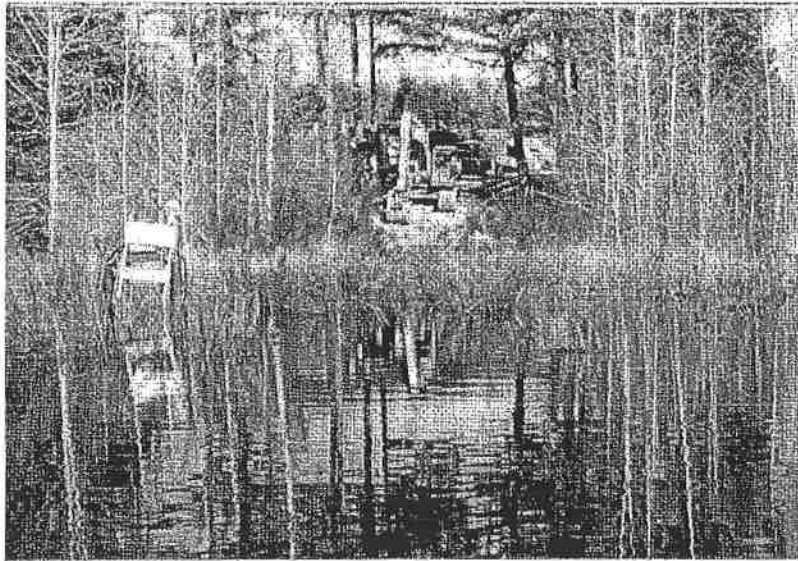
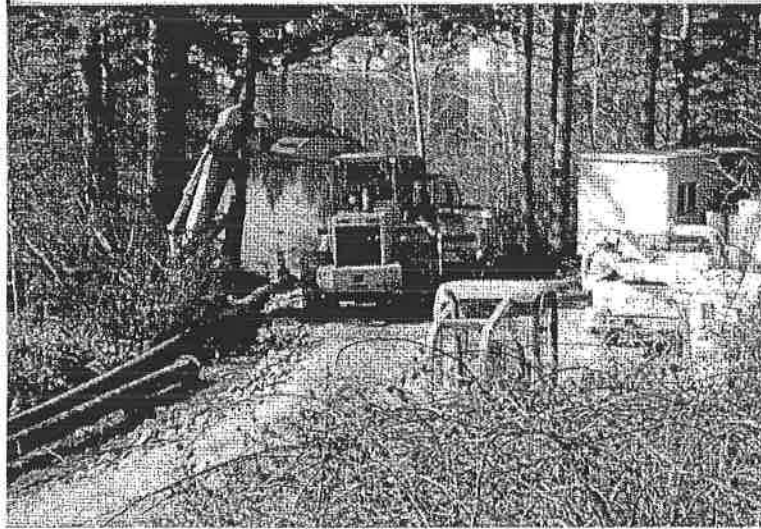


Figure 3. 1996 pumping mobilization on northeast part of Horseshoe Lake

Appendix A. Permit Examples from 2006

Appendix B. King County and Property Owner Contacts

Parcel Number	Property Owner (2006)	Address	Phone Number
3463400330	Scott D'Amato	32602 224 th Pl 98092	
3463400320	Jeffrey Ross	32606 224 th Pl 98092	360-886-0464
3463400310	Richard and Roberta Hayes	32610 224 th Pl 98092	360-886-7788
3463400300	John and Tamara Gilgan	32618 224 th Pl 98092	
1521069099	Plum Creek Timber Corp	SE Auburn-Black Diamond Road	
1521069100	Plum Creek Timber Corp	SE Auburn-Black Diamond Road	
1521069096	Plum Creek Timber Corp	SE Auburn-Black Diamond Road	
1521069079	Al and Marlene Stredike	Auburn Black Diamond Highway (next to Osgard)	
1521069002	Nelda and Lawrence Osgard	23703 Roberts Drive (SE Auburn Black Diamond Road)	

King County Water and Land Resources Contacts

Don Althaus, Supervisor, Capital Projects Section

Steve Foley, Supervising Engineer ?? Stormwater Services Section- hydrologic information

Sally Abella, Supervisor, Lake Stewardship Program- water quality and permits, liason with Horseshoe Lake Volunteer Monitors and City of Black Diamond

Rachel Berryessa, Senior Engineer, Capital Projects Section, Manager of Emergency Response Program

Brian Landau, Design Engineer, Capital Projects Section- engineering and construction

Mason Bowles, Senior Ecologist, Capital Projects Section- permits

Appendix C. King County WLRD Pumping Recommendations

Appendix D. Pumping Vendors and Cost Estimate