DESIGN MEMORANDUM

BUREAU VERITAS
Berryman & Henigar

Date: April 11, 2005

To: Lay Chin Foo, City of Bainbridge Island

From: Larry Amans, P.E.

Re: Pump Station Evaluations

Project and Task Number 40246.05, Task 2.0

I Introduction

The City of Bainbridge Island owns and maintains fourteen pump stations. Locations are shown on Figure 1. The station names and numbering are as follows:

1. (High School Way—decommissioned)
2. Village (aka Highway North)
3. Old Treatment Plant
4. Lower Hawley
5. Sunday Cove (aka Weaver)
6. Lower Lovell (aka Lovell)
7. Wing Point
8. Highway 305 (aka Highway South)
9. Island Terrace
10. (Upper Hawley—decommissioned)
11. (Number not used)
12. Ferry Dock (aka Ferry Terminal)
13. Klickitat Place NE
14. Woodward School

-- Lynwood Center
-- Sakai Village
-- North Town Woods

Many of the stations were originally constructed in the late 1970's. With the mechanical and electrical components now reaching their anticipated useful life, the City wants an evaluation of the stations and a proposed capital improvement program to upgrade the inadequate and/or aging station components. Also, the City would like the modifications, and any new stations, to be standardized as much as possible so that the control systems and pumping equipment will eventually be similar for all stations.

This report has been prepared to address two major topics: 1) an inventory of the existing pump

stations and a recommended capital improvement program for upgrades; and 2) a detailed evaluation of the first station slated for upgrading—the Sunday Cove Pump Station. Subsequent evaluations on the other stations will spring from the decisions made on the Sunday Cove Pump Station.

II Inventory of Existing Stations

Station Components

The major station features are summarized on Table 1. Pump station age ranges from 2 to 26 years, with most stations having been constructed in 1979. The majority of the stations are of the wetpit/drypit configuration, although two stations contain submersible pumps in a single wetpit structure. The pump brands include Cornell (5 each), Crane Deming (4 each), Fairbanks Morse (2 each), Paco (2 submersible stations), and Hydromatic (submersible station). The pump motors vary from 3 to 40 horsepower.

Detailed information on each station was compiled by City operations staff and furnished to us in June 2004. The data includes such things as structure sizes and material, pump and motor brand and serial numbers, valve size and brand, force main size and length, electrical gear, generator data, and wetwell control levels. This data was entered onto standardized forms and is included in Appendix A.

Additional information on pump station history, controls, and recent maintenance upgrades was also provided by City operations staff. These reports are included herein as Appendix B.

One gap in the data is tested flow rate on the largest station—Highway 305 Pump Station (Station No. 8). The station contains three 25-horsepower Cornell pumps. Although there was no pump capacity data on file with the City, the observed serial number allowed us to obtain a pump curve from the manufacturer. The curve is included at the end of the Pump Station No. 8 data sheets in Appendix A, and indicates a flow range of approximately 600 to 2,000 gallons per minute (gpm). Unfortunately, the flowrate cannot be determined from this curve without some additional information—impeller size and force main elevation data. A conservative (low) estimate of the flowrate is shown in Table 1 as 800 gpm, corresponding to a relatively low efficiency of 62%. Actual flowrate may, of course, be higher or lower than this assumption.

Maintenance Issues

City operations and maintenance staff were interviewed to discover known and recurring maintenance issues for the pump stations. Reported information is as follows:

Overall—general problems include:

- Galvanized bubbler system lines need replacing from time to time
- Electrical systems are old on about half the stations
- The steel drypit shells may have cathodic protection anodes, but have not been maintained or checked; interiors need to be repainted on some
- Pump parts have a long lead time for the larger pumps

Sunday Cove

- Wiring is old, needs replacing
- Starters and electrical contacts need to be checked frequently for the pumps that are cycling too much

III Data Analysis

Pump Cycling and Run Times

City staff provided daily pump run data for the past several years. The existing telemetry system program tabulates daily run time and number of cycles per day for each pump at each pump station. By sorting this data, we computed the number of pump cycles and the average daily pump run time for each station. The results are shown on Table 2 for year 2004 data. Using the average daily pump run time and the measured average pumping rate for each station, the average pumpage in million gallons per month and gallons per minute was also computed and shown on Table 2.

The number of pump cycles is useful in determining whether a pump station is experiencing too many pump starts, which accelerates wear on the pump motors and starters. This reduces the reliability of the station. In Table 2 we have shown the number of pump cycles for the maximum day, the daily average in the maximum month, and the annual average day.

The preferred cycle time for pumps is generally taken to be approximately 6 starts per hour (Sanks, page 375, and Metcalf & Eddy, page 212). Although the number of desired starts per day is not usually mentioned in the literature, an approximate target value can be computed as follows:

Daytime hours, 6 am to 10 pm—6 starts per hour x 16 hours =	96 starts
Nightime hours, 10 pm to 6 am—one start every 2 hours for 8 hours =	4 starts
Total starts per day, per pump	100

In Table 2, the values shown are the total for two pumps (or three pumps for Highway 305). Therefore, the desirable number of starts per day would be approximately 200 or less for the typical two-pump station, and 300 or less for the three-pump Highway 305 Station. We suggest that this standard be applied to the maximum month values. By this measure, the following pump stations exceed the standard:

Station	Cycles per Day in Max Month	Desirable Cycles per Day
Sunday Cove	445	200
Village	278	200
Highway 305	331	300

The data substantiates what City staff had previously concluded—that the Sunday Cove pump station was cycling much too frequently and is most in need of modifications. Against this criterion of frequent starts, the Village Pump Station is the second most in need of upgrading. The Highway 305 Pump Station is only slightly in excess of the standard (10% above), and is judged to be adequate at this time.

Infiltration and Inflow

The pump run data is also useful for determining infiltration and inflow (I/I) amounts that enter the collection system. Table 3 shows peak winter day flows versus average dry weather flows for years 2002, 2003, and 2004. The shaded cells give the highest I/I value for each station during the three year timeframe. These peak I/I numbers are summarized in Table 4.

Significant I/I flows are observed at the Village, Sunday Cove and Wing Point Stations. All are in the approximate 100 gpm or more range. Further analysis of the sewer basins contributing to these stations would be needed to determine whether I/I rates per mile of pipe, or per acre, are in the acceptable range or not. This analysis does, however, provide some useful initial information in targeting which basins to focus on for reducing I/I flows in the City's system.

IV Capital Improvement Program

Staff Preferences

Operations staff were interviewed to determine their preferences for future pump station features. The following features were stated:

- Type of station—submersible pumps in a single wetpit structure
- Pump brand—1st = Hydromatic (better parts availability); 2nd = Flygt
- Level controls—pressure transducer probe (e.g. Druck), with backup floats (high water, and high-high water alarms)
- Telemetry gear—S&B system, with three-tiered level control backup system

Improvement Needs

Based on operation staff's observations and the pump run time analysis herein, fourteen specific areas of improvement were identified for one or more stations, and are listed in Table 5.

Improvements range from fairly costly system replacements—all wiring and controls, or generators—to upgrades such as security fences, generator sound attenuation, new valves, fixed lighting, or new cathodic protection systems.

Preliminary budget cost values are given for each improvement in Table 5, based on cost data from past projects, cost estimating handbooks, and consultations with vendors. The Ferry Dock Pump Station is not included in this list since it is scheduled for abandonment.

Complete control cabinet replacement, including motor starters and controls, is recommended by operations staff for three of the stations because of advanced age and multiple rewirings and repairs. Costs are estimated to be approximately $55,000 per station, based on an estimate prepared for the new S&B-fabricated cabinet and controls at the Rockaway Beach Pump Station, which is currently under construction.

"VFD's" (variable frequency drives) or added wetpit are listed for the two stations that need to reduce cycle times. Specific analyses are required to determine if VFD's are the appropriate solution, or if a new/expanded wetpit is preferred. For Sunday Cove, a detailed analysis is contained in a subsequent section of this report, concluding that an added wetpit is desirable. Since VFD's would typically cost more than an "add-on" wetpit, the VFD alternative is used in Table 5 for the other station—Village--to give conservative budgetary values.

Changes to the control systems are desirable for some of the stations to raise them to the intrinsically safe level, so that explosion hazard risk is reduced from low to near zero. This has been done at several stations over the years by S&B under contract to the City. The cost for new controls as well as new telemetry system components in a new control cabinet is estimated by S&B to cost approximately $22,000 for the installed panel, plus an additional $8,000 for new concrete pad, trenching, connections to existing gear, and level controls.

Generator sound attenuation is desirable where stations are near dwellings and/or businesses. The City has identified the need for sound attenuation at the Highway 305 and Village Pump Stations. Full replacement of generators, with attenuators, is recommended for these stations because of the approximate 30-year age.

The Lynwood Center Pump Station does not have an auxiliary connection for a portable generator ("pigtail"), which is a desirable feature in case the primary generator should fail. The cost for one, if part of a larger contract, is approximately $2,000.

Item 6 in Table 5, "pumparound/pig station", is a piping modification that consists of a new pipe connection downstream of the station that would allow a portable pump to be connected to bypass the station in the event of station shutdown in an emergency. The portable pump—either submersible or self-priming—would withdraw sewage from the wetpit and discharge it through portable hosing to the new pipe connection. The connection would consist of a below-grade vault containing an isolation valve and upturned wye fitting with a quick coupler system for attachment to the portable hose. The fitting could also be used to insert a cleaning pig to scour the force main. A "pigcatcher" station would need to be installed downstream at the receiving manhole if one is not already in place. Addition of this feature is included in the cost estimate.

Item 7—"replacement valves"—are listed for the 1970's pump stations since the pump suction and discharge side valves have been found in the past to exhibit significant wear. This would include plug valves on both sides of the pumps, plus check valves on the discharge side.

Security fencing is shown for two stations, as recommended by operations staff. A 30-foot by 50-foot area enclosed by a 6-foot chain link fence is assumed, including a 12-foot double leaf gate.

Repainting the interiors of drypits is listed for pump stations that are 20 years or more old. An industrial coatings vendor, Tnemec, was contacted to determine if this could be done on an existing station. The potential problems are explosion hazard and damage to existing pumps and electrical gear due to either the typical cleaning step of sandblasting, or the vapors caused by spray painting. Tnemec has successfully done retrofit projects on drypit pump stations by using the following approach:

- Cleaning with wire brush, sandpaper, and power wire brush in lieu of sandblasting
- Applying polyurethane primer and topcoat with hand brushing or rolling in lieu of spraying

Polyurethane paint is typically specified by designers for this type of application because of its resistance to acids, its good adhesion, long life, and flexibility. The paint generates very low odors/vapors, and does not present an explosion risk according to the vendor. Additional worker protection can be achieved by furnishing a blower to continuously supply fresh air. With one painter in the drypit and a second worker above to man a blower (confined space entry) and furnish supplies, the total estimated cost is approximately $5,000.

Sealing of the wetwell for the Lower Lovell station is included since it is reported to be receiving sea water intrusion through the manhole joints.

Spare impellers should be ordered for all 1970's vintage pump stations because they are long lead time items. Impellers need to be individually ordered for each pump since there are clockwise and counterclockwise rotation impellers. Mechanical seals and bearings are available locally and do not need to be ordered ahead of time, according to operations staff.

Improved ventilation is listed for nearly all the stations since the original fans in the drypits are typically small bathroom-type fans that likely do not meet current standards for the required number of air changes per hour. Ventilation is governed by the National Fire Protection Association's standard NFPA 820, "Fire Protection in Wastewater Treatment and Collection Facilities", 1995. This standard was developed to safeguard against the fire and explosion hazards specific to wastewater plants and associated collection and pumping systems. It requires that drypits be exhausted at the rate of at least 6 air changes per hour in order to prevent explosive buildup of vapors from flammable or combustible liquids that may be present in raw sewage, or from underground natural gas leaks that can seep into an underground chamber through holes or gaps in the walls. As an example, the Sunday Cove drypit requires a fan delivering at least 59 cubic feet per minute to change the air 6 times per hour in a 7'11" diameter room of 12-foot height.

Fixed lighting is listed for all stations to be used during a nighttime service call, in lieu of portable lights. This is a typical feature on new pump stations.

An impressed current cathodic protection system is budgeted for all the pump stations with steel drypits. This type of station was typically equipped with buried anodes and, presumably, a test station to measure electric potential over time. However, these items are typically not maintained or tested, and such is the case for these stations. To preserve the integrity of the steel shells, they should be tested and new cathodic protection systems installed if necessary. Steel thickness can be measured with a non-destructive ultrasonic device. A corrosion engineer was consulted who furnished typical retrofitting costs as follows: anode and test station replacement costs of approximately $3,000, or an impressed current station at a cost of approximately $13,000. Field visits to check steel shell thickness, soil corrosivity, and to furnish a report were estimated at $6,000 for all six stations required. This raises the per-station cost to approximately $4,000 with anodes only, or $14,000 with impressed current stations. Based on a corrosion engineer's recommendation to install the impressed current stations for the tested Sunday Cove and Village Pump Stations (see subsequent section of this report), the more conservative $14,000 value is used in these estimates. Future testing may demonstrate that some of the other stations may only require the less expensive added anode.

Odor has been identified as a problem by City staff at the Lynwood Center Pump Station. Odorous gases can be passed through a filter, or "scrubber", to remove or reduce the offensive odors. The filter media is ordinarily granular activated carbon or a proprietary media such as "Sulfa Treat". The media is ordinarily housed in a steel drum on an at-grade concrete pad, and is equipped with a blower motor to pull air from the wetpit and push it through the media. The media must be removed and replaced periodically after it becomes "loaded" with contaminants.

Finally, an allowance for design costs and contingencies is shown. Detailed design costs will need to be prepared once a closer examination of the stations is performed. However, the allowances shown are believed to be sufficient if all stations are designed by the same firm. It was assumed that inspection services for these modest-size upgrade projects would be handled by City staff, so no consultant cost for this was listed.

The first station slated for construction, Sunday Cove, has the highest design cost since it will be the first development of plans and specifications for a pump station rehabilitation. After the first design is completed, many of the specifications and typical details can be reused on subsequent stations, so per-station design costs were reduced in this estimate for the subsequent designs.

A contingency allowance of 20 percent at this initial study level is included to compensate for lack of detailed information, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of information becomes better as the design process advances, smaller contingency allowances may be applied.

Recommended Construction Priority

A suggested capital improvement program is shown in summary form in Table 6.

It shows the Sunday Cove Pump Station as the first priority, as desired by the City based on the need for decreasing frequent pump starts and replacing old electrical equipment. The order of subsequent work was based on the following assumptions; a different order could of course be followed if desired by City staff:

- The spare parts for the Highway 305 Pump Station are listed in the first year along with Sunday Cove because it is the largest in the City system, but the cost for this is relatively small.

- The stations requiring VFD's and all electrical gear are listed next (Village Pump Station), based on reliability considerations.

- Stations requiring all electrical gear are listed next (Wing Point), again based on reliability concerns.

- With reliability issues dealt with, stations requiring an upgrade to intrinsically safe controls are listed next. Those with generator replacement or silencing are listed first.

- Listed last are the stations that have relatively minor upgrades, and with the exception of the Old Treatment Plant, are the newest stations in the City system. The Lynwood Center improvements might be moved up in the schedule if the odor control feature is considered more urgent.

A yearly program of $200,000 to $500,000 in costs was assumed, which allowed performing more than one upgrade in a single year. The result was a six-year program, from 2005 to 2010. Upgrades could be spread out over more time, of course, if the budget numbers for a particular year are deemed to be too high.

V Sunday Cove Pump Station

Pump Test

On September 3, 2004 a flow test was conducted by City staff and observed by me. Wetpit fill time and pump-down time were measured with a stopwatch. A constant one-foot drop or rise in the water surface was measured with a floating staff gage apparatus. Three or four tests were run for each of three pumping conditions until consistent results were achieved—for pump number 1, pump number 2, and then with both pumps running at the same time.

The results are shown in Appendix C. One pump averaged 428 gallons per minute (gpm), the second pump averaged 424 gallons per minute, and both pumps produced 539 gpm.

Also included in Appendix C is the original pump curve, with the September 3 field pump test operating point added. A comparison to the original design point is as follows:

Item	Design	Tested

Flow Rate	490 gpm	426 gpm (avg. of 424 and 428)
TDH	117'	109 to 120'
Efficiency	64%	61%

The tested performance is very good, with the flow rate at 87% of design, and the tested efficiency very close to the original design. This indicates that the pumps' volutes, impellers, and force main are in very good condition, despite their age. We did not measure the actual head, so we are showing the approximate range of 109 feet (on the computed system head curve) to 120 feet (intersecting an assumed trimmed impeller curve). The efficiency, however, remains fairly constant in this range, at 61%.

We conclude that the pumps do not need to be replaced at this time because the wear on the pump interiors does not appear significant, and maintenance staff appear to have been doing a good job of keeping wear parts replaced on a regular basis.

Future Flows Compared to Station and Force Main Capacity

A separate report by us, entitled "Sunday Cove Pump Station, Buildout Analysis" contains estimates of future sewage flows to this station. The results are summarized as follows:

Year	Peak Q, gpm
2004	318
2010	320
2020	339
2030	362
Buildout	493

As noted above, the existing capacity of the pumps is 424 or 428 gpm for 1 pump, and 539 gpm for both pumps. With one pump in standby mode as required by DOE standards, the station capacity of 424 gpm is adequate past year 2030. The pumps may eventually need to be upsized when design flows exceed approximately 420 gpm.

The population of the service area may in fact increase faster than area planning agencies predict. Therefore, this study should be updated approximately every 10 years to develop revised projections.

The 6-inch diameter HDPE force main is adequately sized for both existing flows and ultimate buildout flows. The velocity for the current pump capacity of 424 gpm is approximately 4.8 feet per second (fps). The velocity would increase to approximately 5.6 fps at the computed buildout design flow of 493 gpm. Both velocities are in the generally recommended range of 3 to 8 fps.

Pump Cycling

Pump stations should be sized to minimize the number of pump starts in order to lengthen pump motor and starter life. The general equation used to size wetpits for achieving this is:

$V = Tq/4xN$

where V is in gallons, T is time between starts (cycle time), q is the design flow, and N is number of alternating pumps (2 in this case).

This equation gives the minimum cycle time, when flow is at 50 percent of the design flow.

The desired cycle time from this equation is generally taken to be a minimum of 10 minutes, or 6 starts per hour (Sanks, page 375, and Metcalf & Eddy page 212). Sanks further states that a more specific time for various sizes and types of motors can be found in NEMA Publication MG-10, and suggests using 2/3 of the values given, to be conservative. This value, for the 25 hp motors at Sunday Cove, is: 2/3 x 8.8 starts per hour = 5.9 starts, or 10.2 minutes between starts. A 10-minute target is recommended.

With a year 2004 design peak hour inflow of 318 gpm, design wetpit volume is then:

$V = (10)(318)/(4)(2) = 398$ gallons

A comparable design volume for project year 2030 peak hour flow is 616 gallons.

We computed an available volume of only 247 gallons, based on a 6-foot-diameter wetpit with operating depth of 1.17 feet. The available volume is only about 60 percent of the design volume for year 2004, dropping to 55 percent of the design volume for 2030. This accounts for the observed too-frequent cycling of the pumps.

There are generally three potential solutions to this problem:

- Changing the wetpit control settings to provide a larger active volume
- Constructing a new larger, or second, wetpit chamber
- Installing variable frequency drive (VFD) controllers on the pump motors

City staff have already adjusted the wetpit controls to what we believe is the maximum safe wetpit volume. The lag pump start point is at the incoming sewer invert, which is typically the highest setting used. The lead pump start point is about 1 foot below that, which is probably an optimum setting due to bubbler system variability. The pump "off" level is at 2.75 above the pump intake pipe inverts, which provides a typical mimimum submergence of the pumps. Therefore, resetting wetpit controls to provide more storage is not feasible. The problem with the station construction is that the floor elevations of the drypit and wetpit were not set low enough to provide a greater active depth, and therefore greater volume.

A larger replacement wetpit is possible, but the simpler approach to keeping the existing station in operation during upgrades is to build a nearby second wetpit, connected by a short pipe. An

additional 8-foot-diameter wetpit would suffice for storage needs at the buildout level of development. This option, however, will require a shoreline permit, which could take up to 6 months to obtain. If timing is a problem, another approach might be preferable.

VFD's are an approach often used in both rehabilitation projects like this and in new construction to minimize pump cycling time, increasing the life of the pump starters and motors. The VFD's can be programmed to run over a predetermined range, and are typically set to run the pumps at 50 to 100 percent of full capacity flow. When the first "ON" level is reach in the wetpit, the VFD starts the pump running at 50 percent of peak flow. This enables the pumps to run for considerable lengths of time during medium-inflow conditions, without on-and-off cycling. As inflow increases, the VFD "ramps up" the motors to match the higher flows until 100 percent speed is reached, at which point the pump operates the same as a constant speed pump. In a two-pump station such as Sunday Cove, a VFD is installed for each pump, allowing maximum flexibility of running each pump at variable pumping rates.

For VFD's, an important design consideration is maintenance of adequate cleansing velocity in the force main during low flow periods, when the first pump begins at 50 percent of its capacity. The 50 percent flow value is 212 gpm for this station (half of the tested 424 gpm). This produces a computed 2.40 feet per second (fps) in the 6-inch force main. This meets the criterion of 2 fps recommended by most experts as the minimum velocity to keep solids from settling out in the force main. Velocities will be higher than this when inflows to the station exceed 212 gpm, and the pump ramps up to higher discharge rates to track the higher inflow. If solids buildup does become a problem, the "low" setting on the VFD's can be raised above 50 percent of pump capacity in order to increase the force main velocities. Another potential cleaning option is to program a flushing cycle each day by running one or both pumps at full power. However, this is not feasible for this pump station since the small wetpit volume requires a total of seven pumpdowns to evacuate all the water from the force main. During the pump "off" times, solids will settle out again, and potentially slide back downhill toward the pumps, defeating the purpose of the flushing cycles.

Originally, the schedule was to construct the pump station modifications in year 2005. The long lead time for a shoreline permit made the new wetwell option infeasible with this schedule. However, the current schedule is to make the modifications in year 2006. With the shoreline permit timing no longer and issue, we recommend installing a second, 8-foot-diameter wetwell as the solution for the frequent pump start problem. It is less expensive—estimated at $12,000 versus $18,000 for VFD's. It has the added advantage of not having a potential for breakdown, as the VFD's do. Finally, with the pumps continuing to operate at 100 percent power, there is less risk of force main plugging which might occur with the lower velocity flows generated with the VFD-driven pumps operating at lower discharge rates.

Corrosion Protection

Norton Corrosion Limited was retained to perform field testing at both the Sunday Cove and Village Pump Stations to determine two things: 1) steel thickness of existing drypit shells, and 2) the need for cathodic protection of the steel shells. Norton's report is included herein as Appendix D. Findings are summarized as follows:

Sunday Cove

- Shell thickness—limited readings due to inability to read through heavy paint, but available readings averaged approximately 0.40" floor thickness and approximately 0.28" wall thickness on east side.
- Corrosivity—soils are moderately corrosive
- Protection—an impressed current station is recommended. A passive anode system would be more expensive due to the need for a large number of anodes.

Village

- Shell thickness--limited readings due to inability to read through heavy paint, but one reading behind the ladder was 0.253"
- Corrosivity—soils are moderately corrosive
- Protection—an impressed current station is recommended. A passive anode system would be more expensive due to the need for a large number of anodes.

Since shell thickness readings were not possible all over the steel shell, we recommend that additional testing be performed. Norton advises that another non-destructive thickness testing instrument has been used in cases like this with paint interference, and could be used to re-test the stations. We recommend that this be done as a next step for the Sunday Cove Pump Station rehabilitation program.

Permitting

The following permits may be required for each pump station including Sunday Cove:

- SEPA checklist
- Right-of-way permits
- Shoreline permit (for those stations within 200 feet of a shoreline)

We consulted with the City's Planning Department, and learned that the SEPA process may result in a categorical exemption or a Determination of Non-Significance, depending upon the level of construction anticipated and the proximity to sensitive areas. It appears from an examination of WAC Section 197-11-800 that the pump station upgrades may simply be categorically exempt because they consist of "minor alteration of existing private or public structures...involving no material expansions or changes in use beyond that previously existing." We recommend having an initial meeting with the Planning Department, with Public Works representatives in attendance, to discuss the permitting requirements. It might be prudent to address all the pump station upgrades in one SEPA document at the outset to save time and expense.

Assuming that the pump station is in the public right-of-way, a right-of way permit would be required but would be a routine matter applied for, and granted, by the Public Works Department. The consultant would ordinarily fill out the forms and submit them to Public Works.

Since the Sunday Cove Pump Station is within 200 feet of a shoreline, a Shoreline Permit would be required.

Proposed Improvements and Next Steps

The proposed improvements are shown in the aforementioned Table 5. Total estimated cost of the upgrades for Sunday Cove is $277,000, including design cost and a 20 percent contingency.

The recommended next step is to begin design of the Sunday Cove upgrades this year, with construction beginning in the summer of 2006. Construction is likely to take about six months, allowing time for the ordering and fabrication of the electrical control panel.

WOODWARD MIDDLE SCHOOL PUMP STATION (NO. 14)

NORTH TOWN WOODS PUMP STATION

SAKAI VILLAGE PUMP STATION

ABANDONED HIGH SCHOOL WAY PUMP STATION (NO. 14)

VILLAGE PUMP STATION (NO. 2)

ISLAND TERRACE PUMP STATION (NO. 9)

KLICKITAT PL NE PUMP STATION (NO. 13)

LOWER HAWLEY PUMP STATION (NO. 4)

ABANDONED UPPER HA LEY PUMP STATION (NO. 10)

SUNDAY COVE PUMP STATION (NO. 5)

FERRY DOCK PUMP STATION (NO. 12)

LOWER LOWELL PUMP STATION (NO. 6)

OLD TREATMENT PLANT PUMP STATION (NO. 3)

HIGH AY 305 PUMP STATION (NO. 8)

ING POINT PUMP STATION (NO. 7)

LYNNWOOD CENTER PUMP STATION

NE NEW BROOKLYN RD
NE HIGH SCHOOL RD
NE BAKER HILL RD
MADISON AVE NE
COMMODORE LANE
FERNCLIFF AVE NE
STATE HIGHWAY 305 NE
INLAND WAY
WALLACE WAY
WYATT WAY NW
SHEPHARD WAY
WINSLOW WAY
WINSLOW WAY E
WING POINT WAY NE
WING POINT ROAD NE
POINT WHITE DR NE
LYNNWOOD CENTER RD NE
BLAKELY HEIGHTS DR
PLEASANT BEACH DRIVE
WEAVER AVE NW
LOWELL AVE NW
GROW AVE NW
MADISON AVE N
LOWELL AVE SW
MADISON AVE S

NORTH

0 1000 2000

Scale in Feet

SOURCE:
CITY OF BAINBRIDGE ISLAND SYSTEM MAP, NOVEMBER 2004

Figure 1
Pump Station Locations
Bainbridge Island, Washington

Berryman & Henigar
720 Third Avenue, Suite 1200
Seattle, Washington 98104-1820
Tel: (206) 505-3400
Fax: (206) 505-3406
www.us.bureauveritas.com

PLOT DATE & TIME: APR 04 2005 15:35:49
FILE NAME (UPDATED BY): S:\CAD\BAINBRIDGE\4024605-001\DWG\P24605001PS11X17.DWG (PLS)
XREFS: X24605001xrss, X24605001parcel2

Table 1
Summary of Pump Station Characteristics

Station Number	Station Name	Year Installed	Type	Drywell Material	Pump Brand	Horsepower	Tested Flow Rate Each, gpm
1	(Decommissioned)						
2	Village	1979	Wet/Dry	Steel	Cornell	2 @ 20	538
3	Old Treatment Plant	1978	Wet/Dry	Concrete	Cornell	2 @ 10	256
4	Lower Hawley	1979	Wet/Dry	Steel	Crane Deming	2 @ 3	121
5	Sunday Cove	1979	Wet/Dry	Steel	Crane Deming	2 @ 25	424
6	Lower Lovell	1979	Wet/Dry	Steel	Crane Deming	2 @ 7.5	104
7	Wing Point	1979	Wet/Dry	Steel	Crane Deming	2 @ 5	209
8	Highway 305	1979	Wet/Dry	Steel	Cornell	3 @ 25	+/- 800
9	Island Terrace	1984	Wet/Dry	Concrete	Cornell	2 @ 3	122
10	(Decommissioned)						
11	(Not Used)						
12	Ferry Dock	Unkown	Submers.	Concrete	Paco	2 @ 10	150
13	Klickitat Place NE	1992	Wet/Dry	Steel	Cornell	2 @ 7.5	144
14	Woodward School	1995	Submers.	Concrete	Paco	2 @ 15	60
	Lynnwood Center	1999	Wet/Dry	Concrete	Fairbanks Morse	2 @ 40	237
	North Town Woods	1999	Wet/Dry	Concrete	Fairbanks Morse	2 @ 30	106
	Sakai Village	2003	Submers.	Concrete	Hydromatic	2 @ 10	160

Table 2
Pump Run Records for Year 2004

No.	Station Name	Pump Cycles Per:			Average Daily Pump Run Time (hours)	Average Pumpage		
		Max Day	Daily In Max Month (3)	Average Day		Pump Rate (gpm) (4)	MG/mo.	gpm
1	See Note 1	---	---	---	---	---	---	---
2	Village	469	278	233	3.096	538	3.040	69.4
3	Old Treatment Plant	252	178	146	2.127	256	0.994	22.7
4	Lower Hawley	186	94	83	0.860	121	0.190	4.3
5	Sunday Cove	597	445	325	3.454	424	2.672	61.0
6	Lower Lovell	240	200	163	2.781	104	0.528	12.0
7	Wing Point	237	89	59	0.552	209	0.211	4.8
8	Highway 305	452	331	297	4.216	N/A	N/A	N/A
9	Island Terrace	147	99	71	1.820	122	0.405	9.3
10	See Note 2	---	---	---	---	---	---	---
12	Ferry Dock	18	5	5	0.238	150	0.065	1.5
13	Klickitat	116	21	17	0.378	144	0.099	2.3
14	Woodward School	16	4	4	0.467	60	0.051	1.2
---	Lynnwood Center	58	31	32	0.764	237	0.331	4.6
---	North Town Woods	101	57	44	2.393	104	0.454	2.0
---	Sakai Village	30	10	7	0.319	160	0.093	3.1

Notes:

(1) Pump Station No. 1 -- The High School Way Pump Station -- was decommissioned in 1997, with flows routed by gravity to Sunday Cove Pump Station
(2) Pump Station No. 10 -- Upper Hawley Pump Station -- was decommissioned in year 2000.
(3) Values shown are for December or January of 2004, which are typically the peak month for each pump station based on review of the records
(4) Pumping rate is as tested by City of Bainbridge Island staff.

N/A = Data not available

Table 3
Infiltration/Inflow Data
Year 2002

No.	Station Name	Pump Rate (gpm) (4)	June-Sept Average Daily		Peak Winter Day Results		
			Pump Run Time (hours)	gpm	Pump Run Time (hours)	gpm	I/I (gpm)
1	See Note 1	---	---	---	---	---	---
2	Village	538	2.434	54.6	6.52	146.2	91.6
3	Old Treatment Plant	256	1.952	20.8	6.15	65.6	44.8
4	Lower Hawley	121	1.007	5.1	9.35	47.1	42.1
5	Sunday Cove	424	2.724	48.1	8.03	141.9	93.7
6	Lower Lovell	104	2.689	11.7	6.5	28.2	16.5
7	Wing Point	209	0.543	4.7	5.35	46.6	41.9
8	Highway 305	N/A	3.785	N/A	10.22	N/A	N/A
9	Island Terrace	122	1.461	7.4	11.89	60.4	53.0
10	See Note 2	---	---	---	---	---	---
12	Ferry Dock	150	0.385	2.4	0.65	4.1	1.7
13	Klickitat	144	0.233	1.4	0.6	3.6	2.2
14	Woodward School	60	0.252	0.6	3.39	8.5	7.8
---	Lynnwood Center	237	0.174	1.7	1.25	12.3	10.6
---	North Town Woods	104	1.372	5.9	3.54	15.3	9.4
---	Sakai Village (Note 3)	160	0	0.0	0	0.0	0.0

Infiltration/Inflow Data
Year 2003

No.	Station Name	Pump Rate (gpm) (4)	June-Sept Average Daily		Peak Winter Day Results		
			Pump Run Time (hours)	gpm	Pump Run Time (hours)	gpm	I/I (gpm)
1	See Note 1	---	---	---	---	---	---
2	Village	538	2.669	59.8	9.6	215.2	155.4
3	Old Treatment Plant	256	1.830	19.5	4.73	50.5	30.9
4	Lower Hawley	121	0.787	4.0	3.45	17.4	13.4
5	Sunday Cove	424	2.910	51.4	6.97	123.1	71.7
6	Lower Lovell	104	2.638	11.4	7.94	34.4	23.0
7	Wing Point	209	0.462	4.0	10.91	95.0	91.0
8	Highway 305	800	4.028	134.3	8.94	298.0	163.7
9	Island Terrace	122	1.478	7.5	11.29	57.4	49.9
10	See Note 2	---	---	---	---	---	---
12	Ferry Dock	150	0.279	1.7	0.73	4.6	2.8
13	Klickitat	144	0.262	1.6	0.72	4.3	2.8
14	Woodward School	60	0.316	0.8	2.1	5.3	4.5
---	Lynnwood Center	237	0.384	3.8	1.44	14.2	10.4
---	North Town Woods	104	1.585	6.9	6.53	28.3	21.4
---	Sakai Village	160	0.135	0.9	0.59	3.9	3.0

Infiltration/Inflow Data
Year 2004

No.	Station Name	Pump Rate (gpm) (4)	June-Sept Average Daily		Peak Winter Day Results		
			Pump Run Time (hours)	gpm	Pump Run Time (hours)	gpm	I/I (gpm)
1	See Note 1	---	---	---	---	---	---
2	Village	538	2.792	62.6	7.37	165.2	102.6
3	Old Treatment Plant	256	2.063	22.0	4.25	45.3	23.3
4	Lower Hawley	121	0.809	4.1	2.15	10.8	6.8
5	Sunday Cove	424	3.213	56.8	6.03	106.5	49.8
6	Lower Lovell	104	2.640	11.4	4.41	19.1	7.7
7	Wing Point	209	0.565	4.9	2.53	22.0	17.1
8	Highway 305	N/A	3.901	N/A	7.78	N/A	N/A
9	Island Terrace	122	1.438	7.3	4.21	21.4	14.1
10	See Note 2	---	---	---	---	---	---
12	Ferry Dock	150	0.297	1.9	0.89	5.6	3.7
13	Klickitat	144	0.298	1.8	0.73	4.4	2.6
14	Woodward School	60	0.306	0.8	2.48	6.2	5.4
---	Lynnwood Center	237	0.696	6.9	1.93	19.1	12.2
---	North Town Woods	104	1.820	7.9	6.09	26.4	18.5
---	Sakai Village	160	0.337	2.2	1.64	10.9	8.7

Notes:

(1) Pump Station No. 1 -- The High School Way Pump Station -- was decommissioned in 1997, with flows routed by gravity to Sunday Cove Pump Station
(2) Pump Station No. 10 -- Upper Hawley Pump Station -- was decommissioned in year 2000.
(3) No data was recorded for this station for year 2002.
(4) Pumping rate is as tested by City of Bainbridge Island staff.

Table 4.
Infiltration/Inflow Summary

Station Number	Station Name	June-Sept. 2002 to 2004 Avg. Flow in Year of Peak Inflow Event, gpm	2002 to 2004 Peak Day Flow, gpm	2002 to 2004 Peak Day I/I, gpm
1	(Decommissioned)			
2	Village	59.8	215.2	155.4
3	Old Treatment Plant	20.8	65.6	44.8
4	Lower Hawley	5.1	47.1	42.0
5	Sunday Cove	48.1	141.9	93.8
6	Lower Lovell	11.4	34.4	23.0
7	Wing Point	4.0	95.0	91.0
8	Highway 305	N/A	N/A	N/A
9	Island Terrace	7.4	60.4	53.0
10	(Decommissioned)			
11	(Not Used)			
12	Ferry Dock	1.9	5.6	3.7
13	Klickitat Place NE	1.6	4.3	2.7
14	Woodward School	0.6	8.5	7.9
---	Lynnwood Center	6.9	19.1	12.2
---	North Town Woods	6.9	28.3	21.4
---	Sakai Village	2.2	10.9	8.7

N/A = Data not available

Table 5.
Improvement Needs

Item	Estimated Cost													
	2. Village	3. Old Treatment Plant	4. Lower Hawley	5. Sunday Cove	6. Lower Lovell	7. Wing Point	8. Highway 305	9. Island Terrace	13. Klickitat Place NE	14. Woodward School	Lynnwood Center	North Town Woods	Sakai Village
1. Control cabinet replacement	$ 55,000			$ 55,000		$ 51,000							
2. VFD's or added wetpit	$ 18,000			$ 12,000									
3. New controls, intrinsic safety			$ 30,000		$ 30,000		$ 30,000	$ 30,000					
4. Generator sound attenuation*	$45,000						$45,000						
5. Generator pigtail											$ 2,000		
6. Pumparound/pig station	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000		$ 25,000
7. Replacement valves	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000						
8. Security fencing	$ 5,000							$ 5,000					
9. Repaint drypit interior	$ 5,000			$ 5,000	$ 5,000	$ 5,000	$ 5,000						
10. Seal wetwell					$ 10,000								
11. Spare impeller	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 5,000	$ 4,000					
12. Improved ventilation	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000		$ 3,000	$ 3,000	$ 3,000	
13. Fixed lighting	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
14. Cathodic protection system	$ 14,000		$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000						
15. Odor scrubber											$ 15,000		
Subtotal	$ 181,000	$ 39,000	$ 83,000	$ 125,000	$ 98,000	$ 109,000	$ 134,000	$ 70,000	$ 28,000	$ 31,000	$ 48,000	$ 6,000	$ 28,000
Mobilization @ 10% + Tax @ 8.5%	$ 33,485	$ 7,215	$ 15,355	$ 23,125	$ 18,130	$ 20,165	$ 24,790	$ 12,950	$ 5,180	$ 5,735	$ 8,880	$ 1,110	$ 5,180
Subtotal	$ 214,485	$ 46,215	$ 98,355	$ 148,125	$ 116,130	$ 129,165	$ 158,790	$ 82,950	$ 33,180	$ 36,735	$ 56,880	$ 7,110	$ 33,180
Design & Permit Assistance	$ 70,000	$ 25,000	$ 40,000	$ 83,000	$ 40,000	$ 40,000	$ 41,000	$ 35,000	$ 14,000	$ 17,000	$ 20,000	$ 8,000	$ 11,000
Subtotal	$ 284,485	$ 71,215	$ 138,355	$ 231,125	$ 156,130	$ 169,165	$ 199,790	$ 117,950	$ 47,180	$ 53,735	$ 76,880	$ 15,110	$ 44,180
Contingency, 20%	$ 56,515	$ 13,785	$ 27,645	$ 45,875	$ 30,870	$ 33,835	$ 40,210	$ 24,050	$ 9,820	$ 10,265	$ 15,120	$ 1,890	$ 8,820
TOTAL	$ 341,000	$ 85,000	$ 166,000	$ 277,000	$ 187,000	$ 203,000	$ 240,000	$ 142,000	$ 57,000	$ 64,000	$ 92,000	$ 17,000	$ 53,000

*Note: For Stations 2 and 8, complete replacement of the 100kw generators is indicated because they are approximately 30 years old

Table 6.
Capital Improvement Program

No.	Station	Primary Upgrades	Estimated Cost	Year
5	Sunday Cove	Wetwell, all electric	$273,000	2005
---	No. 2 to 8	Spare impellers	$33,000	2005
2	Village	VFD's, all electric, new generator	$337,000	2006
7	Wing Point	All electric	$199,000	2007
8	Highway 305	Controls	$235,000	2007
4	Lower Hawley	Controls	$162,000	2008
6	Lower Lovell	Controls, seal wetwell	$183,000	2008
9	Island Terrace	Controls	$142,000	2009
13	Klickitat	Miscellaneous	$57,000	2009
3	Treatment Plant	Miscellaneous	$81,000	2009
14	Woodward School	Miscellaneous	$64,000	2009
---	Lynnwood Center	Odor control, misc.	$92,000	2010
---	North Town Woods	Fan, light	$17,000	2010
---	Sakai Village	Miscellaneous	$53,000	2010

Note: Cost totals for Stations 2 to 8 are $4,000 to $5,000 less than the totals shown in Table 5 because the spare impellers for each station are all paid for as a group in 2005.