King County

King County Department of Natural Resources and Parks

Barton, Murray, South Magnolia, and North Beach CSO Projects

Technical Memorandum No. 202.1
CSO Control Approach and Planning Boundaries

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KING COUNTY DEPARTMENT OF NATURAL RESOURCES AND PARKS

BARTON, MURRAY, SOUTH MAGNOLIA, AND NORTH BEACH CSO PROJECTS

TECHNICAL MEMORANDUM NO. 202.1

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ES.0 EXECUTIVE SUMMARY

ES.1 Purpose

The purpose of this Technical Memorandum (TM) is to identify potential Combined Sewer Overflow (CSO) control approaches that may be used in the Barton, Murray, South Magnolia, and North Beach CSO basins, and to define the planning boundaries for each basin. Potential control approaches have been identified by consideration of the following elements:

- The goals and policies of the King County Department of Natural Resources and Parks (KCDNRP, County) CSO Control Program;
- The local and national regulatory framework that defines requirements for CSO Control;
- Technical feasibility and relative cost of potential approaches;
- Preliminary evaluation criteria as established by the KCDNRP and Consultant team.

The preliminary screening of approaches described in this TM is used to identify the most likely alternatives that should be further refined and evaluated in subsequent planning phases. Additional detail will be developed for alternatives within each recommended approach. Alternative selection will be made with input from key stakeholders and the affected public, and summarized in TM 205.1, "Siting Report."

ES.2 Evaluation Methodology

ES.2.1 Basis of Peak Flows and Volumes

Computer modeling of wastewater flows for each of the basins was completed by KCDNRP-WTD prior to the start of this project. Model results included analyses of project elements needed to meet various levels of confidence for both storage and conveyance that would be required to meet the project requirements. In general, it was agreed (as proposed by KCDNRP-WTD) that the 90% probability of meeting the CSO regulations would become the project requirement for the minimum level of control. A summary of the pumping and storage requirements needed within each basin to meet CSO regulations is presented in Tables ES.1 and ES.2, respectively.

Table ES.1 Conveyance Capacity Requirements Assuming No Storage Upgrades CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects			
Service Basin	**Existing Conveyance Capacity[1]**	**Total Future Conveyance Capacity Required**	**Additional Conveyance Capacity Required**
Barton	28 mgd	53 mgd	25 mgd
Murray[2]	31.5 mgd	55 mgd	23.5 mgd
Murray[3]	31.5 mgd	69 mgd	37.5 mgd
South Magnolia	4.3 mgd	15 mgd	11 mgd
North Beach	3.4 mgd	10 mgd	6.5 mgd

1. Schock, K., "Description of CSO Modeling for the CSO Facilities Project," KCDNRP, 2007.
2. The required conveyance capacity presented assumes no increase in peak flow from the Barton basin (i.e., flow reduction achieved within the Barton basin).
3. The required conveyance capacity presented assumes conveyance of future peak flows from Barton Basin to Murray Basin (i.e., no flow reduction achieved within the Barton basin).

Table ES.2 Storage Volume Requirements Assuming No Conveyance Upgrades CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects		
Service Basin	**Existing Conveyance Capacity[1]**	**Additional Storage Volume Required**
Barton	28 mgd	0.5 MG
Murray[2]	31.5 mgd	1.3 MG
Murray[3]	31.5 mgd	1.7 MG
South Magnolia	4.3 mgd	2.6 MG
North Beach	3.4 mgd	3.5 MG

1. Schock, K., "Description of CSO Modeling for the CSO Facilities Project," KCDNRP, 2007.
2. The storage volume presented assumes flow reduction achieved within the Barton basin.
3. The storage volumes presented assumes no flow reduction achieved within the Barton basin.

ES.2.2 Regulatory and Policy Constraints

Chapter 173-245 of the Washington Administrative Code requires that dischargers with CSOs develop and implement plans to achieve the greatest reasonable reduction at each CSO site. The greatest reasonable reduction is defined as control of each CSO in such a way that an average of one untreated discharge may occur per year.

The County's West Point Service Area NPDES permit further specifies that the "permittee shall discharge no more than an average of 1 overflow event per year per CSO based on a long term average" and establishes that permit compliance will be based on a 5-year average for the permit cycle.

ES.2.3 Initial Evaluation Criteria

The following criteria were developed by the project team to evaluate the proposed CSO control approaches and the associated alternatives:

- Cost Effectiveness
- Operations and Maintenance Feasibility
- Technical Feasibility
- Public Health and Environmental Benefits
- Flexibility
- Community Issues
- Program Compatibility

Based on these evaluations, a shortlist of preferred alternatives was developed for further review and investigation as part of the Alternatives Development phase of this work.

ES.3 Summary of Findings

General findings of the scenario evaluations for all four basins are as follows:

- Storage needed to meet the project requirements is generally greater (up to 25 times larger) than predicted by the previous CSO plan.
- Pumping needed to meet the project requirements is generally greater than predicted by the previous CSO plan (up to 3 times more capacity is needed).
- Conveyance improvements could be used in lieu of storage, if downstream conveyance and treatment capacity are sufficient.
- Combinations of storage, conveyance, treatment, and demand management could be used to meet regulatory requirements.

The specific findings for the conveyance, storage, and demand management requirements of each basin were summarized in a series of graphs and tables provided by the County modeling staff, and are included in Appendix A. These findings were presented to the Project Team as part of Workshop No. 1, held on March 20, 2007. The results of Workshop 1 are included in Appendix B of this TM.

ES.3.1 Barton and Murray Basin Findings

Preliminary cost estimates and approach evaluations indicated that within the Barton and Murray Basins, peak flow storage and peak flow reduction approaches appeared more favorable than the peak flow conveyance and end of pipe treatment approaches.

The County should perform follow up flow monitoring at the Fauntleroy School Site to determine if storage at the site is feasible. In addition, the County should conduct public outreach efforts to determine if storage at Lowman Beach Park is possible. The County should continue to evaluate other storage sites within the basins in case storage at one of the preliminary sites is not feasible. In addition, the County should continue to coordinate

with SPU to determine if demand management within the Barton and Murray Basins is feasible, as this approach may need to be implemented in conjunction with storage to achieve CSO control within the basins.

ES.3.2 South Magnolia Basin Findings

Based on an evaluation of the peak flows within the basin, and results of the workshops, the preferred CSO approaches for the South Magnolia basin are end of pipe treatment (3A) and storage (1B and 1C).

End of pipe treatment appears to be the least cost alternative for the South Magnolia basin. Additional investigation should be made to determine the feasibility of obtaining a new permit for treatment at this location, as well as for SPU's Pump Station #77, which would require an upgrade as part of the end of pipe treatment CSO control alternative.

The topography of the South Magnolia basin is such that very few siting locations exist for storage facilities, due to potential challenges to construction. It is recommended that further analysis be conducted to identify and evaluate all the potential site locations to further develop the viability of this CSO approach.

Demand Management, if feasible has potential for reducing storage requirements; combined approaches may offer benefits for meeting control requirements.

ES.3.3 North Beach Basin Findings

The three most favorable alternatives for controlling overflows within the North Beach basin are end of pipe treatment (3A), storage (1C), and a combination of onsite storage and I/I reduction (5A).

The topography of the North Beach basin presents a challenge in locating a storage facility that would not require pumping from the North Beach Pump Station to the storage tank. Based on an initial review of potential site locations, the only feasible alternative to convey flow through gravity into a storage tank is at the site of the North Beach Pump Station. However, the site footprint is not large enough to construct a storage facility of sufficient size to control overflow events within the basin. Therefore, the only storage-based alternative that was determined to be a viable CSO control approach is offsite storage, which requires pumping into the storage facility. Several example sites were identified for this purpose.

Following Workshop 2, another example site was identified: the former Crown Hill Elementary School site. This site holds significant potential as a location that would not require additional pumping from the storage facility into the collection system. It is recommended that further evaluation of this site and others within the North Beach basin be conducted as part of the Alternatives Development phase of this project.

End of pipe treatment is the least cost alternative for controlling overflows in the North Beach basin. Additionally, it is considered to be the simplest approach to implement, and if

constructed below grade, would have reduced impacts on the neighboring community. It is recommended that this approach be further evaluated as part of the next phase of this project.

Demand management, including both inflow and infiltration reduction, appears to be technically feasible to control overflows within the North Beach basin. However, it would require an aggressive implementation plan to rehabilitate approximately 70%-80% of the sewer infrastructure within the basin. Implementation of demand management to any degree will reduce the corresponding size and capacity of the supplemental infrastructure needed to sufficiently reduce overflows to one event per year. It is recommended that the costs and feasibility of implementing demand management in combination with peak flow storage be more fully evaluated to determine the viability of this CSO approach.

ES.4 Next Steps

The next steps in the CSO Control project are development of the CSO Facility Selection Criteria (Task X03) and Alternatives Development (Task X05), which will lead to the selection of one preferred CSO control scenario for each of the four basins. Based on the interest in demand management exhibited in Workshop 2, further discussions with King County staff have been scheduled. These meetings may identify the need for additional analysis of demand management, including techniques, costs, and implementation constraints. Once the preferred alternative for each basin has been more fully developed, additional tasks will be conducted, including those relating to environmental services, public involvement (community relations), geotechnical evaluations and land surveys for easement or property acquisition, and development of costs for the preferred alternative.

1.0 INTRODUCTION

The purpose of this memorandum is to describe planning boundaries and technical approaches to CSO control within the Barton, Murray, South Magnolia, and North Beach CSO basins. This TM also presents the findings and results of the Planning Confirmation Workshops Nos. 1 and 2, held respectively on March 20 and May 30, 2007.

1.1 Background

The Barton, Murray, South Magnolia, and North Beach CSO basins are associated with the Regional Wastewater Services Plan and are assigned the goal of reducing uncontrolled combined sewer overflows to meet the current regulatory standard. These projects are scheduled to be complete by 2013.

The objective of the Barton, Murray, South Magnolia, and North Beach CSO Projects is to develop a comprehensive CSO Facilities Plan for each basin. These plans will be developed as part of a three-phase approach, including Planning Confirmation and Criteria Development, Alternative Evaluation, and Facilities Planning. This TM presents the findings of the first phase of this project, Planning Confirmation and Criteria Development, and

presents the alternative evaluation criteria and a short-list of the preferred CSO approaches for each basin. Subsequent phases of this effort will include development of a preferred CSO alternative for each basin, preliminary design of the CSO facilities, environmental services, public involvement, geotechnical evaluations, land surveys for easement or property acquisition, and development of the project costs for the preferred alternative. These tasks will culminate in the development of a Facilities Plan for each basin, in preparation for completion of full design of the CSO facilities, subsequent to 2009.

1.2 CSO Policy and Regulatory Framework

Combined sewer overflow management and control requirements are established by Washington rules and regulations, federal law, and the US EPA CSO Control Policy. The US EPA CSO Control Policy was issued in 1994 and establishes nine minimum controls for CSOs as well as a presumptive level of control that is protective of water quality. This presumptive level of control is no more than four uncontrolled overflow events per year or an 85% reduction in CSO volumes following implementation of control measures. For most communities with combined sewers, this 85% level of control typically results in 2-3 uncontrolled discharges per year.

The level of CSO control established by the State of Washington was adopted in 1987, prior to development of the US EPA CSO Control Policy and is more restrictive in terms of level of control. Chapter 173-245 of the Washington Administrative Code (WAC) requires dischargers with CSOs to develop and implement plans to achieve the greatest reasonable reduction at each CSO site. The greatest reasonable reduction is defined as control of each CSO in such a way that an average of one untreated discharge may occur per year.

The County's West Point Service Area NPDES permit requires that the County implement the nine minimum controls from the US EPA Control Policy and further defines the level of control established by state rules. The permit requires that the "permittee shall discharge no more than an average of 1 overflow event per year per CSO based on a long term average" and establishes that permit compliance will be based on a 5-year average for the permit cycle.

The Washington State Department of Ecology (DOE) has recently indicated that their policy is evolving on their interpretation of WAC 173-245 and that control requirements may become more restrictive than established in the County's current permit. KCDNRP staff has initiated discussions with the DOE to determine what the potential impacts are on the County's future NPDES permit requirements.

The control approaches outlined within this technical memorandum are based upon current NPDES permit requirements of one uncontrolled CSO discharge at each outfall based upon a five-year rolling average.

1.3 Prior Planning Assumptions and Conclusions

1.3.1 Barton and Murray CSO Basins

The Barton and Murray CSO basins have interdependent systems; the Barton Street Pump Station conveys flows to the Murray Avenue Pump Station, which handles flows from both the Barton and Murray basins. Therefore, the flow analysis, planning confirmation, and scenario evaluation of these two basins will be addressed together throughout this TM.

The 1997 CSO Plan Update[1] evaluated alternatives involving the different combinations of the following technical approaches to CSO controls in the Barton and Murray CSO Basins:

1. **Partial separation of the storm water drainage from the combined sewer.** This alternative included separation of approximately 150 acres of impervious area drainage from the combined sewer.

2. **Storage within the CSO Basins to offset excessive peak flows to the Barton and Murray pump stations.** This included offline storage with 0.5 million gallons (MG) storage at the Fauntleroy School within the Barton CSO Basin and 1.0 MG of storage along 48th Avenue SW within the Murray CSO Basin.

3. **Additional conveyance at the Barton pump station and storage at other affected downstream facilities to convey the excess peak flows downstream.** This alternative included a combination of conveyance and storage improvements to the collection system to control CSOs. An additional 7.5 million gallons per day (mgd) of conveyance at the Barton Street pump station, through installation of a new pump station and force main, was recommended to convey the peak flows downstream to the Murray CSO Basin. A 0.5 MG storage facility at Lowman Beach Park was recommended to reduce peak flows to the Murray Avenue pump station. Approximately 0.6 MG of storage under SW Alaska Drive was also recommended.

4. **Additional conveyance at the Barton Pump Station for treatment at the Alki CSO Treatment Plant.** The alternative included conveyance of the excess peak flows from the Barton Street pump station to the Alki CSO Treatment Plant. Improvements for this alternative included a new 7.5 mgd pump station and force main from the Fauntleroy Ferry Dock to Lowman Beach Park, a new 18 mgd pump station and force main from Lowman Beach Park to SW Alaska Drive, a new 28 mgd pump station and force main from SW Alaska Drive to the Alki CSO Treatment Plant, and upgrades to the Alki CSO Treatment Plant to handle the additional 28 mgd in peak flows.

1 "King County CSO 5-Year Update, Task 4.0 Development of Alternatives," Brown and Caldwell, December 1997.

1.3.2 South Magnolia CSO Basin[1]

Flow monitoring was conducted within the South Magnolia basin for several years in the mid-1990s. This monitoring identified that the average annual overflow volume in the basin was 5.4 MG, and the volume of the once annual event at the South Magnolia overflow was 1.3 MG. The control alternatives evaluated to address these overflows were storage and roof drain disconnection.

The storage alternative required construction of a diversion structure that would route the overflows to a new 1.3 MG underground storage tank. Following the storm event, the storage tank would release the flow back into the system for treatment at the West Point Treatment Plant. The estimated cost for this alternative was $6 million (in 1997 dollars).

The roof drain disconnection alternative was proposed to reduce impervious area within the basin by disconnecting the roof drains of 900 residences from the combined sewer system. It was estimated that the cost for implementing this alternative was $2.9 million (in 1997 dollars), or approximately $3,200 per residence.

1.3.3 North Beach CSO Basin[1]

The North Beach Pump Station experiences overflow events several times each year. To address this issue, King County developed a pre-design study that identified several alternatives to minimize the overflow occurrences. These alternatives included construction of a storage facility, followed by additional improvements such as expansion of the pump station capacity, forcemain replacement, and minor modifications to the City of Seattle pipelines.

The recommended storage capacity was a 140,000-gallon underground storage tank at the site of the North Beach Pump Station. This was expected to reduce the number of overflows from 18 to 4 events per year, thereby reducing the overflow volume from 1.9 MG to 1.0 MG each year. The secondary improvements would further reduce the overflow frequency to once per year, and would reduce the overflow volume to 0.2 MG annually. The secondary improvements consisted primarily of upgrading the North Beach Pump Station from 3.5 mgd to 4.5 mgd and replacing 2,060 feet of the approximately 2,200 feet of forcemain within Carkeek Park. Stored flow was to be pumped to the Carkeek CSO Treatment Plant using the expanded pump station following each storm event. The estimated cost for these improvements (storage, pump station, and forcemain) was $3.5 million (in 1997 dollars), which is equivalent to a unit cost of $1.75 per gallon.

1.4 Evaluation Approach

Five CSO control approaches were evaluated as part of this planning effort:

1. **Peak Flow Storage.** Store peak flows that exceed conveyance capacity in the basin during each storm event, and use existing pumping and piping facilities to convey stored flow out of the basin once the rainfall event has subsided.

2. Convey and Treat Peak Flows. Convey peak flows out of the basin by increasing pumping and forcemain capacity, or the capacity of the gravity sewer system. This approach also requires treatment plant upgrades at the point where the peak flows are discharged, as the capacity of these facilities are not adequate to handle the additional flows and loads.

3. End of Pipe Treatment for Peak Flows. Treat and discharge peak flows at or near the current CSO locations. Typical processes used for remote, end of pipe treatment include primary treatment and disinfection. In this effort, high rate clarification (HRC) and ultraviolet (UV) disinfection are recommended for end of pipe treatment.

4. Peak Flow Reduction (Demand Management). Reduce the magnitude of the flow in the collection system through infiltration and inflow (I/I) reduction in separated systems, or by disconnecting impervious areas in combined systems.

5. Combined Approach. Reduce peak flows within the basin by implementing a combination of two or more of the previously mentioned CSO approaches.

This TM presents the initial list of CSO control alternatives for each CSO approach. Selected alternatives from each approach will be screened for effectiveness based on cost and non-cost evaluation criteria. A short list of alternatives will be further developed in subsequent TMs. A Facilities Plan will then be developed for the recommended alternative in each basin.

1.4.1 Alternatives and Theoretical Site Locations

For each CSO basin, the five CSO control approaches (identified above) were considered. For each CSO approach, a group of alternatives was evaluated. For example, in the case of the North Beach CSO Basin, for the Peak Flow Storage approach, three alternatives were developed. These alternatives consider the range of options available to treat the CSO events for the specified approach, and identify the necessary infrastructure improvements and theoretical site locations of the proposed improvements. The site locations were chosen based on their proximity to the pump stations, and the feasibility of using gravity to convey flow into and out of the proposed infrastructure. It should be noted that the site locations identified in this TM are examples only; further evaluation of these locations must be made as part of the Alternatives Development before recommended site locations are proposed.

1.4.2 Criteria for Alternative Screening

To evaluate the CSO control approaches and associated alternatives for the Barton, Murray, South Magnolia, and North Beach CSO basins, a list of screening criteria were developed. These criteria were presented and discussed as part of Workshop No. 1, held March 20, 2007, and were subsequently reviewed by the King County Department of Natural Resources and Parks (County) staff.

To evaluate each of the control approaches, criteria within the following categories were developed:

- Cost Effectiveness
- Operations and Maintenance Feasibility
- Technical Feasibility
- Public Health and Environmental Benefits
- Flexibility
- Community Issues
- Program Compatibility

Cost Effectiveness

The impact of each CSO control approach was evaluated based on its capital cost relative to the other approaches.

Operations and Maintenance (O&M) Feasibility

The impact of each CSO control approach was evaluated based on its O&M feasibility relative to the other approaches. The level of O&M impact was determined by King County O&M staff during the evaluation and screening process.

Technical Feasibility

CSO approaches that were deemed to be infeasible based on program compatibility, constructability, engineering criteria, permitting constraints, and land availability were eliminated during the screening process.

Public Health and Environmental Benefits

Public health and safety was evaluated for each approach. All approaches were required to meet fundamental CSO goals, and limit public exposure to CSOs. Specific impacts of the various approaches include:

Demand Management: The potential for increased stormwater runoff to decrease slope stability was considered, and will be further evaluated in selected basins where Demand Management is considered alone or in combination with other approaches.

Flexibility

Approaches with a high degree of flexibility to meet future changes in regulation or flow were favored. Specific impacts of the various approaches include:

Storage: Peak flow storage was considered to be the lease flexible approach, particularly when limited area for facility siting was available.

Community Considerations

All approaches under consideration will have some level of community impact. Specific impacts of the various approaches include:

Storage: The local impact of facility on property and construction implementation was considered.

Convey and Treat: Community impact due to shoreline and/or roadways for pipeline

construction was considered.

End of Pipe Treatment: Local impact of facility on property and construction implementation, and long-term impact due to facility operation was considered.

Demand Management: Community impact to public rights-of-way and private property was considered, along with the potential stormwater impacts associated with separation of storm flow from the combined system (such as soil stability, flooding, etc.).

Program Compatibility

CSO approaches that were deemed to be incompatible with other programs and initiatives (including the plans of Seattle Parks, Public Utilities, and Transportation departments, as well as other County-wide plans) were eliminated during the screening process.

The specific criteria identified for each of these categories is presented in Table 1. Further description regarding the specifics of these criteria can be found in Technical Memorandum 203.1, "Screening Criteria for CSO Approaches and Alternatives."

These criteria were used to evaluate the proposed CSO control scenarios presented in Workshop No. 2, held May 30, 2007. The purpose of this workshop was to present and evaluate the potential CSO control alternatives for each basin. Specific information about each alternative, including capacity, component elements, location, and relative cost, was presented and discussed. Based on this information, the workshop participants ranked the proposed scenarios with respect to the evaluation criteria, identified potential implementation issues, and identified areas of remaining uncertainty requiring further evaluation. This TM provides a summary of the outcome of this workshop, and presents a short-list of the preferred scenarios, which will be further evaluated and developed as part of the next phase of this CSO control project: Alternatives Evaluation.

1.4.3 Basis of Capital Costs

In order to use the Selection Criteria to evaluate CSO control approaches, it is necessary to develop planning level costs of the technical elements of the approaches. Planning level capital costs were developed for each approach as part of the planning confirmation phase of this project. It should be noted that all costs presented in this TM are capital costs only; total lifecycle costs were not evaluated as part of this effort. The eight major project elements identified as part of the CSO control alternatives are as follows:

- CSO storage tanks
- Gravity sewers
- Force mains
- Microtunnels
- Tunnels
- Submersible pump stations
- High head pump stations
- Treatment facilities (High Rate Clarification / Disinfection)

Three sources were used to develop the planning level costs:

- Design estimates and bid experience from recent projects (storage tanks, high head pump stations, and treatment facilities).

Table 1 Alternatives Evaluation Criteria
CSO Control Approach and Planning Boundaries
Barton, Murray, South Magnolia, and North Beach CSO Projects

Cost Effectiveness	Operations and Maintenance Feasibility	Technical Feasibility	Public Health and Environmental Benefits	Flexibility	Community	Compatibility with Other Programs and Initiatives
-Capital cost -Life cycle costs -Use of existing facilities -Grants/loan ranking	-Reliably meet CSO objectives -WTD automation -Ease of start-up/shut-down -Ease of maintenance -No adverse impacts to - County or City -Ease of regulatory reporting	-Compatible with existing system -Technically feasible -Can be permitted -Land is available -Minimize federal & state permit constraints	-Meet CSO requirements -Minimizes public exposure -Minimal environmental footprint -Minimizes environmental risks -Minimize or avoid contact with endangered species -Coordinates with Puget Sound goals	-Future regulations -Climate change -Implementation	-Neighborhood equity -Cost allocation -Minimal shoreline impacts -Minimal property disruption -Minimal implementation impacts -Minimal operations impacts -Minimal disturbance of archeological areas	-Coordinate with Seattle parks, SPU, and transportation -Sediment management plan -County-wide planning policies -Stormwater management responsibilities -Conveyance system improvement policies -WTD productivity initiative -WTD CSO Program

- Engineers' estimates based on vendor quotes (submersible pump stations and treatment facilities.)
- King County Tabula cost estimating model (pipelines and tunnels.)

The planning-level capital cost estimates for the CSO alternatives are based on cost curves developed from the current design of similar facilities and/or Tabula, the County's cost estimating tool. These costs were then escalated to develop total project costs, including general contractor overhead and profit, an estimating contingency of 30%, and allied costs of 30% (including engineering, legal, and administrative costs). The cost estimates of the discrete scenario elements and the cost curves (based on data from recent bid prices, design of similar facilities, and Tabula) are included in Appendix C.

2.0 FLOW ANALYSIS AND PROBLEM DEFINITION

This section compares existing King County facility conveyance capacities to projected peak flows obtained from the updated flow modeling results prepared by the County. Existing pumping and conveyance (gravity or force main) capacities within each basin, combined with the capacities of downstream conveyance and treatment facilities, dictate the magnitude of flow that must be controlled to limit CSOs and meet regulatory requirements. Various alternatives to control CSOs are presented in Sections 4 - 7 of this TM.

To identify the flows and volume of storage needed to limit overflows to one event per year, King County modeled the impacts of wet weather events on the sewer system of each of the four CSO basins. The Runoff/Transport model was calibrated against observed sewer flows using measured rainfall data from the City of Seattle, which maintains a system of rain gauges throughout the metropolitan area. Flow data was obtained from the King County Flow Metering Group and the online King County Sewage Data Retrieval System. Following calibration, the model simulations were developed to provide a 28-year hydrograph for each basin.

The County's NPDES permit requires that no more than an average of one overflow event occur per year, based on a 5-year moving average. To meet these requirements, the County selected the 90% level of confidence for developing flow and storage requirements.

For a specified flow capacity, the volume of additional storage needed to meet the regulatory requirements without increasing conveyance capacity was determined from the hydrographs that exceeded the existing conveyance capacity. In contrast, the conveyance capacity needed to meet the regulatory requirements without increasing storage was determined by increasing the capacity within the model until only one overflow event occurred annually. A summary of the pumping and conveyance requirements needed to meet the CSO regulations is presented in Table 2. A summary of the storage requirements (with no increase in conveyance capacity) to meet the CSO regulations is presented in Table 3.

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Figure 1

Barton Basin

Barton, Murray, Magnolia and North Beach CSO Projects

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Figure

Murray Basin

Barton, Murray, Magnolia and North Beach CSO Projects

Table 2	Conveyance Capacity Requirements Assuming No Storage Upgrades CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects		
Service Basin	**Existing Conveyance Capacity[1,2]**	**Total Future Conveyance Capacity Required**	**Additional Conveyance Capacity Required**
Barton	28 mgd	53 mgd	25 mgd
Murray[3]	31.5 mgd	55 mgd	23.5 mgd
Murray[4]	31.5 mgd	69 mgd	37.5 mgd
South Magnolia	4.3 mgd	15 mgd	11 mgd
North Beach	3.4 mgd	10 mgd	6.5 mgd

1. Schock, K., "Description of CSO Modeling for the CSO Facilities Project," KCDNRP, 2007.
2. It should be noted that the existing conveyance requirements are based on the actual conveyance capability of the individual pump stations. For example, the peak design flow of the pump station may be greater than the conveyance capacity of the downstream pipeline, therefore, the resulting overall existing capacity of the pump station is limited to the overall conveyance capacity of the system.
3. The required conveyance capacity presented assumes no increase in peak flow from the Barton basin (i.e., flow reduction achieved within the Barton basin).
4. The required conveyance capacity presented assume conveyance of future peak flows from Barton Basin to Murray Basin (i.e., no flow reduction achieved within the Barton basin).

Table 3	Storage Volume Requirements Assuming No Conveyance Upgrades CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects	
Service Basin	**Existing Conveyance Capacity[1,2]**	**Additional Storage Volume Required**
Barton	28 mgd	0.5 MG
Murray[3]	31.5 mgd	1.3 MG
Murray[4]	31.5 mgd	1.7 MG
South Magnolia	4.3 mgd	2.6 MG
North Beach	3.4 mgd	3.5 MG

1. Schock, K., "Description of CSO Modeling for the CSO Facilities Project," KCDNRP, 2007.
2. Total system conveyance capacity reported (including pump stations and pipelines). Values do not necessarily reflect total or firm pumping capacity.
3. The storage volume presented assumes flow reduction achieved within the Barton basin.
4. The storage volumes presented assume no flow reduction achieved within the Barton basin.

In addition to establishing conveyance and volume requirements needed to meet DOE regulations, the model was used to determine the impacts of inflow and infiltration (I/I) reduction on the storage requirements for each basin. Inflow and Infiltration is defined as the total quantity of water entering a sewer system. Inflow sources include runoff from impervious areas that are directly connected into the sewer system (roof drains, catch

basins, etc.). Infiltration is groundwater and stormwater which permeates through the soil into laterals, side sewers, and manholes.

Inflow has the most immediate impact on the sewer system; because inflow is due to direct connections from impervious areas, these flows are the first to enter the sewer system. If inflow is reduced, the corresponding peak flow response is reduced and delayed, thereby reducing the necessary storage volume to handle the peak flows. The impact on storage from inflow reduction was modeled at 25%, 50%, and 75% impervious area disconnection within each basin. The results are presented in Table 4.

Table 4 Storage Volume Associated with Inflow Reduction CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects

Service Basin	Impervious Area Reduction			
	0%	25%	50%	75%
Barton	0.5 MG	0.16 MG	0 MG	N/A
Murray	1.4 MG	0.7 MG	0.15 MG	0 MG
South Magnolia	2.6 MG	1.8 MG	1.1 MG	0.4 MG
North Beach	3.5 MG	3.2 MG	2.8 MG	2.5 MG

1. Storage volumes are based on a 10% probability of exceedance.
2. The impact of impervious disconnection in the Murray basin is based on the existing pump capacity of the Barton Pump Station.

2.1 Barton and Murray CSO Basins

2.1.1 Existing Facilities

The Barton Basin comprises 1080 acres within the Alki Basin of West Seattle (Figure 1). The basin is built out, consisting primarily of residential land use within the basin. Most of the impervious pavement areas are disconnected from the combined sewer; however, there is a small section at the east side of the basin in which approximately 27 acres of pavement area drains to the combined sewer system. In addition, most of the building roofs within the basin are connected directly to the combined sewer. An evaluation of the roof drainage system for several homes within the Barton Basin is provided in Appendix D. All flow from the combined sewer system in this basin drains to the Barton Street Pump Station, which is located next to the Fauntleroy Ferry Dock. KCDNRP-WTD field tests indicate that the Barton Street Pump Station, which pumps into parallel 24-inch force mains, has a peak capacity of approximately 28 mgd. From the Barton Pump Station, the combined sewer flows are conveyed downstream to the Murray Avenue Pump Station and then to the West Seattle Tunnel during dry weather conditions or to the Alki CSO Treatment Plant during wet weather conditions.

The Murray Basin is comprised of 966 acres within the Alki Basin of West Seattle (Figure 2). The basin is almost completely built out with mostly residential land use within the basin.

Most of the impervious pavement areas are disconnected from the combined sewer; however, most of the building roofs within the basin are connected directly to the combined sewer. An evaluation of the roof drainage system for several homes within the Murray Basin is provided in Appendix E. All flow from the combined sewer system in this basin drains to the Murray Avenue Pump Station, which is located within Lowman Beach Park. KCDNRP-WTD field tests indicate that the Murray Avenue Pump Station, which pumps into parallel 27-inch force mains, has a peak capacity of approximately 31.5 mgd. From the Murray Pump Station, the combined sewer flows are conveyed downstream to the West Seattle Tunnel during dry weather conditions or to the Alki CSO Treatment Plant during wet weather conditions.

KCDNRP-WTD has indicated that several facilities located downstream of the Barton and Murray basins, including the conveyance piping downstream of the Murray Avenue Pump Station, the 63rd Street Pump Station, the West Seattle Tunnel, and the Alki CSO Treatment Plant, do not have sufficient capacity to handle additional peak flows. This finding is important as it indicates that improvements to these downstream facilities would be required if conveyance improvements at the Barton and Murray basins were selected as the CSO control approach.

2.1.2 Peak Flow Analysis Summary

The updated modeling performed by KCDNRP-WTD indicates that the peak design flow to the Barton Street pump station is 53 mgd. With the increased peak design flow to the pump station, KCDNRP-WTD modeling has indicated a need for disconnection of 70 acres of impervious area within the basin, 0.5 MG of storage, or an additional 25 mgd of conveyance at the Barton Pump Station to meet the current CSO regulatory standard.

As stated previously, because the Barton Street Pump Station conveys flows directly to the Murray Avenue Pump Station, any improvements at the Barton Pump Station will have an effect on the upgrades required at the Murray Pump Station. A flow chart is provided in Figure 3 to illustrate the different combinations of approaches. An alpha-numeric coding convention was developed in order to describe the different combinations of approaches by basin. The first term in the coding convention, B1A for example, uses the leading character "B" to indicate the Barton Basin combined with a number (1 through 4) to describe the approach alternative for a given basin. In this example, approach 1 refers to storage as the CSO control approach.

If storage or flow reduction approaches are implemented at the Barton CSO basin (as indicated by the portion of Figure 3 below the blue dashed line) the updated modeling performed by KCDNRP-WTD indicates that the peak design flow to the Murray Pump Station will be 55 mgd. With the increased peak design flow to the pump station, KCDNRP-WTD modeling has indicated a need for disconnection of 40 acres of impervious area within the basin, 1.3 MG of storage, or an additional 23.5 mgd of conveyance at the Murray Avenue Pump Station to meet the current CSO regulatory standard.

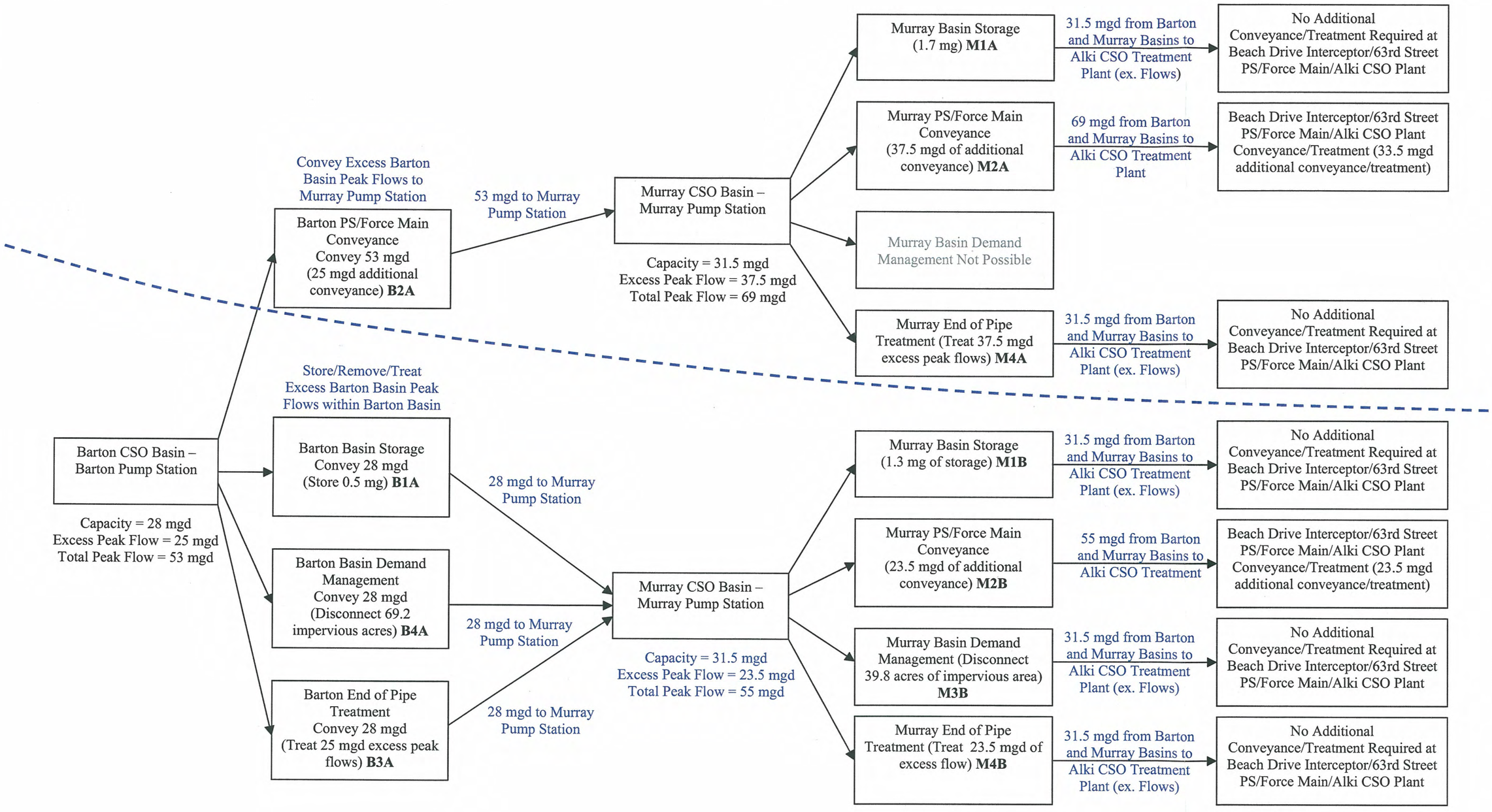

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Figure 3
CSO CONTROL ALTERNATIVES FOR BARTON AND MURRAY BASINS
BARTON, MURRAY, MAGNOLIA, AND
NORTH BEACH CSO PROJECTS
KING COUNTY DEPARTMENT OF NATURAL RESOURCES
AND PARKS

If storage or flow reduction approaches are not implemented at the Barton CSO basin and the peak flows are conveyed to the Murray Avenue Pump Station (as indicated by the portion of Figure 3 above the blue dashed line) the updated modeling performed by KCDNRP-WTD indicates that the peak design flow to the Murray Avenue Pump Station will be 69 mgd. With the increased peak design flow to the pump station, KCDNRP-WTD modeling has indicated a need for 1.7 MG of storage, or an additional 37.5 mgd of conveyance at the Murray Avenue Pump Station to meet the current CSO regulatory standard.

2.2 South Magnolia CSO Basin

2.2.1 Existing Facilities

The South Magnolia Basin comprises 751 acres in the Magnolia neighborhood of Seattle. The basin is largely built out as a residential area (approximately 3,000 residential properties) with one small commercial area. The majority of the sewerage in the basin is combined sewers, and there are about ten blocks of separated sewers, according to GIS sewer map coding provided by King County. There are storm sewers in a large portion of the basin, that according to County GIS information, have catch basins at street corners; whether or not there are connections from individual parcels is unknown. Of the total basin area, KCDNRP-WTD modeling indicates that 12% of the area is impervious surfaces that contribute flow to the combined sewer system.

A GIS-based analysis of the basin indicates that about 2,400 houses are within 100-feet of a storm sewer inlet; rooftops are estimated to comprise about 65-acres of impervious surface. This area is larger than the total impervious area estimated by current modeling (see section 3.2.2 below.)

The sewer system owned by the City of Seattle is tributary by gravity and one SPU pump station (Pump Station #77, firm capacity of 1.4 mgd [personal communication Andrew Lee, 5/29/07]) to a single control manhole (Metro number D026-153) located at the foot of 32nd Avenue, as shown in Figure 4. Flow up to 4.3 mgd is conveyed via the South Magnolia Interceptor (also referred to as the South Magnolia Trunk) to the Interbay Pump Station, where it is pumped to the West Point Treatment Plant through the Elliott Bay Interceptor. The capacity of the South Magnolia Interceptor just downstream of the control manhole is approximately 4.3 mgd, according to an analysis by KCDNRP-WTD, completed in 2004. There are minimal connections to the interceptor downstream of the control manhole, most notably the Elliott Bay Marina. Capacity downstream of the marina has not been calculated, but is estimated to be 6.8 mgd based on review of County record drawings.

2.2.2 Peak Flow Analysis Summary

Flows exceeding 4.3 mgd overflow at the control manhole are discharged through a County outfall that extends about 750 feet offshore at the foot of 32nd Avenue to a depth of approximately 75.50 feet (per County staff) or about 18-feet below the Mean Low-Low

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Figure

Magnolia Basin

Barton, Murray, Magnolia and North Beach CSO Projects

Water level. The outfall was replaced in 1988. The South Magnolia Interceptor consists of about 7,300 feet of 18-inch and 27-inch diameter pipe. The 18-inch pipe which is primarily in the beach area along the south side of Magnolia bluff, and about 4,600 feet long, is pressure pipe with a maximum operating head of about 27 feet. At full pressure, computed capacity is just over 5 mgd. Originally cast iron (1966), much of the pipe was replaced in 1988 with ductile iron prior to construction of the Elliott Bay Marina. The remaining pipe is a conventional reinforced concrete (RCP) gravity sewer with manholes at irregular intervals. The capacity of the gravity portion of the sewer is just over 6 mgd.

As previously discussed, the 1997 CSO planning study proposed two alternatives to limit overflows to one event per year: a 1.3 MG storage tank or disconnection of roof drains from 900 houses within the basin. To update these findings, King County staff conducted additional modeling of the basin under existing conditions. This modeling indicates a need for either twice the amount of storage (2.6 MG) without reduction in impervious area contribution, or a combination 1.3 MG storage and disconnection of about 40% of the rooftop drains. Even if 100% of impervious area is disconnected, 0.2 MG of storage will be required.

2.3 North Beach CSO Basin

2.3.1 Existing Facilities

The North Beach basin comprises 691 acres in the northwest Seattle, immediately adjacent to Golden Gardens Park. This basin is mostly residential (approximately 2,600 residential properties are within the basin), and is primarily a separated sewer system; only a small portion of the basin has combined storm and sewer infrastructure. Figure 5 shows the sewer conveyance systems within the North Beach basin.

The SPU sewer system currently conveys flow to the North Beach Pump Station, which has a maximum capacity of 9 mgd, and a firm capacity of 5.5 mgd. However, it should be noted that the current capacity of the North Beach Pump Station is limited by the capacity of the downstream forcemain, which is 3.5 mgd. The flow is conveyed through this 14-inch forcemain to the Carkeek Pump Station and CSO Treatment Plant located in Carkeek Park. The capacity of the Carkeek Pump Station and the Treatment Plant are 20 mgd each. During dry weather, the flow from North Beach Pump Station is pumped through the Carkeek Pump Station to the 8th Avenue Interceptor for treatment at the West Point Wastewater Treatment Plant. During wet weather, when the 8th Avenue Interceptor is full, the flow is pumped from the North Beach Pump Station to the Carkeek Treatment Plant where it is treated and discharged through a 33-inch outfall into Puget Sound. When wet weather flows exceed the capacity of the Carkeek Treatment Plant, overflows occur at the North Beach Pump Station.

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Figure 5

North Beach Basin

BARTON, MURRAY, MAGNOLIA AND NORTH BEACH CS[illegible] PROJECTS

2.3.2 Peak Flow Analysis Summary

Peak flows and resulting storage volumes in the North Beach basin were updated by King County in February of 2007. The data are based on continuous flow simulation modeling using more recent flow monitoring data in the basin, and criteria that account for the range of expected model accuracy. This effort has identified that the storage needed to reduce overflows to one event per year in the North Beach basin is 3.5 MG. In lieu of storage, the pumping capacity of the North Beach Pump Station would need to be increased to 10-12 mgd. Because the North Beach basin is largely a separated system, a significant portion of wet weather flow is due to infiltration through laterals, side sewers, sewer mains, and manholes. A previous inflow and infiltration (I/I) study[2], conducted in 1988, established that the North Beach basin I/I flows are roughly 49% inflow (through direct connections into the sewer) and 51% infiltration. The recent flow modeling is in agreement with this conclusion.

3.0 BARTON AND MURRAY BASIN EVALUATION

As previously mentioned, the Barton and Murray basins are interdependent. Therefore, the scenarios described in this section incorporate the combined CSO approach for both basins.

The flow analysis modeling results for the Barton basin indicate that the peak flow conveyance requirements to control CSOs (53 mgd) were significantly greater than the storage requirements (0.5 MG). Additionally, conveyance improvement options within the Barton basin require additional upgrades at all of the facilities downstream of the Barton Street Pump Station. Because of these factors, the conveyance and end of pipe treatment approaches for the Barton basin were estimated to be 3 to 4 times more expensive than storage options. These approaches have been evaluated on a preliminary basis (and are provided in Appendices D and E, respectively), but are not considered to be viable compared to the storage and demand management CSO approaches for the Barton basin. Therefore, the scenarios associated with these control approaches are not presented in the following sections.

3.1 Barton Peak Flow Storage Alternatives

Four alternatives were evaluated that incorporated storage within the Barton basin in conjunction with other CSO approaches in the Murray basin:

- B1A-M1B: Peak Flow Storage at Barton and Murray Basins
- B1A-M2B: Peak Flow Storage at Barton and Peak Flow Conveyance at Murray
- B1A-M3B: Peak Flow Storage at Barton and Demand Management at Murray

2 "Inflow/Infiltration Analysis", Brown and Caldwell, 1988.

- B1A-M4B: Peak Flow Storage at Barton and End of Pipe Treatment at Murray

It should be noted that the site location of facilities described in this section are provided only to illustrate the different approaches to CSO control by basin. Additional siting options for facilities within the basins are to be explored during the Alternative Development and Siting Evaluation phase of the project.

Alternative B1A–M1B: Peak Flow Storage at Barton and Murray Basins

This alternative requires construction of two storage tanks (one per basin), to store peak flows during wet weather events and then release these flows back into the collection system following the storm event. The example locations provided for this alternative are a 0.5 MG rectangular storage tank located at the Fauntleroy School within the Barton basin and a 1.3 MG storage tank located at the Lowman Beach Park within the Murray basin.

As an example, a 0.5 MG storage tank for the Barton basin could be located at the Fauntleroy School parking lot. The tank dimensions would be approximately 80 feet long, 40 feet wide, with an assumed storage depth of 25 feet. The storage tank would include a flow control structure that would divert flows from the 24-inch interceptor along SW Director Street during rain events that cause flows in excess of the capacity of the Barton Pump Station. Following the storm event, the tank will re-introduce the stored volume back into the 24-inch interceptor along SW Director Street with a 0.5 mgd pump system designed to dewater the tank within 24 hours. All the "Barton Storage"-based alternatives require the construction of this storage tank at this location, and therefore include the assumptions, benefits, and limitations of the "Barton Storage" component of the proposed scenario (see description below).

A 1.3 MG storage tank for the Murray CSO Basin could be located at the Lowman Beach Park. The tank dimensions would be approximately 120 feet long, 60 feet wide, with an assumed storage depth of 25 feet. The tank will re-introduce the stored volume back into the Murray Pump Station with a 1.3 mgd pump system designed to dewater the tank within 24 hours.

The benefits and limitations of this alternative include the following:

- The benefits of this alternative are 1) relatively low cost, 2) minimal impact related to operations and maintenance, and 3) technical feasibility.

- The main challenge associated with this alternative is the limited options for storage siting within the two basins.

  In the Barton basin, the Fauntleroy School site appears to be the most viable alternative, but because it is located in the uplands portion of the basin, this site would present flow regulator challenges because the peak flow may pass through the system and inundate the Barton Street Pump Station before the controls system could react. In the Murray basin, there may be significant challenges associated with

public acceptance of siting the 1.3 MG storage tank in the Lowman Beach Park, as it would cause significant disruption during construction.

This scenario is based on the assumption that sufficient flows can be intercepted at the Fauntleroy School to adequately attenuate the peak flows at the Barton Street Pump Station. This assumption is based on a geographic information system (GIS) analysis which indicates that approximately 50% of the basin area drains to the interceptor pipe located adjacent to the Fauntleroy School. Therefore, it appears to be possible to intercept sufficient flow at the Fauntleroy School site to control CSOs within the Barton basin. However, additional flow monitoring and modeling is needed to verify this assumption.

Alternative B1A–M2B: Peak Flow Storage at Barton and Peak Flow Conveyance at Murray

In this alternative, peak flows from the Barton basin would be stored and pumped back into the collection system following the storm event, while the incremental peak flows from the Murray basin would be conveyed downstream through the construction of a new wet weather pump station and force main. A 0.5 MG rectangular storage tank could be located at the Fauntleroy School within the Barton basin and a new 23.5 mgd wet weather pump station could be constructed at the Lowman Beach Park in the Murray basin.

The 0.5 MG storage tank for the Barton CSO basin was evaluated at the Fauntleroy School parking lot location and would have the same configuration and operation as described in Alternative B1A – M1B. The new 23.5 mgd wet weather pump station in the Murray basin would convey flows approximately 13,500 feet through a new 42-inch force main routed along Beach Drive SW and would discharge to the existing 63rd Street Pump Station. This alternative would also require upgrades to the 63rd Street Pump Station and Alki CSO Treatment Plant to handle the additional peak flows from the Murray basin. Alternatively, it may be possible to convey the flows through the new wet weather pump station/force main to the 63rd Street Pump Station and then to the West Seattle Tunnel; however, KCDNRP-WTD modeling results indicate that there is not excess capacity in the West Seattle Tunnel so this alternative does not appear feasible.

The challenges associated with this alternative are 1) the significant costs to upgrade the existing 63rd Street Pump Station and the outfall at the Alki CSO Treatment Plant, 2) the proposed location of the storage tank within the Barton basin (see Alternative B1A-M1B), and 3) public acceptance and the community impacts of constructing an additional facility at Lowman Beach Park.

Alternative B1A–M3B: Peak Flow Storage at Barton and Demand Management at Murray

Peak flows from the Barton basin would be stored and pumped back into the collection system after the storm event subsides, while the incremental peak flows from the Murray basin would be eliminated through roof drain disconnections within the Murray basin. It is

proposed that a 0.5 MG rectangular storage tank be located at the Fauntleroy School in the Barton basin and that 40 acres of roof drains are disconnected within the Murray basin.

The 0.50 MG storage tank at the Fauntleroy School parking lot would have the same configuration and operation as described in Alternative B1A–M1B. The demand management efforts in the Murray basin would consist of disconnecting 40 acres of roof drains from the sewer system. A GIS analysis has confirmed that all of the roof drain disconnections would be within 100 feet of an existing storm inlet or catch basin.

The benefit of using demand management to reduce peak flows is that no additional infrastructure needs to be constructed within the Murray basin. The challenges of this alternative include 1) the proposed location of the storage tank within the Barton basin (see Alternative B1A-M1B) and 2) implementation of the roof drain disconnection program, including re-routing of drainage flows.

Although there appears to be a sufficient number of homes that can be disconnected to achieve CSO control within the Murray basin, challenges do exist with implementing this alternative. Implementation costs, siting challenges, and maintenance issues to implement the disconnections are the primary challenges to the peak flow reduction approach. KCDNRP-WTD is facilitating ongoing discussions with SPU regarding design, construction, and maintenance of the roof drain disconnections to determine the feasibility of implementing demand management within the project basins.

Alternative B1A–M4B: Peak Flow Storage at Barton and End of Pipe Treatment at Murray

This scenario requires the construction of a 0.5 MG storage tank at the Fauntleroy School to store peak flows from within the Barton basin, in combination with a new 23.5 mgd treatment facility located in Lowman Beach Park to treat peak flows from the Murray basin.

The Barton basin storage tank is located at the same site and has the same configuration and operation as described in Alternative B1A–M1B. The new 23.5 mgd treatment facility would include high rate clarification (HRC) followed by UV disinfection. The treatment facility would be located in the Lowman Beach Park and would discharge 23.5 mgd of treated flow into Puget Sound.

The challenges with this scenario are 1) the siting issues (as previously discussed for Alternative B1A-M1B), 2) public acceptance of an additional facility located at Lowman Beach Park, and 3) the acquisition of a permit for additional treatment and discharge into Puget Sound.

3.2 Barton Pump and Treatment Alternatives

As previously discussed, the cost to convey and treat the peak flows from the Barton CSO basin was significantly more expensive (3 to 4 times greater) than the estimated cost of the storage-based alternative. Therefore, these alternatives are not presented in detail in this

section. A preliminary evaluation of these alternatives is provided in Appendix F. It should be noted that the flow analysis was updated following Workshop 2; the pump and treatment capacity (and associated costs) was increased from 8.5 mgd to 23.5 mgd. The documents presented in Appendix F do not reflect the updated flow analysis results.

3.3 Barton End of Pipe Treatment Alternatives

The estimated cost for end of pipe treatment of the peak flows from the Barton basin is 3 to 4 times greater than the cost of the storage option. Therefore, these alternatives are not presented in detail in this section. A preliminary evaluation of these alternatives is provided in Appendix G. It should be noted that the flow analysis was updated following Workshop 2; the end of pipe treatment capacity (and associated costs) was increased from 8.5 mgd to 23.5 mgd. The documents presented in Appendix G do not reflect the updated flow analysis results.

3.4 Barton Peak Flow Reduction Alternatives

Four alternatives were evaluated that used a peak flow reduction approach within the Barton CSO basin in conjunction with different CSO approaches in the Murray CSO basin:

- B4A–M1B: Demand Management at Barton and Peak Flow Storage at Murray
- B4A–M2B: Demand Management at Barton and Peak Flow Conveyance at Murray
- B4A–M3B: Demand Management at Barton and Murray
- B4A–M4B: Demand Management at Barton and End of Pipe Treatment at Murray

It should be noted that the site location of facilities described in this section are provided only to illustrate the different approaches to CSO control by basin. Additional siting options for facilities within the basins are to be explored during the Alternative Development and Siting Evaluation phase of the project.

Alternative B4A–M1B: Demand Management at Barton and Storage at Murray

In this alternative, peak flows from the Barton basin would be eliminated from the system through roof drain disconnections and other impervious area disconnections, while the peak flows from the Murray basin would be stored and pumped back into the collection system following the storm event. This scenario requires disconnection of 70 acres of impervious area within the Barton basin and construction of a 1.3 MG rectangular storage tank at the Lowman Beach Park within the Murray basin.

A GIS analysis of the roof drain connections in the Barton basin has identified approximately 45 acres of rooftops with direct connections into the sewer system which are within 150 feet of an existing storm inlet or catch basin. Additionally, a 25-acre section of impervious area has been identified which is still connected into the combined sewer. The

combined total of 70 acres of impervious area would satisfy the demand management requirements to eliminate the excess Barton peak flows. All the "Barton Demand Management"-based alternatives require the disconnection of 70 acres of impervious area within the basin, and include the assumptions, benefits, and challenges of the "Barton Demand Management" component of the proposed scenario (see description below).

The 1.3 MG storage tank for the Murray CSO basin would be approximately 120 feet long, 60 feet wide, with an assumed storage depth of 25 feet. The storage tank would be connected to the existing Murray Pump Station wet well and would be filled by gravity. Once the wet well level has returned to the level set-point, the tank will re-introduce the flows back into the Murray Pump Station Wet Well with a 1.3 MGD pump system designed to dewater the tank within 24 hours.

The benefit of this alternative is that less infrastructure (as compared to the non-demand management-based scenarios) would be needed to manage CSOs. The challenge of this alternative is that although there appears to be a sufficient number of homes that can be disconnected to achieve the CSO control within the Barton basin, implementation costs, siting challenges, and maintenance issues to implement disconnections may impede the implementation of this peak flow reduction approach. Additionally, there may be significant challenges to public acceptance of siting the 1.3 MG storage tank in the Lowman Beach Park, due to the impacts of construction to the community.

Alternative B4A–M2B: Demand Management at Barton and Peak Flow Conveyance at Murray

This alternative requires that peak flows from the Barton basin be eliminated from the system through impervious area disconnections, while the incremental peak flows from the Murray basin would be conveyed downstream through the construction of a new pump station and force main. It is proposed that 70 acres of impervious area be disconnected within the Barton basin and a new 23.5 mgd wet weather pump station be constructed at the Lowman Beach Park to manage peak flows from the Murray basin.

Approximately 70 acres of roof drain disconnection within the Barton CSO basin was evaluated as described in Alternative B4A –M1B. The new 23.5 mgd pump station would convey flow through 13,500 feet of 42-inch force main routed along Beach Drive SW and would discharge to the existing 63rd Street Pump Station. This alternative would also require upgrades at the 63rd Street Pump Station and Alki CSO Treatment Plant to handle the additional peak flows from the Murray CSO basin.

The benefits and challenges of this alternative include the following:

- Benefit: Less infrastructure (as compared to the non-demand management-based scenarios) would need to be constructed to manage CSOs within the two basins.

- Challenges: 1) Implementation costs, siting challenges, and maintenance issues to implement disconnections may impede the implementation of the demand management CSO approach, 2) significant costs are associated with the upgrade of the existing 63rd Street Pump Station and the Alki CSO Treatment Plant, and 3) obtaining public acceptance may be difficult due to the community impacts of constructing an additional facility at Lowman Beach Park.

Alternative B4A–M3B: Peak Flow Reduction at Barton and Murray

For this alternative, peak flows from both the Barton and Murray basins would be eliminated from the system through roof drain disconnections. This alternative requires disconnection of 70 acres of impervious area in the Barton basin and disconnection of 40 acres of roof drains within the Murray basin.

As previously discussed (Alternative B4A–M1B), a GIS analysis of the Barton basin has identified approximately 70 acres of impervious area that is connected into the Barton sewer system. Disconnection of this area would satisfy the demand management requirements (as identified by the County) to eliminate the excess Barton peak flows. The roof drain disconnection analysis for the Murray basin indicates that 40 acres of roof drainage is within 100 feet of an existing storm sewer inlet or catch basin. Disconnection of these roof drains would effectively limit overflows to one event per year in the Murray basin.

The benefits and limitations of this alternative are as follows:

- Benefits: 1) Peak flows can be handled by the existing infrastructure (significantly reducing capital costs), and 2) demand management is a sustainable method to reduce peak flows in the basin.

- Challenges: 1) Implementation costs, siting challenges, and maintenance issues to implement disconnections may impede the implementation of the demand management CSO approach, 2) flow monitoring is required to evaluate the impacts of the reduction efforts, and 3) coordination with SPU is needed to repair the existing infrastructure system.

Alternative B4A–M4B: Peak Flow Reduction at Barton and End of Pipe Treatment at Murray

In this alternative, peak flows from the Barton basin would be eliminated from the system through roof drain disconnections, while the incremental peak flows from the Murray basin would be treated within the Murray basin. Approximately 70 acres of impervious area would be disconnected within the Barton basin and a 23.5 mgd treatment facility would be constructed for the excess peak flows in the Murray basin.

Approximately 70 acres of roof drain disconnection within the Barton CSO basin was evaluated as described in Alternative B4A–M1B. A new 23.5 mgd HRC/UV treatment facility

located in Lowman Beach Park would be constructed to provide end of pipe treatment for the excess peak flows from the Murray CSO basin.

The benefits and challenges of this alternative are as follows:

- Benefits: Less infrastructure (as compared to the non-demand management-based scenarios) would need to be constructed to manage CSOs within the two basins.
- Challenges: 1) Implementation costs, siting challenges, and maintenance issues to implement disconnections may impede the implementation of the demand management CSO approach, 2) siting issues associated with public acceptance of new construction at Lowman Beach Park (as previously discussed for Alternative B1A-M1B), and 3) acquisition of a permit is required for additional treatment and discharge into Puget Sound.

3.5 Combined Approach Alternatives

It may be necessary to implement more than one approach in each of the basins because of the significant challenges of siting facilities in these highly urbanized areas. Because the end of pipe treatment and conveyance approaches were estimated to be 3 to 4 times more expensive than the peak flow reduction and storage options, only combinations of peak flow reduction (demand management) and storage were considered.

3.6 Barton and Murray Conclusions and Recommendations

General Recommendations

The peak flow storage and reduction approaches are the preferred CSO approaches because preliminary cost estimates indicate that peak flow conveyance and end of pipe treatment were 3 to 4 times more expensive. Findings and recommendations for the preferred peak flow storage and reduction alternatives within the approaches are summarized below.

Barton CSO Basin Recommendations

There are very few options for storage siting within the Barton and Murray basins. Many of the available sites, such as the Fauntleroy School parking lot site in the Barton basin, have significant technical feasibility issues. The KCDNRP-WTD should perform follow up flow monitoring at this location to determine the technical feasibility of storage at this site. Other options, such as a combined Barton/Murray storage facility under Lincoln Park should also be evaluated.

It appears that there may be enough impervious area which could be disconnected within the Barton basin such that no other CSO controls would be required. However, this would require a highly aggressive roof drain disconnection program with almost 100 percent resident participation to disconnect the required 70 acres of impervious area. Even with a

highly aggressive program, the cost to perform disconnections and maintain the stormwater facilities could be significantly more expensive than other approaches, depending on the level of water quality treatment measures that would need to be implemented. KCDNRP-WTD is continuing to evaluate and negotiate the design and maintenance criteria with SPU for roof drain disconnections to determine if it is feasible to perform the disconnections. Another option that should be further evaluated is disconnection of pavement areas at the east side of the Barton basin in conjunction with storage along the east side of Fauntleroy Avenue SW, near the ferry docks.

Murray CSO Basin Recommendations

Although it appears to be technically feasible to locate a storage facility at Lowman Beach Park in the Murray CSO basin, the siting of storage at this location is likely to incur issues with public acceptance. The implications of utilizing this site should be further evaluated. Additionally, other sites within the Murray basin, such as the site located east of 48th Avenue SW, about one quarter mile uphill from the Lowman Beach Park, should also be evaluated. This site may be classified as environmentally sensitive, so an environmental assessment of the site should be conducted to determine the permit requirements and suitability for locating a storage facility at this site.

Peak flows within the Murray basin can be sufficiently reduced by roof drain disconnection to meet the CSO regulations of one overflow event per year. However, these disconnections face the same technical and cost challenges as those in the Barton basin. KCDNRP-WTD is continuing to evaluate and negotiate the design and maintenance criteria with SPU for roof drain disconnections to determine if it is feasible to perform the disconnections.

3.6.1 Alternative Screening

The feasible CSO alternatives and related scenarios for storage, conveyance and treatment, end of pipe treatment, demand management, or a combination thereof, were presented and discussed in Workshop No. 2. The results of this workshop have identified preferred scenarios which will be further developed as part of the Alternatives Development phase of this CSO Control project. The preferred scenarios are presented below.

The most favorable alternatives for controlling overflows within the Barton and Murray basins are storage (B1A-M1B) ,end of pipe treatment (B1A-M4B, B4A-M4B), and demand management (B1A-M3B, B4A-M3B), should this alternative be determined to be viable.

- Storage in both the Barton and Murray basins was identified as the most favorable alternative. However, concerns were expressed regarding the siting limitations associated with the proposed storage locations. This alternative was rated favorably with respect to Cost Effectiveness, Operations and Maintenance impacts, Technical Feasibility, Pubic Health and Environmental Benefits, and Flexibility.

- Storage in the Barton basin, combined with demand management in the Murray basin, was rated favorably with respect to Public Health and Environmental Benefits, as well as Technical Feasibility, and Operations and Maintenance impacts.

- Demand management in both the Barton and Murray basins was not rated by all four stakeholder groups during the workshop. However, the ratings that were provided indicate that this alternative would likely be among the preferred scenarios. Further investigation of the feasibility of reducing peak flows to control the overflows in the two basins should be conducted as part of the Alternatives Development phase of this project.

- Peak flow end of pipe treatment for the Barton Basin does not appear feasible, as there is not sufficient space for treatment facilities near the outlet of the Basin. For the Murray Basin, peak flow end of pipe treatment was determined to have siting limitations similar to those cited for the storage approach; however, this alternative was rated favorably with respect to Public Health and Environmental Benefits. Based on the feedback in Workshop 2, this approach should continue to be considered as a method for controlling CSOs within the Murray Basin.

The concerns and challenges cited by the stakeholders at the workshop were similar to those listed in the alternative descriptions above and include the following:

1. Peak flow conveyance was identified as an unfavorable CSO approach because it requires upgrades to the downstream facilities and requires continued maintenance for the life cycle of the proposed facility.

2. Peak flow storage appeared to be a favored approach; however, the representative site alternatives of the Fauntleroy School and the Lowman Beach Park were considered somewhat unfavorable due to technical feasibility and public acceptance issues.

3. Peak flow reductions (demand management) appeared to be a favorable alternative worthy of further consideration, although at the time of the workshop, the design and maintenance criteria for flow reduction put forth by SPU was not yet known.

3.6.2 Planning Area Boundary Delineation

With the technical and stakeholder evaluations effectively ruling out the peak flow conveyance and end of pipe treatment approaches, the peak flow storage and reduction alternatives lead to a planning area boundary that extends into the uplands of the basin and is bounded at the downstream end of the CSO basins by the respective pump stations.

4.0 SOUTH MAGNOLIA BASIN EVALUATION

Seven alternatives were initially investigated during Planning Confirmation. Three storage alternatives, two convey and treat alternatives, one end of pipe treatment alternative, and one combination alternative were evaluated.

4.1 Peak Flow Storage Alternatives

Three alternatives for peak flow storage in the South Magnolia basin were evaluated during the Planning Confirmation phase:

- 1A: Store peak flows up basin from the CSO control point
- 1B: Store peak flows near the CSO control point
- 1C: Store peak flows east of the marina

A description of each storage alternative is presented below.

Alternative 1A: Peak Flow Storage Up Basin

This scenario follows the recommendations of the 1997 CSO Plan to construct a storage tank in the vicinity of West Lynn Street and 32nd Avenue, approximately 2,200 feet north of the South Magnolia basin CSO control point. The storage facility would be 2.6 MG rectangular tank, and could be located on a parcel of land comprising approximately 0.5 acres. The tank would be connected to extant combined sewers for approximately 31% of the basin tributary to that area (approximately 235 acres). The storage facility would include submersible pumps to drain the basin.

The existing gravity system would continue to collect sewage from the remaining 69% of the basin. A new pump station would be required at the CSO control point to transfer those flows to the storage tank. A new gravity discharge pipeline would also be required to convey flow from the tank to the existing South Magnolia Interceptor.

The challenges of this alternative include the following: 1) Relatively high construction cost, 2) limited site locations available, and 3) the proposed land use for the potential site location may preclude construction of the storage facility.

Alternative 1B: Peak Flow Storage Near CSO Control Point

In this scenario, a 2.6 MG rectangular storage tank would be constructed on 32nd Avenue near the CSO control point. Adjacent property would be acquired for the tank. The SPU pump station #77 would likely have to be modified (to be determined by further investigation) to increase pumping head sufficiently to lift flow into the tank. The discharge line for the pump station would be extended to the tank. Capacity of the SPU station is currently unknown.

Depending on location and footprint, a pump station may be needed to empty the tank into the South Magnolia Interceptor upstream of the CSO control point.

The advantages and limitations of this alternative include the following:

- Advantages: 1) the capital costs are the lowest of all the storage-based scenarios for the South Magnolia basin, and 2) less pumping is required; it is possible that the storage tank could be drawn down through gravity alone.
- Challenges: 1) siting limitations (the storage facility would be located in a ravine near the control point), 2) impacts to the community, 3) obtaining easements / approval from the City, and 4) obtaining the necessary permits to upgrade to the SPU pump station.

Alternative 1C: Peak Flow Storage East of Elliott Bay Marina

A storage tank would be constructed north and east of the Marina on 23rd Avenue on a site currently owned by the City of Seattle, which is currently used as a sports field. A pump station would be required to empty the tank.

A new gravity sewer would be constructed from the CSO control point to the tank, approximately 3,000 feet long, to convey flow from the basin. The SPU pump station and discharge line would likely be upgraded for higher head and distance needed to convey flows from approximately 20% of the basin to the new sewer. The existing South Magnolia Interceptor would remain in service for local connections between 32nd Avenue and the storage tank, which would then be re-routed into the storage tank.

This alternative is based on the assumptions that microtunneling can be conducted in this area of the basin. A geotechnical study will need to be conducted to confirm this assumption. An alternative to the construction of a new sewer line to the storage tank is conversion of the existing pressure sewer to a force main, with a pump station located at the foot of 32nd Avenue. This requires further investigation of the pressure rating, and other details of the existing pipeline.

The challenges of this alternative include: 1) obtaining easements and/or right-of-ways from the City for construction of the new sewer main, 2) constructability due to geotechnical/ slope stability issues, and 3) obtaining the necessary permits for storage and to upgrade the SPU pump station.

4.2 Pump and Treatment Alternatives

Options 2A and 2B comprised two conveyance upgrades (complete replacement or partial parallel) of the existing interceptor to convey flow to the Interbay Pump Station. Based on discussions with KCDNRP-WTD staff, it was determined that due to operational constraints, there is not sufficient capacity within the Interbay Pump Station to convey peak flows to the

West Point Treatment Plant during a wet weather event. Therefore, this CSO control approach has not been included for analysis within the South Magnolia basin.

4.3 End of Pipe Treatment Alternatives

End of pipe treatment was also considered to reduce overflow events within the South Magnolia Basin. A description of the alternative is presented below:

Alternative 3A: Treatment at South Magnolia CSO Control Point

A new 15 mgd HRC/UV wet weather treatment plant would be constructed near the CSO control point. New control structures would divert flows above 4.3 mgd to the treatment plant. Plant footprint is approximately 90 x 105 feet (including odor control, electrical buildings and an allowance for setbacks and access. A pump station would be needed to empty the plant after use. It should be noted that SPU pump station #77 would require an upgrade to pump flow to the proposed plant.

The primary benefit of this alternative is its low relative cost as compared to the other CSO control approaches in the South Magnolia basin. The limitations associated with this alternative are 1) confirming the soils condition at the proposed site location for construction of a new treatment facility, and 2) obtaining the necessary permits to upgrade to the SPU pump station and construct a new treatment facility at the South Magnolia CSO control point.

4.4 Peak Flow Reduction Alternatives

As an alternative to the facility improvements described above (storage, pumping, end of pipe treatment), other methods were evaluated to reduce overflow events in the basin. Following the flow analysis conducted by King County, it was determined that impervious area disconnection could significantly reduce peak flows within the South Magnolia Basin. A description of the alternative is discussed below:

Alternative 4A: Impervious Area Disconnection

During the planning confirmation phase of this project, an assessment was made of the impervious area that could be feasibly disconnected to reduce the peak flows during a storm event. Based on conservations with SPU, which has recently been implementing a flow reduction program, it was determined that a maximum distance of 100 feet would be used to identify potential sites for roof drain disconnection. The 100-foot standard is based on two main objectives: 1) reducing the impacts of sheet flow on the system and 2) preventing construction of additional storm sewer infrastructure.

A GIS-based analysis of sewerage maps of the basin identified that 65 acres of impervious roof tops are located within 100 feet of the catch basins connected to the storm sewers. These roof drains could feasibly be disconnected from the storm sewer to reduce peak flows into the combined system. However, the flow analysis model, which was used to

determine the storage volume needed to meet CSO regulations, was based on an assumed area of impervious rooftops of 58 acres. Based on this assumption, it was found that disconnection of the impervious area would not be sufficient to completely manage the excess flows; approximately 0.2 MG of storage would still be required. Further field investigation is necessary to confirm the extent of rooftop drains that could be disconnected to achieve reductions in required storage volumes. Field investigations would include windshield surveys to validate GIS-based estimates of connected roofs, and topography and other site influences such as topographic differences between house and street that might limit disconnection opportunities. Following validation, conceptual engineering estimates would be required to estimate costs based on SPU requirements and neighborhood constraints such as landscaping.

By implementing demand management within the basin, CSO flows could be reduced because the initial peak flows from a storm event would be delayed. The storm flows would not be routed directly into the combined sewer system, but would rather percolate through the soil into the groundwater table or could eventually enter into the combined sewer system through leaks in the infrastructure from tree roots and other sources. In either case, the system would be able to more effectively handle the storm event, leading to a reduction in combined sewer overflows. However, it should be noted that demand management would require significant cooperation between the County and SPU. SPU is the owner/operator of the direct connections (roof drains, catch basins, others) and side sewers into the combined sewer, while the County is the owner/operator of the sewer mains and manholes.

The challenges associated with this alternative include 1) roof drain disconnection is not sufficient to control CSOs completely, 2) interjurisdictional cooperation between the County and SPU, 3) the need to obtain approval from residential home owners to work on their private property, and 4) the cost of implementing the demand management strategy in comparison to other CSO control approaches.

4.5 Combined Approach Alternatives

As previously stated, the impacts of roof drain disconnection within the South Magnolia Basin are not sufficient to reduce overflow events to once per year. Therefore, additional overflow abatement measures would have to be implemented, such as construction of a new storage facility. The storage requirements of such a combined scenario are as little as 0.2 MG with 100% rooftop disconnection, or up to 1.1 MG with 50% rooftop disconnection.

Alternative 4A includes a storage tunnel constructed to store additional flows; this tunnel would be located along the Galer Street right of way, and would be used to store approximately 1.1 mgd of peak flow (with 50% roof drain disconnection). The tunnel would end in the vicinity of 23rd Avenue. Interconnecting sewers would connect the upstream and downstream ends of the tunnel to the existing South Magnolia Interceptor.

4.6 South Magnolia Conclusions and Recommendations

The topography of the South Magnolia basin is such that very few siting locations exist for storage facilities, with the exception of sites east and north of the Elliott Bay Marina. The potential sites pose challenges to construction (namely, geotechnical concerns) and require an upgrade of SPU Pump Station #77 to convey peak flows to the storage facility. It is recommended that further consideration be made for locating the storage facility at either the CSO control point or near the Marina. Geotechnical analysis of the two proposed site locations should also be conducted to further develop the viability of this CSO approach.

The convey and treat control approach was determined to be technically infeasible because of capacity limitations within the South Magnolia Trunk and the Interbay Pump Station, and the impacts of operations at the West Point Treatment Plant during a wet weather event. Therefore, these scenarios have been removed from further consideration.

End of pipe treatment appears to be the least cost alternative for the South Magnolia basin. Therefore, it is recommended that a geotechnical analysis of the soil conditions be conducted to determine the feasibility of locating a 10 mgd facility at this site. Additional investigation should be made to determine the feasibility of obtaining a new permit for treatment and discharge at this location, as well as for SPU's Pump Station #77.

Demand management, based on impervious area disconnection, may not be sufficient to fully reduce CSOs to one event per year within the South Magnolia basin. Therefore, demand management must be used in combination with storage to meet the CSO regulations. It is recommended that the costs and feasibility (technical, interjurisdictional, others) associated with implementing demand management within the South Magnolia basin be more fully evaluated to determine the viability of this combined approach.

4.6.1 Alternative Screening

The five CSO approaches and related scenarios for storage, conveyance and treatment, end of pipe treatment, demand management, or a combination thereof, were presented and discussed in Workshop No. 2, held on May 30, 2007. A summary of the workshop findings is provided in Appendix H of this TM.

The project team, consisting of staff from King County, SPU, and consultants, evaluated the proposed scenarios with respect to the evaluation criteria presented in Section 2.4 of this TM. The results of this workshop have identified preferred scenarios which will be further developed as part of the Alternatives Development phase of this CSO Control project. The preferred scenarios are presented below.

Both end of pipe treatment (3A) and storage (1B and 1C) have been identified as preferred control approaches to meet overflow requirements within the South Magnolia Basin.

- End of pipe treatment was ranked most favorably with respect to Cost Effectiveness, and was also evaluated favorably for Public Health and Environmental Benefits, Flexibility, and Program Compatibility.

- Onsite storage near the South Magnolia CSO control point was ranked favorably for Public Health and Environmental Benefits, Cost Effectiveness, and Operations and Maintenance Impacts.

- Offsite storage at the Marina, with treatment at West Point (1C), was ranked favorably with respect to Public Health and Environmental Benefits, Operations and Maintenance Impacts, and (to a lesser degree) Program Compatibility, Community, and Flexibility.

The least favorable scenario was identified as offsite storage at West Lynn Street due to concerns regarding Community Impacts, Technical Feasibility, Operations and Maintenance Impacts, and Cost Effectiveness.

4.6.2 Planning Area Boundary Delineation

Based on the outcome of Workshop No. 2, which identified that the Convey and Treat control approach was not feasible for the South Magnolia Basin, the planning boundary for this basin has been established as the basin boundary (see Figure 4).

5.0 NORTH BEACH BASIN EVALUATION

As discussed in Section 3.3, the North Beach Pump Station has a firm capacity of 5.5 mgd, but is limited by the capacity of the downstream forcemain (3.5 mgd) to the Carkeek Pump Station and CSO Treatment Plant. Therefore, to meet the CSO regulations of one overflow event per year, the North Beach Pump Station and forcemain need to be upgraded for all of the proposed CSO approaches, with the exception of Peak Flow Storage. Peak Flow Storage would not require an upgrade to the North Beach Pump Station and forcemain, because the peak flows would be stored and released following the storm event, so that the existing capacity of the pump station and forcemain would be sufficient to meet the CSO regulations. However, it should be noted that the existing condition of the forcemain is suspected to be poor due to its age and leak history. Therefore, all the CSO approaches and corresponding alternatives that utilize the existing forcemain will also require repair or other upgrades to the forcemain to improve the condition of the pipeline.

5.1 Peak Flow Storage Alternatives

Three alternatives for peak flow storage in the North Beach basin were evaluated during the Planning Confirmation phase:

- 1A: Store peak flows at the NBPS site, then pump to Carkeek PS (via NBPS) following the storm event.

- 1B: Pump peak flows to an alternate storage location in the North Beach basin, then use the NBPS to pump to Carkeek PS following the storm event.
- 1C: Pump peak flows to an alternate storage location in the North Beach basin, then pump or gravity feed to the 8th Avenue interceptor for transfer to the West Point WWTP following the storm event.

Alternative 1A: Peak Flow Storage at the North Beach Pump Station

Alternative 1A assumes no increase in the pumping capacity at the NBPS, but would require a storage tank volume of 3.5 MG. This alternative also requires that the storage be located at an elevation low enough in the basin to intercept the peak flows generated during a wet weather event. The topography of the North Beach basin varies from elevation ± 350 feet at the top of the basin to sea level at the CSO outfall. Figure 6 shows that there are essentially no alternative open spaces below elevation 225 feet, therefore the storage would need to be located directly adjacent to the North Beach Pump Station and CSO outfall.

The storage facility would include submersible pumps to drain the basin, as well as washdown facilities. Following the storm event, the stored water would be pumped by the NBPS to the Carkeek PS through the existing 14-inch forcemain. The flow would then be pumped up to the 8th Avenue Interceptor and conveyed to the West Point WWTP for secondary treatment.

The benefits and challenges of Alternative 1A include the following:

- Benefits: 1) Relatively low-cost option for CSO control, 2) Low impact on operations and maintenance efforts.
- Challenges: 1) Storage is unlikely to fit on NBPS site, 2) May require increased pump station capacity to drain tank following peak flow event, 3) Does not improve the existing condition of the North Beach forcemain, 4) Will require double pumping of peak flows.

Alternative 1B: Peak Flow Storage at Alternate Site within the North Beach Basin, Pump to Carkeek Pump Station

In this alternative, peak flows would be pumped from the existing North Beach Pump Station (NBPS) to an offsite storage tank, and following the high flow event, would then be pumped back to the NBPS for conveyance to the Carkeek Pump Station.

A new 10 mgd high head pump station would be constructed at the NBPS site. From this pump station, a 24-inch forcemain would convey the peak flows (10 mgd) to a new 3.5 MG rectangular storage facility located within the North Beach basin. The storage facility would include a submersible pump and washdown facilities. Following the storm event, the peak flows would be pumped from a new 3.5 mgd submersible pump station at the storage tank

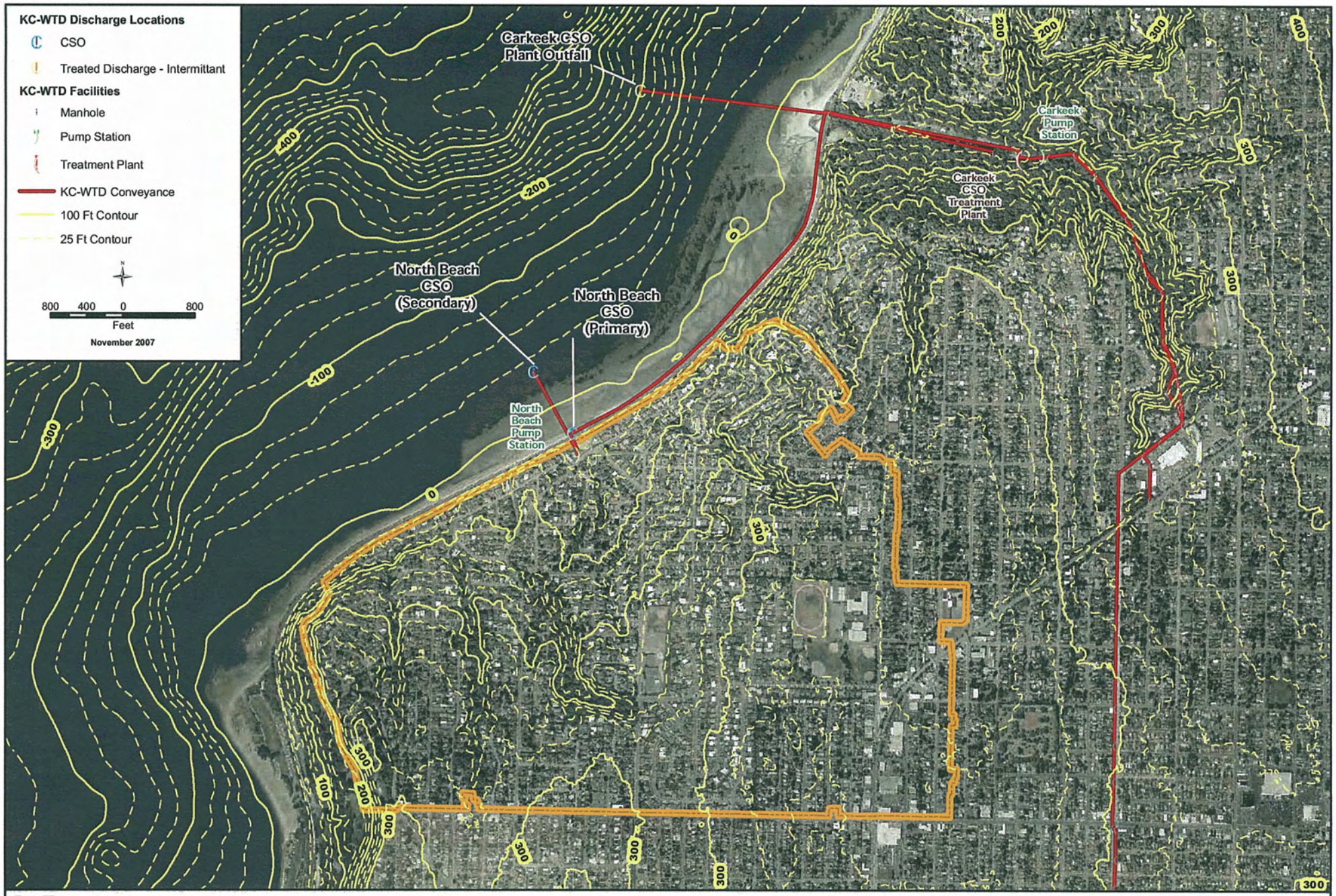

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Figure 6

North Beach Basin Topography

BARTON, MURRAY, MAGNOLIA AND NORTH BEACH CS[illegible]ROJECTS

to the existing NBPS through a new 14-inch, 3.5 mgd forcemain. The flows would then be pumped to the Carkeek PS through the existing 14-inch forcemain alignment along the beach.

The benefit of Alternative 1B is the ability to more easily site the storage tank at a different location. The challenges associated with this alternative are the same as those associated with Alternative 1A.

Alternative 1C: Peak Flow Storage at Alternate Site within the North Beach Basin, Pump to West Point Wastewater Treatment Plant

In Alternative 1C, peak flows would be pumped from a new high head pump station located at the North Beach Pump Station (NBPS) site to an offsite storage tank, and following the high flow event, would be gravity fed (or pumped, if necessary) to the existing 8th Avenue Interceptor for conveyance to the West Point Wastewater Treatment Plant (West Point WWTP).

A new 10 mgd high head pump station would be constructed at the NBPS site. From this pump station, a new 24-inch forcemain would convey 10 mgd from the NBPS to a new 3.5 MG rectangular storage facility located within the North Beach Basin. The storage facility would include a submersible pump and washdown facilities. Following the storm event, the peak flows would be gravity fed (or pumped through a new 14-inch forcemain) into the existing 8th Avenue Interceptor. The flows would then be conveyed to the West Point WWTP through the 11th Avenue Interceptor and Ballard siphons.

The benefits of Alternative 1C include 1) the ability to more easily site the storage tank, and 2) will likely eliminate the need for double pumping of the peak flows. The main limitation of this alternative is the fact that the condition of the North Beach forcemain would not be improved.

5.2 Pump and Treatment Alternatives

Two alternatives for conveying and treating peak flows in the North Beach basin were evaluated during the Planning Confirmation phase:

- 2A: Convey peak flows from North Beach Pump Station to Carkeek CSO TP through a beachfront alignment.
- 2B: Convey peak flows from North Beach Pump Station site to the Carkeek CSO TP through a neighborhood alignment.

Alternative 2A: Convey and Treat at Carkeek TP (Beachfront Alignment)

Alternative 2A would require peak flows to be pumped from the existing North Beach Pump Station site (parallel to the existing North Beach forcemain) to the Carkeek CSO Treatment Plant for treatment and discharge to Puget Sound.

A new submersible pump station would be constructed at the NBPS site, which would convey peak flows up to approximately 10 mgd through a 24-inch forcemain to a new treatment facility at the Carkeek TP. One potential forcemain alignment would travel parallel to the existing 14-inch forcemain along the beach to the Carkeek TP. The treatment facility at Carkeek TP would be expanded to include high rate clarification (HRC) and additional disinfection capacity for the peak flow from North Beach. Treated flow from the HRC train would be discharged to Puget Sound via a new 24-inch outfall.

The benefits and challenges of Alternative 2A include the following:

- Benefits: 1) New submersible pump station at NBPS is less costly than construction of a high-head pump station, 2) Potential exists to improve the condition of the existing North Beach forcemain.
- Challenges: 1) Expansion of Carkeek TP may be difficult to construct due to space limitations, 2) Construction of a beachfront forcemain may be difficult due to permitting and constructability issues, and 3) Cost of constructing a new forcemain from NBPS to Carkeek, as well as expanding the Carkeek TP and outfall, will be significant.

Alternative 2B: Convey and Treat at Carkeek TP (Neighborhood Alignment)

Under Alternative 2B, peak flows would be pumped from the existing North Beach Pump Station site via a neighborhood alignment (through the basin rather than along the shoreline) to the Carkeek CSO Treatment Plant for treatment and discharge to Puget Sound.

A high head pump station would be constructed at the NBPS site, which would convey peak flows up to approximately 10 mgd through a 24-inch forcemain to a gravity pipeline, which would then connect into a new treatment facility at the Carkeek TP. One potential forcemain alignment (approximately 1.1 miles) would travel east from the new high head pump station, along NW 100th Street to the intersection of NW 100th Street and 8th Avenue NW. The forcemain would then tie in to a new gravity pipeline, which would head north along 8th Avenue NW and into Carkeek Park, before connecting into the existing gravity pipeline which conveys flow to the Carkeek TP. The treatment facility at Carkeek TP would be expanded to include high rate clarification (HRC) and additional disinfection capacity for the peak flow from North Beach. Treated flow from the HRC train would be discharged to Puget Sound via a new 24-inch outfall.

The challenges of this alternative include 1) Significant cost for construction (high head pump station, new forcemain, expansion of Carkeek TP and outfall), 2) Impact to the community resulting from the neighborhood alignment of the new forcemain and expansion of the Carkeek TP, 3) Condition of the existing North Beach forcemain would not be improved.

5.3 End of Pipe Treatment Alternatives

Alternative 3A: End of Pipe Treatment

This approach requires the construction of a new treatment facility at the North Beach Pump Station site, which would treat and discharge peak flows directly to Puget Sound. The new, approximately 10 mgd treatment facility would include high rate clarification (HRC) and disinfection, such as UV or Sodium Hypochlorite. Treated flow from the new treatment facility would then be discharged to Puget Sound via the existing 24-inch North Beach outfall. It should be noted that for this alternative, no upgrades or modification would be made to improve the condition of the existing forcemain from the North Beach Pump Station to the Carkeek TP.

The benefits and limitations of this alternative include the following:

- Benefits: 1) Lowest cost alternative to meet CSO requirements, 2) Will likely have the least impact on the community during construction, 3) Fits easily onto the NBPS site.
- Challenges: 1) Public perception of a new treatment facility near parks and homes, 2) May be difficult to acquire a permit for a new treatment and discharge.

5.4 Peak Flow Reduction Alternatives

Alternative 4A: I/I Reduction

As previously mentioned, the 1988 I/I Analysis conducted for SPU has identified that the inflow and infiltration components resulting from a wet weather event within the North Beach basin are 49% and 51%, respectively. Additionally, the impacts of reducing I/I within King County were evaluated as part of a series of case studies conducted in 2005[3]. The case studies identified that the individual components of I/I could be reduced by repairing or replacing select portions of the sewer infrastructure. Table 5 presents the I/I flow components, associated infrastructure components, and the expected percent flow reduction resulting from repair of the infrastructure.

3 "King County I/I Control Program Pilot Project Report," Earth Tech, 2004.

Table 5	Impacts of I/I Reduction within the North Beach Basin CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects				
I/I Component	**System Component**	**Percent of I/I Flow**	**Flow (mgd)**	**Expected Percent Reduction**	**Predicted I/I Flow (mgd)**
Fast Response (Inflow)	Catch basins, roof drains, other direct connections	49%	6.4	10%-15%	5.4-5.7
Rapid Infiltration	Laterals, side sewers, foundation drains	40%	5.2	50%-60%	2.1-2.6
Slow and Base Infiltration	Manholes, sewer drains	11%	1.4	30%	1.0
All	All of the above	100%	13.0	70%-80%	2.6 - 3.9

The case studies also identified that the percent flow reduction could be dramatically increased to 70% - 80%, if the entire infrastructure system leading into the sewer main was repaired. Therefore, it is feasible that through I/I reduction alone, the peak flows in the North Beach basin could be sufficiently reduced so as to not require any additional infrastructure in the management of peak flows.

The benefits of this approach are that 1) Peak flows can be handled by existing infrastructure, and 2) Demand management is a sustainable method to reduce peak flows in the basin. The challenges associated with this approach include 1) An aggressive reduction target of 70%-80%, 2) Requires flow monitoring to evaluate the impacts of the reduction efforts, 3) Requires coordination with SPU to repair the existing infrastructure system, and 4) Requires approval from private property owners regarding the impacts of construction on their land and in the right-of-way. It should be noted that the impacts of I/I reduction could potentially impact slope stability and residential owners; further evaluation of the impacts of I/I should be conducted as part of the Alternatives Development phase of this evaluation.

5.5 Combined Approach Alternatives

Combined approach alternatives were also considered to reduce peak flows for CSO control in the North Beach basin. These alternatives included I/I reduction with storage, I/I reduction with conveyance and treatment, and I/I reduction with end of pipe treatment.

Alternative 5A: Storage and I/I Reduction

Because offsite storage is more costly than storage located at the NBPS site, these combinations were not initially considered. Additionally, due to sizing constraints, storage located at the NBPS site would be limited in capacity to less than 200,000 gallons. To utilize the NBPS site for storage, demand management efforts would need to be sufficient to reduce I/I flows by about 70%; making no significant impact on the costs of implementing I/I reduction (as compared to Alternative 4A).

Because onsite storage is significantly limited in capacity due to site constraints, and the resulting reduction in demand management efforts is therefore minimal, offsite storage locations (in combination with demand management) were again considered as a feasible option. It is possible that the increased cost associated with off-site storage would be offset by a potentially significant reduction in demand management efforts (thereby reducing the overall costs of this alternative as compared to 4A). This possibility will need to be further evaluated as part of the Alternatives Evaluation phase of this effort.

Alternative 5B: Convey and Treat with I/I Reduction

The combined I/I reduction and convey and treat scenarios are possibilities for CSO control within the North Beach basin; however, the relative cost of constructing the new infrastructure to convey and treat the excess flows (even if significantly reduced through I/I reduction) is still significantly higher than the other CSO control approaches.

Alternative 5C: End of Pipe Treatment and I/I Reduction

Implementing a combined end of pipe treatment scenario with I/I reduction would be more costly than end of pipe treatment alone, and would require flow monitoring and coordination with SPU. However, the benefits of this alternative are that the costs are likely to be lower than those associated with conveying and treating peak flows, as well as incorporating the sustainability measures associated with I/I reduction.

5.6 North Beach Conclusions and Recommendations

The five alternatives and related scenarios for storage, conveyance and treatment, end of pipe treatment, demand management, or a combination thereof, were presented and discussed in Workshop No. 2. The results of this workshop have identified preferred scenarios which will be further developed as part of the Alternatives Development phase of this CSO Control project. The preferred scenarios are presented in Section 6.6.1.

The topography of the North Beach basin presents a challenge in locating a storage facility that would not require pumping from the North Beach Pump Station to the storage tank. Based on an initial review of potential site locations, the only feasible alternative to convey flow through gravity into a storage tank is at the site of the North Beach Pump Station. However, the site footprint is not large enough to construct a storage facility of sufficient size to control overflow events within the basin. Therefore, the only storage-based alternative that was determined to be a viable CSO control approach is offsite storage, which requires pumping into the storage facility.

However, following Workshop 2, it was identified that the former Crown Hill Elementary School site is being sold by Seattle Public Schools. This site holds significant potential as a location that would not require additional pumping from the storage facility into the collection system. Therefore, it is recommended that further evaluation of this site and others (including North Beach Elementary and the Soundview Playfield) be conducted as part of the Alternatives Development phase of this project.

The convey and treat control approach was determined to be technically feasible, but is by far the most costly alternative of the proposed CSO approaches. Therefore, these scenarios are not included in the shortlist of preferred alternatives for the North Beach basin.

End of pipe treatment is the least cost alternative for controlling overflows in the North Beach basin. Additionally, it is considered to be the simplest approach to implement, and if constructed primarily below grade, would have minimal impact on the community. It is recommended that this approach be further evaluated as part of the next phase of this project.

Demand management, including both inflow and infiltration reduction, appears to be technically feasible to control overflows within the North Beach basin. However, it would require an aggressive implementation plan to rehabilitate approximately 70%-80% of the sewer infrastructure within the basin. It is recommended that the costs and feasibility of implementing demand management within the North Beach basin be more fully evaluated to determine the viability of this CSO approach.

5.6.1 Alternative Screening and Recommendations

The three most favorable alternatives for controlling overflows within the North Beach basin (as evaluated by the project team during Workshop 2) are end of pipe treatment (3A), storage (1C), and a combination of storage and I/I reduction (5A).

- End of pipe treatment was ranked most favorably for Cost Effectiveness, Technical Feasibility, Public Health and Environmental Benefits, and Program Compatibility, and (to a lesser degree), Operations and Maintenance Impacts.
- Offsite storage, with treatment at West Point Wastewater Treatment Plant, was ranked most favorably with respect to Technical Feasibility and Flexibility, followed by Public Health and Environmental Benefits.
- The combined scenario of onsite storage and I/I reduction was also ranked highly with respect to Public Health and Environmental Benefits, Program Compatibility, and Technical Feasibility.

The least favorable alternatives are conveyance and treatment (2A, 2B) and offsite storage (1B). Conveyance and treatment was ranked as least favorable due primarily to capital

costs and community impacts. Offsite storage with treatment at Carkeek was ranked poorly due primarily to Operations and Maintenance impacts.

A summary of the rankings for each alternative with respect to the evaluation criteria is provided in Appendix H.

5.6.2 Planning Area Boundary Delineation

Based on the outcome of Workshop No. 2, which identified that the convey and treat control approach was among the least favorable scenarios for the North Beach Basin, the planning boundary for this basin has been established as the actual basin boundary (see Figure 5).

6.0 SUMMARY AND NEXT STEPS

As part of the flow analysis and planning confirmation phases of this project, a short-list of the preferred CSO control alternatives for each basin has been developed. These alternatives are summarized in Table 6.

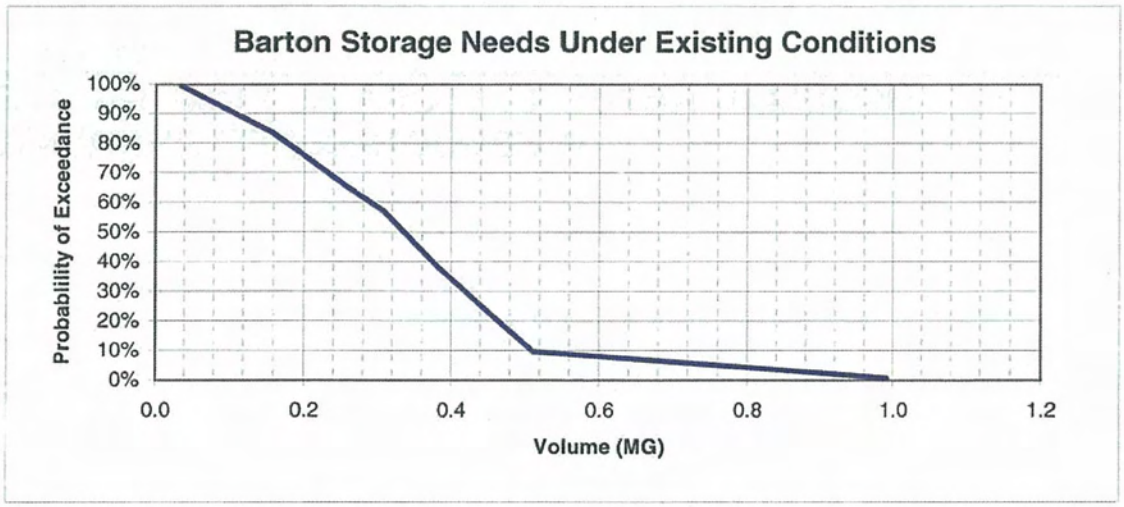
The next steps in the CSO Control project are development of the CSO Facility Selection Criteria (Task X03) and Alternatives Development (Task X05), which will lead to the selection of one preferred CSO control scenario for each of the four basins. Based on the interest in demand management exhibited in Workshop 2, further discussions with King County staff have been scheduled. These meetings may identify the need for additional analysis of demand management, including techniques, costs, and implementation constraints. Once the preferred alternative for each basin has been more fully developed, additional tasks will be conducted, including those relating to environmental services, public involvement (community relations), geotechnical evaluations and land surveys for easement or property acquisition, and development of costs for the preferred alternative.

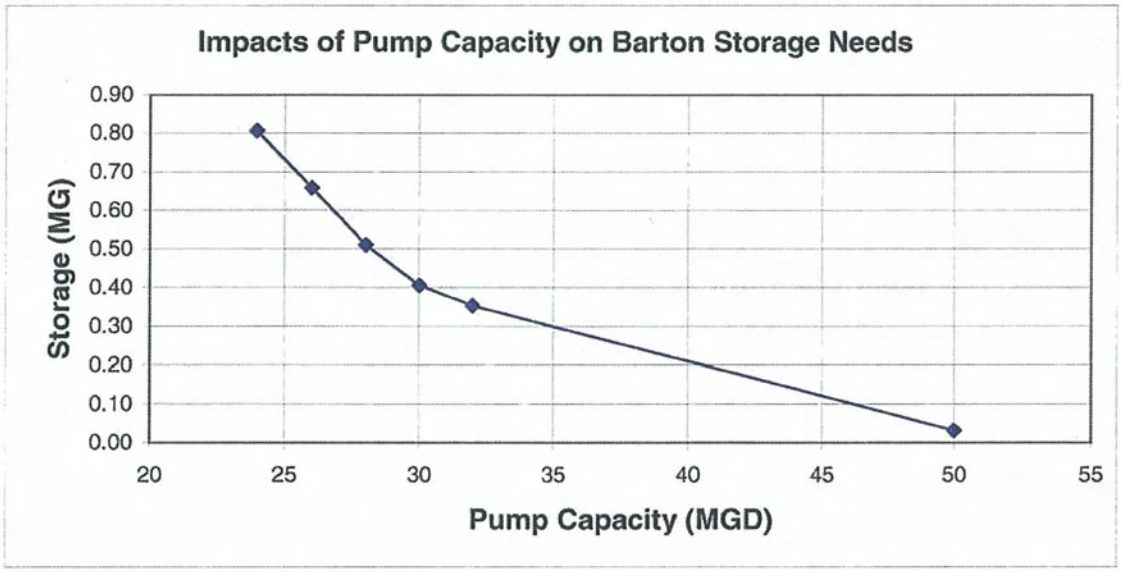
Table 6	Short-List of Preferred Alternatives by Basin CSO Control Approach and Planning Boundaries Barton, Murray, South Magnolia, and North Beach CSO Projects
CSO Control Approach	**Preferred Scenarios**
	Barton and Murray
Storage	B1A-M1B: 0.5 MG storage tank in Barton basin and 1.3 MG storage in Murray basin
Storage / End of Pipe Treatment	B1A-M4B: 0.5 MG storage tank in Barton Basin and 23.5 mgd of end of pipe treatment in Murray Basin
Demand Management / End of Pipe Treatment	B4A-M4B: Disconnection of 70 acres of impervious area in Barton Basin and 23.5 mgd of end of pipe treatment in Murray Basin
Storage / Demand Management	B1A-M3B: 0.5 MG storage tank in Barton basin and disconnection of 40 impervious acres in Murray basin
Demand Management	B4A-M3B: Disconnection of 70 acres of impervious area in Barton basin and 40 acres of impervious area in Murray basin
	South Magnolia
Storage	1C: Offsite storage with treatment at West Point WWTP
	1B: Storage near Control Point
End of Pipe Treatment	3A: HRC/UV at Control Point
	North Beach
Storage	1C: Offsite storage with treatment at West Point WWTP
End of Pipe Treatment	3A: HRC/UV at NBPS site
Combination	5A: Storage and demand management
	5C: End of pipe treatment and demand management

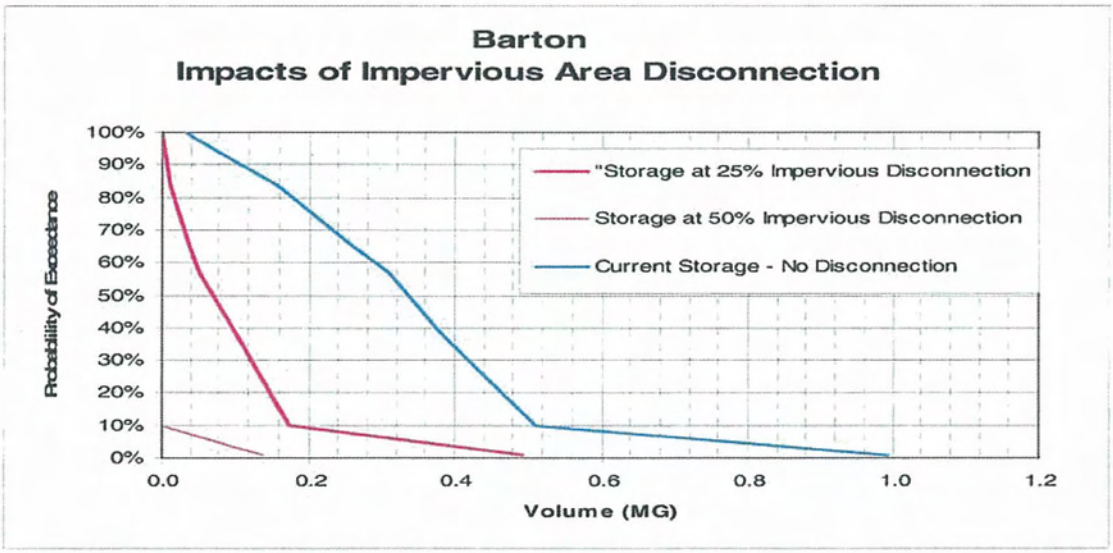
Note: The viability of demand management within the four basins has not yet been fully evaluated. The demand management alternatives included in this short-list are based on the assumption that demand management is determined to be cost effective and is not maintenance intensive. These issues will be more fully developed as part of the Alternatives Development phase of this project.

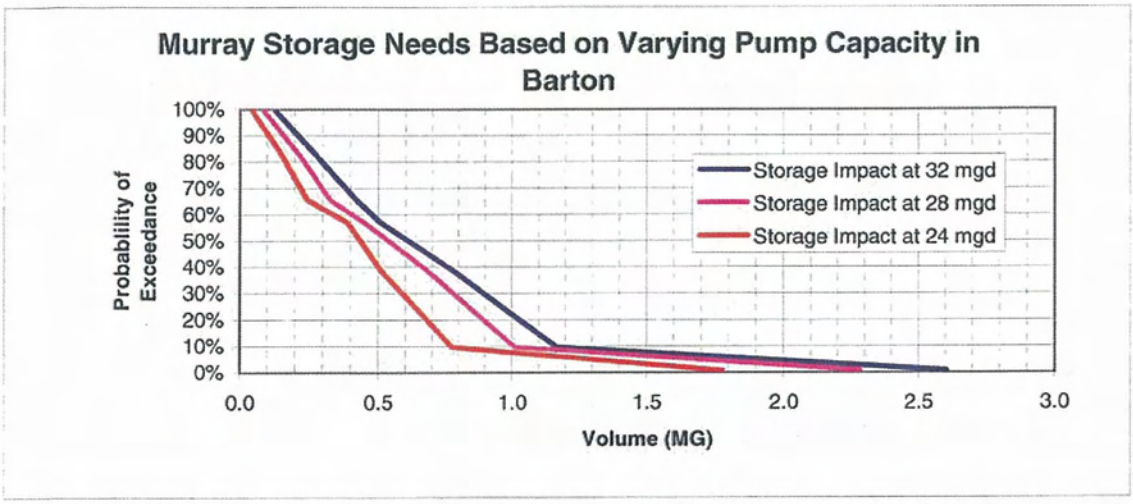
Appendix A

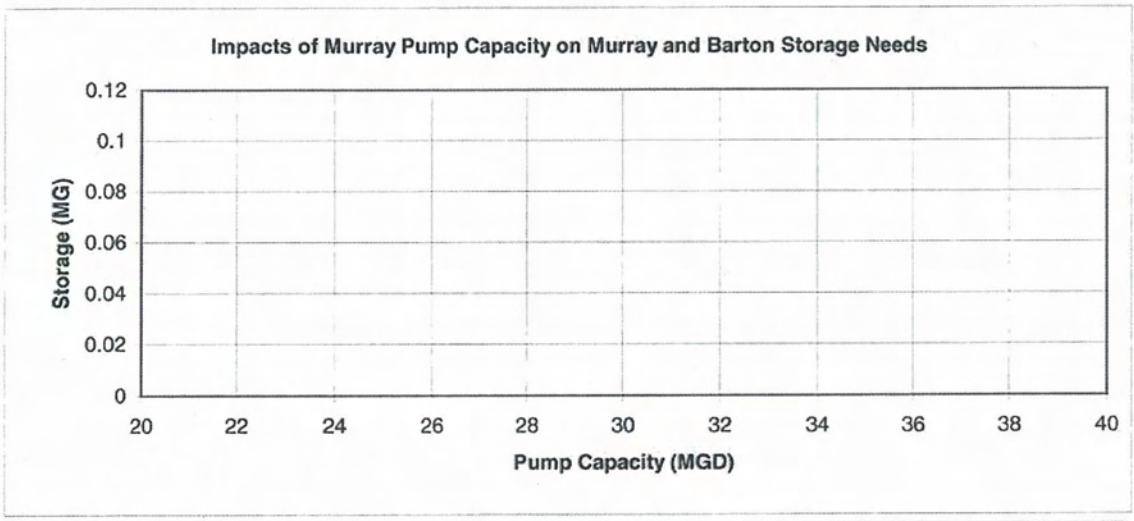
MODELING RESULTS: STORAGE, PUMPING, AND I/I REDUCTION REQUIREMENTS

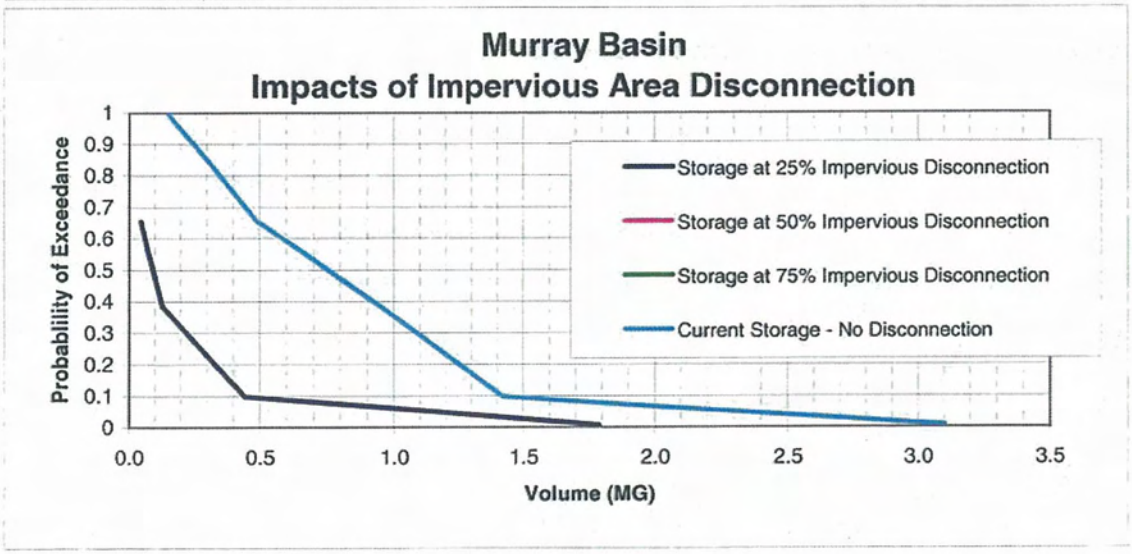

Barton Storage Needs Under Existing Conditions
Probability of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Volume (MG)

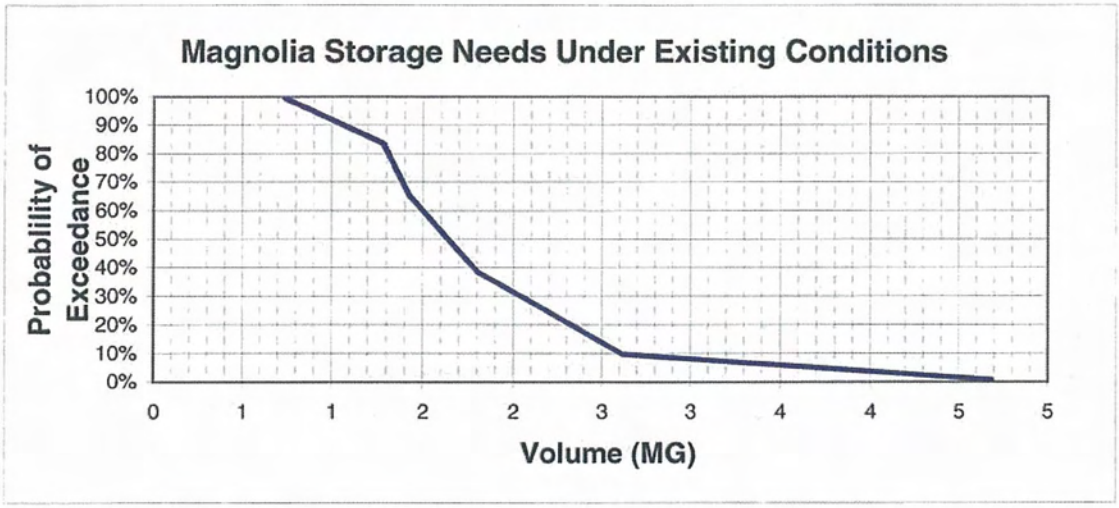

Impacts of Pump Capacity on Barton Storage Needs
Storage (MG)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
20
25
30
35
40
45
50
55
Pump Capacity (MGD)

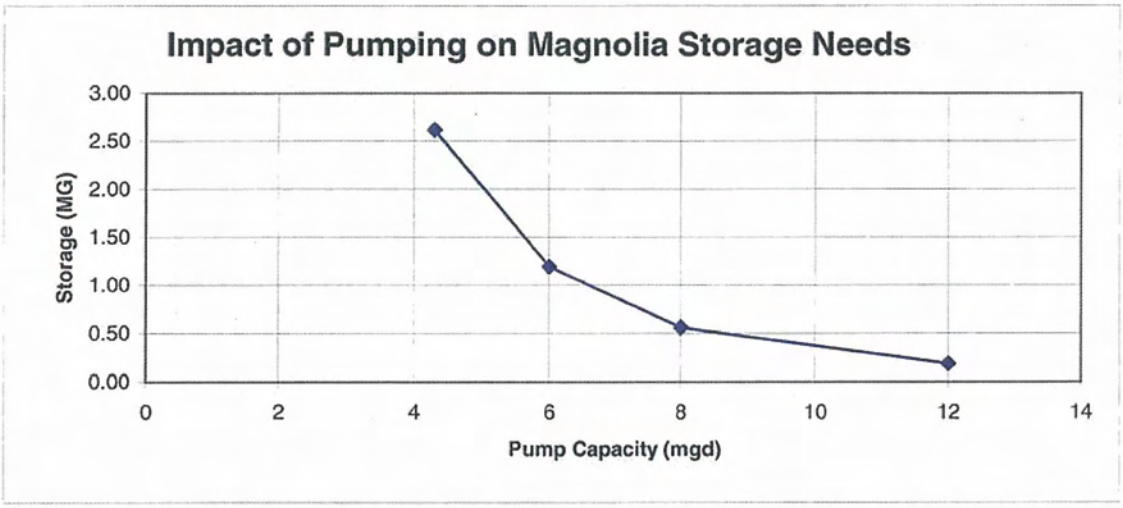

Barton
Impacts of Impervious Area Disconnection
Probability of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Volume (MG)
"Storage at 25% Impervious Disconnection
Storage at 50% Impervious Disconnection
Current Storage - No Disconnection

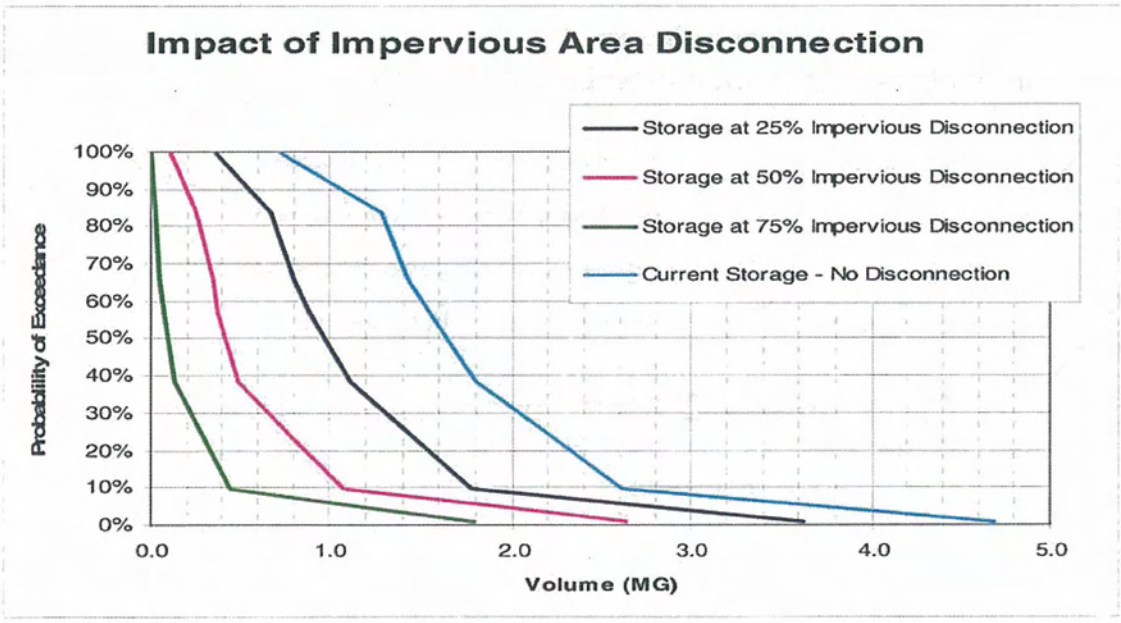

Murray Storage Needs Based on Varying Pump Capacity in Barton
Probability of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Volume (MG)
Storage Impact at 32 mgd
Storage Impact at 28 mgd
Storage Impact at 24 mgd


Impacts of Murray Pump Capacity on Murray and Barton Storage Needs
Storage (MG)
0.12
0.1
0.08
0.06
0.04
0.02
0
20
22
24
26
28
30
32
34
36
38
40
Pump Capacity (MGD)

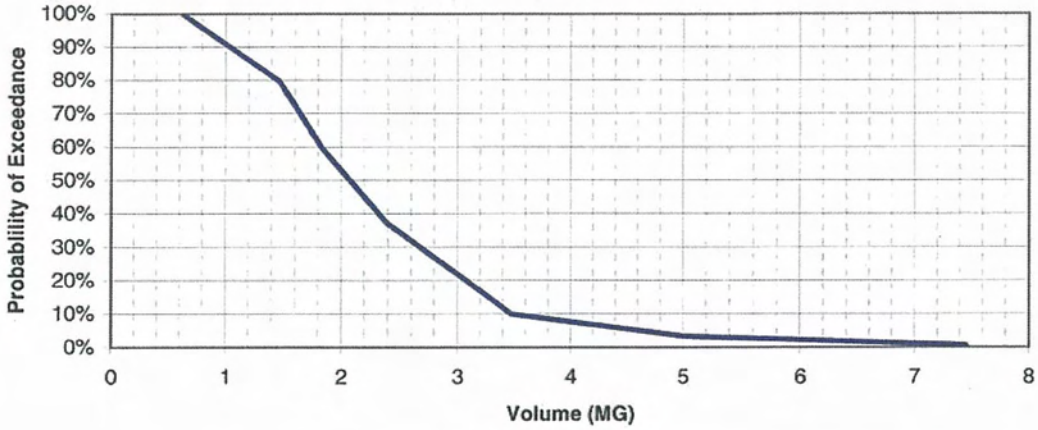

Murray Basin
Impacts of Impervious Area Disconnection
Probability of Exceedance
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Volume (MG)
Storage at 25% Impervious Disconnection
Storage at 50% Impervious Disconnection
Storage at 75% Impervious Disconnection
Current Storage - No Disconnection


Magnolia Storage Needs Under Existing Conditions
Probablility of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
1
2
2
3
3
4
4
5
5
Volume (MG)

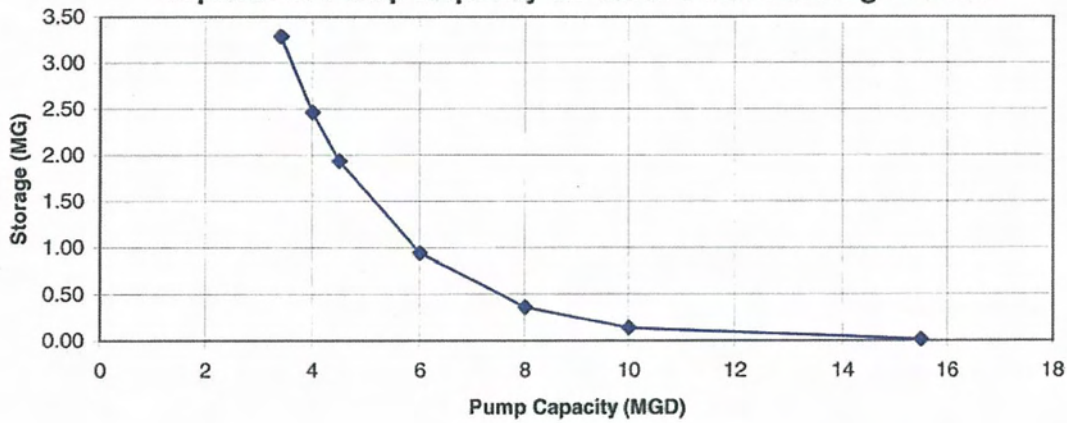

Impact of Pumping on Magnolia Storage Needs
Storage (MG)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
2
4
6
8
10
12
14
Pump Capacity (mgd)


Impact of Impervious Area Disconnection
Storage at 25% Impervious Disconnection
Storage at 50% Impervious Disconnection
Storage at 75% Impervious Disconnection
Current Storage - No Disconnection
Probability of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
1.0
2.0
3.0
4.0
5.0
Volume (MG)

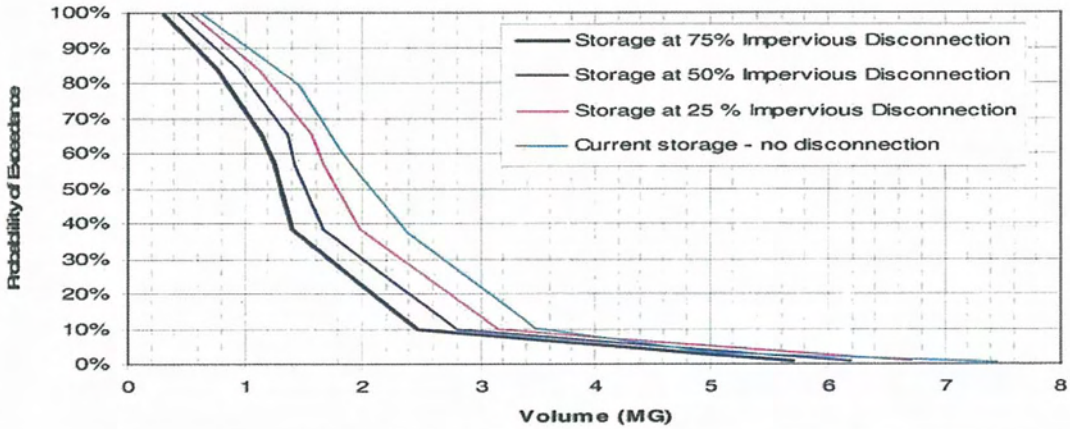
North Beach Storage Needs under Existing Conditions



Impacts of Pump Capacity on North Beach Storage Needs



North Beach
Impact of Impervious Area Disconnection



Appendix B

WORKSHOP NO. 1 PRESENTATION

King County

Barton, Murray, Magnolia, and North Beach

CSO Facilities

Workshop No. 1

March 20, 2007

carollo engineers

Project Background

- Summary of Previous Planning

Purpose and Goals of Planning Confirmation Phase

- Common understanding of problem
- Screening of potential solutions
- Identify issues and constraints
- Develop evaluation criteria
- Develop list of alternatives to be developed and evaluated in detail

Planning Confirmation Workshops

- Workshop 1
  - Problem definition
  - Range of control options
  - Identification of policy issues
  - Evaluation criteria
- Workshop 2
  - Short-list of feasible alternatives
  - Finalize evaluation criteria
- Workshop 3
  - Final list of alternatives to be developed in detail
  - Understanding of potential issues and technical info needs

CSO Basin Leads

- North Beach CSO Basin
  - Brian Matson – Basin Coordinator
  - Jennifer Kauffman – Public Involvement
- Barton / Murray CSO Basin
  - Jeff Lykken – Basin Coordinator
  - Martha Tuttle – Public Involvement
- Magnolia CSO Basin
  - Allen de Steiguer – Basin Coordinator
  - Jennifer Kauffman – Public Involvement

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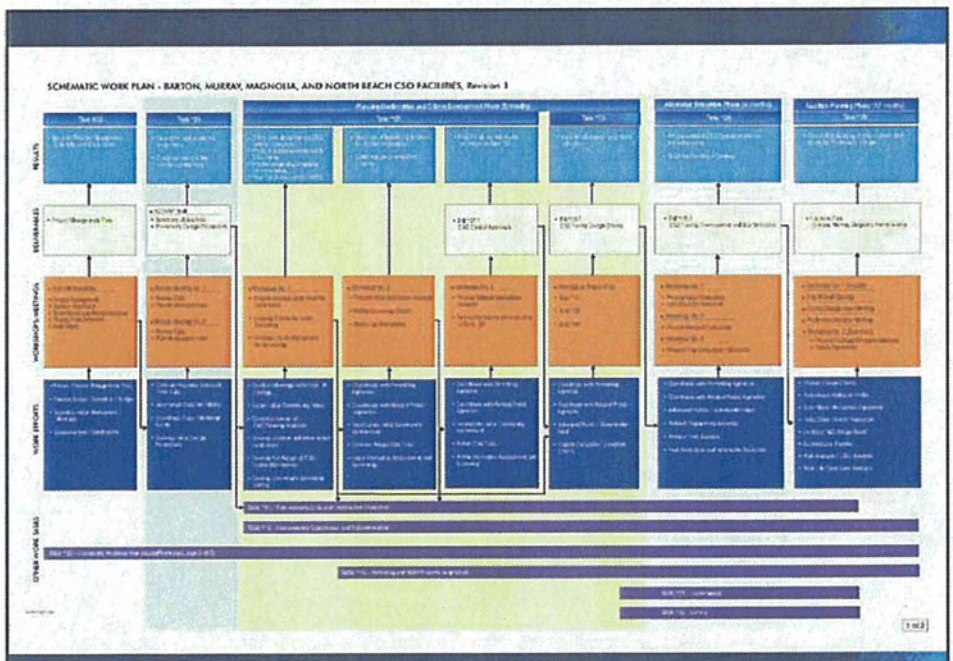

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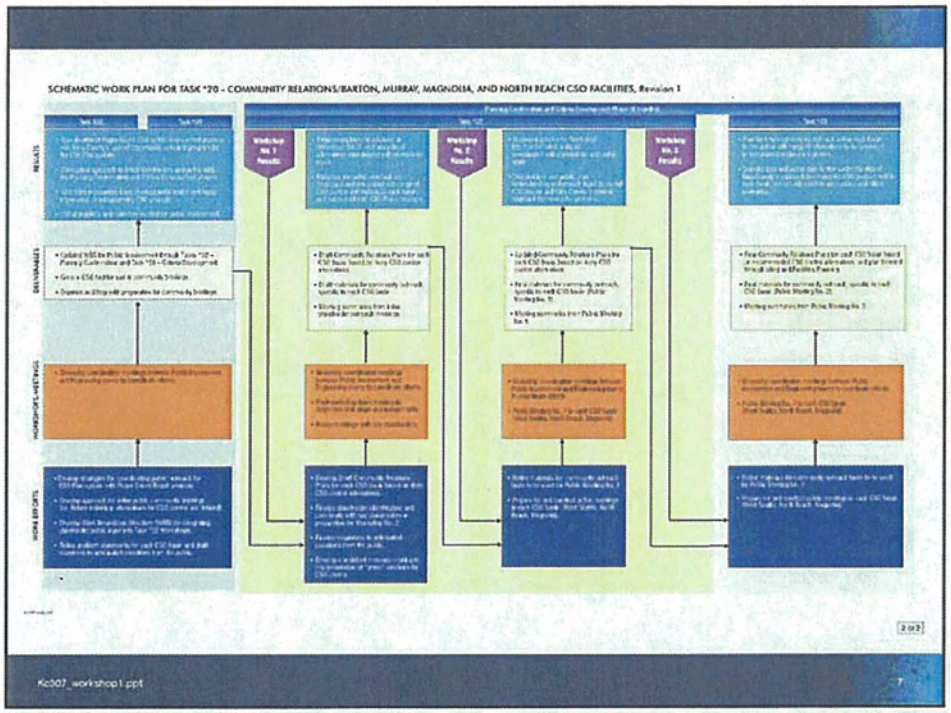

SEPA/SERP Coordination

- Initial coordination for developing alternative evaluation criteria
- Subsequent coordination following alternative screening

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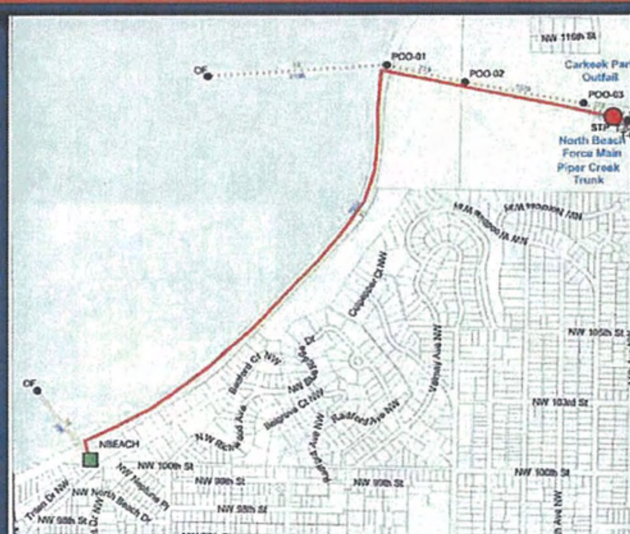
Overview of CSO Basins in Project

- North Beach
- Barton and Murray
- Magnolia

North Beach Basin Schematic



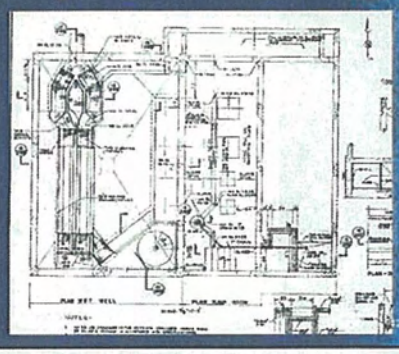
North Beach CSO Basin

- XXX acres
- Collection system largely disconnected
- Wet weather flow primarily caused by infiltration

Kc307_workshop1.ppt 11

North Beach Pump Station

- Pumping Capacity (4 pumps)
  - Total Installed: 2 @ 3.5 mgd
    2 @ 1.3 mgd
  - Firm: 3.5 mgd (head limits capacity)



Kc307_workshop1.ppt 12

North Beach Pump Station

- Forcemain Capacity
  - 7,100 ± lf 14" forcemain NW of railroad tracks to Carkeek Treatment Plant
  - 3.5 mgd at 5 fps

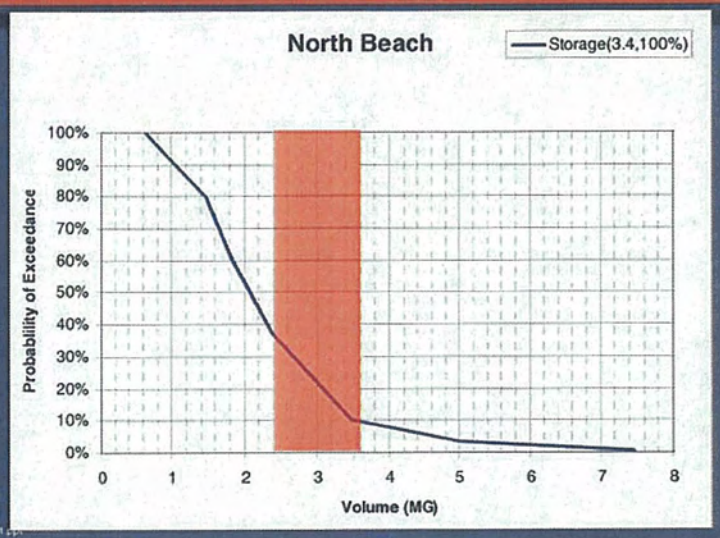
Previous CSO Planning Recommendations

- Install 140,000 gal storage adjacent to existing pump station
- Expand pump station - upgrade firm pumping capacity to 4.2 mgd
- Build new forcemain – 2,060 LF
- Other sewer improvements

Current modeling approach

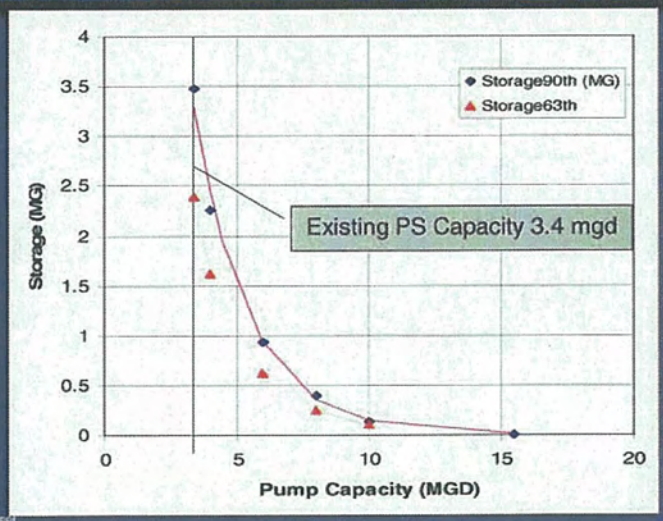
- Modeled storage requirements with current pumping and existing conditions
- Modeled impact of increasing pumping capacity
- Modeled impact of disconnecting impervious area

Storage Capacity Requirement

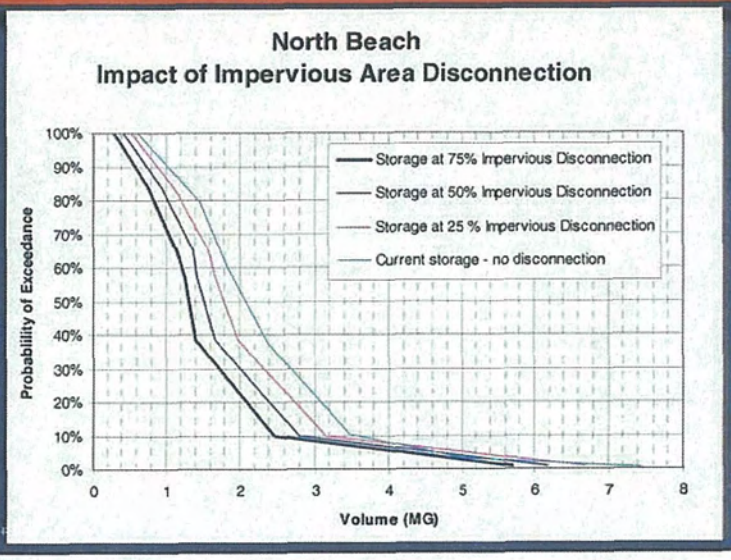


Footprint of Storage at North Beach

Increasing North Beach Pump Station capacity could reduce or eliminate storage



Disconnecting impervious area does not have big impact on storage needs



North Beach Flow Modeling Preliminary Conclusions

- Required storage volume without increased pumping capacity has increased from 140,000 gallons to approx. 2.5 - 3.5 MG
- Pumping capacity to eliminate storage = 10-12 mgd
- Limited benefit from disconnecting impervious areas

Questions to be answered

- Is storage practical in vicinity of park and North Beach Pump Station?
- How would additional pumping impact downstream facilities?
  - Add treatment capacity/capability to Carkeek.
  - Lift to 8th Ave Interceptor ?
- Pursue partial separation?

Possible Alternatives

- 3.5 MG storage?
- Increase PS capacity to 10-12 mgd
  - Increase Carkeek wet weather treatment
  - Improve treatment performance?
  - Pump to 8th Avenue Interceptor for conveyance to West Point
  - Forcemain alignment impacts capacity
- Combined storage/pumping

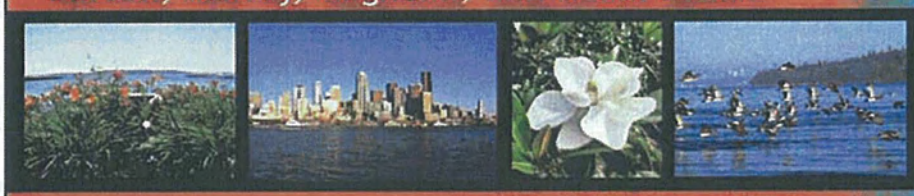
North Beach Basin Public Involvement Status and Summary

- Introduce KC and need for project
- Start with property owner associations in basin (Blue Ridge, N. Beach, Olympic M.)
  - Research property covenants
- Consult vicinity groups with drainage/CSO expertise (Carkeek, Piper's)
- Expand public outreach as relationships are built, options developed

Kc307_workshop1.ppt 23

King County

Barton, Murray, Magnolia, and North Beach

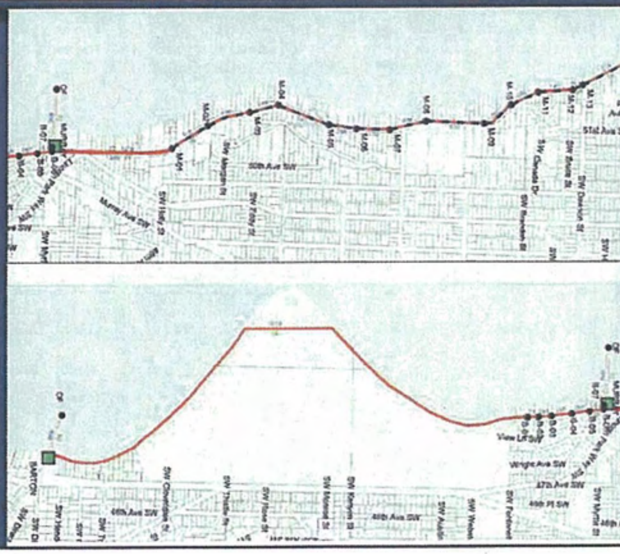


CSO Facilities

BREAK

carollo engineers

Barton and Murray Basins Schematic



Kc307_workshop1.ppt 25

Barton CSO Basin

- XXX acres
- Mostly combined
- Barton Pump Station pumps to Murray

Kc307_workshop1.ppt 26

Barton Conveyance

- Barton Pump Station: County calculated capacity of 28 MGD
- Discharges to twin 24-inch force mains upgraded by emergency repair
- Pump station upgrade currently being planned by County

Kc307_workshop1.ppt 27

Barton Pump Station Site

Kc307_workshop1.ppt 28

Previous CSO Planning Recommendations for Barton

- Add 7.5 MGD of pumping capacity
- New wet weather pump station located in Vashon/Southworth Ferry Dock parking lot
- Assumed a submersible station with upgraded conveyance capacity to Murray
- 0.5 MG storage option at Fauntleroy School also investigated in 1997 Plan Update

Kc307_workshop1.ppt 29

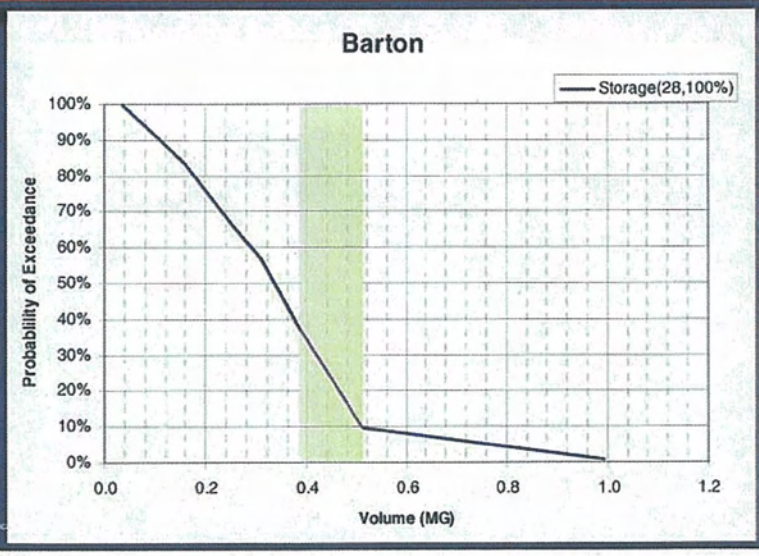
Barton Optional Storage Site Fauntleroy School Parking Lot

Kc307_workshop1.ppt 30

Barton Optional Storage Site
Fauntleroy School Parking Lot

Kc307_workshop1.ppt 31

Storage Capacity Requirement



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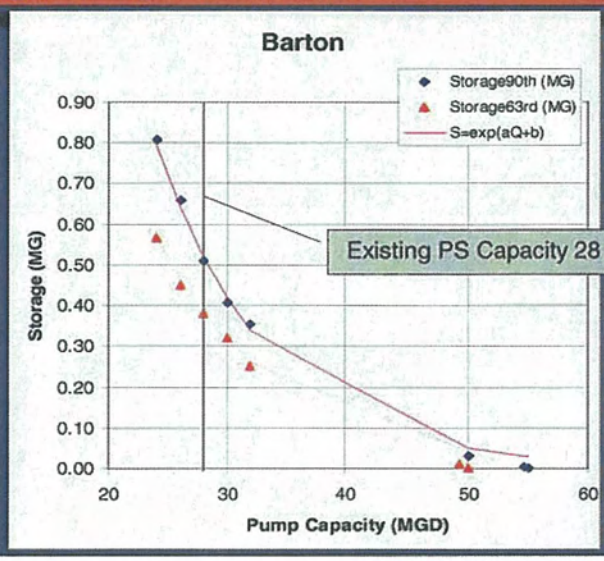
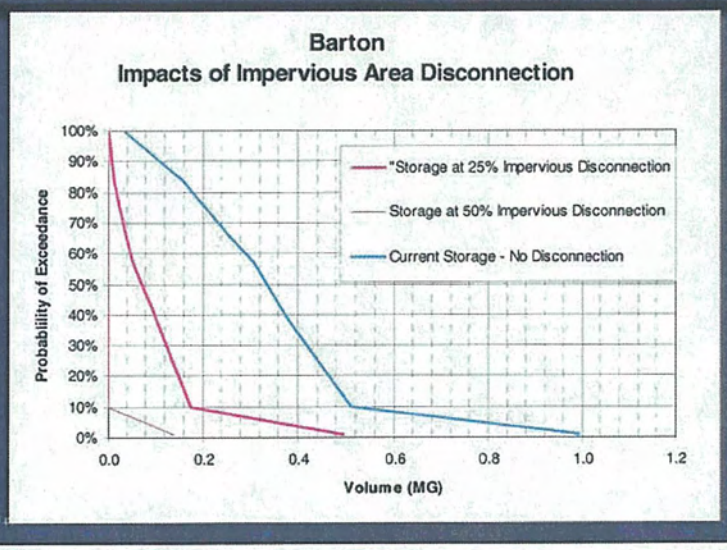
Footprint of Storage at Barton

Impacts of increasing pumping on storage requirement



Disconnecting Impervious Area Impacts Storage Requirement



Barton Flow Modeling Preliminary Conclusions

- Required storage volume without increased pumping capacity is approximately 0.5 MG
- Pump capacity to eliminate storage ± 53 mgd
- Significant benefit from disconnecting impervious areas – target 50 percent disconnection

Murray CSO Basin

- XXX acres
- Basin partially separated
- Well developed storm drainage system

Murray Conveyance

- Murray Pump Station: County calculated capacity of 31.5 MGD
- Discharges to twin 27-inch force mains
- Pump station upgrade currently being planned by County

Murray Pump Station Site

Kc307_workshop1.ppt 39

Murray Pump Station Site

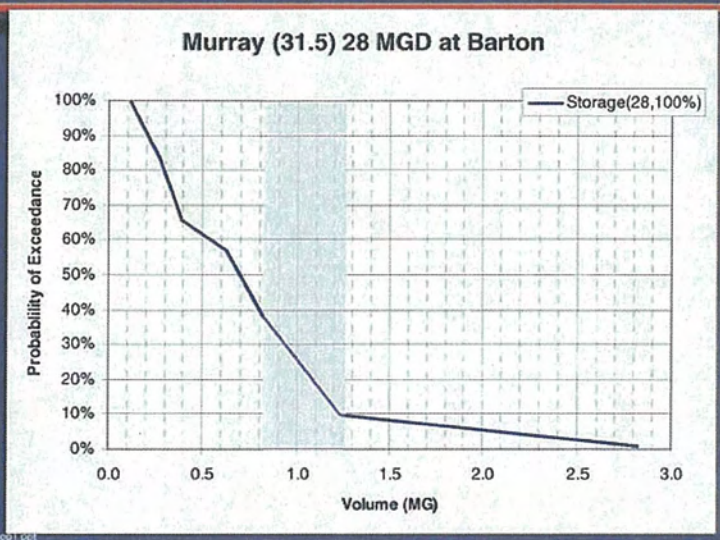
Kc307_workshop1.ppt 40

Previous CSO Planning Recommendations

- 0.8 MG storage tank
- Tank located approximately ¼ mile east of pump station site
- Approximately 500 feet of new 24-inch conveyance piping required for filling and emptying of tank.

Murray Storage Site?

Storage Capacity Requirement

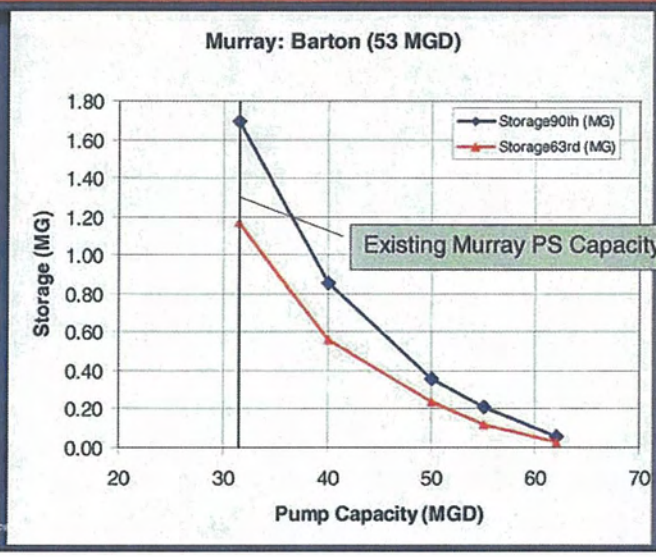


Kc307_workshop1.ppt 43

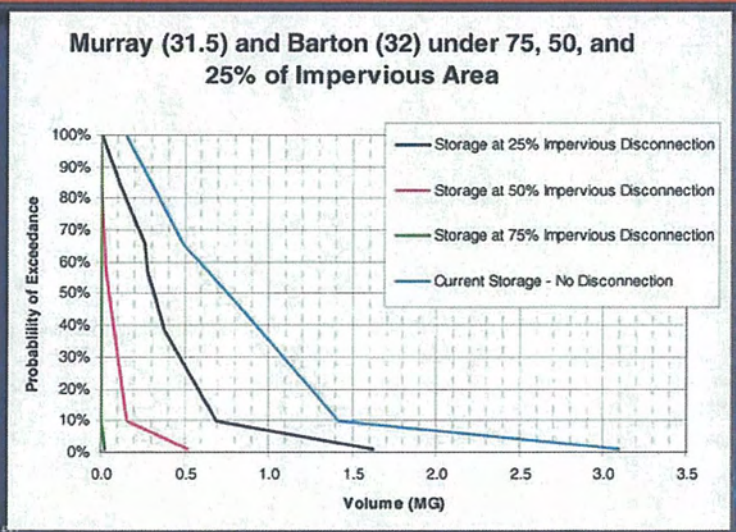
Footprint of Murray Storage

Kc307_workshop1.ppt 44

Murray Pumping Capacity to Eliminate Storage at Both Barton and Murray – No storage



Impacts on Murray Storage from Impervious Area Disconnection



Murray Flow Modeling Preliminary Conclusions

- Required storage volume without increased pumping capacity is approximately 1.3 MG
- Pump capacity to eliminate storage at both Barton and Murray ± 65 mgd
- Significant benefit from disconnecting impervious areas – target 50 –75% disconnection

Kc307_workshop1.ppt 47

Barton and Murray Potential Solutions

- Increased pumping with no storage
  - Barton 53 mgd
  - Murray 65 mgd
  - Increase flow to Alki?
- Storage alone
  - Barton 0.5 MG
  - Murray 1.3 MG
- Impervious area disconnection
  - Target > 50% to eliminate overflows
- Combinations?

Kc307_workshop1.ppt 48

Barton and Murray Questions to be answered

- How much impervious area connected that contributes inflow in each basin?
- How high in the basins can storage reasonably be accomplished?
- What storage locations are "off the table"?

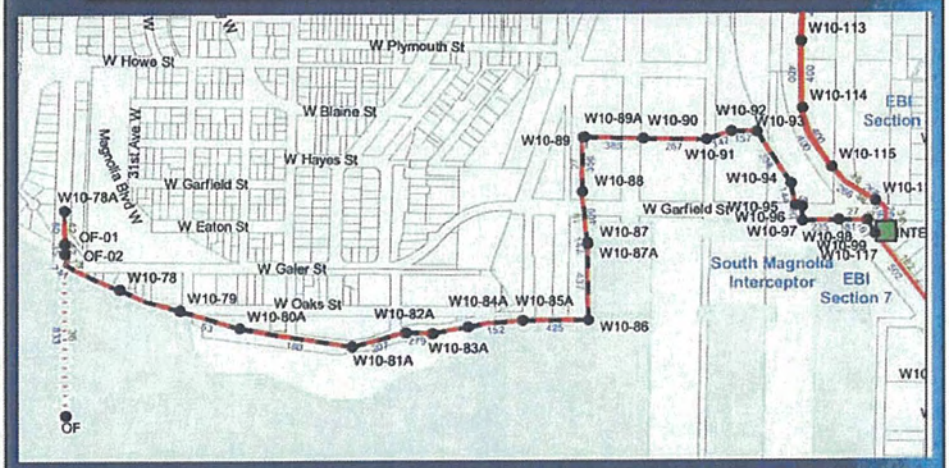
Barton & Murray Public Involvement Strategy

- Outreach strategy starts with existing community organizations
- Next work with immediate neighbors
- Develop succinct purpose and need statement
- Identify interested stakeholders
- Work with City of Seattle where possible
- Develop public involvement strategy as project progresses

Previous Promises

- Murray – "We will not build a storage tank in your park"
- Fauntleroy – Promised a coordinated effort between planned Barton Pump Station improvements and future CSO projects

South Magnolia Basin Schematic



South Magnolia CSO Basin

- XXX Acres
- Mostly connected
- Well developed storm drainage system

Kc307_workshop1.ppt 53

South Magnolia Trunk

- S. Magnolia Trunk, apparent capacity 4.3 mgd.
- Existing 18-inch sewer passes under marina parking.
- No improvements currently planned

Kc307_workshop1.ppt 54

Previous CSO Planning Recommendations

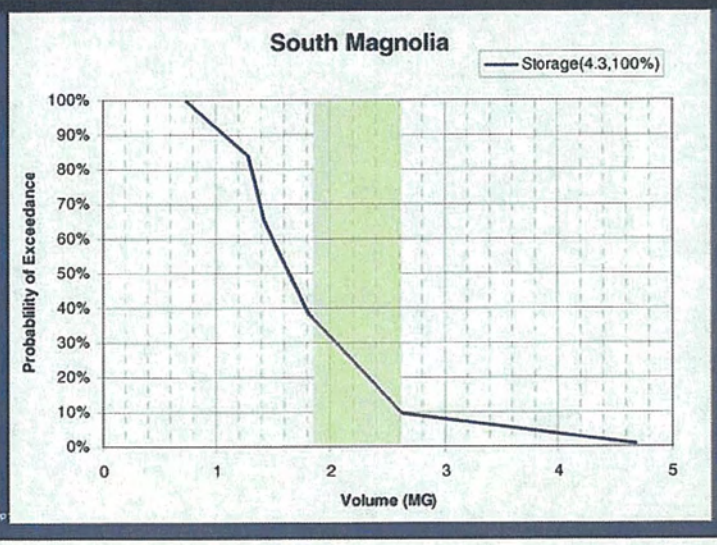
- 1.3 MG storage Tank
  - $6 million in $1997

Or, alternatively

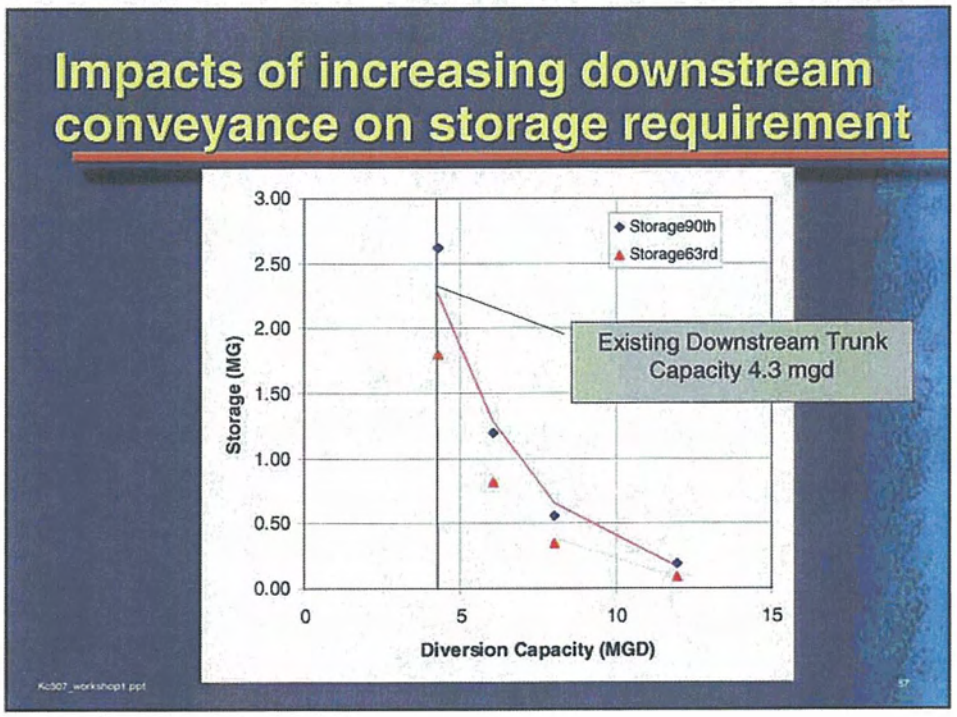
- Rooftop separation of 900 homes
  - $3 million in $1997.

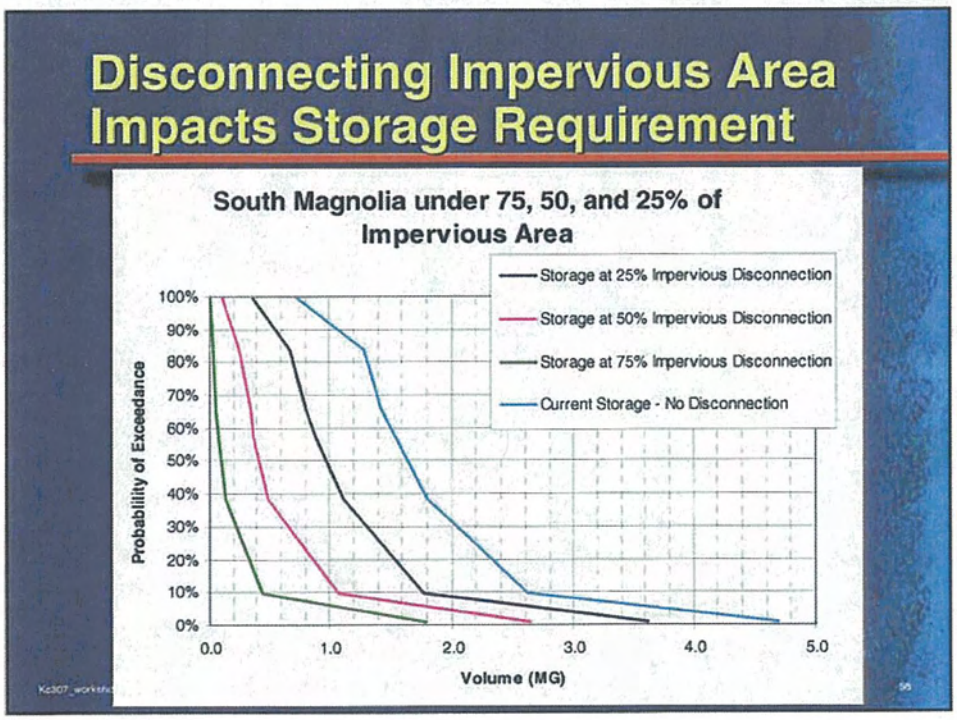
Kc307_workshop1.ppt 55

Storage Capacity Requirement



Kc307_workshop 56


Impacts of increasing downstream conveyance on storage requirement
Storage90th
Storage63rd
Existing Downstream Trunk Capacity 4.3 mgd
Storage (MG)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
5
10
15
Diversion Capacity (MGD)


Disconnecting Impervious Area Impacts Storage Requirement
South Magnolia under 75, 50, and 25% of Impervious Area
Storage at 25% Impervious Disconnection
Storage at 50% Impervious Disconnection
Storage at 75% Impervious Disconnection
Current Storage - No Disconnection
Probability of Exceedance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
1.0
2.0
3.0
4.0
5.0
Volume (MG)

S. Magnolia Flow Modeling Preliminary Conclusions

- Required storage volume has increased from 1.3 MG to ± 2.6 MG
- 40% impervious area disconnection required to meet previous storage volume.
- ±15 mgd downstream conveyance capacity required with no storage

Kc307_workshop1.ppt 59

Questions to be answered

- What are downstream capacity constraints, EBI Section 8, and Interbay PS?
- Should we consider increasing capacity of South Magnolia Trunk as option?
- How much connected impervious area contributes inflow?

Kc307_workshop1.ppt 60

Possible Alternatives

- 2.6 MG storage
- No basin storage and add capacity to South Magnolia Trunk (15 mgd)
- Increase conveyance to 15 mgd and put storage upstream of Interbay PS.
- Combination

South Magnolia Public Involvement Status and Summary

- Develop purpose and need statement and outreach strategy
- Start with immediate neighbors
- Explore options with Port of Seattle
- Consult three major community groups
- Expand public involvement as options develop

Summary and Input Needed

- Level of Control
  - 63% vs. 90%
- Establishing pump station capacity
  - Peak capacity needs
  - Redundancy requirements
- Flexibility with storage locations
  - How far up into basin can storage be located?
- Partial Separation
  - Private property issues
  - Stormwater permit requirements
  - Additional modeling will be needed
  - KC/SPU working relationship and commitments
  - Cost effectiveness evaluation more complex

Draft Evaluation Criteria

- Screening level criteria
- More refined criteria will be subsequently developed to evaluate site specific alternatives
- Weighting of criteria?

Evaluation Criteria

- Affordability
- Ease of Operation and Maintenance
- Technical Feasibility and Compatibility
- Environmental Benefit
- Flexibility
- Community Considerations
- Fits with Other Programs and Initiatives

Discussion of Alternatives to Be Considered

- Concerns and issues with storage
  - North Beach
  - Murray and Barton
  - Magnolia
- Pumping and downstream conveyance/treatment
- Disconnecting Impervious Area
  - Implementation Issues
  - Low tech and low cost option?
- Other options?
  - Change regulatory requirements

Appendix C
BASIS OF COSTS

Carollo
Engineers...Working Wonders With Water™

APPENDIX C

Project Name:	Barton, Murray, South Magnolia, and North Beach CSO Projects	**Date:**	October 29, 2007
Client:	King County Department of Natural Resources and Parks	**Project Number:**	7562A.10
Subject:	Basis of Costs		

Planning level capital costs were developed for each of the technical elements for the five CSO control approaches. These costs were based on three sources which were used to generate cost curves for each project element. The basis for the cost curves for each element are presented in the following Project Memorandum.

The sources for the planning level capital costs are as follows:

- Design estimates and bid experience from recent projects
- Engineers' estimates based on vendor quotes
- King County Tabula cost estimating model

A summary of the major project elements, the party responsible for developing the capital costs, and the source of the capital costs are presented in Table 1.

Table 1. Summary of Development for Basis of Costs
Appendix C - Basis of Costs
Barton, Murray, South Magnolia, and North Beach CSO Projects

Project Elements	Responsible Party	Source
Storage Tanks	Tetra Tech / KCM	Design Estimates
Gravity Sewers	Carollo	Tabula
Force Mains	Carollo	Tabula
Microtunnels	Carollo	Tabula
Tunnels	Carollo	Tabula
Submersible Pump Stations	Carollo	Engineers' Estimates
High Head Pump Stations	Carollo	Design Estimates
Treatment Facilities	Carollo	Design Estimates, Engineers' Estimates

carollo engineers

PROJECT MEMORANDUM

Project Name:	Barton, Murray, Magnolia, and North Beach CSO Facilities	**Date:**	05/22/2007
Client:	KCDNRP (County)	**Project Number:**	7562A.10
Prepared By:	Allen de Steiguer, Cara Wilson		
Reviewed By:	Brian Matson		
Subject:	Basis of Costs		
Distribution:	Project Team		

Background

As part of the Barton, Murray, Magnolia, and North Beach CSO Facilities project, a review of previous planning efforts, as well as development of alternative approaches, has been conducted to identify approaches to meet the County's combined sewer overflow (CSO) control goals and policies for each of the four basins. This planning confirmation effort includes development of several evaluation criteria by which the alternatives are assessed, including the development of planning-level cost estimates.

Purpose

The purpose of this project memorandum (PM) is to present the methods and assumptions used in the development of the planning-level cost estimates for the combined sewer overflow (CSO) alternatives. This document and the attached cost curves will be included as an appendix to TM X05.1, "Siting Report," for each of the four basins.

Project Elements

Planning level costs have been developed for each alternative as part of Task X02, "Planning Confirmation" and Task X05, "Project Alternative Development and Siting Evaluation." The major project elements identified as part of the CSO control alternatives are listed below:

- CSO storage tanks
- Gravity sewers
- Force mains
- Microtunnels
- Tunnels
- Submersible pump stations
- High head pump stations
- Treatment facilities (High Rate Clarification / Disinfection)

Basis of Cost Estimates

The planning-level cost estimates for the CSO alternatives are based on cost curves developed from the current design of similar facilities and/or Tabula, the County's cost estimating tool. These costs were then escalated to develop total project costs, including general contractor overhead and profit, an estimating contingency, and allied costs (including engineering, legal, and administrative costs. The common cost-estimating elements to all the alternatives are provided below:

- Year: 2007, ENR CCI: 8626
- Contingency: 30%
- Allied Costs: 30%
- Contractor markups: included
- Sales tax: none

The basis of the direct cost estimates developed for the major project elements are presented in the following sections. The cost curves, based on data from recent bid prices, design of similar facilities, and Tabula, are included in the Appendix.

Storage Tanks

- Project Element Size/Capacity Range: 0.5-10 MG
- Key materials: Buried cast-in-place concrete tank (≤8 ft. of fill over top of tank)
- Key elements:
    - Rectangular tank; up to 30 feet deep
    - Fill by gravity; drain by internal submersible pumps
    - Weir controlled regulator
    - Tank cleaning by flushing gates similar to North Creek storage facility
    - Carbon odor control
- Site conditions:
    - Stable ground; no pile support system required
    - No land or easement acquisition
    - No mitigation costs included
- Cost source: Cost curves developed from recent bid prices, internal reports, and published data on storage tank costs.

Gravity Sewers

- Project Element Size / Capacity Range: 12-96 inch diameter
- Basis of per foot cost: 1,000 feet.
- Key Materials: Reinforced Concrete Pipe
- Key Elements: Pipe, manholes every 500 feet.
- Depth of Cover: 4 - 12 feet
- Manhole spacing: 500 feet.
- Site conditions:
    - Collector or Arterial street, half-width restoration
    - Minimal dewatering for shallow sewers; significant for deep sewers
    - Heavy traffic
    - Average utilities
    - No land or easement acquisition
- Trench conditions: Vertical. Trench box to 8-feet total depth, special shoring for trenches

greater than 8-feet total excavation.
- Cost source: Tabula, 12/05 version, King County

Force Mains

- Project Element Size / Capacity Range: 12-48 inch diameter
- Basis of per foot cost: 1,000 feet.
- Key Materials: Ductile Iron Pipe
- Key Elements: Piping
- Depth of Cover: 4 feet
- Site conditions:
    - Trench width restoration
    - Minimal dewatering
    - Heavy traffic
    - Average utilities
    - No land or easement acquisition
- Trench conditions: Vertical, Trench box to 8-feet total depth.
- Cost source: Tabula, 12/05 version, King County

Tunnels

- Project Element Size: 8-foot to 16-foot
- Basis of per foot cost: 1,000 feet.
- Key Materials: Segmental concrete lining assumed (Tabula does not specify methods of lining)
- Key Elements: Launch and retrieval shafts, dewatering, spoils removal, lining.
- Depth of Cover: 25-35 feet assumed.
- Site conditions:
    - No land or easement acquisition.
    - No significant traffic issues.
    - Easements under residential land.
- Geotechnical conditions: significant dewatering
- Cost source: Tabula, 12/05 version, King County

Microtunnels

- Project Element Size: 24-inch to 84-inch
- Basis of per foot cost: 1,000 feet.
- Key Materials: Direct concrete jacking with jacking pipe, no casing assumed (Tabula does not specify methods or materials).
- Key Elements: Launch, retrieval, and one intermediate shaft per 1,000 feet.
- Depth of Cover: 20-30 feet.
- Site conditions:
    - No land or easement acquisition.
    - No significant traffic issues.
    - Easements under residential land.
- Geotechnical conditions: significant dewatering.
- Cost source: Tabula, 12/05 version, King County

Submersible Wet Weather Pump Stations

- Project Element Size / Capacity Range: 3.5 mgd - 8.5 mgd
- Key materials: Concrete

- Key elements: Wet well, pumps, odor control, electrical
- Site conditions:
    - No land or easement acquisition
- Cost source: Cost curves developed from recent bid prices, internal reports, and recent design of similar facilities.

High Head Pump Stations

- Project Element Size / Capacity Range: 10 mgd
- Key materials: Concrete
- Key elements: Wet well, pumps, odor control, electrical
- Site conditions:
    - No land or easement acquisition
    - Below grade valve vault
- Cost source: Cost curves developed from recent bid prices, internal reports, and recent design of similar facilities.

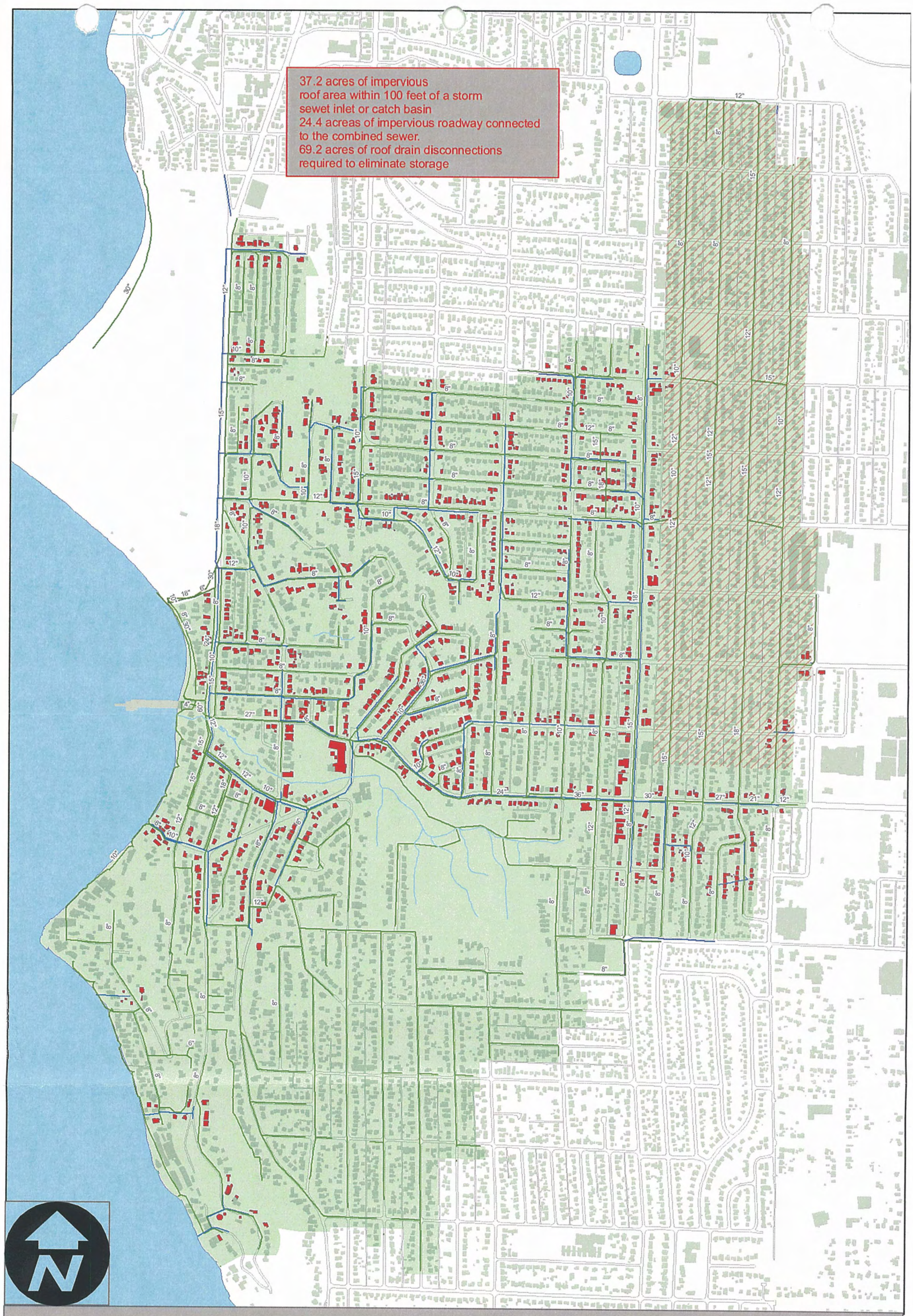
Treatment Facilities (High Rate Clarification / Disinfection)

- Project Element Size / Capacity Range: 8.5 mgd - 10 mgd
- Key materials:
- Key elements: High rate clarification (such as Actiflo), followed by disinfection (UV or NaHCl)
- Site conditions:
    - No land or easement acquisition
- Cost source: Cost curves developed from recent bid prices, internal reports, and recent design of similar facilities.

Appendix

COST CURVES

DRAFT



0 520 1,040 1,560 2,080 Feet

1 inch equals 800 feet

Legend

- Barton
- Buildings within 100 feet of Storm Sewer Inlets
- Impervious_Roadway_Areas
- Storm
- Sanitary/Combined

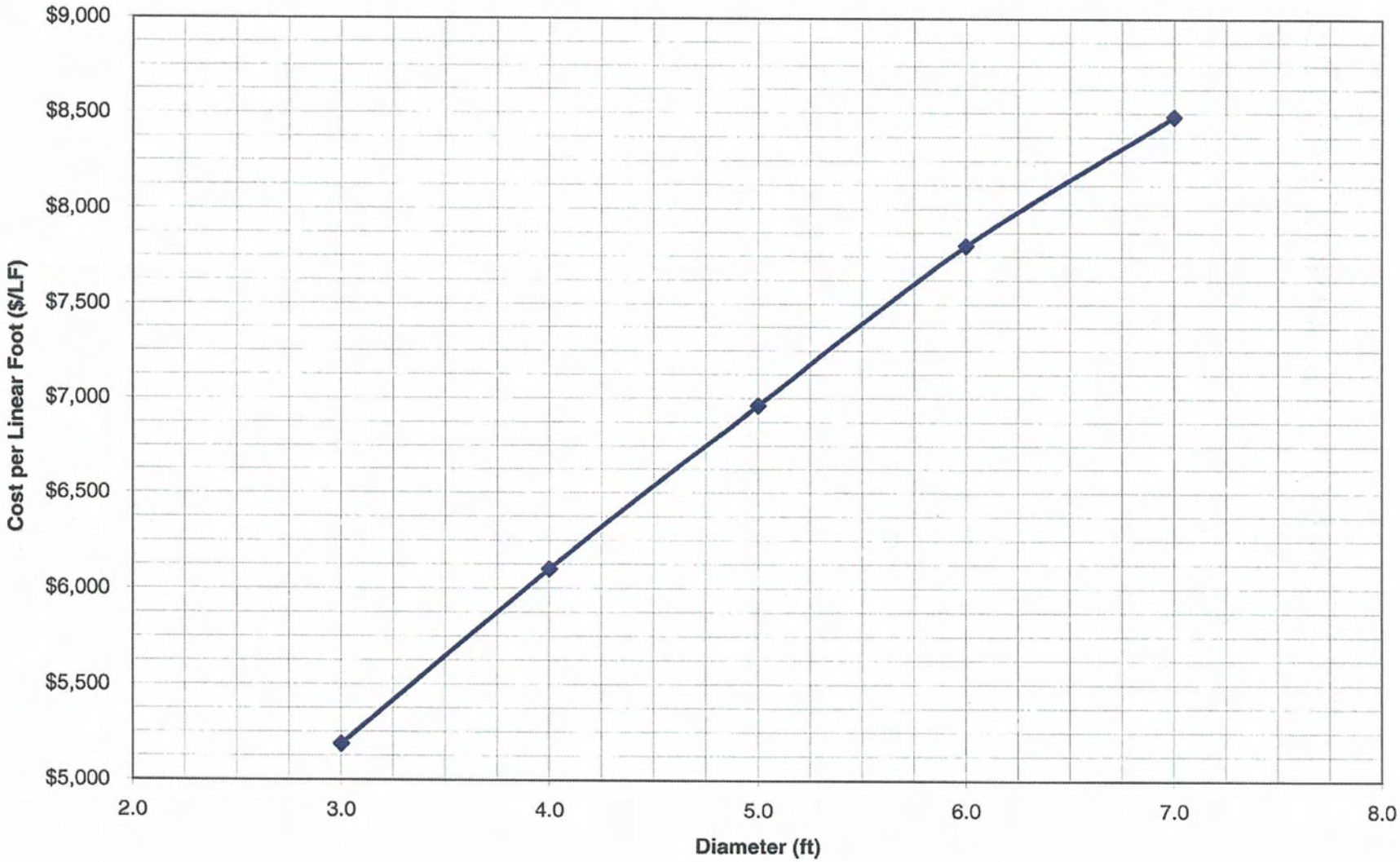
Barton CSO Basin

Potential Sites for Roof
Drain Disconnections

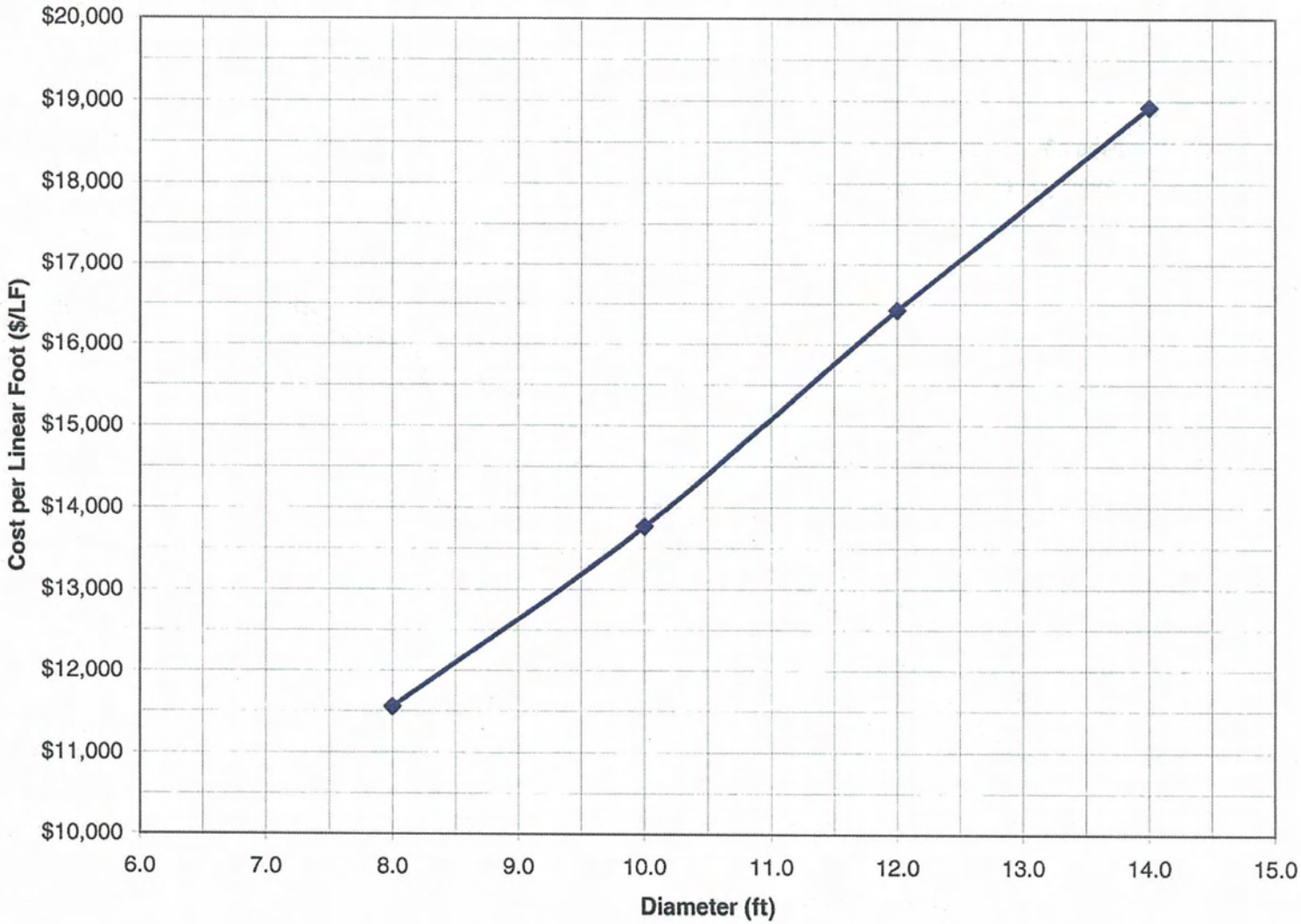
Appendix D

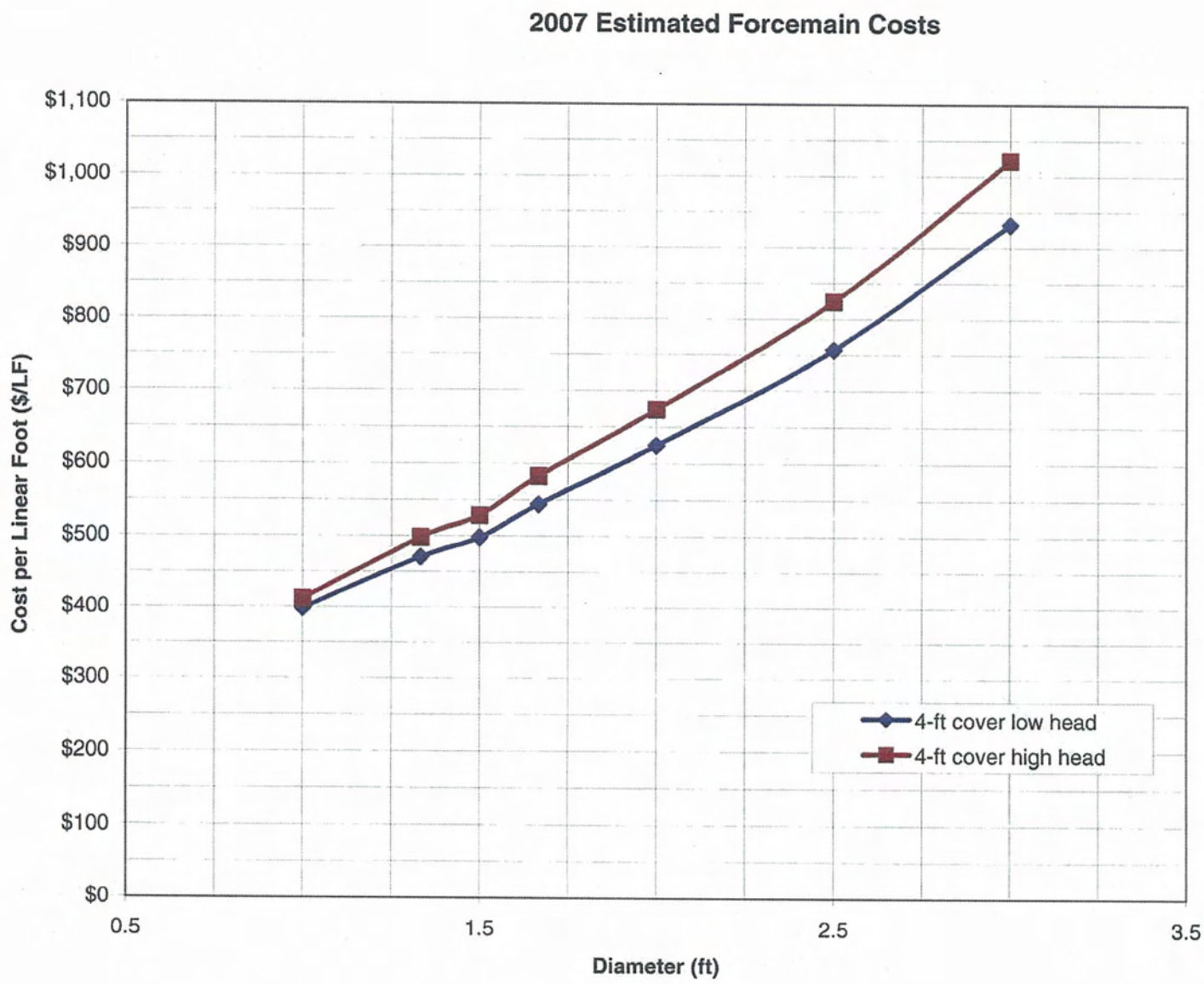
BARTON BASIN ROOF DRAIN EVALUATION

2007 Estimated Mictrotunnel Costs

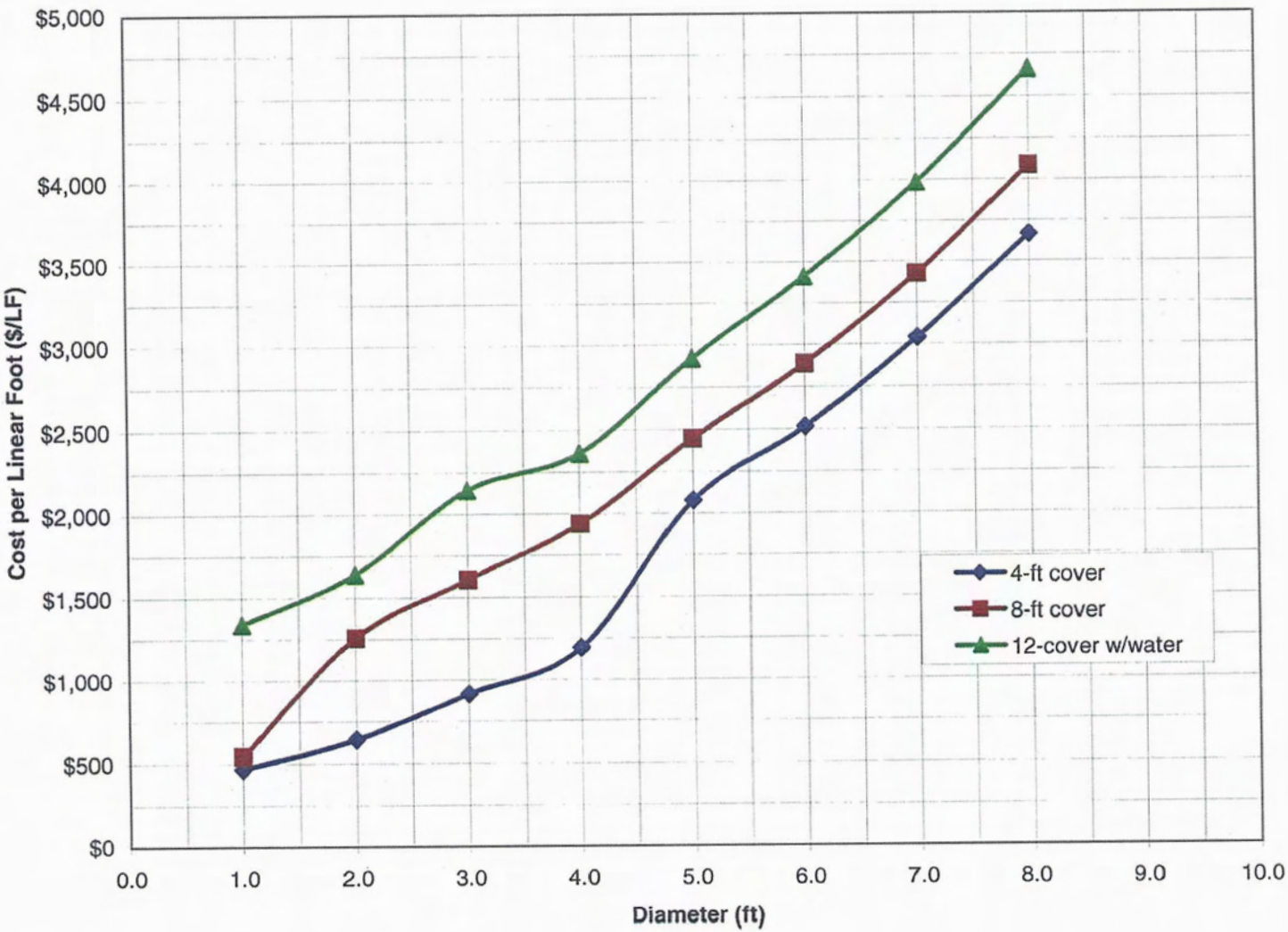


2007 Estimated Tunnel costs

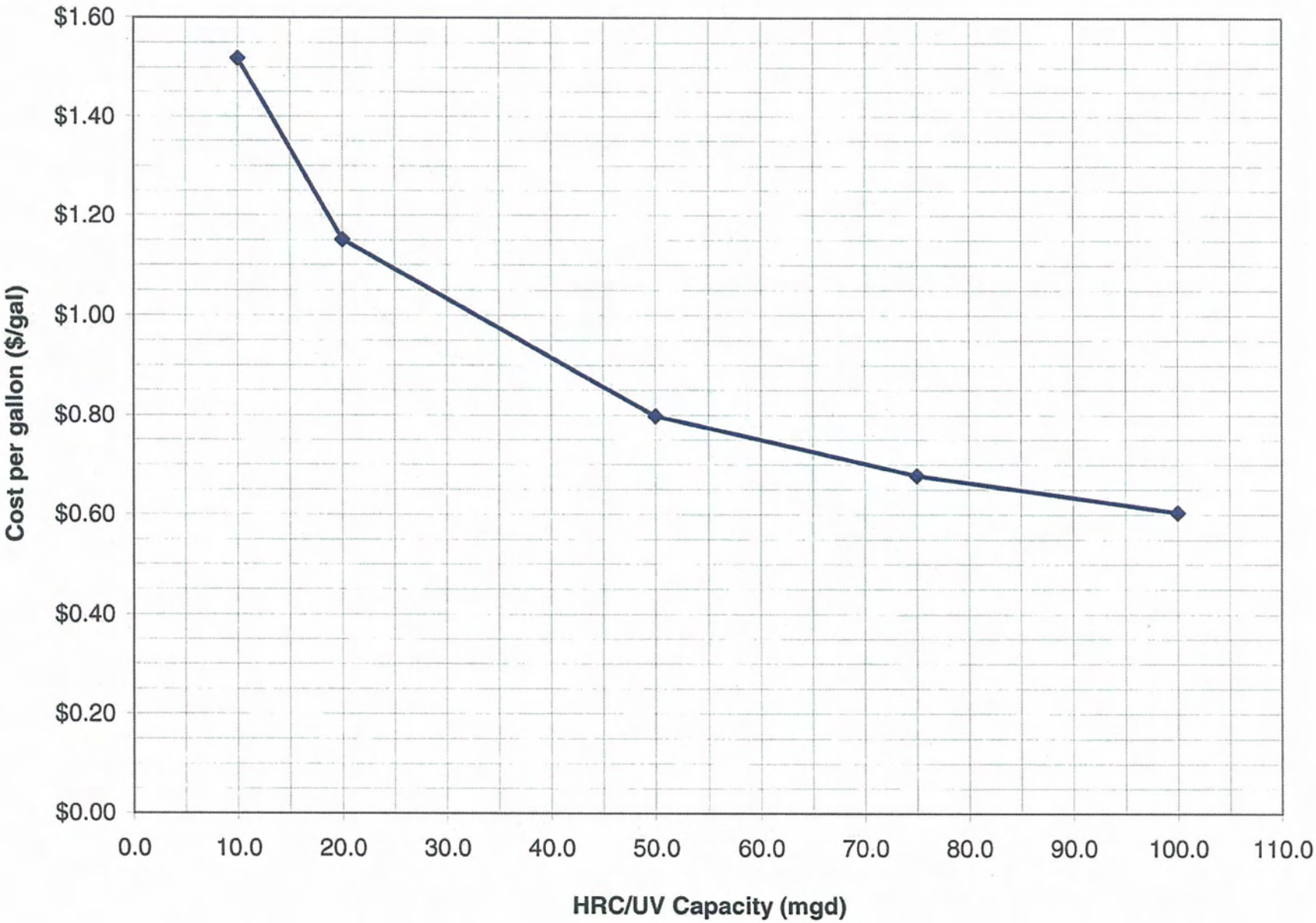


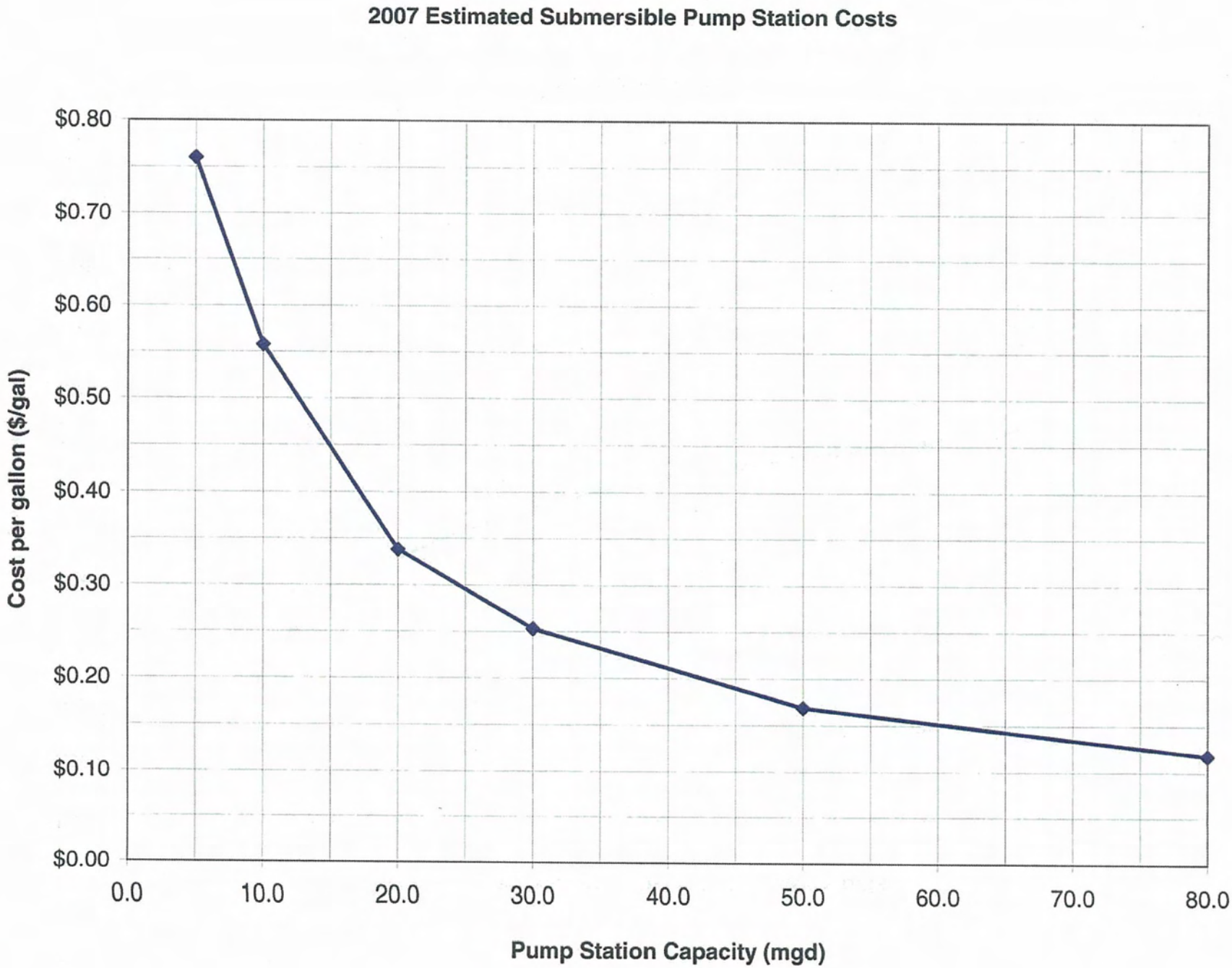

2007 Estimated Forcemain Costs
$1,100
$1,000
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Cost per Linear Foot ($/LF)
0.5
1.5
2.5
3.5
Diameter (ft)
4-ft cover low head
4-ft cover high head

2007 Estimated RCP Gravity Sewer Costs

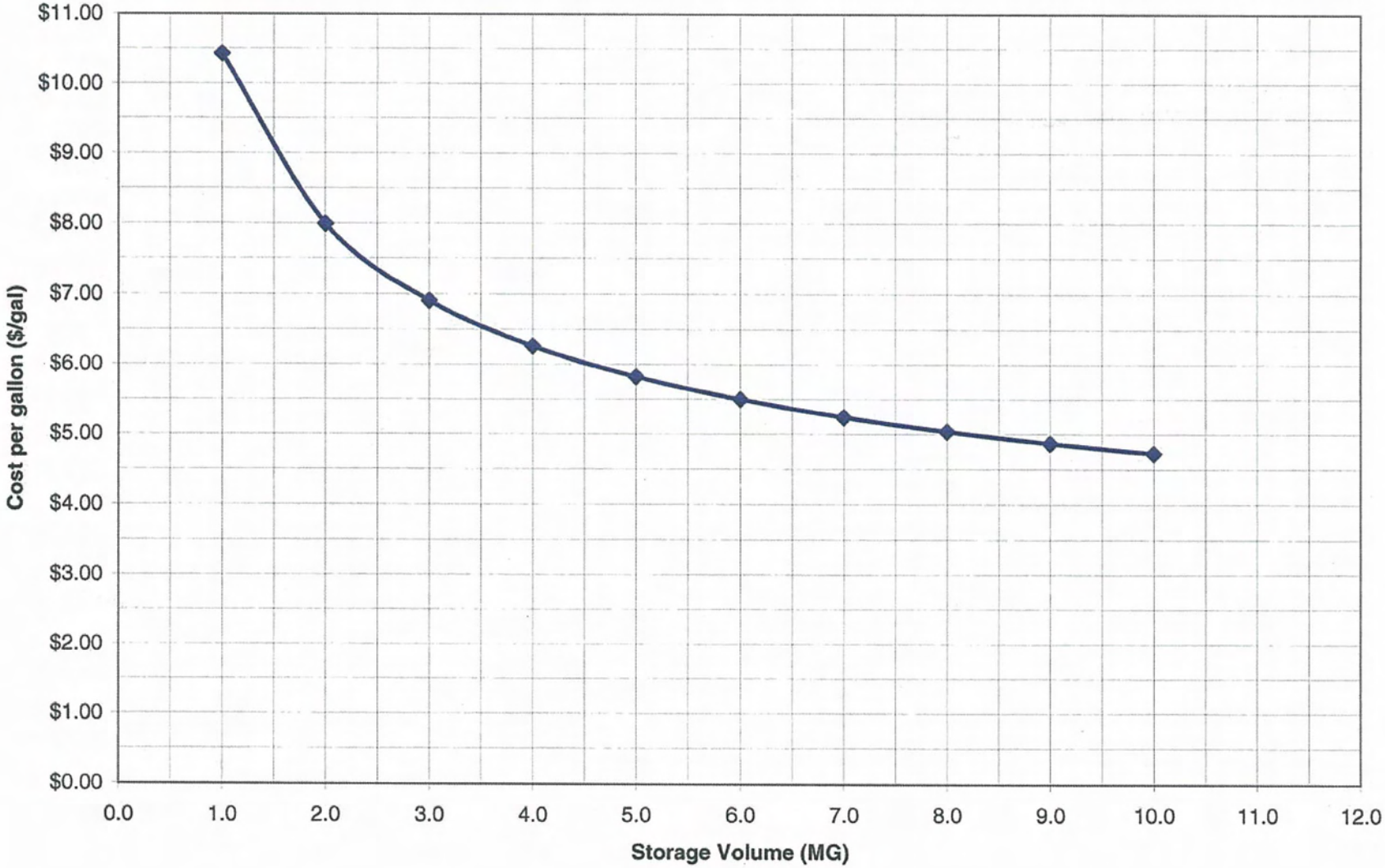


2007 Estimated HRC/UV Treatment Costs



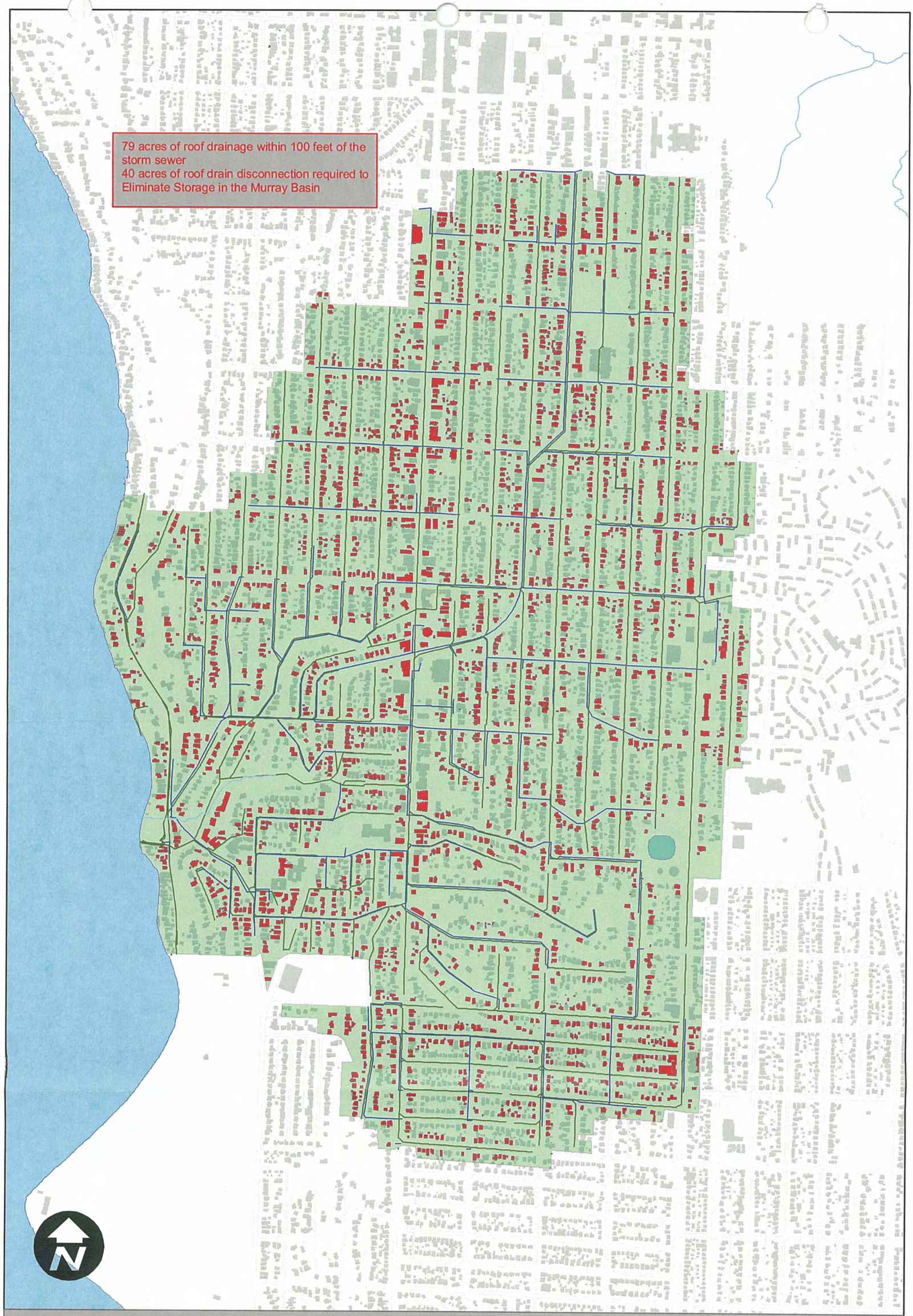

2007 Estimated Submersible Pump Station Costs
$0.80
$0.70
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
$0.00
Cost per gallon ($/gal)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Pump Station Capacity (mgd)

2007 Estimated Storage Tank Construction Costs



Appendix E

MURRAY BASIN ROOF DRAIN EVALUATION



0 500 1,000 1,500 2,000 Feet

1 inch equals 800 feet

Legend

- Murray
- Buildings within 100 feet of Storm Sewer Not Disconnected
- stream

Murray CSO Basin

Potential Sites for Roof Drain Disconections

Appendix F

BARTON AND MURRAY BASIN PUMP AND TREAT CSO ALTERNATIVES

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B2A/M1A:	Provide Conveyance for the Peak Flows in the Barton Basin and Provide Storage in the Murray Basin at Lowman Beach Park

APPROACH: CONVEY PEAK FLOWS FROM BARTON BASIN TO THE MURRAY PUMP STATION AND STORE PEAK FLOWS FOR BOTH BARTON AND MURRAY BASINS AT THE LOWMAN BEACH PARK

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be conveyed downstream to the Murray pump station and peak flows from both the Barton and Murray Basins would be stored in the Murray Basin and pumped back into the collection system after the storm event has subsided. A new 25 MGD wet weather pump station located in the parking lot south of the Fauntleroy Ferry Dock is proposed for the Barton CSO Basin and a 1.8 MG rectangular storage tank at the Lowman Beach Park is proposed for the Murray CSO basin.

The new wet weather pump station will convey flows through a new 42-inch force main that follows an upland alignment along Fauntleroy Ave. SW to the Murray Pump Station.

The 1.8 MG storage tank for the Murray CSO Basin would be approximately 120 feet long, 80 feet wide, with an assumed storage depth of 25 feet. The storage tank would be connected to the existing Murray Pump Station wet well and would be filled by gravity. Once the wet well level has returned to the level set-point (i.e. – normal operation conditions), the tank will re-introduce the stored volume back into the Murray Pump Station Wet Well with a 1.8 MGD pump system designed to dewater the tank within 24 hours.

ASSUMPTIONS

- The new Barton 25 MGD wet weather pump station will fit in the parking lot south of the Fauntleroy Ferry Dock
- The 1.8 MG storage tank can be put in the Lowman Beach Park?

PROPOSED IMPROVEMENTS

Pump Stations

- 25 MGD Pump Station at the parking lot south of the Fauntleroy Ferry Dock
- 1.8 MGD Submersible Pump System inside the Murray Storage Tank

Conveyance Pipelines

- Approximately 7,000 feet of 42-inch force main from the Barton Pump Station to the Murray Pump Station

Storage

- 1.8 MG Storage Tank in the Murray CSO Basin

Treatment Processes

- N/A

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B2A-M1A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f12-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B2A/M2A:	Provide Conveyance for the Peak Flows in the Barton and Murray Basins and Additional Treatment Capacity at the Alki CSO Plant

APPROACH: CONVEY PEAK FLOWS FROM BARTON AND MURRAY BASINS

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be conveyed downstream to the Murray Pump Station and peak flows from both the Barton and Murray Basins would be conveyed downstream to the 63rd Street Pump Station and then to the Alki CSO Treatment Plant for treatment and discharge into the Puget Sound. A new 25 MGD wet weather pump station located in the parking lot south of the Fauntleroy Ferry Dock is proposed for the Barton CSO Basin and a new 33.5 MGD wet weather pump station is proposed at the Lowman Beach Park for the Murray CSO basin.

The new 25 MGD Barton wet weather pump station will convey flows through a new 42-inch force main that follows an upland alignment along Fauntleroy Ave. SW to the Murray Pump Station.

The new 33.5 MGD Murray wet weather pump station will convey flows though 13,500 feet of new 48-inch force main routed along Beach Drive SW and discharge to the existing 63rd Street Pump Station.

ASSUMPTIONS

- The 25 MGD pump station will fit in the parking lot south of the Fauntleroy Ferry Dock
- There is enough capacity in the 63rd St. Pump Station and force main to handle the additional 33.5 MGD conveyance to the Alki Treatment Plant.
- There is not enough capacity at the Alki CSO Treatment Plant to handle the additional 33.5 MGD. Upgrades will be required.
- The 33.5 MGD pump station can be put in the Lowman Beach Park.

PROPOSED IMPROVEMENTS

Pump Stations

- 25 MGD Pump Station in the parking lot south of the Fauntleroy Ferry Dock
- 33.5 MGD Pump Station at Lowman Beach Park

Conveyance Pipelines

- Approximately 7,000 feet of 42-inch force main from the Barton Pump Station to the Murray Pump Station
- Approximately 13,500 feet of 48-inch force main from the Lowman Beach Park to the 63rd Street Pump Station.

Storage

- N/A

Treatment Processes

- Provide an additional 33.5 MGD treatment capacity at the Alki Treatment Plant.

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B2A-M2A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f13-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B2A/M4A:	Provide Conveyance for the Peak Flows in the Barton Basin and provide end of pipe treatment for the peak flows from Barton and Murray at the Lowman Beach Park in the Murray Basin

APPROACH: CONVEY PEAK FLOWS FROM BARTON BASIN AND PROVIDE END OF PIPE TREATMENT IN THE MURRAY BASIN FOR PEAK FLOWS FROM BOTH THE BARTON AND MURRAY BASINS

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be conveyed downstream to the Murray pump station and peak flows from both the Barton and Murray Basins would be treated through an end of pipe treatment facility in the Murray Basin. A new 25 MGD wet weather pump station located in the parking lot south of the Fauntleroy Ferry Dock is proposed for the Barton CSO Basin and end of pipe treatment is proposed at the Lowman Beach Park in the Murray CSO Basin to handle peak flows from both basins.

The new Barton wet weather pump station will convey flows through a new 42-inch force main that follows an upland alignment along Fauntleroy Ave. SW to the Murray Pump Station.

A 33.5 MGD treatment system located in the Lowman Beach Park is proposed to provide end of the pipe treatment for the excess peak flows from the Murray CSO basin area.

ASSUMPTIONS

- The 25 MGD pump station will fit in the parking lot south of the Fauntleroy Ferry Docks
- The end of pipe treatment can be located in the Lowman Beach Park

PROPOSED IMPROVEMENTS

Pump Stations

- 25 MGD Pump Station at the parking lot south of the Fauntleroy Ferry Docks

Conveyance Pipelines

- Approximately 7,000 feet of 42-inch force main from the Barton Pump Station to the Murray Pump Station

Storage

- N/A

Treatment Processes

- 33.5 MGD end of pipe treatment system for excess peak flows in the Barton and Murray Basins

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B2A-M4A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f15-7562.ai

Appendix G

BARTON AND MURRAY BASIN END OF PIPE TREATMENT CSO ALTERNATIVES

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B3A/M1B:	Provide End of Pipe Treatment for the Excess Peak Flows in the Barton Basin and Provide Storage at the Lowman Beach Park in the Murray Basin

APPROACH: PROVIDE END OF PIPE TREATMENT FOR EXCESS PEAK FLOWS IN THE BARTON BASIN AND STORE PEAK FLOWS FOR THE MURRAY BASIN

ALTERNATIVE DESCRIPTION

In this alternative, end of pipe treatment would be provided for the excess peak flows to the Barton Pump Station, while the peak flows from the Murray basin would be stored and pumped back into the collection system after the storm event has subsided. A treatment system that is capable of handling the excess peak flows of 25 MGD to the Barton Pump Station is proposed for the Barton CSO Basin and a 1.3 MG rectangular storage tank at the Lowman Beach Park is proposed for the Murray CSO basin.

A 25 MGD treatment system located in the parking area south of the Ferry Docks is proposed to provide end of the pipe treatment for the excess peak flows from the Barton CSO basin area.

The 1.3 MG storage tank for the Murray CSO Basin would be approximately 120 feet long, 60 feet wide, with an assumed storage depth of 25 feet. The storage tank would be connected to the existing Murray Pump Station wet well and would be filled by gravity. Once the wet well level has returned to the level set-point (i.e. – normal operating conditions), the tank will re-introduce the stored volume back into the Murray Pump Station Wet Well with a 1.3 MGD pump system designed to dewater the tank within 24 hours.

ASSUMPTIONS

- The end of pipe treatment can fit in the area south of the Ferry Dock.
- The end of pipe treatment can be located near the Ferry Docks
- The 1.3 MG storage tank can be put in the Lowman Beach Park

PROPOSED IMPROVEMENTS

Pump Stations

- 1.3 MGD Submersible Pump System inside the Murray Storage Tank

Conveyance Pipelines

- N/A

Storage

- 1.3 MG Tank in the Murray CSO Basin at Lowman Beach Park

Treatment Processes

- 25 MGD end of pipe treatment for excess peak flows in the Barton Basin

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B3A-M1B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f16-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B3A/M2B:	Provide End of Pipe Treatment for the Excess Peak Flows in the Barton Basin and Provide Additional Conveyance at the Murray Pump Station and Additional Treatment Capacity at the Alki CSO Treatment Plant

APPROACH: PROVIDE END OF PIPE TREATMENT FOR EXCESS PEAK FLOWS IN THE BARTON BASIN AND PROVIDE ADDITIONAL CONVEYANCE AT THE MURRAY PUMP STATION

ALTERNATIVE DESCRIPTION

In this alternative, end of pipe treatment would be provided for the excess peak flows to the Barton Pump Station, while the incremental peak flows from the Murray Basin would be conveyed downstream through the construction of the new pump station and force main. A treatment system that is capable of handling the excess peak flows of 25 MGD to the Barton Pump Station is proposed for the Barton CSO Basin and a new 8.5 million gallon per day (MG) wet weather pump station at the Lowman Beach Park is proposed for the Murray CSO basin.

A 25 MGD treatment system located in the parking area south of the Ferry Docks is proposed to provide end of the pipe treatment for the excess peak flows from the Barton CSO basin area.

The new 8.5 MGD Murray wet weather pump station will convey flows through 13,500 feet of 24-inch force main routed along Beach Drive SW and discharge to the existing 63rd Street Pump Station.

ASSUMPTIONS

- The end of pipe treatment can fit in the area south of the Fauntleroy Ferry Docks.
- Storing at Barton CSO basin will result excess peak flows only from the Murray CSO Basin, which are approximately 8.5 MGD.
- There is not enough capacity in the Murray Pump Station and force main to handle the additional 8.5 MGD.
- There is enough capacity in the 63rd St. Pump Station and force main to handle the additional 8.5 MGD of conveyance to the Alki Treatment Plant.
- There is not enough capacity at the Alki CSO Treatment Plant to handle the additional 8.5 MGD. Upgrades will be required.
- The end of pipe treatment can be located near the Fauntleroy Ferry Docks.
- The 8.5 MGD pump station can be located in the Lowman Beach Park.

PROPOSED IMPROVEMENTS

Pump Stations

- 8.5 MGD Submersible Pump Station to convey Murray Peak Flows

Conveyance Pipelines

- 13,500 feet of 24-inch force main from Lowman Beach Park to the 63rd Street Pump Station to convey excess Murray Peak Flows

Storage

- N/A

Treatment Processes

- 25 MGD end of pipe treatment system for excess peak flows in the Barton Basin
- Provide an additional 8.5 MGD treatment capacity at the Alki Treatment Plant

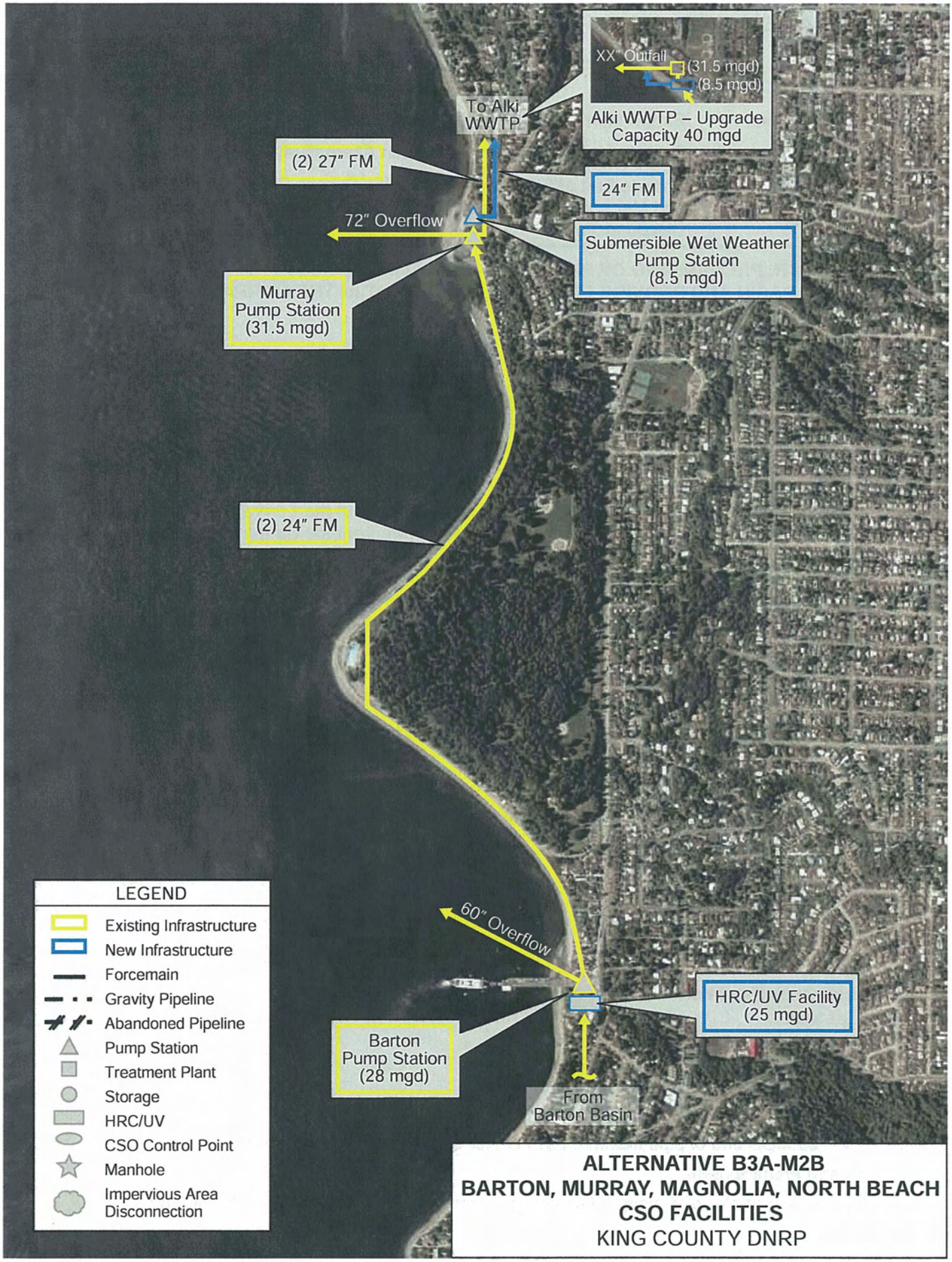
Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.



ALTERNATIVE B3A-M2B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

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TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B3A/M3B:	Provide End of Pipe Treatment for the Excess Peak Flows in the Barton Basin and Manage Demand within the Murray CSO Basin through Roof Drain Disconnections

APPROACH: PROVIDE END OF PIPE TREATMENT FOR EXCESS PEAK FLOWS IN THE BARTON BASIN AND PROVIDE DEMAND MANAGEMENT IN THE MURRAY BASIN

ALTERNATIVE DESCRIPTION

In this alternative, end of pipe treatment would be provided for the excess peak flows to the Barton Pump Station, while the incremental peak flows from the Murray Basin would be eliminated through roof drain disconnections within the Murray Basin. A treatment system that is capable of handling the excess peak flows of 25 MGD to the Barton Pump Station is proposed for the Barton CSO Basin and disconnection of 40 acres of roof area is proposed for the Murray CSO basin.

A 25 MGD treatment system located in the parking area south of the Ferry Docks is proposed to provide end of the pipe treatment for the excess peak flows from the Barton CSO basin area.

The roof drain disconnection analysis for the Murray CSO Basin indicates that 40 acres of roof drain connections to the combined sewer is within 100 feet of an existing storm sewer inlet or catch basin. These roof areas would be disconnected as part of this proposed alternative.

ASSUMPTIONS

- The end of pipe treatment can fit in the area south of the Fauntleroy Ferry Docks.
- Disconnecting 40 acres of roof drains within the Murray Basin will eliminate the excess peak flows from this area.
- The end of pipe treatment can be located near the Fauntleroy Ferry Docks
- The roof drains can be effectively disconnected within the Barton and Murray CSO Basin.

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

Treatment Processes

- 25 MGD end of pipe treatment system for excess peak flows in Barton Basin

Demand Management

- 40 acres of roof drainage disconnected from the combined sewer in the Murray Basin

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B3A-M3B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f18-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B3A/M4B:	Provide End of Pipe Treatment for the Excess Peak Flows in the Barton and Murray Basins

APPROACH: PROVIDE END OF PIPE TREATMENT FOR EXCESS PEAK FLOWS IN THE BARTON AND MURRAY BASINS

ALTERNATIVE DESCRIPTION

In this alternative, end of pipe treatment would be provided for the excess peak flows to the Barton and Murray CSO Basins. A treatment system that is capable of handling the excess peak flows of 25 MGD to the Barton Pump Station is proposed for the Barton CSO Basin and a treatment system that is capable of handling the excess peak flows of 8.5 MGD to the Murray Pump Station is proposed for the Murray CSO Basin

A 25 MGD treatment system located in the parking area south of the Ferry Docks is proposed to provide end of the pipe treatment for the excess peak flows from the Barton CSO basin area.

An 8.5 MGD treatment system located in the Lowman Beach Park is proposed to provide end of the pipe treatment for the excess peak flows from the Murray CSO basin area.

ASSUMPTIONS

- The end of pipe treatment can be located near the Fauntleroy Ferry Docks and in the Lowman Beach Park

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

Treatment Processes

- 25 MGD end of pipe treatment system for excess peak flows from the Barton Basin
- 8.5 MGD end of pipe treatment system for excess peak flows from the Murray Basin

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B3A-M4B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

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Appendix H

WORKSHOP NO. 2 PRESENTATION

King County

Barton, Murray, Magnolia, and North Beach

CSO Facilities

Workshop No. 2

May 30, 2007

carollo engineers

Review of Workshop #1

- Modeling Results and Problem Definition
  - North Beach
  - Barton and Murray
  - Magnolia
- Discussion of Range of Possible Solutions
- Evaluation Criteria

Kc307_workshop1.ppt 2

North Beach Potential Solutions

- 3.5 MG storage?
- Increase PS capacity to 10-12 mgd
  - Increase Carkeek wet weather treatment
  - Improve treatment performance?
  - Pump to 8th Avenue Interceptor for conveyance to West Point
  - Forcemain alignment impacts capacity
- Combined storage/pumping

Barton and Murray Potential Solutions

- Increased pumping with no storage
  - Barton 53 mgd
  - Murray 65 mgd
  - Increase flow to Alki?
- Storage alone
  - Barton 0.5 MG
  - Murray 1.3 MG
- Impervious area disconnection
  - Target > 50% to eliminate overflows
- Combinations?

Magnolia Potential Solutions

- 2.6 MG storage
- No basin storage and add capacity to South Magnolia Trunk (15 mgd)
- Increase conveyance to 15 mgd and put storage upstream of Interbay PS.
- Combination

CSO Control Approach Overview

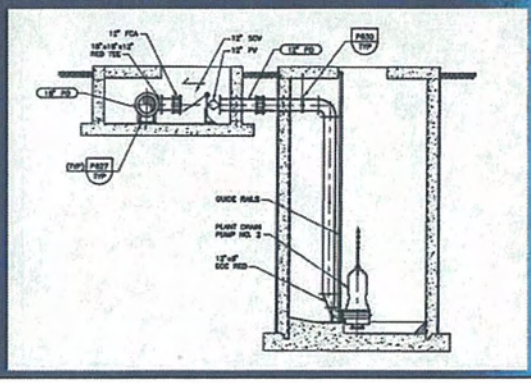
1. Store Peak Flows in Basin
2. Convey Peak Flows, Treat, and Discharge
3. Provide End of Pipe Treatment at CSO
4. Reduce Peak Flows, "Demand Management"
5. Combinations

Approach No. 1 - Storage

- Rectangular, cast-in-place concrete basins
- Below grade, depths up to 30 ft
- Fill by gravity, drain with submersible drainage pumps
- Wash down facilities similar to North Creek
- Carbon odor control

Approach No. 2 – Convey & Treat

- Submersible PS for head < 200 ft
- High Head (Carkeek) PS for head > 200 ft
- All pumps in service for peak hour flow



Approach No. 2 – Convey & Treat

- Limit force main velocity to ± 5 ft/s
- Provide expanded capacity at Carkeek and Alki WWTPs
  - High Rate Clarification (HRC)
  - Ultraviolet Disinfection (UV) or hypo/dechlor
  - New outfalls for hydraulic capacity

Approach No. 3 – End of Pipe Treatment

- Remote facility installed at CSO location
  - HRC provides primary treatment
  - UV provides disinfection
- Designed for rapid, automated startup
- Mix of below grade tanks and above grade support facilities
  - Electrical
  - Chemical storage

HRC Features

- Physical/chemical process
- Ballast used to promote rapid settling
- Very small footprint
- Effective with UV disinfection

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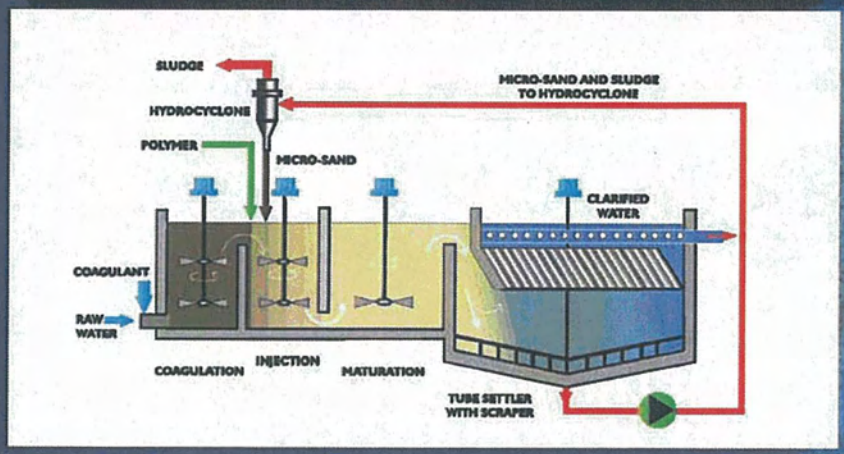
HRC Process Schematic



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Approach No. 4 – Peak Flow Reduction

- Targeting roof drain disconnects within 100 ft of storm drain inlets
- Roof areas and connections determined from SPU GIS
- Limited field investigation to verify GIS data

King County

Barton, Murray, Magnolia, and North Beach

CSO Facilities

North Beach

carollo engineers

1A: Storage at NBPS Site

Store peak flows at NBPS site, pump to Carkeek following event

LEGEND

- Existing infrastructure
- New infrastructure
- Forcemain
- Gravity Pipeline
- Pump Station
- Treatment Plant
- Storage
- HRC/UV

NORTH BEACH ALTERNATIVE 1A
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

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1A: Storage at NBPS Site

Store peak flows at NBPS site, pump to Carkeek following event

- Assumptions:
  - Sufficient space is available at NBPS site for 3.5 MG tank
  - Capacity of NBPS allows storage to be drained in 1 day while base flows are pumped
- Key Issues
  - Neighborhood impacts
  - Storage siting

Kc307_workshop1.ppt 16

1A: Storage at NBPS Site

Store peak flows at NBPS site, pump to Carkeek following event

- Summary and Initial Conclusions
  - Relatively low cost option for CSO management
  - Low impact on O&M
  - Very unlikely that storage will fit on site, even if entire park is utilized
  - Likely require increased pump station capacity to drain storage following event
  - Does not correct existing NB FM (suspect condition)
  - Results in double pumping peak flows

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1B: Storage at Alternate NB Site

Pump to storage site, pump to Carkeek following event

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1B: Storage at Alternate NB Site

Pump to storage site, pump to Carkeek following event

- Assumptions:
  - Sufficient space is available at NBPS site for 10 mgd high head PS
  - An alternate location for storage can be found in the NB basin
  - The same pipeline can be used to convey flow to/from storage
  - Capacity of NBPS allows storage to be drained in 1 day while base flows are pumped
- Key Issues
  - Neighborhood impacts
  - Storage siting
  - PS siting and FM siting/alignment

1B: Storage at Alternate NB Site

Pump to storage site, pump to Carkeek following event

- Summary and Initial Conclusions
  - Likely require increased pump station capacity to drain storage following event
  - Does not correct existing NB FM (suspect condition)
  - Results in double pumping peak flows
  - Easier to site storage (relative to Alt. 1A)

1C: Storage at Alternate NB Site

Pump to storage site, transfer to West Point following event

LEGEND

- Existing infrastructure
- New infrastructure
- Forcemain
- Gravity Pipeline
- Pump Station
- Treatment Plant
- Storage
- HRC/UV

NORTH BEACH ALTERNATIVE 1C
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

1C: Storage at Alternate NB Site

Pump to storage site, transfer to West Point following event

- Assumptions:
  - Sufficient space is available at NBPS site for 10 mgd high head PS
  - An alternate location for storage can be found in the NB basin
  - Conveyance capacity to West Point allows storage to be drained in 1 day following storm event
- Key Issues
  - Neighborhood impacts
  - PS, storage and FM siting/alignment

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1C: Storage at Alternate NB Site

Pump to storage site, transfer to West Point following event

- Summary and Initial Conclusions
  - Easier to site storage (relative to Alt. 1A)
  - Does not correct existing FM (suspect condition)
  - Eliminates double pumping of peak flows

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2A: Convey and Treat Peak Flow

Pump to Carkeek through new beachside FM, upgrade Carkeek capacity by 10 mgd

Kc307_workshop1.ppt 24

2A: Convey and Treat Peak Flow

Pump to Carkeek through new beachside FM, upgrade Carkeek capacity by 10 mgd

- Assumptions:
  - Sufficient space is available at NBPS site for 10 mgd submersible PS
  - A new 24" FM can be constructed along the beach and through Carkeek Park
  - An additional 10 mgd discharge into Puget Sound will be permitted from the Carkeek WWTP
  - A new outfall and diffuser can be constructed from the Carkeek WWTP
- Key Issues
  - Environmental permitting (beach, Carkeek Park)
  - Neighborhood impact (PS construction)
  - Regulatory permitting (increase Carkeek discharge)

2A: Convey and Treat Peak Flow

Pump to Carkeek through new beachside FM, upgrade Carkeek capacity by 10 mgd

- Summary and Initial Conclusions
  - Involves a smaller, less costly submersible pump station near the NBPS
  - Cost of FM construction along beach and in Carkeek Park eliminates PS savings
    - Opportunity to correct existing 14" FM
  - Capacity expansion at Carkeek possible but difficult to construct
  - Increasing outfall capacity from Carkeek adds to cost

2B: Convey and Treat Peak Flow

Pump to Carkeek through new FM in residential alignment, upgrade Carkeek capacity by 10 mgd

2B: Convey and Treat Peak Flow

Pump to Carkeek through new FM in residential alignment, upgrade Carkeek capacity by 10 mgd

- Assumptions:
  - Sufficient space is available at NBPS site for 10 mgd high head PS
  - A new 24" FM can be constructed through the neighborhoods of North Beach & Blue Ridge
  - An additional 10 mgd discharge into Puget Sound will be permitted from the Carkeek WWTP
  - A new outfall and diffuser can be constructed from the Carkeek WWTP
- Key Issues
  - Environmental permitting (Carkeek Park)
  - Neighborhood impact (PS, FM construction)
  - Regulatory permitting (increase Carkeek discharge)

2B: Convey and Treat Peak Flow

Pump to Carkeek through new FM in residential alignment, upgrade Carkeek capacity by 10 mgd

- Summary and Initial Conclusions
  - Capacity expansion at Carkeek possible but difficult to construct
  - Increasing outfall capacity from Carkeek adds to cost
  - Difficult residential alignment causes neighborhood impacts, high head
  - Does not correct existing FM (suspect condition)

Kc307_workshop1.ppt 29

3A: End of Pipe Treatment

Treat and discharge peak flows (10 mgd) at NBPS site

LEGEND

- Existing infrastructure
- New infrastructure
- Forcemain
- Gravity Pipeline
- Pump Station
- Treatment Plant
- Storage
- HRC/UV

NORTH BEACH ALTERNATIVE 3A
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
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3A: End of Pipe Treatment

Treat and discharge peak flows (10 mgd) at NBPS site

- Assumptions:
  - An additional 10 mgd discharge will be permitted from a remote HRC facility
  - Sufficient space is available at NBPS site for treatment
  - Existing outfall(s) at NB can be used to discharge treated effluent
- Key Issues
  - Neighborhood impact and perception (construction & treatment facility)
  - Regulatory permitting (permit remote HRC discharge)

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Footprint of Storage at North Beach

Footprint of HRC/UV at North Beach

3A: End of Pipe Treatment

Treat and discharge peak flows (10 mgd) at NBPS site

- Summary and Initial Conclusions
  - Lowest cost relative to all other alternatives
  - Seems to have least impact during construction
  - Fits well on site next to NBPS
  - Difficulty with public perception – treatment facility near park & homes
  - May be difficult to get NPDES permit

Approach to I/I Reduction

Description

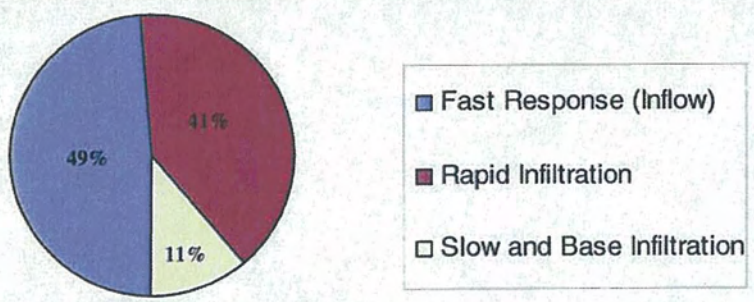
- Manage peak flows through I/I reduction
- Sources
  - Inflow
    - –Roof drains
    - –Catch basins
    - –Other direct connections
  - Infiltration
    - –Laterals
    - –Side sewers
    - –Foundation drains
    - –Sewer main
    - –Manholes

I/I Reduction Techniques

- Inflow
  - Drain disconnection
  - New storm sewers
- Infiltration
  - Rehabilitation (slip lining)
  - Replacement (dig and replace, pipe bursting)

I/I Quantification

- Estimated I/I flow: 13.5-15.5 mgd
- Flow per source:



I/I Reduction Study, Brown and Caldwell, 1988

Impacts of I/I Component Reduction

I/I Component	System Component	Percent of I/I Flow	Flow (mgd)	Expected Percent Reduction	Predicted I/I Flow (mgd)
Fast Response (Inflow)	Catch basins, roof drains, other direct connections	49%	6.4	10%-15%	5.4 - 5.7
Rapid Infiltration	Laterals, side sewers, foundation drains	40%	5.2	50%-60%	2.1 - 2.6
Slow & Base Infiltration	Manholes, sewer mains	11%	1.4	30%	1.0
Total		100%	13.0		

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Impacts of Complete Replacement

- King County pilot studies indicate 70-80% I/I reduction can be achieved, with replacement of:
  - Laterals
  - Side Sewers
  - Manholes
  - Direct Connections
- 75% reduction of 13.5 mgd = 3.4 mgd
- Peak flows can be handled by existing infrastructure

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Conclusions: Alternative 4A

Evaluation based on previous reports

- I/I Reduction Study (Brown and Caldwell, 1988)
- Pilot Study (Earth Tech, 2005)

Technically feasible to sufficiently reduce I/I so that no additional facilities are needed (storage, pumping). Cost and timeline uncertain

Conclusions 4A (cont'd.)

- Issues
  - 70-80% reduction is very aggressive strategy
  - Requires flow monitoring (~1 year)
  - Requires coordination with SPU
- Remaining Technical Evaluations
  - Verify modeling results to determine feasibility
  - Identify areas for disconnection or rehabilitation

Approach 5: Combinations

- Previous study identified that storage of <0.2MG will fit on NBPS site
  - This would require about 70% I/I reduction
    - No significant decrease in costs for I/I reduction
  - Storage at NBPS site not reasonable alternative with I/I
- Lowest infrastructure cost alternative is End of Pipe Treatment
  - Consider End of Pipe and I/I Reduction?
    - More costly than End of Pipe Treatment alone
    - Would require coordination with SPU
    - Would require flow monitoring for 1 year

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Summary of North Beach Alternatives

Alternative	Cost Rankings	Feasible
1A: On-site storage, pump to Carkeek	1.3	No
1B: Off-site storage, pump to Carkeek	1.7	Yes
1C: Off-site storage, pump to West Point	1.9	Yes
2A: Pump to Carkeek, beach alignment, HRC/UV at Carkeek	2.3	Yes
2B: Pump to Carkeek, neighborhood alignment, HRC/UV at Carkeek	2.2	Yes
3A: Provide HRC/UV at NBPS site	1.0	Yes
4A: Reduce Inflow/Infiltration	2.4+	?
5A: Combination	2.4+	?

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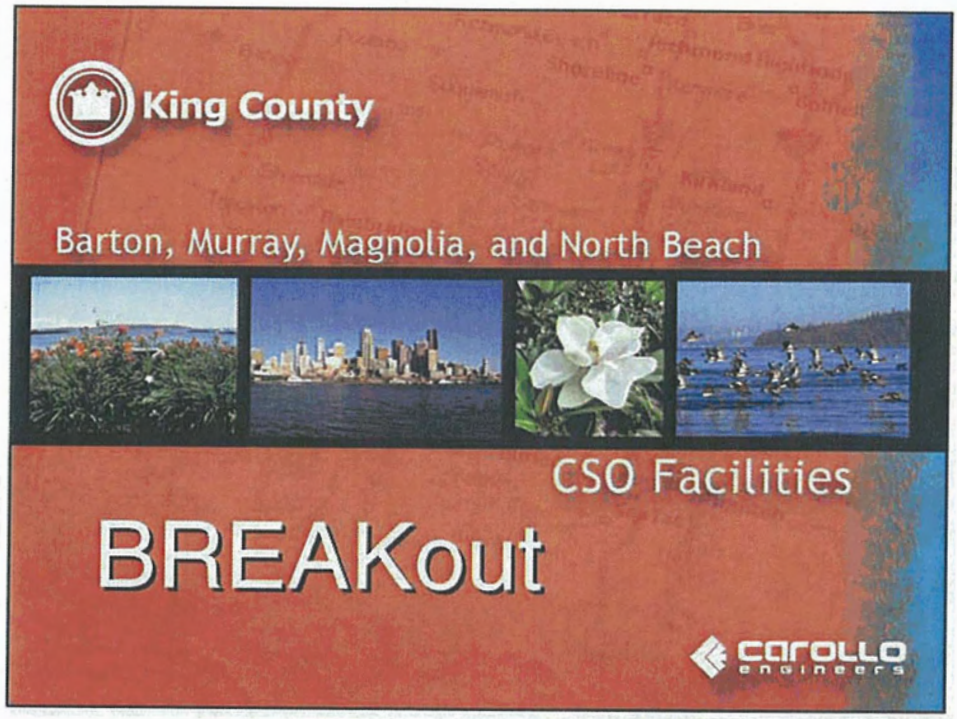
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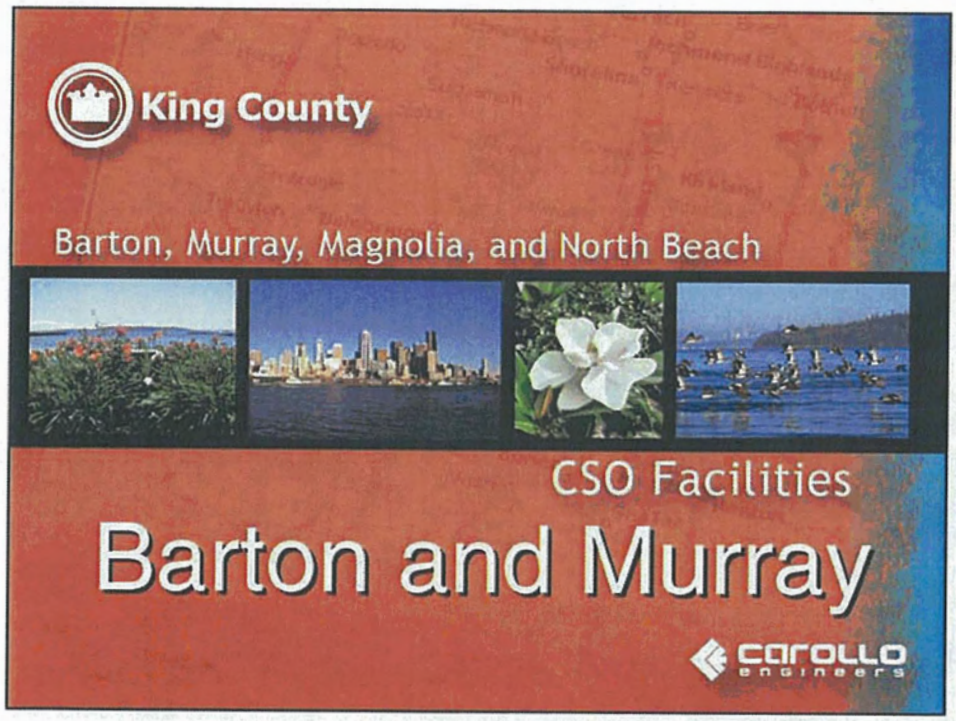
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Barton and Murray
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Barton Basin Significantly Favors Storage

- Peak flows high compared to required storage volume
- Pumping has higher cost and flows must still be dealt with at Murray
- Because of high peak flows – end of pipe treatment much more expensive and difficult to site
- Potential for demand management

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Summary of Barton Analysis

Description	*Relative Cost*
Storage – 0.5 MG at Fauntleroy School	1.0
Pumping – 25 mgd and increases cost at Murray	2.0
Demand Management	--
End of Pipe Treatment	4.0

Kc307_workshop1.ppt 46

B1A/M1B: On-Site Storage

Fauntleroy School storage - Lowman Beach Park storage

Kc307_workshop1.ppt

B1A/M1B: On-Site Storage

Fauntleroy School storage - Lowman Beach Park storage

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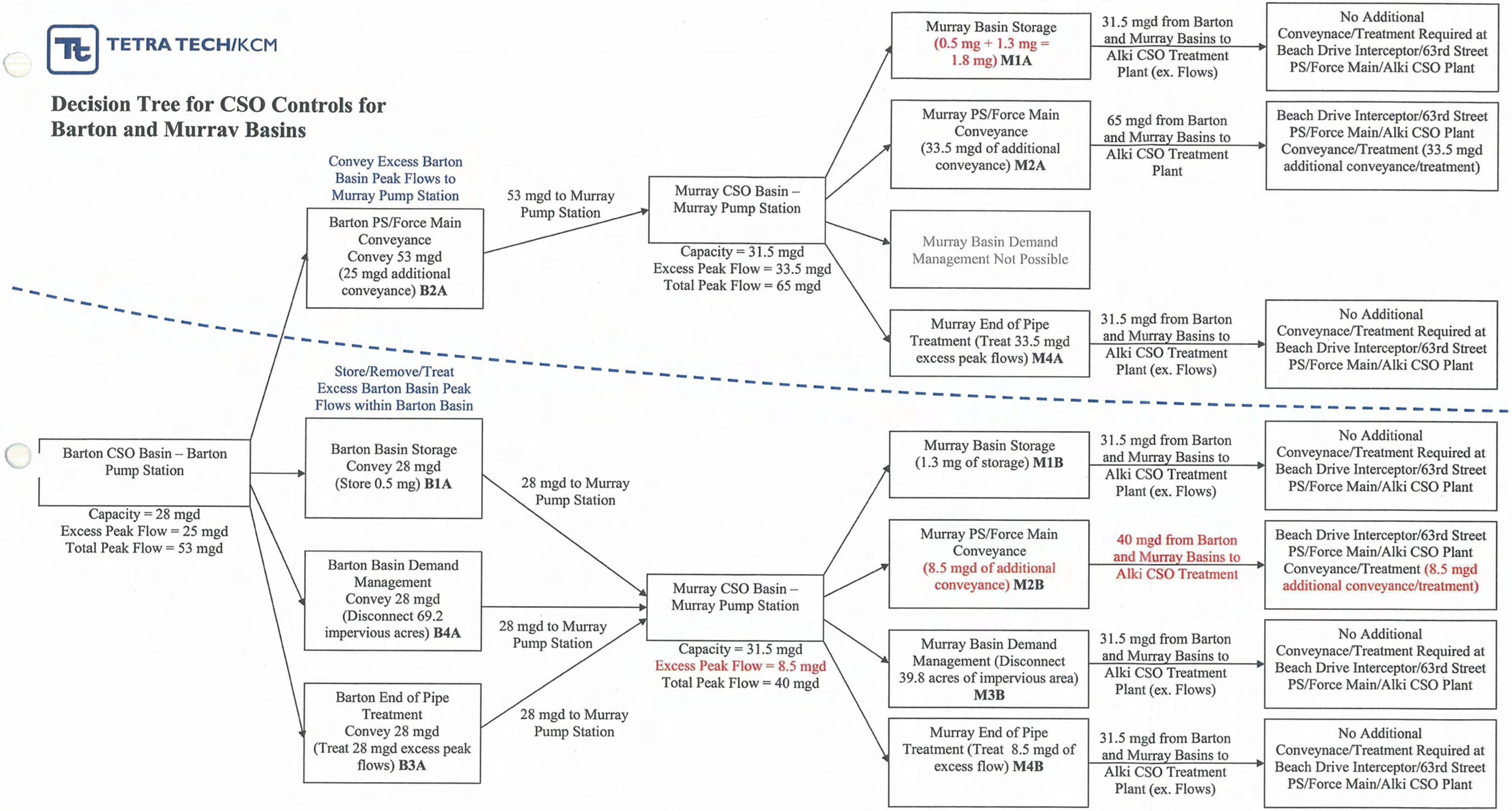
TETRA TECH/KCM

Decision Tree for CSO Controls for Barton and Murrav Basins



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B1A/M1B: On-Site Storage

Fauntleroy School storage - Lowman Beach Park storage

B1A/M1B: On-Site Storage

Fauntleroy School storage - Lowman Beach Park storage

- Assumptions:
  - Sufficient flow can be intercepted at Fauntleroy School to adequately attenuate peak at Barton PS
  - Flows can be effectively regulated to the Barton Pump Station
- Key Issues:
  - Public acceptance challenges for siting storage facilities

B1A/M1B: On-Site Storage

Fauntleroy School storage - Lowman Beach Park storage

- Summary and Initial Conclusions:
  - Limited options for storage siting within Barton and Murray Basins
  - Upland storage siting presents flow regulator challenges

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B1A/M2B: Barton Storage-Murray Conveyance

Fauntleroy School storage – Murray conveyance & treatment

Kc307_workshop1.ppt 54

B1A/M2B: Barton Storage-Murray Conveyance

Fauntleroy School storage – Murray conveyance & treatment

- Summary and Initial Conclusions:
  - Limited options for storage siting within Barton Basin
  - Upland storage siting presents flow regulator challenges
  - Constricted conveyance corridor along Beach Drive
  - Highest relative cost of the paired alternatives

Kc307_workshop1.ppt 55

B1A/M2B: Barton Storage-Murray Conveyance

Fauntleroy School storage – Murray conveyance & treatment

- Assumptions:
  - Sufficient flow can be intercepted at Fauntleroy School to adequately attenuate peak at Barton PS
  - Flows can be effectively regulated to the Barton Pump Station
  - 8.5 mgd peak flow requirement from Murray Basin
- Key Issues:
  - Permit issues for additional 8.5 mgd discharge at Alki outfall?

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B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

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M4: Murray Demand Management

Murray Impervious Area Disconnection

Kc307_workshop1.ppt

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B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

- Summary and Initial Conclusions:
  - Limited options for storage siting within Barton Basin
  - Upland storage siting presents flow regulator challenges
  - Sufficient impervious area available for disconnection

B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

- Assumptions:
  - Sufficient flow can be intercepted at Fauntleroy School to adequately attenuate peak at Barton PS
  - Flows can be effectively regulated to the Barton Pump Station

B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

- Key Issues:
  - Confirmation of SPU requirements for disconnected areas
  - Confirmation of areas that are currently connected
  - Adequacy of existing storm drainage infrastructure to convey increased peak flows
  - Infiltration capacity of soils in the basin
  - Challenges of routing disconnected flows away from property

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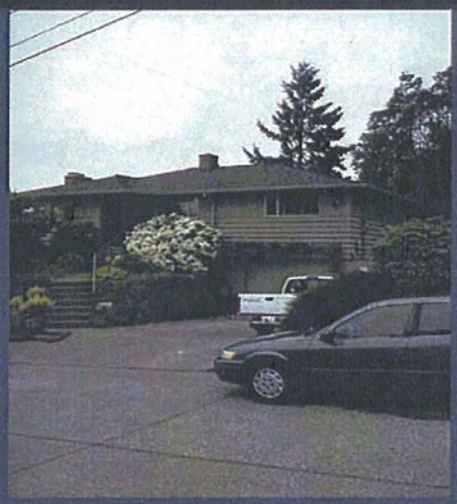
B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

Kc307_workshop1.ppt 62

B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection



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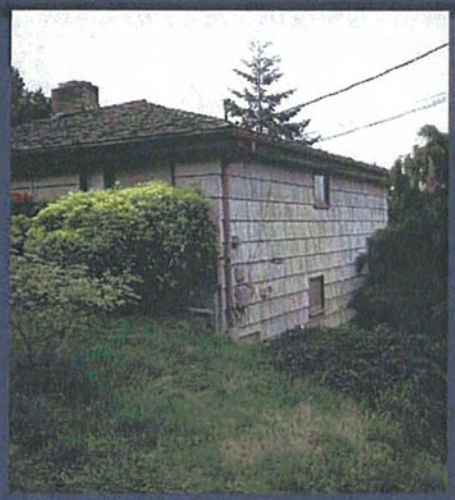
B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection

Kc307_workshop1.ppt 64

B1A/M3B: Barton Storage-Murray Demand Management

Fauntleroy School storage – Murray impervious area disconnection



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B1A/M4B: Barton Storage-Murray End of Pipe Treatment

Fauntleroy School storage – Treatment at Lowman Beach Park

Kc307_workshop1.ppt

B1A/M4B: Barton Storage-Murray End of Pipe Treatment

Fauntleroy School storage – Treatment at Lowman Beach Park

- Summary and Initial Conclusions:
  - Limited options for storage siting within Barton Basin
  - Upland storage siting presents flow regulator challenges
  - Lowest relative cost of the paired alternatives

Kc307_workshop1.ppt 67

B1A/M4B: Barton Storage-Murray End of Pipe Treatment

Fauntleroy School storage – Treatment at Lowman Beach Park

- Assumptions:
  - 8.5 mgd peak flow requirement from Murray Basin
  - Sufficient flow can be intercepted at Fauntleroy School to adequately attenuate peak at Barton PS
  - Flows can be effectively regulated to the Barton Pump Station
- Key Issues:
  - Public acceptance challenges for siting treatment facility
  - Permit issues for additional 8.5 mgd discharge at Murray outfall?

Kc307_workshop1.ppt 68

B4A-M1B: Barton Demand Management

Barton Impervious Area Disconnection

B4A-M1B: Barton Demand Management

Barton Impervious Area Disconnection

- Summary and Initial Conclusions:
  - Questionable whether sufficient impervious area is available
  - Less storm drainage infrastructure in place in basin

King County

Barton, Murray, Magnolia, and North Beach

CSO Facilities

Magnolia

carollo engineers

1A: Magnolia Upper Basin Storage

Pump and gravity to storage site, gravity sewer to ex. interceptor

1A: Magnolia Upper Basin Storage

Pump and gravity to storage site, gravity sewer to ex. interceptor

- Assumptions:
  - 30% of basin above storage site.
  - 70% of basin below storage site.
  - New sewer needed to discharge tank to existing interceptor due to local flows downstream.
- Key Issues
  - Neighborhood impacts
  - PS, storage and FM siting/alignment
  - Need to upgrade SPU pump station or build new.

Kc307_workshop1.ppt 75

1A: Magnolia Upper Basin Storage

Pump and gravity to storage site, gravity sewer to ex. interceptor

- Summary and Initial Conclusions
  - May not be feasible due to proposed land use.
  - Only one site available.
  - 70% of flow must be pumped to storage.
  - SPU pump station upgrade may be problematic due to siting and permits.

Kc307_workshop1.ppt 76

1B: Magnolia storage at CSO site

Move storage down the hill, gravity sewer to ex. interceptor

1B: Magnolia storage at CSO site

Move storage down the hill, gravity sewer to ex. interceptor

- Assumptions:
  - 77% of basin above storage site
  - 23% of basin below storage site.
  - SPU PS capacity may need increase.
- Key Issues
  - Neighborhood impacts
  - PS, storage and FM siting/alignment
  - Need to upgrade SPU pump station.

1B: Magnolia storage at CSO site

Move storage down the hill, gravity sewer to ex. interceptor

- Summary and Initial Conclusions
  - Site in ravine constrained by topography.
  - Site has to be west of local connections.
  - Less pumping required – all gravity?
  - SPU pump station upgrade may be problematic due to siting and permits.

Kc307_workshop1.ppt 79

1C: Magnolia storage near Marina

Pump to storage east of Marina

Kc307_workshop1.ppt 80

1C: Magnolia storage near Marina

Pump to storage east of Marina

- Assumptions:
  - Pressure or gravity sewer to new storage.
  - SPU PS may be upgraded or replaced.
- Key Issues
  - PS, storage and MT siting/alignment.
  - MT feasibility due to land and geology.
  - Need to upgrade SPU pump station.

Kc307_workshop1.ppt 81

1C: Magnolia storage near Marina

Pump to storage east of Marina

- Summary and Initial Conclusions
  - Geotechnical conditions for microtunneling need investigation.
  - Easements/ROW/property must be acquired from Seattle Parks.
  - SPU pump station upgrade may be problematic due to siting and permits.

Kc307_workshop1.ppt 82

2A: Magnolia Convey and Treat

Replacement interceptor to Interbay PS then to West Point

2A: Magnolia Convey and Treat

Replacement interceptor to Interbay PS then to West Point

- Assumptions:
  - Replace existing interceptor to Interbay.
  - Available capacity at Interbay for increased flow of 10.6 mgd.
  - SPU PS may be upgraded or replaced.
- Key Issues
  - Capacity at Interbay
  - MT siting/alignment.
  - MT feasibility due to land and geology.
  - Need to upgrade SPU pump station.

2A: Magnolia Convey and Treat

Replacement interceptor to Interbay PS then to West Point

- Summary and Initial Conclusions
  - Unlikely 10 mgd capacity available at Interbay PS
  - Geotechnical conditions for microtunneling new interceptor need investigation.
  - SPU pump station upgrade may be problematic due to siting and permits.

Kc307_workshop1.ppt 85

2B: Magnolia Convey and Treat

Parallel interceptor to Interbay PS then to West Point

Kc307

2B: Magnolia Convey and Treat

Parallel interceptor to Interbay PS then to West Point

- Assumptions:
  - Parallel ex. Interceptor, 10.7 mgd capacity.
  - Available capacity at Interbay for increased flow of 10.6 mgd.
  - 27% of basin to pumped through SPU PS77 to inlet sewer.
  - SPU PS must be upgraded.
- Key Issues
  - Capacity at Interbay
  - MT siting/alignment.
  - MT feasibility due to land and geology.
  - Need to upgrade SPU pump station.

2B: Magnolia Convey and Treat

Parallel interceptor to Interbay PS then to West Point

- Summary and Initial Conclusions
  - Unlikely 10 mgd capacity available at Interbay PS
  - Geotechnical conditions for microtunneling new interceptor need investigation.
  - SPU pump station upgrade may be problematic due to siting and permits.

3A: Magnolia End of Pipe Treatment

Pump and gravity to treatment

3A: Magnolia End of Pipe Treatment

Pump and gravity to treatment

- Assumptions:
  - Land available
  - Existing infrastructure has adequate capacity for peak flows.
  - SPU PS may need upgrade.
- Key Issues
  - Land must be acquired from Seattle Parks.
  - Neighborhood impacts.
  - Need to upgrade SPU pump station.

3A: Magnolia End of Pipe Treatment

Pump and gravity to treatment

- Summary and Initial Conclusions
  - Geotechnical conditions for treatment plant need investigation.
  - SPU pump station upgrade may be problematic due to siting and permits.

Kc307_workshop1.ppt 91

4A: Magnolia Demand Management

Reduce impervious area to reduce storage by 50%

Kc307

4A: Magnolia Demand Management

Reduce impervious area to reduce storage by 50%

- Assumptions:
  - 29 ac roofs can be disconnected (50%)
  - 3,000 ft, 8-ft. diameter tunnel storage in lieu of tank.
  - SPU PS must be upgraded for higher head.
- Key Issues
  - Easement must be acquired from Seattle Parks.
  - Neighborhood impacts.
  - Need to upgrade SPU pump station.

4A: Magnolia Demand Management

Reduce impervious area to reduce storage by 50%

- Summary and Initial Conclusions
  - Disconnection of all rooftops would not eliminate storage requirement.
  - Most expensive due to tunnel storage.
  - Demand management in combination with Option 1B may be least expensive option.

Summary of Magnolia Alternatives

Alternative	Cost Rankings	Feasible
1A: Upper Basin Storage	2.0	?
1B: Storage at CSO Control Point	1.5	Yes
1C: Storage near Marina	1.9	Yes
2A: Convey and Treat (New sewer)	1.0	No
2B: Convey and Treat (Parallel sewer)	1.2	No
3A: End of Pipe Treatment	1.3	Yes
4A: Demand Management	2.1+	?

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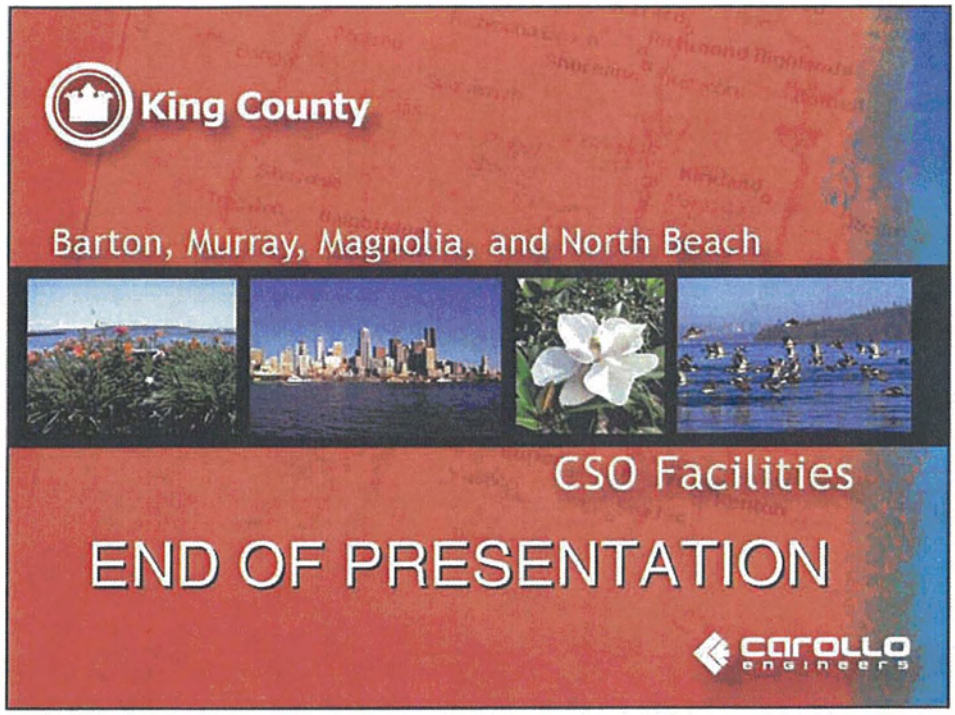
King County

Barton, Murray, Magnolia, and North Beach

CSO Facilities

BREAKout

carollo engineers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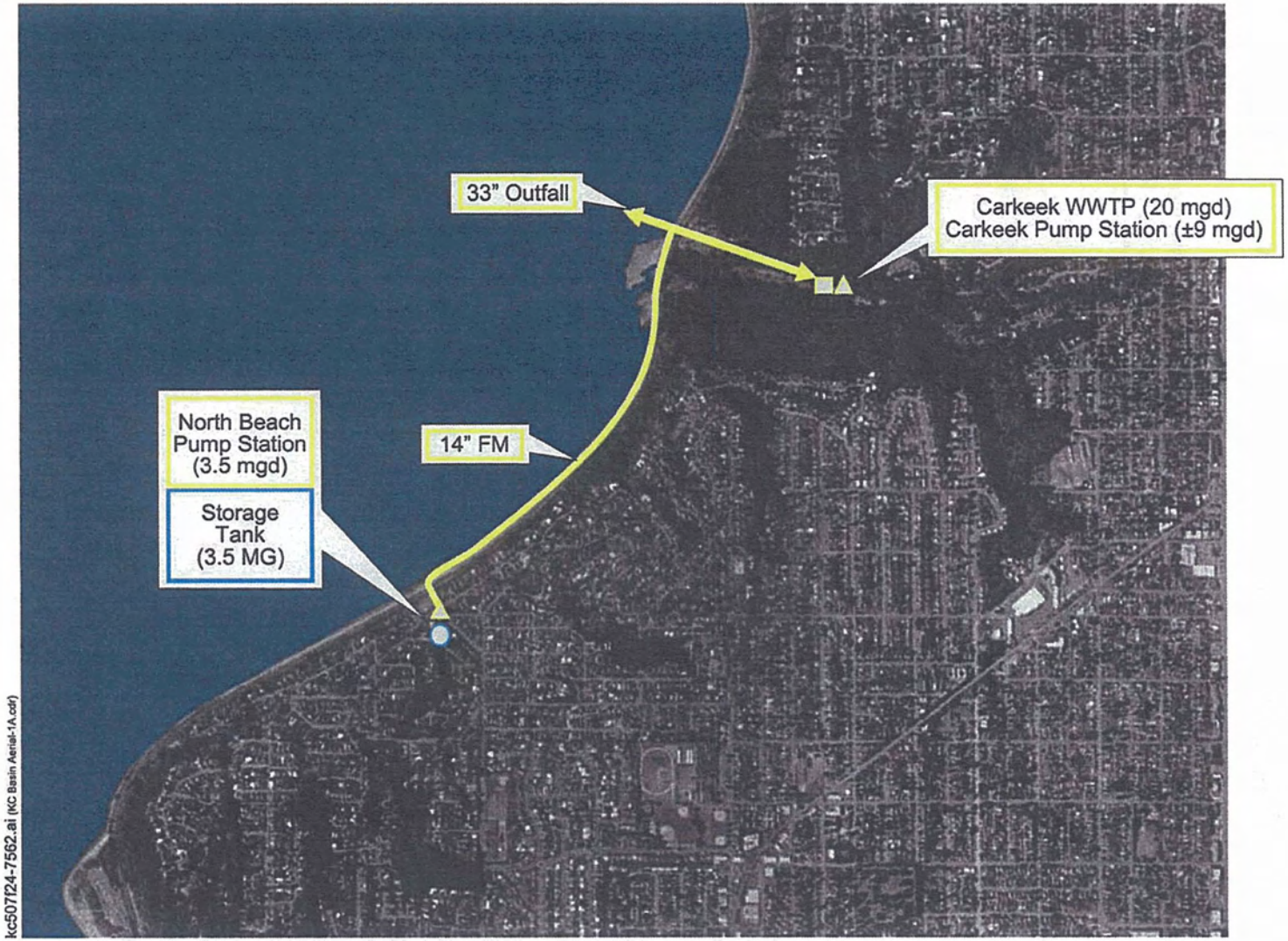
CSO Facilities
END OF PRESENTATION
carollo
engineers



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LEGEND	
Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 1A
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 1B:	Pump peak flows to an alternate storage location in the North Beach basin, then use the NBPS to pump to Carkeek PS following the storm event.

APPROACH: STORAGE

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be pumped from the North Beach Pump Station (NBPS) site to a storage facility, and, following the high flow event, would then be transferred back to the NBPS for conveyance to the Carkeek Pump Station.

A new 10 mgd high head pump station would be constructed at the NBPS site. From this pump station a 24-inch forcemain would convey the peak flows (10 mgd) to a new 3.5 MG rectangular storage facility located within the North Beach Basin. The storage facility would include a submersible pumps to drain the basin, and washdown facilities. Following the storm event, stored flow would be transferred back to the NBPS through the same 24-inch forcemain. All flow would then be pumped to the Carkeek PS through the existing 14-inch forcemain. The flow would then be pumped up to the 8th Avenue Interceptor and conveyed to the West Point WWTP for secondary treatment.

ASSUMPTIONS

- Sufficient area is available near the NBPS to construct a new 10 mgd high head pump station.
- Sufficient area is available at an alternate location within the North Beach Basin to construct a 3.5 MG rectangular storage tank.
- The same forcemain can be used to convey peak flows to and from storage.
- Sufficient pump station capacity exists at the NBPS to dewater the storage facility and continue to pump base flow to Carkeek.

PROPOSED IMPROVEMENTS

Pump Stations

- High head pump station at Blue Ridge Park.
  - Wet pit/dry pit, capacity = 10 mgd

Conveyance Pipelines

- Forcemain connecting the high head pump station to the new storage tank.
  - +/- 3,000 feet, 24-inch

Storage

- 3.5 MG rectangular tank

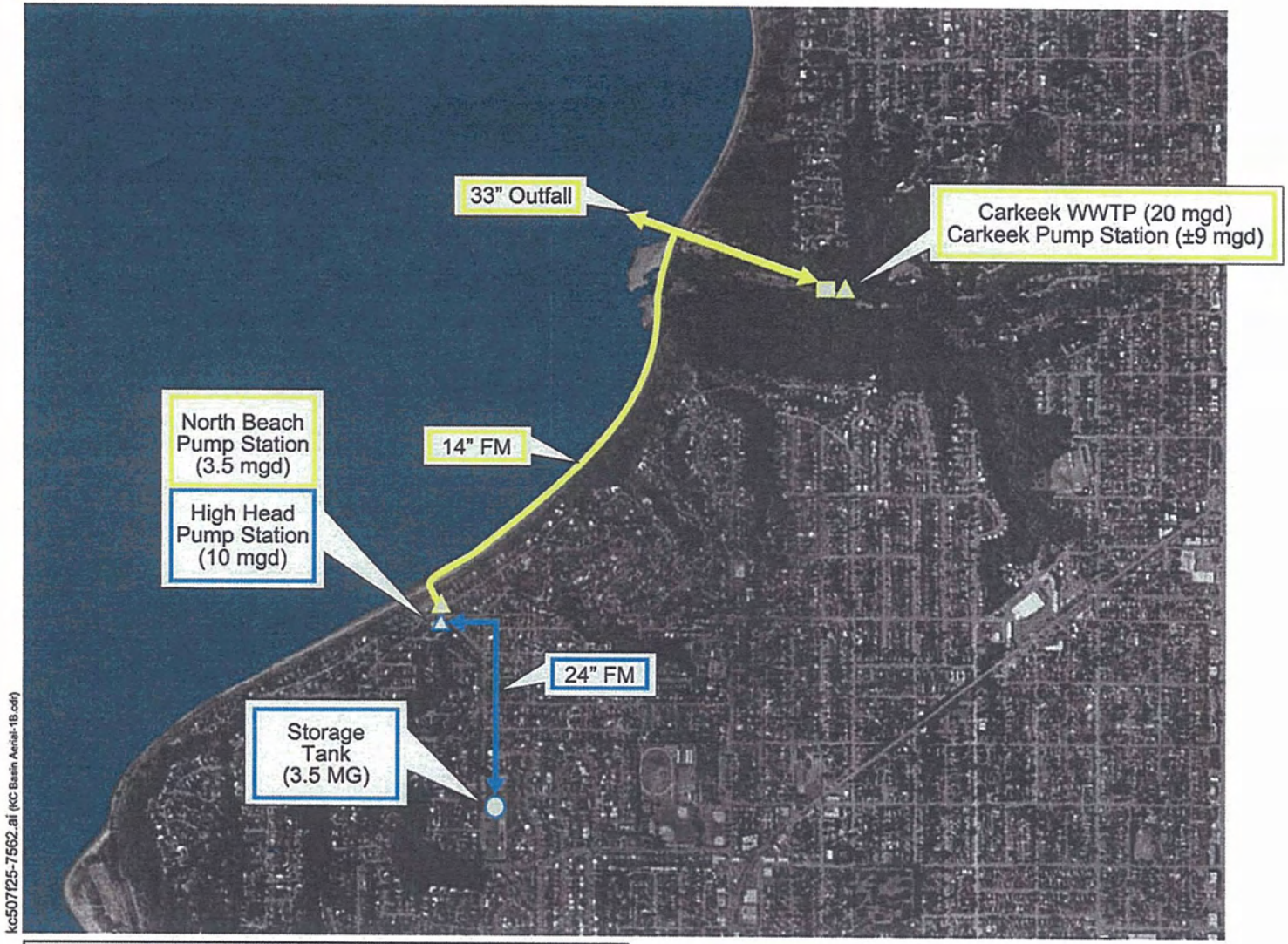
Treatment Processes

- N/A

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.



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LEGEND

Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 1B
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 1C:	Pump peak flows to an alternate storage location in the North Beach basin, then pump or gravity feed to the 8th Avenue interceptor for transfer to the West Point WWTP following the storm event.

APPROACH: STORAGE

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be pumped from the North Beach Pump Station (NBPS) site to a storage facility and, following the high flow event, would then be fed by gravity (or pumped, if necessary) to the existing 8th Avenue Interceptor for conveyance to West Point.

A new 10 mgd high head pump station would be constructed at the NBPS site. From this pump station a new 24-inch forcemain would convey peak flows (10 mgd) to a new 3.5 MG rectangular storage facility located within the North Beach Basin. The storage facility would include a submersible pumps to drain the basin, and washdown facilities. Following the storm event, stored flow would be discharged through a new 14-inch pipe connecting to the 8th Avenue Interceptor. Flow would be conveyed to the West Point WWTP for treatment.

ASSUMPTIONS

- Sufficient area is available near the NBPS to construct a new 10 mgd high head pump station.
- Sufficient area is available at an alternate location within the North Beach basin to construct a 3.5 MG rectangular storage tank.
- Sufficient capacity is available in the 8th Avenue Interceptor (and beyond) to convey an additional 3.5 mgd to the West Point WWTP following the storm event.

PROPOSED IMPROVEMENTS

Pump Stations

- High head pump station at Blue Ridge Park
  - Wet pit/dry pit, capacity = 10 mgd

Conveyance Pipelines

- Forcemain from high head pump station to the storage tank
  - +/- 6,000 feet, 24-inch
- Pipeline from storage tank to 8th Avenue Interceptor
  - +/- 3,500 feet, 14-inch

Storage

- 3.5 MG rectangular tank

Treatment Processes

- N/A

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B1A/M1B:	Provide Storage for Peak Flows at Fauntleroy School in the Barton Basin and Lowman Beach Park in the Murray Basin

APPROACH: STORE PEAK FLOWS FOR BARTON AND MURRAY BASINS

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from both basins would be stored and pumped back into the collection system after the storm event has subsided. A 0.5 million gallon (MG) rectangular storage tank located at the Fauntleroy School is proposed for the Barton CSO Basin and a 1.3 MG rectangular storage tank at the Lowman Beach Park is proposed for the Murray CSO basin.

The 0.50 MG storage tank for the Barton CSO Basin would be approximately 80 feet long, 40 feet wide, with an assumed storage depth of 25 feet. The storage tank would include a flow control structure that would divert flows from the 24-inch interceptor along SW Director Street during rain events that cause flows in excess of the capacity of the Barton Pump Station. This flow control would be accomplished by measuring the depth within the Barton Pump Station wet well and the depth within the 24-inch interceptor along SW Director Street. If the wet well level exceeds the high water alarm at the Barton Pump Station, or the level of flow in the 24-inch interceptor along SW Director Street exceeds 80% of full depth in the pipe, flow will be diverted into the proposed 0.5 MG storage tank. Once the wet well level has returned to the level set-point (i.e. – normal operating conditions), the tank will re-introduce the stored volume back into the 24-inch interceptor along SW Director Street with a 0.5 million gallons per day (MGD) pump system designed to dewater the tank within 24 hours.

The 1.3 MG storage tank for the Murray CSO Basin would be approximately 120 feet long, 60 feet wide, with an assumed storage depth of 25 feet. The storage tank would be connected to the Murray Pump Station wet well and would be filled by gravity. Once the wet well level has returned to the level set-point (i.e. – normal operating conditions), the tank will re-introduce the stored volume back into the Murray Pump Station Wet Well with a 1.3 MGD pump system designed to dewater the tank within 24 hours.

ASSUMPTIONS

- There is sufficient flow in the existing 24-inch interceptor along SW Director Street to attenuate peak flows at the existing Barton Pump Station
- The 1.3 MG storage tank can be put in the Lowman Beach Park
- The 0.5 MG tank can be located at the Fauntleroy School?

PROPOSED IMPROVEMENTS

Pump Stations

- Pump Systems in the Barton and Murray Storage Tanks
  - 0.5 MGD Submersible Pump System for the Barton Tank
  - 1.3 MGD Submersible Pump System for the Murray Tank

Conveyance Pipelines

- N/A

Storage

- Storage Tanks in the Murray and Barton CSO Basins
  - 0.5 MG rectangular tank in the Barton CSO Basin
  - 1.3 MG rectangular tank in the Murray CSO Basin

Treatment Processes

- N/A

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B1A-M1B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f8-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B1A/M2B:	Provide Storage for Peak Flows at Fauntleroy School in the Barton Basin and Convey Peak Flows from the Murray Incremental Area and Additional Treatment Capacity at the Alki CSO Treatment Plant

APPROACH: STORE PEAK FLOWS FOR BARTON AND CONVEY PEAK FLOWS FROM THE MURRAY INCREMENTAL AREA

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be stored and pumped back into the collection system after the storm event has subsided, while the incremental peak flows from the Murray Basin would be conveyed downstream through the construction of a new wet weather pump station and force main. A 0.5 million gallon (MG) rectangular storage tank located at the Fauntleroy School is proposed for the Barton CSO Basin and a new 8.5 million gallon per day (MG) wet weather pump station at the Lowman Beach Park is proposed for the Murray CSO basin.

The 0.50 MG storage tank for the Barton CSO Basin would be approximately 80 feet long, 40 feet wide, with an assumed storage depth of 25 feet. The storage tank would include a flow control structure that would divert flows from the 24-inch interceptor along SW Director Street during rain events that cause flows in excess of the capacity of the Barton Pump Station. This flow control would be accomplished by measuring the depth within the Barton Pump Station wet well and the depth within the 24-inch interceptor along SW Director Street. If the wet well level exceeds the high water alarm at the Barton Pump Station, or the level of flow in the 24-inch interceptor along SW Director Street exceeds 80% of full depth in the pipe, flow will be diverted into the proposed 0.5 MG storage tank. Once the wet well level has returned to the level set-point (i.e. – normal operating conditions), the tank will re-introduce the stored volume back into the 24-inch interceptor along SW Director Street with a 0.5 million MGD pump system designed to dewater the tank within 24 hours.

The new 8.5 MGD wet weather pump station will convey flows through 13,500 feet of new 24-inch force main routed along Beach Drive SW and discharging to the existing 63rd Street Pump Station.

ASSUMPTIONS

- There is sufficient flow in the existing 24-inch interceptor along SW Director Street to attenuate peak flows at the existing Barton Pump Station.
- Providing 0.5 MG of storage within the Barton Basin will result in excess peak flows only from the Murray CSO Basin, which are estimated to be 8.5 MGD.
- There is not sufficient capacity in the existing Murray Pump Station and force main to accommodate the additional 8.5 MGD.
- There is adequate capacity in the 63rd St. Pump Station and force main to handle the additional 8.5 MGD conveyance to the Alki Treatment Plant.
- There is not sufficient capacity at the Alki CSO Treatment Plant to handle the additional 8.5 MGD. Upgrades will be required.
- The 8.5 MGD pump station can be located in the Lowman Beach Park

- The 0.5 MG tank can be located at the Fauntleroy School

PROPOSED IMPROVEMENTS

Pump Stations

- 0.5 MGD Pump System in the Barton Storage Tank
- 8.5 MGD Submersible Pump Station to convey Murray Peak Flows

Conveyance Pipelines

- 13,500 feet of 24-inch force main from Lowman Beach Park to the 63rd Street Pump Station to convey excess Murray Peak Flows

Storage

- 0.5 MG storage tank in the Barton CSO Basin

Treatment Processes

- Provide an additional 8.5 MGD treatment capacity at the Alki Treatment Plant

Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B1A-M2B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f9-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B1A/M3B:	Provide Storage for Peak Flows at Fauntleroy School in the Barton Basin and Manage Demand in Murray Basin through Roof Drain Disconnections

APPROACH: STORE PEAK FLOWS FOR BARTON AND PROVIDE DEMAND MANAGEMENT IN THE MURRAY BASIN

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be stored and pumped back into the collection system after the storm event has subsided, while the incremental peak flows from the Murray Basin would be eliminated through roof drain disconnections within the Murray Basin. A 0.5 million gallon (MG) rectangular storage tank located at the Fauntleroy School is proposed for the Barton CSO Basin and 40 acres of roof drain disconnections are proposed for the Murray CSO basin.

The 0.50 MG storage tank for the Barton CSO Basin would be approximately 80 feet long, 40 feet wide, with an assumed storage depth of 25 feet. The storage tank would include a flow control structure that would divert flows from the 24-inch interceptor along SW Director Street during rain events that cause flows in excess of the capacity of the Barton Pump Station. This flow control would be accomplished by measuring the depth within the Barton Pump Station wet well and the depth within the 24-inch interceptor along SW Director Street. If the wet well level exceeds the high water alarm at the Barton Pump Station, or the level of flow in the 24-inch interceptor along SW Director Street exceeds 80% of full depth in the pipe, flow will be diverted into the proposed 0.5 MG storage tank. Once the wet well level has returned to the level set-point (i.e. normal operating conditions), the tank will re-introduce the stored volume back into the 24-inch interceptor along SW Director Street with a 0.5 million MGD pump system designed to dewater the tank within 24 hours.

40 acres of roof drainage in the Murray Basin would be disconnected as part of this alternative. All of the roof drain disconnections would be within 100 feet of an existing storm inlet or catch basin.

ASSUMPTIONS

- There is sufficient flow in the 24-inch interceptor along SW Director Street to attenuate peak flows at the existing Barton Pump Station
- Disconnecting 40 acres of roof drains within the Murray Basin will eliminate the excess peak flows from this area.
- The roof drains can be effectively disconnected within the Murray CSO Basin
- The 0.5 MG tank can be located at the Fauntleroy School

PROPOSED IMPROVEMENTS

Pump Stations

- 0.5 MGD Pump System in the Barton Storage Tank

Conveyance Pipelines

- N/A

Storage

- 0.5 MG storage tank in the Barton CSO Basin

Treatment Processes

- N/A

Demand Management

- 40 acres of roof drainage disconnected from the combined sewer in Murray CSO Basin

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B1A-M3B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f10-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B1A/M4B:	Provide Storage for Peak Flows at Fauntleroy School in the Barton Basin and Treat Excess Peak Flows at Murray Basin

APPROACH: STORE PEAK FLOWS FOR BARTON AND TREAT EXCESS PEAK FLOWS FROM THE MURRAY INCREMENTAL AREA

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be stored and pumped back into the collection system after the storm event has subsided, while the incremental peak flows from the Murray Basin would be treated within the Murray Basin. A 0.5 million gallon (MG) rectangular storage tank located at the Fauntleroy School is proposed for the Barton CSO Basin and a 8.5 MGD treatment system is proposed for the excess peak flows from the Murray CSO basin.

The 0.50 MG storage tank for the Barton CSO Basin would be approximately 80 feet long, 40 feet wide, with an assumed storage depth of 25 feet. The storage tank would include a flow control structure that would divert flows from the 24-inch interceptor along SW Director Street during rain events that cause flows in excess of the capacity of the Barton Pump Station. This flow control would be accomplished by measuring the depth within the Barton Pump Station wet well and the depth within the 24-inch interceptor along SW Director Street. If the wet well level exceeds the high water alarm at the Barton Pump Station, or the level of flow in the 24-inch interceptor along SW Director Street exceeds 80% of full depth in the pipe, flow will be diverted into the proposed 0.5 MG storage tank. Once the wet well level has returned to the level set-point (i.e. normal operating conditions), the tank will re-introduce the stored volume back into the 24-inch interceptor along SW Director Street with a 0.5 million MGD pump system designed to dewater the tank within 24 hours.

An 8.5 MGD treatment system located in the Lowman Beach Park is proposed to provide end of the pipe treatment for the excess peak flows from the Murray CSO basin area.

ASSUMPTIONS

- There is sufficient flow in the 24-inch interceptor along SW Director Street to attenuate peak flows at the Barton Pump Station
- The treatment facility can be located in the Lowman Beach Park
- The 0.5 MG tank can be located at the Fauntleroy School

PROPOSED IMPROVEMENTS

Pump Stations

- 0.5 MGD Pump System in the Barton Storage Tank

Conveyance Pipelines

- N/A

Storage

- 0.5 MG storage tank in the Barton CSO Basin

Treatment Processes

- 8.5 MGD end of pipe treatment system for excess peak flows in the Murray Basin

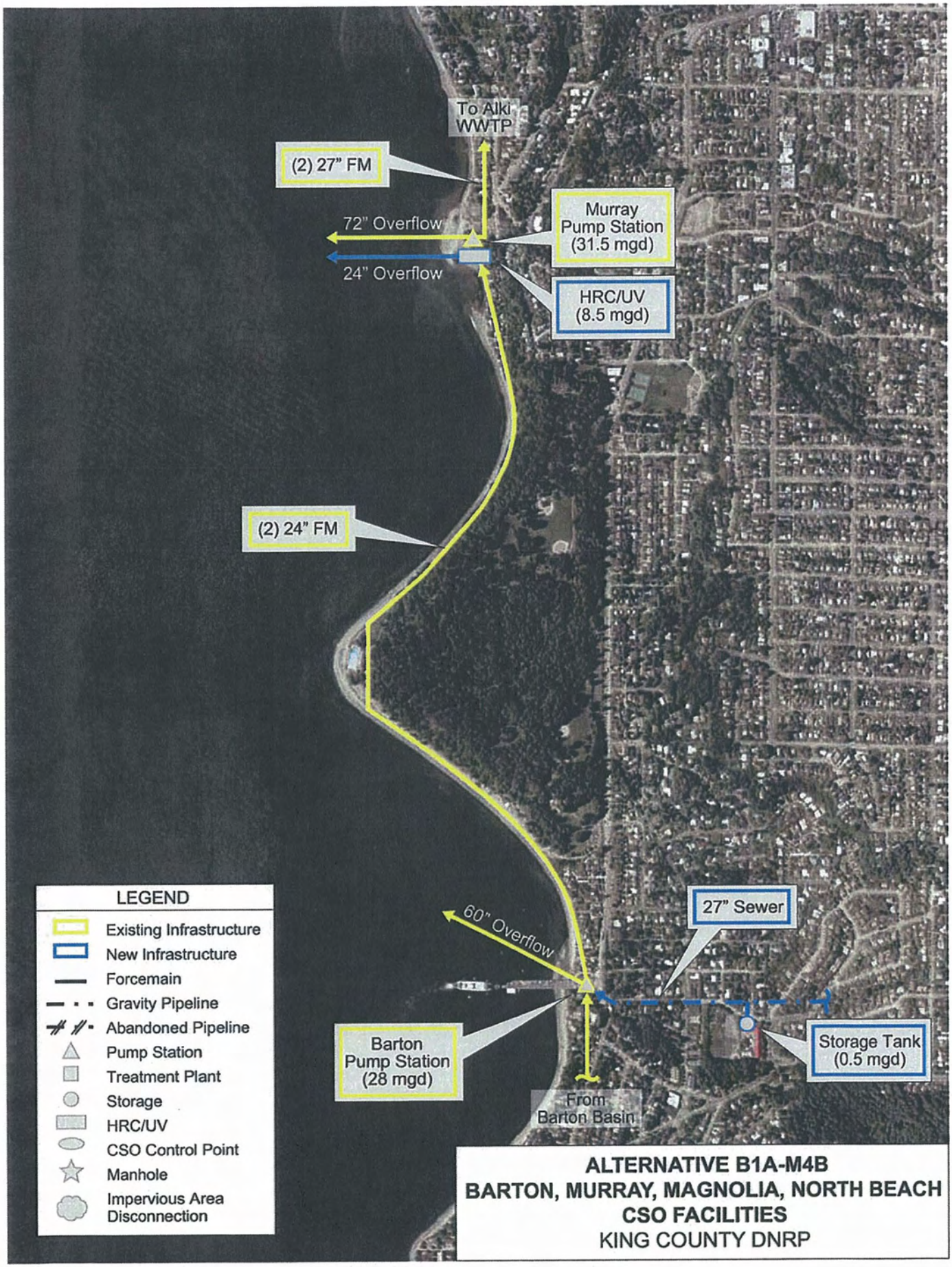
Demand Management

- N/A

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.



ALTERNATIVE B1A-M4B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

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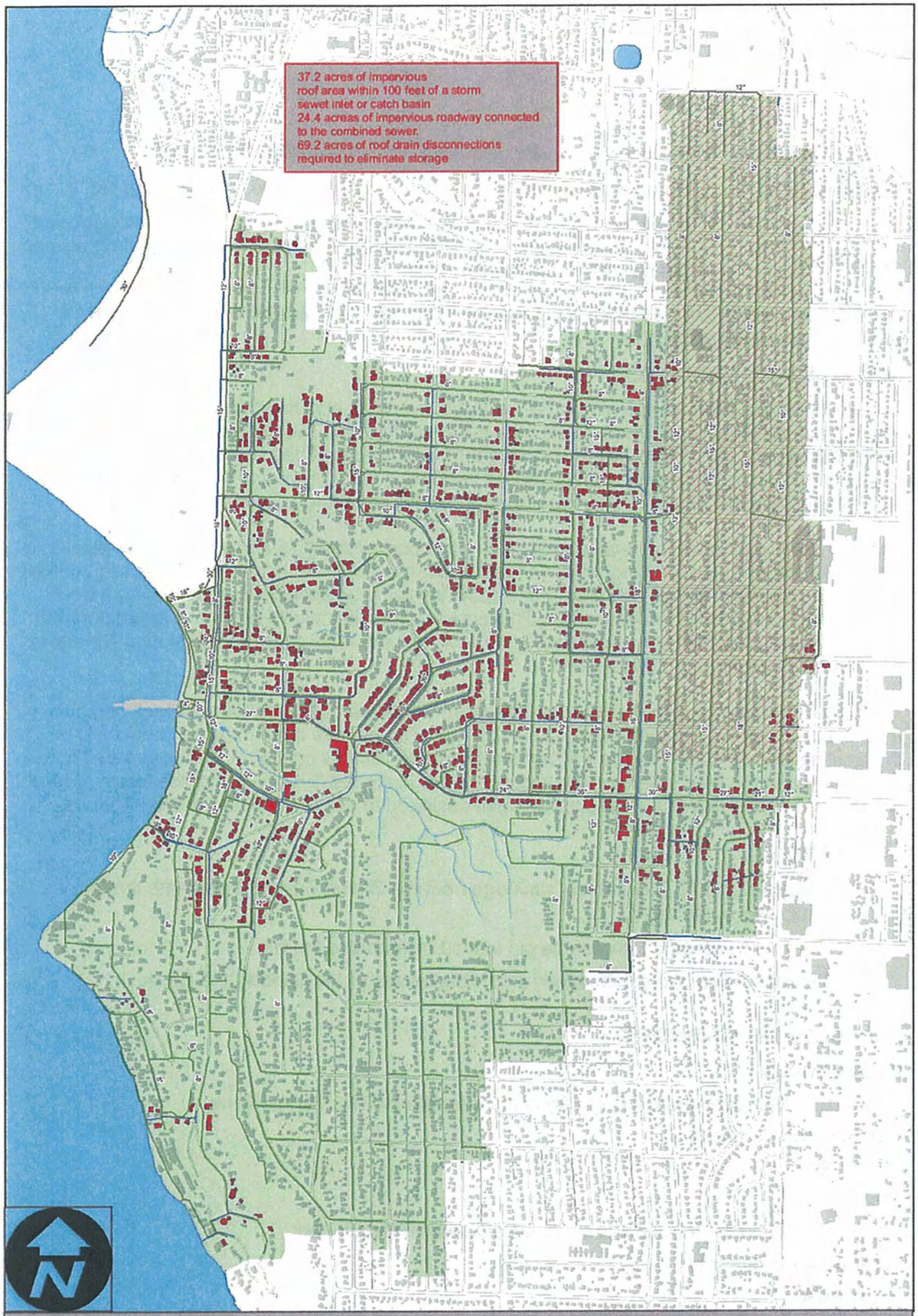


0 520 1,040 1,560 2,080 Feet

1 inch equals 800 feet

Legend

- Barton
- Buildings within 100 feet of Storm Sewer Inlets
- Impervious_Roadway_Areas
- Storm
- Sanitary/Combined

Barton CSO Basin

Potential Sites for Roof
Drain Disconections

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B4A/M1B:	Eliminate Excess Peak Flows within the Barton CSO Basin through Roof Drain Disconnections and Provide Storage for Peak Flows at the Lowman Beach Park in the Murray Basin

APPROACH: PROVIDE DEMAND MANAGEMENT IN BARTON BASIN AND STORE PEAK FLOWS FOR MURRAY BASIN

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be eliminated from the system through roof drain disconnections, while the peak flows from the Murray Basin would be stored and pumped back into the collection system after the storm event has subsided. Disconnection of 70 acres of impervious area is proposed for the Barton CSO Basin and a 1.3 MG rectangular storage tank at the Lowman Beach Park is proposed for the Murray CSO basin.

The roof drain disconnection analysis indicates that approximately 45 acres of roof drainage is within 150 feet of an existing storm inlet or catch basin. In addition, there is a large section of the Barton Basin located on the east side of the basin in which the pavement areas have not been disconnected from the combined sewer. This area is approximately 25 acres and combined with the 45 acres of roof drainage would satisfy the area requirements as indicated by King County to eliminate the excess Barton peak flows.

The 1.3 MG storage tank for the Murray CSO Basin would be approximately 120 feet long, 60 feet wide, with an assumed storage depth of 25 feet. The storage tank would be connected to the existing Murray Pump Station wet well and would be filled by gravity. Once the wet well level has returned to the level set-point, the tank will re-introduce the flows back into the Murray Pump Station Wet Well with a 1.3 MGD pump system designed to dewater the tank within 24 hours.

ASSUMPTIONS

- Disconnecting 70 acres of roof drainage from the Barton Basin will eliminate the excess peak flows in the basin.
- The 1.3 MG storage tank can be put in the Lowman Beach Park,
- The roof drains can be effectively disconnected within the Barton CSO Basin.

PROPOSED IMPROVEMENTS

Pump Stations

- 1.3 MGD Submersible Pump System inside the Murray Storage Tank

Conveyance Pipelines

- N/A

Storage

- 1.3 MG Storage in the Murray Basin at Lowman Beach Park

Treatment Processes

- N/A

Demand Management

- 70 acres of roof drainage disconnected from the combined sewer in the Barton Basin

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B4A-M1B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f19-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B4A/M2B:	Eliminate Excess Peak Flows within the Barton CSO Basin through Roof Drain Disconnections and Convey Peak Flows from the Murray Incremental Area and Additional Treatment Capacity at the Alki Treatment Plant

APPROACH: PROVIDE DEMAND MANAGEMENT FOR THE BARTON BASIN AND CONVEY PEAK FLOWS FROM THE MURRAY INCREMENTAL AREA

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be eliminated from the system through roof drain disconnections, while the incremental peak flows from the Murray Basin would be conveyed downstream through the construction of the new pump station and force main. Disconnection of 70 acres of impervious area is proposed for the Barton CSO Basin and a new 8.5 million gallon per day (MGD) wet weather pump station at the Lowman Beach Park is proposed for the Murray CSO basin.

The roof drain disconnection analysis indicates that approximately 45 acres of roof drainage is within 150 feet of an existing storm inlet or catch basin. In addition, there is a large section of the Barton Basin located on the east side of the basin in which the pavement areas have not been disconnected from the combined sewer. This area is approximately 25 acres and combined with the 45 acres of roof drainage would satisfy the area requirements as indicated by King County to eliminate the excess Barton peak flows.

The new 8.5 MGD pump station will convey flow through 13,500 feet of 24-inch force main routed along Beach Drive SW and discharging to the existing 63rd Street Pump Station.

ASSUMPTIONS

- Flow Management at Barton CSO basin will result excess peak flows only from the Murray CSO Basin, which are approximately 8.5 MGD.
- There is not enough capacity in the Murray Pump Station and force main to handle the additional 8.5 MGD.
- There is enough capacity in the 63rd St. Pump Station and force main to handle the additional 8.5 MGD of conveyance to the Alki Treatment Plant.
- There is not enough capacity at the Alki CSO Treatment Plant to handle the additional 8.5 MGD. Upgrades will be required.
- Disconnecting 70 acres of roof drainage from the Barton Basin will eliminate the excess peak flows in the basin.
- The 8.5 MGD pump station can be located in the Lowman Beach Park
- The roof drains can be effectively disconnected within the Barton CSO Basin.

PROPOSED IMPROVEMENTS

Pump Stations

- 8.5 MGD Submersible Pump Station to convey Murray Peak Flows

Conveyance Pipelines

- 13,500 feet of 24-inch force main from Lowman Beach Park to the 63rd Street Pump Station to convey excess Murray Peak Flows

Storage

- N/A

Treatment Processes

- Provide an additional 8.5 MGD treatment capacity at the Alki Treatment Plant

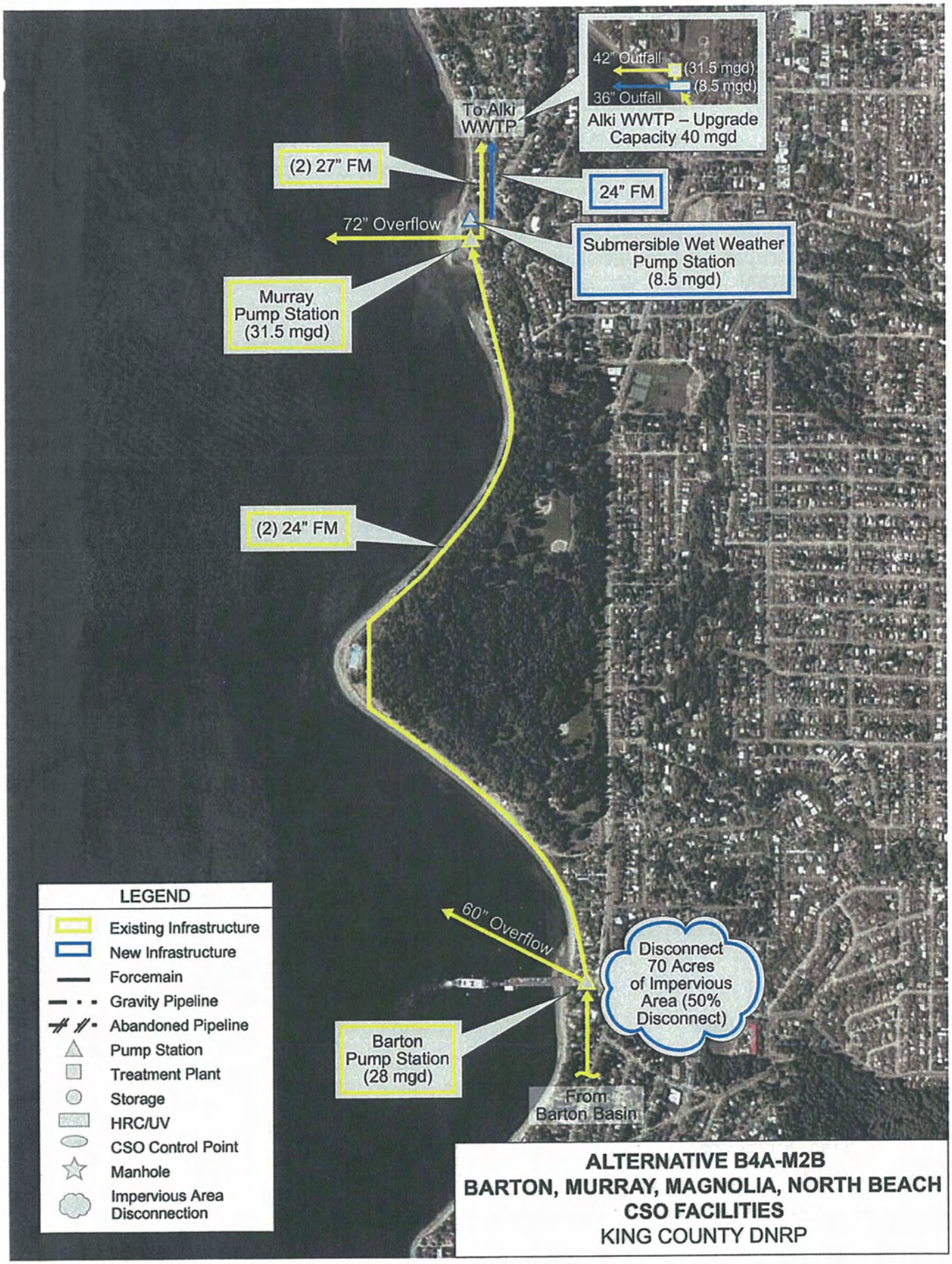
Demand Management

- 70 acres of roof drainage disconnected from the combined sewer in the Barton Basin

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.



ALTERNATIVE B4A-M2B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f22-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B4A/M3B:	Manage Demand in Barton and Murray CSO Basins through Disconnection of Impervious Areas from the Combined Sewers

APPROACH: PROVIDE DEMAND MANAGEMENT FOR THE MURRAY AND BARTON CSO BASINS THROUGH DISCONNECTION OF IMPERVIOUS AREAS FROM THE COMBINED SEWER SYSTEM

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be eliminated from the system through roof drain disconnections, while the incremental peak flows from the Murray Basin would be eliminated through the roof drain disconnections within the Murray Basin. Disconnection of 70 acres of impervious area is proposed for the Barton CSO Basin and 40 acres of roof drain disconnections is proposed for the Murray CSO basin.

The roof drain disconnection analysis indicates that approximately 45 acres of roof drainage is within 150 feet of an existing storm inlet or catch basin. In addition, there is a large section of the Barton Basin located on the east side of the basin in which the pavement areas have not been disconnected from the combined sewer. This area is approximately 25 acres and combined with the 45 acres of roof drainage would satisfy the area requirements as indicated by King County to eliminate the excess Barton peak flows.

The roof drain disconnection analysis for the Murray CSO Basin indicates that 40 acres of roof drainage is within 100 feet of an existing storm sewer inlet or catch basin. These roof areas will be disconnected as part of this proposed alternative.

ASSUMPTIONS

- Disconnecting 70 acres of roof drainage from the Barton Basin will eliminate the excess peak flows in the basin.
- Disconnecting 40 acres of roof drains within the Murray Basin will eliminate the excess peak flows from this area.
- The roof drains can be effectively disconnected within the Barton and Murray CSO Basin

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

Treatment Processes

- N/A

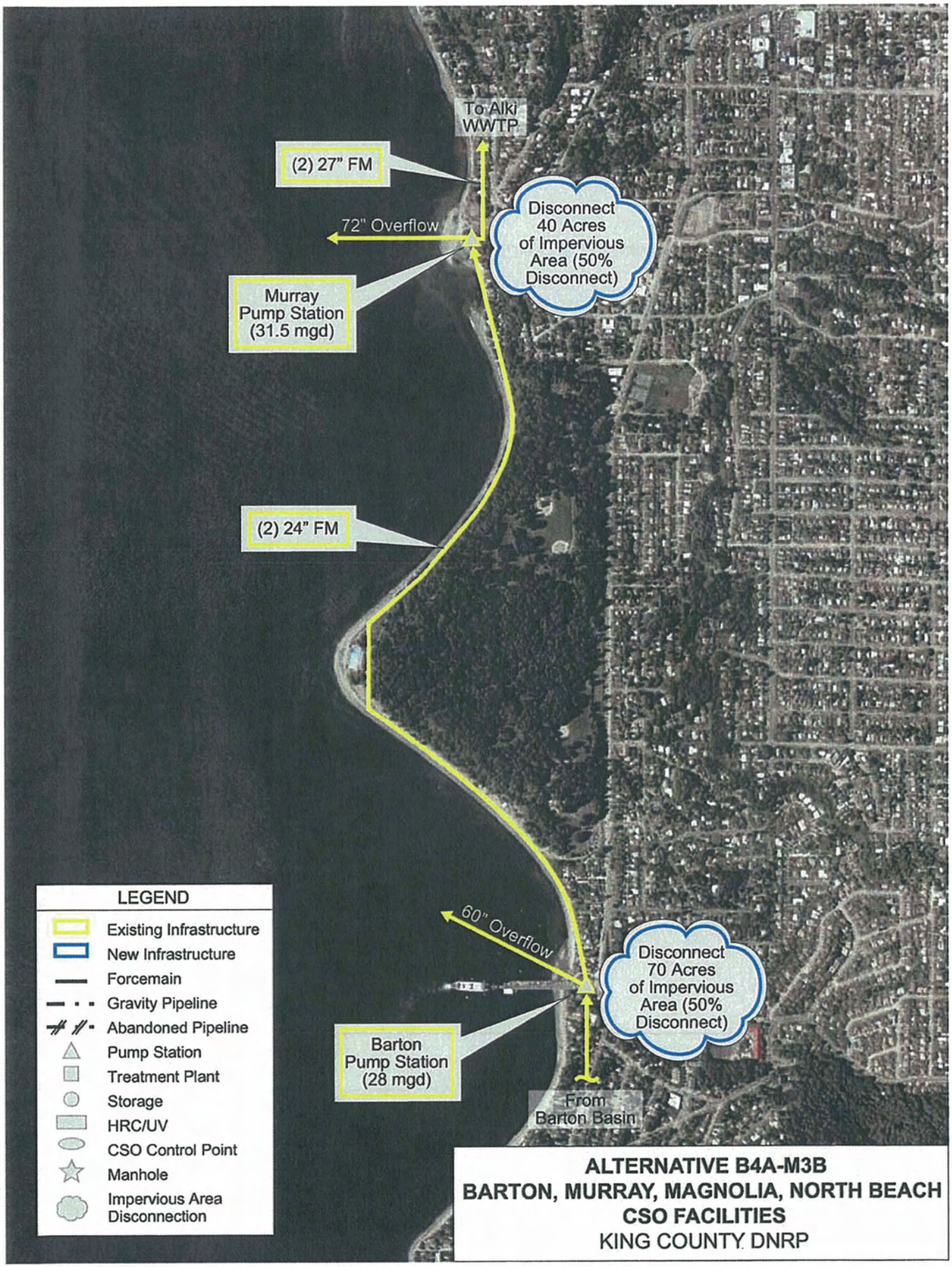
Demand Management

- 40 acres of roof drainage disconnected from the combined sewer in the Murray Basin
- 70 acres of roof drainage disconnected from the combined sewer in the Barton Basin

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.



ALTERNATIVE B4A-M3B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f23-7562.ai

TETRA TECH/KCM

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative B4A/M4B:	Provide Demand Management at Barton CSO Basin through Roof Drain Disconnections and Treat Excess Peak Flows at Murray Basin

APPROACH: PROVIDE DEMAND MANAGEMENT IN THE BARTON BASIN AND TREAT EXCESS PEAK FLOWS FROM THE MURRAY INCREMENTAL AREA

ALTERNATIVE DESCRIPTION

In this alternative, peak flows from the Barton Basin would be eliminated from the system through roof drain disconnections, while the incremental peak flows from the Murray Basin would be treated within the Murray Basin. Approximately 70 acres of roof drainage is proposed for disconnection in the Barton CSO Basin and an 8.5 MGD treatment system is proposed for end of pipe treatment for the excess peak flows from the Murray CSO basin.

The roof drain disconnection analysis indicates that approximately 45 acres of roof drainage is within 150 feet of an existing storm inlet or catch basin. In addition, there is a large section of the Barton Basin located on the east side of the basin in which the pavement areas have not been disconnected from the combined sewer. This area is approximately 25 acres and combined with the 45 acres of roof drainage would satisfy the area requirements as indicated by King County to eliminate the excess Barton Peak Flows.

An 8.5 MGD treatment system located in the Lowman Beach Park is proposed to provide end of the pipe treatment for the excess peak flows from the Murray CSO basin area.

ASSUMPTIONS

- Disconnecting 70 acres of roof drainage from the Barton Basin will eliminate the excess peak flows in the basin.
- A treatment facility can be located in the Lowman Beach Park
- Almost 70 acres of impervious area can be disconnected in the Barton Basin

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

Treatment Processes

- 8.5 MGD end of pipe treatment system for excess peak flows from the Murray Basin

Demand Management

- Disconnection of 70 acres of impervious area within the Barton Basin.

POLICY IMPLICATIONS

- N/A

A schematic and map of the existing and proposed facilities are shown on the following page.

ALTERNATIVE B4A-M4B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH CSO FACILITIES
KING COUNTY DNRP

kc507f20-7562.ai

carollo engineers

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 1A:	Store flow in a tank up basin from the CSO control point.

APPROACH: STORAGE

ALTERNATIVE DESCRIPTION

Following the recommendations of the 1997 CSO Plan, a storage tank would be constructed in the vicinity of W. Lynn Street and 32nd Avenue, approximately 2,200 feet north of the CSO control point. The storage tank could be located on a triangular parcel of land of an area of approximately 0.4 Ac. The tank would be connected to extant combined sewers for approximately 31% of the basin tributary to that area (approximately 235 Ac.) A pump station would be needed to empty the tank.

Existing gravity sewerage would continue to collect sewage from the remaining 69% of the basin. A pump station would be required at the CSO control point to transfer those flows to the storage tank. Further modeling is required to adequately determine the capacity of the pump station. A new gravity discharge pipeline would be required to convey flow from the tank to the existing S.Magnolia Interceptor.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- One, at 10 mgd, 150-feet head
- One, at 4.3 mgd, 30-feet head

Conveyance Pipelines

- Forcemain from High Head Pump Station to storage tank.
  - +/- 2,200 feet, 12-inch diameter
- Gravity Pipeline from storage tank to existing S. Magnolia Interceptor
  - 4.3 mgd capacity
  - +/- 2,200 feet, 18-inch diameter.

Storage

- 2.6 MG, rectangular tank, 100 x 100 feet, 34-feet sidewater depth.

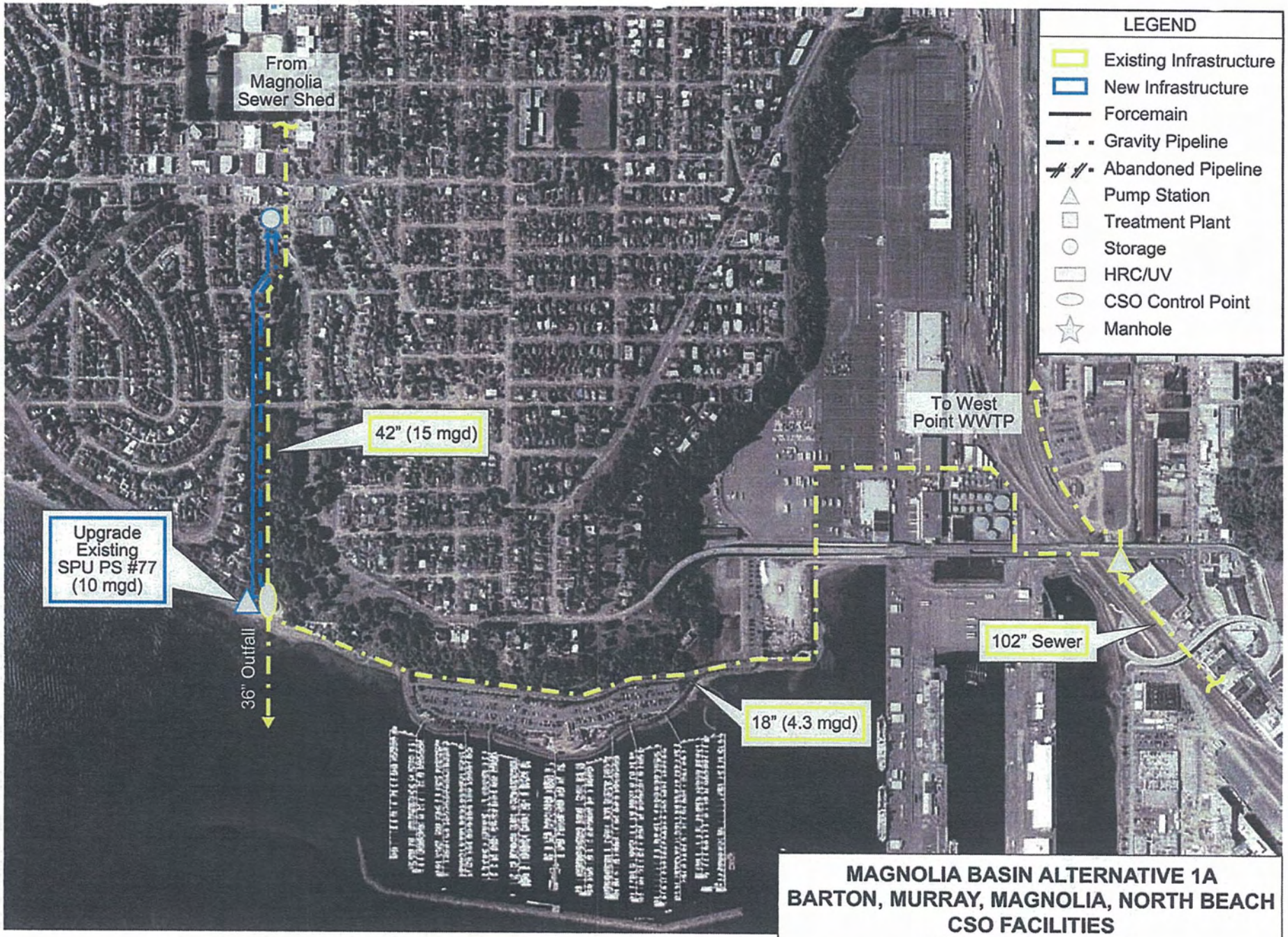
Treatment Processes

- NA

POLICY IMPLICATIONS

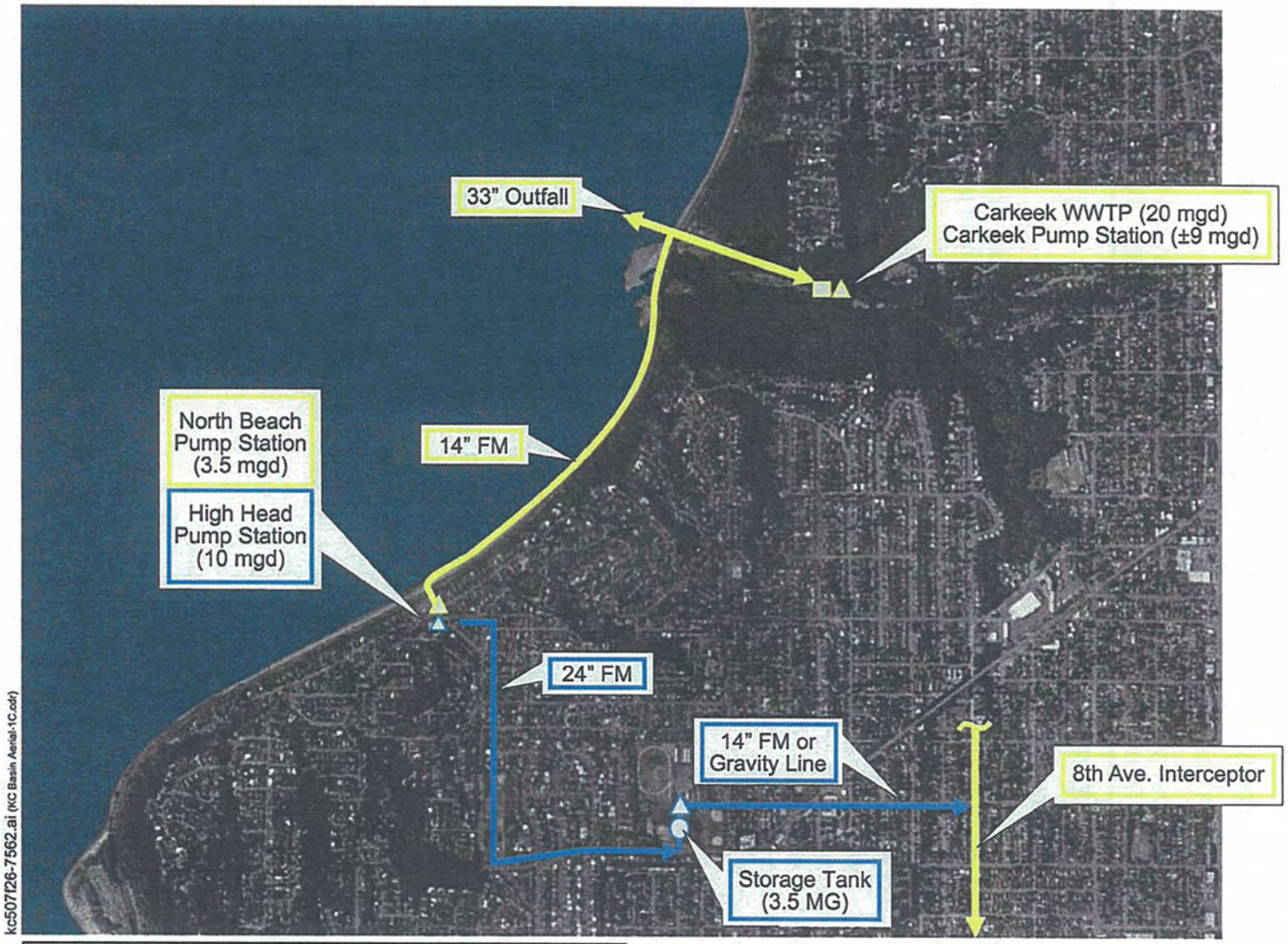
- ?

A schematic and map of the existing and proposed facilities are shown on the following page.



MAGNOLIA BASIN ALTERNATIVE 1A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f1-7562.ai



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LEGEND	
Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 1C
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 2A:	Convey peak flows from the North Beach Pump Station site to the Carkeek WWTP using a new wet weather pump station and beach-side forcemain.

APPROACH: CONVEY AND TREAT PEAK FLOWS

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be pumped from the existing North Beach Pump Station (NBPS) site to the Carkeek Wet Weather Treatment Plant (WWTP) for treatment and discharge to Puget Sound.

A submersible pump station would be constructed at the NBPS site, which would convey peak flows through a 24-inch forcemain to the Carkeek WWTP. The assumed forcemain alignment would parallel the existing 14-inch forcemain along the beach to Carkeek Park. The capacity of the Carkeek WWTP would be expanded by constructing high rate clarification (HRC) and additional disinfection capacity. Treated flow from the HRC train would be discharged to Puget Sound via a new 24-inch outfall. The existing Carkeek WWTP and outfall would remain in their current service.

ASSUMPTIONS

- An additional 10 mgd discharge into Puget Sound will be permitted from the Carkeek WWTP.
- Sufficient area is available near the NBPS to construct a new submersible wet weather pump station.
- Sufficient space is available at the Carkeek WWTP to add a 10 mgd HRC facility, and expand disinfection capacity.
- A new 24-inch diameter forceman can be constructed along the beach and through Carkeek Park.
- A new 24-inch outfall can be constructed at the Carkeek WWTP.

PROPOSED IMPROVEMENTS

Pump Stations

- Submersible pump station at the NBPS site
  - Wet pit, capacity = 10 mgd

Conveyance Pipelines

- Forcemain from submersible pump station to Carkeek PS
  - +/- 7,300 feet, 24-inch
  - Beach-site alignment

Storage

- N/A

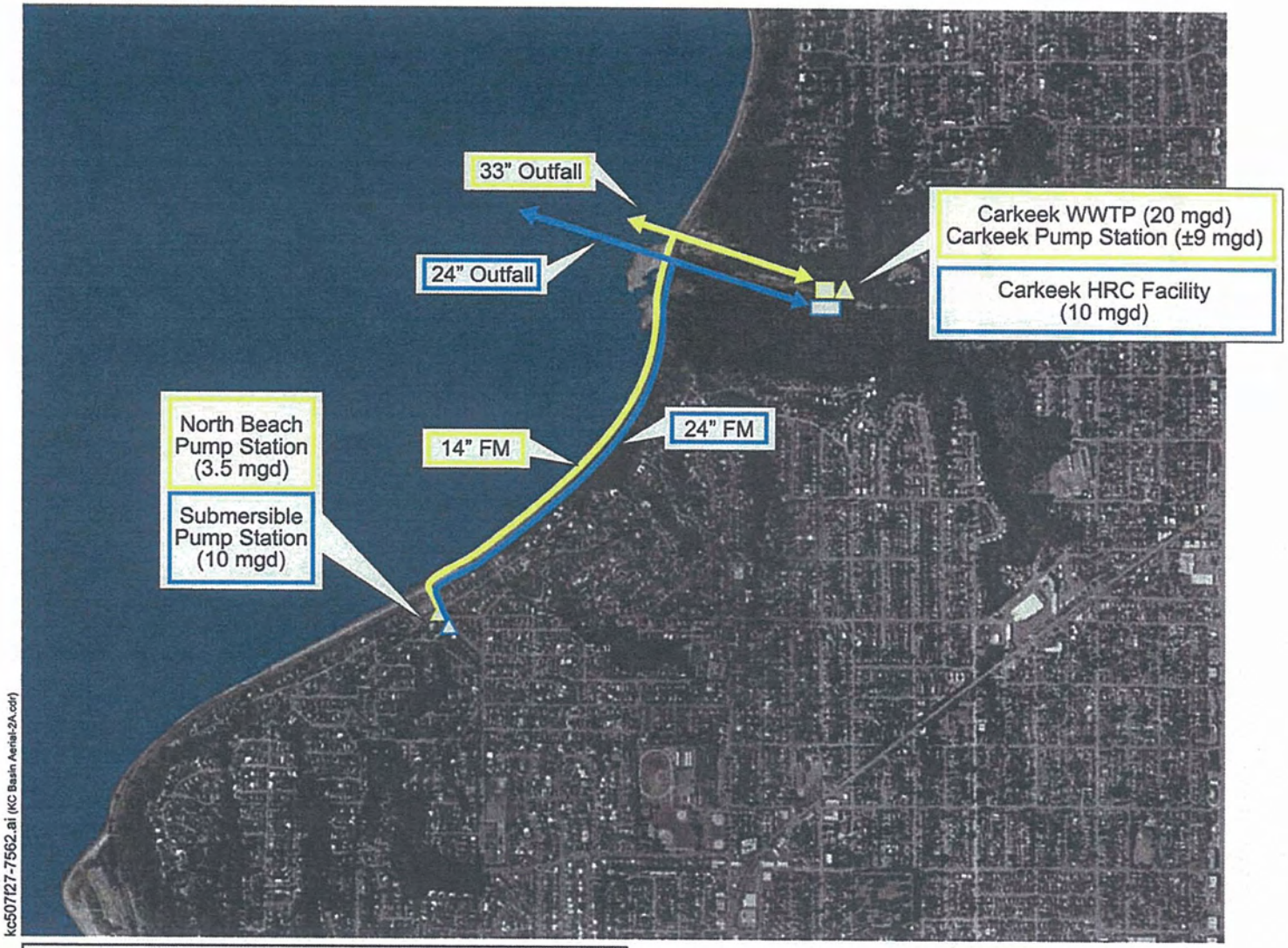
Treatment Processes

- Expand capacity of Carkeek WWTP by 10 mgd
  - Fine Screening (1/4-inch)
  - High Rate Clarification (HRC)
  - Disinfection (UV or expanded sodium hypochlorite with dechlorination)
- New Outfall from HRC Facility
  - 24-inch pipeline and new diffuser

POLICY IMPLICATIONS

- New permit required to increase discharge to Puget Sound from Carkeek WWTP.
- Others?

A schematic and map of the existing and proposed facilities are shown on the following pages.



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LEGEND

Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 2A
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 2B:	Convey peak flows from the North Beach Pump Station site to the Carkeek WWTP using a new high head pump station and forcemain along a residential street alignment.

APPROACH: CONVEY AND TREAT PEAK FLOWS

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be pumped from the existing North Beach Pump Station (NBPS) site to the Carkeek Wet Weather Treatment Plant (WWTP) for treatment and discharge to Puget Sound.

A high head pump station would be constructed at the NBPS site, which would convey peak flows through a 24-inch forcemain and gravity line connecting to the Carkeek WWTP. The assumed forcemain alignment follows NW 100th Street to the intersection of NW 100th Street and 8th Avenue NW. From this point a new gravity pipeline could convey peak flows to the Carkeek WWTP. The treatment facility at Carkeek WWTP would be expanded to include high rate clarification (HRC) and additional disinfection capacity. Treated flow from the HRC train would be discharged to Puget Sound via a new 24-inch outfall. The existing Carkeek WWTP and outfall would remain in their current service.

ASSUMPTIONS

- An additional 10 mgd discharge into Puget Sound will be permitted from the Carkeek WWTP.
- Sufficient area is available near the NBPS to construct a new high head pump station.
- New forcemains and gravity pipelines can be constructed in streets between the NBPS and the Carkeek WWTP.
- Sufficient space is available at the Carkeek WWTP to add a 10 mgd HRC facility, and expand disinfection capacity.
- A new 24-inch diameter forceman can be constructed along the beach and through Carkeek Park.
- A new 24-inch outfall can be constructed at the Carkeek WWTP.

PROPOSED IMPROVEMENTS

Pump Stations

- High head pump station at the NBPS site
  - Wet pit/dry pit, capacity = 10 mgd

Conveyance Pipelines

- Forcemain from high head pump station
  - +/- 6,000 feet, 24-inch
- Gravity Pipeline to Carkeek WWTP
  - +/- 3,000 feet, 24 to 36-inch

Storage

- N/A

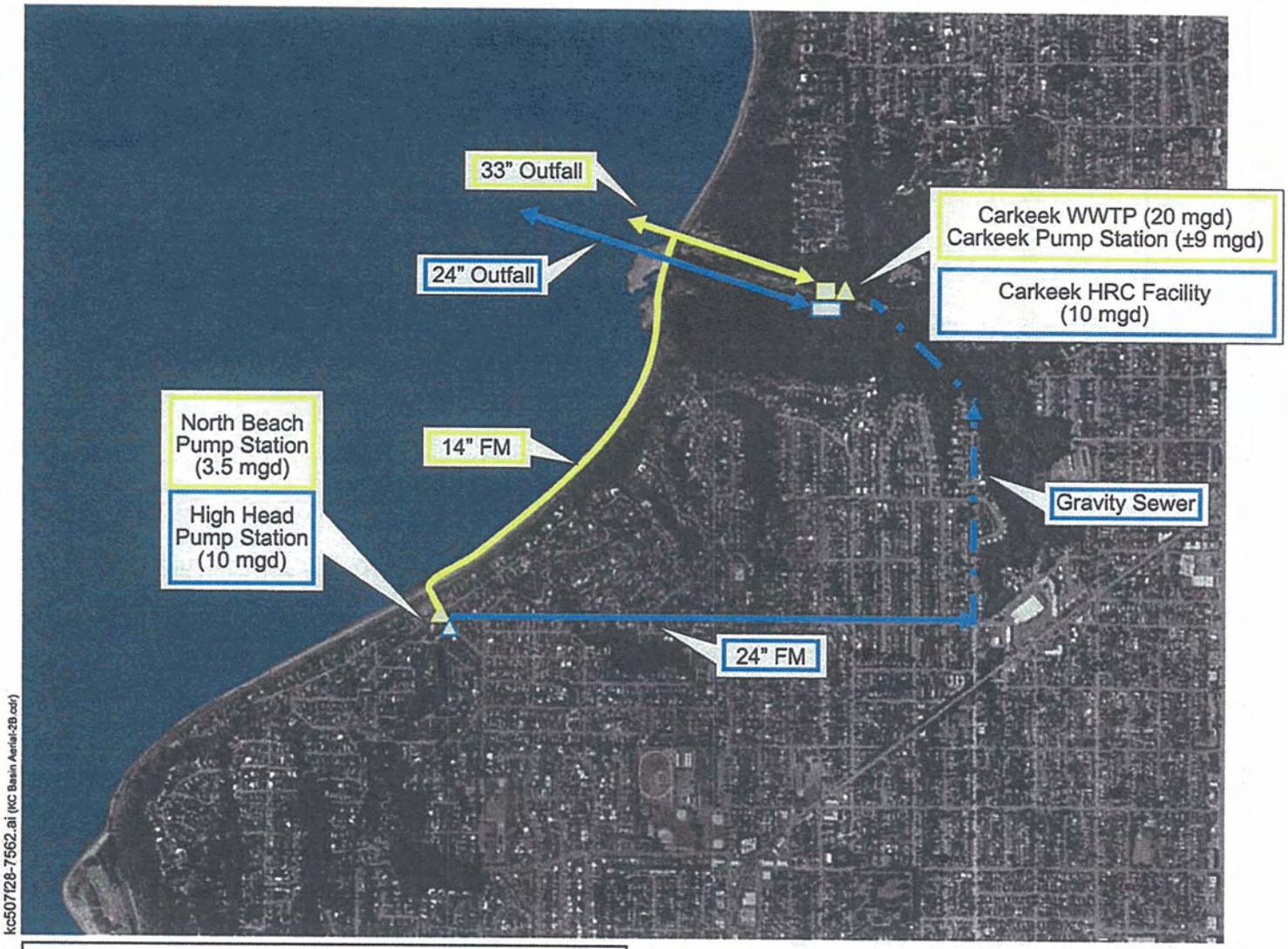
Treatment Processes

- Expand capacity of Carkeek WWTP by 10 mgd
  - Fine Screening (1/4-inch)
  - High Rate Clarification (HRC)
  - Disinfection (UV or expanded sodium hypochlorite with dechlorination)
- New Outfall from HRC Facility
  - 24-inch pipeline and new diffuser

POLICY IMPLICATIONS

- New permit required to increase discharge to Puget Sound from Carkeek WWTP.
- Others?

A schematic and map of the existing and proposed facilities are shown on the following page.



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LEGEND

Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 2B
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 3A:	Treat peak flows at NBPS site, discharge into Puget Sound

APPROACH: END OF PIPE TREATMENT

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be treated at the existing North Beach Pump Station (NBPS) site, and discharged directly to Puget Sound.

A new 10 mgd treatment facility would be constructed at the NBPS site. The facility would include high rate clarification (HRC) and disinfection to treat peak flows. Effluent from the new treatment facility would be discharged to the Puget Sound via the existing 24-inch North Beach outfall.

ASSUMPTIONS

- An additional 10 mgd discharge into Puget Sound will be permitted from a remote wet weather treatment facility.
- Sufficient area is available adjacent to the NBPS to site a remote wet weather treatment facility.
- The existing North Beach outfall(s) can be used to discharge treated effluent from the HRC facility.

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

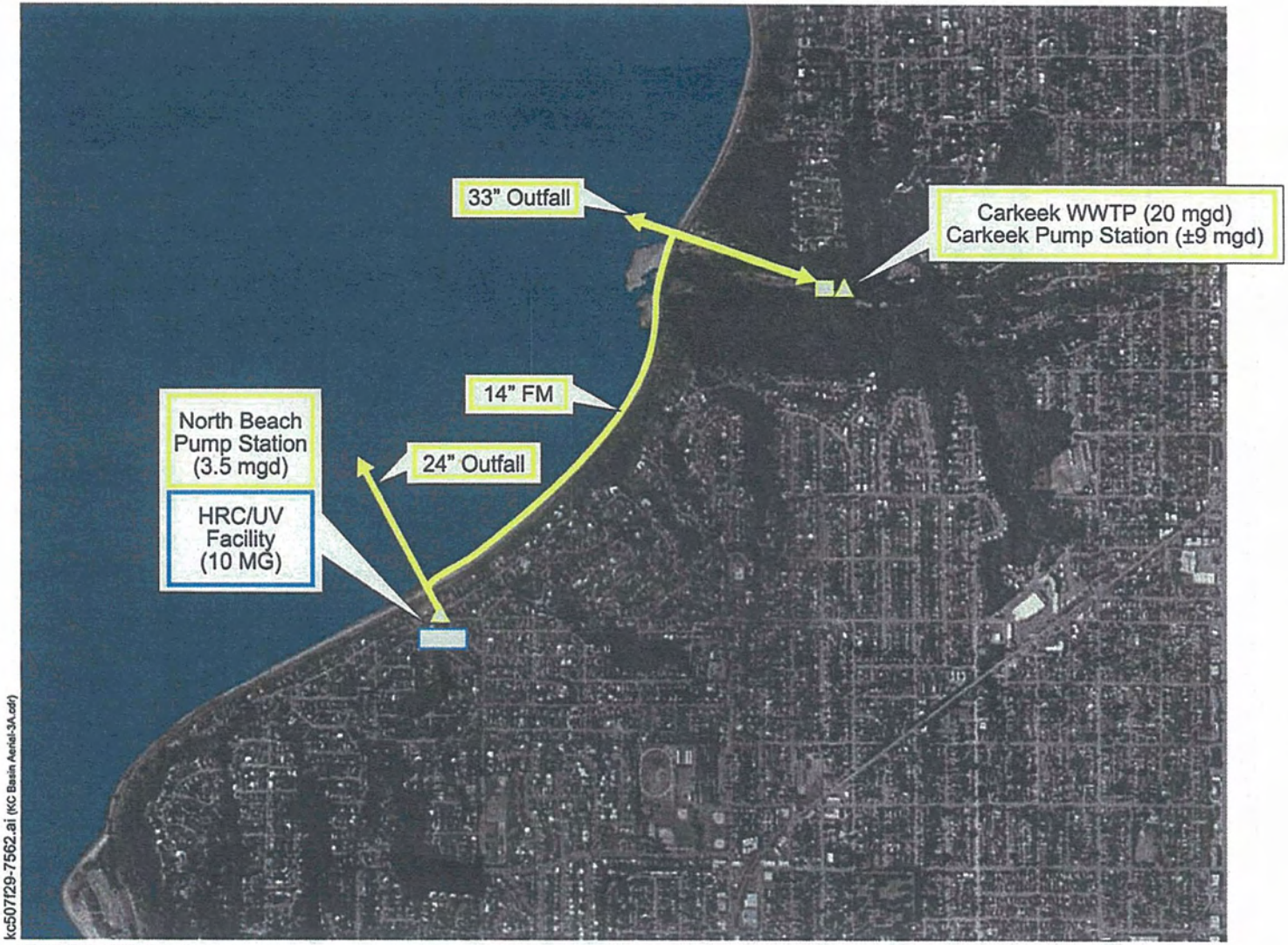
Treatment Processes

- New 10 mgd treatment facility at the NBPS site
  - Fine Screening (1/4-inch)
  - High Rate Clarification (HRC)
  - Ultraviolet disinfection (UV)

POLICY IMPLICATIONS

- New permit required to increase discharge to Puget Sound.
- Others?

A schematic and map of the existing and proposed facilities are shown on the following page.



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LEGEND

Existing infrastructure	Pump Station
New infrastructure	Treatment Plant
Forcemain	Storage
Gravity Pipeline	HRC/UV

NORTH BEACH ALTERNATIVE 3A
MAGNOLIA BASIN
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	Summary of CSO Control Approach Alternatives for Workshop No. 2
Basin:	North Beach
Alternative 4A:	Control CSOs by reducing I/I in North Beach Basin

APPROACH: PEAK FLOW REDUCTION

ALTERNATIVE DESCRIPTION

In this alternative, peak flows would be reduced by implementing an aggressive inflow and infiltration (I/I) reduction program, including roof drain/catch basin disconnections, side sewer and lateral replacement, and main-line sewer rehabilitation within the North Beach Basin.

ASSUMPTIONS

- I/I reduction will reduce peak flows sufficiently to yield only one overflow per year, without additional storage or peak flow conveyance/treatment.
- I/I can be removed from the system without a low risk of creating negative impacts on the community (i.e.: slope stability, basement flooding, etc.).
- Storm water removed from the combined system can be discharged to Puget Sound (potentially following treatment).

PROPOSED IMPROVEMENTS

Pump Stations

- N/A

Conveyance Pipelines

- N/A

Storage

- N/A

Treatment Processes

- N/A

POLICY IMPLICATIONS

- Extensive coordination with SPU required to implement I/I reduction program.
- Others?

carollo engineers

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 1B:	Store flow in a tank near the CSO control point.

APPROACH: STORAGE

ALTERNATIVE DESCRIPTION

A storage tank would be constructed on 32nd Ave. near the CSO control point. Adjacent property would be acquired for the tank. The SPU pump station #77 would be modified to increase pumping head sufficiently to lift flow into the tank. The discharge line for the pump station would be extended to the tank. Capacity of the SPU station is currently unknown.

Depending on location and footprint, a pump station may be needed to empty the tank into the S. Magnolia Interceptor upstream of the CSO control point.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- Improve SPU pump station #77.

Conveyance Pipelines

- Local connector to and from tank, 200 feet, 18-inch diameter.
- Extend SPU pump station discharge line to tank, approximately 400 feet, 12-inch diameter.

Storage

- 2.6 MG rectangular tank, 50 x 200 feet, 34-feet sidewater depth.

Treatment Processes

- NA

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 1B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f2-7562.ai

carollo engineers

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 1C:	Store flow in a tank east of Marina.

APPROACH: STORAGE

ALTERNATIVE DESCRIPTION

A storage tank would be constructed north and east of the Marina on 23rd Ave. on a site currently owned by Seattle Parks, and currently used as a sports field. A pump station would be required to empty the tank.

A new gravity sewer would be constructed from the CSO control point to the tank, approximately 3,000 feet long, to convey flow from the basin. The SPU pump station and discharge line might be upgraded for higher head and distance needed to convey flows from approximately 20% of the basin to the new sewer.

The existing S. Magnolia Interceptor would remain in service for local connections between 32nd Ave. and the storage tank. It would be re-routed into the tank.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- Upgrade SPU pump station #77.
- Tank discharge pump station, 4.3 mgd.

Conveyance Pipelines

- Gravity sewer, +/- 3,100 feet, 27 inch diameter, 15 mgd.
- Upgrade discharge line from SPU pump station #77 to new gravity sewer.

Storage

- 2.6 MG rectangular tank, 100 x 350 feet, 10-feet sidewater depth.

Treatment Processes

- NA

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 1C
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f3-7562.ai

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 2A:	Replacement Sewer to Convey all flow to Interbay Pump Station.

APPROACH: CONVEY AND TREAT

ALTERNATIVE DESCRIPTION

A new gravity sewer would be constructed using a combination of open cut and trenchless methods to convey peak flows to the Interbay PS for conveyance to West Point. The sewer would begin near the CSO control point and end at the Interbay PS. SPU pump station #77 may require upgrade to enable pumping flow from approximately 20% of the basin to the new gravity sewer.

The existing S. Magnolia Interceptor would be interconnected at appropriate points to provide local service downstream of the CSO control point.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- NA

Conveyance Pipelines

- Gravity sewer, +/- 6,000 feet, 27-inch diameter, 15 mgd.

Storage

- NA

Treatment Processes

- NA

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 2A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f4-7562.ai

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 2B:	Parallel Sewer to Convey all flow to Interbay Pump Station.

APPROACH: CONVEY AND TREAT

ALTERNATIVE DESCRIPTION

A new parallel gravity sewer would be constructed using a combination of open cut and trenchless methods to convey peak flows to the Interbay PS for conveyance to West Point. The sewer would begin near the CSO control point and end at the Interbay PS. A new control structure would be built to divert flows above 4.3mgd away from the S. Magnolia Interceptor. SPU pump station #77 may require upgrading to enable flow to be discharged to the new sewer.

The existing S. Magnolia Interceptor would be continue to carry flows up to 4.3 mgd.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- NA

Conveyance Pipelines

- Gravity sewer, +/- 6,000 feet, 24-inch diameter, 10.7 mgd.

Storage

- NA

Treatment Processes

- NA

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 2B
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f5-7562.ai

carollo engineers

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 3A:	End of Pipe Treatment

APPROACH: END OF PIPE TREATMENT

ALTERNATIVE DESCRIPTION

A new HRC/UV wet weather treatment plant would be constructed near the CSO control point. New control structures would divert flows above 4.3 mgd to the treatment plant. Plant footprint is approximately 90 x 105 feet. A pump station would be needed to empty the plant after use.

SPU pump station #77 would require an upgrade to pump flow to the plant.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- Upgrade SPU pump station #77.

Conveyance Pipelines

- Interconnecting sewers, 400 feet.

Storage

- NA

Treatment Processes

- HRC/UV treatment, 15 mgd.

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 3A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

kc507f6-7562.ai

carollo engineers

Project Name:	Barton Murray, Magnolia, and North Beach CSO Facilities
Subject:	South Magnolia Basin: Summary of CSO Control Approach Alternatives for Workshop No. 2
Alternative 4A:	Impervious Area Disconnection.

APPROACH: DEMAND MANAGEMENT

ALTERNATIVE DESCRIPTION

Approximately 50% of the connected impervious area in the basin would be separated.

A tunneled pipeline, located generally along the Galer St. right of way, east of the CSO control point would be used to store approximately 1.1 mgd of peak flow. The tunnel wouold end in the vicinity of 23rd Ave. Interconnecting sewers would connect the upstream and downstream ends of the tunnel to the existing S. Magnolia Interceptor.

ASSUMPTIONS

- Sufficient capacity in existing tributary SPU infrastructure, except as noted in the alternative description.
- Sufficient capacity in existing County conveyance infrastructure, except as noted in the alternative description.
- No outfall improvements needed.
- Land can be acquired through normal processes.
- No mitigation assumed at this level of alternative description.
- Geotechnical conditions are conducive to construction methods implied by the alternative description.

PROJECT ELEMENTS

Pump Stations

- NA

Conveyance Pipelines

- Interconnecting sewers.

Storage

- Tunnel, 3,000 feet, 96-inch diameter, 1.1 MG.

Treatment Processes

- NA

POLICY IMPLICATIONS

- ?

A schematic and map of the existing and proposed facilities are shown on the following page.

MAGNOLIA BASIN ALTERNATIVE 4A
BARTON, MURRAY, MAGNOLIA, NORTH BEACH
CSO FACILITIES
KING COUNTY DNRP

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NORTH BEACH BASIN
ALTERNATIVES EVALUATION - WORKSHOP 2

ALTERNATIVE		RELATIVE COST	SCREENING CRITERIA																												NOTES
			COST EFFECTIVENESS				O & M				TECHNICAL FEASIBILITY / COMPATIBILITY				PUBLIC HEALTH & ENVIRONMENTAL BENEFIT				FLEXIBILITY				COMMUNITY				PROGRAM COMPATIBILITY				
ID	DESCRIPTION		Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	
1A	Storage: Tank at NBPS site	1.3																													- Permitting Risk High (Group 4) - Community Impacts High (Group 4) - Lower replacement costs for equipment (Group 2)
1B	Storage: Offsite Tank, Treat at Carkeek	1.7																													
1C	Storage: Offsite Tank, Treat at West Point	1.9																													- Concern about impacts to SPU collection system that discharges to 8th Ave (?) (Group 1)
2A	Convey and Treat: Submersible Pump Station, Treat at Carkeek	2.3																													- High Cost (Group 4) - Permitting - Services may not allow (Group 4) - Energy high (Group 2) - Carkeek outfall with permitting issues (Group 1)
2B	Convey and Treat: High Head Pump Station, Treat at Carkeek	2.2																													- Energy high (Group 2) - Carkeek outfall with permitting issues (Group 1)
3A	End of Pipe Treatment: HRC/UV at NBPS site	1.0																													- O&M: All going off at once - one more site (Group 4) - End of pipe treatment was favored by this group due to: simplicity - we know what would be built; only use it when needed; most straight forward; provides flexibility - more capacity in conveyance and West Point Treatment for City to pursue storage projects in Ballard and Fremont/Wallingford for future CSO reduction projects (true for all alternatives that do not convey flows to West Point) (Group 2) - Below grade would get a "green dot" for Community (Group 3)
4A	Demand Management: Reduce I/I Flows to Eliminate Storage or Pumping																														
5A	Combinations: Storage Plus Demand Management																														- Investigate further. Smoke test. (Group 2)
5B	Combinations: Convey & Treat Plus Demand Management																														
5C	Combinations: Convey & Treat Plus Storage																														

GENERAL COMMENTS
- Any new facilities must include new staffing requirements (Group 3)
- Onsite treatment combined with demand management option: Green dots for Cost Effectiveness, Technical Feasibility/Compatibility, Public Health & Environmental Benefit. Yellow dots for O&M, Flexibility, community, Program Compatibility. (Group 3)

SCREENING CRITERIA COMPONENTS

Cost Effectiveness	Operations & Maintenance	Technical Feasibility/ Compatibility	Public Health & Environmental Benefit	Flexibility	Community	Program Compatibility
Capital Cost	Reliably meet CSO objectives	Compatible with Existing System	Meet CSO Requirements	Future Regulations	Neighborhood Equity	Seattle Parks, SPU, Transportation
Life Cycle Costs	WTD Automation	Technically Feasible	Minimizes Public Exposure	Climate Change	Cost Allocation	Sediment Management Plan
Use of Existing Facilities	Ease of Start-up / Shut-Down	Can be Permitted	Minimal Environmental Footprint	CSO Program Objectives	Minimal Shoreline Impacts	County Planning Policies
Grants/Loan Ranking	Ease of Maintenance	Land is Obtainable	Minimizes Environmental Risks	Implementation	Minimal Property Disruption	Stormwater Management Responsibilities
	No Adverse Impacts - County	Minimize Federal / State Permit Constraints	Endangered Species		Minimal Implementation Impacts	Conveyance System Improvement Policies
	No Adverse Impacts - Seattle		Coordinates with Puget Sound Goals		Minimal Operations Impacts	WTD Productivity Initiative
	Ease of Regulatory Reporting				Minimal Distubance of Archeological Areas	Puget Sound Restoration
						WTD Balanced Scorecard
						WTD CSO Program

LEGEND
- High ranking as compared to other alternatives
- Neutral ranking / unknown / undecided
- Low ranking as compared to other alternatives

MAGNOLIA BASIN
ALTERNATIVES EVALUATION - WORKSHOP 2

ALTERNATIVE		RELATIVE COST	SCREENING CRITERIA																												NOTES
			COST EFFECTIVENESS				O & M				TECHNICAL FEASIBILITY / COMPATIBILITY				PUBLIC HEALTH & ENVIRONMENTAL BENEFIT				FLEXIBILITY				COMMUNITY				PROGRAM COMPATIBILITY				
ID	DESCRIPTION		Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	
1A	Storage: Offsite Tank at W. Lynn St., Treat at West Point	2.0																													
1B	Storage: Tank near Magnolia CSO Control Point	1.5																													
1C	Storage: Offsite Tank east of Marina, Treat at West Point	1.9																													- Check microtunnel feasibility (Group 2)
2A	Convey and Treat:	1.0																													
2B	Convey and Treat:	1.2																													
3A	End of Pipe Treatment:	1.3																													- May have to extend outfall (Group 3) - Need new outfall? (Group 2)
4A	Demand Management:	2.1 +																													- Due to geotech and topography, demand management is questionable (Group 3) - Capacity of SPU storm system? Treatment needs? (Group 1) - Check slope stability with extra surface water (Group 2)
5A	Combinations:																														- Multiple small storage unit option: interested in looking at northwest beach area, may capture more flow than 25% (Group 3)
5B	Combinations:																														
5C	Combinations:																														

GENERAL COMMENTS
- Any new facilities must include new staffing requirements (Group 3)
- Look at geotech for all options, evaluate constructability (esp. ravine) and slope stability (Group 1)
- Evaluate land ownership and land use in area; it's more than Seattle Parks. Also SDOT, SPU, Port and multiple private owners (Group 1)
- Need to evaluate impacts of options on SPU system (Group 1)

SCREENING CRITERIA COMPONENTS

Cost Effectiveness	Operations & Maintenance	Technical Feasibility/ Compatibility	Public Health & Environmental Benefit	Flexibility	Community	Program Compatibility
Capital Cost	Reliably meet CSO objectives	Compatible with Existing System	Meet CSO Requirements	Future Regulations	Neighborhood Equity	Seattle Parks, SPU, Transportation
Life Cycle Costs	WTD Automation	Technically Feasible	Minimizes Public Exposure	Climate Change	Cost Allocation	Sediment Management Plan
Use of Existing Facilities	Ease of Start-up / Shut-Down	Can be Permitted	Minimal Environmental Footprint	CSO Program Objectives	Minimal Shoreline Impacts	County Planning Policies
Grants/Loan Ranking	Ease of Maintenance	Land is Obtainable	Minimizes Environmental Risks	Implementation	Minimal Property Disruption	Stormwater Management Responsibilities
	No Adverse Impacts - County	Minimize Federal / State Permit Constraints	Endangered Species		Minimal Implementation Impacts	Conveyance System Improvement Policies
	No Adverse Impacts - Seattle		Coordinates with Puget Sound Goals		Minimal Operations Impacts	WTD Productivity Initiative
	Ease of Regulatory Reporting				Minimal Distubance of Archeological Areas	Puget Sound Restoration
						WTD Balanced Scorecard
						WTD CSO Program

LEGEND
- High ranking as compared to other alternatives
- Neutral ranking / unknown / undecided
- Low ranking as compared to other alternatives

BARTON AND MURRAY BASINS
ALTERNATIVES EVALUATION - WORKSHOP 2

ALTERNATIVE		RELATIVE COST	SCREENING CRITERIA																												NOTES
ID	DESCRIPTION		COST EFFECTIVENESS				O & M				TECHNICAL FEASIBILITY / COMPATIBILITY				PUBLIC HEALTH & ENVIRONMENTAL BENEFIT				FLEXIBILITY				COMMUNITY				PROGRAM COMPATIBILITY				
			Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4	
B1A - M1B	0.5 MG storage at Fauntleroy and 1.3 MG storage at Murray	1.2																													
B1A - M2B	0.5 MG storage at Fauntleroy and 8.5 mgd conveyance capacity at Murray	2.1																													
B1A - M3B	0.5 MG storage at Fauntleroy and demand management at Murray																														
B1A - M4B	0.5 MG storage at Fauntleroy and 8.5 mgd end of pipe treatment at Murray	1.0																													
B4A - M1B	Demand management in Barton and 1.3 MG storage at Murray																														
B4A - M2B	Demand management in Barton and 8.5 mgd conveyance capacity at Murray																														
B4A - M3B	Demand management in both Barton and Murray																														
B4A - M4B	Demand management in Barton and end of pipe treatment at Murray																														

GENERAL COMMENTS
- Any new facilities must include new staffing requirements (Group 3)
- What about a deep tunnel/in-line storage under Lincoln Park with portals on both edges of the park? It wouldn't be in anybody's special park areas, plus this could offload more flow from Alki. (Group 3)

SCREENING CRITERIA COMPONENTS

Cost Effectiveness	Operations & Maintenance	Technical Feasibility/ Compatibility	Public Health & Environmental Benefit	Flexibility	Community	Program Compatibility
Capital Cost	Reliably meet CSO objectives	Compatible with Existing System	Meet CSO Requirements	Future Regulations	Neighborhood Equity	Seattle Parks, SPU, Transportation
Life Cycle Costs	WTD Automation	Technically Feasible	Minimizes Public Exposure	Climate Change	Cost Allocation	Sediment Management Plan
Use of Existing Facilities	Ease of Start-up / Shut-Down	Can be Permitted	Minimal Environmental Footprint	CSO Program Objectives	Minimal Shoreline Impacts	County Planning Policies
Grants/Loan Ranking	Ease of Maintenance	Land is Obtainable	Minimizes Environmental Risks	Implementation	Minimal Property Disruption	Stormwater Management Responsibilities
	No Adverse Impacts - County	Minimize Federal / State Permit Constraints	Endangered Species		Minimal Implementation Impacts	Conveyance System Improvement Policies
	No Adverse Impacts - Seattle		Coordinates with Puget Sound Goals		Minimal Operations Impacts	WTD Productivity Initiative
	Ease of Regulatory Reporting				Minimal Distubance of Archeological Areas	Puget Sound Restoration
						WTD Balanced Scorecard
						WTD CSO Program

LEGEND
- High ranking as compared to other alternatives
- Neutral ranking / unknown / undecided
- Low ranking as compared to other alternatives