CHAPTER NO. 5

METHODOLOGY FOR DEVELOPING AND EVALUATING ALTERNATIVES

5.1 OVERVIEW

This chapter describes the process used to develop and evaluate alternatives for meeting the CSO control objective for the Barton and Murray CSO basins. Alternatives that could achieve the objective were developed for the broad CSO control approaches described in Chapter 4: storage, treatment, conveyance, peak flow reduction, or a combination of these. Each alternative was evaluated for technical merit, ability to be implemented, and cost. The number of alternatives was reduced to a shortlist of most feasible options. New alternatives were then developed based on public input, and a recommendation for each basin was chosen from the shortlisted and public-input alternatives.

Phase 1 of the project began in January 2007 with review of county-produced flow projections, assessment of the broad CSO control approaches, and development of initial criteria for evaluating alternatives. In Phase 1, work included the following:

- County-produced flow data was reviewed, which indicated that fieldwork was needed to better define the origin of peak flows.
- Flow monitoring was conducted between December 2007 and June 2008.
- Hydraulic models were developed between March 2008 and June 2009.
- The flow monitoring and modeling results were used to help define peak flow contributions from discrete sub-basins and to confirm previous county modeling.
- Using the modeling results, CSO control volumes were developed for sub-basins, and overall control volumes for the basins were refined.
- The modeling results were used to determine peak-flow projections, control volumes, and impervious-area disconnection requirements at the sub-basin level. This information was used to create and evaluate alternatives.

Phase 2 of the project included creating and evaluating a preliminary suite of alternatives. The work included the following:

- Development and evaluation of preliminary alternatives
- Selection of a shortlist of alternatives for further evaluation
- Development of public-input alternatives and refinement of the shortlisted alternatives using expanded information
- Recommendation of a proposed CSO control alternative.

Documentation of the evaluation and selection of alternatives is presented in Appendix B.

5.2 PHASE 1

Phase 1 consisted of development of initial criteria to screen control approaches and identify initial alternatives that respond to the criteria. During this phase, the project boundaries were established, as depicted in Figure 2.1.

The process of developing CSO control approaches as described in Chapter 4 was initiated in 2007 based on existing county documentation, modeling data, and basin-specific fieldwork. Preliminary evaluations of potential approaches were performed, including constraints and opportunities in each basin. During this effort, it was recognized that additional information relating to the distribution of peak flows in each sub-basin was needed to fully evaluate the feasibility of distributed control approaches or approaches away from the bottom of the basin. Therefore, a flow monitoring and modeling program was implemented to obtain data for smaller areas in each basin. Phase 1 included the steps described below.

5.2.1 Step 1.1: Define Criteria Categories

Criteria that were used to determine viability of CSO control approaches were defined by the project team. Seven criteria categories were selected, as illustrated in Table 5.1.

5.2.2 Step 1.2: Identify Control Approaches

The CSO control approaches evaluated are described in detail in Technical Memorandum 202.1 (Carollo, 2007a) and in Chapter 4 of this facility plan. The approaches are as follows:

- **Control Approach 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 downstream once the rainfall event has subsided.
- **Control Approach 2, Convey and Treat Peak Flows.** Convey peak flows out of the basin by increasing pumping and force main capacity, or the capacity of the gravity sewer system. This approach may also require treatment upgrades at the point where the peak flows are discharged, as the capacity of existing treatment facilities may not be adequate for additional flows and loads.
- **Control Approach 3, End of Pipe Treatment for Peak Flows.** Treat and discharge peak flows at or near the current CSO locations. The typical treatment process used for end of pipe treatment includes high rate clarification (HRC) and ultraviolet (UV) disinfection.
- **Control Approach 4, Peak Flow Reduction.** 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.
- **Control Approach 5, Combined Approach.** Reduce peak flows within the basin by implementing a combination of two or more of the previously mentioned CSO approaches.

Table 5.1 Initial Evaluation Criteria

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

5.2.3 Step 1.3: Develop Initial Conceptual Alternatives

Initial alternatives were developed in order to assess each control approach. Each alternative identified necessary infrastructure and locations chosen based on proximity to the CSO and the feasibility of using gravity sewers for flow to and from the new infrastructure. Storage alternatives identified in this phase were all centralized; dispersed storage options were identified in Phase 2, after flow monitoring and modeling were completed.

5.2.4 Step 1.4: Evaluation and Initial Results

Following the development of initial alternatives, an assessment of the viability of each control approach or a combination of control approaches was completed considering the constraints of the Barton and Murray CSO basins (topography, land use, downstream capacity, and peak-flow sources). The conclusions of this assessment were as follows:

- **Peak-Flow Storage Approach.** The topography of the Barton and Murray CSO basins is such that few locations exist for siting storage facilities at the bottom of basin. Each potential site identified faces construction challenges (available space, existing land use, proximity to Puget Sound, and geotechnical concerns). In the Barton CSO basin, there is no land available immediately adjacent to the existing Barton Pump Station; any construction near the pump station would require removal of several private properties and would involve significant disruption of traffic to the ferry terminal. However, the Barton CSO basin is suitable for a mid-basin storage facility that can achieve CSO control at the bottom of the basin. In Murray, storage facilities must be located at the bottom of the basin to reliably provide control. The topography and land use provide few opportunities to site the required facilities. Some identified sites involve park property or private property. A preliminary geotechnical investigation of the basins recommended that a geotechnical evaluation be conducted on the recommended alternatives for each basin as part of preliminary design.
- **Convey and Treat Approach.** The convey and treat control approach was determined to be technically infeasible because of capacity limitations of the Alki Wet Weather Treatment Plant.
- **End-of-Pipe Treatment Approach.** End-of-pipe treatment was determined to be technically feasible. It was recommended that a geotechnical analysis of soil conditions be conducted to determine the feasibility of locating facilities near the Barton and Murray Pump Stations.
- **Peak-Flow Reduction Approach.** Evaluation of peak-flow reduction using impervious area disconnection indicated that it would not be sufficient by itself to reduce CSOs to one event per year in the Murray CSO basin.
- **Combination of Approaches.** Peak-flow reduction could be used in combination with storage to meet the CSO regulations in this basin. There is enough connected impervious area in Barton Sub-basin 416 for disconnection to provide control for the

Barton CSO basin, once the proposed capacity upgrade of the Barton Pump Station is completed.

These are initial assessments of the viability of each control approach. Further consideration was given in Phase 2 to control approaches identified here as not viable. Approaches were reviewed with agency stakeholders an Agency Workshop on May 7, 2009. Input from the workshop was used to help develop and refine the alternatives and criteria for Phase 2.

5.3 PHASE 2

Phase 2 comprised re-evaluation and refinement of CSO approaches and development of preliminary alternatives following completion of flow monitoring and hydraulic modeling. Community information meetings and briefings with citizens in late 2007 and early 2009 elicited comments on community concerns and support or opposition to approaches.

5.3.1 Step 2.1: Develop and Evaluate CSO Control Alternatives

The August 19, 2009 team memoranda, “Developing Criteria for Evaluating CSO Alternatives” (Carollo Engineers) and “Selecting Candidate Sites for CSO Control Approaches” (Carollo Engineers) describe the process for developing and evaluating alternatives. The process is summarized below.

5.3.1.1 <u>Step 2.1A: Criteria Development</u>

“Category Leads” were designated for each of seven categories of selection criteria to be used in evaluating alternatives. The Category Leads developed criteria as follows:

- Select up to five criteria for each final category shown in Table 5.2. In the operations and maintenance (O&M) category, for example, one criterion might be “Reliability,” another might be “Site Access,” etc. As part of this process, the seven categories developed in Phase 1 were refined. During refinement, some categories were combined and renamed as shown in Table 5.2. Two initial categories, “Flexibility” and “Compatibility with other Programs and Initiatives” were combined with other categories due to their interrelationship. The “Land Use / Acquisition / Permitting” category was subdivided into two categories in recognition of differences between land acquisition and project permitting.

- Develop questions to be answered for each criterion. These questions were used to “test” the impact of a particular alternative on the criteria being considered. For example, one question for the “Reliability” criterion was, “Does the alternative rely on complex automation for successful operation?” Another question may be, “Has the alternative proven to be a reliable CSO control method in other installations?”

- Develop a description of how the criterion will be measured using the rating scale (i.e. Low, Moderate, and High impact). For the question, “Does the alternative rely on complex automation for successful operation?” a “High” score would be described by, “The alternative requires substantial automation of mechanical equipment for performance." A "Low" score would be described by, "The alternative is relatively simple and requires limited automation and equipment for performance."

Table 5.2 Evaluation Category Development

Initial Category (June 2007)	Final Category (September 2009)
Cost Effectiveness	Cost
Ease of Operations and Maintenance	Operations and Maintenance (O&M)
Technical Feasibility and Compatibility	Technical
Public Health and Environmental	Environmental
Community Considerations	Community Impact
Flexibility[(1)]	Land Use / Acquisition[(2)]
Compatibility with other Programs and Initiatives[(1)]	Permitting[(2)]

Notes:
1. Criteria combined with other categories in final criteria category list.
2. Category added following initial criteria category development.

The final criteria, questions, and rating scales developed through this process are included in Appendix B and summarized in Table 5.3.

5.3.1.2 Step 2.1B: Alternatives Development

Site suitability criteria for the evaluation were developed and then used together with GIS data to identify potential preliminary sites. Available land areas where new system components could be sited and constructed were identified based on the "technical feasibility" of the resulting alternative. "Technical feasibility" was defined as follows:

- Availability of Peak Flows. The resulting alternative must be sited in a location that allows sufficient peak flows to be captured and routed to the new facility.
- Constructability. The resulting alternative (and associated system components) must be constructible on the site. In order for an alternative to be constructible, the site where components would be built must be of sufficient size, with reasonable access for construction activities (staging, shoring, excavation, tank construction, etc.).
- Operational Performance. The resulting alternative (and system components) must be capable of meeting the intended performance within the existing hydraulic profile of the CSO outfall and combined sewer system.

Table 5.3 Evaluation Criteria, Questions and Rating Scale

Questions	Rating Scale: Low Impact (rating of 3)	Rating Scale: Moderate Impact (rating of 2)	Rating Scale: High Impact (rating of 1)
LAND USE AND PERMITTING CRITERIA			
Criterion 1. City of Seattle Comprehensive Plan			
1. Project location consistent with Seattle planning policies?	Yes	Partly consistent	Potentially inconsistent
Criterion 2. Seattle Municipal Code			
1. Construction location and type consistent with Municipal Code and Growth Management Act?	Yes	Partly consistent	Inconsistent
Criterion 3. Shoreline Master Program			
1. Project location consistent with the Shoreline Master Program?	Not located in shoreline zone	Located in shoreline zone, generally consistent	Located in shoreline zone, potentially inconsistent
Criterion 4. Permitting Complexity			
1. Discretionary permits required?	SEPA and local permits	Shoreline substantial development permit, and/or discretionary land use permit	3 – 4 required with Public Notice. Shoreline and critical area reviews required
2. Project changes NPDES permit requirements?	Meets baseline reporting requirements		Requires additional monitoring and/or reporting
3. Project requires marine access or in-water work? Multiple work closures due to habitat?	No marine access required. No known fish or wildlife impact.	Marine access may be required. Fish and wildlife impacts low to moderate.	Marine access required. Fish and wildlife impacts higher and more certain.
4. Significant traffic and noise impacts?	Roadways not affected, or only low-volume roads.	Project requires attention to traffic control and access	Major traffic and access issues.
Criterion 5. Property Acquisition Complexity			
1. Property rights can be acquired within project timeline?	King County has ownership.	Voluntary seller identified or use of ROW	Ability to acquire property rights unknown
2. Potential acquisition variables that impact cost?	Owner and King County agree on price	Owner requests additional compensation	Significant costs of acquisition probable
3. Impacts on stakeholders & current use?	No conflict w/ current use	Owners /tenants require relocation	Strong opposition from stakeholders
ENVIRONMENT CRITERIA			
Criterion 1. Cultural Resources			
1. Construction impact on archaeological resources?	No known archaeological resource sites in or near site and potential is low.	Site contains no known archaeological resources but there is potential.	Project area contains or is adjacent to known archaeological sites.
2. Construction impact on historic resources?	No historic properties in or near the project area.	Historic properties in or near project area, but no construction impact on them.	Historic properties in or near project area, and likely construction impact on them.
Criterion 2. Fish and Wildlife			
1. Project construction or operation will adversely affect fish, wildlife or habitat?	Benefit or no adverse impact.	Potential adverse impact.	Likely adverse impact.
Criterion 3. Wetlands, Streams, and Shoreline			
1. Project construction impact on wetlands, streams or shorelines?	Project unlikely to impact wetlands, streams, buffers or shorelines.	Likely direct impact on buffer, but not wetlands, streams or shorelines.	Likely direct impact on wetlands, streams or shorelines.

Table 5.3 Evaluation Criteria, Questions and Rating Scale

Questions	Rating Scale Low Impact (rating of 3)	Moderate Impact (rating of 2)	High Impact (rating of 1)
ENVIRONMENT CRITERIA (continued)			
Criterion 4. Soils and Sediments			
1. Will construction disturb contaminated soils?	Project area has no known contaminated soils and potential for contaminated soils on the site is low.	Project area has no known contaminated soils but there is potential for contaminated soils on the site.	The project site area is known to contain contaminated soils.
2. Will construction disrupt steep slopes or increase landslide risk?	No likely effect.	Temporary effect.	Long-term effect.
Criterion 5. Water Quality			
1. Will operation result in a new discharge of untreated stormwater to a surface water?	No	Possibly	Yes
TECHNICAL CRITERIA			
Criterion 1. Technical Complexity			
1. Does project require complex controls and infrastructure to direct flow? Will it reliably meet CSO control objectives?	Measurement and control for flow routing is simple. Project is near or within existing infrastructure.	Requires remote measurement of flows and controlled routing of flows. Modifications to infrastructure are simple.	More than two locations require flow control. Complex controls required to route flow. New pipelines of significant length may be needed.
2. How many individual sites are included? Are technical and construction approaches consistent across sites?	Only one site. All controls and infrastructure are located on the site or on adjacent right of way or county-owned property.	Two non-adjacent sites, potentially with differing construction methods. Structures may be needed adjacent to sites.	Multiple non-adjacent sites. Two or more construction technologies may be required.
Criterion 2. Compatibility with Existing Wastewater System			
1. Do standards of other agencies affect project design and operation?	King county design standards are the only applicable standards.	Flow routing structures may be located in City of Seattle infrastructure, and be subject to City standards. No City access permissions needed.	Major structures within City infrastructure, where City standards apply. Permissions and coordination needed for normal O&M access.
2. Does the project affect other parts of the wastewater system?	The project is stand-alone. Peak flows at West Point are not affected.	Project may require modifications to county infrastructure. Peak flows at West Point may be affected.	The project requires modification of City of Seattle and county infrastructure and operational methods for both.
Criterion 3. Flexibility/ Adaptive Management			
1. Can the project meet changing control criteria?	Yes	Possibly	No
2. Can the project be easily modified to meet future flow conditions?	Yes	Possibly	No
Criterion 4. Constructability/Implementation Schedule			
1. Significant construction risks associated with groundwater, steep slopes, or soil materials?	Project is on stable, low-slope site with no effect from groundwater.	Site may have low to moderate slope, require some dewatering and foundations.	Site has steep slopes, groundwater and soil conditions that increase instability. High erosion potential. Special measures needed to stabilize site.
2. Significant construction risks associated with access, staging, specialty contractors, power, etc.?	No constraints. Adequate area for access, staging and operation of equipment.	Contractor may have to provide offsite staging and operations.	Construction requires offsite staging and operations, and sequencing to accommodate specialty contractors.
3. Can project meet the schedule?	Yes	Possibly	No

Table 5.3 Evaluation Criteria, Questions and Rating Scale

Questions	Rating Scale: Low Impact (rating of 3)	Rating Scale: Moderate Impact (rating of 2)	Rating Scale: High Impact (rating of 1)
O&M CRITERIA			
Criterion 1. Staffing			
1. Can the facility be started up easily and operate autonomously under design conditions?	Yes	Facility can be automatically started but requires attention during design conditions.	Facility requires operator attention during startup and design conditions.
2. What level of staffing is required for peak operation and for shutdown?	Facility can be remotely operated. Peak staffing less than 1 FTE. Facility can be shut down with minimal staff time. Cleanup is automated or can be integrated with other duties.	Operation requires operator periodically. Peak staffing is 1-2 FTE. Facility can be shut down with minimal staff time. Most cleanup is automated and can be integrated with other duties, but 1-2 FTE may be required.	Facility requires operator attention. Peak staffing is 2 or more. Significant effort required for shut down. Cleanup work is generally manual; 2 or more FTE for more than one day.
3. Does the project impact downstream treatment facility processes?	No impact on downstream secondary processes or secondary treatment bypass frequency.	Impact on downstream secondary processes but no effect on permit compliance. Increased secondary treatment bypass frequency within permit limits.	Impact on downstream secondary processes that may affect permit compliance. Increased secondary treatment bypass frequency not within permit limits.
Criterion 2. Training			
1. How much staff training is required? Is existing staff familiar with the technology?	Minimal training required. Staff is familiar with the technology and similar processes are used at other CSO projects.	Minimal training is required. Staff does not routinely operate similar processes or the processes are distinctly different from those used at other CSO projects.	Significant training is required. Staff does not routinely operate similar processes and the processes are distinctly different from those used at other CSO projects.
2. Are similar control approaches specified with identical components? Can the facilities be used to simulate an event for testing and training?	Similar control approaches are specified with identical components at each facility. Control procedures are similar to existing facilities. Facilities can be used to simulate an event for testing and training.	Somewhat similar control approaches are specified at each facility, with some differences. Control procedures are not similar to existing facilities. Facilities can be used to simulate an event for testing and training.	Different control approaches are specified at each facility. Control procedures are not similar to existing facilities. Facilities cannot be used to simulate an event for testing and training.
Criterion 3. Reliability			
1. How complex is the system? How complex are the startup procedures and controls? Are redundant control systems provided? Is dedicated backup power available?	The project has minimal components. Startup is passive or automated remotely with redundant control systems and backup power.	The project has several components. Startup is automated locally with redundant control systems and backup power.	The project has numerous components. Startup is generally automated locally but may require operator action, with redundant control systems. No backup power.
2. Proven technology? Are the control systems routinely used for similar facilities and similar applications?	Project uses processes commonly used by King County and the industry. Control requirements are minimal and routinely used for similar facilities.	Project uses processes commonly used within the industry. Control requirements may be significant but are routinely used for similar facilities.	Project uses processes not commonly used within the industry. Control requirements may be significant and unique.

Table 5.3 Evaluation Criteria, Questions and Rating Scale

Questions	Rating Scale: Low Impact (rating of 3)	Rating Scale: Moderate Impact (rating of 2)	Rating Scale: High Impact (rating of 1)
O&M CRITERIA (continued)			
Criterion 4. Maintenance			
1. What is the level of normal maintenance? How many mechanical/instrumentation components are required?	Annual preventive maintenance. Minimal mechanical/ instrumentation components.	Monthly maintenance. Moderate level of mechanical/ instrumentation components.	Monthly maintenance. High level of mechanical/ instrumentation components.
2. Are facility components accessible? Access and staging available for maintenance vehicles? Traffic control required for routine maintenance?	The facilities are accessible.	Facilities are accessible for routine O&M. Special procedures or traffic control may be required for irregular maintenance.	Facilities have restricted access for routine O&M. Special procedures or traffic control may be required for irregular maintenance.
3. Do the facilities require interaction with other agencies (Seattle Parks, etc.) for O&M?	No	Not for operation, but for some routine maintenance	Yes
Criterion 5. Safety			
1. Does the facility have right-of-way access requirements or require confined space entry? Are traffic control procedures required? Does access require street use permit or lane closure?	No right-of-way access requirements, confined space entry or traffic control required for O&M.	Right of way access requirements, confined space entry or traffic control required for non-routine O&M.	Right of way access requirements, confined space entry or traffic control required for routine O&M.
COST EFFECTIVENESS CRITERIA			
Criterion 1. Project Costs			
1. Are project costs predictable and quantifiable for design, permitting and mitigation?	Technology and construction methods of are common. Costs for design and construction are controllable within the expertise of the county. Construction schedule, sequencing, and site constraints are low.	Technology and construction methods include both well-known and somewhat new to elements. Cost experience of other local agencies or the designer is adequate to control costs. Construction schedule, sequencing, and site constraints are quantifiable.	New technologies with complex controls and multi agency interactions create project cost variables that are not within the county's or designer's experience. Schedule, site constraints, and sequencing add variables that are hard to control.
2. What is the relative premium to provide flexibility and durability to meet future uncertainty?	Technology is modular and can be easily expanded in the future.	Design to meet future needs requires extra measures, but additions for capacity or performance are modular.	Technology is not amenable to future changes. Planning for separate future projects may be needed.

Table 5.3 Evaluation Criteria, Questions and Rating Scale

	Rating Scale		
Questions	Low Impact (rating of 3)	Moderate Impact (rating of 2)	High Impact (rating of 1)
COST EFFECTIVENESS CRITERIA			
Criterion 2. Operation Costs			
1. Are operational costs predictable and quantifiable?	Few components require O&M attention. Activities are predictable, can be scheduled, have annual frequency, and use familiar procedures and technology. Operation is easily remotely controlled.	3-4 components require O&M attention. Activities are predictable, can be scheduled, have monthly frequency, and use procedures and technology that may require training. Operation may require attention to confirm performance. Maintenance access may be restricted.	More than 4 components require O&M attention. Activities are predictable, can be scheduled, have monthly or greater frequency, and use procedures and technology that require special training and staffing. Operation requires attention to confirm performance. Maintenance access may be restricted.
2. Are costs for training, energy, staffing, and external agency activities high or low?	Project does not require special training; no chemicals or significant power are required, and there are no routine external agency costs.	Project requires additional training within existing skill sets; no chemicals or significant power are required. There are annual costs associated with external agency coordination.	Project requires additional training for new skill sets; chemicals and significant power are required. There are frequent costs associated with external agency coordination.
3. Are additional staff positions required for operation?	No	Limited additional staff needed for maintenance.	Additional staff needed for operation and maintenance.
Criterion 3. Maintenance Costs			
1. Does the project require significant maintenance resources?	Maintenance is limited to annual cycle with existing staff resources.	Maintenance is monthly with increased staff resources and increased complexity.	Maintenance is monthly with increased staff resources and complex processes.
2. Does the project require maintenance skills beyond the County's typical expertise?	No	Requires additional training within existing skill sets.	Project requires additional training within new skill sets.
3. Does maintenance cost increase with capacity?	No	Capacity increases require more mechanical or electrical maintenance and more cleaning, not directly proportional to capacity.	Mechanical or electrical maintenance and additional cleaning are directly proportional to capacity increase.
Criterion 4. External Costs			
1. How does the cost of land and land development compare with other alternatives?	County owns the land.	County must purchase ground lease but does not have to acquire the land.	County must purchase the land and mitigate or replace displaced resources.
2. Are extra costs imposed by design standards or durability requirements of external agencies or stakeholders?	County controls all design requirements.	County has to provide additional design elements to meet standards.	County has to invest heavily into meeting external standards and costs are not controllable.
3. Are there extra costs for durability elements to insure successful operation and maintenance?	No	Some parts of the project are under external agency control for design standards, durability, or operation.	All parts of the project will be constructed and operated by others.
Criterion 5. Grant Opportunities			
1. Does the project have attributes that make it more amenable to grant funding ("green" technology, public benefits, etc.)?	The project has several such components.	Some components of the project may help to win grants.	No

Table 5.3 Evaluation Criteria, Questions and Rating Scale

Questions	Rating Scale Low Impact (rating of 3)	Rating Scale Moderate Impact (rating of 2)	Rating Scale High Impact (rating of 1)
COMMUNITY IMPACT CRITERIA			
Criterion 1. Location			
1. Does facility change or impede surrounding land and marine uses?	No	Facility requires design elements to limit changes or impediments to surrounding uses.	Facility changes or impedes surrounding uses and changes cannot be addressed in design.
Criterion 2. Potential Community Impacts			
1. Is use compatible with community vision of itself at project outset?	Facility is consistent with or does not affect community's vision of itself.	Facility and grounds can be designed to remain consistent with community's vision of itself.	Facility is not in character with community's vision of area and difference cannot be addressed in design.
2. What are the impacts of O&M activities on the surrounding community?	Minimal staff will be present infrequently and maintenance is carried out within facilities.	Routine maintenance will be needed, and staff may be onsite round the clock to check facilities. Some special equipment may be necessary, but disruptions are minor.	Routine maintenance will be needed, and multiple staff will be present around the clock. Parking, traffic or access disruptions during maintenance operations.
Criterion 3. Construction Impacts			
1. What is the construction schedule/duration?	Short term project in residential area, long term project in business/ industrial area, or longer term project on alignment.	Project extends over 1 year on a site near residences of any kind, or over two years on an alignment.	Project extends several years, or follows another substantial construction project in one area.
2. Will construction be carried out in public access areas?	Project on site with no public access, or public access can be maintained during construction.	Project located in public access area; access may be reduced, but some access can be maintained during construction.	Project lasts a year or more, in heavy use roadway, park or beach area , with serious and unavoidable area closures.
3. What are anticipated construction impacts on neighbors? What are the traffic disruptions?	Neighbors will experience limited impacts.	Construction will be near residences and businesses, but impacts will be limited to ordinary work hours and can be mitigated with reasonable effort.	Construction will be adjacent to residences and businesses, and it will be difficult to mitigate impacts. Environmental monitoring will be necessary.
4. How will truck traffic affect area?	Limited amount of hauling required; roadways sufficient to support traffic.	Moderate level of hauling that may occur on residential streets but can be scheduled to avoid conflicts.	High-volume, long-term truck traffic on constricted roadways that cannot be done on a restricted schedule or route.
5. What is construction area requirement?	Construction can be carried out on facility site, with limited offsite area required.	Construction can be carried out on facility site, but additional offsite areas will be required.	Additional property or extensive easements must be obtained for the project to be constructed. Multiple offsite areas will be required, with ongoing transport of materials to primary site.

A hierarchy of technical considerations was used to judge "technical feasibility" and identify potential sites for the CSO control approaches. They are listed in order from most favorable to less favorable as follows:

1. Favor locations and facility configurations at the bottom of the basin near the existing CSO outfall.
   a. Provides ability to capture 100 percent of the flow in the basin and route it to the new facility.
   b. Reduces complexity of control system required to route flows to new facility; thereby reducing risks of future overflows.
   c. Minimizes conveyance system construction requirements.
2. Favor locations along existing combined sewer trunk lines through which 50 percent or more of the total basin peak flow is conveyed.
   a. Helps ensure sufficient volumes are captured to adequately reduce peak flows and volumes at the bottom of the basin at the existing CSO outfall.
3. Favor locations and facility configurations that allow a passive diversion of peak flows to the new facility (e.g., over a weir wall) rather than more complex control systems requiring telemetry or SCADA (supervisory control and data acquisition).
   a. Increases reliability by eliminating the need for power and control system (e.g., automated gates).
   b. Reduces the potential need to oversize the facility to limit overflows.
4. Favor locations and facility configurations where the bottom of new structures will not exceed a depth of 30 feet below the ground surface elevation.
   a. Minimizes shoring and dewatering requirements.
   b. Requires less area for construction and staging.
   c. Shallower facilities are easier to access.
   d. Avoids excessive structural requirements for tanks and treatment facilities.
   e. Increases feasibility of cut-and-cover construction for storage pipes vs. riskier and more expensive tunneled construction.

5.3.2 Step 2.2: Alternatives Screening

This step involved screening the alternatives to develop a shortlist for detailed evaluation. Step 2.2 was completed in a series of non-technical and technical meetings. The screening process for reducing the preliminary alternatives to three is described in two technical memoranda (Carollo, 2009g and Carollo, 2009h) and summarized in Table 5.4. During the development of a shortlist of alternatives, potential sites were further refined so the project team could focus on the characteristics of specific sites and how they would affect the implementation of each alternative.

5.3.3 Step 2.3: Selection of a Preferred Project

Between January 2010 and December 2010, two concurrent processes were used for developing alternatives and arriving at recommended projects for the Barton and Murray CSO basins:

- In the Barton CSO basin, the shortlisted alternatives were further developed for final evaluation. Detailed information is provided in the project memorandum *Barton Basin Alternatives Update Information* (Tetra Tech, 2010).

Table 5.4 Screening Steps and Schedule for Shortlist of Alternatives

Meeting Date	Meeting Purpose	Alternative Version	Description
August 2009	Present preliminary alternatives for initial comment.	V1	Preliminary cut at alternatives by Consultant.
September 2009	Non-technical focus meetings to identify information needed to complete alternative review matrices.	V2	Revisions to V1 based on comments received from CSO Team (non-technical focus).
October 2009	Technical focus meetings to add detail for O&M issues (layouts, configurations, etc.).	V3	Revisions to V2 based on comments received from CSO Team (technical focus).
November 2009	Team workshop to complete review matrices for each alternative.	V4	Revisions to V3 based on comments received from CSO Team
December 2009	Team workshops to select 3 alternatives.	V5	Select 3 alternatives by an initial straw poll and subsequent meetings to iteratively select the 3 alternatives.

- In the Murray Basin, the County and the consultant team entered into a public participation process with a Community Advisory Group empanelled by the County. This was to respond community concerns about potential impacts on parks and the proximity of proposed facilities to residences. The charter of this group was to become educated about the requirements of the CSO program and to work together with the county and consultant team to identify possible alternatives that would fulfill the CSO program requirements and address or relieve the community's concerns. This process brought forward some new alternatives, which were screened through the processes outlined for Step 2.2.

During the Community Advisory Group process for the Murray CSO basin, the Barton CSO basin evaluation was put on hold because the two basins are hydraulically inter-related, and a decision on a Barton CSO control project could have an effect on a decision for the Murray CSO basin.

Step 2.3 was completed in a series of non-technical and technical meetings to identify information needed to complete the alternative review and prepare evaluation matrices for each alternative.

Following the evaluation process, the project team forwarded to King County management a list of key evaluation points for three shortlisted projects in each of the Barton and Murray CSO basins. County management used this information for a final review and selection of proposed CSO control projects for the two basins. King County management made a final selection of a project on December 8, 2010.

5.4 BASIS OF DESIGN

The basis of planning for control of the Barton and Murray CSO basins is presented in Chapter 4 of this facility plan (see Table 4.1). This information was used to size facilities for each CSO control approach.

The basis of design criteria are key criteria for sizing equipment and laying out facilities. Consistency of design criteria is important for evaluating alternatives. Documenting the design criteria also provides key input for final design of the improvements. Figures 5.1 through 5.3 illustrate typical details for potential facilities common to many of the alternatives developed, including storage (rectangular and pipeline), conveyance (pump station), and end of pipe treatment. Table 5.5 highlights key design criteria for these facilities.

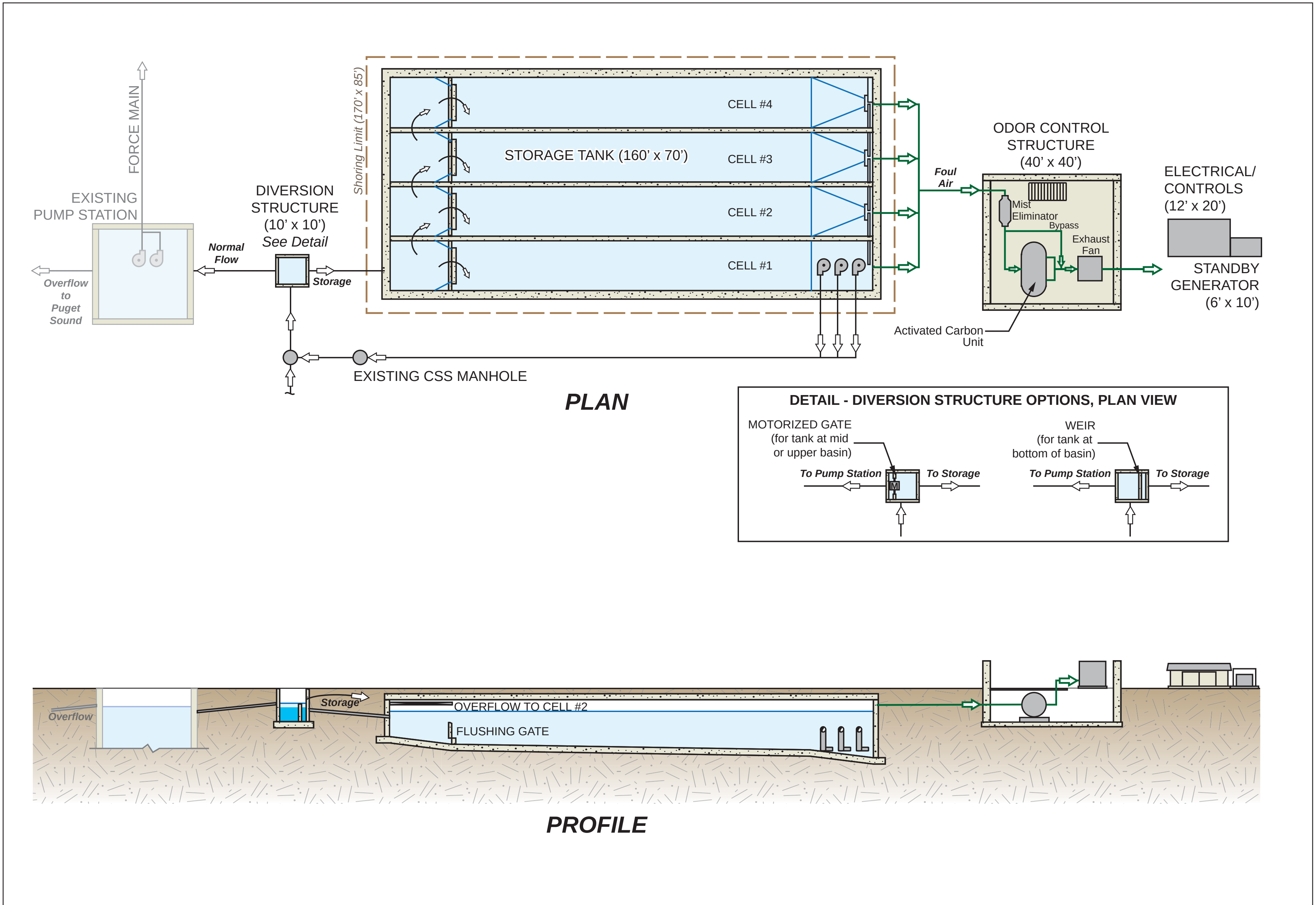
Table 5.5 Basis of Design Criteria

Facility	Design Criteria
Storage (Rectangular or Pipeline)	
Number of Cells	Rectangular - 2 to 4; Pipeline - 1
Floor Slope	1%
Minimum Freeboard	2 feet
Number of Drain Pumps	3 duty
Type of Pumps	Submersible
Maximum Time to Drain Storage	12 hours
Odor Control	Peak air displacement rate (peak flow to storage) or 2 air changes per hour (whichever is greater)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 24-hour capacity + 20% free capacity for future expansion.
Access	Every 200 feet (maximum); outside right-of-way
Equipment Materials	Corrosion resistant (304/316 stainless steel or fiberglass reinforced pipe)
Pump Station	
Number of Pumps	3 duty + 1 standby (per stage[1])
Type of Pumps	Centrifugal
Firm Capacity	Required conveyance capacity[2]
Wet well	Self-cleaning with modeling for proper design
Odor Control	2 air changes per hour (wet well)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 36 hour capacity
Force Main	10 feet per second up to 12 feet per second with permission (maximum)
Equipment Materials	Corrosion resistant (304/316 stainless steel or fiberglass reinforced pipe)

Table 5.5 Basis of Design Criteria

Facility	**Design Criteria**
<u>End of Pipe Treatment</u>	
Influent Screening	
Type	Perforated plate
Number of Screens	2
Screen Spacing	6 mm
High Rate Clarification	
Number of Trains	2
Total Suspended Solids Removal	85% or 10 mg/L (maximum)
Biochemical Oxygen Demand Removal	50% or 10 mg/L (maximum)
Chemical Feed Systems	Coagulant and Polymer
Ultraviolet Disinfection	
Number of Channels	1
Transmittance @254 nm	70%
Minimum Dose	40 mJ/sq. cm
Odor Control	2 air changes per hour (process basins)
Air Treatment	Activated carbon; 1 pass; 50 fpm; constant speed fan/blower
Occupied Space Ventilation	12 air changes per hour
Standby Generator	Total estimated load; diesel w/ 36 hour capacity
Equipment Materials	Corrosion resistant (316 stainless steel or fiberglass reinforced pipe)

<u>Notes:</u>
1 Total head above 200 feet requires 2-stage pumping for solids pumps.
2 See Table 4.1.

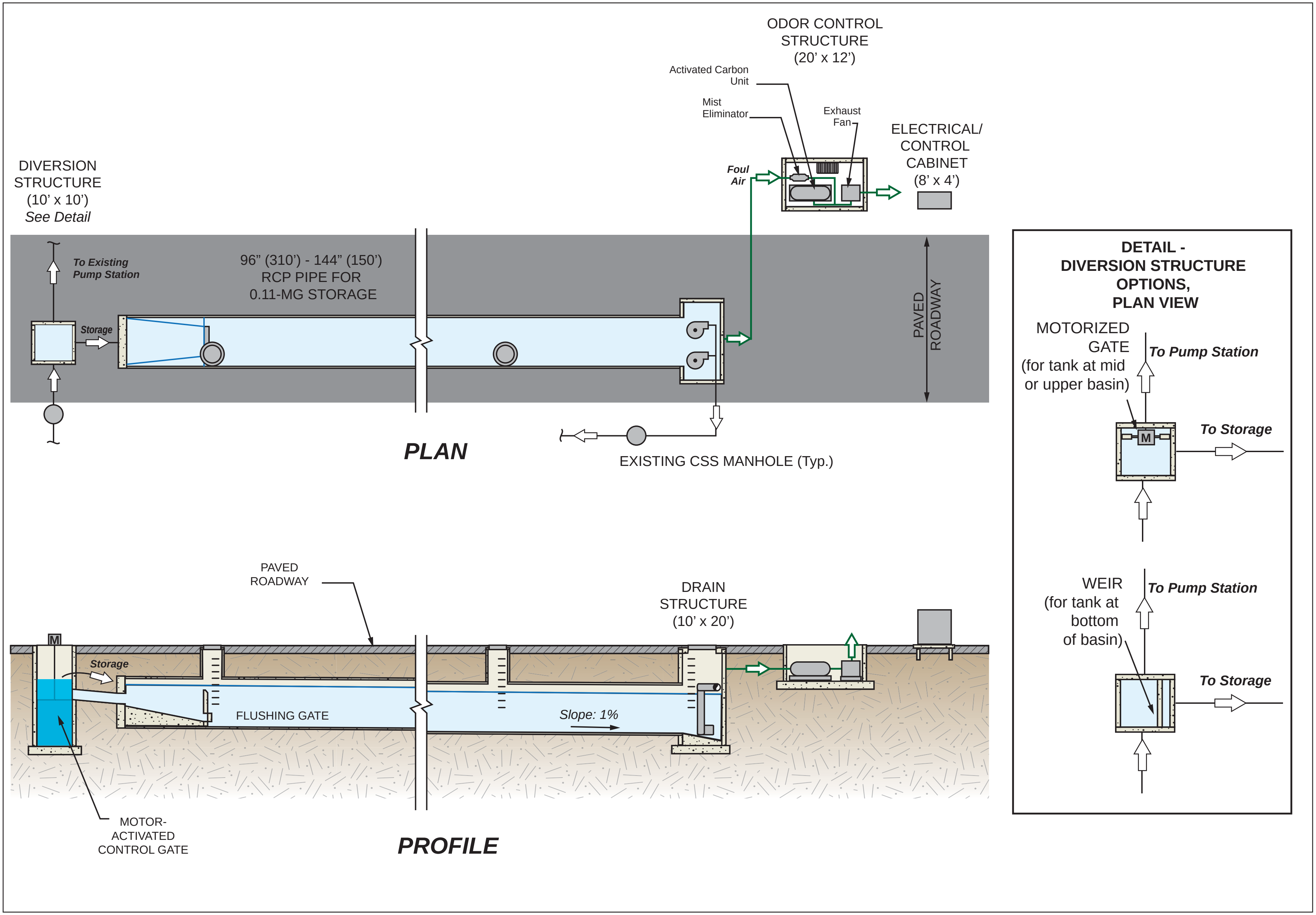


BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN

DRAFT – February 2011

Figure 5.1.
BASIS OF DESIGN TYPICAL DETAIL FOR RECTANGULAR STORAGE TANK

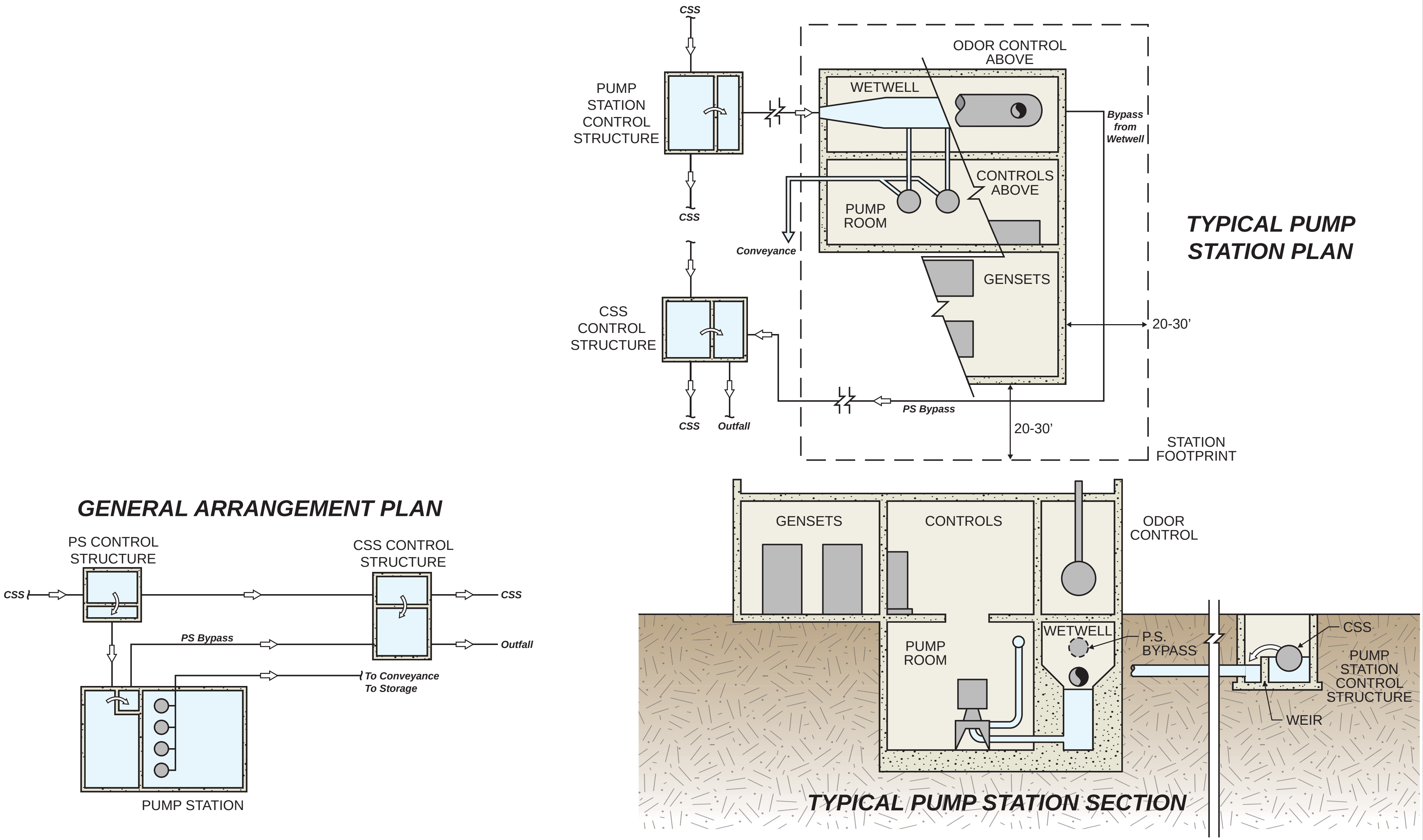
King County
Department of Natural Resources and Parks
Wastewater Treatment Division



3630023/Fig5-02_StoragePipeSchematic.ai

BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN DRAFT – February 2011	**Figure 5.2.** BASIS OF DESIGN TYPICAL DETAIL FOR STORAGE PIPE

King County
Department of Natural Resources and Parks
Wastewater Treatment Division



3630023/Fig5-03_PumpStationSchematic.ai

BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN DRAFT – February 2011	**Figure 5.3.** BASIS OF DESIGN TYPICAL DETAIL FOR PUMP STATION

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

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