METRO CSO 5-YEAR UPDATE

TASK 5 REPORT

METRO REGIONAL WASTEWATER SERVICES PLAN
SYSTEM ALTERNATIVES

SUPPORTING CSO PROJECT DESCRIPTIONS

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I. INTRODUCTION

This report provides brief descriptions and cost estimates for Combined Sewer Overflow (CSO) control alternatives to be included in development of system wide plans for wastewater conveyance and treatment under Metro's Regional Wastewater Services Plan (RWSP). The RWSP is considering alternative system wide configurations including new wastewater treatment and conveyance facilities, CSO control projects, alternative Biosolids programs and wastewater reclamation and reuse. Certain wastewater treatment and conveyance alternatives considered in the Wastewater 2020+ study (WW2020+) have different impacts on CSOs, or present different opportunities for optimization with CSO control. For example, selection of an alternative that constructs a new treatment plant in the Duwamish area presents the opportunity for joint use of the facilities for CSO treatment. For inclusion in the RWSP process, distinct groups of CSO control projects were developed to merge with the various WW2020+ configurations and to present a range of policy choices for decision makers.

The CSO control facility options that will be included in the system wide alternatives have been arranged into seven groups, corresponding to the West Point northern and southern service areas, and a miscellaneous collection of outlying CSO locations. A complete system will consist of the Group 1 configuration, one of the alternative configurations listed for the West Point Northern Service Area, and one of the alternative configurations listed for the West Point Southern Service Area; the choices depend on the WW 2020+ configuration.

The West Point Northern Service Area options consist of two levels of alternative control strategies depending on whether or not additional flows are conveyed from north of Lake Washington to the West Point Treatment Plant via a new line constructed parallel to the existing Kenmore to Matthews Beach Lake Line, along the northwest side of Lake Washington. One strategy would consist of the construction of a large underground storage tank, or series of tanks, in the University/Montlake area, at 3rd Avenue W, and in Ballard. The second strategy would involve construction of deep tunnel storage sufficient to store the University, Montlake, and 3rd Avenue W overflows with tanks in Ballard. The size of the storage tank(s) or deep tunnel would be dependent upon whether or not the parallel Lake Line is constructed and whether or not deep tunnel storage is selected for the West Point Southern Service Area. The West Point Southern Service Area options consist of 5 alternatives for managing south end CSOs, including storage, combined sewer separation, flow transfer, on-site treatment, and centralized treatment. A summary of the CSO alternative groups is presented in Table 1.

Each group of CSO control options would result in the diversion of base flows from a combined sewer area to primary and/or secondary treatment plants. Groups that include separation of combined sewer areas as a control option would result in increased stormwater flow volumes in the associated stormwater drainage systems. Diversion of flows through treatment facilities would result in a corresponding increase in biosolids

Table 1. Summary Alternative CSO Control Groups

Group	Description	Corresponds with WW2020+ Alternatives	Capital Project Cost, $million	Annual O&M Cost, $1000	Year Major Elements On Line	Unit Capital Cost, $/1000 gal	Storage Tanks	Partial Separation Projects (acres)	Tunnel Storage	Vortex Separator Projects	CSO Treatment Plants	Waste water Treat ment Plants	Receiving Water
Constant Projects--do not depend on WW2020+ configuration; common to all system alternatives													
1	Small storage tanks associated with outlying CSOs not effected by WW2020+ decisions	All	$81	$1,300	2005, 2010	$355	10 tanks	Roof tops 2 areas			Alki, Carkeek	WP, Renton	Lk Wash, Alki, Duwamish, Elliott Bay
West Point Northern Service Area - No New Lake Line													
2a1	Storage Tanks	A1, B1, B2	$86	$700	2020	$634	4 tanks				Alki, Carkeek	WP, Renton	Lk Wash, Ship Canal
2a2	Deep Tunnel	A1, B1, B2	$126	$400	2020	$933	2 tanks (Ballard)		15,800 ft 12-ft dia		Alki, Carkeek	WP, Renton	Lk Wash, Ship Canal
West Point Northern Service Area - With New Lake Line													
2b1-3	Storage Tanks	A2, A3, A4,B3,D1	$146-$178	$1,200	2010	$462-$562	5-8 tanks				Alki, Carkeek	WP, Renton	Lk Wash, Ship Canal
2b2	Deep Tunnel	A2, A3, A4,B3,D1	$172	$550	2010	$541	2 tanks (Ballard)		15,800 ft 17.5-ft dia		Alki, Carkeek	WP Renton	Lk Wash, Ship Canal
West Point Southern Service Area													
3b	Duwamish Secondary/CSO Treatment--DTP in 2005[a]	D1	$280	$900	2005	$208	1 tank		Denny		Alki, Carkeek, Duwamish	WP, Renton, Duwamish	Duwamish, Elliott Bay
3c	Duwamish CSO Treatment	A1, A2 B1, B2, B3	$437	$1,700	2005	$324	3 tanks	1 project (129)	Denny		Alki, Carkeek, Duwamish, Denny	WP, Renton	Duwamish, Elliott Bay
4	Transfer Flow from WPSSA to Renton[b]	A3, A4 (B1, B2, B3)	$238	$1,600	2005	$176	5 tanks	2 projects (290)	Denny	Denny[c]	Alki, Carkeek	WP, Renton	Duwamish, Elliott Bay
5	Distributed CSO Treatment	A1, A2 B1, B2, B3	$326	$1,200	2005	$242	2 tanks	One project (52)	Denny	Denny[c], Conneticut, Lander, Michigan	Alki, Carkeek	WP, Renton	Duwamish, Elliott Bay
6	Separation/Storage with CSO Treatment	A1, A2 B1, B2, B3	$293	$1,900	2005	$217	4 tanks	3 projects (419)	Denny	Denny[c], Lander	Alki, Carkeek	WP, Renton	Duwamish, Elliott Bay
7a	CSO Deep Tunnel with Alki Plant in Operation[d]	A1, A2 B1, B2, B3	$515	$1,550	2005	$381	1 tank		Denny, 24-ft dia Ship Canal to Lander		Alki, Carkeek	WP, Renton	Duwamish, Elliott Bay

[a]Assumes construction of secondary treatment plant in the Duwamish by 2005 ("DTP" = Duwamish Treatment Plant).

[b]Facilities to transfer base flow (2.25 times AWWF) not included. Must be added to CSO for 2020+ B1, B2 and B3 configurations.

[c]Denny project could be vortex separators or CSO treatment similar to Alki or Carkeek.

[d]Selection modifies Groups 2a and 2b by eliminating control for 3rd Ave. West.

production at the various treatment plants. A summary of the increases in stormwater flow volumes and biosolids production associated with each group is shown in Table 2.

As shown in Table 2, implementation of the Group 6 projects would result in the greatest increase in annual stormwater volume that would be directed to the storm drainage system, followed by the Group 4, Group 3c, and Group 5 projects, respectively. All of the other CSO control groups would have no impact on the storm drainage infrastructure. The Group 3 and Group 4 projects would result in the greatest increase in annual biosolids production followed closely by Group 7, as these projects would enable significantly more central primary and secondary treatment for CSO volumes than the other CSO control groups. Group 5 and Group 6 projects would also result in substantial increases in annual biosolids production because they would provide on-site primary treatment for several drainage areas, in addition to relatively extensive central primary and secondary treatment for CSOs originating in other drainage areas.

In order to size CSO control projects, it is necessary to establish the peak flow rate at the West Point Treatment Plant. The current plant design calls for a peak flow rate during wet weather of 440 million gallons per day (mgd). There are concerns that it may not always be possible to accept this rate at West Point due to safety and equipment issues, and that a peak flow of 400 mgd may be more representative of future operations. Reduction in the peak flow allowance increases CSOs in the West Point Southern Service Area (Elliott Bay waterfront and Duwamish River). On the other hand, a lower peak flow at West Point reduces overflows along the Lake Washington Ship Canal. Because of the uncertainty, CSO control projects have been developed for the worst case condition. Therefore, projects in the Southern Service Area were sized for a peak West Point flow rate of 400 mgd, while those along the Ship Canal were sized for a peak of 440 mgd. This approach provides a conservative estimate of facility sizing and costs.

The scheduling of the various projects included in each group is presented in Table 3. The projects have been designed to achieve 75 percent reduction in CSO flows by the year 2006, and ultimately a maximum of one overflow event per year at each location to meet Washington Department of Ecology (Ecology) requirements.

CSO Project Phasing to Meet Ecology Requirements

Table 3 shows various CSO control projects which have been identified as alternatives that would control overflows at CSO sites to the one event per year level required by Ecology. The alternative projects have been grouped into families. The expectation is that Metro will undertake all the projects listed in Group 1. Metro must then chose additional projects, one for the Group 2 subsets to control overflows along the North Interceptor, and one for the West Point Southern Service Area Groups 3 through 7, in order to reach Department of Ecology goals.

Table 2. Summary of CSO/Stormwater Volumes and Biosolids Production

Group	Annual Control Volume, MG[a]	Annual Stormwater Discharge, MG[b]	Volume to On-Site Primary, MG/yr[c]	Volume to Central Primary, MG/yr[d]	Volume to Secondary Treatment, MG/yr[e]	Raw Solids to Drying, ton/yr[f]	Sec. Solids to Digestion, ton/yr[g]
1	229	0	0	197	98	49	8
2a	135	0	0	116	58	29	5
2b	317	0	0	273	58	29	5
3b	1350	0	0	1161	581	290	48
3c	1313	76	556	1027	226	272	48
4[h]	1270	147	556	582	291	175	34
5	1330	22	1226	642	321	245	55
6	1232	223	927	694	347	238	50
7a	1350	0	0	1161	581	290	48

[a]Includes reduction for stormwater separation if applicable.

[b]Additional stormwater discharges associated with CSO control.

[c]Treated in satellite CSO treatment facilities near the CSO location.

[d]Treated at a centralized treatment plant.

[e]Additional flows passed to secondary treatment at West Point. Secondary treatment volumes assume only 50% of CSO flows are so treated.

[f]Additional primary solids generated at West Point.

[g]New activated sludge solids generated at West Point. Secondary solids production assumes only 50% of the primary volume is treated in secondary facilities.

[h]Treatment volumes and biosolids do not include transfer to East Division Reclamation Plant (EDRP). The CSO-related loading to the EDRP is about 307 MG/yr flow and 128 ton/yr biosolids.

Table 3. CSO Control Project Phasing (page 1 of 3)

Projects to meet 75 percent volume reduction from 1981-83 baseline by 2006, and one overflow event per year at each CSO as a long-term goal. Assume prjects after 2006 scheduled to be completed by 2030.

CSO Group	CSO Location	1981-83 Annual Baseline CSO, MG	Project Type	Year on-line	Remarks
Constant Projects that do not change with WW2020+ configuration					
1	8th Ave S	15	1.0 MG storage	2010	Projects scheduled here for
	W. Michigan	2	Conveyance	2010	2010 would be re-scheduled to
	Terminal 115	5	0.5 MG storage	2010	2020 if Group 2b where chosen
	Harbor	55	Store in Alki Tun.	1997	because of the economic impact.
	MLK Way	88	6.2 MG storage	2005	
	Henderson pump sta.	10	1.3 MG storage	2005	
	Norfolk	60	0.75 MG storage	2010	
	S. Magnolia	15	1.3 MG storage	2010	
	Rainier @ Hanford[a]	7	0.6 MG storage	2010	
	Dexter	15	Store	2000	Included in Denny Way Project.
	Murray PS	5	0.5 MG storage	2010	
	Barton	7	New pump sta.	2010	
	SW Alaska St.	12	0.7 MG storage	2010	
	North Beach	2	Store/pump	2010	
	WP CSO Improve.			2005	
WP NSA Projects without new flows from Kenmore (no new Lake Line). WP at 133 mgd					
2a	University	110	Store	2020	One storage tank addresses both
	Montlake	10	7.5 MG storage	2020	University and Montlake.
	Canal Street	1	None		
	3rd Ave. West	125	5.5 MG storage	2020	
	Ballard	--[b]	1.0 MG storage	2020	Joint City/Metro-Metro share 40%.
	11th Ave. West	90	1.7 MG storage	2020	
WP NSA Projects with a new Lake Line. WP at 159 mgd.					
2b	University	110	Store	2010	One to four tanks address both
	Montlake	10	12 MG storage	2010	University and Montlake.
	Canal Street	1	None		Earlier scheduling based on
	3rd Ave. West	125	6.7 MG storage	2010	WW2020+ Lake Line schedule.
	Ballard	--[b]	1.0 MG storage	2010	Joint City/Metro-Metro share 60%.
	11th Ave. West	90	2.0 MG storage	2010	

[a] Bayview North, Bayview South, and Rainier at Hanford ultimately discharge at the Hanford #1 CSO location.
[b] Ballard baseline overflow included in 11th Ave. West value.
[c] West Point CSO Improvements uncertain. Could be additional secondary clarifiers or dissolved air floatation assistance in CSO primary clarifiers.

WP NSA = West Point Northern Service area.

Table 3. CSO Control Project Phasing (page 3 of 3)

Projects to meet 75 percent volume reduction from 1981-83 baseline by 2006, and one overflow event per year at each CSO as a long-term goal. Assume prjects after 2006 scheduled to be completed by 2030.

CSO Group	CSO Location	1981-83 Annual Baseline CSO, MG	Project Type	Year on-line	Remarks
West Point Southern Service Area Projects					
4	Michigan	190	Separate/store	2005	5.5 MG storage/238 ac. sep.
	Brandon	60	Separate/store	2005	3 MG storage/52 ac. separation
	Hanford #2	605	3.5 MG storage	2025	Add 3.5 MG at Lander in 2025
	Lander	190	3 MG storage	2005	
	Connecticut	90	2.5 MG storage	2025	
	King Street	55	storage	2025	Combined with Conneticut
	Denny Way	200	Preferred Alter.	2000	15.4 MG tunnel and tank
	Denny Way	205	On-site CSO Trt	2005	Add 2.5 MG storage/treatment
	Chelan	73	4 MG storage	2030	
5	Michigan	190	On-site CSO Trt	2005	75 mgd
	Brandon	60	Trt or Sep/store[a]	2005	25 mgd
	Hanford #2	605	On-site CSO Trt	2025	90 mgd
	Lander	190	On-site CSO Trt	2005	60 mgd
	Connecticut	90	On-site CSO Trt	2025	55 mgd
	King Street	55	On-site CSO Trt	2025	Combined w/ Connecticut-25 mgd
	Denny Way	200	Preferred Alter.	2000	15.4 MG tunnel and tank
	Denny Way	405	On-site CSO Trt	2005	Add storage/treatment-80 mgd
	Chelan	73	4 MG storage	2030	
6	Michigan	190	Separate/store	2005	5.5 MG storage/238 ac. sep.
	Brandon	60	Separate/store	2005	3 MG storage/52 ac. separation
	Hanford #2	605	On-site CSO Trt	2025	90 mgd
	Lander	190	On-site CSO Trt	2005	60 mgd
	Connecticut	90	Separate/store	2025	8.5 MG storage
	King Street	55	Storage	2025	Combined with Connecticut
	Denny Way	200	Preferred Alter.	2000	15.4 MG tunnel and tank
	Denny Way	405	On-site CSO Trt	2005	Add 2.5 MG storage/treatment
	Chelan	73	4 MG storage	2030	
7a	Michigan	190	Convey to Tunnel	2025	84-inch pipe
	Brandon	60	Convey to Tunnel	2025	84-inch pipe
	Hanford #2	605	Convey to Tunnel	2030	96-inch pipe
	Lander	190	Deep Tunnel	2005	24-foot diameter from 6th Ave. W.
	Connecticut	90	Deep Tunnel	2005	and W. Nickerson to Lander St.
	King Street	55	Deep Tunnel	2005	
	Denny Way[b]	405	Shallow Tunnel	2000	12.9 MG tunnel storage
	Chelan	73	4 MG storage	2030	
	3rd Ave. West	125	Store	2005	Subtract from NSA 2a or 2b

[a] Brandon is separation/storage in Group 5a, and storage/treatment in 5b.

[b] Denny includes tunnel, regulators and conveyance at east end, 3 regulators at west end, two drop shafts at west end and a new short outfall for existing overflow.

Table 3. CSO Control Project Phasing (page 2 of 3)

Projects to meet 75 percent volume reduction from 1981-83 baseline by 2006, and one overflow event per year at each CSO as a long-term goal. Assume prjects after 2006 scheduled to be completed by 2030.

CSO Group	CSO Location	1981-83 Annual Baseline CSO, MG	Project Type	Year on-line	Remarks
Duwamish CSO treatment with Secondary and Alki Phase Out--Secondary constructed in 2010					
3a	Michigan	190	Convey to DTP	2025	72-inch RCP + storage
	Brandon	60	Convey to DTP	2025	72-inch RCP + storage
	Hanford #2	605	Convey to DTP	2005	96-in RCP + new regulator
	Lander	190	Convey to DTP	2005	Includes 4 MG storage tank
	Lander		Convey to DTP	2010	Gate in EBI, new diversion, pump
	Connecticut	90	Convey to WPTP	2010	New Diversion
	King Street	55	Convey to WPTP	2010	New Diversion
	Chelan/Alki	73	Convey to DTP	2030	Tunnel, pump station
	Denny Way	405	Preferred Alter.	2000	15.4 MG tunnel and tank
	Denny Way		On-site CSO Trt	2005	Add 2.5 MG storage/treatment
	Regulator mod's		New diversions	2010	Connecticut, King, Denny
	CSO Treatment		DTP Primary	2005	115 mgd
	CSO Treatment		DTP Primary	2010	Add 25 mgd with secondary
	CSO Treatment		DTP Primary	2025	Add 70 mgd for Mich.+ Brandon
	CSO Treatment		DTP Primary	2030	Add 90 mgd for Alki
	CSO Outfall		60->102 inch	2005	Increase outfall size
Duwamish CSO treatment with Secondary, Alki remains in operation--Secondary constructed in 2005					
3b	Michigan	190	Convey to DTP	2025	84-inch conveyance
	Brandon	60	Convey to DTP	2025	84-inch conveyance
	Hanford #2	605	Convey to DTP	2005	New Diversion
	Lander	190	Convey to DTP	2005	Gate in EBI, new diversion, pump
	Connecticut	90	Convey to WPTP	2005	New diversion
	King Street	55	Convey to WPTP	2005	New diversion
	Chelan	73	4 MG storage	2030	
	Denny Way[a]	405	12.9 MG tunnel	2000	Includes New diversion
	CSO Treatment		DTP Primary	2005	140 mgd
	CSO Treatment		DTP Primary	2025	add 75 mgd Mich.+ Brandon
	CSO Outfall		60->102 inch	2005	Increase outfall size
Duwamish CSO treatment-stand alone without secondary treatment plant					
3c	Michigan	190	Convey to DTP	2025	84-inch conveyance
	Brandon	60	Convey to DTP	2005	84-inch conveyance
	Hanford #2	605	Convey to DTP	2005	96-in RCP + new regulator
	Lander	190	Convey to DTP	2005	Includes 4 MG storage
	Connecticut	90	Separate/store	2025	8.5 MG storage/129 ac. sep.
	King Street	55	Storage	2025	Combined with Connecticut
	Chelan	73	4 MG storage	2030	
	Denny Way	405	Preferred alter.	2000	15.4 MG tunnel and tank
	Denny Way		On-site CSO Trt	2005	Add 2.5 MG storage/treatment
	CSO Treatment		DTP Primary	2005	140 mgd
	CSO Treatment		DTP Primary	2025	Add 75 mgd for Michigan/Brandon
	CSO Outfall		84-inch	2005	

[a] Denny includes tunnel, regulators and conveyance at east and west, a 70 mgd pump station and a new short outfall for the existing overflow.

DTP = Duwamish Treatment Plant
WPTP = West Point Treatment Plant

Volumes Required to be Controlled

Starting from a baseline annual overflow volume of 2391 million gallons (MG), Metro projects through Phase 2 of the *1988 CSO Control Plan* (i.e., projects which will be completed by 1996) are expected to have controlled 796 to 886 MG by 1998, depending on whether the West Point Treatment Plant will be able to accommodate 440 mgd of influent flows or whether Metro must reduce in-coming flows to 400 mgd. Metro must therefore find projects which will control another 907 MG to 997 MG of annual overflows by 2006. Accordingly, the groups were developed on a "worst case" conservative basis, assuming a West Point set point of 400 mgd for projects in the Southern Service Area and 440 mgd for projects in the Northern Service Area.

Phasing Criteria

Decisions about which projects to include in which phase can be made simply on the basis of lowest unit cost. Those projects having the lowest cost per MG controlled would be scheduled first. On the other hand, water quality and beneficial use protection could be used as a criterion for making phasing decisions as well, and the earliest projects would be the ones which produce the greatest water quality benefits, even though such an approach would produce higher capital costs through the end of 2005.

Metro's Water Quality Assessment staff support phasing to implement projects in the Duwamish/Elliott Bay area early. These are the lowest unit-cost projects. The phasing process thus selected large Duwamish/Elliott Bay CSOs to be controlled to reach 75 percent reduction by the end of 2005. These projects do not, however, address overflow concerns at North Beach, Alki and along the Ship Canal, all locations which are subject to a large amount of use by the public.

Phasing Assumptions

The following assumptions about project phasing are implicit in Table 3:

- It was assumed that one-event-per-year control would be achieved by 2030. There is no specific requirement that control be achieved by this date, so that completion of the entire program could be extended. Mechanisms to reduce floatables at uncontrolled outfalls would likely be needed earlier pursuant to federal CSO policy.

- Metro has already committed itself to the Harbor CSO Pipeline, which will be part of the Alki project, and the Denny/Lake Union CSO Control Project.

- Metro will commit itself to early completion of the South Henderson/Martin Luther King Way control projects because overflows at those locations represent the last uncontrolled CSO discharges to Lake Washington.

- Metro will commit itself to the other projects listed in Group 1 of the table because they involve a high benefit in terms of the protection they provide to high-value beneficial uses. Thus the remainder of the Group 1 projects were scheduled for 2010. These could be delayed on economic grounds since they are not necessary by this date to meet Department of Ecology requirements.

- While given a priority in the table, Group 1 projects could be delayed by decisions made by Wastewater 2020+. In the event of a decision to begin early construction of a new lake line from the Northern Service Area to West Point, for example, overflows in the University area and other locations might increase, causing projects in Group 2 locations to be given a higher priority.

- Southern Service Area projects in Groups 3 through 6 were scheduled to achieve 75 percent control by the end of 2005. Except for Groups 3 and 7, controls at Connecticut, King and Chelan were scheduled by 2025 or 2030 because they are not required earlier to meet 75 percent control and can be arrayed near the end of the program.

- Group 7a includes control at Connecticut, King and 3rd Avenue West by 2005 because of the nature of the alternatives and the construction requirements. The deep tunnel begins near 3rd Avenue West and runs south to Hanford Street. If Group 7a is chosen for implementation, then Group 2 projects would be reduced accordingly.

- The remaining projects are scheduled so as to provide progress towards Ecology's one-event-per-year goal by 2030. Group 2a projects are scheduled to be completed by 2020 to provide intermediate milestones over the next 35 years. Those same projects have been moved ahead to 2010 in Group 2b in the event of a Wastewater 2020+ decision to build a new lake line for the West Point Northern Service Area. It may be possible to delay some of the group 2b projects by making use of storage capacity in such a new lake line, however.

Project Cost Estimates

The capital costs and operation and maintenance (O&M) costs of the alternative groups for the Northern Service Area and Southern Service Area are included in Table 1, and are also shown in Figures 1a and 1b. Figures 1a and 1b show 1994 capital cost plus the present worth of a constant stream of O&M costs over 20 years (1994-2014) for comparison purposes. Actual phasing is not considered in the charts. Cost breakdowns for the individual projects within each group are presented in the following sections, which provide detailed descriptions of each CSO alternative group. These cost breakdowns account for project phasing.

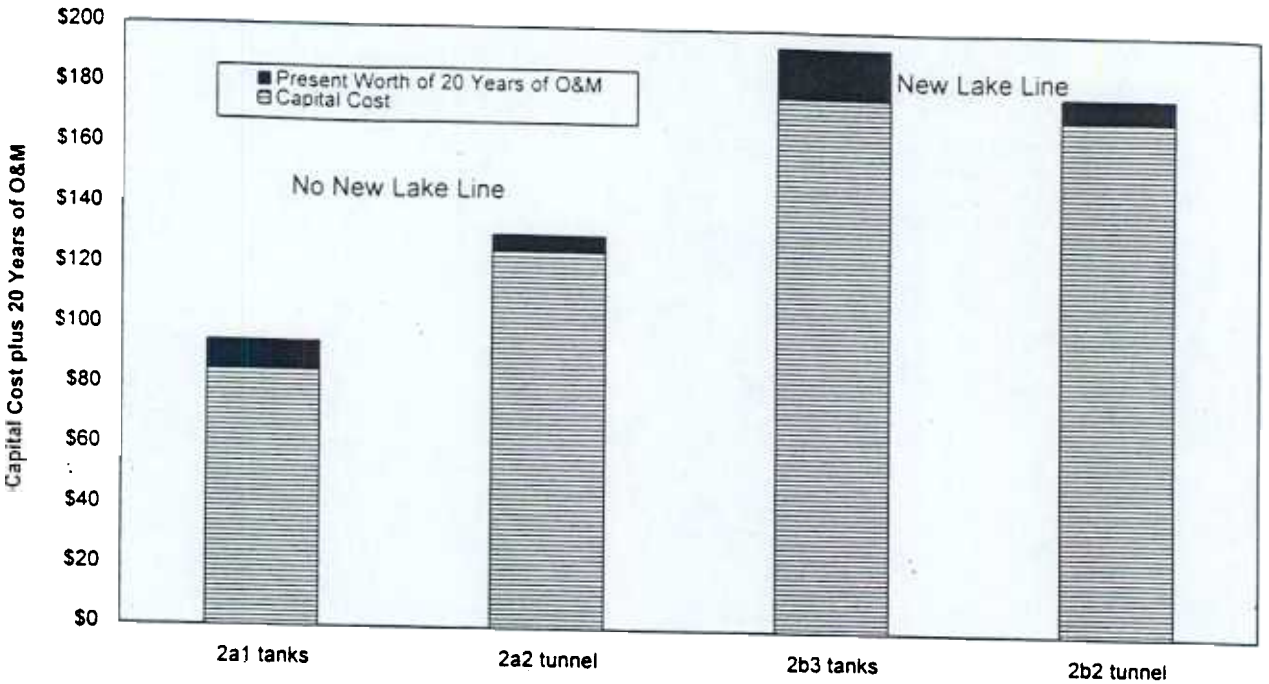


Figure 1a. Costs Associated with West Point Northern Service Area CSO Control Group Alternatives.

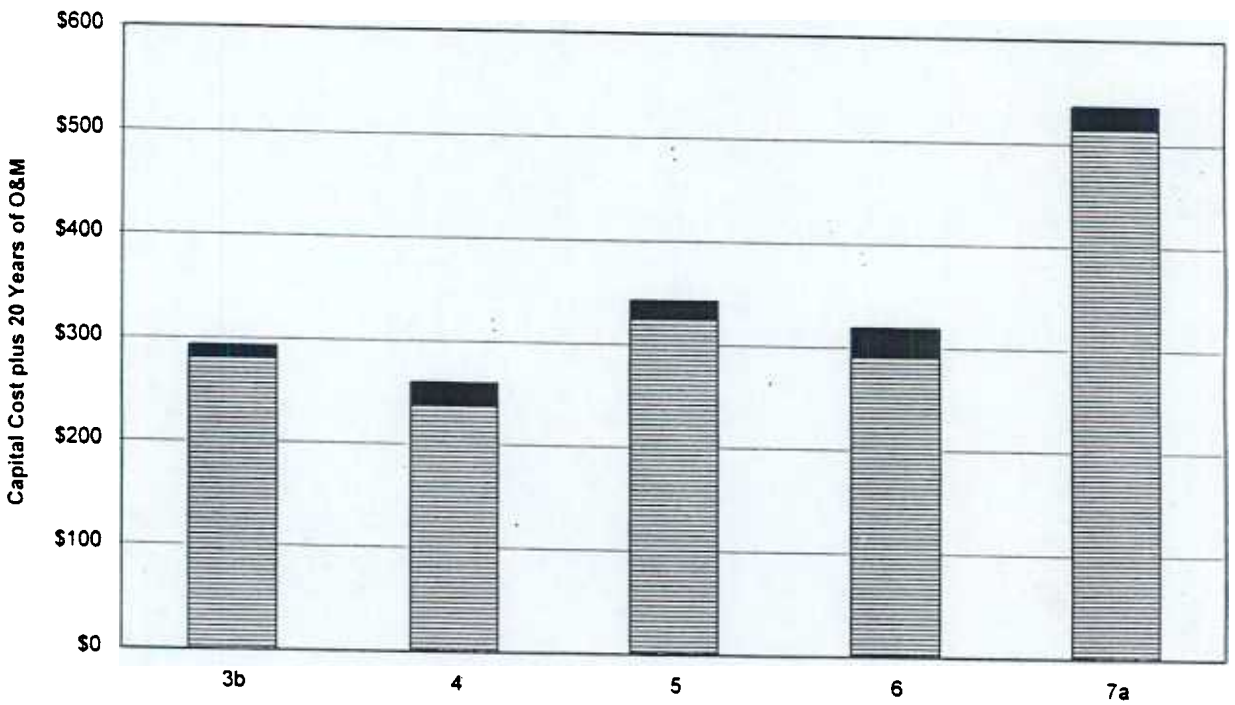


Figure 1b. Costs Associated with West Point Southern Service Area CSO Control Group Alternatives

II. GROUP 1: CONSTANT PROJECTS

General Description

This group consists of CSO control projects at 14 locations including a combination of conveyance facilities and ten underground storage facilities. The group has been named "constant projects" because the facilities would be the same regardless of which of the WW2020+ alternatives were selected.

In addition to facilities at outlying CSO locations, this group includes an allowance for capital improvements at West Point to address CSO flows returned to the system from storage facilities. This allowance is necessary to enhance the ability of the plant to meet permit limits under conditions of prolonged high flows resulting from the drainage of CSO storage/treatment tanks. These improvements may include early addition of two secondary claifiers (to reduce peak secondary overflow rates, or addition of mechanical improvements (such as dissolved air floatation) to the portion of the primary sedimentation tanks used for CSO related flows.

The CSO locations and a brief description of the control facility proposed for each location are listed in Table 4. A system map illustrating the locations of Group 1 projects is shown in Figure 2.

CSO Control Volumes

Baseline and projected flow volumes associated with each Group 1 CSO location are shown in Table 4. The 1998 annual volume refers to the average overflow estimated to occur after all current CSO control projects are complete. Projects in this group are not affected by the peak flow set point at West Point. The CSO facilities within this group have been designed to control the Design Storm No. 6 volume, limiting each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

Brief descriptions of the CSO control facility locations and site requirements are compiled in Table 4. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1.

The total estimated project capital cost and the unit project cost per million gallons (MG) of CSO controlled for each facility are shown in Table 4. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 5 for each facility as well as the year in which the facility would come on-line. Summary project costs, annual O&M costs, and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 5 includes information on project phasing specific to Group 1. The three projects scheduled for completion prior to the year 2006 are storage tanks at Martin Luther King Way and in the vicinity of the Henderson pump station, and West Point CSO Improvements. The Martin Luther King Way and Henderson CSOs are the last uncontrolled discharges to Lake Washington.

Relationship to WW2020+ and Biosolids Projects

A summary of the volumes of liquids and biosolids generated by Group 1 projects is shown in Table 2. Group 1 projects would result in an increase in total system biosolids production at West Point of 57 tons per year.

To achieve the long-term goal of one overflow event per year (on average) at each CSO location, projects in Group 1 would need to be completed regardless of which WW2020+ alternatives were selected (A2, A4, B1, B2, D1, F1).

Programmatic Issues

Table 5 contains $400,000 for programmatic issues associated with Group 1 in the O&M cost column. This cost represents the combined annual costs of two distinct programs intended to reduce CSO volumes and thereby reduce the scale of CSO control projects, perhaps eliminating the need for those projects entirely. The two programs are a rooftop separation support program and a drainage ordinance/system optimization support program. These two programs are described briefly below.

Rooftop Separation Program Group 1 contains storage projects along Alki beach in West Seattle, in South Magnolia, and in the South Henderson Street/Martin Luther King Way area of South Seattle. Each of these three areas are served by storm drains. However, roof drains have never been connected to the storm drains in these areas, and therefore rooftop runoff continues to discharge to the sanitary sewers. A voluntary program of homeowner rooftop drainage disconnection might prove to be a cost-effective means of reducing CSO volumes. Such a program would, however, introduce costs of its own, including the following:

- A pilot study would be required for the Alki or South Magnolia area.
- A public information and outreach program would be required to inform homeowners of the benefits available to them under the rooftop disconnect program.

- A grant or reimbursement program would be required to fund payments to homeowners who have disconnected their roof leaders.

- A survey would be required to determine the extent of removal required from individual homes and to confirm that disconnection has taken place.

- Analyses of the potential water quality impacts attributable to increased roof drainage in stormwater runoff would have to be conducted, and a public education program would have to be pursued to inform homeowners about nontoxic alternatives to rooftop moss retardants.

Table 5 assumes an annual cost of $200,000 for these elements of the rooftop separation program. The program could also be extended to other areas, like University or Hanford, which have significant areas of partial separation. Section XI of this report provides additional information on issues associated with a rooftop flow separation program.

Drainage Ordinance / System Optimization Support Table 5 also assumes a total annual cost of $200,000 for monitoring compliance with and effectiveness of the Seattle Drainage Ordinance, and for making optimum use of available on-line storage capacity. Section XI of this report provides additional information on issues associated with the Drainage Ordinance and drainage system storage optimization.

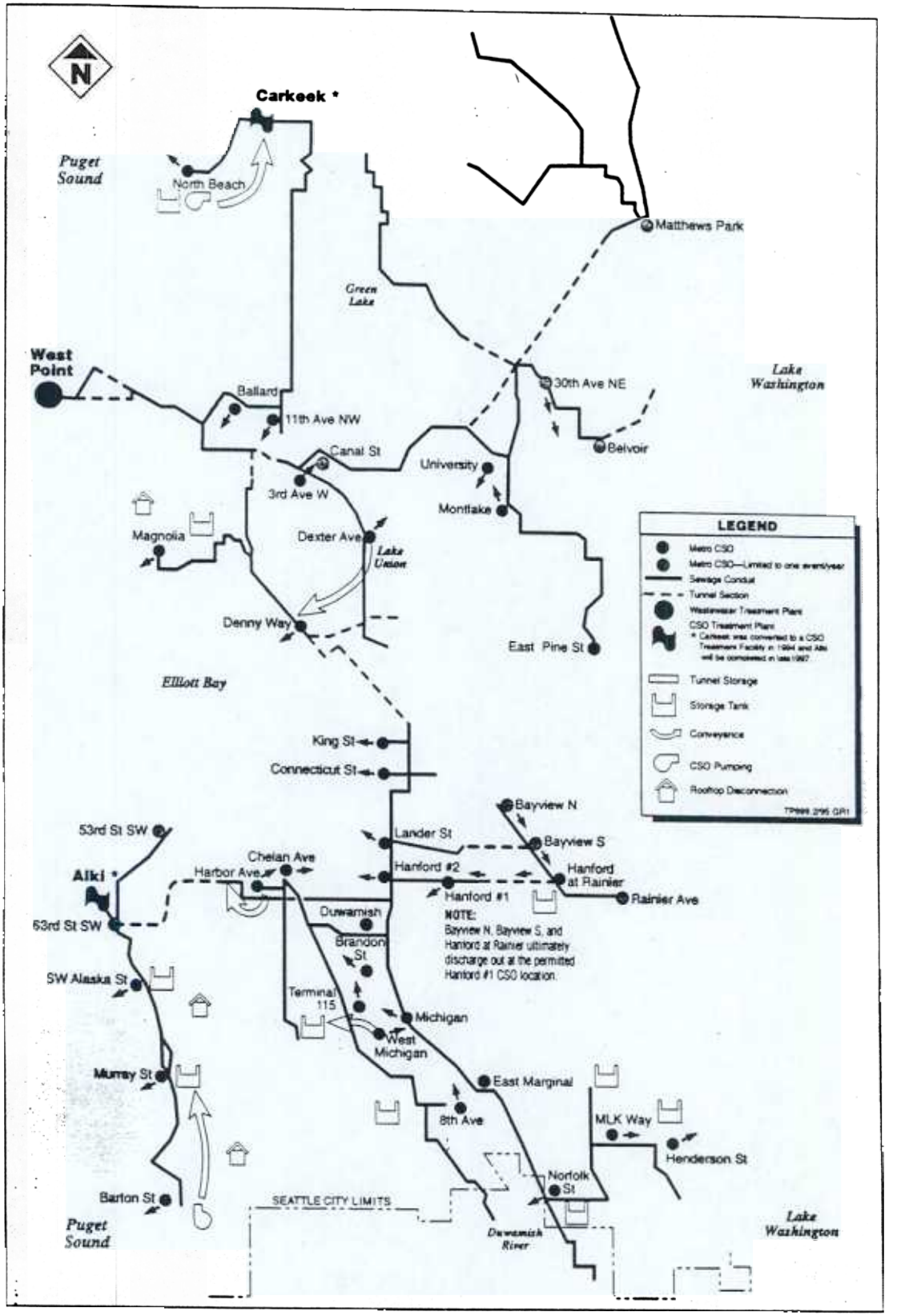


Figure 2. Group 1 projects: constant projects that do not change with WW2020+

Table 4. Estimated Flow Volumes and Costs for Group 1 Projects

Southern Service Area and Alki projects that do not change with WW2020+ configurations

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
8th Ave S	15	12	12	1.0	$6.1	$509,000	1.0 MG storage tank	0.3	Private property adjacent to Regulator station
W. Michigan	2	2	9	0.1	$0.4	$175,000	Conveyance	--	Provide more capacity in connection to interceptor
Terminal 115	5	5	8	0.5	$3.5	$700,000	0.5 MG storage tank	0.1	Adjacent to Terminal 115. Volume includes W. Michigan
Harbor	55	58	56	3.4	$0.8	$13,000	Store in Alki tunnel	--	Harbor CSO pipeline project
MLK Way	88	88	23	6.2	$28.6	$325,000	Rectangular storage tank	1.6	Open space beneath power lines at S. Trenton St and MLK Way
S. Henderson PS	10	10	16	1.3	$8.2	$820,000	Circular storage tank	0.3	Rainier Beach High School parking lot
Norfolk	60	6	4	0.8	$4.7	$784,000	Circular storage tank	0.2	Associated Grocers truck parking lot
S. Magnolia	15	15	21	1.3	$6.0	$400,000	Circular storage tank	0.3	Private property on 32nd Ave W south of W. McGraw St.
Hanford@Rainier	7	7	3	0.6	$2.9	$415,000	Circular storage tank	0.2	Playground at Rainier Ave S. and Mt Baker Blvd S.
Murray PS	5	5	8	0.4	$4.5	$900,000	Circular storage tank	0.1	Lowman Beach Park
Barton	7	7	23	0.5	$8.3	$1,186,000	New pump station		Ferry parking lot - force main along beach
SW Alaska St.	12	12	23	0.7	$3.8	$317,000	Rectangular storage tank	0.2	SW Alaska Drive right of way
63rd Ave PS	95	0	<1	0.0			No project required		
North Beach	2	2	18	0.5	$3.5	$1,750,000	Storage/capacity increase	--	Existing pump station site. Metro pre-designed project.
West Point Improvements					$15.0				Add two secondary clarifiers or modify primary clarifiers.
Totals	378	229		17.3	$96	$421,000		3.2	
					$59.4				

Additional Information:

West Point capacity is assumed set at 400 mgd.
Denny Way project is assumed to be underway (18-ft tunnel, 2.5 MG storage).
Storage projects at Henderson/MLK Way and Norfolk are subject to change as a result of an engineering evaluation currently underway.
Storage projects at S. Magnolia and in Alki should be preceded by efforts to produce volunteer (and/or grant-funded) roof leader removal (see discussion in Section XI on programmatic issues).
Pipe storage (4-6 blocks of 96-inch) can be substitued for tank storage in the 0.4-0.7 MG range. Capital cost is 3-4 times tank storage, but operational cost is smaller.
Storage in the range of one MG could be provided by a box structure beneath streets. Capital cost is about twice that of circular storage tanks.
For perspective, one olympic-sized swimming pool contains about 1.5 MG of water.

Table 5. Capital Cost and O&M Phasing Summary for Group 1 Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #1
SSA and Alki Projects which do not change with WW2020+ configurations

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
8th Avenue South	2010	$785,625	$0	$5,357,999	$0	$6,143,624	$83,455	$4,364	$4,340,790
W. Michigan	2010	$349,721	$0	$0	$0	$349,721	$14,097	$48	$322,784
Terminal 115	2010	$670,386	$0	$2,802,724	$0	$3,473,110	$45,013	$1,528	$2,425,889
Harbor	1997	$750,000	$0	$0	$0	$750,000	$24,163	$6,182	$1,230,624
MLK Way	2005	$1,609,990	$0	$26,958,356	$0	$28,568,346	$248,136	$21,842	$22,922,641
S. Henderson PS	2005	$1,019,259	$0	$7,155,755	$0	$8,175,014	$67,372	$4,182	$6,488,648
Norfolk	2010	$684,887	$0	$4,058,265	$0	$4,743,152	$59,159	$2,474	$3,297,843
S. Magnolia	2010	$655,798	$0	$5,362,645	$0	$6,018,443	$84,389	$4,490	$4,276,570
Rainer @ Hanford	2010	$158,217	$0	$2,750,383	$0	$2,908,600	$47,699	$1,727	$2,119,646
Dexter									
Murray PS	2010	$732,718	$0	$3,738,863	$0	$4,471,581	$60,697	$2,621	$3,153,111
Barton	2010	$7,470,937	$0	$797,432	$0	$8,268,369	$26,977	$1,133	$5,080,902
SW Alaska St.	2010	$732,718	$0	$3,039,371	$0	$3,772,089	$53,663	$2,196	$2,680,199
63rd Ave. PS									
North Beach	2010	$3,500,000	$0	$0	$0	$3,500,000	$16,024	$936	$2,193,952
West Point CSO Improvements	2005	$0	$0	$0	$15,000,000	$15,000,000	$243,300	$6,990	$13,261,867
Programatic Issues	1996						$400,000	$0	$7,370,832
Subtotals:		$19,120,256	$0	$62,021,793	$15,000,000	$96,142,049	$1,474,144	$60,713	$81,166,297
Totals (Rounded):		**$19,100,000**	**$0**	**$62,000,000**	**$15,000,000**	**$96,100,000**	**$1,500,000**	**$60,000**	**$81,200,000**
					Total Present Worth Estimate for Alternative:				**$81,200,000**

III. GROUP 2a: WEST POINT NORTHERN SERVICE AREA – NO NEW LAKE LINE

General Description

This group corresponds to CSO control facilities located in the West Point Northern Service Area between Ballard and the University District, including points along the Ship Canal and the Montlake Cut. Comparable levels of CSO control can be accomplished by either construction of four storage tanks or construction of a combination of two storage tanks and deep tunnel storage. The decision on which of the two configurations is preferable will be partially dependent on whether it will be possible to site a large storage tank in the University/Montlake area. The Group 2a CSO locations and a brief description of the control facility proposed for each location are listed in Table 6. System maps illustrating the locations of Group 2a projects are shown in Figures 3 and 4.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 2a CSO location are shown in Table 6. It is assumed that no new flows will be coming from the area north of Lake Washington. Average wet weather flows at West Point are assumed to be 133 mgd. The 1998 annual volume refers to the overflow estimated to occur after all current CSO control projects are completed. The projects were sized assuming a West Point peak flow set point of 440 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 2a. The CSO facilities within this group have been designed to control the Design Storm No. 6 volume, limiting each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

Brief descriptions of the CSO control facility locations and site requirements are compiled in Table 6. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1. This group includes a 7.5 million gallon (MG) storage tank that would be constructed near Husky Stadium east of Montlake Boulevard. A discussion of environmental issues associated with this project is provided in the following section on Group 2b projects.

The total estimated project cost and the unit cost for each facility are shown in Table 6. Present worth project costs are shown graphically in Figure 1a. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 7 for each facility as well as the year in which the facility would come on-line. Summary project costs, annual O&M costs, and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 7 includes information on project phasing specific to Group 2a. All of the projects in this group are scheduled for completion by the year 2020.

Relationship to WW2020+ and Biosolids Projects

The WW2020+ alternatives to which this CSO control group correspond are alternatives A1, B1 and B2, as indicated in Table 1.

A summary of the volumes of liquids and biosolids generated by Group 2a projects is shown in Table 2. Group 2a projects would result in an increase in total system biosolids production of 34 tons per year.

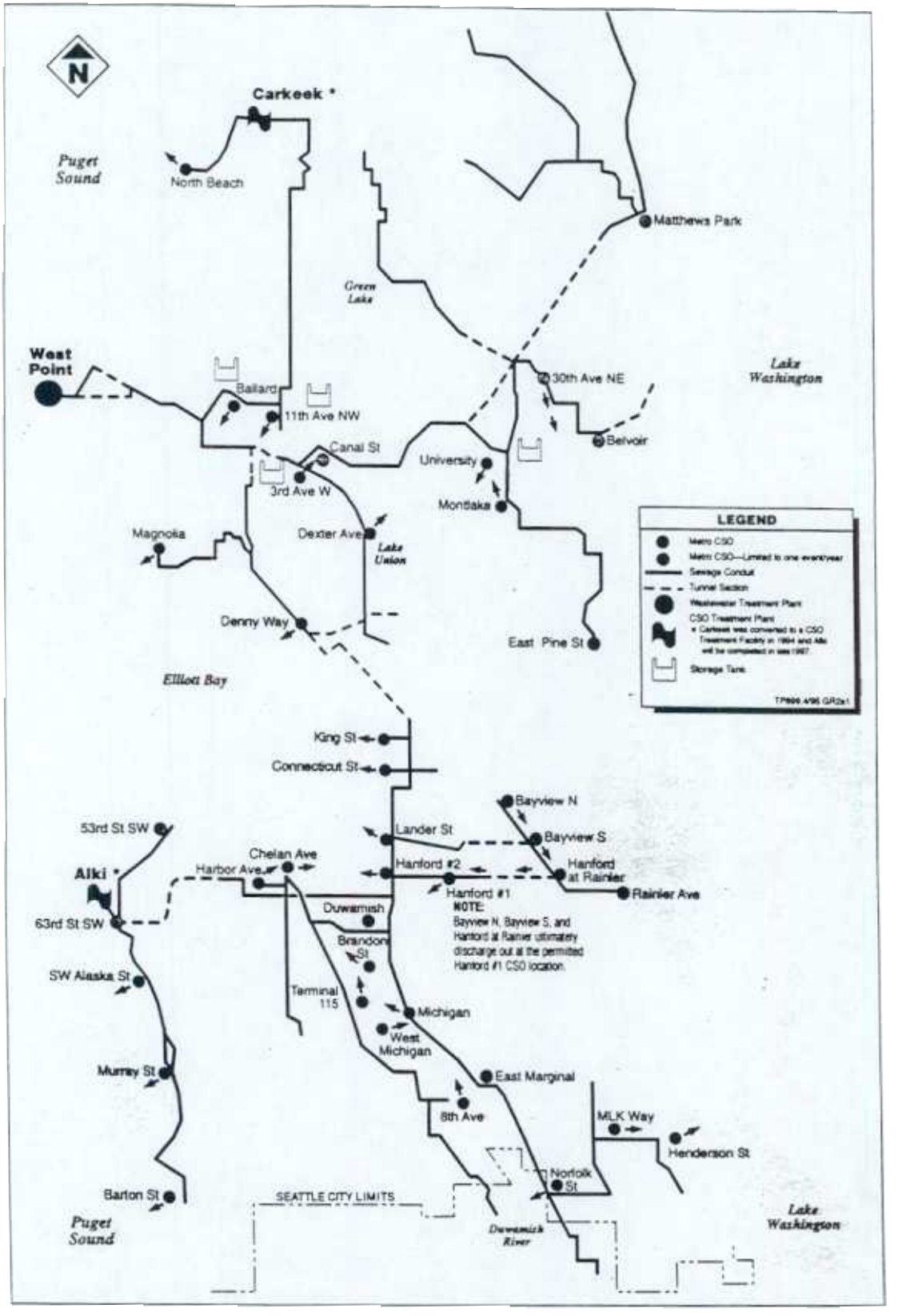


Figure 3. Group 2a1 projects: North Interceptor without a new Lake Line, surface storage option

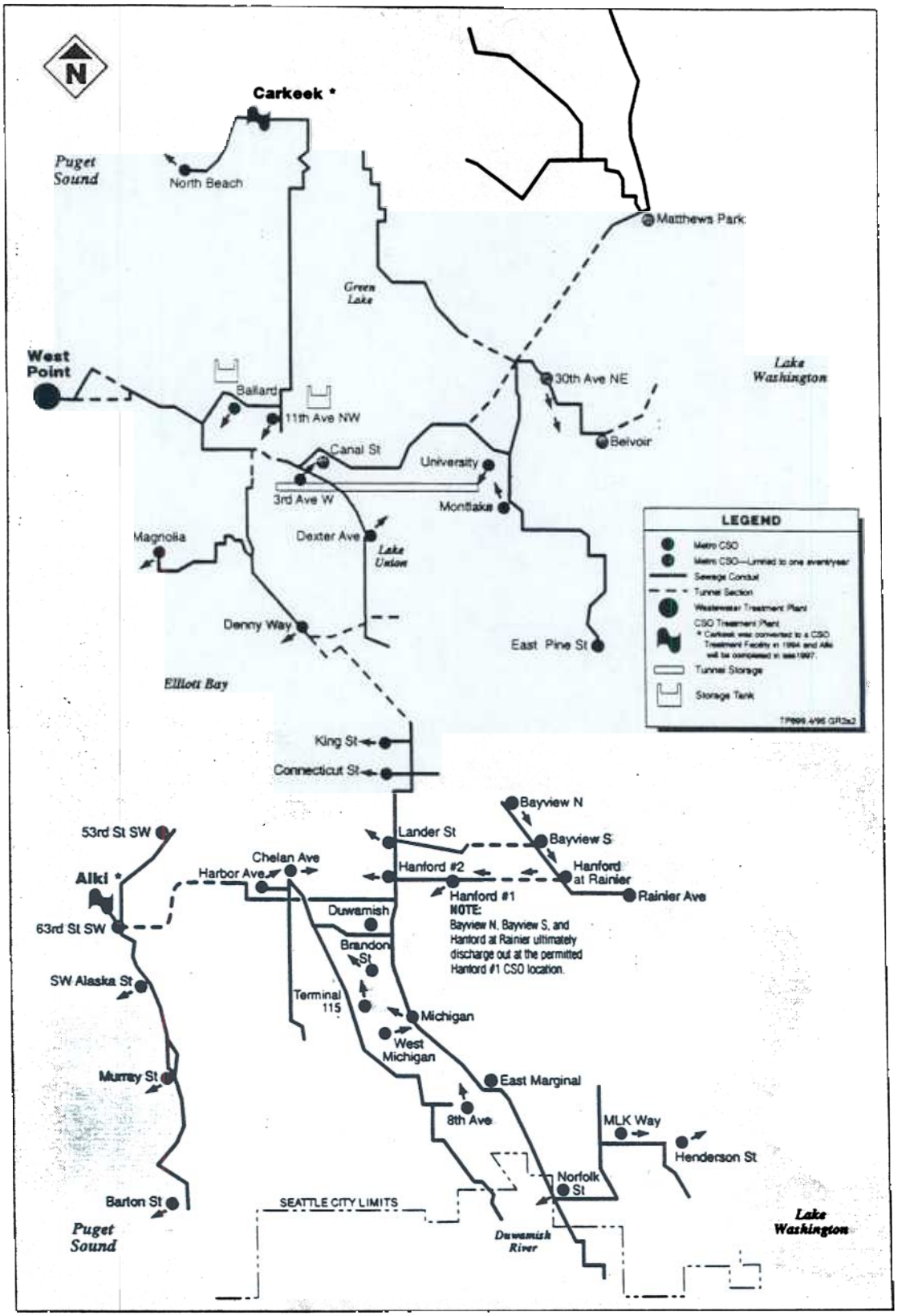


Figure 4. Group 2a2 projects: North Interceptor without a new Lake Line, deep tunnel option

Table 6. Estimated Flow Volumes and Costs for Group 2a Projects

North Interceptor without a new Lake Line (West Point at 133 mgd)
Corresponds with WW2020+ Alternatives A1, B1, and B2.

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
2a1 Near Surface Storage Storage Tanks									
University	110	58	8	6.6					Combined storage for University and Montlake Regulators
Montlake	10	4	4	0.8	$48	$768,000	7.5 MG storage tank	1.9	Parking lot south of Husky Stadium
Canal Street	1	<1	<1	0	$0				
3rd Ave. West	125	51	12	5.5	$25	$495,000	5.5 MG storage tank	1.4	Extension of Ewing St. east of 3rd Ave. adjacent to Ship Canal
Ballard		4	5	0.4	$3	$650,000	1.0 MG storage tank	0.1	Community open space on east side of Shilshole Ave. NW; joint city project
11th Ave. NW [a]	90	18	15	1.7	$10	$567,000	1.7 MG storage tank	0.4	Beneath segment of NW 45th St. or adjacent private property
Total	336	135		15	$86	$635,000		3.8	
2a2 Deep Tunnel Storage									
15,800 ft of 12-ft Dia Univ to 6th W	246	113	8	12.9	$113	$1,002,000	Deep Tunnel	0.4	Large access shafts at both ends--open space north of Husky Stadium, 6th Ave. West street end. Drop shaft at Canal St. CSO.
Ballard		4	5	0.4	$3	$650,000	1.0 MG storage tank	0.1	Community open space on east side of Shilshole Ave. NW; joint city project
11th Ave. NW [a]	90	18	15	1.7	$10	$567,000	1.7 MG storage tank	0.4	Beneath segment of NW 45th St. or adjacent private property
Total	336	135			$126	$934,000		0.5	

[a] 11th Ave. NW annual CSO baseline volume includes Ballard overflows

Additional Information:

West Point capacity is assumed set at 440 mgd.

Table 7. Capital Cost and O&M Phasing Summary for Group 2a Projects

Financial Assumptions:

Gross Discount Rate	**6.50%**
Inflation Rate (General):	**3.00%**
Inflation Rate (Energy):	**4.00%**

Base Year:	**1994**
Final Year:	**2030**
Base ENR (Capital Costs):	**5630**
Base ENR (O&M Costs):	**5747**
Analysis Period (Years):	**20**
Net Discount Rate (General):	**3.50%**
Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #2a
North Interceptor without a new lake line
Alternative #2a is a Stand-Alone Alternative

Note: Only 40% of Total O&M Estimate and 40% of Capital Cost Estimate is Reported for the Ballard Project

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Near Surface Storage									
University									
Montlake	2020	$11,442,798	$0	$36,117,056	$0	$47,559,854	$276,366	$24,971	$21,030,800
Canal Street									
3rd Avenue West	2020	$732,718	$0	$24,442,915	$0	$25,175,633	$218,634	$18,514	$11,409,921
Ballard (40% Capital Cost)	2020	$778,716	$0	$1,788,440	$0	$2,567,156	$28,218	$1,281	$1,181,271
11th Avenue West	2020	$997,046	$0	$9,157,978	$0	$10,155,024	$98,081	$5,716	$4,628,624
Subtotals:		$13,951,278	$0	$71,506,389	$0	$85,457,667	$621,299	$50,482	$38,250,616
Totals (Rounded):		**$14,000,000**	**$0**	**$71,500,000**	**$0**	**$85,500,000**	**$600,000**	**$100,000**	**$38,300,000**
				Total Present Worth Estimate for Alternative:					**$38,300,000**
Deep Tunnel Storage									
Deep Tunnel (Univ. to 6th Ave.)	2020	$12,481,515	$0	$100,726,453	$0	$113,207,968	$137,816	$3,454	$47,981,902
Ballard (40% of Capital Costs)	2020	$778,716	$0	$1,788,440	$0	$2,567,156	$28,218	$1,281	$1,181,271
11th Avenue West	2020	$997,046	$0	$9,157,978	$0	$10,155,024	$98,081	$5,716	$4,628,624
Subtotals:		$14,257,277	$0	$111,672,871	$0	$125,930,148	$264,115	$10,451	$53,791,797
Totals (Rounded):		**$14,300,000**	**$0**	**$111,700,000**	**$0**	**$125,900,000**	**$300,000**	**$0**	**$53,800,000**
				Total Present Worth Estimate for Alternative:					**$53,800,000**

IV. GROUP 2b: WEST POINT NORTHERN SERVICE AREA – WITH NEW LAKE LINE

General Description

This group corresponds to the Wastewater 2020 alternatives associated with a new conveyance/storage line to bring additional flows to West Point from north of Lake Washington. The related CSO control facilities are located in the West Point Northern Service Area between Ballard and the University District, including points along the Ship Canal and the Montlake Cut. Comparable levels of CSO control can be accomplished by either the construction of four to five storage tanks, or construction of a combination of two storage tanks and deep tunnel storage. The decision on which of the two configurations is preferable will be partially dependent on whether it will be possible to site a large storage tank in the University/Montlake area. The Group 2b CSO locations and a brief description of the control facility proposed for each location are listed in Table 8. System maps illustrating the locations of Group 2b projects are shown in Figures 5 and 6.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 2b CSO location are shown in Table 8. It is assumed that new flows from the area north of Lake Washington will be conveyed to West Point via a new line constructed parallel to the existing Kenmore to Matthews Beach Lake Line.. The 1998 annual volume refers to the overflow estimated to occur after all current CSO control projects are complete. The projects were sized assuming a West Point peak flow set point of 440 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 2b. The CSO facilities within this group have been designed to control the Design Storm No. 6 volume, limiting each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

A brief description of the CSO control facility locations and site requirements are compiled in Table 8. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1.

The total estimated project cost and the unit cost for each facility is shown in Table 8. Present worth project costs are shown graphically in Figure 1a. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 9 for each facility as well as the year in which the facility would come on-line. Summary project costs, annual O&M costs, and unit capital costs for the group, as a whole, are shown in Table 1.

Overview of Environmental Issues – University/Montlake Area Storage Tank Sites

Given the anticipated CSO storage requirements in the University/Montlake area, several potential sites were identified for location of an above- or below-ground storage facility. The total storage capacity needed in this area would be approximately 12 MG. This capacity could be provided by a single storage facility, or by a combination of smaller storage facilities at multiple locations. Several potential sites in the area were identified for a single (12MG) tank, but only three appeared to have adequate area for such a facility. Three additional sites that could accommodate a smaller storage tank were identified in the area.

Figure 7 shows the storage tank site locations in the University/Montlake area. Each tank location would require a pump station to drain the storage facility, and associated ancillary equipment. In addition, each tank facility would require odor controls, which would include a vent stack emerging from the ground or from a building on the surface. The following paragraphs provide information on siting issues associated with each identified storage location.

Site 1: University of Washington Montlake parking lot

The Montlake parking lot is constructed on an abandoned municipal landfill; in order to construct any facility at the site, extensive geotechnical investigation would be required. It would be necessary to characterize the nature of the landfill: depth and type of fill, structural competence of the subsurface material, etc. Because only cursory information is available, the cooperation of the University of Washington would be needed for conducting site-specific investigations.

Potential issues associated with the site include the possibility of contaminated fill, possibility of explosive/dangerous fill, potential to exacerbate or cause ground water contamination during construction, worker safety issues, and structural foundation problems. It is not likely that the University of Washington would be willing to accept the considerable risk associated with these investigations without a perceived significant benefit to the university. It might be difficult to convince the university that potential benefits from using this site outweigh the potential risks.

The tank could be constructed above grade in an attempt to avoid removal of the old fill material. The tank would be supported on piling driven through the existing asphalt surface. It is likely, however, that the Department of Ecology would still require that the fill below each pile be completely characterized to determine if the piling would penetrate any hazardous material. In addition, the prospect of driving pilings could open the issue of ground water contamination, if penetration of the bottom of the old fill area were to occur.

Other potentially major issues associated with this site include parking and local traffic. It would be necessary to provide approximately 6 acres of interim parking

during construction, and the possible location of this parking area has not been identified at this time. Once the site-specific investigations have been conducted, the nature of additional mitigation measures could be determined. These could be significant, including disposal of hazardous fill material and ground water cleanup. Extensive negotiations would be necessary among all parties involved, including permitting agencies, that could considerably extend the schedule for construction.

Site 2: Field area northeast of Montlake parking lot along NE 45th Street

This site is currently a soccer field between the university's baseball field and the driving range. Issues are similar to those discussed above for the Montlake parking lot, because this area was also created by fill. This area is also former municipal landfill; site-specific investigations would be required to determine the nature of the fill. Historically, structures in this area have experienced settling and other instability problems associated with building on fill. The close proximity to the Ravenna Slough would indicate potential for high ground water levels, shoreline issues, and potential concerns about ground water/lake contamination associated with any disruption of potentially contaminated fill. It would be necessary to completely characterize the site according to the nature of fill and surface/ground water interaction. Providing interim parking would not be an issue, but post-construction aesthetics would be an important concern. As described for Site 1, additional mitigation measures (such as wetland enhancement) could be determined following completion of the site-specific investigations.

Site 3: Parking lot and open area south of Husky Stadium

The primary issues associated with this site would include replacement of parking during construction, minimization of potential impacts to operation of Husky Stadium, and reduction of traffic impacts during construction. Site-specific geotechnical investigations would be required, but the potential environmental implications would be less of a concern as compared to Sites 1 and 2 because most of this area is underlain by native material rather than fill. The area east of the parking lot is currently vegetated with grass and ornamental trees. It would be important to construct the storage tank underground with minimal visual impact, because of the visible nature of the location. The university is likely to be concerned about any perceived risk to Husky Stadium. If the tank were constructed totally in the open area adjacent to the Ship Canal to minimize impact to the stadium parking area, shoreline issues would have to be addressed.

Use of this site offers lower risk to the university than either Site 1 or Site 2. Even with the potentially lower risks at this site, it is likely that negotiations with the university would be extensive. Due to limitations on use at this site during football season, it is assumed that construction would require two eight month seasons. However, of the three sites considered for construction of a single 12

MG tank facility this site appears to have the lowest potential environmental and regulatory risks.

Site 4: Area bounded by Montlake Boulevard NE, NE 45th Street, and 25th Avenue NE

This site is presently intersected by a road connecting 25th Avenue NE with Montlake Boulevard NE. Site 4 has sufficient area to permit the construction of approximately 3.5 MG of storage. It is uncertain whether this area is underlain by a portion of the abandoned landfill; if it is, similar environmental problems as discussed above for Site 1 would arise. More likely, this area was created by earth fill in what was formerly a large peat bog in the vicinity of University Village. Site-specific investigations would be needed to determine the nature of the fill.

Disruption of existing traffic flow and parking usage would be concerns with this site, as construction of the tank would require temporary closure of the roadway crossing the site and the on-site parking lot. The road through the site presently provides a route for traffic on NE 45th Street to reach northbound 25th Avenue NE. Because of the daily volume of traffic that uses this route, closure of the roadway during tank construction is potentially a significant concern. The on-site parking lot is relatively small, so the temporary loss of parking in this area would be less of a concern. Large parking facilities are available nearby in the University Village area northeast of the site and in the university's Montlake parking lot southeast of the site, so it should be possible to provide for the displaced parking spaces in the immediate vicinity. Mitigation measures to lessen the impact of tank construction on parking, traffic flow, and environmental aspects of the fill material underlying the site could be identified following completion of site-specific investigations.

Site 5: Ravenna Creek corridor through University Village

This site would involve tank construction adjacent to and/or beneath Ravenna Creek in conjunction with a proposed re-establishment of the Ravenna Creek channel through University Village. Plans are currently being pursued to reopen Ravenna Creek by creating a surface channel system and closing off the existing underground pipe through which it flows to Lake Washington. A storage tank would be constructed beneath the proposed corridor for the stream channel, either within the University Village parking lot or along the east side of 25th Avenue NE. It is estimated that as much as 2.0 MG of storage could be constructed in this corridor. Because either location would allow for the tank to be constructed before the Ravenna Creek channel was constructed above it, adverse impacts of tank construction on the creek would be minimal. Such an arrangement would be a benefit to the Ravenna Creek re-establishment project because the presence of a large storage tank beneath the creek would provide insurance that future development plans would not result in relocation or physical destruction of the creek in the tank area. As with Site 4, it is likely that the site area is underlain by

earth fill. Site-specific investigations would be needed to determine the nature of the fill.

Disruption of existing traffic flow and parking usage would be concerns with this site, as construction of the tank could require temporary closure of roadways and/or parking areas. If the preferred Ravenna Creek channel location is within University Village, then the tank construction project would primarily affect the parking lot area. If the preferred Ravenna Creek channel location is along the east side of 25th Avenue NE then the tank construction activities could affect traffic flow along the street and on access roads into University Village. This area experiences significant traffic flows, and therefore disruptions of traffic would be a major concern. Mitigation measures to lessen the impact of tank construction on parking and traffic flow could be identified following completion of site-specific investigations.

Site 6: Portage Bay Vista open area on the University of Washington southwest campus

This site would involve tank construction beneath a newly created open space area called Portage Vista in the UW Southwest Campus Plan. The University does not have the funding to create Portage Vista, and therefore it would likely seek to have Metro assist in creating the project in conjunction with storage tank construction. Thus, the cost to Metro could be disproportionately high with this site, as the university may wish to have Metro pay for improvements to the surrounding area that are not associated with the tank itself. If the project were to happen, the result would be an open space area, probably a parkway, with the tank facilities buried beneath it. Depending on the final configuration of the Vista, it is estimated that up to 5.5 MG of storage could be constructed at this site.

The need for timing the tank construction project with the university's plans for the southwest campus would be critical. The tank construction would likely be forced to fit into the university's schedule of improvements for the area, and scheduling uncertainties may create difficulties in pursuing this site.

The potential for odor impacts would be a significant concern with this site, since it is located close to several busy campus facilities. Additional odor control facilities, in comparison to other potential tank sites, may be required at this site as mitigation for those impacts.

Other sites

Other potential storage tank locations considered included the University Village parking lot, and the parking lot at the Museum of History and Industry. The University Village area is largely constructed on fill, with associated issues as described above for Sites 1 and 2. In addition, potential parking and traffic issues at this site would be considerable. The Museum of History and Industry is located adjacent to sensitive wetland/riparian habitat areas, and most of its parking would

be lost during construction. Public opposition to siting a major CSO facility at both these locations would likely be significant. Odor and noise would be of particular concern. For these reasons, these two sites are considered not feasible.

Of all the alternative tank sites identified, sites 1 and 2 are deemed to have the lowest likelihood of implementation. Construction of a single 20 MG tank at site 3 may also be difficult due to the size of the project and the associated potential for interference with Husky Stadium operations. Thus, a combination of smaller storage tank projects at sites 3, 4, 5 and 6 is probably the most viable option for implementation.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 9 includes information on project phasing specific to Group 2b. All of the projects in this group are scheduled for completion by the year 2010 to correspond with WW2020+ phasing of New Lake Line flows. It is possible that these projects could be delayed if sufficient storage volume is available in the New Lake Line to mitigate additional overflows in early years of use.

Relationship to WW2020+ and Biosolids Projects

The WW2020+ alternatives to which this CSO control group correspond are alternatives A2, A3, A4, B3, and D1, as indicated in Table 1. The deep tunnel configuration also corresponds to WW2020+ F1.

A summary of the volumes of liquids and biosolids generated by Group 2b projects is shown in Table 2. Group 2b projects would result in an increase in total system biosolids production of 34 tons per year.

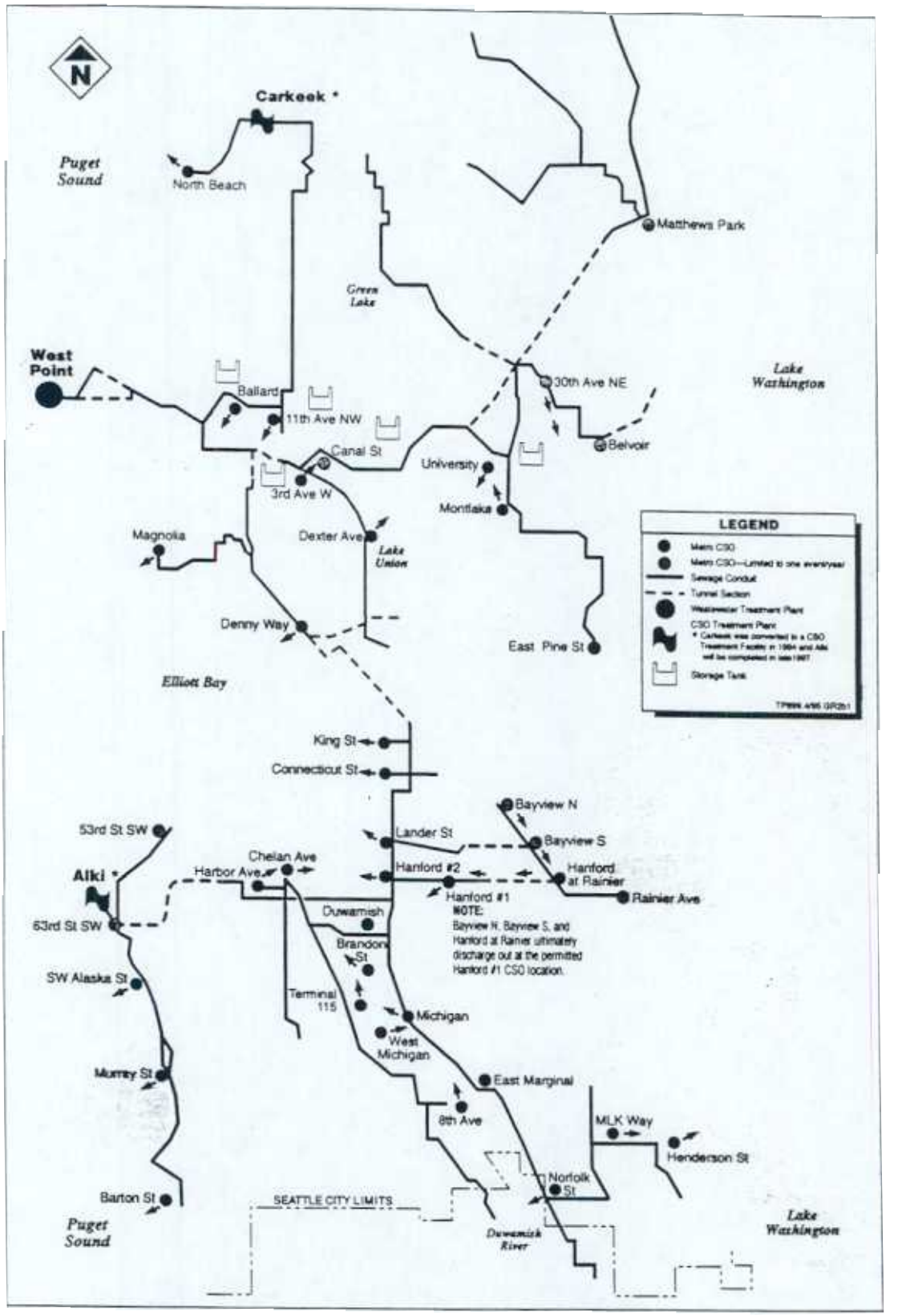


Figure 5. **Group 2b1 projects: North Interceptor with a new Lake Line, surface storage option**

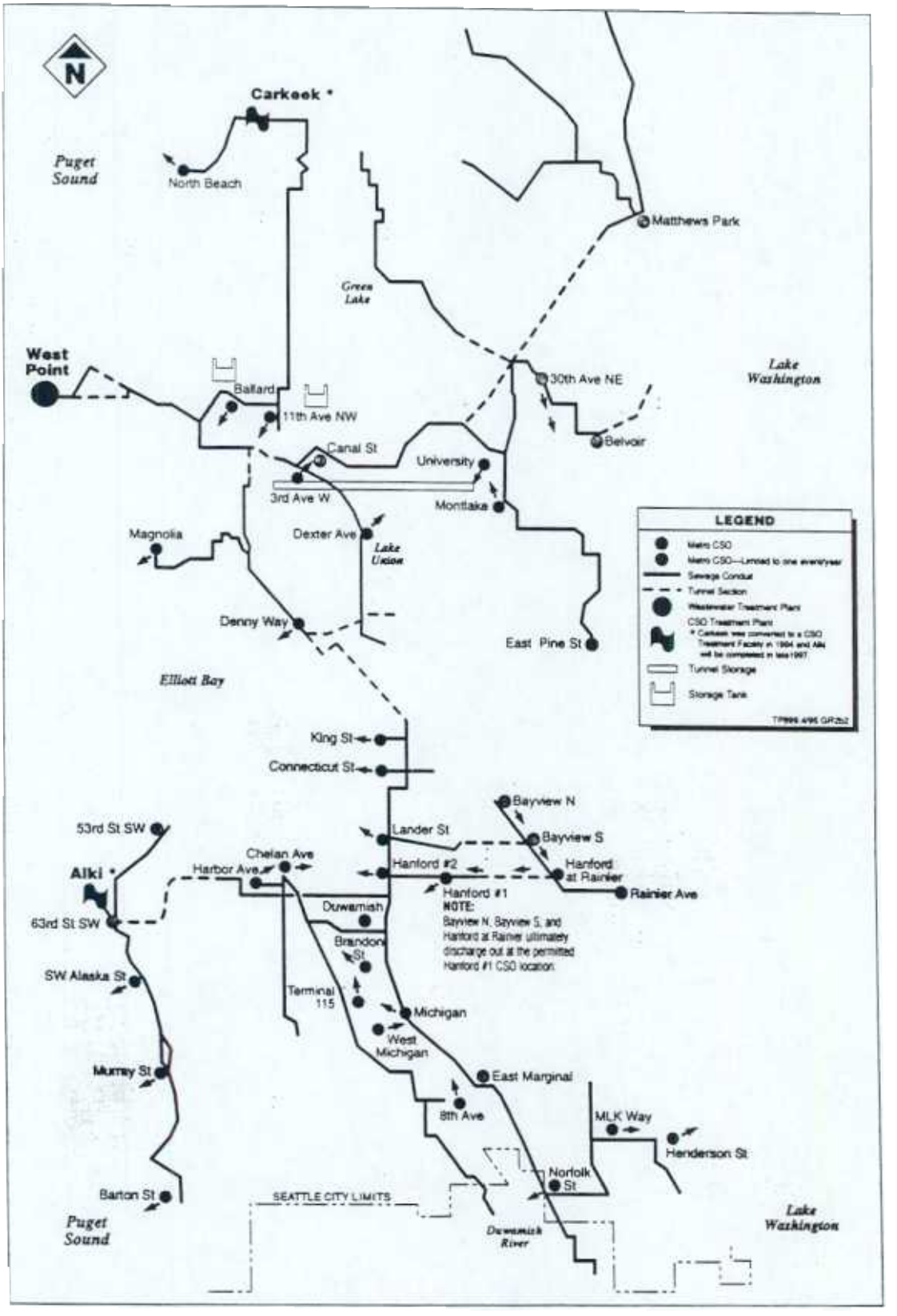


Figure 6. Group 2b2 projects: North Interceptor with a new Lake Line, deep tunnel option

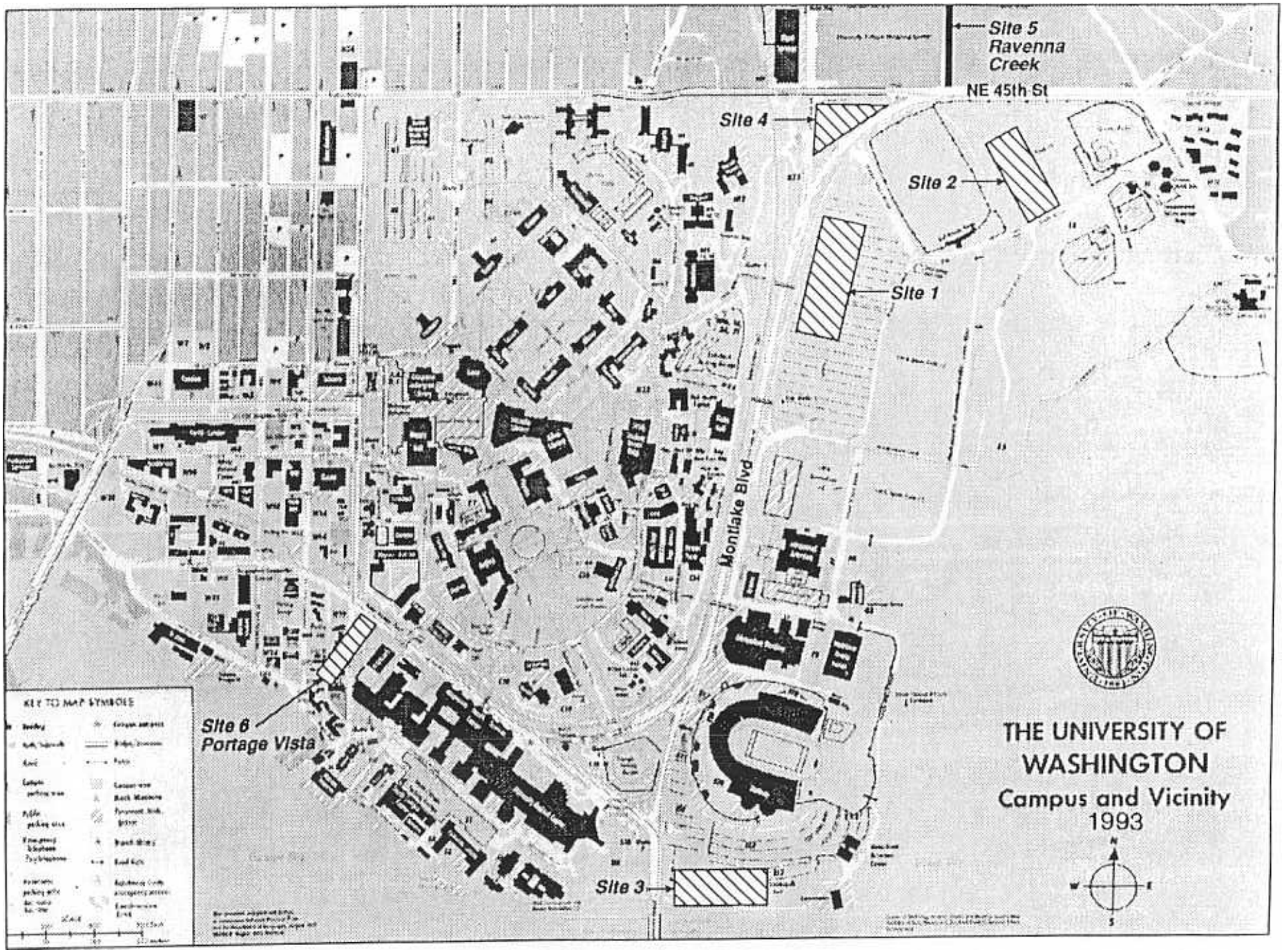


Figure 7. **University and Montlake area alternative storage tank sites**

Table 8. Estimated Flow Volumes and Costs for Group 2b Projects

North Interceptor with a new Lake Line (West Point at 159 mgd)
Corresponds with WW2020+ Alternatives A2, A3, A4, B3, and D1. Deep tunnel alternative integrates with F1.

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
2b1 Near Surface Storage Tanks									
University	110	107		10.7					Combined storage for University and Montlake Regulators
Montlake	10	13		1.3	$68	$564,000	12 MG storage tank	3.1	Parking lot south of Husky Stadium
Canal Street	1	0		0.0					
3rd Ave. West	125	67		6.7	$32	$484,000	7 MG storage tank	1.7	Extension of Ewing St. east of 3rd Ave. adjacent to Ship Canal
Ballard		4		0.4	$3	$650,000	1.0 MG storage tank	0.4	Community open space on east side of Shilshole Ave. NW; joint city project
11th Ave. West [a]	90	20		2.0	$12	$575,000	2.0 MG storage tank	0.5	Beneath segment of NW 45th St. or adjacent private property
Total		211			$114	$541,000		5.7	
2b2 Deep Tunnel Storage									
15,800 ft of 14-ft Dia Univ to 6th W	246	187		18.7	$131	$700,000	Deep Tunnel	0.4	Large access shafts at both ends--open space north of Husky Stadium, 6th Ave. West street end. Drop shaft at Canal St. & 3rd W CSOs.
Ballard		4		0.4	$3	$650,000	1.0 MG storage tank	0.4	Community open space on east side of Shilshole Ave. NW; joint city project
11th Ave. West [a]	90	20		2.0	$12	$575,000	2.0 MG storage tank	0.5	Beneath segment of NW 45th St. or adjacent private property
Total		211			$145	$687,000		1.3	

a 11th Ave. W. annual baseline CSO volume includes Ballard overflows

Additional Information:

West Point capacity is asumed set at 440 mgd.

Table 9. Capital Cost and O&M Phasing Summary for Group 2b Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #2b
North Interceptor with a new lake line
Alternative #2b is a Stand-Alone Alternative

Note: Only 40% of Total O&M Estimate and 40% of Capital Cost Estimate is Reported of the Ballard Project

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Near Surface Storage									
University									
Montlake	2010	$7,379,475	$0	$60,230,000	$0	$67,609,475	$576,628	$64,215	$45,096,328
Canal Street	2010	$0	$0	$0	$0	$0	$69,282	$3,113	$610,071
3rd Avenue West	2010	$788,720	$0	$31,590,000	$0	$32,378,720	$285,580	$26,390	$21,628,988
Ballard (40% of Capital Costs)	2010	$778,716	$0	$1,788,440	$0	$2,567,156	$34,761	$1,781	$1,812,449
11th Avenue West	2010	$997,046	$0	$10,524,367	$0	$11,521,413	$108,076	$6,649	$7,720,848
Subtotals:		$9,943,956	$0	$104,132,807	$0	$114,076,763	$1,074,327	$102,148	$76,868,684
Totals (Rounded):		**$9,900,000**	**$0**	**$104,100,000**	**$0**	**$114,100,000**	**$1,100,000**	**$100,000**	**$76,900,000**
				Total Present Worth Estimate for Alternative:					**$76,900,000**
Deep Tunnel Storage									
Deep Tunnel (Univ. to 6th Ave.)	2010	$14,414,093	$0	$116,418,000	$0	$130,832,093	$243,241	$4,166	$78,720,495
Ballard	2010	$778,716	$0	$1,788,440	$0	$2,567,156	$34,761	$1,781	$1,812,449
11th Avenue West	2010	$997,046	$0	$10,524,367	$0	$11,521,413	$108,076	$6,649	$7,720,848
Subtotals:		$16,189,855	$0	$128,730,807	$0	$144,920,662	$386,078	$12,596	$88,253,792
Totals (Rounded):		**$16,200,000**	**$0**	**$128,700,000**	**$0**	**$144,900,000**	**$400,000**	**$0**	**$88,300,000**
				Total Present Worth Estimate for Alternative:					**$88,300,000**

V. GROUPS 3a AND 3b: WEST POINT SOUTHERN SERVICE AREA – SECONDARY WASTEWATER PLUS PRIMARY CSO TREATMENT FACILITY AT DUWAMISH

General Description

These two groups involve a combination of one storage tank (Chelan), conveyance facilities, system controls and centralized CSO treatment. Groups 3a and 3b would provide a new centralized CSO treatment facility in conjunction with the secondary wastewater treatment plant located near the Duwamish pump station that is included in WW 2020 alternative D1. Group 3a was created to show the impacts of phasing out the Alki CSO treatment plant, and of a delay in construction of secondary treatment facilities past 2006. Group 3b does not include phase-out of the Alki plant, and assumes that secondary treatment facilities are on-line by 2006. If the secondary facilities were delayed beyond 2006, additional CSO control elements would be required to meet the 75 percent volume reduction requirement by the end of 2005. Because of the cost implications of the secondary schedule, it has been assumed that WW2020 alternative D1 treatment facilities will be rescheduled from 2010 to 2005.

Construction of a secondary treatment plant in the Duwamish area would allow the Elliott Bay Interceptor (EBI) to be blocked off just north of the Lander regulator station. With this modification, the remainder of the EBI from Lander to the Interbay pump station would be available to accept CSOs from the Connecticut, King, and Denny Way regulators. Control at Connecticut and King would be achieved by simply enlarging the pipe between the regulator stations and the EBI. The Denny project would be reduced in scale to include only an 18-foot diameter tunnel and connecting pipelines—no storage or treatment facilities would be required on the site west of Elliott Avenue, and no new outfall would be required. The Group 3b CSO locations and a brief description of the control facilities proposed are listed in Table 10. A system map illustrating the locations of Group 3b projects is shown in Figure 8.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 3b CSO location are shown in Table 10. The 1998 annual volume refers to the CSO remaining after completion of on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Groups 3a and 3b. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

Brief descriptions of the CSO control facility locations and site requirements are compiled in Table 10. Detailed site layouts will be determined during final design. A conceptual site layout of the storage facility for the Chelan location near the West Seattle pump station is shown in Attachment 1. A conceptual layout of the proposed tunnel that would provide storage capacity for the Denny Way CSO is also shown in Attachment 1.

The total estimated project cost and the unit cost for each Group 3b facility is shown in Table 10. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 11 for Group 3b projects, for each facility as well as the year in which the facility would come on-line. Summary project costs and unit capital costs for the Group 3b projects, as a whole, are shown in Table 1.

Group 3a would add a deep tunnel and pump station to convey Chelan, Harbor, and Alki flows to the Duwamish site (capital cost $53.4 million), and would enlarge CSO treatment capacity by 85 mgd (capital cost $45.5 million). These additions would occur in 2030.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 11 includes information on project phasing specific to Group 3b. The bulk of the CSO treatment capacity would be on-line in 2006. Additional capacity to accept flows from Michigan and Brandon would be constructed in 2025.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, Group 3b corresponds to WW2020+ alternative D1.

A summary of the volumes of liquids and biosolids generated by Group 3b projects is shown in Table 2. Group 3b projects would result in an increase in total system biosolids production of 338 tons per year.

Table 10. Estimated Flow Volumes and Costs for Group 3b Projects

Duwamish secondary/CSO treatment
Corresponds to WW2020+ Alternative D1; Alki remains in operation

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$13	$77,000	Convey to site		84-inch conveyance pipeline.
Brandon	60	57	40	4.5	$6	$111,000	Convey to site		84-inch conveyance pipeline.
Duwamish PS	1	<1	<1						
Hanford #2	605	207	23	18.8	$2	$9,000	Conveyance		Hanford/Lander conveyed to plant site in existing EBI.
Lander #1	190	164	23	15.2			96-inch control valve in EBI		Gate in EBI at Lander, 0.5 mgd PS to drain EBI south of Lander.
Connecticut	90	93	25	9.2			Conveyed north in EBI		Conneticut and King CSO conveyed north
King Street	55	33	31	2.2			Conveyed north in EBI		to West Point.
Chelan	73	66	25	4.0	$16	$247,000	4.0 MG storage tank	0.5	Twin 90-ft dia. caissons adjacent to West Seattle PS
Dexter	15	15	4	0.5			Included in Denny		Overflow diverted to Denny tunnel
Denny Way[a]	405	556	51	43.5	$71	$129,000	Tunnel storage	1.0	18-ft tunnel, regulators, outfall and pipelines interconnecting with existing tunnel and regulators. No Blackstock facilities.
Increase RS diversions					$9				Enlarge pipes from regulators to EBI.
CSO Treatment					$148			1.5	215 mgd Vortex Separator plant [b]
CSO Outfall Addition					$15				Outfall joint use with secondary. 60-inch required for secondary 102-inch required for secondary plus CSO
Total	1684	1349			$280	$208,000			

[a]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

[b]Vortex separator treatment is a representative technology; in the development of a specific project other on-site primary treatment technology may be used.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 11. Capital Cost and O&M Phasing Summary for Group 3b Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #3b
CSO Treatment w/Secondary Treatment at Duwamish (Alki Remains)

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Michigan	2025	$13,282,951	$0	$0	$0	$13,282,951	$3,800	$0	$4,720,318
Brandon	2025	$6,291,924	$0	$0	$0	$6,291,924	$1,800	$0	$2,235,940
Duwamish PS		$0	$0	$0	$0	$0			
Hanford #2	2005	$1,721,332	$0	$0	$0	$1,721,332	$16,464	$119	$1,381,444
Lander	2005	$0	$0	$0	$0	$0	$0	$12,775	$181,249
Connecticut	2005	$0	$0	$0	$0	$0	$34,317	$2,918	$433,025
King Street	2005	$0	$0	$0	$0	$0			
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,339	$4,946,698
Denny Way	2000	$20,200,000	$0	$51,000,000	$0	$71,200,000	$328,301	$18,344	$63,538,817
Increase RS Diversions	2005	$9,012,225	$0	$0	$0	$9,012,225	$2,500	$0	$6,268,691
CSO Treatment (2005)	2005	$41,021,479	$0	$0	$67,761,312	$108,782,791	$150,111	$22,768	$77,358,472
CSO Treatment (2025)	2025	$17,478,782	$0	$0	$21,573,449	$39,052,231	$70,641	$10,715	$13,996,993
CSO Outfall	2005	$14,752,252	$0	$0	$0	$14,752,252	$17,627	$0	$10,415,776
Subtotals:		$125,158,004	$0	$65,855,625	$89,334,761	$280,348,390	$832,633	$81,978	$185,477,423
Totals (Rounded):		**$125,200,000**	**$0**	**$65,900,000**	**$89,300,000**	**$280,300,000**	**$800,000**	**$100,000**	**$185,500,000**
					Total Present Worth Estimate for Alternative:				**$185,500,000**

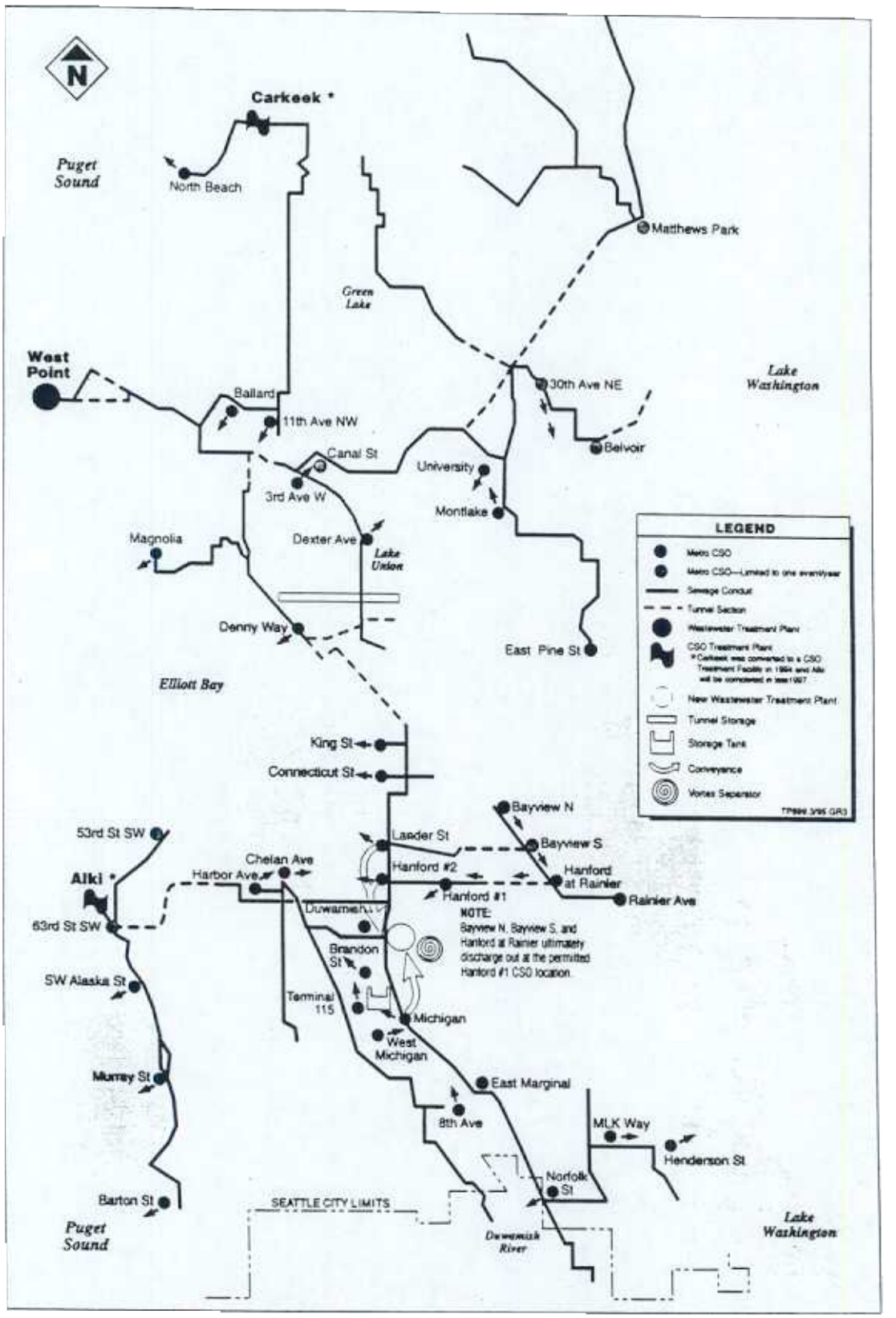


Figure 8. Group 3b and 3c projects: Duwamish secondary/CSO treatment

VI. GROUP 3c: WEST POINT SOUTHERN SERVICE AREA – SECONDARY WASTEWATER PLUS PRIMARY CSO TREATMENT FACILITY AT DUWAMISH

General Description

This group involves a combination of storage facilities, conveyance facilities, system controls, and CSO treatment. Group 3c would be similar to Groups 3a and 3b, but the new treatment facility near the Duwamish pump station would not provide secondary wastewater treatment (i.e., it would provide primary CSO treatment only). The Group 3c CSO locations and a brief description of the control facility proposed for each location are listed in Table 12. A system map illustrating the locations of Group 3c projects is shown in Figure 8.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 3c CSO location are shown in Table 12. The 1998 annual volume refers to the overflow remaining after completion of on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 3c. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

Brief descriptions of the CSO control facility locations and site requirements are compiled in Table 12. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1.

Group 3c includes three storage tanks at the Chelan, Lander, and Connecticut CSO locations. Completion of the partial separation of the Connecticut tributary area as recommended in pre-design studies is included to reduce the Connecticut tank size. Lander CSOs are conveyed to centralized treatment via the existing cross-tie pipeline connecting Lander to Hanford. The Lander storage tank would contain peak flows in excess of the capacity of this line. King CSOs would be conveyed to the Connecticut tank for storage. CSO flows from Hanford, Michigan, and Brandon would be conveyed to the centralized CSO treatment plant near the Duwamish pump station. The Denny project would be modified to convert the 2.5 MG storage tank on the site west of Elliott Avenue to CSO treatment. All other elements of the preferred Denny project are included.

The total estimated project cost and the unit cost for each facility are shown in Table 12. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 13 for each facility as well as the year in which the facility would come on-line. Summary project costs and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 13 includes information on project phasing specific to Group 3c. Project phasing is similar to Group 3b.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, this CSO control group corresponds to WW2020+ alternatives A1, A2, B1, B2, and B3.

A summary of the volumes of liquids and biosolids generated by Group 3c projects is shown in Table 2. Group 3c projects would result in an increase in total system biosolids production of 320 tons per year. This group would also result in new stormwater discharges totaling 76 MG per year.

Table 12. Estimated Flow Volumes and Costs for Group 3c Projects

Duwamish CSO treatment
Corresponds to WW2020+ Alternatives A1, A2, B1, B2, and B3. Alki remains in operation

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$13	$77,000	Convey to site		84-inch conveyance pipeline.
Brandon	60	57	40	4.5	$6	$111,000	Convey to site		84-inch conveyance pipeline.
Duwamish PS	1	<1	<1						
Hanford #2	605	207	23	18.8	$17	$80,000	Conveyance		Hanford conveyed to plant site in new 96 inch. 4 MG storage
Lander #1	190	164	23	15.2	$21	$130,000	Storage		at Lander. Lander conveyed south in exiting cross-tie line.
Connecticut	90	93	25	9.2	$21	$222,000	Separation/storage	129	Partially separate 129 acres and 6 MG storage tank.
King Street	55	33	31	2.2	$7	$200,000	Storage at Connecticut	0.8	2.5 MG storage
Chelan	73	66	25	4.0	$16	$247,000	4.0 MG storage tank	0.5	Twin 90-ft dia. caissons adjacent to West Seattle PS
Dexter	15	15	4	0.5			Included in Denny		Overflow diverted to Denny tunnel
Denny Way[a]	405	556	51	43.5	$119	$215,000	Tunnel storage and CSO treatment	1.3	Preferred alternative with 2.5 MG tank changed to 80 mgd CSO treatment plant.
Increase RS diversions					$5				Enlarge pipes from regulators to EBI.
CSO Treatment					$167			1.5	215 mgd CSO Primary sedimentation plant.
CSO Outfall					$45				Outfall joint use with secondary. 60-inch required for secondary 102-inch required for secondary plus CSO
Total	1684	1349			$437	$324,000			

[a]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 13. Capital Cost and O&M Phasing Summary for Group 3c Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #3c
Stand Alone CSO Projects

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Michigan	2025	$13,282,951	$0	$0	$0	$13,282,951	$3,800	$0	$4,720,318
Brandon	2005	$6,291,924	$0	$0	$0	$6,291,924	$1,800	$0	$4,377,137
Duwamish PS		$0	$0	$0	$0	$0			
Hanford #2	2005	$16,544,193	$0	$0	$0	$16,544,193	$34,584	$119	$11,851,737
Lander	2005	$0	$0	$21,263,970	$0	$21,263,970	$149,796	$12,775	$16,614,118
Connecticut	2025	$4,883,507	$1,607,240	$14,106,865	$0	$20,597,612	$397,104	$30,374	$8,014,165
King Street	2025	$2,533,340	$0	$4,102,388	$0	$6,635,728	$15,300		$2,379,592
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,339	$4,946,698
Denny Way	2000	$31,800,000	$0	$51,000,000	$36,392,336	$119,192,336	$593,156	$21,149	$106,849,290
Increase RS Diversions	2005	$5,407,335	$0	$0	$0	$5,407,335	$1,500	$0	$3,761,215
CSO Treatment (2005)	2005	$41,021,479	$0	$0	$78,928,751	$119,950,230	$82,424	$11,280	$84,155,490
CSO Treatment (2025)	2025	$17,478,782	$0	$0	$29,567,977	$47,046,759	$57,278	$7,839	$16,806,506
CSO Outfall	2005	$44,566,658	$0	$0	$0	$44,566,658	$17,627	$0	$31,059,591
Subtotals:		$185,207,228	$1,607,240	$105,328,848	$144,889,064	$437,032,380	$1,561,441	$97,875	$295,535,857
Totals (Rounded):		**$185,200,000**	**$1,600,000**	**$105,300,000**	**$144,900,000**	**$437,000,000**	**$1,600,000**	**$100,000**	**$295,500,000**
					Total Present Worth Estimate for Alternative:				**$295,500,000**

VII. GROUP 4: WEST POINT SOUTHERN SERVICE AREA – FLOW TRANSFER TO EDRP AT RENTON

General Description

This group involves a combination of CSO separation, storage, treatment, and conveyance facilities. Base flows from a portion of the West Point Southern Service Area would be pumped to the East Division Reclamation Plant at Renton (EDRP) via the Duwamish pump station (WW2020+ alternatives A3 and A4). This would dramatically reduce CSOs at the Hanford #2, Lander, Connecticut, and King regulator stations. Two hundred ninety acres of sewered areas contributing to the Brandon Street and Michigan Street CSOs would be separated, and five storage tanks would be provided. The separated stormwater would be discharged to the Duwamish River via a new outfall. The CSO control at Denny Way associated with this group would involve construction of a vortex separator or primary sedimentation facilities for treatment of flows prior to discharge. The Group 4 CSO locations and a brief description of the control facility proposed for each location are listed in Table 14. A system map illustrating the locations of Group 4 projects is shown in Figure 9.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 4 CSO location are shown in Table 14. The 1998 annual volume refers to the CSO remaining after completion of on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 4. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

A brief description of the CSO control facility locations and site requirements are compiled in Table 14. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities for the Michigan Street, Brandon Street, and Chelan Avenue locations are shown in Attachment 1.

The total estimated project cost and the unit cost for each facility is shown in Table 14. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 15 for each facility as well as the year in which the facility would come on-line. Summary project costs, annual O&M costs, and unit capital costs for the group, as a whole, are shown in Table 1. The costs for the transfer pump station, pipeline, upgrades at the EDRP, and the Effluent Transfer System (ETS) are not included. These are assumed to be WW2020+ costs.

Project Phasing

According to the WW2020+ plan, the transfer to the EDRP at Renton is not scheduled until 2010, whereas CSO projects must be on-line by 2005 to meet the 75 percent reduction target. Costs were not added to the CSO project options to correct for this discrepancy. It is assumed that the storage tanks for the Hanford/Lander and Connecticut/King CSOs would be designed to provide treatment for overflows in the interim period. Negotiations with Ecology may be necessary to support this designation in light of the 75 percent CSO reduction goal.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, this CSO control group corresponds to WW2020+ alternatives A3 and A4.

A summary of the volumes of liquids and biosolids generated by Group 4 projects is shown in Table 2. Group 4 projects would result in an increase in total system biosolids production of 209 tons per year at West Point. The separation component of the CSO controls under Group 4 would result in increased discharges to the stormwater infrastructure of 147 MG per year. The CSO-related loadings to the EDRP would be about 307 MG per year of flow and 128 tons per year of biosolids.

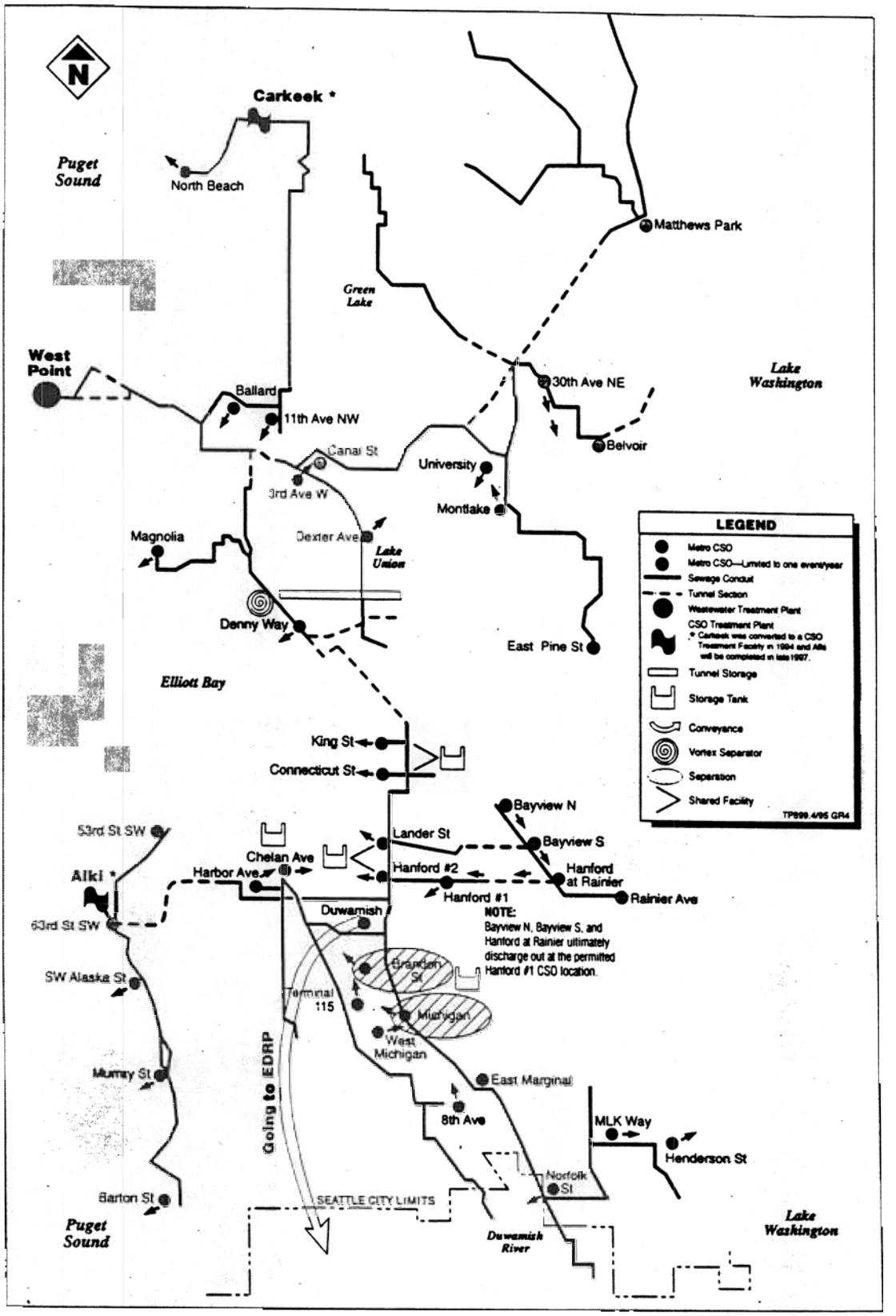


Figure 9. Group 4 projects: Southern Service Area transfer to EDRP

Table 14. Estimated Flow Volumes and Costs for Group 4 Projects

Southern Service Area transfer to EDRP at Renton
Corresponds to WW2020+ Alternatives A3 and A4

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$31	$178,000	Separation&Storage	238	
Brandon	60	57	40	4.5	$14	$243,000	Separation&Storage	52	
Duwamish PS	1	1	<1						
Hanford #2 [a]	605	207	23						Joint facility located along the intertie between Hanford and
Lander #1	190	164	23	6.5	$32	$88,000	Rectangular Storage tank	1.7	Lander Regulators.
Connecticut	90	93	25						Joint Conneticut/King facility located in the
King Street	55	33	31	2.5	$18	$142,000	Rectangular Storage tank	0.6	Kingdome parking lot or land to south of Royal Brougham.
Dexter	15	15	4	0.5			Included in Denny		
Denny Way [b]	405	556	51	43.5	$127	$228,000	Storage/Treatment	1.3	Denny Way project upgraded for vortex treatment [d]
Chelan	73	66	25	4.0	$16	$247,000	Storage	0.5	Twin 90-ft dia. caissons adjacent to West Seattle PS
Totals [c]	1684	1350		74.6	$238	$176,000		294	

[a]Includes Hanford #1 overflows.

[b]Denny 1998 volume includes Dexter and City of Seattle flows from east Lake Union project.

[c]Does not include transfer line and pump station - WW2020 cost.

[d]Vortex treatment is a representative technology; in the development of a specific project other on-site primary treatment technology may be used.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 15. Capital Cost and O&M Phasing Summary for Group 4 Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #4
Southern Service Area Transfer to EDTP at Renton

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Michigan	2005	$7,981,839	$9,056,917	$13,694,359	$0	$30,733,115	$389,051	$19,610	$25,998,002
Brandon	2005	$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653	$185,326	$10,686	$11,843,039
Duwamish PS		$0	$0	$0	$0	$0			
Hanford #2	2025	$0	$0	$17,435,689	$0	$17,435,689	$131,861	$12,498	$6,427,171
Lander	2005	$0	$0	$14,852,624	$0	$14,852,624	$103,605	$9,819	$11,605,771
Connecticut	2025	$3,565,101	$0	$14,244,023	$0	$17,809,124	$140,924	$8,666	$6,565,705
King Street	2025	$0	$0	$0	$0	$0	$0	$0	$0
Denny Way	2000	$31,800,000	$0	$51,000,000	$45,200,000	$128,000,000	$343,232	$23,817	$110,343,722
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,339	$4,946,698
Subtotals:		$47,791,148	$10,818,299	$135,104,442	$45,200,000	$238,913,889	$1,501,071	$99,435	$177,730,106
Totals (Rounded):		**$47,800,000**	**$10,800,000**	**$135,100,000**	**$45,200,000**	**$238,900,000**	**$1,500,000**	**$100,000**	**$177,700,000**
					Total Present Worth Estimate for Alternative:				**$177,700,000**

VIII. GROUP 5: WEST POINT SOUTHERN SERVICE AREA – ON-SITE TREATMENT EMPHASIS

General Description

This group also involves a combination of CSO separation, storage, treatment, and conveyance facilities. Localized CSO treatment via vortex separation or primary sedimentation of flow would be implemented at three or four locations in the West Point Southern Service Area.

Two sub-groups were created. Group 5a includesCSO treatment at Denny Way, at Michigan Street, a shared facility at King and Connecticut, and a shared facility at Hanford #2 and Lander. Partial separation of a portion of the Brandon area (52 acres) is included together with an associated storage tank. The treatment facilities have been assumed to be vortex separator plants for the purposes of estimating costs. The vortex plants are assumed to contain 'primary units' designed for a peak hydraulic loading rate of 5.0 gallons per minute per square foot of surface area (gpm/sqft) during Metro's Design Storm 6. In addition to the primary units, 'secondary' vortex units of the same size are included to further concentrate the solids laden stream from the primary units. These provide an additional 20 percent surface area, and thus could be used to reduce peak hydraulic loading to 4.0 gpm/sqft. Initial pilot studies if Vortex separator technology indicates little suspended or settleable solids removal occurs at hydraulic loadings of 4 to 5 gpm/sqft. The average rate during an overflow event will be significantly less than the peak, however so that removals will occur at lower flows. The vortex units would be constructed below grade. The units are assumed to have diameters of 35 to 40 feet, with a water depth equal to the diameter.

Group 5b was created to examine the impact of using highly loaded rectangular primary like storage/treatment tanks. In this sub-group, CSO treatment facilities are located at the Brandon CSO as well as the others listed under Group 5a. The tanks are assumed to be similar to rectangular primary tanks constructed with the top of the walls about 5-feet above grade. The tanks would be furnished with aluminum covers and odor control equipment. An allowance of 5 to 10 percent (from Metro's experience depending on surrounding land use) was added to the construction cost estimate to provide for mitigation of the above grade facilities. The tanks were assumed to be loaded at a peak hydraulic rate of 4000 gallons per day per square foot (gdp/sqft), or between 2.5 and 3.0 gpm/sqft. The literature and Metro experience indicate that little if any suspended or settleable solids removal will occur at these peak rates. These tanks are assumed to have a 15 foot water depth and sludge would be accumulated in the tanks until clean up after storms. Because the storage/treatment units are above grade and of significantly less liquid depth, the construction cost estimates are lower than the vortex systems even though the surface area is greater. The difference in excavation costs is significant.

Achievement of Ecology CSO treatment requirements of 50 percent suspended solids removal and 0.3 ml/l/hr effluent settleable solids concentrations in rectangular

storage/treatment facilities or vortex separators in these groups will depend on the average rate at which the units operate over an annual cycle. If average rates are significantly below the peak design rates most of the time, then treatment standards might be met. It is also possible that chemical addition and mechanical enhancement (e.g. dissolved air floatation) will be required to ensure reliablely meeting effluent requirements

Short near-shore outfalls would be used for discharge of treated CSO flows with the exception of Denny Way where an outfall over 1000 feet off-shore is planned. All treatment systems would be furnished with disenfection facilities using the detention time in the units One storage tank is included at the Chelan CSO location. The Group 5 CSO locations and a brief description of the control facility proposed for each location are listed in Tables 16a and 16 b. A system map illustrating the locations of Group 5 projects is shown in Figure 10.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 5 CSO location are shown in Table 16. The 1998 annual volume refers to the overflow remaining after completion of all on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 5. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

A brief description of the CSO control facility locations and site requirements are compiled in Table 16. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1.

The total estimated project cost and the unit cost for each facility is shown in Table 16. Component capital costs, annual O&M costs, and total present worth costs are shown in Tables 17a and 17b for each facility as well as the year in which the facility would come on-line. Summary project costs and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 17 includes information on project phasing specific to Group 5. By 2005, onsite treatment or storage/separation would be provided for Denny Way, Michigan, Brandon and Lander CSO locations.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, this CSO control group corresponds to WW2020+ alternatives A1, A2, B1, B2, and B3.

A summary of the volumes of liquids and biosolids generated by Group 5a projects is shown in Table 2. Group 5a projects would result in new stormwater discharges of 22 MG per year. Group 5b would not increase stormwater discharge. Group 5 projects would result in an increase in total system biosolids production of 300 tons per year.

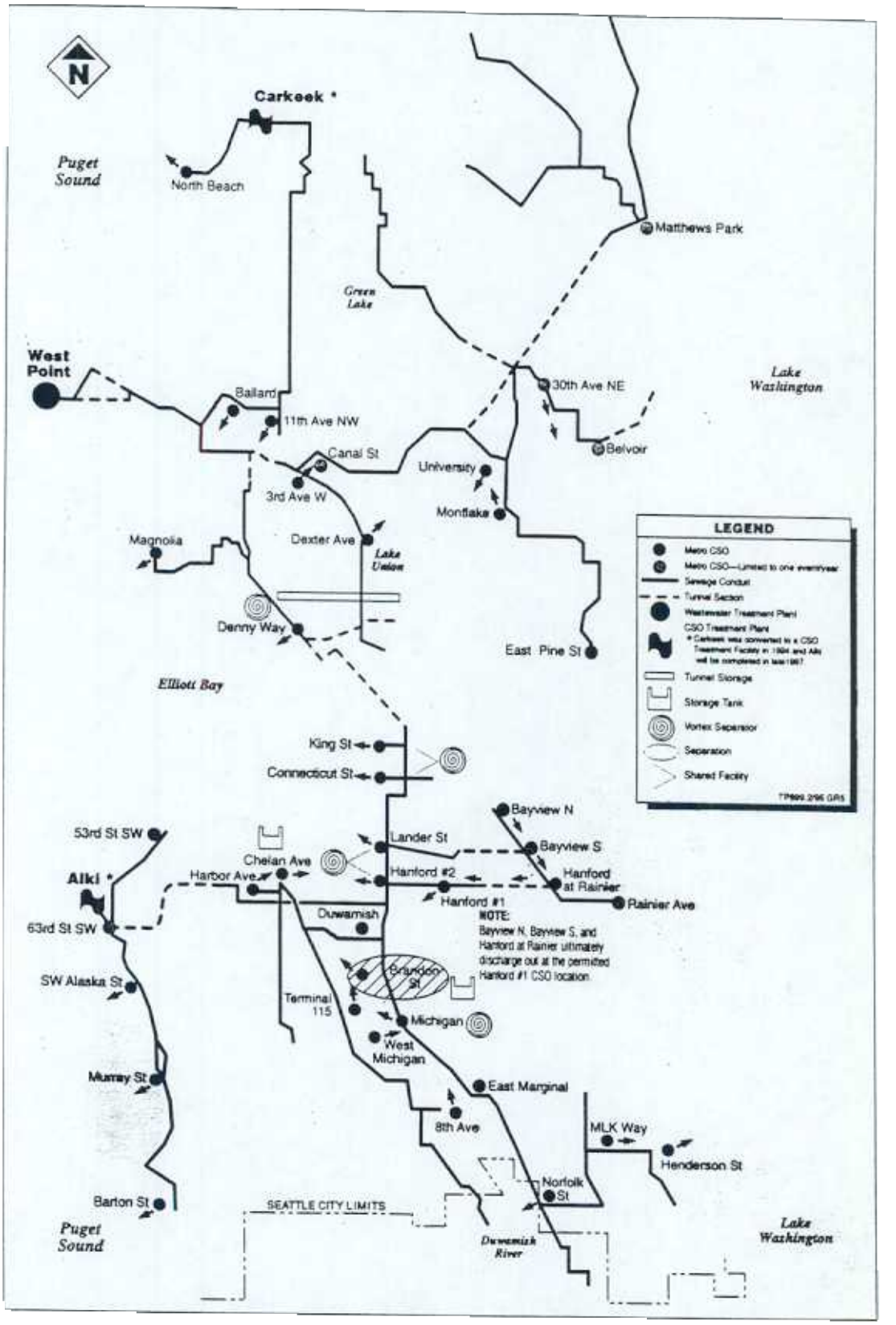


Figure 10. Group 5 projects: Southern Service Area on-site treatment emphasis

Table 16a. Estimated Flow Volumes and Costs for Group 5a Projects

Denny/Duwamish CSO treatment
Corresponds to WW2020+ Alternatives A1, A2, B1, B2 and B3

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$44	$254,000	Vortex treatment [a]	0.5	
Brandon	60	57	40	4.5	$14	$243,000	Separation and storage	52	
Duwamish PS	1	1	<1						
Hanford #2 [b]	605	207	23	18.8	$46		Vortex treatment [a]		Joint facility located along the intertie between Hanford and
Lander #1	190	164	23	15.2	$31	$83,000	Vortex treatment [a]	0.7	Lander Regulators.
Connecticut	90	93	25	9.2	$45	$379,000	Vortex treatment [a]	0.7	Kingdome parking lot or land to south of Royal Brougham
King Street	55	33	31	2.2	$3		Convey to Conneticut		
Dexter	15	15	4	0.5			Included in Denny		
Denny Way [c]	405	556	51	43.5	$128	$231,000	Storage/treatment	1.3	Denny project upgraded for vortex treatment
Chelan	73	66	25	4.0	$16	$247,000	Storage	0.5	Twin 90-ft dia. caissons adjacent to West Seattle PS
Totals	1684	1350		111	$326	$242,000		56	

[a]Vortex treatment is a representative technology; in the development of a specific project other on-site primary treatment technology may be used.

[b]Includes Hanford #1 overflows.

[c]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 16b. Estimated Flow Volumes and Costs for Group 5b Projects

Denny/Duwamish CSO treatment
Corresponds to WW2020+ Alternatives A1, A2, B1, B2 and B3

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology[a]	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$29	$167,000	CSO Treatment (2.1 MG)	1.4	
Brandon	60	57	40	4.5	$12	$204,000	CSO Treatment (0.7 MG)	0.5	
Duwamish PS	1	1	<1						
Hanford #2 [b]	605	207	23	18.8	$25		CSO Treatment (3.3 MG)	1.7	Joint facility located along the intertie between Hanford and
Lander #1	190	164	23	15.2	$23	$130,000	CSO Treatment (1.5 MG)	1.2	Lander Regulators.
Connecticut	90	93	25	9.2	$28	$247,000	CSO Treatment (2.1 MG)	1.4	Kingdome parking lot or land to south of Royal Brougham
King Street	55	33	31	2.2	$3		Convey to Conneticut	0.2	
Dexter	15	15	4	0.5			Included in Denny		
Denny Way [c]	405	556	51	43.5	$104	$194,000	Storage (15.4 MG)	1.3	Denny project upgraded for vortex treatment
Denny Way Treatment					$15		CSO Treatment (+1.0 MG)		2.5 MG storage enlarged and converted to CSO treatment
Chelan	73	66	25	4.0	$16	$247,000	Storage (4 MG)		Twin 90-ft dia. caissons adjacent to West Seattle PS
Totals	1684	1350		111	$255	$189,000		8	

[a]CSO Treatment assumed to be primary sedimentation with peak overflow rate of about 4000 gpd/sqft in Design Storm #6

[b]Includes Hanford #1 overflows.

[c]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 17a. Capital Cost and O&M Phasing Summary for Group 5a Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #5
Denny/Duwamish CSO Treatment

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Preser Worth (O&M Plus Capital) (1994 $)
Michigan	2005	$13,651,513	$0	$0	$30,182,239	$43,833,752	$68,596	$6,145	$31,220,9
Brandon	2005	$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653	$185,326	$10,686	$11,843,0
Duwamish PS		$0	$0	$0	$0	$0			
Hanford #2	2025	$9,086,881	$0	$0	$36,868,765	$45,955,646	$68,444	$3,909	$16,428,4
Lander	2005	$6,057,921	$0	$0	$24,579,177	$30,637,098	$53,777	$3,072	$21,870,7
Connecticut	2025	$12,344,512	$0	$0	$32,554,295	$44,898,807	$65,068	$5,354	$16,051,1
King Street	2025	$2,832,383	$0	$0	$0	$2,832,383	$15,300	$0	$1,029,7
Denny Way	2000	$31,800,000	$0	$51,000,000	$45,200,000	$128,000,000	$440,317	$19,937	$111,734,4
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,339	$4,946,6
Subtotals:		$80,217,418	$1,761,382	$74,877,747	$169,384,476	$326,241,023	$1,103,900	$63,442	$215,125,2
Totals (Rounded):		**$80,200,000**	**$1,800,000**	**$74,900,000**	**$169,400,000**	**$326,200,000**	**$1,100,000**	**$100,000**	**$215,100,**
					Total Present Worth Estimate for Alternative:				**$215,100,0**

Table 17b. Capital Cost and O&M Phasing Summary for Group 5b Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #5b
Modified Denny/Duwamish CSO Treatment

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Preser Worth (O&M Plu: Capital) (1994 $)
Michigan (S/T@4000 gpd/sf)	2005	$13,023,620	$0	$0	$15,814,000	$28,837,620	$68,596	$6,145	$20,837,4
Brandon (S/T @4000 gpd/sf)	2005	$732,000	$0	$0	$10,850,000	$11,582,000	$185,326	$10,686	$10,286,0
Duwamish PS		$0	$0	$0	$0	$0			
Hanford #2 (S/T @3400 gpd/sf)	2025	$2,511,120	$0	$0	$22,330,000	$24,841,120	$68,444	$3,909	$8,934,6
Lander (S/T @4000 1st phase)	2005	$2,511,120	$0	$0	$20,610,000	$23,121,120	$53,777	$3,072	$16,666,5
Connecticut (S/T @4000)	2025	$3,243,837	$0	$0	$25,080,000	$28,323,837	$65,068	$5,354	$10,168,5
King Street (to Conn.)	2025	$2,832,383	$0	$0	$0	$2,832,383	$15,300	$0	$1,029,7
Denny Way (S/T @4000 gpd/sf)	2005	$31,800,000	$0	$51,000,000	$36,392,336	$119,192,336	$440,317	$19,937	$87,837,8
Chelan (4 MG storage)	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,339	$4,946,6
Subtotals:		$58,051,139	$0	$65,855,625	$131,076,336	$254,983,100	$1,103,900	$63,442	$160,707,6
Totals (Rounded):		**$58,100,000**	**$0**	**$65,900,000**	**$131,100,000**	**$255,000,000**	**$1,100,000**	**$100,000**	**$160,700,**
					Total Present Worth Estimate for Alternative:				**$160,700,**

IX. GROUP 6: WEST POINT SOUTHERN SERVICE AREA – SEPARATION AND STORAGE EMPHASIS

General Description

This group would provide an alternative to the collection of facilities identified for Group 5 by substituting separation and storage for on-site CSO treatment at some locations. Vortex separation or primary sedimentation would still be used at two of the CSO locations (Hanford/Lander and Denny); however, a combination of separation and storage facilities would provide CSO control at other locations. Three partial separation projects and four storage tanks are included. Discharge from the CSO treatment facilities would be through near-shore outfalls, except for Denny Way. The CSO locations and a brief description of the control facility proposed for each location are listed in Table 18. A system map illustrating the locations of Group 6 projects is shown in Figure 11.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 6 CSO location are shown in Table 18. The 1998 annual volume refers to the overflow remaining after completion of all on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 6. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

A brief description of the CSO control facility locations and site requirements are compiled in Table 18. Detailed site layouts will be determined during final design. Conceptual site layouts of the control facilities are shown in Attachment 1.

The total estimated project cost and the unit cost for each facility is shown in Table 18. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 19 for each facility as well as the year in which the facility would come on-line. Summary project costs and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 19 includes information on project phasing specific to Group 6. By 2005, onsite treatment would be provided at Denny Way and at Hanford/Lander streets.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, this CSO control group corresponds to WW2020+ alternatives A1, A2, B1, B2, and B3.

A summary of the volumes of liquids and biosolids generated by Group 6 projects is shown in Table 2. Group 6 projects would result in new stormwater discharges totaling 223 MG per year, and an increase in total system biosolids production of 288 tons per year.

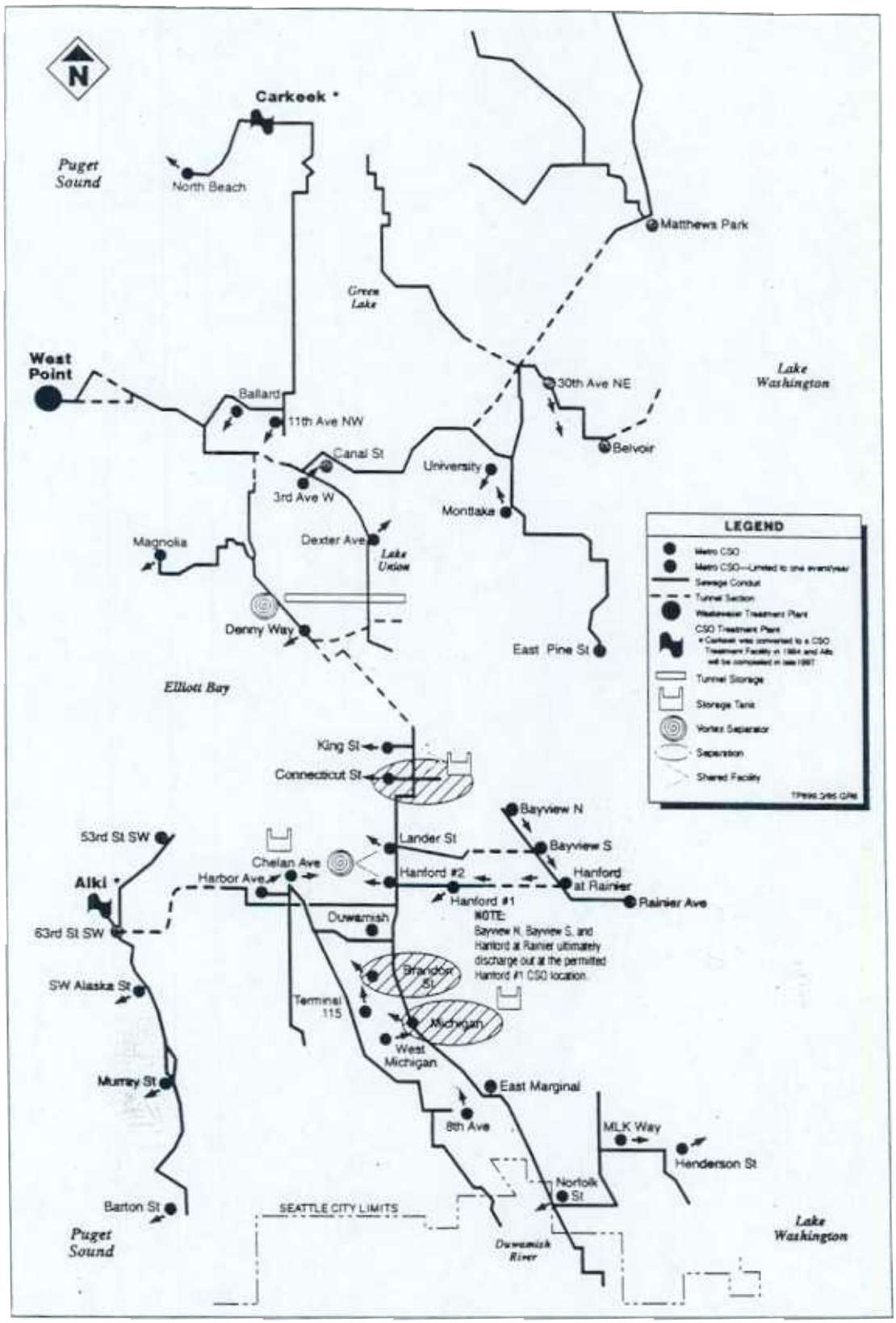


Figure 11. Group 6 projects: Southern Service Area alternative configuration to Group 5, separation and storage with on-site treatment

Table 18. Estimated Flow Volumes and Costs for Group 6 Projects

Southern Service Area separation/storage/on-site treatment emphasis
Corresponds to WW2020+ Alternatives A1, A2, B1, B2 and B3

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1	$31	$178,000	Separation and storage	238	
Brandon	60	57	40	4.5	$14	$243,000	Separation and storage	52	
Duwamish PS	1	1	<1						
Hanford #2 [a]	605	207	23	18.8	$46		Vortex treatment [b]		Joint facility located along the intertie between Hanford and
Lander #1	190	164	23	15.2	$31	$207,000	Vortex treatment [b]	0.7	Lander Regulators.
Connecticut	90	93	25	9.2	$21	$217,000	Separation and storage	129	Kingdome parking lot or land to south of Royal Brougham
King Street	55	33	31	2.2	$7		Convey to Conneticut		
Dexter	15	15	4	0.5			Included in Denny		
Denny Way [c]	405	556	51	43.5	$128	$231,000	Storage/treatment	1.3	Denny Way project upgraded for vortex treatment
Chelan	73	66	25	4.0	$16	$247,000	Storage	0.5	Twin 90-ft dia. caissons adjacent to West Seattle PS
Totals	1684	1350		111	$293	$217,000		421	

[a]Vortex treatment is a representative technology; in the development of a specific project other on-site primary treatment technology may be used.

[b]Includes Hanford #1 overflows.

[c]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 19. Capital Cost and O&M Phasing Summary for Group 6 Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #6
SSA Separation/Storage/On-Site Treatment Emphasis

CSO Location	On-Line Year	Component Cost Breakdown				Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflat Annualiz O&M (Energy (1994 $
		Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")			
Michigan	2005	$7,981,839	$9,056,917	$13,694,359	$0	$30,733,115	$389,051	$19,
Brandon	2005	$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653	$185,326	$10,
Duwamish PS		$0	$0	$0	$0	$0		
Hanford #2	2025	$9,086,881	$0	$0	$36,868,765	$45,955,646	$68,444	$3,
Lander	2005	$6,057,921	$0	$0	$24,579,177	$30,637,098	$53,777	$3,
Connecticut	2025	$4,883,507	$1,607,240	$14,106,865	$0	$20,597,612	$397,104	$30,
King Street	2025	$2,533,340	$0	$4,102,388	$0	$6,635,728	$15,300	
Denny Way	2000	$31,800,000	$0	$51,000,000	$45,200,000	$128,000,000	$440,317	$19,
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$14,
Subtotals:		$66,787,696	$12,425,539	$106,781,359	$106,647,942	$292,642,536	$1,756,391	$101
Totals (Rounded):		**$66,800,000**	**$12,400,000**	**$106,800,000**	**$106,600,000**	**$292,600,000**	**$1,800,000**	**$10**

Total Present Worth Estimate for Alternative:

X. GROUP 7a: WEST POINT SOUTHERN SERVICE AREA – DEEP TUNNEL STORAGE

General Description

This group would involve CSO storage in a deep, 24-foot-diameter tunnel which would run 30,600 feet from Lander Street to Nickerson Street and Sixth Avenue West. The CSOs at Michigan, Brandon, and Hanford would be conveyed to the end of the tunnel at Lander Street. The CSO locations and a brief description of the control facility proposed for each location are listed in Table 20. A system map illustrating the locations of Group 7a projects is shown in Figure 12. A single storage tank is included at Chelan. The Denny project would be reduced to only include the 18-foot tunnel and connecting pipelines. A Group 7b was developed earlier to include phase-out of the Alki plant. This group was eliminated from consideration.

CSO Control Volumes

The baseline and projected flow volumes associated with each Group 7a CSO location are shown in Table 20. The 1998 annual volume refers to the overflow remaining after completion of all on-going projects. The facilities have been sized assuming a West Point set point of 400 mgd. This set point at West Point allows planning for worst-case CSO events at the locations included in Group 7a. The CSO facilities within this group have been designed to limit each CSO to an average frequency of one untreated overflow event per year.

Facility Design and Cost Estimates

A brief description of the CSO control facility locations and site requirements are compiled in Table 20. Detailed site layouts will be determined during final design. A conceptual layout of the Chelan Avenue storage facility is shown in Attachment 1. A conceptual layout of the proposed tunnel that would provide storage capacity for the Denny Way CSO is also shown in Attachment 1.

The total estimated project cost and the unit cost for each facility is shown in Table 20. Component capital costs, annual O&M costs, and total present worth costs are shown in Table 21 for each facility as well as the year in which the facility would come on-line. Summary project costs and unit capital costs for the group, as a whole, are shown in Table 1.

Project Phasing

A summary of project phasing for all CSO control groups is presented in Table 3. Table 21 includes information on project phasing specific to Group 7a. All of the facilities in this group except the storage tanks at Chelan Avenue would be completed by 2005.

Relationship to WW2020+ and Biosolids Projects

As indicated in Table 1, this CSO control group corresponds to WW2020+ alternatives A1, A2, B1, B2, B3, and F1.

A summary of the volumes of liquids and biosolids generated by Group 7a projects is shown in Table 2. Group 7a projects would result in an increase in total system biosolids production of 338 tons per year.

Relationship to West Point Northern Service Area Group 2 CSO Control Projects

The Group 7a deep tunnel runs from Nickerson Street and Sixth Avenue W to Lander Street, and was sized to include overflows from the Third Avenue W CSO location. As a result, selection of Group 7a would modify the Group 2 projects described earlier by either eliminating the Third Avenue W storage tank or reducing the Group 2 deep tunnel diameter. Tables 22 and 23 present the modified capital, O&M and present worth costs for Groups 2a and 2b, respectively, that would result if Group 7a projects are implemented. Savings in capital costs for Group 2 are as follows:

Group 2a1	$25.2 million
Group 2a2	$36.0 million
Group 2b1	$34.2 million
Group 2b2	$26.6 million

The above capital costs would be subtracted from the corresponding Group 2 total if Group 7a is selected for implementation.

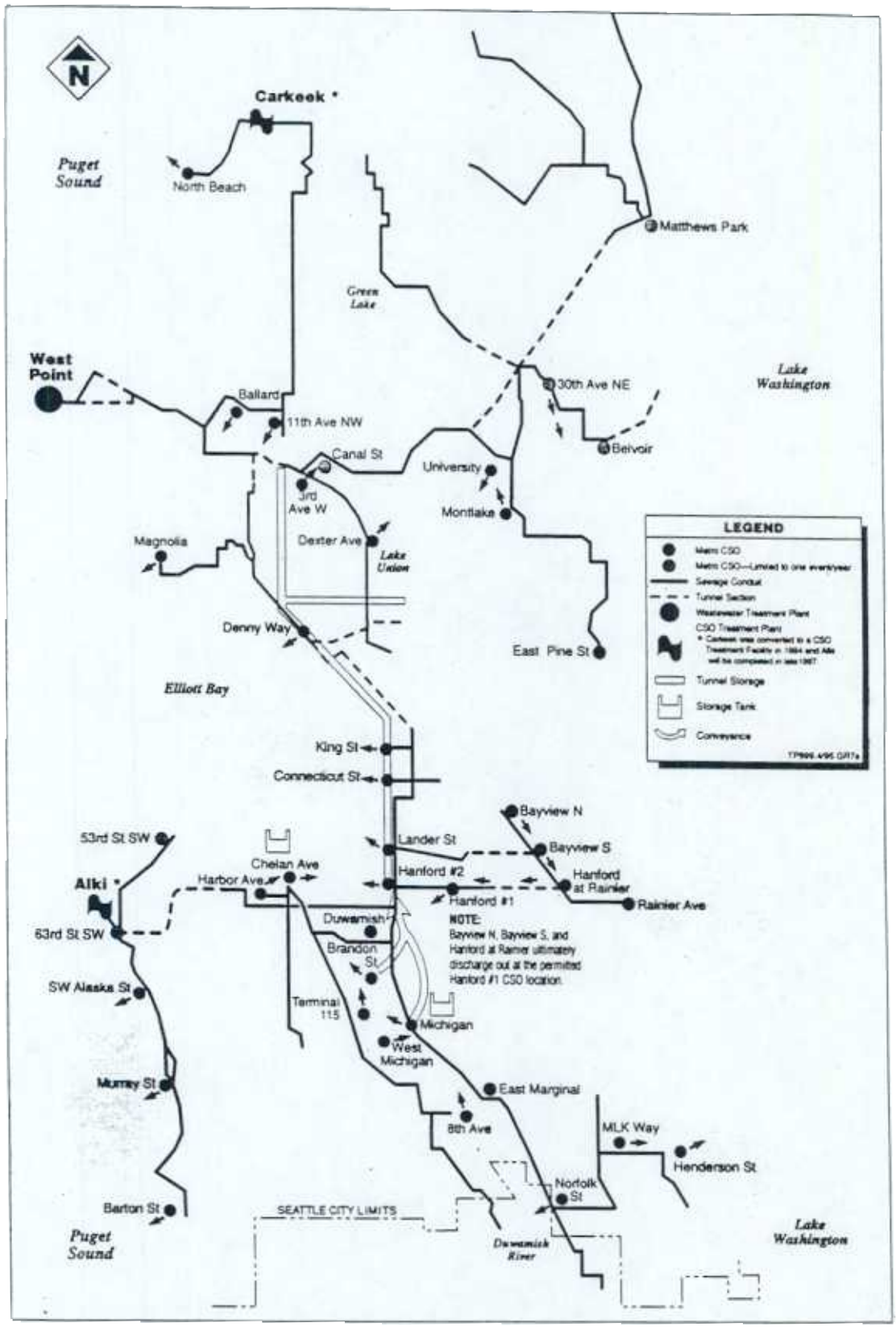


Figure 12. Group 7a projects: Southern Service Area deep tunnels for CSO control

Table 20. Estimated Flow Volumes and Costs for Group 7a Projects

Deep tunnel storage in Southern Service Area -- Michigan/Brandon conveyed to tunnel end at Hanford Street
Corresponds to WW2020+ Alternatives A1, A2, B2, B3 and F1

CSO Location	1981-83 Annual Baseline CSO, MG	1998 Annual CSO, MG	Annual Freq., 1998	Storm 6 Vol., MG	Proj. Cost, $mill	Unit Project Cost, $/MG	Technology	Acres of Impact	Facility Location
Michigan	190	173	40	13.1			Convey to end of tunnel		84-inch pipe
Brandon	60	57	40	4.5	$42		at Hanford St.		
Duwamish PS	1	1	<1						
Hanford #2 [a]	605	207	23	18.8			Storage in 24-ft dia. deep		
Lander #1	190	164	23	15.2			tunnel from Lander St.		
Connecticut	90	93	25	9.2			to Nickerson and 6th W.		
King Street	55	33	31	2.2	$391	$595,000	(30,600-ft)	0.6	
Chelan	73	66	25	4.0	$16	$247,000	Storage	0.5	Two 90-ft dia. caissons adjacent to West Seattle PS
Dexter	15	15	4	0.5			Included in Denny project		
Denny Way [b]	405	556	51	43.5	$66	$118,000	Storage	0.4	18-ft shallow tunnel; Blackstock storage and outfall not included
Totals	1684	1350		111	$515	$382,000		1.5	

[a]Includes Hanford #1 overflows.

[b]Denny 1998 CSO volume includes Dexter and City of Seattle flows from east Lake Union project.

Additional Information:

West Point capacity is assumed set at 400 mgd.

Table 21. Capital Cost and O&M Phasing Summary for Group 7a Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #7a
Deep Tunnel Storage in SSA

CSO Location	On-Line Year	Component Cost Breakdown				Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninfl Annua O&I (Ener (1994
		Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")			
Michigan	2025	$41,557,417	$0	$0	$0	$41,557,417	$13,400	
Brandon	2025	$0	$0	$0	$0	$0	$0	
Duwamish PS	2005	$0	$0	$0	$0	$0	$0	
Hanford #2	2005						$0	
Lander	2005						$0	
Connecticut	2005						$0	
King Street	2005	$13,020,066	$0	$378,329,290	$0	$391,349,356	$781,356	$2
Chelan	2030	$1,397,059	$0	$14,855,625	$0	$16,252,684	$207,072	$1
Denny Way	2000	$14,600,000	$0	$51,000,000	$0	$65,600,000	$307,497	$1
Subtotals:		$70,574,542	$0	$444,184,915	$0	$514,759,457	$1,309,325	$5
Totals (Rounded):		**$70,600,000**	**$0**	**$444,200,000**	**$0**	**$514,800,000**	**$1,300,000**	**$1**

Total Present Worth Estimate for Alternative:

Table 22. Modified Capital Cost and O&M Phasing Summary for Group 2a Projects when Combined with Group 7a Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #2a
North Interceptor without a new lake line
Alternative #2a is Combined with Alternative #7a

Note: Only 40% of Total O&M Estimate and 40% of Capital Cost Estimate is Reported for the Ballard Project

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Near Surface Storage									
University									
Montlake	2020	$11,442,798	$0	$36,117,056	$0	$47,559,854	$276,366	$24,971	$21,030,800
Canal Street									
3rd Avenue West	2020	$0	$0	$0	$0	$0	$218,634	$18,514	$850,054
Ballard (40% Capital Cost)	2020	$778,716	$0	$1,788,440	$0	$2,567,156	$28,218	$1,281	$1,181,271
11th Avenue West	2020	$997,046	$0	$9,157,978	$0	$10,155,024	$98,081	$5,716	$4,628,624
Subtotals:		$13,218,560	$0	$47,063,474	$0	$60,282,034	$621,299	$50,482	$27,690,750
Totals (Rounded):		**$13,200,000**	**$0**	**$47,100,000**	**$0**	**$60,300,000**	**$600,000**	**$100,000**	**$27,700,000**
				Total Present Worth Estimate for Alternative:					**$27,700,000**
Deep Tunnel Storage									
Deep Tunnel (Univ. to 6th Ave.)	2020	$0	$0	$77,172,825	$0	$77,172,825	$137,816	$3,454	$32,867,036
Ballard (40% of Capital Costs)	2020	$778,716	$0	$1,788,440	$0	$2,567,156	$28,218	$1,281	$1,181,271
11th Avenue West	2020	$997,046	$0	$9,157,978	$0	$10,155,024	$98,081	$5,716	$4,628,624
Subtotals:		$1,775,762	$0	$88,119,243	$0	$89,895,005	$264,115	$10,451	$38,676,931
Totals (Rounded):		**$1,800,000**	**$0**	**$88,100,000**	**$0**	**$89,900,000**	**$300,000**	**$0**	**$38,700,000**
				Total Present Worth Estimate for Alternative:					**$38,700,000**

Table 23. Modified Capital Cost and O&M Phasing Summary for Group 2b Projects when Combined with Group 7a Projects

Financial Assumptions:

		Base Year:	**1994**
		Final Year:	**2030**
		Base ENR (Capital Costs):	**5630**
		Base ENR (O&M Costs):	**5747**
Gross Discount Rate	**6.50%**	Analysis Period (Years):	**20**
Inflation Rate (General):	**3.00%**	Net Discount Rate (General):	**3.50%**
Inflation Rate (Energy):	**4.00%**	Net Discount Rate (Energy):	**2.50%**

Alternative Name: CSO/RWSP Alternative Group #2b
North Interceptor with a new lake line
Alternative #2b is Combined with Alternative #7a

Note: Only 40% of Total O&M Estimate and 40% of Capital Cost Estimate is Reported of the Ballard Project

CSO Location	On-Line Year	Component Cost Breakdown: Conveyance ("C")	Separation ("SE")	Storage ("ST")	Treatment ("T")	Total Uninflated Capital Cost (1994 $)	Uninflated Annualized O&M (General) (1994 $)	Uninflated Annualized O&M (Energy) (1994 $)	Total Present Worth (O&M Plus Capital) (1994 $)
Near Surface Storage									
University									
Montlake	2010	$7,379,475	$0	$60,230,000	$0	$67,609,475	$576,628	$64,215	$45,096,328
Canal Street	2010	$0	$0	$0	$0	$0	$69,282	$3,113	$610,071
3rd Avenue West	2010	$0	$0	$0	$0	$0	$285,580	$26,390	$2,659,241
Ballard (40% of Capital Costs)	2010	$778,716	$0	$1,788,440	$0	$2,567,156	$34,761	$1,781	$1,812,449
11th Avenue West	2010	$997,046	$0	$10,524,367	$0	$11,521,413	$108,076	$6,649	$7,720,848
Subtotals:		$9,155,237	$0	$72,542,807	$0	$81,698,044	$1,074,327	$102,148	$57,898,937
Totals (Rounded):		**$9,200,000**	**$0**	**$72,500,000**	**$0**	**$81,700,000**	**$1,100,000**	**$100,000**	**$57,900,000**
				Total Present Worth Estimate for Alternative:					**$57,900,000**
Deep Tunnel Storage									
Deep Tunnel (Univ. to 6th Ave.)	2010	$12,481,515	$0	$97,824,900	$0	$110,306,415	$243,241	$4,166	$66,695,099
Ballard	2010	$778,716	$0	$1,788,440	$0	$2,567,156	$34,761	$1,781	$1,812,449
11th Avenue West	2010	$997,046	$0	$10,524,367	$0	$11,521,413	$108,076	$6,649	$7,720,848
Subtotals:		$14,257,277	$0	$110,137,707	$0	$124,394,984	$386,078	$12,596	$76,228,396
Totals (Rounded):		**$14,300,000**	**$0**	**$110,100,000**	**$0**	**$124,400,000**	**$400,000**	**$0**	**$76,200,000**
				Total Present Worth Estimate for Alternative:					**$76,200,000**

XI. PROGRAMMATIC ISSUES

Roof Leader Disconnection Program

In areas of Seattle where partial combined sewer separation is in place, there is an opportunity to reduce remaining inflow to the system by encouraging building owners to disconnect roof leaders from the sanitary sewer and discharge the rainwater to the ground or to the street. This would significantly reduce overflow volumes, and the scale and cost of subsequent capital works.

Such a program was undertaken in Portland, Oregon on a pilot scale. A public outreach program was conducted to solicit volunteers. The City of Portland reimbursed home owners in the pilot area for the costs of materials (generally less than $200-400 per connection). Where home owners wanted to join the program but were physically unable to perform the work, the city hired contractors to perform the disconnection (generally about $800 per connection). Homeowner benefits for all disconnections were limited to reimbursement.

The soils in Portland are generally very porous; thus, disconnected roof leaders could be discharged directly to rock pockets. The City of Seattle has used this technique under its Drainage Ordinance. However, the less-porous soils in Seattle may require that roof drainage be piped directly to the street in many cases. In addition, this infiltration technique should not be applied where there is a danger of creating landslides (which was not a problem in Portland). Thus, disconnection of roof leaders is most applicable where storm sewers already exist in the streets.

Portland's pilot program generated a participation rate of only five to seven percent of the homeowners in the target neighborhoods. This low participation occurred in spite of the fact that the city staff and neighborhood associations actively publicized the program and aggressively recruited participants. Actual participation contrasted sharply with the program's target disconnect rate of 46 percent, suggesting the need for either mandatory participation or additional financial incentives to homeowners to encourage participation.

For a Seattle program, grants could be offered to building owners (say $500-$700, an increase in financial incentive compared to Portland's pilot program) as an inducement to join the program. Volunteers could be solicited through a public outreach program, and Metro would pay the grant once the disconnection took place and verification was complete.

If the program were successful in disconnecting most of the roof leaders in a drainage area, then the capital costs to construct storage facilities for CSO control in the drainage area could be reduced by 50-70 percent. In the Martin Luther King Way area for example, the tributary area is about 1,000 acres with at least six building units per acre. At a cost of $700 per unit ($4.2 million total), the preliminary estimated cost of the storage facility identified might be reduced by at least half (savings of $13 million).

Drainage Ordinance Enforcement and System Optimization Opportunities

An important part of long-term control of CSOs under 1988 CSO control plans by both the City of Seattle and Metro is enforcement of Seattle's Drainage Ordinance. That ordinance requires new developments or major remodeling projects to include site stormwater separation elements. The runoff from rooftops should be either diverted to storm drains, diverted to areas where the runoff could infiltrate into the soil, or stored for later release to the sanitary sewer system following a CSO event when sewer capacity is once again available. As the city redevelops over time, more rooftop drainage should be removed from the combined sewer system, freeing up capacity in the conveyance system and reducing the volume and frequency of overflows to allow CSO control projects to be reduced in scale or eliminated entirely. While in theory the ordinance provides for reduction of overflow volumes over time, no effort has been made by Metro to track compliance with the ordinance or to estimate resulting (or potential) volume reductions.

In addition, in areas where partial sewer separation has already taken place, the trunk sewers may contain additional storage capacity that is not presently being utilized. An investment in additional engineering or geographic information system (GIS) studies to evaluate the potential use of existing on-line storage capacity might result in a reduction of the size of storage facilities required to achieve one overflow event per year control, thus reducing system-wide costs.

ATTACHMENT 1

CONCEPTUAL SITE LAYOUTS FOR CSO CONTROL FACILITIES

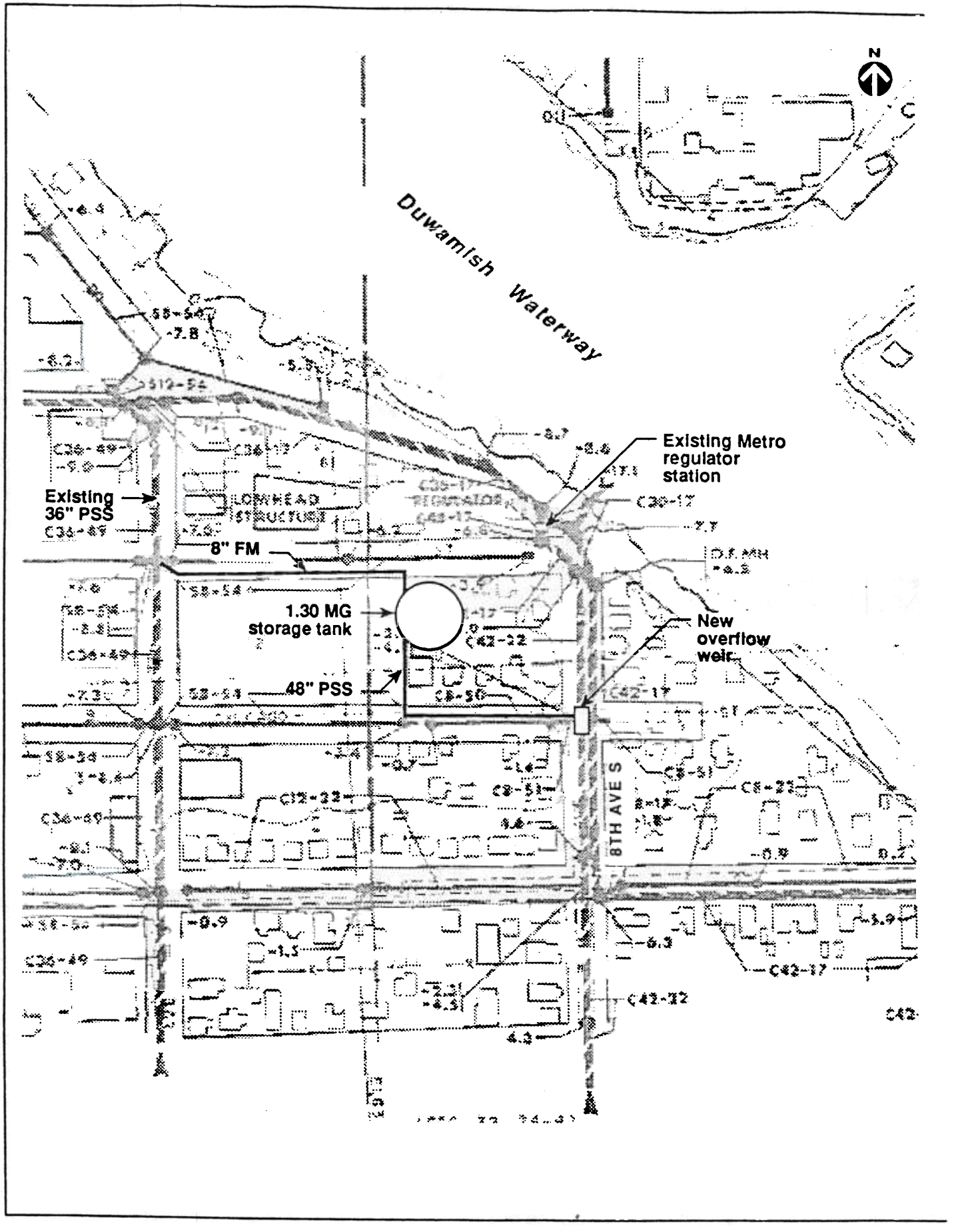


Figure A-1. Conceptual layout of 8th Avenue South CSO control storage alternative.

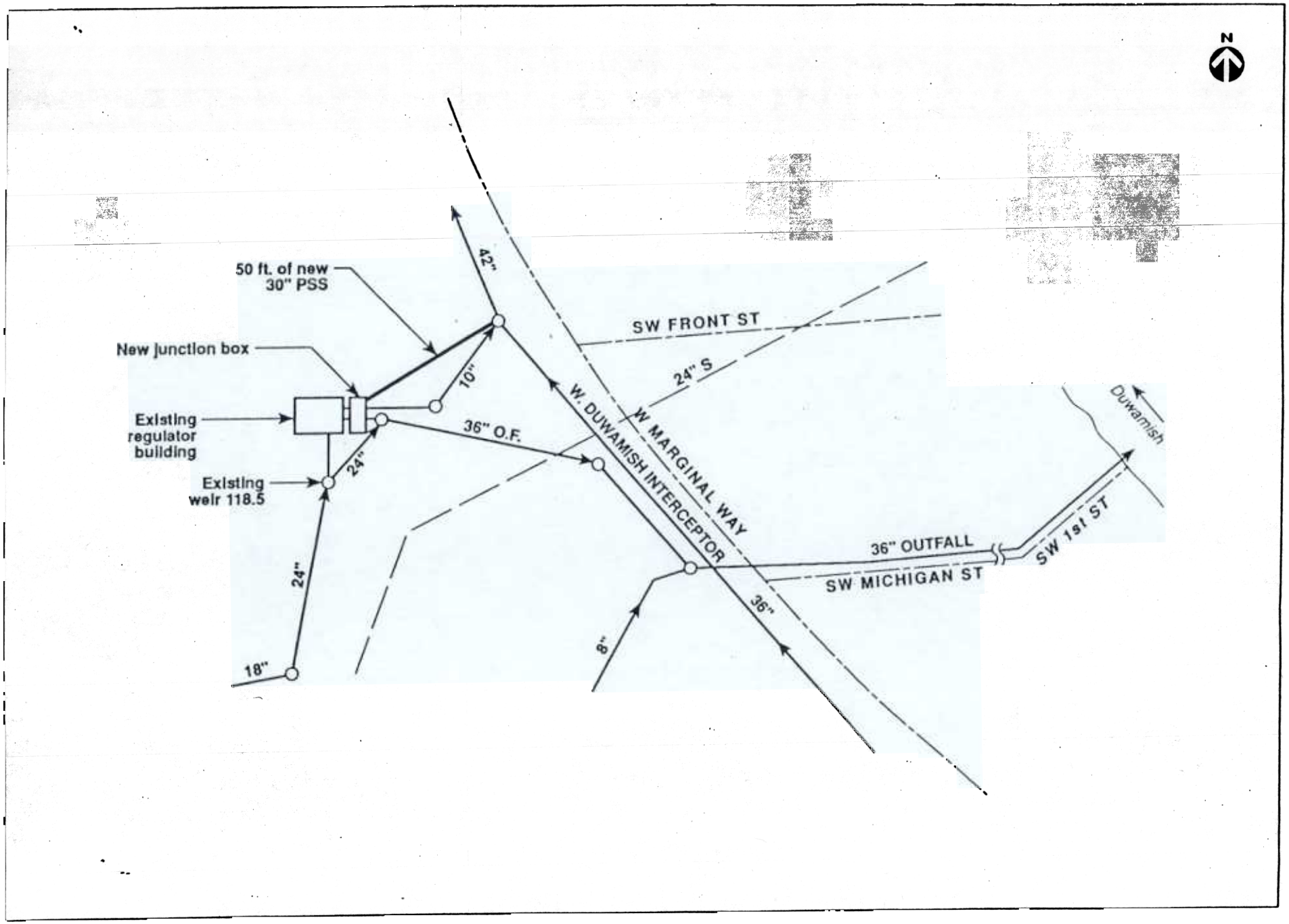


Figure A-2. **Conceptual layout of SW Michigan Street CSO control diversion alternative.**

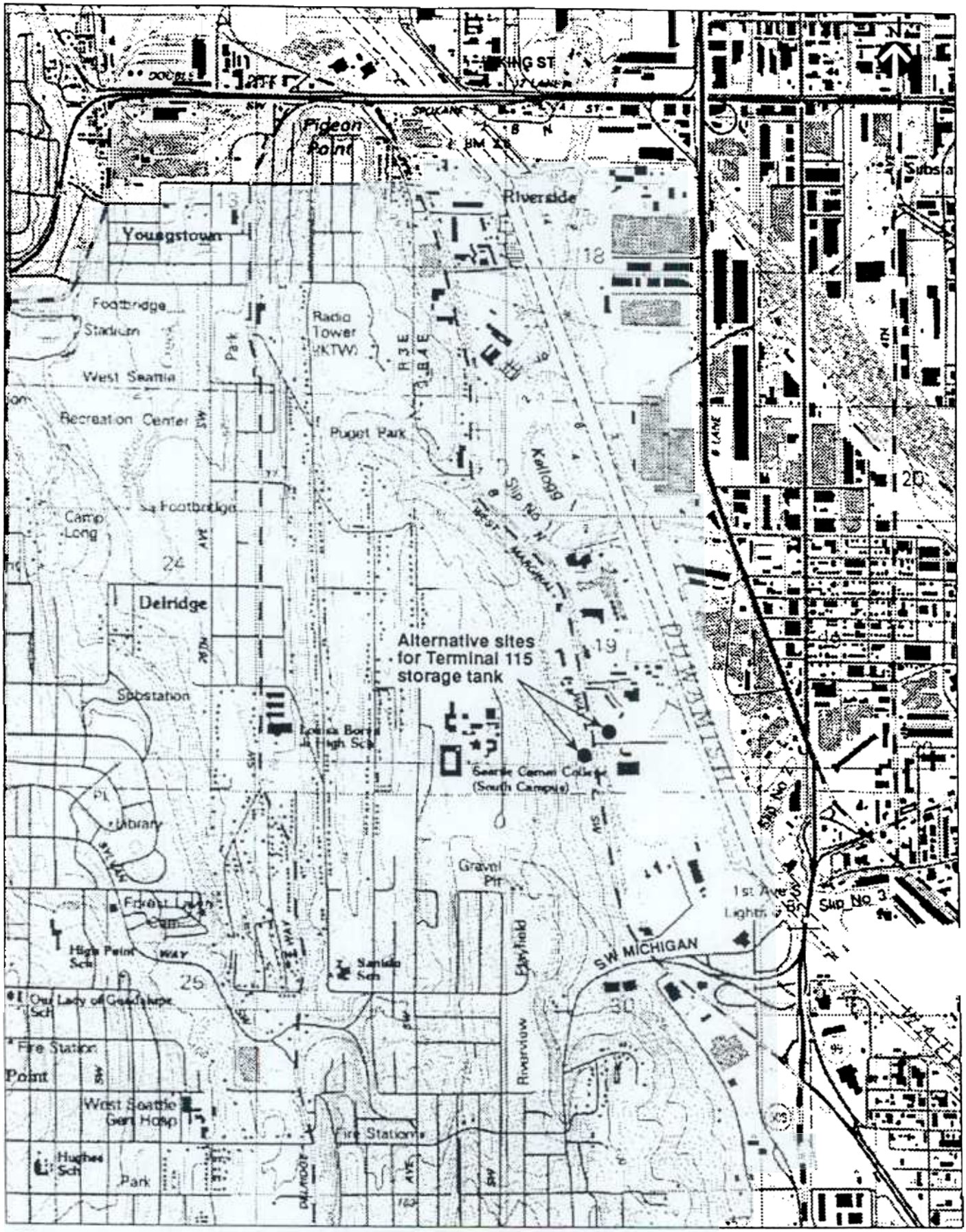


Figure A-3. Alternative sites for Terminal 115 CSO control storage tank.

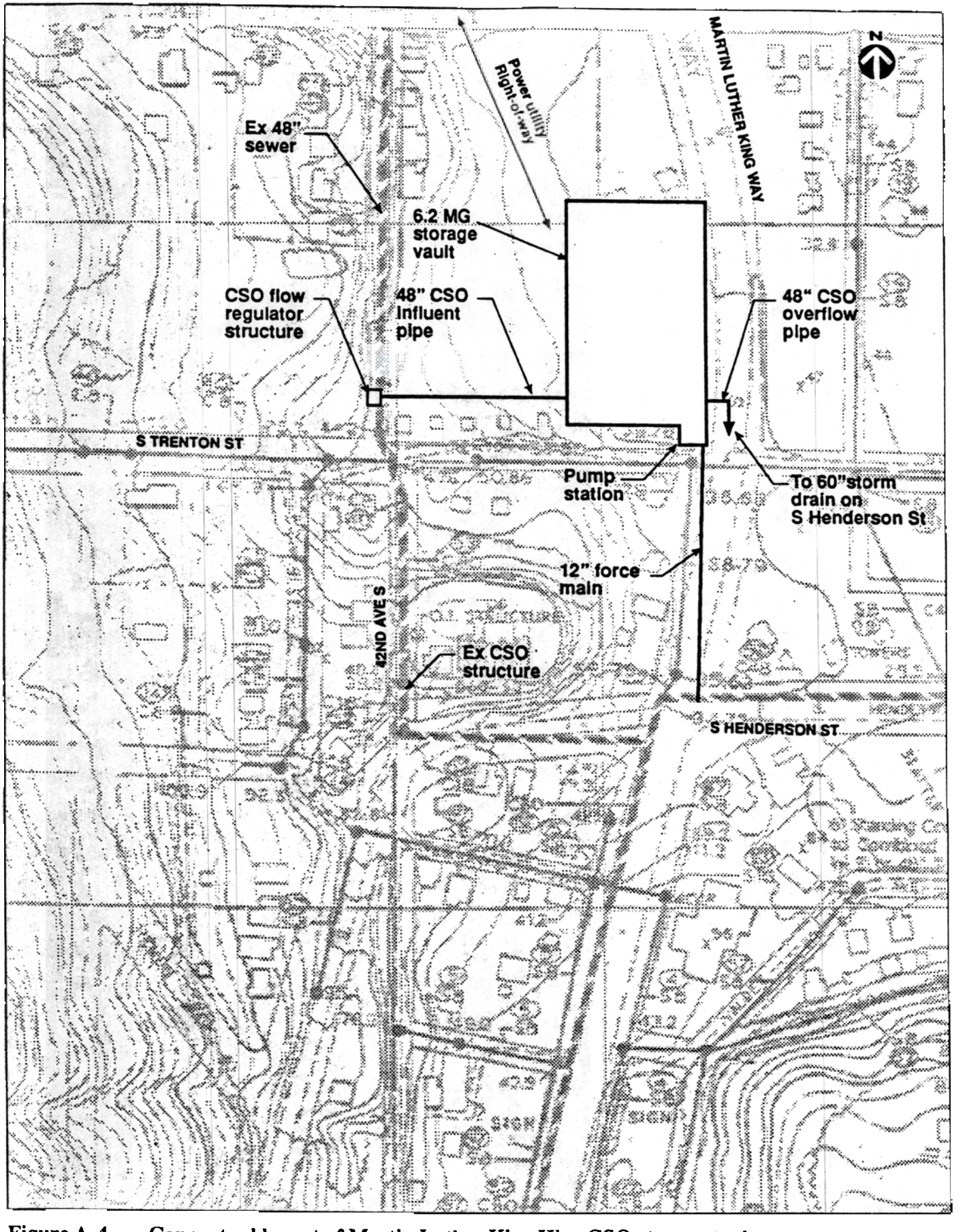


Figure A-4. Conceptual layout of Martin Luther King Way CSO storage tank.

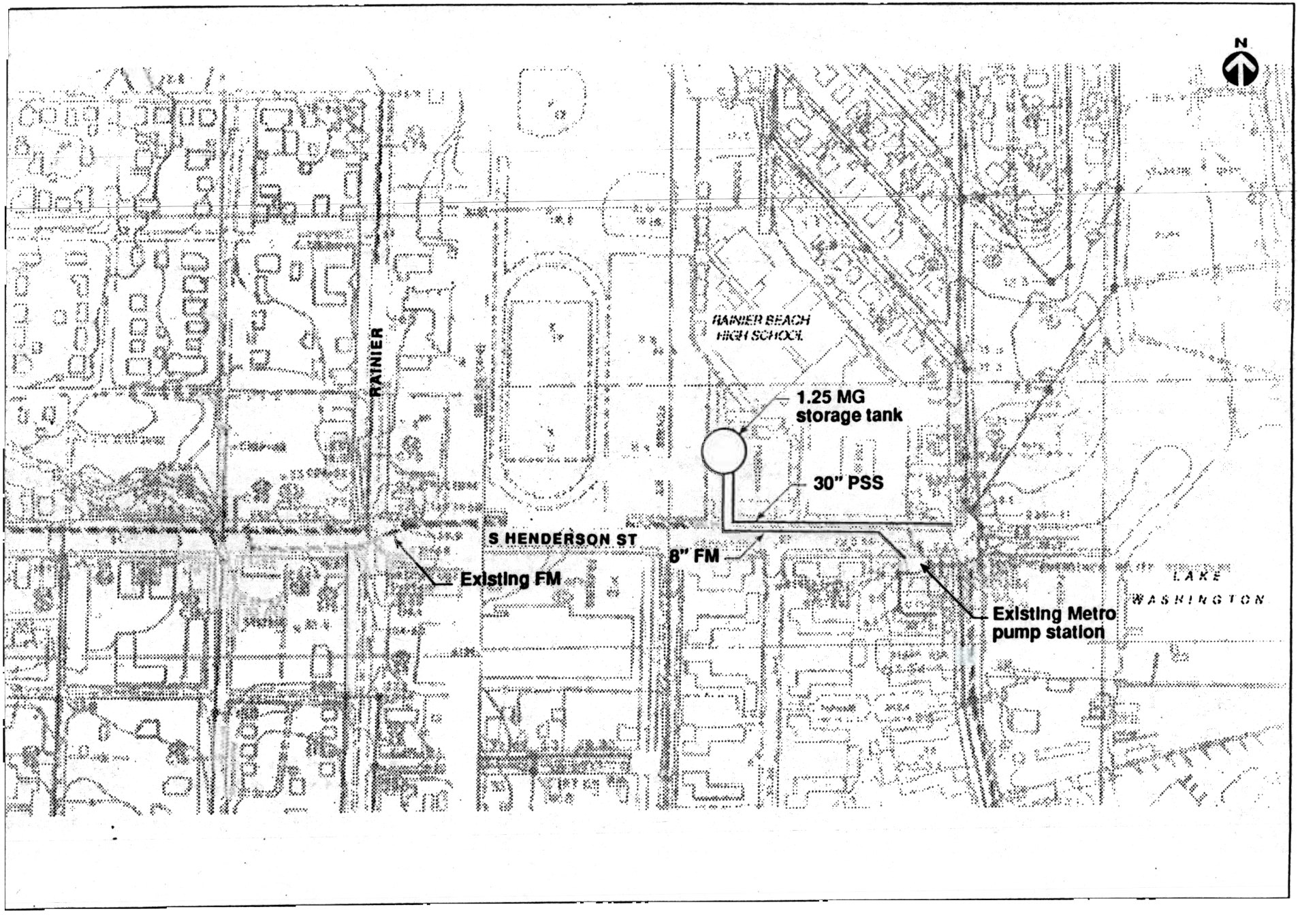


Figure A-5. Conceptual layout of South Henderson Street CSO control storage alternative.

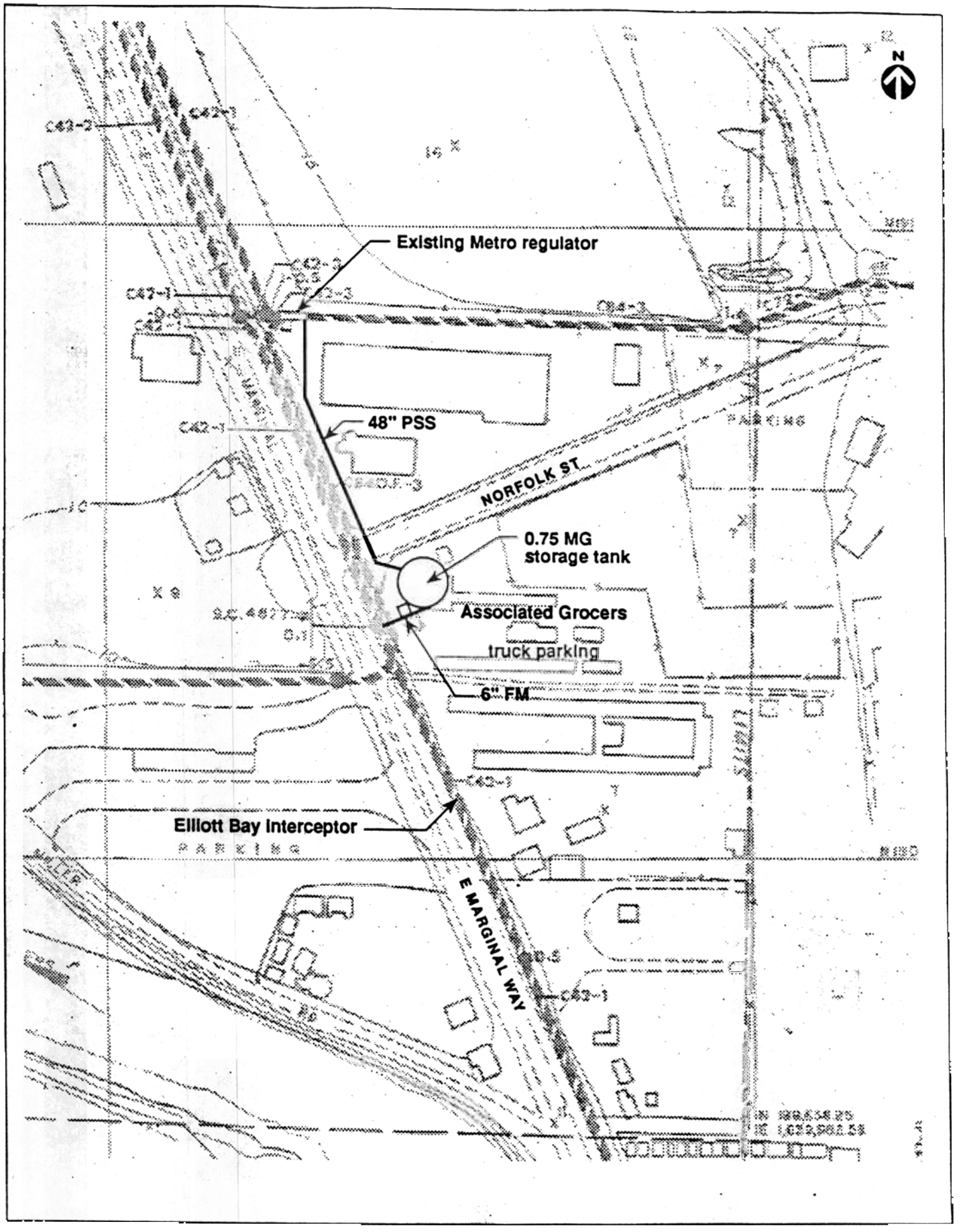


Figure A-6. Conceptual layout of Norfolk CSO control storage alternative.

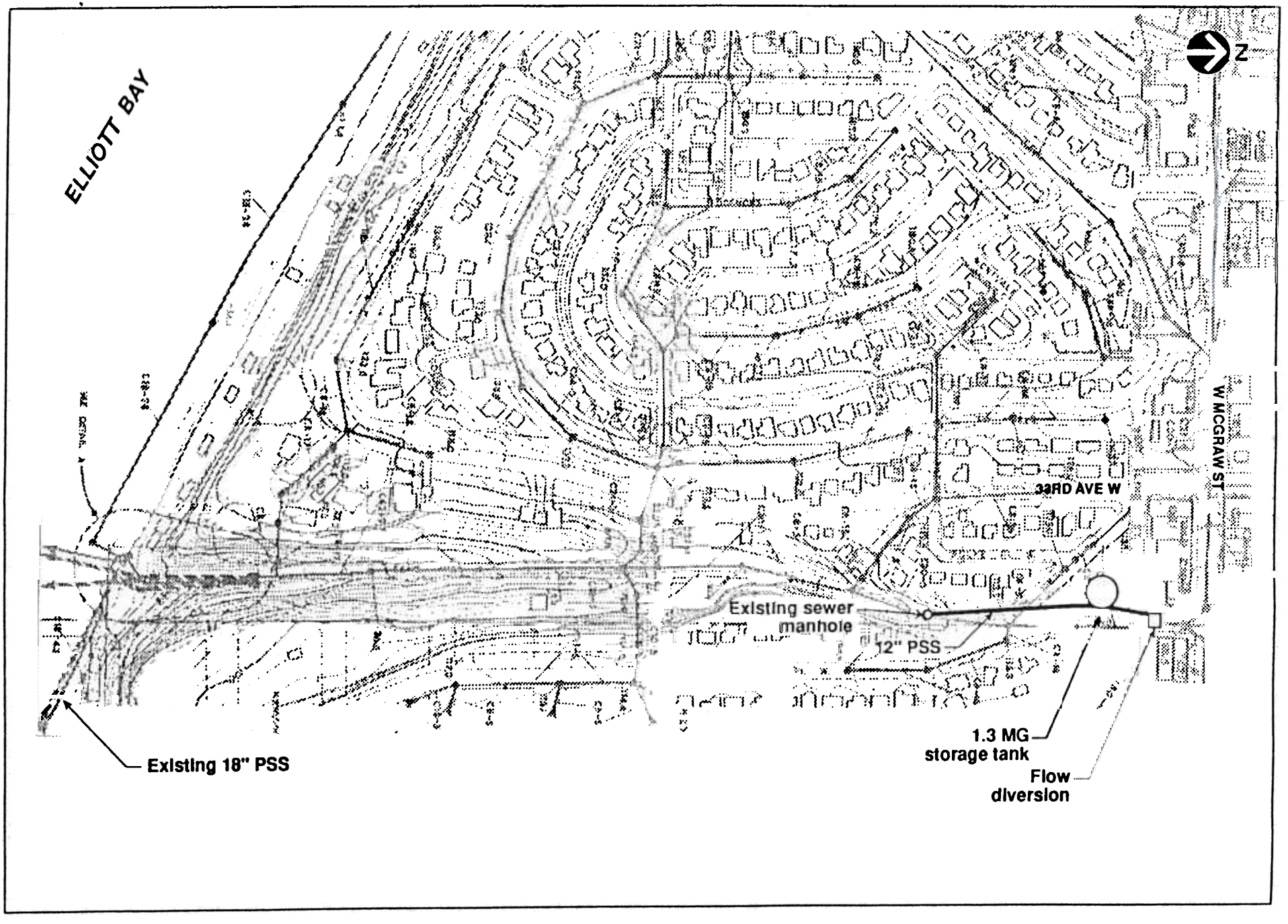


Figure A-7. Conceptual layout of South Magnolia CSO control storage alternative.

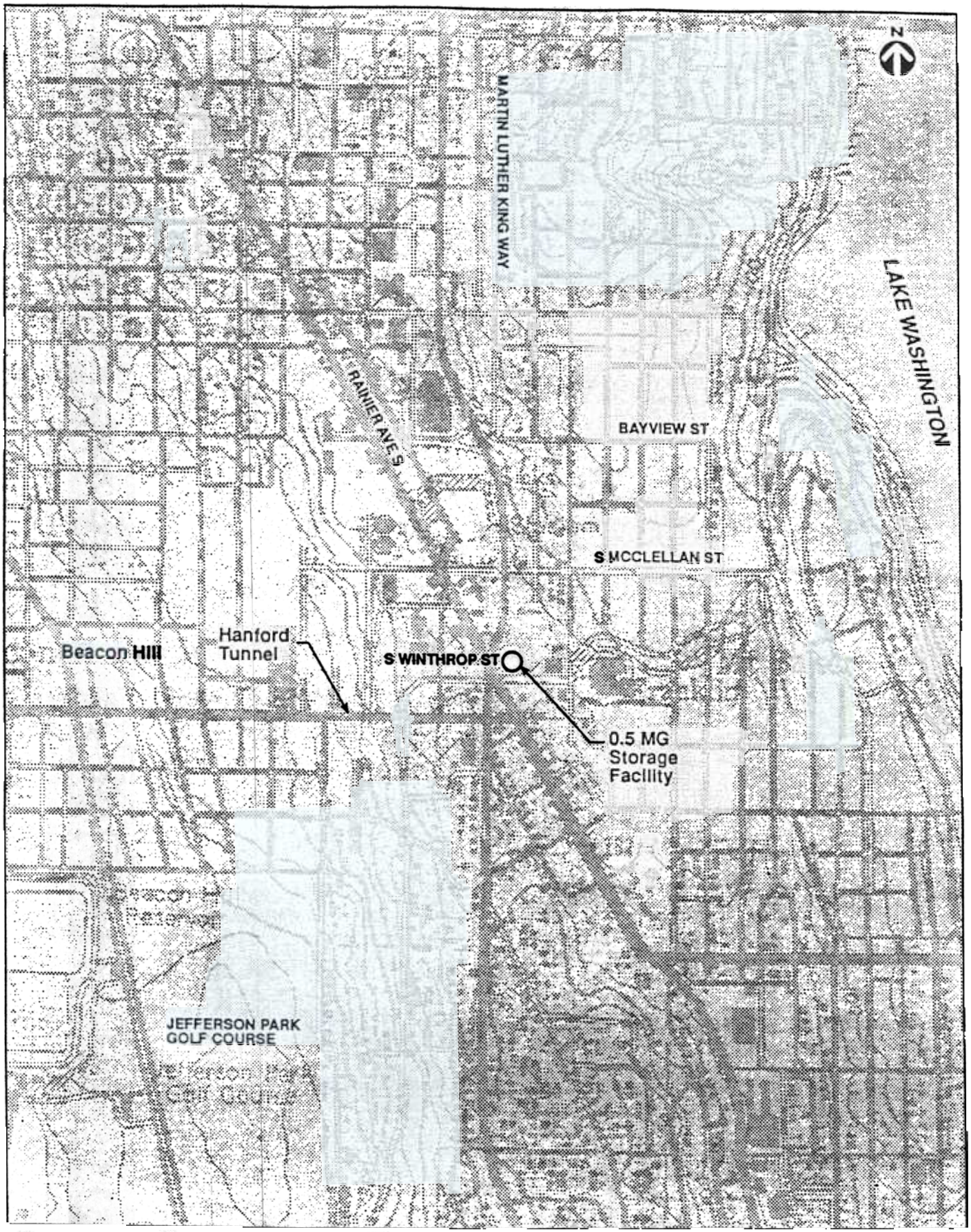
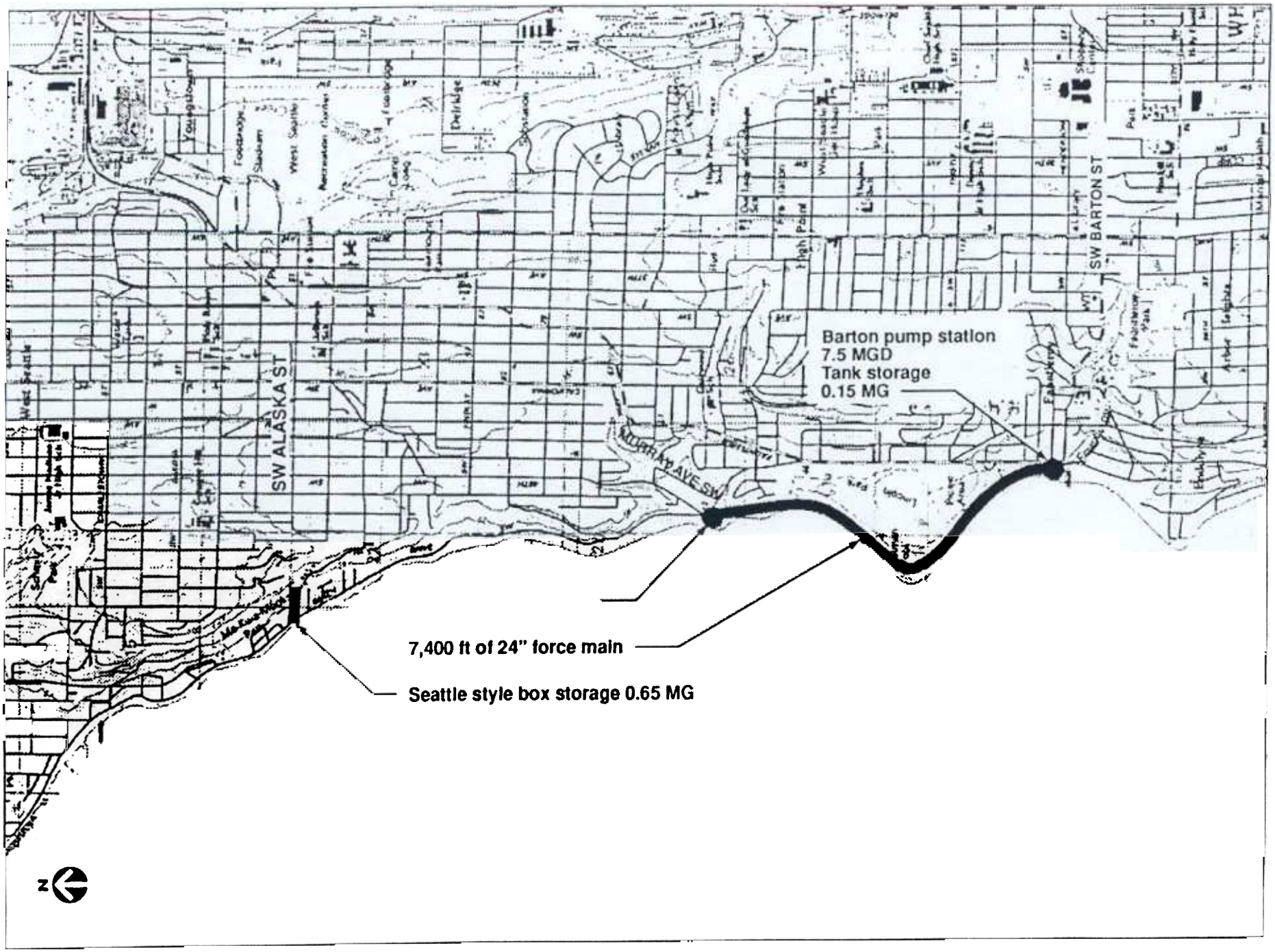


Figure A-8. Conceptual yout of CSO storage facil ty near mout of Hanford treet tunnel.


Barton pump station
7.5 MGD
Tank storage
0.15 MG
7,400 ft of 24" force main
Seattle style box storage 0.65 MG
SW ALASKA ST
SW BARTON ST
MURRAY AVE SW
N

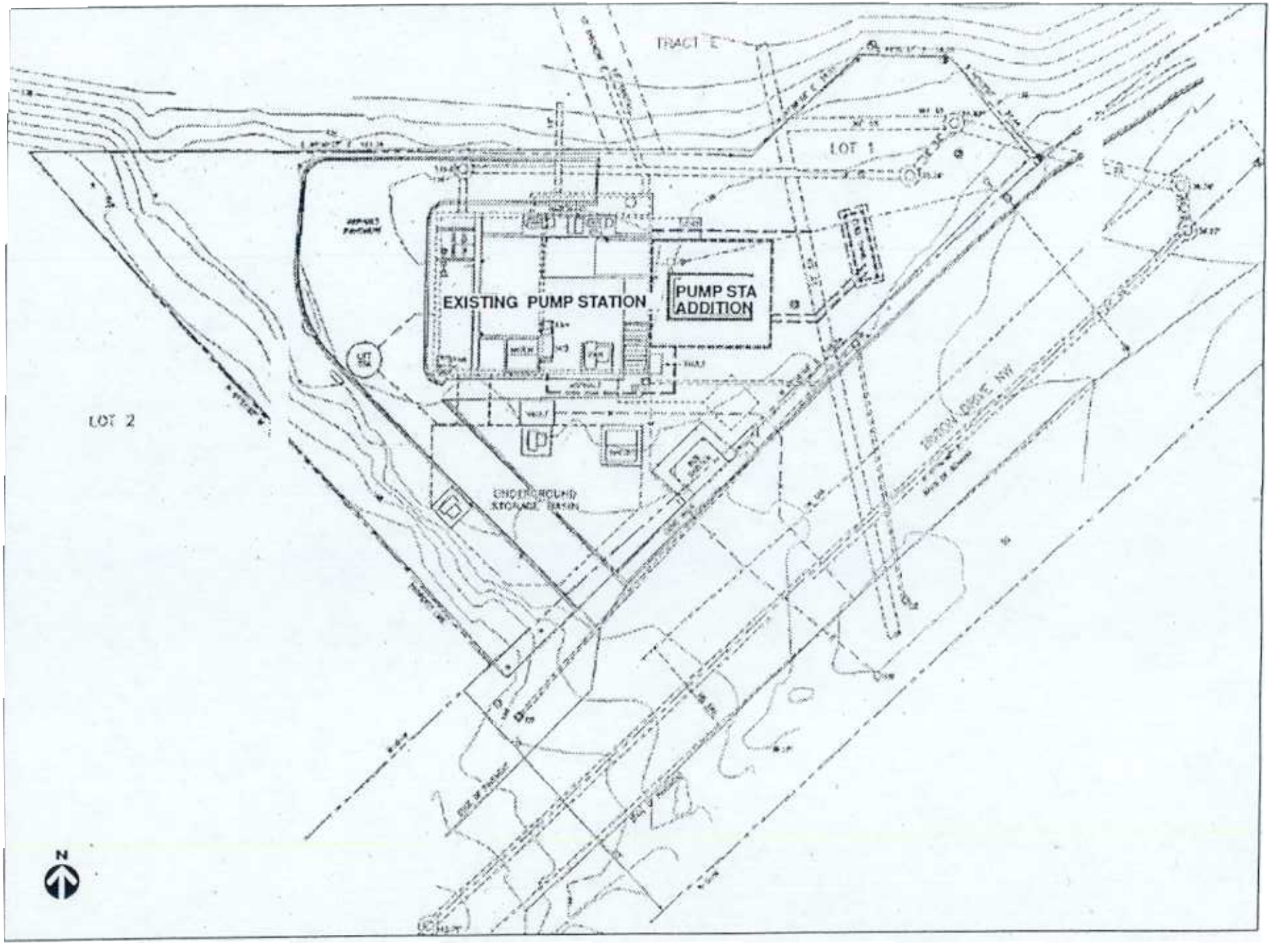


Figure A-10. Conceptual layout of North Beach pump station expansion CSO control alternative.

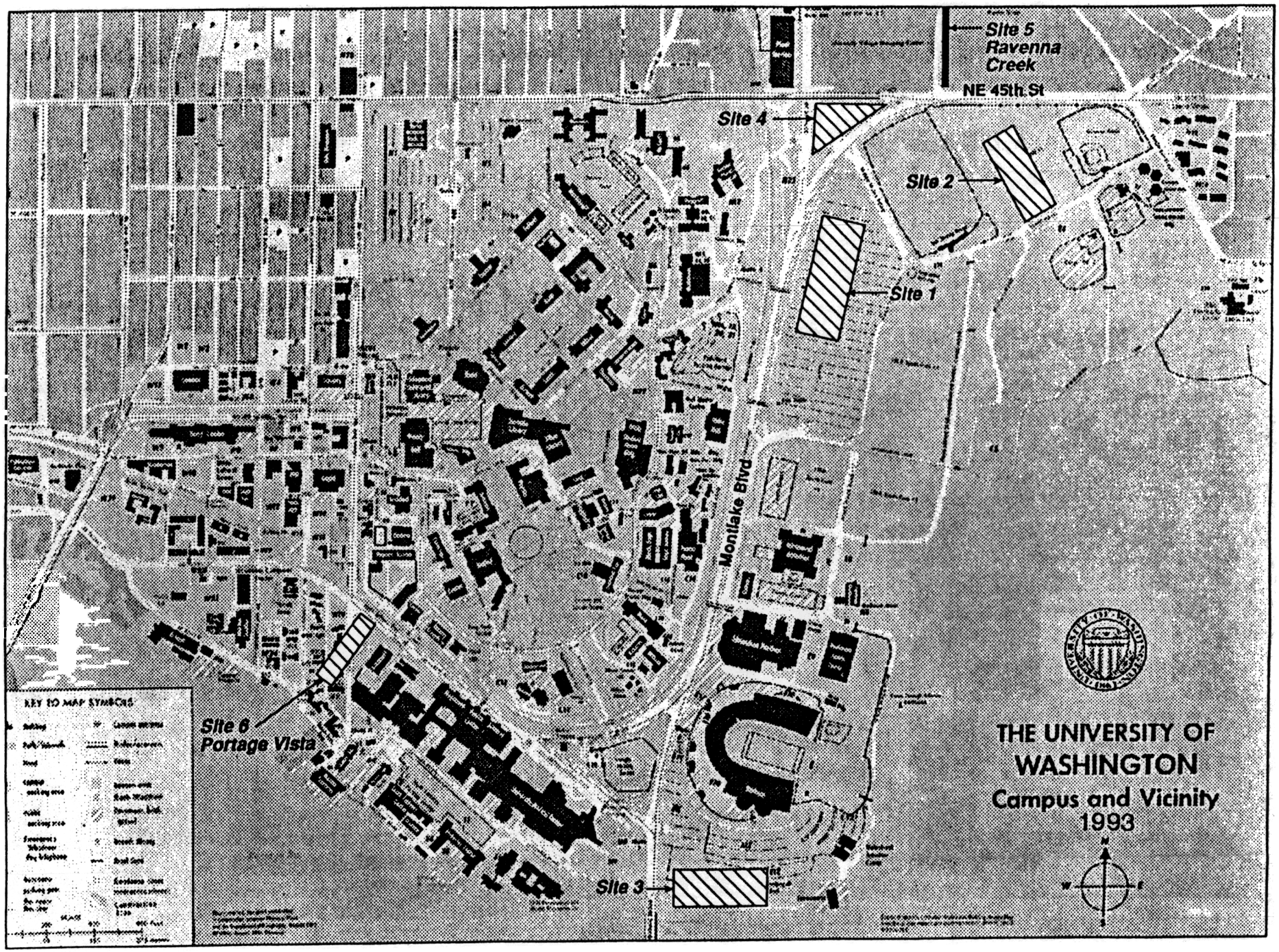


Figure A-11. University and Montlake area alternative storage tank sites.

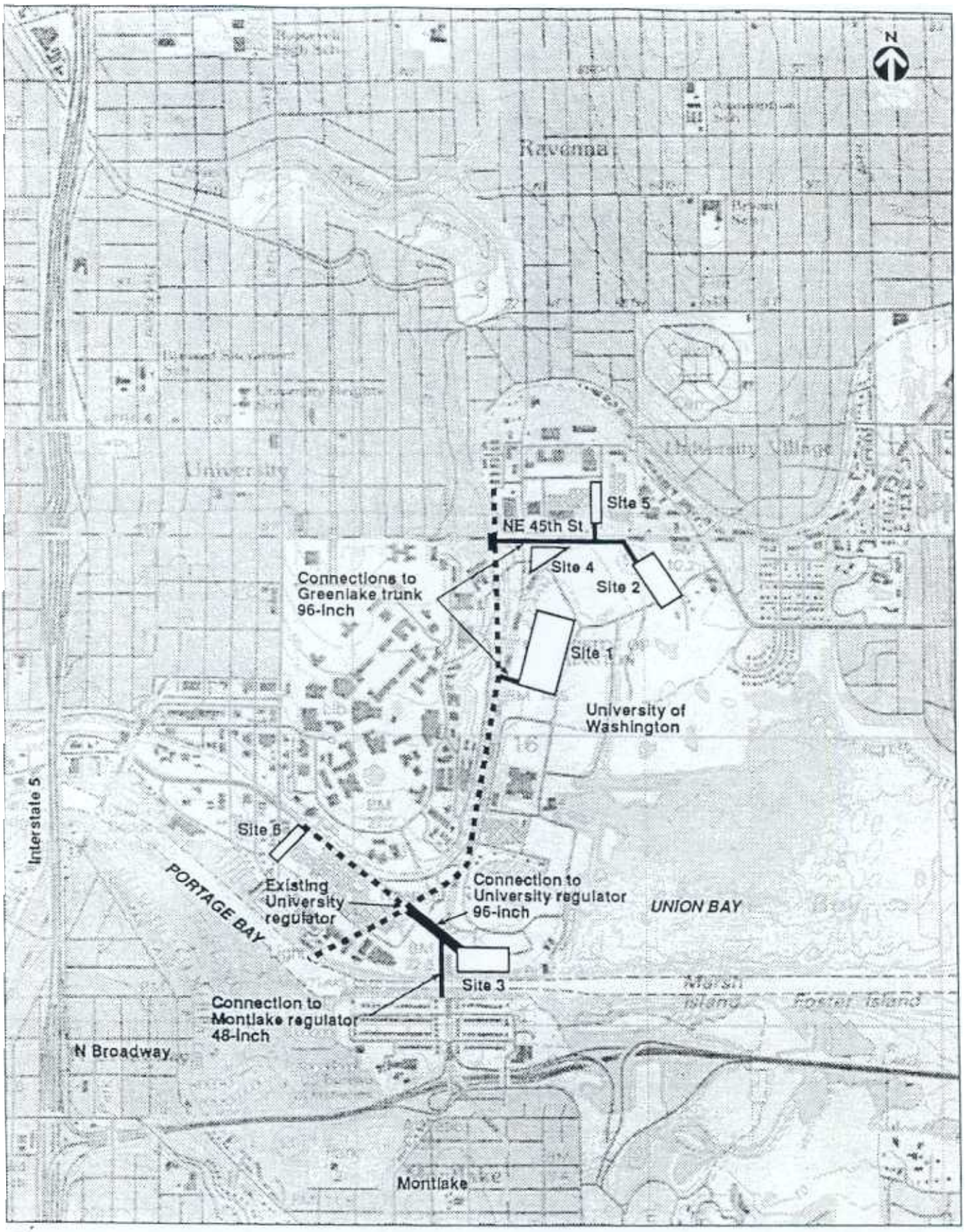


Figure A-12. Conveyance system connections to University and Montlake area alternative storage tank sites.

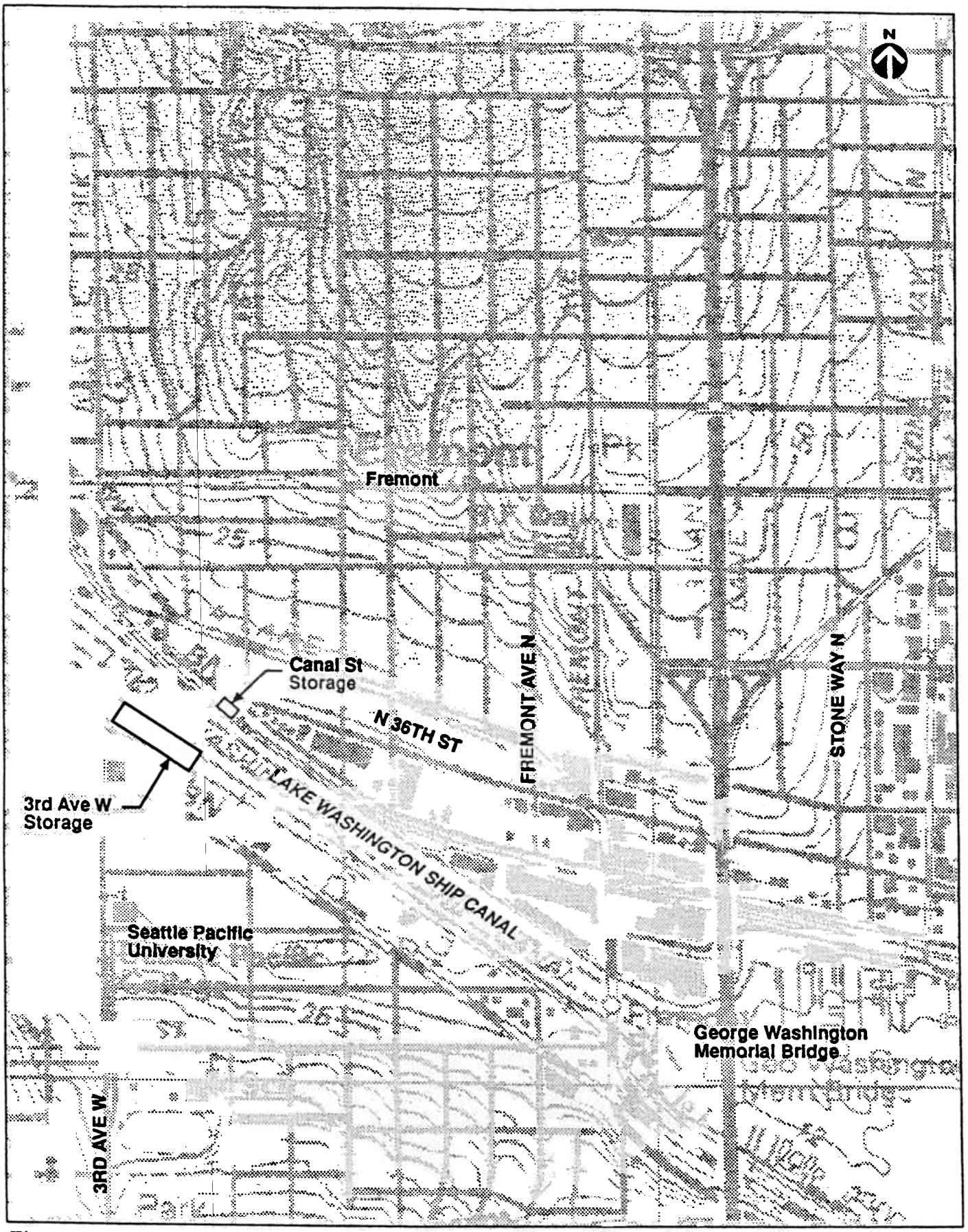


Figure A-13. Conceptual layout of 3rd Avenue West and Canal Street CSO control storage tanks.

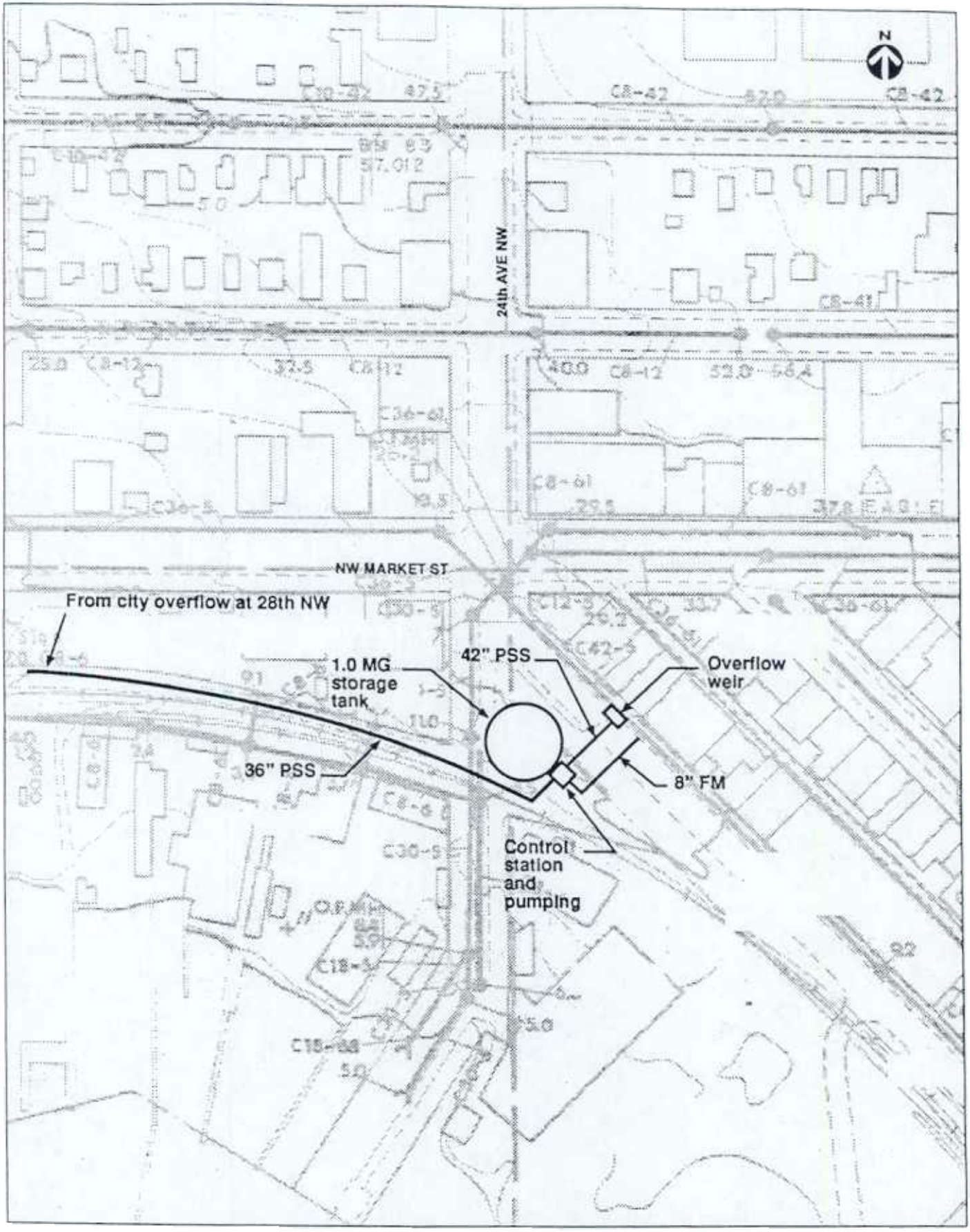


Figure A-14. Conceptual layout of city and Metro Ballard CSO control storage alternative.

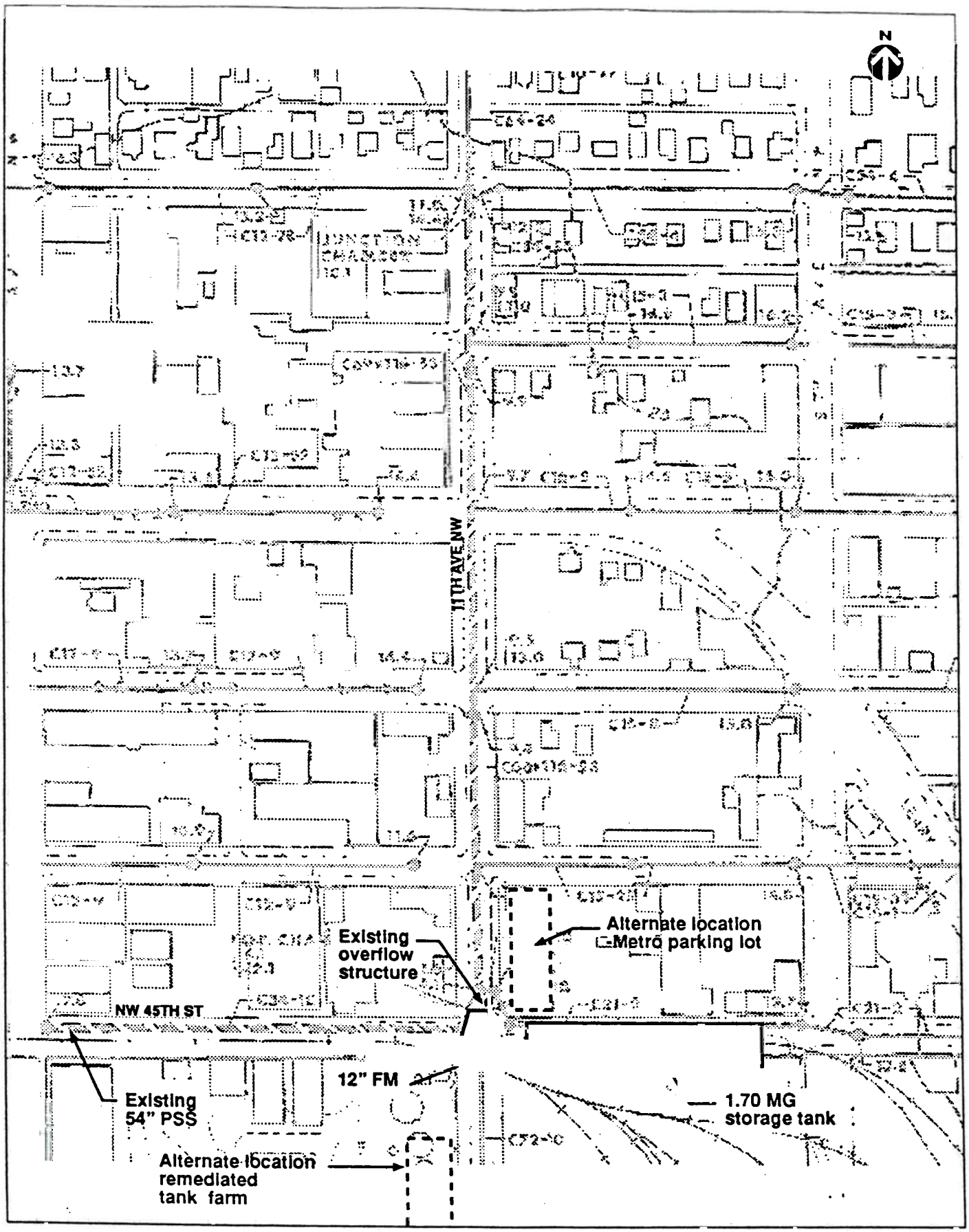


Figure A-15. Conceptual layout of CSO control storage alternative at 11th Avenue NW weir.

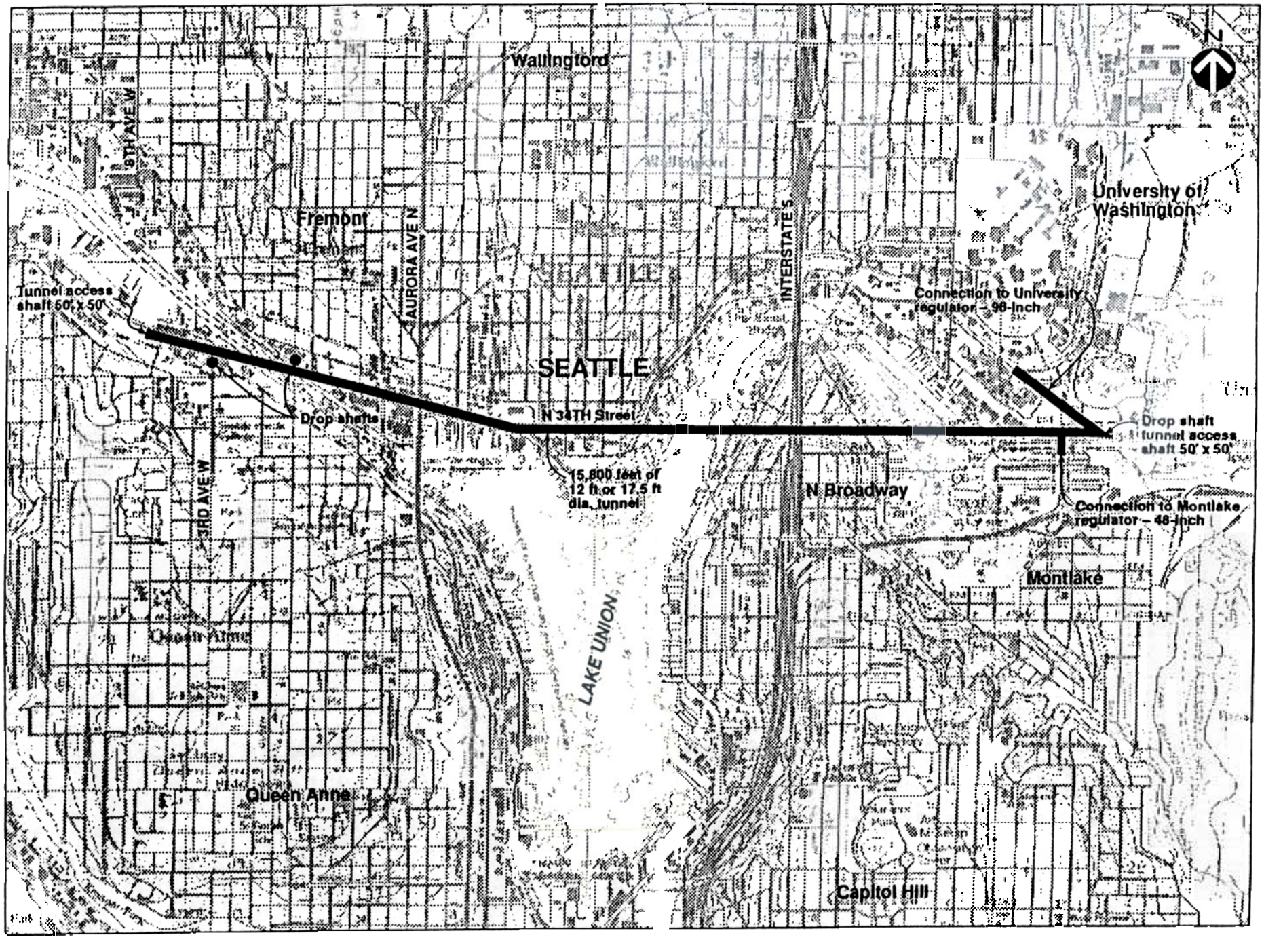


Figure A-16. Conceptual layout of University regulator to 6th Avenue West deep tunnel CSO control alternative.

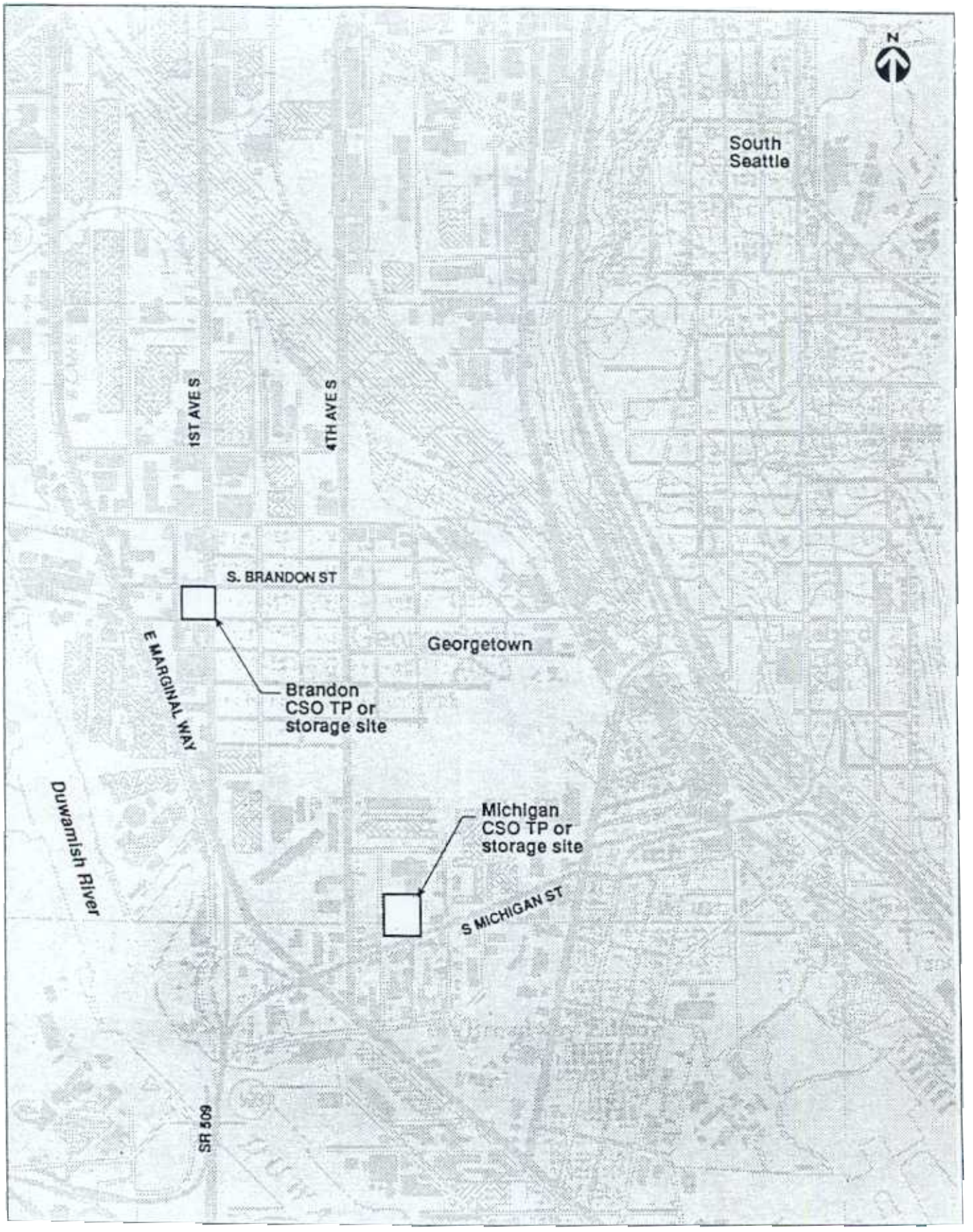


Figure A-17. Conceptual layout of Brandon and Michigan CSO treatment or storage sites.

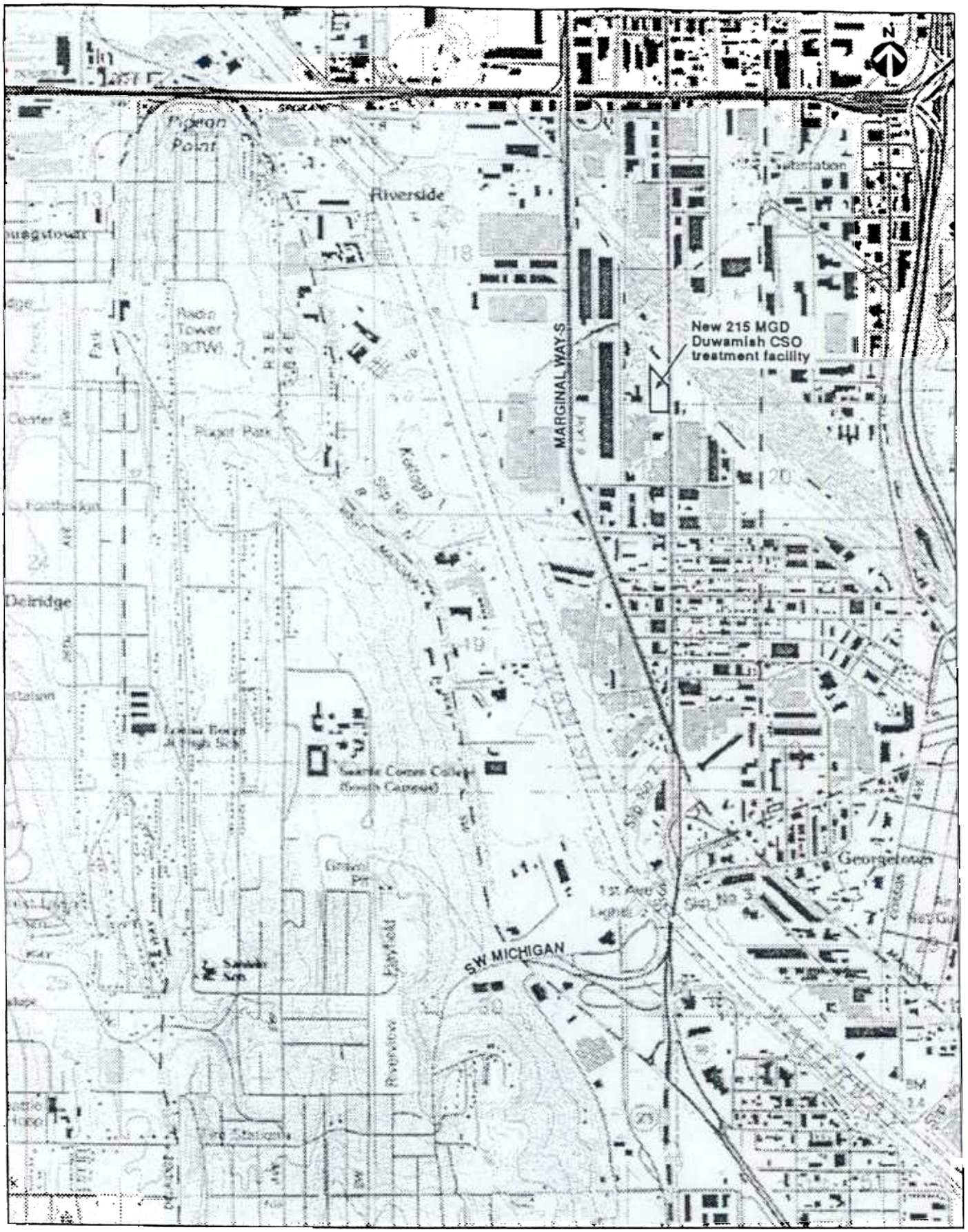

Pigeon Point
Riverside
Delridge
MARGINAL WAY S
New 215 MGD
Duwamish CSO
treatment facility
Seattle Center College
(South Campus)
Georgetown
S.W. MICHIGAN

Figure A-18.

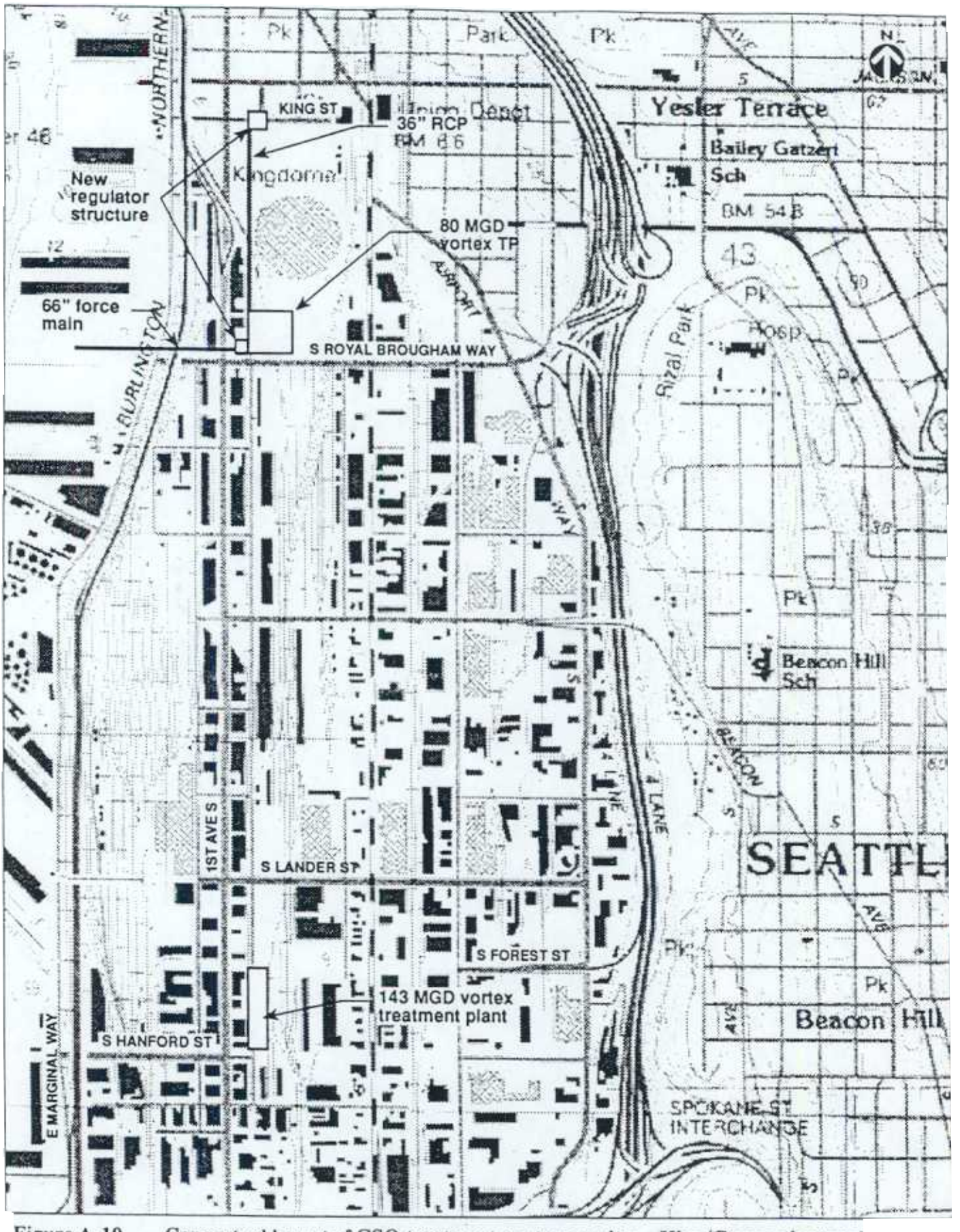


Figure A-19. Conceptual layout of CSO treatment or storage sites - King/Connecticut and Hanford/Lander.

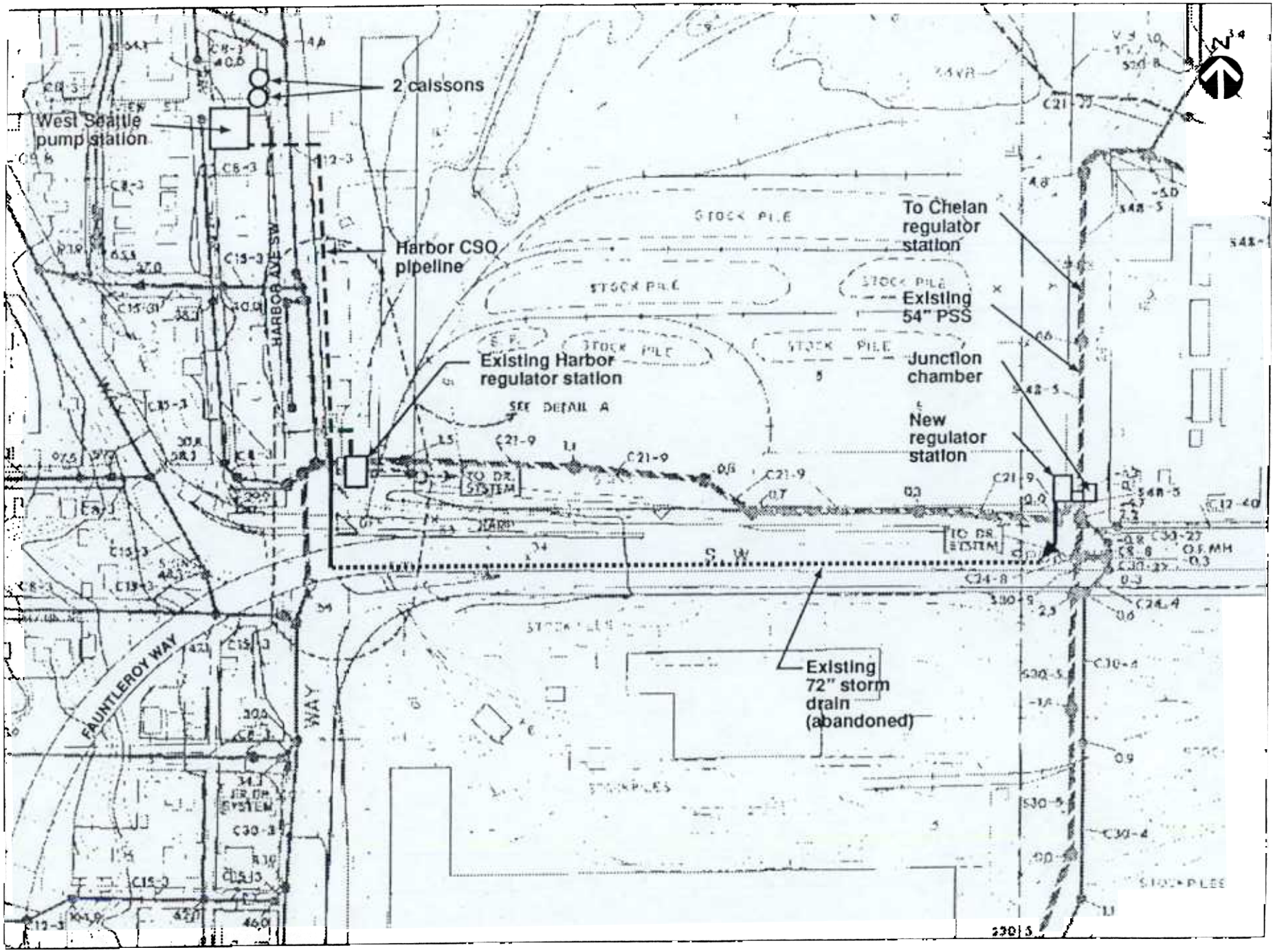


Figure A-20. Conceptual layout of Chelan regulator CSO control conveyance/storage alternative.

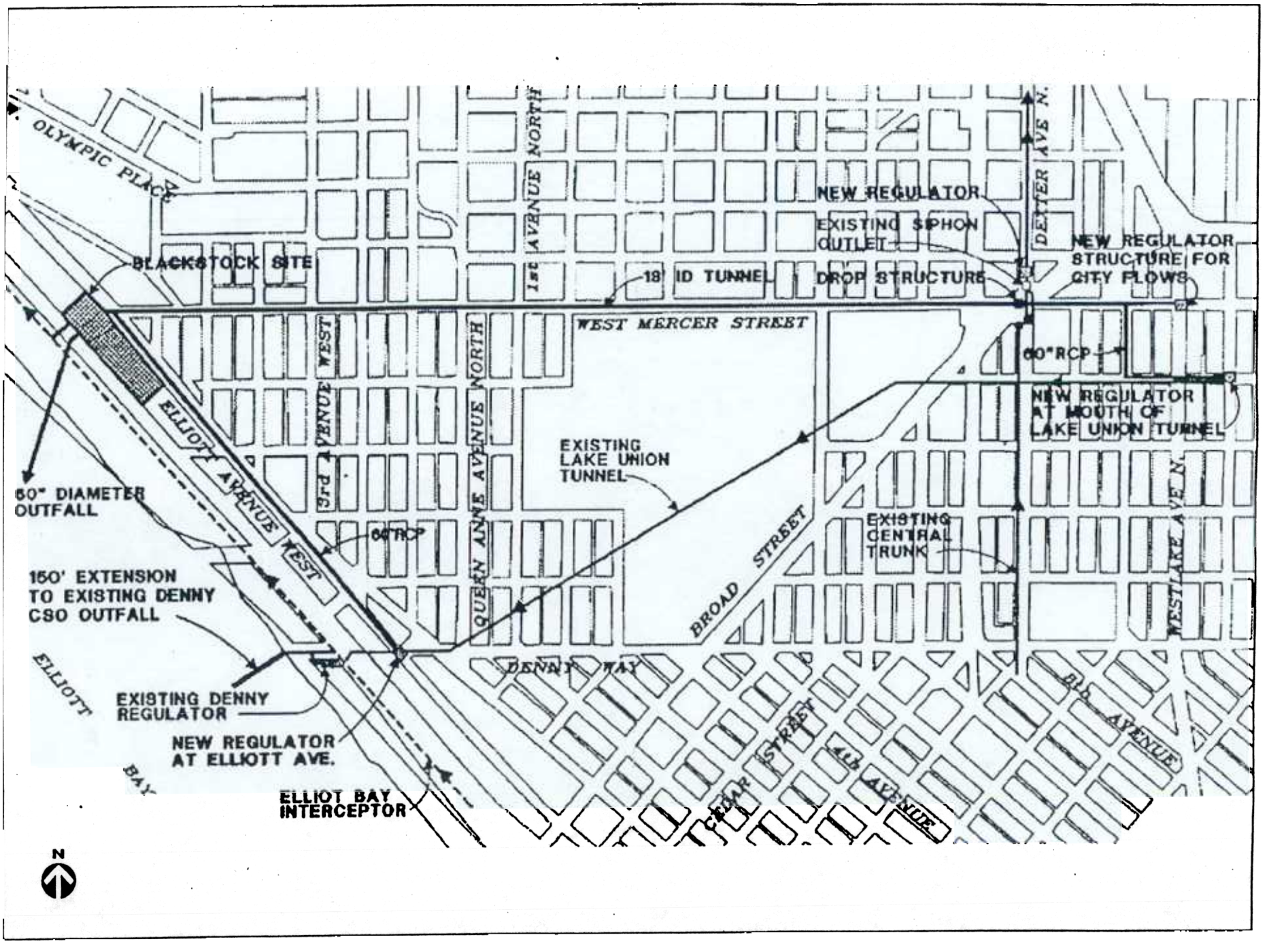


Figure A-21 Conceptual layout of Denny regulator CSO control facilities

ATTACHMENT 2

ADDITIONAL CAPITAL COST DETAIL

Group #1 - SSA and Alki Projects which do not change with WW2020+ Configurations

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Separation	Storage	Treatment	Total Capital Cost
			Component Breakdown				
8th Avenue South	Eighth Ave. CSO Storage (Option #1)	Alki	$785,625	$0	$5,357,999	$0	$6,143,624
W. Michigan	Southwest Michigan Street Regulator	Waterfront	$349,721	$0		$0	$349,721
Terminal 115	Terminal 115 CSO Storage	Alki	$670,386	$0	$2,802,724	$0	$3,473,110
Harbor	From Metro Predesign		$750,000	$0		$0	$750,000
MLK Way	Martin Luther King CSO Storage	Waterfront	$1,609,990	$0	$26,958,356	$0	$28,568,346
S. Henderson PS	South Henderson St. PS (Storage Alternative)	Waterfront	$1,019,259	$0	$7,155,755	$0	$8,175,014
Norfolk	Norfolk Regulator CSO Control Alternative	Waterfront	$684,887	$0	$4,058,265	$0	$4,743,152
S. Magnolia	Magnolia Storage	Ballard	$655,798	$0	$5,362,645	$0	$6,018,443
Rainer @ Hanford	Storage at Mouth of Hanford Tunnel	Waterfront	$158,217	$0	$2,750,383	$0	$2,908,600
Dexter	Included in Denny Project		$0	$0	$0	$0	$0
Murray PS	West Seattle Off-Line Storage With PS (partial) (includes control structure & 0.8 MG storage)	Alki	$732,718	$0	$3,738,863	$0	$4,471,581
Barton	West Seattle Off-Line Storage With PS (partial) (includes control structure, 7.5 mgd p/s with 0.07 MG wet well, and 7400' of 24" force main)	Alki	$7,470,937	$0	$797,432	$0	$8,268,369
SW Alaska St.	West Seattle Off-Line Storage With PS (partial) (includes control structure & 0.6 MG storage)	Alki	$732,718	$0	$3,039,371	$0	$3,772,089
63rd Ave. PS	----------		$0	$0	$0	$0	$0
North Beach	Metro Pre-Design (Steve Will Send Info)		$3,500,000	$0		$0	$3,500,000
West Point Upgrade	Add two secondary clarifiers					$15,000,000	$15,000,000
		Subtotals:	$19,120,256	$0	$62,021,793	$15,000,000	$96,142,049
		Totals:	$19,100,000	$0	$62,000,000	$15,000,000	$96,100,000

Group #2a - North Interceptor without a New Lake Line (West Point at 133 MGD)

Question: ***Is Group #2a(Near Surface Storage) a Stand Alone Alternative or is it Combined with #7a? (S or C)*** **S**

Capital Cost for Alternative Group #2a(Near Surface Storage) as Stand-Alone.

3rd Ave. West	3rd Avenue West Storage (WP440)		$732,718	$0	$24,442,915	$0	$25,175,633

Capital Cost for Alternative Group #2a(Near Surface Storage) when Combined With #7a

3rd Ave. West	No Storage at 3rd Ave. West		$0	$0	$0	$0	$0

				Component Breakdown			Total Capital
CSO Location	**Cost Estimate Source or Task 4.0 Alternative Name**	**Basin**	**Conveyance**	**Separation**	**Storage**	**Treatment**	**Cost**
Near Surface Storage							
University	University/Montlake Storage (WP440)	Ballard					
Montlake	"	"	$11,442,798	$0	$36,117,056	$0	$47,559,854
Canal Street	------		$0	$0	$0	$0	$0
3rd Ave. West	3rd Avenue West Storage (WP440)	Ballard	$732,718	$0	$24,442,915	$0	$25,175,633
Ballard	Ballard CSO Storage Alternative (Option 1) (includes 1.0 MG circular storage, overflow weir structure, 80' of 42" RCP, and 1650' of 36" RCP)	Ballard	$1,946,789	$0	$4,471,100	$0	$6,417,889
11th Avenue West	Ballard CSO Storage Alternative (Option 1) (includes 1.7 MG rectangular storage, flow regulator structure, 60' of 54" RCP, and 200' of 8" force main)	Ballard	$997,046	$0	$9,157,978	$0	$10,155,024
		Subtotals:	$15,119,351	$0	$74,189,049	$0	$89,308,400
		Totals:	$15,100,000	$0	$74,200,000	$0	$89,300,000

Question: ***Is Group #2a(Deep Tunnel Storage) a Stand Alone Alternative or is it Combined with #7a? (S or C)*** **S**

Capital Cost for Alternative Group #2a(Deep Tunnel Storage) as Stand-Alone (15,800' of 12' Tunnel - Univ. to 6th)

3rd Ave. West	Deep Tunnel - NSA Case #1	Ballard	$12,481,515	$0	$100,726,453	$0	$113,207,968

Capital Cost for Alternative Group #2a(Deep Tunnel Storage) when Combined With #7a (15,800' of 9' Tunnel - Univ. to 6th)

3rd Ave. West	Deep Tunnel - NSA Case #1	Ballard	$0	$0	$77,172,825	$0	$77,172,825
Deep Tunnel Storage							
Univ. to 6th Ave West	Deep Tunnel - NSA Case #1	Ballard	$12,481,515	$0	$100,726,453	$0	$113,207,968
Ballard	Ballard CSO Storage Alternative (Option 1)	Ballard	$1,946,789	$0	$4,471,100	$0	$6,417,889
11th Avenue West	Ballard CSO Storage Alternative (Option 1)	Ballard	$997,046	$0	$9,157,978	$0	$10,155,024
		Subtotals:	$15,425,350	$0	$114,355,531	$0	$129,780,881
		Totals	$15,400,000	$0	$114,400,000	$0	$129,800,000

Group #2b - North Interceptor with a New Lake Line (West Point at 159 MGD)

Question:	***Is Group #2b(Near Surface Storage) a Stand Alone Alternative or is it Combined with #7a? (S or C)***						**S**
Capital Cost for Alternative Group #2b(Near Surface Storage) as Stand-Alone.							
3rd Ave. West	3rd Avenue West CSO Storage		$788,720	$0	$31,590,000	$0	$32,378,720
Capital Cost for Alternative Group #2b(Near Surface Storage) when Combined With #7a							
3rd Ave. West	No Storage at 3rd Avenue West		$0	$0	$0	$0	$0

Modified 6/20/95--Steve Merrill

				Component Breakdown			Total Capital
CSO Location	**Cost Estimate Source or Task 4.0 Alternative Name**	**Basin**	**Conveyance**	**Separation**	**Storage**	**Treatment**	**Cost**
Near Surface Storage-2b1							
University	1400-ft of 84in connection to tank		$6,020,000				
Montlake	Univ/Mntlk Storage (12 MG)		$1,359,475	$0	$60,230,000	$0	$67,609,475
Canal Street	-------	Ballard	$0	$0	$0	$0	$0
3rd Ave. West (6.7 MG)	3rd Avenue West CSO Storage	Ballard	$788,720	$0	$31,590,000	$0	$32,378,720
Ballard	Ballard CSO Storage Alternative (Option 1) (includes 1.0 MG circular storage, overflow weir structure, 80' of 42" RCP, and 1650' of 36" RCP)	Ballard	$1,946,789	$0	$4,471,100	$0	$6,417,889
11th Avenue West	Ballard CSO Storage Alternative (Option 4) (includes 2.0 MG rectangular storage, flow regulator structure, 60' of 54" RCP, and 200' of 8" force main)	Ballard	$997,046	$0	$10,524,367	$0	$11,521,413
		Subtotals:	$11,112,030	$0	$106,815,467	$0	$117,927,497
		Totals:	$11,100,000	$0	$106,800,000	$0	$117,900,000

Question:	***Is Group #2b(Deep Tunnel Storage) a Stand Alone Alternative or is it Combined with #7a? (S or C)***						**S**
Capital Cost for Alternative Group #2b(Deep Tunnel Storage) as Stand-Alone (15,800' of 14' Tunnel - Univ. to 6th)							
3rd Ave. West	Deep Tunnel - NSA Case #1	Ballard	$14,414,093	$0	$116,418,000	$0	$130,832,093
Capital Cost for Alternative Group #2b(Deep Tunnel Storage) when Combined With #7a (15,800' of 11.5' Tunnel - Univ. to 6th)							
3rd Ave. West	Deep Tunnel - NSA Case #1	Ballard	$12,481,515	$0	$97,824,900	$0	$110,306,415
Deep Tunnel Storage							
15,800 ft of 14-ft Tunnel Univ. to 6th Ave West	Deep Tunnel - NSA Case #2	Ballard	$14,414,093	$0	$116,418,000	$0	$130,832,093
Ballard	Ballard CSO Storage Alternative (Option 1)	Ballard	$1,946,789	$0	$4,471,100	$0	$6,417,889
11th Avenue West	Ballard CSO Storage Alternative (Option 4)	Ballard	$997,046	$0	$10,524,367	$0	$11,521,413
		Subtotals:	$17,357,928	$0	$131,413,467	$0	$148,771,395
		Totals	$17,400,000	$0	$131,400,000	$0	$148,800,000

Group #3a - CSO Treatment w/Secondary Treatment at Duwamish (Phase out of Alki)

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Duwamish Secondary/CSO Treatment (Partial) (0.75 MG tank plus 3800 LF of 72" RCP)	Waterfront	$12,243,868	$0	$4,058,265	$0	$16,302,133
Brandon	Duwamish Secondary/CSO Treatment (Partial) (0.25 MG tank plus 1800 LF of 72" RCP)	Waterfront	$5,799,727	$0	$1,908,590	$0	$7,708,317
Duwamish PS	---------		$0	$0	$0	$0	$0
Hanford #2	Duwamish Secondary/CSO Treatment (Partial) (96" Butterfly Valve, a 0.5 MGD PS, 4,620 LF of 96" RCP, and a regulator)	Waterfront	$16,544,193	$0	$0	$0	$16,544,193
Lander	Duwamish Secondary/CSO Treatment (Partial) (includes 4 MG Rectangular Storage)	Waterfront	$0	$0	$21,263,970	$0	$21,263,970
Connecticut	---------		$0		$0	$0	$0
King Street	---------		$0	$0	$0	$0	$0
Chelan/Alki	Deep Tunnel - SSA Case #2 (includes 8500' of 9' tunnel and 100 MGD p/s)	Waterfront	$10,544,431	$0	$42,872,379	$0	$53,416,810
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative in addition to a second 2.5 MG treatment/storage tank.	Denny	$31,800,000		$51,000,000	$45,200,000	$128,000,000
Increase RS Diversions	Duwamish Secondary/CSO Treatment (Partial) (2,500 LF of 72-inch Diversion Pipe)	Waterfront	$9,012,225	$0	$0	$0	$9,012,225
CSO Treatment (2005)	Duwamish Secondary/CSO Treatment Alt. (includes 1500' of 84" RCP, 1500' of 96" RCP, reverse flow control structure, 115 MGD influent and effluent pump stations, and 115 MGD Vortex CSO treatment plant)	Waterfront	$37,492,077	$0	$0	$60,860,616	$98,352,693
CSO Treatment (2010)	Includes Additional 25 MGD Capacity to the Influent/Effluent Pump Stations and Treatment	Waterfront	$10,315,878	$0	$0	$6,900,766	$17,216,644
CSO Treatment (2025)	Includes Additional 70 MGD Capacity to the Influent/Effluent Pump Stations and Treatment	Waterfront	$16,756,180	$0	$0	$20,716,696	$37,472,876
CSO Treatment (2030)	Includes Additional 90 MGD Capacity to the Influent/Effluent Pump Stations and Treatment	Waterfront	$19,644,410	$0	$0	$25,886,871	$45,531,281
CSO Outfall	Duwamish Secondary/CSO Treatment (Partial) (capital cost was calculated from the difference between 12,000 LF of 60" outfall and 12,000' of 102" outfall)	Waterfront	$14,752,252	$0	$0	$0	$14,752,252
		Subtotals:	$184,905,241	$0	$121,103,204	$159,564,949	$465,573,394
		Totals	$184,900,000	$0	$121,100,000	$159,600,000	$465,600,000

Group #3b - CSO Treatment w/Secondary Treatment at Duwamish (Alki Remains)

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Duwamish Secondary/CSO Treatment (Partial) (includes 3,800 LF of 84" RCP)	Waterfront	$13,282,951	$0	$0	$0	$13,282,951
Brandon	Duwamish Secondary/CSO Treatment (Partial) (includes 1,800 LF of 84" RCP)	Waterfront	$6,291,924	$0	$0	$0	$6,291,924
Duwamish PS	---------		$0	$0	$0	$0	$0
Hanford #2	Duwamish Secondary/CSO Treatment (Partial) (96" Butterfly Valve, a 0.5 MGD PS)	Waterfront	$1,721,332	$0	$0	$0	$1,721,332
Lander	---------	Waterfront	$0	$0	$0	$0	$0
Connecticut	---------		$0	$0	$0	$0	$0
King Street	---------		$0	$0	$0	$0	$0
Chelan/Alki	Chelan Avenue Regulator/Weir (includes all components from the Chelan Avenue Regulator/Weir alternative in Task 4.0 report)	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
Denny Way	Preferred Denny Alternative (includes all of the components in the Task 6.0 preferred Denny alternative except to the 70 MGD effluent P/S, the 1600' of 60" outfall and the 2.5 MG storage/treatment)	Denny	$20,200,000		$51,000,000	$0	$71,200,000
Increase RS Diversions	Duwamish Secondary/CSO Treatment (Partial) (2,500 LF of 72-inch Diversion Pipe)	Waterfront	$9,012,225	$0	$0	$0	$9,012,225
CSO Treatment (2005)	Duwamish Secondary/CSO Treatment Alt. (includes 1500' of 84" RCP, 1500' of 96" RCP, reverse flow control structure, 175 MGD influent and effluent pump stations, and 175 MGD CSO treatment plant)	Waterfront	$41,021,479	$0	$0	$67,761,312	$108,782,791
CSO Treatment (2025)	Includes Additional 40 MGD Capacity to the Influent/Effluent Pump Stations and Treatment	Waterfront	$17,478,782	$0	$0	$21,573,449	$39,052,231
CSO Outfall	Duwamish Secondary/CSO Treatment (Partial) (capital cost was calculated from the difference between 12,000 LF of 60" outfall and 12,000' of 102" outfall)	Waterfront	$14,752,252	$0	$0	$0	$14,752,252
		Subtotals:	$125,158,004	$0	$65,855,625	$89,334,761	$280,348,390
		Totals	$125,200,000	$0	$65,900,000	$89,300,000	$280,300,000

Group #3c - Stand Alone CSO Projects

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Duwamish Secondary/CSO Treatment (Partial) (includes 3,800 LF of 84" RCP)	Waterfront	$13,282,951	$0	$0	$0	$13,282,951
Brandon	Duwamish Secondary/CSO Treatment (Partial) (includes 1,800 LF of 84" RCP)	Waterfront	$6,291,924	$0	$0	$0	$6,291,924
Duwamish PS	---------		$0	$0	$0	$0	$0
Hanford #2	Duwamish Secondary/CSO Treatment (Partial) (96" Butterfly Valve, a 0.5 MGD PS, 4,620 LF of 96" RCP, and a regulator)	Waterfront	$16,544,193	$0	$0	$0	$16,544,193
Lander	Duwamish Secondary/CSO Treatment (Partial) (includes 4 MG Rectangular Storage)	Waterfront	$0	$0	$21,263,970	$0	$21,263,970
Connecticut	KCM 1992 Metro Predesign (includes 3050 LF of Sanitary Sewer, 128.5 acres of separation, one regulator, and a 6.0 MG storage tank)		$4,883,507	$1,607,240	$14,106,865	$0	$20,597,612
King Street	Vortex Treatment - Industrial Area (Partial) (includes regulator and 1800' of 36" RCP and 2.5 MG storage - cost from Steve Merril)		$2,533,340	$0	$4,102,388	$0	$6,635,728
Chelan/Alki	Chelan Avenue Regulator/Weir (includes all components from the Chelan Avenue Regulator/Weir alternative in Task 4.0 report)	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative except the 2.5 MG Storage/Treatment was converted to 80 MGD Above Grade Primary Treatment)	Denny	$31,800,000		$51,000,000	$36,392,336	$119,192,336
Increase RS Diversions	Duwamish Secondary/CSO Treatment (Partial) (1,500 LF of 72-inch Diversion Pipes)	Waterfront	$5,407,335	$0	$0	$0	$5,407,335
CSO Treatment (2005)	Duwamish Secondary/CSO Treatment Alt. (includes 1500' of 84" RCP, 1500' of 96" RCP, reverse flow control structure, 140 MGD influent and effluent pump stations, and 140 MGD Primary Sedimentation Plant)	Waterfront	$41,021,479	$0	$0	$78,928,751	$119,950,230
CSO Treatment (2025)	Includes Additional 75 MGD Capacity to the Influent/Effluent Pump Stations and Treatment	Waterfront	$17,478,782	$0	$0	$29,567,977	$47,046,759
CSO Outfall	Duwamish Secondary/CSO Treatment (Partial) (includes 10,000 LF of 84" RCP and 2,000 LF of 84" marine outfall)	Waterfront	$44,566,658	$0	$0	$0	$44,566,658
		Subtotals:	$185,207,228	$1,607,240	$105,328,848	$144,889,064	$437,032,380
		Totals	$185,200,000	$1,600,000	$105,300,000	$144,900,000	$437,000,000

Group #4 - Southern Service Area Transfer to EDTP at Renton

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	KCM 1992 Metro Predesign (includes 3430 LF of Sanitary Sewer, 238 acres of separation, one regulator, and a 5.5 MG storage tank)		$7,981,839	$9,056,917	$13,694,359	$0	$30,733,115
Brandon	KCM 1992 Metro Predesign (includes 1640 LF of Sanitary Sewer, 52 acres of separation, one regulator, and a 3.0 MG storage tank)		$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653
Duwamish PS	----------		$0	$0	$0	$0	$0
Hanford #2	Joint Hanford/Lander CSO Storage Facility (54% of Capital Cost Allocated to Hanford for Phasing Purposes)	Waterfront	$0	$0	$17,435,689	$0	$17,435,689
Lander	Joint Hanford/Lander CSO Storage Facility (46% of Capital Cost Allocated to Lander for Phasing Purposes)	Waterfront	$0	$0	$14,852,624	$0	$14,852,624
Connecticut	Joint Connecticut/ King St. CSO Storage	Waterfront	$3,565,101	$0	$14,244,023	$0	$17,809,124
King Street	"	"					
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative in addition to a second 2.5 MG treatment/storage tank.	Denny	$31,800,000		$51,000,000	$45,200,000	$128,000,000
Chelan	Chelan Avenue Regulator/Weir	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
		Subtotals:	$47,791,148	$10,818,299	$135,104,442	$45,200,000	$238,913,889
		Totals	$47,800,000	$10,800,000	$135,100,000	$45,200,000	$238,900,000

Group #5 - Denny/Duwamish CSO Treatment

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Vortex Treatment - Industrial Area (75 MGD)	Waterfront	$13,651,513	$0	$0	$30,182,239	$43,833,752
Brandon	KCM 1992 Metro Predesign (includes 1640 LF of Sanitary Sewer, 52 acres of separation, one regulator, and a 3.0 MG storage tank)		$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653
Duwamish PS	----------	Waterfront	$0	$0	$0	$0	$0
Hanford #2	Vortex Treatment - Industrial Area (150 MGD) (60% of Capital Cost Allocated to Hanford for Phasing Purposes)	Waterfront	$9,086,881	$0	$0	$36,868,765	$45,955,646
Lander	Vortex Treatment - Industrial Area (150 MGD) (40% of Capital Cost Allocated to Lander for Phasing Purposes)	Waterfront	$6,057,921	$0	$0	$24,579,177	$30,637,098
Connecticut	Vortex Treatment - Industrial Area (80 MGD) (includes treatment plant, 80 MGD p/s, regulator, force main)	Waterfront	$12,344,512			$32,554,295	$44,898,807
King Street	Vortex Treatment - Industrial Area (80 MGD) (includes regulator and 1800' of 36" RCP)	Waterfront	$2,832,383	$0	$0		$2,832,383
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative in addition to a second 2.5 MG treatment/storage tank.	Denny	$31,800,000		$51,000,000	$45,200,000	$128,000,000
Chelan	Chelan Avenue Regulator/Weir	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
		Subtotals:	$80,217,418	$1,761,382	$74,877,747	$169,384,476	$326,241,023
		Totals	$80,200,000	$1,800,000	$74,900,000	$169,400,000	$326,200,000

Group #5b - Modified Denny/Duwamish CSO Treatment

Extimate prepared by Steve Merrill, BC--6/20/95

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Storage/treatment @ 4000 gpd/sf	Waterfront	$13,023,620	$0	$0	$15,814,000	$28,837,620
Brandon	Storage/treatment @ 4000 gpd/sf		$732,000			$10,850,000	$11,582,000
Duwamish PS	----------	Waterfront	$0	$0	$0	$0	$0
Hanford #2	Storage/Treatment @ 3400 gpd/sf on total of Hanford and Lander--increment for Hanford Reduces combined freq 50%	Waterfront	$2,511,120	$0	$0	$22,330,000	$24,841,120
Lander	Storage/Treatment @ 4000 gpd/sf Includes forcemain for Hfd+Lander	Waterfront	$2,511,120	$0	$0	$20,610,000	$23,121,120
Connecticut	Storage/treatment @ 4000 gpd/sf Includes capacity for King	Waterfront	$3,243,837	$0	$0	$25,080,000	$28,323,837
King Street	Conveyance to Connecticut facility	Waterfront	$2,832,383	$0	$0		$2,832,383
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative in addition to a primary treatment facility.	Denny	$31,800,000		$51,000,000	$36,392,336	$119,192,336
Chelan	Chelan Avenue Regulator/Weir	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
		Subtotals:	$58,051,139	$0	$65,855,625	$131,076,336	$254,983,100
		Totals	$58,100,000	$0	$65,900,000	$131,100,000	$255,000,000

Group #6 -SSA Separation/Storage/On-Site Treatment Emphasis

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	KCM 1992 Metro Predesign (includes 3430 LF of Sanitary Sewer, 238 acres of separation, one regulator, and a 5.5 MG storage tank)		$7,981,839	$9,056,917	$13,694,359	$0	$30,733,115
Brandon	KCM 1992 Metro Predesign (includes 1640 LF of Sanitary Sewer, 52 acres of separation, one regulator, and a 3.0 MG storage tank)		$3,047,149	$1,761,382	$9,022,122	$0	$13,830,653
Duwamish PS	----------		$0	$0	$0	$0	$0
Hanford #2	Vortex Treatment - Industrial Area (150 MGD) (60% of Capital Cost Allocated to Hanford for Phasing Purposes)	Waterfront	$9,086,881	$0	$0	$36,868,765	$45,955,646
Lander	Vortex Treatment - Industrial Area (150 MGD) (40% of Capital Cost Allocated to Lander for Phasing Purposes)	Waterfront	$6,057,921	$0	$0	$24,579,177	$30,637,098
Connecticut	KCM 1992 Metro Predesign (includes 3050 LF of Sanitary Sewer, 128.5 acres of separation, one regulator, and a 6.0 MG storage tank)		$4,883,507	$1,607,240	$14,106,865	$0	$20,597,612
King Street	Vortex Treatment - Industrial Area (Partial) (includes regulator and 1800' of 36" RCP and 2.5 MG storage - cost from Steve Merril)		$2,533,340	$0	$4,102,388	$0	$6,635,728
Denny Way	Preferred Denny Alternative (inlcudes all of the components in the Task 6.0 preferred Denny alternative in addition to a second 2.5 MG treatment/storage tank.	Denny	$31,800,000		$51,000,000	$45,200,000	$128,000,000
Chelan	Chelan Avenue Regulator/Weir	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
		Subtotals:	$66,787,696	$12,425,539	$106,781,359	$106,647,942	$292,642,536
		Totals	$66,800,000	$12,400,000	$106,800,000	$106,600,000	$292,600,000

Group #7a - Deep Tunnel Storage in SSA without Alki Phase-Out

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Deep Tunnel Alternative SSA Case #1 (Partial)	Waterfront	$41,557,417		$0		$41,557,417
Brandon	(Includes 13,400' of 84" RCP)						
Duwamish PS	----------		$0	$0	$0	$0	$0
Hanford #2	Deep Tunnel Alternative SSA Case #1 (Partial)	Waterfront					
Lander	(includes 30,600 LF of 24' I.D. tunnel, 3rd Ave.	"					
Connecticut	regulator, 1200 LF 48" RCP, 100 MGD P/S	"					
King Street	at 6th Avenue West)	"	$13,020,066		$378,329,290		$391,349,356
Chelan	Chelan Avenue Regulator/Weir	Alki	$1,397,059	$0	$14,855,625	$0	$16,252,684
Denny Way	Preferred Denny Alternative	Denny	$14,600,000		$51,000,000	$0	$65,600,000
	(inlcudes all of the components in the Task 6.0 preferred Denny alternative except 60" outfall, outfall regulator, 70MGD influent and effluent p/s, and 2.5 MG storage)						
		Subtotals:	$70,574,542	$0	$444,184,915	$0	$514,759,457
		Totals	$70,600,000	$0	$444,200,000	$0	$514,800,000

Group #7b - Deep Tunnel Storage in SSA Including Alki Phase-Out

THIS GROUP WAS ELIMINATED FROM CONSIDERATION (3/9/95)

CSO Location	Cost Estimate Source or Task 4.0 Alternative Name	Basin	Conveyance	Component Breakdown Separation	Storage	Treatment	Total Capital Cost
Michigan	Deep Tunnel Alternative SSA Case #3 (Partial)	Waterfront	$13,020,066		$526,026,094		$539,046,160
Brandon	(includes 44,000 LF of 20' I.D. tunnel, 3rd Ave.	"					
Duwamish PS	West regulator, 1200 LF of 48" RCP, 100	"					
Hanford #2	MGD p/s at 6th Ave. West, and 8500 LF	"					
Lander	of 9' I.D. Deep Tunnel (Chelan Extension)	"					
Connecticut	"	"					
King Street	"	"					
Chelan/Alki	"	"					
Denny Way	Denny Separation (SEP-1) (partial) (includes 6800 LF of 18' tunnel, 6 flow regulator structures, 4000 LF of 60" RCP, and 70 MGD p/s)	Denny	$23,467,470	$0	$49,640,562	$0	$73,108,032
		Subtotals:	$36,487,536	$0	$575,666,656	$0	$612,154,192
		Totals	$36,500,000	$0	$575,700,000	$0	$612,200,000