M E M O R A N D U M

TO	Lynn Sullivan, Project Manager	DATE	November 27, 2006
	Seattle Parks and Recreation	PROJECT No	200607
	800 Maynard Avenue South, 3rd Floor	PROJECT	(WC2281)
	Seattle, Washington 98134		Lake Washington Boulevard
CC			South Drainage Improvements
SUBJECT	Drainage Assessment and Conceptual Design	FROM	Mike DeLilla, P.E.
		PAGE	1 OF 10

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Problem

The Seattle Parks and Recreation Department (SPRD) has identified five locations on Lake Washington Boulevard South that are current drainage problems between the Mount Baker Bathing and Boating Park to Seward Park. See Exhibit 1. These five "hotspots" have been evaluated by Rosewater staff (RWE) and are based on field observations of these locations during heavy rainfall, research of City of Seattle asbuilts and sewer card documents. Recommendations for the maintenance of existing drainage systems, conceptual solutions and costs opinion of improvements in the area(s) are provided in this memorandum. The site visit for all locations was on November 3, 2006.

Field Observations: Site A

Site A is located in the vicinity of the entrance to the Mount Baker Bathing and Boating Park. Drainage problems occur in the driveway and along both sides of Lake Washington Boulevard South. See Figure A-1. There are twelve existing pot drain systems located in the lawn areas and spaced approximately 70-feet apart along the roadway. Each system consists of one pot drain on each side of the road and is connected to each other by pipe. It is unknown if the pipes connecting the pot drains are damaged. The size of the pot drains are 6-inches in diameter and are covered by leaves and debris. The lawn around the drains is overgrown and obstructs the runoff which causes standing water in the roadway and saturates the lawn areas. The outfall to each system appears to be located along the grass bank into Lake Washington. Most outfalls could not be identified during the site visit and appear buried.

Figure A-1
Looking south on Lake Washington Boulevard South from the driveway entrance

Site A Improvement Options

On the north side of the entrance, storm drainage from the roadway sheet flows down the driveway where it crosses the sidewalk and continues into the parking lot. See Figure A-2. The concentration of flow from the roadway may create a hazard to pedestrians using the sidewalk. Replacing the existing storm drain manhole with a circular grate and diverting flow into this structure will reduce the amount of flow coming into the parking lot. Diverting flow may be done by either lowering the structure or adding an asphalt edge/berm.

The existing pot drains are outdated and assumed no longer functioning. SPRD would like to replace or install additional pot drain systems to improve the drainage in this area. The replacement of culvert pipe crossing Lake Washington Boulevard South and the outfall pipe are also estimated. These small systems are susceptible to clogging and scheduled maintenance will be needed to keep these drains functioning during the wet season. Areas around all the pot drains should be cleared to prevent future problems with overgrowth. See Figure A-3. Other grate options such as trash racks may be used for additional protection against leaves and debris. Larger structures such as City of Seattle Type 252 inlets provide a greater collection area and less maintenance.

The cost of the replacement varies based on the conditions of the each individual drainage system. If the entire system of pot drain systems will be replaced, the majority of the costs will be trenching across Lake Washington Boulevard South. Trenchless construction methods may also be considered if the culvert pipe needs to be replaced.

Figure A-2
Storm water sheet flows down the driveway to the boat park

Construction Improvement Costs for Site A: $103,800* (see Appendix for itemized breakdown)
*Costs include a design and general condition contingency of 20% and 15%, respectively.

- Remove and replace all existing pot drains
- Remove and replace all existing culvert and outfall pipe
- Unit cost to remove and replace individual pot drain system is approximately $6,250.00
- Replace grate and modify pavement in driveway $500.00

Figure A-3
Existing pot drain clogged with leaves and no flow path into the structure

Field Observations: Site B

Site B is located on the west side of Lake Washington Boulevard South in the vicinity of Horton Place loop. The drainage problems occur along the west edge of the roadway. See Figure B-1. Drainage for the west half of the road flows north along the roadway shoulder. There is one existing pot drain within the lawn and the flow path to this drain is obstructed by the growth of the lawn. Since the lawn area is higher than the roadway the storm water is trapped and begins to encroach into the traveled way. Temporary clearing of a path to the pot drain shows the storm water slowly retreating from the roadway. Further inspection uncovered that the drain structure is missing allowing debris to fill the void and pipe culvert underneath Lake Washington Boulevard South. See Figure B-2

Figure B-1
Looking north on Lake Washington Boulevard South

Improvement Options

Cutting back the lawn and lowering the grade will move the storm water off the roadway. A larger structure such as City of Seattle Type 252 inlet will provide a greater collection area and less maintenance. Providing an unobstructed flow path into the replaced structure will alleviate the existing encountered problems. If this structure is replaced and maintained, this area will drain more effectively. The condition of the culvert pipe crossing Lake Washington Boulevard South is unknown. The replacement of this pipe will be similar to Site A costs.

Figure B-2
Temporary clearing to pot drain

Figure B-3
Location of missing pot drain

Construction Improvement Costs for Site B: $12,500* (see Appendix for itemized breakdown)

*Costs include a design and general condition contingency of 20% and 15%, respectively.

- Remove and replace existing pot drain system. Install Type 252 inlet on west side.
- Minor grading and lawn maintenance

Field Observations: Site C

Site C is located on the west side of Lake Washington Boulevard South between 50th Avenue South and 51st Avenue South. The drainage problems occur along the west curb line and within the lawn adjacent to the roadway. See Figure C-1. An existing inlet near the south west corner of the intersection with 50th Avenue South collects roadway runoff between the two streets along with storm water from 51st Avenue South. The flat roadway and long path to the inlet causes standing water along the curb line during heavy rain events. However, it appears that that storm water is flowing into the structure at a very slow rate. The lawn area is flat and in some places depressed. Storm water collects and absorbs slowly into the subsurface creating soggy condtions. Currently, there is no drainage system for the lawn area. Runoff from the hillside may also add to the lawn area being oversaturated.



Figure C-1

Improvement Options

Storm water appears to pond in this area because of the flat grade along the curb line. Storm flow loses momentum around the roadway curve and is impeded by a portion of the curb that needs adjustment. See Figure C-2. It appears that the curb in this location is raised so that it moves flow out of the curb line. From this point, planing of the existing roadway along the curb line will increase the fall towards the north. The existing inlet is shallow and connects approximately 10-feet north to a storm drain manhole at the south west corner of 50th Avenue South. Removing the inlet to allow storm water to flow directly into this manhole will provide sufficient depth to lower the structure and increase the grade. Roadway surveying is required to determine how much the storm drain manhole could be lowered to maximize the grade. The storm drain manhole will need to be replaced with a circular grate.

An alternative option is to install an additional catch basin in the area of the ponding. The new structure will outfall directly to the east into the grass banks of Lake Washington via culvert pipe underneath the roadway. Outfall protection will need to be placed to prevent erosion. The curb mentioned previously will also be fixed in this option. Further investigation involving other utilities in the roadway will need to be determined to discuss the feasibility of adding a structure and culvert.


Figure C-2

Existing curb to be replaced

The amount of surface runoff may be reduced by adding an inlet structure to the northwest corner of the intersection of 51st Avenue South. See Figure C-3. Adding this structure will reduce the runoff coming from 51st Avenue South and Lake Washington Boulevard South. The new structure will connect to the existing storm drain manhole (Figure C-3) to minimize roadway impacts.

Figure C-3
Proposed location for added inlet to collect runoff from the south

Adding fill to re-grade the lawn will provide a slope that drains to the roadway so storm water is not detained in the grass area. The amount of fill may be as deep as 18-inches to match the existing grade on the west hillside. Surveying will need to be done prior to final design to minimize the amount of fill. An under drain system may be considered in this area, but is most likely the high cost alternative. Under drain systems require the import of free-draining stratum above the perforated pipe drains and an outlet pipe. Subsurface investigation in this area will need to be assessed to determine the feasibility of the under drain system design.

Construction Improvement Costs for Site C: $14,500* (see Appendix for itemized breakdown)
*Costs include a design and general condition contingency of 20% and 15%, respectively. Cost also includes $5,000.00 for mobilization and traffic control.

- Remove existing curb inlet and lower existing storm drain manhole, replace solid cover with grate
- Lower roadway by planing pavement, repair curb and gutter
- Alternative Option to add extra inlet and outfall to Lake Washington is $13,900.00* (See Above)
- Unit Cost to add fill to lawn area and grass seed is $13,850.00
- Unit Cost to install new catch basin and connect to existing storm drain system on 51st Ave SW is $3,543.00.

Field Observations: Site D

Site D is located at the intersection of S. Orcas Street and Lake Washington Boulevard South. The drainage problems occur along the east curb line stretching between and beyond the two "new" ADA ramps. See Figure D-1 and D-2. There are existing curb drains throughout this area, but settlement in the flat roadway prevents storm runoff to be conveyed to these drains. The drains are currently clogged causing storm water to pond and encroach into the traveled roadway. If these drains were maintained it would only alleviate some of the drainage problems in this area. Additional roadway and drainage improvements will need to be made in this location.

Figure D-1
North ADA ramp

Figure D-2
South ADA ramp

Figure D-3
Clogged drain near the north ADA ramp

Improvement Options

Settlement in the roadway is the biggest cause for the drainage problems in this area. The cause of the settlement is unknown and is likely this section of the roadway will eventually need to be repaired. See Figure D-4 and D-5. Resurfacing the roadway to eliminate the undulations will improve flow to the existing drains in these areas. Planing the ridges in the pavement will reduce the standing water to flow into the existing drains. See Figure D-5. Installing additional curb penetrations in low spots that outfall east into Lake Washington will improve this area; however,

these drains will have to be maintained. Curb penetrations near the ADA ramps will help in reducing the standing water in the area.

Figure D-4
Roadway settlement in the northbound lane

Figure D-5
Ponding caused by the settlement in the roadway

Figure D-6
Undulations in the roadway preventing runoff to drain

Construction Improvement Costs for Site D: $22,600* (see Appendix for itemized breakdown)
*Costs include a design and general condition contingency of 20% and 15%, respectively.

- Install curb penetrations near ADA ramps and low points
- Repair roadway, and planing pavement ridges

Field Observations: Site E

Site E is located on the west side of Lake Washington Boulevard South approximately north of the entrance to Seward park where ponding occurs along the curb line and encroaches into the roadway. There is one existing catch basin to drain this area, but due to the flat and undulating roadway, the storm water is not conveyed to this drain. See Figure E-1.

Figure E-1

Improvement Options

Resurfacing the roadway in this area to remove the undulations will create grade to the existing drain. The west half of the roadway will need to be removed by planing the existing asphalt overlay. At the low point, the new pavement could be placed as high as the top of the curb. This will provide sufficient grade along the curb to the existing drain. Further field investigation and roadway surveying will be needed to finalize the design.

An additional option is to install a catch basin in the area of the low point, and connect to the existing catch basin to the north.

Construction Improvement Costs for Site E: $9,200* (see Appendix for itemized breakdown)
*Costs include a design and general condition contingency of 20% and 15%, respectively.

- Regrade roadway by planing existing pavement
- Alternative Option to install CB is $12,677

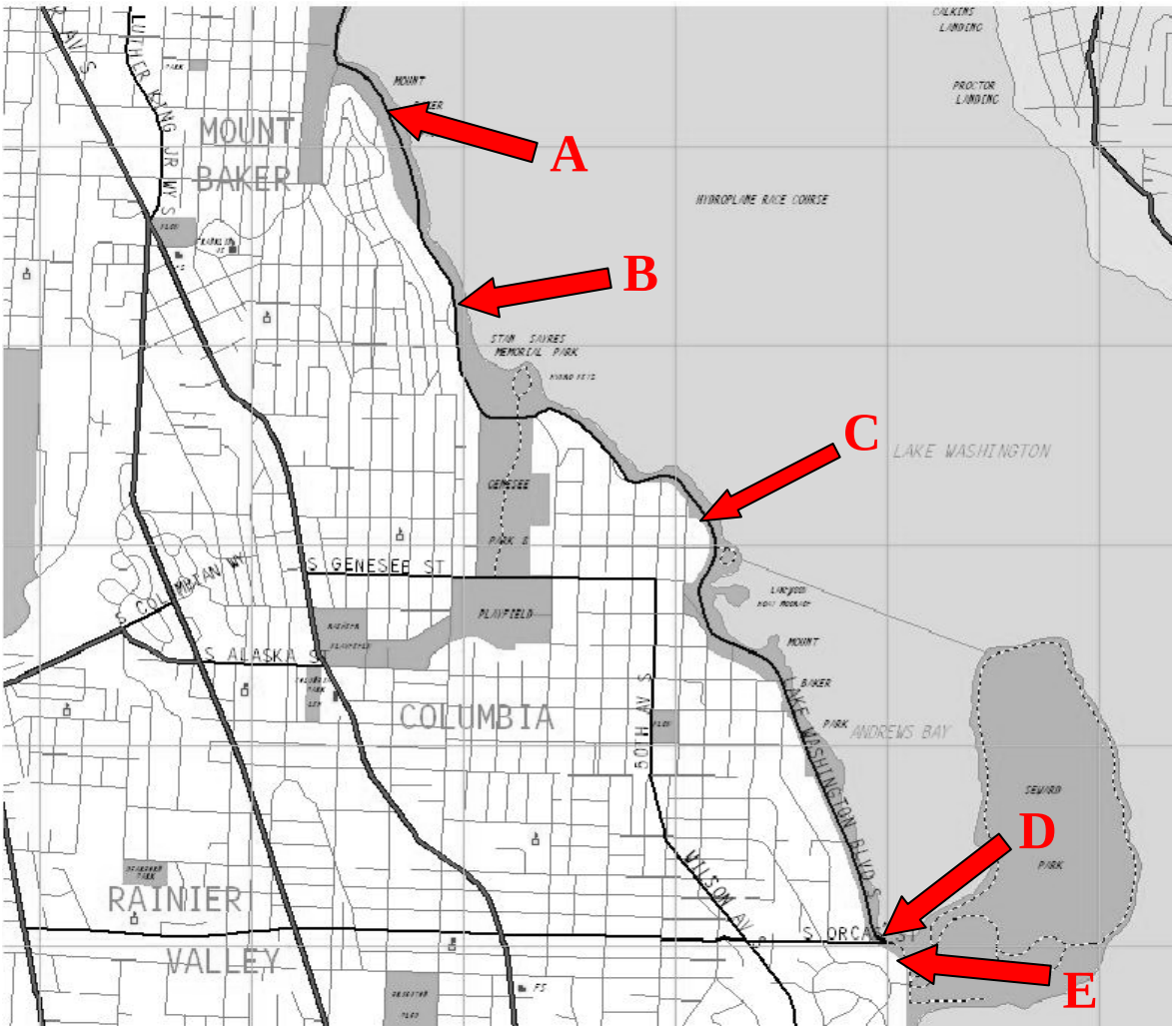

Exhibit 1
Lake Washington Boulevard South Drainage
Site Locations

Site	Seattle Parks & Recreation Site Descriptions
A	Approximately 70-feet of the west shoulder of Lake Washington Blvd near the entrance of the Mount Baker Bathing and Boating Park;
B	Lawn area/west shoulder of Lake Washington Blvd at Horton loop;
C	West side of Lake Washington Blvd between 50th and 51st Ave S.;
D	Three (3) new ADA ramps located near the intersection of South Orcas St. and Lake Washington Blvd;
E	And the catch basin located on the west side of Lake Washington Blvd south of South Orcas St. and North of Lake Washington Blvd.