



MEMORANDUM

TO: Andy Haub, Stormwater Engineering Supervisor

FROM: Melissa McFadden, P.E., Project Engineer II

MM

DATE: February 11, 2005

SUBJECT: Traditional versus Pervious Concrete Sidewalks
Construction and Maintenance Cost

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This document presents the results of a present value comparison of traditional concrete sidewalk versus pervious concrete sidewalk. The results indicate that pervious concrete sidewalk is more cost-effective to construct and maintain than traditional concrete sidewalk when requirements for storage and treatment of stormwater are met. Given this information, I would recommend that pervious concrete be considered whenever possible in construction of sidewalks in City-funded projects.

The net present value cost for walk construction was calculated by assuming that 5,100 square yards of sidewalk (7,650 linear feet at 6 feet wide) will be constructed each year. Based on an average of 7 locations per year for the next 10 years, a total of 51,000 square yards of sidewalk will be constructed. When the total construction and maintenance costs (see Table 1) are considered for the entire 51,000 square yards, the cost per yard for traditional concrete sidewalk is \$101.16 per square yard and the cost for pervious concrete sidewalk is \$54.16 per square yard. It should be noted that the cost of pond construction and maintenance associated with the construction of traditional sidewalk, based on the current *Department of Ecology Surface Water Guidelines*, nearly tripled the cost of traditional concrete sidewalk construction.

Table 1—Construction and Maintenance Costs for Traditional Concrete Sidewalk and Pervious Concrete Sidewalk.

Traditional Concrete Sidewalk		Pervious Concrete Sidewalk	
Construction Cost	Maintenance Cost	Construction Cost	Maintenance Cost
\$5,003,000	\$156,000	\$2,615,000	\$147,000
TOTAL = \$5,159,000 \$101.16 per square yard		TOTAL = \$2,762,000 \$54.16 per square yard	

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Included in the 5,100 square yards are sidewalks constructed as part of the sidewalk program, and sidewalks constructed as part of Capital Facility Projects. Ursula Euler, Accounting Supervisor, provided the interest rates of 3 percent for inflation and 5.93 percent (rounded to 6 percent) for Capital Facility Projects (based on interest paid in December 2004). It should be noted that this is not a life-cycle cost analysis as the entire life of the sidewalk was not considered. The fact that pervious concrete sidewalk is much less expensive over the 10-year period implies that it will continue to be a more cost-effective option through time, especially with continuing study of mix designs and performance. In addition, it is likely that maintenance practices and technology will undergo change during that time and alter future costs.

In the event that a combination of traditional and pervious sidewalks are installed, it may be prudent to perform further calculations to ensure that spending for additional equipment and staffing are optimized.

If you have any questions or comments, please call me at 8297.

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Enclosure

cc: **Craig Tosomeen, P.E., Project Engineer II**
Sophie Stimson, TDM Planner
Sheri Smith, Project Manager
Mark Blosser, Senior Project Engineer
Fran Eide, P.E., City Engineer
Randy Wesselman, Transportation Engineer Supervisor

Appendix A – The Calculations

Four separate considerations:

1. Traditional Concrete with BMPs Construction Cost	
Cost for Sidewalk Construction	\$1,740,160
Cost for Pond Construction/Fee in Lieu	<u>\$3,262,870</u>
	\$5,003,030
2. Pervious Concrete Construction Cost	
Cost for Sidewalk Construction	\$2,615,359
3. Traditional Concrete with BMPs Maintenance Cost	
Cost for Pond Maintenance	\$155,610
4. Pervious Concrete Maintenance Cost	
Cost for Sweeping (Sweeper)	\$26,913
(Labor and Equipment)	\$54,639
Cost for Pressure Washing	<u>\$65,577</u>
	\$147,129

For all, the life used was 10 years.

1. Traditional Concrete with BMPs – Construction Cost

A. Cost for Sidewalk Construction

The cost for sidewalk construction over the next 10 years was calculated by assuming that 5,100 square yards of sidewalk would be constructed per year (at an average of 7 locations for the next 10 years). These are both sidewalks constructed as part of the sidewalk program and sidewalks constructed as part of Capital Facility Projects. An inflation rate of 3 percent was used (per Ursula Euler, Accounting Supervisor, in December 2004).

The bid tab database was used to calculate an average cost per square yard of concrete sidewalk for a *similarly-sized project* with each of the 7 areas assumed to be a project (~730 square yards each). A cost of \$40 per square yard was used. The annual cost for the first year at this rate for construction of the sidewalk only was found to be \$204,000. This cost applied annually at 3 percent inflation for 10 years (P/A, 3 percent, 10 years) was found to be **\$1,740,160**.

B. Cost for Pond Construction/Fee in Lieu

In addition to the construction of the sidewalk, it was assumed that a pond would be constructed for each of the 7 area projects. As costs for ponds vary widely in accordance with topography, soils, availability of right-of-way, etc., the City of Olympia's fee in lieu calculator was used to determine the cost for each pond.

INPUTS: The sidewalk was considered to be “pollution-generating” impervious surface in order to kick-in the treatment option on the spreadsheet. The reason is in the traditional sidewalk construction, the sidewalk falls toward the street and mixes with roadway runoff before being diverted to a collection structure. It is, therefore, required to be treated. The disturbed area for sidewalk construction was estimated to be 1 foot behind the sidewalk. An average sidewalk width was estimated at 6 feet, with a 2 percent average slope. ENR provided the January 2005 construction cost index for entry into the spreadsheet. Finally, it was assumed that the ponds were located in the watersheds with the most stringent requirements in order to meet the requirements of the *2005 City of Olympia Stormwater Manual*.

OUTPUT: For each walk, the fee in lieu was calculated at \$54,644. With 7 sidewalks constructed per year at this cost, the annual cost was found to be \$382,508. With 7 sidewalks constructed per year for 10 years at 3 percent inflation, the cost for ponds was found to be **\$3,262,870** (in 2005 dollars).

2. Pervious Concrete – Construction Cost

Cost for Sidewalk Construction

The cost for sidewalk construction over the next 10 years was calculated by assuming that 5,100 square yards of sidewalk would be constructed per year (at an average of 7 locations for the next 10 years). These are both sidewalks constructed as part of the sidewalk program and sidewalks constructed as part of Capital Facility Projects. An inflation rate of 3 percent was used (per Ursula Euler, Accounting Supervisor, in December 2004).

The bid tab database and historical information (per Craig Tosomeen, P.E., Project Engineer II) were used to calculate an average cost per square yard of impervious concrete sidewalk for a *similarly-sized project* with each of the 7 areas assumed to be one project (~730 square yards each). A cost of \$60 per square yard of pervious concrete was used (per Craig Tosomeen, P.E., Project Engineer II). In addition, a geotextile layer is typically used in construction costing an estimated \$4.50 per square yard (based on prior bid tabs). Finally, the 8-inch layer of bankrun gravel that would be specified for pervious concrete walk was estimated at \$20 per cubic yard from bid tab information, with a total of 162 cubic yards needed for each project. The annual cost for construction of the sidewalk during the first year was found to be \$306,600. This cost applied annually at 3 percent inflation for 10 years (P/A, 3 percent, 10 years) was found to be **\$2,615,359**.

3. Traditional Concrete with BMPs – Maintenance Cost

Cost for Pond Maintenance

Pond maintenance was assumed to occur every other year at each of the 7 sites. The 3-person crew is assumed be able to work 6 hours per day (at one site), with 2 hours of mobilization/demobilization time. Historical evidence (per Steve Wise, Code Enforcement Officer) indicates that the crew can inspect and clean pipe inlets/outlets, clear vegetation, and mulch it on-site (with no disposal cost) for a small pond in one day.

Equipment required would include a truck and trailer, hand tools, and a “Merry Mac.” Equipment costs were assumed to be around \$28 per day per piece of equipment (per a conversation with Al Carver, Sewer/Stormwater Supervisor) for 2 pieces of equipment (truck/trailer and “Merry Mac”), with fuel and possible hand-tool costs being added at \$20 per day and \$10 per day, respectively. In year 2, the first year that pond maintenance would be required, all 7 ponds constructed during year 1 would be cleaned in approximately 7 days at a total cost of \$8,161 (in 2005 dollars), including both labor and equipment. During year 3, ponds constructed during year 2 would be cleaned. In year 4, BOTH year 3 and year 1 (again) would need to be cleaned. Every 2nd year, the number of ponds to be cleaned would increase by 7, with an additional requirement of 7 days to complete. In year 10, the amount of time needed to clean ponds would be 35 days per year.

Year	Ponds Cleaned from Year(s)	Number of Ponds Cleaned	Number of Days Required
1	-	-	-
2	1	7	7
3	2	7	7
4	1/3	14	14
5	2/4	14	14
6	1/3/5	21	21
7	2/4/6	21	21
8	1/3/5/7	28	28
9	2/4/6/8	28	28
10	1/3/5/7/9	35	35

The total cost for maintenance of ponds constructed in conjunction with traditional sidewalks was found to be **\$155,610**.

4. Pervious Concrete – Maintenance Cost

A. Cost for Sweeping

The initial cost for a used sweeper (with some repairs) was estimated by Mark Blosser, Senior Project Engineer, at \$15,000. He also asked that we assume replacement in 7 years for \$15,000 (in 2005 dollars). The future value of this amount was calculated at an inflation rate of 3 percent, then reduced to present value using the capital project investment rate of 6 percent (the amount invested now at 6 percent that would yield an inflated \$15,000 in 7 years). The total capital cost was found to be **\$26,913**.

The sidewalks were assumed to have been constructed at 7 locations per year (on average) of about 730 square yards each. Sweeping was set to occur twice per year at each location.

With 1.5 hours of mobilization/demobilization, 0.5 hours of travel time between 7 sites (7 sites swept per day – 3.5 hours travel time), the 1-person crew would have a total of 3 hours left for sweeping per day. Sweeping may occur at a speed of 1.0 mile/hour (a

conservative estimate), which would allow for a total of 15,840 lineal feet per day. With 2 passes per walk, 2 days would be needed to clean all of the sidewalks constructed in year 1. Subsequent years would increase by this amount (2 days more per year) as new sidewalk is constructed. At \$28.66 per hour (cost per hour of labor estimated by Mark Blosser, Senior Project Engineer), the cost in year 1 would be \$458.56. This was considered as the annual cost (A) as well as the gradient (G). The total labor cost for sweeping over the 10 years considered is \$20,561. In addition, costs for equipment, cleaners, fuel, supplies, and parts came to \$380 per day of sweeping (per Mark Blosser, Senior Project Engineer). With an annual cost (A) and a gradient cost (G) of \$380 per day for 2 days per year (\$760 per year), the total cost over 10 years was found to be \$34,078. Therefore, the total cost for labor and equipment/miscellaneous costs came to **\$54,639**.

B. Cost for Pressure Washing

Pressure washing was assumed to occur once every 5 years at each site. The 2-person crew is assumed be able to work 6 hours per day (at one site), with 2 hours of mobilization/demobilization time. Historical evidence (per Craig Tosomeen, P.E., Project Engineer II) indicates that the crew can pressure wash approximately 34.5 lineal feet of a 6-foot-wide sidewalk per person hour. In year 5, the first year that pressure-washing would be required, all sidewalks constructed during year 1 would be pressure washed in approximately 19 days. For years 6 through 9, the same amount of time would be required per year as the same amount of sidewalk will be constructed per year during years 2 through 5. However, in year 10, the amount of time needed to pressure wash the sidewalks would double as the sidewalks constructed during year 6 would require cleaning as well as the sidewalks constructed during year 1 (its second cleaning – 5 years after the first). Henceforth, every 5 years the total pressure washing time required would increase by an additional 19 days. For the sake of this analysis, only the first 10 years was considered.

In addition to crew costs, equipment, fuel, parts, supplies, and maintenance costs were also considered. These costs came to approximately \$160 per day. The total annual cost for labor and equipment came to \$3,040. Total pressure-washing cost for the 10 years considered came to **\$65,577**.