Pollutant Loading Estimates

Annual pollutant load is calculated when preparing Discipline Reports to assess potential impacts of a project. Two methods are described and summarized below that are appropriate for use in the early planning stage of a project. These loading rates are not intended to provide site-specific values but can be used as a comparative tool to identify differences in stormwater impacts between project alternatives. The methods were selected because they are: (1) based on recent WSDOT highway runoff data, (2) easy to apply or (3) specific to the Pacific Northwest. Emphasis should be placed on describing the difference in pollutant loads between alternatives, instead of focusing on derived values. Over the next year, WSDOT will be reevaluating existing impact assessment methods with the intent of incorporating a watershed based approach.

Method 1: WSDOT Data-FHWA method.

This method estimates pollutant loads based on highway runoff data collected in western Washington since 2001 (Table 1). The data is representative of runoff from a wide range of average daily traffic (ADT) volume highways (1,700-93,000) in western Washington. However, most of the water quality data was obtained from urban monitoring locations. At this time WSDOT doesn't have sufficient data to separately estimate annual loads for rural highways across the rest of the state. One can, however, use the western Washington urban area loading rates for rural highways with the understanding that the data represents a worst-case scenario.

The FHWA method, derived by (Driscoll et al., 1990), and source pollutant concentration data used to populate WSDOT's 2009 HI-RUN Model, were combined to generate the annual pollutant loading estimates in Table 1. To use this method:

1. Create a table with the number of acres of highway surface that currently exist and the number of acres of highway surface for each proposed alternative (see the Table 2 example). Include the number of acres that will be treated and those that will remain untreated, if applicable, for each alternative. Exclude surfaces where runoff is infiltrated since they do not discharge to surface water bodies.

2. Multiply the acres of treated and untreated surface by the corresponding annual pollutant load values, using the means from Table 1.

3. Add the pollutant loads from the untreated and treated surfaces for each alternative (including no-build or existing conditions) to generate a total pollutant load in pounds per year.

4. Calculate the percent change using the following equation,
   [(Final value - Initial value) / (Initial value)] x 100

5. Data from the completed table can be directly inserted into discipline studies to compare impacts associated with each alternative.

Table 1: Estimated annual pollutant loads from untreated and treated highway runoff in (Lbs./year • acre)

Pollutant	Mean load from Untreated runoff	Mean load from Treated runoff
Total Suspended Solids	769	88
Total Copper	0.16	0.04
Dissolved Copper	0.04	0.03
Total Zinc	0.98	0.21
Dissolved Zinc	0.31	0.14

Note: Values were derived using W. WA WSDOT source data from the 1/7/09 HI-RUN Model Documentation. WSDOT hasn't yet vetted the data set through a formal QA/QC process. During development of annual loading estimates, apparent discrepancies were noted in the data. If discrepancies are valid, source data and loading rate estimates will be reevaluated.

Table 2: Example table for estimating annual pollutant loads using *Method 1*.

	No-build	Alternative 1	Alternative 2
Treated Highway (acres)	0	7	12
Untreated Highway (acres)	20	15	13
Total Highway (acres)	20	22	25
Annual load of Total Suspended Solids (Lbs./year)	15,378	12,147	11,048
(% Change)	**0**	**-21**	**-28**
Annual load of Total Copper (Lbs./year)	3.2	2.7	2.5
(% Change)	**0**	**-16**	**-19**
Annual load of Dissolved Copper (Lbs./year)	0.7	0.7	0.8
(% Change)	**0**	**-0.4**	**7**
Annual load of Total Zinc (Lbs./year)	19.5	16.1	15.1
(% Change)	**0**	**-18**	**-22**
Annual load of Dissolved Zinc (Lbs./year)	6.1	5.6	5.7
(% Change)	**0**	**-9**	**-8**

If multiple drainage basins will be affected by stormwater from the proposed project alternatives, modify Table 2 or provide additional tables showing how many acres will be impacted in each basin by each alternative. Once the acreages are known for each basin, repeat the above instructions to compare the affects of each alternative on each basin in addition to the overall project total.

Some disadvantages of ***Method 1*** are that it doesn't take into account the changes in pollutant loads due to conversion of previously developed lands. Some land conversions, like replacing commercial land with highways, can result in a net reduction in stormwater pollutants. Accordingly, ***Method 1*** should be limited to projects that don't include significant conversions of other land uses to highways.

Method 2: Application of Literature Values.

The second method uses data, largely collected in the Pacific Northwest in the 1980's, from a variety of land uses to generate pollutant loading estimates (Horner, 1992). Table 3 summarizes the range of pollutant yields measured from varying land uses. This method is a very general estimating method and should be noted as such in the methods and discussion sections of a Discipline Report.

An advantage of this method is the ability to capture changes in pollutant loads associated with the conversion of developed areas, like commercial or residential lands into highways. Disadvantages associated with this method are: (1) the data is over 19 years old, and (2) the "road" pollutant estimates are based on a variety of road types and not exclusively on highways. Because the data doesn't specifically represent highway runoff, use ***Method 1*** to calculate the loads from treated and untreated highways. The values for "road" in Table 3 estimate pollutant loading of other roadways (county or city streets, etc.) and should be used to estimate pollutant loads for a project that will convert other roadways (county or city streets, etc.) into WSDOT highway in order to characterize the change in pollutant loading between the two types of roadway.

Table 3: Annual Pollutant Loading Rates by Land Use

Land Use	Yield Estimate Basis[1]	Total Suspended Solids	Total Zinc	Total Copper
Road[2]	Median	447	0.28	0.05
Commercial	Median	717	2.94	1.87
Single Family Low Density	Median	178	0.12	0.16
Single Family High Density	Median	287	0.20	0.27
Multifamily Residential	Median	396	0.30	0.45
Forest	Median	77	0.02	0.03
Grass	Median	308	0.09	0.03
Pasture	Median	306	0.09	0.03

[1] All units are in Lbs/year•acre. These values were converted from kilograms/year•hectare in the original study's table. Table 3 incorporates a subset of information that was provided by the original study. Only pollutants comparable to those contained in Table 1 have been included here.

[2] Values estimate the pollutant loading of other roadways (county or city street, etc.). These values should only be used when non-highway roads are being converted into highway. To calculate WSDOT highway pollutant loading use values from Table 1.

Reference: Horner 1992.

This method is fairly straightforward to apply. Estimate the number of acres of land that will be contributing to the point of interest (e.g., a stormwater facility or receiving water) and multiply the area by the values in Table 3 for the pollutants of interest. For example, the calculation for the median annual load of total suspended solids (TSS) from an untreated 10 acre commercial lot is as follows:

- Median annual TSS load = (717 lbs/year•acre)(10 acres) = 7,170 lbs/year.

Repeat the above calculation for each area subject to applicable land uses in Table 3 other than highways. Use values from ***Method 1*** for treated and untreated highway surfaces. Add the annual loads for each land use area to produce total loads for each alternative as shown in Table 4. Then calculate percent change.

Table 4: Example table for developing annual pollutant loads for comparison of project alternatives

	No-build	Alternative 1	Alternative 2	Alternative 3
Untreated Highway(acres)	50	100	0	50
Treated Highway (acres)	0	0	100	20
Multi-family residential (acre) **Note: Median value used**	25	0	0	5
Commercial (acres) **Note: Median value used**	25	0	0	25
Total project area	100	100	100	100
Annual load of Total Suspended Solids (Lbs./year)	66,275	76,900	8,800	60,115
(% Change)	**0**	**16**	**-87**	**-9**
Annual load of Total Copper (Lbs./year)	66.0	16.0	4.0	57.8
(% Change)	**0**	**-76**	**-94**	**-12**
Annual load of Total Zinc (Lbs./year)	130.0	98.0	21.0	128.2
(% Change)	**0**	**-25**	**-84**	**-1**

If multiple drainage basins will be affected by stormwater from the proposed project alternatives, modify the project's version of Table 4 or provide additional tables showing how many acres will be impacted in each basin by each alternative. Once the acreages are known for each basin, repeat the above instructions to quantify the affects of each alternative on each basin in addition to the overall project total.

References

Driscoll, E., P.E. Shelley, and E.W. Strecker, 1990. *Pollutant Loadings and Impacts from Highway Stormwater Runoff, Volume III: Analytical Investigations and Research Report*. FHWA RD-88-008. Federal Highway Administration, Woodward-Clyde Consultants, Oakland, California.

Horner, R.R. 1992. Water quality criteria/pollutant loading estimation/treatment effectiveness estimation. In R.W. Beck and Associates. *Covington Master Drainage Plan*. King County Surface Water Management Division., Seattle, Washington.

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