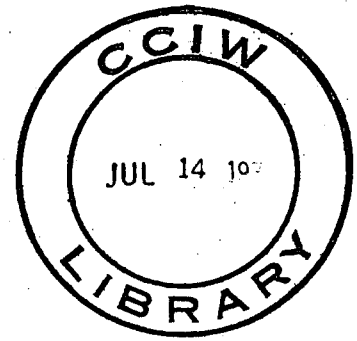


HYDRAULICS RESEARCH DIVISION  
Technical Note



**DATE:** May 1978      **REPORT NO:** 78-02(A)  
(Addendum)

**TITLE:** "Annual Unit Pollutant Loads in Urban Runoff and Combined Sewer Overflows"

**AUTHOR:** J. Marsalek

**REASON FOR REPORT:**

Written at the request of Dr. M. G. Johnson, Regional Director, Fisheries & Marine Service, Ontario Region.

This is an addendum to the Technical Note 78-02 entitled "Overview of Annual Unit Pollutant Loads for Urban Runoff and Combined Sewer Overflows".

**CORRESPONDENCE FILE NO:**

1135-J2-2-3

The Hydraulics Research Division has been requested to provide estimates of annual unit pollutant loads in storm water and combined sewer overflows. Such loads were presented for various land use and several basic constituents in a previous technical note [1] (HRD Technical Note No. 78-02). Several recommendations on further refinement of these loads and their use in PLUARG modelling activities were also given in Technical Note 78-02. Following discussions with PLUARG researchers, these recommendations were somewhat amended and adopted as the terms of reference for this addendum to the original technical note (78-02). A brief summary of the terms of reference follows:

- (1) Propose a simplified system for land use classification.
- (2) Establish annual unit loads for additional constituents.
- (3) Provide a revised pollutant loads table which would incorporate items (1) and (2).

## 2.0 LAND USE CLASSIFICATION

In the Technical Note HRD 78-02, a conventional land use classification was adopted. According to this classification, the following types of land use were considered:

- (a) Residential (low, medium and high density)
- (b) Commercial
- (c) Industrial
- (d) Other developed

This conventional land use classification was found inappropriate for PLUARG modelling activities because of the following reasons:

- (1) The conventional classification was not fully compatible with the land use data available to the PLUARG researchers.
- (2) The conventional classification did not fully reflect the potential of various land uses to contribute to pollutant loadings in urban runoff. For example, in the conventional classification, low-nuisance non-manufacturing industrial activities fall into the same category as hazardous or noxious industrial activities.

Consequently, an amended classification of urban land use is proposed below. Basically, four types of land use are considered.

### Land Use Group 1

This type of land use contributes relatively low pollutant loads. Among typical land uses included in this group, one could name low and medium density residential land use, and limited-nuisance industrial activities (wholesale, warehouses).

### Land Use Group 2

This type of land use generates intermediate pollutant loads. Typical land use included in this group are high density residential (~ 50 people/acre), and commercial land use.

### Land Use Group 3

This type of land use contributes the highest pollutant loads. Typical land uses included in this group are medium and high intensity industrial land use.

#### Land Use Group 4

This type of land use contributes very low pollutant loads. Typical land uses which belong to this group are parks, playgrounds, etc.

Finally, a mention should be made of newly developed urban land. This stage of land development is characterized, for all land uses, by high production of suspended solids because of soil erosion. If no erosion prevention measures are taken during the development, the suspended solids loads should be increased for all newly developed urban land up to 1500 lbs/acre/year. For other constituents, the loads from new developments may be taken as identical to those for the established areas.

### 3. POLLUTANT LOADS FOR SELECTED METALS

The previous technical note dealt with four basic constituents: Biochemical Oxygen Demand (BOD), Nitrogen (N), Phosphorus (P), and Suspended Solids (SS). In addition to these basic constituents, other constituents were identified for further study and their loads are given in this note. In particular, the following additional constituents were studied: Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel (Ni), Lead (Pb), and Zinc (Zn).

Only limited data on metal loads in urban runoff were found. These data were collected in two test catchments. The first catchment, known as the Malvern catchment\*, represents a modern residential area which is served by storm sewers. The Malvern loads were adopted as typical loads for storm water and the land use group 1; for other land uses, these loads were corrected by means of the coefficients which were given in the APWA report [2]. These coefficients are listed below; the unit loads are given in Table A.

#### APWA Correction Coefficients [2]:

$$L_2 = 1.10 L_1 \quad L_3 = 1.71 L_1 \quad L_4 = 0.14 L_1$$

where  $L$  is the unit pollutant load (lbs/acre/year), subscripts 1-4 refer to the land use groups described in the preceding subsection.

For areas served by combined sewers, the data from the Hamilton test catchment were used [3]. The Hamilton test catchment\*\* represents an older residential area which is served by combined sewers. Considering combined sewage as a mixture of sanitary sewage and storm water, pollutant concentrations in combined sewage were estimated as weighted averages of concentrations observed in sanitary sewage and in storm water. Pollutant loads were then determined for appropriate flow volumes and taken as the loads which correspond to the land use group 1. For other land uses, the APWA correction coefficients (listed above) were again applied. The final loads are given in Table A.

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\* Malvern Catchment was established and operated by the Hydraulics Research Division of the National Water Research Institute (NWRI).

\*\* Hamilton Catchment was established and operated under a contract commissioned by the Hydraulics Research Division (NWRI) to Gore & Storrie, Ltd.

#### 4.0 REVISED POLLUTANT LOADS

Annual unit pollutant loads are given in Table A for eleven selected constituents and four land use groups. For the basic four constituents (BOD, N, P, and SS), the loads in Table A are more or less identical to those recommended in the previous note (see HRD Technical Note 78-02, Table 5). For the remaining constituents, new loads were developed for this note.

As stressed before, the loads in Table A should be considered as first-level estimates which are likely to contain large uncertainties.

#### 5.0 REFERENCES

1. Marsalek, J. "Overview of Annual Unit Pollutant Loads for Urban Runoff and combined Sewer Overflows". Technical Note No. 78-02, Hydraulics Research Division, National Water Research Institute, Burlington, January 1978.
2. Sullivan, R. H., Hurst, W. D., Kipp, T. M., Heaney, J. P., Huber, W. C., and Nix, S. "Evaluation of the Magnitude and Significance of Pollution Loading from Urban Stormwater Runoff - Ontario". A contract report commissioned by the Urban Drainage Subcommittee to the American Public Works Association, July 1977.
3. Gore & Storrie, Ltd. "Hamilton Test Catchment - Progress Report". A draft report submitted to the Hydraulics Research Division, National Water Research Institute, 1977.

TABLE A ANNUAL UNIT POLLUTANT LOADINGS IN LBS/ACRE/YEAR

Sewerage System	Constituent	Land Use Group 1 [1]	Land Use Group 2 [2]	Land Use Group 3 [3]	Land Use Group 4 [4]
Storm Sewers	BOD	30.0	80.0	30.0	1.0
	N	8.0	10.0	7.0	.2
	P	1.4	3.0	2.0	.04
	SS	350.0	500.0	600.0	10.0
	Cd	.012	.013	.021	.002
	Cr	.023	.025	.039	.003
	Cu	.040	.044	.069	.006
	Hg	.034	.038	.058	.005
	Ni	.026	.029	.045	.004
	Pb	.140	.155	.240	.020
	Zn	.510	.563	.874	.072
Combined Sewers	BOD	120.0	262.0	100.0	1.4
	N	28.1	32.6	30.8	1.0
	P	9.1	10.2	9.7	0.3
	SS	690.0	600.0	660.0	10.0
	Cd	.014	.015	.024	.002
	Cr	.025	.028	.043	.003
	Cu	.057	.063	.097	.008
	Hg	.038	.042	.065	.005
	Ni	.030	.033	.051	.004
	Pb	.145	.160	.247	.020
	Zn	.571	.628	.971	.080

[1] Land Use Group 1 - Low-to-medium density residential, light industry

[2] Land Use Group 2 - High density residential, commercial

[3] Land Use Group 3 - Industrial land

[4] Open land - parks, etc.

Note: For newly developed urban land, increase the SS-loadings to 1500 lbs/acre/year for all the land uses.