

## **Mobilization of heavy metals in highway runoff with medium average daily traffic. Study of a pilot catchment in Galicia (Spain).**

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### **Introduction**

The overall aim of the EU Water Framework Directive (WFD, 2000/60/EC) is the protection and enhancement of all water resources in the European Union. The WFD requires that member states estimate and identify significant pollution sources and take action to limit these emissions if they are considered to be harmful. The "Common Implementation Strategy for the Water Framework Directive (2000/60/EC) - Guidance Document No.3 - Analysis of Pressures and Impacts" established the highway runoff as significant pressures. It establishes the need to characterize the pollutants, especially hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), lead and herbicides. This type of contaminated flows are unregulated in Spain (other European countries have regulations) and the problem is still ignored.

The pilot study is developed to assess the contamination of runoff from highways in the northwest of Spain. This region is characterized by a temperate climate, about 1300 mm of precipitation per year and about 130 wet weather days per year. The results obtained are trying to show the problem and allows the comparison with studies from other countries. The study will also assess if the legislation from other countries is valid for this region of Spain.

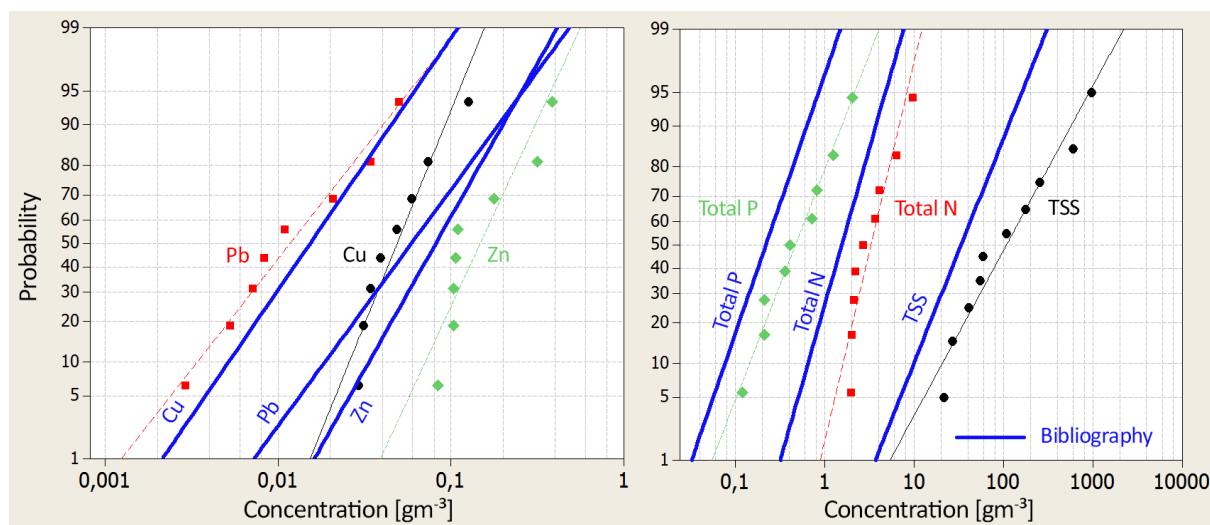
The pilot basin characterized is part of N-651 Road (Fene Municipality, A Coruña, Galicia - Spain). The road is set to 4 lanes and it has an area of 4.46 ha (runoff coefficient 0.8). Runoff is discharged to the Ferrol estuary, classified as "sensitive" under Directive 91/271 of the EU. ADT is 19,000 vehicles per day and it has pavement with asphalt aggregate.

### **Methodology**

The work began with an intensive review of the international literature and regulations on pollution runoff from highways and roads. In the pilot basin was installed a control section (area-velocity flow meter, autosampler, GPRS communication system, rain gauge). 11 rain events were characterized. On these events were measured hyetographs, hydrographs and pollutographs (between 5 and 12 single samples per event). In each of the simple samples were measured conventional pollutants (BOD<sub>5</sub>, COD, TSS, TDS, TS, nitrogen forms, phosphorus forms), heavy metals (particulate and dissolved fractions), hydrocarbons and bacteriological contamination (FC, TC, E coli).

An assessment of the mobilized contamination has been done and the results have been compared with literature values. Relations between particulate and dissolved forms of heavy

metal mobilized were analyzed. Concentrations and masses (in each event and during a year) with different predictive models (SETRA, 2006; Kayhanian, 2007, Bannerman, 1991) have been compared.



**Figure 1.1** Comparison between values from different European studies (Hvitved-Jacobsen, 2010) and the values obtained in the pilot basin Fene (Spain). Percentage probability that concentration is less than the indicated value

## Conclusions

The measured fluxes have very significant pollution loads and must be controlled and treated to avoid their impact on the natural environment and it is necessary to develop control legislation in Spain has been reaffirmed. The data obtained show a runoff with medium-high pollution when they are compared with other references. The measured fluxes clearly represent and important impact.

Note are the low concentrations of lead measures, justified by its elimination in fuels, and higher values in copper concentrations.

Predictive models have not provided values close to those measured data, neither concentrations nor annual charges. It is necessary to continue checking the literature on predictive models of European countries with similar climatic conditions.

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## References

- Bannerman, R. (1991). Pollutants in Wisconsin stormwater, unpublished report by the Wisconsin Department of Natural Resources, Madison, WI.
- Kayhanian, M., Suverkropp, C., Ruby, A., Tsay, K. (2007). Characterization and prediction of highway runoff constituent event mean concentration. *Journal of Environmental Management*, Volume 85, Issue 2, October 2007, Pages 279-295.
- SETRA (2006). Calcul des charges de pollution chronique des eaux de ruissellement issues des plates-formes routières. s.l. Service d'Études Techniques des routes et autoroutes. France.
- Hvitved-Jacobsen, T., Vollersen, J., Haaning, A. (2010). Urban and highway stormwater pollution. Concepts and Engineering. CRC Press, ISBN 978-1-4398-2685-0.