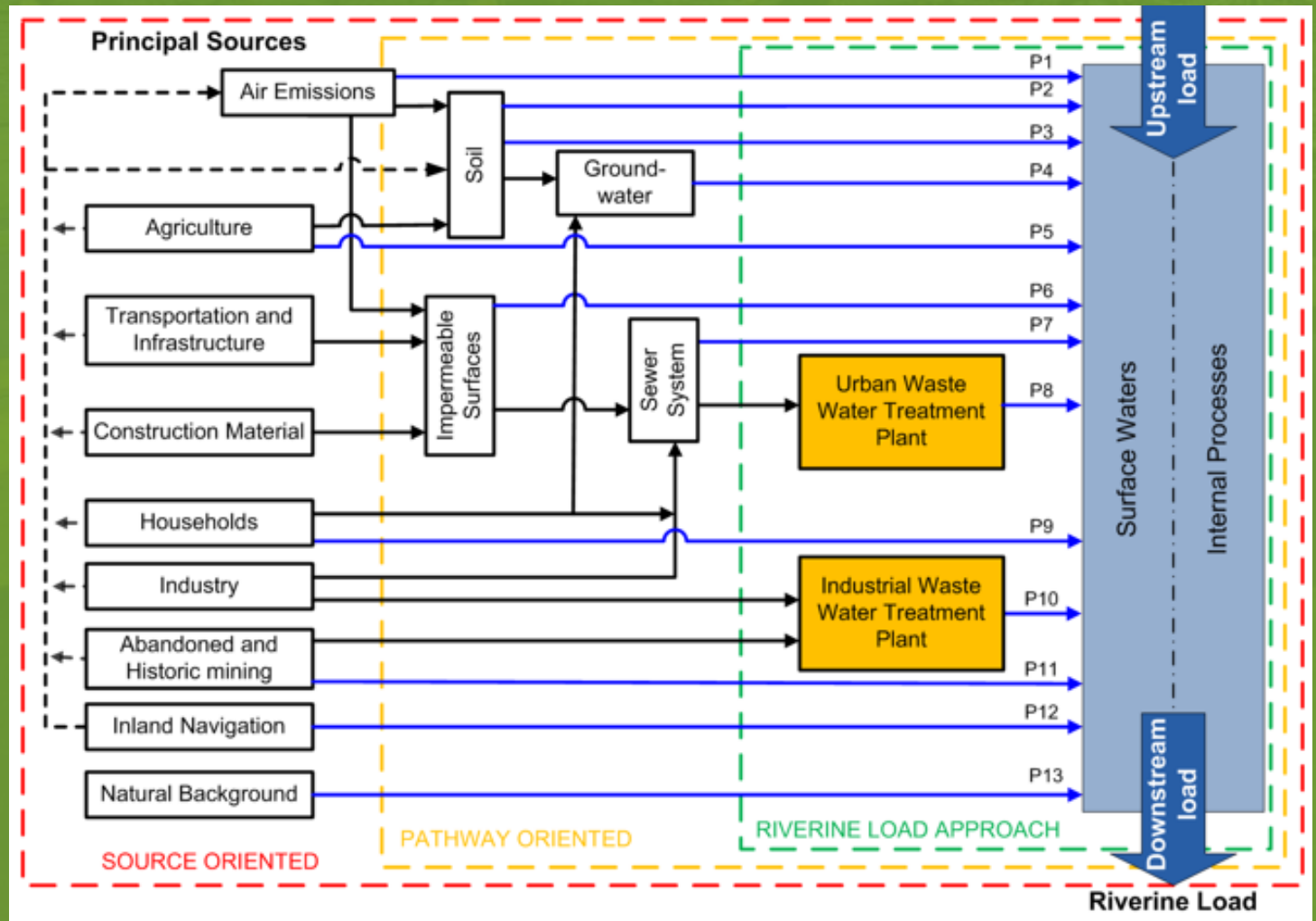


DIFFUSE SOURCES OF METALS TO THE AQUATIC ENVIRONMENT

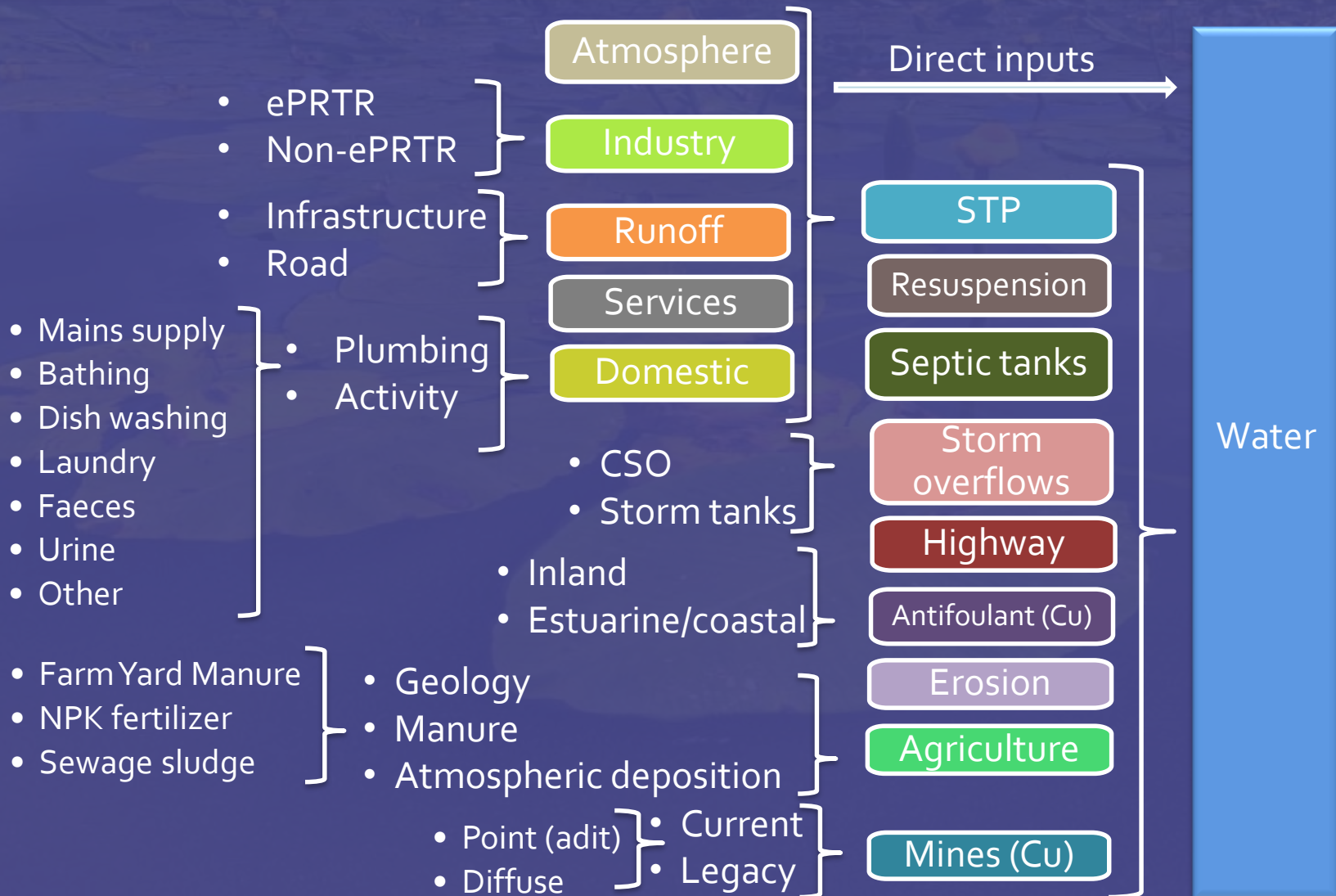
Sean Comber WRA, Geneviève Deviller DERAC,
Adam Peters, Iain Wilson, Graham Merrington wca



A source oriented approach – maps similar to Deltares approach



Diffuse sources to water (metals- Cu, Cd, Ni, Pb)

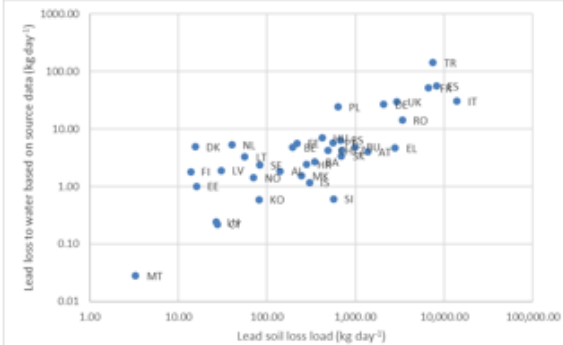
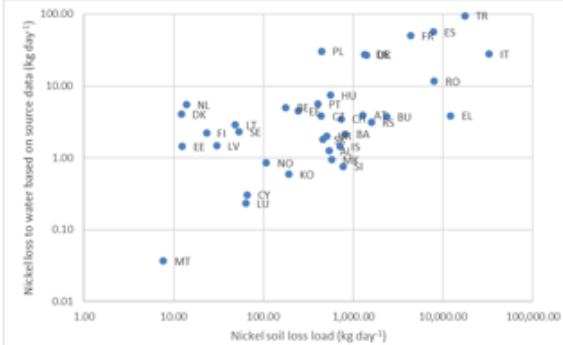
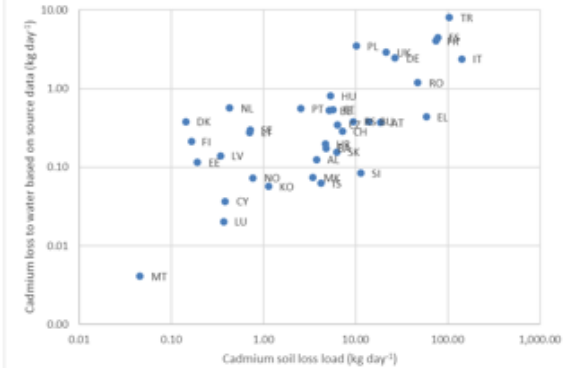


- Concentration data – metals in manures, biosolids, NPK, soil
 - » Open literature
 - » Scientific literature
 - » Gov/EU reports
- Databases – Eurostat etc
 - » Fertiliser use
 - » Animal numbers (pigs, sheep, cattle, poultry – weight)
 - » Land use (agriculture, inland water, urban, and arable split)
 - » Biosolid use
 - » Soil loss
 - » Annual rainfall
 - » Atmospheric deposition (EMEP)

Metal loss from soil



- Based on Cu/Zn modelling data (IDMM etc)
 - » Inputs, leaching, plant uptake, mineralisation
- Extrapolated to other metals via use of soil:water partition coefficients from literature
- Cu, Cd, Ni = 9%, Pb = 8%, Zn = 10%



Septic tanks – many assumptions



- Inputs based on per capita crude sewage
- Efficiency of removal of treatment
- Drainage field serviceability
- Slope to water body
- Soil type
- Distance to water body

Septic tank factors – e.g. Cu



Variable	Method	Comment	Scaling ¹
Removal efficiency	Currently provided for by 'good', 'moderate' and 'poor' providing factors in table below	Varies according to substance	Fractional transmission: G = 0.8 M = 0.9 P = 1
Distance	The EA database provides a distance from septic tank to nearest water body. An exponential 'decay' factor has been applied, taking account of a specified distance where influence is reduced by 50%.	The specified 'half distance' may be varied and is currently arbitrary.	Fractional transmission: G = 0.5 M = 0.7 P = 1
Slope to watercourse	Fixed via PSYCHIC output 1km grid data for slope based on digital terrain data	Probably as good as required	Fractional transmission: G = 0.8 M = 0.9 P = 1
Soil type/permeability	Fixed via PSYCHIC output 1km grid data for soil type	Probably as good as required	Fractional transmission: G = 0.8 M = 0.9 P = 1
Drainage field serviceability	Expert judgement		Fractional transmission: G = 0.8 M = 0.9 P = 1
Overall transmission factor			0.41

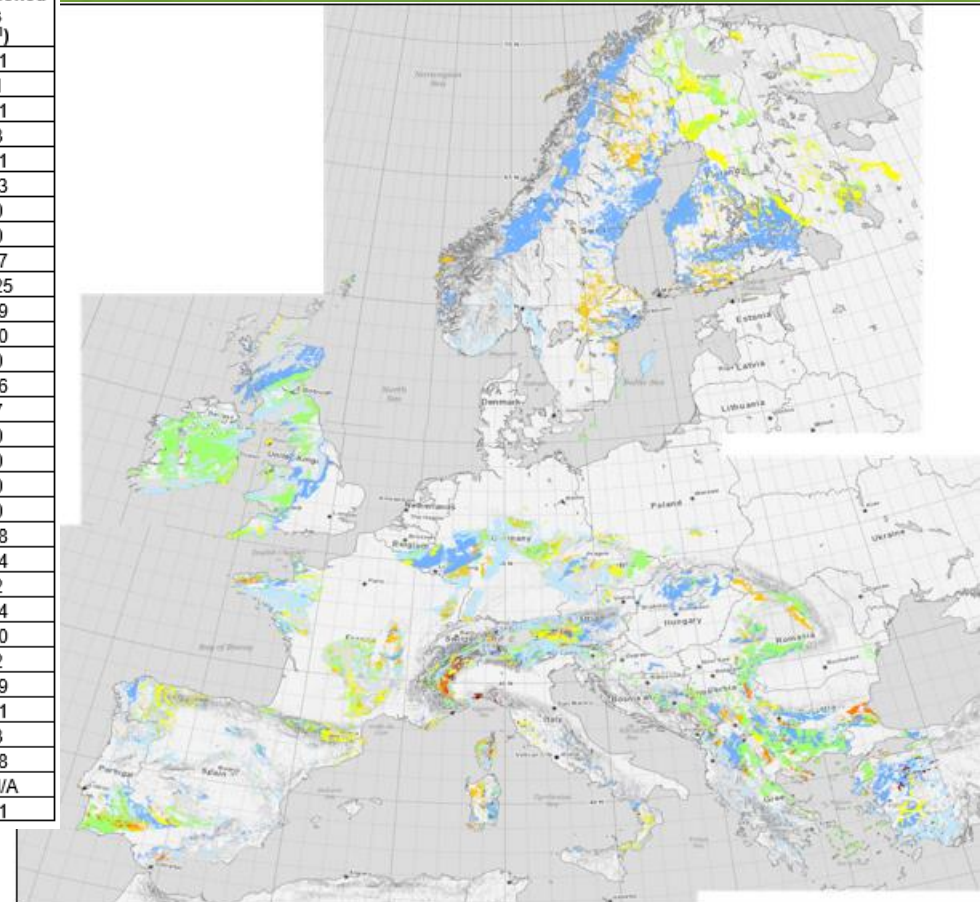
¹ bold = value used for this assessment

Abandoned mine sources – Promine occurrence data



Copper load estimated from abandoned mines with extracted copper data from mines (2012) for comparison

Country	Total Area (km ²)	Abandoned mine loads (kg/d)	2012 mined (tonnes)	Area as a ratio based on favourability score (yellow, green, red)	Possible mineralised areas (km ²)	Estimated Cu input per km ² of mineralised area (kg d ⁻¹ km ⁻²)	Cu load to water from abandoned mines (kg d ⁻¹)
Austria	88945			0.15	13342		61
Belgium	30158			0.01	302		1
Bulgaria	110993.6		118255	0.1	11099		51
Croatia	56594			0.01	566		3
Cyprus	9250		4328	0.5	4625		21
Czech Republic	78866			0.12	9464		43
Denmark	43094			0.001	43		0
Estonia	45226			0.001	45		0
Finland	338000		25446	0.05	16900		77
France	550000			0.05	27500		125
Germany	356854	38		0.03	10706	3.6E-03	49
Greece	131957			0.05	6598		30
Hungary	93030			0.001	93		0
Ireland	70000			0.3	21000		96
Italy	301263			0.005	1506		7
Latvia	64589			0	0		0
Lithuania	65200			0	0		0
Malta	316			0	0		0
Netherlands	41864			0	0		0
Norway	385203			0.01	3852		18
Poland	312685		427064	0.01	3127		14
Portugal	92072		74043	0.005	460		2
Romania	238391		5902	0.05	11920		54
Serbia	88361		32205	0.05	4418		20
Slovenia	20273			0.02	405		2
Spain	504782		97636	0.03	15143		69
Sweden	450000		82422	0.03	13500		61
Switzerland	41285			0.015	619		3
UK	242500	107		0.08	19400	5.5E-03	88
Macedonia	#N/A		9506	0.07	#N/A		#N/A
Turkey	783562		101700	0.02	15671		71



Likelihood of copper mineralisation (EGDI, 2020). Red = high, through orange, yellow, green to blue =low).

Summary of estimated EU27 diffuse loads of Cd, Ni and Pb compared with point source data generated from other reported



Loading (kg/d)		to soil Cd	to water Cd	to soil Ni	to water Ni	to soil Pb	to water Pb
ePRTR	Soil background		521		73803		43800
	Industrial ¹		4.73		63		30.4
ePRTR	STP		8.27		179		46.7
ETAP	STP ²		32		668		n/a
	Agriculture Total	271	27	2938	292	3452	301
	Septic tank		2		16		37
	Lost lead sinkers ³		#N/A		#N/A		11
	Lead ammunition ³		#N/A		#N/A		4781
Agriculture break down	Sludge to land	10.5		208		395	
	NPK fertilisers	29		53		13	
	FYM fertilisers cows	11		187		136	
	FYM fertilisers pigs	3.3		84		48	
	FYM fertilisers sheep	2.8		0.96		63	
	FYM fertilisers goats	0.13		0.2		0.2	
	FYM fertilisers poultry	128		1116		815	
	Atmospheric deposition on agricultural land	86		1289		1982	

¹ Load to water not including wastewater treatment plant inputs reported below

² Data provided from Comer et al., 2021 in preparation

³ Data from Arche Consulting (2020) Pb emission inventory for the environment. Final Report, 3/12/2020. Ferencz N., Eliat M. and Verdonck F.