Metal Concentrations in Sediments within Restored and Unrestored London Rivers

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1. Introduction

• Restoration practices alter the hydraulic and physical conditions within rivers making them favourable to sediment accumulation and in-channel vegetation growth.

• Sediments act as stores for various contaminants including metals, with the extent of metal storage dependent upon various sediment characteristics including grain size and organic matter.

• Sediment associated contaminants can have detrimental impacts upon ecology and water quality.

• This research considers how restoration practices affect sediment storage and hence contaminant storage and potential ecosystem health.

2. Methods

• Research was undertaken on the River Quaggy, an urban river in South London.

• The restored stretch was in Sutcliffe Park (restored 2004) and the unrestored stretch downstream.

Restored

Unrestored

• Fieldwork was undertaken in August 2010 and comprised: mapping and classification of bed sediment types, surface sediment collection, sediment pH and porewater collection.

• Sediment samples were analysed for: organic matter, particle size (% <63µm) and metals (Al, Cr, Cu, Fe, Mn, Ni, Pb, Zn).

• Porewater samples were analysed for Fe (II) concentrations as a proxy for redox.

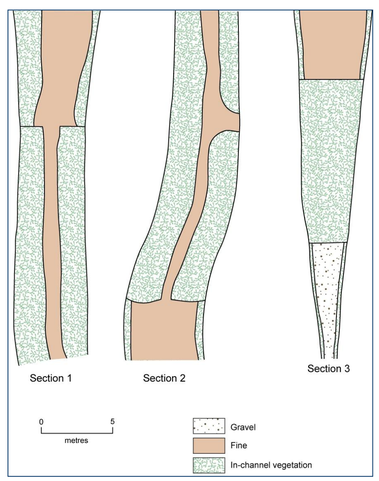
3. Results

Bed sediment type patterns

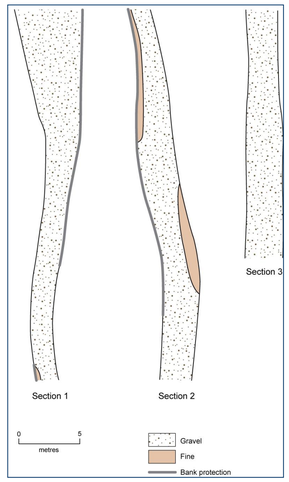
• The dominant bed sediment types in the restored stretch were fine and sediment around in-channel vegetation. In the unrestored stretch it was gravel.

• Sediment around in-channel vegetation was only present in the restored stretch.

• Some bank protection was present in the unrestored stretch.



Restored



Unrestored

Sediment characteristics in different bed sediment types

• There was no statistically significant difference in organic matter, % <63µm, pH and Fe (II) between restored fine and restored in-channel vegetation sediment (Mann-Whitney *U*-tests (MWU), *P* >0.05).

• Restored fine had statistically significant higher concentrations of organic matter and % <63µm (MWU, *P*<0.01) and lower pH (MWU, *P*<0.01) than unrestored fine.

• Restored gravel had statistically lower concentrations of organic matter (MWU, *P*<0.05) and higher % <63µm and pH (MWU, *P*<0.05) than unrestored gravel.

• Redox (Fe (II) concentrations) were not statistically significantly different between restored and unrestored fine or restored and unrestored gravel (MWU, *P*>0.05).

Restored Fine	Unrestored Fine	Restored Gravel	Unrestored Gravel
Organic Matter	Organic Matter	Organic Matter	**Organic Matter**
% <63µm	% <63µm	**% <63µm**	% <63µm
pH	**pH**	**pH**	pH
Redox	Redox	Redox	Redox

Metal concentrations

• Detectable concentrations of Al, Cr, Cu, Fe, Mn, Ni, Pb and Zn were found in all samples.

• There was no statistically significant difference in metal concentrations between restored fine and restored in-channel vegetation sediment (MWU, *P*>0.05).

• Restored fine had statistically significant higher concentrations of Al, Cr, Cu, Fe, Ni, Pb and Zn than unrestored fine (MWU, *P*<0.05).

• Restored gravel had statistically significant lower concentrations of Cu, Fe, Mn, Pb and Zn than unrestored gravel (MWU, *P*<0.05).

• Environment Agency draft sediment quality guidelines for Cr, Cu, Ni, Pb and Zn:

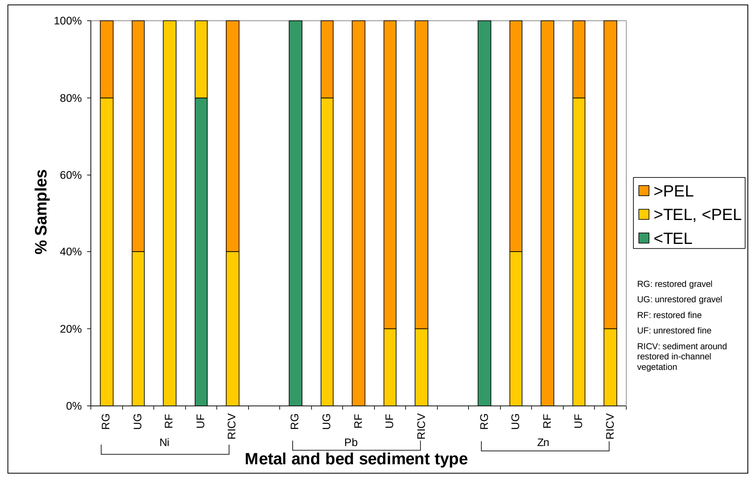
> 'Threshold Effect Level' (**TEL**): concentration below which metal is not considered a significant hazard to aquatic organisms.
>
> 'Predicted Effect Level' (**PEL**): lower limit of range of metal concentrations associated with adverse biological effects.

• TEL was exceeded for some samples for every metal.

• Greater exceedances occurred for Ni, Pb and Zn.

• Restored fine showed a greater % of samples exceeding guidelines than unrestored fine for every metal.

• Restored gravel showed a lower % of samples exceeding guidelines than unrestored gravel for every metal.



4. Discussion and Conclusion

This research has shown:

• There are different sediment storage patterns between the restored and unrestored stretch, with greater areas of fine sediment in the restored stretch as opposed to the unrestored stretch. This may be due to slower flows occurring within the restored stretch resulting in greater deposition of fine sediment.

• Different bed sediment types have different sediment characteristics and metal concentrations. Higher metal concentrations occur in the restored fine and the unrestored gravel as opposed to the unrestored fine and restored gravel**.** Relating the sediment characteristics of the bed sediment types to these metal concentrations suggests that organic matter may be the factor controlling metal storage within the sediments at this site.

Further work:

• Calculate total metal loadings within restored and unrestored stretches.

• Undertake similar analysis on other sites to see if similar differences occur.

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