



**Royal
HaskoningDHV**
Enhancing Society Together

Developing an evidence base for in situ contaminated sediment hazards in England

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In situ contaminated sediments

- In this context:

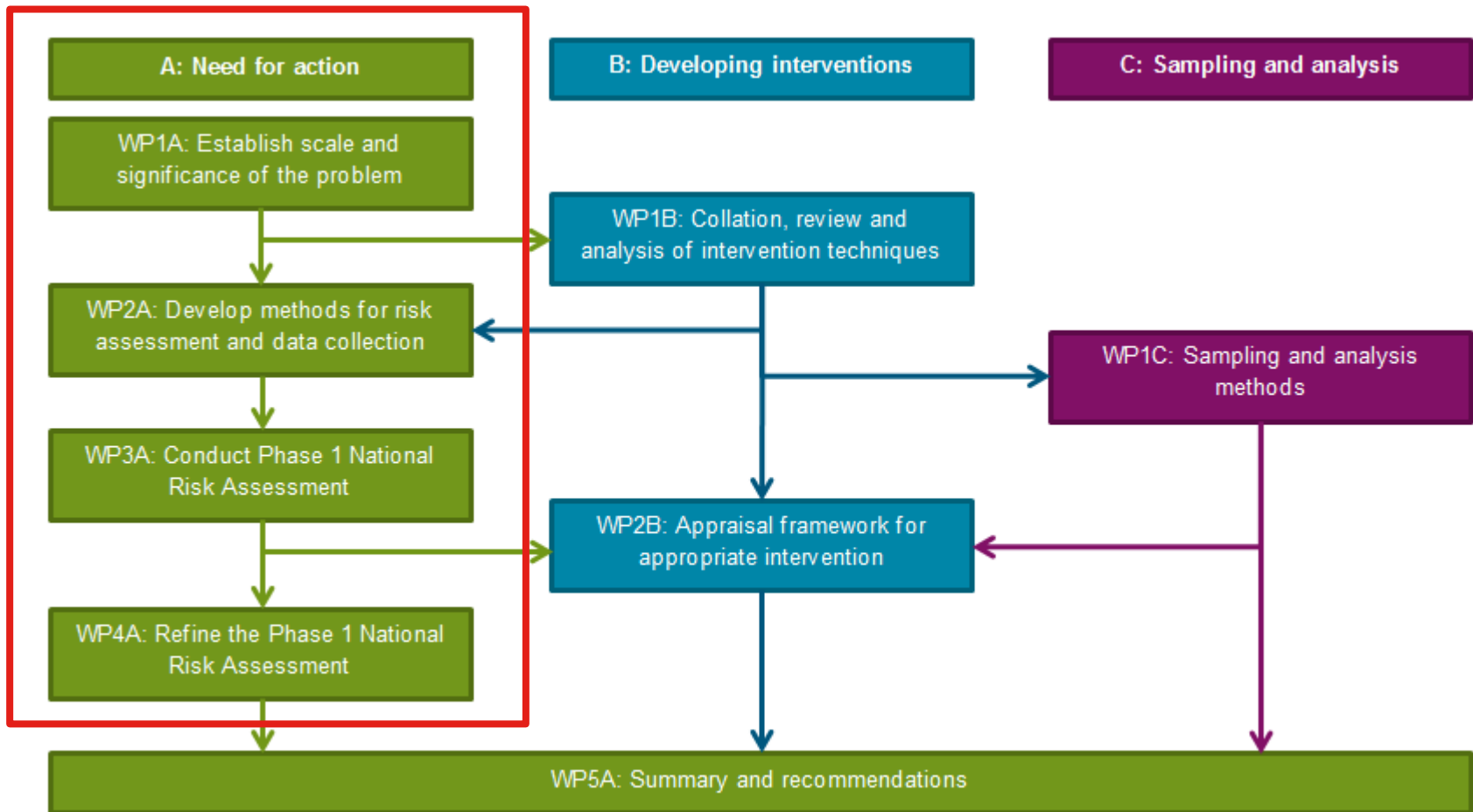
Chemically contaminated sediment within the water column, bed, banks and floodplain of a surface water body that has been transported alongside the normal sediment load and deposited by fluvial and coastal processes

- Project objective:

- Provide a sound evidence base on in situ contaminated sediments in England
- Underpin the development of tools to help regulators make evidence-based decisions



Project structure



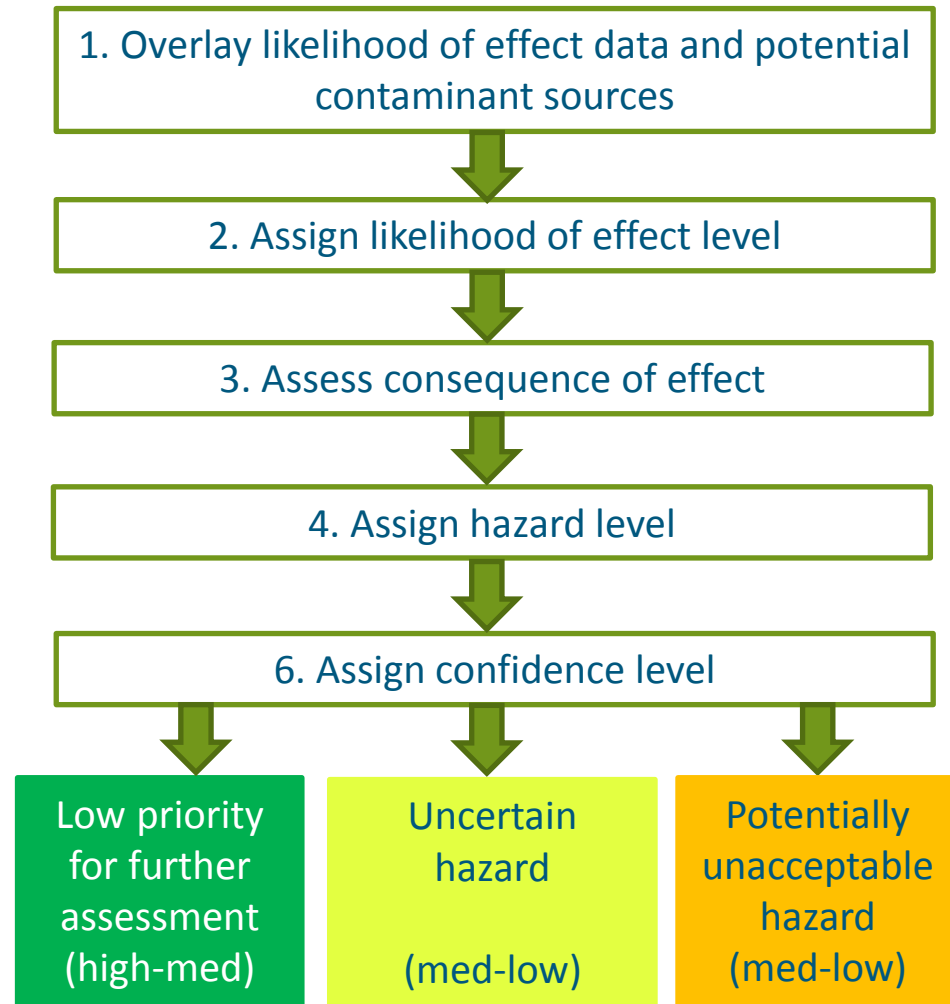
Conceptual model

- Comprehensive literature review
 - Conceptual model of contaminated sediment hazards
 - Identify potential datasets
 - Underpin national-scale hazard assessment



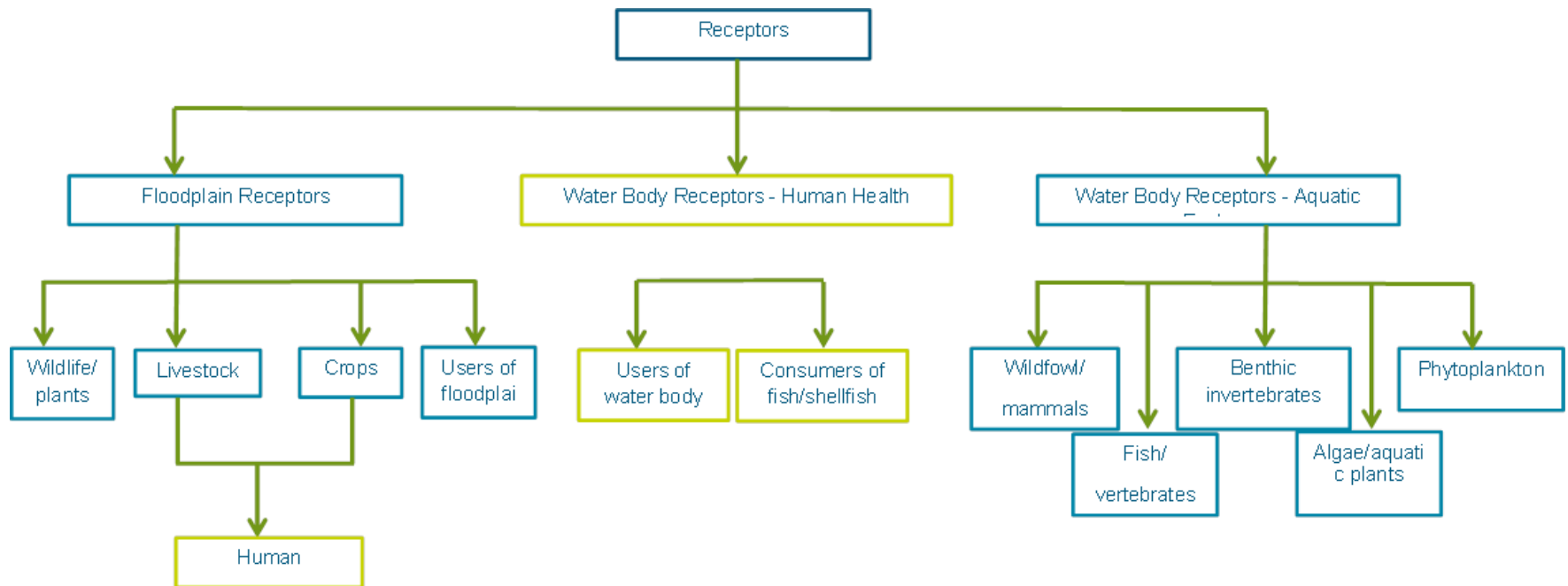
National hazard assessment

- GIS-based approach
 - 1km grid squares
 - Likelihood x Consequence = Hazard
 - Confidence based on uncertainties
- Use existing national datasets
 - Contaminant sources
 - Sediment quality
 - WFD classification
 - Catchment characteristics (hydrology, geomorphology)



National hazard assessment

- Three assessments
 - Potential hazards to aquatic receptors
 - Potential hazards to terrestrial receptors
 - Potential hazards from historical contamination (all receptors)

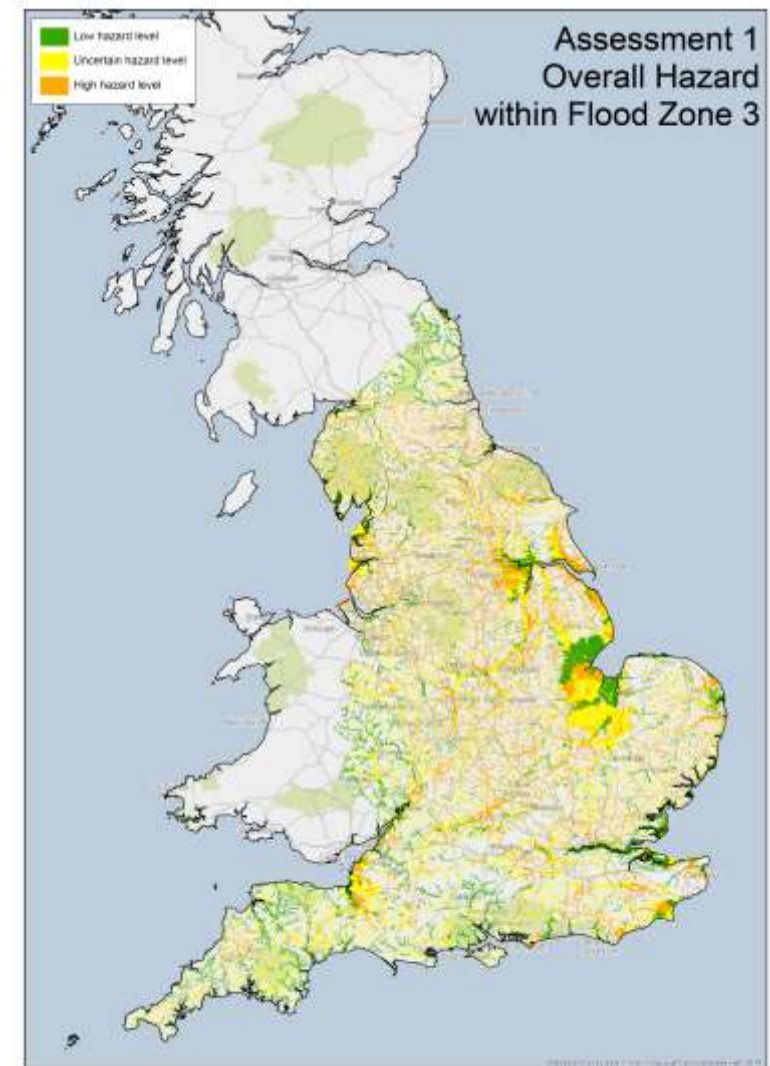


National hazard assessment

Assessment	Likelihood	Consequence
Aquatic receptors	<ul style="list-style-type: none"> • Sediment type (grain size) • Contaminant concentrations (compared to Cefas & Canadian SQGs) 	<ul style="list-style-type: none"> • WFD classification (benthic invertebrates & fish) • Protected area status
Terrestrial receptors	<ul style="list-style-type: none"> • Contaminants in surface soils • Contaminants in stream sediments 	<ul style="list-style-type: none"> • Grazing intensity (land use)
Historical contaminants	<ul style="list-style-type: none"> • Likelihood of erosion (river bank type, coastal erosion risk, presence of defences) • Likelihood of historical contamination (urbanisation & mining) 	<ul style="list-style-type: none"> • Response to rainfall (time to peak flow) • Climate change (UKCP09 median projection)

Results (national scale)

- Potential hazards to aquatic receptors
 - Large areas with at least one SQG failure, but hazards generally low
 - Hazards greater in urban areas and historically mined catchments
- Potential hazards to terrestrial receptors
 - Potential hazards where contaminants in stream sediments > floodplain soils
 - Urban areas and mined catchments
- Potential hazards from historical contamination
 - Hazards generally low
 - Higher in urban areas and mined catchments with medium (or greater) risk of erosion



Results (catchment scale)

- Examined results in more detail in selected catchments with detailed data
- River Swale, North Yorkshire
 - Long history of metal mining
 - High concentrations of Pb, Zn and Cd in stream and floodplain sediments
 - WFD failures in mined tributaries
- Potential hazards to aquatic and terrestrial receptors
 - High hazard in mined tributaries - expected
 - Lower hazard along main river – not expected
 - Reflects lack of evidence of biological harm (limited WFD failures)



Limitations

- Data limitations
 - Datasets do not always have national coverage
 - Inconsistent coverage of contaminants
 - Different analytical methods
 - Some data not available (historical contamination, industrial sites, landfills)

- Lack of suitable SQGs
 - Cefas Action Levels for dredging in marine environment
 - BUT no values for freshwater sediments
 - Canadian SQGs may not be suitable



**Canadian Sediment Quality
Guidelines for the Protection
of Aquatic Life**

Evidence of harm – is there a real hazard?

- National datasets do not consistently show that there is a significant hazard
 - WFD failures in some catchments
 - No failures in areas where database shows significant contamination
 - Data does not pick up on nuances, e.g. contamination in Swale not bioavailable due to pH buffering
- Literature does clearly demonstrate that contaminated sediments can be a hazard
 - Livestock grazing on contaminated floodplains
 - Ingest contaminated sediments following flooding
 - Metals in blood, PCBs in milk



Conclusions

- National assessment identified potential problem
 - Major urban centres and mined catchments
 - Low hazard levels elsewhere
- BUT no definitive evidence of harm or environmental impacts at a national scale
 - Extensive evidence of harm for some sources (e.g. historical metal mining, urban pressures)
 - Very little evidence for others
 - Data quality is a problem
- Hazards likely to be site specific and localised
 - Further investigations in catchments with uncertain or unacceptable hazard
 - Improved data to further refine and test the national hazard assessment process



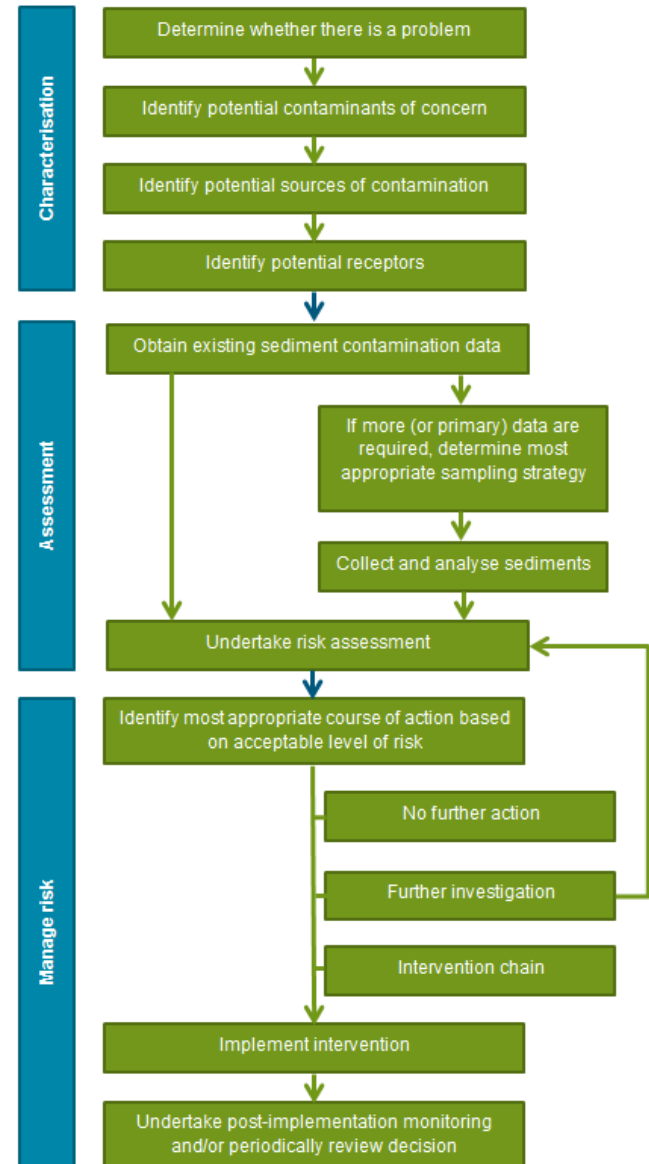
Recommendations

- Develop specific environmental quality guidelines or standards for sediments
 - Consistent “baseline” against which contaminant levels can be assessed

- Develop a standardised contaminated sediment assessment process
 - Consistent approaches to sampling and analysis
 - Improved data coverage

- Produce practical, user-friendly guidance
 - Consistent approaches to assessing and managing hazards

- Assess climate change risks
 - Increased cycling of contaminants
 - Long term problem



What next?

- Currently working on a guidance document for CIRIA
 - CIRIA Research Project 1037
 - Contaminated sediments: A guide for risk assessment and management
 - Due for publication early 2018



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CIRIA Research Project 1037

Contaminated sediments:

A guide for risk assessment and management

1st draft

Royal HaskoningDHV

June 2017

