RISK ASSESSMENT AND CONTROL APPROACHES FOR STORMWATER FLOOD AND POLLUTION MANAGEMENT

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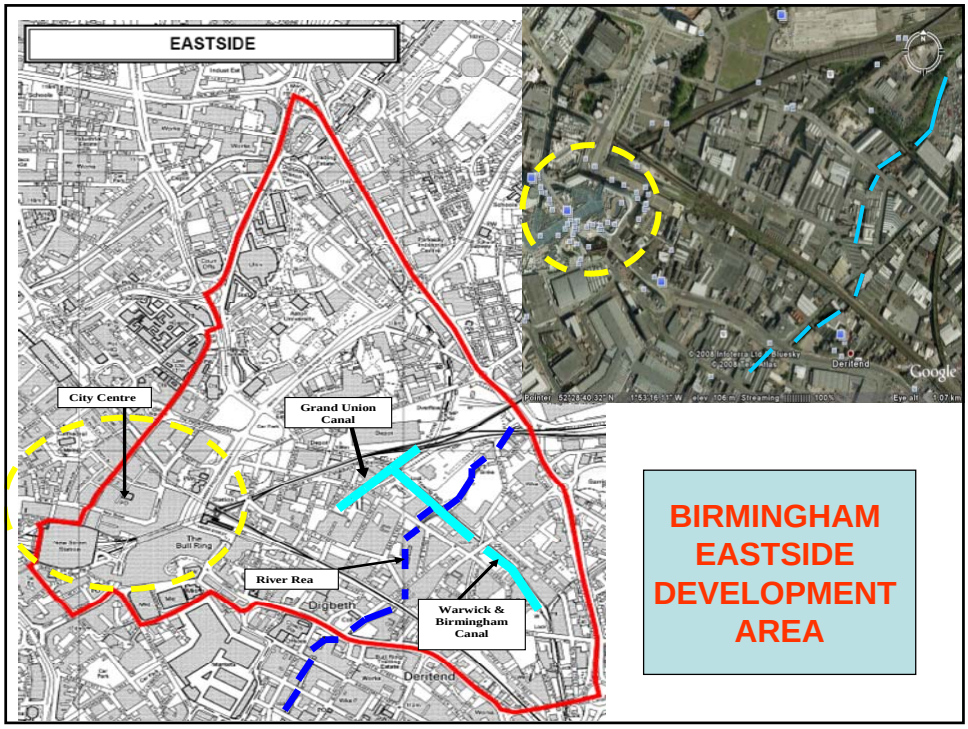
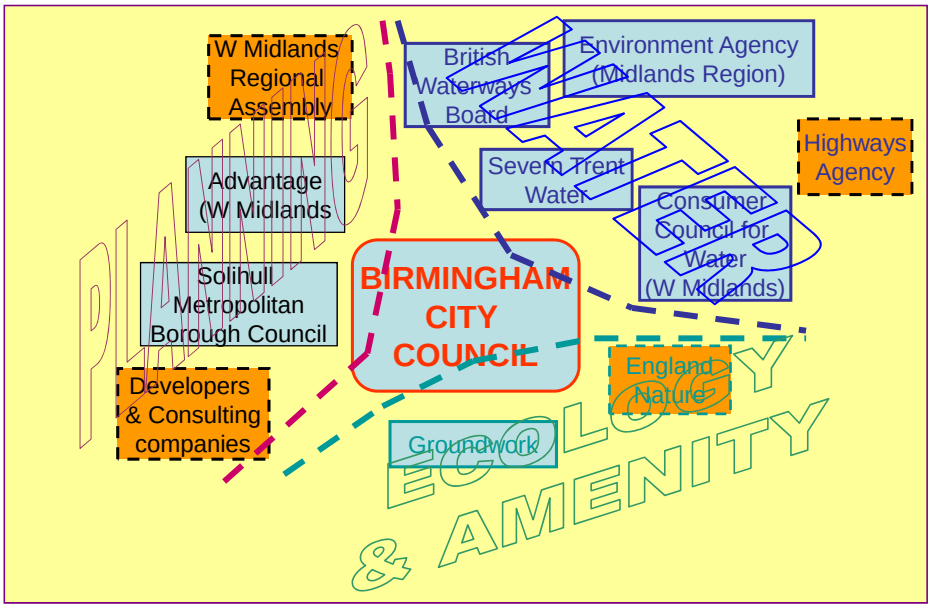
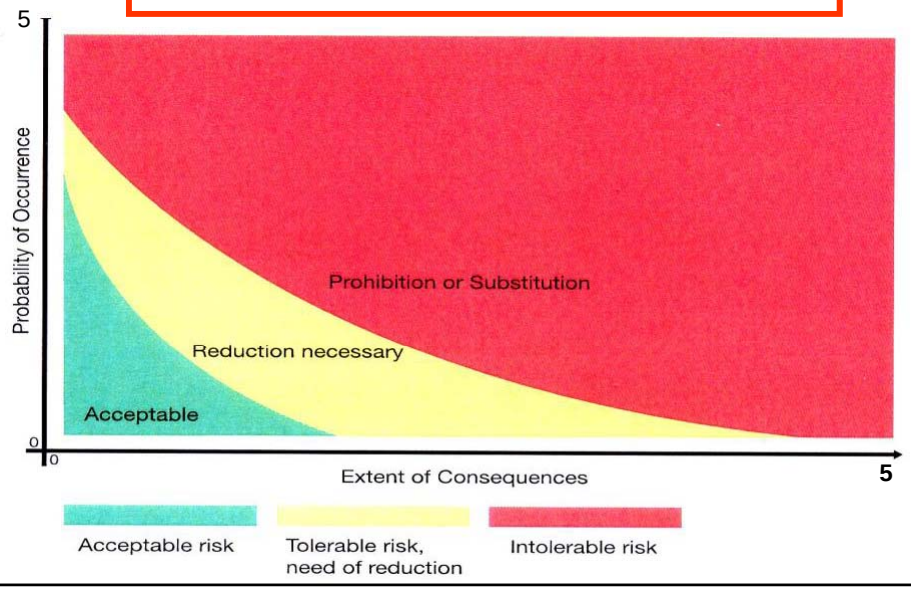
URBAN FLOOD, POLLUTION AND HABITAT RISKS



THE BIRMINGHAM LEARNING ALLIANCE (LA)



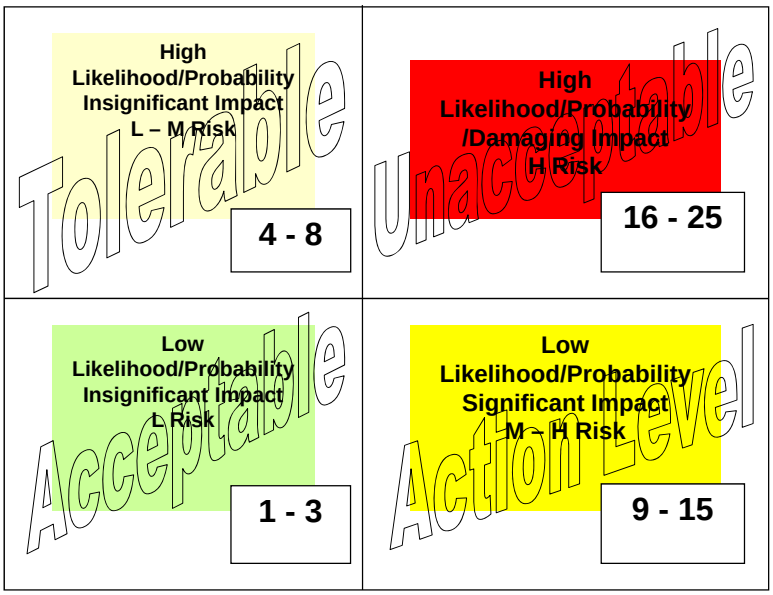
RISK CHARACTERISATION
THE TRAFFIC-LIGHT APPROACH



RISK MATRIX

LIKELIHOOD of OCCURRENCE		IMPACT SEVERITY/CONSEQUENCE				
		Insignificant (1)	Minor 2)	Significant (3)	Damaging 4)	Critical (5)
PROBABILITY	Very Low 1)	1	2	3	4	5
	Low (2)	2	4	6	8	10
	Medium (3)	3	6	9	12	15
	High (4)	4	8	12	16	20
	Very High (5)	5	10	15	20	25

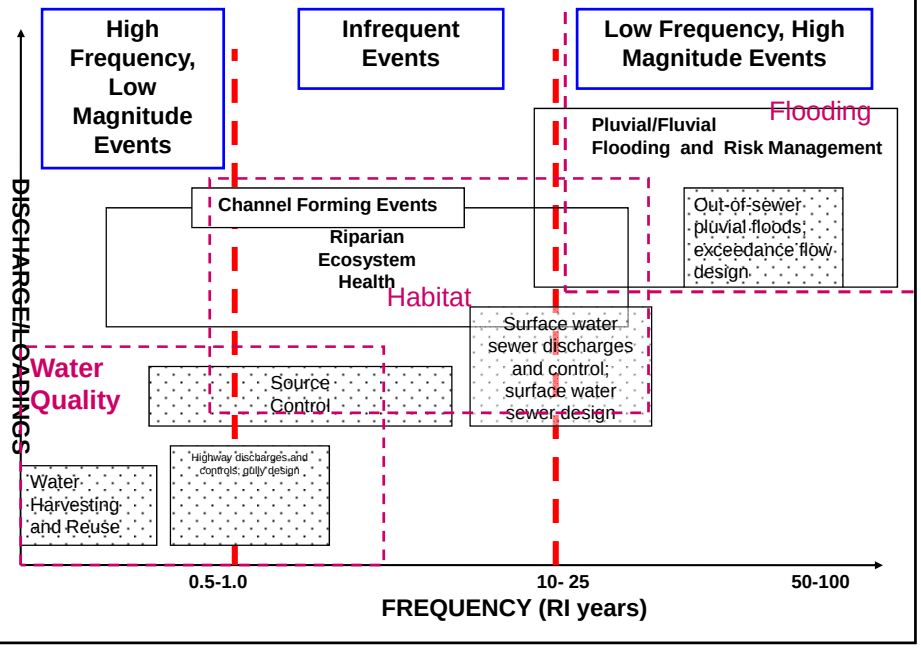
Risk Quadrants



LEARNING ALLIANCE RISK ASSESSMENT PARAMETERS

- **HYDRAULIC PERFORMANCE: FLOOD RISKS** Increased flood frequency and damage
- **WATER QUALITY RISKS** Increased wet weather pollution; Compliance with receiving water standards and quality objectives
- **ECOLOGICAL/HABITAT RISKS** Suppression of biodiversity; Impacts on channel morphology; Reduced amenity value
- **SURFACE WATER MANAGEMENT RISKS** Institutional/organisational arrangements and responsibilities; Integrated urban water management; Stakeholder consultation/participation in decision-making on infrastructure; Management of separate/combined sewer systems
- **URBAN LAND USE PLANNING RISKS** Planning controls on urban development/creep; Compatibility of district, municipal, state and national legislation and planning objectives; Co-consideration of flood, pollution and amenity values/objectives in planning
- **BMP/SUDS IMPLEMENTATION RISKS** Appropriate design/installation guidance; lack of technical knowledge and working expertise; Uncertainties on safety and health risks; O&M and adoption risks; Incentives (financial/public amenity etc) for controls and rainwater harvesting

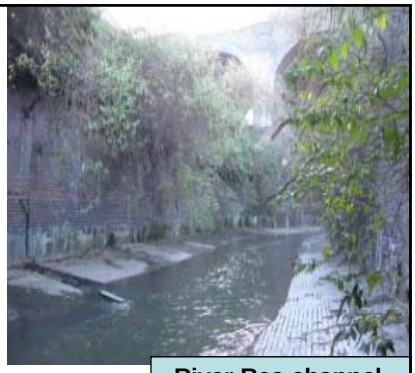
STORMWATER MANAGEMENT SCALES



BIRMINGHAM EASTSIDE FLOOD RISK ASSESSMENT

Identified threat	Likelihood of Occurrence		Level of Consequence		Likelihood of Occurrence		Level of Consequence		Risk score	
	Within the next 5 years	Score	Within the next 5 years	Score	In 25-30 yrs time	Score	In 25-30 yrs time	Score	Within the next 5 yrs	In 25-30 yrs time
Increased flooding	- Surcharging of surface water Sewers from combined system during extreme (>1:10RI) events - Increased and more frequent summer storm intensities - Backing-up of surface water outfalls/drains by river flooding - Increased likelihood of pluvial surface water flooding with exceedance flows - Ageing sewer infrastructure; insufficient hydraulic capacity - No record of surface flooding for Eastside area and July 2007 floods (>1:80-60 RI) did not seriously impact on the surface water drainage system. - High level of service protection (>M75-60 event) provided by deep, culverted Rea channel - Urban creep and re-development extending impermeable surface area.	3	- Flood risk consequences are currently minimal given channelled depth of the Rea and extent of urban dereliction within the Eastside floodplain area. - Flood nuisance to local traffic and pedestrian movement - Routing of overland exceedance flows (storms >1:30RI) along street and gutter pathways - Blockage and damage to surface water outfall flaps - Blockage of gullies and surface drains due to low cleaning frequencies	1/2	- Introduction of upstream flood controls will help to reduce downstream flood occurrence - Works on flood control employing upstream detention basins; control target stated as 50-year return period. - Reduction in CSO spillages resulting from rehabilitation and repair drainage asset planning (DAP) programmes - Increased l ikelihood of flood potential with climate change, urban creep and ageing sewer infrastructure	2	- Reduction in frequency and volume of CSO spillages - Dwellings relocated from high risk areas; increased flood resilient building - Increased land and property values following development	2	3 - 6 Level of risk: low to medium 10 – 15 Medium to High Pluvial flooding	4 Level of risk: low 6 – 8 Low to Medium Pluvial flooding

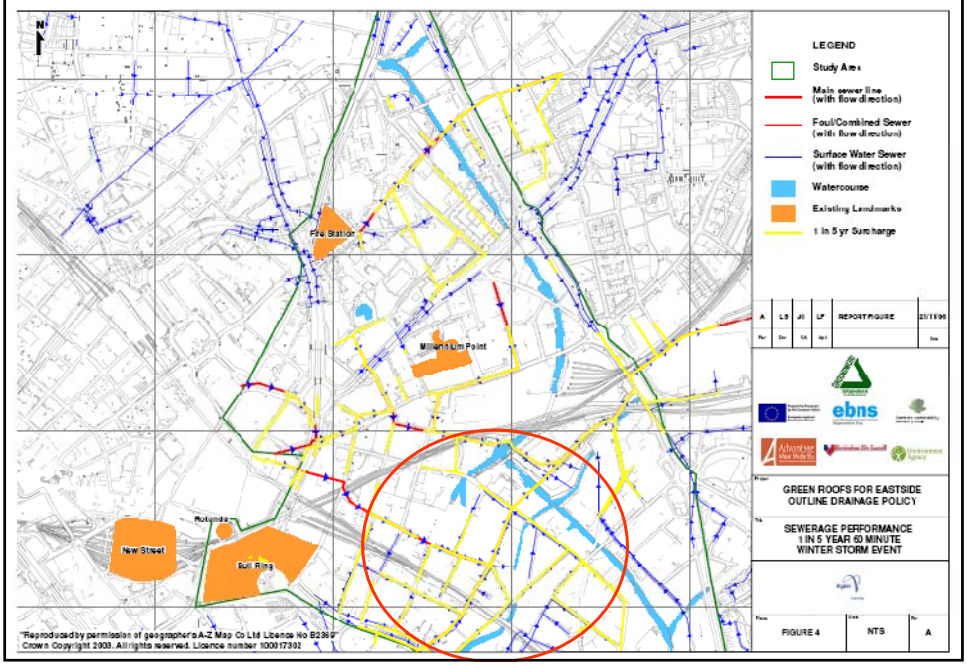
River Rea channel near Custard Factory



River Rea channel near Deritend viaduct

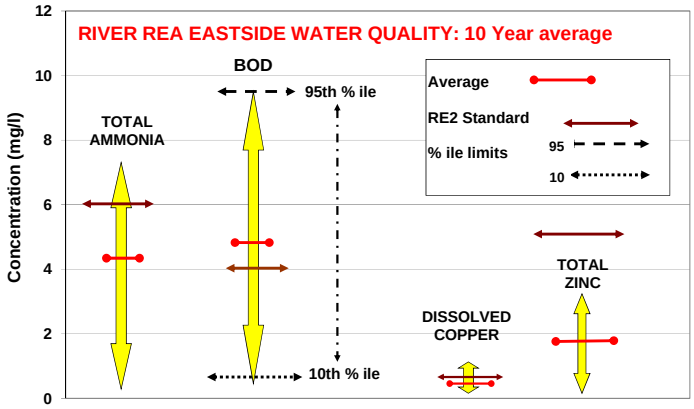
M80-60 extreme pluvial exceedance flood event in Eastside

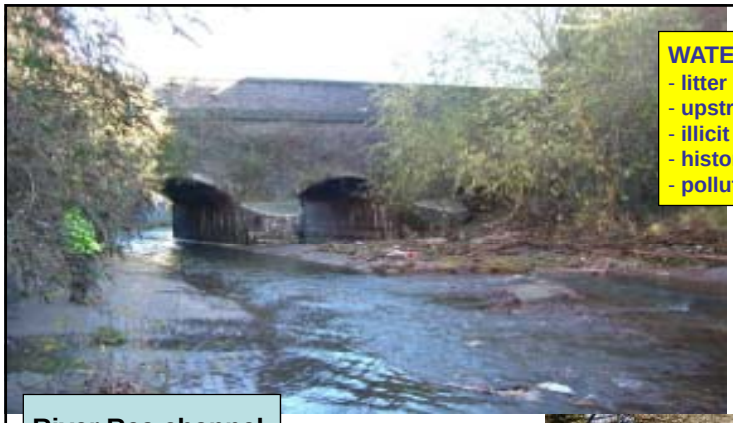
M5-60 STORM EVENT SURFACE SEWER SURCHARGING



BIRMINGHAM EASTSIDE POLLUTION RISK ASSESSMENT

Identified threat	Likelihood of Occurrence		Level of Consequence		Likelihood of Occurrence		Level of Consequence		Risk score	
	Within the next 5 years	Score	Within the next 5 years	Score	In 25-30 yrs time	Score	In 25-30 yrs time	Score	Within the next 5 yrs	In 25-30 yrs time
Persistent pollution of receiving waters	- Very high due to lack of interceptors, cross connections and Combined Sewer Overflows (CSOs) and Stormwater Outfalls (SWOs) - No provision for sewer separation in drainage asset management planning process (AMP) - Untreated separate surface water flows from impermeable surfaces associated with all wet weather events. - Surcharging from combined to surface water sewers during extreme (>1:10) storm events - Fly tipping, debris and litter	4/5	- Consistently poor surface water quality with high concentration of pollutants associated with extensive impermeable areas on commercial, retail and industrial land uses - Poor quality due to lack of interceptors, presence of illicit cross connections and CSO/SWO outfalls/spillages - High BOD and low DO especially during/after wet weather (strong first-flush); marginal eco-chemical (GQA) compliance with Standards - Contaminated bed sediments; micro-pollutants, oils etc - Unsightly aesthetic channel appearance due to litter, debris etc. - Degradation of river banks ; strongly engineered watercourse - Poor quality groundwater leakage from historical industrial heritage; lack of strategy for groundwater management	5	- Planned improvements in the sewer system: construction of interceptors and reduction in cross connections and CSOs. - Target of eliminating all cross connections not totally feasible. - EU Water Framework Directive (WFD) implementation but probably derogation under highly modified water body (HMWB) status; likely to suppress urgency for future quality Improvements - Climate change resulting in more frequent and polluting SWO flush Discharges - Upstream source BMP and SUDS controls	3/4	- Reduced BOD and improved DO as a result of planned improvements under asset management planning (AMP) programmes in the sewer system and reduction in CSO frequency: construction of interceptors and reduction in cross connections etc. - Improved aquatic quality and habitat resulting from implementation of national diffuse pollution control programmes by central government agencies (e.g Defra, OFWAT etc) - Achievement of higher biochemical GQA quality status (~ Grade 2/3). - Research work on hyperoic zone interaction and natural groundwater remediation.	3/4	20 - 25 Level of risk: high	9 - 16 Level of (but low confidence in rating)





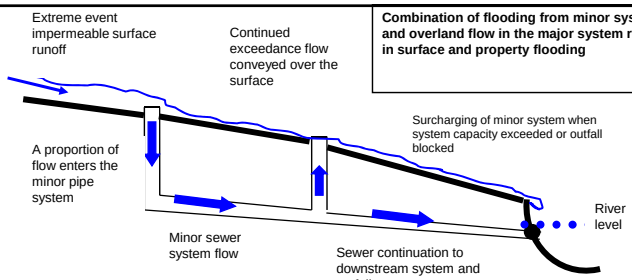
WATER QUALITY
- litter
- upstream CSO discharges
- illicit connections
- historical pollution
- polluted substrates

River Rea channel at canal junction Fazeley Street

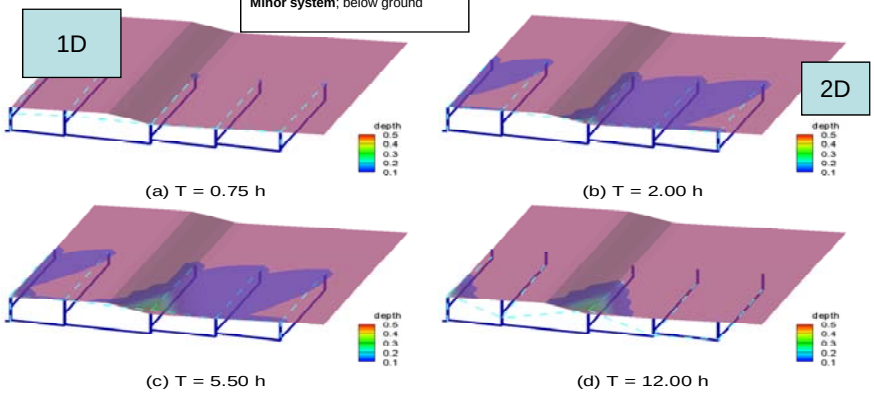
Walkway along Rea north of canal junction

AMENITY
- restricted ecology and habitat
- little public amenity
- sterile channel

1D-2D PLUVIAL EXCEEDANCE MODELLING SIMULATION



Major system: above ground
Minor system; below ground



(a) T = 0.75 h

(b) T = 2.00 h

(c) T = 5.50 h

(d) T = 12.00 h

REAL TIME PLUVIAL EXCEEDANCE FLOOD MAPPING

Below ground retrofits

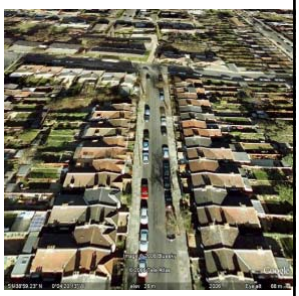
Pollution hotspot operations

Small car park area retrofits

WHERE/WHAT TO RETROFIT ON-SITE???

Hardscape street conversions

Individual rooftops



Individual streets

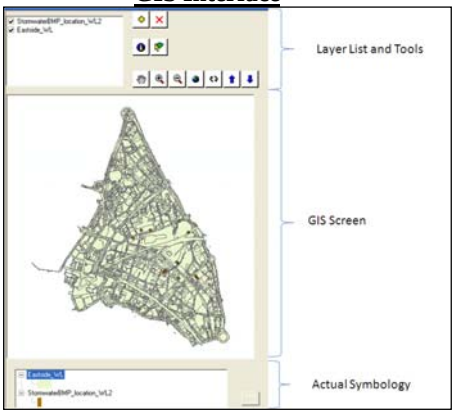
The SWITCH Stormwater BMP Decision Support System. DSS

- Interactive tool to support users in identifying appropriate BMPs and their location
- Communication of information in user-friendly format
- Stakeholder discussion tool for BMP decision-making

Integrates three stormwater BMP assessment components:

- Site characteristics (including urban land use types)
- BMP pollutant removal potential
- End-user preferences (multi-criteria comparator)

GIS Interface

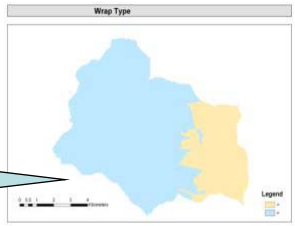


User-Friendly Interface

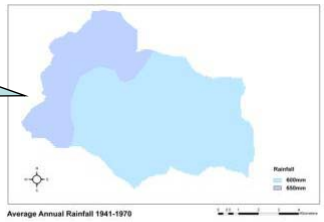
BMP Assessment Component 1: Site characteristics

- **Urban land use type**

- **Depth to groundwater**
- **Soil type**



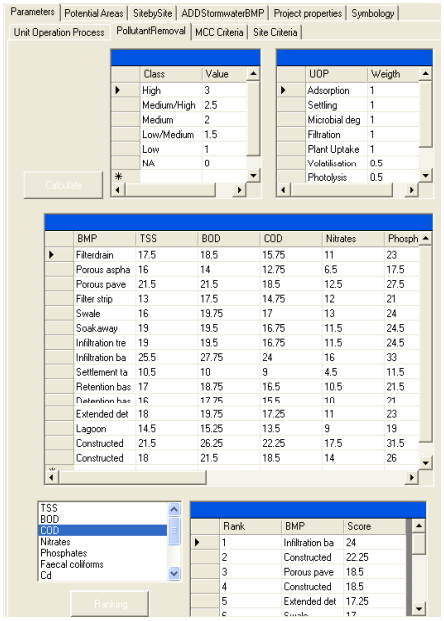
- **Slope/gradient**
- **Contributing drainage area (rainfall-runoff)**
- **Presence of 'flat' roofs**



- **Default values relate BMP type to the above criteria**
- **Set of 'rules' which determine which BMP can be located at a particular site**
- **User able to change default settings**

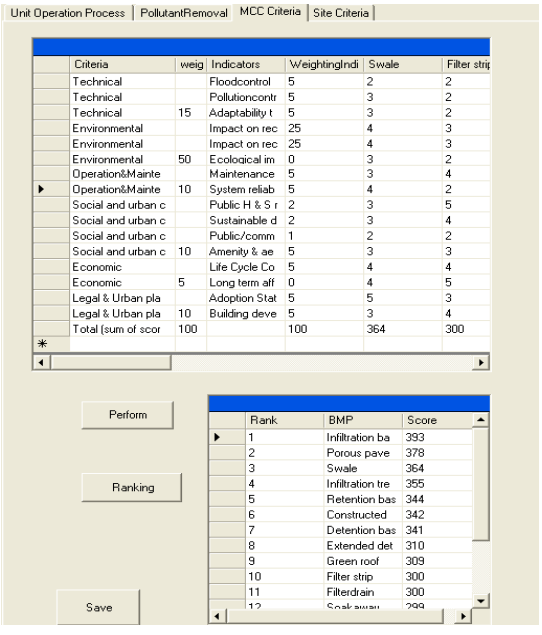
BMP Assessment Component 2: Pollutant Removal Potential

- **Combination of field data and expert judgement**
- **Assess potential for 7 pollutant removal process to occur in range of BMPs**
- **Assess the potential for specific pollutants to be removed by these 7 pollutant removal processes**
- **Information combined to develop single unit value describing the relative potential for a particular pollutant to be removed by specific BMP**
- **Ranking values enables a BMP pollutant-specific order of preference to be developed**

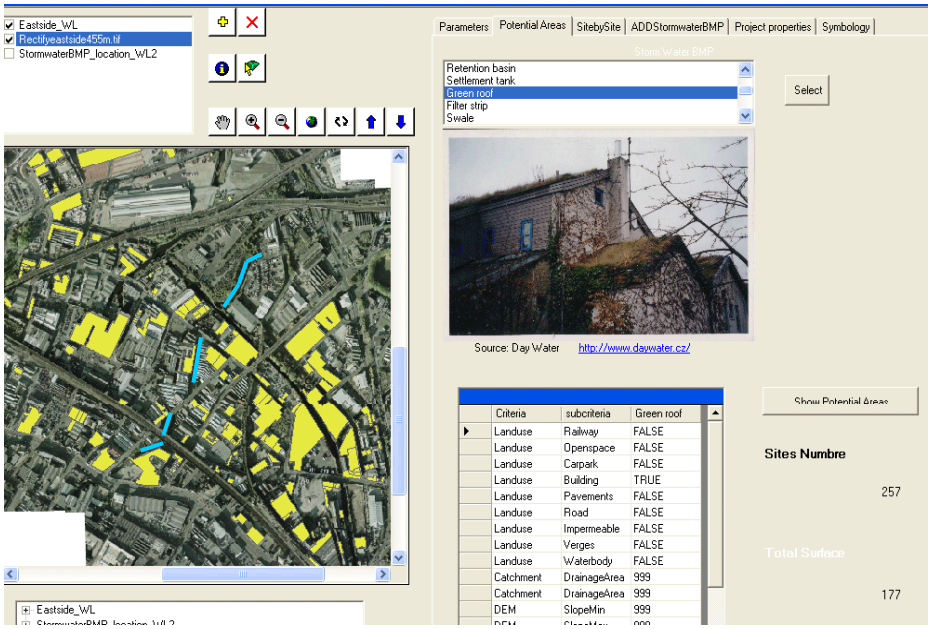


BMP Assessment Component 3: Multi-criteria Comparator

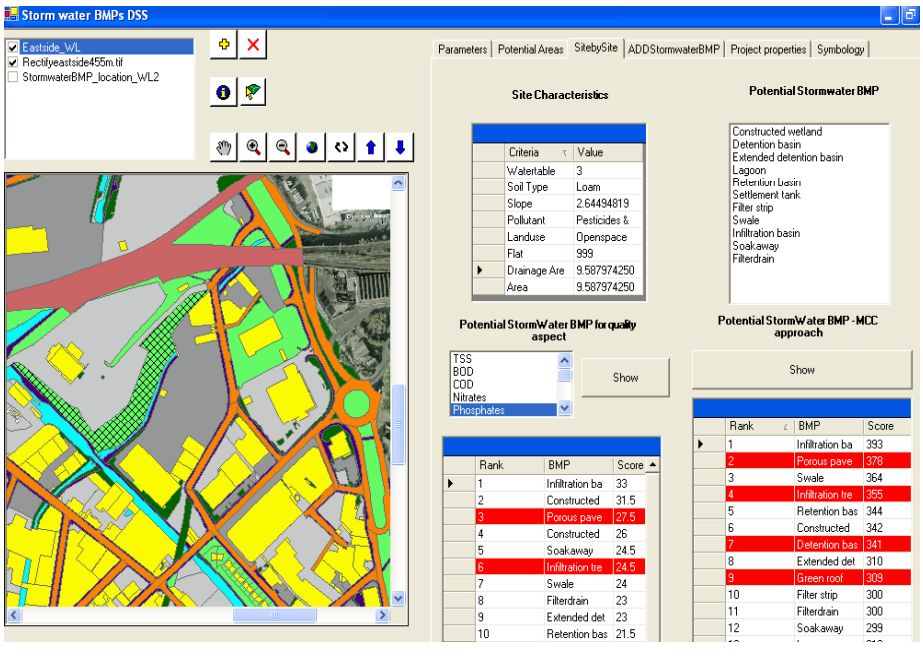
- **Use default scores (developed during the EU FP5 DayWater project) or user can enter their own values**
- **Users can apply weightings which are combined with scores to generate a BMP order of preference**
- **Users able to assess the performance of BMPs against wide range of criteria and indicators**



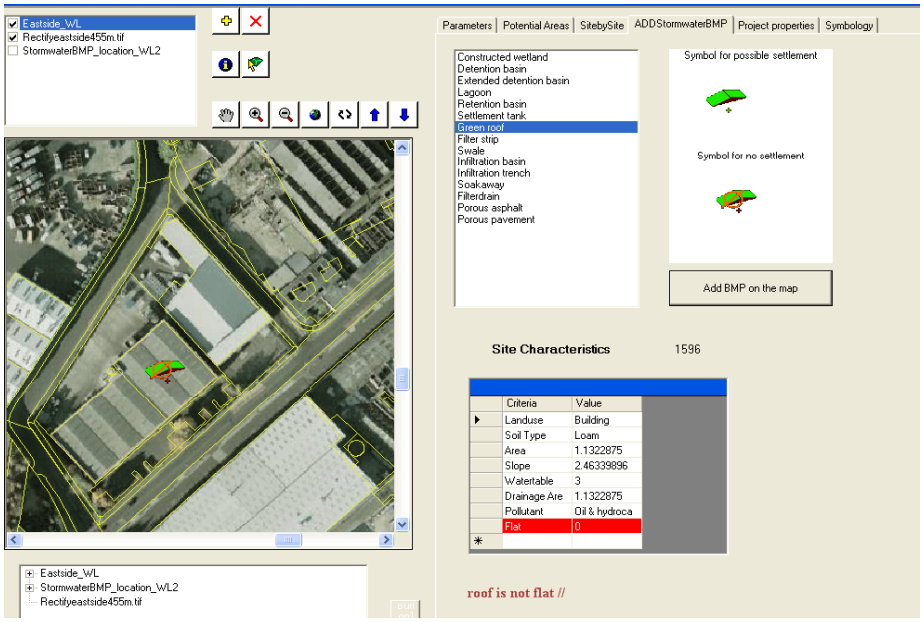
Interactive Map Functionality 1: Potential Areas Tool



Interactive Map Functionality 2: Site-by-site Assessment Tool



Interactive Map Functionality 3: Add BMP tool



FUTURE WORK WITH GIS DSS

- **Basis for a user-friendly tool capable of handling data from variety of sources**
- **Interactive map tool supports users in identifying locations for BMPs based on site characteristics**
- **List of possible BMPs can then be refined using the BMP pollutant removal tool and/or the multi-criteria comparator tool**

- **Within SWITCH, this stormwater BMP DSS will be:**
  - **integrated with a hydraulic stormwater model for identification of exceedance flow routes, velocities and ponding depths**
  - **trialled within Birmingham, Belo Horizonte, Lodz, and the Emscher region of Germany**

STORMWATER RISK MANAGEMENT

requires

- pluvial exceedance flood risk maps for extreme events—preferably in real time (flow routes, velocities, depths, ponding locations)
- fluvial flood (and pollution) risk maps for extreme events—based on 1D/2D sewer and river channel modelling.
- identification of vulnerability and exposure to both pluvial and fluvial flooding/pollution
- assessment of consequences e.g depth/damage curves; habitat damage etc.
- identification of mitigating controls and appropriate management approaches

Need to clarify limits of the modelling and management approaches/tools prior to attempting any integrated, holistic management decision-making framework

SWITCH WP2 STORMWATER RISK ASSESSMENT & MANAGEMENT

- Development and trialling of risk assessment methodology for flood and pollution management (contemporary and city-of-the-future)
- Developing GIS-based modelling tool for identifying and mitigating real time flood and pollution risks
- User-friendly methodologies intended to support stakeholder decision-making process for surface water infrastructure